CITY OF EDINBURG SOLID WASTE MANAGEMENT

PERMIT AMENDMENT APPLICATION

Part III, Attachment 2

SURFACE WATER DRAINAGE REPORT

Edinburg Regional Disposal Facility

Edinburg, Hidalgo County, Texas

TCEQ Permit MSW-956C

Submitted To: City of Edinburg
Department of Solid Waste Management
8601 North Jasman Road
Edinburg, Texas 78542 USA

Submitted By: Golder Associates Inc.
500 Century Plaza Drive, Suite 190
Houston, TX 77073 USA

STATE OF TEXAS
1/11/18
CHARLES G. DOMINGUEZ
83247
REGISTERED
PROFESSIONAL ENGINEER

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

INTENDED FOR PERMITTING PURPOSES ONLY

July 2017
Revised: November 2017
Revised: January 2018

Project No. 1401491

Golder Associates

Table of Contents

STATE OF TEXAS
CHARLES G. DOMINGUEZ
83247
REGISTERED
PROFESSIONAL ENGINEER

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

INTENDED FOR PERMITTING PURPOSES ONLY

List of Tables

List of Figures

List of Appendices

STATE OF TEXAS
1/11/18
CHARLES G. DOMINGUEZ
83247
REGISTERED PROFESSIONAL ENGINEER

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

INTENDED FOR PERMITTING PURPOSES ONLY

EXECUTIVE SUMMARY

30 TAC §330.63(c) and 30 TAC Subchapter G

This Surface Water Drainage Report provides a detailed description of the hydrologic and hydraulic analyses performed for the facility design and includes detailed design calculations and operational considerations for the management of site stormwater. As demonstrated, the facility design complies with the requirements of 30 TAC §330.63(c) and 30 TAC 330 Subchapter G, and will not adversely alter existing or permitted drainage patterns. The facility will be constructed, maintained, and operated to manage run-on and runoff during the peak discharge of a 25-year rainfall event and will prevent the off-site discharge of waste and feedstock material, including, but not limited to, in-process and/or processed materials. Surface water drainage within the facility will be controlled to minimize surface water running onto, into, and off the treatment area.

1.0 SURFACE WATER DESIGN OVERVIEW

The natural topography in the landfill expansion and surrounding areas is relatively flat. Stormwater runoff generally ponds on site or at depressions along the site boundary, with minimal off-site discharge. The lack of local streams or channels to transport stormwater runoff from the facility necessitates the construction of stormwater storage ponds. Stormwater that is collected in these ponds will evaporate or be used for site operations such as dust control. Under the proposed post-development conditions, the landfill will be encompassed with a perimeter berm along the entire permit boundary, and all stormwater runoff within the berm will be collected and directed to the stormwater storage ponds. There will be no off-site stormwater discharge other than the insignificant runoff from the exterior slope of the perimeter berm to the natural topography.

The surface water design considers flow from both the off-site (run-on) and on-site (runoff) areas contributing to the site. The existing topography at the site does not present any measureable run-on to the site due to the natural grades and existing perimeter berms on parts of the site. On-site stormwater runoff is controlled with a variety of structures that reduce the slopes (and the velocities) at which the water travels. These include add-on berms, downchutes, slope contouring, perimeter drainage ditches, and culverts.

Figure III2-1 presents the locations of the pre-development analysis control points for the site. The pre-development condition is a combination of the previously permitted final cover condition in the TCEQ Permit MSW-956B and the 2015 existing conditions in the expansion area. Figure III2-2 depicts the post-development drainage plan and surface water conveyance structures proposed for the expanded facility.

For landfill development, the landfill final cover has been divided into sections which drain to protected downchutes that extend down the 4 horizontal to 1 vertical (4H:1V) sideslopes. The sideslopes of the final cover have add-on berms sloped at 2 percent at 40-foot vertical intervals down the 4H:1V slopes. These add-on berms collect the stormwater from the sideslopes and convey it to the downchutes. The downchutes discharge into perimeter channels which then convey the flows to the stormwater storage ponds.

The current TCEQ Permit MSW-956B permits two stormwater storage ponds: the existing West Pond and the proposed East Pond. The existing West pond will be reconstructed per the final landfill development. The East Pond designed in TCEQ Permit MSW-956B has not been and will not be constructed. The final landfill development (TCEQ Permit MSW-956C) will include 11 stormwater ponds: seven ponds on the west side (Ponds W1 through W7) and four ponds on the east side (Ponds E1 through E4). Figure III2-2 shows the locations of the stormwater ponds. The ponds are designed to retain runoff from the 25-year, 24-hour storm.

Figures III2-3 through III-2-5 present the add-on berm, perimeter channels, downchute, and culvert details. Figures III2-6 through III-2-8 present the pond details. Figures III2-9 through III-2-13 depict flowline elevations, water surface elevations, and velocities along the entire length of the drainage structures. Figures III2-14 and III2-15 shows details for erosion and sedimentation control.

2.0 DETAILED DRAINAGE CALCULATIONS

Appendix III2A, Detailed Drainage Calculations includes following hydrologic and hydraulic analyses:

- Estimation of pre-development run-on and runoff peak flows and volumes using the US Soil Conservation Service (SCS) Technical Release Number 55 (TR-55), the SCS hydrograph methodology, and the US Army Corps of Engineers' (USACE) Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) computer software;
- Similar estimation of post-development peak flows and volumes at defined control points using TR-55, the SCS hydrograph methodology, and the HEC-HMS computer software;
- Estimation of pre-development velocities at runoff control points (there is no post-development runoff resulting from the 25-year, 24-hour design storm);
- Design of add-on berms, downchute channels, culverts, and perimeter channels;
- Estimation of the water surface elevation resulting from the 25-year recurrence interval 24-hour design storm per TCEQ and the City of Edinburg requirements in the perimeter channels using Manning's Equation assuming normal depth;
- Estimation of the water surface elevation resulting from the 25-year, 24-hour storm event for the downchutes and add-on berms using Manning's Equation assuming normal depth; and
- Development of required storage for the proposed Ponds utilizing the HEC-HMS computer software and spreadsheet stage-storage calculations for the 25-year, 24-hour storm.

2.1 Hydrologic Methods

2.1.1 Drainage Modeling System

30 TAC §330.305(f)(2)

The facility is greater than 200 acres. Therefore, calculations for discharges are computed using USACE HEC-HMS (Hydrologic Engineering Center-Hydrologic Modeling System).

2.1.2 25-year Rainfall Intensity

30 TAC §330.63(c)(1)(D)(i)

Rainfall intensity for a 25-year, 24-hour storm event from the Natural Resources Conservation Service (NRCS) (formerly called the Soil Conservation Service (SCS)) Technical Release 55 (TR-55) published in 1986 was used for facility stormwater drainage design. In Hidalgo County, the 24-hour rainfall events have an SCS Type III synthetic temporal distribution with rainfall depths of 4.3, 8.5, and 11.0 inches for the 2-, 25-, 100-year events respectively. Composite SCS curve numbers were estimated consistent with previous work and local regulations. Selected hydrologic methods and input parameters are presented in Appendix III2A, Detailed Drainage Calculations.

2.1.3 Peak Flow Rates and Runoff Volumes

30 TAC §330.63(c)(1)(D)

The HEC-HMS hydrologic model was used to determine the peak flows and volumes resulting from the 25-year, 24-hour design storm. The NRCS unit hydrograph transformation methodology was used for all drainage basins. Times of concentrations were calculated using TR-55 methodology. Peak flow rates were used to design stormwater channels required in the drainage design (perimeter channels, downchutes, and add-on berms). Channel calculations were performed using a spreadsheet that solves Manning's equation for normal depth. Culvert sizing calculations were carried out using HY-8 software developed by the U. S. Department of Transportation Federal Highway Administration. Peak flow rates and runoff volumes are included in Appendix III2A, Detailed Drainage Calculations.

2.2 Drainage Pattern Analyses

30 TAC §§330.63(c)(1)(C), 330.63(c)(1) (D)(iii) & 330.305(a)

Existing drainage patterns will not be adversely altered as a result of the proposed landfill development as demonstrated in the comparison of peak flow rates, runoff volumes, and velocities in the pre-development and post-development conditions. Analysis points were located for the pre-development and post-development conditions to represent locations where run-on flows enter the site or runoff exits the site. The analysis points and contributing drainage areas are shown on Figure III2-1, Pre-Development Drainage Plan and Figure III2-2, Post-Development Drainage Plan.

The determination of no adverse alteration of drainage patterns is based on three factors related to discharge of surface water: 1) peak flows, 2) velocities, and 3) volumes as measured at the permit boundary. The pre-development condition at the facility has only two discharge points – one at CP-3 and one at CP-9. In addition, there is one discharge point at CP-7 where water accumulates at a depression along the permit boundary. The following bullets address these three discharge points:

- CP-3: In the pre-development condition an approximately 8-acre area drained to a depression just west of the permit boundary in this part of the site. In the post-development condition the contributing area to this discharge point is routed to an on-site stormwater pond used to manage surface water. As a result, the flow to this depression is redirected to the pond. This does not impact a receiving stream or channel downstream as there is not one. The discharge velocity decreases from a non-erosive velocity to zero, resulting in minimal change in post-development conditions related to velocity. The volume of discharge is likewise routed to the stormwater pond and does not pond in the off-site depression, and does not adversely impact existing drainage patterns because the discharge volume is lower than in pre-development conditions and has no apparent beneficial use.

- CP-9: In the pre-development condition an approximately 8-acre area drained off site to the south. The elimination of this discharge does not impact a receiving stream or channel downstream as there is not one. The discharge velocity decreases from a non-erosive velocity to zero, resulting in minimal change in post-development conditions related to velocity. The removal of the volume of discharge at this location does not adversely impact existing drainage patterns because the discharge volume is lower than in pre-development conditions and has no apparent beneficial use.
- At discharge point CP-7 there is a depression in the surface topography where runoff ponds along the permit boundary. In the pre-development condition, the contributing area for this runoff is 19.8 acres. The post-development condition reduces this contributed area to 6.3 acres, but does not alter the drainage pattern into the depression. Since the contributing area is lower, the peak flows, velocities, and volumes will all be lower and therefore do not adversely alter existing drainage patterns. There is no apparent beneficial use of the runoff at this location either, therefore the reduced runoff volume does not have any adverse alteration to the drainage patterns.

2.2.1 Drainage Areas

30 TAC §330.63(c)(1)(A)

The pre-development and post-development contributing areas for all analysis points were evaluated. Subbasins for the pre-development condition were delineated using the final cover grades and drainage design within approved TCEQ Permit MSW-956B and existing topography within the lateral expansion area as shown on Figure III2-1, Pre-Development Drainage Plan. Likewise, subbasins for the post-development condition were delineated using the final cover design, the stormwater conveyance structure design (add-on berms, downchutes, perimeter channels, culverts, etc.), and existing topography as shown on Figure III2-2, Post-Development Drainage Plan. As demonstrated in Table III2-1, analysis points CP-3 and CP-9 are the only relevant off-site discharge points in the pre-development condition.

Table III2-1: Summary of Contributing Areas

Analysis/Control Point	Contributing Area (acre)		Runoff Flow Pattern during Pre-development Conditions
	Pre-Development	Post-Development	
CP-1	19.7	0	Ponding on-site
CP-2	205.8	276.9 (total to the west ponds)	
CP-3	8.2	0	Discharges to an off-site depression adjacent to Permit Boundary
CP-4	5.9	0	Accumulate at depressions along permit boundary
CP-5	59.9	0	
CP-6	84.5	0	
CP-7	19.8	6.3	
CP-8	19.3	319.3 (total for the east ponds)	Ponding on-site
CP-9	8.3	0	Discharges off-site
CP-10	39.9	0	Ponding on-site

Analysis/Control Point	Contributing Area (acre)		Runoff Flow Pattern during Pre-development Conditions
	Pre-Development	Post-Development	
CP-11	72.0	0	
CP-12	24.4	0	
CP-13	34.9	0	
Total Area	602.6	602.5	

Note: As shown above, CP-3 and CP-9 are the only relevant off-site discharge points during pre-development conditions. The total contributing area obtained by summing the areas contributing to CP-1 through CP-13 is 602.56 and 602.38 acres, for pre-development and post-development, respectively. There is a 0.02 percent difference in total area between pre- and post-development contributing areas. This insignificant difference is a result of numerical rounding of the areas of numerous small sub-basins. Figures III2-1 and III2-2 depict the pre- and post-development drainage maps and show all contributing areas.

2.2.2 Peak Discharges

30 TAC §330.63(c)(1)(D)

Using the drainage contributing areas and associated flows to analysis points; peak discharges were computed for the pre- and post-development conditions. The pre-development condition shows minor discharges at control points CP-3 and CP-9. In the post-development condition, stormwater flows are routed through the surface water conveyance system (add-on berms, downchutes, perimeter channels, culverts, etc.) and collected and stored in the stormwater ponds, except an insignificant amount of runoff from the exterior slope of the perimeter berm. As demonstrated in Table III2-2, the post-development flows, volumes, and velocities are less than pre-development at both control points CP-3 and CP-9.

Table III2-2: Summary of Peak Flow Rates, Runoff Volumes, and Velocities

<table>
<tr><th rowspan="2">Control Point</th><th colspan="6">25-year, 24-hour Storm Event</th></tr>
<tr><th>Pre-Development Peak Flow Rate (cfs)</th><th>Post-Development Peak Flow Rate (cfs)</th><th>Pre-Development Runoff Volume (ac-ft)</th><th>Post-Development Runoff Volume (ac-ft)</th><th>Pre-Development Velocity (ft/sec)</th><th>Post-Development Velocity (ft/sec)</th></tr>
<tr><td>CP-1</td><td>47.5</td><td rowspan="5">Routed to west ponds</td><td>9.8</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>CP-2</td><td>548.8</td><td>115.2</td><td>164.9 (total for west ponds)</td><td>-</td><td>-</td></tr>
<tr><td>CP-3</td><td>32.5</td><td>4.1</td><td>-</td><td>2.3</td><td>0</td></tr>
<tr><td>CP-4</td><td>21.0</td><td>2.9</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>CP-5</td><td>226.4</td><td>29.8</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>CP-6</td><td>250.6</td><td>Routed to east ponds</td><td>42.1</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>CP-7</td><td>51.1</td><td>19.5 (partially routed to east ponds)</td><td>9.8</td><td>3.9 (partially routed to east ponds)</td><td>-</td><td>-</td></tr>
</table>

Control Point	25-year, 24-hour Storm Event					
	Pre-Development Peak Flow Rate (cfs)	Post-Development Peak Flow Rate (cfs)	Pre-Development Runoff Volume (ac-ft)	Post-Development Runoff Volume (ac-ft)	Pre-Development Velocity (ft/sec)	Post-Development Velocity (ft/sec)
CP-8	55.6	Routed to east ponds	9.6	187.7 (total for east ponds)	-	-
CP-9	19.6		4.1	-	1.6	0
CP-10	117.6		19.9	-	-	-
CP-11	324.0		41.0	-	-	-
CP-12	89.3	Routed to west ponds	10.2	-	-	-
CP-13	117.9		17.4	-	-	-

Notes:

cfs = cubic feet per second
ac-ft = acre-feet
Discharge velocities are calculated for discharge points only.
CP-2 is used to represent the west ponds; CP-8 is used to represent the east ponds.

2.3 Stormwater Collection, Drainage, and Detention Structures

30 TAC §§330.63(c)(1)(D)(ii) & 330.63(c)(1)(D)(iv)

Stormwater is collected and conveyed into stormwater ponds by add-on berms, downchutes, perimeter channels, and culverts. Stormwater collection and drainage structures were designed using Manning's Equation assuming normal depth from the design storm event.

2.3.1 Perimeter Channels

30 TAC §330.63(c)(1)(B)

The perimeter channels collect stormwater for conveyance into stormwater ponds. They are generally trapezoidal in shape, designed with uniform slopes of 0.1 to 0.15 percent, variable bottom widths, and variable depths allowing a minimum of 0.5 feet of freeboard for the design storm event. Perimeter channels are grass-lined for areas where the velocity is no greater than 5 feet per second and lined with riprap for areas with a greater velocity.

Perimeter channel locations are depicted on Figure III2-2, Post-Development Drainage Plan. A typical detail is shown on Figure III2-3, Drainage Control Details I – Channels and Berms along with a schedule that describes the size, slope, water elevations, flow velocity, channel lining, and length for each channel. Flowline profiles showing grades, flow rates, water surface elevations, velocities, and flowline elevations along the entire length for the stormwater perimeter channels are provided in Figures III2-9 and III2-10.

2.3.2 Add-on Berms

Add-on berms are designed with a uniform slope of 2 percent to keep flow velocities below 5 feet per second. The channels formed by the add-on berms with an internal 2H:1V sideslope have a depth of 2 feet allowing 0.5 feet of freeboard for the design storm event. Add-on berm locations are depicted on Figure III2-2, Post-Development Drainage Plan and add-on berm details are presented on Figure III2-3, Drainage Control Details I – Channels and Berms.

2.3.3 Downchutes

Downchutes are designed with a maximum slope of 25 percent and are formed by side berms with an internal 2H:1V sideslopes and a design depth allowing 0.5 feet of freeboard for the design storm event. Downchute channels are lined with 60-mil textured geomembrane; however a suitable alternative to geomembrane may be used provided that the design is verified by a professional engineer. Stormwater flow from the downchutes channel through energy dissipation structures into a low water road crossing before discharging into either a perimeter channel lined with riprap or directly into a stormwater pond.

Downchute locations are depicted on Figure III2-2, Post-Development Drainage Plan. A typical detail is shown on Figure III2-4, Drainage Control Details II – Stormwater Downchute Details and Crossings along with a schedule that describes the size, slope, water elevations, flow velocity, and length for each downchute. Flowline profiles showing grades, flow rates, water surface elevations, velocities, and flowline elevations along the entire length for the downchutes are provided in Figures III2-11 through III2-13.

2.3.4 Culverts

Adequacy of both existing and design culverts were evaluated using the Federal Highway Administration's HY-8 Culvert Analysis software. Culvert locations are depicted on Figure III2-2, Post-Development Drainage Plan. Typical culvert details are shown on Figure III2-5, Drainage Control Details III – Culverts.

2.3.5 Stormwater Ponds

Stormwater is collected into 11 ponds: 7 are located west of Unit 7 and north of Units 1 – 6 designated at Ponds W1 – W7; and 4 are located east of Unit 7 designated as Ponds E1 – E4 as depicted on Figure III2-2, Post-Development Drainage Plan. Figure III2-6, Drainage Control Details IV - West Ponds and Sections and Figure III2-7, Drainage Control Details V - East Ponds and Sections show pond profiles; and Figure III2-8, Drainage Control Details VI – Pond Details provides pond dimensions and design elevations. The ponds will be constructed in a phased manner as needed to contain the stormwater runoff on-site as dictated by the extent of landfill development. The stormwater ponds will be lined with 60-mil HDPE in accordance with Part III3F, Liner Quality Control Plan. Hydrostatic uplift of the stormwater pond liner is not anticipated because the pond liner is above seasonal high groundwater levels.

Based on the runoff volume of the receiving areas, the ponds will be interconnected via equalization pipes as follows: Ponds W1 through W3 will be equalized; Ponds W4 through W6 will be equalized; and Ponds E1, E2, E3, and E4 will be equalized. The estimated maximum water elevations for design storm event in feet above mean sea level (ft-msl) are summarized in Table III2-3. Comparison of the maximum water elevations in the ponds and the pond crest elevations demonstrates that the ponds have sufficient storage capacity and freeboards ranging from approximately of 5 feet to over 10 feet. Such design ensures the ponds have adequate capacity for more severe storms or consecutive storms. The designed ponds have adequate capacity to contain runoffs from two consecutive 25-year 24-hour storms as shown in Table III2-4. Furthermore, Pond W7 is not required for the design storm event, rather it is designed as a contingency to provide additional storage capacity in case of extreme weather conditions. Pond W7 may be equalized with Ponds W4 through W6 when needed or may be utilized by pumping stormwater from other ponds under extreme weather conditions.

Table III2-3: Pond Water Elevations for 25-Year, 24-Hour Storm

Pond	Runoff Volume (ac-ft)	Maximum Pond Water El. (ft-msl)	Minimum Elev. of the Pond Levee (ft-msl)	Pond Freeboard (ft)
	25-year 24-hour storm	25-year 24-hour storm	-	25-year 24-hour storm
W1	29.2	85.7	91.0	5.3
W2	37.0	85.7	91.0	5.3
W3	6.5	85.7	91.0	5.3
W4	7.1	83.7	91.0	7.3
W5	7.1	83.7	91.0	7.3
W6	70.2	83.7	91.0	7.3
W7	7.8	78.5	91.0	12.5
E1	80.9	76.8	94.0	17.2
E2	87.2	76.8	94.0	17.2
E3	11.1	76.8	94.0	17.2
E4	8.5	76.8	94.0	17.2

Table III2-4: Pond Storage Capacity Vs. Two 25-Year, 24-Hour Storms

Pond	Runoff Volume (ac-ft)	Pond Storage Capacity (ac-ft)	Adequate Capacity to Contain Runoffs from Two 25-year 24-hour Storms?
	Two 25-year 24-hour Storms	-	
W1 through W3	146	199	YES
W4 through W6	170	291	YES
E1 through E4	374	908	YES

The semi-arid climate at the site allows for the evaporation pond design. The majority of the water in the ponds will evaporate, while a smaller portion will be used for site operations such as dust control. According to the 61-year historical weather data (from 1954 to 2014) published by Texas Water Development Board, the average annual lake evaporation rate is 62.60 inches and the average annual precipitation is 21.70 inches. The weather conditions combined with the pond system design will ensure adequate storage and evaporation capacity at the site.

Further analysis has been performed to demonstrate the long-term performance of the ponds under the post-development conditions. The analysis uses the 61-year historical weather data to model the pond performance with consideration of evaporation. For conservative purposes, it is assumed that the average monthly rainfall will occur within a 24-hour time period and the fact the water may be used for irrigation of the final cover vegetation is omitted. As demonstrated in Appendix III2F, all ponds will have adequate long-term storage capacity for 30 years under the post-developments conditions. For the west ponds, Pond W1 through W6, the average annual evaporation potential surpasses the annual stormwater runoff volume. For the east ponds, Ponds E1 through E4, stormwater runoff may accumulate in the ponds, however, the pond capacity still exceeds the estimated stormwater volume in the ponds after 30 years. Beyond 30 years, i.e. at the end of post-closure care period, use of the pond water may be re-evaluated in conjunction with the land use at the time.

3.0 CONTAMINATED SURFACE WATER OR GROUNDWATER

30 TAC §330.305(g)

The City shall handle, store, treat, and dispose of surface or groundwater that has become contaminated by contact with the working face of the landfill or with leachate in accordance with 30 TAC §330.207, Contaminated Water Management.

3.1 Contaminated Water Storage Area Design

30 TAC §330.305(g)

Run-on and runoff controls for active disposal areas will be utilized to minimize the potential for stormwater contamination. The working face of the active disposal area will be encompassed by a run-on berm (top berm) and a runoff berm (toe berm) for the purpose of segregating potentially contaminated and non-contact stormwater. Daily disposal operations will include an evaluation of the existing containment berm's capability to manage stormwater run-on and runoff.

3.1.1 Run-on Control System

30 TAC §330.305(b)

The City shall design, construct, and maintain a run-on control system capable of preventing flow onto the active portion of the landfill during the peak discharge from at least a 25-year rainfall event. The run-on berms are designed to accommodate the 25-year, 24-hour storm, the equivalent of an 8.5-inch rainfall event to divert uncontaminated stormwater from upstream watersheds around the working area. The run-on berm height requirements and design configurations are detailed in Appendix III2B, Active Face Berm Sizing.

3.1.2 Runoff Management System

30 TAC §330.305(c)

The City shall design, construct, and maintain a runoff management system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm. The run-off berms are designed to accommodate the 25-year, 24-hour storm, the equivalent of an 8.5-inch rainfall event to provide adequate storage of stormwater that has potentially contacted the open working face. The run-off berm height requirements and design configurations are detailed in Appendix III2B, Active Face Berm Sizing.

4.0 EROSION AND SEDIMENT CONTROL

30 TAC §§330.305(d), 330.305(d)(1), & 330.305(d)(2)

The landfill design provides effective erosional stability to top dome surfaces and external embankment side slopes during all phases of landfill operation, closure, and post-closure care. Estimated peak velocities for top surfaces and external embankment slopes are less than the permissible non-erodible velocities under similar conditions. The top surfaces and external embankment slopes area designed to minimize erosion and soil loss through the use of appropriate side slopes, vegetation, and other structural and nonstructural controls, as necessary. Soil erosion loss (tons/acre) for the top surfaces and external embankment slopes were calculated and the potential soil loss does not exceed the permissible soil loss for comparable soil-slope lengths and soil-cover conditions.

4.1 Applicability

According to the 2007 draft TCEQ guidance for addressing erosional stability during all phases of landfill operation, the landfill cover phases are defined as daily cover, intermediate cover, and final cover. Top dome surfaces and external embankment sideslopes are defined as:

- Those above-grade slopes that directly drain to the perimeter stormwater management system (i.e., directly to a perimeter channel or a detention pond).
- Those above-grade slopes that have received intermediate or final cover.
- Those above-grade slopes that have either reached their permitted elevation, or will subsequently remain inactive for longer than 180 days.

Slopes not addressed above that drain into active areas, excavations or areas under construction, or areas that have only received daily cover (short-term), are not considered external slopes and are not required to maintain the erosion management practices outlined in this plan. An area under daily cover that remains inactive for longer than 180 days will be converted to intermediate cover and those applicable erosion controls, as discussed in the following sections, will be required.

4.2 Erosion and Sedimentation Control Plan

This plan is organized to present the erosion and sediment control design and best management practices (BMPs) for all three landfill conditions: active disposal areas, intermediate cover areas, and final cover areas. The erosion and sedimentation controls were developed to provide low runoff velocities, adequate storage detention, and to limit sediment and soil loss impacts to stormwater discharge quality. Soil erosion loss was estimated utilizing the Texas Natural Resource Conservation Commission's "Use of the Universal Soil Loss Equation in Final Cover/Configuration Design," Procedural Handbook, Permits Section, Municipal Solid Waste Division, October 1993. The selection of erosion and sediment control structures will be a continual evolution of temporary and permanent control devices. The facility fill sequence plans will be used to manage the proper selection of both temporary and permanent erosion and sediment controls to ensure stormwater quality standards as presented in the facility's stormwater discharge permit. Temporary (short-term) erosion controls will typically be used during landfill operations, and permanent (long-term) controls will be used for final cover conditions. Temporary erosion controls are defined as controls that are installed or constructed within 180 days from when the intermediate cover is constructed and in place until permanent controls are constructed for the final cover or additional placement of waste is resumed on the intermediate cover area.

Some typical controls have been selected and evaluated for typical site operations. Any controls that the site manager chooses to use which are not specifically addressed in this plan shall be evaluated for equivalency. Equivalency demonstrations that verify effectiveness of performance and durability will be kept in the site operating record. Furthermore, any control measures and practices used in keeping soil loss and flow velocity within permissible limits prior to the establishment of vegetation or in conjunction with vegetation not approved with this plan, must be approved by the TCEQ prior to implementation.

4.3 General Erosion and Sedimentation Assessment

In assessing the landfill construction and operational practices for potential erosion and sedimentation, the site will consider potential impacts to sensitive areas, such as steep slopes, surface waters, areas with erodible soils, and existing discharge channels. Also, the facility will disturb the smallest vegetated area reasonably possible, keep the amount of cut and fill to a minimum, and maintain the aforementioned sensitive areas. During the construction of landfill cells, it will be necessary to disturb the soil by clearing and grubbing, excavating and stockpiling, rough and final grading, constructing perimeter channel(s), and seeding and/or planting. The BMPs described in the following sections will be utilized to ensure minimal impacts to stormwater quality during these phases of construction and stockpiling activities. Standard TxDOT specifications of these BMPs are included in Appendix III2D, Example BMP Specifications.

To guard against soil loss, the phased development plan for landfill cell construction and solid waste placement will be followed. The figures in Part II, §3.0 Facility Layout Plan describe in detail the planned sequence of development, including sequencing of drainage and runoff controls, to ensure adequate slope stability and limited erosion and soil loss.

4.4 Erosion and Sediment Control for Intermediate Cover Areas

30 TAC §330.305(e)(2)

This sub-section describes the interim controls that may be used during phased landfill development to minimize erosion of top dome surfaces and external embankment sideslopes with intermediate cover or that have reached the permitted elevations. Based on velocity and soil erosion analyses, a selection of BMPs is identified and general installation guidance is provided. Examples of standard published specifications are also provided. Standard published specifications, which will be discussed in the following sections, are provided in Appendix III2D, Example BMP Specifications. In accordance with 30 TAC §330.165(c) and TCEQ guidelines, temporary erosion and sedimentation controls will be implemented on intermediate cover areas within 180 days after placing intermediate cover, including a vegetative cover of at least 60 percent. Depending on the weather conditions and the season of the year when the intermediate cover is placed, methods of temporary control, as discussed in the following sections, will be implemented to provide for erosion protection. Pursuant to TCEQ guidelines, all calculations in support of this erosion and sedimentation control plan are based on 60 percent cover.

4.4.1 Erosion and Sedimentation Control Design – Intermediate Cover Areas

Since the exact conditions of the various interim conditions are impossible to predict due to daily changes in fill patterns, a conservative approach is taken to determine the worst-case slope conditions. Therefore, the built-out condition of the final cover scenario is used as the worst-case slopes. are determined from this scenario. Even though interim conditions that are this extreme are unlikely, this is a conservative assumption so that any possible interim slope conditions or lengths are covered by this extreme case. In accordance with 30 TAC §330.305(d), the effective erosional stability of top dome surfaces and external embankment side slopes of landfill operation, closure, and post-closure care was analyzed based on the following criteria:

- The estimated peak velocity should be less than the permissible non-erodible velocities under similar conditions. The applicable non-erodible velocities are 3.75 feet per second for bare soil slopes and 5.0 feet per second for grassed (60 percent vegetation) slopes, considering the soil types, grass types, grass conditions, and slope angles at the facility (refer to Appendix III2C, Interim Erosion and Sediment Control Analysis).
- The potential soil erosion loss should not exceed the permissible soil loss for comparable soil-slope lengths and soil-cover conditions. The 2007 TCEQ guidance document has specified that the permissible soil loss is not to exceed 50 tons/acre/year and the recommended cover is 60 percent.

The top dome surface is sloped at 5 percent with a maximum length of approximately 114 feet. The external embankment sideslopes are 4H:1V slopes. Analysis indicates that the stormwater velocity on the top dome surfaces will not exceed the permissible non-erodible velocity in the worst-case conditions, and the length of the 4H:1V slope will be limited to 240 feet to satisfy the flow velocity criteria. The velocity analyses are included in Appendix III2C, Interim Erosion and Sediment Control Analysis and are summarized in Table III2-5.

Table III2-5: Summary of Interim Slope Velocities

Cover Slope	Slope Segment	Flow Velocity (fps)
5% slope	Segment 1 ~114 ft	0.85
4H:1V slope	Segment 1 0–240 ft	1.89

If an intermediate slope in excess of 240 feet is constructed, then a portion of the slope must be converted to final cover with permanent erosion controls, or temporary soil berms can be installed at 60-foot vertical intervals (i.e. 240 feet along the slope) along the intermediate cover slopes.

The potential soil erosion loss was calculated using the Natural Resources Conservation Service of the United States Department of Agriculture (USDA) Revised Universal Soil Loss Equation (RUSLE). A permissible soil loss of 50 tons/acre/year and a cover of 60 percent are selected as the design criteria for interim erosion and sediment controls. Results of the soil erosion analyses demonstrate that both the top surfaces and the external embankment sideslopes can achieve effective erosional stability without any stormwater diversion structures provided that the soil surfaces are stabilized with at least 60 percent ground cover. Furthermore, since the flow velocities are the governing parameter for the maximum length of the 4H:1V slopes between the soil berms, the actual amount of soil loss will be reduced. Limiting the uninterrupted length of 4H:1V slopes to a maximum of 240 feet will reduce the maximum soil loss on the intermediate slopes to approximately 18.7 tons/acre/year.

The analyses for interim erosion and sediment controls are included in Appendix III2C-1, Intermediate Cover Soil Erosion Loss Analysis.

4.4.2 Erosion and Sedimentation Control BMPs – Intermediate Cover Areas

There are numerous BMPs that can be implemented during landfill operations to meet the soil stabilization and stormwater diversion requirements. These BMPs can be used prior to establishing vegetation or in conjunction with vegetation. The selected BMPs for this site are commonly used and are discussed below. The common BMPs discussed below include a specification and/or detail for reference. The controls discussed below are available from several manufacturers. The site manager has the flexibility to purchase a control similar to that specified from any manufacturer based on local availability and/or cost. Any other BMPs that may not be commonly used today, such as new technologies as they become available, may be implemented if they are proven to provide satisfactory ground cover and effective erosion controls. The evaluation for effectiveness and the demonstration of equivalency of erosion and sediment control BMPs that are not included in this plan will be maintained within the facility's site operating record, furnished upon request to the TCEQ, and made available for inspection by TCEQ personnel, as necessary. Furthermore, any control measures and practices used to keep soil loss and flow velocity within permissible limits prior to establishing vegetation or in conjunction with vegetation not approved with this plan, must be approved by the TCEQ prior to implementation.

4.4.2.1 Soil Surface Stabilization

Intermediate cover will be temporarily stabilized during installation and maintained throughout facility operations. Erosion and sedimentation controls will be implemented on intermediate covers within 180 days after placing intermediate cover, in accordance with 30 TAC §330.165(c). The soil surface stabilization BMPs that may be implemented at the site are listed below. Vegetation is the most effective erosion control, but until this is achieved, geosynthetics may be used to stabilize the surface of the soil until vegetation can root, spread, and properly grow. These stabilization materials will be removed, if applicable, once the required 60 percent cover is established.

- Vegetation – Vegetative cover reduces erosion potential by shielding the soil surface from the direct erosive impact of raindrops, improving the soil's porosity and water storage capacity so more water can infiltrate, slowing the runoff, allowing the sediment to drop out, and physically holding the soil in place with plant roots. Grass types that are suitable for the area will be selected in accordance with guidelines published by the state or local agency or other similar sources. The standard seeding specification published by TxDOT is provided in Appendix III2D, Example BMP Specifications.

- Mulch – Mulching is the application of a layer of organic, biodegradable material that is spread over areas where vegetation is not yet established. Types of mulch include compost, straw, wood chips, or manufactured products. Mulch application can be in dry or hydraulic forms. When applied dry, the thickness of the mulch will vary depending on the type of mulch applied. Primary-grind mulch (e.g., wood shreds that form a mass of intertwined fragments) used primarily for erosion control, will be applied using spreading equipment, such as a bulldozer, at a minimum thickness of 2 inches. Compost material, which may consist of more finely ground mulch, will be applied using mechanical spreaders or sprayers. A tackifier or binder may be used to increase the strength and durability of the mulch. Hydraulic mulch includes hydromulch, bonded fiber matrix, flexible growth medium (FGM), and other commercially available products. Hydraulic mulch includes a tackifier or binder that increases the strength and durability of the mulch. Seeds can be applied to the soil first or mixed into the hydraulic mulch. The application method and application rate of hydraulic mulch will be based on manufacturers' recommendations to ensure a uniform and complete coverage. The application method and rate of mulch for other products will be in accordance with that particular product's specifications and recommendations.
- Geosynthetics – Geosynthetic products available for soil erosion controls include geotextile, geomembrane, rolled-erosion control products (RECPs), etc. Erosion control blankets and turf reinforcement mats are examples of the RECPs. Erosion control blankets include straw or other mulch material stitched with degradable thread to a photodegradable polypropylene netting structure. The standard specification for rolled erosion control products published by the Erosion Control Technology Council is provided in Appendix III2D, Example BMP Specifications. There are numerous products available on the market that can be used. Any material specifically chosen by the site based on cost or local availability will be installed in accordance with that particular manufacturer's specifications and recommendations.

4.4.2.2 Temporary Stormwater Diversions and Sediment Control Structures

Examples of the temporary stormwater diversion and sediment control structures that will be used on the intermediate cover areas are presented below. These structures can be used both prior to and after establishing cover.

- Soil Berms – Soil diversion berms (i.e., temporary add-on berms) are constructed with compacted on-site soils to intercept the flow on the slope and convey the flow laterally to a downchute. The berm design will be minimum 2-feet high, as measured from the invert of the channel to the top of berm, with the invert sloped at 2.0 percent in the direction of flow. The slopes of the soil berms will be stabilized with vegetation, mulch, or geosynthetics. The maximum berm length will be controlled to limit the drainage area to less than 4.6 acres, as demonstrated in the calculation included in Appendix III2C-2, Intermediate Cover Soil Berm Calculation. This limit is based on the channel flow capacity, including a maximum flow velocity of 5.0 feet per second, and the rainfall intensity for Hidalgo County. These temporary soil berms will be constructed in the same manner as the permanent soil berms on the final cover. A detail of the temporary soil berms is shown on Figure III2-15.
- Silt Fences – Silt fences or fabric filter fences may be used along the slope to intercept the flow and capture the sediment. The maximum drainage area captured by the silt fence

should not exceed the manufacturer's specification, but should also be limited to 0.5 acre per 100 feet of fence. The standard specification and detail drawing published by City of Edinburg is provided on Figures III2-14 and III2-15.

- Hay Bales – Hay bales may be used along the slope, perpendicular to the flow to intercept the flow and capture the sediment, similar to the function of a silt fence. The standard specification and detail drawing published by City of Edinburg is provided on Figures III2-14 and III2-15.
- Biodegradable Logs or Organic Berms – These types of diversion structures are alternatives to traditional silt fences and hay bales. The biodegradable logs or organic berms are placed along the slope contours to catch the sediment from sheet flow and allow the stormwater to flow through at a reduced speed. A biodegradable log consists of mulch contained in a synthetic mesh sock or tube. The logs are installed on the slope with stake anchors. Organic berms are constructed of compost/mulch. A specification for the compost/mulch filter berm published by TxDOT is included in Appendix III-2D, Example BMP Specifications. Any type of biodegradable log or organic berm may be used as long as it is installed in accordance with the manufacturer's specifications and recommendations. The standard specification and detail drawing published by City of Edinburg is provided on Figures III2-14 and III2-15.

4.4.2.3 Additional Erosion and Sedimentation Control BMPs

In addition to the soil stabilization and stormwater diversion BMPs listed above, the site has 11 stormwater holding ponds, which will provide stormwater storage capacity and sediment control.

Temporary downchutes will be required when soil diversion berms are installed. Based on the calculations included in Appendix III2C-2, Intermediate Cover Soil Berm Calculation the maximum allowable drainage area for the soil diversion berms yields a maximum berm length of 835 feet (corresponding to the maximum drainage area of 4.6 acres). The temporary downchute will be installed at the termination of the temporary soil diversion berm as necessary to collect runoff from the intermediate slope surface. The recommended minimum temporary downchute channels are 2-feet deep, with 2H:1V sideslopes. The downchute width will be determined based on the contributing drainage area as demonstrated in Appendix III2C-3, Intermediate Cover Downchute Channel Calculation. A geosynthetic lining material (e.g., geomembrane sheet) will be used to line the temporary downchute channels. The hydraulic design of the temporary downchutes is included in Appendix III2C-3, Intermediate Cover Downchute Channel Calculation. A detail of the temporary downchute channels is shown on Figure III2-15, Erosion and Sedimentation Control Details - II. In lieu of downchute channels, corrugated plastic downchute pipes or metal pipes with equivalent flow capacity may be used. If pipes are used as downchutes, the demonstration of equivalency of downchute pipes will be maintained within the facility's site operating record, furnished upon request to the TCEQ, and made available for inspection by TCEQ personnel, as necessary.

For on-site stockpiles, the BMPs discussed previously, such as silt fence, hay bales, or rock or organic berms, may be used at the site manager's discretion to control erosion and runoff around the stockpile areas. Details of these BMPs are shown on Figures III2-14 and III2-15.

4.4.3 Placing and Removing Temporary BMPs

The BMPs discussed in the previous sections will be placed in accordance with the specifications as included in Appendix III2D, Example BMP Specifications or in accordance with the manufacturers' guidelines for that particular material. Since these BMPs are only temporary, they will be removed at the site manager's discretion when the specific situation warrants that the control is no longer needed or if a different control is implemented. Examples of when a control will be removed or replaced are as follows:

- 60 percent cover has been established.
- The BMP has been destroyed or damaged beyond repair.
- The BMP is not functioning efficiently.
- The intermediate cover area will become part of the active disposal area again.
- The intermediate cover area will receive final cover and permanent erosion controls.
- The BMP becomes a hindrance to daily site operations.

At other times, if deemed necessary by the site manager, the control may be removed to aid in the daily ongoing waste fill and construction activities that may not specifically be itemized in the above list. The placement and removal of temporary BMPs should not hinder the site operations, but should be considered by the site manager as an effective tool to minimize future maintenance or repairs.

BMPs will be removed or replaced as part of the site's daily operations. Removed BMPs that have been destroyed or damaged will be disposed of at the working face of the facility. The site manager will determine a location to store reusable BMPs so they are easily accessible for future construction.

4.5 Erosion and Sedimentation Control for Final Cover Areas

30 TAC §330.305(e)

4.5.1 Erosion and Sedimentation Control Design – Final Cover Areas

The final cover stormwater system design includes crownslope add-on berms along the 5 percent final cover top slopes and sideslope add-on berms spaced at 40-foot vertical intervals along the 4H:1V final cover slopes, or a maximum length of uninterrupted flow of 160 feet. The selection of stormwater management control structures will be a continual evolution of temporary and permanent control devices. The facility fill sequence plans included in Figures II-20, Operational Sequence Phases I – V will be used to properly select both temporary and permanent stormwater structural controls. The stormwater management structural controls were developed to provide low runoff velocities, to provide adequate storage and detention, and to limit sediment and soil loss impacts on stormwater discharge quality. Soil erosion loss and control was estimated using the Universal Soil Loss Equation in the USDA Handbook No. 703 – "Predicting Soil Erosion By Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE)," 1997.

The design results in a maximum estimated soil loss of 2.1 tons/acre/year for the 4H:1V sideslopes of the landfill final cover. This estimate is equal to approximately 0.01 inches per year eroded from the final cover for this worst-case scenario. Soil loss calculations are presented in Appendix III2E, Final Cover Erosion Soil Loss Calculation.

4.5.2 Erosion and Sedimentation Control BMPs – Final Cover Areas

Permanent stormwater management controls include seeding, add-on berms, downchute channels, slope contours, perimeter berms, final cap design, detention ponds, and discharge control structures.

To stabilize the final cover soil, a 6-inch thick top soil layer that is capable of supporting native vegetation growth will be installed on the final cover surfaces. Maintenance and inspection, as addressed in §5.0 Inspection, Maintenance, and Restoration Plan of this report, will be implemented to ensure a minimum 90 percent ground cover on the final cover and to ensure that the diversion structures, including the detention ponds, function as designed.

4.6 Minimizing Off-site Vehicular Tracking of Sediments

To minimize the off-site vehicular tracking of sediments onto public roadways, traffic routing and site operation practices will be developed. The following preventative measures will be utilized to control sediment tracking:

- Maintain the site entrance to minimize the accumulation of excessive mud, dirt, dust, and rocks.
- Schedule maintenance and construction of paved and temporary roads to limit disruption of traffic flow patterns or create vehicular safety problems.
- Control traffic routing during wet weather conditions to limit the impact of sediment tracking.

5.0 INSPECTION, MAINTENANCE, AND RESTORATION PLAN

30 TAC §330.305(e)(1)

In addition to the design and operational considerations previously described in the §4.0 Erosion and Sedimentation Control Plan of this report, it is necessary to inspect and maintain the stormwater management system and erosion control measures to maintain the required effectiveness of the system components. The City will maintain the stormwater management system as designed and will restore and repair the drainage system in the event of washout or failure in accordance to Part IV, Site Operating Plan §4.22.6 Erosion of Cover. The inspection, maintenance, and repair guidelines as discussed in the following sections will be implemented into the employee training program as outlined in Part IV, Site Operating Plan §4.1 Personnel Training. Documentation of the inspections and repairs, as outlined below, will be denoted in the Cover Application Log and will be maintained as part of the site operating record, in accordance with the Part IV, Site Operating Plan §4.22.7 Cover Inspection Record.

5.1 Stormwater Management System

The site will be monitored to ensure the integrity and adequate operation of the stormwater collection, drainage, and storage facilities. On a weekly basis, all temporary and permanent drainage facilities will be inspected. Following a significant rainfall event (greater than 0.5 inches within 24 hours), all temporary and permanent drainage facilities will be inspected within 48 hours after the rain event, as ground conditions allow. In the event of a washout or failure, the drainage system will be restored and repaired. Plans and actions will be developed to address and remediate the problem to ensure protection to ground and surface waters. Sediment and debris will be removed from channels, ponds, and from around outfall structures, as needed, to maintain the effectiveness of the stormwater management system. Minor maintenance requirements, such as removing excessive sediment and vegetation, will be undertaken as required. Upon completion of sediment removal from lined stormwater ponds, the ponds' HDPE liner will be inspected for damage and, if necessary, repaired in accordance with Part III3F, Liner Quality Control Plan.

5.2 Landfill Cover Materials

Landfill cover soils are inspected on a regular basis. Daily cover soils are inspected and applied in accordance with the Part IV, Site Operating Plan §4.22.1 Daily Cover. During the active life of the site, inspections of intermediate and final cover also will be performed within 48 hours after a significant rain event (greater than 0.5 inches within 24 hours) in which runoff occurs, as ground conditions allow. During the post-closure maintenance period of the site, the final cover will be inspected quarterly. The inspections will include any temporary or permanent erosion measures that are in place at the time of the inspection. Reports of these inspections will be documented in the Cover Application Log and will be maintained as part of the site operating record, in accordance with Part IV, Site Operating Plan §4.22.7 Cover Inspection Record.

Erosion gullies or washed-out areas deep enough to jeopardize the intermediate or final cover must be repaired within 5 days of detection. An eroded area is considered to be deep enough to jeopardize the intermediate or final cover if it exceeds 4 inches in depth, as measured from the vertical plane from the erosion feature and the 90-degree intersection of this plane with the horizontal slope face or surface. Damage to any temporary or permanent erosion measures noted during the inspections will be repaired or replaced within 14 days of detection. The repair schedule, as outlined for the cover or the erosion measures, may be extended due to inclement weather conditions or the severity of the condition requiring an extended repair schedule. The TCEQ's regional office in Harlingen will be notified to coordinate a revised schedule in case an extended repair schedule is required.

6.0 FLOODPLAIN EVALUATION

Consistent with 30 TAC §§330.61(m)(1), 330.63(c)(2), 330.307, and 330.547, an evaluation of the 100-year floodplain has been prepared and discussed in Part II §2.8, Floodplains and Part IIC, Floodplains.

6.1 100-year Floodplain Location

30 TAC §330.63(c)(2)(A)

As discussed in Part II §2.8.1, Location the permit boundary for the facility extends into two small unnamed ponding areas designated Special Flood Hazard Area (SFHA) Flood Zone A as shown in Figure IIC-3, FEMA Q3 Flood Data. Note that these two SFHA areas are both localized small depressions and are not connected with any floodways. Future construction of the facility perimeter berm fill in the areas are required prior to any waste acceptance in the associated areas. As a result, the waste footprint will be outside the 100-year floodplain.

6.2 Data Source for Floodplain Determination

30 TAC §330.63(c)(2)(B)

As discussed in Part II §2.8.2, Data Source, the facility's property boundary is located on the Flood Insurance Rate Map (FIRM) panel number 480334 0325D dated June 6, 2000, which was revised by LOMR 01-06-1095P dated May 17, 2001. The SFHA changes made by subsequent Letter of Map Changes (LMOCs) have not yet been incorporated into FEMA's National Flood Insurance Program (NFIP) National Flood Hazard Layer (NFHL) digital database and does not yet contain high resolution flood hazard mapping data for Hidalgo County. The most current SFHA delineations available for the project area are FEMA Quality Level 3 (Q3) Flood Data files as verified by FEMA.

6.3 Flood Protection of the Facility

30 TAC §330.63(c)(2)(C)

As demonstrated in Part IIC2-1, FEMA CLOMR-F Request, construction of the facility perimeter berm and storm water management structures—placement of fill in the SFHA Zone A areas—will not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste so as to pose a hazard to human health and the environment. The facility perimeter berm encompassing the entire waste footprint will provide a minimum of three feet of freeboard above the 100-year design flood.

6.4 Construction Approval

A request for Conditional Letter of Map Revision Based on the Placement of Fill (CLOMR-F) was submitted to FEMA included in Part IIC2-2, FEMA CLOMR-F Request. The submittal included a detailed discussion of proposed fill in the two SHFA Zone A areas, figures detailing facility design plan and profiles, and required documentation. FEMA responded that the proposed development does not encroach on a FEMA designated floodway and no buildings are anticipated to be constructed on the site, there are no procedures under the NFIP regulations that require action by FEMA. Hidalgo County, or other agencies having jurisdiction of the site, may have requirements that apply.

The City of Edinburg has jurisdiction over the facility and adjacent properties. The Director of Public Works reviewed and approved the request for CLOMR-F and signed the Community Acknowledgement Form included in Appendix IIC2-3, Community Floodplain Management Review and Approval.

FIGURES

APPENDIX III2A

DETAILED DRAINAGE CALCULATION

DETAIL DRAINAGE CALCULATION

Made By: VJE
Checked by: MX
Reviewed by: CGD

1.0 OBJECTIVE

Develop a surface water management plan for the proposed development at the Edinburg Regional Disposal Facility (RDF) located in Hidalgo County, Texas. Compare pre- and post-development peak flows, volumes, and velocities for the 25-year, 24-hour storm event.

STATE OF TEXAS
1/11/18
CHARLES G. DOMINGUEZ
83247
REGISTERED
PROFESSIONAL ENGINEER

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

INTENDED FOR PERMITTING PURPOSES ONLY

2.0 METHOD

The proposed Edinburg Regional Disposal Faciltiy expansion site is greater than 200 acres. Therefore, Golder utilizes the USACE HEC-HMS modeling software for the drainage analysis. Subbasins were delineated for pre- and post-development conditions using existing topography and proposed final cover topography respectively (see Figures III2A-1 and III2A-2). The pre-development conditions consist of the permittted final grades and drainage design in the currently permitted area and existing topography in the expansion area. The post-development conditions consist of the proposed final grades and drainage design.

Composite SCS curve numbers (CN) were estimated for each subbasin (USSCS, 1986). The SCS method was used to estimate a time of concentration (Tc) for each subbasin; lag times (required for HEC-HMS input) were calculated as 0.6 * Tc. Subbasin areas, curve numbers, and lag times were entered into HEC-HMS to estimate peak flows and runoff volumes.

Peak flows from the HEC-HMS hydrology model were used to design stormwater channels required for the surface water management plan (downchutes, perimeter channels, add-on berms, and perimeter drainage ditches). Channel calculations were performed using a spreadsheet that solves Manning's equation for normal depth. Culvert sizing calculations were carried out using HY8 software (FHWA, 1996).

Stage-storage relationships for all ponds were developed using site contours and spreadsheet calculations.

3.0 ASSUMPTIONS

- 24-hour rainfall depths (TR-55, 1986):
    - 2-year = 4.3 in (used in time of concentration calculations)
    - 25-year = 8.5 in
    - 100-year = 11.0 in (used in time of concentration calculations)
- 24-hour rainfall events have an SCS Type III synthetic temporal distribution (TR-55, 1986).
- Curve numbers (consistent with previous work and local regulations/practice):
    - Landfill final cover and other open areas, CN = 85
    - Paved areas, CN = 98
    - Areas where minimum infiltration are expected (ponds), CN = 98
    - Expansion area currently grassed or used for agricultural purposes, CN = 79
- Manning's roughness coefficients:
    - Grass-lined channels, n = 0.035
    - Riprap channels, n=0.040
- Landfill downchutes are armored with flexible Geomembrane.
    - Geomembrane lined channels, n = 0.012
- Landfill downchutes are sized to convey runoff from the 25-year, 24-hour storm event and allowing 0.5 feet of freeboard.
- Add-on berms have 2H:1V and 2H:1V side slopes and form triangular channels at 2 percent longitudinal slopes on the final cover slope.
- Add-on berms are sized to convey runoff from the 25-year, 24-hour storm event and provide a minimum of 0.5 feet of freeboard.
- Perimeter channels are trapezoidal with 3H:1V side slopes and varying bottom widths and longitudal slopes. Minimum longitudal slope is 0.1%.
- Perimeter channels are sized to convey runoff from the 25-year, 24-hour storm event and provide a minimum of 1.0 feet of freeboard.
- Perimeter channels are armored with riprap where flow velocities exceed 5 ft/s, as applicable.

4.0 CALCULATIONS

Tables 1A.1, 1A.2, 1B.1, and 1B.2 contain composite curve number and time of concentration calculations for the pre- and post-development conditions. The stage-storage relationships were developed in the spreadsheets shown in Tables 2A through 2D (proposed pond E1, E2, E3, E4, W1, W2, W3, W4, W5, W6, and W7). Table 3 contains calculations for the design of downchutes, add-on berm channels, and perimeter channels. Table 4 contains calculations of the run-off velocities at the control points for pre-development and post-development conditions. Table 5 includes time of concentration and manning's flow coefficients.

Attachment A contains HEC-HMS model input and output information including basin parameters, a routing diagram, and peak flows. HY8 reports summarizing the culvert sizing calculations are included as Attachment B. See Figures III2-A-1 and III2-A-2 for subbasin delineations and channel alignments.

5.0 CONCLUSIONS/RESULTS

The post-development downchutes, add-on berms and perimeter channels are designed to accommodate runoff from the 25-year, 24-hour storm event with 0.5' freeboard (design shown in Table 3). Riprap sizing and gradations are found in Appendix III2-A-3.

The post-development ponds (design shown in Tables 2A through 2D) are sufficiently sized to store the runoff from the 25-year, 24-hour storm event. The maximum water surface elevations in the ponds during the 25-year, 24-hour storm event are summarized below. The water surface elevation is below the pond crest in all ponds.

POND	**Runoff Volume (ac-ft)**	**Maximum Pond Water El. (ft-msl)**	**Minimum Elev.of the Pond Levee (ft-msl)**
	25-year 24-hour storm	25-year 24-hour storm	
W1	31.8	85.7	91.0
W2	34.6	85.7	91.0
W3	6.9	85.7	91.0
W4	7.1	83.7	91.0
W5	7.2	83.7	91.0
W6	70.8	83.7	91.0
W7	7.9	78.5	91.0
E1	80.2	76.8	94.0
E2	86.1	76.8	94.0
E3	11.5	76.8	94.0
E4	8.7	76.8	94.0

The culvert design for the post-development conditon is summarized in the table below:

Culvert ID	25-year, 24-hour Design Storm	
	Flow Rate (cfs)	Culvert Design (number of barrels)
C1	209.0	3 - 6' x 3' conc. box
C2	238.8	6 - 4' x 2' conc. box
C3	555.5	6 - 6' x 3' conc. box

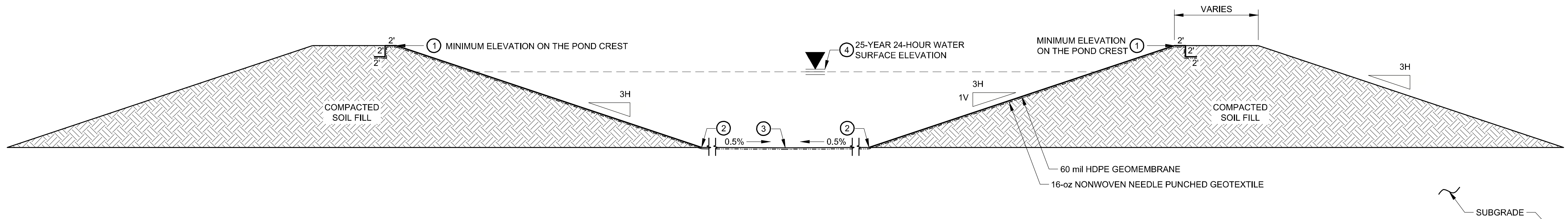
Note: See Figure III2-A-2 for locations of the proposed culvert. Alternative designs may be utilized if they provide adequate flow capacity.

The flow rates and volumes at the control points for both the pre-development and post-development conditions are summarized below.

Run-off Control Point	Flow Rates Pre-Development 25-year, 24-hour (cfs)	Flow Rates Post-Development 25-year, 24-hour (cfs)	Volumes Pre-Development 25-year, 24-hour (cfs)	Volumes Post-Development 25-year, 24-hour (cfs)
CP1	47.5	0	9.8	0
CP2	548.8	0	115.2	164.9 (west ponds)
CP3	32.5	0	4.1	0
CP4	21.0	0	2.9	0
CP5	226.4	0	29.8	0
CP6	250.6	0	42.1	0.0
CP7	51.1	19.5	9.8	3.9
CP8	55.6	0	9.6	187.7 (east ponds)
CP9	19.6	0	4.1	0
CP10	117.6	0	19.9	0
CP11	324.0	0	41.0	0
CP12	89.3	0	10.2	0
CP13	117.9	0	17.4	0

6.0 REFERENCE

1. Texas State Department of Highways and Public Transportation. December 1985. *Bridge Division* Hydraulic Manual, 3rd Edition.
2. TR-55. June 1986. Urban Hydrology for Small Watersheds. Washington D.C.: Department of Agriculture for Natural Resources Conservation Service, Conservation Engineering Division.
3. U.S. Federal Highway Administration (FHWA). 1996. *HY8 - Culverts Version 7.3 FHWA Culvert Analysis*. Washington, D.C.: FHA Office of Technology Applications [software package].
4. U. S. Soil Conservation Service (USSCS). 1986. *Urban hydrology for small watersheds, 2nd edition*. (USSCS Technical Release Number 55). Washington D.C.: United States Department of Agriculture.
5. US Army Corps of Engineers. 2003. *HEC-HMS Hydrologic Modeling System* [computer software] May 2003 Version 4.0.
6. US Army Corps of Engineers *EM 1110-2-1601 Hydraulic Design of Flood Control Channels*. July 1991.



SCALE NTS 11 III2-8 TYPICAL POND DETAILS

WEST POND ELEVATION

NUMBER	W1	W2	W3	W4	W5	W6	W7
1	91.0	91.0	91.0	91.0	91.0	91.0	91.0
2	83.0	81.0	79.5	81.0	81.0	79.0	77.0
3	82.3	80.3	78.8	80.2	80.2	78.2	76.2
4*	85.7	85.7	85.7	83.7	83.7	83.7	78.5

*25-YEAR 24-HOUR WATER SURFACE ELEVATION BASED THE POND BEING EMPTY.

EAST POND ELEVATION

NUMBER	E1	E2	E3	E4
1	94.0	94.0	94.0	94.0
2	78.0	67.0	78.0	75.0
3	67.5	63.0	75.8	69.3
4	76.8	76.8	76.8	76.8

ISSUED FOR PERMITTING PURPOSES ONLY

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2018-01-11	RESPONSE TO TCEQ SECOND NOTICE OF DEFICIENCY	CEI	TNB	MX	CGD
1	2017-11-07	RESPONSE TO TCEQ FIRST NOTICE OF DEFICIENCY	MX	TNB	MX	CGD
0	2017-07-21	PERMIT AMENDMENT APPLICATION SUBMITTAL	VJE	TNB	MX	CGD

SEAL

STATE OF TEXAS
CHARLES G. DOMINGUEZ
83247
REGISTERED PROFESSIONAL ENGINEER

GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

CLIENT

CITY OF EDINBURG SOLID WASTE MANAGEMENT

CONSULTANT

Golder Associates

HOUSTON OFFICE
500 CENTURY PLAZA DRIVE, SUITE 190
HOUSTON, TEXAS
USA
[+1] (281) 821-6868
www.golder.com

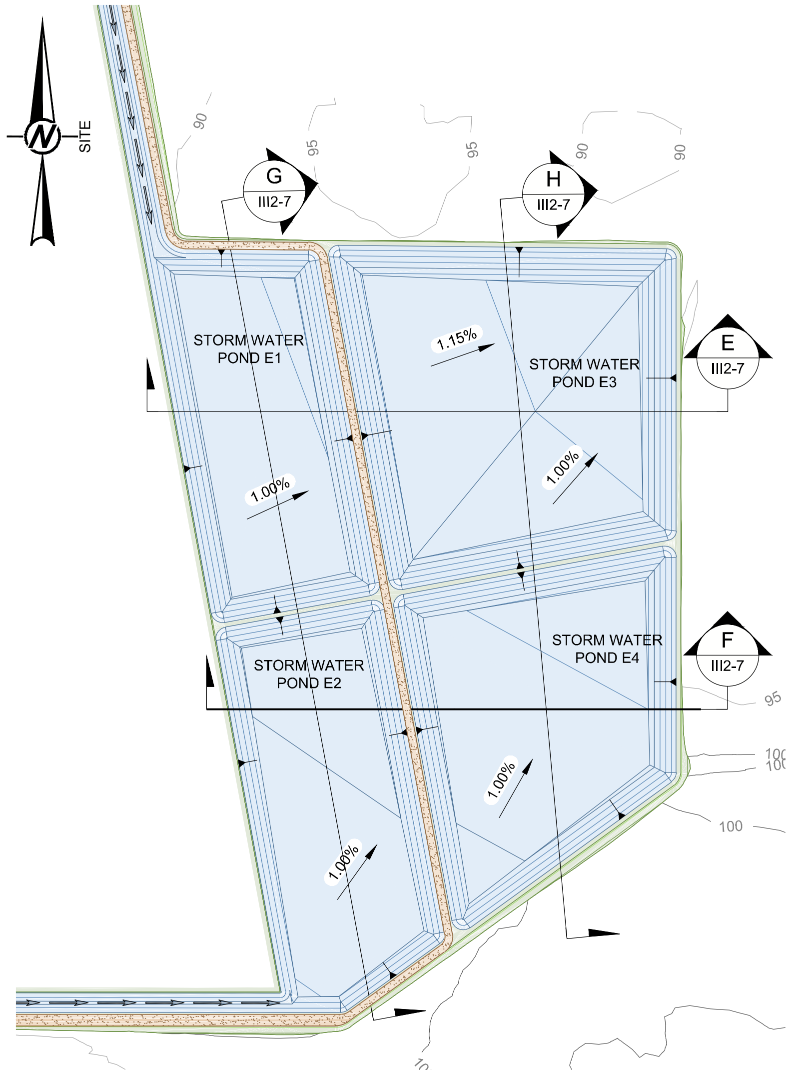
PROJECT
EDINBURG REGIONAL DISPOSAL FACILITY
PERMIT AMENDMENT APPLICATION TCEQ PERMIT MSW-956C
EDINBURG, HIDALGO COUNTY, TEXAS

TITLE
DRAINAGE CONTROL DETAILS VI - POND DETAILS

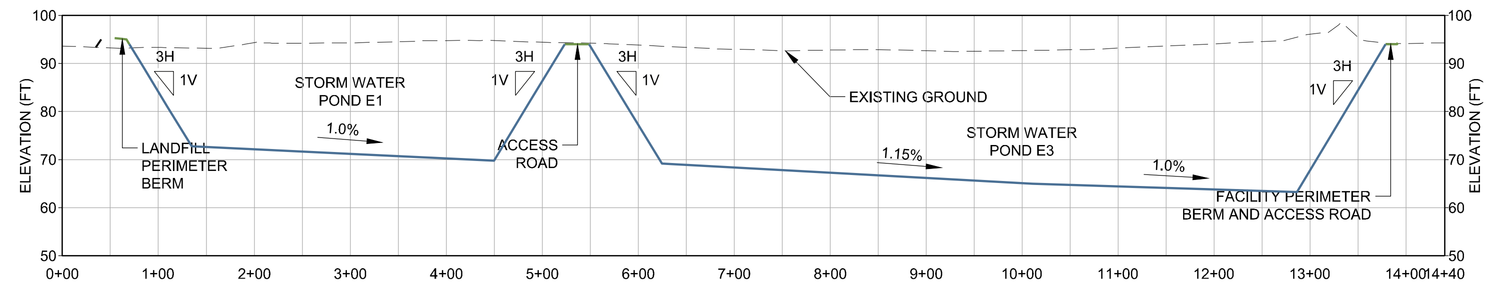
PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	2	8 of 15	III2-8

LEGEND

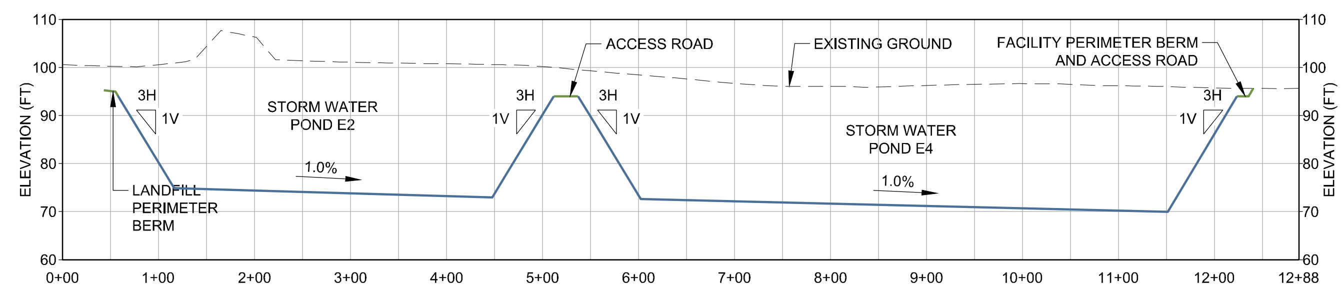
- PERMIT BOUNDARY
- EXISTING GROUND 25 ft CONTOUR
- EXISTING GROUND 5 ft CONTOUR
- PERIMETER BERM 25 ft CONTOUR
- PERIMETER BERM 5ft CONTOUR
- STORMWATER POND 25 ft CONTOUR
- STORMWATER POND 5 ft CONTOUR
- SURFACE WATER PERIMETER CHANNEL FLOW DIRECTION
- ACCESS ROADS



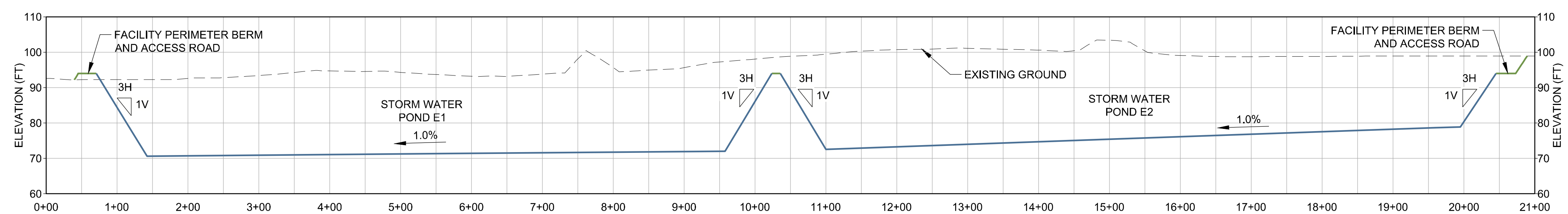
SCALE 1" = 500' 10 III2-7 EAST PONDS



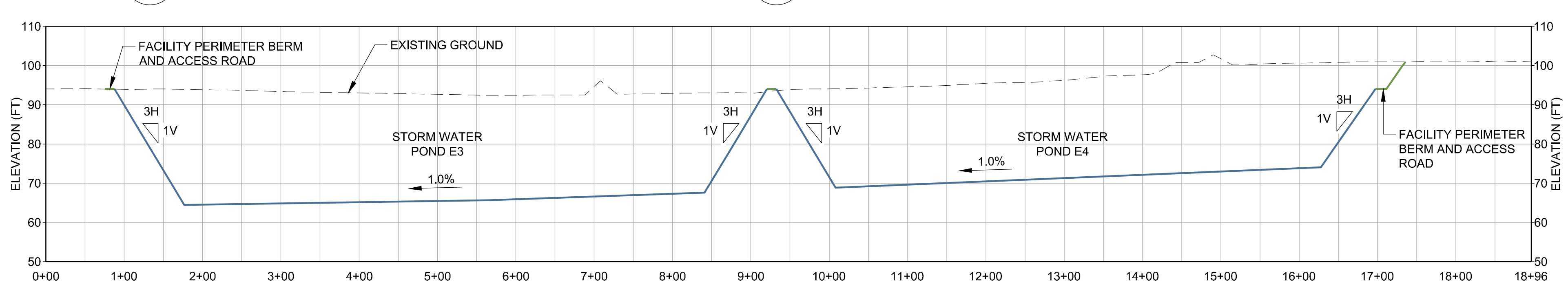
SCALE 1" = 200' E III2-7 EAST PONDS



SCALE 1" = 200' F III2-7 EAST PONDS



SCALE 1" = 200' G III2-7 EAST PONDS



SCALE 1" = 200' H III2-7 EAST PONDS

ISSUED FOR PERMITTING PURPOSES ONLY

0 100 200
1" = 200' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2018-01-11	RESPONSE TO TCEQ SECOND NOTICE OF DEFICIENCY	CEI	TNB	MX	CGD
1	2017-11-07	RESPONSE TO TCEQ FIRST NOTICE OF DEFICIENCY	MX	TNB	MX	CGD
0	2017-07-21	PERMIT AMENDMENT APPLICATION SUBMITTAL	VJE	TNB	MX	CGD

SEAL

STATE OF TEXAS
CHARLES G. DOMINGUEZ
83247
REGISTERED PROFESSIONAL ENGINEER

GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

CLIENT

CITY OF EDINBURG SOLID WASTE MANAGEMENT

CONSULTANT

Golder Associates

HOUSTON OFFICE
500 CENTURY PLAZA DRIVE, SUITE 190
HOUSTON, TEXAS
USA
[+1] (281) 821-6868
www.golder.com

PROJECT
EDINBURG REGIONAL DISPOSAL FACILITY
PERMIT AMENDMENT APPLICATION TCEQ PERMIT MSW-956C
EDINBURG, HIDALGO COUNTY, TEXAS

TITLE
DRAINAGE CONTROL DETAILS V - EAST PONDS AND SECTIONS

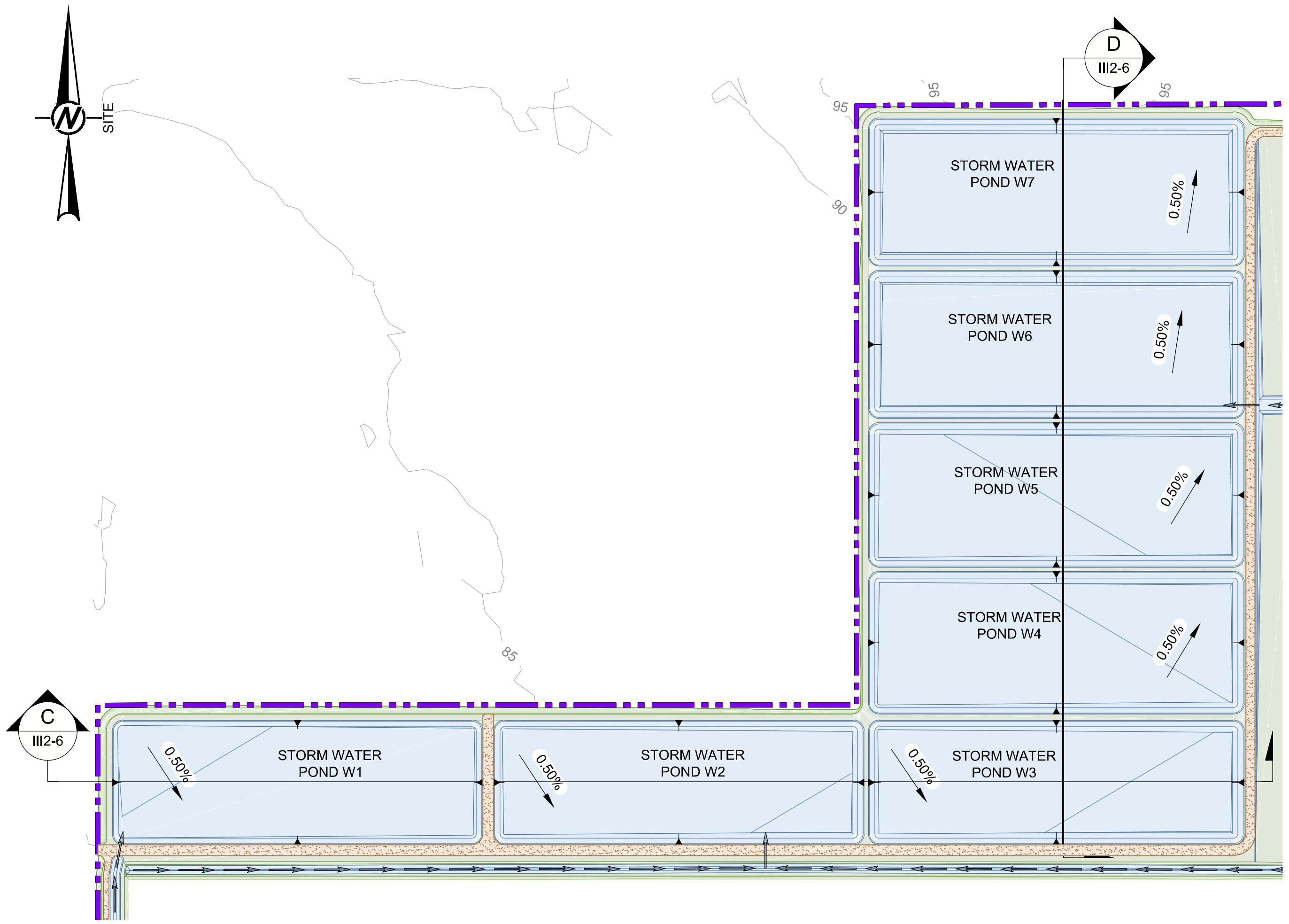
PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	2	7 of 15	III2-7

Path: \\houston\drafting_2014\1401491 - city of edinburg\PRODUCTION\A - Permit Amendment Application\ | File Name: 1401491A164.dwg

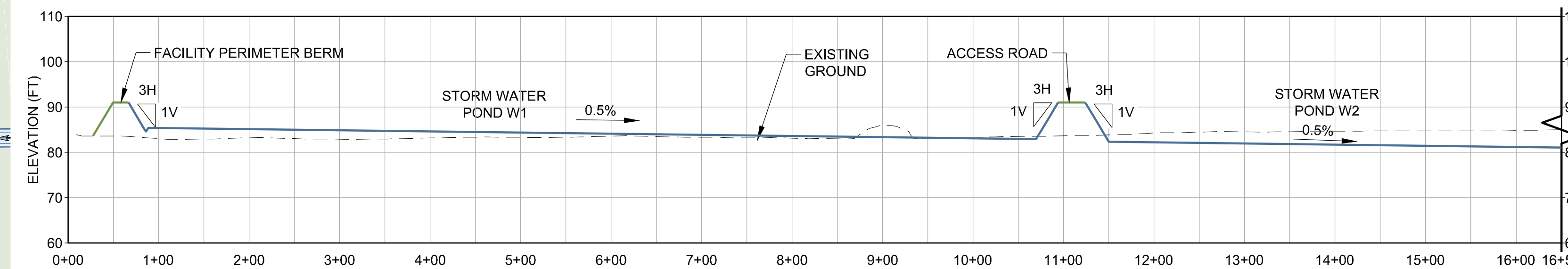
1 in IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

LEGEND

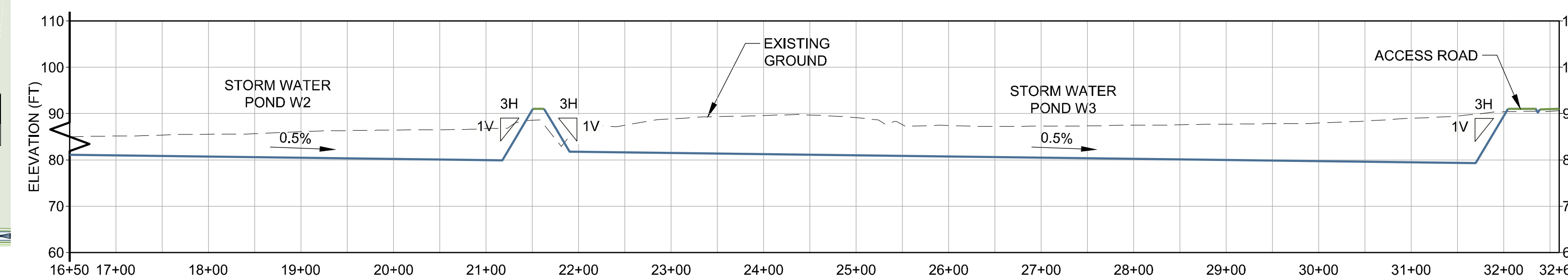
- PERMIT BOUNDARY
- EXISTING GROUND 25 ft CONTOUR
- EXISTING GROUND 5 ft CONTOUR
- PERIMETER BERM 25 ft CONTOUR
- PERIMETER BERM 5ft CONTOUR
- STORMWATER POND 25 ft CONTOUR
- STORMWATER POND 5 ft CONTOUR
- SURFACE WATER PERIMETER CHANNEL FLOW DIRECTION
- ACCESS ROADS



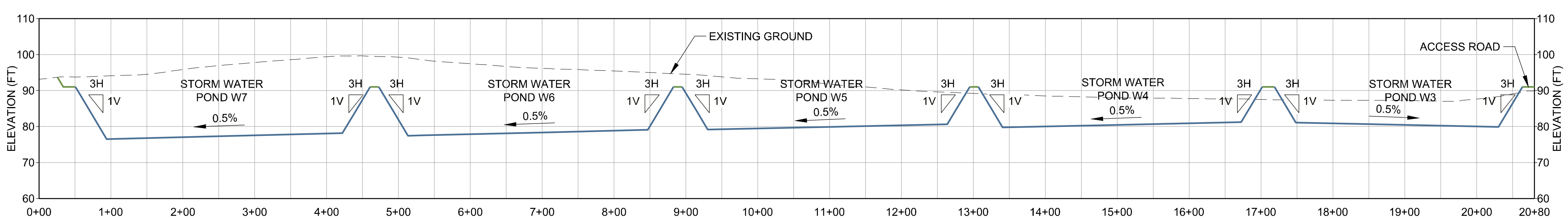
SCALE 1" = 500' 9 III2-6 WEST PONDS



SCALE 1" = 200' C III2-6 WEST PONDS



SCALE 1" = 200' C III2-6 WEST PONDS



SCALE 1" = 200' D III2-6 WEST PONDS

ISSUED FOR PERMITTING PURPOSES ONLY

0 100 200
1" = 200' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2018-01-11	RESPONSE TO TCEQ SECOND NOTICE OF DEFICIENCY	CEI	TNB	MX	CGD
1	2017-11-07	RESPONSE TO TCEQ FIRST NOTICE OF DEFICIENCY	MX	TNB	MX	CGD
0	2017-07-21	PERMIT AMENDMENT APPLICATION SUBMITTAL	VJE	TNB	MX	CGD

SEAL

STATE OF TEXAS
CHARLES G. DOMINGUEZ
83247
REGISTERED PROFESSIONAL ENGINEER

GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

CLIENT

CITY OF EDINBURG SOLID WASTE MANAGEMENT

CONSULTANT

Golder Associates

HOUSTON OFFICE
500 CENTURY PLAZA DRIVE, SUITE 190
HOUSTON, TEXAS
USA
[+1] (281) 821-6868
www.golder.com

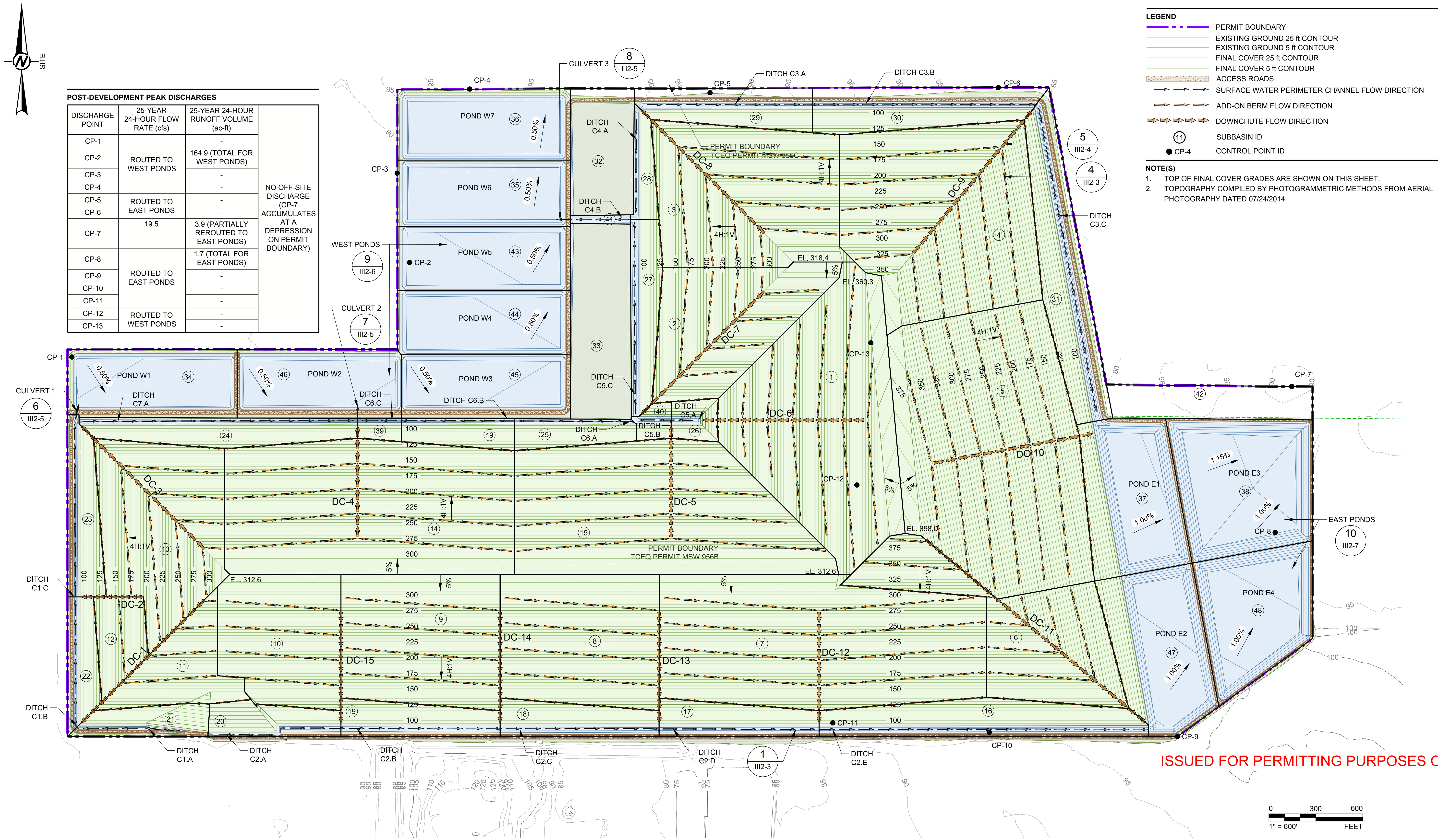
PROJECT
EDINBURG REGIONAL DISPOSAL FACILITY
PERMIT AMENDMENT APPLICATION TCEQ PERMIT MSW-956C
EDINBURG, HIDALGO COUNTY, TEXAS

TITLE
DRAINAGE CONTROL DETAILS IV - WEST PONDS AND SECTIONS

PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	2	6 of 15	III2-6

1 in IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Path: \\houston\drafting_2014\1401491 - city of edinburg\PRODUCTION\A - Permit Amendment Application\ | File Name: 1401491A164.dwg



POST-DEVELOPMENT PEAK DISCHARGES

DISCHARGE POINT	25-YEAR 24-HOUR FLOW RATE (cfs)	25-YEAR 24-HOUR RUNOFF VOLUME (ac-ft)	
CP-1	ROUTED TO WEST PONDS	-	NO OFF-SITE DISCHARGE (CP-7 ACCUMULATES AT A DEPRESSION ON PERMIT BOUNDARY)
CP-2		164.9 (TOTAL FOR WEST PONDS)	
CP-3		-	
CP-4		-	
CP-5	ROUTED TO EAST PONDS	-	
CP-6		-	
CP-7	19.5	3.9 (PARTIALLY REROUTED TO EAST PONDS)	
CP-8	ROUTED TO EAST PONDS	1.7 (TOTAL FOR EAST PONDS)	
CP-9		-	
CP-10		-	
CP-11		-	
CP-12	ROUTED TO WEST PONDS	-	
CP-13		-	

LEGEND

- PERMIT BOUNDARY
- EXISTING GROUND 25 ft CONTOUR
- EXISTING GROUND 5 ft CONTOUR
- FINAL COVER 25 ft CONTOUR
- FINAL COVER 5 ft CONTOUR
- ACCESS ROADS
- SURFACE WATER PERIMETER CHANNEL FLOW DIRECTION
- ADD-ON BERM FLOW DIRECTION
- DOWNCHUTE FLOW DIRECTION
- 11 SUBBASIN ID
- ● CP-4 CONTROL POINT ID

NOTE(S)

1. TOP OF FINAL COVER GRADES ARE SHOWN ON THIS SHEET.
2. TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY DATED 07/24/2014.

ISSUED FOR PERMITTING PURPOSES ONLY

0 300 600
1" = 600' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2018-01-11	RESPONSE TO TCEQ SECOND NOTICE OF DEFICIENCY	CEI	TNB	MX	CGD
1	2017-11-07	RESPONSE TO TCEQ FIRST NOTICE OF DEFICIENCY	CEI	TNB	MX	CGD
0	2017-07-21	PERMIT AMENDMENT APPLICATION SUBMITTAL	VJE	TNB	MX	CGD

SEAL
STATE OF TEXAS
CHARLES G. DOMINGUEZ
83247
REGISTERED PROFESSIONAL ENGINEER

GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

CLIENT
CITY OF EDINBURG SOLID WASTE MANAGEMENT

CONSULTANT
Golder Associates

HOUSTON OFFICE
500 CENTURY PLAZA DRIVE, SUITE 190
HOUSTON, TEXAS
USA
[+1] (281) 821-6868
www.golder.com

PROJECT
EDINBURG REGIONAL DISPOSAL FACILITY
PERMIT AMENDMENT APPLICATION TCEQ PERMIT MSW-956C
EDINBURG, HIDALGO COUNTY, TEXAS

TITLE
POST-DEVELOPMENT DRAINAGE PLAN

PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	2	2 of 15	III2-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Path: \\houston\drafting_2014\1401491 - city of edinburg\PRODUCTION\A - Permit Amendment Application | File Name: 1401491A032.dwg

APPENDIX III2A

TABLES

CITY OF EDINBURG
EDINBURG REGIONAL DISPOSAL FACILTY
HIDALGO COUNTY, TEXAS
PROJECT NO.: 1401491

Date:	7/6/17
By:	VJE
Chkd:	MX
Apprvd:	CGD

TABLE 2A: POND W1 THROUGH W3 STAGE-STORAGE VOLUME (25-YEAR STORM)

In order to calculate the total storage of the hydrologic reservoir routing, it is necessary to construct a storage-indication curve.
Construct an Elevation-Storage (E-S) curve using the working design drawing and the following formula:

$$S = \Delta h \frac{A_1 + A_2 + (A_1 A_2)^{0.5}}{3}$$

where:

S = pond volume (ft^3)
Δh = height of volume element (ft)
A_1 = surface area of bottom of volume element (ft^2)
A_2 = surface area of top of volume element (ft^2)

Pond W1

Elevation (ft MSL)	Area (ft^2)	Area (acres)	Inc. Volume (ft^3)	Inc. Volume (acre-ft)	Σ Volume (ft^3)	Σ Volume (acre-ft)
82.5	1,986	0.05	0	0	0	0
84.0	129,933	2.98	73,991	1.70	73,991	1.70
86.0	313,409	7.19	430,093	9.87	504,084	11.57
88.0	329,564	7.57	642,905	14.76	1,146,990	26.33
90.0	345,492	7.93	674,993	15.50	1,821,983	41.83
91.0	353,541	8.12	349,509	8.02	2,171,492	
						56.32

Pond W3

Elevation (ft MSL)	Area (ft^2)	Area (acres)	Inc. Volume (ft^3)	Inc. Volume (acre-ft)	Σ Volume (ft^3)	Σ Volume (acre-ft)
79.0	4,274	0.10	0	0	0	0
80.0	79,524	1.83	34,078	0.78	34,078	0.78
82.0	280,105	6.43	339,252	7.79	373,330	8.57
84.0	302,930	6.95	582,886	13.38	956,216	21.95
86.0	318,587	7.31	621,451	14.27	1,577,667	36.22
88.0	334,469	7.68	652,992	14.99	2,230,658	51.21
90.0	350,577	8.05	684,983	15.72	2,915,641	66.93
91.0	358,716	8.23	354,639	8.14	3,270,280	75.08

Combined Stage Storage Volumes for Ponds W1 throught W3 (Interconnected by Equalizing Pipes)

Elevation (ft MSL)	Σ Volume (acre-ft)
78.8	0
80.0	0.78
82.0	13.60
84.0	41.01
86.0	79.20
88.0	123.72
90.0	170.43

Volume required per HEC-HMS model:

Pond Name	Volume (acre-ft)
W1	31.8
W2	34.60
W3	6.90
Σ Volume	73.30

Pond W2

Elevation (ft MSL)	Area (ft^2)	Area (acres)	Inc. Volume (ft^3)	Inc. Volume (acre-ft)	Σ Volume (ft^3)	Σ Volume (acre-ft)
79.5	1,900	0.04	0	0	0	0
82.0	239,627	5.50	219,054	5.03	219,054	5.03
84.0	298,375	6.85	536,930	12.33	755,983	17.35
86.0	313,851	7.20	612,161	14.05	1,368,144	31.41
88.0	329,556	7.57	643,343	14.77	2,011,487	46.18
90.0	345,489	7.93	674,982	15.50	2,686,470	61.67
91.0	353,541	8.12	349,507	8.02	3,035,977	0.00
						69.40

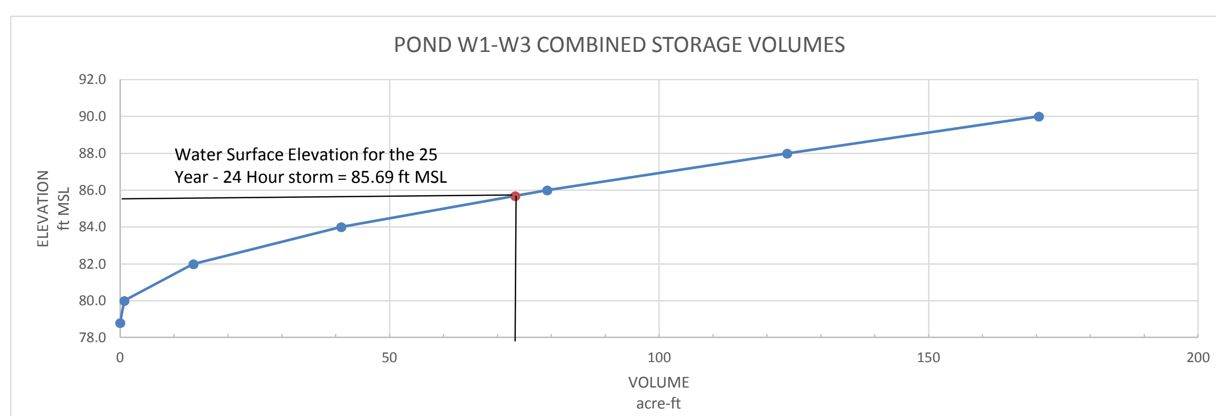
Next, the water surface elevation of the peak volume for the 25 year - 24 hour storm event. The peak volume is calculated using the HEC-HMS program. The water surface elevation is calculated by interpolation based on the stage storage table.

$$y_2 = \frac{(x_2 - x_1)(y_3 - y_1)}{(x_3 - x_1)} + y_1$$

y = elevations (ft MSL)
x = volume (ac-ft)

25 year - 24 hour storm event
Peak Volume = 73.30 ac-ft
Water Surface Elevation = **85.69** ft MSL

References:
1. US Army Corps of Engineers. 2003. *HEC-HMS Hydrologic Modeling System* [computer software] May 2003 Version 4.0.



CITY OF EDINBURG
EDINBURG REGIONAL DISPOSAL FACILTY
HIDALGO COUNTY, TEXAS
PROJECT NO.: 1401491

Date:	7/6/17
By:	VJE
Chkd:	MX
Apprvd:	CGD

TABLE 2B: POND W4 THROUGH W6 STAGE-STORAGE VOLUME (25-YEAR STORM)

In order to calculate the total storage of the hydrologic reservoir routing, it is necessary to construct a storage-indication curve.
Construct an Elevation-Storage (E-S) curve using the working design drawing and the following formula:

$$S = \Delta h \frac{A_1 + A_2 + (A_1 A_2)^{0.5}}{3}$$

where:

S = pond volume (ft^3)
Δh = height of volume element (ft)
A_1 = surface area of bottom of volume element (ft^2)
A_2 = surface area of top of volume element (ft^2)

Pond W4

Elevation (ft MSL)	Area (ft^2)	Area (acres)	Inc. Volume (ft^3)	Inc. Volume (acre-ft)	Σ Volume (ft^3)	Σ Volume (acre-ft)
79.0	7,598	0.17	0	0	0	0
82.0	324,773	7.46	382,046	8.77	382,046	8.77
84.0	352,930	8.10	677,508	15.55	1,059,554	24.32
86.0	369,187	8.48	722,056	16.58	1,781,610	40.90
88.0	385,669	8.85	754,795	17.33	2,536,405	58.23
90.0	402,377	9.24	787,987	18.09	3,324,392	76.32
91.0	410,816	9.43	406,589	9.33	3,730,981	85.65

Pond W5

Elevation (ft MSL)	Area (ft^2)	Area (acres)	Inc. Volume (ft^3)	Inc. Volume (acre-ft)	Σ Volume (ft^3)	Σ Volume (acre-ft)
78.5	11,872	0.27	0	0	0	0
82.0	341,842	7.85	486,989	11.18	486,989	11.18
84.0	357,938	8.22	699,718	16.06	1,186,707	27.24
86.0	374,256	8.59	732,133	16.81	1,918,841	44.05
88.0	390,797	8.97	764,993	17.56	2,683,834	61.61
90.0	407,561	9.36	798,299	18.33	3,482,133	79.94
91.0	416,026	9.55	411,786	9.45	3,893,920	89.39

Combined Stage Storage Volumes for Ponds W4 and W5 (Interconnected by Equalizing Pipes)

Elevation (ft MSL)	Σ Volume (acre-ft)
80.2	8.50
82.0	44.23
84.0	92.37
86.0	143.02
88.0	195.94
90.0	251.15
91.0	279.63

Volume required per HEC-HMS model:

Pond Name	Volume (acre-ft)
W4	7.1
W5	7.2
W6	70.8
Σ Volume	85.1

Pond W6

Elevation (ft MSL)	Area (ft^2)	Area (acres)	Inc. Volume (ft^3)	Inc. Volume (acre-ft)	Σ Volume (ft^3)	Σ Volume (acre-ft)
77.5	22,253	0.51	0	0	0	0
80.0	335,744	7.71	370,361	8.50	370,361	8.50
82.0	351,720	8.07	687,402	15.78	1,057,764	24.28
84.0	367,930	8.45	719,589	16.52	1,777,353	40.80
86.0	384,367	8.82	752,237	17.27	2,529,590	58.07
88.0	401,029	9.21	785,337	18.03	3,314,927	76.10
90.0	417,917	9.59	818,888	18.80	4,133,815	94.90
91.0	426,446	9.79	422,174	9.69	4,555,989	104.59

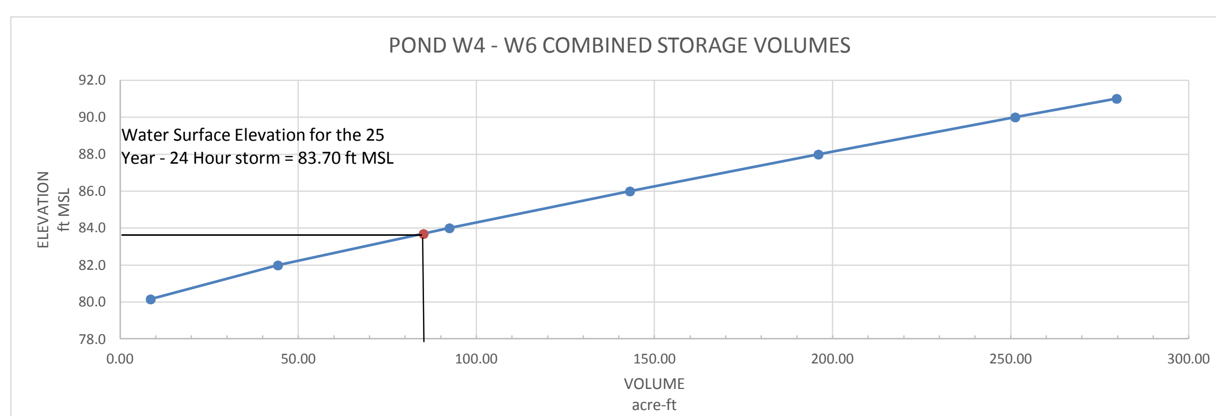
Next, the water surface elevation of the peak volume for the 25 year - 24 hour storm event. The peak volume is calculated using the HEC-HMS program. The water surface elevation is calculated by interpolation based on the stage storage table.

$$y_2 = \frac{(x_2 - x_1)(y_3 - y_1)}{(x_3 - x_1)} + y_1$$

y = elevations (ft MSL)
x = volume (ac-ft)

25 year - 24 hour storm event
Peak Volume = 85.10 ac-ft
Water Surface Elevation = **83.70** ft MSL

References:
1. US Army Corps of Engineers. 2003. *HEC-HMS Hydrologic Modeling System* [computer software] May 2003 Version 4.0.



CITY OF EDINBURG
EDINBURG REGIONAL DISPOSAL FACILTY
HIDALGO COUNTY, TEXAS
PROJECT NO.: 1401491

Date:	7/6/17
By:	VJE
Chkd:	MX
Apprvd:	CGD

TABLE 2C: POND W7 STAGE-STORAGE VOLUME (25-YEAR STORM)

In order to calculate the total storage of the hydrologic reservoir routing, it is necessary to construct a storage-indication curve.
Construct an Elevation-Storage (E-S) curve using the working design drawing and the following formula:

$$S = \Delta h \frac{A_1 + A_2 + (A_1 A_2)^{0.5}}{3}$$

where:

S = pond volume (ft^3)
Δh = height of volume element (ft)
A_1 = surface area of bottom of volume element (ft^2)
A_2 = surface area of top of volume element (ft^2)

Pond W7

Elevation (ft MSL)	Area (ft^2)	Area (acres)	Inc. Volume (ft^3)	Inc. Volume (acre-ft)	Σ Volume (ft^3)	Σ Volume (acre-ft)
76.5	13,228	0.30	0	0	0	0
78.0	284,823	6.54	179,716	4.13	179,716	4.13
80.0	335,744	7.71	619,869	14.23	799,585	18.36
82.0	351,720	8.07	687,402	15.78	1,486,988	34.14
84.0	367,930	8.45	719,589	16.52	2,206,577	50.66
86.0	384,367	8.82	752,237	17.27	2,958,814	67.92
88.0	401,029	9.21	785,337	18.03	3,744,151	85.95
90.0	417,917	9.59	818,888	18.80	4,563,039	104.75
91.0	426,446	9.79	422,174	9.69	4,985,213	114.44

Next, the water surface elevation of the peak volume for the 25 year - 24 hour storm event. The peak volume is calculated using the HEC-HMS program. The water surface elevation is calculated by interpolation based on the stage storage table.

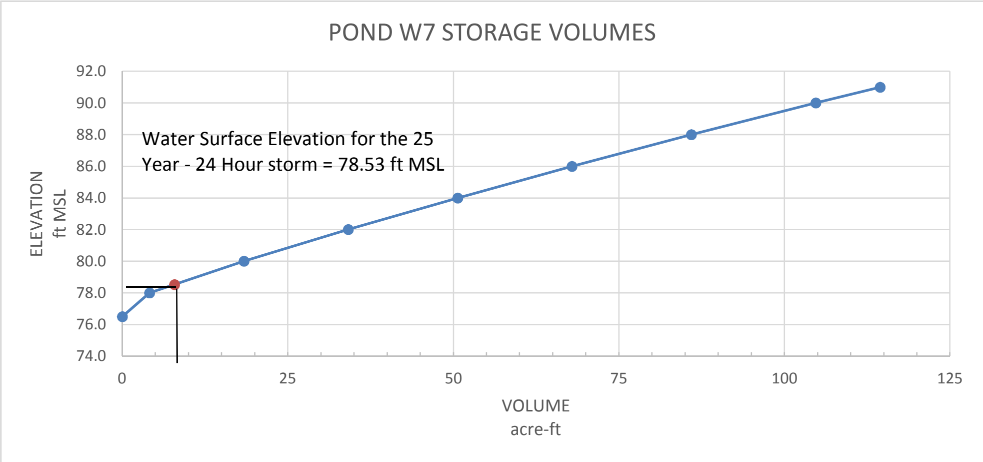
$$y_2 = \frac{(x_2 - x_1)(y_3 - y_1)}{(x_3 - x_1)} + y_1$$

y = elevations (ft MSL)
x = volume (ac-ft)

25 year - 24 hour storm event
Peak Volume = 7.9 ac-ft
Water Surface Elevation = **78.53** ft MSL

References:

1. US Army Corps of Engineers. 2003. *HEC-HMS Hydrologic Modeling System* [computer software] May 2003 Version 4.0.



CITY OF EDINBURG
EDINBURG REGIONAL DISPOSAL FACILTY
HIDALGO COUNTY, TEXAS
PROJECT NO.: 1401491

Date:	7/6/17
By:	VJE
Chkd:	MX
Apprvd:	CGD

Revised 11/2/2017

TABLE 2D: POND E1, E2, E3, & E4 STAGE-STORAGE VOLUME (25-YEAR STORM)

In order to calculate the total storage of the hydrologic reservoir routing, it is necessary to construct a storage-indication curve.
Construct an Elevation-Storage (E-S) curve using the working design drawing and the following formula:

$$S = \Delta h \frac{A_1 + A_2 + (A_1 A_2)^{0.5}}{3}$$

where:

S = pond volume (ft^3)
Δh = height of volume element (ft)
A_1 = surface area of bottom of volume element (ft^2)
A_2 = surface area of top of volume element (ft^2)

Pond E1

Elevation (ft MSL)	Area (ft^2)	Area (acres)	Inc. Volume (ft^3)	Inc. Volume (acre-ft)	Σ Volume (ft^3)	Σ Volume (acre-ft)
69.5	2,920	0.07	0	0	0	0
70.0	20,761	0.48	5,244	0.12	5,244	0.12
70.5	54,822	1.26	18,220	0.42	23,464	0.54
72.0	185,897	4.27	170,835	3.92	194,300	4.46
74.0	271,166	6.23	454,388	10.43	648,688	14.89
76.0	285,242	6.55	556,349	12.77	1,205,036	27.66
78.0	299,609	6.88	584,792	13.42	1,789,829	41.09
80.0	314,266	7.21	613,817	14.09	2,403,645	55.18
82.0	329,214	7.56	643,422	14.77	3,047,067	69.95
84.0	344,453	7.91	673,610	15.46	3,720,677	85.41
86.0	359,962	8.26	704,358	16.17	4,425,035	101.58
88.0	375,722	8.63	735,628	16.89	5,160,663	118.47
90.0	391,731	8.99	767,397	17.62	5,928,060	136.09
92.0	407,991	9.37	799,667	18.36	6,727,727	154.45
94.0	424,500	9.75	832,436	19.11	7,560,163	173.56

Pond E2

Elevation (ft MSL)	Area (ft^2)	Area (acres)	Inc. Volume (ft^3)	Inc. Volume (acre-ft)	Σ Volume (ft^3)	Σ Volume (acre-ft)
72.0	2,717	0.06	0	0	0	0
76.0	167,105	3.84	254,840	5.85	254,840	5.85
78.0	268,141	6.16	431,283	9.90	686,123	15.75
80.0	328,502	7.54	595,623	13.67	1,281,745	29.42
82.0	345,184	7.92	673,617	15.46	1,955,362	44.89
84.0	360,755	8.28	705,882	16.20	2,661,244	61.09
86.0	376,582	8.65	737,280	16.93	3,398,525	78.02
88.0	392,645	9.01	769,171	17.66	4,167,696	95.68
90.0	408,943	9.39	801,533	18.40	4,969,228	114.08
92.0	425,476	9.77	834,364	19.15	5,803,593	133.23
94.0	442,245	10.15	867,667	19.92	6,671,260	153.15

Combined Stage Storage Volumes for Ponds E1, E2, & E4 (Interconnected by Equalizing Pipes)

Elevation (ft MSL)	Σ Volume (acre-ft)
62.8	0
68.0	22.60
70.0	44.18
72.0	76.65
74.0	121.86
76.0	179.61
78.0	244.52
80.0	315.45
82.0	390.40
84.0	468.35
86.0	549.34
88.0	633.40
90.0	720.58
92.0	810.92
94.0	874.14

Volume required per HEC-HMS model:

Pond Name	Volume (acre-ft)
E1	80.2
E2	86.1
E4	8.7
E3	11.5
Σ Volume	186.5

Pond E3

Elevation (ft MSL)	Area (ft^2)	Area (acres)	Inc. Volume (ft^3)	Inc. Volume (acre-ft)	Σ Volume (ft^3)	Σ Volume (acre-ft)
61.0	338	0.01	0	0	0	0
62.0	12,161	0.28	4,842	0.11	4,842	0.11
66.0	223,405	5.13	383,586	8.81	388,428	8.92
68.0	373,819	8.58	590,807	13.56	979,236	22.48
70.0	471,045	10.81	842,993	19.35	1,822,228	41.83
72.0	487,737	11.20	958,733	22.01	2,780,961	63.84
74.0	504,719	11.59	992,407	22.78	3,773,369	86.62
76.0	521,992	11.98	1,026,663	23.57	4,800,032	110.19
78.0	539,556	12.39	1,061,500	24.37	5,861,531	134.56
80.0	557,410	12.80	1,096,918	25.18	6,958,449	159.74
82.0	575,555	13.21	1,132,917	26.01	8,091,366	185.75
84.0	593,991	13.64	1,169,497	26.85	9,260,863	212.60
86.0	612,692	14.07	1,206,634	27.70	10,467,497	240.30
88.0	631,634	14.50	1,244,278	28.56	11,711,776	268.86
90.0	650,818	14.94	1,282,405	29.44	12,994,180	298.30
92.0	670,243	15.39	1,321,013	30.33	14,315,193	328.63
94.0	689,908	15.84	1,360,103	31.22	15,675,297	329.53

Pond E4

Elevation (ft MSL)	Area (ft^2)	Area (acres)	Inc. Volume (ft^3)	Inc. Volume (acre-ft)	Σ Volume (ft^3)	Σ Volume (acre-ft)
67.5	1,555	0.04	0	0	0	0
70.0	81,709	1.88	78,780	1.81	78,780	1.81
72.0	213,336	4.90	284,716	6.54	363,496	8.34
74.0	312,509	7.17	522,699	12.00	886,195	20.34
76.0	366,021	8.40	677,826	15.56	1,564,021	35.90
78.0	383,919	8.81	749,869	17.21	2,313,889	53.12
80.0	399,486	9.17	783,353	17.98	3,097,243	71.10
82.0	415,363	9.54	814,797	18.71	3,912,040	89.81
84.0	431,459	9.90	846,771	19.44	4,758,811	109.25
86.0	448,003	10.28	879,410	20.19	5,638,221	129.44
88.0	464,683	10.67	912,635	20.95	6,550,857	150.39
90.0	481,589	11.06	946,222	21.72	7,497,078	172.11
92.0	498,721	11.45	980,260	22.50	8,477,338	194.61
94.0	516,079	11.85	1,014,751	23.30	9,492,089	217.91

Next, the water surface elevation of the peak volume for the 25 year - 24 hour storm event. The peak volume is calculated using the HEC-HMS program.
The water surface elevation is calculated by interpolation based on the stage storage table.

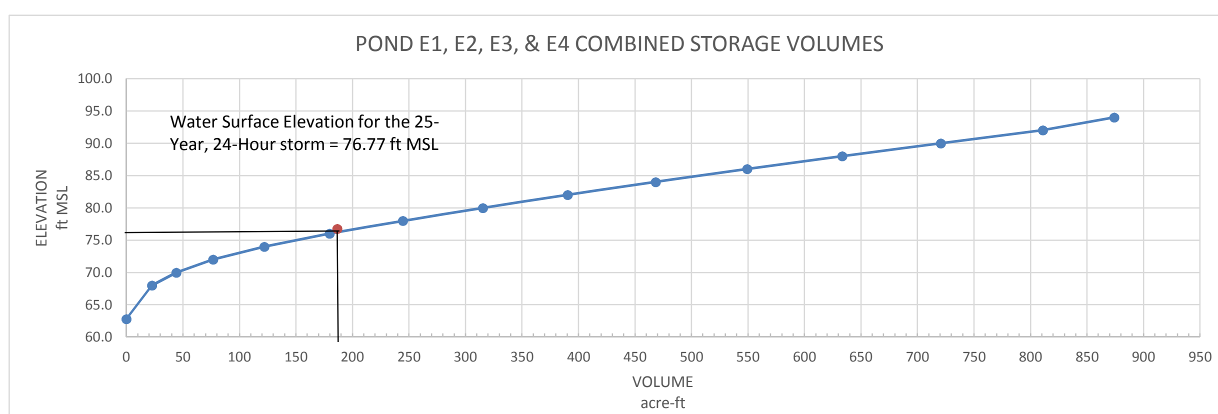
$$y_2 = \frac{(x_2 - x_1)(y_3 - y_1)}{(x_3 - x_1)} + y_1$$

y = elevations (ft MSL)
x = volume (ac-ft)

25 year - 24 hour storm event
Peak Volume = 186.50 ac-ft
Water Surface Elevation = **76.77** ft MSL

References:

1. US Army Corps of Engineers. 2003. *HEC-HMS Hydrologic Modeling System* [computer software] May 2003 Version 4.0.

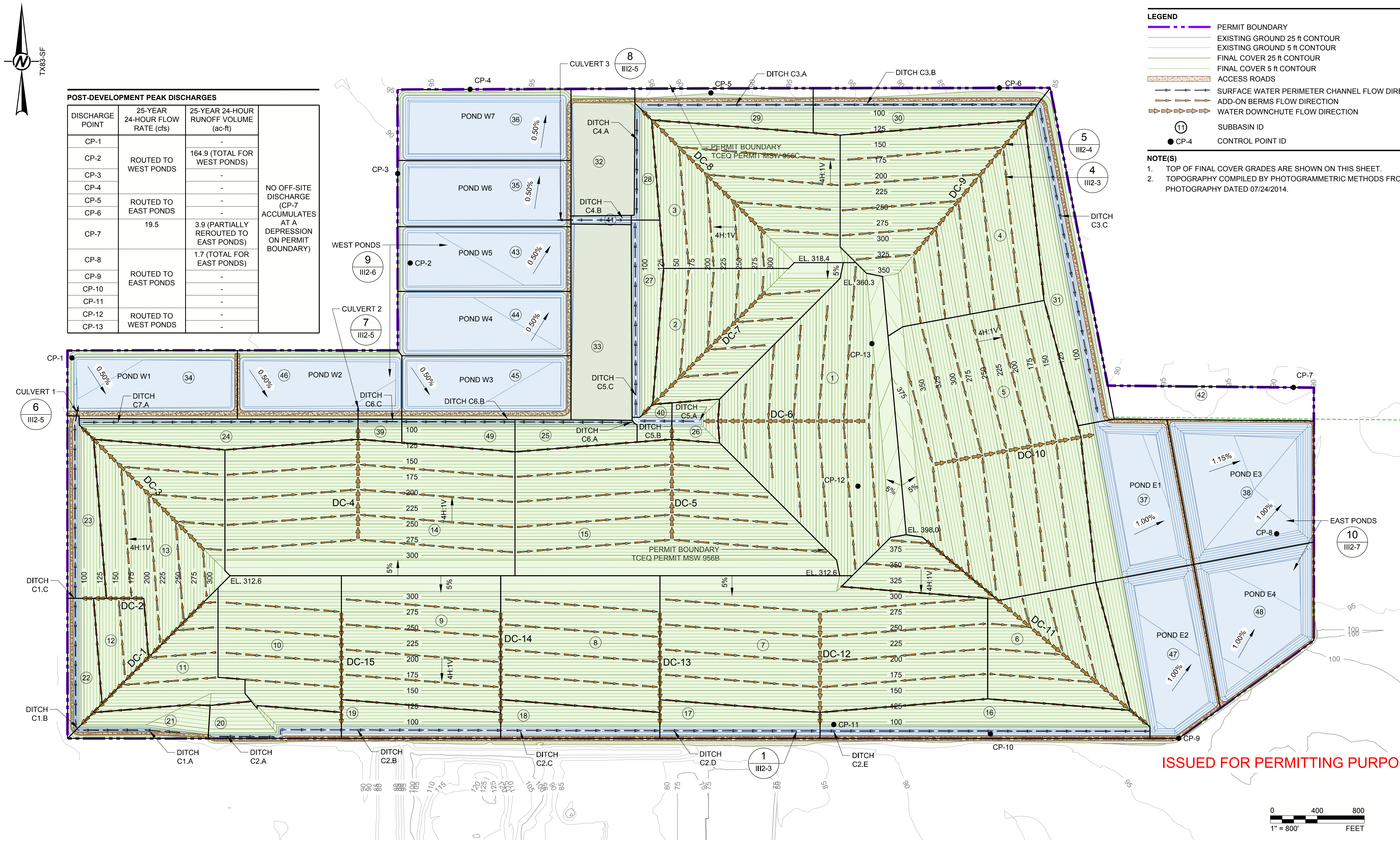


APPENDIX III2A

FIGURES

POST-DEVELOPMENT PEAK DISCHARGES

DISCHARGE POINT	25-YEAR 24-HOUR FLOW RATE (cfs)	25-YEAR 24-HOUR RUNOFF VOLUME (ac-ft)	
CP-1	ROUTED TO WEST PONDS	-	NO OFF-SITE DISCHARGE (CP-7 ACCUMULATES AT A DEPRESSION ON PERMIT BOUNDARY)
CP-2		164.9 (TOTAL FOR WEST PONDS)	
CP-3		-	
CP-4		-	
CP-5	ROUTED TO EAST PONDS	-	
CP-6		-	
CP-7	19.5	3.9 (PARTIALLY REROUTED TO EAST PONDS)	
CP-8	ROUTED TO EAST PONDS	1.7 (TOTAL FOR EAST PONDS)	
CP-9		-	
CP-10		-	
CP-11		-	
CP-12	ROUTED TO WEST PONDS	-	
CP-13		-	



LEGEND

- PERMIT BOUNDARY
- EXISTING GROUND 25 ft CONTOUR
- EXISTING GROUND 5 ft CONTOUR
- FINAL COVER 25 ft CONTOUR
- FINAL COVER 5 ft CONTOUR
- ACCESS ROADS
- SURFACE WATER PERIMETER CHANNEL FLOW DIRECTION
- ADD-ON BERMS FLOW DIRECTION
- WATER DOWNCHUTE FLOW DIRECTION
- (11) SUBBASIN ID
- ● CP-4 CONTROL POINT ID

NOTE(S)

1. TOP OF FINAL COVER GRADES ARE SHOWN ON THIS SHEET.
2. TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY DATED 07/24/2014.

ISSUED FOR PERMITTING PURPOSES ONLY

0 400 800
1" = 800' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2018-01-11	RESPONSE TO TCEQ SECOND NOTICE OF DEFICIENCY	CEI	TNB	MX	CGD
1	2017-11-07	RESPONSE TO TCEQ FIRST NOTICE OF DEFICIENCY	MX	TNB	MX	CGD
0	2017-07-21	PERMIT AMENDMENT APPLICATION SUBMITTAL	TNB	VJE	MX	CGD

SEAL

STATE OF TEXAS
CHARLES G. DOMINGUEZ
83247
REGISTERED PROFESSIONAL ENGINEER

GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

CLIENT

CITY OF EDINBURG SOLID WASTE MANAGEMENT

CONSULTANT

Golder Associates

HOUSTON OFFICE
500 CENTURY PLAZA DRIVE, SUITE 190
HOUSTON, TEXAS
USA
[+1] (281) 821-6868
www.golder.com

PROJECT
EDINBURG REGIONAL DISPOSAL FACILITY
PERMIT AMENDMENT APPLICATION TCEQ PERMIT MSW-956C
EDINBURG, HIDALGO COUNTY, TEXAS

TITLE
POST-DEVELOPMENT DRAINAGE PLAN

PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491		2	2 of 2	III2A-2

APPENDIX III2F

LONG-TERM POND STORAGE CAPACITY ANALYSIS

LONG-TERM POND STORAGE CAPACITY ANALYSIS

Made By: MX
Checked by: CEI
Reviewed by: CGD
Rev. 1/2/2018

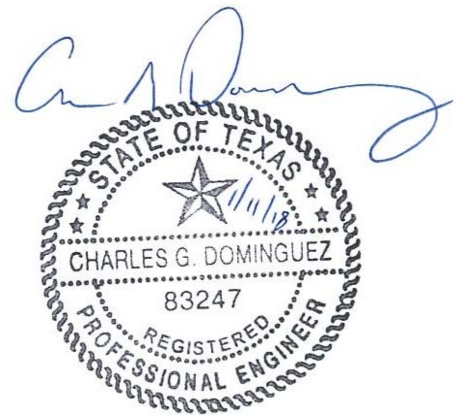
1.0 OBJECTIVE

Evaluate the long-term storage capacity, considering both the rainfall runoff and evaporation, of the stormwater storage and evaporation Ponds W1-W3, Ponds W4-W6, and Ponds E1-E4.

2.0 GIVEN

The proposed post-development ponds at the facility are retention ponds, designed to store the stormwater runoff. Additionally, the semi-arid weather at the site allows for the evaporation pond design.

The proposed ponds have been demonstrated to have adequate storage capacity to contain the runoff from the 25-year 24-hour design storm with adequate freeboard. Discussion is included in Part III2 § 2.3.5, Stormwater Ponds and calculations are provided in Part III2A, Detailed Drainage Calculations.



GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

INTENDED FOR PERMITTING PURPOSES ONLY

Precipation and gross lake evaporation data published by Texas Water Development Board are used for the evaluation. Based on 61-year the histroical weather data (from years 1954 to 2014) (Reference 1), the average annual lake evaporation is 62.6 inches and the average annual precipitation is 21.7 inches. Both the average monthly precipitation and total average annual precipitation are provided in the table below.

Precipitation (inches)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Annual Total**
	1.10	1.20	0.75	1.28	2.36	2.31	1.69	1.90	4.20	2.51	1.22	1.18	**21.70**

To estimate the runoff volume to the ponds, we conservatively assumed that the average rainfall for each month occurs within 24 hours.

3.0 CALCULATIONS

The runoff volume was calculated using the NRCS Curve Number Method (Reference 2).

Composite SCS Curve Number	**S = (1000/CN)-10**
88	1.36

Runoff Volume (ac-ft)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Annual Total**
Ponds W1-W3	3.20	3.85	1.27	4.39	12.94	12.51	7.40	9.07	29.88	14.25	3.98	3.72	**106**
Ponds W4-W6	3.70	4.44	1.46	5.06	14.94	14.44	8.55	10.48	34.50	16.45	4.59	4.29	**123**
Ponds E1-E4	8.30	9.98	3.29	11.38	33.56	32.44	19.20	23.54	77.49	36.95	10.32	9.64	**276**

Made By: MY

	Runoff Watershed Area (ac)	Annual Evaporation Volume from the Ponds (ac-ft)	Pond Storage Capacity (ac-ft)	25-Year 24-Hr Storm Runoff Volume (ac-ft)	Does Pond have Adequate Capcity to Contain the 25-Yr 24-Hr Storm Runoff?	Average Annual Runoff Volume (ac-ft)	Cumulative Stormwater Remain in Pond After 30 Years	Does Pond Have Adequate Capacity to Store the 30-Yr Cumulative Storwater Volume?
	(a)	(b)	(c)	(d)	(c) > (d)?	(e)	(f)= ((e)-(b))x30	(c) > (f)?
Ponds W1-W3	123	127.29	199	73	YES	106	0	YES
Ponds W4-W6	142	150.24	291	85	YES	123	0	YES
Ponds E1-E4	319	248.84	908	187	YES	274	764	YES

4.0 CONCLUSION/RESULTS

The above calculations demonstrate that all the ponds will have adequate long-term storage capacity for a minimum of 30 years under the post-development conditions. As disussed earlier, this analysis is based on conserative assumptions (assuming the monthly rainfall occur within 24 hours). Furthermore, the pond water may be used for site use to irrigate the final cover surfaces. After a 30-year period, water use in the ponds may be re-evaluated in conjunction with the land use at the time.

5.0 REFERENCES

1) Texas Water Development Board Weather Data.

2) U.S. Soil Conservation Service (TR-55). 1986. Urban Hydrology for Small Watersheds, 2nd Edition. (USSCS Technical Release Number 55). Washington D.C.: United States Department of Agriculture.