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

STATE OF TEXAS
7/21/17
CHARLES G. DOMINGUEZ
83247
LICENSED
PROFESSIONAL ENGINEER

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

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

INTENDED FOR PERMITTING PURPOSES ONLY

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

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CHARLES G. DOMINGUEZ
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STATE OF TEXAS
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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.

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
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>
<tr><td>CP-8</td><td>55.6</td><td rowspan="4">Routed to east ponds</td><td>9.6</td><td>187.7 (total for east ponds)</td><td>-</td><td>-</td></tr>
<tr><td>CP-9</td><td>19.6</td><td>4.1</td><td>-</td><td>1.6</td><td>0</td></tr>
<tr><td>CP-10</td><td>117.6</td><td>19.9</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>CP-11</td><td>324.0</td><td>41.0</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>CP-12</td><td>89.3</td><td rowspan="2">Routed to west ponds</td><td>10.2</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>CP-13</td><td>117.9</td><td>17.4</td><td>-</td><td>-</td><td>-</td></tr>
</table>

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.

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. 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.

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, 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. Furthermore, Ponds W7 and E3 are not required for the design storm event, rather they are designed as a contingency to provide additional storage capacity in case of 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	85.1	91.0	5.9
W2	37.0	85.1	91.0	5.9
W3	6.5	85.1	91.0	5.9
W4	7.1	84.3	91.0	6.7
W5	7.1	84.3	91.0	6.7
W6	70.2	84.3	91.0	6.7
W7	7.8	78.5	91.0	12.5
E1	80.9	82.0	94.0	12.0
E2	87.2	82.0	94.0	12.0
E3	11.1	66.6	94.0	27.4
E4	8.5	82.0	94.0	12.0

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 21.78 inches. The weather conditions combined with the pond system design will ensure adequate storage and evaporation capacity at the site.

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. 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 III2-4.

Table III2-4: 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, Interim Erosion and Sediment Control 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. Other lining materials, such as riprap, gabion baskets, or interlocking concrete blocks, may also be used at the site manager's discretion if adequate hydraulic capacities are provided. 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. 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. 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.

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. Floodplain evaluation figures detailing facility design plan and profiles are included in Part IIC, Floodplains.

6.1 100-year Floodplain Location

30 TAC §330.63(c)(2)(A)

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 Part IIC, Floodplains. Note that these two SFHA areas are both localized small depressions and are not connected with any floodways. Future construction of the 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)

The facility property is located in Hidalgo County, National Flood Insurance Program (NFIP) community number 480338. The facility's property boundary is located on the Flood Insurance Rate Map (FIRM) panel number 480334 0325D, which was most recently revised by the Letter of Map Revision Based on Fill (LOMR-F) case number 03-06-153P in 2003. The SFHA changes made by LOMR-F 03-06-153P have not yet been incorporated into a FIRM revision and FEMA's National Flood Insurance Program (NFIP) National Flood Hazard Layer (NFHL) digital database does not yet contain high resolution flood hazard mapping data for Hidalgo County. The most current SFHA delineations available are FEMA Quality Level 3 (Q3) Flood Data files. The source information section of the Q3 Flood Data metadata file lists a modification in 2005 confirming the Q3 incorporates the 2003 LOMR-F 03-06-153P map changes in the SFHA delineations. Part IIC1, FEMA CLOMR-F Request presents the current Q3 Flood Data Zone A delineations (provided by Texas Natural Resources Information System Data Support Team in January 2016) overlaying the unrevised effective FIRM panel, annotated to show where the property is located.

6.3 Flood Protection of the Facility

30 TAC §330.63(c)(2)(C)

Construction of the facility's landfill 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 perimeter berm encompassing the entire waste footprint will provide a minimum of three feet of freeboard above the 100-year design flood.

6.4 Preliminary Plan Approval

A request for Conditional Letter of Map Revision Based on the Placement of Fill (CLOMR-F) was submitted to FEMA included in Part IIC1, 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. In addition, FEMA noted that 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.

7.0 ALTERNATIVE SYNTHETIC GRASS FINAL COVER DRAINAGE DESIGN

The alternative synthetic grass final cover presented in Part III7, Closure Plan will consist of the following from top to bottom:

- HDPE synthetic grass
- Sand infill
- Woven geotextile filter backing
- 50-mil linear low density polyethylene (LLDPE) Super Gripnet® geomembrane with integrated drainage layer

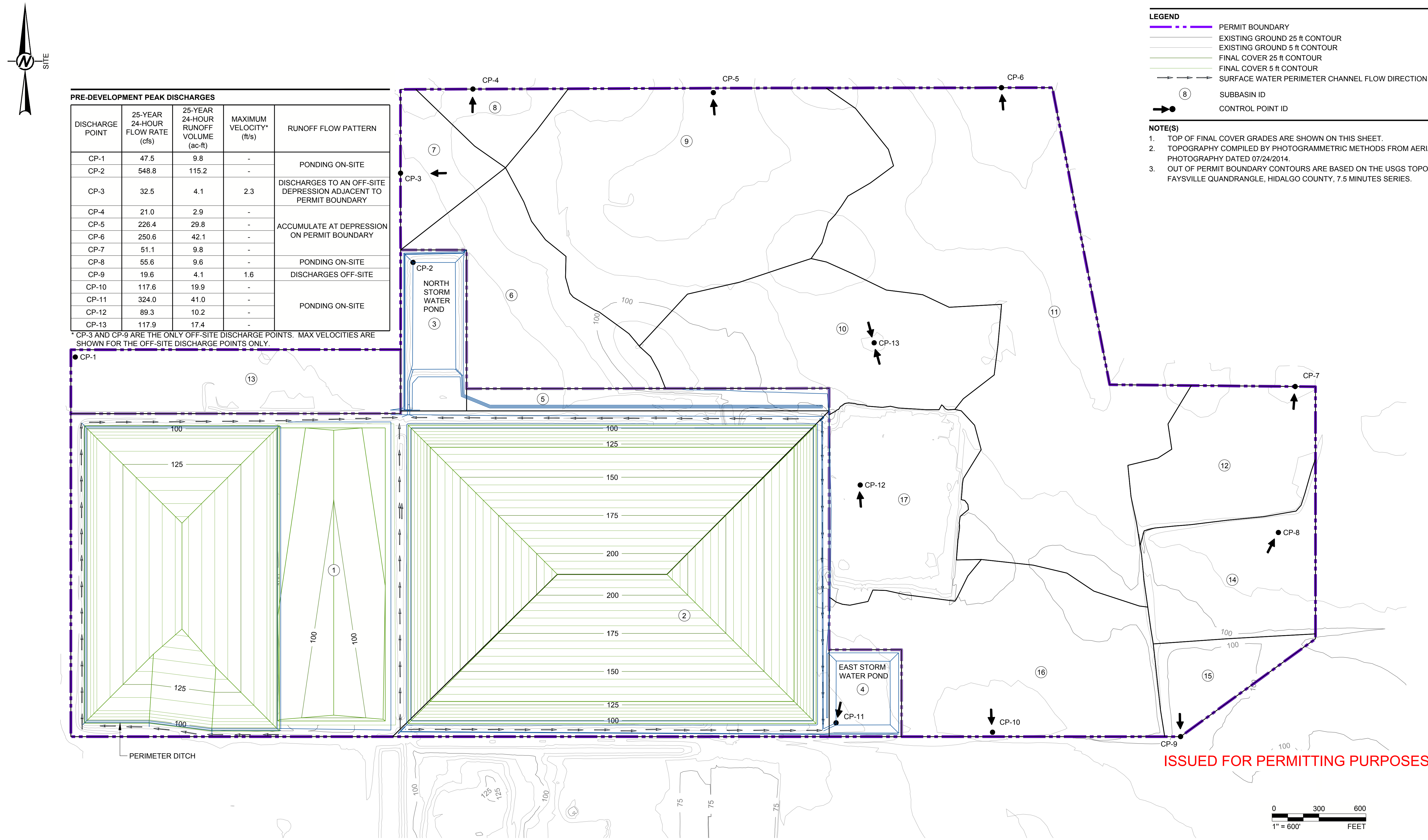
A major consideration of the synthetic grass cover on the drainage system is that the surface runoff coefficient (CN) number is higher; a CN number of 98 for the entire final cover area was used for the analysis. Appendix III2F, Synthetic Grass Cover Drainage Calculation shows that the perimeter channels and the stormwater ponds have adequate capacity using analysis methods consistent with those discussed in Appendix III2A, Detailed Drainage Calculation.

FIGURES

PRE-DEVELOPMENT PEAK DISCHARGES

DISCHARGE POINT	25-YEAR 24-HOUR FLOW RATE (cfs)	25-YEAR 24-HOUR RUNOFF VOLUME (ac-ft)	MAXIMUM VELOCITY* (ft/s)	RUNOFF FLOW PATTERN
CP-1	47.5	9.8	-	PONDING ON-SITE
CP-2	548.8	115.2	-	
CP-3	32.5	4.1	2.3	DISCHARGES TO AN OFF-SITE DEPRESSION ADJACENT TO PERMIT BOUNDARY
CP-4	21.0	2.9	-	ACCUMULATE AT DEPRESSION ON PERMIT BOUNDARY
CP-5	226.4	29.8	-	
CP-6	250.6	42.1	-	
CP-7	51.1	9.8	-	
CP-8	55.6	9.6	-	PONDING ON-SITE
CP-9	19.6	4.1	1.6	DISCHARGES OFF-SITE
CP-10	117.6	19.9	-	PONDING ON-SITE
CP-11	324.0	41.0	-	
CP-12	89.3	10.2	-	
CP-13	117.9	17.4	-	

* CP-3 AND CP-9 ARE THE ONLY OFF-SITE DISCHARGE POINTS. MAX VELOCITIES ARE SHOWN FOR THE OFF-SITE DISCHARGE POINTS ONLY.



LEGEND

- PERMIT BOUNDARY
- EXISTING GROUND 25 ft CONTOUR
- EXISTING GROUND 5 ft CONTOUR
- FINAL COVER 25 ft CONTOUR
- FINAL COVER 5 ft CONTOUR
- SURFACE WATER PERIMETER CHANNEL FLOW DIRECTION
- SUBBASIN ID
- 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.
3. OUT OF PERMIT BOUNDARY CONTOURS ARE BASED ON THE USGS TOPO MAP, FAYSVILLE QUADRANGLE, HIDALGO COUNTY, 7.5 MINUTES SERIES.

ISSUED FOR PERMITTING PURPOSES ONLY

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
0	2017-07-21	PERMIT AMENDMENT APPLICATION SUBMITTAL	VJE	TNB	MX	CGD

SEAL

STATE OF TEXAS
CHARLES G. DOMINGUEZ
83247
LICENSED 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

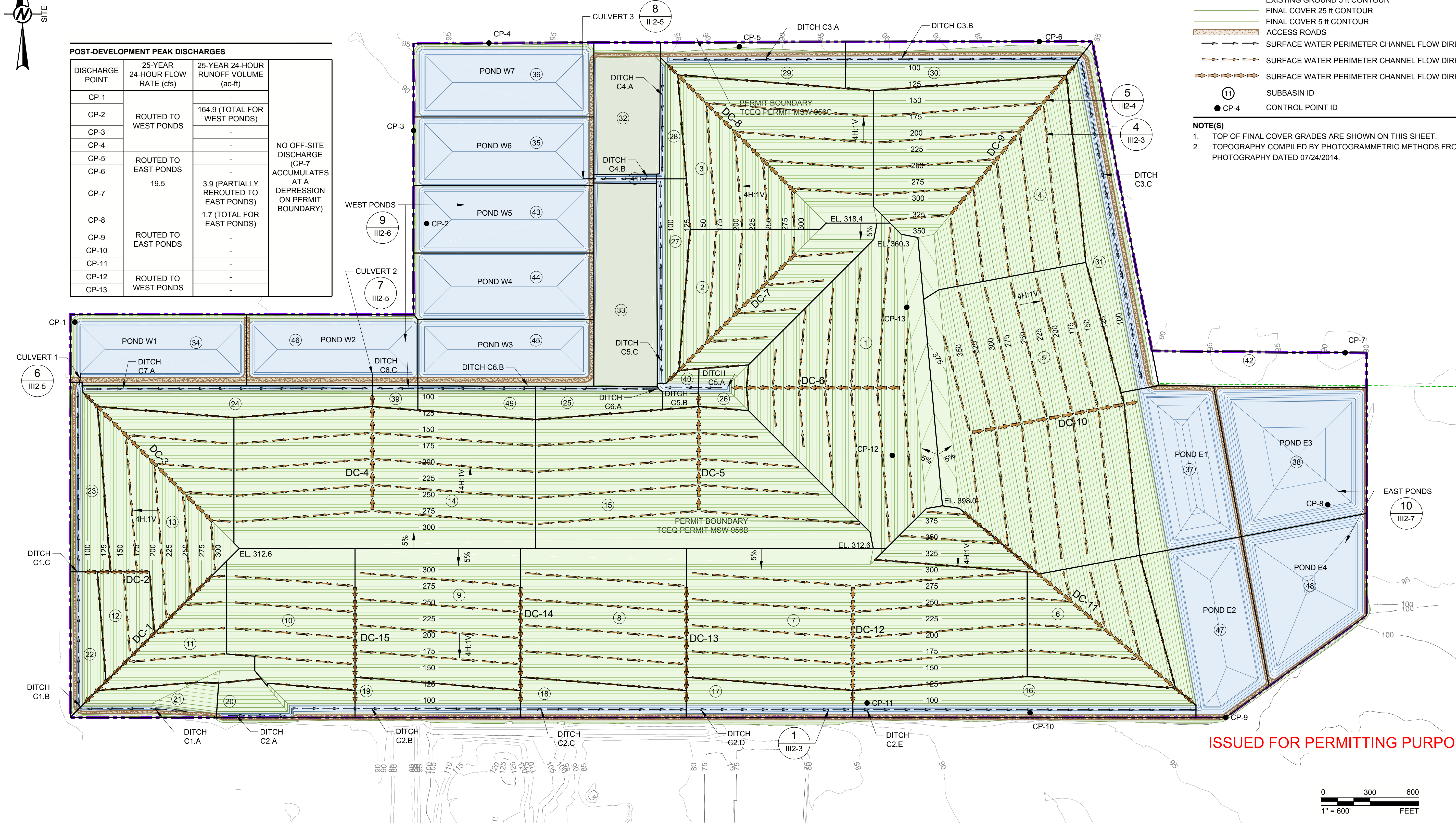
PROJECT
EDINBURG REGIONAL DISPOSAL FACILITY
PERMIT AMENDMENT APPLICATION TCEQ PERMIT MSW-956C
EDINBURG, HIDALGO COUNTY, TEXAS

TITLE
PRE-DEVELOPMENT DRAINAGE PLAN

PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	0	1 of 15	III2-1

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
- SURFACE WATER PERIMETER CHANNEL FLOW DIRECTION
- SURFACE WATER PERIMETER CHANNEL 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
0	2017-07-21	PERMIT AMENDMENT APPLICATION SUBMITTAL	VJE	TNB	MX	CGD

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PROJECT

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

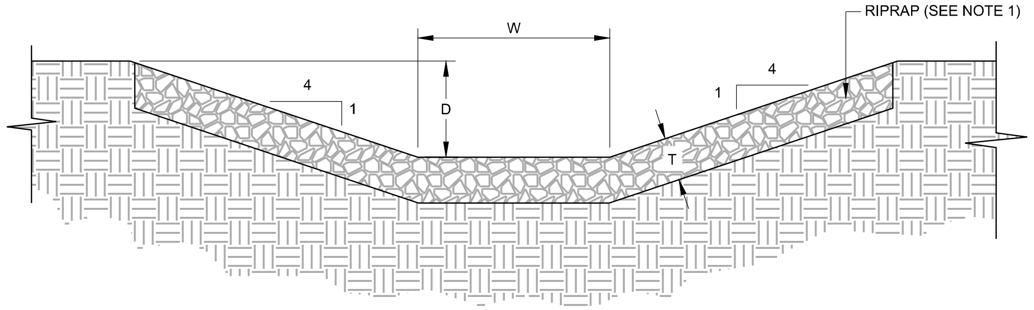
TITLE

POST-DEVELOPMENT DRAINAGE PLAN

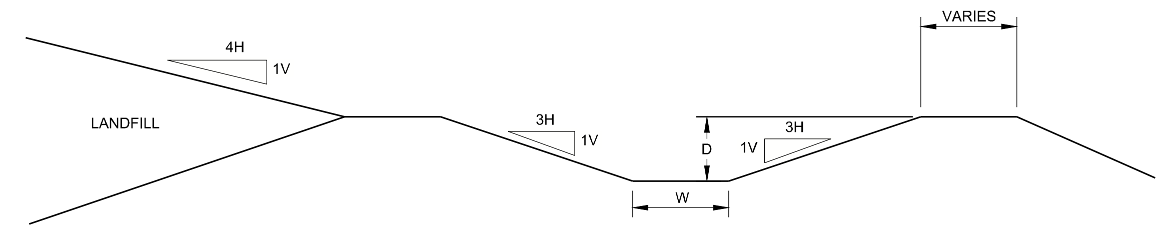
PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	0	2 of 15	III2-2

NOTES

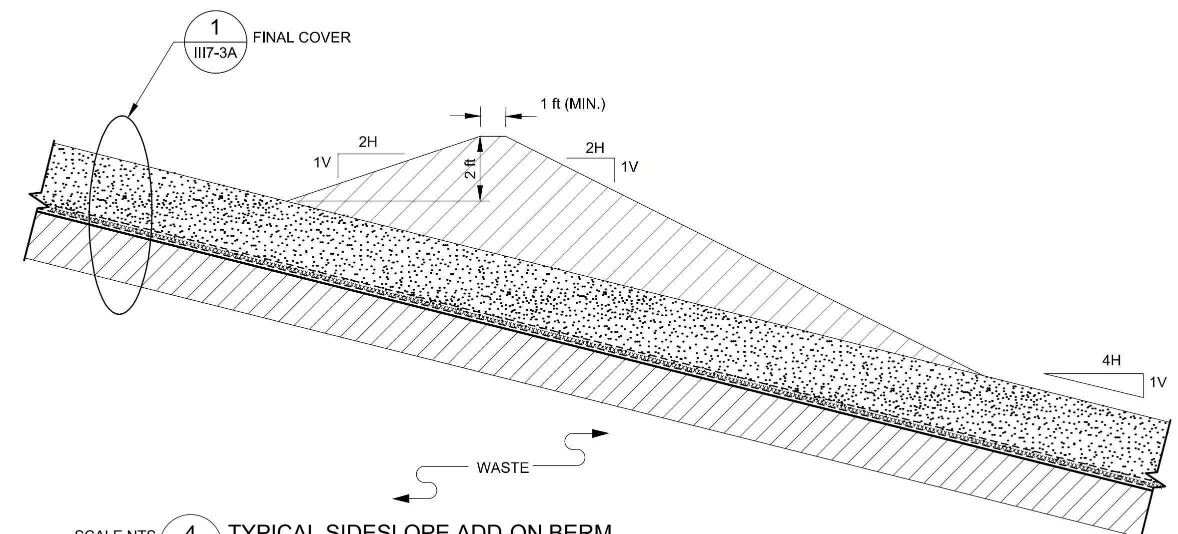
1. A GEOTEXTILE FILTER FABRIC SHALL BE INSTALLED PRIOR TO PLACEMENT OF RIPRAP. RECYCLED CRUSHED CONCRETE MAY BE USED AS RIPRAP PROVIDED THAT IT MEETS THE GRADATION REQUIREMENTS AND DOES NOT CONTAIN REINFORCING STEEL. RIPRAP D_{50} = 15", MIN. THICKNESS = 2.5 ft.
2. FINAL COVER DETAILS ARE LOCATED IN PART III7, CLOSURE PLAN.
3. THE DEPTH (D) AND WIDTH (W) OF THE PERIMETER DRAINAGE DITCHES AND CHANNELS VARIES AS SHOWN ON THE SCHEDULE BELOW.



SCALE NTS 1 III2-3 RIP-RAP LINED PERIMETER CHANNEL



SCALE NTS 2 III2-3 PERIMETER DRAINAGE DITCH DETAIL



SCALE NTS 4 III2-3 TYPICAL SIDESLOPE ADD-ON BERM

PERIMETER DRAINAGE DITCHES AND CHANNELS SCHEDULE

DITCH DESIGNATION	DITCH SLOPE (FT/FT)	CHANNEL WIDTH W, (FT)	CHANNEL DEPTH D, (FT)	CHANNEL SIDESLOPES H:1 (FT)	FLOWLINE ELEV. (FT-MSL) UPSTREAM	FLOWLINE ELEV. (FT-MSL) DOWNSTREAM	WSE* (FT-MSL) UPSTREAM	WSE* (FT-MSL) DOWNSTREAM	MAX* VELOCITY (FT/SEC)	CHANNEL LINING	LENGTH OF CHANNEL (FT)
DITCH C1.A	0.001	8	2.4	3:1	89.6	89.0	90.9	90.3	1.3	GRASS	610
DITCH C1.B	0.001	8	3.3	3:1	89.0	88.2	91.3	90.5	1.8	GRASS	842
DITCH C1.C	0.001	8	4.0	3:1	88.2	87.0	91.1	89.9	2.0	GRASS	1157
DITCH C2.A	0.001	9	2.4	3:1	92.5	91.7	93.8	93.0	1.3	GRASS	855
DITCH C2.B	0.001	20	3.4	3:1	91.7	90.7	94.0	93.0	2.0	GRASS	1015
DITCH C2.C	0.001	20	4.4	3:1	90.7	89.6	94.0	93.0	2.4	GRASS	1015
DITCH C2.D	0.001	17.5	5.3	3:1	89.6	88.6	93.9	92.9	2.7	GRASS	1020
DITCH C2.E	0.001	15	6.4	3:1	88.6	86.4	94.2	92.0	3.1	GRASS	2167
DITCH C3.A	0.001	15	4.0	3:1	91.0	89.9	93.8	92.7	2.1	GRASS	1117
DITCH C3.B	0.001	11	5.1	3:1	89.9	88.5	93.8	92.4	2.5	GRASS	1425
DITCH C3.C	0.001	15	5.6	3:1	88.5	86.3	93.2	91.1	2.8	GRASS	2120
DITCH C4.A	0.001	0	3.1	3:1	88.8	88.1	90.7	90.0	1.2	GRASS	678
DITCH C4.B	0.003	30	3.9	3:1	88.1	87.0	91.4	90.3	4.3	GRASS	376
DITCH C5.A	0.0015	20	4.3	3:1	90.6	90.4	93.3	93.1	2.7	GRASS	172
DITCH C5.B	0.0015	20	4.7	3:1	90.4	90.0	94.3	93.9	3.2	GRASS	247
DITCH C5.C	0.0015	20	5.0	3:1	90.0	88.1	94.5	92.5	3.5	GRASS	1291
DITCH C6.A	0.001	0	3.4	3:1	89.7	89.0	91.8	91.1	1.4	GRASS	722
DITCH C6.B	0.001	0	4.0	3:1	89.0	88.2	91.6	90.9	1.6	GRASS	720
DITCH C6.C	0.001	0	4.1	3:1	88.2	88.0	91.0	90.7	1.6	GRASS	280
DITCH C7.A	0.001	0	4.1	3:1	89.7	88.0	92.4	91.3	1.6	GRASS	1771

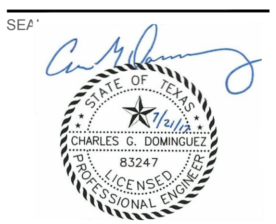
* VALUES BASED ON 25-YEAR, 24-HOUR STORM EVENT.

**SEE FIGURES III2-III2-3 AND III2-III2-4 FOR RIPRAP DESIGN IN AREAS OF PERIMETER CHANNELS DIRECTLY BELOW THE DOWNCHUTES.

ISSUED FOR PERMITTING PURPOSES ONLY

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
0	2017-07-21	PERMIT AMENDMENT APPLICATION SUBMITTAL	VJE	TNB	MX	CGD

SEAL



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TEXAS REGISTRATION F-2578

CLIENT

CITY OF EDINBURG SOLID WASTE MANAGEMENT

CONSULTANT

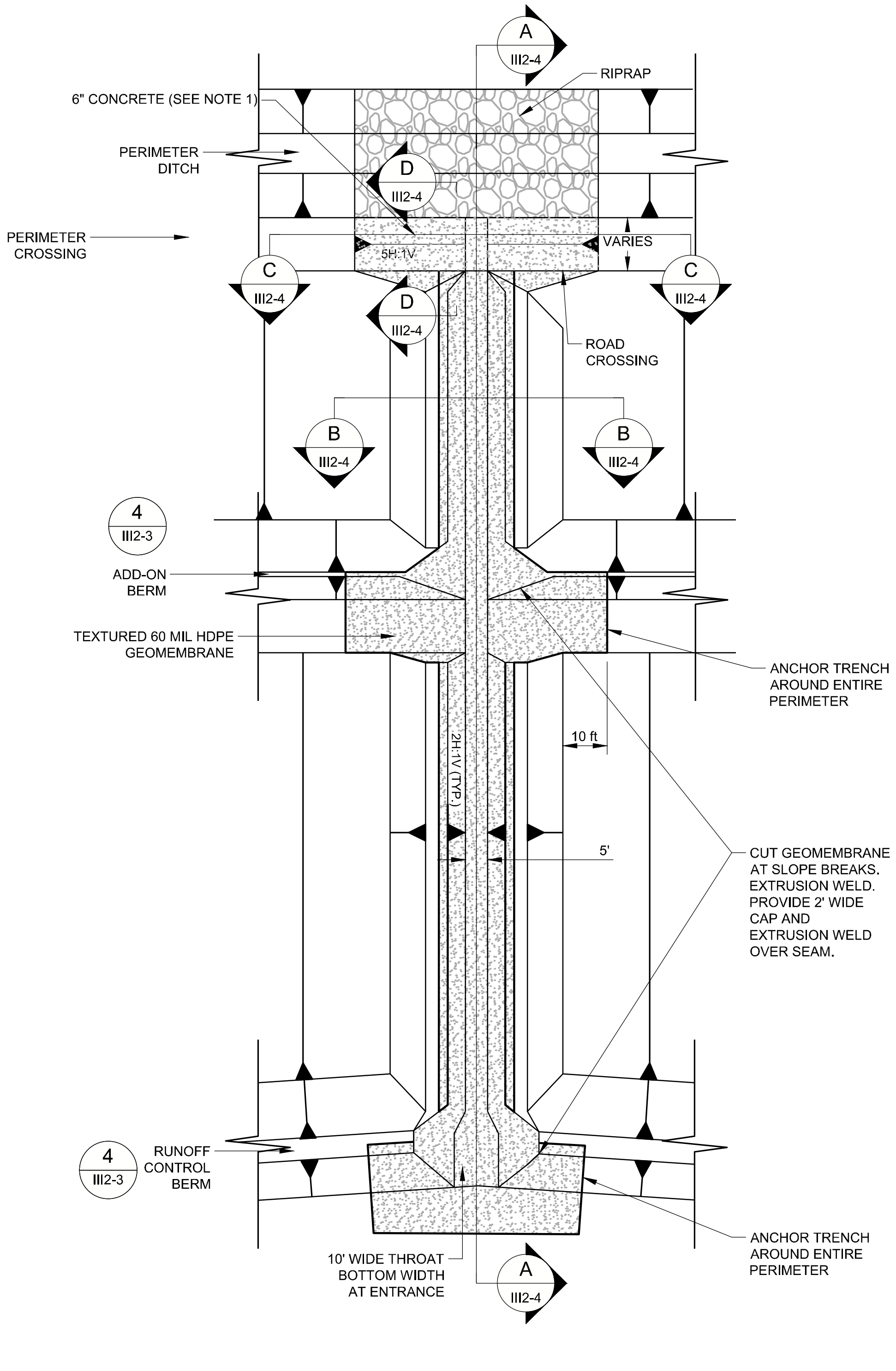
Golder Associates

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

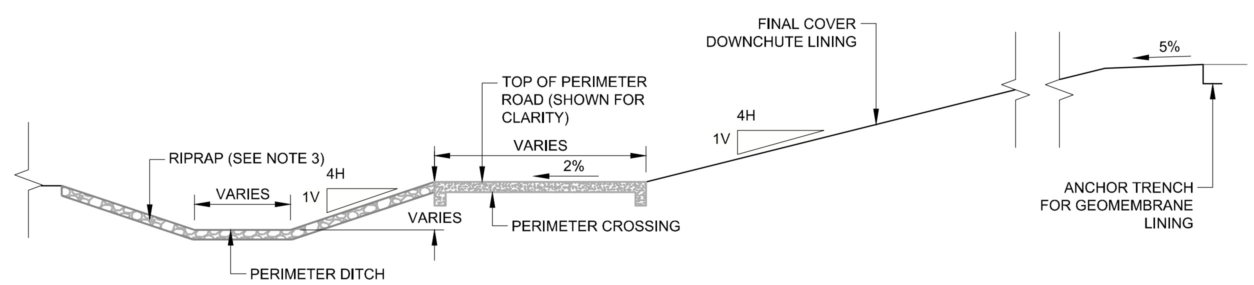
PROJECT
EDINBURG REGIONAL DISPOSAL FACILITY
PERMIT AMENDMENT APPLICATION TCEQ PERMIT MSW-956C
EDINBURG, HIDALGO COUNTY, TEXAS

TITLE
DRAINAGE CONTROL DETAILS I - CHANNELS AND BERMS

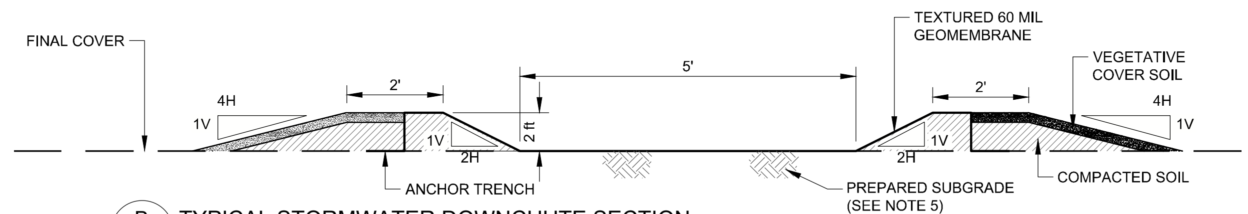
PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	0	3 of 15	III2-3



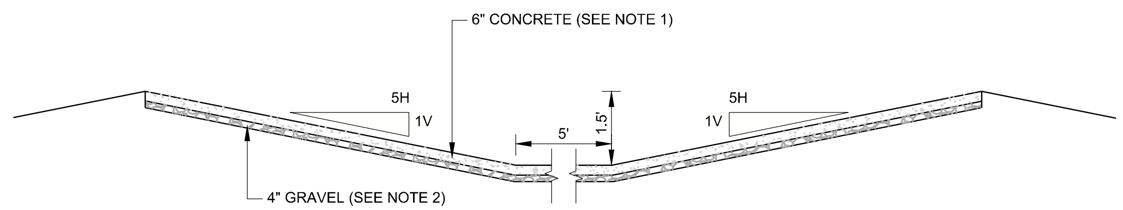
SCALE NTS 5 III2-4 TYPICAL STORMWATER DOWNCHUTE DETAIL



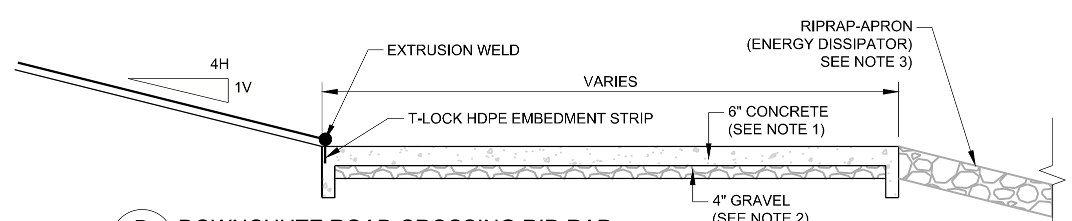
SCALE NTS A III2-4 TYPICAL SIDESLOPE DETAIL



SCALE NTS B III2-4 TYPICAL STORMWATER DOWNCHUTE SECTION



SCALE NTS C III2-4 DOWNCHUTE ROAD CROSSING



SCALE NTS D III2-4 DOWNCHUTE ROAD CROSSING RIP-RAP

NOTES

1. CONTROL JOINTS TO BE PLACED EVERY 20 FEET TO CONTROL SHRINKAGE CRACKING AND MAINTAIN AGGREGATE INTERLOCK BETWEEN ADJACENT REINFORCED CONCRETE SLABS. NO DOWEL BARS ARE REQUIRED. SIX INCH REINFORCED CONCRETE SHOULD HAVE A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 4,000 PSI AND SHOULD BE REINFORCED WITH 12x12, W5xW5 WELDED WIRE FABRIC FOR TEMPERATURE CRACKING.
2. THE MATERIAL SHALL BE WELL GRADED AND SHALL MEET THE FOLLOWING REQUIREMENTS:

SIEVE US	DESIGNATION SI	% RETAINED
1 3/4"	45 mm	0
7/8"	22.4 mm	10-35
3/8"	9.5 mm	30-50
#4	4.75 mm	45-65
#40	425 mm	70-85

3. RIPRAP D_{50} = 15" MIN THICKNESS = 2.5'. A GEOTEXTILE FILTER FABRIC SHALL BE INSTALLED PRIOR TO PLACEMENT OF RIPRAP. RECYCLED CRUSHED CONCRETE MAY BE USED AS RIPRAP PROVIDED THAT IT MEETS THE GRADATION REQUIREMENTS AND DOES NOT CONTAIN REINFORCING STEEL.
4. GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY.
5. THIS SUBGRADE SHALL BE SMOOTH AND WITHOUT SHARP PROTRUSIONS THAT MIGHT DAMAGE THE GEOMEMBRANE.

DOWNCHUTE SCHEDULE

DOWNCHUTE DESIGNATION	SLOPE, S (ft/ft)	DEPTH, D (ft)	BOTTOM WIDTH W, (ft)
DC1	0.177	2	5
DC2	0.25	2	5
DC3	0.177	2	5
DC4	0.25	2	5
DC5	0.25	2	5
DC6	0.25	2	5
DC7	0.177	2	5
DC8	0.177	2	5
DC9	0.192	2	5
DC10	0.25	2	5
DC11	0.16	2	5
DC12	0.25	2	5
DC13	0.25	2	5
DC14	0.25	2	5
DC15	0.25	2	5

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SEAL
STATE OF TEXAS
CHARLES G. DOMINGUEZ
83247
LICENSED
PROFESSIONAL ENGINEER
GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

CLIENT
CITY OF EDINBURG SOLID WASTE MANAGEMENT

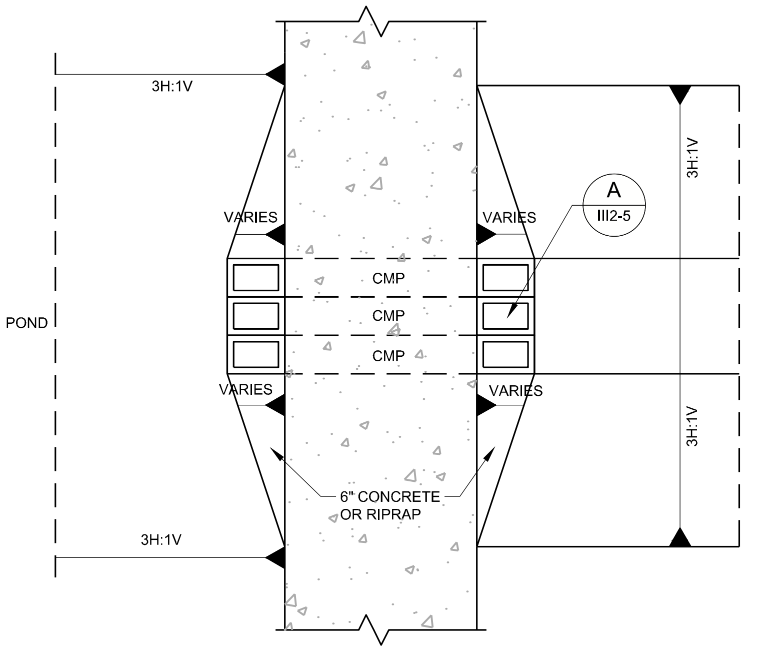
CONSULTANT
Golder Associates

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

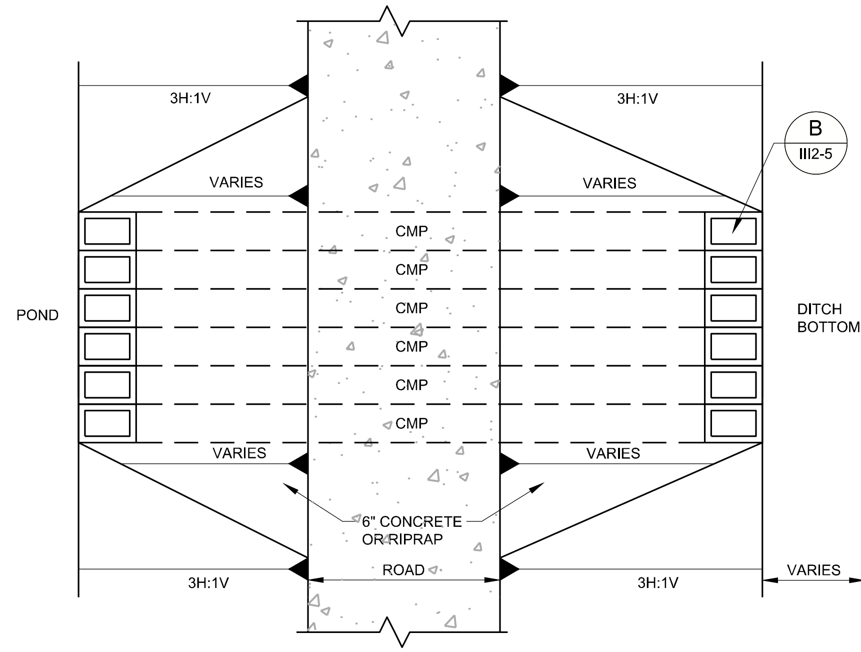
PROJECT
EDINBURG REGIONAL DISPOSAL FACILITY
PERMIT AMENDMENT APPLICATION TCEQ PERMIT MSW-956C
EDINBURG, HIDALGO COUNTY, TEXAS

TITLE
DRAINAGE CONTROL DETAILS II - STORMWATER DOWNCHUTE DETAILS AND CROSSINGS

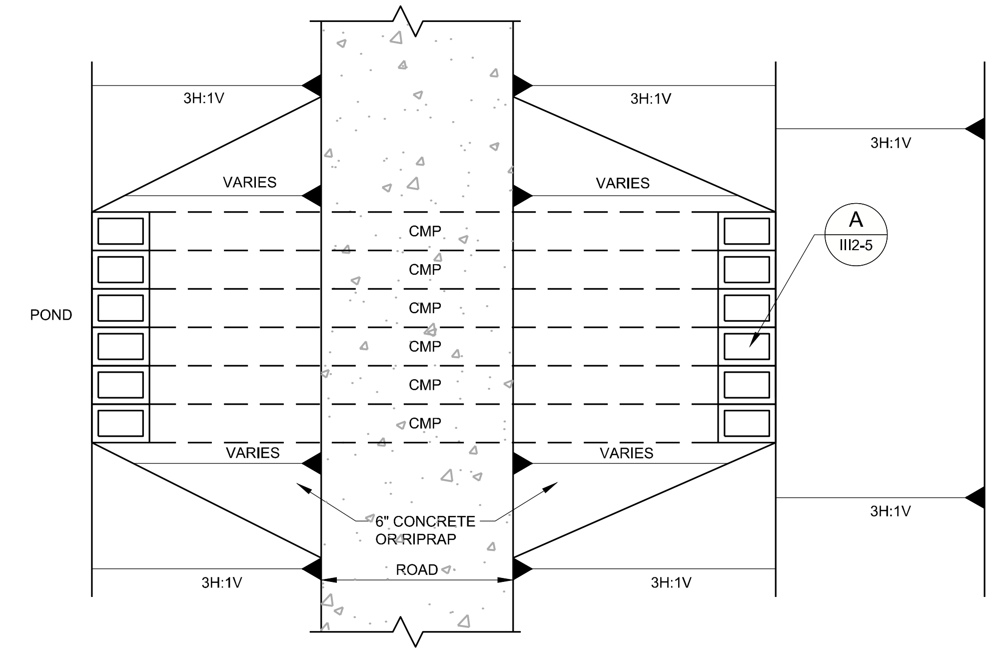
PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	0	4 of 15	III2-4



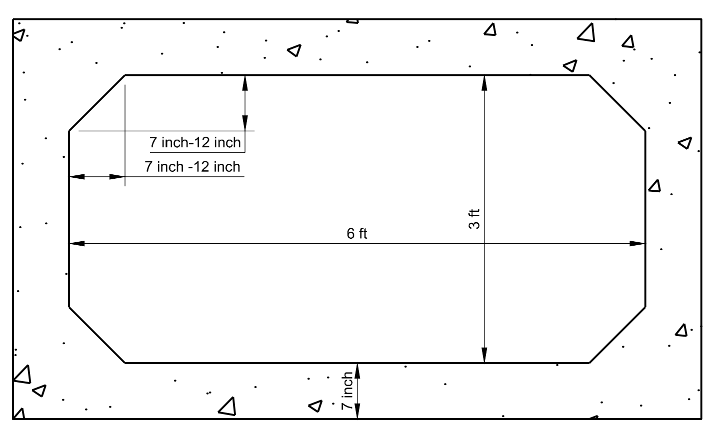
SCALE NTS 6 III2-5 ROAD CROSSING CULVERT 1



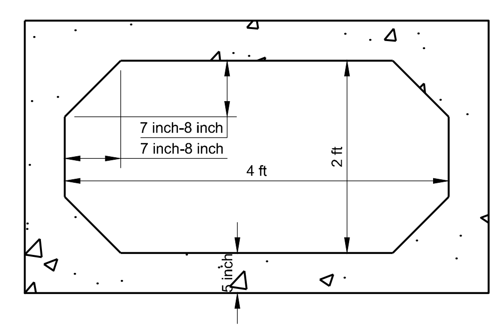
SCALE NTS 7 III2-5 ROAD CROSSING CULVERT 2



SCALE NTS 8 III2-5 ROAD CROSSING CULVERT 3



SCALE NTS A III2-5 SECTION THROUGH 6ft x 3ft BOX CULVERT



SCALE NTS B III2-5 SECTION THROUGH 4ft x 2ft BOX CULVERT

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CHARLES G. DOMINGUEZ
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LICENSED PROFESSIONAL ENGINEER

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USA
[+1] (281) 821-6868
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PROJECT
EDINBURG REGIONAL DISPOSAL FACILITY
PERMIT AMENDMENT APPLICATION TCEQ PERMIT MSW-956C
EDINBURG, HIDALGO COUNTY, TEXAS

TITLE
DRAINAGE CONTROL DETAILS III - CULVERTS

PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	0	5 of 15	III2-5

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

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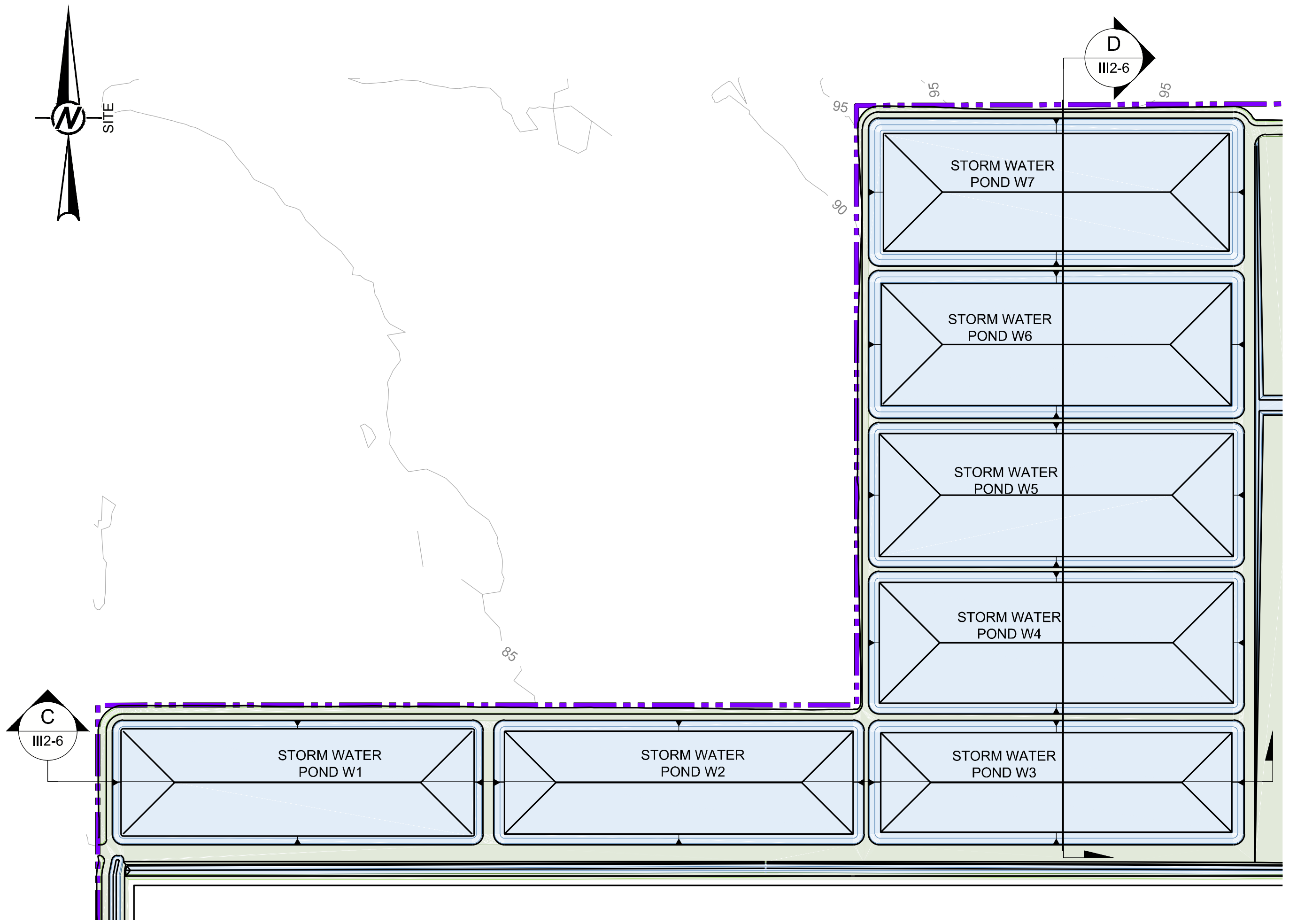
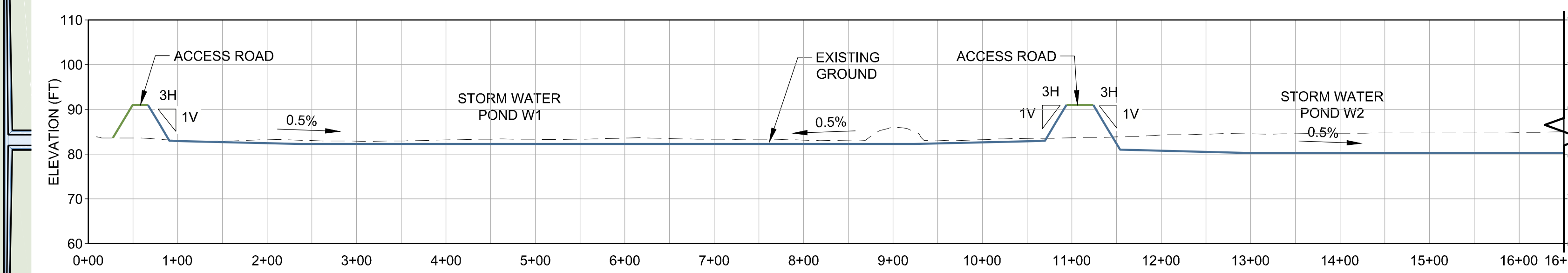
LEGEND

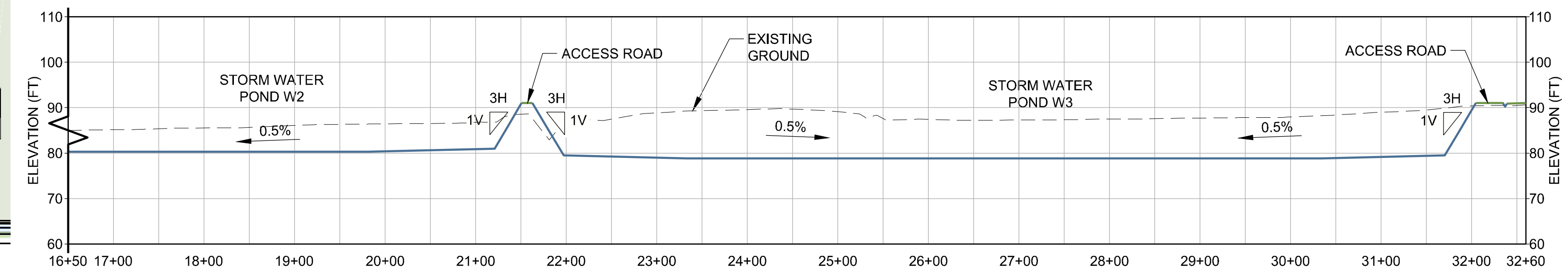
PERMIT BOUNDARY
EXISTING GROUND 25 ft CONTOUR
EXISTING GROUND 5 ft CONTOUR
PERIMETER BERM 25 ft CONTOUR
PERIMETER BERM 5ft CONTOUR
STORMWATER POND 25 ft CONTOUR
STORMWATER POND 5 ft CONTOUR



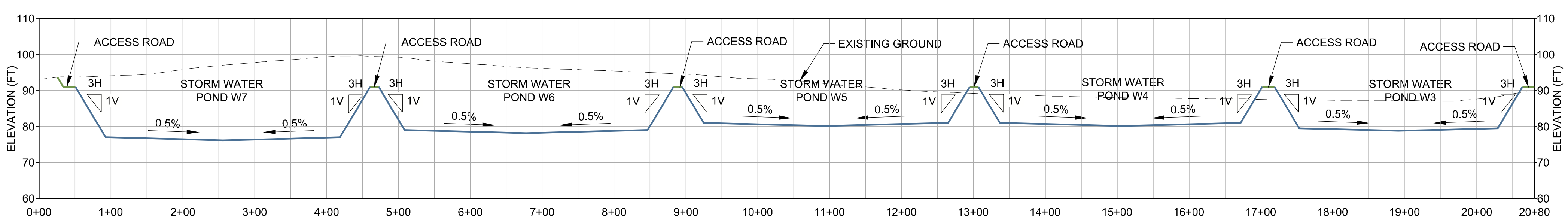
SCALE 1" = 500' 9 III2-6 WEST PONDS



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
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CHARLES G. DOMINGUEZ
83247
LICENSED PROFESSIONAL ENGINEER

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TEXAS REGISTRATION F-2578

CLIENT

CITY OF EDINBURG SOLID WASTE MANAGEMENT

CONSULTANT

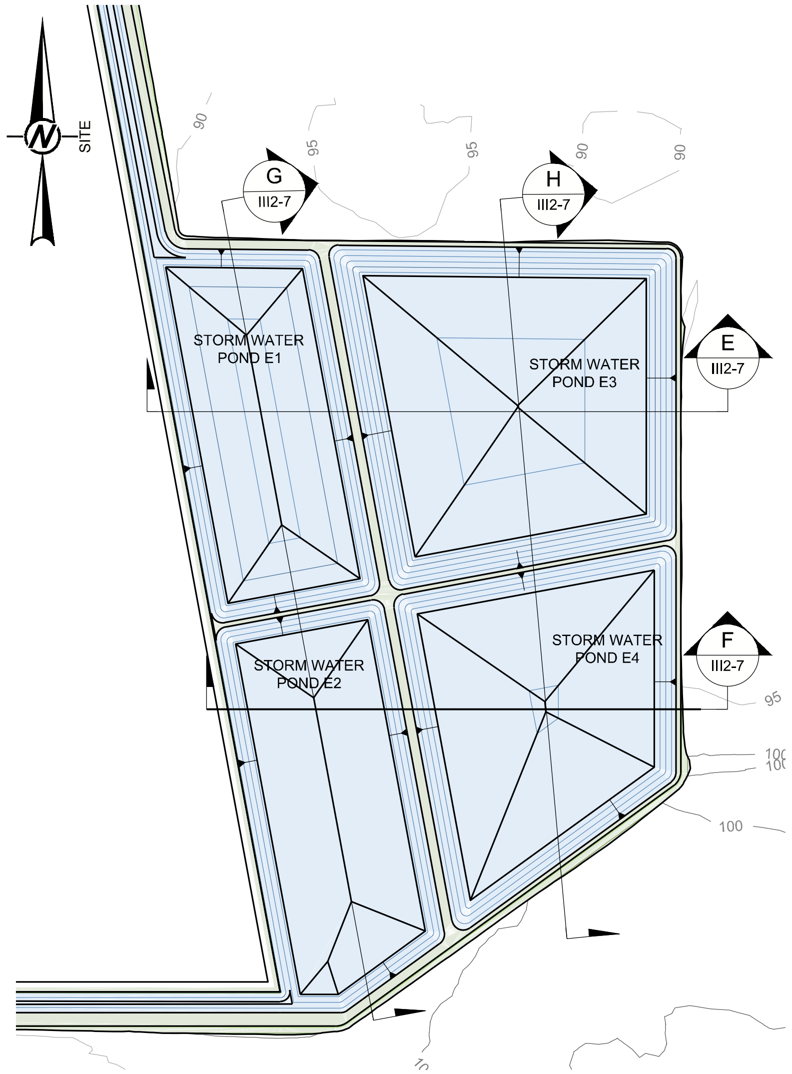
Golder Associates

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

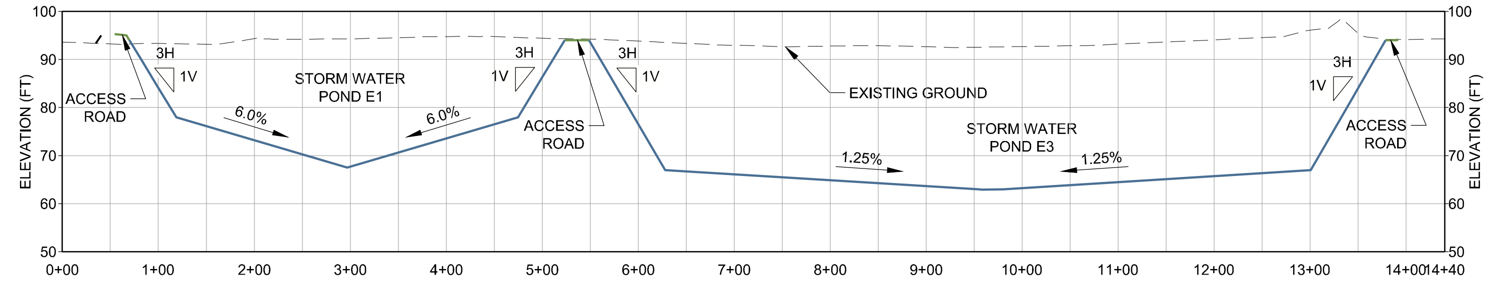
PROJECT
EDINBURG REGIONAL DISPOSAL FACILITY
PERMIT AMENDMENT APPLICATION TCEQ PERMIT MSW-956C
EDINBURG, HIDALGO COUNTY, TEXAS

TITLE
DRAINAGE CONTROL DETAILS IV - WEST PONDS AND SECTIONS

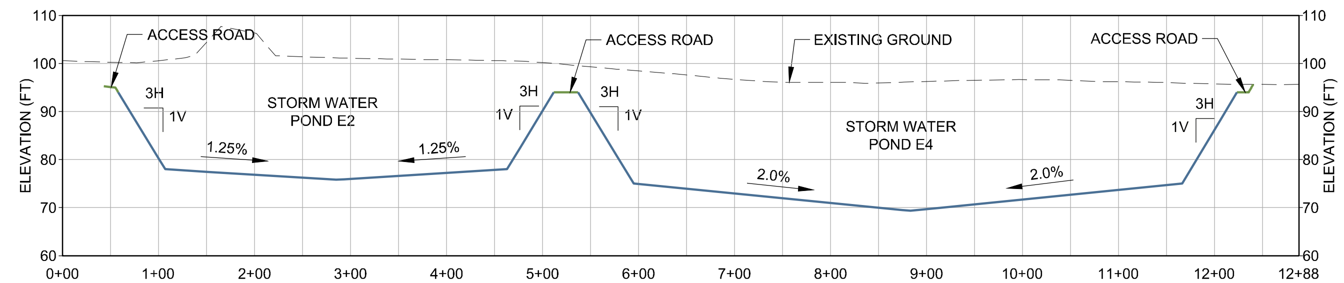
PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	0	6 of 15	III2-6



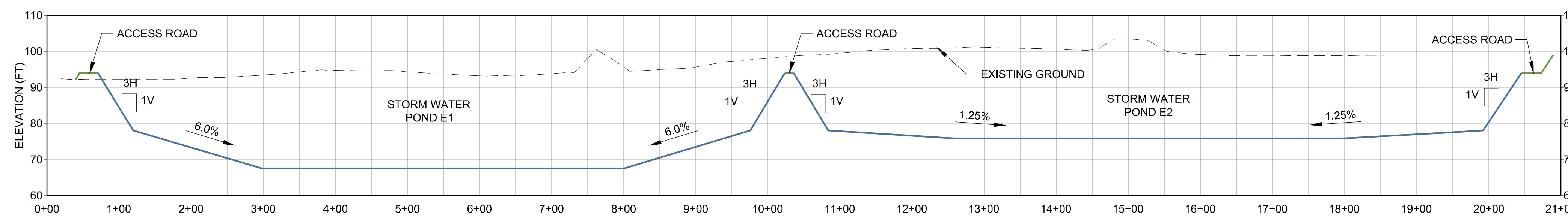
SCALE 1" = 500' 10 III2-7 EAST PONDS



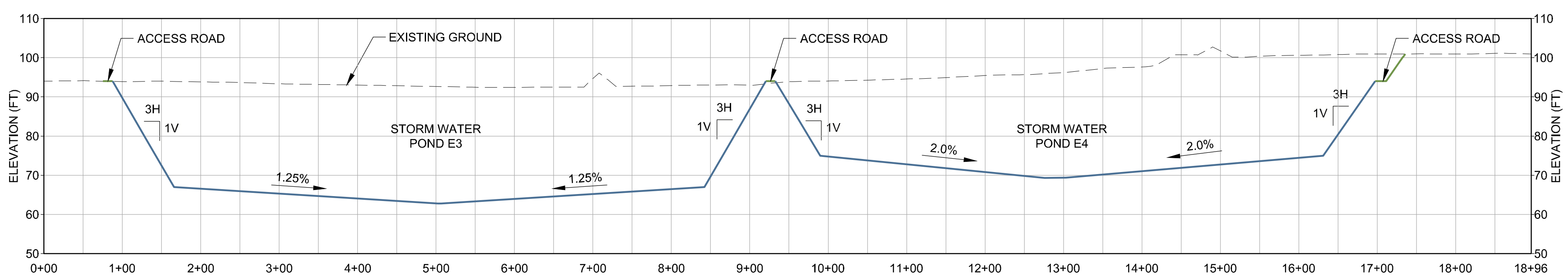
SCALE 1" = 200' E III2-7 EAST PONDS



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



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



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

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

ISSUED FOR PERMITTING PURPOSES ONLY

0 100 200
1" = 200' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
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SEAL
STATE OF TEXAS
CHARLES G. DOMINGUEZ
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LICENSED PROFESSIONAL ENGINEER
GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

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CONSULTANT
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HOUSTON OFFICE
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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	0	7 of 15	III2-7

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

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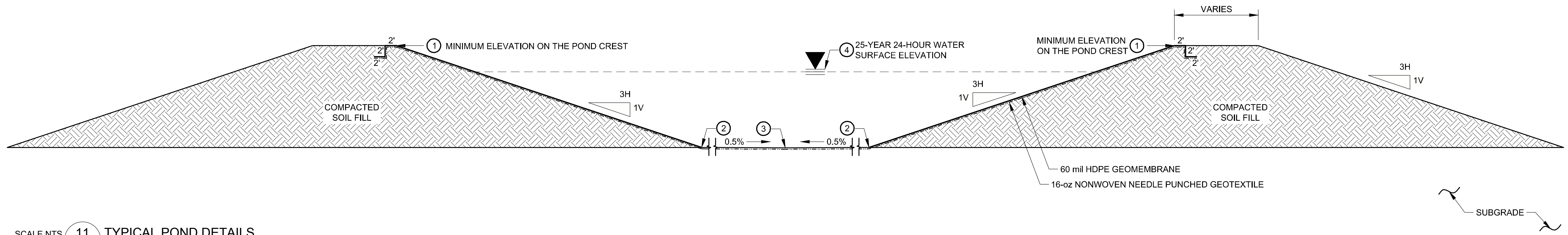

SCALE NTS 11 III2-8 TYPICAL POND DETAILS

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	85.1	85.1	85.1	84.3	84.3	84.2	78.5

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	82.0	82.0	66.6	82.1

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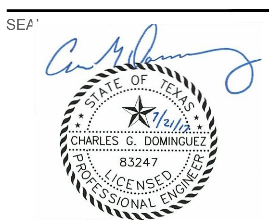
SEAL



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

TITLE
DRAINAGE CONTROL DETAILS VI - POND DETAILS

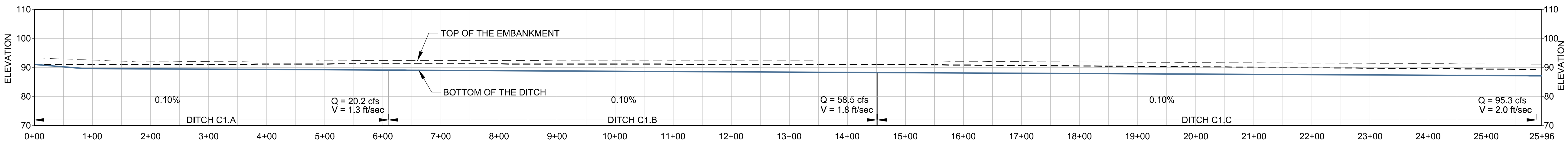
PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	0	8 of 15	III2-8

LEGEND

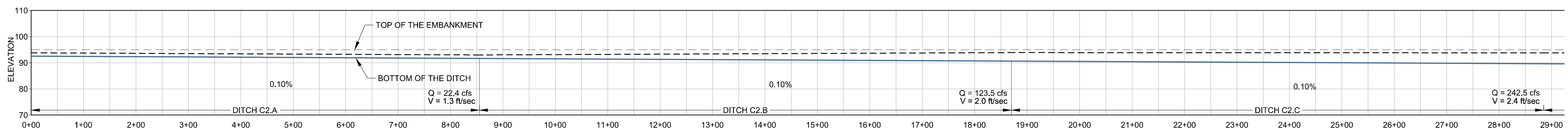
TOP OF EMBANKMENT
MAXIMUM WATER SURFACE ELEVATION (25-YR, 24-HR STORM)
FLOWLINE ELEVATION

NOTES

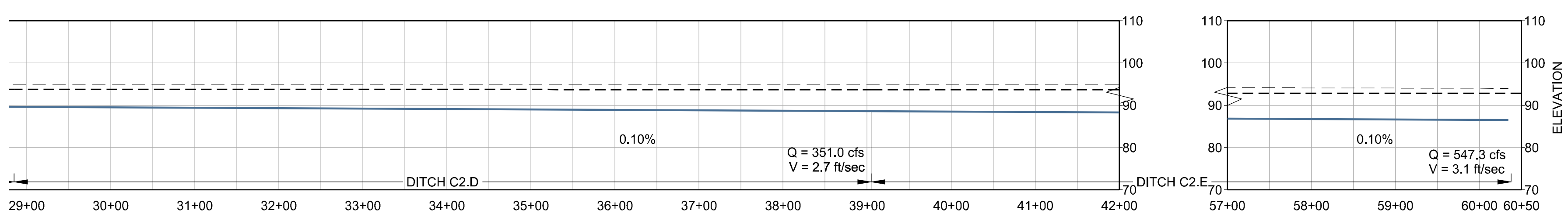
1. REFER TO FIGURE III2-2 FOR PERIMETER CHANNELS AND DOWNCHUTE LOCATION.



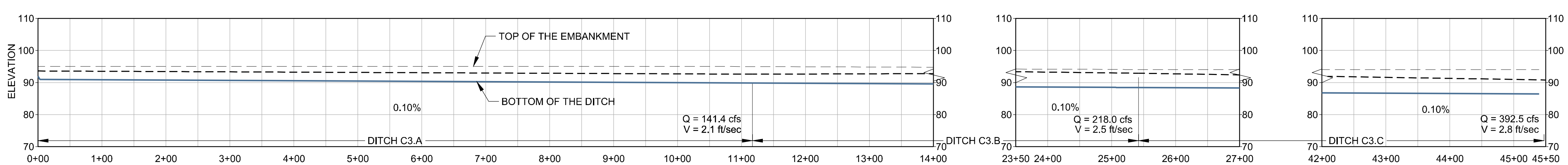
HORIZONTAL SCALE 1" = 200'
VERTICAL SCALE 1" = 40'
12 PERIMETER DITCH C1
III2-9



HORIZONTAL SCALE 1" = 200'
VERTICAL SCALE 1" = 40'
13 PERIMETER DITCH C2
III2-9



HORIZONTAL SCALE 1" = 200'
VERTICAL SCALE 1" = 40'
14 PERIMETER DITCH C2
III2-9



HORIZONTAL SCALE 1" = 200'
VERTICAL SCALE 1" = 40'
15 PERIMETER DITCH C3
III2-9

ISSUED FOR PERMITTING PURPOSES ONLY

0 100 200
1" = 200' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
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CONSULTANT
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PROJECT
EDINBURG REGIONAL DISPOSAL FACILITY
PERMIT AMENDMENT APPLICATION TCEQ PERMIT MSW-956C
EDINBURG, HIDALGO COUNTY, TEXAS

TITLE
FLOWLINE PROFILES I - PERIMETER DRAINAGE DITCHES I

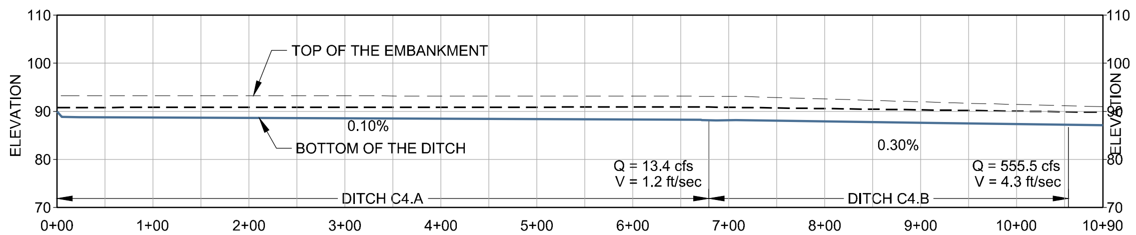
PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	0	9 of 15	III2-9

LEGEND

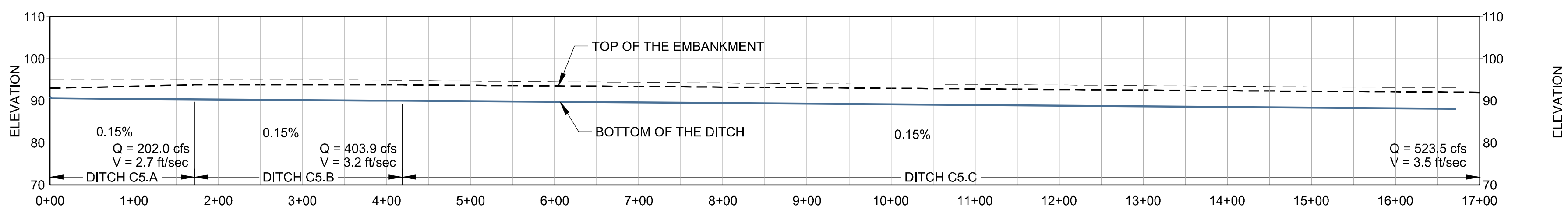
- TOP OF EMBANKMENT
- MAXIMUM WATER SURFACE ELEVATION (25-YR, 24-HR STORM)
- FLOWLINE ELEVATION

NOTES

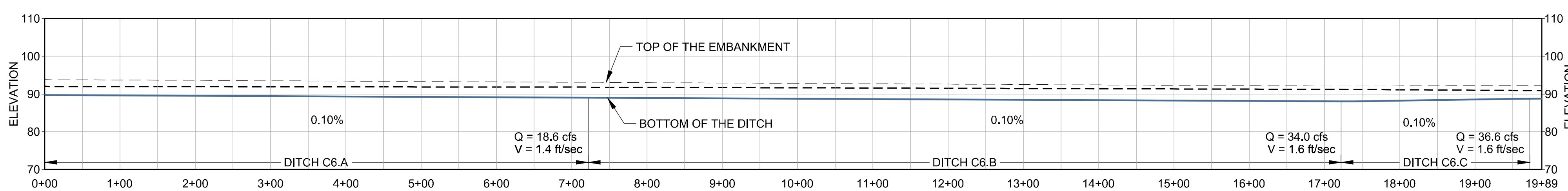
1. REFER TO FIGURE III2-2 FOR PERIMETER CHANNELS AND DOWNCHUTE LOCATION.



HORIZONTAL SCALE 1" = 200'
VERTICAL SCALE 1" = 40'
16 III2-10 PERIMETER DITCH C4



HORIZONTAL SCALE 1" = 200'
VERTICAL SCALE 1" = 40'
17 III2-10 PERIMETER DITCH C5



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VERTICAL SCALE 1" = 40'
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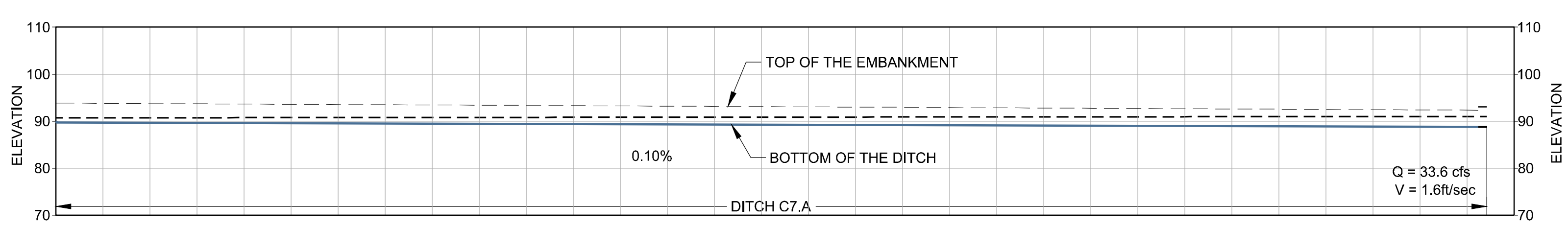

HORIZONTAL SCALE 1" = 200'
VERTICAL SCALE 1" = 40'
19 III2-10 PERIMETER DITCH C7

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0 100 200
1" = 200' FEET

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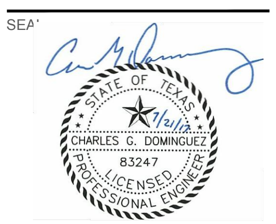

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CONSULTANT
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HOUSTON OFFICE
500 CENTURY PLAZA DRIVE, SUITE 190
HOUSTON, TEXAS
USA
[+1] (281) 821-6868
www.golder.com

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

TITLE
FLOWLINE PROFILES II - PERIMETER DRAINAGE DITCHES II

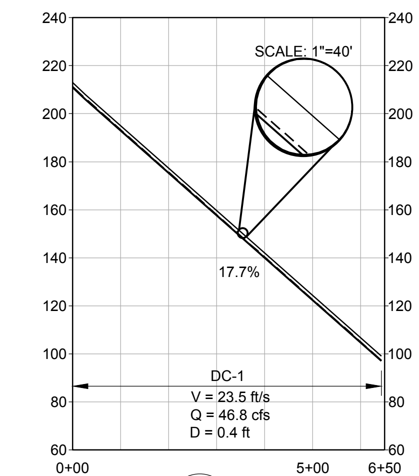
PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	0	10 of 15	III2-10

LEGEND

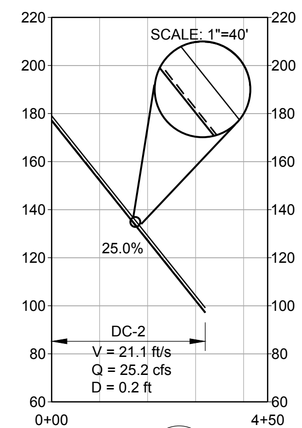
- TOP OF EMBANKMENT
- MAXIMUM WATER SURFACE ELEVATION (25-YR, 24-HR STORM)
- FLOWLINE ELEVATION

NOTES

1. REFER TO FIGURE III2-2 FOR PERIMETER CHANNELS AND DOWNCHUTE LOCATION.



HORZ. SCALE 1"=400' VERT. SCALE 1"=80' 19 III2-11 PROFILE DOWNCHUTE 1



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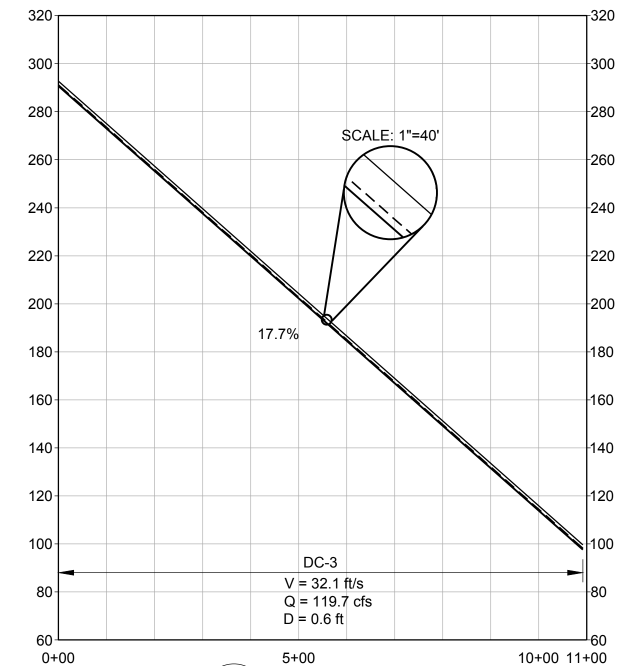

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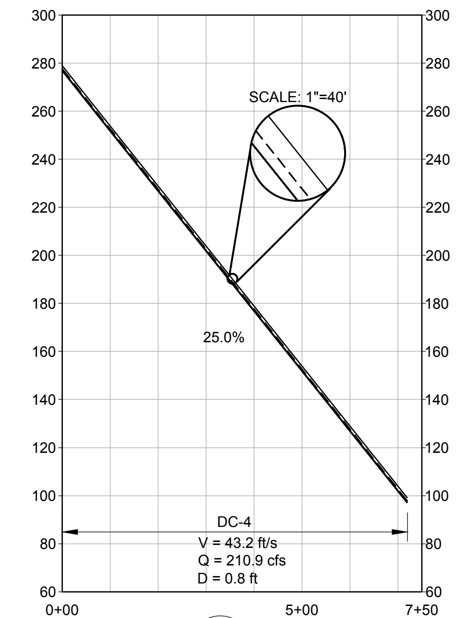

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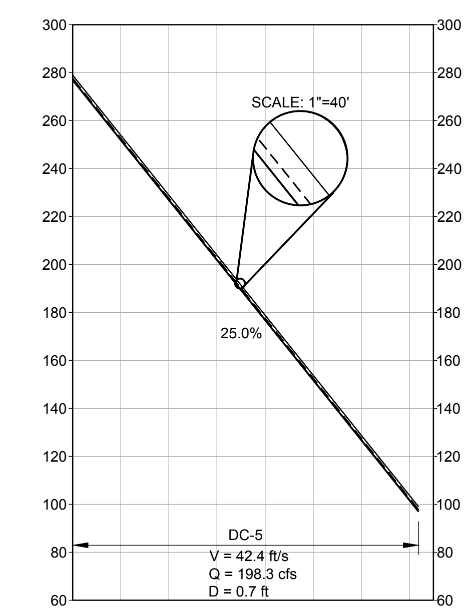

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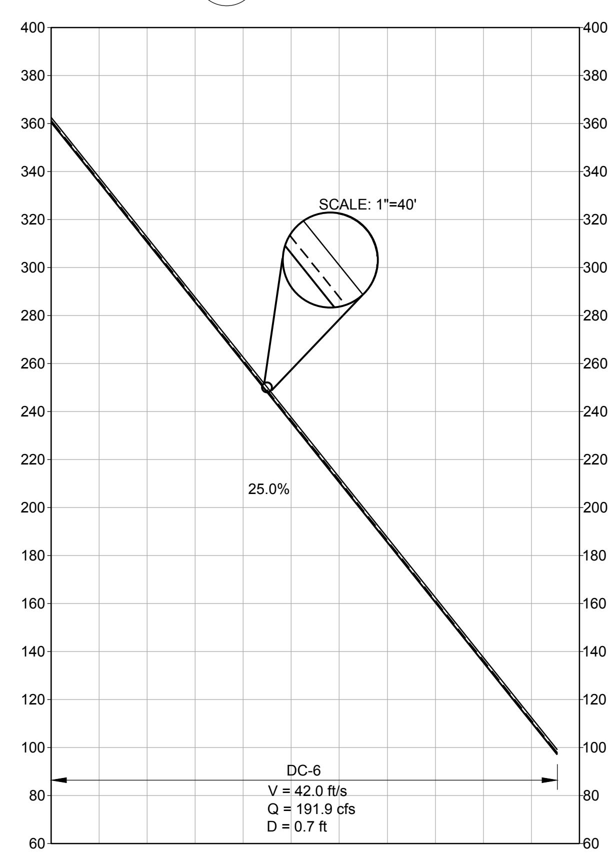

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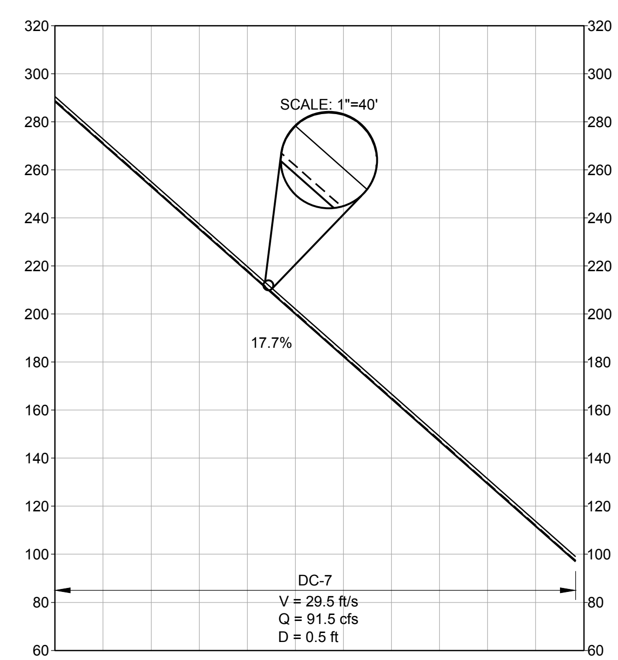

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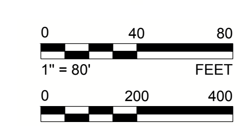

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CHARLES G. DOMINGUEZ
83247
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GOLDER ASSOCIATES INC.
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CITY OF EDINBURG SOLID WASTE MANAGEMENT

CONSULTANT

Golder Associates

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

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EDINBURG REGIONAL DISPOSAL FACILITY
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EDINBURG, HIDALGO COUNTY, TEXAS

TITLE

FLOWLINE PROFILES III - DOWNCHUTE SECTIONS I

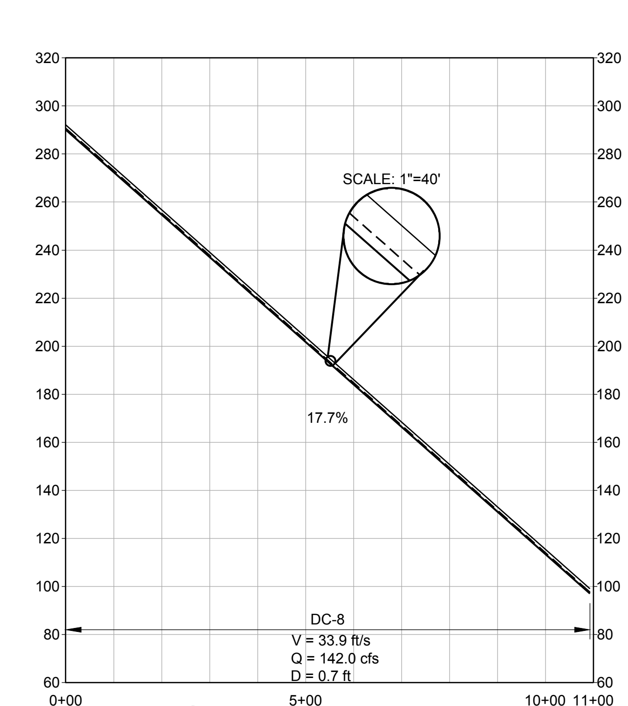
PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	0	11 of 15	III2-11

LEGEND

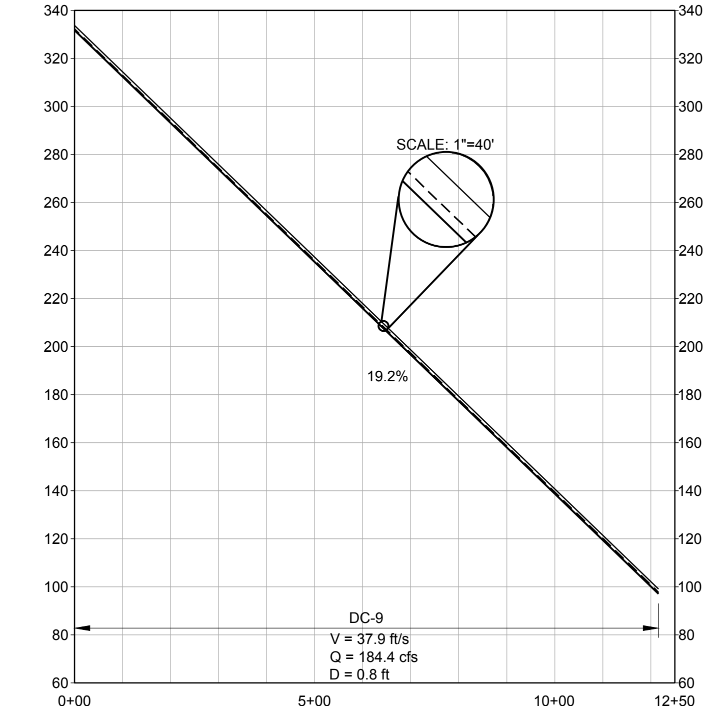
- TOP OF EMBANKMENT
- MAXIMUM WATER SURFACE ELEVATION (25-YR, 24-HR STORM)
- FLOWLINE ELEVATION

NOTES

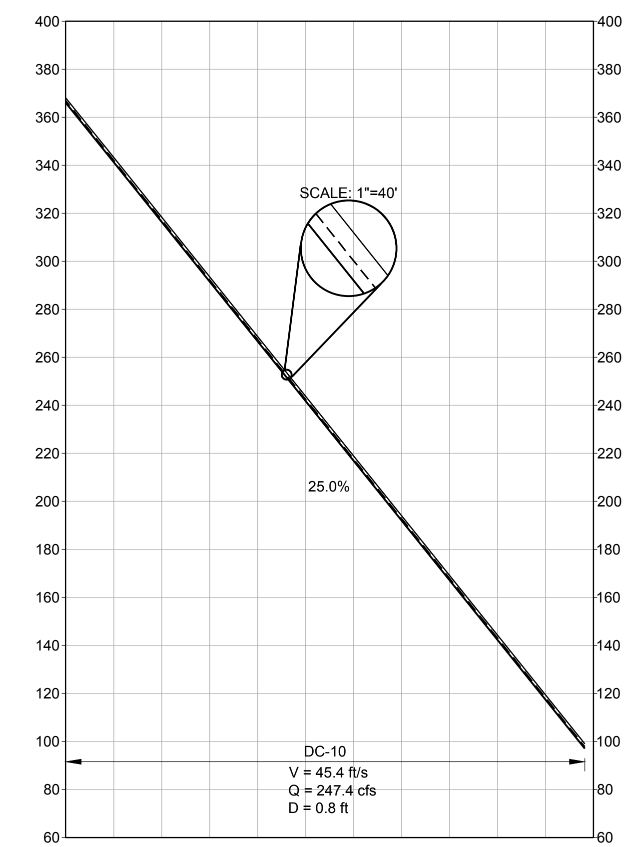
1. REFER TO FIGURE III2-2 FOR PERIMETER CHANNELS AND DOWNCHUTE LOCATION.



HORZ. SCALE 1"=400' VERT. SCALE 1"=80' 26 III2-12 PROFILE DOWNCHUTE 8



HORZ. SCALE 1"=400' VERT. SCALE 1"=80' 27 III2-12 PROFILE DOWNCHUTE 9



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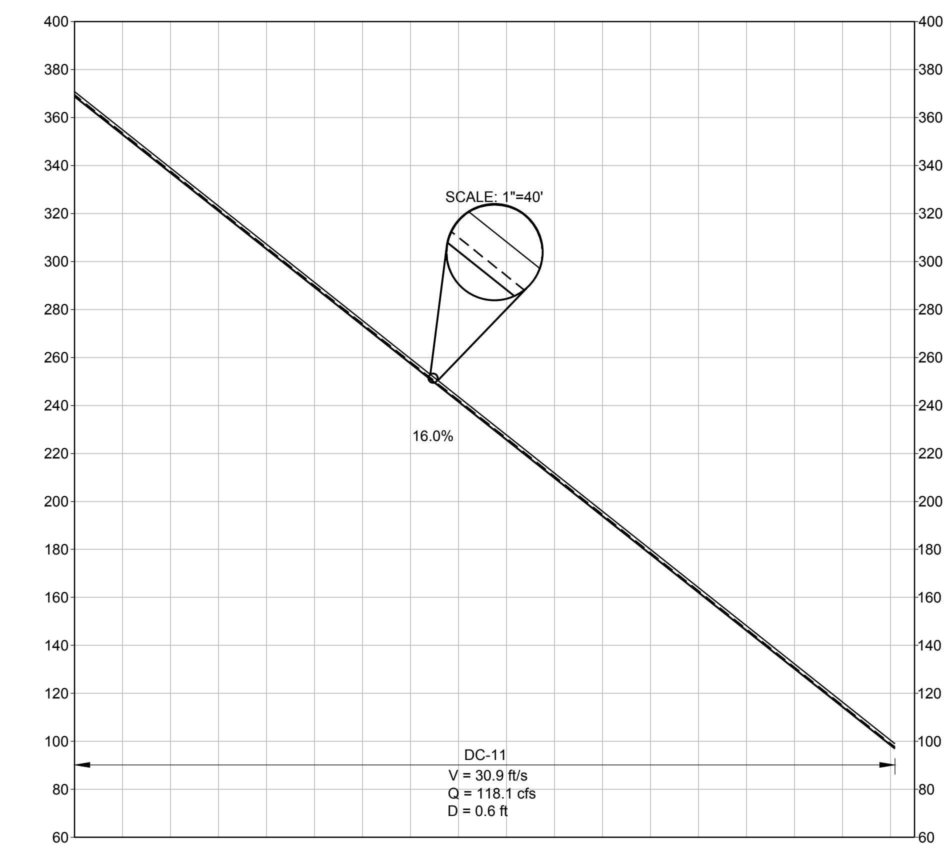

HORZ. SCALE 1"=400' VERT. SCALE 1"=80' 29 III2-12 PROFILE DOWNCHUTE 11

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0 40 80 1" = 80' FEET

0 200 400 1" = 400' FEET

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CHARLES G. DOMINGUEZ
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LICENSED PROFESSIONAL ENGINEER

GOLDER ASSOCIATES INC.
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CITY OF EDINBURG SOLID WASTE MANAGEMENT

CONSULTANT

Golder Associates

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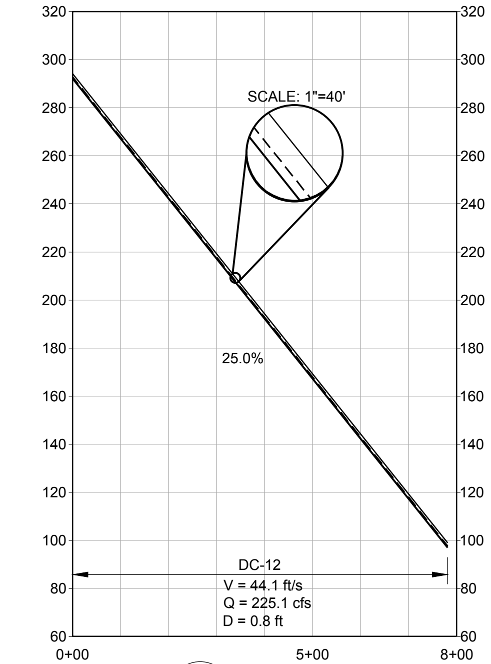
TITLE

FLOWLINE PROFILES IV - DOWNCHUTES SECTIONS II

PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	0	12 of 15	III2-12



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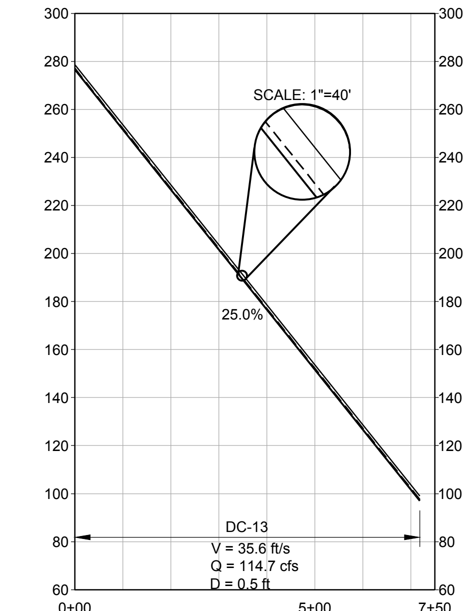
VERT. SCALE 1"=80'
30
III2-13
PROFILE DOWNCHUTE 12



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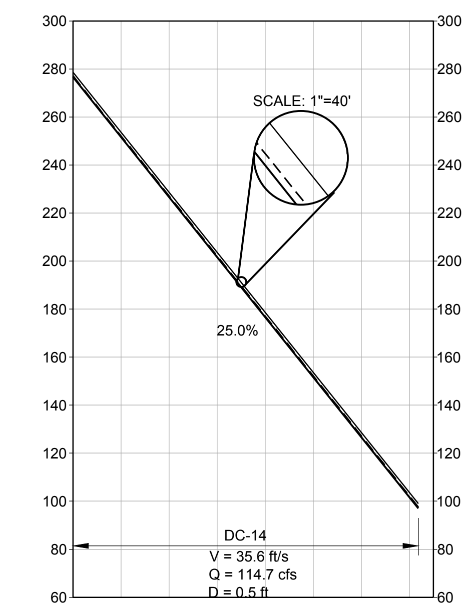
VERT. SCALE 1"=80'
31
III2-13
PROFILE DOWNCHUTE 13



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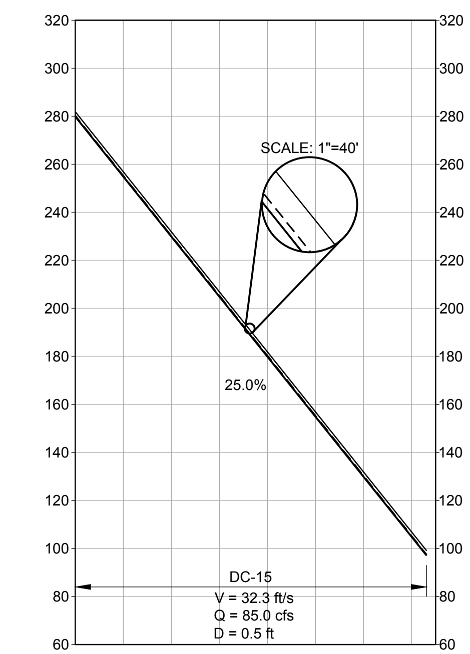
32
III2-13
PROFILE DOWNCHUTE 14



HORZ. SCALE 1"=400'
VERT. SCALE 1"=80'
33
III2-13
PROFILE DOWNCHUTE 15

LEGEND

- TOP OF EMBANKMENT
- MAXIMUM WATER SURFACE ELEVATION (25-YR, 24-HR STORM)
- FLOWLINE ELEVATION

NOTES

1. REFER TO FIGURE III2-2 FOR PERIMETER CHANNELS AND DOWNCHUTE LOCATION.

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0 40 80
1" = 80' FEET
0 200 400
1" = 400' FEET

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83247
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PROFESSIONAL ENGINEER
GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

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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

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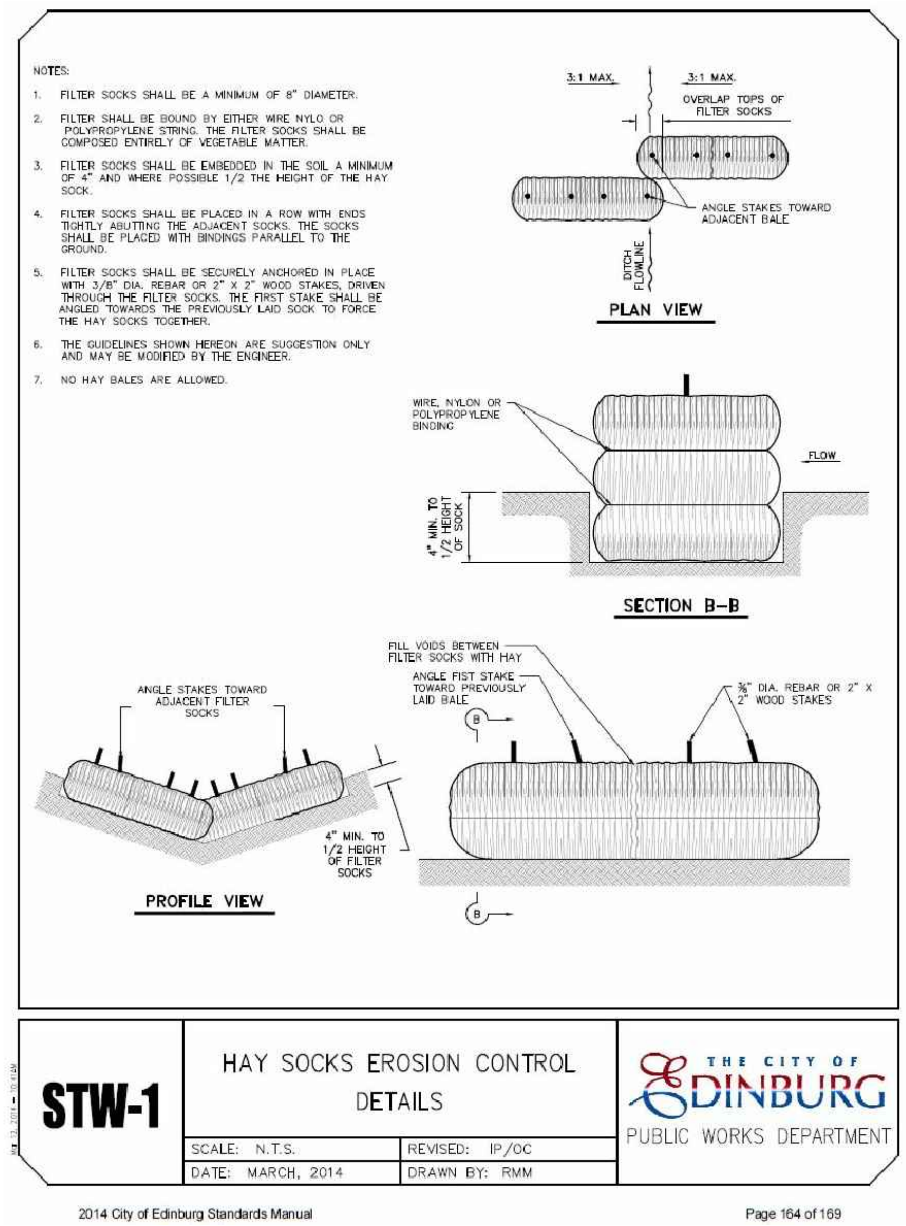
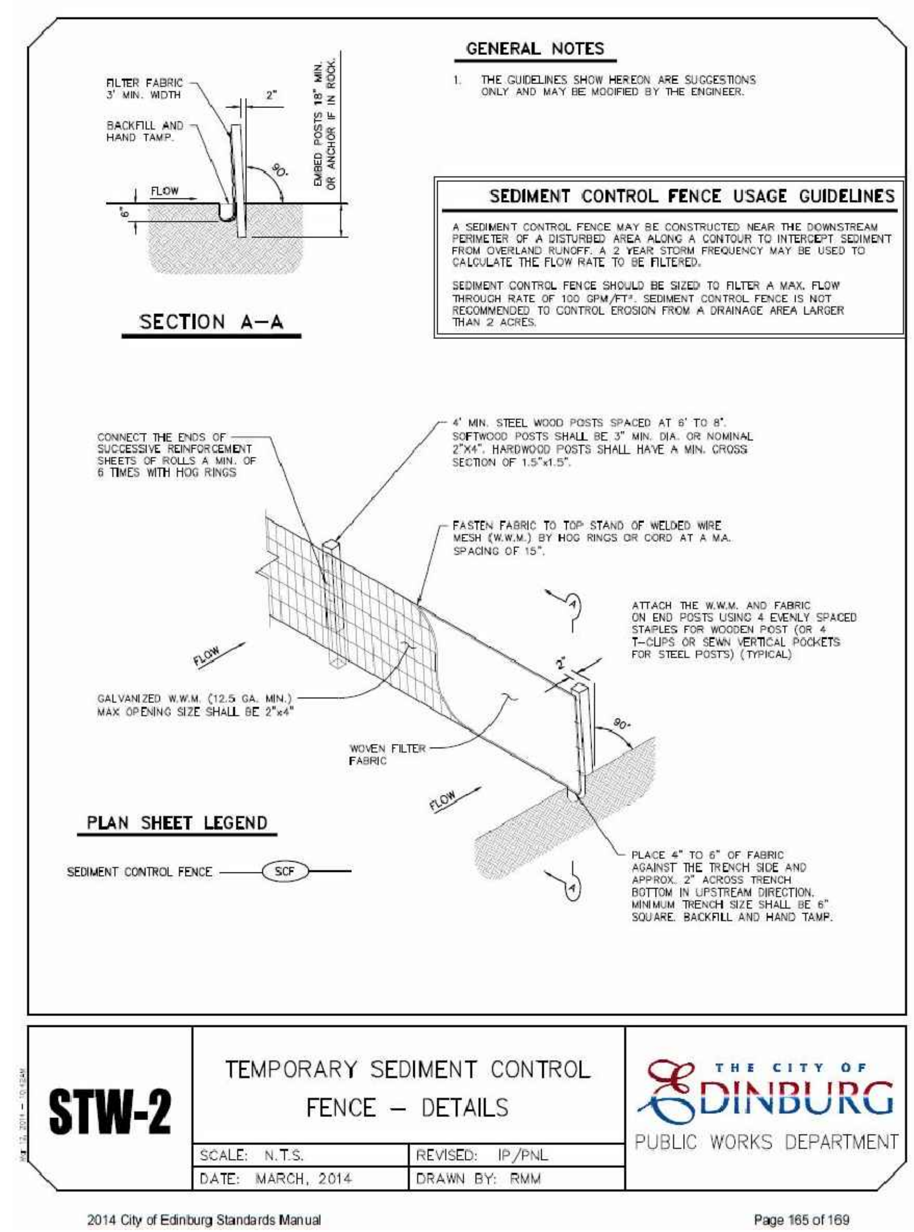
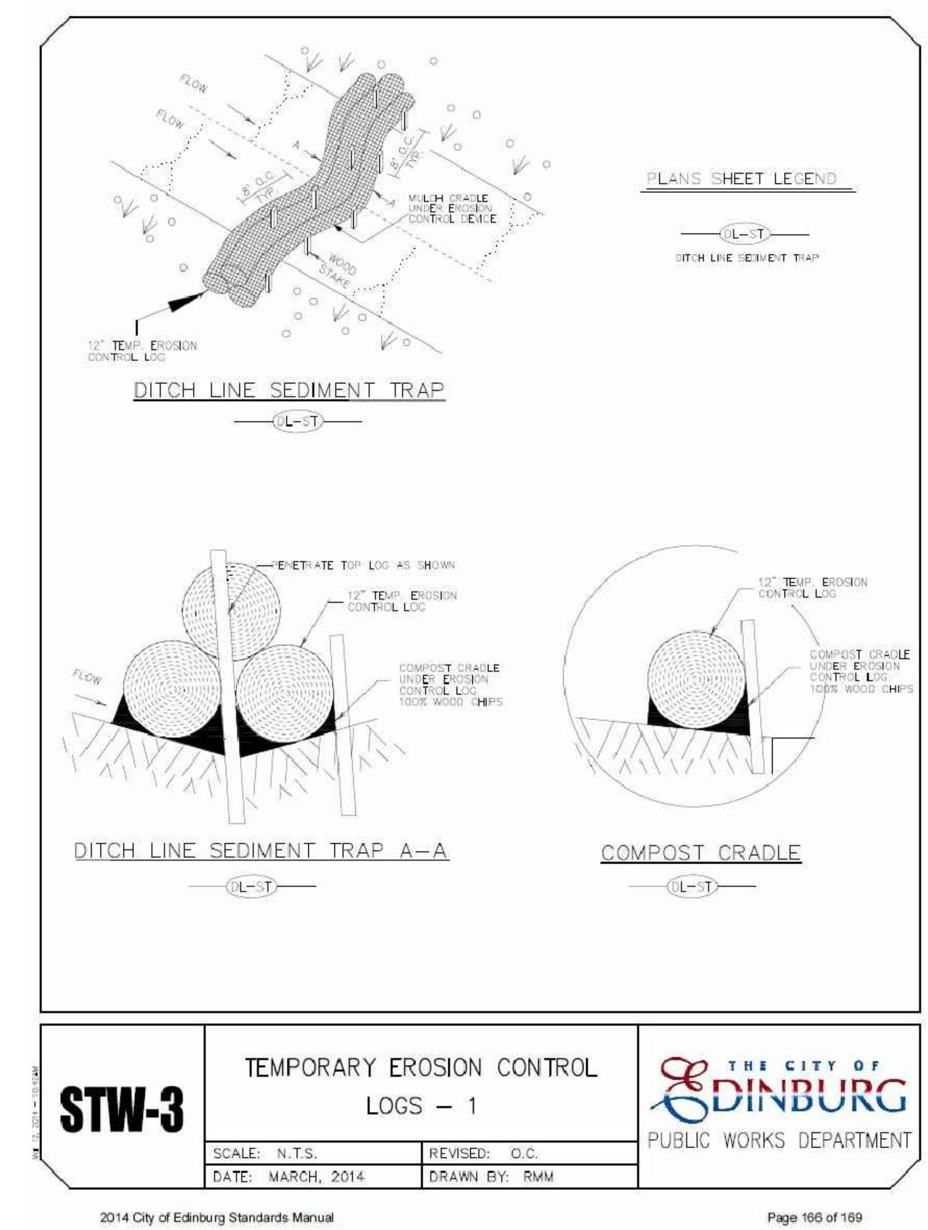
EDINBURG, HIDALGO COUNTY, TEXAS

TITLE
FLOWLINE PROFILES V - DOWNCHUTES SECTIONS III

PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	0	13 of 15	III2-13







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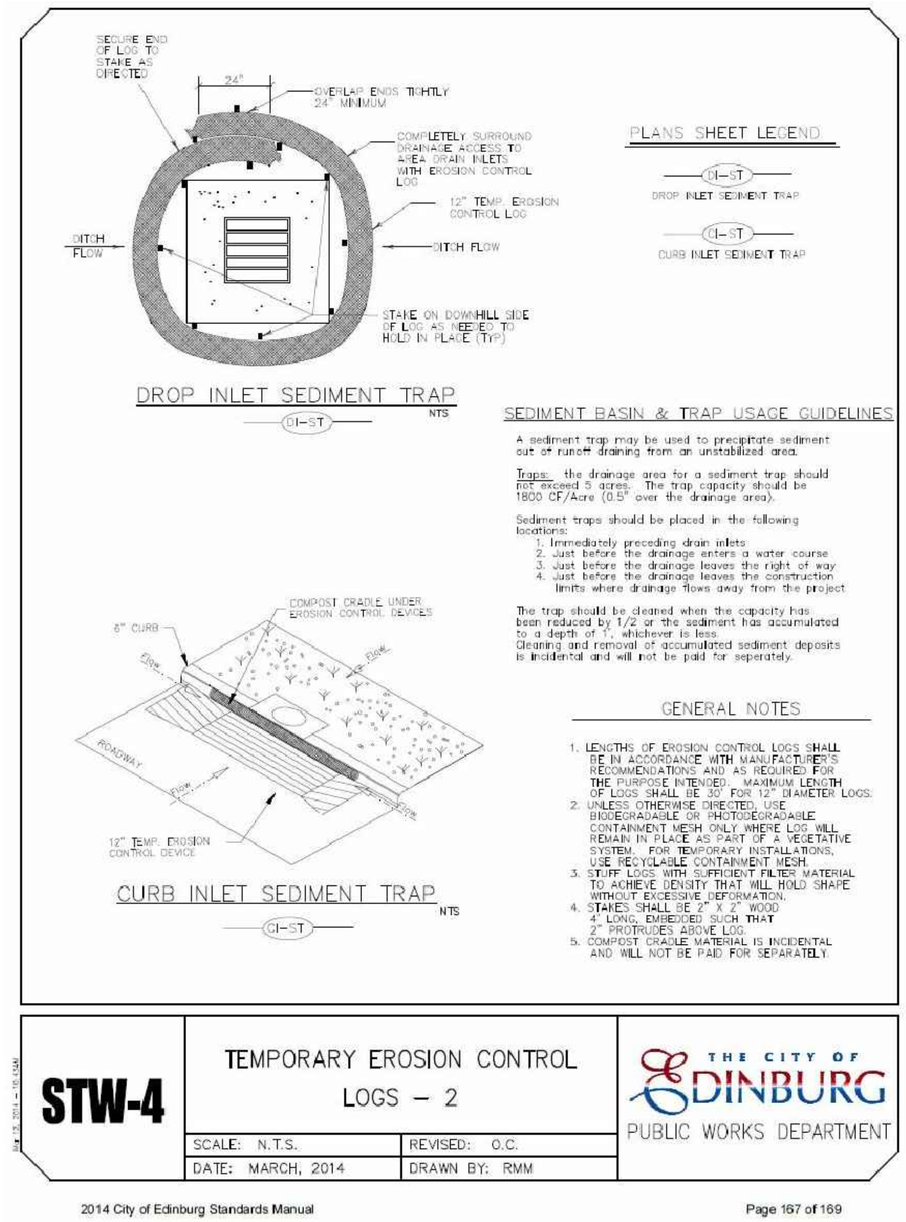
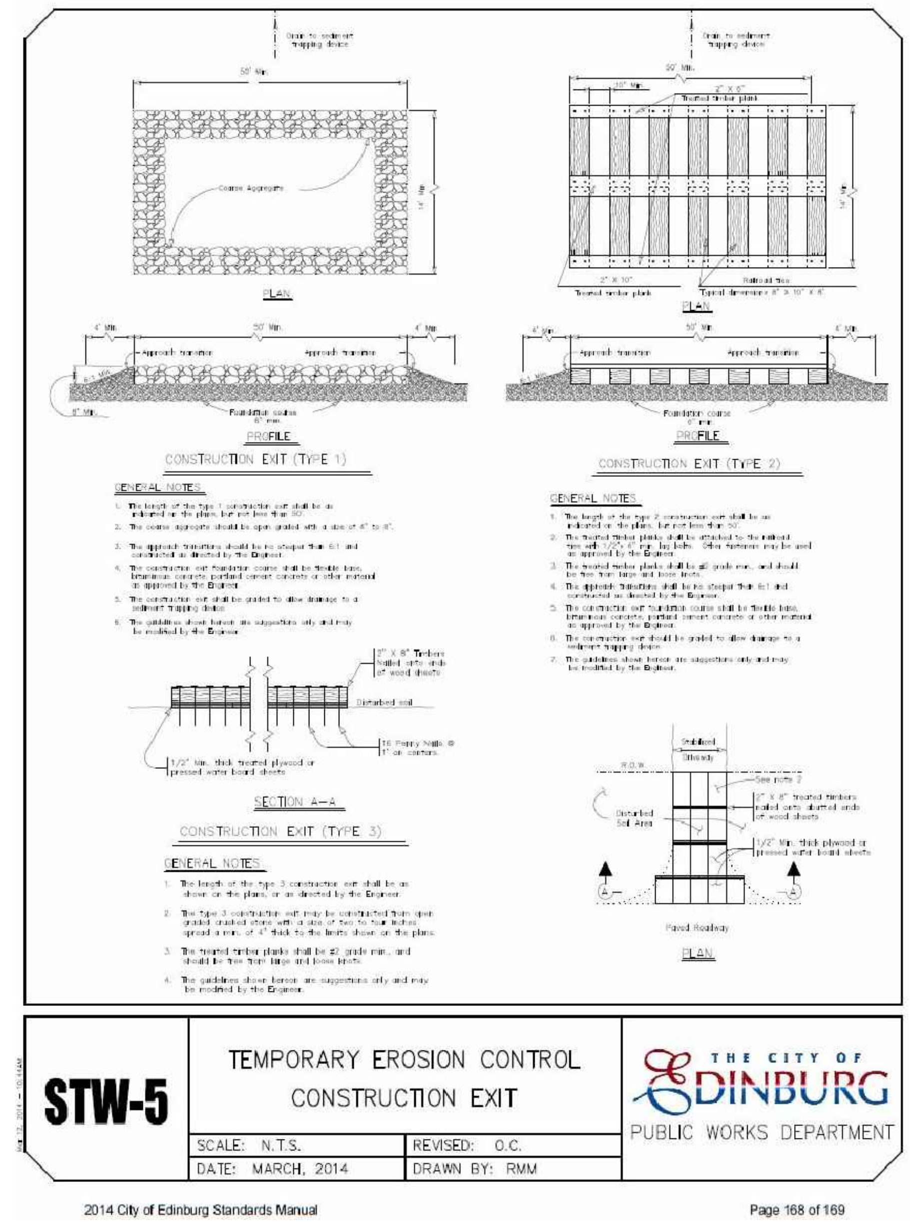
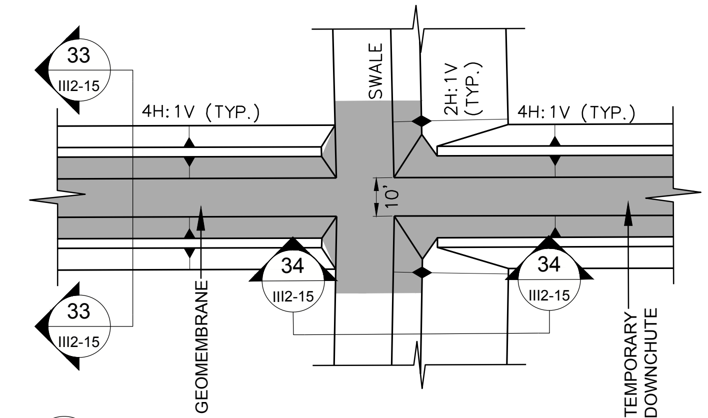
EDINBURG, HIDALGO COUNTY, TEXAS

TITLE
EROSION AND SEDIMENTATION CONTROL DETAILS - I

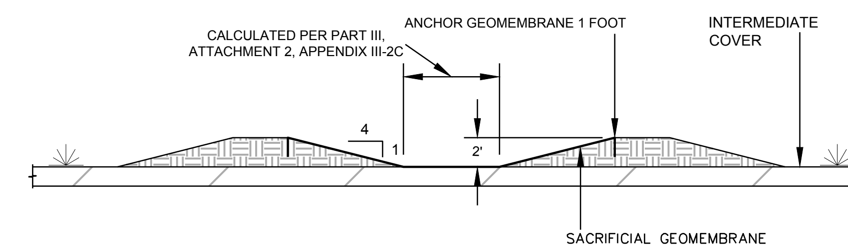
PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	0	14 of 15	III2-14



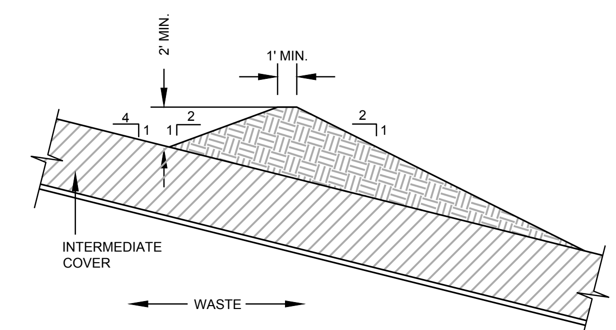




SCALE: NTS 34 III2-15 TEMPORARY DIVERSION BERM AND DOWNCHUTE CONFLUENCE



SCALE: NTS 35 III2-15 TEMPORARY DOWNCHUTE CHANNEL



SCALE: NTS 36 III2-15 TEMPORARY SURFACE WATER DIVERSION BERM

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CHARLES G. DOMINGUEZ
83247
LICENSED PROFESSIONAL ENGINEER
7/21/17

GOLDER ASSOCIATES INC.
TEXAS REGISTRATION F-2578

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CITY OF EDINBURG SOLID WASTE MANAGEMENT

CONSULTANT

Golder Associates

HOUSTON OFFICE
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[+1] (281) 821-6868
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TITLE
EROSION AND SEDIMENTATION CONTROL DETAILS - II

PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2	0	15 of 15	III2-15

1 in

APPENDIX III-2A

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
7/21/17
CHARLES G. DOMINGUEZ
83247
LICENSED
PROFESSIONAL ENGINEER

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

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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 2E (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 2E) 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	85.1	91.0
W2	34.6	85.1	91.0
W3	6.9	85.1	91.0
W4	7.1	84.3	91.0
W5	7.2	84.3	91.0
W6	70.8	84.3	91.0
W7	7.9	78.5	91.0
E1	80.2	82.0	94.0
E2	86.1	82.0	94.0
E3	11.5	66.6	94.0
E4	8.7	82.0	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.

APPENDIX III-2A

TABLES

TABLE 1A.1
PRE-DEVELOPMENT COMPOSITE CURVE NUMBER CALCULATIONS

CITY OF EDINBURG
EDINBURG REGIONAL DISPOSAL FACILITY
Project Number: 1401491

Date:	2/10/16
By:	VJE
Chkd:	MX
Apprvd:	CGD

Design Storm 25 **-Year Reoccurance Interval**

Storm Duration (hours)	2-Year Depth (inches)	25 -Year Depth (inches)	Storm Distribution
24	4.3	8.5	III

Subbasin ID	Subbasin Area (ft^2)	Subbasin Area (acres)	Subbasin Area (sq mile)	CN = 98 CONCRETE - PAVED AREAS OR POND AREAS (acres)	CN = 92 DIRT ROADS - UNPAVED AREAS (acres)	CN = 85 LANDFILL FINAL COVER AREAS (acres)	Composite SCS Curve No.	S = $\frac{1000}{CN}$ - 10	Unit Runoff Q (in)	Runoff Volume (ac-ft)	Runoff Volume (ft^3)
EXISTING LANDFILL AREA											
1	7,143,840	164.00	0.2563			164.00	CN = 85	1.76	6.70	91.52	3,986,587
2	2,880,187	66.12	0.1033			66.12	CN = 85	1.76	6.70	36.90	1,607,275
3	432,551	9.93	0.0155	9.93			CN = 98	0.20	8.26	6.84	297,736
4	256,568	5.89	0.0092	5.89			CN = 98	0.20	8.26	4.05	176,603
5	330,185	7.58	0.0118		7.58		CN = 92	0.87	7.54	4.76	207,432
Subbasin ID	Subbasin Area (ft^2)	Subbasin Area (acres)	Subbasin Area (sq mile)	CN = 98 CONCRETE - PAVED AREAS OR POND AREAS (acres)	CN = 92 DIRT ROADS - UNPAVED AREAS (acres)	CN = 79 CONTINUOUS GRASS, OPEN LAND (acres)	Composite SCS Curve No.	S = $\frac{1000}{CN}$ - 10	Unit Runoff Q (in)	Runoff Volume (ac-ft)	Runoff Volume (ft^3)
EXPANSION AREA											
6	1,055,459	24.23	0.0379			24.23	CN = 79	2.66	5.98	12.06	525,538
7	358,063	8.22	0.0128			8.22	CN = 79	2.66	5.98	4.09	178,288
8	257,004	5.90	0.0092			5.90	CN = 79	2.66	5.98	2.94	127,968
9	2,608,373	59.88	0.0936			59.88	CN = 79	2.66	5.98	29.82	1,298,770
10	1,518,937	34.87	0.0545			34.87	CN = 79	2.66	5.98	17.36	756,314
11	3,683,434	84.56	0.1321			84.56	CN = 79	2.66	5.98	42.10	1,834,067
12	862,052	19.79	0.0309			19.79	CN = 79	2.66	5.98	9.85	429,236
13	859,003	19.72	0.0308			19.72	CN = 79	2.66	5.98	9.82	427,718
14	841,144	19.31	0.0302			19.31	CN = 79	2.66	5.98	9.61	418,825
15	358,934	8.24	0.0129			8.24	CN = 79	2.66	5.98	4.10	178,722
16	1,738,044	39.90	0.0623			39.90	CN = 79	2.66	5.98	19.87	865,413
17	1,064,171	24.43	0.0382			24.43	CN = 79	2.66	5.98	12.16	529,875
Total:	26,247,949	602.57	0.94							317.87	13,846,365

CITY OF EDINBURG
EDINBURG REGIONAL DISPOSAL FACILITY
PROJECT NUMBER: 1401491

TABLE 1A.2
BASIN TIME OF CONCENTRATION CALCULATIONS
PRE-DEVELOPMENT

Date:	2/10/16
By:	VJE
Chkd:	MX
Apprvd:	CGD

				Flow Segment 1							Flow Segment 2							Flow Segment 3							Flow Segment 4						
Subbasin ID	Composite Curve Number	Total Lag (0.6*Tc) (min)	Total Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[(1)]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[(1)]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[(1)]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[(1)]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
EXISTING LANDFILL AREA																															
1	85	44.4	74.0	Sheet	300	0.006	F	Dense Grass		48.0	Shallow	192.0	0.006	U	Unpaved		2.6	Shallow	137	0.250	U	Unpaved		0.3	Channel	4350	0.001	G	Grass-lined	3.56	23.2
2	85	16.3	27.2	Sheet	300	0.103	F	Dense Grass		15.4	Shallow	515.0	0.103	U	Unpaved		1.7	Shallow	146	0.250	U	Unpaved		0.3	Channel	1692	0.001	G	Grass-lined	3.13	9.8
3	98	0.0	0.0																												
4	98	0.0	0.0																												
5	92	15.8	26.4	Channel	2700	0.001	G	Grass-lined	1.43	26.4																					
EXPANSION AREA																															
6	79	26.9	44.8	Sheet	177	0.036	F	Dense Grass		15.4	Sheet	123.0	0.050	F	Dense Grass		10.1	Shallow	81	0.050	U	Unpaved		0.4	Shallow	579	0.001	U	Unpaved		18.9
7	79	19.0	31.7	Sheet	94	0.027	F	Dense Grass		10.4	Sheet	206.0	0.031	F	Dense Grass		18.4	Shallow	75	0.031	U	Unpaved		0.4	Shallow	269	0.013	U	Unpaved		2.4
8	79	24.1	40.1	Sheet	136	0.013	F	Dense Grass		18.8	Sheet	153.0	0.024	F	Dense Grass		16.0	Sheet	8	0.006	F	Dense Grass		2.6	Shallow	206	0.006	U	Unpaved		2.7
9	79	21.2	35.4	Sheet	179	0.034	F	Dense Grass		15.8	Sheet	70.0	0.044	F	Dense Grass		6.7	Sheet	50	0.038	F	Dense Grass		5.5	Shallow	225	0.001	U	Unpaved		7.3
10	79	26.8	44.6	Sheet	300	0.014	F	Dense Grass		34.0	Shallow	429.0	0.014	U	Unpaved		3.7	Shallow	795	0.014	U	Unpaved		6.9							
11	79	34.4	57.3	Sheet	300	0.022	F	Dense Grass		28.8	Shallow	83.0	0.022	U	Unpaved		0.6	Shallow	448	0.008	U	Unpaved		5.1	Shallow	2515	0.013	U	Unpaved		22.8
12	79	43.7	72.8	Sheet	300	0.003	F	Dense Grass		62.5	Shallow	400.0	0.003	U	Unpaved		7.4	Shallow	356	0.017	U	Unpaved		2.8							
13	79	49.0	81.6	Sheet	300	0.004	F	Dense Grass		54.8	Shallow	1700.0	0.004	U	Unpaved		26.8														
14	79	36.3	60.5	Sheet	60	0.154	F	Dense Grass		3.6	Sheet	240.0	0.003	F	Dense Grass		51.0	Shallow	346	0.036	U	Unpaved		1.9	Shallow	215	0.003	U	Unpaved		4.0
15	79	50.0	83.4	Sheet	105	0.121	F	Dense Grass		6.2	Sheet	195.0	0.001	F	Dense Grass		67.0	Shallow	326	0.001	U	Unpaved		10.2							
16	79	34.7	57.9	Sheet	300	0.009	F	Dense Grass		41.0	Shallow	21.0	0.009	U	Unpaved		0.2	Shallow	385	0.001	U	Unpaved		12.6	Shallow	308	0.006	U	Unpaved		4.1
17	79	15.8	26.4	Sheet	26	0.019	F	Dense Grass		4.3	Sheet	139.0	0.286	F	Dense Grass		5.5	Sheet	135	0.018	F	Dense Grass		16.4	Shallow	27	0.018	U	Unpaved		0.2

Notes:
1. Refer to Table 5 for Roughness Condition descriptions and Tc Coefficients.

TABLE 1B.1
POST-DEVELOPMENT COMPOSITE CURVE NUMBER CALCULATIONS

CITY OF EDINBURG
EDINBURG REGIONAL DISPOSAL FACILITY
Project Number: 1401491

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

Design Storm 25 -Year Reoccurance Interval

Storm Duration (hours)	2-Year Depth (inches)	25 -Year Depth (inches)	Storm Distribution
24	4.3	8.5	III

Subbasin ID	Subbasin Area (ft^2)	Subbasin Area (acres)	Subbasin Area (sq mile)	CN = 98 CONCRETE - PAVED AREAS OR POND AREAS (acres)	CN = 92 DIRT ROADS - UNPAVED AREAS (acres)	CN = 85 LANDFILL FINAL COVER AREAS (acres)	Composite SCS Curve No.	$S = \frac{1000}{CN} - 10$	Unit Runoff Q (in)	Runoff Volume (ac-ft)	Runoff Volume (ft^3)
LANDFILL AREA											
1	1,443,117	33.13	0.0518			33.13	CN = 85	1.76	6.70	18.49	805,325
2	688,212	15.80	0.0247			15.80	CN = 85	1.76	6.70	8.82	384,053
3	1,035,025	23.76	0.0371			23.76	CN = 85	1.76	6.70	13.26	577,591
4	1,402,384	32.19	0.0503			32.19	CN = 85	1.76	6.70	17.97	782,594
5	1,910,231	43.85	0.0685			43.85	CN = 85	1.76	6.70	24.47	1,065,996
6	783,691	17.99	0.0281			17.99	CN = 85	1.76	6.70	10.04	437,335
7	1,632,679	37.48	0.0586			37.48	CN = 85	1.76	6.70	20.92	911,109
8	842,299	19.34	0.0302			19.34	CN = 85	1.76	6.70	10.79	470,041
9	841,863	19.33	0.0302			19.33	CN = 85	1.76	6.70	10.79	469,798
10	626,465	14.38	0.0225			14.38	CN = 85	1.76	6.70	8.03	349,596
11	319,636	7.34	0.0115			7.34	CN = 85	1.76	6.70	4.09	178,371
12	167,623	3.85	0.0060			3.85	CN = 85	1.76	6.70	2.15	93,541
13	849,288	19.50	0.0305			19.50	CN = 85	1.76	6.70	10.88	473,941
14	1,537,160	35.29	0.0551			35.29	CN = 85	1.76	6.70	19.69	857,805
15	1,443,630	33.14	0.0518			33.14	CN = 85	1.76	6.70	18.49	805,611
16	434,144	9.97	0.0156		4.15	5.82	CN = 88	1.36	7.06	5.86	255,332
17	210,063	4.82	0.0075		2.01	2.81	CN = 88	1.36	7.06	2.84	123,544
18	208,252	4.78	0.0075		1.99	2.79	CN = 88	1.36	7.06	2.81	122,479
19	208,961	4.80	0.0075		2.00	2.79	CN = 88	1.36	7.06	2.82	122,896
20	168,189	3.86	0.0060		1.18	2.69	CN = 87	1.49	6.94	2.23	97,230
21	156,182	3.59	0.0056		1.46	2.13	CN = 88	1.36	7.06	2.11	91,855
22	153,625	3.53	0.0055		1.68	1.85	CN = 88	1.36	7.06	2.07	90,351
23	224,887	5.16	0.0081		2.28	2.89	CN = 88	1.36	7.06	3.04	132,262
24	282,859	6.49	0.0101		2.01	4.48	CN = 87	1.49	6.94	3.75	163,521
25	133,014	3.05	0.0048		0.75	2.30	CN = 87	1.49	6.94	1.77	76,895

TABLE 1B.1
POST-DEVELOPMENT COMPOSITE CURVE NUMBER CALCULATIONS

Subbasin ID	Subbasin Area (ft^2)	Subbasin Area (acres)	Subbasin Area (sq mile)	CN = 98 CONCRETE - PAVED AREAS OR POND AREAS (acres)	CN = 92 DIRT ROADS - UNPAVED AREAS (acres)	CN = 85 LANDFILL FINAL COVER AREAS (acres)	Composite SCS Curve No.	$S = \frac{1000}{CN} - 10$	Unit Runoff Q (in)	Runoff Volume (ac-ft)	Runoff Volume (ft^3)
26	76,227	1.75	0.0027		0.33	1.42	CN = 86	1.63	6.82	0.99	43,303
27	212,726	4.88	0.0076		1.85	3.04	CN = 88	1.36	7.06	2.87	125,110
28	92,401	2.12	0.0033		0.77	1.35	CN = 88	1.36	7.06	1.25	54,343
29	264,954	6.08	0.0095		3.56	2.52	CN = 89	1.24	7.18	3.64	158,483
30	364,708	8.37	0.0131		4.67	3.70	CN = 89	1.24	7.18	5.01	218,151
31	516,735	11.86	0.0185		6.52	5.34	CN = 89	1.24	7.18	7.10	309,087
32	327,237	7.51	0.0117		7.51		CN = 92	0.87	7.54	4.72	205,580
33	481,780	11.06	0.0173		11.06		CN = 92	0.87	7.54	6.95	302,668
34	469,344	10.77	0.0168	10.77			CN = 98	0.20	8.26	7.42	323,061
35	466,282	10.70	0.0167	10.70			CN = 98	0.20	8.26	7.37	320,954
36	501,126	11.50	0.0180	11.50			CN = 98	0.20	8.26	7.92	344,938
37	584,734	13.42	0.0210	10.66		2.77	CN = 95	0.53	7.90	8.84	384,924
38	726,939	16.69	0.0261	16.69			CN = 98	0.20	8.26	11.49	500,371
39	38,609	0.89	0.0014		0.30	0.58	CN = 87	1.49	6.94	0.51	22,320
40	48,110	1.10	0.0017		0.39	0.72	CN = 87	1.49	6.94	0.64	27,812
41	21,377	0.49	0.0008	.	0.49		CN = 92	0.87	7.54	0.31	13,429
42	274,088	6.29	0.0098	.	6.29		CN = 92	0.87	7.54	3.95	172,190
43	455,154	10.45	0.0163	10.45			CN = 98	0.20	8.26	7.19	313,294
44	451,849	10.37	0.0162	10.37			CN = 98	0.20	8.26	7.14	311,019
45	438,373	10.06	0.0157	10.06			CN = 98	0.20	8.26	6.93	301,743
46	457,914	10.51	0.0164	10.51			CN = 98	0.20	8.26	7.24	315,194
47	594,650	13.65	0.0213	11.10		2.55	CN = 96	0.42	8.02	9.12	397,408
48	549,303	12.61	0.0197	12.61			CN = 98	0.20	8.26	8.68	378,099
49	127,689	2.93	0.0046		0.76	2.17	CN = 87	1.49	6.94	1.69	73,817
Total:	22,788,674	602.52	0.94							357.13	15,556,371

CITY OF EDINBURG
EDINBURG REGIONAL DISPOSAL FACILITY
PROJECT NUMBER: 1401491

TABLE 1B.2
BASIN TIME OF CONCENTRATION CALCULATIONS
POST-DEVELOPMENT

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

				Flow Segment 1							Flow Segment 2							Flow Segment 3						
Subbasin ID	Composite Curve Number	Total Lag (0.6*Tc) (min)	Total Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
LANDFILL AREA																								
1	85	8.9	14.8	Sheet	112	0.050	F	Dense Grass		9.4	Sheet	71	0.250	F	Dense Grass		3.4	Channel	944	0.020	G	Grass-lined	1.54	2.0
2	85	8.9	14.9	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	102	0.177	F	Dense Grass		5.2	Channel	428	0.020	G	Grass-lined	1.16	1.1
3	85	7.9	13.1	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	72	0.250	F	Dense Grass		3.5	Channel	507	0.020	G	Grass-lined	1.38	1.1
4	85	9.2	15.3	Sheet	112	0.050	F	Dense Grass		9.4	Sheet	115	0.250	F	Dense Grass		5.0	Channel	439	0.020	G	Grass-lined	1.51	0.9
5	85	9.7	16.2	Sheet	112	0.050	F	Dense Grass		9.4	Sheet	115	0.250	F	Dense Grass		5.0	Channel	901	0.020	G	Grass-lined	1.68	1.8
6	85	5.0	8.3	Sheet	160	0.250	F	Dense Grass		6.5	Channel	786	0.020	G	Grass-lined	1.32	1.8							
7	85	7.8	13.1	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	48	0.250	F	Dense Grass		2.5	Channel	1017	0.020	G	Grass-lined	1.64	2.0
8	85	8.1	13.4	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	48	0.250	F	Dense Grass		2.5	Channel	1017	0.020	G	Grass-lined	1.27	2.4
9	85	8.1	13.4	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	48	0.250	F	Dense Grass		2.5	Channel	1017	0.020	G	Grass-lined	1.27	2.4
10	85	8.3	13.8	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	73	0.250	F	Dense Grass		3.5	Channel	712	0.020	G	Grass-lined	1.14	1.8
11	85	6.0	9.9	Sheet	89	0.250	F	Dense Grass		4.1	Sheet	54	0.200	F	Dense Grass		3.0	Channel	969	0.020	G	Grass-lined	0.92	2.8
12	85	5.0	8.3	Sheet	160	0.250	F	Dense Grass		6.5	Channel	526	0.020	G	Grass-lined	0.74	1.8							
13	85	7.1	11.9	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	60	0.250	F	Dense Grass		3.0	Channel	174	0.020	G	Grass-lined	1.30	0.4
14	85	7.9	13.1	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	49	0.250	F	Dense Grass		2.5	Channel	1003	0.020	G	Grass-lined	1.60	2.0
15	85	7.9	13.2	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	49	0.250	F	Dense Grass		2.5	Channel	1003	0.020	G	Grass-lined	1.56	2.1
16	88	14.6	24.4	Sheet	79	0.250	F	Dense Grass		3.7	Channel	2103	0.001	G	Grass-lined	1.42	20.7							
17	88	11.4	19.0	Sheet	160	0.250	F	Dense Grass		6.5	Channel	1020	0.001	G	Grass-lined	1.02	12.5							
18	88	11.7	19.5	Sheet	160	0.250	F	Dense Grass		6.5	Channel	1014	0.001	G	Grass-lined	0.96	12.9							
19	88	11.6	19.4	Sheet	160	0.250	F	Dense Grass		6.5	Channel	1015	0.001	G	Grass-lined	0.97	12.9							
20	87	9.4	15.7	Sheet	200	0.200	F	Dense Grass		8.5	Channel	619	0.001	G	Grass-lined	1.11	7.2							
21	88	10.6	17.6	Sheet	174	0.200	F	Dense Grass		7.6	Channel	827	0.001	G	Grass-lined	1.04	10.0							
22	88	8.0	13.3	Sheet	134	0.250	F	Dense Grass		5.7	Channel	672	0.001	G	Grass-lined	1.13	7.7							
23	88	11.4	19.1	Sheet	180	0.250	F	Dense Grass		7.2	Channel	1105	0.001	G	Grass-lined	1.24	11.9							
24	87	12.9	21.4	Sheet	81	0.250	F	Dense Grass		3.8	Channel	1685	0.001	G	Grass-lined	1.29	17.7							
25	87	8.2	13.6	Sheet	101	0.250	F	Dense Grass		4.5	Channel	737	0.001	G	Grass-lined	1.01	9.1							
26	86	5.7	9.6	Sheet	147	0.177	F	Dense Grass		7.0	Channel	175	0.0015	G	Grass-lined	0.58	2.5							
27	88	6.7	11.2	Sheet	70	0.250	F	Dense Grass		3.4	Channel	1174	0.006	G	Grass-lined	0.71	7.8							
28	88	6.9	11.5	Sheet	64	0.250	F	Dense Grass		3.1	Channel	622	0.001	G	Grass-lined	0.89	8.3							
29	89	8.4	14.0	Sheet	64	0.250	F	Dense Grass		3.1	Channel	1029	0.001	G	Grass-lined	1.28	10.8							
30	89	11.1	18.4	Sheet	160	0.250	F	Dense Grass		6.5	Channel	1244	0.001	G	Grass-lined	1.48	11.9							
31	89	7.8	13.0	Sheet	65	0.250	F	Dense Grass		3.2	Channel	1150	0.001	G	Grass-lined	1.75	9.8							
32	92	65.6	109.4	Sheet	300	0.001	F	Dense Grass		98.3	Shallow	340	0.001	U	Unpaved		11.1							
33	92	60.6	101.0	Sheet	300	0.001	F	Dense Grass		98.3	Shallow	84	0.001	U	Unpaved		2.7							
34	98	0.0	0.0																					
35	98	0.0	0.0																					
36	98	0.0	0.0																					
37	95	3.9	6.5	Sheet	160	0.250	F	Dense Grass		6.5														
38	98	0.0	0.0																					
39	87	6.1	10.1	Sheet	120	0.250	F	Dense Grass		5.2	Channel	279	0.001	G	Grass-lined	0.59	4.9							
40	87	4.5	7.4	Sheet	78	0.250	F	Dense Grass		3.7	Channel	227	0.0015	G	Grass-lined	0.48	3.8							
41	92	4.6	7.6	Channel	376	0.003	G	Grass-lined	0.21	7.6														
42	92	42.8	71.3	Sheet	300	0.003	F	Dense Grass		63.3	Shallow	1010	0.017	U	Unpaved		8.0							
43	98	0.0	0.0																					
44	98	0.0	0.0																					
45	98	0.0	0.0																					
46	98	0.0	0.0																					
47	96	3.9	6.5	Sheet	160	0.250	F	Dense Grass		6.5														
48	98	0.0	0.0																					
49	87	9.4	15.7	Sheet	160	0.250	F	Dense Grass		6.5	Channel	721	0.001	G	Grass-lined	0.96	9.2							

Notes:
1. Refer to Table 5 for Roughness Condition descriptions and Tc Coefficients.

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)
82.3	0	0.00	0	0	0	0
84.0	298,385	6.85	173,362	3.98	173,362	3.98
86.0	313,861	7.21	612,181	14.05	785,543	18.03
88.0	329,564	7.57	643,361	14.77	1,428,904	32.80
90.0	345,492	7.93	674,993	15.50	2,103,898	48.30
91.0	353,542	8.12	349,510	8.02	2,453,407	
						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)
78.8	0	0.00	0	0	0	0
80.0	272,303	6.25	108,013	2.48	108,013	2.48
82.0	287,471	6.60	559,705	12.85	667,719	15.33
84.0	302,882	6.95	590,286	13.55	1,258,005	28.88
86.0	318,533	7.31	621,349	14.26	1,879,353	43.14
88.0	334,425	7.68	652,894	14.99	2,532,247	58.13
90.0	350,559	8.05	684,921	15.72	3,217,168	73.86
91.0	358,717	8.23	354,630	8.14	3,571,798	82.00

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	2.48
82.0	19.04
84.0	49.92
86.0	92.29
88.0	136.82
90.0	183.53

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)
80.3	0	0.00	0	0	0	0
82.0	283,135	6.50	161,576	3.71	161,576	3.71
84.0	298,385	6.85	581,454	13.35	743,030	17.06
86.0	313,862	7.21	612,182	14.05	1,355,212	31.11
88.0	329,564	7.57	643,362	14.77	1,998,573	45.88
90.0	345,492	7.93	674,993	15.50	2,673,566	61.38
91.0	353,542	8.12	349,510	8.02	3,023,076	0.00
						69.40

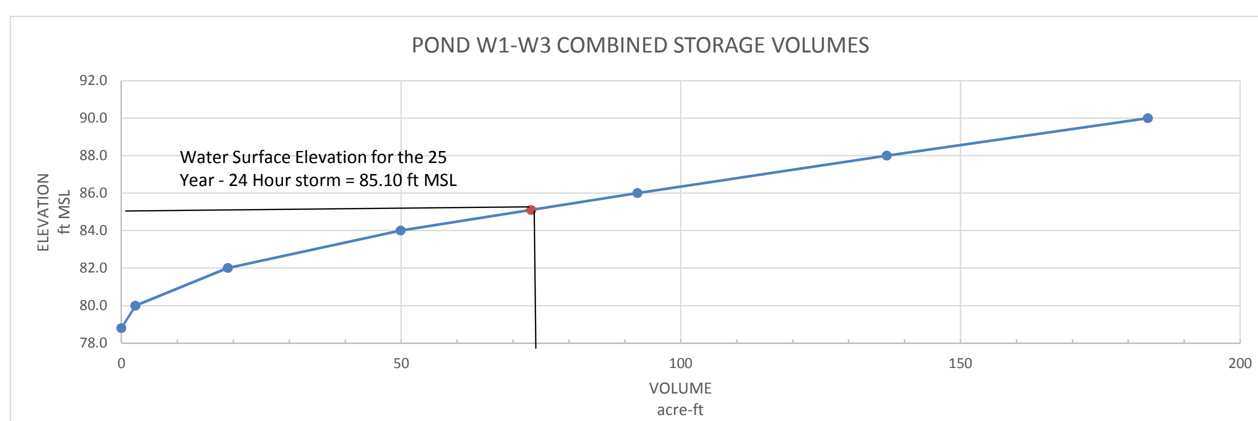
Next, the water surface elevation of the peak volume for the 25 year - 24 hour storm event. The peak volume is calculated using the HEC-HMS program. The water surface elevation is calculated by interpolation based on the stage storage table.

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

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

25 year - 24 hour storm event
Peak Volume = 73.30 ac-ft
Water Surface Elevation = **85.10** ft MSL

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



Date:	
By:	
Chkd:	
Apprvd:	

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)
80.2	0	0.00	0	0	0	0
82.0	336,900	7.73	206,295	4.74	206,295	4.74
84.0	352,930	8.10	689,769	15.83	896,064	20.57
86.0	369,187	8.48	722,056	16.58	1,618,120	37.15
88.0	385,669	8.85	754,795	17.33	2,372,915	54.47
90.0	402,377	9.24	787,987	18.09	3,160,902	72.56
91.0	410,817	9.43	406,590	9.33	3,567,492	81.90

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)
80.2	0	0.00	0	0	0	0
82.0	341,840	7.85	210,801	4.84	210,801	4.84
84.0	357,930	8.22	699,709	16.06	910,510	20.90
86.0	374,247	8.59	732,116	16.81	1,642,627	37.71
88.0	390,789	8.97	764,976	17.56	2,407,603	55.27
90.0	407,557	9.36	798,287	18.33	3,205,890	73.60
91.0	416,027	9.55	411,785	9.45	3,617,675	83.05

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

Elevation (ft MSL)	Σ Volume (acre-ft)
80.2	4.74
82.0	30.09
84.0	78.51
86.0	129.16
88.0	182.07
90.0	237.29
91.0	265.77

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)
78.2	0	0.00	0	0	0	0
80.0	335,739	7.71	206,479	4.74	206,479	4.74
82.0	351,680	8.07	687,357	15.78	893,836	20.52
84.0	367,866	8.45	719,485	16.52	1,613,321	37.04
86.0	384,297	8.82	752,103	17.27	2,365,423	54.30
88.0	400,973	9.21	785,210	18.03	3,150,633	72.33
90.0	417,894	9.59	818,808	18.80	3,969,442	91.13
91.0	426,447	9.79	422,163	9.69	4,391,605	100.82

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.

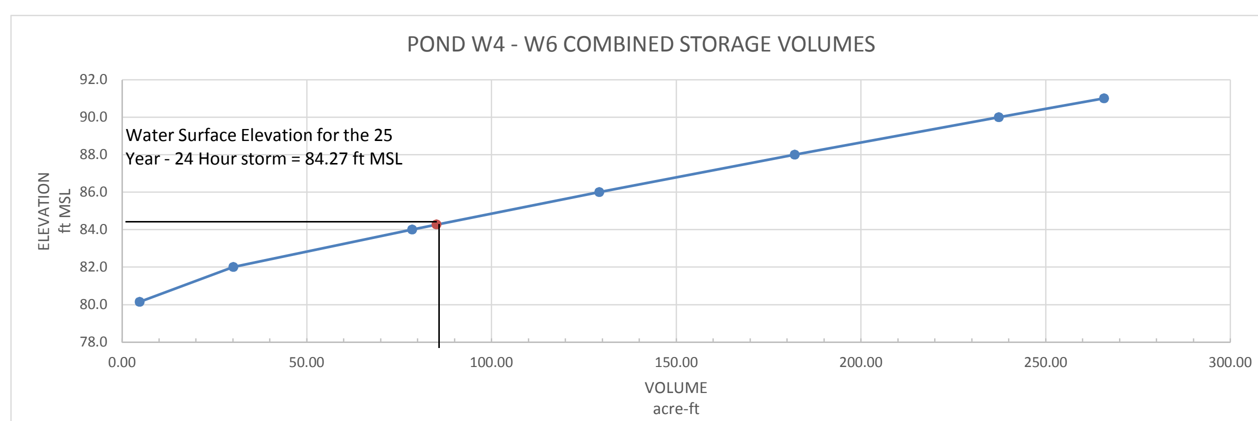
$$y_2 = \frac{(x_2 - x_1)(y_3 - y_1)}{(x_3 - x_1)} + y_1$$

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

25 year - 24 hour storm event
Peak Volume = 85.10 ac-ft
Water Surface Elevation = **84.27** ft MSL

References:

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



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)
76.2	0	0.00	0	0	0	0
78.0	320,044	7.35	193,627	4.45	193,627	4.45
80.0	335,708	7.71	655,690	15.05	849,317	19.50
82.0	351,629	8.07	687,276	15.78	1,536,593	35.28
84.0	367,807	8.44	719,375	16.51	2,255,968	51.79
86.0	384,240	8.82	751,987	17.26	3,007,955	69.05
88.0	400,930	9.20	785,111	18.02	3,793,067	87.08
90.0	417,877	9.59	818,749	18.80	4,611,815	105.87
91.0	426,447	9.79	422,155	9.69	5,033,970	115.56

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.

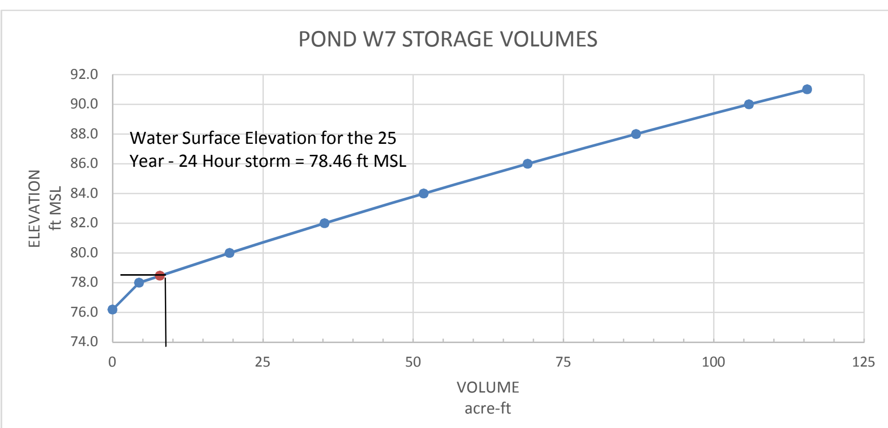
$$y_2 = \frac{(x_2 - x_1)(y_3 - y_1)}{(x_3 - x_1)} + y_1$$

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

25 year - 24 hour storm event
Peak Volume = 7.9 ac-ft
Water Surface Elevation = **78.46** ft MSL

References:

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



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

TABLE 2D: POND E1, E2 & 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)
67.5	0	0.00	0	0	0	0
68.0	8,659	0.20	1,443	0.03	1,443	0.03
70.0	78,903	1.81	75,801	1.74	77,244	1.77
72.0	98,120	2.25	176,675	4.06	253,918	5.83
74.0	156,310	3.59	252,182	5.79	506,101	11.62
76.0	223,473	5.13	377,788	8.67	883,889	20.29
78.0	299,609	6.88	521,225	11.97	1,405,114	32.26
80.0	314,258	7.21	613,809	14.09	2,018,923	46.35
82.0	329,183	7.56	643,383	14.77	2,662,306	61.12
84.0	344,382	7.91	673,507	15.46	3,335,813	76.58
86.0	359,856	8.26	704,181	16.17	4,039,994	92.75
88.0	375,574	8.62	735,374	16.88	4,775,368	109.63
90.0	391,576	8.99	767,095	17.61	5,542,463	127.24
92.0	407,871	9.36	799,392	18.35	6,341,856	145.59
94.0	424,438	9.74	832,254	19.11	7,174,110	164.69

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)
75.8	0	0.00	0	0	0	0
76.0	17,140	0.39	1,074	0.02	1,074	0.02
78.0	314,858	7.23	270,306	6.21	271,381	6.23
80.0	329,877	7.57	644,678	14.80	916,058	21.03
82.0	345,155	7.92	674,975	15.50	1,591,033	36.52
84.0	360,391	8.27	705,491	16.20	2,296,525	52.72
86.0	376,486	8.64	736,818	16.91	3,033,343	69.64
88.0	392,591	9.01	769,021	17.65	3,802,364	87.29
90.0	408,909	9.39	801,445	18.40	4,603,809	105.69
92.0	425,505	9.77	834,359	19.15	5,438,167	124.84
94.0	442,359	10.16	867,809	19.92	6,305,976	144.76

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)
69.3	0	0.00	0	0	0	0
70.0	6,724	0.15	1,461	0.03	1,461	0.03
72.0	84,064	1.93	76,374	1.75	77,836	1.79
74.0	247,310	5.68	317,040	7.28	394,876	9.07
76.0	368,657	8.46	611,943	14.05	1,006,819	23.11
78.0	383,892	8.81	752,498	17.27	1,759,318	40.39
80.0	399,413	9.17	783,254	17.98	2,542,572	58.37
82.0	415,220	9.53	814,582	18.70	3,357,154	77.07
84.0	431,313	9.90	846,482	19.43	4,203,636	96.50
86.0	447,691	10.28	878,953	20.18	5,082,589	116.68
88.0	464,356	10.66	911,996	20.94	5,994,585	137.62
90.0	481,306	11.05	945,611	21.71	6,940,196	159.32
92.0	498,542	11.44	979,798	22.49	7,919,994	181.82
94.0	516,080	11.85	1,014,572	23.29	8,934,567	205.11

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

Elevation (ft MSL)	Σ Volume (acre-ft)
67.5	0
68.0	0.03
70.0	1.81
72.0	7.62
74.0	20.68
76.0	43.43
78.0	78.88
80.0	125.75
82.0	174.71
84.0	225.80
86.0	279.06
88.0	334.53
90.0	392.25
92.0	452.25
94.0	514.57

Volume required per HEC-HMS model:

Pond Name	Volume (acre-ft)
E1	80.2
E2	86.1
E4	8.7
Σ Volume	175.0

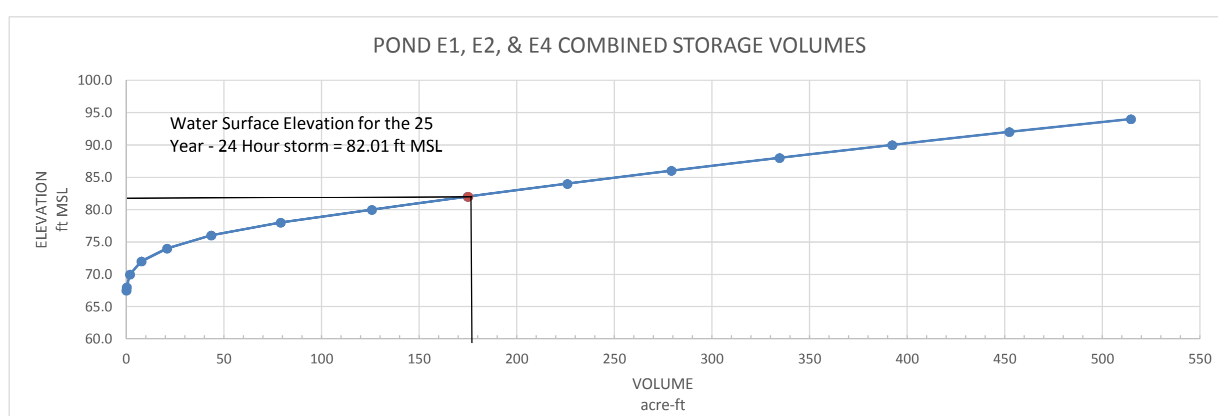
Next, the water surface elevation of the peak volume for the 25 year - 24 hour storm event. The peak volume is calculated using the HEC-HMS program.
The water surface elevation is calculated by interpolation based on the stage storage table.

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

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

25 year - 24 hour storm event
Peak Volume = 175.00 ac-ft
Water Surface Elevation = **82.01** 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 2E: POND E3 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 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)
62.8	0	0.00	0	0	0	0
64.0	36,899	0.85	14,760	0.34	14,760	0.34
66.0	263,730	6.05	266,184	6.11	280,944	6.45
68.0	462,503	10.62	716,990	16.46	997,934	22.91
70.0	478,420	10.98	940,878	21.60	1,938,812	44.51
72.0	494,599	11.35	972,974	22.34	2,911,786	66.85
74.0	511,041	11.73	1,005,595	23.09	3,917,381	89.93
76.0	527,745	12.12	1,038,741	23.85	4,956,122	113.78
78.0	544,712	12.50	1,072,413	24.62	6,028,535	138.40
80.0	561,942	12.90	1,106,610	25.40	7,135,145	163.80
82.0	579,435	13.30	1,141,332	26.20	8,276,477	190.00
84.0	597,190	13.71	1,176,580	27.01	9,453,057	217.01
86.0	615,208	14.12	1,212,353	27.83	10,665,410	244.84
88.0	633,488	14.54	1,248,651	28.66	11,914,061	273.51
90.0	652,031	14.97	1,285,475	29.51	13,199,535	303.02
92.0	670,837	15.40	1,322,823	30.37	14,522,359	333.39
94.0	689,909	15.84	1,360,702	31.24	14,560,237	334.26

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.

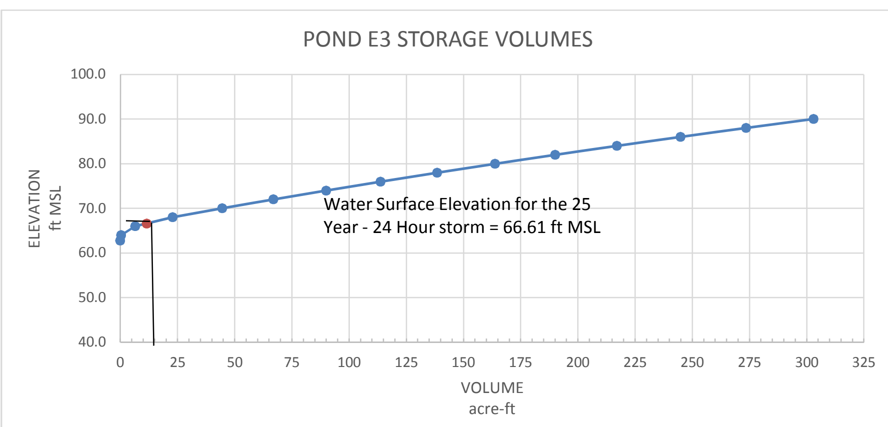
$$y_2 = \frac{(x_2 - x_1)(y_3 - y_1)}{(x_3 - x_1)} + y_1$$

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

25 year - 24 hour storm event
Peak Volume = 11.5 ac-ft
Water Surface Elevation = **66.61** ft MSL

References:

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



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HIDALGO COUNTY, TEXAS
PROJECT NO.: 1401491

Table 3
Channel Hydraulic Calculations

Date:	7/15/17
By:	VJE
Chkd:	MX
Apprvd:	CGD

			Channel Design Geometry						Channel Roughness Parameters			Hydraulic Calculations							Channel Evaluations	
Reach Designation	Q (cfs)	Storm Event	Approximate Channel Length (ft)	Bed Slope (ft/ft)	Left Side Slope (H:1V)	Right Side Slope (H:1V)	Bottom Width (ft)	Minimum Channel Depth (ft)		Design Channel Lining	Mannings 'n'	Maximum Velocity (ft/sec)	Maximum Normal Flow Depth (ft)	Froude Number	Normal Depth Shear Stress (lb/ft^2)	Stream Power (W/m^2)	Top Width of Flow (ft)	Top Width of Channel (ft)	Available Freeboard (ft)	
Perimeter Channels																				
C1.A	20.2	25yr	610	0.0010	3.0	3.0	8.00	2.40	GL	Grass-lined	0.035	1.3	1.30	0.23	0.08	1.54	15.8	22.4	1.10	
C1.B	58.5	25yr	842	0.0010	3.0	3.0	8.00	3.30	GL	Grass-lined	0.035	1.8	2.26	0.25	0.14	3.59	21.5	27.8	1.04	
C1.C	95.3	25yr	1157	0.0010	3.0	3.0	8.00	4.00	GL	Grass-lined	0.035	2.0	2.87	0.26	0.18	5.20	25.2	32.0	1.13	
C2.A	22.4	25yr	855	0.0010	3.0	3.0	9.00	2.40	GL	Grass-lined	0.035	1.3	1.31	0.23	0.08	1.57	16.9	23.4	1.09	
C2.B	123.5	25yr	1015	0.0010	3.0	3.0	20.00	3.40	GL	Grass-lined	0.035	2.0	2.31	0.26	0.14	4.15	33.9	40.4	1.09	
C2.C	242.5	25yr	1015	0.0010	3.0	3.0	20.00	4.40	GL	Grass-lined	0.035	2.4	3.33	0.27	0.21	7.32	40.0	46.4	1.07	
C2.D	351.0	25yr	1020	0.0010	3.0	3.0	17.50	5.30	GL	Grass-lined	0.035	2.7	4.25	0.28	0.27	10.50	43.0	49.3	1.05	
C2.E	547.3	25yr	2167	0.0010	3.0	3.0	15.00	6.40	GL	Grass-lined	0.035	3.1	5.56	0.29	0.35	15.63	48.4	53.4	0.84	
C3.A	141.4	25yr	1117	0.0010	3.0	3.0	15.00	4.00	GL	Grass-lined	0.035	2.1	2.82	0.26	0.18	5.46	31.9	39.0	1.18	
C3.B	218.0	25yr	1425	0.0010	3.0	3.0	11.00	5.11	GL	Grass-lined	0.035	2.5	3.90	0.27	0.24	8.69	34.4	41.7	1.21	
C3.C	392.5	25yr	2120	0.0010	3.0	3.0	15.00	5.55	GL	Grass-lined	0.035	2.8	4.73	0.28	0.30	12.17	43.4	48.3	0.82	
C4.A	13.4	25yr	678	0.0010	3.0	3.0	0.00	3.10	GL	Grass-lined	0.035	1.2	1.89	0.23	0.12	2.14	11.3	18.6	1.21	
C4.B	555.5	25yr	376	0.0030	3.0	3.0	30.00	3.90	GL	Grass-lined	0.035	4.3	3.23	0.47	0.60	38.00	49.4	53.4	0.67	
C5.A	202.0	25yr	172	0.0015	3.0	3.0	20.00	4.30	GL	Grass-lined	0.035	2.7	2.71	0.32	0.25	9.75	36.2	45.8	1.59	
C5.B	403.9	25yr	247	0.0015	3.0	3.0	20.00	4.65	GL	Grass-lined	0.035	3.2	3.92	0.34	0.37	17.27	43.5	47.9	0.73	
C5.C	523.5	25yr	1291	0.0015	3.0	3.0	20.00	5.00	GL	Grass-lined	0.035	3.5	4.48	0.34	0.42	21.26	46.9	50.0	0.52	
C6.A	18.6	25yr	722	0.0010	3.0	3.0	0.00	3.40	GL	Grass-lined	0.035	1.4	2.14	0.23	0.13	2.62	12.8	20.4	1.26	
C6.B	34.0	25yr	720	0.0010	3.0	3.0	0.00	4.00	GL	Grass-lined	0.035	1.6	2.68	0.24	0.17	3.83	16.1	24.0	1.32	
C6.C	36.6	25yr	280	0.0010	3.0	3.0	0.00	4.10	GL	Grass-lined	0.035	1.6	2.76	0.24	0.17	4.01	16.5	24.6	1.34	
C7.A	33.6	25yr	1771	0.0010	3.0	3.0	0.00	4.10	GL	Grass-lined	0.035	1.6	2.67	0.24	0.17	3.80	16.0	24.6	1.43	
Add-on Berm	30.5	25-yr	1188	0.020	2.0	4.0	0	2.0	GL	Grass-lined	0.035	4.70	1.47	0.97	1.83	125.20	8.82	12.00	0.53	
with largest contributing area																				
Downchute Channels																				
DC-1	46.8	25yr	1120	0.177	2.0	2.0	5	2.0	PL	Plastic	0.012	23.52	0.35	7.43	3.86	1315.81	6.40	13.00	1.65	
DC-2	25.2	25yr	420	0.250	2.0	2.0	5	2.0	PL	Plastic	0.012	21.13	0.22	8.27	3.42	1048.55	5.88	13.00	1.78	
DC-3	119.7	25yr	1120	0.177	2.0	2.0	5	2.0	PL	Plastic	0.012	32.14	0.60	7.99	6.63	3092.61	7.40	13.00	1.40	
DC-4	210.9	25yr	720	0.250	2.0	2.0	5	2.0	PL	Plastic	0.012	43.24	0.75	9.76	11.70	7341.78	8.00	13.00	1.25	
DC-5	198.3	25yr	720	0.250	2.0	2.0	5	2.0	PL	Plastic	0.012	42.42	0.72	9.72	11.31	6957.74	7.90	13.00	1.28	
DC-6	191.9	25yr	1054	0.250	2.0	2.0	5	2.0	PL	Plastic	0.012	41.99	0.71	9.70	11.10	6760.97	7.85	13.00	1.29	
DC-7	91.5	25yr	1083	0.177	2.0	2.0	5	2.0	PL	Plastic	0.012	29.46	0.52	7.83	5.69	2431.09	7.06	13.00	1.48	
DC-8	142.0	25yr	1093	0.177	2.0	2.0	5	2.0	PL	Plastic	0.012	33.94	0.66	8.08	7.31	3597.81	7.65	13.00	1.34	
DC-9	184.4	25yr	1216	0.192	2.0	2.0	5	2.0	PL	Plastic	0.012	37.87	0.75	8.55	8.98	4931.46	8.00	13.00	1.25	
DC-10	247.4	25yr	1060	0.250	2.0	2.0	5	2.0	PL	Plastic	0.012	45.42	0.82	9.87	12.80	8430.88	8.28	13.00	1.18	
DC-11	118.1	25yr	1810	0.160	2.0	2.0	5	2.0	PL	Plastic	0.012	30.92	0.61	7.61	6.12	2746.88	7.45	13.00	1.39	
DC-12	225.1	25yr	720	0.250	2.0	2.0	5	2.0	PL	Plastic	0.012	44.12	0.78	9.81	12.14	7769.47	8.11	13.00	1.22	
DC-13	114.7	25yr	720	0.250	2.0	2.0	5	2.0	PL	Plastic	0.012	35.63	0.53	9.34	8.28	4281.64	7.12	13.00	1.47	
DC-14	114.7	25yr	720	0.250	2.0	2.0	5	2.0	PL	Plastic	0.012	35.63	0.53	9.34	8.28	4281.64	7.12	13.00	1.47	
DC-15	85.0	25yr	731	0.250	2.0	2.0	5	2.0	PL	Plastic	0.012	32.27	0.45	9.13	6.97	3263.61	6.79	13.00	1.55	

CITY OF EDINBURG
EDINBURG REGIONAL DISPOSAL FACILITY
PROJECT NO. 1401491

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

TABLE 4. RUN-OFF VELOCITY CALCULATIONS

HYDROLOGIC PARAMETERS

DESIGN STORM: 25-YEAR 24-HOUR

STORM DURATION (hours)
24

RUN-OFF CONTROL POINTS		Q (cfs)	SHEET/OVERLAND FLOW				SHALLOW CONCENTRATED FLOW			MANNINGS CHANNEL FLOW						
			SURFACE CONDITION[a]	LENGTH (ft)	SLOPE (ft/ft)	ESTIMATED VELOCITY (fps)	SURFACE CONDITION[a]	SLOPE (ft/ft)	ESTIMATED VELOCITY (fps)	MANNINGS n	BOTTOM WIDTH (ft)	SIDE SLOPE (H:1V)	APPROXIMATE CHANNEL DEPTH (ft)	SLOPE (ft/ft)	ESTIMATED NORMAL FLOW DEPTH (FT)	ESTIMATED VELOCITY (fps)
Pre-Dev	CP-3	32.5	-	-	-	-	U	0.02	2.3	-	-	-	-	-	-	-
	CP-9	19.6	-	-	-	-	U	0.01	1.6	-	-	-	-	-	-	-

a. An "F" surface condition reflects dense grass conditions. A "U" surface condition reflects unpaved conditions.

TR-55 (1986)

Sheet Flow Velocity

Flow Velocity (ft/sec) = L/(3600T_t)

Where:

T_t = travel time (hrs); n' = roughness coefficient;
P_2 = 2-yr storm depth (inches); s = slope (ft/ft)
L = flow length (ft);

$$T_t = \frac{0.007\,(n'\,L)^{0.8}}{(P_2)^{0.5}\,S^{0.4}}$$

Note: Roughness coefficient for Surface Type F (dense grass) = 0.024

Shallow Concentrated Flow Velocity

Flow Velocity (ft/sec) = $mS^{0.5}$

Where:

m = roughness coeffient
S = slope (ft/ft)

Note: Roughness coefficient for Surface Type U (unpaved) = 16.1345

Channel Flow velocities obtained using Manning's Equation

Table 5
Time of Concentration and Mannings Flow Coefficients

TR-55 (1986)

Sheet Flow Travel time (SCS Upland Method)

$$T_t = \frac{0.007\,(n'\,L)^{0.8}}{(P_2)^{0.5}\,S^{0.4}}$$

Where: T_t = travel time (hr); n' = roughness coefficient; L = flow length (ft);
P_2 = 2-yr storm depth (inches); s = slope (ft/ft)
flow velocity = L/(60T_t)

Flow Type	Surface Type	roughness n	Surface Description	Short Description
Sheet/Overland Flow	A	0.011	Smooth surfaces (concrete, asphalt, gravel, bare soil)	Smooth
	B	0.05	Fallow (no residue)	Fallow
	C	0.06	Cultivated soils: Residue cover <= 20%	Cover<20%
	D	0.17	Cultivated soils: Residue cover > 20%	Cover>20%
	E	0.15	Grass: Short grass prairie	Short Grass
	F	0.24	Grass: Dense grasses	Dense Grass
	G	0.41	Grass: Bermuda grass	Bermuda Grass
	H	0.13	Range (natural)	Range
	I	0.40	Woods: Light underbrush	Light woods
	J	0.80	Woods: Heavy underbrush	Heavy Woods

Shallow Concentrated Flow Velocity (SCS Upland Method)

$v = mS^{0.5}$

Where: v = velocity (fps); m = roughness coeffient; S = slope (ft/ft)

Flow Type	Surface Type	Roughness m	Surface Description	Short Description
Shallow Conc. Flow	P	20.3282	Paved Surfaces	Paved
	U	16.1345	Unpaved Surfaces	Unpaved

Channel Flow Velocity (Mannings Velocity)

$v = 1.49/n\ Rh^{2/3}S^{1/2}$

Where: v = velocity (fps); n = roughness coeffient; Rh = Hydraulic Radius (ft), S = slope (ft/ft)

Lining Type	Mannings n for Depth	Mannings n for Velocity	Material	Maximum Velocity	Maximum Shear Stress
A	0.026	0.026	ACB	25	
C	0.024	0.020	CSP	50	
E	0.025	0.022	Earth-lined	3	
G	0.035	0.030	Grass-lined	5	
I	0.017	0.013	Ductile Iron	50	
P	0.012	0.009	Plastic	25	
R	0.040	0.035	Riprap	15	
T	0.035	0.030	Turf Reinf.	10	1.5
Z	0.060	0.005	Other	25	

APPENDIX III-2A

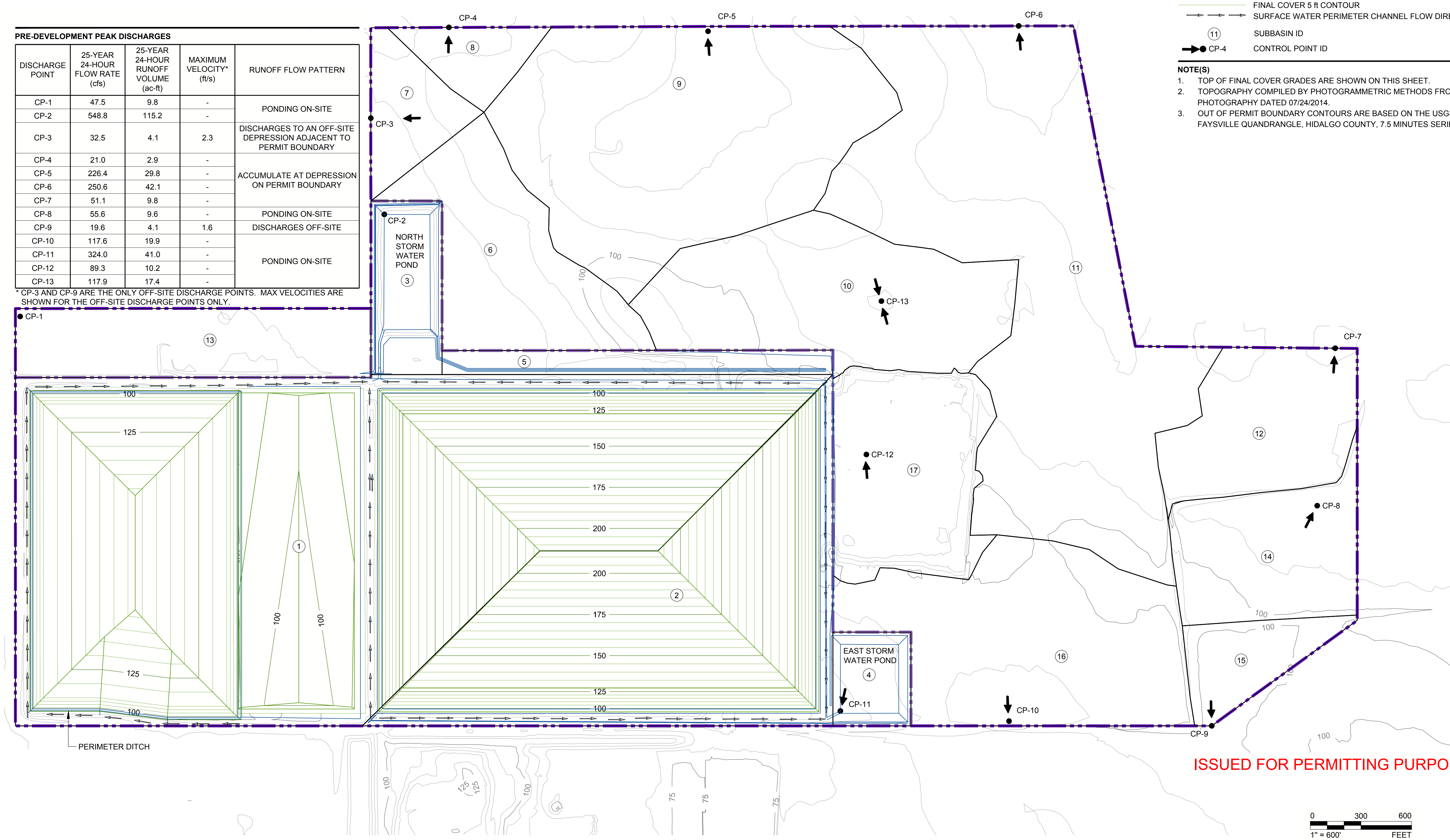
FIGURES

SITE

PRE-DEVELOPMENT PEAK DISCHARGES

DISCHARGE POINT	25-YEAR 24-HOUR FLOW RATE (cfs)	25-YEAR 24-HOUR RUNOFF VOLUME (ac-ft)	MAXIMUM VELOCITY* (ft/s)	RUNOFF FLOW PATTERN
CP-1	47.5	9.8	-	PONDING ON-SITE
CP-2	548.8	115.2	-	
CP-3	32.5	4.1	2.3	DISCHARGES TO AN OFF-SITE DEPRESSION ADJACENT TO PERMIT BOUNDARY
CP-4	21.0	2.9	-	ACCUMULATE AT DEPRESSION ON PERMIT BOUNDARY
CP-5	226.4	29.8	-	
CP-6	250.6	42.1	-	
CP-7	51.1	9.8	-	
CP-8	55.6	9.6	-	PONDING ON-SITE
CP-9	19.6	4.1	1.6	DISCHARGES OFF-SITE
CP-10	117.6	19.9	-	PONDING ON-SITE
CP-11	324.0	41.0	-	
CP-12	89.3	10.2	-	
CP-13	117.9	17.4	-	

* CP-3 AND CP-9 ARE THE ONLY OFF-SITE DISCHARGE POINTS. MAX VELOCITIES ARE SHOWN FOR THE OFF-SITE DISCHARGE POINTS ONLY.



LEGEND

- PERMIT BOUNDARY
- EXISTING GROUND 25 ft CONTOUR
- EXISTING GROUND 5 ft CONTOUR
- FINAL COVER 25 ft CONTOUR
- FINAL COVER 5 ft CONTOUR
- SURFACE WATER PERIMETER CHANNEL 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.
3. OUT OF PERMIT BOUNDARY CONTOURS ARE BASED ON THE USGS TOPO MAP, FAYSVILLE QUADRANGLE, HIDALGO COUNTY, 7.5 MINUTES SERIES.

ISSUED FOR PERMITTING PURPOSES ONLY

0 300 600
1" = 600' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
0	2017-07-21	PERMIT AMENDMENT APPLICATION SUBMITTAL	VJE	TNB	MX	CGD

SEAL
STATE OF TEXAS
CHARLES G. DOMINGUEZ
83247
LICENSED 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

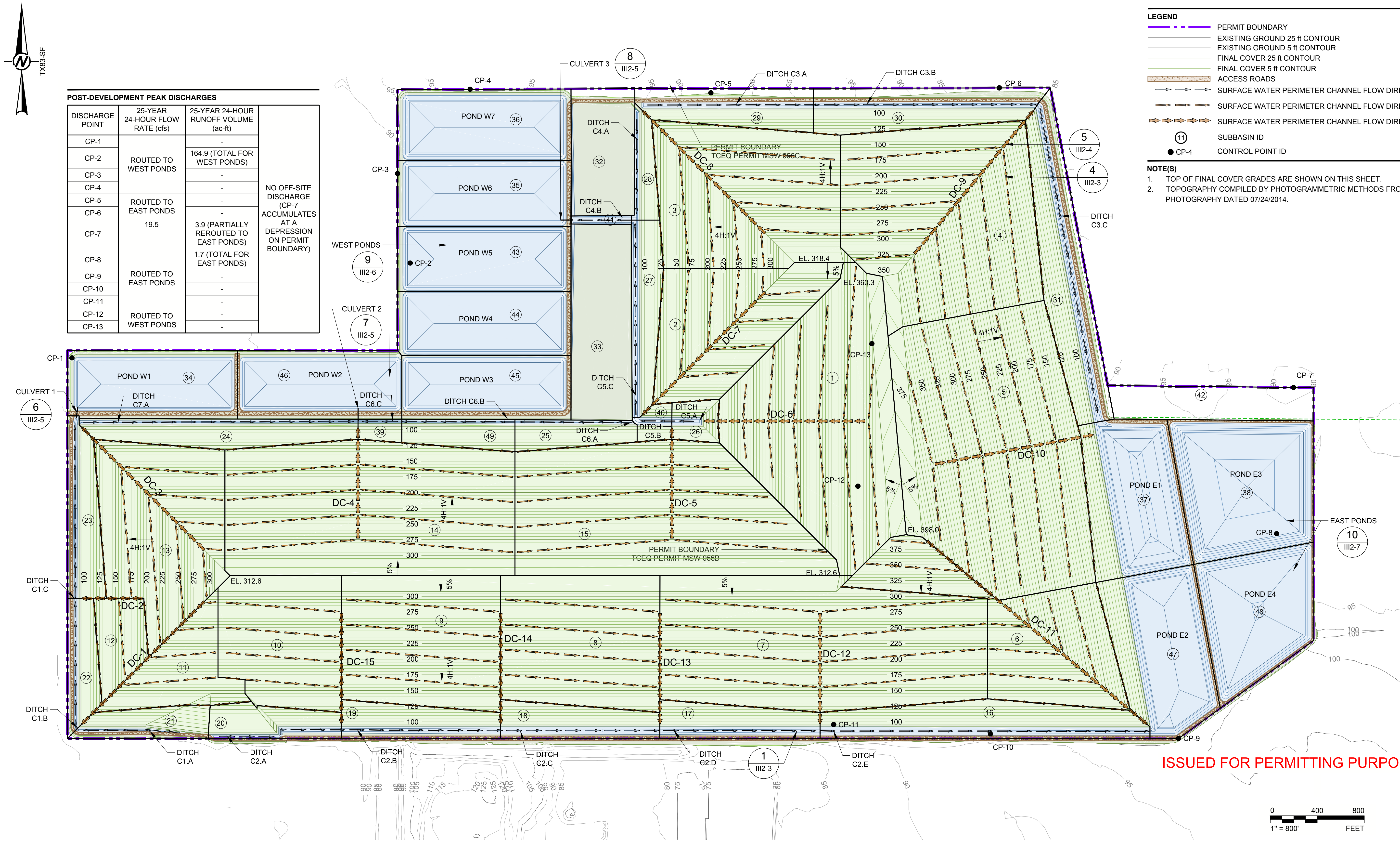
PROJECT
EDINBURG REGIONAL DISPOSAL FACILITY
PERMIT AMENDMENT APPLICATION TCEQ PERMIT MSW-956C
EDINBURG, HIDALGO COUNTY, TEXAS

TITLE
PRE-DEVELOPMENT DRAINAGE PLAN

PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2A	0	1 of 2	III2A-1

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
- SURFACE WATER PERIMETER CHANNEL FLOW DIRECTION
- SURFACE WATER PERIMETER CHANNEL 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.

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
----	----	----				
0	2017-07-21	PERMIT AMENDMENT APPLICATION SUBMITTAL	TNB	VJE	MX	CGD

SEAL

STATE OF TEXAS
CHARLES G. DOMINGUEZ
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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		0	2 of 2	III2A-2

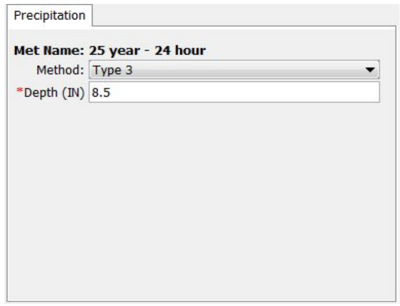
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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

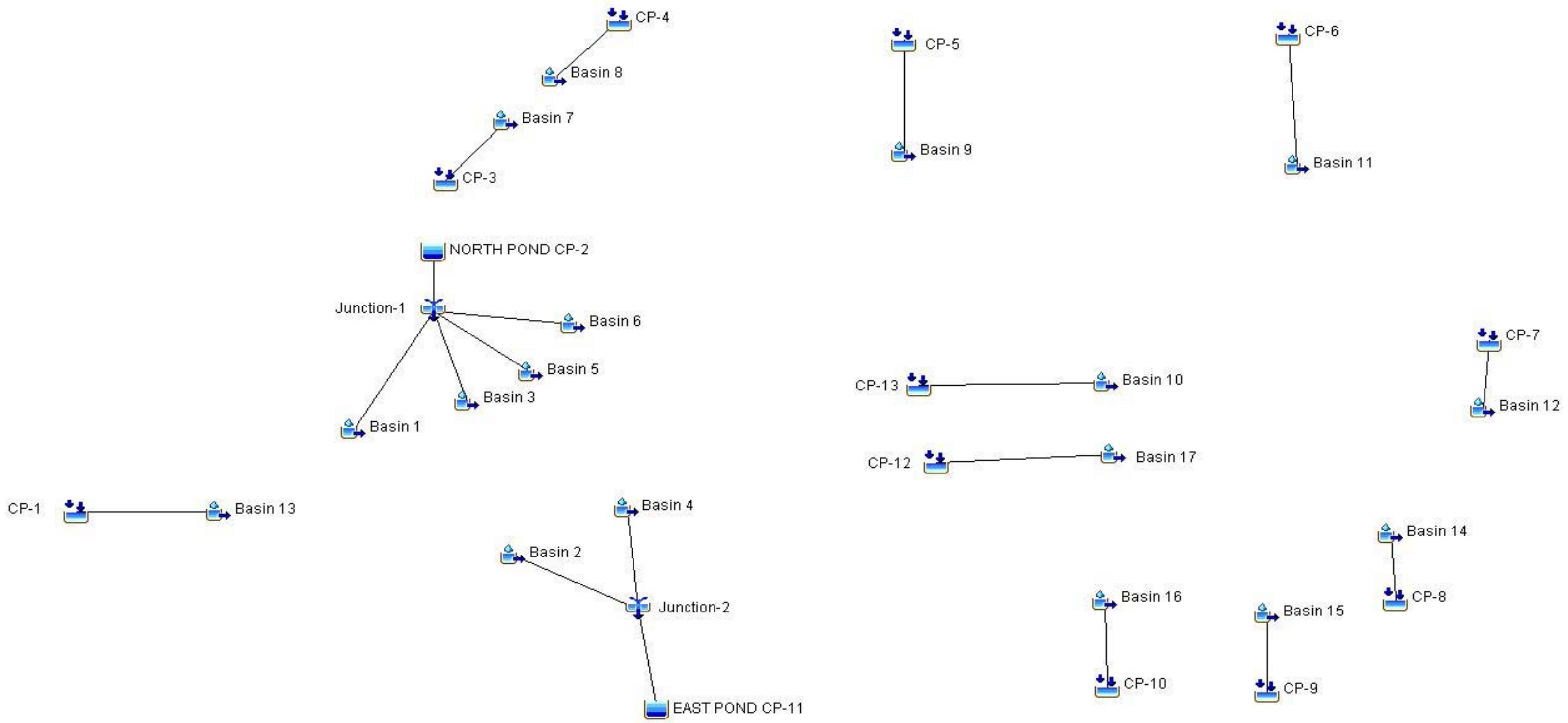
APPENDIX III-2A-1

HEC-HMS INPUT AND OUTPUT

Precipitation Input
25-year, 24-hour and 100-year, 24-hour Storm Events



PRE-DEVELOPMENT



Basin: Pre-Development
Last Modified Date: 6 April 2016
Last Modified Time: 13:56:49
Version: 4.0
Filepath Separator: \
Unit System: English
Missing Flow To Zero: No
Enable Flow Ratio: No
Compute Local Flow At Junctions: No

Enable Sediment Routing: No

Enable Quality Routing: No
End:

Subbasin: Basin 1
Canvas X: -3997.6415094339627
Canvas Y: 141.50943396226376
Area: 0.2563
Downstream: Junction-1

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 44.4
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Basin 6
Canvas X: -1780.6603773584902
Canvas Y: 1273.5849056603774
Area: 0.0379
Downstream: Junction-1

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 79

Transform: SCS
Lag: 26.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Basin 3
Canvas X: -2853.7735849056608
Canvas Y: 448.1132075471696
Label X: 0.0
Label Y: 1.0
Area: 0.0155
Downstream: Junction-1

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Basin 5
Canvas X: -2205.1886792452833
Canvas Y: 754.7169811320755
Area: 0.0118
Downstream: Junction-1

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 92

Transform: SCS
Lag: 15.8
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: Junction-1
Canvas X: -3195.7547169811323
Canvas Y: 1415.0943396226417
Label X: -91.0
Label Y: 0.0
Downstream: NORTH POND CP-2
End:

Reservoir: NORTH POND CP-2
Canvas X: -3195.7547169811323
Canvas Y: 2051.8867924528304

Route: None
End:

Subbasin: Basin 11
Canvas X: 5554.245283018869
Canvas Y: 2983.490566037736
Area: 0.1321
Downstream: CP-6

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 79

Transform: SCS
Lag: 34.4
Unitgraph Type: STANDARD

Baseflow: None
End:

Sink: CP-6
Canvas X: 5471.698113207547
Canvas Y: 4398.584905660377
End:

Subbasin: Basin 2
Canvas X: -2382.0754716981137
Canvas Y: -1214.6226415094343
Area: 0.1033
Downstream: Junction-2

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 16.3
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Basin 4
Canvas X: -1226.4150943396226
Canvas Y: -707.5471698113206
Label X: -1.0
Label Y: 0.0
Area: 0.0092
Downstream: Junction-2

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 98
Initial Abstraction: 0

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: Junction-2
Canvas X: -1120.2830188679245
Canvas Y: -1792.4528301886794
Label X: 4.0
Label Y: -1.0
Downstream: EAST POND CP-11
End:

Reservoir: EAST POND CP-11
Canvas X: -931.6037735849059
Canvas Y: -2877.3584905660373
Label X: 0.0
Label Y: -1.0

Route: None
End:

Subbasin: Basin 9
Canvas X: 1580.1886792452824
Canvas Y: 3125.0
Area: 0.0936
Downstream: CP-5

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0

Curve Number: 79

Transform: SCS
Lag: 21.2
Unitgraph Type: STANDARD

Baseflow: None
End:

Sink: CP-5
Canvas X: 1580.1886792452824
Canvas Y: 4339.622641509434
Label X: 4.0
Label Y: -6.0
End:

Subbasin: Basin 16
Canvas X: 3608.4905660377353
Canvas Y: -1709.9056603773588
Label X: 0.0
Label Y: 1.0
Area: 0.0623
Downstream: CP-10

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 79

Transform: SCS
Lag: 34.7
Unitgraph Type: STANDARD

Baseflow: None
End:

Sink: CP-10
Canvas X: 3632.0754716981137
Canvas Y: -2629.7169811320755
End:

Subbasin: Basin 10
Canvas X: 3620.2830188679236
Canvas Y: 648.5849056603774
Area: 0.0545
Downstream: CP-13

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 79

Transform: SCS
Lag: 26.8
Unitgraph Type: STANDARD

Baseflow: None
End:

Sink: CP-13
Canvas X: 1721.698113207547
Canvas Y: 625.0
Label X: -64.0
Label Y: -3.0
End:

Subbasin: Basin 13
Canvas X: -5365.566037735849
Canvas Y: -742.9245283018872
Area: 0.0308
Downstream: CP-1

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 79

Transform: SCS
Lag: 49.0
Unitgraph Type: STANDARD

Baseflow: None
End:

Sink: CP-1
Canvas X: -6804.245283018868
Canvas Y: -742.9245283018872
Label X: -68.0
Label Y: 0.0
End:

Subbasin: Basin 17
Canvas X: 3702.830188679245
Canvas Y: -129.7169811320755
Label X: 5.0
Label Y: -5.0
Area: 0.0382
Downstream: CP-12

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 71

Transform: SCS
Lag: 15.8
Unitgraph Type: STANDARD

Baseflow: None
End:

Sink: CP-12
Canvas X: 1898.5849056603765
Canvas Y: -212.2641509433961
Label X: -68.0
Label Y: -3.0
End:

Subbasin: Basin 12
Canvas X: 7441.037735849057
Canvas Y: 365.566037735849
Area: 0.0309
Downstream: CP-7

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 79

Transform: SCS
Lag: 43.7
Unitgraph Type: STANDARD

Baseflow: None
End:

Sink: CP-7
Canvas X: 7500.0
Canvas Y: 1096.698113207547
Label X: 0.0
Label Y: 2.0
End:

Subbasin: Basin 14
Canvas X: 6509.433962264151
Canvas Y: -990.566037735849
Area: 0.0302
Downstream: CP-8

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 79

Transform: SCS
Lag: 36.3
Unitgraph Type: STANDARD

Baseflow: None
End:

Sink: CP-8
Canvas X: 6556.603773584906
Canvas Y: -1698.1132075471696
End:

Subbasin: Basin 15
Canvas X: 5247.641509433963
Canvas Y: -1851.4150943396226
Area: 0.0129
Downstream: CP-9

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 79

Transform: SCS
Lag: 50.0
Unitgraph Type: STANDARD

Baseflow: None
End:

Sink: CP-9
Canvas X: 5247.641509433963
Canvas Y: -2676.8867924528304
End:

Subbasin: Basin 7
Canvas X: -2452.830188679245
Canvas Y: 3466.9811320754716
Area: 0.0128
Downstream: CP-3

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 79

Transform: SCS
Lag: 19.0
Unitgraph Type: STANDARD

Baseflow: None
End:

Sink: CP-3
Canvas X: -3066.037735849057
Canvas Y: 2830.188679245283
Label X: 0.0
Label Y: -1.0
End:

Subbasin: Basin 8
Canvas X: -1969.3396226415098
Canvas Y: 3926.8867924528304
Label X: 0.0
Label Y: 2.0
Area: 0.0092
Downstream: CP-4

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 79

Transform: SCS
Lag: 24.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Sink: CP-4
Canvas X: -1308.9622641509432
Canvas Y: 4551.88679245283
End:

Basin Schematic Properties:
Last View N: 5000.0
Last View S: -5000.0
Last View W: -5000.0
Last View E: 5000.0
Maximum View N: 5000.0
Maximum View S: -5000.0
Maximum View W: -5000.0
Maximum View E: 5000.0
Extent Method: Elements
Buffer: 0
Draw Icons: Yes
Draw Icon Labels: Name
Draw Map Objects: No
Draw Gridlines: No
Draw Flow Direction: No
Fix Element Locations: Yes
Fix Hydrologic Order: No
End:

Pre-Development

HMS Element	Control Point	25-Year 24-Hour Peak Flow (cfs)	25-Year 24-Hour Volume (ac-ft)	Drainage Area (sq mi)
CP-1	CP-1	47.5	9.8	0.031
NORTH POND CP-2	CP-2	548.8	115.2	0.322
CP-3	CP-3	32.5	4.1	0.013
CP-4	CP-4	21.0	2.9	0.009
CP-5	CP-5	226.4	29.8	0.094
CP-6	CP-6	250.6	42.1	0.132
CP-7	CP-7	51.1	9.8	0.031
CP-8	CP-8	55.6	9.6	0.030
CP-9	CP-9	19.6	4.1	0.013
CP-10	CP-10	117.6	19.9	0.062
EAST POND CP-11	CP-11	324.0	41.0	0.113
CP-12	CP-12	89.3	10.2	0.038
CP-13	CP-13	117.9	17.4	0.055

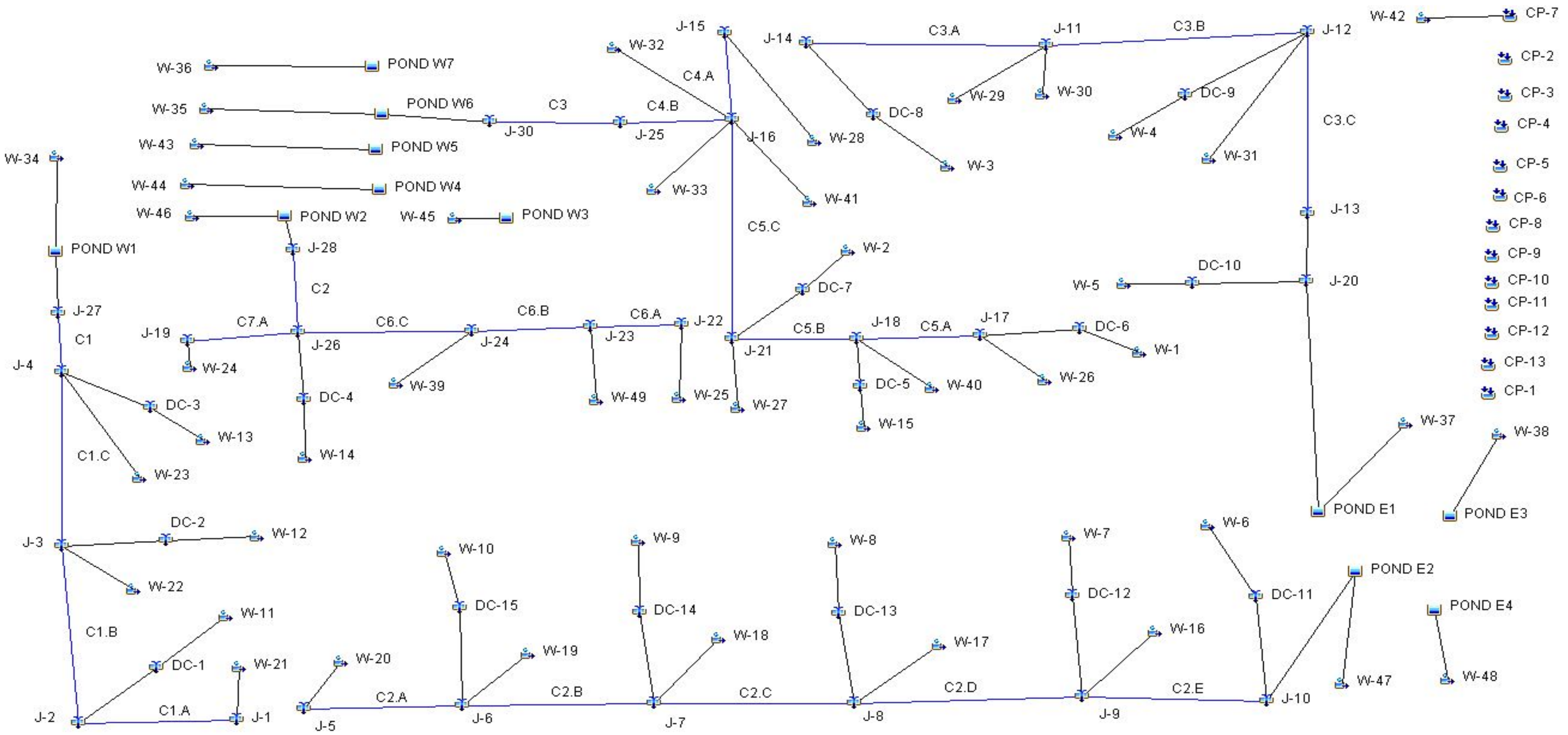
HEC-HMS Summary of Results

Pre-Development, 25-yr 24-hr Results

Start of Run:	01 Jan 2040, 00:00		Basin Model:	Pre-Development
End of Run:	03 Jan 2040, 00:01		Met. Model:	25 year - 24 hourr
			Control Specs:	48 hour - 1 minute

Hydrologic Element	Drainage Area (mi sq)	Discharge Peak (cfs)	Time of Peak	Volume (ac-ft)
Basin 1	0.256	461.8	01Jan2040, 12:47	91.5
Basin 6	0.038	81.8	01Jan2040, 12:30	12.1
Basin 3	0.016	79.8	01Jan2040, 12:01	6.8
Basin 5	0.012	38.4	01Jan2040, 12:17	4.7
Junction-1	0.322	548.8	01Jan2040, 12:43	115.2
NORTH POND CP-2	0.322	548.8	01Jan2040, 12:43	115.2
Basin 11	0.132	250.6	01Jan2040, 12:38	42.1
CP-6	0.132	250.6	01Jan2040, 12:38	42.1
Basin 2	0.103	307.8	01Jan2040, 12:18	36.9
Basin 4	0.009	47.4	01Jan2040, 12:01	4.1
Junction-2	0.113	324.0	01Jan2040, 12:18	41.0
EAST POND CP-11	0.113	324.0	01Jan2040, 12:18	41.0
Basin 9	0.094	226.4	01Jan2040, 12:24	29.8
CP-5	0.094	226.4	01Jan2040, 12:24	29.8
Basin 16	0.062	117.6	01Jan2040, 12:38	19.9
CP-10	0.062	117.6	01Jan2040, 12:38	19.9
Basin 10	0.055	117.9	01Jan2040, 12:30	17.4
CP-13	0.055	117.9	01Jan2040, 12:30	17.4
Basin 13	0.031	47.5	01Jan2040, 12:53	9.8
CP-1	0.031	47.5	01Jan2040, 12:53	9.8
Basin 17	0.038	89.3	01Jan2040, 12:18	10.2
CP-12	0.038	89.3	01Jan2040, 12:18	10.2
Basin 12	0.031	51.1	01Jan2040, 12:47	9.8
CP-7	0.031	51.1	01Jan2040, 12:47	9.8
Basin 14	0.030	55.6	01Jan2040, 12:40	9.6
CP-8	0.030	55.6	01Jan2040, 12:40	9.6
Basin 15	0.013	19.6	01Jan2040, 12:54	4.1
CP-9	0.013	19.6	01Jan2040, 12:54	4.1
Basin 7	0.013	32.5	01Jan2040, 12:21	4.1
CP-3	0.013	32.5	01Jan2040, 12:21	4.1
Basin 8	0.009	21.0	01Jan2040, 12:27	2.9
CP-4	0.009	21.0	01Jan2040, 12:27	2.9

POST-DEVELOPMENT



C:\Users\KCrowe\SharePoint\1401491, City of Edinburg Per - Doc\Application\Part III\III2 Surface Water Drainage Report\III2A Detailed Drainage Calculations\ATT A\HMS input output rev July 2017.xlsm Post-D HMS Graphic
Revised 7/22/2017

Basin: Post-Development
Last Modified Date: 15 July 2017
Last Modified Time: 20:30:41
Version: 4.0
Filepath Separator: \
Unit System: English
Missing Flow To Zero: No
Enable Flow Ratio: No
Compute Local Flow At Junctions: No

Enable Sediment Routing: No

Enable Quality Routing: No
End:

Subbasin: W-10
Canvas X: -3113.2075471698117
Canvas Y: -1438.6792452830186
Area: 0.0225
Downstream: DC-15

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 8.3
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-15
Canvas X: -2948.1132075471696
Canvas Y: -2087.264150943396
Downstream: J-6
End:

Subbasin: W-19
Canvas X: -2228.7735849056608
Canvas Y: -2606.132075471698
Area: 0.0075
Downstream: J-6

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 88

Transform: SCS
Lag: 11.6
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: W-20
Canvas X: -4198.11320754717
Canvas Y: -2688.6792452830186
Area: 0.0060
Downstream: J-5

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 87

Transform: SCS
Lag: 9.4
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-5
Canvas X: -4599.056603773585
Canvas Y: -3231.132075471698
Label X: -3.0
Label Y: -18.0
Downstream: C2.A
End:

Reach: C2.A
Canvas X: -2924.528301886792
Canvas Y: -3195.7547169811314
From Canvas X: -4599.056603773585
From Canvas Y: -3231.132075471698
Label X: -19.0
Label Y: 6.0
Downstream: J-6

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 855
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 9

Side Slope: 3
Channel Loss: None
End:

Junction: J-6
Canvas X: -2924.528301886792
Canvas Y: -3195.7547169811314
Label X: -4.0
Label Y: -14.0
Downstream: C2.B
End:

Reach: C2.B
Canvas X: -908.0188679245284
Canvas Y: -3172.169811320755
From Canvas X: -2924.528301886792
From Canvas Y: -3195.7547169811314
Label X: -19.0
Label Y: 9.0
Downstream: J-7

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1015
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 20
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-9
Canvas X: -1073.1132075471696
Canvas Y: -1320.7547169811323
Area: 0.0302
Downstream: DC-14

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 8.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-14
Canvas X: -1049.5283018867922
Canvas Y: -2134.433962264151
Label X: -1.0
Label Y: 0.0
Downstream: J-7
End:

Subbasin: W-18
Canvas X: -224.05660377358436
Canvas Y: -2429.2452830188677
Area: 0.0075
Downstream: J-7

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 88

Transform: SCS
Lag: 11.7
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-7
Canvas X: -908.0188679245284
Canvas Y: -3172.169811320755
Label X: -3.0
Label Y: -20.0
Downstream: C2.C
End:

Reach: C2.C
Canvas X: 1202.830188679245
Canvas Y: -3172.169811320755
From Canvas X: -908.0188679245284
From Canvas Y: -3172.169811320755
Label X: -25.0
Label Y: 7.0
Downstream: J-8

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1015
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 20
Side Slope: 3
Channel Loss: None

End:

Subbasin: W-8
    Canvas X: 1002.3584905660373
    Canvas Y: -1344.3396226415098
    Area: 0.0302
    Downstream: DC-13

    Canopy: None
    Plant Uptake Method: None

    Surface: None

    LossRate: SCS
    Percent Impervious Area: 0.0
    Curve Number: 85

    Transform: SCS
    Lag: 8.1
    Unitgraph Type: STANDARD

    Baseflow: None
End:

Junction: DC-13
    Canvas X: 1037.735849056604
    Canvas Y: -2146.2264150943392
    Downstream: J-8
End:

Subbasin: W-17
    Canvas X: 2110.8490566037744
    Canvas Y: -2500.0
    Area: 0.0075
    Downstream: J-8

    Canopy: None
    Plant Uptake Method: None

    Surface: None

    LossRate: SCS
    Percent Impervious Area: 0.0
    Curve Number: 88

    Transform: SCS
    Lag: 11.4
    Unitgraph Type: STANDARD

    Baseflow: None
End:

Junction: J-8
    Canvas X: 1202.830188679245
    Canvas Y: -3172.169811320755
    Label X: -5.0
    Label Y: -14.0
    Downstream: C2.D
End:

Reach: C2.D
    Canvas X: 3608.4905660377353
    Canvas Y: -3101.4150943396226
    From Canvas X: 1202.830188679245
    From Canvas Y: -3172.169811320755
    Label X: -33.0
    Label Y: 9.0
    Downstream: J-9

    Route: Kinematic Wave
    Channel: Kinematic Wave
    Length: 1020
    Energy Slope: 0.001
    Shape: Trapezoid
    Mannings n: 0.035
    Number of Increments: 2
    Width: 17.5
    Side Slope: 3
    Channel Loss: None
End:

Subbasin: W-7
    Canvas X: 3466.9811320754725
    Canvas Y: -1261.7924528301883
    Area: 0.0586
    Downstream: DC-12

    Canopy: None
    Plant Uptake Method: None

    Surface: None

    LossRate: SCS
    Percent Impervious Area: 0.0
    Curve Number: 85

    Transform: SCS
    Lag: 7.8
    Unitgraph Type: STANDARD

    Baseflow: None
End:

Junction: DC-12
    Canvas X: 3502.3584905660373
    Canvas Y: -1945.7547169811323
    Downstream: J-9
End:

Subbasin: W-16
    Canvas X: 4386.792452830188
    Canvas Y: -2346.698113207547

Area: 0.0156
Downstream: J-9

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 88

Transform: SCS
Lag: 14.6
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-9
Canvas X: 3608.4905660377353
Canvas Y: -3101.4150943396226
Label X: 2.0
Label Y: -18.0
Downstream: C2.E
End:

Reach: C2.E
Canvas X: 5554.245283018869
Canvas Y: -3148.5849056603774
From Canvas X: 3608.4905660377353
From Canvas Y: -3101.4150943396226
Label X: -15.0
Label Y: 7.0
Downstream: J-10

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 2167
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 15
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-6
Canvas X: 4941.037735849057
Canvas Y: -1143.867924528302
Area: 0.0281
Downstream: DC-11

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 5.0
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-11
Canvas X: 5448.1132075471705
Canvas Y: -1957.5471698113206
Downstream: J-10
End:

Junction: J-10
Canvas X: 5554.245283018869
Canvas Y: -3148.5849056603774
Downstream: POND E2
End:

Subbasin: W-47
Canvas X: 6356.132075471698
Canvas Y: -2948.1132075471696
Area: 0.0213
Downstream: POND E2

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 96

Transform: SCS
Lag: 3.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND E2
Canvas X: 6497.641509433963
Canvas Y: -1674.5283018867922

Route: None
End:

Subbasin: W-3

Canvas X: 2193.396226415094
Canvas Y: 2959.905660377359
Label X: 4.0
Label Y: -2.0
Area: 0.0371
Downstream: DC-8

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 7.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-8
Canvas X: 1403.301886792453
Canvas Y: 3537.735849056604
Downstream: J-14
End:

Junction: J-14
Canvas X: 695.7547169811314
Canvas Y: 4363.207547169812
Label X: -48.0
Label Y: 2.0
Downstream: C3.A
End:

Reach: C3.A
Canvas X: 3231.132075471698
Canvas Y: 4339.622641509434
From Canvas X: 695.7547169811314
From Canvas Y: 4363.207547169812
Label X: -11.0
Label Y: 10.0
Downstream: J-11

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1117
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 15
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-30
Canvas X: 3195.7547169811314
Canvas Y: 3785.3773584905657
Area: 0.0131
Downstream: J-11

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 89

Transform: SCS
Lag: 11.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: W-29
Canvas X: 2264.1509433962256
Canvas Y: 3726.4150943396226
Area: 0.0095
Downstream: J-11

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 89

Transform: SCS
Lag: 8.4
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-11
Canvas X: 3231.132075471698
Canvas Y: 4339.622641509434
Label X: -6.0
Label Y: 13.0
Downstream: C3.B
End:

Reach: C3.B
Canvas X: 5990.566037735849

Canvas Y: 4492.924528301886
From Canvas X: 3231.132075471698
From Canvas Y: 4339.622641509434
Label X: -16.0
Label Y: 9.0
Downstream: J-12

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1425
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 11
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-4
Canvas X: 3962.264150943396
Canvas Y: 3313.6792452830186
Area: 0.0503
Downstream: DC-9

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 9.2
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-9
Canvas X: 4693.396226415094
Canvas Y: 3761.7924528301887
Downstream: J-12
End:

Subbasin: W-31
Canvas X: 4952.830188679245
Canvas Y: 3042.4528301886794
Area: 0.0185
Downstream: J-12

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 89

Transform: SCS
Lag: 7.8
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-12
Canvas X: 5990.566037735849
Canvas Y: 4492.924528301886
Downstream: C3.C
End:

Reach: C3.C
Canvas X: 5990.566037735849
Canvas Y: 2417.4528301886794
From Canvas X: 5990.566037735849
From Canvas Y: 4492.924528301886
Downstream: J-13

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 2120
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 15
Side Slope: 3
Channel Loss: None
End:

Junction: J-13
Canvas X: 5990.566037735849
Canvas Y: 2417.4528301886794
Label X: 7.0
Label Y: 2.0
Downstream: J-20
End:

Subbasin: W-5
Canvas X: 4056.603773584906
Canvas Y: 1615.566037735849
Label X: -55.0
Label Y: -4.0
Area: 0.0685
Downstream: DC-10

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 9.7
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-10
Canvas X: 4775.943396226416
Canvas Y: 1615.566037735849
Label X: -8.0
Label Y: 14.0
Downstream: J-20
End:

Junction: J-20
Canvas X: 5978.773584905661
Canvas Y: 1639.1509433962265
Label X: 7.0
Label Y: -2.0
Downstream: POND E1
End:

Subbasin: W-37
Canvas X: 7016.509433962265
Canvas Y: 23.584905660377444
Area: 0.0210
Downstream: POND E1

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 3.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND E1
Canvas X: 6096.698113207547
Canvas Y: -990.566037735849
Route: None
End:

Subbasin: W-1
Canvas X: 4209.905660377359
Canvas Y: 837.2641509433961
Area: 0.0518
Downstream: DC-6

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 8.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-6
Canvas X: 3584.905660377359
Canvas Y: 1096.698113207547
Downstream: J-17
End:

Subbasin: W-26
Canvas X: 3219.33962264151
Canvas Y: 518.867924528302
Area: 0.0027
Downstream: J-17

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 86

Transform: SCS
Lag: 5.7
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-17
Canvas X: 2535.3773584905666
Canvas Y: 1025.9433962264152

Label X: -12.0
Label Y: 14.0
Downstream: C5.A
End:

Reach: C5.A
Canvas X: 1226.4150943396235
Canvas Y: 990.566037735849
From Canvas X: 2535.3773584905666
From Canvas Y: 1025.9433962264152
Label X: -11.0
Label Y: 7.0
Downstream: J-18

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 172
Energy Slope: 0.0015
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 20
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-15
Canvas X: 1308.9622641509432
Canvas Y: -11.792452830188267
Area: 0.0518
Downstream: DC-5

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 7.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-5
Canvas X: 1273.5849056603765
Canvas Y: 448.1132075471696
Downstream: J-18
End:

Subbasin: W-40
Canvas X: 2028.301886792453
Canvas Y: 424.5283018867922
Area: 0.0017
Downstream: J-18

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 87

Transform: SCS
Lag: 4.5
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-18
Canvas X: 1226.4150943396235
Canvas Y: 990.566037735849
Label X: 0.0
Label Y: 13.0
Downstream: C5.B
End:

Reach: C5.B
Canvas X: -82.54716981132151
Canvas Y: 990.566037735849
From Canvas X: 1226.4150943396235
From Canvas Y: 990.566037735849
Label X: -14.0
Label Y: 7.0
Downstream: J-21

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 247
Energy Slope: 0.0015
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 20
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-2
Canvas X: 1143.867924528302
Canvas Y: 1992.9245283018868
Area: 0.0247
Downstream: DC-7

Canopy: None

Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 8.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-7
Canvas X: 660.3773584905666
Canvas Y: 1544.8113207547171
Downstream: J-21
End:

Subbasin: W-27
Canvas X: -23.584905660376535
Canvas Y: 200.47169811320782
Area: 0.0076
Downstream: J-21

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 88

Transform: SCS
Lag: 6.7
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-21
Canvas X: -82.54716981132151
Canvas Y: 990.566037735849
Label X: -2.0
Label Y: -13.0
Downstream: C5.C
End:

Reach: C5.C
Canvas X: -86.32138114209829
Canvas Y: 3486.0557768924305
From Canvas X: -82.54716981132151
From Canvas Y: 990.566037735849
Downstream: J-16

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1291
Energy Slope: 0.0015
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 20
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-33
Canvas X: -909.694555112882
Canvas Y: 2689.2430278884462
Label X: 3.0
Label Y: -3.0
Area: 0.0173
Downstream: J-16

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 92

Transform: SCS
Lag: 60.6
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: W-32
Canvas X: -1321.3811420982738
Canvas Y: 4309.428950863214
Area: 0.0117
Downstream: J-16

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 92

Transform: SCS
Lag: 65.6
Unitgraph Type: STANDARD

    Baseflow: None
End:

Subbasin: W-28
    Canvas X: 790.0943396226412
    Canvas Y: 3242.9245283018868
    Area: 0.0033
    Downstream: J-15

    Canopy: None
    Plant Uptake Method: None

    Surface: None

    LossRate: SCS
    Percent Impervious Area: 0.0
    Curve Number: 88

    Transform: SCS
    Lag: 6.9
    Unitgraph Type: STANDARD

    Baseflow: None
End:

Junction: J-15
    Canvas X: -153.30188679245293
    Canvas Y: 4481.132075471698
    Label X: -53.0
    Label Y: 4.0
    Downstream: C4.A
End:

Reach: C4.A
    Canvas X: -86.32138114209829
    Canvas Y: 3486.0557768924305
    From Canvas X: -153.30188679245293
    From Canvas Y: 4481.132075471698
    Label X: -51.0
    Label Y: -2.0
    Downstream: J-16

    Route: Kinematic Wave
    Channel: Kinematic Wave
    Length: 678
    Energy Slope: 0.001
    Shape: Triangular
    Mannings n: 0.035
    Number of Increments: 2
    Side Slope: 3
    Channel Loss: None
End:

Subbasin: W-41
    Canvas X: 742.9245283018863
    Canvas Y: 2558.9622641509436
    Area: 0.0008
    Downstream: J-16

    Canopy: None
    Plant Uptake Method: None

    Surface: None

    LossRate: SCS
    Percent Impervious Area: 0.0
    Curve Number: 92

    Transform: SCS
    Lag: 4.6
    Unitgraph Type: STANDARD

    Baseflow: None
End:

Junction: J-16
    Canvas X: -86.32138114209829
    Canvas Y: 3486.0557768924305
    Label X: 0.0
    Label Y: -18.0
    Downstream: C4.B
End:

Reach: C4.B
    Canvas X: -1261.7924528301883
    Canvas Y: 3455.1886792452833
    From Canvas X: -86.32138114209829
    From Canvas Y: 3486.0557768924305
    Label X: -37.0
    Label Y: 11.0
    Downstream: J-25

    Route: Kinematic Wave
    Channel: Kinematic Wave
    Length: 376
    Energy Slope: 0.003
    Shape: Trapezoid
    Mannings n: 0.035
    Number of Increments: 2
    Width: 30
    Side Slope: 3
    Channel Loss: None
End:

Junction: J-25
    Canvas X: -1261.7924528301883
    Canvas Y: 3455.1886792452833
    Label X: 0.0
    Label Y: -13.0
    Downstream: C3
End:

Reach: C3
Canvas X: -2641.5094339622638
Canvas Y: 3466.9811320754716
From Canvas X: -1261.7924528301883
From Canvas Y: 3455.1886792452833
Label X: -18.0
Label Y: 13.0
Downstream: J-30

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 275
Energy Slope: 0.01
Shape: Circular
Mannings n: 0.021
Number of Increments: 5
Width: 3
Channel Loss: None
End:

Junction: J-30
Canvas X: -2641.5094339622638
Canvas Y: 3466.9811320754716
Label X: 0.0
Label Y: -11.0
Downstream: POND W6
End:

Subbasin: W-35
Canvas X: -5624.169986719788
Canvas Y: 3618.857901726428
Label X: -58.0
Label Y: -3.0
Area: 0.0167
Downstream: POND W6

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND W6
Canvas X: -3778.220451527224
Canvas Y: 3552.456839309429
Label X: 8.0
Label Y: 7.0

Route: None
End:

Subbasin: W-14
Canvas X: -4581.673306772908
Canvas Y: -365.20584329349185
Area: 0.0551
Downstream: DC-4

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 7.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-4
Canvas X: -4594.953519256308
Canvas Y: 285.52456839309434
Downstream: J-26
End:

Subbasin: W-25
Canvas X: -636.7924528301883
Canvas Y: 318.39622641509413
Area: 0.0048
Downstream: J-22

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 87

Transform: SCS
Lag: 8.2
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-22
    Canvas X: -613.2075471698117
    Canvas Y: 1155.6603773584907
    Label X: -2.0
    Label Y: 1.0
    Downstream: C6.A
End:

Reach: C6.A
    Canvas X: -1568.396226415095
    Canvas Y: 1120.2830188679245
    From Canvas X: -613.2075471698117
    From Canvas Y: 1155.6603773584907
    Label X: -18.0
    Label Y: 8.0
    Downstream: J-23

    Route: Kinematic Wave
    Channel: Kinematic Wave
    Length: 722
    Energy Slope: 0.001
    Shape: Triangular
    Mannings n: 0.035
    Number of Increments: 2
    Side Slope: 3
    Channel Loss: None
End:

Subbasin: W-49
    Canvas X: -1509.433962264151
    Canvas Y: 294.8113207547167
    Area: 0.0046
    Downstream: J-23

    Canopy: None
    Plant Uptake Method: None

    Surface: None

    LossRate: SCS
    Percent Impervious Area: 0.0
    Curve Number: 87

    Transform: SCS
    Lag: 9.4
    Unitgraph Type: STANDARD

    Baseflow: None
End:

Junction: J-23
    Canvas X: -1568.396226415095
    Canvas Y: 1120.2830188679245
    Label X: 0.0
    Label Y: -11.0
    Downstream: C6.B
End:

Reach: C6.B
    Canvas X: -2831.858407079645
    Canvas Y: 1080.9102402022759
    From Canvas X: -1568.396226415095
    From Canvas Y: 1120.2830188679245
    Label X: -24.0
    Label Y: 14.0
    Downstream: J-24

    Route: Kinematic Wave
    Channel: Kinematic Wave
    Length: 1000
    Energy Slope: 0.001
    Shape: Triangular
    Mannings n: 0.035
    Number of Increments: 2
    Side Slope: 3
    Channel Loss: None
End:

Subbasin: W-39
    Canvas X: -3620.2830188679254
    Canvas Y: 483.49056603773624
    Label X: -1.0
    Label Y: -5.0
    Area: 0.0014
    Downstream: J-24

    Canopy: None
    Plant Uptake Method: None

    Surface: None

    LossRate: SCS
    Percent Impervious Area: 0.0
    Curve Number: 87

    Transform: SCS
    Lag: 6.1
    Unitgraph Type: STANDARD

    Baseflow: None
End:

Junction: J-24
    Canvas X: -2831.858407079645
    Canvas Y: 1080.9102402022759
    Label X: -5.0
    Label Y: -12.0
    Downstream: C6.C
End:

Reach: C6.C
    Canvas X: -4661.354581673307

Canvas Y: 1055.776892430279
From Canvas X: -2831.858407079645
From Canvas Y: 1080.9102402022759
Label X: -20.0
Label Y: 6.0
Downstream: J-26

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 250
Energy Slope: 0.001
Shape: Triangular
Mannings n: 0.035
Number of Increments: 2
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-24
Canvas X: -5801.886792452831
Canvas Y: 672.1698113207549
Label X: -2.0
Label Y: -4.0
Area: 0.0101
Downstream: J-19

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 87

Transform: SCS
Lag: 12.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-19
Canvas X: -5825.471698113208
Canvas Y: 955.1886792452829
Label X: -51.0
Label Y: 5.0
Downstream: C7.A
End:

Reach: C7.A
Canvas X: -4661.354581673307
Canvas Y: 1055.776892430279
From Canvas X: -5825.471698113208
From Canvas Y: 955.1886792452829
Label X: -18.0
Label Y: 11.0
Downstream: J-26

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1771
Energy Slope: 0.001
Shape: Triangular
Mannings n: 0.035
Number of Increments: 2
Side Slope: 3
Channel Loss: None
End:

Junction: J-26
Canvas X: -4661.354581673307
Canvas Y: 1055.776892430279
Label X: -1.0
Label Y: -14.0
Downstream: C2
End:

Reach: C2
Canvas X: -4705.188679245283
Canvas Y: 1992.9245283018868
From Canvas X: -4661.354581673307
From Canvas Y: 1055.776892430279
Downstream: J-28

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 70
Energy Slope: 0.01
Shape: Circular
Mannings n: 0.012
Number of Increments: 5
Width: 2
Channel Loss: None
End:

Junction: J-28
Canvas X: -4705.188679245283
Canvas Y: 1992.9245283018868
Downstream: POND W2
End:

Subbasin: W-46
Canvas X: -5766.509433962265
Canvas Y: 2393.867924528302
Label X: -59.0
Label Y: 0.0
Area: 0.0164
Downstream: POND W2

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND W2
Canvas X: -4799.528301886793
Canvas Y: 2393.867924528302
Label X: 0.0
Label Y: -3.0

Route: None
End:

Subbasin: W-13
Canvas X: -5660.377358490567
Canvas Y: -165.0943396226412
Area: 0.0305
Downstream: DC-3

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 7.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-3
Canvas X: -6214.622641509433
Canvas Y: 200.47169811320782
Downstream: J-4
End:

Subbasin: W-11
Canvas X: -5412.735849056604
Canvas Y: -2169.8113207547167
Area: 0.0115
Downstream: DC-1

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 6.0
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-1
Canvas X: -6155.66037735849
Canvas Y: -2771.2264150943392
Downstream: J-2
End:

Subbasin: W-21
Canvas X: -5283.018867924528
Canvas Y: -2759.433962264151
Area: 0.0056
Downstream: J-1

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 88

Transform: SCS
Lag: 10.6
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-1
Canvas X: -5306.603773584906
Canvas Y: -3360.8490566037744
Downstream: C1.A
End:

Reach: C1.A
Canvas X: -6969.33962264151
Canvas Y: -3396.2264150943392
From Canvas X: -5306.603773584906
From Canvas Y: -3360.8490566037744

Label X: -12.0
Label Y: 7.0
Downstream: J-2

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 610
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 8
Side Slope: 3
Channel Loss: None
End:

Junction: J-2
Canvas X: -6969.33962264151
Canvas Y: -3396.2264150943392
Label X: -49.0
Label Y: 3.0
Downstream: C1.B
End:

Reach: C1.B
Canvas X: -7146.226415094339
Canvas Y: -1379.7169811320755
From Canvas X: -6969.33962264151
From Canvas Y: -3396.2264150943392
Downstream: J-3

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 842
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 8
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-12
Canvas X: -5094.33962264151
Canvas Y: -1261.7924528301883
Area: 0.0060
Downstream: DC-2

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 5.0
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-2
Canvas X: -6049.528301886792
Canvas Y: -1320.7547169811323
Label X: -9.0
Label Y: 14.0
Downstream: J-3
End:

Subbasin: W-22
Canvas X: -6391.509433962265
Canvas Y: -1875.0
Area: 0.0055
Downstream: J-3

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 88

Transform: SCS
Lag: 8.0
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-3
Canvas X: -7146.226415094339
Canvas Y: -1379.7169811320755
Label X: -45.0
Label Y: 1.0
Downstream: C1.C
End:

Reach: C1.C
Canvas X: -7146.226415094339
Canvas Y: 601.4150943396226
From Canvas X: -7146.226415094339
From Canvas Y: -1379.7169811320755
Downstream: J-4

Route: Kinematic Wave
Channel: Kinematic Wave

Length: 1157
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 8
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-23
Canvas X: -6332.547169811321
Canvas Y: -589.6226415094343
Area: 0.0081
Downstream: J-4

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 88

Transform: SCS
Lag: 11.4
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-4
Canvas X: -7146.226415094339
Canvas Y: 601.4150943396226
Label X: -53.0
Label Y: 4.0
Downstream: C1
End:

Reach: C1
Canvas X: -7193.396226415094
Canvas Y: 1273.5849056603774
From Canvas X: -7146.226415094339
From Canvas Y: 601.4150943396226
Downstream: J-27

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 85
Energy Slope: 0.01
Shape: Circular
Mannings n: 0.021
Number of Increments: 4
Width: 3
Channel Loss: None
End:

Junction: J-27
Canvas X: -7193.396226415094
Canvas Y: 1273.5849056603774
Downstream: POND W1
End:

Subbasin: W-34
Canvas X: -7205.188679245283
Canvas Y: 3066.037735849057
Label X: -56.0
Label Y: -5.0
Area: 0.0168
Downstream: POND W1

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND W1
Canvas X: -7216.981132075472
Canvas Y: 1981.132075471698

Route: None
End:

Subbasin: W-38
Canvas X: 8007.075471698114
Canvas Y: -106.13207547169804
Area: 0.0261
Downstream: POND E3

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1

Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND E3
Canvas X: 7488.207547169812
Canvas Y: -1037.735849056604
Label X: -1.0
Label Y: 0.0

Route: None
End:

Subbasin: W-48
Canvas X: 7464.622641509433
Canvas Y: -2889.1509433962265
Area: 0.0197
Downstream: POND E4

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND E4
Canvas X: 7323.1132075471705
Canvas Y: -2110.8490566037735
Label X: 0.0
Label Y: 2.0

Route: None
End:

Subbasin: W-36
Canvas X: -5566.037735849057
Canvas Y: 4103.773584905661
Label X: -58.0
Label Y: -5.0
Area: 0.0180
Downstream: POND W7

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND W7
Canvas X: -3879.7169811320755
Canvas Y: 4091.9811320754716

Route: None
End:

Subbasin: W-43
Canvas X: -5717.131474103586
Canvas Y: 3207.171314741036
Label X: -61.0
Label Y: -3.0
Area: 0.0163
Downstream: POND W5

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND W5
Canvas X: -3831.341301460823
Canvas Y: 3154.050464807437

Route: None
End:

Subbasin: W-44
Canvas X: -5823.373173970784
Canvas Y: 2755.644090305445
Label X: -59.0
Label Y: -4.0

Area: 0.0162
Downstream: POND W4

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND W4
Canvas X: -3804.7808764940237
Canvas Y: 2689.2430278884462

Route: None
End:

Subbasin: W-45
Canvas X: -3007.0754716981137
Canvas Y: 2370.2830188679245
Label X: -58.0
Label Y: -1.0
Area: 0.0157
Downstream: POND W3

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND W3
Canvas X: -2464.6226415094343
Canvas Y: 2358.490566037736
Label X: 0.0
Label Y: 1.0

Route: None
End:

Subbasin: W-42
Canvas X: 7216.9811320754725
Canvas Y: 4646.226415094339
Label X: -57.0
Label Y: -1.0
Area: 0.0098
Downstream: CP-7

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 92

Transform: SCS
Lag: 42.8
Unitgraph Type: STANDARD

Baseflow: None
End:

Sink: CP-7
Canvas X: 8125.0
Canvas Y: 4681.603773584906
End:

Sink: CP-6
Canvas X: 8018.867924528302
Canvas Y: 2629.7169811320755
Label X: -2.0
Label Y: -5.0
End:

Sink: CP-2
Canvas X: 8066.037735849055
Canvas Y: 4186.320754716981
End:

Sink: CP-3
Canvas X: 8066.037735849055
Canvas Y: 3761.7924528301887
End:

Sink: CP-4
Canvas X: 8030.66037735849
Canvas Y: 3408.0188679245284
End:

Sink: CP-5
Canvas X: 8018.867924528302

Canvas Y: 2959.905660377359
End:

End:

Sink: CP-8
Canvas X: 7948.113207547169
Canvas Y: 2275.943396226415
End:

Sink: CP-9
Canvas X: 7936.32075471698
Canvas Y: 1933.9622641509436
End:

Sink: CP-10
Canvas X: 7936.32075471698
Canvas Y: 1627.3584905660377
End:

Sink: CP-11
Canvas X: 7936.32075471698
Canvas Y: 1379.7169811320755
End:

Sink: CP-12
Canvas X: 7936.32075471698
Canvas Y: 1049.5283018867926
End:

Sink: CP-13
Canvas X: 7900.943396226416
Canvas Y: 695.7547169811323
End:

Sink: CP-1
Canvas X: 7900.943396226416
Canvas Y: 365.566037735849
End:

Basin Schematic Properties:
Last View N: 5000.0
Last View S: -5000.0
Last View W: -5000.0
Last View E: 5000.0
Maximum View N: 5000.0
Maximum View S: -5000.0
Maximum View W: -5000.0
Maximum View E: 5000.0
Extent Method: Elements
Buffer: 0
Draw Icons: Yes
Draw Icon Labels: Name
Draw Map Objects: No
Draw Gridlines: No
Draw Flow Direction: No
Fix Element Locations: Yes
Fix Hydrologic Order: No

Post-Development

HMS Element	Control Point	25-Year 24-Hour Peak Flow (cfs)	25-Year 24-Hour Volume (ac-ft)	Drainage Area (sq mi)
CP-1	CP-1	0.0	0.0	0.0000
CP-2	CP-2	0.0	0.0	0.0000
CP-3	CP-3	0.0	0.0	0.0000
CP-4	CP-4	0.0	0.0	0.0000
CP-5	CP-5	0.0	0.0	0.0000
CP-6	CP-6	0.0	0.0	0.0000
CP-7	CP-7	19.5	3.9	0.0098
CP-8	CP-8	0.0	0.0	0.0000
CP-9	CP-9	0.0	0.0	0.0000
CP-10	CP-10	0.0	0.0	0.0000
CP-11	CP-11	0.0	0.0	0.0000
CP-12	CP-12	0.0	0.0	0.0000
CP-13	CP-13	0.0	0.0	0.0000

HEC-HMS Summary of Results				
Post-Development, 25-yr 24-hr Results				
Start of Run:	01 Jan 2020, 00:00		Basin Model:	Post Development
End of Run:	03 Jan 2020, 00:01		Met. Model:	25 Year - 24 Hour
			Control Specs:	48hr 1 minute
Hydrologic Element	Drainage Area (mi sq)	Discharge Peak (cfs)	Time of Peak	Volume (ac-ft)
W-10	0.0225	85.0	01Jan2040, 12:10	8.0
DC-15	0.0225	85.0	01Jan2040, 12:10	8.0
W-19	0.0075	26.5	01Jan2040, 12:13	2.8
W-20	0.0060	22.4	01Jan2040, 12:11	2.2
J-5	0.0060	22.4	01Jan2040, 12:11	2.2
C2.A	0.0060	22.4	01Jan2040, 12:19	2.2
J-6	0.0360	124.4	01Jan2040, 12:11	13.1
C2.B	0.0360	123.5	01Jan2040, 12:18	13.1
W-9	0.0302	114.7	01Jan2040, 12:09	10.8
DC-14	0.0302	114.7	01Jan2040, 12:09	10.8
W-18	0.0075	26.4	01Jan2040, 12:13	2.8
J-7	0.0737	243.3	01Jan2040, 12:13	26.7
C2.C	0.0737	242.5	01Jan2040, 12:18	26.7
W-8	0.0302	114.7	01Jan2040, 12:09	10.8
DC-13	0.0302	114.7	01Jan2040, 12:09	10.8
W-17	0.0075	26.6	01Jan2040, 12:13	2.8
J-8	0.1114	351.4	01Jan2040, 12:16	40.3
C2.D	0.1114	351.0	01Jan2040, 12:20	40.3
W-7	0.0586	225.1	01Jan2040, 12:09	20.9
DC-12	0.0586	225.1	01Jan2040, 12:09	20.9
W-16	0.0156	50.5	01Jan2040, 12:16	5.9
J-9	0.1856	548.0	01Jan2040, 12:16	67.1
C2.E	0.1856	547.3	01Jan2040, 12:24	67.0
W-6	0.0281	118.1	01Jan2040, 12:06	10.0
DC-11	0.0281	118.1	01Jan2040, 12:06	10.0
J-10	0.2137	592.5	01Jan2040, 12:23	77.0
W-47	0.0213	101.8	01Jan2040, 12:05	9.1
POND E2	0.2350	627.8	01Jan2040, 12:22	86.1
W-3	0.0371	142.0	01Jan2040, 12:09	13.3
DC-8	0.0371	142.0	01Jan2040, 12:09	13.3
J-14	0.0371	142.0	01Jan2040, 12:09	13.3
C3.A	0.0371	141.4	01Jan2040, 12:16	13.2
W-30	0.0131	47.4	01Jan2040, 12:12	5.0
W-29	0.0095	37.4	01Jan2040, 12:10	3.6
J-11	0.0597	219.4	01Jan2040, 12:14	21.9
C3.B	0.0597	218.0	01Jan2040, 12:21	21.9
W-4	0.0503	184.4	01Jan2040, 12:11	18.0
DC-9	0.0503	184.4	01Jan2040, 12:11	18.0
W-31	0.0185	74.4	01Jan2040, 12:09	7.1
J-12	0.1285	393.6	01Jan2040, 12:17	46.9
C3.C	0.1285	392.5	01Jan2040, 12:26	46.9
J-13	0.1285	392.5	01Jan2040, 12:26	46.9
W-5	0.0685	247.4	01Jan2040, 12:11	24.5
DC-10	0.0685	247.4	01Jan2040, 12:11	24.5
J-20	0.1970	548.0	01Jan2040, 12:19	71.3
W-37	0.0210	99.9	01Jan2040, 12:05	8.8
POND E1	0.2180	589.4	01Jan2040, 12:18	80.2
W-1	0.0518	191.9	01Jan2040, 12:10	18.5
DC-6	0.0518	191.9	01Jan2040, 12:10	18.5

HEC-HMS Summary of Results				
Post-Development, 25-yr 24-hr Results				
Start of Run:	01 Jan 2020, 00:00		Basin Model:	Post Development
End of Run:	03 Jan 2020, 00:01		Met. Model:	25 Year - 24 Hour
			Control Specs:	48hr 1 minute
Hydrologic Element	Drainage Area (mi sq)	Discharge Peak (cfs)	Time of Peak	Volume (ac-ft)
W-26	0.0027	11.3	01Jan2040, 12:07	1.0
J-17	0.0545	202.4	01Jan2040, 12:10	19.5
C5.A	0.0545	202.0	01Jan2040, 12:11	19.5
W-15	0.0518	198.3	01Jan2040, 12:09	18.5
DC-5	0.0518	198.3	01Jan2040, 12:09	18.5
W-40	0.0017	7.4	01Jan2040, 12:06	0.6
J-18	0.1080	405.0	01Jan2040, 12:10	38.6
C5.B	0.1080	403.9	01Jan2040, 12:11	38.6
W-2	0.0247	91.5	01Jan2040, 12:10	8.8
DC-7	0.0247	91.5	01Jan2040, 12:10	8.8
W-27	0.0076	31.4	01Jan2040, 12:08	2.9
J-21	0.1403	524.4	01Jan2040, 12:10	50.3
C5.C	0.1403	523.5	01Jan2040, 12:15	50.3
W-33	0.0173	27.9	01Jan2040, 13:03	7.0
W-32	0.0117	17.9	01Jan2040, 13:08	4.7
W-28	0.0033	13.5	01Jan2040, 12:08	1.2
J-15	0.0033	13.5	01Jan2040, 12:08	1.2
C4.A	0.0033	13.4	01Jan2040, 12:15	1.2
W-41	0.0008	3.7	01Jan2040, 12:06	0.3
J-16	0.1734	556.5	01Jan2040, 12:15	63.5
C4.B	0.1734	555.5	01Jan2040, 12:16	63.5
J-25	0.1734	555.5	01Jan2040, 12:16	63.5
C3	0.1734	554.9	01Jan2040, 12:16	63.5
J-30	0.1734	554.9	01Jan2040, 12:16	63.5
W-35	0.0167	86.0	01Jan2040, 12:01	7.4
POND W6	0.1901	586.3	01Jan2040, 12:16	70.8
W-14	0.0551	210.9	01Jan2040, 12:09	19.7
DC-4	0.0551	210.9	01Jan2040, 12:09	19.7
W-25	0.0048	18.6	01Jan2040, 12:09	1.8
J-22	0.0048	18.6	01Jan2040, 12:09	1.8
C6.A	0.0048	18.6	01Jan2040, 12:16	1.8
W-49	0.0046	17.2	01Jan2040, 12:11	1.7
J-23	0.0094	34.1	01Jan2040, 12:14	3.5
C6.B	0.0094	34.0	01Jan2040, 12:22	3.5
W-39	0.0014	5.8	01Jan2040, 12:07	0.5
J-24	0.0108	36.7	01Jan2040, 12:22	4.0
C6.C	0.0108	36.6	01Jan2040, 12:24	4.0
W-24	0.0101	33.9	01Jan2040, 12:14	3.7
J-19	0.0101	33.9	01Jan2040, 12:14	3.7
C7.A	0.0101	33.6	01Jan2040, 12:28	3.7
J-26	0.0760	238.8	01Jan2040, 12:10	27.4
C2	0.0760	238.7	01Jan2040, 12:10	27.4
J-28	0.0760	238.7	01Jan2040, 12:10	27.4
W-46	0.0164	84.5	01Jan2040, 12:01	7.2
POND W2	0.0924	281.3	01Jan2040, 12:07	34.6
W-13	0.0305	119.7	01Jan2040, 12:08	10.9
DC-3	0.0305	119.7	01Jan2040, 12:08	10.9
W-11	0.0115	46.8	01Jan2040, 12:07	4.1
DC-1	0.0115	46.8	01Jan2040, 12:07	4.1

HEC-HMS Summary of Results				
Post-Development, 25-yr 24-hr Results				
Start of Run:	01 Jan 2020, 00:00		Basin Model:	Post Development
End of Run:	03 Jan 2020, 00:01		Met. Model:	25 Year - 24 Hour
			Control Specs:	48hr 1 minute
Hydrologic Element	Drainage Area (mi sq)	Discharge Peak (cfs)	Time of Peak	Volume (ac-ft)
W-21	0.0056	20.4	01Jan2040, 12:12	2.1
J-1	0.0056	20.4	01Jan2040, 12:12	2.1
C1.A	0.0056	20.2	01Jan2040, 12:18	2.1
J-2	0.0171	58.8	01Jan2040, 12:09	6.2
C1.B	0.0171	58.5	01Jan2040, 12:15	6.2
W-12	0.0060	25.2	01Jan2040, 12:06	2.1
DC-2	0.0060	25.2	01Jan2040, 12:06	2.1
W-22	0.0055	21.7	01Jan2040, 12:09	2.1
J-3	0.0286	95.6	01Jan2040, 12:11	10.4
C1.C	0.0286	95.3	01Jan2040, 12:19	10.4
W-23	0.0081	28.7	01Jan2040, 12:13	3.0
J-4	0.0672	209.0	01Jan2040, 12:12	24.4
C1	0.0672	208.9	01Jan2040, 12:13	24.4
J-27	0.0672	208.9	01Jan2040, 12:13	24.4
W-34	0.0168	86.5	01Jan2040, 12:01	7.4
POND W1	0.0840	241.9	01Jan2040, 12:07	31.8
W-38	0.0261	134.4	01Jan2040, 12:01	11.5
POND E3	0.0261	134.4	01Jan2040, 12:01	11.5
W-48	0.0197	101.5	01Jan2040, 12:01	8.7
POND E4	0.0197	101.5	01Jan2040, 12:01	8.7
W-36	0.0180	92.7	01Jan2040, 12:01	7.9
POND W7	0.0180	92.7	01Jan2040, 12:01	7.9
W-43	0.0163	83.9	01Jan2040, 12:01	7.2
POND W5	0.0163	83.9	01Jan2040, 12:01	7.2
W-44	0.0162	83.4	01Jan2040, 12:01	7.1
POND W4	0.0162	83.4	01Jan2040, 12:01	7.1
W-45	0.0157	80.9	01Jan2040, 12:01	6.9
POND W3	0.0157	80.9	01Jan2040, 12:01	6.9
W-42	0.0098	19.5	01Jan2040, 12:45	3.9
CP-7	0.0098	19.5	01Jan2040, 12:45	3.9
CP-6	0.0000	0	01Jan2040, 00:00	0.0
CP-2	0.0000	0	01Jan2040, 00:00	0.0
CP-3	0.0000	0	01Jan2040, 00:00	0.0
CP-4	0.0000	0	01Jan2040, 00:00	0.0
CP-5	0.0000	0	01Jan2040, 00:00	0.0
CP-8	0.0000	0	01Jan2040, 00:00	0.0
CP-9	0.0000	0	01Jan2040, 00:00	0.0
CP-10	0.0000	0	01Jan2040, 00:00	0.0
CP-11	0.0000	0	01Jan2040, 00:00	0.0
CP-12	0.0000	0	01Jan2040, 00:00	0.0
CP-13	0.0000	0	01Jan2040, 00:00	0.0
CP-1	0.0000	0	01Jan2040, 00:00	0.0

APPENDIX III-2A-2

CULVERT SIZING OUTPUT

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 209 cfs

Maximum Flow: 209 cfs

Table 1 - Summary of Culvert Flows at Crossing: CULVERT 1

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
87.06	0.00	0.00	0.00	1
87.65	20.90	20.90	0.00	1
88.00	41.80	41.80	0.00	1
88.29	62.70	62.70	0.00	1
88.55	83.60	83.60	0.00	1
88.78	104.50	104.50	0.00	1
89.00	125.40	125.40	0.00	1
89.20	146.30	146.30	0.00	1
89.40	167.20	167.20	0.00	1
89.59	188.10	188.10	0.00	1
89.77	209.00	209.00	0.00	1
91.00	343.61	343.61	0.00	Overtopping

Table 2 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	87.06	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
20.90	20.90	87.65	0.590	0.0*	1-S2n	0.242	0.347	0.242	0.000	4.799	0.000
41.80	41.80	88.00	0.937	0.0*	1-S2n	0.374	0.551	0.374	0.000	6.217	0.000
62.70	62.70	88.29	1.228	0.0*	1-S2n	0.483	0.722	0.504	0.000	6.918	0.000
83.60	83.60	88.55	1.487	0.094	1-S2n	0.580	0.875	0.611	0.000	7.601	0.000
104.50	104.50	88.78	1.720	0.273	1-S2n	0.671	1.015	0.712	0.000	8.158	0.000
125.40	125.40	89.00	1.936	0.452	1-S2n	0.755	1.147	0.809	0.000	8.614	0.000
146.30	146.30	89.20	2.141	0.632	1-S2n	0.836	1.271	0.902	0.000	9.014	0.000
167.20	167.20	89.40	2.337	0.815	1-S2n	0.913	1.389	0.992	0.000	9.359	0.000
188.10	188.10	89.59	2.527	1.002	1-S2n	0.987	1.502	1.084	0.000	9.641	0.000
209.00	209.00	89.77	2.713	1.193	1-S2n	1.059	1.612	1.165	0.000	9.964	0.000

* Full Flow Headwater elevation is below inlet invert.

****

Straight Culvert

Inlet Elevation (invert): 87.06 ft,   Outlet Elevation (invert): 86.21 ft

Culvert Length: 85.00 ft,   Culvert Slope: 0.0100

****

Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 87.06 ft

Outlet Station: 85.00 ft

Outlet Elevation: 86.21 ft

Number of Barrels: 3

Culvert Data Summary - Culvert 1

Barrel Shape: Concrete Box

Barrel Span: 6.00 ft

Barrel Rise: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge (90º) Headwall

Inlet Depression: None

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 238.8 cfs

Maximum Flow: 238.8 cfs

Table 3 - Summary of Culvert Flows at Crossing: CULVERT 2

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
87.97	0.00	0.00	0.00	1
88.50	23.88	23.88	0.00	1
88.82	47.76	47.76	0.00	1
89.07	71.64	71.64	0.00	1
89.30	95.52	95.52	0.00	1
89.51	119.40	119.40	0.00	1
89.71	143.28	143.28	0.00	1
89.90	167.16	167.16	0.00	1
90.10	191.04	191.04	0.00	1
90.29	214.92	214.92	0.00	1
90.50	238.80	238.80	0.00	1
91.00	291.10	291.10	0.00	Overtopping

Table 4 - Culvert Summary Table: Culvert 2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	87.97	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
23.88	23.88	88.50	0.533	0.0*	1-S2n	0.223	0.313	0.223	0.000	4.458	0.000
47.76	47.76	88.82	0.845	0.0*	1-S2n	0.347	0.497	0.347	0.000	5.742	0.000
71.64	71.64	89.07	1.105	0.021	1-S2n	0.450	0.652	0.468	0.000	6.377	0.000
95.52	95.52	89.30	1.332	0.213	1-S2n	0.543	0.789	0.570	0.000	6.987	0.000
119.40	119.40	89.51	1.542	0.408	1-S2n	0.630	0.916	0.664	0.000	7.488	0.000
143.28	143.28	89.71	1.740	0.611	1-S2n	0.711	1.034	0.756	0.000	7.894	0.000
167.16	167.16	89.90	1.933	0.823	1-S2n	0.789	1.146	0.845	0.000	8.247	0.000
191.04	191.04	90.10	2.127	1.046	5-S2n	0.865	1.253	0.929	0.000	8.566	0.000
214.92	214.92	90.29	2.325	1.279	5-S2n	0.937	1.355	1.013	0.000	8.842	0.000
238.80	238.80	90.50	2.531	1.524	5-S2n	1.008	1.454	1.094	0.000	9.099	0.000

* Full Flow Headwater elevation is below inlet invert.

****

Straight Culvert

Inlet Elevation (invert): 87.97 ft,   Outlet Elevation (invert): 87.27 ft

Culvert Length: 70.00 ft,   Culvert Slope: 0.0100

****

Site Data - Culvert 2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 87.97 ft

Outlet Station: 70.00 ft

Outlet Elevation: 87.27 ft

Number of Barrels: 6

Culvert Data Summary - Culvert 2

Barrel Shape: Concrete Box

Barrel Span: 4.00 ft

Barrel Rise: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge (90º) Headwall

Inlet Depression: None

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 555.5 cfs

Maximum Flow: 555.5 cfs

Table 5 - Summary of Culvert Flows at Crossing: CULVERT 3

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 3 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
87.00	0.00	0.00	0.00	1
87.71	55.55	55.55	0.00	1
88.13	111.10	111.10	0.00	1
88.49	166.65	166.65	0.00	1
88.79	222.20	222.20	0.00	1
89.07	277.75	277.75	0.00	1
89.34	333.30	333.30	0.00	1
89.59	388.85	388.85	0.00	1
89.83	444.40	444.40	0.00	1
90.08	499.95	499.95	0.00	1
90.32	555.50	555.50	0.00	1
91.00	698.70	698.70	0.00	Overtopping

Table 6 - Culvert Summary Table: Culvert 3

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	87.00	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
55.55	55.55	87.71	0.715	0.0*	1-S2n	0.310	0.420	0.320	0.000	4.824	0.000
111.10	111.10	88.13	1.135	0.175	1-S2n	0.480	0.666	0.501	0.000	6.156	0.000
166.65	166.65	88.49	1.487	0.419	1-S2n	0.623	0.873	0.658	0.000	7.032	0.000
222.20	222.20	88.79	1.793	0.654	1-S2n	0.750	1.058	0.803	0.000	7.686	0.000
277.75	277.75	89.07	2.073	0.889	1-S2n	0.869	1.227	0.939	0.000	8.212	0.000
333.30	333.30	89.34	2.335	1.128	1-S2n	0.981	1.386	1.069	0.000	8.658	0.000
388.85	388.85	89.59	2.586	1.372	1-S2n	1.088	1.536	1.194	0.000	9.043	0.000
444.40	444.40	89.83	2.832	1.625	1-S2n	1.190	1.679	1.315	0.000	9.387	0.000
499.95	499.95	90.08	3.076	1.886	5-S2n	1.290	1.816	1.432	0.000	9.698	0.000
555.50	555.50	90.32	3.323	2.156	5-S2n	1.387	1.948	1.546	0.000	9.983	0.000

* Full Flow Headwater elevation is below inlet invert.

****

Straight Culvert

Inlet Elevation (invert): 87.00 ft,   Outlet Elevation (invert): 86.48 ft

Culvert Length: 65.00 ft,   Culvert Slope: 0.0080

****

Site Data - Culvert 3

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 87.00 ft

Outlet Station: 65.00 ft

Outlet Elevation: 86.48 ft

Number of Barrels: 6

Culvert Data Summary - Culvert 3

Barrel Shape: Concrete Box

Barrel Span: 6.00 ft

Barrel Rise: 3.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge (90º) Headwall

Inlet Depression: None

APPENDIX III-2A-3

RIPRAP SIZING AND GRADATION

ATTACHMENT III-2A-3

RIPRAP TYPE

Riprap Designation	Percent Smaller Than Given Size By Weight	Intermediate Rock Dimension (inches)	D_{50} Dia. (inches)
Type XL	100% passing 12 inch 50% > 3 inch		
Type VL	70 - 100 50 - 70 35 - 50 2 - 10	12 9 6 2	6
Type L	70 - 100 50 - 70 35 - 50 2 - 10	15 12 9 3	9
Type M	70 - 100 50 - 70 35 - 50 2 - 10	21 18 12 4	12
Type H	100 50 - 70 35 - 50 2 - 10	30 24 18 6	18
Type VH	100 50 - 70 35 - 50 2 - 10	42 33 24 9	24

APPENDIX III-2B

ACTIVE FACE BERM SIZING

ACTIVE FACE BERM SIZING

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

STATE OF TEXAS
7/21/17
CHARLES G. DOMINGUEZ
83247
LICENSED
PROFESSIONAL ENGINEER

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

INTENDED FOR PERMITTING PURPOSES ONLY

1.0 OBJECTIVE

Calculate the required size of the stormwater containment berm at the landfill active face as a function of plane area of the active area.

2.0 GIVEN

- Waste slope of 4H:IV
- 25 years, 24 hour storm event of 8.5 inches;
- Berm slope of 2H:1V;
- 1.0 ft. freeboard on berm

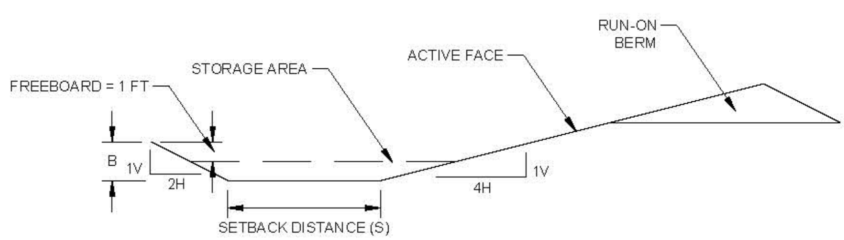
3.0 ASSUMPTIONS

- Stormwater run-on to the active face will not be allowed
- 50 percent run-off from the active face, i.e., 50% infiltration

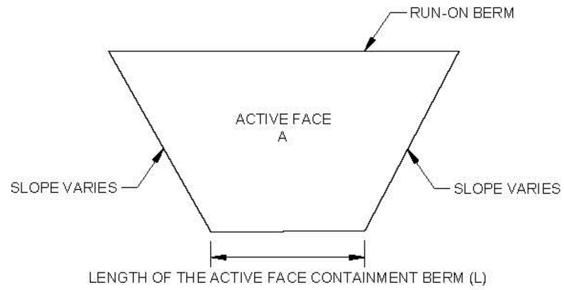
4.0 CALCULATION

Derive relationships for the amount of runoff from the 8.5 inch design storm and the available storage volume as a function of the active face area.

Cross-section of the Active Face and Containment Berm



Elevation View of the Active Face and Containment Berm



4.1 Runoff, R

$$R = .5\left(8.5 \div 12\,{}^{in}/_{ft}\right) \times A = \frac{.71}{2} \times A = .35 \times A$$

Where:

R = total runoff into the active area containment berm (cf)

A = total area of the active face (sf)

4.2 Storage, V

$$V = L \times \left(\frac{S + (S + (B-1) \times 2 \times (B-1) \times 4)}{2}\right) \times (B-1)$$

$$V = (3B^2 + (S-6) \times B - S + 3) \times L$$

Where:

V = storage capacity an active face containment berm (cf)

L = length of the active face containment berm (ft)

4.3 Height of Berm, B

Now set runoff, R, equal to storage, V, and solve for the height of berm, B.

$$B = \frac{6 - S + \sqrt{S^2 + 4.2\frac{A}{L}}}{6}$$

For typical site operations, the maximum berm height will be 6 ft. The operator can vary the berm length and setback distance to limit the berm height to 6 ft.

Now plot B versus L for various values of S and A. Figures 1 through 4 present the plots for active working areas of 10,000, 20,000, 30,000, and 40,000 sf, respectively.

4.4 Procedure To Select Berm Size

Procedure to select berm size using Figures 1 trough 4:

1) Determine the active face area (A);

2) Select a figure from Figures 1-4 that has an active area closest to, but no less than the actual A. For example, if A=25,000, choose Figure 3 (A=30,000);

3) Determine the minimum setback distance (S) for the daily operation, and select the corresponding curve. If the setback distance falls between the numbers shown on the figure, the closest but smaller value of S will be used. For example, if S=25 ft, choose the curve representing 20 ft; and

4) Measure the length of the active face containment berm, and determine the required berm height from the selected curve. Figures 1 through 4 cover a wide range of berm length (i.e. toe width of the active face) for normal waste fill operations. If the actual berm length is longer than the maximum value on the curve, the maximum berm length can be used to determine a conservative berm height. If the actual berm length is shorter than the minimum value on the curve, the operator can use equation (1) above to determine berm height.

Example using attached figures: A = 10,000 sf, s = 20 ft, L = 200 ft => B = 1.8 ft (from Figure 1, curve S = 20 ft).

5.0 CONCLUSION

Figures 1 through 4 and the procedure discussed above provide guidance for determining the size of the stormwater containment berm based on the height of the active face (runoff area), the length of the containment berm, and the setback distance from the active face. The equations presented in this calculation may be used to determine the required berm height for various active face areas, berm lengths, and setback distances.

Figure 1. Berm Height vs. Berm Length for Various Setbacks

A = 10,000 sf

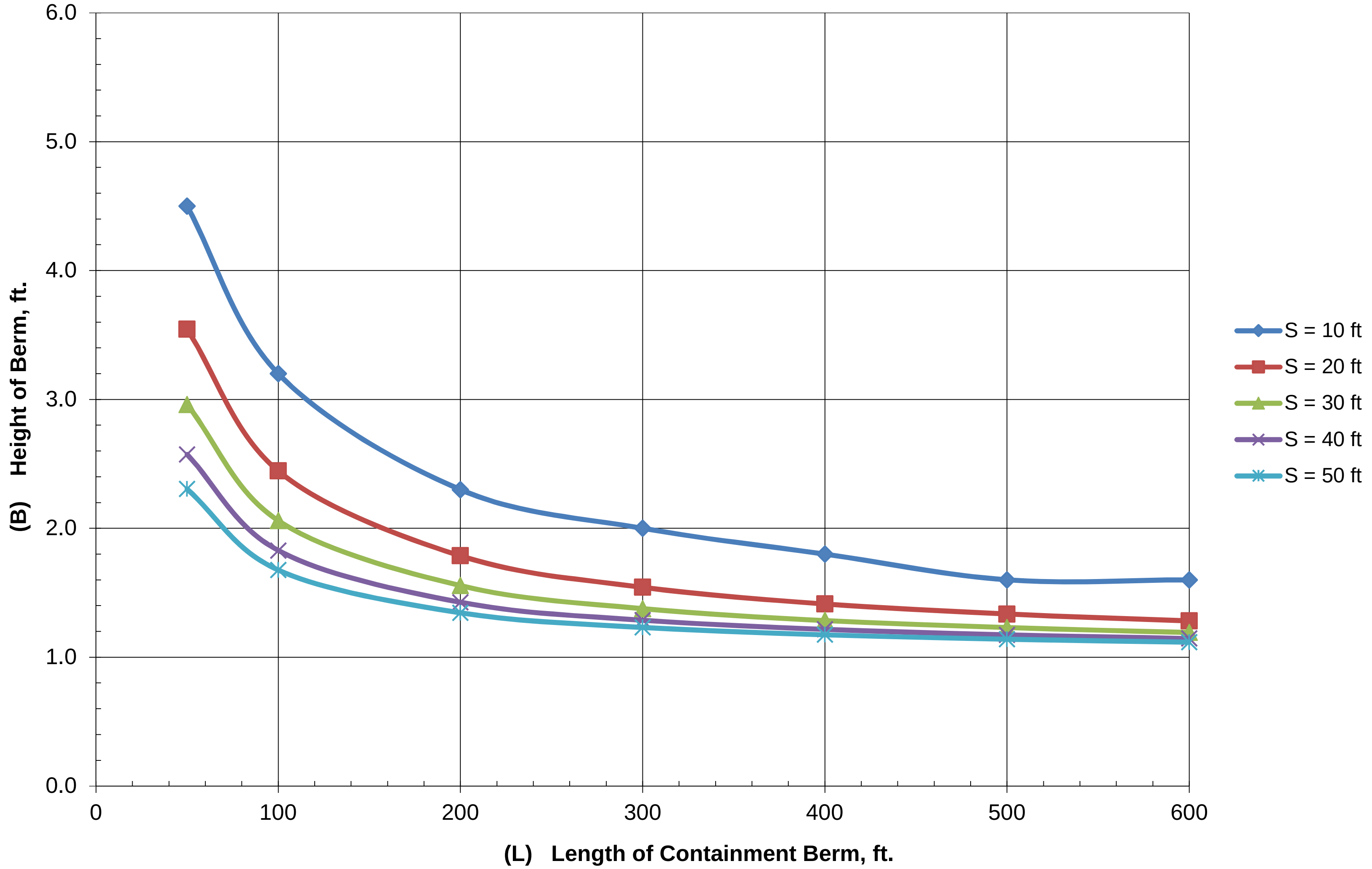


Figure 2. Berm Height vs. Berm Length for Various Setbacks

A = 20,000 sf

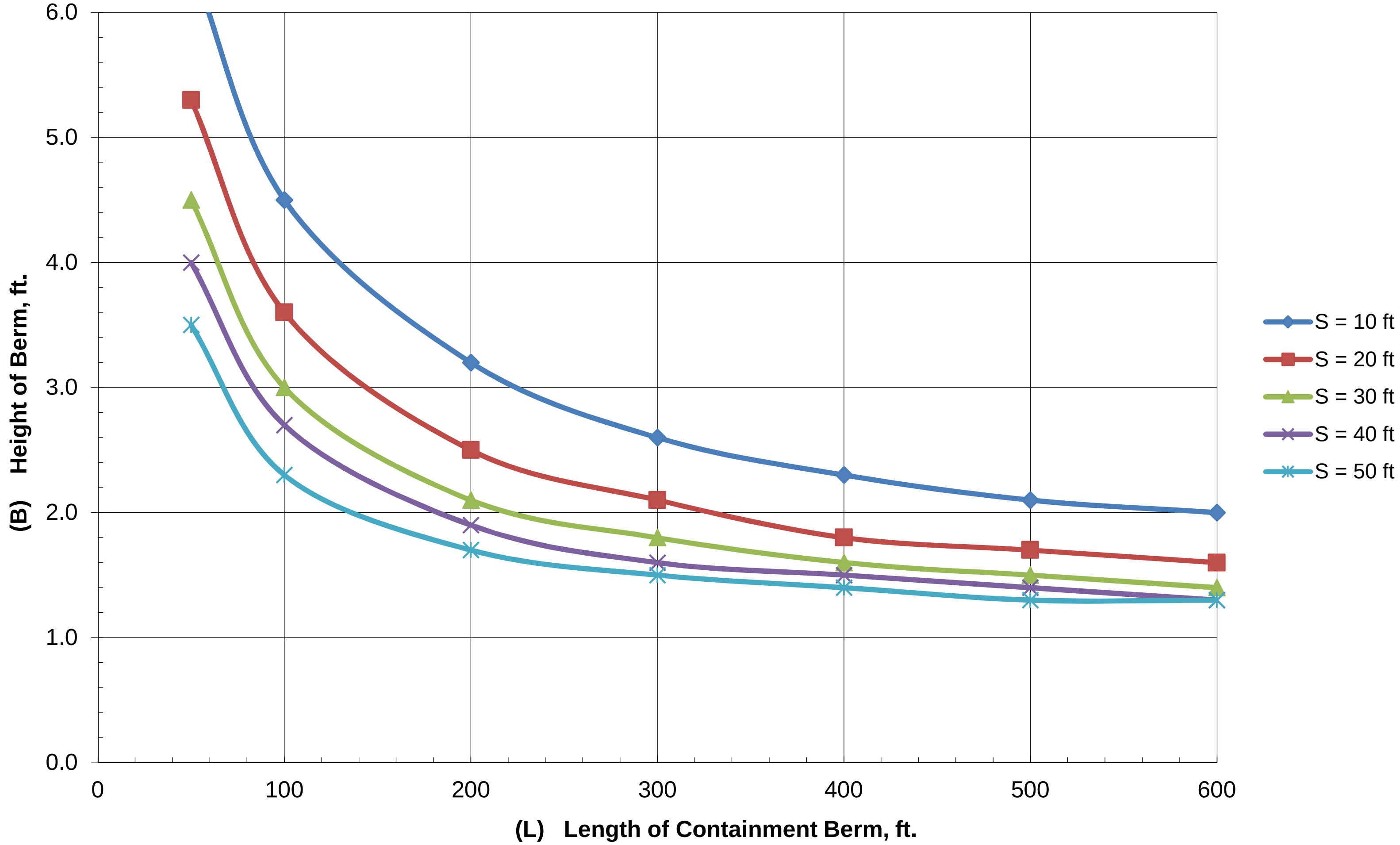
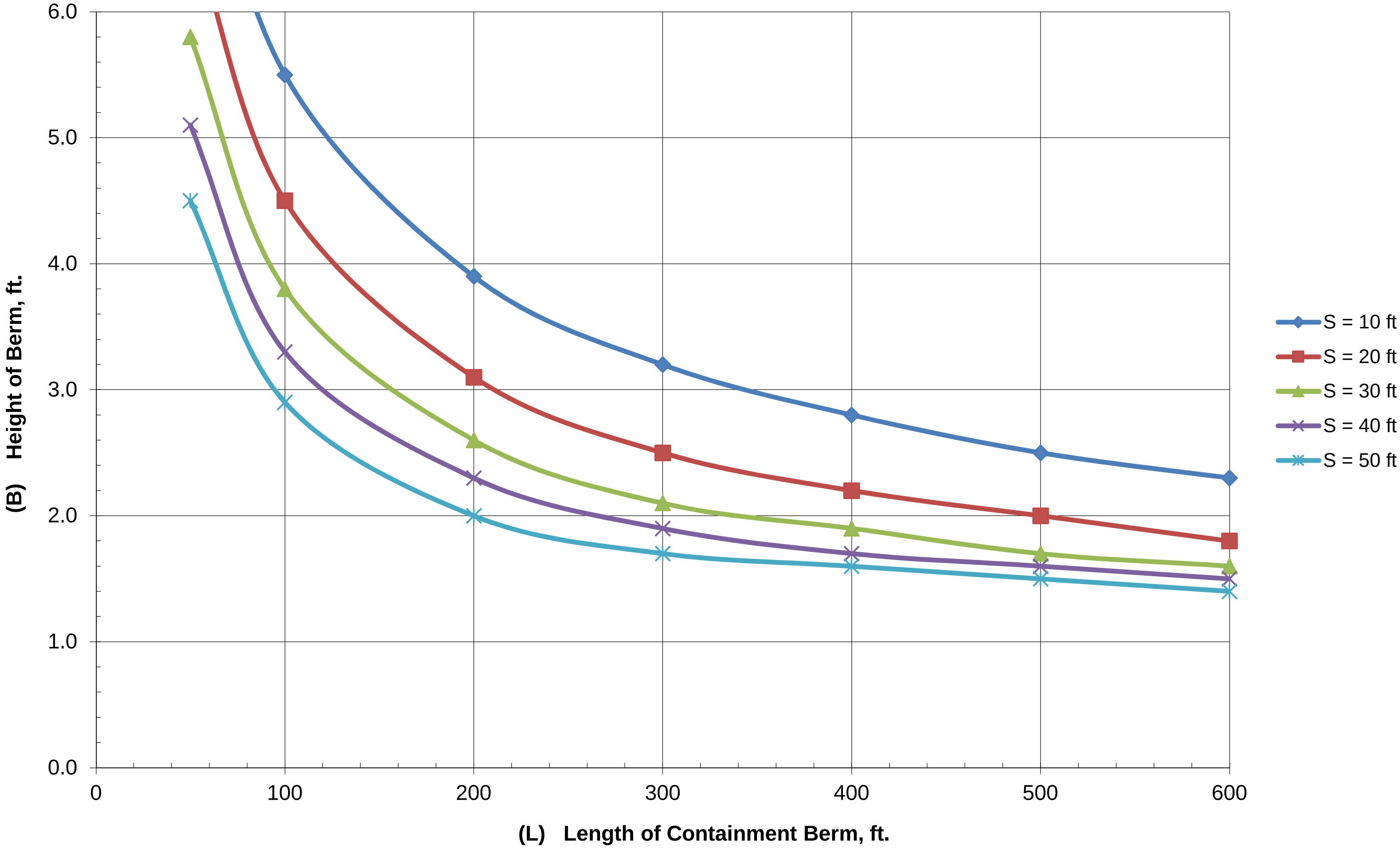


Figure 3. Berm Height vs. Berm Length for Various Setbacks

A = 30,000 sf



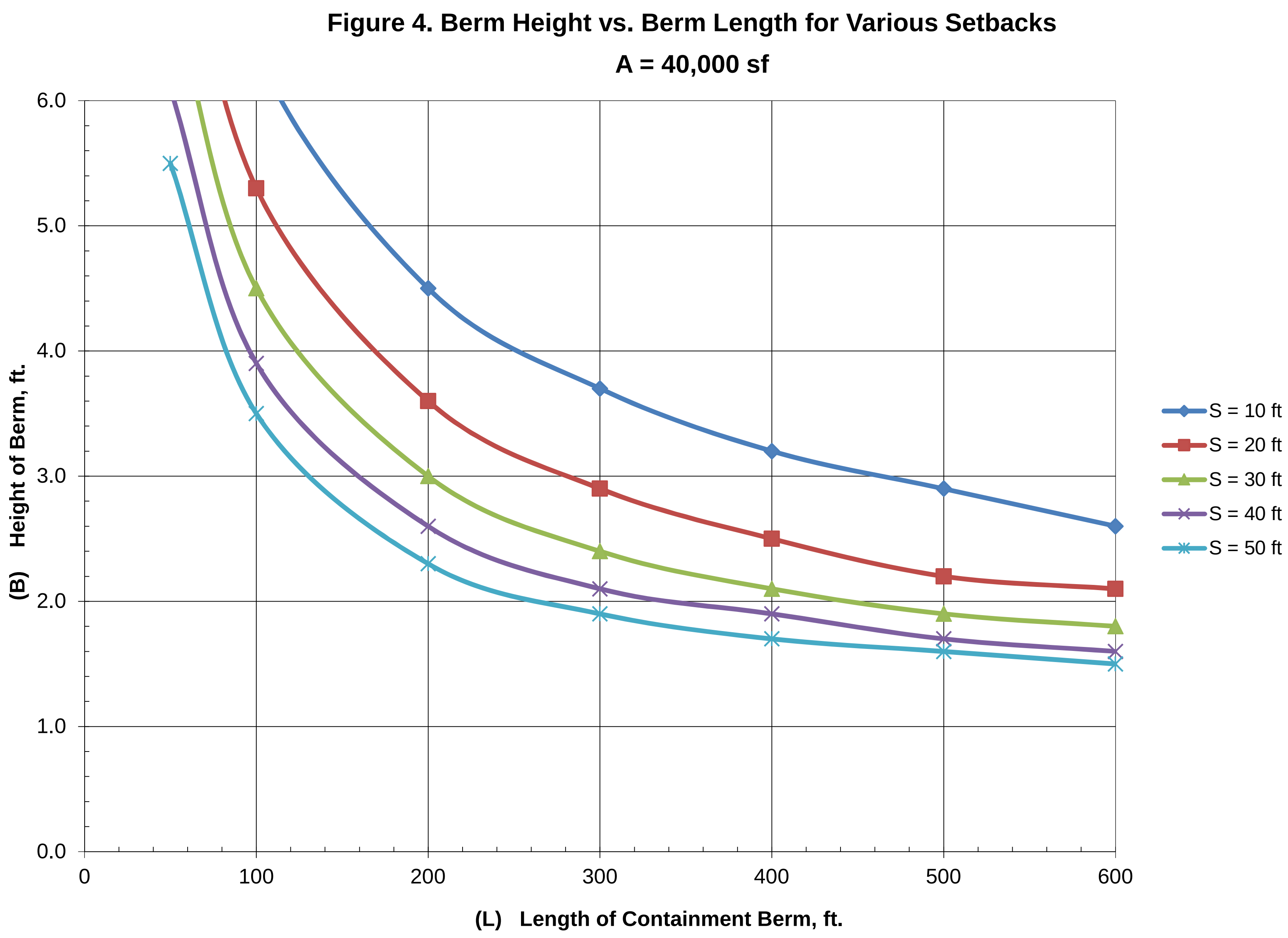


Figure 4. Berm Height vs. Berm Length for Various Setbacks
A = 40,000 sf
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
100
200
300
400
500
600
(B) Height of Berm, ft.
(L) Length of Containment Berm, ft.
S = 10 ft
S = 20 ft
S = 30 ft
S = 40 ft
S = 50 ft

APPENDIX III-2C

INTERIM EROSION AND SEDIMENT CONTROL ANALYSIS

APPENDIX III-2C-1

INTERMEDIATE COVER SOIL EROSION LOSS ANALYSIS

INTERMEDIATE COVER SOIL EROSION LOSS ANALYSIS

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

STATE OF TEXAS
7/21/17
CHARLES G. DOMINGUEZ
83247
LICENSED
PROFESSIONAL ENGINEER

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

INTENDED FOR PERMITTING PURPOSES ONLY

1.0 OBJECTIVE

1) Design the interim erosion and sediment controls for the proposed at the Edinburg Regional Disposal Facility in accordance with 30 TAC §330.305(d).

2) Estimate erosion losses for worst-case intermediate cover slopes for both the top dome surface and external embankment side slopes.

3) Estimate flow velocity and compare to permissible non-erodible velocity.

2.0 DESIGN CRITERIA

In accordance with 30 TAC §330.305(d), the soil erosion and sediment controls are designed according to the following criteria:

- The estimated peak velocity should be less than the permissible non-erodible velocities under similar conditions.
- The potential soil erosion loss should not exceed the permissible soil loss for comparable soil-slope lengths and soil-cover conditions. The soil erosion loss of 50 ton/acre/year is selected as the permissible soil erosion loss for interim erosion and sediment controls (based on TCEQ guidance - Reference 1).

The permissible non-erodible flow velocity on a grass-covered slope is typically 5.0 ft/sec (Reference 2). The permissible non-erodible flow velocity for bare clay loam soil is 3.75 ft/sec (Reference 3).

Based on TCEQ draft guidance on erosional stability (Reference 1), for the interim condition, the permissible soil loss is not to exceed 50 tons/acre/year and the recommended vegetative cover is 60%. In accordance with the TCEQ draft guidance, the Natural Resources Conservation Services, formerly Soil Conservation Service, of the United States Department of Agriculture's Revised Universal Soil Loss Equation remains to be the most suitable method for calculating soil loss from a landfill.

60% of ground cover is assumed to be achievable during the operational phase of the site (based on TCEQ guidance - Reference 1).

3.0 METHODS

3.1 Flow Velocity

The storm water flow velocity on the slope is calculated following the method provided in the USDA TR-55 (Reference 4). For the slopes less than 300 feet long, sheet flow along the slope is expected. The sheet flow velocities for the 5% and 25% slopes are 0.85 ft-sec and 1.89 ft/sec, respectively (Table 1). Results showed that the sheet flow velocities for all proposed slope gradients are below the permissible non-erodible velocities of 5 ft/sec.

On the 4H:1V external embankment side slopes, water diversion structures are required and the spacing of the diversion structures is a maximum of 240 feet along the slope. The design will ensure flow velocities less than permissible non-erodible flow velocity.

The proposed top dome surface is at 5% slope with a maximum slope length of 114 feet. Therefore the flow on the top dome surface is sheet flow at 0.85 ft/sec, i.e. below the permissible 5 ft/sec. The flow velocity criterion is satisfied on the top dome surface without any slope interrupters.

Table 1: Sheet Flow Velocity Calculation

Flow Type	Roughness Coefficient n^ote^:	Surface Description	Surface Condition
Sheet/Overland Flow	0.011	Smooth surface (concrete, asphalt, gravel, bare soil)	A
	0.05	Fallow (no residue)	B
	0.06	**Cultivated soils: Residue cover ≤ 20%**	**C**
	0.17	Cultivated soils: Residue cover > 20%	D
	0.15	Grass: Short grass prairie	E
	0.24	Grass: Dense grasses	F
	0.41	Grass Bermuda grass	G
	0.13	Range (natural)	H
	0.4	Woods: Light underbrush	I
	0.8	Woods: Heavy underbrush	J

Notes: The roughness coefficient for sheet flow were from Table 3-1, TR-55 (Reference 4).

Slopes	Sheet/Overland Flow			
	Surface Condition	**Length (ft)**	**Slope (ft/ft)**	**Estimated Flow Velocity (ft/sec)**
Top Surface – 5%	C	114	0.05	0.85
External Embankment Side Slope – 25% slope	C	240	0.25	1.89

3.1.1 Example Sheet/Overland Flow Velocity Calculation

For sheet flow calculated for a distance of up to 300 feet, use:

$$T_t = \frac{0.007(nL)^{0.8}}{P_{25}^{\ 0.5} s^{0.4}}$$

$$T_t = \frac{L}{3600V}$$

Where:

T_t = travel time (hr);

n = Manning's roughness coefficient (Table 1);

L = flow length (ft);

P_{25} = 25-year, 24-hour rainfall (in);

s = slope of hydraulic grade line (land slope, ft/ft); and

V = average velocity (ft/s)

Using the 25% slope as an example, the average velocity would be calculated as follows:

$$T_t = \frac{0.007(0.06*240)^{0.8}}{(8.5)^{0.5}(0.25)^{0.4}}$$

T_t= 0.03531 hours

Therefore:

$$V = \frac{L}{3600(T_t)}$$

V= 1.89 ft/sec

3.1.2 Soil Erosion Loss

The soil erosion loss was calculated using the Revised Universal Soil Loss Equation (RUSLE), (USDA, 1997, Reference 5).

$$A=R*LS*K*C*P$$

Where:

A = Soil erosion loss, tons/acre/year;

R = Rainfall erosion index = 255 (Reference 6);

K = Soil erodibility factor = 0.21 (4% organic matter for clay loam material form "Table 1, Approximate Values of Factor K for USDA Textural Classes", Reference 6);

LS = Slope length and steepness factor (calculated from Eqs. 8.39-41 and 43 (p. 261) (Haan, 1994) Reference 7);

C = Cover-management factor = 0.042 (Table 2 from Reference 6 assuming no appreciable canopy and 60% ground cover);

P = Support Practice Factor = 1.0 (conservation assumption).

4.0 CALCULATIONS/RESULTS

An excel spreadsheet was developed for the soil erosion loss calculation using the RUSLE equation. The expected soil loss were computed for the top surface slope of 5% and for the external embankment slope of 25%. In accordance with TCEQ guidance (Reference 1), 60% ground cover was assumed for the operational phase of site development, resulting in a cover management factor, C, of 0.042. The longest attainable or allowable slopes were analyzed: 114 feet at 5% and 240 feet at 25% (the max length between slope interrupters).

Table 2 presents the results of the soil loss calculations. The soil loss is significantly less than the permissible soil erosion loss of 50 ton per acre per year recommended by the TCEQ for interim erosion and sediment controls.

Table 2: Soil Erosion Loss Calculation Results – c = 60%

R	K	Slope	Length (l)	Rill susceptibility	LS	C	P	A_i
		(ft/ft)	(ft)	low, mod, high				ton/ac/yr
Top Surface								
255	0.21	0.05	100	mod	0.190	0.042	1	0.4
Example Calculation for External Embankment Side Slope								
255	0.21	0.25	240	mod	8.304	0.042	1	18.7

5.0 CONCLUSION

The proposed 5% top surface can achieve erosional stability during interim conditions of 60% ground cover. Soil loss for the 5% top surface was calculated to be 0.4 tons/acre/year, well below the permissible soil erosion loss of 50 tons/acre/year recommended by the TCEQ for interim erosion and sediment controls.

The external embankment side slopes can achieve erosional stability with a combination of ground cover and storm water diversion structures. To maintain sheet flow runoff (and therefore keep surface water flow velocities below 5 feet per second) and following the typical operation practices, the maximum length of the 25% side slopes is limited to 240 feet. At 60% ground cover, this results in an estimated soil loss of 18.7 tons/acre/year, well below the permissible soil erosion loss of 50 tons/acre/year recommended by the TCEQ for interim erosion and sediment controls.

6.0 REFERENCES

1) Texas Commission of Environmental Quality, “Guidance for Addressing Erosional Stability During All Phases of Landfill Operations (30 TAC §330.305(c), (d), and (e)).” February 2007, Draft.

2) TCEQ Regulatory Guidance, "Guidelines for Preparing a Surface Water Drainage Report for a Municipal Solid Waste Facility.", August 2006

3) McCuen Richard. 1998. *Hydrologic Analysis and Design*. New Jersey: Prentice Hall

4) U.S. Department of Agriculture (USDA). 1986. Urban Hydrology for Small Watersheds. TR-55

5) U.S. Department of Agriculture (USDA). 1997. Predicting soil erosion by water: A guide to conservation planning with the revised universal soil loss equation (RUSLE). (Agricultural Handbook Number 703) US Government Printing Office, Washington, DC.

6) Texas Natural Resource Conservation Commission - Use of the Universal Soil Loss Equation in Final Cover/Configuration Design - Procedural Handbook - Permits Section, Municipal Solid Waste Division - October 1993

7) Haan C.T., B. J. Barfield, and J.C. Hayes. 1994. Design hydrology and sedimentology for small catchments. San Diego CA: Academic Press Inc.

APPENDIX III-2C-2

INTERMEDIATE COVER SOIL BERM CALCULATION

INTERMEDIATE COVER SOIL BERM CALCULATION

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

STATE OF TEXAS
7/21/17
CHARLES G. DOMINGUEZ
83247
LICENSED
PROFESSIONAL ENGINEER

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

INTENDED FOR PERMITTING PURPOSES ONLY

1.0 OBJECTIVE

Calculate the maximum allowable drainage area for the temporary storm water diversion berms (add-on berms) that may be used on areas of

2.0 DESIGN CRITERIA

1) The proposed soil berm is at 2-foot high as measured from the invert of the channel to the top of berm, with the invert sloped at 2% in the direction of flow. The side slope of the soil berm are 4H:1V and 2H:1V.

2) The allowable flow velocity in the proposed diversion channel is 5 ft/sec.

3) Manning's equation is used to calculate the channel flow capacity.

4) Rational method is used to back-calculate the allowable drainage area based on the channel flow capacity.

3.0 METHOD

I) Mannings's equation

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Where:

Q = flow rate

A = cross-sectional area of the flow

R = hydraulic radius

S = slope

n = Manning's n for grass-lined channels = 0.035

II) Rational Method

Q=CIA

Where:

Q = Runoff flow rate;

C = Runoff coefficient = 0.7 for slopes greater than 5% (Reference 1);

i = Rainfall intensity coefficient (Reference 1, TxDot data as shown in Table 2);

A = Drainage area.

4.0 CALCULATIONS

Using Manning's equation to calculate the channel capacity as shown in Table 1.

Using the channel capacity as a limiting factor, the maximum subbasin drainage area for the proposed diversion channel is calculated as shown in Table 2.

Table 1: Channel Flow Capacity

Q (cfs)	Slope (ft/ft)	Left Side Slope (H:1V)	Right Side Slope (H:1V)	Channel Depth (ft)	Bottom Width (ft)	Mannings n	Max Velocity (fps)	Max Normal Flow Depth (ft)	Available Freeboard (ft)
32.2	0.02	2	4	2	0	0.035	**4.8**	**1.5**	0.5

Table 2: Maximum Drainage Area

Coefficient	25-year
e (in)	0.771
b	98
d (mins)	9.2
Intensity (in/hr)	10.0

i =	10.0	in/hr
C =	0.7	For Slopes Greater than 5%
A =	4.6	Acres
Q =	32.2	cfs = channel flow capacity from Table 1

5.0 CONCLUSION

During site operations, the maximum drainage area for the proposed temporary diversion channels is 4.6 acres. As an example, if the diversion channels (add-on berms) are spaced at 240 feet apart along the slope (i.e. 60-foot vertical spacing), the maximum diversion berm length is 835 feet. Downchutes should be constructed at the termination of the diversion berm or in the same location where the final cover downchutes are located as applicable.

6.0 REFERENCE

1) Texas Department of Transportation “Hydraulic Design Manual” Revised March 2004.

APPENDIX III-2C-3

INTERMEDIATE COVER DOWNCHUTE CHANNEL CALCULATION

INTERMEDIATE COVER DOWNCHUTE CHANNEL CALCULATION

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

STATE OF TEXAS
7/21/17
CHARLES G. DOMINGUEZ
83247
LICENSED
PROFESSIONAL ENGINEER

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

INTENDED FOR PERMITTING PURPOSES ONLY

1.0 OBJECTIVE

Evaluate the flow capacity of the temporary downchute channels that may be used on areas of intermediate cover.

2.0 DESIGN CRITERIA

The temporary downchute channels are proposed to be trapezoidal channels. The channels will have 4H:1V side slopes and a depth of 2 ft. The slope of the downchute channels will be no greater than 25% (4H:1V).

- Use Geomembrane lining on the channel bottom and side slopes.

- Manning's equation is used to calculate the channel flow capacity.

-The Rational method is used to calculate peak flow rate.

-Temporary downchutes will be installed at the approximate locations of the final cover downchutes or at the termination points of the diversion channels (add-on berms). Therefore, the drainage area for the temporary downchute will be typically less than or equal to the maximum drainage area of the final cover downchutes.

-At the final cover downchute locations, the intermediate downchute will be constructed with the same dimensions as the final cover downchutes. i.e. 2-feet deep trapezoidal channels with 4:1 (H:V) side slopes.

-At other locations, intermediate downchute dimensions will be based on the watershed area. All intermediate downchutes will be 2-feet deep trapezoidal channels with 4:1 (H:V) slopes. The variable will be the channel bottom width, which can be calculated following the demonstration presented herein.

3.0 METHOD

I) Mannings's equation

Manning's n for plastic-lined channels = 0.012 for stability

$$Q = \frac{1.49}{n} AR^{2/3}S^{1/2}$$

Where:

Q = flow rate

A = cross-sectional area of the flow

R = hydraulic radius

S = slope

II) Rational Method

$$Q=CIA$$

Where:

Q = Runoff flow rate;

C = Runoff coefficient = 0.7 for slopes greater than 5% (Reference 1);

i = Rainfall intensity coefficient;

A = Drainage area.

4.0 CALCULATIONS

- Use 10 acre as an example to demonstrate the procedure for calculating the bottom width of the intermediate downchute channel.

I) Calculate peak flow rates:

A= 10 acres

Assume C= 0.7

$i=b/(t_c+d)^e$ for Hidalgo county, and a 25-year storm event

b= 98

d= 9.2

e= 0.771

t_c= 10 min (conservative assumption)

i= 10 in/hr

Peak flow rate, Q = C*i*A

II) Calculate downchute channel flow capacity

Drainage Area (acres)	Q (cfs)	Slope (ft/ft)	Left Side Slope (H:1V)	Right Side Slope (H:1V)	Channel Depth (ft)	Bottom Width (ft)	Mannings n	Max Velocity (fps)	Max Normal Flow Depth (ft)	Shear Stress (lb/ft^2)	Available Freeboard (ft)
10	**70**	0.25	2	2	2	5	0.012	**30.2**	**0.4**	6.23	1.6

The max velocity is 30.2 ft/sec, which is considered acceptable for geomembrane lined channels. The above analysis shows that for a drainage area of 10 acres, the above-proposed downchute channel will have adequate flow capacity.

5.0 CONCLUSION

The temporary downchute channels will be trapezoidal channels; and they will be constructed at approximately same locations of the final cover downchutes or at the termination points of the diversion berms. The temporary downchute dimensions will either be the same as the final cover downchutes or calculated following the procedure presented in this calculation.

6.0 REFERENCE

1) Texas Department of Transportation "Hydraulic Design Manual" Revised March 2004.

APPENDIX III-2D

EXAMPLE BMP SPECIFICATIONS

ITEM 164

SEEDING FOR EROSION CONTROL

164.1. Description. Provide and install temporary or permanent seeding for erosion control as shown on the plans or as directed.

164.2. Materials.

A. Seed. Provide seed from the previous season's crop meeting the requirements of the Texas Seed Law, including the testing and labeling for pure live seed (PLS = Purity x Germination). Furnish seed of the designated species, in labeled unopened bags or containers to the Engineer before planting. Use within 12 mo. From the date of the analysis. When Buffalograss is specified, use seed that is treated with KNO_3 (potassium nitrate) to overcome dormancy.

Use Tables 1 through 4 to determine the appropriate seed mix and rates as specified on the plans.

Table 1
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils		Sandy Soils	
	Species and Rates (lb. PLS/ac.)		Species and Rates (lb. PLS/ac.)	
1 (Paris) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.2	Bermudagrass	1.5
	Bermudagrass	1.8	Bahiagrass (Pensacola)	6.0
	Little Bluestem (Native)	1.7	Sand Lovegrass	0.6
	Illinois Bundleflower	1.0	Weeping Lovegrass (Ermelo)	0.8
			Partridge Pea	1.0
2 (Ft. Worth) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	2.7	Sand Lovegrass	0.5
	Bermudagrass	0.9	Bermudagrass	1.8
	Little Bluestem (Native)	1.0	Weeping Lovegrass (Ermelo)	0.8
	Blue Grama (Hachita)	0.9	Sand Dropseed	0.4
	Illinois Bundleflower	1.0	Partridge Pearl	1.0
3 (Wichita Falls) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	2.7	Bermudagrass	1.2
	Bermudagrass	0.9	Sand Dropseed	0.4
	Buffalograss (Texoka)	1.6	Sand Bluestem	2.4
	Western Wheatgrass	2.1	Sand Lovegrass	0.3
	Blue Grama (Hachita)	0.6	Weeping Lovegrass (Ermelo)	0.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
4 (Amarillo) Feb. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Weeping Lovegrass (Ermelo)	0.8
	Blue Grama (Hachita)	1.2	Blue Grama (Hachita)	1.0
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.3
	Illinois Bundleflower	1.0	Sand Bluestem	1.8
			Purple Prairieclover	0.5
5 (Lubbock) Feb. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Weeping Lovegrass (Ermelo)	0.8
	Blue Grama (Hachita)	1.2	Blue Grama (Hachita)	1.0
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.3
	Illinois Bundleflower	1.0	Sand Bluestem	1.8
			Purple Prairieclover	0.5

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/ac.)		Sandy Soils Species and Rates (lb. PLS/ac.)	
6 (Odessa) Feb. 1 – May 15	Green Sprangletop Sideoats Grama (Haskell) Blue Grama (Hachita) Alkali Sacaton Galleta Illinois Bundleflower	0.3 2.3 0.8 0.4 2.1 1.0	Green Sprangletop Blue Grama Sand Dropseed Weeping Lovegrass (Ermelo) Indian Ricegrass Purple Prairieclover	0.3 0.8 0.4 0.6 3.0 0.5
7 (San Angelo) Feb. 1 – May 1	Green Sprangletop Sideoats Grama (Haskell) Buffalograss (Texoka) Little Bluestem (Native) Blue Grama (Hachita) Galleta Illinois Bundleflower	0.3 2.7 1.6 1.7 0.9 1.6 1.0	Green Sprangletop Sideoats Grama (Haskell) Weeping Lovegrass (Ermelo) Sand Dropseed Purple Prairieclover	0.3 2.7 0.6 0.4 0.5
8 (Abilene) Feb. 1 – May 15	Green Sprangletop Sideoats Grama (Haskell) Blue Grama (Hachita) Galleta Buffalograss (Texoka) Little Bluestem (Native) Illinois Bundleflower	0.3 2.7 0.9 1.6 1.6 1.7 1.0	Green Sprangletop Sand Bluestem Weeping Lovegrass (Ermelo) Sand Dropseed Purple Prairieclover	0.3 3.0 1.2 0.5 0.5
9 (Waco) Feb. 1 – May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell) Little Bluestem (Native) Illinois Bundleflower	0.3 1.2 3.6 2.0 1.0	Green Sprangletop Bermudagrass Sand Dropseed Weeping Lovegrass (Ermelo) Partridge Pea	0.3 2.4 0.5 0.8 1.0
10 (Tyler) Feb. 1 – May 15	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Sideoats Grama (Haskell) Illinois Bundleflower	0.3 1.8 9.0 2.7 1.0	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Weeping Lovegrass (Ermelo) Sand Lovegrass Lance-Leaf Coreopsis	0.3 1.8 9.0 0.5 0.5 1.0
11 (Lufkin) Feb. 1 – May 15	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Sideoats Grama (Haskell) Illinois Bundleflower	0.3 1.8 9.0 2.7 1.0	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Sand Lovegrass Lance-Leaf Coreopsis	0.3 2.1 9.0 0.5 1.0
12 (Houston) Jan. 15 – May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell) Little Bluestem (Native) Illinois Bundleflower	0.3 2.1 3.2 1.4 1.0	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Weeping Lovegrass (Ermelo) Lance-Leaf Coreopsis	0.3 2.4 10.5 0.5 1.0
13 (Yoakum) Jan. 15 – May 15	Green Sprangletop Sideoats Grama (Haskell) Bermudagrass Little Bluestem (Native) Illinois Bundleflower	0.3 3.6 1.8 1.4 1.0	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Sand Lovegrass Weeping Lovegrass (Ermelo) Partridge Pea	0.3 1.8 6.0 0.6 0.6 1.0

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/ac.)		Sandy Soils Species and Rates (lb. PLS/ac.)	
14 (Austin) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	0.9	Bermudagrass	2.4
	Sideoats Grama (Haskell)	2.7	Weeping Lovegrass (Ermelo)	0.8
	Little Bluestem (Native)	1.0	Sand Lovegrass	0.8
	Blue Grama (Hachita)	0.9	Partridge Pea	1.0
	Illinois Bundleflower	1.0		
15 (San Antonio) Feb. 1 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.2	Bermudagrass	1.8
	Sideoats Grama (Haskell)	2.7	Lehmanns Lovegrass	0.6
	Little Bluestem (Native)	1.4	Sand Lovegrass	0.6
	Plains Bristlegrass	1.2	Buffelgrass (Common)	0.4
	Illinois Bundleflower	1.0	Partridge Pea	1.0
16 (Corpus Christi) Jan. 1 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	2.7	Bermudagrass	1.8
	Bermudagrass	1.8	Buffelgrass (Common)	0.4
	Buffalograss (Texoka)	1.6	Sand Lovegrass	0.6
	Plains Bristlegrass	1.2	Lehmanns Lovegrass	0.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
17 (Bryan) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.5	Bermudagrass	1.5
	Sideoats Grama (Haskell)	3.6	Bahiagrass (Pensacola)	7.5
	Little Bluestem (Native)	1.7	Weeping Lovegrass (Ermelo)	0.6
	Illinois Bundleflower	1.0	Sand Lovegrass	0.6
			Lance-Leaf Coreopsis	1.0
18 (Dallas) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.2	Bermudagrass	1.8
	Sideoats Grama (El Reno)	2.7	Weeping Lovegrass (Ermelo)	0.6
	Little Bluestem (Native)	2.0	Sand Lovegrass	0.6
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.4
	Illinois Bundleflower	1.0	Partridge Pea	1.0
19 (Atlanta) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	2.1
	Sideoats Grama (Haskell)	4.5	Bahiagrass (Pensacola)	7.5
	Illinois Bundleflower	1.0	Sand Lovegrass	0.6
			Lance-Leaf Coreopsis	1.0
20 (Beaumont) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.7	Bermudagrass	2.1
	Sideoats Grama (Haskell)	4.1	Bahiagrass (Pensacola)	7.5
	Illinois Bundleflower	1.0	Sand Lovegrass	0.6
			Lance-Leaf Coreopsis	1.0
21 (Pharr) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Bermudagrass	1.8
	Plains Bristlegrass	1.2	Buffelgrass (Common)	0.4
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.4
	Bermudagrass	1.2	Lehmanns Lovegrass	0.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils: Species and Rates (lb. PLS/ac.)		Sandy Soils: Species and Rates (lb. PLS/ac.)	
22 (Laredo) Jan. 15 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Bermudagrass	1.8
	Bermudagrass	1.2	Buffelgrass (Common)	0.4
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.4
	Plains Bristlegrass	1.2	Lehmanns Lovegrass	0.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
23 (Brownwood) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	2.7	Bermudagrass	1.8
	Bermudagrass	0.6	Weeping Lovegrass (Ermelo)	0.6
	Blue Grama (Hachita)	0.9	Sand Lovegrass	0.6
	Galleta	2.1	Sand Dropseed	0.4
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
24 (El Paso) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Butte)	2.7	Sand Dropseed	0.4
	Blue Grama (Hachita)	0.9	Lehmanns Lovegrass	0.9
	Galleta	2.1	Blue Grama (Hachita)	1.0
	Alkali Sacaton	0.4	Indian Ricegrass	1.6
	Illinois Bundleflower	1.0	Purple Prairieclover	0.5
25 (Childress) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	2.7	Weeping Lovegrass (Ermelo)	1.2
	Blue Grama (Hachita)	0.9	Sand Dropseed	0.5
	Western Wheatgrass	2.1	Sand Lovegrass	0.8
	Galleta	1.6	Purple Prairieclover	0.5
	Illinois Bundleflower	1.0		

Table 2
Permanent Urban Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/ac.)		Sandy Soils Species and Rates (lb. PLS/ac.)	
1 (Paris) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
2 (Ft. Worth) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Sideoats Grama (El Reno)	3.6
	Bermudagrass	2.4	Bermudagrass	2.1
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.3
3 (Wichita Falls) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	4.5	Sideoats Grama (El Reno)	3.6
	Bermudagrass	1.8	Bermudagrass	1.8
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.4
4 (Amarillo) Feb. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Sideoats Grama (El Reno)	2.7
	Blue Grama (Hachita)	1.2	Blue Grama (Hachita)	0.9
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.4
			Buffalograss (Texoka)	1.6
5 (Lubbock) Feb. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Sideoats Grama (El Reno)	2.7
	Blue Grama (Hachita)	1.2	Blue Grama (Hachita)	0.9
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.4
			Buffalograss (Texoka)	1.6
6 (Odessa) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Sideoats Grama (Haskell)	2.7
	Blue Grama (Hachita)	1.2	Sand Dropseed	0.4
	Buffalograss (Texoka)	1.6	Blue Grama (Hachita)	0.9
			Buffalograss (Texoka)	1.6
7 (San Angelo) Feb. 1 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	7.2	Sideoats Grama (Haskell)	3.2
	Buffalograss (Texoka)	1.6	Sand Dropseed	0.3
			Blue Grama (Hachita)	0.9
			Buffalograss (Texoka)	1.6

Table 2 (continued)
Permanent Urban Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/ac.)		Sandy Soils Species and Rates (lb. PLS/ac.)	
8 (Abilene) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Sand Dropseed	0.3
	Blue Grama (Hachita)	1.2	Sideoats Grama (Haskell)	3.6
	Buffalograss (Texoka)	1.6	Blue Grama (Hachita)	0.8
			Buffalograss (Texoka)	1.6
9 (Waco) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	1.8	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Sideoats Grama (Haskell)	4.5	Sand Dropseed	0.4
10 (Tyler) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
11 (Lufkin) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
12 (Houston) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	4.5	Bermudagrass	5.4
	Bermudagrass	2.4		
13 (Yoakum) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	4.5	Bermudagrass	5.4
	Bermudagrass	2.4		
14 (Austin) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	4.8
	Sideoats Grama (Haskell)	3.6	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6		
15 (San Antonio) Feb. 1 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Bermudagrass	4.8
	Bermudagrass	2.4	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6		
16 (Corpus Christi) Jan. 1 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Bermudagrass	4.8
	Bermudagrass	2.4	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6		

Table 2 (continued)
Permanent Urban Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/ac.)		Sandy Soils Species and Rates (lb. PLS/ac.)	
17 (Bryan) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
18 (Dallas) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Bermudagrass	2.4	Sand Dropseed	0.4
19 (Atlanta) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
20 (Beaumont) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
21 (Pharr) Jan. 15 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Bermudagrass	2.4	Sand Dropseed	0.4
22 (Laredo) Jan. 15 – May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	4.5	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	3.6
	Bermudagrass	1.8	Sand Dropseed	0.4
23 (Brownwood) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Buffalograss (Texoka)	1.6
	Bermudagrass	1.2	Bermudagrass	3.6
	Blue Grama (Hachita)	0.9	Sand Dropseed	0.4
24 (El Paso) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Butte)	3.6	Buffalograss (Texoka)	1.6
	Blue Grama (Hachita)	1.2	Sand Dropseed	0.4
	Buffalograss (Texoka)	1.6	Blue Grama (Hachita)	1.8
25 (Childress) Feb. 1 – May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Sand Dropseed	0.4
	Blue Grama (Hachita)	1.2	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	1.8

Table 3
Temporary Cool Season Seeding

Districts	Dates	Seed Mix and Rates (lb./ac.)	
Paris (1), Amarillo (4), Lubbock (5), Dallas (18)	September 1 – November 30	Tall Fescue Western Wheatgrass Wheat (Red, Winter)	4.5 5.6 34
Odessa (6), San Angelo (7), El Paso (24)	September 1 – November 30	Western Wheatgrass Wheat (Red, Winter)	8.4 50
Waco (9), Tyler (10), Lufkin (11), Austin (14), San Antonio (15), Bryan (17), Atlanta (19)	September 1 – November 30	Tall Fescue Oats Wheat	4.5 24 34
Houston (12), Yoakum (13), Corpus Christi (16), Beaumont (20), Pharr (21), Laredo (22)	September 1 – November 30	Oats	72
Ft. Worth (2), Wichita Falls (3), Abilene (8), Brownwood (23), Childress (25)	September 1 – November 30	Tall Fescue Western Wheatgrass Cereal Rye	4.5 5.6 34

Table 4
Temporary Warm Season Seeding

Districts	Dates	Seed Mix and Rates (lb./ac.)	
All	May 1 – August 31	Foxtail Millet	34

B. Fertilizer. Use fertilizer in conformance with Article 166.2, "Materials."

C. Vegetative Watering. Use water that is clean and free of industrial wastes and other substances harmful to the growth of vegetation.

D. Mulch.

1. **Straw or Hay Mulch.** Use straw or hay mulch in conformance with Article 162.2.E, "Mulch."
2. **Cellulose Fiber Mulch.** Use only cellulose fiber mulches that are on the approved list published in "Field Performance of Erosion Control Products," available from the Maintenance Division. Submit 1 full set of manufacturer's literature for the selected material. Keep mulch dry until applied. Do not use molded or rotted material.

E. Tacking Methods. Use a tacking agent applied in accordance with the manufacturer's recommendations or a crimping method on all straw or hay mulch operations. Tacking agents must be approved before use, or specified on the plans.

164.3. Construction. Cultivate the area to a depth of 4 in. before placing the seed unless otherwise directed. When performing permanent seeding after an established temporary seeding, cultivate the seedbed to a depth of 4 in. or mow the area before placement of the permanent seed. Plant the seed specified and mulch, if required, after the area has been completed to lines and grades as shown on the plans.

A. Broadcast Seeding. Distribute the seed or seed mixture uniformly over the areas shown on the plans using hand or mechanical distribution or hydro-seeding on top of the soil. When seed and water are to be distributed as a slurry during hydro-seeding, apply the mixture to the area to be seeded within 30 min. of placement of components in the equipment. Roll the planted area with a light roller or other suitable equipment. Roll sloped areas along the contour of the slopes.

B. Straw or Hay Mulch Seeding. Plant seed according to Section 164.3.A, "Broadcast Seeding." Immediately after planting the seed or seed mixture, apply straw or hay mulch uniformly over the seeded area. Apply straw mulch at 2 to 2.5 tons per acre. Apply hay mulch at 1.5 to 2 tons per acre. Use a tacking method over the mulched area.

C. **Cellulose Fiber Mulch Seeding.** Plant seed according to Section 164.3.A, "Broadcast Seeding." Immediately after planting the seed or seed mixture, apply cellulose fiber mulch uniformly over the seeded area at the following rates:

- Sandy Soils with slopes of 3:1 or less—2500 lb. per acre.
- Sandy Soils with slopes greater than 3:1—3000 lb. per acre.
- Clay Soils with slopes of 3:1 or less—2000 lb. per acre.
- Clay Soils with slopes greater than 3:1—2300 lb. per acre.

Cellulose fiber mulch rates are based on dry weight of mulch per acre. Mix cellulose fiber mulch and water to make a slurry and apply uniformly over the seeded area using suitable equipment.

D. **Drill Seeding.** Plant seed or seed mixture uniformly over the area shown on the plans at a depth of 1/4 to 1/3 in. using a pasture or rangeland type drill. Plant seed along the contour of the slopes.

E. **Straw or Hay Mulching.** Apply straw or hay mulch uniformly over the area as indicated on the plans. Apply straw mulch at 2 to 2.5 tons per acre. Apply hay mulch at 1.5 to 2 tons per acre. Use a tacking method over the mulched area.

Apply fertilizer in conformance with Article 166.3, "Construction." Seed and fertilizer may be distributed simultaneously during "Broadcast Seeding" operations, provided each component is applied at the specified rate. When temporary and permanent seeding are both specified for the same area, apply half of the required fertilizer during the temporary seeding operation and the other half during the permanent seeding operation.

Water the seeded areas at the rates and frequencies as shown on the plans or as directed.

164.4. Measurement. This Item will be measured by the square yard or by the acre.

164.5. Payment. The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Broadcast Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Broadcast Seeding (Temp)" of warm or cool season specified, "Straw or Hay Mulch Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Straw or Hay Mulch Seeding (Temp)" of warm or cool season specified, "Cellulose Fiber Mulch Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Cellulose Fiber Mulch Seeding (Temp)" of warm or cool season specified, "Drill Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Drill Seeding (Temp)" of warm or cool season specified, and "Straw or Hay Mulching." This price is full compensation for furnishing materials, including water for hydro-seeding and hydro-mulching operations, mowing, labor, equipment, tools, supplies, and incidentals. Fertilizer will not be paid for directly but will be subsidiary to this Item. Water for irrigating the seeded area, when specified, will be paid for under Item 168, "Vegetative Watering."

High Performance Erosion Control

Flexterra® HP-FGM™

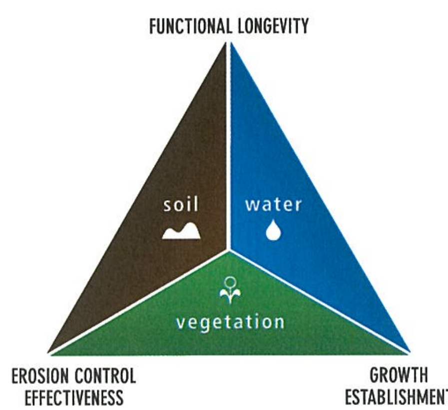
Profile®

Green Design Engineering™

GREEN DESIGN ENGINEERING™
EARTH-FRIENDLY SOLUTIONS FOR SUSTAINABLE RESULTS™

GREEN DESIGN ENGINEERING™ AT ITS FINEST

Flexterra® HP-FGM™ represents the pinnacle of Profile's Green Design Engineering,™ a holistic approach combining agronomic and engineering expertise to produce a broad array of cost-effective and earth-friendly solutions. Illustrated to the right is Profile's Green Design Triangle, a fundamental component of Green Design Engineering that integrates the three primary natural variables: soil, water and vegetation—with the three pillars of product performance—erosion control effectiveness, growth establishment and functional longevity. To obtain an optimal solution of sustainable vegetation, designers must account for these natural variables while selecting products with the proper balance of performance characteristics to achieve project success, particularly when confronted with harsh soil conditions and severe slopes.



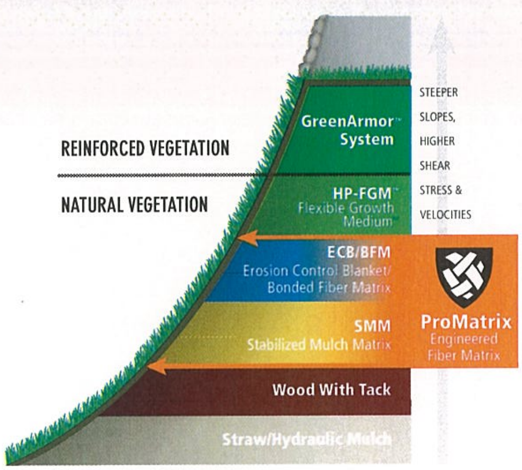
Flexterra® HP-FGM™: The pinnacle of Profile's Green Design Engineering™

Patented Flexterra® High Performance-Flexible Growth Medium™ (HP-FGM™) represents the next generation in Flexible Growth Media—proven to surpass *all* hydraulically applied mulch products and rolled erosion control blankets:

- Immediately effective upon application—bonds directly to soil
- Superior erosion control—99% effective at multiple large-scale testing laboratories
- Less soil preparation, faster lay down and lower installed cost than rolled blankets
- Faster vegetative establishment and greater biomass production than *any* rolled blanket or hydraulically applied mulch available
- Minimizes soil loss and turbidity of effluent runoff

Flexterra HP-FGM has also proven to be more environmentally friendly:

- 100% recycled wood fibers
- Phyto-sanitized wood fibers eliminate weed seeds and pathogens
- 100% biodegradable man-made fibers
- Naturally derived biopolymers
- Non-toxic components
- No nettings, threads or staples to endanger wildlife



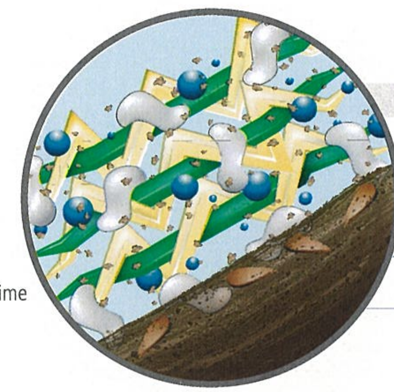
Green Design Engineering™ delivers superior erosion control across our spectrum of products, producing reliable, sustainable solutions for slopes, channels, shorelines, water management projects, pipeline restorations, waste and fly ash containment sites, landfills, fine turf areas and other environmentally sensitive sites. By ensuring more successful erosion control through faster and denser vegetation establishment, Green Design Engineering also helps you achieve the highest return on investment:

- Affordably achieve and maintain environmental compliance
- Meet current and proposed EPA protocols to ensure safety of aquatic and terrestrial life
- Eliminate callbacks and "do-overs" due to insufficient erosion protection or "grow in"
- Contribute to LEED credits

Patented technologies and greener components deliver unmatched performance

Patented new technologies developed through Green Design Engineering,™ combined with the patented composition of original Flexterra, are what make Flexterra® HP-FGM™ stand apart from the crowd. Flexterra HP-FGM combines both chemical and mechanical bonding techniques to lock the engineered medium in place and promote accelerated germination with minimal soil loss. Greener from the inside-out, here's what makes it work so well:

- New, revolutionary patented "Micro-Pore" particles optimize water and nutrient retention while contributing to increased erosion control effectiveness
- 100% recycled Thermally Refined® wood fibers not only produce the highest yield and coverage per unit weight applied, they are also phyto-sanitized, eliminating weed seeds and pathogens
- 100% biodegradable interlocking man-made fibers help increase erosion control effectiveness and minimize curing time
- 100% non-toxic biopolymers and water absorbents further enhance overall performance

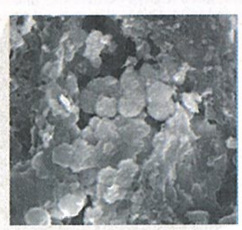


	HP-FGM™
EROSION CONTROL EFFECTIVENESS (%)	≥ 99
GROWTH ESTABLISHMENT (% IMPROVEMENT)	800
LONGEVITY (MONTHS)	≤ 18

Micro-Pore Technology

PATENTED, REVOLUTIONARY MICRO-PORE TECHNOLOGY INCREASES STRENGTH AND ESTABLISHMENT

Micro-Pore particles increase erosion control effectiveness of the flexible growth medium, yielding increased resistance to raindrop impact and sheet flow.

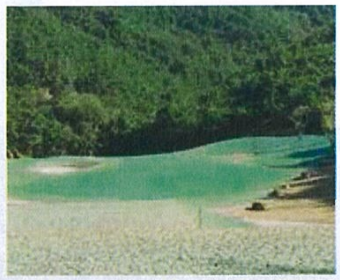


Micro-Pore particle magnified 500 times. Each particle traps and holds moisture and nutrients, reduces soil surface evaporation and improves oxygen exchange, all of which contribute to faster, more uniform vegetation establishment.

Proven to outperform in any application

Flexterra® HP-FGM™ delivers a nearly perfect balance between three fundamental pillars of performance—erosion control effectiveness, growth establishment and functional longevity—to create the highest performing hydraulically applied medium on the market today.

Highway Projects

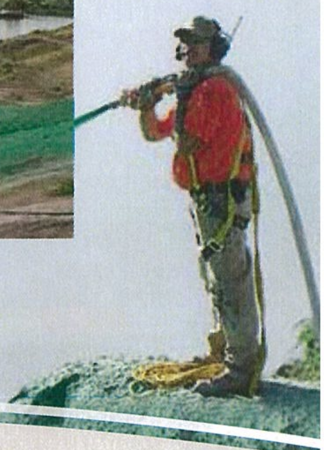

Golf Course Construction


Commercial and Residential Development


Oil and Gas Restoration


Mine and Fire Reclamation


Waterways



Thermally Refined® Wood Fibers


Fibers magnified 45 times by independent lab specializing in fiber analysis.

THERMALLY REFINED® WOOD FIBERS— SUPERIOR FIBERS DELIVER SUPERIOR RESULTS

Profile starts with 100% recycled wood chips that are Thermally Refined® in a process that creates fine, long and highly absorbent fibers. These engineered fibers are the source for Profile's superior:

- Yield and coverage
- Water-holding capacity
- Growth establishment
- Erosion control effectiveness

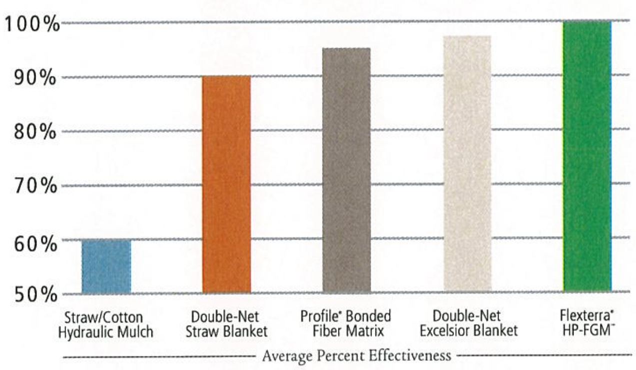

Inferior wood fiber magnified 45 times.

THERMALLY REFINED WOOD FIBERS VS. ALTERNATIVE HYDRAULIC MULCHES

Competitive refining technologies develop inferior fibers that deliver less yield, coverage and water-holding capacity. You need more bales to achieve the coverage and performance of Profile's Thermally Refined wood fiber matrices. Unlike competitive mulches, our fibers also maintain their water-holding ability, enabling them to enhance germination and growth establishment. Claims by competitive mulches that save or use less water during application, just don't hold water.

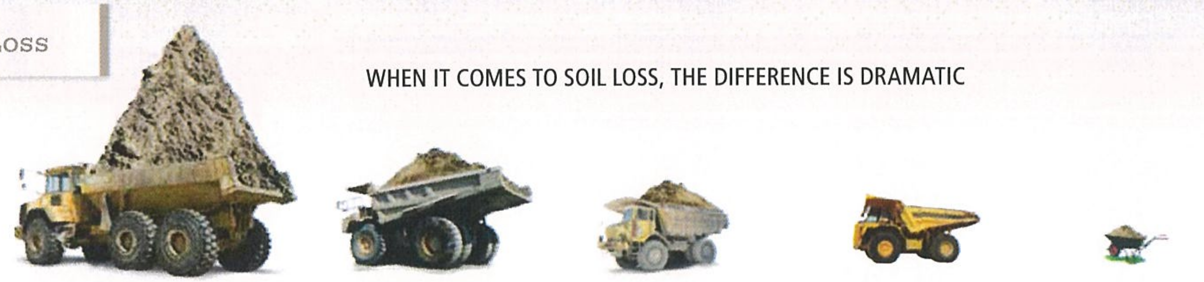
Nothing keeps more soil on site

Flexterra® HP-FGM™ has demonstrated nearly perfect erosion control performance—even on slopes as severe as 0.25H:1V. It immediately bonds to the soil surface, and has proven to be greater than 99% effective upon curing. Its flexible, yet stable matrix features greater erosion control effectiveness, yielding increased sheet flow resistance. In addition to minimizing soil loss, the turbidity (NTU) of runoff is greatly reduced. In large scale testing, Flexterra HP-FGM reduced effluent turbidities of sandy loam soils to less than 100 NTU.



Soil Loss

WHEN IT COMES TO SOIL LOSS, THE DIFFERENCE IS DRAMATIC



Straw/Cotton Hydraulic Mulch	Double-Net Straw Blanket	Bonded Fiber Matrix	Double-Net Excelsior Blanket	Flexterra® HP-FGM™
75,520 lb soil loss/ac	**18,025 lb** soil loss/ac	**8,935 lb** soil loss/ac	**6,050 lb** soil loss/ac	**173 lb** soil loss/ac
(84,647 kg soil loss/ha)	(20,203 kg soil loss/ha)	(10,015 kg soil loss/ha)	(6,781 kg soil loss/ha)	(194 kg soil loss/ha)

Testing conducted at the Utah Water Research Laboratory at a rate of 5 inches of rain per hour on a 2.5H:1V slope with a sandy loam soil.

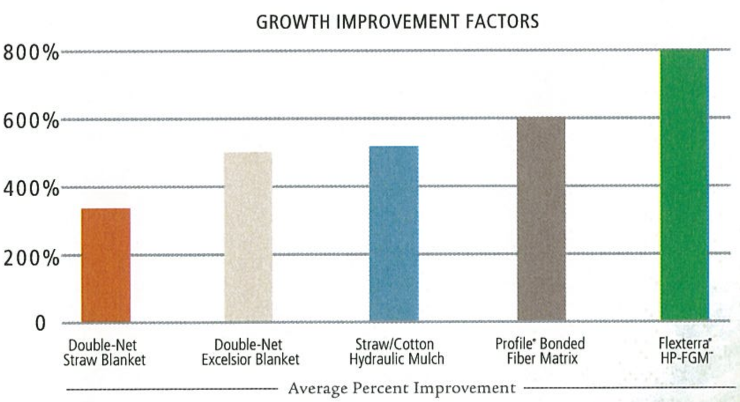
FLEXTERRA® HP-FGM™ REQUIRES MINIMAL SOIL PREPARATION VS. ROLLED BLANKETS

Why incur the cost of smoothing your slopes for erosion control blankets that are prone to bridging and voiding? Experts recognize that rough seedbeds demonstrate lower erosion potential and their undulations retain seed and moisture for growth. With Flexterra® HP-FGM,™ fine grading and extensive soil preparation are unnecessary, allowing you to apply the product for immediate protection and superior performance at reduced overall costs. Flexterra HP-FGM can be applied quickly—even under wet conditions—using less labor and minimizing safety and access concerns. Get the job done and move on to the next one with fewer rainouts.

Nothing establishes vegetation more reliably

Flexterra's high-performance matrix outperforms all other erosion control products through a combination of optimized water/nutrient retention and enhanced growth environment. The loft of the HP-FGM™ matrix creates air space, which not only captures more moisture to improve seedling emergence, it also improves the oxygen exchange necessary for robust plant development. Patented Micro-Pore Technology gives the matrix additional water and nutrient retention properties, which results in superior vegetation establishment as documented in independent testing.

Establishing vegetation quickly and completely is the key to long-term erosion control. Compare Flexterra® HP-FGM™ to the average values of common technologies as documented in published AASHTO-NTPEP reports and independent laboratory testing using standard test method ASTM D7322.



ProPlus® Solutions

ProPlus®

WHEN YOU NEED ADVANCED AGRONOMIC SOLUTIONS

Soil is the foundation of sustainable vegetation. Profile's agronomic experts have engineered a diverse line of unique ProPlus® Prescriptive Agronomic Formulations (PAFs) designed to take erosion control effectiveness to the highest levels possible. Each PAF product addresses specific soil challenges in order to provide optimal growing conditions and help achieve denser vegetative cover more quickly:

- Enhance soil structure
- Increase soil moisture infiltration and retention
- Improve nutrient uptake by plants
- Stimulate germination and growth

SOIL NEUTRALIZERS

NeutraLime™ and **Aqua-pHix™** neutralize acidic and alkaline soils, respectively, to promote more complete germination and establish sustainable vegetation, faster. Balancing soil pH ensures more efficient nutrient uptake and minimizes fertilizer runoff and leaching.

GROWTH STIMULANTS

To establish vegetation faster with long-term effectiveness on challenging soils that lack organic matter and beneficial biotic microorganisms, Profile® offers **JumpStart™** and **BioPrime.™** Both are proven to deliver improved germination, increased root mass and better plant vitality.

Flexterra® HP-FGM™ is the first erosion control product to offer documented functional longevity based upon ASTM D5338 protocol

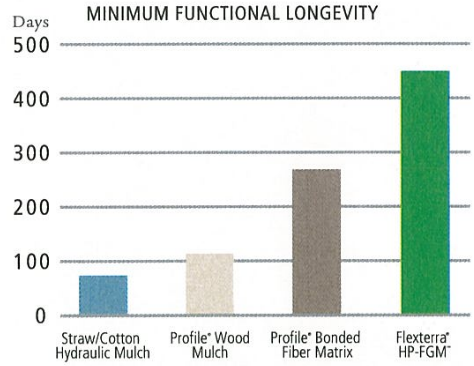
Functional longevity is a term describing how long an erosion control material is predicted to provide desired performance attributes. Actual functional longevity is determined by a material's physical composition as well as site-specific conditions such as temperature, moisture, sunlight, soil composition, biological activity and other environmental factors.

The ASTM D5338 protocol confirms Flexterra® HP-FGM's observed functional longevity of up to 18 months. As illustrated in the test results presented below, Flexterra® HP-FGM™ is proven to last longer than other hydraulically applied erosion control products.

Long-lasting Flexterra HP-FGM is designed to:

- Provide protection on bare soil over periods of dormancy, such as winter or extended dry periods, when seed germination is not possible; yet soil erosion and seed washout can occur from snow melt and runoff.
  - > Flexterra HP-FGM assures that when more optimal growing conditions arrive, the seed and nutrients are still in place and in an environment conducive to germination and emergence.
- Ensure sustainability of plants
  - > Emerging seedlings need moisture and nutrients near the surface. The exceptional absorptive properties of Flexterra HP-FGM nurture vegetation to better withstand environmental stress.
- Accommodate a broad range of vegetative species
  - > Seed from native and forage grasses, fine turf, shrubs, forbs and other types of vegetation have different germination and establishment requirements. Flexterra HP-FGM protects and helps to cultivate even the slowest developing species.

MINIMUM FUNCTIONAL LONGEVITY



Based on ASTM D5338 Half Life Data

YOUR SINGLE SOURCE FOR SUSTAINABLE, SITE-SPECIFIC SOLUTIONS

As the industry's first and only web-based design and selection tool, Profile Soil Solutions Software (PS³) integrates erosion and sediment control engineering with agronomic excellence. It addresses both the physical and chemical properties of soil and site characteristics to help you develop holistic, sustainable and environmentally friendly solutions. PS³:

- Facilitates soil testing and offers agronomic recommendations to ensure effective growth establishment
- Integrates slope and channel erosion design methodology using universally accepted protocols
- Provides access to complete documentation, including product specifications, installation guidelines, CAD details and other pertinent technical information
- Offers 24/7 availability, with access to design, diagnostics, explanations and guidance in creating sustainable erosion and sediment control solutions

PS³ Online Tool

PS³ PROFILE SOIL SOLUTIONS SOFTWARE

Log on to www.profileps3.com for convenient, comprehensive assistance.

Site available in English and Spanish languages as well as English and metric units.

Flexterra® HP-FGM™ leaves nothing but a better environment behind

A result of Profile's Green Design Engineering,™ Flexterra® HP-FGM™ not only leads to sustainable vegetation, it enhances the natural environment. Flexterra HP-FGM:

- Is 100% biodegradable as verified by ASTM Test Method D5338
- Uses 100% recycled (verified via ISO 14021), phyto-sanitized and sterilized wood fibers which are heated to 380° F (193° C) during Thermally Refined® processing, making them weed and pathogen free
- Is non-toxic to aquatic and terrestrial life forms as verified via EPA 2021.0 protocol
- Contains no excessive heavy metals as verified by US EPA Standard Methods 18th Edition
- Exhibits effluent runoff turbidity values less than 100 NTU, well below proposed EPA Effluent Limitation Guidelines (ELGs)
- Has no nets or threads to endanger wildlife and disrupt maintenance activities, a common hazard with many rolled erosion control blankets

SAFETY IN NUMBERS

FLEXTERRA HP-FGM

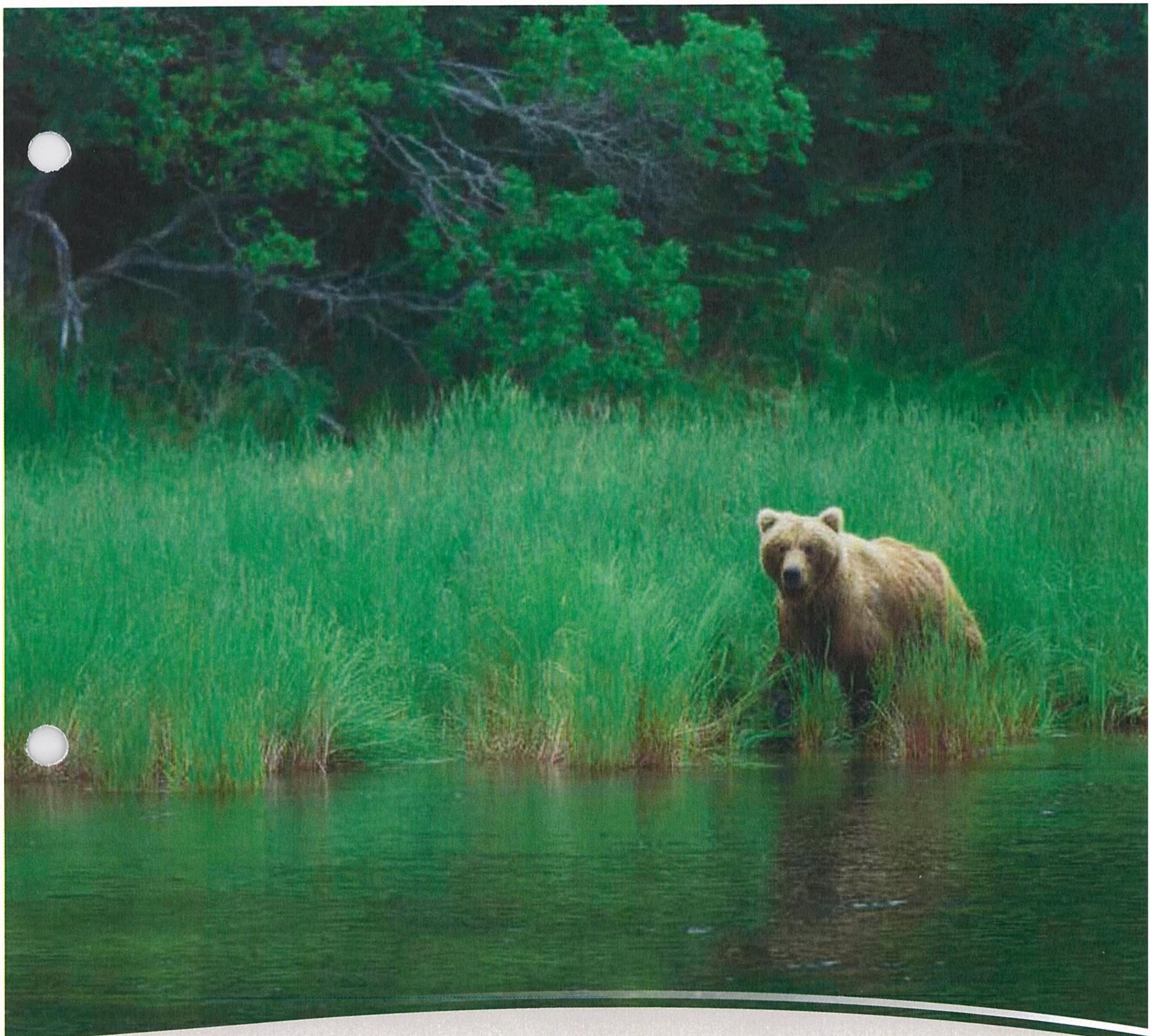
ENVIRONMENTAL PROPERTIES	TEST METHOD	UNITS	TYPICAL VALUE
ECOTOXICITY	EPA 2021.0	%	96-hr LC50 > 100%
EFFLUENT TURBIDITY	Large Scale Rainfall Testing	NTU	100
BIODEGRADABILITY	ASTM D5338	%	100

Specifications

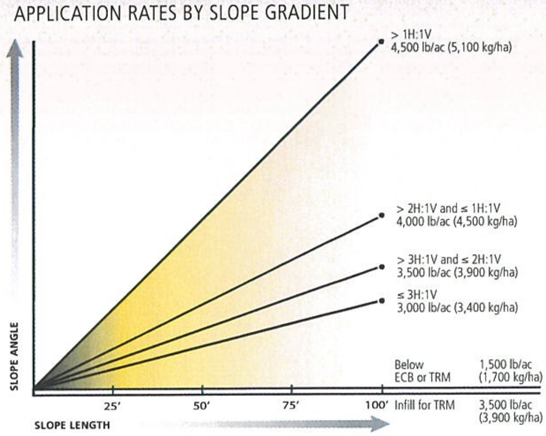
FLEXTERRA® HP-FGM™: THE GOLD STANDARD

Flexterra® HP-FGM™ is a fully biodegradable, hydraulically applied, flexible erosion control blanket composed of 100% recycled and Thermally Refined® wood fibers, crimped interlocking man-made biodegradable fibers, micro-pore granules, naturally derived cross-linked biopolymers and water absorbents. Flexterra HP-FGM is phyto-sanitized, free from plastic netting, requires no curing period and upon application, forms an intimate bond with the soil surface to create a continuous, porous, absorbent and flexible erosion resistant blanket that allows for rapid germination and accelerated plant growth.

HP-FGM shall have a documented erosion control effectiveness rating of 99% (via approved large-scale testing laboratory), an 800% growth improvement factor (via ASTM D7322), exhibit functional longevity of 12-18 months (via ASTM D5338) and as observed under field conditions as well as conform to other performance and physical property values as listed in the Flexterra HP-FGM CSI formatted specification. This document is readily downloadable at www.profileproducts.com.



APPLICATION RATES BY SLOPE GRADIENT



INSTALLATION INSTRUCTIONS

Strictly comply with manufacturer's installation instructions and recommendations. Use approved hydro-spraying machines with fan-type nozzle (50-degree tip). To achieve optimum soil surface coverage, apply HP-FGM™ from opposing directions to soil surface.

STEP ONE

Apply seed, fertilizer and other soil amendments with small amount of Flexterra® HP-FGM for visual metering.

STEP TWO

Mix 50 lb (22.7 kg) of HP-FGM per 125 gal (475 L) of water; confirm loading rates with equipment manufacturer.

BAGS

Net Weight—50 lb (22.7 kg), UV-resistant plastic film.

PALLETS

Weatherproof, stretch-wrapped with UV-resistant pallet cover, 40 bags/pallet, 1 ton/pallet (0.91 tonnes/pallet).

For more details, visit: www.profileproducts.com

Delivering greater value, project after project

A global leader in erosion control and revegetation science, PROFILE Products LLC provides our customers with cost effective and sustainable solutions using environmentally friendly products. We are the preeminent manufacturer and supplier of hydraulically applied erosion control technologies, rolled erosion control blankets, turf reinforcement mats, and vegetation establishment products.

Many of today's industry standards were innovations developed and introduced by Profile incorporating Green Design Engineering™, our holistic approach that combines environmentally beneficial project design with products that are ecologically responsible. We endeavor to provide measurable value to our customers through our team of consulting professionals, innovative products, aggressive research and development, industry support, and delivery of educational resources.

Find us on Facebook
facebook.com/profileproducts

Profile
Solutions for your Environment™

For technical information or distribution, please call (800) 508-8681. For customer service, call (800) 366-1180.

 For warranty information, visit www.profileproducts.com. 750 Lake Cook Road – Suite 440, Buffalo Grove, IL 60089

U.S. Patent #'s: 5,942,029; 5,779,782; 5,741,832; 6,360,478; 7,752,804

www.flexterra.com

IECA

HP-02 03/12

Profile
Solutions for your Environment™

Flexterra® HP-FGM™

High Performance Erosion Control

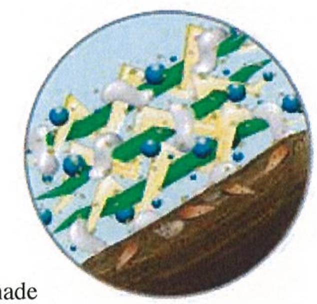
Absolutely The Most Effective Erosion Control Medium Available.

Flexterra® HP-FGM™ represents the next generation in Flexible Growth Media and is proven to surpass the original's outstanding performance.

Flexterra HP-FGM Delivers:

- The highest germination and growth establishment
- Greater than 99% erosion control effectiveness immediately upon application
- 100% biodegradability
- Greater safety for even the most sensitive aquatic environment because it's non-toxic
- Near-perfect erosion control and denser vegetation while protecting the natural environment

HP Technology: Greener By Design

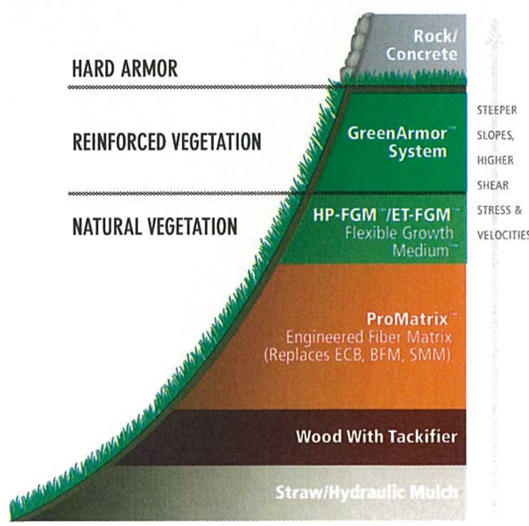


100% recycled Thermally Refined® wood fibers produce the highest yield and coverage per unit weight and are phyto-sanitized, eliminating weed seeds and pathogens

100% biodegradable interlocking man-made fibers increase mechanical bonding of the matrix to provide immediate performance upon installation

100% non-toxic biopolymers and water absorbents enhance erosion control resistance and growth establishment

Revolutionary Micro-Pore particles optimize water and nutrient retention



Flexterra® HP-FGM™ Technical Data:

	TEST METHOD	UNITS	MINIMUM VALUE
PHYSICAL PROPERTIES*			
Mass/Unit Area	ASTM D6566[1]	g/m² (oz/yd²)	407 (12)
Thickness	ASTM D6525[1]	mm (in)	5.6 (0.22)
Erosion Control Effectiveness	ASTM D6818[1]	N/m (lb/ft)	131 (9)
Ground Cover	ASTM D6567[1]	%	99
Water-Holding Capacity	ASTM D7367	%	1700
Material Color	Observed	n/a	Green
ENVIRONMENTAL PROPERTIES*	**TEST METHOD**	**UNITS**	**TYPICAL VALUE**
Biodegradability	ASTM D5338	%	100
Functional Longevity[2]	ASTM D5338	n/a	Up to 18 months
Ecotoxicity	EPA 2021.0	%	96-hr LC50 > 100%
Effluent Turbidity	Large Scale[3]	NTU	< 100
PERFORMANCE PROPERTIES*	**TEST METHOD**	**UNITS**	**VALUE**
Cover Factor[4]	Large Scale[3]	n/a	< 0.01
Percent Effectiveness[5]	Large Scale[3]	%	> 99
Cure Time	Observed	hours	0-2
Vegetation Establishment	ASTM D7322[1]	%	> 800
PRODUCT COMPOSITION			**TYPICAL VALUE**
Thermally Processed Wood Fibers[6] (within a pressurized vessel)			80% ± 3%
Cross-Linked Biopolymers and Water Absorbents			10% ± 1%
Crimped, Man-Made Biodegradable Interlocking Fibers			5% ± 1%
Proprietary Mineral Activator			5% ± 1%

** When uniformly applied at a rate of 3500 lb/ac (3900 kg/ha) under laboratory conditions.*

1. *ASTM test methods developed for Rolled Erosion Control Products that have been modified to accommodate Hydraulic Erosion Control Products.*
2. *Functional Longevity is the estimated time period, based upon field observations, that a material can be anticipated to provide erosion control and agronomic benefits as influenced by composition, as well as site-specific conditions, including; but not limited to—temperature, moisture and light conditions, soils, biological activity, vegetative establishment and other environmental factors.*
3. *Large Scale testing conducted at Utah Water Research Laboratory. For specific testing information please contact a Profile technical service representative at 866-325-6262.*
4. *Cover Factor is calculated as soil loss ratio of treated surface versus an untreated control surface.*
5. *Percent Effectiveness = One minus Cover Factor multiplied by 100%.*
6. *Heated to a temperature greater than 193 degrees C (380 degrees F) for 5 minutes at a pressure greater than 345 kPa (50 psi) in order to be Thermally Refined®/Processed and to achieve phyto-sanitization.*

SETTING THE BAR EVEN HIGHER

Better Erosion Control—Flexterra® HP-FGM™ immediately bonds to the soil surface. Its flexible yet stable matrix retains > 99% of soil, vastly reducing turbidity of runoff for up to 18 months.

Greater Seed Germination and Growth—High Performance matrix outperforms traditional Flexterra FGM with 600% better initial germination and 250% increased biomass due to a combination of optimized water and nutrient retention.

Safer for the Environment—Unlike rolled erosion control blankets, Flexterra HP-FGM has no nets or threads to endanger wildlife. It uses 100% biodegradable crimped interlocking fibers and 100% recycled and phyto-sanitized wood fibers. Flexterra HP-FGM is 100% safe for aquatic and terrestrial life forms.

Earth-Friendly and Sustainable Results—Flexterra HP-FGM is a result of Profile's Green Design Engineering™, creating cost-effective and environmentally superior solutions through the design, manufacture and application of sustainable erosion control and vegetation establishment technologies.

GREEN DESIGN ENGINEERING™
EARTH-FRIENDLY SOLUTIONS FOR SUSTAINABLE RESULTS™

Green Design Engineering™ is a holistic approach that combines agronomic and engineering expertise with advanced technologies to provide cost-effective and earth-friendly solutions. Profile strives to deliver Green Design Engineering across our team of consulting professionals, innovative products and educational resources.

PS³
PROFILE SOIL SOLUTIONS SOFTWARE

PS³ is a free, comprehensive 24/7 online resource you can use to design a project and select the right products that address both the physical and agronomic needs of your site. It will help you develop holistic, sustainable solutions for cost-effective erosion control, vegetation establishment and subsequent reductions in sediment and other pollutants from leaving disturbed sites. Because good plans start with the soil, PS³ offers free soil testing to ensure this critical step is considered. To access the site, design your project and take advantage of a free soil analysis, visit **www.profileps3.com**.

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Section 31 25 14.13 – Hydraulically-Applied Erosion Control: High Performance-Flexible Growth Medium

GENERAL

1.01 SUMMARY

A. This section specifies a hydraulically-applied, 100% biodegradable, High Performance-Flexible Growth Medium (HP-FGM) that is manufactured in the United States and is composed of 100% recycled thermally refined (within a pressure vessel) wood fibers, crimped interlocking man-made biodegradable fibers, mineral activators, naturally derived crosslinked biopolymers and water absorbents. The HP-FGM is phytosanitized, free from plastic netting, requires no curing period and upon application forms an intimate bond with the soil surface to create a continuous, porous, absorbent and flexible erosion resistant blanket that allows for rapid germination and accelerated plant growth

B. Related Sections: Other Specification Sections, which directly relate to the work of this Section include, but are not limited to the following:
   1. *Section 01 57 00 – Temporary Erosion and Sediment Control*
   2. *Section 31 00 00 – Earthwork*
   3. *Section 31 91 00 – Planting Preparation*
   4. *Section 32 92 00 – Turf and Grasses*

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions. Include required substrate preparation, list of materials and application rate.

B. Certifications: Manufacturer shall submit a letter of certification that the product meets or exceeds all technical and packaging requirements.

1.03 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in UV and weather-resistant factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage, weather, excessive temperatures and construction operations.

PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

A. PROFILE Products LLC
750 Lake Cook Road – Suite 440
Buffalo Grove, IL 60089
800-366-1180 (Fax 847-215-0577)
www.profileproducts.com

2.02 MATERIALS

A. The HP-FGM shall be Flexterra® HP-FGM and conform to the following property values when uniformly applied at a rate of 3500 pounds per acre (3900 kilograms/hectare) under laboratory conditions.

Property	Test Method	Req. Value (English)	Req. Value (SI)
Physical			
Mass Per Unit Area	ASTM D6566[1]	12 oz/yd^2 minimum	407 g/m^2 minimum
Thickness	ASTM D6525[1]	0.22 inch minimum	5.6 mm. minimum
Wet Bond Strength	ASTM D6818[1]	9 lb/ft	131 N/m
Ground Cover	ASTM D6567[1]	99% minimum	99% minimum
Water Holding Capacity	ASTM D7367	1700% minimum	1700% minimum
Material Color	Observed	Green	Green
Performance			
Cover Factor[2]	Large Scale Testing[4]	0.01 maximum	0.01 maximum
% Effectiveness[3]	Large Scale Testing[4]	99 % minimum	99 % minimum
Cure time	Observed	0 - 2 hours	0 - 2 hours
Vegetation Establishment	ASTM D7322[1]	800 % minimum	800 % minimum
Yield[5]	Calculated	2.6 minimum	2245 minimum
Kinetic Energy Absorption Potential[6]	Calculated	2.0 minimum	734 minimum
Environmental			
Functional Longevity[7]	ASTM D5338	Up to 18 months	Up to 18 months
Ecotoxicity	EPA 2021.0	96-hr LC50 > 100%	96-hr LC50 > 100%
Effluent Turbidity	Large Scale Testing[4]	100 NTU maximum	100 NTU maximum
Biodegradability	ASTM D5338	100% minimum	100% minimum

1. ASTM test methods developed for Rolled Erosion Control Products and have been modified to accommodate Hydraulically-Applied Erosion Control Products.
2. Cover Factor is calculated as soil loss ratio of treated surface versus an untreated control surface.
2. % Effectiveness = One minus Cover Factor multiplied by 100%.
4. Large scale testing conducted at Utah Water Research Laboratory. For specific testing information please contact a Profile technical service representative at 866-325-6262.
5. Yield = (Mass per Unit Area)*(Thickness)*(Ground Cover Percentage).
6. Kinetic Energy Absorption Potential = (Wet Bond Strength)*(Thickness)
7. Functional Longevity is the estimated time period, based upon ASTM D5338 testing and field observations, that a material can be anticipated to provide erosion control and agronomic benefits as influenced by composition, as well as site-specific conditions, including; but not limited to – temperature, moisture, light conditions, soils, biological activity, vegetative establishment and other environmental factors.

2.03 COMPOSITION

A. All components of the HP-FGM shall be pre-packaged by the Manufacturer to assure both material performance and compliance with the following values. No chemical additives with the exception of fertilizer, soil pH modifiers, extended-term dyes and biostimulant materials should be added to this product.

1. Thermally Processed (within a pressure vessel) Wood Fiber – 80% ± 3%
   - Heated to a temperature greater than 380 degrees Fahrenheit (193 degrees Celsius) for 5 minutes at a pressure greater than 50 psi (345 kPa)

   Crosslinked Biopolymers and Water Absorbents – 10% ± 1%
   Crimped, Man-made Biodegradable Interlocking Fibers – 5% ± 1%
   Micro-Pore Granules – 5% ± 1%

2.04 PACKAGING

A. Bags: Net Weight – 50 lb, UV and weather-resistant plastic film
Pallets: Weather-proof, stretch-wrapped with UV resistant pallet cover
Pallet Quantity: 40 bags/pallet or 1 ton/pallet

EXECUTION

3.01 SUBSTRATE AND SEEDBED PREPARATION

A. Examine substrates and conditions where materials will be applied. Apply product to geotechnically stable slopes that have been designed and constructed to divert runoff away from the face of the slope. Do not proceed with installation until satisfactory conditions are established.

B. Depending upon project sequencing and intended application, prepare seedbed in compliance with other specifications under Section 1.01 B

3.02 INSTALLATION

A. Strictly comply with equipment manufacturer's installation instructions and recommendations. Use approved hydro-spraying machines with fan-type nozzle (50-degree tip). To achieve optimum soil surface coverage, apply HP-FGM from opposing directions to soil surface. Rough surfaces (rocky terrain, cat tracks and ripped soils) may require higher application rates to achieve 100% cover. Slope interruption devices or water diversion techniques are recommended when slope lengths exceed 100 feet (30 m). Maximum slope length is for product applications on a 3H:1V slope. For application on steeper slopes, slope interruption lengths may need to be decreased based on actual site conditions. Not recommended for channels or areas with concentrated water flow. This product may be applied on saturated soils and does not require a curing period to be effective. No chemical additives with the exception of fertilizer, liming and biostimulant materials should be added to this product.

B. For Erosion Control and Revegetation: To ensure proper application rates, measure and stake area. For maximum performance, apply HP-FGM in a two-step process*:

1. *Step One: Apply fertilizer with specified prescriptive agronomic formulations and 50% of seed with a small amount of HP-FGM for visual metering.*
2. *Step Two: Mix balance of seed and apply HP-FGM at a rate of 50 lb per 125 gallons (23 kg/475 liters) of water over freshly seeded surfaces. Confirm loading rates with equipment manufacturer. Do not leave seeded surfaces unprotected, especially if precipitation is imminent.*

**Depending upon site conditions HP-FGM may be applied in a one-step process where all components may be mixed together in single tank loads. Consult with Manufacturer for further details.*

Best results and more rapid curing are achieved at temperatures exceeding 60°F (15°C). Curing times may be accelerated in high temperature, low humidity conditions with product applied on dry soils.

Over-application of product may inhibit germination and plant growth.

C. Mixing: A mechanically agitated hydraulic-application machine is strongly recommended:

1. *Fill 1/3 of mechanically agitated hydroseeder with water. Turn pump on for 15 seconds and purge and pre-wet lines. Turn pump off.*
2. *Turn agitator on and load low density materials first (i.e. seed).*
3. *Continue slowly filling tank with water while loading fiber matrix into tank.*
4. *Consult application and loading charts to determine number of bags to be added for desired area and application rate. Mix at a rate of 50 lb of HP-FGM per 125 gallons (23 kg/475 liters). Contact Equipment manufacturer to confirm optimum mixing rates.*
5. *All HP-FGM should be completely loaded before water level reaches 75% of the top of tank.*
6. *Top off with water and mix until all fiber is fully broken apart and hydrated (minimum of 10 minutes — increase mixing time when applying in cold conditions). This is very important to fully activate the bonding additives and to obtain proper viscosity.*
7. *Add fertilizer*
8. *Shut off recirculation valve to minimize potential for air entrainment within the slurry.*
9. *Slow down agitator and start applying with a 50-degree fan tip nozzle.*
10. *Spray in opposing directions for maximum soil coverage.*

D. Application Rates: These application rates are for standard conditions. Designers may wish to reduce rates to encourage faster vegetation establishment or may need to increase application rates on rough surfaces.

Slope Gradient / Condition	English	SI
≤ 4H to 1V	2500 lb/ac	2800 kg/ha
> 4H to 1V and ≤ 3H to 1V	3000 lb/ac	3400 kg/ha
≥ 3H to 1V and ≤ 2H to 1V	3500 lb/ac	3900 kg/ha
> 2H to 1V and ≤ 1H to 1V	4000 lb/ac	4500 kg/ha
> 1H to 1V	4500 lb/ac	5100 kg/ha
Below ECB or TRM	1500 lb/ac	1700 kg/ha
As infill for TRM*	3500 lb/ac	3900 kg/ha

*Use only approved and tested TRMs to create the GreenArmor™ System

3.03 CLEANING AND PROTECTION

A. After application, thoroughly flush the tank, pumps and hoses to remove all material. Wash all material from the exterior of the machine and remove any slurry spills. Once dry, material will be more difficult to remove.

B. Clean spills promptly. Advise owner of methods for protection of treated areas. Do not allow treated areas to be trafficked or subjected to grazing.

Revision Date: 06/2010

STANDARD SPECIFICATION
FOR
ROLLED EROSION CONTROL PRODUCTS

This work consists of constructing temporary and permanent installations to control erosion, enhance vegetation establishment, and survivability on slopes, channels, and includes installing rolled erosion control products.

Temporary Rolled Erosion Control Products
For applications where natural vegetation alone will provide sufficient permanent erosion protection, furnish a temporary rolled erosion control product with the necessary longevity and performance properties to effectively control erosion and assist in the establishment of vegetation under the anticipated immediate site conditions. The temporary rolled erosion control product shall conform to one of the following specifications and corresponding properties found in Table 1.

Permanent Rolled Erosion Control Products
For applications where natural vegetation alone will not sustain expected flow conditions and/or provide sufficient long-term erosion protection, furnish a permanent rolled erosion control product with the necessary performance properties to effectively control erosion and reinforce vegetation under the expected long-term site conditions. The permanent erosion control product shall conform to one of the specifications and corresponding properties found in Table 2.

Rolled erosion control products are designated as follows:

(a) **Mulch control netting.** A planar woven natural fiber or extruded geosynthetic mesh used as a temporary degradable rolled erosion control product to anchor loose fiber mulches.

(b) **Open weave textile.** A temporary degradable rolled erosion control product composed of processed natural or polymer yarns woven into a matrix, used to provide erosion control and facilitate vegetation establishment.

(c) **Erosion control blanket.** A temporary degradable rolled erosion control product composed of processed natural or polymer fibers mechanically, structurally or chemically bound together to form a continuous matrix to provide erosion control and facilitate vegetation establishment.

(d) **Turf reinforcement mat.** A rolled erosion control product composed of non-degradable synthetic fibers, filaments, nets, wire mesh and/or other elements, processed into a permanent, three-dimensional matrix of sufficient thickness. TRMs, which may be supplemented with degradable components, are designed to impart immediate erosion protection, enhance vegetation establishment and provide long-term functionality by permanently reinforcing vegetation during and after maturation. Note: TRMs are typically used in hydraulic applications, such as high flow ditches and channels, steep slopes, stream banks, and shorelines, where erosive forces may exceed the limits of natural, unreinforced vegetation or in areas where limited vegetation establishment is anticipated.

ECTC / Final 060004 / version 3.0

Rev. 4904

Installation Guide for Rolled Erosion Control Products (RECPs) Including Mulch Control Nettings (MCNs), Open Weave Textiles (OWTs), Erosion Control Blankets (ECBs), and Turf Reinforcement Mats (TRMs)

This document is intended to provide general guidelines for the installation of RECPs and does not supersede manufacture's guidelines. The following sections summarize the general, accepted procedures for installation of RECPs and provide basic guidance for slope and channel installations. Detailed design/installation information should be obtained from the manufacturer.

General Procedure. Prepare a stable and firm soil surface free of rocks and other obstructions. Apply soil amendments as necessary to prepare seedbed. Place fertilizer, water, and seed in accordance with manufacturer, local/state regulations, or engineer/specifiers requirements. Typically, RECPs are unrolled parallel to the primary direction of flow. Ensure the product maintains intimate contact with the soil surface over the entirety of the installation. Do not stretch or allow material to bridge over surface inconsistencies. Staple/stake RECPs to soil such that each staple/stake is flush with underlying soil. Install anchor trenches, seams and terminal ends as specified.

Install RECPs after application of seed, fertilizer, mulches (if necessary) and other necessary soil amendments, unless soil in-filling of the TRM is required. For TRMs if soil in-filling, install TRM, apply seed, and other soil amendments lightly brush or rake 0.3 to 0.7 in. (8 to 18 mm) of topsoil into TRM matrix to fill the product thickness. If in-filling with a hydraulically-applied matrix or medium is required; install TRM, then install hydraulically-applied matrix or medium at the manufacturer's suggested application rate.

Apply MCNs (Materials Type 1.A., 2.A., 3.A.) immediately after dry mulch application.

Anchor Trenches, Seams and Terminal Ends

(A) Anchor Trenches – utilize one of the methods detailed below for initial anchoring of RECPs

(1) Staples. Install the RECPs 3 ft. (900 mm) beyond the shoulder of the slope onto flat final grade. Secure roll end with a single row of stakes/staples on 1 ft. (300-mm) centers.

(2) Anchor trench. Excavate a 6 in. by 6 in. (150 mm by 150 mm) anchor trench. Extend the upslope terminal end of the RECPs 3 ft. (900 mm) past the anchor trench. Use stakes or staples to fasten the product into the bottom of the anchor trench on 1 ft. (300 mm) centers. Backfill the trench and compact the soil into the anchor trench. Apply seed and any necessary soil amendments to the compacted soil and cover with remaining 1 ft. (300 mm) terminal end of the RECPs. Secure terminal end of RECPs with a single row of stakes or staples on 1 ft. (300 mm) centers.

(3) Check slot. Construct a stake/staple check slot along the top edge of the RECPs by installing two rows of staggered stakes/staples 4 in. (100 mm) apart on 4 in. (100 mm) centers.

(B) Seams – utilize one of the methods detailed below for seaming of RECPs

(1) Adjacent seams. Overlap edges of adjacent RECPs by 2 to 4 in. (50 to 100 mm) or by abutting products as defined by manufacturer. Use a sufficient number of stakes or staples to prevent seam or abutted rolls from separating.

(2) Consecutive rolls. Shingle and overlap consecutive rolls 2 to 6 in. (50 to 150 mm) in the direction of flow.

(3) Check seam. Construct a stake/staple check seam along the top edge of RECPs for slope application and at specified intervals in a channel by installing two staggered rows of stakes/staples 4 in. (100 mm) apart on 4 in. (100 mm) centers.

(C) Terminal Ends – utilize one of the methods detailed below for all terminal ends of RECPs

(1) Staples. Install the RECPs 3 ft. (900 mm) beyond the end of the channel and secure end with a single row of stakes/staples on 1 ft. (300-mm) centers. Stakes/staples for securing RECPS to the soil are typically 6 in. (150 mm) long.

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(2) Anchor trench. Excavate a 6 in. by 6 in. (150 mm by 150 mm) anchor trench. Extend the terminal end of the RECPs 3 ft. (900 mm) past the anchor trench. Use stakes or staples to fasten the product into the bottom of the anchor trench on 1 ft. (300 mm) centers. Backfill the trench and compact the soil into the anchor trench. Apply seed and any necessary soil amendments to the compacted soil and cover with remaining 1 ft. (300 mm) terminal end of the RECPs. Secure terminal end of RECPs with a single row of stakes or staples on 1 ft. (300 mm) centers.
(3) Check slot. Construct a stake/staple check slot along the terminal end of the RECPs by installing two rows of staggered stakes/staples 4 in. (100 mm) apart on 4 in. (100 mm) centers.

Slope Installations. At the top of slope, anchor the RECPs according to one of the method detailed in Section (A) above. Securely fasten all RECPs to the soil by installing stakes/staples at a minimum rate of 1.3/yd^2 (1.5/m^2). For the most effective RECP installation use stake/staple patterns and densities as recommended by the manufacturer. For adjacent and consecutive rolls of RECPs follow seaming instructions detailed in Section (B) above. The terminal end of the RECPs installation must be anchored using one of the methods detailed in Section (C) above.

Channel Installations. Construct an anchor trench at the beginning of the channel across its entire width according to Section (A) (2) above. Follow the manufacturer's installation guidelines in constructing additional anchor trenches or stake/staple check slots at intervals along the channel reach and at the terminal end of the channel, according to paragraph (A) above respectively. Unroll RECPs down the center of the channel in the primary water flow direction. Securely fasten all RECPs to the soil by installing stakes/staples at a minimum rate of 1.7/yd^2 (1.5/m^2). Significantly higher anchor rates and longer stakes/staples may be necessary in sandy, loose, or wet soils and in severe applications. For adjacent and consecutive rolls of RECPs follow seaming instructions detailed in Section (B) above. All terminal ends of the RECPs must be anchored using one of the methods detailed in Section (C) above.

With any RECP installation, ensure sufficient staples to resist uplift from hydraulics, wind, mowers, and foot traffic. For the most effective installation of RECPs, the ECTC recommends using stake/staple patterns and densities as recommended by the manufacturer.

Repair any damaged areas immediately by restoring soil to finished grade, re-applying soil amendments and seed, and replacing the RECPs.

Table 1. ECTC Standard Specification For Temporary Rolled Erosion Control Products

For use where natural vegetation alone will provide permanent erosion protection

ULTRA SHORT-TERM - Typical 3 month functional longevity.

Type	Product Description	Material Composition	Slope Applications* Maximum Gradient	Slope Applications* C Factor[2,5]	Channel Applications* Max. Shear Stress[3,4,6]	Minimum Tensile Strength[1]
1.A	Mulch Control Nets	A photodegradable synthetic mesh or woven biodegradable natural fiber netting.	5:1 (H:V)	$\leq$ 0.10 @ 5:1	0.25 lbs/ft² (12 Pa)	5 lbs/ft (0.073 kN/m)
1.B	Netless Rolled Erosion Control Blankets	Natural and/or polymer fibers mechanically interlocked and/or chemically adhered together to form a RECP.	4:1 (H:V)	$\leq$ 0.10 @ 4:1	0.5 lbs/ft² (24 Pa)	5 lbs/ft (0.073 kN/m)
1.C	Single-net Erosion Control Blankets & Open Weave Textiles	Processed degradable natural and/or polymer fibers mechanically bound together by a single rapidly degrading, synthetic or natural fiber netting or an open weave textile of processed rapidly degrading natural or polymer yarns or twines woven into a continuous matrix.	3:1 (H:V)	$\leq$ 0.15 @ 3:1	1.5 lbs/ft² (72 Pa)	50 lbs/ft (0.73 kN/m)
1.D	Double-net Erosion Control Blankets	Processed degradable natural and/or polymer fibers mechanically bound together between two rapidly degrading, synthetic or natural fiber nettings.	2:1 (H:V)	$\leq$ 0.20 @ 2:1	1.75 lbs/ft² (84 Pa)	75 lbs/ft (1.09 kN/m)

SHORT-TERM - Typical 12 month functional longevity.

Type	Product Description	Material Composition	Slope Applications* Maximum Gradient	Slope Applications* C Factor[2,5]	Channel Applications* Max. Shear Stress[3,4,6]	Minimum Tensile Strength[1]
2.A	Mulch Control Nets	A photodegradable synthetic mesh or woven biodegradable natural fiber netting.	5:1 (H:V)	$\leq$ 0.10 @ 5:1	0.25 lbs/ft² (12 Pa)	5 lbs/ft (0.073 kN/m)
2.B	Netless Rolled Erosion Control Blankets	Natural and/or polymer fibers mechanically interlocked and/or chemically adhered together to form a RECP.	4:1 (H:V)	$\leq$ 0.10 @ 4:1	0.5 lbs/ft² (24 Pa)	5 lbs/ft (0.073 kN/m)
2.C	Single-net Erosion Control Blankets & Open Weave Textiles	An erosion control blanket composed of processed degradable natural or polymer fibers mechanically bound together by a single degradable synthetic or natural fiber netting to form a continuous matrix or an open weave textile composed of processed degradable natural or polymer yarns or twines woven into a continuous matrix.	3:1 (H:V)	$\leq$ 0.15 @ 3:1	1.5 lbs/ft² (72 Pa)	50 lbs/ft (0.73 kN/m)
2.D	Double-net Erosion Control Blankets	Processed degradable natural and/or polymer fibers mechanically bound together between two degradable, synthetic or natural fiber nettings.	2:1 (H:V)	$\leq$ 0.20 @ 2:1	1.75 lbs/ft² (84 Pa)	75 lbs/ft (1.09 kN/m)

EXTENDED-TERM - Typical 24 month functional longevity.

Type	Product Description	Material Composition	Slope Applications* Maximum Gradient	Slope Applications* C Factor[2,5]	Channel Applications* Max. Shear Stress[3,4,6]	Minimum Tensile Strength[1]
3.A	Mulch Control Nets	A slow degrading synthetic mesh or woven natural fiber netting.	5:1 (H:V)	$\leq$ 0.10 @ 5:1	0.25 lbs/ft² (12 Pa)	25 lbs/ft (0.36 kN/m)
3.B	Erosion Control Blankets & Open Weave Textiles	An erosion control blanket composed of processed slow degrading natural or polymer fibers mechanically bound together between two slow degrading synthetic or natural fiber nettings to form a continuous matrix or an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix.	1.5:1 (H:V)	$\leq$ 0.25 @ 1.5:1	2.00 lbs/ft² (96 Pa)	100 lbs/ft (1.45 kN/m)

LONG-TERM - Typical 36 month functional longevity.

Type	Product Description	Material Composition	Slope Applications* Maximum Gradient	Slope Applications* C Factor[2,5]	Channel Applications* Max. Shear Stress[3,4,6]	Minimum Tensile Strength[1]
4	Erosion Control Blankets & Open Weave Textiles	An erosion control blanket composed of processed slow degrading natural or polymer fibers mechanically bound together between two slow degrading synthetic or natural fiber nettings to form a continuous matrix or an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix.	1:1 (H:V)	$\leq$ 0.25 @ 1:1	2.25 lbs/ft² (108 Pa)	125 lbs/ft (1.82 kN/m)

** "C" factor and shear stress for Types 1.A., 2.A. and 3.A mulch control nettings must be obtained with netting used in conjunction with pre-applied mulch material.*

1 Minimum Average Roll Values, Machine direction using ECTC Mod. ASTM D 5035.

2 "C" Factor calculated as ratio of soil loss from RECP protected slope (tested at specified or greater gradient, h:v) to ratio of soil loss from unprotected (control) plot in large-scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions using Erosion Control Technology Council (ECTC) Test Method # 2.

3 Required minimum shear stress RECP (unvegetated) can sustain without physical damage or excess erosion (> 12.7 mm (0.5 in) soil loss) during a 30-minute flow event in large-scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using Erosion Control Technology Council (ECTC) Test Method #3.

4 The permissible shear stress levels established for each performance category are based on historical experience with products characterized by Manning's roughness coeffecients in the range of 0.01 - 0.05.

5 Acceptable large-scale test methods may include ASTM D6459, Erosion Control Technology Council (ECTC) Test Method # 2, or other independent testing deemed acceptable by the engineer.

6 Per the engineers discretion. Recommended acceptable large-scale testing protocol may include ASTM D6460, Erosion Control Technology Council (ECTC) Test Method #3 or other independent testing deemed acceptable by the engineer.

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Table 2. ECTC Standard Specification For Permanent Rolled Erosion Control Products

For applications where vegetation alone will not sustain expected flow conditions and/or provide sufficient long-term erosion protection.

Permanent[1] - All categories of TRMs must have a minimum thickness of 0.25 inches (6.35 mm) per ASTM D 6525 and U.V. stability of 80% per ASTM D 4355 (500 hours exposure).

Type	Product Description	Material Composition	Slope Applications Maximum Gradient	Channel Applications Maximum Shear Stress[4,5]	Minimum Tensile Strength[2,3]
5.A	Turf Reinforcement Mat	Turf Reinforcement Mat (TRM) – A rolled erosion control product composed of non-degradable synthetic fibers, filaments, nets, wire mesh and/or other elements, processed into a permanent, three-dimensional matrix of sufficient thickness. TRMs, which may be supplemented with degradable components, are designed to impart immediate erosion protection, enhance vegetation establishment and provide long-term functionality by permanently reinforcing vegetation during and after maturation. Note: TRMs are typically used in hydraulic applications, such as high flow ditches and channels, steep slopes, stream banks, and shorelines, where erosive forces may exceed the limits of natural, unreinforced vegetation or in areas where limited vegetation establishment is anticipated.	0.5:1 (H:V)	6.0 lbs/ft^2 (288 Pa)	125 lbs/ft (1.82 kN/m)
5.B	Turf Reinforcement Mat		0.5:1 (H:V)	8.0 lbs/ft^2 (384 Pa)	150 lbs/ft (2.19 kN/m)
5.C	Turf Reinforcement Mat		0.5:1 (H:V)	10.0 lbs/ft^2 (480 Pa)	175 lbs/ft (2.55 kN/m)

[1] *For TRMs containing degradable components, all property values must be obtained on the non-degradable portion of the matting alone.*

[2] *Minimum Average Roll Values, machine direction only for tensile strength determination using ASTM D6818 (Supercedes Mod. ASTM D5035 for RECPs)*

[3] *Field conditions with high loading and/or high survivability requirements may warrant the use of a TRM with a tensile strength of 44 kN/m (3,000 lb/ft) or greater.*

[4] *Required minimum shear stress TRM (fully vegetated) can sustain without physical damage or excess erosion (> 12.7 mm (0.5 in.) soil loss) during a 30-minute flow event in large scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using Erosion Control Technology Council (ECTC) Test Method #3.*

[5] *Acceptable large-scale testing protocol may include ASTM D6460, Erosion Control Technology Council (ECTC) Test Method #3, or other independent testing deemed acceptable by the engineer.*

SPECIAL SPECIFICATION

1011

Compost/Mulch Filter Berm

1. **Description.** Furnish, place and remove compost filter berms or mulch filter berms as shown on the plans.

2. **Materials.** Furnish compost in accordance with Item 161, "Compost." Furnish untreated wood chips less than or equal to 5 in. in length with 95% passing a 2-in. screen and less than 30% passing a 1-in. screen.

   A. **Compost Filter Berm (CFB).** Furnish CFB consisting of 50% wood chips blended with 50% compost measured by volume.

   B. **Mulch Filter Berm (MFB).** Furnish MFB consisting of 100% wood chips.

3. **Construction.** Prepare the compost, wood chips, or both for use on the project and stockpile at the jobsite. Unless otherwise directed, construct a 1-1/2 ft. high by 3 ft. wide berm at locations shown on the plans.

4. **Maintenance.** Routinely inspect and maintain filter berm in a functional condition at all times. Correct deficiencies immediately. Install additional filter berm material as directed. Remove sediment after it has reached 1/3 of the height of the berm. Disperse filter berm or leave in place as directed.

5. **Measurement.** This Item will be measured by the cubic yard.

6. **Payment.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Compost Filter Berm" or "Mulch Filter Berm." This price is full compensation for loading, hauling, stockpiling, blending, placing, maintaining, removing, equipment, labor, materials, tools and incidentals. Costs associated with passing Quality Assurance (QA) testing for compost will be paid for by force account at invoice price.

   Removal of accumulated sediment deposits will be measured and paid for under Item 506, "Temporary Erosion, Sedimentation and Environmental Controls."

APPENDIX III-2E

FINAL COVER EROSION SOIL LOSS CALCULATION

FINAL COVER EROSION SOIL LOSS CALCULATION

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

1.0 OBJECTIVE:

Estimate add-on berm spacing required under final closure conditions for the Edinburg Regional Disposal Facility to limit the average annual erosion to 2.0-3.0 ton/acre/year.

STATE OF TEXAS
7/21/17
CHARLES G. DOMINGUEZ
83247
LICENSED
PROFESSIONAL ENGINEER

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

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2.0 METHOD AND ASSUMPTIONS:

Add-on berm spacing was determined using the Revised Universal Soil Loss Equation (RUSLE), (UDSA,1997).

Soil series is primarily Hargill fine sandy loam (USDA, Soil Conservation Service, Soil Survey of Hidalgo County, Texas, 1981),

Facility slopes are 4H:1V on the sides, 5% on top,

Use revised universal soil loss equation.

A = R K L S C P Variables described below

Rainfall and erosivity index (R)

From Fig. 1, Reference1(Page 5), the average annual rainfall erosion index for the site is approx. **255**

Soil Erodibility Factor (K)

Assume a sandy clay loam with an organic matter content of 4% and use Table 1, Reference 1 (Page 6), to determine the K factor.

Use K = 0.21

Cover and Management Factor [C]

Assume 90% ground cover and interpolate C from values shown on Table 2, Reference 1 (Page 7)

C = 0.006

Support Practice Factor (P)

Surface tracked with dozer -- rough surface

Use P = 1

Length Slope Factor (LS) (Reference 2)

For regular slopes > 15 ft long, the **Slope Steepness Factor, S** =

S = 10.8 sin Θ + 0.03; sin Θ < 0.09 Eqn. 8.39

or 16.8 sin Θ - 0.50; sin Θ $\geq$ 0.09 Eqn. 8.40

Where: Θ = slope angle

Length Factor, L

$$L = \frac{\lambda}{72.6}^{m}$$ Eqn. 8.43

λ = slope length (measured as the horizontal projection of plot length)

m is an exponent dependent upon slope given by

$$m = \frac{\beta}{1+\beta}$$ Eqn. 8.44

β for soils moderately susceptible to erosion is given by (Reference 3):

$$\beta_{\text{mod}} = \frac{11.16 \sin\Theta}{3.0(\sin\Theta)^{0.8} + 0.56}$$ Eqn. 8.45

β is modified as follows for soils of low and high susceptibility to erosion:

$\beta_{low} = (1/2)\beta_{mod}$

$\beta_{high} = 2\beta_{mod}$

3.0 CALCULATIONS

RUSLE calculations were performed for the longest final cover side slope between add-on berms. The 4:1 (H:V) side slopes are more critical than the 5% top dome in terms of erosion.

Summaries of the RUSLE calculation is presented in Table 1.

4.0 CONCLUSION/RESULTS

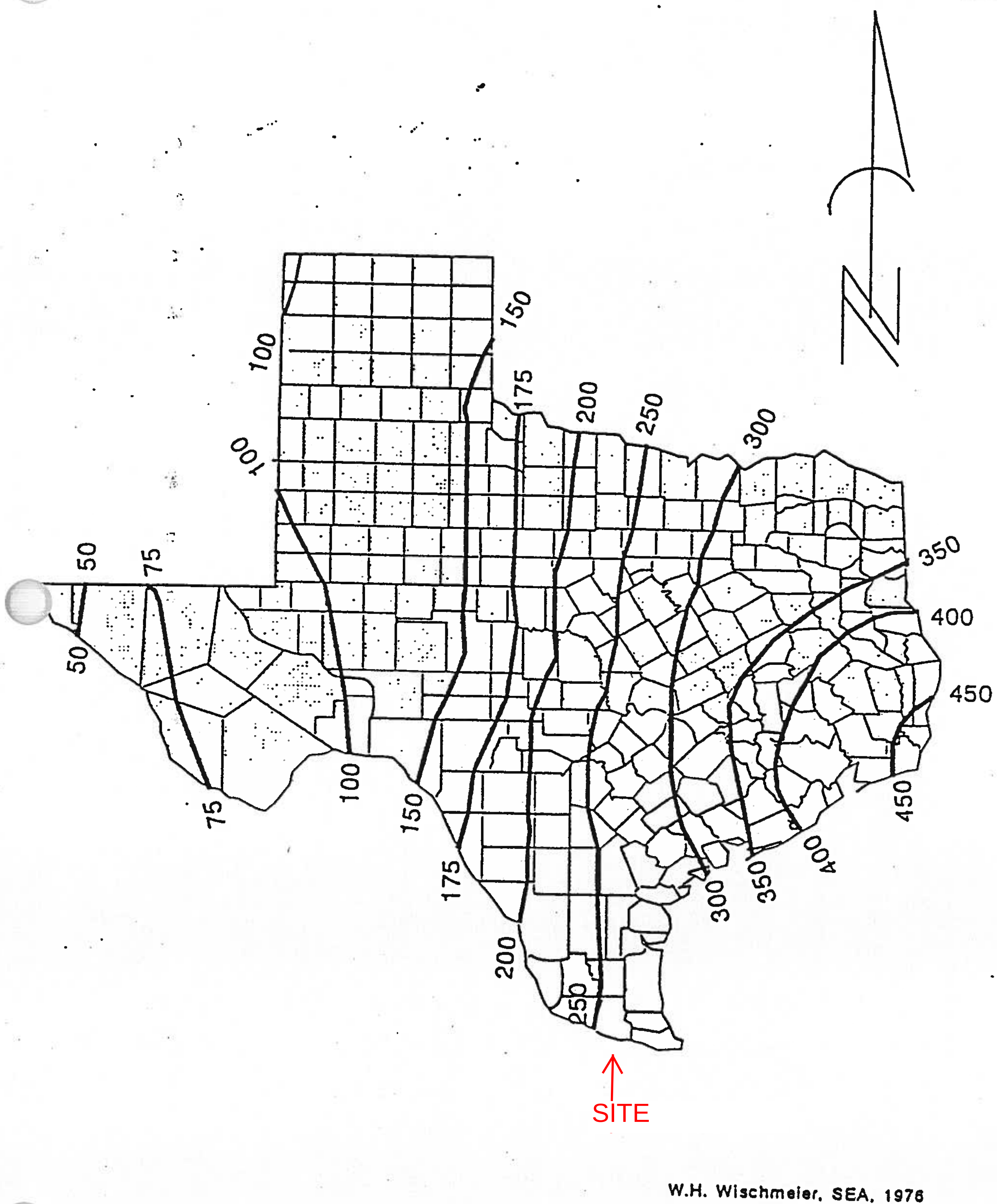
RUSLE calculation for a simple slope is found in Tables 1. Recommended horizontal add-on berm spacing for closure is 160 feet (or 40 vertical feet).

5.0 REFERENCES:

1) Use of the Universal Soil Loss Equation in Final Cover/Configuration Design, Procedural Handbook," TNRCC, Permits Section, October 1993.

2) Haan C.T., B. J. Barfield, and J.C. Hayes. 1994. Design hydrology and sedimentology for small catchments. San Diego CA : Academic Press Inc.

3) TCEQ Regulatory Guidance, "Guidelines for Preparing a Surface Water Drainage Report for a Municipal Solid Waste Facility.", August 2006



...URE 1. - AVERAGE ANNUAL VALUES OF THE RAINFALL EROSION INDEX

Table 1 Approximate Values of Factor K for USDA Textural Classes

TABLE 1

Texture Class	Organic Matter Content <0.5% K	2% K	4% K
Sand	0.05	0.03	0.02
Fine Sand	0.16	0.14	0.10
Very Fine Sand	0.42	0.36	0.28
Loamy Sand	0.12	0.10	0.08
Loamy Fine Sand	0.24	0.20	0.16
Loamy Very Fine Sand	0.44	0.38	0.30
Sandy Loam	0.27	0.24	0.19
Fine Sandy Loam	0.35	0.30	0.24
Very Fine Sandy Loam	0.47	0.41	0.33
Loam	0.38	0.32	0.29
Silt Loam	0.48	0.42	0.33
Silt	0.60	0.52	0.42
Sandy Clay Loam	0.27	0.25	0.21
Clay Loam	0.28	0.25	0.21
Silty Clay Loam	0.37	0.32	0.26
Sandy Clay	0.14	0.13	0.12
Silty Clay	0.25	0.23	0.19
Clay	0.13 - 0.29		

The values shown are estimated averages of broad ranges of specific-soil values. When a texture is near the borderline of two texture classes, use the average of the two K values.

Table 2 Factor C for permanent pasture, range, and idle land[1]

Vegetative Canopy		Cover that contacts the soil surface						
Type and height[2]	Percent cover[3]	Percent ground cover						
		0	20	40	60	70	80	90
No Appreciable Canopy		0.45	0.20	0.10	0.042	.028	0.013	0.006
[redacted]								
Tall weeds or short brush with average drop fall height of 20 in.								
	50	0.26	0.13	0.07	0.035	.023	0.012	0.006
	75	0.17	0.10	0.06	0.032	.022	0.011	0.005

Extracted from:
United States Department of Agriculture, AGRICULTURE HANDBOOK NUMBER 537

1 The listed C values assume that the vegetation and mulch are randomly distributed over the entire area.

2 Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 33 ft.

3 Portions of total-area surface that would be hidden from view by canopy in a vertical projection (a bird's-eye view).

The impact of changes in saturated hydraulic conductivity on the K factor must be accounted for by the nomograph in Fig. 8.9. To accomplish this correction using Eq. (8.38), relationships between hydraulic conductivity and permeability classes used in Fig. 8.9 must be known. Rawls *et al.* (1982) proposed the relationship shown in Table 8.3.

Example Problem 8.4. Effects of rock fragments on K

A silty clay loam soil is classified as permeability class 5. Based on textural information, soil structure, and a permeability class of 5, K is estimated as 0.21 in English units. What would be the value for K as corrected for rock fragments if the percentage of rock fragments greater than 2 mm occupies 40% of the soil mass by weight?

Solution:

1. Impact of rock fragment on hydraulic conductivity. From Table 8.3, k_f for a silty clay loam soil is between 0.04 and 0.08 in./hr. Assume a value of 0.06 in./hr. From Eq. (8.38)

$$k_b = k_f(1 - R_w) = 0.06(1 - 0.40) = 0.036 \text{ in./hr.}$$

2. Estimating the revised permeability class. From Table 8.3, the permeability class for $k_b = 0.036$ in./hr is 6.

3. Estimating the new erodibility. Entering Fig. 8.9 with an estimated K of 0.21 for a permeability class of 5, the K value for a class 6 permeability is estimated as 0.22 (English units).

It is again important to note that this procedure corrects only for the effects of rock fragments on infiltration. Impacts on the C factor must be based on percentage ground cover, as discussed in a subsequent section.

Rough Estimates of K from Textural Information and Experimental Values for Construction and Mined Sites

The USDA–SCS has developed estimates of K based on textural classification for topsoil, subsoil, and residual materials as shown in Table 8.4. These values are first estimates only and do not include the influence of soil structure or infiltration characteristics.

A limited number of data sets have been developed for drastically disturbed lands and for reconstructed soils. A summary of the data is given in Table 8.5 along with a comparison to values from the Wischmeier *et al.* (1971) nomograph shown in Fig. 8.9. The comparison is sufficiently favorable to warrant the use of the nomograph for a first estimate of K on disturbed topsoil or A-horizon material. The comparison is not favorable for subsoil materials.

Length and Slope Factors L and S

The effects of topography on soil erosion are determined by dimensionless L and S factors, which account for both rill and interrill erosion impacts.

Slope Steepness Factor S

The slope steepness factor S is used to predict the effect of slope gradient on soil loss. For slope lengths

Table 8.3 Soil Water Data for the Major USDA Soil Textural Classes (after Rawls *et al.*, 1982)

Texture	Permeability class[a]	Saturated hydraulic conductivity in./hr	Saturated hydraulic conductivity mm/hr	Hydrologic soil group[b]
Silty clay, clay	6	< 0.04	<1	D
Silty clay loam, sandy clay	5	0.04–0.08	1–2	C–D
Sandy clay loam, clay loam	4	0.08–0.20	2–5	C
Loam, silt loam	3	0.20–0.80	5–20	B
Loamy sand, sandy loam	2	0.80–2.40	20–60	A
Sand	1	> 2.40	>60	A+

[a]See Soil Conservation Service National Soils Handbook (SCS, 1983).

[b]See Soil Conservation Service National Engineering Handbook (SCS, 1972, 1984).

[c]Note: Although the silt texture is missing from the NEH because of inadequate data, it undoubtedly should be in permeability class 3.

greater than 15 ft, the S factor from the USLE was modified significantly by McCool *et al.* (1987, 1993) after extensive evaluation of the original USLE data base. The modified version is

$$S = 10.8 \sin\theta + 0.03; \qquad \sin\theta < 0.09 \qquad (8.39)$$

$$S = 16.8 \sin\theta - 0.50; \qquad \sin\theta \geq 0.09, \qquad (8.40)$$

where θ is the slope angle. Based on an evaluation of data from disturbed lands with slopes up to 84%, McIssac *et al.* (1987) developed an equation similar to (8.39) and (8.40) with exponents in the same range; thus McCool *et al.* (1993) recommend that Eqs. (8.39) and (8.40) also be used for disturbed lands.

For slope lengths less than 15 ft, the S factor is not as strongly related to slope (slope exponent less than 1.0) since rilling would not have been initiated. The recommended factor is

$$S = 3.0(\sin\theta)^{0.8} + 0.56. \qquad (8.41)$$

Under conditions where thawing of recently tilled soils is occurring and surface runoff is the primary factor causing erosion (typical of the Pacific Northwest in the spring), the S factor should be (McCool *et al.*, 1987, 1993)

$$S = 4.25(\sin\theta)^{0.6}, \qquad \sin\theta \geq 0.09. \qquad (8.42)$$

For thawing soils with slopes less than 9%, Eq. (8.39) should be used.

The S factor in the RUSLE is significantly modified from the original USLE as a result of an extensive reevaluation of the original data base, addition of the factors for short slope lengths, and new values for thawing soils (McCool *et al.*, 1987). The original data base did not include values beyond 20%. When using the quadratic form of the equation for S developed for the original USLE, projections beyond 20% yielded unreasonably high values for erosion. The RUSLE equation with the linear function corrects this problem.

Table 8.4 K Value Estimates based on Textural Information (English Units) (Soil Conservation Service, 1978)

Texture	Estimated K value[a]
Topsoil	
Clay, clay loam, loam, silty clay	0.32[b]
Fine sandy loam, loamy very fine sand, sandy loam	0.24
Loamy fine sand, loamy sand	0.17
Sand	0.15
Silt loam, silty clay loam, very fine sandy loam	0.37
Subsoil and Residual Material	
Outwash Soils	
Sand	0.17
Loamy sand	0.24
Sandy loam	0.43
Gravel, fine to moderate fine	0.24
Gravel, medium to moderate coarse	0.49
Lacrustrine Soils	
Silt loam and very fine sandy loam	0.37
Silty clay loam	0.28
Clay and silty clay	0.28
Glacial Till	
Loam, fine to moderate fine subsoil	0.32
Loam, medium subsoil	0.37
Clay loam	0.32
Clay and silty clay	0.28
Loess	0.37
Residual	
Sandstone	0.49
Siltstone, nonchannery	0.43
Siltstone, channery	0.32
Acid clay shale	0.28
Calcareous clay shale or limestone residuum	0.24

[a]These values are typical based only on textural information. Values for an actual soil can be considerably different due to different structure and infiltration.

[b]Units on K in this table are English units (tons•acre•hr/hundreds•acre•ft•tonsf•in.). To convert to metric units (t•ha•h/ha•MJ•mm), multiply K values by 0.1317.

Slope Length Factor

The slope length factor was developed by McCool *et al.* (1989, 1993) from the original USLE data base augmented with theoretical considerations. The L factor retains its original form

$$L = \left[\frac{\lambda}{72.6}\right]^m, \qquad (8.43)$$

where λ is the slope length in feet, 72.6 ft is the length of a standard erosion plot, and m is a variable slope length exponent. Slope length, λ, is the horizontal projection of plot length, not the length measured along the slope. The difference in horizontal projections and slope lengths becomes important on steeper slopes.

The slope length exponent is related to the ratio of rill to interrill erosion, β (Foster *et al.*, 1977b; McCool *et al.*, 1989, 1993), by

$$m = \frac{\beta}{1+\beta}. \qquad (8.44)$$

Table 8.5 Experimental K Value Estimates for Disturbed Lands (English Units)

Reclaimed soil or residual material	Location of experimental site	K Exp[a]/Nomo[b]	Reference
Hosmer silt loam	Indiana	0.387/0.485[c]	Stein *et al.* (1983)
Alfred silt loam	Southern Indiana	0.812/0.485	
Ava silt loam	Southern Indiana	0.842/0.478	
Graded overburden	Southern Indiana	0.197–0.835/ 0.250–0.478	
Clinton silt loam[d]	Western Illinois	0.370/0.360	Mitchell *et al.* (1983)
Tama silty clay loam[d]	Western Illinois	0.210/0.310	
Hosmer silt loam[d]	Southern Indiana	0.450–0.650/ 0.470	
Sadler silt loam (A horizon)	Western Kentucky	0.415/0.385	Barfield *et al.* (1988)
Sadler silt loam (B horizon)	Western Kentucky	0.380/0.640	
Shale spoil material	Western Kentucky	0.140/0.180	

[a]Values measured experimentally with rainfall simulators.
[b]Values calculated from Wischmeier *et al.* (1971) nomograph shown in Fig. 8.9.
[c]Values in English units of tons•acre•hr/hundreds•acre•ft•tonsf•in. To convert to metric units of t•a•h/ha•MJ•mm, multiply by 0.1317.
[d]The dominant soil series. Some mixing occurred with other series.

For soils that are classed as being moderately susceptible to erosion, McCool *et al.* (1989) proposed that

$$\beta_{\text{mod}} = \frac{11.16 \sin \theta}{3.0(\sin \theta)^{0.8} + 0.56}, \tag{8.45}$$

where θ is the slope angle. Thus, the slope exponent is a function of the slope angle θ.

Soils in the RUSLE are classed as having low, moderate, or high susceptibility to rill erosion. Equation (8.45) is for soils that are moderately susceptible to erosion. Conversions for soils that have low or high susceptibility to erosion are given in Table 8.6. Values in Table 8.6 are based on the assumption that moderately erodible soils have a β defined by Eq. (8.45), soils highly susceptible to rilling have a β that is twice that given by Eq. (8.45), and soils with low susceptibility to rilling have a β that is defined by half that given by Eq. (8.45).

For soils in the Pacific Northwest, or other soils that are exposed to runoff during thawing without sufficient rainfall energy to cause interrill erosion, the values in Table 8.6 should not be used. Instead, McCool *et al.* (1989) recommend that a slope length exponent of 0.5 be used for all slopes. When runoff on thawing soils is exposed to rainfall sufficient to cause significant interrill erosion, the slope length exponent for the low rill to interrill erosion ratio should be used (column 1 in Table 8.6). For rangeland soils, the use of a low rill to interrill erosion ratio is proposed. Selection of the appropriate column to use in Table 8.6 requires professional judgement. The assistance of a soil scientist may be helpful.

Combined Length and Slope Factors

Combined slope length and slope steepness factors were calculated using the factors from Eqs. (8.39) to (8.43). These combination factors are given in Fig. 8.13 for all susceptibilities and for thawing soils.

Irregular and Segmented Slopes

Soil loss is strongly impacted by slope shape (Foster and Huggins, 1979). A convex shape will have greater erosion than a uniform slope by as much as 30%. A concave slope will have less erosion than a uniform slope. Foster and Wischmeier (1974) developed a procedure for evaluating the impact of irregular slopes by dividing the slope into segments. The soil loss per unit area from the ith segment is

$$A_i = RK_iC_iP_iS_i\left[\frac{\lambda_i^{m+1} - \lambda_{i-1}^{m+1}}{(\lambda_i - \lambda_{i-1})72.6^m}\right], \tag{8.46}$$

where λ_i and λ_{i-1} are the slope lengths at the start and end of segment i, and K_i, C_i, P_i, and S_i are USLE factors for segment i. Equation (8.46) can be used for each segment i. The total erosion from each segment

Table 8.6 Slope Length Exponent m in Eq. (8.43) (after McCool *et al.*, 1993)[a]

Percentage slope	Rill/interrill ratio		
	Low[b]	Moderate[c]	High[d]
0.2	0.02	0.04	0.07
0.5	0.04	0.08	0.16
1.0	0.08	0.15	0.26
2.0	0.14	0.24	0.39
3.0	0.18	0.31	0.47
4.0	0.22	0.36	0.53
5.0	0.25	0.40	0.57
6.0	0.28	0.43	0.60
8.0	0.32	0.48	0.65
10.0	0.35	0.52	0.68
12.0	0.37	0.55	0.71
14.0	0.40	0.57	0.72
16.0	0.41	0.59	0.74
20.0	0.44	0.61	0.76
25.0	0.47	0.64	0.78
30.0	0.49	0.66	0.79
40.0	0.52	0.68	0.81
50.0	0.54	0.70	0.82
60.0	0.55	0.71	0.83

[a] Values in table are not applicable to thawing soils. See text for explanation.
[b] $\beta = 1/2$ value from Eq. (8.45) in Eq. (8.44).
[c] $\beta = 1 \times$ value from Eq. (8.45) in Eq. (8.44).
[d] $\beta = 2 \times$ value from Eq. (8.45) in Eq. (8.44).

would be $A_i(\lambda_i - \lambda_{i-1})$, and the average erosion per unit area over the entire slope length would be

$$A = R \sum_{i=1}^{n} K_i C_i P_i S_i \frac{\left[\lambda_i^{m+1} - \lambda_{i-1}^{m+1}\right]}{\lambda_e 72.6^m}, \qquad (8.47)$$

where λ_e is the total slope length. Equation (8.47) can also be used to evaluate the effects of variation in K, C, and P over the slope length.

An alternate method for evaluating irregular slopes is the use of a slope length adjustment factor (SAF). If the slope is divided into n increments of equal length ΔX, then

$$A = R \sum_{i=1}^{n} K_i C_i P_i S_i \frac{\left[(i\,\Delta X)^{m+1} - ([i-1]\,\Delta X)^{m+1}\right]}{n\,\Delta X 72.6^m}. \qquad (8.48)$$

Dividing by n times the soil loss from a uniform slope of equal length and assuming constant values of K_i C_i P_i along the slope, a slope adjustment factor can be developed for each segment, or

$$\mathrm{SAF}_i = \frac{A_i}{A} = \frac{i^{m+1} - (i-1)^{m+1}}{n^m}, \qquad (8.49)$$

where n is the number of segments and SAF is the slope adjustment factor. The sum of the SAF_i for a given slope is equal to the number of segments n; thus the average erosion over the slope is

$$A = \frac{R}{n} \sum_{i=1}^{n} K_i C_i P_i S_i L_i (\mathrm{SAF})_i. \qquad (8.50a)$$

where L_i is the slope length factor calculated from Eq. (8.43) using the m value corresponding to the segment steepness. In the development of a SAF relationship, R, K, C, and P remain constant over all segments; thus Eq. (8.50a) can be solved for an equivalent LS factor

$$LS = \frac{1}{n} \sum_{i=1}^{n} S_i L_i (\mathrm{SAF})_i. \qquad (8.50b)$$

Factors calculated from Eq. (8.50b) are given in Table 8.7. An example of its use is given in Example Problem 8.5.

Example Problem 8.5. Estimating *LS* factors

A soil that is very susceptible to rilling has a slope length of 210 ft and an average slope of 15%. Estimate the *LS* factor if:

(1) the slope is uniform
(2) the slope is convex with slopes of 10, 15, and 20% on segments 1, 2, and 3
(3) the slope is concave with slopes of 20, 15, and 10% on segments 1, 2, and 3.

Assume that the soil is not freezing and thawing.

Solution:

1. *Uniform slope.* The slope angle is

$$\theta = \tan^{-1} 0.15 = 8.53°.$$

From Eq. (8.45) for soils moderately susceptible to rilling,

$$\beta = \frac{11.16 \sin 8.53}{3.0(\sin 8.53)^{0.8} + 0.56} = 1.37.$$

APPENDIX III-2F

SYNTHETIC GRASS COVER DRAINAGE CALCULATION

SYNTHETIC GRASS COVER DRAINAGE CALCULATION

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

STATE OF TEXAS
7/21/17
CHARLES G. DOMINGUEZ
83247
LICENSED PROFESSIONAL ENGINEER

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

INTENDED FOR PERMITTING PURPOSES ONLY

1.0 OBJECTIVE

Develop a surface water management plan for the proposed synthetic grass final cover development at the Edinburg Regional Disposal Facility located in Hidalgo County, Texas. The purpose of this calculations is to check the flow capacity of perimeter ditches and the storage capacity of the ponds.

2.0 METHOD

The proposed Edinburg Regional Disposal Facility expansion site is greater than 200 acres. Therefore, Golder utilizes the USACE HEC-HMS modeling software for the drainage analysis. Subbasins were delineated for the post-development conditions using existing topography and proposed final cover topography respectively (see Figures III2F-1). The post-development conditions consist of the proposed final grades and drainage design. Subbasins are delineated at perimeter channel grade break points to facilitate channel design. A most conservative drainage condition is analyzed herein assuming no add-on berms and downchute channels. These assumptions will generate higher flow rates for conservative perimeter channel 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 (perimeter channels). 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 (T -55, 1986).
- Curve numbers (consistent with previous work and local regulations/practice):
  - Landfill synthetic grass cover, CN = 98
  - Paved areas, CN = 98
  - Areas where minimum infiltration are expected (ponds), CN = 98
  - Dirt roads, CN = 92
- Manning's roughness coefficients:
  - Grass-lined channels, n = 0.035
  - Riprap channels, n=0.040
- Perimeter channels are trapezoidal with 3:1 (H:V) (typ.) side slopes and varying bottom widths and longitudal slopes. Minimum longitudal slope is 0.1% (typ.).
- Perimeter channels are sized to convey runoff from the 25-year, 24-hour storm event and provide a minimum of 0.3 feet of freeboard.
- Perimeter channels are armored with riprap where flow velocities exceed 5 ft/s.

4.0 CALCULATIONS

Tables 1F and 2F contain composite curve number and time of concentration calculations for the post-development conditions, respectively. Table 3F contains calculations for the design of the perimeter channels. The stage-storage relationships were developed in the spreadsheets shown in Tables 4F through 8F (proposed pond E1, E2, E3, E4, W1, W2, W3, W4, W5, W6, and W7).

Attachment A contains HEC-HMS model input and output information including basin parameters, a routing diagram, and peak flows. See Figures III2F-1 for subbasin delineations and channel alignments.

5.0 CONCLUSIONS/RESULTS

The post-development perimeter channels are designed to accommodate runoff from the 25-year, 24-hour storm event with 1 ft freeboard (design shown in Table 3F).

The post-development ponds (design shown in Tables 4F through 8F) are sufficiently sized to attentuate the discharge rate 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	36.7	85.6	91.0
W2	40.5	85.6	91.0
W3	6.9	85.6	91.0
W4	7.1	84.7	91.0
W5	7.2	84.7	91.0
W6	82.4	84.7	91.0
W7	7.9	78.5	91.0
E1	95.1	83.3	94.0
E2	102.8	83.3	94.0
E3	11.5	66.6	94.0
E4	8.7	83.3	94.0

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	188.7 (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	4.3
CP8	55.6	0	9.6	218.1 (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.
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.

APPENDIX III-2F

TABLES

TABLE 1F
SYNTHETIC GRASS COVER COMPOSITE CURVE NUMBER CALCULATIONS

CITY OF EDINBURG
EDINBURG REGIONAL DISPOSAL FACILITY
Project Number: 1401491

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

Design Storm 25 -Year Reoccurance Interval

Storm Duration (hours)	2-Year Depth (inches)	25 -Year Depth (inches)	Storm Distribution
24	4.3	8.5	III

Subbasin ID	Subbasin Area (ft^2)	Subbasin Area (acres)	Subbasin Area (sq mile)	CN = 98 CONCRETE - PAVED AREAS OR POND AREAS (acres)	CN = 92 DIRT ROADS - UNPAVED AREAS (acres)	CN = 98 SYNTHETIC GRASS (acres)	Composite SCS Curve No.	$S = \frac{1000}{CN} - 10$	Unit Runoff Q (in)	Runoff Volume (ac-ft)	Runoff Volume (ft^3)
LANDFILL AREA											
1	1,443,117	33.13	0.0518			33.13	CN = 98	0.20	8.26	22.80	993,335
2	688,212	15.80	0.0247			15.80	CN = 98	0.20	8.26	10.87	473,714
3	1,035,025	23.76	0.0371			23.76	CN = 98	0.20	8.26	16.36	712,435
4	1,402,384	32.19	0.0503			32.19	CN = 98	0.20	8.26	22.16	965,297
5	1,910,231	43.85	0.0685			43.85	CN = 98	0.20	8.26	30.19	1,314,861
6	783,691	17.99	0.0281			17.99	CN = 98	0.20	8.26	12.38	539,435
7	1,632,679	37.48	0.0586			37.48	CN = 98	0.20	8.26	25.80	1,123,815
8	842,299	19.34	0.0302			19.34	CN = 98	0.20	8.26	13.31	579,776
9	841,863	19.33	0.0302			19.33	CN = 98	0.20	8.26	13.30	579,476
10	626,465	14.38	0.0225			14.38	CN = 98	0.20	8.26	9.90	431,212
11	319,636	7.34	0.0115			7.34	CN = 98	0.20	8.26	5.05	220,014
12	167,623	3.85	0.0060			3.85	CN = 98	0.20	8.26	2.65	115,379
13	849,288	19.50	0.0305			19.50	CN = 98	0.20	8.26	13.42	584,587
14	1,537,160	35.29	0.0551			35.29	CN = 98	0.20	8.26	24.29	1,058,067
15	1,443,630	33.14	0.0518			33.14	CN = 98	0.20	8.26	22.81	993,688
16	434,144	9.97	0.0156		4.15	5.82	CN = 96	0.42	8.02	6.66	290,141
17	210,063	4.82	0.0075		2.01	2.81	CN = 95	0.53	7.90	3.17	138,282
18	208,252	4.78	0.0075		1.99	2.79	CN = 96	0.42	8.02	3.20	139,176
19	208,961	4.80	0.0075		2.00	2.79	CN = 95	0.53	7.90	3.16	137,557
20	168,189	3.86	0.0060		1.18	2.69	CN = 96	0.42	8.02	2.58	112,402
21	156,182	3.59	0.0056		1.46	2.13	CN = 96	0.42	8.02	2.40	104,377
22	153,625	3.53	0.0055		1.68	1.85	CN = 95	0.53	7.90	2.32	101,130
23	224,887	5.16	0.0081		2.28	2.89	CN = 95	0.53	7.90	3.40	148,040
24	282,859	6.49	0.0101		2.01	4.48	CN = 96	0.42	8.02	4.34	189,036
25	133,014	3.05	0.0048		0.75	2.30	CN = 97	0.31	8.14	2.07	90,225
26	76,227	1.75	0.0027		0.33	1.42	CN = 97	0.31	8.14	1.19	51,706

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TABLE 1F
SYNTHETIC GRASS COVER COMPOSITE CURVE NUMBER CALCULATIONS

				CN = 98	CN = 92	CN = 98					
Subbasin ID	Subbasin Area (ft^2)	Subbasin Area (acres)	Subbasin Area (sq mile)	CONCRETE - PAVED AREAS OR POND AREAS (acres)	DIRT ROADS - UNPAVED AREAS (acres)	SYNTHETIC GRASS (acres)	Composite SCS Curve No.	$S = \frac{1000}{CN} - 10$	Unit Runoff Q (in)	Runoff Volume (ac-ft)	Runoff Volume (ft^3)
27	212,726	4.88	0.0076		1.85	3.04	CN = 96	0.42	8.02	3.26	142,166
28	92,401	2.12	0.0033		0.77	1.35	CN = 96	0.42	8.02	1.42	61,752
29	264,954	6.08	0.0095		3.56	2.52	CN = 94	0.64	7.78	3.94	171,762
30	364,708	8.37	0.0131		4.67	3.70	CN = 95	0.53	7.90	5.51	240,083
31	516,735	11.86	0.0185		6.52	5.34	CN = 95	0.53	7.90	7.81	340,161
32	327,237	7.51	0.0117		7.51		CN = 92	0.87	7.54	4.72	205,580
33	481,780	11.06	0.0173		11.06		CN = 92	0.87	7.54	6.95	302,668
34	469,344	10.77	0.0168	10.77			CN = 98	0.20	8.26	7.42	323,061
35	466,282	10.70	0.0167	10.70			CN = 98	0.20	8.26	7.37	320,954
36	501,126	11.50	0.0180	11.50			CN = 98	0.20	8.26	7.92	344,938
37	584,734	13.42	0.0210	10.66		2.77	CN = 98	0.20	8.26	9.24	402,488
38	726,939	16.69	0.0261	16.69			CN = 98	0.20	8.26	11.49	500,371
39	38,609	0.89	0.0014		0.30	0.58	CN = 96	0.42	8.02	0.59	25,802
40	48,110	1.10	0.0017		0.39	0.72	CN = 96	0.42	8.02	0.74	32,152
41	21,377	0.49	0.0008	.	0.49		CN = 92	0.87	7.54	0.31	13,429
42	274,088	6.29	0.0098	.	6.29		CN = 92	0.87	7.54	3.95	172,190
43	455,154	10.45	0.0163	10.45			CN = 98	0.20	8.26	7.19	313,294
44	451,849	10.37	0.0162	10.37			CN = 98	0.20	8.26	7.14	311,019
45	438,373	10.06	0.0157	10.06			CN = 98	0.20	8.26	6.93	301,743
46	457,914	10.51	0.0164	10.51			CN = 98	0.20	8.26	7.24	315,194
47	594,650	13.65	0.0213	11.10		2.55	CN = 98	0.20	8.26	9.40	409,313
48	549,303	12.61	0.0197	12.61			CN = 98	0.20	8.26	8.68	378,099
49	127,689	2.93	0.0046		0.76	2.17	CN = 96	0.42	8.02	1.96	85,335
Total:	22,788,674	602.52	0.82							410.94	17,900,720

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CITY OF EDINBURG
EDINBURG REGIONAL DISPOSAL FACILITY
PROJECT NUMBER: 1401491

TABLE 2F
SYNTHETIC GRASS COVER
BASIN TIME OF CONCENTRATION CALCULATIONS
POST-DEVELOPMENT

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

				Flow Segment 1							Flow Segment 2							Flow Segment 3						
Subbasin ID	Composite Curve Number	Total Lag (0.6*Tc) (min)	Total Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)	Type of Flow	Length (ft)	Slope (ft/ft)	Roughness Condition[1]		Typical Hydraulic Radius (Channel Only) (ft)	Travel Time (min)
LANDFILL AREA																								
1	98	8.9	14.8	Sheet	112	0.050	F	Dense Grass		9.4	Sheet	71	0.250	F	Dense Grass		3.4	Channel	944	0.020	G	Grass-lined	1.54	2.0
2	98	8.9	14.9	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	102	0.177	F	Dense Grass		5.2	Channel	428	0.020	G	Grass-lined	1.16	1.1
3	98	7.9	13.1	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	72	0.250	F	Dense Grass		3.5	Channel	507	0.020	G	Grass-lined	1.38	1.1
4	98	9.2	15.3	Sheet	112	0.050	F	Dense Grass		9.4	Sheet	115	0.250	F	Dense Grass		5.0	Channel	439	0.020	G	Grass-lined	1.51	0.9
5	98	9.7	16.2	Sheet	112	0.050	F	Dense Grass		9.4	Sheet	115	0.250	F	Dense Grass		5.0	Channel	901	0.020	G	Grass-lined	1.68	1.8
6	98	5.0	8.3	Sheet	160	0.250	F	Dense Grass		6.5	Channel	786	0.020	G	Grass-lined	1.32	1.8							
7	98	7.8	13.1	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	48	0.250	F	Dense Grass		2.5	Channel	1017	0.020	G	Grass-lined	1.64	2.0
8	98	8.1	13.4	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	48	0.250	F	Dense Grass		2.5	Channel	1017	0.020	G	Grass-lined	1.27	2.4
9	98	8.1	13.4	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	48	0.250	F	Dense Grass		2.5	Channel	1017	0.020	G	Grass-lined	1.27	2.4
10	98	8.3	13.8	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	73	0.250	F	Dense Grass		3.5	Channel	712	0.020	G	Grass-lined	1.14	1.8
11	98	6.0	9.9	Sheet	89	0.250	F	Dense Grass		4.1	Sheet	54	0.200	F	Dense Grass		3.0	Channel	969	0.020	G	Grass-lined	0.92	2.8
12	98	5.0	8.3	Sheet	160	0.250	F	Dense Grass		6.5	Channel	526	0.020	G	Grass-lined	0.74	1.8							
13	98	7.1	11.9	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	60	0.250	F	Dense Grass		3.0	Channel	174	0.020	G	Grass-lined	1.30	0.4
14	98	7.9	13.1	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	49	0.250	F	Dense Grass		2.5	Channel	1003	0.020	G	Grass-lined	1.60	2.0
15	98	7.9	13.2	Sheet	100	0.050	F	Dense Grass		8.5	Sheet	49	0.250	F	Dense Grass		2.5	Channel	1003	0.020	G	Grass-lined	1.56	2.1
16	96	14.6	24.4	Sheet	79	0.250	F	Dense Grass		3.7	Channel	2103	0.001	G	Grass-lined	1.42	20.7							
17	95	11.4	19.0	Sheet	160	0.250	F	Dense Grass		6.5	Channel	1020	0.001	G	Grass-lined	1.02	12.5							
18	96	11.7	19.5	Sheet	160	0.250	F	Dense Grass		6.5	Channel	1014	0.001	G	Grass-lined	0.96	12.9							
19	95	11.6	19.4	Sheet	160	0.250	F	Dense Grass		6.5	Channel	1015	0.001	G	Grass-lined	0.97	12.9							
20	96	9.4	15.7	Sheet	200	0.200	F	Dense Grass		8.5	Channel	619	0.001	G	Grass-lined	1.11	7.2							
21	96	10.6	17.6	Sheet	174	0.200	F	Dense Grass		7.6	Channel	827	0.001	G	Grass-lined	1.04	10.0							
22	95	8.0	13.3	Sheet	134	0.250	F	Dense Grass		5.7	Channel	672	0.001	G	Grass-lined	1.13	7.7							
23	95	11.4	19.1	Sheet	180	0.250	F	Dense Grass		7.2	Channel	1105	0.001	G	Grass-lined	1.24	11.9							
24	96	12.9	21.4	Sheet	81	0.250	F	Dense Grass		3.8	Channel	1685	0.001	G	Grass-lined	1.29	17.7							
25	97	8.2	13.6	Sheet	101	0.250	F	Dense Grass		4.5	Channel	737	0.001	G	Grass-lined	1.01	9.1							
26	97	5.7	9.6	Sheet	147	0.177	F	Dense Grass		7.0	Channel	175	0.0015	G	Grass-lined	0.58	2.5							
27	96	6.7	11.2	Sheet	70	0.250	F	Dense Grass		3.4	Channel	1174	0.006	G	Grass-lined	0.71	7.8							
28	96	6.9	11.5	Sheet	64	0.250	F	Dense Grass		3.1	Channel	622	0.001	G	Grass-lined	0.89	8.3							
29	94	8.4	14.0	Sheet	64	0.250	F	Dense Grass		3.1	Channel	1029	0.001	G	Grass-lined	1.28	10.8							
30	95	11.1	18.4	Sheet	160	0.250	F	Dense Grass		6.5	Channel	1244	0.001	G	Grass-lined	1.48	11.9							
31	95	7.8	13.0	Sheet	65	0.250	F	Dense Grass		3.2	Channel	1150	0.001	G	Grass-lined	1.75	9.8							
32	92	65.6	109.4	Sheet	300	0.001	F	Dense Grass		98.3	Shallow	340	0.001	U	Unpaved		11.1							
33	92	60.6	101.0	Sheet	300	0.001	F	Dense Grass		98.3	Shallow	84	0.001	U	Unpaved		2.7							
34	98	0.0	0.0																					
35	98	0.0	0.0																					
36	98	0.0	0.0																					
37	98	3.9	6.5	Sheet	160	0.250	F	Dense Grass		6.5														
38	98	0.0	0.0																					
39	96	6.1	10.1	Sheet	120	0.250	F	Dense Grass		5.2	Channel	279	0.001	G	Grass-lined	0.59	4.9							
40	96	4.5	7.4	Sheet	78	0.250	F	Dense Grass		3.7	Channel	227	0.0015	G	Grass-lined	0.48	3.8							
41	92	4.6	7.6	Channel	376	0.003	G	Grass-lined	0.21	7.6														
42	92	42.8	71.3	Sheet	300	0.003	F	Dense Grass		63.3	Shallow	1010	0.017	U	Unpaved		8.0							
43	98	0.0	0.0																					
44	98	0.0	0.0																					
45	98	0.0	0.0																					
46	98	0.0	0.0																					
47	98	3.9	6.5	Sheet	160	0.250	F	Dense Grass		6.5														
48	98	0.0	0.0																					
49	96	9.4	15.7	Sheet	160	0.250	F	Dense Grass		6.5	Channel	721	0.001	G	Grass-lined	0.96	9.2							

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

Table 3F
SYNTHETIC GRASS COVER
Channel Hydraulic Calculations

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

			Channel Design Geometry						Channel Roughness Parameters			Hydraulic Calculations							Channel Evaluations
Reach Designation	Q (cfs)	Storm Event	Approximate Channel Length (ft)	Bed Slope (ft/ft)	Left Side Slope (H:1V)	Right Side Slope (H:1V)	Bottom Width (ft)	Minimum Channel Depth (ft)	Design Channel Lining		Mannings 'n'	Maximum Velocity (ft/sec)	Maximum Normal Flow Depth (ft)	Froude Number	Normal Depth Shear Stress (lb/ft^2)	Stream Power (W/m^2)	Top Width of Flow (ft)	Top Width of Channel (ft)	Available Freeboard (ft)
Perimeter Channels																			
C1.A	21.6	25yr	610	0.0010	3.0	3.0	8.00	2.40	GL	Grass-lined	0.035	1.3	1.35	0.23	0.08	1.62	16.1	22.4	1.1
C1.B	64.2	25yr	842	0.0010	3.0	3.0	8.00	3.30	GL	Grass-lined	0.035	1.8	2.36	0.25	0.15	3.85	22.2	27.8	0.9
C1.C	104.6	25yr	1157	0.0010	3.0	3.0	8.00	4.00	GL	Grass-lined	0.035	2.1	3.00	0.26	0.19	5.57	26.0	32.0	1.0
C2.A	24.0	25yr	855	0.0010	3.0	3.0	9.00	2.40	GL	Grass-lined	0.035	1.4	1.36	0.23	0.08	1.66	17.2	23.4	1.0
C2.B	136.2	25yr	1015	0.0010	3.0	3.0	20.00	3.40	GL	Grass-lined	0.035	2.0	2.44	0.26	0.15	4.51	34.6	40.4	1.0
C2.C	268.0	25yr	1015	0.0010	3.0	3.0	20.00	4.40	GL	Grass-lined	0.035	2.5	3.51	0.27	0.22	7.94	41.1	46.4	0.9
C2.D	387.8	25yr	1020	0.0010	3.0	3.0	17.50	5.30	GL	Grass-lined	0.035	2.8	4.47	0.28	0.28	11.35	44.3	49.3	0.8
C2.E	610.3	25yr	2167	0.0010	3.0	3.0	15.00	6.40	GL	Grass-lined	0.035	3.2	5.86	0.29	0.37	16.95	50.2	53.4	0.5
C3.A	156.4	25yr	1117	0.0010	3.0	3.0	15.00	4.00	GL	Grass-lined	0.035	2.2	2.97	0.26	0.19	5.92	32.8	39.0	1.0
C3.B	236.8	25yr	1425	0.0010	3.0	3.0	11.00	5.11	GL	Grass-lined	0.035	2.5	4.06	0.27	0.25	9.25	35.4	41.7	1.1
C3.C	432.5	25yr	2120	0.0010	3.0	3.0	15.00	5.55	GL	Grass-lined	0.035	2.9	4.96	0.28	0.31	13.10	44.8	48.3	0.6
C4.A	14.2	25yr	678	0.0010	3.0	3.0	0.00	3.10	GL	Grass-lined	0.035	1.3	1.93	0.23	0.12	2.22	11.6	18.6	1.2
C4.B	611.8	25yr	376	0.0030	3.0	3.0	30.00	3.90	GL	Grass-lined	0.035	4.5	3.41	0.48	0.64	41.30	50.4	53.4	0.5
C5.A	223.6	25yr	172	0.0015	3.0	3.0	20.00	4.30	GL	Grass-lined	0.035	2.7	2.86	0.33	0.27	10.62	37.2	45.8	1.4
C5.B	447.9	25yr	247	0.0015	3.0	3.0	20.00	4.65	GL	Grass-lined	0.035	3.3	4.13	0.34	0.39	18.77	44.8	47.9	0.5
C5.C	579.7	25yr	1291	0.0015	3.0	3.0	20.00	5.00	GL	Grass-lined	0.035	3.6	4.72	0.35	0.44	23.04	48.3	50.0	0.3
C6.A	20.0	25yr	722	0.0010	3.0	3.0	0.00	3.40	GL	Grass-lined	0.035	1.4	2.20	0.23	0.14	2.75	13.2	20.4	1.2
C6.B	36.6	25yr	720	0.0010	3.0	3.0	0.00	4.00	GL	Grass-lined	0.035	1.6	2.76	0.24	0.17	4.01	16.5	24.0	1.2
C6.C	39.7	25yr	280	0.0010	3.0	3.0	0.00	4.10	GL	Grass-lined	0.035	1.6	2.84	0.24	0.18	4.21	17.1	24.6	1.3
C7.A	36.3	25yr	1771	0.0010	3.0	3.0	0.00	4.10	GL	Grass-lined	0.035	1.6	2.75	0.24	0.17	3.99	16.5	24.6	1.4

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

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

SYNTHETIC GRASS COVER
TABLE 4F: 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)	
82.3	0	0.00	0	0	0	0	
84.0	298,385	6.85	173,362	3.98	173,362	3.98	6.8499798
86.0	313,861	7.21	612,181	14.05	785,543	18.03	7.2052667
88.0	329,564	7.57	643,361	14.77	1,428,904	32.80	7.5657427
90.0	345,492	7.93	674,993	15.50	2,103,898	48.30	7.9314092
91.0	353,542	8.12	349,510	8.02	2,453,407		8.1162175
							0
						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)	
78.8	0	0.00	0	0	0	0	
80.0	272,303	6.25	108,013	2.48	108,013	2.48	6.2512061
82.0	287,471	6.60	559,705	12.85	667,719	15.33	6.599436
84.0	302,882	6.95	590,286	13.55	1,258,005	28.88	6.9532028
86.0	318,533	7.31	621,349	14.26	1,879,353	43.14	7.3125067
88.0	334,425	7.68	652,894	14.99	2,532,247	58.13	7.6773475
90.0	350,559	8.05	684,921	15.72	3,217,168	73.86	8.0477253
91.0	358,717	8.23	354,630	8.14	3,571,798	82.00	

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	2.48
82.0	19.04
84.0	49.92
86.0	92.29
88.0	136.82
90.0	183.53
91.0	82.00

Volume required per HEC-HMS model:

Pond Name	Volume (acre-ft)
W1	36.7
W2	40.5
W3	6.9
Σ Volume	84.10

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)	
80.3	0	0.00	0	0	0	0	
82.0	283,135	6.50	161,576	3.71	161,576	3.71	6.4998912
84.0	298,385	6.85	581,454	13.35	743,030	17.06	6.8499852
86.0	313,862	7.21	612,182	14.05	1,355,212	31.11	7.2052697
88.0	329,564	7.57	643,362	14.77	1,998,573	45.88	7.5657446
90.0	345,492	7.93	674,993	15.50	2,673,566	61.38	7.9314099
91.0	353,542	8.12	349,510	8.02	3,023,076	0.00	8.1162175
						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.

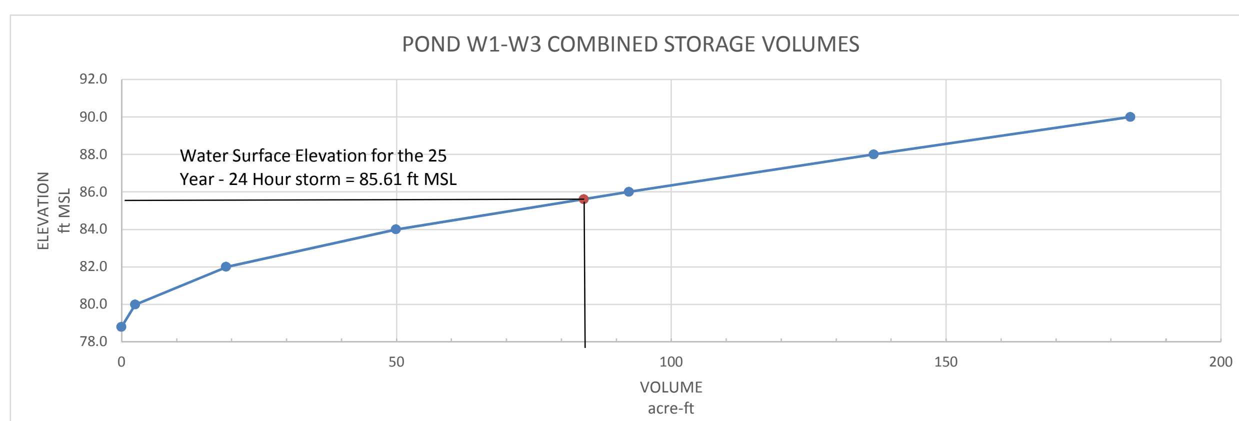
$$y_2 = \frac{(x_2 - x_1)(y_3 - y_1)}{(x_3 - x_1)} + y_1$$

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

25 year - 24 hour storm event
Peak Volume = 84.10 ac-ft
Water Surface Elevation = **85.61** ft MSL

References:

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



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

SYNTHETIC GRASS COVER
TABLE 5F: 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)
80.2	0	0.00	0	0	0	0
82.0	336,900	7.73	206,295	4.74	206,295	4.74
84.0	352,930	8.10	689,769	15.83	896,064	20.57
86.0	369,187	8.48	722,056	16.58	1,618,120	37.15
88.0	385,669	8.85	754,795	17.33	2,372,915	54.47
90.0	402,377	9.24	787,987	18.09	3,160,902	72.56
91.0	410,817	9.43	406,590	9.33	3,567,492	81.90

8.1021661

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)
80.2	0	0.00	0	0	0	0
82.0	341,840	7.85	210,801	4.84	210,801	4.84
84.0	357,930	8.22	699,709	16.06	910,510	20.90
86.0	374,247	8.59	732,116	16.81	1,642,627	37.71
88.0	390,789	8.97	764,976	17.56	2,407,603	55.27
90.0	407,557	9.36	798,287	18.33	3,205,890	73.60
91.0	416,027	9.55	411,785	9.45	3,617,675	83.05

8.2169503

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

Elevation (ft MSL)	Σ Volume (acre-ft)
80.2	4.74
82.0	30.09
84.0	78.51
86.0	129.16
88.0	182.07
90.0	237.29
91.0	265.77

Volume required per HEC-HMS model:

Pond Name	Volume (acre-ft)
W4	7.1
W5	7.2
W6	82.4
Σ Volume	96.7

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)
78.2	0	0.00	0	0	0	0
80.0	335,739	7.71	206,479	4.74	206,479	4.74
82.0	351,680	8.07	687,357	15.78	893,836	20.52
84.0	367,866	8.45	719,485	16.52	1,613,321	37.04
86.0	384,297	8.82	752,103	17.27	2,365,423	54.30
88.0	400,973	9.21	785,210	18.03	3,150,633	72.33
90.0	417,894	9.59	818,808	18.80	3,969,442	91.13
91.0	426,447	9.79	422,163	9.69	4,391,605	100.82

8.4450335

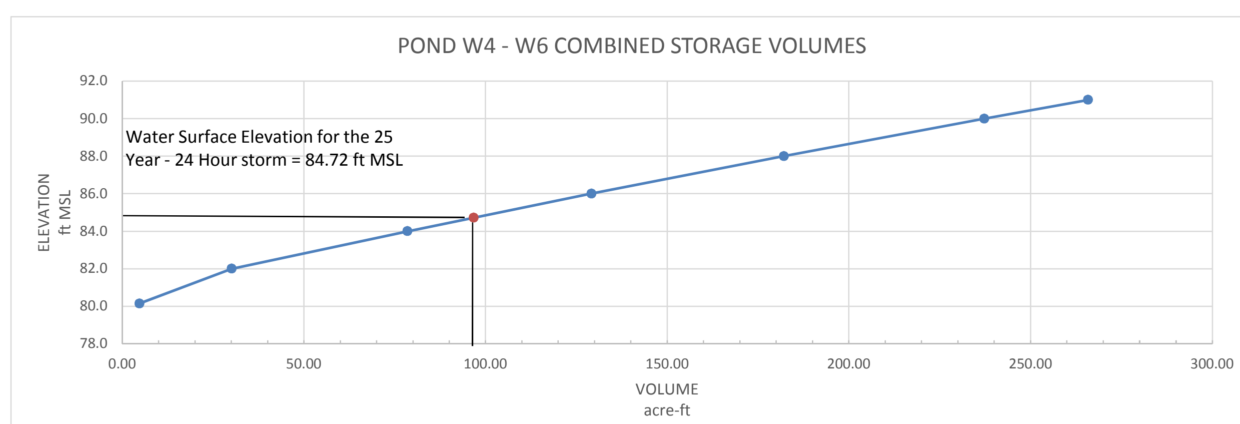
Next, the water surface elevation of the peak volume for the 25 year - 24 hour storm event. The peak volume is calculated using the HEC-HMS program. The water surface elevation is calculated by interpolation based on the stage storage table.

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

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

25 year - 24 hour storm event
Peak Volume = 96.70 ac-ft
Water Surface Elevation = **84.72** ft MSL

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



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

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

SYNTHETIC GRASS COVER
TABLE 6F: 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:

$$S = \Delta h \frac{A_1 + A_2 + (A_1A_2)^{0.5}}{3}$$

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)
76.2	0	0.00	0	0	0	0
78.0	320,044	7.35	193,627	4.45	193,627	4.45
80.0	335,708	7.71	655,690	15.05	849,317	19.50
82.0	351,629	8.07	687,276	15.78	1,536,593	35.28
84.0	367,807	8.44	719,375	16.51	2,255,968	51.79
86.0	384,240	8.82	751,987	17.26	3,007,955	69.05
88.0	400,930	9.20	785,111	18.02	3,793,067	87.08
90.0	417,877	9.59	818,749	18.80	4,611,815	105.87
91.0	426,447	9.79	422,155	9.69	5,033,970	115.56

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.

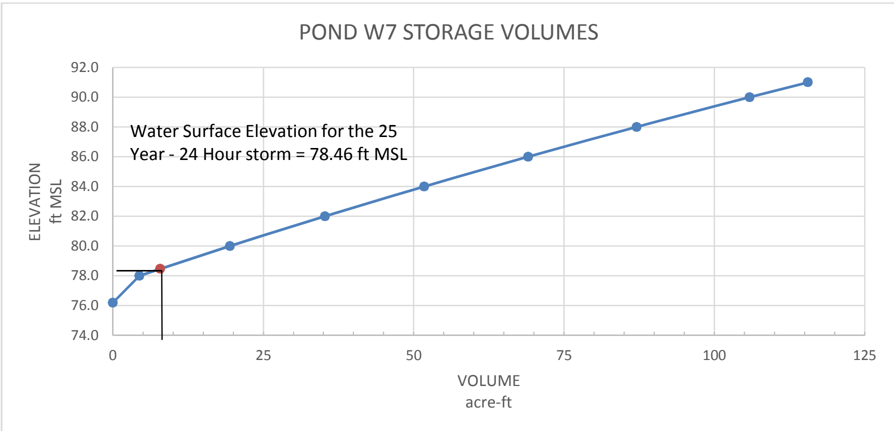
$$y_2 = \frac{(x_2 - x_1)(y_3 - y_1)}{(x_3 - x_1)} + y_1$$

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

25 year - 24 hour storm event
Peak Volume = 7.9 ac-ft
Water Surface Elevation = **78.46** ft MSL

References:

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



SYNTHETIC GRASS COVER - mx 4132016 .xlsm TABLE 6F W7

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

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

SYNTHETIC GRASS COVER
TABLE 7F: POND E1, E2 & 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)
67.5	0	0.00	0	0	0	0
68.0	8,659	0.20	1,443	0.03	1,443	0.03
70.0	78,903	1.81	75,801	1.74	77,244	1.77
72.0	98,120	2.25	176,675	4.06	253,918	5.83
74.0	156,310	3.59	252,182	5.79	506,101	11.62
76.0	223,473	5.13	377,788	8.67	883,889	20.29
78.0	299,609	6.88	521,225	11.97	1,405,114	32.26
80.0	314,258	7.21	613,809	14.09	2,018,923	46.35
82.0	329,183	7.56	643,383	14.77	2,662,306	61.12
84.0	344,382	7.91	673,507	15.46	3,335,813	76.58
86.0	359,856	8.26	704,181	16.17	4,039,994	92.75
88.0	375,574	8.62	735,374	16.88	4,775,368	109.63
90.0	391,576	8.99	767,095	17.61	5,542,463	127.24
92.0	407,871	9.36	799,392	18.35	6,341,856	145.59
94.0	424,438	9.74	832,254	19.11	7,174,110	164.69

5.1302342
6.8780736
7.2143787

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)
75.8	0	0.00	0	0	0	0
76.0	17,140	0.39	1,074	0.02	1,074	0.02
78.0	314,858	7.23	270,306	6.21	271,381	6.23
80.0	329,877	7.57	644,678	14.80	916,058	21.03
82.0	345,155	7.92	674,975	15.50	1,591,033	36.52
84.0	360,391	8.27	705,491	16.20	2,296,525	52.72
86.0	376,486	8.64	736,818	16.91	3,033,343	69.64
88.0	392,591	9.01	769,021	17.65	3,802,364	87.29
90.0	408,909	9.39	801,445	18.40	4,603,809	105.69
92.0	425,505	9.77	834,359	19.15	5,438,167	124.84
94.0	442,359	10.16	867,809	19.92	6,305,976	144.76

7.5729452

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

Elevation (ft MSL)	Σ Volume (acre-ft)
67.5	0
68.0	0.03
70.0	1.81
72.0	7.62
74.0	20.68
76.0	43.43
78.0	78.88
80.0	125.75
82.0	174.71
84.0	225.80
86.0	279.06
88.0	334.53
90.0	392.25
92.0	452.25
94.0	514.57

Volume required per HEC-HMS model:

Pond Name	Volume (acre-ft)
E1	95.1
E2	102.8
E4	8.7
Σ Volume	206.6

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)
69.3	0	0.00	0	0	0	0
70.0	6,724	0.15	1,461	0.03	1,461	0.03
72.0	84,064	1.93	76,374	1.75	77,836	1.79
74.0	247,310	5.68	317,040	7.28	394,876	9.07
76.0	368,657	8.46	611,943	14.05	1,006,819	23.11
78.0	383,892	8.81	752,498	17.27	1,759,318	40.39
80.0	399,413	9.17	783,254	17.98	2,542,572	58.37
82.0	415,220	9.53	814,582	18.70	3,357,154	77.07
84.0	431,313	9.90	846,482	19.43	4,203,636	96.50
86.0	447,691	10.28	878,953	20.18	5,082,589	116.68
88.0	464,356	10.66	911,996	20.94	5,994,585	137.62
90.0	481,306	11.05	945,611	21.71	6,940,196	159.32
92.0	498,542	11.44	979,798	22.49	7,919,994	181.82
94.0	516,080	11.85	1,014,572	23.29	8,934,567	205.11

8.4632099
8.8129567
9.1692669

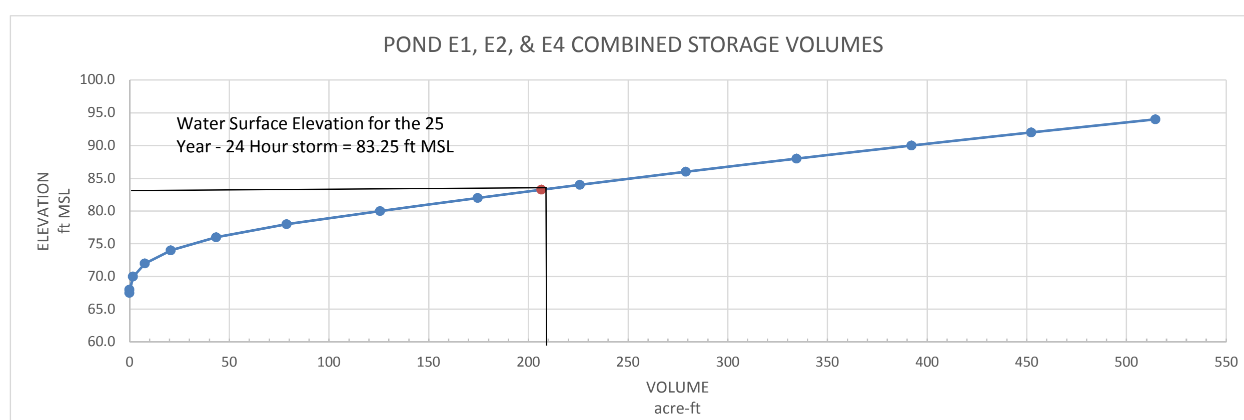
Next, the water surface elevation of the peak volume for the 25 year - 24 hour storm event. The peak volume is calculated using the HEC-HMS program. The water surface elevation is calculated by interpolation based on the stage storage table.

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

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

25 year - 24 hour storm event
Peak Volime = 206.60 ac-ft
Water Surface Elevation = **83.25** 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

SYNTHETIC GRASS COVER
TABLE 8F: POND E3 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 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)
62.8	0	0.00	0	0	0	0
64.0	36,899	0.85	14,760	0.34	14,760	0.34
66.0	263,730	6.05	266,184	6.11	280,944	6.45
68.0	462,503	10.62	716,990	16.46	997,934	22.91
70.0	478,420	10.98	940,878	21.60	1,938,812	44.51
72.0	494,599	11.35	972,974	22.34	2,911,786	66.85
74.0	511,041	11.73	1,005,595	23.09	3,917,381	89.93
76.0	527,745	12.12	1,038,741	23.85	4,956,122	113.78
78.0	544,712	12.50	1,072,413	24.62	6,028,535	138.40
80.0	561,942	12.90	1,106,610	25.40	7,135,145	163.80
82.0	579,435	13.30	1,141,332	26.20	8,276,477	190.00
84.0	597,190	13.71	1,176,580	27.01	9,453,057	217.01
86.0	615,208	14.12	1,212,353	27.83	10,665,410	244.84
88.0	633,488	14.54	1,248,651	28.66	11,914,061	273.51
90.0	652,031	14.97	1,285,475	29.51	13,199,535	303.02
92.0	670,837	15.40	1,322,823	30.37	14,522,359	333.39
94.0	689,909	15.84	1,360,702	31.24	14,560,237	334.26

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.

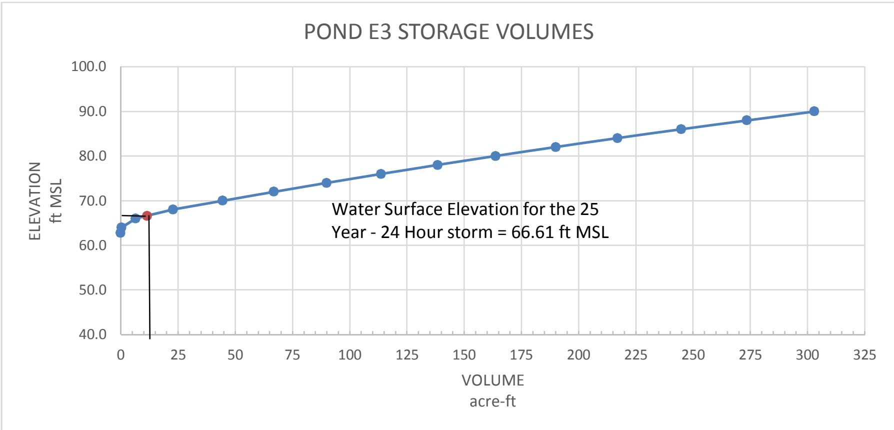
$$y_2 = \frac{(x_2 - x_1)(y_3 - y_1)}{(x_3 - x_1)} + y_1$$

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

25 year - 24 hour storm event
Peak Volume = 11.5 ac-ft
Water Surface Elevation = **66.61** ft MSL

References:

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

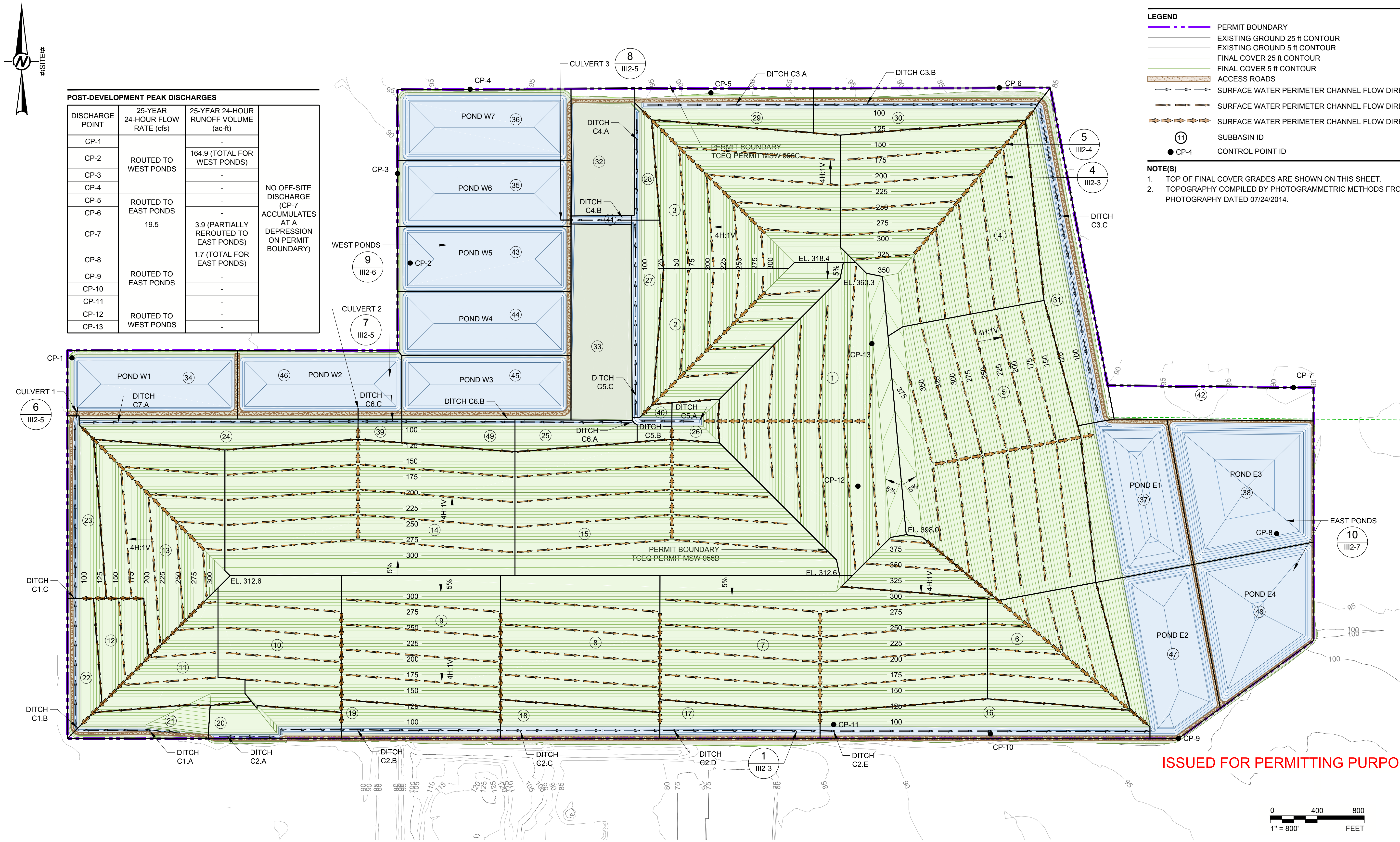


APPENDIX III-2F

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
- SURFACE WATER PERIMETER CHANNEL FLOW DIRECTION
- SURFACE WATER PERIMETER CHANNEL 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
0	2017-07-21	PERMIT AMENDMENT APPLICATION SUBMITTAL	VJE	TNB	MX	CGD

SEAL
STATE OF TEXAS
CHARLES G. DOMINGUEZ
83247
LICENSED 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 FOR SYNTHETIC GRASS COVER

PROJECT NO.	APPLICATION SECTION	REV.		FIGURE
1401491	III2F	0	1 of 1	III2F-1

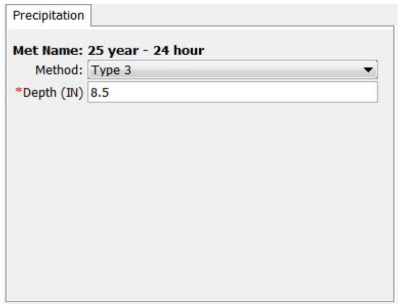
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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

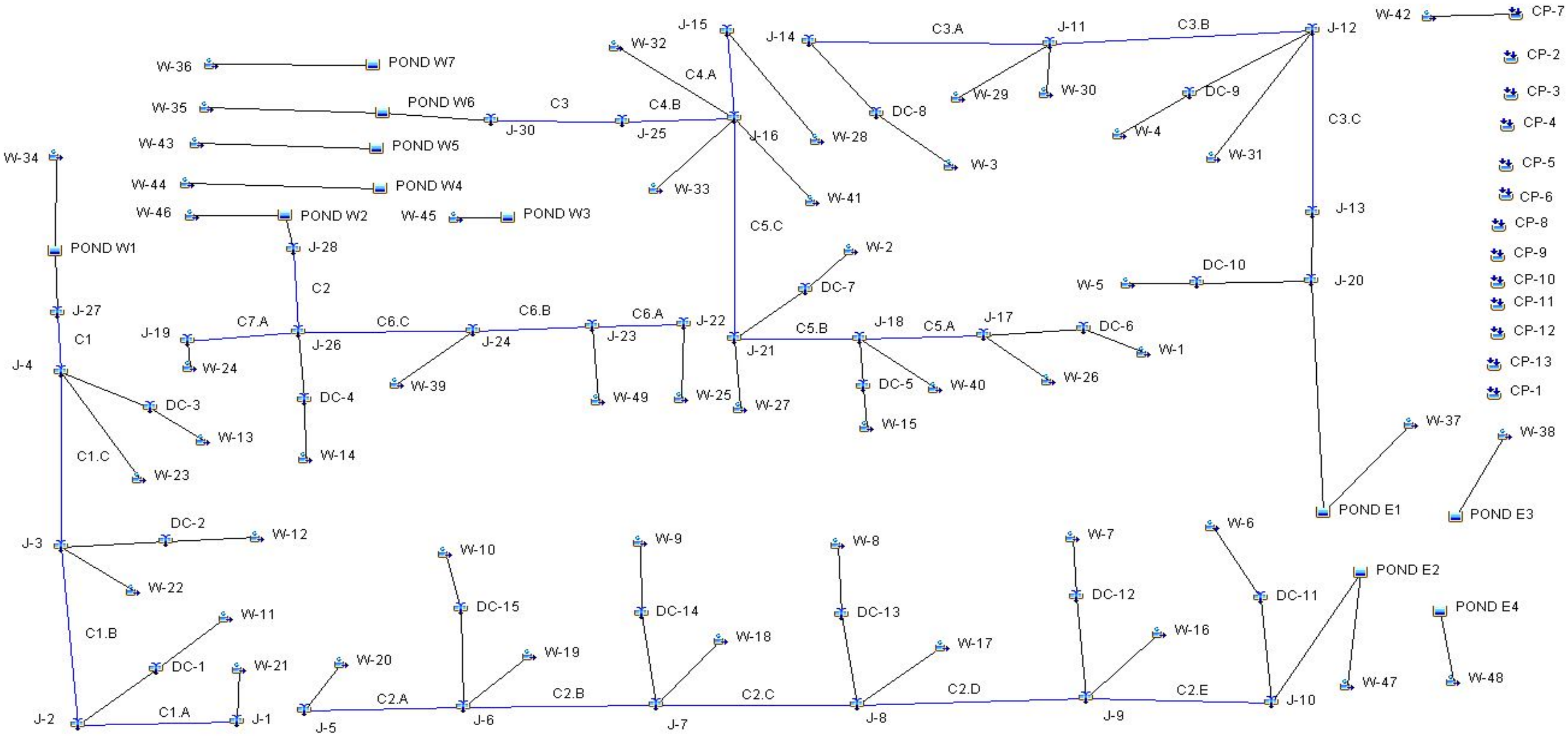
APPENDIX III-2F-1

HEC-HMS INPUT AND OUTPUT

Precipitation Input
25-year, 24-hour Storm Events



SYNTHETIC GRASS COVER



C:\Users\KCrowe\SharePoint\1401491, City of Edinburg Per - Doc\Application\Part III\III2 Surface Water Drainage Report\III2F Synthetic Grass Cover Drainage Calculation\III2F-2F-1\HMS input output.xlsm SGC HMS Graphic
Submitted: June 2017

Basin: Synthetic Grass Cover
    Last Modified Date: 16 July 2017
    Last Modified Time: 23:07:07
    Version: 4.0
    Filepath Separator: \
    Unit System: English
    Missing Flow To Zero: No
    Enable Flow Ratio: No
    Compute Local Flow At Junctions: No

    Enable Sediment Routing: No

    Enable Quality Routing: No
End:

Subbasin: W-10
    Canvas X: -3113.2075471698117
    Canvas Y: -1438.6792452830186
    Area: 0.0225
    Downstream: DC-15

    Canopy: None
    Plant Uptake Method: None

    Surface: None

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

    Transform: SCS
    Lag: 8.3
    Unitgraph Type: STANDARD

    Baseflow: None
End:

Junction: DC-15
    Canvas X: -2948.1132075471696
    Canvas Y: -2087.264150943396
    Downstream: J-6
End:

Subbasin: W-19
    Canvas X: -2228.7735849056608
    Canvas Y: -2606.132075471698
    Area: 0.0075
    Downstream: J-6

    Canopy: None
    Plant Uptake Method: None

    Surface: None

    LossRate: SCS
    Percent Impervious Area: 0.0
    Curve Number: 95

    Transform: SCS
    Lag: 11.6
    Unitgraph Type: STANDARD

    Baseflow: None
End:

Subbasin: W-20
    Canvas X: -4198.11320754717
    Canvas Y: -2688.6792452830186
    Area: 0.0060
    Downstream: J-5

    Canopy: None
    Plant Uptake Method: None

    Surface: None

    LossRate: SCS
    Percent Impervious Area: 0.0
    Curve Number: 96

    Transform: SCS
    Lag: 9.4
    Unitgraph Type: STANDARD

    Baseflow: None
End:

Junction: J-5
    Canvas X: -4599.056603773585
    Canvas Y: -3231.132075471698
    Label X: -3.0
    Label Y: -18.0
    Downstream: C2.A
End:

Reach: C2.A
    Canvas X: -2924.528301886792
    Canvas Y: -3195.7547169811314
    From Canvas X: -4599.056603773585
    From Canvas Y: -3231.132075471698
    Label X: -19.0
    Label Y: 6.0
    Downstream: J-6

    Route: Kinematic Wave
    Channel: Kinematic Wave
    Length: 855
    Energy Slope: 0.001
    Shape: Trapezoid
    Mannings n: 0.035
    Number of Increments: 2
    Width: 9

Side Slope: 3
Channel Loss: None
End:

Junction: J-6
Canvas X: -2924.528301886792
Canvas Y: -3195.7547169811314
Label X: -4.0
Label Y: -14.0
Downstream: C2.B
End:

Reach: C2.B
Canvas X: -908.0188679245284
Canvas Y: -3172.169811320755
From Canvas X: -2924.528301886792
From Canvas Y: -3195.7547169811314
Label X: -19.0
Label Y: 9.0
Downstream: J-7

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1015
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 20
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-9
Canvas X: -1073.1132075471696
Canvas Y: -1320.7547169811323
Area: 0.0302
Downstream: DC-14

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 8.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-14
Canvas X: -1049.5283018867922
Canvas Y: -2134.433962264151
Label X: -1.0
Label Y: 0.0
Downstream: J-7
End:

Subbasin: W-18
Canvas X: -224.05660377358436
Canvas Y: -2429.2452830188677
Area: 0.0075
Downstream: J-7

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 96

Transform: SCS
Lag: 11.7
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-7
Canvas X: -908.0188679245284
Canvas Y: -3172.169811320755
Label X: -3.0
Label Y: -20.0
Downstream: C2.C
End:

Reach: C2.C
Canvas X: 1202.830188679245
Canvas Y: -3172.169811320755
From Canvas X: -908.0188679245284
From Canvas Y: -3172.169811320755
Label X: -25.0
Label Y: 7.0
Downstream: J-8

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1015
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 20
Side Slope: 3
Channel Loss: None

End:

Subbasin: W-8
Canvas X: 1002.3584905660373
Canvas Y: -1344.3396226415098
Area: 0.0302
Downstream: DC-13

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 8.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-13
Canvas X: 1037.735849056604
Canvas Y: -2146.2264150943392
Downstream: J-8
End:

Subbasin: W-17
Canvas X: 2110.8490566037744
Canvas Y: -2500.0
Area: 0.0075
Downstream: J-8

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 11.4
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-8
Canvas X: 1202.830188679245
Canvas Y: -3172.169811320755
Label X: -5.0
Label Y: -14.0
Downstream: C2.D
End:

Reach: C2.D
Canvas X: 3608.4905660377353
Canvas Y: -3101.4150943396226
From Canvas X: 1202.830188679245
From Canvas Y: -3172.169811320755
Label X: -33.0
Label Y: 9.0
Downstream: J-9

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1020
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 17.5
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-7
Canvas X: 3466.9811320754725
Canvas Y: -1261.7924528301883
Area: 0.0586
Downstream: DC-12

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 7.8
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-12
Canvas X: 3502.3584905660373
Canvas Y: -1945.7547169811323
Downstream: J-9
End:

Subbasin: W-16
Canvas X: 4386.792452830188
Canvas Y: -2346.698113207547

    Area: 0.0156
    Downstream: J-9

    Canopy: None
    Plant Uptake Method: None

    Surface: None

    LossRate: SCS
    Percent Impervious Area: 0.0
    Curve Number: 96

    Transform: SCS
    Lag: 14.6
    Unitgraph Type: STANDARD

    Baseflow: None
End:

Junction: J-9
    Canvas X: 3608.4905660377353
    Canvas Y: -3101.4150943396226
    Label X: 2.0
    Label Y: -18.0
    Downstream: C2.E
End:

Reach: C2.E
    Canvas X: 5554.245283018869
    Canvas Y: -3148.5849056603774
    From Canvas X: 3608.4905660377353
    From Canvas Y: -3101.4150943396226
    Label X: -15.0
    Label Y: 7.0
    Downstream: J-10

    Route: Kinematic Wave
    Channel: Kinematic Wave
    Length: 2167
    Energy Slope: 0.001
    Shape: Trapezoid
    Mannings n: 0.035
    Number of Increments: 2
    Width: 15
    Side Slope: 3
    Channel Loss: None
End:

Subbasin: W-6
    Canvas X: 4941.037735849057
    Canvas Y: -1143.867924528302
    Area: 0.0281
    Downstream: DC-11

    Canopy: None
    Plant Uptake Method: None

    Surface: None

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

    Transform: SCS
    Lag: 5.0
    Unitgraph Type: STANDARD

    Baseflow: None
End:

Junction: DC-11
    Canvas X: 5448.1132075471705
    Canvas Y: -1957.5471698113206
    Downstream: J-10
End:

Junction: J-10
    Canvas X: 5554.245283018869
    Canvas Y: -3148.5849056603774
    Downstream: POND E2
End:

Subbasin: W-47
    Canvas X: 6356.132075471698
    Canvas Y: -2948.1132075471696
    Area: 0.0213
    Downstream: POND E2

    Canopy: None
    Plant Uptake Method: None

    Surface: None

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

    Transform: SCS
    Lag: 3.9
    Unitgraph Type: STANDARD

    Baseflow: None
End:

Reservoir: POND E2
    Canvas X: 6497.641509433963
    Canvas Y: -1674.5283018867922

    Route: None
End:

Subbasin: W-3

Canvas X: 2193.396226415094
Canvas Y: 2959.905660377359
Label X: 4.0
Label Y: -2.0
Area: 0.0371
Downstream: DC-8

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 7.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-8
Canvas X: 1403.301886792453
Canvas Y: 3537.735849056604
Downstream: J-14
End:

Junction: J-14
Canvas X: 695.7547169811314
Canvas Y: 4363.207547169812
Label X: -48.0
Label Y: 2.0
Downstream: C3.A
End:

Reach: C3.A
Canvas X: 3231.132075471698
Canvas Y: 4339.622641509434
From Canvas X: 695.7547169811314
From Canvas Y: 4363.207547169812
Label X: -11.0
Label Y: 10.0
Downstream: J-11

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1117
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 15
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-30
Canvas X: 3195.7547169811314
Canvas Y: 3785.3773584905657
Area: 0.0131
Downstream: J-11

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 11.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: W-29
Canvas X: 2264.1509433962256
Canvas Y: 3726.4150943396226
Area: 0.0095
Downstream: J-11

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 94

Transform: SCS
Lag: 8.4
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-11
Canvas X: 3231.132075471698
Canvas Y: 4339.622641509434
Label X: -6.0
Label Y: 13.0
Downstream: C3.B
End:

Reach: C3.B
Canvas X: 5990.566037735849

Canvas Y: 4492.924528301886
From Canvas X: 3231.132075471698
From Canvas Y: 4339.622641509434
Label X: -16.0
Label Y: 9.0
Downstream: J-12

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1425
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 11
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-4
Canvas X: 3962.264150943396
Canvas Y: 3313.6792452830186
Area: 0.0503
Downstream: DC-9

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 9.2
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-9
Canvas X: 4693.396226415094
Canvas Y: 3761.7924528301887
Downstream: J-12
End:

Subbasin: W-31
Canvas X: 4952.830188679245
Canvas Y: 3042.4528301886794
Area: 0.0185
Downstream: J-12

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 7.8
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-12
Canvas X: 5990.566037735849
Canvas Y: 4492.924528301886
Downstream: C3.C
End:

Reach: C3.C
Canvas X: 5990.566037735849
Canvas Y: 2417.4528301886794
From Canvas X: 5990.566037735849
From Canvas Y: 4492.924528301886
Downstream: J-13

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 2120
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 15
Side Slope: 3
Channel Loss: None
End:

Junction: J-13
Canvas X: 5990.566037735849
Canvas Y: 2417.4528301886794
Label X: 7.0
Label Y: 2.0
Downstream: J-20
End:

Subbasin: W-5
Canvas X: 4056.603773584906
Canvas Y: 1615.566037735849
Label X: -55.0
Label Y: -4.0
Area: 0.0685
Downstream: DC-10

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 9.7
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-10
Canvas X: 4775.943396226416
Canvas Y: 1615.566037735849
Label X: -8.0
Label Y: 14.0
Downstream: J-20
End:

Junction: J-20
Canvas X: 5978.773584905661
Canvas Y: 1639.1509433962265
Label X: 7.0
Label Y: -2.0
Downstream: POND E1
End:

Subbasin: W-37
Canvas X: 7016.509433962265
Canvas Y: 23.584905660377444
Area: 0.0210
Downstream: POND E1

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 3.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND E1
Canvas X: 6096.698113207547
Canvas Y: -990.566037735849

Route: None
End:

Subbasin: W-1
Canvas X: 4134.007585335019
Canvas Y: 701.6434892541092
Area: 0.0518
Downstream: DC-6

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 8.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-6
Canvas X: 3584.905660377359
Canvas Y: 1096.698113207547
Downstream: J-17
End:

Subbasin: W-26
Canvas X: 3219.33962264151
Canvas Y: 518.867924528302
Area: 0.0027
Downstream: J-17

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 97

Transform: SCS
Lag: 5.7
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-17
Canvas X: 2535.3773584905666
Canvas Y: 1025.9433962264152

Label X: -12.0
Label Y: 14.0
Downstream: C5.A
End:

Reach: C5.A
Canvas X: 1226.4150943396235
Canvas Y: 990.566037735849
From Canvas X: 2535.3773584905666
From Canvas Y: 1025.9433962264152
Label X: -11.0
Label Y: 7.0
Downstream: J-18

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 172
Energy Slope: 0.0015
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 20
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-15
Canvas X: 1308.9622641509432
Canvas Y: -11.792452830188267
Area: 0.0518
Downstream: DC-5

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 7.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-5
Canvas X: 1273.5849056603765
Canvas Y: 448.1132075471696
Downstream: J-18
End:

Subbasin: W-40
Canvas X: 2028.301886792453
Canvas Y: 424.5283018867922
Area: 0.0017
Downstream: J-18

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 96

Transform: SCS
Lag: 4.5
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-18
Canvas X: 1226.4150943396235
Canvas Y: 990.566037735849
Label X: 0.0
Label Y: 13.0
Downstream: C5.B
End:

Reach: C5.B
Canvas X: -82.54716981132151
Canvas Y: 990.566037735849
From Canvas X: 1226.4150943396235
From Canvas Y: 990.566037735849
Label X: -14.0
Label Y: 7.0
Downstream: J-21

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 247
Energy Slope: 0.0015
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 20
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-2
Canvas X: 1143.867924528302
Canvas Y: 1992.9245283018868
Area: 0.0247
Downstream: DC-7

Canopy: None

Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 8.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-7
Canvas X: 660.3773584905666
Canvas Y: 1544.8113207547171
Downstream: J-21
End:

Subbasin: W-27
Canvas X: -23.584905660376535
Canvas Y: 200.47169811320782
Area: 0.0076
Downstream: J-21

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 96

Transform: SCS
Lag: 6.7
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-21
Canvas X: -82.54716981132151
Canvas Y: 990.566037735849
Label X: -2.0
Label Y: -13.0
Downstream: C5.C
End:

Reach: C5.C
Canvas X: -86.32138114209829
Canvas Y: 3486.0557768924305
From Canvas X: -82.54716981132151
From Canvas Y: 990.566037735849
Downstream: J-16

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1291
Energy Slope: 0.0015
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 20
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-33
Canvas X: -909.694555112882
Canvas Y: 2689.2430278884462
Label X: 3.0
Label Y: -3.0
Area: 0.0173
Downstream: J-16

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 92

Transform: SCS
Lag: 60.6
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: W-32
Canvas X: -1321.3811420982738
Canvas Y: 4309.428950863214
Area: 0.0117
Downstream: J-16

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 92

Transform: SCS
Lag: 65.6
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: W-28
Canvas X: 790.0943396226412
Canvas Y: 3242.9245283018868
Area: 0.0033
Downstream: J-15

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 96

Transform: SCS
Lag: 6.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-15
Canvas X: -153.30188679245293
Canvas Y: 4481.132075471698
Label X: -53.0
Label Y: 4.0
Downstream: C4.A
End:

Reach: C4.A
Canvas X: -86.32138114209829
Canvas Y: 3486.0557768924305
From Canvas X: -153.30188679245293
From Canvas Y: 4481.132075471698
Label X: -51.0
Label Y: -2.0
Downstream: J-16

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 678
Energy Slope: 0.001
Shape: Triangular
Mannings n: 0.035
Number of Increments: 2
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-41
Canvas X: 742.9245283018863
Canvas Y: 2558.9622641509436
Area: 0.0008
Downstream: J-16

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 92

Transform: SCS
Lag: 4.6
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-16
Canvas X: -86.32138114209829
Canvas Y: 3486.0557768924305
Label X: 0.0
Label Y: -18.0
Downstream: C4.B
End:

Reach: C4.B
Canvas X: -1261.7924528301883
Canvas Y: 3455.1886792452833
From Canvas X: -86.32138114209829
From Canvas Y: 3486.0557768924305
Label X: -37.0
Label Y: 11.0
Downstream: J-25

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 376
Energy Slope: 0.003
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 30
Side Slope: 3
Channel Loss: None
End:

Junction: J-25
Canvas X: -1261.7924528301883
Canvas Y: 3455.1886792452833
Label X: 0.0
Label Y: -13.0
Downstream: C3
End:

Reach: C3
Canvas X: -2641.5094339622638
Canvas Y: 3466.9811320754716
From Canvas X: -1261.7924528301883
From Canvas Y: 3455.1886792452833
Label X: -18.0
Label Y: 12.0
Downstream: J-30

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 275
Energy Slope: 0.01
Shape: Rectangular
Mannings n: 0.021
Number of Increments: 5
Width: 4
Channel Loss: None
End:

Junction: J-30
Canvas X: -2641.5094339622638
Canvas Y: 3466.9811320754716
Label X: 0.0
Label Y: -11.0
Downstream: POND W6
End:

Subbasin: W-35
Canvas X: -5624.169986719788
Canvas Y: 3618.857901726428
Label X: -58.0
Label Y: -3.0
Area: 0.0167
Downstream: POND W6

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND W6
Canvas X: -3778.220451527224
Canvas Y: 3552.456839309429
Label X: 8.0
Label Y: 7.0

Route: None
End:

Subbasin: W-14
Canvas X: -4581.673306772908
Canvas Y: -365.20584329349185
Area: 0.0551
Downstream: DC-4

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 7.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-4
Canvas X: -4594.953519256308
Canvas Y: 285.52456839309434
Downstream: J-26
End:

Subbasin: W-25
Canvas X: -636.7924528301883
Canvas Y: 318.39622641509413
Area: 0.0048
Downstream: J-22

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 97

Transform: SCS
Lag: 8.2
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-22
Canvas X: -613.2075471698117
Canvas Y: 1155.6603773584907
Label X: -2.0
Label Y: 1.0
Downstream: C6.A
End:

Reach: C6.A
Canvas X: -1568.396226415095
Canvas Y: 1120.2830188679245
From Canvas X: -613.2075471698117
From Canvas Y: 1155.6603773584907
Label X: -18.0
Label Y: 8.0
Downstream: J-23

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 722
Energy Slope: 0.001
Shape: Triangular
Mannings n: 0.035
Number of Increments: 2
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-49
Canvas X: -1509.433962264151
Canvas Y: 294.8113207547167
Area: 0.0046
Downstream: J-23

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 96

Transform: SCS
Lag: 9.4
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-23
Canvas X: -1568.396226415095
Canvas Y: 1120.2830188679245
Label X: 0.0
Label Y: -11.0
Downstream: C6.B
End:

Reach: C6.B
Canvas X: -2441.037735849057
Canvas Y: 1191.0377358490568
From Canvas X: -1568.396226415095
From Canvas Y: 1120.2830188679245
Label X: -24.0
Label Y: 14.0
Downstream: J-24

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 720
Energy Slope: 0.001
Shape: Triangular
Mannings n: 0.035
Number of Increments: 2
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-39
Canvas X: -3620.2830188679254
Canvas Y: 483.49056603773624
Label X: -1.0
Label Y: -5.0
Area: 0.0014
Downstream: J-24

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 96

Transform: SCS
Lag: 6.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-24
Canvas X: -2441.037735849057
Canvas Y: 1191.0377358490568
Label X: -5.0
Label Y: -12.0
Downstream: C6.C
End:

Reach: C6.C
Canvas X: -4661.354581673307

Canvas Y: 1055.776892430279
From Canvas X: -2441.037735849057
From Canvas Y: 1191.0377358490568
Label X: -20.0
Label Y: 6.0
Downstream: J-26

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 280
Energy Slope: 0.002
Shape: Triangular
Mannings n: 0.035
Number of Increments: 2
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-24
Canvas X: -5801.886792452831
Canvas Y: 672.1698113207549
Label X: -2.0
Label Y: -4.0
Area: 0.0101
Downstream: J-19

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 96

Transform: SCS
Lag: 12.9
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-19
Canvas X: -5825.471698113208
Canvas Y: 955.1886792452829
Label X: -51.0
Label Y: 5.0
Downstream: C7.A
End:

Reach: C7.A
Canvas X: -4661.354581673307
Canvas Y: 1055.776892430279
From Canvas X: -5825.471698113208
From Canvas Y: 955.1886792452829
Label X: -18.0
Label Y: 11.0
Downstream: J-26

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 1771
Energy Slope: 0.001
Shape: Triangular
Mannings n: 0.035
Number of Increments: 2
Side Slope: 3
Channel Loss: None
End:

Junction: J-26
Canvas X: -4661.354581673307
Canvas Y: 1055.776892430279
Label X: -1.0
Label Y: -14.0
Downstream: C2
End:

Reach: C2
Canvas X: -4705.188679245283
Canvas Y: 1992.9245283018868
From Canvas X: -4661.354581673307
From Canvas Y: 1055.776892430279
Downstream: J-28

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 70
Energy Slope: 0.01
Shape: Rectangular
Mannings n: 0.012
Number of Increments: 5
Width: 3
Channel Loss: None
End:

Junction: J-28
Canvas X: -4705.188679245283
Canvas Y: 1992.9245283018868
Downstream: POND W2
End:

Subbasin: W-46
Canvas X: -5766.509433962265
Canvas Y: 2393.867924528302
Label X: -59.0
Label Y: 0.0
Area: 0.0164
Downstream: POND W2

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND W2
Canvas X: -4799.528301886793
Canvas Y: 2393.867924528302
Label X: 0.0
Label Y: -3.0

Route: None
End:

Subbasin: W-13
Canvas X: -5660.377358490567
Canvas Y: -165.0943396226412
Area: 0.0305
Downstream: DC-3

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 7.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-3
Canvas X: -6214.622641509433
Canvas Y: 200.47169811320782
Downstream: J-4
End:

Subbasin: W-11
Canvas X: -5412.735849056604
Canvas Y: -2169.8113207547167
Area: 0.0115
Downstream: DC-1

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 6.0
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-1
Canvas X: -6155.66037735849
Canvas Y: -2771.2264150943392
Downstream: J-2
End:

Subbasin: W-21
Canvas X: -5283.018867924528
Canvas Y: -2759.433962264151
Area: 0.0056
Downstream: J-1

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 96

Transform: SCS
Lag: 10.6
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-1
Canvas X: -5306.603773584906
Canvas Y: -3360.8490566037744
Downstream: C1.A
End:

Reach: C1.A
Canvas X: -6969.33962264151
Canvas Y: -3396.2264150943392
From Canvas X: -5306.603773584906
From Canvas Y: -3360.8490566037744

Label X: -12.0
Label Y: 7.0
Downstream: J-2

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 610
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 8
Side Slope: 3
Channel Loss: None
End:

Junction: J-2
Canvas X: -6969.33962264151
Canvas Y: -3396.2264150943392
Label X: -49.0
Label Y: 3.0
Downstream: C1.B
End:

Reach: C1.B
Canvas X: -7146.226415094339
Canvas Y: -1379.7169811320755
From Canvas X: -6969.33962264151
From Canvas Y: -3396.2264150943392
Downstream: J-3

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 842
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 8
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-12
Canvas X: -5094.33962264151
Canvas Y: -1261.7924528301883
Area: 0.0060
Downstream: DC-2

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 5.0
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: DC-2
Canvas X: -6049.528301886792
Canvas Y: -1320.7547169811323
Label X: -9.0
Label Y: 14.0
Downstream: J-3
End:

Subbasin: W-22
Canvas X: -6391.509433962265
Canvas Y: -1875.0
Area: 0.0055
Downstream: J-3

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 8.0
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-3
Canvas X: -7146.226415094339
Canvas Y: -1379.7169811320755
Label X: -45.0
Label Y: 1.0
Downstream: C1.C
End:

Reach: C1.C
Canvas X: -7146.226415094339
Canvas Y: 601.4150943396226
From Canvas X: -7146.226415094339
From Canvas Y: -1379.7169811320755
Downstream: J-4

Route: Kinematic Wave
Channel: Kinematic Wave

Length: 1157
Energy Slope: 0.001
Shape: Trapezoid
Mannings n: 0.035
Number of Increments: 2
Width: 8
Side Slope: 3
Channel Loss: None
End:

Subbasin: W-23
Canvas X: -6332.547169811321
Canvas Y: -589.6226415094343
Area: 0.0081
Downstream: J-4

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 95

Transform: SCS
Lag: 11.4
Unitgraph Type: STANDARD

Baseflow: None
End:

Junction: J-4
Canvas X: -7146.226415094339
Canvas Y: 601.4150943396226
Label X: -53.0
Label Y: 4.0
Downstream: C1
End:

Reach: C1
Canvas X: -7193.396226415094
Canvas Y: 1273.5849056603774
From Canvas X: -7146.226415094339
From Canvas Y: 601.4150943396226
Downstream: J-27

Route: Kinematic Wave
Channel: Kinematic Wave
Length: 85
Energy Slope: 0.01
Shape: Rectangular
Mannings n: 0.021
Number of Increments: 4
Width: 3
Channel Loss: None
End:

Junction: J-27
Canvas X: -7193.396226415094
Canvas Y: 1273.5849056603774
Downstream: POND W1
End:

Subbasin: W-34
Canvas X: -7205.188679245283
Canvas Y: 3066.037735849057
Label X: -56.0
Label Y: -5.0
Area: 0.0168
Downstream: POND W1

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND W1
Canvas X: -7216.981132075472
Canvas Y: 1981.132075471698

Route: None
End:

Subbasin: W-38
Canvas X: 8007.075471698114
Canvas Y: -106.13207547169804
Area: 0.0261
Downstream: POND E3

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1

Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND E3
Canvas X: 7488.207547169812
Canvas Y: -1037.735849056604
Label X: -1.0
Label Y: 0.0

Route: None
End:

Subbasin: W-48
Canvas X: 7464.622641509433
Canvas Y: -2889.1509433962265
Area: 0.0197
Downstream: POND E4

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND E4
Canvas X: 7323.1132075471705
Canvas Y: -2110.8490566037735
Label X: 0.0
Label Y: 2.0

Route: None
End:

Subbasin: W-36
Canvas X: -5566.037735849057
Canvas Y: 4103.773584905661
Label X: -58.0
Label Y: -5.0
Area: 0.0180
Downstream: POND W7

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND W7
Canvas X: -3879.7169811320755
Canvas Y: 4091.9811320754716

Route: None
End:

Subbasin: W-43
Canvas X: -5717.131474103586
Canvas Y: 3207.171314741036
Label X: -61.0
Label Y: -3.0
Area: 0.0163
Downstream: POND W5

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND W5
Canvas X: -3831.341301460823
Canvas Y: 3154.050464807437

Route: None
End:

Subbasin: W-44
Canvas X: -5823.373173970784
Canvas Y: 2755.644090305445
Label X: -59.0
Label Y: -4.0

Area: 0.0162
Downstream: POND W4

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND W4
Canvas X: -3804.7808764940237
Canvas Y: 2689.2430278884462

Route: None
End:

Subbasin: W-45
Canvas X: -3007.0754716981137
Canvas Y: 2370.2830188679245
Label X: -58.0
Label Y: -1.0
Area: 0.0157
Downstream: POND W3

Canopy: None
Plant Uptake Method: None

Surface: None

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

Transform: SCS
Lag: 0.1
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: POND W3
Canvas X: -2464.6226415094343
Canvas Y: 2358.490566037736
Label X: 0.0
Label Y: 1.0

Route: None
End:

Subbasin: W-42
Canvas X: 7216.9811320754725
Canvas Y: 4646.226415094339
Label X: -57.0
Label Y: -1.0
Area: 0.0098
Downstream: CP-7

Canopy: None
Plant Uptake Method: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 92

Transform: SCS
Lag: 42.8
Unitgraph Type: STANDARD

Baseflow: None
End:

Sink: CP-7
Canvas X: 8125.0
Canvas Y: 4681.603773584906
End:

Sink: CP-6
Canvas X: 8018.867924528302
Canvas Y: 2629.7169811320755
Label X: -2.0
Label Y: -5.0
End:

Sink: CP-2
Canvas X: 8066.037735849055
Canvas Y: 4186.320754716981
End:

Sink: CP-3
Canvas X: 8066.037735849055
Canvas Y: 3761.7924528301887
End:

Sink: CP-4
Canvas X: 8030.66037735849
Canvas Y: 3408.0188679245284
End:

Sink: CP-5
Canvas X: 8018.867924528302

Canvas Y: 2959.905660377359
End:

End:

Sink: CP-8
Canvas X: 7948.113207547169
Canvas Y: 2275.943396226415
End:

Sink: CP-9
Canvas X: 7936.32075471698
Canvas Y: 1933.9622641509436
End:

Sink: CP-10
Canvas X: 7936.32075471698
Canvas Y: 1627.3584905660377
End:

Sink: CP-11
Canvas X: 7936.32075471698
Canvas Y: 1379.7169811320755
End:

Sink: CP-12
Canvas X: 7936.32075471698
Canvas Y: 1049.5283018867926
End:

Sink: CP-13
Canvas X: 7900.943396226416
Canvas Y: 695.7547169811323
End:

Sink: CP-1
Canvas X: 7900.943396226416
Canvas Y: 365.566037735849
End:

Basin Schematic Properties:
Last View N: 5000.0
Last View S: -5000.0
Last View W: -5000.0
Last View E: 5000.0
Maximum View N: 5000.0
Maximum View S: -5000.0
Maximum View W: -5000.0
Maximum View E: 5000.0
Extent Method: Elements
Buffer: 0
Draw Icons: Yes
Draw Icon Labels: Name
Draw Map Objects: No
Draw Gridlines: No
Draw Flow Direction: No
Fix Element Locations: Yes
Fix Hydrologic Order: No

Synthetic Grass Cover

HMS Element	Control Point	25-Year 24-Hour Peak Flow (cfs)	25-Year 24-Hour Volume (ac-ft)	Drainage Area (sq mi)
CP-1	CP-1	0.0	0.0	0.000
CP-2	CP-2	0.0	0.0	0.000
CP-3	CP-3	0.0	0.0	0.000
CP-4	CP-4	0.0	0.0	0.000
CP-5	CP-5	0.0	0.0	0.000
CP-6	CP-6	0.0	0.0	0.000
CP-7	CP-7	19.5	3.9	0.010
CP-8	CP-8	0.0	0.0	0.000
CP-9	CP-9	0.0	0.0	0.000
CP-10	CP-10	0.0	0.0	0.000
CP-11	CP-11	0.0	0.0	0.000
CP-12	CP-12	0.0	0.0	0.000
CP-13	CP-13	0.0	0.0	0.000

HEC-HMS Summary of Results				
Synthetic Grass Cover, 25-yr 24-hr Results				
Start of Run:	01 Jan 2040, 00:00		Basin Model:	Synthetic Grass Cover
End of Run:	03 Jan 2040, 00:01		Met. Model:	25 YEAR - 24 HOUR
			Control Specs:	48 HOUR - 1 MINUTE
Hydrologic Element	Drainage Area (mi sq)	Discharge Peak (cfs)	Time of Peak	Volume (ac-ft)
W-10	0.0225	94.2	01Jan2040, 12:09	9.9
DC-15	0.023	94.2	01Jan2040, 12:09	9.9
W-19	0.008	28	01Jan2040, 12:13	3.2
W-20	0.006	24.1	01Jan2040, 12:10	2.6
J-5	0.006	24.1	01Jan2040, 12:10	2.6
C2.A	0.006	24	01Jan2040, 12:18	2.6
J-6	0.036	136.4	01Jan2040, 12:11	15.6
C2.B	0.036	136.2	01Jan2040, 12:17	15.6
W-9	0.030	127.4	01Jan2040, 12:09	13.3
DC-14	0.030	127.4	01Jan2040, 12:09	13.3
W-18	0.008	28.1	01Jan2040, 12:13	3.2
J-7	0.074	269.4	01Jan2040, 12:13	32.1
C2.C	0.074	268	01Jan2040, 12:18	32.1
W-8	0.030	127.4	01Jan2040, 12:09	13.3
DC-13	0.030	127.4	01Jan2040, 12:09	13.3
W-17	0.008	28.2	01Jan2040, 12:12	3.2
J-8	0.111	388.7	01Jan2040, 12:15	48.6
C2.D	0.111	387.8	01Jan2040, 12:19	48.6
W-7	0.059	249.6	01Jan2040, 12:09	25.8
DC-12	0.059	249.6	01Jan2040, 12:09	25.8
W-16	0.016	53.8	01Jan2040, 12:16	6.7
J-9	0.186	611.4	01Jan2040, 12:15	81.1
C2.E	0.186	610.3	01Jan2040, 12:23	81
W-6	0.028	130.8	01Jan2040, 12:06	12.4
DC-11	0.028	130.8	01Jan2040, 12:06	12.4
J-10	0.214	661.4	01Jan2040, 12:22	93.4
W-47	0.021	102.4	01Jan2040, 12:05	9.4
POND E2	0.235	698.6	01Jan2040, 12:22	102.8
W-3	0.037	157.5	01Jan2040, 12:09	16.3
DC-8	0.037	157.5	01Jan2040, 12:09	16.3
J-14	0.037	157.5	01Jan2040, 12:09	16.3
C3.A	0.037	156.4	01Jan2040, 12:15	16.3
W-30	0.013	49.7	01Jan2040, 12:12	5.5
W-29	0.010	39	01Jan2040, 12:10	3.9
J-11	0.060	238.5	01Jan2040, 12:14	25.8
C3.B	0.060	236.8	01Jan2040, 12:21	25.8
W-4	0.050	204.8	01Jan2040, 12:10	22.2
DC-9	0.050	204.8	01Jan2040, 12:10	22.2

HEC-HMS Summary of Results				
Synthetic Grass Cover, 25-yr 24-hr Results				
Start of Run:	01 Jan 2040, 00:00		Basin Model:	Synthetic Grass Cover
End of Run:	03 Jan 2040, 00:01		Met. Model:	25 YEAR - 24 HOUR
			Control Specs:	48 HOUR - 1 MINUTE
Hydrologic Element	Drainage Area (mi sq)	Discharge Peak (cfs)	Time of Peak	Volume (ac-ft)
W-31	0.019	77.9	01Jan2040, 12:09	7.8
J-12	0.129	433.6	01Jan2040, 12:17	55.7
C3.C	0.129	432.5	01Jan2040, 12:25	55.7
J-13	0.129	432.5	01Jan2040, 12:25	55.7
W-5	0.069	274.6	01Jan2040, 12:11	30.2
DC-10	0.069	274.6	01Jan2040, 12:11	30.2
J-20	0.197	611.2	01Jan2040, 12:18	85.9
W-37	0.021	101	01Jan2040, 12:05	9.3
POND E1	0.218	654	01Jan2040, 12:17	95.1
W-1	0.052	213	01Jan2040, 12:10	22.8
DC-6	0.052	213	01Jan2040, 12:10	22.8
W-26	0.003	12.3	01Jan2040, 12:07	1.2
J-17	0.055	224.3	01Jan2040, 12:10	24
C5.A	0.055	223.6	01Jan2040, 12:11	24
W-15	0.052	220	01Jan2040, 12:09	22.8
DC-5	0.052	220	01Jan2040, 12:09	22.8
W-40	0.002	8	01Jan2040, 12:06	0.7
J-18	0.108	448.7	01Jan2040, 12:10	47.5
C5.B	0.108	447.9	01Jan2040, 12:11	47.5
W-2	0.025	101.6	01Jan2040, 12:10	10.9
DC-7	0.025	101.6	01Jan2040, 12:10	10.9
W-27	0.008	33.3	01Jan2040, 12:08	3.3
J-21	0.140	581.4	01Jan2040, 12:10	61.7
C5.C	0.140	579.7	01Jan2040, 12:14	61.6
W-33	0.017	27.9	01Jan2040, 13:03	7
W-32	0.012	17.9	01Jan2040, 13:08	4.7
W-28	0.003	14.4	01Jan2040, 12:08	1.4
J-15	0.003	14.4	01Jan2040, 12:08	1.4
C4.A	0.003	14.2	01Jan2040, 12:15	1.4
W-41	0.001	3.7	01Jan2040, 12:06	0.3
J-16	0.173	613	01Jan2040, 12:14	75
C4.B	0.173	611.8	01Jan2040, 12:15	75
J-25	0.173	611.8	01Jan2040, 12:15	75
C3	0.173	611	01Jan2040, 12:16	75
J-30	0.173	611	01Jan2040, 12:16	75
W-35	0.017	86	01Jan2040, 12:01	7.4
POND W6	0.190	642.8	01Jan2040, 12:15	82.4
W-14	0.055	234	01Jan2040, 12:09	24.3
DC-4	0.055	234	01Jan2040, 12:09	24.3
W-25	0.005	20.1	01Jan2040, 12:09	2.1
J-22	0.005	20.1	01Jan2040, 12:09	2.1

HEC-HMS Summary of Results				
Synthetic Grass Cover, 25-yr 24-hr Results				
Start of Run:	01 Jan 2040, 00:00		Basin Model:	Synthetic Grass Cover
End of Run:	03 Jan 2040, 00:01		Met. Model:	25 YEAR - 24 HOUR
			Control Specs:	48 HOUR - 1 MINUTE
Hydrologic Element	Drainage Area (mi sq)	Discharge Peak (cfs)	Time of Peak	Volume (ac-ft)
C6.A	0.005	20	01Jan2040, 12:16	2.1
W-49	0.005	18.5	01Jan2040, 12:10	2
J-23	0.009	36.8	01Jan2040, 12:14	4.1
C6.B	0.009	36.6	01Jan2040, 12:19	4.1
W-39	0.001	6.3	01Jan2040, 12:07	0.6
J-24	0.011	39.8	01Jan2040, 12:19	4.6
C6.C	0.011	39.7	01Jan2040, 12:21	4.6
W-24	0.010	36.5	01Jan2040, 12:14	4.3
J-19	0.010	36.5	01Jan2040, 12:14	4.3
C7.A	0.010	36.3	01Jan2040, 12:28	4.3
J-26	0.076	269.8	01Jan2040, 12:10	33.2
C2	0.076	269.7	01Jan2040, 12:10	33.2
J-28	0.076	269.7	01Jan2040, 12:10	33.2
W-46	0.016	84.5	01Jan2040, 12:01	7.2
POND W2	0.092	312.9	01Jan2040, 12:07	40.5
W-13	0.031	132.8	01Jan2040, 12:08	13.4
DC-3	0.031	132.8	01Jan2040, 12:08	13.4
W-11	0.012	51.9	01Jan2040, 12:07	5.1
DC-1	0.012	51.9	01Jan2040, 12:07	5.1
W-21	0.006	21.7	01Jan2040, 12:12	2.4
J-1	0.006	21.7	01Jan2040, 12:12	2.4
C1.A	0.006	21.6	01Jan2040, 12:17	2.4
J-2	0.017	64.5	01Jan2040, 12:09	7.5
C1.B	0.017	64.2	01Jan2040, 12:14	7.5
W-12	0.006	27.9	01Jan2040, 12:06	2.6
DC-2	0.006	27.9	01Jan2040, 12:06	2.6
W-22	0.006	23	01Jan2040, 12:09	2.3
J-3	0.029	105.3	01Jan2040, 12:11	12.4
C1.C	0.029	104.6	01Jan2040, 12:18	12.4
W-23	0.008	30.4	01Jan2040, 12:12	3.4
J-4	0.067	232.4	01Jan2040, 12:12	29.3
C1	0.067	232.4	01Jan2040, 12:12	29.3
J-27	0.067	232.4	01Jan2040, 12:12	29.3
W-34	0.017	86.5	01Jan2040, 12:01	7.4
POND W1	0.084	266.5	01Jan2040, 12:07	36.7
W-38	0.026	134.4	01Jan2040, 12:01	11.5
POND E3	0.026	134.4	01Jan2040, 12:01	11.5
W-48	0.020	101.5	01Jan2040, 12:01	8.7
POND E4	0.020	101.5	01Jan2040, 12:01	8.7
W-36	0.018	92.7	01Jan2040, 12:01	7.9
POND W7	0.018	92.7	01Jan2040, 12:01	7.9
W-43	0.016	83.9	01Jan2040, 12:01	7.2

HEC-HMS Summary of Results				
Synthetic Grass Cover, 25-yr 24-hr Results				
Start of Run:	01 Jan 2040, 00:00		Basin Model:	Synthetic Grass Cover
End of Run:	03 Jan 2040, 00:01		Met. Model:	25 YEAR - 24 HOUR
			Control Specs:	48 HOUR - 1 MINUTE
Hydrologic Element	Drainage Area (mi sq)	Discharge Peak (cfs)	Time of Peak	Volume (ac-ft)
POND W5	0.016	83.9	01Jan2040, 12:01	7.2
W-44	0.016	83.4	01Jan2040, 12:01	7.1
POND W4	0.016	83.4	01Jan2040, 12:01	7.1
W-45	0.016	80.9	01Jan2040, 12:01	6.9
POND W3	0.016	80.9	01Jan2040, 12:01	6.9
W-42	0.010	19.5	01Jan2040, 12:45	3.9
CP-7	0.010	19.5	01Jan2040, 12:45	3.9
CP-6	0.000	0	01Jan2040, 00:00	0
CP-2	0.000	0	01Jan2040, 00:00	0
CP-3	0.000	0	01Jan2040, 00:00	0
CP-4	0.000	0	01Jan2040, 00:00	0
CP-5	0.000	0	01Jan2040, 00:00	0
CP-8	0.000	0	01Jan2040, 00:00	0
CP-9	0.000	0	01Jan2040, 00:00	0
CP-10	0.000	0	01Jan2040, 00:00	0
CP-11	0.000	0	01Jan2040, 00:00	0
CP-12	0.000	0	01Jan2040, 00:00	0
CP-13	0.000	0	01Jan2040, 00:00	0
CP-1	0.000	0	01Jan2040, 00:00	0