Part III
Attachment III-C
Appendix III-C.1

FACILITY SURFACE WATER DRAINAGE REPORT NARRATIVE

Pescadito Environmental Resource Center
MSW No. 2374
Webb County, Texas

PESCADITO
ENVIRONMENTAL RESOURCE CENTER

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STATE OF TEXAS
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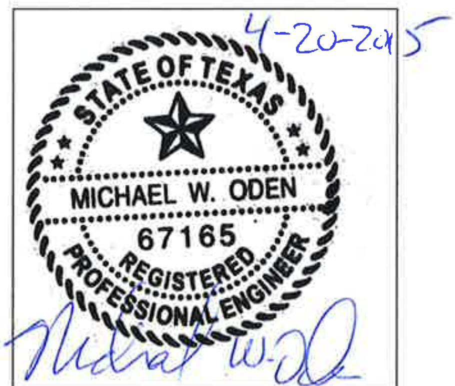
Attachments



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1.0 INTRODUCTION

This Facility Surface Water Drainage Report (FSWDR) for the Pescadito Environmental Resource Center (PERC) has been designed to collect, route, and detain stormwater runoff from the facility in an environmentally sound manner. The Plan for the landfill contains design features that follow best management practices that meet or exceed the regulations applicable to stormwater management outlined in Title 30 of the Texas Administrative Code (30 TAC), Section 330, Municipal Solid Waste. Specifically, Sections 330.63(c), 330.303, 330.305, and 330.307 are addressed.

Specific regulations of note include:

- ❑ Section 330.63(c) – Facility Surface Water Drainage Report
  - *"The owner or operator of a municipal solid waste (MSW) facility shall include a statement that the facility design complies with the requirements of 330.303 of this title (relating to Surface Water Drainage for Municipal Solid Waste Facilities). Additionally, applications for landfill and compost units shall include a surface water drainage report to satisfy the requirements of Subchapter G of this chapter (relating to Surface Water Drainage)."*
- ❑ Section 330.303 – Surface Water Drainage for Municipal Solid Waste Facilities
  - *"(a) A facility must be constructed, maintained, and operated to manage run-on and runoff during the peak discharge of a 25-year rainfall event*
  - *(b) Surface water drainage in and around a facility shall be controlled to minimize surface water running onto, into, and off the treatment area"*
- ❑ Section 330.305 – Additional Surface Water Drainage Requirements for Landfills
  - *"(a) Existing or permitted drainage patterns must not be adversely altered.*
  - *(b) The owner or operator 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.*
  - *(c) The owner or operator 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.*

- *(d) The landfill design must provide effective erosional stability to top dome surfaces and external embankment side slopes during all phases of landfill operation, closure, and post-closure care.*
- *(e) Dikes, embankments, drainage structures, or diversion channels must be sized and graded to handle the design runoff and be graded to minimize the potential for erosion."*

❑ Section 330.307 – Flood Protection

- *"(a) The facility shall be protected from flooding by suitable levees constructed to provide protection from a 100-year frequency flood.*
- *(b) Flood protection levees must be designed and constructed to prevent the washout of solid waste from the facility."*

Stormwater modeling has been completed with the software program HydroCAD. HydroCAD is a computer aided design program used to model hydrology and hydraulics of stormwater using either TR-20 or TR-55 procedures developed by the Soil Conservation Service (now the Natural Resource Conservation Service). HydroCAD was selected for the modeling software due to the large number of stormwater control devices that will be utilized at the PERC. Unlike models such as HEC-HMS, HydroCAD can link multiple models together to allow the user to model a large number of nodes. Model linking has been utilized in this analysis.

2.0 DRAINAGE REVISIONS PRIOR TO LANDFILL FACILITY DEVELOPMENT

The goal in developing a surface water drainage plan is to show that the development of a facility will not adversely alter, to any significant degree, the natural drainage patterns of the watershed that will be affected by the proposed development. This goal is typically achieved by comparing pre-development conditions to post-development conditions for both peak discharge rates (flows) and discharge volumes for various storm events. In the case of the PERC, several drainage modifications were designed in 2011 in order to remove the 100-year floodplain where landfilling was anticipated to occur. Stormwater analyses were developed that considered detailed grading plans for areas outside of the landfill facility boundary and split the landfill facility between two areas. These modifications have added an Intermediate Conditions step that must be used to compare pre-development and post-development conditions.

The 2011 drainage modifications were developed for the purpose of securing a Conditional Letter of Map Revision (CLOMR) from the Federal Emergency Management Agency (FEMA) which would approve modifying the location of the 100-year floodplain based on the proposed CLOMR modifications. A CLOMR Application was developed that included stormwater analyses that considered the detailed grading plans for areas outside of the landfill facility and general assumptions of discharge rates and locations for the facility which was not yet designed. The impact of these developments and the anticipated design on natural drainage patterns were thoroughly evaluated by FEMA and approved on November 21, 2014.

The following text briefly describes the pre-development and intermediate development (post-CLOMR) conditions that are expanded upon within the CLOMR Application in Attachment A of this Appendix (III-C.1-A).

2.1 Pre-Development Conditions

The proposed facility will be located on a 953 acre tract of land owned by Rancho Viejo Waste Management, LLC (RVWM). The facility is located approximately 20 miles east of Laredo in Webb County, Texas. The site is located entirely within the 12,194 acre Yugo Ranch that is owned by Rancho Viejo Cattle Company, Ltd., the same owner as the PERC, and has been used for cattle ranching and oil and gas production for many years.

The facility site slopes from north to south at approximate grades of 0.5 to 1 percent. Surficial soils generally have very low permeability, and the site is uniformly covered with native vegetation consisting of brush, forbs and grass. Stormwater runoff historically has not eroded bed-and-bank features into the shallow swales that covey drainage from the site. In recent times, several impoundments have been created on site by shallow excavation and embankment construction across the swales to create livestock watering tanks. Historically, patterns of storm water runoff have thus been significantly altered by the capture of rainfall by these tanks.

Drawing 1 of Appendix III-C.2 shows the regional pre-development topography of all areas that were reviewed as part of the CLOMR. The "drainage areas" (also referred to as "subcatchment areas") that were used for pre-development conditions modeling within the CLOMR are also shown on Drawing 1. Drawing 2 shows the pre-development topography of the facility and immediately surrounding area at a smaller scale to provide greater clarity.

2.2 Intermediate Conditions (Post-CLOMR Modifications)

Hydrologic modifications will be completed in accordance with CLOMR modifications prior to development of the facility. These intermediate conditions will remove the floodplain from the majority of the PERC without increasing peak flood discharges to downstream receiving areas. The CLOMR modifications include the removal of numerous impoundments located within the project area, ranging in size from very small to large (Burrito Tank). Three new detention basins outside the perimeter of the facility will be constructed in order to prevent run-on to the facility. Two of these detention basins are to be located to the north of the site and have been be designed to completely capture the 100-year flood inflows. A larger detention basin located west of the property will also intercept flows from the western drainage area and from other areas to the north that currently flow through the project site. The basin is designed for temporary detention and attenuation of flows from the revised drainage basin. A new channel capable of handling the basin outflows and redirecting them around the project site will link this basin to a series of existing surface water features south of the project site. These modifications are fully described within the CLOMR Application, which has been reviewed and approved by FEMA.

Drawing 3 of Appendix III-C.2 shows the regional intermediate topography described within the CLOMR. The "drainage areas" (also referred to as "subcatchment areas") that were used for intermediate conditions modeling within the CLOMR are also shown on Drawing 3. Drawing 4 shows the intermediate topography of the facility and immediately surrounding area at a smaller scale to provide greater clarity. It is noted that the text and Figures 4-6 of the CLOMR Application provide additional information regarding these modifications, as provided in Attachment A of this Appendix (III-C.1-A).

As can be seen on Drawings 3 and 4 in III-C.2, the intermediate (post-CLOMR) conditions discharge from two points within the area that the landfill is intended to be constructed. In fact, a drainage divide runs approximately through the middle of the landfill. This drainage divide separates Drainage Areas DA2 and DA3. It is noted in the text of the CLOMR that this drainage divide was placed in this location based on the assumption that stormwater would be evenly divided after landfill development.

2.3 Key Conclusion of CLOMR

A key conclusion of the CLOMR, which includes an assumed discharge rate from the landfill property, is included on page 10 of the report:

> *"Comparing the two peak discharges from the site, the proposed peak flow rate of 14,096 cfs is lower than the existing peak flow of 14,568 cfs. This shows that the proposed West Detention Basin attenuates peak flows sufficiently to prevent increases in flooding downstream of the site. Examining the existing amount of runoff of 6,732.5 acre-feet and the proposed 6,751.2 acre-feet, the two values differ by less than 0.3%. This shows that the models generate roughly the same amount of runoff, confirming that the two models reflect the same characteristics despite heavy modifications to drainage basin delineation and recalculation of curve numbers."*

2.4 Incorporation of CLOMR Assumptions into Proposed Design

Based on the general post-development CLOMR stormwater analysis that has been reviewed and approved by FEMA, CB&I has intentionally designed the landfill to be consistent with the CLOMR's assumptions regarding the landfill's discharge rates, drainage areas, and discharge locations. It is the opinion of CB&I that this approach validates the findings of the CLOMR and confirms that the proposed landfill design will not adversely alter to any significant degree the natural drainage patterns of the watershed.

Additional information regarding the CLOMR is provided within this document. The entire CLOMR application is provided as Attachment A to this Appendix (III-C.1-A), as it is a key component in the stormwater analysis.

3.0 OBJECTIVES OF MODELING

Based on the above discussion, this Facility Surface Water Drainage Report approaches stormwater modeling with the following objectives:

1. Demonstrate that the HydroCAD software produces similar discharge rates and volumes as the HEC-HMS models presented in the CLOMR. This step is completed to ensure an "apples-to-apples" comparison between software models.
2. Develop a detailed stormwater model that reflects the post-development design of the landfill. Model every stormwater management component to ensure that they are adequately sized and can convey stormwater at rates that will not cause erosion (e.g. less than five feet per second) for the 100-year, 24-hour storm. The 100-year storm is selected based on the need to demonstrate that the CLOMR is maintained. It is noted that the CLOMR modeled 100-year storms to accurately delineate the 100-year floodplain. It is also noted that Texas regulations require sizing the facility stormwater management components for the smaller 25-year 24-hour storm.
3. Update the intermediate conditions model (which was based on general landfill hydrology assumptions) with the detailed landfill design described in Objective 2. This model is a hybrid:
   a. Areas inside of the landfill's stormwater management footprint will use the detailed stormwater modeling based on CB&I's design.
   b. Areas outside of the landfill's stormwater management footprint that will be modified from the existing conditions that are modeled as described within the CLOMR.
   c. The purpose of this hybrid model is to verify that the results are substantially similar to the intermediate conditions described in the CLOMR for the 100-year storm to ensure that the CLOMR conclusions are maintained.
4. Run the pre-development HydroCAD model and the post-development HydroCAD model described in Goal #3 for the 25-year 24-hour storm to determine the discharge rates. Demonstrate that the post-development design maintains similar discharge rates and volumes to pre-development conditions, indicating that the landfill development will not produce adverse effects to area stormwater management.

By developing a detailed stormwater model for the proposed facility, CB&I is able to demonstrate that all stormwater features used to convey stormwater within the facility are adequately sized. Additionally, by demonstrating that discharge rates and Drainage Area locations for the facility are consistent with those developed within the CLOMR, the results of the CLOMR and its approach can be maintained.

4.0 OBJECTIVE 1

Demonstrate that the HydroCAD software produces similar discharge rates and volumes as the HEC-HMS models presented in the CLOMR.

Due to the fact that the existing and intermediate development conditions described in the CLOMR were modeled in HEC-HMS, CB&I re-created the HEC-HMS models using HydroCAD to ensure that the two software models produce similar discharge rate and volume determinations for the various stormwater control elements. All input areas and curve numbers identified for the drainage areas were input into HydroCAD exactly as they were input into the HEC-HMS models. It is noted that the drainage areas were converted from square miles (HEC-HMS input) to acres (HydroCAD input). The same elevation-area and elevation-discharge values were also used for the detention basins.

Due to the fact that HEC-HMS determines runoff based on lag time and HydroCAD determines runoff based on time of concentration, the lag times identified in the CLOMR were adjusted to represent time of concentration to be input into HydroCAD. Lag time can be converted to time of concentration using multiple approximations, but is typically found to be between 60 and 70% of time of concentration. The models were found to offer calculated discharge volumes and rates within one percent when using the following conversion:

Time of Concentration = (Lag Time / 66.6%) or (Lag Time x 1.5)

The overall discharge from the facility (HEC-HMS model vs HydroCAD model; node Junction-1) are compared in Tables 1 and 2 below. As is evident, the models provide very similar results. The overall difference between the discharge rates of the existing models is less than 0.2% and 0.1% for the existing and proposed conditions, respectively. The overall difference between the discharge volumes of the existing models is 0.04% and 0.0% for the existing and proposed conditions, respectively.

The modeling results clearly demonstrate that HydroCAD software produces similar discharge rates and volumes as the HEC-HMS models presented in the CLOMR, satisfying Objective 1. Therefore, the intermediate conditions model that has been recreated in HydroCAD can be updated with the detailed landfill design for the purpose of comparison to existing conditions and for validation of the CLOMR results.

Table 1 Peak Discharge Rate – 100-Year, 24-Hour Model Comparison			
Model Run	HEC-HMS – CLOMR (cfs)	HydroCAD – Recreated (cfs)	Percent Difference
Pre-development Conditions			
DA1	7860.9	7890.0	0.37%
DA2	1676.8	1687.6	0.64%
DA3	3823.2	3835.91	0.33%
DA4	3824.2	3819.7	-0.12%
Junction-2	6905.7	6926.7	0.30%
Burrito Tank	7714.2	7720.42	0.08%
Reach 1	3272.6	3272.8	0.01%
Junction-1 (Downstream Discharge Point)	14567.6	14540.47	-0.19%
Intermediate Conditions			
DA1	6852.4	6885.92	0.49%
DA2	2082.6	2084.3	0.08%
DA3	4690.7	4709.99	0.41%
DA4	3824.2	3819.9	-0.11%
DA5	468.5	471.92	0.73%
DA6	378.5	380.18	0.44%
DA7	1015.7	1024.75	0.89%
West Detention Basin	5980.8	5960.38	-0.34%
NW Detention Basin	0	0	0.00%
NE Detention Basin	0	0	0.00%
Reach 1	5980.8	5960.38	-0.34%
Junction-1 (Downstream Discharge Point)	14096.1	14083.77	-0.09%

Table 2 Peak Discharge Volume – 25-Year, 24-Hour Model Comparison			
Model Run	**HEC-HMS – CLOMR (cfs)**	**HydroCAD – Recreated (cfs)**	**Percent Difference**
Pre-development Conditions			
DA1	3272.6	3272.9	0.01%
DA2	364.6	363.7	-0.25%
DA3	1263.3	1262.4	-0.07%
DA4	1832	1830.9	-0.06%
Junction-2	3095.3	3093.3	-0.06%
Burrito Tank	3272.6	3272.9	0.01%
Reach 1	3272.6	3272.9	0.01%
Junction-1 (Downstream Discharge Point)	6732.5	6729.8	-0.04%
Intermediate Conditions			
DA1	2520.7	2522.4	0.07%
DA2	557.5	557	-0.09%
DA3	1547.6	1547.6	0.00%
DA4	1832	1830.9	-0.06%
DA5	78.6	78.8	0.25%
DA6	51.8	51.7	-0.19%
DA7	163	162.9	-0.06%
West Detention Basin	2599.3	2601.2	0.07%
Reach 1	2599.3	2601.2	0.07%
NW Detention Basin	0	0	0.00%
NE Detention Basin	0	0	0.00%
Junction-1 (Downstream Discharge Point)	6536.4	6536.6	0.00%

Note: 25 year storm event results were not provided in the CLOMR text. HEC-HMS results shown in Table 2 were obtained from the digital HEC-HMS model files provided with the CLOMR submission.

5.0 OBJECTIVE 2

Develop a detailed stormwater model that reflects the post-development design of the landfill. Model every stormwater management component to ensure that they are adequately sized and can convey stormwater at rates that will not cause erosion (e.g. less than five feet per second) for storm events equal to or less than the 100-year storms.

5.1 Model Analysis Setup

To ensure that the proposed stormwater management features are adequately sized for actual stormwater needs, all elements were computer modeled with numerous conservative assumptions. The computer model HydroCAD was used to develop discharge rates and volumes for various storm events for each stormwater feature described in this Plan. Runoff was evaluated for the 24-hour duration for the 100-year and 25-year storm frequencies. The analyses meet or exceed state and federal requirements for landfills.

The stormwater modeling methodology used the following analysis methods:

Runoff Calculation Method:	SCS TR-20
Reach Routing Method:	Storage Indication Method (also known as Modified-Puls)
Pond Routing Method:	Storage Indication Method (also known as Modified-Puls)
Storm Distribution:	SCS Type III 24-hour storm
Unit Hydrograph:	SCS

5.2 Rainfall

The precipitation for the 100-year storm was obtained from Technical Paper No. 40, "Rainfall Frequency Atlas of the United States" (TP-40). A summary of all rainfall depths associated with the 25-year and 100-year modeled storms is provided in Appendix III-C.3-1. The Soil Conservation Service Storm Type III rainfall distribution was used to develop the peak rainfall for the 100-year and 25-year frequency rainfall events.

The CLOMR was developed using a correction factor of 97% of the rainfall depicted in TP-40, based on Figure 15 – Area-Depth Curves, included in TP-40, which provide correction factors for rainfall over a given drainage area and storm duration. Based on a 22.9 square mile drainage area for the area evaluated, the correction factor is 97%.

For purposes of comparing the CLOMR's existing conditions to intermediate conditions during the 100-year 24-hour storm, the correction factor is used to remain consistent with the CLOMR design approach. However, the model was run without the correction factor for the 25-year, 24-hour storm, which leads to slightly higher rainfall totals, to ensure that all stormwater management features are appropriately sized with respect to 30 TAC Section 330.301 through 307 requirements.

5.3 Model Inputs

Detailed model inputs of all key stormwater management features are provided in the calculations and summaries provided in Appendix III-C.3 and are briefly discussed in the following text sections. Detailed information provided in Appendix III-C.3 includes:

1. Rainfall Totals and Distributions
2. Stormwater Management Feature Delineation
3. Runoff Curve Number Determination
4. Subcatchment Lag Time
5. Subcatchment Area Discharge Rates
6. Terrace Bench Sizing
7. Downchute Sizing
8. Perimeter Channel Sizing
9. Culvert Sizing
10. South Detention Basin Sizing and Discharge Rates

Modeling diagrams and output files are provided in Appendix III-C.4. Output files for pre-development (pre-CLOMR), intermediate (post-CLOMR), and post-development conditions are provided.

It is noted that the landfill catchment boundaries generally have two configuration types, as shown on Drawing 6 of Appendix III-C.2 and described in Appendix III-C.3-2 (Stormwater Management Features Delineation). Representative catchment areas are Landfill Catchment A (representative of Catchments C, E, G, I, K, M, and O) and Landfill Catchment B (representative of Catchments D, F, J, L, N, and P). Therefore, model output summary files are only provided for these representative catchments. However, all model output data is available upon request from TCEQ. Output files for all perimeter ditches, culverts, and the South Detention Basin are included in Appendix III-C.4.

5.4 Post-Development Hydrologic Overview

As previously mentioned, the intermediate conditions described within the CLOMR include all modifications that will take place prior to the development of the facility. However, intermediate conditions (post-CLOMR) modeling (identified as Proposed Conditions within the CLOMR) included assumed discharge rates, drainage areas, and discharge locations from the proposed landfill facility. For this reason, CB&I has intentionally developed the detailed landfill design to be consistent with the CLOMR assumptions. Additionally, all stormwater management features have been designed to ensure that the stormwater management system complies with all applicable regulations in 30 TAC, Section 330, Subchapter G. An overview of the post-development conditions is provided as Drawing 5 in Appendix III-C.2.

The proposed design has two waste units, both which have 4H:1V sideslopes and six percent plateau slopes. The northern landfill unit has a peak elevation of approximately 855 ft MSL, while the southern landfill unit has a peak elevation of approximately 840 ft MSL. The landfill units both drain to a common perimeter ditch drainage network that drains into the South Detention Basin, where stormwater ultimately discharges from the facility, as described in the following text.

5.4.1 Terrace benches

Vegetated terrace benches will be used to intercept stormwater sheet flow, collect runoff, and control erosion along the sideslopes of the landfill final cover. Terrace benches are located approximately every 200 horizontal feet. The terrace benches will be constructed in the locations shown on Drawing 6 in Appendix III-C.2.

The terrace benches will have check dams approximately every 250 to 450 feet to slow water and allow for a controlled release rate. Check dams will be installed at the downslope side of each subcatchment area, as detailed on Drawing 7. Check dams will be constructed of soil and will have 7 inch (South Unit) or 14 inch (North Unit) diameter in-line drainage pipes at the base to allow stormwater to pass in a controlled manner. The terrace benches are modeled as catch basins due to the fact that the check dams temporarily hold stormwater to allow its discharge into the next terrace berm/check dam segment in a controlled manner. However, due to the presence of in-line drainage pipes through the check dams, stormwater will only be temporarily held and will not pond on the landfill final cover. Erosion will not occur due to the fact that check dam construction will limit flow length and velocity of the stormwater on the face of the final landform and convey it to downchutes lined with rip-rap or other erosion control material (ECM). The terrace benches have been designed to function without overtopping during the modeled 100-year 24-hour and 25-year 24-hour storms, which exceeds the requirements specified in 30 TAC 330.303.

5.4.2 Downchutes

Downchutes (also known as downslope ditches) will be constructed to convey the stormwater collected by the terrace benches down the slope of the landfill and into the perimeter ditches. The downchutes will be lined with riprap or other erosion control material (ECM) to minimize scour and prevent erosion. The downchutes are designed to adequately handle runoff flow rates from the peak 100-year storm without overtopping, exceeding the requirements of 30 TAC 330.305. The planned locations of the downchutes are shown on Drawing 6 of Attachment III-C.2. Details of the downchutes are provided on Drawing 7. The design parameters for the downchutes and calculations demonstrating that the downchutes will provide adequate stormwater control and are sufficiently sized are presented in Attachment III-C.3-7.

5.4.3 Perimeter Ditches

As shown on Drawing 6 of Appendix III-C.2, ditches are positioned around the landfill perimeter. These ditches are used to convey non-contact stormwater runoff from the landfill units, landfill perimeter access road, and ancillary areas to the South Detention Basin. Perimeter ditch sizes vary between the North and South Units of the landfill to provide adequate size to handle the peak discharge rates of the 100-year storm without overtopping. The North Unit perimeter ditches are designed with 4H:1V side slopes, 4-ft depth, and a 15-ft bottom width. The South Unit perimeter ditches are designed with side slopes of 4H:1V and 3H:1V, a depth of 4-ft, and a bottom width of 40-ft. Details for the perimeter ditches are provided on Drawing 7. Ditch profiles are shown on Drawings 9 and 10.

Ditches will be vegetated. In the event that vegetation cannot be established within the ditches, they may be lined with an erosion control material (ECM), such as SmartDitch™, riprap, or other ECM to minimize scour potential. Any portions of the perimeter ditch that show velocities over 5-ft/sec for the 25-year, 24 hour storm event within Appendix III-C.3-8 will be lined with a Turf Reinforced Mat (TRM). All ditches have been designed with excess capacity to convey the peak flow rates and depths of the 100-year 24-hour storm event (and thus, passing the 25-year, 24-hour storm), which exceeds the requirements specified in 30 TAC 330.305. The design parameters for the perimeter ditches and calculations demonstrating that the ditches will provide adequate stormwater control and are sufficiently sized are presented in Appendix III-C.3-8.

5.4.4 Ditch Discharge Culverts

Culverts will be installed at the discharge locations of the perimeter ditches into the South Detention Basin, as shown on Drawing 6 and 11 of Appendix III-C.2. Culverts will be in-line with stormwater ditches and have been sized to handle the 100-year 24-hour storm event, which is equal to the 100-year discharge rate in the ditch at that location. Culverts will be box culverts constructed of concrete, unless an alternate culvert design is approved. The design parameters for the culverts and demonstration that the culverts will safely convey stormwater associated with the 100-year 24-hour storm are provided in Appendix III-C.3-9.

5.4.5 South Detention Basin

The South Detention Basin will be installed along the southern border of the facility to temporarily detain all stormwater that falls on the landfill, perimeter roads, and ancillary facilities. The detention basin receives stormwater through the perimeter ditches. The size of the South Detention Basin has been designed based on a fully developed landfill footprint, although detention basin may be constructed in stages, provided that adequate storage capacity and discharge can be demonstrated. The location of the South Detention Basin is shown in Drawings 5, 6, 11 and 12 of Appendix III-C.2. Profiles and details of the basin are provided on Drawings 11 and 12.

The basin has been designed with excess capacity to safely detain and release the 100-year, 24-hour and 25-year, 24-hour storm events while maintaining one foot of freeboard above the maximum water level, in accordance with best management practices.

5.4.6 South Detention Basin Discharge

The South Detention Basin will have two discharge points, located approximately at the southwest and southeast corners of the basin. Each discharge point will contain multiple culvert outlets that will facilitate the controlled release of stormwater. Stormwater will discharge through the culverts to the outside of the basin. Riprap or other erosion control material will be placed at the discharge locations to minimize the potential for erosion and scour. Refer to Drawing 12 of Appendix III-C.2 for details of the proposed outlet structure design.

Discharge from the detention basin will be sent to both the east and the west into Drainage Areas DA-3 and DA-2, respectively. Percentage of the discharge volume from the detention basin to DA-2 and DA-3 has been split to provide discharge rates and volumes consistent with the CLOMR (intermediate conditions). Additional stormwater conveyance features may be installed at the discretion of the owner and engineer to direct water directly into the San Jaunito Creek tributary system. Please note that the outlet structure design may be changed at the owner/operator's discretion, provided that the revised design provides adequate reinforcement and protection of the outfall and equivalent release rates to the modeled design.

The outlet structures are designed so that the total release rates from the post-development conditions of the modeled storm events are similar to the corresponding discharge rates for the intermediate conditions, as demonstrated and described in the subsequent modeling text.

5.4.7 Run-On Protection

Run-on from off-site areas will be prevented from flowing onto the active portion of the landfill by virtue of the fact that outer alignment of the perimeter road, which will surround both waste units, has been designed to be at least one foot higher than the surrounding existing topography. This creates an island affect where surficial water will flow around the landfill facility. Additionally, the waste boundary is located one-foot in elevation higher than the crest of the perimeter channels, which are designed to convey the 100-year storm. Thus, the top of slope for the waste boundary is located at least two feet in elevation higher than the surrounding topography in all areas of the landfill.

5.4.8 Flood Protection

No portion of the landfill footprint, proposed landfill development, ancillary facilities, or associated appurtenances are located within the revised 100-year floodplain, as shown on Drawing 5 and 6 of Appendix III-C.2. Consistent with 30 TAC Section 330.63(c)(2), 330.307, 330.547(a) and (b), neither waste disposal unit or any operations area will be located within the 100-year floodplain. The facility development will not restrict the flow of the 100-year flood, will not reduce the temporary water storage capacity of the floodplain, and will not result in the washout of solid waste.

5.4.9 Contaminated Water Management

Contaminated water is defined in TAC Section 330.3(36) as leachate, gas condensate, or water that has come into contact with waste. Stormwater will be managed carefully in all areas of the landfill to limit the quantity that may come in contact with waste. Two-foot tall earthen berms will be used to separate rainfall that has not become contaminated from exposed waste and contain stormwater that has come into contact with waste from leaving the active area (See Detail 2 on drawing III-D.3-8. An intact layer of soil, or other approved cover will be placed over the waste to prevent rainfall from contacting the waste. Ditches, swales, culverts, and other structures as appropriate will be constructed to prevent stormwater run-on onto the active fill areas. The handling, storage, treatment, and disposal of contaminated surface or groundwater will be managed according to TAC Section 330.207. See Appendix III-D.6 for a detailed leachate and contaminated water plan.

5.5 Key Modeling Results for Landfill Stormwater Management Components

As previously mentioned, detailed descriptions of all elements and model inputs are thoroughly described in the calculations provided in Appendix III-C.3. All stormwater controls were found to be appropriately sized to convey the 100-year and 25-year, 24-hour storm events (surpassing local, state, and federal requirements). Key findings include the following:

1. All terrace benches are appropriately sized to pass the peak discharge of the 100-year, 24-hour storm event without overtopping. Additionally, they are not anticipated to experience erosion or scour due to the check dams.
2. Downchutes can safely convey the 100-year, 24-hour storm. Downchutes will be armoured with riprap or other equivalent erosion control material.
3. All stormwater ditches are appropriately sized to convey the 100-year, 24-hour storm event without overtopping under design conditions. All stormwater ditches will be vegetated, lined with SmartDitch™, riprap, or lined with other erosion control material to minimize the potential for erosion or scour. Areas where peak velocities within the stormwater ditch is over 5-ft/sec for the 25-year, 24-hour storm will be lined with Turf Reinforced Mats (TRM).
4. All culverts are appropriately sized to convey stormwater within the perimeter ditches for the 100-year, 24-hour storm event. The culverts will not back up or lead to overtopping conditions within the stormwater ditches.
5. The detention basin is sufficiently sized to detain the 100-year, 24-hour storm event. Sufficient sediment storage is provided below the normal water level without impeding basin performance.

Based on the results summarized above and described in detail within the calculations, all stormwater management features for the post-development design of the landfill have been modeled and have been shown to be adequately sized to manage the 100-year and 25-year storm events, satisfying 30 TAC 330.305. Furthermore, areas of the perimeter ditch exhibiting peak storwmater velocities greater than five ft/sec will be lined with TRM. Downchutes will be reinforced with rip-rap or an alternative erosion control material. Therefore, Objective 2 has been satisfied.

6.0 OBJECTIVE 3

Update the Intermediate Conditions (post-CLOMR) Model to include detailed landfill design. Verify that the updated results are substantially similar to the intermediate conditions described in the CLOMR for the 100-year storm to ensure that the CLOMR conclusions are maintained.

In order to ensure that the determinations made in the CLOMR were maintained, the proposed stormwater model including the detailed stormwater management system was compared to the proposed stormwater model from the CLOMR for the 100-year, 24-hour event.

This model is a hybrid:

A. Areas inside of the landfill's stormwater management footprint will use the detailed stormwater modeling based on CB&I's design.
B. Areas outside of the landfill's stormwater management footprint that will be modified from existing conditions are modeled as described within the CLOMR.

Because some of the drainage areas in the CLOMR proposed model were modified by the detailed proposed model, the two models were compared at the "Junction 1-Downstream Discharge Point" for the 100-year, 24-hour storm event to demonstrate that the design of the stormwater management system does not significantly or negatively impact the downstream discharge values determined in the CLOMR. The stormwater model output files are provided in Appendix III-C.4. Table 5 below summarizes the comparison of the two models.

Table 5
100-Year, 24-Hour Storm Event Model Comparison

Model Run	Intermediate (post-CLOMR)	Post Development	Percent Difference
Peak Discharge Rate (cfs)			
Junction-1 (Downstream Discharge Point)	14,083.77	14,070.88	-0.1%
Peak Discharge Volume (af)			
Junction-1 (Downstream Discharge Point)	6,536.62	6,734.90	3.0%

Based on the fact that both models produce peak discharge rates and volumes within 5 percent, Objective 3 is satisfied. This demonstrates that the CLOMR results are valid when incorporating the detailed landfill design.

7.0 OBJECTIVE 4

Run the pre-development HydroCAD model and the post-development HydroCAD model described in Objective #3 for the 100-year storm to determine the discharge rates associated with the 100-year storms. Demonstrate that post-development design maintains similar discharge rates and volumes to pre-development conditions, indicating that the landfill development will not produce adverse effects to area stormwater management.

In order to demonstrate compliance with 30 TAC, Section 330, Subchapter G, the proposed stormwater model including the detailed stormwater management system was compared to the existing conditions stormwater model. The two models were compared at the "Junction 1-Downstream Discharge Point" to demonstrate that the design of the stormwater management system does not significantly or negatively impact the existing downstream discharge values. Table 6 below summarizes the comparison of the two models.

Table 6
100-Year, 24-Hour Storm Event Model Comparison

Model Run	Pre-Development (pre-CLOMR)	Post-Development	Percent Difference
Peak Discharge Rate			
Junction-1 (Downstream Discharge Point)	14,540.47	14,070.88	-3.3%
Peak Discharge Volume			
Junction-1 (Downstream Discharge Point)	6,729.82	6,734.90	0.1%

Based on the fact that the post-development conditions will discharge water downstream at flow rates and volumes that are within 5 percent of existing conditions demonstrates that the proposed landfill will not adversely affect drainage conditions. Therefore, Objective 4 is achieved.