

**City of Laredo Landfill Permit Amendment 1693B
City of Laredo, Texas
Permit Amendment MSW Permit 1693B
Laredo, Texas
Webb County, Texas
August 2014**

**PART III
Site Development Plan**

**August 2014
Revised June 2015**

**LAREDO LANDFILL
PART III
Site Development Plan**

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Table III.3
Waste Quantity Projections

<i>Year</i>	<i>Projected Tons/Year</i>	<i>Cumulative Tons</i>	<i>Average TPD</i>	<i>Peak TPD</i>
2014	364,519	364,519	1,168	1,752
2015	364,519	729,038	1,168	1,752
2016	383,194	1,112,232	1,228	1,842
2017	402,826	1,515,059	1,291	1,937
2018	423,464	1,938,523	1,357	2,036
2019	445,160	2,383,683	1,427	2,140
2020	467,966	2,851,649	1,500	2,250
2021	479,458	3,331,107	1,537	2,305
2022	491,231	3,822,338	1,574	2,362
2023	503,294	4,325,633	1,613	2,420
2024	515,653	4,841,286	1,653	2,479
2025	528,316	5,369,602	1,693	2,540
2026	541,069	5,910,670	1,734	2,601
2027	554,130	6,464,800	1,776	2,664
2028	567,506	7,032,306	1,819	2,728
2029	581,205	7,613,510	1,863	2,794
2030	595,234	8,208,745	1,908	2,862
2030	595,234	8,208,745	1,908	2,862
2031	608,921	8,817,666	1,952	2,928
2032	622,922	9,440,588	1,997	2,995
2033	637,245	##### <u>10,077,833</u>	2,042	3,064
2034	651,898	##### <u>10,729,731</u>	2,089	3,134
2035	666,887	##### <u>11,396,618</u>	2,137	3,206
2036	682,221	##### <u>12,078,839</u>	2,187	3,280

No “new” waste will be disposed on the northern portion of the Landfill in the future.

In addition to the buffer along the southern border of the site, the City owns the property where administrative and fleet maintenance vehicles are located and represents an additional 800’ of buffer between the Landfill permit boundary and SH 359. The City commits to maintaining ownership of this property throughout the life of the landfill, and through the post-closure care period.

Table III.4 presents a summary of buffer zone distances for the Landfill both with and without the additional easements. As mentioned, the official buffer boundary around the fill limits is shown in Part II, Attachment 1, Figure II.1.4 and on the Site Layout Plan, Part III, Attachment 1.

Table III.4 Buffer Zones

	<u>Buffer from Toe of Fill</u>	<u>Buffer from New Waste</u>
<u>North</u>	<u>345’ – 365’</u>	<u>946’ – 962’</u>
<u>East</u>	<u>230’ – 412’</u>	<u>238’ – 800’</u>
<u>West</u>	<u>206’ – 246’</u>	<u>227’ – 785’</u>
<u>South</u>	<u>819’ – 884’</u>	<u>970’ – 971’</u>

	<u>Existing Buffer To Permit Boundary</u>	<u>Drainage Easement & City Owned Property Buffer Zone</u>
<u>Northern Boundary (no new waste located along Northern boundary)</u>	<u>53’ to 64’</u>	<u>352’ to 430’</u>
<u>East Boundary</u>	<u>126’ to 316’</u>	<u>231’ to 421’</u>
<u>Southern Boundary (no new waste within 125’ of the current limit of fill along Southern Boundary)</u>	<u>77’ to 269</u>	<u>777’ to 969’</u>
<u>Western Boundary</u>	<u>105’ to 146’</u>	<u>205’ to 207’</u>

Attachment III-2 includes cross-sections of the Landfill. These figures illustrate the bottom contours of the Landfill, permitted elevations, recent elevations for the Landfill and final elevations proposed for the permit amendment. Included in these figures are soil boring results at various locations along the cross-sections.

Attachment III-3 presents the existing contour maps for the Landfill, including the existing topographic map for the entire Landfill and the existing topographic information for East Phase and West Phase of the Landfill.

Attachment III-7 presents the final contours for the Landfill, including a figure illustrating final drainage patterns for the Landfill once it reaches capacity.

5.1.1 Access Road

The access road is located on the north side of SH 359 and accesses the Landfill's southern boundary near its midpoint. Access is controlled through a lockable gate and, during operations, a scale facility. The access road has two lanes for ingress and one for egress. There is an emergency exit from the Landfill that is located on the southwest corner of the Landfill.

5.1.2 Scale Facility

The Scale Facility is located within the permit boundary. The City currently maintains an in-coming scale and an outgoing scale and a third scale for trucks with tare weights (weight of an empty vehicle). The City is authorized to add an additional scale if it is appropriate or necessary. The Scale Facility is continuously staffed while the Landfill is accepting waste.

5.1.3 Landfill Phases

The Landfill is currently divided into four phases. These phases are separated by an electric utility easement which runs north and south and an abandoned natural gas pipeline which runs east and west. ~~Table III.5 presents the permitted maximum depth and maximum height of the four Landfill phases.~~ As of 2014, Phase I and Phase II have been utilized for waste disposal and both have remaining capacity. Phase III is planned to be constructed in 2014. One cell of Phase IV has been used for the disposal of construction and demolition waste. Under the current 1999 permit, the minimum permitted waste elevations (top of liner elevations) are 445' msl for Phase 1 (NW), 445' msl for Phase 2 (NE), 445' msl for Phase 3 (SE), and 490' msl for Phase 4 (SW). The current permit set the maximum final cover elevations as 640.5' msl for Phase 1 (NW), 637' msl for Phase 2 (NE), 546.5' msl for Phase 3 (SE) and 576.5' msl for Phase 4 (SW). Based on a two-foot thickness for the typical standard final cover, the maximum waste placement elevations would be 638.5' msl for Phase 1 (NW), 635' msl for Phase 2 (NE), 544.5' msl for Phase 3 (SE) and 574.5'. Table III.5 presents the permitted maximum depth and maximum height of the four Landfill phases.

**Table III.5
Current Landfill Approximate Depth and Height
Elevation in Feet (MSL)**

Phase / Type of Disposal Operation	Location on Site	Permitted Top of Liner	Permitted Final Maximum Elevation
1 (Type I)	North West	452445.0'	640.5'640.0'
2 (Type I)	North East	430445.0'	637.0'
3 (Type I)	South East	490445.0'	547,0546.5'
4 (Type IV)	South West	498490.0'	575,0576.5'
Source: 1999 Permit Amendment Cross Sections			

5.1.4 Liners

The Landfill was originally permitted in 1986, prior to the implementation of Subtitle D Regulations. Cells 1 through 16 of Phase I and Cell 1 of Phase II were constructed with in-situ compacted clay liners. Phase I Cells 17 and 18 and Phase II Cells 2-14 were designed with a Subtitle D composite liner, using either clay or a geosynthetic clay liner and geomembrane liner. The existing liner cross-sections for the ~~most recently currently~~ constructed Pre-Subtitle D Type I and Subtitle D Type I cells, Phase II-Cells 13/14, and the current Type IV liner alternatives are described in Table III.6 below. ~~This is a typical design configuration for future cells.~~

Phase IV is currently permitted as a Type IV- Construction/Demolition Landfill. This area is approved with a 3' clay or geocomposite liner. The existing cell liner configuration is shown on Figure III.15.1. Liner Details are presented in Attachment III.15 – Leachate and Contaminated Water Plan.

Table III.6 – Existing Liner Alternatives

Phase II–Cell 13/14 Existing Subtitle D Type I Liner Components

<u>Alternative 1</u>	
Material	Thickness
Protective Cover	12"
Drainage Layer	12"
Geotextile	Negligible
Geomembrane	60 mil HDPE
Geosynthetic Clay Liner	Negligible
Prepared Subgrade	24"
<u>Alternate 2</u>	
Material	Thickness
Protective Cover	12"
Drainage Layer	12"
Geosynthetic Clay Liner	Negligible

<u>Insitu and Compacted Clay Liner</u>	<u>24"</u>
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Existing Pre-Subtitle D Type I Liner Components

<u>Material</u>	<u>Thickness</u>
<u>Protective Cover</u>	<u>12"</u>
<u>Drainage Layer</u>	<u>12"</u>
<u>Insitu and Compacted Clay Liner</u>	<u>36"</u>

Existing Type IV Liner Components

<u>Alternate 1</u>	
<u>Material</u>	<u>Thickness</u>
<u>Protective Cover</u>	<u>12"</u>
<u>Drainage Layer</u>	<u>12"</u>
<u>Geosynthetic Clay Liner</u>	<u>Negligible</u>

<u>Prepared Subgrade</u>	<u>24"</u>
<u>Alternate 2</u>	
<u>Material</u>	<u>Thickness</u>
<u>Protective Cover</u>	<u>12"</u>
<u>Drainage Layer</u>	<u>12"</u>
<u>Insitu and Compacted Clay Liner</u>	<u>36"</u>

<u>Alternate 3</u>	
<u>Material</u>	<u>Thickness</u>
<u>Protective Cover</u>	<u>12"</u>
<u>Drainage Layer</u>	<u>12"</u>
<u>Geosynthetic Clay Liner</u>	<u>Negligible</u>
<u>Insitu and Compacted Clay Liner</u>	<u>6"</u>

Table III.8B in Section 5.2.3 lists all existing and proposed waste cells with each cell's construction and filling status, liner type, lowest permitted liner elevation, drainage media components, sump identification, slope of leachate collection piping and minimum floor slope. Liner Details are presented in Attachment III.15 – Leachate and Contaminated Water Plan as Figure III-15.5 through Figure III-15.7A.

5.1.5 Leachate Collection System

A leachate collection system is constructed in existing cells where Subtitle D liners were constructed. Leachate is collected by gravity through a series of pipes and pumped via a force-main that directs the leachate to a storage tank. During construction of Cell 1 of Phase III, the existing leachate storage tank will be demolished and leachate will be temporarily collected in tanker trucks located in a

cleared area of Phase IV. This system was approved in a 2013 permit modification. The existing Leachate Management Collection System layout is shown on Figure III.15.2. The overall management of Leachate is presented in Attachment III.15

5.1.6 Landfill Gas Monitoring and Management

The Landfill has an active gas collection system. Gas is collected from a series of wells that are primarily located on the north side of the Landfill. Gas is piped to a flare facility and combusted. The City has 21 gas monitoring probes located around the perimeter of the site. These wells are monitored on a quarterly basis. The location of the monitoring probes are shown on Figure III.14.1. The Landfill Gas Management Plan is presented in Attachment III-14.

5.1.7 Groundwater Monitoring Wells

A total of 12 groundwater monitoring wells are located around the perimeter of the Landfill. The location of these wells was approved in a 2005 Permit Modification. Wells are monitored and sampled on a semi-annual basis. The location of these monitoring wells are shown on Figure III.11.1. The overall Groundwater Monitoring Plan is presented in Attachment III-11.

5.1.8 Drainage Facilities

The site is designed to manage the 25-year, 24-hour rainfall water through a series of channels, culverts, and detention ponds. A complete description of the drainage design is included in the Surface Protection Plan and Drainage Plan (Attachment III-6).

5.1.9 Final Closure & Post-Closure Care

No areas of the Landfill have been closed or received final cover. All of Phase I and a majority of Phase II have intermediate cover in place in accordance with the SOP. Cell 1 of Phase 4 that has been partially filled and has received intermediate cover. The intermediate cover is maintained to prevent storm water pollution and provide for erosion control. The Closure and Post-closure Care Cost Estimate, Closure Plan and Post-Closure Care Plan are presented in Attachments III-8, III-12 and III-13 respectively.

5.2 Amended General Facility Design

5.2.1 Landfill Capacity

The design of the Landfill, as amended, will have an estimated total capacity of 25.25 million cubic yards. The West Phase will have a capacity of 12.5 million cubic yards and the East Phase will have a capacity of 12.75 million cubic yards. The height of

the landfill is increased from 640.50' to 664.5' on the West Phase and from 637' feet to 6524.5' on the East Phase. Phases 1 and 2 are constructed and their lowest elevations of liner will remain unchanged at 445.0 for Phase 1 and 445.0 for Phase 2. The lowest permitted liner in Phase 3 will in its reconfigured footprint will remain at elevation 445.0. The lowest permitted liner elevation in Phase 4 will be lowered from 490.0 to 467.0. Attachment III-1 provides drawings depicting the Landfill boundary, phases, development plan, and design features. Attachment III-2 presents site cross-sections. Attachment III-3 provides the existing site topography and drainage. Attachment III-7 is the final contour map

The disposal area will be increased about 5 acres to +/- 155 acres. To attain the additional disposal area, the abandoned natural gas pipeline bisecting the Landfill will be excavated and removed. Portions of the pipeline have already been excavated and material recovered has been recycled. A liner and leachate collection system will be constructed over these areas. The area between phases 2 and 3 will be an extension of Phase 3 and the area between Phases 1 and 4 will be identified as Phase 5. The final landfill condition will be two larger hills instead of the currently permitted four hills. The western hill will include Phases 1, 4 and 5 and the eastern hill will include Phases 2 and 3. The two hills will be divided by the existing power line easement that runs north to south through the center of the permit boundary.

Phase IV will be changed from a Type IV operation to a Type I unit with a leachate collection system. The lowest excavation elevation will remain at the 445' (msl) as previously permitted in Permit No. MSW-1693A.

In 2013, the City had an estimated 4.8 million cubic yards of remaining capacity, assuming no amendment was granted – including the airspace in Phase 4, the construction/demolition waste fill area. Table III.7 provides a summary of waste volume capacity for the various Phases of the Landfill. The permit amendment design provides an additional 4.1 million cubic yards. Assuming waste quantities presented in Table III.7, the Landfill operational life is estimated to extend beyond 2030 through 2035. If recycling and source reduction programs are successfully implemented, or there are major shifts in the flow of waste to the Landfill, this time-frame could be different.

Table III.7
Laredo Landfill Volume Summary

Phase	Volume Remaining in Permitted Hills	Additional Volume Between Amended and Permitted Hills	Volume Remaining With Amendment
West Side			
Phase 1	1,050,000	950,000	2,000,000
Phase 4	850,000	500,000	1,350,000
Phase 5	0	380,000	380,000
West Total	1,900,000	1,830,000	3,730,000
East – Option 1			
Phase 2	1,950,000	1,000,000	2,950,000
Phase 3	1,450,000	450,000	1,900,000
Phase 3 (expanded)	0	900,000	900,000
East – Total	3,400,000	2,350,000	5,750,000
Totals – Option 1	5,300,000	4,180,000	9,480,000

5.2.2 Facility Access 330.63 (b)(1)

5.2.2.1 Landfill Entrance

The site currently has two lanes for ingress and one lane for egress. Access is controlled by a lockable gate. The Landfill entrance has a scale house facility which is manned during Landfill Operations. The scales have two lanes for incoming vehicles and one lane for exiting vehicles. There are two access lanes that allow equipment operators and other authorized vehicles to bypass the scales.

Currently, the entrance road from SH 359 is approximately 800' in length. This provides queuing for approximately 30 solid waste collection vehicles, assuming an average vehicle length of 23 feet, and two feet clearance for each vehicle. Historically, waste flows to the Landfill have been dispersed widely throughout the time of operation and queuing has not been an issue. [Figure III-1.11 shows the landfill entry facilities.](#)

5.2.2.2 Onsite Access Roads

The main road into the Landfill from SH 359 is an asphalt roadway owned by the City. The City maintains this roadway through periodic grading and addition of asphalt. This is an all-weather road allowing access to the site in inclement weather.

The onsite access roads provide access to the entire perimeter of the Landfill and there is another access road that is located between the east and west phases. The access roads are constructed of compacted subgrade material and graded to allow drainage. These access roads are a minimum of 15 feet wide and provide access to all points around the landfill perimeter including stormwater retention/detention facilities, gas flare, leachate storage, tire chipping and other storage areas. Periodic maintenance and regrading of the access roads is required to minimize depressions, ruts and potholes and to keep them safely operable. During dry weather, the City will control dust by sprinkling the roads and ramps with water. The water used for dust control must be uncontaminated. Leachate may not be used. Acceptable water sources are the sedimentation ponds or any other source of uncontaminated water available at the site.

5.2.2.3 Site Access Control

Site access control will consist of at least a three-strand barbed wire fence around the entire perimeter of the site, with the exception of the east side where a 9' tall metal panel fence is constructed. Control features at the site entrance include a lockable gate and a scale house. Site personnel will inspect the fencing, report any failure and see that any damage is quickly repaired. All security features, including the metal entry gate, and the locks will be kept in proper working order, maintained, and quickly replaced if inoperable and/or irreparable. Maintenance will be performed to site security mechanisms, as necessary, to maintain access control.

Gatehouse personnel at the main entrance will control site access whenever the entry gate is open. When the site is closed, the entry gate will be locked to prevent unauthorized and uncontrolled waste disposal, and locked when no personnel are present on site. Vehicular access to the site at points other than the entry gate will be prevented by the perimeter fencing and a lockable gate.

The gate attendant will direct drivers to the active disposal area. There, the drivers will be directed by landfill personnel to a specific unloading area. The use of internal signs may also be used to direct drivers to the appropriate disposal locations.

5.2.3 Landfill Method, Waste Movement & Landfill Cells 330.63(B)(b)(2)

The current and proposed landfill method for this facility is the area fill method for both above and below grade fills. Waste will be covered daily, creating daily cells which are separated from each other by at least 6" of clean soil, or the approved alternative daily cover material.

The Landfill has been in operation since 1986. Prior to Subtitle D regulations becoming effective, the landfill was lined with re-compacted and density controlled

in-situ material. Following the implementation of Subtitle D, landfill cells have been constructed with approved liners and leachate collection systems.

Installation of a piggy-back separation liner is planned over the existing Type IV waste in Phase 4 and the Pre-Subtitle D waste area in Phase 1 where vertical expansion is proposed. These liners will sloped to direct leachate flow towards Subtitle D lined areas that contain leachate collection systems. The piggy-back separation liner over the Pre-Subtitle D waste in Phase 1 will be installed with a 3% minimum slope that will cause leachate to flow from north to south and away from the side slopes. The liner will extend beyond the limits of the Pre-Subtitle D waste and into the area above the Subtitle D waste of Phase 1, Cells 17 and 18 where it will be anchored into compacted fill placed on the existing intermediate cover. It will be installed at a maximum elevation of 629 MSL which is lower than the currently permitted maximum waste elevations of the top dome and the sideslopes of Phase 1.

As stated, the proposed piggyback separation liner to be installed over existing Pre-Subtitle D Type 1 waste is to contain leachate and direct it toward Subtitle D lined areas without leachate ponding. To assure that the piggyback separation liner's performance is not compromised over time due to settlement, the expected maximum differential in future settlement of Phase 1 below the piggyback separation liner will be analyzed. To do this, the fill beneath the liner will be considered to be made up of four different components: 1) Pre 1999 waste, 2) 1999 to 2012 waste, 3) new waste, and 4) compacted earthen fill.

The anticipated settlement of a solid waste hill under normal operating procedures is generally accepted to be between 5% and 10% of the total depth of the fill. The base liner elevation for the cells within the Pre-Subtitle D area is approximately 458.11' msl. The topographic survey prepared for the 1999 permit amendment shows the average fill elevation to be at elevation 535' msl creating an approximate depth of 77 feet. Assuming that 90% of the anticipated settlement will have occurred by the time the piggyback separation liner is constructed, the future settlement in the pre 1999 waste is anticipated to be between 0.5% and 1% of the 77 feet, or 0.39 feet to 0.77 feet. This indicates that the maximum difference in settlement between two locations could be expected to be 0.39 feet for the pre-1999 waste.

The topographic survey prepared in 2012 shows the average fill elevation to be at elevation 606' msl creating an approximate depth of 71 feet down to the pre-1999 waste. Assuming that 75% of the anticipated settlement for this layer will have occurred by the time the piggyback separation liner is constructed, the future settlement in the 1999 to 2012 waste is anticipated to be between 1.25% and 2.5% of the 71 feet, or 0.89 feet to 1.78 feet. This indicates that the maximum difference in settlement between two locations could be expected to be 0.89 feet for the 1999 to 2012 waste.

The maximum depth of new waste below the liner will be approximately 12 feet and would be at or near the north end (upslope end) of the proposed liner. Assuming this

waste will settle between 5% and 10% of its depth, the expected settlement will be between 0.6 feet and 1.2 feet, or a differential of 0.6 feet. The differential settlement of the 3-foot minimum thick compacted earth layer is considered to be negligible.

By this analysis, the maximum differential in settlement between two points on the proposed piggyback separation liner is 1.88 feet (0.39+0.89+0.6). Making the assumption that the expected settlement differential between two analysis points decreases as the distance between the points decreases, the minimum separation distance to be considered is 100 feet. Therefore, it can be expected that the maximum difference in settlement between two points separated by 100 feet is 1.88 feet. If the upslope point were to settle more than the downslope point, the slope on the liner would be reduced by 1.88% which is less than the 2% liner slope to be constructed. This means that there would still be positive grade provided on the liner and ponding should not occur. The liner is to be constructed to direct leachate away from the liner edges and southward in a sheet flow manner towards the Subtitle D cells. In addition to the 2% liner slope for the interior portion of the liner, the outer edges of the liner will be raised an additional foot to provide additional assurance that leachate will not collect along the edges or escape to the surface. Figure III-2.3 provides the cross section longitudinally through the center of the proposed piggyback separation liner. Figure III-2.5 provides the cross section laterally through the proposed liner. Figure III-2.8 shows the limits of the four layers used in this analysis. Details of the proposed piggyback separation liner are provided on Figures III-15.7 and III-15.7A.

The differential settlement previously described would be considered the worst case scenario since the piggyback separation liner's toe of the slope in question begins at an approximate elevation of 600' msl. The top of the slope is at an approximately 615' msl. Therefore, most of the differential settlement would be expected to occur in the 15 foot (615' msl – 600' msl) elevation difference below the low end of the slope to the high end of the slope. The rest of the waste thickness (~460' msl to ~600' msl) would be expected to settle relatively consistently over time since the waste is normally placed in lifts, leveled, and then compacted as the waste is accepted in the different landfill cells.

The cross section components of proposed liner system alternatives are presented in Table III.8A below.

Table III.8A – Proposed Liner Alternatives

Typical Proposed Type I Liner Components

<u>Material</u>	<u>Thickness</u>
<u>Protective Cover</u>	<u>12"</u>
<u>Drainage Layer</u>	<u>12"</u>
<u>Geotextile</u>	<u>Negligible</u>
<u>Geomembrane</u>	<u>60 mil HDPE</u>
<u>Geosynthetic Clay Liner</u>	<u>Negligible</u>
<u>Prepared Subgrade</u>	<u>24"</u>

Typical Proposed Piggyback Separation Liner Components

<u>Material</u>	<u>Thickness</u>
<u>Protective Cover</u>	<u>12"</u>
<u>Drainage Layer</u>	<u>12"</u>
<u>Geotextile</u>	<u>Negligible</u>
<u>Geomembrane</u>	<u>60 mil HDPE</u>
<u>Geosynthetic Clay Liner</u>	<u>Negligible</u>
<u>Prepared Subgrade</u>	<u>36"</u>

Table III.8B presents a summary of liner details throughout the site, including cells that will be constructed in the future. Liner details for existing and future cells are presented in Attachment III-15 - Leachate and Contaminated Water Plan as Figure III-15.5 through Figure III-15.7A. The liners are to be constructed in accordance with the Soil Liner Quality Control Plan – Attachment III-10. Liners may be constructed using 2 feet of clay, or an approved geosynthetic clay liner as defined in the SLQCP.

Table III.8B
Existing & Future Cell Configurations

<u>CELL (STATUS)</u>	<u>LINER TYPE</u>	<u>APPROX. LOWEST TOP OF LINER ELEVATION (ft) MSL</u>	<u>DRAINAGE MEDIA COMPONENTS</u>	<u>LCS SUMP</u>	<u>SLOPE OF LCS PIPES</u>	<u>SLOPE OF FLOOR</u>
Phase 1, Cells 1 through 16 <u>(Constructed and partially filled)</u>	In-situ and compacted clay	458.11	N/A	N/A	N/A	N/A
Phase 2, Cell 1 <u>(Constructed and partially filled)</u>	In-situ	470.00	N/A	N/A	N/A	N/A

Phase 2, Cell 2 <u>(Constructed and partially filled)</u>	GCL, 60-mil HDPE	452.46	Sidewalls: geonet w/geotextile both sides and 2 ft of protective cover floor: 1 ft of gravel, 1 ft of protective cover and chimney	No. 2-2	2%	2.83%
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CELL (STATUS)	LINER TYPE	APPROX. LOWEST TOP OF LINER ELEVATION (ft) MSL	DRAINAGE MEDIA COMPONENTS	LCS SUMP	SLOPE OF LCS PIPES	SLOPE OF FLOOR
			drains			
Phase 2, Cell 3 <u>(Constructed and partially filled)</u>	2 ft clay, 60- mil HDPE	453.00	Sidewalls: geonet w/geotextile both sides and 2 ft of protective cover floor: 1 ft of gravel, 1 ft of protective cover and chimney drains	No. 2-3	1%	1.41%
Phase 2, Cell 4 <u>(Constructed and partially filled)</u>	2 ft clay, GCL, 60-mil HDPE	453.57	Sidewalls: geonet w/geotextile both sides and 2 ft of protective cover floor: 1 ft of gravel, 1 ft of protective cover and chimney drains	No. 2-4	2%	2.83%
Phase 2, Cell 5/6 <u>(Constructed and partially filled)</u>	GCL, 60-mil HDPE	455.00	Geonet w/ geotextile one side, 2 ft of protective cover	No. 2- 5/6	1%	2%
Phase 2, Cell 7/8 <u>(Constructed and partially filled)</u>	GCL, 60-mil HDPE	455.00	Geonet w/ geotextile one side, 2 ft of protective cover	No. 2- 7/8	1%	2.5%
Phase 2, Cell 9/10 <u>(Constructed and partially filled)</u>	GCL, 60-mil HDPE	454.00	Geonet w/ geotextile one side, 2 ft of protective cover	No. 2- 9/10	1%	2%
Phase 2, Cell 11/12 <u>(Constructed and partially filled)</u>	GCL, 60-mil HDPE	454.00	Geonet w/ geotextile one side, 2 ft of protective cover	No. 2- 11/12	1%	2%
Phase 2, Cell 13/14 <u>(Constructed, active cell)</u>	GCL, 60-mil HDPE	449.50	Geonet w/ geotextile one side, 2 ft of protective cover	No. 2- 13/14	1.6%	2.5%
Phase 3, Cell 1	GCL, 60-mil HDPE	443.00	Geonet w/ geotextile one side, 2 ft of protective cover	No. 3-1	1%	2%

CELL (STATUS)	LINER TYPE	APPROX. LOWEST TOP OF LINER ELEVATION (ft) MSL	DRAINAGE MEDIA COMPONENTS	LCS SUMP	SLOPE OF LCS PIPES	SLOPE OF FLOOR
Phase 3, Cell 2 (Future)	GCL, 60-mil HDPE	454.00	Geonet w/ geotextile one side, 2 ft of protective cover	No. 2- 13/14	???	???
Phase 4, Cell IV-1 Type 4 Waste (Constructed and partially filled)	GCL	495.00	N/A	N/A	N/A	N/A
Phase 4, Cell IV-1 Type I Design (Future)	Engineered Fill and GCL, 60-mil HDPE	522.00	Geonet w/ geotextile one side, 2 ft of protective cover	N/A	1.5%	Varies, 2% min
Phase 4, Cell IV-2 (Future)	GCL, 60-mil HDPE	486.00	Geonet w/ geotextile one side, 2 ft of protective cover	No. 4-2	1%	2%
Phase 4, Cell IV-3 (Future)	GCL, 60-mil HDPE	465.50	Geonet w/ geotextile one side, 2 ft of protective cover	No. 4-3	1%	2%
Phase 5 (Future)	GCL, 60-mil HDPE	501.50	Geonet w/ geotextile one side, 2 ft of protective cover	No. 5-1 & No. 5-2	3%	3.2%

5.2.3.1 Waste Movement

Part II, Attachment II.6 presents the sequencing plan for the Landfill. This information is repeated in Part III, Attachment III.1.

Approximately 155 acres of the 203.1 acres will be used for disposal operations. This includes the previously permitted areas and the additional acreages where the abandoned pipe line was previously located. The site is currently divided into four phases, each separated by the north-to-south electrical easement and the west-to-east abandoned natural gas pipeline easement. The phases are designated 1, 2, 3, and 4 and represent separate waste units as shown on Part III, Attachment 1. Phase 3 of the current design will be expanded to include the area to be lined where the abandoned pipeline was located. A new Phase 5 will be constructed where the abandoned pipeline was located on the West Phase of the Landfill. The Type IV, Phase 4, will be converted to a Type I Area.

In 2014, waste filling operations are progressing in Cells 13 and 14 of Phase 2.

The Permit Amendment will make the following waste storage changes to the facility design:

- The area between Phases 2 and 3 will be lined and filled as part of Phase 3. The new area will include a leachate collection system.
- The eastern limit of Phase 3 will be moved westward to allow modification to the current detention pond facility.
- The height of the East Phase will be increased from an elevation of 637 msl to 654.~~7~~5 msl. All new waste on the East Phase will be placed over areas that were lined in accordance with Subtitle D regulations.
- Phase 4 will be converted from a Type IV operation to a Type I operation. Engineered fill will be constructed on top of construction/demolition waste that has been put in place. A liner will be placed over the constructed fill and unused areas of Phase 4. A leachate collection system will be part of the amended Phase IV design.
- A new Phase 5 will be constructed in the area between Phase 1 and 4. This area will include a liner and leachate collection system.
- In Phase 1, a separation liner will be constructed over engineered fill on top of waste that was previously filled over Pre-Subtitle D cells. A liner will be constructed and designed so that leachate drains to the existing leachate collection system.
- The height of the West Phase will be increased from 640.~~5~~0 msl to 664.~~8~~5 msl.

Part IV - Site Operating Plan provides a generalized processing design and working plan for waste brought to the landfill. A process flow diagram for waste handling is provided as Figure III-1.13

5.2.3.2 Maximum Time 300.63(d)(1)(B)

Waste accepted at the site is directed to the working face and disposed. All waste must be covered with at least 6" of clean soil or approved alternative liner material by the end of the working day. The City will operate the facility in a manner that reduces the size of the working face of the Landfill to reduce potential nuisances.

5.2.4 Sanitation & Contaminated Water

All equipment cleaning is done offsite. White goods storage may take place on the additional 3.5 acre tract of land. No equipment cleaning will be conducted within the permitted area.. Berms will be constructed around the storage area to redirect storm water from the storage area. The storm water that comes in contact with white goods will be treated as uncontaminated water and be directed to the storm water system.

5.2.4.1 Control of Spills & Contaminated Water 330.63(d)(1)(B)

Landfill design and operations are designed to protect groundwater and surface water resources. The Site Operating Plan details means and methods to reduce the introduction of contaminated liquids into the site, unless they meet waste acceptance standards.

The design of the Landfill includes provisions for the protection of surface waters through the drainage plan, intermediate and final cover systems.

Intermediate and final cover systems are designed to keep water from infiltrating into the waste. The intermediate cover system includes a minimum of 2 feet of compacted soil and a protective vegetative layer. Due to the arid conditions in Laredo, it is difficult to establish vegetation on the side slopes of the Landfill. When vegetation has not become established, the City will periodically inspect the intermediate cover and add soil to provide sufficient depth and to re-grade to prevent infiltration of storm water through the cover and into the waste.

The final cover closure design and closure plan are presented in the Final Closure Plan (Part III, Attachment 12). Three options for final cover design will be available. They are (i) a standard Subtitle D final cover; (ii) an alternative final cover system which utilizes geosynthetic clay in place of 2 feet of compacted clay; and a “water balance” final cover system. The demonstration for these liner options is presented in the Final Closure Care Plan. For each of the three final cover options, the Final Cover Plan also addresses options for a final cover system that utilizes vegetation and a non-vegetative final cover system that relies on other means to reduce erosion, including long-term maintenance.

5.2.4.2 Contaminated Water Collection & Treatment

Part III, Attachment 15 is the Leachate and Contaminated Water Plan. Three components of the Contaminated Water Plan are: (i) reduce generation of contaminated water; (ii) collection; and (iii) treatment. The City reduces the amounts of contaminated water generated by reducing the working face of the Landfill, by inspecting loads of waste as they enter the Landfill, diversion berms, around the flare facility, and interim drainage controls.

Drainage features that direct uncontaminated water to the storm water system are to be constructed and maintained. These features are presented in Attachment III-6, Groundwater and Surface Water Protection and Drainage Plan.

The landfill currently processes white goods and used tires within the permit boundary near the western end of Phase 3. Diesel fuel for landfill use is also stored in this area. Brush mulching currently occurs outside of the permit boundary. With this permit, the used tire processing and white goods processing operations will be relocated to the area of the 3.12 acre horizontal permit boundary expansion near the southeast corner of the site. These areas will incorporate proper storm water protection design and operating procedures to

reduce the generation of contaminated water. These measures will include concrete pads built above grade, double containment protection for the diesel fuel storage and operating procedures to limit the time that shredded tires are stored on-site.

5.2.4.3 Containment Berms

Storm water that may come into contact with solid waste or alternate daily cover will be retained as contaminated water in the vicinity of the active waste area so that it does not mix with uncontaminated water or flow off site. The containment berms at the working face will be capable of handling a 25-year, 24-hour storm event. Berm sizing calculations are contained in the Run-Off/Run-On Control Plan in Part III, Attachment 15 (Leachate and Contaminated Water Management Plan), Appendix A. A typical berm configuration at the working face is shown in Part III, Attachment 6. The berms will be maintained and relocated as necessary to assure that the containment berm is always ahead of disposal operations.

5.2.4.4 Effluent Processing

Due to the semi-arid climate of the region, only small amounts of leachate are produced by the landfill. Leachate will be removed from the collection sumps and pumped to a leachate storage tank located in a newly added area of the Landfill located south of Phase 3. The tank will be double contained and periodically pumped out into trucks and taken to the wastewater treatment plant operated by the City of Laredo for treatment. Leachate may also be stored in a tanker truck, recirculated over Subtitle D lined areas or piped to a wastewater pipeline and delivered to a public owned wastewater treatment facility.

Any stormwater that has become contaminated from contact with waste or spillages will be contained and kept separated from uncontaminated storm water sources. The contaminated storm water will be treated as leachate.

5.2.5 All-Weather Operations

The facility entrance road is an all-weather asphalt roadway. The site does not currently nor does it propose to have a separate wet weather area. Laredo is typically semi-arid. If rain slows operations, the landfill will close to the general public. This procedure has worked in the site's past history and has proven not to cause unreasonable down-times during the infrequent "wet weather conditions" which occur at the site.

To help minimize the tracking of mud from the facility onto public roads, the 800' site entrance road is constructed of all-weather asphalt surface from the entrance at State Highway 359 to 30' past the gate house. During periods of inclement weather,

the Landfill Supervisor will inspect the main access road on a daily basis and, as needed, will clear mud tracked onto the pavement by washing, blading or sweeping.

As a routine procedure, a stockpile of cover material will be maintained near the working area. This will provide daily cover on a contingency basis for such conditions as inclement weather, unanticipated down-time of cover hauling equipment, and fire/hot load control at the working face. Any interruption in disposal operations, due to weather or equipment problems would be expected to be short since protracted rains in this semi-arid area are rare and the City has sufficient reserve equipment to reinitiate operations to protect public health within the community.

5.2.6 Leachate Collection & Storage

Leachate that is collected in the leachate collection system is pumped by force main that is located along the perimeter of the Landfill cells and parallel to the existing electric transmission easement. The force main is a four inch diameter pipe that transports the leachate from each of the sump locations to a storage tank that will be located on the additional 3.12 acre tract of land. The leachate storage tank will provide sufficient storage for leachate to be collected and stored. [Figure III-1.12 shows the proposed horizontal expansion area of the landfill and the location of the proposed leachate storage tank.](#)

Part III, Attachment 15 is the Leachate Collection and Contaminated Water Plan and provides greater detail on the design of the system and storage options available to the City.

Once collected, leachate may either be recirculated over areas where there is a standard Subtitle D liner system; transported to an approved wastewater treatment facility via truck; or transported via pipeline to an approved wastewater treatment facility.

5.2.7 Landfill Gas Management Infrastructure

Landfill gas is collected and piped to a flare facility. The flare facility is located on the northern area of the Landfill, adjacent to the road that is located along the central area of the Landfill. Landfill gas monitoring, collection and flare facility are discussed in greater detail in Part III, Attachment 14, the Landfill Gas Management Plan.

5.2.8 Groundwater Monitoring Wells

The Landfill has an approved groundwater monitoring program for the Landfill. A total of 12 wells are located around the perimeter of the Landfill. These wells are monitored in accordance with the Ground Water Sampling and Analysis Plan. The GWSAP is included in Attachment III-11.

5.3 Surface Water Drainage for Municipal Solid Waste Facilities TAC 330.303

Attachment III-6, Groundwater and Surface Water Protection Plan & Drainage Plan provides demonstration that the Landfill design meets the requirements of TAC § 330.303. Specifically, the Surface Water Drainage Report demonstrates the following.

- The Landfill is designed to maintain and manage run-on and runoff during the peak discharge of a 25-year, 24 hour rainfall event and is designed to prevent the off-site discharge of waste and feedstock material, including, but not limited to, in-process and/or processed materials.
- Drainage facilities in and around the Landfill will control and minimize surface water running onto, into, and off the Landfill using a system of berms, channels, culverts and sedimentation/detention ponds.

5.3.1 Existing Drainage Patterns

The Landfill is designed so that permitted drainage patterns will not be adversely altered. As described in Part III, Attachment 6, the Landfill is designed to achieve the following.

- The Landfill's run-on control systems are capable of preventing flow onto the active portion of the landfill during the peak discharge from at least a 25-year, 24 hour rainfall event.
- The City has maintained, and will continue to maintain, a runoff management system from the active portion of the landfill to collect and control at a minimum the water volume resulting from a 24-hour, 25-year storm.
- The landfill design is designed to provide effective erosional stability to top dome surfaces and external embankment side slopes during all phases of landfill operation, closure, and post-closure care
- Embankments, drainage structures and diversion channels are sized and graded to handle the design runoff must be provided. The slopes of the sides and toe will be graded in such a manner as to minimize the potential for erosion. The surface water protection and erosion control practices are designed to maintain low non-erodible velocities, minimize soil erosion losses below permissible levels, and provide long-term, low maintenance geotechnical stability to the final cover.
- The City will maintain the collection, drainage, and/or storage units as designed, and will restore and repair the drainage system in the event of washout or failure as quickly as practical; and
- The City will also control erosion and sedimentation, including having interim controls for phased development as shown in the Attachment III-6.

5.3.2 Flood Protection for Landfill

The fill area of the Landfill is not located in the 100-year floodplain, as demonstrated in Attachment II-15. Therefore, flood protection structures are not required.

5.3.3 Stormwater Management

Stormwater run-on and run-off will be controlled with channels and berms to keep uncontaminated water from coming into contact with waste storage, processing and disposal activities. Refer to Attachment III-6 for the Landfill's Storm Water Pollution Prevention Plan.

In accordance with 30 TAC §330.15(h), the design and operation of the Laredo facility will provide for the following.

1. *No discharge of solid wastes or pollutants adjacent to or into the water in the state, including wetlands, that is in violation of the requirements of the Texas Water Code, §26.121.* During the active life of the disposal facility, all stormwater coming into contact with solid waste or alternate daily cover will be retained as contaminated water and treated or disposed of as outlined in Attachment III-15, the Leachate and Contaminated Water Plan.
2. *No discharge of pollutants into waters of the United States, including wetlands, that violates any requirements of the Clean Water Act, including, but not limited to, the National Pollutant Discharge Elimination System (NPDES) requirements, pursuant to §402 as amended.* The operations related to the handling of contaminated water at the Landfill will prevent the discharge of pollutants associated with solid waste. Pollutant discharge associated with contaminated stormwater runoff from the active portion of the site will be prevented by incorporating best management practices (BMPs) to limit erosion and sediment discharge. Best management practices include the proper vegetation of the final cover, the use of drainage terraces and rundown channels to control and decrease the velocity of the final cover exposed to surface runoff, provisions for sedimentation basins to detain the surface water runoff and trap the sediment prior to discharging from the site, seeding and mulching of drainage channels and detention/sedimentation basins, and providing erosion protection at critical points in the drainage channels. The design of the surface water runoff system, which incorporates best management practices, is included in the Drainage Plan, Attachment III-6.

The facility is currently covered by an EPA NPDES storm water multi-sector general permit # TXR05A2Z35. A copy of the permit is included in the Part III, Attachment 6.

3. *No discharge of dredged or fill material to waters of the United States, including wetlands, that is in violation of the requirements under the Federal Clean Water Act, §404, as amended.* - A wetlands field investigation of the Laredo Sanitary Landfill site was conducted in 2013 for this application. No jurisdictional wetlands or waters of the US were identified within the permit boundary. Refer to Attachment II.16.

4. *No discharge of a nonpoint source pollution of waters of the United States, including wetlands, that violates any requirement of an area-wide or statewide water quality management plan that has been approved under the Federal Clean Water Act, §208 or §319, as amended.* The proposed Laredo facility will be in compliance with §208 of the Clean Water Act.

5.4 Odor Control Measures

Methods to control potential odors emanating from the site will vary depending on the odor source type and its location within the landfill. An Odor Control Plan is part of the Site Operating Plan (SOP). These methods include the following.

Landfill and Working Face

- Repair areas where soil cover has eroded.
- Minimize the size of the working face.
- Remove ponded water if creating objectionable odor.
- Identify potential odor sources at the gatehouse and alerting working face personnel about incoming material.
- Immediately cover the odorous material with other waste or soil material.
- Immediately clean up or covering odorous material spills.
- Properly dispose of dead animals received as outlined in the SOP.
- Periodically inspect and properly maintain the leachate collection and storage facilities.

Other Areas

- Prohibit the unloading of putrescible material in unauthorized areas.
- Non-paved storage areas will be maintained to prevent ponding that might produce objectionable odors.
- Paved storage areas will be periodically cleaned with street sweeping or similar equipment.

6.0 Endangered Species Protection

According to the criterion in 30 TAC §330.63(b)(5) the impact of a solid waste disposal facility upon endangered or threatened species shall be considered. The facility and the operation of the facility shall not result in the destruction or adverse modification of the critical habitat of endangered or threatened species, or cause or contribute to the taking of any endangered or threatened species. Refer to Attachment II.14.

7.0 Landfill Markers §330.55(b)(10)

7.1 Colors/Codes

The benchmark and all required site grid markers will be maintained so that they are visible during operating hours. Markers that are removed or destroyed will be replaced

stamped on it. The location of the benchmark is shown on [Figure III.1-1 in Attachment III.1](#).

City of Laredo Landfill Permit Amendment 1693B
City of Laredo, Texas
Permit Amendment MSW Permit 1693B
Laredo, Texas
Webb County, Texas
August 2014
Revised June 2015

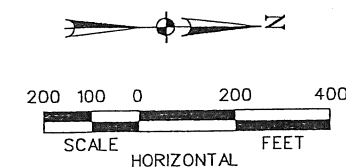
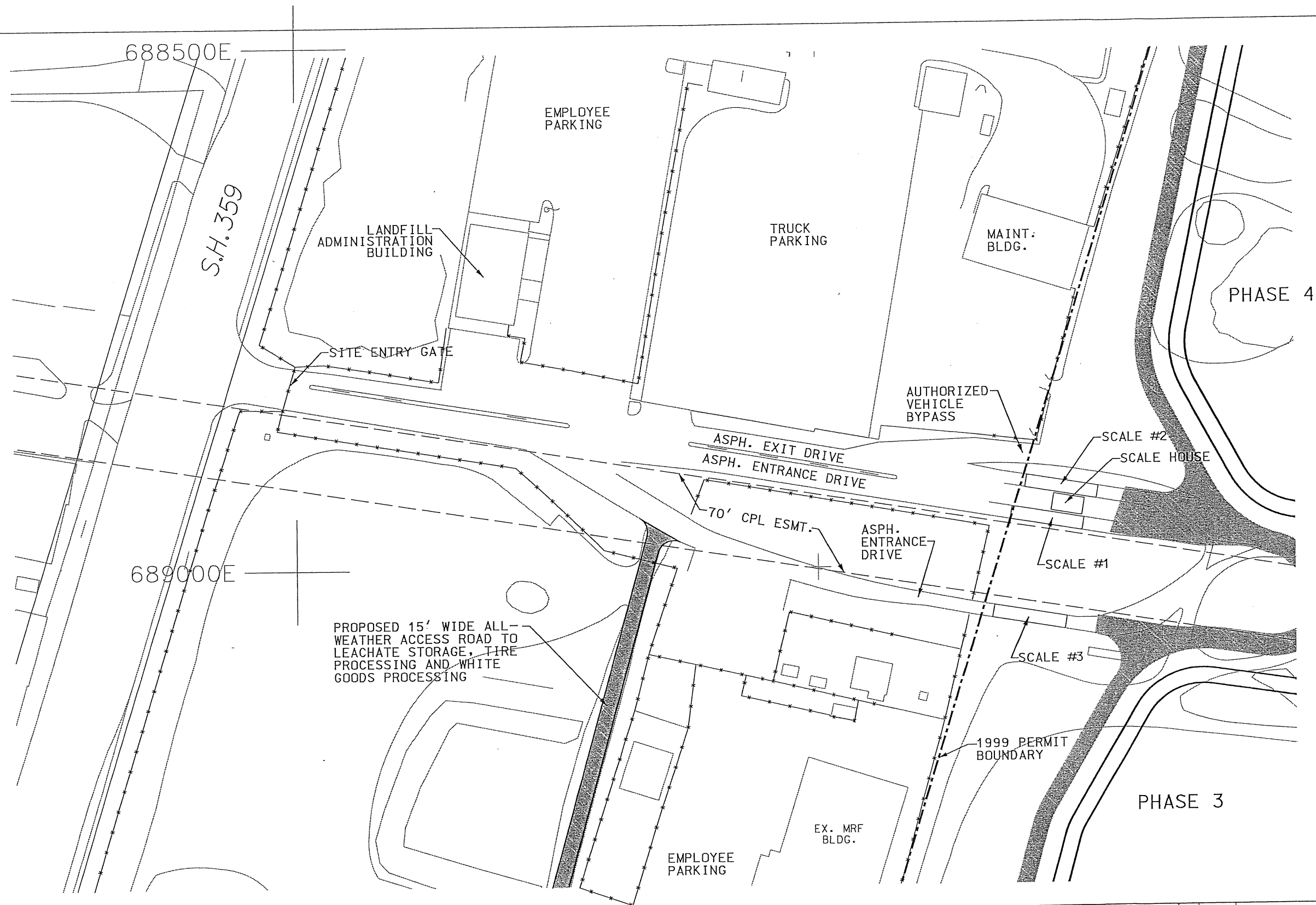
PART III
Attachment 1
Site Layout Plan

LAREDO LANDFILL
PART III
Attachment 1
Site Layout Plan

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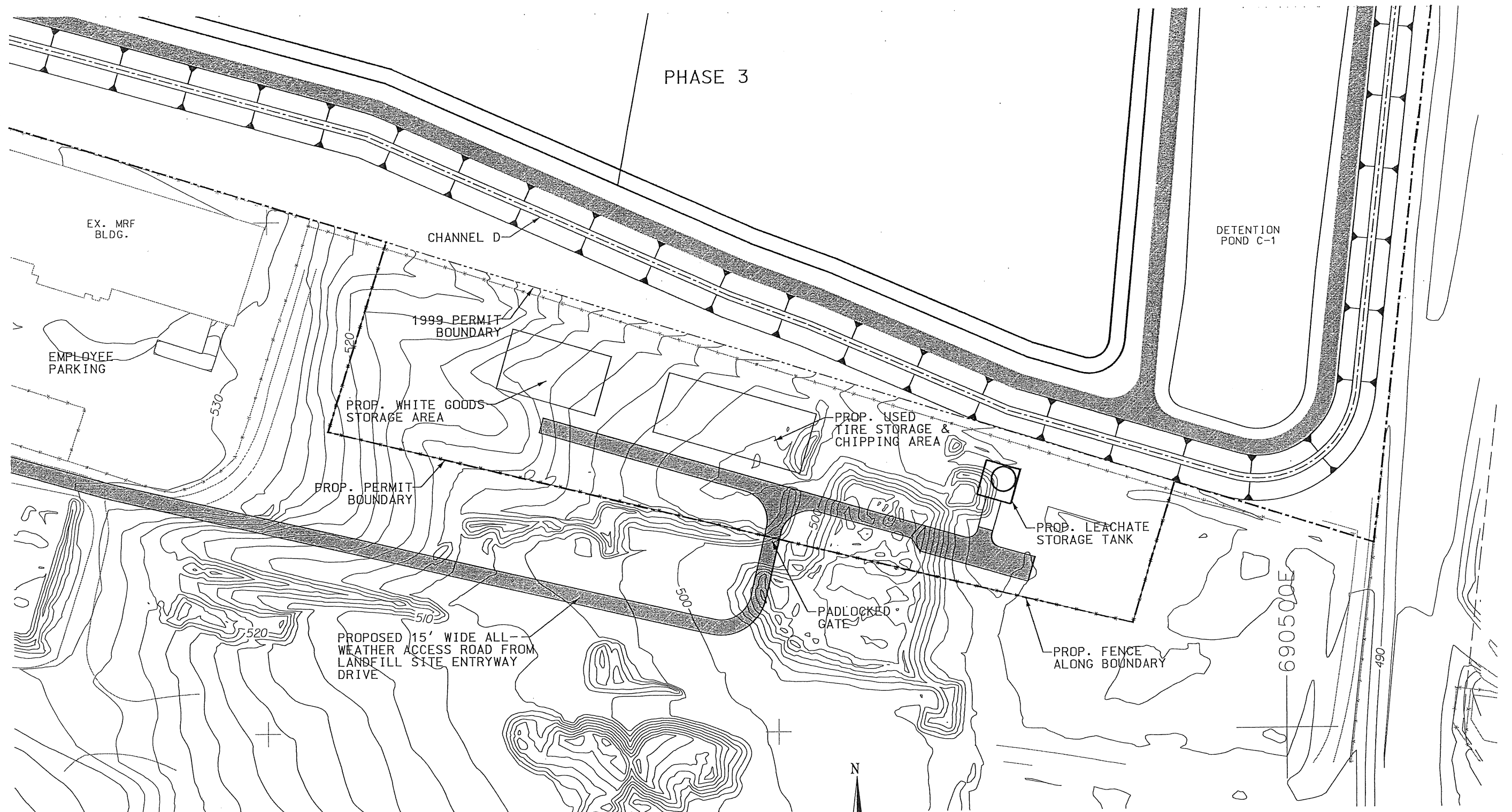
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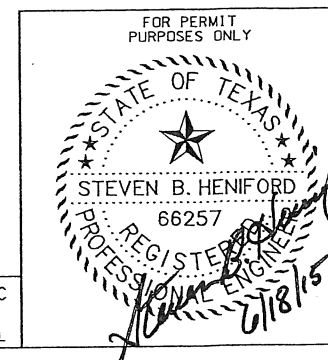


FOR PERMIT PURPOSES ONLY		1 6/12/15 NOD NO. 1		SBH	SBH
REV	DATE	DESCRIPTION		DES BY	APP BY
CITY PROJ. No.		LAREDO LANDFILL VERTICAL EXPANSION			
AZB PROJ. No. 212029		PERMIT AMENDMENT APPLICATION No. MSW-1693B			
DATE: AUGUST 2014		WEBB COUNTY, TEXAS			
DES BY	SH	SITE ENTRANCE PLAN FIGURE III-1.11		SHEET OF	
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CHK BY	SH			ATTACHMENT:	
APP BY	MC			III-1	
		CITY OF LAREDO			

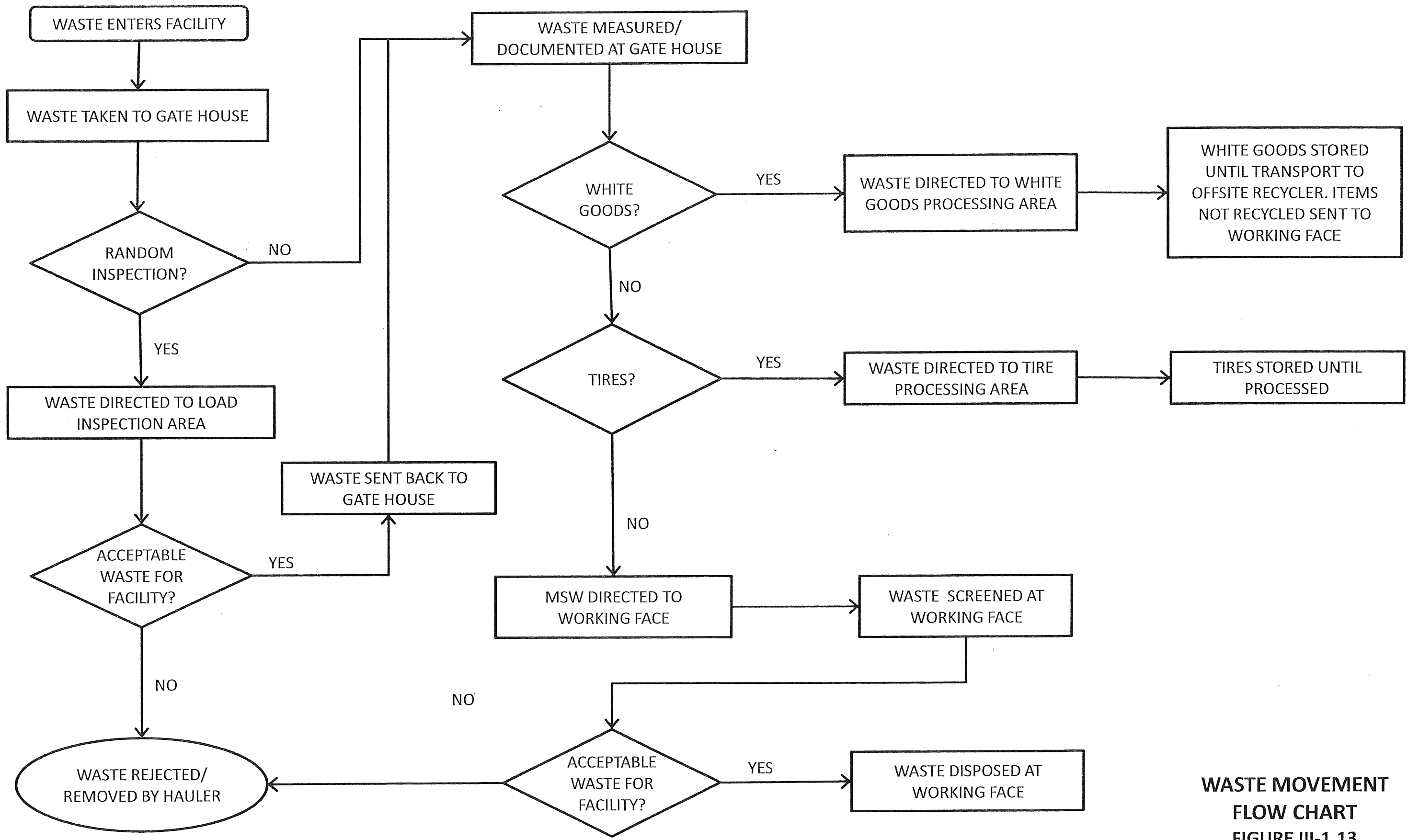
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CITY PROJ. No.		LAREDO LANDFILL VERTICAL EXPANSION		
AZB PROJ. No. 212029		PERMIT AMENDMENT APPLICATION No. MSW-1693B		
DATE: AUGUST 2014		WEBB COUNTY, TEXAS		
DES BY	SH	PERMIT BOUNDARY EXPANSION PLAN FIGURE III-1.12		
DRN BY	AZB			
CHK BY	SH			
APP BY	MC			
CITY OF LAREDO		SHEET OF		
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**WASTE MOVEMENT
FLOW CHART
FIGURE III-1.13**

City of Laredo Landfill Permit Amendment 1693B
City of Laredo, Texas
Permit Amendment MSW Permit 1693B
Laredo, Texas
Webb County, Texas
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Revised June 2015

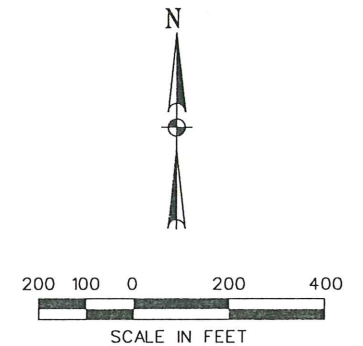
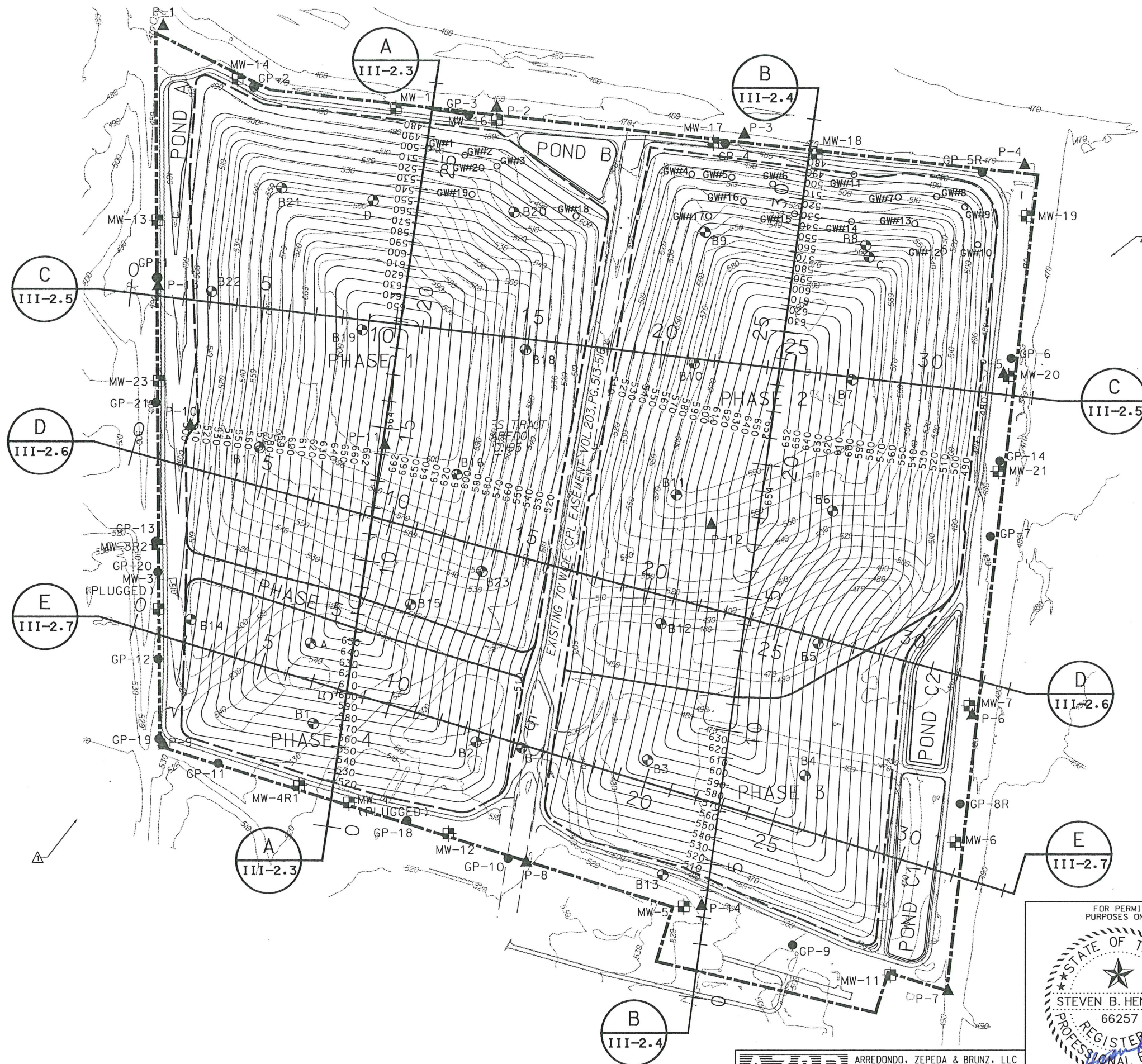
PART III
Attachment 2
Fill Cross Sections

**LAREDO LANDFILL
PART III
Attachment 2
Fill Cross Sections**

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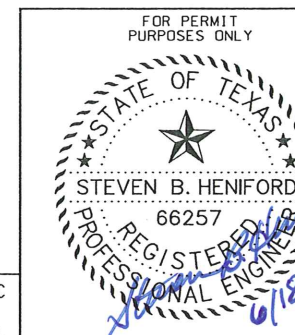
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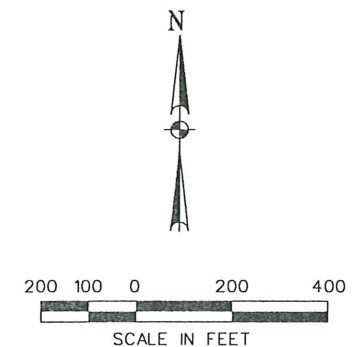
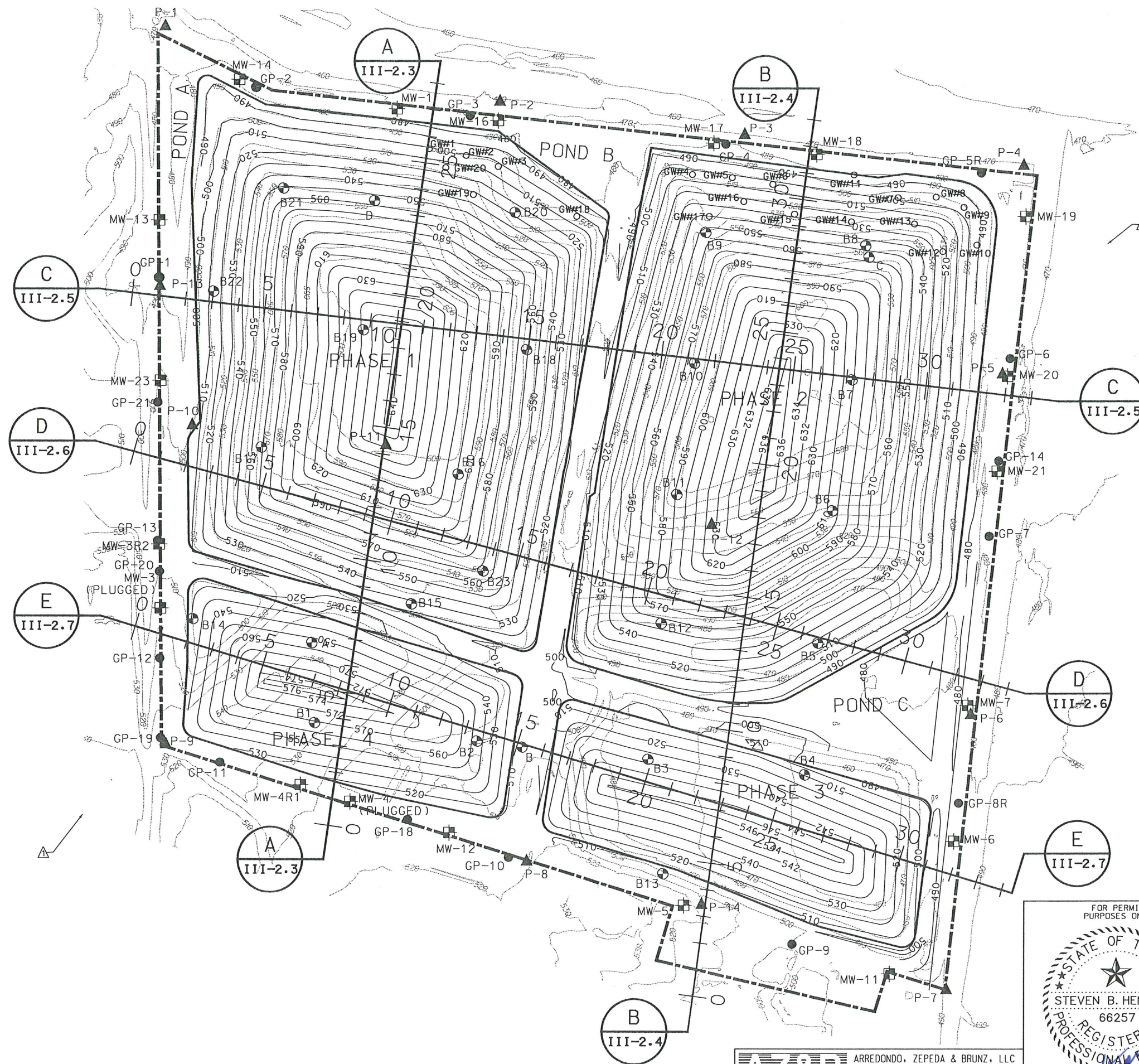
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- PHASE BOUNDARY
- LIMITS OF HILL
- PROPOSED 10-FT CONTOURS
- EXISTING 10-FT CONTOURS
- SOIL BORING
- PIEZOMETER
- GROUNDWATER MONITORING WELL
- GAS PROBE
- GAS COLLECTION WELL



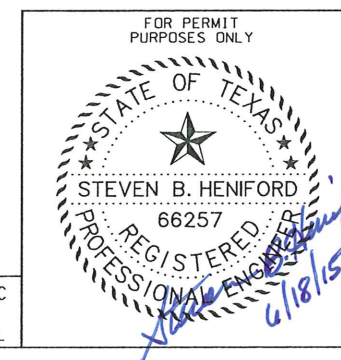
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AZB PROJ. No. 212029		PERMIT AMENDMENT APPLICATION No. MSW-1693B		
DATE: AUGUST 2014		WEBB COUNTY, TEXAS		
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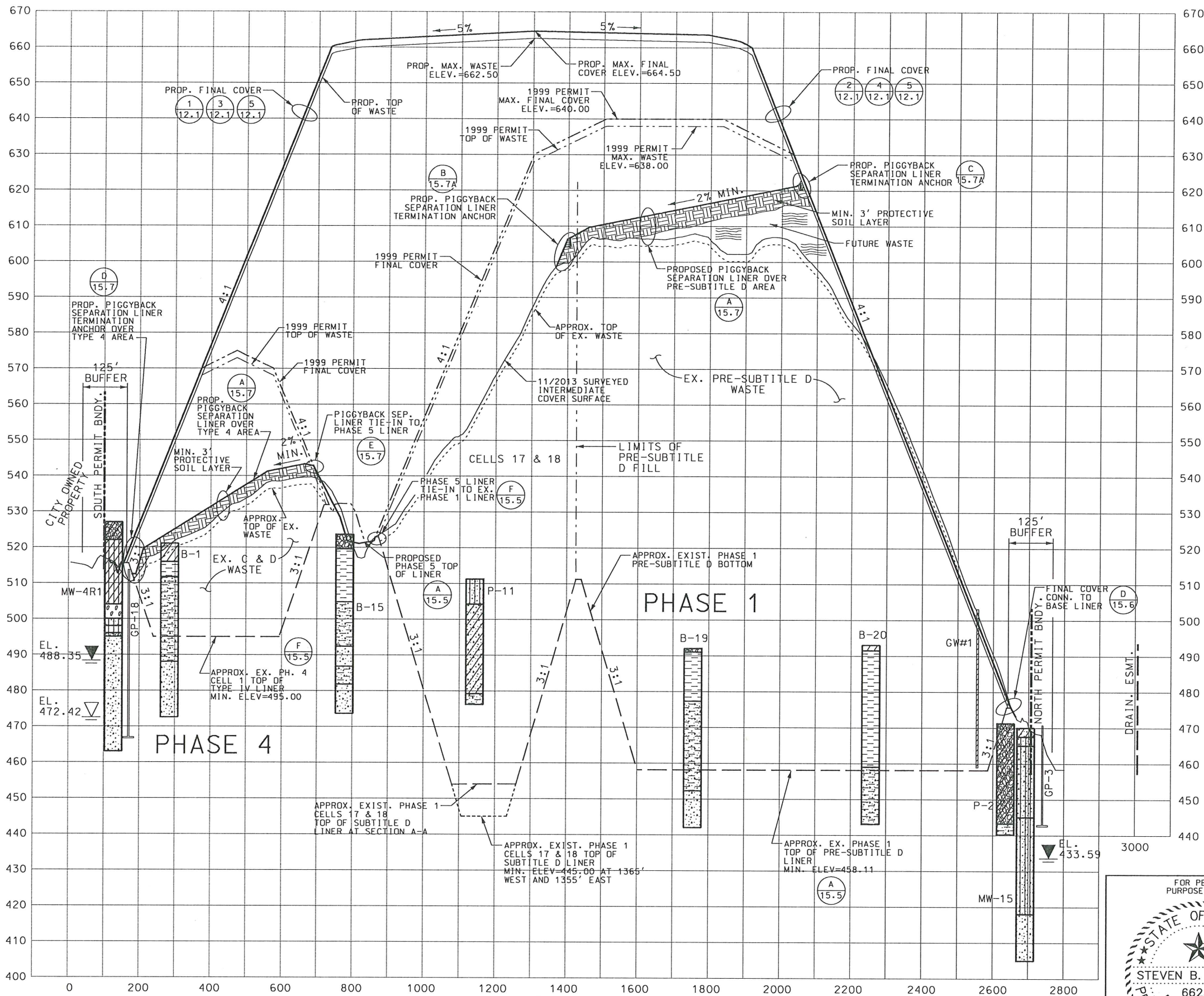
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- PERMIT BOUNDARY
- PHASE BOUNDARY & LIMITS OF HILL
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- 500 ----- EXISTING 10-FT CONTOURS
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- P-6 PIEZOMETER
- MW-19 GROUNDWATER MONITORING WELL
- GP-9 GAS PROBE
- GW#8 GAS COLLECTION WELL

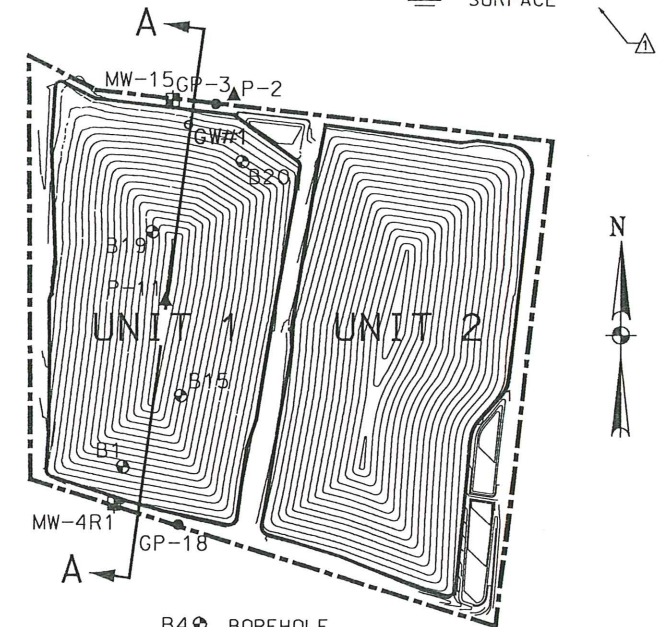
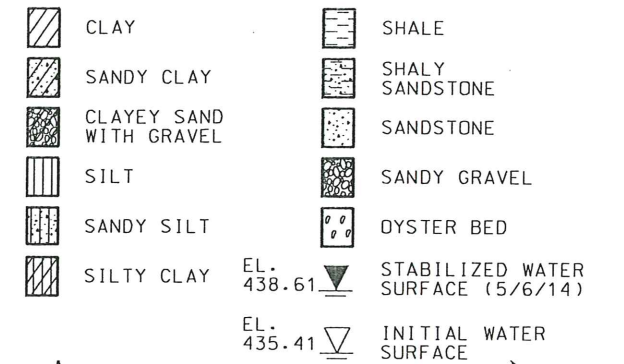


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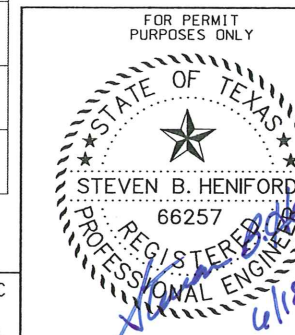
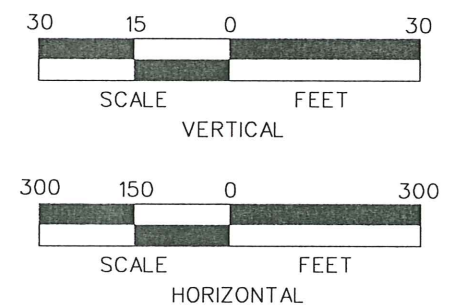
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AZB PROJ. No. 212029		PERMIT AMENDMENT APPLICATION No. MSW-1693B		
DATE: AUGUST 2014		WEBB COUNTY, TEXAS		
DES BY	SH	1999 PERMIT CROSS SECTION LAYOUT FIGURE III-2.2		
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CHK BY	SH			
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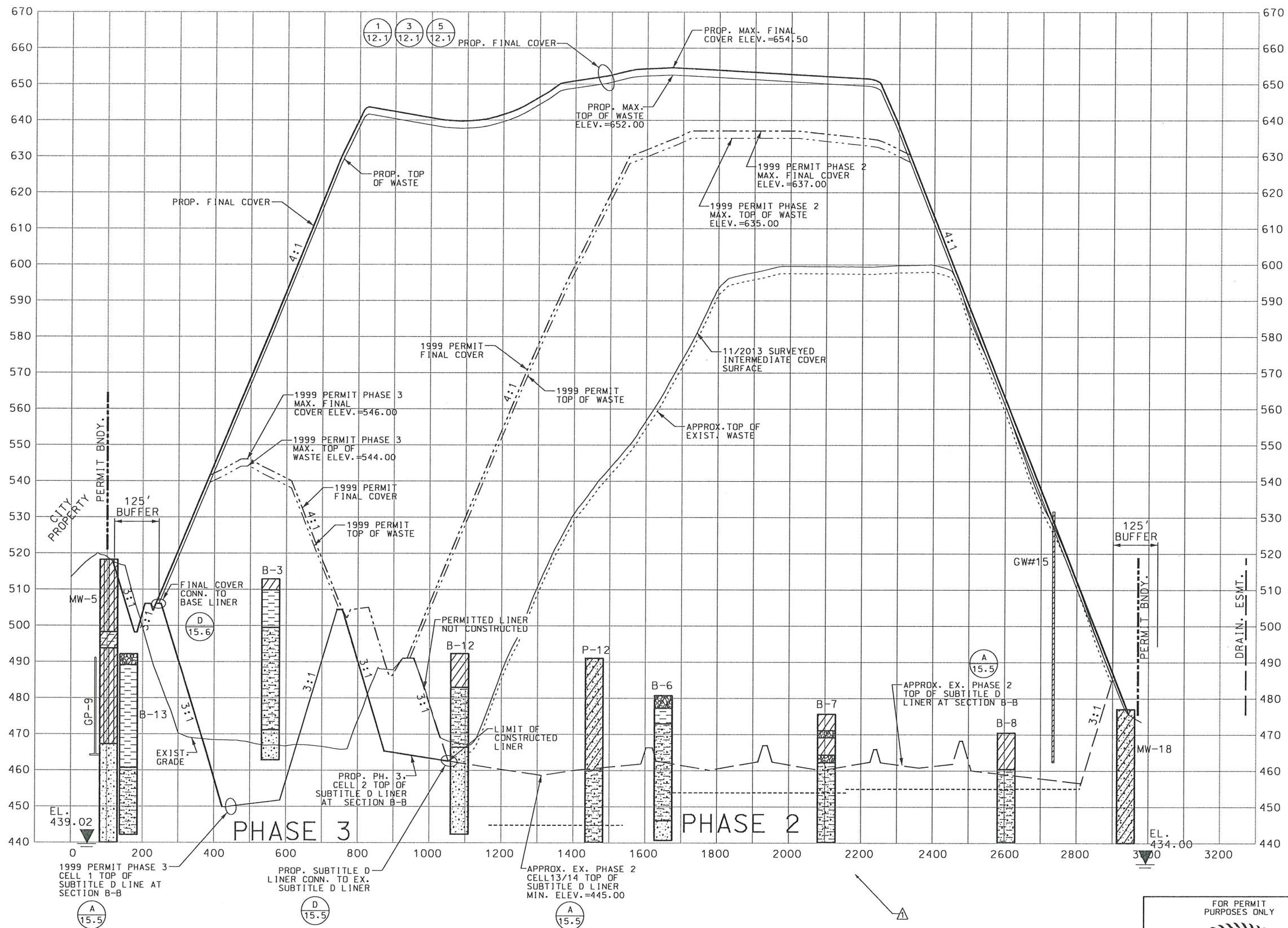


- B4 BOREHOLE
- P-2 PIEZOMETER (PLUGGED)
- MW-6 GW MONITOR WELL
- GP-8R GAS PROBE
- GW#1 GAS COLLECTION WELL

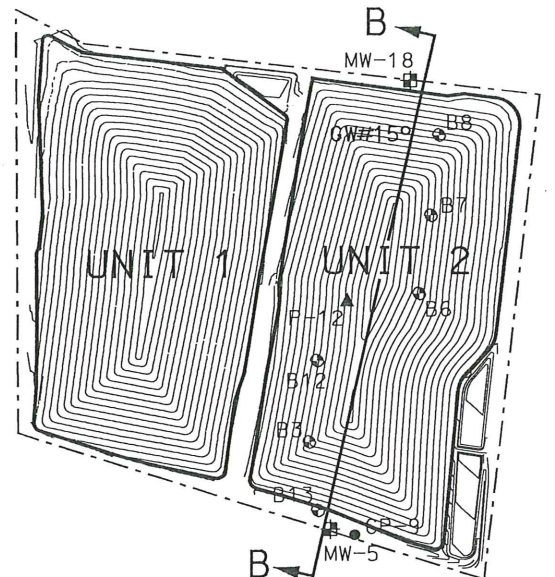
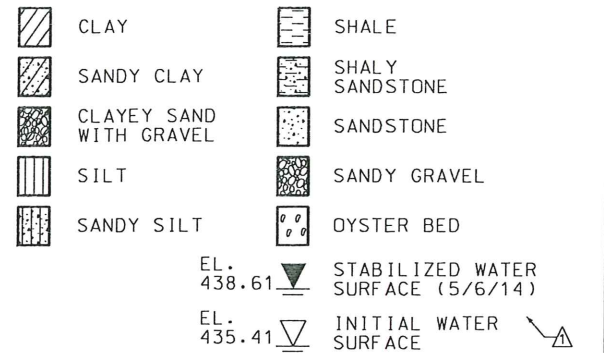


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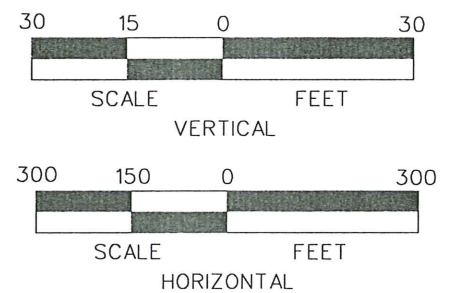
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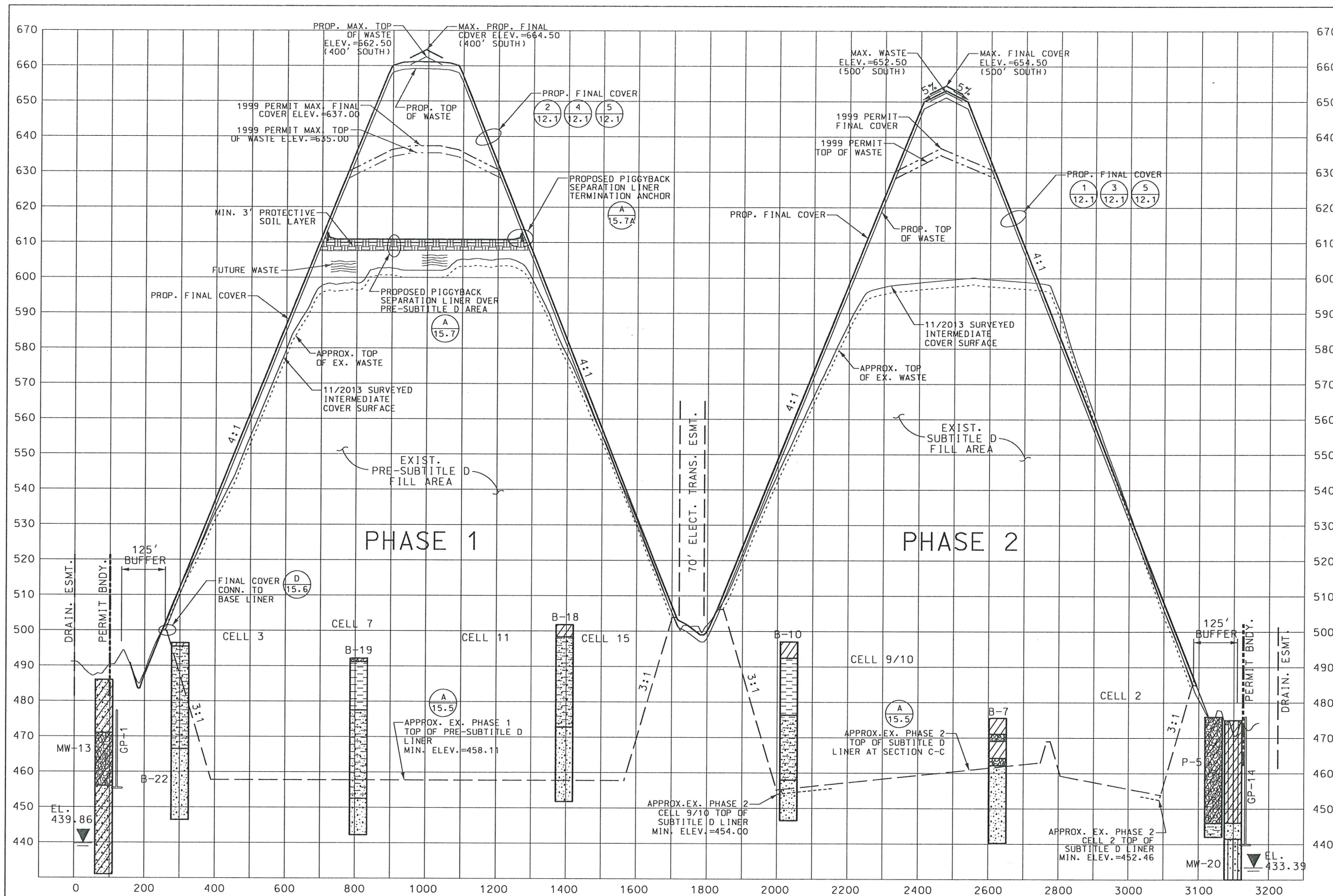
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- P-2 PIEZOMETER (PLUGGED)
- MW-6 GW MONITOR WELL
- GP-8R GAS PROBE
- GW#1 GAS COLLECTION WELL



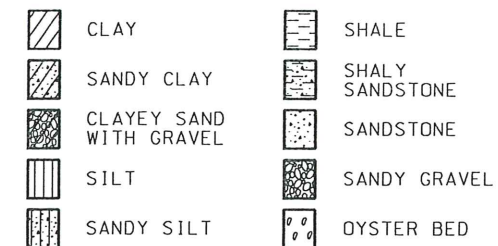
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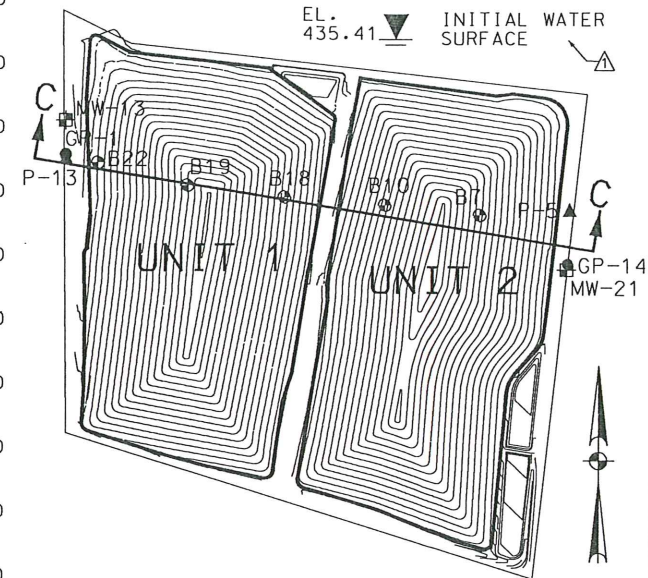




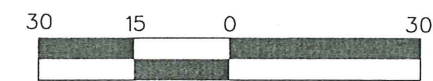
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EL. 438.61 STABILIZED WATER SURFACE (5/6/14)
 EL. 435.41 INITIAL WATER SURFACE



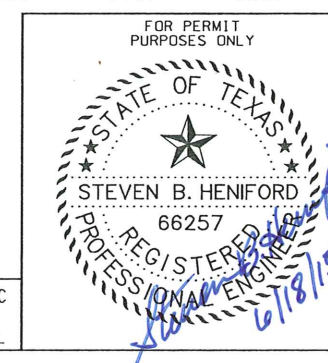
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- P-2 PIEZOMETER (PLUGGED)
- MW-6 GW MONITOR WELL
- GP-8R GAS PROBE
- GW#1 GAS COLLECTION WELL



SCALE FEET
VERTICAL

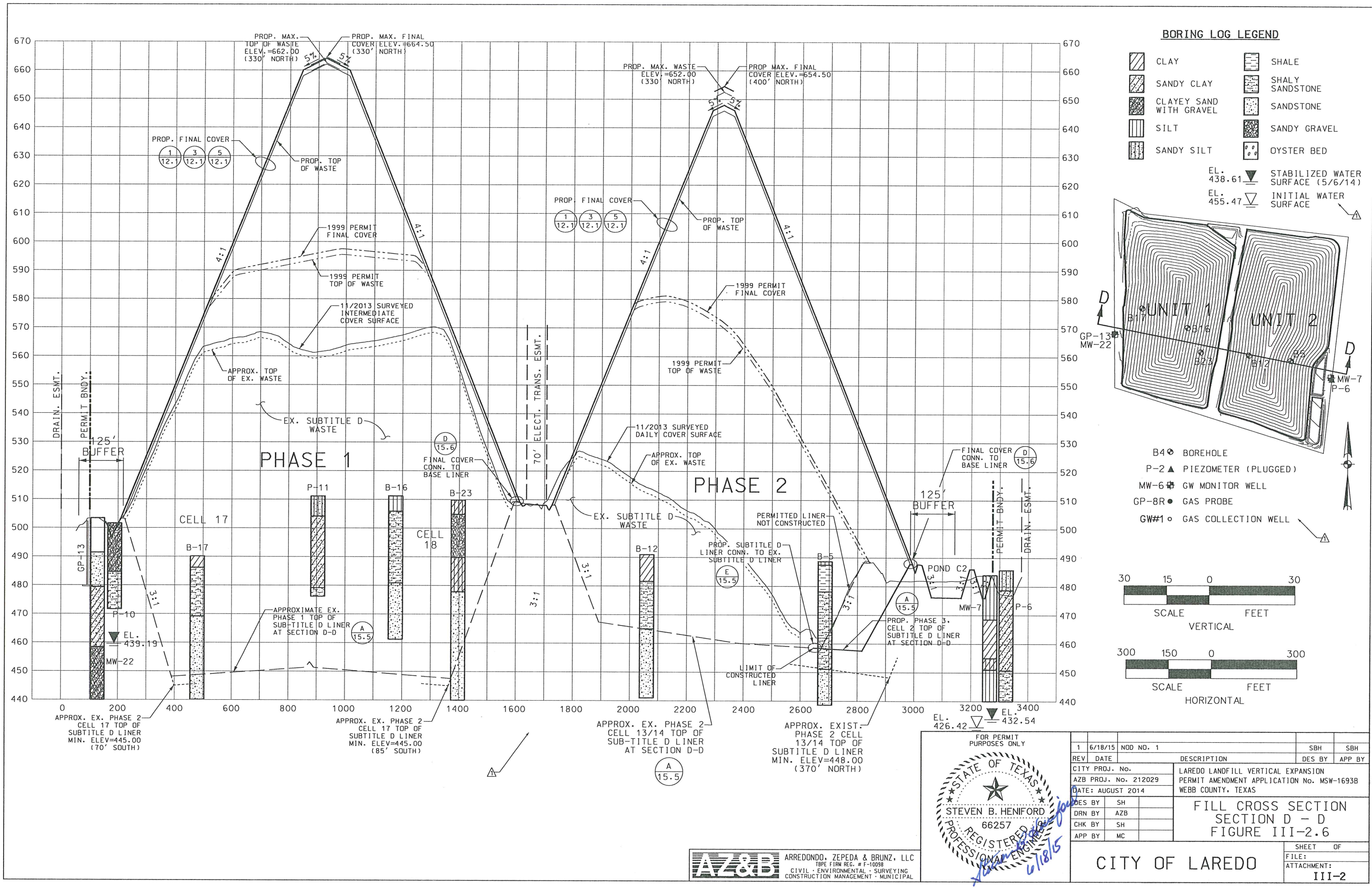


SCALE FEET
HORIZONTAL



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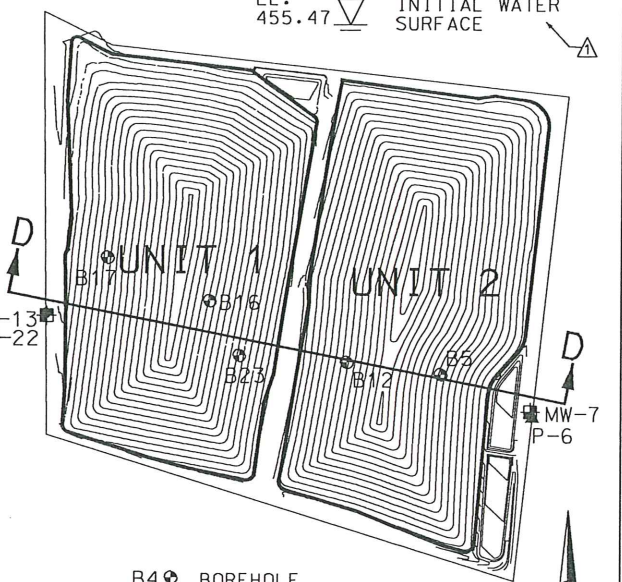
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DATE: AUGUST 2014		WEBB COUNTY, TEXAS		
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FILL CROSS SECTION SECTION C - C FIGURE III-2.5				
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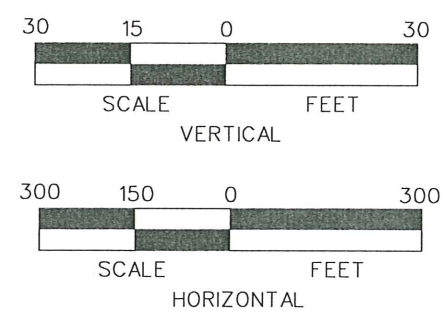
BORING LOG LEGEND

- | | |
|-------------------------|-----------------|
| CLAY | SHALE |
| SANDY CLAY | SHALY SANDSTONE |
| CLAYEY SAND WITH GRAVEL | SANDSTONE |
| SILT | SANDY GRAVEL |
| SANDY SILT | OYSTER BED |

EL. 438.61 ▽ STABILIZED WATER SURFACE (5/6/14)
EL. 455.47 ▽ INITIAL WATER SURFACE



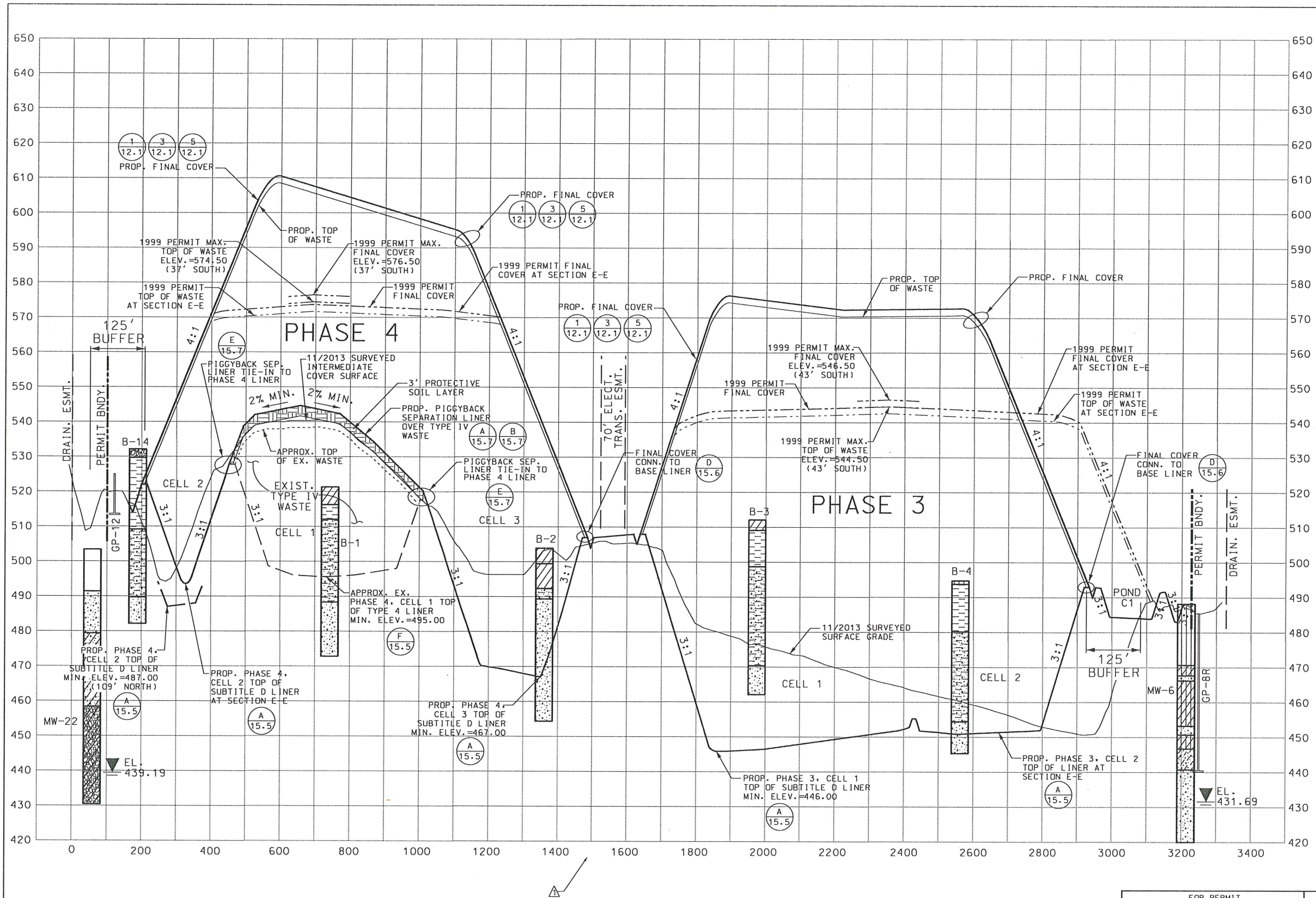
- B-4 BOREHOLE
P-2 PIEZOMETER (PLUGGED)
MW-6 GW MONITOR WELL
GP-8R GAS PROBE
GW#1 GAS COLLECTION WELL



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DATE: AUGUST 2014		WEBB COUNTY, TEXAS			
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DRN BY	AZB				
CHK BY	SH				
APP BY	MC				
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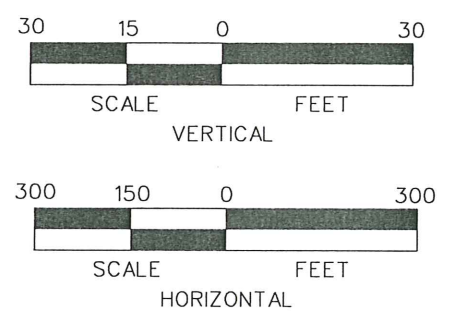
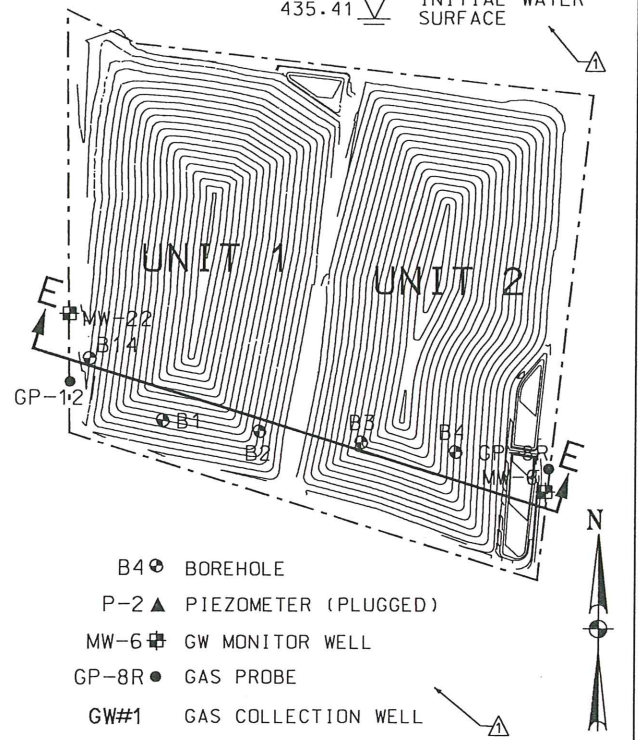


BORING LOG LEGEND

	CLAY		SHALE
	SANDY CLAY		SHALY SANDSTONE
	CLAYEY SAND WITH GRAVEL		SANDSTONE
	SILT		SANDY GRAVEL
	SANDY SILT		OYSTER BED

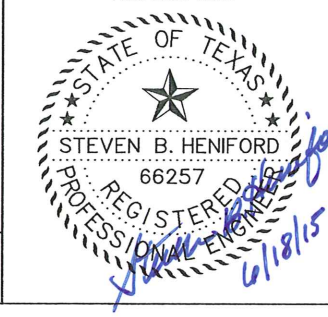
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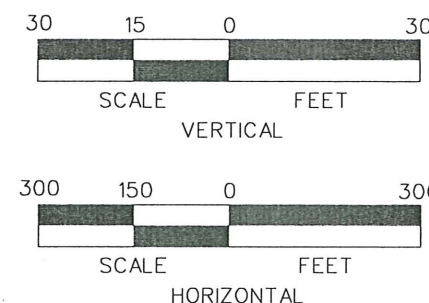
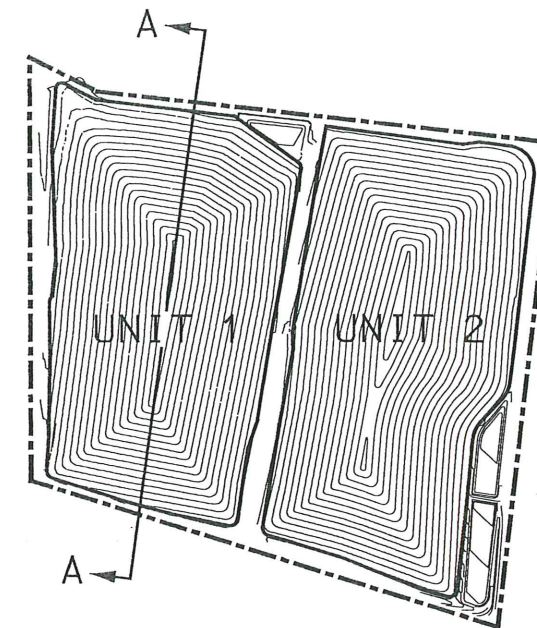
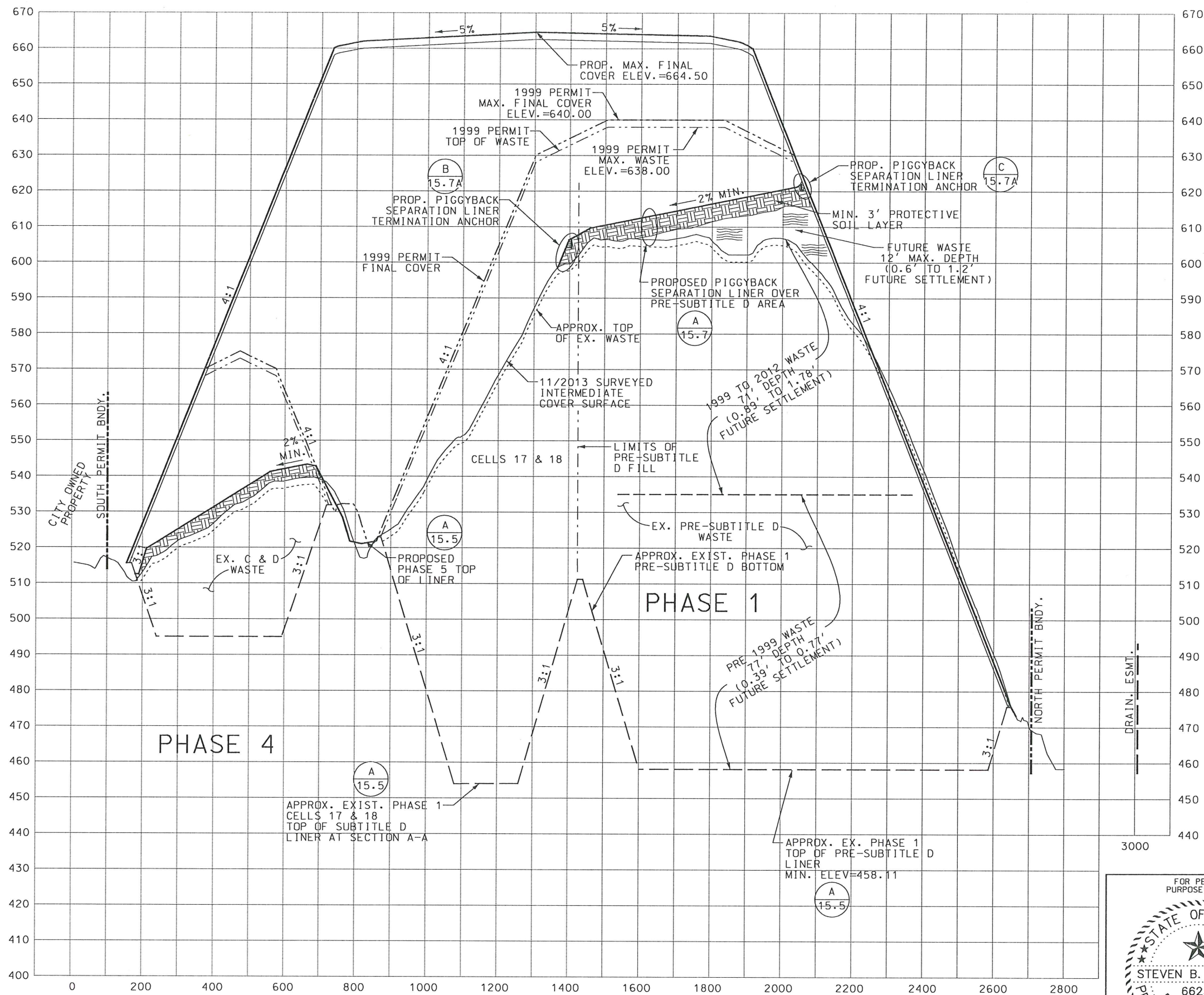
EL. 435.41 INITIAL WATER SURFACE



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DATE: AUGUST 2014			PERMIT AMENDMENT APPLICATION No. MSW-1693B		
				WEBB COUNTY, TEXAS	
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CHK BY	SH			FIGURE III-2.7	
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AZB PROJ. No. 212029	PERMIT AMENDMENT APPLICATION No. MSW-1693B				
DATE: AUGUST 2014	WEBB COUNTY, TEXAS				
DES BY	SH	PIGGYBACK SEPARATION LINER ANALYSIS SECTION			
CHK BY	AZB	FIGURE III-2.8			
APP BY	MC				
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		III-2			

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City of Laredo Landfill Permit Amendment 1693B
City of Laredo, Texas
Permit Amendment MSW Permit 1693B
Laredo, Texas
Webb County, Texas
August 2014
Revised June 2015

PART III
Attachment 6
Groundwater and Surface Water Protection
Plan and Drainage Plan

**LAREDO LANDFILL
PART III
Attachment 6
Groundwater and Surface Water Protection
Plan and Drainage Plan**

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Figure III-6.11: Channel A1 Plan and Profile, Sta. 17+00 to Sta. 19+31
Figure III-6.12: Channel B1 Plan and Profile

loss calculations in accordance with 30 TAC §330.305(d); refer to the calculations presented in Appendix 6B of this Part III, Attachment 6.

The drainage terrace channels will be sloped at approximately three (3) percent toward the rundown channels. This slope was designed to prevent the flow in the drainage terraces from scouring the final cover soil due to high velocities. Shear stress analysis as described in the section below, 3.3.2 Drainage Ditch Design, was used for the most severe case (highest velocity) to assure soil stability of the drainage terraces.

Rundown channels link the drainage terraces, carry the surface water run-off down the final cover, and discharge into the perimeter ditches or sedimentation ponds. The rundown channels are trapezoidal in shape with 2H: 1V sideslopes, a bottom width of 9 feet and a surface comprised of rock riprap contained within wire mesh cages called reno mattresses to control erosion by the expected high velocities. The rundown channels will be sloped at 25 percent down the side of the hills. Energy dissipation in the form of rock/concrete riprap or concrete channel lining will be provided at the end of rundown channels to minimize erosion of the perimeter ditches. Channel flow design analysis for the terraces and rundowns will be accomplished using Manning's equation for open channel flow. This equation is identified as Equation 6-2 in TxDOT's Hydraulic Design Manual and is represented as:

$$V = 1.486 / n \times R^{2/3} \times S^{1/2}$$

Where:

v = Velocity in fps

n = Manning's roughness coefficient (unitless)

R = Hydraulic Radius in feet = A / WP

WP = Wetted perimeter (the length of the channel boundary in direct contact with the water)

S = Slope of the energy grade line in ft./ft.

Flow (discharge) capacity is then determined by combining Manning's Equation with the Continuity Equation.

$$Q = v \times A$$

Where:

Q = discharge in cfs

A = Cross-sectional area of flow in square feet.

Detailed design calculations of the drainage terraces and rundown channels are provided in Appendix 6A, Drainage Structures – Design Calculations.

1.3.5 Working Face Run-on/Run-off Prevention

The working face will be protected from the 24-hour, 25-year event stormwater run-on by the channel along the south and east boundaries described in Section 1.1.2.

Protection from stormwater run-off will be achieved by the use of working face berms. These berms will be temporary in nature, moving in location and size as the working face moves through the disposal areas. As with other drainage control features, working face berms will be designed for the 25-year, 24-hour storm. They will be installed prior to commencing disposal activities or removing existing berms currently protecting waste disposal areas. Working face berms will direct run-off towards other drainage features designed to handle the expected flow rate. Run-off and run-on flow rates for these working face berms will be calculated using the Rational Method previously described since the drainage areas will be less than 200 acres. A typical working face berm cross section is provided on Figure III.6.8.

If any stormwater comes into contact with the working face, other waste or leachate, it will be considered as contaminated water/leachate and will be handled in accordance with TAC 330.207. The design and construction of each cell will be done in a manner where stormwater that becomes contaminated will flow under gravity to a separated collection sump for pumping into the leachate collection system or will flow directly into the leachate collection system. The size of the receiving sump or leachate facility shall be designed with the capacity to hold the expected runoff volume generated by the 24-hour, 25-year rainfall event for the contributing area.

1.3.6 Erosion Stability

Temporary and permanent erosion control measures during fill operations and post-closure are provided to prevent and reduce erosion and sediment transfer from the site. The final cover of the ~~hill tops-top domes~~ will have a maximum slope of 5.0% ~~to keep flow velocities to a minimum and sideslopes will have a maximum slope of 25% (4H:1V).~~ Overland flow velocities created by the proposed landfill design should be below the non-erosive velocity for similar soil and vegetative cover conditions. A typically used maximum non-erosive flow velocity for a similar sparsely vegetated intermediate cover condition is 4 feet per second (fps). For the final cover, the maximum non-erosive velocity is 3 fps based on a surface partially vegetated with short grass.

Overland sheet flow velocities were calculated for the worst case situation for the top domes and sideslopes. The methodology used to calculate the sheet flow velocities was as follows:

1. Determine 25-year, 24-hour peak flow rate for a standard unit width of one foot (1-ft.) using the Rational Method as specified in TxDOT's Hydraulic Design manual and described in Section 1.2.1 Rational Method Calculations.

2. Determine depth of flow using Manning's Equation presented in Section 1.3.1 Drainage Terrace and Rundown Channel Design and rearranging to solve for the flow depth, y
3. Calculate the peak flow velocity using the Continuity Equation identified as $V=q/A$, where:
 - a. V = Peak Velocity (fps)
 - b. q = Peak Flow for 1-ft. unit width.
 - c. A = Cross sectional area of a 1-ft. unit width, or the flow depth, y in this case.

The calculated velocities will then be compared to the maximum non-erosive velocities to check that erosive conditions are not being created.

The worst case situation is where the longest overland flow length is experienced. For both the top dome and sideslopes in both the intermediate and final cover conditions, this occurs on the north face of the western finished hill. There, the maximum top dome flow length is 95 feet for each cover condition and the maximum sideslope flow length is 790 feet for the intermediate cover condition and 165 feet for the final cover. Using the methodology described above for the intermediate cover condition, the 5% top dome slope creates a maximum flow velocity of 0.82 fps and 3.08 fps for the 25% sideslope. Both of these calculated values are less than the 4 fps maximum non-erosive velocity for intermediate cover and are therefore acceptable. For the final cover condition, the 5% top dome slope creates a maximum flow velocity of 0.71 fps and 1.44 fps for the 25% sideslope. Both of these calculated values are less than the 3 fps maximum non-erosive velocity for the final cover and are therefore acceptable.
Sideslopes have been designed to minimize soil loss from erosion by placing permanent berms on the final cover slopes at 165-foot spacing (40-foot vertical and 160- ft horizontal) to create terraces that intercept the run-off. The calculations for overland sheet flow velocities are provided in Appendix 6A – Drainage Structures – Design Calculations.

These terraces will be designed with slopes that limit flow velocities to non-erosion causing values and will direct the runoff to lined rundown channels. The rundown channels will convey the run-off down into the perimeter ditch and sedimentation/retention pond systems. Locations of the terraces are shown on Figures III.6.5 and III.6.6. The perimeter ditches are also designed to control erosion by using slopes that convey the flow at lower velocities. Where ditch velocity generates a shear stress that exceeds 1.0 psf, the ditch will be concrete or rock rip-rap lined. At ditch flow line drops and pipe outfalls in un-lined ditches, rip-rap will be placed to minimize erosion. Sedimentation/detention ponds are strategically located on the site to detain flow from onsite areas and allow the capture of suspended sediments. A complete description of permanent erosion and sedimentation measures to be employed along with supporting calculations are presented in Appendix 6B of this attachment. Interim erosion control measures for phased development are discussed in Appendix 6B, Section 1.3 – Interim Conditions.

Proposed Rundown Channels

- Proposed Rundown Channel Time of Concentration Calculations
- Proposed Rundown Channel Runoff Calculations
- Proposed Rundown Channel Hydraulic Calculations

Proposed Channels

- Proposed Channel Time of Concentration Calculations
- Proposed Channel Runoff Calculations
- Proposed Channel Hydraulic Calculations
- Permissible Shear Stress Calculations for Proposed Channels

Proposed Storm Drains

- Proposed Storm Drain Time of Concentration and Runoff Calculations
- Proposed Storm Drain Hydraulic Calculations

Proposed Culvert 1 HY-8 Analysis

HEC-HMS Detention Pond Analyses Input & Output

Top Dome and Sideslope Velocity Calculations

1.5 Sequencing of Drainage Improvements

The landfill site has been in operation since 1986 and at this time has some of its drainage structures already constructed and in operation per the current permit. Some of these structures are identical or very similar to the proposed structures shown in this amendment. These identical or very similar existing features include Ponds A and B, and drainage channels A1, B1, B2, C1, and C3.

As indicated on the Site Development Plan, Stage 1 drawing, ongoing fill operations in Phase 2 will continue until filled approximately to the current permit's allowable height. No new drainage structures need to be constructed to accomplish this.

As shown on the Stage 2 drawing, Cell 1 of Phase 3 will be constructed. With this stage, the culvert across the entrance road, Culvert 1 and Channel D along the south and east boundaries will be constructed. Channel C4 and portions of Channel C5 will be constructed around the Cell 1 perimeter. Storm Drain 1 will be constructed in this stage even though it will not be utilized until later stages. The existing channel between Phases 2 and 3 will be maintained as well as existing Pond C.

Stage 3 includes fill operations in Cell 1 of Phase 3 while Phase 3, Cell 2 is constructed. With this stage, the remainder of Channel C5 along with Channels C6, C7 and C8 will be constructed. Pond C and the existing channel between Phases 2 and 3 will be removed and

Appendix 6A: Drainage Structures – Design Calculations

Revised June 2015

Pond A Input Data

Outlet Pipe

Type: 3 - 36" Diameter Corrugated Metal Pipes
Length: 50 Feet
Inlet Elev.: 475.00
Entrance Coeff.: 0.5
Outlet Elev.: 474.50
Exit Coeff.: 1.0
Mannings n: 0.024

Spillway

Elev: 479.00
Length: 20
Weir Coeff.: 3.0

Dam

Elev.: 480.00
Length: 50
Coeff.: 3.0

Area-Elev. Table	
Elev. (Feet)	Area (Acres)
475.0	0.0000
476.0	0.4007
477.0	0.5166
478.0	0.6779
479.0	0.7664
480.0	0.8844
481.0	0.9650

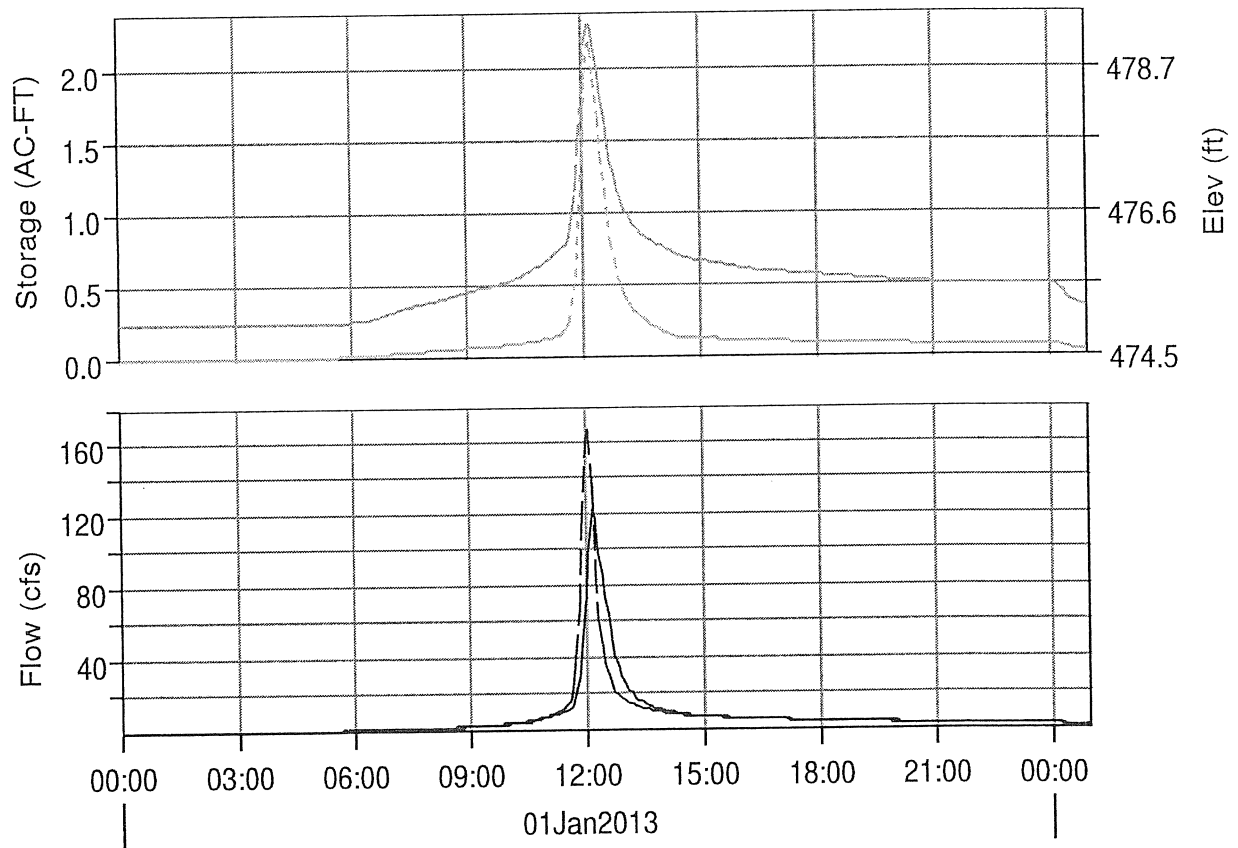
Project: Laredo Proposed
Simulation Run: 25 year Reservoir: Pond A
Start of Run: 01Jan2013, 00:00 Basin Model: Basin 1
End of Run: 02Jan2013, 00:55 Meteorologic Model: 25 year 24 hr
Compute Time: 17Sep2014, 11:13:14 Control Specifications: Control 1

Volume Units: IN

Computed Results

Peak Inflow :	167.7 (CFS)	Date/Time of Peak Inflow :	01Jan2013, 12:05
Peak Outflow :	122.3 (CFS)	Date/Time of Peak Outflow :	01Jan2013, 12:10
Total Inflow :	4.42 (IN)	Peak Storage :	2.2 (AC-FT)
Total Outflow :	4.41 (IN)	Peak Elevation :	479.3 (FT)

Reservoir "Pond A" Results for Run "25 year"



- Run:25 YEAR Element:POND A Result:Storage
- Run:25 YEAR Element:POND A Result:Pool Elevation
- Run:25 year Element:POND A Result:Outflow
- Run:25 YEAR Element:POND A Result:Combined Flow

Project: Laredo Proposed
Simulation Run: 25 year Reservoir: Pond A

Start of Run: 01Jan2013, 00:00 Basin Model: Basin 1
End of Run: 02Jan2013, 00:55 Meteorologic Model: 25 year 24
Compute Time: 17Sep2014, 11:13:14 Control Specifications: Contr

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	00:00	0.0	0.0	475.0	0.0
01Jan2013	00:05	0.0	0.0	475.0	0.0
01Jan2013	00:10	0.0	0.0	475.0	0.0
01Jan2013	00:15	0.0	0.0	475.0	0.0
01Jan2013	00:20	0.0	0.0	475.0	0.0
01Jan2013	00:25	0.0	0.0	475.0	0.0
01Jan2013	00:30	0.0	0.0	475.0	0.0
01Jan2013	00:35	0.0	0.0	475.0	0.0
01Jan2013	00:40	0.0	0.0	475.0	0.0
01Jan2013	00:45	0.0	0.0	475.0	0.0
01Jan2013	00:50	0.0	0.0	475.0	0.0
01Jan2013	00:55	0.0	0.0	475.0	0.0
01Jan2013	01:00	0.0	0.0	475.0	0.0
01Jan2013	01:05	0.0	0.0	475.0	0.0
01Jan2013	01:10	0.0	0.0	475.0	0.0
01Jan2013	01:15	0.0	0.0	475.0	0.0
01Jan2013	01:20	0.0	0.0	475.0	0.0
01Jan2013	01:25	0.0	0.0	475.0	0.0
01Jan2013	01:30	0.0	0.0	475.0	0.0
01Jan2013	01:35	0.0	0.0	475.0	0.0
01Jan2013	01:40	0.0	0.0	475.0	0.0
01Jan2013	01:45	0.0	0.0	475.0	0.0
01Jan2013	01:50	0.0	0.0	475.0	0.0
01Jan2013	01:55	0.0	0.0	475.0	0.0
01Jan2013	02:00	0.0	0.0	475.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	02:05	0.0	0.0	475.0	0.0
01Jan2013	02:10	0.0	0.0	475.0	0.0
01Jan2013	02:15	0.0	0.0	475.0	0.0
01Jan2013	02:20	0.0	0.0	475.0	0.0
01Jan2013	02:25	0.0	0.0	475.0	0.0
01Jan2013	02:30	0.0	0.0	475.0	0.0
01Jan2013	02:35	0.0	0.0	475.0	0.0
01Jan2013	02:40	0.0	0.0	475.0	0.0
01Jan2013	02:45	0.0	0.0	475.0	0.0
01Jan2013	02:50	0.0	0.0	475.0	0.0
01Jan2013	02:55	0.0	0.0	475.0	0.0
01Jan2013	03:00	0.0	0.0	475.0	0.0
01Jan2013	03:05	0.0	0.0	475.0	0.0
01Jan2013	03:10	0.0	0.0	475.0	0.0
01Jan2013	03:15	0.0	0.0	475.0	0.0
01Jan2013	03:20	0.0	0.0	475.0	0.0
01Jan2013	03:25	0.0	0.0	475.0	0.0
01Jan2013	03:30	0.0	0.0	475.0	0.0
01Jan2013	03:35	0.0	0.0	475.0	0.0
01Jan2013	03:40	0.0	0.0	475.0	0.0
01Jan2013	03:45	0.0	0.0	475.0	0.0
01Jan2013	03:50	0.0	0.0	475.0	0.0
01Jan2013	03:55	0.0	0.0	475.0	0.0
01Jan2013	04:00	0.0	0.0	475.0	0.0
01Jan2013	04:05	0.0	0.0	475.0	0.0
01Jan2013	04:10	0.0	0.0	475.0	0.0
01Jan2013	04:15	0.0	0.0	475.0	0.0
01Jan2013	04:20	0.0	0.0	475.0	0.0
01Jan2013	04:25	0.0	0.0	475.0	0.0
01Jan2013	04:30	0.0	0.0	475.0	0.0
01Jan2013	04:35	0.0	0.0	475.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	04:40	0.0	0.0	475.0	0.0
01Jan2013	04:45	0.0	0.0	475.0	0.0
01Jan2013	04:50	0.0	0.0	475.0	0.0
01Jan2013	04:55	0.0	0.0	475.0	0.0
01Jan2013	05:00	0.0	0.0	475.0	0.0
01Jan2013	05:05	0.0	0.0	475.0	0.0
01Jan2013	05:10	0.0	0.0	475.0	0.0
01Jan2013	05:15	0.0	0.0	475.0	0.0
01Jan2013	05:20	0.0	0.0	475.0	0.0
01Jan2013	05:25	0.0	0.0	475.0	0.0
01Jan2013	05:30	0.0	0.0	475.0	0.0
01Jan2013	05:35	0.0	0.0	475.0	0.0
01Jan2013	05:40	0.0	0.0	475.0	0.0
01Jan2013	05:45	0.0	0.0	475.0	0.0
01Jan2013	05:50	0.0	0.0	475.0	0.0
01Jan2013	05:55	0.0	0.0	475.0	0.0
01Jan2013	06:00	0.0	0.0	475.0	0.0
01Jan2013	06:05	0.1	0.0	475.0	0.0
01Jan2013	06:10	0.1	0.0	475.0	0.0
01Jan2013	06:15	0.1	0.0	475.0	0.0
01Jan2013	06:20	0.2	0.0	475.0	0.0
01Jan2013	06:25	0.2	0.0	475.0	0.0
01Jan2013	06:30	0.2	0.0	475.0	0.0
01Jan2013	06:35	0.3	0.0	475.1	0.0
01Jan2013	06:40	0.3	0.0	475.1	0.0
01Jan2013	06:45	0.3	0.0	475.1	0.1
01Jan2013	06:50	0.4	0.0	475.1	0.1
01Jan2013	06:55	0.4	0.0	475.1	0.1
01Jan2013	07:00	0.4	0.0	475.1	0.1
01Jan2013	07:05	0.5	0.0	475.1	0.2
01Jan2013	07:10	0.5	0.0	475.2	0.2

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	07:15	0.6	0.0	475.2	0.3
01Jan2013	07:20	0.6	0.0	475.2	0.3
01Jan2013	07:25	0.6	0.0	475.2	0.4
01Jan2013	07:30	0.7	0.0	475.2	0.4
01Jan2013	07:35	0.7	0.0	475.2	0.5
01Jan2013	07:40	0.8	0.0	475.2	0.5
01Jan2013	07:45	0.8	0.0	475.3	0.6
01Jan2013	07:50	0.8	0.0	475.3	0.6
01Jan2013	07:55	0.9	0.0	475.3	0.7
01Jan2013	08:00	0.9	0.0	475.3	0.7
01Jan2013	08:05	1.0	0.0	475.3	0.8
01Jan2013	08:10	1.0	0.0	475.3	0.8
01Jan2013	08:15	1.1	0.0	475.3	0.9
01Jan2013	08:20	1.2	0.0	475.3	1.0
01Jan2013	08:25	1.2	0.0	475.3	1.0
01Jan2013	08:30	1.3	0.0	475.3	1.1
01Jan2013	08:35	1.4	0.0	475.4	1.2
01Jan2013	08:40	1.5	0.0	475.4	1.3
01Jan2013	08:45	1.6	0.1	475.4	1.3
01Jan2013	08:50	1.7	0.1	475.4	1.4
01Jan2013	08:55	1.8	0.1	475.4	1.5
01Jan2013	09:00	1.9	0.1	475.4	1.6
01Jan2013	09:05	2.0	0.1	475.4	1.8
01Jan2013	09:10	2.1	0.1	475.5	1.9
01Jan2013	09:15	2.2	0.1	475.5	2.0
01Jan2013	09:20	2.3	0.1	475.5	2.1
01Jan2013	09:25	2.4	0.1	475.5	2.2
01Jan2013	09:30	2.4	0.1	475.5	2.3
01Jan2013	09:35	2.5	0.1	475.5	2.3
01Jan2013	09:40	2.6	0.1	475.5	2.4
01Jan2013	09:45	2.7	0.1	475.5	2.5

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	09:50	2.9	0.1	475.5	2.6
01Jan2013	09:55	3.0	0.1	475.5	2.7
01Jan2013	10:00	3.2	0.1	475.6	2.9
01Jan2013	10:05	3.4	0.1	475.6	3.0
01Jan2013	10:10	3.6	0.1	475.6	3.2
01Jan2013	10:15	3.8	0.1	475.6	3.4
01Jan2013	10:20	4.1	0.1	475.6	3.7
01Jan2013	10:25	4.3	0.1	475.7	3.9
01Jan2013	10:30	4.6	0.1	475.7	4.2
01Jan2013	10:35	4.9	0.1	475.7	4.4
01Jan2013	10:40	5.3	0.1	475.7	4.8
01Jan2013	10:45	5.7	0.1	475.8	5.1
01Jan2013	10:50	6.1	0.1	475.8	5.5
01Jan2013	10:55	6.6	0.1	475.8	6.0
01Jan2013	11:00	7.1	0.1	475.8	6.4
01Jan2013	11:05	7.7	0.1	475.9	7.0
01Jan2013	11:10	8.4	0.1	475.9	7.5
01Jan2013	11:15	9.2	0.1	476.0	8.3
01Jan2013	11:20	10.2	0.1	476.0	8.9
01Jan2013	11:25	11.4	0.1	476.0	9.3
01Jan2013	11:30	12.7	0.2	476.1	10.0
01Jan2013	11:35	15.2	0.2	476.1	10.9
01Jan2013	11:40	22.8	0.2	476.2	13.0
01Jan2013	11:45	38.7	0.3	476.5	17.9
01Jan2013	11:50	66.3	0.5	476.9	28.9
01Jan2013	11:55	112.2	0.9	477.5	47.4
01Jan2013	12:00	159.2	1.4	478.3	74.4
01Jan2013	12:05	167.7	1.9	479.0	99.8
01Jan2013	12:10	132.5	2.2	479.3	122.3
01Jan2013	12:15	90.0	2.1	479.3	116.8
01Jan2013	12:20	62.2	1.9	479.0	99.7

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	12:25	46.4	1.7	478.6	86.7
01Jan2013	12:30	36.2	1.4	478.3	73.7
01Jan2013	12:35	29.0	1.1	477.9	61.6
01Jan2013	12:40	24.0	0.9	477.6	50.3
01Jan2013	12:45	20.6	0.8	477.3	41.6
01Jan2013	12:50	18.3	0.7	477.1	35.0
01Jan2013	12:55	16.6	0.6	476.9	29.5
01Jan2013	13:00	15.3	0.5	476.7	25.0
01Jan2013	13:05	14.4	0.4	476.6	21.8
01Jan2013	13:10	13.5	0.4	476.5	19.4
01Jan2013	13:15	12.8	0.3	476.4	17.5
01Jan2013	13:20	12.2	0.3	476.4	16.1
01Jan2013	13:25	11.7	0.3	476.3	15.0
01Jan2013	13:30	11.2	0.3	476.3	14.0
01Jan2013	13:35	10.7	0.2	476.2	13.2
01Jan2013	13:40	10.2	0.2	476.2	12.5
01Jan2013	13:45	9.8	0.2	476.2	11.9
01Jan2013	13:50	9.5	0.2	476.1	11.3
01Jan2013	13:55	9.1	0.2	476.1	10.8
01Jan2013	14:00	8.7	0.2	476.1	10.4
01Jan2013	14:05	8.4	0.2	476.1	9.9
01Jan2013	14:10	8.1	0.2	476.0	9.5
01Jan2013	14:15	7.9	0.1	476.0	9.2
01Jan2013	14:20	7.7	0.1	476.0	8.9
01Jan2013	14:25	7.5	0.1	476.0	8.3
01Jan2013	14:30	7.4	0.1	475.9	7.8
01Jan2013	14:35	7.3	0.1	475.9	7.5
01Jan2013	14:40	7.1	0.1	475.9	7.3
01Jan2013	14:45	7.0	0.1	475.9	7.2
01Jan2013	14:50	6.9	0.1	475.9	7.1
01Jan2013	14:55	6.8	0.1	475.9	6.9

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	15:00	6.7	0.1	475.9	6.8
01Jan2013	15:05	6.6	0.1	475.9	6.7
01Jan2013	15:10	6.4	0.1	475.9	6.6
01Jan2013	15:15	6.3	0.1	475.9	6.5
01Jan2013	15:20	6.2	0.1	475.8	6.3
01Jan2013	15:25	6.1	0.1	475.8	6.2
01Jan2013	15:30	5.9	0.1	475.8	6.1
01Jan2013	15:35	5.8	0.1	475.8	6.0
01Jan2013	15:40	5.7	0.1	475.8	5.9
01Jan2013	15:45	5.6	0.1	475.8	5.7
01Jan2013	15:50	5.5	0.1	475.8	5.6
01Jan2013	15:55	5.4	0.1	475.8	5.5
01Jan2013	16:00	5.2	0.1	475.8	5.4
01Jan2013	16:05	5.1	0.1	475.8	5.3
01Jan2013	16:10	5.0	0.1	475.8	5.2
01Jan2013	16:15	4.9	0.1	475.7	5.0
01Jan2013	16:20	4.8	0.1	475.7	4.9
01Jan2013	16:25	4.8	0.1	475.7	4.9
01Jan2013	16:30	4.8	0.1	475.7	4.8
01Jan2013	16:35	4.7	0.1	475.7	4.8
01Jan2013	16:40	4.7	0.1	475.7	4.7
01Jan2013	16:45	4.6	0.1	475.7	4.7
01Jan2013	16:50	4.5	0.1	475.7	4.6
01Jan2013	16:55	4.5	0.1	475.7	4.6
01Jan2013	17:00	4.5	0.1	475.7	4.6
01Jan2013	17:05	4.5	0.1	475.7	4.5
01Jan2013	17:10	4.4	0.1	475.7	4.5
01Jan2013	17:15	4.3	0.1	475.7	4.4
01Jan2013	17:20	4.3	0.1	475.7	4.4
01Jan2013	17:25	4.2	0.1	475.7	4.3
01Jan2013	17:30	4.2	0.1	475.7	4.3

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	17:35	4.2	0.1	475.7	4.2
01Jan2013	17:40	4.2	0.1	475.7	4.2
01Jan2013	17:45	4.1	0.1	475.7	4.2
01Jan2013	17:50	4.0	0.1	475.7	4.1
01Jan2013	17:55	4.0	0.1	475.7	4.1
01Jan2013	18:00	4.0	0.1	475.7	4.0
01Jan2013	18:05	3.9	0.1	475.7	4.0
01Jan2013	18:10	3.9	0.1	475.7	4.0
01Jan2013	18:15	3.8	0.1	475.7	3.9
01Jan2013	18:20	3.8	0.1	475.7	3.9
01Jan2013	18:25	3.8	0.1	475.7	3.8
01Jan2013	18:30	3.7	0.1	475.6	3.8
01Jan2013	18:35	3.7	0.1	475.6	3.8
01Jan2013	18:40	3.6	0.1	475.6	3.7
01Jan2013	18:45	3.5	0.1	475.6	3.6
01Jan2013	18:50	3.5	0.1	475.6	3.6
01Jan2013	18:55	3.5	0.1	475.6	3.6
01Jan2013	19:00	3.5	0.1	475.6	3.5
01Jan2013	19:05	3.4	0.1	475.6	3.5
01Jan2013	19:10	3.3	0.1	475.6	3.4
01Jan2013	19:15	3.3	0.1	475.6	3.4
01Jan2013	19:20	3.3	0.1	475.6	3.3
01Jan2013	19:25	3.2	0.1	475.6	3.3
01Jan2013	19:30	3.2	0.1	475.6	3.3
01Jan2013	19:35	3.2	0.1	475.6	3.2
01Jan2013	19:40	3.1	0.1	475.6	3.2
01Jan2013	19:45	3.0	0.1	475.6	3.1
01Jan2013	19:50	3.0	0.1	475.6	3.1
01Jan2013	19:55	3.0	0.1	475.6	3.0
01Jan2013	20:00	2.9	0.1	475.6	3.0
01Jan2013	20:05	2.9	0.1	475.6	3.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	20:10	2.9	0.1	475.6	2.9
01Jan2013	20:15	2.8	0.1	475.6	2.9
01Jan2013	20:20	2.8	0.1	475.6	2.9
01Jan2013	20:25	2.8	0.1	475.6	2.8
01Jan2013	20:30	2.8	0.1	475.6	2.8
01Jan2013	20:35	2.7	0.1	475.6	2.8
01Jan2013	20:40	2.8	0.1	475.6	2.8
01Jan2013	20:45	2.8	0.1	475.6	2.8
01Jan2013	20:50	2.7	0.1	475.5	2.8
01Jan2013	20:55	2.7	0.1	475.5	2.7
01Jan2013	21:00	2.7	0.1	475.5	2.7
01Jan2013	21:05	2.7	0.1	475.5	2.7
01Jan2013	21:10	2.7	0.1	475.5	2.7
01Jan2013	21:15	2.7	0.1	475.5	2.7
01Jan2013	21:20	2.7	0.1	475.5	2.7
01Jan2013	21:25	2.7	0.1	475.5	2.7
01Jan2013	21:30	2.7	0.1	475.5	2.7
01Jan2013	21:35	2.7	0.1	475.5	2.7
01Jan2013	21:40	2.7	0.1	475.5	2.7
01Jan2013	21:45	2.7	0.1	475.5	2.7
01Jan2013	21:50	2.6	0.1	475.5	2.7
01Jan2013	21:55	2.6	0.1	475.5	2.6
01Jan2013	22:00	2.6	0.1	475.5	2.6
01Jan2013	22:05	2.6	0.1	475.5	2.6
01Jan2013	22:10	2.6	0.1	475.5	2.6
01Jan2013	22:15	2.6	0.1	475.5	2.6
01Jan2013	22:20	2.6	0.1	475.5	2.6
01Jan2013	22:25	2.6	0.1	475.5	2.6
01Jan2013	22:30	2.6	0.1	475.5	2.6
01Jan2013	22:35	2.5	0.1	475.5	2.6
01Jan2013	22:40	2.5	0.1	475.5	2.6

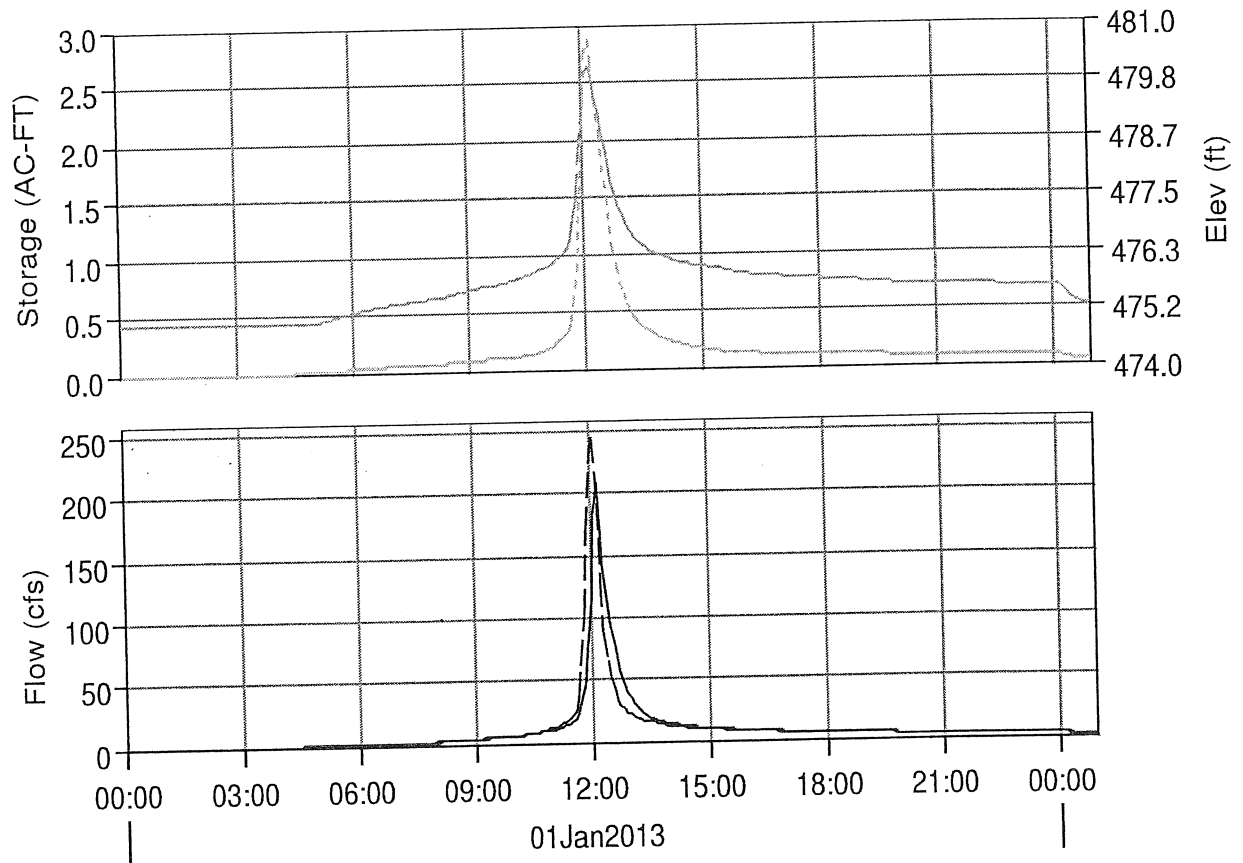
Project: Laredo Proposed
 Simulation Run: 100 year Reservoir: Pond A
 Start of Run: 01Jan2013, 00:00 Basin Model: Basin 1
 End of Run: 02Jan2013, 00:55 Meteorologic Model: 100 year 24 hr
 Compute Time: 17Sep2014, 11:11:16 Control Specifications: Control 1

Volume Units: IN

Computed Results

Peak Inflow :	245.2 (CFS)	Date/Time of Peak Inflow :	01Jan2013, 12:05
Peak Outflow :	209.7 (CFS)	Date/Time of Peak Outflow :	01Jan2013, 12:10
Total Inflow :	6.57 (IN)	Peak Storage :	2.9 (AC-FT)
Total Outflow :	6.57 (IN)	Peak Elevation :	480.1 (FT)

Reservoir "Pond A" Results for Run "100 year"



- Run:100 YEAR Element:POND A Result:Storage
- Run:100 YEAR Element:POND A Result:Pool Elevation
- Run:100 year Element:POND A Result:Outflow
- Run:100 YEAR Element:POND A Result:Combined Flow

Project: Laredo Proposed
Simulation Run: 100 year Reservoir: Pond A

Start of Run: 01Jan2013, 00:00 Basin Model: Basin 1
End of Run: 02Jan2013, 00:55 Meteorologic Model: 100 year 2
Compute Time: 17Sep2014, 11:11:16 Control Specifications: Control

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	00:00	0.0	0.0	475.0	0.0
01Jan2013	00:05	0.0	0.0	475.0	0.0
01Jan2013	00:10	0.0	0.0	475.0	0.0
01Jan2013	00:15	0.0	0.0	475.0	0.0
01Jan2013	00:20	0.0	0.0	475.0	0.0
01Jan2013	00:25	0.0	0.0	475.0	0.0
01Jan2013	00:30	0.0	0.0	475.0	0.0
01Jan2013	00:35	0.0	0.0	475.0	0.0
01Jan2013	00:40	0.0	0.0	475.0	0.0
01Jan2013	00:45	0.0	0.0	475.0	0.0
01Jan2013	00:50	0.0	0.0	475.0	0.0
01Jan2013	00:55	0.0	0.0	475.0	0.0
01Jan2013	01:00	0.0	0.0	475.0	0.0
01Jan2013	01:05	0.0	0.0	475.0	0.0
01Jan2013	01:10	0.0	0.0	475.0	0.0
01Jan2013	01:15	0.0	0.0	475.0	0.0
01Jan2013	01:20	0.0	0.0	475.0	0.0
01Jan2013	01:25	0.0	0.0	475.0	0.0
01Jan2013	01:30	0.0	0.0	475.0	0.0
01Jan2013	01:35	0.0	0.0	475.0	0.0
01Jan2013	01:40	0.0	0.0	475.0	0.0
01Jan2013	01:45	0.0	0.0	475.0	0.0
01Jan2013	01:50	0.0	0.0	475.0	0.0
01Jan2013	01:55	0.0	0.0	475.0	0.0
01Jan2013	02:00	0.0	0.0	475.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	02:05	0.0	0.0	475.0	0.0
01Jan2013	02:10	0.0	0.0	475.0	0.0
01Jan2013	02:15	0.0	0.0	475.0	0.0
01Jan2013	02:20	0.0	0.0	475.0	0.0
01Jan2013	02:25	0.0	0.0	475.0	0.0
01Jan2013	02:30	0.0	0.0	475.0	0.0
01Jan2013	02:35	0.0	0.0	475.0	0.0
01Jan2013	02:40	0.0	0.0	475.0	0.0
01Jan2013	02:45	0.0	0.0	475.0	0.0
01Jan2013	02:50	0.0	0.0	475.0	0.0
01Jan2013	02:55	0.0	0.0	475.0	0.0
01Jan2013	03:00	0.0	0.0	475.0	0.0
01Jan2013	03:05	0.0	0.0	475.0	0.0
01Jan2013	03:10	0.0	0.0	475.0	0.0
01Jan2013	03:15	0.0	0.0	475.0	0.0
01Jan2013	03:20	0.0	0.0	475.0	0.0
01Jan2013	03:25	0.0	0.0	475.0	0.0
01Jan2013	03:30	0.0	0.0	475.0	0.0
01Jan2013	03:35	0.0	0.0	475.0	0.0
01Jan2013	03:40	0.0	0.0	475.0	0.0
01Jan2013	03:45	0.0	0.0	475.0	0.0
01Jan2013	03:50	0.0	0.0	475.0	0.0
01Jan2013	03:55	0.0	0.0	475.0	0.0
01Jan2013	04:00	0.0	0.0	475.0	0.0
01Jan2013	04:05	0.0	0.0	475.0	0.0
01Jan2013	04:10	0.0	0.0	475.0	0.0
01Jan2013	04:15	0.0	0.0	475.0	0.0
01Jan2013	04:20	0.0	0.0	475.0	0.0
01Jan2013	04:25	0.0	0.0	475.0	0.0
01Jan2013	04:30	0.0	0.0	475.0	0.0
01Jan2013	04:35	0.0	0.0	475.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	07:15	1.6	0.1	475.4	1.4
01Jan2013	07:20	1.7	0.1	475.4	1.5
01Jan2013	07:25	1.7	0.1	475.4	1.6
01Jan2013	07:30	1.8	0.1	475.4	1.6
01Jan2013	07:35	1.9	0.1	475.4	1.7
01Jan2013	07:40	1.9	0.1	475.4	1.8
01Jan2013	07:45	2.0	0.1	475.4	1.8
01Jan2013	07:50	2.0	0.1	475.5	1.9
01Jan2013	07:55	2.1	0.1	475.5	2.0
01Jan2013	08:00	2.2	0.1	475.5	2.0
01Jan2013	08:05	2.3	0.1	475.5	2.1
01Jan2013	08:10	2.3	0.1	475.5	2.2
01Jan2013	08:15	2.4	0.1	475.5	2.2
01Jan2013	08:20	2.6	0.1	475.5	2.3
01Jan2013	08:25	2.7	0.1	475.5	2.5
01Jan2013	08:30	2.8	0.1	475.5	2.6
01Jan2013	08:35	3.0	0.1	475.5	2.7
01Jan2013	08:40	3.2	0.1	475.6	2.9
01Jan2013	08:45	3.3	0.1	475.6	3.0
01Jan2013	08:50	3.5	0.1	475.6	3.2
01Jan2013	08:55	3.7	0.1	475.6	3.4
01Jan2013	09:00	3.8	0.1	475.6	3.5
01Jan2013	09:05	4.0	0.1	475.6	3.7
01Jan2013	09:10	4.2	0.1	475.7	3.9
01Jan2013	09:15	4.3	0.1	475.7	4.1
01Jan2013	09:20	4.5	0.1	475.7	4.2
01Jan2013	09:25	4.6	0.1	475.7	4.4
01Jan2013	09:30	4.6	0.1	475.7	4.5
01Jan2013	09:35	4.7	0.1	475.7	4.6
01Jan2013	09:40	4.8	0.1	475.7	4.7
01Jan2013	09:45	5.0	0.1	475.7	4.8

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	09:50	5.3	0.1	475.7	5.0
01Jan2013	09:55	5.5	0.1	475.8	5.2
01Jan2013	10:00	5.8	0.1	475.8	5.4
01Jan2013	10:05	6.1	0.1	475.8	5.7
01Jan2013	10:10	6.4	0.1	475.8	6.0
01Jan2013	10:15	6.8	0.1	475.8	6.3
01Jan2013	10:20	7.2	0.1	475.9	6.7
01Jan2013	10:25	7.7	0.1	475.9	7.1
01Jan2013	10:30	8.1	0.1	475.9	7.5
01Jan2013	10:35	8.6	0.1	476.0	8.0
01Jan2013	10:40	9.1	0.1	476.0	8.5
01Jan2013	10:45	9.7	0.1	476.0	8.9
01Jan2013	10:50	10.4	0.1	476.0	9.1
01Jan2013	10:55	11.2	0.2	476.0	9.5
01Jan2013	11:00	12.0	0.2	476.1	10.0
01Jan2013	11:05	12.9	0.2	476.1	10.6
01Jan2013	11:10	13.9	0.2	476.1	11.3
01Jan2013	11:15	15.2	0.2	476.2	12.1
01Jan2013	11:20	16.8	0.2	476.2	13.1
01Jan2013	11:25	18.7	0.3	476.3	14.4
01Jan2013	11:30	20.6	0.3	476.4	15.8
01Jan2013	11:35	24.5	0.3	476.4	17.7
01Jan2013	11:40	36.3	0.4	476.6	21.5
01Jan2013	11:45	60.5	0.6	476.9	30.4
01Jan2013	11:50	101.8	0.9	477.5	45.7
01Jan2013	11:55	168.7	1.4	478.3	73.2
01Jan2013	12:00	235.4	2.1	479.3	116.0
01Jan2013	12:05	245.2	2.7	480.0	184.4
01Jan2013	12:10	192.5	2.9	480.1	209.7
01Jan2013	12:15	130.1	2.7	479.9	177.0
01Jan2013	12:20	89.5	2.4	479.5	139.3

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	12:25	66.6	2.0	479.2	109.3
01Jan2013	12:30	51.7	1.8	478.8	92.5
01Jan2013	12:35	41.3	1.5	478.4	79.3
01Jan2013	12:40	34.0	1.3	478.1	67.4
01Jan2013	12:45	29.2	1.0	477.8	56.2
01Jan2013	12:50	25.9	0.9	477.5	47.1
01Jan2013	12:55	23.4	0.8	477.3	40.2
01Jan2013	13:00	21.6	0.7	477.1	35.0
01Jan2013	13:05	20.3	0.6	477.0	30.7
01Jan2013	13:10	19.1	0.5	476.8	27.0
01Jan2013	13:15	18.1	0.5	476.7	24.2
01Jan2013	13:20	17.2	0.4	476.6	22.1
01Jan2013	13:25	16.5	0.4	476.6	20.5
01Jan2013	13:30	15.8	0.4	476.5	19.2
01Jan2013	13:35	15.1	0.3	476.5	18.1
01Jan2013	13:40	14.4	0.3	476.4	17.1
01Jan2013	13:45	13.8	0.3	476.4	16.2
01Jan2013	13:50	13.3	0.3	476.3	15.5
01Jan2013	13:55	12.8	0.3	476.3	14.8
01Jan2013	14:00	12.2	0.3	476.3	14.2
01Jan2013	14:05	11.8	0.3	476.3	13.6
01Jan2013	14:10	11.4	0.2	476.2	13.1
01Jan2013	14:15	11.1	0.2	476.2	12.6
01Jan2013	14:20	10.8	0.2	476.2	12.2
01Jan2013	14:25	10.5	0.2	476.2	11.8
01Jan2013	14:30	10.3	0.2	476.2	11.5
01Jan2013	14:35	10.2	0.2	476.1	11.2
01Jan2013	14:40	10.0	0.2	476.1	10.9
01Jan2013	14:45	9.9	0.2	476.1	10.7
01Jan2013	14:50	9.7	0.2	476.1	10.5
01Jan2013	14:55	9.5	0.2	476.1	10.3

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	15:00	9.4	0.2	476.1	10.1
01Jan2013	15:05	9.2	0.2	476.1	9.9
01Jan2013	15:10	9.0	0.2	476.1	9.7
01Jan2013	15:15	8.8	0.2	476.0	9.5
01Jan2013	15:20	8.7	0.1	476.0	9.3
01Jan2013	15:25	8.5	0.1	476.0	9.2
01Jan2013	15:30	8.3	0.1	476.0	9.0
01Jan2013	15:35	8.1	0.1	476.0	8.8
01Jan2013	15:40	8.0	0.1	476.0	8.4
01Jan2013	15:45	7.8	0.1	476.0	8.1
01Jan2013	15:50	7.7	0.1	475.9	7.9
01Jan2013	15:55	7.5	0.1	475.9	7.7
01Jan2013	16:00	7.3	0.1	475.9	7.6
01Jan2013	16:05	7.1	0.1	475.9	7.4
01Jan2013	16:10	7.0	0.1	475.9	7.2
01Jan2013	16:15	6.8	0.1	475.9	7.0
01Jan2013	16:20	6.7	0.1	475.9	6.9
01Jan2013	16:25	6.7	0.1	475.9	6.8
01Jan2013	16:30	6.7	0.1	475.9	6.7
01Jan2013	16:35	6.6	0.1	475.9	6.7
01Jan2013	16:40	6.5	0.1	475.9	6.6
01Jan2013	16:45	6.4	0.1	475.9	6.5
01Jan2013	16:50	6.4	0.1	475.9	6.5
01Jan2013	16:55	6.3	0.1	475.8	6.4
01Jan2013	17:00	6.3	0.1	475.8	6.4
01Jan2013	17:05	6.3	0.1	475.8	6.3
01Jan2013	17:10	6.1	0.1	475.8	6.3
01Jan2013	17:15	6.0	0.1	475.8	6.2
01Jan2013	17:20	6.0	0.1	475.8	6.1
01Jan2013	17:25	5.9	0.1	475.8	6.0
01Jan2013	17:30	5.9	0.1	475.8	5.9

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	17:35	5.9	0.1	475.8	5.9
01Jan2013	17:40	5.8	0.1	475.8	5.9
01Jan2013	17:45	5.8	0.1	475.8	5.8
01Jan2013	17:50	5.6	0.1	475.8	5.8
01Jan2013	17:55	5.5	0.1	475.8	5.7
01Jan2013	18:00	5.5	0.1	475.8	5.6
01Jan2013	18:05	5.5	0.1	475.8	5.6
01Jan2013	18:10	5.4	0.1	475.8	5.5
01Jan2013	18:15	5.3	0.1	475.8	5.4
01Jan2013	18:20	5.3	0.1	475.8	5.4
01Jan2013	18:25	5.3	0.1	475.8	5.3
01Jan2013	18:30	5.2	0.1	475.8	5.3
01Jan2013	18:35	5.1	0.1	475.8	5.2
01Jan2013	18:40	5.0	0.1	475.8	5.1
01Jan2013	18:45	4.9	0.1	475.7	5.0
01Jan2013	18:50	4.9	0.1	475.7	5.0
01Jan2013	18:55	4.9	0.1	475.7	5.0
01Jan2013	19:00	4.8	0.1	475.7	4.9
01Jan2013	19:05	4.7	0.1	475.7	4.8
01Jan2013	19:10	4.7	0.1	475.7	4.8
01Jan2013	19:15	4.6	0.1	475.7	4.7
01Jan2013	19:20	4.6	0.1	475.7	4.6
01Jan2013	19:25	4.5	0.1	475.7	4.6
01Jan2013	19:30	4.5	0.1	475.7	4.5
01Jan2013	19:35	4.4	0.1	475.7	4.5
01Jan2013	19:40	4.3	0.1	475.7	4.4
01Jan2013	19:45	4.2	0.1	475.7	4.3
01Jan2013	19:50	4.1	0.1	475.7	4.3
01Jan2013	19:55	4.1	0.1	475.7	4.2
01Jan2013	20:00	4.1	0.1	475.7	4.1
01Jan2013	20:05	4.0	0.1	475.7	4.1

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	20:10	4.0	0.1	475.7	4.1
01Jan2013	20:15	3.9	0.1	475.7	4.0
01Jan2013	20:20	3.9	0.1	475.7	4.0
01Jan2013	20:25	3.9	0.1	475.7	3.9
01Jan2013	20:30	3.9	0.1	475.7	3.9
01Jan2013	20:35	3.8	0.1	475.7	3.9
01Jan2013	20:40	3.8	0.1	475.7	3.8
01Jan2013	20:45	3.8	0.1	475.7	3.8
01Jan2013	20:50	3.8	0.1	475.7	3.8
01Jan2013	20:55	3.7	0.1	475.6	3.8
01Jan2013	21:00	3.7	0.1	475.6	3.8
01Jan2013	21:05	3.8	0.1	475.6	3.8
01Jan2013	21:10	3.8	0.1	475.6	3.8
01Jan2013	21:15	3.7	0.1	475.6	3.8
01Jan2013	21:20	3.7	0.1	475.6	3.7
01Jan2013	21:25	3.7	0.1	475.6	3.7
01Jan2013	21:30	3.7	0.1	475.6	3.7
01Jan2013	21:35	3.7	0.1	475.6	3.7
01Jan2013	21:40	3.7	0.1	475.6	3.7
01Jan2013	21:45	3.7	0.1	475.6	3.7
01Jan2013	21:50	3.7	0.1	475.6	3.7
01Jan2013	21:55	3.6	0.1	475.6	3.7
01Jan2013	22:00	3.6	0.1	475.6	3.7
01Jan2013	22:05	3.6	0.1	475.6	3.6
01Jan2013	22:10	3.6	0.1	475.6	3.6
01Jan2013	22:15	3.6	0.1	475.6	3.6
01Jan2013	22:20	3.6	0.1	475.6	3.6
01Jan2013	22:25	3.6	0.1	475.6	3.6
01Jan2013	22:30	3.6	0.1	475.6	3.6
01Jan2013	22:35	3.5	0.1	475.6	3.6
01Jan2013	22:40	3.5	0.1	475.6	3.5

Pond B Input Data

Outlet Pipe

Type:

1 - 36" Diameter Corrugated Metal StandPipe
(See Pond B Elevation-Discharge Calculations
for Standpipe Orifice Information)

Length:

109 Feet

Top Inlet Elev.:

477.00

Outlet Elev.:

469.00

Exit Coeff.:

1.0

Mannings n:

0.024

Spillway

Elev:

479.00

Length:

20

Weir Coeff.:

3.0

Dam

Elev.:

480.00

Length:

50

Coeff.:

3.0

Elev. - Discharge Table		
Elev. (Feet)	Discharge (cfs)	
470.0	0.0	
470.5	0.0	
471.0	0.7	
471.5	0.9	
472.0	1.2	
472.5	1.3	
473.0	2.2	
473.5	2.6	
474.0	2.9	
474.5	3.2	
475.0	4.2	
475.5	4.7	
476.0	5.1	
476.5	5.5	
477.0	5.9	
477.5	16.2	
478.0	34.8	
478.5	58.8	
479.0	87.1	
479.5	151.0	
480.0	274.6	
480.5	468.7	

Area-Elev. Table	
Elev. (Feet)	Area (Acres)
470.0	0.0000
471.0	0.6571
472.0	0.7371
473.0	0.7943
474.0	0.8620
475.0	0.9300
476.0	0.9959
478.0	1.1411
479.0	1.2321
480.0	1.3218
481.0	1.5000

POND B ELEVATION-DISCHARGE CALCULATIONS

Pond Flowline= 470.00 Orifice Flow Equation Wier L= 20 ft. Wier Flow Equation
 Orifice Coeff. C= 0.60 $q_x = C \times A \times (2 \times g \times h)^{0.5}$ Wier El.= 479 msl $Q = 3 \times L \times h^{1.5}$
 Orifice Size (in.)= 3.00 # orifices Wier SS= 10 :1

Orifice Elev. 1= 470.50 4 Stack Pipe Top Elev = 477.00 msl
 Orifice Elev. 2= 472.50 4 Stack Pipe Diam.= 3.00 ft.
 Orifice Elev. 3= 474.50 4

WS Elevation	ORIFICE CALCULATIONS							PIPE STACK CALCULATIONS		WIER CALCULATIONS		Total Q for Elev.
	h1	h2	h3	q1 (cfs)	q2 (cfs)	q3 (cfs)	Orifice Flow q _o (cfs)	Pipe Stack Head, h _p (ft)	Pipe Stack Flow, Q _p (cfs)	Wier Head h _w (ft)	Wier Flow Q _w (cfs)	
470.0	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
470.5	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
471.0	0.50	0.00	0.00	0.7	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.7
471.5	1.00	0.00	0.00	0.9	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.9
472.0	1.50	0.00	0.00	1.2	0.0	0.0	1.2	0.0	0.0	0.0	0.0	1.2
472.5	2.00	0.00	0.00	1.3	0.0	0.0	1.3	0.0	0.0	0.0	0.0	1.3
473.0	2.50	0.50	0.00	1.5	0.7	0.0	2.2	0.0	0.0	0.0	0.0	2.2
473.5	3.00	1.00	0.00	1.6	0.9	0.0	2.6	0.0	0.0	0.0	0.0	2.6
474.0	3.50	1.50	0.00	1.8	1.2	0.0	2.9	0.0	0.0	0.0	0.0	2.9
474.5	4.00	2.00	0.00	1.9	1.3	0.0	3.2	0.0	0.0	0.0	0.0	3.2
475.0	4.50	2.50	0.50	2.0	1.5	0.7	4.2	0.0	0.0	0.0	0.0	4.2
475.5	5.00	3.00	1.00	2.1	1.6	0.9	4.7	0.0	0.0	0.0	0.0	4.7
476.0	5.50	3.50	1.50	2.2	1.8	1.2	5.1	0.0	0.0	0.0	0.0	5.1
476.5	6.00	4.00	2.00	2.3	1.9	1.3	5.5	0.0	0.0	0.0	0.0	5.5
477.0	6.50	4.50	2.50	2.4	2.0	1.5	5.9	0.0	0.0	0.0	0.0	5.9
477.5	7.00	5.00	3.00	2.5	2.1	1.6	6.3	0.5	10.0	0.0	0.0	16.2
478.0	7.50	5.50	3.50	2.6	2.2	1.8	6.6	1.0	28.3	0.0	0.0	34.8
478.5	8.00	6.00	4.00	2.7	2.3	1.9	6.9	1.5	51.9	0.0	0.0	58.8
479.0	8.50	6.50	4.50	2.8	2.4	2.0	7.2	2.0	80.0	0.0	0.0	87.1
479.5	9.00	7.00	5.00	2.8	2.5	2.1	7.5	2.5	111.8	0.5	31.8	151.0
480.0	9.50	7.50	5.50	2.9	2.6	2.2	7.7	3.0	146.9	1.0	120.0	274.6
480.5	10.00	8.00	6.00	3.0	2.7	2.3	8.0	3.5	185.1	1.5	275.6	468.7

Orifice Calculations

h1 = height above orifices at Elev. 1
 h2 = height above orifices at Elev. 2
 h3 = height above orifices at Elev. 3
 q1 = flow into orifices at Elev. 1, $q_x = C \times A \times (2 \times g \times h1)^{0.5}$
 q2 = flow into orifices at Elev. 2, $q_x = C \times A \times (2 \times g \times h2)^{0.5}$
 q3 = flow into orifices at Elev. 3, $q_x = C \times A \times (2 \times g \times h3)^{0.5}$
 q_o= total orifice flow for that water surface elevation

Pipe Stack Calculations

h_p = surface water height above top of stack pipe
 Q_p = flow into top of stack pipe using weir equation

Weir Calculations

h_w = surface water height above weir flowline elev.
 Q_w = flow weir using weir equation

Total Q = Total flow through orifices, stack pipe and weir

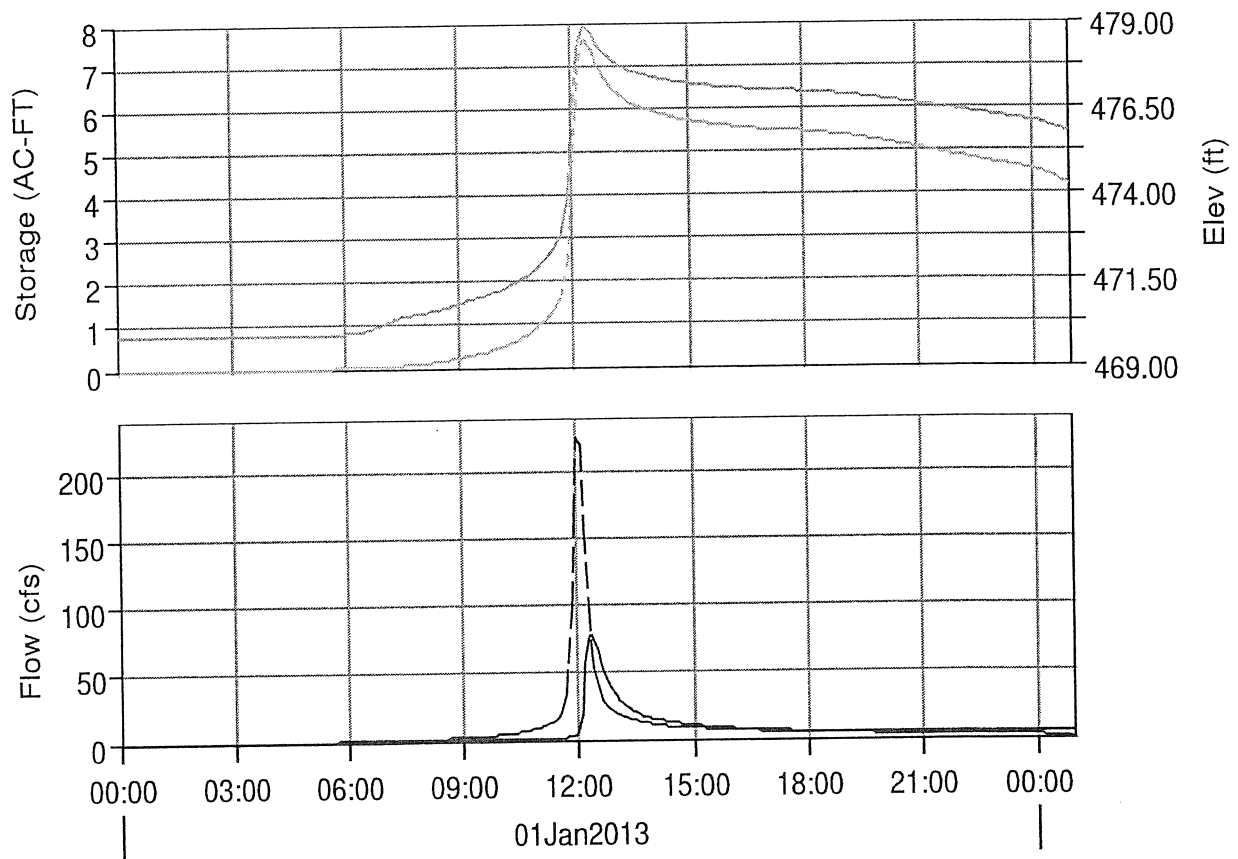
Project: Laredo Proposed
 Simulation Run: 25 year Reservoir: Pond B
 Start of Run: 01Jan2013, 00:00 Basin Model: Basin 1
 End of Run: 02Jan2013, 00:55 Meteorologic Model: 25 year 24 hr
 Compute Time: 17Sep2014, 11:13:14 Control Specifications: Control 1

Volume Units: IN

Computed Results

Peak Inflow :	224.4 (CFS)	Date/Time of Peak Inflow :	01Jan2013, 12:00
Peak Outflow :	79.0 (CFS)	Date/Time of Peak Outflow :	01Jan2013, 12:20
Total Inflow :	4.42 (IN)	Peak Storage :	7.6 (AC-FT)
Total Outflow :	3.30 (IN)	Peak Elevation :	478.9 (FT)

Reservoir "Pond B" Results for Run "25 year"



- - - - - Run:25 YEAR Element:POND B Result:Storage
- . - . - Run:25 YEAR Element:POND B Result:Pool Elevation
- Run:25 year Element:POND B Result:Outflow
- — — Run:25 YEAR Element:POND B Result:Combined Flow

Project: Laredo Proposed
Simulation Run: 25 year Reservoir: Pond B

Start of Run: 01Jan2013, 00:00 Basin Model: Basin 1
End of Run: 02Jan2013, 00:55 Meteorologic Model: 25 year 24
Compute Time: 17Sep2014, 11:13:14 Control Specifications: Contr

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	00:00	0.0	0.0	470.0	0.0
01Jan2013	00:05	0.0	0.0	470.0	0.0
01Jan2013	00:10	0.0	0.0	470.0	0.0
01Jan2013	00:15	0.0	0.0	470.0	0.0
01Jan2013	00:20	0.0	0.0	470.0	0.0
01Jan2013	00:25	0.0	0.0	470.0	0.0
01Jan2013	00:30	0.0	0.0	470.0	0.0
01Jan2013	00:35	0.0	0.0	470.0	0.0
01Jan2013	00:40	0.0	0.0	470.0	0.0
01Jan2013	00:45	0.0	0.0	470.0	0.0
01Jan2013	00:50	0.0	0.0	470.0	0.0
01Jan2013	00:55	0.0	0.0	470.0	0.0
01Jan2013	01:00	0.0	0.0	470.0	0.0
01Jan2013	01:05	0.0	0.0	470.0	0.0
01Jan2013	01:10	0.0	0.0	470.0	0.0
01Jan2013	01:15	0.0	0.0	470.0	0.0
01Jan2013	01:20	0.0	0.0	470.0	0.0
01Jan2013	01:25	0.0	0.0	470.0	0.0
01Jan2013	01:30	0.0	0.0	470.0	0.0
01Jan2013	01:35	0.0	0.0	470.0	0.0
01Jan2013	01:40	0.0	0.0	470.0	0.0
01Jan2013	01:45	0.0	0.0	470.0	0.0
01Jan2013	01:50	0.0	0.0	470.0	0.0
01Jan2013	01:55	0.0	0.0	470.0	0.0
01Jan2013	02:00	0.0	0.0	470.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	02:05	0.0	0.0	470.0	0.0
01Jan2013	02:10	0.0	0.0	470.0	0.0
01Jan2013	02:15	0.0	0.0	470.0	0.0
01Jan2013	02:20	0.0	0.0	470.0	0.0
01Jan2013	02:25	0.0	0.0	470.0	0.0
01Jan2013	02:30	0.0	0.0	470.0	0.0
01Jan2013	02:35	0.0	0.0	470.0	0.0
01Jan2013	02:40	0.0	0.0	470.0	0.0
01Jan2013	02:45	0.0	0.0	470.0	0.0
01Jan2013	02:50	0.0	0.0	470.0	0.0
01Jan2013	02:55	0.0	0.0	470.0	0.0
01Jan2013	03:00	0.0	0.0	470.0	0.0
01Jan2013	03:05	0.0	0.0	470.0	0.0
01Jan2013	03:10	0.0	0.0	470.0	0.0
01Jan2013	03:15	0.0	0.0	470.0	0.0
01Jan2013	03:20	0.0	0.0	470.0	0.0
01Jan2013	03:25	0.0	0.0	470.0	0.0
01Jan2013	03:30	0.0	0.0	470.0	0.0
01Jan2013	03:35	0.0	0.0	470.0	0.0
01Jan2013	03:40	0.0	0.0	470.0	0.0
01Jan2013	03:45	0.0	0.0	470.0	0.0
01Jan2013	03:50	0.0	0.0	470.0	0.0
01Jan2013	03:55	0.0	0.0	470.0	0.0
01Jan2013	04:00	0.0	0.0	470.0	0.0
01Jan2013	04:05	0.0	0.0	470.0	0.0
01Jan2013	04:10	0.0	0.0	470.0	0.0
01Jan2013	04:15	0.0	0.0	470.0	0.0
01Jan2013	04:20	0.0	0.0	470.0	0.0
01Jan2013	04:25	0.0	0.0	470.0	0.0
01Jan2013	04:30	0.0	0.0	470.0	0.0
01Jan2013	04:35	0.0	0.0	470.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	04:40	0.0	0.0	470.0	0.0
01Jan2013	04:45	0.0	0.0	470.0	0.0
01Jan2013	04:50	0.0	0.0	470.0	0.0
01Jan2013	04:55	0.0	0.0	470.0	0.0
01Jan2013	05:00	0.0	0.0	470.0	0.0
01Jan2013	05:05	0.0	0.0	470.0	0.0
01Jan2013	05:10	0.0	0.0	470.0	0.0
01Jan2013	05:15	0.0	0.0	470.0	0.0
01Jan2013	05:20	0.0	0.0	470.0	0.0
01Jan2013	05:25	0.0	0.0	470.0	0.0
01Jan2013	05:30	0.0	0.0	470.0	0.0
01Jan2013	05:35	0.0	0.0	470.0	0.0
01Jan2013	05:40	0.0	0.0	470.0	0.0
01Jan2013	05:45	0.0	0.0	470.0	0.0
01Jan2013	05:50	0.0	0.0	470.0	0.0
01Jan2013	05:55	0.0	0.0	470.0	0.0
01Jan2013	06:00	0.1	0.0	470.0	0.0
01Jan2013	06:05	0.1	0.0	470.0	0.0
01Jan2013	06:10	0.1	0.0	470.0	0.0
01Jan2013	06:15	0.2	0.0	470.0	0.0
01Jan2013	06:20	0.2	0.0	470.0	0.0
01Jan2013	06:25	0.3	0.0	470.1	0.0
01Jan2013	06:30	0.3	0.0	470.1	0.0
01Jan2013	06:35	0.4	0.0	470.1	0.0
01Jan2013	06:40	0.4	0.0	470.1	0.0
01Jan2013	06:45	0.5	0.0	470.1	0.0
01Jan2013	06:50	0.5	0.0	470.2	0.0
01Jan2013	06:55	0.5	0.0	470.2	0.0
01Jan2013	07:00	0.6	0.0	470.2	0.0
01Jan2013	07:05	0.7	0.0	470.3	0.0
01Jan2013	07:10	0.7	0.0	470.3	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	07:15	0.7	0.0	470.4	0.0
01Jan2013	07:20	0.8	0.0	470.4	0.0
01Jan2013	07:25	0.9	0.1	470.5	0.0
01Jan2013	07:30	0.9	0.1	470.5	0.0
01Jan2013	07:35	1.0	0.1	470.5	0.0
01Jan2013	07:40	1.0	0.1	470.5	0.0
01Jan2013	07:45	1.1	0.1	470.5	0.1
01Jan2013	07:50	1.1	0.1	470.6	0.1
01Jan2013	07:55	1.2	0.1	470.6	0.1
01Jan2013	08:00	1.2	0.1	470.6	0.1
01Jan2013	08:05	1.3	0.1	470.6	0.1
01Jan2013	08:10	1.3	0.1	470.6	0.2
01Jan2013	08:15	1.4	0.1	470.6	0.2
01Jan2013	08:20	1.5	0.1	470.7	0.2
01Jan2013	08:25	1.6	0.1	470.7	0.2
01Jan2013	08:30	1.7	0.2	470.7	0.3
01Jan2013	08:35	1.9	0.2	470.7	0.3
01Jan2013	08:40	2.0	0.2	470.7	0.3
01Jan2013	08:45	2.1	0.2	470.8	0.4
01Jan2013	08:50	2.3	0.2	470.8	0.4
01Jan2013	08:55	2.4	0.2	470.8	0.4
01Jan2013	09:00	2.5	0.2	470.8	0.5
01Jan2013	09:05	2.7	0.2	470.9	0.5
01Jan2013	09:10	2.8	0.3	470.9	0.6
01Jan2013	09:15	2.9	0.3	470.9	0.6
01Jan2013	09:20	3.0	0.3	471.0	0.7
01Jan2013	09:25	3.1	0.3	471.0	0.7
01Jan2013	09:30	3.2	0.3	471.0	0.7
01Jan2013	09:35	3.3	0.3	471.1	0.7
01Jan2013	09:40	3.4	0.4	471.1	0.7
01Jan2013	09:45	3.5	0.4	471.1	0.7

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	09:50	3.7	0.4	471.1	0.8
01Jan2013	09:55	4.0	0.4	471.2	0.8
01Jan2013	10:00	4.2	0.4	471.2	0.8
01Jan2013	10:05	4.4	0.5	471.2	0.8
01Jan2013	10:10	4.7	0.5	471.3	0.8
01Jan2013	10:15	5.0	0.5	471.3	0.8
01Jan2013	10:20	5.4	0.5	471.4	0.8
01Jan2013	10:25	5.7	0.6	471.4	0.9
01Jan2013	10:30	6.1	0.6	471.5	0.9
01Jan2013	10:35	6.5	0.6	471.5	0.9
01Jan2013	10:40	7.0	0.7	471.6	0.9
01Jan2013	10:45	7.5	0.7	471.6	1.0
01Jan2013	10:50	8.1	0.8	471.7	1.0
01Jan2013	10:55	8.7	0.8	471.8	1.1
01Jan2013	11:00	9.4	0.9	471.8	1.1
01Jan2013	11:05	10.2	0.9	471.9	1.2
01Jan2013	11:10	11.1	1.0	472.0	1.2
01Jan2013	11:15	12.2	1.1	472.1	1.2
01Jan2013	11:20	13.7	1.2	472.2	1.2
01Jan2013	11:25	15.3	1.3	472.3	1.3
01Jan2013	11:30	16.9	1.4	472.5	1.3
01Jan2013	11:35	20.8	1.5	472.6	1.5
01Jan2013	11:40	32.8	1.6	472.9	1.9
01Jan2013	11:45	56.5	1.9	473.2	2.4
01Jan2013	11:50	97.3	2.4	473.8	2.8
01Jan2013	11:55	163.8	3.3	474.8	3.9
01Jan2013	12:00	224.4	4.6	476.2	5.2
01Jan2013	12:05	219.0	6.1	477.5	18.0
01Jan2013	12:10	157.0	7.1	478.5	56.7
01Jan2013	12:15	100.7	7.5	478.8	76.5
01Jan2013	12:20	70.2	7.6	478.9	79.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	12:25	52.8	7.5	478.8	74.1
01Jan2013	12:30	41.6	7.3	478.6	66.6
01Jan2013	12:35	33.8	7.2	478.5	58.6
01Jan2013	12:40	28.3	7.0	478.4	51.8
01Jan2013	12:45	24.7	6.8	478.2	45.5
01Jan2013	12:50	22.3	6.7	478.1	40.0
01Jan2013	12:55	20.6	6.6	478.0	35.4
01Jan2013	13:00	19.2	6.5	477.9	32.1
01Jan2013	13:05	18.1	6.4	477.9	29.4
01Jan2013	13:10	17.1	6.3	477.8	27.0
01Jan2013	13:15	16.2	6.3	477.7	24.8
01Jan2013	13:20	15.5	6.2	477.7	23.0
01Jan2013	13:25	14.8	6.2	477.6	21.4
01Jan2013	13:30	14.2	6.1	477.6	20.0
01Jan2013	13:35	13.6	6.1	477.6	18.7
01Jan2013	13:40	13.0	6.1	477.5	17.6
01Jan2013	13:45	12.5	6.0	477.5	16.6
01Jan2013	13:50	12.0	6.0	477.5	15.9
01Jan2013	13:55	11.6	6.0	477.5	15.4
01Jan2013	14:00	11.1	6.0	477.4	14.9
01Jan2013	14:05	10.7	5.9	477.4	14.4
01Jan2013	14:10	10.4	5.9	477.4	13.9
01Jan2013	14:15	10.1	5.9	477.4	13.5
01Jan2013	14:20	9.8	5.9	477.3	13.1
01Jan2013	14:25	9.6	5.8	477.3	12.6
01Jan2013	14:30	9.4	5.8	477.3	12.3
01Jan2013	14:35	9.3	5.8	477.3	11.9
01Jan2013	14:40	9.2	5.8	477.3	11.6
01Jan2013	14:45	9.0	5.8	477.3	11.3
01Jan2013	14:50	8.9	5.7	477.2	11.0
01Jan2013	14:55	8.7	5.7	477.2	10.7

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	15:00	8.6	5.7	477.2	10.5
01Jan2013	15:05	8.4	5.7	477.2	10.2
01Jan2013	15:10	8.2	5.7	477.2	10.0
01Jan2013	15:15	8.1	5.7	477.2	9.8
01Jan2013	15:20	7.9	5.7	477.2	9.5
01Jan2013	15:25	7.8	5.7	477.2	9.3
01Jan2013	15:30	7.6	5.6	477.2	9.1
01Jan2013	15:35	7.4	5.6	477.1	8.9
01Jan2013	15:40	7.3	5.6	477.1	8.7
01Jan2013	15:45	7.2	5.6	477.1	8.6
01Jan2013	15:50	7.1	5.6	477.1	8.4
01Jan2013	15:55	6.9	5.6	477.1	8.2
01Jan2013	16:00	6.7	5.6	477.1	8.0
01Jan2013	16:05	6.5	5.6	477.1	7.9
01Jan2013	16:10	6.4	5.6	477.1	7.7
01Jan2013	16:15	6.3	5.6	477.1	7.5
01Jan2013	16:20	6.2	5.6	477.1	7.4
01Jan2013	16:25	6.2	5.5	477.1	7.2
01Jan2013	16:30	6.2	5.5	477.1	7.1
01Jan2013	16:35	6.1	5.5	477.1	7.0
01Jan2013	16:40	6.0	5.5	477.0	6.9
01Jan2013	16:45	5.9	5.5	477.0	6.7
01Jan2013	16:50	5.8	5.5	477.0	6.6
01Jan2013	16:55	5.8	5.5	477.0	6.5
01Jan2013	17:00	5.8	5.5	477.0	6.5
01Jan2013	17:05	5.8	5.5	477.0	6.4
01Jan2013	17:10	5.6	5.5	477.0	6.3
01Jan2013	17:15	5.5	5.5	477.0	6.2
01Jan2013	17:20	5.5	5.5	477.0	6.1
01Jan2013	17:25	5.4	5.5	477.0	6.0
01Jan2013	17:30	5.4	5.5	477.0	6.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	17:35	5.4	5.5	477.0	5.9
01Jan2013	17:40	5.4	5.5	477.0	5.9
01Jan2013	17:45	5.3	5.5	477.0	5.9
01Jan2013	17:50	5.2	5.5	477.0	5.9
01Jan2013	17:55	5.1	5.5	477.0	5.9
01Jan2013	18:00	5.1	5.5	477.0	5.9
01Jan2013	18:05	5.1	5.5	477.0	5.9
01Jan2013	18:10	5.0	5.4	477.0	5.9
01Jan2013	18:15	4.9	5.4	477.0	5.9
01Jan2013	18:20	4.9	5.4	477.0	5.9
01Jan2013	18:25	4.9	5.4	476.9	5.9
01Jan2013	18:30	4.8	5.4	476.9	5.9
01Jan2013	18:35	4.7	5.4	476.9	5.8
01Jan2013	18:40	4.6	5.4	476.9	5.8
01Jan2013	18:45	4.6	5.4	476.9	5.8
01Jan2013	18:50	4.6	5.4	476.9	5.8
01Jan2013	18:55	4.5	5.4	476.9	5.8
01Jan2013	19:00	4.5	5.4	476.9	5.8
01Jan2013	19:05	4.3	5.4	476.9	5.8
01Jan2013	19:10	4.3	5.3	476.9	5.8
01Jan2013	19:15	4.3	5.3	476.9	5.8
01Jan2013	19:20	4.2	5.3	476.9	5.8
01Jan2013	19:25	4.2	5.3	476.8	5.8
01Jan2013	19:30	4.1	5.3	476.8	5.8
01Jan2013	19:35	4.1	5.3	476.8	5.8
01Jan2013	19:40	4.0	5.3	476.8	5.7
01Jan2013	19:45	3.9	5.3	476.8	5.7
01Jan2013	19:50	3.8	5.3	476.8	5.7
01Jan2013	19:55	3.8	5.2	476.8	5.7
01Jan2013	20:00	3.8	5.2	476.8	5.7
01Jan2013	20:05	3.7	5.2	476.7	5.7

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	20:10	3.7	5.2	476.7	5.7
01Jan2013	20:15	3.6	5.2	476.7	5.7
01Jan2013	20:20	3.6	5.2	476.7	5.7
01Jan2013	20:25	3.6	5.2	476.7	5.7
01Jan2013	20:30	3.6	5.1	476.7	5.6
01Jan2013	20:35	3.5	5.1	476.7	5.6
01Jan2013	20:40	3.6	5.1	476.7	5.6
01Jan2013	20:45	3.6	5.1	476.6	5.6
01Jan2013	20:50	3.5	5.1	476.6	5.6
01Jan2013	20:55	3.4	5.1	476.6	5.6
01Jan2013	21:00	3.5	5.1	476.6	5.6
01Jan2013	21:05	3.5	5.0	476.6	5.6
01Jan2013	21:10	3.5	5.0	476.6	5.6
01Jan2013	21:15	3.5	5.0	476.6	5.5
01Jan2013	21:20	3.4	5.0	476.5	5.5
01Jan2013	21:25	3.5	5.0	476.5	5.5
01Jan2013	21:30	3.4	5.0	476.5	5.5
01Jan2013	21:35	3.4	5.0	476.5	5.5
01Jan2013	21:40	3.5	4.9	476.5	5.5
01Jan2013	21:45	3.4	4.9	476.5	5.5
01Jan2013	21:50	3.4	4.9	476.5	5.5
01Jan2013	21:55	3.4	4.9	476.4	5.5
01Jan2013	22:00	3.3	4.9	476.4	5.4
01Jan2013	22:05	3.3	4.9	476.4	5.4
01Jan2013	22:10	3.3	4.9	476.4	5.4
01Jan2013	22:15	3.3	4.8	476.4	5.4
01Jan2013	22:20	3.3	4.8	476.4	5.4
01Jan2013	22:25	3.3	4.8	476.4	5.4
01Jan2013	22:30	3.3	4.8	476.3	5.4
01Jan2013	22:35	3.2	4.8	476.3	5.4
01Jan2013	22:40	3.2	4.8	476.3	5.4

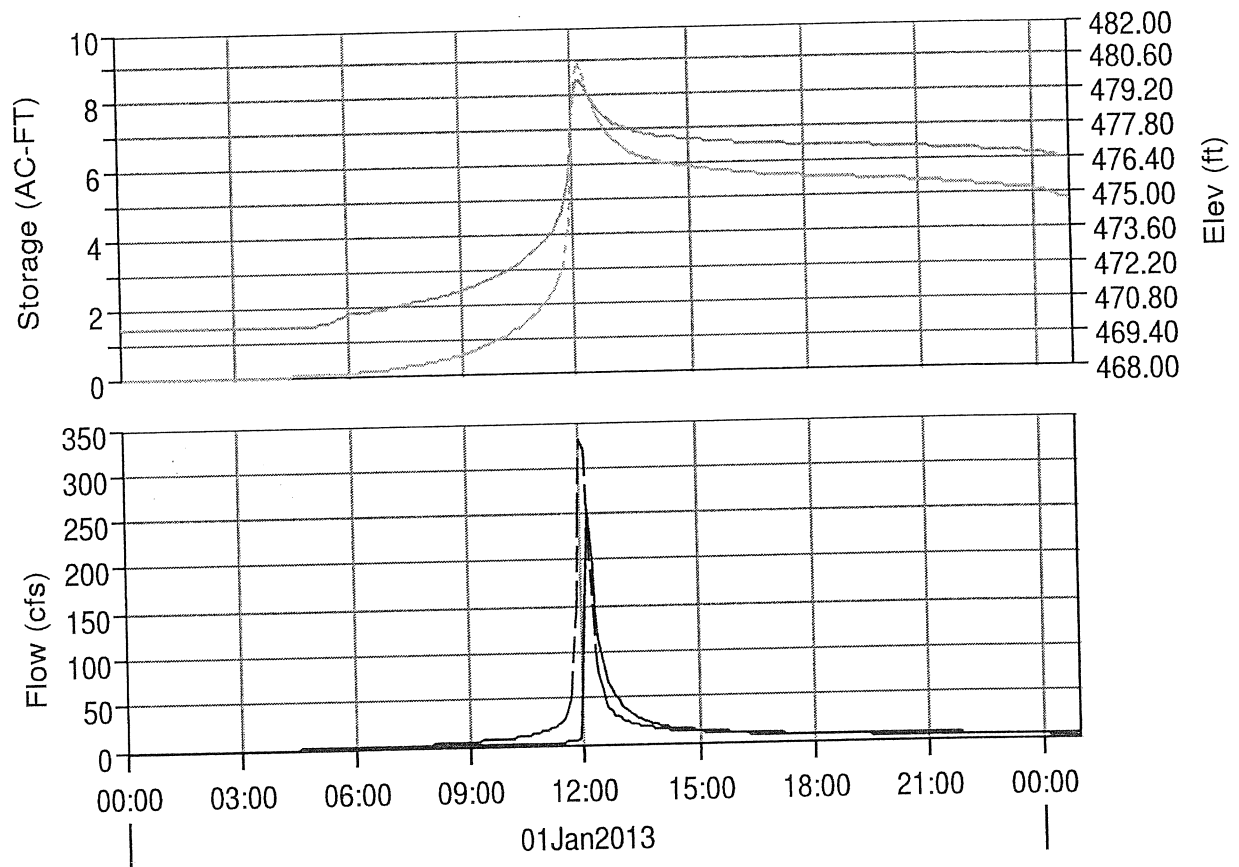
Project: Laredo Proposed
Simulation Run: 100 year Reservoir: Pond B
Start of Run: 01Jan2013, 00:00 Basin Model: Basin 1
End of Run: 02Jan2013, 00:55 Meteorologic Model: 100 year 24 hr
Compute Time: 17Sep2014, 11:11:16 Control Specifications: Control 1

Volume Units: IN

Computed Results

Peak Inflow :	330.5 (CFS)	Date/Time of Peak Inflow :	01Jan2013, 12:00
Peak Outflow :	257.0 (CFS)	Date/Time of Peak Outflow :	01Jan2013, 12:10
Total Inflow :	6.57 (IN)	Peak Storage :	9.0 (AC-FT)
Total Outflow :	5.30 (IN)	Peak Elevation :	479.9 (FT)

Reservoir "Pond B" Results for Run "100 year"



- Run:100 YEAR Element:POND B Result:Storage
- . - . - Run:100 YEAR Element:POND B Result:Pool Elevation
- Run:100 year Element:POND B Result:Outflow
- Run:100 YEAR Element:POND B Result:Combined Flow

Project: Laredo Proposed
Simulation Run: 100 year Reservoir: Pond B

Start of Run: 01Jan2013, 00:00 Basin Model: Basin 1
End of Run: 02Jan2013, 00:55 Meteorologic Model: 100 year 2
Compute Time: 17Sep2014, 11:11:16 Control Specifications: Control

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	00:00	0.0	0.0	470.0	0.0
01Jan2013	00:05	0.0	0.0	470.0	0.0
01Jan2013	00:10	0.0	0.0	470.0	0.0
01Jan2013	00:15	0.0	0.0	470.0	0.0
01Jan2013	00:20	0.0	0.0	470.0	0.0
01Jan2013	00:25	0.0	0.0	470.0	0.0
01Jan2013	00:30	0.0	0.0	470.0	0.0
01Jan2013	00:35	0.0	0.0	470.0	0.0
01Jan2013	00:40	0.0	0.0	470.0	0.0
01Jan2013	00:45	0.0	0.0	470.0	0.0
01Jan2013	00:50	0.0	0.0	470.0	0.0
01Jan2013	00:55	0.0	0.0	470.0	0.0
01Jan2013	01:00	0.0	0.0	470.0	0.0
01Jan2013	01:05	0.0	0.0	470.0	0.0
01Jan2013	01:10	0.0	0.0	470.0	0.0
01Jan2013	01:15	0.0	0.0	470.0	0.0
01Jan2013	01:20	0.0	0.0	470.0	0.0
01Jan2013	01:25	0.0	0.0	470.0	0.0
01Jan2013	01:30	0.0	0.0	470.0	0.0
01Jan2013	01:35	0.0	0.0	470.0	0.0
01Jan2013	01:40	0.0	0.0	470.0	0.0
01Jan2013	01:45	0.0	0.0	470.0	0.0
01Jan2013	01:50	0.0	0.0	470.0	0.0
01Jan2013	01:55	0.0	0.0	470.0	0.0
01Jan2013	02:00	0.0	0.0	470.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	02:05	0.0	0.0	470.0	0.0
01Jan2013	02:10	0.0	0.0	470.0	0.0
01Jan2013	02:15	0.0	0.0	470.0	0.0
01Jan2013	02:20	0.0	0.0	470.0	0.0
01Jan2013	02:25	0.0	0.0	470.0	0.0
01Jan2013	02:30	0.0	0.0	470.0	0.0
01Jan2013	02:35	0.0	0.0	470.0	0.0
01Jan2013	02:40	0.0	0.0	470.0	0.0
01Jan2013	02:45	0.0	0.0	470.0	0.0
01Jan2013	02:50	0.0	0.0	470.0	0.0
01Jan2013	02:55	0.0	0.0	470.0	0.0
01Jan2013	03:00	0.0	0.0	470.0	0.0
01Jan2013	03:05	0.0	0.0	470.0	0.0
01Jan2013	03:10	0.0	0.0	470.0	0.0
01Jan2013	03:15	0.0	0.0	470.0	0.0
01Jan2013	03:20	0.0	0.0	470.0	0.0
01Jan2013	03:25	0.0	0.0	470.0	0.0
01Jan2013	03:30	0.0	0.0	470.0	0.0
01Jan2013	03:35	0.0	0.0	470.0	0.0
01Jan2013	03:40	0.0	0.0	470.0	0.0
01Jan2013	03:45	0.0	0.0	470.0	0.0
01Jan2013	03:50	0.0	0.0	470.0	0.0
01Jan2013	03:55	0.0	0.0	470.0	0.0
01Jan2013	04:00	0.0	0.0	470.0	0.0
01Jan2013	04:05	0.0	0.0	470.0	0.0
01Jan2013	04:10	0.0	0.0	470.0	0.0
01Jan2013	04:15	0.0	0.0	470.0	0.0
01Jan2013	04:20	0.0	0.0	470.0	0.0
01Jan2013	04:25	0.0	0.0	470.0	0.0
01Jan2013	04:30	0.0	0.0	470.0	0.0
01Jan2013	04:35	0.0	0.0	470.0	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	04:40	0.0	0.0	470.0	0.0
01Jan2013	04:45	0.0	0.0	470.0	0.0
01Jan2013	04:50	0.1	0.0	470.0	0.0
01Jan2013	04:55	0.1	0.0	470.0	0.0
01Jan2013	05:00	0.2	0.0	470.0	0.0
01Jan2013	05:05	0.2	0.0	470.0	0.0
01Jan2013	05:10	0.3	0.0	470.1	0.0
01Jan2013	05:15	0.4	0.0	470.1	0.0
01Jan2013	05:20	0.4	0.0	470.1	0.0
01Jan2013	05:25	0.5	0.0	470.1	0.0
01Jan2013	05:30	0.6	0.0	470.2	0.0
01Jan2013	05:35	0.6	0.0	470.2	0.0
01Jan2013	05:40	0.7	0.0	470.2	0.0
01Jan2013	05:45	0.8	0.0	470.3	0.0
01Jan2013	05:50	0.8	0.0	470.3	0.0
01Jan2013	05:55	0.9	0.0	470.4	0.0
01Jan2013	06:00	1.0	0.0	470.4	0.0
01Jan2013	06:05	1.0	0.1	470.5	0.0
01Jan2013	06:10	1.1	0.1	470.5	0.0
01Jan2013	06:15	1.2	0.1	470.5	0.0
01Jan2013	06:20	1.3	0.1	470.5	0.1
01Jan2013	06:25	1.3	0.1	470.6	0.1
01Jan2013	06:30	1.4	0.1	470.6	0.1
01Jan2013	06:35	1.5	0.1	470.6	0.1
01Jan2013	06:40	1.6	0.1	470.6	0.2
01Jan2013	06:45	1.6	0.1	470.6	0.2
01Jan2013	06:50	1.7	0.1	470.7	0.2
01Jan2013	06:55	1.8	0.1	470.7	0.3
01Jan2013	07:00	1.9	0.2	470.7	0.3
01Jan2013	07:05	1.9	0.2	470.7	0.3
01Jan2013	07:10	2.0	0.2	470.8	0.4

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	07:15	2.1	0.2	470.8	0.4
01Jan2013	07:20	2.2	0.2	470.8	0.4
01Jan2013	07:25	2.3	0.2	470.8	0.5
01Jan2013	07:30	2.4	0.2	470.9	0.5
01Jan2013	07:35	2.4	0.2	470.9	0.5
01Jan2013	07:40	2.5	0.3	470.9	0.6
01Jan2013	07:45	2.6	0.3	470.9	0.6
01Jan2013	07:50	2.6	0.3	471.0	0.6
01Jan2013	07:55	2.7	0.3	471.0	0.7
01Jan2013	08:00	2.9	0.3	471.0	0.7
01Jan2013	08:05	2.9	0.3	471.0	0.7
01Jan2013	08:10	3.0	0.3	471.1	0.7
01Jan2013	08:15	3.2	0.4	471.1	0.7
01Jan2013	08:20	3.4	0.4	471.1	0.7
01Jan2013	08:25	3.6	0.4	471.1	0.8
01Jan2013	08:30	3.7	0.4	471.2	0.8
01Jan2013	08:35	3.9	0.4	471.2	0.8
01Jan2013	08:40	4.2	0.5	471.2	0.8
01Jan2013	08:45	4.4	0.5	471.3	0.8
01Jan2013	08:50	4.6	0.5	471.3	0.8
01Jan2013	08:55	4.8	0.5	471.3	0.8
01Jan2013	09:00	5.0	0.6	471.4	0.9
01Jan2013	09:05	5.3	0.6	471.4	0.9
01Jan2013	09:10	5.5	0.6	471.5	0.9
01Jan2013	09:15	5.7	0.7	471.5	0.9
01Jan2013	09:20	5.8	0.7	471.6	0.9
01Jan2013	09:25	5.9	0.7	471.6	1.0
01Jan2013	09:30	6.0	0.8	471.7	1.0
01Jan2013	09:35	6.1	0.8	471.7	1.0
01Jan2013	09:40	6.3	0.8	471.8	1.1
01Jan2013	09:45	6.5	0.9	471.8	1.1

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	09:50	6.9	0.9	471.9	1.1
01Jan2013	09:55	7.3	0.9	471.9	1.2
01Jan2013	10:00	7.6	1.0	472.0	1.2
01Jan2013	10:05	8.0	1.0	472.0	1.2
01Jan2013	10:10	8.4	1.1	472.1	1.2
01Jan2013	10:15	9.0	1.1	472.2	1.2
01Jan2013	10:20	9.5	1.2	472.3	1.3
01Jan2013	10:25	10.1	1.2	472.3	1.3
01Jan2013	10:30	10.6	1.3	472.4	1.3
01Jan2013	10:35	11.3	1.4	472.5	1.3
01Jan2013	10:40	12.0	1.4	472.6	1.5
01Jan2013	10:45	12.8	1.5	472.7	1.6
01Jan2013	10:50	13.8	1.6	472.8	1.8
01Jan2013	10:55	14.8	1.7	472.9	2.0
01Jan2013	11:00	15.8	1.8	473.0	2.2
01Jan2013	11:05	17.0	1.9	473.1	2.3
01Jan2013	11:10	18.5	2.0	473.3	2.4
01Jan2013	11:15	20.2	2.1	473.4	2.5
01Jan2013	11:20	22.4	2.2	473.6	2.6
01Jan2013	11:25	24.9	2.4	473.7	2.7
01Jan2013	11:30	27.4	2.5	473.9	2.9
01Jan2013	11:35	33.3	2.7	474.1	3.0
01Jan2013	11:40	51.9	3.0	474.5	3.2
01Jan2013	11:45	88.2	3.4	475.0	4.1
01Jan2013	11:50	148.8	4.2	475.8	4.9
01Jan2013	11:55	245.4	5.5	477.1	7.1
01Jan2013	12:00	330.5	7.3	478.6	64.2
01Jan2013	12:05	319.2	8.6	479.7	194.7
01Jan2013	12:10	227.5	9.0	479.9	257.0
01Jan2013	12:15	145.3	8.7	479.7	201.1
01Jan2013	12:20	100.8	8.3	479.4	143.3

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	12:25	75.5	8.0	479.2	114.6
01Jan2013	12:30	59.2	7.8	479.0	90.1
01Jan2013	12:35	48.0	7.6	478.8	78.6
01Jan2013	12:40	40.1	7.4	478.7	69.0
01Jan2013	12:45	35.0	7.2	478.5	60.3
01Jan2013	12:50	31.6	7.0	478.4	53.4
01Jan2013	12:55	29.1	6.9	478.3	47.7
01Jan2013	13:00	27.2	6.8	478.2	42.8
01Jan2013	13:05	25.5	6.7	478.1	38.7
01Jan2013	13:10	24.1	6.6	478.0	35.3
01Jan2013	13:15	22.9	6.5	477.9	32.8
01Jan2013	13:20	21.8	6.5	477.9	30.6
01Jan2013	13:25	20.9	6.4	477.8	28.7
01Jan2013	13:30	20.0	6.3	477.8	27.0
01Jan2013	13:35	19.1	6.3	477.8	25.5
01Jan2013	13:40	18.3	6.3	477.7	24.1
01Jan2013	13:45	17.6	6.2	477.7	22.8
01Jan2013	13:50	16.9	6.2	477.6	21.7
01Jan2013	13:55	16.3	6.2	477.6	20.7
01Jan2013	14:00	15.6	6.1	477.6	19.7
01Jan2013	14:05	15.0	6.1	477.6	18.8
01Jan2013	14:10	14.6	6.1	477.5	18.0
01Jan2013	14:15	14.2	6.1	477.5	17.2
01Jan2013	14:20	13.8	6.0	477.5	16.6
01Jan2013	14:25	13.5	6.0	477.5	16.1
01Jan2013	14:30	13.2	6.0	477.5	15.7
01Jan2013	14:35	13.1	6.0	477.5	15.4
01Jan2013	14:40	12.9	6.0	477.4	15.1
01Jan2013	14:45	12.7	5.9	477.4	14.8
01Jan2013	14:50	12.4	5.9	477.4	14.5
01Jan2013	14:55	12.2	5.9	477.4	14.3

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	15:00	12.0	5.9	477.4	14.0
01Jan2013	15:05	11.8	5.9	477.4	13.7
01Jan2013	15:10	11.5	5.9	477.4	13.5
01Jan2013	15:15	11.3	5.9	477.4	13.2
01Jan2013	15:20	11.1	5.9	477.3	13.0
01Jan2013	15:25	10.9	5.8	477.3	12.7
01Jan2013	15:30	10.6	5.8	477.3	12.5
01Jan2013	15:35	10.4	5.8	477.3	12.3
01Jan2013	15:40	10.2	5.8	477.3	12.0
01Jan2013	15:45	10.0	5.8	477.3	11.8
01Jan2013	15:50	9.9	5.8	477.3	11.6
01Jan2013	15:55	9.6	5.8	477.3	11.3
01Jan2013	16:00	9.4	5.8	477.3	11.1
01Jan2013	16:05	9.1	5.7	477.2	10.9
01Jan2013	16:10	8.9	5.7	477.2	10.7
01Jan2013	16:15	8.8	5.7	477.2	10.4
01Jan2013	16:20	8.6	5.7	477.2	10.2
01Jan2013	16:25	8.6	5.7	477.2	10.0
01Jan2013	16:30	8.6	5.7	477.2	9.8
01Jan2013	16:35	8.5	5.7	477.2	9.7
01Jan2013	16:40	8.4	5.7	477.2	9.5
01Jan2013	16:45	8.3	5.7	477.2	9.4
01Jan2013	16:50	8.2	5.7	477.2	9.2
01Jan2013	16:55	8.2	5.6	477.2	9.1
01Jan2013	17:00	8.2	5.6	477.2	9.0
01Jan2013	17:05	8.0	5.6	477.1	8.9
01Jan2013	17:10	7.9	5.6	477.1	8.8
01Jan2013	17:15	7.7	5.6	477.1	8.7
01Jan2013	17:20	7.7	5.6	477.1	8.5
01Jan2013	17:25	7.6	5.6	477.1	8.4
01Jan2013	17:30	7.5	5.6	477.1	8.3

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	17:35	7.6	5.6	477.1	8.2
01Jan2013	17:40	7.5	5.6	477.1	8.1
01Jan2013	17:45	7.4	5.6	477.1	8.1
01Jan2013	17:50	7.2	5.6	477.1	8.0
01Jan2013	17:55	7.1	5.6	477.1	7.9
01Jan2013	18:00	7.1	5.6	477.1	7.8
01Jan2013	18:05	7.1	5.6	477.1	7.7
01Jan2013	18:10	6.9	5.6	477.1	7.6
01Jan2013	18:15	6.8	5.6	477.1	7.5
01Jan2013	18:20	6.8	5.6	477.1	7.4
01Jan2013	18:25	6.8	5.6	477.1	7.4
01Jan2013	18:30	6.7	5.6	477.1	7.3
01Jan2013	18:35	6.5	5.5	477.1	7.2
01Jan2013	18:40	6.4	5.5	477.1	7.1
01Jan2013	18:45	6.4	5.5	477.1	7.0
01Jan2013	18:50	6.4	5.5	477.1	6.9
01Jan2013	18:55	6.3	5.5	477.0	6.9
01Jan2013	19:00	6.2	5.5	477.0	6.8
01Jan2013	19:05	6.0	5.5	477.0	6.7
01Jan2013	19:10	6.0	5.5	477.0	6.6
01Jan2013	19:15	5.9	5.5	477.0	6.5
01Jan2013	19:20	5.8	5.5	477.0	6.5
01Jan2013	19:25	5.8	5.5	477.0	6.4
01Jan2013	19:30	5.7	5.5	477.0	6.3
01Jan2013	19:35	5.6	5.5	477.0	6.2
01Jan2013	19:40	5.5	5.5	477.0	6.2
01Jan2013	19:45	5.4	5.5	477.0	6.1
01Jan2013	19:50	5.3	5.5	477.0	6.0
01Jan2013	19:55	5.3	5.5	477.0	5.9
01Jan2013	20:00	5.3	5.5	477.0	5.9
01Jan2013	20:05	5.2	5.5	477.0	5.9

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	20:10	5.1	5.5	477.0	5.9
01Jan2013	20:15	5.1	5.5	477.0	5.9
01Jan2013	20:20	5.0	5.5	477.0	5.9
01Jan2013	20:25	5.0	5.4	477.0	5.9
01Jan2013	20:30	5.0	5.4	477.0	5.9
01Jan2013	20:35	4.9	5.4	477.0	5.9
01Jan2013	20:40	4.9	5.4	477.0	5.9
01Jan2013	20:45	5.0	5.4	476.9	5.9
01Jan2013	20:50	4.9	5.4	476.9	5.9
01Jan2013	20:55	4.8	5.4	476.9	5.8
01Jan2013	21:00	4.8	5.4	476.9	5.8
01Jan2013	21:05	4.8	5.4	476.9	5.8
01Jan2013	21:10	4.9	5.4	476.9	5.8
01Jan2013	21:15	4.8	5.4	476.9	5.8
01Jan2013	21:20	4.8	5.4	476.9	5.8
01Jan2013	21:25	4.8	5.4	476.9	5.8
01Jan2013	21:30	4.8	5.4	476.9	5.8
01Jan2013	21:35	4.8	5.4	476.9	5.8
01Jan2013	21:40	4.8	5.3	476.9	5.8
01Jan2013	21:45	4.8	5.3	476.9	5.8
01Jan2013	21:50	4.7	5.3	476.9	5.8
01Jan2013	21:55	4.7	5.3	476.9	5.8
01Jan2013	22:00	4.7	5.3	476.8	5.8
01Jan2013	22:05	4.6	5.3	476.8	5.8
01Jan2013	22:10	4.6	5.3	476.8	5.8
01Jan2013	22:15	4.6	5.3	476.8	5.8
01Jan2013	22:20	4.6	5.3	476.8	5.8
01Jan2013	22:25	4.6	5.3	476.8	5.7
01Jan2013	22:30	4.6	5.3	476.8	5.7
01Jan2013	22:35	4.5	5.3	476.8	5.7
01Jan2013	22:40	4.5	5.3	476.8	5.7

Pond C1 Input Data

Outlet Pipe

Type: 1 - 36" Diameter Corrugated Metal Pipe
Length: 70 Feet
Inlet Elev.: 480.50
Entrance Coeff.: 0.5
Outlet Elev.: 480.00
Exit Coeff.: 0.5
Mannings n: 0.024

Spillway

Elev: 487.50
Length: 30
Weir Coeff.: 3.0

Dam

Elev.: 489.00
Length: 100
Coeff.: 3.0

Area-Elev. Table	
Elev. (Feet)	Area (Acres)
480.5	0.0000
481.0	0.2891
482.0	0.6820
483.0	1.0831
484.0	1.4924
485.0	1.8692
486.0	1.9983
487.0	2.1103
488.0	2.2190
489.0	2.4300
490.0	2.6500
491.0	2.7500

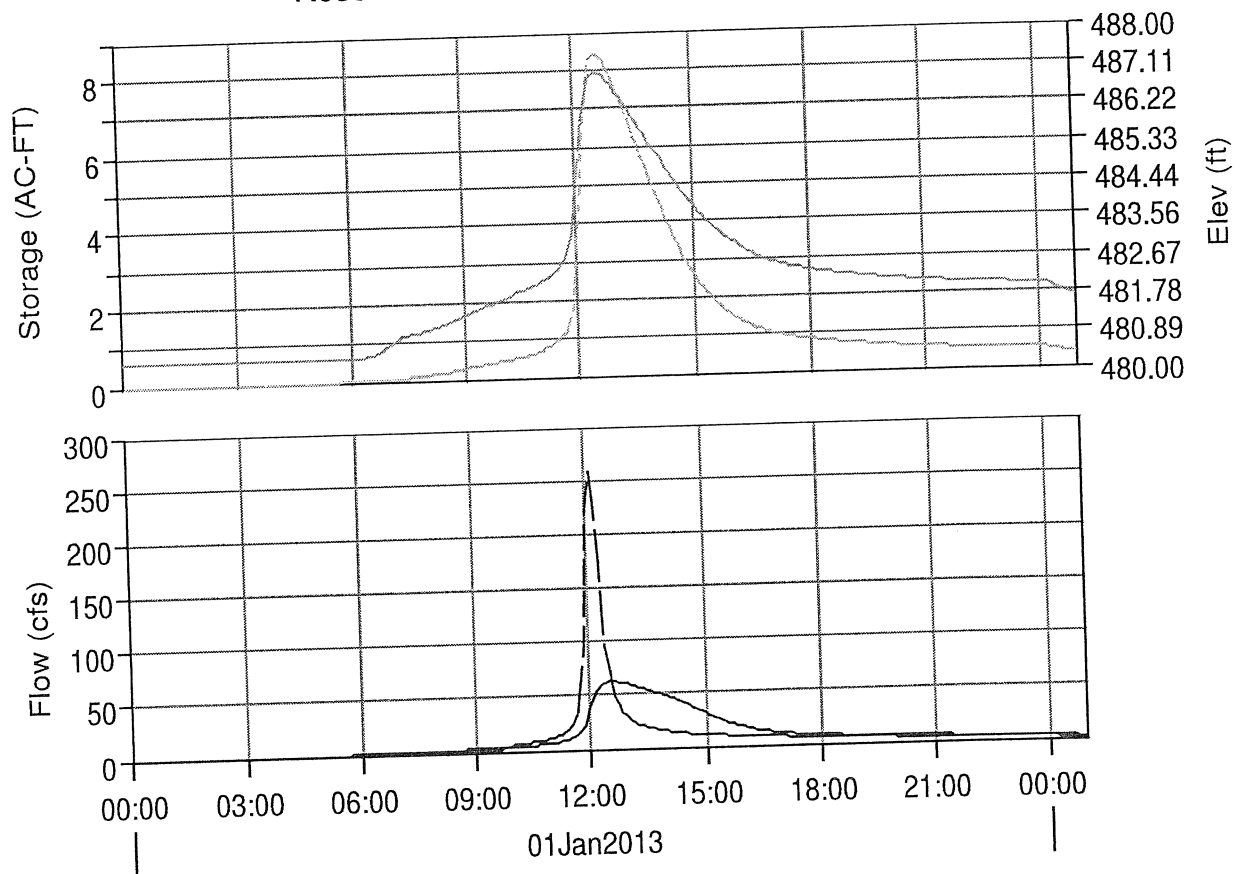
Project: Laredo Proposed
Simulation Run: 25 year Reservoir: Pond C1
Start of Run: 01Jan2013, 00:00 Basin Model: Basin 1
End of Run: 02Jan2013, 00:55 Meteorologic Model: 25 year 24 hr
Compute Time: 17Sep2014, 11:13:14 Control Specifications: Control 1

Volume Units: IN

Computed Results

Peak Inflow :	260.0 (CFS)	Date/Time of Peak Inflow :	01Jan2013, 12:05
Peak Outflow :	62.3 (CFS)	Date/Time of Peak Outflow :	01Jan2013, 12:35
Total Inflow :	4.42 (IN)	Peak Storage :	8.4 (AC-FT)
Total Outflow :	4.34 (IN)	Peak Elevation :	487.0 (FT)

Reservoir "Pond C1" Results for Run "25 year"



- Run:25 year Element:POND C1 Result:Storage
- Run:25 year Element:POND C1 Result:Pool Elevation
- Run:25 year Element:POND C1 Result:Outflow
- Run:25 year Element:POND C1 Result:Combined Flow

Project: Laredo Proposed
Simulation Run: 25 year Reservoir: Pond C1

Start of Run: 01Jan2013, 00:00 Basin Model: Basin 1
End of Run: 02Jan2013, 00:55 Meteorologic Model: 25 year 24
Compute Time: 17Sep2014, 11:13:14 Control Specifications: Contr

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	00:00	0.0	0.0	480.5	0.0
01Jan2013	00:05	0.0	0.0	480.5	0.0
01Jan2013	00:10	0.0	0.0	480.5	0.0
01Jan2013	00:15	0.0	0.0	480.5	0.0
01Jan2013	00:20	0.0	0.0	480.5	0.0
01Jan2013	00:25	0.0	0.0	480.5	0.0
01Jan2013	00:30	0.0	0.0	480.5	0.0
01Jan2013	00:35	0.0	0.0	480.5	0.0
01Jan2013	00:40	0.0	0.0	480.5	0.0
01Jan2013	00:45	0.0	0.0	480.5	0.0
01Jan2013	00:50	0.0	0.0	480.5	0.0
01Jan2013	00:55	0.0	0.0	480.5	0.0
01Jan2013	01:00	0.0	0.0	480.5	0.0
01Jan2013	01:05	0.0	0.0	480.5	0.0
01Jan2013	01:10	0.0	0.0	480.5	0.0
01Jan2013	01:15	0.0	0.0	480.5	0.0
01Jan2013	01:20	0.0	0.0	480.5	0.0
01Jan2013	01:25	0.0	0.0	480.5	0.0
01Jan2013	01:30	0.0	0.0	480.5	0.0
01Jan2013	01:35	0.0	0.0	480.5	0.0
01Jan2013	01:40	0.0	0.0	480.5	0.0
01Jan2013	01:45	0.0	0.0	480.5	0.0
01Jan2013	01:50	0.0	0.0	480.5	0.0
01Jan2013	01:55	0.0	0.0	480.5	0.0
01Jan2013	02:00	0.0	0.0	480.5	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	02:05	0.0	0.0	480.5	0.0
01Jan2013	02:10	0.0	0.0	480.5	0.0
01Jan2013	02:15	0.0	0.0	480.5	0.0
01Jan2013	02:20	0.0	0.0	480.5	0.0
01Jan2013	02:25	0.0	0.0	480.5	0.0
01Jan2013	02:30	0.0	0.0	480.5	0.0
01Jan2013	02:35	0.0	0.0	480.5	0.0
01Jan2013	02:40	0.0	0.0	480.5	0.0
01Jan2013	02:45	0.0	0.0	480.5	0.0
01Jan2013	02:50	0.0	0.0	480.5	0.0
01Jan2013	02:55	0.0	0.0	480.5	0.0
01Jan2013	03:00	0.0	0.0	480.5	0.0
01Jan2013	03:05	0.0	0.0	480.5	0.0
01Jan2013	03:10	0.0	0.0	480.5	0.0
01Jan2013	03:15	0.0	0.0	480.5	0.0
01Jan2013	03:20	0.0	0.0	480.5	0.0
01Jan2013	03:25	0.0	0.0	480.5	0.0
01Jan2013	03:30	0.0	0.0	480.5	0.0
01Jan2013	03:35	0.0	0.0	480.5	0.0
01Jan2013	03:40	0.0	0.0	480.5	0.0
01Jan2013	03:45	0.0	0.0	480.5	0.0
01Jan2013	03:50	0.0	0.0	480.5	0.0
01Jan2013	03:55	0.0	0.0	480.5	0.0
01Jan2013	04:00	0.0	0.0	480.5	0.0
01Jan2013	04:05	0.0	0.0	480.5	0.0
01Jan2013	04:10	0.0	0.0	480.5	0.0
01Jan2013	04:15	0.0	0.0	480.5	0.0
01Jan2013	04:20	0.0	0.0	480.5	0.0
01Jan2013	04:25	0.0	0.0	480.5	0.0
01Jan2013	04:30	0.0	0.0	480.5	0.0
01Jan2013	04:35	0.0	0.0	480.5	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	09:50	4.6	0.4	481.8	2.7
01Jan2013	09:55	4.9	0.4	481.8	2.9
01Jan2013	10:00	5.2	0.4	481.8	3.1
01Jan2013	10:05	5.5	0.5	481.9	3.3
01Jan2013	10:10	5.8	0.5	481.9	3.6
01Jan2013	10:15	6.2	0.5	481.9	3.8
01Jan2013	10:20	6.6	0.5	482.0	4.1
01Jan2013	10:25	7.0	0.5	482.0	4.4
01Jan2013	10:30	7.4	0.5	482.0	4.6
01Jan2013	10:35	7.9	0.6	482.0	4.8
01Jan2013	10:40	8.5	0.6	482.1	5.1
01Jan2013	10:45	9.1	0.6	482.1	5.3
01Jan2013	10:50	9.8	0.6	482.1	5.6
01Jan2013	10:55	10.6	0.7	482.2	6.0
01Jan2013	11:00	11.4	0.7	482.2	6.3
01Jan2013	11:05	12.3	0.7	482.2	6.8
01Jan2013	11:10	13.4	0.8	482.3	7.2
01Jan2013	11:15	14.6	0.8	482.3	7.8
01Jan2013	11:20	16.2	0.9	482.4	8.4
01Jan2013	11:25	18.0	0.9	482.5	9.2
01Jan2013	11:30	20.0	1.0	482.5	10.1
01Jan2013	11:35	23.4	1.1	482.6	11.1
01Jan2013	11:40	32.7	1.2	482.7	12.8
01Jan2013	11:45	52.7	1.4	483.0	15.8
01Jan2013	11:50	89.4	1.7	483.3	20.2
01Jan2013	11:55	151.3	2.4	483.8	28.3
01Jan2013	12:00	223.5	3.4	484.5	38.9
01Jan2013	12:05	260.0	4.8	485.2	47.4
01Jan2013	12:10	236.4	6.2	485.9	53.6
01Jan2013	12:15	180.2	7.2	486.5	57.7
01Jan2013	12:20	129.1	7.9	486.8	60.3

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	12:25	95.8	8.2	486.9	61.7
01Jan2013	12:30	74.2	8.4	487.0	62.2
01Jan2013	12:35	58.7	8.4	487.0	62.3
01Jan2013	12:40	47.7	8.4	487.0	62.2
01Jan2013	12:45	40.0	8.2	487.0	61.7
01Jan2013	12:50	34.7	8.1	486.9	61.1
01Jan2013	12:55	30.9	7.9	486.8	60.3
01Jan2013	13:00	27.9	7.7	486.7	59.5
01Jan2013	13:05	25.5	7.4	486.6	58.7
01Jan2013	13:10	23.7	7.2	486.5	57.7
01Jan2013	13:15	22.3	7.0	486.3	56.8
01Jan2013	13:20	21.1	6.7	486.2	55.8
01Jan2013	13:25	20.2	6.5	486.1	54.9
01Jan2013	13:30	19.3	6.3	486.0	53.9
01Jan2013	13:35	18.4	6.0	485.9	52.8
01Jan2013	13:40	17.6	5.8	485.7	51.8
01Jan2013	13:45	16.9	5.6	485.6	50.9
01Jan2013	13:50	16.2	5.3	485.5	49.8
01Jan2013	13:55	15.6	5.1	485.4	48.7
01Jan2013	14:00	15.0	4.9	485.3	47.7
01Jan2013	14:05	14.4	4.6	485.1	46.6
01Jan2013	14:10	13.9	4.4	485.0	45.6
01Jan2013	14:15	13.5	4.2	484.9	44.6
01Jan2013	14:20	13.1	4.0	484.8	43.2
01Jan2013	14:25	12.8	3.8	484.7	41.7
01Jan2013	14:30	12.5	3.6	484.5	40.1
01Jan2013	14:35	12.3	3.4	484.4	38.5
01Jan2013	14:40	12.1	3.2	484.3	37.0
01Jan2013	14:45	11.9	3.1	484.2	35.5
01Jan2013	14:50	11.7	2.9	484.1	34.1
01Jan2013	14:55	11.5	2.8	484.0	32.7

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	15:00	11.3	2.6	484.0	31.1
01Jan2013	15:05	11.1	2.5	483.9	29.5
01Jan2013	15:10	10.9	2.4	483.8	28.0
01Jan2013	15:15	10.7	2.3	483.7	26.6
01Jan2013	15:20	10.5	2.1	483.6	25.3
01Jan2013	15:25	10.3	2.0	483.5	24.1
01Jan2013	15:30	10.1	2.0	483.4	22.9
01Jan2013	15:35	9.8	1.9	483.4	21.9
01Jan2013	15:40	9.6	1.8	483.3	20.9
01Jan2013	15:45	9.5	1.7	483.2	20.0
01Jan2013	15:50	9.3	1.6	483.2	19.2
01Jan2013	15:55	9.1	1.6	483.1	18.4
01Jan2013	16:00	8.9	1.5	483.1	17.7
01Jan2013	16:05	8.6	1.5	483.0	17.0
01Jan2013	16:10	8.4	1.4	483.0	16.4
01Jan2013	16:15	8.3	1.3	482.9	15.5
01Jan2013	16:20	8.1	1.3	482.9	14.8
01Jan2013	16:25	8.1	1.3	482.8	14.1
01Jan2013	16:30	8.0	1.2	482.8	13.5
01Jan2013	16:35	8.0	1.2	482.8	12.9
01Jan2013	16:40	7.9	1.1	482.7	12.4
01Jan2013	16:45	7.8	1.1	482.7	12.0
01Jan2013	16:50	7.7	1.1	482.7	11.6
01Jan2013	16:55	7.6	1.1	482.6	11.2
01Jan2013	17:00	7.6	1.0	482.6	10.9
01Jan2013	17:05	7.5	1.0	482.6	10.6
01Jan2013	17:10	7.4	1.0	482.5	10.3
01Jan2013	17:15	7.3	1.0	482.5	10.0
01Jan2013	17:20	7.2	1.0	482.5	9.8
01Jan2013	17:25	7.1	0.9	482.5	9.5
01Jan2013	17:30	7.0	0.9	482.5	9.3

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	17:35	7.0	0.9	482.4	9.1
01Jan2013	17:40	7.0	0.9	482.4	8.9
01Jan2013	17:45	6.9	0.9	482.4	8.8
01Jan2013	17:50	6.8	0.9	482.4	8.6
01Jan2013	17:55	6.7	0.9	482.4	8.4
01Jan2013	18:00	6.7	0.9	482.4	8.3
01Jan2013	18:05	6.6	0.8	482.4	8.1
01Jan2013	18:10	6.5	0.8	482.4	8.0
01Jan2013	18:15	6.4	0.8	482.3	7.9
01Jan2013	18:20	6.4	0.8	482.3	7.8
01Jan2013	18:25	6.3	0.8	482.3	7.6
01Jan2013	18:30	6.3	0.8	482.3	7.5
01Jan2013	18:35	6.2	0.8	482.3	7.4
01Jan2013	18:40	6.0	0.8	482.3	7.3
01Jan2013	18:45	6.0	0.8	482.3	7.2
01Jan2013	18:50	5.9	0.8	482.3	7.1
01Jan2013	18:55	5.9	0.7	482.3	7.0
01Jan2013	19:00	5.8	0.7	482.3	6.9
01Jan2013	19:05	5.7	0.7	482.2	6.8
01Jan2013	19:10	5.6	0.7	482.2	6.8
01Jan2013	19:15	5.6	0.7	482.2	6.7
01Jan2013	19:20	5.5	0.7	482.2	6.6
01Jan2013	19:25	5.5	0.7	482.2	6.5
01Jan2013	19:30	5.4	0.7	482.2	6.4
01Jan2013	19:35	5.3	0.7	482.2	6.3
01Jan2013	19:40	5.2	0.7	482.2	6.3
01Jan2013	19:45	5.1	0.7	482.2	6.2
01Jan2013	19:50	5.0	0.7	482.2	6.1
01Jan2013	19:55	5.0	0.7	482.2	6.0
01Jan2013	20:00	4.9	0.7	482.2	5.9
01Jan2013	20:05	4.9	0.6	482.1	5.9

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	20:10	4.8	0.6	482.1	5.8
01Jan2013	20:15	4.8	0.6	482.1	5.7
01Jan2013	20:20	4.7	0.6	482.1	5.6
01Jan2013	20:25	4.6	0.6	482.1	5.6
01Jan2013	20:30	4.6	0.6	482.1	5.5
01Jan2013	20:35	4.6	0.6	482.1	5.4
01Jan2013	20:40	4.6	0.6	482.1	5.4
01Jan2013	20:45	4.6	0.6	482.1	5.3
01Jan2013	20:50	4.6	0.6	482.1	5.3
01Jan2013	20:55	4.5	0.6	482.1	5.2
01Jan2013	21:00	4.5	0.6	482.1	5.2
01Jan2013	21:05	4.5	0.6	482.1	5.1
01Jan2013	21:10	4.5	0.6	482.1	5.1
01Jan2013	21:15	4.5	0.6	482.1	5.0
01Jan2013	21:20	4.5	0.6	482.1	5.0
01Jan2013	21:25	4.5	0.6	482.1	5.0
01Jan2013	21:30	4.5	0.6	482.0	4.9
01Jan2013	21:35	4.5	0.6	482.0	4.9
01Jan2013	21:40	4.5	0.6	482.0	4.9
01Jan2013	21:45	4.5	0.6	482.0	4.8
01Jan2013	21:50	4.4	0.6	482.0	4.8
01Jan2013	21:55	4.4	0.5	482.0	4.8
01Jan2013	22:00	4.4	0.5	482.0	4.8
01Jan2013	22:05	4.3	0.5	482.0	4.7
01Jan2013	22:10	4.3	0.5	482.0	4.7
01Jan2013	22:15	4.3	0.5	482.0	4.7
01Jan2013	22:20	4.3	0.5	482.0	4.7
01Jan2013	22:25	4.3	0.5	482.0	4.6
01Jan2013	22:30	4.3	0.5	482.0	4.6
01Jan2013	22:35	4.2	0.5	482.0	4.6
01Jan2013	22:40	4.2	0.5	482.0	4.6

Project: Laredo Proposed
Simulation Run: 100 year Reservoir: Pond C1

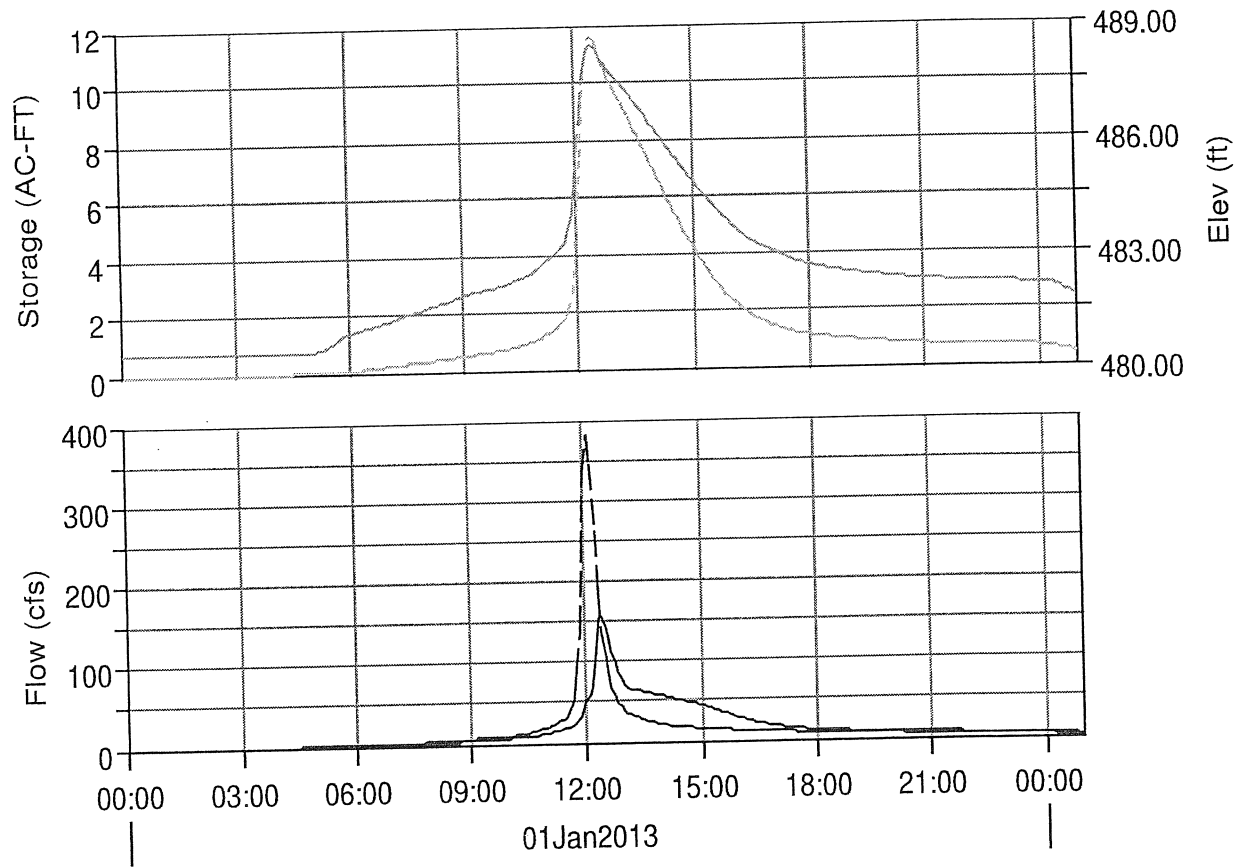
Start of Run:	01Jan2013, 00:00	Basin Model:	Basin 1
End of Run:	02Jan2013, 00:55	Meteorologic Model:	100 year 24 hr
Compute Time:	17Sep2014, 11:11:16	Control Specifications:	Control 1

Volume Units: IN

Computed Results

Peak Inflow :	382.2 (CFS)	Date/Time of Peak Inflow :	01Jan2013, 12:05
Peak Outflow :	156.9 (CFS)	Date/Time of Peak Outflow :	01Jan2013, 12:25
Total Inflow :	6.57 (IN)	Peak Storage :	11.6 (AC-FT)
Total Outflow :	6.49 (IN)	Peak Elevation :	488.5 (FT)

Reservoir "Pond C1" Results for Run "100 year"



- - - Run:100 YEAR Element:POND C1 Result:Storage
- - - Run:100 YEAR Element:POND C1 Result:Pool Elevation
- Run:100 year Element:POND C1 Result:Outflow
- - - Run:100 YEAR Element:POND C1 Result:Combined Flow

Project: Laredo Proposed
Simulation Run: 100 year Reservoir: Pond C1

Start of Run: 01Jan2013, 00:00 Basin Model: Basin 1
End of Run: 02Jan2013, 00:55 Meteorologic Model: 100 year 2
Compute Time: 17Sep2014, 11:11:16 Control Specifications: Contr

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	00:00	0.0	0.0	480.5	0.0
01Jan2013	00:05	0.0	0.0	480.5	0.0
01Jan2013	00:10	0.0	0.0	480.5	0.0
01Jan2013	00:15	0.0	0.0	480.5	0.0
01Jan2013	00:20	0.0	0.0	480.5	0.0
01Jan2013	00:25	0.0	0.0	480.5	0.0
01Jan2013	00:30	0.0	0.0	480.5	0.0
01Jan2013	00:35	0.0	0.0	480.5	0.0
01Jan2013	00:40	0.0	0.0	480.5	0.0
01Jan2013	00:45	0.0	0.0	480.5	0.0
01Jan2013	00:50	0.0	0.0	480.5	0.0
01Jan2013	00:55	0.0	0.0	480.5	0.0
01Jan2013	01:00	0.0	0.0	480.5	0.0
01Jan2013	01:05	0.0	0.0	480.5	0.0
01Jan2013	01:10	0.0	0.0	480.5	0.0
01Jan2013	01:15	0.0	0.0	480.5	0.0
01Jan2013	01:20	0.0	0.0	480.5	0.0
01Jan2013	01:25	0.0	0.0	480.5	0.0
01Jan2013	01:30	0.0	0.0	480.5	0.0
01Jan2013	01:35	0.0	0.0	480.5	0.0
01Jan2013	01:40	0.0	0.0	480.5	0.0
01Jan2013	01:45	0.0	0.0	480.5	0.0
01Jan2013	01:50	0.0	0.0	480.5	0.0
01Jan2013	01:55	0.0	0.0	480.5	0.0
01Jan2013	02:00	0.0	0.0	480.5	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	02:05	0.0	0.0	480.5	0.0
01Jan2013	02:10	0.0	0.0	480.5	0.0
01Jan2013	02:15	0.0	0.0	480.5	0.0
01Jan2013	02:20	0.0	0.0	480.5	0.0
01Jan2013	02:25	0.0	0.0	480.5	0.0
01Jan2013	02:30	0.0	0.0	480.5	0.0
01Jan2013	02:35	0.0	0.0	480.5	0.0
01Jan2013	02:40	0.0	0.0	480.5	0.0
01Jan2013	02:45	0.0	0.0	480.5	0.0
01Jan2013	02:50	0.0	0.0	480.5	0.0
01Jan2013	02:55	0.0	0.0	480.5	0.0
01Jan2013	03:00	0.0	0.0	480.5	0.0
01Jan2013	03:05	0.0	0.0	480.5	0.0
01Jan2013	03:10	0.0	0.0	480.5	0.0
01Jan2013	03:15	0.0	0.0	480.5	0.0
01Jan2013	03:20	0.0	0.0	480.5	0.0
01Jan2013	03:25	0.0	0.0	480.5	0.0
01Jan2013	03:30	0.0	0.0	480.5	0.0
01Jan2013	03:35	0.0	0.0	480.5	0.0
01Jan2013	03:40	0.0	0.0	480.5	0.0
01Jan2013	03:45	0.0	0.0	480.5	0.0
01Jan2013	03:50	0.0	0.0	480.5	0.0
01Jan2013	03:55	0.0	0.0	480.5	0.0
01Jan2013	04:00	0.0	0.0	480.5	0.0
01Jan2013	04:05	0.0	0.0	480.5	0.0
01Jan2013	04:10	0.0	0.0	480.5	0.0
01Jan2013	04:15	0.0	0.0	480.5	0.0
01Jan2013	04:20	0.0	0.0	480.5	0.0
01Jan2013	04:25	0.0	0.0	480.5	0.0
01Jan2013	04:30	0.0	0.0	480.5	0.0
01Jan2013	04:35	0.0	0.0	480.5	0.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	04:40	0.0	0.0	480.5	0.0
01Jan2013	04:45	0.0	0.0	480.5	0.0
01Jan2013	04:50	0.1	0.0	480.5	0.0
01Jan2013	04:55	0.1	0.0	480.5	0.0
01Jan2013	05:00	0.2	0.0	480.5	0.0
01Jan2013	05:05	0.3	0.0	480.5	0.0
01Jan2013	05:10	0.3	0.0	480.6	0.0
01Jan2013	05:15	0.4	0.0	480.6	0.0
01Jan2013	05:20	0.5	0.0	480.6	0.0
01Jan2013	05:25	0.6	0.0	480.7	0.0
01Jan2013	05:30	0.6	0.0	480.7	0.0
01Jan2013	05:35	0.7	0.0	480.7	0.0
01Jan2013	05:40	0.8	0.0	480.8	0.0
01Jan2013	05:45	0.9	0.0	480.9	0.0
01Jan2013	05:50	1.0	0.0	480.9	0.0
01Jan2013	05:55	1.1	0.0	481.0	0.0
01Jan2013	06:00	1.2	0.1	481.0	0.0
01Jan2013	06:05	1.3	0.1	481.0	0.0
01Jan2013	06:10	1.3	0.1	481.1	0.0
01Jan2013	06:15	1.4	0.1	481.1	0.0
01Jan2013	06:20	1.5	0.1	481.1	0.0
01Jan2013	06:25	1.6	0.1	481.1	0.1
01Jan2013	06:30	1.7	0.1	481.1	0.1
01Jan2013	06:35	1.8	0.1	481.2	0.1
01Jan2013	06:40	1.9	0.1	481.2	0.2
01Jan2013	06:45	2.0	0.2	481.2	0.2
01Jan2013	06:50	2.1	0.2	481.2	0.3
01Jan2013	06:55	2.2	0.2	481.3	0.3
01Jan2013	07:00	2.3	0.2	481.3	0.4
01Jan2013	07:05	2.4	0.2	481.3	0.5
01Jan2013	07:10	2.5	0.2	481.4	0.6

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	07:15	2.6	0.2	481.4	0.7
01Jan2013	07:20	2.7	0.2	481.4	0.8
01Jan2013	07:25	2.8	0.3	481.4	0.9
01Jan2013	07:30	3.0	0.3	481.5	1.0
01Jan2013	07:35	3.1	0.3	481.5	1.1
01Jan2013	07:40	3.2	0.3	481.5	1.3
01Jan2013	07:45	3.3	0.3	481.5	1.4
01Jan2013	07:50	3.3	0.3	481.6	1.5
01Jan2013	07:55	3.5	0.3	481.6	1.7
01Jan2013	08:00	3.6	0.3	481.6	1.8
01Jan2013	08:05	3.7	0.4	481.7	2.0
01Jan2013	08:10	3.8	0.4	481.7	2.1
01Jan2013	08:15	4.0	0.4	481.7	2.3
01Jan2013	08:20	4.2	0.4	481.7	2.4
01Jan2013	08:25	4.4	0.4	481.8	2.6
01Jan2013	08:30	4.6	0.4	481.8	2.8
01Jan2013	08:35	4.9	0.4	481.8	3.0
01Jan2013	08:40	5.1	0.4	481.8	3.2
01Jan2013	08:45	5.4	0.5	481.9	3.4
01Jan2013	08:50	5.7	0.5	481.9	3.6
01Jan2013	08:55	6.0	0.5	481.9	3.9
01Jan2013	09:00	6.3	0.5	482.0	4.1
01Jan2013	09:05	6.6	0.5	482.0	4.4
01Jan2013	09:10	6.9	0.5	482.0	4.6
01Jan2013	09:15	7.1	0.5	482.0	4.8
01Jan2013	09:20	7.3	0.6	482.0	4.9
01Jan2013	09:25	7.5	0.6	482.1	5.1
01Jan2013	09:30	7.7	0.6	482.1	5.3
01Jan2013	09:35	7.8	0.6	482.1	5.4
01Jan2013	09:40	8.0	0.6	482.1	5.6
01Jan2013	09:45	8.2	0.6	482.1	5.8

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	09:50	8.6	0.7	482.2	6.0
01Jan2013	09:55	9.0	0.7	482.2	6.2
01Jan2013	10:00	9.4	0.7	482.2	6.4
01Jan2013	10:05	9.9	0.7	482.2	6.7
01Jan2013	10:10	10.4	0.7	482.3	7.0
01Jan2013	10:15	11.0	0.8	482.3	7.3
01Jan2013	10:20	11.7	0.8	482.3	7.6
01Jan2013	10:25	12.4	0.8	482.3	8.0
01Jan2013	10:30	13.1	0.9	482.4	8.4
01Jan2013	10:35	13.9	0.9	482.4	8.8
01Jan2013	10:40	14.7	0.9	482.5	9.3
01Jan2013	10:45	15.7	1.0	482.5	9.8
01Jan2013	10:50	16.8	1.0	482.6	10.4
01Jan2013	10:55	18.0	1.1	482.6	11.0
01Jan2013	11:00	19.3	1.1	482.7	11.8
01Jan2013	11:05	20.7	1.2	482.7	12.6
01Jan2013	11:10	22.3	1.2	482.8	13.5
01Jan2013	11:15	24.3	1.3	482.9	14.5
01Jan2013	11:20	26.7	1.4	483.0	15.6
01Jan2013	11:25	29.5	1.4	483.0	16.8
01Jan2013	11:30	32.6	1.5	483.1	17.9
01Jan2013	11:35	37.8	1.6	483.2	19.2
01Jan2013	11:40	52.1	1.8	483.3	21.2
01Jan2013	11:45	82.8	2.1	483.6	24.9
01Jan2013	11:50	138.0	2.7	484.0	31.9
01Jan2013	11:55	228.7	3.7	484.6	40.9
01Jan2013	12:00	332.3	5.3	485.5	49.8
01Jan2013	12:05	382.2	7.4	486.5	58.5
01Jan2013	12:10	345.0	9.5	487.5	66.3
01Jan2013	12:15	261.6	10.9	488.2	121.4
01Jan2013	12:20	186.7	11.5	488.4	154.1

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	12:25	138.0	11.6	488.5	156.9
01Jan2013	12:30	106.5	11.4	488.4	145.3
01Jan2013	12:35	84.0	11.1	488.2	129.5
01Jan2013	12:40	68.0	10.8	488.1	113.6
01Jan2013	12:45	56.9	10.5	488.0	99.6
01Jan2013	12:50	49.2	10.2	487.9	87.6
01Jan2013	12:55	43.8	9.9	487.7	78.2
01Jan2013	13:00	39.5	9.7	487.6	71.3
01Jan2013	13:05	36.1	9.5	487.5	66.6
01Jan2013	13:10	33.5	9.3	487.4	65.3
01Jan2013	13:15	31.5	9.1	487.3	64.6
01Jan2013	13:20	29.8	8.8	487.2	63.7
01Jan2013	13:25	28.4	8.6	487.1	63.0
01Jan2013	13:30	27.1	8.4	487.0	62.2
01Jan2013	13:35	25.9	8.1	486.9	61.1
01Jan2013	13:40	24.8	7.9	486.8	60.2
01Jan2013	13:45	23.8	7.6	486.7	59.3
01Jan2013	13:50	22.8	7.4	486.5	58.4
01Jan2013	13:55	21.9	7.1	486.4	57.5
01Jan2013	14:00	21.0	6.9	486.3	56.5
01Jan2013	14:05	20.2	6.6	486.2	55.6
01Jan2013	14:10	19.5	6.4	486.1	54.6
01Jan2013	14:15	18.9	6.2	485.9	53.6
01Jan2013	14:20	18.4	5.9	485.8	52.5
01Jan2013	14:25	17.9	5.7	485.7	51.5
01Jan2013	14:30	17.5	5.5	485.6	50.4
01Jan2013	14:35	17.2	5.2	485.5	49.4
01Jan2013	14:40	16.9	5.0	485.3	48.4
01Jan2013	14:45	16.7	4.8	485.2	47.3
01Jan2013	14:50	16.4	4.6	485.1	46.5
01Jan2013	14:55	16.1	4.4	485.0	45.6

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	15:00	15.8	4.2	484.9	44.5
01Jan2013	15:05	15.5	4.0	484.8	43.2
01Jan2013	15:10	15.2	3.8	484.7	41.8
01Jan2013	15:15	14.9	3.6	484.6	40.4
01Jan2013	15:20	14.7	3.5	484.5	39.0
01Jan2013	15:25	14.4	3.3	484.4	37.6
01Jan2013	15:30	14.1	3.1	484.3	36.2
01Jan2013	15:35	13.8	3.0	484.2	34.8
01Jan2013	15:40	13.5	2.9	484.1	33.5
01Jan2013	15:45	13.2	2.7	484.0	32.3
01Jan2013	15:50	13.0	2.6	483.9	30.8
01Jan2013	15:55	12.8	2.5	483.8	29.4
01Jan2013	16:00	12.4	2.4	483.8	28.0
01Jan2013	16:05	12.1	2.3	483.7	26.7
01Jan2013	16:10	11.8	2.2	483.6	25.5
01Jan2013	16:15	11.6	2.1	483.5	24.4
01Jan2013	16:20	11.4	2.0	483.5	23.3
01Jan2013	16:25	11.3	1.9	483.4	22.4
01Jan2013	16:30	11.2	1.8	483.3	21.5
01Jan2013	16:35	11.1	1.8	483.3	20.6
01Jan2013	16:40	11.0	1.7	483.2	19.9
01Jan2013	16:45	10.9	1.6	483.2	19.2
01Jan2013	16:50	10.7	1.6	483.2	18.5
01Jan2013	16:55	10.6	1.5	483.1	17.9
01Jan2013	17:00	10.6	1.5	483.1	17.3
01Jan2013	17:05	10.5	1.4	483.0	16.9
01Jan2013	17:10	10.4	1.4	483.0	16.4
01Jan2013	17:15	10.2	1.4	483.0	15.7
01Jan2013	17:20	10.1	1.3	482.9	15.2
01Jan2013	17:25	9.9	1.3	482.9	14.6
01Jan2013	17:30	9.8	1.3	482.8	14.1

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	17:35	9.8	1.2	482.8	13.7
01Jan2013	17:40	9.8	1.2	482.8	13.3
01Jan2013	17:45	9.7	1.2	482.8	12.9
01Jan2013	17:50	9.5	1.2	482.7	12.6
01Jan2013	17:55	9.4	1.1	482.7	12.3
01Jan2013	18:00	9.3	1.1	482.7	12.0
01Jan2013	18:05	9.2	1.1	482.7	11.7
01Jan2013	18:10	9.1	1.1	482.6	11.5
01Jan2013	18:15	9.0	1.1	482.6	11.3
01Jan2013	18:20	8.9	1.1	482.6	11.0
01Jan2013	18:25	8.8	1.0	482.6	10.8
01Jan2013	18:30	8.8	1.0	482.6	10.6
01Jan2013	18:35	8.6	1.0	482.6	10.5
01Jan2013	18:40	8.4	1.0	482.5	10.3
01Jan2013	18:45	8.3	1.0	482.5	10.1
01Jan2013	18:50	8.3	1.0	482.5	10.0
01Jan2013	18:55	8.2	1.0	482.5	9.8
01Jan2013	19:00	8.1	1.0	482.5	9.6
01Jan2013	19:05	8.0	0.9	482.5	9.5
01Jan2013	19:10	7.9	0.9	482.5	9.4
01Jan2013	19:15	7.8	0.9	482.5	9.2
01Jan2013	19:20	7.7	0.9	482.4	9.1
01Jan2013	19:25	7.6	0.9	482.4	9.0
01Jan2013	19:30	7.5	0.9	482.4	8.8
01Jan2013	19:35	7.4	0.9	482.4	8.7
01Jan2013	19:40	7.3	0.9	482.4	8.6
01Jan2013	19:45	7.1	0.9	482.4	8.5
01Jan2013	19:50	7.0	0.9	482.4	8.4
01Jan2013	19:55	6.9	0.8	482.4	8.2
01Jan2013	20:00	6.9	0.8	482.4	8.1
01Jan2013	20:05	6.8	0.8	482.4	8.0

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)
01Jan2013	20:10	6.7	0.8	482.3	7.9
01Jan2013	20:15	6.6	0.8	482.3	7.8
01Jan2013	20:20	6.5	0.8	482.3	7.7
01Jan2013	20:25	6.5	0.8	482.3	7.6
01Jan2013	20:30	6.4	0.8	482.3	7.5
01Jan2013	20:35	6.4	0.8	482.3	7.4
01Jan2013	20:40	6.4	0.8	482.3	7.3
01Jan2013	20:45	6.4	0.8	482.3	7.3
01Jan2013	20:50	6.4	0.8	482.3	7.2
01Jan2013	20:55	6.3	0.8	482.3	7.1
01Jan2013	21:00	6.3	0.8	482.3	7.1
01Jan2013	21:05	6.3	0.7	482.3	7.0
01Jan2013	21:10	6.3	0.7	482.3	6.9
01Jan2013	21:15	6.3	0.7	482.2	6.9
01Jan2013	21:20	6.2	0.7	482.2	6.8
01Jan2013	21:25	6.2	0.7	482.2	6.8
01Jan2013	21:30	6.2	0.7	482.2	6.7
01Jan2013	21:35	6.2	0.7	482.2	6.7
01Jan2013	21:40	6.2	0.7	482.2	6.7
01Jan2013	21:45	6.2	0.7	482.2	6.6
01Jan2013	21:50	6.2	0.7	482.2	6.6
01Jan2013	21:55	6.1	0.7	482.2	6.6
01Jan2013	22:00	6.1	0.7	482.2	6.5
01Jan2013	22:05	6.0	0.7	482.2	6.5
01Jan2013	22:10	6.0	0.7	482.2	6.5
01Jan2013	22:15	6.0	0.7	482.2	6.4
01Jan2013	22:20	6.0	0.7	482.2	6.4
01Jan2013	22:25	6.0	0.7	482.2	6.4
01Jan2013	22:30	6.0	0.7	482.2	6.3
01Jan2013	22:35	5.9	0.7	482.2	6.3
01Jan2013	22:40	5.9	0.7	482.2	6.3

Pond C2 Input Data

Outlet Pipe

Type:

1 - 36" Diameter Corrugated Metal StandPipe
(See Pond C2 Elevation-Discharge Calculations
for Standpipe Orifice Information)

Length:

86 Feet

Top Inlet Elev.:

483.00

Outlet Elev.:

475.5

Exit Coeff.:

1.0

Mannings n:

0.024

Spillway

Elev:

485.00

Length:

20

Weir Coeff.:

3.0

Dam

Elev.:

486.00

Length:

50

Coeff.:

3.0

Elev. - Discharge Table		
Elev. (Feet)	Discharge (cfs)	
476.0	0.0	
476.5	0.0	
477.0	0.0	
477.5	0.7	
478.0	0.9	
478.5	1.6	
479.0	2.2	
479.5	2.6	
480.0	3.6	
480.5	4.1	
481.0	4.6	
481.5	5.0	
482.0	5.4	
482.5	5.8	
483.0	6.1	
483.5	16.5	
484.0	35.0	
484.5	59.0	
485.0	87.3	
485.5	151.2	
486.0	274.8	
486.5	468.8	

Area-Elev. Table	
Elev. (Feet)	Area (Acres)
476.0	0.0000
477.0	0.2395
478.0	0.6927
479.0	1.1054
480.0	1.3791
481.0	1.4760
482.0	1.5596
483.0	1.6559
484.0	1.7466
485.0	1.8405
486.0	1.9367
487.0	2.1000
487.5	2.2000

POND C2 ELEVATION-DISCHARGE CALCULATIONS

Wier Flow Equation
 $Q = 3 \times L \times h^{1.5}$

Wier L= 20 ft.
Wier EI= 487 msl
Wier SS= 10 :1

Orifice Flow Equation
 $q_x = C \times A \times (2 g h)^{0.5}$

Pond Flowline= 476.00
Orifice Coeff. C= 0.60
Orifice Size (in.)= 3.00

orifices

Orifice Elev. 1= 477.00 3
Orifice Elev. 2= 478.50 3
Orifice Elev. 3= 480.00 3

Stack Pipe Top Elev = 484.50 msl
Stack Pipe Diam.= 1.50 ft.

WS Elevation	ORIFICE CALCULATIONS						PIPE STACK CALCULATIONS		WIER CALCULATIONS			
	h1 (ft)	h2 (ft)	h3 (ft)	q1 (cfs)	q2 (cfs)	q3 (cfs)	Orifice Flow q _o (cfs)	Pipe Stack Head, h _p (ft)	Pipe Stack Flow, Q _p (cfs)	Wier Head h _w (ft)	Wier Flow Q _w (cfs)	Total Q for Elev. (cfs)
476.0	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
476.5	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
477.0	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
477.5	0.50	0.00	0.00	0.5	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.5
478.0	1.00	0.00	0.00	0.7	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.7
478.5	1.50	0.00	0.00	0.9	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.9
479.0	2.00	0.50	0.00	1.0	0.5	0.0	1.5	0.0	0.0	0.0	0.0	1.5
479.5	2.50	1.00	0.00	1.1	0.7	0.0	1.8	0.0	0.0	0.0	0.0	1.8
480.0	3.00	1.50	0.00	1.2	0.9	0.0	2.1	0.0	0.0	0.0	0.0	2.1
480.5	3.50	2.00	0.50	1.3	1.0	0.5	2.8	0.0	0.0	0.0	0.0	2.8
481.0	4.00	2.50	1.00	1.4	1.1	0.7	3.2	0.0	0.0	0.0	0.0	3.2
481.5	4.50	3.00	1.50	1.5	1.2	0.9	3.6	0.0	0.0	0.0	0.0	3.6
482.0	5.00	3.50	2.00	1.6	1.3	1.0	3.9	0.0	0.0	0.0	0.0	3.9
482.5	5.50	4.00	2.50	1.7	1.4	1.1	4.2	0.0	0.0	0.0	0.0	4.2
483.0	6.00	4.50	3.00	1.7	1.5	1.2	4.5	0.0	0.0	0.0	0.0	4.5
483.5	6.50	5.00	3.50	1.8	1.6	1.3	4.7	0.0	0.0	0.0	0.0	4.7
484.0	7.00	5.50	4.00	1.9	1.7	1.4	5.0	0.0	0.0	0.0	0.0	5.0
484.5	7.50	6.00	4.50	1.9	1.7	1.5	5.2	0.0	0.0	0.0	0.0	5.2
485.0	8.00	6.50	5.00	2.0	1.8	1.6	5.4	0.5	5.0	0.0	0.0	10.4
485.5	8.50	7.00	5.50	2.1	1.9	1.7	5.6	1.0	14.1	0.0	0.0	19.7
486.0	9.00	7.50	6.00	2.1	1.9	1.7	5.8	1.5	26.0	0.0	0.0	31.8
486.5	9.50	8.00	6.50	2.2	2.0	1.8	6.0	2.0	40.0	0.0	0.0	46.0
487.0	10.00	8.50	7.00	2.2	2.1	1.9	6.2	2.5	55.9	0.0	0.0	62.1
487.5	10.50	9.00	7.50	2.3	2.1	1.9	6.4	3.0	73.5	0.5	31.8	111.6
488.0	11.00	9.50	8.00	2.4	2.2	2.0	6.5	3.5	92.6	1.0	120.0	219.1
488.5	11.50	10.00	8.50	2.4	2.2	2.1	6.7	4.0	113.1	1.5	275.6	395.4
489.0	12.00	10.50	9.00	2.5	2.3	2.1	6.9	4.5	135.0	2.0	509.1	651.0

Pipe Stack Calculations

h_p = surface water height above top of stack pipe
Q_p = flow into top of stack pipe using weir equation

Weir Calculations

h_w = surface water height above weir flowline elev.
Q_w = flow weir using weir equation

Total Q = Total flow through orifices, stack pipe and weir

Orifice Calculations

h1 = height above orifices at Elev. 1
h2 = height above orifices at Elev. 2
h3 = height above orifices at Elev. 3
q1 = flow into orifices at Elev. 1, $q_x = C \times A \times (2 g h_1)^{0.5}$
q2 = flow into orifices at Elev. 2, $q_x = C \times A \times (2 g h_2)^{0.5}$
q3 = flow into orifices at Elev. 3, $q_x = C \times A \times (2 g h_3)^{0.5}$
q_o = total orifice flow for that water surface elevation

Project: Laredo Proposed
Simulation Run: 25 year Reservoir: Pond C2

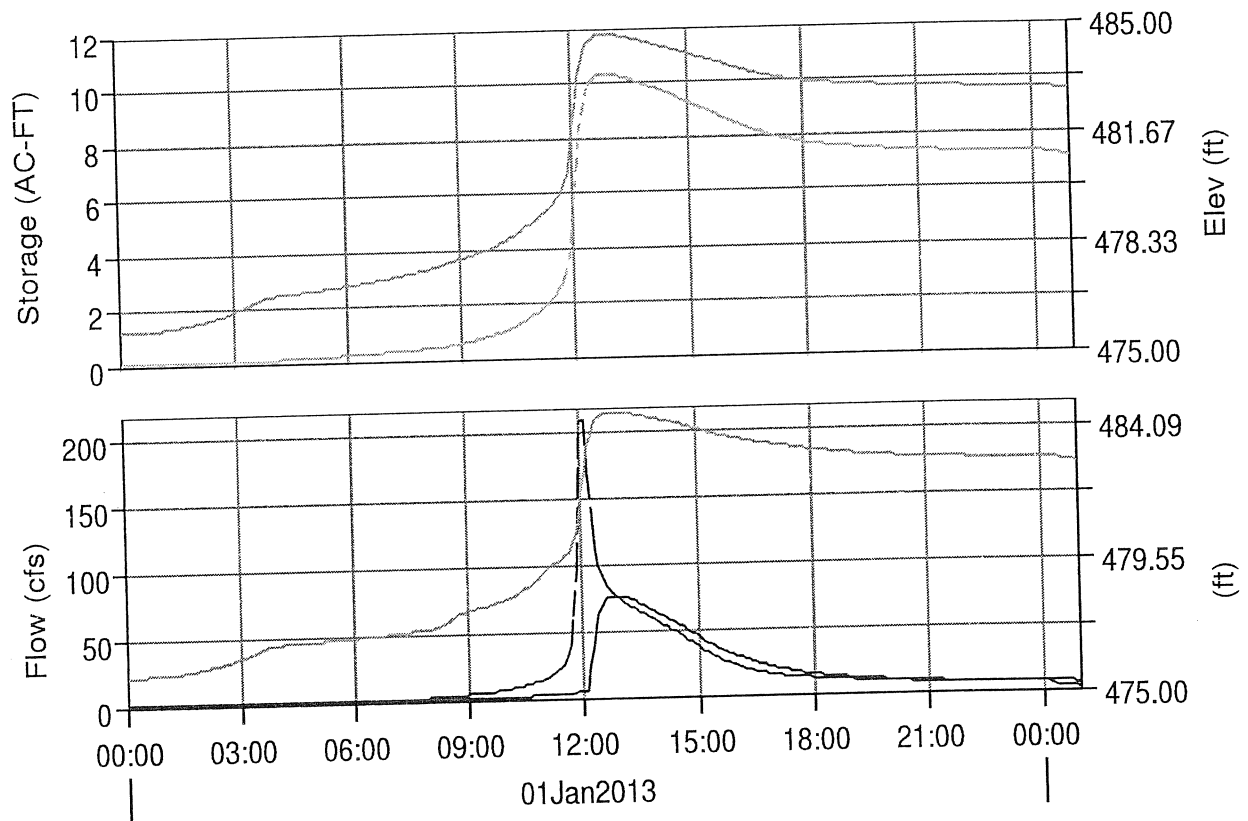
Start of Run:	01Jan2013, 00:00	Basin Model:	Basin 1
End of Run:	02Jan2013, 00:55	Meteorologic Model:	25 year 24 hr
Compute Time:	17Sep2014, 11:13:14	Control Specifications:	Control 1

Volume Units: IN

Computed Results

Peak Inflow :	211.1 (CFS)	Date/Time of Peak Inflow :	01Jan2013, 12:05
Peak Outflow :	76.6 (CFS)	Date/Time of Peak Outflow :	01Jan2013, 12:50
Total Inflow :	4.53 (IN)	Peak Storage :	10.3 (AC-FT)
Total Outflow :	3.60 (IN)	Peak Elevation :	484.8 (FT)

Reservoir "Pond C2" Results for Run "25 year"



- Run:25 YEAR Element:POND C2 Result:Storage
- Run:25 YEAR Element:POND C2 Result:Pool Elevation
- Run:25 year Element:POND C2 Result:Outflow
- Run:25 YEAR Element:POND C2 Result:Combined Flow
- Run:25 year Element:POND C2 Result:Stage

Project: Laredo Proposed
Simulation Run: 25 year Reservoir: Pond C2

Start of Run: 01Jan2013, 00:00 Basin Model: Basin 1
End of Run: 02Jan2013, 00:55 Meteorologic Model: 25 year 24
Compute Time: 17Sep2014, 11:13:14 Control Specifications: Contr

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	00:00	0.0	0.0	476.0	0.0	476.0
01Jan2013	00:05	0.0	0.0	476.0	0.0	476.0
01Jan2013	00:10	0.0	0.0	476.0	0.0	476.0
01Jan2013	00:15	0.0	0.0	476.0	0.0	476.0
01Jan2013	00:20	0.0	0.0	476.0	0.0	476.0
01Jan2013	00:25	0.0	0.0	476.0	0.0	476.0
01Jan2013	00:30	0.0	0.0	476.0	0.0	476.0
01Jan2013	00:35	0.0	0.0	476.0	0.0	476.0
01Jan2013	00:40	0.1	0.0	476.0	0.0	476.0
01Jan2013	00:45	0.1	0.0	476.0	0.0	476.0
01Jan2013	00:50	0.1	0.0	476.0	0.0	476.0
01Jan2013	00:55	0.1	0.0	476.0	0.0	476.0
01Jan2013	01:00	0.1	0.0	476.0	0.0	476.0
01Jan2013	01:05	0.1	0.0	476.1	0.0	476.1
01Jan2013	01:10	0.1	0.0	476.1	0.0	476.1
01Jan2013	01:15	0.1	0.0	476.1	0.0	476.1
01Jan2013	01:20	0.1	0.0	476.1	0.0	476.1
01Jan2013	01:25	0.2	0.0	476.1	0.0	476.1
01Jan2013	01:30	0.2	0.0	476.1	0.0	476.1
01Jan2013	01:35	0.2	0.0	476.1	0.0	476.1
01Jan2013	01:40	0.2	0.0	476.1	0.0	476.1
01Jan2013	01:45	0.2	0.0	476.2	0.0	476.2
01Jan2013	01:50	0.2	0.0	476.2	0.0	476.2
01Jan2013	01:55	0.2	0.0	476.2	0.0	476.2
01Jan2013	02:00	0.3	0.0	476.2	0.0	476.2

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	02:05	0.3	0.0	476.2	0.0	476.2
01Jan2013	02:10	0.3	0.0	476.3	0.0	476.3
01Jan2013	02:15	0.3	0.0	476.3	0.0	476.3
01Jan2013	02:20	0.3	0.0	476.3	0.0	476.3
01Jan2013	02:25	0.3	0.0	476.3	0.0	476.3
01Jan2013	02:30	0.3	0.0	476.4	0.0	476.4
01Jan2013	02:35	0.3	0.0	476.4	0.0	476.4
01Jan2013	02:40	0.4	0.0	476.4	0.0	476.4
01Jan2013	02:45	0.4	0.0	476.5	0.0	476.5
01Jan2013	02:50	0.4	0.0	476.5	0.0	476.5
01Jan2013	02:55	0.4	0.0	476.5	0.0	476.5
01Jan2013	03:00	0.4	0.0	476.6	0.0	476.6
01Jan2013	03:05	0.4	0.0	476.6	0.0	476.6
01Jan2013	03:10	0.5	0.1	476.6	0.0	476.6
01Jan2013	03:15	0.5	0.1	476.7	0.0	476.7
01Jan2013	03:20	0.5	0.1	476.7	0.0	476.7
01Jan2013	03:25	0.5	0.1	476.8	0.0	476.8
01Jan2013	03:30	0.5	0.1	476.8	0.0	476.8
01Jan2013	03:35	0.5	0.1	476.9	0.0	476.9
01Jan2013	03:40	0.6	0.1	476.9	0.0	476.9
01Jan2013	03:45	0.6	0.1	476.9	0.0	476.9
01Jan2013	03:50	0.6	0.1	477.0	0.0	477.0
01Jan2013	03:55	0.6	0.1	477.0	0.0	477.0
01Jan2013	04:00	0.6	0.1	477.0	0.0	477.0
01Jan2013	04:05	0.6	0.1	477.0	0.0	477.0
01Jan2013	04:10	0.6	0.1	477.0	0.0	477.0
01Jan2013	04:15	0.7	0.1	477.0	0.0	477.0
01Jan2013	04:20	0.7	0.1	477.1	0.1	477.0
01Jan2013	04:25	0.7	0.1	477.1	0.1	477.0
01Jan2013	04:30	0.7	0.1	477.1	0.1	477.0
01Jan2013	04:35	0.8	0.1	477.1	0.1	477.1

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	04:40	0.8	0.1	477.1	0.1	477.1
01Jan2013	04:45	0.8	0.1	477.1	0.1	477.1
01Jan2013	04:50	0.8	0.1	477.1	0.1	477.1
01Jan2013	04:55	0.8	0.1	477.1	0.1	477.1
01Jan2013	05:00	0.9	0.1	477.1	0.1	477.1
01Jan2013	05:05	0.9	0.1	477.2	0.1	477.1
01Jan2013	05:10	0.9	0.2	477.2	0.1	477.1
01Jan2013	05:15	0.9	0.2	477.2	0.2	477.1
01Jan2013	05:20	1.0	0.2	477.2	0.2	477.1
01Jan2013	05:25	1.0	0.2	477.2	0.2	477.1
01Jan2013	05:30	1.0	0.2	477.2	0.2	477.1
01Jan2013	05:35	1.0	0.2	477.2	0.2	477.1
01Jan2013	05:40	1.1	0.2	477.2	0.2	477.2
01Jan2013	05:45	1.1	0.2	477.3	0.2	477.2
01Jan2013	05:50	1.1	0.2	477.3	0.2	477.2
01Jan2013	05:55	1.2	0.2	477.3	0.3	477.2
01Jan2013	06:00	1.2	0.2	477.3	0.3	477.2
01Jan2013	06:05	1.2	0.2	477.3	0.3	477.2
01Jan2013	06:10	1.2	0.2	477.3	0.3	477.2
01Jan2013	06:15	1.3	0.2	477.3	0.3	477.2
01Jan2013	06:20	1.3	0.2	477.4	0.3	477.2
01Jan2013	06:25	1.4	0.2	477.4	0.3	477.2
01Jan2013	06:30	1.4	0.3	477.4	0.3	477.2
01Jan2013	06:35	1.4	0.3	477.4	0.4	477.3
01Jan2013	06:40	1.4	0.3	477.4	0.4	477.3
01Jan2013	06:45	1.5	0.3	477.4	0.4	477.3
01Jan2013	06:50	1.5	0.3	477.5	0.4	477.3
01Jan2013	06:55	1.5	0.3	477.5	0.4	477.3
01Jan2013	07:00	1.6	0.3	477.5	0.4	477.3
01Jan2013	07:05	1.6	0.3	477.5	0.5	477.3
01Jan2013	07:10	1.6	0.3	477.5	0.5	477.3

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	07:15	1.6	0.3	477.5	0.5	477.3
01Jan2013	07:20	1.7	0.3	477.6	0.5	477.4
01Jan2013	07:25	1.7	0.3	477.6	0.5	477.4
01Jan2013	07:30	1.8	0.3	477.6	0.5	477.4
01Jan2013	07:35	1.8	0.4	477.6	0.6	477.4
01Jan2013	07:40	1.8	0.4	477.6	0.6	477.4
01Jan2013	07:45	1.9	0.4	477.7	0.6	477.4
01Jan2013	07:50	1.9	0.4	477.7	0.6	477.4
01Jan2013	07:55	2.0	0.4	477.7	0.6	477.4
01Jan2013	08:00	2.1	0.4	477.7	0.6	477.5
01Jan2013	08:05	2.1	0.4	477.7	0.7	477.5
01Jan2013	08:10	2.2	0.4	477.8	0.7	477.5
01Jan2013	08:15	2.3	0.4	477.8	0.7	477.5
01Jan2013	08:20	2.5	0.4	477.8	0.7	477.6
01Jan2013	08:25	2.6	0.5	477.8	0.8	477.6
01Jan2013	08:30	2.8	0.5	477.9	0.8	477.7
01Jan2013	08:35	3.0	0.5	477.9	0.8	477.8
01Jan2013	08:40	3.2	0.5	477.9	0.8	477.9
01Jan2013	08:45	3.4	0.5	478.0	0.9	477.9
01Jan2013	08:50	3.6	0.5	478.0	0.9	478.0
01Jan2013	08:55	3.8	0.6	478.0	0.9	478.0
01Jan2013	09:00	4.1	0.6	478.1	1.0	478.0
01Jan2013	09:05	4.3	0.6	478.1	1.0	478.1
01Jan2013	09:10	4.6	0.6	478.1	1.0	478.1
01Jan2013	09:15	4.8	0.6	478.1	1.1	478.1
01Jan2013	09:20	5.0	0.7	478.2	1.1	478.1
01Jan2013	09:25	5.2	0.7	478.2	1.1	478.2
01Jan2013	09:30	5.4	0.7	478.2	1.2	478.2
01Jan2013	09:35	5.7	0.8	478.3	1.2	478.2
01Jan2013	09:40	5.9	0.8	478.3	1.3	478.3
01Jan2013	09:45	6.2	0.8	478.3	1.3	478.3

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	09:50	6.6	0.9	478.4	1.4	478.3
01Jan2013	09:55	7.0	0.9	478.4	1.4	478.4
01Jan2013	10:00	7.4	0.9	478.5	1.5	478.4
01Jan2013	10:05	7.8	1.0	478.5	1.6	478.5
01Jan2013	10:10	8.3	1.0	478.6	1.6	478.5
01Jan2013	10:15	8.8	1.1	478.6	1.7	478.6
01Jan2013	10:20	9.4	1.1	478.7	1.8	478.6
01Jan2013	10:25	9.9	1.2	478.7	1.8	478.7
01Jan2013	10:30	10.4	1.2	478.8	1.9	478.8
01Jan2013	10:35	11.0	1.3	478.9	2.0	478.8
01Jan2013	10:40	11.6	1.4	478.9	2.1	478.9
01Jan2013	10:45	12.3	1.4	479.0	2.2	479.0
01Jan2013	10:50	13.0	1.5	479.1	2.3	479.1
01Jan2013	10:55	13.9	1.6	479.1	2.4	479.2
01Jan2013	11:00	14.8	1.6	479.2	2.5	479.3
01Jan2013	11:05	15.8	1.7	479.3	2.6	479.4
01Jan2013	11:10	17.0	1.8	479.3	2.7	479.5
01Jan2013	11:15	18.5	1.9	479.4	2.8	479.6
01Jan2013	11:20	20.2	2.0	479.5	2.9	479.7
01Jan2013	11:25	22.2	2.2	479.6	3.1	479.7
01Jan2013	11:30	24.4	2.3	479.7	3.2	479.8
01Jan2013	11:35	28.5	2.5	479.9	3.4	479.9
01Jan2013	11:40	39.8	2.7	480.0	3.6	480.0
01Jan2013	11:45	61.7	3.0	480.2	3.8	480.2
01Jan2013	11:50	97.3	3.5	480.6	4.2	480.6
01Jan2013	11:55	155.2	4.4	481.2	4.7	481.2
01Jan2013	12:00	209.2	5.6	482.0	5.4	482.0
01Jan2013	12:05	211.1	7.0	482.9	6.0	482.8
01Jan2013	12:10	169.6	8.2	483.6	23.0	483.7
01Jan2013	12:15	131.5	9.0	484.1	38.4	484.1
01Jan2013	12:20	111.6	9.5	484.4	53.6	484.4

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	12:25	100.2	9.9	484.5	63.2	484.6
01Jan2013	12:30	92.5	10.1	484.7	69.2	484.7
01Jan2013	12:35	86.9	10.2	484.7	72.9	484.7
01Jan2013	12:40	82.8	10.3	484.8	75.1	484.8
01Jan2013	12:45	79.7	10.3	484.8	76.2	484.8
01Jan2013	12:50	77.3	10.3	484.8	76.6	484.8
01Jan2013	12:55	75.3	10.3	484.8	76.6	484.8
01Jan2013	13:00	73.5	10.3	484.8	76.2	484.8
01Jan2013	13:05	71.9	10.3	484.8	75.6	484.8
01Jan2013	13:10	70.2	10.3	484.8	74.7	484.8
01Jan2013	13:15	68.6	10.2	484.7	73.8	484.8
01Jan2013	13:20	67.1	10.2	484.7	72.7	484.7
01Jan2013	13:25	65.7	10.2	484.7	71.5	484.7
01Jan2013	13:30	64.3	10.1	484.7	70.3	484.7
01Jan2013	13:35	62.7	10.1	484.7	69.1	484.7
01Jan2013	13:40	61.2	10.0	484.6	67.8	484.7
01Jan2013	13:45	60.0	10.0	484.6	66.5	484.6
01Jan2013	13:50	58.6	9.9	484.6	65.2	484.6
01Jan2013	13:55	57.1	9.9	484.6	63.8	484.6
01Jan2013	14:00	55.7	9.9	484.5	62.5	484.6
01Jan2013	14:05	54.3	9.8	484.5	61.1	484.5
01Jan2013	14:10	53.2	9.8	484.5	59.8	484.5
01Jan2013	14:15	51.9	9.7	484.4	58.5	484.5
01Jan2013	14:20	50.3	9.7	484.4	57.1	484.5
01Jan2013	14:25	48.6	9.6	484.4	55.7	484.4
01Jan2013	14:30	47.0	9.6	484.4	54.3	484.4
01Jan2013	14:35	45.3	9.5	484.3	52.8	484.4
01Jan2013	14:40	43.7	9.5	484.3	51.3	484.3
01Jan2013	14:45	42.1	9.4	484.3	49.7	484.3
01Jan2013	14:50	40.5	9.4	484.3	48.2	484.3
01Jan2013	14:55	39.0	9.3	484.2	46.6	484.2

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	15:00	37.4	9.3	484.2	45.1	484.2
01Jan2013	15:05	35.6	9.2	484.2	43.5	484.2
01Jan2013	15:10	34.0	9.1	484.1	41.9	484.1
01Jan2013	15:15	32.5	9.1	484.1	40.3	484.1
01Jan2013	15:20	31.0	9.0	484.1	38.8	484.1
01Jan2013	15:25	29.7	9.0	484.0	37.2	484.0
01Jan2013	15:30	28.5	8.9	484.0	35.8	484.0
01Jan2013	15:35	27.3	8.9	484.0	34.6	484.0
01Jan2013	15:40	26.2	8.8	484.0	33.7	484.0
01Jan2013	15:45	25.2	8.8	483.9	32.8	483.9
01Jan2013	15:50	24.3	8.7	483.9	31.9	483.9
01Jan2013	15:55	23.4	8.7	483.9	31.0	483.9
01Jan2013	16:00	22.5	8.6	483.8	30.2	483.9
01Jan2013	16:05	21.7	8.6	483.8	29.3	483.8
01Jan2013	16:10	21.0	8.5	483.8	28.4	483.8
01Jan2013	16:15	20.1	8.5	483.7	27.5	483.8
01Jan2013	16:20	19.2	8.4	483.7	26.7	483.8
01Jan2013	16:25	18.6	8.4	483.7	25.8	483.8
01Jan2013	16:30	18.0	8.3	483.7	25.0	483.7
01Jan2013	16:35	17.3	8.3	483.6	24.2	483.7
01Jan2013	16:40	16.8	8.2	483.6	23.4	483.7
01Jan2013	16:45	16.3	8.2	483.6	22.6	483.7
01Jan2013	16:50	15.8	8.1	483.5	21.9	483.6
01Jan2013	16:55	15.4	8.1	483.5	21.2	483.6
01Jan2013	17:00	15.1	8.1	483.5	20.5	483.6
01Jan2013	17:05	14.7	8.0	483.5	19.9	483.6
01Jan2013	17:10	14.4	8.0	483.5	19.3	483.6
01Jan2013	17:15	14.0	8.0	483.4	18.8	483.6
01Jan2013	17:20	13.7	7.9	483.4	18.2	483.5
01Jan2013	17:25	13.5	7.9	483.4	17.7	483.5
01Jan2013	17:30	13.2	7.9	483.4	17.2	483.5

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	17:35	13.0	7.8	483.4	16.8	483.5
01Jan2013	17:40	12.8	7.8	483.4	16.3	483.5
01Jan2013	17:45	12.6	7.8	483.3	15.9	483.5
01Jan2013	17:50	12.3	7.8	483.3	15.6	483.5
01Jan2013	17:55	12.1	7.7	483.3	15.2	483.4
01Jan2013	18:00	12.0	7.7	483.3	14.8	483.4
01Jan2013	18:05	11.8	7.7	483.3	14.5	483.4
01Jan2013	18:10	11.6	7.7	483.3	14.2	483.4
01Jan2013	18:15	11.4	7.7	483.3	13.9	483.4
01Jan2013	18:20	11.3	7.7	483.3	13.6	483.4
01Jan2013	18:25	11.2	7.6	483.3	13.4	483.3
01Jan2013	18:30	11.0	7.6	483.2	13.1	483.3
01Jan2013	18:35	10.8	7.6	483.2	12.9	483.3
01Jan2013	18:40	10.6	7.6	483.2	12.6	483.3
01Jan2013	18:45	10.5	7.6	483.2	12.4	483.3
01Jan2013	18:50	10.4	7.6	483.2	12.2	483.3
01Jan2013	18:55	10.3	7.6	483.2	12.0	483.3
01Jan2013	19:00	10.2	7.5	483.2	11.8	483.3
01Jan2013	19:05	10.0	7.5	483.2	11.6	483.3
01Jan2013	19:10	9.9	7.5	483.2	11.4	483.3
01Jan2013	19:15	9.7	7.5	483.2	11.2	483.2
01Jan2013	19:20	9.6	7.5	483.2	11.1	483.2
01Jan2013	19:25	9.5	7.5	483.2	10.9	483.2
01Jan2013	19:30	9.4	7.5	483.2	10.7	483.2
01Jan2013	19:35	9.3	7.5	483.2	10.6	483.2
01Jan2013	19:40	9.1	7.5	483.2	10.4	483.2
01Jan2013	19:45	9.0	7.5	483.1	10.3	483.2
01Jan2013	19:50	8.8	7.4	483.1	10.1	483.2
01Jan2013	19:55	8.8	7.4	483.1	10.0	483.2
01Jan2013	20:00	8.7	7.4	483.1	9.8	483.2
01Jan2013	20:05	8.5	7.4	483.1	9.7	483.2

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	20:10	8.4	7.4	483.1	9.6	483.2
01Jan2013	20:15	8.3	7.4	483.1	9.4	483.2
01Jan2013	20:20	8.2	7.4	483.1	9.3	483.2
01Jan2013	20:25	8.1	7.4	483.1	9.2	483.1
01Jan2013	20:30	8.1	7.4	483.1	9.1	483.1
01Jan2013	20:35	8.0	7.4	483.1	9.0	483.1
01Jan2013	20:40	8.0	7.4	483.1	8.8	483.1
01Jan2013	20:45	7.9	7.4	483.1	8.7	483.1
01Jan2013	20:50	7.8	7.4	483.1	8.6	483.1
01Jan2013	20:55	7.7	7.4	483.1	8.5	483.1
01Jan2013	21:00	7.7	7.3	483.1	8.5	483.1
01Jan2013	21:05	7.6	7.3	483.1	8.4	483.1
01Jan2013	21:10	7.6	7.3	483.1	8.3	483.1
01Jan2013	21:15	7.5	7.3	483.1	8.2	483.1
01Jan2013	21:20	7.5	7.3	483.1	8.1	483.1
01Jan2013	21:25	7.5	7.3	483.1	8.1	483.1
01Jan2013	21:30	7.4	7.3	483.1	8.0	483.1
01Jan2013	21:35	7.4	7.3	483.1	7.9	483.1
01Jan2013	21:40	7.4	7.3	483.1	7.9	483.1
01Jan2013	21:45	7.3	7.3	483.1	7.8	483.1
01Jan2013	21:50	7.3	7.3	483.1	7.8	483.1
01Jan2013	21:55	7.2	7.3	483.1	7.7	483.1
01Jan2013	22:00	7.2	7.3	483.1	7.6	483.1
01Jan2013	22:05	7.2	7.3	483.1	7.6	483.1
01Jan2013	22:10	7.1	7.3	483.0	7.5	483.1
01Jan2013	22:15	7.1	7.3	483.0	7.5	483.1
01Jan2013	22:20	7.1	7.3	483.0	7.4	483.1
01Jan2013	22:25	7.1	7.3	483.0	7.4	483.1
01Jan2013	22:30	7.0	7.3	483.0	7.4	483.1
01Jan2013	22:35	6.9	7.3	483.0	7.3	483.1
01Jan2013	22:40	6.9	7.3	483.0	7.3	483.1

Project: Laredo Proposed
Simulation Run: 100 year Reservoir: Pond C2

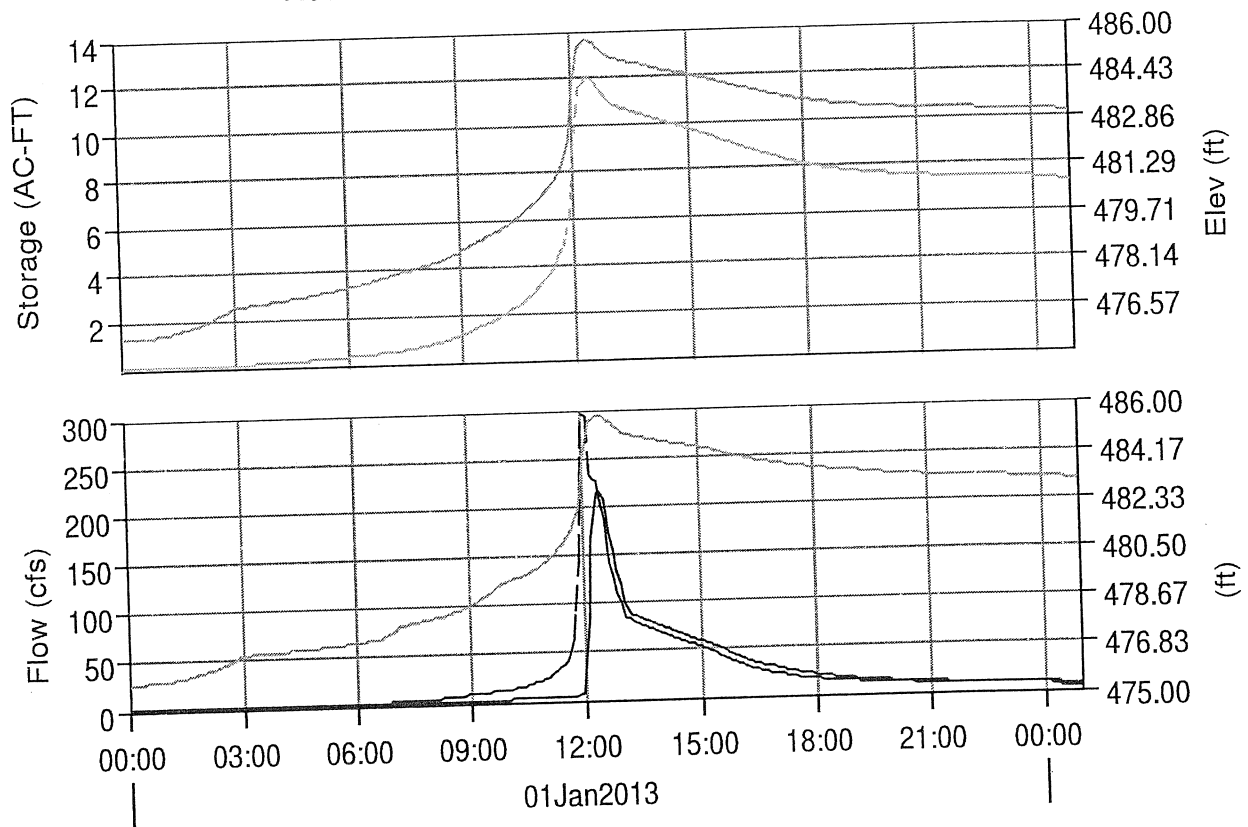
Start of Run:	01Jan2013, 00:00	Basin Model:	Basin 1
End of Run:	02Jan2013, 00:55	Meteorologic Model:	100 year 24 hr
Compute Time:	17Sep2014, 11:11:16	Control Specifications:	Control 1

Volume Units: IN

Computed Results

Peak Inflow :	294.8 (CFS)	Date/Time of Peak Inflow :	01Jan2013, 12:00
Peak Outflow :	215.8 (CFS)	Date/Time of Peak Outflow :	01Jan2013, 12:25
Total Inflow :	6.68 (IN)	Peak Storage :	12.0 (AC-FT)
Total Outflow :	5.73 (IN)	Peak Elevation :	485.7 (FT)

Reservoir "Pond C2" Results for Run "100 year"



- Run:100 YEAR Element:POND C2 Result:Storage
- Run:100 YEAR Element:POND C2 Result:Pool Elevation
- Run:100 year Element:POND C2 Result:Outflow
- Run:100 YEAR Element:POND C2 Result:Combined Flow
- Run:100 year Element:POND C2 Result:Stage

Project: Laredo Proposed
Simulation Run: 100 year Reservoir: Pond C2
Start of Run: 01Jan2013, 00:00 Basin Model: Basin 1
End of Run: 02Jan2013, 00:55 Meteorologic Model: 100 year 2
Compute Time: 17Sep2014, 11:11:16 Control Specifications: Contr

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	00:00	0.0	0.0	476.0	0.0	476.0
01Jan2013	00:05	0.0	0.0	476.0	0.0	476.0
01Jan2013	00:10	0.0	0.0	476.0	0.0	476.0
01Jan2013	00:15	0.0	0.0	476.0	0.0	476.0
01Jan2013	00:20	0.0	0.0	476.0	0.0	476.0
01Jan2013	00:25	0.0	0.0	476.0	0.0	476.0
01Jan2013	00:30	0.1	0.0	476.0	0.0	476.0
01Jan2013	00:35	0.1	0.0	476.0	0.0	476.0
01Jan2013	00:40	0.1	0.0	476.0	0.0	476.0
01Jan2013	00:45	0.1	0.0	476.0	0.0	476.0
01Jan2013	00:50	0.1	0.0	476.0	0.0	476.0
01Jan2013	00:55	0.2	0.0	476.1	0.0	476.1
01Jan2013	01:00	0.2	0.0	476.1	0.0	476.1
01Jan2013	01:05	0.2	0.0	476.1	0.0	476.1
01Jan2013	01:10	0.2	0.0	476.1	0.0	476.1
01Jan2013	01:15	0.2	0.0	476.1	0.0	476.1
01Jan2013	01:20	0.3	0.0	476.1	0.0	476.1
01Jan2013	01:25	0.3	0.0	476.2	0.0	476.2
01Jan2013	01:30	0.3	0.0	476.2	0.0	476.2
01Jan2013	01:35	0.3	0.0	476.2	0.0	476.2
01Jan2013	01:40	0.3	0.0	476.3	0.0	476.3
01Jan2013	01:45	0.4	0.0	476.3	0.0	476.3
01Jan2013	01:50	0.4	0.0	476.3	0.0	476.3
01Jan2013	01:55	0.4	0.0	476.4	0.0	476.4
01Jan2013	02:00	0.4	0.0	476.4	0.0	476.4

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	02:05	0.5	0.0	476.4	0.0	476.4
01Jan2013	02:10	0.5	0.0	476.5	0.0	476.5
01Jan2013	02:15	0.5	0.0	476.5	0.0	476.5
01Jan2013	02:20	0.5	0.0	476.6	0.0	476.6
01Jan2013	02:25	0.6	0.0	476.6	0.0	476.6
01Jan2013	02:30	0.6	0.1	476.7	0.0	476.7
01Jan2013	02:35	0.6	0.1	476.7	0.0	476.7
01Jan2013	02:40	0.6	0.1	476.8	0.0	476.8
01Jan2013	02:45	0.6	0.1	476.8	0.0	476.8
01Jan2013	02:50	0.7	0.1	476.9	0.0	476.9
01Jan2013	02:55	0.7	0.1	476.9	0.0	476.9
01Jan2013	03:00	0.7	0.1	477.0	0.0	477.0
01Jan2013	03:05	0.8	0.1	477.0	0.0	477.0
01Jan2013	03:10	0.8	0.1	477.0	0.0	477.0
01Jan2013	03:15	0.8	0.1	477.0	0.0	477.0
01Jan2013	03:20	0.8	0.1	477.0	0.0	477.0
01Jan2013	03:25	0.9	0.1	477.1	0.1	477.0
01Jan2013	03:30	0.9	0.1	477.1	0.1	477.0
01Jan2013	03:35	0.9	0.1	477.1	0.1	477.1
01Jan2013	03:40	0.9	0.1	477.1	0.1	477.1
01Jan2013	03:45	1.0	0.1	477.1	0.1	477.1
01Jan2013	03:50	1.0	0.1	477.1	0.1	477.1
01Jan2013	03:55	1.0	0.1	477.1	0.1	477.1
01Jan2013	04:00	1.0	0.1	477.2	0.1	477.1
01Jan2013	04:05	1.1	0.2	477.2	0.1	477.1
01Jan2013	04:10	1.1	0.2	477.2	0.2	477.1
01Jan2013	04:15	1.1	0.2	477.2	0.2	477.1
01Jan2013	04:20	1.2	0.2	477.2	0.2	477.1
01Jan2013	04:25	1.2	0.2	477.2	0.2	477.1
01Jan2013	04:30	1.3	0.2	477.2	0.2	477.2
01Jan2013	04:35	1.3	0.2	477.3	0.2	477.2

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	04:40	1.3	0.2	477.3	0.2	477.2
01Jan2013	04:45	1.3	0.2	477.3	0.3	477.2
01Jan2013	04:50	1.4	0.2	477.3	0.3	477.2
01Jan2013	04:55	1.4	0.2	477.3	0.3	477.2
01Jan2013	05:00	1.5	0.2	477.3	0.3	477.2
01Jan2013	05:05	1.5	0.2	477.4	0.3	477.2
01Jan2013	05:10	1.5	0.2	477.4	0.3	477.2
01Jan2013	05:15	1.6	0.3	477.4	0.4	477.3
01Jan2013	05:20	1.6	0.3	477.4	0.4	477.3
01Jan2013	05:25	1.7	0.3	477.4	0.4	477.3
01Jan2013	05:30	1.7	0.3	477.5	0.4	477.3
01Jan2013	05:35	1.7	0.3	477.5	0.4	477.3
01Jan2013	05:40	1.8	0.3	477.5	0.4	477.3
01Jan2013	05:45	1.9	0.3	477.5	0.5	477.3
01Jan2013	05:50	1.9	0.3	477.5	0.5	477.3
01Jan2013	05:55	1.9	0.3	477.6	0.5	477.4
01Jan2013	06:00	2.0	0.3	477.6	0.5	477.4
01Jan2013	06:05	2.0	0.4	477.6	0.5	477.4
01Jan2013	06:10	2.1	0.4	477.6	0.6	477.4
01Jan2013	06:15	2.1	0.4	477.7	0.6	477.4
01Jan2013	06:20	2.2	0.4	477.7	0.6	477.4
01Jan2013	06:25	2.3	0.4	477.7	0.6	477.5
01Jan2013	06:30	2.4	0.4	477.7	0.7	477.5
01Jan2013	06:35	2.4	0.4	477.8	0.7	477.5
01Jan2013	06:40	2.5	0.4	477.8	0.7	477.5
01Jan2013	06:45	2.6	0.4	477.8	0.7	477.6
01Jan2013	06:50	2.7	0.5	477.8	0.8	477.6
01Jan2013	06:55	2.8	0.5	477.9	0.8	477.7
01Jan2013	07:00	3.0	0.5	477.9	0.8	477.8
01Jan2013	07:05	3.1	0.5	477.9	0.8	477.9
01Jan2013	07:10	3.2	0.5	478.0	0.9	477.9

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	07:15	3.4	0.5	478.0	0.9	478.0
01Jan2013	07:20	3.5	0.5	478.0	0.9	478.0
01Jan2013	07:25	3.7	0.6	478.0	1.0	478.0
01Jan2013	07:30	3.9	0.6	478.1	1.0	478.1
01Jan2013	07:35	4.1	0.6	478.1	1.0	478.1
01Jan2013	07:40	4.2	0.6	478.1	1.0	478.1
01Jan2013	07:45	4.4	0.7	478.1	1.1	478.1
01Jan2013	07:50	4.6	0.7	478.2	1.1	478.2
01Jan2013	07:55	4.8	0.7	478.2	1.2	478.2
01Jan2013	08:00	5.0	0.7	478.2	1.2	478.2
01Jan2013	08:05	5.2	0.8	478.3	1.2	478.2
01Jan2013	08:10	5.4	0.8	478.3	1.3	478.3
01Jan2013	08:15	5.7	0.8	478.3	1.3	478.3
01Jan2013	08:20	6.0	0.8	478.4	1.4	478.3
01Jan2013	08:25	6.3	0.9	478.4	1.4	478.4
01Jan2013	08:30	6.6	0.9	478.4	1.5	478.4
01Jan2013	08:35	7.0	0.9	478.5	1.5	478.4
01Jan2013	08:40	7.4	1.0	478.5	1.6	478.5
01Jan2013	08:45	7.8	1.0	478.6	1.6	478.5
01Jan2013	08:50	8.2	1.1	478.6	1.7	478.6
01Jan2013	08:55	8.6	1.1	478.7	1.8	478.6
01Jan2013	09:00	9.0	1.2	478.7	1.8	478.7
01Jan2013	09:05	9.5	1.2	478.8	1.9	478.8
01Jan2013	09:10	9.9	1.3	478.8	2.0	478.8
01Jan2013	09:15	10.1	1.3	478.9	2.1	478.9
01Jan2013	09:20	10.3	1.4	479.0	2.1	479.0
01Jan2013	09:25	10.6	1.4	479.0	2.2	479.0
01Jan2013	09:30	10.8	1.5	479.1	2.3	479.1
01Jan2013	09:35	11.0	1.6	479.1	2.4	479.2
01Jan2013	09:40	11.3	1.6	479.2	2.4	479.3
01Jan2013	09:45	11.7	1.7	479.2	2.5	479.4

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	09:50	12.1	1.7	479.3	2.6	479.5
01Jan2013	09:55	12.6	1.8	479.3	2.6	479.5
01Jan2013	10:00	13.1	1.9	479.4	2.7	479.6
01Jan2013	10:05	13.6	1.9	479.4	2.8	479.6
01Jan2013	10:10	14.3	2.0	479.5	2.9	479.6
01Jan2013	10:15	15.0	2.1	479.6	3.0	479.7
01Jan2013	10:20	15.7	2.2	479.6	3.1	479.7
01Jan2013	10:25	16.5	2.3	479.7	3.2	479.8
01Jan2013	10:30	17.3	2.4	479.8	3.3	479.8
01Jan2013	10:35	18.3	2.5	479.9	3.4	479.9
01Jan2013	10:40	19.3	2.6	479.9	3.5	480.0
01Jan2013	10:45	20.4	2.7	480.0	3.6	480.0
01Jan2013	10:50	21.8	2.8	480.1	3.7	480.1
01Jan2013	10:55	23.2	2.9	480.2	3.8	480.2
01Jan2013	11:00	24.7	3.1	480.3	3.9	480.3
01Jan2013	11:05	26.3	3.2	480.4	4.0	480.4
01Jan2013	11:10	28.3	3.4	480.5	4.1	480.5
01Jan2013	11:15	30.7	3.6	480.6	4.2	480.6
01Jan2013	11:20	33.5	3.8	480.8	4.4	480.8
01Jan2013	11:25	36.5	4.0	480.9	4.5	480.9
01Jan2013	11:30	39.4	4.2	481.1	4.7	481.1
01Jan2013	11:35	45.3	4.5	481.2	4.8	481.2
01Jan2013	11:40	61.6	4.8	481.5	5.0	481.5
01Jan2013	11:45	92.9	5.3	481.8	5.2	481.8
01Jan2013	11:50	145.1	6.1	482.3	5.6	482.3
01Jan2013	11:55	225.1	7.3	483.1	7.6	483.1
01Jan2013	12:00	294.8	8.9	484.0	35.8	484.0
01Jan2013	12:05	292.5	10.6	484.9	82.8	484.9
01Jan2013	12:10	231.4	11.5	485.4	166.1	485.6
01Jan2013	12:15	226.2	11.8	485.6	198.0	485.7
01Jan2013	12:20	226.7	12.0	485.7	212.5	485.7

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	12:25	211.3	12.0	485.7	215.8	485.8
01Jan2013	12:30	187.9	11.9	485.6	207.6	485.7
01Jan2013	12:35	164.0	11.8	485.6	191.5	485.7
01Jan2013	12:40	142.5	11.6	485.5	172.0	485.6
01Jan2013	12:45	124.8	11.4	485.3	152.4	485.5
01Jan2013	12:50	110.3	11.2	485.3	134.7	485.4
01Jan2013	12:55	99.2	11.0	485.2	119.4	485.3
01Jan2013	13:00	90.9	10.9	485.1	107.0	485.2
01Jan2013	13:05	85.1	10.8	485.1	97.3	485.1
01Jan2013	13:10	82.8	10.7	485.0	90.5	485.0
01Jan2013	13:15	81.1	10.7	485.0	86.9	485.0
01Jan2013	13:20	79.5	10.6	485.0	85.7	485.0
01Jan2013	13:25	78.1	10.6	484.9	84.4	484.9
01Jan2013	13:30	76.6	10.6	484.9	83.1	484.9
01Jan2013	13:35	74.9	10.5	484.9	81.8	484.9
01Jan2013	13:40	73.4	10.5	484.9	80.4	484.9
01Jan2013	13:45	72.0	10.4	484.8	79.0	484.9
01Jan2013	13:50	70.6	10.4	484.8	77.6	484.8
01Jan2013	13:55	69.2	10.3	484.8	76.2	484.8
01Jan2013	14:00	67.8	10.3	484.8	74.8	484.8
01Jan2013	14:05	66.4	10.2	484.7	73.4	484.8
01Jan2013	14:10	65.1	10.2	484.7	72.0	484.7
01Jan2013	14:15	63.8	10.1	484.7	70.6	484.7
01Jan2013	14:20	62.5	10.1	484.7	69.2	484.7
01Jan2013	14:25	61.2	10.0	484.6	67.9	484.7
01Jan2013	14:30	60.0	10.0	484.6	66.6	484.6
01Jan2013	14:35	58.8	9.9	484.6	65.3	484.6
01Jan2013	14:40	57.6	9.9	484.6	64.0	484.6
01Jan2013	14:45	56.5	9.9	484.5	62.7	484.6
01Jan2013	14:50	55.4	9.8	484.5	61.5	484.5
01Jan2013	14:55	54.4	9.8	484.5	60.3	484.5

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	15:00	53.2	9.7	484.5	59.1	484.5
01Jan2013	15:05	51.7	9.7	484.4	57.9	484.5
01Jan2013	15:10	50.2	9.7	484.4	56.6	484.5
01Jan2013	15:15	48.6	9.6	484.4	55.3	484.4
01Jan2013	15:20	47.0	9.6	484.4	53.9	484.4
01Jan2013	15:25	45.4	9.5	484.3	52.5	484.4
01Jan2013	15:30	43.9	9.5	484.3	51.1	484.3
01Jan2013	15:35	42.4	9.4	484.3	49.6	484.3
01Jan2013	15:40	40.9	9.4	484.3	48.2	484.3
01Jan2013	15:45	39.5	9.3	484.2	46.7	484.2
01Jan2013	15:50	38.0	9.3	484.2	45.3	484.2
01Jan2013	15:55	36.3	9.2	484.2	43.8	484.2
01Jan2013	16:00	34.7	9.2	484.1	42.3	484.2
01Jan2013	16:05	33.3	9.1	484.1	40.8	484.1
01Jan2013	16:10	31.9	9.1	484.1	39.3	484.1
01Jan2013	16:15	30.7	9.0	484.1	37.8	484.1
01Jan2013	16:20	29.5	9.0	484.0	36.4	484.0
01Jan2013	16:25	28.6	8.9	484.0	35.1	484.0
01Jan2013	16:30	27.7	8.9	484.0	34.3	484.0
01Jan2013	16:35	26.8	8.8	483.9	33.5	484.0
01Jan2013	16:40	25.9	8.8	483.9	32.7	483.9
01Jan2013	16:45	25.2	8.7	483.9	31.9	483.9
01Jan2013	16:50	24.4	8.7	483.9	31.1	483.9
01Jan2013	16:55	23.8	8.6	483.8	30.3	483.9
01Jan2013	17:00	23.2	8.6	483.8	29.6	483.9
01Jan2013	17:05	22.7	8.5	483.8	28.9	483.8
01Jan2013	17:10	22.0	8.5	483.8	28.1	483.8
01Jan2013	17:15	21.3	8.5	483.7	27.4	483.8
01Jan2013	17:20	20.7	8.4	483.7	26.7	483.8
01Jan2013	17:25	20.1	8.4	483.7	26.0	483.8
01Jan2013	17:30	19.6	8.3	483.7	25.3	483.7

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	17:35	19.1	8.3	483.6	24.7	483.7
01Jan2013	17:40	18.7	8.3	483.6	24.0	483.7
01Jan2013	17:45	18.3	8.2	483.6	23.4	483.7
01Jan2013	17:50	17.8	8.2	483.6	22.8	483.7
01Jan2013	17:55	17.4	8.2	483.6	22.3	483.7
01Jan2013	18:00	17.1	8.1	483.5	21.7	483.6
01Jan2013	18:05	16.8	8.1	483.5	21.2	483.6
01Jan2013	18:10	16.5	8.1	483.5	20.7	483.6
01Jan2013	18:15	16.2	8.0	483.5	20.2	483.6
01Jan2013	18:20	16.0	8.0	483.5	19.7	483.6
01Jan2013	18:25	15.7	8.0	483.5	19.3	483.6
01Jan2013	18:30	15.5	8.0	483.4	18.9	483.6
01Jan2013	18:35	15.2	7.9	483.4	18.5	483.6
01Jan2013	18:40	14.9	7.9	483.4	18.1	483.5
01Jan2013	18:45	14.7	7.9	483.4	17.8	483.5
01Jan2013	18:50	14.5	7.9	483.4	17.4	483.5
01Jan2013	18:55	14.3	7.9	483.4	17.1	483.5
01Jan2013	19:00	14.1	7.8	483.4	16.8	483.5
01Jan2013	19:05	13.9	7.8	483.4	16.5	483.5
01Jan2013	19:10	13.7	7.8	483.3	16.2	483.5
01Jan2013	19:15	13.5	7.8	483.3	15.9	483.5
01Jan2013	19:20	13.3	7.8	483.3	15.6	483.5
01Jan2013	19:25	13.2	7.8	483.3	15.3	483.4
01Jan2013	19:30	13.0	7.7	483.3	15.1	483.4
01Jan2013	19:35	12.8	7.7	483.3	14.8	483.4
01Jan2013	19:40	12.6	7.7	483.3	14.6	483.4
01Jan2013	19:45	12.4	7.7	483.3	14.4	483.4
01Jan2013	19:50	12.2	7.7	483.3	14.1	483.4
01Jan2013	19:55	12.1	7.7	483.3	13.9	483.4
01Jan2013	20:00	11.9	7.7	483.3	13.7	483.4
01Jan2013	20:05	11.7	7.6	483.3	13.5	483.4

Date	Time	Inflow (CFS)	Storage (AC-FT)	Elevation (FT)	Outflow (CFS)	Stage (FT)
01Jan2013	20:10	11.6	7.6	483.2	13.3	483.3
01Jan2013	20:15	11.5	7.6	483.2	13.1	483.3
01Jan2013	20:20	11.3	7.6	483.2	12.9	483.3
01Jan2013	20:25	11.2	7.6	483.2	12.7	483.3
01Jan2013	20:30	11.1	7.6	483.2	12.5	483.3
01Jan2013	20:35	11.0	7.6	483.2	12.4	483.3
01Jan2013	20:40	10.9	7.6	483.2	12.2	483.3
01Jan2013	20:45	10.8	7.6	483.2	12.1	483.3
01Jan2013	20:50	10.7	7.6	483.2	11.9	483.3
01Jan2013	20:55	10.6	7.5	483.2	11.8	483.3
01Jan2013	21:00	10.5	7.5	483.2	11.7	483.3
01Jan2013	21:05	10.5	7.5	483.2	11.5	483.3
01Jan2013	21:10	10.4	7.5	483.2	11.4	483.3
01Jan2013	21:15	10.3	7.5	483.2	11.3	483.2
01Jan2013	21:20	10.3	7.5	483.2	11.2	483.2
01Jan2013	21:25	10.3	7.5	483.2	11.1	483.2
01Jan2013	21:30	10.2	7.5	483.2	11.0	483.2
01Jan2013	21:35	10.1	7.5	483.2	10.9	483.2
01Jan2013	21:40	10.1	7.5	483.2	10.8	483.2
01Jan2013	21:45	10.1	7.5	483.2	10.7	483.2
01Jan2013	21:50	10.0	7.5	483.2	10.7	483.2
01Jan2013	21:55	9.9	7.5	483.2	10.6	483.2
01Jan2013	22:00	9.9	7.5	483.2	10.5	483.2
01Jan2013	22:05	9.8	7.5	483.2	10.4	483.2
01Jan2013	22:10	9.8	7.5	483.1	10.4	483.2
01Jan2013	22:15	9.8	7.5	483.1	10.3	483.2
01Jan2013	22:20	9.7	7.5	483.1	10.2	483.2
01Jan2013	22:25	9.7	7.4	483.1	10.2	483.2
01Jan2013	22:30	9.6	7.4	483.1	10.1	483.2
01Jan2013	22:35	9.5	7.4	483.1	10.1	483.2
01Jan2013	22:40	9.5	7.4	483.1	10.0	483.2

TOP DOME AND SIDESLOPE VELOCITY CALCULATIONS

INTERMEDIATE COVER

Analysis Element	S	L	DA	C	Tc	I ₂₅	q ₂₅	n	y	V
	(ft./ft.)	(ft.)	(ac.)		(min.)	(in/hr)	(cfs/ft.)		(ft.)	(fps)
Top Dome	0.05	95	0.0022	0.65	10	8.7	0.012	0.025	0.015	0.82
Sideslope	0.25	790	0.0181	0.65	10	8.7	0.103	0.025	0.033	3.08

FINAL COVER

Analysis Element	Slope	Longest Flow Length	Drainage Area	C	Tc	I ₂₅	q ₂₅	n	y	V
	(%)	(ft.)	(ac.)		(min.)	(in/hr)	(cfs/ft.)		(ft.)	(fps)
Top Dome	0.05	95	0.0022	0.61	10	8.7	0.012	0.03	0.016	0.71
Sideslope	0.25	165	0.0038	0.61	10	8.7	0.020	0.03	0.014	1.44

Where:

Slope, S (ft./ft.) = Slope of Analysis Element

Longest Flow Length, L (ft.) = Longest flow length contributing to flow

Drainage Area, DA (acres) = L (ft) X Unit Width (ft) / 43,560 sf/acre

Rational Method Runoff Coefficient, C (unitless) = Cr+Ci+Cv+Cs for Rural Watersheds From TxDOT

Hydraulic Manual Table 4-11 as indicated in the attached Reference Material

Time of Concentration, Tc (min.) = 10 min. (Typical conservative value)

25-yr, 24-hr. Rainfall Intensity, I₂₅ (in./hr.) = 8.7 in./hr. (based on 10 min. Tc)

25-yr, 24-hr. Flow Rate per unit width, q₂₅ (cfs/ft) = Peak Flow Rate for 1-ft unit width

Mannings Roughness Coefficient, n (unitless) = From TxDOT Hydraulic Design Manual Table 4-7

Floodplain pasture, no brush and short grass for Final Cover

Floodplain cultivated areas, no crops for Intermediate Cover

Flow Depth, y (ft.) = $((q_{25} \times n) / 1.49 \times S^{0.5})^{0.6}$

Peak Flow Velocity, V (fps) = q₂₅ / (y X unit width)

Appendix 6B: Erosion and Sedimentation Control Plan

Revised June 2015

- **Drainage Channels, Interceptor Berms and Check Dams** – Drainage channels and interceptor berms will be used to direct stormwater run-off away from working areas and into sedimentation ponds. Channels and berms will be designed to convey the design run-off at non-erosive velocities. Where velocities cannot be kept below the non-erosive level, the channel will be armored with rock riprap. At specified locations, rock check dams will be placed in channels to reduce discharge velocities and capture suspended sediment prior to leaving the site. Interceptor berms shall be constructed on the final cover at a maximum of 40 vertical-feet intervals to keep soil loss below the 3 ton/year allowable threshold as is demonstrated in the soil loss calculations provided in Attachment 12, Appendix B. Perimeter and rundown channels will be installed as shown on the drainage plans in Attachment 6.
- **Sedimentation Ponds** – Onsite channels will direct run-off to sedimentation ponds designed to hold water long enough for sediment to settle, allowing less sediment from leaving the site. Sediment captured during rainfall events will collect in these ponds and will have to be periodically removed to maintain the pond's design capacity. The design operation characteristics of each pond are described in Part III, Attachment 6.
- **Vegetation** – Due to the dry climate conditions of Webb County, the advantages of temporarily vegetating areas will be limited. Perimeter areas of the landfill that are not impacted by ongoing site operations or construction will be vegetated and allowed to grow undisturbed. Landfill areas that reach final permitted elevations may be vegetated or have an alternative cover placed in accordance with the Final Cover Plan presented in Part III, Attachment 12.
- **Silt Fences and Hay Bales** – Silt fences and hay bales will be installed where sheet flow occurs such as around the base of soil stockpile areas, active excavation and construction areas, along/around drainage features, and other areas as necessary to minimize transport of sediment in stormwater runoff. Silt fences will be placed so that the intercepted drainage area does not exceed the manufacturer's specification and in no case greater than 0.5 acre per 100 feet of silt fence.
- **Compost Filter Berms** – Compost filter berms or mesh socks filled with compost, mulch, straw, or similar materials may be installed at the bottom or on sides of slopes, and at locations along the perimeter drainage system to intercept runoff, capture sediments from the runoff, reduce flow velocity, and release the runoff as sheet flow. Filter berms should be at least 1-foot high by 2-feet wide and not allow stormwater to pool on the landfill cover system.
- **Rock Armoring** – The top of dome and 4:1 sideslopes may be protected from erosion by the placement of rock armoring on the surface of the hills. This option may be used if vegetative cover cannot be successfully established due to

climatic conditions. The rock armor cover alternative is presented in the Final Cover Plan presented in Part III, Attachment 12, which includes soil loss calculations.

As permanent drainage and erosion control measures are constructed and become affective during the operating phase of the landfill, the temporary erosion control measures may be removed.

2.1.2 Non-Structural Controls are BMPs that do not involve a structured or engineered solution. They include such measures as site inspection, site maintenance, phased development planning, education, and following stormwater management regulations. The Final Cover Plan identifies the non-structural erosion prevention/control measures to be taken during the closure process for areas of the landfill.

During the development process, non-structural erosion prevention and control measures will need to be employed prior to final cover being installed. Since vegetation will be difficult and/or slow to become established to an affective level, post-rainfall and periodic inspection and maintenance of the hill tops, sloped surfaces and drainage features will be necessary. Landfill personnel will make an inspection of all erosion prevention and drainage facilities at least once per month. On the next working day after a significant rainfall event that historically generates erosive conditions at the landfill, the erosion control devices and drainage structures will be inspected by site personnel for integrity and performance. Any failures or inoperable structures will be repaired as soon as feasible. Each inspection, maintenance operation or repair performed will be documented by the landfill operator in the Site Operating Record. The landfill operator is required to maintain the drainage facilities at all times so that run-off will not flow into the active portion of the landfill and solid waste or leachate will not be discharged from the site. The dry climate does reduce the number of rain events that will require post-event surface maintenance. Inspection, maintenance and repair operations will be performed by qualified personnel and these erosion control plans will be part of the training curricula.

Continual inspection of the site's temporary and permanent erosion control devices will be necessary to identify failures prior to expected rainfall events. Drainage structures will need to be inspected to determine operational capability and to determine remaining holding capacities of sedimentation ponds. All sediment removed from the ponds, channels and other structures and devices will be utilized in waste operations or site maintenance. Sediment removal will be accomplished using typical excavation equipment and trucks.

3. Soil Loss Calculation

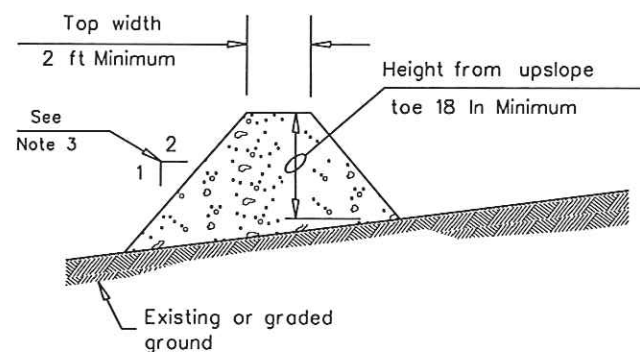
Soil loss calculations were completed using the Revised Soil Loss Equation (RUSLE) as provided by the National Resource Conservation Service (NRCS). These calculations are presented in Attachment 12, Appendix ~~A-3B~~.

4. Permissible Non-erodible Velocity Calculation

Temporary and permanent erosion control measures during fill operations and post-closure are provided to prevent and reduce erosion and sediment transfer from the site. The final cover of the top domes will have a maximum slope of 5.0% and sideslopes will have a maximum slope of 25% (4H:1V). Overland flow velocities created by the proposed landfill design should be below the non-erosive velocity for similar soil and vegetative cover conditions. A typically used maximum non-erosive flow velocity for a similar sparsely vegetated intermediate cover condition is 4 feet per second (fps). For the final cover, the maximum non-erosive velocity is 3 fps based on a surface partially vegetated with short grass.

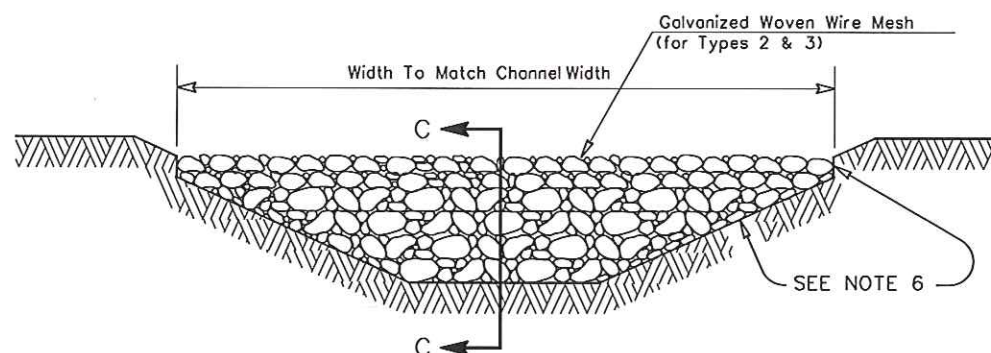
Overland sheet flow velocities were calculated for the worst case situation for the top domes and sideslopes. The methodology used to calculate the sheet flow velocities is provided in Attachment 6, Section 1.3.6 – Erosion Stability. The calculated velocities will then be compared to the maximum non-erosive velocities to check that erosive conditions are not being created.

The worst case situation is where the longest overland flow length is experienced. For both the top dome and sideslopes in both the intermediate and final cover conditions, this occurs on the north face of the western finished hill. There, the maximum top dome flow length is 95 feet for each cover condition and the maximum sideslope flow length is 790 feet for the intermediate cover condition and 165 feet for the final cover. Using the methodology described above for the intermediate cover condition, the 5% top dome slope creates a maximum flow velocity of 0.82 fps and 3.08 fps for the 25% sideslope. Both of these calculated values are less than the 4 fps maximum non-erosive velocity for intermediate cover and are therefore acceptable. For the final cover condition, the 5% top dome slope creates a maximum flow velocity of 0.71 fps and 1.44 fps for the 25% sideslope. Both of these calculated values are less than the 3 fps maximum non-erosive velocity for the final cover and are therefore acceptable. The calculations for overland sheet flow velocities are provided in Appendix 6A – Drainage Structures – Design Calculations.



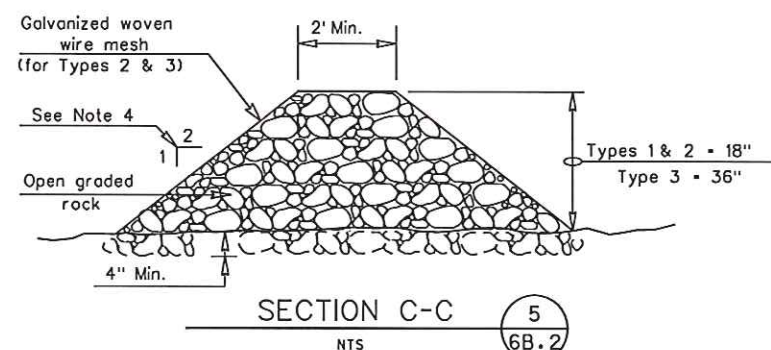
TYPICAL BERM SECTION
NTS

1
6B.2



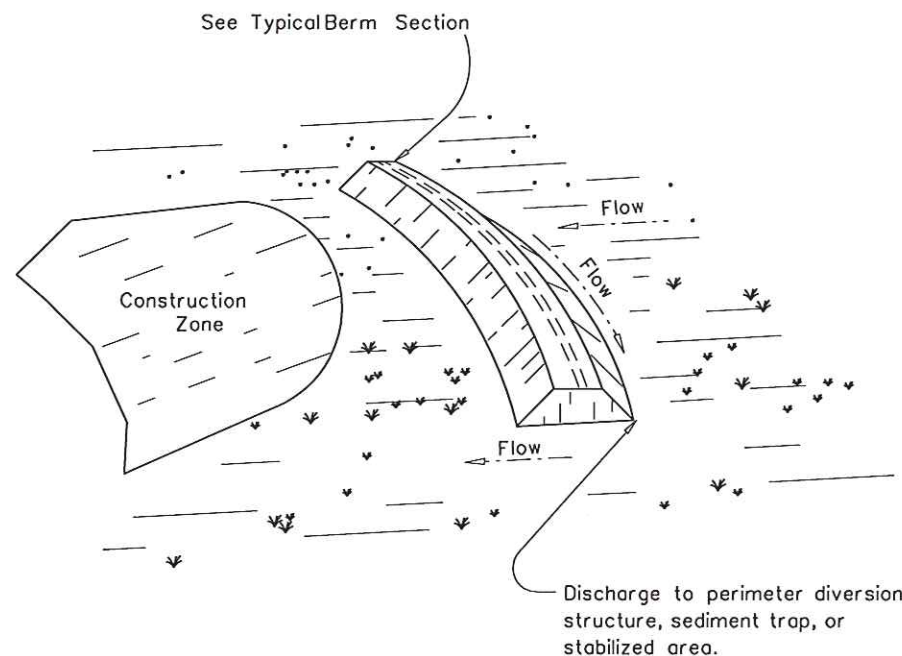
FILTER DAM AT CHANNEL SECTIONS
NTS

4
6B.2



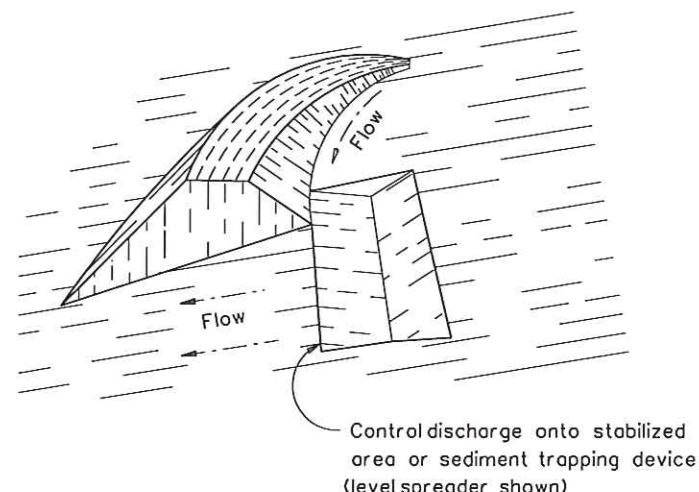
SECTION C-C
NTS

5
6B.2



INTERCEPTOR BERM
NTS

2
6B.2



PERIMETER BERM
NTS

3
6B.2

BERM USAGE GUIDELINES

A berm may be used to intercept runoff and divert it around unstabilized areas or to divert sediment laden runoff to an erosion control device (sediment basin or trap, rock filter dam, etc.).

The drainage area contributing runoff to a berm should not exceed 5 acres. The spacing of berms should be as follows:

Slope of disturbed areas above berm	greater than 10%	5 - 10%	less than 5%
Maximum distance between berms	100'	200'	300'

Intercepted runoff flowing along a berm should outlet to a stabilized area (vegetation, rock, etc.).

ROCK FILTER DAM USAGE GUIDELINES

Rock Filter Dams should be constructed downstream from disturbed areas to intercept sediment from overland runoff and/or concentrated flow. The dams should be sized to filter a maximum flow through rate of 60 GPM/FT² of cross sectional area. A 2 year storm frequency may be used to calculate the flow rate.

Type 1 (18" high with no wire mesh): Type 1 may be used at the toe of slopes, around inlets, in small ditches, and at dike or swale outlets. This type of dam is recommended to control erosion from a drainage area of 5 acres or less. Type 1 may not be used in concentrated high velocity flows (approx. 8 Ft/Sec or more) in which aggregate wash out may occur. Sandbags may be used at the embedded foundation (4" deep min.) for better filtering efficiency of low flows if called for on the plans or directed by the Engineer.

Type 2 (18" high with wire mesh): Type 2 may be used in ditches and at dike or swale outlets.

Type 3 (36" high with wire mesh): Type 3 may be used in stream flow and should be secured to the stream bed.

Type 4 (Sack gabions): Type 4 May be used in ditches and smaller channels to form an erosion control dam.

GENERAL NOTES:

1. Soil used in dike construction shall be machine compacted.
2. Top width and height of dike may be modified with prior approval of the Engineer.
3. Side slopes within the safety clear zone of a roadway shall be 6:1 or flatter.
4. Grading shall be shown elsewhere in the plans or as directed by the Engineer.
5. The Engineer reserves the right to modify the dimensions shown for the dike dependent on runoff volume characteristics.
6. Dikes that are in place for more than 14 calendar days should be stabilized to prevent sediment runoff.
7. The guidelines shown hereon are suggestions only and may be modified by the Engineer.

FOR PERMIT PURPOSES ONLY		1 6/18/15 NOD NO. 1		SBH	SBH
REV	DATE	DESCRIPTION		DES BY	APP BY
CITY PROJ. No.		LAREDO LANDFILL VERTICAL EXPANSION			
AZB PROJ. No. 212029		PERMIT AMENDMENT APPLICATION No. MSW-1693B			
DATE: AUGUST 2014		WEBB COUNTY, TEXAS			
DES BY	SH	EROSION CONTROL DETAILS			
DRN BY	AZB	BERM & CHECK DAMS			
CHK BY	SH	FIGURE III-6B.2			
APP BY	MC				
CITY OF LAREDO		SHEET OF			
		FILE:			
		ATTACHMENT:			
		III-6B			

AZ&B ARREDONDO, ZEPEDA & BRUNZ, LLC
TYPE FIRM REG. # F-10038
CIVIL • ENVIRONMENTAL • SURVEYING
CONSTRUCTION MANAGEMENT • MUNICIPAL

City of Laredo Landfill Permit Amendment 1693B
City of Laredo, Texas
Permit Amendment MSW Permit 1693B
Laredo, Texas
Webb County, Texas
August 2014
Revised June 2015

PART III
Attachment 10
Soil and Liner Quality Control Plan
§330.339

~~**10A Soil and Liner Quality Control Plan for the Type I Cells**~~
~~**10B Soil and Liner Quality Control Plan for the Type IV Cells**~~
~~**10C Geosynthetic Clay Liner Quality Control Plan for the Type IV Cells**~~

TABLE II-2
SOIL CONSTRUCTION TESTING FREQUENCIES

City of Laredo
Webb County, Texas

SOIL TEST CATEGORY	TYPE OF TEST	STANDARD TEST METHOD ^B	FREQUENCY OF TESTING
Quality Control Testing of Source Borrow Materials	Moisture/Density Relationship	ASTM D 698 or D 1557	Once per soil type <u>(B)</u>
	Sieve (Gradation)	ASTM D 422 or D 1140	
	Atterberg Limits	ASTM D 4318	
	Coefficient of Permeability	ASTM D 5084 or CoE EM1110-2-1906	1/Moisture/Density Relationship
Constructed Soil Liners	Field Density	ASTM D 1556, D 2167, or D 6938	1/8,000 ft ² per 6-inch parallel lift ^A ; 1/100 lineal ft per 12 inches sidewall liner (horizontal lifts) ^A
	Sieve (Gradation)	ASTM D 422 or D 1140	1/100,000 ft ² per 6-inch parallel lift ^A ; 1/2000 lineal ft per 12 inches sidewall liner (horizontal lifts) ^A
	Atterberg Limits	ASTM D 4318	
	Coefficient of Permeability	ASTM D 5084 or CoE EM1110-2-1906 (laboratory) Air-Entry Permeameter (field)	
	Thickness	Registered Surveyor	1/5,000 ft ² (parallel lifts) ^A ; 50-ft cross-sections (horizontal-lift sidewall liners) ^A

Notes:

A- A minimum of one of each of the designated tests must be conducted for each unit thickness of liner as indicated, regardless of liner area or length.

A-B- The soil type shall be based on different locations (i.e. off-site locations), color, and texture of the material.

If the anchor trench is excavated in a supporting soil susceptible to desiccation, no more than the amount of trench required for the geomembrane to be anchored in one day shall be excavated (unless otherwise specified) to minimize desiccation potential of the anchor trench soils. Backfilling of the anchor trench shall be conducted in accordance with the project specifications.

4.2 Geomembrane Placement

4.2.1 Panel Identification

A panel is the unit area of geomembrane which is to be seamed in the field, i.e., a panel is a roll or a portion of roll cut in the field.

Each panel shall be given an "identification code" (number or letter-number) consistent with the layout plan. This identification code shall be agreed upon by the Owner/Project Manager, Installer and the CQA personnel. This panel identification code shall be as simple and logical as possible. (Note that roll numbers established in the manufacturing plant are usually cumbersome and are not related to location in the field.)

4.2.2 Panel Placement

4.2.2.1 Location

The CQA personnel shall verify that panels are generally installed at the location indicated in the Design Engineer's or Installer's layout plan, as approved or modified.

The CQA personnel shall establish an "as-built" panel layout drawing showing panel numbers. The panel layout drawing shall also include seam numbers, test locations, and repair locations.

4.2.2.2 Installation Schedule

Field panels will be installed to protect any GCL that was placed on any given day. Installation normally should begin at the high point area and proceed toward the low point with "shingle" overlaps to facilitate drainage in the event of precipitation. It is also usually beneficial to proceed in the direction of prevailing winds. Accordingly, an early decision regarding installation scheduling should be made if and only if weather conditions can be predicated with certainty. Otherwise, scheduling decisions must be made during installation, in accordance with varying conditions. In any event, the Installer is fully responsible for the decision made regarding placement procedures.

~~Panels may be installed, as approved, using any one of the following schedules:~~

- ~~• All panels are placed prior to field seaming (in order to protect the subgrade from desiccation by drying or erosion by rain);~~
- ~~• Panels are placed one at a time and each panel is seamed immediately after its placement (in order to minimize the number of unsealed panels exposed to wind); and~~

- ~~Any combination of the above.~~

~~If a decision is reached to place all panels prior to field seaming, it is usually beneficial to begin in the sump area and proceed upward and outward with "shingle" overlaps to facilitate drainage in the event of precipitation. It is also usually beneficial to proceed in the direction of prevailing winds. Accordingly, an early decision regarding installation scheduling should be made if and only if weather conditions can be predicted with reasonable certainty. Otherwise, scheduling decisions must be made during installation, in accordance with varying conditions.~~

The CQA Officer shall evaluate every change in the schedule proposed by the Installer and advise the Project Manager on the acceptability of that change. The CQA personnel shall verify that the condition of the supporting soil has not changed detrimentally during installation.

The CQA personnel shall record the identification code, location and date of installation of each panel.

4.2.2.24.2.2.3 Weather Conditions

Geomembrane placement shall not proceed at an ambient temperature below 5°C (40°F) or above 40°C (104°F) unless otherwise authorized. Geomembrane placement shall not be done during any precipitation, in the presence of excessive moisture (e.g. fog, dew), in an area of ponded water, or in the presence of excessive winds. Additionally, the CQA personnel shall verify that the supporting soil has not been damaged by weather condition.

The CQA personnel shall verify that the above conditions are fulfilled, and shall inform the Owner/Project Manager if geomembrane is installed during adverse weather conditions.

4.2.2.34.2.2.4 Method of Placement

The CQA personnel shall verify and document the following:

- Weather conditions including temperature, wind and humidity;
- Any small equipment with low contact pressure used by the Installer does not damage the geomembrane by handling, trafficking, excessive heat, leakage of hydrocarbons or other means;
- Verify that no stones, construction debris, or other items are present beneath the geomembrane which could cause damage;
- All personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in other activities which could damage the geomembrane;
- Verify that the surface beneath the geomembrane has not deteriorated since previous acceptance;
- The method used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil;
- Observe the condition of the panels as they are deployed, and note any defects;
- The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels);

4.2.2.44.2.2.5 Damage

The CQA personnel, along with the Installer, shall inspect each panel after placement and prior to seaming for damage. The CQA personnel shall advise the Owner/Project Manager which panels, or portion of panels, should be rejected, repaired, or accepted. Damaged panels or portion of damaged panels which have been rejected shall be marked and their removal from this work area recorded by the CQA personnel. Repairs shall be made according to procedures described in Section 4.4.

4.3 Seaming

4.3.1 Seam Layout

The Design Engineer or the Installer shall provide the Owner/Project Manager with a drawing of the facility to be lined showing all expected seams. The Owner/Project Manager shall provide this seam layout to the CQA personnel. The CQA personnel shall review the seam layout and verify that it is consistent with accepted state of practice.

In general, seams should be oriented parallel to the line of maximum slope (i.e., oriented along, not across, the slope). In corners and odd-shaped geometric locations, the number of seams should be minimized. No horizontal seam (i.e. parallel to the toe of slope) should be placed on a slope, unless otherwise specified.

A seam numbering system compatible with the panel numbering system shall be agreed upon by the CQA personnel and the Installer.

There are two types of seams typically used to join HDPE membrane. These seams include extrusion, single fusion, and double fusion welds. Figure 2 (see Appendix A) illustrates the types of seams, destructive tests, and failure modes. A description of each type of seam follows:

- Extrusion- Welding of a seam where a ribbon of molten resin is introduced along the edge of a seam overlap. The molten polymer causes some of the material of each sheet to be liquefied resulting in a homogeneous bond between the molten weld bead and the surfaces of the sheets.
- Fusion- Welding of a seam where a heated wedge is placed between two overlapped sheets such that the surface of both sheets are heated above the melting point. Once heated by the wedge, the sheets are passed through a set of pressure wheels which compress the sheets together to form a continuous homogeneous fusion weld. This type of weld can be completed with either a single track or double track.

4.3.2 Overlapping and Temporary Bonding

The CQA personnel shall verify that:

- The panels of HDPE geomembrane are overlapped by a minimum of 4 inches for fusion welding and 3.5 inches for extrusion welding; and

4.3.7 General Seaming Procedures

Unless otherwise specified, the general seaming procedure used by the Installer shall be as follows:

- Seaming shall extend to the outside edge of panels to be placed in the anchor trench;
- If required, a firm substrate shall be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support; and
- Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane extending a minimum of 6 inches beyond the cut in all directions. There shall be no unrepaired folds, large wrinkles or fish mouths allowed along the seam.

During welding operations, the CQA personnel shall document the following:

- The extrudate is purged prior to beginning each weld until all the heat-degraded extrudate is removed (extrusion welding only);
- Seam grinding has been completed less than one hour before seam welding (extrusion welding only);
- The ambient temperature measured at the FML surface is above 40 degrees Fahrenheit;
- The end of old welds, more than five minutes old, are ground to expose new material before restarting a weld (extrusion welding only);
- The weld is free of dust and other debris;
- For cross seams, the seam is ground to a smooth incline prior to welding (fusion welding only);
- The seams are overlapped according to specifications;
- No solvents or adhesives are present in the seam area;
- The procedure used to temporarily hold the panels together does not damage the panels and does not preclude CQA testing;
- The panels are being welded in accordance with the construction drawings and specifications; and
- There is no free moisture in the weld area.

The CQA personnel shall verify that the above seaming procedures (or any other procedures agreed upon) are followed, and shall inform the Owner/Project Manager if they are not.

4.3.8 Non-destructive Seam Continuity Testing

4.3.8.1 Procedure for Non-destructive Testing

The Installer shall non-destructively test 100 percent of all field seams and factory seams (if used) over their full length using air-pressure testing or a vacuum rest unit. The purpose of this

test is to check the continuity of seams, and does not provide any information on seam strength. Continuity testing shall be done as the seaming work progresses, not at the completion of seaming. Air-pressure testing of seams shall be utilized whenever possible for double welded fusion seams. If air-pressure testing is impractical or not productive, (such as for short double welded fusion seams, extrusion welded seams or failed air-tested seams), then the seams shall be vacuum tested for continuity.

Air-pressure testing procedures of double welded fusion seams are as follows:

- Seal both ends of the seam to be tested;
- Insert a needle pressure feed device into the air channel created by the fusion weld;
- Energize an air pump to a pressure of approximately 30 psi, close valve and sustain pressure for at least five minutes;
- A pressure loss of 4 psi is acceptable if it is determined that the air channel is not blocked between the sealed ends;
- If loss of pressure exceeds 4 psi within five minutes, locate faulty area and repair
- Before removing needle or pressure feed device, the opposite end of the air channel shall be pierced, and the resulting pressure drop observed, to assure the entire seam has been tested; and
- The geotechnical professional or his representative ~~should~~will observe and record all pressure gauge readings.

The following procedures shall be followed for vacuum testing (ASTM D 4437):

- Energize the vacuum pump and reduce the tank pressure to approximately 5 psi absolute;
- Wet a strip of geomembrane approximately 12 inches by 48 inches with a soapy solution;
- Place the vacuum box over the wetted area;
- Close the bleed valve and open the vacuum valve;
- Ensure that a leak tight seal is created;
- For a period of approximately 10 to 15 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles;
- If no bubble(s) appear during the test, (excluding the areas at the ends of the vacuum box), close the vacuum valve and open the bleed valve, wet another strip of seam, move the box over the next adjoining area with a minimum 3 inch overlap, and repeat the process; and
- All areas where soap bubbles appear shall be marked and repaired in accordance with Section 4.4.

4.3.8.2 Quality Assurance of Non-destructive Testing

The CQA personnel shall:

- Observe all continuity testing;
- Record location, date, test unit number, name of tester, pressures used, time and outcome of all testing; and
- Inform the Installer and Owner/Project Manager of any required repairs.

The seam must be reconstructed in both directions from the original failed location and either one or both of the above procedures can be used to reconstruct the seam.

**TABLE III-1
FML TEST SPECIFICATIONS – 60 MIL HDPE**

City of Laredo
Webb County, Texas

TEST	TYPE OF TEST	STANDARD TEST METHOD	FREQUENCY OF TESTING
Resin	Density	ASTM D 1505	per 100,000 ft² and every resin lot
	Melt Flow Index	ASTM D 1238 (90/2.16 and 190/21.6)	
Manufacturer's Quality Control	Testing per GRI Standard GM13 ^A		
Conformance Testing by 3 rd Party Independent Laboratory	Thickness	ASTM D 5199 (smooth HDPE) or D 5994 (textured HDPE)	per 50,000 ft² and every resin lot
	Specific Gravity/Density	ASTM D 1505/D 792	per 100,000 ft² and every resin lot
	Carbon Black Content	ASTM D 1603	
	Carbon Black Dispersion	ASTM D 5596	
	Tensile Properties	ASTM D 6693 Type IV Dumbbell, 2 ipm, GL=2.0 in	
Destructive Seam Field Testing	Shear & Peel	ASTM D 6392	varies for field, lab, and archive
Non-destructive Seam Field Testing	Air Pressure	GRI GM12 GM6	all dual-track fusion
	Vacuum	ASTM D 4437	all non-air pressure tested seams when possible
	Other		concurrence of TCEQ

Notes:

A- UV Resistance testing not required for HDPE which is to be immediately covered.

4.7.2 Sumps and Appurtenances

A copy of the specifications prepared by the Design Engineer for sumps and appurtenances shall be given by the Owner/Project Manager to the CQA Officer. The CQA personnel shall review these specifications and verify the use of geosynthetic layers between concrete and geomembranes, if necessary.

The CQA personnel shall verify that:

- Installation of the geomembrane in sump and appurtenance areas, and connection of geomembrane to sumps appurtenances have been made according to the specifications;
- Extreme care is taken while welding around appurtenances since both non-destructive and destructive testing might not be feasible in these areas; and
- The geomembrane has not been visibly damaged while making connections to sumps and appurtenances.
- The CQA personnel will observe and record destructive testing and welding around the sumps and appurtenances.

The CQA personnel shall inform the Owner/Project Manager if the above conditions are not fulfilled.

SECTION IV: GEOTEXTILES AND GEONETS CQA

1.0 INTRODUCTION

Any geotextile and geonet (or geocomposite) materials used in conjunction with construction of the composite liner will be documented by the Manufacturers and CQA personnel. The following sections outline the quality assurance for geotextile and geonet materials.

2.0 MANUFACTURING

The Geotextile and geonet (or geocomposite) manufacturers will provide the Owner/Project Manager with a list of guaranteed "minimum average roll value" properties for the type of geotextile and geonet (or geocomposite) to be delivered. The manufacturer shall also provide a written quality control certification, signed by a responsible party employed by the Manufacturer, that the material delivered has properties that meet or exceed the guaranteed "minimum average roll value" properties. The contractor shall provide the material property data to the Owner/Project Manager when the product is delivered to the site.

Quality control certificates shall include the following:

- Roll identification numbers;
- Sampling procedures; and
- Results of quality control testing.

The Manufacturer of the geotextile shall provide, as a minimum, the following test results:

2.1.3 Gravel Packing Around Pipes

Gravel packing shall be placed around the collection pipes to ensure sufficient flow of leachate into the pipes. The gravel packing around the leachate collection pipes shall consist of rounded granular soils meeting the requirements of ASTM C 33 for coarse aggregate and Size No.4 gradation requirements or the requirements stated in the construction specifications, and shall have a permeability of 1×10^{-2} cm/s or greater as determined by ASTM D 2434. The gravel shall not have a calcium carbonate or calcium sulfate content that exceeds 15 percent by weight as determined by procedures set forth in the ASTM D 3042 modified method, since a calcium carbonate or calcium sulfate concentration above this value may induce clogging of the pipes when subjected to leachate.

The installation of the gravel packing shall be monitored to ensure the following:

- Gravel packing is properly placed around the collection pipes and meets the gradation requirements stated in the CQA manual of the construction specifications; and
- The gravel packing is properly wrapped and completely enclosed with a geotextile.

2.1.4 Sumps and Collection Trenches

Sumps and collection trenches should be constructed to the appropriate dimensions and grades. The thickness of day liner in the area of sumps and collection trenches shall be verified.

2.2 Granular Drainage Layer

This site may utilize a granular LCS drainage layer instead of using a geocomposite drainage layer with protective cover. The granular LCS drainage layer shall be constructed of rounded granular soils meeting the requirements of ASTM C 33 for coarse aggregate and Size No. 67 gradation requirements, or smaller, or the requirements stated in the construction specifications. These granular soils shall be selected on the basis of their permeability, grain size distribution, and calcium carbonate content. Once delivered at the site, the granular soils shall be tested to ensure that they meet the gradation and permeability specifications and are free from excessive amounts of fines or organic materials. The gravel shall be rounded and properly graded, and have a permeability, of 1×10^{-2} cm/s or greater as determined by ASTM D 2434. The percent of calcium carbonate or calcium sulfate shall not exceed 15 percent by weight, as determined by procedures set forth in the Concrete Handbook or the X-Ray Fluorescent technique respectively, to minimize clogging potential.

The granular drainage layer shall be a minimum 1-foot thick continuous granular blanket and the CQA personnel shall monitor the installation of the drainage layer to ensure the following:

- The thickness of the drainage layer meets the specified requirements; and
- The transport of fines by runoff into the LCS is prevented by barriers or filters.

Placement of the granular-material shall be conducted such that the material is not dumped or pushed directly on the geomembrane. The material shall be placed outside of the construction

During geotextile placement, the CQA personnel shall:

- Document all defects and corrective measures implemented to repair or eliminate the defects;
- Verify that equipment used does not damage the geotextile by equipment transit, leakage of hydrocarbons, or other means;
- Verify that people working on the geotextile do not smoke, wear shoes that could damage the geotextile, or engage in activities that could damage the geotextile;
- Verify that the geotextile are anchored to prevent movement by the wind;
- Verify that seams are overlapped in accordance with the specifications; and
- Verify that the panels are being joined in accordance with the specifications.

The CQA personnel shall inform both the construction contractor(s) and the Owner/Project Manager if the above conditions are not met.

All deficiencies with the geotextile shall be repaired in accordance with the construction specifications. The CQA personnel shall document all repairs on the daily construction report. Repair procedures may include the following:

- Patching- Used to repair large holes, tears, large defects, and destructive sample locations; and
- Removal- Used to replace areas with large defects where the preceding method is not appropriate.

3.0 PROTECTIVE COVER

A minimum 2-foot thick protective cover (2 feet on slopes using a geocomposite drainage layer) shall be placed over the LCS. The thickness of the protective cover shall be verified through subsequent surveys. The protective cover shall consist of onsite soils resulting from landfill excavation which will possess a permeability of approximately 1×10^{-4} cm/sec or greater after minimal compaction. The protective cover in conjunction with the LCS shall provide a minimum of 2 feet of protection to the FML. Care shall be implemented during placement of the protective cover to avoid damage to the LCS. The protective cover will be tested every 20,000 cy for permeability (ASTM D2434). If the protective cover does not meet the permeability criteria, gravel-filled leachate drains tied into the underlying drainage layer may be constructed.

The protective cover will be placed with low ground pressure equipment (< 5psi). In areas of heavy traffic (such as access ramps) the thickness should be at least 2 to 3 feet (< 16 psi equipment).

APPENDIX D
GEOSYNTHETIC CLAY LINER CQA

GEOSYNTHETIC CLAY LINER QUALITY ASSURANCE

1.0 INTRODUCTION

This document includes the requirements for selection, installation and protection of the Geosynthetic Clay Liner (GCL) as used in conjunction with the FML as the primary liner.

The overall goal of the GCL quality assurance program is to assure that proper construction techniques and procedures are implemented, and that the GCL is installed in accordance with construction drawings and specifications. The GCL portion of the liner system shall be installed and tested in accordance with the construction drawings and specifications, and this CQA document. To monitor compliance, the quality assurance program shall include:

- A review of the construction contractor's quality control submittals;
- Material conformance testing on samples collected prior to installation; and
- On-site construction monitoring.

2.0 MATERIALS

The GCL material to be used for this construction shall be an approved GCL, as either bentonite sandwiched between two geotextiles, such as Claymax produced by the James Clem Corporation, or bentonite bonded to a geomembrane, such as Gundseal produced by Gundle Lining Systems. The contractor shall provide the material property data to the Owner/Project Manager when the product is delivered to the site. The bentonite shall be natural sodium bentonite. The GCL shall meet the minimum specification for this project of a hydraulic conductivity of 5×10^{-9} cm/sec and an internal friction angle of 69° for unreinforced GCL in a hydrated state. A reinforced GCL ~~containing a nonwoven geotextile on both sides~~ shall be utilized on all cell side slopes. The material must exhibit an internal friction angle of 9° for the bottom liner system and 2418° for the final cover system. The Manufacturer shall provide "minimum specifications" for the GCL and its components (bentonite and geotextile/FML facing) prior to construction to verify conformity with project specifications. The Manufacturer shall also provide a written certification that the GCL and its components meet the "minimum specifications", that the GCL has been continuously inspected and found to be needle-free, and that the bentonite will not shift during transportation or installation.

Quality control certificates shall also be submitted by the Manufacturer, which will be signed by a responsible party of the Manufacturer, and shall contain roll identification numbers and results of quality control tests. The GCL Manufacturer quality control tests shall include, at a minimum, clay mass per unit area (minimum of 0.75 lbs/sq.ft., oven dried at 105°), water content of bentonite (maximum of 25%), free swell (minimum of 24 ml), permeability, fluid loss (maximum 18 ml), and internal shear resistance. The bentonite manufacturer quality control tests shall include, at a minimum, water content, free swell, and liquid limit (minimum of 500%) or plate water absorption (minimum of 800%). The geosynthetic manufacturer tests shall include at a minimum, mass per unit area and strength properties (e.g., grab and Mullen burst strength) for geotextiles or density, thickness, melt flow index, tensile properties, tear resistance, and puncture resistance for FMLs, depending on the material provided for use. The Owner and Engineer

TABLE D-1
LABORATORY TEST STANDARDS
FOR GCL MATERIALS
City of Laredo, Webb County, Texas

Manufacturer's Quality Control			(Reinforced/Non-Reinforced)	
Test	Method (1)	Testing Freq.	Units	Min. Requirements
Bentonite Swell Index ²	ASTM D 5890	1 per 100,000 lbs	mL/g	≥24/2 (min)
Bentonite Fluid Loss ²	ASTM D 5891	1 per 100,000 lbs	mL	≤18 (max)
Bentonite Mass per Area ³	ASTM D 5993	40,000 ft ²	lb/ft ²	≥0.75 (min)
Bentonite Moisture Content	ASTM D 4643 ASTM D 5993 2216	1 per 100,000 lbs	%	≤12%
Geotextile Mass per Area	ASTM D 5261	200,000 ft ²	oz/yd ²	≥3 oz MARV
Geotextile Grab Tensile Strength	ASTM D 4632 ASTM D 6768	200,000 ft ²	lbs/ft	N/A
Geomembrane Mass/Unit Area ⁸	ASTM D 5261 ASTM D 1525	200,000 ft ²	g/cm ³	≥94
Geomembrane Thickness ⁸	ASTM D 5199 (Smooth) ASTM D 5944 (Textured)	200,000 ft ²	mil	20 avg./18 min.
Geomembrane Tensile Properties ⁸ (Strength / Elongation)	ASTM D 638 ASTM D6693	200,000 ft ²	lbs./in. / %	30 MARV / 100% MARV
GCL Grab Strength ⁴	ASTM D 4632 ASTM D 6768	200,000 ft ²	lbs/in	≥30 MARV
GCL Peel Strength ⁴	ASTM D 6496	40,000 ft ²	lbs/in	≥3.5 MARV
GCL Index Flux ⁵	ASTM D 5887	1 per week	m ³ /m ² /s	≤1 x 10 ⁻⁸ (max)
GCL Permeability ⁵	ASTM D 5887	1 per week	cm/sec	≤5 x 10 ⁻⁹ (max)
Lap Joint Permeability	Flow box or other suitable device	(7)	—/—	N/A
Conformance Testing by CQA Engineer			(Reinforced/Non-Reinforced)	
Bentonite Mass per Area ³	ASTM D 5993	100,000 ft ²	lb/ft ²	0.75 (min)
GCL Grab Strength ⁴	ASTM D 4632 ASTM D 6768	100,000 ft ²	lbs/in	≥30 MARV
GCL Peel Strength ⁴ (reinforced only)	ASTM D 4632/6496	100,000 ft ²	lbs/in	≥3.5/NA MARV
GCL Permeability ⁵	ASTM D 5887	100,000 ft ²	cm/sec	5 x 10 ⁻⁹ (max)
GCL Hydrated Internal Shear Strength ⁶	ASTM D 5321 ASTM D 6243	Periodic (6)	psf	≥500 typical @ 200 psf (min) / ≥100 typical @ 200 psf (min)

(See Table D-1 notes on next page)

Notes:

1. Test to be performed according to the latest test method as approved by the certifying engineer.
2. These parameters are for the bentonite incorporated into the GCL and do not necessarily reflect the properties of the bentonite in the finished product.
3. Bentonite mass per area is exclusive of the average weight of the geotextiles and is normalized by 0 percent moisture content per ASTM D 5993.
4. All tensile testing is performed in the machine direction, with results as minimum average roll values unless otherwise indicated.
5. Index flux and permeability testing with deaired distilled/deionized water at 80 psi cell pressure, 77 psi headwater pressure and 75 psi tail water pressure. Reported value is equivalent to 925 gal/acre/day. This flux value is equivalent to a permeability of 5×10^{-9} cm/sec for typical GCL thickness. This flux value should not be used for equivalency calculations unless gradient used represent field conditions. A flux test using gradients that represent field conditions must be performed to determine equivalency. The last 20 weekly values prior to end of the production date of the supplied GCL may be provided.
6. ASTM D 5321-08 (geosynthetics) or D 6243 (GCLs) internal direct shear performed on GCL sample hydrated under 200 psf normal load and then sheared at 0.2 in./min. max for Procedure A and 0.04 in/min for Procedure B. Use wet conditions as per ASTM D 5321. The testing is required prior to construction of the first ECS Cell.
7. GCL Panels will be installed using the manufacturer's recommended overlap distances.
8. The use of geomembrane backed GCL's must be approved by the POR and TCEQ prior to use.

LAREDO SOLID WASTE
MANAGEMENT DEPARTMENT
6912 SH 359
LAREDO, TEXAS 78043

PART III, ATTACHMENT 11

GROUNDWATER SAMPLING AND ANALYSIS PLAN

Original Prepared by City of Laredo – April 1966
Revised by Drukell Trahan, R.P.G., Rust Environment and Infrastructure, December 1998
Revised by SCS Engineers – September 2006
Revised by Stephen Phillips, P.G., PS Phillips Environmental – December 2013
Revised by Stephen Phillips, P.G., PS Phillips Environmental – June 2015

LAREDO LANDFILL
PART III
Attachment 11
Groundwater Sampling and Analysis Plan

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~~The City proposes to terminate groundwater sampling over a period of time based on an arid exemption. A review of the 2011 and 2012 groundwater monitoring reports indicates that there is currently no groundwater contamination. No volatile organic compounds (VOCs) were detected in any wells. No metals were detected in any wells above federally promulgated maximum concentration levels (MCLs). The only statistically significant change (SSC) seen was for thallium in MW 12 during the May 2011 sampling event. However, confirmation resampling of MW 12 during the November 2011 sampling event indicated a non-detect for thallium. Therefore the SSC for thallium from May 2011 was not confirmed. Thallium was not detected during the November 2012 sampling event.~~

~~Data obtained from the National weather Service, South Texas Climate Normals from 1981 through 2010 indicate a yearly precipitation average of 20.2 inches.~~

~~The Texas Climate Extremes indicates that Laredo is the fifth driest city in Texas with an average rainfall amount of 16.22 inches per year. This statement is based on data from the National Climatic Data Center. It is unknown the period of time from which this average was derived.~~

~~The Texas Water Atlas indicates the average annual precipitation for the Laredo area ranges from 20.01 to 25.00 inches based on data from the National Oceanographic and Atmospheric Administration from the years 1971 through 2000. Copies of the above data bases are included in **Appendix 2B**.~~

~~The proposed schedule for terminating groundwater monitoring is as follows:~~

~~Year 1: Maintain current semi-annual schedule and analysis. Year 1 schedule will be maintained until two consecutive semi-annual results indicated no VOCs present that cannot be reconciled and metals remain below MCLs.~~

~~;~~

~~Years 2 and 3: One sampling per year for metals only.~~

~~Year 4+: If metals remained below MCLs for years 2 and 3, then groundwater sampling will be discontinued. Groundwater monitoring will return to this schedule beginning with the Year 1 protocol if the quantity of leachate measured decreases by over 10 percent of the previous year's quantity.~~

C. GROUNDWATER SAMPLING AND ANALYSIS PROCEDURES

The Groundwater Sampling and Analysis Procedures for the CLLF are prepared in compliance with the requirements of the Municipal Solid Waste Management Regulations as listed in 30 TAC, Chapter 330–Subchapter J, §§330.405, 330.407,

330.409, and 330.419. These procedures are intended to provide an accurate representation of the groundwater quality at the background and downgradient wells located at the facility.

1. Sampling and Analysis Procedures

For each sampling event, the qualified groundwater scientist (QGWS) will use the following procedures:

- Record water levels of all wells prior to sampling. Determine the flow direction and select the order of well sampling in accordance with §330.405(b) (2). Sampling will be conducted from highest water-level elevation to those of successively lower elevations unless contamination is known to be present, in which case wells not likely to be contaminated will be sampled prior to those known to be contaminated.
- Data collected prior to sampling shall be recorded in a field log and shall include the initial depth to groundwater, measured well depth, height of the water column, well volume, purging discharge rate, well purging time, volume of water purged from the well, a record of pH, conductivity, and temperature readings, information from the well inspection, time of day, weather conditions, the names of the sampling personnel and any other pertinent information.
- Using the dedicated pneumatic bladder pumps and laboratory-supplied containers, purge the well of three well volumes. Store the purge water in suitable containers until the results of the groundwater analysis are received. If concentrations are below levels of concern, the purge water may be discharged to the soil surface (but not to any landfill cell). If concentrations indicate the presence of contaminants, discharge the water at an approved facility.
- The groundwater level shall be measured in the well immediately before sampling (after purging) in order to determine the recovery rate and to determine if there is enough water for sampling. The well shall be sampled within 24 hours after purging, and, if feasible, after the groundwater has recharged to at least 90% of the original static water level. Due to slow recharge rates at wells 3R2, MW -2 and MW -5, these wells may be sampled when recovered water levels are less than 90% of their original static levels. Sampling may extend beyond 24 hours with TCEQ approval if adequate volume is not available to collect the full suite of samples.
- **Samples will not be field filtered.** Collect the samples starting with the most volatile constituents to the least volatile constituents. For VOC samples, if air bubbles are seen at any time, the sample will be discarded and the collection process restarted.
- Label each container with the sample number and TCEQ permit number, well number, date and time, sampler name and firm, and analysis requested.
- Properly preserve all samples according to the specifications in the methods, and send to the laboratory in well-sealed, labeled coolers. Add sufficient ice to

the coolers to maintain a temperature of 4°C +/- 2°C. Place custody seals on the outside lids of the coolers.

- Field test for pH, temperature, alkalinity, conductance, and/or other tests as may be appropriate. Inspect and calibrate all field instrumentation prior to and following the sampling event. Each field instrument is standardized in the field prior to use, and the standardization/calibration is recorded in the field log. Battery-operated equipment is checked to ensure full operating capacity.
- Prepare field report of sampling event recording:
 - sampling methodology
 - purpose of event (initial sampling, semi-annual event, etc.)
 - condition of the steel protective and well casings
 - condition of well pad
 - any field equipment malfunction
 - any other conditions affecting sampling protocol or reported results
 - sampling preservation methods
 - sampling sequences
 - number and location of samples taken water levels prior to purging
 - purging date and time, if different from sampling date field conditions (weather, water turbidity, etc.)
 - field measurements
 - sample collector's name
 - chain-of-custody forms and method of transport to laboratory

Analysis for the detection monitoring events shall include the 62 constituents (15 metals and 47 VOCs) listed in 40 CFR 258 Appendix I, July 14, 2005, as referenced by 30 TAC §330.419. The analytical testing shall be conducted by a properly equipped and qualified laboratory using the appropriate testing methods for the specified constituents, as established by *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA SW-846*. The laboratory shall have a documented quality control program, incorporating quality assurance criteria by established review and testing programs.

Laboratory analyses will use as a practical quantitation limit (PQL) the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions available to the facility. The PQL is analogous to the limit of quantitation (LOQ) definition in the most recent NELAC (National Environmental Laboratory Accreditation Conference) Standard. The PQL is method specific, instrument specific, medium specific, and analyte specific, and may be updated as more data becomes available. The PQL must be below the groundwater protection standard established for that analyte as defined by 30 TAC §330.409(h), unless approved otherwise by the TCEQ. The precision and accuracy of the PQL shall be initially determined from the PQLs reported over the course of a minimum of eight groundwater monitoring events. The results obtained from these events shall be used to demonstrate that the PQLs meet the specified precision and accuracy as shown below in **Table 2**. Laboratory standards, which include a laboratory

reagent grade sample matrix spiked with the chemicals of concern (COC), will be used to support the PQL. A PQL check will be performed at least quarterly during the calendar year to demonstrate that the PQL continues to meet the specified limits for precision and accuracy as defined in the table below.

Table 2. Quality Control Specification Limits for PQLs.

COC	Precision (% RSD)	Accuracy (% Recovery)
Metals	10	70-130
Volatiles	20	50-150
Semi-volatiles	30	50-150

For analytes that the established PQL cannot meet the precision and accuracy requirements of Table 1, the owner/operator will ensure that the laboratory will submit sufficient documentation and information to the TCEQ for alternate precision and accuracy limits on a case by case basis. Non-detected results will be reported as less than the established PQL limit that meets the precision and accuracy requirements.

2. Statistical Methods for Determination of Statistically Significant Change (SSC)

In accordance with §330.405(e) and (f), statistical analysis of groundwater data at this site will be performed using an intra-well control chart approach that gives control limits for each constituent. Statistical parameters shall be determined after considering the number of samples in the background database, the data distribution, and the range of values for each constituent of concern. Statistical parameters shall be selected to be protective of human health and the environment and to provide a site-wide false negative rate for a five standard deviation release (the chance of failing to report a release from the landfill of five standard deviations above the mean) of less than 5%. Parameters will also be chosen to maintain a false positive rate below 5%.

Existing wells already have a background database used for statistical analyses. Any new wells will collect at least ~~four~~ eight statistically independent samples on a quarterly basis as outlined in Section B. Every two years, additional groundwater sampling data may be incorporated into the background dataset (after submitting the proposed data set to TCEQ and receiving permission) for each well so long as the new data is representative of background groundwater quality and does not include a statistically significant change from background due to waste management activities.

Nonparametric limits will be used for constituents which are rarely or never detected and whose data are not normally distributed. For constituents whose background data are all non-detects after ~~13~~ 8 samples, the limit will be set at the

~~median~~ practical quantification limit for that constituent in that well. Constituents which are detected less than 25% of the time will use a limit equal to the highest of the detected background concentrations or the median quantification limit.

Verification resampling is an integral part of the statistical methodology used for this site. Verification resampling allows the application of a much smaller prediction limit, therefore minimizing both the false positive and false negative rates. Under this procedure, a statistically significant increase is not declared and should not be reported until the results of the verification are known. The probability of an initial exceedance is much higher than 5% for the site as a whole.²

D. REPORTING OF SAMPLE ANALYSIS RESULTS

The reporting of groundwater sampling and analyses will be in accordance with §330.407 "Detection Monitoring Program for Type I Landfills." Within 60 days of each sampling event, the City will determine whether there has been a statistically significant increase over background of any tested constituent at any compliance well. Statistically significant increases over background will be reported in writing to the TCEQ and any local pollution agency with jurisdiction requesting to be notified within 14 days of the determination. If there has been an initial exceedance, a verification resampling report will be submitted 60 days of the verification resampling event, and the City will verify whether there has been a statistically significant increase over background. The TCEQ and any local pollution agency with jurisdiction requesting to be notified will be notified in writing of any verified statistically significant increases within 14 days of the determination, and the owner/operator will immediately place a notice describing the increase into the operating record and then establish an assessment monitoring program meeting the requirements of §330.409 within 90 days of the date of the notice to TCEQ.

If a statistically significant increase over background of any tested constituent at any compliance well has occurred and the City has reasonable cause to think that a source other than a monitored landfill unit caused the contamination or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality, then the City will submit a report providing documentation to this effect. In making a demonstration under this paragraph, the City will notify TCEQ, and any local pollution agency with jurisdiction that has requested to be notified, in writing, within 14 days of determining a statistically significant increase over background at the compliance point that the City intends to make this demonstration. Within 90 days of determining a statistically significant increase, the City will submit a report to TCEQ, and any local pollution agency with jurisdiction that has requested to be notified, that demonstrates that a source other than a monitored landfill unit caused the contamination or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Groundwater samples collected for this documentation will not be filtered prior

to laboratory analysis and the City will continue to monitor in accordance with the detection monitoring program. The report will be prepared and certified by a QGWS.

If the demonstration is not determined satisfactory by TCEQ, then the City will begin assessment monitoring as described in Section E of this GWSAP.

If an initial exceedance fails to verify, then no statistically significant change has occurred and no reporting is necessary prior to the annual report and the City will continue with detection monitoring.

The City will submit an annual detection monitoring report within 90 days after the second semi-annual groundwater sampling event in a calendar year. The report will include the following information determined since the previously submitted annual report:

- a statement regarding whether a statistically significant increase has occurred over background values in any compliance well during the previous calendar year period and the status of any statistically significant increase events;
- the results of all groundwater monitoring, testing, and analytical work obtained or prepared under the requirements of this permit, including a summary of background groundwater quality values, groundwater monitoring analyses, statistical calculations, graphs, and drawings;
- background groundwater concentration measurements of each constituent of concern listed in Appendix I, for each monitoring well;
- a potentiometric map will be included using the data collected during the preceding calendar year's sampling events from the monitoring wells of the detection monitoring program. The owner or operator shall also include in the report all documentation used to determine the groundwater flow rate and direction of groundwater flow; and
- recommendation for any changes., and
- any other items requested by the Executive Director.

The City will submit analytical data from the laboratory, a laboratory case narrative (LCN) identifying any potential bias and/or problems during the analysis, and either a laboratory checklist or a copy of the laboratory QA/QC and analytical data to TCEQ. The analytical report, LCN, and the laboratory QA/QC or checklist shall be included with the TCEQ-0312 forms for all groundwater monitoring events. The checklist may be modified as long as the information that is in the enclosure is included in the facility's checklist. Any information required in the laboratory case narrative that cannot be completed by the laboratory will be completed by the permittee.

If the City determines that the detection monitoring program no longer satisfies the requirements of this section, the City will submit an application for a permit amendment or modification within 90 days of this determination to make any appropriate changes to the program.

CITY OF LAREDO
MUNICIPAL SOLID WASTE LANDFILL
LAREDO, TEXAS
WEBB COUNTY

CLOSURE PLAN
ATTACHMENT III.12

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

PERMIT NO.: 1693B

Applicant:

City of Laredo Municipal Solid Waste Landfill
Solid Waste Services Department
6912 Highway 359
Laredo, TX 78044

April 2015

Prepared by:

CP&Y, Inc.
1820 Regal Row
Dallas, TX 75235
F-1741

CLOSURE PLAN
CITY OF LAREDO
MUNICIPAL SOLID WASTE LANDFILL
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1. Introduction

The following closure requirements were written to comply with TCEQ Municipal Solid Waste Management Regulations in 30 TAC §330.63(h) and Subchapter K (relating to Closure and Post Closure) and with EPA's RCRA Subtitle D regulations. The City of Laredo Municipal Solid Waste Landfill must comply with §330.457 - Closure Requirements for Solid Waste Landfill Units that Receive Waste on or after October 9, 1993.

2. Final Cover Design, Methods, and Procedures for Installation §330.457(e)(1)

The landfill shall install a final cover system that is designed and constructed to minimize infiltration and erosion. The final cover system shall be composed of no less than two feet of soil and consist of a clay-rich soil cover layer overlain by an erosion layer as follows.

- For landfill phases with a synthetic bottom liner, a synthetic membrane that has a permeability less than or equal to the permeability of any bottom liner system overlain by a clay-rich soil cover layer (barrier layer) consisting of a minimum of 18 inches of earthen material with a coefficient of permeability no greater than 1×10^{-5} centimeters/second (cm/sec). The minimum thickness of the synthetic membrane shall be 20 mils, or 60 mils in the case of high-density polyethylene, in order to ensure proper seaming of the synthetic membrane.
- For landfill phases with no synthetic bottom liner, the clay-rich soil cover layer (barrier layer) shall consist of a minimum of 18 inches of earthen material with a coefficient of permeability less than or equal to the permeability of any constructed bottom liner or natural subsoil present. The coefficient of permeability of the infiltration layer shall in no case exceed 1×10^{-5} cm/sec, even though the coefficient of permeability of the constructed bottom liner or natural subsoil is greater than 1×10^{-5} cm/sec or no data exist for the value(s) of the coefficient of permeability of the constructed bottom liner or natural subsoil.
- The erosion layer shall consist of a minimum of six inches of earthen material that is capable of sustaining native plant growth and shall be seeded or sodded immediately following the application of the final cover in order to minimize erosion. In addition to the prescriptive covers described in §330.457(a)(1),(2), and (3), which require MSW landfills to utilize final cover systems designed and constructed to minimize infiltration and erosion, composed of no less than two feet of soil, and consisting of a clay-rich soil cover (infiltration layer) with a coefficient of permeability no greater than that of the constructed bottom liner system (less than or equal to 1×10^{-5} cm/sec) overlain by an erosion layer.

In addition to the prescriptive covers described in §330.457(a)(1),(2), and (3), the following currently approved alternative final cover systems may be used at the Landfill.

2.1. Currently Approved Alternative Final Cover Systems

As required by §330.457(d), the following final cover systems achieve an equivalent reduction in infiltration and protection from wind and water erosion as the standard covers described in 330.457(a)(1). Calculations to determine equivalency of infiltration and protection from wind and water erosion is provided in Attachment A and B of this Plan.

2.1.1. Alternative Final Cover with Composite Bottom Liner

This final cover system has previously been approved in 1999 by TCEQ during a major Permit amendment to the 1986 original permit. There are no changes proposed to the following alternative final cover system. This alternative final cover system is for disposal areas with a composite geomembrane bottom liner system (Subtitle D). A geosynthetic clay liner (GCL) with a hydraulic conductivity less than or equal to 5×10^{-9} cm/sec will serve as the barrier layer. The GCL is overlain by a 60 mil minimum HDPE geomembrane or equivalent. Double-sided textured material is required on the 4:1 slopes. The geomembrane is overlain by a drainage layer consisting of a geonet with a minimum 6 oz/sy non-woven geotextile heat bonded to each side (geocomposite). The geocomposite is then covered by a protective layer consisting of 18-in. of cover soil and an erosion layer consisting of 6-in. of topsoil capable of supporting vegetation. See Appendix C for Figures. It shall be seeded, sodded, or covered in 2 to 4 inch thick angular rock armor immediately following the application of the final cover in order to minimize erosion. Other erosion prevention techniques may be used and are discussed in more detail in Section 2.3.6.

An infiltration equivalency demonstration is presented in Section 2.1 of Appendix A to this Attachment (Appendix III.12A).

2.1.2. Alternative Final Cover with Soil Bottom Liner

This final cover system has previously been approved by TCEQ during a major permit amendment in 1999. There are no changes proposed to the following alternative final cover system. This alternative final cover system is for disposal areas that contain only a constructed clay liner, in-situ liner (pre-Subtitle D), or a Type IV liner. The cover system consists of a GCL having a hydraulic conductivity less than or equal to 3×10^{-9} cm/sec will serve as the barrier layer. The GCL is overlain by a protective layer consisting of 12-in. of cover soil and an erosion layer consisting of 12-in. of topsoil capable of supporting vegetation. See Appendix C for Figures. It shall be seeded, sodded, or covered in 2 to 4 inch thick angular rock armor immediately following the application of the final cover in order to minimize erosion. Other erosion prevention techniques may be used and are discussed in more detail in Section 2.3.6.

2.2. Water Balance Alternative Cover System

The City also proposes the use of a water balance (WB) cover system. This cover system has been designed in accordance with 30 TAC 330.457(d) and TCEQ's "Guidance for Requesting a Water Balance Alternative Cover for a Municipal Solid Waste Landfill" revised January 2012.

This alternative cover may be utilized over any portion of the landfill regardless of the bottom liner system. The WB final cover system will consist of a 24" monolithic soil layer, compacted to 85% Standard Proctor, overlain by a 6" erosion layer, and be capable of supporting native vegetation. See Appendix C for Figures. All soil used in the construction of the landfill cover shall be excavated from an area near the landfill or shall meet the requirements discussed in Section 2.3. It shall be seeded, sodded, or covered with 2 to 4 inch thick angular rock armor immediately following the application of the final cover in order to minimize erosion. Other erosion prevention techniques may be used and are discussed in more detail in Section 2.3.6. See Appendix A – Alternative Final Cover Demonstration for further discussion.

2.3. Final Cover Installation §330.457(e)(1)

When a portion of a disposal area is completed to within an elevation appropriate to the thickness of final cover required, the area will be prepared for the placement of final cover. The daily/intermediate cover will be graded smooth and any protruding objects will be removed. The installation procedures, as applicable to the type of final cover system being used, are discussed in the following sections.

2.3.1. Barrier Layer

Installation of a soil barrier layer (soil where the permeability must be 1×10^{-5} cm/sec or less) will be performed by placing 8 in. thick loose lifts of cohesive soil that is free of foreign material. Methods of construction will be as described in Part III, Attachment 10, Section 2 of the Soil Liner Quality Control Plan (SLQCP). The lifts will be uniformly compacted. In instances where a GCL is used as the barrier layer, the surface of the daily/intermediate cover will be prepared in the same manner and the GCL panels will be deployed in accordance with the requirements outlined in Part III, Attachment 10C, Section 2.3 of the SLQCP for installation of GCL's.

2.3.2. Geomembrane Layer

The geomembrane layer, if included in the final cover system configuration, will be installed over the soil or the GCL barrier layer. The installation surface will be smooth and free of any loose rocks, protrusions, or void areas. Panels of the geomembrane will be deployed, welded, and leak-tested in accordance with the CQA and installation requirements outlined in Part III, Attachment 10A, Section III of the SLQCP.

2.3.3. Drainage Layer

The drainage layer (geocomposite) will be installed above the geomembrane. The geocomposite will be deployed and seamed or tied, as applicable, in accordance with the CQA and installation requirements outlined in Part III, Attachment 10A, Section IV of the SLQCP.

2.3.4. Erosion Layer

The ~~uppermost~~ erosion layer ~~shall~~may consist of a 6-in. or 12-in. ~~of soil layer cover~~, consisting of earthen material capable of supporting grass or vegetative cover, ~~or 2 to 4 in. thick angular rock armor. For areas of final cover where a soil layer is designed with no permeability requirement, a 12 in. or 18 in. thick layer may be installed, as applicable.~~

2.3.5. Water Balance Monolithic Layer

The 24" monolithic soil layer consisting of onsite borrow soil capable of supporting vegetative cover shall have the following properties.

- Plasticity Index $16 < PI < 28$
- Passing #4 Greater than 79% Passing
- Passing #40 59% - 99% Passing
- Passing #200 26% - 52% Passing
- Soil Classification CL or SC
- In-place hydraulic conductivity $< 2 \times 10^{-7}$

The cover shall be placed at or near 85% standard proctor density. The cover will be constructed, installed, and CQA tested in accordance with Section 2.4 of this Attachment, current TCEQ regulations. See Appendix A – Alternative Final Cover Demonstration for further discussion of the water balance cover system including model simulation descriptions and results.

2.3.6. Erosion Control

The completed cover will be seeded or sodded following placement of the top soil. Bermuda or Buffalo grasses are recommended for permanent vegetative cover. Native or adapted grasses and wildflowers may also be used. A temporary cover of rye grass, winter wheat or other cool weather vegetation may also be used if final cover is installed during the winter.

During the early stages of vegetative growth, mulching, slope regrading, and mowing will be performed to complete vegetative coverage and effective erosion control. Soil loss calculations are provided in Attachment B of this Plan. A summary of the calculations are provided in Table 1. As shown for all cases, the soil loss for both the top slope and sideslope is less than the permissible soil loss of 50 tons/acre/year for intermediate cover and less than 3 tons/acre/year for final cover.

Due to the climate at the Laredo Landfill, it may be difficult to establish a 80~~75~~% vegetative cover immediately after final cover installation. It may require up to 5 years to establish permanent vegetation. During that time, periodic inspection and maintenance of the final cover system shall be required to prevent excessive erosion on the side slopes. Eroded soil which accumulates in ditches and ponds will be removed and used in repair of erosion damage.

If permanent vegetation cannot be established, a 4 inch thick rock armor layer may be installed to help prevent erosion in the absence of vegetation.

**TABLE 1
SOIL LOSS SUMMARY**

Case		A (tons/acre/year)
Interim	5% Slope	<u>2.973.66</u>
	25% Vegetated	
Interim	4H:1V Slope	<u>32.0643.96</u>
	25% Vegetated	
Final	5% Slope	<u>0.220.42</u>
	75% Vegetated	
Final	4H:1V Slope	<u>2.382.79</u>
	80 75% Vegetated	
Final	4H:1V Slope	<u>2.752.01</u>
	Rock armor	

2.4. Quality Control

Hydraulic conductivity testing of undisturbed samples of the cover material will be performed by the construction quality assurance (CQA) monitor at a frequency of not less than one test per surface acre of final cover. Portions of the soil barrier layer that do not exhibit the required hydraulic conductivity will be reworked and retested. The final cover will be bored to verify thickness and collect soil samples for analysis or surveyed prior to and following placement of final cover. Such borings will be backfilled with a soil/bentonite mixture. Permeability data shall be submitted to the Executive Director in a format stipulated in technical guidelines furnished by the executive director. Construction quality control of the barrier layer, drainage layer, ~~and~~ geomembrane layer, and protective cover shall be governed by the SLQCP. CQA details are provided in the following sections.

**TABLE 2
CQA REQUIREMT LOCATIONS**

<u>Cover Layer</u>	<u>CQA Location</u>
<u>Clay Liner (Barrier Layer)</u>	<u>SLQCP – Attachment 10 - Section II</u>
<u>Geocomposite Clay Liner (Barrier Layer)</u>	<u>SLQCP – Attachment 10 – Appendix D</u>
<u>Geomembrane</u>	<u>SLQCP – Attachment 10 - Section III</u>
<u>Drainage Geocomposite Layer (Drainage Layer)</u>	<u>SLQCP – Attachment 10 - Section IV</u>
<u>Protective Cover</u>	<u>SLQCP – Attachment 10 - Section VI</u>

2.5. Largest Area §330.457(e)(2)

The largest area of the MSWLF unit or MSW site ever requiring a final cover at one time during the active life of the unit is approximately 155.59 acres. This area is depicted on Figure 1.

FIGURE 1
LARGEST AREA EVER REQUIRING FINAL COVER



may acknowledge the termination of operation and closure of the facility or site and deem it properly closed.

- §330.457(g) – Within 10 days after completion of final closure activities of the site, the City shall submit to the Executive Director, by registered mail, a certified copy of an "Affidavit to the Public" in accordance with the requirements of §330.19 of the TCEQ Solid Waste Management Regulations, and place a copy of the affidavit in the operating record. In addition, the City shall record a certified notation on the deed to the facility or site property, or on some other instrument that is normally examined during title search, that will in perpetuity notify any potential purchaser of the property that the land has been used as a landfill facility and use of the land is restricted according to the provisions specified in 30 TAC §330.465. The City shall submit a certified copy of the modified deed to the Executive Director and place a copy of the modified deed in the operating record within the time frame specified in this paragraph.

4. Closure Cost Estimate §330.63(j)

In accordance to Title 30 Chapter 37, Subchapter R relating to Financial Assurance for MSW facilities, the City shall provide continuous financial assurance coverage for closure until the facility is officially placed under the post-closure maintenance period and all requirements of the final closure plan have been approved as evidenced in writing by the Executive Director. In addition, the City shall provide continuous financial assurance coverage for post-closure care until the facility is officially released in writing by the executive director from the post-closure care period in accordance with all requirements of the Post Closure Plan (Attachment III.13).

A detailed written estimate, in current dollars (2015), of the cost of hiring a third party to close the largest area (see Section 2.5 – Largest Area) of all MSWLF units ever requiring a final cover at any time during the active life, ~~when the extent and manner of its operation would make closure most expensive, as indicated by this closure plan~~ is presented as Table 2. The Landfill shall review the permit conditions on an annual basis and verify that the current active areas match the areas on which closure cost estimates are based. An increase or decrease in the closure cost estimate shall be made if changes to the final closure plan or the landfill conditions dictate.

The following Closure Cost Estimate includes costs associated with the closure of all waste storage, processing, and disposal units at the City of Laredo Landfill.

- The landfill closure costs includes engineering and construction costs associated with the installation of a prescriptive cover system. Engineering costs include survey procurement, site evaluation and development of design plans, contract administration assistance, and inspection and CQA testing during construction of the cover system. Construction costs include material and labor costs associated with the installation of the final cover system and erosion protection.
- The tire chipping and storage unit includes costs associated with the removal of all stored tires, cleaning of the site, and disposing of all solids resulting from the cleanup. Soil sampling and analysis costs and final closure report is also included.
- The white goods and metal storage areas closure costs associated with the removal of all recyclable material, cleaning of the site, and disposing of all solids resulting from the cleanup. Soil sampling and analysis costs and final closure report is also included.

TABLE 3
CLOSURE COST ESTIMATE

The following closure cost estimate, in current dollars, shows the cost of hiring a third party to close the waste storage, processing and disposal facilities at the City of Laredo Landfill

Landfill					
The following landfill closure cost estimate, in current dollars, shows the cost of hiring a third party to close the largest waste fill area that could potentially be open in the year to follow and those areas that have not received final cover in accordance with the final closure plan. The Facility shall review the permit conditions on an annual basis and verify that the current active areas match the areas on which closure cost estimates are based. An increase or decrease in the closure cost estimate shall be made if changes to the final closure plan or the landfill conditions dictate.					
	Quantity	Unit	Cost (\$/unit)	Total Cost (qty x disposal cost)	
Engineering					
Topographic survey	156	Acre	\$ 100.00	\$	15,559.00
Boundary Survey	1	Lump Sum	\$ 4,000.00	\$	4,000.00
Site Evaluation	156	Acre	\$ 250.00	\$	38,897.50
Development of Final Closure Plans	156	Acre	\$ 280.00	\$	43,565.20
Contract, Administration, Bidding & Award	1	Lump Sum	\$ 10,000.00	\$	10,000.00
Administrative Costs	1	Lump Sum	\$ 5,000.00	\$	5,000.00
Inspection & Testing (Subtitle D Area)	43	Acre	\$ 5,000.00	\$	217,000.00
Inspection & Testing (Pre-Subtitle D Area)	49	Acre	\$ 3,200.00	\$	157,120.00
Construction					
Pre-Subtitle D Area (43 Acres)					
Erosion Layer - 6" (sourced on-site)	34,687	CY	\$ 4.00	\$	138,746.67
Infiltration Layer - 18"	104,060	CY	\$ 4.00	\$	416,240.00
Subtitle D Area (49 Acres)					
Erosion Layer - 6" (sourced on-site)	158,107	CY	\$ 4.00	\$	632,426.67
Geocomposite	2,134,440	SF	\$ 0.55	\$	1,173,942.00
Flexible Membrane Liner (textured)	2,134,440	SF	\$ 0.50	\$	1,067,220.00
Infiltration Layer (18")	118,580	CY	\$ 4.00	\$	474,320.00
Seeding or Rock Armor	156	AC	\$ 2,000.00	\$	312,000.00
Site Grading & Drainage	156	AC	\$ 1,000.00	\$	156,000.00
Total Landfill Closure Cost				\$	4,862,037.03

Tire Chipping and Storage Unit					
	*Quantity	Unit	**Disposal Cost (\$/unit)	Total Cost (qty x disposal cost)	
Whole Tire Storage	100	TON	\$ 26.15	\$	2,615.00
Chipped Tire Storage	50	TON	\$ 26.15	\$	1,307.50
Labor (Washdown, Cleanup)	1	LS	\$ 1,500.00	\$	1,500.00
Solids from Cleanup	500	LBS	\$ 0.30	\$	150.00
Soil Sampling & Analytics	1	LS	\$ 1,200.00	\$	1,200.00
Closure Report Preparation	1	LS	\$ 2,000.00	\$	2,000.00
Total Tire Chipping and Storage Unit Closure Cost				\$	8,772.50

*Quantity represents the maximum amount of material stored during the life of the facility

**Disposal cost include loading, transport to, and disposal cost at the nearest authorized disposal facility.

TABLE 3 - CONTINUED
CLOSURE COST ESTIMATE

White Goods and Metals Storage Area				
	*Quantity	Unit	**Disposal Cost (\$/unit)	Total Cost (qty x disposal cost)
White Goods Storage	5	TON	\$ 36.20	\$ 181.00
Recyclable Metals Storage	20	TON	\$ 27.20	\$ 544.00
Labor (Washdown, Cleanup)	1	LS	\$ 1,500.00	\$ 1,500.00
Solids from Cleanup	500	LBS	\$ 0.30	\$ 150.00
Soil Sampling & Analytics	1	LS	\$ 1,200.00	\$ 1,200.00
Closure Report Preparation	1	LS	\$ 2,000.00	\$ 2,000.00
Total White Goods and Metal Storage Area Closure Cost				\$ 5,575.00

*Quantity represents the maximum amount of material stored during the life of the facility

**Disposal cost include loading, transport to, and disposal cost at the nearest authorized disposal facility.

Total Closure Cost Estimate	
	Closure Cost
Landfill	\$ 4,862,037.03
Tire Chipping and Storage Unit	\$ 8,772.50
White Goods and Metals Storage Area	\$ 5,575.00
Total Closure Cost Estimate	\$ 4,876,384.53

Engineering Costs

Cost Item	Unit	Cost	Quantity	Total Cost
Topographic Survey	Acre	\$ 100.00	156	\$ 15,559.00
Boundary Survey for Affidavit	Lump Sum	\$ 4,000.00	1	\$ 4,000.00
Site Evaluation	Acre	\$ 250.00	156	\$ 38,897.50
Final Closure Plans	Acre	\$ 280.00	156	\$ 43,565.20
Contract, Administration, Bidding, and Award	Lump Sum	\$ 10,000.00	1	\$ 10,000.00
Administrative Costs	Lump Sum	\$ 5,000.00	1	\$ 5,000.00
Closure Inspection & Testing (Subtitle D Area)	Acre	\$ 5,000.00	43	\$ 217,000.00
Closure Inspection & Testing (Non-Subtitle D Area)	Acre	\$ 3,200.00	49	\$ 157,120.00
Subtotal				\$ 491,141.70
10% Contingency				\$ 49,114.17
Engineering Total				\$ 540,255.87

Construction Costs

Cost Item	Unit	Cost	Quantity	Total Cost
Water Balance Cover - Soils Testing	Lump Sum	\$ 10,000.00	1	\$ 10,000.00
Monolithic Water Balance Cover Placement	Cubic Yard	\$ 5.00	298,466	\$ 1,492,330.00
Vegetation	Acre	\$ 2,000.00	156	\$ 311,180.00
Site Grading & Drainage	Acre	\$ 1,000.00	156	\$ 155,590.00
Subtotal				\$ 1,959,100.00
10% Contingency				\$ 195,910.00
Construction Total				\$ 2,155,010.00

Total Closure Cost **\$ 2,695,265.87**

APPENDIX B – SOIL EROSION CALCULATIONS



1820 Regal Row
Dallas, Texas 75235
214-638-0500

Project # LARE1301

Client	<u>Laredo Municipal Solid Waste Landfill</u>	Prepared By	<u>BW</u>	on	<u>8/30/2013</u>
Project	<u>Permit Amendment Application</u>	Reviewed By	<u>FP</u>	on	<u>4/28/2015</u>
Subject	<u>Soil Loss Calculations</u>	Approved By	<u>FP</u>	on	<u>4/28/2015</u>

A Required

Evaluate the expected soil loss from the Final Cover consistent with 30 TAC §330.305(d)(2).

B Method

The expected soil loss is calculated using the RUSLE. The annual soil loss is calculated for each slope configuration. This total annual soil loss is compared to the permissible soil loss of 3 tons/acre/year for final cover and 50 tons/acre/year for intermediate cover; as referenced from the TCEQ's "Guidance for Addressing Erosional Stability During all Phases of Landfill Operation", as prepared March, 2013.

C References

- 1 United States Department of Agriculture, Agricultural Handbook No. 703
- 2 TCEQ, Guidance for Addressing Erosional Stability During all Phases of Landfill Operation, as prepared March, 2013

D Input

A = RKLSCP

Where:

- A = Soil Loss (tons/acre/year)
- R = Rainfall/Runoff Factor
- K = Soil Erodibility Factor
- LS = Slope Length/Steepness Factor
- C = Cover Management Factor
- P = Erosion Control Practice Factor

Rainfall Factor

The R factor represents the average storm erosive index value over a 22-year record. R is an indication of the two most important characteristics of a storm determining its erosivity: amount of rainfall and peak intensity sustained over an extended period. Using Exhibit 1 - Average annual R factor, The applicable R factor for Webb County, Texas is:

R = 225

Soil Erodibility Factor

The K factor is soil erodibility factor which represents both susceptibility of soil to erosion as a function of the soils physical and chemical properties. Using Exhibit 1, Table 1 - K Factor, Rock free - Webb County, Texas, the applicable K factor for the Laredo Landfill area is:

$$K = 0.21$$

Slope Length and Steepness Factors

The slope length factor, L, and the slope steepness factor, S, represent the erosion of the soil due to both slope length and degree of slope.

$$L = \text{Slope Length Factor} \quad (\lambda/72.6)^m$$
$$\lambda = \text{Horizontal Projection of the Slope}$$
$$m = \text{Slope-Length Exponent} \quad \beta/(1+\beta)$$
$$\beta = \text{Ratio of Rill to Interrill Erosion} \quad (\sin \theta/0.0896) / [3*(\sin \theta)^{0.8} + 0.56]$$
$$\theta = \text{Slope Angle in Degrees}$$

Case		Slope	θ	β	m	$\lambda_{\max}$	L
1	Top Slope	5%	2.9	0.67	0.40	130	1.26
2	Sideslope	25%	14.0	1.78	0.64	155	1.63

$$S = \text{Slope Steepness Factor}$$
$$S = 10.8 \sin \theta + 0.03 \quad \text{for slope} < 9\%$$
$$S = 16.8 \sin \theta - 0.50 \quad \text{for slope} \geq 9\%$$

Slope		Slope	θ	S
1	Top Slope	5%	2.86	0.569
2	Sideslope	25%	14.04	2.649

Cover Management Factor

The C factor represents the effects of plants, soil cover, soil biomass, and soil disturbing activities on erosion. For intermediate cover the City will seed or sod the cover. A conservative 25% vegetative cover was assumed. For final cover the City will seed or sod after installation. A conservative 80% vegetative cover was assumed. Since vegetation is hard to grow and sustain at the Laredo Landfill and optional rock armor (minimum 4" thick) on the final cover side slopes may be used for erosion control. The top surface will remain 80% vegetated.

$$C = 0.175 \quad \text{25\% vegetated cover} \quad (\text{interpolated from Table 1 - Page 8})$$
$$C = 0.013 \quad \text{80\% vegetated cover} \quad (\text{from Table 1 - Page 8})$$
$$C = 0.015 \quad \text{Rock armor cover}$$

Table 2 - Page 8 provides C values for crushed stone mulch (1/4" to 1-1/2"). The maximum application rate defined as 240 tons/acre (approximately 1" thick) has a C factor of 0.02. The proposed application rate of 700 tons/acre is approximately 3 times the amount shown on Table 2. A C factor of 0.015 was used.

Erosion Control Practice Factor

The erosion control practice factor, P, measures the effect of control practices that reduce the erosion potential of the runoff by influencing drainage patterns, runoff concentration, and runoff velocity.

For purposes of calculating soil loss, the P factor is:

P	=	0.5	Landslope 2% to 7%
P	=	0.9	Landslope 19% to 24%

E Calculation

Case		R	K	L	S	C	P	A (tons/acre/year)
Interim	5% Slope	225	0.21	1.26	0.569	0.175	0.5	2.97
	25% Vegetated							
Interim	4H:1V Slope	225	0.21	1.63	2.649	0.175	0.9	32.06
	25% Vegetated							
Final	5% Slope	225	0.21	1.26	0.569	0.013	0.5	0.22
	75% Vegetated							
Final	4H:1V Slope	225	0.21	1.63	2.649	0.013	0.9	2.38
	75% Vegetated							
Final	4H:1V Slope Rock armor	225	0.21	1.63	2.649	0.015	0.9	2.75

F Conclusion

The above soil loss calculations represent the all scenarios in which erosion may happen on a landfill cover system. As shown for all cases, the soil loss for both the top slope and sideslope is less than the permissible soil loss of 50 tons/acre/year for intermediate cover and less than 3 tons/acre/year for final cover.

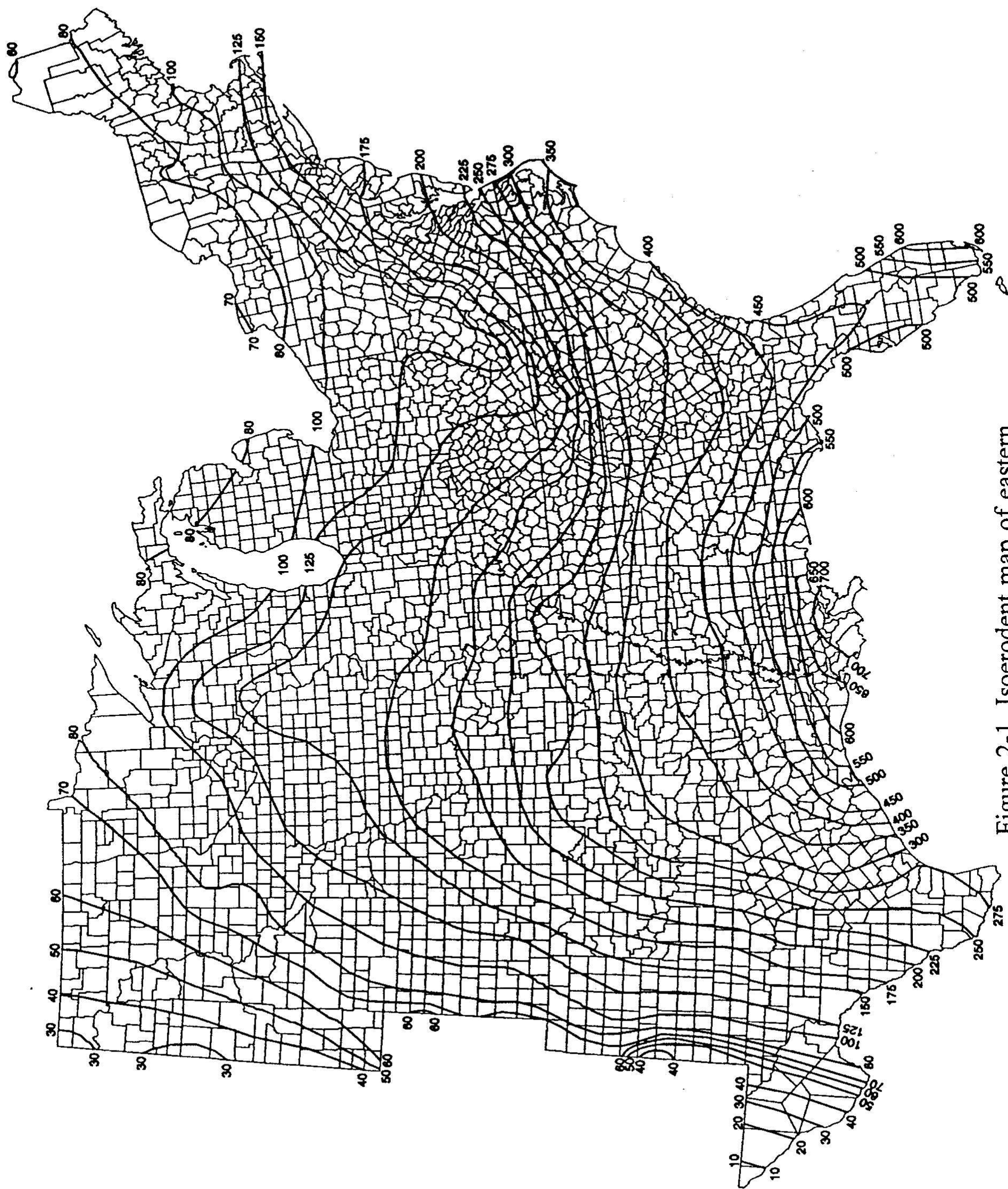
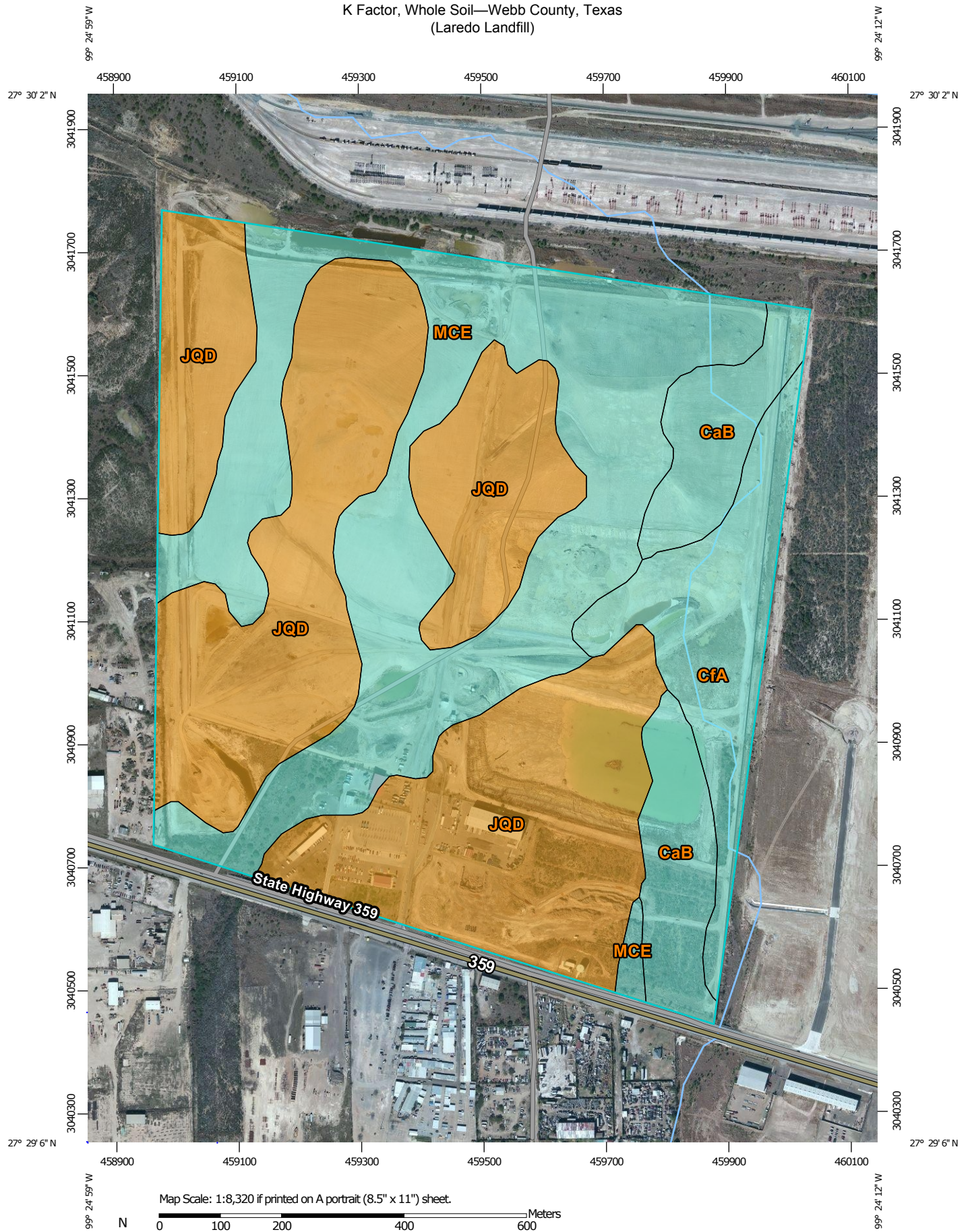


Figure 2-1. Isoerodent map of eastern United States. Units are hundreds ft·tonf·in(ac·h·yr)⁻¹.

K Factor, Whole Soil—Webb County, Texas
(Laredo Landfill)

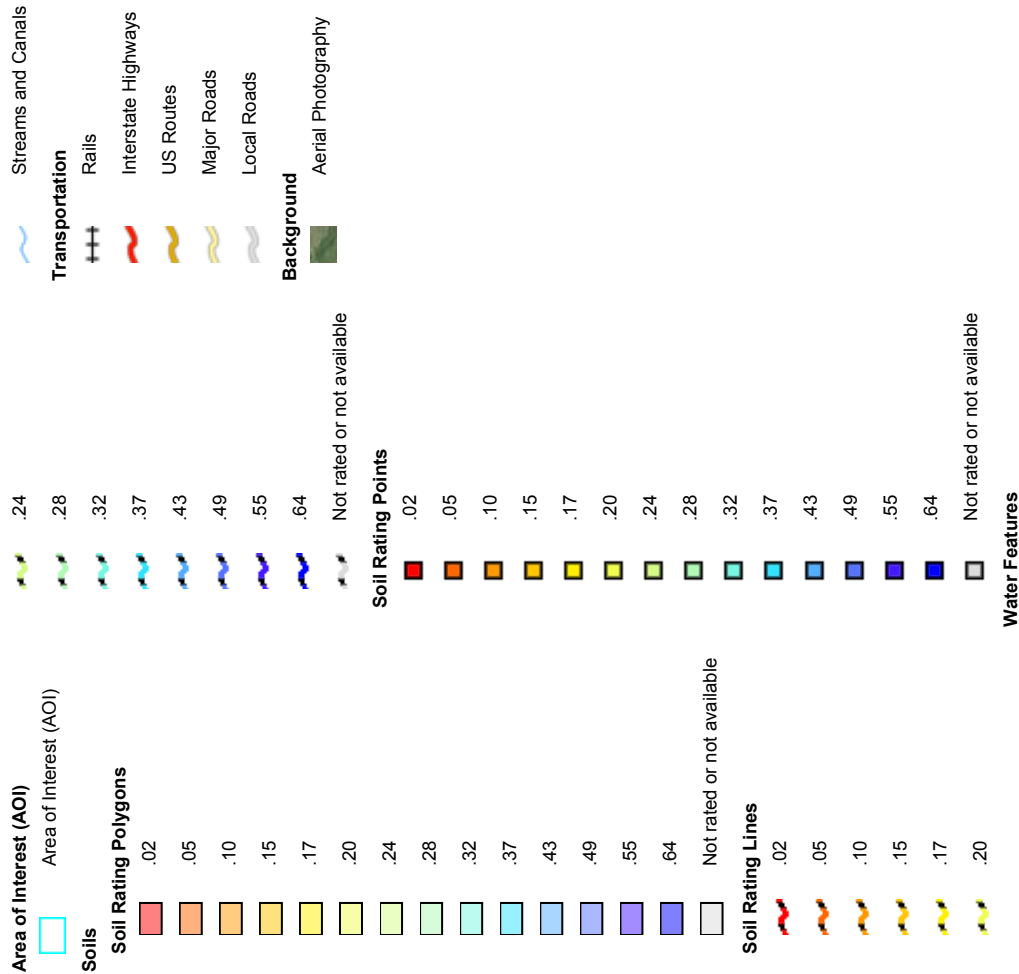


**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey
ATT.12B-5

9/19/2013
Page 1 of 3

MAP LEGEND



MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:31,700.

Warning: Soil Map may not be valid at this scale.
Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Webb County, Texas
Survey Area Data: Version 9, Sep 21, 2012

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 12, 2010—Jan 22, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

K Factor, Whole Soil

K Factor, Whole Soil— Summary by Map Unit — Webb County, Texas (TX479)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CaB	Catarina clay, 0 to 2 percent slopes	.32	25.4	9.3%
CfA	Catarina clay, occasionally flooded	.32	25.1	9.2%
JQD	Jimenez-Quemado complex, undulating	.10	133.9	49.0%
MCE	Maverick-Catarina complex, gently rolling	.32	89.1	32.6%
Totals for Area of Interest			273.5	100.0%

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

C FACTOR

Table 1 - Cover Factor C Values for Established Plants (data from NEH chapter 3 and Wischmeier and Smith 1978)

			Percentage of surface covered by residue in contact with the soil:					
			0%	20	40	60	80	95+
C factor for grass, grasslike plants, or decaying compacted plant litter.	0	Grass	0.45	0.2	0.1	0.042	0.013	0.003
C factor for broadleaf herbaceous plants (including most weeds with little lateral root networks), or undecayed residues.	0	Weeds	0.45	0.24	0.15	0.091	0.043	0.011
Tall weeds or short brush with average drop height ² of ≥20 inches	25	Grass	0.36	0.17	0.09	0.038	0.013	0.003
		Weeds	0.36	0.2	0.13	0.083	0.041	0.011
	50	Grass	0.26	0.13	0.07	0.035	0.012	0.003
		Weeds	0.26	0.16	0.11	0.076	0.039	0.011
	75	Grass	0.17	0.1	0.06	0.032	0.011	0.003
		Weeds	0.17	0.12	0.09	0.068	0.038	0.011
Mechanically prepared sites, with no live vegetation and no topsoil, and no litter mixed in.	0	None	0.94	0.44	0.3	0.2	0.1	Not given

¹ percent cover is the portion of the total area surface that would be hidden from view by canopy if looking straight downward.

Table 2 - Site Mulching C Factors for Different Slopes (Wischmeier and Smith 1978)

Type of Mulch	Mulch Rate (tons per acre)	Land Slope (%)	Mulching C Factor
None	0	all	1.0
Straw or hay, tied down by anchoring and tacking equipment	1.0	1-5	0.20
	1.0	6-10	0.20
	1.5	1-5	0.12
	1.5	6-10	0.12
	2.0	1-5	0.06
	2.0	6-10	0.06
	2.0	11-15	0.07
	2.0	16-20	0.11
	2.0	21-25	0.14
	2.0	26-33	0.17
	2.0	34-50	0.20
Crushed stone, 1/4" to 1-1/2 inch	135	<16	0.05
	135	16-20	0.05
	135	21-33	0.05
	135	34-50	0.05
	240	<21	0.02
	240	21-33	0.02
	240	34-50	0.02
Wood chips	7	<16	0.08
	7	16-20	0.08
	12	<16	0.05
	12	16-20	0.05
	12	21-33	0.05
	25	<16	0.02
	25	16-20	0.02
	25	21-33	0.02
	25	34-50	0.02

APPENDIX C – CLOSURE PLAN FIGURES

CITY OF LAREDO
MUNICIPAL SOLID WASTE LANDFILL
LAREDO, TEXAS
WEBB COUNTY

CLOSURE PLAN FIGURES

ATTACHMENT III.12 – APPENDIX C

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

PERMIT NO.: 1693B

Applicant:
City of Laredo Municipal Solid Waste Landfill
Solid Waste Services Department
6912 Highway 359
Laredo, TX 78044

September 2014
Revised June 2015

Prepared by:

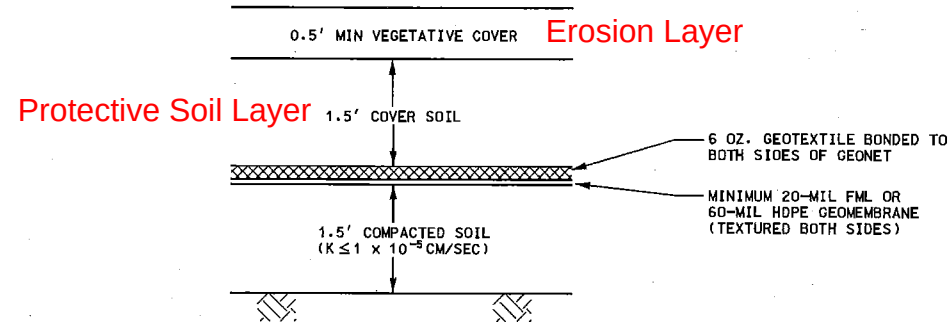
Arredondo, Zepeda & Brunz, LLC
11355 McCree Road
Dallas, TX 75238
F-10098

**LAREDO LANDFILL
PART III
Attachment 12, Appendix C
Closure Plan Figures**

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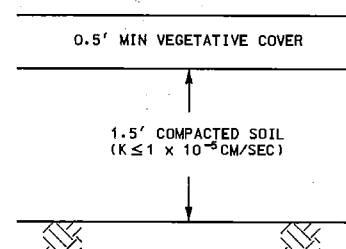
Figure III-12.1	Final Cover Details
Figure III-12.2	Final Cover Tie-in Details <u>1</u>
<u>Figure III-12.3</u>	<u>Final Cover Tie-in Details 2</u>
<u>Figure III-12.4</u>	<u>Final Cover Tie-in Details 3</u>
<u>Figure III-12.5</u>	<u>Final Cover Tie-in Details 4</u>
<u>Figure III-12.6</u>	<u>Final Cover Tie-in Details 5</u>



STANDARD FINAL COVER PROFILE
(SUBTITLE D AREAS)

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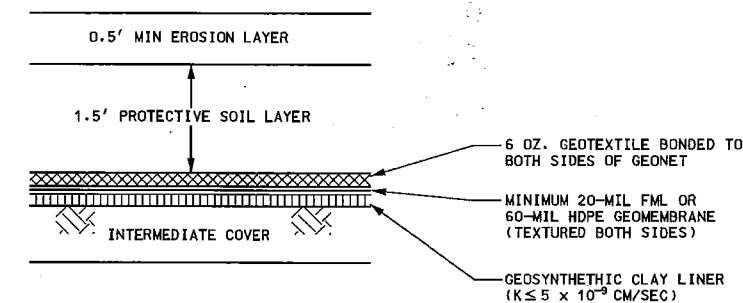
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STANDARD FINAL COVER PROFILE
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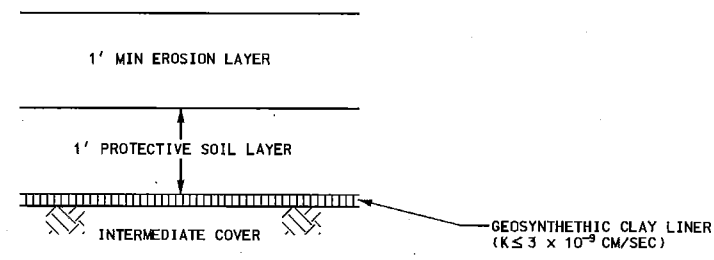
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ALTERNATIVE FINAL COVER PROFILE
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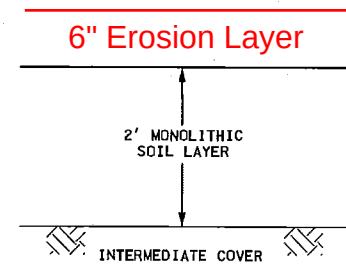
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ALTERNATE FINAL COVER PROFILE
(PRE-SUBTITLE D & TYPE IV AREAS)

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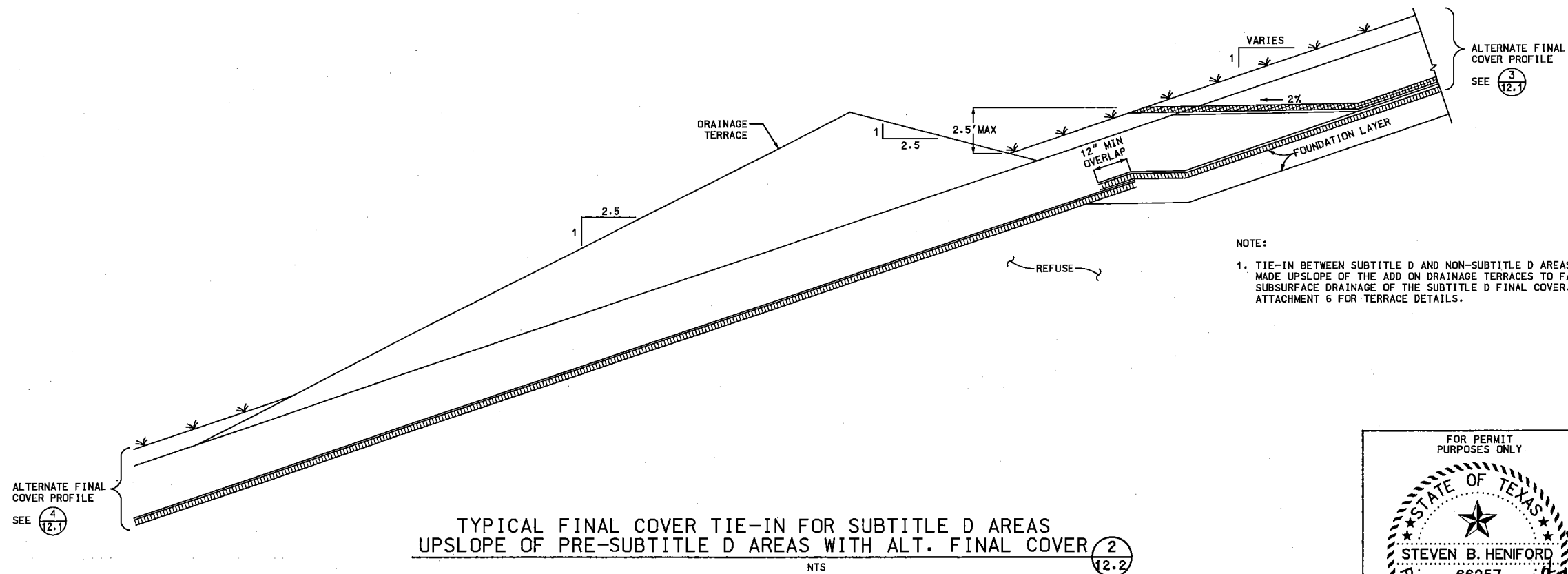
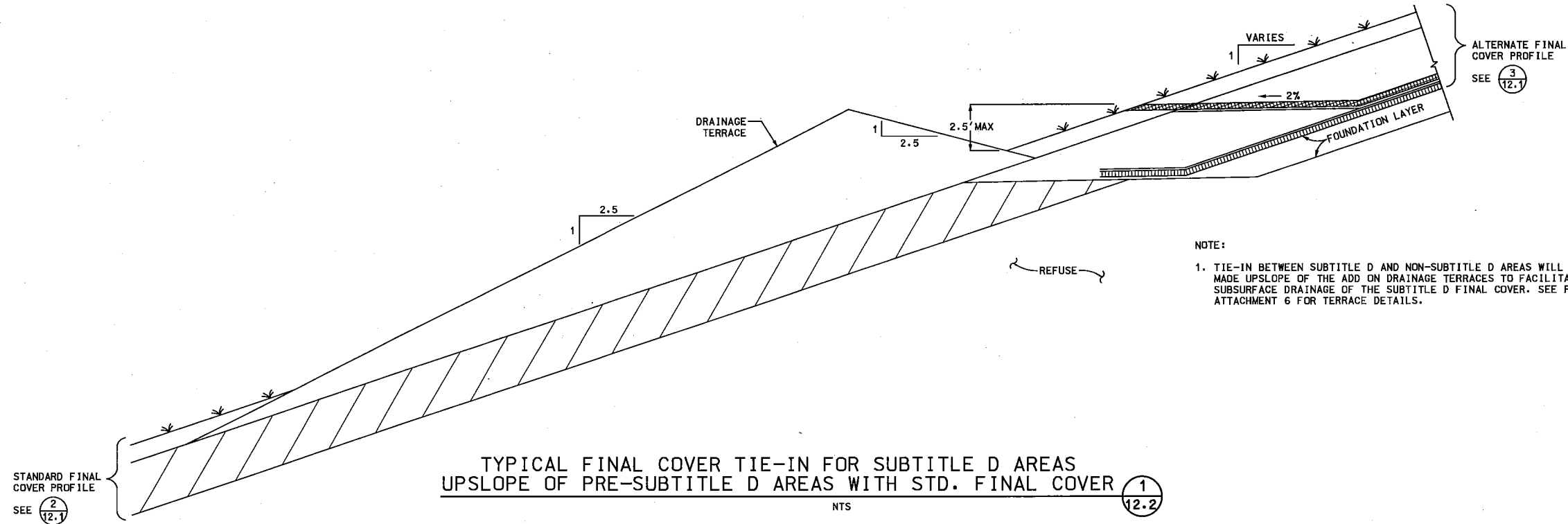
ALTERNATE FINAL COVER PROFILE
(WATER BALANCE)

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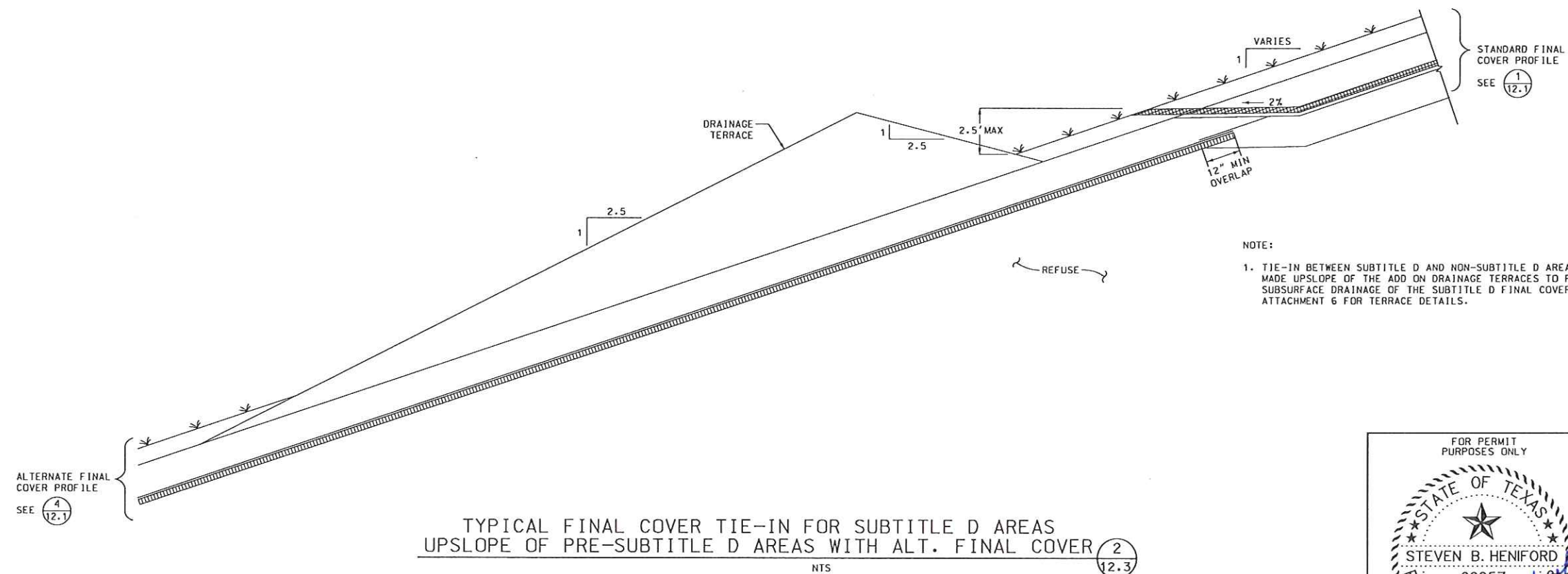
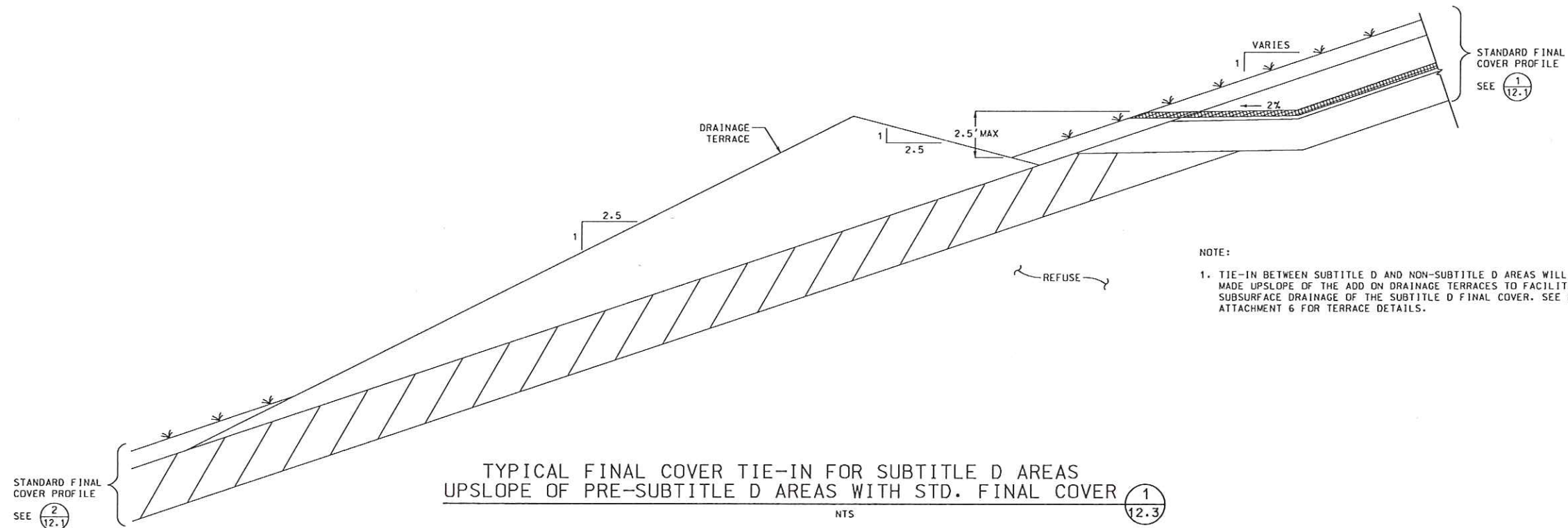
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TYPE FIRM REG. # F-10098
CIVIL • ENVIRONMENTAL • SURVEYING
CONSTRUCTION MANAGEMENT • MUNICIPAL

FOR PERMIT PURPOSES ONLY					
REV	DATE	DESCRIPTION		DES BY	APP BY
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		AZB PROJ. No. 212029			
		DATE: AUGUST 2014			
DES BY	SH				
DRN BY	AZB				
CHK BY	SH				
APP BY	MC				
				FINAL COVER DETAILS FIGURE III-12C-1	
				CITY OF LAREDO	
				SHEET	OF
				FILE:	
				ATTACHMENT:	
				III-12	



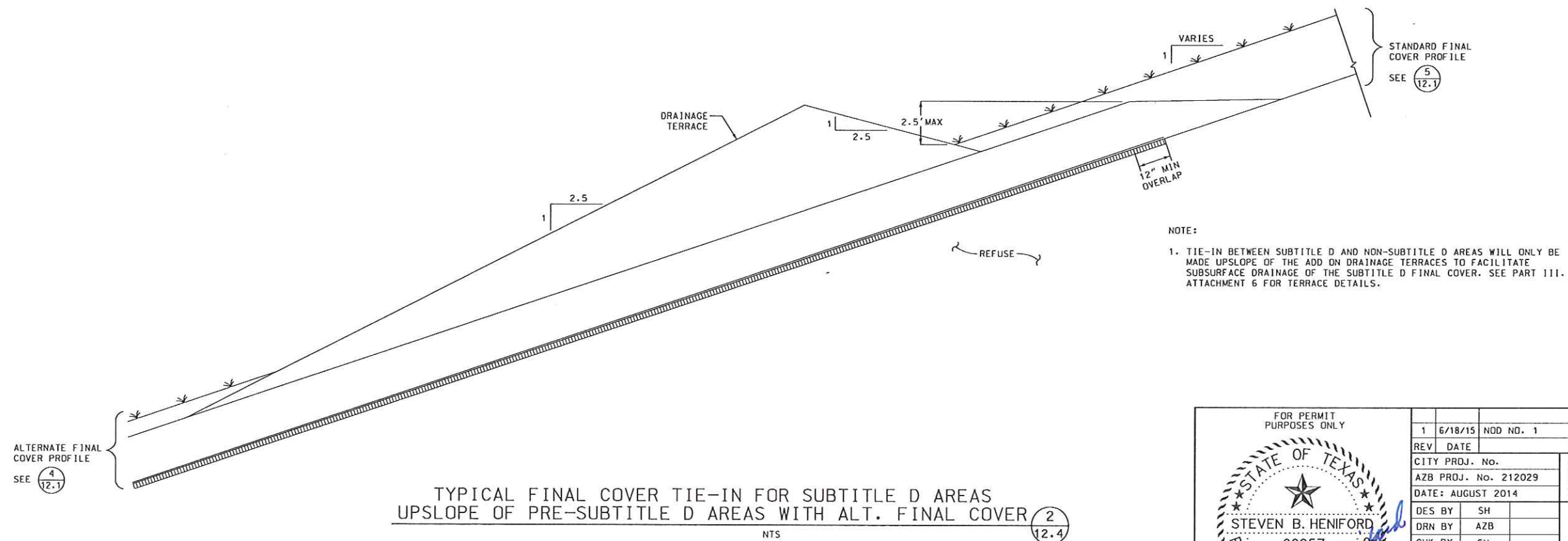
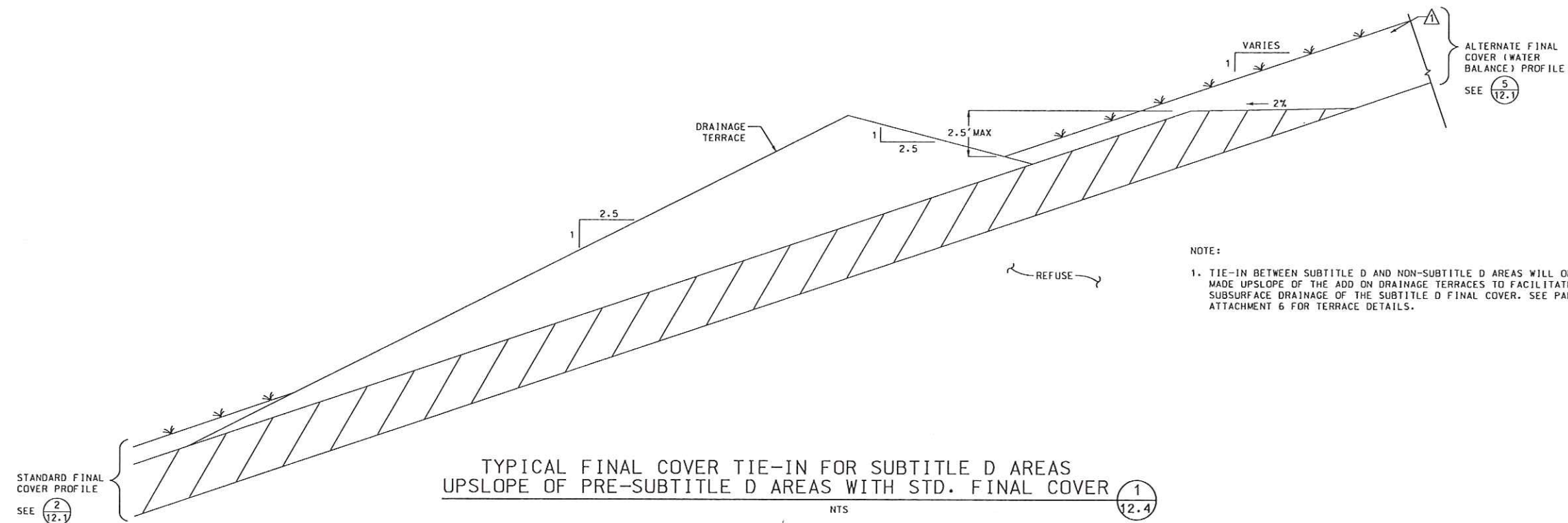
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DATE: AUGUST 2014		DATE: AUGUST 2014		WEBB COUNTY, TEXAS			
DES BY	SH	DRN BY	AZB	CHK BY	SH	APP BY	MC
STEVEN B. HENIFORD REGISTERED PROFESSIONAL ENGINEER 66257				FINAL COVER TIE-IN DETAILS FIGURE III-12C-2			
CITY OF LAREDO				SHEET OF FILE: ATTACHMENT: III-12			

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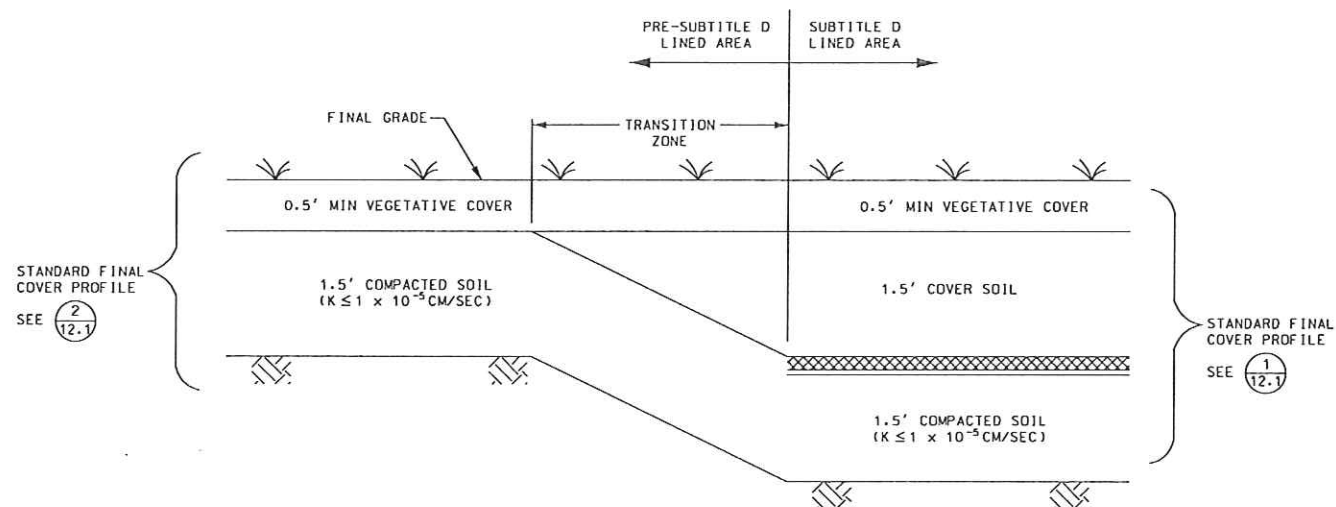
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APP BY	MC			III-12	
CITY OF LAREDO					

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 TEXAS FIRM REG. # F-10058
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 CONSTRUCTION MANAGEMENT - MUNICIPAL



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DATE: AUGUST 2014		WEBB COUNTY, TEXAS			
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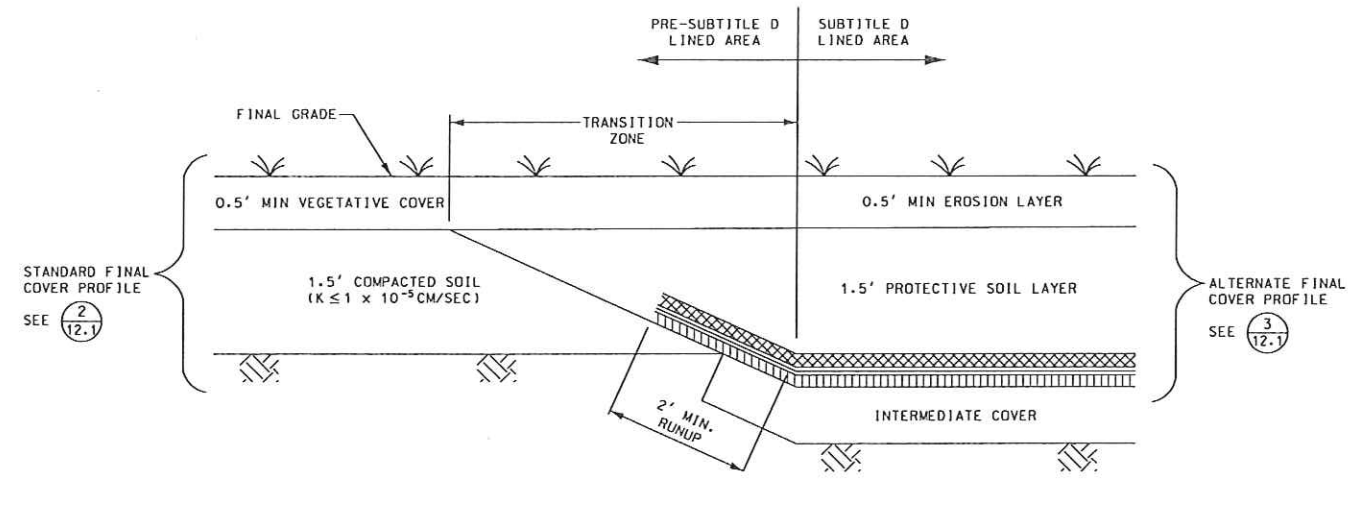
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 T&E FIRM REG. # F-10098
 CIVIL • ENVIRONMENTAL • SURVEYING
 CONSTRUCTION MANAGEMENT • MUNICIPAL



TYPICAL FINAL COVER TIE-IN FOR
PRE-SUBTITLE D CROSS-SLOPE AREA

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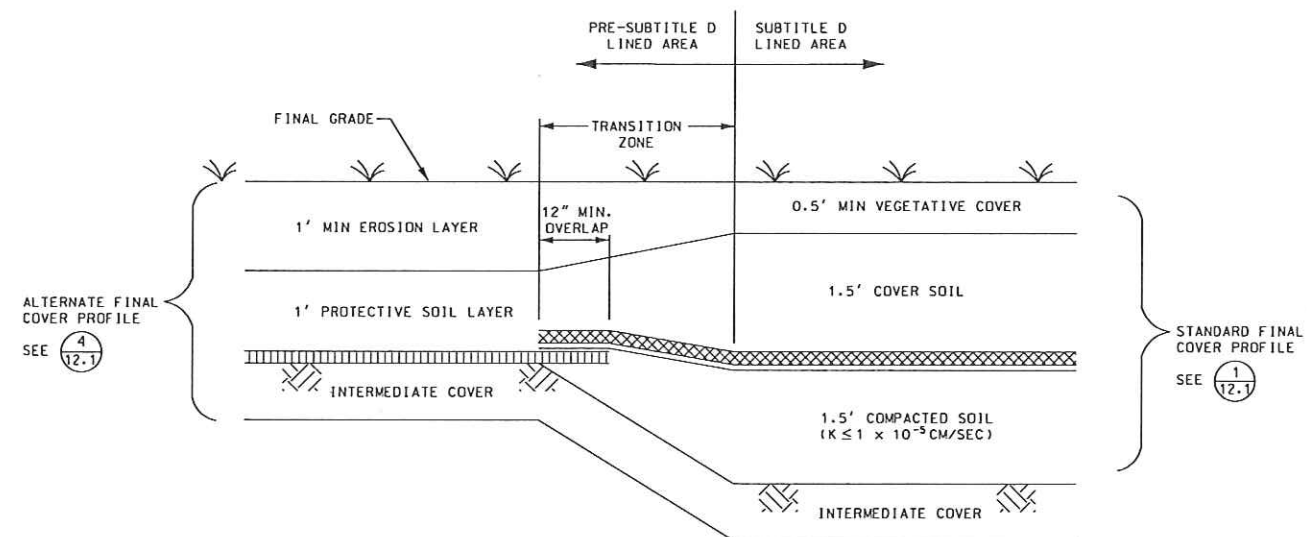
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TYPICAL FINAL COVER TIE-IN FOR
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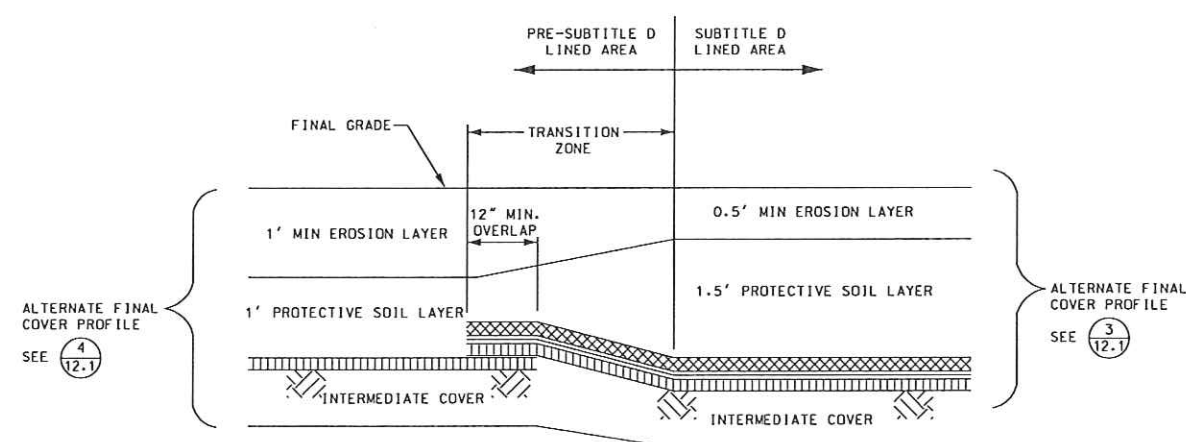
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TYPICAL FINAL COVER TIE-IN FOR
PRE-SUBTITLE D CROSS-SLOPE AREA

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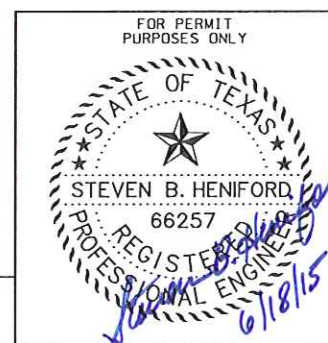
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PRE-SUBTITLE D CROSS-SLOPE AREA

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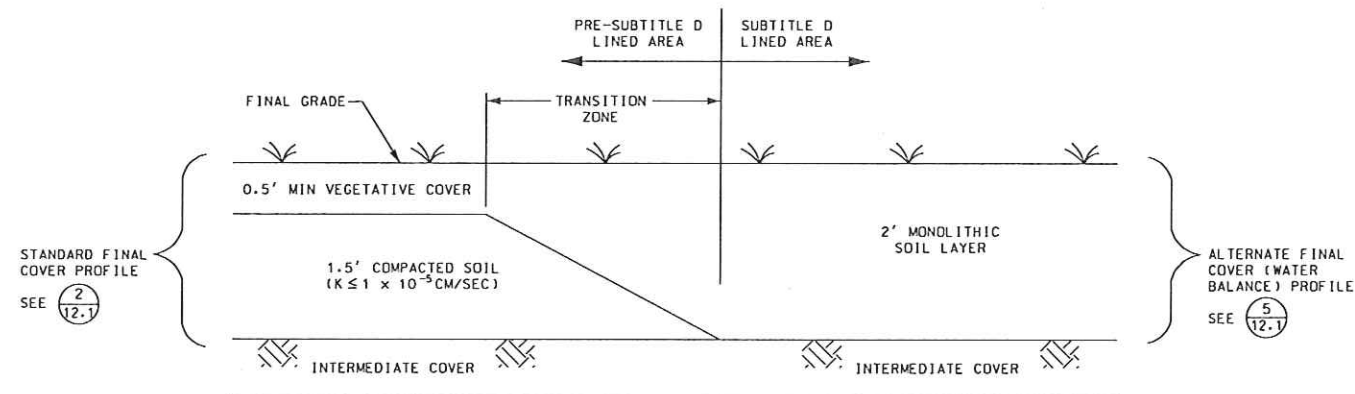
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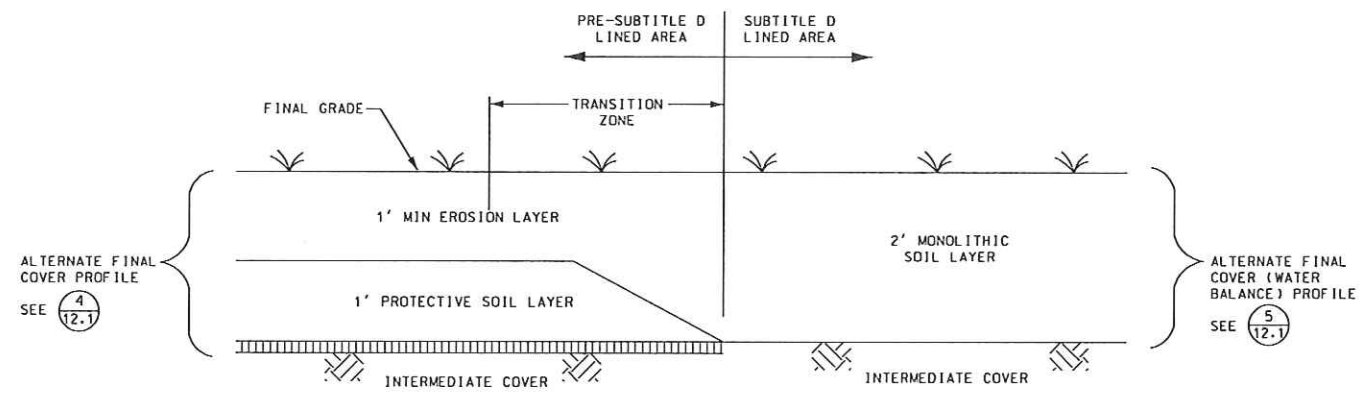
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AZB PROJ. No. 212029											
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CHK BY		SH									
APP BY		MC									
CITY OF LAREDO						SHEET OF					
						FILE:					
						ATTACHMENT: III-12					



TYPICAL FINAL COVER TIE-IN FOR
PRE-SUBTITLE D CROSS-SLOPE AREA

NTS

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TYPICAL FINAL COVER TIE-IN FOR
PRE-SUBTITLE D CROSS-SLOPE AREA

NTS

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T&E FIRM REG. # F-10058
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CONSTRUCTION MANAGEMENT • MUNICIPAL

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AZB PROJ. No. 212029		PERMIT AMENDMENT APPLICATION NO. MSW-1693B			
DATE: AUGUST 2014		WEBB COUNTY, TEXAS			
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CHK BY	SH			ATTACHMENT:	
APP BY	MC			III-12	
CITY OF LAREDO					

CITY OF LAREDO
MUNICIPAL SOLID WASTE LANDFILL
LAREDO, TEXAS
WEBB COUNTY

POST CLOSURE PLAN
ATTACHMENT III.13

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

PERMIT NO.: 1693B

Applicant:

City of Laredo Municipal Solid Waste Landfill
Solid Waste Services Department
6912 Highway 359
Laredo, TX 78044

April 2015

Prepared by:

CP&Y, Inc.
1820 Regal Row
Dallas, TX 75235
F-1741

POST CLOSURE PLAN
CITY OF LAREDO
MUNICIPAL SOLID WASTE LANDFILL

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1. Introduction

The following closure requirements were written to comply with TCEQ Municipal Solid Waste Management Regulations in 30 TAC §330.63(i), §330.463, §330.465, and with EPA's RCRA Subtitle D regulations.

The City of Laredo will be responsible for a total post-closure care period of 30 years, except as specified by Section 3 of this Post Closure Plan. Provisions include a regularly scheduled program to monitor groundwater, landfill gas, maintain berms, cover, vegetation, and site aesthetics; and to repair erosion and subsidence problems promptly. Annual inspection will be in accordance with the Site Operating Plan. The TCEQ and the City shall retain right of entry for the post closure period for inspections, maintenance and/or remediation activities as needed to maintain the integrity of the closed facility.

2. Post Closure Care Requirements

In accordance with §330.463, the City of Laredo shall meet the following requirements during post closure.

2.1. Post Closure Care Requirements §330.463(b)

After a licensed Professional Engineer has certified the completion of closure requirements for the Landfill and it has been accepted by the Executive Director, the City of Laredo shall conduct post-closure care maintenance for the unit or facility for 30 years, except as specified by Section 3 of this Post Closure Plan. Post-closure care maintenance shall consist, at a minimum, of the following.

- The City shall retain the right of entry to and maintain all rights-of-way to the Landfill and conduct maintenance and/or remediation activities as needed in order to maintain the integrity and effectiveness of all final cover, facility vegetation and drainage control systems, to correct any effects of settlement, subsidence, ponded water, erosion or other events or failures detrimental to the integrity of the closed unit and to prevent any surface run-on and run-off from eroding or otherwise damaging the final cover system.
- The City will continue to maintain and operate the leachate collection system in accordance with the regulations in §330.331 and §330.333. The Executive Director may allow the City to stop managing leachate if the City can demonstrate that leachate no longer poses a threat to human health and the environment.
- The City shall monitor groundwater in accordance the Groundwater Sampling and ~~Analysis~~Analysis Plan (GWSAP) Attachment III-11)
- The City shall maintain and operate the gas monitoring system in accordance with the requirements of §330.371(e).

3. Length of Post Closure Care §330.463(b)(2)

The length of the post-closure care period may be

- decreased by the Executive Director if the owner or operator submits to the Executive Director for review and approval a documented certification, signed by a licensed Professional Engineer and including all applicable documentation necessary to support the certification, that demonstrates that the reduced period is sufficient to protect human health and the environment; or,
- increased by the Executive Director if it is determined that the lengthened period is necessary to protect human health and the environment. If there is evidence of a release of leachate from a municipal solid waste unit, the Executive Director may require an investigation into the nature and extent of the release and an assessment of measures necessary to correct any impact to groundwater.

4. Monitoring and Maintenance Activities §330.463(b)(3)(A)

The City shall place a copy of the Post Closure Plan in the operating record immediately upon approval by TCEQ. For the complete post closure maintenance period the City shall perform the ~~following~~following:

- Maintain and operate the leachate collection system until such time as the Executive Director determines that leachate no longer poses a threat to human health and the environment.
- Make semiannual visits to the site to monitor the groundwater in accordance with the GWSAP.
- Make Quarterly visits to the site to monitor the landfill gas.
- During the first 5 years make monthly visits to:
 - Inspect the site for erosion of the final cover, lack of appropriate vegetative growth, any ponding of water on the closed unit, and any evidence of gas or leachate migration;
 - Correct any deficiencies noted; and
 - Prepare a report of the site visit and actions taken and place it in the facility records.
- For the remaining twenty five years, inspection visits shall be semiannually for all monitoring and inspection activities, with the exception of gas monitoring, which shall remain quarterly.

5. Post Closure Care Contact Information §330.463(b)(3)(B)

The name, address, and telephone number of the office or person responsible for overseeing and/or conducting the post-closure care maintenance activities at the closed unit or facility during the post-closure period. Currently, the person responsible for post closure maintenance is:

Manager, Solid Waste Services
City of Laredo
P.O. Box 1965
Laredo, Texas 78044
(956) 795-2510

6. Planned Uses §330.463(b)(3)(C)

In accordance with §330.465, portions of the site may be used as public parkland, or other suitable land uses during or after the post closure period. Post-closure uses shall not in any way jeopardize the integrity of the landfill cover, liner, stormwater systems, leachate systems, or gas systems.

7. Post Closure Cost Estimate §330.463(b)(3)(D)

A detailed written estimate, in current dollars (2015), of the cost of post-closure care maintenance and any corrective action as described in the post-closure care plan, required by the Executive Director of the TCEQ, is presented in Table 1.

The largest area requiring post-closure care is 200-acres. In accordance with §330.507(a)(1) & (2), an increase in post-closure care cost estimate shall be made if changes in the post-closure care plan or unit conditions increase the maximum costs of post closure care. Additionally, a reduction in post-closure cost estimate may be allowed if the cost estimate exceeds the maximum costs of post-closure care remaining over the post-closure care period, and the City has provided written notice to the executive director of the detailed justification. The City may request a reduction in the cost estimate and the financial assurance as a permit modification.

TABLE 1
POST CLOSURE CARE COST ESTIMATE

Post Closure Care Cost Estimate

The following is a detailed estimate, in current dollars (2015), of the cost of post-closure care maintenance and any corrective action as described in the post-closure care plan as required by §330.463(b)(3)(D). The largest area requiring post-closure care is 200 acres.

Engineering Costs

Cost Item	Unit	Cost	Quantity	Total Cost
Post Closure Plan	Acre	\$100.00	200	\$20,000.00
Site Inspection & Record Keeping	Lump Sum	\$4,000.00	1	\$4,000.00
Correctional Plans & Specifications	Acre	\$250.00	200	\$50,000.00
Subtotal				\$74,000.00
10% Contingency				\$7,400.00
Engineering Total				\$81,400.00

Site Monitoring Costs

Cost Item	Unit	Cost	Quantity	Total Cost
Ground Water Monitoring (12 Wells, Annual)	Each	\$2,500.00	12	\$30,000.00
Gas Monitoring (21 Probes Quarterly)	Per Quarter	\$1,500.00	4	\$6,000.00
Leachate Disposal (50 gallons/day/acre)	Per Gallon	\$0.05	31,250	\$1,562.50
Final Cover Inspection for Vegetation (5 Years)	Quarterly	\$500.00	20	\$10,000.00
Subtotal				\$47,562.50
10% Contingency				\$4,756.25
Site Monitoring Total				\$52,318.75

Construction Costs

Cost Item	Unit	Cost	Quantity	Total Cost
Site Maintenance, Correctional Construction	Acre	\$130.00	200	\$26,000.00
Subtotal				\$26,000.00
10% Contingency				\$2,600.00
Construction Total				\$28,600.00

Annual Cost for Post Closure Care	\$162,318.75
Total Cost 30-year	\$4,869,562.50

Post Closure Care Cost Estimate					
Engineering Costs					
Cost Item	Year of Cost Estimate	Unit	Cost	Quantity	Total Cost
Post Closure Plan	2014	Acre	\$100.00	200	\$20,000.00
Site Inspection & Record Keeping	2014	Lump Sum	\$4,000.00	1	\$4,000.00
Correctional Plans & Specifications	2014	Acre	\$250.00	200	\$50,000.00
Subtotal					\$74,000.00
10% Contingency					\$7,400.00
Engineering Total					\$81,400.00
Site Monitoring Costs					
Cost Item		Unit	Cost	Quantity	Total Cost
Ground Water Monitoring (12 Wells, Annual)	2014	Each	\$2,500.00	12	\$30,000.00
Gas Monitoring (21 Probes Quarterly)	2014	Per Quarter	\$1,500.00	4	\$6,000.00
Leachate Disposal (50 gallons/day/acre)	2014	Per Gallon	\$0.05	31,250	\$1,562.50
Final Cover Inspection for Vegetation (5 Years)	2014	Quarterly	\$500.00	20	\$10,000.00
Subtotal					\$47,562.50
10% Contingency					\$4,756.25
Site Monitoring Total					\$52,318.75
Construction Costs					
Cost Item		Unit	Cost	Quantity	Total Cost
Site Maintenance, Correctional Construction	2014	Acre	\$130.00	200	\$26,000.00
Subtotal					\$26,000.00
10% Contingency					\$2,600.00
Construction Total					\$28,600.00
Annual Cost for Post Closure Care					\$162,318.75
Total Cost 30-year					\$4,869,562.50

8. Certification of Completion of Post Closure §330.465

In accordance with §330.465, Following completion of the post-closure care maintenance period, the City of Laredo shall submit to the Executive Director for review and approval a certification signed by an independent, licensed Professional Engineer, verifying that post closure care has been completed in accordance with the approved post closure care plan. The submittal to the Executive Director shall include all applicable documentation necessary for the certification of completion of post closure care.

Upon completion of the post closure care period for the final unit at the facility, the City shall also submit to the Executive Director a request for voluntary revocation of the facility permit.

**City of Laredo Landfill Permit Amendment 1693B
City of Laredo, Texas
Permit Amendment MSW Permit 1693B
Laredo, Texas
Webb County, Texas
August 2014**

**PART III
Attachment 14
Gas Management Plan**

**Table III-14.1
Cell Dimensions**

Cell Identification	Size (square acres)	Liner Design	Status (2013)
Phase 1			
Cell 1	3.91	In-situ compacted clay	Constructed
Cell 2	3.2	In-situ compacted clay	Constructed
Cell 3	2.96	In-situ compacted clay	Constructed
Cell 4	2.62	In-situ compacted clay	Constructed
Cell 5	2.15	In-situ compacted clay	Constructed
Cell 6	2.15	In-situ compacted clay	Constructed
Cell 7	2.15	In-situ compacted clay	Constructed
Cell 8	2.15	In-situ compacted clay	Constructed
Cell 9	2.15	In-situ compacted clay	Constructed
Cell 10	2.15	In-situ compacted clay	Constructed
Cell 11	2.15	In-situ compacted clay	Constructed
Cell 12	2.15	In-situ compacted clay	Constructed
Cell 13	2.90	In-situ compacted clay	Constructed
Cell 14	2.75	In-situ compacted clay	Constructed
Cell 15	2.69	In-situ compacted clay	Constructed
Cell 16	2.58	In-situ compacted clay	Constructed
Cell 17	7.90	GCL, 60 mil HDPE	Constructed
Cell 18	9.86	GCL, 60 mil HDPE	Constructed
Phase 2			
Cell 1	5.24	In-situ compacted clay	Constructed
Cell 2	5.24	GCL, 60 mil HDPE	Constructed
Cell 3	3.58	2' clay, 60 mil HDPE	Constructed
Cell 4	2.75	2' clay, GCL, 60 mil HDPE	Constructed
Cell 5/6	7.94	GCL, 60 mil HDPE	Constructed
Cell 7/8	6.25	GCL, 60 mil HDPE	Constructed
Cell 9/10	6.42	GCL, 60 mil HDPE	Constructed
Cell 11/12	6.48	GCL, 60 mil HDPE	Constructed
Cell 13/14	18.90	GCL, 60 mil HDPE	Constructed
Phase 3			
Cell 1	9.2	GCL, 60 mil HDPE	<u>Completed in 2015 – Accepting waste</u>
Cell 2	13.56	GCL, 60 mil HDPE	Not constructed – construction will be initiated after permit amendment

Phase 4			
Cell 1	6.56	GCL (existing waste to be overlain with GCL and Geocomposite)	Constructed with the exception of overlay liner
Cell 2	2.51	GCL, 60 mil HDPE	Not constructed
Cell 3	6.19	GCL, 60 mil HDPE	Not constructed
Phase 5			
Cell 1	3.77	GCL, 60 mil HDPE	Not constructed

The temporary leachate storage tank is relocated to an area on the west side of the CPL electric easement, where Phase 4 is located. A permanent leachate storage tank will be located on the additional 3.1 acres that is being added to the permitted area. The relocation of the leachate storage tank was approved as part of a 2014 permit modification.

2.1.2.2 Landfill Final Cover

Once areas have been filled, a final cover system will be constructed. The final cover options available to the City will include: (i) a Standard Subtitle D final cover system; (ii) the use of GCL as an alternative to clay; and (iii) a “water balance” cover that provides sufficient cover with soil versus the use of plastic material to enhance long-term slope stability. The City will maintain vegetation to the extent practical given Laredo’s lack of rainfall and poor soils or use a rock armor option in place of vegetation. The City will continuously monitor the site’s slopes, through closure and post-closure care for erosion, and make necessary improvements to maintain the integrity of the final cover. Refer to the Final Cover Plan for more details.

2.2 Site Operations

Since its initial opening, the City has continuously upgraded its operations to meet state and federal rule changes in the construction of liners, leachate collection systems, intermediate and final cover and landfill gas management plans. In 1999, the Landfill Permit was amended to increase the height of the landfill. The design and the operation of the Landfill meet existing TCEQ and federal standards.

This additional capacity will increase the landfill from roughly 4.8 million cubic yards to 8.9 million cubic yards. The newly developed area will be identified as an expanded Phase 2 (between original Phases 2 and 3) and Phase 5 (between original Phases 1 and 4).

2.2.1 Current Gas Management System

The Landfill operates under Title V Air Permit Number 02371 and holds a TCEQ general operating permit (GOP) number 517. The Laredo Landfill is considered a Category -2 MSWLF which is defined as follows.

2.3 Site Information

2.3.1 Geology

The landfill facility is located on an outcrop of the Laredo Formation. The Laredo Formation is a geologic unit occurring in the Claiborne Group of the Eocene Series within the Tertiary System. The Geologic Atlas of Texas, Laredo Sheet, 1976, characterizes the Laredo Formation as sandstone and clay with thick sandstone members in the upper and lower surface. The formation is described as very fine to fine-grained, in part glauconitic, micaceous, ferruginous, cross-bedded, dominantly red and brown with clay in the middle. It weathers to an orange-yellow color with dark gray limestone layers and concretions, some of which are fossiliferous with abundant marine megafossils. The average thickness beneath the facility is about 620 feet. The site geology has been previously described in various site investigation reports, Huntingdon, 1994, F. G. Bryant, 1983, and Rust E&I (REI), 1997.

The upper Laredo Formation beneath the facility was further informally subdivided into four hydrogeologic units known as Layers I-IV during the 1997 subsurface investigation conducted by REI.

2.3.2 Hydrogeologic Conditions

Ground-water conditions at the Laredo facility have been described in a total of four reports prepared as part of three subsurface investigations and on-going monitoring events. First, the ground-water conditions were studied by Frank G. Bryant and Associates, Inc. in September 1983. It indicates that ground water was not present above the 40 feet below ground surface. The further investigation shows the ground water range between 40.5 feet to 48.8 feet below ground surface. In January 1999, ground water was measured and ranged from 423.15' msl near the southeastern corner of the facility, to 475.60' msl, near the southwestern corner of the facility. However, groundwater generally flows from the southwest corner to the north and northeast. In a July 2014 ground water monitoring event, groundwater was measured at between 430 to 472.

2.3.3 Hydraulic Conditions

Topography at the site shows the highest elevation is approximately 540' msl in the southwest corner, and the lowest elevation of approximately 470' msl is near the northeast corner. The maximum elevation change across the site is approximately 94'. The highest proposed final contour would be 664' msl at the west landfill and 652' msl at the east landfill as shown on Figure III.1.2 – Overall Site Development Plan.

2.3.4 On-site Structure

The gatehouse and the flare building are the only onsite structures at the landfill. The gatehouse is occupied whenever the Landfill is in operation; the flare building is only occupied periodically during inspection and routine maintenance. Neither of these structures is located over filled areas; no waste is planned to be filled at these locations in the future. On-site structures and any other area where potential gas buildup would be of concern will be monitored continuously by a

device such as the Sierra Model 4101-28 Combustion Gas Monitoring, or equivalent; to ensure concentrations do not exceed 1.25% by volume in facility structures. Gatehouse and flare building are to be monitored as well as any additional structures that may be constructed. Areas within the structures to be monitored include corners, baseboards, crawl spaces, attics, and utility services.

2.3.5 Easement, Right-of-Way and Utilities

There is one easement recorded within the Laredo facility permit boundary. The easement owners and descriptions follows.

- Central Power & Light P.O. Box 2121 Corpus Christi, TX 78403. Tel: 1-800-274-2611

The 70 foot wide overhead electric transmission line easement bisects the site in a north-south direction. Disposal operations will not occur within 25 feet of the easement.

2.3.6 Drainage

The newly modified onsite detention ponds will be at the southeast corner, the northwest corner and north part of the Landfill along the utility easement to capture the increasing runoff from the newly developed Laredo Landfill. The location of easement and detention ponds are depicted in Attachments III-1 and III-6.

2.3.7 Surrounding Land Use

The Landfill Gas Management Plan (LGMP) also identifies surrounding land use as it relates to the Landfill. There is currently a mixture of ranch land, vacant property, commercial, light industrial and residential uses within a 1-mile radius of the site. A description of each surrounding quadrant is detailed below:

- Northeast Side: This area consists of ranch land with the Texas Mexican Railroad right-of-way. There are also 13 stock tanks in this area.
- East Side: This area is primarily ranch land with 7 stock tanks, 3 businesses, and 5 residences.
- West Side: This area includes a mixture of residential, commercial, and industrial land. The Larga Vista Subdivision consists of approximately 120 homes, including the Larga Vista Head Start School. There is also an industrial park situated in this area that consists of approximately 20 businesses. Lastly, there are a few additional scattered businesses and 6 stock tanks in this area.
- Southwest Side: This area includes a mixture of ranch land, commercial (Bordertown Flea Market), industrial (Enron, Chevron, and Leckendeyer Oil), and scattered residential. This area also includes 9 stock tanks.

2.3.8 Off-site Structures Within 1,000 Feet of Facility Boundary

depths and to supplement information provided by the first 13 probes. This will ensure the monitoring achieves less distance for gas migration. Locations of these existing 21 monitoring gas probes (GP) were based upon the proximity of habitable structures, depth and location of solid waste and easements, access, site geology, and groundwater depths. A revision to the Gas Plan, dated March 2006, reduced the number of probes from 21 to 18. GP 15, GP 16 and GP 17 are no longer being monitored on a quarterly basis. GP 8R, GP 7, GP 14, and GP 6 are located along the eastern perimeter of the landfill. GP 8R is located at the location of the abandoned pipeline to monitor possible migration through this area. GP 13 and GP 20 are located at the western end of the abandoned pipeline. GP 9, GP 10, and GP 18 are located along the southern boundary of the landfill. GP 10 is located near the scale house to monitor possible migration to this facility. GP 19, GP 12, GP 20, GP 13, GP 21, and GP 1 are located on the western perimeter of the landfill. The probes will identify possible migration to sites to the west of the landfill. GP 2, GP 3, GP 4, and GP 5R monitor possible gas migration on the northern perimeter.

The existing permanent 18 MP locations indicated above are shown on Figure III-14.1.

4.1.1 SGVP and Permanent Probe Design and Installation

The existing 21 permanent monitoring gas probes have 2 components; 1) riser pipe and 2) screened section. ~~Both~~ Screened section ~~are~~ is made from 1-inch diameter schedule 40 PVC pipe. The riser section consists of a 2-inch diameter schedule 40 PVC solid pipe 3-5 feet above the ground and extends to 20-30-5 feet below the ground surface. The tip of the underground riser pipe is connected with the screened section to reach the final depth of each GP. The existing GPs location is detailed in Table 15-2 - Existing GP Elevation Detail in Laredo Landfill.

The final design depth of the initial permanent GP installation will be determined during construction from the probe hole boring logs by the depth of nearby existing probes, the depth of base of the nearby waste cell, and the highest measured groundwater elevation at that location. If necessary, a field change for each GP will be made and recorded on-site. A typical single screen probe is shown in Figure 14.2 - Typical Landfill Gas Probe ~~and Multi Level Probe~~ Detail. ~~If the two permeable strata layers are penetrated, the multi-level or nested probe may be desirable in that location, as detailed for the multi-level probe also shown in Figure 14.2—Typical Landfill Gas Probe and Multi Level Probe Detail.~~ Copies of the record drawings and associated information will be submitted to the TCEQ, when the Laredo landfill needs to install the new permanent GP.

Table 14.2
Existing GP Elevation Detail in Laredo Landfill

Monitoring Gas Probe ID	Total GP Depth (ft)	<u>Depth to Top of Screen (ft)</u>	<u>Length of Screen (ft)</u>
GP-1	26.0	<u>5</u>	<u>19.9</u>
GP-2	30.9	<u>5</u>	<u>24.8</u>
GP-3	31.8	<u>5</u>	<u>25.7</u>
GP-4	31.0	<u>5</u>	<u>24.9</u>
GP-5R	32.2	<u>5</u>	<u>26.1</u>
GP-6	26.5	<u>5</u>	<u>20.4</u>
GP-7	18.1	<u>5</u>	<u>12.0</u>
GP-8R	47.0	<u>5</u>	<u>40.9</u>
GP-9	30.0	<u>5</u>	<u>23.9</u>
GP-10	31.4	<u>5</u>	<u>25.3</u>
GP-11	31.0	<u>5</u>	<u>24.9</u>
GP-12	29.0	<u>5</u>	<u>22.9</u>
GP-13	29.0	<u>5</u>	<u>22.9</u>
GP-14	35.0	<u>5</u>	<u>28.9</u>
GP-18	45.0	<u>5</u>	<u>38.9</u>
GP-19	70.0	<u>5</u>	<u>63.9</u>
GP-20	40.0	<u>5</u>	<u>33.9</u>
GP-21	NA		
Scale House			

In the event additional GPs are needed, the guidelines in this section should be used for design and installation.

A licensed Professional Engineer (PE) must review all applicable test procedures, shop drawings, reports, manufacturer instructions and the manufacture's certificates to verify that methane monitoring system equipment conforms to the manufacturing requirement and industry standard prior to SGVP construction. Typical SGVP construction leaves probe tips embedded at the desired sampling depth together with sampling tubes connected to the tips which runs to the surface for sample collection. During construction, a qualified system inspector will inspect the probe installation to prevent failure of the system. The SGVP can be used as the site permit boundary monitoring system instead of permanent GP. However, when any such SGVP location detects methane gas above 5%, a permanent GP must be installed.

The process prior to installation of the permanent GP is similar to the SGVP installation. A permanent GP is drilled by the qualified drilling contractor. The following characteristics will be considered in the design and installation of the new permanent GP:

- Geology
- Proximity of on-site and nearby structures
- Permanent low seasonal underground water table
- Depth of the solid waste

4.1.2 Monitoring SGVPs and Permanent Gas Monitoring Probes

Methane monitoring will be conducted by means of testing GPs. The monitoring frequency of each permanent probe ~~may~~will be increased if explosive gas exceeds 5% explosive gas by volume. The equipment to monitor the gas probe should be able to measure methane gas pressure and atmospheric pressure, methane gas temperature and ambient air temperature, methane gas level, and water depth in the probe. The minimum parameters needed to monitor explosive gas probes are:

- Static Gas Pressure - A suitable pressure gauge such as the Dwyer Series 2000 Magnehelic Gauge (Appendix B), or equivalent
- Explosive Gas - A suitable monitoring device must have a Dual Range Methane Monitoring with the ability to measure the combustible explosive gas indicator (CGI) and infrared gas detection device or equivalent.

The result of the pressure measured in the gas probe can fluctuate, causing inaccuracies if venting has occurred during the monitoring.

If explosive gas concentration is detected at or above the LEL at any bar-hole location, the additional bar-holes will be used to check the distance of the gas migration. The additional probe locations will be added in the pattern, at 5 foot increments, to detect the methane level. The 5 feet incremental monitoring must be continued until the reading shows 0% methane level. Information obtained from this procedure will be plotted to determine the extent of gas migration. If no methane gas migrates beyond the permit area, the information will be detailed in the Quarterly Report. If the above LEL methane migration is detected off-site, the detailed information along with the proposed mitigation measurement will be addressed as described in section 5.0 CONTINGENCY PLAN.

4.1.4 Continuous Monitoring of On-site Structures

The gatehouse is the only occupied structure at the Landfill. The gatehouse is not located over a current or planned disposal area. This only permanent on-site occupied structure will be monitored for the potential migration of explosive gas by the using the hand-held explosive gas indicators such as Thermo GasTech Innova Model LS or equivalent. On-site structures and any other area where potential gas buildup would be of concern will be monitored continuously by a device such as the Sierra Model 4101-28 Combustion Gas Monitoring, or equivalent; to ensure concentrations do not exceed 1.25% by volume in facility structures. Gatehouse and flare building are to be monitored as well as any additional structures that may be constructed. Areas within the structures to be monitored include corners, baseboards, crawl spaces, attics, and utility services. The gatehouse or any future structures will be monitored routinely on a quarterly basis.

Any verifiable detection of methane in the gatehouse above the TCEQ requirement will be immediately addressed and reported as described in section 5.0 CONTINGENCY PLAN. In addition the monitoring information such as date, time and condition of each area in gatehouse will be recorded on the field data form as shown on the Appendix 14A - Field Data Form.

4.1.5 Utility Vent Installation and Monitoring

Permanent gas vents will be installed on any future subsurface utility that crosses the permit boundary of the Landfill. Both monitoring and installation activities will be under the supervision of site manager or site supervisor in order to comply with City and TCEQ requirements. A typical utility vent detail drawing will be prepared at the time of installation. The drawing will include all underground utilities and ground surface either near or at the utility vent. In addition, the City will need to obtain the approval from utility owners before utility vent installation.

Utility vents will be monitored quarterly in conjunction with the regularly monitored gas probes around the perimeter site and conform with TCEQ requirements. The exceeding explosive gas level will be addressed and reported in accordance with section 5.0 CONTINGENCY PLAN.

4.1.6 Reporting of Data and Record Keeping

All quarterly monitoring data acquired during the monitoring will be recorded and noted on the field data form as show on Appendix 14A - Field Data Form and kept in the site's operating record. The excess explosive gas level in any location will be reported to TCEQ and necessary organization or personnel. The methane versus time chart will be updated and included in the quarterly report and placed within the seven days after the detecting of above methane gas concentration in the Site Operating Record (SOR) at any monitoring locations.

Documentation of the exceed methane limit required by TCEQ will be submitted to:

- Municipal Solid Waste Permit Section, MC 124
Texas Commission on Environmental Quality (TCEQ)
P.O. Box 13087
Austin, TX 78711-3087
(512) 239-2335

The report will also include all the information related to the methane gas migration and control as well as records of any contingency plans that were implemented as a result of migration as explained in section 5.0 CONTINGENCY PLAN. Photocopies of completed quarterly reports will be placed in the SOR for at least two yearsthe life of the facility, including post closure care.

A separate calibration log for each device will be placed on-site and will include the following information:

- Location of equipment with serial number and model number
- Date and time of calibration
- Name of personnel who calibrates the equipment according to the manufacturing manual
- Type of calibration
- Results of calibration

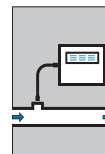
4.2 Schedule for Installation of Monitoring Elements

The existing 18 permanent GP are already installed as explained in Section 4.1 Proposed Landfill Gas Monitoring Procedure. No additional GP are required at this time. If the City determines that the additional permanent GP, beyond 18 GP shown on Figure 14.1 - Original Cell and Phase Layout with Monitoring Gas Probes Location, are needed, a permit modification request will be prepared and submitted to the TCEQ showing probe recorded drawing, location and installation schedule. After approval from TCEQ, the City will install the probes and submit the as-built documentation after the installation completion.

4.3 Plan Implementation Schedule

The City is at present implementing this Landfill Gas Management Plan as approved with the 1999 permit amendment and since modified. The existing gas control system will continue to serve the landfill and implement this LGMP unless the requirement of Federal New Source Performance Standards and Emission Guidelines modify to different standard.

Appendix 14B: Gas Monitoring Equipment Specifications



The GEM™2000 combines the GEM™500 and the GA-90 into one faster, more accurate, intrinsically safe instrument

The GEM™2000 design specifically for use on landfills to monitor landfill gas (LFG) extraction systems, flares, and migration control systems. The GEM™2000 samples and analyzes the methane, carbon dioxide and oxygen content of landfill gas.

Features

- Measures % CH₄, CO₂ and O₂ Volume, static pressure and differential pressure
- Calculates balance gas, flow (SCFM) and calorific value (KW or BTU)
- Displays % LEL of CH₄, and user-defined comments
- Records site and well conditions
- Extended operation (10 - 14 hrs use from one charge)
- Certified intrinsically safe for landfill use
- Two instruments in one (GA and GEM mode)

Benefits

- Designed specifically for use on landfills to monitor landfill gas (LFG) extraction systems, flares, and migration control systems.
- No need to take more than one instrument to site
- Can be used for routine sub-surface migration monitoring of landfill site perimeter probes and for measuring gas composition, pressure and flow in gas extraction systems
- The user is able to set up comments and questions to record information at site and at each sample point
- Ensures consistent collection of data for better analysis
- Allows balancing of gas extraction systems

Applications

- Landfills
- Gas Extraction Wells
- Flare Monitoring
- Subsurface Migration Probes



Technical Specification

Gases Measured

CH₄, CO₂, by dual wavelength infrared cell with reference channel. O₂ by internal electrochemical cell

CH ₄	0-100% Reading		
CO ₂	0-100% Reading	O ₂	0-25%

Gas Accuracy	CH ₄	CO ₂	O ₂
0-5%	±0.3%	±0.3%	±1.0%
5-15%	±1.0%	±1.0%	±1.0%
15% - Full Scale	±3.0%	±3.0%	±1.0%

Other Parameters	Unit	Resolution	Comments
Energy	BTU/hr	1000 BTU/hr	Calculated from specific parameters.
Static Pressure	in.H ₂ O	0.1 in.H ₂ O	Direct Measurement
Differential Pressure	in.H ₂ O	0.001 in.H ₂ O	Direct Measurement

Flow	Typically 300 cc/min
Flow with 5.9 in.Hg vacuum	Approximately 250 cc/min
Operating Temperature Range	32°F - 104°F
Operating Pressure	-100 in. H ₂ O, +100 in. H ₂ O
Relative Humidity	0-95% non condensing
Barometric Pressure	±5.9 in.Hg from calibration pressure
Barometric Pressure Accuracy	±1% typically
Battery Life	Typical use 10 hours from fully charged
Charge Time	Approximately 2 hours from complete discharge.
Certifications	UL- Certified to Class 1, Zone 1, AEx ib d Ila T1



The Climate Registry



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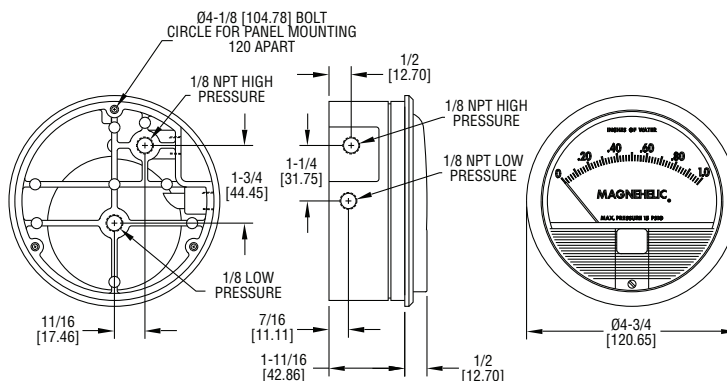
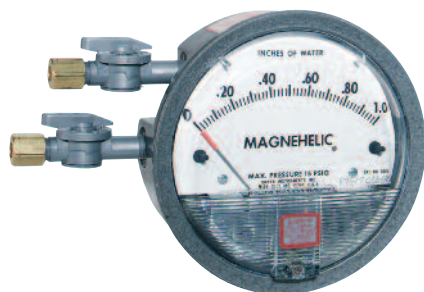
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Series 2000 Magnehelic® Air Filter Gages

Specifications - Installation and Operating Instructions



The Magnehelic® gage consists of two pressure-tight compartments separated by a molded flexible diaphragm.

The interior of the gage case serves as the "high" pressure compartment and a sealed chamber behind the diaphragm serves as the "low" pressure compartment.

Differences in pressure between the "high" and "low" sides of the diaphragm cause the diaphragm to assume a balanced position between the two pressures. The front support plate of the diaphragm is linked to a leaf spring which is anchored at one end. The spring provides calibrated resistance to the diaphragm motion. Motion of the spring is transmitted through an exclusive magnetic linkage to the pointer.

The Magnehelic® gage requires no maintenance. The only field adjustment required is occasional zero setting of the pointer which is done by opening the plastic vent valves and turning the adjustment of the gage.

STANDARD ACCESSORIES FURNISHED

Two 1/8" NPT plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapter and three flush mounting adapters with screws. (Mounting and snap ring retainer substituted for 3 adapters in MP & HP gage accessories.)



Air Filter accessories furnished are mounting panel with necessary screws, two static pressure taps with integral compression fittings, two five foot lengths of 1/4" aluminum tubing and the two molded plastic vent valve with compression fittings.

The Magnehelic® gage with molded plastic vent valves for easy zeroing. Available with adjustable signal flag (not shown; option "ASF" at extra cost) for immediate visual reference to maximum allowable pressure drop; External front screw for zero adjustment. Red and green scale overlays to highlight safe and dangerous readings are also available.

FEATURES

- Easiest reading for personnel accustomed to dial type gages.
- Lowest cost pointer type gage.
- Easy zeroing with molded plastic vent valves.
- Sensitivity to 0.01" w.c.
- Withstands vibration.
- Unaffected by over range pressure surges.

SPECIFICATIONS

Service: Air and non-combustible, compatible gases. (Natural Gas option available.)

Wetted Materials: Consult Factory.

Housing: Die cast aluminum case and bezel, with acrylic cover, Exterior finish is coated gray to withstand 168 hour salt spray corrosion test.

Accuracy: ±2% of full scale (±3% on - 0 and ±4% on - 00 ranges), throughout range at 70°F (21.1°C).

Pressure Limits: -20" Hg. to 15 psig.† (-0.677 bar to 1.034 bar); MP option; 35 psig (2.41 bar), HP option; 80 psig (5.52 bar).

Overpressure: Relief plug opens at approximately 25 psig (1.72 kPa), standard gages only.

Temperature Limits: 20 to 140°F.* (-6.67 to 60°C).

Size: 4" (101.6 mm) Diameter dial face.

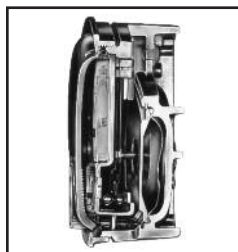
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.

Process Connections: 1/8" female NPT duplicate high and low pressure taps - one pair side and one pair back.

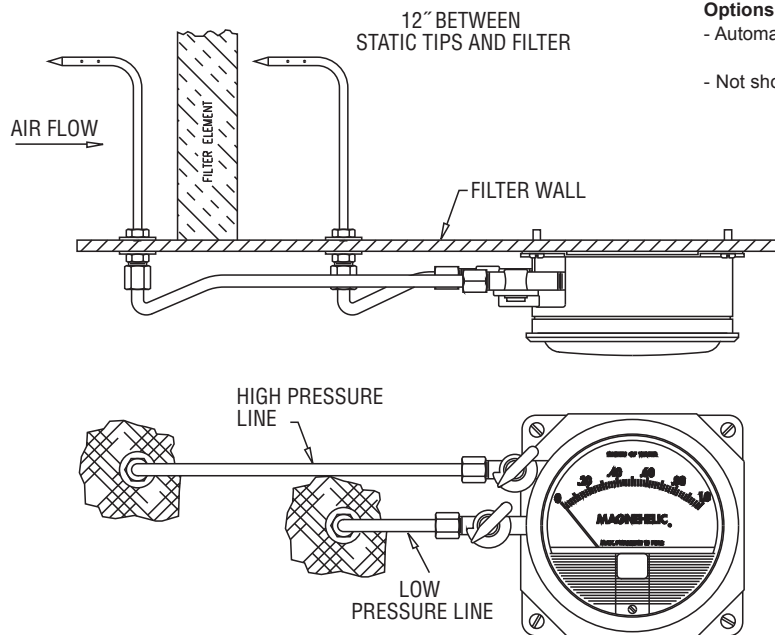
Weight: 1 lb 2 oz (510 g), MP & HP 2 lb 2 oz (963 g).

* Low temperature models available as special option.

† For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at lower left.



Cutaway view of the Magnehelic® gage showing the actuating diaphragm, the leaf spring with magnet, the helix which turns the indicating pointer in response to the position of the magnet without mechanical linkages.



Options Not Shown:

- Automatic signal flag integral with plastic gage cover
- Not shown Scale plate overlays in green and red

INSTALLATION PROCEDURE

1. Screw vent valves into side connections of gage. Be sure back connections of gage are sealed with plugs provided with the gage. Attach gage to mounting plate with three No. 6-32 screws provided.
2. Select a convenient location on filter wall and punch or drill four 1/8" dia. max. holes for mounting plate as shown in drawing above. Attach mounting plate to filter wall with four self-tapping screws provided. If gage is to be flush mounted in control panel, refer to Bulletin No. A-27.
3. Drill two 7/16" holes in the duct, one on each side of the filter and at least 12" distant*. Secure the static pressure tips as in the drawing above, with the tips directed into the air flow.
4. Connect 1/4" metal tubing from the static pressure tips to the gage. The tip on the downstream side of the filter is connected to the vent valve in the low pressure connection of the gage. The tip on the upstream side is connected to the vent valve in the high pressure connection.
5. Turn both vent valves to "VENT" position and adjust the gage pointer to zero by means of the external adjustment screw in the face of the gage. After zeroing, turn vent valves to "LINE" position.

***NOTE On location of static pressure tips:** The location of static pressure tips is of primary importance in securing reliable readings. For maximum accuracy, it is essential that the influence of the velocity of the air be eliminated to permit sensing the true static pressure. Note that some installations do not provide a straight duct approach to the filter bank which may cause air to swirl and eddy.

Tips should be located as recommended by the specifying engineer or by the filter manufacturer. In the absence of such recommendations, locate the tips at least 12" upstream and downstream from the filters in a zone of minimum turbulence.

INSTALLATION CHECK AND TROUBLE SHOOTING

Before putting your air filter gage into service or in the event of initial pressure drop readings that do not agree with the filter manufacturer's specified pressure drop, make the following checks:

1. Check zero adjustment of the gage as described above.
2. Check all tubing connections for tightness from the gage to the static tip or fitting connection.
3. Check plastic cover of gage to be sure it is securely in place and air tight.
4. Check static pressure tips or fittings to be sure they are not plugged.
5. Check installation of static tips or fittings*. Be sure static pressure tips point directly into the air stream. A velocity pressure error can be created if the air blows directly into the opening.

OPERATION

With vent valves in "LINE" position the gage will indicate pressure drop across the filter. If the reading varies substantially from the filter manufacturer's rating for a clean filter, check the system for proper setting of controls, air balancing of system, leakage in system and whether or not the correct filter has been installed.

When pressure drop across the filter reaches the minimum recommended by the manufacturer, the filter should be serviced or replaced.

Model 4101 Series Gas Sensor Modules

The Model 4101 Series Gas Sensor Modules feature accurate detection of the specified gas with linear 4-20 mA output.

The Sierra Monitor Model 4101 Series provides the user with the features needed in a stand-alone, fixed-point hazardous gas monitor system. Utilizing electrochemical sensor technology the Model 4101 provides accurate monitoring of hazardous gas conditions. Proven sensor design matched with reliable state-of-the-art electronics results in the ideal complete single channel package to protect your plant and personnel.

Automatic Low Sensitivity Check

Monitoring integrity is ensured with the automatic low sensitivity check. After calibration, a sensor sensitivity check confirms that the sensor response to gas is sufficient to provide reliable operation without false indication. If the sensor has low sensitivity, an LED lights to indicate that sensor replacement is due.

False Alarm Avoidance

During Power-Up and Calibration, the transmitter output is locked at 4 mA. The output remains locked for five minutes directly after power is applied or after calibration gas is removed, allowing sufficient time to fully stabilize before coming on-line. This avoids erroneous readings during warm-up and prevents alarm caused by calibration gas.

Convenient Diagnostic Measurements

Critical measurements are made at convenient jacks for a Volt Ohm Meter. Each measurement location is clearly marked. All modules have a signal output adjustment.



Simple Zero and Span Adjustments

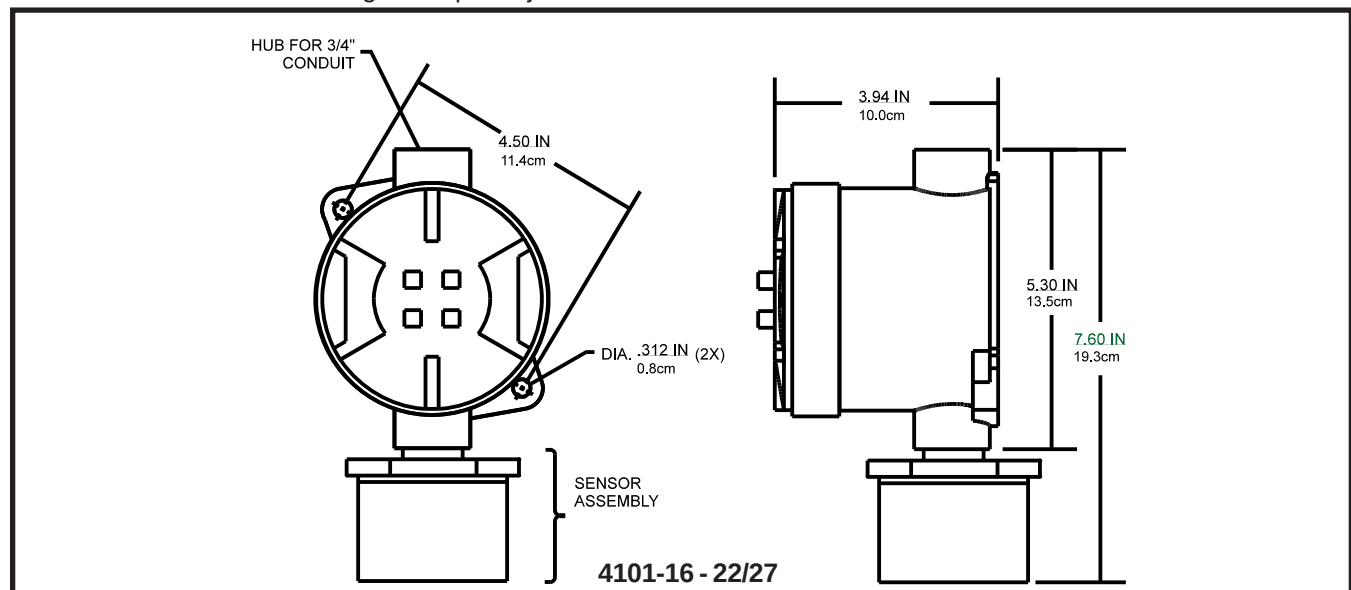
Easily accessible potentiometers enable calibration adjustments to be made in minutes by non-technical personnel for reduced maintenance cost.

Flexible Alarm and Logging Options

The analog gas sensor modules can be used as part of a facility gas risk management plan. The 4-20 mA output signal is ideally suited to interface with a wide range of instrumentation for alarm annunciation and recording.

The sensor module is housed in a NEMA-7 enclosure rated for Class 1, Division 1, Groups C, D environments. An optional NEMA 4 Group B enclosure is available.

Be sure to also look at the 5100-XX-IT Series Intelligent Gas Sensor Modules for network-enabled hazardous gas monitoring.



Specifications

Gas Type	Model	Sensor	Std. Range ⁶	Units	Resolution	Response Time ²	Sensor Life ³	Operating Range		
								°F	°C	RH
Oxygen	5100-03-IT ¹	EC	5-25	% Vol.	+/- 0.1%	<10 Sec.	2 Yrs.	5 to 122	-15 to 50	15-99%
Carbon Monoxide	5100-04-IT ¹	EC	0-500	PPM	0.5 PPM	<25 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-99%
Hydrogen Sulfide	5100-05-IT ¹	EC	0-100	PPM	0.1 PPM	<30 Sec.	2 Yrs.	-40 to 122	-40 to 50	15-99%
Chlorine	5100-06-IT ¹	EC	0-10	PPM	0.1 PPM	<60 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-99%
Sulfur Dioxide	5100-10-IT ¹	EC	0-100	PPM	0.5 PPM	<20 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-90%
Nitrogen Dioxide	5100-12-IT ¹	EC	0-20	PPM	0.2 PPM	<35 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-90%
Carbon Monoxide ⁴	4101-16	EC	0-2000	PPM	0.1 PPM	<35 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-90%
Nitric Oxide	4101-19	EC	0-20	PPM	0.5 PPM	<15 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-90%
Hydrogen Chloride	4101-21	EC	0-20	PPM	0.1 PPM	<100 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-90%
Hydrogen Cyanide	4101-22	EC	0-20	PPM	0.1 PPM	<70 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-90%
Ammonia	5100-25-IT ¹	EC	0-50	PPM	1.0 PPM	<30 Sec.	⁵	14 to 122	-10 to 50	20-95%
Hydrogen Fluoride ⁵	4101-26	EC	0-10	PPM	1.0 PPM	<30 Sec.	⁵	14 to 122	-10 to 50	20-95%
Ethylene Oxide	4101-27	EC	0-20	PPM	0.1 PPM	<90 Sec.	2 Yrs.	-4 to 122	-20 to 50	15-90%
Notes:		¹ 5100-XX-IT Series provide intelligent network-enabled hazardous gas detection ² Response time to 90% full signal value for applied concentration ³ Sensor life typical for use at standard temperature and pressure with occasional exposure to gas of interest ⁴ Hydrogen tolerant ⁵ Diffusion via memberane. Requires electrolyte ⁶ Optional ranges available								

Electrical Data

Loop Type: 3 wire
Loop Resistance: 800 Ohm with 28VDC
Input Voltage DC: 14-30 VDC
Input Current: 40 mA
Input Power Max: 1.4W
Signal Output: 4-20 mA DC linear (trouble 0 mA)

Operating Pressure: +10% (variation from ambient)

Mounting: 3/4" NPT

Housing: Explosion proof (NEMA 7)
 (Div. I, Class 1, 2, Groups C, D, E, F, G)
 Optional NEMA 4 Group B housing available

Construction:
Modules
Dimensions
Weight

4101-16-27	H: 8.0", D: 4.5", W: 4.0" (20.3 x 15.2 x 15.2 cm)	2.7 lb (1.3 Kg)
4101-26	H: 10.2", D: 6.0", W: 6.0" (25.9 x 15.2 x 15.2 cm)	2.7 lb (1.3 Kg)

Warrenty: Two year on non-consumables



02/10

CITY OF LAREDO
MUNICIPAL SOLID WASTE LANDFILL
LAREDO, TEXAS
WEBB COUNTY

LEACHATE AND CONTAMINATED WATER PLAN
ATTACHMENT III.15

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

PERMIT NO.: 1693B

Applicant:

City of Laredo Municipal Solid Waste Landfill
Solid Waste Services Department
6912 Highway 359
Laredo, TX 78044

Revised June 2015

Prepared by:

CP&Y, Inc.
1820 Regal Row
Dallas, TX 75235
F-1741

- Be of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying wastes, waste cover materials, and by any equipment used at the landfill. (*See Appendix B – LCS Design Calculations*).
- Be designed and operated to function through the scheduled closure and post-closure care period of the landfill considering the following factors;
 - drainage media specifications and performance (see section 2.3.2) pipe material and strength (see section 2.3.4)
 - pipe network spacing and grading (see section 2.3.4)
 - capacity of sumps (see section 2.3.5)
 - collection sump materials and strength (see section 2.3.5)
 - estimated rate of leachate removal (see section 2.3.6), and
 - be resistant to clogging and capable of being cleaned (LCS cleanouts shall be placed to allow cleaning as necessary. They will be placed as shown on Figure III.15.2)

All previously constructed Subtitle D cells were constructed with a LCS; and sump riser pipes for leachate extraction. The existing waste pack elevation in these cells is past the interim height condition, or worst case operating condition in regards to maximum leachate head on liner; thus, leachate head over the liner in these cells will not increase by this proposed vertical expansion.

2.2.2. Subtitle D Type IV Landfill Cells

In accordance with §330.331(d) there is no requirement for a LCS in Type IV landfill cells. Currently, Cells 1, 2 and 3 of Phase 4 are designated as Type IV landfill cells. The proposed expansion modifies Cells 2 and 3 into Type I Cells. Cell 1 of Phase 4 will be the only remaining Type IV cell at the Laredo Landfill. However, this cell will be covered with a separation liner (see Figure III.15.63) and Type I waste will be filled over the entire Phase 4. The separation liner will be graded to allow leachate generated from the proposed fill to be collected in the proposed sumps located in Cells 2 and 3, and in Phase 5.

2.2.3. Pre-Subtitle D Landfill Cells

There is no requirement for a LCS in Pre-Subtitle D Landfill Cells. Cells 1 thru 16 of Phase 1 and Cell 1 of Phase 2 are constructed with Pre-Subtitle D liners. No leachate collection is provided in these areas.

Due to the vertical expansion, some areas of Phase 1, located above Pre-Subtitle D bottom liners will be filled. These areas (Cells 7,8,11, and 12) will be covered with a separation liner ~~–(see Figure III.15.6)~~. The liner will be graded to the south to allow leachate from this fill to discharge into the existing sumps of Cells 17 and 18 of Phase 1, and the proposed sumps of Phase 5. Cells 17 and 18 of Phase 1 currently have an intermediate cover in place. The leachate flowing off the separation liner that does not infiltrate through the intermediate cover above Cells 17 and 18 will flow southward down the slope and into the Subtitle D lined area of Phase 5. –See Figures III.15.67 and 7A for details of the separation liner.

2.3.5. Leachate Collection Sumps

Leachate entering the drainage layer and collection pipes is subsequently conveyed to leachate collection sumps. The sumps will be constructed to minimum dimensions shown on Figure III.15.38. In accordance with §330.333(3)(B), minimum sump capacity is approximately 11,000 gallons. The bottom of each sump is lined with an extra layer of geomembrane for added protection. The sump shall be backfilled with leachate drainage aggregate. The leachate drainage aggregate within the sump is identical to that specified in Section 2.3.2 of this plan. Additional geotextile is placed between the leachate drainage aggregate contained in the sump and the geomembrane liner, as shown on Figure III.15.3. The sumps will store the leachate until it is pumped into onsite leachate storage tank(s) and/or transported off-site for disposal. The pumps will be operated to prevent leachate levels from rising above the top of the sump. Sump pumps can be set to maintain leachate levels below the lip elevation of the sump or to limit maximum depth of the leachate to the geocomposite layer thickness. Brief excursions above the sump may occur, but never in excess of 12" above the lip of the sump. Sump capacity and material strength calculations are presented in Attachment B – LCS Design Calculations.

2.3.6. Sump and Cleanout Risers

Sump riser pipes are located along the disposal area perimeter directly up the sideslope from the sumps. Sump riser pipes provide means for lowering submersible pumps down the sideslope incline into the leachate collection sumps. The lower portion of the sump riser pipe within the sump is perforated to allow leachate to flow to the pumps. Cleanout risers, adjacent to the sump riser pipes on the side slopes, provide access to the leachate collection piping for cleaning purposes. The riser system will terminate at a concrete pad or vault designed to contain accidental spillage should the pump need to be serviced or the collection system be cleaned.

Due to the lateral expansion into proposed Phase 5, the sump and cleanout risers for existing Cells 17 and 18 of Phase 1 will be extended and routed to the proposed limits of waste at the edge of proposed Phase 5. A new pad or vault will be constructed at the end of the new riser. Care shall be taken when installing the pump as to not damage the interior of the riser pipe. See Figure III.15.4

Extraction of leachate from the collection sumps is accomplished by electric or pneumatic submersible pumps. Submersible pumps are operated manually or automatically, depending on what conveyance method is used; manually to load tanker trucks, or automatically with level switches to discharge to a storage or recirculation system. A delivery rate of 10 gpm to 200 gpm at operating head conditions is generally desirable. The pumping rate will be determined in the field based on actual leachate accumulations in the sump. For the first two months after installation, the sumps will be checked weekly to verify compliance. At least once a month, thereafter, leachate levels will be checked at all sumps. After twelve consecutive months of compliance, the manual verification may be modified to quarterly checks. Leachate levels will be checked using either a water level meter or pneumatic bubbler. A water level indicator, such as Slope Indicator model 51417402 or equivalent, has a probe attached to a tape indicating distance in ft. with units to 0.01 ft. This will be the method most likely to be used in recently constructed areas of the facility, or locations not provided with an automatic pump for extraction of leachate.

APPENDIX B – LCS DESIGN CALCULATIONS



1820 Regal Row
Dallas, Texas 75235
214-638-0500

Project # LARE1301

Client Laredo Municipal Solid Waste Landfill
Project Permit Amendment Application
Subject LCS Sump Calculations

Prepared By BW on 4/30/2013
Reviewed By FP on 11/6/2013
Approved By FP on 9/22/2014

A LCS Sump Sizing

$$\text{Volume} = (\text{Top Area} + \text{Base Area} + \sqrt{\text{Top Area} \times \text{Base Area}}) \times \frac{H}{3}$$

Minimum Sump Sizing

Sump Size 9 ft x 9 ft
Side Slope 3 : 1
Sump Depth / Height 3 ft
Top Area 729 sf
Base Area 81 sf
Total Volume 1053 cf
Aggregate Void Space 40%

Total Leachate Volume 421.2 cf = 3151 Gallons
1 cf = 7.481 Gallons



1820 Regal Row
Dallas, Texas 75235
214-638-0500

Project #

LARE1301

Client Laredo Municipal Solid Waste Landfill
Project Permit Amendment Application
Subject LCS Geocomposite Calculations

Prepared By BW on 4/30/2013
Reviewed By FP on 11/6/2013
Approved By FP on 9/22/2014

Base / Design Geocomposite:

Transmissivity $T = 5.00E-04$ m²/s @ 10,000 psf
Thickness $t = 0.18$ in @ unloaded

Geocomposite Thickness

Assume the geocomposite will undergo linear compression due to the weight of soil and waste.

Unloaded geocomposite thickness = 0.18 in
Compressibility at 20,000 psf = 50 %

Unit weight of waste = 44.4 pcf = 1,200 lb/CY
Unit weight of soil = 120 pcf

Fill Condition	d_w^1 (ft)	d_s^2 (ft)	P^3 (psf)	t^4 (in)
Active	20	3	1249	0.18
Interim	80	3	3916	0.17
Closed	203	3	9382	0.15

- d_w is the depth of waste above the geocomposite
- d_s is the depth of soil above the geocomposite
- P is the pressure on the geocomposite due to the weight of the waste and soil.
- t is the thickness of the geocomposite after being subjected to linear compression.

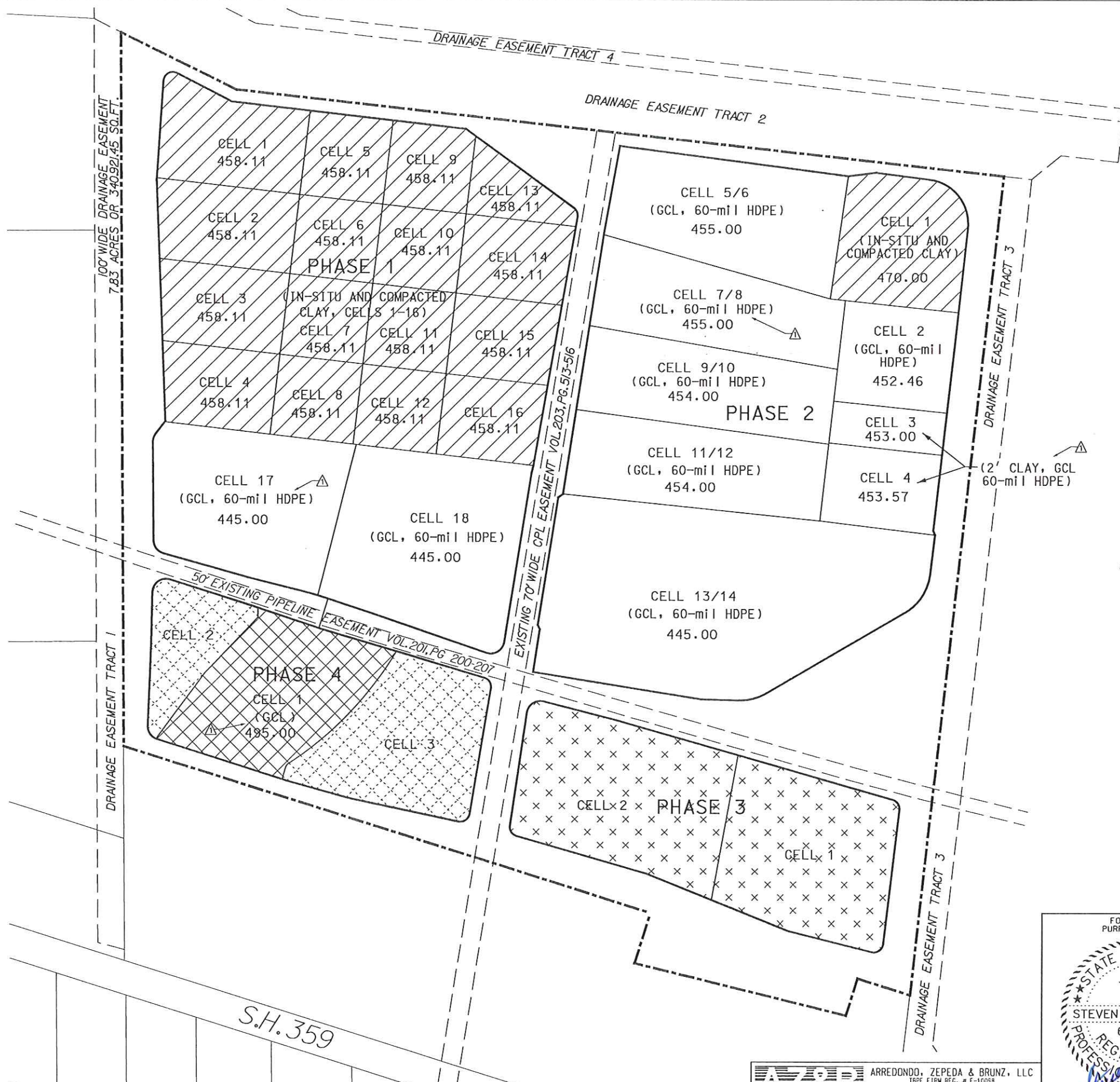
Factors of safety for Strength and Environmental Conditions.

Factor of Safety	Fill Condition		
	Active (40' Waste)	Interim (80' Waste)	Closed (120' Waste)
Geotextile Intrusion	1.0	1.20	1.40
Creep Deformation	1.0	1.00	1.00
Chemical Clogging	1.0	1.20	1.40
Biological Clogging	1.0	1.20	1.40
FS Factor	1.00	1.73	2.74

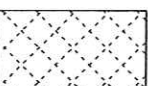
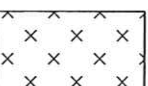
Compute the hydraulic conductivity under confined conditions.

Fill Condition	d_w (ft)	P (psf)	t (in)	T^1 (m ² /s)	FS	T_{FS}^2 (m ² /s)	k^3 (cm/s)
Active	20	1249	0.18	8.10E-04	1.00	8.10E-04	18.06
Interim	80	3916	0.17	5.76E-04	1.73	3.33E-04	7.75
Closed	203	9382	0.15	5.00E-04	2.74	1.82E-04	4.65

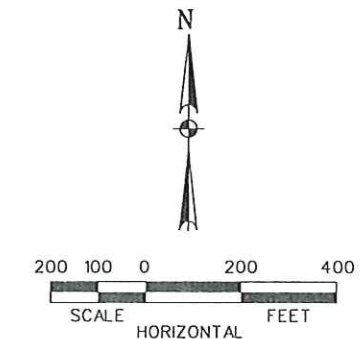
- T is the rated geocomposite Transmissivity value.
- T_{FS} is the geocomposite Transmissivity taking into account the FS.
- k is the geocomposite hydraulic conductivity $k = TFS/t$



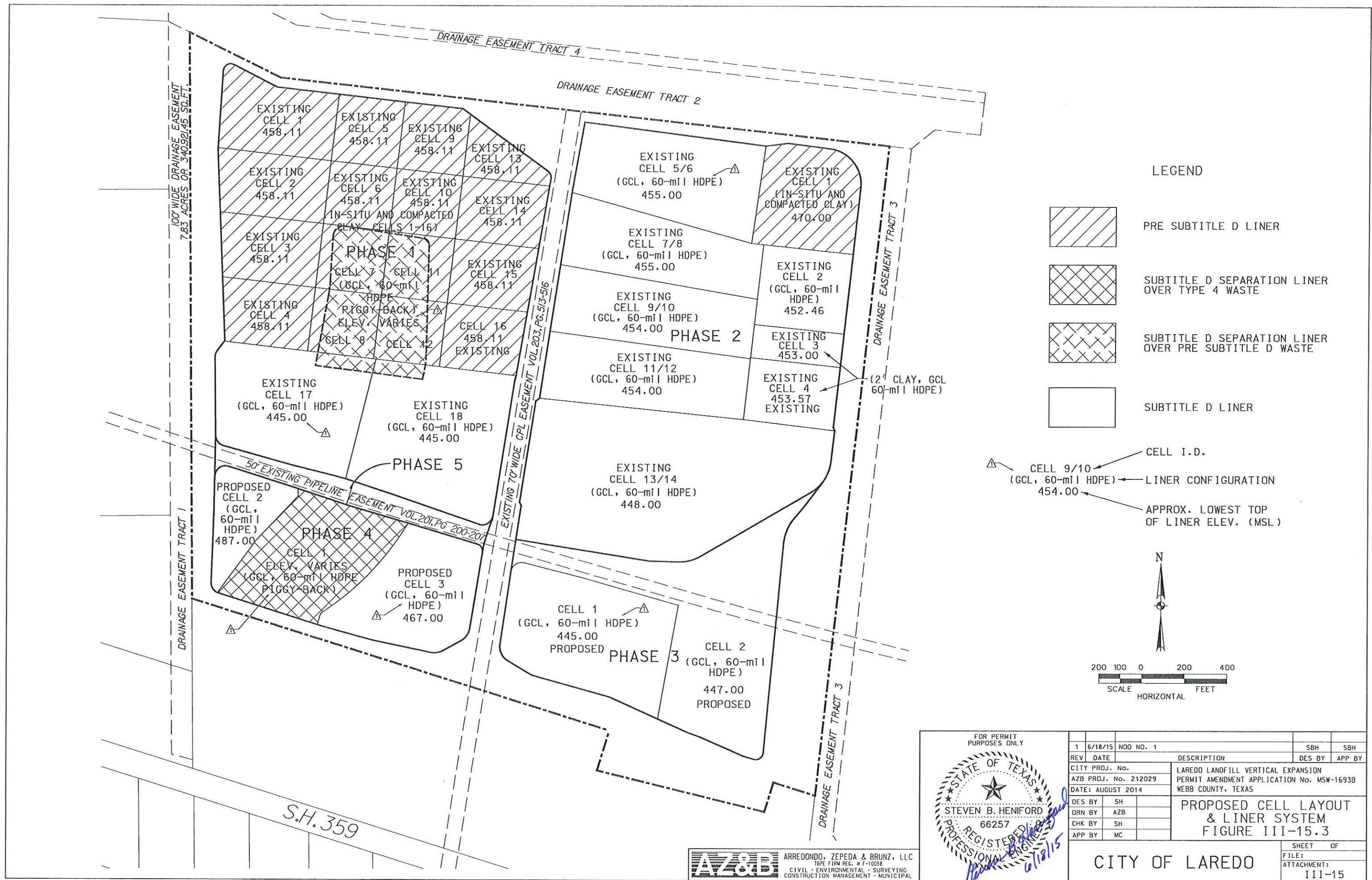
LEGEND

-  EXISTING PRE SUBTITLE D LINER
-  EXISTING TYPE 4 LINER
-  PERMITTED TYPE 4 LINER (UNCONSTRUCTED)
-  EXISTING SUBTITLE D LINER
-  PERMITTED SUBTITLE D LINER (UNCONSTRUCTED)

 CELL I.D.
 CELL 9/10 (GCL, 60-mil HDPE) LINER CONFIGURATION
 APPROX. LOWEST TOP OF LINER ELEV. (MSL)



		1 6/18/15 NOD NO. 1		SBH	SBH
		REV	DATE	DESCRIPTION	DES BY
CITY PROJ. No.		LAREDO LANDFILL VERTICAL EXPANSION			
AZB PROJ. No. 212029		PERMIT AMENDMENT APPLICATION No. MSW-1693B			
DATE: AUGUST 2014		WEBB COUNTY, TEXAS			
DES BY	SH	EXISTING CELL LAYOUT & LINER SYSTEM FIGURE III-15.1			
DRN BY	AZB				
CHK BY	SH				
APP BY	MC				
 ARREDONDO, ZEPEDA & BRUNZ, LLC TYPE FIRM REG. # F-16058 CIVIL - ENVIRONMENTAL - SURVEYING CONSTRUCTION MANAGEMENT - MUNICIPAL		CITY OF LAREDO		SHEET OF FILE: ATTACHMENT: III-15	





NT



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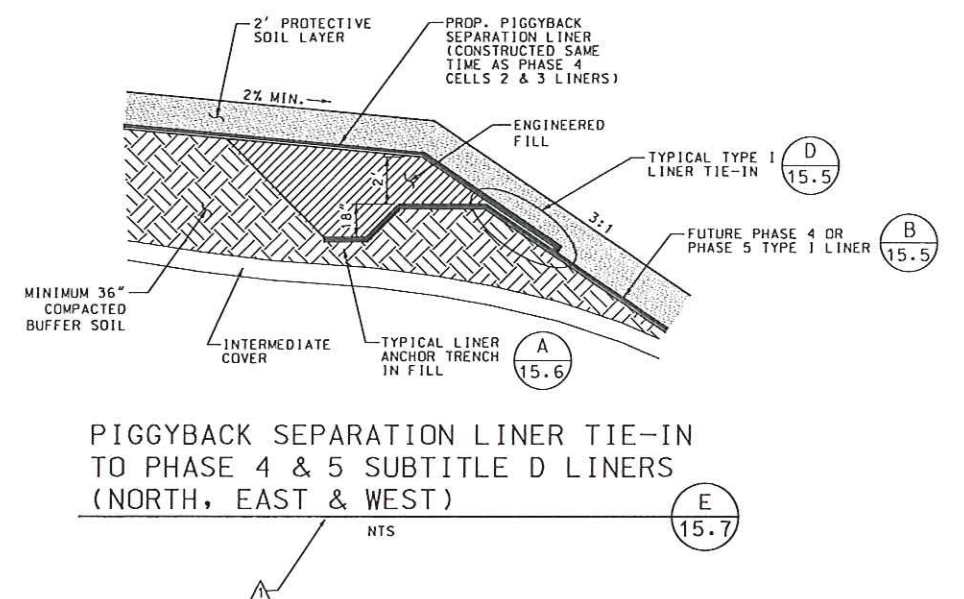
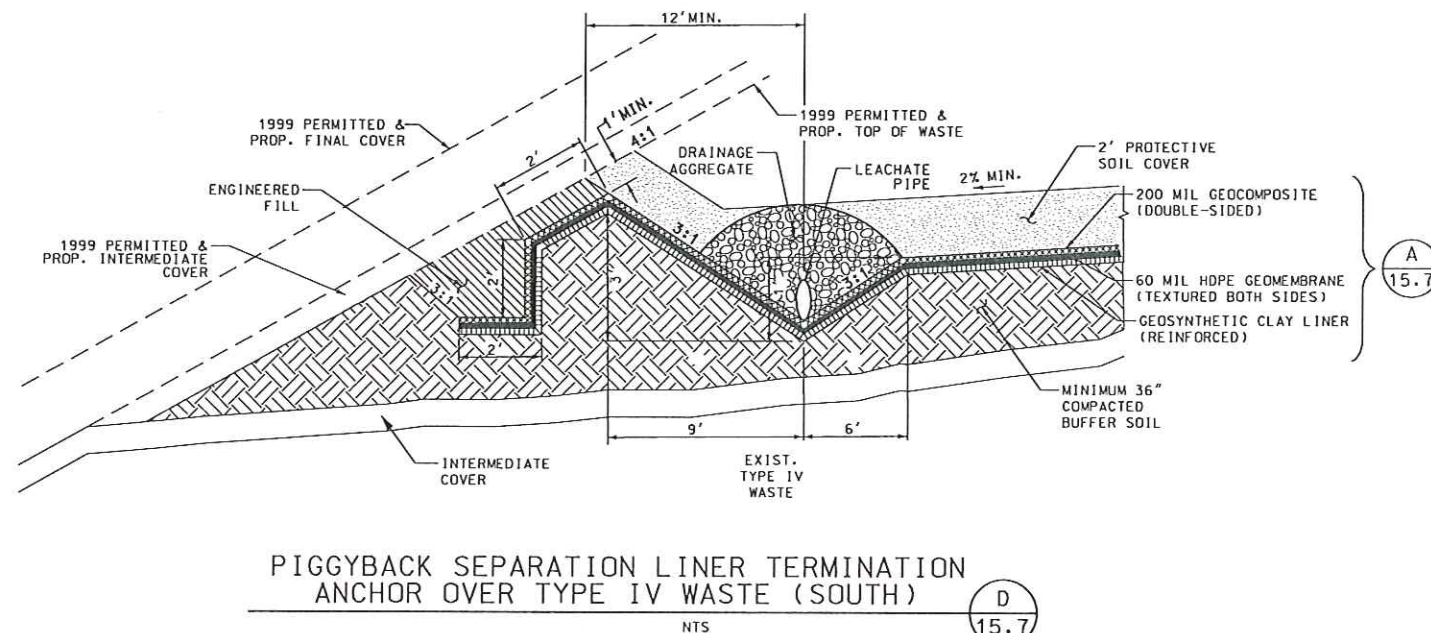
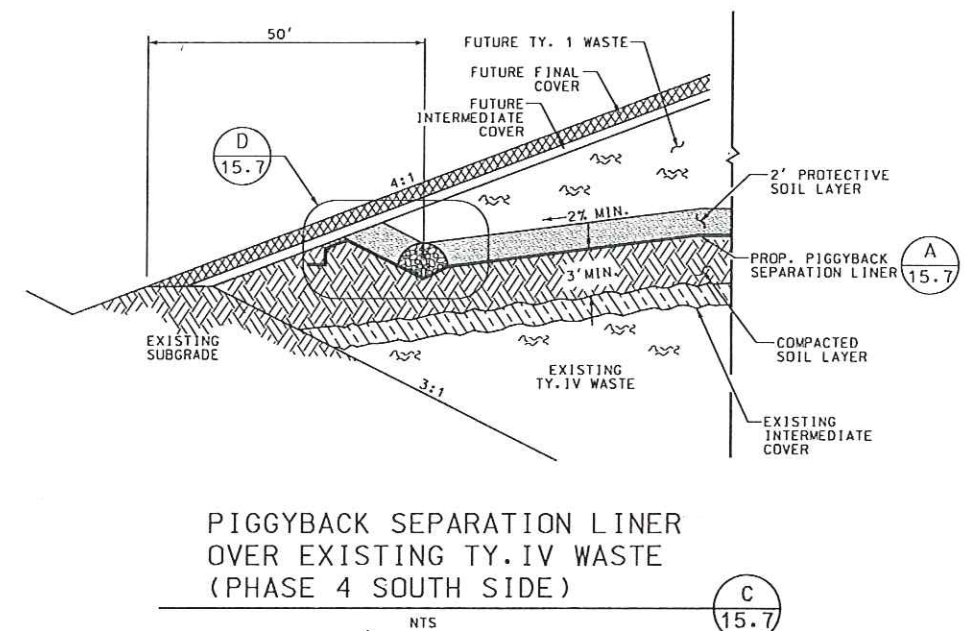
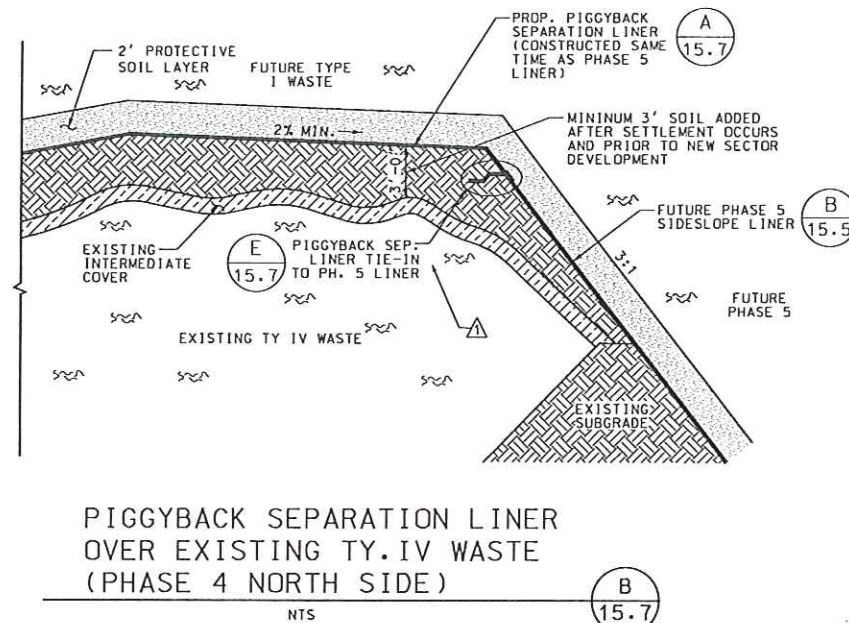
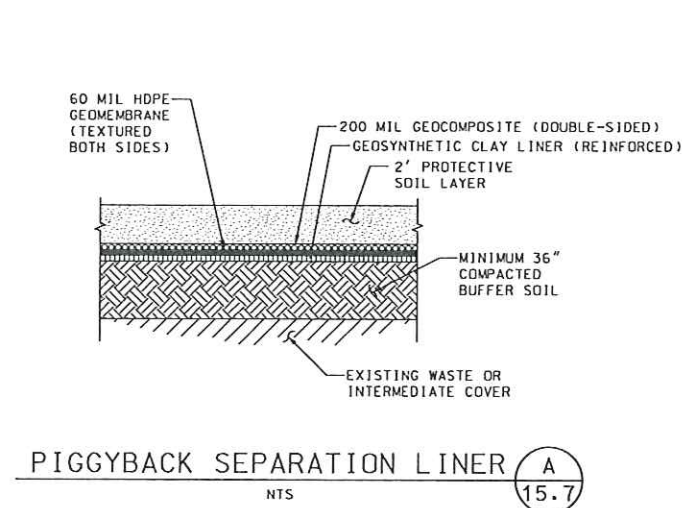


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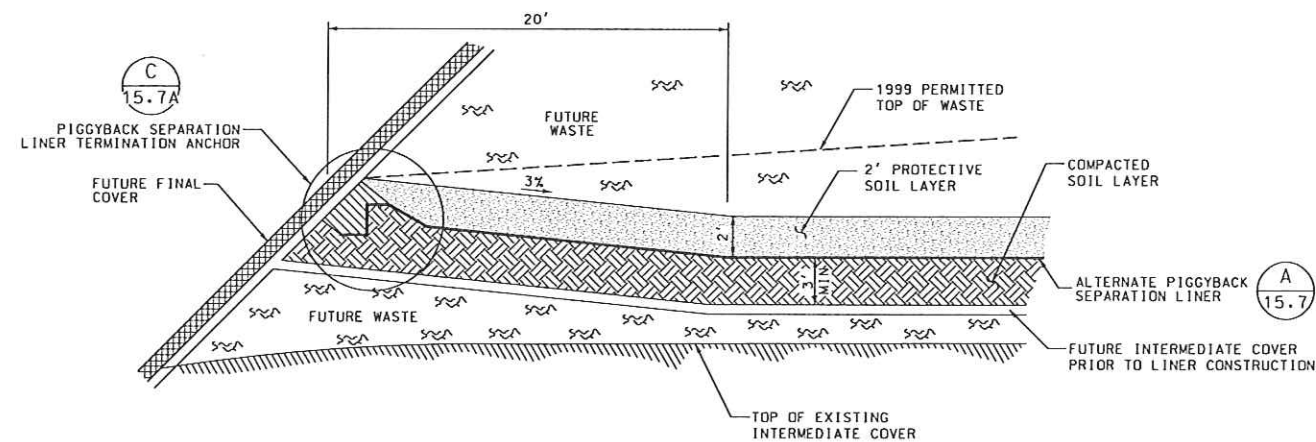
$$\begin{array}{c} \text{F} \\ \hline 15.5 \end{array}$$

- III.15-15

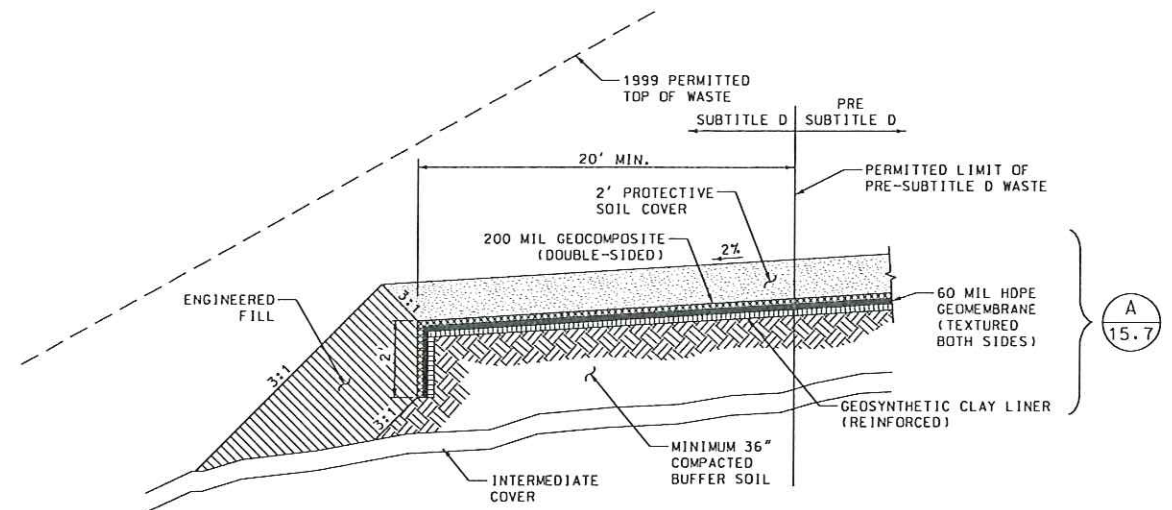


AZ&B ARREDONDO, ZEPEDA & BRUNZ, LLC
 TYPE FIRM REG. # F-10038
 CIVIL - ENVIRONMENTAL - SURVEYING
 CONSTRUCTION MANAGEMENT - MUNICIPAL

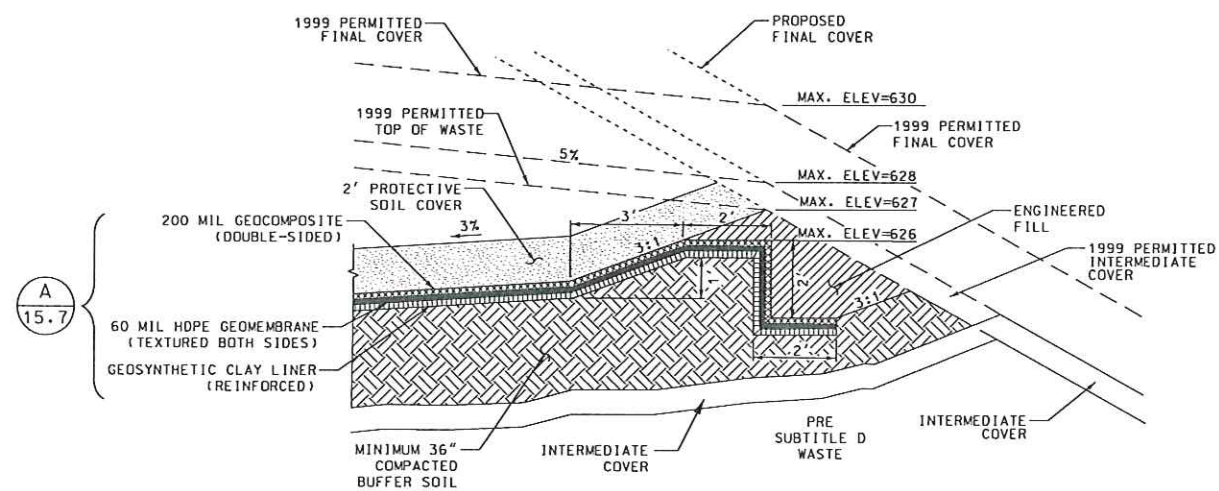
FOR PERMIT PURPOSES ONLY		1 6/18/15 NOD NO. 1		SBH	SBH
REV	DATE	DESCRIPTION		DES BY	APP BY
CITY PROJ. No.		LAREDO LANDFILL VERTICAL EXPANSION			
AZB PROJ. No. 212029		PERMIT AMENDMENT APPLICATION No. MSW-1693B			
DATE: AUGUST 2014		WEBB COUNTY, TEXAS			
DES BY	SH	PIGGY-BACK SEPARATION LINER DETAILS			
DRN BY	AZB	FIGURE III-15.7			
CHK BY	SH				
APP BY	MC				
CITY OF LAREDO				SHEET OF	
				FILE:	
				ATTACHMENT:	
				III-15	



PIGGYBACK SEPARATION LINER OVER
EXISTING PRE-SUB. D WASTE (PHASE 1)
NTS



PIGGYBACK SEPARATION LINER TERMINATION
ANCHOR OVER TYPE 1 WASTE (SOUTH)
NTS



PIGGYBACK SEPARATION LINER TERMINATION
ANCHOR OVER TYPE 1 WASTE (NORTH, EAST & WEST)
NTS

FOR PERMIT PURPOSES ONLY		1 6/18/15 NDD NO. 1		SBH	SBH
REV	DATE	DESCRIPTION		DES BY	APP BY
CITY PROJ. No.		LAREDO LANDFILL VERTICAL EXPANSION			
AZB PROJ. No. 212029		PERMIT AMENDMENT APPLICATION No. MSW-1693B			
DATE: AUGUST 2014		WEBB COUNTY, TEXAS			
DES BY	SH				
DRN BY	AZB				
CHK BY	SH				
APP BY	MC				
				PIGGY-BACK LINER DETAILS 2 FIGURE III-15.7A	
CITY OF LAREDO				SHEET OF	
				FILE:	
				ATTACHMENT:	
				III-15	