CCR CLOSURE PLAN
MARTIN LAKE STEAM ELECTRIC STATION
A-1 AREA LANDFILL
PANOLA COUNTY, TEXAS

OCTOBER 2016

PREPARED FOR:

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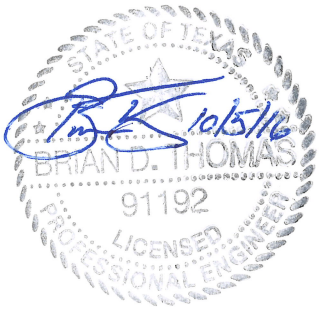
PBW Project No. 5196B

PROFESSIONAL CERTIFICATION

This document and all attachments were prepared by Pastor, Behling & Wheeler, LLC under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I hereby certify that the conceptual closure plan was developed in accordance with the requirements of 40 CFR 257.102(b) of the CCR Rule.



10/5/16

Brian Thomas, P.E.
Principal Engineer
PASTOR, BEHLING & WHEELER, LLC

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1.0 INTRODUCTION

Luminant Generation Company, LLC (Luminant) owns and operates the Martin Lake Steam Electric Station (MLSES) located approximately five miles southwest of Tatum in Rusk County, Texas. The power plant and related support areas occupy approximately 700 acres on a peninsula on the southwest side of Martin Lake (Figure 1) The MLSES consists of three coal/lignite-fired units with a combined operating capacity of approximately 2,250 megawatts. Coal Combustion Residuals (CCR) including fly ash, bottom ash, gypsum are generated as part of MLSES unit operation. The CCRs are transported off-site for beneficial use by third-parties, are managed by Luminant on-site at one of several CCR surface impoundments or are disposed at Luminant's A-1 Area Landfill. The landfill is located within a reclaimed portion of Luminant's Beckville Mine in Panola County (Figure 2).

The CCR Rule (40 CFR 257 Subpart D - *Standards for the Receipt of Coal Combustion Residuals in Landfills and Surface Impoundments*) has been promulgated by EPA to regulate the management and disposal of CCRs as solid waste under Resource Conservation and Recovery Act (RCRA) Subtitle D. The final CCR Rule was published in the Federal Register on April 17, 2015. The effective date of the CCR Rule was October 19, 2015.

The CCR Rule establishes national operating criteria for existing CCR surface impoundments and landfills, including development of closure plans for all CCR impoundments and landfills. Pastor, Behling & Wheeler, LLC (PBW) was retained by Luminant to develop this closure plan for the A-1 Area Landfill at the MLSES.

1.1 CCR Unit Closure Plan Requirements

40 CFR 257.102(b) of the CCR Rule specifies that a written closure plan must be prepared for each existing CCR landfill that describes the steps necessary to close the unit at any point during the active life of the unit consistent with recognized and generally accepted good engineering practices. The closure plan must include, at a minimum, the following information:

- A narrative description of how the CCR landfill will be closed in accordance with 40 CFR 257.102;
- If closure of the CCR unit will be accomplished by leaving CCR in place, the closure plan will provide a description of the final cover system designed in accordance with 40 CFR 257.102(d) of the CCR Rule, including details concerning the methods and procedures used to install the final cover. The closure plan must also discuss how the final cover system will achieve the following performance standards specified in 40 CFR 257.102(d):
    - Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration

of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;

- Preclude the probability of future impoundment of water, sediment, or slurry;
- Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period;
- Minimize the need for further maintenance of the unit; and
- Be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices.

The final cover system must be designed and constructed to meet the following criteria:

- The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1 X 10^{-5} cm/sec, whichever is less.
- The infiltration of liquids through the closed CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 24 inches of earthen material.
- The erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.
- The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

An alternative final cover system design may also be used, provided the alternative final cover system is designed and constructed to meet the following criteria:

- The alternative final cover system must include an infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified above.
- The alternative final cover system must include an erosion layer that provides equivalent protection from wind or water erosion as the erosion layer specified above
- The disruption of the integrity of the alternative final cover system must be minimized through a design that accommodates settling and subsidence.

- An estimate of the maximum inventory of CCR ever on-site over the active life of the landfill and an estimate of the largest area of the landfill ever requiring a final cover at any time during the active life of the unit.
- A schedule for completing all activities necessary to satisfy the closure criteria, including an estimate of the year in which all closure activities for the landfill will be completed. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the unit, including identification of major milestones such as coordinating with and obtaining necessary approvals and permits from other agencies, installation of the final cover system, and the estimated timeframes to complete each step or phase of unit closure.

- In accordance with 40 CFR 257.102(e)(1) of the CCR Rule, closure of a CCR unit must be initiated no later than 30 days after the date on which the landfill receives the known final receipt of CCR or non-CCR waste. Alternatively, under 40 CFR 257.102(e)(2), closure of the landfill must be initiated if the landfill has been idle and has not received CCR or non-CCR waste for two years. Additional two year extensions to initiate closure may be obtained with appropriate documentation.

- In accordance with 40 CFR 257.102(f)(i) of the CCR Rule, closure of a landfill must be completed within six months of commencing closure activities. Additional extensions to complete closure may be obtained with appropriate documentation.

The landfill closure plan must be certified by a qualified professional engineer and must document how the closure plan has been designed and constructed to comply with the requirements of 40 CFR 257.102(b)(4) of the CCR Rule.

In accordance with 40 CFR 257.102(b)(2) of the CCR Rule, the initial written closure plan for an existing CCR landfill must be completed and placed in the facility operating record no later than October 17, 2016.

1.2 MLSES Landfills Subject to CCR Closure Plan Requirements

The only CCR Unit at the MLSES that meets the definition of a CCR Landfill is the A-1 Area Landfill. This closure plan was prepared for the A-1 Area Landfill. In accordance with 40 CFR 257.104 of the CCR Rule, the closure plan must be amended when future landfill construction and/or lateral expansions are constructed at the A-1 Area Landfill.

1.3 Description of A-1 Area Landfill

The A-1 Area Landfill is located approximately 2.5 miles southeast of the MLSES in Panola County (Figure 2). An existing site plan for the A-1 Area Landfill is shown on Figure 3. CCR is transported to the landfill in train cars, off loaded and placed within the active disposal areas at the landfill. The registered boundary of the A-1 Area Landfill covers an area of approximately 986 acres and is located entirely within the reclaimed section of the Luminant Beckville Mine. The A-1 Area Landfill is registered with the Texas Commission on Environmental Quality under SWR31277 (WMU 002) and began receiving CCR in 1980.

The active portion of the A-1 Area Landfill is surrounded by earthen embankments constructed of mine spoil that extend approximately 10 to 20 feet or more above surrounding grade. Prior to the placement of CCR, a 1-foot thick compacted clay bottom liner is constructed over prepared subgrade (clay-rich mine spoil 70-100 feet in thickness). The bottom liner consists of clay scarified and re-compacted to achieve

the design specification of 95 percent of maximum density and an in-place permeability of $1x10^{-7}$ cm/sec or less. Continuous construction of the existing clay liner commenced prior to effective date of the CCR Rule, and the approximate current extent of the completed clay liner is illustrated on Figure 3. Specifications for the construction of the perimeter embankments include placement of a 3-foot thick compacted clay liner on the interior slope of the embankment, which was specified not to exceed a 3:1 (horizontal:vertical) sideslope.

Final cover has been placed over approximately 450-acres of the A-1 Area landfill, which consists of the placement of a 3-foot thick compacted clay cap to achieve the design specification of 95 percent of maximum density and an in-place permeability of $1x10^{-7}$ cm/sec or less with a minimum 2-foot thick vegetative cover layer. Progressive capping/closure of the A-1 Area Landfill is performed as placement of CCR reaches the target cap subgrade elevations.

2.0 CLOSURE PLAN FOR A-1 AREA LANDFILL

Although the closure plan presented herein for the A-1 Area Landfill was developed in accordance with the requirements of 40 CFR 257.102 of the CCR Rule, this plan should be considered conceptual in nature given the fundamental assumptions used as the basis of the closure plan. As part of the initiation of final CCR unit closure activities, the conceptual closure plan should be reviewed and revised as needed to ensure appropriate modifications are incorporated into the final design plans and specifications prior to release for bidding and construction.

2.1 Description of A-1 Area Landfill Closure

As described in Section 1, Luminant plans to continue the on-going progressive capping/closure of the A-1 Area Landfill and final closure will comply with 40 CFR 257.102(d) of the CCR Rule, which specifies criteria for leaving CCR in-place and constructing a final cover system over the CCR located within the landfill. The cover system for the A-1 Area Landfill will be designed to achieve the performance standards listed in Section 1.1.

2.2 Removal of Run-off Collection Areas

Although the A-1 Area Landfill operates as a dry CCR unit, run-off collection areas are present within the registered boundary of the landfill. These areas allow for runoff from active disposal areas to be retained prior to discharge or treatment, if needed. Collected run-off in these areas will be removed from the landfill and managed in accordance with applicable state regulations or discharge permits. These areas will be reclaimed to remove sediment and either re-graded to convey stormwater away from the landfill cover system, allowed to remain as reclaimed ponds (beyond the limits of the cover system), or capped as part of the progressive installation of the landfill cover system.

Luminant currently anticipates that the North Run-off Collection Area (NROCA) will be capped or reclaimed within the next five years as placement of the final cover system progresses. The South Run-off Collection Area (SROCA), the Former South Run-off Collection Area (FSROCA), the South Treatment Pond (STP), and the North Treatment Pond (NTP) will remain in-service while active placement of CCR is occurring within the landfill. With exception of the NROCA and NTP, Luminant currently anticipates that these areas will be reclaimed. The NTP and NROCA will be dewatered and accumulated sediment will be stabilized prior to placement of the final cover system in this area.

2.3 Final Cover System – A-1 Area Landfill

The proposed final grading plan for the final cover system is illustrated in Figure 4 and a conceptual surface water control plan is included as Figure 5. In accordance with 40 CFR 257.102(d) of the CCR Rule, the permeability of the final cover system will be less than or equal to the permeability of the existing bottom liner in the A-1 Area Landfill (i.e. 1 foot clay liner with a permeability of $<1 \times 10^{-7}$ cm/sec). Given the status of the on-going progressive construction of the final cover system for the landfill and availability of suitable clay soil, placement of a compacted cap will continue as a preferred means of in-place closure of CCR. Typical construction details and surface water drainage controls for the final cover system are provided in Figures 6 and 7.

Technical Specifications for material selection and placement of the proposed final cover system and the associated cap subgrade have been developed to minimize potential for differential settlement and subsidence. Post-closure monitoring activities will be performed to ensure the cover system complies with the requirements of the CCR Rule. Furthermore, an evaluation of infiltration through the proposed cover systems was developed using the U.S. Army Corps of Engineers – Hydrologic Evaluation of Landfill Performance (HELP) model (Appendix B). As demonstrated by the HELP model results, the permeability of the clay cap (infiltration layer) final cover system will be less than or equal to the permeability of the bottom liner system. The final cover option is designed to minimize impounding of water on the cap and associated long-term care activities.

2.3.1 Compacted Clay Cap

Select fill and/or CCR deemed suitable for beneficial use will be placed within the proposed limits of the landfill cover system to the lines and grades specified for the cap subgrade (Figure 4). Upon placement of cap subgrade to within approximately five feet of proposed finished grade, approved select fill material (i.e. stockpiled suitable fill) will be placed in accordance with the specifications for cap subgrade. A three-foot thick compacted clay liner with permeability of no greater than 1×10^{-7} cm/sec will be placed on the prepared cap subgrade material. Cap subgrade and clay cap material selection, placement, compaction and testing will conform to the Technical Specifications in Section 02320 and 02330, respectively (Appendix A). The vegetative soil layer is placed in a single loose lift over the prepared clay cap to allow for establishment of permanent vegetative cover.

2.4 Final Cover System Slope Stability

Selection of suitable construction materials, proper material placement, and quality assurance testing of both the subgrade preparation and cover system installation in accordance with the Technical Specifications (Appendix A) will ensure stability of the final cover system. The SLIDE 7.0 equilibrium slope stability model was used to demonstrate that the proposed cover system is stable at the slopes specified in the conceptual closure plan (see Appendix C).

2.5 Stormwater Run-off Control

Surface drainage of the cap covering CCR will generally consist of sheet flow or shallow concentrated flow along stormwater diversion berms that will convey run-off to reinforced stormwater let-down structures. The final cover system will allow for lateral drainage of infiltration off the capped area to prevent saturation of the vegetative layer and/or ponding on the cover system.

Existing areas of the landfill where the final cover system is in-place are typically sloped from one to five percent from the landfill crest to the perimeter embankments. The existing perimeter exterior embankments are typically 5:1 (horizontal:vertical) or less steep. The proposed final cover system for the active portion of the existing landfill varies from three to five percent from the crest to perimeter areas where the cap slopes more steeply to match surrounding grades. These steeper portions of the capped area vary between 3:1 and 5:1 with slope lengths less than 250 feet. Stormwater let-down structures will be constructed at intervals on these steeply sloped faces to convey run-off from the limits of the capped area away from the landfill. Slope stabilization material (Geocells, or approved equivalent) will be placed across the cross-section of the stormwater let-down structures to control erosion in these areas.

A surface water control plan for the A-1 Area Landfill is shown on Figure 5. A conceptual run-off control plan that includes estimated peak discharges based on the 25-year/24-hour storm event (8.6 inches) for the capped area is presented in Appendix D. Typical construction details for the stormwater let-down structures and related appurtenances are provided on Figures 6 and 7. Technical Specifications for the stormwater let-down structures and related appurtenances are included in Appendix A.

2.6 CCR Inventory and Area to Be Capped

For the purposes of this conceptual closure plan, in-place closure of CCR within the A-1 Area Landfill is based on the CCR contained in the landfill achieving the particular lines and grades associated with each distribution area outlined in the attached grading plan (Figure 5). To date, Luminant estimates that over

40,000,000 cubic yards of CCR has been placed in the landfill. Based on this assumption, the landfill will contain over 50,000,000 cubic yards of CCR at time of closure. The registered total surface area of the A-1 Area Landfill is 986 acres. To date approximately 450 acres has previously been permanently closed by the placement of a compacted clay cap. The remaining active disposal area (approximately 370 acres) will be progressively closed as various sections of the landfill reach the target cap subgrade elevations.

2.7 Closure Schedule

The timing of the closure of the A-1 Area Landfill will be in accordance with the CCR rules. The assumption is that final closure of the A-1 Area Landfill will be triggered by inactivity (i.e. inactive for 2-years), which will require final closure of the landfill to be completed within 6 months of start of closure. However, Sections 257.102(f)(2) and 257.103 of the CCR Rule allow for extension of the closure schedule under certain circumstances or demonstration that alternative closure requirements should apply to the CCR units. A Gantt chart illustrating the sequential steps of the CCR closure process, including pre-construction activities (i.e. necessary notifications and permitting) as well as closure milestones, is included as Appendix E.

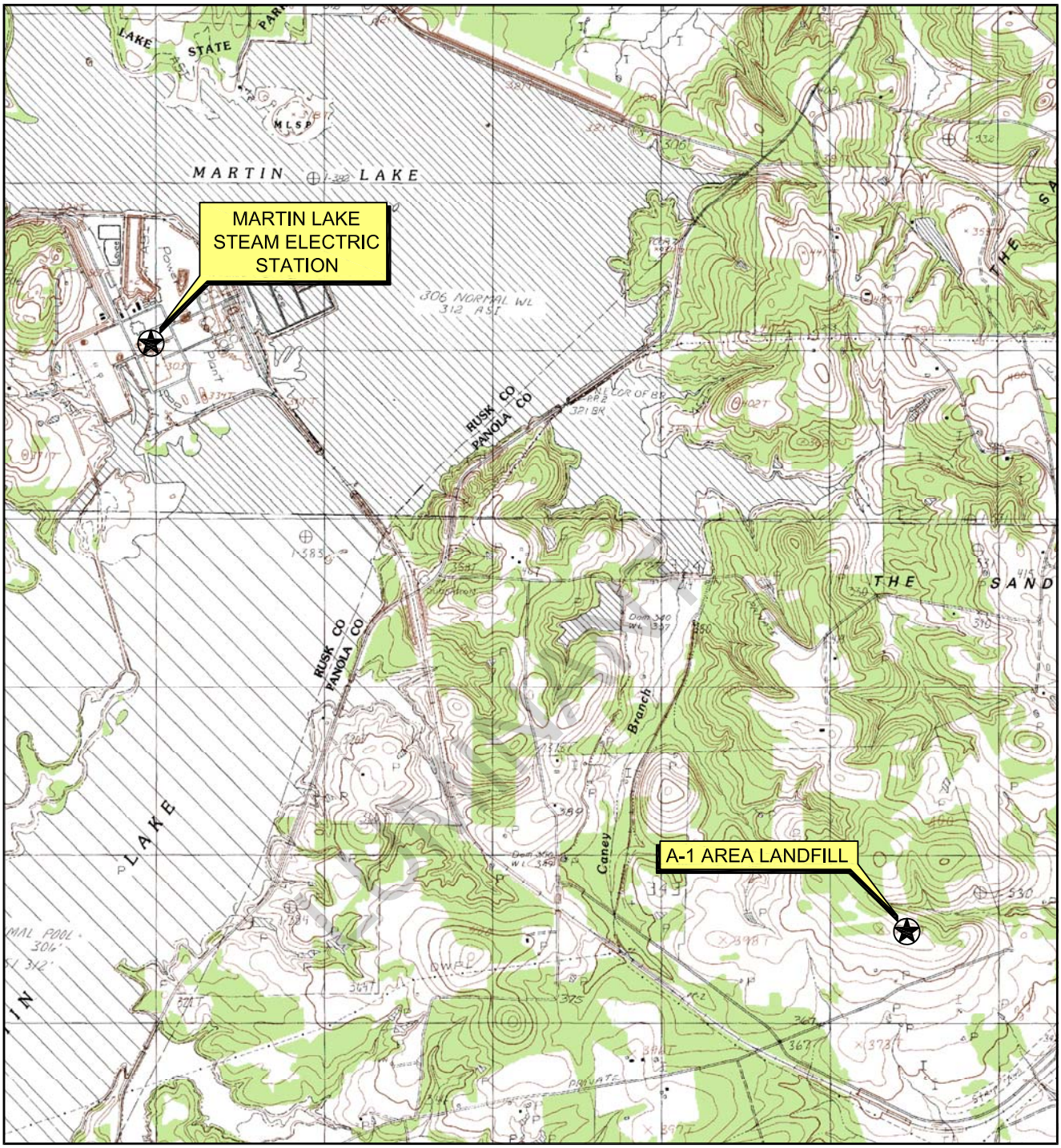
3.0 REFERENCES

Hershfield, OM. 1961. Rainfall Frequency Atlas of the United States for Durations from 30 minutes to 24 hours and Return Periods from 1 to 100 Years, U.S. Dept. Commerce, Weather Bureau. Technical Paper No. 40. Washington, DC.

U.S. Army Corps of Engineer, 1997, *Hydrologic Evaluation of Landfill Performance (Version 3.07), November 1*.

United States Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS), 1986. *Urban Hydrology for Small Watersheds - TR-55*, June.

FIGURES



TEXAS

QUADRANGLE LOCATION

N

Scale in Feet

0 1500 3000

SOURCE:
Base map from www.tnris.gov, Tatum, TX 7.5 min. USGS quadrangle dated 1983.

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MARTIN LAKE STEAM ELECTRIC STATION

Figure 1

SITE LOCATION MAP

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DATE: SEPT., 2016	CHECKED: BDT	

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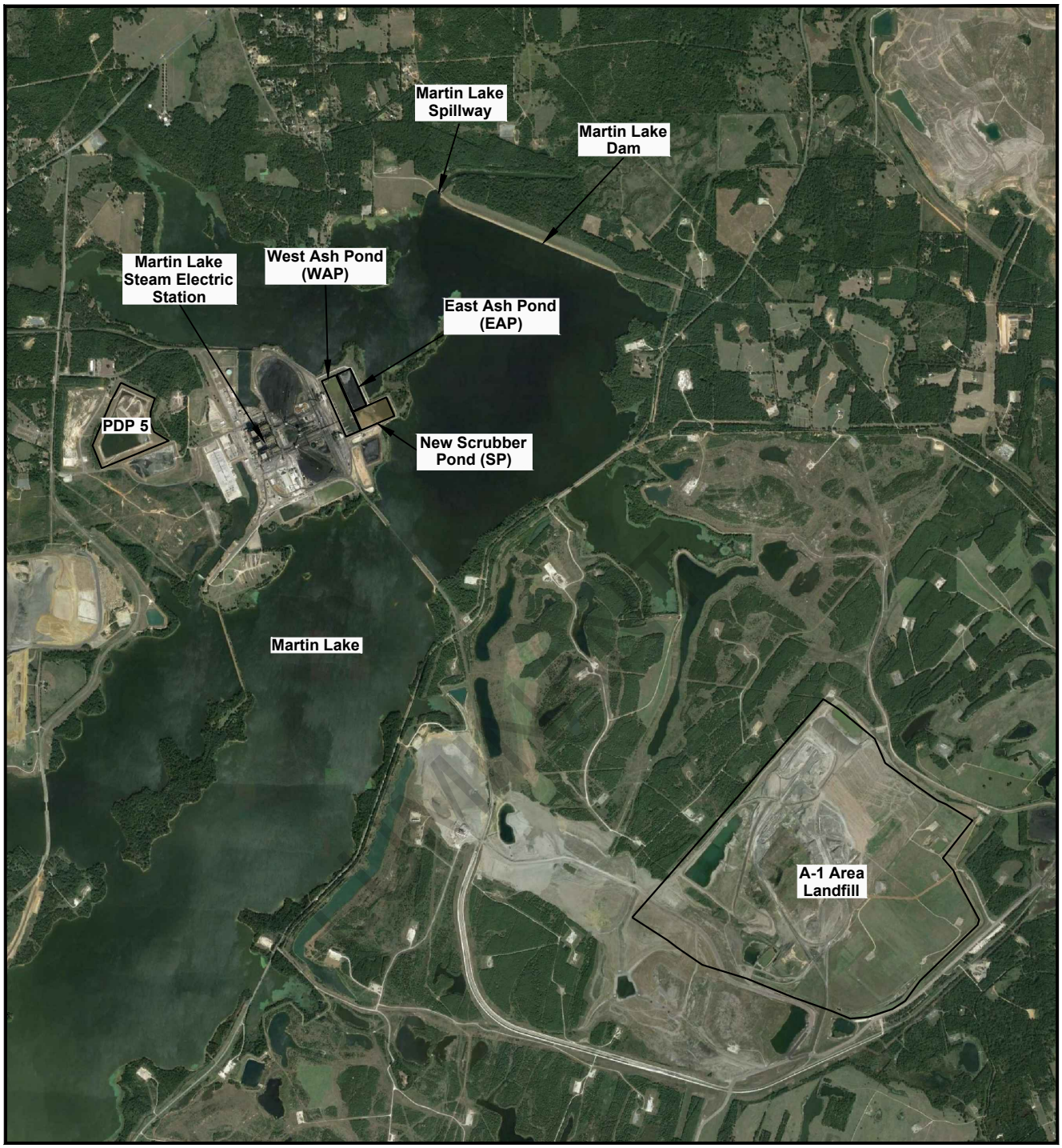

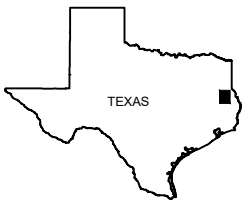

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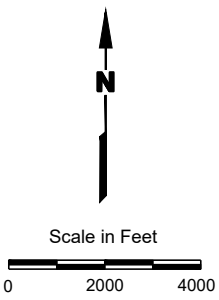

SOURCE:
Imagery from Google Earth, photography dated October 1, 2015.

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MARTIN LAKE STEAM ELECTRIC STATION

Figure 2

SITE VICINITY MAP

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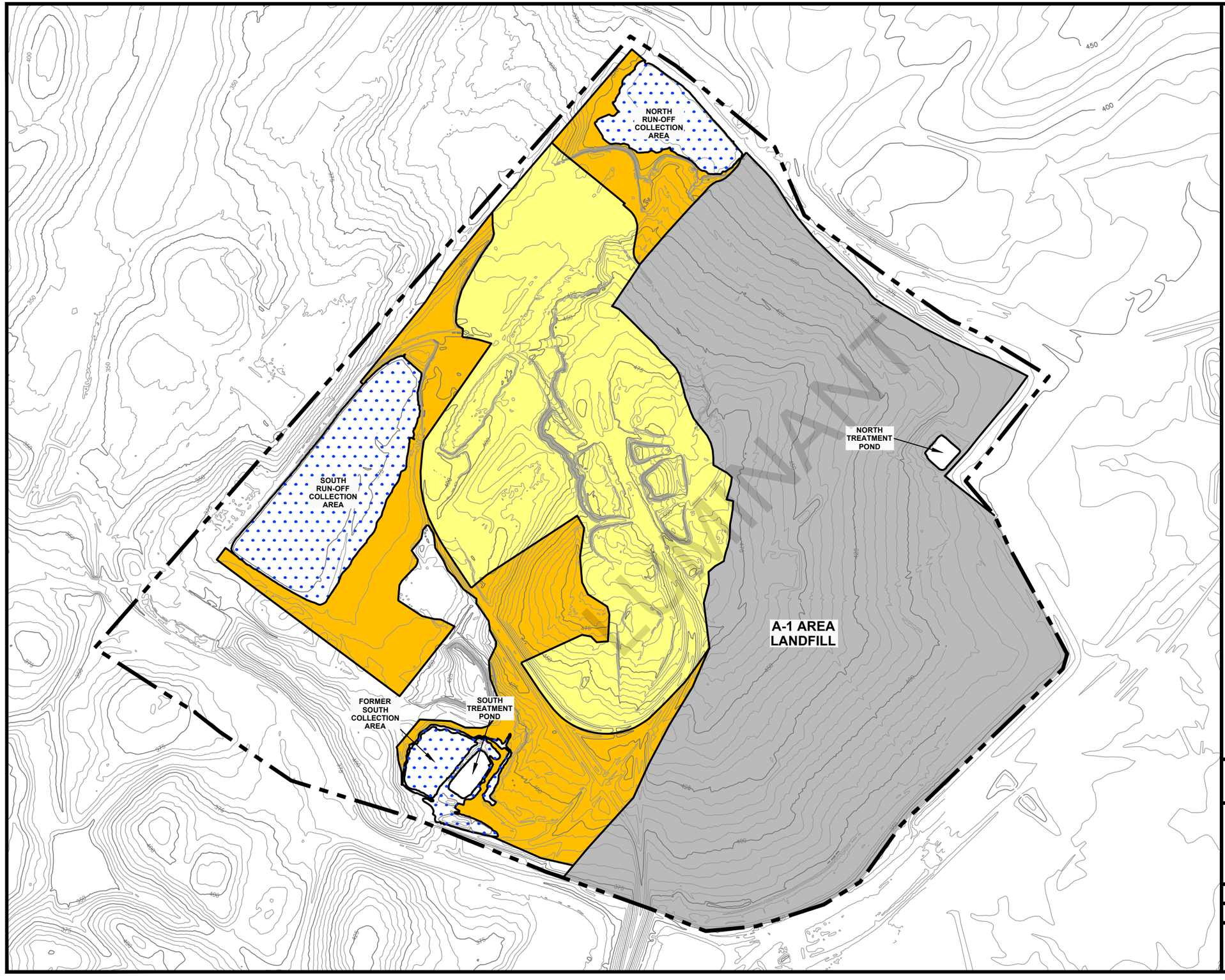

EXPLANATION

- Landfill Registration Boundary
- Existing Grade Contour 5 ft Interval
- Existing Grade Contour 25 ft Interval
- Capped Area (Existing)
- Active CCR Disposal/ Disturbed Area
- Existing Compacted Clay Liner
- Run-off Collection Area

Notes:
1. Extent of Capped Areas based on October 2016 site conditions.
2. Run-Off Collection Areas and Treatment Ponds are lined with compacted clay.

N

Scale in Feet
0 450 900

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Figure 3

EXISTING SITE PLAN

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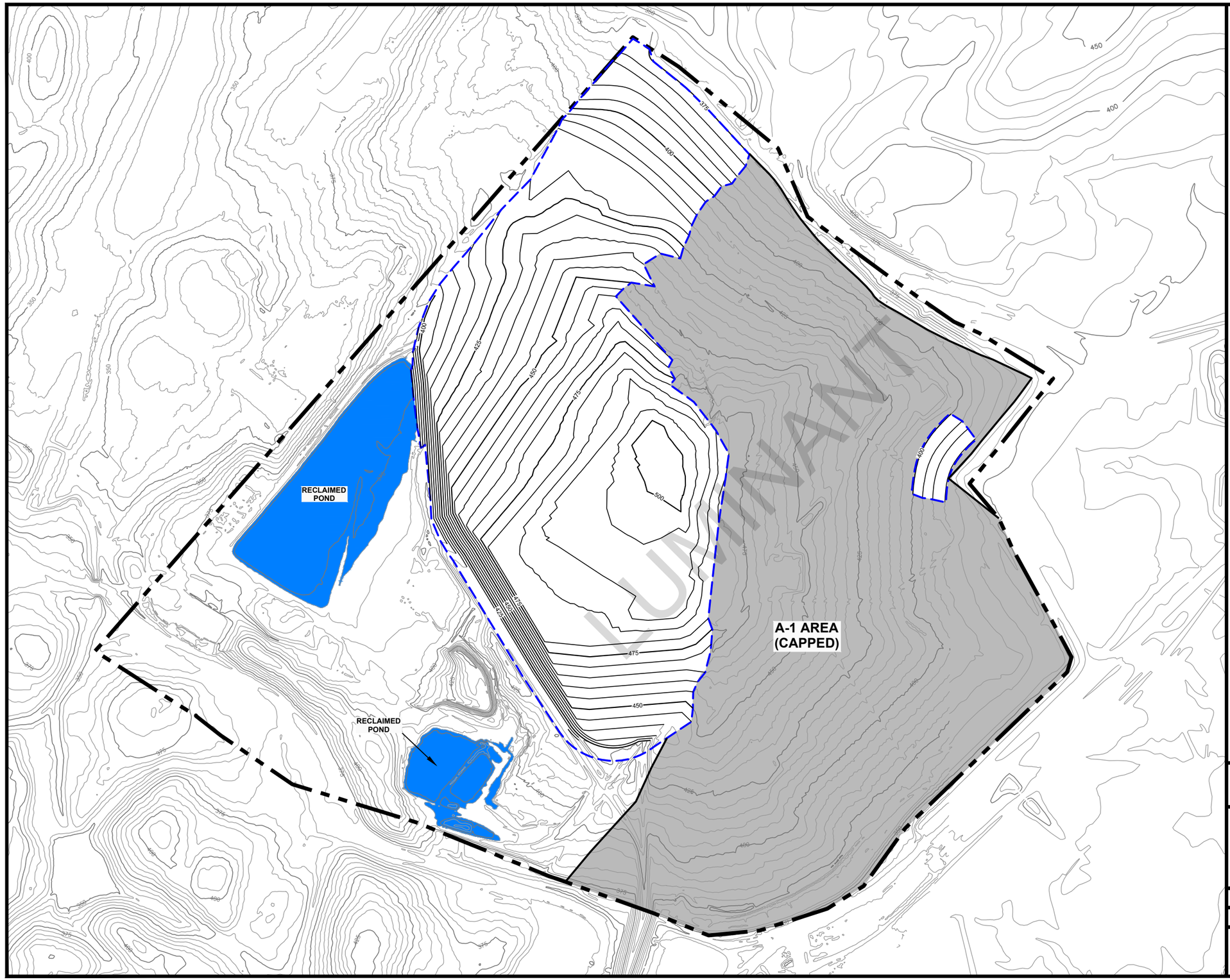

EXPLANATION

- Landfill Registration Boundary
- Existing Grade Contour 5 ft Interval
- Existing Grade Contour 25 ft Interval
- Proposed Finished Grade Contour 5 ft Interval
- Proposed Finished Grade Contour 25 ft Interval
- Proposed Limits of CAP
- Capped Area (Existing)

N

Scale in Feet
0 450 900

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MARTIN LAKE STEAM ELECTRIC STATION

Figure 4

PROPOSED GRADING PLAN

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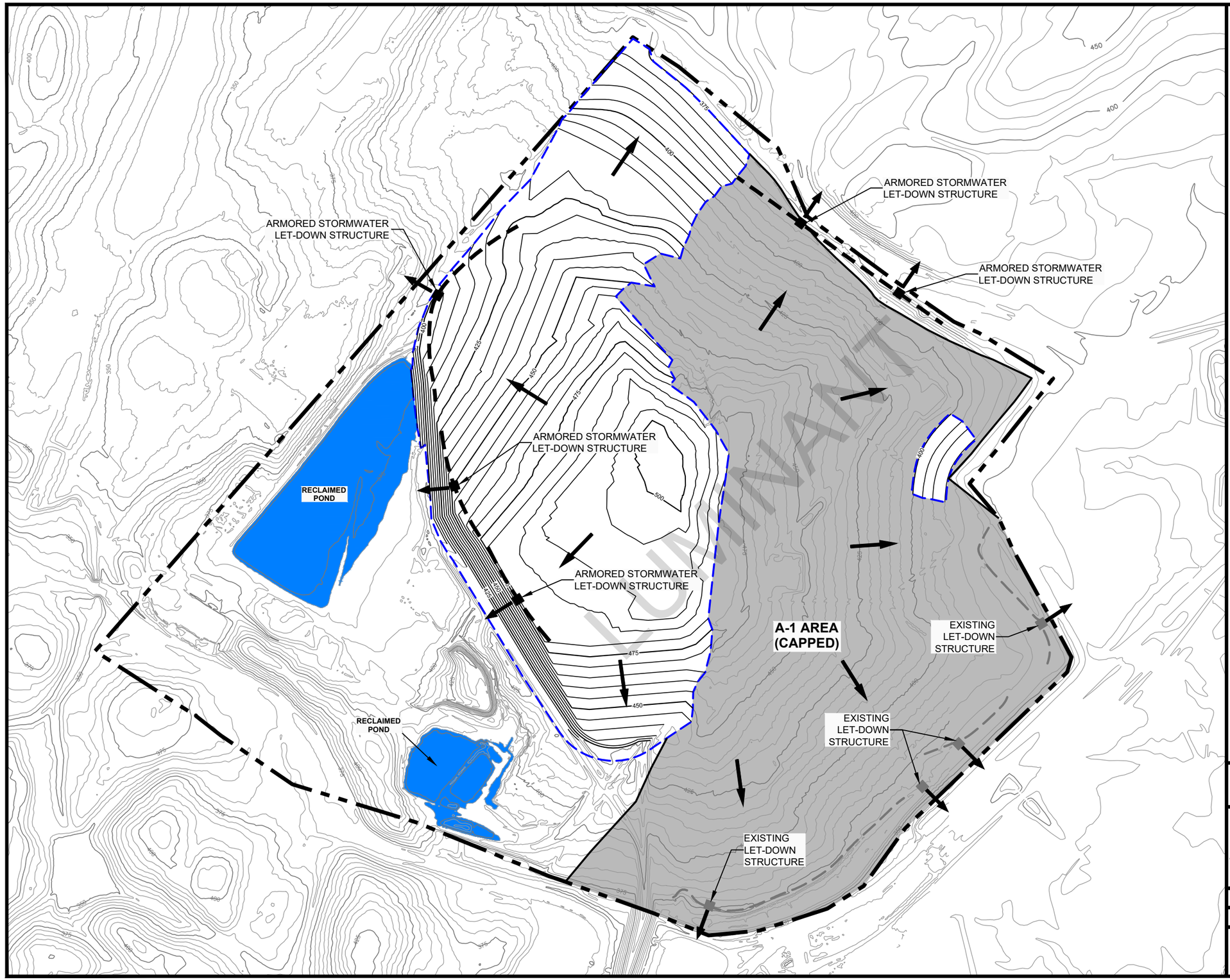

EXPLANATION

- Landfill Registration Boundary
- Existing Grade Contour 5 ft Interval
- Existing Grade Contour 25 ft Interval
- Proposed Finished Grade Contour 5 ft Interval
- Proposed Finished Grade Contour 25 ft Interval
- Proposed Limits of CAP
- Sheet Flow
- Approximate Alignment Stormwater Diversion Berm
- Approximate Alignment Existing Stormwater Diversion Berm
- Capped Area (Existing)

N

Scale in Feet
0 450 900

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MARTIN LAKE STEAM ELECTRIC STATION

Figure 5

SURFACE WATER CONTROL PLAN

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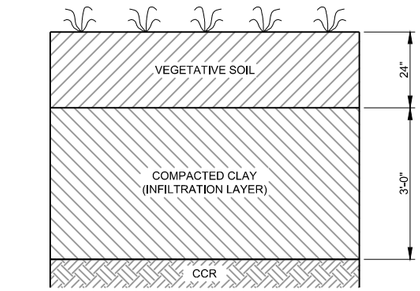

1/6 CLAY CAP DETAIL
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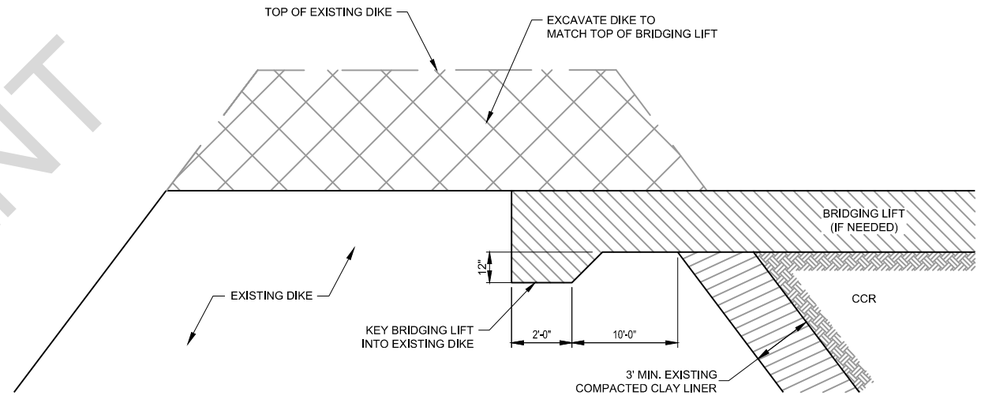

2/6 DIKE CONNECTION DETAIL
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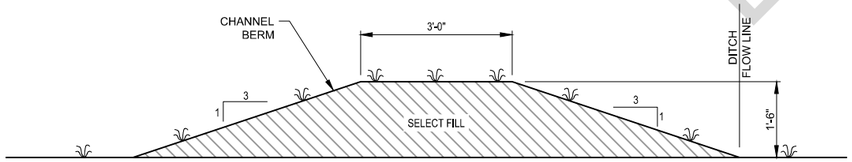

3/6 CHANNEL BERM
NOT TO SCALE

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Figure 6

TYPICAL CONSTRUCTION DETAILS - CCR COVER SYSTEM

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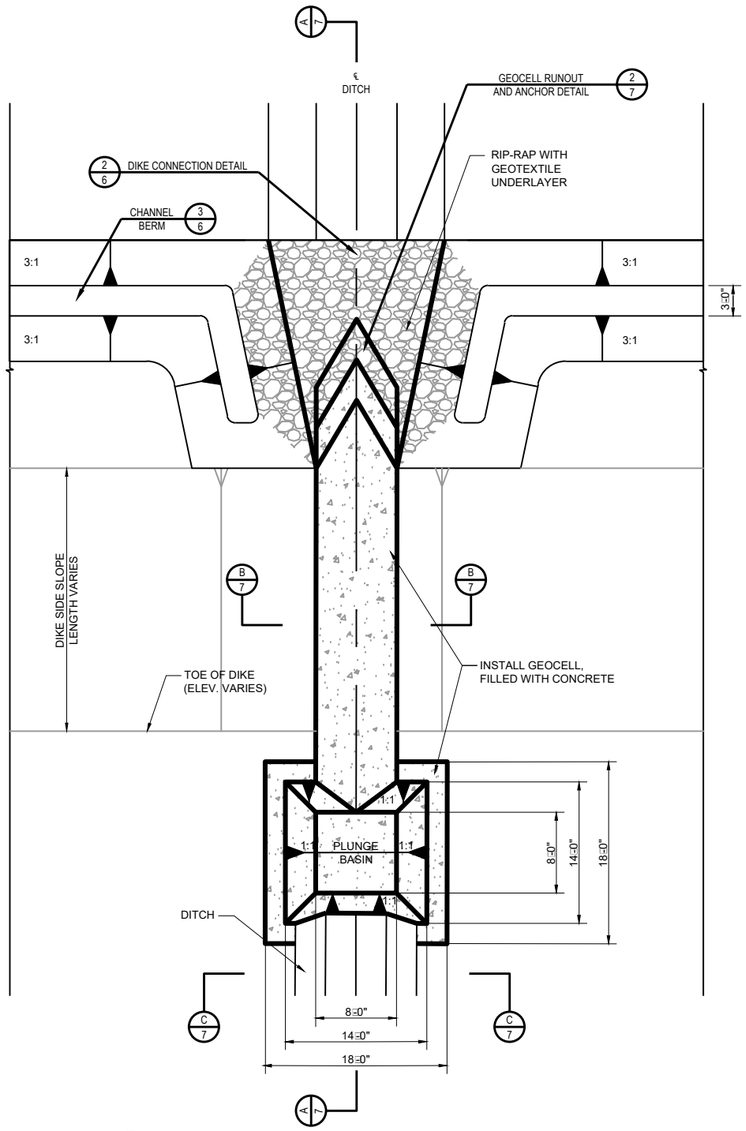
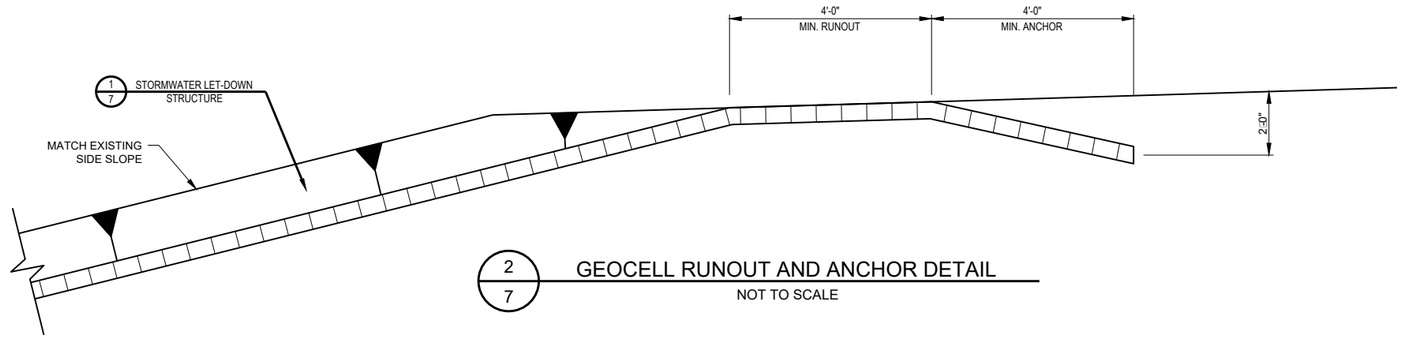


1/7 STORMWATER LET-DOWN STRUCTURE

SCALE: 1"=20' 0 20



2/7 GEOCELL RUNOUT AND ANCHOR DETAIL

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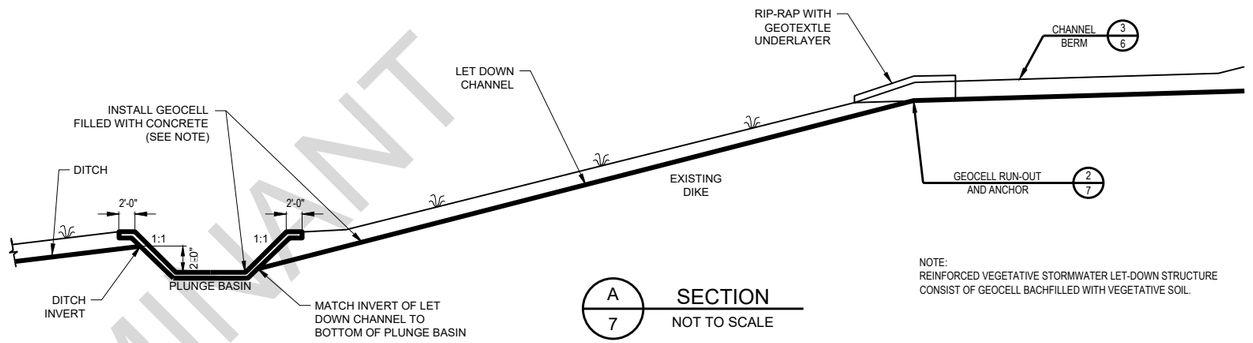
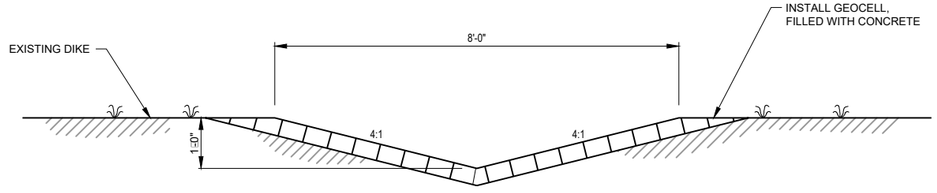


A/7 SECTION

NOT TO SCALE

NOTE:
REINFORCED VEGETATIVE STORMWATER LET-DOWN STRUCTURE CONSIST OF GEOCELL BACHFILLED WITH VEGETATIVE SOIL.



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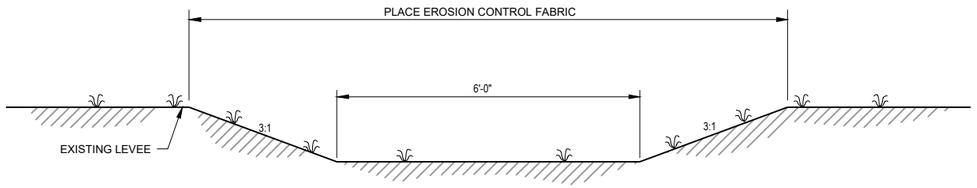

C/7 SECTION

NOT TO SCALE

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MARTIN LAKE STEAM ELECTRIC STATION

Figure 7

TYPICAL DRAINAGE CONTROL DETAILS

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APPENDIX A
TECHNICAL SPECIFICATIONS

A-1 AREA LANDFILL
TECHNICAL SPECIFICATIONS

A-1 AREA LANDFILL
TECHNICAL SPECIFICATIONS
TABLE OF CONTENTS

SECTION 01100

EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section consists of furnishing, placing, and maintaining erosion and sedimentation control measures as shown on the Drawings, as directed by the COMPANY, and where necessary to reduce sediment content of runoff prior to establishment of permanent vegetation.

1.2 PERFORMANCE REQUIREMENTS

A. CONTRACTOR shall provide erosion and sedimentation control measures to control erosion and sediment runoff in any location where erosion and sediment runoff is likely to occur and as required by the COMPANY. Erosion and sedimentation control measures shall remain in place until removal is approved by the COMPANY.

B. Clearing and stripping of vegetation, regrading and other construction activities shall be conducted in a manner to minimize erosion. Existing drainage patterns and vegetation shall be protected and retained to the greatest extent practicable.

C. The size and duration of exposure of disturbed areas shall be kept to a minimum and all disturbed soil shall be stabilized as quickly as practicable. Diversion channels/berms shall be located upstream from disturbed areas to minimize the amount of run-on to the disturbed areas.

D. In the event that erosion and sedimentation control measures used by CONTRACTOR prove to be inadequate as determined by COMPANY, CONTRACTOR shall be required to adjust his operations to the extent necessary to control sedimentation and shall repair areas impacted by sedimentation as directed by COMPANY at no additional cost to COMPANY.

1.3 SUBMITTALS

A. CONTRACTOR shall submit the following to COMPANY a minimum of 14 days prior to initiating field activities:

1. A copy of the construction Storm Water Pollution Prevention Plan (SWPPP) developed for the Work.

2. An installation schedule for erosion and sedimentation control measures. This schedule shall cover all ground disturbance activities including material staging areas and planned excavation and grading areas.

3. Certification that all proposed erosion and sedimentation control products comply with the requirements of these specifications.

PART 2 - PRODUCTS

2.1 SILT FENCE

A. Silt fence fabric material shall be a woven geotextile conforming to the following requirements:

Physical Property	Test Method	Requirement
Tensile Strength, lb.	ASTM D4632	100 Minimum
Elongation @ Yield, %	ASTM D4632	10-40
Trapezoidal Tear, N (lb.)	ASTM D4533	50 Minimum
Apparent Opening Size	ASTM D4751	20-50
Permittivity, 1/sec	ASTM D4491	0.1 Minimum
UV Stability, 500 hr.	ASTM D4355	80 Minimum

B. Posts shall be essentially straight wood or steel posts with a minimum length of 48 inches. Soft wood posts must be at least 3 in. in diameter or nominal 2 x 4 in. Hardwood posts must have a minimum cross-section of 1-1/2 x 1-1/2 inches. T- or L-shaped steel posts must have a minimum weight of 1.3 pounds per foot.

2.2 EROSION CONTROL FABRIC

A. Erosion Control Fabric shall be North American Green S150 or COMPANY-approved equal.

B. Erosion control fabric blanket shall have a minimum width of 6 feet. The fabric mat shall be machine-produced of 100 percent coconut fiber with colored line or thread along outer edges to indicate material overlap limits and shall have a minimum weight of 0.50lb./sq.yd.

C. The top and bottom cover of the fabric shall be heavy-weight polypropylene netting with ultraviolet additives to delay breakdown. The mesh size shall be a minimum of 0.5 inch by 0.5 inch.

D. The blanket and top/bottom covers shall be sown together on 1.5 inch center at 50 stitches per roll width with UV stable polypropylene thread.

E. Erosion Control Fabric shall be installed using 6-in. wooden stakes or metal staples of sufficient material quality, cross-section, and strength to anchor the erosion control blanket against loads imposed by surface runoff and sediment.

2.3 HAY BALES

A. Hay bales may be obtained from local sources and shall weigh 40 to 120 pounds per bale. Only grain hay bales, free of noxious weeds, shall be used. Bales shall be tightly and securely bound with wire to provide a stable bale and to extend the functional life of the bale to the extent practicable. Bales shall be free from rot and mold.

B. Stakes for hay bales shall be wooden stakes or metal rebar of sufficient material quality, cross-section, and strength to secure the hay bales.

2.4 TEMPORARY VEGETATION

A. Temporary Vegetation shall be applied on areas left exposed for greater than 30 days. CONTRACTOR shall use temporary vegetation seed mixture and application rate as specified in Section 02350, "Vegetation," or CONTRACTOR may alternatively submit proposed temporary vegetation seed mix and application rate to COMPANY for approval no later than 7 days prior to use.

B. Mulch shall be applied after temporary vegetation seeding at a rate of 1.5 tons/acre for straw mulch, or at the rate recommended by the manufacturer if wood fiber mulch is used.

CONTRACTOR shall ensure that mulch does not redistribute after application. CONTRACTOR shall reapply mulch as necessary to maintain uniform coverage. Straw mulch shall include dry oat or wheat straw, native hay, or chopped corn stalks. The mulch shall be free from weeds and foreign matter detrimental to plant life. Wood fiber mulch shall include approved wood cellulose fiber in chip form and be free of ingredients that could inhibit germination and growth.

PART 3 - EXECUTION

3.1 GENERAL

A. Delivery, Storage, and Handling. Product delivery, storage and handling shall comply with manufacturer's recommendations. All erosion and sedimentation control products shall be delivered in manufacturer's wrapping and shall be stored in a manner to prevent damage. Damaged or unsuitable products shall be promptly removed from the job site and replaced with products meeting these specifications.

B. All erosion and sedimentation control measures shall be installed in accordance with manufacturer's recommendations and approved by the COMPANY prior to initiating any clearing, demolition or construction activities.

C. Cut Areas. Establish an erosion control line (hay bales or filter fabric) at toe of slope in all cut areas prior to beginning cut operations.

D. Fill Areas. Establish an erosion control line (hay bales or filter fabric) approximately 10 feet from toe of slope of proposed fill areas prior to beginning fill operations.

E. Stockpiles. Sides of soil stockpiles shall have a maximum slope of 2:1. All stockpiles shall be surrounded by a sediment barrier (hay bales or filter fabric) unless other wise approved by the COMPANY. All stockpiles left bare for more than 30 days shall be stabilized with temporary vegetation and/or mulch.

3.2 SILT FENCE

A. Silt fence shall be installed along the downstream perimeter of all disturbed areas to intercept sediment from sheet flow.

B. Posts shall be embedded into the ground at least 18 inches deep and shall be spaced a maximum of 8 feet apart.

C. Filter fabric shall be installed by digging a 6 inch wide by 6 inch deep trench along the upstream side of the fence. Place approximately 6 to 8 inches of the fabric in the trench and backfill the trench.

D. Unless otherwise shown on the Drawings, attach the wire mesh to wooden posts with staples, or to steel posts with T-clips, in at least 4 places equally spaced. Sewn vertical pockets may be used to attach wire mesh or fabric to end posts.

E. Fasten the fabric to the top strand of the reinforcement by rings or cord every 15 inches or less. Locate fabric splices at a fence post with a minimum overlap of 6 inches attached in at least 4 places equally spaced. Do not locate fabric splices in concentrated flow areas.

3.3 EROSION CONTROL FABRIC

A. Erosion control fabric shall be installed following completion of final grading activities in the following disturbed earth areas unless otherwise approved by the COMPANY:

1. All exterior slopes 4(H) to I(V) and steeper; and
2. All drainage ditches, channels and swales.

B. Erosion control fabric shall be anchored at the top of the slope using an anchor trench and shall be rolled down the slope so as to maintain tension to preclude folds and wrinkles. Any folds or wrinkles shall be removed by hand.

C. The erosion control fabric anchor trench shall be 6 inches wide by 6 inches deep. The trench fabric shall be connected to the vertical face of the trench using stakes or staples spaced at 12 inches on center. The trench shall be backfilled and compacted upon completion of stapling.

D. Successive erosion control fabric panels shall be overlapped in such a manner that the upstream and upslope panel is placed over the downstream and downslope panel. Panels shall overlap a minimum of 6 inches at end joints and on sideslopes.

E. Stake or staple through both panels with stakes/staples driven flush with the soil surface. Stake/staple spacing shall be in accordance with manufacturer's recommendations.

3.4 HAY BALES

A. Hay bales shall be installed to form water stops, filtration dams, diversions, etc. as required for erosion and sedimentation control. On sloping terrain, hay bales may be used to trap sediment until vegetation has become established.

B. Place bales lengthwise with ends tight, abutting one another. Install bales with bindings located on the sides.

C. Entrench hay bales a minimum of 4 inches and backfill. Place backfill on the upstream side of the bales.

D. Secure the bale in place with two stakes per bale and insert straw in voids between bales.

3.5 MAINTENANCE

A. All erosion and sedimentation controls shall be maintained in a structurally sound and functional manner. All erosion and sedimentation controls shall be inspected at least on a weekly basis, immediately after each rainfall and daily during prolonged rainfall.

B. Any damaged or deteriorating systems shall be replaced immediately upon discovery or as directed by COMPANY.

C. Sediment deposits shall be removed when the deposit reaches 1/3 the height of the fence or sooner to provide a functional and stable system. Sediment retained by sedimentation and erosion control systems shall be removed by CONTRACTOR and may be used on the project as fill as approved by COMPANY.

D. Areas where temporary vegetation or mulch has been applied shall be inspected to ensure proper growth and coverage. Temporary vegetation or mulch shall be reapplied as necessary to minimize erosion.

3.6 REMOVAL

A. Erosion and sedimentation controls shall remain in-place until the COMPANY directs their removal. Upon removal CONTRACTOR shall dispose of any sediment accumulations, dress the area to the satisfaction of COMPANY, and shall vegetate all bare areas in accordance with the Contract Documents. Temporary erosion control blanket materials specified are biodegradable and will remain in place after establishment of permanent vegetation.

++END OF SECTION++

SECTION 01200

DUST CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section consists of performance of dust control measures as necessary to prevent fugitive dust during construction activities or as directed by the ENGINEER.

1.2 PERFORMANCE REQUIREMENTS

A. CONTRACTOR shall implement all necessary dust control measures to prevent fugitive dust during all construction activities.

B. The need for dust control measures will be based on visual observation of airborne dust. CONTRACTOR shall implement dust control measures on a regular basis throughout the duration of the work unless other wise authorized by the ENGINEER. CONTRACTOR shall adjust operations and/or dust controls as necessary, at no additional cost to OWNER, if directed by ENGINEER to mitigate dust.

1.3 SUBMITTALS

A. CONTRACTOR shall submit the following to ENGINEER a minimum of 5 days prior to initiating dust control measures:

1. Source of dust control water;
2. List of dust control equipment; and
3. Manufacturer specification sheets and material safety data sheets (MSDS) for chemical additives used for dust control.

PART 2 - PRODUCTS

2.1 WATER

A. Water used for dust control need not be potable, but must not be contaminated. Proposed source of dust control water must be approved by ENGINEER prior to initiating dust control measures.

2.2 CHEMICAL ADDITIVES

A. Chemical additives shall be incorporated into dust control measures only if approved by the ENGINEER.

B. Calcium Chloride for dust control shall conform to the requirements of ASTM D98, Type 1 or Type 2.

C. Alternative chemical additives for dust control may be used if approved by the ENGINEER.

2.3 EQUIPMENT

A. Dust control water shall be applied using tank trucks equipped with water cannon capable of delivering water through either front- or rear-mounted nozzles. Tank trucks shall be of sufficient size and mobility and carry a sufficient quantity of water to control dust generated by CONTRACTOR's activities.

B. More than one water tank truck may be required during construction activities to sufficiently suppress dust.

PART 3 - EXECUTION

3.1 IMPLEMENTATION OF DUST CONTROL MEASURES

A. Vehicular traffic in disturbed areas shall be limited to the extent practicable. Construction vehicles shall maintain low speeds to minimize the amount of dust created. Adequate freeboard in loaded trucks shall be maintained to prevent spillage during operations. Roadway surfaces shall be kept free of spilled/tracked soil.

B. Soil stockpiles shall be graded and shaped to minimize surface area. Water or covers shall be applied to stockpiles as needed to control dust.

C. Apply dust control water uniformly over roads and disturbed areas from trucks capable of uniform distribution. Provide suitable devices for positive shut-off and for regulating flow of water.

D. Apply calcium chloride or other chemical additives at locations only when directed by ENGINEER. Spread calcium chloride or other chemical additives by approved devices and methods for uniform distribution.

E. Dust control water and/or chemical additives shall be applied so as to limit and/or prevent formation of standing water and mud; over spray of chemical dust suppressants in areas adjacent to surface water bodies or sensitive habitats; and/or flushing of materials off of the work area.

++END OF SECTION++

SECTION 02200

SITE PREPARATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section consists of all work associated with clearing and preparing the work area, borrow areas, and other work areas for earthwork and other construction activities, including removal of existing vegetation and verification of existing site conditions.

1.2 EXISTING SITE CONDITIONS

A. CONTRACTOR shall verify that existing topographic conditions in the Work Area as shown on the Drawings are an accurate representation of existing site conditions prior to initiating construction activities.

B. If CONTRACTOR contends that existing topographic conditions are different from that shown on the Drawings, Contractor shall submit survey data from a Texas-registered land surveyor to document actual topographic conditions, and shall identify with such submission additional work required which was not accounted for in CONTRACTOR's bid. There shall be no opportunity for a Claim for extra work due to differing topographic conditions once stripping or excavation work has started.

C. Existing site improvements (utilities, monitoring wells, and similar items) shall be located and protected by CONTRACTOR before CONTRACTOR begins clearing operations.

1.3 SUBMITTALS

A. Clearing and grubbing and solid waste generated during cap subgrade preparation shall be placed within the active portion of the landfill unless otherwise approved by the ENGINEER. CONTRACTOR shall submit name and address of the alternate disposal facility proposed for management of trash and rubbish generated in connection with site preparation at least 5 days prior to beginning clearing operations.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 CLEARING

A. Clearing shall consist of the cutting, shredding, and stockpiling of all trees and shrubs and the stripping of all grass and similar surface vegetation within the limits of the landfill and borrow areas. Clearing shall be limited to the areas required to perform the work.

B. CONTRACTOR shall segregate material removed as part of clearing from soils to be incorporated into subsequent earthwork activities.

3.2 VEGETATIVE SOIL STRIPPING AND STOCKPILING

A. After completion of clearing activities, CONTRACTOR shall strip the uppermost approximately 12 inches of existing vegetative soil from the cleared areas. Material identified as vegetative soil shall be subject to ENGINEER’s approval.

B. CONTRACTOR shall stockpile stripped vegetative soil in the work area in a location acceptable to the ENGINEER.

3.3 DISPOSAL OF BRUSH AND OTHER VEGETATIVE MATERIAL

A. CONTRACTOR shall dispose of all brush and other vegetative materials generated during site clearing in accordance with all applicable regulations and as approved by the ENGINEER.

B. If approved by the ENGINEER, CONTRACTOR may burn brush and other vegetative material in accordance with the requirements of TCEQ Publication RG-049 “Outdoor Burning in Texas”, as modified to comply with OWNER requirements. Specific requirements for burning of brush and other vegetative material include, but are not limited to, the following:

1. Commence or continue burning only when the wind direction and other weather conditions are such that the smoke and other pollutants will not present a hazard to any public road, landing strip, or water body or have an adverse effect on any off-site structure.

2. Don’t start burning unless weather conditions are such that the smoke will dissipate (winds of at least 6 miles per hour; no temperature inversions) while still allowing the fire to be contained and controlled (winds no faster than 23 miles per hour).

3. Post someone to flag traffic if at any time the burning causes or may tend to cause smoke to blow onto or across a road or highway.

4. Begin burning no earlier than one hour after sunrise, end it the same day and no later than one hour before sunset, and make sure that a responsible party is present while the burn is active and the fire is progressing.

5. At the end of the burn, extinguish isolated residual fires or smoldering objects if the smoke they produce can be a nuisance or a traffic hazard.

C. CONTRACTOR will be responsible for controlling fires in compliance with all Federal, State, and Local laws and regulations. The securing of necessary burning permits shall be the responsibility of the CONTRACTOR. All burning shall be under the constant care of competent watchmen. All materials resulting from clearing and grubbing operations and disposed of by burning on the site shall be thoroughly and completely reduced to ashes.

D. CONTRACTOR shall be responsible for providing a suitable location (subject to ENGINEER and OWNER approval) for off-site disposal of cleared material not burned on-site. Once ENGINEER and OWNER have approved the disposal location, CONTRACTOR shall transport and dispose the material in accordance with all applicable regulations.

++END OF SECTION++

SECTION 02300

EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section consists of all activities associated with earthwork construction, including, but not necessarily limited to:

1. Excavation, loading, transportation, unloading and stockpiling of soil from COMPANY-designated locations;

2. Placement, compaction, and grading of various earthen materials;

3. Ditch grading; and

4. All other activities required to complete earthwork construction as shown on the Drawings, specified herein and or required by the COMPANY.

1.2 REFERENCES

A. American Society of Testing Materials (ASTM) Standards/Publications (Latest version):

C33	Standard Specification for Concrete Aggregates
D422	Method of Particle Size Analysis of Soils
D698	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3)
D1557	Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3)
D1587	Standard Practice for Thin-walled Tube Sampling of Soils
D2487	Classification of Soils for Engineering Purposes
D2922	Density of Soil In Place by Nuclear Density Gage
D3080	Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions
D4318	Liquid Limit, Plastic Limit and Plasticity Index of Soils
D5084	Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.3 DEFINITIONS

A.	Select Fill:	Soil material suitable for use as cap fill, for dike construction or other areas identified by the COMPANY.
B.	General Fill:	Any non-classified soil deemed suitable by the COMPANY.

C. Liner Subgrade: Soil complying with the specified requirements located immediately beneath the geosynthetic clay liner (GCL).

D. Compacted Clay: Low-permeability soil layer of liner system.

E. Vegetative Soil: Growth medium used along with any necessary admixtures to support vegetation.

F. Gravel: Granular crushed stone material used as erosion protection in ditches.

G. Road Base: Granular material placed on the surface of haul roads, access roads and other areas designated on the Drawings, identified in the Specifications or required by the COMPANY.

H. Rip Rap: Stone armor material used in drainage features for erosion control and energy dissipation.

1.4 SUBMITTALS

A. CONTRACTOR shall identify all earthwork material suppliers and shall submit written verification from his material suppliers that all earthwork materials to be used for the work comply with the requirements of this Section.

B. CONTRACTOR shall submit copies of all geotechnical laboratory reports within 10 working days after sample collection.

1.5 QUALITY CONTROL

A. CONTRACTOR shall perform construction surveys, as needed, to ensure that the lines and grades of all excavations, embankments, ditches, pipe trenches, pipe inverts, and graded surfaces are in accordance with the drawings and specifications.

B. COMPANY may perform pre-construction and post-construction topographic surveys of the work area and related areas and may perform additional quality assurance surveys. CONTRACTOR shall coordinate his activities with COMPANY's surveyor and provide safe access to all excavation areas for survey and/or verification sampling activities.

1.6 TESTING

A. The number and type of testing required for each type of earthwork shall be as specified in the specific section related to the type of earthwork.

B. COMPANY will select the locations for all tests. Tests performed at locations not approved by the COMPANY will not be accepted.

C. All undisturbed earthwork samples shall be collected using a thin-walled sampler complying with ASTM D1587. The length of the sampler shall be suitable for collection of an undisturbed sample over the specified sampling interval.

D. Unless otherwise specified, testing shall be performed in accordance with the following methods:

1. Soil classification shall be performed using ASTM D2487. Liquid Limits, Plastic Limits and Plasticity Indices shall be determined using ASTM D4318.

2. Moisture-Density Relationships shall be determined using ASTM D698. Unless otherwise directed by COMPANY. ASTM D1557 may be used only where specified.

3. In-place density and moisture content shall be determined using ASTM D6938 (Nuclear Density Gage). Other methods for determining in-place density and moisture may not be used unless approved by the COMPANY.

4. Hydraulic conductivity shall be determined using ASTM D5084.

5. Direct shear testing shall be performed in accordance with ASTM D3040.

1.7 TOLERANCES

A. Grades and slopes of all earthwork shall be straight and true. Unless otherwise specified, CONTRACTOR shall complete all earthwork within the dimensional tolerances presented below.

B. Elevation Tolerances:

1.	Compacted Clay Surface:	plus 0.1 foot, minus 0.0 foot.
2.	Liner Subgrade Surface:	plus 0.1 foot, minus 0.0 foot.
3.	Gravel Surface:	plus 0.1 foot, minus 0.0 foot.
4.	All Other Surfaces:	plus 0.2 foot, minus 0.0 foot.

C. Thickness Tolerances:

1.	Compacted Clay Subgrade:	plus 0.2 foot, minus 0.0 foot.
2.	Liner Subgrade:	plus 0.2 foot, minus 0.0 foot.
3	All Other Surfaces:	plus 0.1 foot, minus 0.0 foot.

D. Grade Tolerances: All grades/slopes shall be completed within

1.	Compacted Clay Surface:	plus or minus 0.1 percent of design slope.
2.	Liner Subgrade Surface:	plus or minus 0.1 percent of design slope.
3.	Gravel and Drainage Features:	plus or minus 0.1 percent of design slope.
4.	All Other Surfaces:	plus or minus 0.2 percent of design slope.

E. Horizontal Coordinates and/or Earthwork Dimensions: plus or minus 0.5 feet

1.8 UTILITIES

A. COMPANY will attempt to deactivate electrical and other utilities in areas to be excavated; however, CONTRACTOR shall be ultimately responsible for ensuring that no energized equipment or utilities are present prior to initiating excavation activities. If CONTRACTOR identifies energized or active equipment or utilities, CONTRACTOR shall cease work and notify COMPANY so that the equipment/utilities may be deactivated. CONTRACTOR shall again check the equipment and utilities to ensure they are deactivated prior to proceeding with excavation activities.

B. CONTRACTOR shall note that underground and aboveground utilities may be located in the area of the Work. CONTRACTOR shall be ultimately responsible for protecting the utilities during earthwork and related activities.

1.9 EARTHWORK SAFETY

A. As discussed in other areas of these specifications, CONTRACTOR shall be fully responsible for the health and safety of all personnel in the work area, at all times, and shall take all necessary precautions to protect personnel.

B. In addition to general health and safety responsibilities, CONTRACTOR shall be fully responsible for complying with all applicable OSHA and related regulations regarding earthwork, including, but not limited to, the requirements of 40 CFR Part 126.

PART 2 - PRODUCTS

2.1 SELECT FILL

A. Select fill shall consist of soil excavated during foundation soil grading. CONTRACTOR shall be responsible for loading, transporting, placement and compaction of select fill.

B. Select fill shall classify as CH, CL or SC using ASTM D2487, shall have a plasticity index between 15 and 40, and shall be free of roots, brush, sod, or other perishable materials and debris.

2.2 GENERAL FILL

A. General fill shall be any non-classified soil deemed suitable by the COMPANY. General fill shall be free of trash, rubbish or other deleterious substances. The maximum particle size of general fill shall be 6 inches.

2.3 LINER SUBGRADE

A. Liner Subgrade shall consist of soil excavated from the site during foundation grading. CONTRACTOR shall be responsible for loading, transporting, placement and compaction of Liner Subgrade.

B. Liner Subgrade shall classify as CH or CL using ASTM D2487 and shall contain no organic material, sticks, or other deleterious material.

C. The maximum particle size of liner subgrade shall be 3 inches. Particles larger than 1 inch shall be subrounded to rounded.

2.4 COMPACTED CLAY

A. Compacted Clay shall consist of soil excavated from the COMPANY-designated Borrow Area or other COMPANY-approved off-site source. CONTRACTOR shall be responsible for loading, transporting, placement and compaction of Compacted Clay.

B. Compacted Clay shall classify as CH or CL using ASTM D2487 and shall contain no organic material, sticks, or other deleterious material.

C. Compacted Clay shall conform to the following:

Parameter	Specification
Plasticity Index	15 Minimum
Liquid Limit	30 Minimum
Percent Passing No. 200 Sieve	30% Minimum
Percent Passing 1.5-inch Sieve	100%
Hydraulic Conductivity	1×10^{-7} cm/s Maximum
In-Place Density	95% Standard Proctor Minimum
In-Place Moisture Content	-1% to +3% Optimum Moisture Content

2.5 VEGETATIVE SOIL

A. Vegetative soil shall consist of soil stripped from the work area and stockpiled by the CONTRACTOR. Vegetative soil shall be free of deleterious material, materials toxic to plant growth, noxious weed seeds, rhizomes, roots, subsoil, rocks, or other debris.

2.6 GRAVEL

A. Gravel shall be washed, angular crushed gravel or crushed limestone, free of mud, clay, vegetation or other debris, conforming to ASTM C33 for stone quality.

B. Gravel shall have the following size gradation:

U.S. Sieve Size	Percent Passing
1.5 Inch	100
1 Inch	90 to 100
0.5 Inch	15 to 60
No. 4	0 to 10
No. 8	0 to 5

C. Gravel shall conform to the following:

1. Liquid Limit (LL) less than or equal to 35.

2. Plasticity Index (PI) less than or equal to 10.

2.7 ROAD BASE

A. Road base shall consist of crushed stone, free of mud, clay, vegetation or other debris, conforming to the requirements of TXDOT Item 248, Type A (Grade I). Size Gradation shall comply with the following:

U.S. Sieve Size	Percent Passing
2.5 inch	100
1.75 inch	100
0.875 inch	65 to 90
0.375 inch	50 to 70
No. 4	35 to 55
No. 40	15 to 30
No. 200	0

B. Road Base shall conform to the following:

1. Liquid Limit (LL) less than or equal to 35.

2. Plasticity Index (PI) less than or equal to 10.

2.8 RIPRAP

A. Riprap shall be clean, well-graded durable natural stone with a minimum specific gravity of 2.4.

Unless other wise approved by the COMPANY, riprap shall comply with the following:

1. No deleterious material, noxious weed seeds, roots, subsoil, or other debris shall be present.

2. Riprap shall consist of stone conforming to the following gradation:

Stone Weight (pounds)	Percent Lighter Than
700	100
300	50 to 100
150	15 to 50
45	0 to 15

3. Stones shall be at least 3 inches in their least dimension. The breadth or thickness of each stone shall not be less than one-third the length of the stone.

PART 3 - EXECUTION

3.1 GENERAL

A. All earthwork shall be completed to the lines and grades shown on the Drawings and as required by the COMPANY.

B. CONTRACTOR shall not place material in the presence of water unless approved by the COMPANY. Saturated areas shall be dewatered by CONTRACTOR as specified herein prior to initiating earthwork activities. CONTRACTOR shall remove all saturated soils, muck, organic matter and other materials not suitable for compaction or proof-rolling from dewatered areas prior to placing fill materials.

C. All proof rolling shall be performed as follows unless another method is approved by the COMPANY:

1. Proof rolling equipment shall be approved by the COMPANY. Proof rolling equipment may be self-propelled or towed by a suitable tractor.

2. Proof rolling equipment shall have a rolling width of 8 to 10 feet and shall be capable of operating under various contact pressures.

3. Contact pressure of proof rolling equipment shall be a minimum of 2000 pounds per square foot.

4. A minimum of two passes with the proof rolling equipment shall be completed across the entire native soil surface prior to placement of any material.

5. Any area shown to be unstable or non-uniform after proof rolling shall be recompacted and/or reworked until proof rolled to the satisfaction of the COMPANY.

D. Compaction of all materials shall be performed with an appropriately heavy, properly ballasted penetrating-foot compactor. A minimum of four passes of the compactor shall be performed on each material lift regardless of whether the lift complies with specified density requirements within less than four passes.

E. When target compaction/density is specified using ASTM D698 (Standard Proctor), the minimum weight of the compacting equipment shall be 1500 pounds per linear foot of drum length.

F. The daily work area shall extend a distance no greater than necessary to maintain moist conditions and continuous operations. Desiccation and crusting of the lift surface shall be avoided as much as possible.

G. Water added to soils shall be clean and shall not have come into contact with waste or any objectionable material. Source of water shall be approved by COMPANY prior to application.

H. Unless otherwise specified or approved by the COMPANY, the maximum clod size in each lift prior to compaction shall be 2 inches in diameter. Clod size shall be reduced through discing, pulverizing or similar methods. Unless otherwise approved by the COMPANY, a minimum of 4 passes with discing or pulverizing equipment shall be made across each lift prior to beginning compaction. A pass is defined as one trip across the lift surface. Passes shall be made at alternating right angles across the lift surface.

I. Finished, compacted lifts of all material shall be sprayed with clean water as necessary to prevent drying and desiccation.

J. At the end of each construction day's activities, completed lifts shall be sealed by rolling with a rubber-tired or smooth drum roller. Prior to resuming placement of overlying material, the surface of the previous lift shall be scarified to a minimum depth of 2 inches.

3.2 DEWATERING

A. CONTRACTOR shall note that some of the work may be performed in areas exhibiting saturated conditions at and below the groundwater table. CONTRACTOR shall not place material in the presence of water unless approved by the COMPANY.

B. CONTRACTOR shall dewater the work area using pumps or other method approved by the COMPANY. Dewatering measures shall be implemented by the time the excavation reaches the water level in order to maintain the integrity of the in-situ material. Dewatering water shall be discharged in accordance with COMPANY requirements in a manner that minimizes erosion and other disturbances to existing drainage features and adjacent areas.

C. All dewatering system components, including cofferdams, pumps, piping and related equipment shall be removed by the CONTRACTOR at the completion of the work.

3.3 COMPACTED CLAY

A. Construction of the Compacted Clay layer will begin after the underlying native soil has been finished to the proper lines and grade. The depth of the top of the underlying native soil prior to compacted clay construction shall coincide with the bottom of the Compacted Clay layer. The Compacted Clay layer shall be keyed into the underlying native soil or otherwise constructed to ensure stability.

B. Compacted Clay shall be placed and compacted in lifts. Maximum loose lift thickness shall be 8 inches. Maximum compacted lift thickness shall be 6 inches.

C. New Compacted Clay lifts shall be properly tied back into previous clay sections to ensure continuous clay layer coverage. Compacted Clay layers shall be tied into previously placed Compacted Clay layers using a stair-step construction method with benches, no steeper than a five horizontal to one vertical face.

D. For excavation surfaces with a slope of 3(H):1(V) or flatter, Compacted Clay layer construction may utilize lifts parallel to the finished surface. For excavation surfaces that have steeper than 3(H):1(V) slopes, Compacted Clay lifts shall be placed in successive horizontal lifts. All horizontal lifts shall be sufficiently wide to safely accommodate construction equipment.

E. Testing requirements for lifts placed on all sloped surfaces shall be the same as specified for non-sloped surfaces. Lift areas on sloped surfaces shall be measured parallel to the surface of the excavation.

F. Prior to compaction of each lift, the moisture content of the Compacted Clay shall comply with the requirements of these specifications. If the moisture content is above the specified maximum, the Compacted Clay shall be pulverized, disced or similarly reworked to air dry the material and decrease the moisture content.

G. Each lift shall be compacted to a minimum of 95 percent maximum dry density as determined by ASTM D698 (Standard Proctor). Material with densities less than the specified density shall be recompacted and/or reworked as necessary to achieve the specified density.

H. Each lift shall be thoroughly compacted and shall satisfy all specified requirements before a subsequent lift is placed.

I. After the final lift has been compacted and tested, the surface of the Compacted Clay shall be rolled and sealed with a smooth drum roller. A minimum of four passes of the roller shall be performed on the Compacted Clay. A pass is defined as one trip across the entire Compacted Clay surface.

J. COMPANY will test Compacted Clay per the following guidelines:

1. Pre-Construction Testing. Prior to beginning placement of the Compacted Clay, CONTRACTOR shall collect composite samples from the prospective clay source(s) and test the samples as described below. All composite samples shall consist of equal volumes of soil collected from a minimum of four locations within the prospective clay source.

    a. Two soil classifications in accordance with ASTM D2487 shall be performed from each clay source. Plasticity Index (PI) shall be included in the soil classification.

    b. Two moisture-density relationship tests in accordance with ASTM D698 (Standard Proctor) shall be performed from each clay source.

    c. Two hydraulic conductivity tests by ASTM D5084 shall be performed from each clay source. Each sample shall be compacted to 95 percent maximum dry density as determined by ASTM D698 (Standard Proctor) prior to performing the hydraulic conductivity test.

2. In-Place Testing. After each Compacted Clay lift has been placed, COMPANY will perform the following in-place tests:

    a. One in-place density test in accordance with ASTM D6938 shall be performed per each 4,000 square feet for each lift.

    b. One in-place moisture density relationship shall be reported for every in-place density test performed.

K. After completion of the Compacted Clay layer, but before beginning installation of the overlying materials, CONTRACTOR shall survey the finished elevations of the Compacted Clay to ensure that the top of the Compacted Clay is at the grades and elevations specified on the Drawings. There shall be a minimum of one survey point for every 5,000 square feet of Compacted Clay surface area.

3.4 SELECT FILL

A. Select fill shall be placed and compacted in lifts. Maximum loose lift thickness shall be 8 inches. Maximum compacted lift thickness shall be 6 inches.

B. Prior to compaction, the moisture content of the select fill shall be no greater than plus 3 percent of the optimum moisture content as determined by ASTM D698 (Standard Proctor). If the moisture content is above the specified maximum, select fill shall be pulverized, disced or similarly reworked to air dry the material and decrease the moisture content.

C. Each select fill lift shall be compacted to a minimum of 90 percent maximum dry density as determined by ASTM D698 (Standard Proctor). Material with densities less than the specified density shall be recompacted and/or reworked as necessary to achieve the specified density.

D. Each lift shall be thoroughly compacted and shall satisfy all moisture and density requirements before a subsequent lift is placed.

E. COMPANY will test select fill per the following guidelines:

1. One moisture density relationship test in accordance with ASTM D698 (Standard Proctor) shall be performed for every 50,000 cubic yards placed.

2. One in-place density test in accordance with ASTM D6938 shall be performed for every 20,000 square feet of surface area for each lift. Surface area shall be measured in the horizontal plane.

3. One soil classification in accordance with ASTM D2487 shall be performed for every 50,000 cubic yards placed.

4. Plasticity Index (PI) shall be included in the soil classification. One moisture-density relationship test in accordance with ASTM D698 (Standard Proctor) shall be performed any time a PI change greater than 10 is observed in the soil classification tests.

F. After completion of the select fill, but before beginning installation of the overlying materials, CONTRACTOR shall survey the finished elevations of the select fill to ensure that the top of the select fill is at the grades and elevations specified on the Drawings. There shall be a minimum of one survey point for every 5,000 square feet of select fill surface area.

3.5 SELECT FILL ON STEEP SLOPES

A. Steep slopes are defined as surfaces with slopes steeper than 5 horizontal to 1 vertical.

B. Construction of select fill on steep slopes shall comply with all other requirements for select fill, in addition to those specified herein.

C. Select fill shall be placed and compacted in benched, horizontal lifts. Maximum loose lift thickness shall be 8 inches. Maximum compacted lift thickness shall be 6 inches.

D. Lifts shall be placed and compacted horizontally (benched parallel to the toe of the slope) rather than vertically (up and down the slope). Each lift shall be wide enough to permit passage of compacting equipment.

E. Lifts shall extend horizontally beyond the required final elevations of select fill to permit grading back to the required slopes after compaction and testing.

F. After each lift has been compacted, tested and accepted by the COMPANY, Contractor shall grade the slope to the required elevations

3.6 LINER SUBGRADE

K. Liner Subgrade shall be placed and compacted in lifts. Maximum loose lift thickness shall be 8 inches. Maximum compacted lift thickness shall be 6 inches. A total of 2 lifts will be placed to construct the 12 inch Liner Subgrade thickness.

L. Prior to compaction of each of the lifts, CONTRACTOR shall manually remove all visible rock 3 inches or greater in size from the lift. After the visible rocks have been removed, CONTRACTOR shall compact each lift as discussed below.

C. Prior to compaction of each lift, the moisture content of the Liner Subgrade shall be no greater than plus 4 percent of the optimum moisture content as determined by ASTM D698 (Standard Proctor). If the moisture content is above the specified maximum, Liner Subgrade shall be pulverized, disced or similarly reworked to air dry the material and decrease the moisture content.

D. Each lift shall be compacted to a minimum of 90 percent maximum dry density as determined by ASTM D698 (Standard Proctor). Material with densities less than the specified density shall be recompacted and/or reworked as necessary to achieve the specified density.

E. Each lift shall be thoroughly compacted and shall satisfy all specified requirements before a subsequent lift is placed.

F. After the second lift has been compacted and tested, the surface of the Liner Subgrade shall be rolled and sealed with a smooth drum roller. A minimum of four passes of the roller shall be performed on the Liner Subgrade. A pass is defined as one trip across the entire Liner Subgrade surface.

H. CONTRACTOR shall test Liner Subgrade as specified herein:

1. One moisture density relationship test in accordance with ASTM D698 (Standard Proctor) shall be performed for every 10,000 cubic yards placed.

2. One in-place density test in accordance with ASTM D6938 shall be performed for every 20,000 square feet of surface area for each lift. Surface area shall be measured in the horizontal plane.

3. One soil classification in accordance with ASTM D2487 shall be performed for every 10,000 cubic yards placed.

4. Plasticity Index (PI) shall be included in the soil classification. One moisture-density relationship test in accordance with ASTM D698 (Standard Proctor) shall be performed any time a PI change greater than 10 is observed in the soil classification tests.

5. One hydraulic conductivity test by ASTM D5084 for every 10,000 cubic yards of Liner Subgrade. Each test shall be performed on a composite Liner Subgrade sample collected from the Liner Subgrade stockpile as approved by COMPANY. The composite sample shall be compacted to 90 percent maximum dry density as determined by ASTM D698 (Standard Proctor) prior to performing the hydraulic conductivity test.

I. After completion of the Liner Subgrade, but before beginning installation of the overlying materials, CONTRACTOR shall survey the finished elevations of the Liner Subgrade to ensure that the top of the Liner Subgrade is at the grades and elevations specified on the Drawings. There shall be a minimum of one survey point for every 10,000 square feet of Liner Subgrade surface area.

3.7 VEGETATIVE SOIL

A. Vegetative Soil shall not be placed until the underlying soil has been approved by the COMPANY.

B. Vegetative Soil shall be placed in one 12 inch lift without damaging the underlying soil. Vegetative Soil shall be tracked in and smoothed out using tracked equipment. No direct compactive effort shall be used on vegetative soil.

C. After completion of the Vegetative Soil layer, CONTRACTOR shall survey the finished elevations of the Vegetative Soil to ensure that the top of the vegetative soil is at the grades and elevations specified on the Drawings. There shall be a minimum of one survey point for every 5,000 square feet of Vegetative Soil surface area.

3.8 ROAD BASE

A. Road Base shall be placed on access ramps, on the top of the dike and as required by the COMPANY.

B. Geotextile shall be placed beneath all Road Base in accordance with Section 2430 of these specifications.

C. Road Base shall be placed and compacted in lifts, with a maximum loose lift thickness of 8 inches. Each fill lift shall be compacted using a minimum of four passes of the compactor. A pass is defined as one trip across the lift surface. There is no target maximum density requirement for road base.

D. After completion of the road base, but before beginning installation of the overlying materials, CONTRACTOR shall survey the finished elevations of the road base to ensure that the top of the road base is at the grades and elevations specified on the Drawings. There shall be a minimum of one survey point for every 5,000 square feet of road base surface area.

3.9 RIPRAP

A. Riprap shall be placed on geotextile conforming to the requirements of Section 02300 of these specifications. Place geotextile with the length running up and down the slope. Ensure geotextile has a minimum overlap of 2 feet at all seams.

B. Riprap shall be placed in such manner as to produce a well graded mass of rock with the minimum practicable percentage of voids, and shall be constructed within a tolerance of plus 4 inches or minus 2 inches from the lines and grades shown on the Drawings. Placement shall begin at the bottom of the area to be covered and continue up slope. Subsequent loads of material shall be placed against previously placed material in such a manner as to ensure a relatively homogenous mass. Open joints shall be filled with spalls or small rocks. Rocks shall be arranged to present a uniform finished top surface such that the variation between tops of adjacent rocks shall not exceed 3 inches.

C. No stone shall be dropped through air from a height greater than 3 feet on top of the geotextile. The larger stones shall be well distributed and the entire mass of stones in their final position shall be roughly graded to conform to the gradation specified in this specification. The finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones. Placing riprap by dumping into chutes or by similar methods likely to cause segregation of the various sizes will not be permitted. Placing riprap by dumping it at the top of the slope and pushing it down the slope will not be permitted. Rearranging of individual stones will be required to the extent necessary to obtain a well-graded distribution of stone sizes as specified above.

++END OF SECTION++

SECTION 02320

CAP SUBGRADE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section shall govern work associated with grading, excavation, supply, hauling, placement and compaction of cap subgrade material.

B. Work associated with the cap subgrade shall also conform to Section 02300 – Earthwork of the Specifications.

1.2 MATERIALS INCLUDED IN THIS SECTION

A. Existing Coal Combustion By-Products used as cap subgrade

B. Contractor-supplied material used as cap subgrade

1.3 RELATED SECTIONS

A. Section 02300 Earthwork

B. Section 02330 Clay Cap

1.4 REFERENCES

A. Reference Standards for cap subgrade shall be as referenced in Section 02300 – Earthwork

1.5 SUBMITTALS

A. Submittals for cap subgrade shall be as specified in Section 02300 – Earthwork

PART 2 - PRODUCTS

2.1 COAL COMBUSTION BY-PRODUCTS AS CAP SUBGRADE

A. OWNER will supply CCBs or existing CCBs within the landfill may be re-graded for use as cap subgrade.

B. OWNER will identify the location of CCBs outside of the landfill that may be used to supplement existing landfilled materials. Contractor shall be responsible for loading, transporting, placement, and compaction of CCBs used as cap subgrade.

C. Cap subgrade shall be free of roots, brush, sod, or other perishable materials and debris.

2.2 CONTRACTOR-SUPPLIED MATERIAL AS CAP SUBGRADE

A. Contractor-supplied cap subgrade material shall be as specified herein.

B. Cap subgrade material shall be approved by the Engineer prior to delivery to the Site.

C. Contractor shall provide written Certification to Engineer that material to be supplied conforms to the requirements of this specification.

D. Cap subgrade shall be clean fill material free of waste material, organic material, sticks, or other deleterious material.

E. Cap subgrade may include crushed rock, broken rock, broken concrete and similar materials provided these materials do not exceed 30 percent (by weight) of the total material in the cap subgrade lift of which they are part.

F. Contractor-supplied cap subgrade shall be soil class “CL” or “CH” according to ASTM D2487 and shall conform to the following:

1. No material larger than 3-inch diameter.
2. Plasticity Index (PI) greater than or equal to 7.
3. Particle size distribution shall conform to the following:

U.S. Sieve Size	Percent Passing
No. 4	80-95
No. 40	55-75
No. 200	Greater than 50

PART 3 – EXECUTION

3.1 GENERAL

A. Compaction of all materials shall be performed with an appropriately heavy, properly ballasted penetrating foot compactor. A minimum of four passes of the compactor shall be performed on each material lift. A pass is defined as one trip of the compactor over the lift and back to the starting point by a single drum roller or one trip across the lift surface from one side to the other if the compacting equipment has front and back compacting rollers.

B. The minimum weight of the compacting equipment shall be 1,500 pounds per linear foot of drum length.

C. The daily work area shall extend a distance no greater than necessary to maintain moist conditions and continuous operations. Desiccation and crusting of the lift surface shall be avoided as much as possible.

D. Water added to soils shall be clean and shall not have come into contact with waste or any objectionable material.

3.2 CONSTRUCTION OF CAP SUBGRADE

A. All existing vegetation on areas to be capped or regraded shall be stripped or otherwise removed prior to placing cap subgrade or regarding. Contractor shall be responsible for disposal of all debris resulting from vegetation removal in accordance with applicable laws and regulations.

B. After existing vegetation has been removed, material underlying the cap subgrade shall be scarified to a minimum depth of 2-inches prior to placement of cap subgrade. Areas that only require regarding may not require scarifiying and compaction provided that such areas meet that are regarded to meet the requirements of Subsection 3.2.C of this Specification.

C. Cap subgrade underlying the clay cap shall conform to the following:

1. Cap subgrade shall be placed in compacted lifts. Maximum loose lift thickness shall be 12 inches and a minimum of four passes of the compacting equipment shall be required for each lift.

2. After the final lift has been placed and compacted to the required elevations, the cap subgrade shall be proof rolled using the methods specified herein or other method approved by the Engineer:

   a. Proof rolling equipment shall consist of not less than four pneumatic tired wheels, arranged so that the wheels carry approximately equal loads when operating on uneven surfaces. Proof rolling equipment may be self-propelled or towed by a suitable tractor.

   b. Proof rolling equipment shall have a rolling width of 8 to 10 feet and shall be capable of operating under various contact pressures.

   c. Contact pressure of proof rolling equipment shall be a minimum of 2,000 pounds per square foot.

   d. A minimum of two passes with proof rolling equipment shall be completed across the entire prepared cap subgrade surface.

3. Any area of the cap subgrade shown to be unstable or non-uniform after proof rolling shall be recompacted and/or reworked until proof rolled to the satisfaction of the ENGINEER.

D. Finished lifts of cap subgrade shall be sprayed with clean water as necessary to prevent drying and desiccation.

E. At the end of each construction day's activities, completed lifts shall be sealed by rolling with a rubber-tired or smooth drum roller. Prior to resuming placement of material the surface of the cap subgrade shall be scarified to a minimum depth of 2 inches.

F. After completion of the cap subgrade, but before beginning installation of the overlying clay cap, Contractor shall survey the finished elevations of the cap subgrade to ensure that the top of the cap subgrade is at the specified grades and elevations presented in the Conceptual Closure Plan. There shall be a minimum of one survey point for every 10,000 square feet of cap surface area.

++END OF SECTION++

SECTION 02330

CLAY CAP

PART 1 - GENERAL

3.3 DESCRIPTION

A. This section shall govern work associated with grading, excavation, supply, hauling, placement and compaction of the clay cap material.

B. Work associated with the cap subgrade shall also conform to Section 02300 – Earthwork of the Specifications.

3.4 MATERIALS INCLUDED IN THIS SECTION

A. OWNER-supplied material used as clay cap

B. Contractor-supplied material used as cap subgrade

3.5 RELATED SECTIONS

A. Section 02300 Earthwork

B. Section 02330 Clay Cap

3.6 REFERENCES

A. Reference Standards for cap subgrade shall be as referenced in Section 02300 – Earthwork

1.5 SUBMITTALS

A. Submittals for cap subgrade shall be as specified in Section 02300 – Earthwork

PART 2 - PRODUCTS

2.1 COAL COMBUSTION BY-PRODUCTS AS CAP SUBGRADE

A. OWNER may identify a suitable on-site borrow area for supplying clay cap material.

B. OWNER will identify the location of suitable material that may be used as clay cap. Contractor shall be responsible for loading, transporting, placement, and compaction of material used as the clay cap.

C. Clay cap material shall be free of roots, brush, sod, or other perishable materials and debris.

2.2 CONTRACTOR-SUPPLIED MATERIAL AS CLAY CAP

A. Contractor-supplied clay cap material shall be as specified herein.

B. Cap material shall be approved by the Engineer prior to delivery to the Site.

C. Contractor shall provide written Certification to Engineer that material to be supplied conforms to the requirements of this specification.

D. Clay cap shall be clean fill material free of waste material, organic material, sticks, or other

deleterious material.

E. Contractor-supplied clay cap shall be soil class “CL” or “CH” according to ASTM D2487 and shall conform to the following:

1. No material larger than 3-inch diameter.

2. Plasticity Index (PI) greater than or equal to 15.

3. In-place permeability by ASTM D5084 no greater than $1x10^{-7}$ cm/sec

4. All material retained on the No. 4 Sieve shall be subrounded to rounded.

5. Particle size distribution shall conform to the following:

U.S. Sieve Size	Percent Passing
No. 4	80-95
No. 40	55-75
No. 200	Greater than 50

PART 3 – EXECUTION

3.1 GENERAL

A. Compaction of all materials shall be performed with an appropriately heavy, properly ballasted penetrating foot compactor. A minimum of four passes of the compactor shall be performed on each material lift. A pass is defined as one trip of the compactor over the lift and back to the starting point by a single drum roller or one trip across the lift surface from one side to the other if the compacting equipment has front and back compacting rollers.

B. The minimum weight of the compacting equipment shall be 1,500 pounds per linear foot of drum length.

C. The daily work area shall extend a distance no greater than necessary to maintain moist conditions and continuous operations. Desiccation and crusting of the lift surface shall be avoided as much as possible.

D. Water added to soils shall be clean and shall not have come into contact with waste or any objectionable material.

3.2 CONSTRUCTION OF CAP SUBGRADE

A. Clay cap shall be placed and compacted with a maximum loose lift thickness of 8 inches and a maximum compacted lift thickness of 6 inches.

B. The clay cap shall be compacted as necessary to achieve an in-place permeability of no greater than $1x10^{-7}$ cm/second. At a minimum, four passes of the compacting equipment shall be required for each lift.

G. Contractor shall test the clay cap as specified herein:

1. Two soil classifications in accordance with ASTM D2487 shall be performed for each lift.

2. One in-place density test in accordance with ASTM D2922 shall be performed for every 20,000 square feet of cap subgrade placed for each 12 inches of compacted thickness.

3. One permeability test in accordance with ASTM D5084 shall be performed for every 4 acres of cap subgrade placed for each 12 inches of compacted thickness.

H. Finished lifts of cap subgrade shall be sprayed with clean water as necessary to prevent drying and desiccation.

I. At the end of each construction day's activities, completed lifts shall be sealed by rolling with a rubber-tired or smooth drum roller. Prior to resuming placement of material the surface of the cap subgrade shall be scarified to a minimum depth of 2 inches.

J. After completion of the cap subgrade, but before beginning installation of the overlying clay cap, Contractor shall survey the finished elevations of the cap subgrade to ensure that the top of the cap subgrade is at the specified grades and elevations presented in the Conceptual Closure Plan. There shall be a minimum of one survey point for every 10,000 square feet of cap surface area.

++END OF SECTION++

SECTION 02340

VEGETATIVE SOIL LAYER

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section shall govern work associated with grading, excavation, supply, hauling, placement and compaction of the vegetative soil material.

B. Work associated with the vegetative soil layer shall also conform to Section 02300 – Earthwork of the Specifications.

1.2 MATERIALS INCLUDED IN THIS SECTION

A. OWNER-supplied material used as vegetative soil

B. Contractor-supplied material used as vegetative soil

1.3 RELATED SECTIONS

A. Section 02300 Earthwork

B. Section 02330 Clay Cap

C. Vegetation

1.4 REFERENCES

A. Reference Standards for vegetative soil layer shall be as referenced in Section 02300 – Earthwork

1.5 SUBMITTALS

A. Submittals for cap subgrade shall be as specified in Section 02300 – Earthwork

PART 2 - PRODUCTS

2.1 OWNER-SUPPLIED MATERIAL AS VEGETATIVE SOIL LAYER

A. OWNER will supply Contractor with material for use as vegetative soil layer.

B. OWNER will identify the location of material for Contractor. Contractor shall be responsible for loading, transporting, placement, and compaction of material used as the vegetative soil layer.

2.2 CONTRACTOR-SUPPLIED MATERIAL AS VEGETATIVE SOIL LAYER

A. Vegetative soil layer shall be a clay loam or silty clay loam as classified by the United States Department of Agriculture and shall comply with all of the following:

1. Free of deleterious material, materials toxic to plant growth, noxious weed seeds, rhizomes, roots, subsoil, rocks, or other debris.
2. Maximum sodium adsorption ration (SAR): 8
3. Maximum electrical conductivity (EC): 2 mmhos/cm

4. Maximum particle dimension: 2 inches.
5. The pH shall be between 6.0 and 8.5 standard units. If approved by the Engineer, Contractor may amend soil as necessary to achieve the specified pH.

PART 3 - EXECUTION

3.1 VEGETATIVE SOIL LAYER PLACEMENT

A. Vegetative Soil shall not be placed until the underlying soil has been approved by the ENGINEER.

B. Vegetative Soil shall be placed in one 18 inch lift without damaging the underlying soil. Vegetative Soil shall be tracked in and smoothed out using tracked equipment. No direct compactive effort shall be used on vegetative soil.

C. After completion of the Vegetative Soil layer, CONTRACTOR shall survey the finished elevations of the Vegetative Soil to ensure that the top of the protective soil is at the grades and elevations specified on the Drawings. There shall be a minimum of one survey point for every 10,000 square feet of Vegetative Soil surface area.

++END OF SECTION++

SECTION 02350

VEGETATION

PART 1 – GENERAL

1.1 SUMMARY

A. This Section describes the requirements for vegetation establishment in areas disturbed during construction activities.

1.2 SUBMITTALS

A. CONTRACTOR shall submit information regarding proposed seed, fertilizer, mulch, tackifier and any other materials to be used to establish vegetation at least 10 days prior to delivery.

PART 2 – PRODUCTS

2.1 SEED SUPPLIERS

A. Seed suppliers must provide labeling of variety, purity, and germination. The supplier must satisfy State of Texas seed quality laws. The COMPANY must approve seed supplier.

2.2 SEED DELIVERY, STORAGE, AND HANDLING

A. Grass seed mixture shall be delivered in sealed containers. Seed in damaged packaging will not be accepted. CONTRACTOR shall provide seed mixture in containers showing the percentage of each species in the seed mix, year of production, net weight, date of packaging, name and address of supplier, percent of weed seed content, and guaranteed percentage of purity and germination.

B. Fertilizer shall be delivered in appropriate waterproof containers showing weight, chemical analysis, and name of manufacturer.

2.3 SEED MIXTURE

A. Seed mixture shall be appropriate for the season in which it is planted and shall be approved by the COMPANY prior to placement.

B. Seed shall be hulled, extra-fine grade, treated with fungicide, and shall have a germination and purity that will produce, after allowance for Federal Seed Act tolerances, a pure live seed (PLS) content of not less than 85 percent. Seed shall be labeled in accordance with U.S. Department of Agriculture rules and regulations.

C. Unless otherwise approved by the COMPANY, vegetation seed mixture shall consist of the following grasses at the application rates specified:

Grass Species	Application Rate (pounds PLS per acre)
Gulf Rye	30
Common Bermudagrass	20
Total:	50

D. Alternative seed mixtures may be submitted in writing to the COMPANY and must be approved by the COMPANY prior to seed application.

2.4 ACCESSORIES

A. Mulching materials shall consist of dry oat, wheat, or Bermuda straw, free from weeds and foreign matter detrimental to plant life. Native hay or chopped cornstalks are acceptable. Also acceptable is approved chip-form wood cellulose fiber that is free of ingredients that could inhibit growth or germination.

B. Compost, if used as an organic admixture, shall be applied per TXDOT Special Specification; Item 1027 "Furnishing and Placing Compost." Compost application is optional and subject to the approval of the COMPANY, which must be obtained at least 10 days prior to use.

C. Fertilizer shall be applied to vegetative soil layer material and shall be inorganic chemical fertilizer consisting of 20-5-5 fertilizer applied at 200 pounds per acre.

D. Stakes shall be softwood lumber, chisel pointed.

E. Water shall be from fresh water sources and shall be free from soil, acids, alkalis, salt, or any other substance injurious to growth of grass.

PART 3 – EXECUTION

3.1 INSPECTION OF VEGETATIVE SOIL

A. CONTRACTOR shall verify that vegetative soil and areas disturbed during construction activities are ready to receive the work covered by this section.

3.2 FERTILIZER

A. All fertilizer shall be applied in accordance with manufacturer's instructions.

B. Manure, if used, may be applied at a rate of up to 10 tons/acre. Manure application is optional subject to the approval of the COMPANY, which must be obtained at least 10 days prior to use.

C. Pre-planting fertilizer shall be mixed thoroughly into the upper 3 in. of vegetative-soil layer prior to applying seed.

3.3 SEEDING

A. Drill seed application is acceptable for slopes equal to or flatter than 4(H):1(V).

B. Seed shall be applied evenly by broadcast or hydroseed application at the rate specified in this Section. Adjustment to rate shall be made for variations in seed purity and germination to achieve the PLS equivalent rate. Hydroseeding is acceptable as a broadcast method of seeding and fertilizing. If dry broadcasting is done, seeds must be raked into the upper soil surface and seed must be applied at half of the specified broadcast rate. Designated areas for erosion control may not be seeded in excess of that which can be covered with erosion control material on the same day.

C. CONTRACTOR shall not sow immediately following rain, when ground is too dry, or during windy periods.

3.4 SEED PROTECTION/EROSION CONTROL

A. Straw/hay mulch shall be applied to all seeded areas, with slopes less than 4(H) to 1(V), within 24 hours after seeding operations. Straw or hay mulch shall be applied at a rate of approximately 150 pounds per 1000 square feet (6,500 pounds per acre) and crimped in place. Cellulose fiber

mulch shall be applied at a rate of approximately 75 pounds per 1,000 square feet (3,200 pounds per acre).

B. Seeded sloped areas shall be covered with erosion control fabric on all exterior slopes of 4(H) to I(V) and steeper; and in all drainage channels and swales in accordance with Section 1100, "Erosion and Sedimentation Control."

3.5 IRRIGATION

A. CONTRACTOR shall irrigate seeded areas if and as necessary to comply with the Uniform Grass Coverage (UGC) requirements of this Section.

B. Irrigation may be performed by water truck or by temporary irrigation system. If a temporary irrigation system is used, CONTRACTOR shall remove temporary irrigation system once COMPANY has accepted vegetated areas.

C. Irrigation shall be performed for a minimum of thirty days after initial planting and for as long as necessary to establish UGC across the entire seeded area.

3.6 ESTABLISHMENT AND ACCEPTANCE OF PERMANENT VEGETATION

A. It shall be solely the CONTRACTOR's responsibility to establish UGC across all application areas, regardless of unseasonable climatic conditions or other adverse conditions affecting planting operations and growth of vegetation.

B. Uniform Grass Coverage (UGC) shall be defined as a uniform stand of the specified grass with not less than 12 growing plants per square foot of seeded areas.

C. COMPANY will consider application areas acceptable only when:

1. A statistically significant number of randomly sampled plots have an average of 12 growing plants per square foot.

2. A minimum of one mowing has been performed in the seeded areas.

3. UGC has been deemed to have been achieved by the COMPANY.

D. Any application areas, which are not determined to be acceptable by the COMPANY, shall be replanted, refertilized, and reirrigated at no additional cost to the COMPANY.

E. The life and satisfactory condition of all plants (including grass) shall be guaranteed by CONTRACTOR for a period of up to one calendar year after written notice of first acceptance of vegetation by COMPANY. The guarantee period shall include one complete growing season and dormant period.

++END OF SECTION++

SECTION 02450

GEOCELLS

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section shall govern work associated with furnishing and installing geocells (cellular confinement system) including, but not limited to, layout, installation, and testing.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)

D1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique
D1603	Standard Test Method for Carbon Black In Olefin Plastics
D1693	Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
D5199	Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
D5397	Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test

B. US Army Corps of COMPANYs (USACE)

Technical Report GL-86-19, Appendix A.

1.4 QUALIFICATIONS

A. Geocell Manufacturer's Field Representative shall have worked in a similar capacity on at least 5 geocell projects similar in complexity to the project described in the contract documents.

B. Geocell Installer shall have worked in a similar capacity on at least 5 geocell projects similar in complexity to the project described in the contract documents.

1.5 SUBMITTALS

A. At least 14 days prior to installation of the geocells, CONTRACTOR shall submit for approval the following information:

1. Manufacturer‘s Literature. Submit manufacturer’s literature for proposed geocells, including catalog cut sheets, material samples and, written instructions for delivery, storage, handling, installation, seaming, and repair.

2. Manufacturer Certification. Written certification from the manufacturer that the geocells comply with the requirements of these specifications and is appropriate for the intended application.

1. 6 WARRANTY

A. Material shall include one-year warranty against defects.

B. Installation shall be warranted against defects in workmanship for a period of 1-year from the date of geocell completion.

PART 2 - PRODUCTS

2.1 GEOCELL PRODUCT STANDARD

A. Geocells shall be black Terracell 140 perforated, textured high-density polyethylene (HDPE) geocell as manufactured by Hanes Geo Components, or approved equal.

B. Geocells shall be manufactured to meet the values listed as follows:

Property	Values
Cell Depth	4 in
Nominal Expanded Cell Size	10.2 in X 8.8 in
Nominal Expanded Cell Area	44.8 in
Nominal Expanded Section (L X W)	21.4 ft X 8.4 ft
Cells per Section (L X W)	29 cells X 10 cells
Nominal Expanded Section Area	180 sf
Weld Spacing	14 in

C. Geocells shall be constructed using virgin, non-thermally degraded HDPE with material properties that meet or exceed the following values:

Property	ASTM	Unit	Minimum Values
Polymer Density	D1505	g/cm3	0.935-0.965
Environmental Stress Crack Resistance	D5397	hours	>400
Environmental Stress Crack Resistance	D1693	hours	>6000
Minimum Carbon Black Content	D1603	%	1.5
Nominal Sheet Thickness	D5199	mil	60 (+10%, -5%)
Seam Peel Strength	USACE	lb	320

D. Geocell weld joints shall have a Seam Hang Strength able to support a load of 160 pounds for 30 days minimum or for 7 days minimum while undergoing temperature change from 74 degrees F to 130 degrees F on 1-hour cycle.

E. The HDPE strips used to construct the Geocell shall be textured with diamond shaped indentations. The rhomboidal indentations shall have a surface density of 140 to 200 per in^2.

F. Geocells shall be perforated with10 mm diameter holes spaced at 16.6 mm on center. The holes shall be placed in horizontal rows staggered 8.3 mm on relative to hole centers.

G. Geocell section length shall be in accordance with manufacturer recommendations for intended application.

2.2 ACCESSORIES

A. J-Hooks:

1. J-Hooks shall be uncoated steel reinforcing bars as follows:

   a. Diameter: 0.5 inch
   b. Length: 12 inches minimum.
   c. Hook: 180-degree bend

2.3 INFILL MATERIAL

A. Infill Material shall be concrete. Concrete shall at a minimum be Class A, 3,000-psi concrete with three-quarter inch diameter aggregate.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE and HANDLING

A. Comply with the Manufacturer's recommendations regarding product handling and protection.

B. Deliver products to the job site in their manufacturer's original packaging, with labels intact and legible.

C. Maintain packaged materials with seals unbroken and labels intact until time of use. Maintain in a manner that keeps product clean, dry and free of damage. Promptly remove damaged or unsuitable products from the job site and promptly replace with products meeting the required specifications.

D. Comply with Manufacturer's recommendations when hauling, unloading, deploying, and installing geotextile. Inspect for defects before installing.

3.2 FAMILIARIZATION

A. Inspection

1. Prior to beginning geocell installation, Geocell Installer and Geocell Manufacturer's Field Representative shall carefully inspect and approve the area to receive geocells.

2. If Geocell Installer or Geocell Manufacturer's Field Representative have any concerns regarding the proposed geocell area, they shall immediately notify COMPANY.

3.3 PREPARATION

A. Prepare site by removing vegetative cover, debris, and unacceptable soils from area where geocells will be installed.

B. Replace removed soils with acceptable materials.

3.4 INSTALLATION

A. Install geocells in accordance with manufacturer's instructions at locations indicated on the drawings.

B. Anchor geocell sections as necessary to resist sliding due to gravitational forces and sheet flow. The upper edge of the geocell shall be buried in an anchor trench as recommended by the Manufacturer and shown on the Drawings. Geocells shall also be anchored using J-Hooks in

accordance with manufacturer recommendations.

C. Ensure top edges of adjoining cell walls are flush with each other and in proper alignment.

D. Geocells shall be infilled with concrete. Deliver infill material to geocells from top of slope or channel to bottom in accordance with manufacturer's instructions.

E. Limit drop height of infill material to a maximum of 3 feet to prevent damage to geocells.

F. Manually rake and machine finish concrete infill material.

++END OF SECTION++

APPENDIX B

HELP MODEL OUTPUT

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** HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE **
** HELP MODEL VERSION 3.07 (1 November 1997) **
** DEVELOPED BY ENVIRONMENTAL LABORATORY **
** USAE WATERWAYS EXPERIMENT STATION **
FOR USEPA RISK REDUCTION ENGINEERING LABORATORY
**
**
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****

PRECIPITATION DATA FILE: C:\WHI\VHELP22\data\P8054.VHP_weather1.dat
TEMPERATURE DATA FILE: C:\WHI\VHELP22\data\P8054.VHP_weather2.dat
SOLAR RADIATION DATA FILE: C:\WHI\VHELP22\data\P8054.VHP_weather3.dat
EVAPOTRANSPIRATION DATA: C:\WHI\VHELP22\data\P8054.VHP_weather4.dat
SOIL AND DESIGN DATA FILE: C:\WHI\VHELP22\data\P8054.VHP\I_394356.inp
OUTPUT DATA FILE: C:\WHI\VHELP22\data\P8054.VHP\O_394356.prt

TIME: 10:43 DATE: 9/21/2016

****

TITLE: A1 Landfill Compacted Clay Cap

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NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 6
THICKNESS = 60.96 CM
POROSITY = 0.4530 VOL/VOL
FIELD CAPACITY = 0.1900 VOL/VOL
WILTING POINT = 0.0850 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4275 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.720001612800E-03 CM/SEC
NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 5.00
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 29
THICKNESS = 91.44 CM
POROSITY = 0.4510 VOL/VOL
FIELD CAPACITY = 0.4190 VOL/VOL
WILTING POINT = 0.3320 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.4510 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.100000000000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 6 WITH A

FAIR STAND OF GRASS, A SURFACE SLOPE OF 4.%
AND A SLOPE LENGTH OF 536. METERS.

SCS RUNOFF CURVE NUMBER = 66.18
FRACTION OF AREA ALLOWING RUNOFF = 100.0 PERCENT
AREA PROJECTED ON HORIZONTAL PLANE = 27.5186 HECTARES
EVAPORATIVE ZONE DEPTH = 25.4 CM
INITIAL WATER IN EVAPORATIVE ZONE = 9.953 CM
UPPER LIMIT OF EVAPORATIVE STORAGE = 11.506 CM
LOWER LIMIT OF EVAPORATIVE STORAGE = 2.159 CM
INITIAL SNOW WATER = 0.000 CM
INITIAL WATER IN LAYER MATERIALS = 67.301 CM
TOTAL INITIAL WATER = 67.301 CM
TOTAL SUBSURFACE INFLOW = 0.00 MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Martin Lake (Shreveport)LA

STATION LATITUDE = 32.47 DEGREES
MAXIMUM LEAF AREA INDEX = 4.50
START OF GROWING SEASON (JULIAN DATE) = 58
END OF GROWING SEASON (JULIAN DATE) = 331
EVAPORATIVE ZONE DEPTH = 10.0 INCHES
AVERAGE ANNUAL WIND SPEED = 8.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 70.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 72.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 72.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 72.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Martin Lake (Shreveport)LA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.02	3.46	3.77	4.71	4.70	3.54
3.56	2.52	3.29	2.63	3.77	3.87

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Martin Lake (Shreveport)LA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
46.00	49.80	57.00	65.70	73.00	79.80
82.90	82.40	77.10	66.70	55.70	48.70

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR Martin Lake (Shreveport)LA
AND STATION LATITUDE = 30.56 DEGREES

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MONTHLY TOTALS (IN INCHES) FOR YEAR 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.84	2.07	1.98	2.47	8.45	2.54
	3.24	1.72	3.02	3.65	3.89	3.18
RUNOFF	0.000	0.000	0.000	0.000	3.584	0.000
	0.000	0.000	0.000	0.000	0.780	1.785
EVAPOTRANSPIRATION	1.614	1.745	3.186	3.700	4.537	1.580

	3.644	2.284	1.923	2.535	1.086	1.486
PERCOLATION/LEAKAGE THROUGH	0.1684	0.1456	0.1629	0.1438	0.1537	0.1410
LAYER 2	0.1487	0.1447	0.1385	0.1537	0.1601	0.1733

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	21.488	19.050	19.619	14.723	16.477	13.740
TOP OF LAYER 2	14.762	13.387	12.875	16.458	20.477	23.163
STD. DEVIATION OF DAILY	0.980	0.379	1.017	1.270	3.494	0.160
HEAD ON TOP OF LAYER 2	1.668	0.156	0.155	1.401	2.754	0.639

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ANNUAL TOTALS FOR YEAR 30

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.05	9145222.668	100.00
RUNOFF	6.149	1517733.345	16.60
EVAPOTRANSPIRATION	29.319	7236958.372	79.13
PERC./LEAKAGE THROUGH LAYER 2	1.834348	452780.602	4.95
AVG. HEAD ON TOP OF LAYER 2	17.1849		
CHANGE IN WATER STORAGE	-0.252	-62249.515	-0.68
SOIL WATER AT START OF YEAR	26.972	6657733.258	
SOIL WATER AT END OF YEAR	26.720	6595483.743	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.137	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 30

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.60	2.99	3.85	4.96	4.51	3.71
	3.53	2.17	3.08	2.64	3.69	3.58
STD. DEVIATIONS	2.46	1.49	1.64	2.11	2.06	2.37
	1.79	1.84	1.72	1.45	1.20	2.26
RUNOFF						
TOTALS	1.957	1.027	0.821	0.812	0.350	0.201
	0.082	0.000	0.090	0.120	0.669	1.862
STD. DEVIATIONS	2.245	1.144	1.148	1.010	0.848	0.791
	0.411	0.000	0.295	0.444	1.033	2.055
EVAPOTRANSPIRATION						
TOTALS	1.679	2.116	3.151	4.846	4.872	3.792
	3.455	2.086	2.474	1.663	1.068	1.260
STD. DEVIATIONS	0.174	0.297	0.584	0.659	1.420	2.180
	1.629	1.532	1.238	0.830	0.206	0.203
PERCOLATION/LEAKAGE THROUGH LAYER 2						

TOTALS	0.1708	0.1537	0.1662	0.1571	0.1526	0.1444
	0.1473	0.1458	0.1414	0.1495	0.1557	0.1707
STD. DEVIATIONS	0.0037	0.0047	0.0038	0.0050	0.0056	0.0043
	0.0038	0.0027	0.0046	0.0070	0.0112	0.0061

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	22.3261	21.6228	20.7545	19.4343	16.0974	14.9359
	14.2927	13.7858	13.8841	15.0423	18.9221	22.2857
STD. DEVIATIONS	1.2528	1.4403	1.2917	1.7502	1.9106	1.5274
	1.3042	0.9131	1.6268	2.4005	3.9594	2.0719

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 30

	INCHES		CU. FEET	PERCENT
PRECIPITATION	42.31	(7.468)	10444395.6	100.00
RUNOFF	7.990	(4.7750)	1972313.97	18.884
EVAPOTRANSPIRATION	32.460	(4.3675)	8012269.82	76.714
PERCOLATION/LEAKAGE THROUGH LAYER 2	1.85537	(0.02814)	457970.335	4.38484
AVERAGE HEAD ON TOP OF LAYER 2	17.782	(0.810)		
CHANGE IN WATER STORAGE	0.007	(0.6000)	1841.58	0.018

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 30 and their dates (DDDYYYY)

	(INCHES)	(CU. FT.)	
PRECIPITATION	4.10	1012021.94161	1980021
RUNOFF	3.750	925585.11065	130016
PERCOLATION/LEAKAGE THROUGH LAYER 2	0.005669	1399.35021	110002
AVERAGE HEAD ON TOP OF LAYER 2	24.000		
SNOW WATER	2.84	701139.9388	130002
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4530		
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0850		

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FINAL WATER STORAGE AT END OF YEAR 30

LAYER	(INCHES)	(VOL/VOL)
1	10.4843	0.4368
2	16.2360	0.4510
SNOW WATER	0.000	

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APPENDIX C

SLIDE 7.0 – CAP/COVER SYSTEM SLOPE STABILITY MODEL OUTPUT

Bullock, Bennett & Associates, LLC * 165 N. Lampasas Street * Bertram, Texas 78605
Telephone: 512.355.9198 * Fax: 512.355.9197

September 30, 2016

Mr. Pat Behling
Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664

Re: Evaluation of Landfill Cap Slope Stability, A1 LF – Martin Lake Steam Electric Station, near Beckville, Texas

Dear Mr. Behling:

As requested by Pastor, Behling & Wheeler, LLC (PBW), Bullock, Bennett & Associates, LLC (BBA) has completed evaluation of slope-stability of the proposed cap for the A1 ash disposal facility at the Martin Lake Steam Electric Station (MLSES) located near Beckville, Texas. This analysis is based on the most recent preliminary design drawings dated August 2016, provided to BBA by PBW. No site specific geotechnical data was provided to BBA for this analysis, therefore, assumptions regarding typical soil properties are made in this evaluation. It is recommended that site-specific soils be tested for engineering strength properties, and slope stability analysis using the on-site data and final design criteria be completed prior to construction activities.

The PBW design includes use of a compacted clay liner system, as further discussed below.

Slope Stability Analysis of Clay Cap

The clay cap system consists of the following, bottom to top:

- 1.0 foot-thick subgrade soil;
- 3.0 foot-thick compacted clay liner; and,
- 1.5 foot-thick protective cover/vegetative soil.

A unit weight and internal friction angle of 115 pounds per cubic foot (pcf) and 15 degrees, respectively, were used for the soil and are generally representative of commonly available soils in Texas, including a wide range of silty, sandy, and lean to fat clays commonly used as cover soil.

This slope stability analysis includes evaluation of the clay cap system using Rocscience Slide 7.0 software. The Simplified Bishop and Morgenstern-Price methods of analysis were conducted on over 400 potential failure surfaces, with the lowest calculated safety factor reported. Slope stability evaluation of the cap was performed for assumed short- and long-term conditions. Site specific geotechnical test data is not available; therefore assumptions regarding soil strength properties (for each soil layer) were made as follows:

Short-Term Conditions:	
Cohesion, C:	500 pcf
Friction Angle:	0

Long-Term Conditions:	
Cohesion, C:	250 pcf
Friction Angle:	15

The unit weight of soil was assumed to be 115 pcf for each soil layer. Coal combustion residual (ash) material underlies the cap. It is assumed the ash is non-cohesive, well drained and has been in place for a long time prior to capping. For ash the following properties were assumed for both short and long-term cap analysis:

Dry Unit Weight of Ash:	90 pcf
Saturated Unit Weight of Ash:	95 pcf
Cohesion, C:	0 pcf
Friction Angle:	20 deg

The calculated factor of safety for the short- and long-term conditions were both determined to be approximately 1.5.

Please find attached the landfill cap slope stability analysis and supporting notes, assumptions, and documentation, and please feel free to contact me at (512) 355-9198 if you have any questions about this submittal, or if I can be of any further assistance.

Sincerely,

BBA, LLC

Dan Bullock, P.E.
Principal Engineer

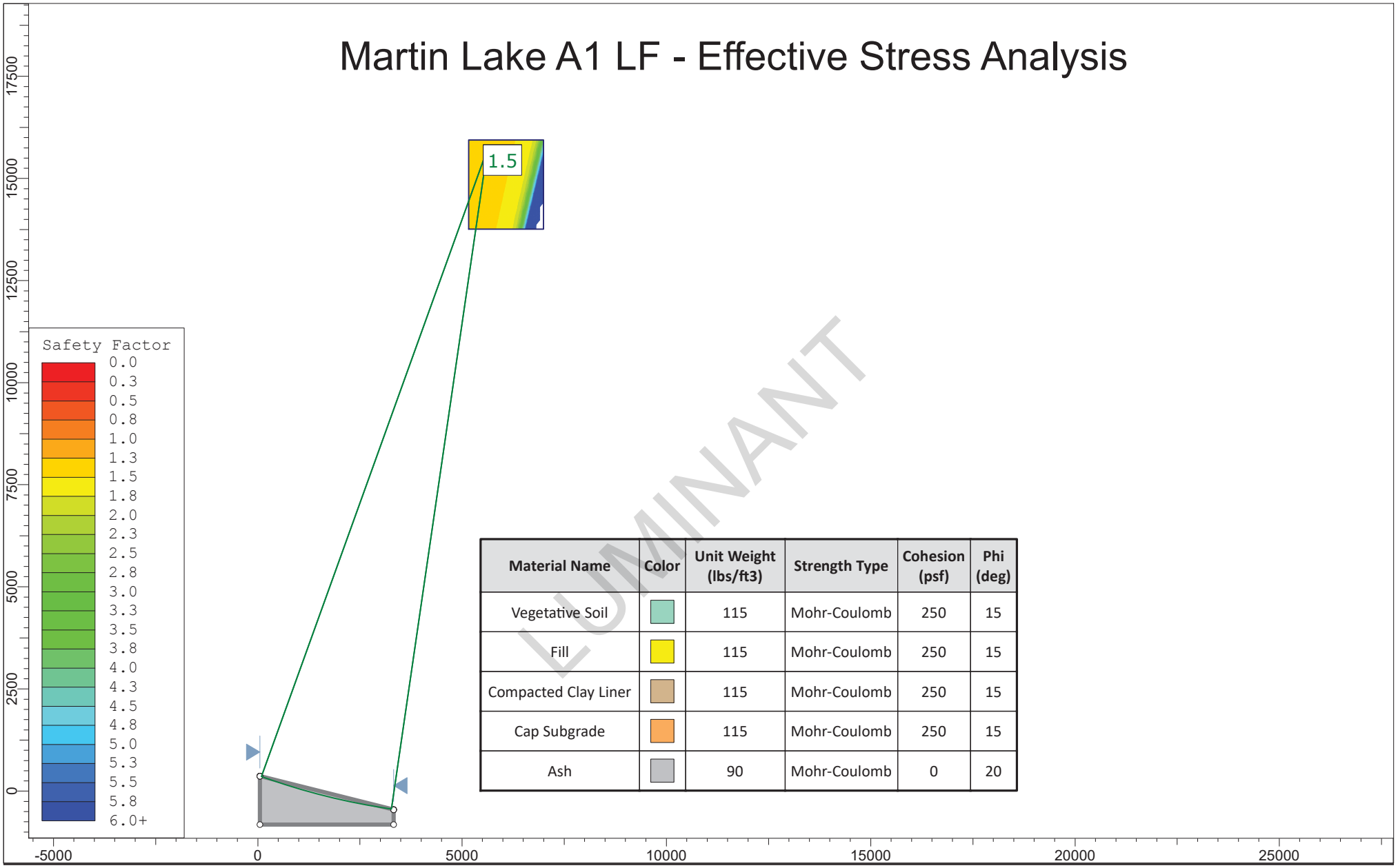
Attachments

ATTACHMENT 1

Landfill Cover Slope Stability Analysis

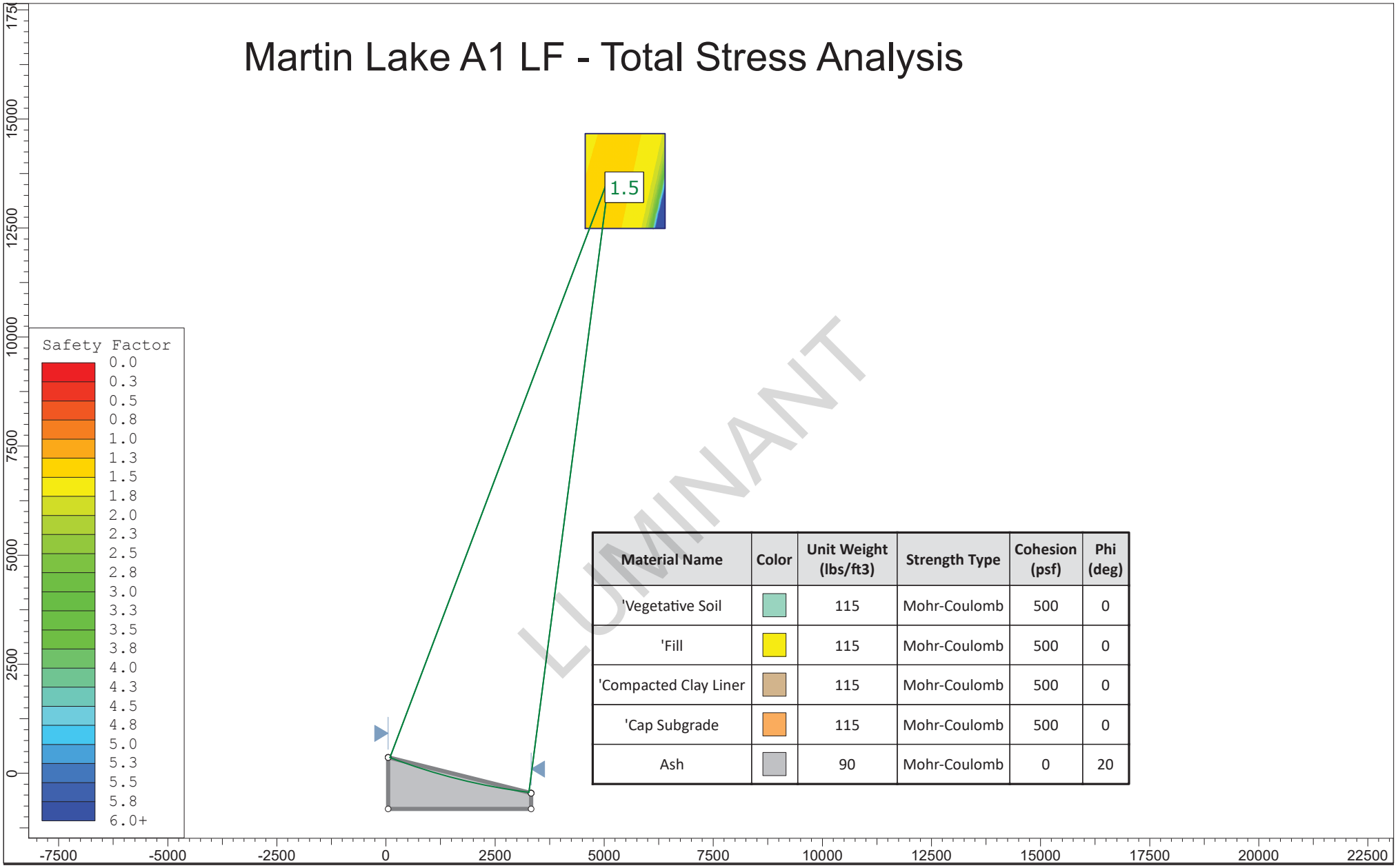
Slide 7.0 Analysis of Clay Cap

Martin Lake A1 LF - Effective Stress Analysis



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Vegetative Soil		115	Mohr-Coulomb	250	15
Fill		115	Mohr-Coulomb	250	15
Compacted Clay Liner		115	Mohr-Coulomb	250	15
Cap Subgrade		115	Mohr-Coulomb	250	15
Ash		90	Mohr-Coulomb	0	20

Martin Lake A1 LF - Total Stress Analysis



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
'Vegetative Soil		115	Mohr-Coulomb	500	0
'Fill		115	Mohr-Coulomb	500	0
'Compacted Clay Liner		115	Mohr-Coulomb	500	0
'Cap Subgrade		115	Mohr-Coulomb	500	0
Ash		90	Mohr-Coulomb	0	20

APPENDIX D
STORMWATER HYDROLOGY CALCULATIONS

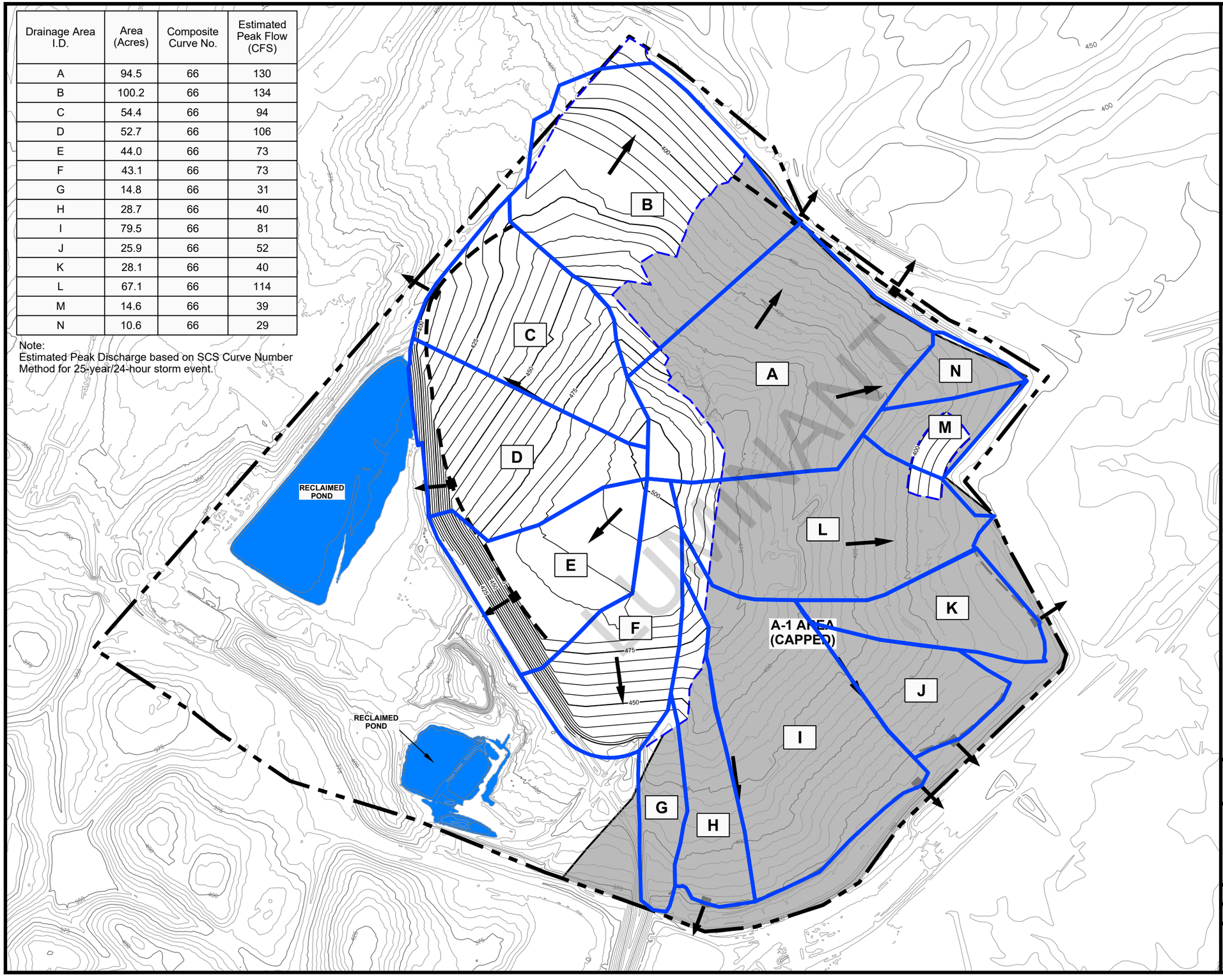
Summary of Peak Flow Estimate - SCC TR-55 Method
Luminant A-1 Area Landfill - Beckville Mine

SCS TR-55 Equation & Variables	
Q_p= Qu*Area (miles2)* Q*Fp	
Q_p= Estimated Peak Discharge (cfs)	$Q= (P-I_a)^2/(P-I_a) + S)$
Q_u=Unit Peak Discharge (cfs/mile2-inch)	P= Design Storm Rainfall (inches)
A= Area (square miles)	Ia=0.2S (Initial abstractions; inches)
Q= Rainfall Excess (Depth of Runoff Over Watershed)	S= 1000/CN-10
F_p= Ponding Factor (% of ponds/swamps)	CN= SCS Curve Number

Drainage Area I.D.	Area (acres)	Area (mi^2)	Composite Curve Number	Estimated Peak Flow (CFS) Q_p	P (25yr,24hr)	S	I_a	Q	I_a/P	TIME OF CONCENTRATION ESTIMATE						Q_u	F_p
										v1=aS^.5 fps	v2	Estimated Time of Concen. (Min.)	CAP Roughness Coeff (Table 3.20)	Cap Slope (ft/ft)	Conc. Flow Slope (ft/ft)		
A1-A	94.5	0.1477	66	130.4	8.6	5.15	1.03	4.50	0.12	0.54	0.18	124	2.5	0.047	0.005	196.0	1
A1-B	100.2	0.1566	66	134.1	8.6	5.15	1.03	4.50	0.12	0.56	0.18	130	2.5	0.05	0.005	190.2	1
A1-C	54.4	0.085	66	93.8	8.6	5.15	1.03	4.50	0.12	0.49	-	85	2.5	0.038	-	245.1	1
A1-D	52.7	0.0823	66	105.6	8.6	5.15	1.03	4.50	0.12	0.57	-	65	2.5	0.052	-	284.6	1
A1-E	44	0.0688	66	72.6	8.6	5.15	1.03	4.50	0.12	0.29	0.18	92	2.5	0.0137	0.005	234.6	1
A1-F	43.1	0.0673	66	73.1	8.6	5.15	1.03	4.50	0.12	0.45	-	88	2.5	0.033	-	241.0	1
A1-G	14.8	0.0231	66	30.7	8.6	5.15	1.03	4.50	0.12	0.54	-	61	2.5	0.047	-	295.0	1
A1-H	28.7	0.0448	66	40.4	8.6	5.15	1.03	4.50	0.12	0.51	0.18	120	2.5	0.041	0.005	200.0	1
A1-I	79.5	0.1242	66	80.5	8.6	5.15	1.03	4.50	0.12	0.49	0.18	198	2.5	0.038	0.005	143.9	1
A1-J	25.9	0.0405	66	51.9	8.6	5.15	1.03	4.50	0.12	0.62	0.18	65	2.5	0.062	0.005	284.6	1
A1-K	28.1	0.0439	66	40.1	8.6	5.15	1.03	4.50	0.12	0.59	0.18	118	2.5	0.055	0.005	202.8	1
A1-L	67.1	0.1048	66	113.7	8.6	5.15	1.03	4.50	0.12	0.55	-	88	2.5	0.048	-	240.7	1
A1-M	14.6	0.0228	66	38.8	8.6	5.15	1.03	4.50	0.12	0.58	-	36	2.5	0.053	-	377.7	1
A1-N	10.6	0.0166	66	29.1	8.6	5.15	1.03	4.50	0.12	0.49	-	34	2.5	0.038	-	390.4	1

Drainage Area I.D.	Area (Acres)	Composite Curve No.	Estimated Peak Flow (CFS)
A	94.5	66	130
B	100.2	66	134
C	54.4	66	94
D	52.7	66	106
E	44.0	66	73
F	43.1	66	73
G	14.8	66	31
H	28.7	66	40
I	79.5	66	81
J	25.9	66	52
K	28.1	66	40
L	67.1	66	114
M	14.6	66	39
N	10.6	66	29

Note:
Estimated Peak Discharge based on SCS Curve Number Method for 25-year/24-hour storm event.



EXPLANATION

- Landfill Registration Boundary
- Existing Grade Contour 5 ft Interval
- Existing Grade Contour 25 ft Interval
- Proposed Finished Grade Contour 5 ft Interval
- Proposed Finished Grade Contour 25 ft Interval
- Proposed Limits of CAP
- Sheet Flow
- Storm Water Drainage Divide
- Capped Area (Existing)

N

Scale in Feet
0 450 900

LUMINANT GENERATION COMPANY, LLC
MARTIN LAKE STEAM ELECTRIC STATION

Appendix D

CCR COVER SYSTEM DRAINAGE AREAS AND ESTIMATED PEAK DISCHARGE

PROJECT: 5196B	BY: AJD	REVISIONS
DATE: SEPT., 2016	CHECKED: BDT	

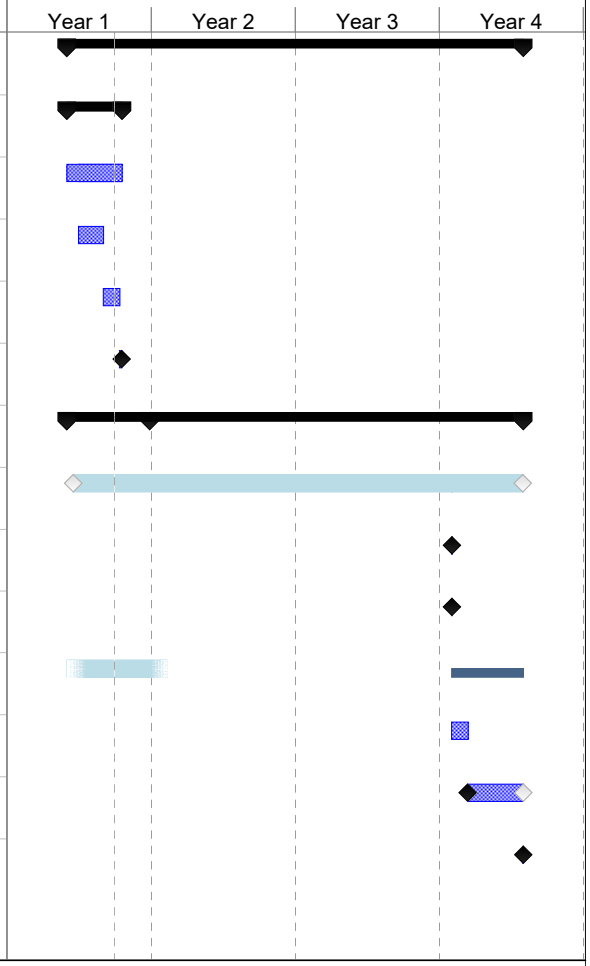
PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

APPENDIX E
PROJECT SCHEDULE – CCR CLOSURE PROCESS

APPENDIX E
PROJECT SCHEDULE - CCR UNIT CLOSURE PROCESS

Thu 9/29/16

ID	Task Name
1	**MLSES A-1 AREA LANDFILL - CLOSURE PLAN**
2	TASK-1 257.102 Closure Planning for CCR Units
3	Preparation of Closure Plan
4	Review Draft Closure Plan
5	Revise Draft Closure Plan
6	Finalize Closure Plan
7	Task 2 - 257.102 (d) Closure In-Place of CCR Unit
8	Closure Triggers
9	Closure Initiated within 2-years of Last Receipt of Waste
10	Closure Initiated within 2-years of Last Beneficial Use of CCR
11	Closure Sequence
12	TPDES Storm Water Construction General Permit NOI
13	Construct Final Cover System
14	Closure Completion Deadline or 2-year Extension Note - Extension requires demonstration of infeasibility 257.102(f)(2))



Task
Split
Milestone
Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
Progress
Deadline

Notes: Schedule does not include administrative/legal/receiver activities. Closure initiation will be determined in accordance with the CCR Rule and this timeline only illustrates the anticipated construction sequencing following closure initiation.