Luminant

Cynthia Vodopivec
Luminant Generation Company LLC
Luminant
6555 Sierra Dr.
Irving, TX 75039

October 23, 2020

Sent via email

Mr. Andrew R. Wheeler, EPA Administrator
Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Mail Code 5304-P
Washington, DC 20460

Re: Martin Lake Revised Alternative Closure Demonstration

Dear Administrator Wheeler:

Luminant Generation Company LLC (Luminant) submits this revised request to the U.S. Environmental Protection Agency (EPA) for approval of a site-specific alternative deadline to initiate closure pursuant to 40 C.F.R. § 257.103(f)(1) for the Ash Pond Area and Permanent Disposal Pond 5 located at the Martin Lake Steam Electric Station near Tatum, Texas. Luminant is requesting an extension pursuant to 40 C.F.R. § 257.103(f)(1) to allow the Ash Pond Area and Permanent Disposal Pond 5 to continue to receive CCR and non-CCR wastestreams after April 11, 2021, such that retrofit activity can be undertaken.

The enclosed demonstration prepared by Burns & McDonnell replaces the demonstration that was previously submitted by Luminant to EPA on September 29, 2020. This demonstration addresses all of the criteria in 40 C.F.R. § 257.103(f)(1)(i)-(iii) and contains the documentation required by 40 C.F.R. § 257.103(f)(1)(iv). As allowed by the agency, in lieu of hard copies of these documents, electronic files were submitted to Kirsten Hillyer, Frank Behan, and Richard Huggins via email. The demonstration is also available on Luminant's publicly available website: https://www.luminant.com/ccr/

Sincerely,

Cynthia Vodopivec
VP - Environmental Health & Safety

Enclosure

cc: Kirsten Hillyer
Frank Behan
Richard Huggins

Martin Lake CCR Surface Impoundments Demonstration for a Site-Specific Alternative to Initiation of Closure Deadline

Luminant Generation Company LLC

Martin Lake Steam Electric Station
Project No. 122702

Revision 1
October 23, 2020

Burns & McDonnell
Engineering Firm F-845

Martin Lake CCR Surface Impoundments Demonstration for a Site-Specific Alternative to Initiation of Closure Deadline

Prepared for

Luminant Generation Company LLC
Martin Lake Steam Electric Station
Project No. 122702
Tatum, Texas

Revision 1
October 23, 2020

Prepared by

Burns & McDonnell Engineering Company, Inc.
Kansas City, Missouri

INDEX AND CERTIFICATION

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Report Index

Certification

I hereby certify, as a Professional Engineer in the state of Texas, that the information in this document as noted in the above Report Index was assembled under my direct personal charge. This report is not intended or represented to be suitable for reuse by the Luminant Generation Company LLC or others without specific verification or adaptation by the Engineer.

RANDELL LEE SEDLACEK
99056

Randell Lee Sedlacek
10/23/20

Randell Lee Sedlacek
Randell Lee Sedlacek, P.E. (Texas License No. 99506)

Date: October 23, 2020

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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
CY	Cubic Yards
EAP	East Ash Pond
ELG	Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category
ERCOT	Electric Reliability Council of Texas
EPA	Environmental Protection Agency
FGD	Flue Gas Desulfurization
gal	Gallons
GCL	Geosynthetic Clay Liner
gpm	Gallons Per Minute
GWPS	Groundwater Protection Standards
HDPE	High Density Polyethylene
Luminant	Luminant Generation Company, LLC
Martin Lake	Martin Lake Steam Electric Station
MGD	Million Gallons Per Day
NSP	New Scrubber Pond
PDP5	Permanent Disposal Pond 5
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and Analysis Plan
SSI(s)	Statistically Significant Increases

Abbreviation	**Term/Phrase/Name**
SSL(s)	Statistically Significant Levels
TPDES	Texas Pollutant Discharge Elimination System
WAP	West Ash Pond

EXECUTIVE SUMMARY

Luminant Generation Company LLC (Luminant) submits this request to the U.S. Environmental Protection Agency (EPA) for approval of a site-specific alternative deadline to initiate retrofit or closure pursuant to 40 C.F.R. § 257.103(f)(1) for the Ash Pond Area and Permanent Disposal Pond 5 (PDP5) located at the Martin Lake Steam Electric Station (Martin Lake). Luminant is requesting an alternative site-specific deadline of June 29, 2022, for the Ash Pond Area, to allow for the continued placement of CCR and non-CCR wastestreams in the Ash Pond Area while the remaining impoundments are sequentially retrofitted. In addition, Luminant is requesting an alternative site-specific deadline of July 1, 2023, for PDP5, to allow for the continued placement of CCR and non-CCR wastestreams in PDP5 during the Ash Pond Area retrofit project and thereafter to begin retrofit of PDP5 (if necessary following an EPA decision on an alternative liner application and demonstration expected to be submitted for PDP5 under the Part B Rule prior to November 30, 2020, and November 30, 2021, respectively).

Martin Lake is a three-unit 2,250-nominal megawatt coal-fired facility located near Tatum, Texas. Martin Lake utilizes the Ash Pond Area (consisting of the East Ash Pond, West Ash Pond, and New Scrubber Pond) and PDP5 to manage sluiced bottom ash, mill rejects, FGD blowdown and non-CCR wastestreams. The various non-CCR wastestreams managed in the impoundments include air pre-heater wash water, boiler non-chemical metal cleaning wastewater, boiler chemical cleaning wastewater, boiler blowdown and boiler sump area flows, and miscellaneous wastewater processes and stormwater. Martin Lake recycles and reuses wastewater stored in the impoundments as makeup water in the plant's operational processes. As a result, Martin Lake also utilizes the CCR surface impoundments to assist in maintaining the site's water balance. To ensure reliable generation and sufficient water storage for plant operations, and to minimize discharge to meet the site's aggressive mass limit of 17.5 pounds of selenium per calendar year into the adjacent Martin Creek Reservoir (combined discharge of all outfalls except for the once-through cooling water (Outfall 001) and discharges from the sewage treatment plant (Outfall 101)), the plant must have access to operate all four of the site's CCR surface impoundments from November through June, and must operate a minimum of three out of the four CCR surface impoundments from July through October. Therefore, Martin Lake has elected to sequentially retrofit its existing CCR surface impoundments, which consists of removing CCR materials from the impoundment to be retrofitted, taking the impoundment out of service and rerouting all wastestreams from the impoundment to the in-service impoundments, relining the impoundment, returning the impoundment to service, and starting the next impoundment retrofit. The retrofit for the East Ash Pond is complete, and Luminant is currently proceeding with the removal of CCR to allow for retrofit of the West Ash Pond before moving to the New Scrubber Pond and potentially PDP5.

1.0 INTRODUCTION

On April 17, 2015, the Environmental Protection Agency (EPA) issued the federal Coal Combustion Residual (CCR) Rule, 40 C.F.R. Part 257, Subpart D, to regulate the disposal of CCR materials generated at coal-fueled electric generating units. The rule is being administered under Subtitle D of the Resource Conservation and Recovery Act (RCRA, 42 U.S.C. § 6901 *et seq*.).

On August 28, 2020, the EPA Administrator issued revisions to the CCR Rule that require all unlined surface impoundments to cease receipt of CCR and non-CCR waste and initiate closure by April 11, 2021, unless an alternative deadline is requested and approved. 40 C.F.R. § 257.101(a)(1) (85 Fed. Reg. 53,516 (Aug. 28, 2020)). Specifically, owners and operators of a CCR surface impoundment may seek and obtain an alternative closure deadline by demonstrating that there is currently no alternative capacity available on or off-site and that it is not technically feasible to complete the development of alternative capacity prior to April 11, 2021. 40 C.F.R. § 257.103(f)(1). To make this demonstration, the facility is required to provide detailed information regarding the process the facility is undertaking to develop the alternative capacity. 40 C.F.R. § 257.103(f)(1). Any extensions granted cannot extend past October 15, 2023, except an extension can be granted until October 15, 2024, if the impoundment qualifies as an “eligible unlined CCR surface impoundment” as defined by the rule. 40 C.F.R. § 257.103(f)(1)(vi). Regardless of the maximum time allowed under the rule, EPA explains in the preamble to the Part A rule that each impoundment “must still cease receipt of waste as soon as feasible, and may only have the amount of time [the owner/operator] can demonstrate is genuinely necessary.” 85 Fed. Reg. at 53,546.

This document serves as Luminant’s Demonstration for a site-specific alternative deadline to initiate retrofit or closure pursuant to 40 C.F.R. § 257.103(f)(1) for the CCR surface impoundments at the Martin Lake Steam Electric Station (Martin Lake), located near Tatum, Texas, which include the following:

- Ash Pond Area:
  - East Bottom Ash Pond (EAP)
  - West Bottom Ash Pond (WAP)
  - New Scrubber Pond (NSP)
- Permanent Disposal Pond 5 (PDP5) – this impoundment qualifies as an “eligible unlined CCR surface impoundment” as defined under § 40 C.F.R. 257.53

To obtain an alternative closure deadline under 40 C.F.R. § 257.103(f)(1), a facility must meet the following three criteria:

1. **§ 257.103(f)(1)(i)** - There is no alternative disposal capacity available on-site or off-site. An increase in costs or the inconvenience of existing capacity is not sufficient to support qualification;
2. **§ 257.103(f)(1)(ii) -** Each CCR and/or non-CCR wastestream must continue to be managed in that CCR surface impoundment because it was technically infeasible to complete the measures necessary to obtain alternative disposal capacity either on or off-site of the facility by April 11, 2021; and
3. **§ 257.103(f)(1)(iii) -** The facility is in compliance with all the requirements of the CCR rule.

To demonstrate that the first two criteria above have been met, 40 C.F.R. § 257.103(f)(1)(iv)(A) requires the owner or operator to submit a work plan that contains the following elements:

- A written narrative discussing the options considered both on and off-site to obtain alternative capacity for each CCR and/or non-CCR wastestream, the technical infeasibility of obtaining alternative capacity prior to April 11, 2021, and the option selected and justification for the alternative capacity selected. The narrative must also include all of the following:
  - An in-depth analysis of the site and any site-specific conditions that led to the decision to select the alternative capacity being developed;
  - An analysis of the adverse impact to plant operations if the CCR surface impoundment in question were to no longer be available for use; and
  - A detailed explanation and justification for the amount of time being requested and how it is the fastest technically feasible time to complete the development of the alternative capacity.
- A detailed schedule of the fastest technically feasible time to complete the measures necessary for alternate capacity to be available, including a visual timeline representation. The visual timeline must clearly show all of the following:
  - How each phase and the steps within that phase interact with or are dependent on each other and the other phases;
  - All of the steps and phases that can be completed concurrently;
  - The total time needed to obtain the alternative capacity and how long each phase and step within each phase will take; and
  - At a minimum, the following phases: engineering and design, contractor selection, equipment fabrication and delivery, construction, and start up and implementation.
- A narrative discussion of the schedule and visual timeline representation, which must discuss the following:

  - Why the length of time for each phase and step is needed and a discussion of the tasks that occur during the specific step;
  - Why each phase and step shown on the chart must happen in the order it is occurring;
  - The tasks that occur during each of the steps within the phase; and
  - Anticipated worker schedules.
- A narrative discussion of the progress the owner or operator has made to obtain alternative capacity for the CCR and/or non-CCR wastestreams. The narrative must discuss all the steps taken, starting from when the owner or operator initiated the design phase up to the steps occurring when the demonstration is being compiled. It must discuss where the facility currently is on the timeline and the efforts that are currently being undertaken to develop alternative capacity.

To demonstrate that the third criterion above has been met, 40 C.F.R. § 257.103(f)(1)(iv)(B) requires the owner or operator to submit the following information:

- A certification signed by the owner or operator that the facility is in compliance with all of the requirements of 40 C.F.R. Part 257, Subpart D;
- Visual representation of hydrogeologic information at and around the CCR unit(s) that supports the design, construction and installation of the groundwater monitoring system. This includes all of the following:
  - Map(s) of groundwater monitoring well locations in relation to the CCR unit(s);
  - Well construction diagrams and drilling logs for all groundwater monitoring wells; and
  - Maps that characterize the direction of groundwater flow accounting for seasonal variations.
- Constituent concentrations, summarized in table form, at each groundwater monitoring well monitored during each sampling event;
- A description of site hydrogeology including stratigraphic cross-sections;
- Any corrective measures assessment conducted as required at § 257.96;
- Any progress reports on corrective action remedy selection and design and the report of final remedy selection required at § 257.97(a);
- The most recent structural stability assessment required at § 257.73(d); and
- The most recent safety factor assessment required at § 257.73(e).

2.0 WORKPLAN

To demonstrate that the criteria in 40 C.F.R. § 257.103(f)(1)(i) and (ii) have been met, the following is a workplan consisting of the elements required by § 257.103(f)(1)(iv)(A). This workplan documents that there is no alternative capacity available on or off-site for each of the CCR and/or non-CCR wastestreams that Luminant plans to continue to manage in the Martin Lake CCR surface impoundments and discusses the options considered for alternative disposal capacity. As discussed in more detail below, **Luminant has elected to retrofit its existing CCR surface impoundments.** The workplan provides a detailed schedule for the retrofit project, including a narrative description of the schedule and an update on the progress already made toward retrofit of the CCR surface impoundments. In addition, the narrative includes an analysis of the site-specific conditions that led to the decision to retrofit the impoundments and an analysis of the adverse impact to plant operations if Martin Lake were no longer able to use the CCR surface impoundments.

2.1 No Alternative Disposal Capacity and Approach to Obtain Alternative Capacity - § 257.103(f)(1)(iv)(A)(1)

Luminant owns and operates Martin Lake, a three-unit 2,250-nominal megawatt coal-fired facility located near Tatum, Texas, that burns a mixture of locally mined lignite and Powder River Basin coal. Martin Lake has four CCR surface impoundments (listed in Table 2-1) that receive both CCR and non-CCR wastestreams. An aerial view of the Martin Lake site and the CCR surface impoundments can be found on Figure 1 in Appendix A. The first three impoundments listed (EAP, WAP, and NSP) in Table 2-1 are part of the Ash Pond Area referenced on Luminant's CCR website. This area is equipped with a multi-unit groundwater monitoring network. The fourth, PDP5, is located separately from the Ash Pond Area (as shown in Figure 1 in Appendix A) and has its own groundwater monitoring network. As described in more detail below, Martin Lake does not have alternate onsite or offsite storage capacity that would allow the site to continue to operate safely with more than one CCR impoundment out of service at one time (concurrent with summer peak operation) and maintain compliance with environmental permits and obligations.

Table 2-1: Martin Lake CCR Surface Impoundment Summary

CCR Surface Impoundment Name	Year Placed in Service	Impoundment Size (acres) / Storage Volume (acre-feet)[1]	Lined?	Complies with Location Restrictions?	Groundwater Status
East Bottom Ash Pond (EAP)	1977	9.6 / 125.8	No	Yes	Assessment Monitoring was initiated in June 2018. SSLs were identified for beryllium, cobalt, and lithium in January 2019. The Assessment of corrective measures was completed in September 2019. Impoundment retrofit is underway for source control, while selection of the groundwater remedy is currently in the feasibility study phase.
West Bottom Ash Pond (WAP)	1977	14.6 / 232.6	No	Yes	
New Scrubber Pond (NSP)	1989	12.5 / 198.9	No	Yes	
Permanent Disposal Pond 5 (PDP5)	2010	40 / 190.3	Yes[2]	Yes	SSIs have been identified with successful Alternate Source Demonstrations completed in 2018 and 2019. Remains in Detection Monitoring.

[1] Values listed in Inflow Design Flood Control System Plan prepared by Pastor, Behling & Wheeler, LLC in October 2016.

[2] PDP5 was originally classified as lined per 40 C.F.R. § 257.71(a)(1)(i), which was subsequently vacated by the U.S. Court of Appeals for the D.C. Circuit. This impoundment now qualifies as an eligible unlined CCR surface impoundment per § 257.53.

The Martin Lake facility is unique because it operates its CCR-related outfalls essentially as zero discharge facilities to maintain a negative or neutral water balance for the plant. For Martin Lake's CCR related processes the term "water balance" means managing the inflow of water and wastewater into the impoundments to equal or exceed the outflow(s). This is expressed as:

$$(S \pm \Delta I) - (E+O+C) \leq 0$$

Where: **S**ources (from reservoir and/or groundwater supply wells or rainfall)
Inventory (ponds, volume in process, etc.)
Evaporation (forced and natural)
Output (discharge)
Consumption (moisture in products)

To achieve the negative/neutral water balance, Martin Lake utilizes the CCR surface impoundments, the low volume wastewater retention pond, and the stormwater retention pond to assist in the storage and management of all the remaining water process flows and stormwater on the plant site. These ponds are inter-connected with pumps and piping systems to allow transport of the non-CCR wastestreams to the CCR surface impoundments as make-up water. There are permitted outfalls for discharge from the wastewater recycling plant (Outfall 201), stormwater retention pond (Outfall 301), low volume wastewater pond (Outfall 401), and from the solid waste disposal area (Outfall 501); however, these outfalls typically do not discharge and the wastewaters are used to support water reuse at the site. The existing site water balance flow diagram is included in Appendix A of this demonstration (see Figure 2) and discussed further in Sections 2.1.1-2.1.2.

The water recycling practices discussed above are both necessary and extremely beneficial from an environmental perspective, minimizing both the discharge of wastewater into and the withdrawal of freshwater from waters of the U.S. Recycling is also necessary because of several factors related to the water quality limitations found in the facility's TPDES wastewater permit. The most restrictive permit requirement is a mass limit of 17.5 pounds for the discharge of selenium per calendar year (2 pounds per rolling 30 days per the selenium monitoring program) into Martin Creek Reservoir, which means that the volume of discharge is inverse to the concentration of selenium in the wastewater. The mass limit applies at all Outfalls combined except for the once-through cooling water (Outfall 001) and discharges from the sewage treatment plant (Outfall 101), which are discharged daily. Further, Outfall 301 (stormwater) and Outfall 401 (low volume wastewater) have daily average limits for selenium of 0.02 and 0.05 parts per million, respectively. Per the TPDES permit for Outfall 401, discharges are authorized only when accumulations of wastewater exceed normal, safe operating water levels as a result of any one or combination of the following:

- Recycle equipment outage, or
- Generating unit outage, or
- A rainfall event or consecutive events equal to or greater than the 10-year/24-hour rainfall event

Due to the combined selenium discharge limitation, and the restrictions on discharge from Outfall 401, Martin Lake is generally limited to discharges of stormwater only via Outfall 301 when the ponds are nearing their maximum capacity. This has not occurred in decades due to the recycling and reuse of stormwater at the site as described further in the sections below.

<u>Rainfall:</u> The largest single input into the site water balance is typically rainfall, which is generally unpredictable for both frequency and volume. The Martin Lake facility is located near the eastern border of Texas in a region known as the Piney Woods. This region is characterized by wet springs, then dry summers with rainfall returning in the fall. The annual rainfall for the area can be highly variable from year to year because of the inflow of the humid Gulf Coast air from the south, dry and/or cool frontal activity from the north, and the occasional hurricane or tropical storm. Located ~12 miles from the nearest weather station at the East Texas Regional Airport, and subject to locally heavy rainfalls, the Martin Lake facility has monitored and recorded its own rainfall data since 1978. In the 41+ year site rainfall record (1978 – September 2020), the average annual rainfall is 48.02 inches, with a minimum of 27.34 inches in 2010, and a maximum of 74.40 inches in 2018.

The facility captures rainfall and runoff from approximately 180 acres of the plant site. This includes 97 acres of direct rainfall into the ponds and 83 acres from areas that have exposed materials such as coal or other industrial activity, including the solids handling area, certain piping routes, secondary containments, and buildings, roads, etc. Of the 83 non-pond acres, the runoff coefficient is normally estimated at 85%. For a 1-inch rainfall, the Martin Lake site usually gains ~ 4.6 million gallons of water into its wastewater management systems. This flow is collected in the low volume wastewater retention pond and stormwater retention pond before being routed to the CCR surface impoundments onsite. Over an average year (e.g., ~48 inches of rainfall), the site gains approximately 675-acre feet of water or 220 million gallons, which depending on the volume and frequency of events, can at times utilize a significant portion of the total operational volume of all ponds on-site.

For reference, the rainfall event most often identified as the standard for water management purposes is the "10-year, 24-hour rainfall event," as defined by the National Weather Service in Technical Paper No. 40, "Rainfall Frequency Atlas of the United States," May 1961. This flow statistically has a 10% chance of occurring each year. For the Martin Lake site, the 10-year/24-hour event is estimated at 7.1 inches, which equates to approximately 34 million gallons of runoff.

<u>Reuse:</u> The wastewater permit limitations at Martin Lake greatly inhibit the management of the captured stormwater in an efficient manner. If it were possible for the site to discharge the captured stormwater in real-time at the permitted daily average limit for selenium (i.e., 0.020 parts per million at Outfall 301), it would reach the mass limit at approximately 105 million gallons, or <48% of the estimated average annual rainfall; however, that same volume would have to be released slowly at 0.40 MGD over a period of 262 days to stay below the 2 pounds per rolling 30 days limitation in the selenium monitoring program. Consequently, due to the discharge limits in the TPDES permit it is not considered feasible for Martin Lake

to discharge this stormwater as it is collected (average monthly rainfall equates to 18 million gallons, with a maximum allowable discharge equal to approximately 12 million gallons per month capped at the maximum of 105 million gallons per year assuming the stormwater meets the selenium concentration and any other applicable limits). The water must be incorporated into the site's CCR surface impoundments to provide adequate storage of this water, particularly during significant rain events that would overwhelm the site stormwater and lignite area runoff ponds. Once this water is comingled with the CCR wastestreams, it can no longer be discharged and must be reused within the plant process systems. It should also be noted that since the stormwater is normally used for make-up to the various systems, that volume would have to be replaced by freshwater.

Martin Lake does have the capability to treat its captured stormwater to a value well below the permitted daily average concentration limit(s), but the treatment processes are physically limited to a rate that is slower than the rate of use of the wastewater as make-up to the CCR systems (an approximately 250 gallons per minute (gpm) treated product water rate vs. an estimated average make-up rate of 2,000 gpm with all units online). The treatment process to produce the lowest selenium concentration achievable involves utilization of multiple water treatment systems in a sequence. These include micro-filtration, reverse osmosis, and demineralizers. This process, however, produces wastestreams of equal volume (approximately 50% of the feed rate) that are essentially untreatable. Introduction of these high concentrate wastestreams back into the wastewater inventory is counter-productive and limits the recycle uses to consumption (i.e., the bottom ash and FGD systems).

Water Availability: The negative/neutral water balance method of operation has also become necessary because of the limited availability of surface water in the State of Texas. Texas is a water rights state, and surface water withdrawals and use are highly regulated. Groundwater is separate but similar issue, with groundwater conservation also highly regulated.

Over the past several decades the addition of new pollution control devices has increased the water consumption at the facility. The use of non-CCR wastewater and site stormwater as make-up to the CCR systems has prevented the need for a large increase in the volume of freshwater needed.

Evaporation: Evaporation, both natural and forced, is another important component of a water balance. Evaporation is the conversion of water from a liquid to a gas. This process is driven by the difference in temperature between the water and the atmosphere and the surface area of the water exposed to the atmosphere.

Natural evaporation occurs at the ambient temperatures for both the water and the air where they interface (i.e., a pond surfaces) and is basically the absorption of heat. Cloud cover is an important factor that slows evaporation, and so is wind which usually enhances evaporation as the wind speed increases. Natural evaporation is highly localized and changes daily, monthly and yearly. It is most often measured as "pan-evaporation", which is a measurement of the water lost from a "Class A evaporation pan", as used by the National Weather Service. Data from that apparatus cannot, however, be directly correlated to waterbodies such as reservoirs or wastewater ponds because of several factors including wind exposure, water depth, water clarity, and other siting conditions. For the Martin Lake site, historical experience has shown that pond evaporation rates are approximately 75% of the Class A pan evaporation rate.

Forced evaporation is water that is consumed through a process due to contact or exposure to above ambient temperatures. At Martin Lake, this is either in the form of hot gases through the FGD system or the hot ash in the bottom ash system. The amount of water lost due to forced evaporation is dependent on operation of the generating units and the amount of electricity produced. A generating unit operating at a 75% load evaporates roughly 25% less than one operating at 100%, or a full load. This is because the unit is consuming less fuel, producing less hot gas that goes through the FGD system and less ash to the bottom ash system, both of which result in less forced evaporation. The Martin Lake site is dispatched by the Electric Reliability Council of Texas (ERCOT), and the level or rate of generation (i.e., forced evaporation), is set by the ERCOT system supply and demand. The changes in the rate of generation are variable, occur in real time, and can have a range of several hundred megawatts over the course of a day. As an industry standard (and consistent with historical calculations for the Martin Lake site), the forced evaporation rate is approximately equal to one gpm per megawatt, or 60 gallons per megawatt hour.

Together, forced and natural evaporation is critical to the water balance at Martin Lake, representing the highest demand and largest consumers of water and wastewater. It is most noticeable during the hot summer season when all generating units are operating, both forced and natural evaporation rates are at their highest, and wastewater inventories decline daily.

<u>Other factors:</u> The third component of water consumption is the percent moisture that is in the products (e.g., bottom ash and scrubber solids or gypsum), that are either sold or properly disposed of in a landfill. This is a relatively constant value, typically around 10 – 12 percent, with the total volume dependent on amount of the materials that are disposed offsite. This is estimated at approximately 13 gpm and 119 gpm for bottom ash and scrubber solids, respectively, in 2019.

The low chloride content of the fuel used at the site is also an important factor in Martin Lake's ability to reuse its wastewater. Chlorides in the water of a mechanical or biological system can quickly become a problem and damage the metallurgy of the FGD equipment requiring frequent purging of the water. The low chlorides in the Martin Lake fuels help to maximize the reuse and recycling of the CCR system wastewaters.

Water Management: Intensive water management is a practice to minimize the amount of stormwater that is required to be captured and maximize the reuse of all water wastestreams produced at the site. This practice also makes it possible to minimize the input of new freshwater to only what is needed for specific processes, help to balance the equation, and avoid discharge of wastewater. At Martin Lake it requires constant diligence since so many of the large inputs and consumptive uses are highly variable and controlled by outside forces (e.g., rainfall, natural evaporation, and unit operation/generation (i.e., forced evaporation)).

These factors allow the Martin Lake site to use its non-CCR wastewater (e.g., low volume wastewater, boiler water treatment wastewater, lignite and coal pile runoff, captured stormwater, etc.) as sources of make-up water. The wastewaters are continuously recycled into the CCR systems which are large consumers of water, that require constant make-up, and that would otherwise require like volumes of freshwater (surface and/or groundwater).

All of this has led Martin Lake to adopt the reuse of wastewater and captured stormwater as make-up to the CCR systems in order to maintain the negative/neutral water balance. These practices are feasible at Martin Lake because of three factors: a generally favorable climate (long, hot summers with high evaporation rate), the use of low chloride fuel sources (lignite & western coal), and intensive wastewater management focused on recycling and reuse of wastewater.

2.1.1 CCR Wastestreams

Luminant evaluated each CCR wastestream generated at Martin Lake (See Table 2-2). The existing site water balance is included in Appendix A of this demonstration (see Figure 2). Fly ash is collected dry and disposed in A-1 Area Landfill onsite, therefore it is not part of this extension request. For the reasons discussed below in Table 2-2, the following CCR wastestreams must continue to be placed in the CCR surface impoundments due to the lack of alternative capacity both on and off-site.

Table 2-2: Martin Lake CCR Wastestreams

CCR Wastestream	Estimated Average Flow (MGD)	Description	Luminant Notes
Bottom Ash (and non-CCR mill reject) sluice	13.14	Operated as closed-loop system with CCR sluiced to dewatering bins for solids removal before collecting flow in Ash Pond Area for reuse.	The water in this system is recycled from the Ash Pond Area (with makeup from the onsite non-CCR ponds) or sent to PDP5 as required to maintain the overall site water balance and avoid discharge of wastewater and site stormwater into Martin Creek Reservoir.
FGD Blowdown	4 (3.3 as overflow, 0.69 as underflow and filtrate)	Purged to thickeners. Overflow returned to FGD system. Underflow can be routed to NSP but is typically routed to solid waste handling system with solids removed and hauled to A-1 Area Landfill. The filtrate (non-CCR) is then returned to the NSP. Underflow can be routed to PDP5 from the NSP when solid waste handling system is down for maintenance or when upset conditions occur in the process.	Water from the NSP is currently recycled to the FGD system through the wastewater recycling facility. The intermittent purges of CCR solids from the system during upsets or maintenance events cannot be routed to another location onsite outside the Ash Pond Area or PDP5. Prior to the April 11, 2021 deadline, Luminant will reroute the filtrate to the retrofitted EAP rather than the unlined NSP during normal operation; however, this wastestream will be comingled with other flows that must be managed in the other unlined portions of the Ash Pond Area and PDP5 to prevent discharges that exceed the permitted limits.

Since these wastestreams contain CCR material, they cannot be routed to any location onsite other than the existing CCR surface impoundments and the volume is too large to be managed onsite in temporary tanks. If 24 hours would provide sufficient residence time for the settling of the fine solids in these wastestreams, approximately 650 frac tanks would be required to store and treat the bottom ash transport water and an additional 35 frac tanks would be required for the FGD wastewater underflow (if the solids handling system is down for maintenance). These tanks would cover approximately 10 acres of the site, and even if there were enough flat area available with truck access for these tanks, they would require significant amounts of interconnecting piping and an unacceptable amount of potential leaks. Furthermore, assuming a solids content of 3% in the comingled wastestreams, approximately 20 of these frac tanks would need to be removed and replaced each day. Per the effluent limits at 40 C.F.R. § 423.16(e)(1), the FGD wastewater cannot be discharged offsite without significant pretreatment, for which the treatment systems currently do not exist onsite and would take over two years to design and install. This treatment system is not required for ELG compliance at Martin Lake and has not been initiated to date since Luminant plans to comply with

ELG using our historical water management practices to maintain zero discharge of CCR wastestreams. Per the limits at 40 C.F.R. § 423.16(g)(1), the bottom ash transport water cannot be disposed offsite. Consequently, the options considered to install temporary tanks to store and reuse this wastewater onsite or to install pipelines or mobilize trucking for offsite disposal of these CCR wastestreams is not considered a feasible alternative at Martin Lake.

2.1.2 Non-CCR Wastestreams

Luminant evaluated each non-CCR wastestream placed in the Martin Lake CCR surface impoundments. For the reasons discussed below in Table 2-3, each of the following non-CCR wastestreams must continue to be placed in the CCR surface impoundments due to lack of alternative capacity both on and off-site.

Table 2-3: Martin Lake Non-CCR Wastestreams

Non-CCR Wastestream	Estimated Average Flow (MGD)	Description	Luminant Notes
Air Pre-Heater Wash Water	Outage Only	Wash water	Prior to the April 11, 2021 deadline, Luminant will reroute this wash water to the retrofitted EAP; however, these wastestreams will be sourced from or comingled with other CCR wastestreams that must be managed in the other unlined portions of the Ash Pond Area and PDP5 to prevent discharges that exceed the permitted limits.
Boiler Non-Chemical Metal Cleaning Wastewater	Outage Only	Wash water from fireside and back-pass washes. Typically sluiced to dewatering bins for solids removal before collecting flow in Ash Pond Area for reuse.	
Boiler Blowdown and Boiler Area Sump Flows	0.186	Boiler Blowdown and Wash Water (this is an estimate of water added to the system and does not include recycled portion of the CCR wastestreams in the sumps from hopper and boiler seal trough overflows which cannot be segregated)	Prior to the April 11, 2021 deadline, Luminant will reroute these flows to the retrofitted EAP; however, these wastestreams will be comingled with other CCR wastestreams that must be managed in the other unlined portions of the Ash Pond Area and PDP5 to prevent discharges that exceed the permitted limits.
Miscellaneous Plant Drains and Wash Water	0.836 to EAP/WAP, 0.438 to NSP	Estimated flow of wash water incorporated into Ash Pond Area from boiler area and FGD solids handling area wash flows. The wastewater permit does not allow these contact waste streams to be routed to the Low Volume Retention Pond (Outfall 401).	

Non-CCR Wastestream	Estimated Average Flow (MGD)	Description	Luminant Notes
Misc. Process Wastewater (includes water pumped from Low Volume Retention Pond for Reuse)	Estimated at 0.448 (including service water contributions for wash activities and excluding stormwater contributions which are intermittent)	Includes, Demineralizer Regeneration Flows, Reverse Osmosis System Reject Flows, Other Water Treatment Wastewaters, Miscellaneous Plant Drains (wash water), and Oil Water Separator discharge.	These flows are routed to the Ash Pond Area (and potentially from the Ash Pond Area to PDP5) via yard sumps and drains. If these wastestreams are no longer managed in the CCR impoundments, major modifications to the wastewater permit would be required as well as the development of additional storage and treatment system capacity, extending the overall compliance schedule. The site is only able to purge low volume wastewater via Outfall 401 under specific permit conditions coincident with equipment/unit outages and/or significant rain events (greater than 10-yr/24-hr storm event). Maximum flow would be at 0.16 MGD after treatment to achieve the permitted daily average selenium concentration allowed, capped at an annual maximum of 4.8 million gallons. Treatment of these flows concentrates the contaminants present in the CCR impoundments and reduces the site's ability to discharge stormwater (due to the combined 17.5-pound maximum annual limit for selenium). The peak flows from rain events cannot feasibly be discharged based on this restriction, and once comingled with CCR wastestreams in the CCR impoundments cannot be discharged at all. The forced evaporation at the site allows for reuse and elimination of this wastewater faster than it can be discharged and prevents the discharge of selenium to the captive biological species in the Martin Creek Reservoir which is open to the public.

Non-CCR Wastestream	Estimated Average Flow (MGD)	Description	Luminant Notes
Captured Site Stormwater (falls directly in the CCR impoundments or is pumped from Low Volume Retention and Stormwater Retention Ponds)	0.6 (based on daily average of average annual precipitation/run off captured; however, this flow is intermittent and has significant peak flow events throughout the year)	Stormwater that falls directly in impoundments (97 acres) or that is captured from solids handling area and the plant yard drains (83 acres)	These flows are routed to the Ash Pond Area (and potentially from the Ash Pond Area to PDP5) via yard sumps and drains. If these wastestreams are no longer managed in the CCR impoundments, major modifications to the wastewater permit would be required as well as the development of additional storage and treatment system capacity, extending the overall compliance schedule. Only able to purge stormwater via Outfall 301 at 0.4 MGD at the permitted daily average selenium concentration allowed, capped at an annual maximum of 105 million gallons per year. The peak flows from rain events cannot feasibly be discharged based on this restriction, and once comingled with CCR wastestreams in the CCR impoundments cannot be discharged at all. The forced evaporation at the site allows for reuse and elimination of this wastewater faster than it can be discharged and prevents the discharge of selenium to the captive biological species in the Martin Creek Reservoir which is open to the public.

2.1.3 Site-Specific Conditions Supporting Alternative Capacity Approach – § 257.103(f)(1)(iv)(A)(1)(i)

The four CCR surface impoundments at Martin Lake receive both the CCR sluice flows and the various non-CCR wastestreams produced onsite. In addition to providing treatment for the reduction of total suspended solids, the CCR impoundments are also a critical component in the management of the overall site water balance as described in Section 2.1.

The design storage and operational capacity of the Martin Lake CCR impoundments are summarized in Table 2-4. Each of these ponds, with the exceptions of PDP5 and the stormwater retention pond, require approximately 40% of the design volume to operate (i.e., the "operational volume" in Table 2-4). This volume is needed to provide suction to the pumps that recirculate the water back to the plant for re-use. Accordingly, only approximately 60% of the design volume of these ponds is available to manage the inflow of water and wastewater into the ponds. The available storage capacity at any point in time is impacted by the accumulation of solids in the impoundments, as well as the ever-changing amount of stormwater and process water contained in the pond system.

Table 2-4: Summary of Pond Design Storage & Operational Capacity

Impoundment	Design Volume (gal)	Operational Volume (gal)
EAP	43,000,000	25,800,000
WAP	70,000,000	42,000,000
NSP	58,000,000	34,800,000
PDP5*	66,000,000	66,000,000
Low Volume Retention Pond	49,550,000	29,730,000
Storm Water Retention Pond*	34,300,000	34,300,000
Total Capacity (gal)	320,850,000	232,630,000

* Surge ponds

Luminant considered the possibility of simultaneously retrofitting two ponds, but an evaluation of the construction complexity, logistical and technical issues for scheduling for two ponds that physically share many common utilities, many of the same dikes, the same roads, and the same access/egress points with the adjacent pond that must remain in-service to support power plant operations, presented unacceptable risk to operation of the generating units. It also presented significant water balance, water management, and wastewater permit compliance risks, even under normal rainfall conditions.

The typical operation and management of the CCR ponds for the past several decades has been that one pond is generally considered out-of-service to allow for solids removal. Ordinarily, it takes 6-8 months of out-of-service time to complete solids removal. If additional work for maintenance or repairs is needed, the out-of-service period is often extended.

If a pond is out-of-service for a simple clean-out, the clean-out operations can be stopped and the pond quickly returned to service temporarily if necessary due to unplanned operational events or heavy rainfall; however, if the pond requires liner repairs or replacement it is critical to the project to complete all the necessary repairs or replacement before the pond is returned to service. This means that during a project involving a liner retrofit, water balance becomes critical and sometimes requires extraordinary management effort.

Figure 2-1 below shows a five-year forecast of the pond levels onsite, assuming all ponds are in service. This figure is based on the average annual rainfall (48 inches per year, distributed on an average monthly basis), the last five years of average monthly generation (from EIA data), forced evaporation at one gpm per megawatt (or 60 gallons per megawatt hour), natural evaporation at 75% of the Class A pan evaporation rate for the pond areas, 50 million gallons per month of boiler blowdown, service water, and low volume wastewater contributions (approximately 1.908 MGD excluding outage flows and stormwater per Table 2-3), pond storage volumes per Table 2-4, and using a starting pond available capacity consistent with measurements at the site on October 20, 2020 (approximately 50% of the pond operational capacity available). As shown, the minimum available pond capacity over the next few years is forecasted to be approximately 48 million gallons in May of 2021, increasing to 73 million gallons in May of 2022, and 97 million gallons in May of 2023 (assuming all of the ponds are in service). Again, these reserve limits are based on average rainfall only, but clearly demonstrate that removing even the smallest remaining CCR impoundment from service for retrofit (the NSP at approximately 35 million gallons of operational volume) significantly compromises the site's storage capacity. Removing two impoundments from service concurrently is not feasible based on average rainfall, historical average monthly evaporation, and the estimated average plant process water contributions.

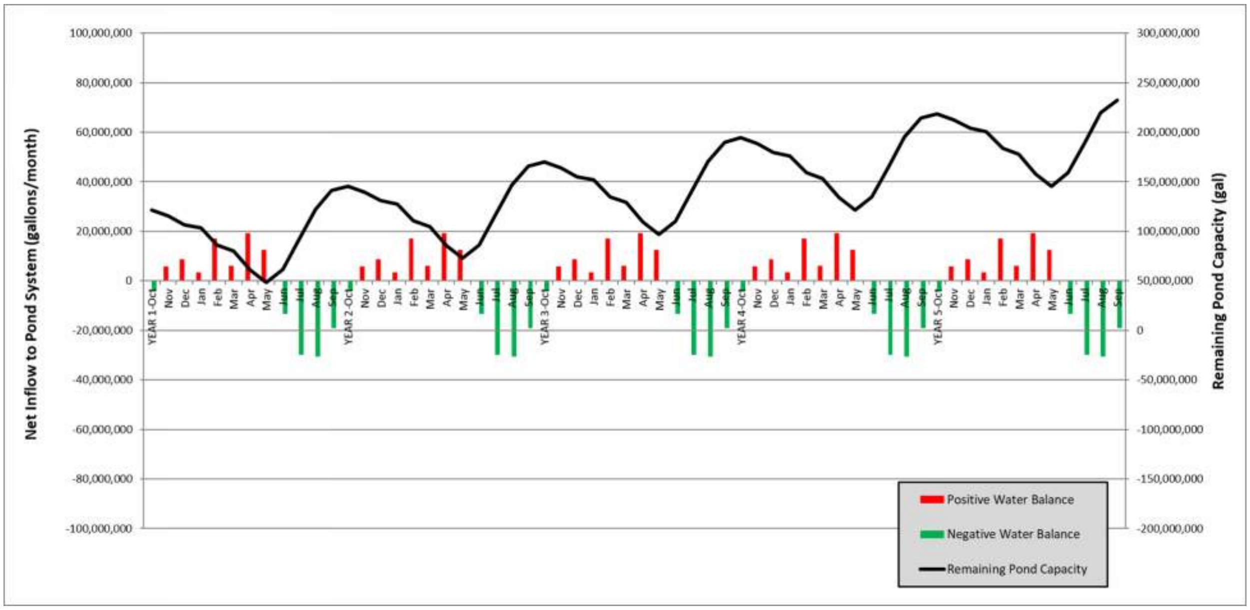

Figure 2-1: Average Monthly Plant Water Balance vs Impoundment Storage Capacity

The current plan involves removing the WAP (70 million gallons of total volume) from service on July 5, 2021, at which point the site is forecasted to have 21 million gallons of remaining storage capacity (not including the WAP). Martin Lake intends to remove solids from the NSP concurrently with the WAP retrofit; however, the NSP will not be removed from service and will remain available to receive additional water as required to maintain the site water balance. If the site were to attempt to remove two ponds from service simultaneously for retrofits, any number of single events such as an unplanned unit outage, equipment failure for the one in-service pond, along with above average rainfall could very likely create wastewater management issues that would require the temporary placement of wastewater back into one of the ponds.

Average rainfall at the site for April through June is 13.12 inches (approximately 190 acre feet or 62 million gallons of water). These wet months are also coincident with spring outages, representing some of the lower forced evaporation rates for the site. Per Figure 2-1, these months represent the periods with the minimum available storage capacity in the site pond system. The following summer months provide the best conditions for earthwork construction, particularly pond work, and consequently, Martin Lake must perform the retrofit activities in the summer months (ideally July through October) during periods with reduced rainfall and peak unit operations. As described in Section 2.1, a 10-year 24-hour storm event at Martin Lake (7.1 inches of rainfall) would contribute approximately 34 million gallons of stormwater runoff which could not be discharged at a rate higher than 0.4 MGD (2 pounds per rolling 30 days per the selenium monitoring program). If this event occurs at any point during the retrofit cycle, the plant's ability to continue operations without discharging would be compromised. Performing the retrofit operations sequentially to have one pond out-of-service at any given time in the summer months provides the operational flexibility and adequate pond space required for upset conditions, such as above average rainfall events or periods or unscheduled unit shutdowns.

2.1.4 Impact to Plant Operations if Alternative Capacity Not Obtained – § 257.103(f)(1)(iv)(A)(1)(ii)

As indicated in Table 2-4 and Figure 2-1, removing any more than one of the CCR impoundments from service would significantly reduce the storage capacity of the site pond system by over 30%. The remaining impoundments onsite (low volume wastewater retention pond, and stormwater retention pond) do not typically have space to independently store and/or treat a 10-year/24-hour rainfall event (due to water already present in the ponds that are never emptied, and due to routine solids accumulation and management) with more than one of the CCR ponds out-of-service. The loss of storage space from any one CCR pond adds to the volume that must be handled by the remaining ponds. Any significant rainfall during the period where more than one impoundment is out of service for retrofit construction would create insurmountable water balance concerns and wastewater management/permit issues.

In addition to the TPDES wastewater permit limitation on selenium (discussed in Section 2.1), there are also other permit limitations that do not allow the reroute of certain non-CCR wastestreams from the CCR ponds to the non-CCR ponds. From a risk and a wastewater compliance standpoint, it is basically untenable to remove more than one of the CCR ponds at the same time while a generating unit is in operation. If the plants were required to cease operation on April 11, 2021, to retrofit the impoundments and maintain CCR compliance, the site's evaporation capacity would be significantly reduced, the rainfall would overwhelm the impoundments, and the site would be forced to discharge wastestreams in potential violation of the permit. Consequently, the requested extension is necessary to allow continued operation of the plant during the retrofit activities.

To maintain reliable generation and sufficient water storage to sustain zero discharge during average and heavy rainfall events, the plant must operate a minimum of three out of the four CCR surface impoundments.[1] Specifically, for the plant to continue operating and generating electricity during retrofit work, the CCR impoundments will require sequential retrofitting to consist of diverting all wastestreams from the impoundment to be retrofitted by pumping water to the other impoundments, removing CCR materials (bottom ash or FGD solids) for disposal in the A-1 Area landfill, relining the impoundment, returning the impoundment to service, and starting the next impoundment retrofit. All of this must take into consideration typical and possibly atypical wet weather conditions.

2.1.5 Options Considered Both On and Off-Site to Obtain Alternative Capacity

As EPA explained in the preamble of the 2015 rule, it is not possible for sites that sluice CCR material to an impoundment to eliminate the impoundment and dispose of the material offsite. *See* 80 Fed. Reg. 21,301, 21,423 (Apr. 17, 2015) ("[W]hile it is possible to transport dry ash off-site to [an] alternate disposal facility that is simply not feasible for wet-generated CCR. Nor can facilities immediately convert to dry handling systems."). Luminant agrees with EPA in this assessment and confirms that off-site alternatives are not an option for wet-generated CCR and wet-generated non-CCR wastestreams. At Martin Lake, all dry-handled CCR wastestreams are currently disposed of in the A-1 Area landfill onsite. The wet-generated CCR wastestreams are comingled with non-CCR wastestreams in the site impoundments and reused within the plant process. If the excess comingled water generated at the site were able to be collected in tanks and trucked offsite, approximately 250 trucks would be required per day driving an unknown distance across rural Texas roads. This significant daily tanker truck volume would result in increased potential for safety

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[1] As EPA recognized in the final rule, "[t]he Martin Lake circumstances are unique in that the facility plans to retrofit four impoundments, and each retrofit must occur sequentially because the facility requires a minimum of three impoundments to be operating at any one time in order for the plant to operate." 85 Fed. Reg. at 53,528.

and noise impacts and further increases in greenhouse gas emissions and carbon footprint. Furthermore, the current ELG rules do not allow offsite discharge of FGD blowdown without pretreatment to meet the effluent limits at 40 C.F.R. § 423.16(e)(1), for which treatment systems do not currently exist and would likely take longer to install than the time expected to retrofit the remaining site impoundments. The ELG rules (at 40 C.F.R. § 423.16(g)(1)) forbid the discharge of bottom ash transport water to publicly owned treatment works (including the waters comingled with the bottom ash transport water). Consequently, there are no feasible offsite-disposal options for the wet-generated wastestreams at Martin Lake. The only feasible onsite alternatives involve continued use of the CCR surface impoundments at Martin Lake.

Martin Lake evaluated the construction of new impoundments as a potential solution for CCR compliance. As shown on Figure 3 in Appendix A, Martin Lake is landlocked with the Martin Creek Reservoir located on the north, east, and south sides of the plant. The western boundary is formed by residential properties and mining operations as shown in Figure 3. Much of the site that is outside the floodplain is occupied with critical infrastructure including the lignite/coal storage piles, the switchyard, transmission lines, railroad lines, the solids handling area, and the existing site impoundments. The limited space and congestion in and around the plant and the solids handling areas does not provide sufficient space for the construction of a new pond(s) or temporary tanks to manage and store the CCR and non-CCR wastestreams. The other areas adjacent to PDP5 are not considered technically feasible to support the construction of new impoundments due to potential wetlands impacts, location restrictions concerns, proximity to the plant boundary and adjacent private water supply wells, acquisition of water rights, and permitting concerns as noted on Figure 3 in Appendix A. Furthermore, additional impoundments would only increase the amount of stormwater captured and managed on the site.

The other options considered for alternative disposal capacity of the wastestreams currently routed to the Martin Lake CCR surface impoundments are summarized in Table 2-5. Additional details on the CCR and non-CCR wastestreams included in this demonstration request are found in Table 2-2 and Table 2-3, respectively.

Table 2-5: Martin Lake Alternatives for Disposal Capacity

Alternative Capacity Technology	Average Time (Months)[1]	Feasible at Martin Lake?	Selected?	Luminant Notes
Conversion to dry handling	33.8	Yes	No	A dry bottom ash conversion could be performed; however, the duration is expected to take longer than the CCR impoundment retrofits and would delay the removal of CCR materials from the unlined impoundments until this conversion is completed. Furthermore, Martin Lake would still require large volumes of storage for the stormwater and other non-CCR wastestreams onsite, which would require the use of real estate currently occupied by the CCR surface impoundments.
Non-CCR wastewater basin	23.5	No	No	This option only provides a partial solution since the CCR wastestreams cannot be directed to non-CCR basins. Furthermore, the volume of non-CCR wastestreams and stormwater cannot be contained within the non-CCR basins that exist onsite, and cannot be fully discharged according to the mass selenium limits in the discharge permit. Additional ponds would increase the amount of stormwater captured onsite, and there is not suitable real estate onsite to construct additional non-CCR basins for the storage of non-CCR wastestreams without significant grading and permitting efforts that would likely extend this average timeline estimated by EPA (see Figure 3 in Appendix A).
Wastewater treatment facility	22.3	No	No	Due to Martin Lake practices for recycling water within the plant, building a treatment system (such as chemical precipitation, settling ponds, or concrete tanks) to remove solids would not assist with overall storage volume needs for stormwater and process water management at the Martin Lake site (hundreds of millions of gallons required). The combined mass limit on selenium restricts the potential to discharge this water to the adjacent Martin Creek Reservoir, so water treatment alone would not provide adequate compliance. The site must capture and reuse the vast majority of its wastewater and stormwater.

Alternative Capacity Technology	Average Time (Months)[1]	Feasible at Martin Lake?	Selected?	Luminant Notes
New CCR surface impoundment	31	No	No	There is not suitable real estate onsite to construct a new CCR surface impoundment that could manage and store the plant's wastestreams (see Figure 3 in Appendix A). The individual USACE 404 permitting activities associated with the remaining areas of the site (or the construction to fill the area and provide adequate aquifer separation) are expected to increase the average time estimated by EPA. This option would also delay the removal of CCR materials from the unlined impoundments until this impoundment construction is completed.
Retrofit of a CCR surface impoundment	29.8	Yes	Yes	This alternative maintains required water storage onsite and accelerates the removal of CCR material from the unlined impoundments earlier than all other options considered.
Multiple technology system	39.1	No	No	Any multi-technology solution would require hundreds of millions of gallons of storage for non-CCR wastestreams and stormwater management. This is not considered technically feasible at Martin Lake as previously discussed.
Temporary treatment system	Not defined	No	No	Treatment and discharge of the water is not an option for the wastestreams at Martin Lake due to the combined mass limit on the discharge of selenium from the Martin Lake outfalls. Luminant would need to provide 35,000,000 gallons of storage to replace the operational volume of the smallest CCR impoundment onsite and allow for continued operation while retrofitting two impoundments simultaneously. Given the size of the wastestreams that would need to be managed and the non-CCR wastewater storage capacity needed to replace the CCR surface impoundments at Martin Lake, temporary treatment systems are not practical. Luminant has chosen to focus on implementing the necessary measures for the retrofit of the Martin Lake CCR surface impoundments rather than try to develop temporary tank-based storage for all wastestreams.

[1] From Table 3. See 85 Fed. Reg. at 53,534.

2.1.6 Approach to Obtain Alternative Capacity

Due to the overall water management needs of the facility, including storage of CCR and non-CCR wastestreams generated at the site, the only viable solution for alternative disposal capacity involves a sequential retrofit of the existing CCR surface impoundments pursuant to the retrofit criteria in 40 C.F.R.

§ 257.102(k). As discussed in more detail in Section 2.1.5 and shown in Figure 3 in Appendix A, there is not enough site footprint available to construct a new CCR surface impoundment outside the boundary of the existing impoundments, and even if dry bottom ash handling systems were installed at Martin Lake, the plant would continue to require the surface area and the volume of the existing impoundments for evaporation and water management at the site. Consequently, even if a dry bottom ash handling system was installed, a similar retrofit activity (removal of CCR material and installation of a new liner system) to manage non-CCR wastestreams would still be required and the dry ash conversion project would likely only extend the schedule required for the overall project.

As shown on the schedule in Appendix B, Luminant has been taking steps to address the CCR surface impoundments at Martin Lake since 2015. Luminant hired Burns & McDonnell to evaluate the steps necessary to comply with the CCR Rule published in April 2015. Burns & McDonnell also evaluated the overall plant water balance to estimate the impacts associated with taking impoundments out of operation during various operational scenarios. Luminant cannot remove more than one of its CCR surface impoundments from service at a time to perform retrofit activities (see Section 2.1.4).

Luminant installed monitoring wells in September of 2015 and performed background groundwater sampling from October of 2015 to December of 2016. During this time, several engineering firms assisted Luminant in preparing the required CCR compliance documentation, which Luminant posted on its public CCR website. Key information is summarized in Table 2-1. As indicated in Luminant's CCR compliance documents, the Martin Lake CCR impoundments comply with the location restrictions, the required safety factors and stability assessments were satisfied, and the impoundments were deemed to be low hazard facilities.

In February 2019, after beryllium, cobalt, and lithium were first identified at statistically significant levels (SSL) above the groundwater protection standards (GWPS), Luminant issued an RFP for engineering services to support the retrofit activities of the Ash Pond Area. HDR was awarded the scope to evaluate retrofit alternatives and design the selected solution. HDR investigated alternatives to perform the retrofit as follows:

1. Retrofit the EAP, Subdivide and Retrofit the WAP, and Decommission the NSP
2. Retrofit the EAP, Subdivide and Retrofit the NSP, and Decommission the WAP
3. Retrofit the EAP, WAP, and NSP (maintaining the existing footprint/storage capacity)
4. Retrofit the EAP, Subdivide and Retrofit the WAP, and Cap-in-Place the NSP

Each alternative, except for Alternative 3, requires elimination of a portion of the CCR surface impoundment area available to the plant, which would reduce the water storage capacity and result in water balance issues, as summarized in Section 2.1.4. Each alternative, except for Alternate 3, also requires construction of intermediate berms within the CCR impoundment footprint, which would extend the permitting and construction schedule for the project and further reduce the usable volume of the impoundments. Consequently, Luminant has selected Alternative 3 to retrofit all three impoundments in the Ash Pond Area in sequence. Each of these impoundments are currently lined with a 4” concrete revetment mat, two layers of HDPE geomembrane material that sandwich a drainage net or geocomposite material, and various thicknesses of underlying clay soils. As discussed in the retrofit plan prepared by HDR pursuant to 40 C.F.R. § 257.102(k), and posted to Luminant’s CCR website, the retrofit project includes leaving this existing liner system in place and retrofitting in the following general sequence for each impoundment, beginning with the EAP in 2020, and then progressing to the WAP in 2021 and the NSP in 2022:

- Remove any CCR material, rocks, and other sediment from the pond. The material will be loaded on railcars for transport to the Martin Lake A-1 Area Landfill.
- Clean the existing concrete revetment mat surface, by washing with water from the adjacent operating ponds and returning both the wash water and sediment to the operating ponds.
- Load and haul general soil fill material from the Owner’s stockpile located at Liberty Mine. This stockpile is located approximately 4.5 miles from the Ash Pond Area. This pile may be relocated as required to support mining operations.
- Place the general fill material over the existing concrete revetment to a depth of at least six (6) inches, nominally compact it, and smooth roll to finish the installation. This material will provide the soil buffer/grading layer above the existing concrete surface as referenced in the facility retrofit plan.
- Install a composite liner system including a geosynthetic clay liner (GCL) with a maximum hydraulic conductivity of 1 x 10^{-9} cm/sec overlain by a 60-mil high-density polyethylene (HDPE) geomembrane, as specified in 40 C.F.R. § 257.70(b).

As shown in Table 2-4, PDP5 provides a significant amount of the excess site storage capacity and must be used to receive CCR and non-CCR wastestreams during the retrofit of the Ash Pond Area. Once the Ash Pond Area is retrofitted and returned to service, PDP5 may be retrofitted beginning in July of 2023 (following the wet spring months and spring outage season that requires increased water storage capacity compared to the summer months at Martin Lake) or, alternatively, PDP5 may qualify for the alternate liner demonstration under the Part B CCR Rule.

2.1.7 Technical Infeasibility of Obtaining Alternative Capacity prior to April 11, 2021

Luminant began designing the retrofit of the Ash Pond Area impoundments in early 2019. The retrofit of the first of three impoundments (EAP) was completed in early October 2020. The remaining two impoundments within the Ash Pond Area will be completed sequentially after the first retrofit is complete, and Luminant and its contractors are anticipating this work to be completed for one pond in each calendar year. PDP5 will be retrofitted with a composite liner following completion of the Ash Pond Area retrofit (unless it qualifies for an alternate liner demonstration under the future Part B Rule). No more than one impoundment can be removed from service at a time without reducing the site water storage capacity below the necessary minimum levels for continued intermittent operation without discharge from the site pond system, and additional storage and treatment system capacity would need to be installed and the discharge permit modified if continued discharge were required. Consequently, it is not possible to implement the measures discussed above in a way that would likely be successful by April 11, 2021.[2]

2.1.8 Justification for Time Needed to Complete Development of Alternative Capacity Approach – § 257.103(f)(1)(iv)(A)(1)(iii)

The schedule for developing alternative disposal capacity is described in more detail in Sections 2.2 and 2.3. The milestones for progress are summarized in Table 2-6 below. Luminant is requesting an alternative site-specific deadline of June 29, 2022, for the Ash Pond Area, to allow for the continued placement of CCR and non-CCR wastestreams in the Ash Pond Area while the remaining impoundments are retrofitted. In addition, Luminant is requesting an alternative site-specific deadline of July 1, 2023, for PDP5, to allow for the continued placement of CCR and non-CCR wastestreams in PDP5 during the Ash Pond Area retrofit project and thereafter to initiate retrofit of PDP5 (if necessary following an EPA decision on the alternate liner application and demonstration expected to be submitted for PDP5 under the Part B Rule prior to November 30, 2020, and November 30, 2021, respectively). As discussed above in Section 0, the primary factor affecting the time needed to complete the retrofit project at Martin Lake is the fact that the facility was designed and experience has shown that no more than one impoundment at a time can be removed from service at a time. The removal of an impoundment for retrofit activities must occur in the summer months, when historically the rainfall volumes are reduced coincident with peak unit operations and evaporation capacity; therefore minimizing the facility's water storage requirements and minimizing the potential discharge from the facility (as well as any potential exceedances of the permitted selenium limit).

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[2] As EPA recognized in the final rule, "[t]he Agency intends for unique circumstances like Martin Lake to be addressed through the alternative closure provisions of the final rule." 85 Fed. Reg. at 53,528.

If Luminant were to consider alternative temporary solutions to allow for more than one impoundment to be removed from service at a time, such a measure would require the use of approximately 1,700 frac tanks to provide similar storage capacity to the operational volume of the smallest impoundment requiring retrofit onsite (the NSP at 34.8 million gallons) simultaneously with the WAP or with PDP5. These tanks would cover over 25 acres of the site, and even if there were enough flat area available with truck access for these tanks, they would require significant amounts of interconnecting piping and an unacceptable number of potential leaks. Furthermore, assuming a solids content of 1% in the comingled wastestreams, approximately 17 of these frac tanks would need to be removed and replaced each day. Luminant expects considerable challenges with removing the solids from these frac tanks at the site landfill.

Because of the high risk of leakage from the tank piping and the need for daily tank removal and replacement due to solid accumulation, the tank site would cover at least 25 acres plus an estimated 10 acres for the roads and pipeline corridors to and from the tank array. As a result, at least 35 acres of controlled stormwater drainage (~45 million gallons) would have to be added to the current 180 acres that is managed in the ponds. Temporary tanks for storage of millions of gallons of stormwater are not considered technically feasible to mobilize and allow for simultaneous retrofit of two site impoundments. Consequently, Luminant believes this requested schedule showing sequential annual retrofits for each of the remaining two (or potentially three) CCR surface impoundments onsite represents the fastest technically feasible timeframe for compliance at Martin Lake, and these durations are consistent with EPA's assessment that 12 months accurately reflects the amount of time needed to retrofit a single surface impoundment. *See* 85 Fed. Reg. at 53,529.

Table 2-6: Retrofit Project Progress Milestones

Year or Progress Reporting Period	Status	Milestone Description	Luminant Notes
2019	Completed	Evaluate retrofit scenarios, Complete Design Activities	Luminant began design of the retrofit solution in early 2019.

Year or Progress Reporting Period	Status	Milestone Description	Luminant Notes
2020	Completed	Bid and Award construction contract for EAP retrofit, complete the EAP retrofit, begin CCR removal from the WAP, submit Demonstration under 257.103(f)(1) requesting extension of the deadline to cease placing wastestreams into Ash Pond Area and PDP5	The construction of the first pond retrofit (EAP) has been completed as of early October 2020.
April 30, 2021	Scheduled	Bid and Award construction contract for WAP retrofit, Continue removal of CCR from WAP	The WAP will remain in service during CCR removal to receive excess rainfall and prevent unnecessary discharge until late June 2021. On July 5, 2021, flows will cease to the WAP and will be routed to the retrofitted EAP and the unlined NSP, and PDP5 will remain in service to continue to provide storage capacity for excess CCR and non-CCR wastestreams and stormwater. In the event the site experiences heavy rain events during the unit outages when the WAP is scheduled to be retrofitted, temporary use of the WAP for wastewater or stormwater storage may be necessary.
October 31, 2021	Scheduled	Complete removal of CCR from WAP, Complete construction of WAP retrofit (other than punchlist items), Begin Dewatering/CCR Removal from NSP	The WAP construction is forecasted to be completed within calendar year 2021. Concurrent with the WAP retrofit, NSP CCR removal operations will be initiated; however, the NSP will remain in service to receive excess rainfall and prevent unnecessary discharge until late June 2022.
April 30, 2022	Scheduled	Continued CCR Removal from NSP, Bid and Award construction contract for NSP retrofit	On June 29, 2022, flows will cease to the NSP and will be routed to the retrofitted EAP and WAP. PDP5 will remain in service to continue to provide storage capacity for excess CCR and non-CCR wastestreams and stormwater. In the event the site experiences heavy rain events during the planned unit outages prior to when the NSP is scheduled to be retrofitted, the temporary use of the NSP for wastewater or stormwater storage may be necessary.

Year or Progress Reporting Period	Status	Milestone Description	Luminant Notes
October 31, 2022	Scheduled	Complete construction of NSP retrofit and begin potential detailed design for PDP5 retrofit	Luminant is projecting that retrofit activities for the Ash Pond Area can be completed by November 1, 2022.This is subject to delays primarily associated with the unknown efficiency of dewatering/dredging of scrubber solids from the NSP. At this point, flows will be concentrated to the retrofitted Ash Pond Area and Luminant will begin removing CCR material from PDP5 if required; however, PDP5 must remain in service to receive excess rainfall and prevent unnecessary discharge until July 1, 2023.
July 1, 2023	TBD (depends on alternate liner status under Part B Rule)	Begin retrofit for PDP5	PDP5 would cease receiving all wastestreams on July 1, 2023, and begin retrofit if it does not qualify for alternate liner demonstration.

2.2 Detailed Schedule to Obtain Alternative Disposal Capacity - § 257.103(f)(1)(iv)(A)(2)

The required visual timeline representation of the schedule is included in Appendix B of this demonstration and described further in Section 2.3 below.

2.3 Narrative of Schedule and Visual Timeline - § 257.103(f)(1)(iv)(A)(3)

The third section for the workplan is a "detailed narrative of the schedule and the timeline discussing all the necessary phases and steps in the workplan, in addition to the overall timeframe that will be required to obtain capacity and cease receipt of waste." 85 Fed. Reg. at 53,544. As EPA explained in the preamble to the Part A rule, this section of the workplan must discuss "why the length of time for each phase and step is needed, including a discussion of the tasks that occur during the specific stage of obtaining alternative capacity. It must also discuss the tasks that occur during each of the steps within the phase." 85 Fed. Reg. at 53,544. In addition, the schedule should "explain why each phase and step shown on the chart must happen in the order it is occurring and include a justification for the overall length of the phase" and the "anticipated worker schedule." 85 Fed. Reg. at 53,544. EPA notes the overall "discussion of the schedule assists EPA in understanding why the time requested is accurate." 85 Fed. Reg. at 53,544.

As described in Section 2.1.6, the CCR surface impoundments must be retrofitted sequentially, with no more than one impoundment undergoing retrofit at any point in time, and preferably during the summer months while the units are operating and evaporating any excess water that could accumulate. These periods require the least total water storage capacity to maintain zero discharge operations at the site. This start date is subject to delays caused by significant rain events as well as any prolonged outages at the plant.

Based on the estimated durations shown in Appendix B, each impoundment retrofit will require a minimum of one construction season for completion. The following paragraphs outline the scope required for the retrofit of each impoundment in the Ash Pond Area. The design drawings, which include additional scope definition for each impoundment, are included in Appendix C (EAP), Appendix D (WAP), and Appendix E (NSP). The design for the PDP5 retrofit will be completed if necessary following the determination of the facility's alternate liner status under the Part B Rule. The construction activities for the PDP5 retrofit are not included within this Demonstration as they will occur after the requested alternative deadline for PDP5 (if retrofit is necessary following EPA's review of PDP5's alternate liner status under the Part B Rule).

EAP Retrofit Activities: As noted on the schedule in Appendix B, the construction for the EAP retrofit has been completed; however, the sequence of activities is included in this narrative as it provides context for the remaining facilities that will rely on similar activities and sequence to this completed project. Luminant removed nearly all the CCR material in 2019. The durations shown on the project schedule match both the estimates developed by the selected construction contractor and experienced on the EAP retrofit. These durations are based on an average work schedule of six days per week, are subject to delays caused by significant rain events, and are based on the following scope of work which must be performed in the sequence listed below:

- Contractor shall order necessary materials and mobilize to the site. The lead time for the liner materials and the piping are shown on the Appendix B schedule and are based on feedback from suppliers and confirmed by the construction contractor.
- Contractor shall remove any remaining CCR material, rocks, and sediment from the EAP, and haul and stockpile this material at the Decant Basin. Luminant will load the stockpiled material onto rail cars for disposal at the Martin Lake A-1 Area Landfill. This effort is referred to as Site Preparation on the Appendix B schedule.
- Contractor shall use water from the adjacent WAP or NSP to wash remaining CCR material off the sides and floor of the EAP and remove the material. The existing revetment mat within the EAP will be visually inspected to confirm CCR material, rocks and sediment have been removed.

- Contractor shall load and haul general soil fill material from the stockpile located at Liberty Mine. This stockpile is located approximately 4.5 miles from the EAP. Contractor shall place the general fill material over the existing concrete revetment to a depth of at least six (6) inches, nominally compact it, and smooth roll to finish the installation.
- Contractor shall load and haul general soil fill material from the stockpile located at Liberty Mine to the location identified as the "Temporary Stockpile Location" south of PDP 5 (see Appendix C Drawings). Upon completion, Contractor shall seed the stockpile and install erosion control measures, such as silt fencing, at the stockpile. The stockpiled material, either from the mine or this temporary location, will be used to support the subsequent WAP and NSP retrofit activities.
- Contractor shall install a GCL over the sides and floor of the EAP and secure it in a perimeter anchor trench.
- Contractor shall install a 60-mil HDPE liner directly on the GCL and secure it in a perimeter anchor trench. This occurred at the same time as the GCL placement, lagging slightly behind it but overlapping. Consequently, these activities are shown on the same timeline in Appendix B. As shown in Appendix C, the GCL and the membrane are also attached to piping (air vents and dewatering line) with pipe boots and are battened to the concrete structures within the impoundment during this installation period.
- Contractor shall modify the existing 48-inch suction line on the south end of the pond by increasing the screened area as shown in the plans (see Appendix C Drawings). This activity is complete.
- Contractor shall install all 12-inch HDPE pipe as shown in the plans. Each pipeline will start at its corresponding isolation valve previously installed by Luminant. This work has been completed so the new lines can be placed into service prior to returning any water to the EAP and to allow for full function of the plant recycle systems once the WAP and eventually NSP are removed from service for retrofitting. As shown in Appendix C, this piping is anchored to a concrete slab that is tied into the new EAP impoundment liner and will not create a new liner penetration. Approximately 5,400 linear feet of piping was rerouted or added as part of this project.
- The Contractor shall pump off stormwater as necessary from the EAP to the WAP during construction. This is an ongoing activity that will be required following each rain event during the construction period. Consequently, it is not shown on the construction schedule.
- Upon completion, Luminant will resume operation of the EAP by transferring a portion of the water from the WAP so CCR material removal efforts can progress more efficiently at that facility.

<u>WAP Retrofit Activities:</u> As noted on the schedule in Appendix B, the design is completed for the WAP retrofit; however, the construction contract has not been bid or awarded at this time. This procurement effort

will be completed in time to support construction of the WAP retrofit (planned for July 2021), after the spring rainfall periods when the storage capacity required at Martin Lake is reduced by the peak summer operation of the generating units. Luminant began removing a majority of the CCR material during the 2020 summer operational period and those efforts are continuing; however, any significant rain events that occur in the fall of 2020 through the spring of 2021 may need to be diverted to the WAP as required. The remaining durations shown on the project schedule are based on the estimated durations and work schedule received from the EAP construction contractor and have been adjusted based on the estimated quantity differences between the EAP and the WAP. The WAP retrofit includes the following scope of work, which must be performed in the sequence listed below:

- Contractor shall order necessary materials and mobilize to the site.
- Contractor shall remove any remaining CCR material, rocks, and sediment from the WAP, and haul and stockpile this material at the Decant Basin. Luminant will load the stockpiled material onto rail cars for disposal at the Martin Lake A-1 Area Landfill.
- Contractor shall use water from the adjacent EAP or NSP to wash remaining CCR material off the sides and floor of the WAP and remove the material. The WAP will be visually inspected to confirm CCR material, rocks and sediment have been removed.
- Contractor shall load and haul general soil fill material from the stockpile, which will have been relocated adjacent to PDP5. Contractor shall place the general fill material over the existing concrete revetment to a depth of at least six (6) inches, nominally compact it, and smooth roll to finish the installation. This activity must be completed after the existing revetment mat is inspected and confirmed to be free of CCR material but before the liner system can be placed.
- Contractor shall install a GCL over the sides and floor of the WAP and secure it in a perimeter anchor trench.
- Contractor shall install a 60-mil HDPE liner directly on the GCL and secure it in a perimeter anchor trench. This will occur at the same time as the GCL placement, lagging slightly behind it but overlapping. Consequently, these activities are shown on the same timeline. As shown in Appendix D, the GCL and the membrane will also be attached to piping (air vents and standpipe) with pipe boots and will be battened to the concrete structures within the impoundment during this installation period.
- The Contractor shall pump off storm water as necessary from the WAP to the EAP during construction. This is an ongoing activity that will be required following each rain event during the construction period. Consequently, it is not shown on the construction schedule.

- Upon completion, Luminant will post the required notification of retrofit completion and resume operation of the WAP, likely by transferring the water from the NSP so that CCR material removal efforts can progress more efficiently at that facility.

NSP Retrofit Activities: As noted on the schedule in Appendix B, the design is completed for the NSP retrofit; however, the construction contract has not been bid or awarded at this time. This procurement effort will be completed in time to support construction of the NSP retrofit beginning approximately July 2022, when the storage capacity required at Martin Lake is reduced by the peak summer operation of the generating units. Luminant will begin removing the CCR material during the summer 2021 operational period and the impoundment will be dewatered once the WAP is placed into service; however, any significant rain events that occur through the spring of 2022 will be diverted to the NSP as required to prevent discharge from the site. The durations shown on the project schedule are based on the estimated durations and work schedule developed by the EAP construction contractor and have been adjusted based on the estimated quantity differences between the EAP and the NSP. The contractor scope for the NSP retrofit is identical to the WAP except for the quantity differences and an additional pipe rack liner attachment. The design drawings for the NSP retrofit are included in Appendix E.

The CCR removal efforts at the NSP will be different than at the WAP. There is a similar amount of material in each pond; however, the scrubber sludge will be significantly more challenging to dewater and decant than the bottom ash fines. This leads to a longer removal schedule necessary to drain the material for excavation and decant the material (at the Decant Pad/Basins) prior to loading on rail cars. Even when dewatered, this material will be significantly wetter than the ash fines which may impact landfill operations during disposal. This operation will likely require a larger surface area to promote spreading and drying of the material prior to compaction, and that could impact the rate at which material can be hauled to the landfill. Luminant will provide ongoing schedule updates in the required semi-annual progress reports; however, this activity, along with any anticipated delays due to rain or delayed starts due to increased demand for water storage onsite, are the primary factors that could extend the schedule for this retrofit project.

PDP5 Retrofit Activities: Luminant intends to evaluate the Part B Rule requirements and anticipates applying for the alternate liner demonstration for PDP5 prior to or on November 30, 2020. For purposes of this request, Luminant has included the construction sequence for a potential PDP5 retrofit that may follow the NSP retrofit in the same sequence described for the Ash Pond Area above if the EPA denies the application or the ensuing demonstration. PDP5 cannot be removed from service until approximately July 1, 2023, following the spring outage season and typically wet spring months and coincident with summer peak operation so that plant operations can be sustained with the reduced pond capacity during the retrofit project. The schedule in Appendix B shows the design and construction procurement efforts being completed as required to meet this allowable construction period.

2.4 Progress Towards Obtaining Alternative Capacity - § 257.103(f)(1)(iv)(A)(4)

In the preamble to the final Part A rule, EPA explains that this "section [of the workplan] must discuss all of the steps taken, starting from when the owner or operator initiated the design phase all the way up to the current steps occurring while the workplan is being drafted." 85 Fed. Reg. at 53,544. The discussion also must indicate where the facility currently is on the timeline and the processes that are currently being undertaken at the facility to develop alternative capacity. 85 Fed. Reg. at 53,545.

As shown in Appendix B and described in Section 2.1.6 and Table 2-6, Luminant has made considerable progress toward creating alternative disposal capacity for the CCR and non-CCR wastestreams at Martin Lake, specifically the Ash Pond Area units. Design for the retrofit project is complete, the required notification of intent to retrofit has been posted to Luminant's CCR website for the Ash Pond Area, and construction of the EAP retrofit has been completed as shown in Appendix B, prior to the April 11, 2021, deadline. Luminant has also started removing the CCR material from the WAP, and that effort is anticipated to be completed early next year.

3.0 DOCUMENTATION AND CERTIFICATION OF COMPLIANCE

To demonstrate that the criteria in 40 C.F.R. § 257.103(f)(1)(iii) has been met, the following information and submissions are submitted pursuant to 40 C.F.R. § 257.103(f)(1)(iv)(B) to demonstrate that the CCR surface impoundments at Martin Lake are in compliance with the CCR rule.

3.1 Owner's Certification of Compliance - § 257.103(f)(1)(iv)(B)(1)

In accordance with 40 C.F.R. § 257.103(f)(1)(iv)(B)(1), I hereby certify that, based on my inquiry of those persons who are immediately responsible for compliance with environmental regulations for the CCR Ash Pond Area and PDP5 at Martin Lake, the facilities are in compliance with all of the requirements contained in 40 C.F.R. Part 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments. Martin Lake's CCR compliance website is up-to-date and contains all the necessary documentation and notification postings.

LUMINANT GENERATION COMPANY LLC

Cynthia E. Vod

Cynthia Vodopivec
VP - Environmental Health & Safety
October 23, 2020

3.2 Visual Representation of Hydrogeologic Information - § 257.103(f)(1)(iv)(B)(2)

Consistent with the requirements of § 257.103(f)(1)(iv)(B)(2)(i) – (iii), Luminant has attached the following items to this demonstration:

- Map(s) of groundwater monitoring well locations in relation to the CCR unit (Appendix F1)
- Well construction diagrams and drilling logs for all groundwater monitoring wells (Appendix F2)
- Maps that characterize the direction of groundwater flow accounting for seasonal variations (Appendix F3)

3.3 Groundwater Monitoring Results - § 257.103(f)(1)(iv)(B)(3)

Tables summarizing constituent concentrations at each groundwater monitoring well for the Ash Pond Area and PDP5 are included as Appendix F4.

3.4 Description of Site Hydrogeology - § 257.103(f)(1)(iv)(B)(4)

A description of site hydrogeology and stratigraphic cross-sections of the site (including the Ash Pond Area and PDP5) are included as Appendix F5.

3.5 Corrective Measures Assessment - § 257.103(f)(1)(iv)(B)(5)

For the Ash Pond Area, the first assessment monitoring samples were collected in June 2018. The results, through the first 2020 semi-annual monitoring period, indicate the Ash Pond area is currently in assessment monitoring, with exceedances of the groundwater protection standards (GWPS) for beryllium, cobalt, and lithium first determined in January of 2019. Accordingly, pursuant to § 257.96, a corrective measures assessment report was prepared for the Ash Pond Area in September 2019 and is included as Appendix F6. For PDP5, detection monitoring has indicated statistically significant increases (SSIs) above the background concentrations; however, Luminant has completed successful alternate source demonstrations and the facility remains in detection monitoring. Accordingly, an assessment of corrective measures is not required for PDP5.

3.6 Remedy Selection Progress Reports - § 257.103(f)(1)(iv)(B)(6)

For the Ash Pond Area, selection of a remedy is underway. Accordingly, pursuant to § 257.97(a), semi-annual remedy selection progress reports were prepared for the Ash Pond Area on March 4, 2020, and September 3, 2020, and are included as Appendix F7. As noted above, an assessment of corrective measures and the resulting remedy selection efforts are not currently required for PDP5.

3.7 Structural Stability Assessment - § 257.103(f)(1)(iv)(B)(7)

Pursuant to § 257.73(d), the initial structural stability assessment report for Martin Lake was prepared in October 2016 and is included as Appendix F8. As required for compliance, another stability assessment will be completed in October 2021.

3.8 Safety Factor Assessment - § 257.103(f)(1)(iv)(B)(8)

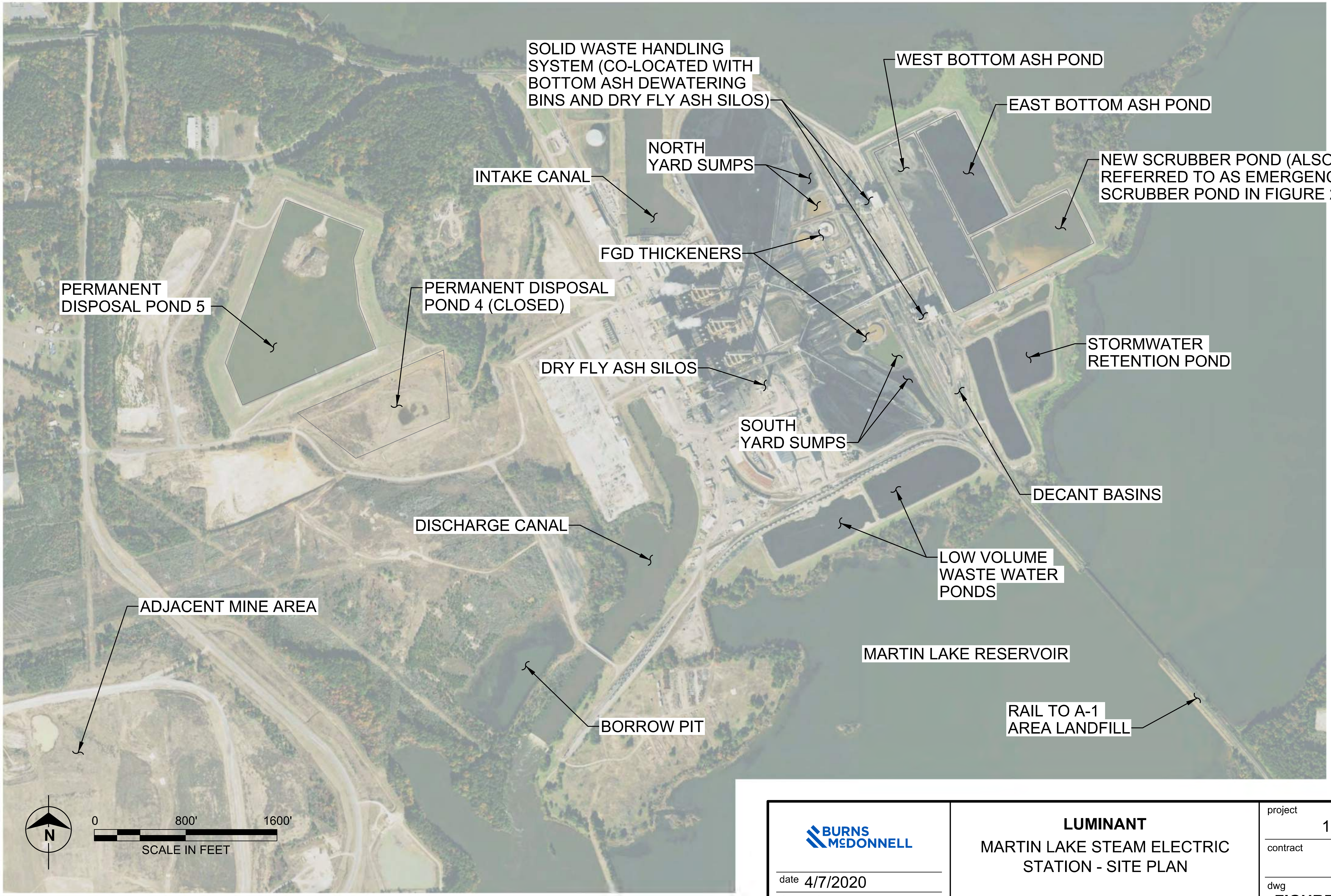
Pursuant to § 257.73(e), the initial safety factor assessment report for Martin Lake was prepared in October 2016 and is included as Appendix F9. As required for compliance, another safety factor assessment will be completed in October 2021.

4.0 CONCLUSION

Based upon the information submitted in this demonstration, the Ash Pond Area and PDP5 at Martin Lake qualify for the site-specific alternative deadline for the initiation of closure as allowed by 40 C.F.R. § 257.103(f)(1).

Therefore, Luminant requests that EPA approve the demonstration and grant an alternative deadline of June 29, 2022, for the Ash Pond Area, to allow for the continued placement of CCR and non-CCR wastestreams in the Ash Pond Area while the remaining impoundments are sequentially retrofitted. In addition, Luminant is requesting an alternative site-specific deadline of July 1, 2023, for PDP5, to allow for the continued placement of CCR and non-CCR wastestreams in PDP5 during the Ash Pond Area retrofit project and thereafter to begin retrofit of PDP5 (if necessary following an EPA decision on the alternate liner application and demonstration expected to be submitted for PDP5 under the Part B Rule prior to November 30, 2020, and November 30, 2021, respectively). If retrofit of PDP5 is necessary, the retrofit work would initiate on July 1, 2023, following the wet spring months coincident with the spring outages when the maximum site water storage capacity is required. Luminant will update EPA on the project and any potential schedule impacts as part of the semi-annual progress reports required at 40 C.F.R. § 257.103(f)(1)(x), and if a need for a later compliance deadline is determined, Luminant will seek additional time as described in 40 C.F.R. § 257.103(f)(1)(vii).

APPENDIX A – SITE PLAN AND WATER BALANCE DIAGRAM



BURNS McDONNELL

date 4/7/2020

designed A. MYERS

LUMINANT

MARTIN LAKE STEAM ELECTRIC STATION - SITE PLAN

project 122702

contract -

dwg **FIGURE 1**

5/20/2020

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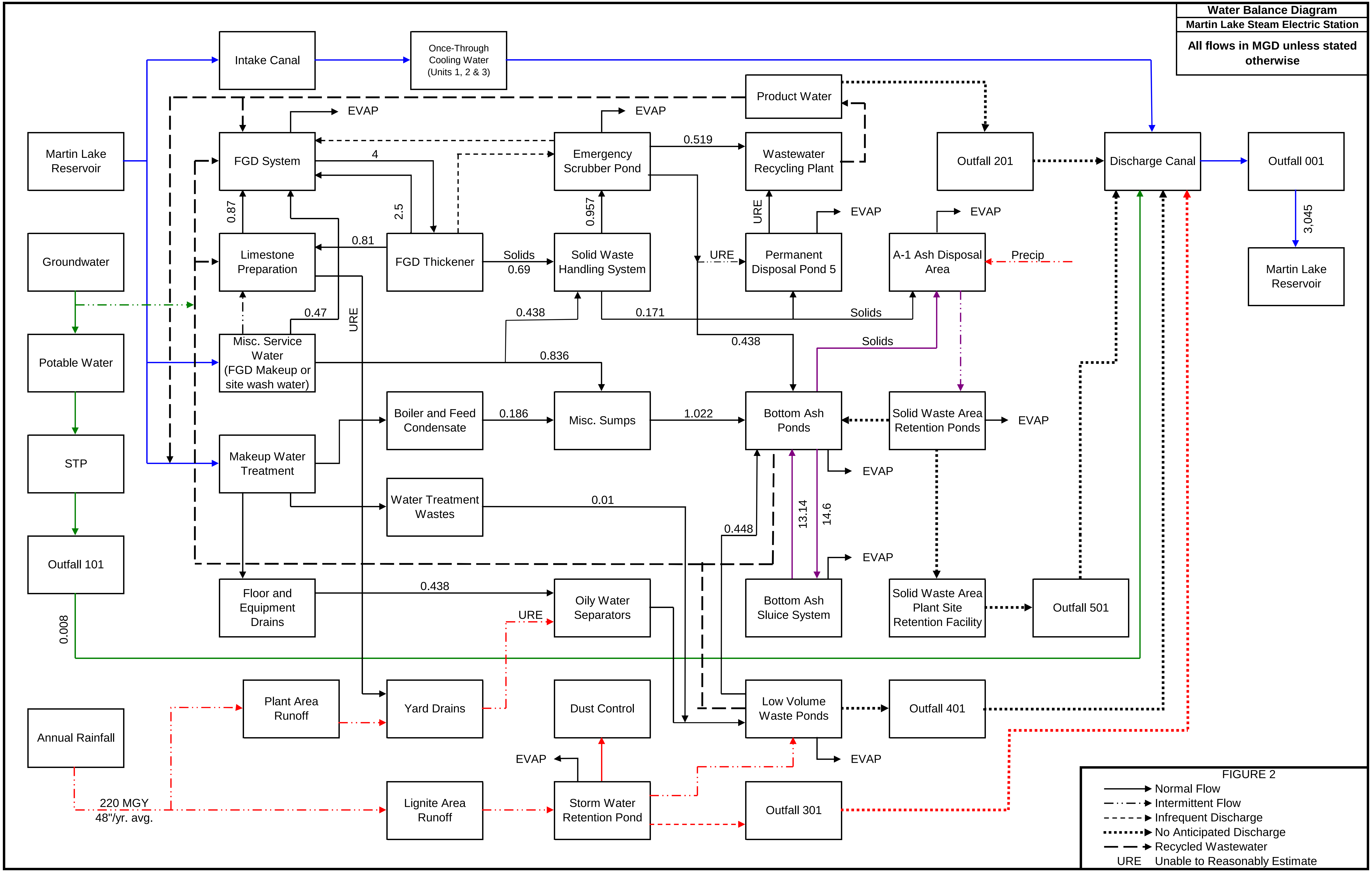
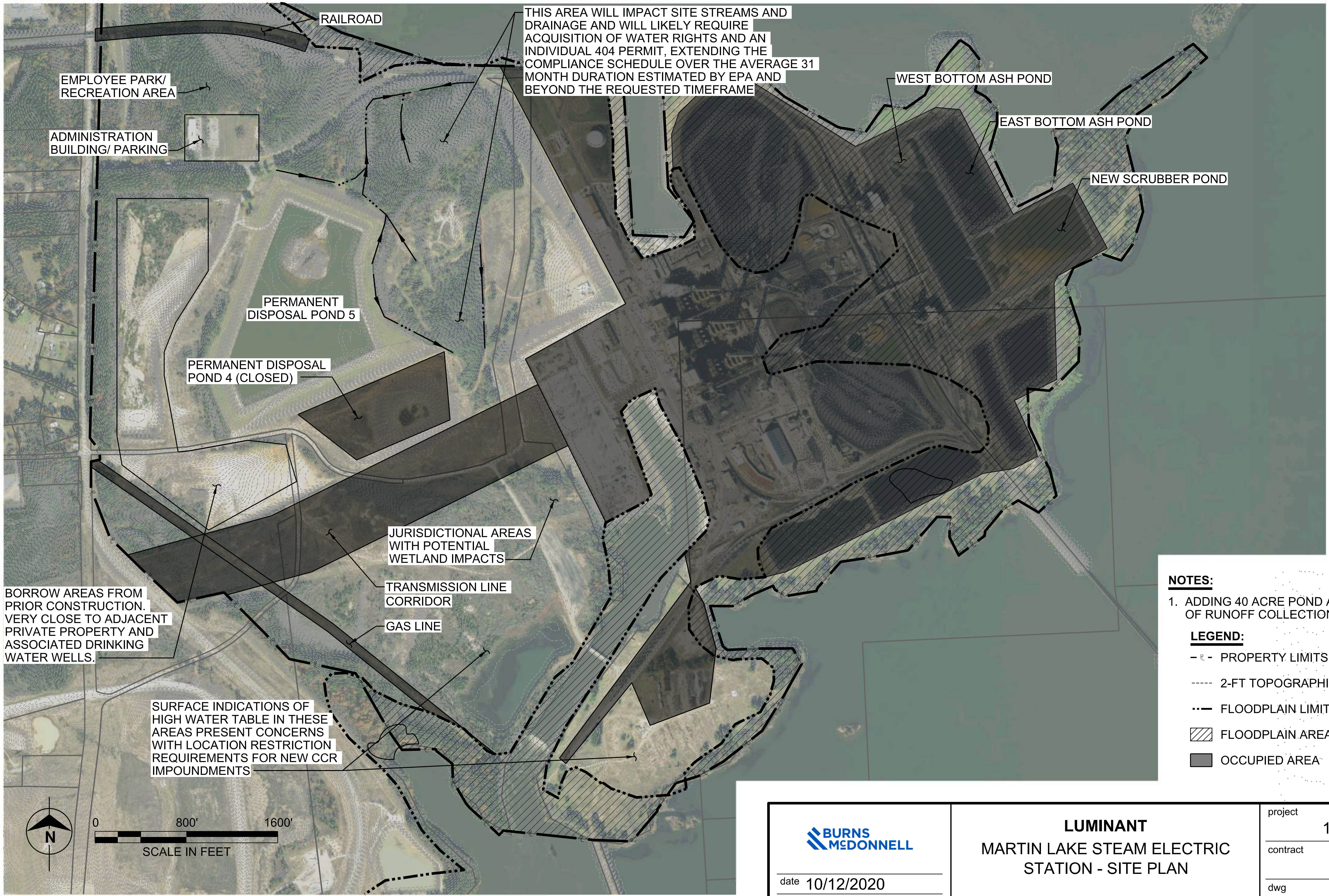

Water Balance Diagram
Martin Lake Steam Electric Station
All flows in MGD unless stated otherwise
Intake Canal
Once-Through Cooling Water (Units 1, 2 & 3)
Product Water
Martin Lake Reservoir
FGD System
EVAP
Emergency Scrubber Pond
EVAP
0.519
Wastewater Recycling Plant
Outfall 201
Discharge Canal
Outfall 001
4
2.5
0.87
0.957
URE
EVAP
EVAP
3,045
Groundwater
Limestone Preparation
0.81
FGD Thickener
Solids
0.69
Solid Waste Handling System
URE
Permanent Disposal Pond 5
A-1 Ash Disposal Area
Precip
Martin Lake Reservoir
0.47
URE
0.438
0.171
Solids
Potable Water
Misc. Service Water (FGD Makeup or site wash water)
0.836
0.438
Solids
Boiler and Feed Condensate
0.186
Misc. Sumps
1.022
Bottom Ash Ponds
Solid Waste Area Retention Ponds
EVAP
STP
Makeup Water Treatment
EVAP
Water Treatment Wastes
0.01
13.14
14.6
0.448
EVAP
Outfall 101
Floor and Equipment Drains
0.438
Oily Water Separators
URE
Bottom Ash Sluice System
Solid Waste Area Plant Site Retention Facility
Outfall 501
0.008
Plant Area Runoff
Yard Drains
Dust Control
Low Volume Waste Ponds
Outfall 401
Annual Rainfall
EVAP
EVAP
220 MGY
48"/yr. avg.
Lignite Area Runoff
Storm Water Retention Pond
Outfall 301
Normal Flow
Intermittent Flow
Infrequent Discharge
No Anticipated Discharge
Recycled Wastewater
URE Unable to Reasonably Estimate

FIGURE 2



NOTES:

1. ADDING 40 ACRE POND ADDS 60 ACRES OF RUNOFF COLLECTION.

LEGEND:

— ℄ - PROPERTY LIMITS

----- 2-FT TOPOGRAPHIC CONTOURS

-··— FLOODPLAIN LIMITS

▨ FLOODPLAIN AREA

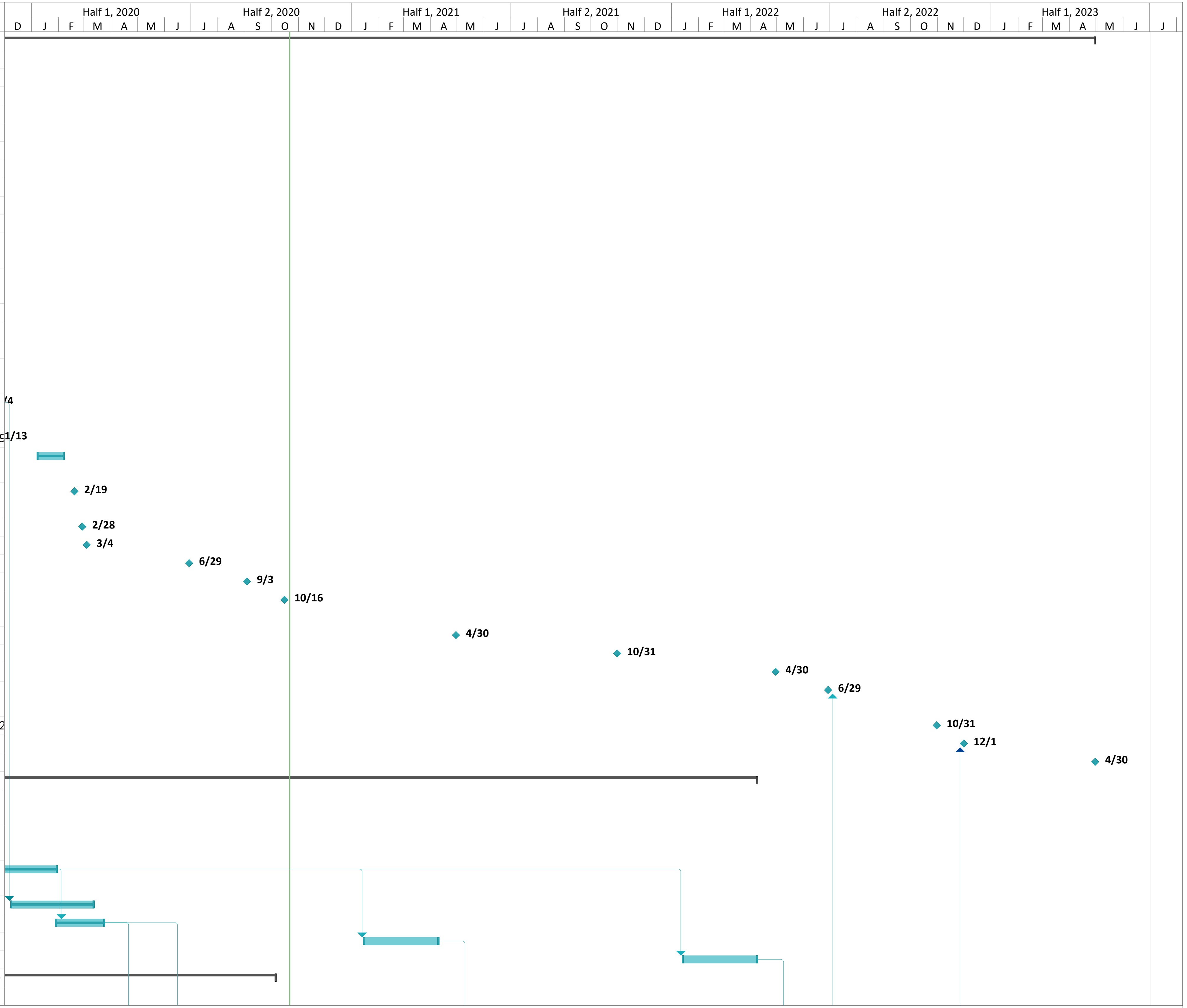
■ OCCUPIED AREA

BURNS McDONNELL	**LUMINANT** MARTIN LAKE STEAM ELECTRIC STATION - SITE PLAN	project 122702
date 10/12/2020		contract -
designed A. MYERS		dwg **FIGURE 3**

10/20/2020 \\bmcd\dfs\Clients\ENR\VistraEnergy\122702_ALTuseDisposal\Design\Civil\Dwgs\Sketches\Martin Lake_Figure3.dgn

APPENDIX B – SCHEDULE

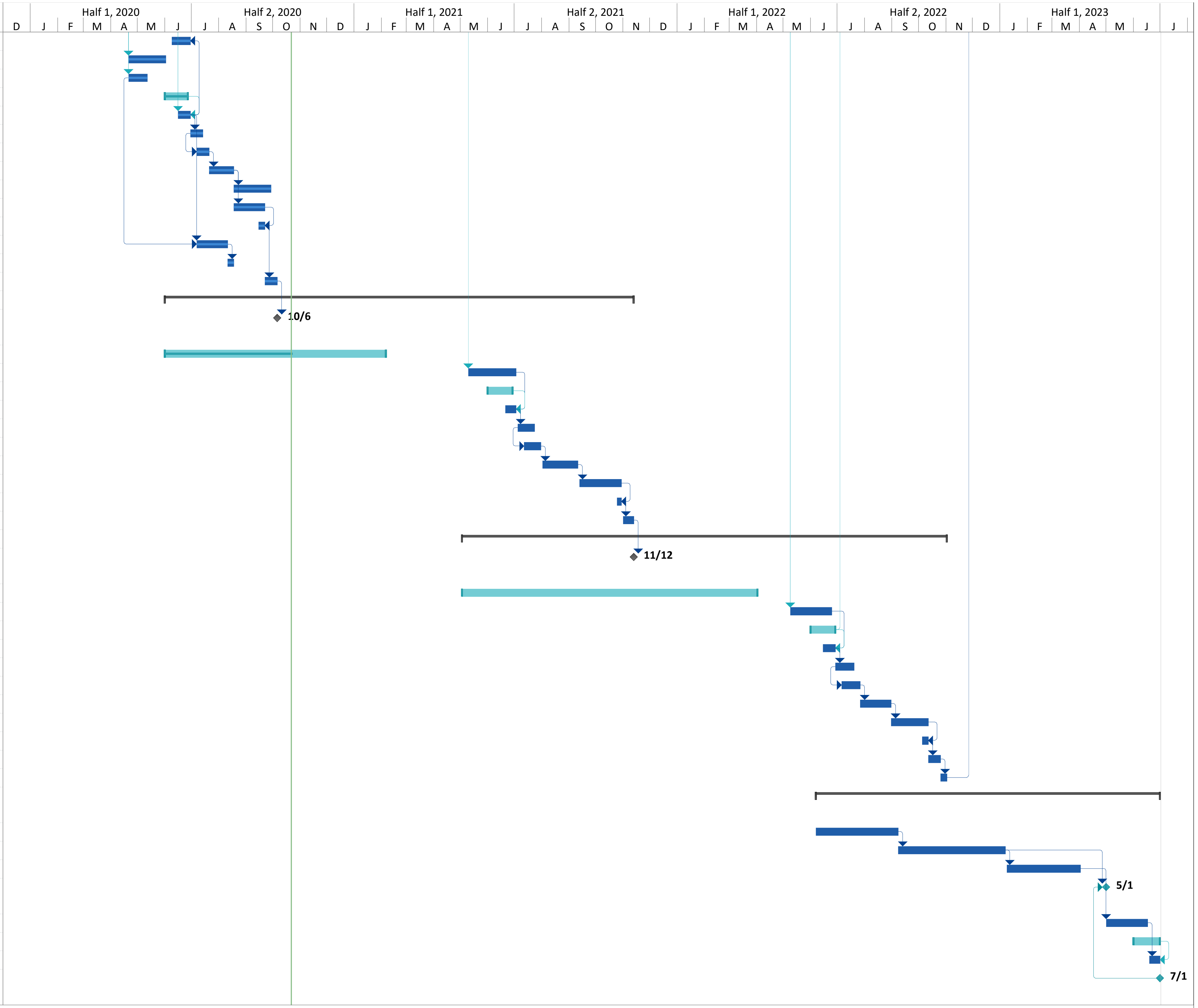
ID	Task Name	Duration	Start	Finish
1	**CCR Compliance Efforts**	**2116 days**	**Mon 3/23/15**	**Sun 4/30/23**
2	BMcD Retained by Luminant to Review CCR Compliance Impacts	95 days	Mon 3/23/15	Fri 7/31/15
3	Final CCR Rule Published in Federal Register	0 days	Fri 4/17/15	Fri 4/17/15
4	BMcD Completed Initial Water Balance Evaluation	94 days	Thu 7/2/15	Tue 11/10/15
5	Luminant Installed Groundwater Monitoring Wells	12 days	Wed 9/9/15	Thu 9/24/15
6	Background Groundwater Sampling	302 days	Mon 10/19/15	Tue 12/13/16
7	BMcD Completed Liner Documentation	0 days	Fri 9/16/16	Fri 9/16/16
8	BMcD Prepared Surface Impoundment History of Construction	0 days	Wed 10/5/16	Wed 10/5/16
9	First Detection Monitoring Samples	0 days	Thu 9/21/17	Thu 9/21/17
10	Ash Pond Area Assessment Monitoring Program - First Round	34 days	Tue 6/12/18	Fri 7/27/18
11	Ash Pond Area Assessment Monitoring Program - Second Round	22 days	Fri 9/7/18	Mon 10/8/18
12	Golder completed Successful Location Restriction Demonstration for Ash Pond Area and PDP 5	0 days	Wed 10/10/18	Wed 10/10/18
13	SSL Determination/Notification - Ash Pond Area - Beryllium, Cobalt, and Lithium	23 days	Mon 1/7/19	Wed 2/6/19
14	Ash Pond Area Assessment Monitoring Program - Third Round	24 days	Tue 5/14/19	Fri 6/14/19
15	Ash Pond Area Assessment Monitoring Program - Fourth Round	24 days	Tue 9/10/19	Fri 10/11/19
16	Corrective Measures Assessment for Ash Pond Area	87 days	Wed 5/8/19	Thu 9/5/19
17	SSL Determination/Notification - Ash Pond Area - Beryllium and Cobalt	23 days	Thu 9/5/19	Mon 10/7/19
18	EPA Released Proposed Draft ELG Rule and CCR Holistic Approach to Closure Part A Rule	0 days	Mon 11/4/19	Mon 11/4/19
19	Public Meeting to review Corrective Measures Assessment	0 days	Wed 11/13/19	Wed 11/13/19
20	SSL Determination/Notification - Ash Pond Area - Beryllium and Cobalt	22 days	Wed 1/8/20	Thu 2/6/20
21	EPA Released Proposed Draft CCR Holistic Approach to Closure Part B Rule	0 days	Wed 2/19/20	Wed 2/19/20
22	Retrofit Plan Published	0 days	Fri 2/28/20	Fri 2/28/20
23	Semiannual Remedy Selection Progress Report Posted	0 days	Wed 3/4/20	Wed 3/4/20
24	Notification of Intent to Retrofit the Ash Pond Area	0 days	Mon 6/29/20	Mon 6/29/20
25	Semiannual Remedy Selection Progress Report Posted	0 days	Thu 9/3/20	Thu 9/3/20
26	EPA Released Pre-published version of Final CCR Holistic Approach to Closure Part B Rule	0 days	Fri 10/16/20	Fri 10/16/20
27	Semi-Annual Progress Report #1	0 days	Fri 4/30/21	Fri 4/30/21
28	Semi-Annual Progress Report #2	0 days	Sun 10/31/21	Sun 10/31/21
29	Semi-Annual Progress Report #3	0 days	Sat 4/30/22	Sat 4/30/22
30	Cease Placing Wastestreams in Unlined Portions of the Ash Pond Area	0 days	Wed 6/29/22	Wed 6/29/22
31	Semi-Annual Progress Report #4 (if required for PDP5)	0 days	Mon 10/31/22	Mon 10/31/22
32	Notification of Completion of Retrofit - Ash Pond Area	0 days	Thu 12/1/22	Thu 12/1/22
33	Semi-Annual Progress Report #5 (if required for PDP5)	0 days	Sun 4/30/23	Sun 4/30/23
34	**Impoundment Retrofit - Engineering and Procurement Efforts**	**823 days**	**Wed 2/13/19**	**Fri 4/8/22**
35	Bid and Award Engineering Services for Ash Pond Area Retrofit Project	67 days	Wed 2/13/19	Thu 5/16/19
36	HDR Performed Alternatives Analysis for Ash Pond Area Retrofit Project	98 days	Fri 5/17/19	Tue 10/1/19
37	HDR Detailed Design: Prepared Ash Pond Area (EAP, WAP, and NSP) Retrofit Bid Documents	87 days	Tue 10/1/19	Wed 1/29/20
38	HDR Performed Alternatives Analysis for PDP 5 Retrofit Project	68 days	Mon 12/9/19	Wed 3/11/20
39	Bid/Award East Ash Pond Retrofit Construction Contract	39 days	Wed 1/29/20	Mon 3/23/20
40	Bid/Award West Ash Pond Retrofit Construction Contract	61 days	Fri 1/15/21	Fri 4/9/21
41	Bid/Award New Scrubber Pond Retrofit Construction Contract	61 days	Fri 1/14/22	Fri 4/8/22
42	**East Ash Pond Retrofit Construction**	**351 days**	**Mon 6/3/19**	**Mon 10/5/20**
43	Luminant Removal of Ponded CCR Material during Operations	90 days	Mon 6/3/19	Fri 10/4/19



Project: Martin Lake CCR Surface Impoundment Extension Demonstration
Date: Thu 10/22/20

Task	▬	Project Summary	⊓	Inactive Milestone	◇	Manual Summary Rollup	▬	Deadline	⇩
Split	┈┈┈	External Tasks	▬	Inactive Summary	⊓	Manual Summary	⊓	Progress	▬
Milestone	◆	External Milestone	◆	Manual Task	▬	Start-only	[	Manual Progress	▬
Summary	⊓	Inactive Task	▬	Duration-only	▬	Finish-only	]		

ID	Task Name	Duration	Start	Finish
44	Dewatering of EAP to other CCR impoundments	15 days	Tue 6/9/20	Mon 6/29/20
45	Liner Material Acquisition	30 days	Tue 4/21/20	Mon 6/1/20
46	Piping Material Acquisition	15 days	Tue 4/21/20	Mon 5/11/20
47	Dewatering to remove Accumulated Spring Rainfall	20 days	Mon 6/1/20	Fri 6/26/20
48	Contractor Mobilization to Site	10 days	Tue 6/16/20	Mon 6/29/20
49	Site Preparation	10 days	Tue 6/30/20	Mon 7/13/20
50	Clean Existing Concrete Revetment Mat	10 days	Tue 7/7/20	Mon 7/20/20
51	Place 6" General Soil Fill Layer	20 days	Tue 7/21/20	Mon 8/17/20
52	Stockpile Soils Material	30 days	Tue 8/18/20	Mon 9/28/20
53	GCL & HDPE Liner Installation	25 days	Tue 8/18/20	Mon 9/21/20
54	Pipe Rack - Liner Attachment	5 days	Tue 9/15/20	Mon 9/21/20
55	12" HDPE Yard Pipe Installation	25 days	Tue 7/7/20	Mon 8/10/20
56	48" Suction Line	5 days	Tue 8/11/20	Mon 8/17/20
57	Punchlist and Contract Closeout	10 days	Tue 9/22/20	Mon 10/5/20
58	**West Ash Pond Retrofit Construction**	**380 days**	**Mon 6/1/20**	**Fri 11/12/21**
59	Potential further reduction in WAP water levels (as water balance allows) to facilitate more efficient CCR removal operations	0 days	Tue 10/6/20	Tue 10/6/20
60	Luminant Removal of Ponded CCR Material during Operations	180 days	Mon 6/1/20	Fri 2/5/21
61	Liner Material Acquisition	40 days	Mon 5/10/21	Fri 7/2/21
62	Dewatering to remove Accumulated Spring Rainfall	20 days	Tue 6/1/21	Mon 6/28/21
63	Contractor Mobilization to Site	10 days	Mon 6/21/21	Fri 7/2/21
64	Site Preparation	15 days	Mon 7/5/21	Fri 7/23/21
65	Clean Existing Concrete Revetment Mat	15 days	Mon 7/12/21	Fri 7/30/21
66	Place 6" General Soil Fill Layer	30 days	Mon 8/2/21	Fri 9/10/21
67	GCL & HDPE Liner Installation	35 days	Mon 9/13/21	Fri 10/29/21
68	Pipe Rack - Liner Attachment	5 days	Mon 10/25/21	Fri 10/29/21
69	Punchlist and Contract Closeout	10 days	Mon 11/1/21	Fri 11/12/21
70	**New Scrubber Pond Retrofit Construction**	**392 days**	**Mon 5/3/21**	**Tue 11/1/22**
71	Potential further reduction in NSP water levels (as water balance allows) to facilitate more efficient CCR removal operations	0 days	Fri 11/12/21	Fri 11/12/21
72	Luminant Removal of Ponded CCR Material during Operations	240 days	Mon 5/3/21	Fri 4/1/22
73	Liner Material Acquisition	35 days	Mon 5/9/22	Fri 6/24/22
74	Dewatering to remove Accumulated Spring Rainfall	20 days	Wed 6/1/22	Tue 6/28/22
75	Contractor Mobilization to Site	10 days	Wed 6/15/22	Tue 6/28/22
76	Site Preparation	15 days	Wed 6/29/22	Tue 7/19/22
77	Clean Existing Concrete Revetment Mat	15 days	Wed 7/6/22	Tue 7/26/22
78	Place 6" General Soil Fill Layer	25 days	Wed 7/27/22	Tue 8/30/22
79	GCL & HDPE Liner Installation	30 days	Wed 8/31/22	Tue 10/11/22
80	Pipe Rack - Liner Attachment	5 days	Wed 10/5/22	Tue 10/11/22
81	Punchlist and Contract Closeout	10 days	Wed 10/12/22	Tue 10/25/22
82	Return Flows to NSP (Ash Pond Area Retrofit Complete)	5 days	Wed 10/26/22	Tue 11/1/22
83	**PDP5 Evaluation and Initiation of Potential Retrofit Project (if required)**	**280 days**	**Tue 6/7/22**	**Sat 7/1/23**
84	Bid and Award Engineering Services for PDP5 Retrofit Project	67 days	Tue 6/7/22	Wed 9/7/22
85	Detailed Design: PDP5 Retrofit Bid Documents	87 days	Thu 9/8/22	Fri 1/6/23
86	Luminant Bid/Award PDP5 Retrofit Construction Contract	61 days	Mon 1/9/23	Sat 4/1/23
87	PDP5 Retrofit Plan Published (if Required after Part B alternate liner demonstration efforts)	0 days	Mon 5/1/23	Mon 5/1/23
88	Liner Material Acquisition	35 days	Mon 5/1/23	Fri 6/16/23
89	Dewatering to remove Accumulated Spring Rainfall	22 days	Thu 6/1/23	Fri 6/30/23
90	Contractor Mobilization to Site	10 days	Mon 6/19/23	Fri 6/30/23
91	Remove PDP5 from Service and Initiate Retrofit (if Required after Part B alternate liner demonstration efforts)	0 days	Sat 7/1/23	Sat 7/1/23



Project: Martin Lake CCR Surface Impoundment
Extension Demonstration
Date: Thu 10/22/20

Task	▬	Project Summary	⊓	Inactive Milestone	◇	Manual Summary Rollup	▬	Deadline	⇩
Split	┈	External Tasks	▬	Inactive Summary	⊓	Manual Summary	⊓	Progress	─
Milestone	◆	External Milestone	◆	Manual Task	▬	Start-only	[	Manual Progress	─
Summary	⊓	Inactive Task	▬	Duration-only	▬	Finish-only	]		

APPENDIX C – EAST ASH POND RETROFIT DESIGN DRAWINGS

HDR
Firm Registration No. F-754
17111 Preston Road, Suite 300
Dallas, Texas 75248-1229
972.960.4400

Luminant

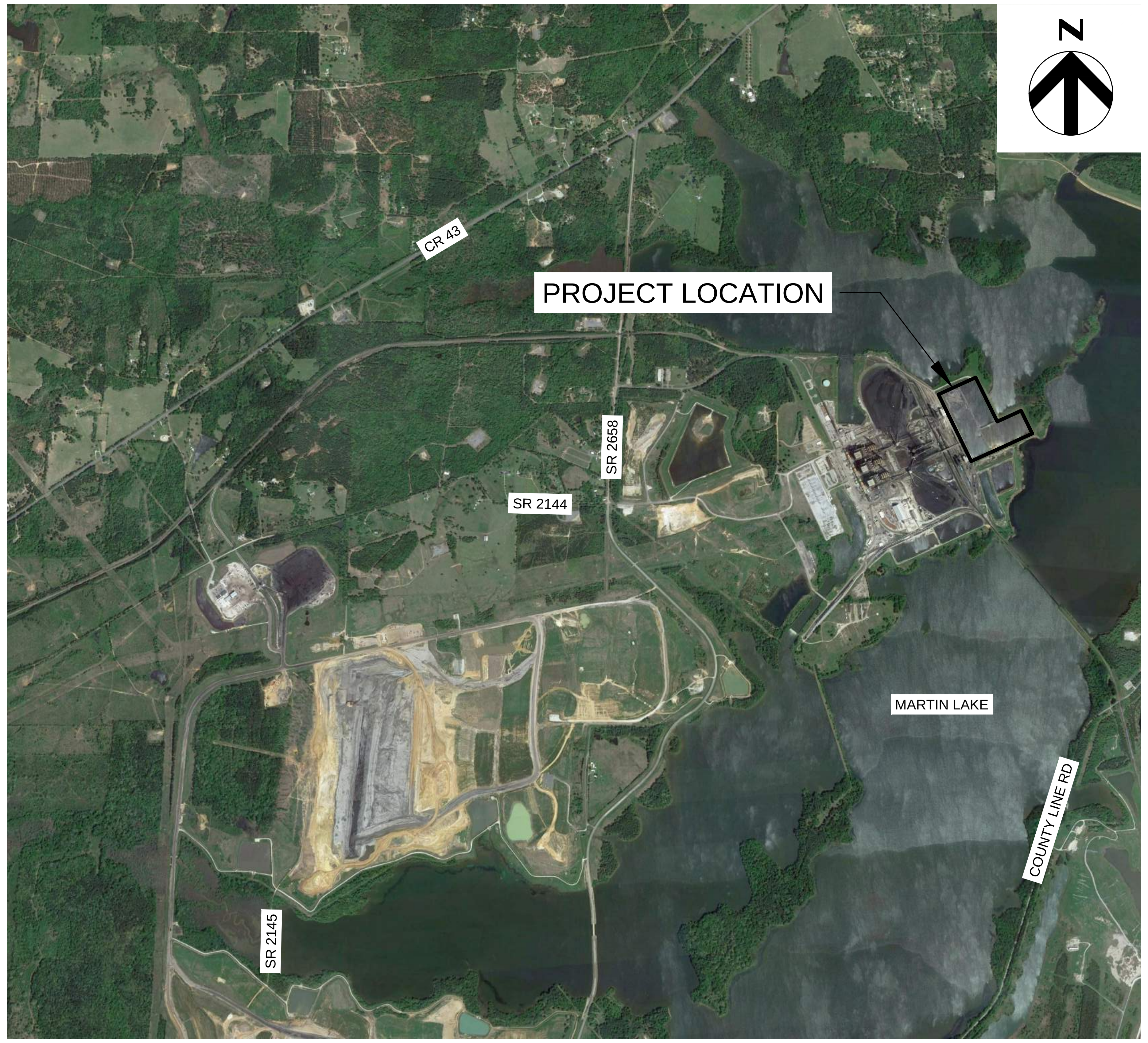
Construction Drawings For

Martin Lake
Steam Electric Station

CCR Impoundment Reline
East Ash Pond

Project No.
10172630

Rusk County, Texas
January 2020



VICINITY MAP
NOT TO SCALE

INDEX OF DRAWINGS

STATE OF TEXAS
DAVID C. VOGT
93905
LICENSED
PROFESSIONAL ENGINEER

1/29/2020

STANDARD ABBREVIATIONS

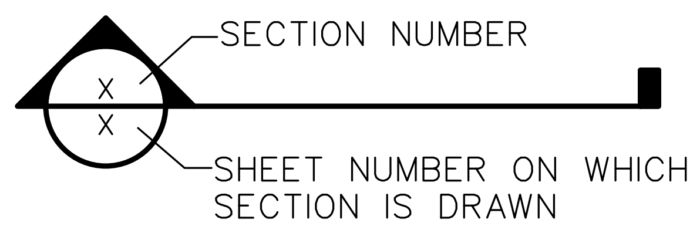
&	AND
APPROX	APPROXIMATELY
@	AT
AVG	AVERAGE
BOE	BOTTOM OF EXCAVATION
BOL	BOTTOM OF LINER
X	BY
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CO	CLEAN OUT
CY	CUBIC YARD
DIA	DIAMETER
DET	DETAIL
DWG	DRAWING
E	EAST
EAP	EAST ASH POND
ELEV	ELEVATION
EW	EACH WAY
EXIST	EXISTING
EXC	EXCAVATION
FGD	FLUE GAS DESULFICATION
FML	FLEXIBLE MEMBRANE LINER
FT	FEET
GAL	GALLON
GND	GROUND
GDL	GRAVEL DRAINAGE LAYER
GNDL	GEONET DRAINAGE LAYER
HDPE	HIGH DENSITY POLYETHYLENE
HORIZ	HORIZONTAL
ID	INSIDE DIAMETER
IN	INCHES
IE	INVERT ELEVATION
LCRS	LEACHATE COLLECTION AND REMOVAL SYSTEM
LCS	LEACHATE COLLECTION SYSTEM
LCP	LEACHATE COLLECTION PIPE
LCPR	LEACHATE COLLECTION PIPE RISER
LF	LINEAR FEET
LB	POUND
MH	MANHOLE
MAX	MAXIMUM
MIL	.001 INCHES
MIN	MINIMUM
MW	MONITOR WELL
MLSES	MARTIN LAKE STEAM ELECTRIC STATION
MSL	MEAN SEA LEVEL
N	NORTH
NIC	NOT IN CONTRACT
NO	NUMBER

NTS	NOT TO SCALE
NTYS	NORTH THICKENER YARD SUMP
OC	ON CENTER
OZ	OUNCE
%	PERCENT
PLCP	PERFORATED LEACHATE COLLECTION PIPE
PERF	PERFORATED
PGL	PROFILE GRADE LINE
PDP	PERMANENT DISPOSAL POND
PC	POINT OF CURVATURE
PI	POINT OF INTERSECTION
PVI	POINT OF VERTICAL INTERSECTION
PT	POINT OF TANGENT
PZ	PIEZOMETER
Q	FLOW
QTY	QUANTITY
R	RADIUS
RCP	REINFORCED CONCRETE PIPE
REF	REFERENCE
REQ	REQUIRED
RD	ROAD
SCH	SCHEDULE
SDL	SAND DRAINAGE LAYER
SEC	SECTION
SHT	SHEET
S	SOUTH
SDR	STANDARD DIMENSION RATIO
SLQCP	SOIL LINER QUALITY CONTROL PLAN
SP	STEEL PIPE
SQ	SQUARE
SS	SIDE SLOPE
STA	STATION
STYS	SOUTH THICKENER YARD SUMP
T.A.S.	TERMINAL ANCHOR SECTION
TL	TANGENT LENGTH
TOC	TOP OF COVER
TOFC	TOP OF FINAL COVER
TOL	TOP OF LINER
TOS	TOE OF SLOPE
TS	TOP SLOPE
TEMP	TEMPORARY
TYP	TYPICAL
UNO	UNLESS NOTED OTHERWISE
VERT	VERTICAL
W	WEST
W/	WITH
WAP	WEST ASH POND
WW	WETWELL
YD	YARD

SYMBOLS

SECTION DETAIL INDICATORS

DRAWING ON WHICH SECTION IS CUT:



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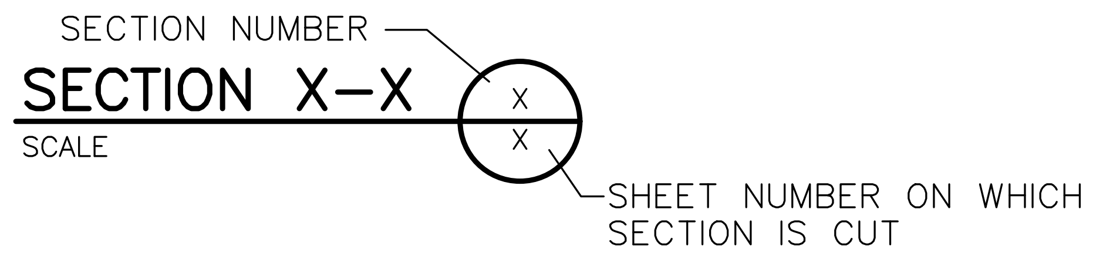

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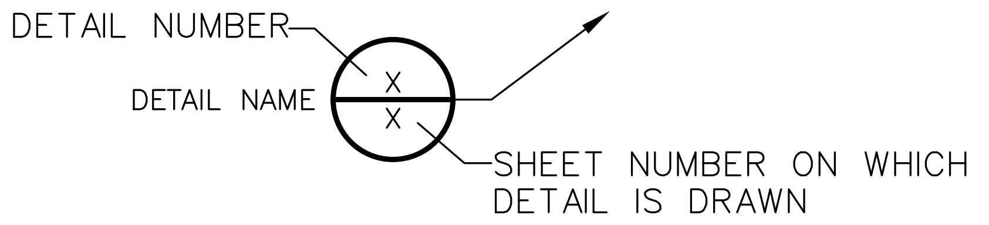

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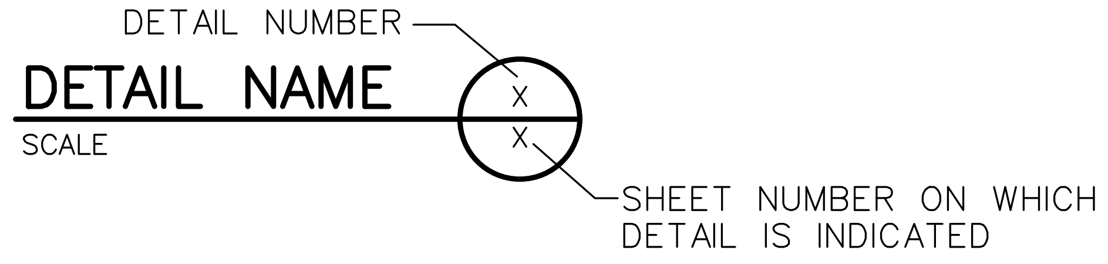
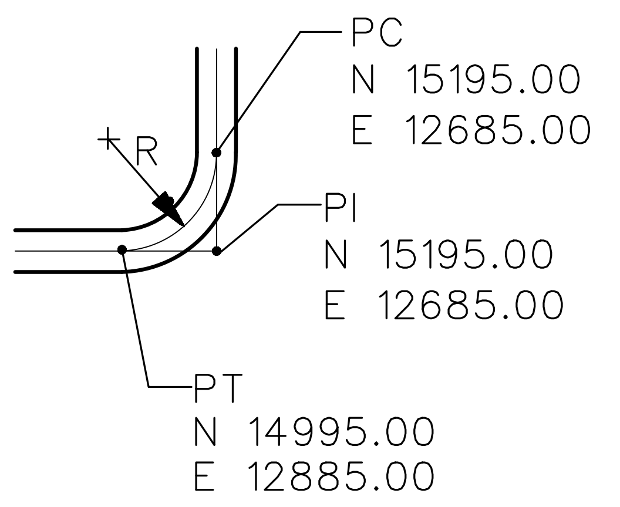
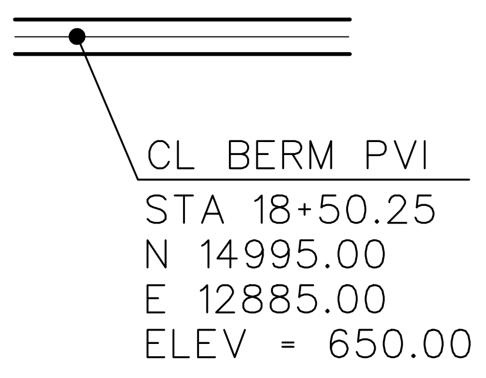
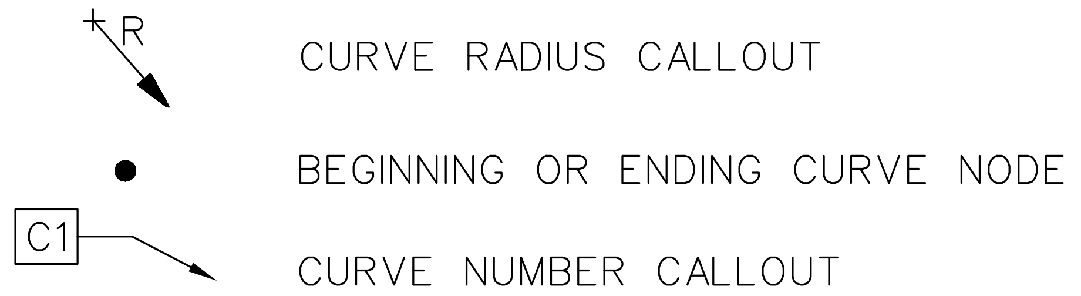


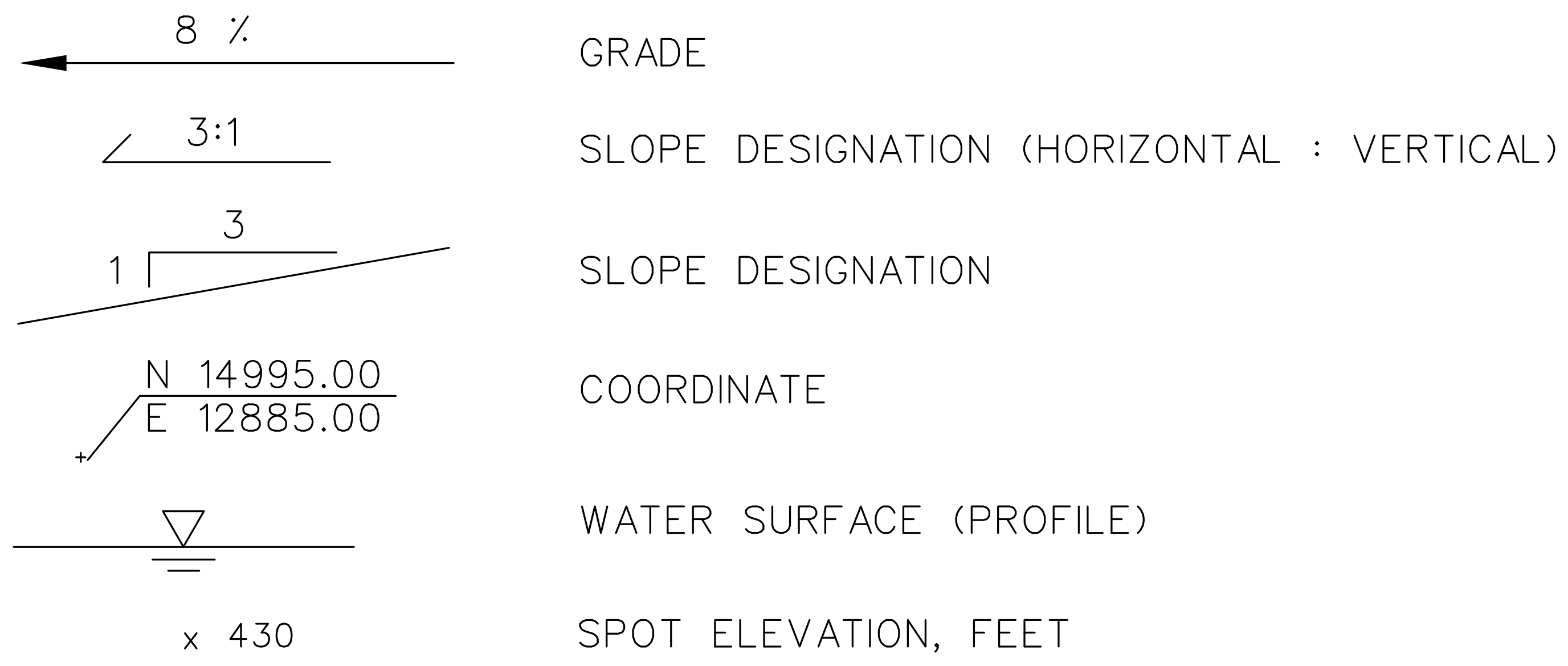




CURVE WITH HORIZONTAL CONTROL:



VERTICAL CONTROL DESIGNATION



CONSTRUCTION SEQUENCE

A. CONTRACTOR SHALL REMOVE EXISTING CCR MATERIAL, ROCKS AND SEDIMENT FROM THE EAP, HAUL AND STOCKPILE IT AT THE DECANT BASIN. LUMINANT WILL LOAD THE STOCKPILED MATERIAL ONTO RAIL CARS FOR DISPOSAL AT THE MARTIN LAKE A-1 AREA LANDFILL.

B. CONTRACTOR SHALL USE WATER FROM THE ADJACENT WEST ASH POND (WAP) OR NEW SCRUBBER POND (SP) TO WASH REMAINING CCR MATERIAL OFF THE SIDES AND FLOOR OF THE EAP AND REMOVE IT. EAP WILL BE VISUALLY INSPECTED BY OWNER'S CQA CONSULTANT TO CONFIRM CCR MATERIAL, ROCKS, AND SEDIMENT HAVE BEEN REMOVED.

C. CONTRACTOR SHALL MODIFY THE EXISTING 48-INCH SUCTION LINE ON THE SOUTH END OF THE POND BY INCREASING THE SCREENED AREA AS SHOWN IN THE PLANS.

D. CONTRACTOR SHALL LOAD AND HAUL GENERAL SOIL FILL MATERIAL FROM THE OWNER'S STOCKPILE LOCATED AT LIBERTY MINE, A LOCATION UNDER THE PROVISIONS OF THE MINE SAFETY AND HEALTH ADMINISTRATION (MSHA) AND APPROXIMATELY 4.5 MILES FROM EAP.

E. CONTRACTOR SHALL PLACE THE GENERAL FILL MATERIAL OVER THE EXISTING CONCRETE REVETMENT TO A DEPTH OF AT LEAST SIX (6) INCHES, NOMINALLY COMPACT, AND SMOOTH ROLL TO FINISH THE INSTALLATION.

F. CONTRACTOR SHALL INSTALL A GEOSYNTHETIC CLAY LINER (GCL) OVER THE SIDES AND FLOOR OF THE EAP AND SECURE IT IN A PERIMETER ANCHOR TRENCH/BATTEN AND STRIP.

G. CONTRACTOR SHALL INSTALL A 60-MIL HDPE LINER DIRECTLY ON THE GCL AND SECURE IT IN A PERIMETER ANCHOR TRENCH/BATTEN AND STRIP.

H. CONTRACTOR SHALL INSTALL 12-INCH HDPE YARD PIPE AS SHOWN IN THE PLANS.

GENERAL NOTES

1. ALL WORK UNDER THIS CONTRACT SHALL BE PERFORMED IN ACCORDANCE WITH THE PLANS AND PROJECT SPECIFICATIONS. IN THE EVENT OF A DISCREPANCY BETWEEN THE PLANS AND THE PROJECT SPECIFICATIONS, THE SPECIFICATIONS SHALL GOVERN.
2. COORDINATE SYSTEM IS BASED ON LOCAL SURVEY. THE BENCHMARKS TO BE USED FOR CONSTRUCTION ARE LOCATED AS SHOWN ON DRAWING NO. 00C-01. EXISTING CONTOURS ARE BASED ON TOPOGRAPHICAL SURVEY PERFORMED FEBRUARY 12-20, 2019 BY LACY SURVEYING. CURRENT GROUND ELEVATIONS MAY VARY FROM THOSE SHOWN DUE TO SITE WORK THAT HAS BEEN PERFORMED SINCE THE SURVEY WAS PERFORMED.
3. THE CONTRACTOR SHALL VERIFY EXISTING CONTOURS PRIOR TO THE START OF WORK.
4. THERE SHALL NOT BE ANY ADDITIONAL PAYMENT OR EXTENSION OF CONTRACT TIME FOR WORKING WITH SATURATED SOILS OR HANDLING WATER SEEPAGE DUE TO RAINFALL, RUNOFF AND INFILTRATION.
5. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT EXISTING ROADS, BENCHMARKS AND EXISTING GROUNDWATER MONITOR WELLS DURING THE CONSTRUCTION PERIOD. THE CONTRACTOR SHALL BE SOLEY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE INCURRED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PROTECT THE GROUNDWATER MONITOR WELLS, BENCHMARKS AND EXISTING ROADS.
6. THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES HAVE NOT BEEN ESTABLISHED BY THE OWNER OR ENGINEER. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTORS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UTILITIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING PROPER SAFE WORKING DISTANCE FROM ALL UTILITY EASEMENTS OR LINES.
7. EXCAVATION BY "BLASTING" IS NOT PERMITTED ON THIS PROJECT.
8. FINISHED GROUND ELEVATIONS SHALL MATCH EXISTING GROUND ELEVATIONS EXCEPT AS SHOWN ON THE PLANS. ALL EXCESS SOIL FROM THE EXCAVATION AND GRADING SHALL BE PLACED IN DESIGNATED STOCKPILE LOCATIONS AS APPROVED BY THE OWNER. IF WASTE IS ENCOUNTERED DURING EXCAVATION, THE OWNER SHALL BE NOTIFIED AND THE WASTE REMOVED AND PLACED IN AREAS DESIGNATED AS APPROVED BY THE OWNER. TRANSPORT OF SOIL TO FILL AREAS SHALL BE CONDUCTED BY THE CONTRACTOR AT NO ADDITIONAL EXPENSE TO THE OWNER.
9. GEOTECHNICAL INVESTIGATION REPORTS FOR THE SITE ARE AVAILABLE FOR REVIEW AT LUMINANT'S DALLAS OFFICES. THE CONTRACTOR MAY PERFORM ADDITIONAL GEOTECHNICAL INVESTIGATIONS, AS DEEMED NECESSARY FOR CONSTRUCTION ACTIVITIES, PROVIDED ALL NECESSARY PERMITS AND APPROVALS ARE OBTAINED FROM LUMINANT PRIOR TO INITIATING SUCH WORK. HOWEVER, THERE SHALL BE NO ADDITIONAL PAYMENT TO THE CONTRACTOR FOR ADDITIONAL GEOTECHNICAL INVESTIGATIONS.
10. THE CONTRACTOR SHALL CONSTRUCT, AND UPON COMPLETION OF THE PROJECT, REMOVE TEMPORARY CONSTRUCTION ACCESS ROADS. SUCH ROADS SHALL BE LOCATED AS APPROVED BY THE OWNER. DRAINAGE PATTERNS AT THE SITE SHALL NOT BE ALTERED BY ROAD CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONSTRUCTION AND MAINTENANCE OF TEMPORARY DRAINAGE STRUCTURES, INCLUDING CULVERTS, AT NO ADDITIONAL COST TO THE OWNER.
11. THE CONTRACTOR SHALL INSTALL, MAINTAIN, AND UPON COMPLETION OF THE PROJECT, REMOVE TEMPORARY EROSION AND SEDIMENT CONTROLS AS APPROVED BY LUMINENT ENVIRONMENTAL SERVICES AND IN ACCORDANCE WITH THE SITE SWPPP AND PURSUANT TO TPDES REQUIREMENTS. SUCH CONTROLS SHALL BE PLACED AT THE LIMITS OF DISTURBED AREAS AND AT INTERMEDIATE LOCATIONS WHERE CONCENTRATED FLOW IS LIKELY.
12. TEMPORARY CONSTRUCTION SLOPES SHALL NOT BE GREATER THAN 2H:1V. STEEPER SLOPES WILL ONLY BE ALLOWED IF THE CONTRACTOR PROVIDES A GEOTECHNICAL ENGINEERING REPORT SPECIFYING MAXIMUM SLOPES AND THE DURATION FOR WHICH SUCH SLOPES SHALL REMAIN IN PLACE.
13. THE CONTRACTOR SHALL REMOVE ALL VEGETATION WITHIN THE CONSTRUCTION LIMITS AS REQUIRED TO CONSTRUCT THE PROJECT. ALL VEGETATION SHALL BE REMOVED BY CONTRACTOR AT NO ADDITIONAL EXPENCE TO OWNER.
14. THE CONTRACTOR SHALL OBTAIN AND CONDUCT WORK CONSISTENT WITH A TPDES PERMIT FOR CONSTRUCTION, REFER TO TECHNICAL SPECIFICATIONS. PREPARATION OF A SWPPP AND OBTAINING THE TPDES PERMIT ARE THE CONTRACTORS RESPONSIBILITY.
15. THE CONTRACTOR SHALL IMMEDIATELY REPORT TO THE ENGINEER ANY ERROR OR DISCREPANCY FOUND ONCE THE CONTRACT DOCUMENT IS CAREFULLY REVIEWED AND ALL ASPECTS OF FIELD WORK HAVE BEEN VERIFIED. IN THE EVENT THE CONTRACTOR CONTINUES TO WORK ON AN ITEM WHERE AN ERROR EXISTS, IT SHALL BE DEEMED THAT THE CONTRACTOR BID AND INTENDED TO EXECUTE THE MORE STRINGENT OR HIGHER QUALITY REQUIREMENT WITHOUT AN INCREASE IN CONTRACT SUM OR TIME. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE TO CORRECT ANY FAILURE OF COMPANY PARTS TO COORDINATE OR FIT PROPERLY INTO FINAL POSITION, AS A RESULT OF CONTRACTOR FAILURE TO RAISE OR RESOLVE A DISCREPANCY.
16. THE DRAWINGS AND SPECIFICATIONS SHOULD AGREE WITH EACH OTHER, AND WORK CALLED FOR BY DRAWINGS AND NOT MENTIONED IN SPECIFICATION, OR VICE VERSA, SHALL BE FURNISHED BY BOTH. WHEN DISCREPANCIES EXIST BETWEEN SCALE AND DIMENSIONS, THE DIMENSIONED FIGURE SHALL BE USED.
17. CONTRACTOR AND EACH SUBCONTRACTOR SHALL VERIFY ALL GRADES, LINES, LEVELS, AND DIMENSIONS AS INDICATED ON DRAWINGS, AND HE SHALL REPORT ERRORS TO THE ENGINEER BEFORE COMMENCING WORK. THE CONTRACTOR SHALL ESTABLISH BENCHMARKS IN AT LEAST TWO WIDELY SEPARATED PLACES, AND AS WORK PROGRESSES THE CONTRACTOR WILL MAINTAIN ADEQUATE HORIZONTAL AND VERTICAL CONTROL.
18. CONTRACTOR SHALL PROVIDE EROSION CONTROL BY SEEDING FOR ALL AREAS DISTURBED BY CONTRACTOR DURING THE CONSTRUCTION OF THIS PROJECT. THE CONTRACTOR SHALL NOT DISTURB ANY AREA WITHOUT THE APPROVAL OF THE ENGINEER. EROSION CONTROL BY SEEDING SHALL CONFORM TO STANDARD SPECIFICATION 02930.
19. CONTRACTOR SHALL INSTALL EROSION AND SEDIMENT CONTROLS AS PER SPECIFICATIONS DURING CONSTRUCTION. SUCH CONTROLS SHALL BE PLACED AT LIMITS OF DISTURBED AREAS AND AT INTERMEDIATE LOCATIONS WHERE CONCENTRATED FLOW IS LIKELY.
20. STORMWATER THAT HAS COME INTO CONTACT WITH THE ASH WITHIN THE EXCAVATED POND IS TO BE CONSIDERED CONTACT STORMWATER. CONTRACTOR WILL CONTROL THE WATER ON SITE IN COMPLIANCE WITH THE TPDES PERMIT.
21. THE CONTRACTOR IS REQUIRED TO PRESENT THE SWPPP TO LUMINANT ENVIRONMENTAL SERVICES FOR APPROVAL PRIOR TO THE COMMENCEMENT OF CONSTRUCTION ACTIVITIES.
22. THE CONTRACTOR IS REQUIRED TO SUBMIT THE NOTICE OF INTENT AND NOTICE OF TERMINATION FOR THE TPDES PERMIT.
23. THE CONTRACTOR IS TO ACQUIRE A DIGGING PERMIT FROM THE PLANT BEFORE COMMENCING ANY EXCAVATION ACTIVITY.

HDR

ISSUE	DATE	DESCRIPTION
F	01/29/2020	ISSUED FOR BID
E	01/23/2020	ISSUED FOR CLIENT REVIEW
D	01/14/2020	ISSUED FOR CLIENT REVIEW
C	12/20/2019	ISSUED FOR CLIENT REVIEW
B	11/26/2019	ISSUED FOR CLIENT REVIEW
A	11/12/2019	ISSUED FOR CLIENT REVIEW

PROJECT MANAGER	D. VOGT, P.E.
DESIGNED BY	K. PERERA
DRAWN BY	J. RAYMOND
CHECKED BY	M. ROBERTS
PROJECT NUMBER	10172630

DAVID C. VOGT
93905

1/29/2020

MARTIN LAKE STEAM ELECTRICAL STATION
EAST ASH POND RELINE
RUSK COUNTY, TEXAS

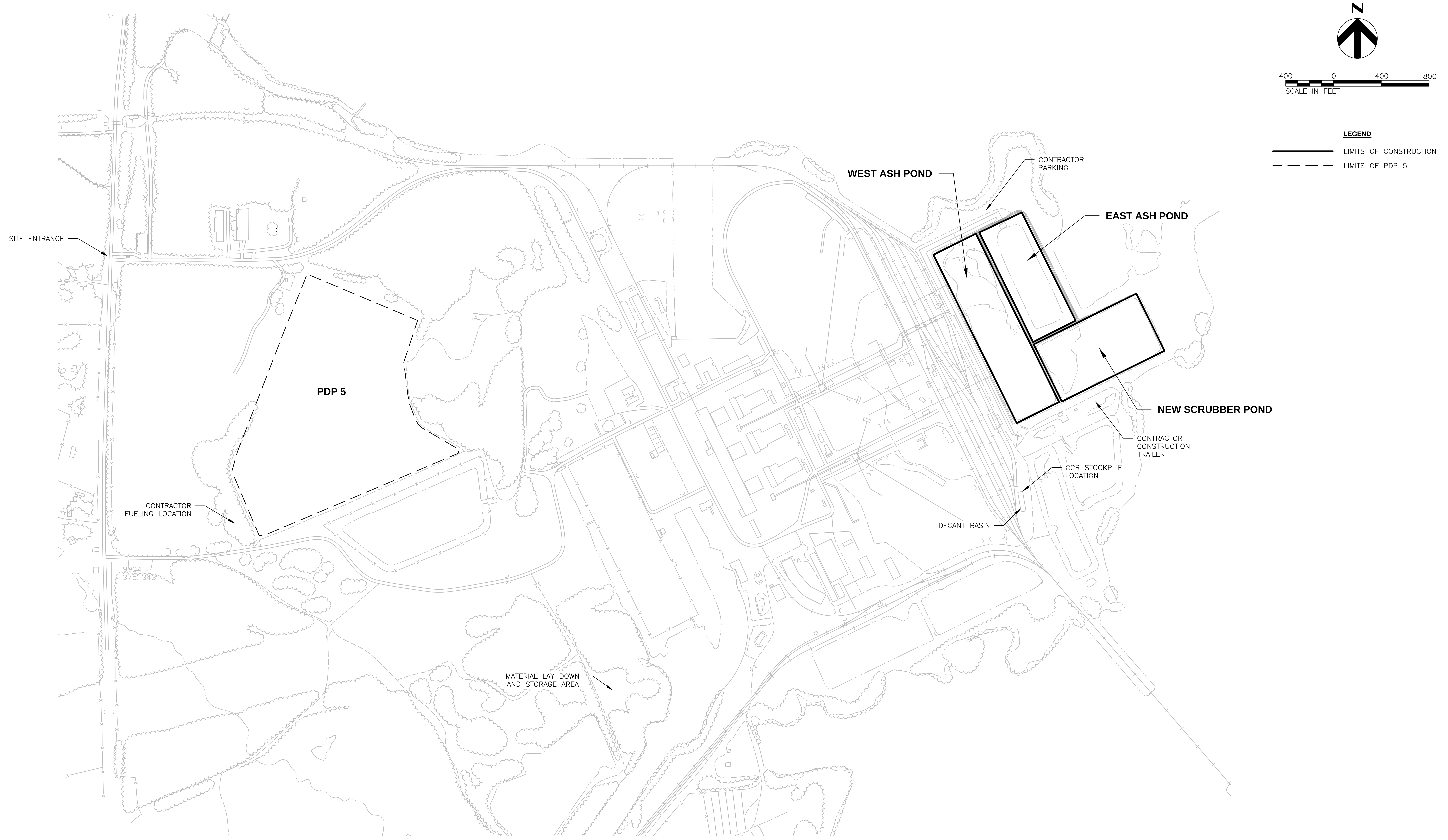
Luminant

ABBREVIATIONS AND GENERAL NOTES

0 1" 2"

FILENAME 00G-02.dwg
SCALE

SHEET 00G-02



ISSUE	DATE	DESCRIPTION
F	01/29/2020	ISSUED FOR BID
E	01/23/2020	ISSUED FOR CLIENT REVIEW
D	01/14/2020	ISSUED FOR CLIENT REVIEW
C	12/20/2019	ISSUED FOR CLIENT REVIEW
B	11/26/2019	ISSUED FOR CLIENT REVIEW
A	11/12/2019	ISSUED FOR CLIENT REVIEW

PROJECT MANAGER	D. VOGT, P.E.
DESIGNED BY	K. PERERA
DRAWN BY	J. RAYMOND
CHECKED BY	M. ROBERTS
PROJECT NUMBER	10172630

DAVID C. VOGT
93905

1/29/2020

MARTIN LAKE STEAM ELECTRICAL STATION
EAST ASH POND RELINE
RUSK COUNTY, TEXAS

Luminant

SITE LAYOUT

0 1" 2"

FILENAME 00C-01.dwg

SCALE 1" = 400'

SHEET

00C-01

LEGEND

- - - - - -	EXISTING MINOR CONTOUR
— —320— —	EXISTING MAJOR CONTOUR
━━ ━━	ANCHOR TRENCH
━ · ━ · ━	BATTEN AND STRIP

NOTES:

1. THE CONTOURS SHOWN ARE TOP OF REVETMENT MATTRESS ELEVATIONS BY COLLINS SURVEYING AND MAPPING DATED 2010.
2. CONTRACTOR SHALL INSTALL PROPOSED LINER SYSTEM OVER ACCESS RAMP. 6-INCH SOIL LAYER SHALL NOT BE INSTALLED OVER CONCRETE ACCESS RAMP.
3. SEE DETAIL 1 & 2/00C-05 FOR FOR PROPOSED LINER SYSTEM DETAILS.

ISSUE	DATE	DESCRIPTION
F	01/29/2020	ISSUED FOR BID
E	01/23/2020	ISSUED FOR CLIENT REVIEW
D	01/14/2020	ISSUED FOR CLIENT REVIEW
C	12/20/2019	ISSUED FOR CLIENT REVIEW
B	11/26/2019	ISSUED FOR CLIENT REVIEW
A	11/12/2019	ISSUED FOR CLIENT REVIEW

PROJECT MANAGER	D. VOGT, P.E.
DESIGNED BY	K. PERERA
DRAWN BY	J. RAYMOND
CHECKED BY	M. ROBERTS
PROJECT NUMBER	10172630

DAVID C. VOGT
93905

1/29/2020

MARTIN LAKE STEAM ELECTRICAL STATION
EAST ASH POND RELINE
RUSK COUNTY, TEXAS

Luminant

EAST ASH POND

0 1" 2"

FILENAME 00C-02.dwg

SCALE 1" = 50'

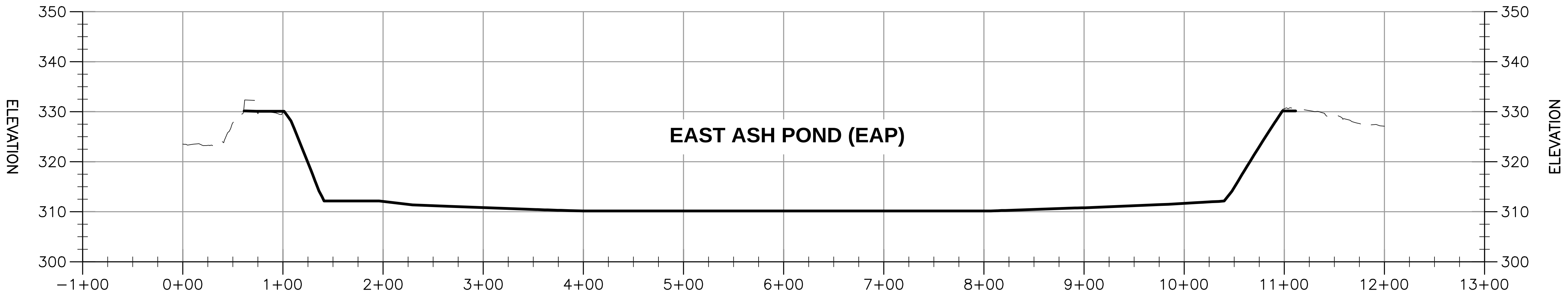
SHEET 00C-02

100 0 100 200
HORIZONTAL SCALE: 1" = 100'

20 0 20 40
VERTICAL SCALE: 1" = 20'

LEGEND

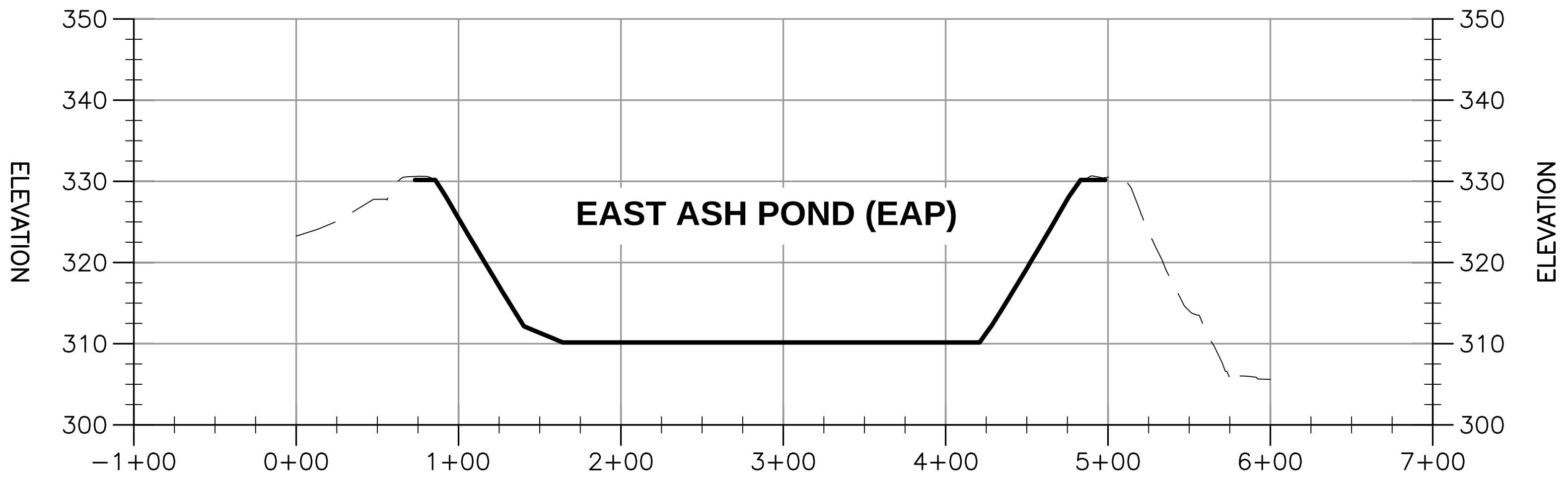
— — — —	EXISTING GROUND SURFACE
———	PROPOSED GRADE



SECTION A–A

HORIZONTAL SCALE: 1" = 100' ; VERTICAL SCALE: 1" = 20'

A–A
00C–02



SECTION B–B

HORIZONTAL SCALE: 1" = 100' ; VERTICAL SCALE: 1" = 20'

B–B
00C–02

HDR

ISSUE	DATE	DESCRIPTION
F	01/29/2020	ISSUED FOR BID
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A	11/12/2019	ISSUED FOR CLIENT REVIEW

PROJECT MANAGER	D. VOGT, P.E.
DESIGNED BY	K. PERERA
DRAWN BY	J. RAYMOND
CHECKED BY	M. ROBERTS
PROJECT NUMBER	10172630

DAVID C. VOGT
93905

1/29/2020

MARTIN LAKE STEAM ELECTRICAL STATION
EAST ASH POND RELINE
RUSK COUNTY, TEXAS

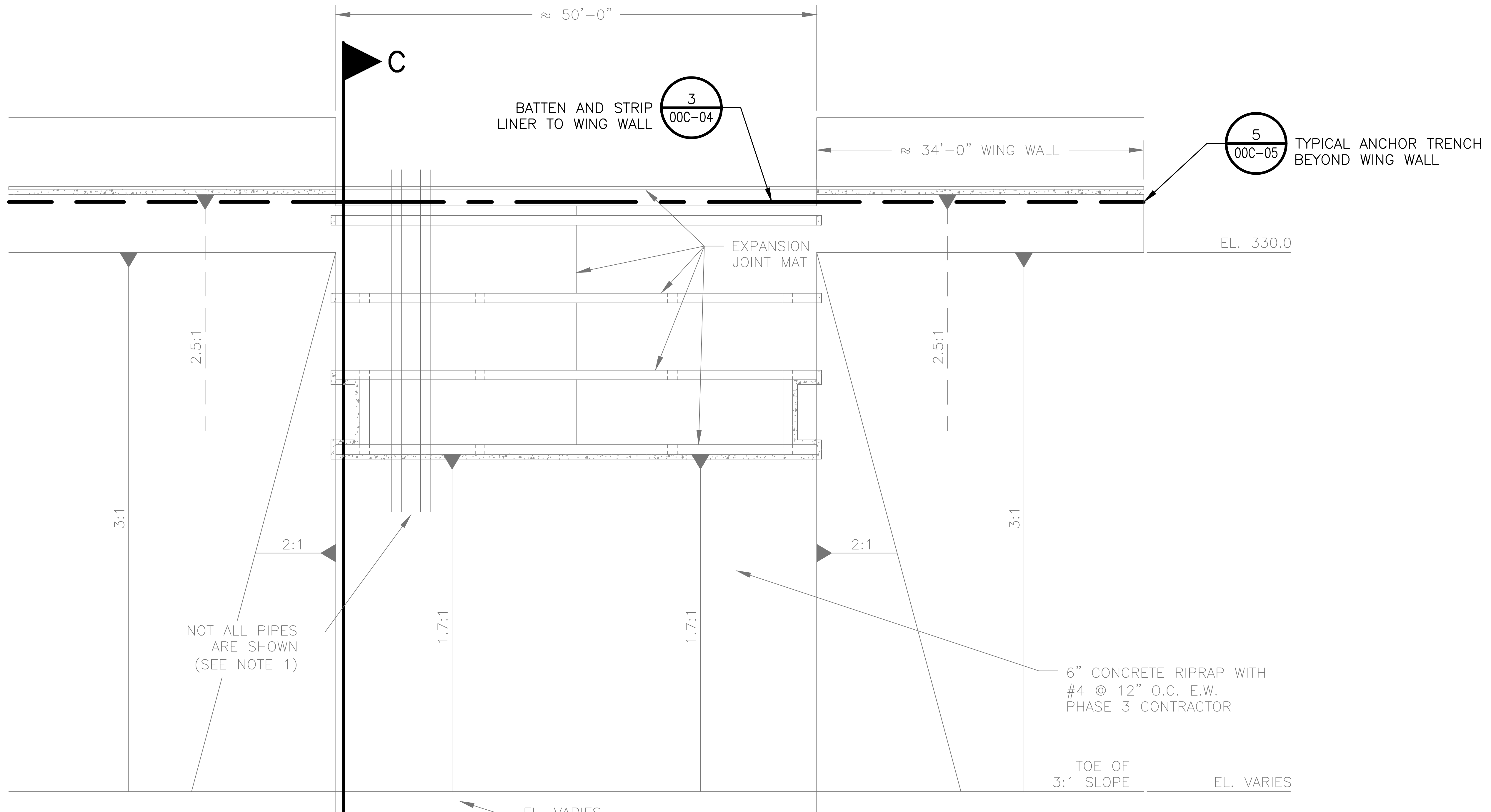
Luminant

CROSS SECTIONS

0 1" 2"

FILENAME	00C-03.dwg
SCALE	H: 1" = 100' ; V: 1" = 20'

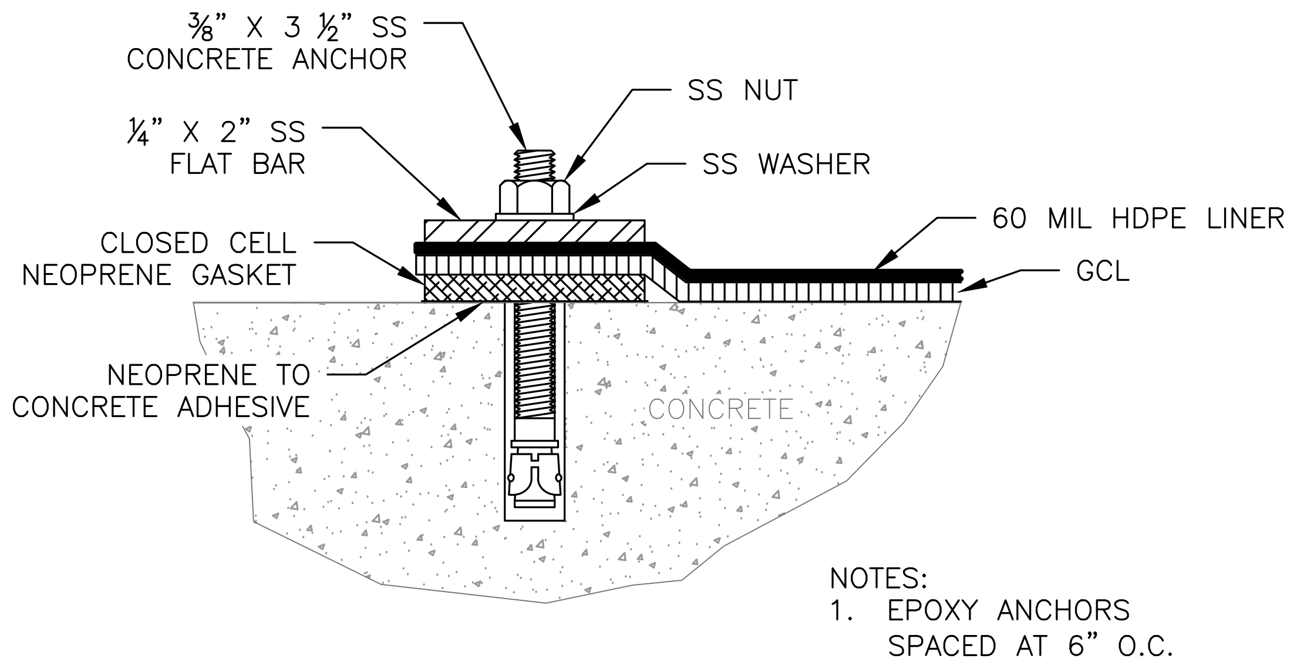
SHEET
00C-03



NOTES:
1. EXISTING INLET PIPES SHALL BE CUT TO INSTALL LINER. UPON INSTALLATION OF THE LINER, PIPES SHALL BE REINSTALLED.

TYPICAL PIPE RACK
1 00C-02

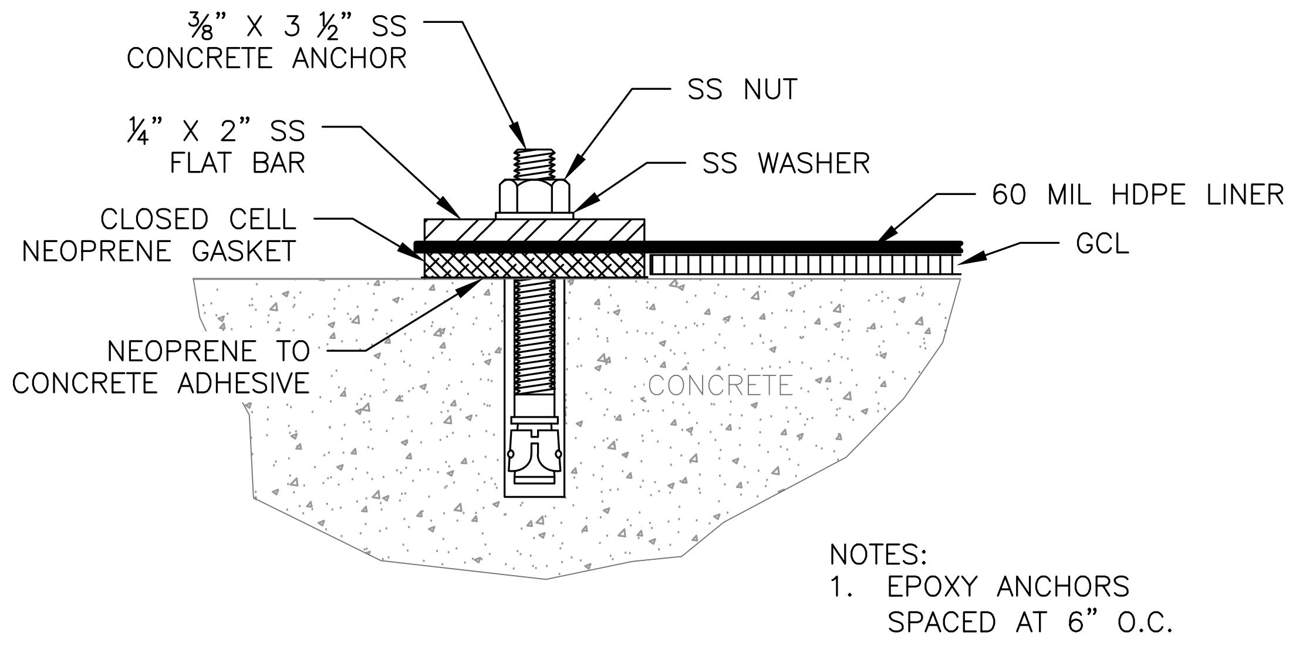
NOT TO SCALE



NOTES:
1. EPOXY ANCHORS SPACED AT 6" O.C.

BATTEN AND STRIP CONNECTION AT ANCHOR TRENCH
2A 00C-06

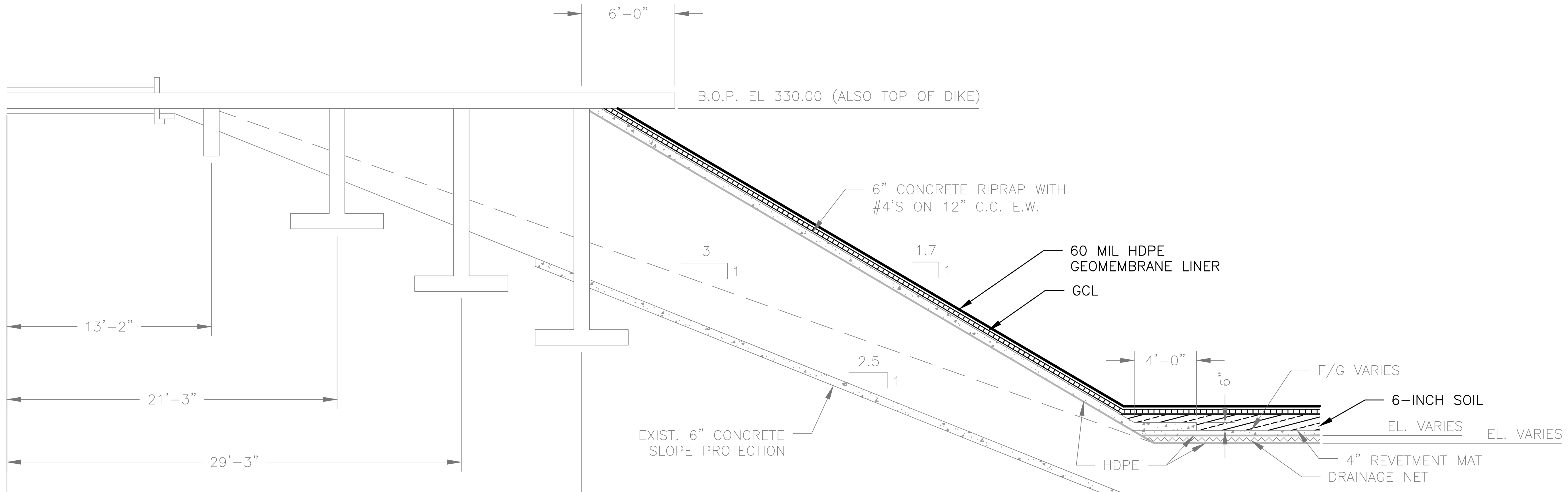
NOT TO SCALE



NOTES:
1. EPOXY ANCHORS SPACED AT 6" O.C.

BATTEN AND STRIP CONNECTION BELOW WATER SURFACE
2B 00C-06

NOT TO SCALE



NOTES:
1. ALL PIPE RACK DIMENSIONS ARE "AS-BUILT" DIMENSIONS FOR EAST ASH POND.

SECTION C–C

NOT TO SCALE

HDR

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PROJECT MANAGER	D. VOGT, P.E.
DESIGNED BY	K. PERERA
DRAWN BY	J. RAYMOND
CHECKED BY	M. ROBERTS
PROJECT NUMBER	10172630

DAVID C. VOGT
93905

1/29/2020

MARTIN LAKE STEAM ELECTRICAL STATION
EAST ASH POND RELINE
RUSK COUNTY, TEXAS

Luminant

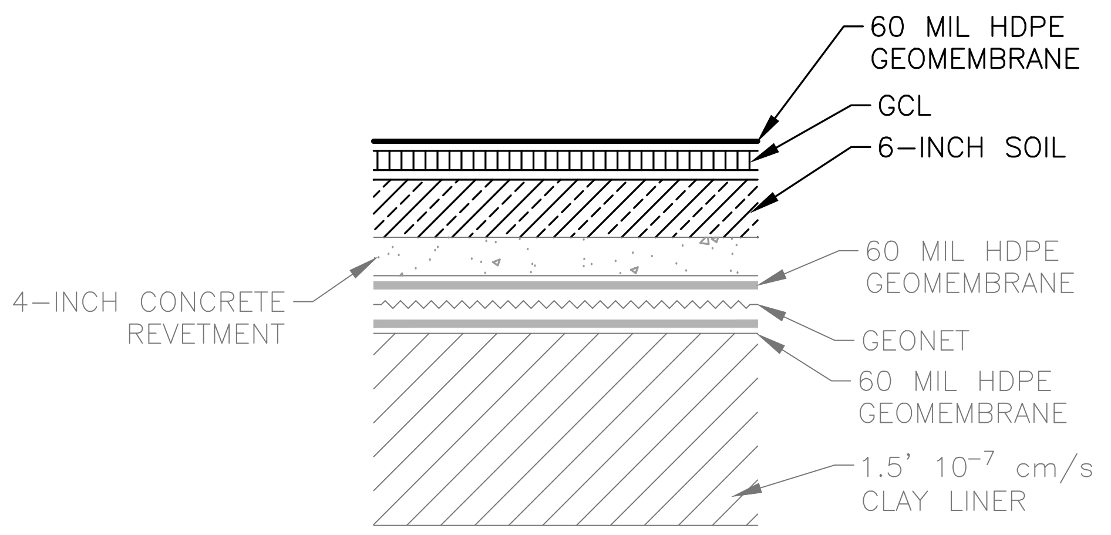
DETAILS
(1 OF 2)

0 1" 2"

FILENAME 00C-04.dwg

SCALE

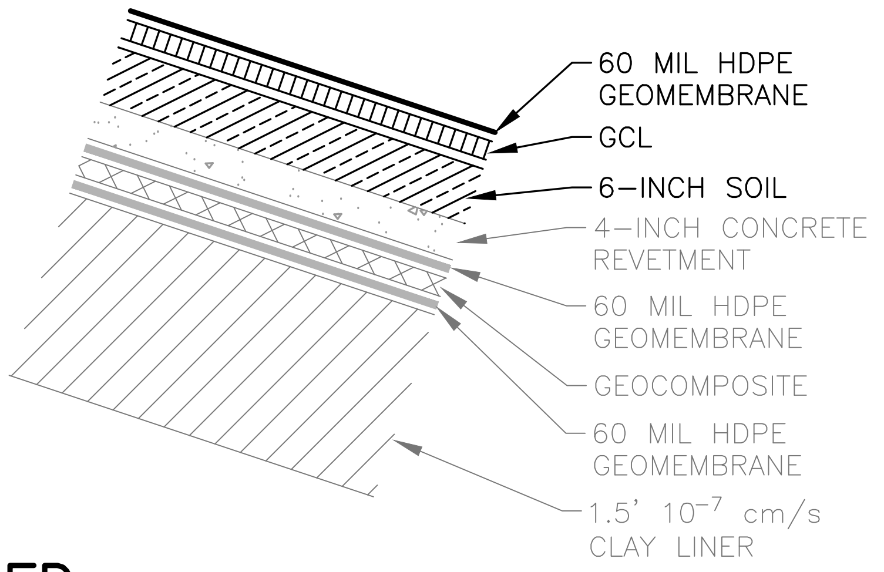
SHEET
00C-04



PROPOSED EAP RETROFIT SECTION (FLOOR)

NOT TO SCALE

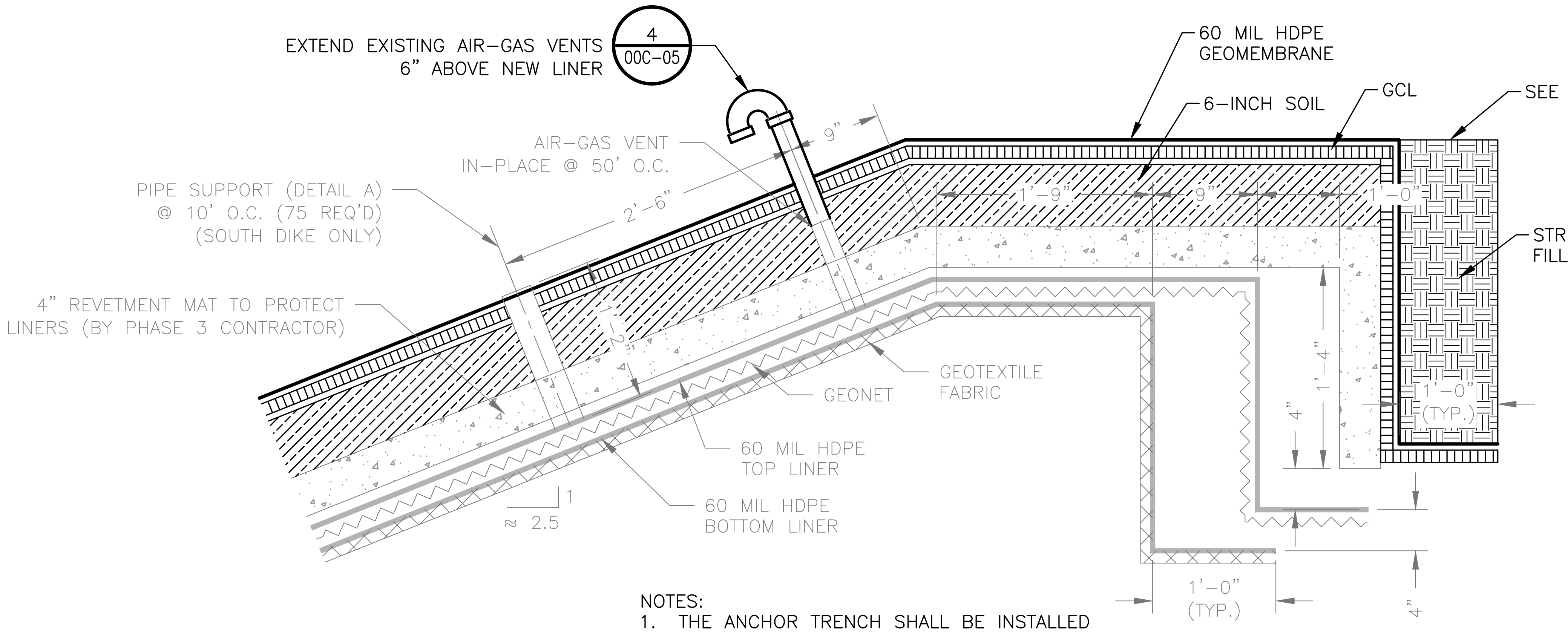
1 / 00C–05



PROPOSED EAP RETROFIT SECTION (SIDESLOPE)

NOT TO SCALE

2 / 00C–05



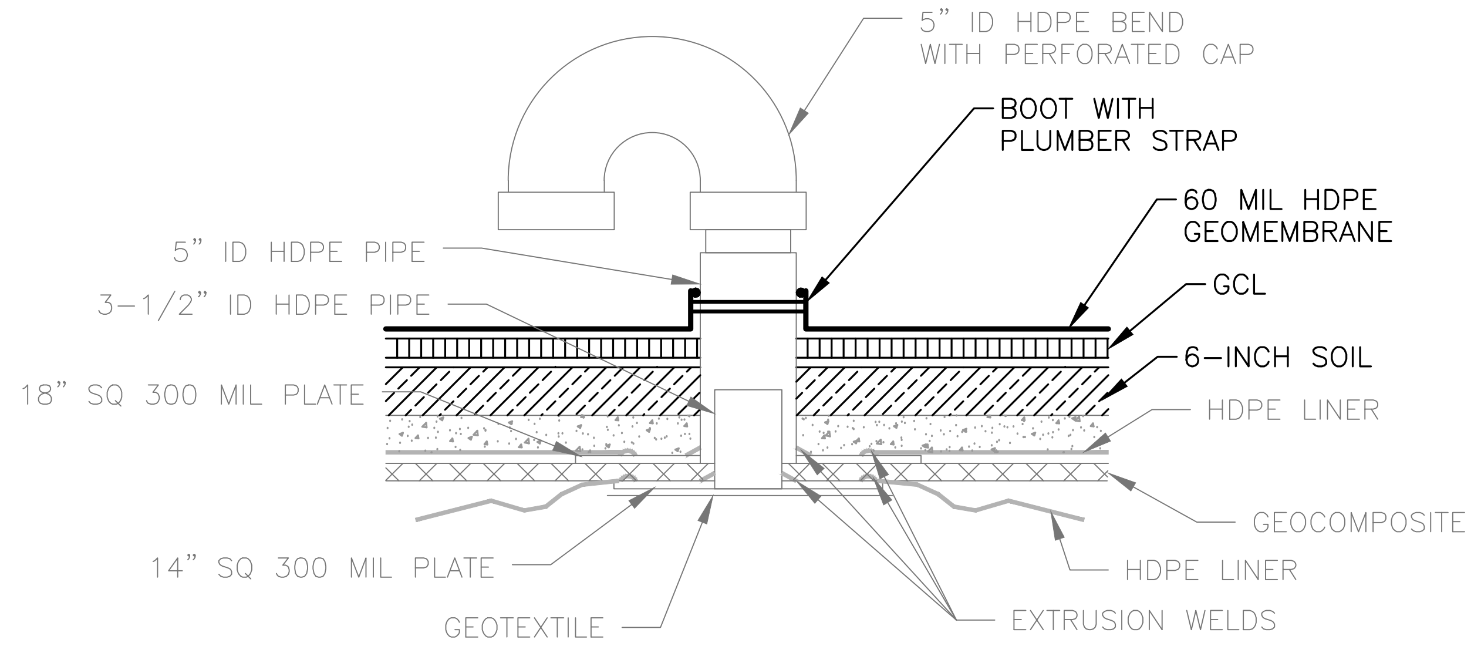
NOTES:

1. THE ANCHOR TRENCH SHALL BE INSTALLED OUTSIDE OF THE EXISTING ANCHOR TRENCH.

ANCHOR TRENCH

NOT TO SCALE

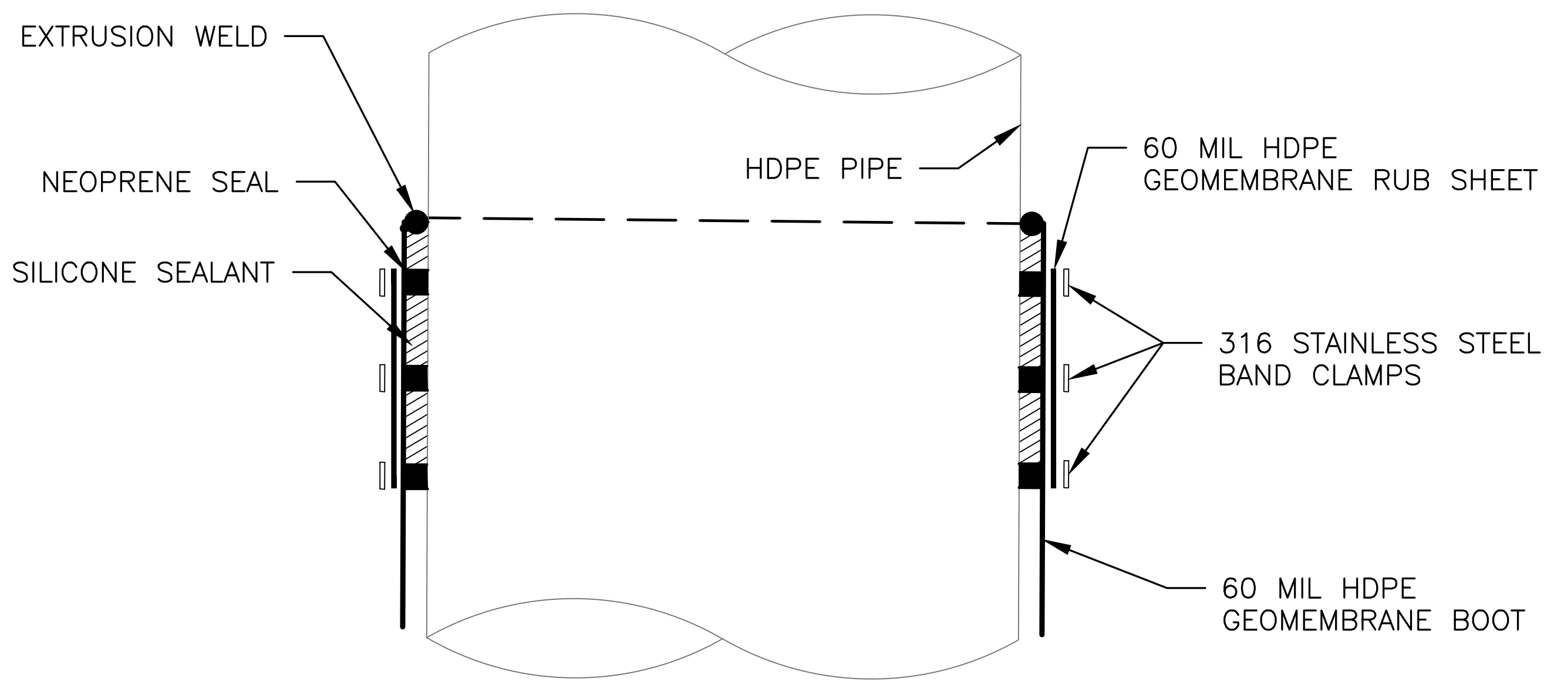
3 / 00C–02



TYPICAL AIR–GAS VENT

NOT TO SCALE

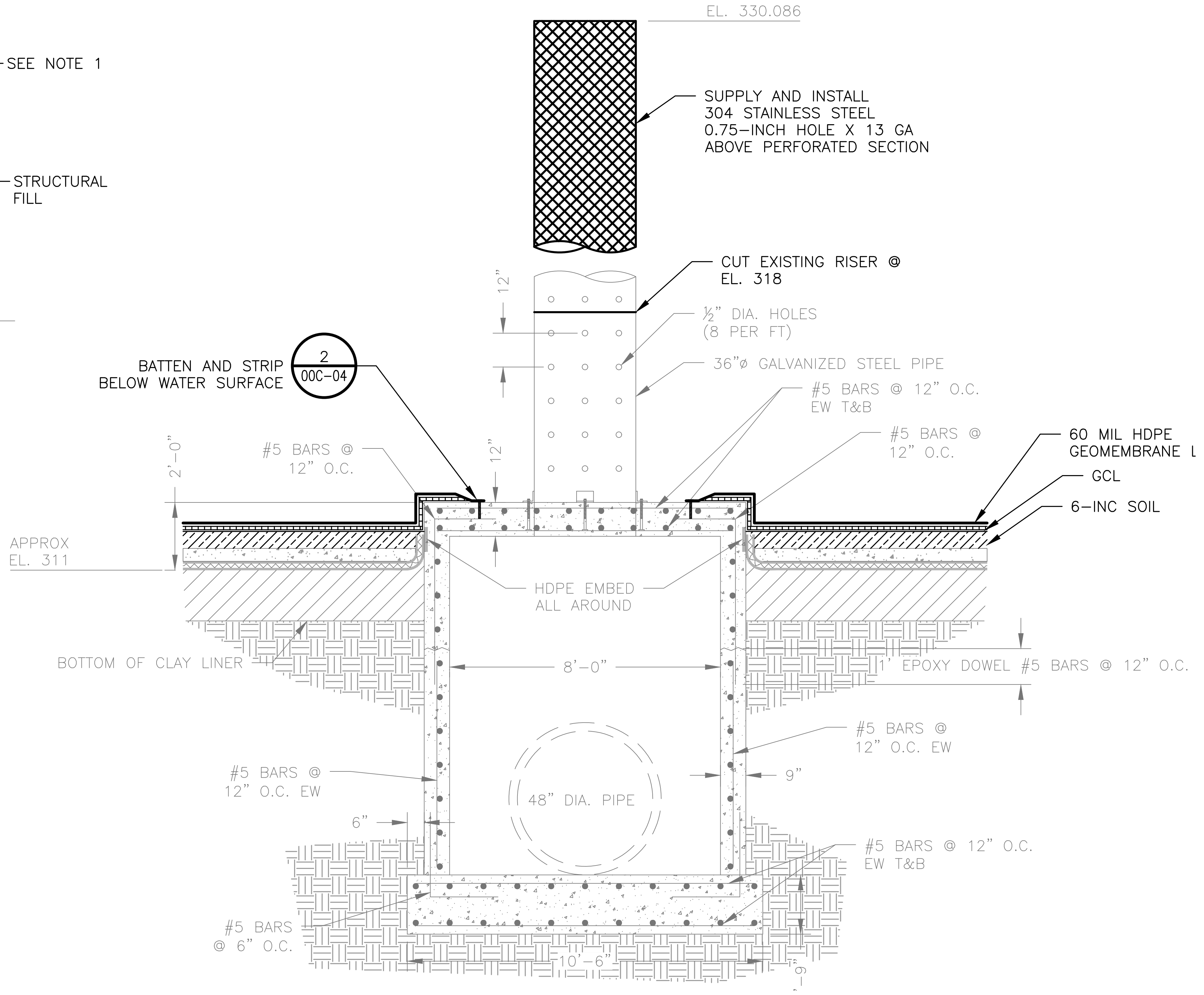
4 / 00C–05



PIPE BOOT

NOT TO SCALE

5 / 00C–02



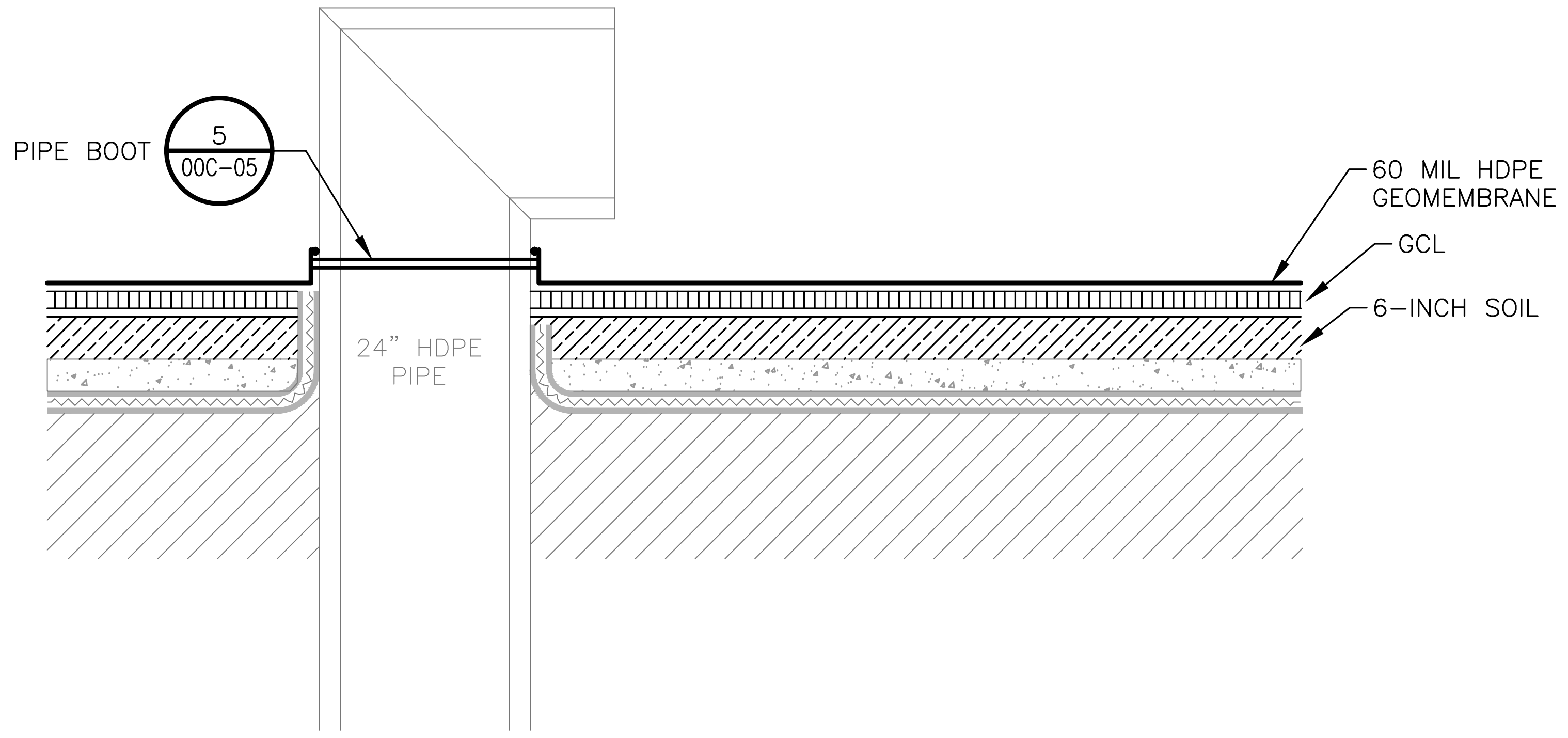
NOTES:

1. THE INTERIOR OF THE INLET STRUCTURE WAS LINED WITH AN EPOXY COATING OF RAVEN LINING 405 AT A MINIMUM THICKNESS OF 200 MILS.

SUCTION LINE INLET STRUCTURE

NOT TO SCALE

6 / 00C–02



24" DEWATERING LINE INLET

NOT TO SCALE

7 / 00C–02

ISSUE	DATE	DESCRIPTION
F	01/29/2020	ISSUED FOR BID
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PROJECT MANAGER	D. VOGT, P.E.
DESIGNED BY	K. PERERA
DRAWN BY	J. RAYMOND
CHECKED BY	M. ROBERTS
PROJECT NUMBER	10172630

DAVID C. VOGT
93905

1/29/2020

MARTIN LAKE STEAM ELECTRICAL STATION
EAST ASH POND RELINE
RUSK COUNTY, TEXAS

DETAILS
(2 OF 2)

0 1" 2"

FILENAME	00C-05.dwg
SCALE	NOT TO SCALE

SHEET
00C-05

LEGEND

— — — — EXISTING NORTH THICKENER PIPELINE
—— – —— EXISTING SOUTH THICKENER PIPELINE
———— EXISTING 304 WETWELL PIPELINE
– – – – – – EXISTING 104 WETWELL PIPELINE
—·—·— EXISTING 104 TO 304 WETWELL PIPELINE
⋈ EXISTING ISOLATION VALVE

GENERAL NOTES:

1. EXISTING PIPELINES SHOWN WILL BE REROUTED TO THE EAST ASH POND IN ORDER TO RELINE THE NEW SCRUBBER POND.
2. SHUTDOWNS REQUIRED FOR CONNECTIONS SHALL BE COORDINATED WITH THE PLANT.
3. THE LOCATIONS OF THE EXISTING PIPELINES ARE APPROXIMATE AND SHOULD BE CONFIRMED IN THE FIELD BY THE CONTRACTOR AND PLANT OPERATIONS.

ISSUE	DATE	DESCRIPTION
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A	11/12/2019	ISSUED FOR CLIENT REVIEW

PROJECT MANAGER	D. VOGT, P.E.
DESIGNED BY	J. ORDONEZ, P.E.
DRAWN BY	J. RAYMOND
CHECKED BY	D. VOGT, P.E.
PROJECT NUMBER	10172630

JAIME ORDONEZ
124838
1/24/2020

MARTIN LAKE STEAM ELECTRICAL STATION
EAST ASH POND RELINE
RUSK COUNTY, TEXAS

Luminant

EXISTING YARD PIPING

0 1" 2"

FILENAME 00C-06.dwg
SCALE 1" = 200'

SHEET
00C-06

LEGEND

EXISTING NORTH THICKENER PIPELINE
EXISTING SOUTH THICKENER PIPELINE
EXISTING 304 WETWELL PIPELINE
EXISTING 104 WETWELL PIPELINE
EXISTING 104 TO 304 WETWELL PIPELINE
NORTH THICKENER PIPELINE REROUTE
SOUTH THICKENER PIPELINE REROUTE
304 WETWELL PIPELINE REROUTE
104 WETWELL PIPELINE REROUTE
EXISTING ISOLATION VALVE

GENERAL NOTES:

1. CONTRACTOR SHALL INSTALL THE 104 WETWELL PIPELINE REROUTE, THE NORTH THICKENER PIPELINE REROUTE AND THE SOUTH THICKENER PIPELINE REROUTE AS SHOWN. EACH PIPELINE STARTS AT ITS CORRESPONDING EXISTING ISOLATION VALVE.
2. SHUTDOWNS REQUIRED FOR CONNECTIONS SHALL BE COORDINATED WITH THE PLANT.
3. THE EXISTING VALVE CONNECTION LOCATIONS TO ALL EXISTING PIPELINES ARE APPROXIMATE AND SHOULD BE CONFIRMED IN THE FIELD BY THE CONTRACTOR AND PLANT OPERATIONS.
4. PIPELINES SHOULD BE INSTALLED FLUSH ON GRADE WITHOUT INTRODUCING INTERMEDIATE HIGH POINTS.
5. ALL JOINTS SHALL BE FUSION WELDED BUTT JOINTS IN ACCORDANCE WITH PROJECT SPECIFICATIONS.

HDR

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PROJECT MANAGER D. VOGT, P.E.
DESIGNED BY J. ORDONEZ, P.E.
DRAWN BY J. RAYMOND
CHECKED BY D. VOGT, P.E.
PROJECT NUMBER 10172630

JAIME ORDONEZ
124838
1/24/2020

MARTIN LAKE STEAM ELECTRICAL STATION
EAST ASH POND RELINE
RUSK COUNTY, TEXAS

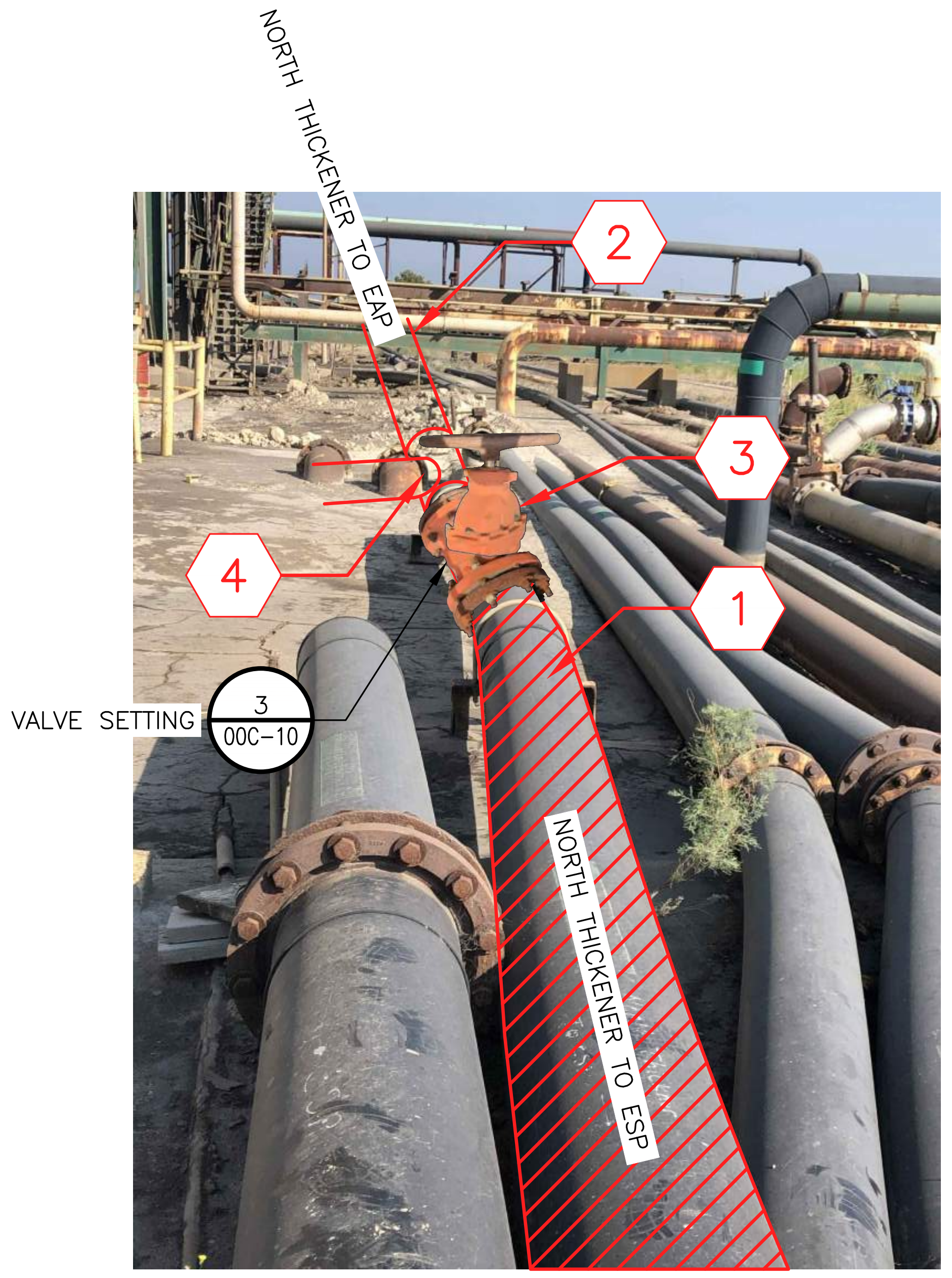
Luminant

MODIFIED YARD PIPING

0 1" 2"

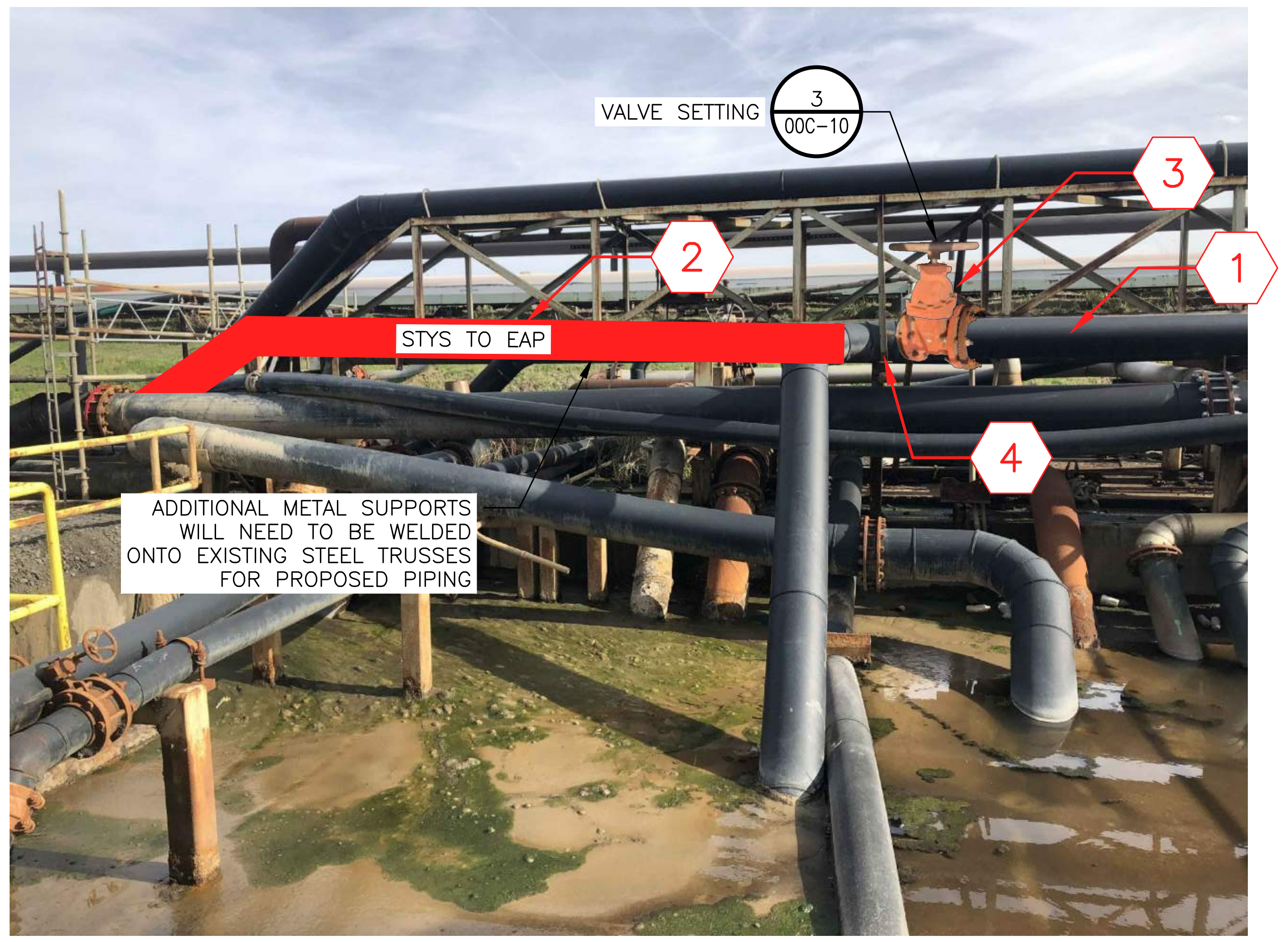
FILENAME 00C-07.dwg
SCALE 1" = 200'

SHEET
00C-07



CONNECTION TO NORTH THICKENER PIPELINE A 00C-07

NOT TO SCALE



CONNECTION TO SOUTH THICKENER PIPELINE B 00C-07

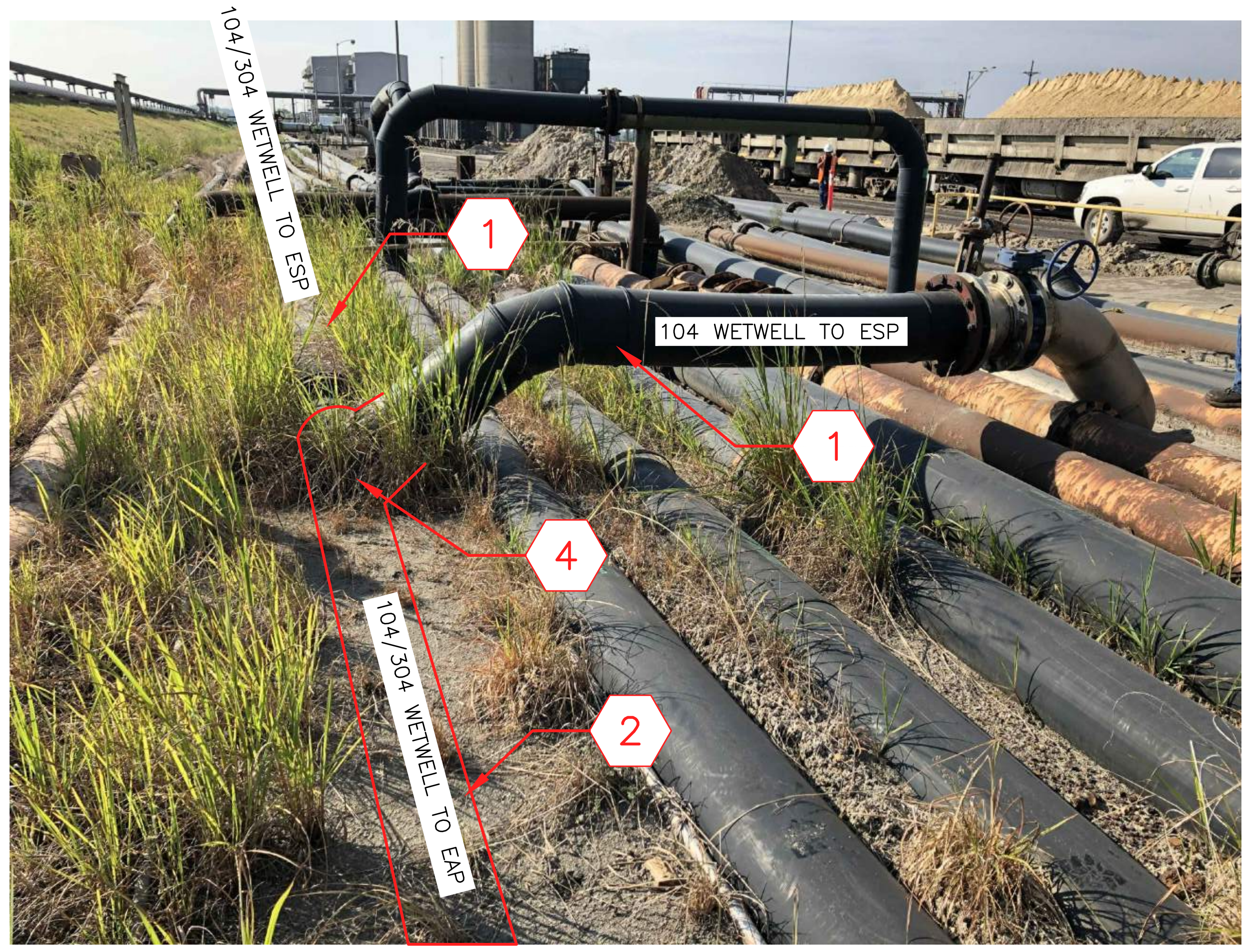
NOT TO SCALE

GENERAL NOTES:

1. SHUTDOWNS REQUIRED FOR CONNECTIONS SHALL BE COORDINATED WITH THE PLANT.
2. THE CONNECTIONS LOCATION TO ALL EXISTING PIPELINES ARE APPROXIMATE AND SHOULD BE CONFIRMED IN THE FIELD BY THE CONTRACTOR AND PLANT OPERATIONS.
3. CONNECTIONS C AND D MUST BOTH BE COMPLETE BEFORE MAKING EITHER OF THESE LINES OPERATIONAL.
4. ALL PIPE AND FITTING SIZES SHALL BE CONFIRMED IN THE FIELD BY THE CONTRACTOR PRIOR TO ORDERING OR MANUFACTURING OF PIPE.

KEY NOTES:

1	EXISTING TO REMAIN
2	PIPELINE REROUTE
3	12" ISOLATION VALVE
4	INSTALL SIZE ON SIZE TEE



CONNECTION TO 104 WETWELL TO ESP PIPELINE C 00C-07

NOT TO SCALE

CONNECTION TO 304 WETWELL TO ESP PIPELINE C 00C-07

NOT TO SCALE

ISSUE	DATE	DESCRIPTION
F	01/29/2020	ISSUED FOR BID
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A	11/12/2019	ISSUED FOR CLIENT REVIEW

PROJECT MANAGER	D. VOGT, P.E.
DESIGNED BY	J. ORDONEZ, P.E.
DRAWN BY	J. RAYMOND
CHECKED BY	D. VOGT, P.E.
PROJECT NUMBER	10172630

JAIME ORDONEZ
124838

MARTIN LAKE STEAM ELECTRICAL STATION
EAST ASH POND RELINE
RUSK COUNTY, TEXAS

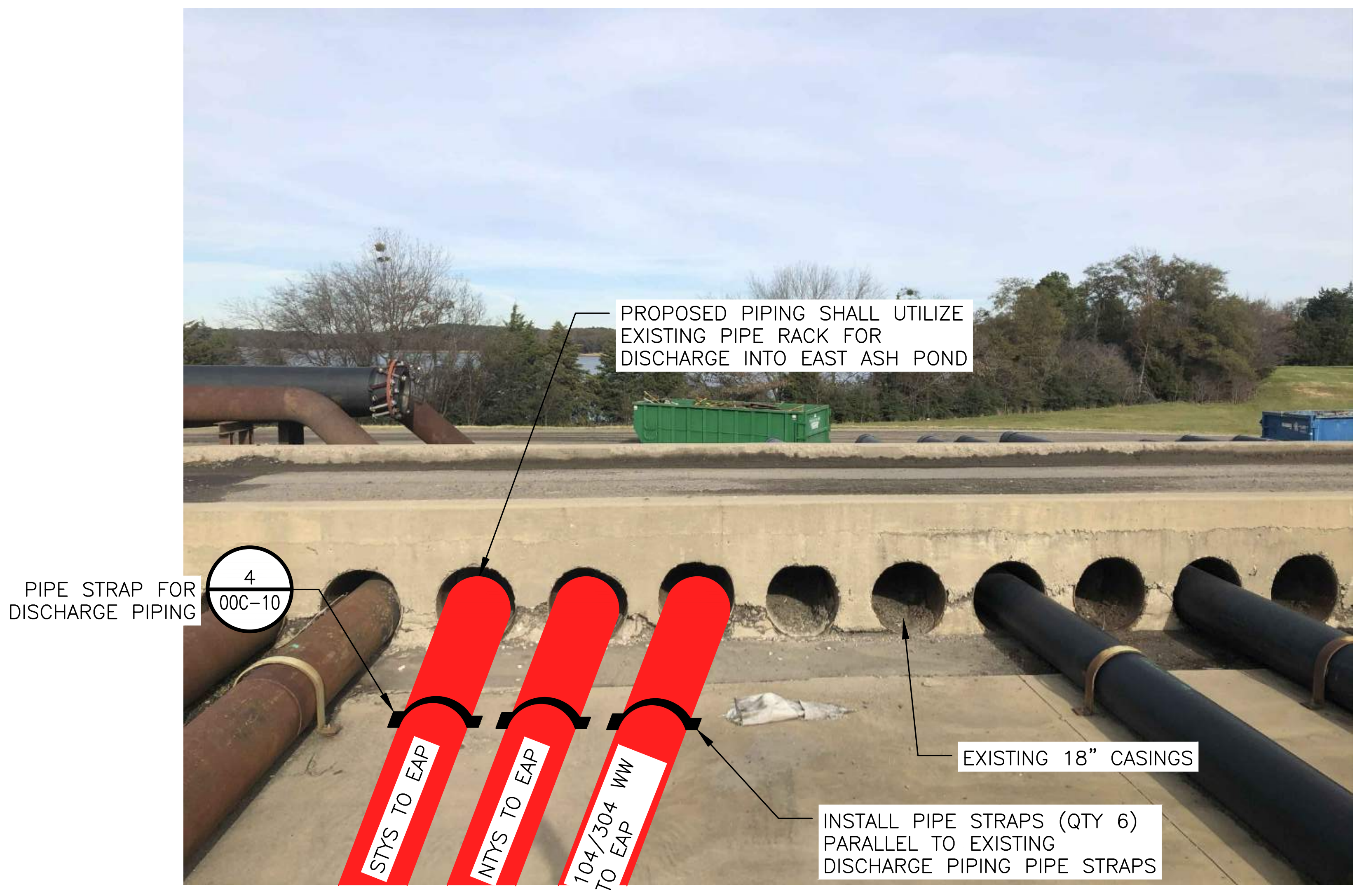
Luminant

YARD PIPING CONNECTIONS AND DETAILS

0 1" 2"

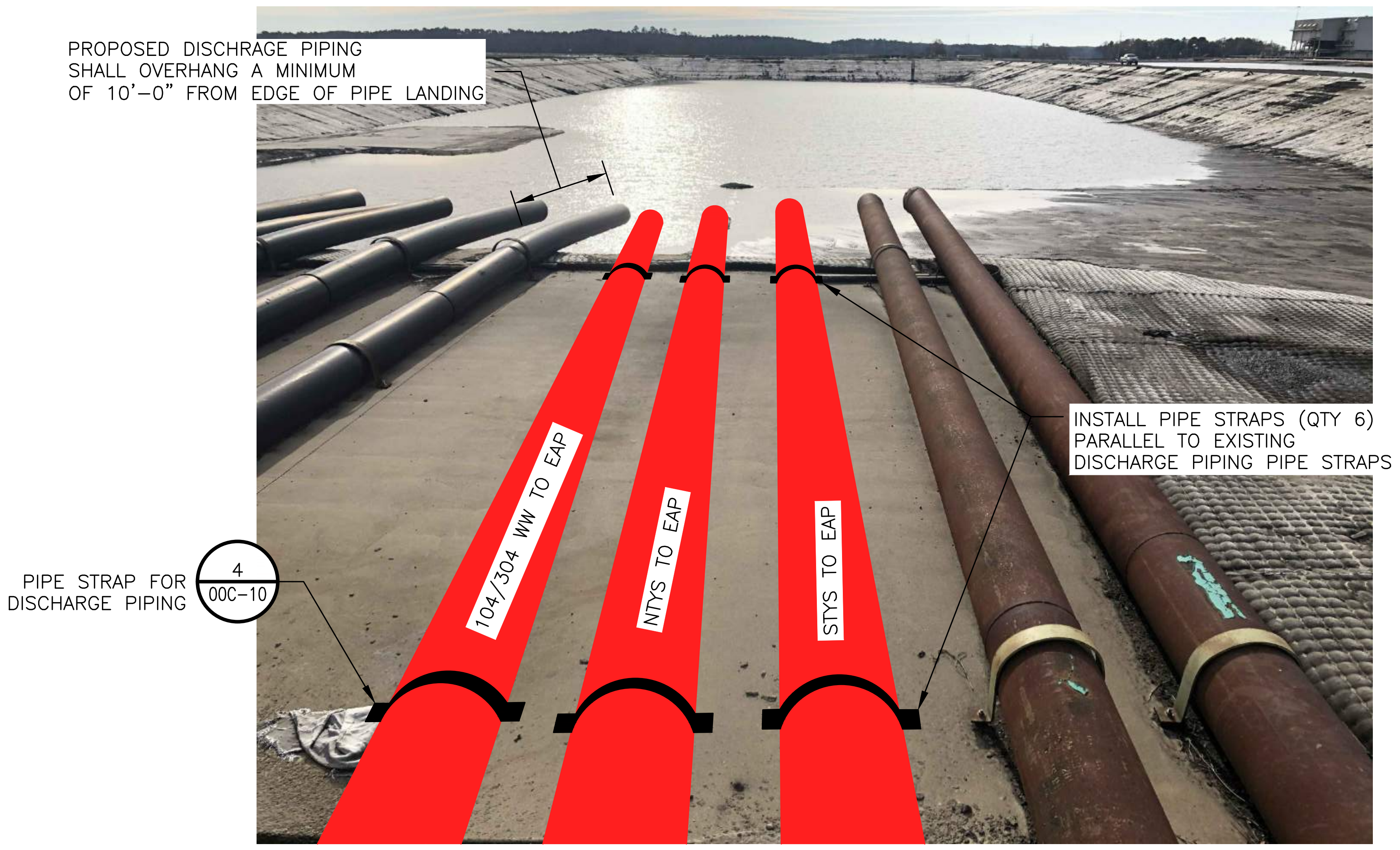
FILENAME	00C-08.dwg
SCALE	NOT TO SCALE

SHEET
00C-08



TERMINATION DETAIL A AT EXISTING PIPE RACK A 00C-08

NOT TO SCALE

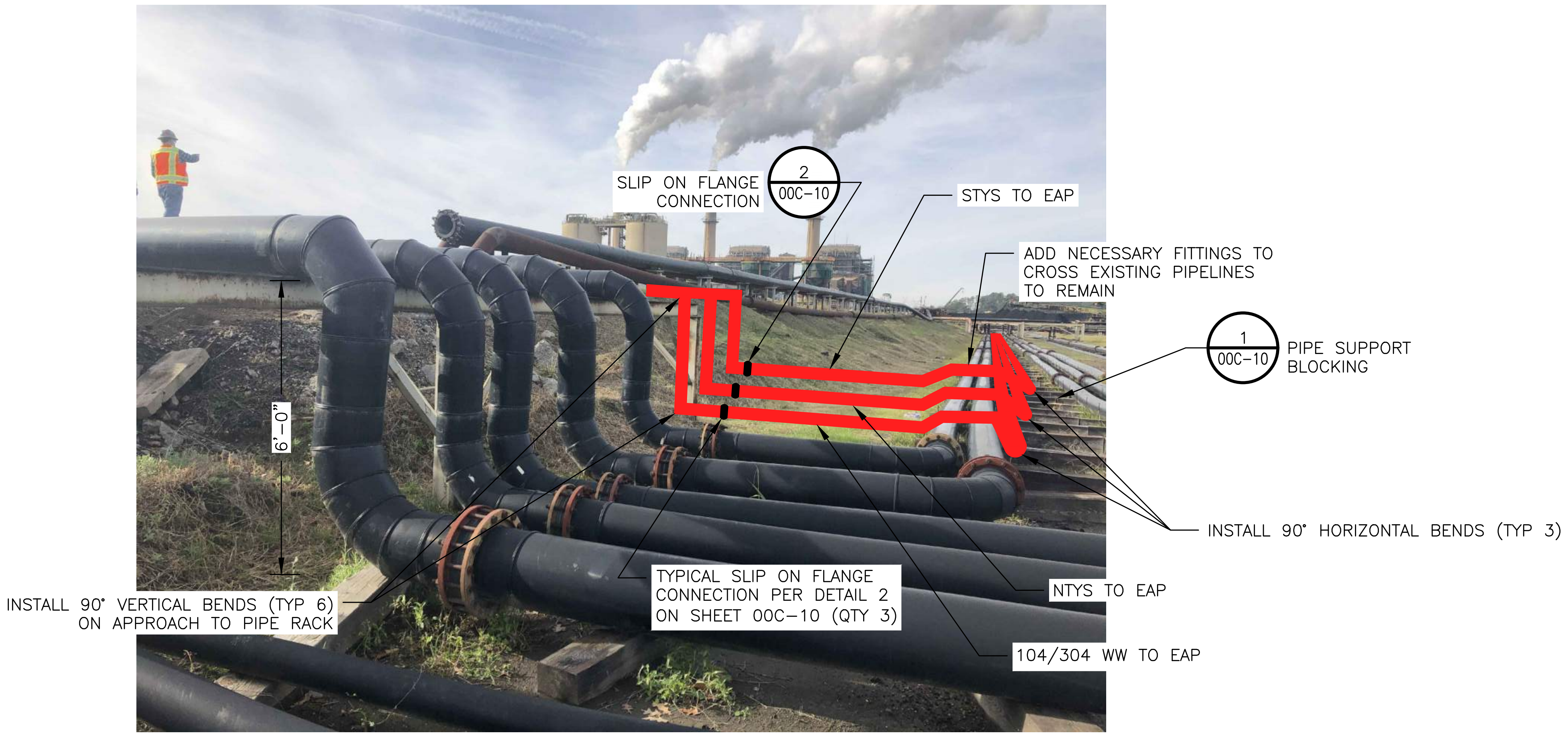


TERMINATION DETAIL B AT EXISTING PIPE RACK B 00C-09

NOT TO SCALE

TERMINATION DETAIL C AT EXISTING PIPE RACK C 00C-09

NOT TO SCALE



TERMINATION DETAIL D AT EXISTING PIPE RACK D 00C-09

NOT TO SCALE

GENERAL NOTES:

1. EXISTING PIPELINES SHOWN SHALL BE REROUTED TO THE EAST ASH POND IN ORDER TO RELINE THE NEW SCRUBBER POND.
2. SHUTDOWNS REQUIRED FOR CONNECTIONS SHALL BE COORDINATED WITH THE PLANT.
3. THE CONNECTIONS LOCATION TO ALL EXISTING PIPELINES ARE APPROXIMATE AND SHOULD BE CONFIRMED IN THE FIELD BY THE CONTRACTOR AND PLANT OPERATIONS.
4. ALL JOINTS SHALL BE FUSION WELDED BUTT JOINTS IN ACCORDANCE WITH PROJECT SPECIFICATIONS, UNLESS OTHERWISE NOTED.
5. ALL PIPE AND FITTING SIZES SHALL BE CONFIRMED IN THE FIELD BY THE CONTRACTOR PRIOR TO ORDERING OR MANUFACTURING OF PIPE.

HDR

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PROJECT MANAGER	D. VOGT, P.E.
DESIGNED BY	J. ORDONEZ, P.E.
DRAWN BY	J. RAYMOND
CHECKED BY	D. VOGT, P.E.
PROJECT NUMBER	10172630

JAIME ORDONEZ
124838

MARTIN LAKE STEAM ELECTRICAL STATION
EAST ASH POND RELINE
RUSK COUNTY, TEXAS

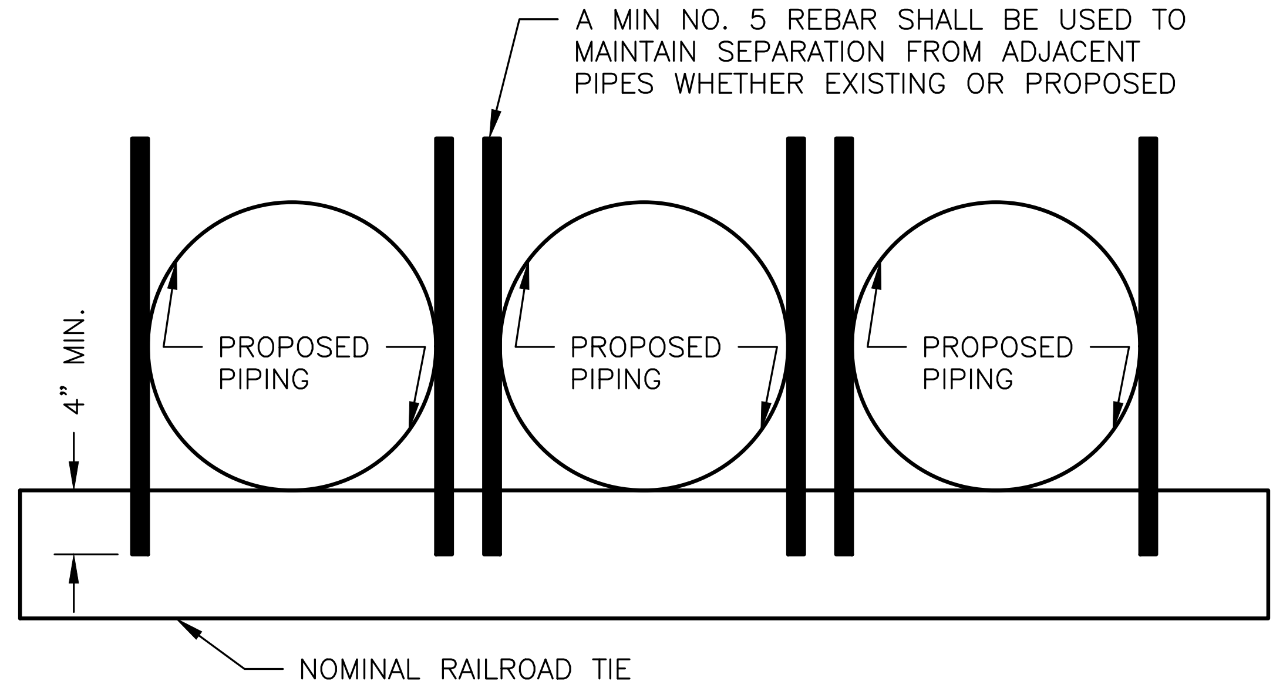
Luminant

YARD PIPING CONNECTIONS AND DETAILS

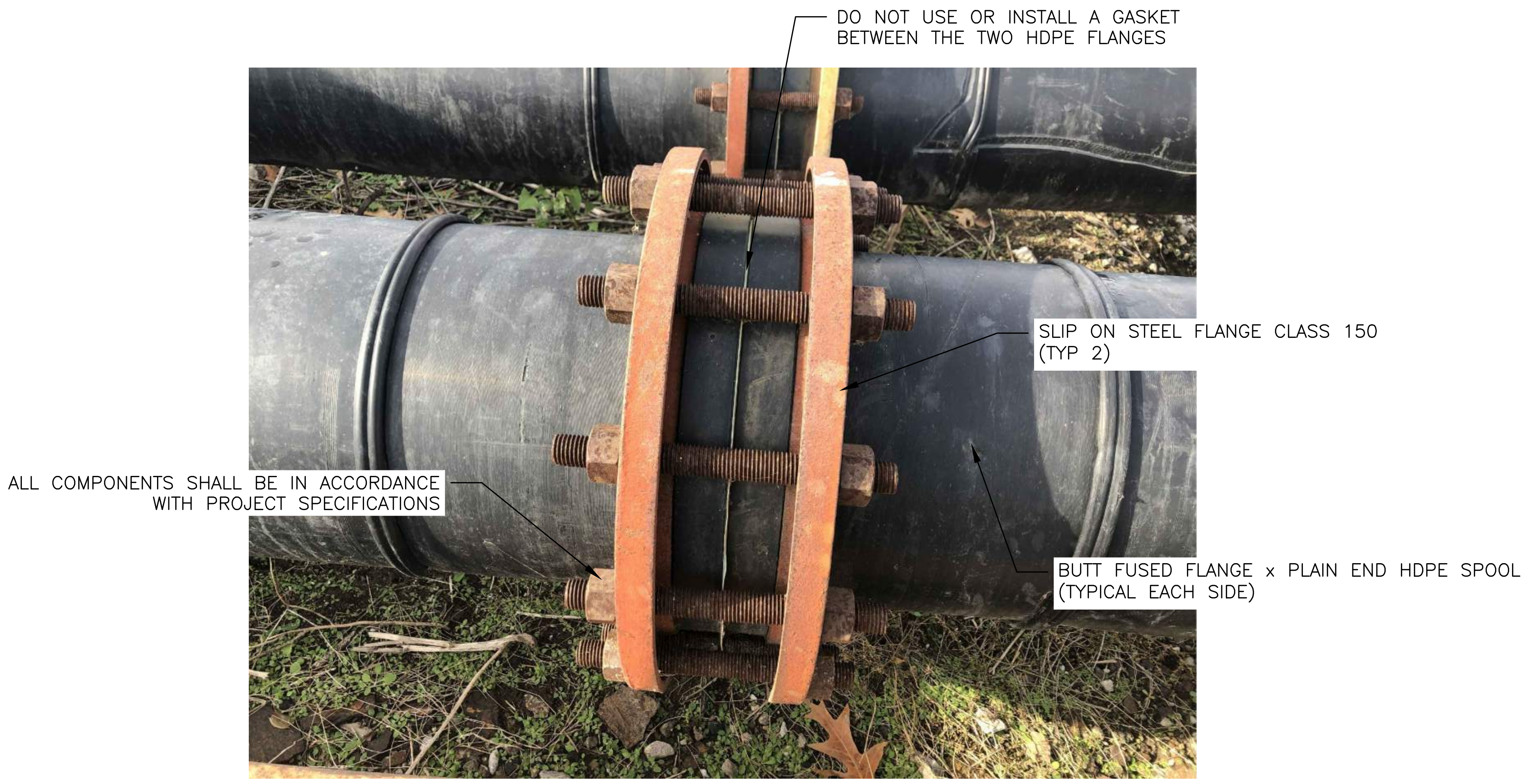
0 1" 2"

FILENAME 00C-09.dwg
SCALE NOT TO SCALE

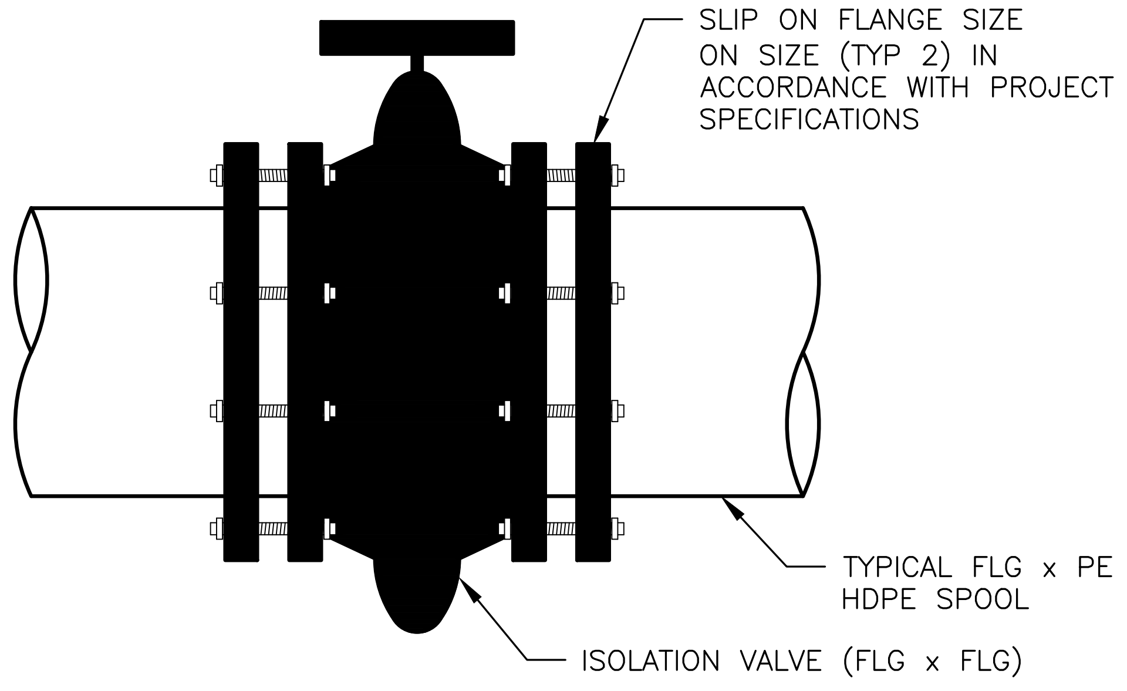
SHEET 00C-09



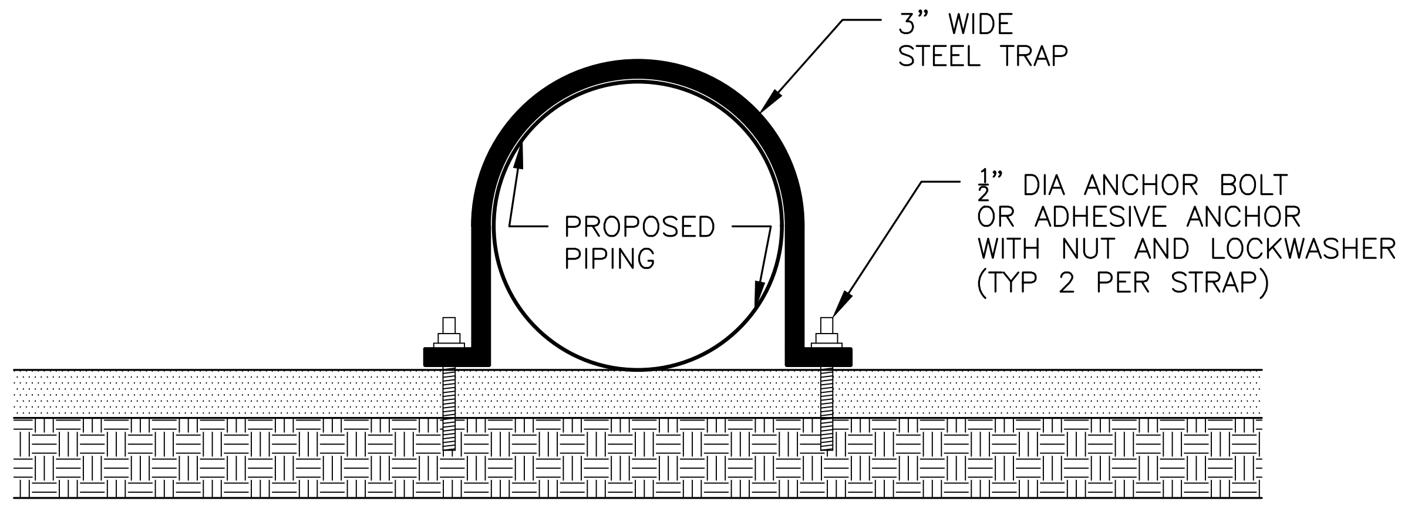
PIPE SUPPORT BLOCKING
NOT TO SCALE
1
00C-09



SLIP ON FLANGE CONNECTION
NOT TO SCALE
2
00C-09



VALVE SETTING
NOT TO SCALE
3
00C-08



PIPE STRAP FOR DISCHARGE PIPING
NOT TO SCALE
4
00C-09

ISSUE	DATE	DESCRIPTION
F	01/29/2020	ISSUED FOR BID
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PROJECT MANAGER	D. VOGT, P.E.
DESIGNED BY	J. ORDONEZ, P.E.
DRAWN BY	J. RAYMOND
CHECKED BY	D. VOGT, P.E.
PROJECT NUMBER	10172630

JAIME ORDONEZ
124838
1/24/2020

MARTIN LAKE STEAM ELECTRICAL STATION
EAST ASH POND RELINE
RUSK COUNTY, TEXAS

Luminant

YARD PIPING DETAILS

0 1" 2"

FILENAME	00C-10.dwg
SCALE	NOT TO SCALE

SHEET
00C-10

HDR

F	01/29/2020	ISSUED FOR BID
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B	11/26/2019	ISSUED FOR CLIENT REVIEW
A	11/12/2019	ISSUED FOR CLIENT REVIEW
ISSUE	**DATE**	**DESCRIPTION**

PROJECT MANAGER D. VOGT, P.E.
DESIGNED BY K. PERERA
DRAWN BY J. RAYMOND
CHECKED BY M. ROBERTS
PROJECT NUMBER 10172630

DAVID C. VOGT
93905

1/29/2020

MARTIN LAKE STEAM ELECTRICAL STATION
EAST ASH POND RELINE
RUSK COUNTY, TEXAS

Luminant

STOCKPILE AND HAUL ROUTE

0 1" 2"

FILENAME 00C-11.dwg
SCALE 1" = 600'

SHEET
00C-11

APPENDIX D – WEST ASH POND RETROFIT DESIGN DRAWINGS

HDR
Firm Registration No. F-754
17111 Preston Road, Suite 300
Dallas, Texas 75248-1229
972.960.4400

Luminant

Construction Drawings For

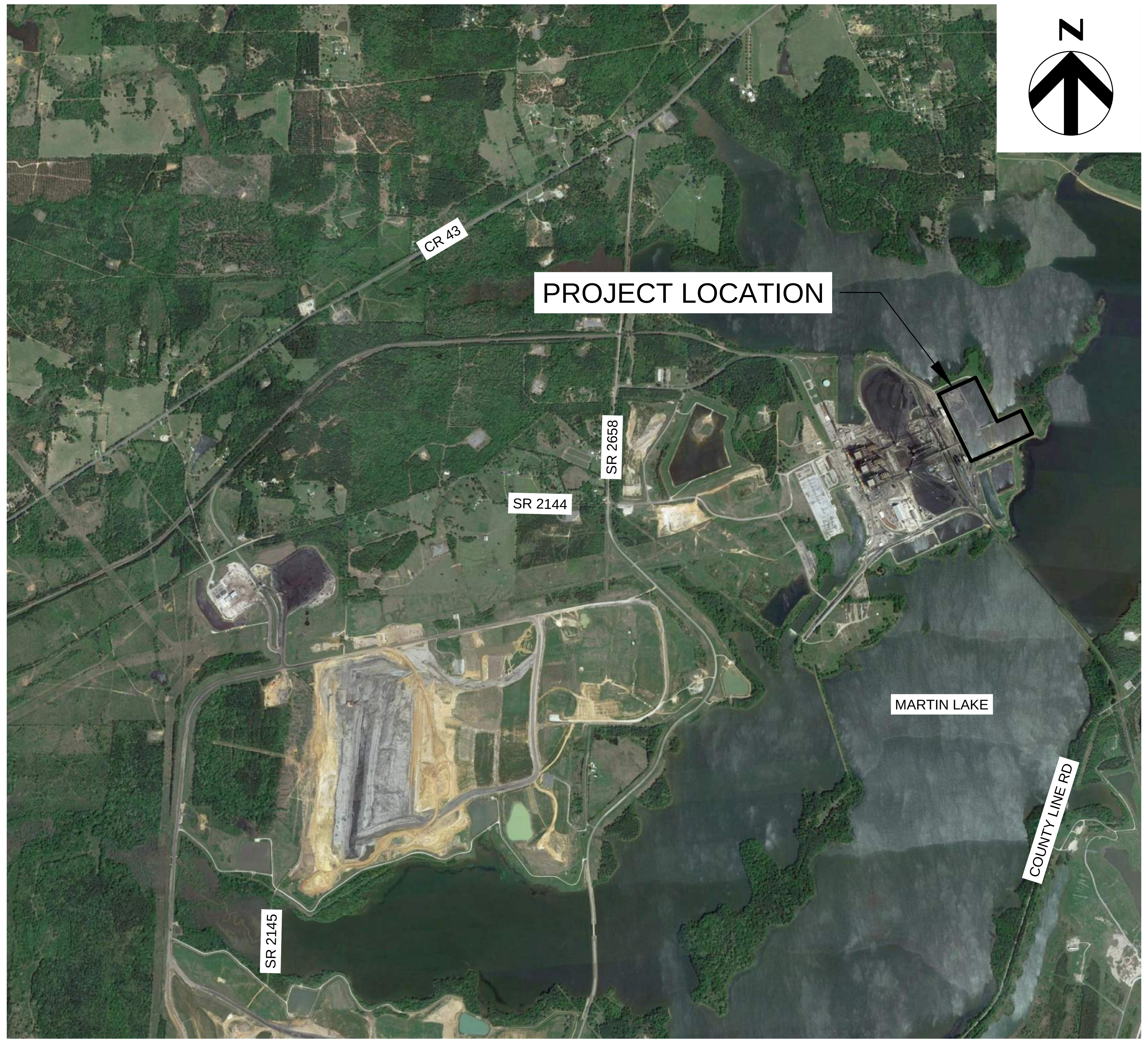
Martin Lake Steam Electric Station

CCR Impoundment Reline West Ash Pond

Project No.
10172630

Rusk County, Texas
January 2020

INDEX OF DRAWINGS



VICINITY MAP
NOT TO SCALE

DAVID C. VOGT
93905

1/31/2020

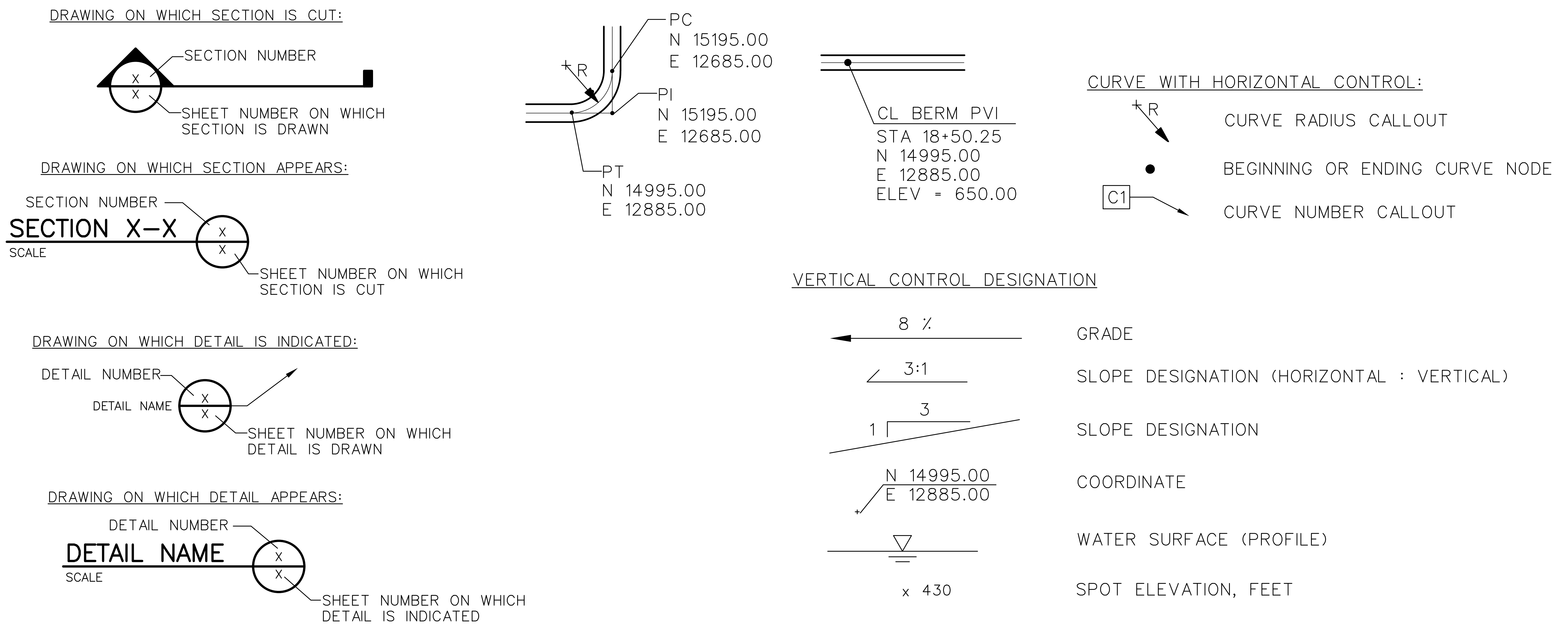
STANDARD ABBREVIATIONS

&	AND
APPROX	APPROXIMATELY
@	AT
AVG	AVERAGE
BOE	BOTTOM OF EXCAVATION
BOL	BOTTOM OF LINER
X	BY
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CO	CLEAN OUT
CY	CUBIC YARD
DIA	DIAMETER
DET	DETAIL
DWG	DRAWING
E	EAST
EAP	EAST ASH POND
ELEV	ELEVATION
EW	EACH WAY
EXIST	EXISTING
EXC	EXCAVATION
FGD	FLUE GAS DESULFICATION
FML	FLEXIBLE MEMBRANE LINER
FT	FEET
GAL	GALLON
GND	GROUND
GDL	GRAVEL DRAINAGE LAYER
GNDL	GEONET DRAINAGE LAYER
HDPE	HIGH DENSITY POLYETHYLENE
HORIZ	HORIZONTAL
ID	INSIDE DIAMETER
IN	INCHES
IE	INVERT ELEVATION
LCRS	LEACHATE COLLECTION AND REMOVAL SYSTEM
LCS	LEACHATE COLLECTION SYSTEM
LCP	LEACHATE COLLECTION PIPE
LCPR	LEACHATE COLLECTION PIPE RISER
LF	LINEAR FEET
LB	POUND
MH	MANHOLE
MAX	MAXIMUM
MIL	.001 INCHES
MIN	MINIMUM
MW	MONITOR WELL
MLSES	MARTIN LAKE STEAM ELECTRIC STATION
MSL	MEAN SEA LEVEL
N	NORTH
NIC	NOT IN CONTRACT
NO	NUMBER

NTS	NOT TO SCALE
NTYS	NORTH THICKENER YARD SUMP
OC	ON CENTER
OZ	OUNCE
%	PERCENT
PLCP	PERFORATED LEACHATE COLLECTION PIPE
PERF	PERFORATED
PGL	PROFILE GRADE LINE
PDP	PERMANENT DISPOSAL POND
PC	POINT OF CURVATURE
PI	POINT OF INTERSECTION
PVI	POINT OF VERTICAL INTERSECTION
PT	POINT OF TANGENT
PZ	PIEZOMETER
Q	FLOW
QTY	QUANTITY
R	RADIUS
RCP	REINFORCED CONCRETE PIPE
REF	REFERENCE
REQ	REQUIRED
RD	ROAD
SCH	SCHEDULE
SDL	SAND DRAINAGE LAYER
SEC	SECTION
SHT	SHEET
S	SOUTH
SDR	STANDARD DIMENSION RATIO
SLQCP	SOIL LINER QUALITY CONTROL PLAN
SP	STEEL PIPE
SQ	SQUARE
SS	SIDE SLOPE
STA	STATION
STYS	SOUTH THICKENER YARD SUMP
T.A.S.	TERMINAL ANCHOR SECTION
TL	TANGENT LENGTH
TOC	TOP OF COVER
TOFC	TOP OF FINAL COVER
TOL	TOP OF LINER
TOS	TOE OF SLOPE
TS	TOP SLOPE
TEMP	TEMPORARY
TYP	TYPICAL
UNO	UNLESS NOTED OTHERWISE
VERT	VERTICAL
W	WEST
W/	WITH
WAP	WEST ASH POND
WW	WETWELL
YD	YARD

SYMBOLS

SECTION DETAIL INDICATORS



CONSTRUCTION SEQUENCE

A. CONTRACTOR SHALL CLEAN THE WAP BY REMOVING ANY REMAINING CCR MATERIAL, ROCKS, AND SEDIMENT.

B. CONTRACTOR SHALL USE WATER FROM THE ADJACENT EAST ASH POND (EAP) OR NEW SCRUBBER POND (SP) TO WASH REMAINING CCR MATERIAL OFF THE SIDES AND FLOOR OF THE WAP AND REMOVE IT. EAP WILL BE VISUALLY INSPECTED BY OWNER'S CQA CONSULTANT TO CONFIRM CCR MATERIAL, ROCKS, AND SEDIMENT HAVE BEEN REMOVED.

C. CONTRACTOR SHALL LOAD AND HAUL GENERAL SOIL FILL MATERIAL FROM THE OWNER'S STOCKPILE LOCATED AT LIBERTY MINE, A LOCATION UNDER THE PROVISIONS OF THE MINE SAFETY AND HEALTH ADMINISTRATION (MSHA) AND APPROXIMATELY 4.5 MILES FROM EAP.

D. CONTRACTOR SHALL PLACE THE GENERAL FILL MATERIAL OVER THE EXISTING CONCRETE REVETMENT TO A DEPTH OF AT LEAST SIX (6) INCHES, NOMINALLY COMPACT, AND SMOOTH ROLL TO FINISH THE INSTALLATION.

E. CONTRACTOR SHALL INSTALL A GEOSYNTHETIC CLAY LINER (GCL) OVER THE SIDES AND FLOOR OF THE WAP AND SECURE IT IN A PERIMETER ANCHOR TRENCH/BATTEN AND STRIP.

F. CONTRACTOR SHALL INSTALL A 60-MIL HDPE LINER DIRECTLY ON THE GCL AND SECURE IT IN A PERIMETER ANCHOR TRENCH/BATTEN AND STRIP.

GENERAL NOTES

1. ALL WORK UNDER THIS CONTRACT SHALL BE PERFORMED IN ACCORDANCE WITH THE PLANS AND PROJECT SPECIFICATIONS. IN THE EVENT OF A DISCREPANCY BETWEEN THE PLANS AND THE PROJECT SPECIFICATIONS, THE SPECIFICATIONS SHALL GOVERN.
2. COORDINATE SYSTEM IS BASED ON LOCAL SURVEY. THE BENCHMARKS TO BE USED FOR CONSTRUCTION ARE LOCATED AS SHOWN ON DRAWING NO. 00C-01. EXISTING CONTOURS ARE BASED ON TOPOGRAPHICAL SURVEY PERFORMED FEBRUARY 12-20, 2019 BY LACY SURVEYING. CURRENT GROUND ELEVATIONS MAY VARY FROM THOSE SHOWN DUE TO SITE WORK THAT HAS BEEN PERFORMED SINCE THE SURVEY WAS PERFORMED.
3. THE CONTRACTOR SHALL VERIFY EXISTING CONTOURS PRIOR TO THE START OF WORK.
4. THERE SHALL NOT BE ANY ADDITIONAL PAYMENT OR EXTENSION OF CONTRACT TIME FOR WORKING WITH SATURATED SOILS OR HANDLING WATER SEEPAGE DUE TO RAINFALL, RUNOFF AND INFILTRATION.
5. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT EXISTING ROADS, BENCHMARKS AND EXISTING GROUNDWATER MONITOR WELLS DURING THE CONSTRUCTION PERIOD. THE CONTRACTOR SHALL BE SOLEY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE INCURRED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PROTECT THE GROUNDWATER MONITOR WELLS, BENCHMARKS AND EXISTING ROADS.
6. THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES HAVE NOT BEEN ESTABLISHED BY THE OWNER OR ENGINEER. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTORS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UTILITIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING PROPER SAFE WORKING DISTANCE FROM ALL UTILITY EASEMENTS OR LINES.
7. EXCAVATION BY "BLASTING" IS NOT PERMITTED ON THIS PROJECT.
8. FINISHED GROUND ELEVATIONS SHALL MATCH EXISTING GROUND ELEVATIONS EXCEPT AS SHOWN ON THE PLANS. ALL EXCESS SOIL FROM THE EXCAVATION AND GRADING SHALL BE PLACED IN DESIGNATED STOCKPILE LOCATIONS AS APPROVED BY THE OWNER. IF WASTE IS ENCOUNTERED DURING EXCAVATION, THE OWNER SHALL BE NOTIFIED AND THE WASTE REMOVED AND PLACED IN AREAS DESIGNATED AS APPROVED BY THE OWNER. TRANSPORT OF SOIL TO FILL AREAS SHALL BE CONDUCTED BY THE CONTRACTOR AT NO ADDITIONAL EXPENSE TO THE OWNER.
9. GEOTECHNICAL INVESTIGATION REPORTS FOR THE SITE ARE AVAILABLE FOR REVIEW AT LUMINANT'S DALLAS OFFICES. THE CONTRACTOR MAY PERFORM ADDITIONAL GEOTECHNICAL INVESTIGATIONS, AS DEEMED NECESSARY FOR CONSTRUCTION ACTIVITIES, PROVIDED ALL NECESSARY PERMITS AND APPROVALS ARE OBTAINED FROM LUMINANT PRIOR TO INITIATING SUCH WORK. HOWEVER, THERE SHALL BE NO ADDITIONAL PAYMENT TO THE CONTRACTOR FOR ADDITIONAL GEOTECHNICAL INVESTIGATIONS.
10. THE CONTRACTOR SHALL CONSTRUCT, AND UPON COMPLETION OF THE PROJECT, REMOVE TEMPORARY CONSTRUCTION ACCESS ROADS. SUCH ROADS SHALL BE LOCATED AS APPROVED BY THE OWNER. DRAINAGE PATTERNS AT THE SITE SHALL NOT BE ALTERED BY ROAD CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONSTRUCTION AND MAINTENANCE OF TEMPORARY DRAINAGE STRUCTURES, INCLUDING CULVERTS, AT NO ADDITIONAL COST TO THE OWNER.
11. THE CONTRACTOR SHALL INSTALL, MAINTAIN, AND UPON COMPLETION OF THE PROJECT, REMOVE TEMPORARY EROSION AND SEDIMENT CONTROLS AS APPROVED BY LUMINENT ENVIRONMENTAL SERVICES AND IN ACCORDANCE WITH THE SITE SWPPP AND PURSUANT TO TPDES REQUIREMENTS. SUCH CONTROLS SHALL BE PLACED AT THE LIMITS OF DISTURBED AREAS AND AT INTERMEDIATE LOCATIONS WHERE CONCENTRATED FLOW IS LIKELY.
12. TEMPORARY CONSTRUCTION SLOPES SHALL NOT BE GREATER THAN 2H:1V. STEEPER SLOPES WILL ONLY BE ALLOWED IF THE CONTRACTOR PROVIDES A GEOTECHNICAL ENGINEERING REPORT SPECIFYING MAXIMUM SLOPES AND THE DURATION FOR WHICH SUCH SLOPES SHALL REMAIN IN PLACE.
13. THE CONTRACTOR SHALL REMOVE ALL VEGETATION WITHIN THE CONSTRUCTION LIMITS AS REQUIRED TO CONSTRUCT THE PROJECT. ALL VEGETATION SHALL BE REMOVED BY CONTRACTOR AT NO ADDITIONAL EXPENCE TO OWNER.
14. THE CONTRACTOR SHALL OBTAIN AND CONDUCT WORK CONSISTENT WITH A TPDES PERMIT FOR CONSTRUCTION, REFER TO TECHNICAL SPECIFICATIONS. PREPARATION OF A SWPPP AND OBTAINING THE TPDES PERMIT ARE THE CONTRACTORS RESPONSIBILITY.
15. THE CONTRACTOR SHALL IMMEDIATELY REPORT TO THE ENGINEER ANY ERROR OR DISCREPANCY FOUND ONCE THE CONTRACT DOCUMENT IS CAREFULLY REVIEWED AND ALL ASPECTS OF FIELD WORK HAVE BEEN VERIFIED. IN THE EVENT THE CONTRACTOR CONTINUES TO WORK ON AN ITEM WHERE AN ERROR EXISTS, IT SHALL BE DEEMED THAT THE CONTRACTOR BID AND INTENDED TO EXECUTE THE MORE STRINGENT OR HIGHER QUALITY REQUIREMENT WITHOUT AN INCREASE IN CONTRACT SUM OR TIME. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE TO CORRECT ANY FAILURE OF COMPANY PARTS TO COORDINATE OR FIT PROPERLY INTO FINAL POSITION, AS A RESULT OF CONTRACTOR FAILURE TO RAISE OR RESOLVE A DISCREPANCY.
16. THE DRAWINGS AND SPECIFICATIONS SHOULD AGREE WITH EACH OTHER, AND WORK CALLED FOR BY DRAWINGS AND NOT MENTIONED IN SPECIFICATION, OR VICE VERSA, SHALL BE FURNISHED BY BOTH. WHEN DISCREPANCIES EXIST BETWEEN SCALE AND DIMENSIONS, THE DIMENSIONED FIGURE SHALL BE USED.
17. CONTRACTOR AND EACH SUBCONTRACTOR SHALL VERIFY ALL GRADES, LINES, LEVELS, AND DIMENSIONS AS INDICATED ON DRAWINGS, AND HE SHALL REPORT ERRORS TO THE ENGINEER BEFORE COMMENCING WORK. THE CONTRACTOR SHALL ESTABLISH BENCHMARKS IN AT LEAST TWO WIDELY SEPARATED PLACES, AND AS WORK PROGRESSES THE CONTRACTOR WILL MAINTAIN ADEQUATE HORIZONTAL AND VERTICAL CONTROL.
18. CONTRACTOR SHALL PROVIDE EROSION CONTROL BY SEEDING FOR ALL AREAS DISTURBED BY CONTRACTOR DURING THE CONSTRUCTION OF THIS PROJECT. THE CONTRACTOR SHALL NOT DISTURB ANY AREA WITHOUT THE APPROVAL OF THE ENGINEER. EROSION CONTROL BY SEEDING SHALL CONFORM TO STANDARD SPECIFICATION 02930.
19. CONTRACTOR SHALL INSTALL EROSION AND SEDIMENT CONTROLS AS PER SPECIFICATIONS DURING CONSTRUCTION. SUCH CONTROLS SHALL BE PLACED AT LIMITS OF DISTURBED AREAS AND AT INTERMEDIATE LOCATIONS WHERE CONCENTRATED FLOW IS LIKELY.
20. STORMWATER THAT HAS COME INTO CONTACT WITH THE ASH WITHIN THE EXCAVATED POND IS TO BE CONSIDERED CONTACT STORMWATER. CONTRACTOR WILL CONTROL THE WATER ON SITE IN COMPLIANCE WITH THE TPDES PERMIT.
21. THE CONTRACTOR IS REQUIRED TO PRESENT THE SWPPP TO LUMINANT ENVIRONMENTAL SERVICES FOR APPROVAL PRIOR TO THE COMMENCEMENT OF CONSTRUCTION ACTIVITIES.
22. THE CONTRACTOR IS REQUIRED TO SUBMIT THE NOTICE OF INTENT AND NOTICE OF TERMINATION FOR THE TPDES PERMIT.
23. THE CONTRACTOR IS TO ACQUIRE A DIGGING PERMIT FROM THE PLANT BEFORE COMMENCING ANY EXCAVATION ACTIVITY.

HDR

ISSUE	DATE	DESCRIPTION
A	01/31/2020	ISSUED FOR BID

PROJECT MANAGER	D. VOGT, P.E.
DESIGNED BY	K. PERERA
DRAWN BY	J. RAYMOND
CHECKED BY	M. ROBERTS
PROJECT NUMBER	10172630

STATE OF TEXAS
DAVID C. VOGT
93905
LICENSED PROFESSIONAL ENGINEER
1/31/2020

MARTIN LAKE STEAM ELECTRICAL STATION
WEST ASH POND RELINE
RUSK COUNTY, TEXAS

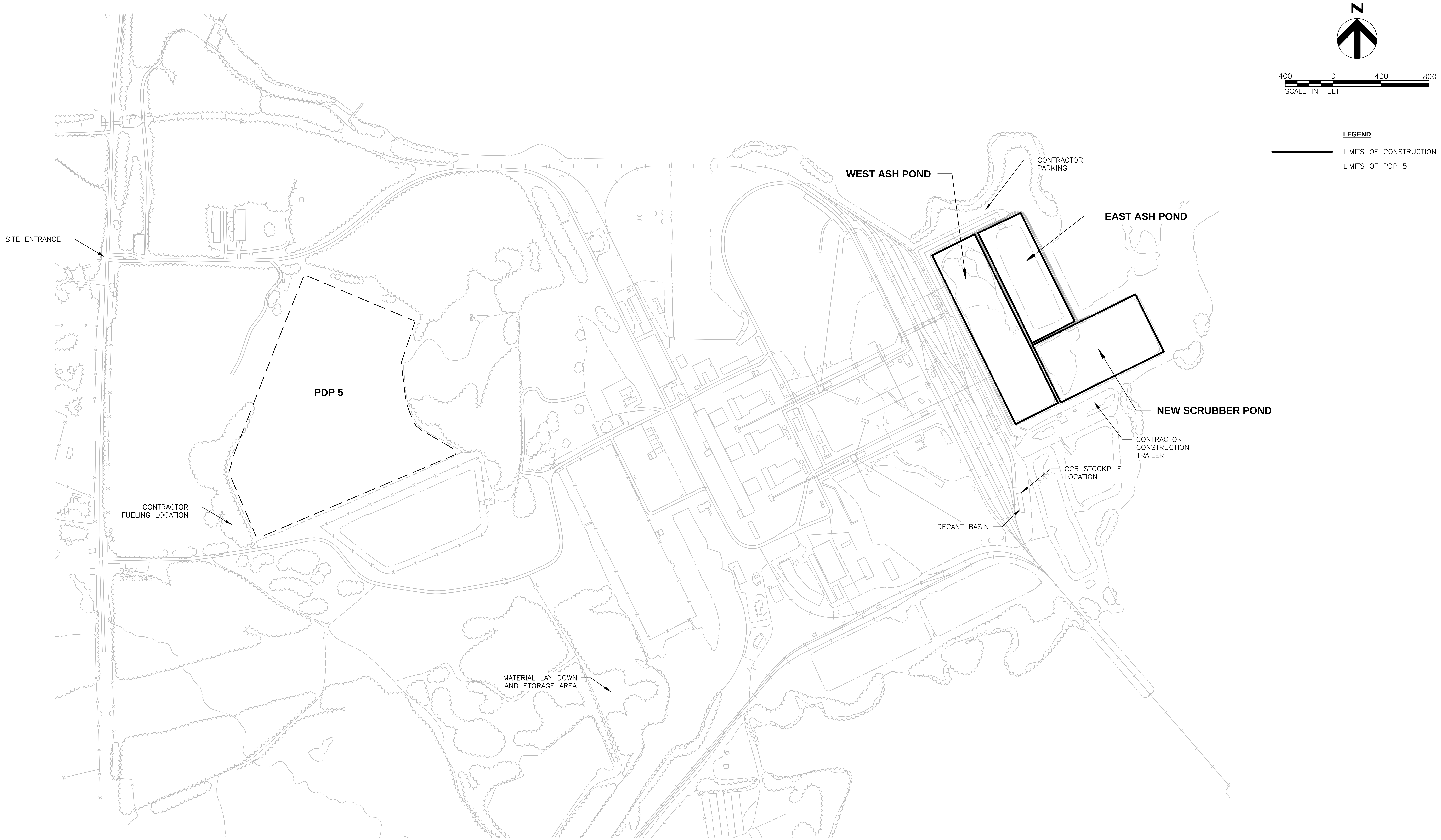
Luminant

ABBREVIATIONS AND GENERAL NOTES

0 1" 2"
SCALE

FILENAME 00G-02.dwg

SHEET 00G-02



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DAVID C. VOGT
93905

1/31/2020

MARTIN LAKE STEAM ELECTRICAL STATION
WEST ASH POND RELINE
RUSK COUNTY, TEXAS

Luminant

SITE LAYOUT

0 1" 2"

FILENAME 00C-01.dwg

SCALE 1" = 400'

SHEET

00C-01

LEGEND

EXISTING MINOR CONTOUR

320 EXISTING MAJOR CONTOUR

PROPOSED MINOR CONTOUR

320 PROPOSED MAJOR CONTOUR

ANCHOR TRENCH

NOTES:

1. THE PROPOSED CONTOURS SHOWN ARE TOP OF REVETMENT MATTRESS ELEVATIONS OBTAINED FROM JULY 1995 AS-BUILT DRAWINGS PREPARED BY TEXAS UTILITIES GENERATING CO.
2. NO EQUIPMENT ALLOWED OVER DETECTION SUMP.
3. SEE DETAIL 1/00C-05 FOR PROPOSED LINER SYSTEM DETAILS.

HDR

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PROJECT NUMBER 10172630

DAVID C. VOGT
93905

1/31/2020

MARTIN LAKE STEAM ELECTRICAL STATION
WEST ASH POND RELINE
RUSK COUNTY, TEXAS

Luminant

WEST ASH POND

0 1" 2"

FILENAME 00C-02.dwg
SCALE 1" = 60'

SHEET
00C-02

100 0 100 200
HORIZONTAL SCALE: 1" = 100'

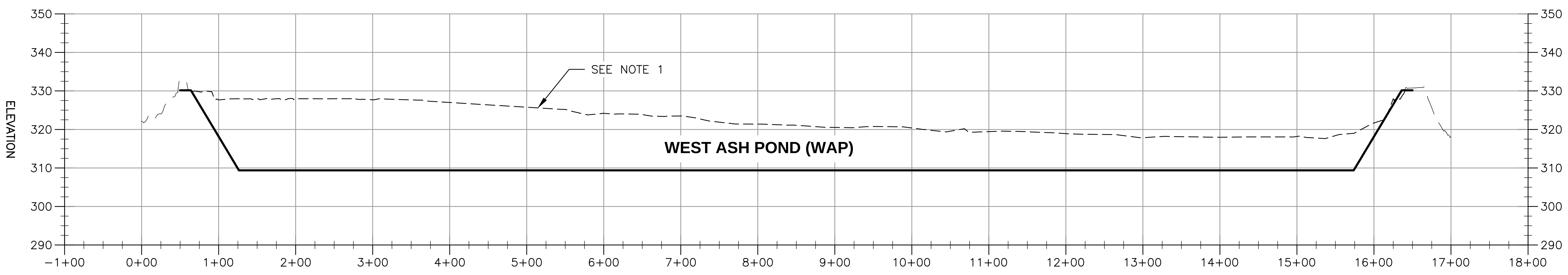
20 0 20 40
VERTICAL SCALE: 1" = 20'

LEGEND

- – – – – – – TOP OF CCR MATERIAL
- — — — — EXISTING GROUND SURFACE
- ——— PROPOSED GRADE

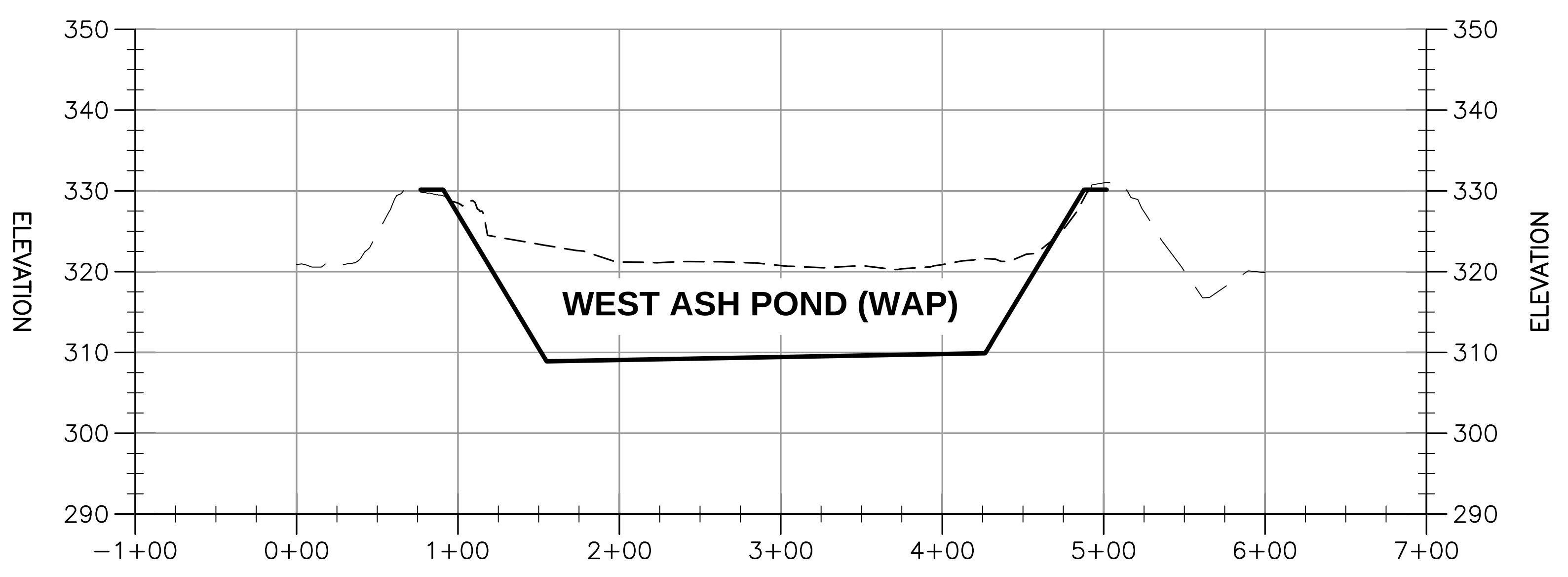
NOTES:

1. CCR ELEVATION FROM BATHYMETRIC SURVEY TAKEN FEBRUARY 2019 BY LACEY SURVEYING OF ARP, TEXAS. AT START OF PROJECT, OWNER WILL HAVE REMOVED BULK OF CCR MATERIAL FROM THE WEST ASH POND
2. CONTRACTOR WILL REMOVE REMAINING CCR MATERIAL, ROCKS AND SEDIMENT WITHIN POND BEFORE INSTALLATION OF THE LINER SYSTEM.



SECTION A–A

HORIZONTAL SCALE: 1" = 100' ; VERTICAL SCALE: 1" = 20' A–A 00C–02



SECTION B–B

HORIZONTAL SCALE: 1" = 100' ; VERTICAL SCALE: 1" = 20' B–B 00C–02

HDR

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A	01/31/2020	ISSUED FOR BID

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DESIGNED BY K. PERERA
DRAWN BY J. RAYMOND
CHECKED BY M. ROBERTS
PROJECT NUMBER 10172630

DAVID C. VOGT
93905
1/31/2020

MARTIN LAKE STEAM ELECTRICAL STATION
WEST ASH POND RELINE
RUSK COUNTY, TEXAS

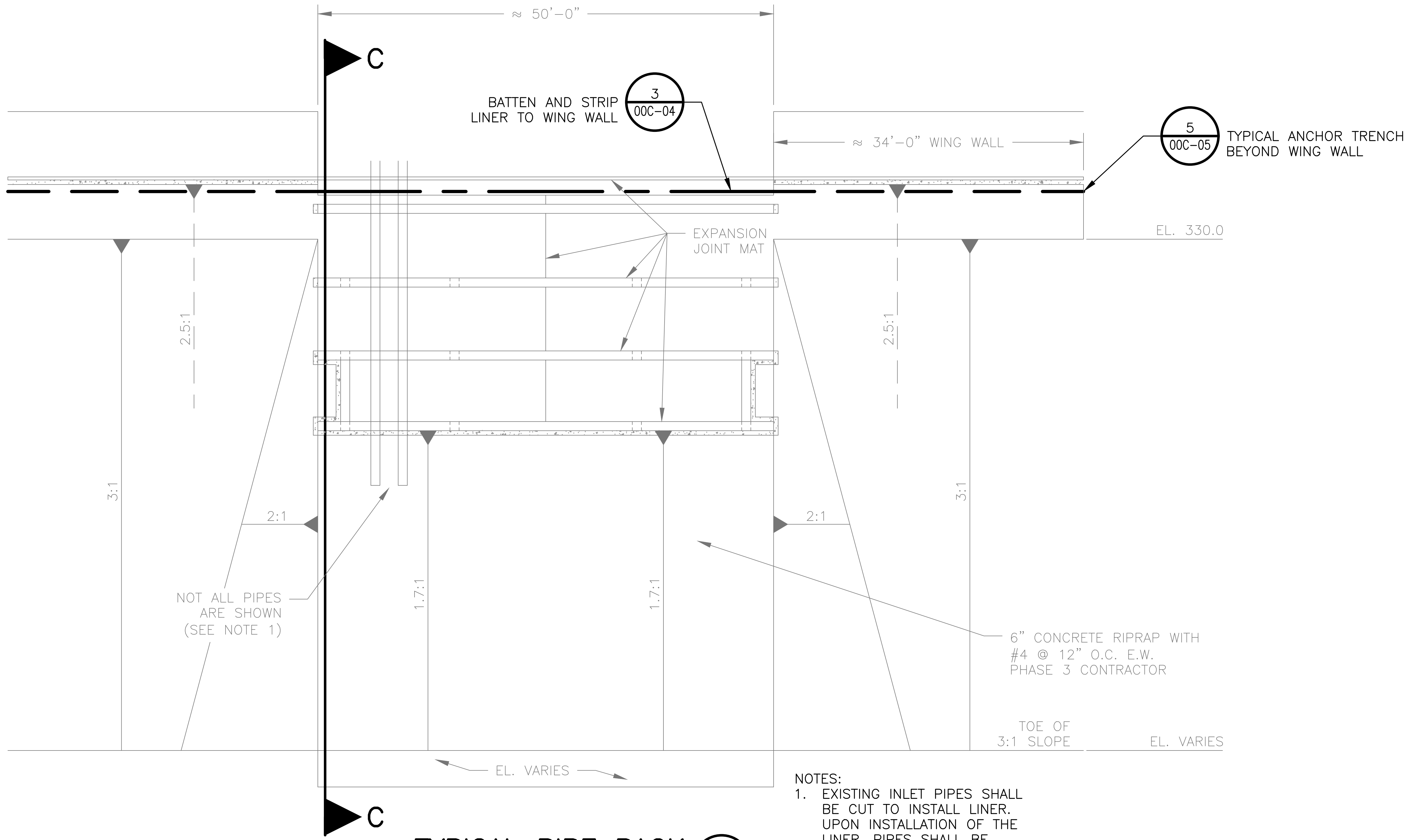
Luminant

CROSS SECTIONS

0 1" 2"

FILENAME 00C-03.dwg
SCALE H: 1" = 100' ; V: 1" = 20'

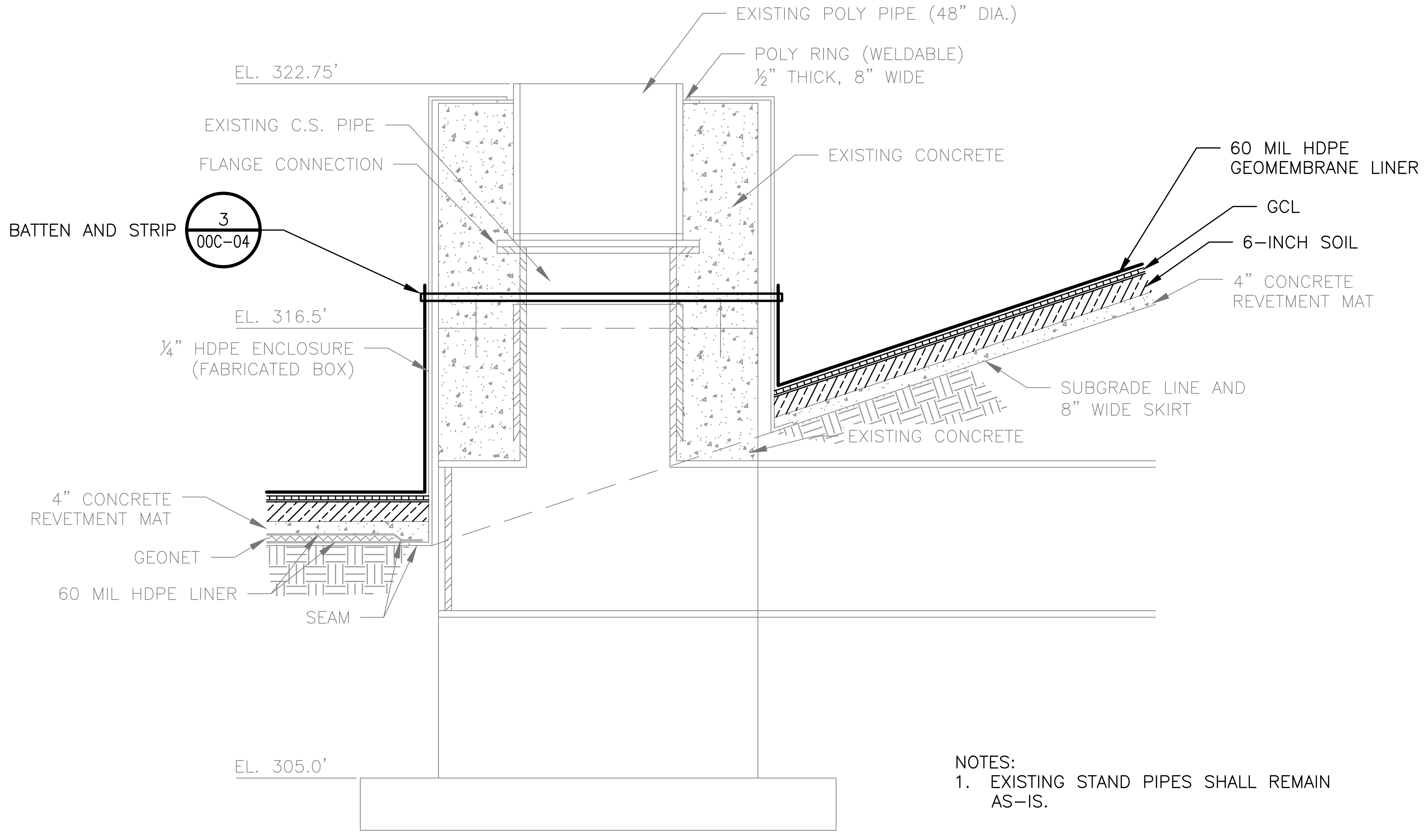
SHEET
00C-03



NOTES:
1. EXISTING INLET PIPES SHALL BE CUT TO INSTALL LINER. UPON INSTALLATION OF THE LINER, PIPES SHALL BE REINSTALLED.

TYPICAL PIPE RACK
1 00C-02

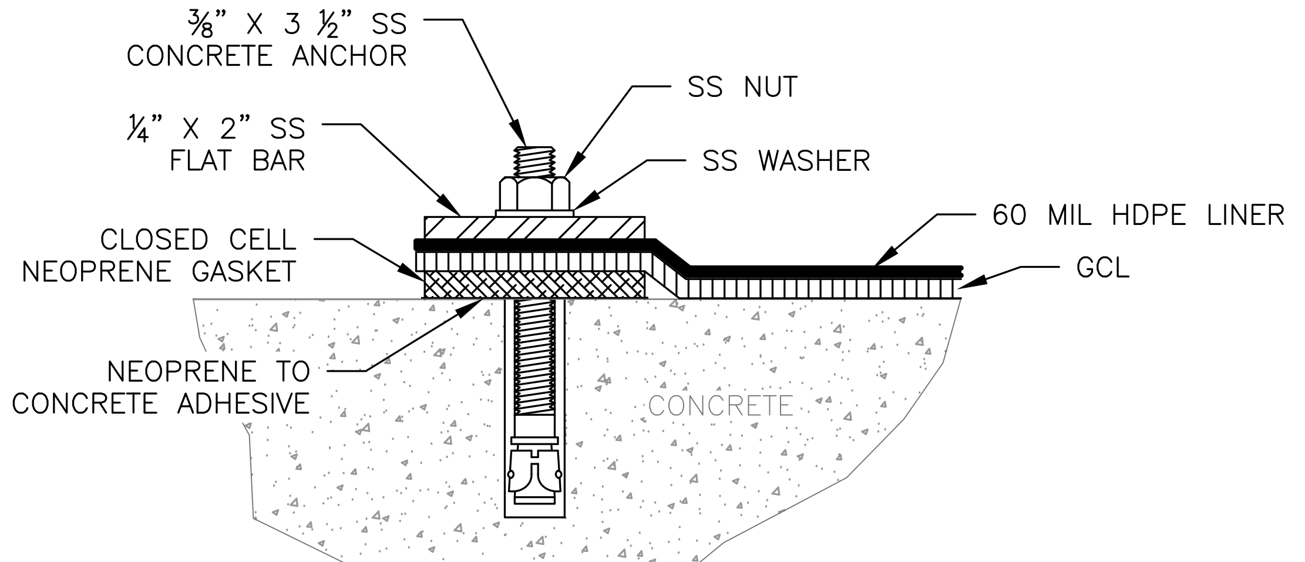
NOT TO SCALE



NOTES:
1. EXISTING STAND PIPES SHALL REMAIN AS-IS.

STANDPIPE ENCLOSURE
2 00C-02

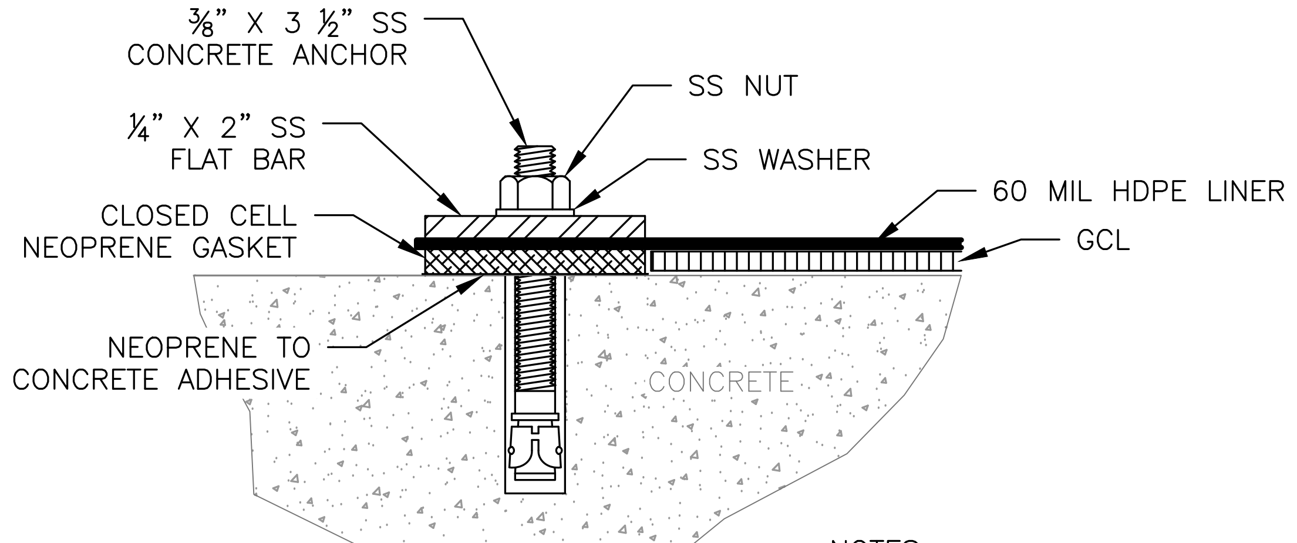
NOT TO SCALE



NOTES:
1. EPOXY ANCHORS SPACED AT 6" O.C.

BATTEN AND STRIP CONNECTION AT ANCHOR TRENCH
3A 00C-04

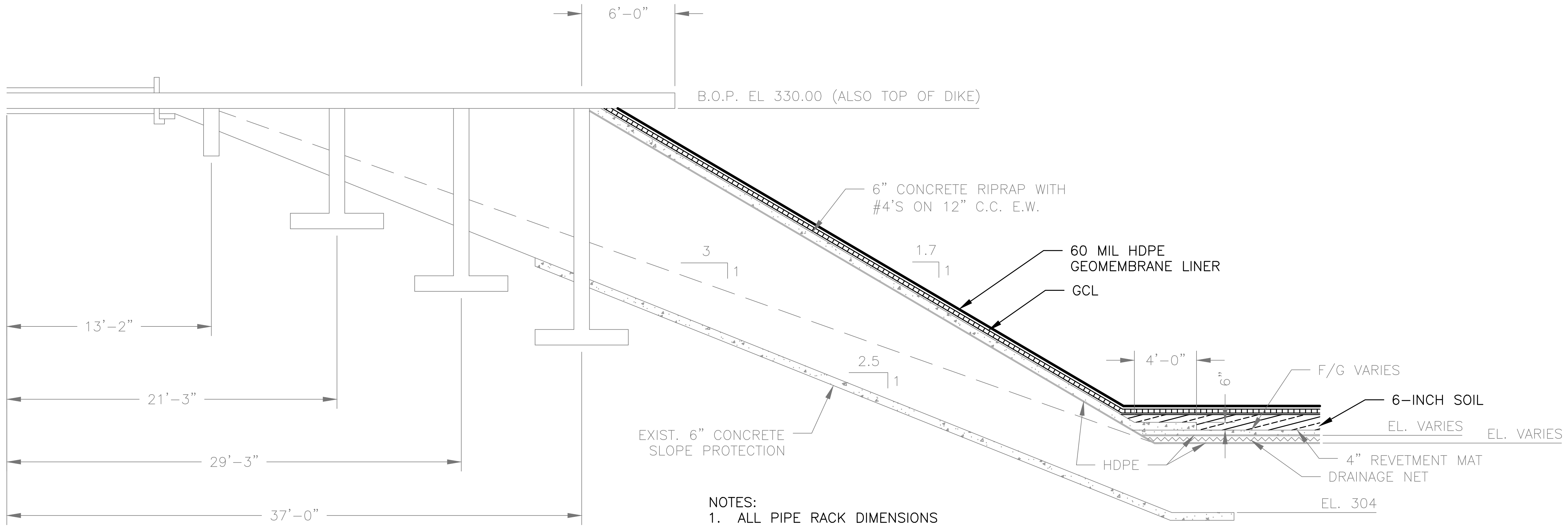
NOT TO SCALE



NOTES:
1. EPOXY ANCHORS SPACED AT 6" O.C.

BATTEN AND STRIP CONNECTION BELOW WATER SURFACE
3B 00C-04

NOT TO SCALE



NOTES:
1. ALL PIPE RACK DIMENSIONS ARE "AS-BUILT" DIMENSIONS FOR EAST ASH POND.

SECTION C–C

NOT TO SCALE

A	01/31/2020	ISSUED FOR BID
ISSUE	DATE	DESCRIPTION

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DESIGNED BY K. PERERA
DRAWN BY J. RAYMOND
CHECKED BY M. ROBERTS
PROJECT NUMBER 10172630

DAVID C. VOGT
93905

1/31/2020

MARTIN LAKE STEAM ELECTRICAL STATION
WEST ASH POND RELINE
RUSK COUNTY, TEXAS

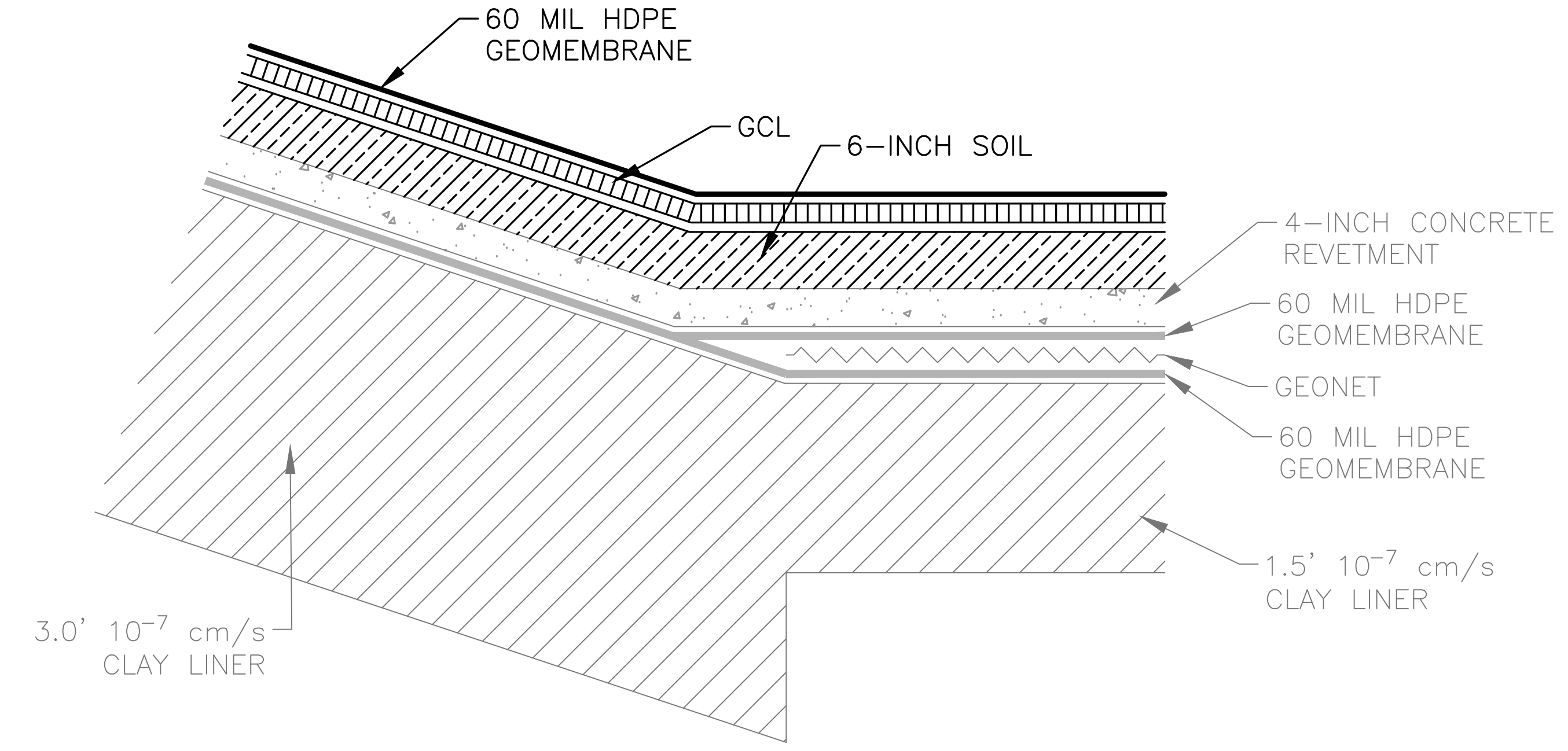
Luminant

DETAILS
(1 OF 2)

0 1" 2"

FILENAME 00C-04.dwg
SCALE

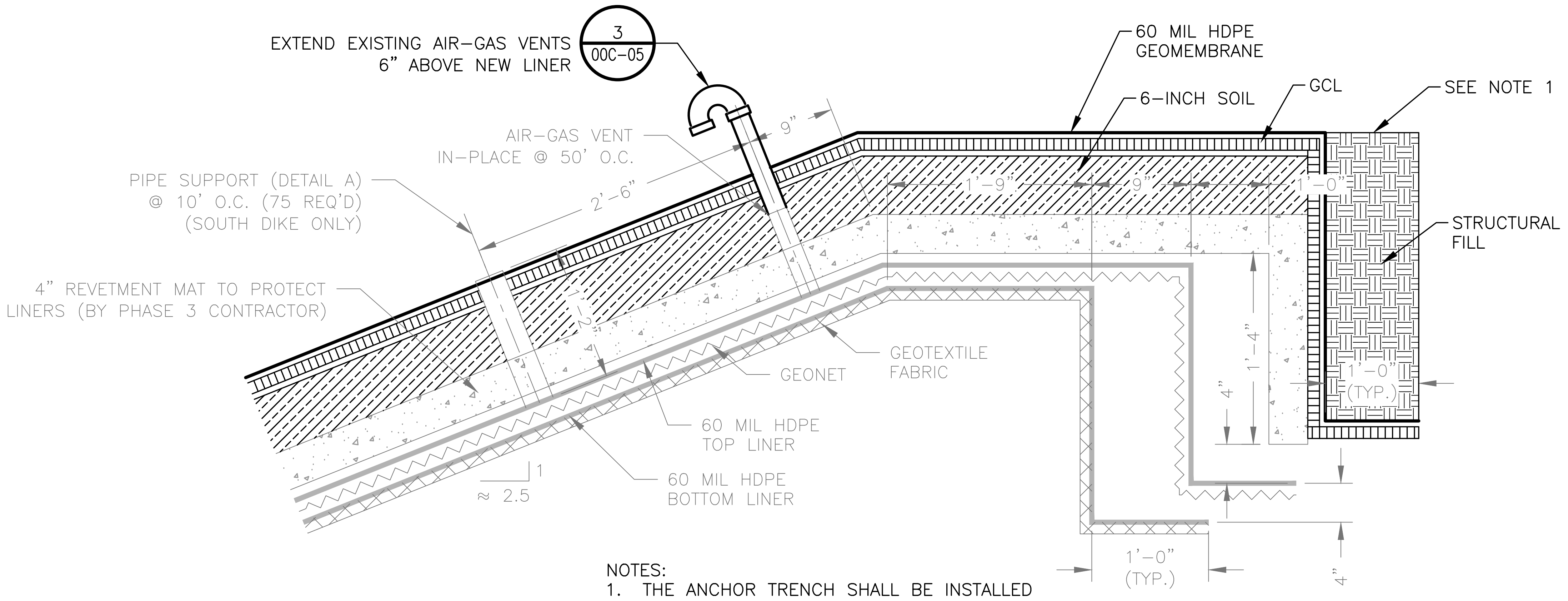
SHEET
00C-04



PROPOSED WAP SECTION

1
00C-05

NOT TO SCALE

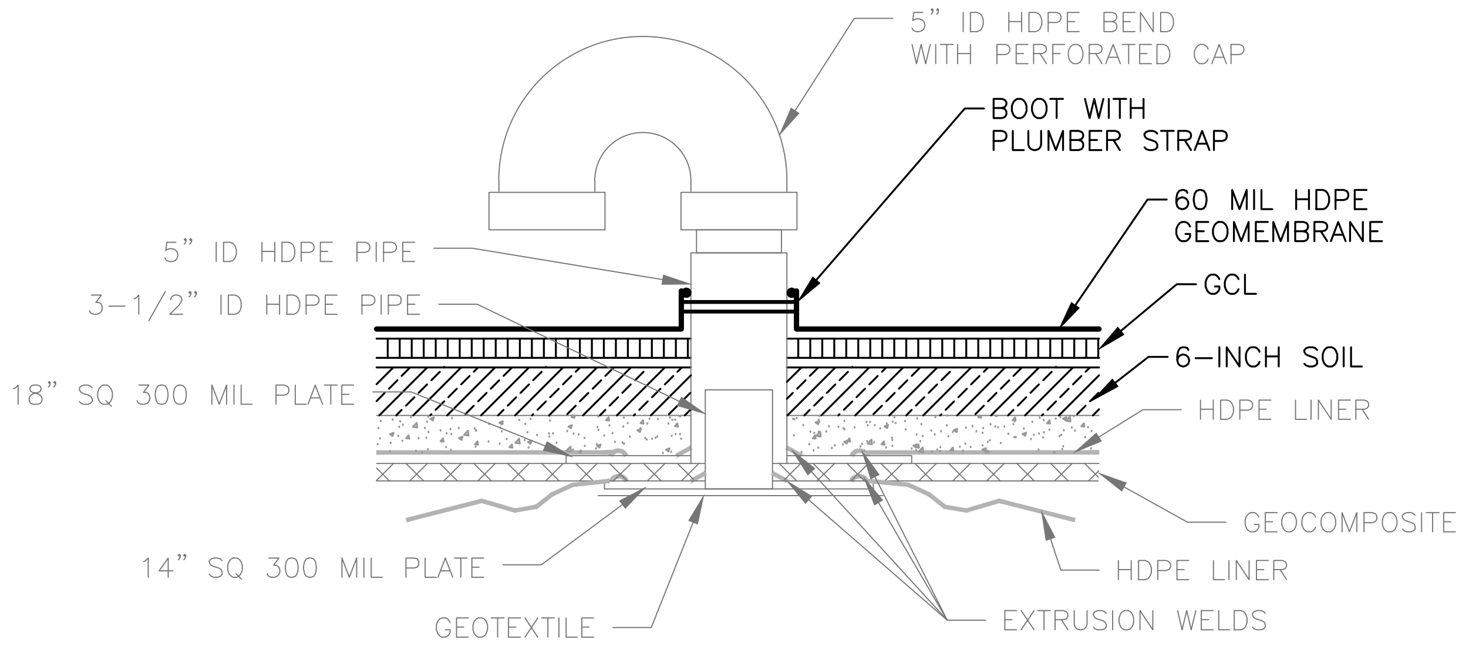


NOTES:
1. THE ANCHOR TRENCH SHALL BE INSTALLED OUTSIDE OF THE EXISTING ANCHOR TRENCH.

ANCHOR TRENCH

2
00C-02

NOT TO SCALE



TYPICAL AIR-GAS VENT

3
00C-05

NOT TO SCALE

HDR

ISSUE	DATE	DESCRIPTION
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93905

1/31/2020

MARTIN LAKE STEAM ELECTRICAL STATION
WEST ASH POND RELINE
RUSK COUNTY, TEXAS

Luminant

DETAILS
(2 OF 2)

0 1" 2"

FILENAME 00C-05.dwg
SCALE NOT TO SCALE

SHEET
00C-05

HDR

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1/31/2020

MARTIN LAKE STEAM ELECTRICAL STATION
WEST ASH POND RELINE
RUSK COUNTY, TEXAS

Luminant

STOCKPILE AND HAUL ROUTE

0 1" 2"

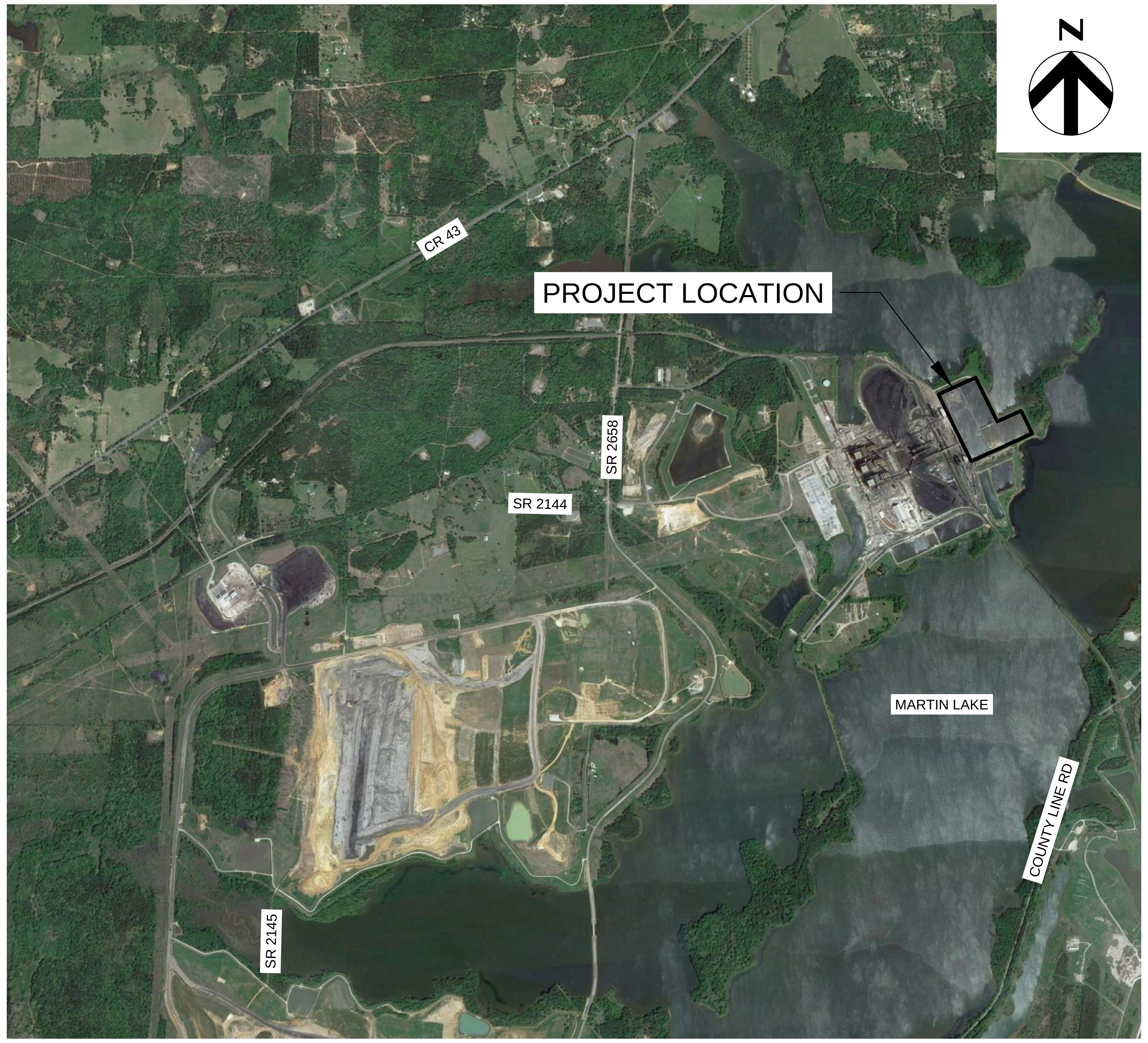
FILENAME 00C-06.dwg
SCALE 1" = 600'

SHEET
00C-06

APPENDIX E – NEW SCRUBBER POND RETROFIT DESIGN DRAWINGS

HDR ENGINEERING, INC.
76 SOUTH LAURA STREET, SUITE 1600
JACKSONVILLE, FL 32202
COA# 4213

Luminant



VICINITY MAP
NOT TO SCALE

Construction Drawings For

Martin Lake Steam Electric Station

CCR Impoundment Reline
New Scrubber Pond

Project No.
10172630

Rusk County, Texas
January 2020

INDEX OF DRAWINGS

DAVID C. VOGT
93905

1/31/2020

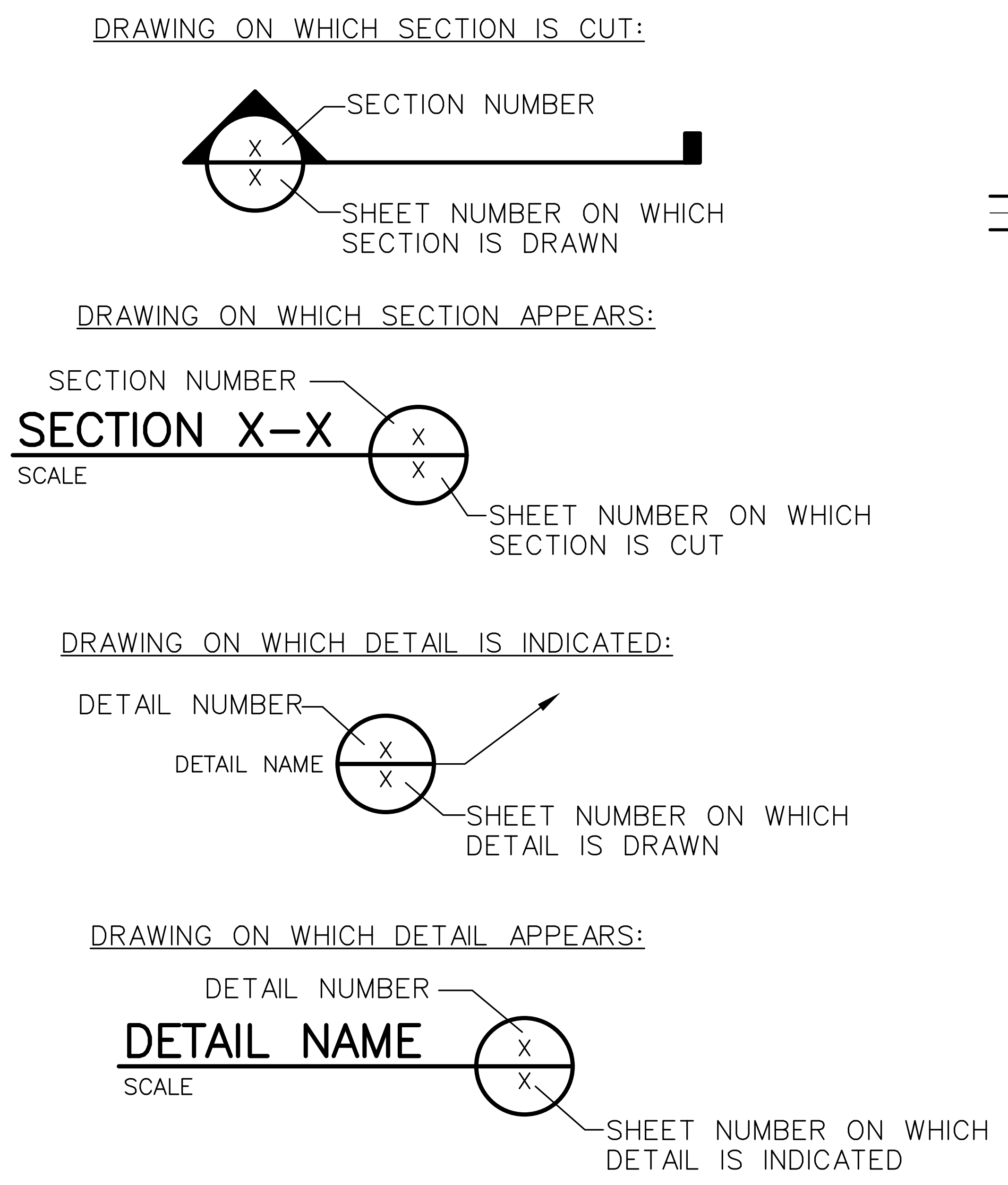
STANDARD ABBREVIATIONS

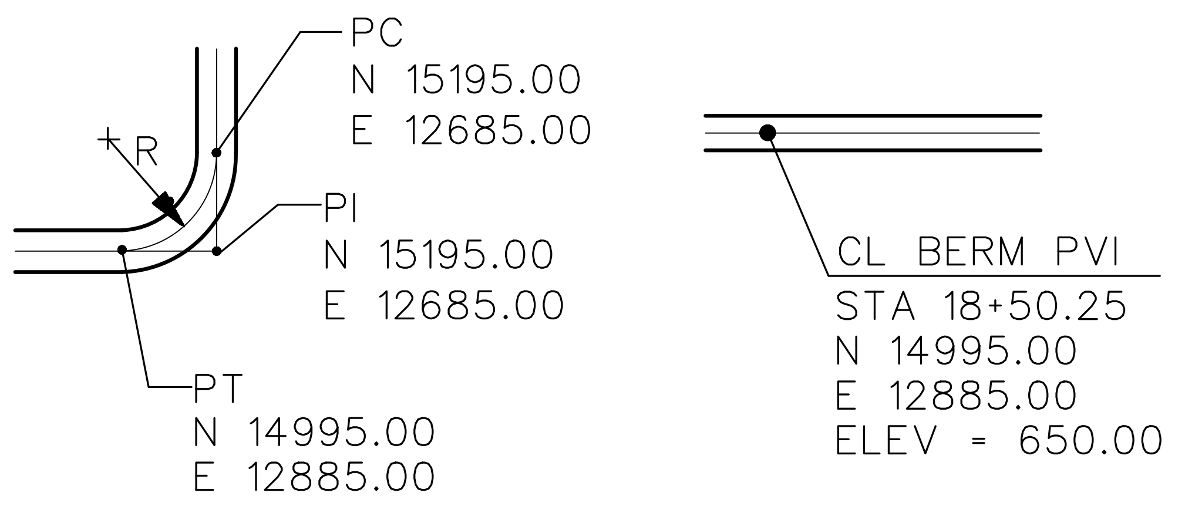
&	AND
APPROX	APPROXIMATELY
@	AT
AVG	AVERAGE
BOE	BOTTOM OF EXCAVATION
BOL	BOTTOM OF LINER
X	BY
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CO	CLEAN OUT
CY	CUBIC YARD
DIA	DIAMETER
DET	DETAIL
DWG	DRAWING
E	EAST
EAP	EAST ASH POND
ELEV	ELEVATION
EW	EACH WAY
EXIST	EXISTING
EXC	EXCAVATION
FGD	FLUE GAS DESULFICATION
FML	FLEXIBLE MEMBRANE LINER
FT	FEET
GAL	GALLON
GND	GROUND
GDL	GRAVEL DRAINAGE LAYER
GNDL	GEONET DRAINAGE LAYER
HDPE	HIGH DENSITY POLYETHYLENE
HORIZ	HORIZONTAL
ID	INSIDE DIAMETER
IN	INCHES
IE	INVERT ELEVATION
LCRS	LEACHATE COLLECTION AND REMOVAL SYSTEM
LCS	LEACHATE COLLECTION SYSTEM
LCP	LEACHATE COLLECTION PIPE
LCPR	LEACHATE COLLECTION PIPE RISER
LF	LINEAR FEET
LB	POUND
MH	MANHOLE
MAX	MAXIMUM
MIL	.001 INCHES
MIN	MINIMUM
MW	MONITOR WELL
MLSES	MARTIN LAKE STEAM ELECTRIC STATION
MSL	MEAN SEA LEVEL
N	NORTH
NIC	NOT IN CONTRACT
NO	NUMBER

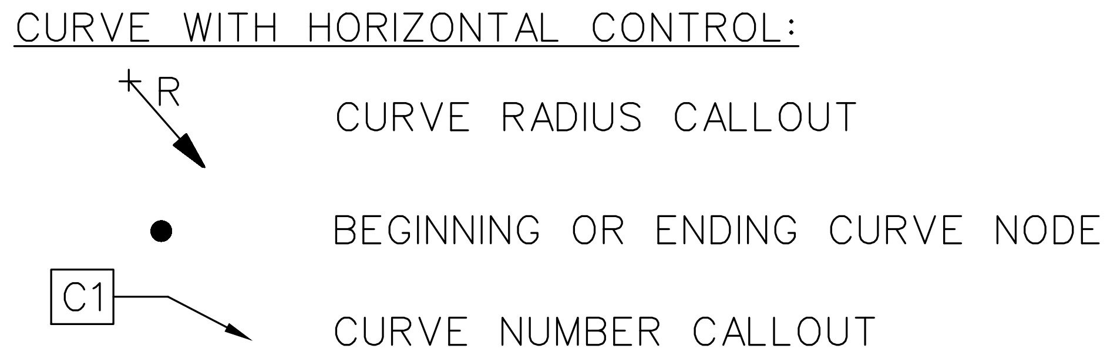
NTS	NOT TO SCALE
NTYS	NORTH THICKENER YARD SUMP
OC	ON CENTER
OZ	OUNCE
%	PERCENT
PLCP	PERFORATED LEACHATE COLLECTION PIPE
PERF	PERFORATED
PGL	PROFILE GRADE LINE
PDP	PERMANENT DISPOSAL POND
PC	POINT OF CURVATURE
PI	POINT OF INTERSECTION
PVI	POINT OF VERTICAL INTERSECTION
PT	POINT OF TANGENT
PZ	PIEZOMETER
Q	FLOW
QTY	QUANTITY
R	RADIUS
RCP	REINFORCED CONCRETE PIPE
REF	REFERENCE
REQ	REQUIRED
RD	ROAD
SCH	SCHEDULE
SDL	SAND DRAINAGE LAYER
SEC	SECTION
SHT	SHEET
S	SOUTH
SDR	STANDARD DIMENSION RATIO
SLQCP	SOIL LINER QUALITY CONTROL PLAN
SP	STEEL PIPE
SQ	SQUARE
SS	SIDE SLOPE
STA	STATION
STYS	SOUTH THICKENER YARD SUMP
T.A.S.	TERMINAL ANCHOR SECTION
TL	TANGENT LENGTH
TOC	TOP OF COVER
TOFC	TOP OF FINAL COVER
TOL	TOP OF LINER
TOS	TOE OF SLOPE
TS	TOP SLOPE
TEMP	TEMPORARY
TYP	TYPICAL
UNO	UNLESS NOTED OTHERWISE
VERT	VERTICAL
W	WEST
W/	WITH
WAP	WEST ASH POND
WW	WETWELL
YD	YARD

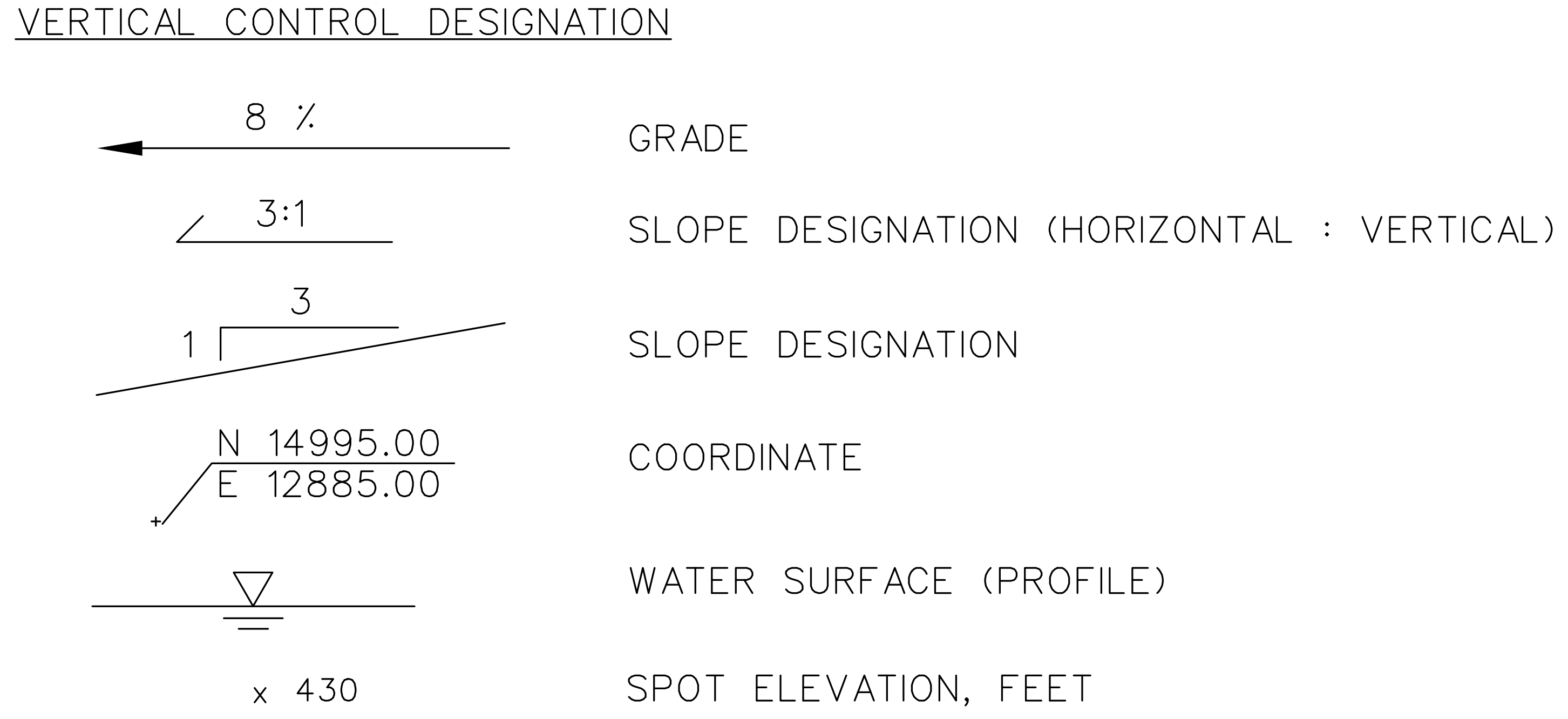
SYMBOLS

SECTION DETAIL INDICATORS









CONSTRUCTION SEQUENCE

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B. CONTRACTOR SHALL USE WATER FROM THE ADJACENT WEST ASH POND (WAP) OR EAST ASH POND (EAP) TO WASH REMAINING CCR MATERIAL OFF THE SIDES AND FLOOR OF THE NSP AND REMOVE IT. EAP WILL BE VISUALLY INSPECTED BY OWNER'S CQA CONSULTANT TO CONFIRM CCR MATERIAL, ROCKS, AND SEDIMENT HAVE BEEN REMOVED.

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2. COORDINATE SYSTEM IS BASED ON LOCAL SURVEY. THE BENCHMARKS TO BE USED FOR CONSTRUCTION ARE LOCATED AS SHOWN ON DRAWING NO. 00C-01. EXISTING CONTOURS ARE BASED ON TOPOGRAPHICAL SURVEY PERFORMED FEBRUARY 12-20, 2019 BY LACY SURVEYING. CURRENT GROUND ELEVATIONS MAY VARY FROM THOSE SHOWN DUE TO SITE WORK THAT HAS BEEN PERFORMED SINCE THE SURVEY WAS PERFORMED.
3. THE CONTRACTOR SHALL VERIFY EXISTING CONTOURS PRIOR TO THE START OF WORK.
4. THERE SHALL NOT BE ANY ADDITIONAL PAYMENT OR EXTENSION OF CONTRACT TIME FOR WORKING WITH SATURATED SOILS OR HANDLING WATER SEEPAGE DUE TO RAINFALL, RUNOFF AND INFILTRATION.
5. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT EXISTING ROADS, BENCHMARKS AND EXISTING GROUNDWATER MONITOR WELLS DURING THE CONSTRUCTION PERIOD. THE CONTRACTOR SHALL BE SOLEY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE INCURRED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PROTECT THE GROUNDWATER MONITOR WELLS, BENCHMARKS AND EXISTING ROADS.
6. THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES HAVE NOT BEEN ESTABLISHED BY THE OWNER OR ENGINEER. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTORS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UTILITIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING PROPER SAFE WORKING DISTANCE FROM ALL UTILITY EASEMENTS OR LINES.
7. EXCAVATION BY "BLASTING" IS NOT PERMITTED ON THIS PROJECT.
8. FINISHED GROUND ELEVATIONS SHALL MATCH EXISTING GROUND ELEVATIONS EXCEPT AS SHOWN ON THE PLANS. ALL EXCESS SOIL FROM THE EXCAVATION AND GRADING SHALL BE PLACED IN DESIGNATED STOCKPILE LOCATIONS AS APPROVED BY THE OWNER. IF WASTE IS ENCOUNTERED DURING EXCAVATION, THE OWNER SHALL BE NOTIFIED AND THE WASTE REMOVED AND PLACED IN AREAS DESIGNATED AS APPROVED BY THE OWNER. TRANSPORT OF SOIL TO FILL AREAS SHALL BE CONDUCTED BY THE CONTRACTOR AT NO ADDITIONAL EXPENSE TO THE OWNER.
9. GEOTECHNICAL INVESTIGATION REPORTS FOR THE SITE ARE AVAILABLE FOR REVIEW AT LUMINANT'S DALLAS OFFICES. THE CONTRACTOR MAY PERFORM ADDITIONAL GEOTECHNICAL INVESTIGATIONS, AS DEEMED NECESSARY FOR CONSTRUCTION ACTIVITIES, PROVIDED ALL NECESSARY PERMITS AND APPROVALS ARE OBTAINED FROM LUMINANT PRIOR TO INITIATING SUCH WORK. HOWEVER, THERE SHALL BE NO ADDITIONAL PAYMENT TO THE CONTRACTOR FOR ADDITIONAL GEOTECHNICAL INVESTIGATIONS.
10. THE CONTRACTOR SHALL CONSTRUCT, AND UPON COMPLETION OF THE PROJECT, REMOVE TEMPORARY CONSTRUCTION ACCESS ROADS. SUCH ROADS SHALL BE LOCATED AS APPROVED BY THE OWNER. DRAINAGE PATTERNS AT THE SITE SHALL NOT BE ALTERED BY ROAD CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONSTRUCTION AND MAINTENANCE OF TEMPORARY DRAINAGE STRUCTURES, INCLUDING CULVERTS, AT NO ADDITIONAL COST TO THE OWNER.
11. THE CONTRACTOR SHALL INSTALL, MAINTAIN, AND UPON COMPLETION OF THE PROJECT, REMOVE TEMPORARY EROSION AND SEDIMENT CONTROLS AS APPROVED BY LUMINENT ENVIRONMENTAL SERVICES AND IN ACCORDANCE WITH THE SITE SWPPP AND PURSUANT TO TPDES REQUIREMENTS. SUCH CONTROLS SHALL BE PLACED AT THE LIMITS OF DISTURBED AREAS AND AT INTERMEDIATE LOCATIONS WHERE CONCENTRATED FLOW IS LIKELY.
12. TEMPORARY CONSTRUCTION SLOPES SHALL NOT BE GREATER THAN 2H:1V. STEEPER SLOPES WILL ONLY BE ALLOWED IF THE CONTRACTOR PROVIDES A GEOTECHNICAL ENGINEERING REPORT SPECIFYING MAXIMUM SLOPES AND THE DURATION FOR WHICH SUCH SLOPES SHALL REMAIN IN PLACE.
13. THE CONTRACTOR SHALL REMOVE ALL VEGETATION WITHIN THE CONSTRUCTION LIMITS AS REQUIRED TO CONSTRUCT THE PROJECT. ALL VEGETATION SHALL BE REMOVED BY CONTRACTOR AT NO ADDITIONAL EXPENCE TO OWNER.
14. THE CONTRACTOR SHALL OBTAIN AND CONDUCT WORK CONSISTENT WITH A TPDES PERMIT FOR CONSTRUCTION, REFER TO TECHNICAL SPECIFICATIONS. PREPARATION OF A SWPPP AND OBTAINING THE TPDES PERMIT ARE THE CONTRACTORS RESPONSIBILITY.
15. THE CONTRACTOR SHALL IMMEDIATELY REPORT TO THE ENGINEER ANY ERROR OR DISCREPANCY FOUND ONCE THE CONTRACT DOCUMENT IS CAREFULLY REVIEWED AND ALL ASPECTS OF FIELD WORK HAVE BEEN VERIFIED. IN THE EVENT THE CONTRACTOR CONTINUES TO WORK ON AN ITEM WHERE AN ERROR EXISTS, IT SHALL BE DEEMED THAT THE CONTRACTOR BID AND INTENDED TO EXECUTE THE MORE STRINGENT OR HIGHER QUALITY REQUIREMENT WITHOUT AN INCREASE IN CONTRACT SUM OR TIME. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE TO CORRECT ANY FAILURE OF COMPANY PARTS TO COORDINATE OR FIT PROPERLY INTO FINAL POSITION, AS A RESULT OF CONTRACTOR FAILURE TO RAISE OR RESOLVE A DISCREPANCY.
16. THE DRAWINGS AND SPECIFICATIONS SHOULD AGREE WITH EACH OTHER, AND WORK CALLED FOR BY DRAWINGS AND NOT MENTIONED IN SPECIFICATION, OR VICE VERSA, SHALL BE FURNISHED BY BOTH. WHEN DISCREPANCIES EXIST BETWEEN SCALE AND DIMENSIONS, THE DIMENSIONED FIGURE SHALL BE USED.
17. CONTRACTOR AND EACH SUBCONTRACTOR SHALL VERIFY ALL GRADES, LINES, LEVELS, AND DIMENSIONS AS INDICATED ON DRAWINGS, AND HE SHALL REPORT ERRORS TO THE ENGINEER BEFORE COMMENCING WORK. THE CONTRACTOR SHALL ESTABLISH BENCHMARKS IN AT LEAST TWO WIDELY SEPARATED PLACES, AND AS WORK PROGRESSES THE CONTRACTOR WILL MAINTAIN ADEQUATE HORIZONTAL AND VERTICAL CONTROL.
18. CONTRACTOR SHALL PROVIDE EROSION CONTROL BY SEEDING FOR ALL AREAS DISTURBED BY CONTRACTOR DURING THE CONSTRUCTION OF THIS PROJECT. THE CONTRACTOR SHALL NOT DISTURB ANY AREA WITHOUT THE APPROVAL OF THE ENGINEER. EROSION CONTROL BY SEEDING SHALL CONFORM TO STANDARD SPECIFICATION 02930.
19. CONTRACTOR SHALL INSTALL EROSION AND SEDIMENT CONTROLS AS PER SPECIFICATIONS DURING CONSTRUCTION. SUCH CONTROLS SHALL BE PLACED AT LIMITS OF DISTURBED AREAS AND AT INTERMEDIATE LOCATIONS WHERE CONCENTRATED FLOW IS LIKELY.
20. STORMWATER THAT HAS COME INTO CONTACT WITH THE ASH WITHIN THE EXCAVATED POND IS TO BE CONSIDERED CONTACT STORMWATER. CONTRACTOR WILL CONTROL THE WATER ON SITE IN COMPLIANCE WITH THE TPDES PERMIT.
21. THE CONTRACTOR IS REQUIRED TO PRESENT THE SWPPP TO LUMINANT ENVIRONMENTAL SERVICES FOR APPROVAL PRIOR TO THE COMMENCEMENT OF CONSTRUCTION ACTIVITIES.
22. THE CONTRACTOR IS REQUIRED TO SUBMIT THE NOTICE OF INTENT AND NOTICE OF TERMINATION FOR THE TPDES PERMIT.
23. THE CONTRACTOR IS TO ACQUIRE A DIGGING PERMIT FROM THE PLANT BEFORE COMMENCING ANY EXCAVATION ACTIVITY.

ISSUE	DATE	DESCRIPTION
A	01/31/2020	ISSUED FOR BID

PROJECT MANAGER	D. VOGT, P.E.
DESIGNED BY	K. PERERA
DRAWN BY	J. RAYMOND
CHECKED BY	M. ROBERTS
PROJECT NUMBER	10172630

DAVID C. VOGT
93905
1/31/2020

MARTIN LAKE STEAM ELECTRICAL STATION
NEW SCRUBBER POND RELINE
RUSK COUNTY, TEXAS

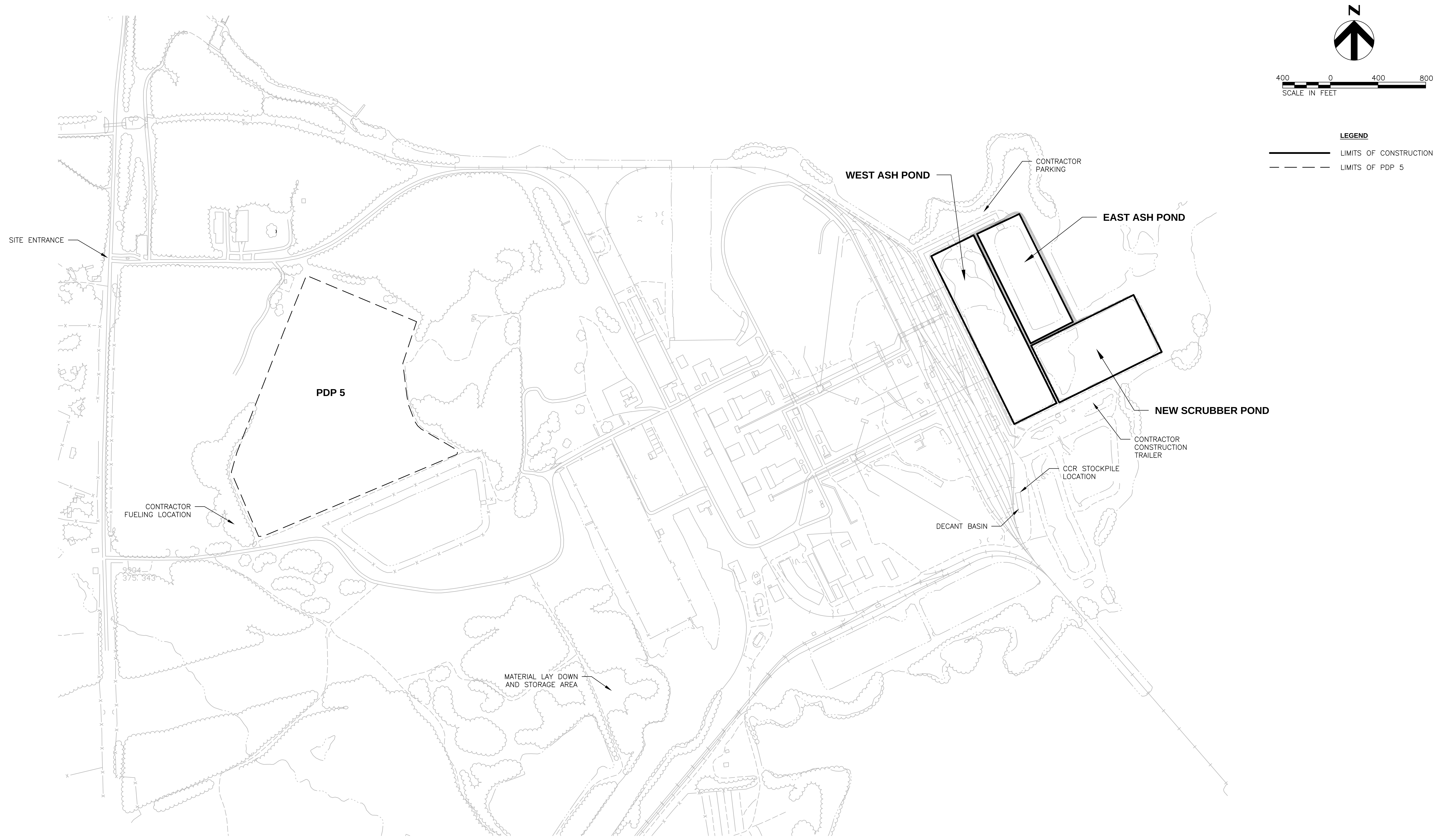
Luminant

ABBREVIATIONS AND GENERAL NOTES

0 1" 2"

FILENAME 00G-02.dwg
SCALE

SHEET 00G-02



ISSUE	DATE	DESCRIPTION
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DESIGNED BY	K. PERERA
DRAWN BY	J. RAYMOND
CHECKED BY	M. ROBERTS
PROJECT NUMBER	10172630

DAVID C. VOGT
93905

1/31/2020

MARTIN LAKE STEAM ELECTRICAL STATION
NEW SCRUBBER POND RELINE
RUSK COUNTY, TEXAS

SITE LAYOUT

0 1" 2"

FILENAME 00C-01.dwg

SCALE 1" = 400'

SHEET 00C-01

LEGEND

- - - - -	EXISTING MINOR CONTOUR
- - 320 - -	EXISTING MAJOR CONTOUR
——	PROPOSED MINOR CONTOUR
—320—	PROPOSED MAJOR CONTOUR
— —	ANCHOR TRENCH

NOTES:

1. THE PROPOSED CONTOURS SHOWN ARE TOP OF REVETMENT MATTRESS ELEVATIONS OBTAINED FROM JULY 1995 AS-BUILT DRAWINGS PREPARED BY TEXAS UTILITIES GENERATING CO.
2. NO EQUIPMENT ALLOWED OVER DETECTION SUMP.
3. SEE DETAIL 1/00C-05 FOR PROPOSED LINER SYSTEM DETAILS.

ISSUE	DATE	DESCRIPTION
A	01/31/2020	ISSUED FOR BID

PROJECT MANAGER	D. VOGT, P.E.
DESIGNED BY	K. PERERA
DRAWN BY	J. RAYMOND
CHECKED BY	M. ROBERTS
PROJECT NUMBER	10172630

DAVID C. VOGT
93905

1/31/2020

MARTIN LAKE STEAM ELECTRICAL STATION
NEW SCRUBBER POND RELINE
RUSK COUNTY, TEXAS

Luminant

NEW SCRUBBER POND

0 1" 2"

FILENAME	00C-02.dwg
SCALE	1" = 50'

SHEET
00C-02

100 0 100 200
HORIZONTAL SCALE: 1" = 100'

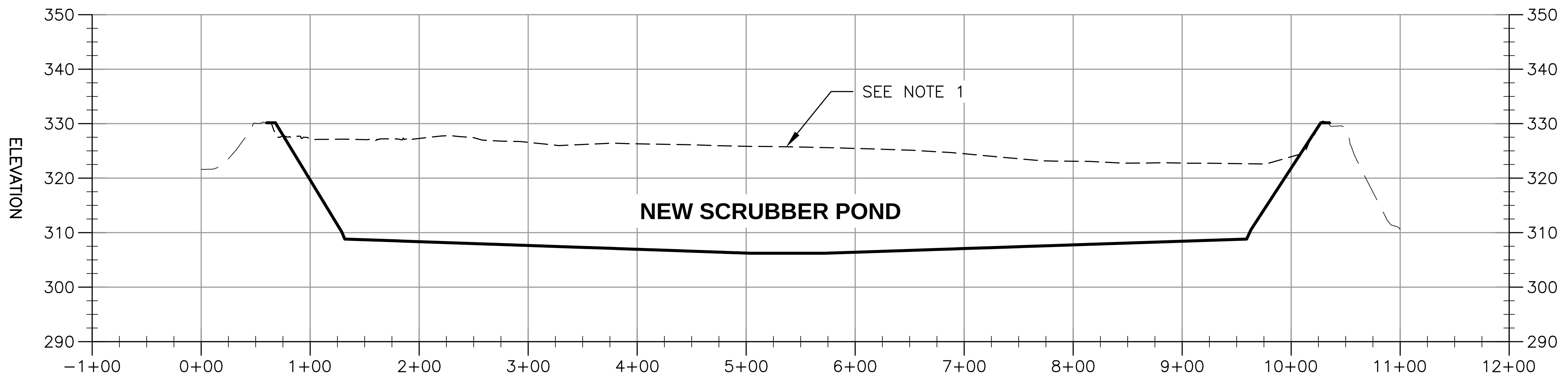
20 0 20 40
VERTICAL SCALE: 1" = 20'

LEGEND

– – – – – –	TOP OF CCR MATERIAL
— — — —	EXISTING GROUND SURFACE
———	PROPOSED GRADE

NOTES:

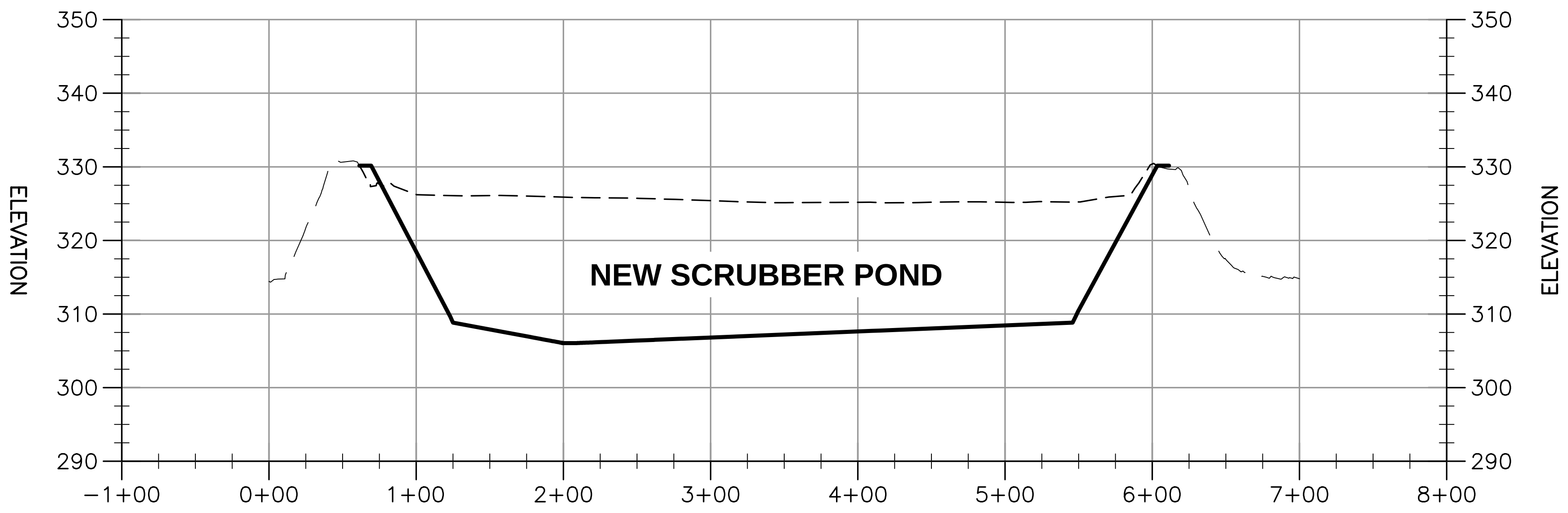
1. CCR ELEVATION FROM BATHYMETRIC SURVEY TAKEN FEBRUARY 2019 BY LACEY SURVEYING OF ARP, TEXAS. AT START OF PROJECT, OWNER WILL HAVE REMOVED BULK OF CCR MATERIAL FROM THE NEW SCRUBBER POND
2. CONTRACTOR WILL REMOVE REMAINING CCR MATERIAL, ROCKS AND SEDIMENT WITHIN POND BEFORE INSTALLATION OF THE LINER SYSTEM.



SECTION A–A

HORIZONTAL SCALE: 1" = 100' ; VERTICAL SCALE: 1" = 20'

A–A
00C–02



SECTION B–B

HORIZONTAL SCALE: 1" = 100' ; VERTICAL SCALE: 1" = 20'

B–B
00C–02

ISSUE	DATE	DESCRIPTION
A	01/31/2020	ISSUED FOR BID

PROJECT MANAGER D. VOGT, P.E.
DESIGNED BY K. PERERA
DRAWN BY J. RAYMOND
CHECKED BY M. ROBERTS
PROJECT NUMBER 10172630

DAVID C. VOGT
93905

1/31/2020

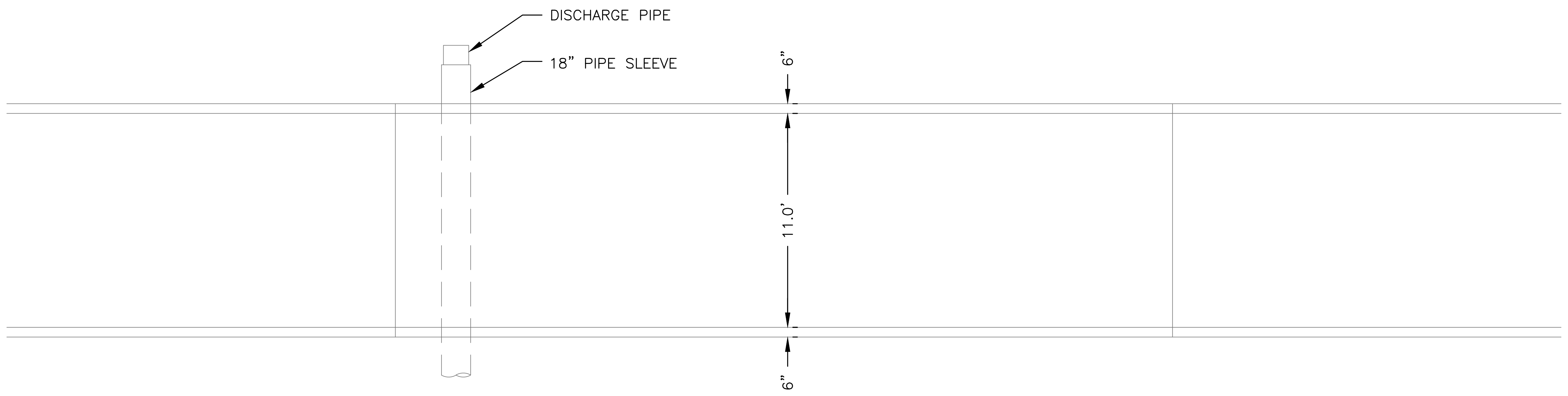
MARTIN LAKE STEAM ELECTRICAL STATION
NEW SCRUBBER POND RELINE
RUSK COUNTY, TEXAS

Luminant

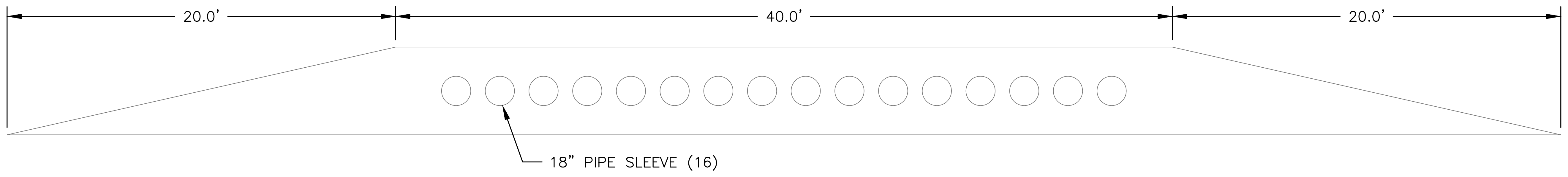
CROSS SECTIONS

0 1" 2"

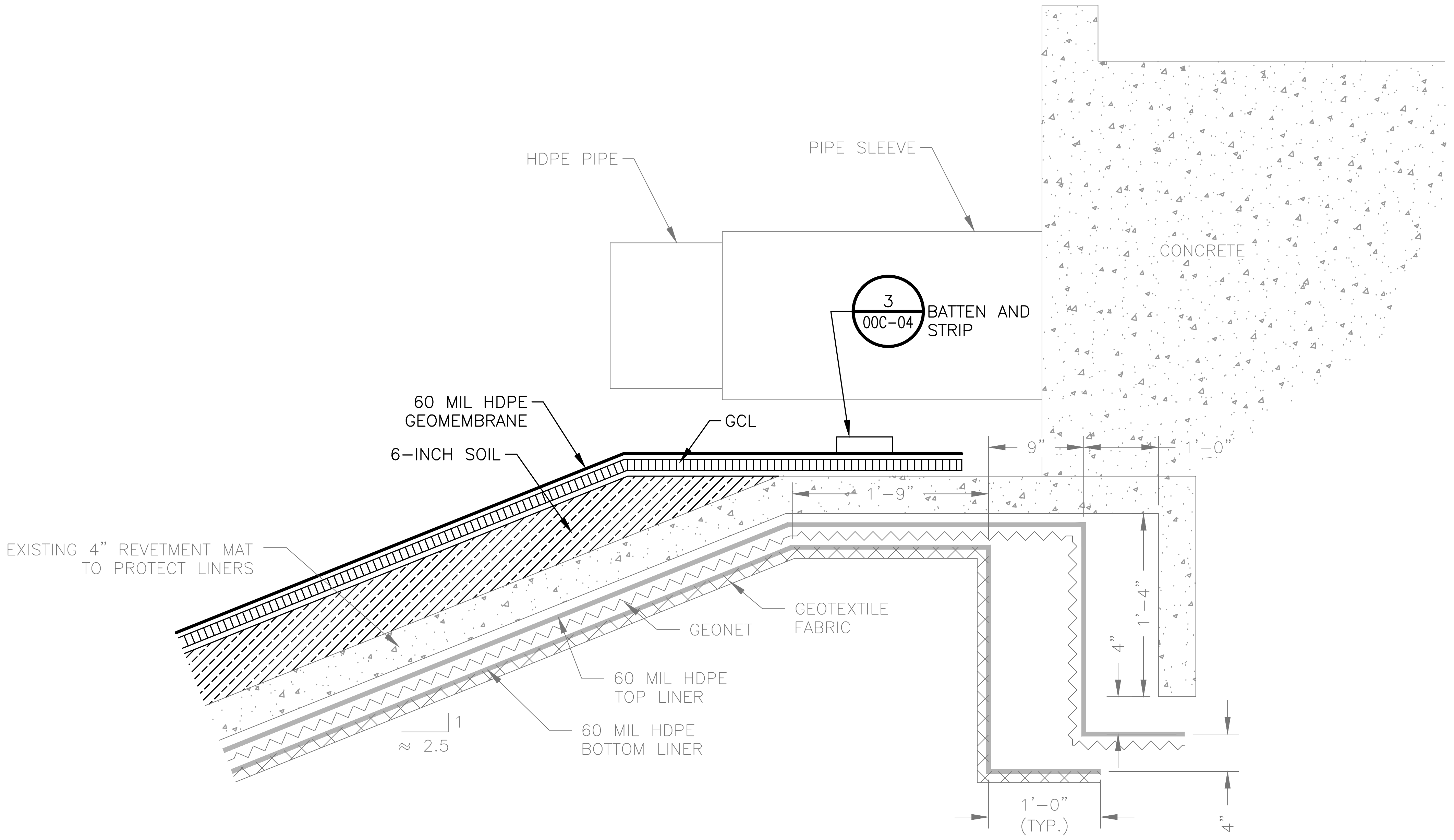
FILENAME 00C-03.dwg
SCALE H: 1" = 100' ; V: 1" = 20'
SHEET 00C-03



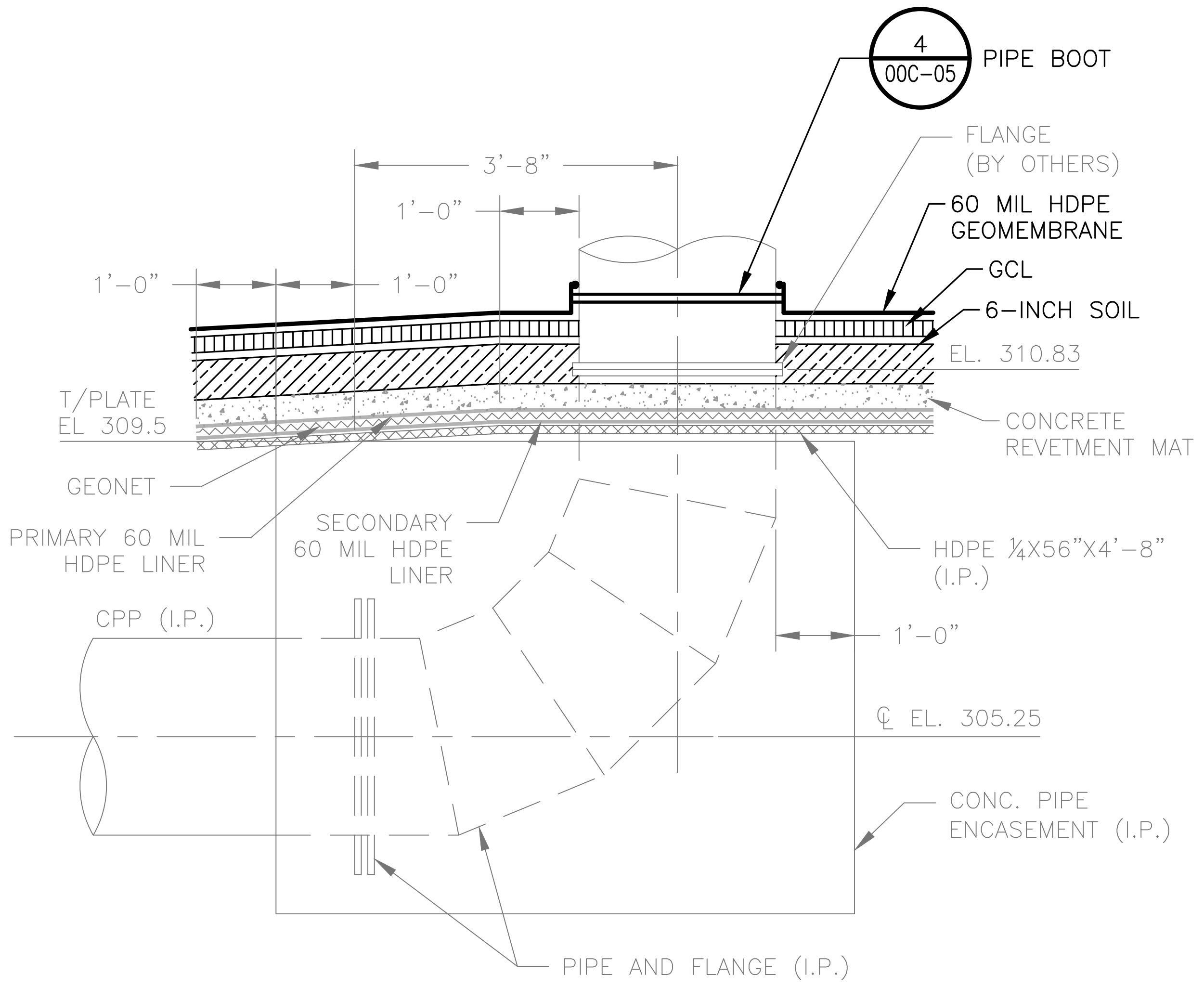
PIPE RACK PLAN VIEW
NOT TO SCALE
1
00C-02



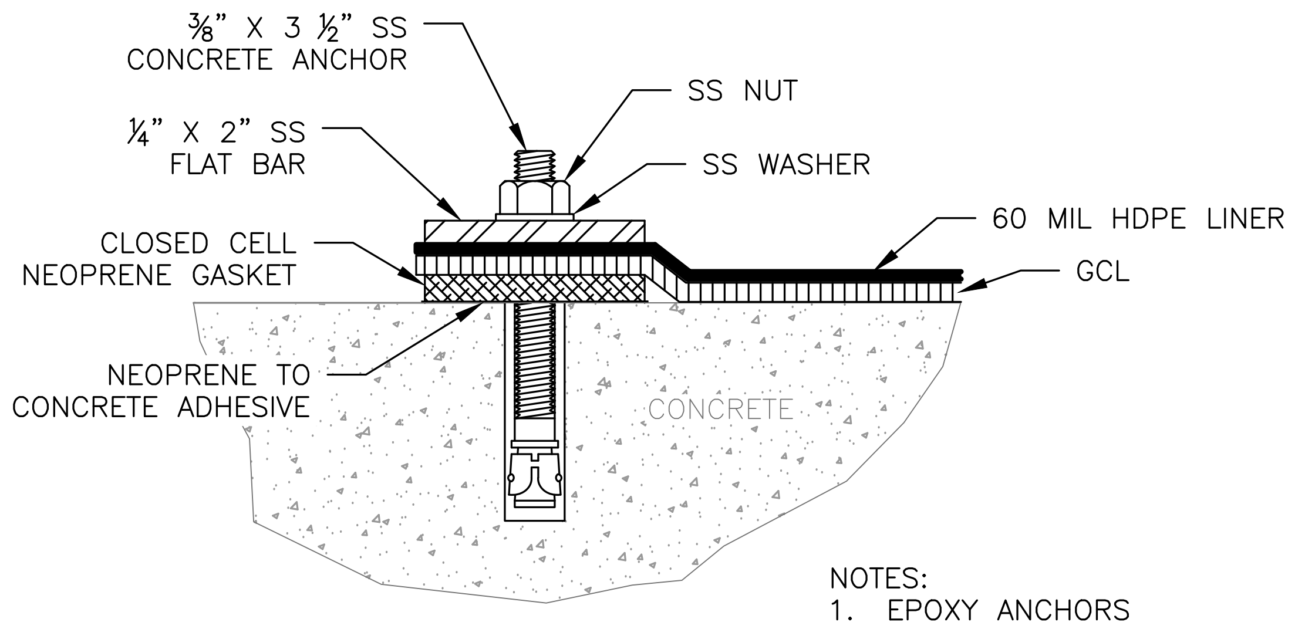
PIPE RACK PROFILE
NOT TO SCALE
1
00C-02



PIPE RACK SECTION
NOT TO SCALE
2
00C-04

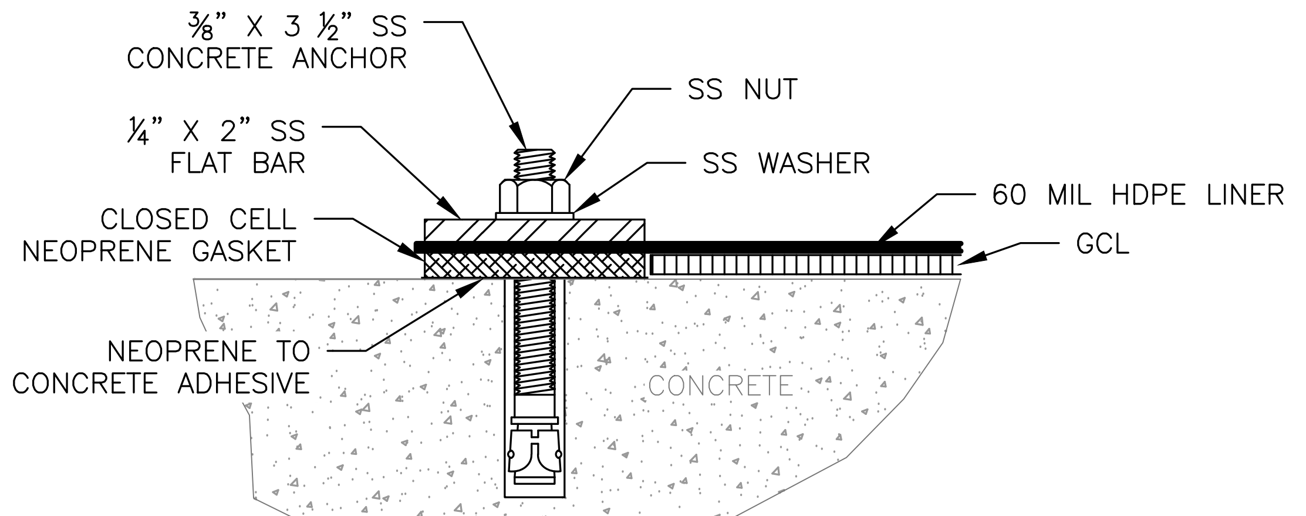


PIPE ENCASEMENT
NOT TO SCALE
2
00C-02



NOTES:
1. EPOXY ANCHORS SPACED AT 6" O.C.

BATTEN AND STRIP CONNECTION AT ANCHOR TRENCH
NOT TO SCALE
3A
00C-02



NOTES:
1. EPOXY ANCHORS SPACED AT 6" O.C.

BATTEN AND STRIP CONNECTION BELOW WATER SURFACE
NOT TO SCALE
3B
00C-02

ISSUE	DATE	DESCRIPTION
A	01/31/2020	ISSUED FOR BID

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DESIGNED BY	K. PERERA
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CHECKED BY	M. ROBERTS
PROJECT NUMBER	10172630

DAVID C. VOGT
93905
1/31/2020

MARTIN LAKE STEAM ELECTRICAL STATION
NEW SCRUBBER POND RELINE
RUSK COUNTY, TEXAS

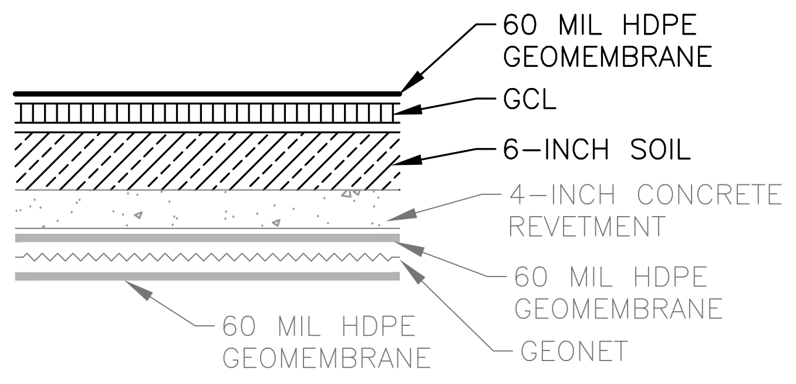
Luminant

DETAILS
(1 OF 2)

0 1" 2"

FILENAME	00C-04.dwg
SCALE	

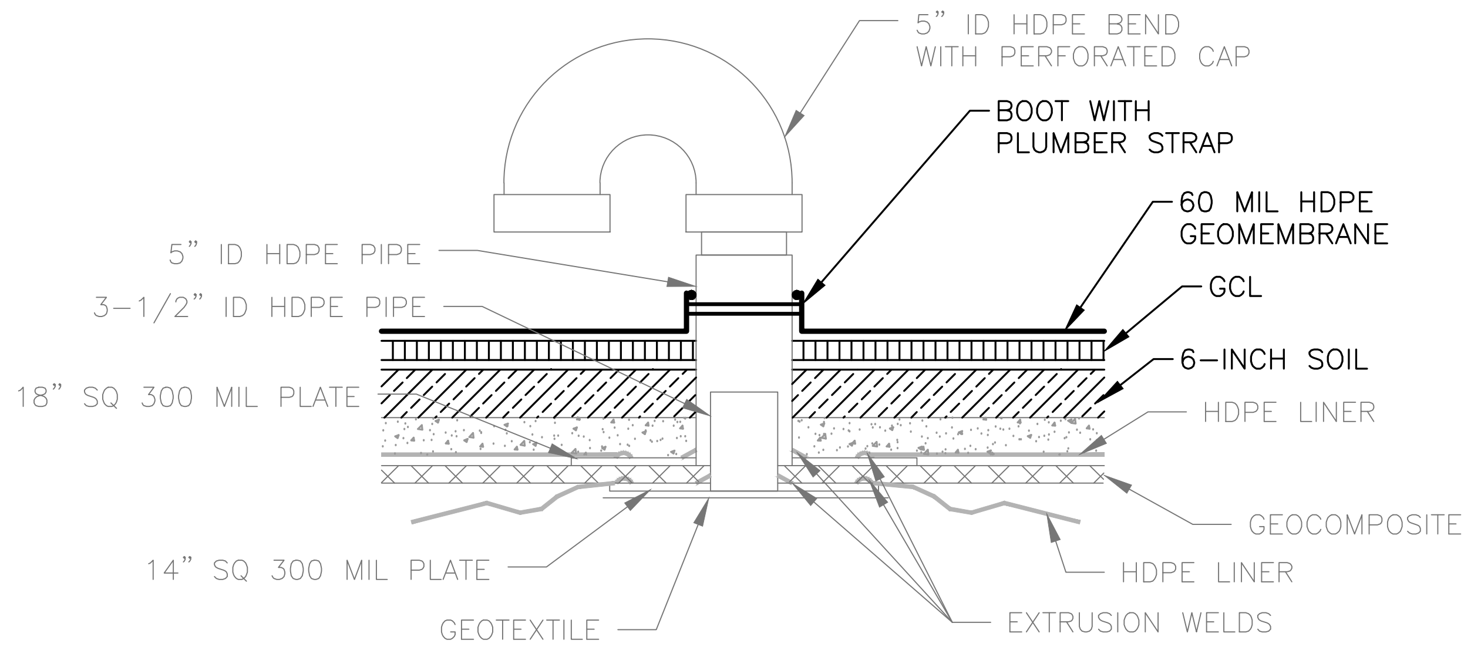
SHEET
00C-04



PROPOSED NEW SCRUBBER POND RETROFIT SECTION

1
00C-05

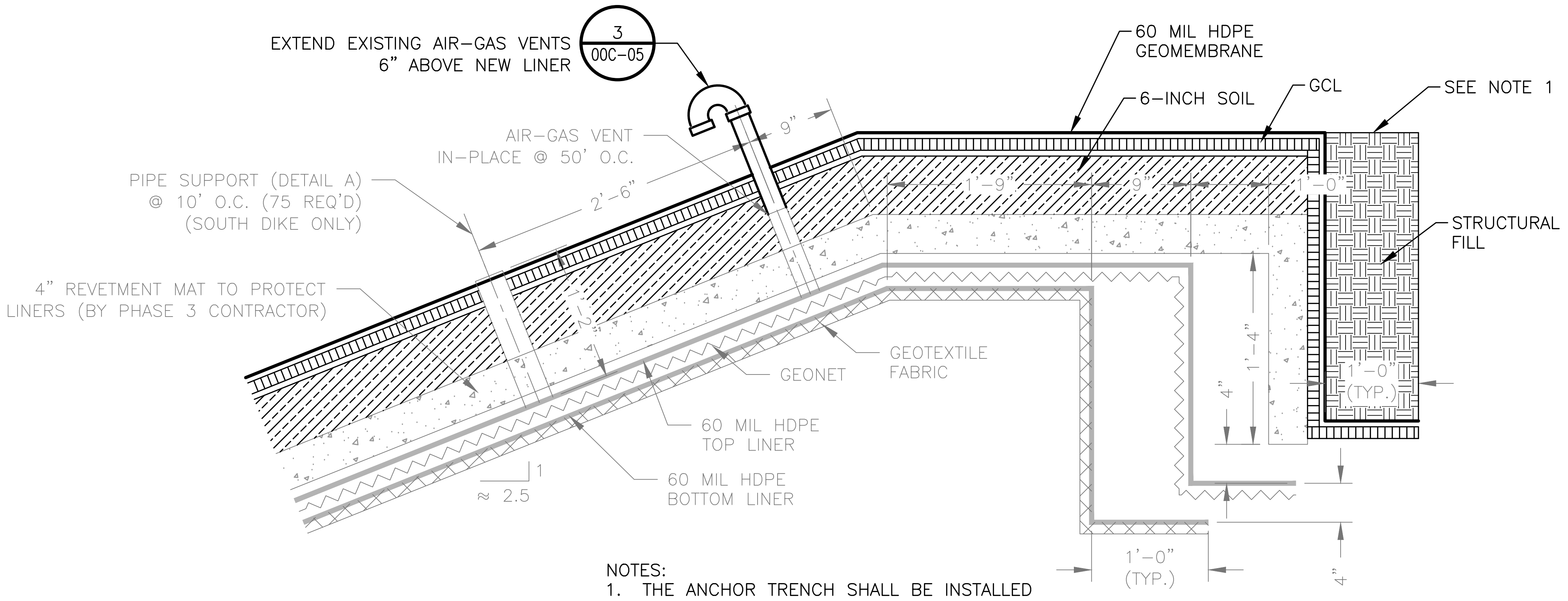
NOT TO SCALE



TYPICAL AIR-GAS VENT

3
00C-05

NOT TO SCALE

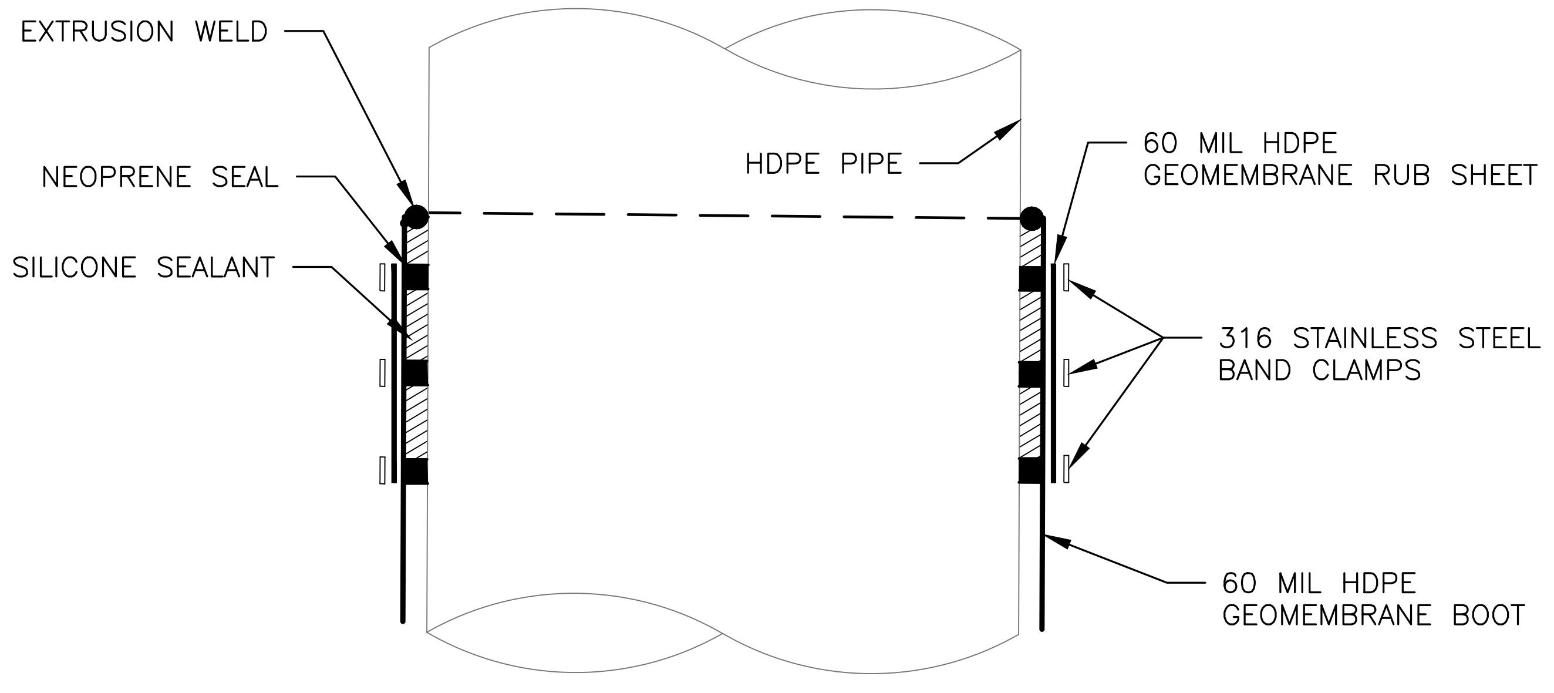


NOTES:
1. THE ANCHOR TRENCH SHALL BE INSTALLED OUTSIDE OF THE EXISTING ANCHOR TRENCH.

ANCHOR TRENCH

2
00C-02

NOT TO SCALE



PIPE BOOT

4
00C-04

NOT TO SCALE

ISSUE	DATE	DESCRIPTION
A	01/31/2020	ISSUED FOR BID

PROJECT MANAGER	D. VOGT, P.E.
DESIGNED BY	K. PERERA
DRAWN BY	J. RAYMOND
CHECKED BY	M. ROBERTS
PROJECT NUMBER	10172630

DAVID C. VOGT
93905

1/31/2020

MARTIN LAKE STEAM ELECTRICAL STATION
NEW SCRUBBER POND RELINE
RUSK COUNTY, TEXAS

Luminant

DETAILS
(2 OF 2)

0 1" 2"

FILENAME	00C-05.dwg
SCALE	NOT TO SCALE

SHEET
00C-05

HDR

ISSUE	DATE	DESCRIPTION
A	01/31/2020	ISSUED FOR BID

PROJECT MANAGER D. VOGT, P.E.
DESIGNED BY K. PERERA
DRAWN BY J. RAYMOND
CHECKED BY M. ROBERTS
PROJECT NUMBER 10172630

DAVID C. VOGT
93905
1/31/2020

MARTIN LAKE STEAM ELECTRICAL STATION
NEW SCRUBBER POND RELINE
RUSK COUNTY, TEXAS

Luminant

STOCKPILE AND HAUL ROUTE

0 1" 2"

FILENAME 00C-06.dwg
SCALE 1" = 600'

SHEET
00C-06

APPENDIX F – COMPLIANCE DOCUMENTS

APPENDIX F1 – MAP OF GROUNDWATER MONITORING WELL LOCATIONS

LEGEND

⊕	DOWNGRADIENT CCR MONITORING WELL
▣	UPGRADIENT CCR MONITORING WELL

REFERENCE(S)

BASE MAP TAKEN FROM GOOGLE EARTH, IMAGERY DATED 4/6/17.

CLIENT
LUMINANT

PROJECT
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

TITLE
DETAILED SITE PLAN - ASH POND AREA

CONSULTANT
GOLDER

YYYY-MM-DD	2020-01-23
DESIGNED	AJD
PREPARED	AJD
REVIEWED	WFV
APPROVED	WFV

PROJECT NO.	REV.	FIGURE
19122262	0	1

Last Edited By: adiamond Date: 2020-01-23 Time:9:52:24 AM | Printed By: adiamond Date: 2020-01-23 Time:9:52:58 AM
Path: \\texarkana\data\Projects - Round Rock_2019\19122262 - Luminant\C - MLSES-Ash Pond Area\ | File Name: FIG 1 - Detailed Site Plan (Ash Pond Area).dwg

EXPLANATION

● CCR Monitoring Well

N

Scale in Feet

0 275 550

SOURCE:
Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

Figure 1

PDP 5 AREA
DETAILED SITE PLAN

PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

APPENDIX F2 – WELL CONSTRUCTION DIAGRAMS AND DRILLING LOGS

Ash Pond Area

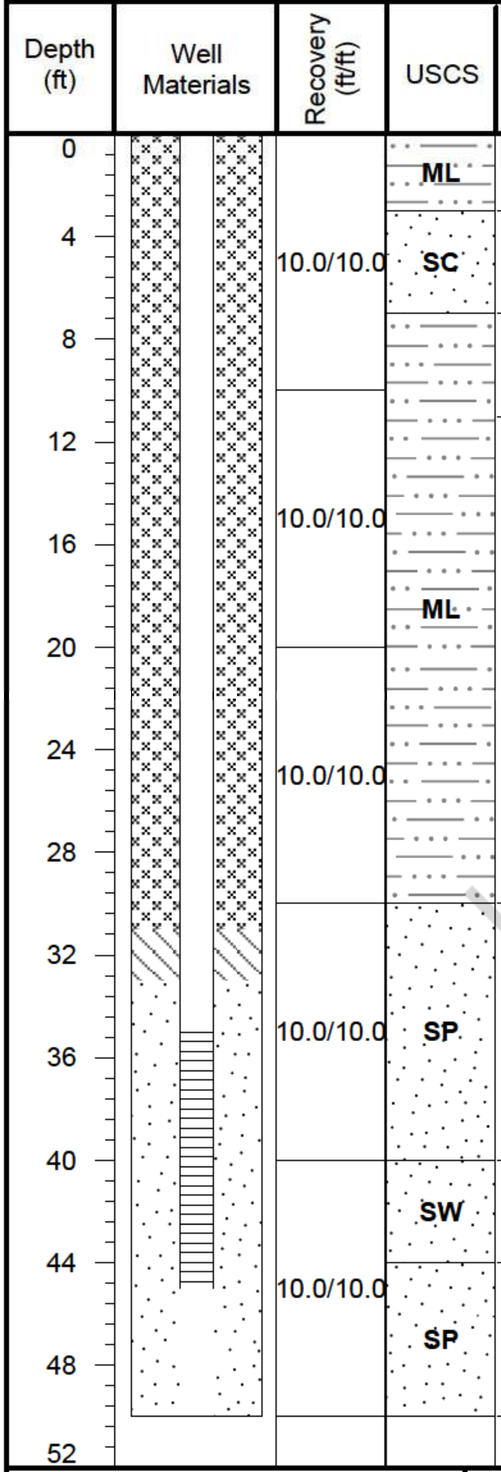
Luminant

Log of Boring: H-26

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/14/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	50
Driller's License:	5814M	TOC Elevation (ft. AMSL):	
Logged By:	Ryan Francis	Northing:	
Sampling Method:	4"x10' Core barrel	Easting:	



USCS	Lithologic Description
ML	(0 - 3) Silty CLAY, dark brown, dry, soft to firm, weak cementation, flat, low plasticity
SC	(3 - 7) Sandy CLAY, red/orange with gray clay ribbons, dry, soft to firm, weak cementation, medium plasticity, minor rounded pebbles
	(7 - 11) Silty SAND, gray, dry, soft, weak cementation, subrounded, sharp contact
ML	(11 - 30) Clayey silty SAND, tan with red and gray ribbons, moist to wet, soft, weak cementation, medium plasticity
SP	(30 - 40) SAND, tan and orange, fine grained, higher clay content (31'-34'), wet, very soft to soft, low to medium plasticity
SW	(40 - 44) SAND, red, wet, soft to firm, moderate cementation, heavy iron content, iron concretions ("rocky" texture)
SP	(44 - 50) SAND, red and gray, wet, soft, fine grained, subrounded, gradual color change to dark brown/black (47'-50'), moisture content decreases with depth, hard sand (48'-50')

PBW

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Notes:
1. This log should not be used separately from the report to which it is attached.

Well Materials
(0-35) Casing, 2" Sch 40 FJT PVC
(35-40) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-31') Grout
(31'-33') Bentonite pellets
(33'-40') 20/40 sand

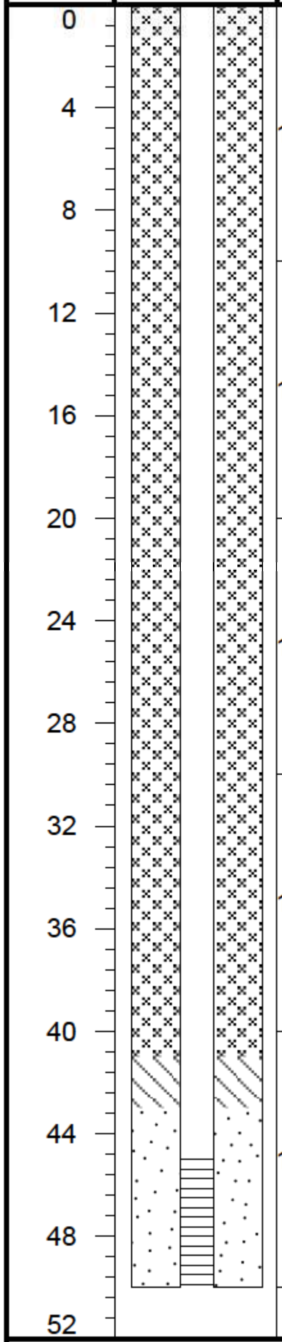
Luminant

Log of Boring: H-27

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/15/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	50
Driller's License:	5814M	TOC Elevation (ft. AMSL):	
Logged By:	Ryan Francis	Northing:	
Sampling Method:	4"x10' Core barrel	Easting:	



Recovery (ft/ft)	USCS	Lithologic Description
10.0/10.0 10.0/10.0	CH	(0 - 20) CLAY, orange and brown mottling, minor black sreaking, blocky, moist, soft to hard, low to high plasticity, dry and variable sand content (5'-7'), wet at 20'
	SP	(20 - 21) SAND, gray, moist, soft, subrounded, sharp contact
10.0/10.0	CL	(21 - 28) CLAY, gray and orange, blocky, moist, firm to hard, moderate cementation, low plasticity
10.0/10.0	SP	(28 - 40) SAND, light gray to tan/orange, moist to wet, soft, none to low plasticity, minor clay content decreasing with depth
	CL	(40 - 44) Sandy CLAY, orange and gray, moist, firm, low to medium plasticity, flat, sharp contact, very hard and little to no sand at 43'
10.0/10.0	SP	(44 - 50) Clayey SAND, orange and gray, wet, soft, low plasticity, fine grained, decreasing clay content with depth, sharp contact, color change to brown at 48'

PBW

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Notes:
1. This log should not be used separately from the report to which it is attached.

Well Materials
(0-45) Casing, 2" Sch 40 FJT PVC
(45-50) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-41') Grout
(41'-43') Bentonite pellets
(43'-50') 20/40 sand

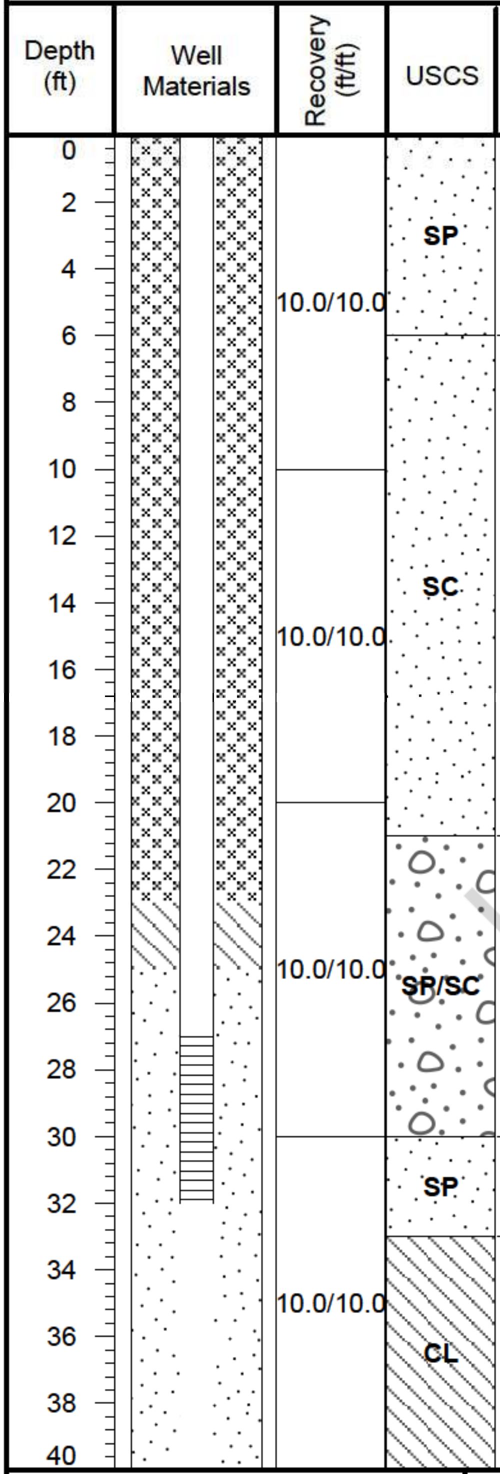
Luminant

Log of Boring: H-28

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/15/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	40
Driller's License:	5814M	TOC Elevation (ft. AMSL):	
Logged By:	Ryan Francis	Northing:	
Sampling Method:	4"x10' Core barrel	Easting:	



USCS	Lithologic Description
SP	(0 - 6) Soil with SAND, tan, dry, firm, moderate cementation, hard packed
SC	(6 - 21) Clayey SAND, moist, soft to firm, weak cementation, none to low plasticity, flat, 6" gray fine to very fine sand lense at 10', gray and orange mottling (11'-21'), fine grained
SP/SC	(21 - 30) Clayey SAND, tan and orange, wet, soft to firm, low plasticity, none to weak cementation, variation in clay content with depth, highest clay content at 21', more orange and less clay (29'-30')
SP	(30 - 33) SAND, orange and gray, fine grained, wet, soft, low plasticity, minor clay content, color change from tna to brown to dark gray
CL	(33 - 40) Silty CLAY, dark gray, moderate sand, dry, hard, weak cementation, flat

PBW

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2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Notes:
1. This log should not be used separately from the report to which it is attached.

Well Materials
(0-27) Casing, 2" Sch 40 FJT PVC
(27-32) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-23') Grout
(23'-25') Bentonite pellets
(25'-32') 20/40 sand

Luminant

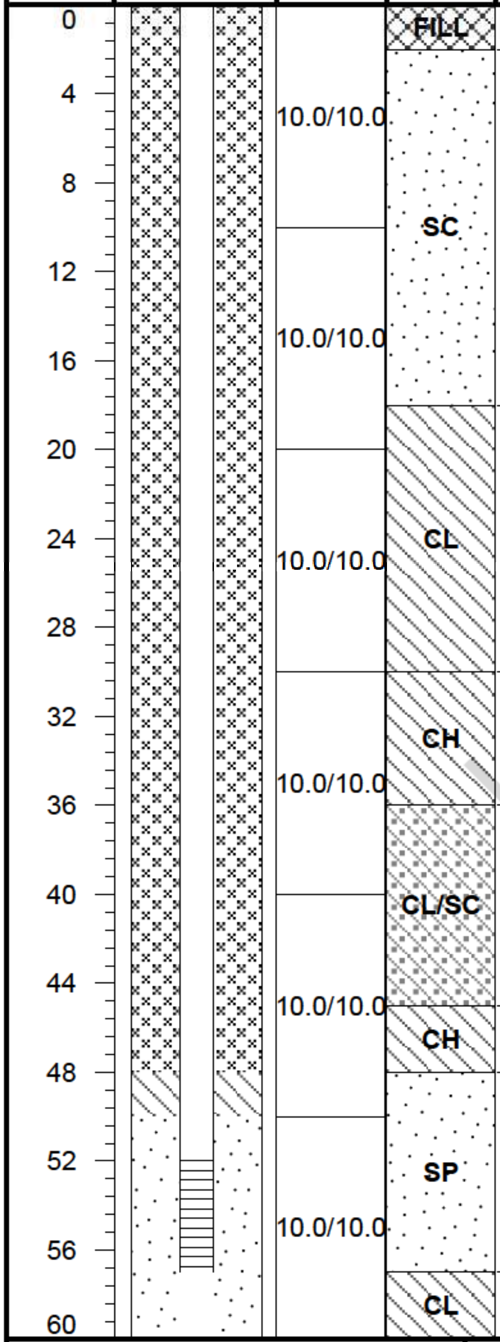
Log of Boring: H-29

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/23/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	60
Driller's License:	5814M	TOC Elevation (ft. AMSL):	
Logged By:	Ryan Francis	Northing:	
Sampling Method:	4"x10' Core barrel	Easting:	

Depth (ft)	Well Materials	Recovery (ft/ft)	USCS	Lithologic Description



(0 - 2) Hard rock road bed, dry

(2 - 18) Clayey SAND, orange and gray mottling, very fine grained, dry to moist, firm, weak cementation, low to medium plasticity, increasing clay content with depth

(18 - 30) CLAY, orange, moist, firm, low to medium plasticity, very little sand or silt, black striping at 22', increasing sand content with depth (28'-30')

(30 - 36) CLAY, orange, moist, soft, friable, high plasticity, minor silt

(36 - 45) Sandy CLAY/Clayey SAND, orange/gray/red mottling, friable, wet, soft to firm, low to medium plasticity, increasing clay content with depth

(45 - 48) CLAY with sand, orange and gray mottling, wet, soft, high plasticity

(48 - 57) SAND, gray, wet, soft, one to low plasticity, some black roots/ organics, interspersed clay lenses

(57 - 60) Silty CLAY, gray/brown, dry, hard, weak cementation, sharp contact

PBW

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Notes:
1. This log should not be used separately from the report to which it is attached.

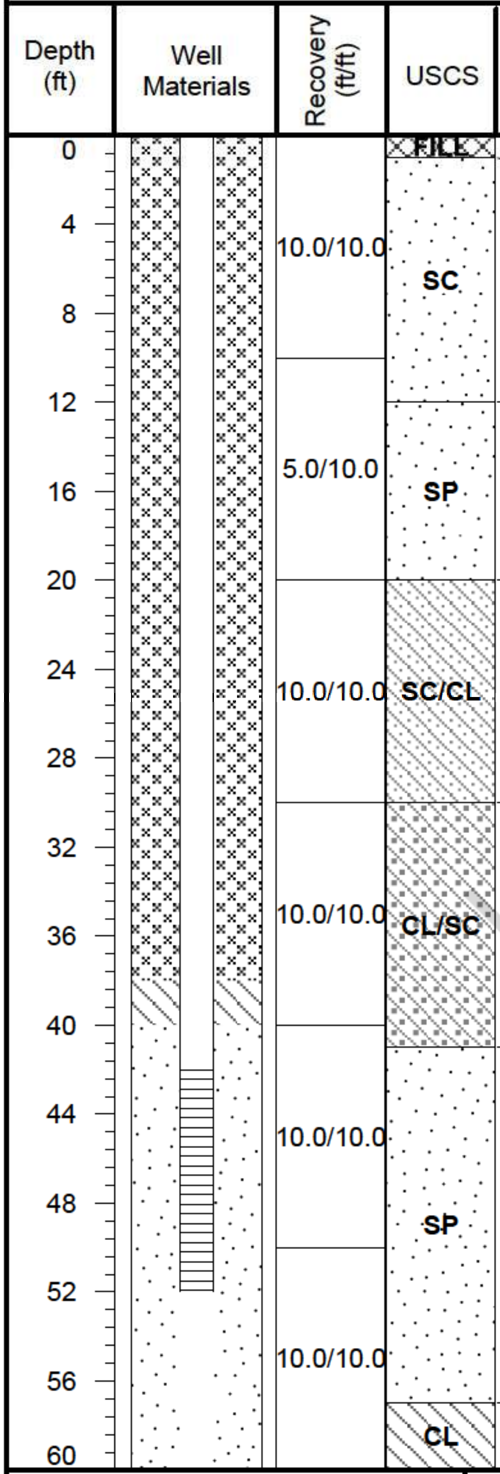
Well Materials
(0-52) Casing, 2" Sch 40 FJT PVC
(52-57) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-48') Grout
(48'-50') Bentonite pellets
(50'-57') 20/40 sand

Luminant

Log of Boring: H-31

Martin Lake Steam Electric Station Tatum, TX	Completion Date:	9/24/2015	Drilling Method:	Sonic
	Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
	Driller:	Timmy Beach	Total Depth (ft):	60
	Driller's License:	5814M	TOC Elevation (ft. AMSL):	
PBW Project No. 5164B	Logged By:	Ryan Francis	Northing:	
	Sampling Method:	4"x10' Core barrel	Easting:	



Lithologic Description

(0 - 1) Hard, packed gravel road bed, dry

(1 - 12) Clayey SAND, orange, dry to moist, soft to firm, low plasticity, fine grained, increasing clay content with depth, gray clay ribbons at 10'

(12 - 20) SAND, orange with red and gray mottling, dry to moist, soft, none to low plasticity, weak cementation, fine grained, very little clay

(20 - 30) Sandy CLAY, orange, dry to moist, firm, crumbly, color variation with depth, low plasticity, some gray sand lenses, very fine grained, color change to gray at 29'

(30 - 41) Sandy CLAY,/ Clayey SAND, gray and tan, moist, soft, fine grained, low plasticity, variations in clay content and firmness with depth, moisture content changes to wet at 35'

(41 - 57) SAND, orange/tan, wet, very soft, fine grained, subrounded, increasing red color with depth starting at 52', hard iron concretion layer with some black staining at 55'

(57 - 60) Sandy CLAY, gray, dry to moist, hard, fine grained, weak cementation, low plasticity, flat

PBW

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Notes:

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Well Materials

(0-42) Casing, 2" Sch 40 FJT PVC
(42-52) Screen, 2" Sch 40 FJT PVC, 0.010" slot

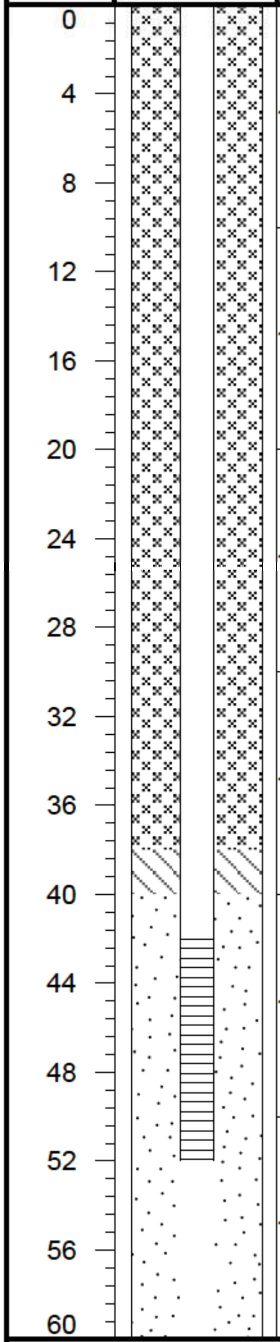
Annular Materials

(0'-38') Grout
(38'-40') Bentonite pellets
(40'-52') 20/40 sand

Luminant

Log of Boring: H-32

Martin Lake Steam Electric Station Tatum, TX	Completion Date:	9/24/2015	Drilling Method:	Sonic
	Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
	Driller:	Timmy Beach	Total Depth (ft):	60
PBW Project No. 5164B	Driller's License:	5814M	TOC Elevation (ft. AMSL):	
	Logged By:	Ryan Francis	Northing:	
	Sampling Method:	4"x10' Core barrel	Easting:	



Recovery (ft/ft)	USCS	Lithologic Description
	FILL	(0 - 1) Hard, packed gravel road bed, dry
10.0/10.0	SC/CL	(1 - 10) Sandy CLAY/Clayey SAND, orange/tan, dry, firm, fine grained, low plasticity, weak cementation
10.0/10.0	CH	(10 - 21) CLAY with minor silt/sand, orange with some black streaks, moist, firm, high plasticity, gradual contact
	SP	(21 - 23.5) SAND, gray, dry, soft to firm, friable, fine grained
10.0/10.0 10.0/10.0	CH	(23.5 - 38) CLAY, orange/tan/gray, moist, soft to firm, unconsolidated, high plasticity, minor sand at 30', tan and gray with orange stripes (30'-38'), sharp contact
10.0/10.0 10.0/10.0	SP	(38 - 57) SAND, orange/tan, moist to wet, very soft to soft, fine grained, subrounded, minor clay, low plasticity, no clay content at 42', gradual coarsening of sand grains (48'-55'), some gray streakings at 49', color change to reddish brown at 52'
	CL	(57 - 60) Sandy CLAY, dark red and brown, wet, soft, low plasticity, layer of dark red concretions at 57', weak cementation, flat

PBW

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Notes:
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Well Materials
(0-42) Casing, 2" Sch 40 FJT PVC
(42-52) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-38') Grout
(38'-40') Bentonite pellets
(40'-52') 20/40 sand

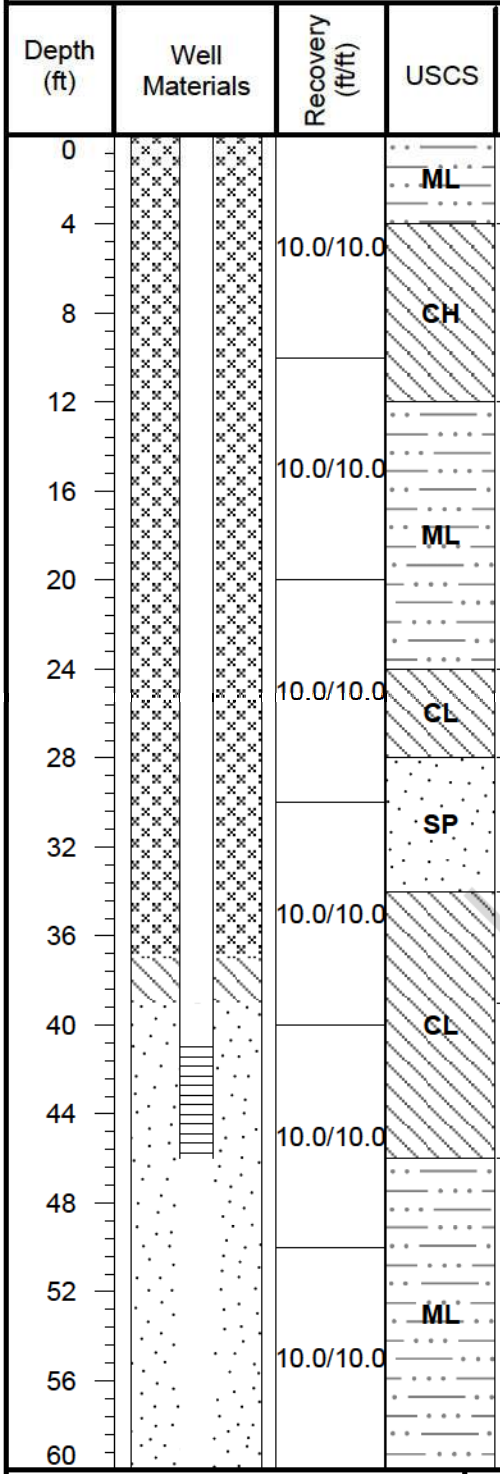
Luminant

Log of Boring: H-33

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/14/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	60
Driller's License:	5814M	TOC Elevation (ft. AMSL):	
Logged By:	Ryan Francis	Northing:	
Sampling Method:	4"x10' Core barrel	Easting:	



USCS	Lithologic Description
ML	(0 - 4) Silty CLAY, minor sand, red and orange with gray ribbons, dry, soft to firm, low to medium plasticity, flat
CH	(4 - 12) CLAY, red with gray concretions, moist, soft to firm, high plasticity, gradual contact
ML	(12 - 24) Sandy SILT, gray and red, dry, soft, weak cementation, sharp contact, red and gray clay lense at 19'
CL	(24 - 28) Clay, red, moist to wet, soft to firm, high plasticity, pebbles present
SP	(28 - 34) SAND, gray, wet, soft to firm, minor clay, low to medium plasticity, subrounded, increasing clay content with depth, sharp contact
CL	(34 - 39) CLAY, orange and gray mottling, dry, very hard, moderate cementation, low plasticity
CL	(39 - 46) Sandy CLAY, orange and gray, moist to wet, firm, medium plasticity, weak cementation, increasing sand content with depth
ML	(46 - 60) Sandy SILT, dark gray, dry, hard, flat

PBW

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Notes:
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Well Materials
(0-41) Casing, 2" Sch 40 FJT PVC
(41-46) Screen, 2" Sch 40 FJT PVC, 0.010" slot

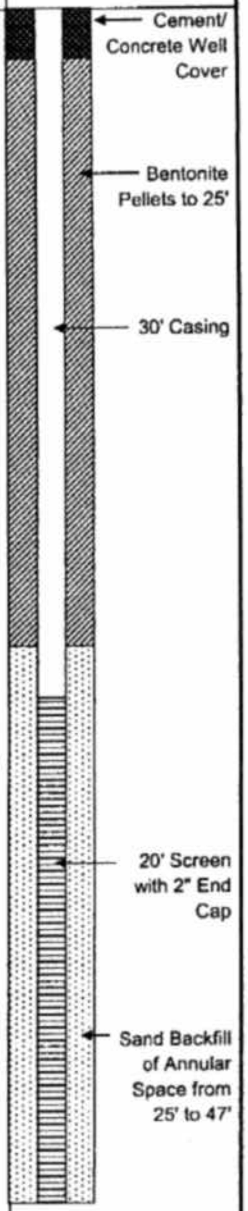
Annular Materials
(0'-37') Grout
(37'-39') Bentonite pellets
(39'-46') 20/40 sand

PDP5

GREEN STAR ENVIRONMENTAL

BORING/WELL CONSTRUCTION LOG

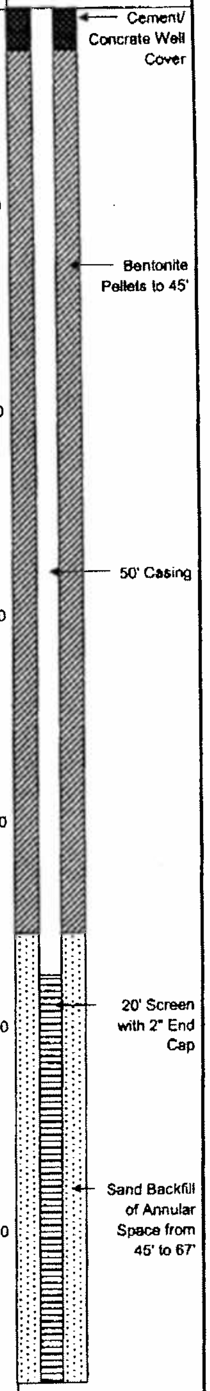
Project Number:	08-1388	Boring/Well Number:	MW-17A
Project Name:	Martin Lake SES	Date Drilled:	October 1, 2008
Location:	8850 FM 2658 Tatum, TX	Casing Type/Diameter:	PVC/2" ID
Drilling Method:	HSA	Screen Type/Diameter:	PVC/0.01"
Sampling Method:	CT	Gravel Pack Type:	8/16 Grade Silica Sand
Ground Elevation:	384.63' msl	Grout Type:	Bentonite Pellets
Top of Casing Elevation:	387.53' msl	Depth to Water/Date:	26.62' BTOC/10-09-2008
Logged by:	T. Ripley	Ground Water Elevation/Date:	360.91' msl/10-09-2008
Remarks:		Drilling Co./Driller:	SCI / M. Bridges

PID (ppm)	Blow Counts	Recovery (%)	Sampling Method	Sample	Depth (ft. BGL)	U.S.C.S	Graphic Log	Lithologic Description	Contact Depth	Well Diagram
NA	NA	NA	CT	NA				See MW-17B boring log for Lithologic Description		
					10				10.0	
					20				20.0	
								▽		
					30				30.0	
					40				40.0	
					50			The boring was terminated and the well was set at 47' bgs. The well was completed with a protective stickup which requires approximately 3 feet of additional casing above grade.	50.0	

GREEN STAR ENVIRONMENTAL

BORING/WELL CONSTRUCTION LOG

Project Number:	08-1388	Boring/Well Number:	MW-18A
Project Name:	Martin Lake SES	Date Drilled:	October 2, 2008
Location:	8850 FM 2658 Tatum, TX	Casing Type/Diameter:	PVC/2" ID
Drilling Method:	HSA	Screen Type/Diameter:	PVC/0.01"
Sampling Method:	CT	Gravel Pack Type:	8/16 Grade Silica Sand
Ground Elevation:	410.83' msl	Grout Type:	Bentonite Pellets
Top of Casing Elevation:	414.43' msl	Depth to Water/Date:	43.17' BTOC/10-09-2008
Logged by:	T. Ripley	Ground Water Elevation/Date:	371.26' msl/10-09-2008
Remarks:		Drilling Co./Driller:	SCI / M. Bridges

PID (ppm)	Blow Counts	Recovery (%)	Sampling Method	Sample	Depth (ft. BGL)	U.S.C.S	Graphic Log	Lithologic Description	Contact Depth	Well Diagram
NA	NA	NA	CT	NA				See MW-18B boring log for Lithologic Description		
					10				10.0	
					20				20.0	
					30				30.0	
					40			∇	40.0	
					50				50.0	
					60				60.0	
					70			The boring was terminated and the well was set at 67' bgs. The well was completed with a protective stickup which requires approximately 3 feet of additional casing above grade.	70.0	

GREEN STAR
ENVIRONMENTAL

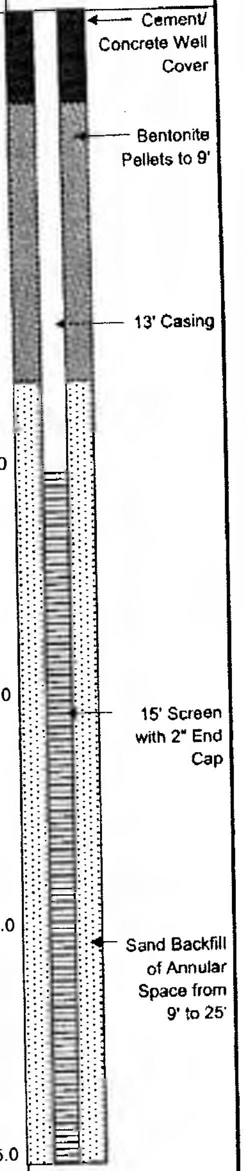
BORING/WELL CONSTRUCTION LOG

Project Number: 08-1388
Project Name: Martin Lake SES
Location: 8850 FM 2658 Tatum, TX
Drilling Method: HSA
Sampling Method: CT
Ground Elevation: 367.84' msl
Top of Casing Elevation: 371.23' msl
Logged by: T. Ripley
Remarks:

Boring/Well Number: MW-19
Date Drilled: September 30, 2008
Casing Type/Diameter: PVC/2" ID
Screen Type/Diameter: PVC/0.01"
Gravel Pack Type: 20/40 Grade Silica Sand
Grout Type: Bentonite Pellets
Depth to Water/Date: 13.89' BTOC/10-09-2008
Ground Water Elevation/Date: 357.34' msl/10-09-2008
Drilling Co./Driller: SCI / M. Bridges

PID (ppm)	Blow Counts	Recovery (%)	Sampling Method	Sample	Depth (ft. BGL)	U.S.C.S	Graphic Log	Lithologic Description	Contact Depth
NA	NA		CT	NA		SC	▩	Moist, medium dense, reddish-brown, CLAYEY SAND (fine-grained SAND)	
		90				CL	▩	Moist, soft, reddish-brown, SANDY CLAY	
		60			5	SP	░	Moist, loose, reddish-brown, fine-grained SAND -gray	5.0
					10	CL	▨	Moist to wet, soft, brown, SANDY CLAY (fine-grained SAND) -stiff -light gray ▽	10.0
						CL	▨	Moist, very stiff, light gray, SILTY CLAY	
		100			15	SC	▩	Moist, dense, gray and reddish-brown, CLAYEY SAND (fine-grained SAND ▽	15.0
		70				SP	░	Wet, loose, light gray and reddish-brown, fine-grained SAND -medium dense	
		100			20	SC	▩	Wet, medium dense, light gray and reddish-brown, CLAYEY SAND (fine-grained SAND) -stringer of dense -stringer of dense	20.0
					25	ML	▥	Moist, very stiff, gray CLAYEY SILT with some iron staining	25.0
								The boring was terminated and the well was set at 25' bgs. The well was completed with a protective stickup which requires approximately 3 feet of additional casing above grade.	

Well Diagram

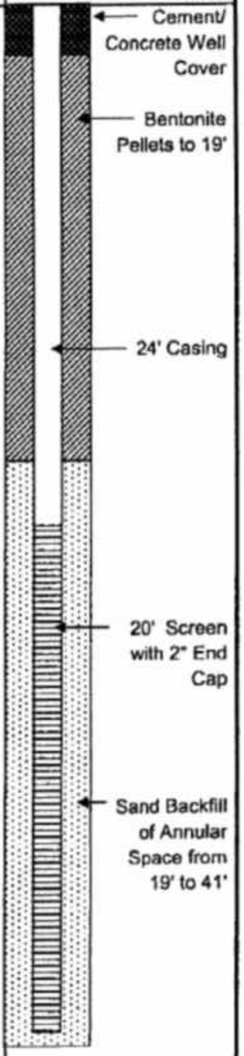


GREEN STAR ENVIRONMENTAL

BORING/WELL CONSTRUCTION LOG

Project Number:	08-1388	Boring/Well Number:	MW-20A
Project Name:	Martin Lake SES	Date Drilled:	September 30, 2008
Location:	8850 FM 2658 Tatum, TX	Casing Type/Diameter:	PVC/2" ID
Drilling Method:	HSA	Screen Type/Diameter:	PVC/0.01"
Sampling Method:	CT	Gravel Pack Type:	20/40 Grade Silica Sand
Ground Elevation:	395.95' msl	Grout Type:	Bentonite Pellets
Top of Casing Elevation:	398.34' msl	Depth to Water/Date:	29.19' BTOC/10-09-2008
Logged by:	T. Ripley	Ground Water Elevation/Date:	369.65' msl/10-09-2008
Remarks:		Drilling Co./Driller:	SCI / M. Bridges

PID (ppm)	Blow Counts	Recovery (%)	Sampling Method	Sample	Depth (ft. BGL)	U.S.C.S	Graphic Log	Lithologic Description	Contact Depth	Well Diagram
NA	NA	NA	CT	NA				See MW-20B boring log for Lithologic Description		
					10				10.0	
					20				20.0	
								▽		
					30				30.0	
					40				40.0	
								The boring was terminated and the well was set at 41' bgs. The well was completed with a protective stickup which requires approximately 3 feet of additional casing above grade.		



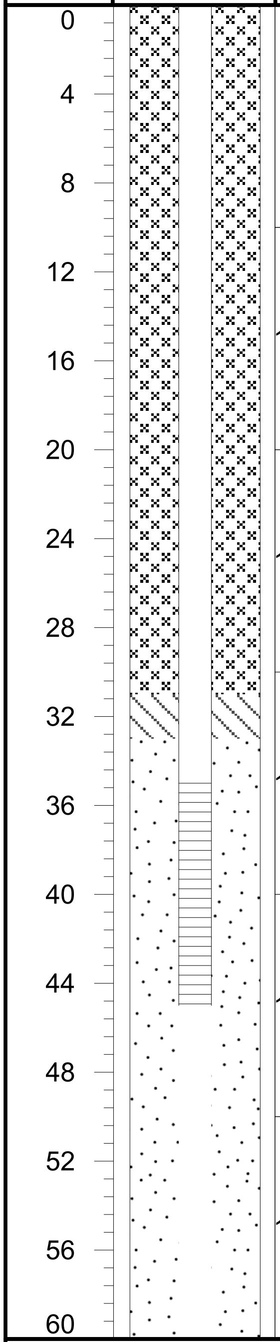
Luminant

Log of Boring: PDP-22

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/9/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	60
Driller's License:	5814M	TOC Elevation (ft. AMSL):	
Logged By:	Ryan Francis	Northing:	
Sampling Method:	4"x10' Core barrel	Easting:	



Recovery (ft/ft)	USCS	Lithologic Description
8.0/10.0	SP	(0 - 3) Fine SAND, tan, dry, very soft, small iron concretions, grass roots
	CL	(3 - 10) Sandy CLAY, red/orange mottled, dry, firm, moderate cementation, flat to subrounded, sharp contact
10.0/10.0	CH	(10 - 20) Silty CLAY with minor sand, dry, firm, moderate cementation, flat to subrounded, medium to high plasticity, micro laminated structure, increasing sand content with depth, transition from red/gray at 10' to tan at 20'
10.0/10.0	SM	(20 - 28) Sandy SILT, gray and tan, dry, firm, moderate cementation, flat to subrounded, grass lense (fill), transition to gray at 26'
		(28 - 30) Silty SAND, iron-rich, dry, soft, weak cementation, subrounded, sharp contact
10.0/10.0 10.0/10.0	SC	(30 - 53) SAND, gray with small streaks and iron at 32', moist to wet, soft, moderate plasticity at 30', transition to low plasticity at 40', minor clay content
10.0/10.0	CL	(53 - 60) Silty CLAY, gray, dry, firm, moderate cementation, dry, flat, transition to very hard gray/dark gray clay at 56'

PBW

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Round Rock, TX 78664
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Notes:
1. This log should not be used separately from the report to which it is attached.

Well Materials
(0-35) Casing, 2" Sch 40 FJT PVC
(35-60) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-31') Grout
(31'-33') Bentonite pellets
(33'-60') 20/40 sand

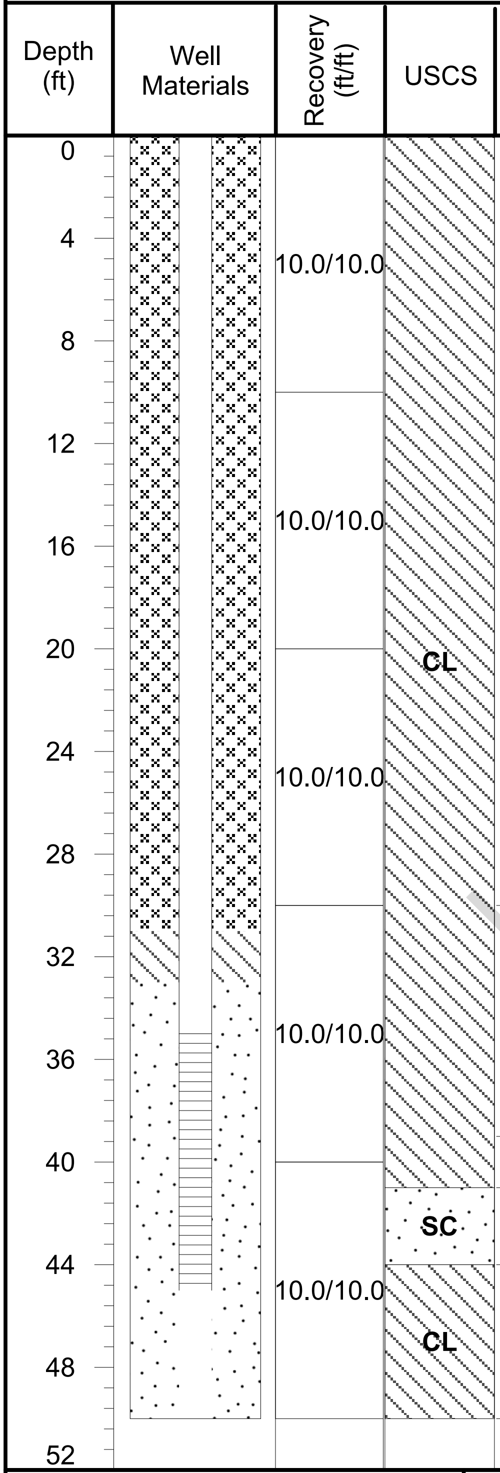
Luminant

Log of Boring: PDP-23

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/10/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	50
Driller's License:	5814M	TOC Elevation (ft. AMSL):	
Logged By:	Ryan Francis	Northing:	
Sampling Method:	4"x10' Core barrel	Easting:	



Lithologic Description

(0 - 30) Sandy CLAY, brown to red to tan, dry, soft to firm, weak cementation, iron rich at 5', none to moderate plasticity, black mottling and some organics present at 10', iron banding and iron nodules with increasing sand cotent at 16', microlaminated iron rich banded gray, tan, and red sandy clay (21' - 30')

(30 - 39) CLAY, gray, micro laminated, minor sand content, dry, firm to hard, weak to moderate cementation, low plasticity

(39 - 41) Sandy CLAY, light gray, dry, firm, weak cementation, medium plasticity

(41 - 44) Clayey SAND, wet, soft, weak cementation, subrounded, medium to high plasticity

(44 - 50) Sandy CLAY, dark gray, dry, hard, moderate cementation

PBW

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Notes:
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Well Materials
(0-35) Casing, 2" Sch 40 FJT PVC
(35-45) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-31') Grout
(31'-33') Bentonite pellets
(33'-45') 20/40 sand

Luminant

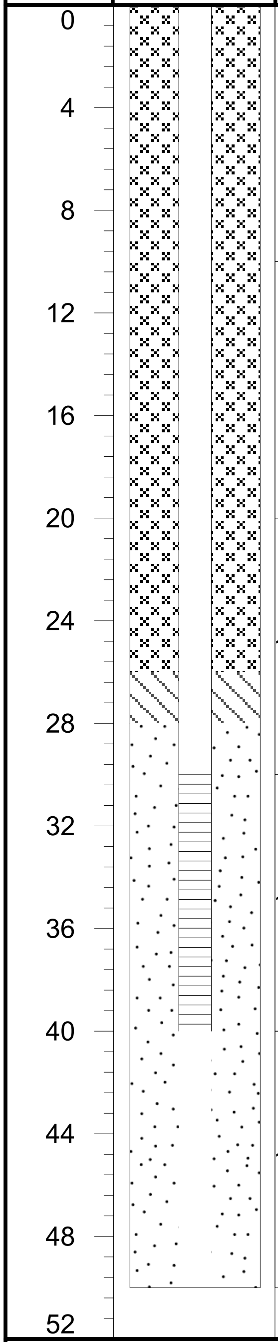
Log of Boring: PDP-24

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/11/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	50
Driller's License:	5814M	TOC Elevation (ft. AMSL):	
Logged By:	Ryan Francis	Northing:	
Sampling Method:	4"x10' Core barrel	Easting:	

Depth (ft) | Well Materials



Recovery (ft/ft)	USCS	Lithologic Description
8.0/10.0 7.0/10.0 10.0/10.0	CL	(0 - 30) Sandy CLAY, red and tan mottling, fine sand, dry to moist, firm, weak cementation, low to medium plasticity, occasional black inclusions, minor very fine sand content in gray and orange clay and high plasticity (20'-30')
10.0/10.0	CL/SC	(30 - 45) Sandy CLAY/Clayey SAND, gray, moist to wet, very fine grained, firm, weak cementation, medium plasticity, softens and increasing wetness with depth (35'-39'), brown with increased iron content (39'-42'), dark gray, dry, and none to low plasticity (39'-45')
10.0/10.0	SP	(45 - 47) Clayey SAND, wet, soft, weak cementation, medium to high plasticity
	CL	(47 - 50) Sandy CLAY, dark gray, fine grained, dry, firm to hard, weak cementation

PBW

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Round Rock, TX 78664
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Notes:
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Well Materials
(0-30) Casing, 2" Sch 40 FJT PVC
(30-40) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-26') Grout
(26'-28') Bentonite pellets
(28'-40') 20/40 sand

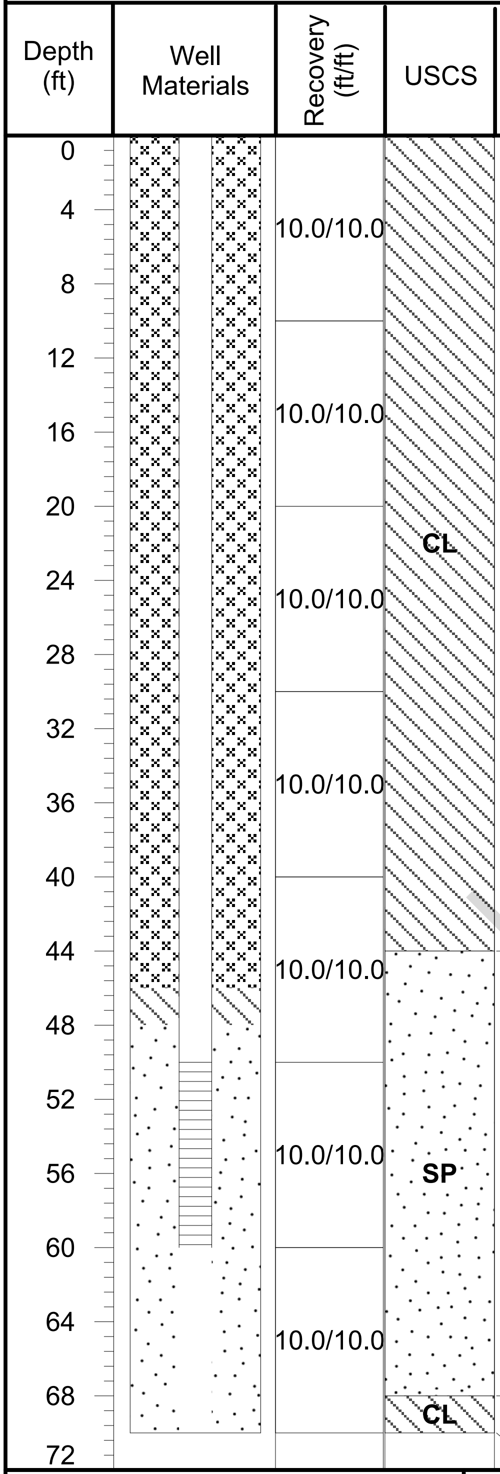
Luminant

Log of Boring: PDP-25

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/11/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	70
Driller's License:	5814M	TOC Elevation (ft. AMSL):	
Logged By:	Ryan Francis	Northing:	
Sampling Method:	4"x10' Core barrel	Easting:	



Lithologic Description

(0 - 44) Sandy CLAY, red to gray and tan, very fine grained, dry to moist, firm, low to medium plasicity, weak to moderate cementation, micro laminated, minor organics, variable sand content with depth, high plasticity and very low sand content (22'-23'), higher sand content and high iron content with occasional subrounded pebbles (27'-30'), red, orange, tan, and gray mottling (30'-44')

(44 - 68) Clayey SAND, gray, moist, soft to firm, minor orange streaking, low plasticity, weak cementation, subrounded, minor wet and soft clay zone (62'-64')

(68 - 70) CLAY, black, minor silt, dry, very hard, moderate cementation, smooth shiny surface when fractured

PBW
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Notes:
1. This log should not be used separately from the report to which it is attached.

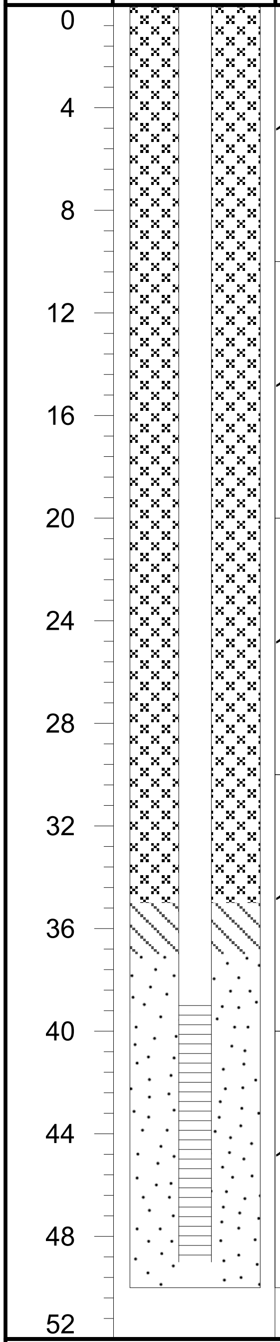
Well Materials
(0-50) Casing, 2" Sch 40 FJT PVC
(50-60) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-46') Grout
(46'-48') Bentonite pellets
(48'-60') 20/40 sand

Luminant

Log of Boring: PDP-26

Martin Lake Steam Electric Station Tatum, TX	Completion Date:	9/9/2015	Drilling Method:	Sonic
	Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
	Driller:	Timmy Beach	Total Depth (ft):	50
PBW Project No. 5164B	Driller's License:	5814M	TOC Elevation (ft. AMSL):	
	Logged By:	Ryan Francis	Northing:	
	Sampling Method:	4"x10' Core barrel	Easting:	



Depth (ft)	Recovery (ft/ft)	USCS	Lithologic Description
0 - 3	10.0/10.0	SP	(0 - 3) SAND, tan, dry, very soft, weak cementation
3 - 6		SC	(3 - 6) Clayey SAND, dry, firm, black lignite present
6 - 9		CL	(6 - 9) CLAY with minor sand, red, moist, firm, medium plasticity, smear zone black lignite
9 - 16	10.0/10.0	SC	(9 - 16) Clayey SAND, tan, moist, soft, low plasticity, more clay content with depth
16 - 40	10.0/10.0 10.0/10.0	CL	(16 - 40) CLAY, tan, micro laminated orange and gray, moist, soft, medium plasticity, dry and silty clay (19'-27'), micro laminated gray and dark gray (27'-36'), increasing sand content (30'-36'), organics layer (36.5'-37'), high iron content (39'-40')
40 - 48	10.0/10.0	SP	(40 - 48) SAND, tan, medium, moist to wet, soft, subrounded
48 - 50		CL	(48 - 50) CLAY, gray, micro laminated, dry, firm, moderate cementation

PBW

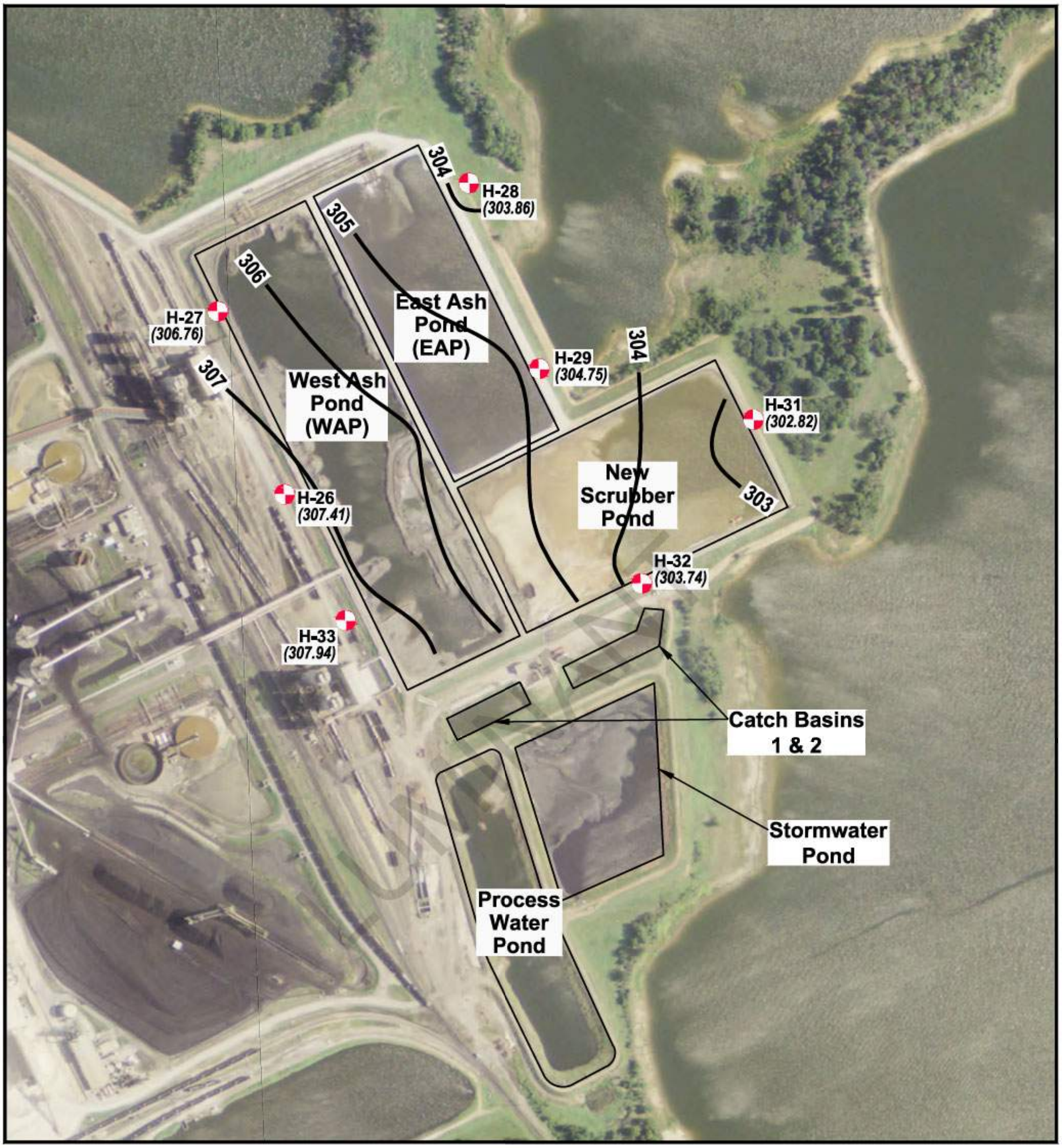
Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Notes:
1. This log should not be used separately from the report to which it is attached.

Well Materials
(0-39) Casing, 2" Sch 40 FJT PVC
(39-49) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-35') Grout
(35'-37') Bentonite pellets
(37'-49') 20/40 sand

APPENDIX F3 – MAPS OF THE DIRECTION OF GROUNDWATER FLOW



EXPLANATION

⊕ CCR Monitoring Well Location

(308.70) Groundwater Potentiometric Surface (ft. MSL)

— 308 — Groundwater Potentiometric Surface Contour (C.I. = 1 ft.)

N

Scale in Feet

0 250 500

SOURCE: Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

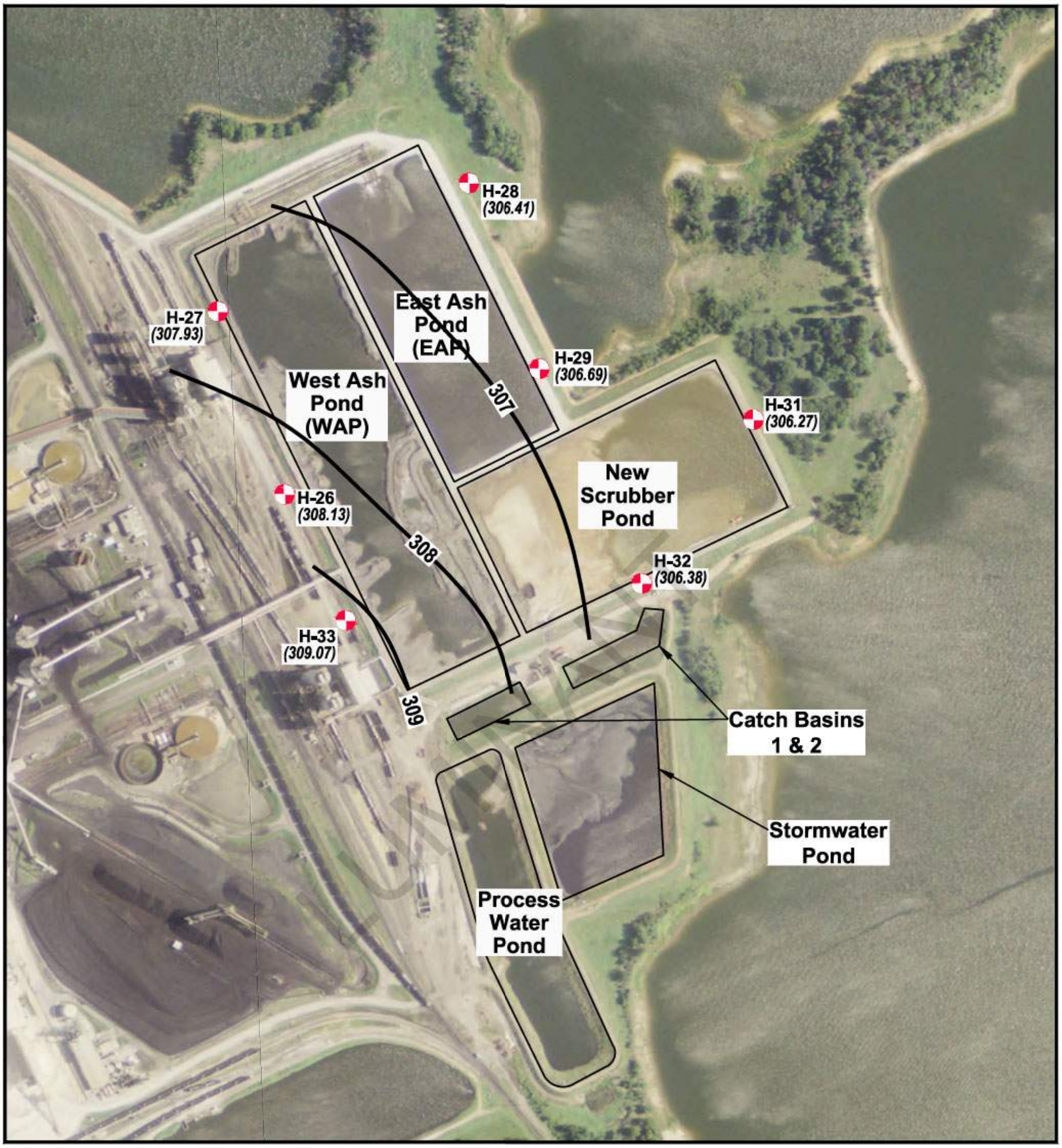
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

Figure 1

ASH POND AREA - GROUNDWATER ZONE B POTENTIOMETRIC SURFACE MAP - OCTOBER 21-22, 2015

PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

● CCR Monitoring Well Location

(308.70) Groundwater Potentiometric Surface (ft. MSL)

— 308 — Groundwater Potentiometric Surface Contour (C.I. = 1 ft.)

N

Scale in Feet

0 250 500

SOURCE: Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

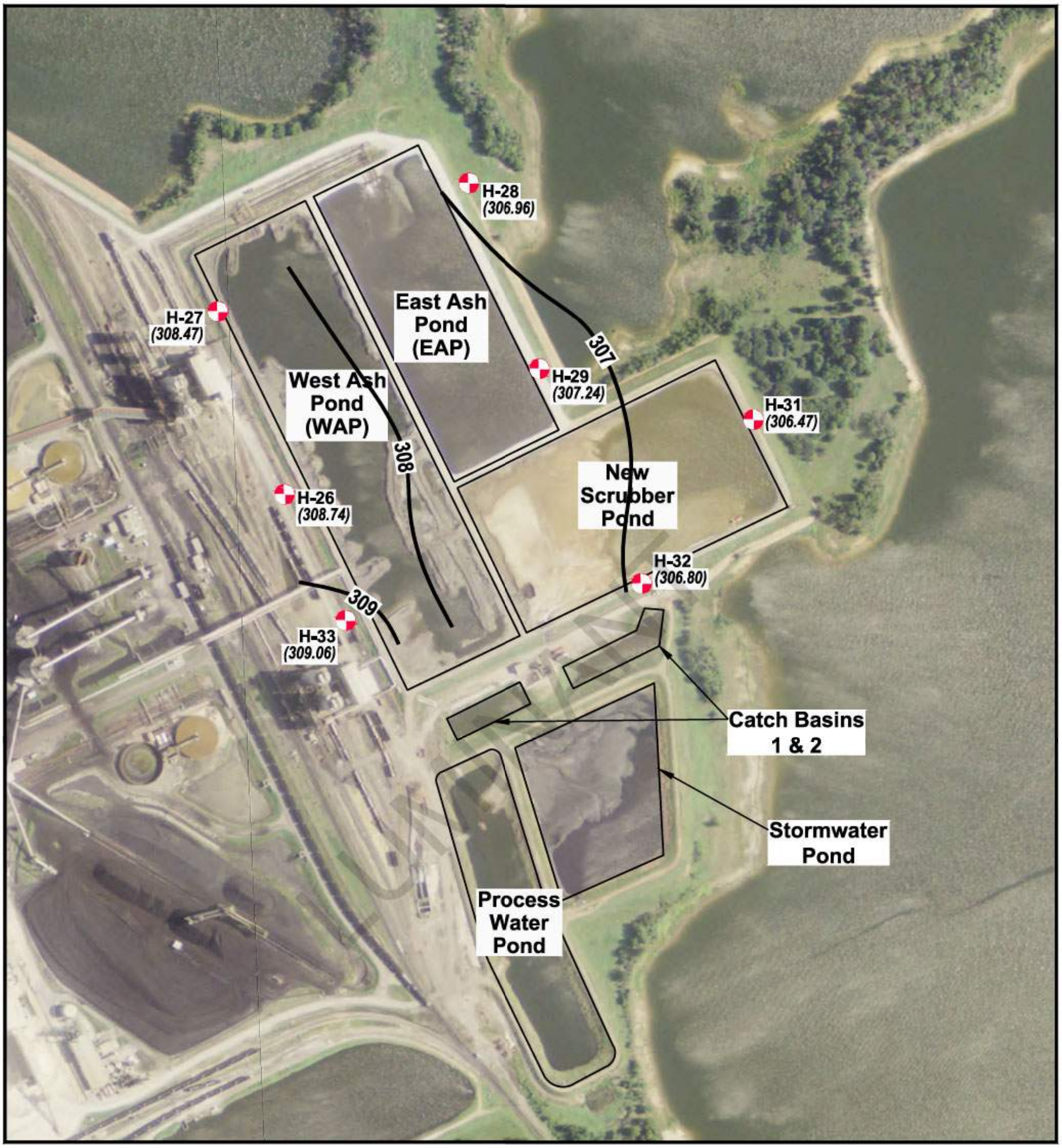
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

Figure 2

ASH POND AREA - GROUNDWATER ZONE B POTENTIOMETRIC SURFACE MAP - DECEMBER 14, 2015

PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

⊕	CCR Monitoring Well Location
(308.70)	Groundwater Potentiometric Surface (ft. MSL)
— 308 —	Groundwater Potentiometric Surface Contour (C.I. = 1 ft.)

N

Scale in Feet

0 250 500

SOURCE: Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

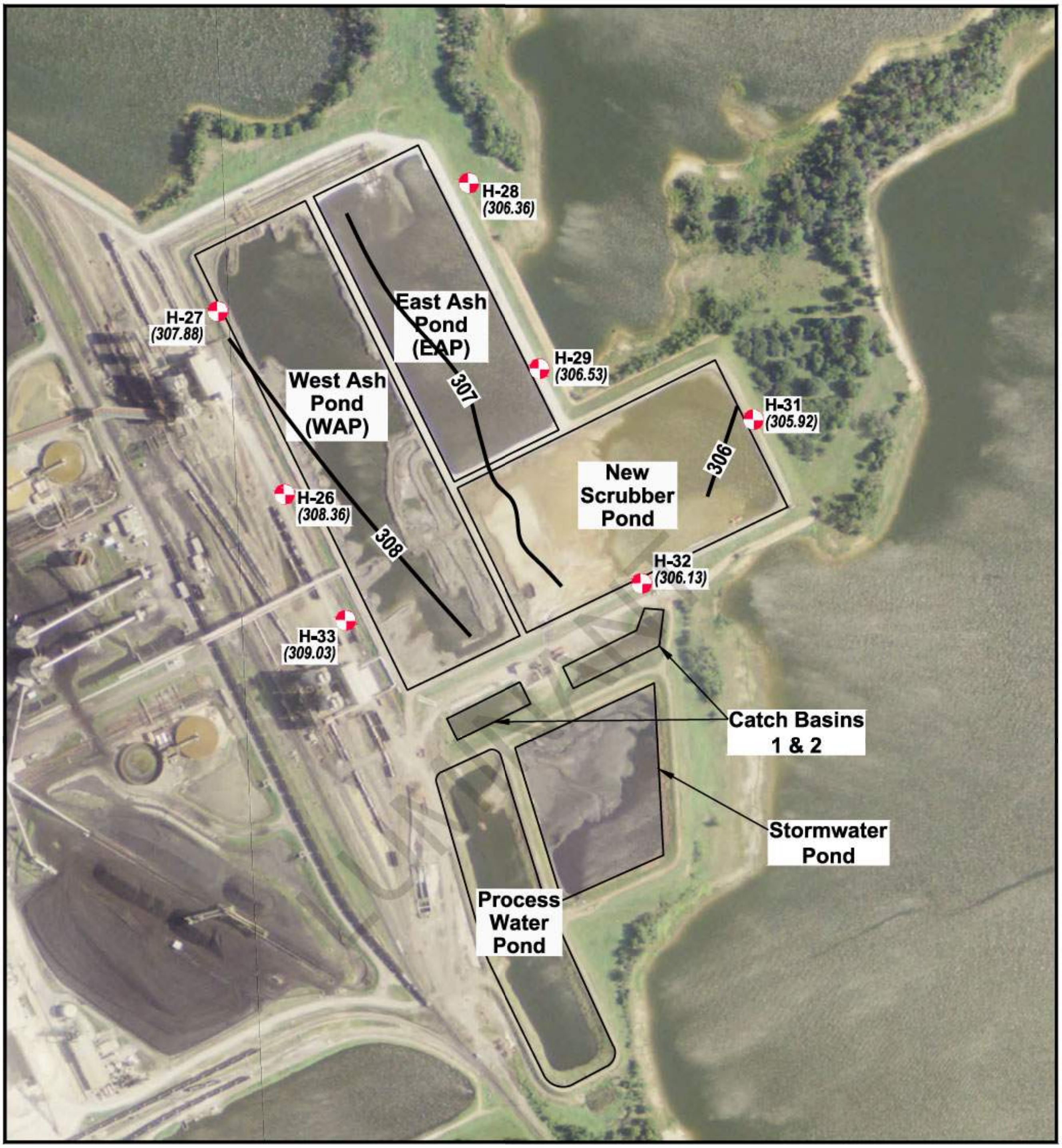
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

Figure 3

ASH POND AREA - GROUNDWATER ZONE B POTENTIOMETRIC SURFACE MAP - FEBRUARY 25, 2016

PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

◐	CCR Monitoring Well Location
(308.70)	Groundwater Potentiometric Surface (ft. MSL)
— 308 —	Groundwater Potentiometric Surface Contour (C.I. = 1 ft.)

N

Scale in Feet

0 250 500

SOURCE: Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

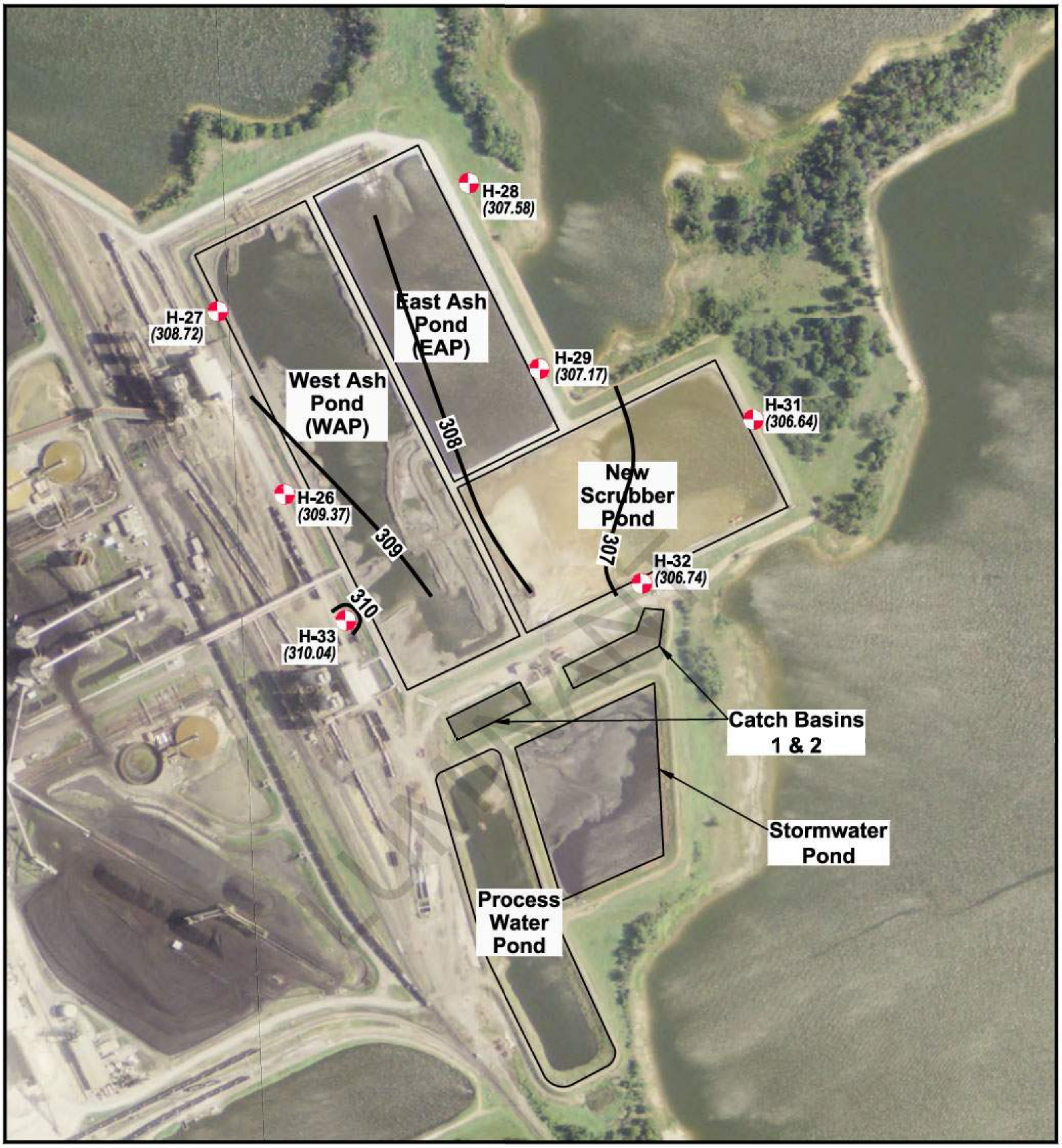
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

Figure 4

ASH POND AREA - GROUNDWATER ZONE B POTENTIOMETRIC SURFACE MAP - APRIL 5, 2016

PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

◆	CCR Monitoring Well Location
(308.70)	Groundwater Potentiometric Surface (ft. MSL)
— 308 —	Groundwater Potentiometric Surface Contour (C.I. = 1 ft.)

SOURCE: Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

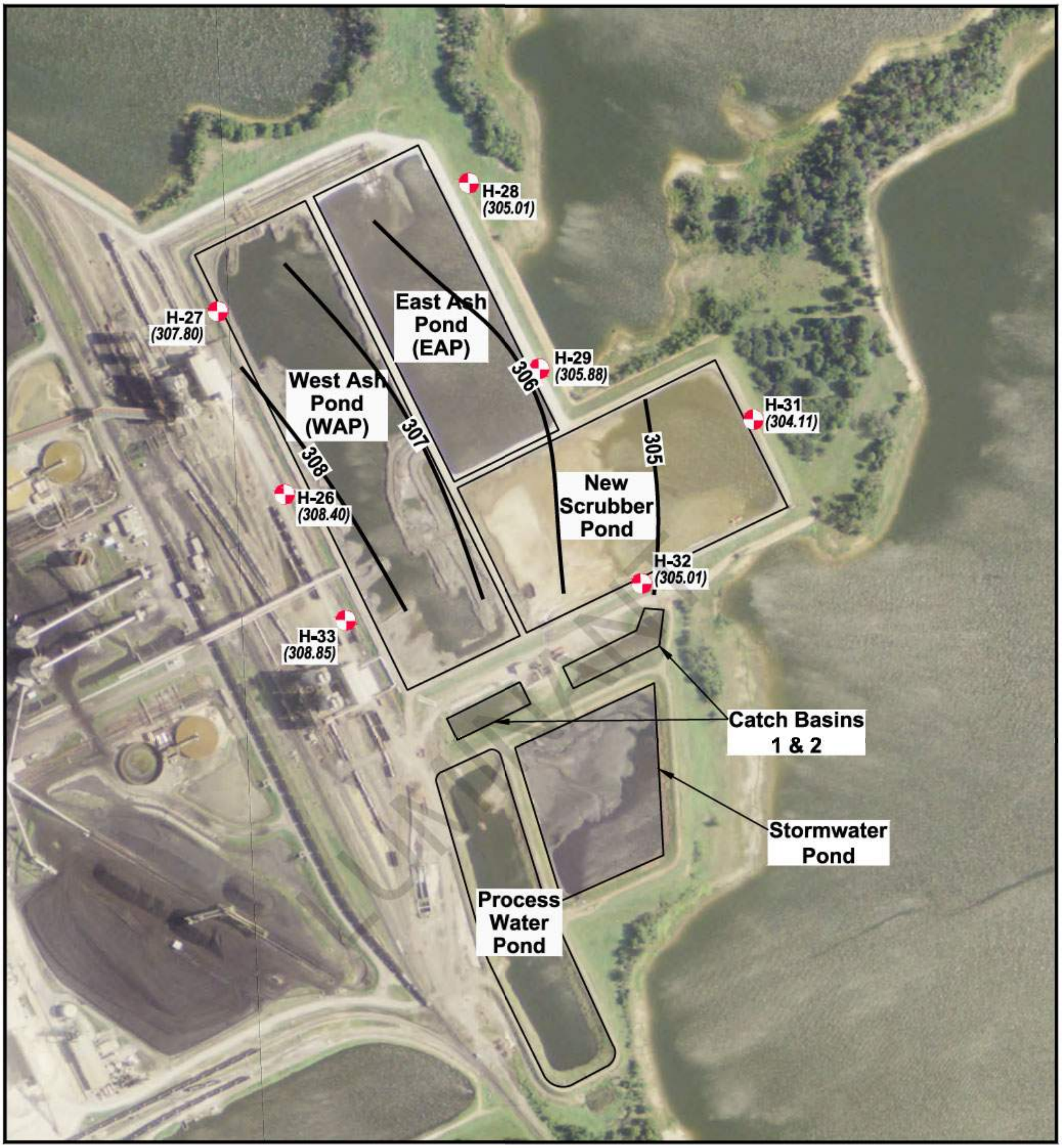
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

Figure 5

ASH POND AREA - GROUNDWATER ZONE B POTENTIOMETRIC SURFACE MAP - JUNE 6, 2016

PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

◐ CCR Monitoring Well Location

(308.70) Groundwater Potentiometric Surface (ft. MSL)

— 308 — Groundwater Potentiometric Surface Contour (C.I. = 1 ft.)

N

Scale in Feet

0 250 500

SOURCE: Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

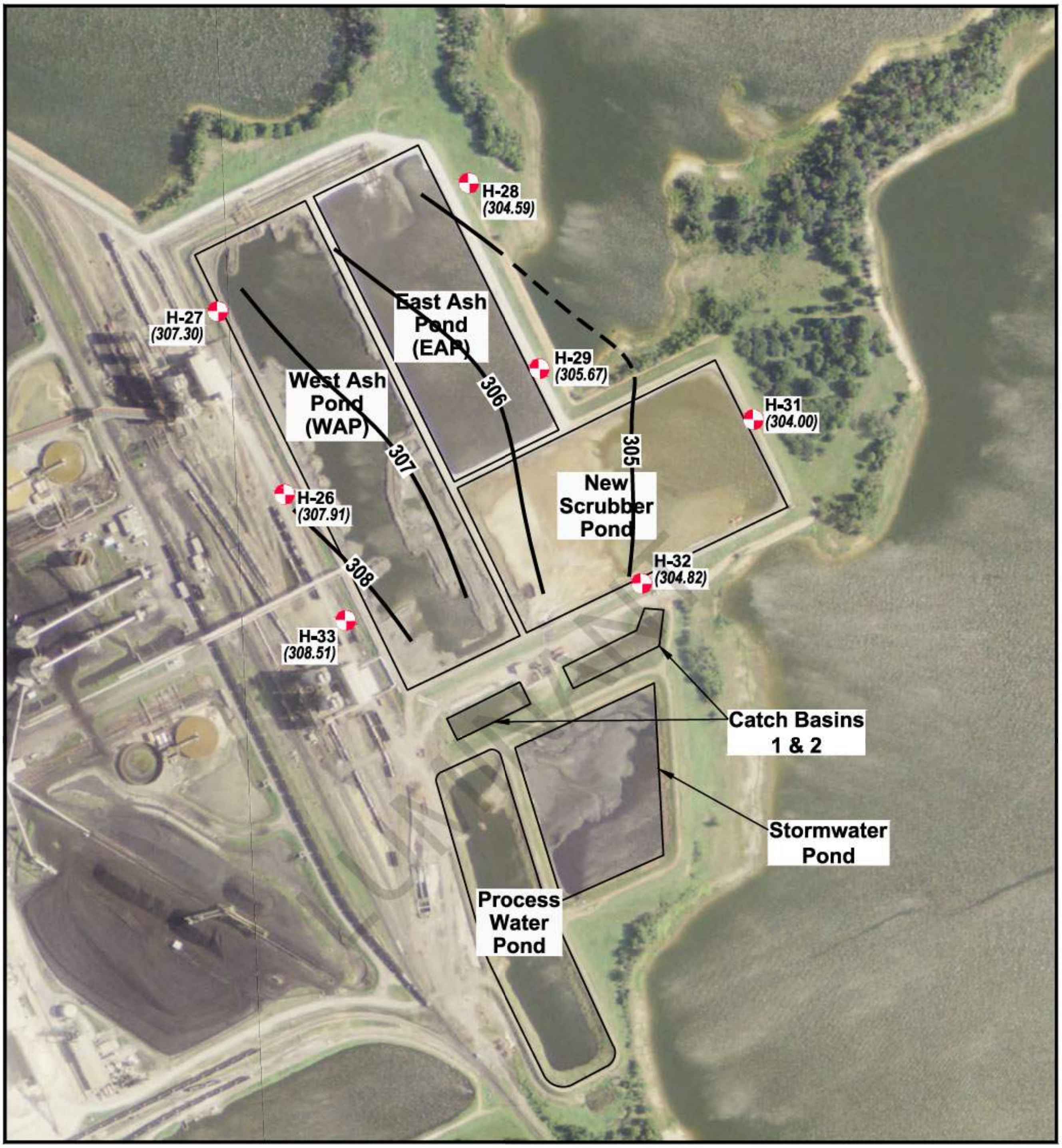
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

Figure 6

ASH POND AREA - GROUNDWATER ZONE B POTENTIOMETRIC SURFACE MAP - AUGUST 9, 2016

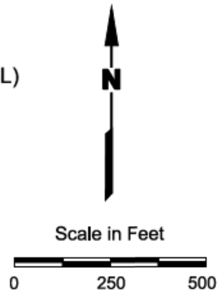
PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

●	CCR Monitoring Well Location
(308.70)	Groundwater Potentiometric Surface (ft. MSL)
— 308 —	Groundwater Potentiometric Surface Contour (C.I. = 1 ft.)



SOURCE: Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

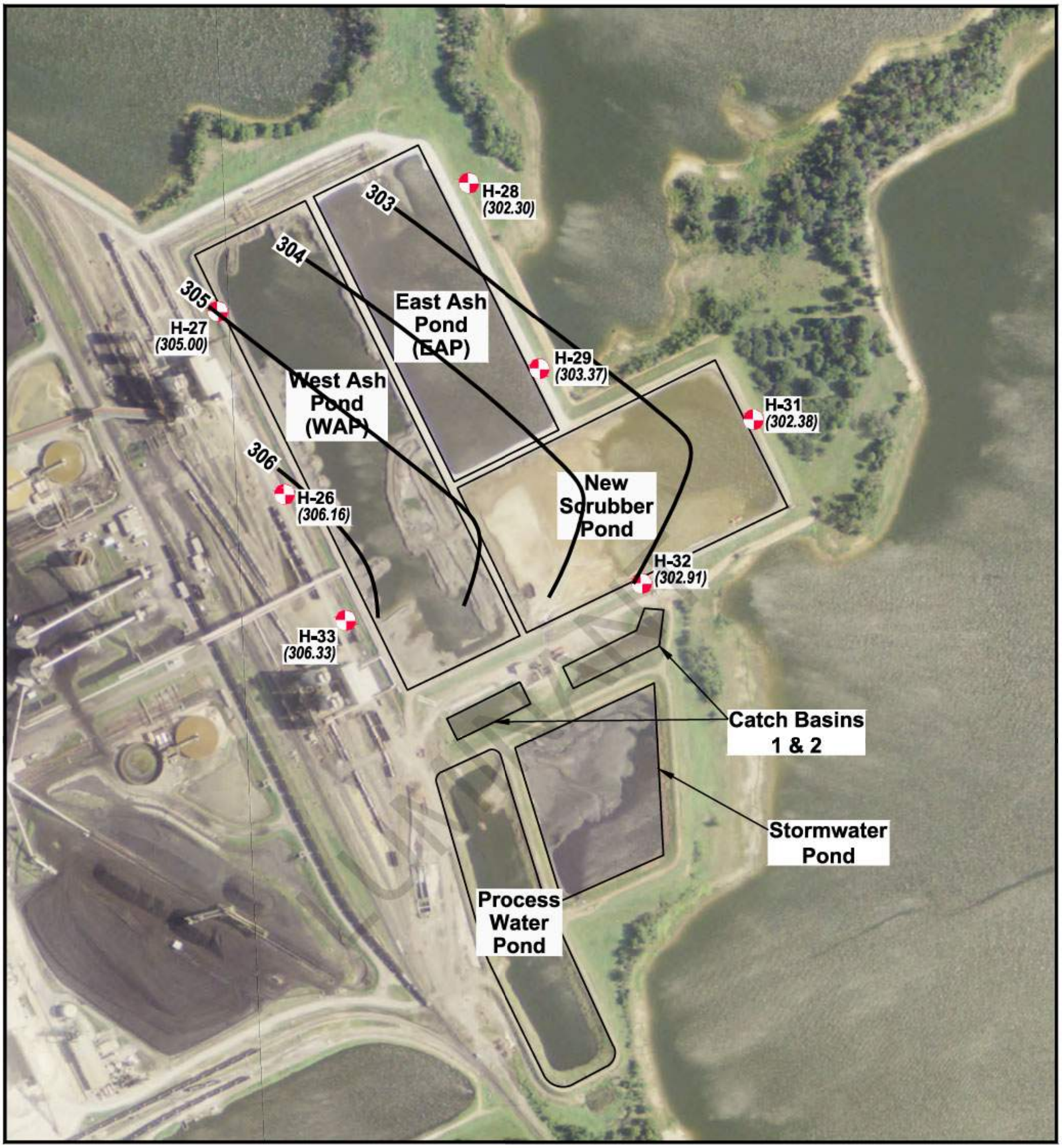
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

Figure 7

ASH POND AREA - GROUNDWATER ZONE B POTENTIOMETRIC SURFACE MAP - OCTOBER 17, 2016

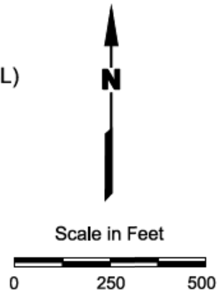
PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

◐	CCR Monitoring Well Location
(308.70)	Groundwater Potentiometric Surface (ft. MSL)
— 308 —	Groundwater Potentiometric Surface Contour (C.I. = 1 ft.)



SOURCE: Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

Figure 8

ASH POND AREA - GROUNDWATER ZONE B POTENTIOMETRIC SURFACE MAP - DECEMBER 11, 2016

PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

LEGEND

🔴	DOWNGRADIENT CCR MONITORING WELL
🟥	UPGRADIENT CCR MONITORING WELL
(308.70)	GROUNDWATER POTENTIOMETRIC SURFACE (FT MSL)
—308—	GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR (C.I. = 1 FT)

REFERENCE(S)

BASE MAP TAKEN FROM GOOGLE EARTH, IMAGERY DATED 4/6/17.

CLIENT
LUMINANT

PROJECT
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

TITLE
ASH POND AREA
POTENTIOMETRIC SURFACE MAP
MAY 14, 2019

CONSULTANT

GOLDER

YYYY-MM-DD	2019-06-24
DESIGNED	AJD
PREPARED	AJD
REVIEWED	WFV
APPROVED	WFV

PROJECT NO.	REV.	FIGURE
19122449	0	6

Last Edited By: pmcbride Date: 2019-06-26 Time:12:45:32 PM | Printed By: PMcBride Date: 2019-07-15 Time:11:20:29 AM
Path: \\texarkana.golder.gds\data\Projects - Round Rock\19122449 - Luminant\Martin Lake\ | File Name: FIG 3 - POT Surface Map-Ash Pond Area (May 2019).dwg

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

0 1 in

EXPLANATION

🟥	CCR Monitoring Well Location
🟦	Non-CCR Monitoring Well Used to Further Evaluate Groundwater Flow Direction
(374.34)	Groundwater Potentiometric Surface (ft. MSL)
— 360 —	Groundwater Potentiometric Surface Contour (C.I. = 5 ft.)

N

Scale in Feet

0 275 550

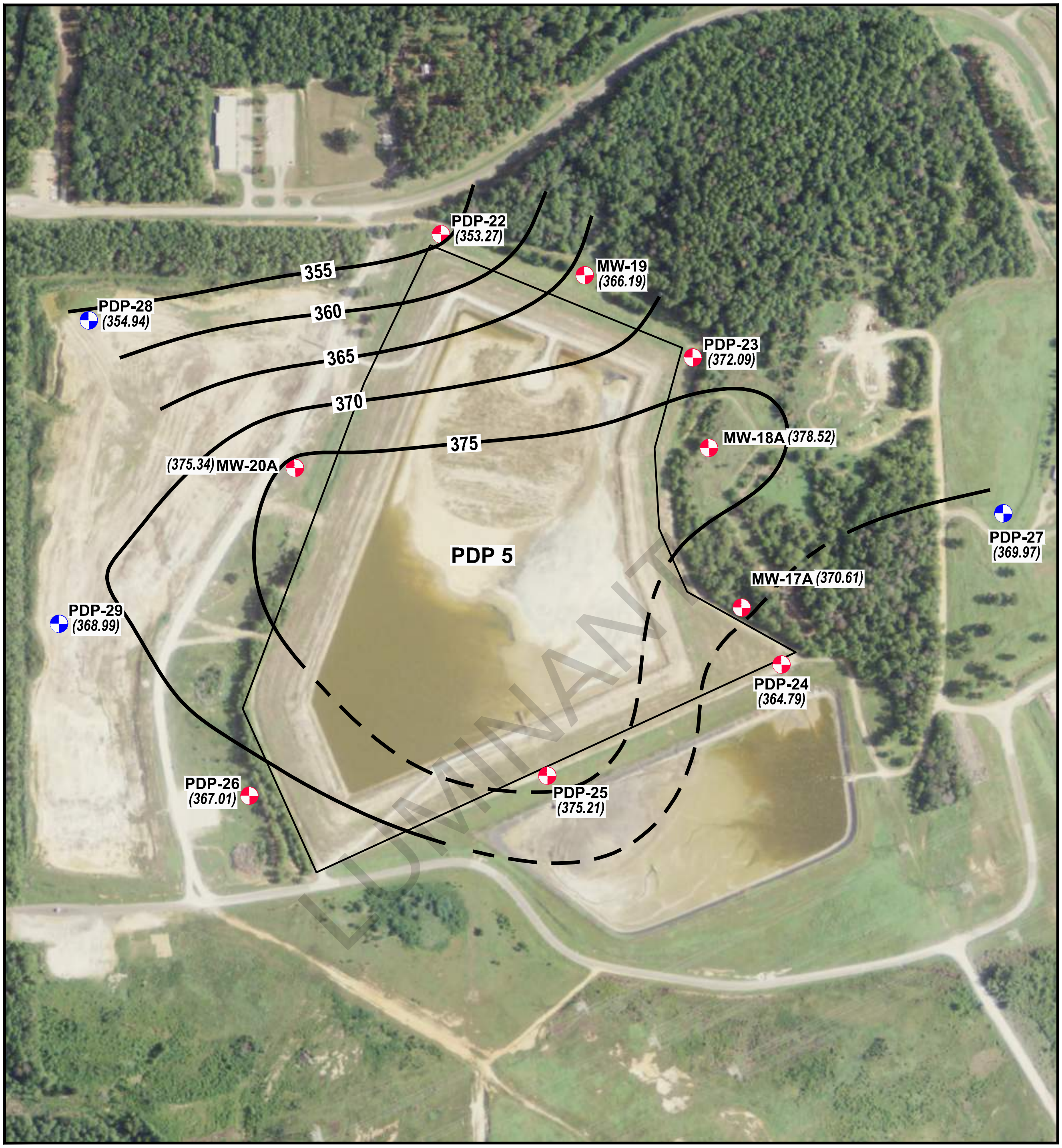
SOURCE:
Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

PDP 5 - GROUNDWATER ZONE A POTENTIOMETRIC SURFACE MAP OCTOBER 20, 2015

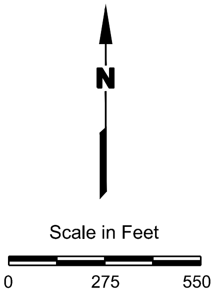
PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

- ● CCR Monitoring Well Location
- ● Non-CCR Monitoring Well Used to Further Evaluate Groundwater Flow Direction
- *(374.34)* Groundwater Potentiometric Surface (ft. MSL)
- — 360 — Groundwater Potentiometric Surface Contour (C.I. = 5 ft.)



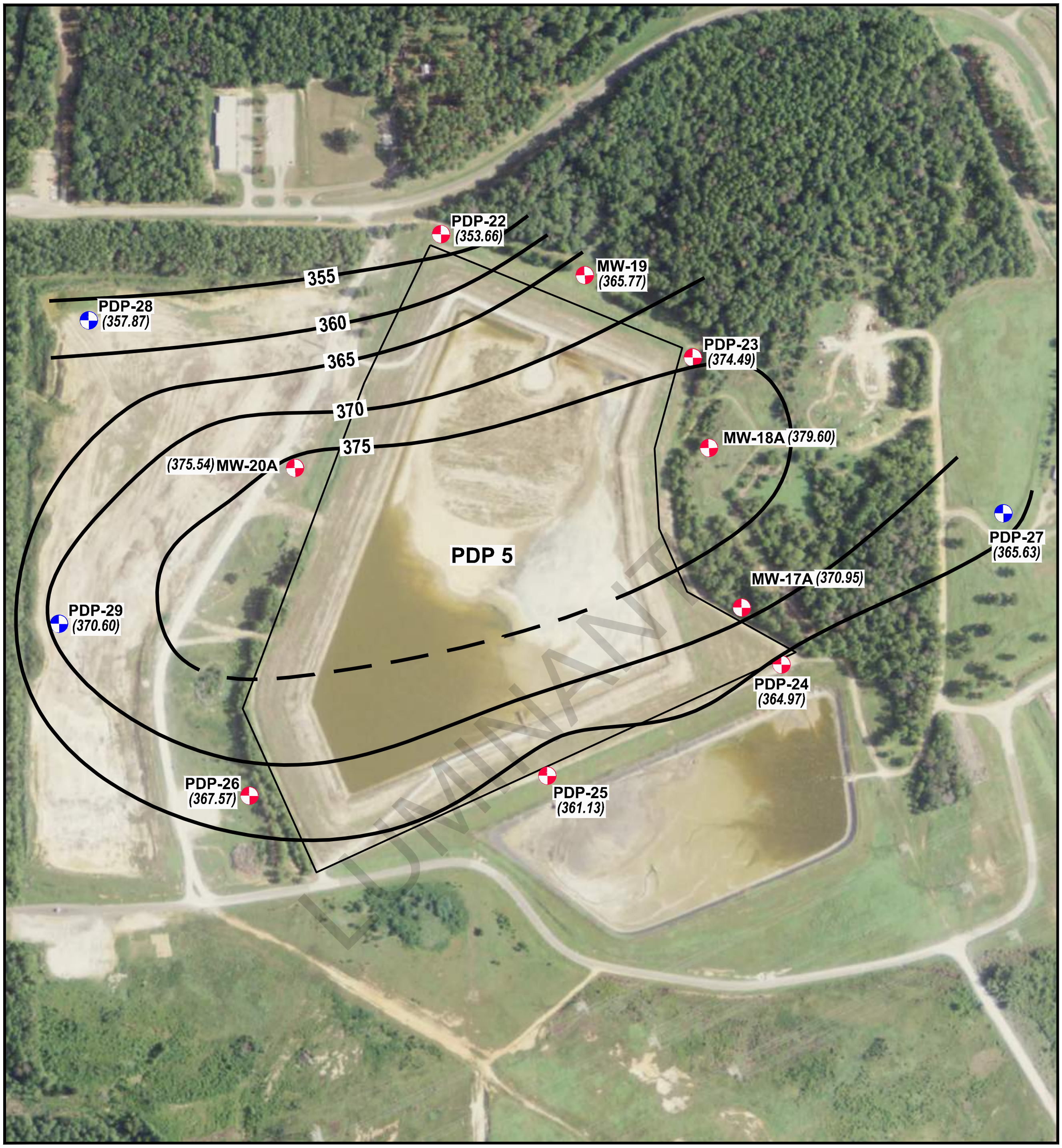
SOURCE:
Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

PDP 5 - GROUNDWATER ZONE A POTENTIOMETRIC SURFACE MAP - DEC. 14, 2015

PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

●	CCR Monitoring Well Location
●	Non-CCR Monitoring Well Used to Further Evaluate Groundwater Flow Direction
(374.34)	Groundwater Potentiometric Surface (ft. MSL)
— 360 —	Groundwater Potentiometric Surface Contour (C.I. = 5 ft.)

N

Scale in Feet

0 275 550

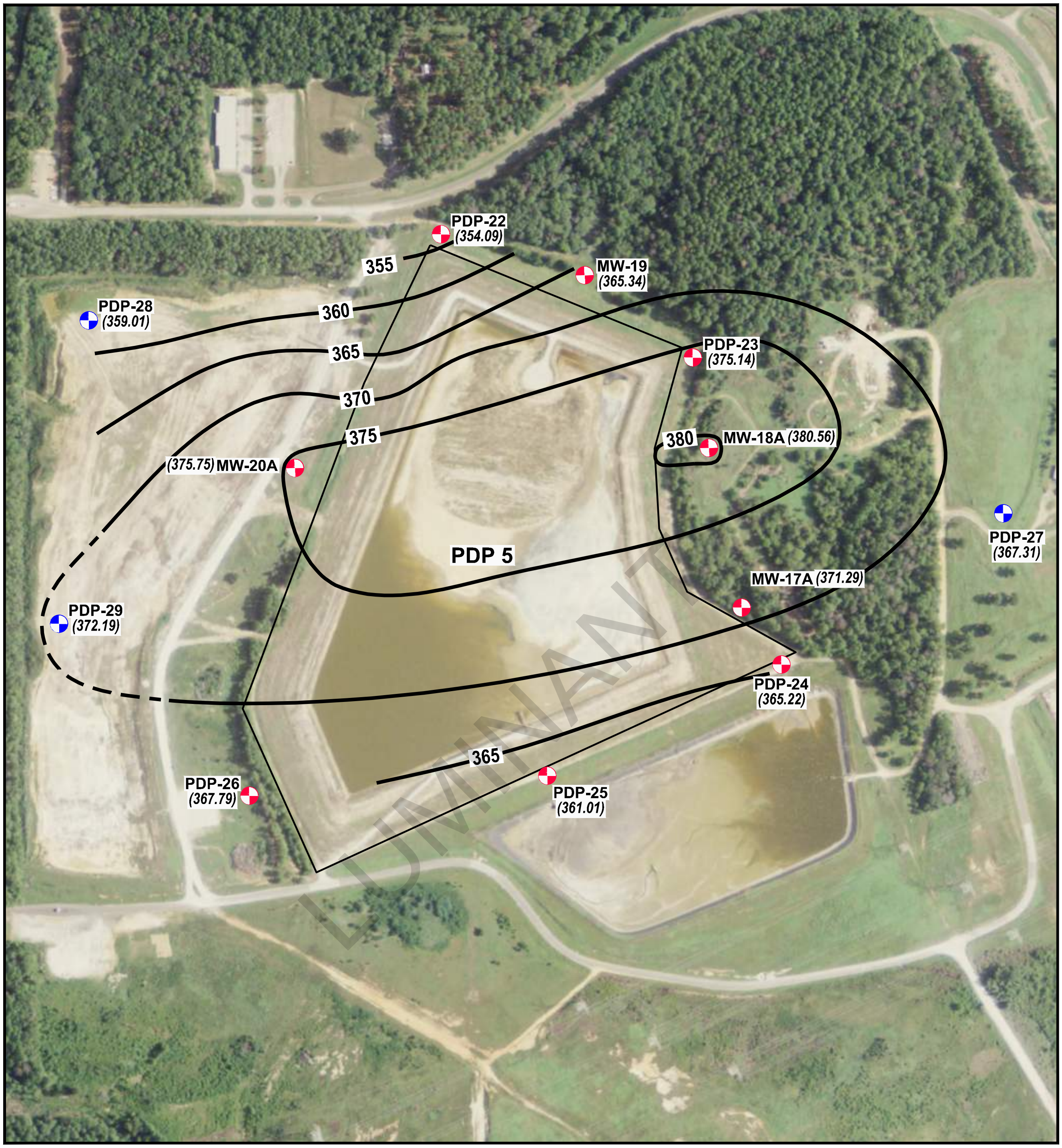
SOURCE:
Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

PDP 5 - GROUNDWATER ZONE A POTENTIOMETRIC SURFACE MAP - FEB. 24, 2016

PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



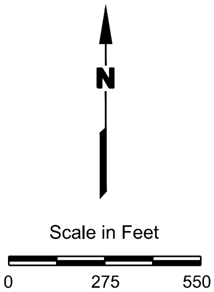
EXPLANATION

● CCR Monitoring Well Location

● Non-CCR Monitoring Well Used to Further Evaluate Groundwater Flow Direction

(374.34) Groundwater Potentiometric Surface (ft. MSL)

— 360 — Groundwater Potentiometric Surface Contour (C.I. = 5 ft.)



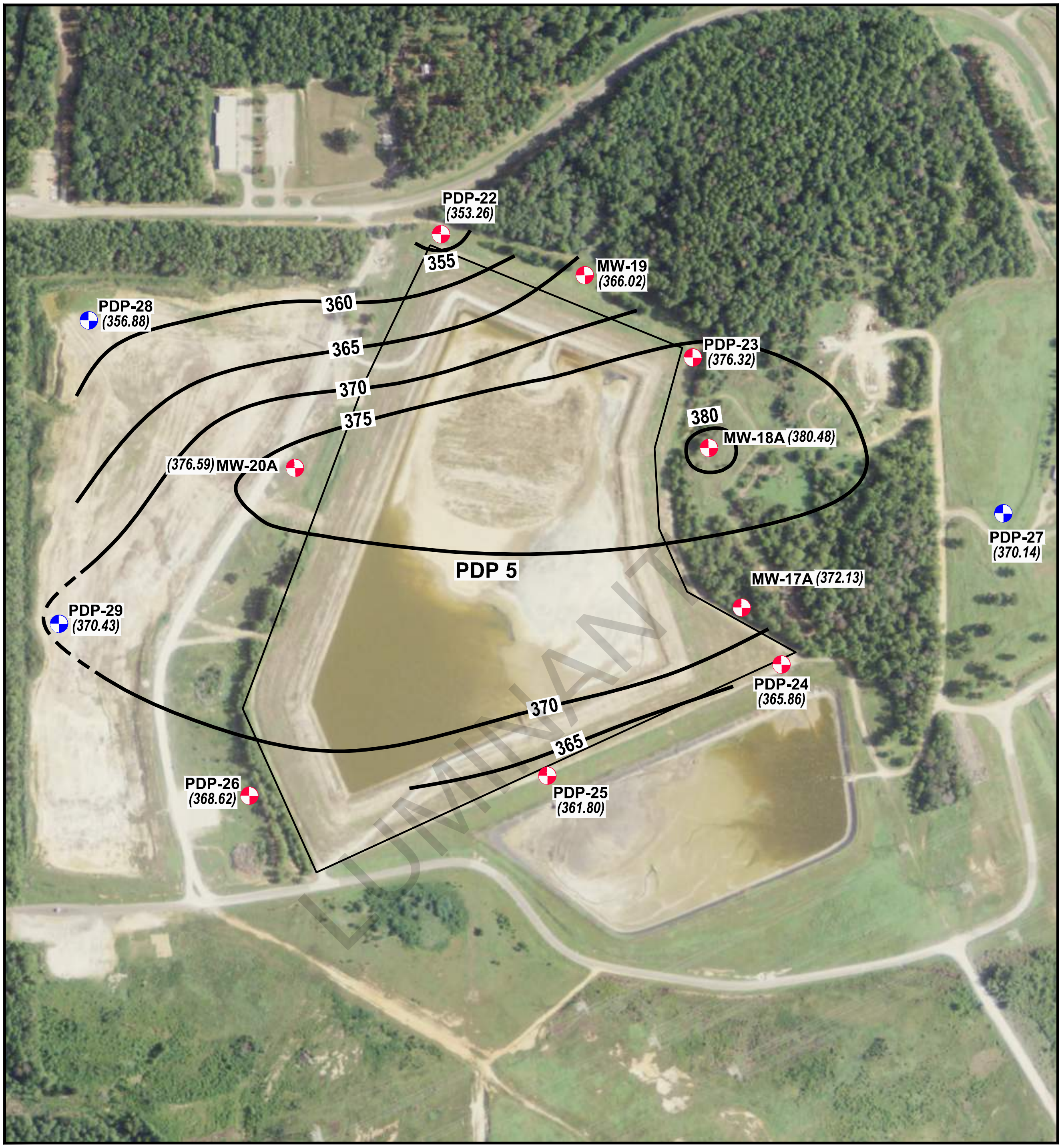
SOURCE:
Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

PDP 5 - GROUNDWATER ZONE A POTENTIOMETRIC SURFACE MAP - APRIL 5, 2016

PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

⊕	CCR Monitoring Well Location
⊕	Non-CCR Monitoring Well Used to Further Evaluate Groundwater Flow Direction
(374.34)	Groundwater Potentiometric Surface (ft. MSL)
— 360 —	Groundwater Potentiometric Surface Contour (C.I. = 5 ft.)

N

Scale in Feet

0 275 550

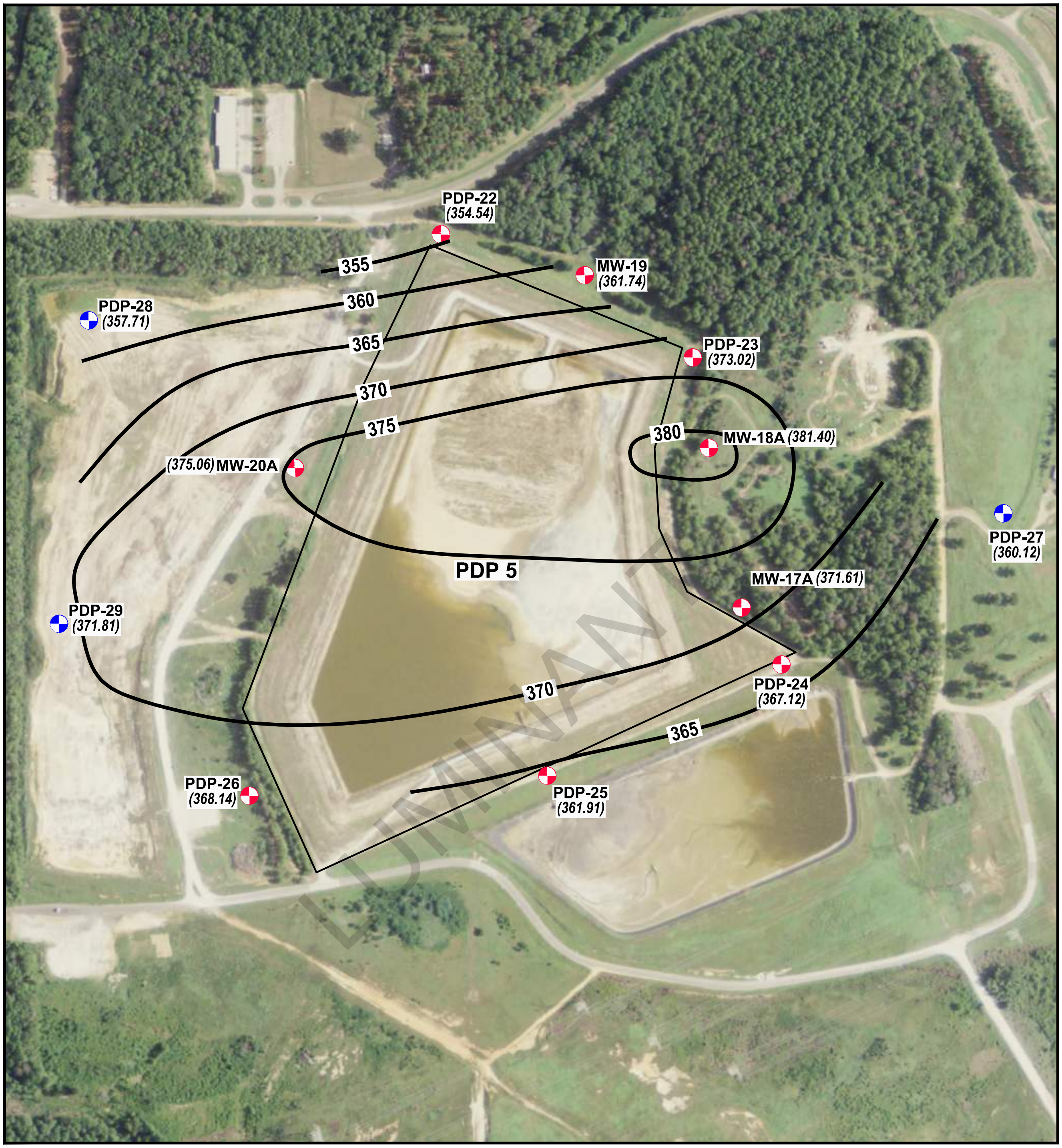
SOURCE:
Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

PDP 5 - GROUNDWATER ZONE A POTENTIOMETRIC SURFACE MAP - JUNE 6, 2016

PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



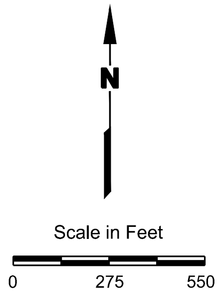
EXPLANATION

🟥 CCR Monitoring Well Location

🟦 Non-CCR Monitoring Well Used to Further Evaluate Groundwater Flow Direction

(374.34) Groundwater Potentiometric Surface (ft. MSL)

— 360 — Groundwater Potentiometric Surface Contour (C.I. = 5 ft.)



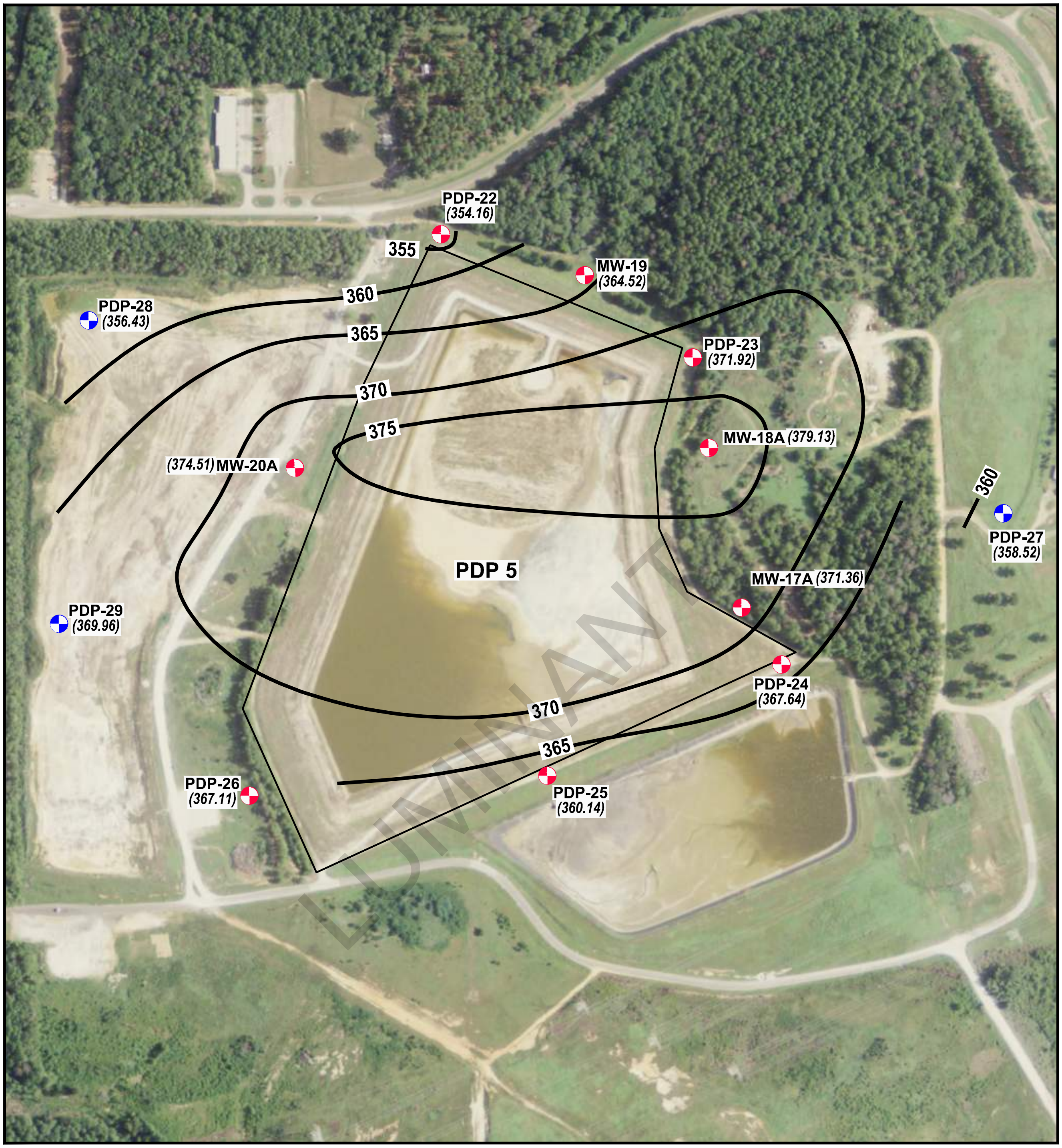
SOURCE:
Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

PDP 5 - GROUNDWATER ZONE A POTENTIOMETRIC SURFACE MAP - AUGUST 9, 2016

PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



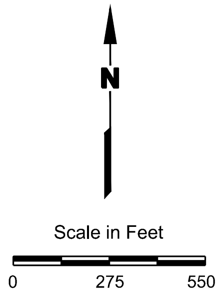
EXPLANATION

🟥 CCR Monitoring Well Location

🟦 Non-CCR Monitoring Well Used to Further Evaluate Groundwater Flow Direction

(374.34) Groundwater Potentiometric Surface (ft. MSL)

— 360 — Groundwater Potentiometric Surface Contour (C.I. = 5 ft.)



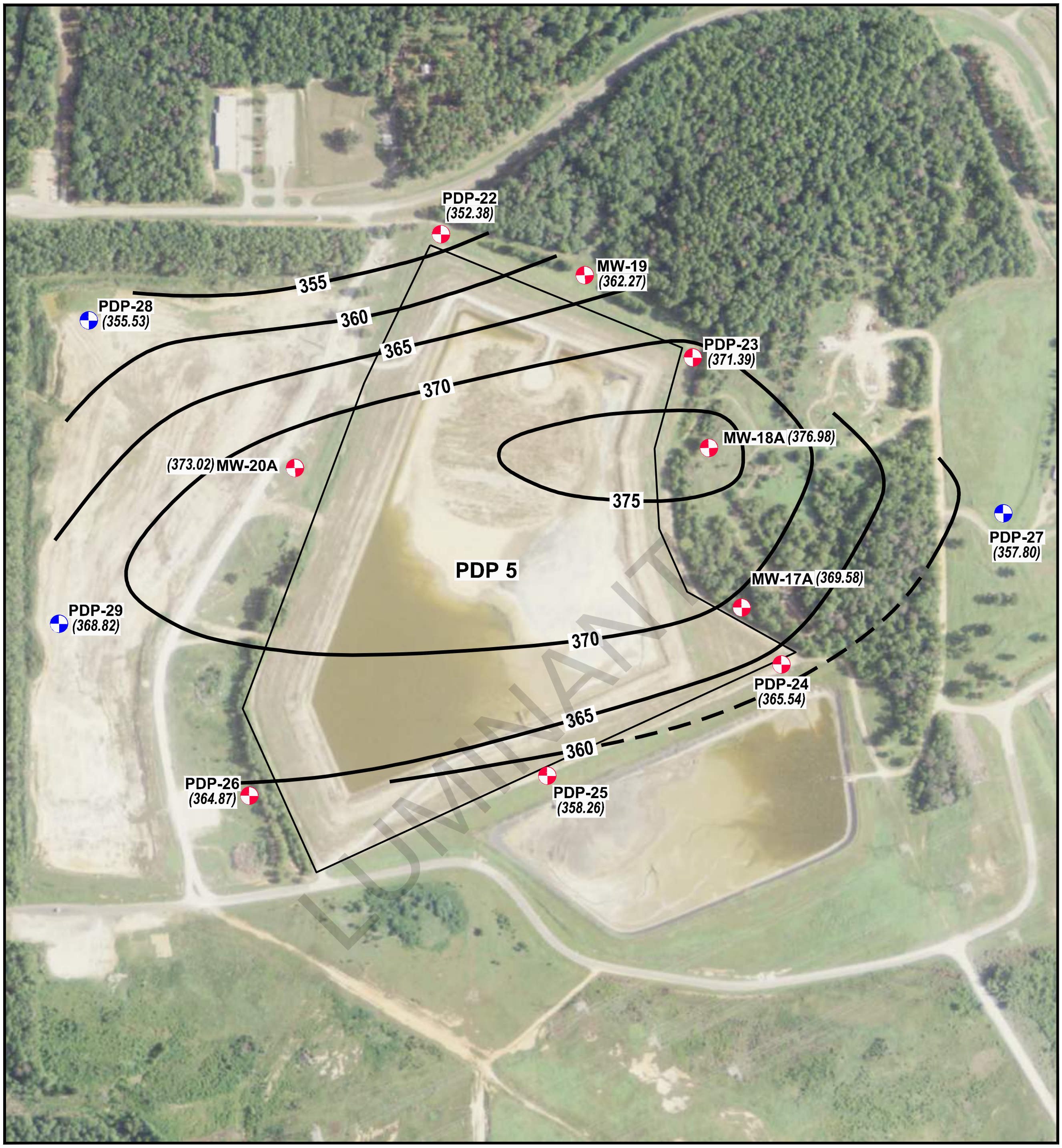
SOURCE:
Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

PDP 5 - GROUNDWATER ZONE A POTENTIOMETRIC SURFACE MAP - OCTOBER 17, 2016

PROJECT: 5164B	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



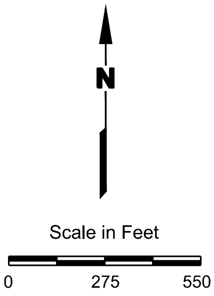
EXPLANATION

🔴 CCR Monitoring Well Location

🔵 Non-CCR Monitoring Well Used to Further Evaluate Groundwater Flow Direction

(374.34) Groundwater Potentiometric Surface (ft. MSL)

— 360 — Groundwater Potentiometric Surface Contour (C.I. = 5 ft.)



SOURCE:
Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.

MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

PDP 5 - GROUNDWATER ZONE A POTENTIOMETRIC SURFACE MAP - DECEMBER 11, 2016

PROJECT: 5164B
BY: AJD
REVISIONS
DATE: SEPT., 2017
CHECKED: PJB

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

APPENDIX F4 – TABLES SUMMARIZING CONSTITUENT CONCENTRATIONS AT EACH MONITORING WELL

TABLE 1
APPENDIX III GROUNDWATER ANALYTICAL DATA
MARTIN LAKE STEAM ELECTRIC STATION
ASH POND AREA

Sample Location	Date Sampled	B (mg/L)	Ca (mg/L)	Cl (mg/L)	Fl (mg/L)	pH (s.u.)	SO_4 (mg/L)	TDS (mg/L)
Prediction Limit		0.602	57.2	153	0.4	4.63 7.6	365	1110
Upgradient Wells								
H-26	10/21/15	0.602	24.2	69.2	<0.1	5.82	154	466
	12/14/15	0.0679	9.88	40.3	<0.1	5.91	75.8	280
	02/23/16	0.206	11.7	17.1	0.151 J	6.84	54	219
	04/05/16	0.289	11.8	27.8	0.199 J	5.89	56.8	213
	06/07/16	0.441	11.7	48.6	<0.1	5.98	72.2	278
	08/09/16	0.569	14	70	<0.1	4.63	90.9	354
	10/18/16	0.439	13.6	49.1	0.127 J	6.63	69.7	263
	12/11/16	0.537	11.9	57.6	0.161 J	6.73	68.8	236
	09/21/17	0.579	13.1	67.8	<0.100	6.88	69.6	288
	06/13/18	0.512	17	66.1	<0.100	6.74	67	313
	09/07/18	0.606	11.3	65.1	<0.100	6.85	60.7	265
	05/14/19	0.0507	85.2	61.7	0.140 J	6.83	88.2	453
	09/10/19	0.505	12	72.1	<0.1	6.75	69.4	265
	05/13/20	0.644	30.4	71	<0.100		58.4	280
H-27	10/21/15	0.58	55.3	117	<0.1	6.24	328	800
	12/14/15	0.474	57.2	112	0.156 J	6.32	317	857
	02/23/16	0.523	53.8	113	0.101 J	5.82	344	811
	04/05/16	0.48	52.7	115	0.124 J	6.04	360	819
	06/07/16	0.319	10.6	40.5	<0.1	6.32	55	207
	08/09/16	0.462	54.3	124	<0.1	4.35	365	854
	10/18/16	0.477	56.5	114	0.144 J	6.87	336	868
	12/11/16	0.427	52.8	119	0.161 J	6.78	355	805
	09/21/17	0.48	61.1	122	<0.100	6.87	378	852
	06/13/18	0.404	57	110	0.208 J	6.52	372	850
	09/07/18	0.347	6.96	58.3	0.14 J	6.72	188	716
	05/14/19	0.35	61.8	132	0.159 J	6.78	406	897
	09/10/19	0.368	57.7	117	<0.1	6.77	365	841
	05/13/20	0.583	53.1	93	<0.100		274	786
H-33	10/20/15	0.0462	17.9	60.5	<0.1	5.78	120	415
	12/14/15	0.0596	10.7	59.6	0.136 J	5.73	110	403
	02/23/16	0.0656	11.2	56.1	0.125 J	6.92	111	625
	04/05/16	0.0659	14.9	58.3	0.14 J	6.31	113	589
	06/07/16	0.0571	20.1	67.5	<0.1	6.04	121	515
	08/09/16	0.0431	11.2	64.9	<0.1	5.13	120	442
	10/18/16	0.0539	11.1	59.2	<0.1	6.86	114	398
	12/11/16	0.0594	12.1	63.2	0.132 J	6.85	112	395
	09/21/17	0.0452	13.7	67.9	<0.100	7.02	107	412
	06/13/18	0.114	24	65.5	0.105 J	6.72	93.8	447
	09/07/18	0.112	22.4	66.2	0.135 J	6.73	96.8	489
	05/14/19	0.0592	68.6	80.4	0.166 J	6.81	104	559
	09/10/19	0.0631	44.1	86.1	<0.1	6.75	119	495
	05/13/20	0.103	24	84.3	<0.100		113	439
Downgradient Wells								
H-28	10/21/15	9.25	113	109	<0.1	5.92	1,010	1,830
	12/14/15	1.02	17.3	15.5	<0.1	6.02	113	299
	02/23/16	10.2	123	97.4	<0.1	4.45	1,070	1,910
	04/05/16	10.3	120	94.4	<0.1	5.97	1,080	1,890
	06/07/16	3.66	45.4	62.2	<0.1	6.16	465	817
	08/09/16	9.29	116	98.4	<0.1	3.83	1,080	2,100
	10/18/16	4.96	67.3	91.4	0.165 J	6.82	643	1,460
	12/11/16	3.94	45.7	56.7	0.114 J	6.64	445	766
	09/21/17	6.06	74.1	88.5	<0.100	6.77	702	1,220
	06/13/18	6.97	92.1	96.5	0.126 J	6.59	826	1,490

TABLE 1
APPENDIX III GROUNDWATER ANALYTICAL DATA
MARTIN LAKE STEAM ELECTRIC STATION
ASH POND AREA

Sample Location	Date Sampled	B (mg/L)	Ca (mg/L)	Cl (mg/L)	Fl (mg/L)	pH (s.u.)	SO_4 (mg/L)	TDS (mg/L)
Prediction Limit		0.602	57.2	153	0.4	4.63 7.6	365	1110
	09/07/18	4.54	60.5	93.4	<0.100	6.84	679	1,330
	05/14/19	8.51	99.7	98.9	<0.100	6.32	935	1,680
	09/10/19	5.69	68.9	95.9	<0.100	6.89	716	1,390
	05/13/20	7.03	88.9	86.7	<0.100		676	1,220
H-29	10/21/15	0.0788	16	65.2	<0.1	5.78	171	441
	12/14/15	0.29	165	8.68	0.56	5.92	178	990
	02/23/16	0.268	59.4	14.6	0.239 J	11.20	156	334
	04/05/16	0.361	80.8	14.2	0.363 J	6.04	181	489
	06/07/16	0.311	29.8	19.3	0.27 J	6.13	166	308
	08/09/16	0.172	64.6	53.1	<0.1	5.97	124	575
	10/18/16	0.953	150	4.33	1.15	6.63	346	607
	12/11/16	1.02	130	4.65	1.4	6.59	365	651
	09/21/17	1.4	147	42	0.304	6.78	170	782
	06/13/18	5.89	81.1	84.1	0.123 J	6.75	713	1,240
	09/07/18	3.21	46.7	78.6	<0.100	6.77	544	1,030
	05/14/19	8.12	95.9	81.8	0.104 J	6.52	780	1,400
	09/10/19	8.05	97.1	90.5	<0.1	6.62	930	1,600
	05/13/20	6.98	84.9	70.7	<0.100		769	1,340
H-31	10/20/15	17.2	194	179	0.889	6.57	1,930	3,270
	12/14/15	20.4	236	147	0.692	6.60	1,740	2,250
	02/23/16	22.3	252	199	0.921	5.33	2,510	4,180
	04/05/16	21.1	250	186	1.36	6.46	2,450	3,920
	06/07/16	22.2	244	241	0.783	6.42	2,720	4,570
	08/09/16	24.1	251	217	0.216 J	4.38	2,730	4,440
	10/18/16	20	236	187	0.298 J	6.82	1,960	3,690
	12/11/16	22.3	246	201	0.892	6.82	2,640	4,170
	09/21/17	23.8	260	227	0.308 J	6.87	2,870	4,570
	06/12/18	16.6	246	205	0.646	6.61	2,390	4,100
	09/07/18	0.838	12.2	17.7	<0.275	6.77	136	457
	05/14/19	20	234	225	0.96	6.42	2,470	4,230
	09/10/18	19.7	234	232	2.1	6.78	2,640	4,220
	05/13/20	22.9	235	223	0.231 J		2,340	4,150
H-32	10/20/15	1.22	42.2	120	0.374 J	6.18	309	797
	12/14/15	1.39	37.4	122	0.619	6.29	325	860
	02/23/16	1.48	45.3	123	0.701	4.82	323	842
	04/05/16	1.65	44.3	125	1.05	6.17	337	831
	06/07/16	1.82	45.6	137	0.858	6.05	350	829
	08/09/16	1.69	45.4	132	0.68	3.64	342	839
	10/18/16	1.72	50.5	121	0.904	6.75	319	888
	12/11/16	2.5 J	44.3	120	1.00	6.83	341	759
	09/21/17	2.07 J	52.8	129	0.519	6.82	337	807
	06/12/18	1.82 J	52.6	126	1.02	6.75	339	793
	09/07/18	0.292 J	10.9	17.8	0.551	6.79	53.8	283
	05/14/19	2.08	45.2	135	1.15	6.02	320	910
	09/10/19	1.87	45.9	127	0.923	6.68	365	810
	05/13/20	2.15	43.3	124	0.641		343	791

Notes:
1. Abbreviations: mg/L - milligrams per liter; TDS - total dissolved solids; s.u. - standard units.
2. J - concentration is below method quantitation limit; result is an estimate.

TABLE 2
APPENDIX IV GROUNDWATER ANALYTICAL DATA
MARTIN LAKE STEAM ELECTRIC STATION
ASH POND AREA

Sample Location	Date Sampled	Sb (mg/L)	As (mg/L)	Ba (mg/L)	Be (mg/L)	Cd (mg/L)	Cr (mg/L)	Co (mg/L)	F (mg/L)	Pb (mg/L)	Li (mg/L)	Hg (mg/L)	Mo (mg/L)	Se (mg/L)	Tl (mg/L)	Ra 226 (pCi/L)	Ra 228 (pCi/L)	Ra 226/228 Comb.^ (pCi/L)
GWPS:		0.006	0.01	2	0.004	0.005	0.1	0.0564	4	0.015	0.177	0.002	0.1	0.05	0.002	--	--	5
Upgradient Wells																		
H-26	10/21/15	<0.0008	0.0036 J	0.0785	0.000349 J	<0.0003	<0.002	0.0385	<0.1	<0.0003	0.0139	<0.00008	<0.002	<0.002	<0.0005	0.919	<1.64	2.56
	12/14/15	<0.0008	<0.002	0.0401	0.000458 J	<0.0003	<0.002	0.0244	<0.1	<0.0003	0.0769	<0.00008	<0.002	<0.002	<0.0005	0.619	<1.95	2.57
	02/23/16	<0.0008	<0.002	0.0423	<0.0003	<0.0003	0.0077	0.00813	0.151 J	0.000315 J	0.0124	<0.00008	0.00248 J	0.0022 J	<0.0005	0.37	<2.06	2.43
	04/05/16	<0.0008	<0.002	0.0408	<0.0003	<0.0003	0.00798	0.0125	0.199 J	<0.0003	0.0121	<0.00008	<0.002	<0.002	<0.0005	<0.243	<1.06	<1.303
	06/07/16	<0.0008	<0.002	0.0467	0.000721 J	<0.0003	<0.002	0.0217	<0.1	<0.0003	0.0132	<0.00008	<0.002	<0.002	<0.0005	0.245	1.67	1.92
	08/09/16	<0.0008	0.0029 J	0.0431	0.00136	<0.0003	<0.002	0.0352	<0.1	<0.0003	0.0155	<0.00008	<0.002	<0.002	<0.0005	<0.2	<0.932	<1.132
	10/18/16	<0.0008	<0.002	0.0497	0.000709 J	<0.0003	<0.002	0.0214	0.127 J	<0.0003	0.0136	<0.00008	<0.002	0.0027 J	<0.0005	0.243	<0.622	0.87
	12/11/16	<0.0008	<0.002	0.0468	0.00146	<0.0003	0.0031 J	0.0275	0.161 J	0.000358 J	0.014	<0.00008	<0.002	<0.002	<0.0005	0.248	1.82	2.07
	06/13/18	<0.0008	<0.002	0.0659	0.0016	<0.0003	0.00213 J	0.0261	<0.100	<0.0003	0.032	<0.00008	<0.002	<0.002	<0.0005	<0.297	3.72	4.017
	09/07/18	NA	<0.002	0.0470	0.00155	<0.0003	0.00319 J	0.0247	<0.100	<0.0003	0.0489	NA	NA	<0.002	NA	<0.473	<0.665	<1.138
	05/14/19	<0.0008	0.0041 J	0.1900	0.00147	<0.0003	0.0406	0.0795	0.140 J	0.000972 J	0.147	<0.00008	<0.002	0.0022 J	<0.0005	1.43	0.598	2.028
	9/10/2019	NA	<0.002	0.046	0.00165	<0.0003	<0.002	0.0237	<0.1	0.000313 J	0.0141	NA	NA	0.0109	NA	0.115	2.74	2.85
	5/13/2020	<0.0008	<0.002	0.129	0.00166	<0.0003	0.00314 J	0.0241	<0.100	0.000798	0.0218 J	<0.00008	<0.002	0.0147	<0.0005	0.295	0.585	0.88
H-27	10/21/15	<0.0008	<0.002	0.0378	<0.0003	<0.0003	<0.002	0.0043 J	<0.1	<0.0003	0.0607	<0.00008	<0.002	<0.002	<0.0005	<0.553	<1.67	<2.223
	12/14/15	<0.0008	0.0021 J	0.039	<0.0003	<0.0003	<0.002	0.00326 J	0.156 J	0.000339 J	0.0624	<0.00008	<0.002	<0.002	<0.0005	0.468	<1.68	2.15
	02/23/16	<0.0008	<0.002	0.0266	<0.0003	<0.0003	<0.002	<0.003	0.101 J	<0.0003	0.0601	<0.00008	<0.002	<0.002	<0.0005	0.921	<1.62	2.54
	04/05/16	<0.0008	<0.002	0.0245	<0.0003	<0.0003	<0.002	<0.003	0.124 J	<0.0003	0.0573	<0.00008	<0.002	<0.002	<0.0005	0.269	<2.05	2.32
	06/07/16	<0.0008	<0.002	0.0342	0.000609 J	<0.0003	<0.002	0.016	<0.1	<0.0003	0.0107	<0.00008	<0.002	<0.002	<0.0005	0.269	<0.658	0.927
	08/09/16	<0.0008	<0.002	0.0241	<0.0003	<0.0003	<0.002	<0.003	<0.1	<0.0003	0.0616	<0.00008	<0.002	<0.002	<0.0005	0.408	<0.632	1.04
	10/18/16	<0.0008	<0.002	0.0248	<0.0003	<0.0003	<0.002	<0.003	0.144J	<0.0003	0.0576	<0.00008	<0.002	<0.002	<0.0005	<0.178	1.07	1.25
	12/11/16	<0.0008	<0.002	0.0236	<0.0003	<0.0003	<0.002	<0.003	0.161 J	<0.0003	0.0606	<0.00008	<0.002	<0.002	<0.0005	0.143	1.54	1.68
	06/13/18	<0.0008	<0.002	0.0237	<0.0003	<0.0003	0.00964	<0.003	0.208 J	<0.0003	0.108	<0.00008	<0.002	<0.002	<0.0005	0.267	<1.4	1.667
	09/07/18	NA	<0.002	0.0196	<0.0003	<0.0003	0.0453	<0.003	0.140 J	<0.0003	0.306	NA	NA	0.00773	NA	<0.285	1.43	1.715
	05/14/19	<0.0008	<0.002	0.0208	<0.0003	<0.0003	<0.002	<0.003	0.159 J	<0.0003	0.0678	<0.00008	<0.002	<0.002	<0.0005	1.10	0.928	2.028
	9/10/2019	NA	<0.002	0.384	<0.0003	<0.0003	0.00668	<0.003	<0.1	<0.0003	0.103	NA	NA	0.0027 J	NA	0.185	3.57	3.76
	5/13/2020	<0.0008	<0.002	0.0668	<0.0003	<0.0003	0.0133	<0.003	<0.100	<0.0003	0.170	<0.00008	<0.002	0.00671	<0.0005	0.166	-0.0371	0.166
H-33	10/20/15	<0.0008	0.0021 J	0.0586	0.000351 J	<0.0003	<0.002	0.0274	<0.1	<0.0003	0.0814	<0.00008	<0.002	<0.002	<0.0005	1.76	1.64	3.40
	12/14/15	<0.0008	0.00205 J	0.0473	0.000382 J	<0.0003	<0.002	0.0293	0.136 J	<0.0003	0.0903	<0.00008	<0.002	<0.002	<0.0005	1.94	<1.79	3.73
	02/23/16	<0.0008	<0.002	0.0529	0.000311 J	<0.0003	0.0194	0.0163	0.125 J	<0.0003	0.182	<0.00008	<0.002	<0.002	<0.0005	0.906	<2.32	3.23
	04/05/16	<0.0008	<0.002	0.0576	0.000302 J	<0.0003	0.0171	0.016	0.14 J	<0.0003	0.16	<0.00008	<0.002	<0.002	<0.0005	0.328	1.08	1.41
	06/07/16	<0.0008	<0.002	0.0774	0.000604 J	<0.0003	0.0153	0.0196	<0.1	<0.0003	0.163	<0.00008	<0.002	<0.002	<0.0005	0.276	0.897	1.17
	08/09/16	<0.0008	<0.002	0.0424	0.000519 J	<0.0003	0.0029 J	0.0284	<0.1	<0.0003	0.102	<0.00008	<0.002	<0.002	<0.0005	<0.149	0.649	0.80
	10/18/16	<0.0008	0.0035 J	0.0464	0.000617 J	<0.0003	0.0309	0.0644	<0.1	0.000329 J	0.118	<0.00008	<0.002	<0.002	<0.0005	0.096	<0.517	0.61
	12/11/16	<0.0008	0.0022 J	0.0537	0.000865 J	<0.0003	0.0368	0.0408	0.132 J	0.000495 J	0.115	<0.00008	<0.002	<0.002	<0.0005	0.159	1.29	1.45
	06/13/18	<0.0008	0.00283 J	0.0741	0.0004 J	<0.0003	0.0182	0.0266	0.105 J	0.0009 J	0.183	<0.00008	<0.002	<0.002	<0.0005	0.795	<0.712	1.507
	09/07/18	NA	0.00239 J	0.0757	0.0003 J	<0.0003	0.0105	0.0288	0.135 J	<0.0003	0.160	NA	NA	<0.002	NA	0.334	<0.645	0.979
	05/14/19	<0.0008	0.00355 J	0.158	0.00114	<0.0003	0.0342	0.0648	0.166 J	0.000772 J	0.161	<0.00008	<0.002	<0.002	<0.0005	0.850	1.35	2.200
	9/10/2019	NA	<0.002	0.111	0.000518 J	<0.0003	0.00637	0.0347	0.01	<0.0003	0.142	NA	NA	<0.002	NA	0.6	2.97	3.57
	5/13/2020	<0.0008	<0.002	0.0784	0.00053 J	<0.0003	0.00755	0.0312	<0.100	0.00191	0.173	<0.00008	<0.002	0.00243 J	<0.0005	0.395	1.9	2.29
Downgradient Wells																		
H-28	10/21/15	<0.0008	0.0028 J	0.0396	0.00148	0.00121	<0.002	0.188	<0.1	0.000491 J	0.154	<0.00008	<0.002	0.00682	<0.0005	<0.558	<1.65	<2.208
	12/14/15	<0.0008	<0.002	0.0224	<0.0003	0.000572 J	<0.002	0.0225	<0.1	<0.0003	0.021	<0.00008	<0.002	<0.002	<0.0005	0.707	<1.18	1.89
	02/23/16	<0.0008	0.00225 J	0.0202	0.00133	0.00151	<0.002	0.201	<0.1	0.00053 J	0.159	<0.00008	<0.002	0.00222 J	<0.0005	<0.396	2.24	2.64
	04/05/16	<0.0008	<0.002	0.0173	0.0011	0.00252	<0.002	0.199	<0.1	0.00087 J	0.15	<0.00008	<0.002	0.00237 J	<0.0005	<0.231	1.76	1.99
	06/07/16	<0.0008	<0.002	0.0468	0.000934 J	0.000664 J	<0.002	0.0944	<0.1	<0.0003	0.0959	<0.00008	<0.002	<0.002	<0.0005	0.310	1.48	1.79
	08/09/16	<0.0008	<0.002	0.0155	0.00275	0.0016	<0.002	0.195	<0.1	0.000774 J	0.155	<0.00008	<0.002	0.0029 J	<0.0005	<0.451	1.41	1.86
	10/18/16	<0.0008	0.00284J	0.0174	0.00685	0.000744 J	<0.002	0.169	0.165J	0.00108	0.155	<0.00008	<0.002	0.0027 J	<0.0005	<0.228	0.645	0.87
	12/11/16	<0.0008	<0.002	0.0471	0.000698 J	0.000668 J	<0.002	0.0924	0.114 J	<0.0003	0.0869	<0.00008	<0.002	<0.002	<0.0005	<0.149	1.13	1.28
	06/13/18	<0.0008	<0.002	0.0186	0.00393	0.0038	<0.002	0.169	0.126 J	0.000448 J	0.18	<0.00008	<0.002	<0.002	<0.0005	0.327	<1.56	1.887
	09/07/18	NA	<0.002	0.0192	0.00704	0.00115	<0.002	0.162	<0.100	0.00118 J	0.203	NA	NA	0.00281 J	NA	<0.243	0.845	1.088
	05/14/19	<0.0008	<0.002	0.0141	0.00281	0.00212	<0.002	0.187	<0.100	0.000595 J	0.172	<0.00008	<0.002	0.00619	<0.0005	0.444	0.615	1.059
	9/10/2019	NA	<0.002	0.145	0.0058	0.000951	<0.002	0.146	<0.1	0.00132	0.169	NA	NA	0.00461	NA	0.205	4.26	4.47
	5/13/2020	<0.0008	<0.002	0.0149	0.00252	0.00126	<0.002	0.159	<0.100	0.00751 J	0.171	<0.00008	<0.002	0.0032 J	<0.0005	0.151	0.984	1.13
H-29	10/21/15	<0.0008	<0.002	0.159	0.000359 J	<0.0003	<0.002	0.0301	<0.1	<0.0003	0.0156	<0.00008	<0.002	<0.002	<0.0005	0.464	1.82	2.28
	12/14/15	<0.0008	<0.002	0.277	<0.0003	<0.0003	0.062	<0.003	0.56	0.000542 J	0.0202	<0.00008	0.00819	0.0282	<0.0005	<0.53	<1.25	<1.78
	02/23/16	<0.0008	0.00203 J	0.151	<0.0003	<0.0003	0.019	<0.003	0.239 J	<0.0003	0.0135	<0.00008	0.00603	0.0148	<0.0005	<0.374	<2.22	<2.594
	04/05/16	<0.0008	<0.002	0.167	<0.0003	<0.0003	0.042	<0.003	0.363 J	<0.0003	0.0175	<0.00008	0.00697	0.0232	<0.0005	<0.228	<0.897	<1.125
	06/07/16	<0.0008	<0.002	0.136	<0.0003	<0.0003	0.0274	<0.003	0.27 J	<0.0003	0.0188	<0.00008	0.00551	0.0152	<0.0005	0.173	<0.834	1.01
	08/09/16	<0.0008	0.00995	0.315	<0.0003	<0.0003	0.003 J	0.0047 J	<0.1	<0.0003	0.0143	<0.00008	<0.002	<0.002	<0.0005	0.261	<0.578	0.84
	10/18/16	<0.0008	<0.002	0.118	<0.0003	<0.0003	0.0041 J	<0.003	1.15	0.000427J	0.0056 J	<0.00008	0.0031 J	0.0681	<0.0005	0.155	<0.439	0.59
	12/11/16	<0.0008	<0.002	0.0779	<0.0003	<0.0003	<0.002	<0.003	1.4	<0.0003	<0.005	<0.00008	0.0031 J	0.0642	<0.0005	<0.113	<0.599	<0.712
	06/13/18	<0.0008	<0.002	0.0157	0.00345	0.00318	<0.002	0.153	0.123 J	0.000779 J	0.153	<0.00008	<0.002	<0.002	<0.0005	<0.274	<1.62	<1.894
	09/07/18	NA	<0.002	0.0374	0.00513	0.000938	<0.002	0.119	<0.100	0.00172	0.145	NA	NA	0.00374 J	NA	<0.371	<0.71	<1.081
	5/14/2019	<0.0008	<0.002	0.0138	0.00341	0.00219	<0.002	0.183	0.104 J	0.000543 J	0.173	<0.00008	<0.002	0.00616	<0.0005	<0.339	<0.707	<1.046
	9/10/2019	NA	<0.002	0.0135	0.00233	0.00127	<0.002	0.164	<0.1	0.000916 J	0.157	NA	NA	0.004 J	NA	0.364	4.99	5.35
	5/13/2020	<0.0008	<0.002	0.0117	0.0013	0.00129	<0.002	0.142	<0.100	0.000684 J	0.134	<0.00008	<0.002	0.00281 J	<0.0005	0.246	0.545	0.791

TABLE 2
APPENDIX IV GROUNDWATER ANALYTICAL DATA
MARTIN LAKE STEAM ELECTRIC STATION
ASH POND AREA

Sample Location	Date Sampled	Sb (mg/L)	As (mg/L)	Ba (mg/L)	Be (mg/L)	Cd (mg/L)	Cr (mg/L)	Co (mg/L)	F (mg/L)	Pb (mg/L)	Li (mg/L)	Hg (mg/L)	Mo (mg/L)	Se (mg/L)	Tl (mg/L)	Ra 226 (pCi/L)	Ra 228 (pCi/L)	Ra 226/228 Comb.^ (pCi/L)
GWPS:		0.006	0.01	2	0.004	0.005	0.1	0.0564	4	0.015	0.177	0.002	0.1	0.05	0.002	--	--	5
H-31	10/20/15	<0.0008	0.0168	0.0732	0.0126	0.0032	0.00687	0.434	0.889	<0.0003	0.137	<0.00008	<0.002	0.116	<0.0005	0.943	<1.88	2.82
	12/14/15	<0.0008	0.00513	0.0388	0.00702	<0.0003	0.00456 J	0.0651	0.692	<0.0003	0.149	<0.00008	<0.002	0.0231	<0.0005	1.61	<1.29	2.90
	02/23/16	<0.0008	0.00436 J	0.0243	0.0101	<0.0003	<0.002	0.0594	0.921	<0.0003	0.146	<0.00008	<0.002	0.0209	<0.0005	<0.419	<1.64	<2.059
	04/05/16	<0.0008	0.00514	0.0241	0.00925	<0.0003	0.00435 J	0.0685	1.36	<0.0003	0.146	<0.00008	<0.002	0.0226	<0.0005	<0.334	<0.897	<1.231
	06/07/16	<0.0008	0.0038 J	0.0242	0.00789	<0.0003	<0.002	0.0406	0.783	<0.0003	0.157	<0.00008	<0.002	0.0307	<0.0005	0.257	<0.555	0.81
	08/09/16	<0.0008	0.00886	0.0191	0.00734	<0.0003	<0.002	0.286	0.216 J	<0.0003	0.17	<0.00008	<0.002	0.0202	<0.0005	1.31	0.900	2.21
	10/18/16	<0.0008	0.0035 J	0.0215	0.00167 J	<0.0003	<0.002	0.0304 J	0.298 J	<0.0003	0.165	<0.00008	<0.002	0.0057 J	<0.0005	0.169	1.18	1.35
	12/11/16	<0.0008	0.0088 J	0.0189	0.0197	<0.0003	0.0039 J	0.23 J	0.892	<0.0003	0.198	<0.00008	<0.002	0.0365	<0.0005	0.195	<0.754	0.95
	06/12/18	<0.0008	0.00532	0.0194	0.00545	<0.0003	0.003 J	0.236	0.646	<0.0003	0.214	<0.00008	<0.002	0.00475 J	<0.0005	<0.26	<0.597	<0.857
	09/07/18	NA	<0.002	0.0287	<0.0003	<0.0003	<0.002	0.00353 J	0.275 J	<0.0003	0.0187	NA	NA	0.00424 J	NA	<0.261	<0.567	<0.828
	05/14/19	<0.0008	0.00675	0.0163	0.00928	<0.0003	0.0032 J	0.389	0.96	<0.0003	0.219	<0.0004	<0.002	0.0261	<0.0005	2.62	<0.789	3.409
	9/10/2019	NA	0.00845	0.0158	0.0312	<0.0003	0.0031 J	0.41	2.1	<0.0003	0.225	NA	NA	0.0642	NA	0.247	2.92	3.17
	5/13/2020	<0.0008	0.011	0.0159	0.0331	<0.0003	0.00367 J	0.449	0.231 J	<0.0003	0.249	<0.00008	<0.002	0.0792	<0.0005	0.0808	1.7	1.78
H-32	10/20/15	<0.0008	0.0028 J	0.16	0.00266	<0.0003	<0.002	0.163	0.374 J	<0.0003	0.0788	<0.00008	<0.002	0.003 J	<0.0005	1.05	<1.90	2.95
	12/14/15	<0.0008	0.0123	0.0384	0.00313	<0.0003	<0.002	0.155	0.619	<0.0003	0.0733	<0.00008	<0.002	<0.002	<0.0005	0.712	<2.21	2.92
	02/23/16	<0.0008	0.00712	0.0277	0.00452	<0.0003	<0.002	0.188	0.701	0.000326 J	0.0821	<0.00008	<0.002	<0.002	<0.0005	1.12	1.60	2.72
	04/05/16	<0.0008	0.00648	0.0237	0.00527	0.00128	<0.002	0.208	1.05	0.00182	0.0818	<0.00008	<0.002	<0.002	<0.0005	<0.364	<1.15	<1.514
	06/07/16	<0.0008	0.0045 J	0.0238	0.00583	0.000997 J	<0.002	0.207	0.858	0.00168	0.087	<0.00008	<0.002	0.003 J	<0.0005	<0.165	0.613	0.778
	08/09/16	<0.0008	0.0034 J	0.0234	0.00548	0.000713 J	<0.002	0.19	0.68	0.00115	0.0774	<0.00008	<0.002	0.0028 J	<0.0005	2.56	<0.446	3.01
	10/18/16	<0.0008	0.0029 J	0.02	0.00567	0.00254	<0.002	0.204	0.904	0.00332	0.0834	<0.00008	<0.002	0.0027 J	<0.0005	<0.139	0.683	0.82
	12/11/16	<0.0008	0.0025 J	0.0205	0.00609	0.00108	<0.002	0.208	1	0.00137	0.0838	<0.00008	<0.002	0.0024 J	<0.0005	<0.163	<0.753	<0.916
	06/12/18	<0.0008	<0.002	0.0175	0.00681	0.000586 J	<0.002	0.215	1.02	0.000701 J	0.0957	<0.00008	<0.002	<0.002	<0.0005	<0.275	0.917	1.192
	09/07/18	NA	<0.002	0.0404	<0.0003	<0.0003	<0.002	0.00347 J	0.551	<0.0003	0.0195	NA	NA	0.0157	NA	0.343	1.25	1.593
	05/14/19	<0.0008	0.002 J	0.0162	0.00713	0.000366 J	<0.002	0.202	1.15	0.000574 J	0.0978	<0.00008	<0.002	0.00675	<0.0005	0.303	<0.546	<0.849
	9/10/2019	NA	<0.002	0.016	0.00678	0.000467 J	<0.002	0.185	0.923	0.00056 J	0.0935	NA	NA	0.0049 J	NA	0.0404	4.74	4.78
	5/13/2020	<0.0008	0.00214 J	0.0166	0.00725	0.000389 J	<0.00200	0.195	0.641	0.000743 J	0.0978	<0.00008	<0.002	0.00401 J	<0.0005	-0.0142	1.15	1.15

Notes:
1. Abbreviations: mg/L - milligrams per liter; pCi/L - picocuries per liter.
2. ^ - Sum of Ra 226 and Ra 228 concentrations. Non-detect isotope results were assigned a value equal to the minimum detectable concentration.
3. J - concentration is below method quantitation limit; result is an estimate.
4. NA = Not analyzed.

Table 3
Appendix III Groundwater Analytical Data Summary
Matin Lake Steam Electric Station
PDP 5

Sample	Date	B		Ca		Cl		Fl		field pH		SO_4		TDS	
Location	Sampled	Prediction Limit	Sample Data	Prediction Limit	Sample Data	Prediction Limit	Sample Data	Prediction Limit	Sample Data	Prediction Limit	Sample Data	Prediction Limit	Sample Data	Prediction Limit	Sample Data
MW-17A	09/22/17	0.538	0.402	6.73	3.1	10.4	8.3	0.4	<0.1	2.5 9.19	6.78	51.9	31.2	170	111
	06/14/18		0.485		6.48		9.16		<0.1		6.87		45.9		129
	09/11/18		0.523		5.06		8.82		0.179 J		5.03		43.1		137
	05/13/19		0.497		4.88		9.18		<0.1		6.79		44.7		145
	11/7/2019		0.52		5.05		8.81		<0.100		6.44		43.9		127
	5/19/2020		0.521		5.09		8.74		<0.100				46.8		140
MW-18A	09/21/17	0.20	0.0654	3.1	1.04	10.4	5.27	0.4	<0.1	4.88 7.92	6.94	9.1	3.23	157	45
	06/14/18		0.102		2		6.56		<0.1		6.92		3.48		71
	09/12/18		**0.211**		**3.23**		9.06		<0.1		5.69		4.82		150
	11/07/18		0.128		--		--		--		--		--		--
	05/13/19		0.117		1.01		6.17		0.138 J		6.64		3.23		73
	11/7/2019		0.127		11.5		6.34		<0.100		6.23		3.67		68
	5/19/2020		**0.225**		1.54		7.09		<0.100				5.97		86
MW-19	09/22/17	0.782	0.0677	237	2.74	57.7	5.36	0.512	<0.1	4.6 8.08	6.94	672	1.46 J	1,380	98
	06/14/18		0.577		133		24.4		0.216 J		6.78		328		758
	09/11/18		0.243		38		**65.1**		0.228 J		6.04		166		597
	11/07/18		--		--		5.22		--		--		--		--
	05/13/19		0.429		122		26.8		0.229 J		6.72		349		813
	11/8/2019		0.529		77.8		49.3		0.189 J		6.87		310		844
	5/19/2020		0.0724		1.49		5.84		<0.100				1.02 J		85
MW-20A	09/22/17	0.213	0.0807	25.7	17.4	12.3	12.6	0.954	0.175 J	3.06 8.76	6.71	148	74.2	381	237
	02/21/18 re-sample		--		--		10.7		--		--		--		--
	06/13/18		0.171		24		10.9		0.672		6.72		132		250
	09/11/18		0.141		7.16		11		0.235 J		4.70		39.1		154
	05/13/19		**0.239**		**37.4**		10.2		0.731		6.81		**178**		328
	11/8/2019		0.132		9.9		10.2		0.465		6.51		88		205
	5/19/2020		0.22		24		10.4		0.413				133		270
PDP-22	09/22/17	0.411	0.221	306	92.5	32.7	12.3	1.07	0.321 J	4.08 8.63	6.98	216	178	1,780	558
	06/14/18		0.115		7.78		11.8		0.239		6.63		186		491
	09/12/18		0.164		61.1		10.9		0.216 J		5.88		143		476
	05/13/19		0.158		98.2		10.1		0.303 J		6.86		184		615
	11/12/2019		0.226		34.3		12.6		0.218 J		6.93		215		482
	5/19/2020		0.0646		54.9		1.06		<0.100				5.21		205
PDP-23	09/22/17	0.0678	0.0463	2	2.34	7.52	4.48	0.4	0.147 J	3.38 8.45	6.77	3.27	1.47 J	143	111
	02/21/18 re-sample		--		2.37		--		--		--		--		--
	06/13/18		0.0357		2.29		6.21		<0.1		6.82		1.26 J		98
	09/11/18		**0.0760**		1.96		6.38		<0.1		5.32		1.52 J		98
	11/07/18		**0.0683**		--		--		--		--		--		--
	05/13/19		0.0628		1.89		6.98		<0.1		6.68		1.28 J		103
	11/12/2019		0.0675		**2.14**		4.98		<0.100		6.72		1.41 J		93
	5/19/2020		0.0709		**2.03**		6.86		<0.100				1.19 J		104
PDP-24	09/22/17	4.92	3.01	45.9	25.8	22.6	17.5	1.03	0.898	1.33 9.97	6.95	533	231	894	440
	06/14/18		2.71		23.9		21.1		0.629		6.82		284		481
	09/11/18		4.08		41.6		19.4		0.832		4.20		460		760
	05/13/19		3.23		23		21		0.871		6.95		300		537
	11/12/2019		3		21.9		20.6		0.751		6.87		295		520
	11/12/2019		2.97		22.2		20.5		0.744		6.87		300		504
	5/19/2020		3.17		21.4		21		0.61				286		512
PDP-25	09/22/17	0.136	0.133	41.3	36.8	197	130	0.4	0.157 J	4.65 7.93	6.81	118	89.1	705	481
	06/14/18		0.119		40.4		111		<0.1		6.78		73.4		439
	09/11/18		**0.167**		36.2		135		0.115 J		5.87		90.3		469
	11/07/18		**0.142**		--		--		--		--		--		--
	05/13/19		**0.144**		**44.4**		108		0.121 J		6.84		69		469
	11/12/2019		**0.184**		38.6		117		<0.100		6.82		71.4		454
	5/19/2020		**0.202**		**53.7**		105		<0.100				62.2		442
PDP-26	09/22/17	0.111	0.0343	4.74	2.32	14.6	5.24	0.577	0.157 J	5.35 7.57	6.84	64.6	5.88	438	107
	06/14/18		0.0225 J		2.93		4.8		<0.1		6.89		4.27		100
	09/12/18		0.0371		2.37		4.88		<0.1		6.07		2.66 J		107
	05/13/19		0.0528		1.9		4.59		0.217 J		6.86		2.7 J		106
	11/12/2019		0.0622		2.25		4.64		0.122 J		6.77		2.1 J		102
	5/19/2020		0.0538		2.09		4.52		<0.100				2.1 J		108

Notes:

1. All concentrations in mg/L. pH in standard units.
2. J - concentration is below sample quantitation limit; result is an estimate.
3. Highlighted sample results exceed the prediction limit.

APPENDIX F5 – SITE HYDROGEOLOGY AND STRATIGRAPHIC CROSS-SECTIONS OF THE SITE

CONCEPTUAL SITE MODEL AND DESCRIPTION OF SITE HYDROGEOLOGY (ASH POND AREA)

The Martin Lake Steam Electric Station (Martin Lake) conceptual site model (CSM) and Description of Site Hydrogeology for the Ash Pond Area (APA), which includes the East Bottom Ash Pond (EAP), West Bottom Ash Pond (WAP), and New Scrubber Pond (NSP) located near Tatum, Texas are described in the following sections.

REGIONAL SETTING

The APA is located in the Martin Creek area on the west flank of the Sabine Uplift within the Sabine River Valley (Golder, 2016). Formations in the Martin Creek area mainly include continental and marine sedimentary deposits of Eocene-aged Wilcox Group (Barnes, 1965; Golder, 2016), which are overlain by sands of the Carrizo Formation at higher elevations (not present at the APA) (Golder, 2019). The Wilcox formation is approximately 650 to 700 feet thick in the Martin Creek area, and includes sandy clays, silty sands, clays, and variable amounts of lignite (Golder, 2016). The Wilcox Group was described as mostly unconsolidated to moderately consolidated clay and silt with variable degrees of interbedded sand and lignite in the area of the Site (Golder, 2019), and derived from a depositional environment associated with fluvial-deltaic processes, which may include inter-channel crevasses splays, overbank deposits, and localized channel fills (Golder, 2019). In the Martin Creek area, the Wilcox Group is underlain by the approximately 900-foot thick silty clay and clay deposits of the Paleocene Midway Group, which overlies approximately 7000 feet of Cretaceous rock (Golder, 2016).

Potable water supply wells are completed in Wilcox Group sands of the Martin Creek area, including two Martin Lake locations upgradient of the APA (screened at depths of at least 300 feet below ground surface) (Golder, 2019). In addition, to these Martin Lake potable water supply wells, other groundwater wells completed in the Wilcox Group sands include well used for domestic, oil and gas, or stock watering purposes (Golder, 2019).

Groundwater occurring within the upper 100 feet below ground surface in the Martin Creek area is typically under unconfined or semi-confined conditions, where the potentiometric surface of these shallow flow systems typically mirror that of the topographic surface (Golder, 2019). Groundwater flow is generally from the potentiometric highs that mimic the topographic highs (coincident with groundwater recharge areas, groundwater divides and surface water divides) toward potentiometric lows and valleys (coincident with groundwater discharge zones) (Golder, 2019).

SITE GEOLOGY

The APA is located in the outcrop area of the Wilcox Group described above (PBW, 2017). Surficial soils in the vicinity of the APA include the following (described in order from shallow to deep) based on soil borings (Golder, 2019):

- Upper Zone - low to medium plasticity lean clay to clayey sand, occurring at thicknesses ranging from approximately 30 to 40 feet.
- Intermediate Zone (Uppermost Aquifer) - poorly-graded fine sand and silty sand, occurring at thicknesses ranging from approximately 5 to 20 feet.
- Lower Confining Unit - laterally-continuous silty to sandy clay.

Cross-sections showing the subsurface materials encountered at the APA are included as an attachment to this demonstration. Drilling logs used to develop the cross-sections are also included as an attachment to this demonstration.

SITE HYDROGEOLOGY

Seven monitoring wells are included in the CCR groundwater monitoring system, which includes three upgradient monitoring wells (H-26, H-27, and H-33) and four downgradient monitoring wells (H-28, H-29, H-31, and H-32) (PBW, 2017) (see Monitoring Well Location Map, and Well Construction Diagrams and Drilling Logs attached to this demonstration). All wells included in the CCR monitoring system are screened in the intermediate zone (i.e., uppermost aquifer) at the APA (PBW, 2017).

Hydraulic Conductivity

Hydraulic conductivity results from field testing (i.e., slug tests) in the upper zone (clayey sand) and intermediate zone (sand and silty sand) ranged from 3.5×10^{-6} to 3.8×10^{-4} centimeters per second (cm/s) and 1.2×10^{-4} to 7.5×10^{-3} cm/s, respectively as reported by PBW (2017).

Groundwater Elevations, Flow Direction and Velocity

Groundwater elevations adjacent to the APA for the eight CCR background monitoring events from October 2015 through December 2016 ranged from approximately 302.30 feet above mean sea level (amsl) to 310.04 feet amsl, corresponding to groundwater depths from 9.24 to 26.94 feet below ground surface (PBW, 2017). In general, groundwater elevations were highest in the west, with inferred groundwater flow direction to the east toward Martin Lake during the eight background monitoring events (PBW, 2017). These groundwater elevations and flow directions are consistent with the groundwater potentiometric map for May 2019 included as an attachment to this demonstration (Golder, 2019). Golder (2019) estimated the lateral groundwater flow velocity in the intermediate zone (i.e., uppermost aquifer) to be 27 feet per year.

REFERENCES

Barnes, Virgil E., 1965. Geologic Atlas of Texas, Tyler Sheet, Texas Bureau of Economic Geology.

Golder Associates Inc. (Golder). 2016. Safety Factor Assessment Report, Martin Lake Steam Electric Station.

Golder Associates Inc. (Golder). 2019. CCR Assessment of Corrective Measures, Martin Lake Steam Electric Station – Ash Pond Area, Rusk County, Texas.

Pastor, Behling & Wheeler (PBW). 2017. Coal Combustion Residual Rule Groundwater Monitoring System Certification, Martin Lake Steam Electric Station, Ash Pond Area, Rusk County, Texas. October 16.

LEGEND

◐	DOWNGRADIENT CCR MONITORING WELL
▣	UPGRADIENT CCR MONITORING WELL
●	LAKE WATER/GROUNDWATER MIXING ZONE SAMPLE
■	MNA SOIL SAMPLE
A —— A'	CROSS SECTION LOCATION

REFERENCE(S)
BASE MAP TAKEN FROM GOOGLE EARTH, IMAGERY DATED 4/6/17.

CLIENT
LUMINANT

PROJECT
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

TITLE
DETAILED SITE PLAN - ASH POND AREA

CONSULTANT
GOLDER

YYYY-MM-DD	2019-08-28
DESIGNED	AJD
PREPARED	AJD
REVIEWED	WFV
APPROVED	WFV

PROJECT NO. 19121403
REV. 0
FIGURE 2

Last Edited By: adiamond Date: 2019-08-28 Time:12:16:40 PM | Printed By: adiamond Date: 2019-08-28 Time:12:33:09 PM
Path: \\corp\usk\data\Projects - Round Rock\19121403 - Luminant\Martin Lake Ash Pond Area\ | File Name: FIG 2 - Detailed Site Plan (Ash Pond Area).dwg

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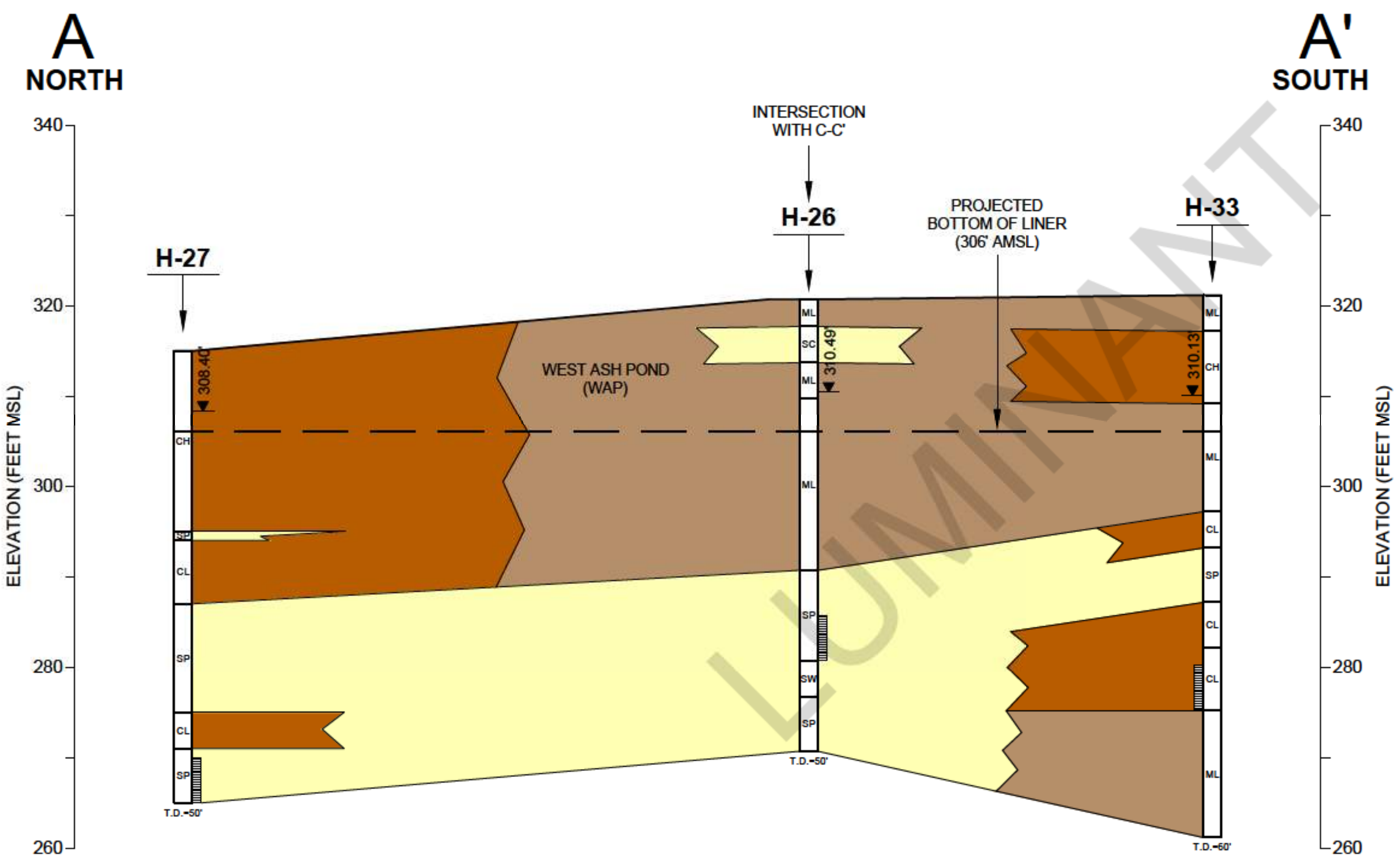
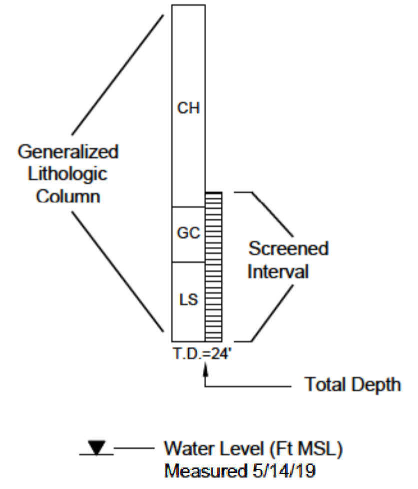


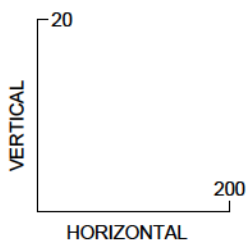
LEGEND

▨	FILL
▨	SAND
▨	CLAY
▨	SILT

MONITORING WELL CONSTRUCTION



SCALE IN FEET



10x Vertical Exaggeration

CLIENT
LUMINANT

PROJECT
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

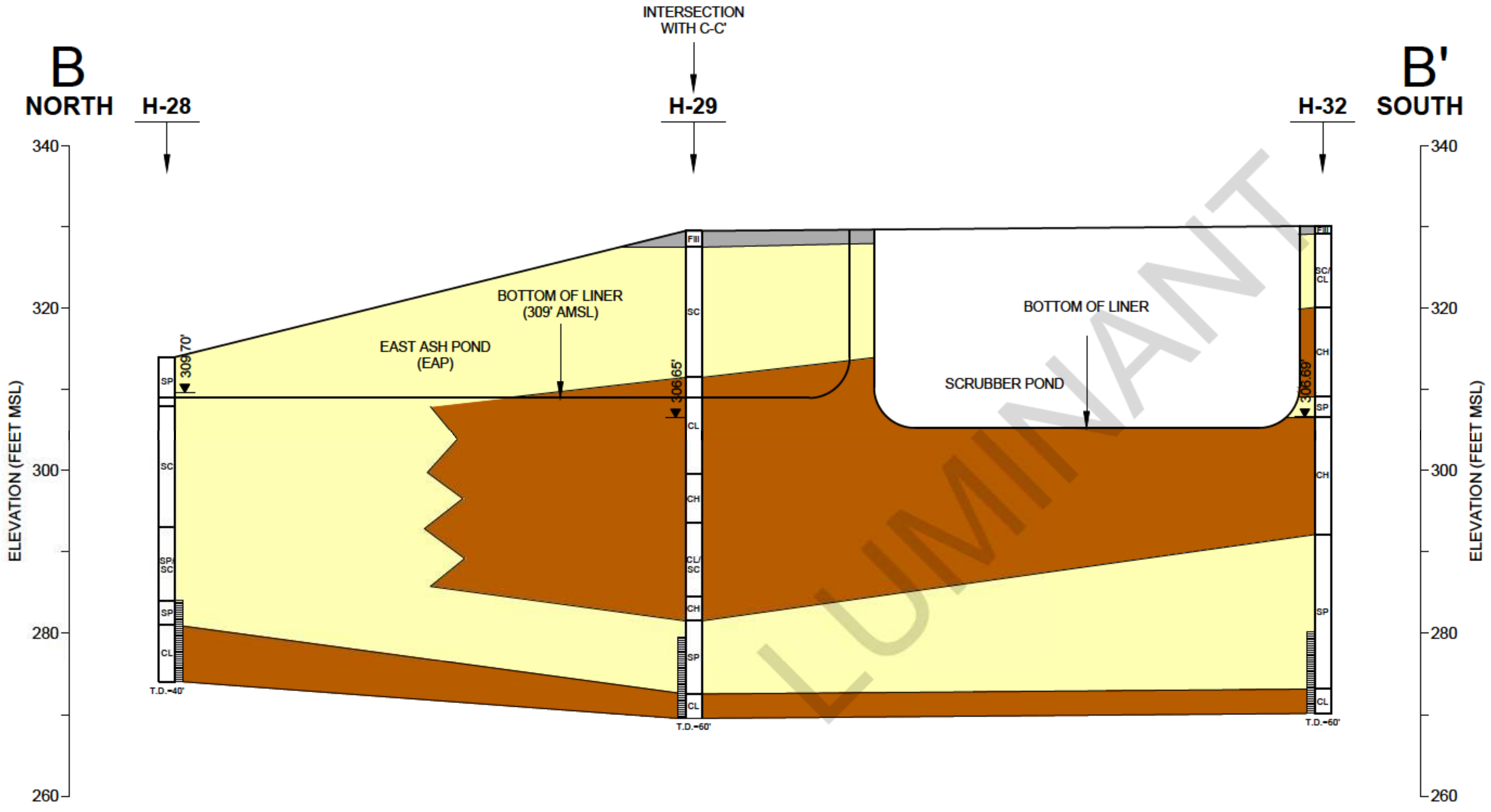
TITLE
ASH POND AREA - GEOLOGIC CROSS SECTION A-A'
WEST SIDE OF WEST ASH POND
THROUGH PROCESS WATER POND

CONSULTANT
GOLDER

YYYY-MM-DD	2019-08-28
DESIGNED	AJD
PREPARED	AJD
REVIEWED	WFV
APPROVED	WFV

PROJECT NO.	REV.	FIGURE
19121403	0	3

Path: \\texarkana\data\Projects - Round Rock\19121403 - Luminant\Martin Lake Ash Pond Area\ | File Name: FIG 3-5 - Cross Sections.dwg | Last Edited By: adiamond Date: 2019-08-28 Time:2:30:44 PM | Printed By: adiamond Date: 2019-08-28 Time:2:52:58 PM



LEGEND

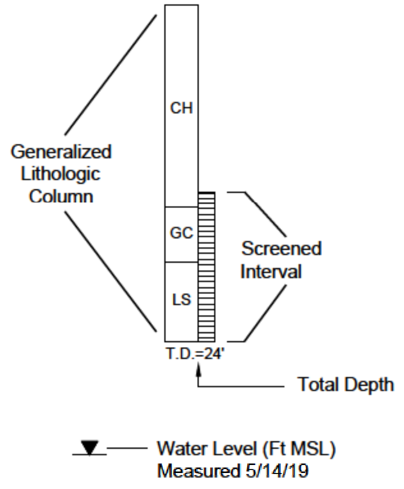
▨ FILL

▨ SAND

▨ CLAY

▨ SILT

MONITORING WELL CONSTRUCTION



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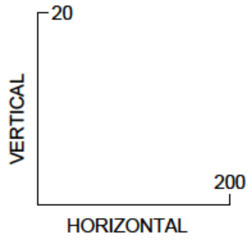


10x Vertical Exaggeration

CLIENT
LUMINANT

PROJECT
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

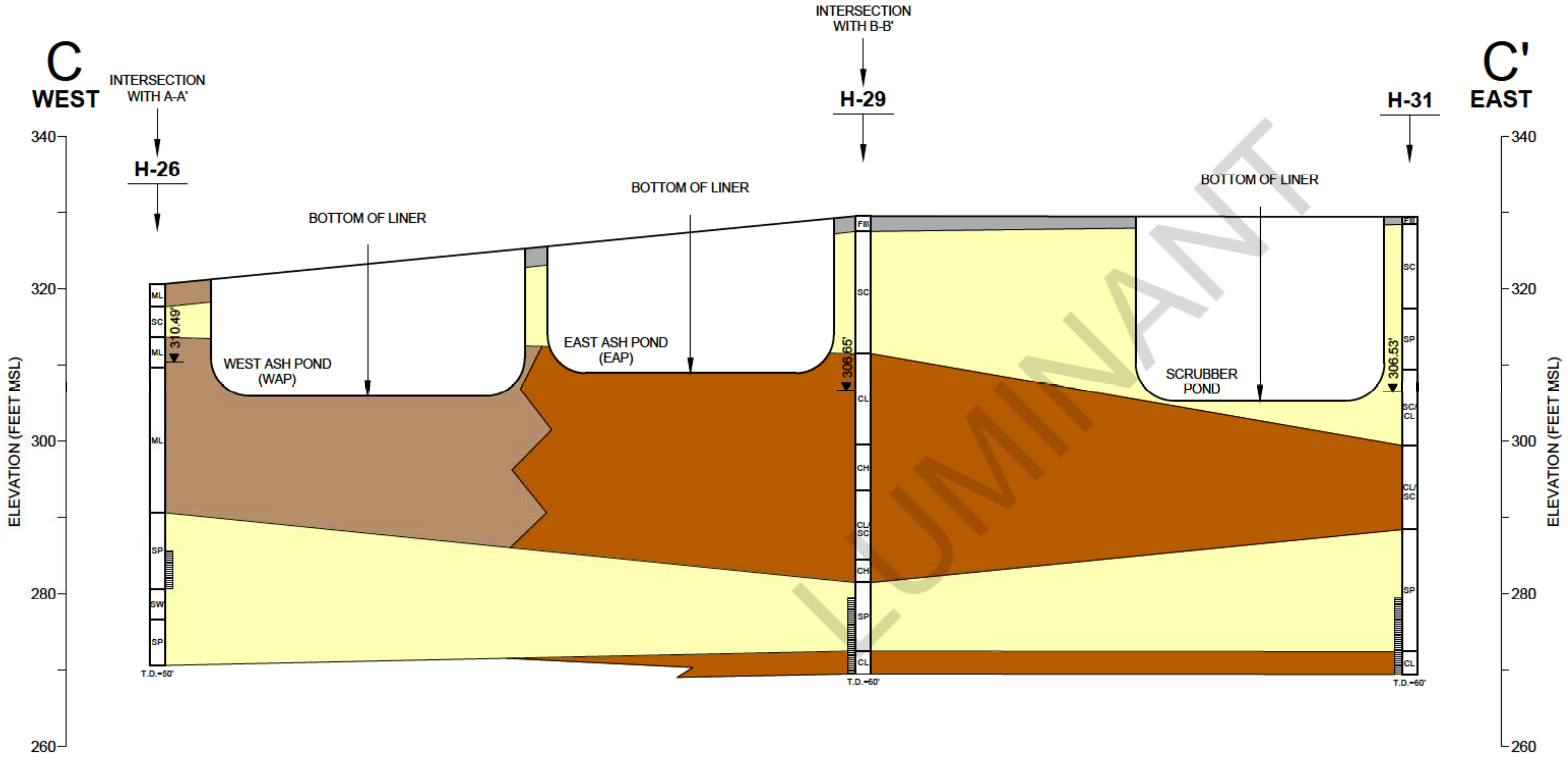
TITLE
ASH POND AREA - GEOLOGIC CROSS SECTION B-B'
EAST SIDE OF ASH POND THROUGH SCRUBBER POND

CONSULTANT
GOLDER

YYYY-MM-DD	2019-08-28
DESIGNED	AJD
PREPARED	AJD
REVIEWED	WFV
APPROVED	WFV

PROJECT NO.	REV.	FIGURE
19121403	0	4

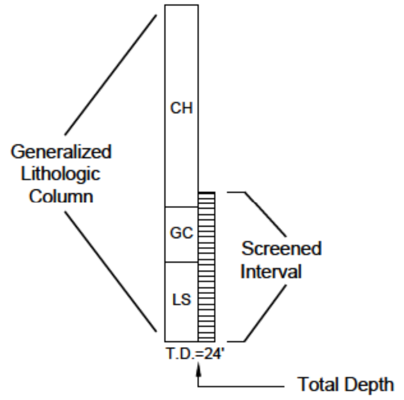
Path: \\texarkana\data\Projects - Round Rock\19121403 - Luminant\Martin Lake Ash Pond Area\ | File Name: FIG 3-5 - Cross Sections.dwg | Last Edited By: adiamond Date: 2019-08-28 Time:2:30:44 PM | Printed By: adiamond Date: 2019-08-28 Time:2:53:35 PM



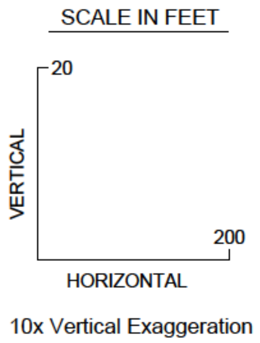
LEGEND

▨	FILL
▨	SAND
▨	CLAY
▨	SILT

MONITORING WELL CONSTRUCTION



▼ Water Level (Ft MSL) Measured 5/14/19



CLIENT
LUMINANT

PROJECT
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

TITLE
ASH POND AREA - GEOLOGIC CROSS SECTION C-C'
THROUGH WEST ASH POND AND EAST ASH POND

CONSULTANT
GOLDER

YYYY-MM-DD	2019-08-28
DESIGNED	AJD
PREPARED	AJD
REVIEWED	WFV
APPROVED	WFV

PROJECT NO.	REV.	FIGURE
19121403	0	5

CONCEPTUAL SITE MODEL AND DESCRIPTION OF SITE HYDROGEOLOGY (PERMANENT DISPOSAL POND 5)

The Martin Lake Steam Electric Station (Martin Lake) conceptual site model (CSM) and Description of Site Hydrogeology for the Permanent Disposal Pond-5 (PDP5), located near Tatum, Texas are described in the following sections.

REGIONAL SETTING

The PDP5 is located in the Martin Creek area on the west flank of the Sabine Uplift within the Sabine River Valley (Golder, 2016). Formations in the Martin Creek area mainly include continental and marine sedimentary deposits of Eocene-aged Wilcox Group (Barnes, 1965; Golder, 2016), which are overlain by sands of the Carrizo Formation at higher elevations (Golder, 2019). The Wilcox formation is approximately 650 to 700 feet thick in the Martin Creek area, and includes sandy clays, silty sands, clays, and variable amounts of lignite (Golder, 2016). The Wilcox Group was described as mostly unconsolidated to moderately consolidated clay and silt with variable degrees of interbedded sand and lignite in the area of the Site (Golder, 2019), and derived from a depositional environment associated with fluvial-deltaic processes, which may include inter-channel crevasses splays, overbank deposits, and localized channel fills (Golder, 2019). In the Martin Creek area, the Wilcox Group is underlain by the approximately 900-foot thick silty clay and clay deposits of the Paleocene Midway Group, which overlies approximately 7000 feet of Cretaceous rock (Golder, 2016).

Potable water supply wells are completed in Wilcox Group sands of the Martin Creek area, including two Martin Lake locations (screened at depths of at least 300 feet below ground surface) (Golder, 2019). In addition, to these Martin Lake potable water supply wells, other groundwater wells completed in the Wilcox Group sands include well used for domestic, oil and gas, or stock watering purposes (Golder, 2019).

Groundwater occurring within the upper 100 feet below ground surface in the Martin Creek area is typically under unconfined or semi-confined conditions, where the potentiometric surface of these shallow flow systems typically mirror that of the topographic surface (Golder, 2019). Groundwater flow is generally from the potentiometric highs that mimic the topographic highs (coincident with groundwater recharge areas, groundwater divides and surface water divides) toward potentiometric lows and valleys (coincident with groundwater discharge zones) (Golder, 2019).

SITE GEOLOGY

The PDP5 is located in the outcrop area of the Wilcox Group described above (PBW, 2017). Surficial soils in the vicinity of PDP5 include the following (described in order from shallow to deep) based on soil borings (PBW, 2017):

- Upper Sand Unit – an upper sand unit is observed on hilltops and other topographically high areas.
- Intermediate Continuous Clay Unit – a continuous clay unit that contains discontinuous packages of relatively thick layers of interbedded sand.
- Lower Silt and Sand Unit (Uppermost Aquifer) – a silt and sand unit that contains discontinuous packages of relatively thick layers of clay.

A cross-section showing the subsurface materials encountered in the vicinity of PDP5 is included as an attachment to this demonstration. Drilling logs used to develop the cross-section are also included as an attachment to this demonstration.

SITE HYDROGEOLOGY

Nine monitoring wells (MW-17A, MW-18A, MW-19, MW-20A, PDP-22, PDP-23, PDP-24, PDP-25, and PDP-26), positioned radially around PDP5, are included in the CCR groundwater monitoring system. Groundwater flow directions around PDP5 indicate there are no upgradient areas in the vicinity of the CCR unit and all nine CCR groundwater monitoring wells are downgradient of PDP5 (PBW, 2017) (see Monitoring Well Location Map, and Well Construction Diagrams and Drilling Logs attached to this demonstration). All wells included in the CCR monitoring system are screened in the lower silt and sand unit (i.e., uppermost aquifer) at the PDP5 (PBW, 2017).

Hydraulic Conductivity

Hydraulic conductivity results from field testing (i.e., slug tests) at monitoring wells PDP-22, PDP-25, and PDP-26 in the lower sand and silt unit (uppermost aquifer) ranged from approximately 2.48 x 10^{-5} to 1.37 x 10^{-4} centimeters per second (cm/s), with a geometric mean of approximately 4.40 x 10^{-5} cm/s (PBW, 2017).

Groundwater Elevations and Flow Direction

Groundwater elevations adjacent to the PDP5 for the eight CCR background monitoring events from October 2015 through December 2016 ranged from approximately 352.38 feet above mean sea level (amsl) to 381.40 feet amsl, corresponding to groundwater depths from 5.14 to 37.46 feet below ground surface (PBW, 2017). In general, mounding was observed within PDP5 with an inferred radial groundwater flow outward from PDP5 (PBW, 2017). These groundwater elevations and flow directions are consistent with the groundwater potentiometric map for December 2016 included as an attachment to this demonstration (PBW, 2017).

REFERENCES

Barnes, Virgil E., 1965. Geologic Atlas of Texas, Tyler Sheet, Texas Bureau of Economic Geology.

Golder Associates Inc. (Golder). 2016. Safety Factor Assessment Report, Martin Lake Steam Electric Station.

Golder Associates Inc. (Golder). 2019. CCR Assessment of Corrective Measures, Martin Lake Steam Electric Station – Ash Pond Area, Rusk County, Texas.

Pastor, Behling & Wheeler (PBW). 2017. Coal Combustion Residual Rule Groundwater Monitoring System Certification, Martin Lake Steam Electric Station, Permanent Disposal Pond 5, Rusk County, Texas. October 16.

EXPLANATION

MW-12A ◑	A Zone Monitoring Well
MW-12B ◑	B Zone Monitoring Well

N

Scale in Feet

0 200 400

SOURCE:
Base map from http://www.tnris.state.tx.us, Tatum SW DOQQ, Texas, 2010.

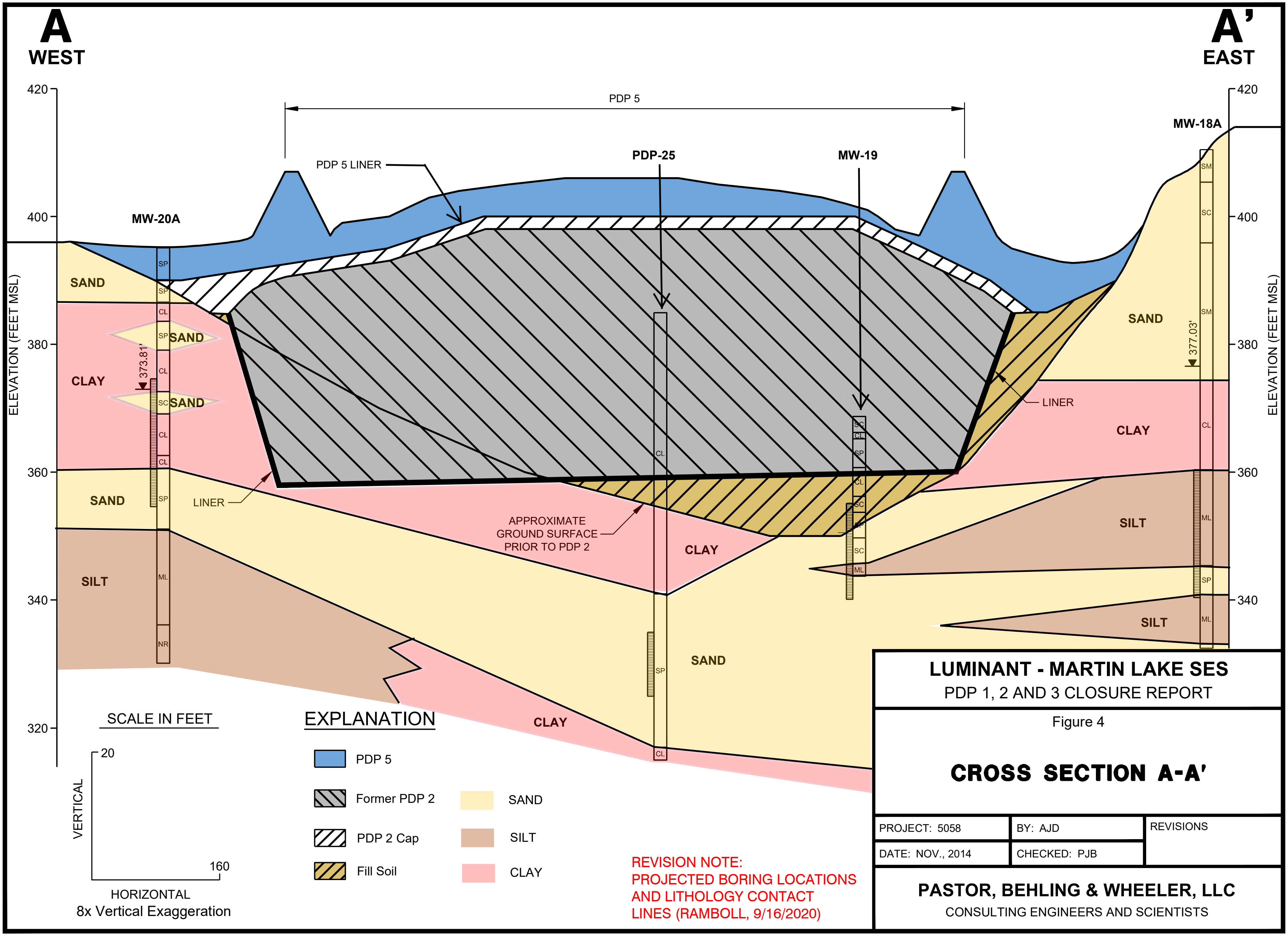
LUMINANT - MARTIN LAKE SES
PDP 1, 2 AND 3 CLOSURE REPORT

Figure 3

PDP 1, 2 AND 3
POST CLOSURE SITE PLAN

PROJECT: 5058	BY: AJD	REVISIONS
DATE: NOV., 2014	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



REVISION NOTE:
PROJECTED BORING LOCATIONS
AND LITHOLOGY CONTACT
LINES (RAMBOLL, 9/16/2020)

LUMINANT - MARTIN LAKE SES
PDP 1, 2 AND 3 CLOSURE REPORT

Figure 4

CROSS SECTION A-A'

PROJECT: 5058	BY: AJD	REVISIONS
DATE: NOV., 2014	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

APPENDIX F6 – CORRECTIVE MEASURES ASSESSMENT (ASH POND AREA)

REPORT

CCR ASSESSMENT OF CORRECTIVE MEASURES

Martin Lake Steam Electric Station - Ash Pond Area
Rusk County, Texas

Submitted to:

Luminant Generation Company LLC

Submitted by:

Golder Associates Inc.
2201 Double Creek Dr, Suite 4004, Round Rock, Texas, USA 78664

+1 512 671-3434

19121403

September 2019

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

Golder Associates Inc. (Golder) has prepared this assessment of corrective measures (ACM) report on behalf of Luminant Generation Company LLC (Luminant) for the West Ash Pond (WAP), East Ash Pond (EAP), and New Scrubber Pond (NSP) (collectively referred to as the “Ash Pond Area”) located at the Martin Lake Steam Electric Station (MLSES) in Rusk County, Texas (hereafter, the “Site”). The ACM was prepared in accordance with §257.96 of the Coal Combustion Residual (CCR) Rule and was required due to the presence of concentrations of selected Appendix IV constituents at statistically significant levels (SSLs) above the groundwater protection standards (GWPS) established for the constituents at the Site. This ACM Report will be placed in the MLSES operating record in accordance with §257.105(h)(10).

This report also incorporates the results of a site investigation conducted at the Site in May and June 2019. The objectives of the site investigation were:

- delineate the nature and extent of the selected Appendix IV constituents to their respective GWPS;
- update the statistical evaluations of the Appendix IV constituents to include data collected during 2019 to confirm that SSL exceedances continue to occur at the Site;
- collect data to evaluate potential future alternate source demonstrations (ASDs) for the Appendix IV constituents; and
- assess the potential for monitored natural attenuation (MNA) to be successful at the Site for the Appendix IV constituents.

The MLSES is located approximately 5 miles southeast of Tatum, Rusk County, Texas (Figure 1). The MLSES is expected to remain in operation for the foreseeable future, depending on future power demands.

The Ash Pond Area is located immediately east of the MLSES power units (Figure 2). The WAP is constructed with a composite liner consisting of an 18-inch thick compacted clay liner, overlain by two 60-mil HDPE geomembrane liners with a geonet drainage layer between the geomembranes. The EAP is constructed with a composite liner consisting of an 18-inch thick compacted clay liner, overlain by a geotextile, overlain by two 60-mil HDPE geomembrane liners with a geonet drainage layer between the geomembranes. A 4-inch thick concrete revetment mat is installed on top of the upper geomembrane liner in both the WAP and EAP. The WAP and EAP are considered unlined surface impoundments under §257.71(a)(1)(ii) of the CCR Rule (BM 2016).

The NSP is constructed with liner system consisting of two 60-mil HDPE geomembrane liners with a geonet drainage layer between the geomembranes, overlain by a 4-inch thick concrete revetment mat. The NSP is considered an unlined surface impoundment under §257.71(a)(1)(ii) of the CCR Rule (BM 2016).

2.0 REGIONAL AND SITE SETTING

2.1 Regional Geology

MLSES is located in the outcrop area of the Eocene-aged Wilcox Group (Barnes, 1965). The Wilcox Group in the vicinity of the Site consists mostly of unconsolidated to moderately consolidated clay and silt, with various amounts of interbedded sand and lignite. The depositional environment is associated with fluvial-deltaic processes such as inter-channel crevasse splays, overbank deposits, and localized channel fills. The Wilcox Group is overlain by sands of the Carrizo Formation, which is present only at higher elevations in the area. The Carrizo Formation is not present at the Site.

2.2 Regional Hydrogeology

Groundwater wells completed in the Wilcox Group sands in the area are typically used for domestic, oil and gas supply, or stock watering purposes. Some potable water supply wells in the region are also completed in the Wilcox Group, including two wells at the MLSES that are both located upgradient of the Ash Pond Area and are screened at depths of 300 feet bgs or greater. Groundwater within the upper 100 feet below ground surface (bgs) in the region typically flows under unconfined to semi-confined conditions. The direction and rate of groundwater movement in the Wilcox Group are affected by a number of physical features, including topography, surface drainage, and geology. The natural groundwater potentiometric surface in these shallow flow systems is generally a subdued replica of topography. In general, groundwater flow occurs from high potentiometric areas (recharge zones) toward valleys (discharge zones). Groundwater divides generally coincide with surface drainage divides.

2.3 Site Hydrogeology and CCR Monitoring Well Network

The CCR groundwater monitoring well network at the Ash Pond Area was established in 2015 using newly installed monitoring wells H-26, H-27, H-28, H-29, H-31, H-32, AND H-33 (Figure 2). Based on soil borings completed at the Site, the geology near the CCR units generally consists of an upper zone composed of an approximately 30- to 40-foot thick low- to medium-plasticity, lean clay to clayey sand unit. The upper zone is underlain by an intermediate zone composed of poorly-graded fine sand and silty sand unit that is generally about 5 to 20 feet thick. The intermediate zone is underlain by a laterally-continuous, silty to sandy confining clay unit. The uppermost aquifer occurs in the intermediate sand and silty sand unit at the Site (PBW 2017a). The CCR monitoring wells are completed in the intermediate zone. Geologic cross sections of the Ash Pond Area are presented on Figures 3, 4, and 5.

Groundwater elevations are generally highest near the western side of the Ash Pond Area with an inferred groundwater flow direction to the east toward Martin Lake. A groundwater potentiometric map constructed using groundwater elevation data collected in May 2019 from the CCR monitoring network is presented on Figure 6. Based on the inferred groundwater flow direction, the location of each CCR monitoring well relative to the Ash Pond Area is as follows:

Upgradient/Background Wells	Downgradient Wells
H-27 H-26 H-33	H-28 H-29 H-31 H-32

Rising- and falling-head aquifer tests (i.e., slug tests) were conducted at the Site as part of a 2011 assessment for the Texas Commission on Environmental Quality (TCEQ) Texas Risk Reduction Program (TRRP) (PBW 2011). Based on the test results, the intermediate zone had an estimated hydraulic conductivity of 1.0E-03 cm/sec and an estimated lateral groundwater flow velocity of 27 feet per year.

Golder performed a survey of water supply wells located in the vicinity of the Ash Pond Area in May 2019 as part of a Texas Commission on Environmental Quality (TCEQ) Texas Risk Reduction Program (TRRP) assessment of the Site. A Drinking Water Survey Report (Golder, 2019) documenting the water well survey activities and findings was approved by the TCEQ in a letter dated August 15, 2019. No imminent threats to water wells or potentially affected drinking water wells were identified.

3.0 NATURE AND EXTENT EVALUATION

3.1 Groundwater Monitoring Summary

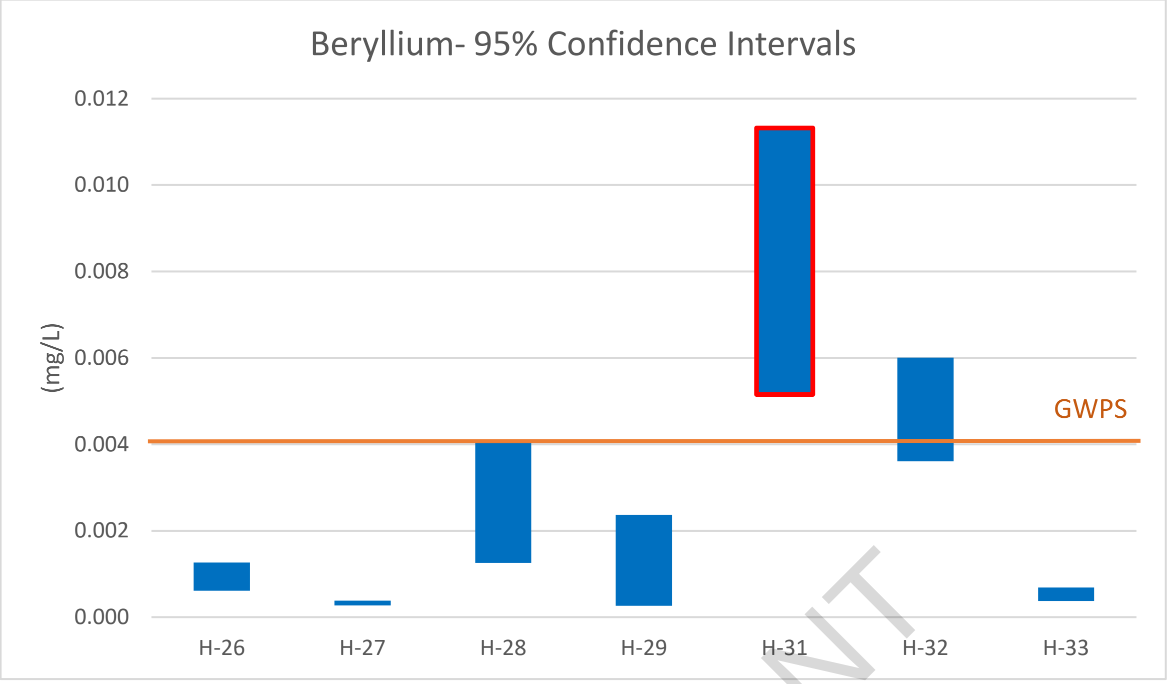
Background monitoring of groundwater in the vicinity of the Ash Pond Area began in October 2015 and was completed in December 2016. Samples collected during this period were analyzed for Appendix III and Appendix IV constituents to establish background concentrations pursuant to §257.94(b).

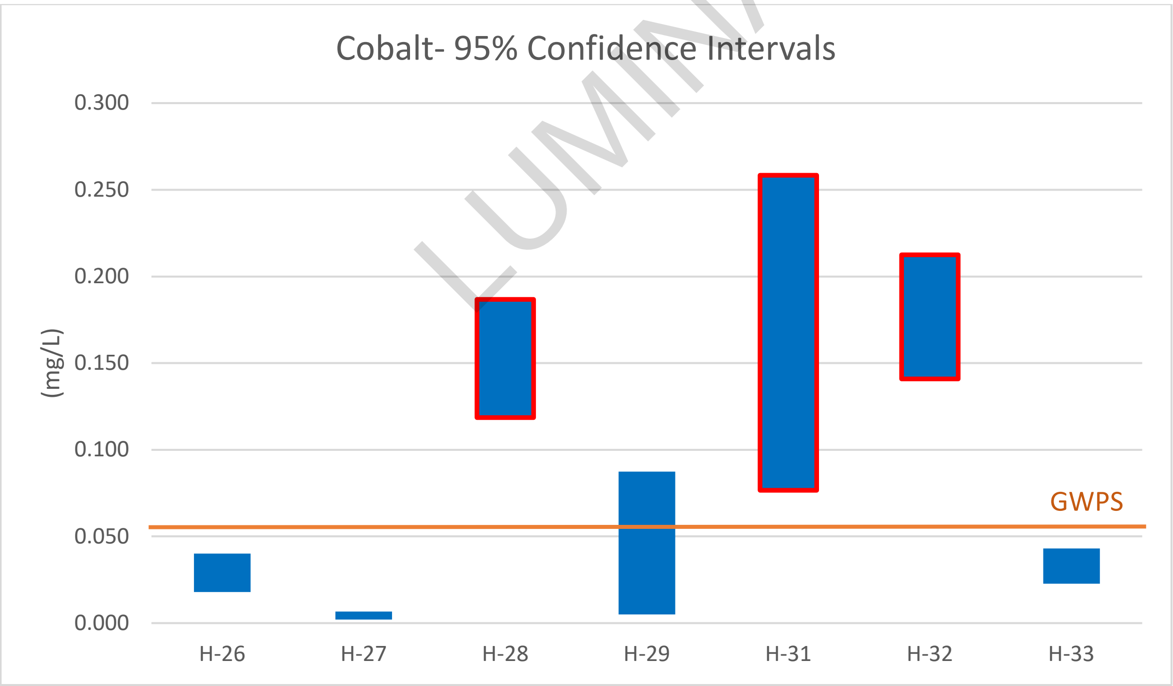
A detection monitoring program in accordance §257.94 was initiated in September 2017. The evaluation of those data was completed in 2018 using procedures described in the Statistical Analysis Plan (PBW 2017b) to identify statistically significant increases (SSIs) of Appendix III parameters above background concentrations. Based on the identification of SSIs for one or more Appendix III parameters, an assessment monitoring program was established pursuant to §257.94(e)(1).

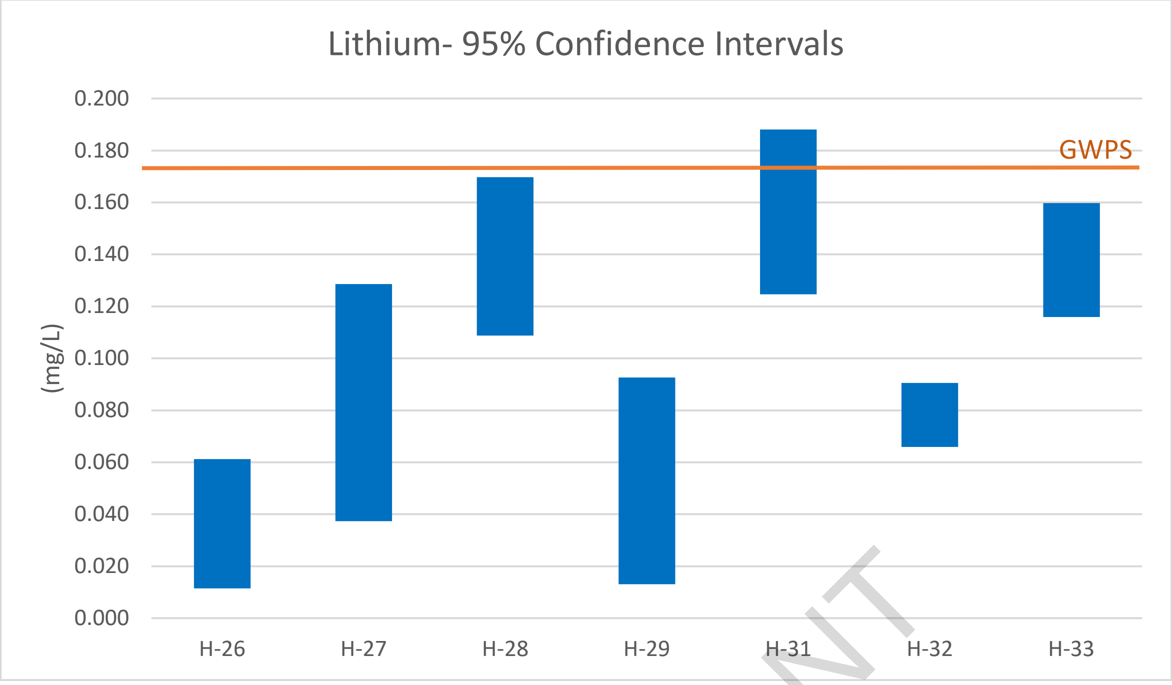
The initial assessment monitoring event was performed in June 2018 and a subsequent semi-annual assessment monitoring event was conducted in September 2018 in accordance with §257.95(a) and §257.95(d). Using the Appendix IV data collected during the assessment monitoring period through September 2018, SSLs above GWPSs were initially identified in downgradient wells in January 2019 for beryllium (H-28, and H-29), cobalt (H-28 and H-29), and lithium (H-28); therefore, an ACM was initiated on April 8, 2019 pursuant to §257.95(g). A justification letter for a 60-day extension due to site-specific circumstances that delayed work on the ACM was certified on July 3, 2019 in accordance with §257.96(a). Based on the extension, the deadline for completing the ACM is September 5, 2019.

3.2 Assessment Monitoring SSL Evaluation

An additional assessment monitoring event was performed in May 2019. Groundwater sampling analytical results for all Appendix IV parameters from 2015 through 2019 are presented in Table 1. An updated statistical analysis of the Appendix IV results from downgradient CCR monitoring wells was conducted including the May 2019 data to evaluate if constituent concentrations detected in the samples remained at SSLs relative to the GWPSs. The updated statistical analysis was performed in accordance with the Statistical Analysis Plan for CCR Groundwater Monitoring (PBW 2017b) and the USEPA Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities-Unified Guidance (USEPA 2009). Confidence intervals were calculated for any Appendix IV parameter that historically has had more than one occurrence in excess of the GWPS in any well within the monitoring network. Plots of the confidence intervals for each of those Appendix IV parameters are presented below (SSLs are highlighted in red around the bars):


Beryllium- 95% Confidence Intervals
0.012
0.010
0.008
0.006
0.004
0.002
0.000
(mg/L)
GWPS
H-26
H-27
H-28
H-29
H-31
H-32
H-33


Cobalt- 95% Confidence Intervals
0.300
0.250
0.200
0.150
0.100
0.050
0.000
(mg/L)
GWPS
H-26
H-27
H-28
H-29
H-31
H-32
H-33



The previous statistical analysis using data collected during the assessment monitoring period through September 2018 indicated SSLs for beryllium (H-28 and H-29), cobalt (H-28 and H-29), and lithium (H-28) as identified in the February 2019 SSL notification; however, the updated statistical analysis only identified beryllium (H-31) and cobalt (H-28, H-31, and H-32) as having SSLs above GWPSs. The monitoring wells will continue to be monitored to confirm that lithium concentrations remain below SSLs in the future in accordance with the CCR Rule. For the purposes of this ACM evaluation, concentrations are conservatively assumed to be present at SSLs above their respective GWPSs for the following constituents in the wells indicated based on the initial and updated statistical evaluations:

- Beryllium (H-28, H-29, and H-31);
- Cobalt (H-28, H-29, H-31, and H-32); and
- Lithium (H-28).

Figure 7 shows the extent of Appendix IV constituents detected at SSLs above GWPSs based on the initial and updated statistical analysis.

3.3 Field Investigation

3.3.1 General

Field investigation activities conducted as part of the ACM included collection of soil samples for a mineralogical assessment and chemical analysis, a lake sample from Martin Lake, groundwater-level measurements, and groundwater sampling and analysis. Figure 2 presents the locations of soil borings and monitoring wells installed and sampled as part of the field investigation.

3.3.2 Soil Sample Collection

Soil borings were completed in June 2019 at soil boring locations AP-2019-1, AP-2019-2, and AP-2019-3. Soil samples were collected within the target GWBU in each of the soil borings. Soil samples were submitted under chain-of-custody for laboratory analysis of the following parameters:

- Mineralogical composition: The purpose of the mineralogical analysis was to identify and quantify the crystalline mineral phases in each sample. This information is required for geochemical modeling as the release or attenuation of constituents of interest is influenced by the mineral phase(s) present in the aquifer (Hem 1985). The mineralogical testing laboratory (SGS Minerals Services) performed the analysis using quantitative (Rietveld) X-ray diffraction (XRD) (ME-LR-MIN-MET-MN-DO5) and a Bruker AXS D8 Advance Diffractometer.

- Total metals: Analysis of total metals was conducted to quantify the chemical composition of soil materials. The total mass of metals, in combination with the results of sequential extraction testing, can be used to determine the provenance of metals and verify sequential extraction results.

- Sequential extraction (SEP): This test consists of a seven-step metals extraction from solids as per Tessier et al. (1979) to identify the provenance of constituents of interest (i.e. the operationally-defined fraction that contains the metal) and determine their potential environmental mobility. For instance, metals bound in the carbonate fraction, or that are exchangeable, are much more likely to become mobile due to changes in groundwater conditions than metals bound within a sulfide or silicate fraction. The total concentration of a metal measured from all seven steps can be compared to the concentration determined from the total metal analysis for compositional accountability.

3.3.3 Groundwater and Surface Water Sampling

Groundwater samples were collected from the CCR monitoring network and one surface water sample was collected from Martin Lake downgradient of the Ash Pond Area in May 2019. Laboratory analytical reports are provided in Appendix B and sampling records, which include field-measured parameters, are presented in Appendix C.

Chemical/geochemical analysis of groundwater samples included field parameters and radionuclides, nutrients, and major cations and anions. The rationale and methods used are as follows:

- Field Parameters: Parameters measured in the field included pH, dissolved oxygen, oxidation reduction potential (ORP), conductivity, and temperature. These parameters were used to evaluate general geochemical conditions in the groundwater and support geochemical modeling.

- Metals and Regulated COIs: Analysis of Appendix III and IV metals and uranium to better understand the geochemical composition of groundwater. Metals analysis allows for the delineation of a potential plume, evaluation of mineral saturation indices, and evaluation of background contributions from natural sources or anthropogenic sources.

- Major Cations, Anions, and Nutrients: Geochemical modeling of mineral solubility, metals attenuation and background contributions requires analysis of major cations and anions because they affect and participate in sorption and mineral dissolution or precipitation reactions.

3.4 Evaluation of Groundwater Water

3.4.1 Geochemical Modeling Approach

Geochemical modeling was conducted to evaluate general groundwater quality, determine the potential for precipitation of sorbent media, evaluate the potential for mineral precipitation or adsorption in the aquifer, and determine the speciation of metals of interest. The geochemical computer code developed by the United States Geological Survey (USGS), PHREEQC, was used for these simulations (Parkhurst and Appelo 2013). PHREEQC version 3.4 is a general-purpose geochemical modeling code used to simulate reactions in water and between water and solid mineral phases (e.g., rocks and sediments). Reactions include aqueous equilibria, mineral dissolution and precipitation, ion exchange, surface complexation, solid solutions, gas-water equilibrium, and kinetic biogeochemical reactions. The widely-accepted thermodynamic database Minteq.v4, 2017 edition, was used as a basis for the thermodynamic constants required for modeling.

The Geochemist's Workbench Version 12 (Bethke 2015) was used to generate graphical representations of geochemical modeling outputs in the form of predominance, or Pourbaix diagrams (also known as Eh-pH diagrams) for the species of interest (i.e. beryllium and cobalt) and trilinear plots (also known as Piper plots) displaying the relative abundance of major ions. The Minteq.v4 database was used as the basis for the Pourbaix diagrams.

3.4.2 Summary of Groundwater and Surface Water Data

Groundwater quality data from background wells H-26, H-27, and H-33; downgradient monitoring wells H-28, H-29, H-31, and H-32; and the surface water sample collected from Martin Lake were used for this evaluation. The water quality monitoring data are presented in Appendices B and C and can be summarized as follows:

General Chemistry Parameters

- pH: The pH of groundwater samples collected from CCR monitoring well network ranged from 6.01 to 6.83 in May 2019. Historically, the pH in the CCR monitoring well network has ranged from 5.8 to 7.0. Isolated values as low as 3.64 and as high as 11.20 have been recorded in some wells; however, these conditions do not persist but pH returns to circumneutral values by the next sampling round. The pH of Martin Lake was 6.79 in May 2019.
- ORP (Redox): Field-measured redox values, corrected to Eh (+200mV), ranged from +113 to +174 mV in the groundwater samples in the CCR monitoring well network.
- Total Dissolved Solids (TDS): Groundwater TDS concentrations were variable in May 2019 in the CCR monitoring well network. The lowest TDS concentration (453 mg/L) occurred in groundwater at CCR monitoring well H-26 (upgradient) and the highest TDS value (4,230 mg/L) was observed at CCR monitoring well H-31 (downgradient). The TDS concentration measured in Martin Lake water was 119 mg/L.
- Major ion chemistry: A Piper plot was generated for groundwater and Martin Lake samples to facilitate the identification of water types and source contributions (Figure 8a). Two distinct groupings of wells are apparent based on their relative major ion proportions. Upgradient wells H-26 and H-33 show close similarity with the water sample from Martin Lake, indicating potential influences of Martin Lake on the groundwater in these locations. Groundwater composition in upgradient well H-27, in contrast, is more closely related to that of the downgradient wells. Based on the molar ratios of calcium, sodium, and sulfate (Figure 8b), all groundwater samples and the Martin Lake water sample generally plot as one group.

- Iron: Oxidized iron (ferric iron - Fe^{+3}) concentrations were variable, ranging from non-detect (<0.05 mg/L) to 8.81 mg/L in May 2019 (Appendix B). Reduced iron (ferrous iron - Fe^{+2}) concentrations were non-detect (<0.05 mg/L) in the groundwater at all CCR monitoring wells except H-31 and H-32. The highest concentration of ferrous iron in groundwater was 49.5 mg/L observed in monitoring well H-31, over 40 times higher than any other monitoring well. This value corresponded to the highest measured beryllium, cobalt, and lithium concentrations in groundwater at the Ash Pond area. Ferric iron in water from Martin Lake was measured at 0.365 mg/L while ferrous iron was non-detect (<0.05 mg/L).

- Nutrients: Nitrate (nitrate as N) was present in groundwater at variable levels, ranging from non-detect (< 0.1 mg/L as N) to 272 mg/L as N at H-32 in May 2019 (Appendix B). Nitrate in CCR monitoring well H-32 at 272 mg/L as N, was orders of magnitude higher than in other monitoring wells, in which nitrate ranged from non-detect (<0.1 mg/L as N) to 0.658 mg/L as N. Nitrate was not detected in Martin Lake water. Phosphate concentrations in groundwater ranged from near non-detect (0.03 mg/L as P) to 0.126 mg/L as P in CCR monitoring wells. Phosphate was not detected in the water of Martin Lake in May 2019. No spatial trend was apparent in the nitrate or phosphate distribution in groundwater.

Constituents Identified in February 2019 SSL Notification

- Beryllium: Beryllium concentrations in groundwater samples historically have exceeded the GWPS (0.004 mg/L) in CCR monitoring wells H-28, H-29, H-31, and H-32 on at least one occasion since October 2015 (Figure 9a). However, due to the variability of beryllium concentrations in groundwater at these wells, only H-31 currently has beryllium at an SSL. As of May 2019, beryllium concentrations in H-31 and H-32 were above the GWPS, at 0.00713 mg/L and 0.00928 mg/L, respectively. The highest beryllium concentration in groundwater was measured in H-31 in December 2016. Beryllium was not detected in the Martin Lake water sample (<0.0003 mg/L). Beryllium is likely present in groundwater as the divalent cation Be^{+2} based on the pH and Eh of groundwater (Figure 10a).

- Cobalt: Cobalt concentrations in groundwater samples historically have exceeded the GWPS (0.0564 mg/L) in all CCR monitoring wells except H-27 on at least one occasion since October 2015 (Figure 9b). All CCR network monitoring wells have also reported groundwater cobalt concentrations below the GWPS on at least one occasion since October 2015, indicating variability in cobalt In May 2019, all wells except H-27 had cobalt concentrations in groundwater above the GWPS. Cobalt was not detected in water from Martin Lake in May 2019 (<0.003 mg/L). Cobalt is likely present in groundwater as the divalent cation Co^{+2} based on the pH and Eh of groundwater (Figure 10b).

- Lithium: Lithium concentrations in groundwater have exceeded the GWPS (0.040 mg/L) since October 2015 in four wells: H-27 (upgradient), H-28, H-31, and H-33 (Figure 9c). In May 2019, only the sample from CCR monitoring well H-31 exceeded the GWPS for lithium. Based on an evaluation of the 95% confidence intervals, the GWPS exceedances for lithium at H-27. H-28. H-31, and H-33 are not at an SSL above the GWPS. Water from Martin Lake did not contain lithium above its detection limit (<0.005 mg/L) in May 2019.

The groundwater analytical results indicate that the Ash Pond Area may be the potential source for the cobalt and/or beryllium concentrations observed at SSLs in monitoring wells H-28, H-31 and H-32. However, the data also indicates that lithium concentrations are not present at SSLs in any of the monitoring wells at the Site.

3.5 Evaluation of Soil

3.5.1 Mineralogical Composition

Quantitative X-ray diffraction (XRD) with Rietveld refinement was used to identify and quantify minerals in three overburden samples collected during the drilling activities - one sample from each of the soil borings completed in June 2019 (AP-2019-1, AP-2019-2, and AP-2019-3). These samples were obtained to better understand the mineralogical composition of the aquifer system and identify any minerals that would potentially influence attenuation of constituents of interest. In contrast, the presence of certain minerals could also indicate a potential for naturally-occurring release of metals into groundwater, for instance due to oxidation of sulfide minerals.

The mineralogical analysis of soil from borehole samples at the Ash Pond Area identified quartz as the predominant mineral, with varying amounts of albite in all three boreholes. Soil samples from boreholes AP-2019-1 and AP-2019-2 (ranging 30’ below ground surface (bgs) to 31’ bgs and 35’ bgs to 36’ bgs) also contained small or trace amounts of the silicate minerals K-felspar, chlorite, muscovite, kaolinite, vermiculite, illite, and montmorillonite. Analytical reports for the XRD samples are provided in Appendix B. These minerals were not identified in the shallower borehole samples of AP-2019-1 (18’ bgs to 19’ bgs), indicating potentially a greater abundance of clay minerals (kaolinite, vermiculite, illite, montmorillonite) in deeper samples.

3.5.2 Chemical Composition and Sequential Extraction

Chemical analysis and sequential extractions were used to determine the chemical composition of the soil and the distribution of constituents of interest over various operationally-defined fractions comprising the soil. Testing was completed as described in Section 3.3.2 on soil samples obtained from three borehole locations (Figure 2) and the analytical reports for the soil analyses are provided in Appendix B.

Soil sample locations were chosen to gain a better understanding of the underlying geological conditions of the area surrounding the Ash Pond Area, mostly adjacent to or downgradient of a CCR monitoring well. In addition, this information allows for a better understanding of naturally-occurring metal contributions to groundwater or the potential for sequestration of constituents from groundwater.

A description of the individual fractions determined by sequential extraction is presented in Section 3.3.2. Metals extracted in steps 1 through 5 are considered environmentally available, whereas metals extracted in steps 6 and 7 are present in refractory fractions and are not expected to be released under conditions typically encountered in aquifers (Tessier et al. 1979). Total metal quantities from the sequential extraction are expressed as “SEP Total” in Appendix B. The sum of the sequential extraction steps is also presented for comparison but does not represent an analytically-determined value.

The results from the chemical analysis and sequential extraction presented in Appendix B are summarized as follows:

General Chemistry Parameters

- Aluminum: Aluminum is not a constituent of interest (COI) at the site but it has been well studied as a sorbing medium in soils (e.g., Karamalidis and Dzombak 2011). Total aluminum in soils ranged from 14,244 to 33,160 mg/kg, and the environmentally-available fraction ranged from 1,044 (AP-2019-3) to 1,989 mg/kg (AP-2019-2). Aluminum in the soil at the site is, therefore, largely (~84% to 87%) present in the residual, or silicate-bound fraction. This fraction is likely at least partially represented by hydrous aluminum phyllosilicate minerals or clays intermixed in the silica sand matrix. Clays can represent an important sorptive reservoir for numerous trace metals and metalloids (Uddin 2017).

- Iron: While not a COI, iron and its minerals commonly represent one of most abundant reservoirs for metal/metalloid attenuation in soils (Dzombak and Morel 1990; Smith 1999). Iron was present in all three core samples analyzed, varying from 5,192 (AP-2019-3) to 13,933 mg/kg (AP-2019-2). In all samples, the non-environmentally available (sulfide and residual) fractions accounted for the largest proportion of total iron (54% to 64%) and, as such, most of the iron is not environmentally available. The remainder of the iron in the samples is present across the exchangeable (except AP-2019-1), carbonate (only in AP-2019-2), amorphous metal, and metal hydroxide phases. These phases, part of the labile fraction in steps 1 through 5, can generally be considered representative of the amount of iron in soil that may be available as a sorbing medium and can, therefore, be important for potential attenuation of beryllium and cobalt.

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- Beryllium: Total beryllium in soil ranged from 0.23 to 0.68 mg/kg, of which 16% to 75% of the beryllium was present in the environmentally-available fraction. The non-environmentally available fraction of beryllium (25% to 84% of total) is also indicative of naturally occurring beryllium in soil at the Ash Pond Area. All of the environmentally-available beryllium resorted in the amorphous metal and metal hydroxide fractions, indicating potential attenuation of beryllium from groundwater (Smith 1999).

- Cobalt: Total cobalt in soil ranged from 1.68 to 6.29 mg/kg while the environmentally-available fraction ranged from 1.4 mg/kg in AP-2019-3 to 4.39 mg/kg in AP-2019-2, representing from 58% to 83% of total cobalt. The majority of the environmentally-available cobalt was present in the metal hydroxide fractions in soils samples AP-2019-1 and AP-2019-2, while the exchangeable fraction hosted the largest proportion of cobalt in soils sample AP-2019-3. Soil sample AP-2019-2 contained cobalt in every fraction of the sequential extraction test, indicating potential attenuation of cobalt from groundwater, and the potential presence of naturally occurring cobalt in soil.

- Lithium: Total lithium in soil ranged from 7.15 to 17.3 mg/kg, of which between only 7% (AP-2019-3) and 24% (AP-2019-2) resorted in the environmentally-available fraction. Lithium that was environmentally available (0.53 to 4.2 mg/kg) was all contained in the metal hydroxide fraction. This indicates the likelihood of the presence of naturally-occurring lithium at the site that is contained within non-environmentally available fractions while attenuation of lithium by metal hydroxide minerals also appears to be occurring.

The results of the soil analysis indicate the following:

- A naturally-occurring source of beryllium, cobalt, and lithium is present in the vicinity of the Ash Pond Area at the MLSES.
- Attenuation of beryllium, cobalt, and lithium in groundwater is likely occurring in the vicinity of the Ash Pond Area.

3.6 Summary of Site Characterization

Based on the above site characterization and nature and extent investigation, the following is concluded with respect to beryllium, cobalt, and lithium:

- Beryllium: Beryllium concentrations statistically exceeded the GWPS in groundwater from only one CCR monitoring well (H-31). Beryllium concentrations in groundwater monitoring well H-31 were the highest in December 2016, followed by a stable or decreasing trend since that occurrence. Beryllium was not detected in water from Martin Lake. Sequential extraction results indicate the potential for attenuation of beryllium by amorphous metals and metal hydroxides (Smith 1999). Beryllium should, therefore, be considered for further evaluation as part of an ACM as a viable candidate for monitored natural attenuation based on the results of this initial assessment (USEPA 2007a, b).

- Cobalt: Historical data from CCR monitoring wells in which cobalt concentrations in groundwater exceeded the GWPS indicate a stable or decreasing concentrations since the highest measured cobalt in groundwater of 0.434 mg/L in October 2015. Cobalt concentrations in groundwater currently statistically exceed the GWPS in three CCR monitoring wells (H-28, H-31 and H-32). Cobalt was not detected in water from Martin Lake. Cobalt was present in nearly every fraction of soil as determined from sequential extraction, indicating the strong potential for cobalt attenuation by soils (Smith 1999). Cobalt should, therefore, be considered for further evaluation as part of an ACM as a viable candidate for monitored natural attenuation based on the results of this initial assessment (USEPA 2007a, b).

- Lithium: Recent data indicates that lithium concentrations in groundwater statistically no longer exceed the GWPS at any monitoring well location. Lithium was not detected in water from Martin Lake. Based on the data collected to date, lithium concentrations in groundwater are no longer considered to be present at an SSL above the GWPS; however, lithium concentrations in groundwater will continue to be monitored to confirm that lithium levels remain below the GWPS in the future. For the purposes of this ACM evaluation, lithium concentrations are conservatively assumed to be present at an SSL above the GWPS in well H-31 based on the February 2019 SSL notification.

4.0 ASSESSMENT OF CORRECTIVE MEASURES

In accordance with §257.96 and §257.97, an ACM was conducted for the Ash Ponds to address concentrations of the following Appendix IV constituents conservatively assumed to occur at SSLs above their respective GWPS based on the February 2019 SSL notification:

- cobalt concentrations in monitoring wells H-28, H-31 and H-32;
- beryllium concentrations in monitoring well H-31; and
- lithium concentrations in monitoring well H-31.

Potential response technologies were identified for Source Control (to reduce the potential for releases of constituents to groundwater) and Groundwater Response Actions (to reduce constituent concentrations below GWPS). The potential response technologies were then screened to identify options that are appropriate for further consideration in developing potential corrective measures alternatives for the Site. The results of the ACM are presented in this section.

4.1 Corrective Measures Objectives and Evaluation Criteria

As described in §257.96(a), the corrective measures must prevent further releases, remediate any releases and restore the affected area to original conditions. Potential corrective measures must meet the requirements specified in §257.97(b):

1) Be protective of human health and the environment;
2) Attain the groundwater protection standard as specified pursuant to § 257.95(h);
3) Control the source(s) of releases to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment;
4) Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, considering factors such as avoiding inappropriate disturbance of sensitive ecosystems;
5) Comply with standards for management of wastes as specified in § 257.98(d).

In accordance with §257.96(c), the assessment of potential corrective measures alternatives must include an evaluation of the following:

1) The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination
2) The time required to begin and complete the remedy
3) Institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(s).

4.2 Potential Source Control Response Technologies

One of the listed objectives in §257.97(b) for the corrective measures is to control the source of releases of Appendix IV constituents to the environment from the CCR Unit. The MLSES Ash Ponds are an integral part of the CCR management system at the plant. As a result, any potential source control technology must keep the WAP, EAP and NSP in operation.

The WAP, EAP and NSP are considered unlined surface impoundments under the CCR Rule. As a result, the WAP, EAP and NSP will be retrofitted with new composite liner systems that comply with the requirements of §257.71(a)(1)(ii) of the CCR Rule to improve the level of source control in the ponds. The new liner systems will be installed in general accordance with the following procedures:

- The ponds will be retrofitted one at a time;
- Water will be removed from the pond being retrofitted and transferred to the other Ash Ponds;
- Solids in the ponds will be dewatered, removed and transported to the MLSES A1 Area Landfill for disposal.
- A minimum of 2 feet of compacted clay liner will be placed at the base of each pond;
- A 60-mil HDPE geomembrane liner will be installed over the 2 feet of compacted clay liner;
- A protective layer of soil, ash or other material will be placed over the geomembrane liner.

Retrofitting the WAP, EAP and NSP with new composite liner systems is assumed to serve as the source control component of the potential corrective measures for the Ash Ponds. The estimated time to retrofit the WAP, EAP and NSP is estimated to be approximately 1 to 2 years per pond, including design and construction.

4.3 Potential Groundwater Response Technologies

For the purposes of this ACM, cobalt, beryllium and lithium are conservatively assumed to be present in groundwater at the Site at SSLs above their respective GWPS based on the February 2019 SSL notification. In this section, potential groundwater response technologies to address these constituents are identified and screened for further consideration in developing potential corrective measures alternatives for the Ash Ponds.

4.3.1 Monitored Natural Attenuation

Monitored natural attenuation (MNA) refers to the reliance on natural attenuation processes (within the context of a carefully controlled and monitored site cleanup approach) to achieve site-specific groundwater remediation objectives within a time frame that is reasonable compared to that offered by more active remediation methods (USEPA 2007a). MNA relies on a range of natural processes, including dispersion, dilution, sorption, (co)precipitation, radioactive decay, and abiotic degradation/transformation to achieve remediation objectives (ITRC 2010). Routine groundwater monitoring would be required to verify MNA is occurring at the Site.

Where necessary, MNA processes can be enhanced through the use of low-energy, in-situ techniques to stimulate or increase the attenuation of contaminants or reduce contaminant loading (ITRC 2010). Enhancement options include increasing the attenuation capacity of the aquifer, decreasing the mobility of contaminants, and/or increasing the stability of immobilized contaminants by increasing the ability of aquifer solids to remove contaminants from groundwater and/or manipulating the geochemistry to reduce remobilization of contaminants by desorption or dissolution of precipitates (ITRC 2010).

MNA has been demonstrated effective in reducing cobalt and beryllium concentrations in groundwater (ITRC 2010; USEPA 2007b). Cobalt is removed through adsorption to iron hydroxides and/or amorphous metals and the level of effectiveness is dependent on iron hydroxide availability as well as pH, alkalinity, and calcium levels (ITRC 2010). Beryllium is removed through adsorption or coprecipitation (DOD 2014). The removal mechanisms for lithium are not identified in the professional literature. As described in Section 3.6 of this report, the Site is a good candidate for MNA, since natural attenuation of cobalt, lithium and beryllium is ongoing at the Site.

MNA would be effective in remediating groundwater beneath t and downgradient of the Ash Ponds. The estimated time to implement MNA is estimated to be approximately 2 to 3 years, including characterization, design, and construction. The estimated time to achieve GWPS for the target Appendix IV constituents is dependent on site-specific conditions and groundwater modelling is needed to evaluate remedial timeframes.

4.3.2 Groundwater Extraction and Treatment

Groundwater extraction and treatment is one of the most widely implemented groundwater remediation technologies and is used to provide 1) hydraulic containment and 2) treatment (USEPA 1996). A groundwater extraction and treatment system consists of the following major components:

- A series of extraction wells or trenches strategically located to modify/interrupt the natural flow of groundwater;
- Extraction pumps installed in each well/trench to pump groundwater from the subsurface;
- A treatment system to remove constituents of concern from the extracted groundwater; and
- A point of discharge for the treated groundwater (surface water, re-injection to groundwater, etc.).

For the Ash Ponds, a system of extraction wells would be installed along the downgradient edge of the ponds to provide hydraulic control of the Appendix IV constituent groundwater plumes. The extracted groundwater would be treated in an on-site treatment system and treated water would be discharged to Martin Lake or re-injected into the aquifer.

Potential groundwater treatment methods for the target Appendix IV constituents include the following:

- Cobalt - ion exchange, adsorptive media, activated carbon, and chemical treatment with membrane filtration (USEPA 2019a).
- Lithium - reverse osmosis, precipitation/co-precipitation, and ion exchange. (USACE, 2010).
- Beryllium - activated alumina, ion exchange, lime softening, coagulation/filtration, and reverse osmosis (USEPA 2003)

Treatment methods for these constituents would need to be bench/pilot tested to evaluate their effectiveness prior to designing a full-scale system. Treatment will generate residual material (sludge, regenerate brine, etc.) containing concentrated levels of the target Appendix IV constituents that must managed.

Groundwater extraction and treatment would be effective in reducing contaminant concentrations in groundwater downgradient of the Ash Ponds through hydraulic containment, but would have little effect on groundwater conditions beneath the ponds. The estimated time to implement groundwater extraction and treatment is estimated to be approximately 3 to 4 years, including testing, design, and construction. The estimated time to achieve GWPS for the target Appendix IV constituents is dependent on site-specific conditions and groundwater modeling is needed to better evaluate remedial timeframes.

4.3.3 Vertical Hydraulic Barrier

A vertical, low permeability hydraulic barrier can be installed to provide a physical barrier to groundwater flow to contain the migration of contaminated groundwater. Vertical hydraulic barriers that have been demonstrated effective at controlling groundwater flow include the following (USEPA 1998):

- Slurry Wall. Slurry walls consist of a narrow, excavated trench that is filled with a soil-bentonite slurry mixture. The slurry shores and supports the trench walls and forms a low-permeability barrier in the trench. Key design considerations include wall depth, key depth, and material compatibility. Slurry trenches can be excavated to depths of 50 feet using standard excavators and over 80 feet using long-reach excavators or a crane mounted drag line/clamshell bucket. Geosynthetic materials can be placed in the trench in conjunction with the slurry wall to improve the hydraulic performance (decrease permeability) and chemical resistance.
- Soil-Mixed Wall. Soil-mixed walls form a hydraulic barrier through in-situ mixing of soil with amendments, such as bentonite and/or cement. Soil-mixed barrier walls can be installed to depths of over 100 feet. The walls are installed by sections or panels that overlap to achieve a continuous barrier.
- Grout Curtain. Grout curtain barriers are constructed by injecting grout into the subsurface in an overlapping injection pattern to form a continuous barrier. Grouted barriers can be installed using permeation grouting, jet grouting, or vibrating beam technologies. Grouted barriers must be designed and constructed to ensure hydrofracturing does not occur and the completed wall is effective at restricting groundwater flow.
- Sheet-pile Wall. Sheet-pile walls consist of steel, vinyl, or other materials driven into the subsurface using a hydraulic percussion hammer or vibratory hammer. Sheet-pile walls are common in civil engineering applications; however, their use in environmental applications has been more limited. One of the major concerns with sheet-walls in environmental applications is leakage through the vertical joints between piles; however, improvements in pile interlock designs have been made to improve joint sealing.

For a vertical hydraulic barrier to be effective, the bottom of the barrier must be “keyed” into a low-permeability confining layer. A detailed engineering analysis and design, likely including a bench/pilot test to identify most appropriate barrier materials, would be required for the construction of a vertical hydraulic barrier.

For the Ash Ponds, the vertical hydraulic barrier would be constructed along the downgradient edge of the ponds to provide hydraulic control of the target Appendix IV constituent groundwater plumes. A vertical hydraulic barrier physically interrupts the natural flow of groundwater; consequently, groundwater elevations upgradient of the barrier will rise, potentially to the point that groundwater could begin to flow around the edges of the barrier. To address this concern, a groundwater extraction and treatment system would be required upgradient of the barrier to control the groundwater levels. The groundwater extraction and treatment system used in conjunction with the vertical hydraulic barrier would be similar to the system described in Section 4.3.2; however, the required capacity of the system would be less since the rate of groundwater extraction would be limited to that required to control upgradient groundwater levels.

Construction of a vertical hydraulic barrier is expected to require significant effort and time. Prior to implementation of the barrier, pre-design field work, including site investigations and bench/pilot-scale barrier material testing would be required, followed by full-scale design and construction. The estimated time to implement a vertical hydraulic barrier with groundwater extraction and treatment is estimated to be approximately 5 to 8 years, including testing, design, and construction. The estimated time to achieve GWPS for the target Appendix IV constituents is dependent on site-specific conditions and groundwater modeling is needed to better evaluate remedial timeframes.

4.3.4 Permeable Reactive Barrier

A permeable reactive barrier (PRB) is an in-situ, permeable treatment zone that contains reactive media designed to intercept impacted groundwater and either immobilize contaminants or transform the contaminants to a more desirable state (ITRC 2011). A PRB is a passive treatment system that acts as a barrier to groundwater contamination but not groundwater flow. The PRB must intercept the flow of impacted groundwater and must be designed and constructed such that impacted groundwater cannot bypass the reactive media by flowing over, under, or around the PRB. A PRB must include the appropriate reactive media and the residence time within the PRB needs to sufficient to allow for effective treatment. The effectiveness of the reactive media will be reduced over time and the media will likely have to be replaced periodically. Groundwater monitoring is used to evaluate the performance/effectiveness of a PRB system.

There are two primary PRB configurations: continuous and funnel-and-gate. A continuous PRB features permeable reactive media across the entire length of the barrier. A funnel-and -gate PRB uses sections of vertical hydraulic barriers to direct groundwater flow through permeable reactive media sections that allow the groundwater to pass through while treating contaminants. In both configurations, the permeability of the reactive media must be greater than the aquifer to ensure flow is not diverted around the PRB media. For the ash Ponds, a PRB system would be constructed along the downgradient edge of the ponds to provide control of the target Appendix IV groundwater plumes.

PRB systems are generally considered a proven technology, however, site conditions and the specific contaminants of interest affect the system performance. The potential applicability of a PRB system for the target Appendix IV constituents can be summarized as follows:

- Cobalt - potentially removed using sulfate-reducing media or combination of zero-valent iron (ZVI) and organic material (Ludwig 2002; ITRC 2011);
- Lithium – potentially precipitated as phosphate using appetite media, (Arnseth 2018).
- Beryllium – potentially removed through in-situ biomass sorption (Goldemund and Robb 2018)

Removal of the target Appendix IV constituents using a PRB system has not been consistently demonstrated under full-scale conditions and bench/pilot-scale testing would be required to confirm the effectiveness of a PRB system at the Site. A groundwater model would be needed to evaluate the remedial timeframes.

Similar to a vertical hydraulic barrier, construction of a PRB system is expected to require significant effort and time. Prior to implementation of the PRB, pre-design field work, including site investigations, groundwater modeling, and bench-scale soil mix testing would be required, followed by full-scale design and construction. The estimated time to implement a PRB system is estimated to be approximately 5 to 8 years, including testing, design, and construction. The estimated time to achieve GWPS for the target Appendix IV constituents is dependent on site-specific conditions and groundwater modeling is needed to better evaluate remedial timeframes.

4.3.5 In-situ Chemical Treatment

In-situ Chemical Treatment (ICT) involves the injection of a chemical reagent or other material into the groundwater aquifer to adjust the geochemistry to enhance the direct precipitation, co-precipitation, or related adsorption/precipitation of the target contaminants (USEPA 2019c). Direct precipitation occurs when a constituent exceeds its solubility in water and precipitates out of solution. Co-precipitation refers to the removal of a constituent through adsorption onto the precipitate of another chemical reaction.

Cobalt has the potential to be removed through adsorption and/or coprecipitation under reducing groundwater conditions and beryllium can potentially be removed through in-situ biomass sorption (Goldemund and Robb 2018). Lithium has the potential to be precipitated as a phosphate under appropriate geochemical conditions (Arnseth 2018).

Injection wells would be installed into the aquifer along the downgradient edge of Ash Ponds and the chemical reagents would be injected to provide control of the target Appendix IV constituent groundwater plumes.

ICT is considered an emerging remediation technology for the target Appendix IV constituents and the effectiveness of the technology on most of the constituents is uncertain. Bench/pilot-scale testing would be required to confirm the effectiveness of an ICT system at the Site. The estimated time to implement an ICT system is estimated to be approximately 5 to 8 years, including testing, design, and construction. The estimated time to achieve GWPS for the target Appendix IV constituents is dependent on site-specific conditions and groundwater modeling is needed to better evaluate remedial timeframes.

4.3.6 Phytoremediation

Phytoremediation refers to the use of plants to partially or substantially remediate selected contaminants in contaminated soil, sludge, sediment, ground water, surface water, and wastewater (USEPA 2001). The process utilizes a variety of plant biological processes and plant physical characteristics to aid in remediation; however, the primary plant process potentially applicable to the target Appendix IV constituents at the Site is phytoextraction, which is the uptake and accumulation of contaminants within aboveground portions of a plant. The contaminants are removed from the Site when the plants are harvested and managed off-site.

Phytoextraction occurs in the root zone of plants, which is typically relatively shallow, with the bulk of roots at shallower rather than deeper depths. This would limit the effectiveness of phytoextraction at the Site due to the depth of groundwater. Phytoremediation for cobalt removal from groundwater has not been demonstrated under full-scale conditions and no information concerning the effectiveness of phytoremediation for lithium and beryllium removal was identified (USEPA 2001).

Implementation of a phytoremediation process at the Site would involve planting appropriate vegetation at intervals along the downgradient edge of the Ash Ponds and across the affected groundwater plume area. A comprehensive bench/pilot testing program would be required to select the most appropriate plants for removal of the target Appendix IV constituents from groundwater at the Site. Since the target Appendix IV constituents would likely accumulate in the plants, management of harvested plants in accordance with RCRA may be required. The estimated time to implement an ICT system is estimated to be approximately 15 to 20 years, based on the success and rate of vegetation growth. The estimated time to achieve GWPS for the target Appendix IV constituents is dependent on site-specific conditions and groundwater modeling is needed to better evaluate remedial timeframes.

4.3.7 Screening of Potential Groundwater Response Technologies

Following identification of potential groundwater response technologies, Golder screened the potential options for further consideration in developing potential corrective measures alternatives for the Ash Ponds. The screening results for each potential source technology are summarized in Table 3. Based on the initial screening, the following potential groundwater response technologies were retained for future evaluation as part of the corrective measures alternatives for the Ash Ponds:

- Monitored Natural Attenuation
- Groundwater Extraction and Treatment
- Vertical Hydraulic Barrier

4.4 Potential Corrective Measures Alternatives

Based on the response technology screening discussed above, Golder assembled the following potential corrective measures alternatives that could be both effective and implementable at the Site:

- Retrofit Liners in WAP, EAP and NSP with Monitored Natural Attenuation
- Retrofit Liners in WAP, EAP and NSP with Groundwater Extraction and Treatment
- Retrofit Liners in WAP, EAP and NSP with Vertical Hydraulic Barrier

A summary of the corrective measure alternatives, including an assessment of each alternative against the evaluation criteria presented in §257.96(c) is provided in Table 4.

4.5 Remedy Selection

The corrective measure alternative proposed as the remedy for the Ash Ponds will be selected in accordance with §257.97 a minimum of 30 days after the public meeting required under §257.96(e) has been completed.

It should also be noted that, for the purposes of this ACM, cobalt, beryllium and lithium concentrations were conservatively assumed to be present at SSLs above their respective GWPSs based on the February 2019 SSL notification. However, as discussed in Sections 3.4-3.6, lithium concentrations are no longer considered to be present at SSLs above the GWPS based on recent data and naturally occurring sources of cobalt, beryllium and lithium exist in the vicinity of the Ash Ponds. Cobalt, beryllium and lithium concentrations in groundwater will continue to be monitored in accordance with the CCR rule to confirm that the concentrations of these constituents remain below the GWPSs in the future. These monitoring results, along with updated statistical analysis and alternate source demonstrations (if applicable), will be considered as part of the remedy selection process.

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Signature Page

Golder Associates Inc.

Patrick J. Behling, P.E.
Principal Engineer

William F. Vienne, P.G.
Senior Hydrogeologist

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TABLES

TABLE 1
APPENDIX IV GROUNDWATER ANALYTICAL DATA SUMMARY
MARTIN LAKE STEAM ELECTRIC STATION
ASH POND AREA

Sample Location	Date Sampled	Sb (mg/L)	As (mg/L)	Ba (mg/L)	Be (mg/L)	Cd (mg/L)	Cr (mg/L)	Co (mg/L)	Fl (mg/L)	Pb (mg/L)	Li (mg/L)	Hg (mg/L)	Mo (mg/L)	Se (mg/L)	Tl (mg/L)	Ra 226 (pCi/L)	Ra 228 (pCi/L)	Ra 226/228 Comb.^ (pCi/L)
GWPS:		0.006	0.01	2	0.004	0.005	0.1	0.0564	4	0.015	0.177	0.002	0.1	0.05	0.002	--	--	5
Upgradient Wells																		
H-26	10/21/15	<0.0008	0.00364 J	0.0785	0.000349 J	<0.0003	<0.002	0.0385	<0.1	<0.0003	0.0139	<0.00008	<0.002	<0.002	<0.0005	0.919	<1.64	2.56
	12/14/15	<0.0008	<0.002	0.0401	0.000458 J	<0.0003	<0.002	0.0244	<0.1	<0.0003	0.0769	<0.00008	<0.002	<0.002	<0.0005	0.619	<1.95	2.57
	02/23/16	<0.0008	<0.002	0.0423	<0.0003	<0.0003	0.0077	0.00813	0.151 J	0.000315 J	0.0124	<0.00008	0.00248 J	0.0022 J	<0.0005	0.37	<2.06	2.43
	04/05/16	<0.0008	<0.002	0.0408	<0.0003	<0.0003	0.00798	0.0125	0.199 J	<0.0003	0.0121	<0.00008	<0.002	<0.002	<0.0005	<0.243	<1.06	<1.303
	06/07/16	<0.0008	<0.002	0.0467	0.000721 J	<0.0003	<0.002	0.0217	<0.1	<0.0003	0.0132	<0.00008	<0.002	<0.002	<0.0005	0.245	1.67	1.92
	08/09/16	<0.0008	0.0029 J	0.0431	0.00136	<0.0003	<0.002	0.0352	<0.1	<0.0003	0.0155	<0.00008	<0.002	<0.002	<0.0005	<0.2	<0.932	<1.132
	10/18/16	<0.0008	<0.002	0.0497	0.000709 J	<0.0003	<0.002	0.0214	0.127 J	<0.0003	0.0136	<0.00008	<0.002	0.00265 J	<0.0005	0.243	<0.622	0.87
	12/11/16	<0.0008	<0.002	0.0468	0.00146	<0.0003	0.00311 J	0.0275	0.161 J	0.000358 J	0.014	<0.00008	<0.002	<0.002	<0.0005	0.248	1.82	2.07
	06/13/18	<0.0008	<0.002	0.0659	0.0016	<0.0003	0.00213 J	0.0261	<0.100	<0.0003	0.032	<0.00008	<0.002	<0.002	<0.0005	<0.297	3.72	4.017
	09/07/18	NA	<0.002	0.0470	0.00155	<0.0003	0.00319 J	0.0247	<0.100	<0.0003	0.0489	NA	NA	<0.002	NA	<0.473	<0.665	<1.138
	05/14/19	<0.0008	0.0041 J	0.1900	0.00147	<0.0003	0.0406	0.0795	0.140 J	0.000972 J	0.147	<0.00008	<0.002	0.00222 J	<0.0005	1.43	0.598	2.028
H-27	10/21/15	<0.0008	<0.002	0.0378	<0.0003	<0.0003	<0.002	0.00432 J	<0.1	<0.0003	0.0607	<0.00008	<0.002	<0.002	<0.0005	<0.553	<1.67	<2.223
	12/14/15	<0.0008	0.0021 J	0.039	<0.0003	<0.0003	<0.002	0.00326 J	0.156 J	0.000339 J	0.0624	<0.00008	<0.002	<0.002	<0.0005	0.468	<1.68	2.15
	02/23/16	<0.0008	<0.002	0.0266	<0.0003	<0.0003	<0.002	<0.003	0.101 J	<0.0003	0.0601	<0.00008	<0.002	<0.002	<0.0005	0.921	<1.62	2.54
	04/05/16	<0.0008	<0.002	0.0245	<0.0003	<0.0003	<0.002	<0.003	0.124 J	<0.0003	0.0573	<0.00008	<0.002	<0.002	<0.0005	0.269	<2.05	2.32
	06/07/16	<0.0008	<0.002	0.0342	0.000609 J	<0.0003	<0.002	0.016	<0.1	<0.0003	0.0107	<0.00008	<0.002	<0.002	<0.0005	0.269	<0.658	0.927
	08/09/16	<0.0008	<0.002	0.0241	<0.0003	<0.0003	<0.002	<0.003	<0.1	<0.0003	0.0616	<0.00008	<0.002	<0.002	<0.0005	0.408	<0.632	1.04
	10/18/16	<0.0008	<0.002	0.0248	<0.0003	<0.0003	<0.002	<0.003	0.144J	<0.0003	0.0576	<0.00008	<0.002	<0.002	<0.0005	<0.178	1.07	1.25
	12/11/16	<0.0008	<0.002	0.0236	<0.0003	<0.0003	<0.002	<0.003	0.161 J	<0.0003	0.0606	<0.00008	<0.002	<0.002	<0.0005	0.143	1.54	1.68
	06/13/18	<0.0008	<0.002	0.0237	<0.0003	<0.0003	0.00964	<0.003	0.208 J	<0.0003	0.108	<0.00008	<0.002	<0.002	<0.0005	0.267	<1.4	1.667
	09/07/18	NA	<0.002	0.0196	<0.0003	<0.0003	0.0453	<0.003	0.140 J	<0.0003	0.306	NA	NA	0.00773	NA	<0.285	1.43	1.715
	05/14/19	<0.0008	<0.002	0.0208	<0.0003	<0.0003	<0.002	<0.003	0.159 J	<0.0003	0.0678	<0.00008	<0.002	<0.002	<0.0005	1.10	0.928	2.028
H-33	10/20/15	<0.0008	0.00208 J	0.0586	0.000351 J	<0.0003	<0.002	0.0274	<0.1	<0.0003	0.0814	<0.00008	<0.002	<0.002	<0.0005	1.76	1.64	3.40
	12/14/15	<0.0008	0.00205 J	0.0473	0.000382 J	<0.0003	<0.002	0.0293	0.136 J	<0.0003	0.0903	<0.00008	<0.002	<0.002	<0.0005	1.94	<1.79	3.73
	02/23/16	<0.0008	<0.002	0.0529	0.000311 J	<0.0003	0.0194	0.0163	0.125 J	<0.0003	0.182	<0.00008	<0.002	<0.002	<0.0005	0.906	<2.32	3.23
	04/05/16	<0.0008	<0.002	0.0576	0.000302 J	<0.0003	0.0171	0.016	0.14 J	<0.0003	0.16	<0.00008	<0.002	<0.002	<0.0005	0.328	1.08	1.41
	06/07/16	<0.0008	<0.002	0.0774	0.000604 J	<0.0003	0.0153	0.0196	<0.1	<0.0003	0.163	<0.00008	<0.002	<0.002	<0.0005	0.276	0.897	1.17
	08/09/16	<0.0008	<0.002	0.0424	0.000519 J	<0.0003	0.00291 J	0.0284	<0.1	<0.0003	0.102	<0.00008	<0.002	<0.002	<0.0005	<0.149	0.649	0.80
	10/18/16	<0.0008	0.00347 J	0.0464	0.000617 J	<0.0003	0.0309	0.0644	<0.1	0.000329 J	0.118	<0.00008	<0.002	<0.002	<0.0005	0.096	<0.517	0.61
	12/11/16	<0.0008	0.00218 J	0.0537	0.000865 J	<0.0003	0.0368	0.0408	0.132 J	0.000495 J	0.115	<0.00008	<0.002	<0.002	<0.0005	0.159	1.29	1.45
	06/13/18	<0.0008	0.00283 J	0.0741	0.0004 J	<0.0003	0.0182	0.0266	0.105 J	0.0009 J	0.183	<0.00008	<0.002	<0.002	<0.0005	0.795	<0.712	1.507
	09/07/18	NA	0.00239 J	0.0757	0.0003 J	<0.0003	0.0105	0.0288	0.135 J	<0.0003	0.160	NA	NA	<0.002	NA	0.334	<0.645	0.979
	05/14/19	<0.0008	0.00355 J	0.158	0.00114	<0.0003	0.0342	0.0648	0.166 J	0.000772 J	0.161	<0.00008	<0.002	<0.002	<0.0005	0.850	1.35	2.200
Downgradient Wells																		
H-28	10/21/15	<0.0008	0.00278 J	0.0396	0.00148	0.00121	<0.002	0.188	<0.1	0.000491 J	0.154	<0.00008	<0.002	0.00682	<0.0005	<0.558	<1.65	<2.208
	12/14/15	<0.0008	<0.002	0.0224	<0.0003	0.000572 J	<0.002	0.0225	<0.1	<0.0003	0.021	<0.00008	<0.002	<0.002	<0.0005	0.707	<1.18	1.89
	02/23/16	<0.0008	0.00225 J	0.0202	0.00133	0.00151	<0.002	0.201	<0.1	0.00053 J	0.159	<0.00008	<0.002	0.00222 J	<0.0005	<0.396	2.24	2.64
	04/05/16	<0.0008	<0.002	0.0173	0.0011	0.00252	<0.002	0.199	<0.1	0.00087 J	0.15	<0.00008	<0.002	0.00237 J	<0.0005	<0.231	1.76	1.99
	06/07/16	<0.0008	<0.002	0.0468	0.000934 J	0.000664 J	<0.002	0.0944	<0.1	<0.0003	0.0959	<0.00008	<0.002	<0.002	<0.0005	0.310	1.48	1.79
	08/09/16	<0.0008	<0.002	0.0155	0.00275	0.0016	<0.002	0.195	<0.1	0.000774 J	0.155	<0.00008	<0.002	0.00286 J	<0.0005	<0.451	1.41	1.86
	10/18/16	<0.0008	0.00284J	0.0174	0.00685	0.000744 J	<0.002	0.169	0.165J	0.00108	0.155	<0.00008	<0.002	0.00273 J	<0.0005	<0.228	0.645	0.87
	12/11/16	<0.0008	<0.002	0.0471	0.000698 J	0.000668 J	<0.002	0.0924	0.114 J	<0.0003	0.0869	<0.00008	<0.002	<0.002	<0.0005	<0.149	1.13	1.28
	06/13/18	<0.0008	<0.002	0.0186	0.00393	0.0038	<0.002	0.169	0.126 J	0.000448 J	0.18	<0.00008	<0.002	<0.002	<0.0005	0.327	<1.56	1.887
	09/07/18	NA	<0.002	0.0192	0.00704	0.00115	<0.002	0.162	<0.100	0.00118 J	0.203	NA	NA	0.00281 J	NA	<0.243	0.845	1.088
	05/14/19	<0.0008	<0.002	0.0141	0.00281	0.00212	<0.002	0.187	<0.100	0.000595 J	0.172	<0.00008	<0.002	0.00619	<0.0005	0.444	0.615	1.059
H-29	10/21/15	<0.0008	<0.002	0.159	0.000359 J	<0.0003	<0.002	0.0301	<0.1	<0.0003	0.0156	<0.00008	<0.002	<0.002	<0.0005	0.464	1.82	2.28
	12/14/15	<0.0008	<0.002	0.277	<0.0003	<0.0003	0.062	<0.003	0.56	0.000542 J	0.0202	<0.00008	0.00819	0.0282	<0.0005	<0.53	<1.25	<1.78
	02/23/16	<0.0008	0.00203 J	0.151	<0.0003	<0.0003	0.019	<0.003	0.239 J	<0.0003	0.0135	<0.00008	0.00603	0.0148	<0.0005	<0.374	<2.22	<2.594
	04/05/16	<0.0008	<0.002	0.167	<0.0003	<0.0003	0.042	<0.003	0.363 J	<0.0003	0.0175	<0.00008	0.00697	0.0232	<0.0005	<0.228	<0.897	<1.125
	06/07/16	<0.0008	<0.002	0.136	<0.0003	<0.0003	0.0274	<0.003	0.27 J	<0.0003	0.0188	<0.00008	0.00551	0.0152	<0.0005	0.173	<0.834	1.01
	08/09/16	<0.0008	0.00995	0.315	<0.0003	<0.0003	0.00297 J	0.00473 J	<0.1	<0.0003	0.0143	<0.00008	<0.002	<0.002	<0.0005	0.261	<0.578	0.84
	10/18/16	<0.0008	<0.002	0.118	<0.0003	<0.0003	0.00412 J	<0.003	1.15	0.000427J	0.0056 J	<0.00008	0.00305 J	0.0681	<0.0005	0.155	<0.439	0.59
	12/11/16	<0.0008	<0.002	0.0779	<0.0003	<0.0003	<0.002	<0.003	1.4	<0.0003	<0.005	<0.00008	0.00307 J	0.0642	<0.0005	<0.113	<0.599	<0.712
	06/13/18	<0.0008	<0.002	0.0157	0.00345	0.00318	<0.002	0.153	0.123 J	0.000779 J	0.153	<0.00008	<0.002	<0.002	<0.0005	<0.274	<1.62	<1.894
	09/07/18	NA	<0.002	0.0374	0.00513	0.000938	<0.002	0.119	<0.100	0.00172	0.145	NA	NA	0.00374 J	NA	<0.371	<0.71	<1.081
	5/14/2019	<0.0008	<0.002	0.0138	0.00341	0.00219	<0.002	0.183	0.104 J	0.000543 J	0.173	<0.00008	<0.002	0.00616	<0.0005	<0.339	<0.707	<1.046

TABLE 1
APPENDIX IV GROUNDWATER ANALYTICAL DATA SUMMARY
MARTIN LAKE STEAM ELECTRIC STATION
ASH POND AREA

Sample Location	Date Sampled	Sb (mg/L)	As (mg/L)	Ba (mg/L)	Be (mg/L)	Cd (mg/L)	Cr (mg/L)	Co (mg/L)	Fl (mg/L)	Pb (mg/L)	Li (mg/L)	Hg (mg/L)	Mo (mg/L)	Se (mg/L)	Tl (mg/L)	Ra 226 (pCi/L)	Ra 228 (pCi/L)	Ra 226/228 Comb.^ (pCi/L)
GWPS:		0.006	0.01	2	0.004	0.005	0.1	0.0564	4	0.015	0.177	0.002	0.1	0.05	0.002	--	--	5
H-31	10/20/15	<0.0008	0.0168	0.0732	0.0126	0.0032	0.00687	0.434	0.889	<0.0003	0.137	<0.00008	<0.002	0.116	<0.0005	0.943	<1.88	2.82
	12/14/15	<0.0008	0.00513	0.0388	0.00702	<0.0003	0.00456 J	0.0651	0.692	<0.0003	0.149	<0.00008	<0.002	0.0231	<0.0005	1.61	<1.29	2.90
	02/23/16	<0.0008	0.00436 J	0.0243	0.0101	<0.0003	<0.002	0.0594	0.921	<0.0003	0.146	<0.00008	<0.002	0.0209	<0.0005	<0.419	<1.64	<2.059
	04/05/16	<0.0008	0.00514	0.0241	0.00925	<0.0003	0.00435 J	0.0685	1.36	<0.0003	0.146	<0.00008	<0.002	0.0226	<0.0005	<0.334	<0.897	<1.231
	06/07/16	<0.0008	0.0038 J	0.0242	0.00789	<0.0003	<0.002	0.0406	0.783	<0.0003	0.157	<0.00008	<0.002	0.0307	<0.0005	0.257	<0.555	0.81
	08/09/16	<0.0008	0.00886	0.0191	0.00734	<0.0003	<0.002	0.286	0.216 J	<0.0003	0.17	<0.00008	<0.002	0.0202	<0.0005	1.31	0.900	2.21
	10/18/16	<0.0008	0.00351 J	0.0215	0.00167 J	<0.0003	<0.002	0.0304 J	0.298 J	<0.0003	0.165	<0.00008	<0.002	0.00567 J	<0.0005	0.169	1.18	1.35
	12/11/16	<0.0008	0.00875 J	0.0189	0.0197	<0.0003	0.00386 J	0.23 J	0.892	<0.0003	0.198	<0.00008	<0.002	0.0365	<0.0005	0.195	<0.754	0.95
	06/12/18	<0.0008	0.00532	0.0194	0.00545	<0.0003	0.003 J	0.236	0.646	<0.0003	0.214	<0.00008	<0.002	0.00475 J	<0.0005	<0.26	<0.597	<0.857
	09/07/18	NA	<0.002	0.0287	<0.0003	<0.0003	<0.002	0.00353 J	0.275 J	<0.0003	0.0187	NA	NA	0.00424 J	NA	<0.261	<0.567	<0.828
	05/14/19	<0.0008	0.00675	0.0163	0.00928	<0.0003	0.00315 J	0.389	0.96	<0.0003	0.219	<0.0004	<0.002	0.0261	<0.0005	2.62	<0.789	3.409
H-32	10/20/15	<0.0008	0.0028 J	0.16	0.00266	<0.0003	<0.002	0.163	0.374 J	<0.0003	0.0788	<0.00008	<0.002	0.00303 J	<0.0005	1.05	<1.90	2.95
	12/14/15	<0.0008	0.0123	0.0384	0.00313	<0.0003	<0.002	0.155	0.619	<0.0003	0.0733	<0.00008	<0.002	<0.002	<0.0005	0.712	<2.21	2.92
	02/23/16	<0.0008	0.00712	0.0277	0.00452	<0.0003	<0.002	0.188	0.701	0.000326 J	0.0821	<0.00008	<0.002	<0.002	<0.0005	1.12	1.60	2.72
	04/05/16	<0.0008	0.00648	0.0237	0.00527	0.00128	<0.002	0.208	1.05	0.00182	0.0818	<0.00008	<0.002	<0.002	<0.0005	<0.364	<1.15	<1.514
	06/07/16	<0.0008	0.00446 J	0.0238	0.00583	0.000997 J	<0.002	0.207	0.858	0.00168	0.087	<0.00008	<0.002	0.00298 J	<0.0005	<0.165	0.613	0.778
	08/09/16	<0.0008	0.00344 J	0.0234	0.00548	0.000713 J	<0.002	0.19	0.68	0.00115	0.0774	<0.00008	<0.002	0.00281 J	<0.0005	2.56	<0.446	3.01
	10/18/16	<0.0008	0.00289 J	0.02	0.00567	0.00254	<0.002	0.204	0.904	0.00332	0.0834	<0.00008	<0.002	0.00267 J	<0.0005	<0.139	0.683	0.82
	12/11/16	<0.0008	0.00246 J	0.0205	0.00609	0.00108	<0.002	0.208	1	0.00137	0.0838	<0.00008	<0.002	0.00237 J	<0.0005	<0.163	<0.753	<0.916
	06/12/18	<0.0008	<0.002	0.0175	0.00681	0.000586 J	<0.002	0.215	1.02	0.000701 J	0.0957	<0.00008	<0.002	<0.002	<0.0005	<0.275	0.917	1.192
	09/07/18	NA	<0.002	0.0404	<0.0003	<0.0003	<0.002	0.00347 J	0.551	<0.0003	0.0195	NA	NA	0.0157	NA	0.343	1.25	1.593
	05/14/19	<0.0008	0.002 J	0.0162	0.00713	0.000366 J	<0.002	0.202	1.15	0.000574 J	0.0978	<0.00008	<0.002	0.00675	<0.0005	0.303	<0.546	<0.849

Notes:
1. Abbreviations: GWPS - groundwater protection standard; mg/L - milligrams per liter; pCi/L - picocuries per liter.
2. ^ - Sum of Ra 226 and Ra 228 concentrations. Non-detect isotope results were assigned a value equal to the minimum detectable concentration.
3. J - concentration is below method quantitation limit; result is an estimate.
4. NA = Not analyzed.

Table 2

Screening of Potential Groundwater Response Technologies
Martin Lake Steam Electric Station
Ash Ponds

Groundwater Response Technology	Description	Protective of Human Health and Environment	Attain Groundwater Protection Standard	Control Source of Release	Remove Contaminated Material From Environment	RCRA Compliance	Screening Comments	Retained for Further Evaluation
Monitored Natural Attenuation	Natural processes (dispersion, dilution, sorption, coprecipitation, degradation/transformation, etc.) remove CCR constituents from groundwater in-situ. Groundwater monitoring to verify MNA effectiveness.	Migration of CCR constituents in groundwater controlled and CCR concentrations in groundwater reduced.	CCR constituents removed through adsorption, precipitation or coprecipitation. CCR constituents removed from groundwater and retained in aquifer soil matrix to achieve GWPS below and downgradient of CCR Unit.	CCR constituents removed from groundwater below and downgradient of CCR Unit.	CCR constituents removed from groundwater and retained in aquifer soil matrix.	Purge water from groundwater monitoring requires management in accordance with applicable RCRA requirements.	Site is good MNA candidate for CCR constituents based on field MNA evaluation. Long-term groundwater monitoring required. Easy to implement. Groundwater modelling required to assess remediation timeframe.	Yes
Groundwater Extraction and Treatment	System of extraction wells along downgradient edge of ponds to provide hydraulic control of CCR constituent groundwater plumes. Extracted groundwater treated in an on-site treatment system and discharged to Martin Lake or re-injected into aquifer. Groundwater monitoring to verify system effectiveness.	Migration of CCR constituents in groundwater controlled.	GWPS attained downgradient of CCR Unit, but limited effect on concentrations beneath unit.	CCR groundwater constituents contained at edge of ponds.	CCR constituents removed from extracted groundwater by treatment system. Treatment residuals (sludge, regenerate brine, etc.) require management.	Treatment residuals (sludge, regenerate brine, etc.) require management in accordance with applicable RCRA requirements.	Regulatory authorization for treated water discharge required. Bench/pilot testing of treatment system required. Groundwater modelling required to assess remediation timeframe.	Yes
Vertical Hydraulic Barrier	Vertical, low permeability hydraulic barrier along downgradient edge of ponds to provide hydraulic control of CCR constituent groundwater plumes. Groundwater extraction and treatment required upgradient of barrier to control groundwater elevations. Groundwater monitoring to verify system effectiveness.	Migration of CCR constituents in groundwater controlled.	GWPS attained downgradient of CCR Unit, but limited effect on concentrations beneath unit.	CCR groundwater constituents contained at edge of ponds.	CCR constituents removed from extracted groundwater by treatment system. Treatment residuals (sludge, regenerate brine, etc.) require management.	Excavated soil generated from barrier installation requires testing and management as necessary. Treatment residuals (sludge, regenerate brine, etc.) require management in accordance with applicable RCRA requirements.	Bench/pilot test of barrier materials likely required. Regulatory authorization for treated water discharge required. Bench/pilot testing of treatment system required. Groundwater modelling required to assess remediation timeframe.	Yes

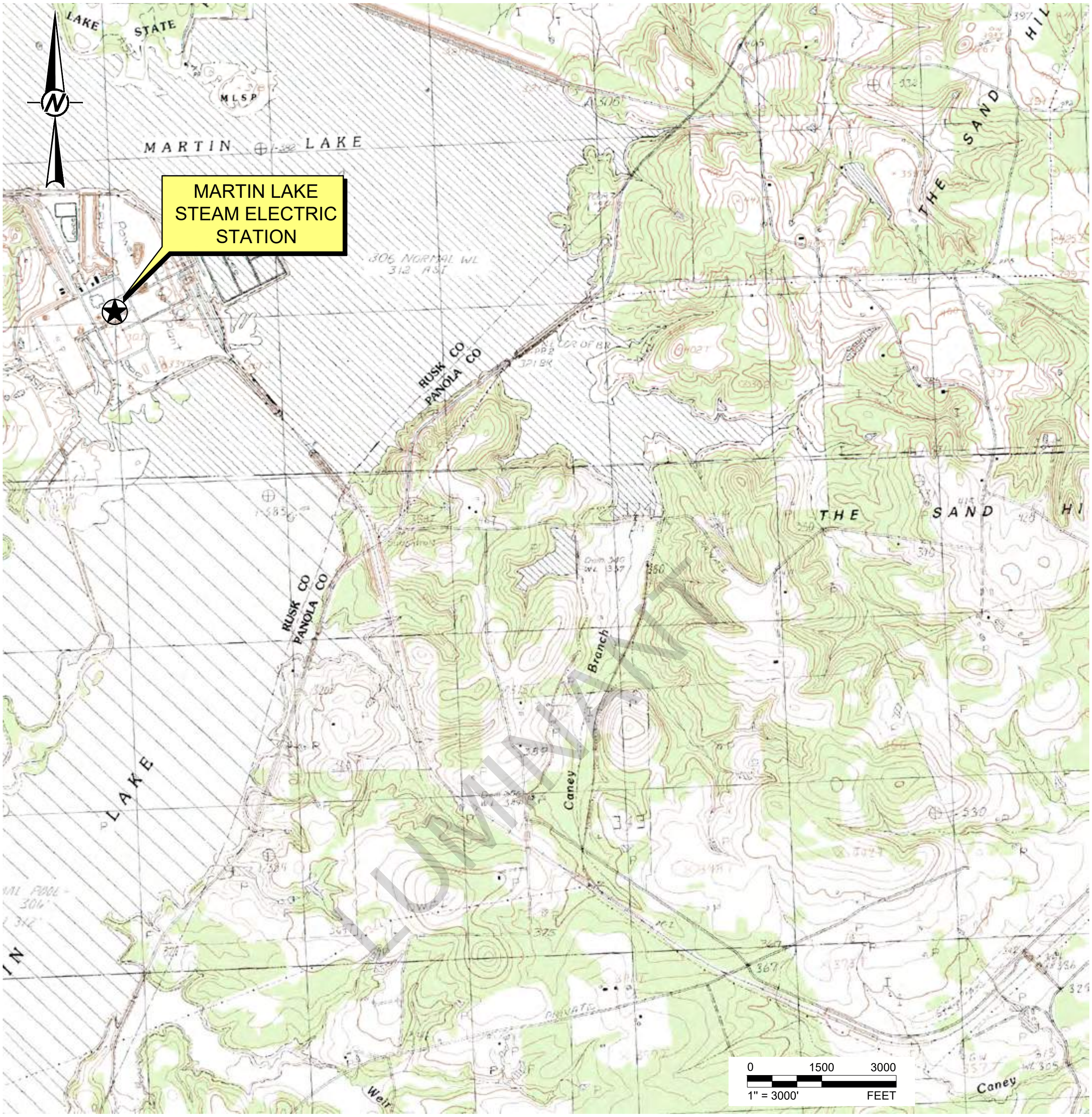
Groundwater Response Technology	Description	Protective of Human Health and Environment	Attain Groundwater Protection Standard	Control Source of Release	Remove Contaminated Material From Environment	RCRA Compliance	Screening Comments	Retained for Further Evaluation
Permeable Reactive Barrier	In-situ, passive, permeable treatment zone containing reactive media designed to intercept impacted groundwater and adjust geochemistry to immobilize CCR contaminants. CCR constituents removed from groundwater through adsorption and/or coprecipitation under reducing groundwater conditions. PRB acts as a barrier to groundwater contamination but not groundwater flow. Groundwater monitoring to verify system effectiveness.	Migration of CCR constituents in groundwater controlled.	GWPS attained downgradient of CCR Unit, but limited effect on concentrations beneath unit.	CCR groundwater constituents removed from groundwater downgradient of CCR Unit.	CCR constituents removed from groundwater and retained on reactive media or aquifer soil matrix.	Excavated soil generated from PRB installation requires testing and management as necessary.	CCR constituent removal using PRB possible but full-scale performance uncertain. Reactive media effectiveness reduced over time and media likely replaced periodically. Bench/pilot testing of PRB media/system required. Groundwater modelling required to assess remediation timeframe.	No
In-Situ Chemical Treatment	Injection of chemical/material into aquifer to adjust geochemistry and enhance precipitation, co-precipitation, or indirect adsorption of CCR constituents. CCR constituents potentially removed through adsorption, precipitation and/or coprecipitation. Groundwater monitoring to verify system effectiveness.	Migration of CCR constituents in groundwater controlled.	GWPS attained downgradient of CCR Unit, but limited effect on concentrations beneath unit.	CCR groundwater constituents removed from groundwater downgradient of CCR Unit.	CCR constituents removed from groundwater and retained on aquifer soil matrix.	No significant RCRA compliance issues anticipated.	ICT considered emerging remediation technology for CCR constituents - not demonstrated under full-scale conditions. Bench/pilot-scale testing of ICT system required. Groundwater modelling required to assess remediation timeframe.	No
Phytoremediation	Use of plants to remove CCR constituents through uptake and accumulation within above ground portions of the plant. Primary plant process for CCR constituent removal is phytoextraction (uptake/accumulation of contaminants within aboveground portions of a plant). Groundwater monitoring to verify system effectiveness.	Migration of CCR constituents in groundwater controlled.	GWPS attained downgradient of CCR Unit, but limited effect on concentrations beneath unit.	CCR groundwater constituents removed from groundwater downgradient of CCR Unit.	CCR constituents removed from groundwater and accumulates in plants.	Management of harvested plants in accordance with RCRA may be required if accumulated CCR constituent concentrations are high.	Phytoextraction occurs in shallow root zone of plants, which limits the effectiveness for the groundwater depths at the Site. Phytoremediation for CCR constituent removal from groundwater has not been demonstrated under full-scale conditions Bench/pilot-scale testing of phytoremediation system required. Groundwater modelling required to assess remediation timeframe.	No

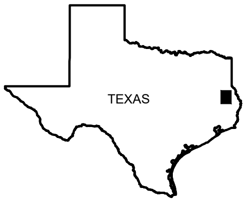
Table 3

Evaluation of Corrective Measures Alternatives
Martin Lake Steam Electric Station
Ash Ponds

Corrective Measures Alternative	Description	Performance	Reliability	Ease of Implementation	Potential Impacts	Time Requirements	Institutional Requirements
Retrofit Liners in WAP, EAP and NSP with Monitored Natural Attenuation	New Liners in WAP, EAP and NSP. MNA to remove CCR constituents from groundwater and control migration. Groundwater monitoring to verify MNA effectiveness.	New Liners in WAP, EAP and NSP isolate CCR material in pond and mitigate on-going source of CCR constituents to groundwater. Site is good MNA candidate for CCR constituents based on MNA field evaluation.	Liner construction is a common and effective source control technology. On-going attenuation of CCR constituents in groundwater demonstrated during MNA field evaluation. Groundwater monitoring used to verify long-term MNA effectiveness.	Readily implementable with common construction techniques.	Source controlled through pond liner systems. CCR constituents removed from groundwater beneath and downgradient of ponds.	Retrofit Implementation: 1-2 years per pond. MNA Implementation: 2-3 years. Groundwater modelling required to assess remediation timeframe.	Minimal regulatory requirements.
Retrofit Liners in WAP, EAP and NSP with Groundwater Extraction and Treatment	New Liners in WAP, EAP and NSP. System of extraction wells along downgradient edge of ponds to provide hydraulic control of CCR constituent groundwater plumes. Extracted groundwater treated in an on-site treatment system and discharged to Martin Lake or re-injected into aquifer. Groundwater monitoring to verify system effectiveness.	New Liners in WAP, EAP and NSP isolate CCR material in pond and mitigate on-going source of CCR constituents to groundwater. Migration of CCR constituents in groundwater controlled at pond boundaries by extraction wells.	Liner construction is a common and effective source control technology. Groundwater extraction and treatment is a common and effective hydraulic control technology. Treatment system operational reliability is key component of overall reliability.	Readily implementable with common construction techniques. Bench/pilot testing of treatment system required. Regulatory authorization for treated water discharge could be difficult to obtain.	Source controlled through pond liner systems. Control of CCR constituent migration downgradient of ponds by extraction wells. Extraction system does not address groundwater beneath ponds.	Retrofit Implementation: 1-2 years per pond. GW Ext/Treatment Implementation: 3-4 years. Groundwater modelling required to assess remediation timeframe.	Regulatory authorization for treated water discharge required. Treatment system residuals (sludge, regenerate brine, etc.) require management.
Retrofit Liners in WAP, EAP and NSP with Vertical Hydraulic Barrier and Groundwater Extraction and Treatment	New Liners in WAP, EAP and NSP. Vertical, low permeability hydraulic barrier along downgradient edge of ponds to provide hydraulic control of CCR constituent groundwater plumes. Groundwater extraction and treatment required upgradient of barrier to control groundwater elevations. Groundwater monitoring to verify system effectiveness.	New Liners in WAP, EAP and NSP isolate CCR material in pond and mitigate on-going source of CCR constituents to groundwater. Migration of CCR constituents in groundwater controlled at pond boundaries by vertical barrier. Groundwater elevations upgradient of barrier controlled by groundwater extraction.	Liner construction is a common and effective source control technology. Vertical hydraulic barrier must be keyed into lower impermeable layer. Groundwater extraction and treatment is a common and effective hydraulic control technology. Treatment system operational reliability is key component of overall reliability.	Readily implementable with common construction techniques. Bench/pilot testing of treatment system required. Regulatory authorization for treated water discharge could be difficult to obtain.	Source controlled through pond liner systems. Control of CCR constituent migration downgradient of pond by vertical barrier. Vertical barrier does not address groundwater beneath pond.	Retrofit Implementation: 1-2 years per pond. Barrier and GW Ext/Treat Implementation: 5-8 years. Groundwater modelling required to assess remediation timeframe.	Regulatory authorization for treated water discharge required. Treatment system residuals (sludge, regenerate brine, etc.) require management.

FIGURES





QUADRANGLE LOCATION

REFERENCE(S)

BASE MAP TAKEN FROM TNRIS.GOV, TATUM, TX 7.5 MIN. USGS QUADRANGLE DATED 1983.

CLIENT
LUMINANT

PROJECT
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

TITLE
SITE LOCATION MAP

CONSULTANT
GOLDER

YYYY-MM-DD	2019-08-28
DESIGNED	AJD
PREPARED	AJD
REVIEWED	WFV
APPROVED	WFV

PROJECT NO.
19121403

REV.
0

FIGURE
1

Last Edited By: adiamond Date: 2019-08-28 Time:12:07:47 PM | Printed By: adiamond Date: 2019-08-28 Time:12:09:57 PM
Path: \\texarkanaldata\Projects - Round Rock\19121403 - Luminant\Martin Lake Ash Pond Area\ | File Name: FIG 1 - Site Location Map.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
0
1 in

LEGEND

🟥	DOWNGRADIENT CCR MONITORING WELL
🟥	UPGRADIENT CCR MONITORING WELL
●	LAKE WATER/GROUNDWATER MIXING ZONE SAMPLE
■	MNA SOIL SAMPLE
A —— A'	CROSS SECTION LOCATION

REFERENCE(S)

BASE MAP TAKEN FROM GOOGLE EARTH, IMAGERY DATED 4/6/17.

CLIENT
LUMINANT

PROJECT
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

TITLE
DETAILED SITE PLAN - ASH POND AREA

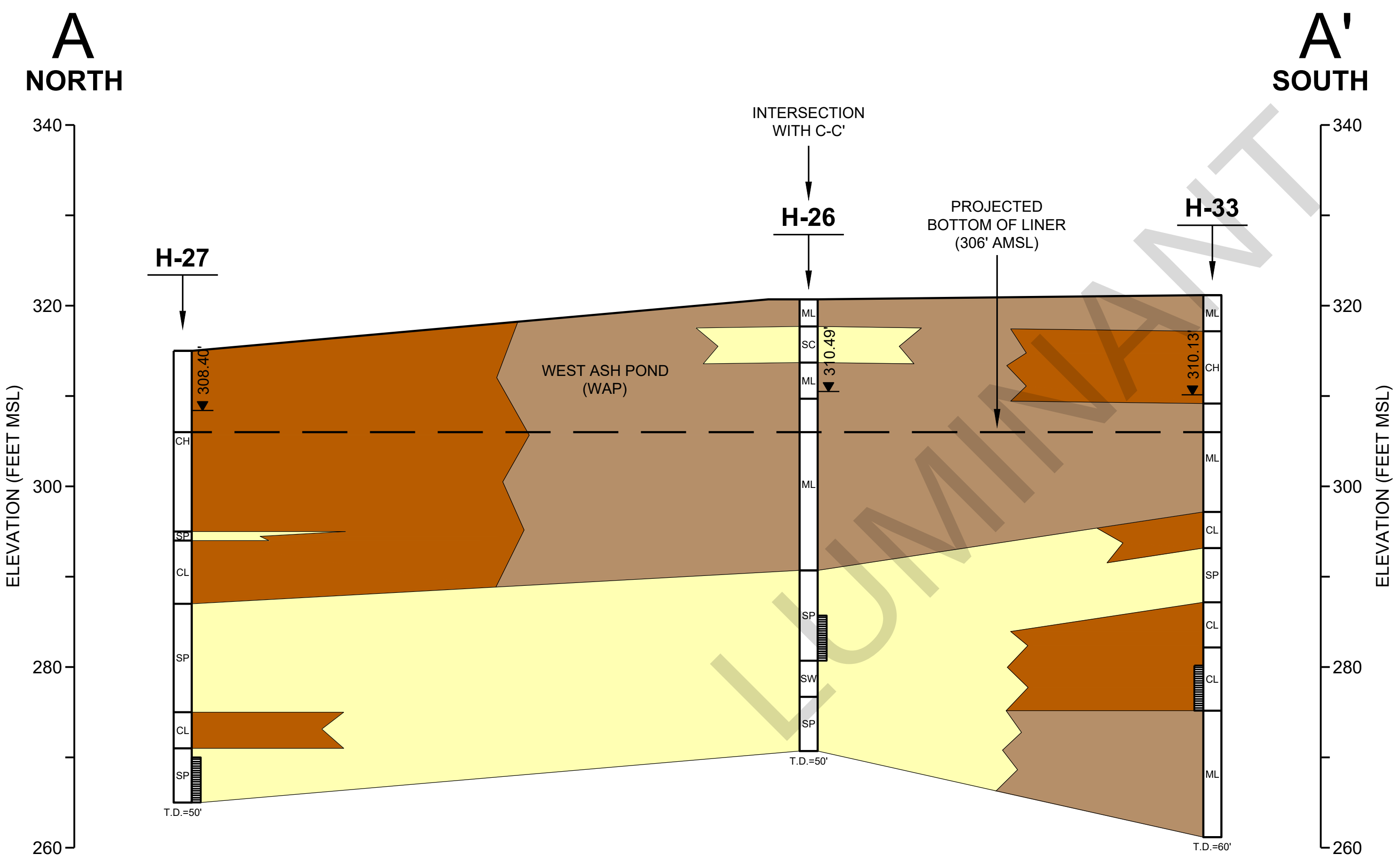
CONSULTANT
GOLDER

YYYY-MM-DD	2019-08-28
DESIGNED	AJD
PREPARED	AJD
REVIEWED	WFV
APPROVED	WFV

PROJECT NO.	REV.	FIGURE
19121403	0	2

Last Edited By: adiamond Date: 2019-08-28 Time:12:16:40 PM | Printed By: adiamond Date: 2019-08-28 Time:12:33:09 PM
Path: \\texarkana\data\Projects - Round Rock\19121403 - Luminant\Martin Lake Ash Pond Area\ | File Name: FIG 2 - Detailed Site Plan (Ash Pond Area).dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
1 in
0



LEGEND

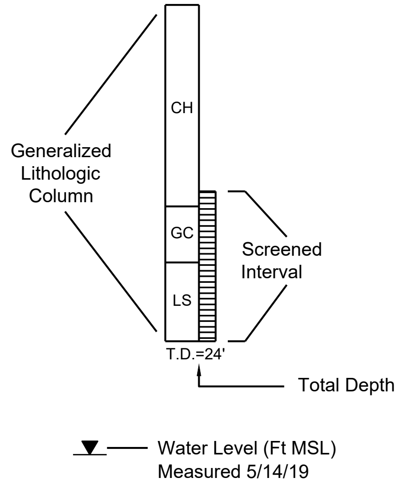
▨ FILL

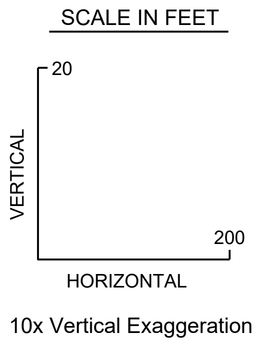
▨ SAND

▨ CLAY

▨ SILT

MONITORING WELL CONSTRUCTION





CLIENT
LUMINANT

PROJECT
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

TITLE
ASH POND AREA - GEOLOGIC CROSS SECTION A-A'
WEST SIDE OF WEST ASH POND
THROUGH PROCESS WATER POND

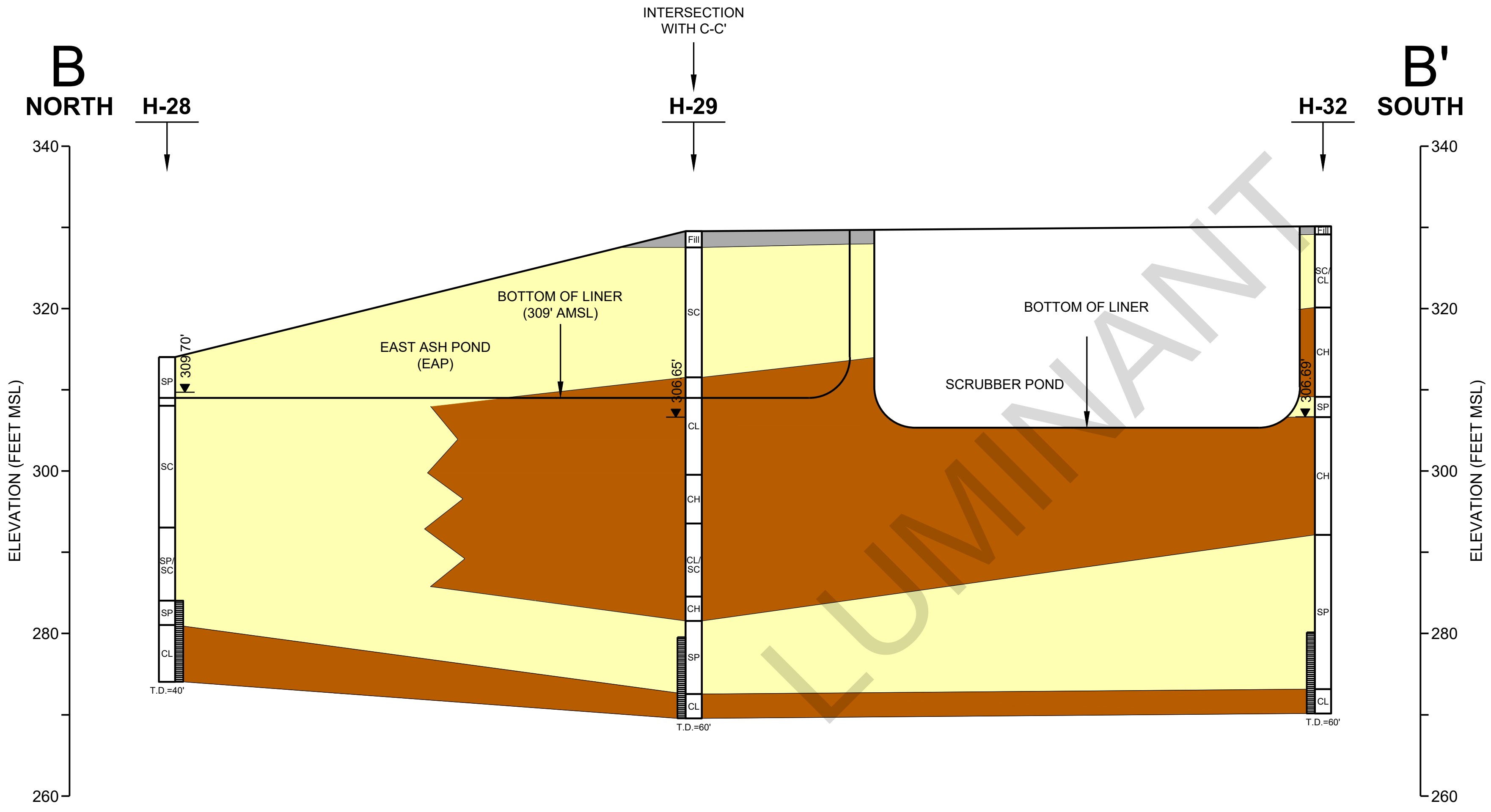
CONSULTANT
GOLDER

YYYY-MM-DD	2019-08-28
DESIGNED	AJD
PREPARED	AJD
REVIEWED	WFV
APPROVED	WFV

PROJECT NO.
19121403

REV.
0

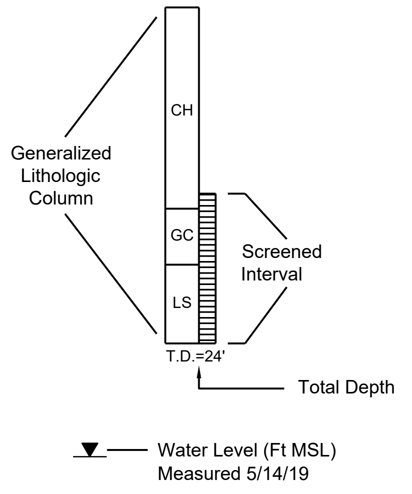
FIGURE
3

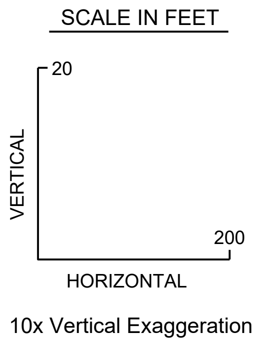


LEGEND

- ▨ FILL
- ▨ SAND
- ▨ CLAY
- ▨ SILT

MONITORING WELL CONSTRUCTION





CLIENT
LUMINANT

PROJECT
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

TITLE
ASH POND AREA - GEOLOGIC CROSS SECTION B-B'
EAST SIDE OF ASH POND THROUGH SCRUBBER POND

CONSULTANT
GOLDER

YYYY-MM-DD	2019-08-28
DESIGNED	AJD
PREPARED	AJD
REVIEWED	WFV
APPROVED	WFV

PROJECT NO. 19121403
REV. 0
FIGURE 4

Path: \\texarkana\data\Projects - Round Rock\19121403 - Luminant\Martin Lake Ash Pond Area\ | File Name: FIG 3-5 - Cross Sections.dwg | Last Edited By: adiamond Date: 2019-08-28 Time:2:30:44 PM | Printed By: adiamond Date: 2019-08-28 Time:2:53:35 PM

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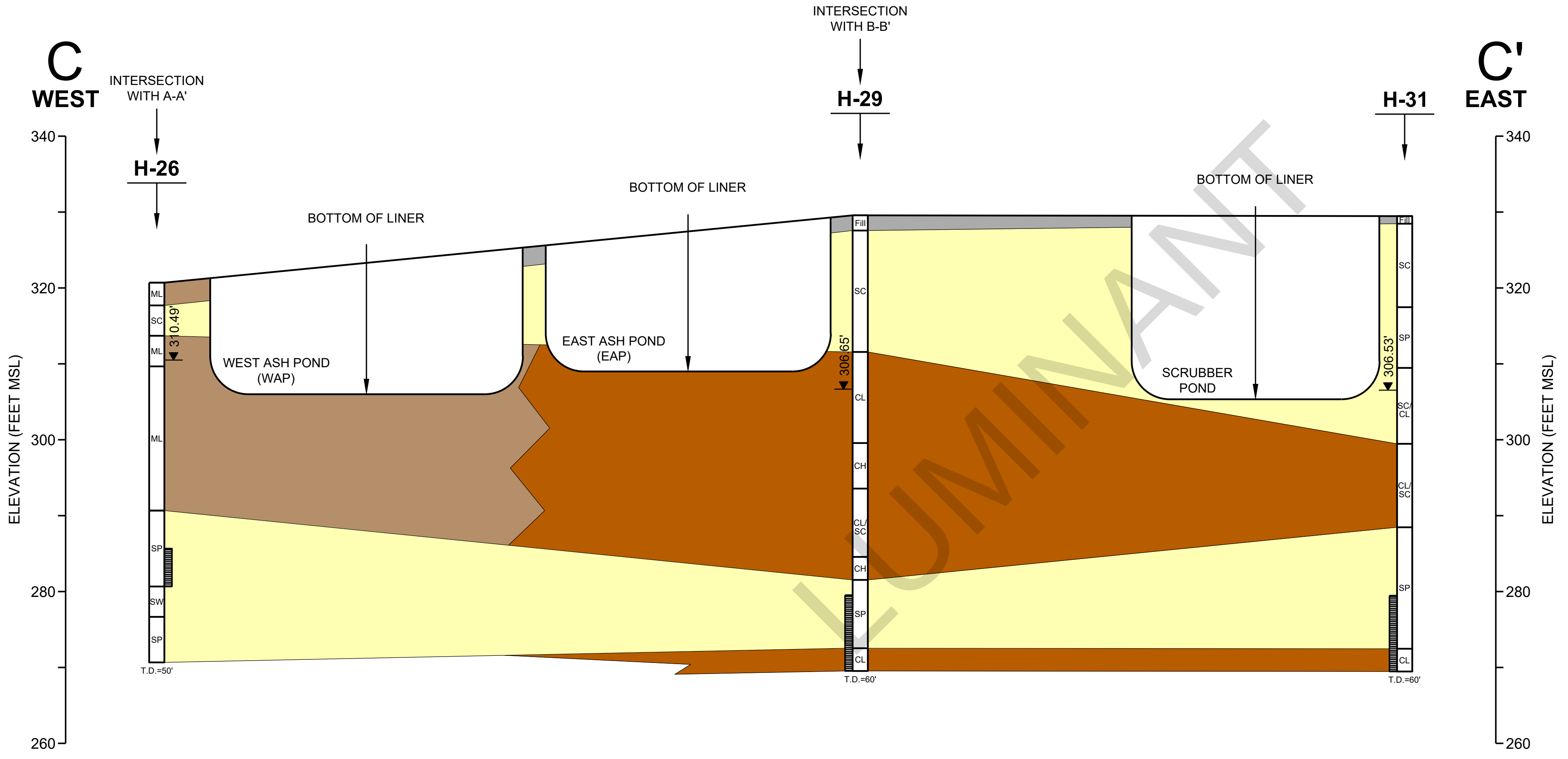
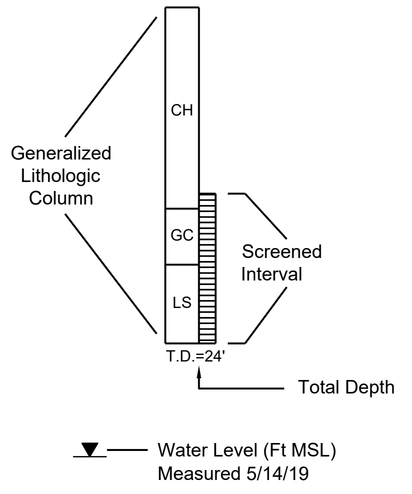
1 in



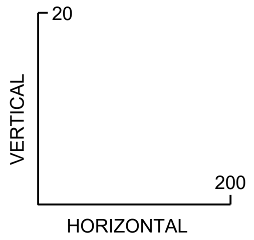
LEGEND

▨	FILL
▨	SAND
▨	CLAY
▨	SILT

MONITORING WELL CONSTRUCTION



SCALE IN FEET



10x Vertical Exaggeration

CLIENT
LUMINANT

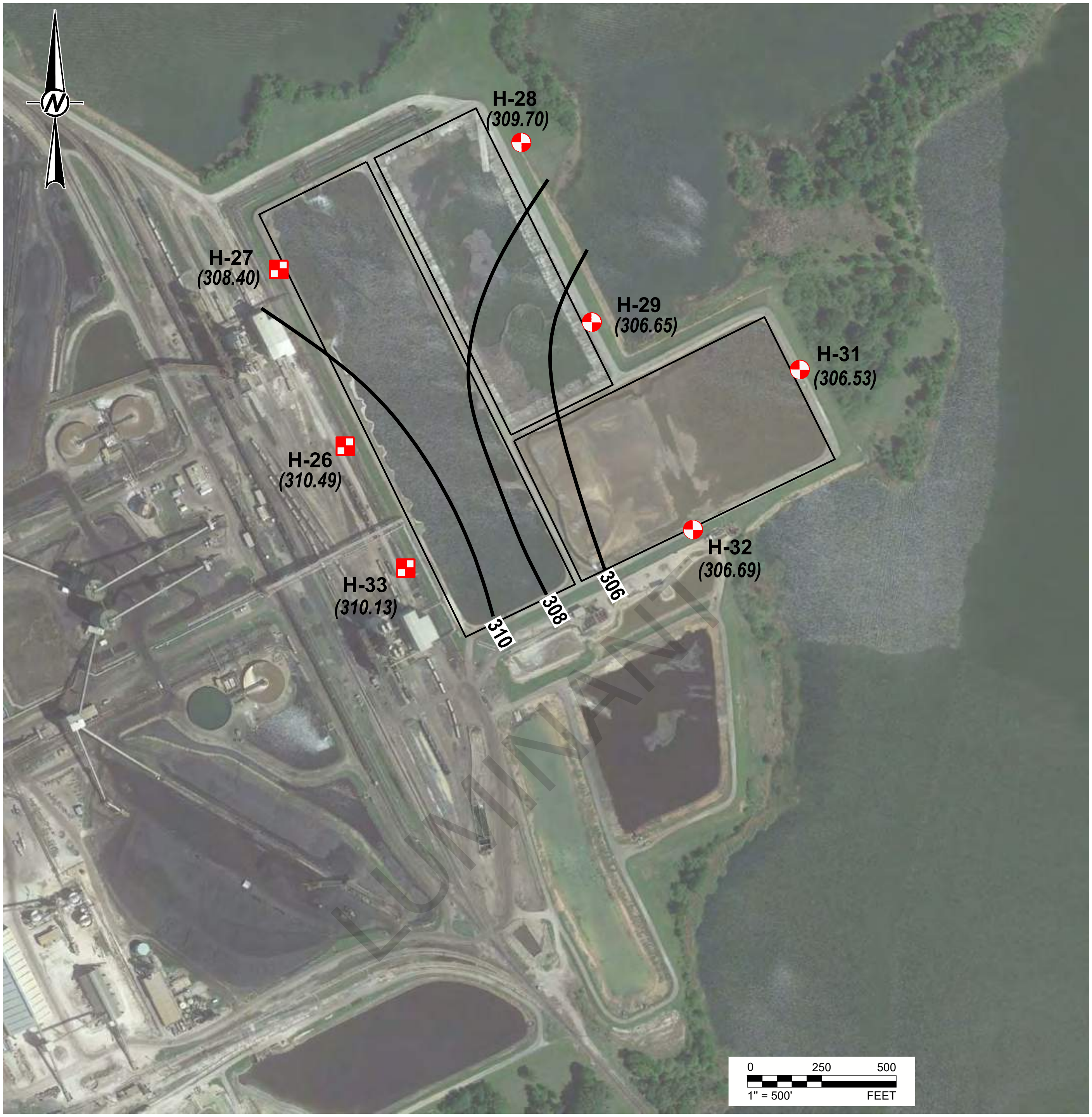
PROJECT
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

TITLE
ASH POND AREA - GEOLOGIC CROSS SECTION C-C'
THROUGH WEST ASH POND AND EAST ASH POND

CONSULTANT
GOLDER

YYYY-MM-DD	2019-08-28
DESIGNED	AJD
PREPARED	AJD
REVIEWED	WFV
APPROVED	WFV

PROJECT NO.	REV.	FIGURE
19121403	0	5



LEGEND

⊕	DOWNGRADIENT CCR MONITORING WELL
▣	UPGRADIENT CCR MONITORING WELL
(308.70)	GROUNDWATER POTENTIOMETRIC SURFACE (FT MSL)
—— 308 ——	GROUNDWATER POTENTIOMETRIC SURFACE CONTOUR (C.I. = 1 FT)

REFERENCE(S)

BASE MAP TAKEN FROM GOOGLE EARTH, IMAGERY DATED 4/6/17.

CLIENT
LUMINANT

PROJECT
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

TITLE
ASH POND AREA
POTENTIOMETRIC SURFACE MAP
MAY 14, 2019

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-24
DESIGNED	AJD
PREPARED	AJD
REVIEWED	WFV
APPROVED	WFV

PROJECT NO.	REV.	FIGURE
19122449	0	6

LEGEND

◐	DOWNGRADIENT CCR MONITORING WELL
▣	UPGRADIENT CCR MONITORING WELL
●	LAKE WATER/GROUNDWATER MIXING ZONE SAMPLE
■	MNA SOIL SAMPLE
🟨	SSLs FOR ONE OR MORE APPENDIX IV CONSTITUENTS IN DOWNGRADIENT WELLS BASED ON INITIAL STATISTICAL EVALUATION
☐	SSLs FOR ONE OR MORE APPENDIX IV CONSTITUENTS IN DOWNGRADIENT WELLS BASED ON UPDATED STATISTICAL EVALUATION

REFERENCE(S)

BASE MAP TAKEN FROM GOOGLE EARTH, IMAGERY DATED 4/6/17.

CLIENT

LUMINANT

PROJECT

MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS

TITLE

ASH POND AREA
EXTENT OF APPENDIX IV CONSTITUENTS
DETECTED AT SSLs ABOVE GWPSs

CONSULTANT

GOLDER

YYYY-MM-DD	2019-08-29
DESIGNED	AJD
PREPARED	AJD
REVIEWED	WFV
APPROVED	WFV

PROJECT NO.	REV.	FIGURE
19121403	0	7

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Path: \\texarkanaldata\Projects - Round Rock\19121403 - Luminant\Martin Lake Ash Pond Area\ | File Name: FIG 7 - Extent of App IV Constituents (Ash Pond Area).dwg

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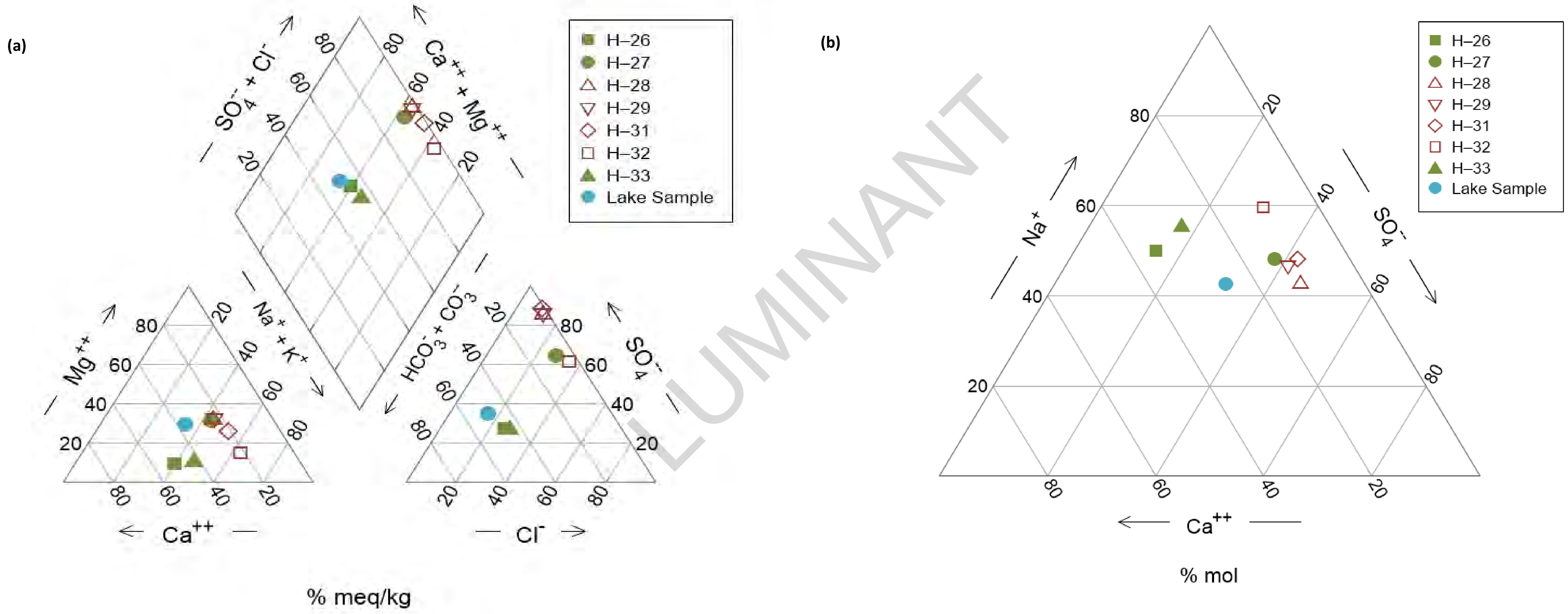
1 in



CLIENT
LUMINANT
MARTIN LAKE SES
ASH POND AREA

CONSULTANT
GOLDER

PROJECT
ASSESSMENT OF CORRECTIVE MEASURES
GEOCHEMICAL ASSESSMENT

TITLE
**MAJOR GROUNDWATER CEHMISTRY (A)
AND SELECT RELATIVE ION ABUNDANCE (B)
IN GROUNDWATER AT MONITORING WELLS**

PROJECT NO.	PHASE	REV.	FIGURE
19122434	01	A	8a-b

PATH: C:\Users\pjnolan\Golder Associates\19121403,Luminant CCR ACM Reports - 5 Technical Work\Phase 1000 - ML Ash Pond Area | FILE NAME: Geochem Figures.xlsx

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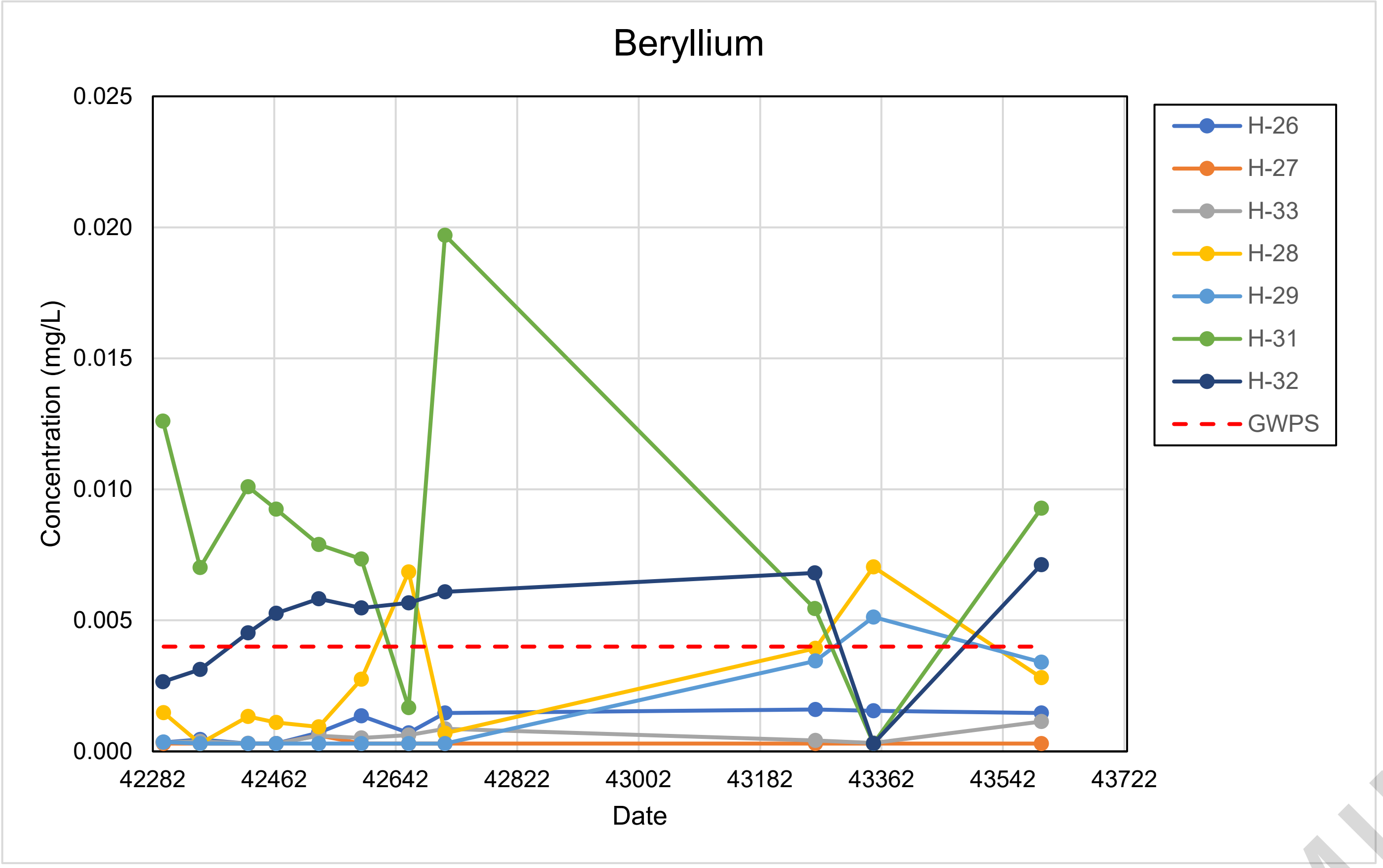

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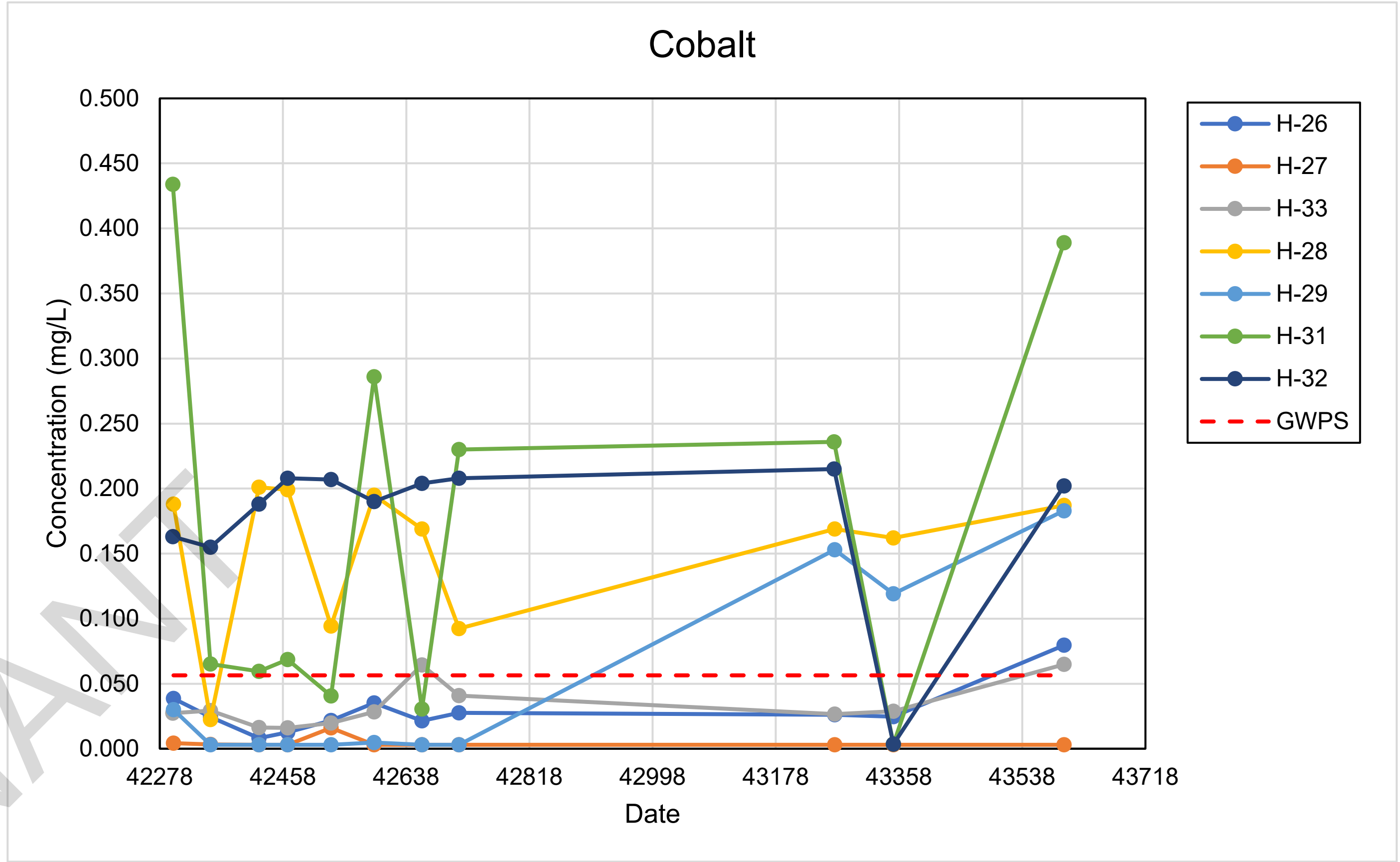

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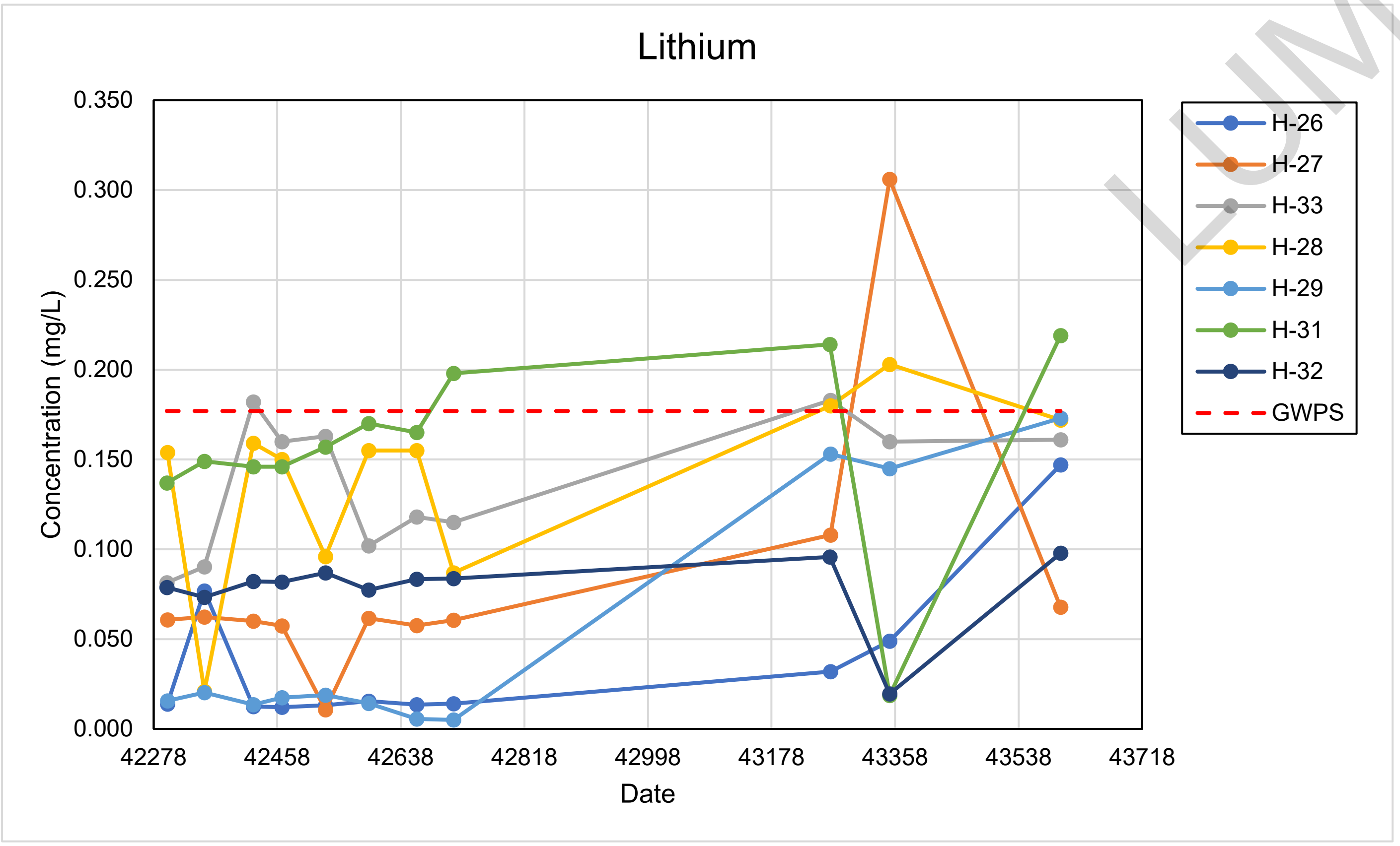


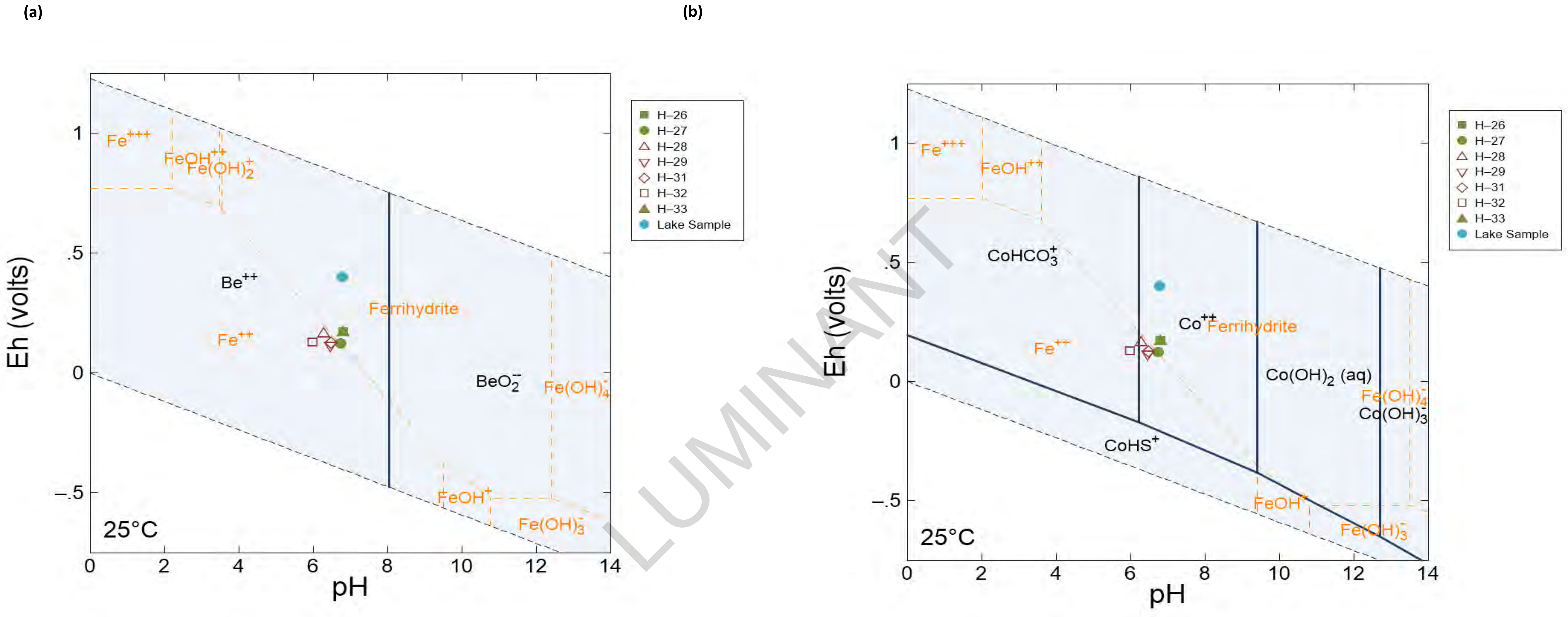
CLIENT
LUMINANT
MARTIN LAKE SES
ASH POND AREA

CONSULTANT
GOLDER

PROJECT
ASSESSMENT OF CORRECTIVE MEASURES
GEOCHEMICAL ASSESSMENT

TITLE
HISTORICAL TRENDS OF BERYLLIUM (A), COBALT (B), AND
LITHIUM (C), IN GROUNDWATER AT MONITORING WELLS

PROJECT NO.	PHASE	REV.	FIGURE
19122434	01	A	9a-c



CLIENT
LUMINANT
MARTIN LAKE SES
ASH POND AREA

CONSULTANT
GOLDER

PROJECT
ASSESSMENT OF CORRECTIVE MEASURES
GEOCHEMICAL ASSESSMENT

TITLE
SPECIATION OF BERYLLIUM (A), AND
COBALT (B), IN GROUNDWATER

PROJECT NO.	PHASE	REV.	FIGURE
164817101	01	A	10a-b

APPENDIX A

BORING LOGS

Luminant

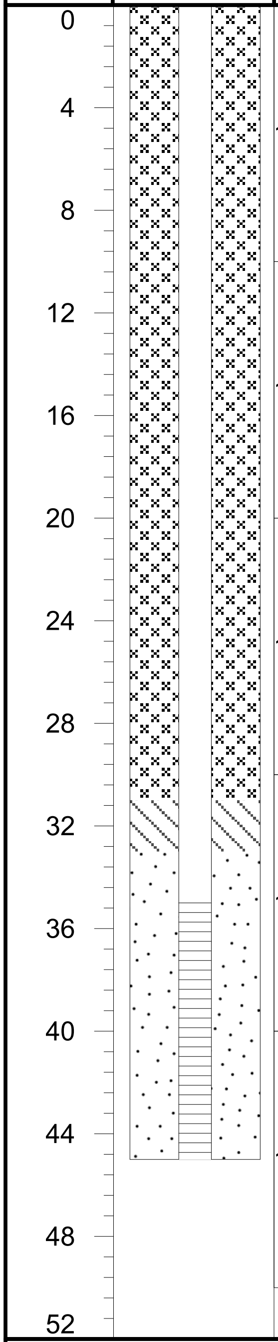
Log of Boring: H-26

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/14/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	50
Driller's License:	5814M	TOC Elevation (ft. AMSL):	323.701
Logged By:	Ryan Francis	Northing:	1042229019.685
Sampling Method:	4"x10' Core barrel	Easting:	2907068.36

Depth (ft) — Well Materials



Recovery (ft/ft)	USCS	Lithologic Description
10.0/10.0	CL	(0 - 3) Silty CLAY, dark brown, dry, soft to firm, weak cementation, low plasticity
		(3 - 7) Sandy CLAY, red/orange with gray clay ribbons, dry, soft to firm, weak cementation, medium plasticity, minor rounded pebbles
	SM	(7 - 11) Silty SAND, gray, dry, soft, weak cementation, subrounded, sharp contact
10.0/10.0 10.0/10.0	SC	(11 - 30) Clayey silty SAND, tan with red and gray ribbons, moist to wet, soft, weak cementation, medium plasticity
10.0/10.0	SP	(30 - 40) SAND, tan and orange, fine grained, higher clay content (31'-34'), wet, very soft to soft, low to medium plasticity
10.0/10.0	SW	(40 - 44) SAND, red, wet, soft to firm, moderate cementation, heavy iron content, iron concretions ("rocky" texture)
	SP	(44 - 50) SAND, red and gray, wet, soft, fine grained, subrounded, gradual color change to dark brown/black (47'-50'), moisture content decreases with depth, hard sand (48'-50')

PBW

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Notes:
1. This log should not be used separately from the report to which it is attached.

Well Materials
(0-35) Casing, 2" Sch 40 FJT PVC
(35-40) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-31') Grout
(31'-33') Bentonite pellets
(33'-40') 20/40 sand

Luminant

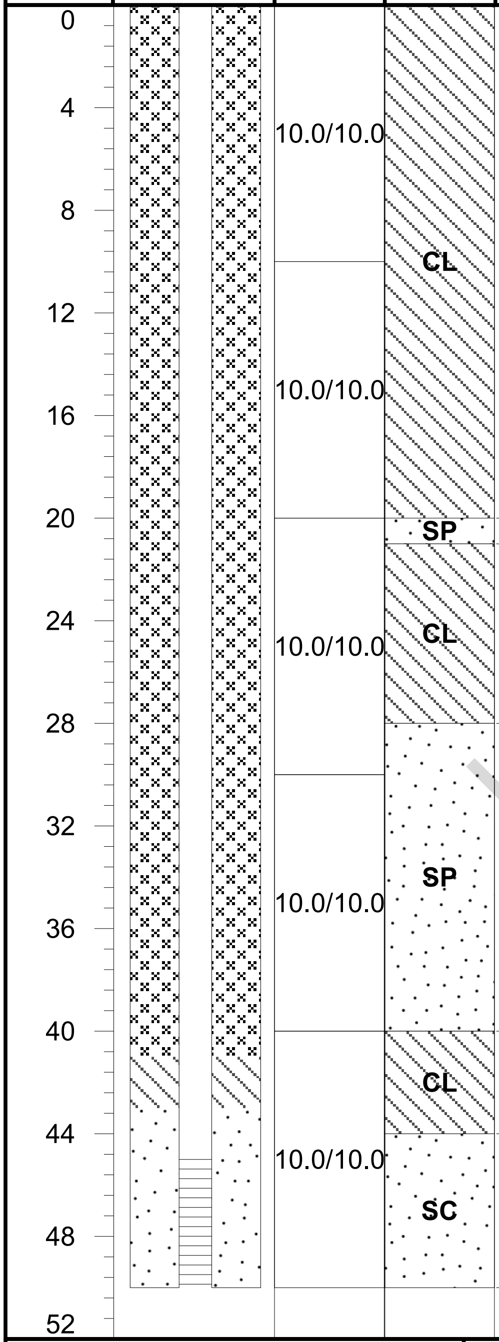
Log of Boring: H-27

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/15/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	50
Driller's License:	5814M	TOC Elevation (ft. AMSL):	330.423
Logged By:	Ryan Francis	Northing:	1038229615.42
Sampling Method:	4"x10' Core barrel	Easting:	2906850.991

Depth (ft)	Well Materials	Recovery (ft/ft)	USCS	Lithologic Description



(0 - 20) CLAY, orange and brown mottling, minor black streaking, blocky, moist, soft to hard, low to high plasticity, dry and variable sand content (5'-7'), wet at 20'

(20 - 21) SAND, gray, moist, soft, subrounded, sharp contact

(21 - 28) CLAY, gray and orange, blocky, moist, firm to hard, moderate cementation, low plasticity

(28 - 40) SAND, light gray to tan/orange, moist to wet, soft, none to low plasticity, minor clay content decreasing with depth

(40 - 44) Sandy CLAY, orange and gray, moist, firm, low to medium plasticity, sharp contact, very hard and little to no sand at 43'

(44 - 50) Clayey SAND, orange and gray, wet, soft, low plasticity, fine grained, decreasing clay content with depth, sharp contact, color change to brown at 48'

PBW

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Notes:
1. This log should not be used separately from the report to which it is attached.

Well Materials
(0-45) Casing, 2" Sch 40 FJT PVC
(45-50) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-41') Grout
(41'-43') Bentonite pellets
(43'-50') 20/40 sand

Luminant

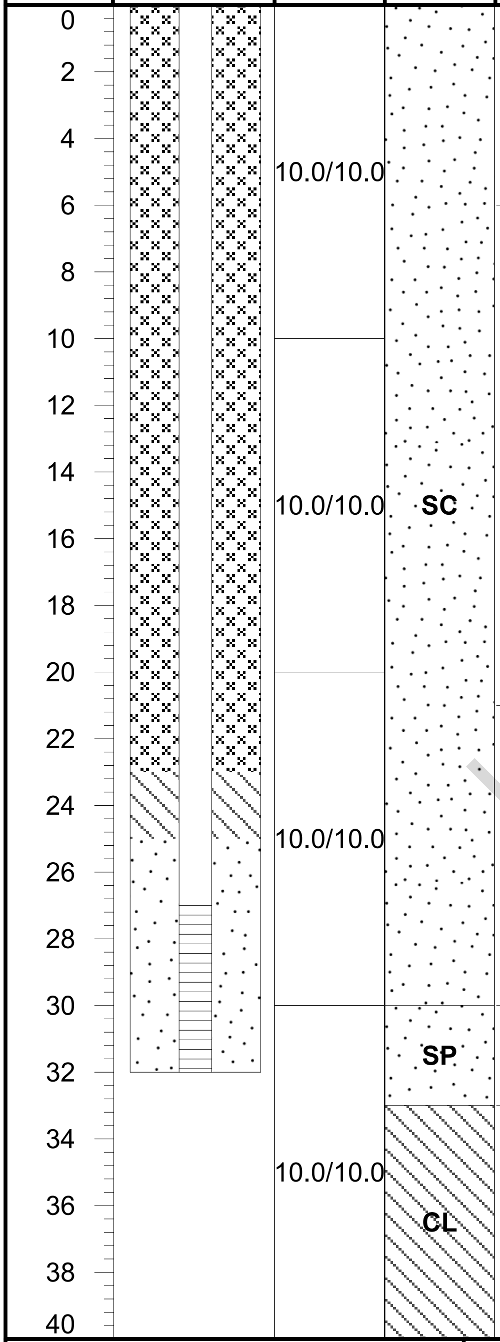
Log of Boring: H-28

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/15/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	40
Driller's License:	5814M	TOC Elevation (ft. AMSL):	316.821
Logged By:	Ryan Francis	Northing:	1030230033.689
Sampling Method:	4"x10' Core barrel	Easting:	2907668.815

Depth (ft)	Well Materials	Recovery (ft/ft)	USCS	Lithologic Description



(0 - 6) Soil with SAND, tan, dry, firm, moderate cementation, hard packed, abundant organics

(6 - 21) Clayey SAND, moist, soft to firm, weak cementation, none to low plasticity, 6" gray fine to very fine sand lense at 10', gray and orange mottling (11'-21'), fine grained

(21 - 30) Clayey SAND, tan and orange, wet, soft to firm, low plasticity, none to weak cementation, variation in clay content with depth, highest clay content at 21', more orange and less clay (29'-30')

(30 - 33) SAND, orange and gray, fine grained, wet, soft, low plasticity, minor clay content, color change from tan to brown to dark gray

(33 - 40) Silty CLAY, dark gray, moderate sand, dry, hard, weak cementation

PBW

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Notes:
1. This log should not be used separately from the report to which it is attached.

Well Materials
(0-27) Casing, 2" Sch 40 FJT PVC
(27-32) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-23') Grout
(23'-25') Bentonite pellets
(25'-32') 20/40 sand

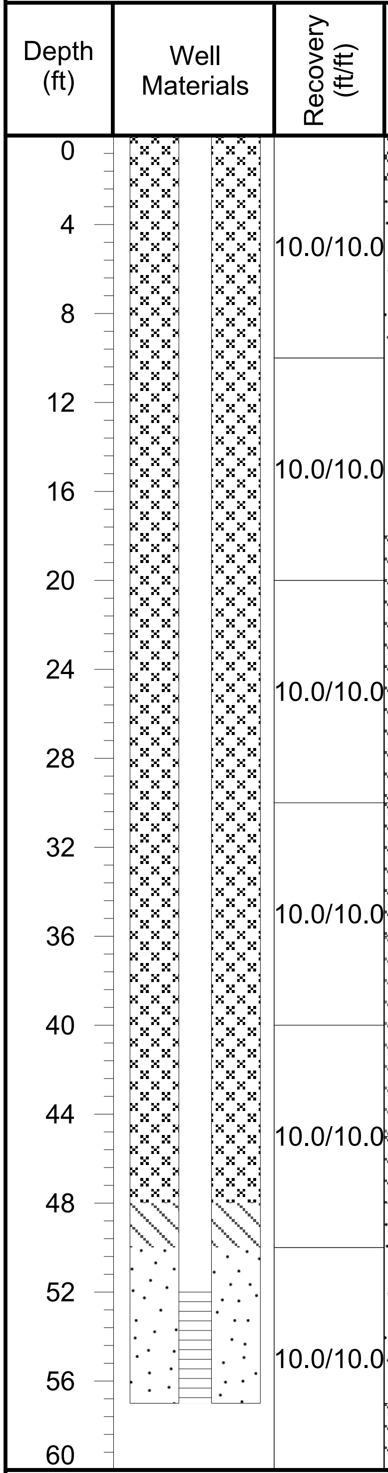
Luminant

Log of Boring: H-29

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/23/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	60
Driller's License:	5814M	TOC Elevation (ft. AMSL):	329.255
Logged By:	Ryan Francis	Northing:	1026229427.784
Sampling Method:	4"x10' Core barrel	Easting:	2907899.511



USCS	Lithologic Description
FILL	(0 - 2) Hard rock road bed, dry
SC	(2 - 18) Clayey SAND, orange and gray mottling, very fine grained, dry to moist, firm, weak cementation, low to medium plasticity, increasing clay content with depth
CL	(18 - 30) CLAY, orange, moist, firm, low to medium plasticity, very little sand or silt, black striping at 22', increasing sand content with depth (28'-30')
CH	(30 - 36) CLAY, orange, moist, soft, friable, high plasticity, minor silt
CL/SC	(36 - 45) Sandy CLAY/Clayey SAND, orange/gray/red mottling, friable, wet, soft to firm, low to medium plasticity, increasing clay content with depth
CH	(45 - 48) CLAY with sand, orange and gray mottling, wet, soft, high plasticity
SP	(48 - 57) SAND, gray, wet, soft, no to low plasticity, some black roots/ organics, interspersed clay lenses
CL	(57 - 60) Silty CLAY, gray/brown, dry, hard, weak cementation, sharp contact

PBW
Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Notes:
1. This log should not be used separately from the report to which it is attached.

Well Materials
(0-52) Casing, 2" Sch 40 FJT PVC
(52-57) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-48') Grout
(48'-50') Bentonite pellets
(50'-57') 20/40 sand

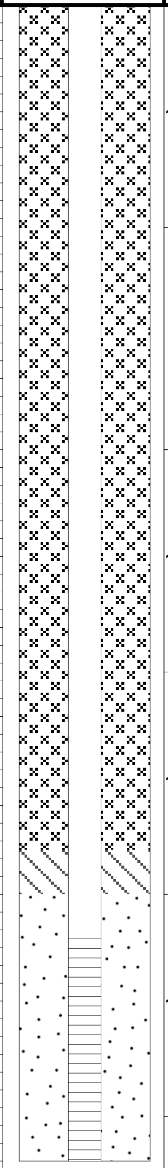
Luminant

Log of Boring: H-31

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/24/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	60
Driller's License:	5814M	TOC Elevation (ft. AMSL):	329.258
Logged By:	Ryan Francis	Northing:	1035229262.289
Sampling Method:	4"x10' Core barrel	Easting:	2908596.681



Depth (ft)	Well Materials	Recovery (ft/ft)	USCS	Lithologic Description
0			FILL	(0 - 1) Hard, packed gravel road bed, dry
4 8		10.0/10.0	SC	(1 - 12) Clayey SAND, orange, dry to moist, soft to firm, low plasticity, fine grained, increasing clay content with depth, gray clay ribbons at 10'
12 16		5.0/10.0	SP	(12 - 20) SAND, orange with red and gray mottling, dry to moist, soft, none to low plasticity, weak cementation, fine grained, very little clay
20 24 28		10.0/10.0	CL	(20 - 30) Sandy CLAY, orange, dry to moist, firm, crumbly, color variation with depth, low plasticity, some gray sand lenses, very fine grained, color change to gray at 29'
32 36 40		10.0/10.0	CL/SC	(30 - 41) Sandy CLAY/ Clayey SAND, gray and tan, moist, soft, fine grained, low plasticity, variations in clay content and firmness with depth, moisture content changes to wet at 35'
44 48 52 56		10.0/10.0 10.0/10.0	SP	(41 - 57) SAND, orange/tan, wet, very soft, fine grained, subrounded, increasing red color with depth starting at 52', hard iron concretion layer with some black staining at 55'
60			CL	(57 - 60) Sandy CLAY, gray, dry to moist, hard, fine grained, weak cementation, low plasticity

PBW

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Notes:
1. This log should not be used separately from the report to which it is attached.

Well Materials
(0-42) Casing, 2" Sch 40 FJT PVC
(42-52) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-38') Grout
(38'-40') Bentonite pellets
(40'-52') 20/40 sand

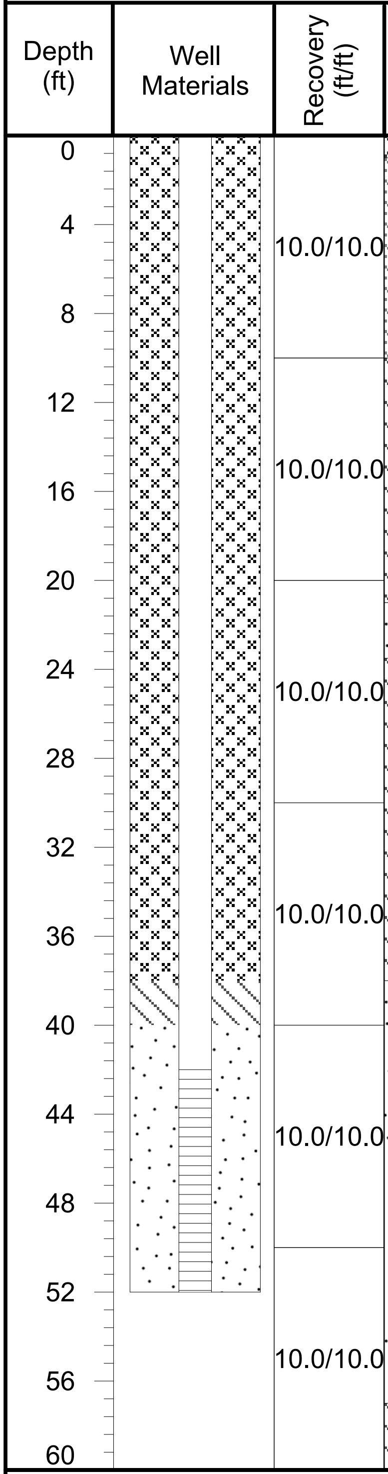
Luminant

Log of Boring: H-32

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/24/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	60
Driller's License:	5814M	TOC Elevation (ft. AMSL):	329.854
Logged By:	Ryan Francis	Northing:	1034228728.295
Sampling Method:	4"x10' Core barrel	Easting:	2908232.588



USCS	Lithologic Description
FILL	(0 - 1) Hard, packed gravel road bed, dry
SC/CL	(1 - 10) Sandy CLAY/Clayey SAND, orange/tan, dry, firm, fine grained, low plasticity, weak cementation
CH	(10 - 21) CLAY with minor silt/sand, orange with some black streaks, moist, firm, high plasticity, gradual contact
SP	(21 - 23.5) SAND, gray, dry, soft to firm, friable, fine grained
CH	(23.5 - 38) CLAY, orange/tan/gray, moist, soft to firm, high plasticity, minor sand at 30', tan and gray with orange stripes (30'-38'), sharp contact
SP	(38 - 57) SAND, orange/tan, moist to wet, very soft to soft, fine grained, subrounded, minor clay, low plasticity, no clay content at 42', gradual coarsening of sand grains (48'-55'), some gray streakings at 49', color change to reddish brown at 52'
CL	(57 - 60) Sandy CLAY, dark red and brown, wet, soft, low plasticity, layer of dark red concretions at 57', weak cementation

PBW

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Notes:
1. This log should not be used separately from the report to which it is attached.

Well Materials
(0-42) Casing, 2" Sch 40 FJT PVC
(42-52) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-38') Grout
(38'-40') Bentonite pellets
(40'-52') 20/40 sand

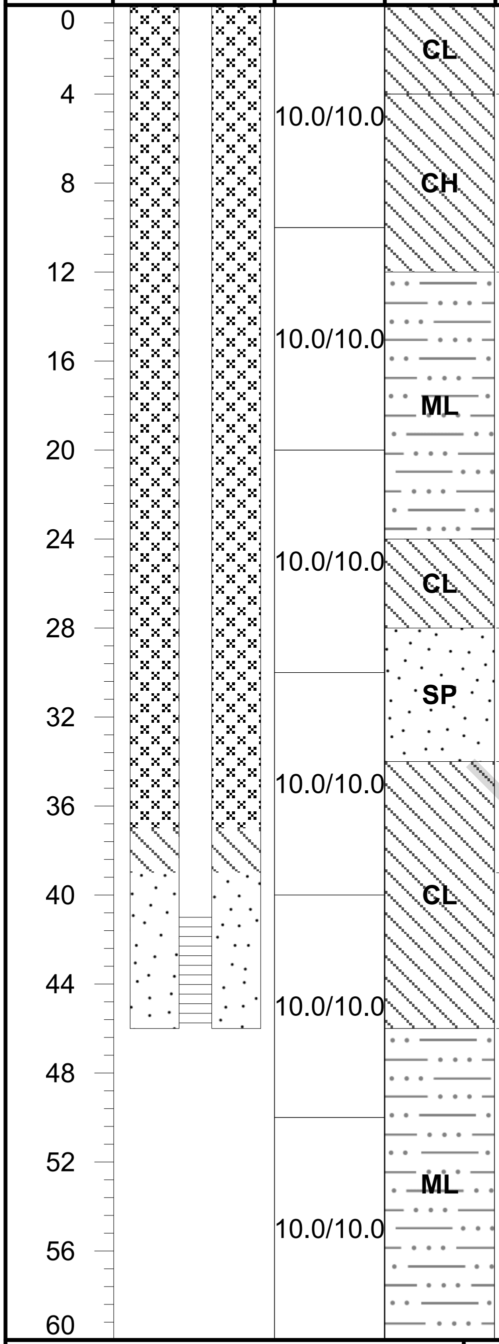
Luminant

Log of Boring: H-33

Martin Lake Steam Electric Station
Tatum, TX

PBW Project No. 5164B

Completion Date:	9/14/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Timmy Beach	Total Depth (ft):	60
Driller's License:	5814M	TOC Elevation (ft. AMSL):	323.845
Logged By:	Ryan Francis	Northing:	1041228608.597
Sampling Method:	4"x10' Core barrel	Easting:	2907267.556



USCS	Lithologic Description
CL	(0 - 4) Silty CLAY, minor sand, red and orange with gray ribbons, dry, soft to firm, low to medium plasticity
CH	(4 - 12) CLAY, red with gray concretions, moist, soft to firm, high plasticity, gradual contact
ML	(12 - 24) Sandy SILT, gray and red, dry, soft, weak cementation, sharp contact, red and gray clay lens at 19'
CL	(24 - 28) CLAY, red, moist to wet, soft to firm, high plasticity, pebbles present
SP	(28 - 34) SAND, gray, wet, soft to firm, minor clay, low to medium plasticity, subrounded, increasing clay content with depth, sharp contact
CL	(34 - 39) CLAY, orange and gray mottling, dry, very hard, moderate cementation, low plasticity
	(39 - 46) Sandy CLAY, orange and gray, moist to wet, firm, medium plasticity, weak cementation, increasing sand content with depth
ML	(46 - 60) Sandy SILT, dark gray, dry, hard

PBW

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
Tel (512) 671-3434 Fax (512) 671-3446

Notes:
1. This log should not be used separately from the report to which it is attached.

Well Materials
(0-41) Casing, 2" Sch 40 FJT PVC
(41-46) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-37') Grout
(37'-39') Bentonite pellets
(39'-46') 20/40 sand

Luminant

Log of Boring: AP-2019-1

Big Brown Steam Electric Station
Franklin, TX

Golder Project No. 19122434E

Completion Date:	6/3/2019	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6
Driller:	Rodney Labrosse	Total Depth (ft):	40
Driller's License:	60059	TOC Elevation (ft. AMSL):	
Logged By:	Kelsey Worley	Northing:	3570888
Sampling Method:	4"x10' Core barrel	Easting:	352661.3

Depth (ft)	Recovery (ft/ft)	USCS	Lithologic Description
0			(0 - 1) Silty CLAY, brown, roots present, low plasticity, slightly moist
5	10.0/10.0	CL	(1 - 8) Silty CLAY, brown to orange, moist, moderate plasticity, soft to hard
10		SC	(8 - 12.5) Clayey SAND, orange and brown, moist, soft, clay content increases with depth, moderate plasticity
15	10.0/10.0	CH	(12.5 - 22) CLAY, gray to light brown, blocky, moist, firm to stiff, low plasticity
20			
25	10.0/10.0	SW	(22 - 34) SAND, light brown to gray and orange, moist, very fine to fine grained, subrounded, soft to firm, iron staining 22'-23.5', color change to light gray and light brown at 24', saturated at 30'
30			
35	10.0/10.0	SC	(34 - 40) Clayey SAND, gray and tan, becomes gray to dark gray at 35.5', stiff, moist, variations in clay content and firmness with depth
40			

GOLDER
2201 Double Creek Dr., Suite 4004
Round Rock, Texas 78664
O·512.671.3434 F·512.671.3446

Notes:
1. This log should not be used separately from the report to which it is attached.

Luminant

Log of Boring: AP-2019-2

Big Brown Steam Electric Station
Franklin, TX

Golder Project No. 19122434E

Completion Date:	6/3/2019	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6
Driller:	Rodney Labrosse	Total Depth (ft):	40
Driller's License:	60059	TOC Elevation (ft. AMSL):	
Logged By:	Kelsey Worley	Northing:	3570800
Sampling Method:	4"x10' Core barrel	Easting:	352739.4

Depth (ft)	Recovery (ft/ft)	USCS	Lithologic Description
0			
			(0 - 6) Silty CLAY, brown to gray, soft to firm, damp, low plasticity
5	10.0/10.0	CL	
			(6 - 11) Sandy CLAY, red and orange with gray, clay ribbons, damp, soft to firm, weak cementation, moderate plasticity
10			
15	10.0/10.0	SC	(11 - 20) Clayey Silty SAND, tan with red and gray, clay ribbons, moist, firm, weak cementation, moderate plasticity
20			
		SW	(20 - 22) SAND, light brown, moist to wet, fine grained, subrounded, soft
25	10.0/10.0		
		SC	(22 - 34) Clayey SAND, gray and tan, becomes gray to dark, gray at 26', stiff, moist, brown clay ribbons from 27'-29.5'
30			
35	10.0/10.0		
		SW	(34 - 40) SAND, gray, very fine to fine grained, wet, subrounded, soft to firm, saturated 35'-38', black organics at 38.8'-40.0'
40			

GOLDER
2201 Double Creek Dr., Suite 4004
Round Rock, Texas 78664
O·512.671.3434 F·512.671.3446

Notes:

1. This log should not be used separately from the report to which it is attached.

Luminant

Log of Boring: AP-2019-3

Big Brown Steam Electric Station
Franklin, TX

Golder Project No. 19122434E

Completion Date:	6/3/2019	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6
Driller:	Rodney Labrosse	Total Depth (ft):	30
Driller's License:	60059	TOC Elevation (ft. AMSL):	
Logged By:	Kelsey Worley	Northing:	352739.4
Sampling Method:	4"x10' Core barrel	Easting:	3570800

Depth (ft)	Recovery (ft/ft)	USCS	Lithologic Description
0 5	10.0/10.0	SM	(0 - 6) Silty SAND, light brown, firm, moderate cementation, roots present 0'-1.5'
10		SC	(6 - 11) Clayey SAND, orange to brown, moist, soft to firm, no plasticity, weak cementation, gray sand lense, fine grained, at 11', fine to very fine grained
15	10.0/10.0		(11 - 18) Clayey SAND, wet, gray and tan to orange, soft to firm, sand content increases with depth
20		SP	(18 - 25) SAND, orange and gray, saturated, fine grained, soft, no cementation
25	10.0/10.0	CL	(25 - 30) Silty CLAY, dark gray, dry, hard, moderate sand content, weak cementation
30			

GOLDER
2201 Double Creek Dr., Suite 4004
Round Rock, Texas 78664
O·512.671.3434 F·512.671.3446

Notes:
1. This log should not be used separately from the report to which it is attached.

APPENDIX B

LABORATORY ANALYTICAL REPORTS

DHL
ANALYTICAL

June 14, 2019

Will Vienne
Golder
2201 Double Creek Dr #4004
Round Rock, Texas 78664

TEL: (512) 671-3434

FAX (512) 671-3446

Order No.: 1905168

RE: Luminant-MLSES Ash Ponds

Dear Will Vienne:

DHL Analytical, Inc. received 7 sample(s) on 5/15/2019 for the analyses presented in the following report.

There were no problems with the analyses and all data met requirements of NELAP except where noted in the Case Narrative. All non-NELAP methods will be identified accordingly in the case narrative and all estimated uncertainties of test results are within method or EPA specifications.

If you have any questions regarding these tests results, please feel free to call. Thank you for using DHL Analytical.

Sincerely,

John DuPont
General Manager

This report was performed under the accreditation of the State of Texas Laboratory Certification Number: T104704211-19-24

Table of Contents

DHL ANALYTICAL

2300 Double Creek Dr. ■ Round Rock, TX 78664
Phone (512) 388-8222 ■ FAX (512) 388-8229
Web: *www.dhlanalytical.com*
E-Mail: *login@dhlanalytical.com*

№ 86479

CHAIN-OF-CUSTODY

CLIENT: GOLDER
ADDRESS: 2201 DOUBLE CREEK DR, ROUND ROCK, TX 78664
PHONE: 512-671-3434 FAX/E-MAIL: 512-671-3446
DATA REPORTED TO: WILL VIENNE
ADDITIONAL REPORT COPIES TO:

DATE: 5-14-19 PAGE 1 OF 1
PO #:
DHL WORK ORDER #: 1905168
PROJECT LOCATION OR NAME: LUMINANT- MLSES ASH PONDS
CLENT PROJECT #: 19122262-C COLLECTOR: J. BRAYTON

Authorize 5% surcharge for TRRP Report?
☐ Yes ☐ No

S=SOIL P=PAINT
W=WATER SL=SLUDGE
A=AIR O=OTHER
L=LIQUID SO=SOLID
SE=SEDIMENT

ANALYSES
BTEX ☐ MTBE ☐ [METHOD 8021]
TPH 1005 ☐ TPH 1006 ☐ HOLD 1006 ☐
GRO [METHOD 8015] ☐ DRO [METHOD 8105] ☐
VOC 8260 ☐ VOC 624 ☐ VOC 8260/5035 ☐
SVOC 8270 ☐ PAH 8270 ☐ HOLD PAH ☐ SVOC 625 ☐
8270 PEST ☐ 625 PEST/PCB ☐ 608 PCB ☐
8270 O-P PEST ☐ 8082 PCB ☐ 8270 PCB ☐
8321 HERB ☐ T PHOS, AMMONIA ☐
METALS 6020 ☐ METALS 200.8 ☐ DISS. METALS ☐
RCRA ☐ TX11 ☐ ______ ☐
PH ☐ HEX CHROM ☐ ALKALINITY ☐ COD ☐
CHLORIDE ☐ ANIONS ______ ☐
TCLP-SVOC ☐ VOC ☐ PEST ☐ HERB ☐
TCLP-METALS ☐ RCRA 8 ☐ TX-11 ☐ Pb ☐
RCI ☐ FLASHPOINT ☐ DGAS ☐
TDS ☐ TSS ☐ % MOISTURE ☐ CYANIDE ☐
APPENDIX III & IV
ALK, NO_3, PO_4, Na, Mg, K
FERROUS & FERRIC IRON

Field Sample I.D.	DHL Lab #	Date	Time	Matrix	Container Type	# of Containers	HCl	HNO_3	H_2SO_4 ☐ NaOH ☐	ICE	UNPRESERVED	APPENDIX III & IV	ALK, NO_3, PO_4, Na, Mg, K	FERROUS & FERRIC IRON	FIELD NOTES
H-31	01	5-14-19	0740	W		7				X		X	X	X	
H-32	02		0825	W		7				X		X	X	X	
H-27	03		0940	W		7				X		X	X	X	
H-29	04		1125	W		7				X		X	X	X	
H-28	05		1230	W		7				X		X	X	X	
H-26	06		1425	W		7				X		X	X	X	
H-33	07		1530	W		7				X		X	X	X	

RELINQUISHED BY: (Signature) DATE/TIME 5-14-19 RECEIVED BY: (Signature) Fed Ex
RELINQUISHED BY: (Signature) Fed Ex DATE/TIME 5/15/19 0943 RECEIVED BY: (Signature)
RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)

☐ *DHL DISPOSAL @ $5.00 each* ☐ *Return*

TURN AROUND TIME
RUSH ☐ CALL FIRST
1 DAY ☐ CALL FIRST
2 DAY ☐
NORMAL ☒
OTHER ☐ ______

LABORATORY USE ONLY:
RECEIVING TEMP: 4.5/3.0C THERM #: 78
CUSTODY SEALS: ☐ BROKEN ☐ INTACT ☒ NOT USED
CARRIER: ☐ LONE STAR ☒ FEDEX ☐ UPS ☐ OTHER
☐ COURIER DELIVERY
☐ HAND DELIVERED

DHL COC Rev 1 | FEB 2010

Eric Lau

From: John DuPont
Sent: Tuesday, May 28, 2019 11:35 AM
To: Eric Lau
Subject: FW: CCR Analysis

Appendix III Parameters:
Metals (Ca and B)
Anions (Cl, F, and SO4)
TDS

Appendix IV Parameters:

Metals (As, Ba, Be, Cd, Co, Cr, Hg, Li, Mo, Pb, Sb, Se, and Tl)
Ra-226
Ra-228

From: Vienne, Will [mailto:William_Vienne@golder.com]
Sent: Tuesday, April 09, 2019 12:48 PM
To: John DuPont <dupont@dhlanalytical.com>
Subject: CCR Analysis

ORIGIN ID:GGGA (512) 671-3434
J . BRAYTON
GOLDER
2201 DOUBLE CREEK DR

ROUND ROCK, TX 78664
UNITED STATES US

SHIP DATE: 14MAY19
ACTWGT: 48.70 LB
CAD: 006994186/SSFE2002
DIMS: 23x13x13 IN

BILL THIRD PARTY

Part # 156297 [illegible] 10/19

TO

DHL
2300 DOUBLE CREEK DR

ROUND ROCK TX 78664
(512) 388-8222
INU:
PO:
REF:
DEPT:

FedEx
Express
E
J191019010701uv

4 of 4
MPS# 7872 5506 5879
0263
Mstr# 7872 5506 5846
0201

WED - 15 MAY 10:30A
PRIORITY OVERNIGHT

A8 BSMA

78664
TX-US **AUS**

ORIGIN ID:GGGA (512) 671-3434
J . BRAYTON
GOLDER
2201 DOUBLE CREEK DR

ROUND ROCK, TX 78664
UNITED STATES US

SHIP DATE: 14MAY19
ACTWGT: 50.90 LB
CAD: 006994166/SSFE2002
DIMS: 23x14x14 IN

BILL THIRD PARTY

Part # 156297-[illegible] 10/19

TO

DHL
2300 DOUBLE CREEK DR

ROUND ROCK TX 78664

(512) 388-8222 REF:
INV:
PO: DEPT:

FedEx
Express

E

J191019010701uv

2 of 4

MPS# 7872 5506 5857 0263

Mstr# 7872 5506 5846 0201

A8 BSMA

WED – 15 MAY 10:30A
PRIORITY OVERNIGHT

78664
TX-US **AUS**

DHL Analytical, Inc.

Sample Receipt Checklist

Client Name Golder

Work Order Number 1905168

Date Received: 5/15/2019

Received by EL

Checklist completed by: Signature 5/15/2019 Date

Reviewed by DL Initials 5/15/2019 Date

Carrier name FedEx 1day

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐	
Custody seals intact on shippping container/cooler?	Yes ☐	No ☐	Not Present ☑	
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑	
Chain of custody present?	Yes ☑	No ☐		
Chain of custody signed when relinquished and received?	Yes ☑	No ☐		
Chain of custody agrees with sample labels?	Yes ☑	No ☐		
Samples in proper container/bottle?	Yes ☑	No ☐		
Sample containers intact?	Yes ☑	No ☐		
Sufficient sample volume for indicated test?	Yes ☑	No ☐		
All samples received within holding time?	Yes ☑	No ☐		
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	4.5 °C	
Water - VOA vials have zero headspace?	Yes ☑	No ☐	No VOA vials submitted ☐	
Water - pH<2 acceptable upon receipt?	Yes ☑	No ☐	NA ☐	LOT # 11837
	Adjusted? no		Checked by EL	
Water - ph>9 (S) or ph>10 (CN) acceptable upon receipt?	Yes ☐	No ☐	NA ☑	LOT #
	Adjusted?		Checked by	

Any No response must be detailed in the comments section below.

Client contacted ____ Date contacted: ____ Person contacted ____

Contacted by: ____ Regarding: ____

Comments: ____

Corrective Action ____

CLIENT: Golder
Project: Luminant-MLSES Ash Ponds
Lab Order: 1905168

CASE NARRATIVE

Samples were analyzed using the methods outlined in the following references:

Method SW6020A - Metals Analysis
Method SW7470A - Mercury Analysis
Method E300 - Anions Analysis
Method M2320 B - Alkalinity Analysis
Method M3500-Fe D - Ferrous Iron Analysis (this parameter is not NELAP certified)
Method M3500-Fe D - Ferric Iron (calculation) (this calculation is not NELAP certified).
Method M4500-P E - Orthophosphate Analysis
Method M2540C - TDS Analysis
Sub-contract - Radium-228 and Radium-226 analyses by methods E904 and SM 7500 Ra B M. Analyzed at Pace Analytical.

LOG IN

The samples were received and log-in performed on 5/15/19. A total of 7 samples were received. The samples arrived in good condition and were properly packaged.

METALS ANALYSIS

For Metals analysis performed on 5/20/19 and 5/21/19 the matrix spike and matrix spike duplicate recoveries were out of control limits for a total of four analytes. These are flagged accordingly in the QC summary report. The sample selected for the matrix spike and matrix spike duplicate was not from this work order. The LCS was within control limits for these analytes. No further corrective actions were taken.

For Metals analysis peformed on 5/20/19 LCVL6-190520 was slightly above control limits for Sodium. This is flagged accordingly. The associated CCV6-190520 was within control limits for this analyte. No further corrective actions were taken.

ANIONS ANALYSIS

For Anions analysis performed on 5/15/19 (batch 90908) the matrix spike and matrix spike duplicate recoveries (1905167-02 MS/MSD) were out of control limits for Chloride and Sulfate. This was due to matrix effect. These are flagged accordingly in the QC summary report. The sample selected for the matrix spike and matrix spike duplicate was not from this work order. The LCS was within control limits for these analytes. No further corrective actions were taken.

FERRIC IRON (CALCULATION)

CASE NARRATIVE

For Ferric Iron calculation the Ferrous Iron result was slightly higher than the total Iron result for sample H-31. This is within the acceptable variation limits. No further corrective actions were taken.

DHL Analytical, Inc. **Date:** *14-Jun-19*

CLIENT: Golder
Project: Luminant-MLSES Ash Ponds
Lab Order: 1905168

Work Order Sample Summary

Lab Smp ID	Client Sample ID	Tag Number	Date Collected	Date Recved
1905168-01	H-31		05/14/19 07:40 AM	5/15/2019
1905168-02	H-32		05/14/19 08:25 AM	5/15/2019
1905168-03	H-27		05/14/19 09:40 AM	5/15/2019
1905168-04	H-29		05/14/19 11:25 AM	5/15/2019
1905168-05	H-28		05/14/19 12:30 PM	5/15/2019
1905168-06	H-26		05/14/19 02:25 PM	5/15/2019
1905168-07	H-33		05/14/19 03:30 PM	5/15/2019

DHL Analytical, Inc.

14-Jun-19

Lab Order: 1905168
Client: Golder
Project: Luminant-MLSES Ash Ponds

PREP DATES REPORT

Sample ID	Client Sample ID	Collection Date	Matrix	Test Number	Test Name	Prep Date	Batch ID
1905168-01A	H-31	05/14/19 07:40 AM	Aqueous	M3500-Fe	Ferrous Iron Prep Water	05/20/19 02:56 PM	91002
	H-31	05/14/19 07:40 AM	Aqueous	M3500-Fe	Ferrous Iron Prep Water	05/20/19 02:56 PM	91002
1905168-01B	H-31	05/14/19 07:40 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-31	05/14/19 07:40 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-31	05/14/19 07:40 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-31	05/14/19 07:40 AM	Aqueous	SW7470A	Mercury Aq Prep	05/21/19 09:56 AM	91017
	H-31	05/14/19 07:40 AM	Aqueous	SW7470A	Mercury Aq Prep	05/21/19 09:56 AM	91017
1905168-01C	H-31	05/14/19 07:40 AM	Aqueous	M2320 B	Alkalinity Preparation	05/16/19 10:12 AM	90940
	H-31	05/14/19 07:40 AM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	H-31	05/14/19 07:40 AM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	H-31	05/14/19 07:40 AM	Aqueous	E300	Anion Preparation	05/16/19 09:16 AM	90935
	H-31	05/14/19 07:40 AM	Aqueous	M4500-P E	Orthophosphate Prep	05/15/19 12:12 PM	90921
	H-31	05/14/19 07:40 AM	Aqueous	M2540C	TDS Preparation	05/16/19 03:23 PM	90953
1905168-02A	H-32	05/14/19 08:25 AM	Aqueous	M3500-Fe	Ferrous Iron Prep Water	05/20/19 02:56 PM	91002
	H-32	05/14/19 08:25 AM	Aqueous	M3500-Fe	Ferrous Iron Prep Water	05/20/19 02:56 PM	91002
1905168-02B	H-32	05/14/19 08:25 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-32	05/14/19 08:25 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-32	05/14/19 08:25 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-32	05/14/19 08:25 AM	Aqueous	SW7470A	Mercury Aq Prep	05/21/19 09:56 AM	91017
1905168-02C	H-32	05/14/19 08:25 AM	Aqueous	M2320 B	Alkalinity Preparation	05/16/19 10:12 AM	90940
	H-32	05/14/19 08:25 AM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	H-32	05/14/19 08:25 AM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	H-32	05/14/19 08:25 AM	Aqueous	M4500-P E	Orthophosphate Prep	05/15/19 12:12 PM	90921
	H-32	05/14/19 08:25 AM	Aqueous	M2540C	TDS Preparation	05/16/19 03:23 PM	90953
1905168-03A	H-27	05/14/19 09:40 AM	Aqueous	M3500-Fe	Ferrous Iron Prep Water	05/20/19 02:56 PM	91002
1905168-03B	H-27	05/14/19 09:40 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-27	05/14/19 09:40 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-27	05/14/19 09:40 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959

Lab Order: 1905168
Client: Golder
Project: Luminant-MLSES Ash Ponds

PREP DATES REPORT

Sample ID	Client Sample ID	Collection Date	Matrix	Test Number	Test Name	Prep Date	Batch ID
1905168-03B	H-27	05/14/19 09:40 AM	Aqueous	SW7470A	Mercury Aq Prep	05/21/19 09:56 AM	91017
1905168-03C	H-27	05/14/19 09:40 AM	Aqueous	M2320 B	Alkalinity Preparation	05/16/19 10:12 AM	90940
	H-27	05/14/19 09:40 AM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	H-27	05/14/19 09:40 AM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	H-27	05/14/19 09:40 AM	Aqueous	M4500-P E	Orthophosphate Prep	05/15/19 12:12 PM	90921
	H-27	05/14/19 09:40 AM	Aqueous	M2540C	TDS Preparation	05/16/19 03:23 PM	90953
1905168-04A	H-29	05/14/19 11:25 AM	Aqueous	M3500-Fe	Ferrous Iron Prep Water	05/20/19 02:56 PM	91002
1905168-04B	H-29	05/14/19 11:25 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-29	05/14/19 11:25 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-29	05/14/19 11:25 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-29	05/14/19 11:25 AM	Aqueous	SW7470A	Mercury Aq Prep	05/21/19 09:56 AM	91017
1905168-04C	H-29	05/14/19 11:25 AM	Aqueous	M2320 B	Alkalinity Preparation	05/16/19 10:12 AM	90940
	H-29	05/14/19 11:25 AM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	H-29	05/14/19 11:25 AM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	H-29	05/14/19 11:25 AM	Aqueous	M4500-P E	Orthophosphate Prep	05/15/19 12:12 PM	90921
	H-29	05/14/19 11:25 AM	Aqueous	M2540C	TDS Preparation	05/16/19 03:23 PM	90953
1905168-05A	H-28	05/14/19 12:30 PM	Aqueous	M3500-Fe	Ferrous Iron Prep Water	05/20/19 02:56 PM	91002
1905168-05B	H-28	05/14/19 12:30 PM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-28	05/14/19 12:30 PM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-28	05/14/19 12:30 PM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-28	05/14/19 12:30 PM	Aqueous	SW7470A	Mercury Aq Prep	05/21/19 09:56 AM	91017
1905168-05C	H-28	05/14/19 12:30 PM	Aqueous	M2320 B	Alkalinity Preparation	05/16/19 10:12 AM	90940
	H-28	05/14/19 12:30 PM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	H-28	05/14/19 12:30 PM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	H-28	05/14/19 12:30 PM	Aqueous	M4500-P E	Orthophosphate Prep	05/15/19 12:12 PM	90921
	H-28	05/14/19 12:30 PM	Aqueous	M2540C	TDS Preparation	05/16/19 03:23 PM	90953
1905168-06A	H-26	05/14/19 02:25 PM	Aqueous	M3500-Fe	Ferrous Iron Prep Water	05/20/19 02:56 PM	91002
1905168-06B	H-26	05/14/19 02:25 PM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959

Lab Order: 1905168
Client: Golder
Project: Luminant-MLSES Ash Ponds

PREP DATES REPORT

Sample ID	Client Sample ID	Collection Date	Matrix	Test Number	Test Name	Prep Date	Batch ID
1905168-06B	H-26	05/14/19 02:25 PM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-26	05/14/19 02:25 PM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-26	05/14/19 02:25 PM	Aqueous	SW7470A	Mercury Aq Prep	05/21/19 09:56 AM	91017
1905168-06C	H-26	05/14/19 02:25 PM	Aqueous	M2320 B	Alkalinity Preparation	05/16/19 10:12 AM	90940
	H-26	05/14/19 02:25 PM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	H-26	05/14/19 02:25 PM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	H-26	05/14/19 02:25 PM	Aqueous	M4500-P E	Orthophosphate Prep	05/15/19 12:12 PM	90921
	H-26	05/14/19 02:25 PM	Aqueous	M2540C	TDS Preparation	05/16/19 03:23 PM	90953
1905168-07A	H-33	05/14/19 03:30 PM	Aqueous	M3500-Fe	Ferrous Iron Prep Water	05/20/19 02:56 PM	91002
1905168-07B	H-33	05/14/19 03:30 PM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-33	05/14/19 03:30 PM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-33	05/14/19 03:30 PM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/17/19 08:40 AM	90959
	H-33	05/14/19 03:30 PM	Aqueous	SW7470A	Mercury Aq Prep	05/21/19 09:56 AM	91017
1905168-07C	H-33	05/14/19 03:30 PM	Aqueous	M2320 B	Alkalinity Preparation	05/16/19 10:12 AM	90940
	H-33	05/14/19 03:30 PM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	H-33	05/14/19 03:30 PM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	H-33	05/14/19 03:30 PM	Aqueous	M4500-P E	Orthophosphate Prep	05/15/19 12:12 PM	90921
	H-33	05/14/19 03:30 PM	Aqueous	M2540C	TDS Preparation	05/16/19 03:23 PM	90953

DHL Analytical, Inc.

14-Jun-19

Lab Order: 1905168
Client: Golder
Project: Luminant-MLSES Ash Ponds

ANALYTICAL DATES REPORT

Sample ID	Client Sample ID	Matrix	Test Number	Test Name	Batch ID	Dilution	Analysis Date	Run ID
1905168-01A	H-31	Aqueous	M3500-Fe D	Ferric Iron (Calculated)	91002	1	05/24/19	UV/VIS_2_190524A
	H-31	Aqueous	M3500-Fe D	Ferrous Iron	91002	1	05/20/19 03:55 PM	UV/VIS_2_190520A
	H-31	Aqueous	M3500-Fe D	Ferrous Iron	91002	100	05/20/19 04:11 PM	UV/VIS_2_190520A
1905168-01B	H-31	Aqueous	SW7470A	Mercury Total: Aqueous	91017	1	05/22/19 10:16 AM	CETAC2_HG_190522A
	H-31	Aqueous	SW7470A	Mercury Total: Aqueous	91017	5	05/22/19 11:21 AM	CETAC2_HG_190522A
	H-31	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	1	05/20/19 03:43 PM	ICP-MS4_190520B
	H-31	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	50	05/21/19 12:54 PM	ICP-MS5_190521A
	H-31	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	1	05/21/19 02:51 PM	ICP-MS5_190521A
1905168-01C	H-31	Aqueous	M2320 B	Alkalinity	90940	1	05/16/19 04:13 PM	TITRATOR_190516A
	H-31	Aqueous	E300	Anions by IC method - Water	90908	10	05/15/19 02:27 PM	IC2_190515A
	H-31	Aqueous	E300	Anions by IC method - Water	90908	1	05/15/19 05:55 PM	IC2_190515A
	H-31	Aqueous	E300	Anions by IC method - Water	90935	100	05/16/19 05:42 PM	IC4_190516A
	H-31	Aqueous	M4500-P E	Orthophosphate	90921	1	05/15/19 02:47 PM	UV/VIS_2_190515B
	H-31	Aqueous	M2540C	Total Dissolved Solids	90953	1	05/17/19 11:40 AM	WC_190517D
1905168-02A	H-32	Aqueous	M3500-Fe D	Ferric Iron (Calculated)	91002	1	05/24/19	UV/VIS_2_190524A
	H-32	Aqueous	M3500-Fe D	Ferrous Iron	91002	1	05/20/19 03:55 PM	UV/VIS_2_190520A
	H-32	Aqueous	M3500-Fe D	Ferrous Iron	91002	5	05/20/19 04:11 PM	UV/VIS_2_190520A
1905168-02B	H-32	Aqueous	SW7470A	Mercury Total: Aqueous	91017	1	05/22/19 10:27 AM	CETAC2_HG_190522A
	H-32	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	1	05/21/19 02:53 PM	ICP-MS5_190521A
	H-32	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	10	05/21/19 12:56 PM	ICP-MS5_190521A
	H-32	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	1	05/20/19 03:45 PM	ICP-MS4_190520B
1905168-02C	H-32	Aqueous	M2320 B	Alkalinity	90940	1	05/16/19 04:15 PM	TITRATOR_190516A
	H-32	Aqueous	E300	Anions by IC method - Water	90908	10	05/15/19 02:43 PM	IC2_190515A
	H-32	Aqueous	E300	Anions by IC method - Water	90908	1	05/15/19 06:11 PM	IC2_190515A
	H-32	Aqueous	M4500-P E	Orthophosphate	90921	1	05/15/19 12:49 PM	UV/VIS_2_190515B
	H-32	Aqueous	M2540C	Total Dissolved Solids	90953	1	05/17/19 11:40 AM	WC_190517D

Lab Order: 1905168
Client: Golder
Project: Luminant-MLSES Ash Ponds

ANALYTICAL DATES REPORT

Sample ID	Client Sample ID	Matrix	Test Number	Test Name	Batch ID	Dilution	Analysis Date	Run ID
1905168-03A	H-27	Aqueous	M3500-Fe D	Ferric Iron (Calculated)	91002	1	05/24/19	UV/VIS_2_190524A
	H-27	Aqueous	M3500-Fe D	Ferrous Iron	91002	1	05/20/19 03:56 PM	UV/VIS_2_190520A
1905168-03B	H-27	Aqueous	SW7470A	Mercury Total: Aqueous	91017	1	05/22/19 10:29 AM	CETAC2_HG_190522A
	H-27	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	1	05/20/19 03:47 PM	ICP-MS4_190520B
	H-27	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	10	05/21/19 12:59 PM	ICP-MS5_190521A
	H-27	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	1	05/21/19 02:14 PM	ICP-MS5_190521A
1905168-03C	H-27	Aqueous	M2320 B	Alkalinity	90940	1	05/16/19 04:20 PM	TITRATOR_190516A
	H-27	Aqueous	E300	Anions by IC method - Water	90908	10	05/15/19 02:59 PM	IC2_190515A
	H-27	Aqueous	E300	Anions by IC method - Water	90908	1	05/15/19 06:27 PM	IC2_190515A
	H-27	Aqueous	M4500-P E	Orthophosphate	90921	1	05/15/19 12:49 PM	UV/VIS_2_190515B
	H-27	Aqueous	M2540C	Total Dissolved Solids	90953	1	05/17/19 11:40 AM	WC_190517D
1905168-04A	H-29	Aqueous	M3500-Fe D	Ferric Iron (Calculated)	91002	1	05/24/19	UV/VIS_2_190524A
	H-29	Aqueous	M3500-Fe D	Ferrous Iron	91002	1	05/20/19 03:56 PM	UV/VIS_2_190520A
1905168-04B	H-29	Aqueous	SW7470A	Mercury Total: Aqueous	91017	1	05/22/19 10:31 AM	CETAC2_HG_190522A
	H-29	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	1	05/20/19 03:49 PM	ICP-MS4_190520B
	H-29	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	1	05/21/19 02:55 PM	ICP-MS5_190521A
	H-29	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	20	05/21/19 01:01 PM	ICP-MS5_190521A
1905168-04C	H-29	Aqueous	M2320 B	Alkalinity	90940	1	05/16/19 04:23 PM	TITRATOR_190516A
	H-29	Aqueous	E300	Anions by IC method - Water	90908	10	05/15/19 03:15 PM	IC2_190515A
	H-29	Aqueous	E300	Anions by IC method - Water	90908	1	05/15/19 06:43 PM	IC2_190515A
	H-29	Aqueous	M4500-P E	Orthophosphate	90921	1	05/15/19 12:49 PM	UV/VIS_2_190515B
	H-29	Aqueous	M2540C	Total Dissolved Solids	90953	1	05/17/19 11:40 AM	WC_190517D
1905168-05A	H-28	Aqueous	M3500-Fe D	Ferric Iron (Calculated)	91002	1	05/24/19	UV/VIS_2_190524A
	H-28	Aqueous	M3500-Fe D	Ferrous Iron	91002	1	05/20/19 03:57 PM	UV/VIS_2_190520A
1905168-05B	H-28	Aqueous	SW7470A	Mercury Total: Aqueous	91017	1	05/22/19 10:34 AM	CETAC2_HG_190522A
	H-28	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	20	05/21/19 01:03 PM	ICP-MS5_190521A

Lab Order: 1905168
Client: Golder
Project: Luminant-MLSES Ash Ponds

ANALYTICAL DATES REPORT

Sample ID	Client Sample ID	Matrix	Test Number	Test Name	Batch ID	Dilution	Analysis Date	Run ID
1905168-05B	H-28	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	1	05/21/19 02:57 PM	ICP-MS5_190521A
	H-28	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	1	05/20/19 03:51 PM	ICP-MS4_190520B
1905168-05C	H-28	Aqueous	M2320 B	Alkalinity	90940	1	05/16/19 04:27 PM	TITRATOR_190516A
	H-28	Aqueous	E300	Anions by IC method - Water	90908	10	05/15/19 03:31 PM	IC2_190515A
	H-28	Aqueous	E300	Anions by IC method - Water	90908	1	05/15/19 06:59 PM	IC2_190515A
	H-28	Aqueous	M4500-P E	Orthophosphate	90921	1	05/15/19 12:50 PM	UV/VIS_2_190515B
	H-28	Aqueous	M2540C	Total Dissolved Solids	90953	1	05/17/19 11:40 AM	WC_190517D
1905168-06A	H-26	Aqueous	M3500-Fe D	Ferric Iron (Calculated)	91002	1	05/24/19	UV/VIS_2_190524A
	H-26	Aqueous	M3500-Fe D	Ferrous Iron	91002	1	05/20/19 03:57 PM	UV/VIS_2_190520A
1905168-06B	H-26	Aqueous	SW7470A	Mercury Total: Aqueous	91017	1	05/22/19 10:36 AM	CETAC2_HG_190522A
	H-26	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	1	05/20/19 03:53 PM	ICP-MS4_190520B
	H-26	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	10	05/21/19 01:05 PM	ICP-MS5_190521A
	H-26	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	1	05/21/19 02:16 PM	ICP-MS5_190521A
1905168-06C	H-26	Aqueous	M2320 B	Alkalinity	90940	1	05/16/19 04:42 PM	TITRATOR_190516A
	H-26	Aqueous	E300	Anions by IC method - Water	90908	10	05/15/19 03:47 PM	IC2_190515A
	H-26	Aqueous	E300	Anions by IC method - Water	90908	1	05/15/19 07:15 PM	IC2_190515A
	H-26	Aqueous	M4500-P E	Orthophosphate	90921	1	05/15/19 12:50 PM	UV/VIS_2_190515B
	H-26	Aqueous	M2540C	Total Dissolved Solids	90953	1	05/17/19 11:40 AM	WC_190517D
1905168-07A	H-33	Aqueous	M3500-Fe D	Ferric Iron (Calculated)	91002	1	05/24/19	UV/VIS_2_190524A
	H-33	Aqueous	M3500-Fe D	Ferrous Iron	91002	1	05/20/19 03:58 PM	UV/VIS_2_190520A
1905168-07B	H-33	Aqueous	SW7470A	Mercury Total: Aqueous	91017	1	05/22/19 10:38 AM	CETAC2_HG_190522A
	H-33	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	1	05/20/19 03:54 PM	ICP-MS4_190520B
	H-33	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	10	05/21/19 01:08 PM	ICP-MS5_190521A
	H-33	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90959	1	05/21/19 02:19 PM	ICP-MS5_190521A
1905168-07C	H-33	Aqueous	M2320 B	Alkalinity	90940	1	05/16/19 04:49 PM	TITRATOR_190516A
	H-33	Aqueous	E300	Anions by IC method - Water	90908	10	05/15/19 04:03 PM	IC2_190515A
	H-33	Aqueous	E300	Anions by IC method - Water	90908	1	05/15/19 07:31 PM	IC2_190515A

Lab Order: 1905168
Client: Golder
Project: Luminant-MLSES Ash Ponds

ANALYTICAL DATES REPORT

Sample ID	Client Sample ID	Matrix	Test Number	Test Name	Batch ID	Dilution	Analysis Date	Run ID
1905168-07C	H-33	Aqueous	M4500-P E	Orthophosphate	90921	1	05/15/19 12:50 PM	UV/VIS_2_190515B
	H-33	Aqueous	M2540C	Total Dissolved Solids	90953	1	05/17/19 11:40 AM	WC_190517D

DHL Analytical, Inc.

Date: *14-Jun-19*

CLIENT:	Golder	**Client Sample ID:**	H-31
Project:	Luminant-MLSES Ash Ponds	**Lab ID:**	1905168-01
Project No:	19122262-C	**Collection Date:**	05/14/19 07:40 AM
Lab Order:	1905168	**Matrix:**	AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
TRACE METALS: ICP-MS - WATER		**SW6020A**					Analyst: **RO**
Antimony	<0.000800	0.000800	0.00250		mg/L	1	05/20/19 03:43 PM
Arsenic	0.00675	0.00200	0.00500		mg/L	1	05/20/19 03:43 PM
Barium	0.0163	0.00300	0.0100		mg/L	1	05/20/19 03:43 PM
Beryllium	0.00928	0.000300	0.00100		mg/L	1	05/20/19 03:43 PM
Boron	20.0	0.500	1.50		mg/L	50	05/21/19 12:54 PM
Cadmium	<0.000300	0.000300	0.00100		mg/L	1	05/20/19 03:43 PM
Calcium	234	5.00	15.0		mg/L	50	05/21/19 12:54 PM
Chromium	0.00315	0.00200	0.00500	J	mg/L	1	05/20/19 03:43 PM
Cobalt	0.389	0.00300	0.00500		mg/L	1	05/20/19 03:43 PM
Iron	48.7	1.50	5.00		mg/L	50	05/21/19 12:54 PM
Lead	<0.000300	0.000300	0.00100		mg/L	1	05/20/19 03:43 PM
Lithium	0.219	0.00500	0.0100		mg/L	1	05/20/19 03:43 PM
Magnesium	170	5.00	15.0		mg/L	50	05/21/19 12:54 PM
Molybdenum	<0.00200	0.00200	0.00500		mg/L	1	05/21/19 02:51 PM
Potassium	6.18	0.100	0.300		mg/L	1	05/20/19 03:43 PM
Selenium	0.0261	0.00200	0.00500		mg/L	1	05/20/19 03:43 PM
Sodium	672	5.00	15.0		mg/L	50	05/21/19 12:54 PM
Thallium	<0.000500	0.000500	0.00150		mg/L	1	05/20/19 03:43 PM
MERCURY TOTAL: AQUEOUS		**SW7470A**					Analyst: **BM**
Mercury	<0.000400	0.000400	0.00100		mg/L	5	05/22/19 11:21 AM
ANIONS BY IC METHOD - WATER		**E300**					Analyst: **JL**
Chloride	225	3.00	10.0		mg/L	10	05/15/19 02:27 PM
Fluoride	0.960	0.100	0.400		mg/L	1	05/15/19 05:55 PM
Nitrate-N	<0.100	0.100	0.500		mg/L	1	05/15/19 05:55 PM
Sulfate	2470	100	300		mg/L	100	05/16/19 05:42 PM
ALKALINITY		**M2320 B**					Analyst: **CC**
Alkalinity, Bicarbonate (As CaCO3)	33.9	10.0	20.0		mg/L @ pH 4.52	1	05/16/19 04:13 PM
Alkalinity, Carbonate (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.52	1	05/16/19 04:13 PM
Alkalinity, Hydroxide (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.52	1	05/16/19 04:13 PM
Alkalinity, Total (As CaCO3)	33.9	20.0	20.0		mg/L @ pH 4.52	1	05/16/19 04:13 PM
FERRIC IRON (CALCULATED)		**M3500-FE D**					Analyst: **CAC**
Iron, Ferric	<0.0500	0.0500	0.100	N	mg/L	1	05/24/19
FERROUS IRON		**M3500-FE D**					Analyst: **BTJ**
Iron, Ferrous	49.5	5.00	10.0	N	mg/L	100	05/20/19 04:11 PM

Qualifiers:	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

CLIENT:	Golder	**Client Sample ID:**	H-31
Project:	Luminant-MLSES Ash Ponds	**Lab ID:**	1905168-01
Project No:	19122262-C	**Collection Date:**	05/14/19 07:40 AM
Lab Order:	1905168	**Matrix:**	AQUEOUS

Analyses	**Result**	**MDL**	**RL**	**Qual**	**Units**	**DF**	**Date Analyzed**
ORTHOPHOSPHATE		**M4500-P E**					Analyst: **CC**
Phosphorus, Total Orthophosphate (As P)	0.0770	0.0300	0.100	J	mg/L	1	05/15/19 02:47 PM
TOTAL DISSOLVED SOLIDS		**M2540C**					Analyst: **JS**
Total Dissolved Solids (Residue, Filterable)	4230	50.0	50.0		mg/L	1	05/17/19 11:40 AM

Qualifiers:				
	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

CLIENT: Golder
Project: Luminant-MLSES Ash Ponds
Project No: 19122262-C
Lab Order: 1905168

Client Sample ID: H-32
Lab ID: 1905168-02
Collection Date: 05/14/19 08:25 AM
Matrix: AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
TRACE METALS: ICP-MS - WATER		**SW6020A**					Analyst: **RO**
Antimony	<0.000800	0.000800	0.00250		mg/L	1	05/20/19 03:45 PM
Arsenic	0.00202	0.00200	0.00500	J	mg/L	1	05/20/19 03:45 PM
Barium	0.0162	0.00300	0.0100		mg/L	1	05/20/19 03:45 PM
Beryllium	0.00713	0.000300	0.00100		mg/L	1	05/20/19 03:45 PM
Boron	2.08	0.100	0.300		mg/L	10	05/21/19 12:56 PM
Cadmium	0.000366	0.000300	0.00100	J	mg/L	1	05/20/19 03:45 PM
Calcium	45.2	1.00	3.00		mg/L	10	05/21/19 12:56 PM
Chromium	<0.00200	0.00200	0.00500		mg/L	1	05/20/19 03:45 PM
Cobalt	0.202	0.00300	0.00500		mg/L	1	05/20/19 03:45 PM
Iron	1.81	0.0300	0.100		mg/L	1	05/20/19 03:45 PM
Lead	0.000574	0.000300	0.00100	J	mg/L	1	05/20/19 03:45 PM
Lithium	0.0978	0.00500	0.0100		mg/L	1	05/20/19 03:45 PM
Magnesium	18.5	0.100	0.300		mg/L	1	05/20/19 03:45 PM
Molybdenum	<0.00200	0.00200	0.00500		mg/L	1	05/21/19 02:53 PM
Potassium	2.57	0.100	0.300		mg/L	1	05/20/19 03:45 PM
Selenium	0.00675	0.00200	0.00500		mg/L	1	05/20/19 03:45 PM
Sodium	151	1.00	3.00		mg/L	10	05/21/19 12:56 PM
Thallium	<0.000500	0.000500	0.00150		mg/L	1	05/20/19 03:45 PM
MERCURY TOTAL: AQUEOUS		**SW7470A**					Analyst: **BM**
Mercury	<0.0000800	0.0000800	0.000200		mg/L	1	05/22/19 10:27 AM
ANIONS BY IC METHOD - WATER		**E300**					Analyst: **JL**
Chloride	135	3.00	10.0		mg/L	10	05/15/19 02:43 PM
Fluoride	1.15	0.100	0.400		mg/L	1	05/15/19 06:11 PM
Nitrate-N	273	1.00	5.00		mg/L	10	05/15/19 02:43 PM
Sulfate	320	10.0	30.0		mg/L	10	05/15/19 02:43 PM
ALKALINITY		**M2320 B**					Analyst: **CC**
Alkalinity, Bicarbonate (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 1.76	1	05/16/19 04:15 PM
Alkalinity, Carbonate (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 1.76	1	05/16/19 04:15 PM
Alkalinity, Hydroxide (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 1.76	1	05/16/19 04:15 PM
Alkalinity, Total (As CaCO3)	<20.0	20.0	20.0		mg/L @ pH 1.76	1	05/16/19 04:15 PM
FERRIC IRON (CALCULATED)		**M3500-FE D**					Analyst: **CAC**
Iron, Ferric	0.640	0.0500	0.100	N	mg/L	1	05/24/19
FERROUS IRON		**M3500-FE D**					Analyst: **BTJ**
Iron, Ferrous	1.17	0.250	0.500	N	mg/L	5	05/20/19 04:11 PM

Qualifiers:				
	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

CLIENT:	Golder	**Client Sample ID:**	H-32
Project:	Luminant-MLSES Ash Ponds	**Lab ID:**	1905168-02
Project No:	19122262-C	**Collection Date:**	05/14/19 08:25 AM
Lab Order:	1905168	**Matrix:**	AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
ORTHOPHOSPHATE		**M4500-P E**					Analyst: **CC**
Phosphorus, Total Orthophosphate (As P)	0.0600	0.0300	0.100	J	mg/L	1	05/15/19 12:49 PM
TOTAL DISSOLVED SOLIDS		**M2540C**					Analyst: **JS**
Total Dissolved Solids (Residue, Filterable)	910	50.0	50.0		mg/L	1	05/17/19 11:40 AM

Qualifiers:				
	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

CLIENT: Golder
Project: Luminant-MLSES Ash Ponds
Project No: 19122262-C
Lab Order: 1905168

Client Sample ID: H-27
Lab ID: 1905168-03
Collection Date: 05/14/19 09:40 AM
Matrix: AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
TRACE METALS: ICP-MS - WATER		**SW6020A**					Analyst: **RO**
Antimony	<0.000800	0.000800	0.00250		mg/L	1	05/20/19 03:47 PM
Arsenic	<0.00200	0.00200	0.00500		mg/L	1	05/20/19 03:47 PM
Barium	0.0208	0.00300	0.0100		mg/L	1	05/20/19 03:47 PM
Beryllium	<0.000300	0.000300	0.00100		mg/L	1	05/20/19 03:47 PM
Boron	0.350	0.0100	0.0300		mg/L	1	05/21/19 02:14 PM
Cadmium	<0.000300	0.000300	0.00100		mg/L	1	05/20/19 03:47 PM
Calcium	61.8	1.00	3.00		mg/L	10	05/21/19 12:59 PM
Chromium	<0.00200	0.00200	0.00500		mg/L	1	05/20/19 03:47 PM
Cobalt	<0.00300	0.00300	0.00500		mg/L	1	05/20/19 03:47 PM
Iron	0.0711	0.0300	0.100	J	mg/L	1	05/20/19 03:47 PM
Lead	<0.000300	0.000300	0.00100		mg/L	1	05/20/19 03:47 PM
Lithium	0.0678	0.00500	0.0100		mg/L	1	05/20/19 03:47 PM
Magnesium	47.3	1.00	3.00		mg/L	10	05/21/19 12:59 PM
Molybdenum	<0.00200	0.00200	0.00500		mg/L	1	05/21/19 02:14 PM
Potassium	3.01	0.100	0.300		mg/L	1	05/20/19 03:47 PM
Selenium	<0.00200	0.00200	0.00500		mg/L	1	05/20/19 03:47 PM
Sodium	123	1.00	3.00		mg/L	10	05/21/19 12:59 PM
Thallium	<0.000500	0.000500	0.00150		mg/L	1	05/20/19 03:47 PM
MERCURY TOTAL: AQUEOUS		**SW7470A**					Analyst: **BM**
Mercury	<0.0000800	0.0000800	0.000200		mg/L	1	05/22/19 10:29 AM
ANIONS BY IC METHOD - WATER		**E300**					Analyst: **JL**
Chloride	132	3.00	10.0		mg/L	10	05/15/19 02:59 PM
Fluoride	0.159	0.100	0.400	J	mg/L	1	05/15/19 06:27 PM
Nitrate-N	0.658	0.100	0.500		mg/L	1	05/15/19 06:27 PM
Sulfate	406	10.0	30.0		mg/L	10	05/15/19 02:59 PM
ALKALINITY		**M2320 B**					Analyst: **CC**
Alkalinity, Bicarbonate (As CaCO3)	49.0	10.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:20 PM
Alkalinity, Carbonate (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:20 PM
Alkalinity, Hydroxide (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:20 PM
Alkalinity, Total (As CaCO3)	49.0	20.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:20 PM
FERRIC IRON (CALCULATED)		**M3500-FE D**					Analyst: **CAC**
Iron, Ferric	0.0711	0.0500	0.100	JN	mg/L	1	05/24/19
FERROUS IRON		**M3500-FE D**					Analyst: **BTJ**
Iron, Ferrous	<0.0500	0.0500	0.100	N	mg/L	1	05/20/19 03:56 PM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
S	Spike Recovery outside control limits	N	Parameter not NELAP certified

DHL Analytical, Inc.

Date: *14-Jun-19*

CLIENT:	Golder	**Client Sample ID:**	H-27
Project:	Luminant-MLSES Ash Ponds	**Lab ID:**	1905168-03
Project No:	19122262-C	**Collection Date:**	05/14/19 09:40 AM
Lab Order:	1905168	**Matrix:**	AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
ORTHOPHOSPHATE		**M4500-P E**					Analyst: **CC**
Phosphorus, Total Orthophosphate (As P)	0.126	0.0300	0.100		mg/L	1	05/15/19 12:49 PM
TOTAL DISSOLVED SOLIDS		**M2540C**					Analyst: **JS**
Total Dissolved Solids (Residue, Filterable)	897	10.0	10.0		mg/L	1	05/17/19 11:40 AM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
S	Spike Recovery outside control limits	N	Parameter not NELAP certified

CLIENT:	Golder	**Client Sample ID:**	H-29
Project:	Luminant-MLSES Ash Ponds	**Lab ID:**	1905168-04
Project No:	19122262-C	**Collection Date:**	05/14/19 11:25 AM
Lab Order:	1905168	**Matrix:**	AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
TRACE METALS: ICP-MS - WATER		**SW6020A**					Analyst: **RO**
Antimony	<0.000800	0.000800	0.00250		mg/L	1	05/20/19 03:49 PM
Arsenic	<0.00200	0.00200	0.00500		mg/L	1	05/20/19 03:49 PM
Barium	0.0138	0.00300	0.0100		mg/L	1	05/20/19 03:49 PM
Beryllium	0.00341	0.000300	0.00100		mg/L	1	05/20/19 03:49 PM
Boron	8.12	0.200	0.600		mg/L	20	05/21/19 01:01 PM
Cadmium	0.00219	0.000300	0.00100		mg/L	1	05/20/19 03:49 PM
Calcium	95.9	2.00	6.00		mg/L	20	05/21/19 01:01 PM
Chromium	<0.00200	0.00200	0.00500		mg/L	1	05/20/19 03:49 PM
Cobalt	0.183	0.00300	0.00500		mg/L	1	05/20/19 03:49 PM
Iron	0.0521	0.0300	0.100	J	mg/L	1	05/20/19 03:49 PM
Lead	0.000543	0.000300	0.00100	J	mg/L	1	05/20/19 03:49 PM
Lithium	0.173	0.00500	0.0100		mg/L	1	05/20/19 03:49 PM
Magnesium	80.5	2.00	6.00		mg/L	20	05/21/19 01:01 PM
Molybdenum	<0.00200	0.00200	0.00500		mg/L	1	05/21/19 02:55 PM
Potassium	2.01	0.100	0.300		mg/L	1	05/20/19 03:49 PM
Selenium	0.00616	0.00200	0.00500		mg/L	1	05/20/19 03:49 PM
Sodium	211	2.00	6.00		mg/L	20	05/21/19 01:01 PM
Thallium	<0.000500	0.000500	0.00150		mg/L	1	05/20/19 03:49 PM
MERCURY TOTAL: AQUEOUS		**SW7470A**					Analyst: **BM**
Mercury	<0.0000800	0.0000800	0.000200		mg/L	1	05/22/19 10:31 AM
ANIONS BY IC METHOD - WATER		**E300**					Analyst: **JL**
Chloride	81.8	3.00	10.0		mg/L	10	05/15/19 03:15 PM
Fluoride	0.104	0.100	0.400	J	mg/L	1	05/15/19 06:43 PM
Nitrate-N	0.121	0.100	0.500	J	mg/L	1	05/15/19 06:43 PM
Sulfate	780	10.0	30.0		mg/L	10	05/15/19 03:15 PM
ALKALINITY		**M2320 B**					Analyst: **CC**
Alkalinity, Bicarbonate (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:23 PM
Alkalinity, Carbonate (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:23 PM
Alkalinity, Hydroxide (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:23 PM
Alkalinity, Total (As CaCO3)	<20.0	20.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:23 PM
FERRIC IRON (CALCULATED)		**M3500-FE D**					Analyst: **CAC**
Iron, Ferric	0.0521	0.0500	0.100	JN	mg/L	1	05/24/19
FERROUS IRON		**M3500-FE D**					Analyst: **BTJ**
Iron, Ferrous	<0.0500	0.0500	0.100	N	mg/L	1	05/20/19 03:56 PM

Qualifiers:	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

CLIENT:	Golder	**Client Sample ID:**	H-29
Project:	Luminant-MLSES Ash Ponds	**Lab ID:**	1905168-04
Project No:	19122262-C	**Collection Date:**	05/14/19 11:25 AM
Lab Order:	1905168	**Matrix:**	AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
ORTHOPHOSPHATE		**M4500-P E**					Analyst: **CC**
Phosphorus, Total Orthophosphate (As P)	0.0570	0.0300	0.100	J	mg/L	1	05/15/19 12:49 PM
TOTAL DISSOLVED SOLIDS		**M2540C**					Analyst: **JS**
Total Dissolved Solids (Residue, Filterable)	1400	50.0	50.0		mg/L	1	05/17/19 11:40 AM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
S	Spike Recovery outside control limits	N	Parameter not NELAP certified

DHL Analytical, Inc.

Date: *14-Jun-19*

CLIENT: Golder
Project: Luminant-MLSES Ash Ponds
Project No: 19122262-C
Lab Order: 1905168

Client Sample ID: H-28
Lab ID: 1905168-05
Collection Date: 05/14/19 12:30 PM
Matrix: AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
TRACE METALS: ICP-MS - WATER		**SW6020A**					Analyst: **RO**
Antimony	<0.000800	0.000800	0.00250		mg/L	1	05/20/19 03:51 PM
Arsenic	<0.00200	0.00200	0.00500		mg/L	1	05/20/19 03:51 PM
Barium	0.0141	0.00300	0.0100		mg/L	1	05/20/19 03:51 PM
Beryllium	0.00281	0.000300	0.00100		mg/L	1	05/20/19 03:51 PM
Boron	8.51	0.200	0.600		mg/L	20	05/21/19 01:03 PM
Cadmium	0.00212	0.000300	0.00100		mg/L	1	05/20/19 03:51 PM
Calcium	99.7	2.00	6.00		mg/L	20	05/21/19 01:03 PM
Chromium	<0.00200	0.00200	0.00500		mg/L	1	05/20/19 03:51 PM
Cobalt	0.187	0.00300	0.00500		mg/L	1	05/20/19 03:51 PM
Iron	0.0715	0.0300	0.100	J	mg/L	1	05/20/19 03:51 PM
Lead	0.000595	0.000300	0.00100	J	mg/L	1	05/20/19 03:51 PM
Lithium	0.172	0.00500	0.0100		mg/L	1	05/20/19 03:51 PM
Magnesium	81.4	2.00	6.00		mg/L	20	05/21/19 01:03 PM
Molybdenum	<0.00200	0.00200	0.00500		mg/L	1	05/21/19 02:57 PM
Potassium	2.06	0.100	0.300		mg/L	1	05/20/19 03:51 PM
Selenium	0.00619	0.00200	0.00500		mg/L	1	05/20/19 03:51 PM
Sodium	210	2.00	6.00		mg/L	20	05/21/19 01:03 PM
Thallium	<0.000500	0.000500	0.00150		mg/L	1	05/20/19 03:51 PM
MERCURY TOTAL: AQUEOUS		**SW7470A**					Analyst: **BM**
Mercury	<0.0000800	0.0000800	0.000200		mg/L	1	05/22/19 10:34 AM
ANIONS BY IC METHOD - WATER		**E300**					Analyst: **JL**
Chloride	98.9	3.00	10.0		mg/L	10	05/15/19 03:31 PM
Fluoride	<0.100	0.100	0.400		mg/L	1	05/15/19 06:59 PM
Nitrate-N	<0.100	0.100	0.500		mg/L	1	05/15/19 06:59 PM
Sulfate	935	10.0	30.0		mg/L	10	05/15/19 03:31 PM
ALKALINITY		**M2320 B**					Analyst: **CC**
Alkalinity, Bicarbonate (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:27 PM
Alkalinity, Carbonate (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:27 PM
Alkalinity, Hydroxide (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:27 PM
Alkalinity, Total (As CaCO3)	<20.0	20.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:27 PM
FERRIC IRON (CALCULATED)		**M3500-FE D**					Analyst: **CAC**
Iron, Ferric	0.0715	0.0500	0.100	JN	mg/L	1	05/24/19
FERROUS IRON		**M3500-FE D**					Analyst: **BTJ**
Iron, Ferrous	<0.0500	0.0500	0.100	N	mg/L	1	05/20/19 03:57 PM

Qualifiers:	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

CLIENT:	Golder	**Client Sample ID:**	H-28
Project:	Luminant-MLSES Ash Ponds	**Lab ID:**	1905168-05
Project No:	19122262-C	**Collection Date:**	05/14/19 12:30 PM
Lab Order:	1905168	**Matrix:**	AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
ORTHOPHOSPHATE		**M4500-P E**					Analyst: **CC**
Phosphorus, Total Orthophosphate (As P)	0.0460	0.0300	0.100	J	mg/L	1	05/15/19 12:50 PM
TOTAL DISSOLVED SOLIDS		**M2540C**					Analyst: **JS**
Total Dissolved Solids (Residue, Filterable)	1680	50.0	50.0		mg/L	1	05/17/19 11:40 AM

Qualifiers:				
	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

CLIENT: Golder
Project: Luminant-MLSES Ash Ponds
Project No: 19122262-C
Lab Order: 1905168

Client Sample ID: H-26
Lab ID: 1905168-06
Collection Date: 05/14/19 02:25 PM
Matrix: AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
TRACE METALS: ICP-MS - WATER		**SW6020A**					Analyst: **RO**
Antimony	<0.000800	0.000800	0.00250		mg/L	1	05/20/19 03:53 PM
Arsenic	0.00410	0.00200	0.00500	J	mg/L	1	05/20/19 03:53 PM
Barium	0.190	0.00300	0.0100		mg/L	1	05/20/19 03:53 PM
Beryllium	0.00147	0.000300	0.00100		mg/L	1	05/20/19 03:53 PM
Boron	0.0507	0.0100	0.0300		mg/L	1	05/21/19 02:16 PM
Cadmium	<0.000300	0.000300	0.00100		mg/L	1	05/20/19 03:53 PM
Calcium	85.2	1.00	3.00		mg/L	10	05/21/19 01:05 PM
Chromium	0.0406	0.00200	0.00500		mg/L	1	05/20/19 03:53 PM
Cobalt	0.0795	0.00300	0.00500		mg/L	1	05/20/19 03:53 PM
Iron	8.81	0.0300	0.100		mg/L	1	05/20/19 03:53 PM
Lead	0.000972	0.000300	0.00100	J	mg/L	1	05/20/19 03:53 PM
Lithium	0.147	0.00500	0.0100		mg/L	1	05/20/19 03:53 PM
Magnesium	9.31	0.100	0.300		mg/L	1	05/20/19 03:53 PM
Molybdenum	<0.00200	0.00200	0.00500		mg/L	1	05/21/19 02:16 PM
Potassium	11.6	0.100	0.300		mg/L	1	05/20/19 03:53 PM
Selenium	0.00222	0.00200	0.00500	J	mg/L	1	05/20/19 03:53 PM
Sodium	69.5	1.00	3.00		mg/L	10	05/21/19 01:05 PM
Thallium	<0.000500	0.000500	0.00150		mg/L	1	05/20/19 03:53 PM
MERCURY TOTAL: AQUEOUS		**SW7470A**					Analyst: **BM**
Mercury	<0.0000800	0.0000800	0.000200		mg/L	1	05/22/19 10:36 AM
ANIONS BY IC METHOD - WATER		**E300**					Analyst: **JL**
Chloride	61.7	3.00	10.0		mg/L	10	05/15/19 03:47 PM
Fluoride	0.140	0.100	0.400	J	mg/L	1	05/15/19 07:15 PM
Nitrate-N	0.239	0.100	0.500	J	mg/L	1	05/15/19 07:15 PM
Sulfate	88.2	1.00	3.00		mg/L	1	05/15/19 07:15 PM
ALKALINITY		**M2320 B**					Analyst: **CC**
Alkalinity, Bicarbonate (As CaCO3)	157	10.0	20.0		mg/L @ pH 4.51	1	05/16/19 04:42 PM
Alkalinity, Carbonate (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.51	1	05/16/19 04:42 PM
Alkalinity, Hydroxide (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.51	1	05/16/19 04:42 PM
Alkalinity, Total (As CaCO3)	157	20.0	20.0		mg/L @ pH 4.51	1	05/16/19 04:42 PM
FERRIC IRON (CALCULATED)		**M3500-FE D**					Analyst: **CAC**
Iron, Ferric	8.81	0.0500	0.100	N	mg/L	1	05/24/19
FERROUS IRON		**M3500-FE D**					Analyst: **BTJ**
Iron, Ferrous	<0.0500	0.0500	0.100	N	mg/L	1	05/20/19 03:57 PM

Qualifiers:				
	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

CLIENT:	Golder	**Client Sample ID:**	H-26
Project:	Luminant-MLSES Ash Ponds	**Lab ID:**	1905168-06
Project No:	19122262-C	**Collection Date:**	05/14/19 02:25 PM
Lab Order:	1905168	**Matrix:**	AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
ORTHOPHOSPHATE		**M4500-P E**					Analyst: **CC**
Phosphorus, Total Orthophosphate (As P)	0.0310	0.0300	0.100	J	mg/L	1	05/15/19 12:50 PM
TOTAL DISSOLVED SOLIDS		**M2540C**					Analyst: **JS**
Total Dissolved Solids (Residue, Filterable)	453	10.0	10.0		mg/L	1	05/17/19 11:40 AM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
S	Spike Recovery outside control limits	N	Parameter not NELAP certified

DHL Analytical, Inc.

Date: *14-Jun-19*

CLIENT:	Golder	**Client Sample ID:**	H-33
Project:	Luminant-MLSES Ash Ponds	**Lab ID:**	1905168-07
Project No:	19122262-C	**Collection Date:**	05/14/19 03:30 PM
Lab Order:	1905168	**Matrix:**	AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
TRACE METALS: ICP-MS - WATER		**SW6020A**					Analyst: **RO**
Antimony	<0.000800	0.000800	0.00250		mg/L	1	05/20/19 03:54 PM
Arsenic	0.00355	0.00200	0.00500	J	mg/L	1	05/20/19 03:54 PM
Barium	0.158	0.00300	0.0100		mg/L	1	05/20/19 03:54 PM
Beryllium	0.00114	0.000300	0.00100		mg/L	1	05/20/19 03:54 PM
Boron	0.0592	0.0100	0.0300		mg/L	1	05/21/19 02:19 PM
Cadmium	<0.000300	0.000300	0.00100		mg/L	1	05/20/19 03:54 PM
Calcium	68.6	1.00	3.00		mg/L	10	05/21/19 01:08 PM
Chromium	0.0342	0.00200	0.00500		mg/L	1	05/20/19 03:54 PM
Cobalt	0.0648	0.00300	0.00500		mg/L	1	05/20/19 03:54 PM
Iron	7.61	0.0300	0.100		mg/L	1	05/20/19 03:54 PM
Lead	0.000772	0.000300	0.00100	J	mg/L	1	05/20/19 03:54 PM
Lithium	0.161	0.00500	0.0100		mg/L	1	05/20/19 03:54 PM
Magnesium	10.6	0.100	0.300		mg/L	1	05/20/19 03:54 PM
Molybdenum	<0.00200	0.00200	0.00500		mg/L	1	05/21/19 02:19 PM
Potassium	13.2	0.100	0.300		mg/L	1	05/20/19 03:54 PM
Selenium	<0.00200	0.00200	0.00500		mg/L	1	05/20/19 03:54 PM
Sodium	79.5	1.00	3.00		mg/L	10	05/21/19 01:08 PM
Thallium	<0.000500	0.000500	0.00150		mg/L	1	05/20/19 03:54 PM
MERCURY TOTAL: AQUEOUS		**SW7470A**					Analyst: **BM**
Mercury	<0.0000800	0.0000800	0.000200		mg/L	1	05/22/19 10:38 AM
ANIONS BY IC METHOD - WATER		**E300**					Analyst: **JL**
Chloride	80.4	3.00	10.0		mg/L	10	05/15/19 04:03 PM
Fluoride	0.166	0.100	0.400	J	mg/L	1	05/15/19 07:31 PM
Nitrate-N	0.287	0.100	0.500	J	mg/L	1	05/15/19 07:31 PM
Sulfate	104	10.0	30.0		mg/L	10	05/15/19 04:03 PM
ALKALINITY		**M2320 B**					Analyst: **CC**
Alkalinity, Bicarbonate (As CaCO3)	181	10.0	20.0		mg/L @ pH 4.51	1	05/16/19 04:49 PM
Alkalinity, Carbonate (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.51	1	05/16/19 04:49 PM
Alkalinity, Hydroxide (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.51	1	05/16/19 04:49 PM
Alkalinity, Total (As CaCO3)	181	20.0	20.0		mg/L @ pH 4.51	1	05/16/19 04:49 PM
FERRIC IRON (CALCULATED)		**M3500-FE D**					Analyst: **CAC**
Iron, Ferric	7.61	0.0500	0.100	N	mg/L	1	05/24/19
FERROUS IRON		**M3500-FE D**					Analyst: **BTJ**
Iron, Ferrous	<0.0500	0.0500	0.100	N	mg/L	1	05/20/19 03:58 PM

Qualifiers:	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

DHL Analytical, Inc. **Date:** *14-Jun-19*

CLIENT:	Golder		**Client Sample ID:**	H-33
Project:	Luminant-MLSES Ash Ponds		**Lab ID:**	1905168-07
Project No:	19122262-C		**Collection Date:**	05/14/19 03:30 PM
Lab Order:	1905168		**Matrix:**	AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
ORTHOPHOSPHATE		**M4500-P E**					Analyst: **CC**
Phosphorus, Total Orthophosphate (As P)	0.123	0.0300	0.100		mg/L	1	05/15/19 12:50 PM
TOTAL DISSOLVED SOLIDS		**M2540C**					Analyst: **JS**
Total Dissolved Solids (Residue, Filterable)	559	10.0	10.0		mg/L	1	05/17/19 11:40 AM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
S	Spike Recovery outside control limits	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **CETAC2_HG_190522A**

The QC data in batch 91017 applies to the following samples: 1905168-01B, 1905168-02B, 1905168-03B, 1905168-04B, 1905168-05B, 1905168-06B, 1905168-07B

Sample ID **MB-91017** Batch ID: **91017** TestNo: **SW7470A** Units: **mg/L**
SampType: **MBLK** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 10:02:31 AM** Prep Date: **5/21/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	<0.0000800	0.000200								

Sample ID **LCS-91017** Batch ID: **91017** TestNo: **SW7470A** Units: **mg/L**
SampType: **LCS** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 10:04:46 AM** Prep Date: **5/21/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00187	0.000200	0.00200	0	93.5	85	115			

Sample ID **LCSD-91017** Batch ID: **91017** TestNo: **SW7470A** Units: **mg/L**
SampType: **LCSD** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 10:07:02 AM** Prep Date: **5/21/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00186	0.000200	0.00200	0	93.0	85	115	0.536	15	

Sample ID **1905168-01B MS** Batch ID: **91017** TestNo: **SW7470A** Units: **mg/L**
SampType: **MS** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 11:23:23 AM** Prep Date: **5/21/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00196	0.00100	0.00200	0	97.8	80	120			

Sample ID **1905168-01B MSD** Batch ID: **91017** TestNo: **SW7470A** Units: **mg/L**
SampType: **MSD** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 11:25:39 AM** Prep Date: **5/21/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00194	0.00100	0.00200	0	97.0	80	120	0.770	15	

Sample ID **1905168-01B SD** Batch ID: **91017** TestNo: **SW7470A** Units: **mg/L**
SampType: **SD** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 11:27:56 AM** Prep Date: **5/21/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	<0.00200	0.00500	0	0				0	10	

Sample ID **1905168-01B PDS** Batch ID: **91017** TestNo: **SW7470A** Units: **mg/L**
SampType: **PDS** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 11:30:13 AM** Prep Date: **5/21/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.0122	0.00100	0.0125	0	97.6	85	115			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **CETAC2_HG_190522A**

Sample ID **ICV-190522**	Batch ID: **R104223**		TestNo: **SW7470A**			Units: **mg/L**				
SampType: **ICV**	Run ID: **CETAC2_HG_190522A**		Analysis Date: **5/22/2019 9:57:56 AM**			Prep Date:				
Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00383	0.000200	0.00400	0	95.8	90	110			

Sample ID **CCV1-190522**	Batch ID: **R104223**		TestNo: **SW7470A**			Units: **mg/L**				
SampType: **CCV**	Run ID: **CETAC2_HG_190522A**		Analysis Date: **5/22/2019 10:41:04 AM**			Prep Date:				
Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00202	0.000200	0.00200	0	101	90	110			

Sample ID **CCV2-190522**	Batch ID: **R104223**		TestNo: **SW7470A**			Units: **mg/L**				
SampType: **CCV**	Run ID: **CETAC2_HG_190522A**		Analysis Date: **5/22/2019 11:08:23 AM**			Prep Date:				
Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00203	0.000200	0.00200	0	102	90	110			

Sample ID **CCV3-190522**	Batch ID: **R104223**		TestNo: **SW7470A**			Units: **mg/L**				
SampType: **CCV**	Run ID: **CETAC2_HG_190522A**		Analysis Date: **5/22/2019 2:51:11 PM**			Prep Date:				
Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00203	0.000200	0.00200	0	102	90	110			

Qualifiers:				
B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS4_190520B**

The QC data in batch 90959 applies to the following samples: 1905168-01B, 1905168-02B, 1905168-03B, 1905168-04B, 1905168-05B, 1905168-06B, 1905168-07B

Sample ID **MB-90959** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **MBLK** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 3:23:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	<0.000800	0.00250								
Arsenic	<0.00200	0.00500								
Barium	<0.00300	0.0100								
Beryllium	<0.000300	0.00100								
Cadmium	<0.000300	0.00100								
Calcium	<0.100	0.300								
Chromium	<0.00200	0.00500								
Cobalt	<0.00300	0.00500								
Iron	<0.0300	0.100								
Lead	<0.000300	0.00100								
Lithium	<0.00500	0.0100								
Magnesium	<0.100	0.300								
Potassium	<0.100	0.300								
Selenium	<0.00200	0.00500								
Sodium	<0.100	0.300								
Thallium	<0.000500	0.00150								

Sample ID **LCS-90959** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCS** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 3:27:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.190	0.00250	0.200	0	94.8	80	120			
Arsenic	0.204	0.00500	0.200	0	102	80	120			
Barium	0.190	0.0100	0.200	0	94.9	80	120			
Beryllium	0.211	0.00100	0.200	0	105	80	120			
Cadmium	0.192	0.00100	0.200	0	95.8	80	120			
Calcium	4.65	0.300	5.00	0	93.1	80	120			
Chromium	0.195	0.00500	0.200	0	97.7	80	120			
Cobalt	0.203	0.00500	0.200	0	101	80	120			
Iron	5.14	0.100	5.00	0	103	80	120			
Lead	0.187	0.00100	0.200	0	93.6	80	120			
Lithium	0.217	0.0100	0.200	0	108	80	120			
Magnesium	5.03	0.300	5.00	0	101	80	120			
Potassium	5.02	0.300	5.00	0	100	80	120			
Selenium	0.204	0.00500	0.200	0	102	80	120			
Sodium	5.07	0.300	5.00	0	101	80	120			
Thallium	0.199	0.00150	0.200	0	99.7	80	120			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

Sample ID **LCSD-90959** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCSD** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 3:29:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.195	0.00250	0.200	0	97.7	80	120	2.98	15	
Arsenic	0.201	0.00500	0.200	0	100	80	120	1.34	15	
Barium	0.194	0.0100	0.200	0	97.2	80	120	2.37	15	
Beryllium	0.210	0.00100	0.200	0	105	80	120	0.345	15	
Cadmium	0.198	0.00100	0.200	0	98.8	80	120	3.14	15	
Calcium	4.68	0.300	5.00	0	93.5	80	120	0.492	15	
Chromium	0.198	0.00500	0.200	0	99.1	80	120	1.40	15	
Cobalt	0.200	0.00500	0.200	0	100	80	120	1.46	15	
Iron	5.15	0.100	5.00	0	103	80	120	0.209	15	
Lead	0.190	0.00100	0.200	0	95.0	80	120	1.54	15	
Lithium	0.211	0.0100	0.200	0	106	80	120	2.37	15	
Magnesium	5.15	0.300	5.00	0	103	80	120	2.30	15	
Potassium	5.07	0.300	5.00	0	101	80	120	1.08	15	
Selenium	0.200	0.00500	0.200	0	99.9	80	120	1.96	15	
Sodium	5.10	0.300	5.00	0	102	80	120	0.502	15	
Thallium	0.200	0.00150	0.200	0	100	80	120	0.279	15	

Sample ID **1905178-02C SD** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **SD** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 3:37:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	<0.00400	0.0125	0	0				0	10	
Arsenic	0.0115	0.0250	0	0.0113				1.19	10	
Barium	0.0249	0.0500	0	0.0269				7.62	10	
Beryllium	<0.00150	0.00500	0	0				0	10	
Cadmium	<0.00150	0.00500	0	0				0	10	
Chromium	0.0104	0.0250	0	0.0104				0.596	10	
Cobalt	<0.0150	0.0250	0	0				0	10	
Iron	0.313	0.500	0	0.303				3.55	10	
Lead	<0.00150	0.00500	0	0				0	10	
Lithium	0.0378	0.0500	0	0.0361				4.57	10	
Potassium	1.53	1.50	0	1.52				0.244	10	
Selenium	<0.0100	0.0250	0	0				0	10	
Thallium	<0.00250	0.00750	0	0				0	10	

Sample ID **1905178-02C PDS** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **PDS** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 3:56:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.193	0.00250	0.200	0	96.4	80	120			
Arsenic	0.209	0.00500	0.200	0.0113	98.9	80	120			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS4_190520B**

Sample ID **1905178-02C PDS** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **PDS** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 3:56:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Barium	0.214	0.0100	0.200	0.0269	93.7	80	120			
Beryllium	0.184	0.00100	0.200	0	91.9	80	120			
Cadmium	0.184	0.00100	0.200	0	91.8	80	120			
Chromium	0.198	0.00500	0.200	0.0104	93.6	80	120			
Cobalt	0.193	0.00500	0.200	0	96.5	80	120			
Iron	5.19	0.100	5.00	0.303	97.7	80	120			
Lead	0.185	0.00100	0.200	0	92.4	80	120			
Lithium	0.224	0.0100	0.200	0.0361	93.9	80	120			
Potassium	6.27	0.300	5.00	1.52	94.9	80	120			
Selenium	0.195	0.00500	0.200	0	97.6	80	120			
Thallium	0.203	0.00150	0.200	0	101	80	120			

Sample ID **1905178-02C MS** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **MS** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 3:58:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.197	0.00250	0.200	0	98.3	80	120			
Arsenic	0.217	0.00500	0.200	0.0113	103	80	120			
Barium	0.223	0.0100	0.200	0.0269	97.8	80	120			
Beryllium	0.187	0.00100	0.200	0	93.6	80	120			
Cadmium	0.185	0.00100	0.200	0	92.5	80	120			
Calcium	65.6	0.300	5.00	62.5	62.2	80	120			S
Chromium	0.198	0.00500	0.200	0.0104	93.7	80	120			
Cobalt	0.196	0.00500	0.200	0	98.1	80	120			
Iron	5.25	0.100	5.00	0.303	98.9	80	120			
Lead	0.188	0.00100	0.200	0	93.9	80	120			
Lithium	0.221	0.0100	0.200	0.0361	92.5	80	120			
Magnesium	65.8	0.300	5.00	63.5	45.8	80	120			S
Potassium	6.56	0.300	5.00	1.52	101	80	120			
Selenium	0.204	0.00500	0.200	0	102	80	120			
Sodium	223	0.300	5.00	229	-120	80	120			S
Thallium	0.201	0.00150	0.200	0	100	80	120			

Sample ID **1905178-02C MSD** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **MSD** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 4:00:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.199	0.00250	0.200	0	99.4	80	120	1.06	15	
Arsenic	0.214	0.00500	0.200	0.0113	101	80	120	1.22	15	
Barium	0.228	0.0100	0.200	0.0269	100	80	120	2.27	15	
Beryllium	0.186	0.00100	0.200	0	92.8	80	120	0.831	15	

Qualifiers:	B	Analyte detected in the associated Method Blank	DF	Dilution Factor
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
	RL	Reporting Limit	S	Spike Recovery outside control limits
	J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

ANALYTICAL QC SUMMARY REPORT

Sample ID **1905178-02C MSD** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **MSD** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 4:00:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Cadmium	0.188	0.00100	0.200	0	94.1	80	120	1.65	15	
Calcium	65.6	0.300	5.00	62.5	61.4	80	120	0.058	15	S
Chromium	0.197	0.00500	0.200	0.0104	93.2	80	120	0.455	15	
Cobalt	0.195	0.00500	0.200	0	97.6	80	120	0.571	15	
Iron	5.20	0.100	5.00	0.303	97.9	80	120	0.922	15	
Lead	0.186	0.00100	0.200	0	93.1	80	120	0.842	15	
Lithium	0.227	0.0100	0.200	0.0361	95.5	80	120	2.65	15	
Magnesium	66.6	0.300	5.00	63.5	62.8	80	120	1.28	15	S
Potassium	6.53	0.300	5.00	1.52	100	80	120	0.365	15	
Selenium	0.201	0.00500	0.200	0	101	80	120	1.07	15	
Sodium	224	0.300	5.00	229	-105	80	120	0.347	15	S
Thallium	0.205	0.00150	0.200	0	103	80	120	2.13	15	

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS4_190520B**

Sample ID **ICV-190520** Batch ID: **R104182** TestNo: **SW6020A** Units: **mg/L**
SampType: **ICV** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 11:23:00 AM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.0968	0.00250	0.100	0	96.8	90	110			
Arsenic	0.0991	0.00500	0.100	0	99.1	90	110			
Barium	0.0948	0.0100	0.100	0	94.8	90	110			
Beryllium	0.102	0.00100	0.100	0	102	90	110			
Cadmium	0.0974	0.00100	0.100	0	97.4	90	110			
Calcium	2.44	0.300	2.50	0	97.7	90	110			
Chromium	0.102	0.00500	0.100	0	102	90	110			
Cobalt	0.101	0.00500	0.100	0	101	90	110			
Iron	2.61	0.100	2.50	0	104	90	110			
Lead	0.0932	0.00100	0.100	0	93.2	90	110			
Lithium	0.106	0.0100	0.100	0	106	90	110			
Magnesium	2.50	0.300	2.50	0	100	90	110			
Potassium	2.53	0.300	2.50	0	101	90	110			
Selenium	0.0979	0.00500	0.100	0	97.9	90	110			
Sodium	2.59	0.300	2.50	0	104	90	110			
Thallium	0.0911	0.00150	0.100	0	91.1	90	110			

Sample ID **LCVL-190520** Batch ID: **R104182** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCVL** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 11:29:00 AM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.00176	0.00250	0.00200	0	87.9	70	130			
Arsenic	0.00489	0.00500	0.00500	0	97.7	70	130			
Barium	0.00432	0.0100	0.00500	0	86.5	70	130			
Beryllium	0.000893	0.00100	0.00100	0	89.3	70	130			
Cadmium	0.000871	0.00100	0.00100	0	87.1	70	130			
Calcium	0.0919	0.300	0.100	0	91.9	70	130			
Chromium	0.00481	0.00500	0.00500	0	96.1	70	130			
Cobalt	0.00485	0.00500	0.00500	0	97.0	70	130			
Iron	0.107	0.100	0.100	0	107	70	130			
Lead	0.000831	0.00100	0.00100	0	83.1	70	130			
Lithium	0.0104	0.0100	0.0100	0	104	70	130			
Magnesium	0.0970	0.300	0.100	0	97.0	70	130			
Potassium	0.0964	0.300	0.100	0	96.4	70	130			
Selenium	0.00489	0.00500	0.00500	0	97.8	70	130			
Sodium	0.0958	0.300	0.100	0	95.8	70	130			
Thallium	0.000816	0.00150	0.00100	0	81.6	70	130			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS4_190520B**

Sample ID **CCV5-190520** Batch ID: **R104182** TestNo: **SW6020A** Units: **mg/L**
SampType: **CCV** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 2:53:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.195	0.00250	0.200	0	97.6	90	110			
Arsenic	0.203	0.00500	0.200	0	102	90	110			
Barium	0.193	0.0100	0.200	0	96.5	90	110			
Beryllium	0.202	0.00100	0.200	0	101	90	110			
Cadmium	0.197	0.00100	0.200	0	98.4	90	110			
Calcium	4.64	0.300	5.00	0	92.9	90	110			
Chromium	0.195	0.00500	0.200	0	97.5	90	110			
Cobalt	0.201	0.00500	0.200	0	100	90	110			
Iron	5.06	0.100	5.00	0	101	90	110			
Lead	0.192	0.00100	0.200	0	96.1	90	110			
Lithium	0.206	0.0100	0.200	0	103	90	110			
Magnesium	5.06	0.300	5.00	0	101	90	110			
Potassium	5.03	0.300	5.00	0	101	90	110			
Selenium	0.205	0.00500	0.200	0	102	90	110			
Sodium	5.17	0.300	5.00	0	103	90	110			
Thallium	0.199	0.00150	0.200	0	99.7	90	110			

Sample ID **LCVL5-190520** Batch ID: **R104182** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCVL** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 3:01:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.00174	0.00250	0.00200	0	87.2	70	130			
Arsenic	0.00487	0.00500	0.00500	0	97.5	70	130			
Barium	0.00423	0.0100	0.00500	0	84.6	70	130			
Beryllium	0.00110	0.00100	0.00100	0	110	70	130			
Cadmium	0.000921	0.00100	0.00100	0	92.1	70	130			
Calcium	0.0952	0.300	0.100	0	95.2	70	130			
Chromium	0.00485	0.00500	0.00500	0	97.1	70	130			
Cobalt	0.00489	0.00500	0.00500	0	97.9	70	130			
Iron	0.108	0.100	0.100	0	108	70	130			
Lead	0.000805	0.00100	0.00100	0	80.5	70	130			
Lithium	0.0108	0.0100	0.0100	0	108	70	130			
Magnesium	0.0983	0.300	0.100	0	98.3	70	130			
Potassium	0.0975	0.300	0.100	0	97.5	70	130			
Selenium	0.00517	0.00500	0.00500	0	103	70	130			
Sodium	0.102	0.300	0.100	0	102	70	130			
Thallium	0.000787	0.00150	0.00100	0	78.7	70	130			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

Sample ID **CCV6-190520** Batch ID: **R104182** TestNo: **SW6020A** Units: **mg/L**
SampType: **CCV** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 4:02:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.194	0.00250	0.200	0	96.9	90	110			
Arsenic	0.205	0.00500	0.200	0	102	90	110			
Barium	0.192	0.0100	0.200	0	96.2	90	110			
Beryllium	0.199	0.00100	0.200	0	99.7	90	110			
Cadmium	0.193	0.00100	0.200	0	96.3	90	110			
Calcium	4.67	0.300	5.00	0	93.4	90	110			
Chromium	0.194	0.00500	0.200	0	96.8	90	110			
Cobalt	0.203	0.00500	0.200	0	101	90	110			
Iron	5.07	0.100	5.00	0	101	90	110			
Lead	0.195	0.00100	0.200	0	97.6	90	110			
Lithium	0.204	0.0100	0.200	0	102	90	110			
Magnesium	5.01	0.300	5.00	0	100	90	110			
Potassium	4.98	0.300	5.00	0	99.6	90	110			
Selenium	0.205	0.00500	0.200	0	103	90	110			
Sodium	5.14	0.300	5.00	0	103	90	110			
Thallium	0.205	0.00150	0.200	0	102	90	110			

Sample ID **LCVL6-190520** Batch ID: **R104182** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCVL** Run ID: **ICP-MS4_190520B** Analysis Date: **5/20/2019 4:06:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.00178	0.00250	0.00200	0	89.2	70	130			
Arsenic	0.00492	0.00500	0.00500	0	98.4	70	130			
Barium	0.00435	0.0100	0.00500	0	87.0	70	130			
Beryllium	0.00105	0.00100	0.00100	0	105	70	130			
Cadmium	0.000933	0.00100	0.00100	0	93.3	70	130			
Calcium	0.0988	0.300	0.100	0	98.8	70	130			
Chromium	0.00475	0.00500	0.00500	0	95.0	70	130			
Cobalt	0.00485	0.00500	0.00500	0	97.1	70	130			
Iron	0.107	0.100	0.100	0	107	70	130			
Lead	0.000828	0.00100	0.00100	0	82.8	70	130			
Lithium	0.0104	0.0100	0.0100	0	104	70	130			
Magnesium	0.0986	0.300	0.100	0	98.6	70	130			
Potassium	0.0940	0.300	0.100	0	94.0	70	130			
Selenium	0.00483	0.00500	0.00500	0	96.6	70	130			
Sodium	0.131	0.300	0.100	0	131	70	130			S
Thallium	0.000822	0.00150	0.00100	0	82.2	70	130			

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS5_190521A**

The QC data in batch 90959 applies to the following samples: 1905168-01B, 1905168-02B, 1905168-03B, 1905168-04B, 1905168-05B, 1905168-06B, 1905168-07B

Sample ID **MB-90959** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **MBLK** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 12:36:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	<0.0100	0.0300								
Molybdenum	<0.00200	0.00500								

Sample ID **LCS-90959** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCS** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 12:38:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.201	0.0300	0.200	0	101	80	120			
Molybdenum	0.195	0.00500	0.200	0	97.3	80	120			

Sample ID **LCSD-90959** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCSD** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 12:41:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.208	0.0300	0.200	0	104	80	120	3.23	15	
Molybdenum	0.192	0.00500	0.200	0	96.2	80	120	1.18	15	

Sample ID **1905178-02C SD** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **SD** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 12:47:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	<1.00	3.00	0	0.525				0	10	
Calcium	70.4	30.0	0	68.2				3.15	10	
Magnesium	63.5	30.0	0	63.5				0.085	10	
Molybdenum	<0.200	0.500	0	0				0	10	
Sodium	227	30.0	0	233				2.75	10	

Sample ID **1905178-02C PDS** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **PDS** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 1:14:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	4.53	0.600	4.00	0.525	100	80	120			
Calcium	170	6.00	100	68.2	102	80	120			
Magnesium	161	6.00	100	63.5	97.1	80	120			
Molybdenum	3.64	0.100	4.00	0	90.9	80	120			
Sodium	331	6.00	100	233	98.2	80	120			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS5_190521A**

Sample ID **1905178-02C MS** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **MS** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 1:17:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.866	0.600	0.200	0.525	170	80	120			S
Molybdenum	0.192	0.100	0.200	0	96.0	80	120			

Sample ID **1905178-02C MSD** Batch ID: **90959** TestNo: **SW6020A** Units: **mg/L**
SampType: **MSD** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 1:19:00 PM** Prep Date: **5/17/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.750	0.600	0.200	0.525	112	80	120	14.3	15	
Molybdenum	0.189	0.100	0.200	0	94.3	80	120	1.76	15	

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS5_190521A**

Sample ID **ICV-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **ICV** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 12:10:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.103	0.0300	0.100	0	103	90	110			
Calcium	2.52	0.300	2.50	0	101	90	110			
Iron	2.60	0.100	2.50	0	104	90	110			
Magnesium	2.49	0.300	2.50	0	99.7	90	110			
Molybdenum	0.0930	0.00500	0.100	0	93.0	90	110			
Sodium	2.56	0.300	2.50	0	103	90	110			

Sample ID **LCVL-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCVL** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 12:15:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.0223	0.0300	0.0200	0	111	70	130			
Calcium	0.104	0.300	0.100	0	104	70	130			
Iron	0.0979	0.100	0.100	0	97.9	70	130			
Magnesium	0.0983	0.300	0.100	0	98.3	70	130			
Molybdenum	0.00464	0.00500	0.00500	0	92.8	70	130			
Sodium	0.0960	0.300	0.100	0	96.0	70	130			

Sample ID **CCV1-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **CCV** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 1:26:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.196	0.0300	0.200	0	98.1	90	110			
Calcium	4.90	0.300	5.00	0	98.0	90	110			
Iron	5.04	0.100	5.00	0	101	90	110			
Magnesium	4.94	0.300	5.00	0	98.8	90	110			
Molybdenum	0.193	0.00500	0.200	0	96.3	90	110			
Sodium	4.93	0.300	5.00	0	98.6	90	110			

Sample ID **LCVL1-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCVL** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 1:30:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.0245	0.0300	0.0200	0	123	70	130			
Calcium	0.0976	0.300	0.100	0	97.6	70	130			
Iron	0.0980	0.100	0.100	0	98.0	70	130			
Magnesium	0.0940	0.300	0.100	0	94.0	70	130			
Molybdenum	0.00478	0.00500	0.00500	0	95.6	70	130			
Sodium	0.0986	0.300	0.100	0	98.6	70	130			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS5_190521A**

Sample ID **CCV2-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **CCV** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 2:05:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.208	0.0300	0.200	0	104	90	110			
Molybdenum	0.201	0.00500	0.200	0	101	90	110			

Sample ID **LCVL2-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCVL** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 2:09:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.0258	0.0300	0.0200	0	129	70	130			
Molybdenum	0.00474	0.00500	0.00500	0	94.7	70	130			

Sample ID **CCV3-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **CCV** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 2:34:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.199	0.0300	0.200	0	99.5	90	110			
Molybdenum	0.199	0.00500	0.200	0	99.7	90	110			

Sample ID **LCVL3-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCVL** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 2:46:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.0227	0.0300	0.0200	0	113	70	130			
Molybdenum	0.00484	0.00500	0.00500	0	96.8	70	130			

Sample ID **CCV4-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **CCV** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 3:00:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Molybdenum	0.199	0.00500	0.200	0	99.7	90	110			

Sample ID **LCVL4-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCVL** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 3:05:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Molybdenum	0.00483	0.00500	0.00500	0	96.6	70	130			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **IC2_190515A**

The QC data in batch 90908 applies to the following samples: 1905168-01C, 1905168-02C, 1905168-03C, 1905168-04C, 1905168-05C, 1905168-06C, 1905168-07C

Sample ID **MB-90908** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **MBLK** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 10:10:50 AM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	<0.300	1.00								
Fluoride	<0.100	0.400								
Nitrate-N	<0.100	0.500								
Sulfate	<1.00	3.00								

Sample ID **LCS-90908** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **LCS** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 10:26:50 AM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	10.1	1.00	10.00	0	101	90	110			
Fluoride	4.00	0.400	4.000	0	99.9	90	110			
Nitrate-N	5.09	0.500	5.000	0	102	90	110			
Sulfate	30.4	3.00	30.00	0	101	90	110			

Sample ID **LCSD-90908** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **LCSD** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 10:42:50 AM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	10.2	1.00	10.00	0	102	90	110	0.674	20	
Fluoride	4.05	0.400	4.000	0	101	90	110	1.26	20	
Nitrate-N	5.08	0.500	5.000	0	102	90	110	0.146	20	
Sulfate	30.9	3.00	30.00	0	103	90	110	1.55	20	

Sample ID **1905167-01CMS** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **MS** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 1:07:36 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	222	10.0	200.0	12.69	105	90	110			
Fluoride	211	4.00	200.0	0	106	90	110			
Nitrate-N	45.6	5.00	45.16	0	101	90	110			
Sulfate	239	30.0	200.0	41.32	98.7	90	110			

Sample ID **1905167-01CMSD** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **MSD** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 1:23:36 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	221	10.0	200.0	12.69	104	90	110	0.308	20	
Fluoride	210	4.00	200.0	0	105	90	110	0.286	20	
Nitrate-N	45.8	5.00	45.16	0	101	90	110	0.495	20	

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

ANALYTICAL QC SUMMARY REPORT

RunID: **IC2_190515A**

Sample ID **1905167-01CMSD** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **MSD** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 1:23:36 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	237	30.0	200.0	41.32	97.7	90	110	0.821	20	

Sample ID **1905167-02CMS** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **MS** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 1:55:36 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	686	10.0	200.0	528.8	78.8	90	110			S
Fluoride	229	4.00	200.0	24.26	102	90	110			
Nitrate-N	56.2	5.00	45.16	10.55	101	90	110			
Sulfate	2520	30.0	200.0	0	1260	90	110			S

Sample ID **1905167-02CMSD** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **MSD** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 2:11:36 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	688	10.0	200.0	528.8	79.8	90	110	0.292	20	S
Fluoride	229	4.00	200.0	24.26	102	90	110	0.251	20	
Nitrate-N	57.3	5.00	45.16	10.55	103	90	110	1.85	20	
Sulfate	<10.0	30.0	200.0	0	0	90	110	0	20	S

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **IC2_190515A**

Sample ID **ICV-190515**	Batch ID: **R104097**	TestNo: **E300**	Units: **mg/L**
SampType: **ICV**	Run ID: **IC2_190515A**	Analysis Date: **5/15/2019 9:38:50 AM**	Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	25.8	1.00	25.00	0	103	90	110			
Fluoride	10.3	0.400	10.00	0	103	90	110			
Nitrate-N	13.0	0.500	12.50	0	104	90	110			
Sulfate	77.8	3.00	75.00	0	104	90	110			

Sample ID **CCV1-190515**	Batch ID: **R104097**	TestNo: **E300**	Units: **mg/L**
SampType: **CCV**	Run ID: **IC2_190515A**	Analysis Date: **5/15/2019 4:51:36 PM**	Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	10.4	1.00	10.00	0	104	90	110			
Fluoride	4.15	0.400	4.000	0	104	90	110			
Nitrate-N	5.13	0.500	5.000	0	103	90	110			
Sulfate	30.8	3.00	30.00	0	103	90	110			

Sample ID **CCV2-190515**	Batch ID: **R104097**	TestNo: **E300**	Units: **mg/L**
SampType: **CCV**	Run ID: **IC2_190515A**	Analysis Date: **5/15/2019 8:35:35 PM**	Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	10.6	1.00	10.00	0	106	90	110			
Fluoride	4.20	0.400	4.000	0	105	90	110			
Nitrate-N	5.20	0.500	5.000	0	104	90	110			
Sulfate	31.5	3.00	30.00	0	105	90	110			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **IC4_190516A**

The QC data in batch 90935 applies to the following samples: 1905168-01C

Sample ID **MB-90935** Batch ID: **90935** TestNo: **E300** Units: **mg/L**
SampType: **MBLK** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 10:26:21 AM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	<1.00	3.00								

Sample ID **LCS-90935** Batch ID: **90935** TestNo: **E300** Units: **mg/L**
SampType: **LCS** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 10:42:21 AM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	29.5	3.00	30.00	0	98.3	90	110			

Sample ID **LCSD-90935** Batch ID: **90935** TestNo: **E300** Units: **mg/L**
SampType: **LCSD** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 10:58:21 AM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	29.8	3.00	30.00	0	99.2	90	110	0.935	20	

Sample ID **1905167-02CMS** Batch ID: **90935** TestNo: **E300** Units: **mg/L**
SampType: **MS** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 5:10:27 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	4830	300	2000	2897	96.9	90	110			

Sample ID **1905167-02CMSD** Batch ID: **90935** TestNo: **E300** Units: **mg/L**
SampType: **MSD** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 5:26:27 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	4880	300	2000	2897	99.1	90	110	0.920	20	

Sample ID **1905168-01CMS** Batch ID: **90935** TestNo: **E300** Units: **mg/L**
SampType: **MS** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 5:58:26 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	4380	300	2000	2468	95.6	90	110			

Sample ID **1905168-01CMSD** Batch ID: **90935** TestNo: **E300** Units: **mg/L**
SampType: **MSD** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 6:14:27 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	4390	300	2000	2468	96.2	90	110	0.273	20	

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT:	Golder
Work Order:	1905168
Project:	Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **IC4_190516A**

Sample ID **ICV-190516**	Batch ID: **R104119**	TestNo: **E300**	Units: **mg/L**
SampType: **ICV**	Run ID: **IC4_190516A**	Analysis Date: **5/16/2019 9:54:21 AM**	Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	74.5	3.00	75.00	0	99.4	90	110			

Sample ID **CCV1-190516**	Batch ID: **R104119**	TestNo: **E300**	Units: **mg/L**
SampType: **CCV**	Run ID: **IC4_190516A**	Analysis Date: **5/16/2019 9:10:26 PM**	Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Sulfate	30.2	3.00	30.00	0	101	90	110			

Qualifiers:	B	Analyte detected in the associated Method Blank	DF	Dilution Factor
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
	RL	Reporting Limit	S	Spike Recovery outside control limits
	J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **TITRATOR_190516A**

The QC data in batch 90940 applies to the following samples: 1905168-01C, 1905168-02C, 1905168-03C, 1905168-04C, 1905168-05C, 1905168-06C, 1905168-07C

Sample ID	**MB-90940**	Batch ID:	**90940**	TestNo:	**M2320 B**	Units:	**mg/L @ pH 4.47**
SampType:	**MBLK**	Run ID:	**TITRATOR_190516A**	Analysis Date:	**5/16/2019 2:00:00 PM**	Prep Date:	**5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	<10.0	20.0								
Alkalinity, Carbonate (As CaCO3)	<10.0	20.0								
Alkalinity, Hydroxide (As CaCO3)	<10.0	20.0								
Alkalinity, Total (As CaCO3)	<20.0	20.0								

Sample ID	**LCS-90940**	Batch ID:	**90940**	TestNo:	**M2320 B**	Units:	**mg/L @ pH 4.08**
SampType:	**LCS**	Run ID:	**TITRATOR_190516A**	Analysis Date:	**5/16/2019 2:04:00 PM**	Prep Date:	**5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Total (As CaCO3)	52.3	20.0	50.00	0	105	74	129			

Sample ID	**1905134-01C DUP**	Batch ID:	**90940**	TestNo:	**M2320 B**	Units:	**mg/L @ pH 4.52**
SampType:	**DUP**	Run ID:	**TITRATOR_190516A**	Analysis Date:	**5/16/2019 2:15:00 PM**	Prep Date:	**5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	205	20.0	0	205.8				0.536	20	
Alkalinity, Carbonate (As CaCO3)	<10.0	20.0	0	0				0	20	
Alkalinity, Hydroxide (As CaCO3)	<10.0	20.0	0	0				0	20	
Alkalinity, Total (As CaCO3)	205	20.0	0	205.8				0.536	20	

Sample ID	**1905168-05C DUP**	Batch ID:	**90940**	TestNo:	**M2320 B**	Units:	**mg/L @ pH 4.51**
SampType:	**DUP**	Run ID:	**TITRATOR_190516A**	Analysis Date:	**5/16/2019 4:30:00 PM**	Prep Date:	**5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	<10.0	20.0	0	0				0	20	
Alkalinity, Carbonate (As CaCO3)	<10.0	20.0	0	0				0	20	
Alkalinity, Hydroxide (As CaCO3)	<10.0	20.0	0	0				0	20	
Alkalinity, Total (As CaCO3)	<20.0	20.0	0	0				0	20	

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **TITRATOR_190516A**

Sample ID **ICV-190516** Batch ID: **R104124** TestNo: **M2320 B** Units: **mg/L @ pH 4.34**
SampType: **ICV** Run ID: **TITRATOR_190516A** Analysis Date: **5/16/2019 1:58:00 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	8.64	20.0	0							
Alkalinity, Carbonate (As CaCO3)	89.3	20.0	0							
Alkalinity, Hydroxide (As CaCO3)	<10.0	20.0	0							
Alkalinity, Total (As CaCO3)	97.9	20.0	100.0	0	97.9	98	102			

Sample ID **CCV1-190516** Batch ID: **R104124** TestNo: **M2320 B** Units: **mg/L @ pH 4.25**
SampType: **CCV** Run ID: **TITRATOR_190516A** Analysis Date: **5/16/2019 3:39:00 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	21.7	20.0	0							
Alkalinity, Carbonate (As CaCO3)	76.8	20.0	0							
Alkalinity, Hydroxide (As CaCO3)	<10.0	20.0	0							
Alkalinity, Total (As CaCO3)	98.5	20.0	100.0	0	98.5	90	110			

Sample ID **CCV2-190516** Batch ID: **R104124** TestNo: **M2320 B** Units: **mg/L @ pH 4.21**
SampType: **CCV** Run ID: **TITRATOR_190516A** Analysis Date: **5/16/2019 4:35:00 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	17.7	20.0	0							
Alkalinity, Carbonate (As CaCO3)	81.3	20.0	0							
Alkalinity, Hydroxide (As CaCO3)	<10.0	20.0	0							
Alkalinity, Total (As CaCO3)	99.0	20.0	100.0	0	99.0	90	110			

Sample ID **CCV3-190516** Batch ID: **R104124** TestNo: **M2320 B** Units: **mg/L @ pH 4.39**
SampType: **CCV** Run ID: **TITRATOR_190516A** Analysis Date: **5/16/2019 4:54:00 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	20.3	20.0	0							
Alkalinity, Carbonate (As CaCO3)	77.1	20.0	0							
Alkalinity, Hydroxide (As CaCO3)	<10.0	20.0	0							
Alkalinity, Total (As CaCO3)	97.4	20.0	100.0	0	97.4	90	110			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **UV/VIS_2_190515B**

The QC data in batch 90921 applies to the following samples: 1905168-01C, 1905168-02C, 1905168-03C, 1905168-04C, 1905168-05C, 1905168-06C, 1905168-07C

Sample ID **MB-90921** Batch ID: **90921** TestNo: **M4500-P E** Units: **mg/L**
SampType: **MBLK** Run ID: **UV/VIS_2_190515B** Analysis Date: **5/15/2019 12:42:00 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Phosphorus, Total Orthophosphate (As	<0.0300	0.100								

Sample ID **LCS-90921** Batch ID: **90921** TestNo: **M4500-P E** Units: **mg/L**
SampType: **LCS** Run ID: **UV/VIS_2_190515B** Analysis Date: **5/15/2019 12:43:00 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Phosphorus, Total Orthophosphate (As	0.513	0.100	0.5000	0	103	80	120			

Sample ID **LCSD-90921** Batch ID: **90921** TestNo: **M4500-P E** Units: **mg/L**
SampType: **LCSD** Run ID: **UV/VIS_2_190515B** Analysis Date: **5/15/2019 12:43:00 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Phosphorus, Total Orthophosphate (As	0.504	0.100	0.5000	0	101	80	120	1.77	15	

Sample ID **1905168-01CMS** Batch ID: **90921** TestNo: **M4500-P E** Units: **mg/L**
SampType: **MS** Run ID: **UV/VIS_2_190515B** Analysis Date: **5/15/2019 12:45:00 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Phosphorus, Total Orthophosphate (As	0.587	0.100	0.5000	0.07700	102	80	120			

Sample ID **1905168-01CMSD** Batch ID: **90921** TestNo: **M4500-P E** Units: **mg/L**
SampType: **MSD** Run ID: **UV/VIS_2_190515B** Analysis Date: **5/15/2019 12:45:00 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Phosphorus, Total Orthophosphate (As	0.525	0.100	0.5000	0.07700	89.6	80	120	11.2	15	

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **UV/VIS_2_190515B**

Sample ID **ICV-190515** Batch ID: **R104071** TestNo: **M4500-P E** Units: **mg/L**
SampType: **ICV** Run ID: **UV/VIS_2_190515B** Analysis Date: **5/15/2019 12:41:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Phosphorus, Total Orthophosphate (As	0.204	0.100	0.2000	0	102	85	115			

Sample ID **CCV1-190515** Batch ID: **R104071** TestNo: **M4500-P E** Units: **mg/L**
SampType: **CCV** Run ID: **UV/VIS_2_190515B** Analysis Date: **5/15/2019 12:51:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Phosphorus, Total Orthophosphate (As	0.509	0.100	0.5000	0	102	85	115			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **UV/VIS_2_190520A**

The QC data in batch 91002 applies to the following samples: 1905168-01A, 1905168-02A, 1905168-03A, 1905168-04A, 1905168-05A, 1905168-06A, 1905168-07A

Sample ID **MB-91002** Batch ID: **91002** TestNo: **M3500-Fe D** Units: **mg/L**
SampType: **MBLK** Run ID: **UV/VIS_2_190520A** Analysis Date: **5/20/2019 3:53:00 PM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	<0.0500	0.100								N

Sample ID **LCS-91002** Batch ID: **91002** TestNo: **M3500-Fe D** Units: **mg/L**
SampType: **LCS** Run ID: **UV/VIS_2_190520A** Analysis Date: **5/20/2019 3:53:00 PM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	0.0888	0.100	0.1000	0	88.8	85	115			N

Sample ID **LCSD-91002** Batch ID: **91002** TestNo: **M3500-Fe D** Units: **mg/L**
SampType: **LCSD** Run ID: **UV/VIS_2_190520A** Analysis Date: **5/20/2019 3:53:00 PM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	0.0879	0.100	0.1000	0	87.9	85	115	1.05	15	N

Sample ID **1905185-11AMS** Batch ID: **91002** TestNo: **M3500-Fe D** Units: **mg/L**
SampType: **MS** Run ID: **UV/VIS_2_190520A** Analysis Date: **5/20/2019 4:03:00 PM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	0.0860	0.100	0.1000	0	86.0	85	115			N

Sample ID **1905185-11AMSD** Batch ID: **91002** TestNo: **M3500-Fe D** Units: **mg/L**
SampType: **MSD** Run ID: **UV/VIS_2_190520A** Analysis Date: **5/20/2019 4:03:00 PM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	0.0861	0.100	0.1000	0	86.1	85	115	0.116	15	N

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **UV/VIS_2_190520A**

Sample ID	**ICV-190520**	Batch ID:	**R104177**	TestNo:	**M3500-Fe D**	Units:	**mg/L**
SampType:	**ICV**	Run ID:	**UV/VIS_2_190520A**	Analysis Date:	**5/20/2019 3:52:00 PM**	Prep Date:	

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	0.0875	0.100	0.1000	0	87.5	85	115			N

Sample ID	**CCV1-190520**	Batch ID:	**R104177**	TestNo:	**M3500-Fe D**	Units:	**mg/L**
SampType:	**CCV**	Run ID:	**UV/VIS_2_190520A**	Analysis Date:	**5/20/2019 3:59:00 PM**	Prep Date:	

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	0.197	0.100	0.2000	0	98.4	85	115			N

Sample ID	**CCV2-190520**	Batch ID:	**R104177**	TestNo:	**M3500-Fe D**	Units:	**mg/L**
SampType:	**CCV**	Run ID:	**UV/VIS_2_190520A**	Analysis Date:	**5/20/2019 4:12:00 PM**	Prep Date:	

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	0.183	0.100	0.2000	0	91.7	85	115			N

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905168
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **WC_190517D**

The QC data in batch 90953 applies to the following samples: 1905168-01C, 1905168-02C, 1905168-03C, 1905168-04C, 1905168-05C, 1905168-06C, 1905168-07C

Sample ID	**MB-90953**	Batch ID:	**90953**	TestNo:	**M2540C**	Units:	**mg/L**
SampType:	**MBLK**	Run ID:	**WC_190517D**	Analysis Date:	**5/17/2019 11:40:00 AM**	Prep Date:	**5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	<10.0	10.0								

Sample ID	**LCS-90953**	Batch ID:	**90953**	TestNo:	**M2540C**	Units:	**mg/L**
SampType:	**LCS**	Run ID:	**WC_190517D**	Analysis Date:	**5/17/2019 11:40:00 AM**	Prep Date:	**5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	745	10.0	745.6	0	99.9	90	113			

Sample ID	**1905167-02C-DUP**	Batch ID:	**90953**	TestNo:	**M2540C**	Units:	**mg/L**
SampType:	**DUP**	Run ID:	**WC_190517D**	Analysis Date:	**5/17/2019 11:40:00 AM**	Prep Date:	**5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	5340	50.0	0	5375				0.747	5	

Sample ID	**1905168-02C-DUP**	Batch ID:	**90953**	TestNo:	**M2540C**	Units:	**mg/L**
SampType:	**DUP**	Run ID:	**WC_190517D**	Analysis Date:	**5/17/2019 11:40:00 AM**	Prep Date:	**5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	940	50.0	0	910.0				3.24	5	

Qualifiers:				
	B	Analyte detected in the associated Method Blank	DF	Dilution Factor
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
	RL	Reporting Limit	S	Spike Recovery outside control limits
	J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

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ANALYTICAL REPORT

June 10, 2019

Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

DHL Analytical, Inc.

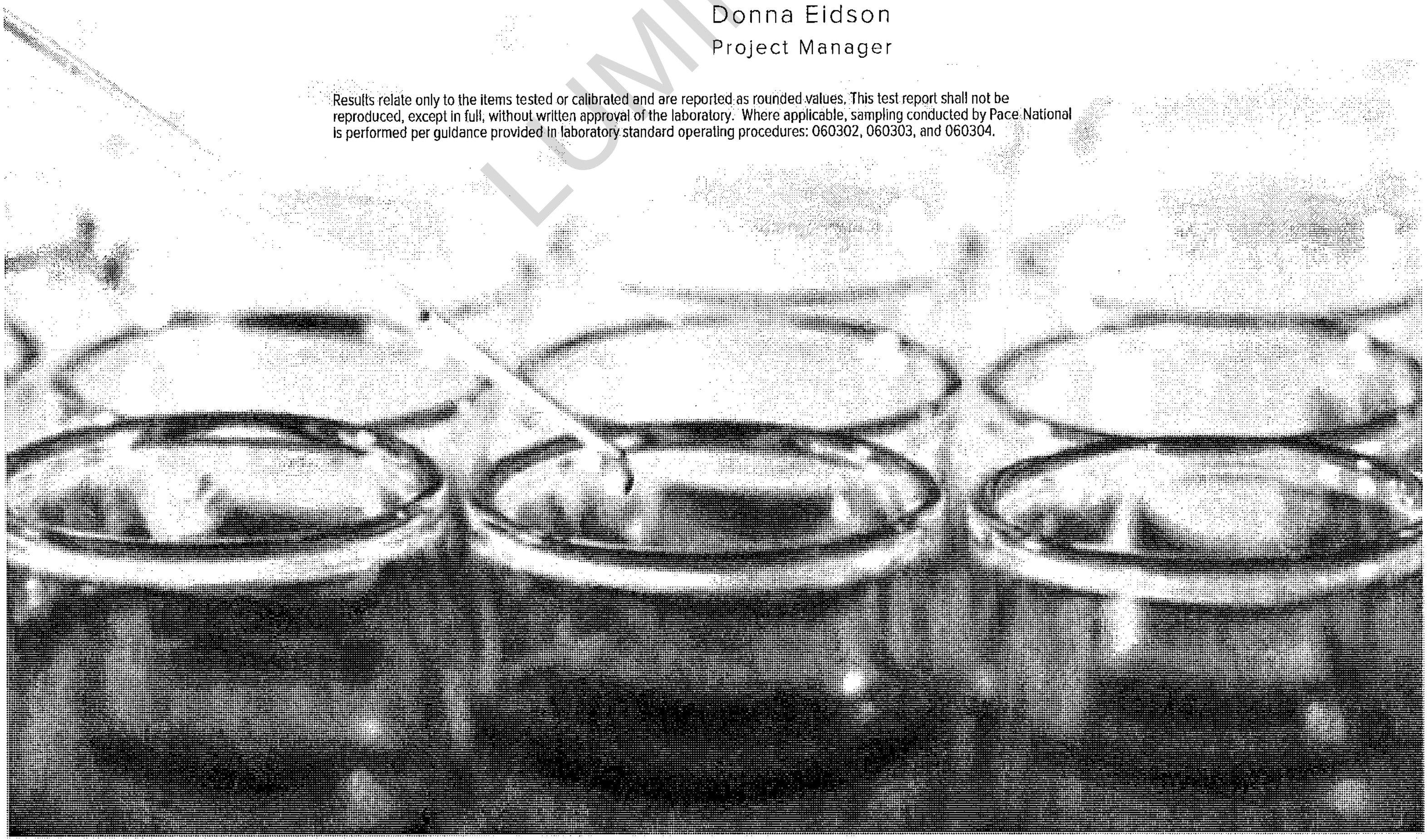
Sample Delivery Group: L1100989
Samples Received: 05/21/2019
Project Number: 1905168
Description:

Report To: John DuPont
2300 Double Creek Drive
Round Rock, TX 78664

Entire Report Reviewed By: DEidson

Donna Eidson
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace National is performed per guidance provided in laboratory standard operating procedures: 060302, 060303, and 060304.



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SAMPLE SUMMARY

H-31 L1100989-01 Non-Potable Water

Collected by	Collected date/time	Received date/time
	05/14/19 07:40	05/21/19 10:10

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904	WG1285651	1	05/24/19 09:05	05/31/19 11:10	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1287234	1	05/29/19 08:27	06/03/19 17:48	RGT	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1287234	1	05/29/19 08:27	06/03/19 17:48	RGT	Mt. Juliet, TN

H-32 L1100989-02 Non-Potable Water

Collected by	Collected date/time	Received date/time
	05/14/19 08:25	05/21/19 10:10

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904	WG1285651	1	05/24/19 09:05	05/31/19 11:10	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1287234	1	05/29/19 08:27	06/03/19 17:48	RGT	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1287234	1	05/29/19 08:27	06/03/19 17:48	RGT	Mt. Juliet, TN

H-27 L1100989-03 Non-Potable Water

Collected by	Collected date/time	Received date/time
	05/14/19 09:40	05/21/19 10:10

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904	WG1285651	1	05/24/19 09:05	05/31/19 11:10	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1287234	1	05/29/19 08:27	06/03/19 17:48	RGT	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1287234	1	05/29/19 08:27	06/03/19 17:48	RGT	Mt. Juliet, TN

H-29 L1100989-04 Non-Potable Water

Collected by	Collected date/time	Received date/time
	05/14/19 11:25	05/21/19 10:10

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904	WG1285651	1	05/24/19 09:05	05/31/19 11:10	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1287234	1	05/29/19 08:27	06/03/19 17:48	RGT	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1287234	1	05/29/19 08:27	06/03/19 17:48	RGT	Mt. Juliet, TN

H-28 L1100989-05 Non-Potable Water

Collected by	Collected date/time	Received date/time
	05/14/19 12:30	05/21/19 10:10

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904	WG1285651	1	05/24/19 09:05	05/31/19 11:10	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1287234	1	05/29/19 08:27	06/03/19 17:48	RGT	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1287234	1	05/29/19 08:27	06/03/19 17:48	RGT	Mt. Juliet, TN

H-26 L1100989-06 Non-Potable Water

Collected by	Collected date/time	Received date/time
	05/14/19 14:25	05/21/19 10:10

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904	WG1285651	1	05/24/19 09:05	05/31/19 11:10	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1287234	1	05/29/19 08:27	06/03/19 17:48	RGT	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1287234	1	05/29/19 08:27	06/03/19 17:48	RGT	Mt. Juliet, TN

SAMPLE SUMMARY

	Collected by	Collected date/time	Received date/time
H-33 L1100989-07 Non-Potable Water		05/14/19 15:30	05/21/19 10:10

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904	WG1285651	1	05/24/19 09:05	05/31/19 11:10	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1287234	1	05/29/19 08:27	06/03/19 17:48	RGT	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1287234	1	05/29/19 08:27	06/03/19 17:48	RGT	Mt. Juliet, TN

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All radiochemical sample results for solids are reported on a dry weight basis with the exception of tritium, carbon-14 and radon, unless wet weight was requested by the client. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

DEidson

Donna Eidson
Project Manager

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Radiochemistry by Method 904

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/l		+ / -	pCi/l	date / time	
RADIUM-228	0.531		0.515	0.789	05/31/2019 11:10	WG1285651
(T) Barium	*120*			*62.0-143*	*05/31/2019 11:10*	WG1285651
(T) Yttrium	*93.0*			*79.0-136*	*05/31/2019 11:10*	WG1285651

Radiochemistry by Method Calculation

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/l		+ / -	pCi/l	date / time	
Combined Radium	3.15		1.09	0.978	06/03/2019 17:48	WG1287234

Radiochemistry by Method SM7500Ra B M

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/l		+ / -	pCi/l	date / time	
RADIUM-226	2.62		0.578	0.189	06/03/2019 17:48	WG1287234
(T) Barium-133	*104*			*30.0-143*	*06/03/2019 17:48*	WG1287234

H-32

Collected date/time: 05/14/19 08:25

SAMPLE RESULTS - 02

L1100989

Radiochemistry by Method 904

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	0.147		0.380	0.546	05/31/2019 11:10	WG1285651
(T) Barium	*100*			*62.0-143*	*05/31/2019 11:10*	WG1285651
(T) Yttrium	*109*			*79.0-136*	*05/31/2019 11:10*	WG1285651

Radiochemistry by Method Calculation

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
Combined Radium	0.450		0.625	0.833	06/03/2019 17:48	WG1287234

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	0.303		0.245	0.287	06/03/2019 17:48	WG1287234
(T) Barium-133	*105*			*30.0-143*	*06/03/2019 17:48*	WG1287234

H-27

Collected date/time: 05/14/19 09:40

SAMPLE RESULTS - 03

L1100989

Radiochemistry by Method 904

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	0.928		0.365	0.563	05/31/2019 11:10	WG1285651
(T) Barium	*96.7*			*62.0-143*	*05/31/2019 11:10*	WG1285651
(T) Yttrium	*98.1*			*79.0-136*	*05/31/2019 11:10*	WG1285651

Radiochemistry by Method Calculation

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
Combined Radium	2.03		0.814	0.854	06/03/2019 17:48	WG1287234

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty +/-	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	1.10		0.449	0.291	06/03/2019 17:48	WG1287234
(T) Barium-133	*85.4*			*30.0-143*	*06/03/2019 17:48*	WG1287234

Radiochemistry by Method 904

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	0.352		0.428	0.707	05/31/2019 11:10	WG1285651
(T) Barium	*116*			*62.0-143*	*05/31/2019 11:10*	WG1285651
(T) Yttrium	*96.5*			*79.0-136*	*05/31/2019 11:10*	WG1285651

Radiochemistry by Method Calculation

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
Combined Radium	0.474		0.641	1.05	06/03/2019 17:48	WG1287234

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	0.122		0.213	0.339	06/03/2019 17:48	WG1287234
(T) Barium-133	*72.2*			*30.0-143*	*06/03/2019 17:48*	WG1287234

Radiochemistry by Method 904

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	0.615		0.370	0.575	05/31/2019 11:10	WG1285651
(T) Barium	*106*			*62.0-143*	*05/31/2019 11:10*	WG1285651
(T) Yttrium	*95.5*			*79.0-136*	*05/31/2019 11:10*	WG1285651

Radiochemistry by Method Calculation

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
Combined Radium	1.06		0.634	0.777	06/03/2019 17:48	WG1287234

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	0.444		0.264	0.202	06/03/2019 17:48	WG1287234
(T) Barium-133	*90.7*			*30.0-143*	*06/03/2019 17:48*	WG1287234

Radiochemistry by Method 904

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	0.598		0.330	0.545	05/31/2019 11:10	WG1285651
(T) Barium	*98.4*			*62.0-143*	*05/31/2019 11:10*	WG1285651
(T) Yttrium	*113*			*79.0-136*	*05/31/2019 11:10*	WG1285651

Radiochemistry by Method Calculation

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
Combined Radium	2.03		0.761	0.783	06/03/2019 17:48	WG1287234

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	1.43		0.431	0.238	06/03/2019 17:48	WG1287234
(T) Barium-133	*103*			*30.0-143*	*06/03/2019 17:48*	WG1287234

Radiochemistry by Method 904

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	1.35		0.414	0.627	05/31/2019 11:10	WG1285651
(T) Barium	*97.4*			*62.0-143*	*05/31/2019 11:10*	WG1285651
(T) Yttrium	*96.3*			*79.0-136*	*05/31/2019 11:10*	WG1285651

Radiochemistry by Method Calculation

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
Combined Radium	2.20		0.764	0.846	06/03/2019 17:48	WG1287234

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	0.850		0.350	0.219	06/03/2019 17:48	WG1287234
(T) Barium-133	*102*			*30.0-143*	*06/03/2019 17:48*	WG1287234

WG1285651

Radiochemistry by Method 904

QUALITY CONTROL SUMMARY

L1100989-01,02,03,04,05,06,07

Method Blank (MB)

(MB) R3417363-1 05/30/19 12:10

Analyte	MB Result pCi/l	MB Qualifier	MB MDA pCi/l
Radium-228	-0.0581		0.396
(T) Barium	*105*		
(T) Yttrium	*110*		

L1100977-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1100977-01 05/30/19 12:10 • (DUP) R3417363-5 05/30/19 12:10

Analyte	Original Result pCi/l	DUP Result pCi/l	Dilution	DUP RPD %	DUP RER	DUP Qualifier	DUP RPD Limits %	DUP RER Limit
Radium-228	-0.0695	0.650	1	200	0.741		20	3
(T) Barium	*109*	*111*						
(T) Yttrium	*113*	*107*						

Laboratory Control Sample (LCS)

(LCS) R3417363-2 05/30/19 12:10

Analyte	Spike Amount pCi/l	LCS Result pCi/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Radium-228	5.00	5.29	106	80.0-120	
(T) Barium			*104*		
(T) Yttrium			*114*		

L1100989-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1100989-01 05/31/19 11:10 • (MS) R3417363-3 05/30/19 12:10 • (MSD) R3417363-4 05/30/19 12:10

Analyte	Spike Amount pCi/l	Original Result pCi/l	MS Result pCi/l	MSD Result pCi/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	MS RER	RPD Limits %
Radium-228	20.0	0.531	20.9	19.5	102	94.8	1	70.0-130			7.08		20
(T) Barium		*120*			*102*	*115*							
(T) Yttrium		*93.0*			*117*	*114*							

WG1287234

Radiochemistry by Method SM7500Ra B M

QUALITY CONTROL SUMMARY

L1100989-01,02,03,04,05,06,07

Method Blank (MB)

(MB) R3419580-1 06/03/19 17:43

Analyte	MB Result pCi/l	MB Qualifier	MB MDA pCi/l
Radium-226	0.00994		0.0573
(T) Barium-133	*67.4*		

L1103100-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1103100-01 06/03/19 17:43 • (DUP) R3419580-7 06/03/19 17:43

Analyte	Original Result pCi/l	DUP Result pCi/l	Dilution	DUP RPD %	DUP RER	DUP Qualifier	DUP RPD Limits %	DUP RER Limit
Radium-226	0.267	1.33	1	133	2.21		20	3
(T) Barium-133	*110*	*102*						

Laboratory Control Sample (LCS)

(LCS) R3419580-2 06/03/19 17:43

Analyte	Spike Amount pCi/l	LCS Result pCi/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Radium-226	5.02	5.10	102	80.0-120	
(T) Barium-133			*56.0*		

L1101875-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1101875-03 06/03/19 17:43 • (MS) R3419580-3 06/03/19 17:43 • (MSD) R3419580-6 06/03/19 17:43

Analyte	Spike Amount pCi/l	Original Result pCi/l	MS Result pCi/l	MSD Result pCi/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	MS RER	RPD Limits %
Radium-226	20.1	0.637	17.9	20.3	86.0	97.8	1	75.0-125			12.4		20
(T) Barium-133		*83.3*			*53.7*	*71.3*							

L1101881-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1101881-03 06/03/19 17:43 • (MS) R3419580-4 06/03/19 17:43 • (MSD) R3419580-5 06/03/19 17:43

Analyte	Spike Amount pCi/l	Original Result pCi/l	MS Result pCi/l	MSD Result pCi/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	MS RER	RPD Limits %
Radium-226	20.1	0.522	21.1	19.2	102	93.1	1	75.0-125			9.23		20
(T) Barium-133		*105*			*89.6*	*99.7*							

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Abbreviations and Definitions

MDA	Minimum Detectable Activity.
Rec.	Recovery.
RER	Replicate Error Ratio.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(T)	Tracer - A radioisotope of known concentration added to a solution of chemically equivalent radioisotopes at a known concentration to assist in monitoring the yield of the chemical separation.
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description

The remainder of this page intentionally left blank, there are no qualifiers applied to this SDG.

ACCREDITATIONS & LOCATIONS

Pace National is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our one location design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be YOUR LAB OF CHOICE.

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace National.

State Accreditations

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN-03-2002-34
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico [1]	n/a
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina [1]	DW21704
Georgia	NELAP	North Carolina [3]	41
Georgia [1]	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LAO00356
Kentucky [1,6]	90010	South Carolina	84004
Kentucky [2]	16	South Dakota	n/a
Louisiana	AI30792	Tennessee [1,4]	2006
Louisiana [1]	LA180010	Texas	T104704245-18-15
Maine	TN0002	Texas [5]	LAB0152
Maryland	324	Utah	TN00003
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	460132
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	9980939910
Montana	CERT0086	Wyoming	A2LA

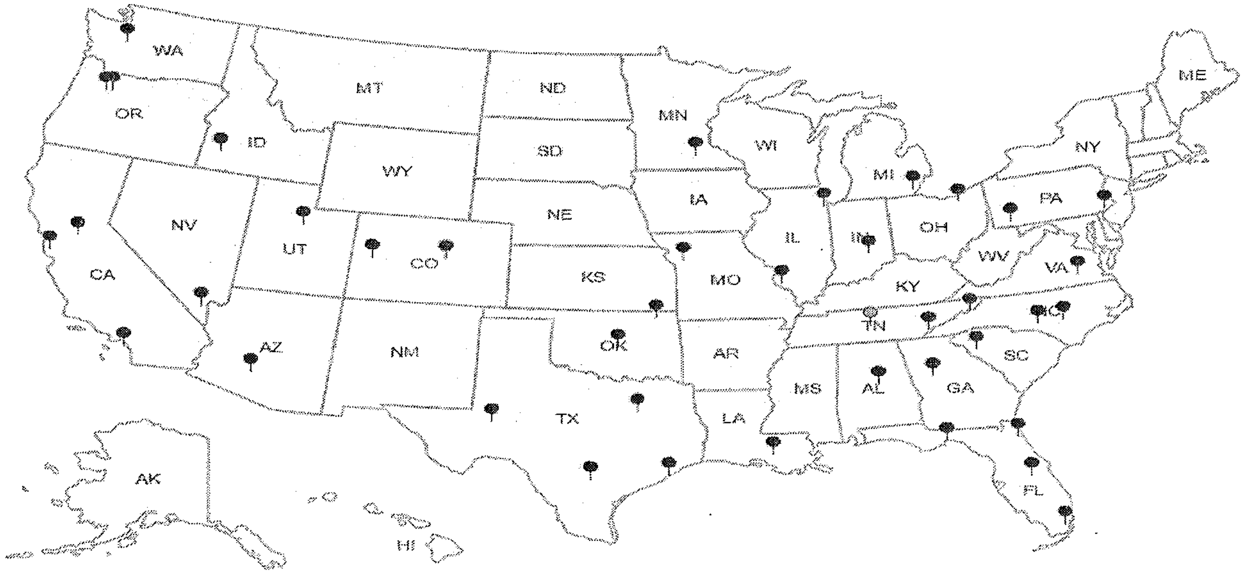
Third Party Federal Accreditations

A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

Our Locations

Pace National has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. Pace National performs all testing at our central laboratory.



Pace Analytical National Center for Testing & Innovation
Cooler Receipt Form

SDG#: 1100989

Client: DHLRRTX

Temperature: Amb

Cooler Received/Opened On: 5/21 /19

Received By: Brock Fariss

Signature:

Receipt Check List	NP	Yes	No
COC Seal Present / Intact?	✓		
COC Signed / Accurate?		✓	
Bottles arrive intact?		✓	
Correct bottles used?		✓	
Sufficient volume sent?		✓	
If Applicable			
VOA Zero headspace?			
Preservation Correct / Checked?		✓	

Kelsey Stephenson

Pace Analytical®
National Center for Testing & Innovation

Login #: L1100989	Client:DHLRRTX	Date:05/21	Evaluated by:Kelsey S

Non-Conformance (check applicable items)

	Sample Integrity		Chain of Custody Clarification	
	Parameter(s) past holding time		Login Clarification Needed	**If Broken Container:**
	Temperature not in range		Chain of custody is incomplete	Insufficient packing material around container
	Improper container type		Please specify Metals requested.	Insufficient packing material inside cooler
x	pH not in range.		Please specify TCLP requested.	Improper handling by carrier (FedEx / UPS / Courie
	Insufficient sample volume.		Received additional samples not listed on coc.	Sample was frozen
	Sample is biphasic.		Sample ids on containers do not match ids on coc	Container lid not intact
	Vials received with headspace.		Trip Blank not received.	**If no Chain of Custody:**
	Broken container		Client did not "X" analysis.	Received by:
	Broken container:		Chain of Custody is missing	Date/Time:
	Sufficient sample remains			Temp./Cont. Rec./pH:
				Carrier:
				Tracking#

Login Comments: 1 of 2 H-32 was received with a pH of 6. pH adj in login 1511 5/21

Client informed by:		Call		Email		Voice Mail		Date:	Time:
TSR Initials:	Client Contact:								

Login Instructions:

Noted 5/21/19 1547

1100989

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

DHL Analytical, Inc.
2300 Double Creek Drive
Round Rock, TX 78664
TEL: *(512) 388-8222* FAX: *(512) 388-8229*
Work Order 1905168

H007

Subcontractor:
Pace Analytical
12065 Lebanon Rd
Mt. Juliet, TN 37122

TEL: (615) 773-5923
FAX:
Acct #: DHLRRTX

15-May-19

Sample Id	Matrix	DHL#	Date Collected	Bottle Type	<2 Ra-228 E904.0	<2 Ra-226 M7500 Ra B M	Requested Tests			
H-31	Aqueous	-01D	05/14/19 07:40 AM	1LHDPEHNO3		1				01
H-31	Aqueous	-01E	05/14/19 07:40 AM	1LHDPEHNO3	1					'
H-32	Aqueous	-02D	05/14/19 08:25 AM	1LHDPEHNO3		1				02
H-32	Aqueous	-02E	05/14/19 08:25 AM	1LHDPEHNO3	1					'
H-27	Aqueous	-03D	05/14/19 09:40 AM	1LHDPEHNO3		1				03
H-27	Aqueous	-03E	05/14/19 09:40 AM	1LHDPEHNO3	1					'
H-29	Aqueous	-04D	05/14/19 11:25 AM	1LHDPEHNO3		1				04
H-29	Aqueous	-04E	05/14/19 11:25 AM	1LHDPEHNO3	1					'
H-28	Aqueous	-05D	05/14/19 12:30 PM	1LHDPEHNO3		1				05
H-28	Aqueous	-05E	05/14/19 12:30 PM	1LHDPEHNO3	1					'
H-26	Aqueous	-06D	05/14/19 02:25 PM	1LHDPEHNO3		1				06
H-26	Aqueous	-06E	05/14/19 02:25 PM	1LHDPEHNO3	1					'
H-33	Aqueous	-07D	05/14/19 03:30 PM	1LHDPEHNO3		1				07
H-33	Aqueous	-07E	05/14/19 03:30 PM	1LHDPEHNO3	1					

General Comments:
Please analyze these samples with Normal Turnaround Time.
Report RA-226, Ra-228 & Combined per Specs.
Quality Control Package Needed: Standard - NELAC Rad Test compliant
Email to cac@dhlanalytical.com & dupont@dhlanalytical.com

UPS
Rec: 14

	Date/Time			Date/Time
Relinquished by:	5/17/19 1700	**Received by:**		5/21/19 1010
Relinquished by:		**Received by:**		

pH adj @ 1511

RAD SCREEN: <0.5 mR/hr AmW

May 30, 2019

Will Vienne
Golder
2201 Double Creek Dr #4004
Round Rock, Texas 78664
TEL: (512) 671-3434
FAX (512) 671-3446

Order No.: 1905167

RE: Luminant-MLSES Ash Ponds

Dear Will Vienne:

DHL Analytical, Inc. received 2 sample(s) on 5/15/2019 for the analyses presented in the following report.

There were no problems with the analyses and all data met requirements of NELAP except where noted in the Case Narrative. All non-NELAP methods will be identified accordingly in the case narrative and all estimated uncertainties of test results are within method or EPA specifications.

If you have any questions regarding these tests results, please feel free to call. Thank you for using DHL Analytical.

Sincerely,

John DuPont
General Manager

This report was performed under the accreditation of the State of Texas Laboratory Certification Number: T104704211-19-24

Table of Contents

DHL ANALYTICAL

2300 Double Creek Dr. ■ Round Rock, TX 78664
Phone (512) 388-8222 ■ FAX (512) 388-8229
Web: *www.dhlanalytical.com*
E-Mail: *login@dhlanalytical.com*

№ 86480

CHAIN-OF-CUSTOD

CLIENT: GOLDER
ADDRESS: 2201 DOUBLE CREEK DR, ROUND ROCK, TX 78664
PHONE: 512-671-3434 FAX/E-MAIL: 512-671-3446
DATA REPORTED TO: WILL VIENNE
ADDITIONAL REPORT COPIES TO:

DATE: 5-14-19 PAGE 1 OF 1
PO #:
DHL WORK ORDER #: 1905167
PROJECT LOCATION OR NAME: LUMINANT - MLSES ASH PONDS
CLENT PROJECT #: 19122262-C COLLECTOR: J. BRAXTON

Authorize 5% surcharge for TRRP Report?
☐ Yes ☐ No

S=SOIL P=PAINT
W=WATER SL=SLUDGE
A=AIR O=OTHER
L=LIQUID SO=SOLID
SE=SEDIMENT

Field Sample I.D.	DHL Lab #	Date	Time	Matrix	Container Type	# of Containers	PRESERVATION HCl	HNO$_3$	H$_2$SO$_4$ ☐ NaOH ☐	ICE	UNPRESERVED	ANALYSES BTEX ☐ MTBE ☐ [METHOD 8021]	TPH 1005 ☐ TPH 1006 ☐ HOLD 1006 ☐	GRO [METHOD 8015] ☐ DRO [METHOD 8105] ☐	VOC 8260 ☐ VOC 624 ☐ VOC 8260/5035 ☐	SVOC 8270 ☐ PAH 8270 ☐ HOLD PAH ☐ SVOC 625 ☐	8270 PEST ☐ 625 PEST/PCB ☐ 608 PCB ☐	8270 O-P PEST ☐ 8082 PCB ☐ 8270 PCB ☐	8321 HERB ☐ T PHOS, AMMONIA ☐	METALS 6020 ☐ METALS 200.8 ☐ DISS. METALS ☐	RCRA ☐ TX11 ☐ ___ ☐	PH ☐ HEX CHROM ☐ ALKALINITY ☐ COD ☐	CHLORIDE ☐ ANIONS ___ ☐	TCLP-SVOC ☐ VOC ☐ PEST ☐ HERB ☐	TCLP-METALS ☐ RCRA 8 ☐ TX-11 ☐ Pb ☐	RCI ☐ FLASHPOINT ☐ DGAS ☐	TDS ☐ TSS ☐ % MOISTURE ☐ CYANIDE ☐	APPENDIX III ETV	ALK, NO3, PO4, Na, Mg, K	FERROUS & FERRIC IRON	FIELD NOTES
LAKE SAMPLE	01	5-14-19	1005	W		7		X		X																		X	X	X	
POND SAMPLE	02	5-14-19	1020	W		7		X		X																		X	X	X	

RELINQUISHED BY: (Signature) DATE/TIME 5-14-19 1800 RECEIVED BY: (Signature) FedEx
RELINQUISHED BY: (Signature) FedEx DATE/TIME 5/15/19 0943 RECEIVED BY: (Signature)
RELINQUISHED BY: (Signature) DATE/TIME RECEIVED BY: (Signature)

☐ *DHL DISPOSAL @ $5.00 each* ☐ *Return*

TURN AROUND TIME
RUSH ☐ CALL FIRST
1 DAY ☐ CALL FIRST
2 DAY ☐
NORMAL ☒
OTHER ☐ ________

LABORATORY USE ONLY:
RECEIVING TEMP: 4.5°C THERM #: 78
CUSTODY SEALS: ☐ BROKEN ☐ INTACT ☒ NOT USED
CARRIER: ☐ LONE STAR ☒ FEDEX ☐ UPS ☐ OTHER
☐ COURIER DELIVERY
☐ HAND DELIVERED

DHL COC Rev 1 | FEB 2010

Eric Lau

From: John DuPont
Sent: Tuesday, May 28, 2019 11:35 AM
To: Eric Lau
Subject: FW: CCR Analysis

Appendix III Parameters:
Metals (Ca and B)
Anions (Cl, F, and SO4)
TDS

Appendix IV Parameters:

Metals (As, Ba, Be, Cd, Co, Cr, Hg, Li, Mo, Pb, Sb, Se, and Tl)
Ra-226
Ra-228

From: Vienne, Will [mailto:William_Vienne@golder.com]
Sent: Tuesday, April 09, 2019 12:48 PM
To: John DuPont <dupont@dhlanalytical.com>
Subject: CCR Analysis

ORIGIN ID:GGGA (512) 671-3434
J . BRAYTON
GOLDER
2201 DOUBLE CREEK DR

ROUND ROCK, TX 78664
UNITED STATES US

SHIP DATE: 14MAY19
ACTWGT: 50.90 LB
CAD: 006994166/SSFE2002
DIMS: 23x14x14 IN

BILL THIRD PARTY

Part # 156297-[illegible] 10/19

TO
DHL
2300 DOUBLE CREEK DR

ROUND ROCK TX 78664
(512) 388-8222
INV:
PO:
REF:
DEPT:

FedEx
Express

E

J191019010701uv

2 of 4
MPS# 0263 **7872 5506 5857**
Mstr# 7872 5506 5846 0201

WED - 15 MAY 10:30A
PRIORITY OVERNIGHT

A8 BSMA

78664
TX-US **AUS**

DHL Analytical, Inc.

Sample Receipt Checklist

Client Name Golder

Date Received: 5/15/2019

Work Order Number 1905167

Received by EL

Checklist completed by: _______ Signature | 5/15/2019 Date

Reviewed by DL Initials | 5/15/2019 Date

Carrier name FedEx 1day

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shippping container/cooler?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	4.5 °C
Water - VOA vials have zero headspace?	Yes ☑	No ☐	No VOA vials submitted ☐
Water - pH<2 acceptable upon receipt?	Yes ☑	No ☐	NA ☐ LOT # 11837
	Adjusted? no		Checked by EL
Water - ph>9 (S) or ph>10 (CN) acceptable upon receipt?	Yes ☐	No ☐	NA ☑ LOT #
	Adjusted? ______		Checked by ______

Any No response must be detailed in the comments section below.

Client contacted ______ Date contacted: ______ Person contacted ______

Contacted by: ______ Regarding: ______

Comments: ______

Corrective Action ______

Page 1 of 1

CLIENT: Golder
Project: Luminant-MLSES Ash Ponds
Lab Order: 1905167

CASE NARRATIVE

Samples were analyzed using the methods outlined in the following references:

Method SW6020A - Metals Analysis
Method SW7470A - Mercury Analysis
Method E300 - Anions Analysis
Method M2320 B - Alkalinity Analysis
Method M3500-Fe D - Ferrous Iron Analysis (this parameter is not NELAP certified)
Method M3500-Fe D - Ferric Iron (calculation) (this calculation is not NELAP certified).
Method M4500-P E - Orthophosphate Analysis
Method M2540C - TDS Analysis
Sub-contract - Radium-228 and Radium-226 analyses by methods E904 and SM 7500 Ra B M. Analyzed at Pace Analytical.

LOG IN

The samples were received and log-in performed on 5/15/19. A total of 2 samples were received. The samples arrived in good condition and were properly packaged.

METALS ANALYSIS

For Metals analysis performed on 5/21/19 the matrix spike and matrix spike duplicate recoveries were below control limits for Calcium and Sodium. These are flagged accordingly in the QC summary report. The sample selected for the matrix spike and matrix spike duplicate was not from this work order. The LCS was within control limits for these analytes. No further corrective actions were taken.

For Metals analysis performed on 5/21/19 the RPD for the serial dilution was slightly above control limits for Potassium. This is flagged accordingly. The PDS was within control limits for this analyte. No further corrective actions were taken.

For Metals analysis performed on 5/21/19 the PDS recovery was out of control limits for three analytes. These are flagged accordingly. The serial dilution was within control limits for these analytes. No further corrective actions were taken.

For Metals analysis peformed on 5/21/19 three LCVLs were out of control limits for Potassium and/or Sodium. These are flagged accordingly. The associated CCVs were within control limits for these analytes. No further corrective actions were taken.

ANIONS ANALYSIS

CLIENT: Golder
Project: Luminant-MLSES Ash Ponds
Lab Order: 1905167

CASE NARRATIVE

For Anions analysis performed on 5/15/19 (batch 90908) the matrix spike and matrix spike duplicate recoveries (1905167-02 MS/MSD) were out of control limits for Chloride and Sulfate. These are flagged accordingly in the QC summary report. The sample selected for the matrix spike and matrix spike duplicate was from this work order. The LCS was within control limits for these analytes. No further corrective actions were taken.

DHL Analytical, Inc. **Date:** *30-May-19*

CLIENT: Golder
Project: Luminant-MLSES Ash Ponds
Lab Order: 1905167

Work Order Sample Summary

Lab Smp ID	Client Sample ID	Tag Number	Date Collected	Date Recved
1905167-01	Lake Sample		05/14/19 10:05 AM	5/15/2019
1905167-02	Pond Sample		05/14/19 10:20 AM	5/15/2019

DHL Analytical, Inc.

30-May-19

Lab Order: 1905167
Client: Golder
Project: Luminant-MLSES Ash Ponds

PREP DATES REPORT

Sample ID	Client Sample ID	Collection Date	Matrix	Test Number	Test Name	Prep Date	Batch ID
1905167-01A	Lake Sample	05/14/19 10:05 AM	Aqueous	M3500-Fe	Ferrous Iron Prep Water	05/20/19 02:56 PM	91002
1905167-01B	Lake Sample	05/14/19 10:05 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/20/19 09:34 AM	90990
	Lake Sample	05/14/19 10:05 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/20/19 09:34 AM	90990
	Lake Sample	05/14/19 10:05 AM	Aqueous	SW7470A	Mercury Aq Prep	05/21/19 09:56 AM	91017
1905167-01C	Lake Sample	05/14/19 10:05 AM	Aqueous	M2320 B	Alkalinity Preparation	05/16/19 10:12 AM	90940
	Lake Sample	05/14/19 10:05 AM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	Lake Sample	05/14/19 10:05 AM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	Lake Sample	05/14/19 10:05 AM	Aqueous	M4500-P E	Orthophosphate Prep	05/15/19 12:12 PM	90921
	Lake Sample	05/14/19 10:05 AM	Aqueous	M2540C	TDS Preparation	05/16/19 03:23 PM	90953
1905167-02A	Pond Sample	05/14/19 10:20 AM	Aqueous	M3500-Fe	Ferrous Iron Prep Water	05/20/19 02:56 PM	91002
1905167-02B	Pond Sample	05/14/19 10:20 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/20/19 09:34 AM	90990
	Pond Sample	05/14/19 10:20 AM	Aqueous	SW3005A	Aq Prep Metals : ICP-MS	05/20/19 09:34 AM	90990
	Pond Sample	05/14/19 10:20 AM	Aqueous	SW7470A	Mercury Aq Prep	05/21/19 09:56 AM	91017
1905167-02C	Pond Sample	05/14/19 10:20 AM	Aqueous	M2320 B	Alkalinity Preparation	05/16/19 10:12 AM	90940
	Pond Sample	05/14/19 10:20 AM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	Pond Sample	05/14/19 10:20 AM	Aqueous	E300	Anion Preparation	05/15/19 09:07 AM	90908
	Pond Sample	05/14/19 10:20 AM	Aqueous	E300	Anion Preparation	05/16/19 09:16 AM	90935
	Pond Sample	05/14/19 10:20 AM	Aqueous	M4500-P E	Orthophosphate Prep	05/15/19 12:12 PM	90921
	Pond Sample	05/14/19 10:20 AM	Aqueous	M2540C	TDS Preparation	05/16/19 03:23 PM	90953

Lab Order: 1905167
Client: Golder
Project: Luminant-MLSES Ash Ponds

ANALYTICAL DATES REPORT

Sample ID	Client Sample ID	Matrix	Test Number	Test Name	Batch ID	Dilution	Analysis Date	Run ID
1905167-01A	Lake Sample	Aqueous	M3500-Fe D	Ferric Iron (Calculated)	91002	1	05/24/19	UV/VIS_2_190524A
	Lake Sample	Aqueous	M3500-Fe D	Ferrous Iron	91002	1	05/20/19 03:54 PM	UV/VIS_2_190520A
1905167-01B	Lake Sample	Aqueous	SW7470A	Mercury Total: Aqueous	91017	1	05/22/19 10:11 AM	CETAC2_HG_190522A
	Lake Sample	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90990	1	05/22/19 12:01 PM	ICP-MS4_190522B
	Lake Sample	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90990	1	05/21/19 03:24 PM	ICP-MS5_190521A
1905167-01C	Lake Sample	Aqueous	M2320 B	Alkalinity	90940	1	05/16/19 04:05 PM	TITRATOR_190516A
	Lake Sample	Aqueous	E300	Anions by IC method - Water	90908	10	05/15/19 12:51 PM	IC2_190515A
	Lake Sample	Aqueous	E300	Anions by IC method - Water	90908	1	05/15/19 05:23 PM	IC2_190515A
	Lake Sample	Aqueous	M4500-P E	Orthophosphate	90921	1	05/15/19 02:47 PM	UV/VIS_2_190515B
	Lake Sample	Aqueous	M2540C	Total Dissolved Solids	90953	1	05/17/19 11:40 AM	WC_190517D
1905167-02A	Pond Sample	Aqueous	M3500-Fe D	Ferric Iron (Calculated)	91002	1	05/24/19	UV/VIS_2_190524A
	Pond Sample	Aqueous	M3500-Fe D	Ferrous Iron	91002	1	05/20/19 03:54 PM	UV/VIS_2_190520A
1905167-02B	Pond Sample	Aqueous	SW7470A	Mercury Total: Aqueous	91017	1	05/22/19 10:13 AM	CETAC2_HG_190522A
	Pond Sample	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90990	100	05/22/19 12:03 PM	ICP-MS4_190522B
	Pond Sample	Aqueous	SW6020A	Trace Metals: ICP-MS - Water	90990	1	05/21/19 03:26 PM	ICP-MS5_190521A
1905167-02C	Pond Sample	Aqueous	M2320 B	Alkalinity	90940	1	05/16/19 04:08 PM	TITRATOR_190516A
	Pond Sample	Aqueous	E300	Anions by IC method - Water	90908	10	05/15/19 01:39 PM	IC2_190515A
	Pond Sample	Aqueous	E300	Anions by IC method - Water	90908	1	05/15/19 05:39 PM	IC2_190515A
	Pond Sample	Aqueous	E300	Anions by IC method - Water	90935	100	05/16/19 04:54 PM	IC4_190516A
	Pond Sample	Aqueous	M4500-P E	Orthophosphate	90921	1	05/15/19 02:47 PM	UV/VIS_2_190515B
	Pond Sample	Aqueous	M2540C	Total Dissolved Solids	90953	1	05/17/19 11:40 AM	WC_190517D

DHL Analytical, Inc.

Date: *30-May-19*

CLIENT: Golder
Project: Luminant-MLSES Ash Ponds
Project No: 19122262-C
Lab Order: 1905167

Client Sample ID: Lake Sample
Lab ID: 1905167-01
Collection Date: 05/14/19 10:05 AM
Matrix: AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
TRACE METALS: ICP-MS - WATER		**SW6020A**					Analyst: **RO**
Antimony	<0.000800	0.000800	0.00250		mg/L	1	05/21/19 03:24 PM
Arsenic	<0.00200	0.00200	0.00500		mg/L	1	05/21/19 03:24 PM
Barium	0.0535	0.00300	0.0100		mg/L	1	05/21/19 03:24 PM
Beryllium	<0.000300	0.000300	0.00100		mg/L	1	05/21/19 03:24 PM
Boron	0.0632	0.0100	0.0300		mg/L	1	05/22/19 12:01 PM
Cadmium	<0.000300	0.000300	0.00100		mg/L	1	05/21/19 03:24 PM
Calcium	12.5	0.100	0.300		mg/L	1	05/21/19 03:24 PM
Chromium	<0.00200	0.00200	0.00500		mg/L	1	05/21/19 03:24 PM
Cobalt	<0.00300	0.00300	0.00500		mg/L	1	05/21/19 03:24 PM
Iron	0.365	0.0300	0.100		mg/L	1	05/21/19 03:24 PM
Lead	<0.000300	0.000300	0.00100		mg/L	1	05/21/19 03:24 PM
Lithium	<0.00500	0.00500	0.0100		mg/L	1	05/21/19 03:24 PM
Magnesium	6.09	0.100	0.300		mg/L	1	05/21/19 03:24 PM
Molybdenum	<0.00200	0.00200	0.00500		mg/L	1	05/21/19 03:24 PM
Potassium	2.56	0.100	0.300		mg/L	1	05/21/19 03:24 PM
Selenium	<0.00200	0.00200	0.00500		mg/L	1	05/21/19 03:24 PM
Sodium	11.9	0.100	0.300		mg/L	1	05/21/19 03:24 PM
Thallium	<0.000500	0.000500	0.00150		mg/L	1	05/21/19 03:24 PM
MERCURY TOTAL: AQUEOUS		**SW7470A**					Analyst: **BM**
Mercury	<0.0000800	0.0000800	0.000200		mg/L	1	05/22/19 10:11 AM
ANIONS BY IC METHOD - WATER		**E300**					Analyst: **JL**
Chloride	12.2	0.300	1.00		mg/L	1	05/15/19 05:23 PM
Fluoride	0.140	0.100	0.400	J	mg/L	1	05/15/19 05:23 PM
Nitrate-N	<0.100	0.100	0.500		mg/L	1	05/15/19 05:23 PM
Sulfate	37.3	1.00	3.00		mg/L	1	05/15/19 05:23 PM
ALKALINITY		**M2320 B**					Analyst: **CC**
Alkalinity, Bicarbonate (As CaCO3)	55.4	10.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:05 PM
Alkalinity, Carbonate (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:05 PM
Alkalinity, Hydroxide (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:05 PM
Alkalinity, Total (As CaCO3)	55.4	20.0	20.0		mg/L @ pH 4.5	1	05/16/19 04:05 PM
FERRIC IRON (CALCULATED)		**M3500-FE D**					Analyst: **CAC**
Iron, Ferric	0.365	0.0500	0.100	N	mg/L	1	05/24/19
FERROUS IRON		**M3500-FE D**					Analyst: **BTJ**
Iron, Ferrous	<0.0500	0.0500	0.100	N	mg/L	1	05/20/19 03:54 PM

Qualifiers:	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

CLIENT:	Golder	**Client Sample ID:**	Lake Sample
Project:	Luminant-MLSES Ash Ponds	**Lab ID:**	1905167-01
Project No:	19122262-C	**Collection Date:**	05/14/19 10:05 AM
Lab Order:	1905167	**Matrix:**	AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
ORTHOPHOSPHATE		**M4500-P E**					Analyst: **CC**
Phosphorus, Total Orthophosphate (As P)	<0.0300	0.0300	0.100		mg/L	1	05/15/19 02:47 PM
TOTAL DISSOLVED SOLIDS		**M2540C**					Analyst: **JS**
Total Dissolved Solids (Residue, Filterable)	119	10.0	10.0		mg/L	1	05/17/19 11:40 AM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
S	Spike Recovery outside control limits	N	Parameter not NELAP certified

CLIENT:	Golder	**Client Sample ID:**	Pond Sample
Project:	Luminant-MLSES Ash Ponds	**Lab ID:**	1905167-02
Project No:	19122262-C	**Collection Date:**	05/14/19 10:20 AM
Lab Order:	1905167	**Matrix:**	AQUEOUS

Analyses	**Result**	**MDL**	**RL**	**Qual**	**Units**	**DF**	**Date Analyzed**
TRACE METALS: ICP-MS - WATER		**SW6020A**					Analyst: **RO**
Antimony	0.00199	0.000800	0.00250	J	mg/L	1	05/21/19 03:26 PM
Arsenic	0.00305	0.00200	0.00500	J	mg/L	1	05/21/19 03:26 PM
Barium	0.0589	0.00300	0.0100		mg/L	1	05/21/19 03:26 PM
Beryllium	<0.000300	0.000300	0.00100		mg/L	1	05/21/19 03:26 PM
Boron	28.2	1.00	3.00		mg/L	100	05/22/19 12:03 PM
Cadmium	<0.000300	0.000300	0.00100		mg/L	1	05/21/19 03:26 PM
Calcium	319	10.0	30.0		mg/L	100	05/22/19 12:03 PM
Chromium	0.00336	0.00200	0.00500	J	mg/L	1	05/21/19 03:26 PM
Cobalt	<0.00300	0.00300	0.00500		mg/L	1	05/21/19 03:26 PM
Iron	<0.0300	0.0300	0.100		mg/L	1	05/21/19 03:26 PM
Lead	<0.000300	0.000300	0.00100		mg/L	1	05/21/19 03:26 PM
Lithium	0.119	0.00500	0.0100		mg/L	1	05/21/19 03:26 PM
Magnesium	553	10.0	30.0		mg/L	100	05/22/19 12:03 PM
Molybdenum	0.0550	0.00200	0.00500		mg/L	1	05/21/19 03:26 PM
Potassium	34.6	10.0	30.0		mg/L	100	05/22/19 12:03 PM
Selenium	2.96	0.200	0.500		mg/L	100	05/22/19 12:03 PM
Sodium	240	10.0	30.0		mg/L	100	05/22/19 12:03 PM
Thallium	<0.000500	0.000500	0.00150		mg/L	1	05/21/19 03:26 PM
MERCURY TOTAL: AQUEOUS		**SW7470A**					Analyst: **BM**
Mercury	0.000119	0.0000800	0.000200	J	mg/L	1	05/22/19 10:13 AM
ANIONS BY IC METHOD - WATER		**E300**					Analyst: **JL**
Chloride	513	30.0	100		mg/L	100	05/16/19 04:54 PM
Fluoride	24.3	1.00	4.00		mg/L	10	05/15/19 01:39 PM
Nitrate-N	11.1	0.100	0.500		mg/L	1	05/15/19 05:39 PM
Sulfate	2900	100	300		mg/L	100	05/16/19 04:54 PM
ALKALINITY		**M2320 B**					Analyst: **CC**
Alkalinity, Bicarbonate (As CaCO3)	79.1	10.0	20.0		mg/L @ pH 4.52	1	05/16/19 04:08 PM
Alkalinity, Carbonate (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.52	1	05/16/19 04:08 PM
Alkalinity, Hydroxide (As CaCO3)	<10.0	10.0	20.0		mg/L @ pH 4.52	1	05/16/19 04:08 PM
Alkalinity, Total (As CaCO3)	79.1	20.0	20.0		mg/L @ pH 4.52	1	05/16/19 04:08 PM
FERRIC IRON (CALCULATED)		**M3500-FE D**					Analyst: **CAC**
Iron, Ferric	<0.0500	0.0500	0.100	N	mg/L	1	05/24/19
FERROUS IRON		**M3500-FE D**					Analyst: **BTJ**
Iron, Ferrous	<0.0500	0.0500	0.100	N	mg/L	1	05/20/19 03:54 PM

Qualifiers:				
	*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
	DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
	S	Spike Recovery outside control limits	N	Parameter not NELAP certified

CLIENT:	Golder	**Client Sample ID:**	Pond Sample
Project:	Luminant-MLSES Ash Ponds	**Lab ID:**	1905167-02
Project No:	19122262-C	**Collection Date:**	05/14/19 10:20 AM
Lab Order:	1905167	**Matrix:**	AQUEOUS

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
ORTHOPHOSPHATE		**M4500-P E**					Analyst: **CC**
Phosphorus, Total Orthophosphate (As P)	<0.0300	0.0300	0.100		mg/L	1	05/15/19 02:47 PM
TOTAL DISSOLVED SOLIDS		**M2540C**					Analyst: **JS**
Total Dissolved Solids (Residue, Filterable)	5380	50.0	50.0		mg/L	1	05/17/19 11:40 AM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	C	Sample Result or QC discussed in the Case Narrative
DF	Dilution Factor	E	TPH pattern not Gas or Diesel Range Pattern
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	RL	Reporting Limit
S	Spike Recovery outside control limits	N	Parameter not NELAP certified

DHL Analytical, Inc. **Date:** *30-May-19*

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **CETAC2_HG_190522A**

The QC data in batch 91017 applies to the following samples: 1905167-01B, 1905167-02B

Sample ID **MB-91017** Batch ID: **91017** TestNo: **SW7470A** Units: **mg/L**
SampType: **MBLK** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 10:02:31 AM** Prep Date: **5/21/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	<0.0000800	0.000200								

Sample ID **LCS-91017** Batch ID: **91017** TestNo: **SW7470A** Units: **mg/L**
SampType: **LCS** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 10:04:46 AM** Prep Date: **5/21/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00187	0.000200	0.00200	0	93.5	85	115			

Sample ID **LCSD-91017** Batch ID: **91017** TestNo: **SW7470A** Units: **mg/L**
SampType: **LCSD** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 10:07:02 AM** Prep Date: **5/21/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00186	0.000200	0.00200	0	93.0	85	115	0.536	15	

Sample ID **1905168-01B MS** Batch ID: **91017** TestNo: **SW7470A** Units: **mg/L**
SampType: **MS** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 11:23:23 AM** Prep Date: **5/21/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00196	0.00100	0.00200	0	97.8	80	120			

Sample ID **1905168-01B MSD** Batch ID: **91017** TestNo: **SW7470A** Units: **mg/L**
SampType: **MSD** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 11:25:39 AM** Prep Date: **5/21/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00194	0.00100	0.00200	0	97.0	80	120	0.770	15	

Sample ID **1905168-01B SD** Batch ID: **91017** TestNo: **SW7470A** Units: **mg/L**
SampType: **SD** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 11:27:56 AM** Prep Date: **5/21/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	<0.00200	0.00500	0	0				0	10	

Sample ID **1905168-01B PDS** Batch ID: **91017** TestNo: **SW7470A** Units: **mg/L**
SampType: **PDS** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 11:30:13 AM** Prep Date: **5/21/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.0122	0.00100	0.0125	0	97.6	85	115			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **CETAC2_HG_190522A**

Sample ID **ICV-190522** Batch ID: **R104223** TestNo: **SW7470A** Units: **mg/L**
SampType: **ICV** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 9:57:56 AM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00383	0.000200	0.00400	0	95.8	90	110			

Sample ID **CCV1-190522** Batch ID: **R104223** TestNo: **SW7470A** Units: **mg/L**
SampType: **CCV** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 10:41:04 AM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00202	0.000200	0.00200	0	101	90	110			

Sample ID **CCV2-190522** Batch ID: **R104223** TestNo: **SW7470A** Units: **mg/L**
SampType: **CCV** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 11:08:23 AM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00203	0.000200	0.00200	0	102	90	110			

Sample ID **CCV3-190522** Batch ID: **R104223** TestNo: **SW7470A** Units: **mg/L**
SampType: **CCV** Run ID: **CETAC2_HG_190522A** Analysis Date: **5/22/2019 2:51:11 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.00203	0.000200	0.00200	0	102	90	110			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS4_190522B**

The QC data in batch 90990 applies to the following samples: 1905167-01B, 1905167-02B

Sample ID **MB-90990** Batch ID: **90990** TestNo: **SW6020A** Units: **mg/L**
SampType: **MBLK** Run ID: **ICP-MS4_190522B** Analysis Date: **5/22/2019 11:49:00 AM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	<0.0100	0.0300								

Sample ID **LCS-90990** Batch ID: **90990** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCS** Run ID: **ICP-MS4_190522B** Analysis Date: **5/22/2019 11:51:00 AM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.203	0.0300	0.200	0	102	80	120			

Sample ID **LCSD-90990** Batch ID: **90990** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCSD** Run ID: **ICP-MS4_190522B** Analysis Date: **5/22/2019 11:53:00 AM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.202	0.0300	0.200	0	101	80	120	0.579	15	

Sample ID **1905218-06A SD** Batch ID: **90990** TestNo: **SW6020A** Units: **mg/L**
SampType: **SD** Run ID: **ICP-MS4_190522B** Analysis Date: **5/22/2019 11:59:00 AM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.103	0.150	0	0.0953				7.85	10	

Sample ID **1905218-06A PDS** Batch ID: **90990** TestNo: **SW6020A** Units: **mg/L**
SampType: **PDS** Run ID: **ICP-MS4_190522B** Analysis Date: **5/22/2019 12:23:00 PM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.277	0.0300	0.200	0.0953	91.1	80	120			

Sample ID **1905218-06A MS** Batch ID: **90990** TestNo: **SW6020A** Units: **mg/L**
SampType: **MS** Run ID: **ICP-MS4_190522B** Analysis Date: **5/22/2019 12:25:00 PM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.288	0.0300	0.200	0.0953	96.1	80	120			

Sample ID **1905218-06A MSD** Batch ID: **90990** TestNo: **SW6020A** Units: **mg/L**
SampType: **MSD** Run ID: **ICP-MS4_190522B** Analysis Date: **5/22/2019 12:27:00 PM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.282	0.0300	0.200	0.0953	93.3	80	120	2.01	15	

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS4_190522B**

Sample ID **ICV-190522** Batch ID: **R104220** TestNo: **SW6020A** Units: **mg/L**
SampType: **ICV** Run ID: **ICP-MS4_190522B** Analysis Date: **5/22/2019 11:38:00 AM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.104	0.0300	0.100	0	104	90	110			
Calcium	2.35	0.300	2.50	0	94.2	90	110			
Magnesium	2.45	0.300	2.50	0	98.2	90	110			
Potassium	2.52	0.300	2.50	0	101	90	110			
Selenium	0.102	0.00500	0.100	0	102	90	110			
Sodium	2.53	0.300	2.50	0	101	90	110			

Sample ID **LCVL-190522** Batch ID: **R104220** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCVL** Run ID: **ICP-MS4_190522B** Analysis Date: **5/22/2019 11:43:00 AM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.0197	0.0300	0.0200	0	98.5	70	130			
Calcium	0.0981	0.300	0.100	0	98.1	70	130			
Magnesium	0.0967	0.300	0.100	0	96.7	70	130			
Potassium	0.0964	0.300	0.100	0	96.4	70	130			
Selenium	0.00494	0.00500	0.00500	0	98.8	70	130			
Sodium	0.0966	0.300	0.100	0	96.6	70	130			

Sample ID **CCV1-190522** Batch ID: **R104220** TestNo: **SW6020A** Units: **mg/L**
SampType: **CCV** Run ID: **ICP-MS4_190522B** Analysis Date: **5/22/2019 12:33:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.210	0.0300	0.200	0	105	90	110			
Calcium	4.65	0.300	5.00	0	92.9	90	110			
Magnesium	5.05	0.300	5.00	0	101	90	110			
Potassium	5.15	0.300	5.00	0	103	90	110			
Selenium	0.215	0.00500	0.200	0	107	90	110			
Sodium	5.08	0.300	5.00	0	102	90	110			

Sample ID **LCVL1-190522** Batch ID: **R104220** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCVL** Run ID: **ICP-MS4_190522B** Analysis Date: **5/22/2019 12:38:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Boron	0.0203	0.0300	0.0200	0	102	70	130			
Calcium	0.0876	0.300	0.100	0	87.6	70	130			
Magnesium	0.0970	0.300	0.100	0	97.0	70	130			
Potassium	0.0932	0.300	0.100	0	93.2	70	130			
Selenium	0.00547	0.00500	0.00500	0	109	70	130			
Sodium	0.102	0.300	0.100	0	102	70	130			

Qualifiers:				
	B	Analyte detected in the associated Method Blank	DF	Dilution Factor
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
	RL	Reporting Limit	S	Spike Recovery outside control limits
	J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS5_190521A**

The QC data in batch 90990 applies to the following samples: 1905167-01B, 1905167-02B

Sample ID **MB-90990** Batch ID: **90990** TestNo: **SW6020A** Units: **mg/L**
SampType: **MBLK** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 3:11:00 PM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	<0.000800	0.00250								
Arsenic	<0.00200	0.00500								
Barium	<0.00300	0.0100								
Beryllium	<0.000300	0.00100								
Cadmium	<0.000300	0.00100								
Calcium	<0.100	0.300								
Chromium	<0.00200	0.00500								
Cobalt	<0.00300	0.00500								
Iron	<0.0300	0.100								
Lead	<0.000300	0.00100								
Lithium	<0.00500	0.0100								
Magnesium	<0.100	0.300								
Molybdenum	<0.00200	0.00500								
Potassium	<0.100	0.300								
Selenium	<0.00200	0.00500								
Sodium	<0.100	0.300								
Thallium	<0.000500	0.00150								

Sample ID **LCS-90990** Batch ID: **90990** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCS** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 3:13:00 PM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.209	0.00250	0.200	0	104	80	120			
Arsenic	0.208	0.00500	0.200	0	104	80	120			
Barium	0.208	0.0100	0.200	0	104	80	120			
Beryllium	0.200	0.00100	0.200	0	99.8	80	120			
Cadmium	0.211	0.00100	0.200	0	105	80	120			
Calcium	5.18	0.300	5.00	0	104	80	120			
Chromium	0.209	0.00500	0.200	0	105	80	120			
Cobalt	0.216	0.00500	0.200	0	108	80	120			
Iron	5.40	0.100	5.00	0	108	80	120			
Lead	0.203	0.00100	0.200	0	101	80	120			
Lithium	0.214	0.0100	0.200	0	107	80	120			
Magnesium	5.35	0.300	5.00	0	107	80	120			
Molybdenum	0.204	0.00500	0.200	0	102	80	120			
Potassium	4.99	0.300	5.00	0	99.9	80	120			
Selenium	0.208	0.00500	0.200	0	104	80	120			
Sodium	5.38	0.300	5.00	0	108	80	120			
Thallium	0.200	0.00150	0.200	0	100	80	120			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS5_190521A**

Sample ID **LCSD-90990** Batch ID: **90990** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCSD** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 3:15:00 PM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.209	0.00250	0.200	0	105	80	120	0.307	15	
Arsenic	0.207	0.00500	0.200	0	104	80	120	0.318	15	
Barium	0.207	0.0100	0.200	0	103	80	120	0.392	15	
Beryllium	0.198	0.00100	0.200	0	99.0	80	120	0.810	15	
Cadmium	0.211	0.00100	0.200	0	105	80	120	0.119	15	
Calcium	5.16	0.300	5.00	0	103	80	120	0.293	15	
Chromium	0.209	0.00500	0.200	0	105	80	120	0.129	15	
Cobalt	0.215	0.00500	0.200	0	108	80	120	0.352	15	
Iron	5.41	0.100	5.00	0	108	80	120	0.077	15	
Lead	0.204	0.00100	0.200	0	102	80	120	0.722	15	
Lithium	0.211	0.0100	0.200	0	105	80	120	1.44	15	
Magnesium	5.37	0.300	5.00	0	107	80	120	0.251	15	
Molybdenum	0.202	0.00500	0.200	0	101	80	120	0.822	15	
Potassium	5.00	0.300	5.00	0	100	80	120	0.175	15	
Selenium	0.208	0.00500	0.200	0	104	80	120	0.274	15	
Sodium	5.38	0.300	5.00	0	108	80	120	0.080	15	
Thallium	0.202	0.00150	0.200	0	101	80	120	0.737	15	

Sample ID **1905218-06A SD** Batch ID: **90990** TestNo: **SW6020A** Units: **mg/L**
SampType: **SD** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 3:22:00 PM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	<0.00400	0.0125	0	0				0	10	
Arsenic	<0.0100	0.0250	0	0				0	10	
Barium	0.0519	0.0500	0	0.0510				1.62	10	
Beryllium	<0.00150	0.00500	0	0				0	10	
Cadmium	<0.00150	0.00500	0	0				0	10	
Calcium	23.9	1.50	0	23.8				0.464	10	
Chromium	<0.0100	0.0250	0	0				0	10	
Cobalt	<0.0150	0.0250	0	0				0	10	
Iron	0.185	0.500	0	0.186				0.629	10	
Lead	<0.00150	0.00500	0	0				0	10	
Lithium	0.0477	0.0500	0	0.0462				3.27	10	
Magnesium	12.2	1.50	0	12.2				0.282	10	
Molybdenum	<0.0100	0.0250	0	0				0	10	
Potassium	1.83	1.50	0	2.08				12.6	10	R
Selenium	<0.0100	0.0250	0	0				0	10	
Sodium	53.2	1.50	0	51.9				2.54	10	
Thallium	<0.00250	0.00750	0	0				0	10	

Qualifiers:	B	Analyte detected in the associated Method Blank	DF	Dilution Factor
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
	RL	Reporting Limit	S	Spike Recovery outside control limits
	J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS5_190521A**

Sample ID **1905218-06A PDS** Batch ID: **90990** TestNo: **SW6020A** Units: **mg/L**
SampType: **PDS** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 3:44:00 PM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.192	0.00250	0.200	0	96.2	80	120			
Arsenic	0.183	0.00500	0.200	0	91.7	80	120			
Barium	0.237	0.0100	0.200	0.0510	92.9	80	120			
Beryllium	0.179	0.00100	0.200	0	89.3	80	120			
Cadmium	0.194	0.00100	0.200	0	97.0	80	120			
Calcium	26.2	0.300	5.00	23.8	48.1	80	120			S
Chromium	0.198	0.00500	0.200	0	98.8	80	120			
Cobalt	0.191	0.00500	0.200	0	95.6	80	120			
Iron	5.16	0.100	5.00	0.186	99.5	80	120			
Lead	0.190	0.00100	0.200	0	94.8	80	120			
Lithium	0.238	0.0100	0.200	0.0462	96.1	80	120			
Magnesium	15.8	0.300	5.00	12.2	72.5	80	120			S
Molybdenum	0.179	0.00500	0.200	0	89.4	80	120			
Potassium	6.49	0.300	5.00	2.08	88.3	80	120			
Selenium	0.178	0.00500	0.200	0	89.1	80	120			
Sodium	51.5	0.300	5.00	51.9	-7.46	80	120			S
Thallium	0.189	0.00150	0.200	0	94.5	80	120			

Sample ID **1905218-06A MS** Batch ID: **90990** TestNo: **SW6020A** Units: **mg/L**
SampType: **MS** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 3:46:00 PM** Prep Date: **5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.196	0.00250	0.200	0	98.1	80	120			
Arsenic	0.189	0.00500	0.200	0	94.4	80	120			
Barium	0.244	0.0100	0.200	0.0510	96.3	80	120			
Beryllium	0.183	0.00100	0.200	0	91.6	80	120			
Cadmium	0.196	0.00100	0.200	0	98.0	80	120			
Calcium	27.3	0.300	5.00	23.8	69.1	80	120			S
Chromium	0.197	0.00500	0.200	0	98.5	80	120			
Cobalt	0.194	0.00500	0.200	0	96.9	80	120			
Iron	5.24	0.100	5.00	0.186	101	80	120			
Lead	0.193	0.00100	0.200	0	96.5	80	120			
Lithium	0.241	0.0100	0.200	0.0462	97.6	80	120			
Magnesium	16.6	0.300	5.00	12.2	89.7	80	120			
Molybdenum	0.189	0.00500	0.200	0	94.4	80	120			
Potassium	6.74	0.300	5.00	2.08	93.2	80	120			
Selenium	0.183	0.00500	0.200	0	91.3	80	120			
Sodium	53.9	0.300	5.00	51.9	39.6	80	120			S
Thallium	0.192	0.00150	0.200	0	95.8	80	120			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS5_190521A**

Sample ID	**1905218-06A MSD**	Batch ID:	**90990**	TestNo:	**SW6020A**	Units:	**mg/L**
SampType:	**MSD**	Run ID:	**ICP-MS5_190521A**	Analysis Date:	**5/21/2019 3:49:00 PM**	Prep Date:	**5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.199	0.00250	0.200	0	99.3	80	120	1.17	15	
Arsenic	0.189	0.00500	0.200	0	94.3	80	120	0.111	15	
Barium	0.246	0.0100	0.200	0.0510	97.3	80	120	0.778	15	
Beryllium	0.181	0.00100	0.200	0	90.4	80	120	1.36	15	
Cadmium	0.197	0.00100	0.200	0	98.7	80	120	0.775	15	
Calcium	27.4	0.300	5.00	23.8	72.7	80	120	0.665	15	S
Chromium	0.198	0.00500	0.200	0	99.1	80	120	0.607	15	
Cobalt	0.196	0.00500	0.200	0	97.8	80	120	0.893	15	
Iron	5.30	0.100	5.00	0.186	102	80	120	1.09	15	
Lead	0.192	0.00100	0.200	0	96.1	80	120	0.414	15	
Lithium	0.238	0.0100	0.200	0.0462	96.0	80	120	1.33	15	
Magnesium	16.8	0.300	5.00	12.2	92.6	80	120	0.883	15	
Molybdenum	0.191	0.00500	0.200	0	95.7	80	120	1.34	15	
Potassium	6.80	0.300	5.00	2.08	94.5	80	120	0.968	15	
Selenium	0.183	0.00500	0.200	0	91.7	80	120	0.351	15	
Sodium	54.6	0.300	5.00	51.9	54.2	80	120	1.35	15	S
Thallium	0.192	0.00150	0.200	0	96.0	80	120	0.248	15	

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS5_190521A**

Sample ID **ICV-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **ICV** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 12:10:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.102	0.00250	0.100	0	102	90	110			
Arsenic	0.103	0.00500	0.100	0	103	90	110			
Barium	0.0990	0.0100	0.100	0	99.0	90	110			
Beryllium	0.0972	0.00100	0.100	0	97.2	90	110			
Cadmium	0.102	0.00100	0.100	0	102	90	110			
Calcium	2.52	0.300	2.50	0	101	90	110			
Chromium	0.103	0.00500	0.100	0	103	90	110			
Cobalt	0.108	0.00500	0.100	0	108	90	110			
Iron	2.60	0.100	2.50	0	104	90	110			
Lead	0.0982	0.00100	0.100	0	98.2	90	110			
Lithium	0.103	0.0100	0.100	0	103	90	110			
Magnesium	2.49	0.300	2.50	0	99.7	90	110			
Molybdenum	0.0930	0.00500	0.100	0	93.0	90	110			
Potassium	2.38	0.300	2.50	0	95.3	90	110			
Selenium	0.104	0.00500	0.100	0	104	90	110			
Sodium	2.56	0.300	2.50	0	103	90	110			
Thallium	0.0977	0.00150	0.100	0	97.7	90	110			

Sample ID **LCVL-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCVL** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 12:15:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.00183	0.00250	0.00200	0	91.4	70	130			
Arsenic	0.00504	0.00500	0.00500	0	101	70	130			
Barium	0.00459	0.0100	0.00500	0	91.8	70	130			
Beryllium	0.000968	0.00100	0.00100	0	96.8	70	130			
Cadmium	0.00106	0.00100	0.00100	0	106	70	130			
Calcium	0.104	0.300	0.100	0	104	70	130			
Chromium	0.00482	0.00500	0.00500	0	96.4	70	130			
Cobalt	0.00494	0.00500	0.00500	0	98.7	70	130			
Iron	0.0979	0.100	0.100	0	97.9	70	130			
Lead	0.000882	0.00100	0.00100	0	88.2	70	130			
Lithium	0.00996	0.0100	0.0100	0	99.6	70	130			
Magnesium	0.0983	0.300	0.100	0	98.3	70	130			
Molybdenum	0.00464	0.00500	0.00500	0	92.8	70	130			
Potassium	0.0691	0.300	0.100	0	69.1	70	130			S
Selenium	0.00633	0.00500	0.00500	0	127	70	130			
Sodium	0.0960	0.300	0.100	0	96.0	70	130			
Thallium	0.000944	0.00150	0.00100	0	94.4	70	130			

Qualifiers:	B	Analyte detected in the associated Method Blank	DF	Dilution Factor
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
	RL	Reporting Limit	S	Spike Recovery outside control limits
	J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS5_190521A**

Sample ID **CCV4-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **CCV** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 3:00:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.203	0.00250	0.200	0	101	90	110			
Arsenic	0.203	0.00500	0.200	0	102	90	110			
Barium	0.202	0.0100	0.200	0	101	90	110			
Beryllium	0.192	0.00100	0.200	0	95.9	90	110			
Cadmium	0.204	0.00100	0.200	0	102	90	110			
Calcium	4.96	0.300	5.00	0	99.3	90	110			
Chromium	0.203	0.00500	0.200	0	101	90	110			
Cobalt	0.213	0.00500	0.200	0	106	90	110			
Iron	5.15	0.100	5.00	0	103	90	110			
Lead	0.198	0.00100	0.200	0	98.8	90	110			
Lithium	0.205	0.0100	0.200	0	103	90	110			
Magnesium	5.15	0.300	5.00	0	103	90	110			
Molybdenum	0.199	0.00500	0.200	0	99.7	90	110			
Potassium	4.83	0.300	5.00	0	96.6	90	110			
Selenium	0.200	0.00500	0.200	0	100	90	110			
Sodium	5.26	0.300	5.00	0	105	90	110			
Thallium	0.197	0.00150	0.200	0	98.4	90	110			

Sample ID **LCVL4-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCVL** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 3:05:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.00207	0.00250	0.00200	0	104	70	130			
Arsenic	0.00491	0.00500	0.00500	0	98.1	70	130			
Barium	0.00487	0.0100	0.00500	0	97.5	70	130			
Beryllium	0.000934	0.00100	0.00100	0	93.4	70	130			
Cadmium	0.00104	0.00100	0.00100	0	104	70	130			
Calcium	0.0913	0.300	0.100	0	91.3	70	130			
Chromium	0.00486	0.00500	0.00500	0	97.1	70	130			
Cobalt	0.00525	0.00500	0.00500	0	105	70	130			
Iron	0.101	0.100	0.100	0	101	70	130			
Lead	0.000868	0.00100	0.00100	0	86.8	70	130			
Lithium	0.0102	0.0100	0.0100	0	102	70	130			
Magnesium	0.104	0.300	0.100	0	104	70	130			
Molybdenum	0.00483	0.00500	0.00500	0	96.6	70	130			
Potassium	0.0524	0.300	0.100	0	52.4	70	130			S
Selenium	0.00506	0.00500	0.00500	0	101	70	130			
Sodium	0.144	0.300	0.100	0	144	70	130			S
Thallium	0.000962	0.00150	0.00100	0	96.2	70	130			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **ICP-MS5_190521A**

Sample ID **CCV5-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **CCV** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 3:51:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.197	0.00250	0.200	0	98.5	90	110			
Arsenic	0.199	0.00500	0.200	0	99.7	90	110			
Barium	0.194	0.0100	0.200	0	96.8	90	110			
Beryllium	0.181	0.00100	0.200	0	90.6	90	110			
Cadmium	0.197	0.00100	0.200	0	98.4	90	110			
Calcium	4.83	0.300	5.00	0	96.7	90	110			
Chromium	0.199	0.00500	0.200	0	99.4	90	110			
Cobalt	0.207	0.00500	0.200	0	104	90	110			
Iron	5.09	0.100	5.00	0	102	90	110			
Lead	0.192	0.00100	0.200	0	96.2	90	110			
Lithium	0.198	0.0100	0.200	0	99.0	90	110			
Magnesium	5.01	0.300	5.00	0	100	90	110			
Molybdenum	0.192	0.00500	0.200	0	95.8	90	110			
Potassium	4.71	0.300	5.00	0	94.2	90	110			
Selenium	0.200	0.00500	0.200	0	99.8	90	110			
Sodium	5.09	0.300	5.00	0	102	90	110			
Thallium	0.192	0.00150	0.200	0	95.8	90	110			

Sample ID **LCVL5-190521** Batch ID: **R104204** TestNo: **SW6020A** Units: **mg/L**
SampType: **LCVL** Run ID: **ICP-MS5_190521A** Analysis Date: **5/21/2019 3:55:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Antimony	0.00208	0.00250	0.00200	0	104	70	130			
Arsenic	0.00481	0.00500	0.00500	0	96.1	70	130			
Barium	0.00469	0.0100	0.00500	0	93.8	70	130			
Beryllium	0.000861	0.00100	0.00100	0	86.1	70	130			
Cadmium	0.000998	0.00100	0.00100	0	99.8	70	130			
Calcium	0.102	0.300	0.100	0	102	70	130			
Chromium	0.00463	0.00500	0.00500	0	92.5	70	130			
Cobalt	0.00508	0.00500	0.00500	0	102	70	130			
Iron	0.0987	0.100	0.100	0	98.7	70	130			
Lead	0.000837	0.00100	0.00100	0	83.7	70	130			
Lithium	0.00978	0.0100	0.0100	0	97.8	70	130			
Magnesium	0.0989	0.300	0.100	0	98.9	70	130			
Molybdenum	0.00479	0.00500	0.00500	0	95.8	70	130			
Potassium	0.0352	0.300	0.100	0	35.2	70	130			S
Selenium	0.00485	0.00500	0.00500	0	97.0	70	130			
Sodium	0.135	0.300	0.100	0	135	70	130			S
Thallium	0.000929	0.00150	0.00100	0	92.9	70	130			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **IC2_190515A**

The QC data in batch 90908 applies to the following samples: 1905167-01C, 1905167-02C

Sample ID **MB-90908** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **MBLK** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 10:10:50 AM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	<0.300	1.00								
Fluoride	<0.100	0.400								
Nitrate-N	<0.100	0.500								
Sulfate	<1.00	3.00								

Sample ID **LCS-90908** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **LCS** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 10:26:50 AM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	10.1	1.00	10.00	0	101	90	110			
Fluoride	4.00	0.400	4.000	0	99.9	90	110			
Nitrate-N	5.09	0.500	5.000	0	102	90	110			
Sulfate	30.4	3.00	30.00	0	101	90	110			

Sample ID **LCSD-90908** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **LCSD** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 10:42:50 AM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	10.2	1.00	10.00	0	102	90	110	0.674	20	
Fluoride	4.05	0.400	4.000	0	101	90	110	1.26	20	
Nitrate-N	5.08	0.500	5.000	0	102	90	110	0.146	20	
Sulfate	30.9	3.00	30.00	0	103	90	110	1.55	20	

Sample ID **1905167-01CMS** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **MS** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 1:07:36 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	222	10.0	200.0	12.69	105	90	110			
Fluoride	211	4.00	200.0	0	106	90	110			
Nitrate-N	45.6	5.00	45.16	0	101	90	110			
Sulfate	239	30.0	200.0	41.32	98.7	90	110			

Sample ID **1905167-01CMSD** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **MSD** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 1:23:36 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	221	10.0	200.0	12.69	104	90	110	0.308	20	
Fluoride	210	4.00	200.0	0	105	90	110	0.286	20	
Nitrate-N	45.8	5.00	45.16	0	101	90	110	0.495	20	
Sulfate	237	30.0	200.0	41.32	97.7	90	110	0.821	20	

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

ANALYTICAL QC SUMMARY REPORT

RunID: IC2_190515A

Sample ID **1905167-02CMS** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **MS** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 1:55:36 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	686	10.0	200.0	528.8	78.8	90	110			S
Fluoride	229	4.00	200.0	24.26	102	90	110			
Nitrate-N	56.2	5.00	45.16	10.55	101	90	110			
Sulfate	2520	30.0	200.0	0	1260	90	110			S

Sample ID **1905167-02CMSD** Batch ID: **90908** TestNo: **E300** Units: **mg/L**
SampType: **MSD** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 2:11:36 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	688	10.0	200.0	528.8	79.8	90	110	0.292	20	S
Fluoride	229	4.00	200.0	24.26	102	90	110	0.251	20	
Nitrate-N	57.3	5.00	45.16	10.55	103	90	110	1.85	20	
Sulfate	<10.0	30.0	200.0	0	0	90	110	0	20	S

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **IC2_190515A**

Sample ID **ICV-190515** Batch ID: **R104097** TestNo: **E300** Units: **mg/L**
SampType: **ICV** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 9:38:50 AM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	25.8	1.00	25.00	0	103	90	110			
Fluoride	10.3	0.400	10.00	0	103	90	110			
Nitrate-N	13.0	0.500	12.50	0	104	90	110			
Sulfate	77.8	3.00	75.00	0	104	90	110			

Sample ID **CCV1-190515** Batch ID: **R104097** TestNo: **E300** Units: **mg/L**
SampType: **CCV** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 4:51:36 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	10.4	1.00	10.00	0	104	90	110			
Fluoride	4.15	0.400	4.000	0	104	90	110			
Nitrate-N	5.13	0.500	5.000	0	103	90	110			
Sulfate	30.8	3.00	30.00	0	103	90	110			

Sample ID **CCV2-190515** Batch ID: **R104097** TestNo: **E300** Units: **mg/L**
SampType: **CCV** Run ID: **IC2_190515A** Analysis Date: **5/15/2019 8:35:35 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	10.6	1.00	10.00	0	106	90	110			
Fluoride	4.20	0.400	4.000	0	105	90	110			
Nitrate-N	5.20	0.500	5.000	0	104	90	110			
Sulfate	31.5	3.00	30.00	0	105	90	110			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **IC4_190516A**

The QC data in batch 90935 applies to the following samples: 1905167-02C

Sample ID **MB-90935** Batch ID: **90935** TestNo: **E300** Units: **mg/L**
SampType: **MBLK** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 10:26:21 AM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	<0.300	1.00								
Sulfate	<1.00	3.00								

Sample ID **LCS-90935** Batch ID: **90935** TestNo: **E300** Units: **mg/L**
SampType: **LCS** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 10:42:21 AM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	9.61	1.00	10.00	0	96.1	90	110			
Sulfate	29.5	3.00	30.00	0	98.3	90	110			

Sample ID **LCSD-90935** Batch ID: **90935** TestNo: **E300** Units: **mg/L**
SampType: **LCSD** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 10:58:21 AM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	9.68	1.00	10.00	0	96.8	90	110	0.745	20	
Sulfate	29.8	3.00	30.00	0	99.2	90	110	0.935	20	

Sample ID **1905167-02CMS** Batch ID: **90935** TestNo: **E300** Units: **mg/L**
SampType: **MS** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 5:10:27 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	2490	100	2000	512.8	98.6	90	110			
Sulfate	4830	300	2000	2897	96.9	90	110			

Sample ID **1905167-02CMSD** Batch ID: **90935** TestNo: **E300** Units: **mg/L**
SampType: **MSD** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 5:26:27 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	2500	100	2000	512.8	99.4	90	110	0.622	20	
Sulfate	4880	300	2000	2897	99.1	90	110	0.920	20	

Sample ID **1905168-01CMS** Batch ID: **90935** TestNo: **E300** Units: **mg/L**
SampType: **MS** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 5:58:26 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	2170	100	2000	212.8	98.1	90	110			
Sulfate	4380	300	2000	2468	95.6	90	110			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **IC4_190516A**

Sample ID **1905168-01CMSD** Batch ID: **90935** TestNo: **E300** Units: **mg/L**
SampType: **MSD** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 6:14:27 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	2170	100	2000	212.8	97.8	90	110	0.235	20	
Sulfate	4390	300	2000	2468	96.2	90	110	0.273	20	

Qualifiers:				
	B	Analyte detected in the associated Method Blank	DF	Dilution Factor
	J	Analyte detected between MDL and RL	MDL	Method Detection Limit
	ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
	RL	Reporting Limit	S	Spike Recovery outside control limits
	J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **IC4_190516A**

Sample ID **ICV-190516** Batch ID: **R104119** TestNo: **E300** Units: **mg/L**
SampType: **ICV** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 9:54:21 AM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	24.7	1.00	25.00	0	99.0	90	110			
Sulfate	74.5	3.00	75.00	0	99.4	90	110			

Sample ID **CCV1-190516** Batch ID: **R104119** TestNo: **E300** Units: **mg/L**
SampType: **CCV** Run ID: **IC4_190516A** Analysis Date: **5/16/2019 9:10:26 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chloride	9.75	1.00	10.00	0	97.5	90	110			
Sulfate	30.2	3.00	30.00	0	101	90	110			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **TITRATOR_190516A**

The QC data in batch 90940 applies to the following samples: 1905167-01C, 1905167-02C

Sample ID **MB-90940** Batch ID: **90940** TestNo: **M2320 B** Units: **mg/L @ pH 4.47**
SampType: **MBLK** Run ID: **TITRATOR_190516A** Analysis Date: **5/16/2019 2:00:00 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	<10.0	20.0								
Alkalinity, Carbonate (As CaCO3)	<10.0	20.0								
Alkalinity, Hydroxide (As CaCO3)	<10.0	20.0								
Alkalinity, Total (As CaCO3)	<20.0	20.0								

Sample ID **LCS-90940** Batch ID: **90940** TestNo: **M2320 B** Units: **mg/L @ pH 4.08**
SampType: **LCS** Run ID: **TITRATOR_190516A** Analysis Date: **5/16/2019 2:04:00 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Total (As CaCO3)	52.3	20.0	50.00	0	105	74	129			

Sample ID **1905134-01C DUP** Batch ID: **90940** TestNo: **M2320 B** Units: **mg/L @ pH 4.52**
SampType: **DUP** Run ID: **TITRATOR_190516A** Analysis Date: **5/16/2019 2:15:00 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	205	20.0	0	205.8				0.536	20	
Alkalinity, Carbonate (As CaCO3)	<10.0	20.0	0	0				0	20	
Alkalinity, Hydroxide (As CaCO3)	<10.0	20.0	0	0				0	20	
Alkalinity, Total (As CaCO3)	205	20.0	0	205.8				0.536	20	

Sample ID **1905168-05C DUP** Batch ID: **90940** TestNo: **M2320 B** Units: **mg/L @ pH 4.51**
SampType: **DUP** Run ID: **TITRATOR_190516A** Analysis Date: **5/16/2019 4:30:00 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	<10.0	20.0	0	0				0	20	
Alkalinity, Carbonate (As CaCO3)	<10.0	20.0	0	0				0	20	
Alkalinity, Hydroxide (As CaCO3)	<10.0	20.0	0	0				0	20	
Alkalinity, Total (As CaCO3)	<20.0	20.0	0	0				0	20	

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **TITRATOR_190516A**

Sample ID **ICV-190516** Batch ID: **R104124** TestNo: **M2320 B** Units: **mg/L @ pH 4.34**
SampType: **ICV** Run ID: **TITRATOR_190516A** Analysis Date: **5/16/2019 1:58:00 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	8.64	20.0	0							
Alkalinity, Carbonate (As CaCO3)	89.3	20.0	0							
Alkalinity, Hydroxide (As CaCO3)	<10.0	20.0	0							
Alkalinity, Total (As CaCO3)	97.9	20.0	100.0	0	97.9	98	102			

Sample ID **CCV1-190516** Batch ID: **R104124** TestNo: **M2320 B** Units: **mg/L @ pH 4.25**
SampType: **CCV** Run ID: **TITRATOR_190516A** Analysis Date: **5/16/2019 3:39:00 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	21.7	20.0	0							
Alkalinity, Carbonate (As CaCO3)	76.8	20.0	0							
Alkalinity, Hydroxide (As CaCO3)	<10.0	20.0	0							
Alkalinity, Total (As CaCO3)	98.5	20.0	100.0	0	98.5	90	110			

Sample ID **CCV2-190516** Batch ID: **R104124** TestNo: **M2320 B** Units: **mg/L @ pH 4.21**
SampType: **CCV** Run ID: **TITRATOR_190516A** Analysis Date: **5/16/2019 4:35:00 PM** Prep Date: **5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	17.7	20.0	0							
Alkalinity, Carbonate (As CaCO3)	81.3	20.0	0							
Alkalinity, Hydroxide (As CaCO3)	<10.0	20.0	0							
Alkalinity, Total (As CaCO3)	99.0	20.0	100.0	0	99.0	90	110			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **UV/VIS_2_190515B**

The QC data in batch 90921 applies to the following samples: 1905167-01C, 1905167-02C

Sample ID **MB-90921** Batch ID: **90921** TestNo: **M4500-P E** Units: **mg/L**
SampType: **MBLK** Run ID: **UV/VIS_2_190515B** Analysis Date: **5/15/2019 12:42:00 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Phosphorus, Total Orthophosphate (As	<0.0300	0.100								

Sample ID **LCS-90921** Batch ID: **90921** TestNo: **M4500-P E** Units: **mg/L**
SampType: **LCS** Run ID: **UV/VIS_2_190515B** Analysis Date: **5/15/2019 12:43:00 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Phosphorus, Total Orthophosphate (As	0.513	0.100	0.5000	0	103	80	120			

Sample ID **LCSD-90921** Batch ID: **90921** TestNo: **M4500-P E** Units: **mg/L**
SampType: **LCSD** Run ID: **UV/VIS_2_190515B** Analysis Date: **5/15/2019 12:43:00 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Phosphorus, Total Orthophosphate (As	0.504	0.100	0.5000	0	101	80	120	1.77	15	

Sample ID **1905168-01CMS** Batch ID: **90921** TestNo: **M4500-P E** Units: **mg/L**
SampType: **MS** Run ID: **UV/VIS_2_190515B** Analysis Date: **5/15/2019 12:45:00 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Phosphorus, Total Orthophosphate (As	0.587	0.100	0.5000	0.07700	102	80	120			

Sample ID **1905168-01CMSD** Batch ID: **90921** TestNo: **M4500-P E** Units: **mg/L**
SampType: **MSD** Run ID: **UV/VIS_2_190515B** Analysis Date: **5/15/2019 12:45:00 PM** Prep Date: **5/15/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Phosphorus, Total Orthophosphate (As	0.525	0.100	0.5000	0.07700	89.6	80	120	11.2	15	

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **UV/VIS_2_190515B**

Sample ID	**ICV-190515**	Batch ID:	**R104071**	TestNo:	**M4500-P E**	Units:	**mg/L**
SampType:	**ICV**	Run ID:	**UV/VIS_2_190515B**	Analysis Date:	**5/15/2019 12:41:00 PM**	Prep Date:	

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Phosphorus, Total Orthophosphate (As	0.204	0.100	0.2000	0	102	85	115			

Sample ID	**CCV1-190515**	Batch ID:	**R104071**	TestNo:	**M4500-P E**	Units:	**mg/L**
SampType:	**CCV**	Run ID:	**UV/VIS_2_190515B**	Analysis Date:	**5/15/2019 12:51:00 PM**	Prep Date:	

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Phosphorus, Total Orthophosphate (As	0.509	0.100	0.5000	0	102	85	115			

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **UV/VIS_2_190520A**

The QC data in batch 91002 applies to the following samples: 1905167-01A, 1905167-02A

Sample ID	**MB-91002**	Batch ID:	**91002**	TestNo:	**M3500-Fe D**	Units:	**mg/L**
SampType:	**MBLK**	Run ID:	**UV/VIS_2_190520A**	Analysis Date:	**5/20/2019 3:53:00 PM**	Prep Date:	**5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	<0.0500	0.100								N

Sample ID	**LCS-91002**	Batch ID:	**91002**	TestNo:	**M3500-Fe D**	Units:	**mg/L**
SampType:	**LCS**	Run ID:	**UV/VIS_2_190520A**	Analysis Date:	**5/20/2019 3:53:00 PM**	Prep Date:	**5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	0.0888	0.100	0.1000	0	88.8	85	115			N

Sample ID	**LCSD-91002**	Batch ID:	**91002**	TestNo:	**M3500-Fe D**	Units:	**mg/L**
SampType:	**LCSD**	Run ID:	**UV/VIS_2_190520A**	Analysis Date:	**5/20/2019 3:53:00 PM**	Prep Date:	**5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	0.0879	0.100	0.1000	0	87.9	85	115	1.05	15	N

Sample ID	**1905185-11AMS**	Batch ID:	**91002**	TestNo:	**M3500-Fe D**	Units:	**mg/L**
SampType:	**MS**	Run ID:	**UV/VIS_2_190520A**	Analysis Date:	**5/20/2019 4:03:00 PM**	Prep Date:	**5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	0.0860	0.100	0.1000	0	86.0	85	115			N

Sample ID	**1905185-11AMSD**	Batch ID:	**91002**	TestNo:	**M3500-Fe D**	Units:	**mg/L**
SampType:	**MSD**	Run ID:	**UV/VIS_2_190520A**	Analysis Date:	**5/20/2019 4:03:00 PM**	Prep Date:	**5/20/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	0.0861	0.100	0.1000	0	86.1	85	115	0.116	15	N

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **UV/VIS_2_190520A**

Sample ID **ICV-190520** Batch ID: **R104177** TestNo: **M3500-Fe D** Units: **mg/L**
SampType: **ICV** Run ID: **UV/VIS_2_190520A** Analysis Date: **5/20/2019 3:52:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	0.0875	0.100	0.1000	0	87.5	85	115			N

Sample ID **CCV1-190520** Batch ID: **R104177** TestNo: **M3500-Fe D** Units: **mg/L**
SampType: **CCV** Run ID: **UV/VIS_2_190520A** Analysis Date: **5/20/2019 3:59:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	0.197	0.100	0.2000	0	98.4	85	115			N

Sample ID **CCV2-190520** Batch ID: **R104177** TestNo: **M3500-Fe D** Units: **mg/L**
SampType: **CCV** Run ID: **UV/VIS_2_190520A** Analysis Date: **5/20/2019 4:12:00 PM** Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Iron, Ferrous	0.183	0.100	0.2000	0	91.7	85	115			N

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

CLIENT: Golder
Work Order: 1905167
Project: Luminant-MLSES Ash Ponds

ANALYTICAL QC SUMMARY REPORT

RunID: **WC_190517D**

The QC data in batch 90953 applies to the following samples: 1905167-01C, 1905167-02C

Sample ID	**MB-90953**	Batch ID:	**90953**	TestNo:	**M2540C**	Units:	**mg/L**
SampType:	**MBLK**	Run ID:	**WC_190517D**	Analysis Date:	**5/17/2019 11:40:00 AM**	Prep Date:	**5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	<10.0	10.0								

Sample ID	**LCS-90953**	Batch ID:	**90953**	TestNo:	**M2540C**	Units:	**mg/L**
SampType:	**LCS**	Run ID:	**WC_190517D**	Analysis Date:	**5/17/2019 11:40:00 AM**	Prep Date:	**5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	745	10.0	745.6	0	99.9	90	113			

Sample ID	**1905167-02C-DUP**	Batch ID:	**90953**	TestNo:	**M2540C**	Units:	**mg/L**
SampType:	**DUP**	Run ID:	**WC_190517D**	Analysis Date:	**5/17/2019 11:40:00 AM**	Prep Date:	**5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	5340	50.0	0	5375				0.747	5	

Sample ID	**1905168-02C-DUP**	Batch ID:	**90953**	TestNo:	**M2540C**	Units:	**mg/L**
SampType:	**DUP**	Run ID:	**WC_190517D**	Analysis Date:	**5/17/2019 11:40:00 AM**	Prep Date:	**5/16/2019**

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	940	50.0	0	910.0				3.24	5	

Qualifiers:

B	Analyte detected in the associated Method Blank	DF	Dilution Factor
J	Analyte detected between MDL and RL	MDL	Method Detection Limit
ND	Not Detected at the Method Detection Limit	R	RPD outside accepted control limits
RL	Reporting Limit	S	Spike Recovery outside control limits
J	Analyte detected between SDL and RL	N	Parameter not NELAP certified

Pace Analytical®
National Center for Testing & Innovation

ANALYTICAL REPORT

May 29, 2019

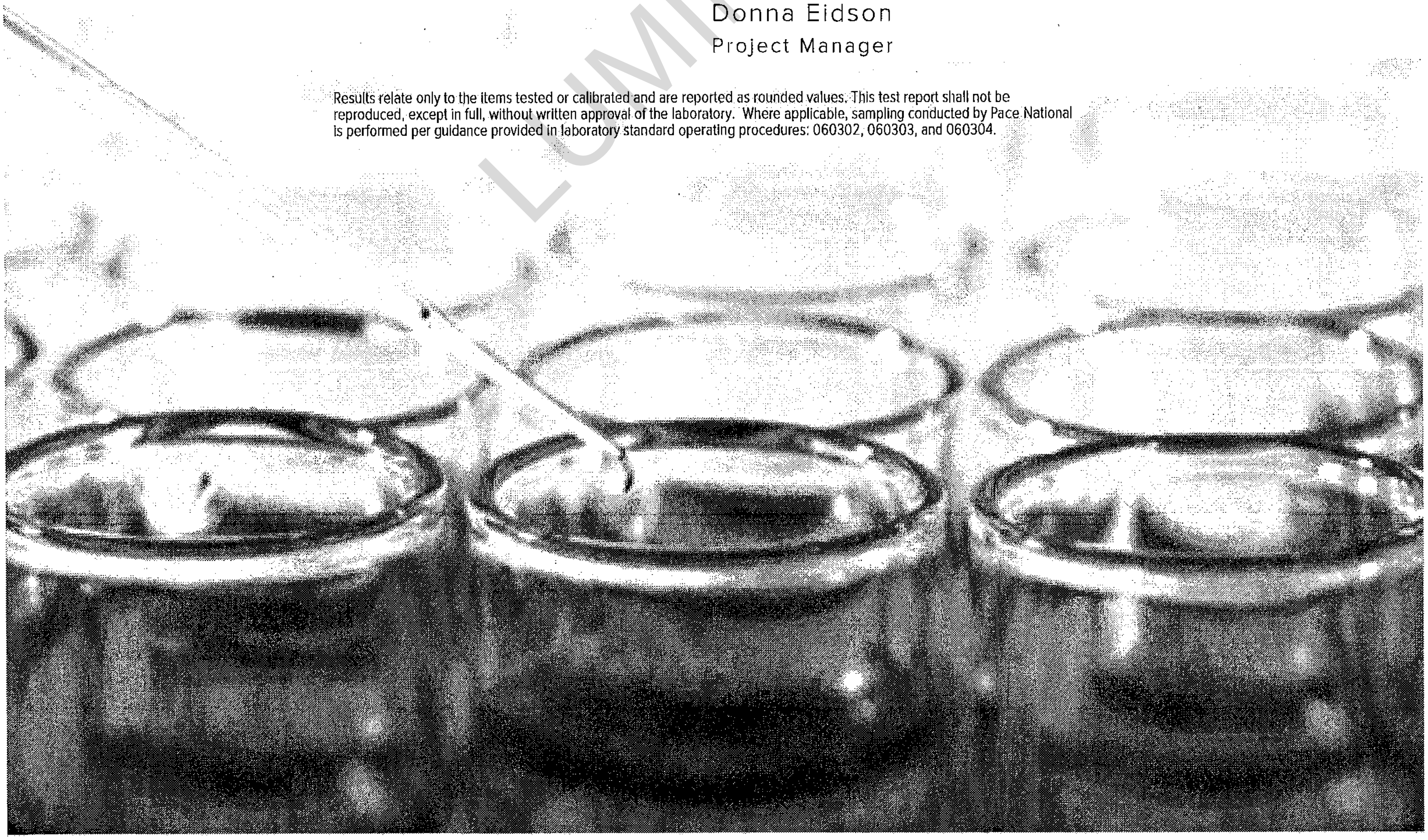
Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

DHL Analytical, Inc.

Sample Delivery Group:	L1100947
Samples Received:	05/21/2019
Project Number:	1905167
Description:	
Report To:	John DuPont 2300 Double Creek Drive Round Rock, TX 78664

Entire Report Reviewed By: DEidson

Donna Eidson
Project Manager



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SAMPLE SUMMARY

LAKE SAMPLE L1100947-01 Non-Potable Water

Collected by	Collected date/time	Received date/time
	05/14/19 10:05	05/21/19 10:10

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904	WG1284744	1	05/22/19 08:25	05/28/19 10:55	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1284773	1	05/23/19 15:02	05/28/19 10:55	RRE	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1284773	1	05/23/19 15:02	05/24/19 17:05	RRE	Mt. Juliet, TN

LAKE SAMPLE L1100947-02 Non-Potable Water

Collected by	Collected date/time	Received date/time
	05/14/19 10:20	05/21/19 10:10

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Radiochemistry by Method 904	WG1284744	1	05/22/19 08:25	05/28/19 10:55	JMR	Mt. Juliet, TN
Radiochemistry by Method Calculation	WG1284773	1	05/23/19 15:02	05/28/19 10:55	RRE	Mt. Juliet, TN
Radiochemistry by Method SM7500Ra B M	WG1284773	1	05/23/19 15:02	05/24/19 17:05	RRE	Mt. Juliet, TN

CASE NARRATIVE

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All radiochemical sample results for solids are reported on a dry weight basis with the exception of tritium, carbon-14 and radon, unless wet weight was requested by the client. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

DEidson

Donna Eidson
Project Manager

Radiochemistry by Method 904

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/l		+ / -	pCi/l	date / time	
RADIUM-228	0.369		0.449	0.769	05/28/2019 10:55	WG1284744
(T) Barium	*102*			*62.0-143*	*05/28/2019 10:55*	WG1284744
(T) Yttrium	*118*			*79.0-136*	*05/28/2019 10:55*	WG1284744

Radiochemistry by Method Calculation

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/l		+ / -	pCi/l	date / time	
Combined Radium	0.772		0.734	1.08	05/28/2019 10:55	WG1284773

Radiochemistry by Method SM7500Ra B M

	Result	Qualifier	Uncertainty	MDA	Analysis Date	Batch
Analyte	pCi/l		+ / -	pCi/l	date / time	
RADIUM-226	0.403		0.285	0.311	05/24/2019 17:05	WG1284773
(T) Barium-133	*92.1*			*30.0-143*	*05/24/2019 17:05*	WG1284773

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

LAKE SAMPLE

Collected date/time: 05/14/19 10:20

SAMPLE RESULTS - 02

L1100947

Radiochemistry by Method 904

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-228	-0.0402		0.349	0.599	05/28/2019 10:55	WG1284744
(T) Barium	*113*			*62.0-143*	*05/28/2019 10:55*	WG1284744
(T) Yttrium	*114*			*79.0-136*	*05/28/2019 10:55*	WG1284744

Radiochemistry by Method Calculation

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
Combined Radium	0.853		0.752	0.895	05/28/2019 10:55	WG1284773

Radiochemistry by Method SM7500Ra B M

Analyte	Result pCi/l	Qualifier	Uncertainty + / -	MDA pCi/l	Analysis Date date / time	Batch
RADIUM-226	0.853		0.403	0.296	05/24/2019 17:05	WG1284773
(T) Barium-133	*83.8*			*30.0-143*	*05/24/2019 17:05*	WG1284773

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Method Blank (MB)

(MB) R3415641-1 05/28/19 10:55

Analyte	MB Result pCi/l	MB Qualifier	MB MDA pCi/l
Radium-228	-0.164		0.413
(T) Barium	*108*		
(T) Yttrium	*115*		

L1100192-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1100192-01 05/28/19 10:55 • (DUP) R3415641-5 05/28/19 10:55

Analyte	Original Result pCi/l	DUP Result pCi/l	Dilution	DUP RPD %	DUP RER	DUP Qualifier	DUP RPD Limits %	DUP RER Limit
Radium-228	0.157	-0.0367	1	200	0.366		20	3
(T) Barium	*91.7*	*102*						
(T) Yttrium	*110*	*107*						

Laboratory Control Sample (LCS)

(LCS) R3415641-2 05/28/19 10:55

Analyte	Spike Amount pCi/l	LCS Result pCi/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Radium-228	5.00	4.47	89.4	80.0-120	
(T) Barium			*103*		
(T) Yttrium			*107*		

L1100922-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1100922-01 05/28/19 10:55 • (MS) R3415641-3 05/28/19 10:55 • (MSD) R3415641-4 05/28/19 10:55

Analyte	Spike Amount pCi/l	Original Result pCi/l	MS Result pCi/l	MSD Result pCi/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	MS RER	RPD Limits %
Radium-228	7.14	-0.136	7.62	7.50	107	105	1	70.0-130			1.50		20
(T) Barium		*111*			*107*	*110*							
(T) Yttrium		*114*			*107*	*110*							

Method Blank (MB)

(MB) R3415635-1 05/24/19 17:04

Analyte	MB Result pCi/l	MB Qualifier	MB MDA pCi/l
Radium-226	0.459		0.209
(T) Barium-133	*84.6*		

L1100844-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1100844-01 05/24/19 17:04 • (DUP) R3415635-5 05/24/19 17:04

Analyte	Original Result pCi/l	DUP Result pCi/l	Dilution	DUP RPD %	DUP RER	DUP Qualifier	DUP RPD Limits %	DUP RER Limit
Radium-226	0.495	0.573	1	14.6	0.182		20	3
(T) Barium-133	*90.4*	*88.8*						

Laboratory Control Sample (LCS)

(LCS) R3415635-2 05/24/19 17:04

Analyte	Spike Amount pCi/l	LCS Result pCi/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Radium-226	20.1	19.1	95.0	80.0-120	
(T) Barium-133			*79.1*		

L1100433-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1100433-01 05/24/19 17:04 • (MS) R3415635-3 05/24/19 17:04 • (MSD) R3415635-4 05/24/19 17:04

Analyte	Spike Amount pCi/l	Original Result pCi/l	MS Result pCi/l	MSD Result pCi/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	MS RER	RPD Limits %
Radium-226	20.1	1.16	19.9	20.9	93.2	98.0	1	75.0-125			4.71		20
(T) Barium-133		*83.2*			*81.1*	*84.7*							

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Abbreviations and Definitions

MDA	Minimum Detectable Activity.
Rec.	Recovery.
RER	Replicate Error Ratio.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(T)	Tracer - A radioisotope of known concentration added to a solution of chemically equivalent radioisotopes at a known concentration to assist in monitoring the yield of the chemical separation.
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
	The remainder of this page intentionally left blank, there are no qualifiers applied to this SDG.

ACCREDITATIONS & LOCATIONS

ONE LAB. NATIONWIDE.

Pace National is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our one location design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be YOUR LAB OF CHOICE.

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace National.

State Accreditations

Alabama	40660
Alaska	17-026
Arizona	AZ0612
Arkansas	88-0469
California	2932
Colorado	TN00003
Connecticut	PH-0197
Florida	E87487
Georgia	NELAP
Georgia [1]	923
Idaho	TN00003
Illinois	200008
Indiana	C-TN-01
Iowa	364
Kansas	E-10277
Kentucky [1,6]	90010
Kentucky [2]	16
Louisiana	AI30792
Louisiana [1]	LA180010
Maine	TN0002
Maryland	324
Massachusetts	M-TN003
Michigan	9958
Minnesota	047-999-395
Mississippi	TN00003
Missouri	340
Montana	CERT0086

Nebraska	NE-OS-15-05
Nevada	TN-03-2002-34
New Hampshire	2975
New Jersey–NELAP	TN002
New Mexico [1]	n/a
New York	11742
North Carolina	Env375
North Carolina [1]	DW21704
North Carolina [3]	41
North Dakota	R-140
Ohio–VAP	CL0069
Oklahoma	9915
Oregon	TN200002
Pennsylvania	68-02979
Rhode Island	LAO00356
South Carolina	84004
South Dakota	n/a
Tennessee [1,4]	2006
Texas	T104704245-18-15
Texas [5]	LAB0152
Utah	TN00003
Vermont	VT2006
Virginia	460132
Washington	C847
West Virginia	233
Wisconsin	9980939910
Wyoming	A2LA

Third Party Federal Accreditations

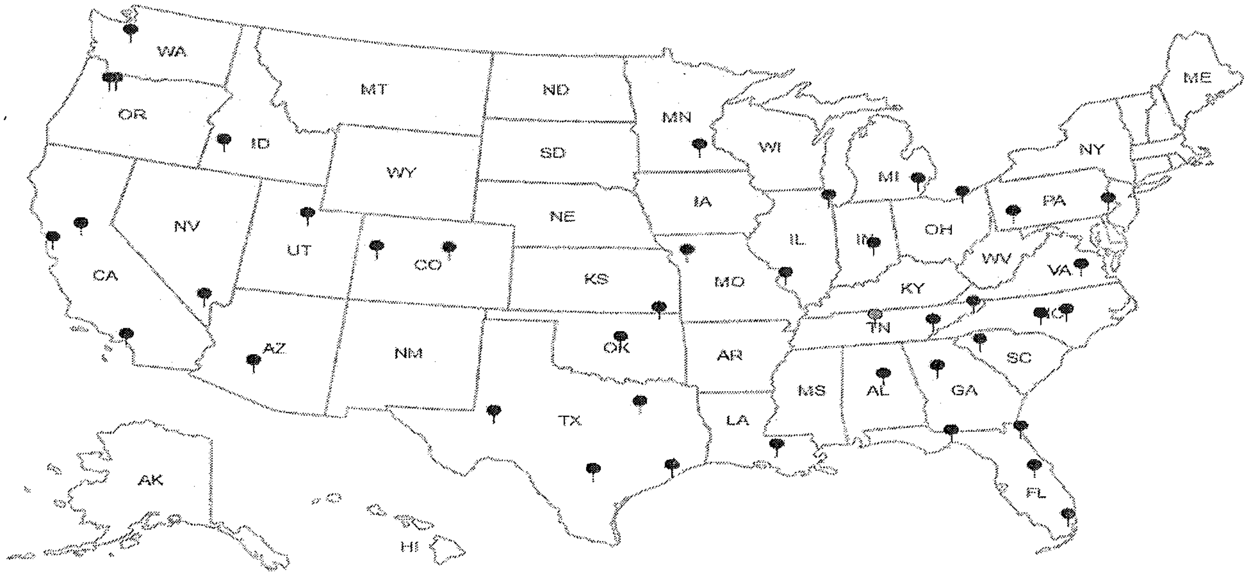
A2LA – ISO 17025	1461.01
A2LA – ISO 17025 [5]	1461.02
Canada	1461.01
EPA–Crypto	TN00003

AIHA-LAP,LLC EMLAP	100789
DOD	1461.01
USDA	P330-15-00234

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

Our Locations

Pace National has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. Pace National performs all testing at our central laboratory.



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Pace Analytical National Center for Testing & Innovation
Cooler Receipt Form

Client: DHLRRTX

SDG#: 1100947

Temperature: Amb

Cooler Received/Opened On: 5/21/19

Received By: Brock Fariss

Signature: Fariss

Receipt Check List	NP	Yes	No
COC Seal Present / Intact?	✓		
COC Signed / Accurate?		✓	
Bottles arrive intact?		✓	
Correct bottles used?		✓	
Sufficient volume sent?		✓	
If Applicable			
VOA Zero headspace?			
Preservation Correct / Checked?		✓	

1100947

Page 1 of 1

CHAIN-OF-CUSTODY RECORD

H004

DHL Analytical, Inc.
2300 Double Creek Drive
Round Rock, TX 78664
TEL: *(512) 388-8222* FAX: *(512) 388-8229*
Work Order: 1905167

Subcontractor:
Pace Analytical
12065 Lebanon Rd
Mt. Juliet, TN 37122

TEL: (615) 773-5923
FAX:
Acct #: DHLRRTX

15-May-19

					Requested Tests					
					<2	<2				
					Ra-228	Ra-226				
Sample Id	Matrix	DHL#	Date Collected	Bottle Type	E904.0	M7500 Ra B M				
Lake Sample	Aqueous	-01D	05/14/19 10:05 AM	1LHDPEHNO3		1				-01
Lake Sample	Aqueous	-01E	05/14/19 10:05 AM	1LHDPEHNO3	1					01
Pond Sample	Aqueous	-02D	05/14/19 10:20 AM	1LHDPEHNO3		1				02
Pond Sample	Aqueous	-02E	05/14/19 10:20 AM	1LHDPEHNO3	1					02

General Comments:
Please analyze these samples with Normal Turnaround Time.
Report RA-226, Ra-228 & Combined per Specs.
Quality Control Package Needed: Standard - NELAC Rad Test compliant
Email to cac@dhlanalytical.com & dupont@dhlanalytical.com

		Date/Time			Date/Time
Relinquished by:		5/17/19 1700	**Received by:**		5/21/19 1010
Relinquished by:			**Received by:**		

Anno

VPS
Rec: 4

[illegible] 5 mR/hr

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*Golder Associates - Will Vienne*
Project Number/ LIMS No.	*17431-01 / MI7012-JUN19*
Batch:	*Martin Lake Ash Ponds*
Sample Receipt:	*June 13, 2019*
Sample Analysis:	*June 28, 2019*
Reporting Date:	*July 19, 2019*
Instrument:	Panalytical X'pert Pro Diffractometer
Test Conditions:	Co radiation, 40 kV, 45 mA Regular Scanning: Step: 0.033°, Step time:0.15s, 2θ range: 6-70°
Interpretations :	HighScore Plus software using Crystallography Open Database (COD) and Joint Committee on Powder Diffraction Standards -International Center for Diffraction Data (JCPDS-ICDD).
Detection Limit :	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Summary of Mineral Assemblages
3) Quantitative XRD Results
4) XRD Pattern(s)

BEaton

Ben Eaton
Junior Mineralogist

Lain Glossop H.B.Sc
Senior Mineralogist

Method Summary

Mineral Identification and Interpretation:

Mineral identification and interpretation involve matching the diffraction pattern of a test sample material to patterns of single-phase reference materials. The reference patterns from the Crystallography Open Database (COD) and the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Quantitative Rietveld Analysis:

Panalytical HighScore Plus software was used to perform the quantitative Rietveld Analysis. This software uses a graphics based profile analysis program built around a non-linear least squares fitting system, to quantitatively determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile (shown as a blue pattern in the analyses plots) until it matches the obtained experimental patterns (shown as the coloured pattern in the analyses plots).

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.5 wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

Summary of Rietveld Quantitative Analysis X-ray Diffraction Results

Quantitative X-ray Diffraction Results

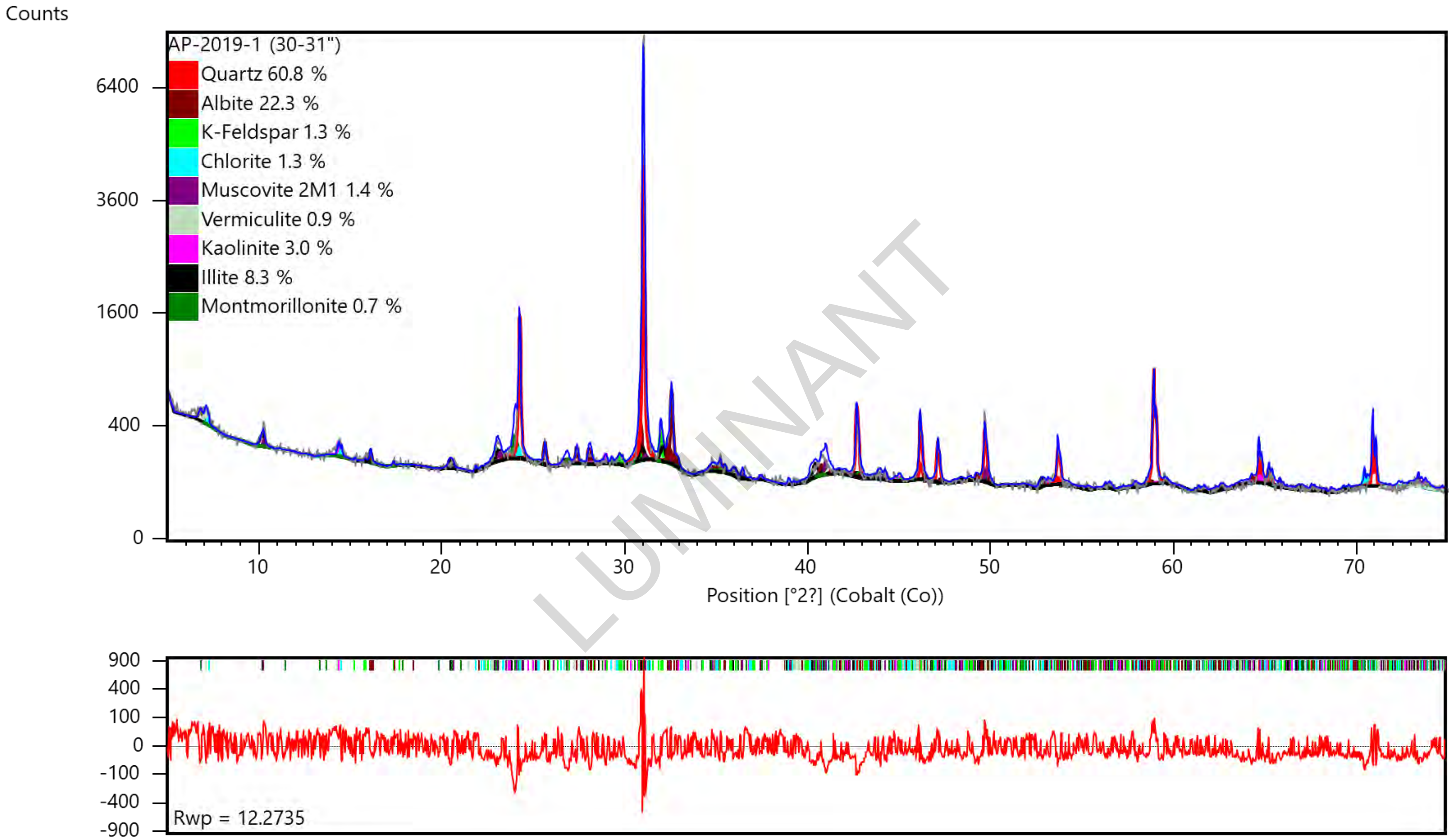
Mineral/Compound	1 AP-2019-1 (30-31")	2 AP-2019-2 (35-36")	3 AP-2019-3 (18-19")
	(wt %)	(wt %)	(wt %)
Quartz	60.8	66.0	99.2
Albite	22.3	16.2	0.8
K-Feldspar	1.3	1.4	--
Chlorite	1.3	2.7	--
Muscovite	1.4	3.2	--
*Vermiculite	0.9	0.7	--
*Kaolinite	3.0	3.4	--
Illite	8.3	6.1	--
*Montmorillonite	0.7	0.4	--
TOTAL	100	100	100

Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

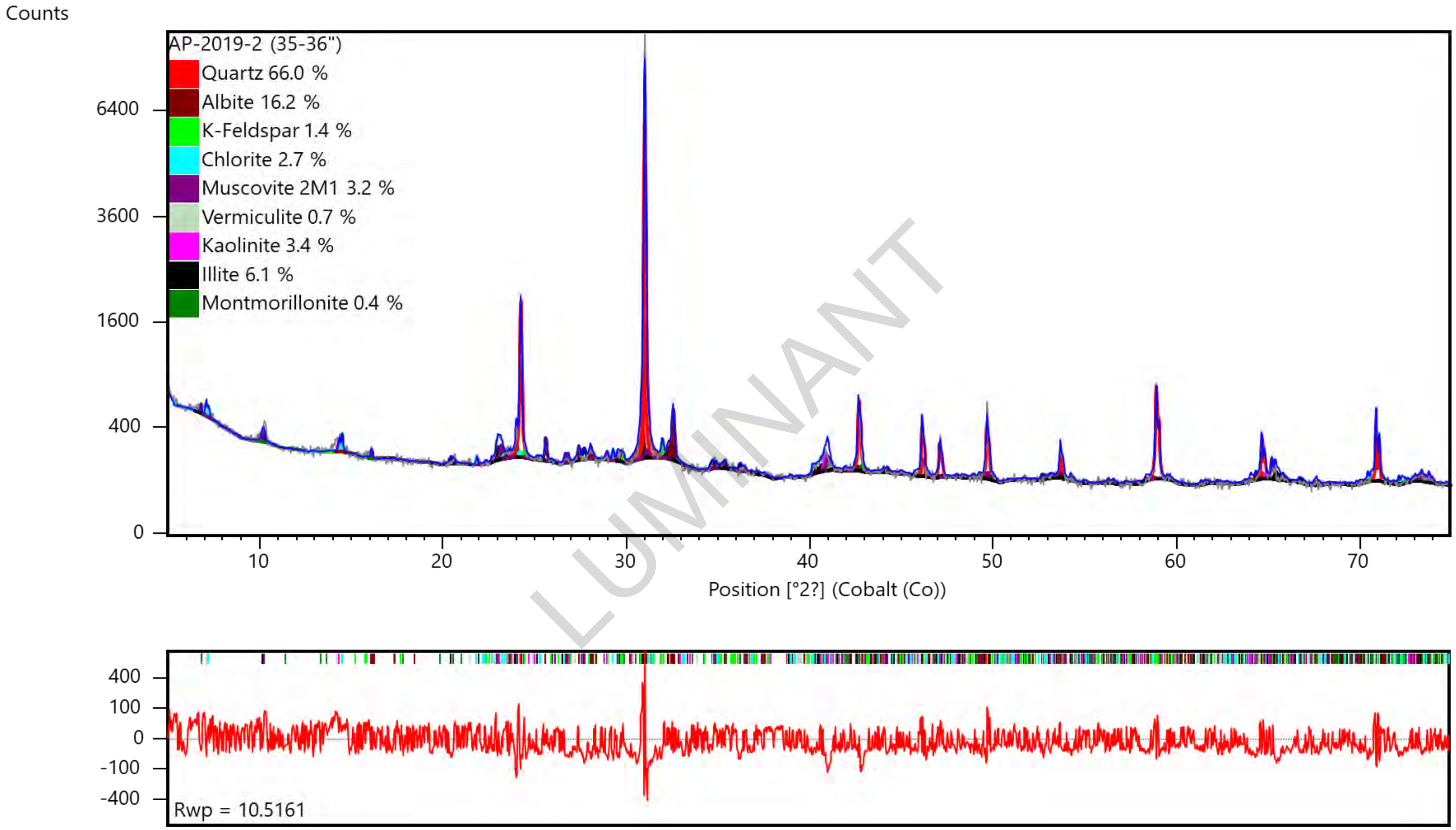
Dashes indicate that the mineral was not identified by the analyst and not included in the refinement calculation for the sample.

** Tentative identification of clays only, further clay XRD analysis will be required for positive identification*

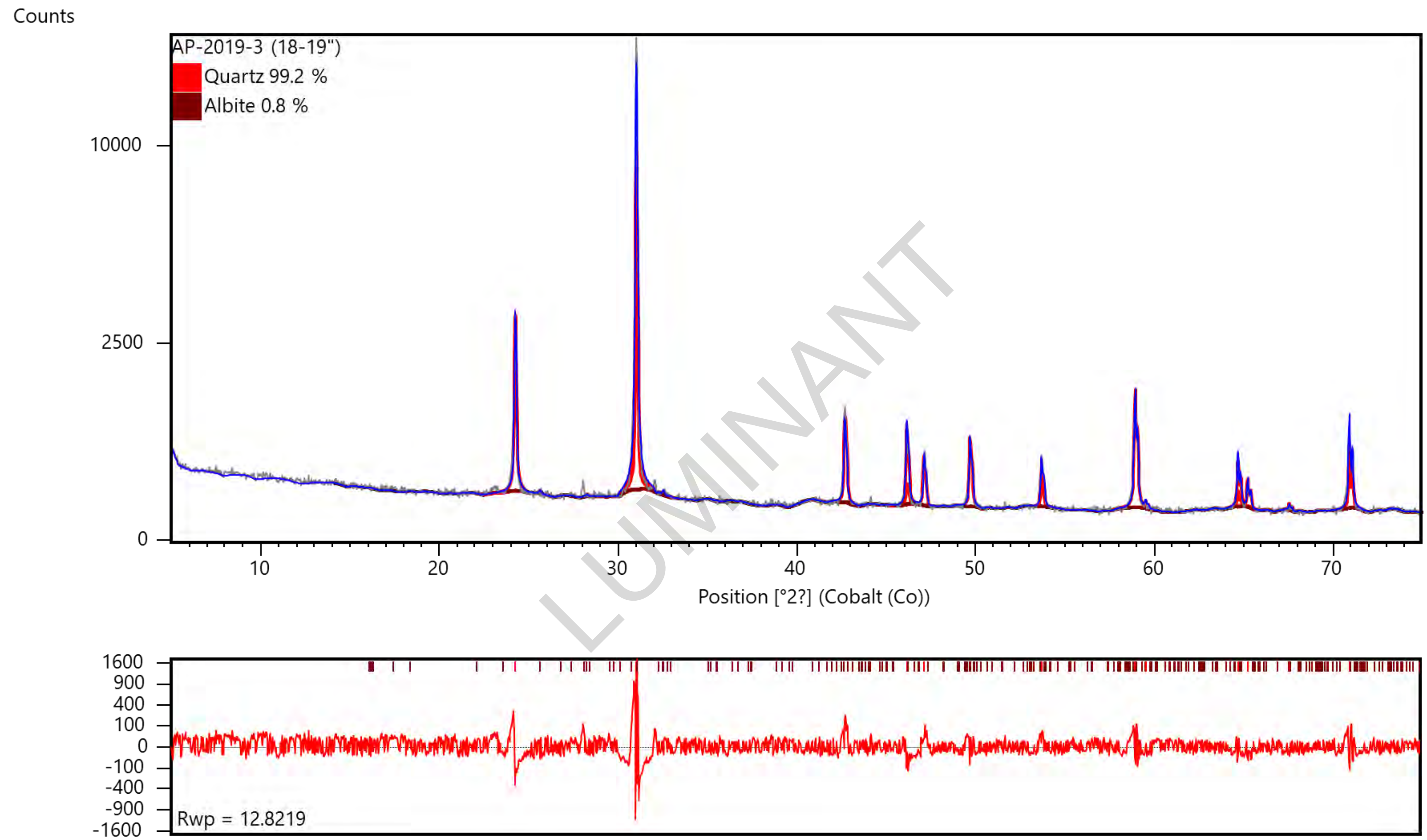
Mineral/Compound	Formula
Quartz	SiO_2
Albite	$NaAlSi_3O_8$
K-Feldspar	$KAlSi_3O_8$
Chlorite	$(Mg_3,Fe_2)Al(AlSi_3)O_{10}(OH)_8$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Vermiculite	$(Mg,Fe,Al)_2(Al,Si)_4O_{10}(OH)_2 \cdot 4(H_2O)$
Kaolinite	$Al_2Si_2O_5(OH)_4$
Illite	$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$
Montmorillonite	$Na_{0.2}Ca_{0.1}Al_{1.5}Mg_{0.5}Si_4O_{10}(OH)_2 \cdot 4(H_2O)$



X-ray diffractogram. The upper pattern is the measured diffractogram, the blue curve is the calculated pattern from the Rietveld Refinement and the lower red curve is the difference plot.



X-ray diffractogram. The upper pattern is the measured diffractogram, the blue curve is the calculated pattern from the Rietveld Refinement and the lower red curve is the difference plot.



X-ray diffractogram. The upper pattern is the measured diffractogram, the blue curve is the calculated pattern from the Rietveld Refinement and the lower red curve is the difference plot.

Environment Testing
TestAmerica

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12
13

ANALYTICAL REPORT

Eurofins TestAmerica, Knoxville
5815 Middlebrook Pike
Knoxville, TN 37921
Tel: (865)291-3000

Laboratory Job ID: 140-15490-1
Client Project/Site: Martin Lake Ash Ponds - SEP + Totals

For:
Golder Associates Inc.
2201 Double Creek Dr
Suite 4004
Round Rock, Texas 78664

Attn: Will Vienne

Terry Walker Wasmund

Authorized for release by:
7/18/2019 5:51:37 PM

Terry Walker Wasmund, Project Manager II
(865)291-3000
terry.wasmund@testamericainc.com

LINKS

Review your project results through TotalAccess

Have a Question? Ask The Expert

Visit us at:
www.testamericainc.com

Table of Contents

Definitions/Glossary

Qualifiers

Metals

Qualifier	Qualifier Description
*	LCS or LCSD is outside acceptance limits.
*	RPD of the LCS and LCSD exceeds the control limits
B	Compound was found in the blank and sample.
F1	MS and/or MSD Recovery is outside acceptance limits.
F5	Duplicate RPD exceeds limit, and one or both sample results are less than 5 times RL. The data are considered valid because the absolute difference is less than the RL.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Case Narrative

Job ID: 140-15490-1

Laboratory: Eurofins TestAmerica, Knoxville

Narrative

Job Narrative
140-15490-1

Receipt

The samples were received on 6/5/2019 at 9:20 AM. The samples arrived in good condition, properly preserved, and on ice. The temperature of the cooler at receipt was 1.2º C.

Metals

7 Step Sequential Extraction Procedure

These soil samples were prepared and analyzed using Eurofins TestAmerica Knoxville standard operating procedure KNOX-MT-0008, “7 Step Sequential Extraction Procedure”. SW-846 Method 6010B as incorporated in Eurofins TestAmerica Knoxville standard operating procedure KNOX-MT-0007 was used to perform the final instrument analyses.

An aliquot of each sample was sequentially extracted using the steps listed below:

- ***Step 1 - Exchangeable Fraction:*** A 5 gram aliquot of sample was extracted with 25 mL of 1M magnesium sulfate (MgSO4), centrifuged and filtered. 5 mL of the resulting leachate was digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
- ***Step 2 - Carbonate Fraction:*** The sample residue from step 1 was extracted with 25 mL of 1M sodium acetate/acetic acid (NaOAc/HOAc) at pH 5, centrifuged and filtered. 5 mL of the resulting leachate was digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
- ***Step 3 - Non-crystalline Materials Fraction:*** The sample residue from step 2 was extracted with 25 mL of 0.2M ammonium oxalate (pH 3), centrifuged and filtered. 5 mL of the resulting leachate was digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
- ***Step 4 - Metal Hydroxide Fraction***: The sample residue from step 3 was extracted with 25 mL of 1M hydroxylamine hydrochloride solution in 25% v/v acetic acid, centrifuged and filtered. 5 mL of the resulting leachate was digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
- ***Step 5 - Organic-bound Fraction:*** The sample residue from step 4 was extracted three times with 25 mL of 5% sodium hypochlorite (NaClO) at pH 9.5, centrifuged and filtered. The resulting leachates were combined and 5 mL were digested using method 3010A and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
- ***Step 6 - Acid/Sulfide Fraction:*** The sample residue from step 5 was extracted with 25 mL of a 3:1:2 v/v solution of HCl-HNO3-H2O, centrifuged and filtered. 5 mL of the resulting leachate was diluted to 50 mL with reagent water and analyzed by method 6010B. Results are reported in mg/kg on a dry weight basis.
- ***Step 7 - Residual Fraction:*** A 1.0 g aliquot of the sample residue from step 6 was digested using HF, HNO3, HCl and H3BO3. The digestate was analyzed by ICP using method 6010B. Results are reported in mg/kg on a dry weight basis.

In addition, a 1.0 g aliquot of the original sample was digested using HF, HNO3, HCl and H3BO3. The digestate was analyzed by ICP using method 6010B. Total metal results are reported in mg/kg on a dry weight basis.

Results were calculated using the following equation:

$$\text{Result, µg/g or mg/Kg, dry weight} = (C \times V \times V1 \times D) / (W \times S \times V2)$$

Where:
C = Concentration from instrument readout, µg/mL
V = Final volume of digestate, mL
D = Instrument dilution factor
V1 = Total volume of leachate, mL
V2 = Volume of leachate digested, mL
W = Wet weight of sample, g
S = Percent solids/100

A method blank, laboratory control sample and laboratory control sample duplicate were prepared and analyzed with each SEP step in order to provide information about both the presence of elements of interest in the extraction solutions, and the recovery of elements of

Job ID: 140-15490-1 (Continued)

Laboratory: Eurofins TestAmerica, Knoxville (Continued)

interest from the extraction solutions. Results outside of laboratory QC limits do not reflect out of control performance, but rather the effect of the extraction solution upon the analyte.

A laboratory sample duplicate was prepared and analyzed with each batch of samples in order to provide information regarding the reproducibility of the procedure.

SEP Report Notes
The final report lists the results for each step, the result for the total digestion of the sample, and a sum of the results of steps 1 through 7 by element.

Magnesium was not reported for step 1 because the extraction solution for this step (magnesium sulfate) contains high levels of magnesium. Sodium was not reported for steps 2 and 5 since the extraction solutions for these steps contain high levels of sodium. The sum of steps 1 through 7 is much higher than the total result for sodium and magnesium due to the magnesium and sodium introduced by the extraction solutions.

The step 1 digestates were reanalyzed for vanadium at a 1/10 dilution due to positive interelement interferences resulting from the high magnesium results. The reporting limits were adjusted accordingly.

The digestates for steps 1, 2 and 5 were analyzed at a dilution due to instrument problems caused by the high solids content of the digestates. The reporting limits were adjusted accordingly.

The serial dilution performed for samples (140-15490-A-1-A SD ^5) and (140-15490-A-1-AD SD ^50) associated with batch 140-31713 was outside control limits.

Samples AP-2019-1 (30-31) (140-15490-1), AP-2019-2 (35-36) (140-15490-2), AP-2019-3 (18-19) (140-15490-3), (140-15490-A-1-AE DU) and (140-15490-A-1-B DU) were diluted due to the presence of Silicon or Titanium which interferes with Arsenic, Cobalt, Selenium and Thallium. Elevated reporting limits (RLs) are provided.

Samples AP-2019-1 (30-31) (140-15490-1), AP-2019-2 (35-36) (140-15490-2), AP-2019-3 (18-19) (140-15490-3), (140-15490-A-1-AE DU) and (140-15490-A-1-B DU) were diluted for Aluminum and Barium due to the nature of the sample matrix. Elevated reporting limits (RLs) are provided.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

General Chemistry - % Moisture
The samples were analyzed for percent moisture using SOP number KNOX-WC-0012 (based on Modified MCAWW 160.3 and SM2540B and on the percent moisture determinations described in methods 3540C and 3550B).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Comments
No additional comments.

Detection Summary

Client Sample ID: AP-2019-1 (30-31) Lab Sample ID: 140-15490-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Barium	0.88	J	13	0.63	mg/Kg	4	☼	6010B SEP	Step 1
Cobalt	0.54	J	13	0.24	mg/Kg	4	☼	6010B SEP	Step 1
Manganese	3.1	J	3.9	0.16	mg/Kg	4	☼	6010B SEP	Step 1
Aluminum	9.7	J *	39	6.3	mg/Kg	3	☼	6010B SEP	Step 2
Barium	0.76	J *	9.9	0.47	mg/Kg	3	☼	6010B SEP	Step 2
Selenium	0.76	J B	2.0	0.67	mg/Kg	3	☼	6010B SEP	Step 2
Aluminum	88		13	2.8	mg/Kg	1	☼	6010B SEP	Step 3
Arsenic	1.8		0.66	0.17	mg/Kg	1	☼	6010B SEP	Step 3
Barium	4.3	B	3.3	0.16	mg/Kg	1	☼	6010B SEP	Step 3
Beryllium	0.067	J	0.33	0.020	mg/Kg	1	☼	6010B SEP	Step 3
Cobalt	0.34	J	3.3	0.059	mg/Kg	1	☼	6010B SEP	Step 3
Iron	580		6.6	3.8	mg/Kg	1	☼	6010B SEP	Step 3
Manganese	2.4	B	0.99	0.036	mg/Kg	1	☼	6010B SEP	Step 3
Selenium	0.22	J B	0.66	0.22	mg/Kg	1	☼	6010B SEP	Step 3
Aluminum	1700		13	2.1	mg/Kg	1	☼	6010B SEP	Step 4
Arsenic	2.8	B	0.66	0.29	mg/Kg	1	☼	6010B SEP	Step 4
Barium	16		3.3	0.16	mg/Kg	1	☼	6010B SEP	Step 4
Beryllium	0.13	J	0.33	0.021	mg/Kg	1	☼	6010B SEP	Step 4
Cobalt	1.5	J	3.3	0.070	mg/Kg	1	☼	6010B SEP	Step 4
Iron	3900		6.6	3.8	mg/Kg	1	☼	6010B SEP	Step 4
Li	3.0	J	3.3	0.20	mg/Kg	1	☼	6010B SEP	Step 4
Manganese	18		0.99	0.17	mg/Kg	1	☼	6010B SEP	Step 4
Aluminum	62	J *	200	31	mg/Kg	5	☼	6010B SEP	Step 5
Barium	7.0	J *	49	2.4	mg/Kg	5	☼	6010B SEP	Step 5
Aluminum	2300		13	2.1	mg/Kg	1	☼	6010B SEP	Step 6
Arsenic	0.94		0.66	0.20	mg/Kg	1	☼	6010B SEP	Step 6
Barium	18		3.3	0.16	mg/Kg	1	☼	6010B SEP	Step 6
Beryllium	0.067	J	0.33	0.016	mg/Kg	1	☼	6010B SEP	Step 6
Cobalt	0.90	J	3.3	0.061	mg/Kg	1	☼	6010B SEP	Step 6
Iron	2500		6.6	3.8	mg/Kg	1	☼	6010B SEP	Step 6
Li	2.1	J	3.3	0.20	mg/Kg	1	☼	6010B SEP	Step 6
Manganese	16		0.99	0.33	mg/Kg	1	☼	6010B SEP	Step 6
Aluminum	29000		130	21	mg/Kg	10	☼	6010B SEP	Step 7
Arsenic	1.2		0.66	0.17	mg/Kg	1	☼	6010B SEP	Step 7
Barium	390		33	1.6	mg/Kg	10	☼	6010B SEP	Step 7
Beryllium	0.56		0.33	0.0099	mg/Kg	1	☼	6010B SEP	Step 7
Cobalt	0.79	J	6.6	0.39	mg/Kg	2	☼	6010B SEP	Step 7
Iron	5200		6.6	5.4	mg/Kg	1	☼	6010B SEP	Step 7
Li	9.6		3.3	0.20	mg/Kg	1	☼	6010B SEP	Step 7
Manganese	26		0.99	0.068	mg/Kg	1	☼	6010B SEP	Step 7
Mo	0.19	J	2.6	0.11	mg/Kg	1	☼	6010B SEP	Step 7
Thallium	0.48	J	4.6	0.47	mg/Kg	2	☼	6010B SEP	Step 7
Aluminum	33000		10	1.6	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Arsenic	6.9		0.50	0.13	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Barium	440		2.5	0.12	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Beryllium	0.83		0.25	0.0075	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Cobalt	4.0		2.5	0.023	mg/Kg	1		6010B SEP	Sum of Steps 1-7

This Detection Summary does not include radiochemical test results.

Detection Summary

Client: Golder Associates Inc. Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Client Sample ID: AP-2019-1 (30-31) (Continued) Lab Sample ID: 140-15490-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Iron	12000		5.0	4.1	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Li	15		2.5	0.15	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Manganese	66		0.75	0.052	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Mo	0.19	J	2.0	0.082	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Selenium	0.98		0.50	0.17	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Thallium	0.48	J	1.8	0.18	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Chromium	13	F1	1.8	0.27	mg/Kg	1	☼	6010B	Total/NA
Lead	6.4		1.8	0.34	mg/Kg	1	☼	6010B	Total/NA
Aluminum	60000		130	21	mg/Kg	10	☼	6010B	Total/NA
Arsenic	6.8		0.66	0.17	mg/Kg	1	☼	6010B	Total/NA
Barium	680		33	1.6	mg/Kg	10	☼	6010B	Total/NA
Beryllium	0.89		0.33	0.0099	mg/Kg	1	☼	6010B	Total/NA
Cobalt	3.8	J	6.6	0.39	mg/Kg	2	☼	6010B	Total/NA
Iron	11000		6.6	5.4	mg/Kg	1	☼	6010B	Total/NA
Lithium	18		3.3	0.20	mg/Kg	1	☼	6010B	Total/NA
Manganese	66		0.99	0.068	mg/Kg	1	☼	6010B	Total/NA
Molybdenum	0.40	J	2.6	0.11	mg/Kg	1	☼	6010B	Total/NA
Hg	0.081	J	0.13	0.053	mg/Kg	1	☼	7470A	Total/NA

Client Sample ID: AP-2019-2 (35-36) Lab Sample ID: 140-15490-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Aluminum	19	J	51	8.2	mg/Kg	4	☼	6010B SEP	Step 1
Barium	0.88	J	13	0.61	mg/Kg	4	☼	6010B SEP	Step 1
Cobalt	1.6	J	13	0.23	mg/Kg	4	☼	6010B SEP	Step 1
Iron	23	J	25	15	mg/Kg	4	☼	6010B SEP	Step 1
Manganese	33		3.8	0.16	mg/Kg	4	☼	6010B SEP	Step 1
Aluminum	18	J *	38	6.1	mg/Kg	3	☼	6010B SEP	Step 2
Barium	0.67	J *	9.6	0.46	mg/Kg	3	☼	6010B SEP	Step 2
Cobalt	0.27	J	9.6	0.24	mg/Kg	3	☼	6010B SEP	Step 2
Iron	110	*	19	11	mg/Kg	3	☼	6010B SEP	Step 2
Manganese	4.2		2.9	1.1	mg/Kg	3	☼	6010B SEP	Step 2
Selenium	0.90	J B	1.9	0.65	mg/Kg	3	☼	6010B SEP	Step 2
Aluminum	97		13	2.7	mg/Kg	1	☼	6010B SEP	Step 3
Arsenic	0.97		0.64	0.17	mg/Kg	1	☼	6010B SEP	Step 3
Barium	4.1	B	3.2	0.15	mg/Kg	1	☼	6010B SEP	Step 3
Beryllium	0.028	J	0.32	0.019	mg/Kg	1	☼	6010B SEP	Step 3
Cobalt	0.17	J	3.2	0.057	mg/Kg	1	☼	6010B SEP	Step 3
Iron	1100		6.4	3.7	mg/Kg	1	☼	6010B SEP	Step 3
Manganese	1.5	B	0.96	0.034	mg/Kg	1	☼	6010B SEP	Step 3
Aluminum	1800		13	2.0	mg/Kg	1	☼	6010B SEP	Step 4
Arsenic	0.78	B	0.64	0.28	mg/Kg	1	☼	6010B SEP	Step 4
Barium	23		3.2	0.15	mg/Kg	1	☼	6010B SEP	Step 4
Beryllium	0.078	J	0.32	0.020	mg/Kg	1	☼	6010B SEP	Step 4
Cobalt	1.5	J	3.2	0.068	mg/Kg	1	☼	6010B SEP	Step 4
Iron	3800		6.4	3.7	mg/Kg	1	☼	6010B SEP	Step 4
Li	4.2		3.2	0.19	mg/Kg	1	☼	6010B SEP	Step 4

This Detection Summary does not include radiochemical test results.

Detection Summary

Client: Golder Associates Inc. Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Client Sample ID: AP-2019-2 (35-36) (Continued) Lab Sample ID: 140-15490-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Manganese	31		0.96	0.17	mg/Kg	1	☼	6010B SEP	Step 4
Aluminum	55	J *	190	30	mg/Kg	5	☼	6010B SEP	Step 5
Barium	11	J *	48	2.3	mg/Kg	5	☼	6010B SEP	Step 5
Cobalt	0.85	J *	48	0.76	mg/Kg	5	☼	6010B SEP	Step 5
Manganese	3.9	J *	14	2.4	mg/Kg	5	☼	6010B SEP	Step 5
Aluminum	2000		13	2.0	mg/Kg	1	☼	6010B SEP	Step 6
Arsenic	0.74		0.64	0.19	mg/Kg	1	☼	6010B SEP	Step 6
Barium	16		3.2	0.15	mg/Kg	1	☼	6010B SEP	Step 6
Beryllium	0.061	J	0.32	0.015	mg/Kg	1	☼	6010B SEP	Step 6
Cobalt	0.80	J	3.2	0.059	mg/Kg	1	☼	6010B SEP	Step 6
Iron	3300		6.4	3.7	mg/Kg	1	☼	6010B SEP	Step 6
Li	2.1	J	3.2	0.19	mg/Kg	1	☼	6010B SEP	Step 6
Manganese	19		0.96	0.32	mg/Kg	1	☼	6010B SEP	Step 6
Aluminum	26000		130	20	mg/Kg	10	☼	6010B SEP	Step 7
Arsenic	0.71		0.64	0.17	mg/Kg	1	☼	6010B SEP	Step 7
Barium	330		32	1.5	mg/Kg	10	☼	6010B SEP	Step 7
Beryllium	0.51		0.32	0.0096	mg/Kg	1	☼	6010B SEP	Step 7
Cobalt	1.1	J	6.4	0.38	mg/Kg	2	☼	6010B SEP	Step 7
Iron	5600		6.4	5.2	mg/Kg	1	☼	6010B SEP	Step 7
Li	11		3.2	0.19	mg/Kg	1	☼	6010B SEP	Step 7
Manganese	34		0.96	0.066	mg/Kg	1	☼	6010B SEP	Step 7
Mo	0.17	J	2.5	0.10	mg/Kg	1	☼	6010B SEP	Step 7
Thallium	0.70	J	4.5	0.46	mg/Kg	2	☼	6010B SEP	Step 7
Aluminum	30000		10	1.6	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Arsenic	3.2		0.50	0.13	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Barium	390		2.5	0.12	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Beryllium	0.68		0.25	0.0075	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Cobalt	6.3		2.5	0.023	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Iron	14000		5.0	4.1	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Li	18		2.5	0.15	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Manganese	130		0.75	0.052	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Mo	0.17	J	2.0	0.082	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Selenium	0.90		0.50	0.17	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Thallium	0.70	J	1.8	0.18	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Chromium	12		1.8	0.27	mg/Kg	1	☼	6010B	Total/NA
Lead	6.2		1.8	0.34	mg/Kg	1	☼	6010B	Total/NA
Aluminum	62000		130	20	mg/Kg	10	☼	6010B	Total/NA
Arsenic	3.0		0.64	0.17	mg/Kg	1	☼	6010B	Total/NA
Barium	560		32	1.5	mg/Kg	10	☼	6010B	Total/NA
Beryllium	0.72		0.32	0.0096	mg/Kg	1	☼	6010B	Total/NA
Cobalt	6.2	J	16	0.96	mg/Kg	5	☼	6010B	Total/NA
Iron	13000		6.4	5.2	mg/Kg	1	☼	6010B	Total/NA
Lithium	26		3.2	0.19	mg/Kg	1	☼	6010B	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample ID: AP-2019-2 (35-36) (Continued) Lab Sample ID: 140-15490-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Manganese	150		0.96	0.066	mg/Kg	1	☼	6010B	Total/NA
Molybdenum	0.41	J	2.5	0.10	mg/Kg	1	☼	6010B	Total/NA
Hg	0.12	J	0.13	0.051	mg/Kg	1	☼	7470A	Total/NA

Client Sample ID: AP-2019-3 (18-19) Lab Sample ID: 140-15490-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Aluminum	14	J	50	8.0	mg/Kg	4	☼	6010B SEP	Step 1
Cobalt	0.87	J	13	0.23	mg/Kg	4	☼	6010B SEP	Step 1
Iron	15	J	25	15	mg/Kg	4	☼	6010B SEP	Step 1
Manganese	1.2	J	3.8	0.16	mg/Kg	4	☼	6010B SEP	Step 1
Selenium	0.68	J B	1.9	0.64	mg/Kg	3	☼	6010B SEP	Step 2
Aluminum	30		13	2.6	mg/Kg	1	☼	6010B SEP	Step 3
Barium	2.3	J B	3.1	0.15	mg/Kg	1	☼	6010B SEP	Step 3
Beryllium	0.025	J	0.31	0.019	mg/Kg	1	☼	6010B SEP	Step 3
Iron	57		6.3	3.6	mg/Kg	1	☼	6010B SEP	Step 3
Manganese	0.11	J B	0.94	0.034	mg/Kg	1	☼	6010B SEP	Step 3
Selenium	0.23	J B	0.63	0.21	mg/Kg	1	☼	6010B SEP	Step 3
Aluminum	880		13	2.0	mg/Kg	1	☼	6010B SEP	Step 4
Arsenic	0.63	B	0.63	0.28	mg/Kg	1	☼	6010B SEP	Step 4
Barium	6.9		3.1	0.15	mg/Kg	1	☼	6010B SEP	Step 4
Beryllium	0.069	J	0.31	0.020	mg/Kg	1	☼	6010B SEP	Step 4
Cobalt	0.53	J	3.1	0.066	mg/Kg	1	☼	6010B SEP	Step 4
Iron	2300		6.3	3.6	mg/Kg	1	☼	6010B SEP	Step 4
Li	0.53	J	3.1	0.19	mg/Kg	1	☼	6010B SEP	Step 4
Manganese	4.2		0.94	0.16	mg/Kg	1	☼	6010B SEP	Step 4
Selenium	0.65	B *	0.63	0.59	mg/Kg	1	☼	6010B SEP	Step 4
Aluminum	120	J *	190	29	mg/Kg	5	☼	6010B SEP	Step 5
Aluminum	1200		13	2.0	mg/Kg	1	☼	6010B SEP	Step 6
Arsenic	0.24	J	0.63	0.19	mg/Kg	1	☼	6010B SEP	Step 6
Barium	2.1	J	3.1	0.15	mg/Kg	1	☼	6010B SEP	Step 6
Beryllium	0.026	J	0.31	0.015	mg/Kg	1	☼	6010B SEP	Step 6
Cobalt	0.28	J	3.1	0.058	mg/Kg	1	☼	6010B SEP	Step 6
Iron	820		6.3	3.6	mg/Kg	1	☼	6010B SEP	Step 6
Li	0.62	J	3.1	0.19	mg/Kg	1	☼	6010B SEP	Step 6
Manganese	2.9		0.94	0.31	mg/Kg	1	☼	6010B SEP	Step 6
Aluminum	12000		130	20	mg/Kg	10	☼	6010B SEP	Step 7
Arsenic	0.79	J	1.3	0.33	mg/Kg	2	☼	6010B SEP	Step 7
Barium	180		31	1.5	mg/Kg	10	☼	6010B SEP	Step 7
Beryllium	0.11	J	0.31	0.0094	mg/Kg	1	☼	6010B SEP	Step 7
Iron	2000		6.3	5.1	mg/Kg	1	☼	6010B SEP	Step 7
Li	6.0		3.1	0.19	mg/Kg	1	☼	6010B SEP	Step 7
Manganese	26		0.94	0.065	mg/Kg	1	☼	6010B SEP	Step 7
Mo	0.12	J	2.5	0.10	mg/Kg	1	☼	6010B SEP	Step 7
Aluminum	14000		10	1.6	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Arsenic	1.7		0.50	0.13	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Barium	190		2.5	0.12	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Beryllium	0.23	J	0.25	0.0075	mg/Kg	1		6010B SEP	Sum of Steps 1-7

This Detection Summary does not include radiochemical test results.

1 2 3 4 5 6 7 8 9 10 11 12 13

Client Sample ID: AP-2019-3 (18-19) (Continued) Lab Sample ID: 140-15490-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Cobalt	1.7	J	2.5	0.023	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Iron	5200		5.0	4.1	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Li	7.2		2.5	0.15	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Manganese	35		0.75	0.052	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Mo	0.12	J	2.0	0.082	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Selenium	1.6		0.50	0.17	mg/Kg	1		6010B SEP	Sum of Steps 1-7
Chromium	4.4		1.8	0.26	mg/Kg	1	☼	6010B	Total/NA
Lead	3.9		1.8	0.33	mg/Kg	1	☼	6010B	Total/NA
Aluminum	20000		130	20	mg/Kg	10	☼	6010B	Total/NA
Arsenic	2.9	J	3.1	0.81	mg/Kg	5	☼	6010B	Total/NA
Barium	240		31	1.5	mg/Kg	10	☼	6010B	Total/NA
Beryllium	0.42		0.31	0.0094	mg/Kg	1	☼	6010B	Total/NA
Cobalt	3.3	J	16	0.94	mg/Kg	5	☼	6010B	Total/NA
Iron	8000		6.3	5.1	mg/Kg	1	☼	6010B	Total/NA
Lithium	9.6		3.1	0.19	mg/Kg	1	☼	6010B	Total/NA
Manganese	47		0.94	0.065	mg/Kg	1	☼	6010B	Total/NA
Molybdenum	0.28	J	2.5	0.10	mg/Kg	1	☼	6010B	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample Results

Client: Golder Associates Inc.
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Job ID: 140-15490-1

Client Sample ID: AP-2019-1 (30-31)

Date Collected: 06/03/19 11:36
Date Received: 06/05/19 09:20

Lab Sample ID: 140-15490-1

Matrix: Solid
Percent Solids: 76.0

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		53	8.4	mg/Kg	☼	06/29/19 08:00	07/11/19 12:49	4
Antimony	ND		16	1.5	mg/Kg	☼	06/29/19 08:00	07/11/19 12:49	4
Arsenic	ND		2.6	0.68	mg/Kg	☼	06/29/19 08:00	07/11/19 12:49	4
Barium	**0.88**	**J**	13	0.63	mg/Kg	☼	06/29/19 08:00	07/11/19 12:49	4
Beryllium	ND		1.3	0.41	mg/Kg	☼	06/29/19 08:00	07/11/19 12:49	4
Cobalt	**0.54**	**J**	13	0.24	mg/Kg	☼	06/29/19 08:00	07/11/19 12:49	4
Iron	ND		26	15	mg/Kg	☼	06/29/19 08:00	07/11/19 12:49	4
Li	ND		13	0.79	mg/Kg	☼	06/29/19 08:00	07/11/19 12:49	4
Manganese	**3.1**	**J**	3.9	0.16	mg/Kg	☼	06/29/19 08:00	07/11/19 12:49	4
Mo	ND		11	0.43	mg/Kg	☼	06/29/19 08:00	07/11/19 12:49	4
Selenium	ND		2.6	0.89	mg/Kg	☼	06/29/19 08:00	07/11/19 12:49	4
Thallium	ND		9.2	1.1	mg/Kg	☼	06/29/19 08:00	07/11/19 12:49	4

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**9.7**	**J ***	39	6.3	mg/Kg	☼	06/30/19 08:00	07/11/19 14:21	3
Antimony	ND		12	1.1	mg/Kg	☼	06/30/19 08:00	07/11/19 14:21	3
Arsenic	ND		2.0	0.51	mg/Kg	☼	06/30/19 08:00	07/11/19 14:21	3
Barium	**0.76**	**J ***	9.9	0.47	mg/Kg	☼	06/30/19 08:00	07/11/19 14:21	3
Beryllium	ND	*	0.99	0.063	mg/Kg	☼	06/30/19 08:00	07/11/19 14:21	3
Cobalt	ND		9.9	0.25	mg/Kg	☼	06/30/19 08:00	07/11/19 14:21	3
Iron	ND	*	20	11	mg/Kg	☼	06/30/19 08:00	07/11/19 14:21	3
Li	ND		9.9	0.59	mg/Kg	☼	06/30/19 08:00	07/11/19 14:21	3
Manganese	ND		3.0	1.1	mg/Kg	☼	06/30/19 08:00	07/11/19 14:21	3
Mo	ND		7.9	0.32	mg/Kg	☼	06/30/19 08:00	07/11/19 14:21	3
Selenium	**0.76**	**J B**	2.0	0.67	mg/Kg	☼	06/30/19 08:00	07/11/19 14:21	3
Thallium	ND		6.9	0.83	mg/Kg	☼	06/30/19 08:00	07/11/19 14:21	3

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**88**		13	2.8	mg/Kg	☼	07/02/19 08:00	07/11/19 16:06	1
Antimony	ND		3.9	0.37	mg/Kg	☼	07/02/19 08:00	07/11/19 16:06	1
Arsenic	**1.8**		0.66	0.17	mg/Kg	☼	07/02/19 08:00	07/11/19 16:06	1
Barium	**4.3**	**B**	3.3	0.16	mg/Kg	☼	07/02/19 08:00	07/11/19 16:06	1
Beryllium	**0.067**	**J**	0.33	0.020	mg/Kg	☼	07/02/19 08:00	07/11/19 16:06	1
Cobalt	**0.34**	**J**	3.3	0.059	mg/Kg	☼	07/02/19 08:00	07/11/19 16:06	1
Iron	**580**		6.6	3.8	mg/Kg	☼	07/02/19 08:00	07/11/19 16:06	1
Li	ND		3.3	0.20	mg/Kg	☼	07/02/19 08:00	07/11/19 16:06	1
Manganese	**2.4**	**B**	0.99	0.036	mg/Kg	☼	07/02/19 08:00	07/11/19 16:06	1
Mo	ND		2.6	0.11	mg/Kg	☼	07/02/19 08:00	07/11/19 16:06	1
Selenium	**0.22**	**J B**	0.66	0.22	mg/Kg	☼	07/02/19 08:00	07/11/19 16:06	1
Thallium	ND		2.3	0.28	mg/Kg	☼	07/02/19 08:00	07/11/19 16:06	1

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**1700**		13	2.1	mg/Kg	☼	07/03/19 08:00	07/11/19 17:49	1
Antimony	ND		3.9	0.59	mg/Kg	☼	07/03/19 08:00	07/11/19 17:49	1
Arsenic	**2.8**	**B**	0.66	0.29	mg/Kg	☼	07/03/19 08:00	07/11/19 17:49	1
Barium	**16**		3.3	0.16	mg/Kg	☼	07/03/19 08:00	07/11/19 17:49	1
Beryllium	**0.13**	**J**	0.33	0.021	mg/Kg	☼	07/03/19 08:00	07/11/19 17:49	1

Client Sample Results

Client: Golder Associates Inc. Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Client Sample ID: AP-2019-1 (30-31) Lab Sample ID: 140-15490-1

Date Collected: 06/03/19 11:36 **Matrix: Solid**
Date Received: 06/05/19 09:20 **Percent Solids: 76.0**

Method: 6010B SEP - SEP Metals (ICP) - Step 4 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cobalt	**1.5**	**J**	3.3	0.070	mg/Kg	☼	07/03/19 08:00	07/11/19 17:49	1
Iron	**3900**		6.6	3.8	mg/Kg	☼	07/03/19 08:00	07/11/19 17:49	1
Li	**3.0**	**J**	3.3	0.20	mg/Kg	☼	07/03/19 08:00	07/11/19 17:49	1
Manganese	**18**		0.99	0.17	mg/Kg	☼	07/03/19 08:00	07/11/19 17:49	1
Mo	ND		2.6	0.11	mg/Kg	☼	07/03/19 08:00	07/11/19 17:49	1
Selenium	ND	*	0.66	0.62	mg/Kg	☼	07/03/19 08:00	07/11/19 17:49	1
Thallium	ND		2.3	0.38	mg/Kg	☼	07/03/19 08:00	07/11/19 17:49	1

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**62**	**J ***	200	31	mg/Kg	☼	07/10/19 08:00	07/12/19 11:54	5
Antimony	ND		59	5.5	mg/Kg	☼	07/10/19 08:00	07/12/19 11:54	5
Arsenic	ND		9.9	2.5	mg/Kg	☼	07/10/19 08:00	07/12/19 11:54	5
Barium	**7.0**	**J ***	49	2.4	mg/Kg	☼	07/10/19 08:00	07/12/19 11:54	5
Beryllium	ND	*	4.9	0.41	mg/Kg	☼	07/10/19 08:00	07/12/19 11:54	5
Cobalt	ND	*	49	0.79	mg/Kg	☼	07/10/19 08:00	07/12/19 11:54	5
Iron	ND	*	99	58	mg/Kg	☼	07/10/19 08:00	07/12/19 11:54	5
Li	ND		49	2.9	mg/Kg	☼	07/10/19 08:00	07/12/19 11:54	5
Manganese	ND	*	15	2.4	mg/Kg	☼	07/10/19 08:00	07/12/19 11:54	5
Mo	ND		39	1.6	mg/Kg	☼	07/10/19 08:00	07/12/19 11:54	5
Selenium	ND		9.9	3.4	mg/Kg	☼	07/10/19 08:00	07/12/19 11:54	5
Thallium	ND	*	35	4.6	mg/Kg	☼	07/10/19 08:00	07/12/19 11:54	5

Method: 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**2300**		13	2.1	mg/Kg	☼	07/10/19 08:00	07/12/19 13:29	1
Antimony	ND		3.9	0.37	mg/Kg	☼	07/10/19 08:00	07/12/19 13:29	1
Arsenic	**0.94**		0.66	0.20	mg/Kg	☼	07/10/19 08:00	07/12/19 13:29	1
Barium	**18**		3.3	0.16	mg/Kg	☼	07/10/19 08:00	07/12/19 13:29	1
Beryllium	**0.067**	**J**	0.33	0.016	mg/Kg	☼	07/10/19 08:00	07/12/19 13:29	1
Cobalt	**0.90**	**J**	3.3	0.061	mg/Kg	☼	07/10/19 08:00	07/12/19 13:29	1
Iron	**2500**		6.6	3.8	mg/Kg	☼	07/10/19 08:00	07/12/19 13:29	1
Li	**2.1**	**J**	3.3	0.20	mg/Kg	☼	07/10/19 08:00	07/12/19 13:29	1
Manganese	**16**		0.99	0.33	mg/Kg	☼	07/10/19 08:00	07/12/19 13:29	1
Mo	ND		2.6	0.13	mg/Kg	☼	07/10/19 08:00	07/12/19 13:29	1
Selenium	ND		0.66	0.22	mg/Kg	☼	07/10/19 08:00	07/12/19 13:29	1
Thallium	ND		2.3	0.28	mg/Kg	☼	07/10/19 08:00	07/12/19 13:29	1

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**29000**		130	21	mg/Kg	☼	07/12/19 09:08	07/15/19 13:08	10
Antimony	ND		3.9	0.18	mg/Kg	☼	07/12/19 09:08	07/15/19 11:39	1
Arsenic	**1.2**		0.66	0.17	mg/Kg	☼	07/12/19 09:08	07/15/19 11:39	1
Barium	**390**		33	1.6	mg/Kg	☼	07/12/19 09:08	07/15/19 13:08	10
Beryllium	**0.56**		0.33	0.0099	mg/Kg	☼	07/12/19 09:08	07/15/19 11:39	1
Cobalt	**0.79**	**J**	6.6	0.39	mg/Kg	☼	07/12/19 09:08	07/15/19 17:11	2
Iron	**5200**		6.6	5.4	mg/Kg	☼	07/12/19 09:08	07/15/19 11:39	1
Li	**9.6**		3.3	0.20	mg/Kg	☼	07/12/19 09:08	07/15/19 11:39	1
Manganese	**26**		0.99	0.068	mg/Kg	☼	07/12/19 09:08	07/15/19 11:39	1
Mo	**0.19**	**J**	2.6	0.11	mg/Kg	☼	07/12/19 09:08	07/15/19 11:39	1

Client Sample Results

Client: Golder Associates Inc.
Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Client Sample ID: AP-2019-1 (30-31)

Lab Sample ID: 140-15490-1

Date Collected: 06/03/19 11:36
Matrix: Solid
Date Received: 06/05/19 09:20
Percent Solids: 76.0

Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		0.66	0.22	mg/Kg	☼	07/12/19 09:08	07/15/19 11:39	1
Thallium	**0.48**	**J**	4.6	0.47	mg/Kg	☼	07/12/19 09:08	07/15/19 17:11	2

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**33000**		10	1.6	mg/Kg			07/16/19 17:31	1
Antimony	ND		3.0	0.14	mg/Kg			07/16/19 17:31	1
Arsenic	**6.9**		0.50	0.13	mg/Kg			07/16/19 17:31	1
Barium	**440**		2.5	0.12	mg/Kg			07/16/19 17:31	1
Beryllium	**0.83**		0.25	0.0075	mg/Kg			07/16/19 17:31	1
Cobalt	**4.0**		2.5	0.023	mg/Kg			07/16/19 17:31	1
Iron	**12000**		5.0	4.1	mg/Kg			07/16/19 17:31	1
Li	**15**		2.5	0.15	mg/Kg			07/16/19 17:31	1
Manganese	**66**		0.75	0.052	mg/Kg			07/16/19 17:31	1
Mo	**0.19**	**J**	2.0	0.082	mg/Kg			07/16/19 17:31	1
Selenium	**0.98**		0.50	0.17	mg/Kg			07/16/19 17:31	1
Thallium	**0.48**	**J**	1.8	0.18	mg/Kg			07/16/19 17:31	1

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	ND		25	12	mg/Kg	☼	06/26/19 08:00	07/10/19 12:59	1
Chromium	**13**	**F1**	1.8	0.27	mg/Kg	☼	06/26/19 08:00	07/10/19 12:59	1
Lead	**6.4**		1.8	0.34	mg/Kg	☼	06/26/19 08:00	07/10/19 12:59	1

Method: 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**60000**		130	21	mg/Kg	☼	06/11/19 08:00	07/15/19 15:45	10
Antimony	ND		3.9	0.18	mg/Kg	☼	06/11/19 08:00	07/15/19 14:24	1
Arsenic	**6.8**		0.66	0.17	mg/Kg	☼	06/11/19 08:00	07/15/19 14:24	1
Barium	**680**		33	1.6	mg/Kg	☼	06/11/19 08:00	07/15/19 15:45	10
Beryllium	**0.89**		0.33	0.0099	mg/Kg	☼	06/11/19 08:00	07/15/19 14:24	1
Cobalt	**3.8**	**J**	6.6	0.39	mg/Kg	☼	06/11/19 08:00	07/15/19 18:28	2
Iron	**11000**		6.6	5.4	mg/Kg	☼	06/11/19 08:00	07/15/19 14:24	1
Lithium	**18**		3.3	0.20	mg/Kg	☼	06/11/19 08:00	07/15/19 14:24	1
Manganese	**66**		0.99	0.068	mg/Kg	☼	06/11/19 08:00	07/15/19 14:24	1
Molybdenum	**0.40**	**J**	2.6	0.11	mg/Kg	☼	06/11/19 08:00	07/15/19 14:24	1
Selenium	ND		0.66	0.22	mg/Kg	☼	06/11/19 08:00	07/15/19 14:24	1
Thallium	ND		4.6	0.47	mg/Kg	☼	06/11/19 08:00	07/15/19 18:28	2

Method: 7470A - SEP Mercury (CVAA) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hg	**0.081**	**J**	0.13	0.053	mg/Kg	☼	06/11/19 08:00	06/16/19 14:04	1

Client Sample Results

Client Sample ID: AP-2019-2 (35-36)
Lab Sample ID: 140-15490-2
Date Collected: 06/03/19 13:20
Matrix: Solid
Date Received: 06/05/19 09:20
Percent Solids: 78.5

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**19**	**J**	51	8.2	mg/Kg	☼	06/29/19 08:00	07/11/19 12:59	4
Antimony	ND		15	1.4	mg/Kg	☼	06/29/19 08:00	07/11/19 12:59	4
Arsenic	ND		2.5	0.66	mg/Kg	☼	06/29/19 08:00	07/11/19 12:59	4
Barium	**0.88**	**J**	13	0.61	mg/Kg	☼	06/29/19 08:00	07/11/19 12:59	4
Beryllium	ND		1.3	0.39	mg/Kg	☼	06/29/19 08:00	07/11/19 12:59	4
Cobalt	**1.6**	**J**	13	0.23	mg/Kg	☼	06/29/19 08:00	07/11/19 12:59	4
Iron	**23**	**J**	25	15	mg/Kg	☼	06/29/19 08:00	07/11/19 12:59	4
Li	ND		13	0.76	mg/Kg	☼	06/29/19 08:00	07/11/19 12:59	4
Manganese	**33**		3.8	0.16	mg/Kg	☼	06/29/19 08:00	07/11/19 12:59	4
Mo	ND		10	0.42	mg/Kg	☼	06/29/19 08:00	07/11/19 12:59	4
Selenium	ND		2.5	0.87	mg/Kg	☼	06/29/19 08:00	07/11/19 12:59	4
Thallium	ND		8.9	1.1	mg/Kg	☼	06/29/19 08:00	07/11/19 12:59	4

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**18**	**J ***	38	6.1	mg/Kg	☼	06/30/19 08:00	07/11/19 14:42	3
Antimony	ND		11	1.1	mg/Kg	☼	06/30/19 08:00	07/11/19 14:42	3
Arsenic	ND		1.9	0.50	mg/Kg	☼	06/30/19 08:00	07/11/19 14:42	3
Barium	**0.67**	**J ***	9.6	0.46	mg/Kg	☼	06/30/19 08:00	07/11/19 14:42	3
Beryllium	ND	*	0.96	0.061	mg/Kg	☼	06/30/19 08:00	07/11/19 14:42	3
Cobalt	**0.27**	**J**	9.6	0.24	mg/Kg	☼	06/30/19 08:00	07/11/19 14:42	3
Iron	**110**	*****	19	11	mg/Kg	☼	06/30/19 08:00	07/11/19 14:42	3
Li	ND		9.6	0.57	mg/Kg	☼	06/30/19 08:00	07/11/19 14:42	3
Manganese	**4.2**		2.9	1.1	mg/Kg	☼	06/30/19 08:00	07/11/19 14:42	3
Mo	ND		7.6	0.31	mg/Kg	☼	06/30/19 08:00	07/11/19 14:42	3
Selenium	**0.90**	**J B**	1.9	0.65	mg/Kg	☼	06/30/19 08:00	07/11/19 14:42	3
Thallium	ND		6.7	0.80	mg/Kg	☼	06/30/19 08:00	07/11/19 14:42	3

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**97**		13	2.7	mg/Kg	☼	07/02/19 08:00	07/11/19 16:16	1
Antimony	ND		3.8	0.36	mg/Kg	☼	07/02/19 08:00	07/11/19 16:16	1
Arsenic	**0.97**		0.64	0.17	mg/Kg	☼	07/02/19 08:00	07/11/19 16:16	1
Barium	**4.1**	**B**	3.2	0.15	mg/Kg	☼	07/02/19 08:00	07/11/19 16:16	1
Beryllium	**0.028**	**J**	0.32	0.019	mg/Kg	☼	07/02/19 08:00	07/11/19 16:16	1
Cobalt	**0.17**	**J**	3.2	0.057	mg/Kg	☼	07/02/19 08:00	07/11/19 16:16	1
Iron	**1100**		6.4	3.7	mg/Kg	☼	07/02/19 08:00	07/11/19 16:16	1
Li	ND		3.2	0.19	mg/Kg	☼	07/02/19 08:00	07/11/19 16:16	1
Manganese	**1.5**	**B**	0.96	0.034	mg/Kg	☼	07/02/19 08:00	07/11/19 16:16	1
Mo	ND		2.5	0.10	mg/Kg	☼	07/02/19 08:00	07/11/19 16:16	1
Selenium	ND		0.64	0.22	mg/Kg	☼	07/02/19 08:00	07/11/19 16:16	1
Thallium	ND		2.2	0.27	mg/Kg	☼	07/02/19 08:00	07/11/19 16:16	1

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**1800**		13	2.0	mg/Kg	☼	07/03/19 08:00	07/11/19 17:59	1
Antimony	ND		3.8	0.57	mg/Kg	☼	07/03/19 08:00	07/11/19 17:59	1
Arsenic	**0.78**	**B**	0.64	0.28	mg/Kg	☼	07/03/19 08:00	07/11/19 17:59	1
Barium	**23**		3.2	0.15	mg/Kg	☼	07/03/19 08:00	07/11/19 17:59	1
Beryllium	**0.078**	**J**	0.32	0.020	mg/Kg	☼	07/03/19 08:00	07/11/19 17:59	1

Client Sample Results

Client Sample ID: AP-2019-2 (35-36)

Lab Sample ID: 140-15490-2

Date Collected: 06/03/19 13:20
Date Received: 06/05/19 09:20

Matrix: Solid
Percent Solids: 78.5

Method: 6010B SEP - SEP Metals (ICP) - Step 4 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cobalt	**1.5**	**J**	3.2	0.068	mg/Kg	☼	07/03/19 08:00	07/11/19 17:59	1
Iron	**3800**		6.4	3.7	mg/Kg	☼	07/03/19 08:00	07/11/19 17:59	1
Li	**4.2**		3.2	0.19	mg/Kg	☼	07/03/19 08:00	07/11/19 17:59	1
Manganese	**31**		0.96	0.17	mg/Kg	☼	07/03/19 08:00	07/11/19 17:59	1
Mo	ND		2.5	0.10	mg/Kg	☼	07/03/19 08:00	07/11/19 17:59	1
Selenium	ND	*	0.64	0.60	mg/Kg	☼	07/03/19 08:00	07/11/19 17:59	1
Thallium	ND		2.2	0.37	mg/Kg	☼	07/03/19 08:00	07/11/19 17:59	1

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**55**	**J ***	190	30	mg/Kg	☼	07/10/19 08:00	07/12/19 12:05	5
Antimony	ND		57	5.4	mg/Kg	☼	07/10/19 08:00	07/12/19 12:05	5
Arsenic	ND		9.6	2.4	mg/Kg	☼	07/10/19 08:00	07/12/19 12:05	5
Barium	**11**	**J ***	48	2.3	mg/Kg	☼	07/10/19 08:00	07/12/19 12:05	5
Beryllium	ND	*	4.8	0.40	mg/Kg	☼	07/10/19 08:00	07/12/19 12:05	5
Cobalt	**0.85**	**J ***	48	0.76	mg/Kg	☼	07/10/19 08:00	07/12/19 12:05	5
Iron	ND	*	96	56	mg/Kg	☼	07/10/19 08:00	07/12/19 12:05	5
Li	ND		48	2.8	mg/Kg	☼	07/10/19 08:00	07/12/19 12:05	5
Manganese	**3.9**	**J ***	14	2.4	mg/Kg	☼	07/10/19 08:00	07/12/19 12:05	5
Mo	ND		38	1.6	mg/Kg	☼	07/10/19 08:00	07/12/19 12:05	5
Selenium	ND		9.6	3.3	mg/Kg	☼	07/10/19 08:00	07/12/19 12:05	5
Thallium	ND	*	33	4.5	mg/Kg	☼	07/10/19 08:00	07/12/19 12:05	5

Method: 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**2000**		13	2.0	mg/Kg	☼	07/10/19 08:00	07/12/19 13:49	1
Antimony	ND		3.8	0.36	mg/Kg	☼	07/10/19 08:00	07/12/19 13:49	1
Arsenic	**0.74**		0.64	0.19	mg/Kg	☼	07/10/19 08:00	07/12/19 13:49	1
Barium	**16**		3.2	0.15	mg/Kg	☼	07/10/19 08:00	07/12/19 13:49	1
Beryllium	**0.061**	**J**	0.32	0.015	mg/Kg	☼	07/10/19 08:00	07/12/19 13:49	1
Cobalt	**0.80**	**J**	3.2	0.059	mg/Kg	☼	07/10/19 08:00	07/12/19 13:49	1
Iron	**3300**		6.4	3.7	mg/Kg	☼	07/10/19 08:00	07/12/19 13:49	1
Li	**2.1**	**J**	3.2	0.19	mg/Kg	☼	07/10/19 08:00	07/12/19 13:49	1
Manganese	**19**		0.96	0.32	mg/Kg	☼	07/10/19 08:00	07/12/19 13:49	1
Mo	ND		2.5	0.13	mg/Kg	☼	07/10/19 08:00	07/12/19 13:49	1
Selenium	ND		0.64	0.22	mg/Kg	☼	07/10/19 08:00	07/12/19 13:49	1
Thallium	ND		2.2	0.27	mg/Kg	☼	07/10/19 08:00	07/12/19 13:49	1

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**26000**		130	20	mg/Kg	☼	07/12/19 09:08	07/15/19 13:19	10
Antimony	ND		3.8	0.18	mg/Kg	☼	07/12/19 09:08	07/15/19 12:05	1
Arsenic	**0.71**		0.64	0.17	mg/Kg	☼	07/12/19 09:08	07/15/19 12:05	1
Barium	**330**		32	1.5	mg/Kg	☼	07/12/19 09:08	07/15/19 13:19	10
Beryllium	**0.51**		0.32	0.0096	mg/Kg	☼	07/12/19 09:08	07/15/19 12:05	1
Cobalt	**1.1**	**J**	6.4	0.38	mg/Kg	☼	07/12/19 09:08	07/15/19 17:21	2
Iron	**5600**		6.4	5.2	mg/Kg	☼	07/12/19 09:08	07/15/19 12:05	1
Li	**11**		3.2	0.19	mg/Kg	☼	07/12/19 09:08	07/15/19 12:05	1
Manganese	**34**		0.96	0.066	mg/Kg	☼	07/12/19 09:08	07/15/19 12:05	1
Mo	**0.17**	**J**	2.5	0.10	mg/Kg	☼	07/12/19 09:08	07/15/19 12:05	1

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Client Sample ID: AP-2019-2 (35-36)

Lab Sample ID: 140-15490-2

Date Collected: 06/03/19 13:20
Matrix: Solid
Date Received: 06/05/19 09:20
Percent Solids: 78.5

Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		0.64	0.22	mg/Kg	☼	07/12/19 09:08	07/15/19 12:05	1
Thallium	**0.70**	**J**	4.5	0.46	mg/Kg	☼	07/12/19 09:08	07/15/19 17:21	2

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**30000**		10	1.6	mg/Kg			07/16/19 17:31	1
Antimony	ND		3.0	0.14	mg/Kg			07/16/19 17:31	1
Arsenic	**3.2**		0.50	0.13	mg/Kg			07/16/19 17:31	1
Barium	**390**		2.5	0.12	mg/Kg			07/16/19 17:31	1
Beryllium	**0.68**		0.25	0.0075	mg/Kg			07/16/19 17:31	1
Cobalt	**6.3**		2.5	0.023	mg/Kg			07/16/19 17:31	1
Iron	**14000**		5.0	4.1	mg/Kg			07/16/19 17:31	1
Li	**18**		2.5	0.15	mg/Kg			07/16/19 17:31	1
Manganese	**130**		0.75	0.052	mg/Kg			07/16/19 17:31	1
Mo	**0.17**	**J**	2.0	0.082	mg/Kg			07/16/19 17:31	1
Selenium	**0.90**		0.50	0.17	mg/Kg			07/16/19 17:31	1
Thallium	**0.70**	**J**	1.8	0.18	mg/Kg			07/16/19 17:31	1

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	ND		24	12	mg/Kg	☼	06/26/19 08:00	07/10/19 13:13	1
Chromium	**12**		1.8	0.27	mg/Kg	☼	06/26/19 08:00	07/10/19 13:13	1
Lead	**6.2**		1.8	0.34	mg/Kg	☼	06/26/19 08:00	07/10/19 13:13	1

Method: 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**62000**		130	20	mg/Kg	☼	06/11/19 08:00	07/15/19 16:10	10
Antimony	ND		3.8	0.18	mg/Kg	☼	06/11/19 08:00	07/15/19 14:36	1
Arsenic	**3.0**		0.64	0.17	mg/Kg	☼	06/11/19 08:00	07/15/19 14:36	1
Barium	**560**		32	1.5	mg/Kg	☼	06/11/19 08:00	07/15/19 16:10	10
Beryllium	**0.72**		0.32	0.0096	mg/Kg	☼	06/11/19 08:00	07/15/19 14:36	1
Cobalt	**6.2**	**J**	16	0.96	mg/Kg	☼	06/11/19 08:00	07/15/19 18:38	5
Iron	**13000**		6.4	5.2	mg/Kg	☼	06/11/19 08:00	07/15/19 14:36	1
Lithium	**26**		3.2	0.19	mg/Kg	☼	06/11/19 08:00	07/15/19 14:36	1
Manganese	**150**		0.96	0.066	mg/Kg	☼	06/11/19 08:00	07/15/19 14:36	1
Molybdenum	**0.41**	**J**	2.5	0.10	mg/Kg	☼	06/11/19 08:00	07/15/19 14:36	1
Selenium	ND		0.64	0.22	mg/Kg	☼	06/11/19 08:00	07/15/19 14:36	1
Thallium	ND		11	1.1	mg/Kg	☼	06/11/19 08:00	07/15/19 18:38	5

Method: 7470A - SEP Mercury (CVAA) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hg	**0.12**	**J**	0.13	0.051	mg/Kg	☼	06/11/19 08:00	06/16/19 14:09	1

Client Sample Results

Client: Golder Associates Inc. Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Client Sample ID: AP-2019-3 (18-19)

Lab Sample ID: 140-15490-3
Date Collected: 06/03/19 15:20
Matrix: Solid
Date Received: 06/05/19 09:20
Percent Solids: 80.0

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**14**	**J**	50	8.0	mg/Kg	☼	06/29/19 08:00	07/11/19 13:04	4
Antimony	ND		15	1.4	mg/Kg	☼	06/29/19 08:00	07/11/19 13:04	4
Arsenic	ND		2.5	0.65	mg/Kg	☼	06/29/19 08:00	07/11/19 13:04	4
Barium	ND		13	0.60	mg/Kg	☼	06/29/19 08:00	07/11/19 13:04	4
Beryllium	ND		1.3	0.39	mg/Kg	☼	06/29/19 08:00	07/11/19 13:04	4
Cobalt	**0.87**	**J**	13	0.23	mg/Kg	☼	06/29/19 08:00	07/11/19 13:04	4
Iron	**15**	**J**	25	15	mg/Kg	☼	06/29/19 08:00	07/11/19 13:04	4
Li	ND		13	0.75	mg/Kg	☼	06/29/19 08:00	07/11/19 13:04	4
Manganese	**1.2**	**J**	3.8	0.16	mg/Kg	☼	06/29/19 08:00	07/11/19 13:04	4
Mo	ND		10	0.41	mg/Kg	☼	06/29/19 08:00	07/11/19 13:04	4
Selenium	ND		2.5	0.85	mg/Kg	☼	06/29/19 08:00	07/11/19 13:04	4
Thallium	ND		8.8	1.1	mg/Kg	☼	06/29/19 08:00	07/11/19 13:04	4

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND	*	38	6.0	mg/Kg	☼	06/30/19 08:00	07/11/19 14:47	3
Antimony	ND		11	1.1	mg/Kg	☼	06/30/19 08:00	07/11/19 14:47	3
Arsenic	ND		1.9	0.49	mg/Kg	☼	06/30/19 08:00	07/11/19 14:47	3
Barium	ND	*	9.4	0.45	mg/Kg	☼	06/30/19 08:00	07/11/19 14:47	3
Beryllium	ND	*	0.94	0.060	mg/Kg	☼	06/30/19 08:00	07/11/19 14:47	3
Cobalt	ND		9.4	0.24	mg/Kg	☼	06/30/19 08:00	07/11/19 14:47	3
Iron	ND	*	19	11	mg/Kg	☼	06/30/19 08:00	07/11/19 14:47	3
Li	ND		9.4	0.56	mg/Kg	☼	06/30/19 08:00	07/11/19 14:47	3
Manganese	ND		2.8	1.1	mg/Kg	☼	06/30/19 08:00	07/11/19 14:47	3
Mo	ND		7.5	0.31	mg/Kg	☼	06/30/19 08:00	07/11/19 14:47	3
Selenium	**0.68**	**J B**	1.9	0.64	mg/Kg	☼	06/30/19 08:00	07/11/19 14:47	3
Thallium	ND		6.6	0.79	mg/Kg	☼	06/30/19 08:00	07/11/19 14:47	3

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**30**		13	2.6	mg/Kg	☼	07/02/19 08:00	07/11/19 16:21	1
Antimony	ND		3.8	0.35	mg/Kg	☼	07/02/19 08:00	07/11/19 16:21	1
Arsenic	ND		0.63	0.16	mg/Kg	☼	07/02/19 08:00	07/11/19 16:21	1
Barium	**2.3**	**J B**	3.1	0.15	mg/Kg	☼	07/02/19 08:00	07/11/19 16:21	1
Beryllium	**0.025**	**J**	0.31	0.019	mg/Kg	☼	07/02/19 08:00	07/11/19 16:21	1
Cobalt	ND		3.1	0.056	mg/Kg	☼	07/02/19 08:00	07/11/19 16:21	1
Iron	**57**		6.3	3.6	mg/Kg	☼	07/02/19 08:00	07/11/19 16:21	1
Li	ND		3.1	0.19	mg/Kg	☼	07/02/19 08:00	07/11/19 16:21	1
Manganese	**0.11**	**J B**	0.94	0.034	mg/Kg	☼	07/02/19 08:00	07/11/19 16:21	1
Mo	ND		2.5	0.10	mg/Kg	☼	07/02/19 08:00	07/11/19 16:21	1
Selenium	**0.23**	**J B**	0.63	0.21	mg/Kg	☼	07/02/19 08:00	07/11/19 16:21	1
Thallium	ND		2.2	0.26	mg/Kg	☼	07/02/19 08:00	07/11/19 16:21	1

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**880**		13	2.0	mg/Kg	☼	07/03/19 08:00	07/11/19 18:04	1
Antimony	ND		3.8	0.56	mg/Kg	☼	07/03/19 08:00	07/11/19 18:04	1
Arsenic	**0.63**	**B**	0.63	0.28	mg/Kg	☼	07/03/19 08:00	07/11/19 18:04	1
Barium	**6.9**		3.1	0.15	mg/Kg	☼	07/03/19 08:00	07/11/19 18:04	1
Beryllium	**0.069**	**J**	0.31	0.020	mg/Kg	☼	07/03/19 08:00	07/11/19 18:04	1

Client Sample ID: AP-2019-3 (18-19)

Lab Sample ID: 140-15490-3
Date Collected: 06/03/19 15:20
Matrix: Solid
Date Received: 06/05/19 09:20
Percent Solids: 80.0

Method: 6010B SEP - SEP Metals (ICP) - Step 4 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cobalt	**0.53**	**J**	3.1	0.066	mg/Kg	☼	07/03/19 08:00	07/11/19 18:04	1
Iron	**2300**		6.3	3.6	mg/Kg	☼	07/03/19 08:00	07/11/19 18:04	1
Li	**0.53**	**J**	3.1	0.19	mg/Kg	☼	07/03/19 08:00	07/11/19 18:04	1
Manganese	**4.2**		0.94	0.16	mg/Kg	☼	07/03/19 08:00	07/11/19 18:04	1
Mo	ND		2.5	0.10	mg/Kg	☼	07/03/19 08:00	07/11/19 18:04	1
Selenium	**0.65**	**B ***	0.63	0.59	mg/Kg	☼	07/03/19 08:00	07/11/19 18:04	1
Thallium	ND		2.2	0.36	mg/Kg	☼	07/03/19 08:00	07/11/19 18:04	1

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**120**	**J ***	190	29	mg/Kg	☼	07/10/19 08:00	07/12/19 12:10	5
Antimony	ND		56	5.3	mg/Kg	☼	07/10/19 08:00	07/12/19 12:10	5
Arsenic	ND		9.4	2.4	mg/Kg	☼	07/10/19 08:00	07/12/19 12:10	5
Barium	ND	*	47	2.3	mg/Kg	☼	07/10/19 08:00	07/12/19 12:10	5
Beryllium	ND	*	4.7	0.39	mg/Kg	☼	07/10/19 08:00	07/12/19 12:10	5
Cobalt	ND	*	47	0.75	mg/Kg	☼	07/10/19 08:00	07/12/19 12:10	5
Iron	ND	*	94	55	mg/Kg	☼	07/10/19 08:00	07/12/19 12:10	5
Li	ND		47	2.8	mg/Kg	☼	07/10/19 08:00	07/12/19 12:10	5
Manganese	ND	*	14	2.3	mg/Kg	☼	07/10/19 08:00	07/12/19 12:10	5
Mo	ND		38	1.6	mg/Kg	☼	07/10/19 08:00	07/12/19 12:10	5
Selenium	ND		9.4	3.3	mg/Kg	☼	07/10/19 08:00	07/12/19 12:10	5
Thallium	ND	*	33	4.4	mg/Kg	☼	07/10/19 08:00	07/12/19 12:10	5

Method: 6010B SEP - SEP Metals (ICP) - Step 6

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**1200**		13	2.0	mg/Kg	☼	07/10/19 08:00	07/12/19 13:55	1
Antimony	ND		3.8	0.35	mg/Kg	☼	07/10/19 08:00	07/12/19 13:55	1
Arsenic	**0.24**	**J**	0.63	0.19	mg/Kg	☼	07/10/19 08:00	07/12/19 13:55	1
Barium	**2.1**	**J**	3.1	0.15	mg/Kg	☼	07/10/19 08:00	07/12/19 13:55	1
Beryllium	**0.026**	**J**	0.31	0.015	mg/Kg	☼	07/10/19 08:00	07/12/19 13:55	1
Cobalt	**0.28**	**J**	3.1	0.058	mg/Kg	☼	07/10/19 08:00	07/12/19 13:55	1
Iron	**820**		6.3	3.6	mg/Kg	☼	07/10/19 08:00	07/12/19 13:55	1
Li	**0.62**	**J**	3.1	0.19	mg/Kg	☼	07/10/19 08:00	07/12/19 13:55	1
Manganese	**2.9**		0.94	0.31	mg/Kg	☼	07/10/19 08:00	07/12/19 13:55	1
Mo	ND		2.5	0.12	mg/Kg	☼	07/10/19 08:00	07/12/19 13:55	1
Selenium	ND		0.63	0.21	mg/Kg	☼	07/10/19 08:00	07/12/19 13:55	1
Thallium	ND		2.2	0.26	mg/Kg	☼	07/10/19 08:00	07/12/19 13:55	1

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**12000**		130	20	mg/Kg	☼	07/12/19 09:08	07/15/19 13:24	10
Antimony	ND		3.8	0.18	mg/Kg	☼	07/12/19 09:08	07/15/19 12:11	1
Arsenic	**0.79**	**J**	1.3	0.33	mg/Kg	☼	07/12/19 09:08	07/15/19 17:27	2
Barium	**180**		31	1.5	mg/Kg	☼	07/12/19 09:08	07/15/19 13:24	10
Beryllium	**0.11**	**J**	0.31	0.0094	mg/Kg	☼	07/12/19 09:08	07/15/19 12:11	1
Cobalt	ND		6.3	0.38	mg/Kg	☼	07/12/19 09:08	07/15/19 17:27	2
Iron	**2000**		6.3	5.1	mg/Kg	☼	07/12/19 09:08	07/15/19 12:11	1
Li	**6.0**		3.1	0.19	mg/Kg	☼	07/12/19 09:08	07/15/19 12:11	1
Manganese	**26**		0.94	0.065	mg/Kg	☼	07/12/19 09:08	07/15/19 12:11	1
Mo	**0.12**	**J**	2.5	0.10	mg/Kg	☼	07/12/19 09:08	07/15/19 12:11	1

Client Sample Results

Client: Golder Associates Inc.
Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Client Sample ID: AP-2019-3 (18-19)

Lab Sample ID: 140-15490-3

Date Collected: 06/03/19 15:20
Matrix: Solid
Date Received: 06/05/19 09:20
Percent Solids: 80.0

Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Selenium	ND		1.3	0.43	mg/Kg	☼	07/12/19 09:08	07/15/19 17:27	2
Thallium	ND		4.4	0.45	mg/Kg	☼	07/12/19 09:08	07/15/19 17:27	2

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**14000**		10	1.6	mg/Kg			07/16/19 17:31	1
Antimony	ND		3.0	0.14	mg/Kg			07/16/19 17:31	1
Arsenic	**1.7**		0.50	0.13	mg/Kg			07/16/19 17:31	1
Barium	**190**		2.5	0.12	mg/Kg			07/16/19 17:31	1
Beryllium	**0.23**	**J**	0.25	0.0075	mg/Kg			07/16/19 17:31	1
Cobalt	**1.7**	**J**	2.5	0.023	mg/Kg			07/16/19 17:31	1
Iron	**5200**		5.0	4.1	mg/Kg			07/16/19 17:31	1
Li	**7.2**		2.5	0.15	mg/Kg			07/16/19 17:31	1
Manganese	**35**		0.75	0.052	mg/Kg			07/16/19 17:31	1
Mo	**0.12**	**J**	2.0	0.082	mg/Kg			07/16/19 17:31	1
Selenium	**1.6**		0.50	0.17	mg/Kg			07/16/19 17:31	1
Thallium	ND		1.8	0.18	mg/Kg			07/16/19 17:31	1

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	ND		24	12	mg/Kg	☼	06/26/19 08:00	07/10/19 13:18	1
Chromium	**4.4**		1.8	0.26	mg/Kg	☼	06/26/19 08:00	07/10/19 13:18	1
Lead	**3.9**		1.8	0.33	mg/Kg	☼	06/26/19 08:00	07/10/19 13:18	1

Method: 6010B - SEP Metals (ICP) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	**20000**		130	20	mg/Kg	☼	06/11/19 08:00	07/15/19 16:15	10
Antimony	ND		3.8	0.18	mg/Kg	☼	06/11/19 08:00	07/15/19 14:41	1
Arsenic	**2.9**	**J**	3.1	0.81	mg/Kg	☼	06/11/19 08:00	07/15/19 18:43	5
Barium	**240**		31	1.5	mg/Kg	☼	06/11/19 08:00	07/15/19 16:15	10
Beryllium	**0.42**		0.31	0.0094	mg/Kg	☼	06/11/19 08:00	07/15/19 14:41	1
Cobalt	**3.3**	**J**	16	0.94	mg/Kg	☼	06/11/19 08:00	07/15/19 18:43	5
Iron	**8000**		6.3	5.1	mg/Kg	☼	06/11/19 08:00	07/15/19 14:41	1
Lithium	**9.6**		3.1	0.19	mg/Kg	☼	06/11/19 08:00	07/15/19 14:41	1
Manganese	**47**		0.94	0.065	mg/Kg	☼	06/11/19 08:00	07/15/19 14:41	1
Molybdenum	**0.28**	**J**	2.5	0.10	mg/Kg	☼	06/11/19 08:00	07/15/19 14:41	1
Selenium	ND		3.1	1.1	mg/Kg	☼	06/11/19 08:00	07/15/19 18:43	5
Thallium	ND		11	1.1	mg/Kg	☼	06/11/19 08:00	07/15/19 18:43	5

Method: 7470A - SEP Mercury (CVAA) - Total

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hg	ND		0.13	0.050	mg/Kg	☼	06/11/19 08:00	06/16/19 14:17	1

Default Detection Limits

Client: Golder Associates Inc.
Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Method: 6010B SEP - SEP Metals (ICP) - Step 1

Prep: 3010A

SEP: Exchangeable

Analyte	RL	MDL	Units
Aluminum	10	1.6	mg/Kg
Antimony	3.0	0.28	mg/Kg
Arsenic	0.50	0.13	mg/Kg
Barium	2.5	0.12	mg/Kg
Beryllium	0.25	0.077	mg/Kg
Cobalt	2.5	0.045	mg/Kg
Iron	5.0	2.9	mg/Kg
Li	2.5	0.15	mg/Kg
Manganese	0.75	0.031	mg/Kg
Mo	2.0	0.082	mg/Kg
Selenium	0.50	0.17	mg/Kg
Thallium	1.8	0.21	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 2

Prep: 3010A

SEP: Carbonate

Analyte	RL	MDL	Units
Aluminum	10	1.6	mg/Kg
Antimony	3.0	0.28	mg/Kg
Arsenic	0.50	0.13	mg/Kg
Barium	2.5	0.12	mg/Kg
Beryllium	0.25	0.016	mg/Kg
Cobalt	2.5	0.063	mg/Kg
Iron	5.0	2.9	mg/Kg
Li	2.5	0.15	mg/Kg
Manganese	0.75	0.28	mg/Kg
Mo	2.0	0.082	mg/Kg
Selenium	0.50	0.17	mg/Kg
Thallium	1.8	0.21	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 3

Prep: 3010A

SEP: Non-Crystalline

Analyte	RL	MDL	Units
Aluminum	10	2.1	mg/Kg
Antimony	3.0	0.28	mg/Kg
Arsenic	0.50	0.13	mg/Kg
Barium	2.5	0.12	mg/Kg
Beryllium	0.25	0.015	mg/Kg
Cobalt	2.5	0.045	mg/Kg
Iron	5.0	2.9	mg/Kg
Li	2.5	0.15	mg/Kg
Manganese	0.75	0.027	mg/Kg
Mo	2.0	0.082	mg/Kg
Selenium	0.50	0.17	mg/Kg
Thallium	1.8	0.21	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Prep: 3010A

SEP: Metal Hydroxide

Method: 6010B SEP - SEP Metals (ICP) - Step 4

Prep: 3010A

SEP: Metal Hydroxide

Analyte	RL	MDL	Units
Aluminum	10	1.6	mg/Kg
Antimony	3.0	0.45	mg/Kg
Arsenic	0.50	0.22	mg/Kg
Barium	2.5	0.12	mg/Kg
Beryllium	0.25	0.016	mg/Kg
Cobalt	2.5	0.053	mg/Kg
Iron	5.0	2.9	mg/Kg
Li	2.5	0.15	mg/Kg
Manganese	0.75	0.13	mg/Kg
Mo	2.0	0.082	mg/Kg
Selenium	0.50	0.47	mg/Kg
Thallium	1.8	0.29	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 5

Prep: 3010A

SEP: Organic-Bound

Analyte	RL	MDL	Units
Aluminum	30	4.7	mg/Kg
Antimony	9.0	0.84	mg/Kg
Arsenic	1.5	0.38	mg/Kg
Barium	7.5	0.36	mg/Kg
Beryllium	0.75	0.063	mg/Kg
Cobalt	7.5	0.12	mg/Kg
Iron	15	8.8	mg/Kg
Li	7.5	0.44	mg/Kg
Manganese	2.3	0.37	mg/Kg
Mo	6.0	0.25	mg/Kg
Selenium	1.5	0.52	mg/Kg
Thallium	5.3	0.70	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 6

SEP: Acid/Sulfide

Analyte	RL	MDL	Units
Aluminum	10	1.6	mg/Kg
Antimony	3.0	0.28	mg/Kg
Arsenic	0.50	0.15	mg/Kg
Barium	2.5	0.12	mg/Kg
Beryllium	0.25	0.012	mg/Kg
Cobalt	2.5	0.046	mg/Kg
Iron	5.0	2.9	mg/Kg
Li	2.5	0.15	mg/Kg
Manganese	0.75	0.25	mg/Kg
Mo	2.0	0.099	mg/Kg
Selenium	0.50	0.17	mg/Kg
Thallium	1.8	0.21	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Step 7

Prep: Residual

Analyte	RL	MDL	Units
Aluminum	10	1.6	mg/Kg

Default Detection Limits

Method: 6010B SEP - SEP Metals (ICP) - Step 7 (Continued)

Prep: Residual

Analyte	RL	MDL	Units
Antimony	3.0	0.14	mg/Kg
Arsenic	0.50	0.13	mg/Kg
Barium	2.5	0.12	mg/Kg
Beryllium	0.25	0.0075	mg/Kg
Cobalt	2.5	0.15	mg/Kg
Iron	5.0	4.1	mg/Kg
Li	2.5	0.15	mg/Kg
Manganese	0.75	0.052	mg/Kg
Mo	2.0	0.082	mg/Kg
Selenium	0.50	0.17	mg/Kg
Thallium	1.8	0.18	mg/Kg

Method: 6010B SEP - SEP Metals (ICP) - Sum of Steps 1-7

Analyte	RL	MDL	Units
Aluminum	10	1.6	mg/Kg
Antimony	3.0	0.14	mg/Kg
Arsenic	0.50	0.13	mg/Kg
Barium	2.5	0.12	mg/Kg
Beryllium	0.25	0.0075	mg/Kg
Cobalt	2.5	0.023	mg/Kg
Iron	5.0	4.1	mg/Kg
Li	2.5	0.15	mg/Kg
Manganese	0.75	0.052	mg/Kg
Mo	2.0	0.082	mg/Kg
Selenium	0.50	0.17	mg/Kg
Thallium	1.8	0.18	mg/Kg

Method: 6010B - Metals (ICP)

Prep: 3050B

Analyte	RL	MDL	Units
Boron	20	10	mg/Kg
Chromium	1.5	0.22	mg/Kg
Lead	1.5	0.28	mg/Kg

Method: 6010B - SEP Metals (ICP) - Total

Prep: Total

Analyte	RL	MDL	Units
Aluminum	10	1.6	mg/Kg
Antimony	3.0	0.14	mg/Kg
Arsenic	0.50	0.13	mg/Kg
Barium	2.5	0.12	mg/Kg
Beryllium	0.25	0.0075	mg/Kg
Cobalt	2.5	0.15	mg/Kg
Iron	5.0	4.1	mg/Kg
Lithium	2.5	0.15	mg/Kg
Manganese	0.75	0.052	mg/Kg
Molybdenum	2.0	0.082	mg/Kg
Selenium	0.50	0.17	mg/Kg
Thallium	1.8	0.18	mg/Kg

Method: 7470A - SEP Mercury (CVAA) - Total

Default Detection Limits

Method: 7470A - SEP Mercury (CVAA) - Total

Prep: Total

Analyte	RL	MDL	Units
Hg	0.10	0.040	mg/Kg

Method: 6010B - Metals (ICP)

Lab Sample ID: MB 140-31128/14-A **Client Sample ID: Method Blank**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 31553 **Prep Batch: 31128**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	ND		20	10	mg/Kg		06/26/19 08:00	07/10/19 11:42	1
Chromium	ND		1.5	0.22	mg/Kg		06/26/19 08:00	07/10/19 11:42	1
Lead	ND		1.5	0.28	mg/Kg		06/26/19 08:00	07/10/19 11:42	1

Lab Sample ID: LCS 140-31128/15-A **Client Sample ID: Lab Control Sample**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 31553 **Prep Batch: 31128**

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Boron			100	101		mg/Kg		101	80 - 120		
Chromium			20.0	20.3		mg/Kg		101	90 - 110		
Lead			10.0	10.1		mg/Kg		101	90 - 110		

Lab Sample ID: 140-15490-1 MS **Client Sample ID: AP-2019-1 (30-31)**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 31553 **Prep Batch: 31128**

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits		
Boron	ND		124	124		mg/Kg	☼	100	75 - 125		
Chromium	13	F1	24.8	45.6	F1	mg/Kg	☼	131	75 - 125		
Lead	6.4		12.4	17.4		mg/Kg	☼	89	75 - 125		

Lab Sample ID: 140-15490-1 MSD **Client Sample ID: AP-2019-1 (30-31)**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 31553 **Prep Batch: 31128**

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Boron	ND		122	123		mg/Kg	☼	101	75 - 125	0	20
Chromium	13	F1	24.4	45.6	F1	mg/Kg	☼	133	75 - 125	0	20
Lead	6.4		12.2	17.5		mg/Kg	☼	91	75 - 125	0	20

Method: 6010B - SEP Metals (ICP) - Total

Lab Sample ID: MB 140-30683/13-A **Client Sample ID: Method Blank**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 31713 **Prep Batch: 30683**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		10	1.6	mg/Kg		06/11/19 08:00	07/15/19 11:13	1
Antimony	ND		3.0	0.14	mg/Kg		06/11/19 08:00	07/15/19 11:13	1
Arsenic	ND		0.50	0.13	mg/Kg		06/11/19 08:00	07/15/19 11:13	1
Barium	ND		2.5	0.12	mg/Kg		06/11/19 08:00	07/15/19 11:13	1
Beryllium	ND		0.25	0.0075	mg/Kg		06/11/19 08:00	07/15/19 11:13	1
Cobalt	ND		2.5	0.15	mg/Kg		06/11/19 08:00	07/15/19 11:13	1
Iron	ND		5.0	4.1	mg/Kg		06/11/19 08:00	07/15/19 11:13	1
Lithium	ND		2.5	0.15	mg/Kg		06/11/19 08:00	07/15/19 11:13	1
Manganese	ND		0.75	0.052	mg/Kg		06/11/19 08:00	07/15/19 11:13	1
Molybdenum	ND		2.0	0.082	mg/Kg		06/11/19 08:00	07/15/19 11:13	1
Selenium	ND		0.50	0.17	mg/Kg		06/11/19 08:00	07/15/19 11:13	1
Thallium	ND		1.8	0.18	mg/Kg		06/11/19 08:00	07/15/19 11:13	1

QC Sample Results

Method: 6010B - SEP Metals (ICP) - Total

Lab Sample ID: LCS 140-30683/14-A **Client Sample ID: Lab Control Sample**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 31713 **Prep Batch: 30683**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Aluminum	100	97.6		mg/Kg		98	75 - 125
Antimony	25.0	25.9		mg/Kg		103	75 - 125
Arsenic	5.00	5.29		mg/Kg		106	75 - 125
Barium	5.00	4.99		mg/Kg		100	75 - 125
Beryllium	2.50	2.51		mg/Kg		100	75 - 125
Cobalt	5.00	5.20		mg/Kg		104	75 - 125
Iron	50.0	51.1		mg/Kg		102	75 - 125
Lithium	5.00	5.12		mg/Kg		102	75 - 125
Manganese	5.00	5.21		mg/Kg		104	75 - 125
Molybdenum	25.0	26.6		mg/Kg		106	75 - 125
Selenium	7.50	7.55		mg/Kg		101	75 - 125
Thallium	20.0	21.2		mg/Kg		106	75 - 125

Lab Sample ID: LCSD 140-30683/15-A **Client Sample ID: Lab Control Sample Dup**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 31713 **Prep Batch: 30683**

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	100	97.0		mg/Kg		97	75 - 125	1	30
Antimony	25.0	25.9		mg/Kg		104	75 - 125	0	30
Arsenic	5.00	5.24		mg/Kg		105	75 - 125	1	30
Barium	5.00	4.95		mg/Kg		99	75 - 125	1	30
Beryllium	2.50	2.48		mg/Kg		99	75 - 125	1	30
Cobalt	5.00	5.16		mg/Kg		103	75 - 125	1	30
Iron	50.0	50.4		mg/Kg		101	75 - 125	1	30
Lithium	5.00	5.04		mg/Kg		101	75 - 125	2	30
Manganese	5.00	5.16		mg/Kg		103	75 - 125	1	30
Molybdenum	25.0	26.5		mg/Kg		106	75 - 125	0	30
Selenium	7.50	7.47		mg/Kg		100	75 - 125	1	30
Thallium	20.0	21.2		mg/Kg		106	75 - 125	0	30

Lab Sample ID: 140-15490-1 DU **Client Sample ID: AP-2019-1 (30-31)**
Matrix: Solid **Prep Type: Total/NA**
Analysis Batch: 31713 **Prep Batch: 30683**

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Antimony	ND		ND		mg/Kg	☼	NC	30
Arsenic	6.8		7.11		mg/Kg	☼	5	30
Beryllium	0.89		0.959		mg/Kg	☼	7	30
Iron	11000		12200		mg/Kg	☼	7	30
Lithium	18		19.7		mg/Kg	☼	7	30
Manganese	66		71.7		mg/Kg	☼	8	30
Molybdenum	0.40	J	0.434	J	mg/Kg	☼	7	30
Selenium	ND		ND		mg/Kg	☼	NC	30

QC Sample Results

Client: Golder Associates Inc. Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Method: 6010B - SEP Metals (ICP) - Total (Continued)

Lab Sample ID: 140-15490-1 DU
Matrix: Solid
Analysis Batch: 31713

Client Sample ID: AP-2019-1 (30-31)
Prep Type: Total/NA
Prep Batch: 30683

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Aluminum	60000		64600		mg/Kg	☼	7	30
Barium	680		733		mg/Kg	☼	7	30

Lab Sample ID: 140-15490-1 DU
Matrix: Solid
Analysis Batch: 31713

Client Sample ID: AP-2019-1 (30-31)
Prep Type: Total/NA
Prep Batch: 30683

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Cobalt	3.8	J	4.35	J	mg/Kg	☼	13	30
Thallium	ND		0.657	J	mg/Kg	☼	NC	30

Method: 6010B SEP - SEP Metals (ICP)

Lab Sample ID: MB 140-31148/13-B ^4
Matrix: Solid
Analysis Batch: 31604

Client Sample ID: Method Blank
Prep Type: Step 1
Prep Batch: 31252

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		40	6.4	mg/Kg		06/29/19 08:00	07/11/19 12:33	4
Antimony	ND		12	1.1	mg/Kg		06/29/19 08:00	07/11/19 12:33	4
Arsenic	ND		2.0	0.52	mg/Kg		06/29/19 08:00	07/11/19 12:33	4
Barium	ND		10	0.48	mg/Kg		06/29/19 08:00	07/11/19 12:33	4
Beryllium	ND		1.0	0.31	mg/Kg		06/29/19 08:00	07/11/19 12:33	4
Cobalt	ND		10	0.18	mg/Kg		06/29/19 08:00	07/11/19 12:33	4
Iron	ND		20	12	mg/Kg		06/29/19 08:00	07/11/19 12:33	4
Li	ND		10	0.60	mg/Kg		06/29/19 08:00	07/11/19 12:33	4
Manganese	ND		3.0	0.12	mg/Kg		06/29/19 08:00	07/11/19 12:33	4
Mo	ND		8.0	0.33	mg/Kg		06/29/19 08:00	07/11/19 12:33	4
Selenium	ND		2.0	0.68	mg/Kg		06/29/19 08:00	07/11/19 12:33	4
Thallium	ND		7.0	0.84	mg/Kg		06/29/19 08:00	07/11/19 12:33	4

Lab Sample ID: LCS 140-31148/14-B ^5
Matrix: Solid
Analysis Batch: 31604

Client Sample ID: Lab Control Sample
Prep Type: Step 1
Prep Batch: 31252

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Aluminum	100	97.0		mg/Kg		97	75 - 125
Antimony	25.0	24.5		mg/Kg		98	75 - 125
Arsenic	5.00	4.89		mg/Kg		98	75 - 125
Barium	5.00	4.35	J	mg/Kg		87	75 - 125
Beryllium	2.50	2.58		mg/Kg		103	75 - 125
Cobalt	5.00	4.93	J	mg/Kg		99	75 - 125
Iron	50.0	49.6		mg/Kg		99	75 - 125
Li	5.00	4.72	J	mg/Kg		94	75 - 125
Manganese	5.00	5.09		mg/Kg		102	75 - 125
Mo	25.0	25.0		mg/Kg		100	75 - 125
Selenium	7.50	7.82		mg/Kg		104	75 - 125
Thallium	20.0	19.7		mg/Kg		98	75 - 125

QC Sample Results

Client: Golder Associates Inc. Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCSD 140-31148/15-B ^5 **Client Sample ID: Lab Control Sample Dup**
Matrix: Solid **Prep Type: Step 1**
Analysis Batch: 31604 **Prep Batch: 31252**

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	100	99.5		mg/Kg		100	75 - 125	3	30
Antimony	25.0	24.7		mg/Kg		99	75 - 125	1	30
Arsenic	5.00	4.78		mg/Kg		96	75 - 125	2	30
Barium	5.00	4.30	J	mg/Kg		86	75 - 125	1	30
Beryllium	2.50	2.59		mg/Kg		104	75 - 125	0	30
Cobalt	5.00	4.89	J	mg/Kg		98	75 - 125	1	30
Iron	50.0	49.5		mg/Kg		99	75 - 125	0	30
Li	5.00	4.84	J	mg/Kg		97	75 - 125	3	30
Manganese	5.00	5.06		mg/Kg		101	75 - 125	1	30
Mo	25.0	25.1		mg/Kg		100	75 - 125	0	30
Selenium	7.50	8.06		mg/Kg		108	75 - 125	3	30
Thallium	20.0	20.1		mg/Kg		101	75 - 125	2	30

Lab Sample ID: 140-15490-1 DU **Client Sample ID: AP-2019-1 (30-31)**
Matrix: Solid **Prep Type: Step 1**
Analysis Batch: 31604 **Prep Batch: 31252**

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Aluminum	ND		ND		mg/Kg	☼	NC	30
Antimony	ND		ND		mg/Kg	☼	NC	30
Arsenic	ND		ND		mg/Kg	☼	NC	30
Barium	0.88	J	0.934	J	mg/Kg	☼	5	30
Beryllium	ND		ND		mg/Kg	☼	NC	30
Cobalt	0.54	J	0.626	J	mg/Kg	☼	15	30
Iron	ND		ND		mg/Kg	☼	NC	30
Li	ND		ND		mg/Kg	☼	NC	30
Manganese	3.1	J	3.66	J	mg/Kg	☼	16	30
Mo	ND		ND		mg/Kg	☼	NC	30
Selenium	ND		ND		mg/Kg	☼	NC	30
Thallium	ND		ND		mg/Kg	☼	NC	30

Lab Sample ID: MB 140-31253/13-B ^3 **Client Sample ID: Method Blank**
Matrix: Solid **Prep Type: Step 2**
Analysis Batch: 31604 **Prep Batch: 31256**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		30	4.8	mg/Kg		06/30/19 08:00	07/11/19 14:06	3
Antimony	ND		9.0	0.84	mg/Kg		06/30/19 08:00	07/11/19 14:06	3
Arsenic	ND		1.5	0.39	mg/Kg		06/30/19 08:00	07/11/19 14:06	3
Barium	ND		7.5	0.36	mg/Kg		06/30/19 08:00	07/11/19 14:06	3
Beryllium	ND		0.75	0.048	mg/Kg		06/30/19 08:00	07/11/19 14:06	3
Cobalt	ND		7.5	0.19	mg/Kg		06/30/19 08:00	07/11/19 14:06	3
Iron	ND		15	8.7	mg/Kg		06/30/19 08:00	07/11/19 14:06	3
Li	ND		7.5	0.45	mg/Kg		06/30/19 08:00	07/11/19 14:06	3
Manganese	ND		2.3	0.84	mg/Kg		06/30/19 08:00	07/11/19 14:06	3
Mo	ND		6.0	0.25	mg/Kg		06/30/19 08:00	07/11/19 14:06	3
Selenium	0.587	J	1.5	0.51	mg/Kg		06/30/19 08:00	07/11/19 14:06	3
Thallium	ND		5.3	0.63	mg/Kg		06/30/19 08:00	07/11/19 14:06	3

QC Sample Results

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCS 140-31253/14-B ^5
Matrix: Solid
Analysis Batch: 31604

Client Sample ID: Lab Control Sample
Prep Type: Step 2
Prep Batch: 31256

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Aluminum	100	ND	*	mg/Kg		1	75 - 125
Antimony	25.0	21.1		mg/Kg		84	75 - 125
Arsenic	5.00	3.95		mg/Kg		79	75 - 125
Barium	5.00	2.28	J *	mg/Kg		46	75 - 125
Beryllium	2.50	1.35	*	mg/Kg		54	75 - 125
Cobalt	5.00	4.62	J	mg/Kg		92	75 - 125
Iron	50.0	ND	*	mg/Kg		2	75 - 125
Li	5.00	4.14	J	mg/Kg		83	75 - 125
Manganese	5.00	4.79		mg/Kg		96	75 - 125
Mo	25.0	20.7		mg/Kg		83	75 - 125
Selenium	7.50	7.34		mg/Kg		98	75 - 125
Thallium	20.0	18.4		mg/Kg		92	75 - 125

Lab Sample ID: LCSD 140-31253/15-B ^5
Matrix: Solid
Analysis Batch: 31604

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 2
Prep Batch: 31256

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	100	ND	*	mg/Kg		-0.3	75 - 125	289	30
Antimony	25.0	21.4		mg/Kg		86	75 - 125	1	30
Arsenic	5.00	4.00		mg/Kg		80	75 - 125	1	30
Barium	5.00	2.28	J *	mg/Kg		46	75 - 125	0	30
Beryllium	2.50	1.32	*	mg/Kg		53	75 - 125	2	30
Cobalt	5.00	4.62	J	mg/Kg		92	75 - 125	0	30
Iron	50.0	ND	*	mg/Kg		3	75 - 125	28	30
Li	5.00	4.15	J	mg/Kg		83	75 - 125	0	30
Manganese	5.00	4.76		mg/Kg		95	75 - 125	1	30
Mo	25.0	20.9		mg/Kg		84	75 - 125	1	30
Selenium	7.50	6.68		mg/Kg		89	75 - 125	10	30
Thallium	20.0	18.6		mg/Kg		93	75 - 125	1	30

Lab Sample ID: 140-15490-1 DU
Matrix: Solid
Analysis Batch: 31604

Client Sample ID: AP-2019-1 (30-31)
Prep Type: Step 2
Prep Batch: 31256

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Aluminum	9.7	J *	11.8	J *	mg/Kg	☼	19	30
Antimony	ND		ND		mg/Kg	☼	NC	30
Arsenic	ND		ND		mg/Kg	☼	NC	30
Barium	0.76	J *	0.792	J *	mg/Kg	☼	4	30
Beryllium	ND	*	ND	*	mg/Kg	☼	NC	30
Cobalt	ND		ND		mg/Kg	☼	NC	30
Iron	ND	*	ND	*	mg/Kg	☼	NC	30
Li	ND		ND		mg/Kg	☼	NC	30
Manganese	ND		ND		mg/Kg	☼	NC	30
Mo	ND		ND		mg/Kg	☼	NC	30
Selenium	0.76	J B	0.794	J	mg/Kg	☼	4	30
Thallium	ND		ND		mg/Kg	☼	NC	30

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: MB 140-31257/13-B
Matrix: Solid
Analysis Batch: 31604

Client Sample ID: Method Blank
Prep Type: Step 3
Prep Batch: 31338

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		10	2.1	mg/Kg		07/02/19 08:00	07/11/19 15:50	1
Antimony	ND		3.0	0.28	mg/Kg		07/02/19 08:00	07/11/19 15:50	1
Arsenic	ND		0.50	0.13	mg/Kg		07/02/19 08:00	07/11/19 15:50	1
Barium	0.151	J	2.5	0.12	mg/Kg		07/02/19 08:00	07/11/19 15:50	1
Beryllium	ND		0.25	0.015	mg/Kg		07/02/19 08:00	07/11/19 15:50	1
Cobalt	ND		2.5	0.045	mg/Kg		07/02/19 08:00	07/11/19 15:50	1
Iron	ND		5.0	2.9	mg/Kg		07/02/19 08:00	07/11/19 15:50	1
Li	ND		2.5	0.15	mg/Kg		07/02/19 08:00	07/11/19 15:50	1
Manganese	0.0515	J	0.75	0.027	mg/Kg		07/02/19 08:00	07/11/19 15:50	1
Mo	ND		2.0	0.082	mg/Kg		07/02/19 08:00	07/11/19 15:50	1
Selenium	0.197	J	0.50	0.17	mg/Kg		07/02/19 08:00	07/11/19 15:50	1
Thallium	ND		1.8	0.21	mg/Kg		07/02/19 08:00	07/11/19 15:50	1

Lab Sample ID: LCS 140-31257/14-B
Matrix: Solid
Analysis Batch: 31604

Client Sample ID: Lab Control Sample
Prep Type: Step 3
Prep Batch: 31338

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Aluminum	100	95.8		mg/Kg		96	75 - 125
Antimony	25.0	24.3		mg/Kg		97	75 - 125
Arsenic	5.00	4.90		mg/Kg		98	75 - 125
Barium	5.00	4.34		mg/Kg		87	75 - 125
Beryllium	2.50	2.56		mg/Kg		102	75 - 125
Cobalt	5.00	4.90		mg/Kg		98	75 - 125
Iron	50.0	54.0		mg/Kg		108	75 - 125
Li	5.00	4.87		mg/Kg		97	75 - 125
Manganese	5.00	5.03		mg/Kg		101	75 - 125
Mo	25.0	24.8		mg/Kg		99	75 - 125
Selenium	7.50	7.37		mg/Kg		98	75 - 125
Thallium	20.0	20.2		mg/Kg		101	75 - 125

Lab Sample ID: LCSD 140-31257/15-B
Matrix: Solid
Analysis Batch: 31604

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 3
Prep Batch: 31338

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	100	98.1		mg/Kg		98	75 - 125	2	30
Antimony	25.0	24.6		mg/Kg		98	75 - 125	1	30
Arsenic	5.00	5.06		mg/Kg		101	75 - 125	3	30
Barium	5.00	4.49		mg/Kg		90	75 - 125	3	30
Beryllium	2.50	2.61		mg/Kg		104	75 - 125	2	30
Cobalt	5.00	4.97		mg/Kg		99	75 - 125	1	30
Iron	50.0	51.0		mg/Kg		102	75 - 125	6	30
Li	5.00	4.95		mg/Kg		99	75 - 125	2	30
Manganese	5.00	5.06		mg/Kg		101	75 - 125	1	30
Mo	25.0	24.9		mg/Kg		100	75 - 125	0	30
Selenium	7.50	7.63		mg/Kg		102	75 - 125	3	30
Thallium	20.0	20.5		mg/Kg		103	75 - 125	2	30

QC Sample Results

Client: Golder Associates Inc. Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: 140-15490-1 DU **Client Sample ID: AP-2019-1 (30-31)**
Matrix: Solid **Prep Type: Step 3**
Analysis Batch: 31604 **Prep Batch: 31338**

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Aluminum	88		90.2		mg/Kg	☼	3	30
Antimony	ND		ND		mg/Kg	☼	NC	30
Arsenic	1.8		1.75		mg/Kg	☼	5	30
Barium	4.3	B	4.58		mg/Kg	☼	7	30
Beryllium	0.067	J	0.0665	J	mg/Kg	☼	1	30
Cobalt	0.34	J	0.478	J F5	mg/Kg	☼	32	30
Iron	580		553		mg/Kg	☼	4	30
Li	ND		ND		mg/Kg	☼	NC	30
Manganese	2.4	B	2.99		mg/Kg	☼	20	30
Mo	ND		ND		mg/Kg	☼	NC	30
Selenium	0.22	J B	0.249	J	mg/Kg	☼	14	30
Thallium	ND		ND		mg/Kg	☼	NC	30

Lab Sample ID: MB 140-31341/13-B **Client Sample ID: Method Blank**
Matrix: Solid **Prep Type: Step 4**
Analysis Batch: 31604 **Prep Batch: 31360**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		10	1.6	mg/Kg		07/03/19 08:00	07/11/19 17:24	1
Antimony	ND		3.0	0.45	mg/Kg		07/03/19 08:00	07/11/19 17:24	1
Arsenic	0.260	J	0.50	0.22	mg/Kg		07/03/19 08:00	07/11/19 17:24	1
Barium	ND		2.5	0.12	mg/Kg		07/03/19 08:00	07/11/19 17:24	1
Beryllium	ND		0.25	0.016	mg/Kg		07/03/19 08:00	07/11/19 17:24	1
Cobalt	ND		2.5	0.053	mg/Kg		07/03/19 08:00	07/11/19 17:24	1
Iron	ND		5.0	2.9	mg/Kg		07/03/19 08:00	07/11/19 17:24	1
Li	ND		2.5	0.15	mg/Kg		07/03/19 08:00	07/11/19 17:24	1
Manganese	ND		0.75	0.13	mg/Kg		07/03/19 08:00	07/11/19 17:24	1
Mo	ND		2.0	0.082	mg/Kg		07/03/19 08:00	07/11/19 17:24	1
Selenium	0.561		0.50	0.47	mg/Kg		07/03/19 08:00	07/11/19 17:24	1
Thallium	ND		1.8	0.29	mg/Kg		07/03/19 08:00	07/11/19 17:24	1

Lab Sample ID: LCS 140-31341/14-B **Client Sample ID: Lab Control Sample**
Matrix: Solid **Prep Type: Step 4**
Analysis Batch: 31604 **Prep Batch: 31360**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Aluminum	100	98.4		mg/Kg		98	75 - 125
Antimony	25.0	25.6		mg/Kg		102	75 - 125
Arsenic	5.00	5.48		mg/Kg		110	75 - 125
Barium	5.00	4.90		mg/Kg		98	75 - 125
Beryllium	2.50	2.66		mg/Kg		106	75 - 125
Cobalt	5.00	4.92		mg/Kg		98	75 - 125
Iron	50.0	50.0		mg/Kg		100	75 - 125
Li	5.00	4.92		mg/Kg		98	75 - 125
Manganese	5.00	4.98		mg/Kg		100	75 - 125
Mo	25.0	25.7		mg/Kg		103	75 - 125
Selenium	7.50	0.762	*	mg/Kg		10	75 - 125
Thallium	20.0	17.2		mg/Kg		86	75 - 125

1 2 3 4 5 6 7 8 9 10 11 12 13

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCSD 140-31341/15-B
Matrix: Solid
Analysis Batch: 31604

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 4
Prep Batch: 31360

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	100	101		mg/Kg		101	75 - 125	3	30
Antimony	25.0	25.9		mg/Kg		103	75 - 125	1	30
Arsenic	5.00	5.55		mg/Kg		111	75 - 125	1	30
Barium	5.00	5.04		mg/Kg		101	75 - 125	3	30
Beryllium	2.50	2.74		mg/Kg		109	75 - 125	3	30
Cobalt	5.00	5.07		mg/Kg		101	75 - 125	3	30
Iron	50.0	51.5		mg/Kg		103	75 - 125	3	30
Li	5.00	5.09		mg/Kg		102	75 - 125	3	30
Manganese	5.00	5.13		mg/Kg		103	75 - 125	3	30
Mo	25.0	25.9		mg/Kg		104	75 - 125	1	30
Selenium	7.50	0.631	*	mg/Kg		8	75 - 125	19	30
Thallium	20.0	17.9		mg/Kg		89	75 - 125	4	30

Lab Sample ID: 140-15490-1 DU
Matrix: Solid
Analysis Batch: 31604

Client Sample ID: AP-2019-1 (30-31)
Prep Type: Step 4
Prep Batch: 31360

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Aluminum	1700		1740		mg/Kg	☼	0.1	30
Antimony	ND		ND		mg/Kg	☼	NC	30
Arsenic	2.8	B	2.56		mg/Kg	☼	10	30
Barium	16		18.8		mg/Kg	☼	15	30
Beryllium	0.13	J	0.135	J	mg/Kg	☼	1	30
Cobalt	1.5	J	1.59	J	mg/Kg	☼	8	30
Iron	3900		3860		mg/Kg	☼	2	30
Li	3.0	J	3.10	J	mg/Kg	☼	2	30
Manganese	18		18.2		mg/Kg	☼	0.4	30
Mo	ND		ND		mg/Kg	☼	NC	30
Selenium	ND	*	0.624	J *	mg/Kg	☼	NC	30
Thallium	ND		ND		mg/Kg	☼	NC	30

Lab Sample ID: MB 140-31436/13-B ^5
Matrix: Solid
Analysis Batch: 31651

Client Sample ID: Method Blank
Prep Type: Step 5
Prep Batch: 31500

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		150	24	mg/Kg		07/10/19 08:00	07/12/19 11:39	5
Antimony	ND		45	4.2	mg/Kg		07/10/19 08:00	07/12/19 11:39	5
Arsenic	ND		7.5	1.9	mg/Kg		07/10/19 08:00	07/12/19 11:39	5
Barium	ND		38	1.8	mg/Kg		07/10/19 08:00	07/12/19 11:39	5
Beryllium	ND		3.8	0.32	mg/Kg		07/10/19 08:00	07/12/19 11:39	5
Cobalt	ND		38	0.60	mg/Kg		07/10/19 08:00	07/12/19 11:39	5
Iron	ND		75	44	mg/Kg		07/10/19 08:00	07/12/19 11:39	5
Li	ND		38	2.2	mg/Kg		07/10/19 08:00	07/12/19 11:39	5
Manganese	ND		11	1.9	mg/Kg		07/10/19 08:00	07/12/19 11:39	5
Mo	ND		30	1.3	mg/Kg		07/10/19 08:00	07/12/19 11:39	5
Selenium	ND		7.5	2.6	mg/Kg		07/10/19 08:00	07/12/19 11:39	5
Thallium	ND		26	3.5	mg/Kg		07/10/19 08:00	07/12/19 11:39	5

QC Sample Results

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCS 140-31436/14-B ^5 **Client Sample ID: Lab Control Sample**
Matrix: Solid **Prep Type: Step 5**
Analysis Batch: 31651 **Prep Batch: 31500**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Aluminum	300	ND	*	mg/Kg		6	75 - 125
Antimony	75.0	81.2		mg/Kg		108	75 - 125
Arsenic	15.0	12.3		mg/Kg		82	75 - 125
Barium	15.0	7.80	J *	mg/Kg		52	75 - 125
Beryllium	7.50	4.23	*	mg/Kg		56	75 - 125
Cobalt	15.0	4.86	J *	mg/Kg		32	75 - 125
Iron	150	ND	*	mg/Kg		2	75 - 125
Li	15.0	16.4	J	mg/Kg		109	75 - 125
Manganese	15.0	4.82	J *	mg/Kg		32	75 - 125
Mo	75.0	64.7		mg/Kg		86	75 - 125
Selenium	22.5	24.8		mg/Kg		110	75 - 125
Thallium	60.0	ND	*	mg/Kg		2	75 - 125

Lab Sample ID: LCSD 140-31436/15-B ^5 **Client Sample ID: Lab Control Sample Dup**
Matrix: Solid **Prep Type: Step 5**
Analysis Batch: 31651 **Prep Batch: 31500**

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	300	ND	*	mg/Kg		7	75 - 125	14	30
Antimony	75.0	82.5		mg/Kg		110	75 - 125	2	30
Arsenic	15.0	12.5		mg/Kg		83	75 - 125	2	30
Barium	15.0	7.73	J *	mg/Kg		52	75 - 125	1	30
Beryllium	7.50	4.34	*	mg/Kg		58	75 - 125	2	30
Cobalt	15.0	5.05	J *	mg/Kg		34	75 - 125	4	30
Iron	150	ND	*	mg/Kg		3	75 - 125	55	30
Li	15.0	16.1	J	mg/Kg		107	75 - 125	2	30
Manganese	15.0	4.97	J *	mg/Kg		33	75 - 125	3	30
Mo	75.0	64.0		mg/Kg		85	75 - 125	1	30
Selenium	22.5	26.2		mg/Kg		116	75 - 125	6	30
Thallium	60.0	ND	*	mg/Kg		0.9	75 - 125	60	30

Lab Sample ID: 140-15490-1 DU **Client Sample ID: AP-2019-1 (30-31)**
Matrix: Solid **Prep Type: Step 5**
Analysis Batch: 31651 **Prep Batch: 31500**

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Aluminum	62	J *	54.9	J *	mg/Kg	☼	12	30
Antimony	ND		ND		mg/Kg	☼	NC	30
Arsenic	ND		ND		mg/Kg	☼	NC	30
Barium	7.0	J *	8.10	J *	mg/Kg	☼	15	30
Beryllium	ND	*	ND	*	mg/Kg	☼	NC	30
Cobalt	ND	*	ND	*	mg/Kg	☼	NC	30
Iron	ND	*	ND	*	mg/Kg	☼	NC	30
Li	ND		ND		mg/Kg	☼	NC	30
Manganese	ND	*	ND	*	mg/Kg	☼	NC	30
Mo	ND		ND		mg/Kg	☼	NC	30
Selenium	ND		ND		mg/Kg	☼	NC	30
Thallium	ND	*	ND	*	mg/Kg	☼	NC	30

QC Sample Results

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: MB 140-31502/13-A
Matrix: Solid
Analysis Batch: 31651

Client Sample ID: Method Blank
Prep Type: Step 6
Prep Batch: 31502

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		10	1.6	mg/Kg		07/10/19 08:00	07/12/19 13:14	1
Antimony	ND		3.0	0.28	mg/Kg		07/10/19 08:00	07/12/19 13:14	1
Arsenic	ND		0.50	0.15	mg/Kg		07/10/19 08:00	07/12/19 13:14	1
Barium	ND		2.5	0.12	mg/Kg		07/10/19 08:00	07/12/19 13:14	1
Beryllium	ND		0.25	0.012	mg/Kg		07/10/19 08:00	07/12/19 13:14	1
Cobalt	ND		2.5	0.046	mg/Kg		07/10/19 08:00	07/12/19 13:14	1
Iron	ND		5.0	2.9	mg/Kg		07/10/19 08:00	07/12/19 13:14	1
Li	ND		2.5	0.15	mg/Kg		07/10/19 08:00	07/12/19 13:14	1
Manganese	ND		0.75	0.25	mg/Kg		07/10/19 08:00	07/12/19 13:14	1
Mo	ND		2.0	0.099	mg/Kg		07/10/19 08:00	07/12/19 13:14	1
Selenium	ND		0.50	0.17	mg/Kg		07/10/19 08:00	07/12/19 13:14	1
Thallium	ND		1.8	0.21	mg/Kg		07/10/19 08:00	07/12/19 13:14	1

Lab Sample ID: LCS 140-31502/14-A
Matrix: Solid
Analysis Batch: 31651

Client Sample ID: Lab Control Sample
Prep Type: Step 6
Prep Batch: 31502

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Aluminum	100	95.4		mg/Kg		95	75 - 125
Antimony	25.0	24.8		mg/Kg		99	75 - 125
Arsenic	5.00	4.94		mg/Kg		99	75 - 125
Barium	5.00	4.58		mg/Kg		92	75 - 125
Beryllium	2.50	2.57		mg/Kg		103	75 - 125
Cobalt	5.00	4.78		mg/Kg		96	75 - 125
Iron	50.0	47.4		mg/Kg		95	75 - 125
Li	5.00	4.71		mg/Kg		94	75 - 125
Manganese	5.00	4.83		mg/Kg		97	75 - 125
Mo	25.0	24.7		mg/Kg		99	75 - 125
Selenium	7.50	7.32		mg/Kg		98	75 - 125
Thallium	20.0	19.8		mg/Kg		99	75 - 125

Lab Sample ID: LCSD 140-31502/15-A
Matrix: Solid
Analysis Batch: 31651

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 6
Prep Batch: 31502

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	100	98.8		mg/Kg		99	75 - 125	4	30
Antimony	25.0	25.5		mg/Kg		102	75 - 125	3	30
Arsenic	5.00	5.16		mg/Kg		103	75 - 125	4	30
Barium	5.00	4.77		mg/Kg		95	75 - 125	4	30
Beryllium	2.50	2.67		mg/Kg		107	75 - 125	4	30
Cobalt	5.00	4.97		mg/Kg		99	75 - 125	4	30
Iron	50.0	49.5		mg/Kg		99	75 - 125	4	30
Li	5.00	4.90		mg/Kg		98	75 - 125	4	30
Manganese	5.00	5.02		mg/Kg		100	75 - 125	4	30
Mo	25.0	25.2		mg/Kg		101	75 - 125	2	30
Selenium	7.50	7.50		mg/Kg		100	75 - 125	2	30
Thallium	20.0	20.6		mg/Kg		103	75 - 125	4	30

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: 140-15490-1 DU
Matrix: Solid
Analysis Batch: 31651

Client Sample ID: AP-2019-1 (30-31)
Prep Type: Step 6
Prep Batch: 31502

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Aluminum	2300		2370		mg/Kg	☼	2	30
Antimony	ND		ND		mg/Kg	☼	NC	30
Arsenic	0.94		0.869		mg/Kg	☼	8	30
Barium	18		18.6		mg/Kg	☼	6	30
Beryllium	0.067	J	0.0691	J	mg/Kg	☼	3	30
Cobalt	0.90	J	0.940	J	mg/Kg	☼	5	30
Iron	2500		2510		mg/Kg	☼	0.4	30
Li	2.1	J	2.17	J	mg/Kg	☼	3	30
Manganese	16		16.1		mg/Kg	☼	0.6	30
Mo	ND		ND		mg/Kg	☼	NC	30
Selenium	ND		ND		mg/Kg	☼	NC	30
Thallium	ND		ND		mg/Kg	☼	NC	30

Lab Sample ID: MB 140-31615/13-A
Matrix: Solid
Analysis Batch: 31713

Client Sample ID: Method Blank
Prep Type: Step 7
Prep Batch: 31615

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aluminum	ND		10	1.6	mg/Kg		07/12/19 09:08	07/15/19 10:58	1
Antimony	ND		3.0	0.14	mg/Kg		07/12/19 09:08	07/15/19 10:58	1
Arsenic	ND		0.50	0.13	mg/Kg		07/12/19 09:08	07/15/19 10:58	1
Barium	ND		2.5	0.12	mg/Kg		07/12/19 09:08	07/15/19 10:58	1
Beryllium	ND		0.25	0.0075	mg/Kg		07/12/19 09:08	07/15/19 10:58	1
Cobalt	ND		2.5	0.15	mg/Kg		07/12/19 09:08	07/15/19 10:58	1
Iron	ND		5.0	4.1	mg/Kg		07/12/19 09:08	07/15/19 10:58	1
Li	ND		2.5	0.15	mg/Kg		07/12/19 09:08	07/15/19 10:58	1
Manganese	ND		0.75	0.052	mg/Kg		07/12/19 09:08	07/15/19 10:58	1
Mo	ND		2.0	0.082	mg/Kg		07/12/19 09:08	07/15/19 10:58	1
Selenium	ND		0.50	0.17	mg/Kg		07/12/19 09:08	07/15/19 10:58	1
Thallium	ND		1.8	0.18	mg/Kg		07/12/19 09:08	07/15/19 10:58	1

Lab Sample ID: LCS 140-31615/14-A
Matrix: Solid
Analysis Batch: 31713

Client Sample ID: Lab Control Sample
Prep Type: Step 7
Prep Batch: 31615

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Aluminum	100	96.8		mg/Kg		97	75 - 125
Antimony	25.0	25.7		mg/Kg		103	75 - 125
Arsenic	5.00	5.23		mg/Kg		105	75 - 125
Barium	5.00	4.99		mg/Kg		100	75 - 125
Beryllium	2.50	2.52		mg/Kg		101	75 - 125
Cobalt	5.00	5.20		mg/Kg		104	75 - 125
Iron	50.0	51.7		mg/Kg		103	75 - 125
Li	5.00	5.15		mg/Kg		103	75 - 125
Manganese	5.00	5.21		mg/Kg		104	75 - 125
Mo	25.0	26.5		mg/Kg		106	75 - 125
Selenium	7.50	7.52		mg/Kg		100	75 - 125
Thallium	20.0	21.2		mg/Kg		106	75 - 125

QC Sample Results

Method: 6010B SEP - SEP Metals (ICP) (Continued)

Lab Sample ID: LCSD 140-31615/15-A
Matrix: Solid
Analysis Batch: 31713

Client Sample ID: Lab Control Sample Dup
Prep Type: Step 7
Prep Batch: 31615

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Aluminum	100	98.0		mg/Kg		98	75 - 125	1	30
Antimony	25.0	25.8		mg/Kg		103	75 - 125	0	30
Arsenic	5.00	5.30		mg/Kg		106	75 - 125	1	30
Barium	5.00	4.99		mg/Kg		100	75 - 125	0	30
Beryllium	2.50	2.50		mg/Kg		100	75 - 125	1	30
Cobalt	5.00	5.21		mg/Kg		104	75 - 125	0	30
Iron	50.0	51.5		mg/Kg		103	75 - 125	0	30
Li	5.00	5.18		mg/Kg		104	75 - 125	1	30
Manganese	5.00	5.21		mg/Kg		104	75 - 125	0	30
Mo	25.0	26.7		mg/Kg		107	75 - 125	1	30
Selenium	7.50	7.55		mg/Kg		101	75 - 125	0	30
Thallium	20.0	21.3		mg/Kg		107	75 - 125	1	30

Lab Sample ID: 140-15490-1 DU
Matrix: Solid
Analysis Batch: 31713

Client Sample ID: AP-2019-1 (30-31)
Prep Type: Step 7
Prep Batch: 31615

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Antimony	ND		ND		mg/Kg	☼	NC	30
Arsenic	1.2		1.16		mg/Kg	☼	6	30
Beryllium	0.56		0.602		mg/Kg	☼	7	30
Iron	5200		5740		mg/Kg	☼	11	30
Li	9.6		10.9		mg/Kg	☼	13	30
Manganese	26		29.0		mg/Kg	☼	9	30
Mo	0.19	J	0.209	J	mg/Kg	☼	10	30
Selenium	ND		ND		mg/Kg	☼	NC	30

Lab Sample ID: 140-15490-1 DU
Matrix: Solid
Analysis Batch: 31713

Client Sample ID: AP-2019-1 (30-31)
Prep Type: Step 7
Prep Batch: 31615

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Aluminum	29000		35900		mg/Kg	☼	23	30
Barium	390		447		mg/Kg	☼	14	30

Lab Sample ID: 140-15490-1 DU
Matrix: Solid
Analysis Batch: 31713

Client Sample ID: AP-2019-1 (30-31)
Prep Type: Step 7
Prep Batch: 31615

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Cobalt	0.79	J	0.899	J	mg/Kg	☼	12	30
Thallium	0.48	J	ND		mg/Kg	☼	NC	30

QC Sample Results

Client: Golder Associates Inc. Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Method: 7470A - SEP Mercury (CVAA) - Total

Lab Sample ID: MB 140-30683/13-B
Matrix: Solid
Analysis Batch: 30868

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 30683

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hg	ND		0.10	0.040	mg/Kg		06/11/19 08:00	06/16/19 13:56	1

Lab Sample ID: LCS 140-30683/14-B
Matrix: Solid
Analysis Batch: 30868

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 30683

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Hg	2.50	2.70		mg/Kg		108	75 - 125

Lab Sample ID: LCSD 140-30683/15-B
Matrix: Solid
Analysis Batch: 30868

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 30683

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Hg	2.50	2.71		mg/Kg		108	75 - 125	0	30

Lab Sample ID: 140-15490-1 DU
Matrix: Solid
Analysis Batch: 30868

Client Sample ID: AP-2019-1 (30-31)
Prep Type: Total/NA
Prep Batch: 30683

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Hg	0.081	J	0.102	J	mg/Kg	☼	23	30

Metals

Prep Batch: 30683

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Total/NA	Solid	Total	
140-15490-2	AP-2019-2 (35-36)	Total/NA	Solid	Total	
140-15490-3	AP-2019-3 (18-19)	Total/NA	Solid	Total	
MB 140-30683/13-A	Method Blank	Total/NA	Solid	Total	
MB 140-30683/13-B	Method Blank	Total/NA	Solid	Total	
LCS 140-30683/14-A	Lab Control Sample	Total/NA	Solid	Total	
LCS 140-30683/14-B	Lab Control Sample	Total/NA	Solid	Total	
LCSD 140-30683/15-A	Lab Control Sample Dup	Total/NA	Solid	Total	
LCSD 140-30683/15-B	Lab Control Sample Dup	Total/NA	Solid	Total	
140-15490-1 DU	AP-2019-1 (30-31)	Total/NA	Solid	Total	

Prep Batch: 30859

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Total/NA	Solid	7470A	30683
140-15490-2	AP-2019-2 (35-36)	Total/NA	Solid	7470A	30683
140-15490-3	AP-2019-3 (18-19)	Total/NA	Solid	7470A	30683
MB 140-30683/13-B	Method Blank	Total/NA	Solid	7470A	30683
LCS 140-30683/14-B	Lab Control Sample	Total/NA	Solid	7470A	30683
LCSD 140-30683/15-B	Lab Control Sample Dup	Total/NA	Solid	7470A	30683
140-15490-1 DU	AP-2019-1 (30-31)	Total/NA	Solid	7470A	30683

Analysis Batch: 30868

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Total/NA	Solid	7470A	30859
140-15490-2	AP-2019-2 (35-36)	Total/NA	Solid	7470A	30859
140-15490-3	AP-2019-3 (18-19)	Total/NA	Solid	7470A	30859
MB 140-30683/13-B	Method Blank	Total/NA	Solid	7470A	30859
LCS 140-30683/14-B	Lab Control Sample	Total/NA	Solid	7470A	30859
LCSD 140-30683/15-B	Lab Control Sample Dup	Total/NA	Solid	7470A	30859
140-15490-1 DU	AP-2019-1 (30-31)	Total/NA	Solid	7470A	30859

Prep Batch: 31128

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Total/NA	Solid	3050B	
140-15490-2	AP-2019-2 (35-36)	Total/NA	Solid	3050B	
140-15490-3	AP-2019-3 (18-19)	Total/NA	Solid	3050B	
MB 140-31128/14-A	Method Blank	Total/NA	Solid	3050B	
LCS 140-31128/15-A	Lab Control Sample	Total/NA	Solid	3050B	
140-15490-1 MS	AP-2019-1 (30-31)	Total/NA	Solid	3050B	
140-15490-1 MSD	AP-2019-1 (30-31)	Total/NA	Solid	3050B	

SEP Batch: 31148

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 1	Solid	Exchangeable	
140-15490-2	AP-2019-2 (35-36)	Step 1	Solid	Exchangeable	
140-15490-3	AP-2019-3 (18-19)	Step 1	Solid	Exchangeable	
MB 140-31148/13-B ^4	Method Blank	Step 1	Solid	Exchangeable	
LCS 140-31148/14-B ^5	Lab Control Sample	Step 1	Solid	Exchangeable	
LCSD 140-31148/15-B ^5	Lab Control Sample Dup	Step 1	Solid	Exchangeable	
140-15490-1 DU	AP-2019-1 (30-31)	Step 1	Solid	Exchangeable	

QC Association Summary

Metals

Prep Batch: 31252

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 1	Solid	3010A	31148
140-15490-2	AP-2019-2 (35-36)	Step 1	Solid	3010A	31148
140-15490-3	AP-2019-3 (18-19)	Step 1	Solid	3010A	31148
MB 140-31148/13-B ^4	Method Blank	Step 1	Solid	3010A	31148
LCS 140-31148/14-B ^5	Lab Control Sample	Step 1	Solid	3010A	31148
LCSD 140-31148/15-B ^5	Lab Control Sample Dup	Step 1	Solid	3010A	31148
140-15490-1 DU	AP-2019-1 (30-31)	Step 1	Solid	3010A	31148

SEP Batch: 31253

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 2	Solid	Carbonate	
140-15490-2	AP-2019-2 (35-36)	Step 2	Solid	Carbonate	
140-15490-3	AP-2019-3 (18-19)	Step 2	Solid	Carbonate	
MB 140-31253/13-B ^3	Method Blank	Step 2	Solid	Carbonate	
LCS 140-31253/14-B ^5	Lab Control Sample	Step 2	Solid	Carbonate	
LCSD 140-31253/15-B ^5	Lab Control Sample Dup	Step 2	Solid	Carbonate	
140-15490-1 DU	AP-2019-1 (30-31)	Step 2	Solid	Carbonate	

Prep Batch: 31256

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 2	Solid	3010A	31253
140-15490-2	AP-2019-2 (35-36)	Step 2	Solid	3010A	31253
140-15490-3	AP-2019-3 (18-19)	Step 2	Solid	3010A	31253
MB 140-31253/13-B ^3	Method Blank	Step 2	Solid	3010A	31253
LCS 140-31253/14-B ^5	Lab Control Sample	Step 2	Solid	3010A	31253
LCSD 140-31253/15-B ^5	Lab Control Sample Dup	Step 2	Solid	3010A	31253
140-15490-1 DU	AP-2019-1 (30-31)	Step 2	Solid	3010A	31253

SEP Batch: 31257

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 3	Solid	Non-Crystalline	
140-15490-2	AP-2019-2 (35-36)	Step 3	Solid	Non-Crystalline	
140-15490-3	AP-2019-3 (18-19)	Step 3	Solid	Non-Crystalline	
MB 140-31257/13-B	Method Blank	Step 3	Solid	Non-Crystalline	
LCS 140-31257/14-B	Lab Control Sample	Step 3	Solid	Non-Crystalline	
LCSD 140-31257/15-B	Lab Control Sample Dup	Step 3	Solid	Non-Crystalline	
140-15490-1 DU	AP-2019-1 (30-31)	Step 3	Solid	Non-Crystalline	

Prep Batch: 31338

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 3	Solid	3010A	31257
140-15490-2	AP-2019-2 (35-36)	Step 3	Solid	3010A	31257
140-15490-3	AP-2019-3 (18-19)	Step 3	Solid	3010A	31257
MB 140-31257/13-B	Method Blank	Step 3	Solid	3010A	31257
LCS 140-31257/14-B	Lab Control Sample	Step 3	Solid	3010A	31257
LCSD 140-31257/15-B	Lab Control Sample Dup	Step 3	Solid	3010A	31257
140-15490-1 DU	AP-2019-1 (30-31)	Step 3	Solid	3010A	31257

SEP Batch: 31341

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 4	Solid	Metal Hydroxide	

Metals (Continued)

SEP Batch: 31341 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-2	AP-2019-2 (35-36)	Step 4	Solid	Metal Hydroxide	
140-15490-3	AP-2019-3 (18-19)	Step 4	Solid	Metal Hydroxide	
MB 140-31341/13-B	Method Blank	Step 4	Solid	Metal Hydroxide	
LCS 140-31341/14-B	Lab Control Sample	Step 4	Solid	Metal Hydroxide	
LCSD 140-31341/15-B	Lab Control Sample Dup	Step 4	Solid	Metal Hydroxide	
140-15490-1 DU	AP-2019-1 (30-31)	Step 4	Solid	Metal Hydroxide	

Prep Batch: 31360

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 4	Solid	3010A	31341
140-15490-2	AP-2019-2 (35-36)	Step 4	Solid	3010A	31341
140-15490-3	AP-2019-3 (18-19)	Step 4	Solid	3010A	31341
MB 140-31341/13-B	Method Blank	Step 4	Solid	3010A	31341
LCS 140-31341/14-B	Lab Control Sample	Step 4	Solid	3010A	31341
LCSD 140-31341/15-B	Lab Control Sample Dup	Step 4	Solid	3010A	31341
140-15490-1 DU	AP-2019-1 (30-31)	Step 4	Solid	3010A	31341

SEP Batch: 31436

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 5	Solid	Organic-Bound	
140-15490-2	AP-2019-2 (35-36)	Step 5	Solid	Organic-Bound	
140-15490-3	AP-2019-3 (18-19)	Step 5	Solid	Organic-Bound	
MB 140-31436/13-B ^5	Method Blank	Step 5	Solid	Organic-Bound	
LCS 140-31436/14-B ^5	Lab Control Sample	Step 5	Solid	Organic-Bound	
LCSD 140-31436/15-B ^5	Lab Control Sample Dup	Step 5	Solid	Organic-Bound	
140-15490-1 DU	AP-2019-1 (30-31)	Step 5	Solid	Organic-Bound	

Prep Batch: 31500

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 5	Solid	3010A	31436
140-15490-2	AP-2019-2 (35-36)	Step 5	Solid	3010A	31436
140-15490-3	AP-2019-3 (18-19)	Step 5	Solid	3010A	31436
MB 140-31436/13-B ^5	Method Blank	Step 5	Solid	3010A	31436
LCS 140-31436/14-B ^5	Lab Control Sample	Step 5	Solid	3010A	31436
LCSD 140-31436/15-B ^5	Lab Control Sample Dup	Step 5	Solid	3010A	31436
140-15490-1 DU	AP-2019-1 (30-31)	Step 5	Solid	3010A	31436

SEP Batch: 31502

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 6	Solid	Acid/Sulfide	
140-15490-2	AP-2019-2 (35-36)	Step 6	Solid	Acid/Sulfide	
140-15490-3	AP-2019-3 (18-19)	Step 6	Solid	Acid/Sulfide	
MB 140-31502/13-A	Method Blank	Step 6	Solid	Acid/Sulfide	
LCS 140-31502/14-A	Lab Control Sample	Step 6	Solid	Acid/Sulfide	
LCSD 140-31502/15-A	Lab Control Sample Dup	Step 6	Solid	Acid/Sulfide	
140-15490-1 DU	AP-2019-1 (30-31)	Step 6	Solid	Acid/Sulfide	

Analysis Batch: 31553

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Total/NA	Solid	6010B	31128
140-15490-2	AP-2019-2 (35-36)	Total/NA	Solid	6010B	31128

QC Association Summary

Metals (Continued)

Analysis Batch: 31553 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-3	AP-2019-3 (18-19)	Total/NA	Solid	6010B	31128
MB 140-31128/14-A	Method Blank	Total/NA	Solid	6010B	31128
LCS 140-31128/15-A	Lab Control Sample	Total/NA	Solid	6010B	31128
140-15490-1 MS	AP-2019-1 (30-31)	Total/NA	Solid	6010B	31128
140-15490-1 MSD	AP-2019-1 (30-31)	Total/NA	Solid	6010B	31128

Analysis Batch: 31604

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 1	Solid	6010B SEP	31252
140-15490-1	AP-2019-1 (30-31)	Step 2	Solid	6010B SEP	31256
140-15490-1	AP-2019-1 (30-31)	Step 3	Solid	6010B SEP	31338
140-15490-1	AP-2019-1 (30-31)	Step 4	Solid	6010B SEP	31360
140-15490-2	AP-2019-2 (35-36)	Step 1	Solid	6010B SEP	31252
140-15490-2	AP-2019-2 (35-36)	Step 2	Solid	6010B SEP	31256
140-15490-2	AP-2019-2 (35-36)	Step 3	Solid	6010B SEP	31338
140-15490-2	AP-2019-2 (35-36)	Step 4	Solid	6010B SEP	31360
140-15490-3	AP-2019-3 (18-19)	Step 1	Solid	6010B SEP	31252
140-15490-3	AP-2019-3 (18-19)	Step 2	Solid	6010B SEP	31256
140-15490-3	AP-2019-3 (18-19)	Step 3	Solid	6010B SEP	31338
140-15490-3	AP-2019-3 (18-19)	Step 4	Solid	6010B SEP	31360
MB 140-31148/13-B ^4	Method Blank	Step 1	Solid	6010B SEP	31252
MB 140-31253/13-B ^3	Method Blank	Step 2	Solid	6010B SEP	31256
MB 140-31257/13-B	Method Blank	Step 3	Solid	6010B SEP	31338
MB 140-31341/13-B	Method Blank	Step 4	Solid	6010B SEP	31360
LCS 140-31148/14-B ^5	Lab Control Sample	Step 1	Solid	6010B SEP	31252
LCS 140-31253/14-B ^5	Lab Control Sample	Step 2	Solid	6010B SEP	31256
LCS 140-31257/14-B	Lab Control Sample	Step 3	Solid	6010B SEP	31338
LCS 140-31341/14-B	Lab Control Sample	Step 4	Solid	6010B SEP	31360
LCSD 140-31148/15-B ^5	Lab Control Sample Dup	Step 1	Solid	6010B SEP	31252
LCSD 140-31253/15-B ^5	Lab Control Sample Dup	Step 2	Solid	6010B SEP	31256
LCSD 140-31257/15-B	Lab Control Sample Dup	Step 3	Solid	6010B SEP	31338
LCSD 140-31341/15-B	Lab Control Sample Dup	Step 4	Solid	6010B SEP	31360
140-15490-1 DU	AP-2019-1 (30-31)	Step 1	Solid	6010B SEP	31252
140-15490-1 DU	AP-2019-1 (30-31)	Step 2	Solid	6010B SEP	31256
140-15490-1 DU	AP-2019-1 (30-31)	Step 3	Solid	6010B SEP	31338
140-15490-1 DU	AP-2019-1 (30-31)	Step 4	Solid	6010B SEP	31360

Prep Batch: 31615

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 7	Solid	Residual	
140-15490-2	AP-2019-2 (35-36)	Step 7	Solid	Residual	
140-15490-3	AP-2019-3 (18-19)	Step 7	Solid	Residual	
MB 140-31615/13-A	Method Blank	Step 7	Solid	Residual	
LCS 140-31615/14-A	Lab Control Sample	Step 7	Solid	Residual	
LCSD 140-31615/15-A	Lab Control Sample Dup	Step 7	Solid	Residual	
140-15490-1 DU	AP-2019-1 (30-31)	Step 7	Solid	Residual	

Analysis Batch: 31651

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 5	Solid	6010B SEP	31500
140-15490-1	AP-2019-1 (30-31)	Step 6	Solid	6010B SEP	31502

Metals (Continued)

Analysis Batch: 31651 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-2	AP-2019-2 (35-36)	Step 5	Solid	6010B SEP	31500
140-15490-2	AP-2019-2 (35-36)	Step 6	Solid	6010B SEP	31502
140-15490-3	AP-2019-3 (18-19)	Step 5	Solid	6010B SEP	31500
140-15490-3	AP-2019-3 (18-19)	Step 6	Solid	6010B SEP	31502
MB 140-31436/13-B ^5	Method Blank	Step 5	Solid	6010B SEP	31500
MB 140-31502/13-A	Method Blank	Step 6	Solid	6010B SEP	31502
LCS 140-31436/14-B ^5	Lab Control Sample	Step 5	Solid	6010B SEP	31500
LCS 140-31502/14-A	Lab Control Sample	Step 6	Solid	6010B SEP	31502
LCSD 140-31436/15-B ^5	Lab Control Sample Dup	Step 5	Solid	6010B SEP	31500
LCSD 140-31502/15-A	Lab Control Sample Dup	Step 6	Solid	6010B SEP	31502
140-15490-1 DU	AP-2019-1 (30-31)	Step 5	Solid	6010B SEP	31500
140-15490-1 DU	AP-2019-1 (30-31)	Step 6	Solid	6010B SEP	31502

Analysis Batch: 31713

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Step 7	Solid	6010B SEP	31615
140-15490-1	AP-2019-1 (30-31)	Step 7	Solid	6010B SEP	31615
140-15490-1	AP-2019-1 (30-31)	Step 7	Solid	6010B SEP	31615
140-15490-1	AP-2019-1 (30-31)	Total/NA	Solid	6010B	30683
140-15490-1	AP-2019-1 (30-31)	Total/NA	Solid	6010B	30683
140-15490-1	AP-2019-1 (30-31)	Total/NA	Solid	6010B	30683
140-15490-2	AP-2019-2 (35-36)	Step 7	Solid	6010B SEP	31615
140-15490-2	AP-2019-2 (35-36)	Step 7	Solid	6010B SEP	31615
140-15490-2	AP-2019-2 (35-36)	Step 7	Solid	6010B SEP	31615
140-15490-2	AP-2019-2 (35-36)	Total/NA	Solid	6010B	30683
140-15490-2	AP-2019-2 (35-36)	Total/NA	Solid	6010B	30683
140-15490-2	AP-2019-2 (35-36)	Total/NA	Solid	6010B	30683
140-15490-3	AP-2019-3 (18-19)	Step 7	Solid	6010B SEP	31615
140-15490-3	AP-2019-3 (18-19)	Step 7	Solid	6010B SEP	31615
140-15490-3	AP-2019-3 (18-19)	Step 7	Solid	6010B SEP	31615
140-15490-3	AP-2019-3 (18-19)	Total/NA	Solid	6010B	30683
140-15490-3	AP-2019-3 (18-19)	Total/NA	Solid	6010B	30683
140-15490-3	AP-2019-3 (18-19)	Total/NA	Solid	6010B	30683
MB 140-30683/13-A	Method Blank	Total/NA	Solid	6010B	30683
MB 140-31615/13-A	Method Blank	Step 7	Solid	6010B SEP	31615
LCS 140-30683/14-A	Lab Control Sample	Total/NA	Solid	6010B	30683
LCS 140-31615/14-A	Lab Control Sample	Step 7	Solid	6010B SEP	31615
LCSD 140-30683/15-A	Lab Control Sample Dup	Total/NA	Solid	6010B	30683
LCSD 140-31615/15-A	Lab Control Sample Dup	Step 7	Solid	6010B SEP	31615
140-15490-1 DU	AP-2019-1 (30-31)	Step 7	Solid	6010B SEP	31615
140-15490-1 DU	AP-2019-1 (30-31)	Step 7	Solid	6010B SEP	31615
140-15490-1 DU	AP-2019-1 (30-31)	Step 7	Solid	6010B SEP	31615
140-15490-1 DU	AP-2019-1 (30-31)	Total/NA	Solid	6010B	30683
140-15490-1 DU	AP-2019-1 (30-31)	Total/NA	Solid	6010B	30683
140-15490-1 DU	AP-2019-1 (30-31)	Total/NA	Solid	6010B	30683

Analysis Batch: 31744

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Sum of Steps 1-7	Solid	6010B SEP	
140-15490-2	AP-2019-2 (35-36)	Sum of Steps 1-7	Solid	6010B SEP	
140-15490-3	AP-2019-3 (18-19)	Sum of Steps 1-7	Solid	6010B SEP	

General Chemistry

Analysis Batch: 30602

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
140-15490-1	AP-2019-1 (30-31)	Total/NA	Solid	Moisture	
140-15490-2	AP-2019-2 (35-36)	Total/NA	Solid	Moisture	
140-15490-3	AP-2019-3 (18-19)	Total/NA	Solid	Moisture	
140-15490-1 DU	AP-2019-1 (30-31)	Total/NA	Solid	Moisture	

Lab Chronicle

Client: Golder Associates Inc. Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Client Sample ID: AP-2019-1 (30-31) Lab Sample ID: 140-15490-1

Date Collected: 06/03/19 11:36 **Matrix: Solid**
Date Received: 06/05/19 09:20

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			31744	07/16/19 17:31	CLJ	TAL KNX
	Instrument ID: NOEQUIP									
Total/NA	Analysis	Moisture		1			30602	06/06/19 14:52	BKD	TAL KNX
	Instrument ID: W3									

Client Sample ID: AP-2019-1 (30-31) Lab Sample ID: 140-15490-1

Date Collected: 06/03/19 11:36 **Matrix: Solid**
Date Received: 06/05/19 09:20 **Percent Solids: 76.0**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			0.536 g	50 mL	31128	06/26/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		1			31553	07/10/19 12:59	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		1			31713	07/15/19 14:24	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		10			31713	07/15/19 15:45	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		2			31713	07/15/19 18:28	KNC	TAL KNX
	Instrument ID: DUO									
Step 1	SEP	Exchangeable			5.000 g	25 mL	31148	06/26/19 09:47	KNC	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	31252	06/29/19 08:00	KNC	TAL KNX
Step 1	Analysis	6010B SEP		4			31604	07/11/19 12:49	KNC	TAL KNX
	Instrument ID: DUO									
Step 2	SEP	Carbonate			5.000 g	25 mL	31253	06/29/19 08:00	KNC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	31256	06/30/19 08:00	KNC	TAL KNX
Step 2	Analysis	6010B SEP		3			31604	07/11/19 14:21	KNC	TAL KNX
	Instrument ID: DUO									
Step 3	SEP	Non-Crystalline			5.000 g	25 mL	31257	06/30/19 08:00	KNC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	31338	07/02/19 08:00	KNC	TAL KNX
Step 3	Analysis	6010B SEP		1			31604	07/11/19 16:06	KNC	TAL KNX
	Instrument ID: DUO									
Step 4	SEP	Metal Hydroxide			5.000 g	25 mL	31341	07/02/19 09:00	KNC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	31360	07/03/19 08:00	KNC	TAL KNX
Step 4	Analysis	6010B SEP		1			31604	07/11/19 17:49	KNC	TAL KNX
	Instrument ID: DUO									
Step 5	SEP	Organic-Bound			5.000 g	75 mL	31436	07/08/19 07:00	KNC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	31500	07/10/19 08:00	KNC	TAL KNX
Step 5	Analysis	6010B SEP		5			31651	07/12/19 11:54	KNC	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5.000 g	250 mL	31502	07/10/19 08:00	KNC	TAL KNX
Step 6	Analysis	6010B SEP		1			31651	07/12/19 13:29	KNC	TAL KNX
	Instrument ID: DUO									

Lab Chronicle

Client: Golder Associates Inc. Job ID: 140-15490-1

Project/Site: Martin Lake Ash Ponds - SEP + Totals

Client Sample ID: AP-2019-1 (30-31) Lab Sample ID: 140-15490-1

Date Collected: 06/03/19 11:36 **Matrix: Solid**

Date Received: 06/05/19 09:20 **Percent Solids: 76.0**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		1			31713	07/15/19 11:39	KNC	TAL KNX
	Instrument ID:	DUO								
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		10			31713	07/15/19 13:08	KNC	TAL KNX
	Instrument ID:	DUO								
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		2			31713	07/15/19 17:11	KNC	TAL KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Prep	7470A			5.0 mL	50.0 mL	30859	06/16/19 08:00	DKW	TAL KNX
Total/NA	Analysis	7470A		1			30868	06/16/19 14:04	DKW	TAL KNX
	Instrument ID:	HG								

Client Sample ID: AP-2019-2 (35-36) Lab Sample ID: 140-15490-2

Date Collected: 06/03/19 13:20 **Matrix: Solid**

Date Received: 06/05/19 09:20

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			31744	07/16/19 17:31	CLJ	TAL KNX
	Instrument ID:	NOEQUIP								
Total/NA	Analysis	Moisture		1			30602	06/06/19 14:52	BKD	TAL KNX
	Instrument ID:	W3								

Client Sample ID: AP-2019-2 (35-36) Lab Sample ID: 140-15490-2

Date Collected: 06/03/19 13:20 **Matrix: Solid**

Date Received: 06/05/19 09:20 **Percent Solids: 78.5**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			0.527 g	50 mL	31128	06/26/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		1			31553	07/10/19 13:13	KNC	TAL KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		1			31713	07/15/19 14:36	KNC	TAL KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		10			31713	07/15/19 16:10	KNC	TAL KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		5			31713	07/15/19 18:38	KNC	TAL KNX
	Instrument ID:	DUO								
Step 1	SEP	Exchangeable			5.000 g	25 mL	31148	06/26/19 09:47	KNC	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	31252	06/29/19 08:00	KNC	TAL KNX
Step 1	Analysis	6010B SEP		4			31604	07/11/19 12:59	KNC	TAL KNX
	Instrument ID:	DUO								

1 2 3 4 5 6 7 8 9 10 11 12 13

Lab Chronicle

Client: Golder Associates Inc. Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Client Sample ID: AP-2019-2 (35-36) Lab Sample ID: 140-15490-2

Date Collected: 06/03/19 13:20 **Matrix: Solid**
Date Received: 06/05/19 09:20 **Percent Solids: 78.5**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 2	SEP	Carbonate			5.000 g	25 mL	31253	06/29/19 08:00	KNC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	31256	06/30/19 08:00	KNC	TAL KNX
Step 2	Analysis	6010B SEP		3			31604	07/11/19 14:42	KNC	TAL KNX
	Instrument ID: DUO									
Step 3	SEP	Non-Crystalline			5.000 g	25 mL	31257	06/30/19 08:00	KNC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	31338	07/02/19 08:00	KNC	TAL KNX
Step 3	Analysis	6010B SEP		1			31604	07/11/19 16:16	KNC	TAL KNX
	Instrument ID: DUO									
Step 4	SEP	Metal Hydroxide			5.000 g	25 mL	31341	07/02/19 09:00	KNC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	31360	07/03/19 08:00	KNC	TAL KNX
Step 4	Analysis	6010B SEP		1			31604	07/11/19 17:59	KNC	TAL KNX
	Instrument ID: DUO									
Step 5	SEP	Organic-Bound			5.000 g	75 mL	31436	07/08/19 07:00	KNC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	31500	07/10/19 08:00	KNC	TAL KNX
Step 5	Analysis	6010B SEP		5			31651	07/12/19 12:05	KNC	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5.000 g	250 mL	31502	07/10/19 08:00	KNC	TAL KNX
Step 6	Analysis	6010B SEP		1			31651	07/12/19 13:49	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		1			31713	07/15/19 12:05	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		10			31713	07/15/19 13:19	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		2			31713	07/15/19 17:21	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Prep	7470A			5.0 mL	50.0 mL	30859	06/16/19 08:00	DKW	TAL KNX
Total/NA	Analysis	7470A		1			30868	06/16/19 14:09	DKW	TAL KNX
	Instrument ID: HG									

Client Sample ID: AP-2019-3 (18-19) Lab Sample ID: 140-15490-3

Date Collected: 06/03/19 15:20 **Matrix: Solid**
Date Received: 06/05/19 09:20

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Sum of Steps 1-7	Analysis	6010B SEP		1			31744	07/16/19 17:31	CLJ	TAL KNX
	Instrument ID: NOEQUIP									
Total/NA	Analysis	Moisture		1			30602	06/06/19 14:52	BKD	TAL KNX
	Instrument ID: W3									

Lab Chronicle

Client: Golder Associates Inc.
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Job ID: 140-15490-1

Client Sample ID: AP-2019-3 (18-19)
Date Collected: 06/03/19 15:20
Date Received: 06/05/19 09:20

Lab Sample ID: 140-15490-3
Matrix: Solid
Percent Solids: 80.0

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			0.527 g	50 mL	31128	06/26/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		1			31553	07/10/19 13:18	KNC	TAL KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		1			31713	07/15/19 14:41	KNC	TAL KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		10			31713	07/15/19 16:15	KNC	TAL KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		5			31713	07/15/19 18:43	KNC	TAL KNX
	Instrument ID:	DUO								
Step 1	SEP	Exchangeable			5.000 g	25 mL	31148	06/26/19 09:47	KNC	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	31252	06/29/19 08:00	KNC	TAL KNX
Step 1	Analysis	6010B SEP		4			31604	07/11/19 13:04	KNC	TAL KNX
	Instrument ID:	DUO								
Step 2	SEP	Carbonate			5.000 g	25 mL	31253	06/29/19 08:00	KNC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	31256	06/30/19 08:00	KNC	TAL KNX
Step 2	Analysis	6010B SEP		3			31604	07/11/19 14:47	KNC	TAL KNX
	Instrument ID:	DUO								
Step 3	SEP	Non-Crystalline			5.000 g	25 mL	31257	06/30/19 08:00	KNC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	31338	07/02/19 08:00	KNC	TAL KNX
Step 3	Analysis	6010B SEP		1			31604	07/11/19 16:21	KNC	TAL KNX
	Instrument ID:	DUO								
Step 4	SEP	Metal Hydroxide			5.000 g	25 mL	31341	07/02/19 09:00	KNC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	31360	07/03/19 08:00	KNC	TAL KNX
Step 4	Analysis	6010B SEP		1			31604	07/11/19 18:04	KNC	TAL KNX
	Instrument ID:	DUO								
Step 5	SEP	Organic-Bound			5.000 g	75 mL	31436	07/08/19 07:00	KNC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	31500	07/10/19 08:00	KNC	TAL KNX
Step 5	Analysis	6010B SEP		5			31651	07/12/19 12:10	KNC	TAL KNX
	Instrument ID:	DUO								
Step 6	SEP	Acid/Sulfide			5.000 g	250 mL	31502	07/10/19 08:00	KNC	TAL KNX
Step 6	Analysis	6010B SEP		1			31651	07/12/19 13:55	KNC	TAL KNX
	Instrument ID:	DUO								
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		1			31713	07/15/19 12:11	KNC	TAL KNX
	Instrument ID:	DUO								
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		10			31713	07/15/19 13:24	KNC	TAL KNX
	Instrument ID:	DUO								
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		2			31713	07/15/19 17:27	KNC	TAL KNX
	Instrument ID:	DUO								

Lab Chronicle

1 2 3 4 5 6 7 8 9 10 11 12 13

Client Sample ID: AP-2019-3 (18-19)

Lab Sample ID: 140-15490-3
Date Collected: 06/03/19 15:20 **Matrix: Solid**
Date Received: 06/05/19 09:20 **Percent Solids: 80.0**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Prep	7470A			5.0 mL	50.0 mL	30859	06/16/19 08:00	DKW	TAL KNX
Total/NA	Analysis	7470A		1			30868	06/16/19 14:17	DKW	TAL KNX
	Instrument ID: HG									

Client Sample ID: Method Blank

Lab Sample ID: MB 140-30683/13-A
Date Collected: N/A **Matrix: Solid**
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		1			31713	07/15/19 11:13	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank

Lab Sample ID: MB 140-30683/13-B
Date Collected: N/A **Matrix: Solid**
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Prep	7470A			5.0 mL	50.0 mL	30859	06/16/19 08:00	DKW	TAL KNX
Total/NA	Analysis	7470A		1			30868	06/16/19 13:56	DKW	TAL KNX
	Instrument ID: HG									

Client Sample ID: Method Blank

Lab Sample ID: MB 140-31128/14-A
Date Collected: N/A **Matrix: Solid**
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			0.500 g	50 mL	31128	06/26/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		1			31553	07/10/19 11:42	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank

Lab Sample ID: MB 140-31148/13-B ^4
Date Collected: N/A **Matrix: Solid**
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 1	SEP	Exchangeable			5.000 g	25 mL	31148	06/26/19 09:47	KNC	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	31252	06/29/19 08:00	KNC	TAL KNX
Step 1	Analysis	6010B SEP		4			31604	07/11/19 12:33	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank

Lab Sample ID: MB 140-31253/13-B ^3

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 2	SEP	Carbonate			5.000 g	25 mL	31253	06/29/19 08:00	KNC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	31256	06/30/19 08:00	KNC	TAL KNX
Step 2	Analysis	6010B SEP		3			31604	07/11/19 14:06	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank

Lab Sample ID: MB 140-31257/13-B

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 3	SEP	Non-Crystalline			5.000 g	25 mL	31257	06/30/19 08:00	KNC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	31338	07/02/19 08:00	KNC	TAL KNX
Step 3	Analysis	6010B SEP		1			31604	07/11/19 15:50	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank

Lab Sample ID: MB 140-31341/13-B

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 4	SEP	Metal Hydroxide			5.000 g	25 mL	31341	07/02/19 09:00	KNC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	31360	07/03/19 08:00	KNC	TAL KNX
Step 4	Analysis	6010B SEP		1			31604	07/11/19 17:24	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank

Lab Sample ID: MB 140-31436/13-B ^5

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 5	SEP	Organic-Bound			5.000 g	75 mL	31436	07/08/19 07:00	KNC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	31500	07/10/19 08:00	KNC	TAL KNX
Step 5	Analysis	6010B SEP		5			31651	07/12/19 11:39	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Method Blank

Lab Sample ID: MB 140-31502/13-A

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 6	SEP	Acid/Sulfide			5.000 g	250 mL	31502	07/10/19 08:00	KNC	TAL KNX
Step 6	Analysis	6010B SEP		1			31651	07/12/19 13:14	KNC	TAL KNX
	Instrument ID: DUO									

Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Client Sample ID: Method Blank

Lab Sample ID: MB 140-31615/13-A

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		1			31713	07/15/19 10:58	KNC	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-30683/14-A

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		1			31713	07/15/19 11:19	KNC	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-30683/14-B

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Prep	7470A			5.0 mL	50.0 mL	30859	06/16/19 08:00	DKW	TAL KNX
Total/NA	Analysis	7470A		1			30868	06/16/19 13:59	DKW	TAL KNX
	Instrument ID:	HG								

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-31128/15-A

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			0.500 g	50 mL	31128	06/26/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		1			31553	07/10/19 11:47	KNC	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-31148/14-B ^5

Date Collected: N/A

Matrix: Solid

Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 1	SEP	Exchangeable			5.000 g	25 mL	31148	06/26/19 09:47	KNC	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	31252	06/29/19 08:00	KNC	TAL KNX
Step 1	Analysis	6010B SEP		5			31604	07/11/19 12:38	KNC	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-31253/14-B ^5

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 2	SEP	Carbonate			5.000 g	25 mL	31253	06/29/19 08:00	KNC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	31256	06/30/19 08:00	KNC	TAL KNX
Step 2	Analysis	6010B SEP		5			31604	07/11/19 14:11	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-31257/14-B

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 3	SEP	Non-Crystalline			5.000 g	25 mL	31257	06/30/19 08:00	KNC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	31338	07/02/19 08:00	KNC	TAL KNX
Step 3	Analysis	6010B SEP		1			31604	07/11/19 15:56	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-31341/14-B

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 4	SEP	Metal Hydroxide			5.000 g	25 mL	31341	07/02/19 09:00	KNC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	31360	07/03/19 08:00	KNC	TAL KNX
Step 4	Analysis	6010B SEP		1			31604	07/11/19 17:29	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-31436/14-B ^5

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 5	SEP	Organic-Bound			5.000 g	75 mL	31436	07/08/19 07:00	KNC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	31500	07/10/19 08:00	KNC	TAL KNX
Step 5	Analysis	6010B SEP		5			31651	07/12/19 11:44	KNC	TAL KNX
	Instrument ID: DUO									

Client Sample ID: Lab Control Sample

Lab Sample ID: LCS 140-31502/14-A

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 6	SEP	Acid/Sulfide			5.000 g	250 mL	31502	07/10/19 08:00	KNC	TAL KNX
Step 6	Analysis	6010B SEP		1			31651	07/12/19 13:19	KNC	TAL KNX
	Instrument ID: DUO									

Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Client Sample ID: Lab Control Sample
Lab Sample ID: LCS 140-31615/14-A

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		1			31713	07/15/19 11:03	KNC	TAL KNX

Instrument ID: DUO

Client Sample ID: Lab Control Sample Dup
Lab Sample ID: LCSD 140-30683/15-A

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		1			31713	07/15/19 11:24	KNC	TAL KNX

Instrument ID: DUO

Client Sample ID: Lab Control Sample Dup
Lab Sample ID: LCSD 140-30683/15-B

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Prep	7470A			5.0 mL	50.0 mL	30859	06/16/19 08:00	DKW	TAL KNX
Total/NA	Analysis	7470A		1			30868	06/16/19 14:02	DKW	TAL KNX

Instrument ID: HG

Client Sample ID: Lab Control Sample Dup
Lab Sample ID: LCSD 140-31148/15-B ^5

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 1	SEP	Exchangeable			5.000 g	25 mL	31148	06/26/19 09:47	KNC	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	31252	06/29/19 08:00	KNC	TAL KNX
Step 1	Analysis	6010B SEP		5			31604	07/11/19 12:43	KNC	TAL KNX

Instrument ID: DUO

Client Sample ID: Lab Control Sample Dup
Lab Sample ID: LCSD 140-31253/15-B ^5

Date Collected: N/A
Matrix: Solid
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 2	SEP	Carbonate			5.000 g	25 mL	31253	06/29/19 08:00	KNC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	31256	06/30/19 08:00	KNC	TAL KNX
Step 2	Analysis	6010B SEP		5			31604	07/11/19 14:16	KNC	TAL KNX

Instrument ID: DUO

Lab Chronicle

Client: Golder Associates Inc. Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Client Sample ID: Lab Control Sample Dup — Lab Sample ID: LCSD 140-31257/15-B

Date Collected: N/A **Matrix: Solid**
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 3	SEP	Non-Crystalline			5.000 g	25 mL	31257	06/30/19 08:00	KNC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	31338	07/02/19 08:00	KNC	TAL KNX
Step 3	Analysis	6010B SEP		1			31604	07/11/19 16:01	KNC	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample Dup — Lab Sample ID: LCSD 140-31341/15-B

Date Collected: N/A **Matrix: Solid**
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 4	SEP	Metal Hydroxide			5.000 g	25 mL	31341	07/02/19 09:00	KNC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	31360	07/03/19 08:00	KNC	TAL KNX
Step 4	Analysis	6010B SEP		1			31604	07/11/19 17:44	KNC	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample Dup — Lab Sample ID: LCSD 140-31436/15-B ^5

Date Collected: N/A **Matrix: Solid**
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 5	SEP	Organic-Bound			5.000 g	75 mL	31436	07/08/19 07:00	KNC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	31500	07/10/19 08:00	KNC	TAL KNX
Step 5	Analysis	6010B SEP		5			31651	07/12/19 11:49	KNC	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample Dup — Lab Sample ID: LCSD 140-31502/15-A

Date Collected: N/A **Matrix: Solid**
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 6	SEP	Acid/Sulfide			5.000 g	250 mL	31502	07/10/19 08:00	KNC	TAL KNX
Step 6	Analysis	6010B SEP		1			31651	07/12/19 13:24	KNC	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: Lab Control Sample Dup — Lab Sample ID: LCSD 140-31615/15-A

Date Collected: N/A **Matrix: Solid**
Date Received: N/A

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		1			31713	07/15/19 11:08	KNC	TAL KNX
	Instrument ID:	DUO								

Lab Chronicle

Client: Golder Associates Inc. Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Client Sample ID: AP-2019-1 (30-31) Lab Sample ID: 140-15490-1 MS

Date Collected: 06/03/19 11:36 **Matrix: Solid**
Date Received: 06/05/19 09:20 **Percent Solids: 76.0**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			0.530 g	50 mL	31128	06/26/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		1			31553	07/10/19 13:04	KNC	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: AP-2019-1 (30-31) Lab Sample ID: 140-15490-1 MSD

Date Collected: 06/03/19 11:36 **Matrix: Solid**
Date Received: 06/05/19 09:20 **Percent Solids: 76.0**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			0.539 g	50 mL	31128	06/26/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		1			31553	07/10/19 13:08	KNC	TAL KNX
	Instrument ID:	DUO								

Client Sample ID: AP-2019-1 (30-31) Lab Sample ID: 140-15490-1 DU

Date Collected: 06/03/19 11:36 **Matrix: Solid**
Date Received: 06/05/19 09:20

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			30602	06/06/19 14:52	BKD	TAL KNX
	Instrument ID:	W3								

Client Sample ID: AP-2019-1 (30-31) Lab Sample ID: 140-15490-1 DU

Date Collected: 06/03/19 11:36 **Matrix: Solid**
Date Received: 06/05/19 09:20 **Percent Solids: 76.0**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		1			31713	07/15/19 14:30	KNC	TAL KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		10			31713	07/15/19 15:50	KNC	TAL KNX
	Instrument ID:	DUO								
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Analysis	6010B		2			31713	07/15/19 18:33	KNC	TAL KNX
	Instrument ID:	DUO								
Step 1	SEP	Exchangeable			5.000 g	25 mL	31148	06/26/19 09:47	KNC	TAL KNX
Step 1	Prep	3010A			5 mL	50 mL	31252	06/29/19 08:00	KNC	TAL KNX
Step 1	Analysis	6010B SEP		4			31604	07/11/19 12:54	KNC	TAL KNX
	Instrument ID:	DUO								
Step 2	SEP	Carbonate			5.000 g	25 mL	31253	06/29/19 08:00	KNC	TAL KNX
Step 2	Prep	3010A			5 mL	50 mL	31256	06/30/19 08:00	KNC	TAL KNX
Step 2	Analysis	6010B SEP		3			31604	07/11/19 14:37	KNC	TAL KNX
	Instrument ID:	DUO								

Lab Chronicle

Client: Golder Associates Inc.
Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Client Sample ID: AP-2019-1 (30-31)
Lab Sample ID: 140-15490-1 DU
Date Collected: 06/03/19 11:36
Matrix: Solid
Date Received: 06/05/19 09:20
Percent Solids: 76.0

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Step 3	SEP	Non-Crystalline			5.000 g	25 mL	31257	06/30/19 08:00	KNC	TAL KNX
Step 3	Prep	3010A			5 mL	50 mL	31338	07/02/19 08:00	KNC	TAL KNX
Step 3	Analysis	6010B SEP		1			31604	07/11/19 16:11	KNC	TAL KNX
	Instrument ID: DUO									
Step 4	SEP	Metal Hydroxide			5.000 g	25 mL	31341	07/02/19 09:00	KNC	TAL KNX
Step 4	Prep	3010A			5 mL	50 mL	31360	07/03/19 08:00	KNC	TAL KNX
Step 4	Analysis	6010B SEP		1			31604	07/11/19 17:54	KNC	TAL KNX
	Instrument ID: DUO									
Step 5	SEP	Organic-Bound			5.000 g	75 mL	31436	07/08/19 07:00	KNC	TAL KNX
Step 5	Prep	3010A			5 mL	50 mL	31500	07/10/19 08:00	KNC	TAL KNX
Step 5	Analysis	6010B SEP		5			31651	07/12/19 12:00	KNC	TAL KNX
	Instrument ID: DUO									
Step 6	SEP	Acid/Sulfide			5.000 g	250 mL	31502	07/10/19 08:00	KNC	TAL KNX
Step 6	Analysis	6010B SEP		1			31651	07/12/19 13:44	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		1			31713	07/15/19 12:00	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		10			31713	07/15/19 13:14	KNC	TAL KNX
	Instrument ID: DUO									
Step 7	Prep	Residual			1.000 g	50 mL	31615	07/12/19 09:08	KNC	TAL KNX
Step 7	Analysis	6010B SEP		2			31713	07/15/19 17:16	KNC	TAL KNX
	Instrument ID: DUO									
Total/NA	Prep	Total			1.000 g	50 mL	30683	06/11/19 08:00	KNC	TAL KNX
Total/NA	Prep	7470A			5.0 mL	50.0 mL	30859	06/16/19 08:00	DKW	TAL KNX
Total/NA	Analysis	7470A		1			30868	06/16/19 14:06	DKW	TAL KNX
	Instrument ID: HG									

Laboratory References:

TAL KNX = Eurofins TestAmerica, Knoxville, 5815 Middlebrook Pike, Knoxville, TN 37921, TEL (865)291-3000

Method Summary

Client: Golder Associates Inc.
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Job ID: 140-15490-1

Method	Method Description	Protocol	Laboratory
6010B	Metals (ICP)	SW846	TAL KNX
6010B	SEP Metals (ICP) - Total	SW846	TAL KNX
6010B SEP	SEP Metals (ICP)	SW846	TAL KNX
7470A	SEP Mercury (CVAA) - Total	SW846	TAL KNX
Moisture	Percent Moisture	EPA	TAL KNX
3010A	Preparation, Total Metals	SW846	TAL KNX
3050B	Preparation, Metals	SW846	TAL KNX
7470A	Preparation, Mercury	SW846	TAL KNX
Acid/Sulfide	Sequential Extraction Procedure, Acid/Sulfide Fraction	TAL-KNOX	TAL KNX
Carbonate	Sequential Extraction Procedure, Carbonate Fraction	TAL-KNOX	TAL KNX
Exchangeable	Sequential Extraction Procedure, Exchangeable Fraction	TAL-KNOX	TAL KNX
Metal Hydroxide	Sequential Extraction Procedure, Metal Hydroxide Fraction	TAL-KNOX	TAL KNX
Non-Crystalline	Sequential Extraction Procedure, Non-crystalline Materials	TAL-KNOX	TAL KNX
Organic-Bound	Sequential Extraction Procedure, Organic Bound Fraction	TAL-KNOX	TAL KNX
Residual	Sequential Extraction Procedure, Residual Fraction	TAL-KNOX	TAL KNX
Total	Preparation, Total Material	TAL-KNOX	TAL KNX

Protocol References:

EPA = US Environmental Protection Agency
SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.
TAL-KNOX = TestAmerica Laboratories, Knoxville, Facility Standard Operating Procedure.

Laboratory References:

TAL KNX = Eurofins TestAmerica, Knoxville, 5815 Middlebrook Pike, Knoxville, TN 37921, TEL (865)291-3000

Sample Summary

Client: Golder Associates Inc.
Job ID: 140-15490-1
Project/Site: Martin Lake Ash Ponds - SEP + Totals

Lab Sample ID	Client Sample ID	Matrix	Collected	Received	Asset ID
140-15490-1	AP-2019-1 (30-31)	Solid	06/03/19 11:36	06/05/19 09:20	
140-15490-2	AP-2019-2 (35-36)	Solid	06/03/19 13:20	06/05/19 09:20	
140-15490-3	AP-2019-3 (18-19)	Solid	06/03/19 15:20	06/05/19 09:20	

Eurofins TestAmerica, Knoxville
5815 Middlebrook Pike
Knoxville, TN 37921
Phone (865) 291-3000 Fax (865) 584-4315

Chain of Custody Record

eurofins | Environment Testing
TestAmerica

Client Information
Client Contact: Will Vienne
Company: Golder Associates Inc.
Address: 2201 Double Creek Dr Suite 4004
City: Round Rock
State, Zip: TX, 78664
Phone: 512-671-3434(Tel)
Email: William_Vienne@golder.com
Project Name: Martin Lake Ash Ponds - SEP + Totals
Site:

Sampler: Kelsey Worley
Phone: 281-750-2734
Due Date Requested:
TAT Requested (days): Standard
PO #: 19122434-C
WO #: 1922434-C
Project #: 14005268
SSOW#:

Lab PM: Walker Wasmund, Terry
E-Mail: terry.wasmund@testamericainc.com
Carrier Tracking No(s):

COC No: 140-6683-2229.1
Page: Page 1 of 1
Job #:

Analysis Requested

140-15490 Chain of Custody

Preservation Codes:

A - HCL
B - NaOH
C - Zn Acetate
D - Nitric Acid
E - NaHSO4
F - MeOH
G - Amchlor
H - Ascorbic Acid
I - Ice
J - DI Water
K - EDTA
L - EDA

M - Hexane
N - None
O - AsNaO2
P - Na2O4S
Q - Na2SO3
R - Na2S2O3
S - H2SO4
T - TSP Dodecahydrate
U - Acetone
V - MCAA
W - pH 4-5
Z - other (specify)

Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	6010B_SEP - 7-Step SEP (12 Metals)	6010B - Total B, Cr, Pb	Total Number of containers	Special Instructions/Note:
			Preservation Code:				N	I		
AP-2019-1 (30-31)	06/03/19	1136	C	S			X	X		On Ice
AP-2019-2 (35-36)	06/03/19	1320	C	S			X	X		" "
AP-2019-3 (18-19)	06/03/19	1520	C	S			X	X		" "

RT: 1.2°C CT: 1.2°C, 1 Cooler
FedEx / Custody seal intact
trK# 7876 7328 2042
KW 6/5/19

Possible Hazard Identification
☑ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *Poison B* ☐ *Unknown* ☐ *Radiological*

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☒ *Disposal By Lab* ☐ *Archive For* ________ *Months*

Deliverable Requested: I, II, III, IV, Other (specify)
Special Instructions/QC Requirements:

Empty Kit Relinquished by: Date: Time: Method of Shipment:

Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Kelsey Worley	06/04/19 1245	Golder		6/5/19 0920	TA-Knox

Custody Seals Intact: Δ Yes Δ No
Custody Seal No.:
Cooler Temperature(s) °C and Other Remarks:

Ver: 01/16/2019

Loc: 140
15490

TESTAMERICA KNOXVILLE SAMPLE RECEIPT/CONDITION UPON RECEIPT ANOMALY CHECKLIST

Log In Number:

Review Items	Yes	No	NA	**If No, what was the problem?**	**Comments/Actions Taken**
1. Are the shipping containers intact?	✓			☐ **Containers, Broken**	
2. Were ambient air containers received intact?			✓	☐ Checked in lab	
3. The coolers/containers custody seal if present, is it intact?	✓			☐ Yes ☐ NA	
4. Is the cooler temperature within limits? (> freezing temp. of water to 6 °C, VOST: 10°C) Thermometer ID : 5C8 Correction factor: +0.0	✓			☐ **Cooler Out of Temp, Client Contacted, Proceed/Cancel** ☐ **Cooler Out of Temp, Same Day Receipt**	
5. Were all of the sample containers received intact?	✓			☐ **Containers, Broken**	
6. Were samples received in appropriate containers?	✓			☐ **Containers, Improper; Client Contacted; Proceed/Cancel**	
7. Do sample container labels match COC? (IDs, Dates, Times)	✓			☐ **COC & Samples Do Not Match** ☐ **COC Incorrect/Incomplete** ☐ **COC Not Received**	
8. Were all of the samples listed on the COC received?	✓			☐ **Sample Received, Not on COC** ☐ **Sample on COC, Not Received**	
9. Is the date/time of sample collection noted?	✓			☐ **COC; No Date/Time; Client Contacted**	**Labeling Verified by: Date:**
10. Was the sampler identified on the COC?	✓			☐ **Sampler Not Listed on COC**	
11. Is the client and project name/# identified?	✓			☐ **COC Incorrect/Incomplete**	**pH test strip lot number:**
12. Are tests/parameters listed for each sample?	✓			☐ **COC No tests on COC**	
13. Is the matrix of the samples noted?	✓			☐ **COC Incorrect/Incomplete**	
14. Was COC relinquished? (Signed/Dated/Timed)	✓			☐ **COC Incorrect/Incomplete**	
15. Were samples received within holding time?	✓			☐ **Holding Time - Receipt**	
16. Were samples received with correct chemical preservative (excluding Encore)?			✓	☐ **pH Adjusted, pH Included (See box 16A)** ☐ **Incorrect Preservative**	
17. Were VOA samples received without headspace?			✓	☐ **Headspace (VOA only)**	
18. Did you check for residual chlorine, if necessary? (e.g. 1613B, 1668) Chlorine test strip lot number:			✓	☐ **Residual Chlorine**	
19. For 1613B water samples is pH<9?			✓	☐ If no, notify lab to adjust	
20. For rad samples was sample activity info. Provided?			✓	☐ Project missing info	

	Box 16A: pH Preservation	Box 18A: Residual Chlorine
Preservative:		
Lot Number:		
Exp Date:		
Analyst:		
Date:		
Time:		

Project #: 1400526P PM Instructions:

Sample Receiving Associate: Date: 6/5/19

QA026R31.doc, 112618

1 2 3 4 5 6 7 8 9 10 11 12 13

APPENDIX C

GROUNDWATER SAMPLING RECORDS

RECORD OF WATER LEVEL READINGS

GOLDER

Project Name: LUMINANT-MLSES-PONDS **Location:** TATUM, TX **Project No.:** 19122262-C

Borehole No.	Date	Time	Measuring Device / Serial No.	Measurement Point (M.P)	Water Level Below M.P.	Correction To Survey Mark	Survey Mark Elevation	Water Level Elevation	By	Comments
H-31	5-14-19	0704	SOLINST	TOC	22.73				JTB	
H-32	5-14-19	0759	SOLINST	TOC	23.16				JTB	
H-27	5-14-19	0903	SOLINST	TOC	22.02				JTB	
H-29	5-14-19	1050	SOLINST	TOC	22.61				JTB	
H-28	5-14-19	1155	SOLINST	TOC	7.12				JTB	
H-26	5-14-19	1350	SOLINST	TOC	13.21				JTB	
H-33	5-14-19	1449	SOLINST	TOC	13.42				JTB	

Sheet 1 of 1

GROUNDWATER SAMPLING RECORD

PAGE 1 of 1

Project Number: 19122262-C Project Name: LUMINANT - MCSES Date: 5-14-19

Sample Number:	H-26	Starting Water Level (ft. BMP):	13.21
Sampling Location (well ID, etc.):	H-26	Casing Stickup (ft.):	-
Sampled by:	JTB	Starting Water Level (ft. BGL):	13.21
Measuring Point (MP) of Well:	TOC/PVC	Total Depth (ft. BGL):	-
Screened Interval (ft. BGL):	-	Casing Diameter (in ID):	2.0
Filter Pack Interval (ft. BGL):	-	Casing Volume (gal.):	-

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment: alconox & DI rinse

Purging: peristaltic / bladder Sampling: Same

Disposal of Discharged Water: on site

INSTRUMENTS (Indicate make, model, I.d.)

Water Level:	KECK	Thermometer:	HORIBA
pH Meter:	HORIBA	Field Calibration:	7-4
Conductivity Meter:	HORIBA	Field Calibration:	1413
Filter / Filter Size:		Other:	

SAMPLING MEASUREMENTS

1352 Time	Cum. Vol. (gal. or [✓ L])	Purge Rate (gal. or [✓ L/m])	Temp. (oC)	pH	Spec. Cond. (mmhos/cm)	D.O	Redox (mV)	Turbidity & Color	Water Depth (ft BMP)
1401	—	.2	23.1	6.81	1730	0.86	-29	8.1	13.44
1406		↓	22.7	6.82	1760	0.63	-37	7.1	13.46
1413		↓	22.8	6.83	1760	0.64	-31	7.7	13.47

Water Level (ft. BMP) at End of Purge: 13.47 Sample Intake Depth (ft. BMP):

SAMPLE INVENTORY

Bottles Collected				Filtration (Y / N)	Preservation	Remarks (quality control sample, other)
Time	Volume	Composition (G, P)	No.			
1425	250ML	P	1	N	—	GEN CHEM
1425	500ML	P	1	N	HNO3	METALS

Comments:

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
(512) 671-3434 Fax (512) 671-3446

GROUNDWATER SAMPLING RECORD

PAGE 1 of 1

Project Number: 19122262-C Project Name: LUMINANT- MCSES Date: 5-14-19

Sample Number: A-27

Sampling Location (well ID, etc.): H-27

Sampled by: JJB

Measuring Point (MP) of Well: TOC/PVC

Screened Interval (ft. BGL): –

Filter Pack Interval (ft. BGL): –

Starting Water Level (ft. BMP): 22.02

Casing Stickup (ft.): –

Starting Water Level (ft. BGL): 22.02

Total Depth (ft. BGL): –

Casing Diameter (In ID): 2.0

Casing Volume (gal.): –

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment: alconox & DI rinse

Purging: peristaltic | bladder Sampling: Same

Disposal of Discharged Water: on site

INSTRUMENTS (Indicate make, model, I.d.)

Water Level: KECK

Thermometer: HORIBA

pH Meter: HORIBA

Field Calibration: 7-4

Conductivity Meter: HORIBA

Field Calibration: 1413

Filter / Filter Size:

Other:

SAMPLING MEASUREMENTS

0906 Time	Cum. Vol. (gal. or [✓ L])	Purge Rate (gal. or [✓ L/m])	Temp. (oC)	pH	Spec. Cond. (mmhos/cm)	D.O	Redox (mV)	Turbidity & Color	Water Depth (ft BMP)
0916	—	.2	22.1	6.74	1610	0.49	-79	7.7	22.23
0921		↓	22.4	6.77	1640	0.51	-81	7.9	22.24
0927			22.4	6.78	1630	0.52	-82	7.9	22.23

Water Level (ft. BMP) at End of Purge: 22.23

Sample Intake Depth (ft. BMP):

SAMPLE INVENTORY

Bottles Collected				Filtration		Remarks
Time	Volume	Composition (G, P)	No.	(Y / N)	Preservation	(quality control sample, other)
0940	250mL	P	1	N	–	GEN CHEM
0940	500mL	P	1	N	HNO3	METALS

Comments:

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
(512) 671-3434 Fax (512) 671-3446

GROUNDWATER SAMPLING RECORD

PAGE 1 of 1

Project Number: 19122262-C	Project Name: LUMINANT- MLSES		Date: 5-14-19
Sample Number: H-28		Starting Water Level (ft. BMP):	7.12
Sampling Location (well ID, etc.): H-28		Casing Stickup (ft.):	—
Sampled by: JTB		Starting Water Level (ft. BGL):	7.12
Measuring Point (MP) of Well: TOC/PVC		Total Depth (ft. BGL):	—
Screened Interval (ft. BGL): —		Casing Diameter (In ID):	2.0
Filter Pack Interval (ft. BGL): —		Casing Volume (gal.):	—

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment: alconox & DI rinse

Purging: peristaltic / bladder Sampling: Same

Disposal of Discharged Water: on site

INSTRUMENTS (Indicate make, model, I.d.)

Water Level:	KECK	Thermometer:	HORIBA
pH Meter	HORIBA	Field Calibration:	7-4
Conductivity Meter:	HORIBA	Field Calibration:	1413
Filter / Filter Size:		Other:	

SAMPLING MEASUREMENTS

1157 Time	Cum. Vol (gal. or [✓ L])	Purge Rate (gal. or [✓ L/m])	Temp. (oC)	pH	Spec. Cond. (mmhos/cm)	D.O	Redox (mV)	Turbidity & Color	Water Depth (ft BMP)
1207	—	.2	22.6	6.29	1580	0.39	-34	3.8	7.29
1211		|	22.9	6.31	1520	0.31	-39	4.6	7.31
1218		↓	22.9	6.32	1510	0.32	-39	4.8	7.32

Water Level (ft. BMP) at End of Purge: 7.32 Sample Intake Depth (ft. BMP):

SAMPLE INVENTORY

Bottles Collected				Filtration		Remarks
Time	Volume	Composition (G, P)	No.	(Y / N)	Preservation	(quality control sample, other)
1230	250mL	P	1	N	—	GEN CHEM
1230	500mL	P	1	N	HNO_3	METALS

Comments:

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
(512) 671-3434 Fax (512) 671-3446

GROUNDWATER SAMPLING RECORD

PAGE 1 of 1

Project Number: 19122262-C Project Name: LUMINANT - MCSES

Date: 5-14-19

Sample Number: H-29

Sampling Location (well ID, etc.): H-29

Sampled by: JTB

Measuring Point (MP) of Well: TOC/PVC

Screened Interval (ft. BGL): –

Filter Pack Interval (ft. BGL): –

Starting Water Level (ft. BMP): 22.61

Casing Stickup (ft.): –

Starting Water Level (ft. BGL): 22.61

Total Depth (ft. BGL): –

Casing Diameter (in ID): 2.0

Casing Volume (gal.): –

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment: alconox & DI rinse

Purging: peristaltic | bladder

Sampling: Same

Disposal of Discharged Water: on site

INSTRUMENTS (Indicate make, model, I.d.)

Water Level: KECK

Thermometer: HORIBA

pH Meter: HORIBA

Field Calibration: 7-4

Conductivity Meter: HORIBA

Field Calibration: 1413

Filter / Filter Size:

Other:

SAMPLING MEASUREMENTS

1053 Time	Cum. Vol. (gal. or [✓ L])	Purge Rate (gal. or [✓ L/m])	Temp. (oC)	pH	Spec. Cond. (mmhos/cm)	D.O	Redox (mV)	Turbidity & Color	Water Depth (ft BMP)
1102	–	.2	21.9	6.46	1710	0.71	-86	7.2	22.88
1107		|	22.6	6.51	1730	0.62	-87	6.2	22.89
1114		↓	22.7	6.52	1730	0.63	-87	6.1	22.89

Water Level (ft. BMP) at End of Purge: 22.89

Sample Intake Depth (ft. BMP):

SAMPLE INVENTORY

Bottles Collected				Filtration		Remarks
Time	Volume	Composition (G, P)	No.	(Y / N)	Preservation	(quality control sample, other)
1125	250mL	P	1	N	–	GEN CHEM
1125	500mL	P	1	N	HNO3	METALS

Comments:

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
(512) 671-3434 Fax (512) 671-3446

GROUNDWATER SAMPLING RECORD

PAGE 1 of 1

Project Number: 19122262-C Project Name: LUMINANT MCSES Date: 5-14-19

Sample Number:	H-31	Starting Water Level (ft. BMP):	22.73
Sampling Location (well ID, etc.):	H-31	Casing Stickup (ft.):	–
Sampled by:	JTB	Starting Water Level (ft. BGL):	22.73
Measuring Point (MP) of Well:	TOC/PVC	Total Depth (ft. BGL):	–
Screened Interval (ft. BGL):	–	Casing Diameter (in ID):	2.0
Filter Pack Interval (ft. BGL):	–	Casing Volume (gal.):	–

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment: alconox & DI rinse

Purging: peristaltic | bladder Sampling: Same

Disposal of Discharged Water: on site

INSTRUMENTS (Indicate make, model, I.d.)

Water Level:	KECK	Thermometer:	HORIBA
pH Meter:	HORIBA	Field Calibration:	7-4
Conductivity Meter:	HORIBA	Field Calibration:	1413
Filter / Filter Size:		Other:	

SAMPLING MEASUREMENTS

0707 Time	Cum. Vol (gal. or [✓ L])	Purge Rate (gal. or [✓ L /m])	Temp. (oC)	pH	Spec. Cond. (mmhos/cm)	D.O	Redox (mV)	Turbidity & Color	Water Depth (ft BMP)
0717	–	.2	22.6	6.49	1670	0.79	-76	4.6	22.92
0722		↓	22.5	6.41	1630	0.61	-77	5.8	22.93
0726		↓	22.4	6.42	1620	0.60	-77	5.6	22.93

Water Level (ft. BMP) at End of Purge: 2293 Sample Intake Depth (ft. BMP):

SAMPLE INVENTORY

Bottles Collected				Filtration		Remarks
Time	Volume	Composition (G, P)	No.	(Y / N)	Preservation	(quality control sample, other)
0740	250mL	P	1	N	–	GEN CHEM
0740	500mL	P	1	N	HNO3	METALS

Comments:

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
(512) 671-3434 Fax (512) 671-3446

GROUNDWATER SAMPLING RECORD

PAGE 1 of 1

Project Number: 19122262-C Project Name: LUMINANT - MLSES Date: 5-14-19

Sample Number: H-32

Sampling Location (well ID, etc.): H-32

Sampled by: JRB

Measuring Point (MP) of Well: TOC/PVC

Screened Interval (ft. BGL): –

Filter Pack Interval (ft. BGL): –

Starting Water Level (ft. BMP): 23.16

Casing Stickup (ft.): –

Starting Water Level (ft. BGL): 23.16

Total Depth (ft. BGL): –

Casing Diameter (In ID): 2.0

Casing Volume (gal.): –

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment: alconox & DI rinse

Purging: peristaltic / bladder Sampling: Same

Disposal of Discharged Water: on site

INSTRUMENTS (Indicate make, model, I.d.)

Water Level: KECK Thermometer: HORIBA

pH Meter: HORIBA Field Calibration: 7-4

Conductivity Meter: HORIBA Field Calibration: 1413

Filter / Filter Size: Other:

SAMPLING MEASUREMENTS

0757 Time	Cum. Vol. (gal. or [✓ L])	Purge Rate (gal. or [✓ L /m])	Temp. (oC)	pH	Spec. Cond. (mmhos/cm)	D.O	Redox (mV)	Turbidity & Color	Water Depth (ft BMP)
0807	–	.2	22.4	5.99	1510	0.41	-71	4.8	23.34
0812		↓	22.7	6.01	1540	0.31	-76	9.2	23.35
0818			22.6	6.02	1540	0.32	-77	8.7	23.35

Water Level (ft. BMP) at End of Purge: 23.35 Sample Intake Depth (ft. BMP):

SAMPLE INVENTORY

Bottles Collected				Filtration		Remarks
Time	Volume	Composition (G, P)	No.	(Y / N)	Preservation	(quality control sample, other)
0825	250mL	P	1	N	–	GEN CHEM
0825	500mL	P	1	N	HNO_3	METALS

Comments:

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
(512) 671-3434 Fax (512) 671-3446

GROUNDWATER SAMPLING RECORD

PAGE 1 of 1

Project Number: 19122262-C Project Name: LUMINANT- MLSES Date: 5-14-19

Sample Number:	H-33	Starting Water Level (ft. BMP):	13.42
Sampling Location (well ID, etc.):	H-33	Casing Stickup (ft.):	–
Sampled by:	JTB	Starting Water Level (ft. BGL):	13.42
Measuring Point (MP) of Well:	TOC/PVC	Total Depth (ft. BGL):	–
Screened Interval (ft. BGL):	–	Casing Diameter (In ID):	2.0
Filter Pack Interval (ft. BGL):	–	Casing Volume (gal.):	–

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment: alconox & DI rinse

Purging: peristaltic | bladder Sampling: Same

Disposal of Discharged Water: on site

INSTRUMENTS (Indicate make, model, I.d.)

Water Level:	KECK	Thermometer:	HORIBA
pH Meter:	HORIBA	Field Calibration:	7-4
Conductivity Meter:	HORIBA	Field Calibration:	1413
Filter / Filter Size:		Other:	

SAMPLING MEASUREMENTS

1451 Time	Cum. Vol. (gal. or [✓ L])	Purge Rate (gal. or [✓ L/m])	Temp. (oC)	pH	Spec. Cond. (mmhos/cm)	D.O.	Redox (mV)	Turbidity & Color	Water Depth (ft BMP)
1501	–	.2	23.4	6.81	1620	0.77	-29	5.9	13.67
1506		↓	23.6	6.82	1640	0.63	-26	7.8	13.66
1512		↓	23.6	6.81	1650	0.62	-26	7.4	13.66

Water Level (ft. BMP) at End of Purge: 13.66 Sample Intake Depth (ft. BMP):

SAMPLE INVENTORY

Bottles Collected				Filtration		Remarks
Time	Volume	Composition (G, P)	No.	(Y / N)	Preservation	(quality control sample, other)
1530	250mL	P	1	N	–	GEN CHEM
1530	500mL	P	1	N	HNO3	METALS

Comments:

Pastor, Behling & Wheeler, LLC
2201 Double Creek Dr., Suite 4004
Round Rock, TX 78664
(512) 671-3434 Fax (512) 671-3446

GOLDER

golder.com

APPENDIX F7 – SEMI-ANNUAL REMEDY SELECTION PROGRESS REPORTS (MARCH 4, 2020 AND SEPTEMBER 3, 2020)

Luminant

March 4, 2020

SEMIANNUAL REMEDY SELECTION PROGRESS REPORT
MARTIN LAKE STEAM ELECTRIC STATION – ASH POND AREA

In accordance with Title 40 Code of Federal Regulations (C.F.R.) § 257.97(a), the owner or operator of a coal combustion residuals (CCR) unit must prepare a semiannual report describing the progress in selecting and designing a remedy for statistically significant levels (SSLs) of constituents listed in Appendix IV of 40 C.F.R. Part 257 over the groundwater protection standards established in accordance with 40 C.F.R. § 257.95(h).

This report is for the Ash Pond Area at the Martin Lake Steam Electric Station.

As stated in the notifications dated February 6, 2019 and October 7, 2019, SSLs for beryllium and cobalt were identified at the Ash Pond Area during assessment monitoring completed in accordance with 40 C.F.R. § 257.95.

In response to the SSLs, an Assessment of Corrective Measures (ACM) report was completed for the Ash Pond Area in September 2019 as required by 40 C.F.R. § 257.96. The ACM report evaluated retrofitting the Ash Ponds liner systems for purposes of source control. Further evaluation of monitored natural attenuation, groundwater extraction and treatment or a vertical hydraulic barrier is ongoing for purposes of selecting a remedy under 40 C.F.R. § 257.97

A public meeting was held on November 13, 2019 at the Henderson Chamber of Commerce in Henderson, Texas to discuss the results of the of the ACM in accordance with 40 C.F.R. § 257.96(e).

Design of the Ash Pond liner system is in progress and the Retrofit Plan has been posted to the Operating Record. Selection of the groundwater remedy for the Ash Pond Area is currently in the feasibility study phase.

Luminant

September 3, 2020

SEMI-ANNUAL REMEDY SELECTION PROGRESS REPORT MARTIN LAKE STEAM ELECTRIC STATION – ASH POND AREA

In accordance with Title 40 Code of Federal Regulations (C.F.R.) § 257.97(a), the owner or operator of a coal combustion residuals (CCR) unit must prepare a semiannual report describing the progress in selecting and designing a remedy for statistically significant levels (SSLs) of constituents listed in Appendix IV of 40 C.F.R. Part 257 over the groundwater protection standards established in accordance with 40 C.F.R. § 257.95(h).

This report is for the Ash Pond Area at the Martin Lake Steam Electric Station.

As stated in the notification dated February 6, 2019, SSLs for beryllium, cobalt and lithium were identified at the Ash Ponds during 2018 assessment monitoring completed in accordance with 40 C.F.R. § 257.95. However, no SSLs for lithium were identified in subsequent semi-annual assessment monitoring events completed in 2019 and 2020. As stated in the notifications dated October 7, 2019, February 7, 2020 and August 21, 2020, SSLs for beryllium and cobalt were identified at the Ash Pond Area during 2019 and 2020 assessment monitoring completed in accordance with 40 C.F.R. § 257.95.

In response to the SSLs, an Assessment of Corrective Measures (ACM) report was completed for the Ash Pond Area in September 2019 as required by 40 C.F.R. § 257.96. The ACM report concluded that the source control remedy would be retrofitting the liner system in the Ash Ponds and the groundwater remedy would be monitored natural attenuation (MNA), groundwater extraction and treatment or a vertical hydraulic barrier.

A public meeting was held on November 13, 2019 at the Henderson Chamber of Commerce in Henderson, Texas to discuss the results of the of the ACM in accordance with 40 C.F.R. § 257.96(e).

A notification of intent to retrofit the Ash Pond Area liner system was posted on June 29, 2020. Design of the Ash Pond Area liner system retrofit has been completed and construction is underway.

A feasibility study to evaluate MNA as a potential groundwater remedy for the Ash Pond Area is currently being performed. Feasibility study activities completed since March 4, 2020 include collection of additional groundwater samples to supplement previous soil and groundwater data and development of site-specific geochemical and groundwater models in order to understand the natural attenuation mechanisms occurring at the Ash Pond Area and evaluate the effectiveness of natural attenuation in meeting applicable groundwater protection standards.

APPENDIX F8 – STRUCTURAL STABILITY ASSESSMENT

REPORT

STRUCTURAL STABILITY ASSESSMENT REPORT

Martin Lake Steam Electric Station

Submitted To: Luminant
1601 Bryan Street
Dallas, TX 75201

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

10/10/16

STATE OF TEXAS
JEFFREY B. FASSETT
85675
LICENSED PROFESSIONAL ENGINEER

Professional Engineering Firm
Registration Number F-2578

October 2016 **Project No. 164816402**

Golder Associates

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1.0 INTRODUCTION

1.1 Purpose

The "Disposal of Coal Combustion Residuals (CCR) from Electric Utilities rule" (40 Code of Federal Regulations (40 CFR) Part 257), effective October 19, 2015, requires that existing CCR surface impoundments meeting the requirements of §257.73(b) conduct initial and periodic structural stability assessments in accordance with §257.73(d). This report provides the structural stability assessment for the Martin Lake Steam Electric Station's (MLSES's) CCR Impoundments, identified as the Bottom Ash Ponds (BAPs) – the West Ash Pond (WAP) and the East Ash Pond (EAP) – the New Scrubber Pond (NSP), and the Permanent Disposal Pond-5 (PDP-5).

1.2 Site Background

The MLSES generates bottom ash, fly ash, and flue gas desulfurization (FGD) material during electricity generation. The following surface impoundments, shown on Figure 1, are in operation at the MLSES and subject to the CCR rule.

1.2.1 The Bottom Ash Ponds (BAPs)

The BAPs include the West Ash Pond (WAP) and the East Ash Pond (EAP). The WAP and EAP receive sluice water from bottom ash dewatering bins and other process wastewater sources that typically include bottom ash fines. The BAPs were originally constructed in 1977 with a 2-feet thick compacted clay liner. In 1989, the WAP was relined with a 60-mil high density polyethylene (HDPE) geomembrane over 3 feet of clay on the sideslopes, and the floor with a double 60-mil HDPE geomembrane with a geonet leak detection layer overlying an 18-inch thick clay liner. Both the sideslopes and floor are overlain with a 4-inch thick concrete revetment mat. In 2010 the sideslopes and floor of the EAP were relined with a double 60-mil HDPE geomembrane with a geonet leak detection layer overlying an 18-inch thick clay layer. A geotextile layer was placed between the lower geomembrane and the clay. The liner system on the sideslopes and floor of the EAP are overlain with a 4-inch thick concrete revetment mat.

1.2.2 New Scrubber Pond (NSP)

The NSP, abutting the southeastern portion of the WAP and the southern portion of the EAP, is used to manage FGD wastes and discharge from the sludge thickener sumps, the plant yard sumps, and stormwater management areas. Water collecting in the NSP serves as wet-well make-up water as well as emergency make-up water in the scrubber area. The NSP was originally constructed with the BAPs and lined with clay liner. In 1989, the NSP was relined with a double 60-mil HDPE geomembrane with a geonet leak detection layer. A geotextile layer was placed between the lower geomembrane and the subgrade and a 4-inch thick concrete revetment mat covers the upper geomembrane.

1.2.3 Permanent Disposal Pond-5 (PDP-5)

PDP-5 is primarily used to manage excess liquids including stormwater and excess process wastewater from both the New Scrubber Pond and Bottom Ash Ponds. Recovered CCR wastewaters are received in PDP-5 during cleaning cycles. PDP-5 was constructed in 2010/2011, above PDP-1, PDP-2, and PDP-3, which were previously closed as landfills. PDP-5 is lined with a 3-foot thick clay liner on the sideslopes and a 2-foot thick clay liner on the floor, both overlain with a 0.5-foot thick protective cover soil layer.

1.3 Previous Slope Stability Evaluations

Golder and ETTL Engineers and Consultants (ETTL) have previously performed evaluations on the BAPs, the NSP and PDP-5 as part of the following reports submitted to Luminant:

- Ash and Scrubber Ponds and Permanent Disposal Pond #4, Stability Investigation Report, Luminant Martin Lake SES, Rusk County, Texas, Golder, dated December 2012.
- Geotechnical Investigation, Luminant Martin Lake SES, Reline East Ash Disposal Pond, Tatum, Texas, ETTL, dated December 2008.

The studies found the BAPs and NSP slopes to be adequately stable.

ETTL performed stability evaluations on PDP-5 in 2009, as presented in the following report:

- Geotechnical Investigation, Luminant Martin Lake SES, Vertical Expansion of Permanent Disposal Ponds 1, 2, and 3, Tatum, Texas. ETTL Engineers and Consultants Inc. Tyler, Texas, dated July 2008.
- Geotechnical Investigation, Luminant Martin Lake SES, Vertical Expansion of Permanent Disposal Ponds 1, 2, and 3, Tatum, Texas – Supplemental Seepage and Slope Stability. ETTL Engineers and Consultants Inc., dated October 2009.

The above reports found the design slopes of PDP-5 to be stable as long as drainage is functional, preventing the embankments from saturating.

2.0 SUBSURFACE CONDITIONS

The MLSES site is located in the Martin Creek area which is situated in the Sabine River Valley and lies on the west flank of the Sabine Uplift. The formations in the region comprise sedimentary deposits of continental and marine origin, mainly the lower Wilcox Group flanked by younger beds like the Carrizo Sand. In the Martin Creek area, the Wilcox formation is estimated to be about 650- to 700-feet thick and consists of sandy clays, silty sands, clays, and lignite in varying amounts. The Rockdale formation is the major component in the area among the sediments of the Wilcox group occupying approximately the middle four-fifths of the Wilcox Section. The Wilcox Group is underlain by the Paleocene Midway Group (containing Upper Willis and Lower Kincaid), which is estimated to be 900-feet thick around the site, and is composed mainly of silty clay and clay. The Midway Group overlies a section of Cretaceous Rocks that are approximately 7000-feet thick (Rone Engineers, 1984).

2.1 Site Geology

2.1.1 Bottom Ash Ponds and Scrubber Pond

2.1.1.1 Subsurface Investigations and Laboratory Testing

Information from previous subsurface investigations was used to characterize the subsurface site conditions. In 2008, ETTL conducted a subsurface investigation for the EAP as part of an effort to reline the pond. ETTL drilled twelve borings along the crest of the EAP embankment at approximate elevation 330 feet – mean sea level (ft-msl). All borings were 40-feet deep except one which was 100-feet deep. The boring map and boring logs are presented in Appendix A. Geotechnical laboratory testing – moisture contents, Atterberg limits, grain size distribution, and consolidated-undrained (CU) triaxial compression tests - was conducted on selected samples. The soil index testing results presented as part of the boring logs, while the CU test results from ETTL are summarized in Appendix B.

Golder conducted a subsurface investigation for the WAP and NSP in December 2012. Golder completed eight, 50- to 60-foot deep borings along the crest of the pond embankments at approximate elevation 330 ft-msl. The boring map and boring logs are presented in Appendix A. As part of the investigation, laboratory testing was performed on selected samples in accordance with commonly accepted methods and practices. Undisturbed and disturbed soil samples were tested to determine water content, Atterberg limits, grain size distribution, and shear strength. Water content determination was performed in accordance with ASTM D2216; Atterberg limits were determined in accordance with ASTM D4318; and grain size distribution was performed in accordance with ASTM D422. Shear strength testing consisted of unconsolidated-undrained (UU) triaxial compression in general accordance with ASTM D2850. Laboratory test results are presented in Appendix B.

The findings from the above subsurface investigations were reviewed for their applicability to this study, and are summarized in the following sections.

2.1.1.2 Subsurface Site Conditions

The above borings consisted of fill and native soils. The soils encountered in the borings generally consisted of stiff to hard sandy clays and firm to very dense sands. The subsurface stratigraphy generally consisted of interchanging layers of clays, sandy clays, clayey sands and non-plastic sands. The clayey sand layers ranged in thickness from 2 to 16 feet where encountered. The sandy clay and clay layers are described as firm to hard, low to high plasticity clays and vary in thickness from 2 to 38 feet. Loose to very dense, silty or poorly graded sand was typically encountered beneath or interlayered with the sandy clay/clayey sand strata. The 100-foot boring by ETTL showed deeper layers of very dense silty sand with intermittent layers of hard low plasticity clay.

Water was encountered in each of the eight borings performed by Golder, ranging between El. 296.1 to 303.3 ft-msl. The average water elevation measured in the Golder boreholes, during drilling, was at El. 300.3 ft-msl. The ETTL borings measured the water level to range between El. 304 to 309 ft-msl, with an average water level of El. 306 ft-msl, coinciding with the normal pool elevation of the adjacent Martin Lake (a man-made reservoir).

Groundwater levels measured in 2015, from wells surrounding the BAPs, varied from approximately El. 304 ft-msl in the southeast corner to El. 307 ft-msl in the northwest corner.

2.1.2 Permanent Disposal Pond - 5

2.1.2.1 Subsurface Investigations and Laboratory Testing

In 2008, ETTL performed a pre-construction subsurface investigation for PDP-5 that included a total of eleven borings within the PDP-5 footprint. In addition, three cone penetrometer tests (CPTs) were performed. As part of a supplemental investigation in 2009, ETTL drilled a further three borings within the pond footprint. The map of the borings, and boring and CPT logs are presented in Appendix A.

ETTL performed laboratory tests including natural moisture contents (ASTM D2216), Atterberg limits (ASTM D4318), particle size distributions (ASTM D 1140 and ASTM D422). Unconsolidated-undrained (UU) triaxial compression tests (ASTM D2850) were performed to determine the strength characteristics of cohesive substrata. Direct shear tests (ASTM D3080) were performed on coarser materials including remolded bulk ash samples. Consolidation tests (ASTM D2435) and permeability tests (ASTM D5084) were also performed but are not relevant to the current study. The results of the laboratory tests performed by ETTL are presented in Appendix B.

2.1.2.2 Subsurface Site Conditions

Most of the above borings were drilled through the bottom ash within closed PDP-1, 2, and 3. Based on particle size, the ash classifies as very loose to medium dense poorly graded sands in some locations, to silts in other locations and depths. The borings passing through existing embankments of PDP-1, 2, and 3 contained medium stiff to very stiff clay of low plasticity and/or high plasticity clay with clayey sand. Native soils were identified in deeper borings as very dense silt with hard low plasticity clay seams.

Two borings located outside of the ash encountered groundwater approximately between El. 355 to 368 ft-msl. Groundwater levels measured in 2015, from wells surrounding PDP-5, indicate that the groundwater level varies from approximately El. 355 ft-msl in the north to El. 375 ft-msl in the south.

3.0 STRUCTURAL STABILITY ASSESSMENT - §257.73(d)(1)(i)-(vii)

The CCR rules require conducting periodic structural stability assessments by a qualified professional engineer to document whether the design, construction, operation and maintenance is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater that can be impounded therein.

3.1 Foundations and Abutments - §257.73(d)(1)(i)

As noted above, the foundation soils for the BAPs and NSP generally consist of stiff to hard sandy clays and compact to dense sand. As discussed below, the embankment fill appears to be well-compacted. The foundation soils and abutments of the BAPs and NSP are stable.

Parts of the foundation soils for PDP-5 embankments are founded on the existing bottom ash of underlying PDP-1, 2, and 3 which were previously closed as landfills. Based on particle size, the bottom ash classifies as very loose to medium dense, poorly graded sand at some locations and silts at other locations and depths. Based on the above mentioned ETTL reports and the preparation of foundation materials during construction, the foundations and abutments are generally considered to be stable. The possibility of liquefaction of bottom ash in the foundation is considered in the Safety Factor Assessment report (Golder, 2016).

3.2 Slope Protection - §257.73(d)(1)(ii)

The downstream slopes of the BAPs, NSP and PDP-5 embankments are protected from erosion and deterioration by the establishment of a vegetative cover. Portions of the EAP and the NSP adjacent to Martin Lake are protected from wave action with roller compacted concrete The vegetative cover is inspected weekly for erosion, signs of seepage, animal burrows, sloughing, and plants that could negatively impact the embankment. For the BAPs and NSP, the interior slopes are protected from wave action by concrete revetment mats or riprap. The interior slopes of PDP-5 are covered with vegetative cover for erosion protection.

3.3 Dikes (Embankment) - §257.73(d)(1)(iii)

3.3.1 Bottom Ash Ponds and Scrubber Pond

No construction documentation or testing details of the original BAPs and NSP embankment fills are available. Based on the borings, the embankments were constructed using a clayey fill likely from an on-site borrow source. Golder's subsurface investigation of 2012 and ETTL's investigation of the EAP in 2008 comprised boreholes drilled into the embankment. These borings found the embankment soils to generally consist of stiff to hard sandy clay, clayey sand, and clay, consistent with well-compacted fill. No significant repairs have been performed to the BAPs and NSP embankments since their initial construction, except the relining of the WAP and NSP in 1989, and the relining of the EAP in 2010. Based on a review of past inspection reports and on recent observations, the BAPs and NSP embankments are sufficient to withstand the range of loading conditions they are subjected to.

3.3.2 Permanent Disposal Pond – 5

PDP-5 was constructed with on-site soils in 2010/2011. A 3-foot thick clay layer was placed over PDP-1, PDP-2 and PDP-3, beneath the new PDP-5 embankment. Sections of the embankment overlie the bottom ash from the closed ponds.

The clay liner was specified to be installed and compacted in 6-inch lifts, to at least 95% Standard Proctor maximum dry density at optimum moisture content to 4% above. The embankment was specified to be constructed in loose lifts of 8-inch maximum thickness, followed by compaction to 95% standard Proctor maximum dry density.

Based on a review of past inspection reports and on recent observations, each of the embankments are sufficient to withstand the range of loading conditions they are subjected to.

3.4 Vegetated Slopes - §257.73(d)(1)(iv)

As of June 14, 2016 the US Court of Appeals for the District of Columbia Circuit issued an Order that remanded and vacated the CCR rule requirement that vegetation on the exterior portions of dikes on CCR surface impoundments be maintained not to exceed six inches in height. EPA will issue a new rulemaking in the future to address this issue.

Each of the surface impoundments at the MLSES are inspected weekly. Luminant maintains the vegetation in a manner that ensures adequate inspections can be conducted.

3.5 Spillways - §257.73(d)(1)(v)

There are no spillways on any of the surface impoundments.

3.6 Hydraulic Structures - §257.73(d)(1)(vi)

The only subsurface penetrations in the BAPs and NSP are 24-inch dewatering lines that pass through the WAP and the NSP embankments, which are used for decanting process wastewater from within the ponds. These dewatering lines connect to a collection sump at the low pressure ash water pump station located to the south of the NSP. All other piping passes above the crest of the embankments.

According to as-built drawings prepared by HDR Engineering, Inc., a 14-inch diameter HDPE overflow pipe, encased in a 20-inch diameter HDPE pipe passes through the southern embankment. Flow through this pipe is controlled with a valve located near the toe of the embankment. Discharge from PDP-5 is accomplished using a submersible pump suspended from a pump platform adjacent to the overflow pipe along the southern embankment. All other piping passes above the crest of the embankment.

No significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or debris were observed that may negatively affect the operation of the surface impoundments.

3.7 Downstream Slopes Adjacent to Water Body - §257.73(d)(1)(vii)

The east slope of the EAP and the south slope of the NSP are adjacent to Martin Lake. The normal pool elevation of Martin Lake is at El. 306 ft-msl. This water level is relatively shallow against the exterior slope. Moreover, the exterior slopes of both the east side of the EAP and the south side of the NSP are lined with roller compacted concrete to protect these slopes from erosion, as well as seepage. Nevertheless, the impact of drawdown of Martin Lake on the stability of the BAP and NSP embankments is considered in the Safety Factor Assessment report (Golder, 2016). The results of stability analysis indicate that the factor of safety for rapid drawdown conditions is approximately 1.6, which exceeds the typically required value of 1.30.

3.8 Structural Stability Deficiencies - §257.73(d)(2)

No structural stability deficiencies were identified during this assessment.

4.0 CONCLUSION

Based on our review of the information provided by Luminant, on information prepared by Golder Associates Inc., and on our on-site observations, no structural stability deficiencies were identified in the surface impoundments during this assessment.

Golder appreciates the opportunity to assist Luminant with this project. If you have any questions, or require further assistance from Golder, please contact the undersigned at (281) 821-6868.

GOLDER ASSOCIATES INC.

Varenya Kumar Staff Engineer	Jeffrey B. Fassett, PE Associate Geotechnical Engineer

VK/JBF/kc

5.0 CERTIFICATION

I hereby certify that this report has been prepared in general accordance with normally accepted civil engineering practices and in accordance with the requirements of 40 CFR 257.73(d).

JEFFREY B. FASSETT
85675

10/10/16

Jeffrey B. Fassett, PE
Golder Associates Inc.
Firm Registration Number F-2578

6.0 REFERENCES

ETTL Engineers and Consultants Inc. 2008. Geotechnical Investigation, Luminant Martin Lake SES, Vertical Expansion of Permanent Disposal Ponds 1, 2, and 3, Tatum, Texas.

ETTL Engineers and Consultants Inc. 2009. Geotechnical Investigation, Luminant Martin Lake SES, Vertical Expansion of Permanent Disposal Ponds 1, 2, and 3, Tatum, Texas – Supplemental Seepage.

Golder Associates Inc. 2012. Ash and Scrubber Ponds and Permanent Disposal Pond #4 – Stability Investigation Report, Luminant Martin Lake Power Plant, Rusk County, Texas.

Golder Associates Inc. 2016. Safety Factor Assessment Report, Luminant Martin Lake Steam Electric Station.

HDR Engineering Inc. 2011. Martin Lake Steam Electric Station, Rusk County, Texas – Permanent Disposal Pond #5 – As Recorded Drawings.

Pastor, Behling & Wheeler Inc. 2016. Annual CCR Inspection Report. Luminant Martin Lake Steam Electric Station, Ash Pond Area, Permanent Disposal Pond No. 5 & A1 Area Landfill, Rusk & Panola County, Texas

REFERENCE(S)
AERIAL PHOTO SOURCED FROM GOOGLE EARTH PRO DATED: 2015-10-01

Jeffrey B. Fassett 10/10/16

JEFFREY B. FASSETT
85675

Professional Engineering Firm
Registration Number F-2578

0 1000 2000
1" = 2000' FEET

CLIENT
LUMINANT POWER
MARTIN LAKE

PROJECT
2016 COAL COMBUSTION RESIDUALS
ENGINEERING SERVICES

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-22
PREPARED	VK
DESIGNED	TNB
REVIEWED	MX
APPROVED	JBF

TITLE
GENERAL SITE MAP

PROJECT NO.	REV.	FIGURE
164816402	----	1

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APPENDIX A

BORING LOCATION MAP & BORING LOGS

BOTTOM ASH PONDS AND SCRUBBER POND

NOTE: Figure Reference - Golder Associates Inc. 2012. Ash and Scrubber Ponds and Permanent Disposal Pond #4 – Stability Investigation Report, Luminant Martin Lake Power Plant, Rusk County, Texas.

LEGEND

● BH-101 BORING LOCATION

REFERENCE

1.) AERIAL SHOWN LICENSED FROM GOOGLE EARTH PROFESSIONAL.

700 0 700
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
LUMINANT - MARTIN LAKE
ASH & SCRUBBER POND SLOPE STABILITY INVESTIGATION REPORT
RUSK COUNTY, TEXAS

TITLE
BORING LOCATIONS

NJ Authorization #24GA28029100
Golder Associates
Mt. Laurel, New Jersey

PROJECT No.	123–94128		FILE No.	12394128A003
DESIGN	MGP	12/04/12	SCALE AS SHOWN	REV. 0
CADD	RG	12/04/12		
CHECK	MGP	12/04/12	FIGURE 1	
REVIEW	PCM	12/04/12		

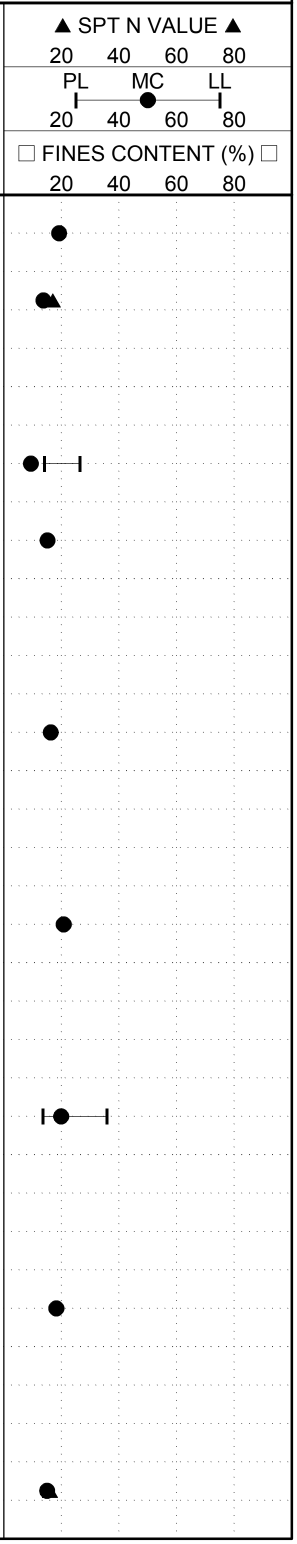
Drawing file: 12394128A003.dwg Dec 06, 2012 – 11:05am

500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-201

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 10/28/12 **COMPLETED** 10/28/12
GROUND ELEVATION 330 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 28.30 ft / Elev 301.70 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	Remove 8" sandy gravel as road base					
	(CL) SILTY CLAY, low plasticity, some sand, trace gravels, red, dry, hard	SH 1	44		5.0	
	(SC) CLAYEY SAND, non-plastic, some silt, tan and gray, dry, compact	SS 2	58	15-10-7 (17)		
5	(CL) SANDY CLAY, low plasticity, some silt, red, tan, and gray, mottled, dry, stiff	SH 3	44		3.5	
	(SC) CLAYEY SAND, fine, subangular, non-plastic, little silt, tan and gray, mottled, dry	SH 4	38		1.5	
10	(CL) SANDY CLAY, low plasticity, little silt and gravel, red, tan, and gray, mottled, dry, hard	SH 5	42		4.5	
15	some silt, no gravel, very stiff at 13.0'	SH 6	58		3.5	
20	some sand veins at 18.0'	SH 7	38		3.0	
25	gray, moist at 23.0'	SH 8	58		2.5	
30	▽ (SC) CLAYEY SAND, fine, subangular, low plasticity, some to little silt	SH 9	71		2.0	
35	some silt, tan and gray, mottled, moist at 33.0'	SS 10	100	9-7-9 (16)		



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500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-201

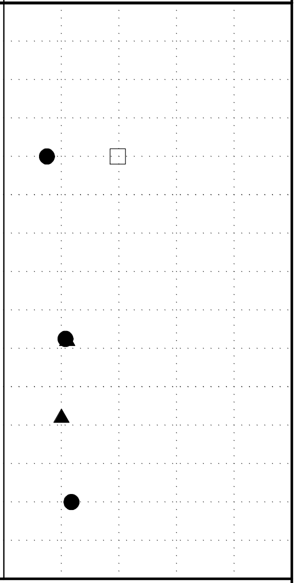
CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 ☐ FINES CONTENT (%) ☐ 20 40 60 80
35								
		some silty sand veins at 38.0'	SH 11	50		2.0		
40								
		(SM) SILTY SAND, fine, subangular, non-plastic, little clay, tan and red, wet, compact	SS 12	100	11-11-11 (22)			
45		(SP) SAND, medium to fine, subangular, poorly graded, some silt, tan, wet, compact	SS 13	100	5-9-11 (20)			
50								



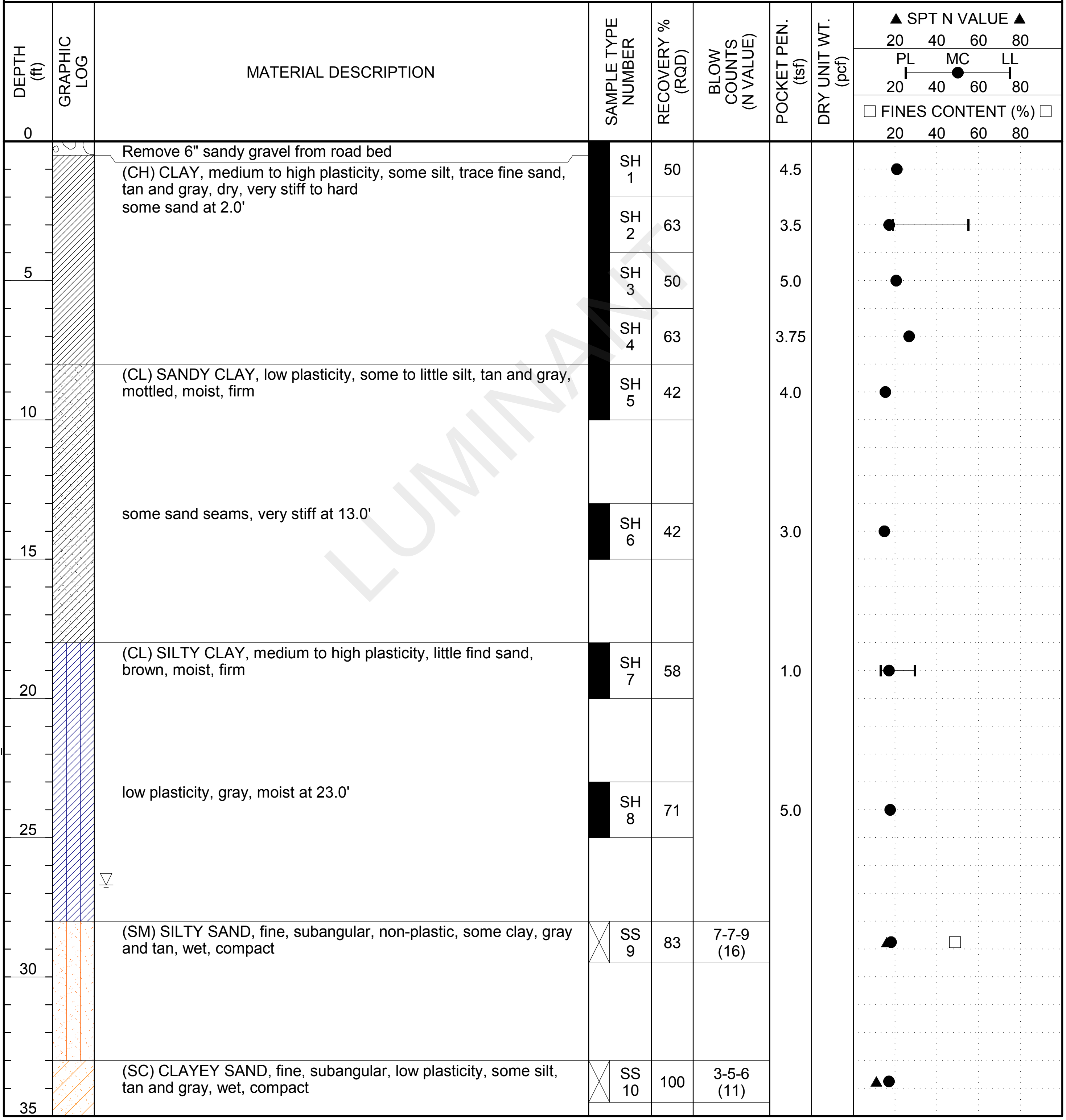
Bottom of borehole at 50.0 feet.

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-202

PAGE 1 OF 2

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 10/29/12 **COMPLETED** 10/29/12
GROUND ELEVATION 330 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 26.70 ft / Elev 303.30 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---



MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
Remove 6" sandy gravel from road bed (CH) CLAY, medium to high plasticity, some silt, trace fine sand, tan and gray, dry, very stiff to hard some sand at 2.0'	SH 1	50		4.5	
	SH 2	63		3.5	
	SH 3	50		5.0	
	SH 4	63		3.75	
(CL) SANDY CLAY, low plasticity, some to little silt, tan and gray, mottled, moist, firm	SH 5	42		4.0	
some sand seams, very stiff at 13.0'	SH 6	42		3.0	
(CL) SILTY CLAY, medium to high plasticity, little find sand, brown, moist, firm	SH 7	58		1.0	
low plasticity, gray, moist at 23.0'	SH 8	71		5.0	
(SM) SILTY SAND, fine, subangular, non-plastic, some clay, gray and tan, wet, compact	SS 9	83	7-7-9 (16)		
(SC) CLAYEY SAND, fine, subangular, low plasticity, some silt, tan and gray, wet, compact	SS 10	100	3-5-6 (11)		

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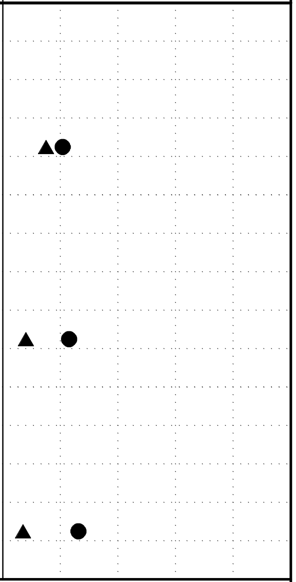
Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-202

CLIENT Luminant **PROJECT NAME** Pond Slope Stability
PROJECT NUMBER 123-94128 **PROJECT LOCATION** Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 ☐ FINES CONTENT (%) ☐ 20 40 60 80
35								
		interbedded clay and sand seams at 38.0'	SS 11	100	8-7-8 (15)			
40								
		no seams at 43.0'	SS 12	89	4-4-4 (8)			
45								
		(SP) SAND, medium to fine, poorly graded, subangular, non-plastic, some silt and clay, wet, loose	SS 13	100	2-3-4 (7)			
50								



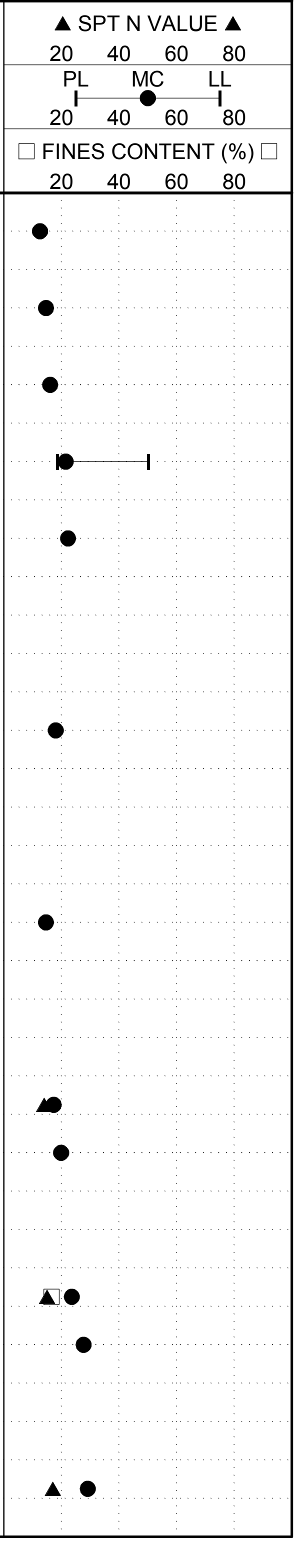
Bottom of borehole at 50.0 feet.

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-203

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 10/30/12 **COMPLETED** 10/30/12
GROUND ELEVATION 330 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
∇ **AT TIME OF DRILLING** 28.80 ft / Elev 301.20 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	remove 14" sandy GRAVEL as roadbed (CL) SILTY CLAY, low plasticity, little sand, gray and tan, mottled, dry, very stiff	SH 1	44		2.75	
	(CL) SANDY CLAY, low plasticity, some silt, gray and tan, mottled, dry, stiff	SH 2	50		1.5	
5	low plasticity, some sand veins, soft	SH 3	42		1.25	
	(CL-CH) CLAY, low plasticity to medium plasticity, some silt, dark to light gray, dry, stiff	SH 4	67		1.75	
	very stiff at 8.0'	SH 5	50		3.25	
10						
	low plasticity, some silt and fine sand, little coarse sand and fine gravels, subrounded, red and tan, stiff at 13.0'	SH 6	38		1.5	
15						
	(CL) SANDY CLAY, low plasticity, some silt, tan and gray, mottled, dry, stiff	SH 7	44		2.0	
20						
	(SC) CLAYEY SAND, low plasticity, some silt, tan and gray, mottled, compact, moist	SS 8	94	3-7-7 (14)		
25						
	∇ low plasticity, with grey silty clay, some sand, tan at 28.0'	SS 9	94	4-7-8 (15)		
30						
	(SM) SILTY SAND, non-plastic, grading to sand, some silt, little to trace clay, gray, wet, compact	SS 10	100	3-8-9 (17)		
35						



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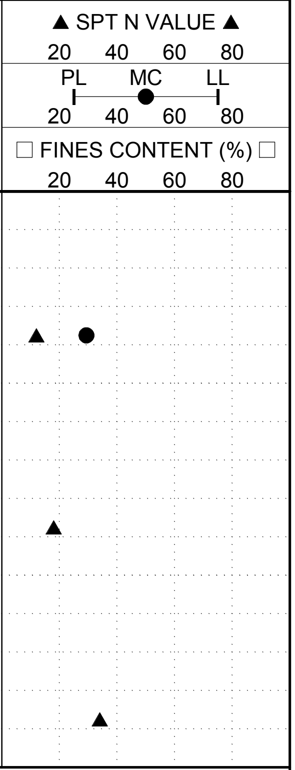
Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-203

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35							
		some clay and silt veins, tan at 38.0'	SS 11	100	3-6-6 (12)		
40							
		(SC) CLAYEY SAND, low plasticity, some silt, tan and brown, wet, compact	SS 12	100	4-8-10 (18)		
45							
		(SM) SILTY SAND, non-plastic, trace clay, tan and gray, wet, dense	SS 13	100	8-14-20 (34)		
50							



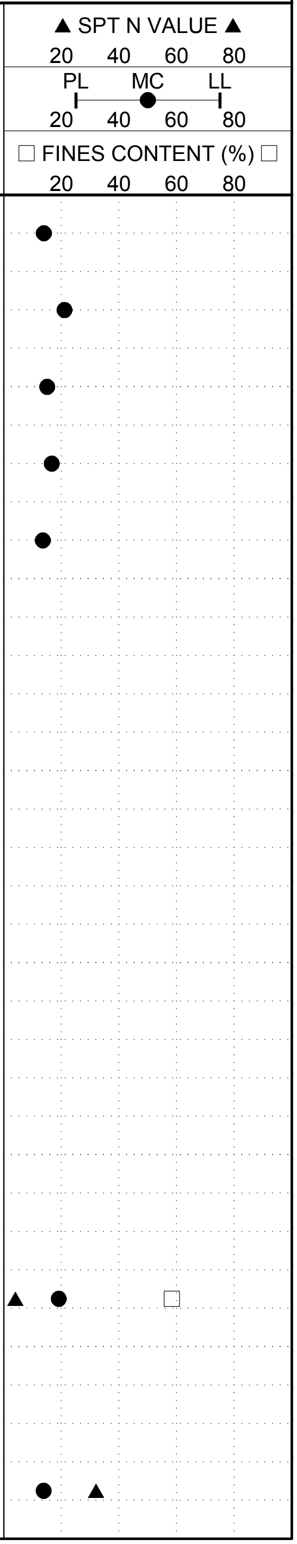
Bottom of borehole at 50.0 feet.

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-204

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 10/30/12 **COMPLETED** 10/30/12
GROUND ELEVATION 330 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 31.80 ft / Elev 298.20 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft) 0	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
	removed SANDY GRAVEL from roadbed					
	(CL) SILTY CLAY, low plasticity, some sand, tan and gray, mottled, dry, hard	SH 1	67		4.25	
	(CL) LEAN CLAY, low plasticity, some silt, sand, and sand veins, red and gray, dry, very stiff	SH 2	50		3.0	
5	(SC) CLAYEY SAND, low plasticity, some silt and black sandy gravel veins, tan and gray, dry	SH 3	33		5.0	
	(CL) SANDY CLAY, low plasticity, little silt, tan and gray, dry, stiff	SH 4	58		2.0	
10	(SC) CLAYEY SAND, non-plastic to low plasticity, little silty clay seam, tan, brown, with little gray, dry	SH 5	44		2.5	
15	(CL) LEAN CLAY, low to medium plasticity, some silt, trace fine sand, tan, brown, and gray, mottled, dry, stiff	SH 6	67		2.0	
20	some sand, little silt	SH 7	67		1.5	
25	(CL) SANDY CLAY, low plasticity, little silt, tan and gray, moist, very stiff	SH 8	46		3.0	
30	(ML) SANDY SILT, low plasticity to non-plastic, fine, subangular, some clay, tan and gray, moist, soft	SS 9	100	2-1-3 (4)		
35	▽ (SM) SILTY SAND, low plasticity to non-plastic, fine, subangular, gray with little brown, dense	SS 10	94	11-14-18 (32)		



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500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-204

PAGE 2 OF 2

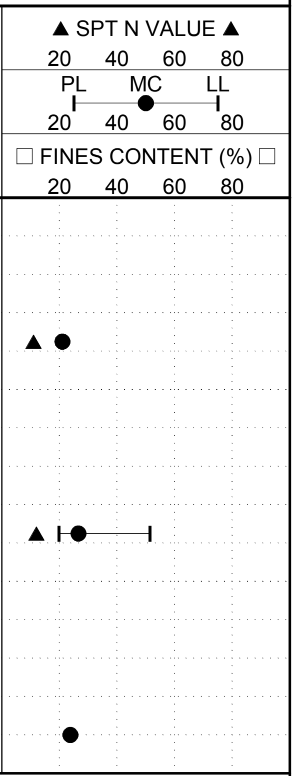
CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35							
		(SC) CLAYEY SAND, fine, subangular, interbedded with gray, silty sand, some clay, tan, wet, compact	SS 11	94	4-5-6 (11)		
40							
		(CH) CLAY, medium plasticity, little silt, trace fine sand, gray, wet, stiff	SS 12	100	3-5-7 (12)		
45							
50			SH 13	75		2.0	



Bottom of borehole at 50.0 feet.

Golder Associates

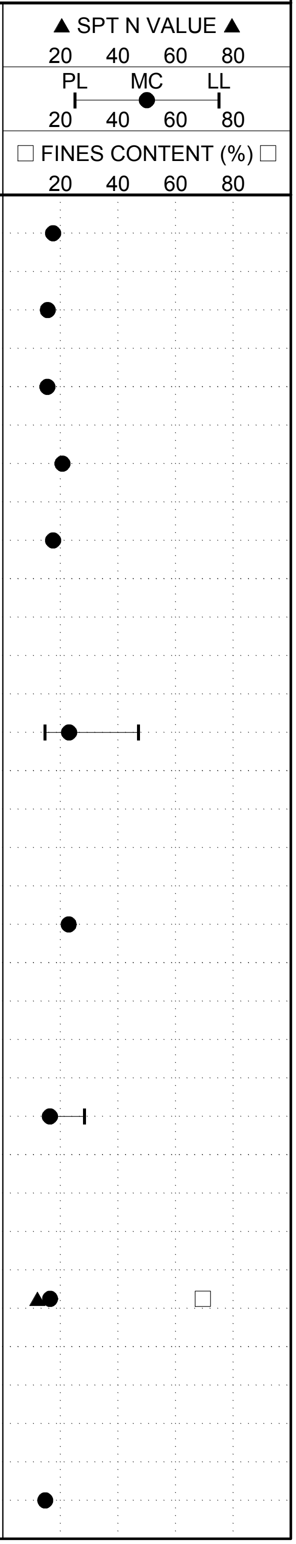
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-205

PAGE 1 OF 2

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 10/30/12 **COMPLETED** 10/30/12
GROUND ELEVATION 330.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 29.40 ft / Elev 301.10 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft) 0	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 ☐ FINES CONTENT (%) ☐ 20 40 60 80
		(CL) LEAN CLAY, medium plasticity, some silt, trace sand, tan and gray, mottled, dry, hard	SH 1	50		4.0		
		with silty sand seams, very stiff at 2.0'	SH 2	60		3.5		
5		stiff at 4.0'	SH 3	40		1.25		
		very stiff at 6.0'	SH 4	58		3.75		
10			SH 5	44		3.5		
15		some to little silt at 13.0'	SH 6	42		3.0		
20		some clayey sand seams, stiff at 18.0'	SH 7	40		1.5		
25		(CL) SILTY CLAY, low plasticity, some sand, dark gray, moist, stiff	SH 8	67		1.75		
30	▽	(CL) SANDY SILTY CLAY, low plasticity, little clay, light gray with little brown, moist, stiff	SS 9	67	2-5-7 (12)			
35		(CL) SANDY CLAY, low plasticity, some silt, tan and gray, moist, very stiff	SH 10	60		3.0		



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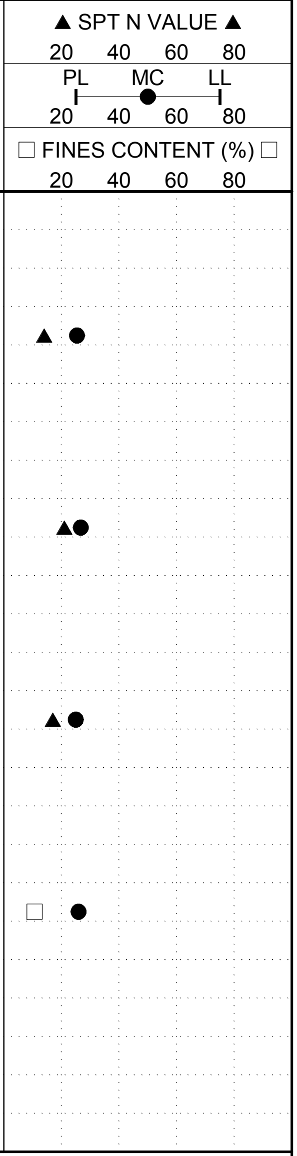
Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-205

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35	▨						
		(SC) CLAYEY SAND, interbedded with gray silty SAND, fine, subangular, little clay, compact, wet	SS 11	100	3-6-8 (14)		
40							
		(SP) SAND, fine, subangular, non-plastic, some clay, little silt, tan and brown, wet, compact	SS 12	100	4-9-12 (21)		
45							
		medium to fine, tan at 48.0'	SS 13	100	3-6-11 (17)		
50							
		very loose at 53.0'	SS 14	33			
55							
60							



Bottom of borehole at 60.0 feet.

GEOTECH BH PLOTS - GINT STD US LAB.GDT - 12/4/12 15:58 - P:_2012 PROJECT FOLDERS\123-94128 LUMINANT POND SLOPE STABILITY\MARTIN LAKE\LAB TESTING\94128MARTINLAKE.GPJ

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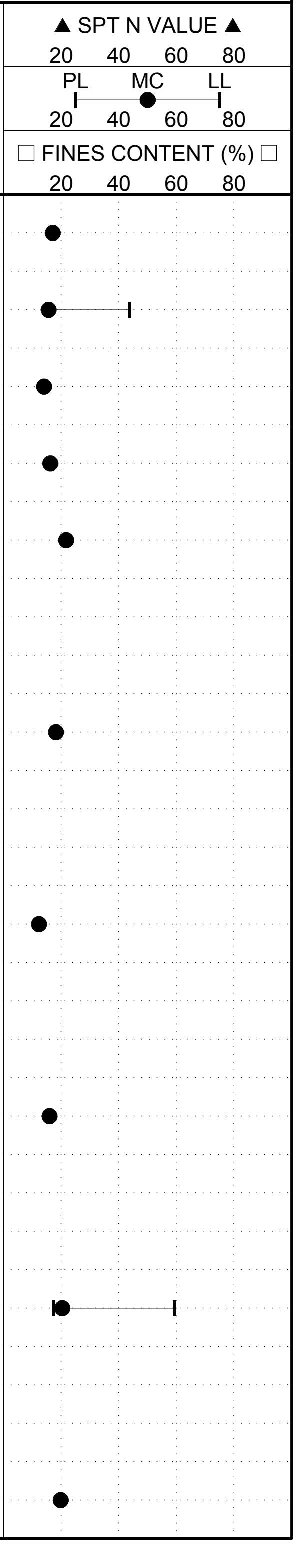
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-206

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 10/30/12 **COMPLETED** 10/30/12
GROUND ELEVATION 330.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 30.20 ft / Elev 300.30 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		(CL) SANDY CLAY, low plasticity, some silt, tan and gray, mottled, dry, stiff	SH 1	44		2.25	
		decreased sand content, very stiff at 2.0'	SH 2	67		3.5	
5		interbedded with silty clay layers, very stiff at 4.0'	SH 3	50		2.25	
		some silty sand veins, very stiff at 6.0'	SH 4	67		3.5	
10			SH 5	52		3.5	
15		trace organics, hard at 13.0'	SH 6	54		4.5	
20		with clayey sand veins, hard at 18.0'	SH 7	50		5.0	
25		some red, moist at 23.0'	SH 8	50		4.5	
30		(CH) SANDY CLAY, medium to high plasticity, some silt, tan and gray, very stiff ▽	SH 9	52		3.25	
35		increased sand and silt content, dark gray, stiff at 33.0'	SH 10	56		1.5	



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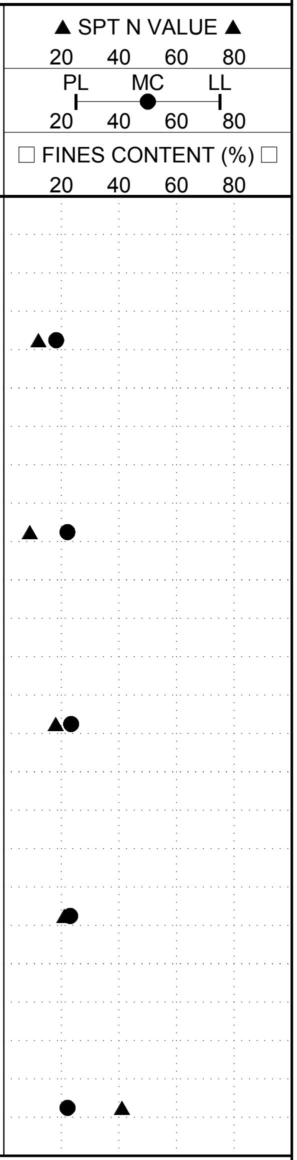
Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-206

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35							
		(SC) CLAYEY SAND, fine, subangular, low plasticity, some to little silt, gray, tan, and red, mottled, wet, compact	SS 11	100	5-6-6 (12)		
40							
		(SM) SILTY SAND, fine, subangular, non-plastic, some clay, wet, loose	SS 12	100	3-4-5 (9)		
45							
		(SP) SAND, medium to fine, trace coarse, poorly graded, subangular, non-plastic, some silt, tan, wet, compact	SS 13	100	2-6-12 (18)		
50							
		no coarse, trace clay at 53.0'	SS 14	100	5-8-13 (21)		
55							
		dense at 58.0'	SS 15	100	9-18-23 (41)		
60							



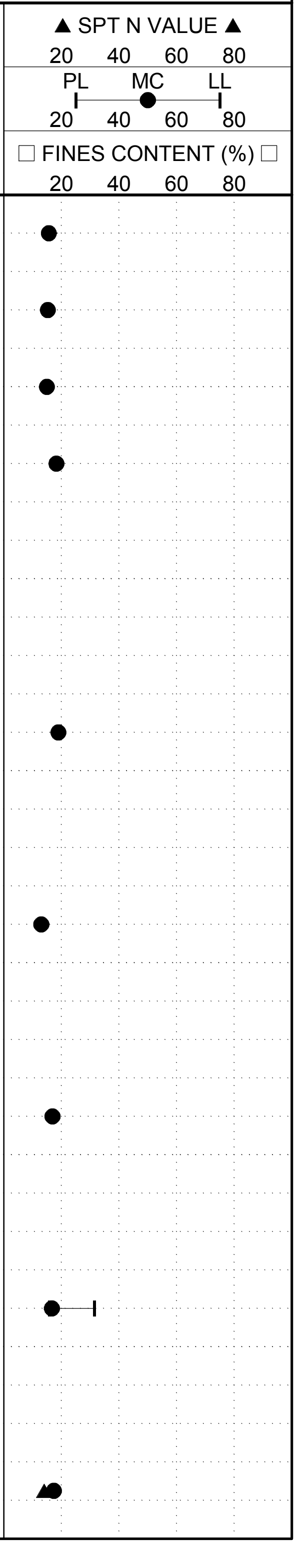
Bottom of borehole at 60.0 feet.

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-207

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 10/31/12 **COMPLETED** 10/31/12
GROUND ELEVATION 330.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 34.40 ft / Elev 296.10 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		remove 8" of SANDY GRAVEL from roadbed					
		(CL) SILTY CLAY, low plasticity, trace fine sand, gray, dry, hard	SH 1	33		5.0	
		(CL) SANDY CLAY, low plasticity, some silt and interbedded sand seams, tan and gray, mottled, dry, firm	SH 2	58		3.0	
5		(SP) SAND, poorly graded, non-plastic, some silt, clay, and gravel, black and tan, dry	SH 3	38		0.0	
		(CL) SANDY CLAY, low plasticity, some silt, gray and tan, dry, firm	SH 4	54		3.0	
		hard at 8.0'	SH 5	50		5.0	
10							
		decrease sand content, stiff at 13.0'	SH 6	56		3.75	
15							
		some sand seams at 18.0'	SH 7	52		2.5	
20							
		(SM) SILTY SAND, non-plastic, fine, subangular, little clay, gray, moist	SH 8	33			
25							
		(CL) SILTY CLAY, non-plastic, some sand, gray, moist, hard	SH 9	60		5.0	
30							
		(SM) SILTY SAND, non-plastic, fine, subangular, little clay, gray with little tan, moist, compact ▽	SS 10	89	6-7-7 (14)		
35							



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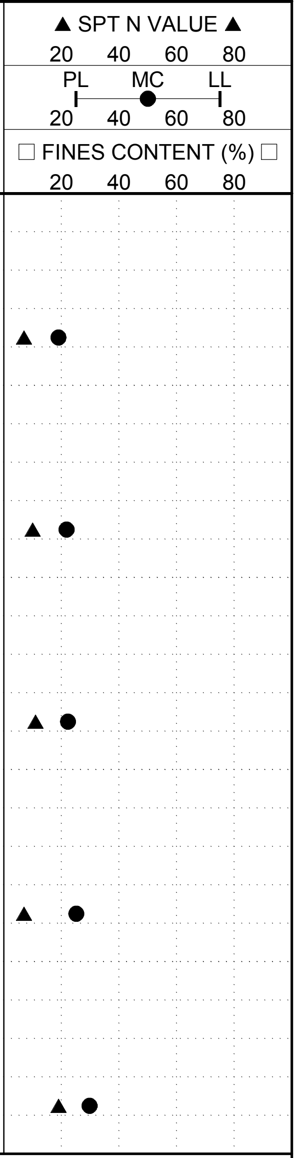
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-207

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35						
	(SC) CLAYEY SAND, non-plastic, fine, subangular, some silt, gray and tan, wet, loose	SS 11	67	2-3-4 (7)		
40						
	compact at 43.0'	SS 12	100	3-5-5 (10)		
45						
		SS 13	100	3-5-6 (11)		
50						
	(SP) SAND, medium to fine, non-plastic, some silt and clay, gray and tan, wet, loose	SS 14	89	2-2-5 (7)		
55						
	(CL) SILTY CLAY, low plasticity, trace fine sand, gray, wet, very stiff	SS 15	100	3-7-12 (19)		
60						



Bottom of borehole at 60.0 feet.

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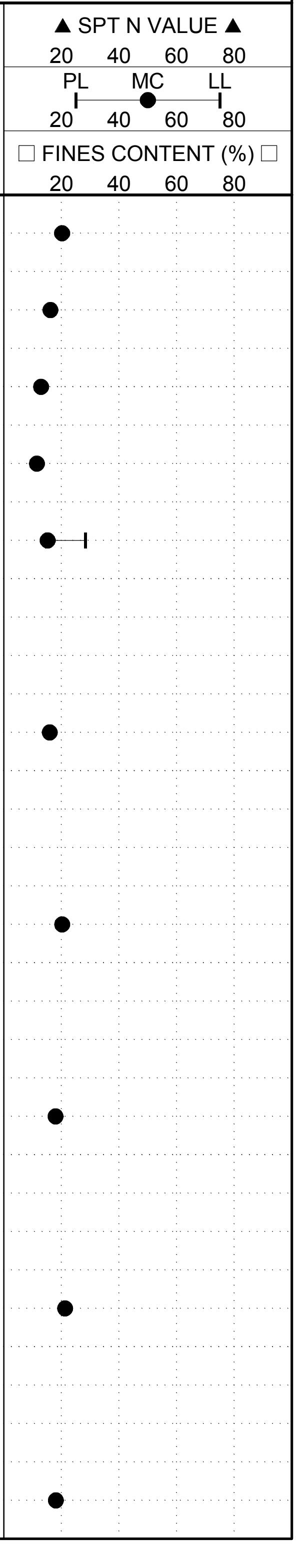
BORING NUMBER BH-208

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 10/31/12 **COMPLETED** 10/31/12
GROUND ELEVATION 330.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 30.00 ft / Elev 300.50 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	remove 12" of SANDY GRAVEL from roadbed					
	(CL) SANDY CLAY, low plasticity, some silt, tan and gray, dry, stiff	SH 1	44		3.5	
	stiff to very stiff at 2.0'	SH 2	50		4.0	
5	hard at 4.0'	SH 3	54		5.0	
	SILTY SAND, nonplastic, some clay, dry	SH 4	31		1.5	
10	(CL) SANDY CLAY, low plasticity, some silt, tan, gray, and red, dry, soft to firm	SH 5	50		2.0	
15		SH 6	40		2.5	
20	very stiff at 18.0'	SH 7	50		3.5	
25	hard at 23.0'	SH 8	46		5.0	
30	some sand seams, moist, very stiff at 28.0' ▽	SH 9	54		3.0	
35	(SC) CLAYEY SAND, fine, subangular, some silt, tan, gray, and red, moist	SH 10	60		2.5	



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BORING NUMBER BH-208

CLIENT Luminant

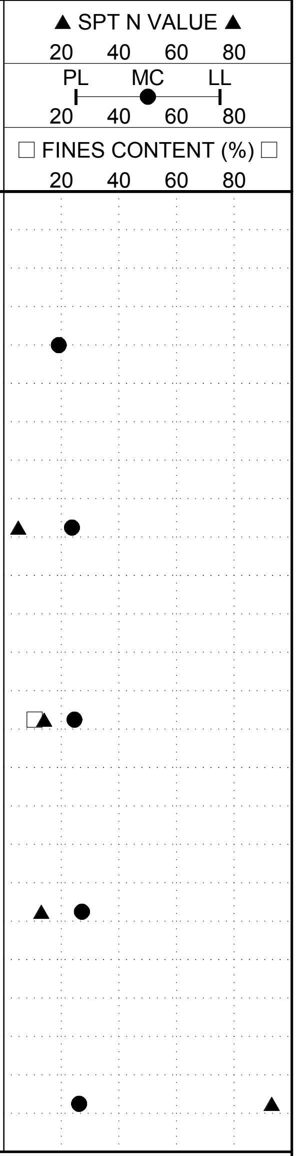
PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35							
		wet at 38.0'	SH 11	50			
40							
		loose at 43.0'	SS 12	100	3-2-3 (5)		
45							
		(SP) SAND, fine, little medium, non-plastic, subangular, little clay, tan, compact	SS 13	72	1-6-8 (14)		
50							
			SS 14	100	3-6-7 (13)		
		(SC) CLAYEY SAND, medium, some silt, brown					
55		(SM) SILTY SAND, fine, subangular, non-plastic, little clay, gray, compact					
		(CL) SILTY CLAY, low plasticity, dark gray, dense	SS 15	100	7-43-50 (93)		
60		SANDY GRAVEL, non-plastic, planar, lignite coal seam, black, hard					

Bottom of borehole at 60.0 feet.



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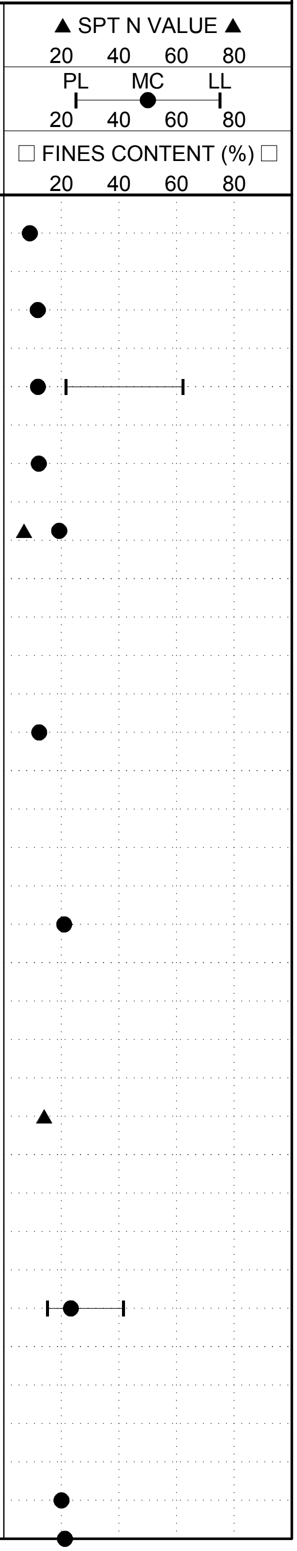
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-209

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 11/1/12 **COMPLETED** 11/1/12
GROUND ELEVATION 360 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 46.20 ft / Elev 313.80 ft no reading, cave in at 46
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		(SC) CLAYEY SAND, fine, subangular, medium plasticity, some fine rounded gravel, red and brown, dry	SH 1	33		5.0	
		trace fine rounded gravel, tan and gray, mottled at 2.0'	SH 2	38		5.0	
5		little silt, no gravel at 4.0'	SH 3	38		5.0	
		some silt at 6.0'	SH 4	29		4.5	
10		(CL) SANDY CLAY, low plasticity, some silt, tan and gray, dry, firm	SS 5	33	2-2-5 (7)		
15		some red, hard at 13.0'	SH 6	21		5.0	
20		gray, moist, very stiff at 18.0'	SH 7	29		2.5	
25		(CL) LEAN CLAY, low plasticity, some silt, trace fine sand, gray and tan, moist, stiff	SS 8	67	4-6-8 (14)		
30		little silt, hard, gray at 28.0'	SH 9	50		5.0	
35		grading to clayey sand, very stiff at 33.0'	SH 10	42		3.0	



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BORING NUMBER BH-209

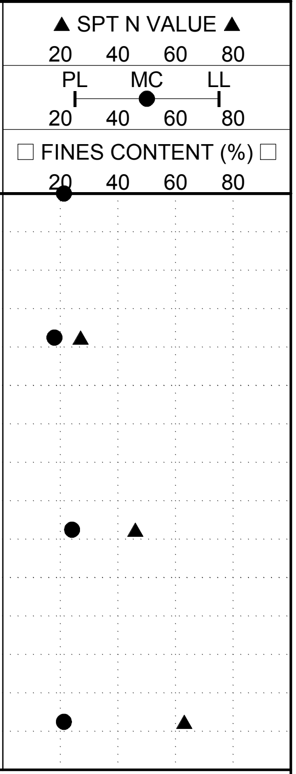
CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35 40	▨	some silt and sand, gray, tan, and brown, hard at 38.0'	SS 11	100	7-13-14 (27)		
45	▨	(CL) SILTY CLAY, low plasticity, dark gray, moist, hard ∇	SS 12	100	12-20-26 (46)		
50	▨	(SM) SILTY SAND, fine, subangular, non-plastic, some clay, tan and gray, moist, very dense	SS 13	100	14-27-36 (63)		



Bottom of borehole at 50.0 feet.

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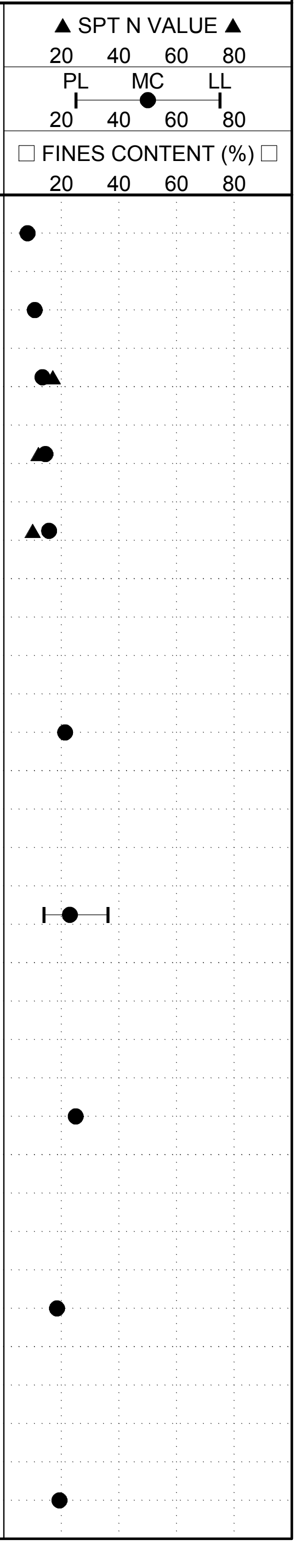
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-210

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 11/1/12 **COMPLETED** 11/1/12
GROUND ELEVATION 360 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 47.00 ft / Elev 313.00 ft no reading, cave in at 47
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(SC) CLAYEY SAND, fine, subangular, some silt, little fine rounded gravel, red, dry trace roots at 1.0'	SH 1	25		5.0	
	tan, gray, and red, mottled at 2.0'	SH 2	21		5.0	
5	compact at 4.0'	SS 3	67	4-7-10 (17)		
		SS 4	39	3-6-6 (12)		
		SS 5	33	3-4-6 (10)		
10						
15	(CL) SANDY CLAY, low to medium plasticity, little silt, red and gray, dry, very stiff	SH 6	21		3.0	
	some silt and sand seams, gray and tan, moist, very stiff at 18.0'	SH 7	89		3.5	
20						
25	little red, hard at 23.0'	SH 8	50		4.5	
30	trace subrounded fine gravels and coarse sand at 28.0'	SH 9	29		4.0	
35	(SC) CLAYEY SAND, fine, subangular, some silt, brown and tan, moist	SH 10	35		4.0	



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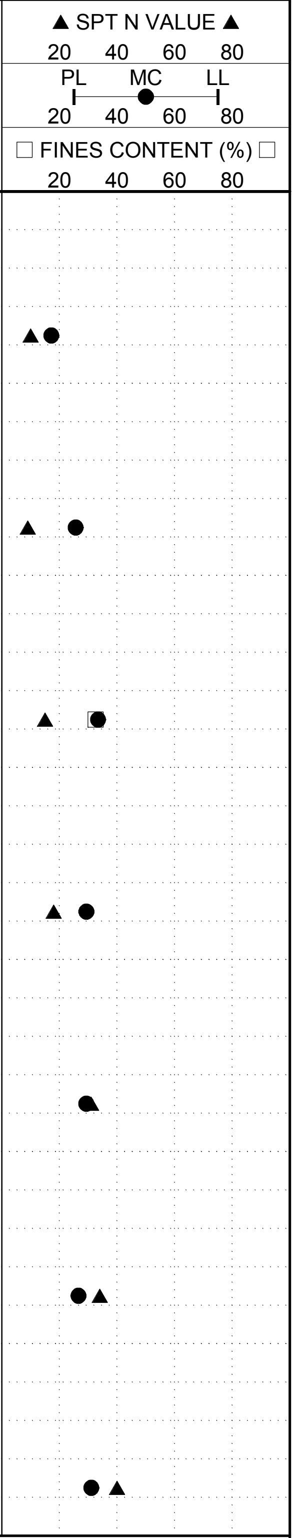
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-210

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35						
	(SM) SILTY SAND, fine, subangular, non-plastic, little clay, dark gray, moist, compact	SS 11	50	4-5-5 (10)		
40						
	(CL) SILTY CLAY, low plasticity, little fine sand, gray, moist, stiff	SS 12	94	2-4-5 (9)		
45						
	▽					
	(SM) SILTY SAND, fine, subangular, non-plastic, some clay, gray and tan, mottled, wet, compact	SS 13	100	4-7-8 (15)		
50						
		SS 14	89	5-9-9 (18)		
55						
	little tan, dense at 58.0'	SS 15	100	7-14-17 (31)		
60						
		SS 16	100	11-15-19 (34)		
65						
	some dark brown clay seams at 68.0'	SS 17	100	10-15-25 (40)		
70						



Bottom of borehole at 70.0 feet.

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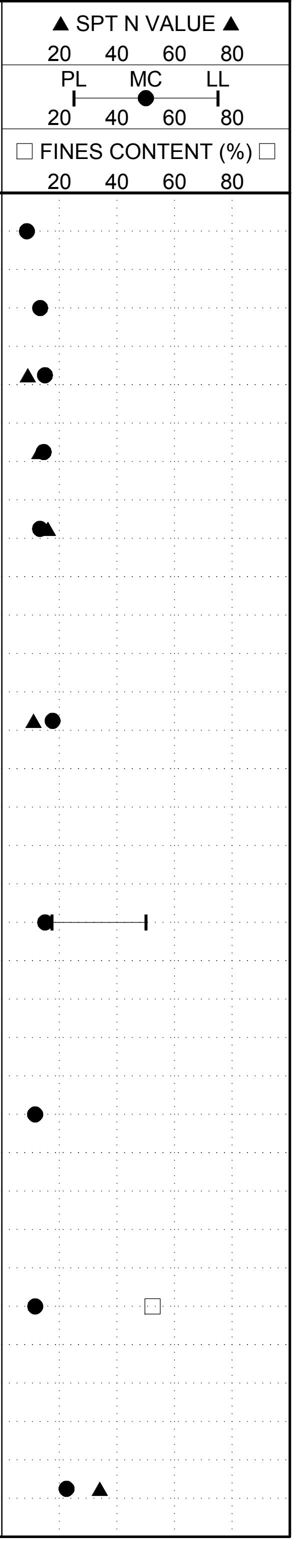
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-211

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 11/2/12 **COMPLETED** 11/2/12
GROUND ELEVATION 360 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 60.20 ft / Elev 299.80 ft no reading, cave in at 6
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft) 0	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
	(SC) CLAYEY SAND, some silt and fine rounded gravel, red, dry	SH 1	29		5.0	
	fine, subangular, gray, tan, and red at 2.0'	SH 2	29		3.5	
5	trace fine gravels and coarse sand, loose at 4.0'	SS 3	50	2-3-6 (9)		
	some sandy clay seams, compact at 6.0'	SS 4	39	4-5-8 (13)		
10	increase clay and silt content at 8.0'	SS 5	72	4-8-8 (16)		
15	(CL-CH) SANDY CLAY, low to medium plasticity, little silt, gray, tan, and red, dry, stiff	SS 6	33	2-5-6 (11)		
20	some silt at 18.0'	SH 7	50		3.25	
25	brown and tan at 23.0'	SH 8	44		5.0	
30	(ML) SANDY SILT, little clay, tan, moist	SH 9	25			
35	(SM) SILTY SAND, fine, subangular, some clay, tan and gray, dense	SS 10	67	7-15-19 (34)		



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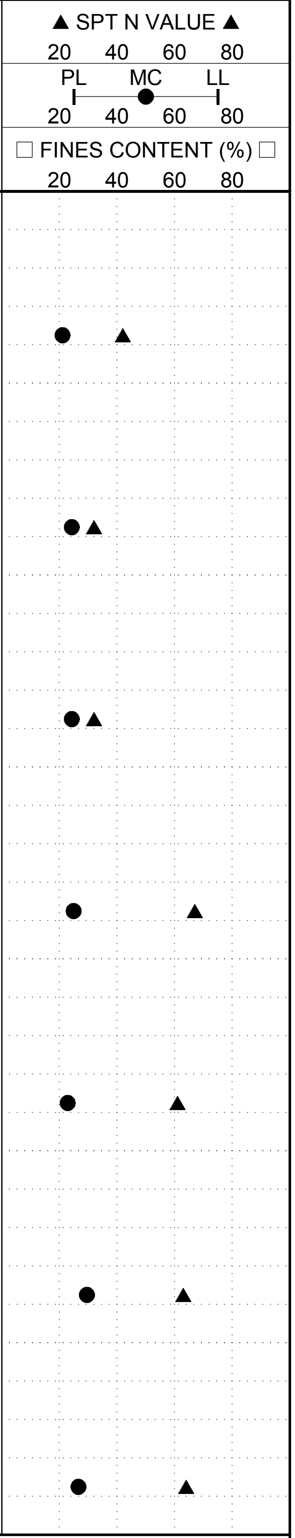
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

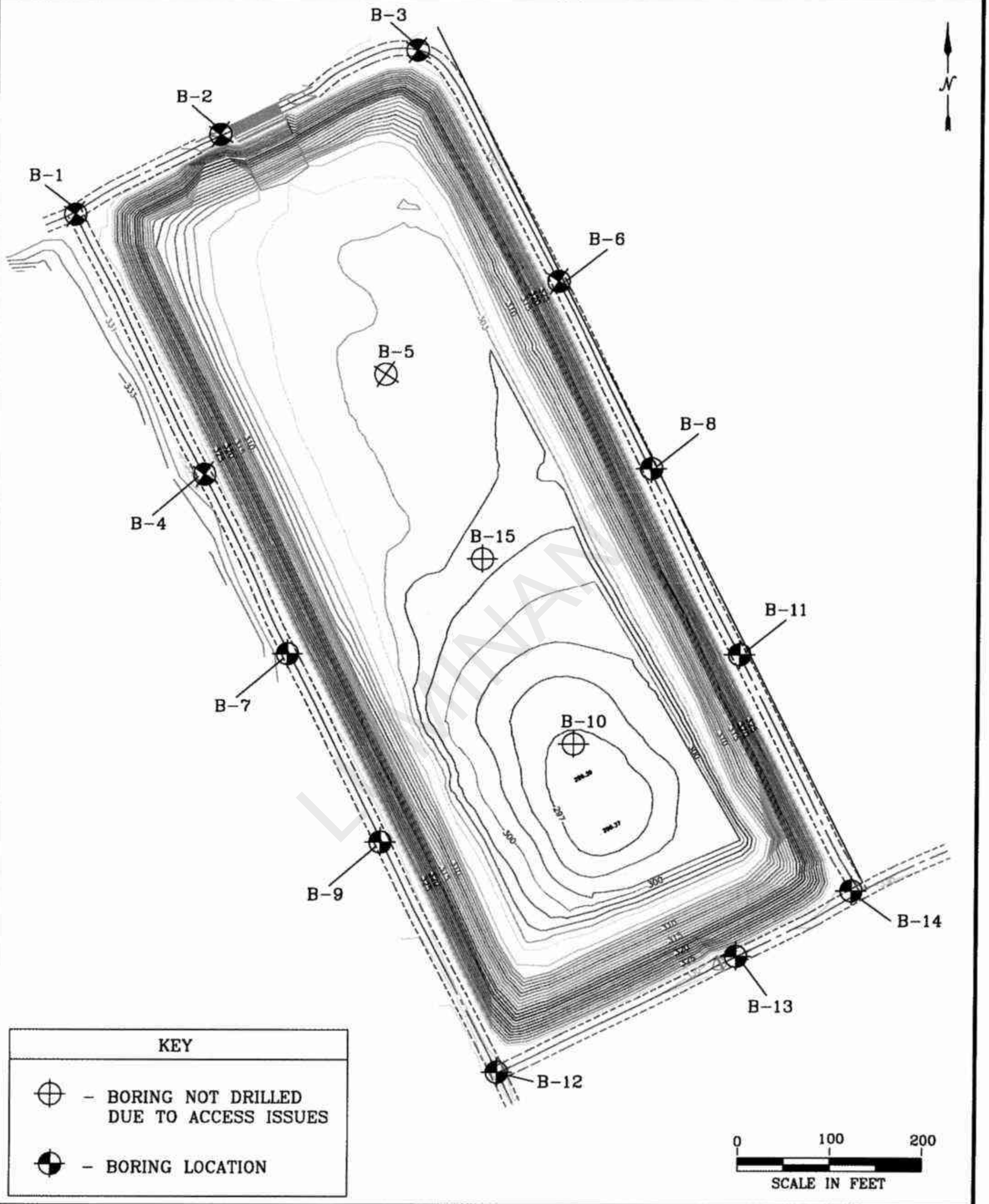
BORING NUMBER BH-211

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35						
		SS 11	89	9-17-25 (42)		
40						
		SS 12	100	10-14-18 (32)		
45						
	(SC) CLAYEY SAND, low plasticity, fine, subangular, some silt and lean clay, gray and tan, wet, dense	SS 13	89	9-14-18 (32)		
50						
	(SP) SAND, fine, subangular, non-plastic, some silt, little to trace clay, tan, wet, very dense	SS 14	100	17-29-38 (67)		
55						
	little medium at 58.0'	SS 15	78	14-28-33 (61)		
60	▽					
		SS 16	100	17-29-34 (63)		
65						
	(SM) SILTY SAND, fine, subangular, non-plastic, little to trace clay, gray and tan, wet, very dense	SS 17	72	18-27-37 (64)		
70						



Bottom of borehole at 70.0 feet.



ETTL ENGINEERS & CONSULTANTS MAIN OFFICE 1717 East Erwin Tyler, Texas 75702 (903) 595-4421	MARTIN LAKE LUMINANT EAST ASH DISPOSAL POND RUSK COUNTY, TEXAS	PLATE 1 - PLAN OF BORINGS		APPROVED BY:
		JOB NO.: G 2972-08		DRAWN BY: K.C.R.
		DATE: NOV. 2008	SCALE: AS SHOWN	

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-1

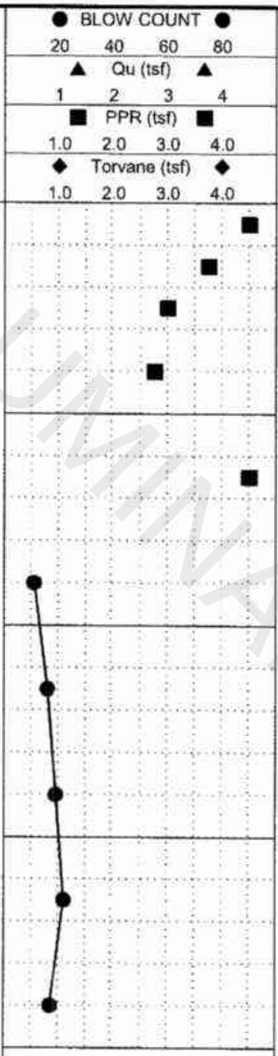
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

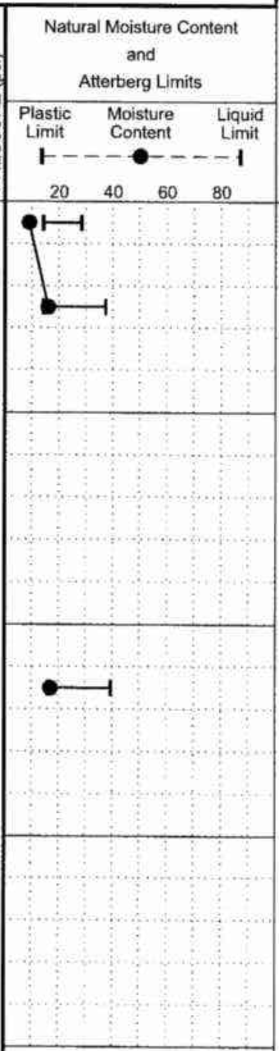
PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/8/08

SURFACE ELEVATION

DEPTH (ft)	USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL		SANDY LEAN CLAY(CL) hard; red, tan, and gray; mottled	P=4.5+					9	28	14	14	55	+40 Sieve =0%, +4 Sieve =0%
			--very stiff	P=3.75										
			--with trace lignite	P=3.0					16	37	14	23	66	+40 Sieve =1%, +4 Sieve =0%
				P=2.75										
10			--hard	P=4.5+										
20				N=11										
		▼		N=16					17	39	16	23	70	+40 Sieve =1%, +4 Sieve =0%
30	SM		SILTY SAND(SM) medium dense; red, tan, and gray	N=19										
			--with gravel	N=22										
40	CL		LEAN CLAY WITH SAND(CL) very stiff; red, tan, and gray; interbedded; laminated	N=17										
			Bottom of Boring @ 40'											





Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 28' while drilling. Water level @ 26' and open to 33' upon completion. Water level @ 24' and open to 27' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.850', W 94°33.910'

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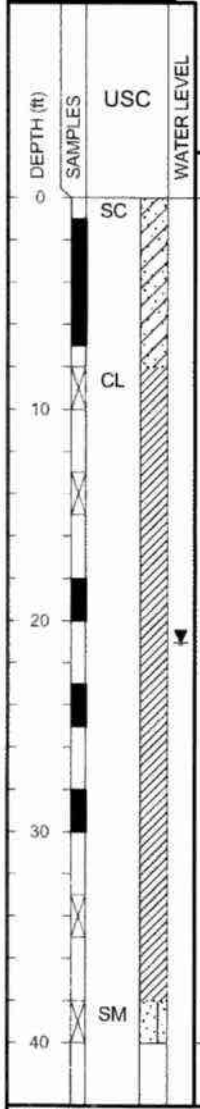
LOG OF BORING B-11

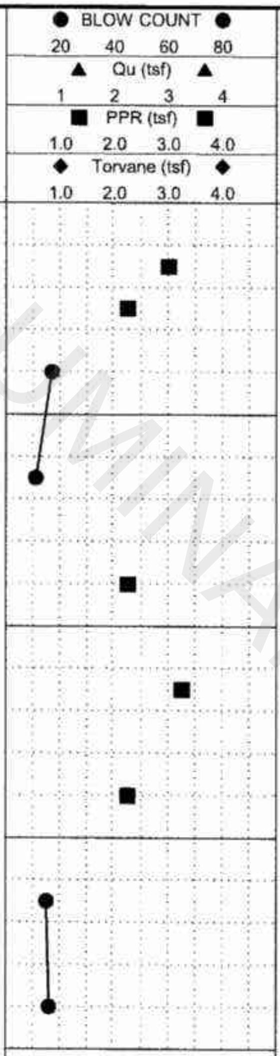
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/7/08

SURFACE ELEVATION





USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	CLAYEY SAND(SC) tan, gray, and red; mottled; with gravel						6	28	12	16	33	+40 Sieve =28%, +4 Sieve =24%
		P=3.0										
		P=2.25										
CL	SANDY LEAN CLAY(CL) very stiff; tan, gray, and red; mottled	N=17					13	32	13	19	56	+40 Sieve =1%, +4 Sieve =0%
	--stiff	N=11										
		P=2.25										
		P=3.25					16	38	14	24	68	+40 Sieve =1%, +4 Sieve =0%
	–red and gray; mottled	P=2.25										
	–tan, red, and gray; mottled	N=15										
SM	SILTY SAND(SM) medium dense; gray	N=16										
	Bottom of Boring @ 40'											

Water Level Est: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 38' while drilling. Water level @ 36' and open to 37' upon completion. Water level @ 21' and open to 22' on 10/8/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.773', W 94°33.782'

ETTL ENGINEERS & CONSULTANTS

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(903) 595-4421

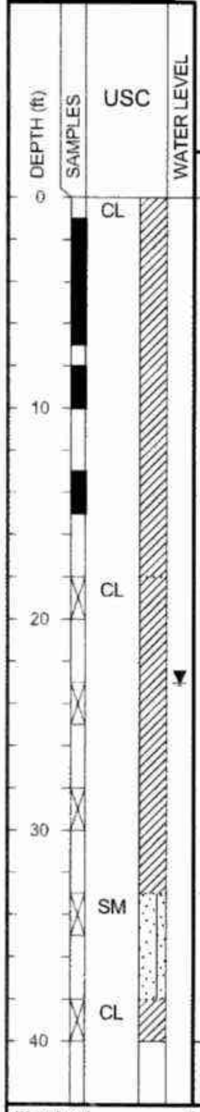
LOG OF BORING B-12

PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

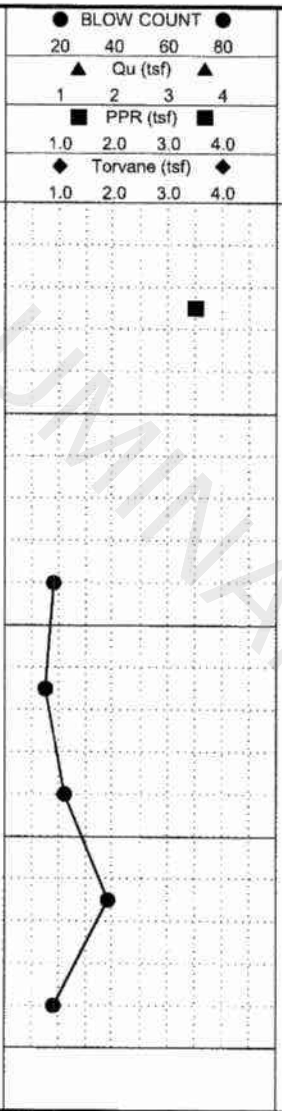
PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/9/08

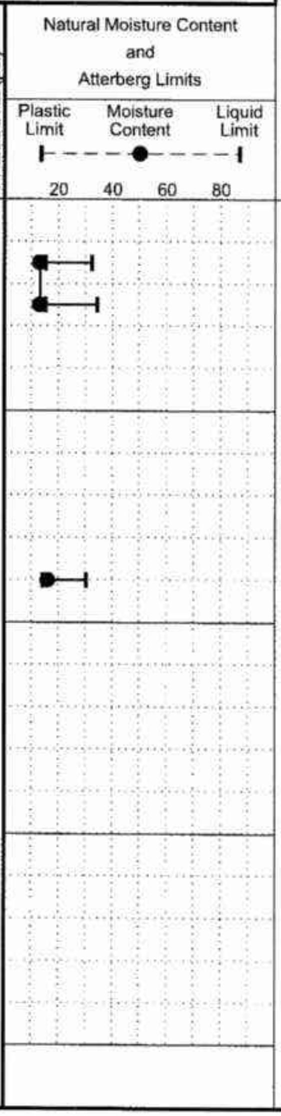
SURFACE ELEVATION



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) brown; with gravel							
			13	32	15	17	54	+40 Sieve =1%, +4 Sieve =0%
	–mottled; tan, red, and gray; with sand seams	P=3.5	13	34	15	19	57	+40 Sieve =0%, +4 Sieve =0%
	–with silty sand							
CL	LEAN CLAY WITH SAND(CL) very stiff; tan, red, and gray; mottled	N=18	16	30	14	16	75	+40 Sieve =1%, +4 Sieve =0%
		N=15						
	–with sand seams	N=22						
SM	SILTY SAND(SM) dense; gray and red; mottled	N=38						
CL	SANDY LEAN CLAY(CL) very stiff; gray, red, and tan; mottled	N=18						
	Bottom of Boring @ 40'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est. ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 33' while drilling. Water level @ 34' and open to 35' upon completion. Water level @ 23' and open to 31' on 10/10/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.696', W 94°33.830'

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

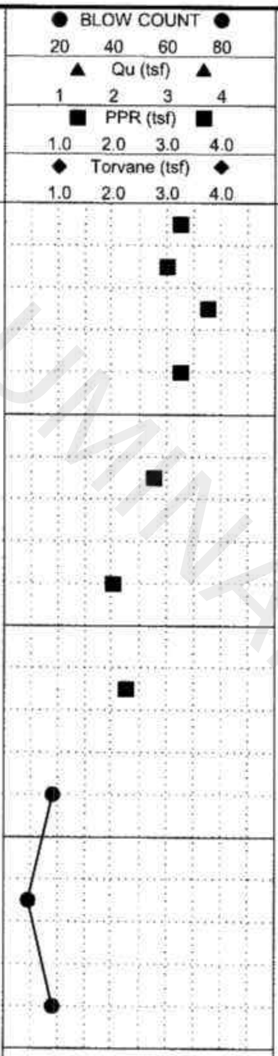
LOG OF BORING B-13

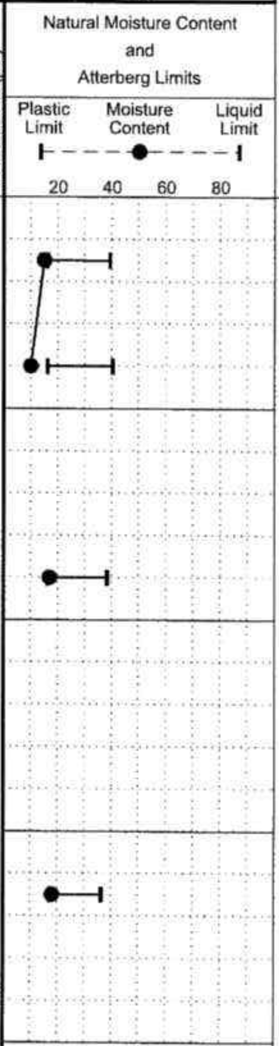
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/7/08

SURFACE ELEVATION





USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) very stiff; tan, gray, and red; mottled	P=3.25										
CL	LEAN CLAY WITH SAND(CL) very stiff; tan, gray, and red; mottled	P=3.0					15	39	16	23	70	+40 Sieve =6%
	–tan and brown	P=3.75										
SC	CLAYEY SAND(SC) dense; tan, brown, and red; with gravel	P=3.25					10	40	16	24	47	+40 Sieve =36%, +4 Sieve =33%
CL	LEAN CLAY WITH SAND(CL) very stiff; tan, brown, and red; with lignite	P=2.75										
	–red and tan	P=2.0					17	38	16	22	74	+40 Sieve =3%, +4 Sieve =0%
		P=2.25										
	–tan, red, and gray; mottled	N=18										
SC	CLAYEY SAND(SC) loose; tan, red, and gray; with trace gravel and ferric material	N=9					18	36	17	19	43	+40 Sieve =36%, +4 Sieve =25%
	–medium dense	N=18										
	Bottom of Boring @ 40'											

DEPTH (ft): 0, 10, 20, 30, 40

Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 37' while drilling. Water level @ 36' and open to 38' upon completion. Water level @ 25' and open to 26' on 10/8/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.713', W 94°33.777'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-14

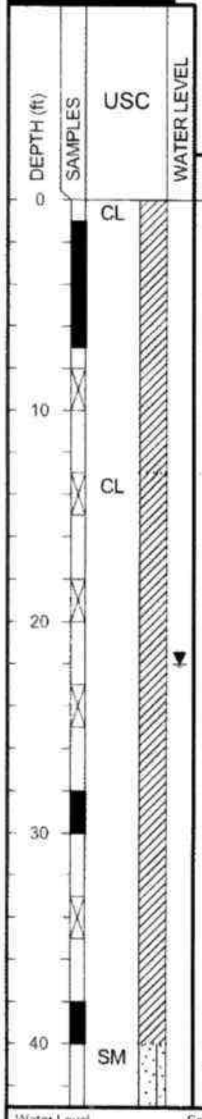
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

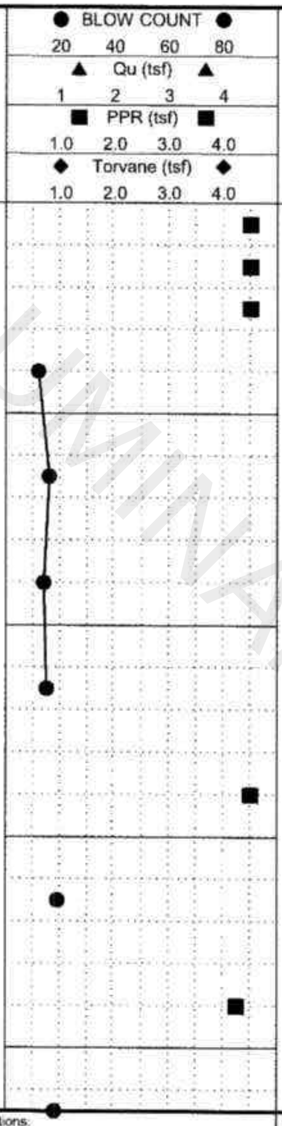
PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/6/08

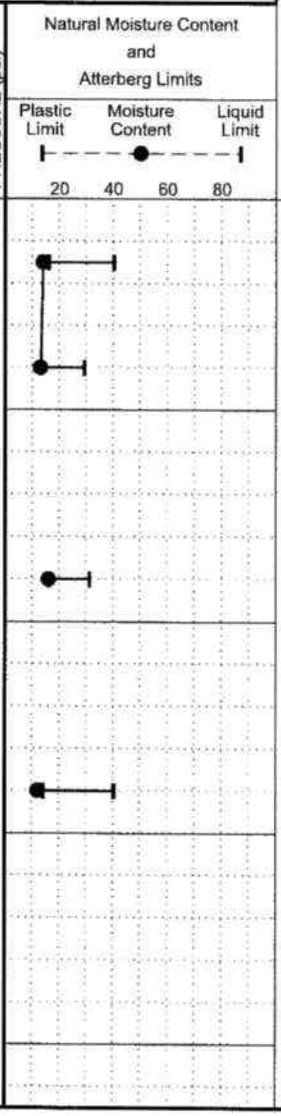
SURFACE ELEVATION

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	SANDY LEAN CLAY(CL) hard; tan, gray, and red; mottled; with gravel	P=4.5+						
			P=4.5+	14	40	16	24	53	+40 Sieve =50%, +4 Sieve =49%
			P=4.5+						
			P=4.5+						
		--stiff	N=12	13	29	13	16	63	+40 Sieve =1%, +4 Sieve =0%
10									
	CL	SANDY LEAN CLAY(CL) very stiff; tan, gray, and red; mottled	N=16						
		--stiff; interbedded	N=14	16	31	16	15	58	+40 Sieve =2%, +4 Sieve =0%
20									
			N=15						
		--hard; brown, tan, and red	P=4.5+	12	40	14	26	77	+40 Sieve =1%, +4 Sieve =0%
30									
			N=19						
		--hard; with gray and brown silty sand	P=4.25						
40	SM	SILTY SAND(SM) medium dense; red and gray; saturated							





DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est: ▽ Measured: ▼ Perched: ▽

Water Observations: Water level @ 22' and open to 89' upon completion. Water level @ 26' and open to 27' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.723', W 94°33.756'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-14

PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

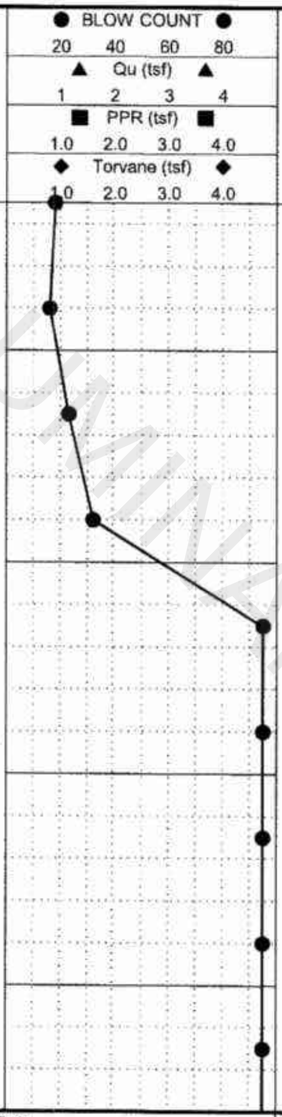
PROJECT NO.: G 2972-08

BORING TYPE: Flight Auger

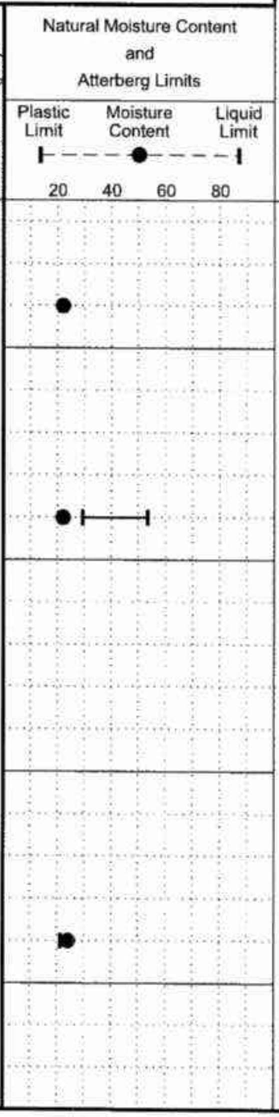
DATE 10/6/08

SURFACE ELEVATION

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
			N=18						
50			N=16	22				25	+40 Sieve =1%, +4 Sieve =0%
		--red and tan	N=23						
60	CL	LEAN CLAY WITH SAND(CL) hard; red and tan; interbedded; laminated; with ferric material seams	N=32	22	53	29	24	77	+40 Sieve =3%, +4 Sieve =0%
		--with black lignite seams	N=50/3"						
70	SM	SILTY SAND(SM) very dense; gray; with fat clay partings	N=50/5.5"						
		--gray	N=50/5"						
80			N=50/6"	24	24	21	3	41	+40 Sieve =0%, +4 Sieve =0%
	CL	LEAN CLAY(CL) hard; gray	N=50/6"						



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 22' and open to 89' upon completion. Water level @ 26' and open to 27' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.723', W 94°33.756'

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LOG OF BORING B-14

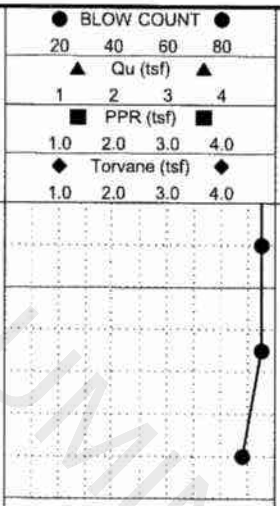
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

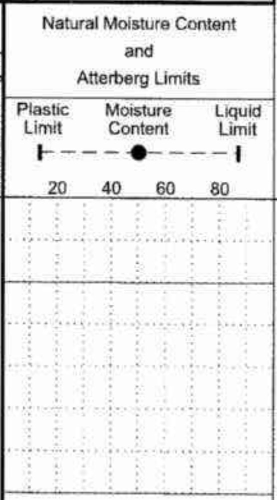
PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/6/08

SURFACE ELEVATION

DEPTH (ft)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
				–with black lignite	N=50/3.5"										
90															
				–dark brown; with silt seams; with lignite seam	N=50/6"										
					N=88										
100					Bottom of Boring @ 100'										





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 22' and open to 89' upon completion. Water level @ 26' and open to 27' on 10/9/08.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.723', W 94°33.756'

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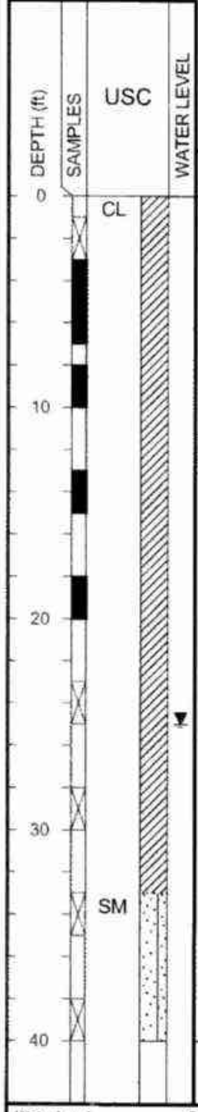
LOG OF BORING B-2

PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

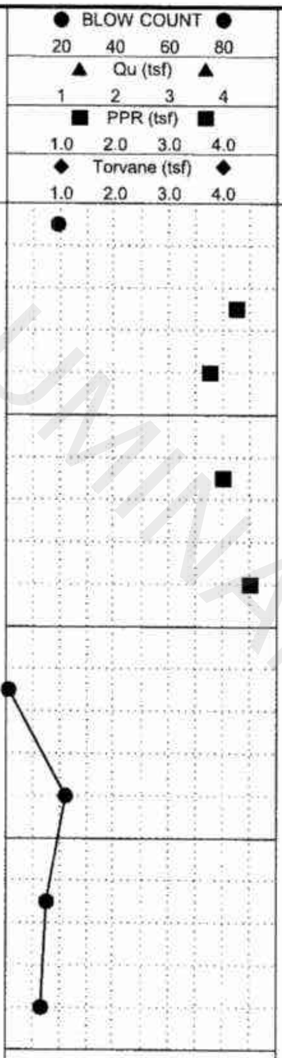
PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/8/08

SURFACE ELEVATION



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SANDY LEAN CLAY(CL) very stiff; tan, red, and gray	N=19	8	32	14	18	50	+40 Sieve =0%, +4 Sieve =0%
–hard; red, tan, and gray; mottled	P=4.25						
	P=3.75						
	P=4.0						
–with some gravel	P=4.5+						
–tan, red, and gray; mottled	N=1	17	28	15	13	63	+40 Sieve =1%, +4 Sieve =0%
–gray, red, and tan; mottled	N=22	13	39	15	24	54	+40 Sieve =0%, +4 Sieve =0%
SILTY SAND(SM) medium dense; red and gray; saturated	N=15						
	N=13						
Bottom of Boring @ 40'							

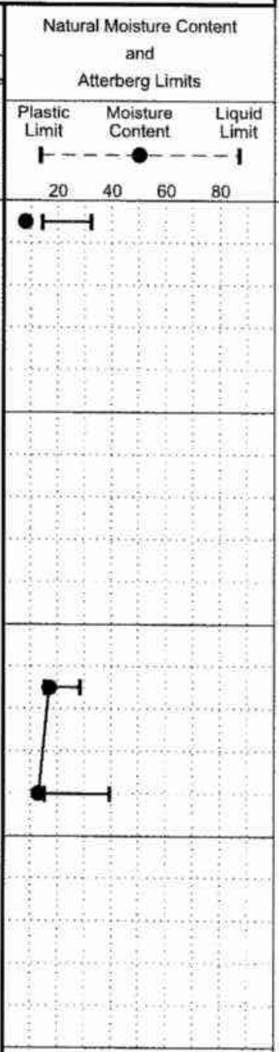


DRY DENSITY (pcf)

COMPRESSIVE STRENGTH (tsf)

FAILURE STRAIN (%)

CONFINING PRESSURE (psi)



Water Level Est.: ∇ Measured: ▼ Perched: ∇

Water Observations: Seepage @ 32' while drilling. Water level @ 29' and open to 32' upon completion. Water level @ 25' and open to 25' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.860', W 94°33.890'

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

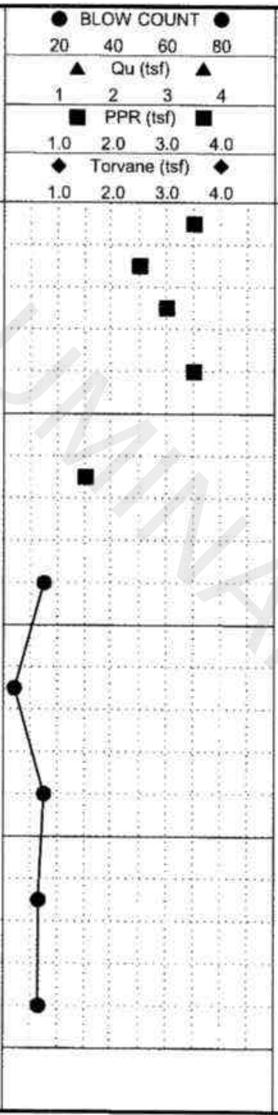
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

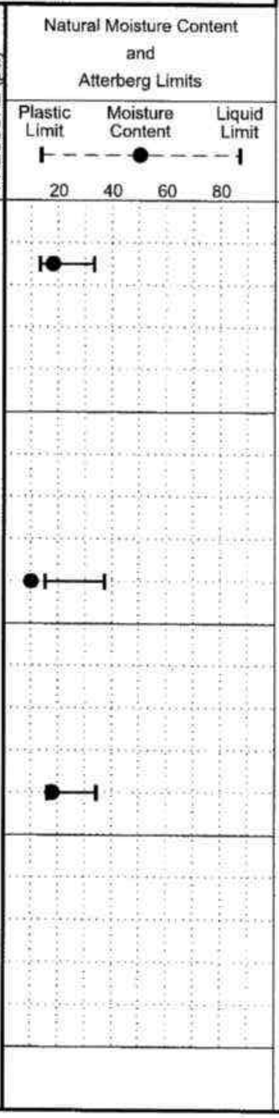
PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/8/08

SURFACE ELEVATION

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	SANDY LEAN CLAY(CL) very stiff; tan, red, and gray; mottled	P=3.5										
			P=2.5					18	33	13	20	68	+40 Sieve =1%, +4 Sieve =0%
			P=3.0										
10			P=3.5										
		--stiff	P=1.5										
20	SC	CLAYEY SAND(SC) medium dense; red	N=15					10	37	15	22	19	+40 Sieve =15%, +4 Sieve =7%
		--gray	N=4										
30	CL	LEAN CLAY WITH SAND(CL) stiff; red, tan, and gray; mottled	N=15					18	34	16	18	71	+40 Sieve =5%, +4 Sieve =0%
		--with sand seams	N=13										
40	SC	CLAYEY SAND(SC) medium dense; gray and red; mottled; with clay seams	N=13										
		Bottom of Boring @ 40'											





Water Level Est: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 29' while drilling. Water level @ 28' and open to 34' upon completion. Water level @ 25' and open to 32' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.876', W 94°33.842'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

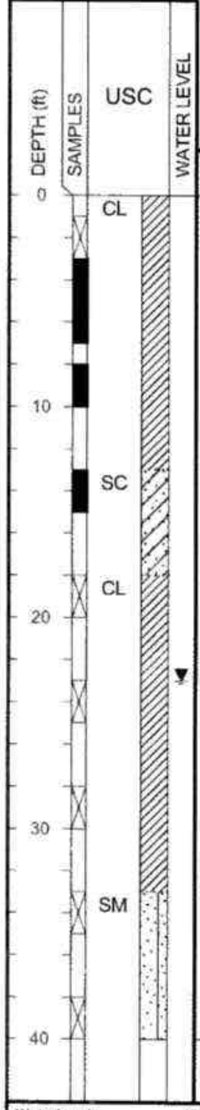
LOG OF BORING B-4

PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

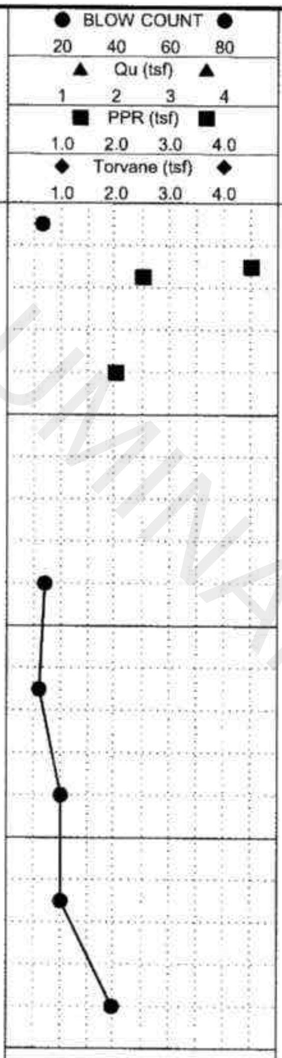
PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/8/08

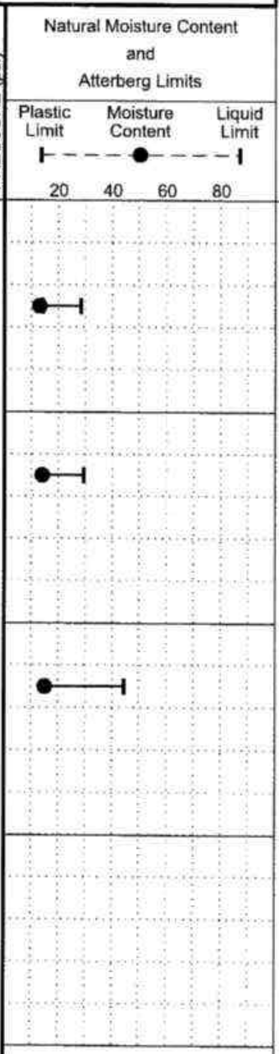
SURFACE ELEVATION



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) stiff; tan, red, and gray; mottled	N=13 P=2.5 P=4.5+ P=2.0	13	28	14	14	60	+40 Sieve =1%, +4 Sieve =0%
SC	CLAYEY SAND(SC) red, tan, and gray; mottled		14	29	14	15	36	+40 Sieve =0%, +4 Sieve =0%
CL	SANDY LEAN CLAY(CL) stiff; tan, red, and gray; mottled; with sand seams	N=14						
	–red and tan	N=12	15	44	15	29	67	+40 Sieve =0%, +4 Sieve =0%
	–with sand seams	N=20						
SM	SILTY SAND(SM) medium dense; red; saturated	N=20						
	–red and tan; with gravel	N=39						
	Bottom of Boring @ 40'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 28' while drilling. Water level @ 27' and open to 30' upon completion. Water level @ 23' and open to 28' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.804', W 94°33.891'

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

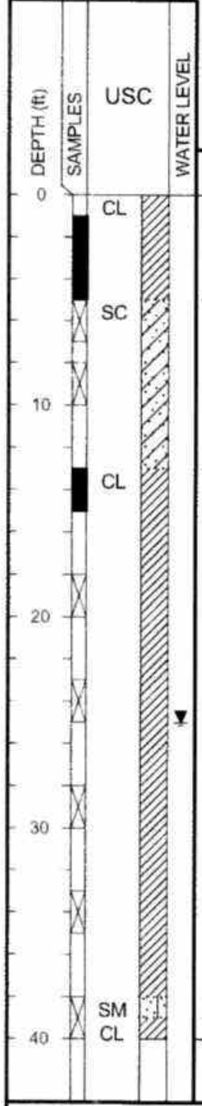
LOG OF BORING B-6

PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

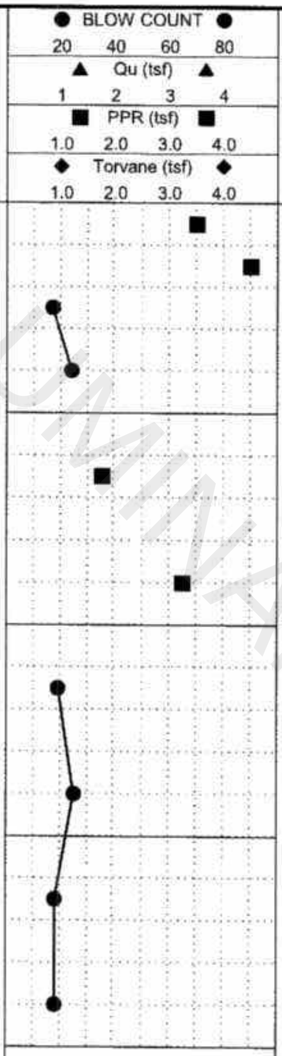
PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

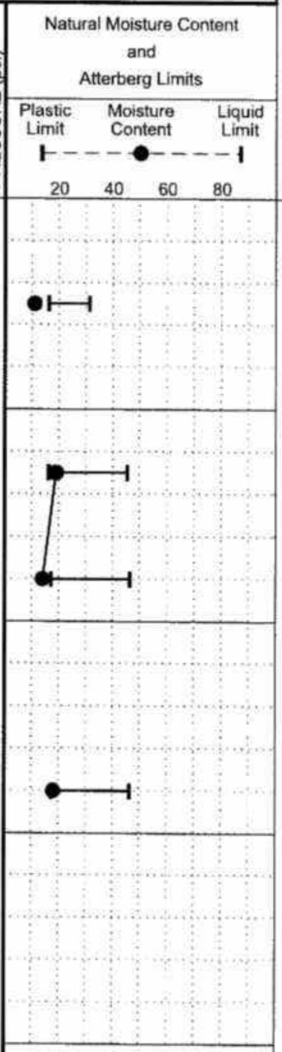
DATE 10/7/08

SURFACE ELEVATION



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) very stiff; tan, red, and gray; mottled	P=3.5 P=4.5+										
SC	CLAYEY SAND(SC) medium dense; tan, red, and gray; mottled	N=17 N=24					11	31	16	15	43	+40 Sieve =1%, +4 Sieve =0%
CL	LEAN CLAY(CL) stiff; tan, red, and gray; mottled	P=1.75					19	45	16	29	88	+40 Sieve =0%, +4 Sieve =0%
	--very stiff; brown, gray, and red; with sand; trace ferric material and lignite	P=3.25					14	46	17	29	74	+40 Sieve =0%, +4 Sieve =0%
	--with sand seams	N=19										
	--tan, red, and gray; mottled	N=25					18	46	17	29	84	+40 Sieve =8%, +4 Sieve =3%
	--tan and gray; mottled	N=18										
SM	SILTY SAND(SM) tan and gray	N=18										
CL	SANDY LEAN CLAY(CL) very stiff; tan and gray											
	Bottom of Boring @ 40'											





Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 28' while drilling. Water level @ 26' and open to 34' upon completion. Water level @ 25' and open to 27' on 10/8/08.

Key to Abbrevations:
- N - SPT Data (Blows/Ft)
- P - Pocket Penetrometer (tsf)
- T - Torvane (tsf)
- L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.833', W 94°33.814'

LOG OF BORING B-7

ETTL ENGINEERS & CONSULTANTS

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

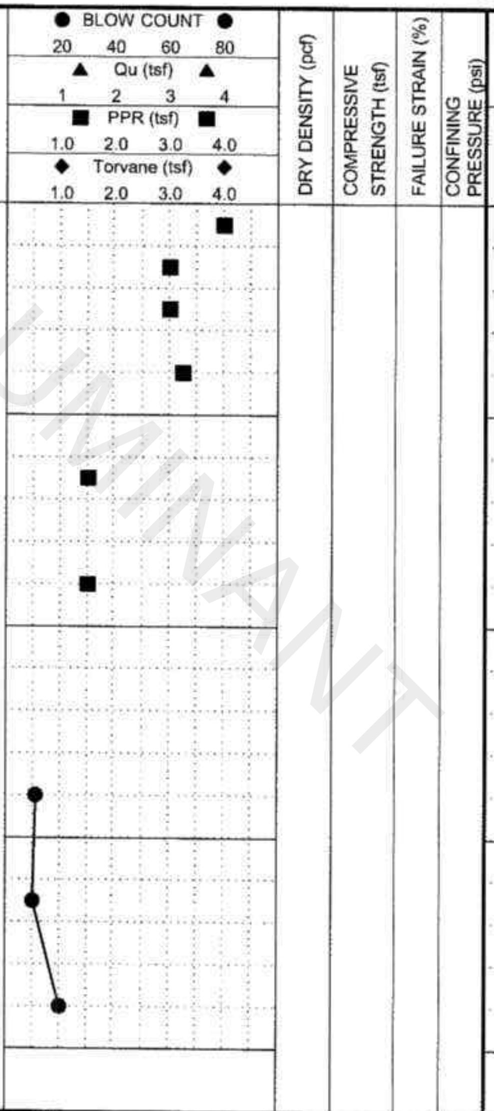
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/8/08

SURFACE ELEVATION

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	SANDY LEAN CLAY(CL) hard; tan, red, and gray; mottled	P=4.0						
	CL ML	SANDY SILTY CLAY(CL-ML) very stiff; tan, red, and gray; mottled	P=3.0	16	21	14	7	63	+40 Sieve =0%, +4 Sieve =0%
			P=3.0						
	CL	LEAN CLAY WITH SAND(CL) very stiff; tan, red, and gray; mottled	P=3.25	15	34	16	18	74	+40 Sieve =1%, +4 Sieve =0%
10									
		--stiff	P=1.5						
			P=1.5	15	36	15	21	72	+40 Sieve =0%, +4 Sieve =0%
20									
	CH	FAT CLAY(CH) stiff; gray, red, and tan; mottled	N=11	25	55	19	36	88	+40 Sieve =1%, +4 Sieve =0%
30									
	SM	SILTY SAND(SM) medium dense; tan, red, gray, mottled	N=10						
	CL	SANDY LEAN CLAY(CL) very stiff; red, tan, and gray; mottled	N=20						
40		Bottom of Boring @ 40'							



Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 33' while drilling. Water level @ 32' and open to 35' upon completion. Water level @ 23' and open to 27' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.775', W 94°33.875'

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(903) 595-4421

LOG OF BORING B-8

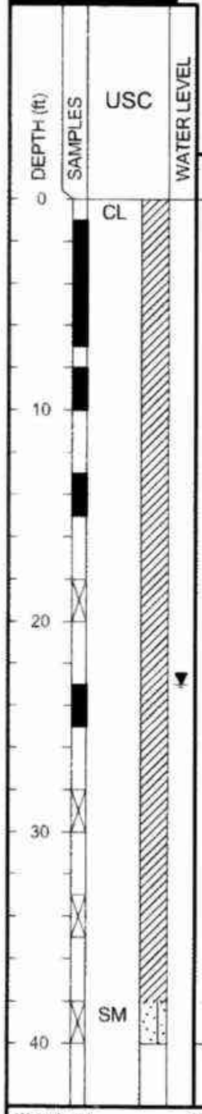
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

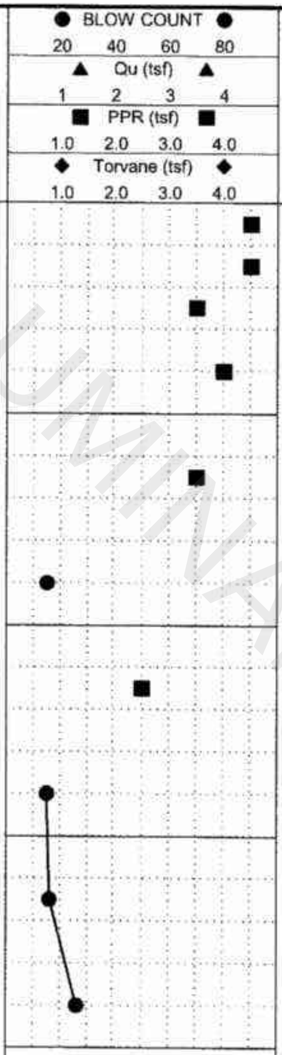
PROJECT NO.: G 2972-08

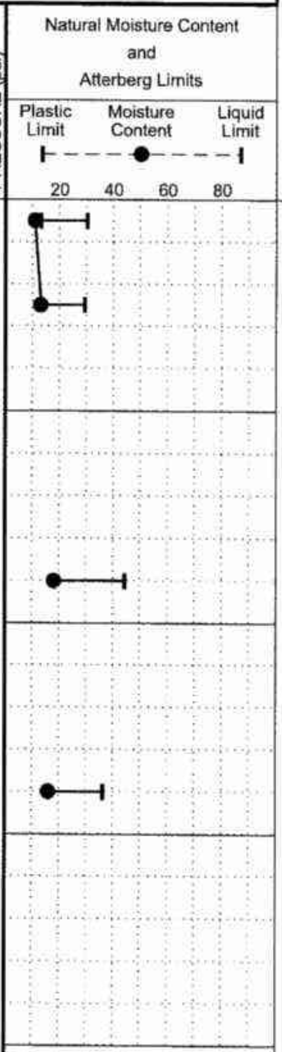
BORING TYPE: Flight Auger

DATE 10/7/08

SURFACE ELEVATION







USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) hard; tan, red, and gray; mottled	P=4.5+					11	30	13	17	67	+40 Sieve =2%, +4 Sieve =0%
		P=4.5+										
		P=3.5					13	29	13	16	67	+40 Sieve =0%, +4 Sieve =0%
		P=4.0										
		P=3.5										
	–very stiff	N=15					18	44	18	26	70	+40 Sieve =3%, +4 Sieve =0%
		P=2.5										
		N=15					16	36	16	20	63	+40 Sieve =9%, +4 Sieve =3%
	–red and gray; mottled	N=16										
SM	SILTY SAND(SM) dense; red, tan, and reddish gray; mottled; saturated	N=26										
	Bottom of Boring @ 40'											

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 38' while drilling. Water level @ 35' and open to 36' upon completion. Water level @ 23' and open to 27' on 10/8/08.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.803', W 94°33.798'

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LOG OF BORING B-9

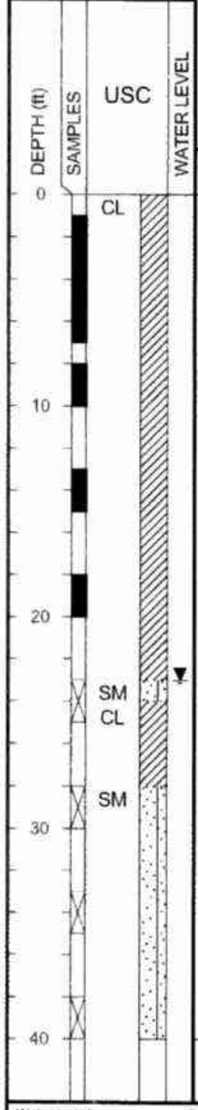
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

PROJECT NO.: G 2972-08

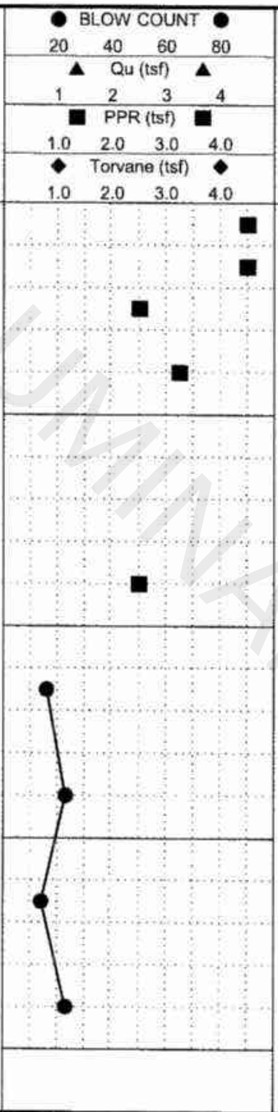
BORING TYPE: Flight Auger

DATE 10/9/08

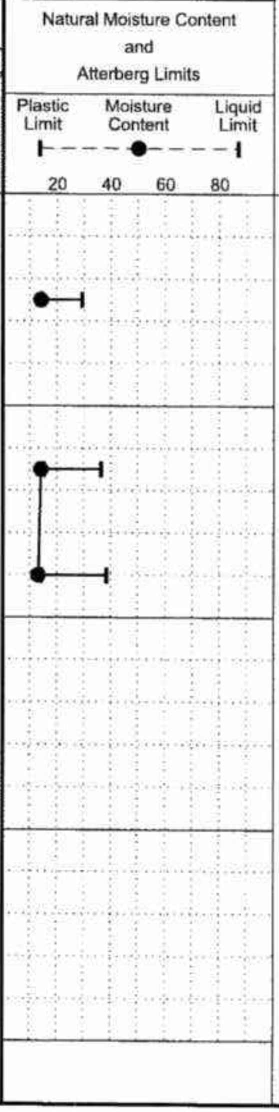
SURFACE ELEVATION



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) hard; tan, red, and gray; mottled	P=4.5+						
		P=4.5						
		P=2.5	14	29	14	15	59	+40 Sieve =2%, +4 Sieve =0%
		P=3.25						
	--sand content increasing	SF	14	36	15	21	58	+40 Sieve =1%, +4 Sieve =0%
	--with bluish green sandy clay	P=2.5	13	38	14	24	56	+40 Sieve =1%, +4 Sieve =0%
SM	SILTY SAND(SM) medium dense; gray, tan, and red; mottled	N=16						
CL	SANDY LEAN CLAY(CL) very stiff; gray, tan, and red; mottled							
SM	SILTY SAND(SM) medium dense; tan, red, and gray	N=23						
	--with clay seams	N=14						
	--saturated	N=23						
	Bottom of Boring @ 40'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



ATTERBERG LIMITS(%)

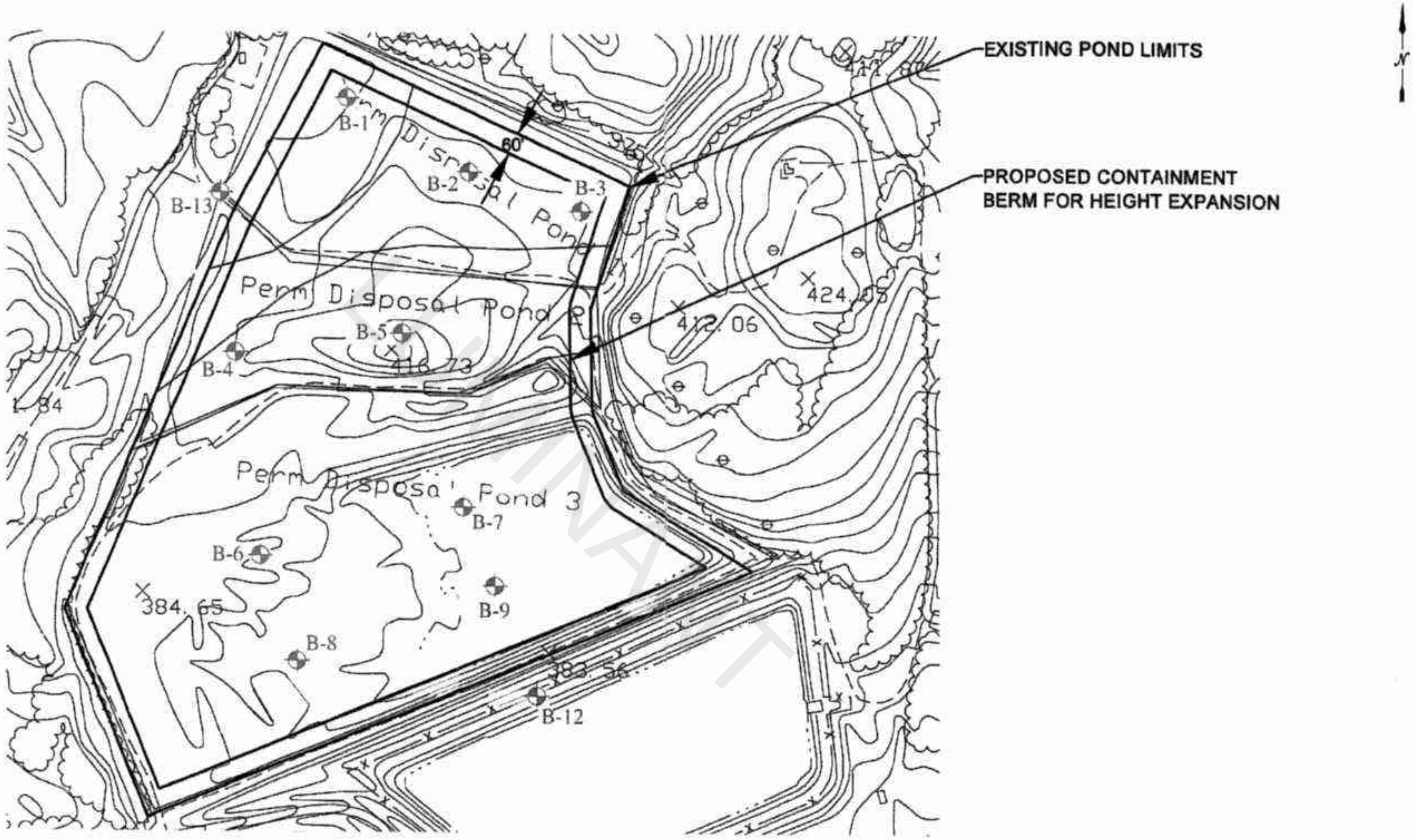
Water Level Est.: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 28' while drilling. Water level @ 23' and open to 31' upon completion. Water level @ 23' and open to 29' on 10/10/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.745', W 94°33.857'

PERMANENT DISPOSAL POND - 5



ETTL ENGINEERS & CONSULTANTS MAIN OFFICE 1717 East Erwin Tyler, Texas 75702	LUMINANT MARTIN LAKE PDP 1-3 TATUM, TEXAS	PLATE 1 – PLAN OF BORINGS	APPROVED BY:
		JOB No.: G 2810-08	DRAWN BY: K.C.R.
		DATE: MARCH 2008 SCALE: N.T.S.	

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

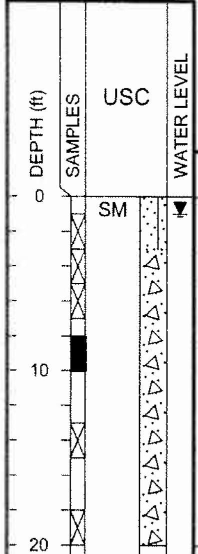
LOG OF BORING B-1

PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

PROJECT NO.: G 2810-08 **BORING TYPE:** Flight Auger

DATE 2/22/08

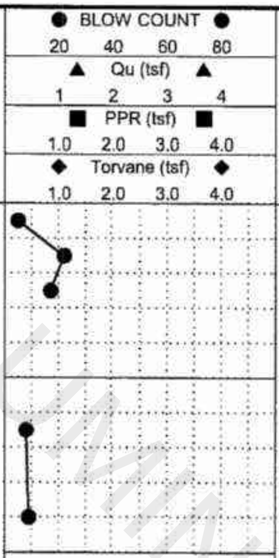
SURFACE ELEVATION 390'

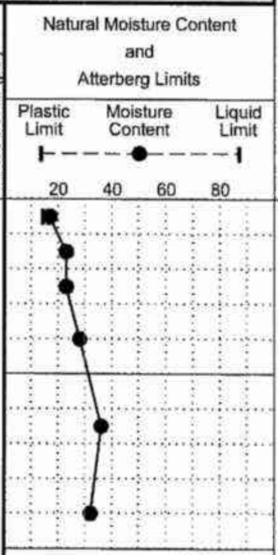


MATERIAL DESCRIPTION

MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SILTY SAND(SM) loose; tan; moist; with ferric oxide; with organics	N=5					17	16	14	2	34	+40 Sieve =8%, +4 Sieve =3%
ASH SEDIMENT medium dense; black and gray; coarse to very fine-grained sand	N=22	101				23					
	N=17					23					
--black		82				28				23	+40 Sieve =55%, +4 Sieve =26%
--loose; black and gray; coarse to very fine-grained sand	N=8					36					
	N=9					32				53	

Bottom of Boring @ 20'





Water Level Est.: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 7' while drilling. Water level @ 1' and caved to 6' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.790', W 94°34.996'. Minus #200 Sieve (53%) @ 18' (Hydrometer - Specific Gravity 2.608). Dry Density (82) @ 8' (Hydraulic Conductivity K=2.79E-04 cm/sec).

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LOG OF BORING B-12

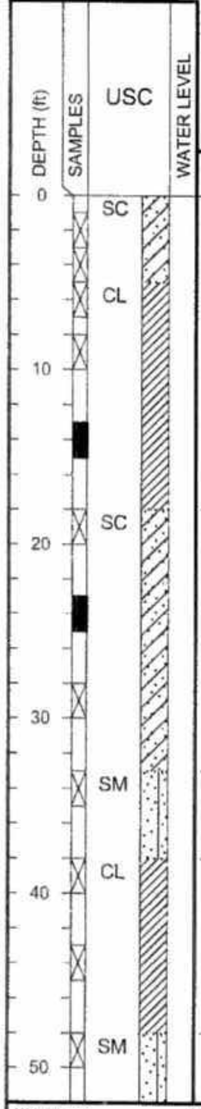
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

PROJECT NO.: G 2810-08

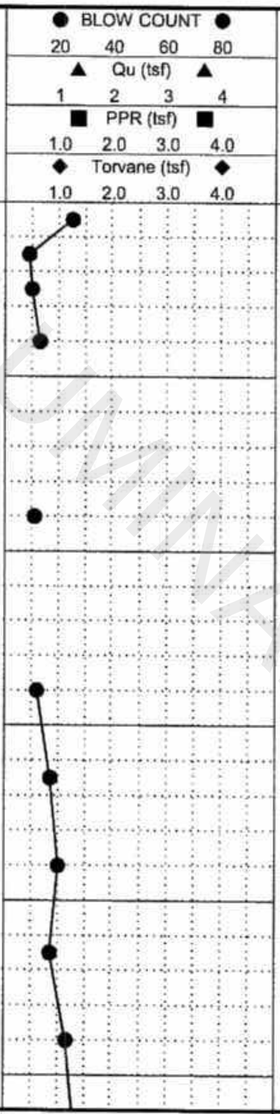
BORING TYPE: Rotary Wash

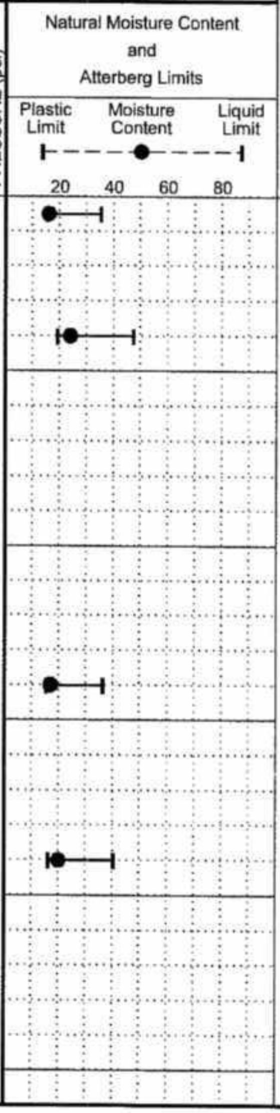
DATE 2/27/08

SURFACE ELEVATION 380'



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	CLAYEY SAND(SC) medium dense; red and orange	N=25					16	35	15	20	37	+40 Sieve =10%, +4 Sieve =3%
	–loose; gray, red, and orange	N=9										
CL	LEAN CLAY WITH SAND(CL) stiff; red, orange, and tan	N=10										
	–gray and red	N=13					24	47	19	28	79	+40 Sieve =3%, +4 Sieve =0%
	–red and orange											
SC	CLAYEY SAND(SC) medium dense; red and orange	N=11										
	–with iron oxide cemented sandstone gravel	N=12					17	36	15	21	44	+40 Sieve =21%, +4 Sieve =18%
SM	SILTY SAND(SM) medium dense; gray, red, and orange	N=17										
CL	SANDY LEAN CLAY(CL) medium dense; red, orange, and gray	N=20					20	40	16	24	61	+40 Sieve =5%, +4 Sieve =3%
		N=17										
	–red and orange; with iron oxide cemented sandstone seam @ 45'											
SM	SILTY SAND(SM) medium dense; gray, orange, and tan	N=23										





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Dry and open to 25' on 2/29/08.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.513', W 94°34.904'.

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(903) 595-4421

LOG OF BORING B-12

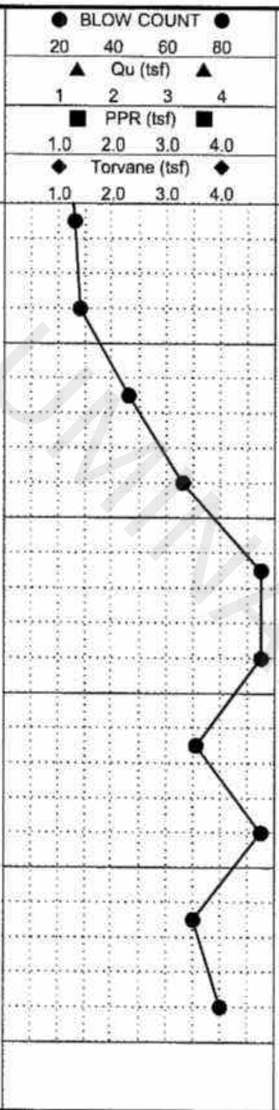
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

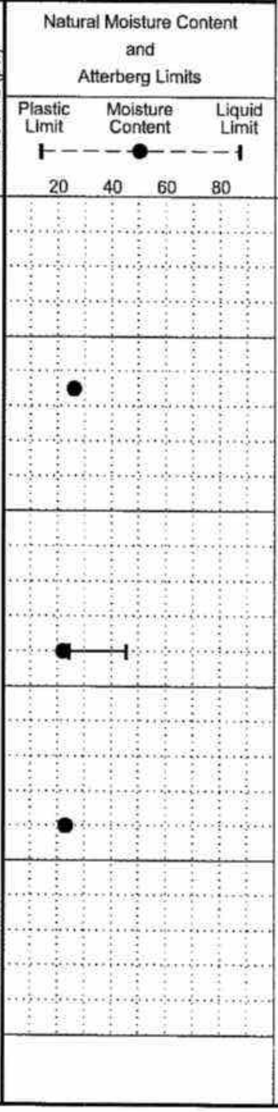
PROJECT NO.: G 2810-08

BORING TYPE: Rotary Wash

DATE 2/27/08

SURFACE ELEVATION 380'





DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
		–gray, red, brown	N=26										
60		–gray and brown	N=28										
	ML	SILT(ML) dense; brown and gray	N=46	99				26				96	+40 Sieve =2%, +4 Sieve =0%
70		–very dense	N=66										
	CL	LEAN CLAY WITH SAND(CL) hard; gray	N=50/3"										
80			N=50/4"	102				22	45	24	21	73	+40 Sieve =24%, +4 Sieve =23%
	ML	SILT(ML) very dense; gray	N=71										
90			N=50/5"	107				23				94	+40 Sieve =2%, +4 Sieve =0%
			N=70										
100			N=80										
		Bottom of Boring @ 100'											

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Dry and open to 25' on 2/29/08.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.513', W 94°34.904'.

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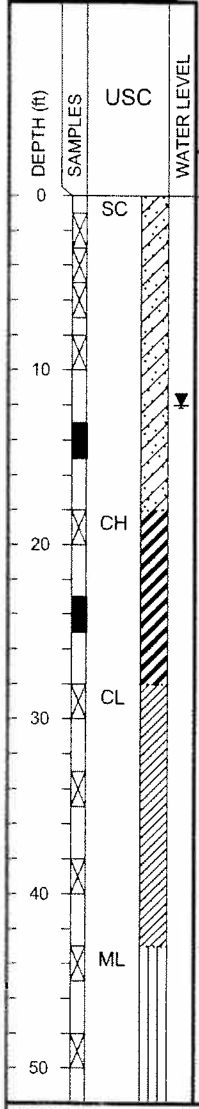
LOG OF BORING B-13

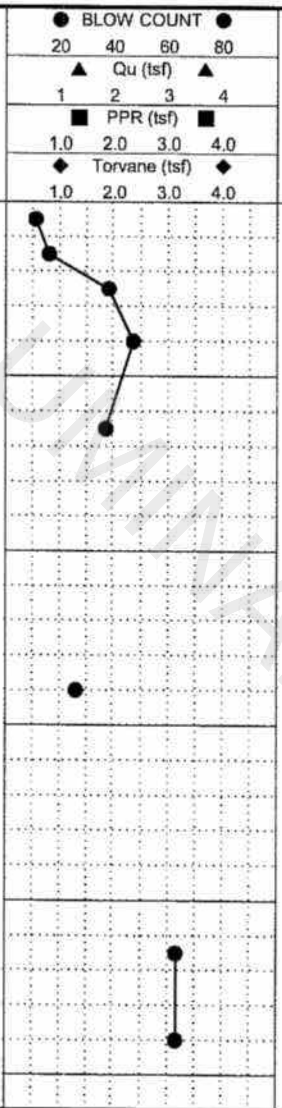
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

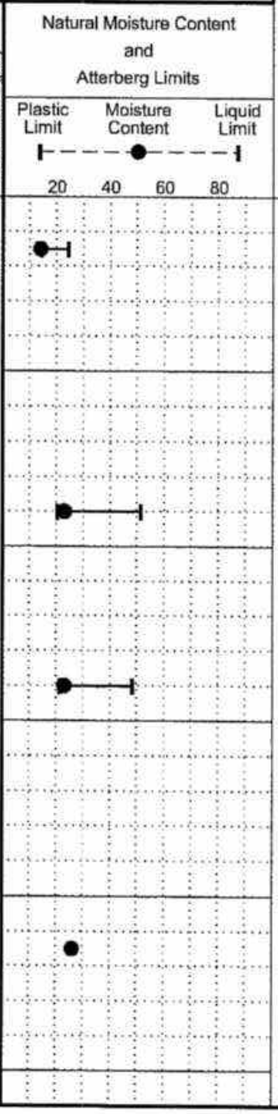
PROJECT NO.: G 2810-08 **BORING TYPE:** Rotary Wash

DATE 2/19/08

SURFACE ELEVATION 380'







MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CLAYEY SAND(SC) medium dense; red	N=11										
	N=16					14	24	14	10	46	+40 Sieve =3%, +4 Sieve =1%
--brown and gray	N=38										
--dense; red and tan	N=47										
--tan, red, and gray	N=37										
FAT CLAY(CH) stiff; red, gray, and tan	P=1.5					23	51	20	31	89	+40 Sieve =7%, +4 Sieve =1%
--with iron laminations	P=1.5 P=1.5										
LEAN CLAY(CL) very stiff; gray	N=26					23	48	21	27	94	+40 Sieve =2%, +4 Sieve =0%
--hard	P=4.5+										
--gray and brown; with iron oxide cemented sandstone seams	P=4.5+										
SANDY SILT(ML) very dense; gray; with clay seams	N=63					26				66	+40 Sieve =2%, +4 Sieve =0%
	N=63										

Water Level Est.: ∇ Measured: ▼ Perched: ∇

Water Observations: Seepage @ 29' while drilling. Water level @ 28' and open upon completion. Water level @ 12' and caved to 14' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.752', W 94°35.072'.

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LOG OF BORING B-13

PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

PROJECT NO.: G 2810-08

BORING TYPE: Rotary Wash

DATE 2/19/08

SURFACE ELEVATION 380'

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	BLOW COUNT (20 40 60 80)	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
		–hard; laminated with sand seams	P=4.5+											
60		–very stiff; gray and green; with sand seams	P=2.5											
	CL	LEAN CLAY(CL) hard; gray; laminated with sand seams	N=76	●					26	47	24	23	96	+40 Sieve =2%, +4 Sieve =0%
70	SM	SILTY SAND(SM) very dense; gray	N=75	●										
			N=50/3.5"	●										
80	ML	SILT(ML) very dense; gray	N=78	●										
		–with clay seams	P=SF											
90			N=50/5"	●										
			N=50/3"	●										
100		Bottom of Boring @ 100'	N=50/4"	●										

Qu (tsf) ▲ 1 2 3 4
PPR (tsf) ■ 1.0 2.0 3.0 4.0
Torvane (tsf) ◆ 1.0 2.0 3.0 4.0

Natural Moisture Content and Atterberg Limits: Plastic Limit ⊢ – – – ● – – – ⊣ Liquid Limit, Moisture Content; 20 40 60 80

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 29' while drilling. Water level @ 28' and open upon completion. Water level @ 12' and caved to 14' on 2/29/08.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.752', W 94°35.072'.

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(903) 595-4421

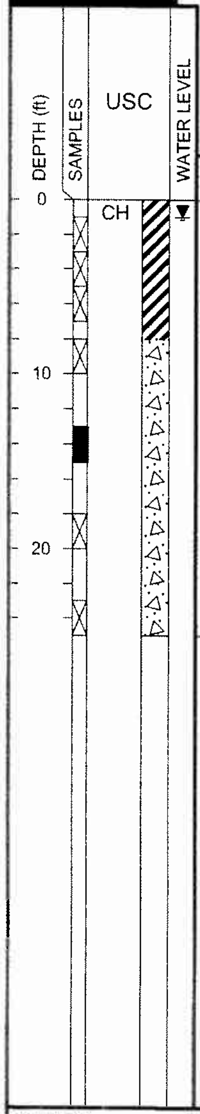
LOG OF BORING B-2

PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

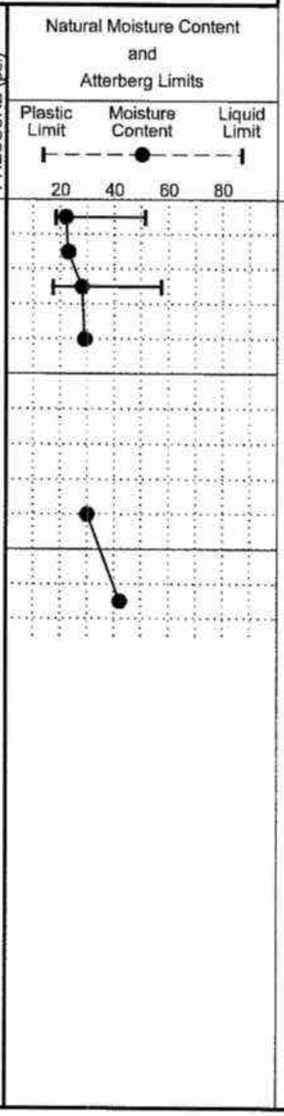
PROJECT NO.: G 2810-08 **BORING TYPE:** Flight Auger

DATE 2/22/08

SURFACE ELEVATION 390'



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SANDY FAT CLAY(CH) stiff; red and orange	N=11					22	51	18	33	65	+40 Sieve =9%, +4 Sieve =6%
	N=11					23					
–with sand	N=12					28	57	17	40	78	+40 Sieve =2%, +4 Sieve =0%
ASH SEDIMENT medium dense; black	N=11					29				16	+40 Sieve =63%, +4 Sieve =40%
–very loose; with organic odor	N=3					30				39	+40 Sieve =36%, +4 Sieve =12%
–light gray						42				93	
Bottom of Boring @ 25'											



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 1' and caved to 8' on 2/29/08.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.764', W 94°34.903'. Minus #200 Sieve (93%) @ 23' (Hydrometer - Specific Gravity 2.675).

LOG OF BORING B-3

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

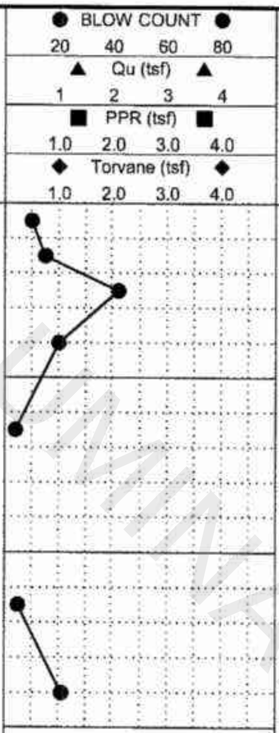
PROJECT NO.: G 2810-08 **BORING TYPE:** Flight Auger

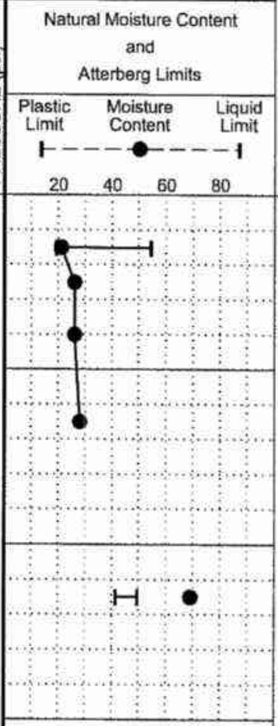
DATE 2/22/08

SURFACE ELEVATION 390'

MATERIAL DESCRIPTION

USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	▼	SANDY FAT CLAY(CH) medium stiff; red and orange	N=10										
		–stiff	N=15					21	54	19	35	69	+40 Sieve =5%, +4 Sieve =1%
		ASH SEDIMENT dense; black	N=42					26				42	
		–medium dense; black and gray; coarse-grained sand	N=20					26				10	+40 Sieve =60%, +4 Sieve =10%
		–very loose; black; coarse to fine-grained sand	N=4					28				9	+40 Sieve =67%, +4 Sieve =35%
		–no recovery											
		–loose; light gray	N=5					69	49	41	8	100	+40 Sieve =0%, +4 Sieve =0%
		–medium dense; black; with organic odor	N=21										
		Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 8' while drilling. Water level @ 2' and caved to 8' on 2/29/08..

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.746', W 94°34.855'. Minus #200 Sieve (42%) @ 5' (Hydrometer - Specific Gravity 2.561).

LOG OF BORING B-4

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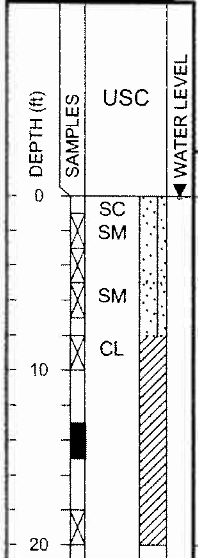
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

PROJECT NO.: G 2810-08

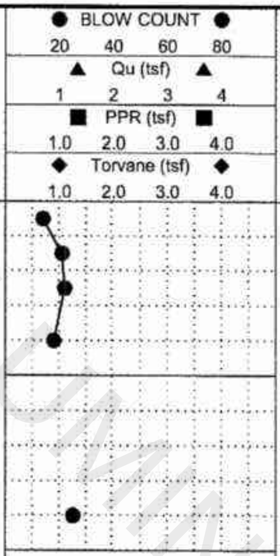
BORING TYPE: Flight Auger

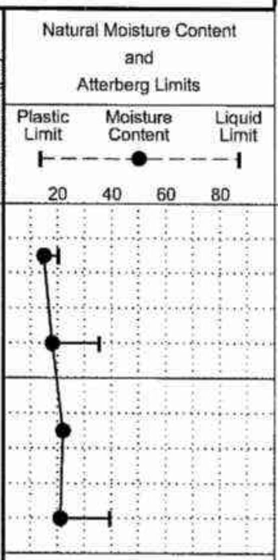
DATE 2/22/08

SURFACE ELEVATION 385'



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC SM	SILTY CLAYEY SAND(SC-SM) medium dense; red and brown	N=14										
	–very stiff; red and orange	N=21					15	20	14	6	42	+40 Sieve =1%, +4 Sieve =0%
SM	SILTY SAND(SM) medium dense; red and tan	N=22										
CL	LEAN CLAY(CL) very stiff; red, orange, and tan	N=18					18	35	18	17	85	+40 Sieve =5%, +4 Sieve =1%
	–red, tan, and gray	P=3.5	99	2.40	10	13	22					
		N=25					21	39	21	18	81	+40 Sieve =0%, +4 Sieve =0%
	Bottom of Boring @ 20'											





Water Level Est.: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 3' while drilling. Water level @ Surface and caved to 15' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.675', W 94°35.083'.

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LOG OF BORING B-5

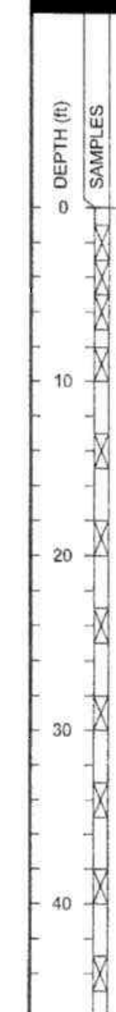
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

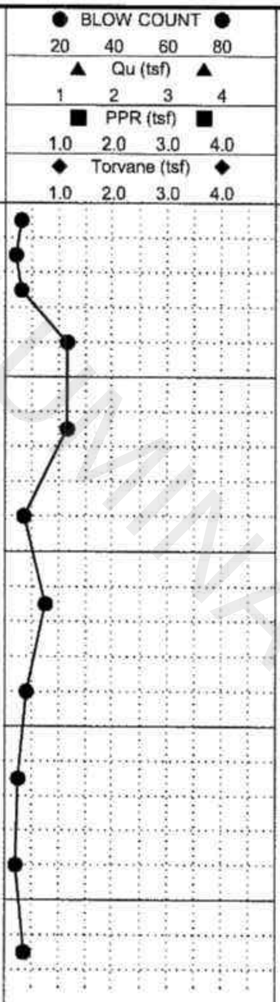
PROJECT NO.: G 2810-08 **BORING TYPE:** Flight Auger

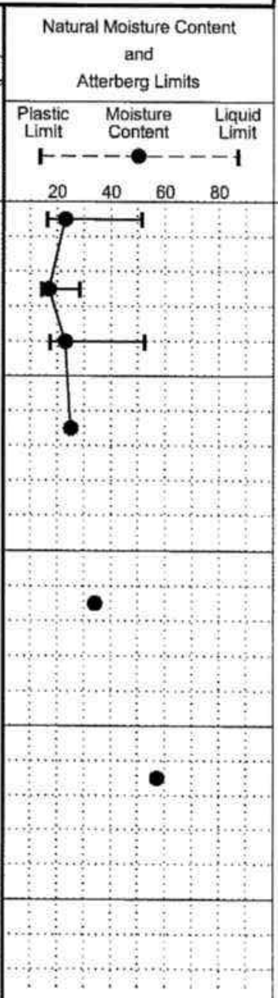
DATE 2/22/08

SURFACE ELEVATION 415'

USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH		FAT CLAY WITH SAND(CH) medium stiff; red, orange, and gray	N=6					23	51	16	35	77	+40 Sieve =4%, +4 Sieve =1%
		--soft	N=4										
CL		SANDY LEAN CLAY(CL) medium stiff; red and orange	N=6					17	28	14	14	60	+40 Sieve =6%, +4 Sieve =1%
CH		FAT CLAY WITH SAND(CH) very stiff; red and orange	N=23					23	52	17	35	77	+40 Sieve =4%, +4 Sieve =1%
		ASH SEDIMENT medium dense; gray and black	N=23					25				16	+40 Sieve =54%, +4 Sieve =24%
		–loose	N=7										
	▼	–medium dense	N=15	62				34				32	+40 Sieve =37%, +4 Sieve =16%
		–loose	N=8										
		–gray	N=5	62				57				99	+40 Sieve =1%, +4 Sieve =0%
		–very loose	N=4										
		–loose	N=7										
		Bottom of Boring @ 45'											







Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Water level @ 23' and caved to 26' on 2/29/08.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes: GPS Coordinates: N 32°15.667', W 94°34.936'.

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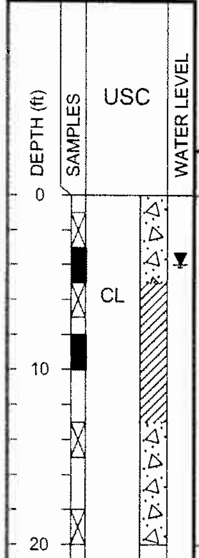
LOG OF BORING B-6

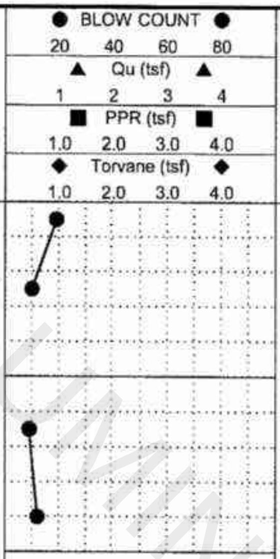
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

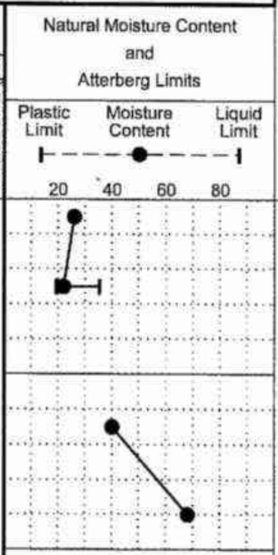
PROJECT NO.: G 2810-08 **BORING TYPE:** Flight Auger

DATE 2/22/08

SURFACE ELEVATION 385'







MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
ASH SEDIMENT medium dense; black and tan	N=19 P=SF					26				44	+40 Sieve =30%, +4 Sieve =13%
SANDY LEAN CLAY(CL) stiff; red and tan	N=10					22	35	19	16	61	+40 Sieve =7%, +4 Sieve =4%
–very stiff	P=2.5										
ASH SEDIMENT loose; black	N=9					40				61	+40 Sieve =5%, +4 Sieve =2%
–medium dense	N=12					68				84	
Bottom of Boring @ 20'											

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 4' while drilling. Water level @ 4' and caved to 7' upon completion. Water level @ 1' and caved to 8' on 2/29/08.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.591', W 94°35.088'. Minus #200 Sieve (84) @ 18' (Hydrometer - Specific Gravity 2.732).

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LOG OF BORING B-7

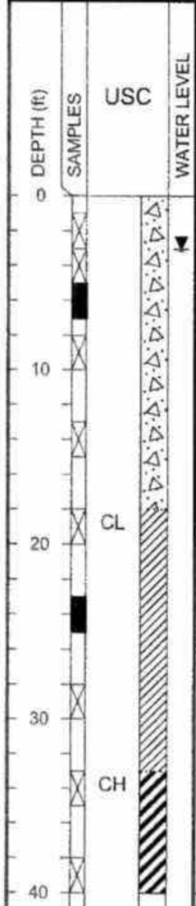
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

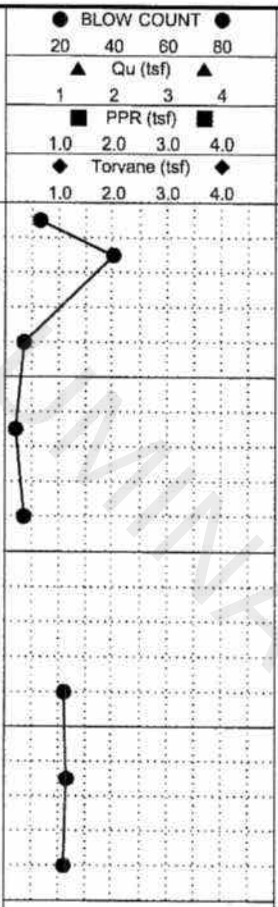
PROJECT NO.: G 2810-08

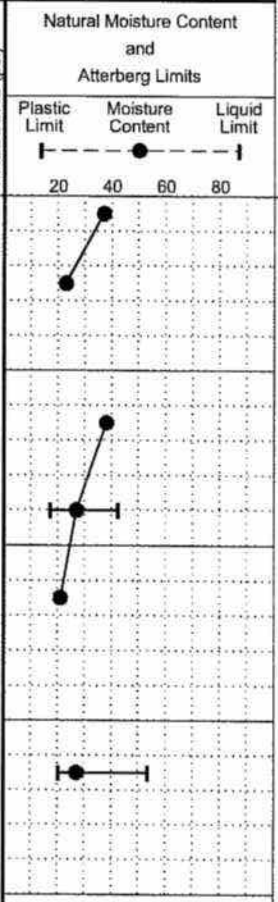
BORING TYPE: Rotary Wash

DATE 2/28/08

SURFACE ELEVATION 390'







USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	ASH SEDIMENT medium dense; black	N=13					37				16	+40 Sieve =49%, +4 Sieve =10%
	--dense; black	N=40										
		P=4.5	98	2.30	2	6	23					
	--loose	N=7										
	--very loose	N=4					38				11	
CL	LEAN CLAY WITH SAND(CL) medium stiff; orange and black	N=7					27	42	17	25	75	+40 Sieve =4%, +4 Sieve =0%
	--tan and red		104	0.50	13	22	21					
	--medium dense; red and orange	N=22										
CH	SANDY FAT CLAY(CH) medium dense; red and orange	N=23					27	53	20	33	69	+40 Sieve =27%, +4 Sieve =22%
		N=22										
	Bottom of Boring @ 40'											

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 3' and caved to 24' on 2/29/08.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.646', W 94°34.870'. Minus #200 Sieve (11%) @ 13' (Hydrometer - Specific Gravity 2.655).

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LOG OF BORING B-8

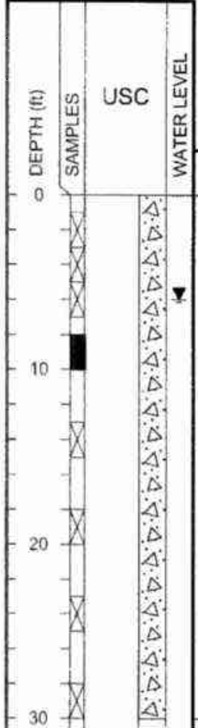
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

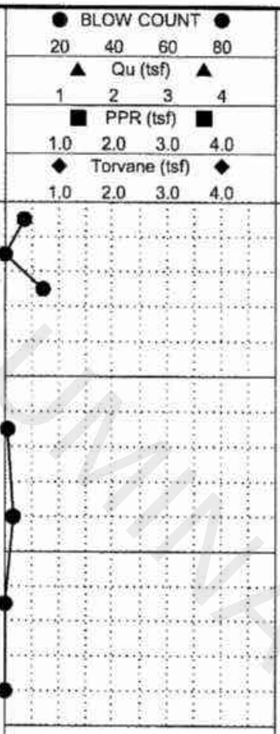
PROJECT NO.: G 2810-08

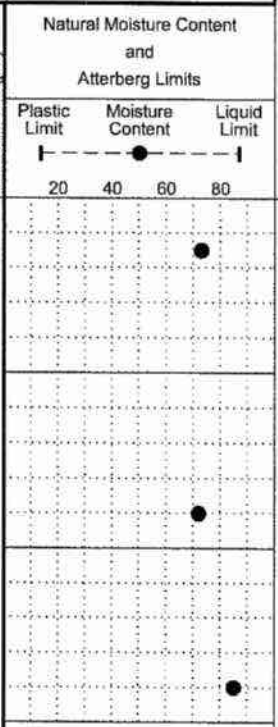
BORING TYPE: Flight Auger

DATE 2/20/08

SURFACE ELEVATION 390'







MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
<u>ASH SEDIMENT</u> loose; gray	N=7										
–very loose; gray and black	N=0					73				95	+40 Sieve =3%, +4 Sieve =0%
–medium dense; brown	N=14										
–very loose; black	N=1										
	N=3					72				95	+40 Sieve =1%, +4 Sieve =0%
	N=0										
–strong odor	N=0					85				99	+40 Sieve =0%, +4 Sieve =0%
Bottom of Boring @ 30'											

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 4' while drilling. Water level @ 6' and caved to 17' upon completion. Dry and caved to 3' and on 2/29/08.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.548', W 94°34.570'.

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LOG OF BORING B-9

PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

PROJECT NO.: G 2810-08 **BORING TYPE:** Flight Auger

DATE 2/20/08

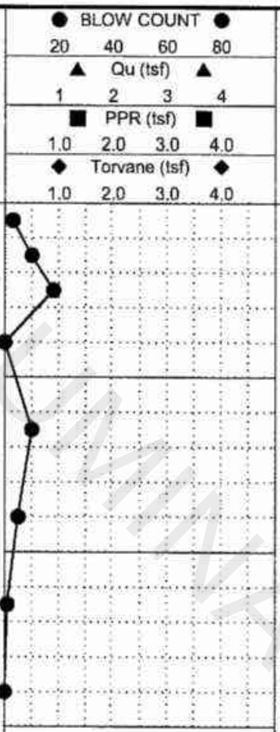
SURFACE ELEVATION 390'

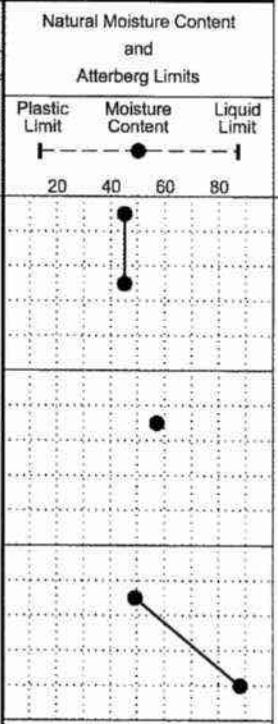
MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
ASH SEDIMENT very loose; gray	N=3					45				89	
–loose; black and gray	N=10										
–medium dense	N=18					45				77	+40 Sieve =4%, +4 Sieve =0%
–very loose; black	N=0										
–loose	N=10					57				94	+40 Sieve =3%, +4 Sieve =0%
	N=5										
–very loose	N=1					49				68	+40 Sieve =4%, +4 Sieve =0%
–gray and black; strong odor	N=0					88				97	+40 Sieve =2%, +4 Sieve =0%

Bottom of Boring @ 30'

DEPTH (ft) 0 10 20 30 | SAMPLES | USC | WATER LEVEL

ATTERBERG LIMITS(%)





Water Level Est.: ▽ Measured: ▼ Perched: ▼

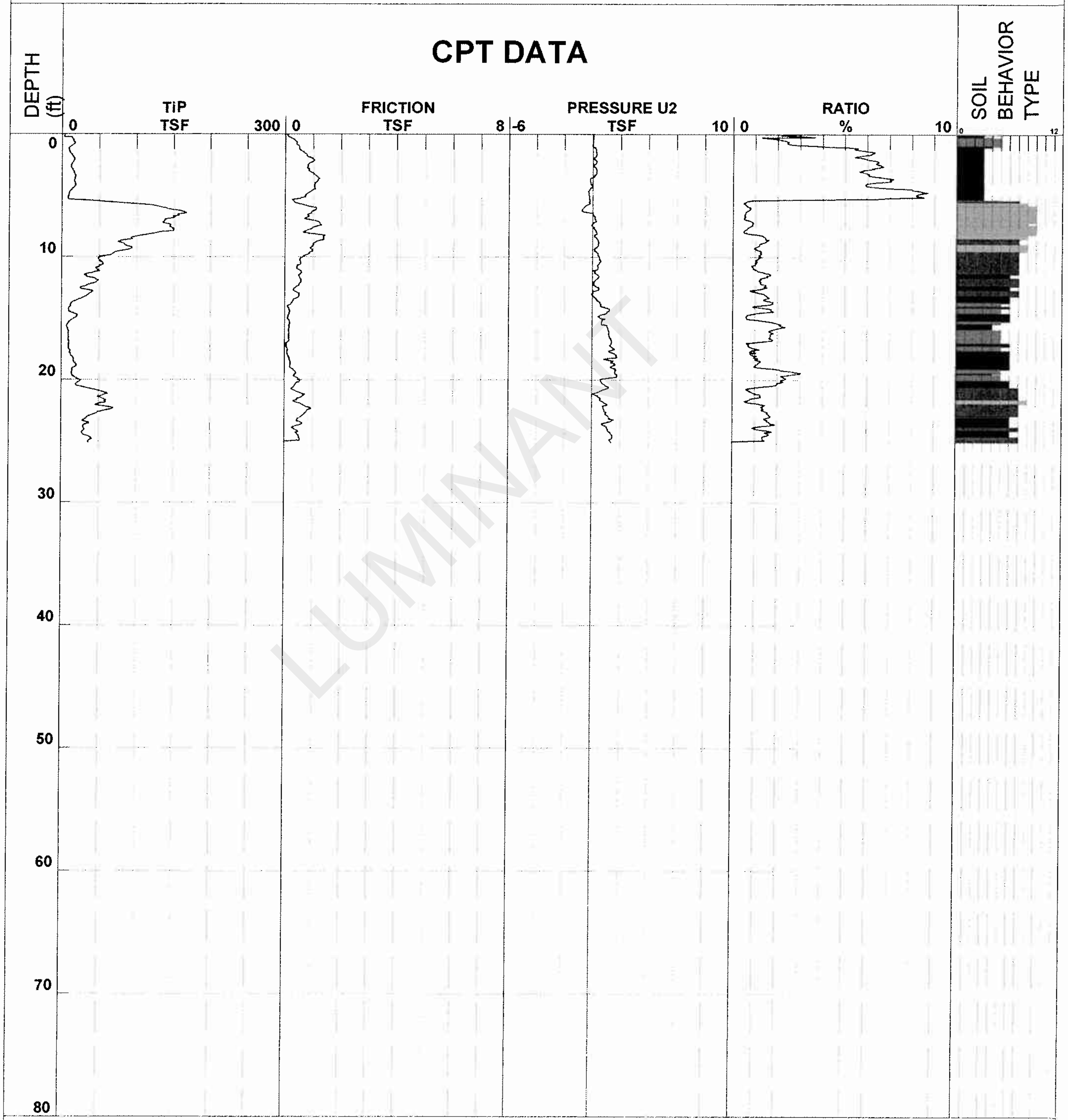
Water Observations: Seepage @ 4' while drilling. Water level @ 6' and caved to 18' upon completion. Dry and caved to 4' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.556', W 94°34.913'. Minus #200 Sieve (89%) @ 1' (Hydrometer - Specific Gravity 2.761).

CPT Data

Job Number 04.1908-0020
CPT Number B-02
Location Tatum-Tx
Operator GLENN JOHNSON
Date and T 16-Apr-2008 13:47:38
Cone Number F7.5CKEW2/B 1866
Client
Elevation
Water Table

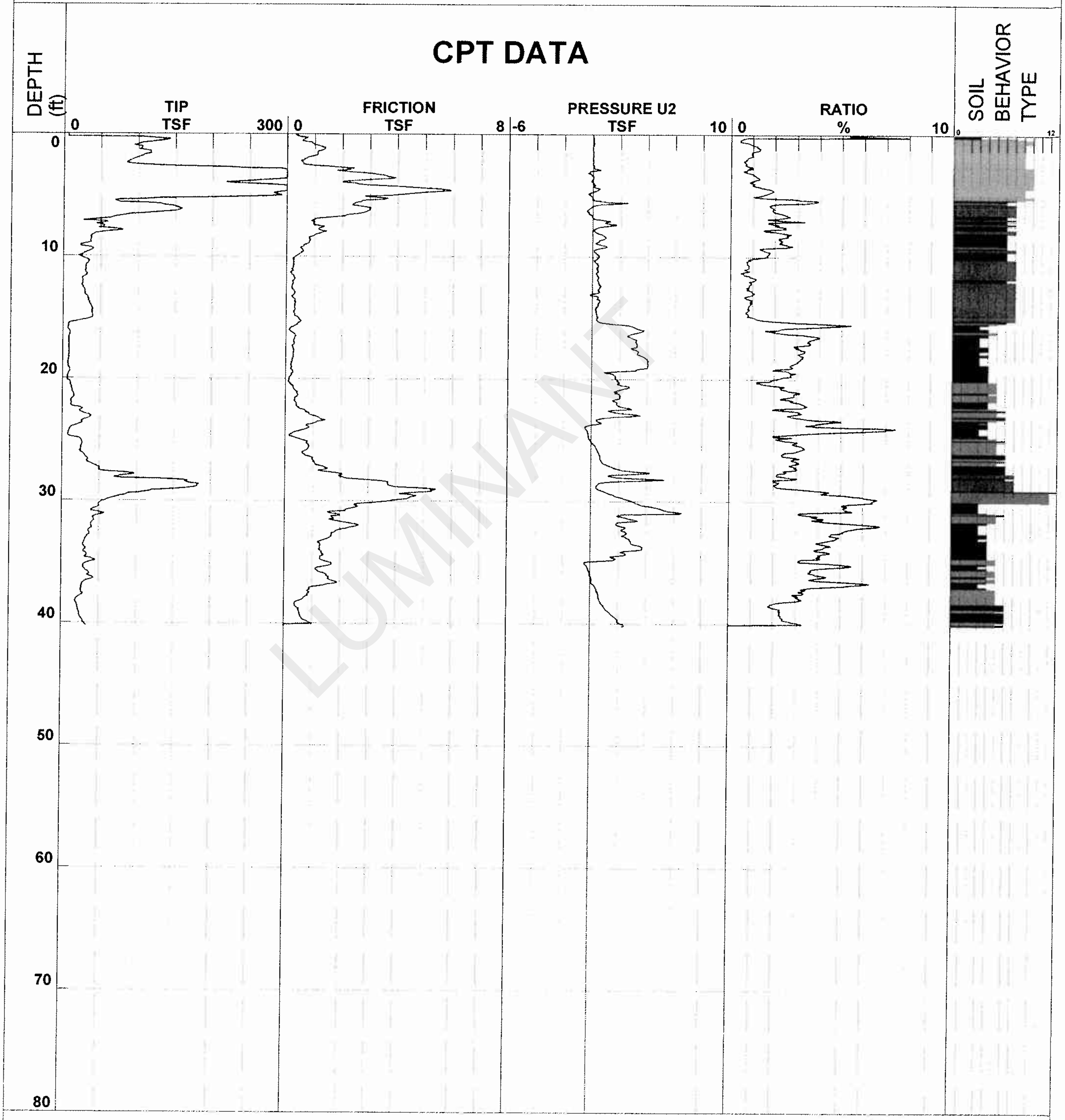


▨ 1 - sensitive fine grained
■ 2 - organic material
■ 3 - clay
■ 4 - silty clay to clay
■ 5 - clayey silt to silty clay
■ 6 - sandy silt to clayey silt
■ 7 - silty sand to sandy silt
▨ 8 - sand to silty sand
▨ 9 - sand
■ 10 - gravelly sand to sand
■ 11 - very stiff fine grained (*)
■ 12 - sand to clayey sand (*)

Robertson et al. 1986 * Overconsolidated or Cemented

CPT Data

Job Number 04.1908-0020
CPT Number B-07
Location Tatum-Tx
Operator GLENN JOHNSON
Date and T 16-Apr-2008 12:40:51
Cone Number F7.5CKEW2/B 1866
Client
Elevation
Water Table

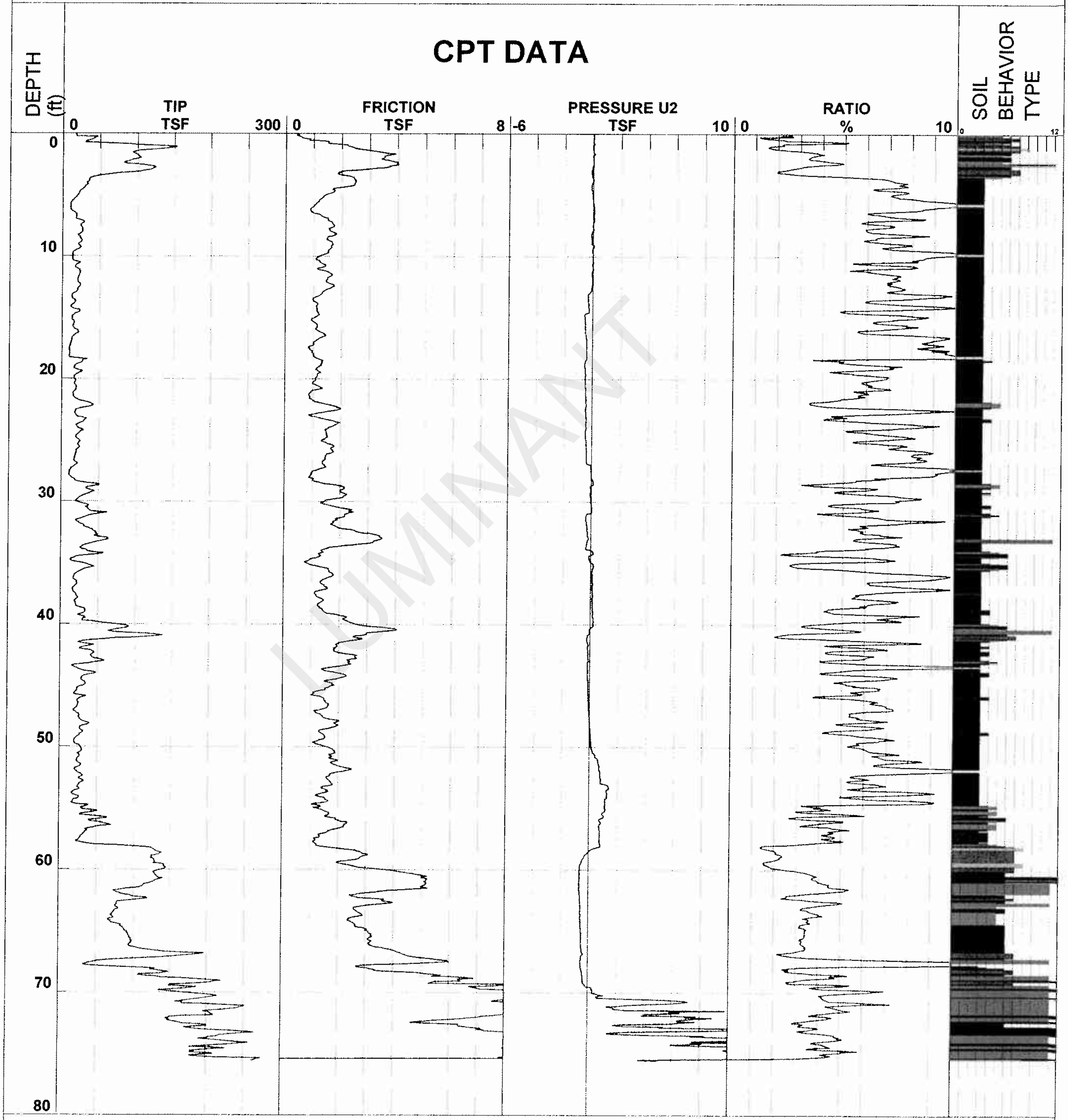


▨ 1 - sensitive fine grained
■ 2 - organic material
■ 3 - clay
■ 4 - silty clay to clay
■ 5 - clayey silt to silty clay
■ 6 - sandy silt to clayey silt
■ 7 - silty sand to sandy silt
▨ 8 - sand to silty sand
▨ 9 - sand
■ 10 - gravelly sand to sand
■ 11 - very stiff fine grained (*)
■ 12 - sand to clayey sand (*)

Robertson et al. 1986 * Overconsolidated or Cemented

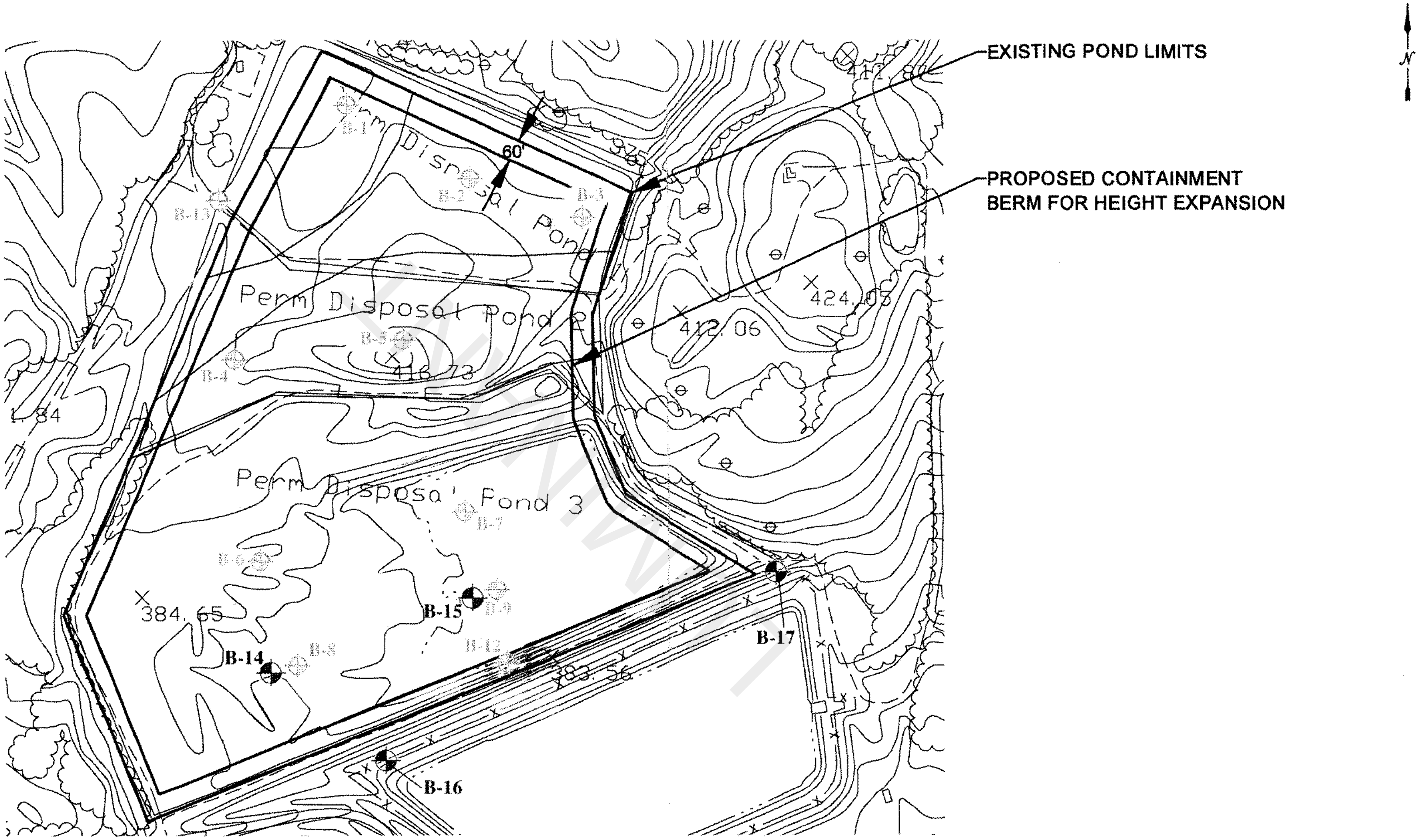
CPT Data

Job Number 04.1908-0020
CPT Number B-12
Location Tatum-Tx
Operator GLENN JOHNSON
Date and T 16-Apr-2008 10:58:47
Cone Number F7.5CKEW2/B 1866
Client
Elevation
Water Table



▨ 1 - sensitive fine grained
■ 2 - organic material
■ 3 - clay
■ 4 - silty clay to clay
■ 5 - clayey silt to silty clay
■ 6 - sandy silt to clayey silt
■ 7 - silty sand to sandy silt
▨ 8 - sand to silty sand
▨ 9 - sand
■ 10 - gravelly sand to sand
■ 11 - very stiff fine grained (*)
■ 12 - sand to clayey sand (*)

Robertson et al. 1986 * Overconsolidated or Cemented



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LUMINANT MARTIN LAKE
PDP 1-3
TATUM, TEXAS

PLATE 1 – PLAN OF BORINGS

JOB No.: G 3219-09

DATE: MARCH 2008

SCALE: N.T.S.

APPROVED BY:

DRAWN BY:
K.C.R.

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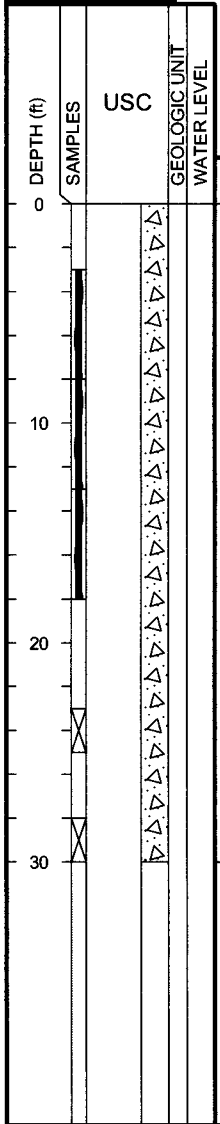
LOG OF BORING B-14

PROJECT: Luminant Martin Lake PDP 1-3 Supplemental
Tatum, Texas

PROJECT NO.: G3219-09 **BORING TYPE:** Rotary Wash

DATE 8/18/09

SURFACE ELEVATION



MATERIAL DESCRIPTION

<u>ASH SEDIMENT</u> black;

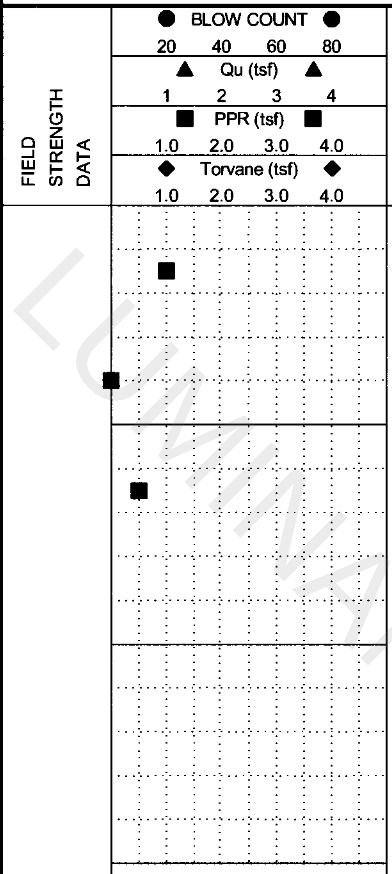
--dark gray; with silty clay

--black; with sand

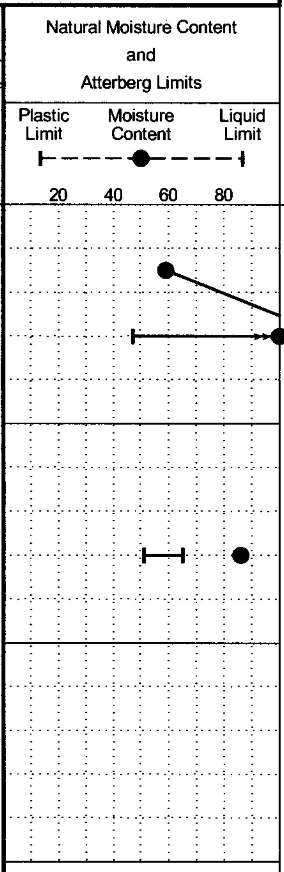
--gray

--black; with silt

Bottom of Boring @ 30'



DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)



MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
59				83	+40 Sieve=3%, +4 Sieve=0%
119	111	47	64	89	+40 Sieve=1%, +4 Sieve=0%
86	65	51	14	95	+40 Sieve=1%, +4 Sieve=0%

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 5' while drilling.

Key to Abbrevations:

N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N 32° 15.549', W 94°34.971'

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LOG OF BORING B-15

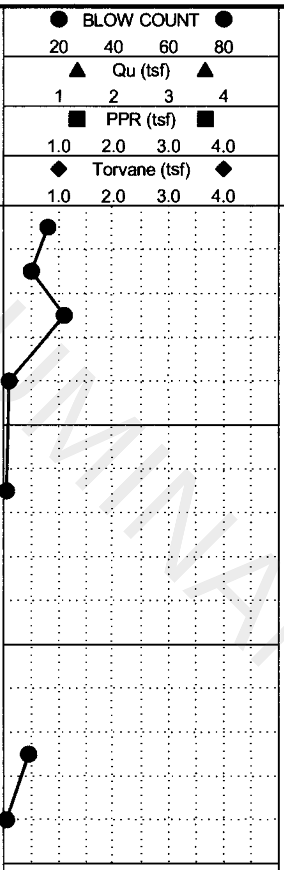
PROJECT: Luminant Martin Lake PDP 1-3 Supplemental
Tatum, Texas

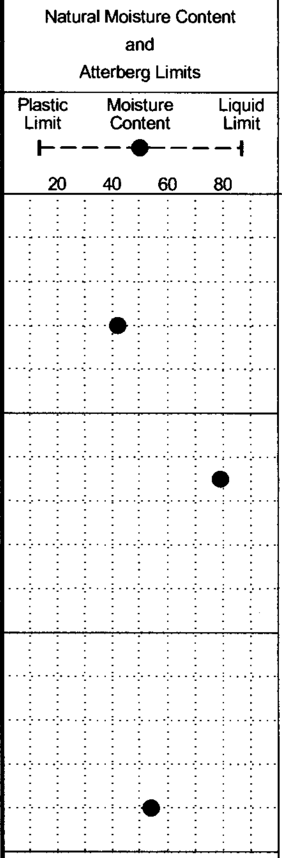
PROJECT NO.: G3219-09 **BORING TYPE:** Rotary Wash

DATE 8/18/09

SURFACE ELEVATION

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	LEAN CLAY(CL) tan, gray, and red											
		ASH SEDIMENT gray	N=16										
		--no recovery	N=10										
		--black; with clay and silt	N=22										
		ASH SEDIMENT gray; with sand; laminated						42				47	+40 Sieve=9%, +4 Sieve=1%
		--with silt	N=2										
10													
		--with sand	N=1					79				95	+40 Sieve=2%, +4 Sieve=0%
		--full recovery											
20													
		--no recovery											
		--black	N=9										
		--black and gray	N=1					54				85	+40 Sieve=7%, +4 Sieve=3%
30		Bottom of Boring @ 30'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 5' while drilling.

Key to Abbrevations:

N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:

GPS Coordinates: N 32° 15.556', W 94°34.913'

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ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-16

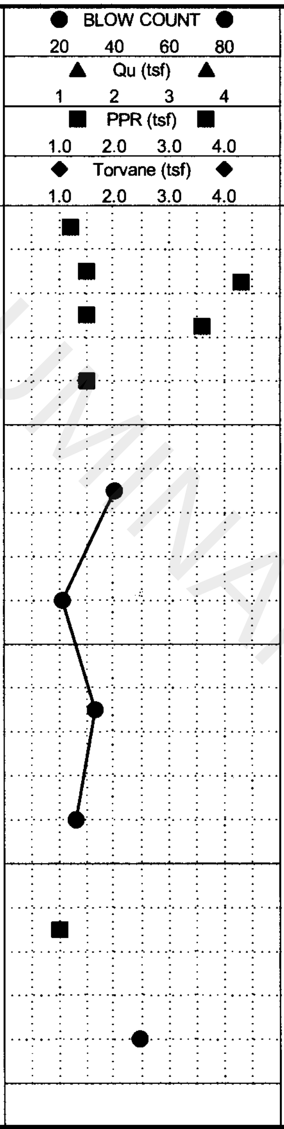
PROJECT: Luminant Martin Lake PDP 1-3 Supplemental
Tatum, Texas

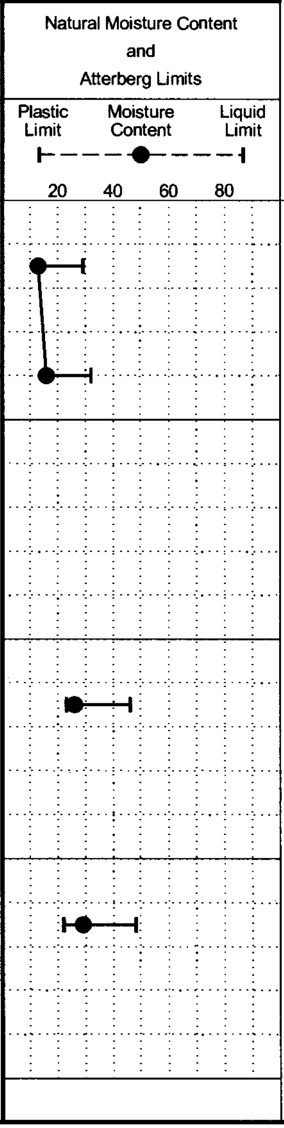
PROJECT NO.: G3219-09 **BORING TYPE:** Rotary Wash

DATE 8/18/09

SURFACE ELEVATION

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	SANDY LEAN CLAY(CL) orange and tan	P=1.2										
		--tan and gray	P=1.5					13	29	14	15	34	+40 Sieve=1%, +4 Sieve=0%
		--orange and tan	P=4.3 P=1.25 P=3.6										
	SC	CLAYEY SAND(SC) gray and orange	P=1.5					16	32	16	16	37	+40 Sieve=0%, +4 Sieve=0%
10													
			N=40										
	ML	SANDY CLAYEY SILT(ML) orange and light gray	N=21										
20	CL	LEAN CLAY(CL) gray and reddish tan											
			N=33					26	46	23	23	82	+40 Sieve=4%, +4 Sieve=1%
		--orange and tan; with trace of lignite	N=26										
30													
	SC	CLAYEY SAND(SC) tan and brown	P=1.0					29	48	22	26	85	+40 Sieve=5%, +4 Sieve=0%
	SP	SAND(SP) gray	N=49										
40		Bottom of Boring @ 40'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations:

Key to Abbrevations:
- N - SPT Data (Blows/Ft)
- P - Pocket Penetrometer (tsf)
- T - Torvane (tsf)
- L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32° 15.484', W 94°34.965'

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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

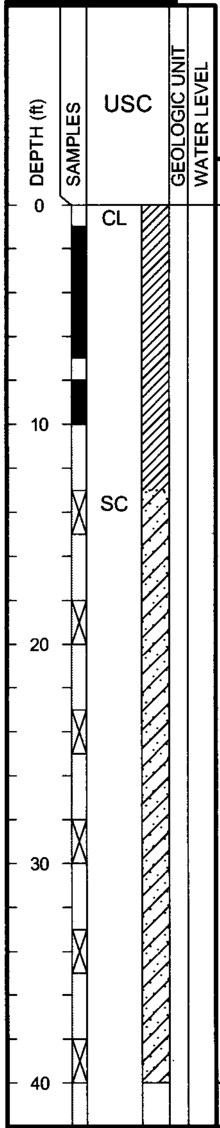
LOG OF BORING B-17

PROJECT: Luminant Martin Lake PDP 1-3 Supplemental
Tatum, Texas

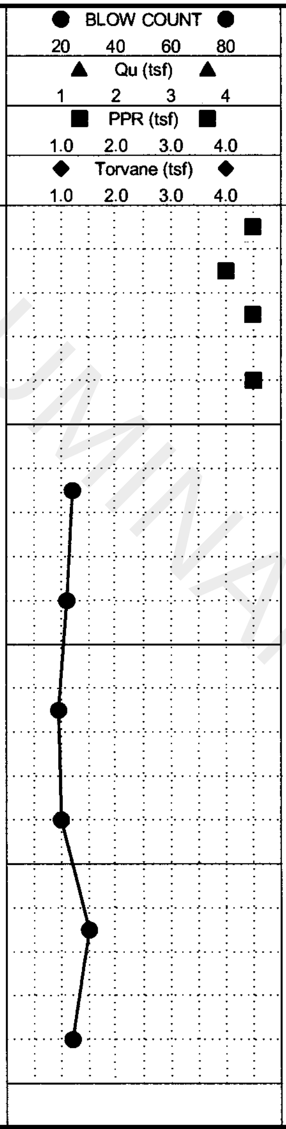
PROJECT NO.: G3219-09 **BORING TYPE:** Rotary Wash

DATE 8/18/09

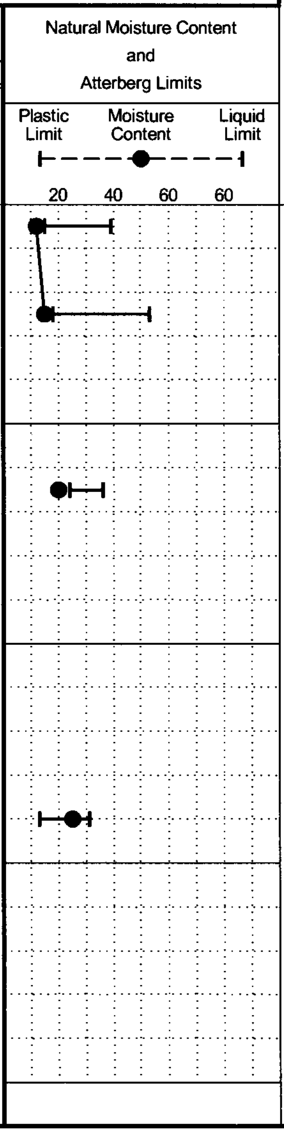
SURFACE ELEVATION



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SANDY LEAN CLAY(CL) orange and tan	P=4.5+	12	39	15	24	60	+40 Sieve=7%, +4 Sieve=4%
--orange and brown	P=4.0						
--red, tan, and yellow	P=4.5	15	53	18	35	51	+40 Sieve=7%, +4 Sieve=1%
--tan and gray	P=4.5+						
CLAYEY SAND(SC) tan	N=40	20	36	24	12	52	+40 Sieve=0%, +4 Sieve=0%
--tan and brown	N=22						
--tan and gray; laminated	N=19						
--gray and orange	N=20	25	31	13	18	39	+40 Sieve=0%, +4 Sieve=0%
--tan	N=30						
--tan and orange	N=24						
Bottom of Boring @ 40'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Bailed to 20' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32° 15.566', W 94°34.736'

APPENDIX B

LABORATORY TEST RESULTS

BOTTOM ASH PONDS AND SCRUBBER POND

SUMMARY OF LABORATORY RESULTS

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
BH-201	0.0							19.2			
BH-201	2.0							13.7			
BH-201	6.0	26	14	12				9.4			
BH-201	8.0							15.1			
BH-201	13.0							16.3			
BH-201	18.0							20.8			
BH-201	23.0	36	14	22				19.9			
BH-201	28.0							18.2			
BH-201	33.0							15.0			
BH-201	38.0				0.85	40		14.9			
BH-201	43.0							21.4			
BH-201	48.0							23.5			
BH-202	0.0							20.8			
BH-202	2.0	55	19	36				17.1			
BH-202	4.0							20.5			
BH-202	6.0							26.7			
BH-202	8.0							15.3			
BH-202	13.0							14.9			
BH-202	18.0	29	13	16				17.1			
BH-202	23.0							17.6			
BH-202	28.0				0.85	49		18.1			
BH-202	33.0							17.0			
BH-202	38.0							20.8			
BH-202	43.0							23.0			
BH-202	48.0							26.2			
BH-203	0.0							12.6			
BH-203	2.0							14.6			
BH-203	4.0							16.1			
BH-203	6.0	50	19	31				21.5			
BH-203	8.0							22.3			
BH-203	13.0							18.0			
BH-203	18.0							14.6			
BH-203	23.0							17.3			
BH-203	25.0							19.9			
BH-203	28.0				2	17		23.6			
BH-203	30.0							27.7			
BH-203	33.0							29.1			
BH-203	38.0							29.4			
BH-204	0.0							13.9			
BH-204	2.0							21.1			
BH-204	4.0							15.0			
BH-204	6.0							16.6			
BH-204	8.0							13.5			

SUMMARY OF LABORATORY RESULTS

CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
BH-204	28.0				4.75	58		19.1			
BH-204	33.0							13.8			
BH-204	38.0							21.0			
BH-204	43.0	51	20	31				26.6			
BH-204	48.0							23.8			
BH-205	0.0							17.5			
BH-205	2.0							15.6			
BH-205	4.0							15.5			
BH-205	6.0							20.7			
BH-205	8.0							17.4			
BH-205	13.0	47	15	32				23.0			
BH-205	18.0							22.9			
BH-205	23.0	28	17	11				16.3			
BH-205	28.0				4.75	69		16.4			
BH-205	33.0							14.7			
BH-205	38.0							25.4			
BH-205	43.0							26.7			
BH-205	48.0							25.0			
BH-205	53.0				9.5	11		25.9			
BH-206	0.0							17.1			
BH-206	2.0	44	15	29				15.6			
BH-206	4.0							14.0			
BH-206	6.0							16.2			
BH-206	8.0							21.7			
BH-206	13.0							18.1			
BH-206	18.0							12.2			
BH-206	23.0							15.9			
BH-206	28.0	59	17	42				20.3			
BH-206	33.0							19.8			
BH-206	38.0							18.2			
BH-206	43.0							22.1			
BH-206	48.0							23.3			
BH-206	53.0							23.0			
BH-206	58.0							22.1			
BH-207	0.0							15.6			
BH-207	2.0							15.3			
BH-207	4.0							14.9			
BH-207	6.0							18.2			
BH-207	13.0							18.9			
BH-207	18.0							13.0			
BH-207	23.0							16.9			
BH-207	28.0	31	16	15				16.7			
BH-207	33.0							17.4			

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

SUMMARY OF LABORATORY RESULTS

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
BH-207	38.0							19.0			
BH-207	43.0							21.8			
BH-207	48.0							22.2			
BH-207	53.0							25.2			
BH-207	58.0							29.8			
BH-208	0.0							20.2			
BH-208	2.0							16.2			
BH-208	4.0							12.9			
BH-208	6.0							11.5			
BH-208	8.0	28	15	13				15.2			
BH-208	13.0							15.9			
BH-208	18.0							20.2			
BH-208	23.0							18.0			
BH-208	28.0							21.3			
BH-208	33.0							18.1			
BH-208	38.0							19.1			
BH-208	43.0							23.7			
BH-208	48.0				4.75	11		24.5			
BH-208	53.0							27.1			
BH-208	58.0							26.1			
BH-209	0.0							9.0			
BH-209	2.0							11.8			
BH-209	4.0	62	21	41				11.8			
BH-209	6.0							12.1			
BH-209	8.0							19.2			
BH-209	13.0							12.3			
BH-209	18.0							21.0			
BH-209	28.0	41	15	26				23.3			
BH-209	33.0							20.0			
BH-209	35.0							21.2			
BH-209	38.0							17.9			
BH-209	43.0							24.0			
BH-209	48.0							21.2			
BH-210	0.0							8.2			
BH-210	2.0							10.7			
BH-210	4.0							13.4			
BH-210	6.0							14.4			
BH-210	8.0							15.7			
BH-210	13.0							21.3			
BH-210	18.0	36	14	22				22.9			
BH-210	23.0							25.0			
BH-210	28.0							18.5			
BH-210	33.0							19.3			

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

SUMMARY OF LABORATORY RESULTS

CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

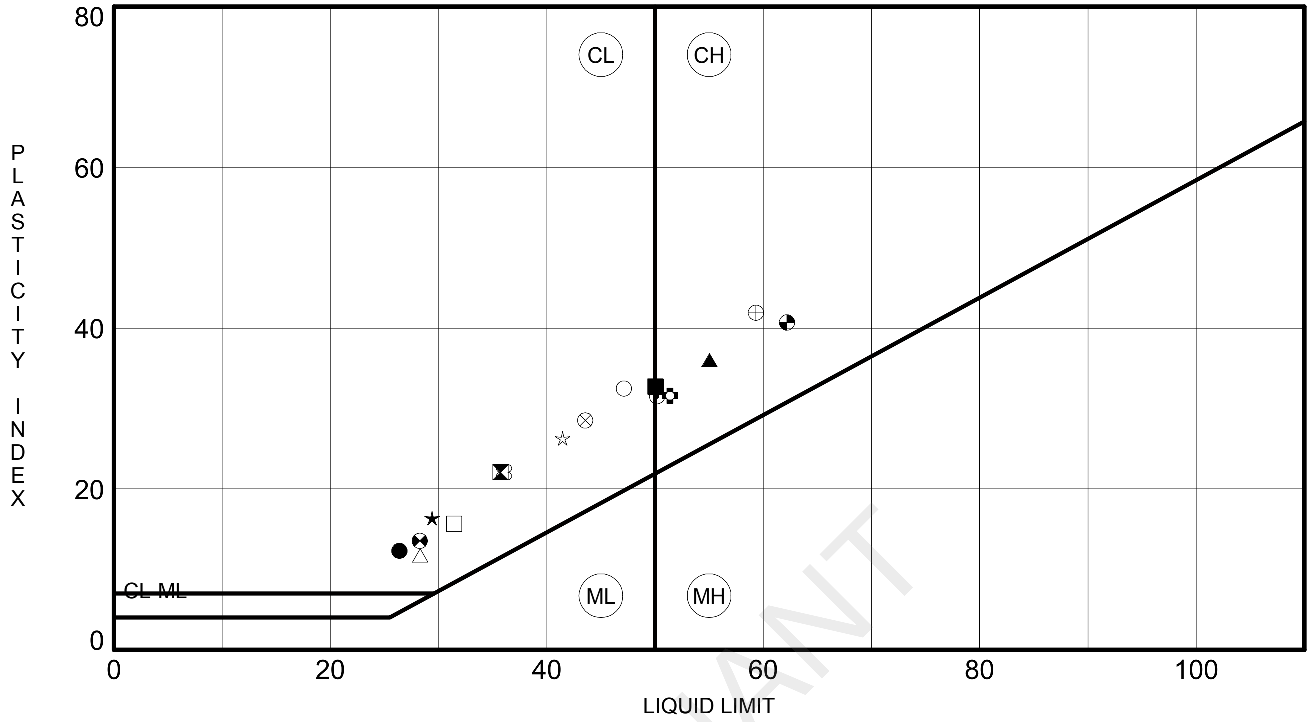
PROJECT LOCATION Martin Lake

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
BH-210	38.0							17.2			
BH-210	43.0							25.6			
BH-210	48.0				9.5	33		33.4			
BH-210	53.0							29.3			
BH-210	58.0							29.3			
BH-210	63.0							26.6			
BH-210	68.0							31.1			
BH-211	0.0							8.7			
BH-211	2.0							13.3			
BH-211	4.0							15.0			
BH-211	6.0							14.5			
BH-211	8.0							13.2			
BH-211	13.0							17.6			
BH-211	18.0	50	17	33				15.0			
BH-211	23.0							11.6			
BH-211	28.0				9.5	52		11.6			
BH-211	33.0							22.5			
BH-211	38.0							21.1			
BH-211	43.0							24.3			
BH-211	48.0							24.3			
BH-211	53.0							24.9			
BH-211	58.0							22.9			
BH-211	63.0							29.5			
BH-211	68.0							26.6			

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

ATTERBERG LIMITS' RESULTS

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake

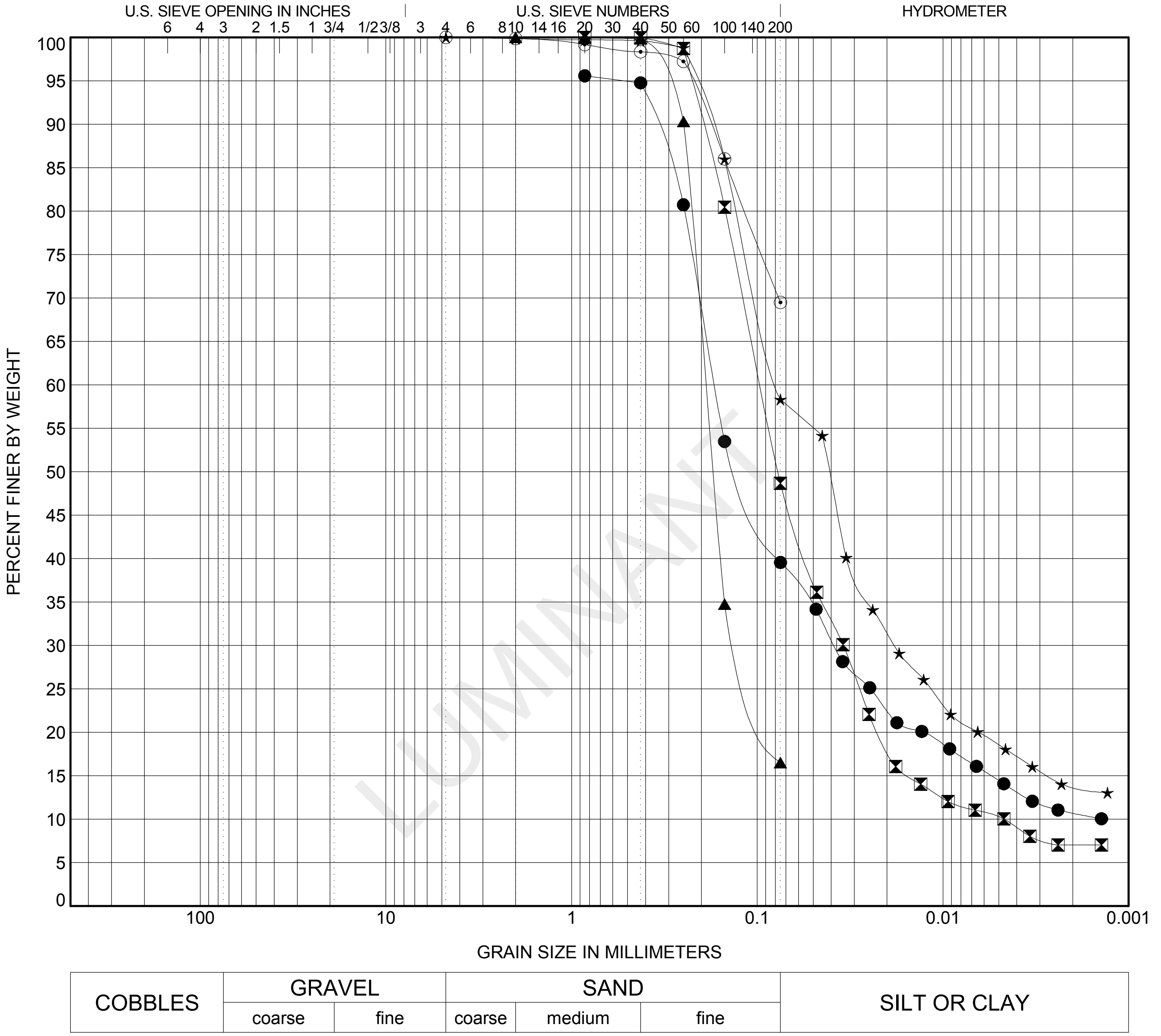


	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**BH-201**	**6.0**	**26**	**14**	**12**		
⧗	**BH-201**	**23.0**	**36**	**14**	**22**		
▲	**BH-202**	**2.0**	**55**	**19**	**36**		
★	**BH-202**	**18.0**	**29**	**13**	**16**		
⊙	**BH-203**	**6.0**	**50**	**19**	**31**		
✿	**BH-204**	**43.0**	**51**	**20**	**31**		
○	**BH-205**	**13.0**	**47**	**15**	**32**		
△	**BH-205**	**23.0**	**28**	**17**	**11**		
⊗	**BH-206**	**2.0**	**44**	**15**	**29**		
⊕	**BH-206**	**28.0**	**59**	**17**	**42**		
□	**BH-207**	**28.0**	**31**	**16**	**15**		
◒	**BH-208**	**8.0**	**28**	**15**	**13**		
◕	**BH-209**	**4.0**	**62**	**21**	**41**		
☆	**BH-209**	**28.0**	**41**	**15**	**26**		
⌘	**BH-210**	**18.0**	**36**	**14**	**22**		
■	**BH-211**	**18.0**	**50**	**17**	**33**		

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

GRAIN SIZE DISTRIBUTION

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake



	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**BH-201**	**38**						
⧗	**BH-202**	**28**					**2.63**	**20.54**
▲	**BH-203**	**28**						
★	**BH-204**	**28**						
⊙	**BH-205**	**28**						

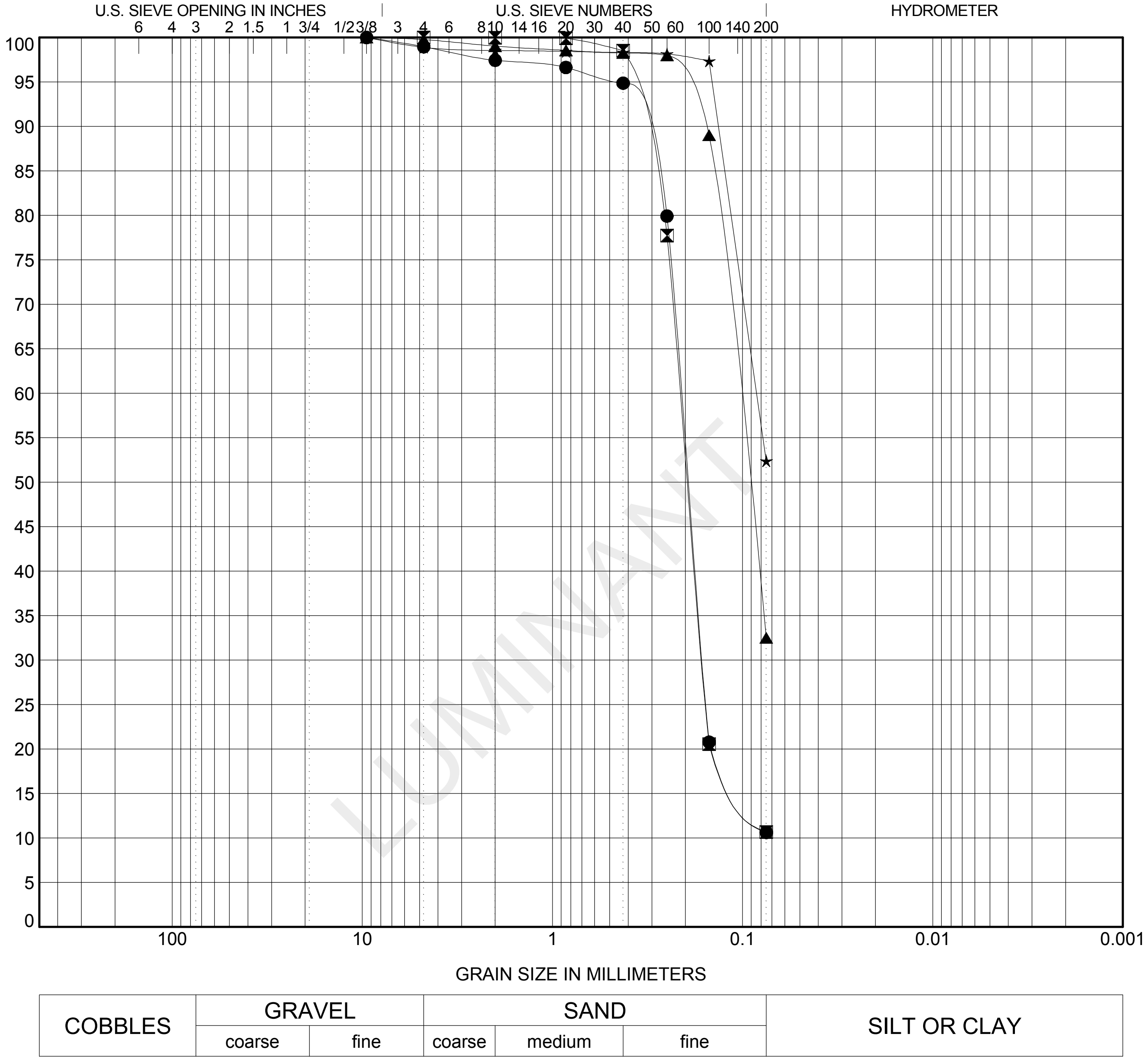
	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH-201**	**38**	**0.85**	**0.169**	**0.038**			**56.0**	**25.1**	**14.4**
⧗	**BH-202**	**28**	**0.85**	**0.096**	**0.034**	**0.005**	**0.0**	**51.3**	**38.4**	**10.2**
▲	**BH-203**	**28**	**2**	**0.189**	**0.125**		**0.0**	**83.5**	**16.5**	
★	**BH-204**	**28**	**4.75**	**0.078**	**0.018**		**0.0**	**41.7**	**39.8**	**18.5**
⊙	**BH-205**	**28**	**4.75**				**0.0**	**30.5**	**69.5**	

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

GRAIN SIZE DISTRIBUTION

CLIENT Luminant **PROJECT NAME** Pond Slope Stability

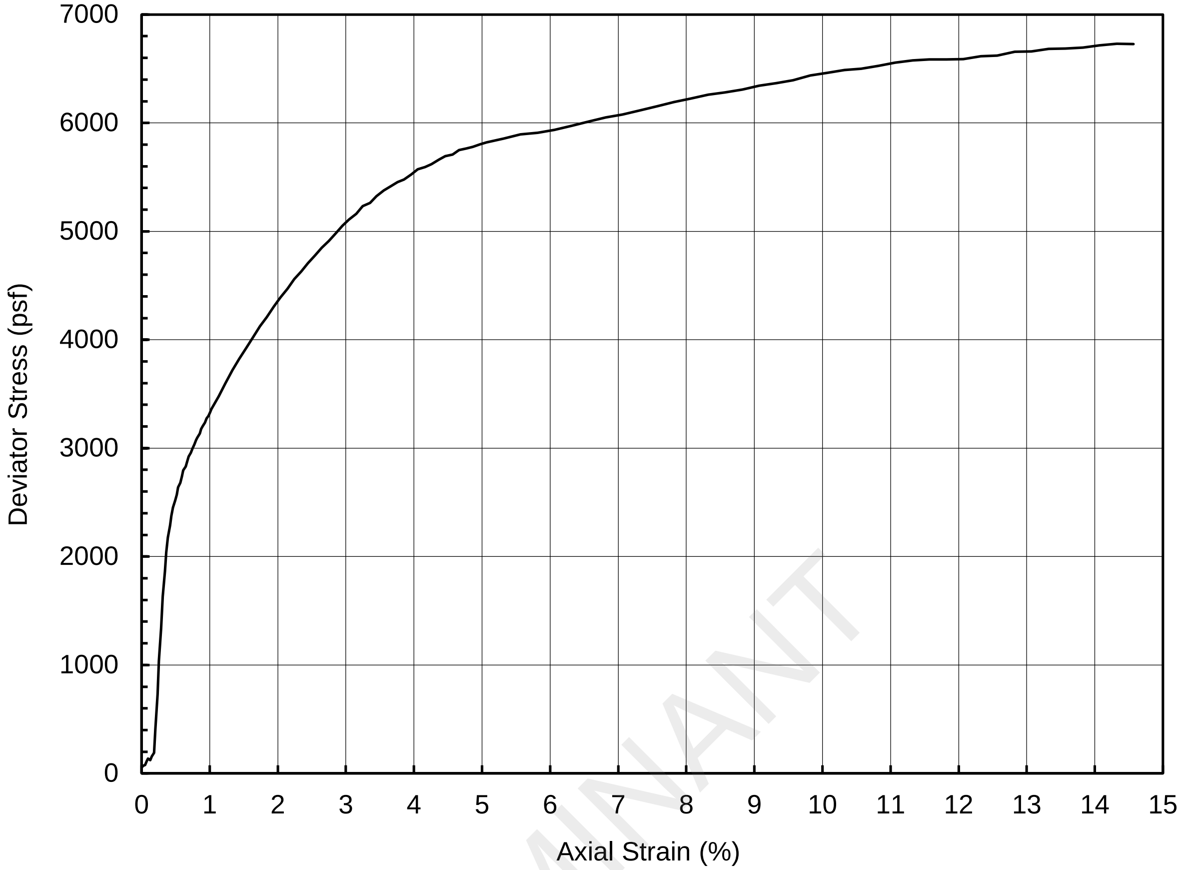
PROJECT NUMBER 123-94128 **PROJECT LOCATION** Martin Lake



	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**BH-205**	**53**					**1.74**	**2.93**
⧗	**BH-208**	**48**					**1.75**	**2.98**
▲	**BH-210**	**48**						
★	**BH-211**	**28**						

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH-205**	**53**	**9.5**	**0.21**	**0.162**		**1.1**	**88.3**	**10.6**	
⧗	**BH-208**	**48**	**4.75**	**0.213**	**0.163**		**0.0**	**89.3**	**10.7**	
▲	**BH-210**	**48**	**9.5**	**0.105**			**0.2**	**67.2**	**32.5**	
★	**BH-211**	**28**	**9.5**	**0.084**			**1.1**	**46.5**	**52.4**	

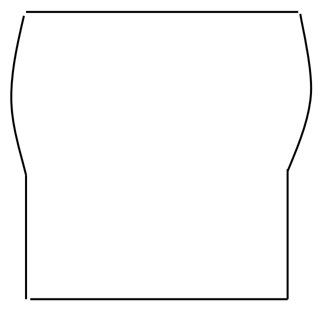
UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Yellow Clay (visual classification)						
LL		PI		LI		USCS	

Depth (ft)	4.0	Confining Pressure (psf)	617
Specimen Height (inch)	6.0	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	6732
Initial Specimen Weight (g)	1263.7	Axial Strain at Peak Stress (%)	14.3
Moist Unit Weight (pcf)	131.9		
Initial Water Content (%)	15		
Initial Dry Unit Weight (pcf)	114.6		

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-201 TO-3
Comments	

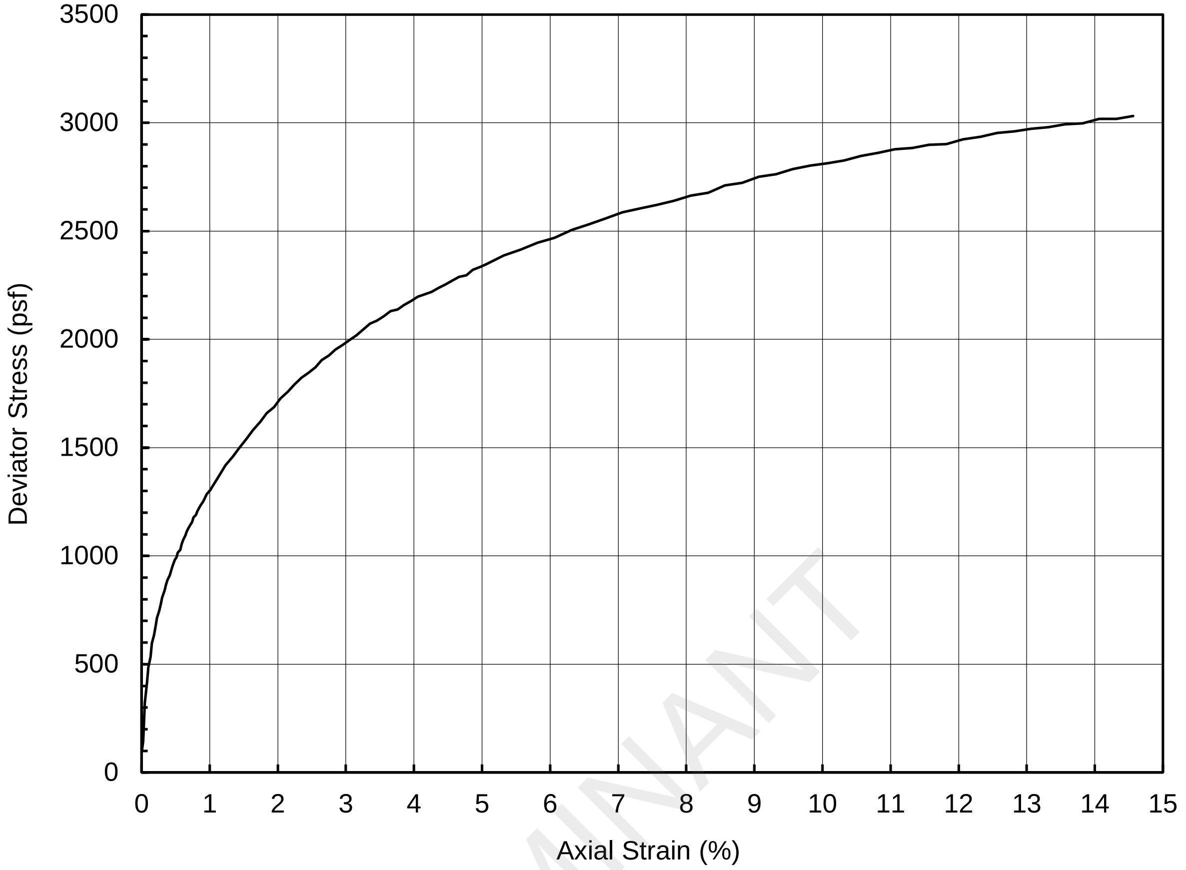


Failure Sketch

Performed by	**PN**
Date	**12-Nov-12**
Check	**HR**
Review	**SBK**

Golder Associates

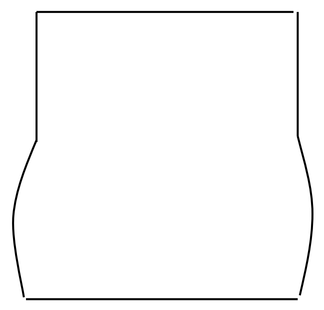
UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Yellow Clay (visual classification)						
LL		PI		LI		USCS	

Depth (ft)	18.0	Confining Pressure (psf)	2371
Specimen Height (inch)	5.9	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	3035
Initial Specimen Weight (g)	1232.8	Axial Strain at Peak Stress (%)	14.8
Moist Unit Weight (pcf)	132.4		
Initial Water Content (%)	19		
Initial Dry Unit Weight (pcf)	111.7		

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-202 TO-7
Comments	

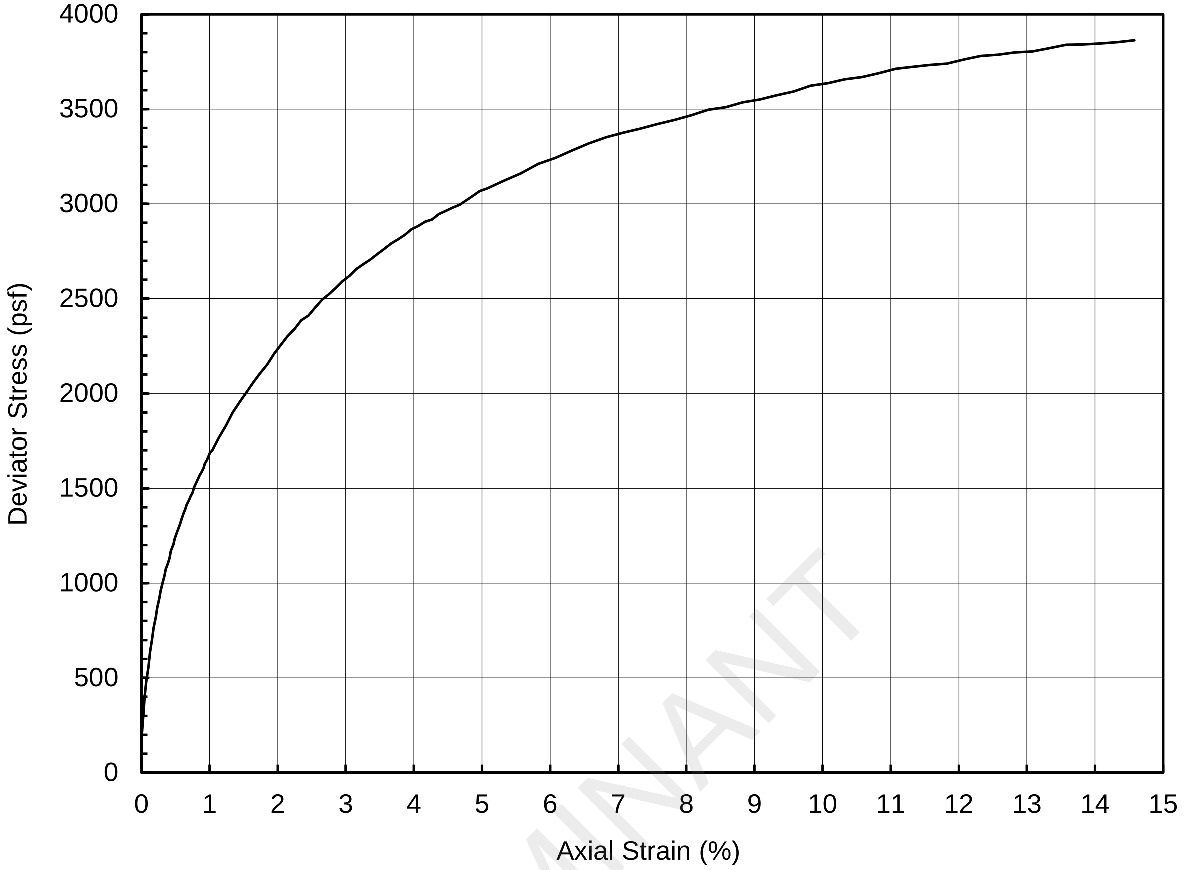


Failure Sketch

Golder Associates

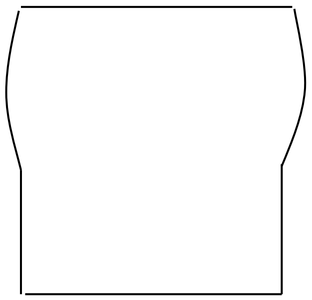
Performed by	**PN**
Date	**13-Nov-12**
Check	**HR**
Review	**SBK**

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Gray Clay (visual classification)						
LL		PI		LI		USCS	

Depth (ft)	6.0	Confining Pressure (psf)	858
Specimen Height (inch)	6.0	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	3877
Initial Specimen Weight (g)	1199.6	Axial Strain at Peak Stress (%)	14.8
Moist Unit Weight (pcf)	124.7		
Initial Water Content (%)	21		
Initial Dry Unit Weight (pcf)	102.7		



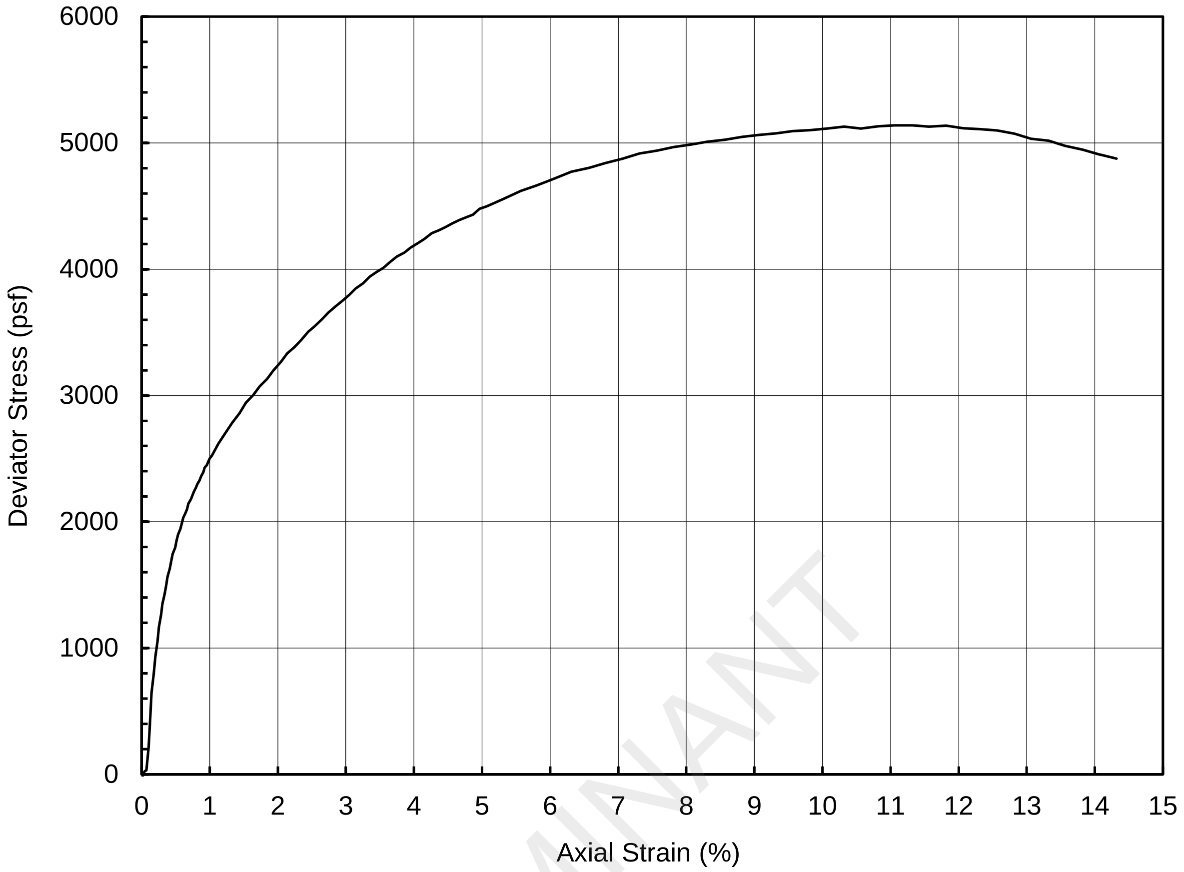
Failure Sketch

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-203 TO-4
Comments	

Golder Associates

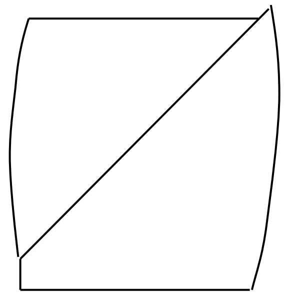
Performed by	**PN**
Date	**13-Nov-12**
Check	**HR**
Review	**SBK**

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Gray Clay (visual classification)						
LL		PI		LI		USCS	

Depth (ft)	23.0	Confining Pressure (psf)	3008
Specimen Height (inch)	6.0	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	5139
Initial Specimen Weight (g)	1192.8	Axial Strain at Peak Stress (%)	11.3
Moist Unit Weight (pcf)	126.6		
Initial Water Content (%)	26		
Initial Dry Unit Weight (pcf)	100.9		



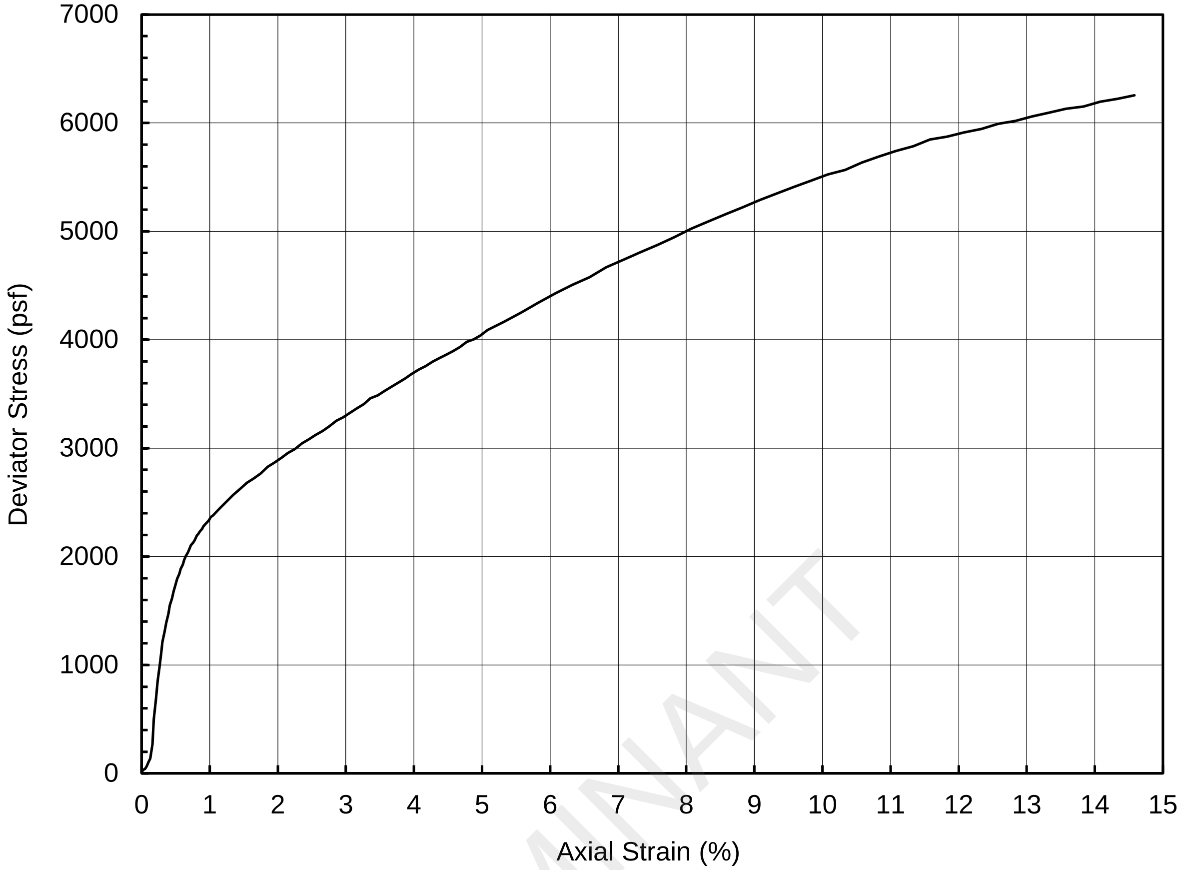
Failure Sketch

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-204 TO-8
Comments	

Golder Associates

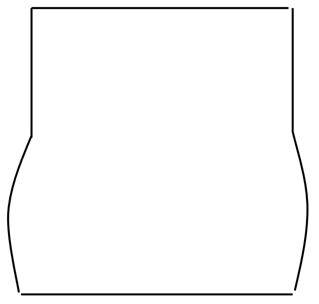
Performed by	**PN**
Date	**13-Nov-12**
Check	**HR**
Review	**SBK**

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Yellow Clay (visual classification)						
LL		PI		LI		USCS	

Depth (ft)	13.0	Confining Pressure (psf)	1760
Specimen Height (inch)	5.9	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	6270
Initial Specimen Weight (g)	1252.5	Axial Strain at Peak Stress (%)	14.8
Moist Unit Weight (pcf)	131.9		
Initial Water Content (%)	27		
Initial Dry Unit Weight (pcf)	104.1		



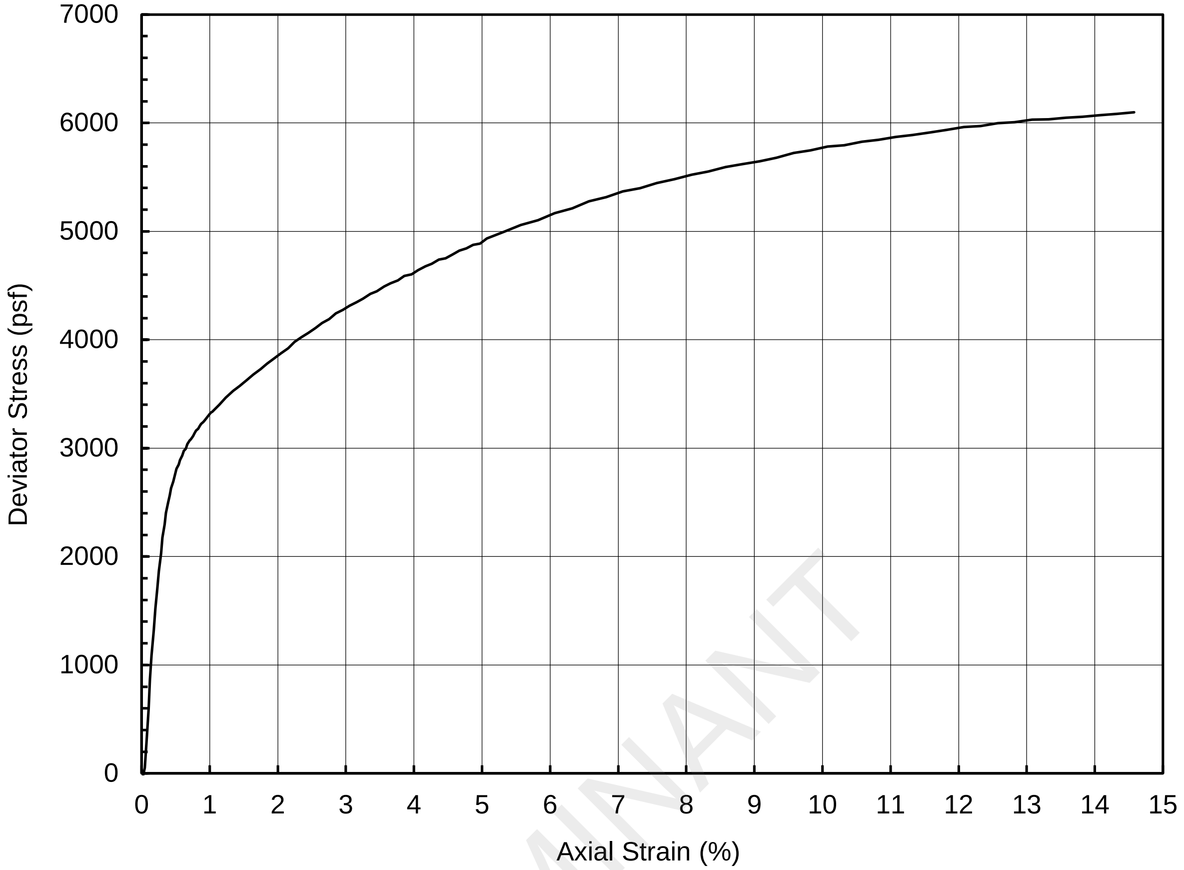
Failure Sketch

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-205 TO-6
Comments	

Golder Associates

Performed by	**PN**
Date	**13-Nov-12**
Check	**HR**
Review	**SBK**

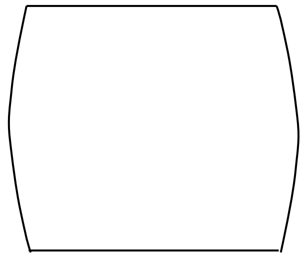
UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Grayish Brown Fat Clay						
LL	59	PI	42	LI	0.1	USCS	CH

Depth (ft)	28.0	Confining Pressure (psf)	3627
Specimen Height (inch)	5.9	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	6110
Initial Specimen Weight (g)	1219.7	Axial Strain at Peak Stress (%)	14.8
Moist Unit Weight (pcf)	127.5		
Initial Water Content (%)	20		
Initial Dry Unit Weight (pcf)	106.6		

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-206 TO-9
Comments	

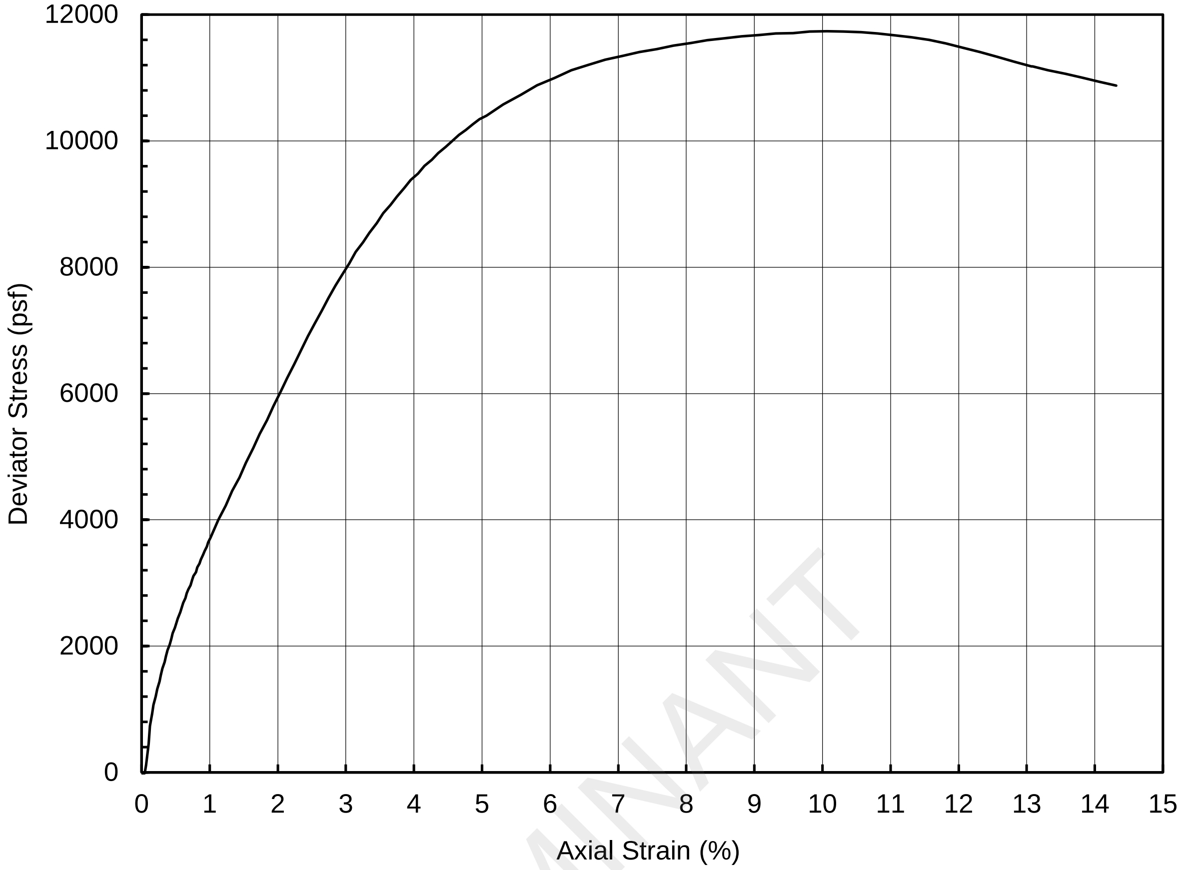


Failure Sketch

Performed by	**PN**
Date	**15-Nov-12**
Check	**HR**
Review	**JF**

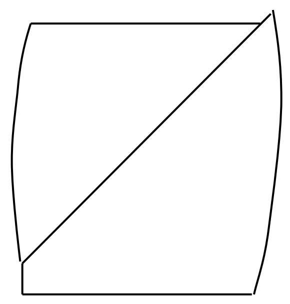
Golder Associates

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Grayish Brown Lean Clay						
LL	31	PI	15	LI	0.0	USCS	CL

Depth (ft)	28.0	Confining Pressure (psf)	3620
Specimen Height (inch)	5.9	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	11735
Initial Specimen Weight (g)	1251.9	Axial Strain at Peak Stress (%)	10.1
Moist Unit Weight (pcf)	127.7		
Initial Water Content (%)	16		
Initial Dry Unit Weight (pcf)	109.9		



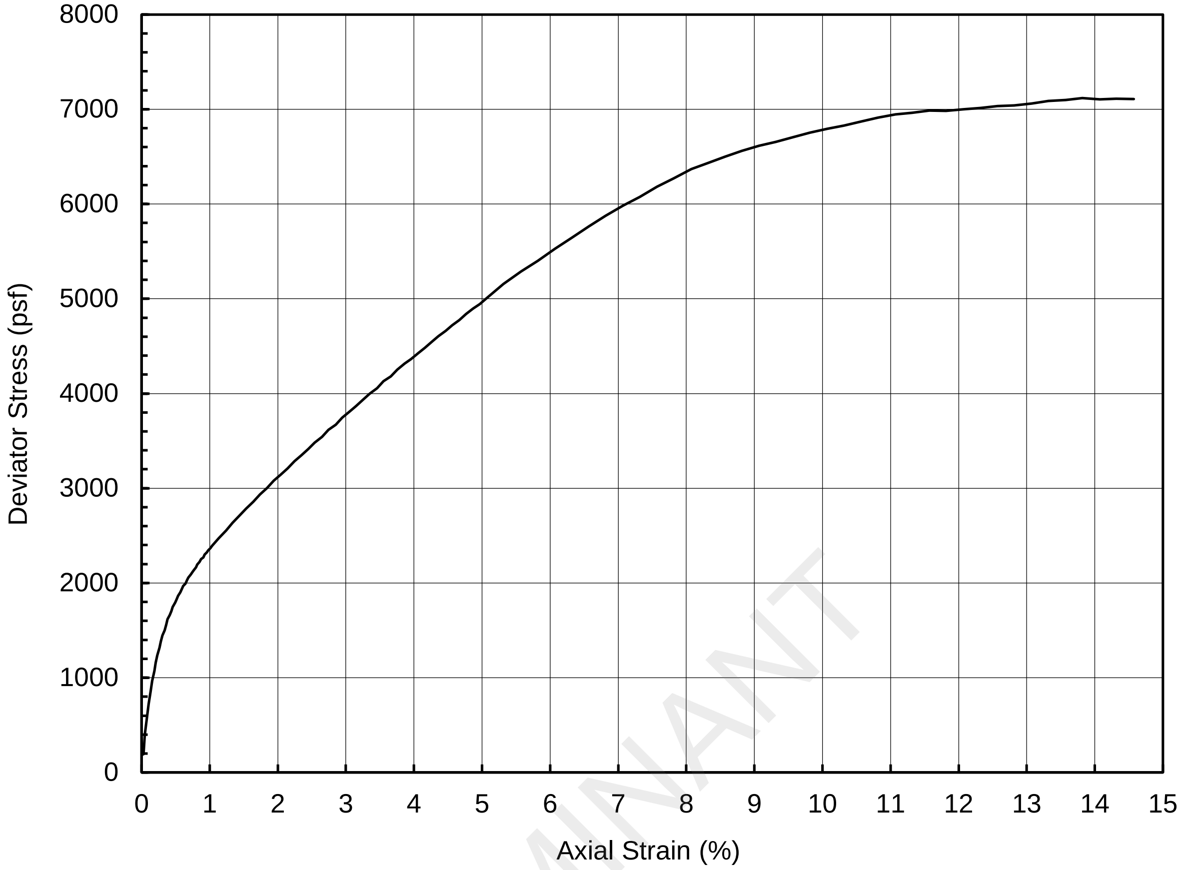
Failure Sketch

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-207 TO-9
Comments	

Golder Associates

Performed by	**PN**
Date	**15-Nov-12**
Check	**HR**
Review	**JF**

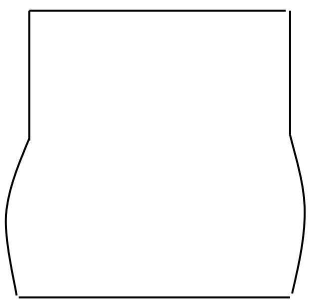
UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Yellow Lean Clay						
LL	28	PI	13	LI	0.0	USCS	CL

Depth (ft)	8.0	Confining Pressure (psf)	1046
Specimen Height (inch)	5.9	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	7118
Initial Specimen Weight (g)	1287.7	Axial Strain at Peak Stress (%)	13.8
Moist Unit Weight (pcf)	138.1		
Initial Water Content (%)	14		
Initial Dry Unit Weight (pcf)	120.7		

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-208 TO-5
Comments	

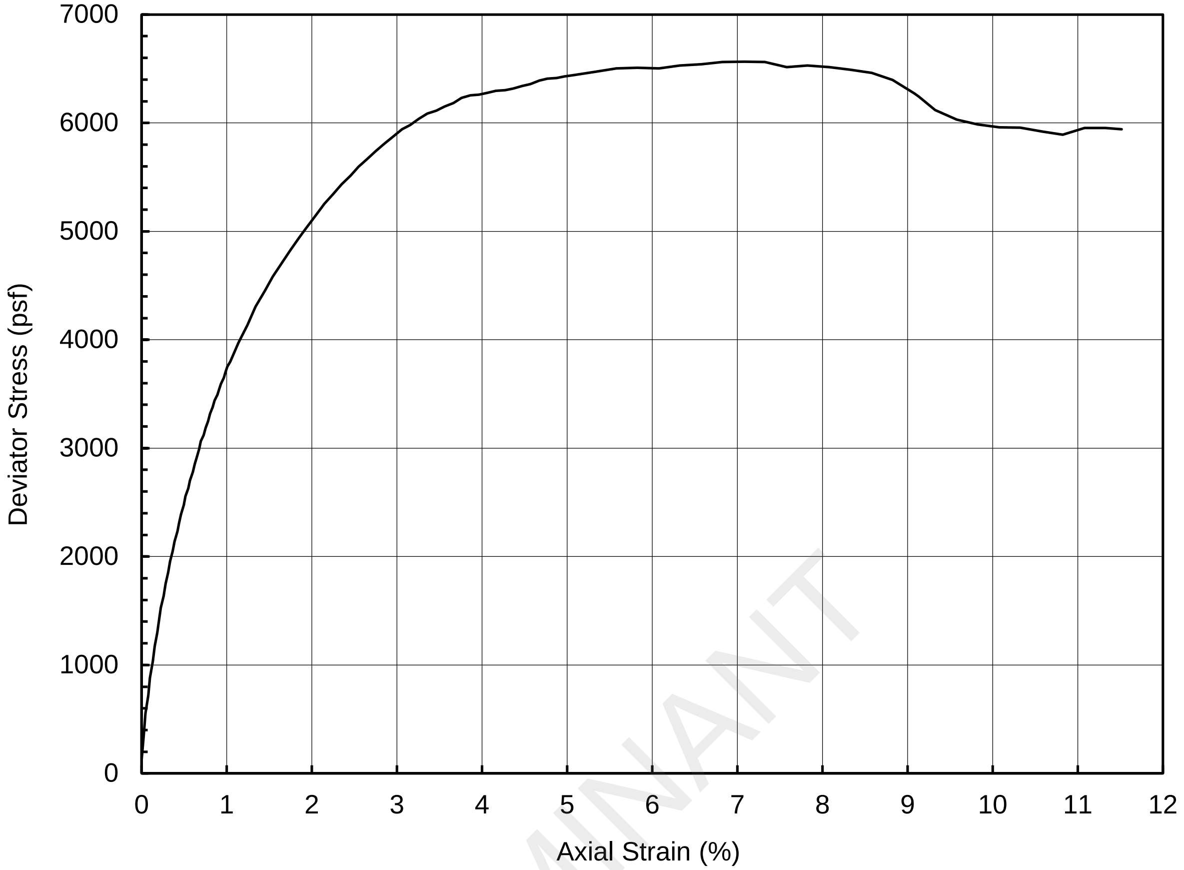


Failure Sketch

Golder Associates

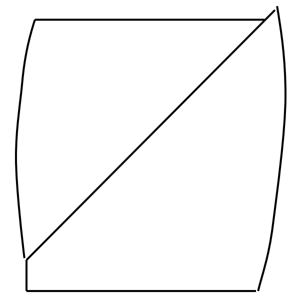
Performed by	**PN**
Date	**16-Nov-12**
Check	**HR**
Review	**JF**

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Grayish Brown Lean Clay						
LL	41	PI	26	LI	0.3	USCS	CL

Depth (ft)	28.0	Confining Pressure (psf)	3624
Specimen Height (inch)	6.0	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	6566
Initial Specimen Weight (g)	1202.8	Axial Strain at Peak Stress (%)	7.1
Moist Unit Weight (pcf)	128.0		
Initial Water Content (%)	22		
Initial Dry Unit Weight (pcf)	104.7		



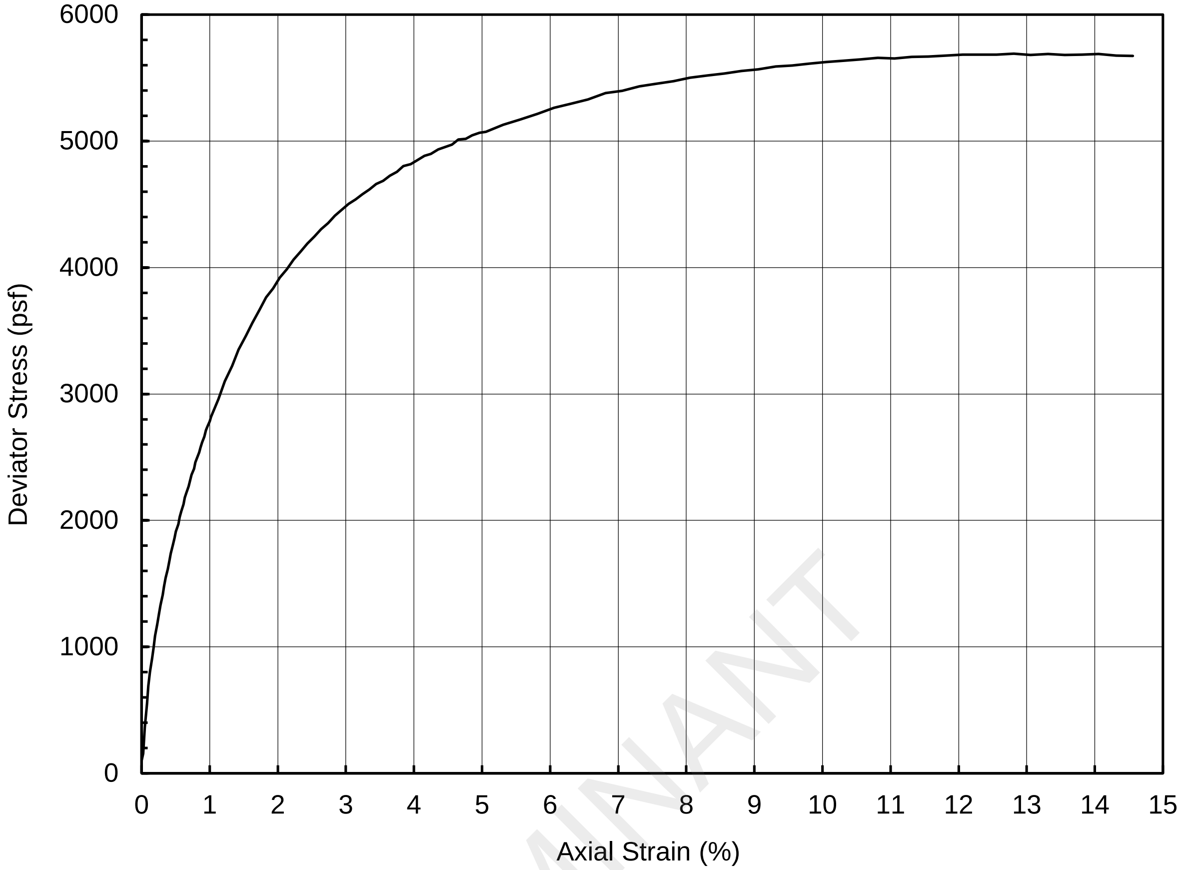
Failure Sketch

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-209 TO-9
Comments	

Golder Associates

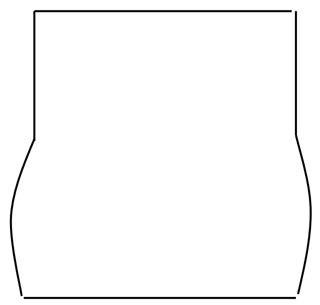
Performed by	**PN**
Date	**16-Nov-12**
Check	**HR**
Review	**JF**

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Gray Lean Clay						
LL	36	PI	22	LI	0.5	USCS	CL

Depth (ft)	18.0	Confining Pressure (psf)	2375
Specimen Height (inch)	6.0	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	5691
Initial Specimen Weight (g)	1192.0	Axial Strain at Peak Stress (%)	12.8
Moist Unit Weight (pcf)	126.7		
Initial Water Content (%)	24		
Initial Dry Unit Weight (pcf)	102.2		



Failure Sketch

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-210 TO-7
Comments	

Golder Associates

Performed by	**PN**
Date	**16-Nov-12**
Check	**HR**
Review	**JF**

PROJECT INFORMATION

PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
Movember 2008

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

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VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

THIS COPY LICENSED TO:
ETTL ENGINEERS AND CONSULTANTS, INC.
1717 East Erwin
Tyler, TX 75702

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Possible Fill Sample
DESCRIPTION: Tan, Brown & Red Sandy Lean Clay
Sampled on Site, B-13 3' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

Number of Specimens = 3

PLATE: B.1

PLATE: B.2

PLATE: B.3

SPECIMEN DATA

SPECIMEN NO. 1

	initial		final		Diameter			Height		
Moist soil & Tare :	522.40	g	621.30	g	top	2.04	in	Ht 1	4.44	in
Dry soil and Tare :	468.70	g	544.40	g	mid	2.04	in	Ht 2	4.44	in
Tare :	129.80	g	119.40	g	bot	2.04	in	Ht 3	4.44	in
Moisture content :	15.85	%	18.09	%	Avg	2.04	in	Ht4	4.44	in
Weight:	496.1	g						Avg Ht	4.44	in

Change in Ht due to saturation :	-0.02	in	Initial specimen vol :	[illegible]	cc
Change in Ht due to consolidation :	-0.018	in	At test specimen vol :	[illegible]	cc
Change in pipet vol due to consolidation :	2.0	cc	Initial dry density :	[illegible]	pcf
Saturation Parameter " B " = 0.95			At test dry density:	[illegible]	pcf

Strain Rate (in/min) = 0.0005
Failure Strain % = 2.7
Effective Cell Pressure (psi) = 10.0
σ_1' Failure (psi) = 20.41
σ_1 Failure (psi) = 25.00
Estimated ν = 0.35
σ_3' Failure (psi) = 5.41
σ_3 Failure (psi) = 10.00
Back Pressure (psi) = 50.0
ΔU = 4.6
Total Pore Pressure = 54.6
Cell Pressure (psi) = 60.0

SPECIMEN NO. 2

	initial		final		Diameter			Height		
Moist soil & Tare :	549.80	g	636.40	g	top	2.01	in	Ht 1	4.44	in
Dry soil and Tare :	489.20	g	560.20	g	mid	2.01	in	Ht 2	4.44	in
Tare :	123.20	g	139.10	g	bot	2.01	in	Ht 3	4.44	in
Moisture content :	16.56	%	18.10	%	Avg	2.01	in	Ht4	4.44	in
Weight:	496.0	g						Avg Ht	4.44	in

Change in Ht due to saturation :	-0.006	in	Initial specimen vol :	[illegible]	cc
Change in Ht due to consolidation :	-0.034	in	At test specimen vol :	[illegible]	cc
Change in pipet vol due to consolidation :	3.9	cc	Initial dry density :	[illegible]	pcf
Saturation Parameter " B " = 0.97			At test dry density:	[illegible]	pcf

Strain Rate (in/min) = 0.0005
Failure Strain % = 3.9
Effective Cell Pressure (psi) = 20.0
σ_1' Failure (psi) = 37.62
σ_1 Failure (psi) = 45.60
Estimated ν = 0.35
σ_3' Failure (psi) = 12.02
σ_3 Failure (psi) = 20.00
Back Pressure (psi) = 50.0
ΔU = 8.0
Total Pore Pressure = 58.0
Cell Pressure (psi) = 70.0

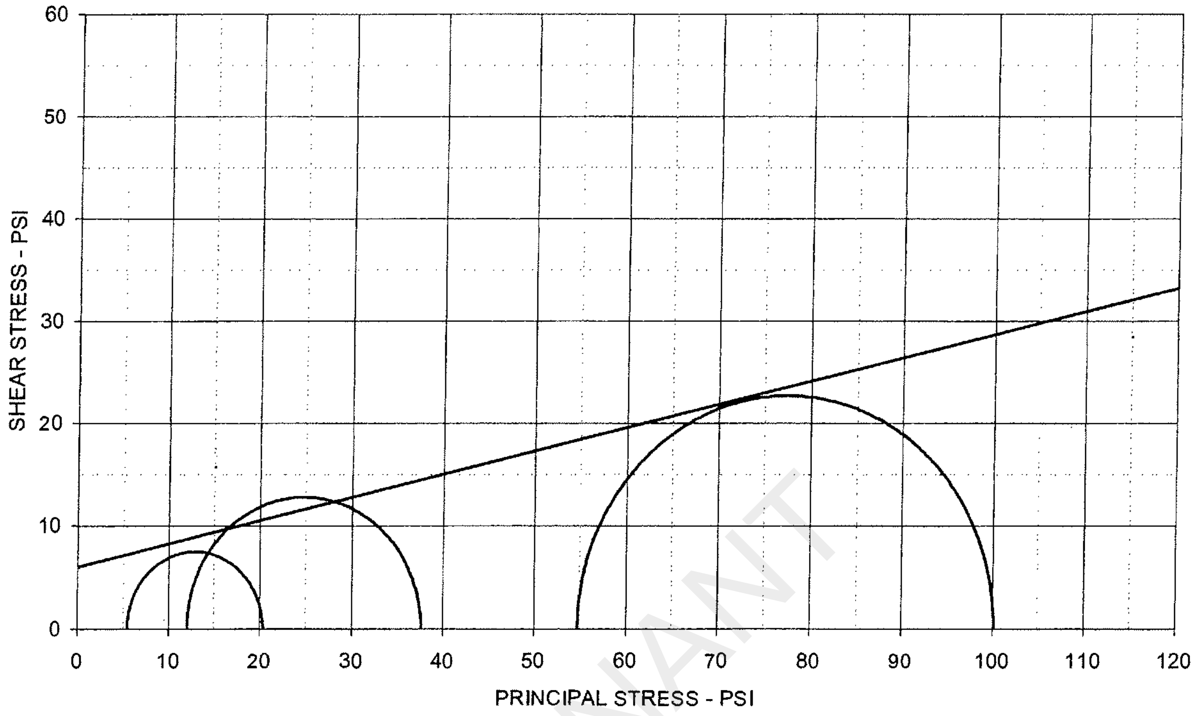
SPECIMEN NO. 3

	initial		final		Diameter			Height		
Moist soil & Tare :	594.50	g	656.50	g	top	2.06	in	Ht 1	4.54	in
Dry soil and Tare :	530.10	g	579.20	g	mid	2.06	in	Ht 2	4.54	in
Tare :	126.30	g	139.30	g	bot	2.06	in	Ht 3	4.54	in
Moisture content :	15.95	%	17.57	%	Avg	2.06	in	Ht4	4.54	in
Weight:	518.0	g						Avg Ht	4.54	in

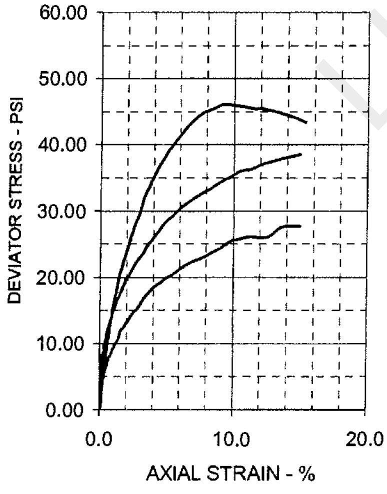
Change in Ht due to saturation :	-0.001	in	Initial specimen vol :	[illegible]	cc
Change in Ht due to consolidation :	-0.052	in	At test specimen vol :	[illegible]	cc
Change in pipet vol due to consolidation :	5.6	cc	Initial dry density :	112.54	pcf
Saturation Parameter " B " = 0.97			At test dry density:	116.14	pcf

Strain Rate (in/min) = 0.0005
Failure Strain % = 8.5
Effective Cell Pressure (psi) = 40.0
σ_1' Failure (psi) = 100.17
σ_1 Failure (psi) = 85.40
Estimated ν = 0.35
σ_3' Failure (psi) = 54.77
σ_3 Failure (psi) = 40.00
Back Pressure (psi) = 50.0
ΔU = -14.8
Total Pore Pressure = 35.2
Cell Pressure (psi) = 90.0

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ ' = 12.8 deg	c' = 6.0 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	15.8	16.6	15.9	
Dry Density - pcf	113.0	115.0	112.5	
Diameter - inches	2.04	2.01	2.06	
Height - Inches	4.44	4.44	4.54	
AT TEST				
Final Moisture - %	18.1	18.1	17.6	
Dry Density - pcf	114.0	116.9	115.1	
Calculated Diameter (in.)	2.02	2.00	2.04	
Height - Inches	4.40	4.40	4.49	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	15.00	25.60	45.40	
Total Pore Pressure - psi	54.6	58.0	35.2	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	2.7	3.9	8.5	
σ_1' Failure - psi	20.41	37.62	100.17	
σ_3' Failure - psi	5.41	12.02	54.77	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Possible Fill Sample
DESCRIPTION: Tan, Brown & Red Sandy Lean Clay
Sampled on Site, B-13 3' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

PROJECT INFORMATION

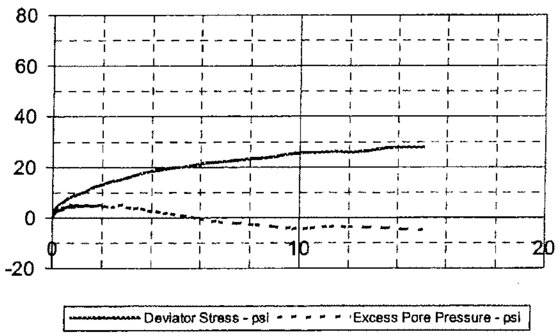
PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
Movember 2008

ETTL ENGINEERS & CONSULTANTS

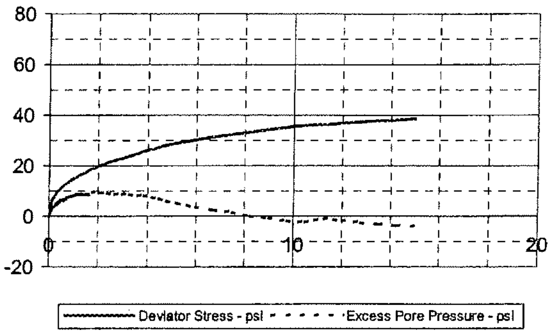
PLATE: B.1

G 2972-08, B-13, 3'-10' Fill

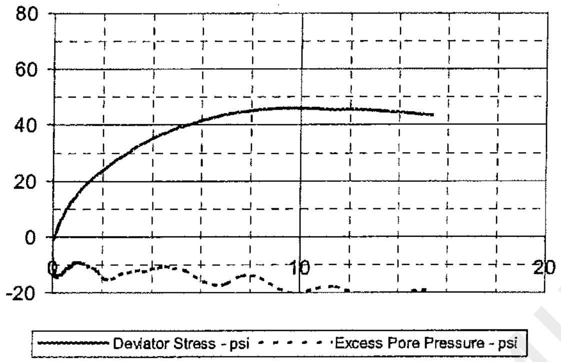
SPECIMEN NO. 1



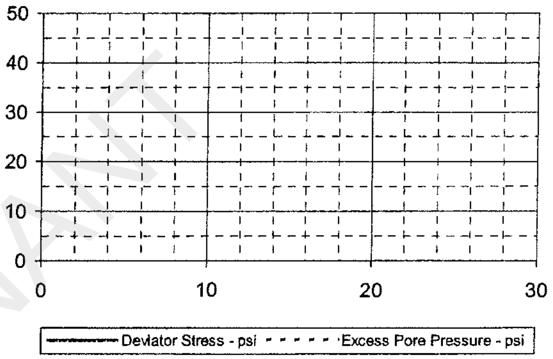
SPECIMEN NO. 2



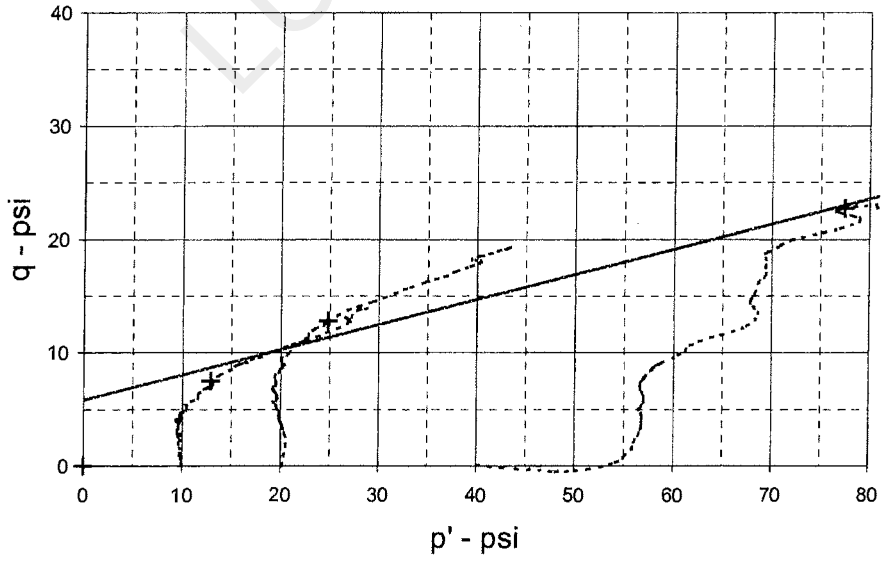
SPECIMEN NO. 3



SPECIMEN NO. 4



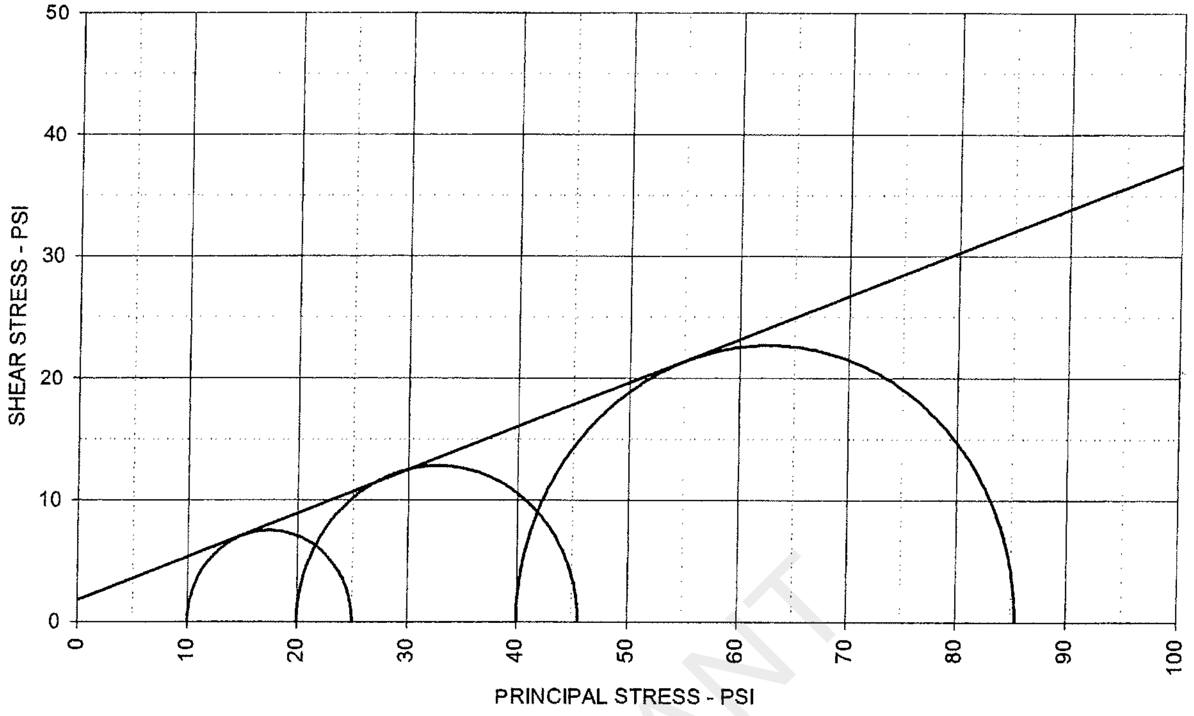
p - q DIAGRAM



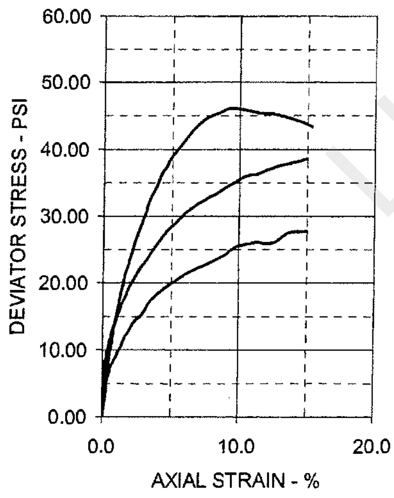
EFFECTIVE STRESS PARAMETERS	$R^2 = 0.97$	α (deg) = 12.5	a (psi) = 5.8
PROJECT: Luminant East Ash Disposal		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 2972 - 08		ETTL ENGINEERS & CONSULTANTS	PLATE: B.2
DESCRIPTION: Tan, Brown & Red Sandy Lean Clay			

G 2972-08, B-13, 3'-10' Fill

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 19.6 deg	c = 1.8 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	15.8	16.6	15.9	
Dry Density - pcf	113.0	115.0	112.5	
Diameter - inches	2.04	2.01	2.06	
Height - Inches	4.44	4.44	4.54	
AT TEST				
Final Moisture - %	18.1	18.1	17.6	
Dry Density - pcf	114.0	116.9	115.1	
Calculated Diameter (In.)	2.02	2.00	2.04	
Height - inches	4.40	4.40	4.49	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	15.00	25.60	45.40	
Total Pore Pressure - psi	54.6	58.0	35.2	
Strain Rate - Inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	2.7	3.9	8.5	
σ_1 Failure - psi	25.00	45.60	85.40	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Possible Fill Sample
DESCRIPTION: Tan, Brown & Red Sandy Lean Clay
Sampled on Site, B-13 3' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
Movember 2008

ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

PROJECT INFORMATION

PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
November 2008

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Sample
DESCRIPTION: Gray, Tan & Redd. Br Sandy Clay w/ some Gravel
Sampled on Site, B-2 8' to 20' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

Number of Specimens = 3

PLATE: B.1

PLATE: B.2

PLATE: B.3

SPECIMEN DATA

SPECIMEN NO. 1

	initial		final		Diameter			Height		
Moist soil & Tare :	479.30	g	630.20	g	top	2.08	in	Ht 1	4.25	in
Dry soil and Tare :	429.60	g	548.70	g	mid	2.08	in	Ht 2	4.25	in
Tare :	129.70	g	128.00	g	bot	2.08	in	Ht 3	4.25	in
Moisture content :	16.57	%	19.37	%	Avg	2.08	in	Ht4	4.25	in
Weight:	496.8	g						Avg Ht	4.25	in

Change in Ht due to saturation : -0.014 in
Change in Ht due to consolidation : 0.005 in
Change in pipet vol due to consolidation : 0.6 cc
Saturation Parameter " B " = 0.96

Initial specimen vol : 236.91 cc
At test specimen vol : 230.34 cc
Initial dry density : 112.24 pcf
At test dry density: [illegible] pcf

Strain Rate (in/min) = 0.0005
σ1' Failure (psi) = 36.26
σ3' Failure (psi) = 8.24
ΔU = 1.8

Failure Strain % = 2.4
σ1 Failure (psi) = 38.02
σ3 Failure (psi) = 10.00
Total Pore Pressure = 51.8

Effective Cell Pressure (psl) = 10.0
Estimated ν = 0.35
Back Pressure (psl) = 50.0
Cell Pressure (psi) = 60.0

SPECIMEN NO. 2

	initial		final		Diameter			Height		
Moist soil & Tare :	505.50	g	616.20	g	top	2.08	in	Ht 1	4.40	in
Dry soil and Tare :	451.40	g	537.60	g	mid	2.08	in	Ht 2	4.40	in
Tare :	114.00	g	102.60	g	bot	2.08	in	Ht 3	4.40	in
Moisture content :	16.03	%	18.07	%	Avg	2.08	in	Ht4	4.40	in
Weight:	611.6	g						Avg Ht	4.40	in

Change in Ht due to saturation : 0.01 in
Change in Ht due to consolidation : -0.048 in
Change in pipet vol due to consolidation : 7.0 cc
Saturation Parameter " B " = 0.98

Initial specimen vol : 245.64 cc
At test specimen vol : 235.54 cc
Initial dry density : 112.05 pcf
At test dry density: 115.34 pcf

Strain Rate (in/min) = 0.0005
σ1' Failure (psi) = 48.53
σ3' Failure (psi) = 13.88
ΔU = 6.1

Failure Strain % = 3.4
σ1 Failure (psi) = 54.65
σ3 Failure (psi) = 20.00
Total Pore Pressure = 56.1

Effective Cell Pressure (psi) = 20.0
Estimated ν = 0.35
Back Pressure (psi) = 50.0
Cell Pressure (psi) = 70.0

SPECIMEN NO. 3

	initial		final		Diameter			Height		
Moist soil & Tare :	414.70	g	721.50	g	top	2.11	in	Ht 1	4.62	in
Dry soil and Tare :	381.70	g	652.20	g	mid	2.11	in	Ht 2	4.62	in
Tare :	102.50	g	139.10	g	bot	2.11	in	Ht 3	4.62	in
Moisture content :	11.82	%	13.51	%	Avg	2.11	in	Ht4	4.62	in
Weight:	579.6	g						Avg Ht	4.62	in

Change in Ht due to saturation : -0.021 in
Change in Ht due to consolidation : -0.018 in
Change in pipet vol due to consolidation : 5.4 cc
Saturation Parameter " B " = 0.99

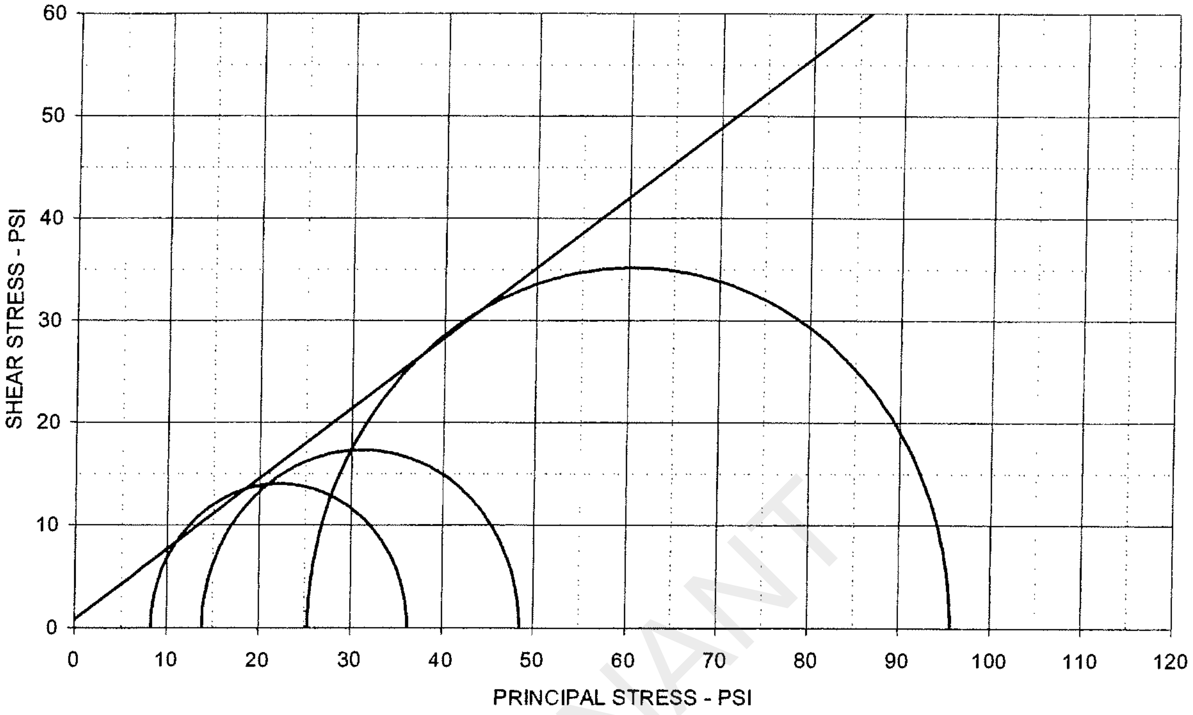
Initial specimen vol : 264.50 cc
At test specimen vol : 259.10 cc
Initial dry density : 122.34 pcf
At test dry density: 124.83 pcf

Strain Rate (in/min) = 0.0005
σ1' Failure (psi) = 95.68
σ3' Failure (psi) = 25.40
ΔU = 14.6

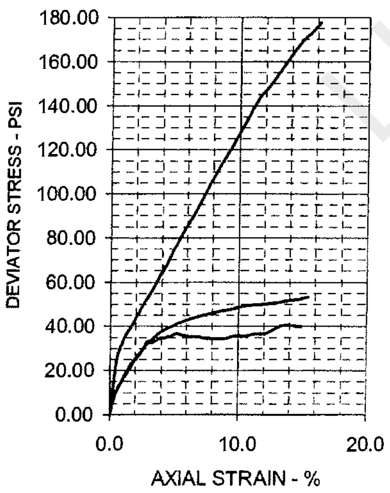
Failure Strain % = 4.6
σ1 Failure (psi) = 110.28
σ3 Failure (psi) = 40.00
Total Pore Pressure = 64.6

Effective Cell Pressure (psi) = 40.0
Estimated ν = 0.35
Back Pressure (psi) = 50.0
Cell Pressure (psi) = 90.0

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	φ ' = 34.4 deg	c' = 0.8 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	16.6	16.0	11.8	
Dry Density - pcf	112.3	112.1	122.3	
Diameter - inches	2.08	2.08	2.11	
Height - inches	4.25	4.40	4.62	
AT TEST				
Final Moisture - %	19.4	18.1	13.5	
Dry Density - pcf	112.6	115.3	124.9	
Calculated Diameter (in.)	2.08	2.07	2.10	
Height - inches	4.24	4.37	4.58	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	28.02	34.65	70.28	
Total Pore Pressure - psi	51.8	56.1	64.6	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	2.4	3.4	4.6	
σ_1' Failure - psi	36.26	48.53	95.68	
σ_3' Failure - psi	8.24	13.88	25.40	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP

SAMPLE TYPE: Native Sample

DESCRIPTION: Gray, Tan & Redd. Br Sandy Clay w/ some Gravel

Sampled on Site, B-2 8' to 20' deep

ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve

LL: PL: PI: Percent -200:

REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

~~G 2972-08, B-2, 8'-20' Native~~

PROJECT INFORMATION

PROJECT: Luminant East Ash Disposal

LOCATION: Rusk County, Texas

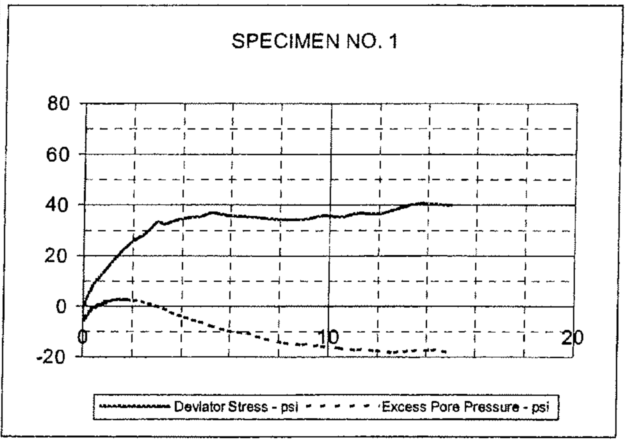
PROJECT NO: G 2972 - 08

CLIENT:

Movember 2008

ETTL ENGINEERS & CONSULTANTS

PLATE: B.1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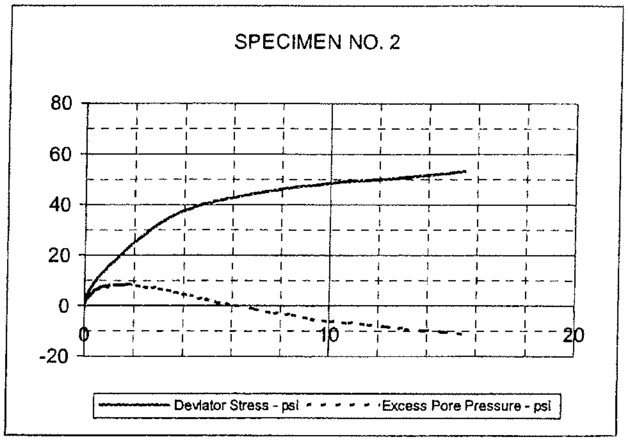
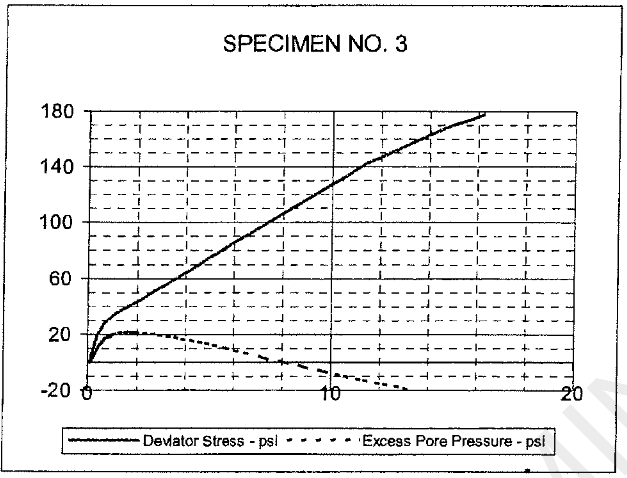
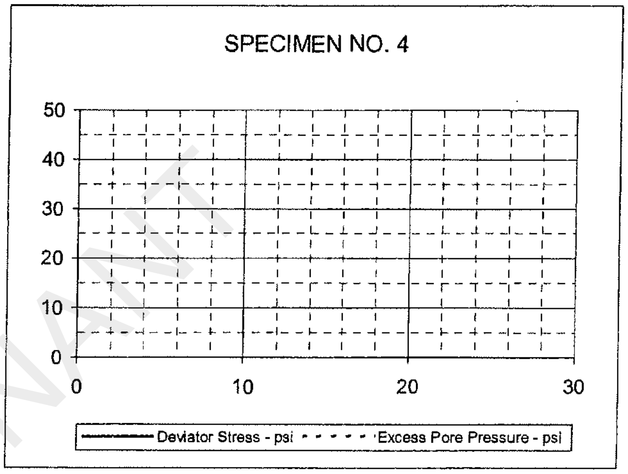
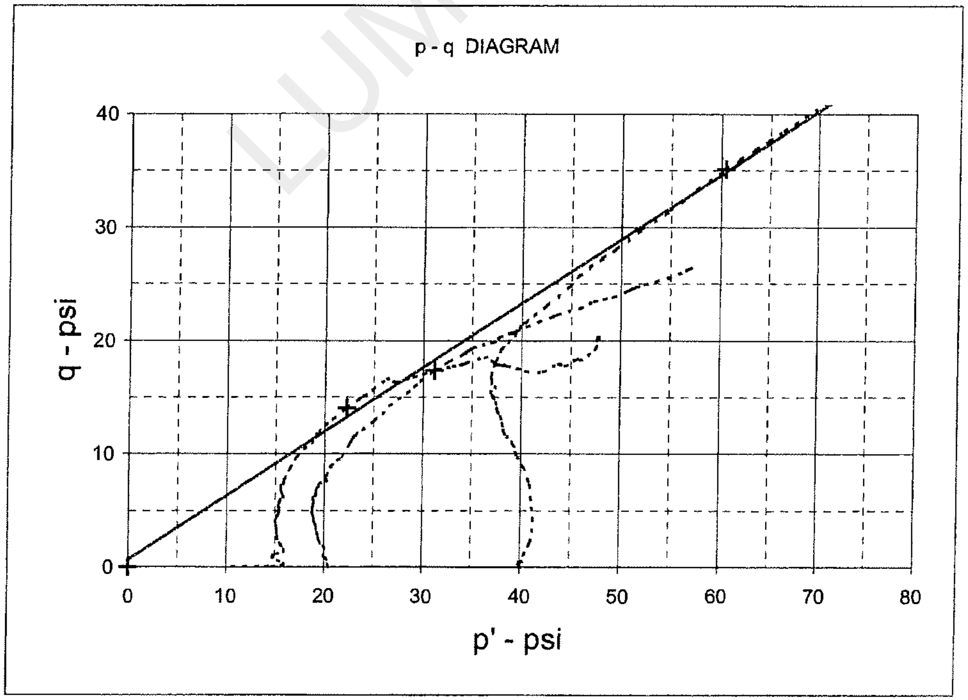

SPECIMEN NO. 2


SPECIMEN NO. 3

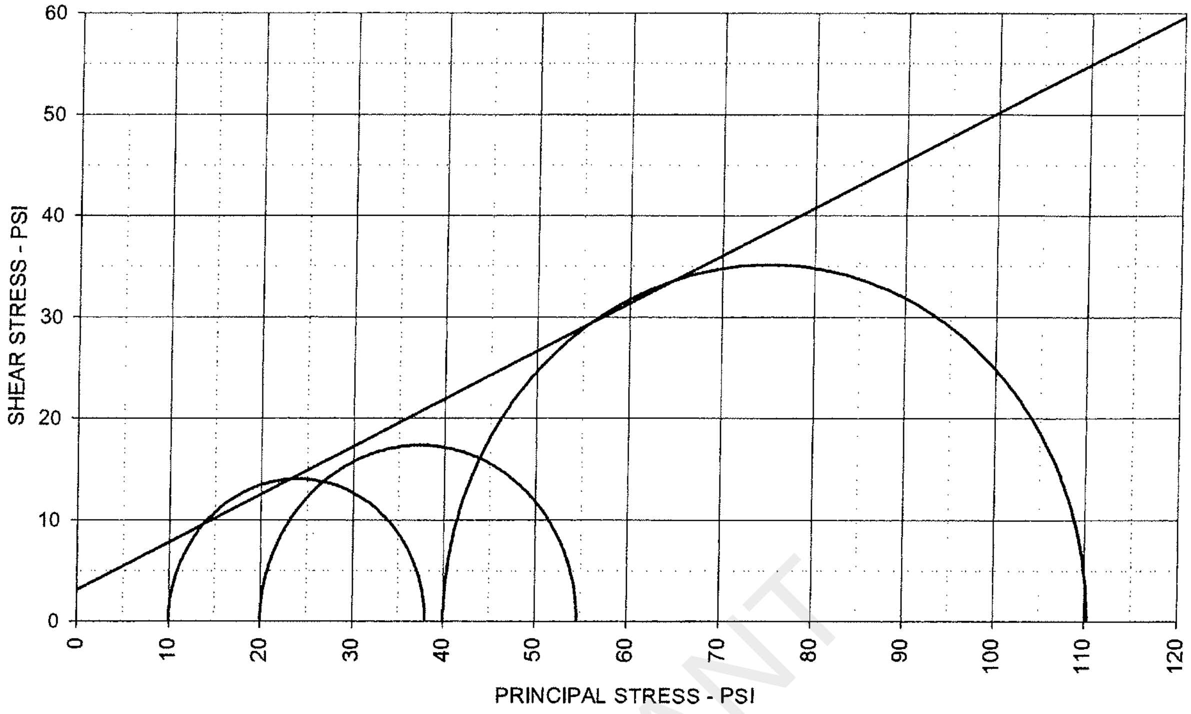

SPECIMEN NO. 4


p - q DIAGRAM

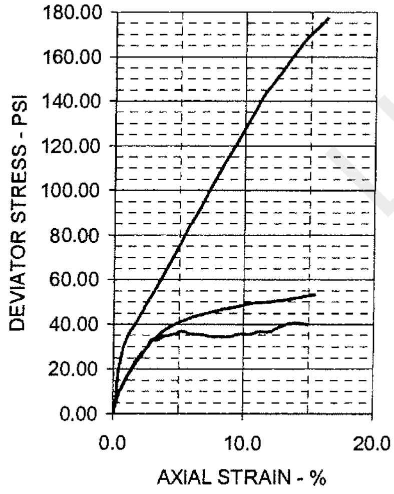
EFFECTIVE STRESS PARAMETERS	R^2 = 0.99	α (deg) = 29.5	a (psi) = 0.7
PROJECT: Luminant East Ash Disposal		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 2972 - 08		ETTL ENGINEERS & CONSULTANTS	PLATE: B.2
DESCRIPTION: Gray, Tan & Redd. Br Sandy Clay w/ some Gravel			

G 2972-08, B-2, 8'-20' Native

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 25.2 deg	c = 3.1 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	16.6	16.0	11.8	
Dry Density - pcf	112.3	112.1	122.3	
Diameter - inches	2.08	2.08	2.11	
Height - inches	4.25	4.40	4.62	
AT TEST				
Final Moisture - %	19.4	18.1	13.5	
Dry Density - pcf	112.6	115.3	124.9	
Calculated Diameter (in.)	2.08	2.07	2.10	
Height - inches	4.24	4.37	4.58	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	28.02	34.65	70.28	
Total Pore Pressure - psi	51.8	56.1	64.6	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	2.4	3.4	4.6	
σ_1 Failure - psi	38.02	54.65	110.28	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Sample
DESCRIPTION: Gray, Tan & Redd. Br Sandy Clay w/ some Gravel
Sampled on Site, B-2 8' to 20' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
Movember 2008

ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

PROJECT INFORMATION

PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
Movember 2008

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

THIS COPY LICENSED TO:
ETTL ENGINEERS AND CONSULTANTS, INC.
1717 East Erwin
Tyler, TX 75702

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Possible Fill Sample
DESCRIPTION: Tan & Red Sandy Lean Clay w/ Roots
Sampled on Site, B-1 3' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

PLATE: B.1

PLATE: B.2

PLATE: B.3

Number of Specimens = 3

SPECIMEN DATA

SPECIMEN NO. 1

	initial		final		Diameter			Height		
Moist soil & Tare :	539.30	g	625.10	g	top	2.07	in	Ht 1	4.23	In
Dry soil and Tare :	482.00	g	548.00	g	mid	2.07	in	Ht 2	4.23	in
Tare :	127.40	g	126.90	g	bot	2.07	in	Ht 3	4.23	in
Moisture content :	16.16	%	18.31	%	Avg	2.07	in	Ht4	4.23	in
Weight:	493.2	g						Avg Ht	4.23	in

Change in Ht due to saturation :	0.02	in	Initial specimen vol :	233.31	cc
Change in Ht due to consolidation :	-0.006	in	At test specimen vol :	232.11	cc
Change in pipet vol due to consolidation :	3.2	cc	Initial dry density :	113.83	pcf
Saturation Parameter " B " = 0.97			At test dry density:	115.19	pcf

Strain Rate (in/min) = 0.0005
σ_1' Failure (psi) = 29.29
σ_3' Failure (psi) = 6.35
ΔU = 3.7
Failure Strain % = 1.4
σ_1 Failure (psi) = 32.94
σ_3 Failure (psi) = 10.00
Total Pore Pressure = 53.7
Effective Cell Pressure (psi) = 10.0
Estimated ν = 0.35
Back Pressure (psi) = 50.0
Cell Pressure (psi) = 60.0

SPECIMEN NO. 2

	initial		final		Diameter			Height		
Moist soil & Tare :	548.00	g	591.00	g	top	2.01	in	Ht 1	4.25	in
Dry soil and Tare :	492.70	g	519.10	g	mid	2.01	in	Ht 2	4.25	in
Tare :	136.60	g	124.60	g	bot	2.01	in	Ht 3	4.25	in
Moisture content :	15.53	%	18.23	%	Avg	2.01	in	Ht4	4.25	in
Weight:	462.2	g						Avg Ht	4.25	in

Change in Ht due to saturation :	-0.009	in	Initial specimen vol :	220.97	cc
Change in Ht due to consolidation :	-0.033	in	At test specimen vol :	216.07	cc
Change in pipet vol due to consolidation :	4.2	cc	Initial dry density :	115.06	pcf
Saturation Parameter " B " = 0.99			At test dry density:	116.27	pcf

Strain Rate (in/min) = 0.0005
σ_1' Failure (psi) = 40.52
σ_3' Failure (psi) = 14.53
ΔU = 5.5
Failure Strain % = 3.0
σ_1 Failure (psi) = 45.99
σ_3 Failure (psi) = 20.00
Total Pore Pressure = 55.5
Effective Cell Pressure (psi) = 20.0
Estimated ν = 0.35
Back Pressure (psi) = 50.0
Cell Pressure (psi) = 70.0

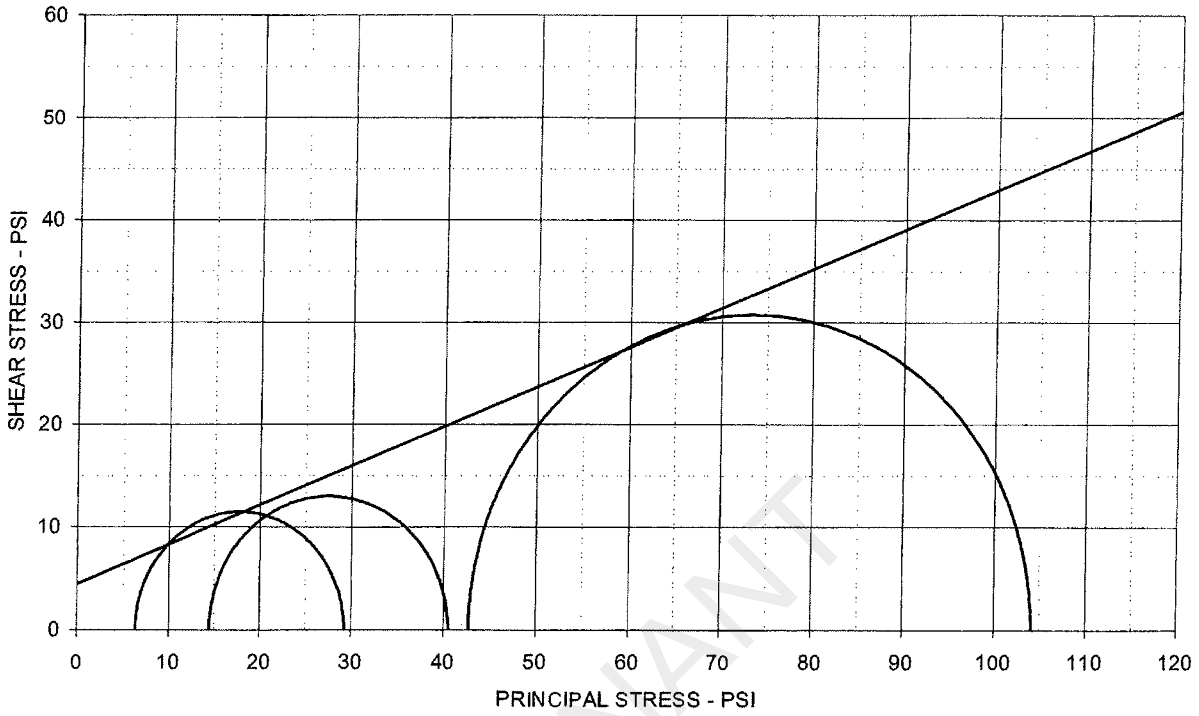
SPECIMEN NO. 3

	initial		final		Diameter			Height		
Moist soil & Tare :	431.00	g	628.40	g	top	2.10	in	Ht 1	4.28	in
Dry soil and Tare :	385.90	g	558.80	g	mid	2.10	in	Ht 2	4.28	in
Tare :	105.00	g	119.40	g	bot	2.10	in	Ht 3	4.28	in
Moisture content :	16.06	%	15.84	%	Avg	2.10	in	Ht4	4.28	in
Weight:	510.5	g						Avg Ht	4.28	in

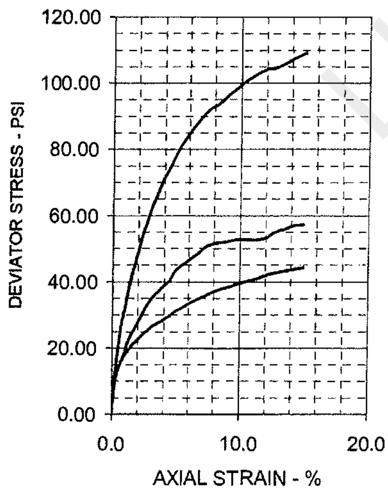
Change in Ht due to saturation :	-0.017	in	Initial specimen vol :	232.47	cc
Change in Ht due to consolidation :	-0.039	in	At test specimen vol :	227.61	cc
Change in pipet vol due to consolidation :	4.6	cc	Initial dry density :	113.24	pcf
Saturation Parameter " B " = 0.97			At test dry density:	116.27	pcf

Strain Rate (in/min) = 0.0005
σ_1' Failure (psi) = 104.13
σ_3' Failure (psi) = 42.71
ΔU = -2.7
Failure Strain % = 3.0
σ_1 Failure (psi) = 101.42
σ_3 Failure (psi) = 40.00
Total Pore Pressure = 47.3
Effective Cell Pressure (psi) = 40.0
Estimated ν = 0.35
Back Pressure (psi) = 50.0
Cell Pressure (psi) = 90.0

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	φ ' = 21.0 deg	c' = 4.5 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	16.2	15.5	16.1	
Dry Density - pcf	113.6	113.1	113.3	
Diameter - Inches	2.07	2.01	2.10	
Height - Inches	4.23	4.25	4.28	
AT TEST				
Final Moisture - %	18.3	18.2	15.8	
Dry Density - pcf	115.2	115.3	115.5	
Calculated Diameter (in.)	2.08	1.99	2.08	
Height - inches	4.24	4.21	4.22	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	22.94	25.99	61.42	
Total Pore Pressure - psi	53.7	55.5	47.3	
Strain Rate - Inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.4	3.0	3.0	
σ_1' Failure - psi	29.29	40.52	104.13	
σ_3' Failure - psi	6.35	14.53	42.71	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Possible Fill Sample
DESCRIPTION: Tan & Red Sandy Lean Clay w/ Roots
Sampled on Site, B-1 3' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

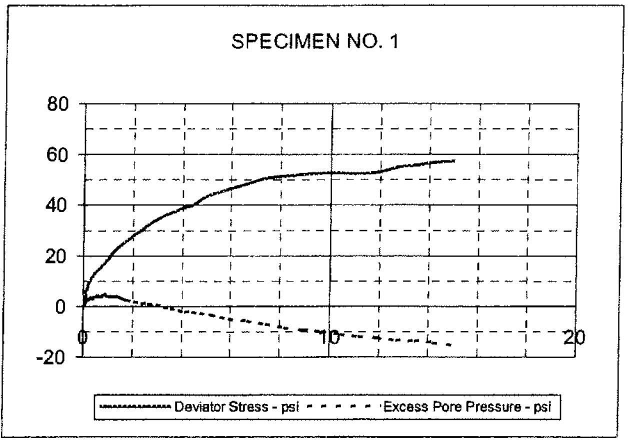
PROJECT INFORMATION

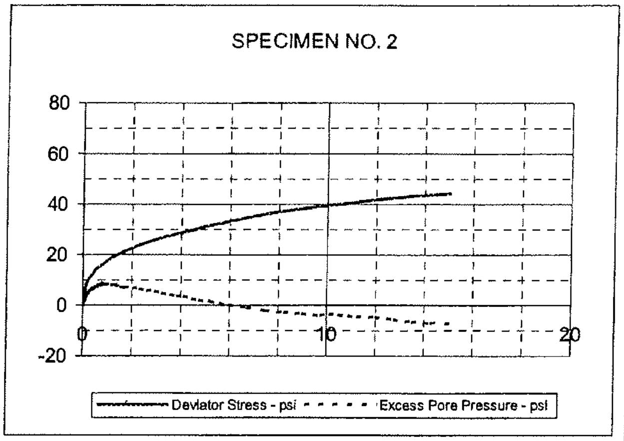
PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
Movember 2008

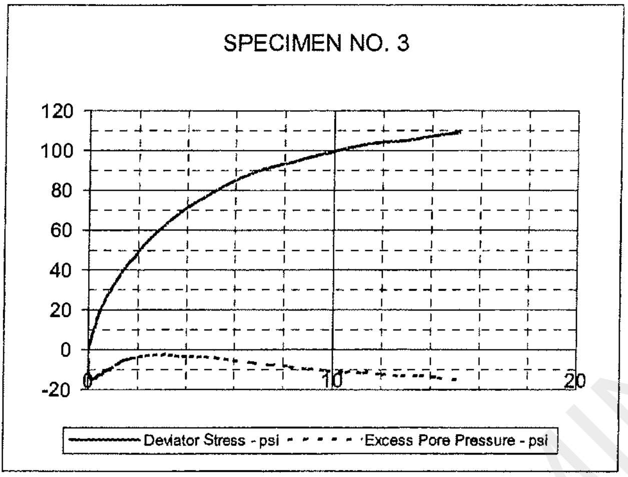
ETTL ENGINEERS & CONSULTANTS

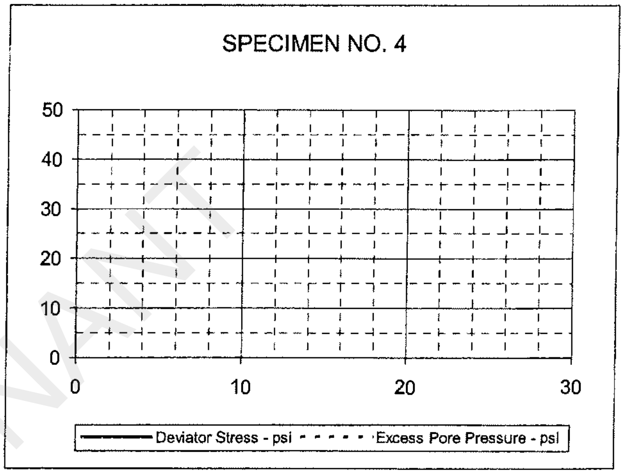
PLATE: B.1

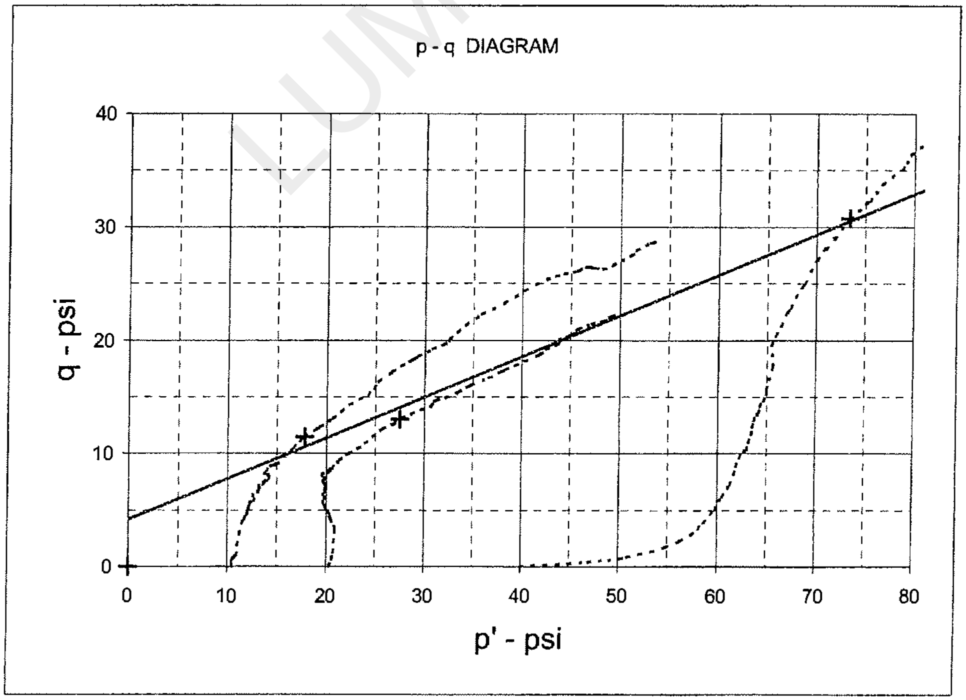
G 2972-08, B-1, 3'-10' Fill







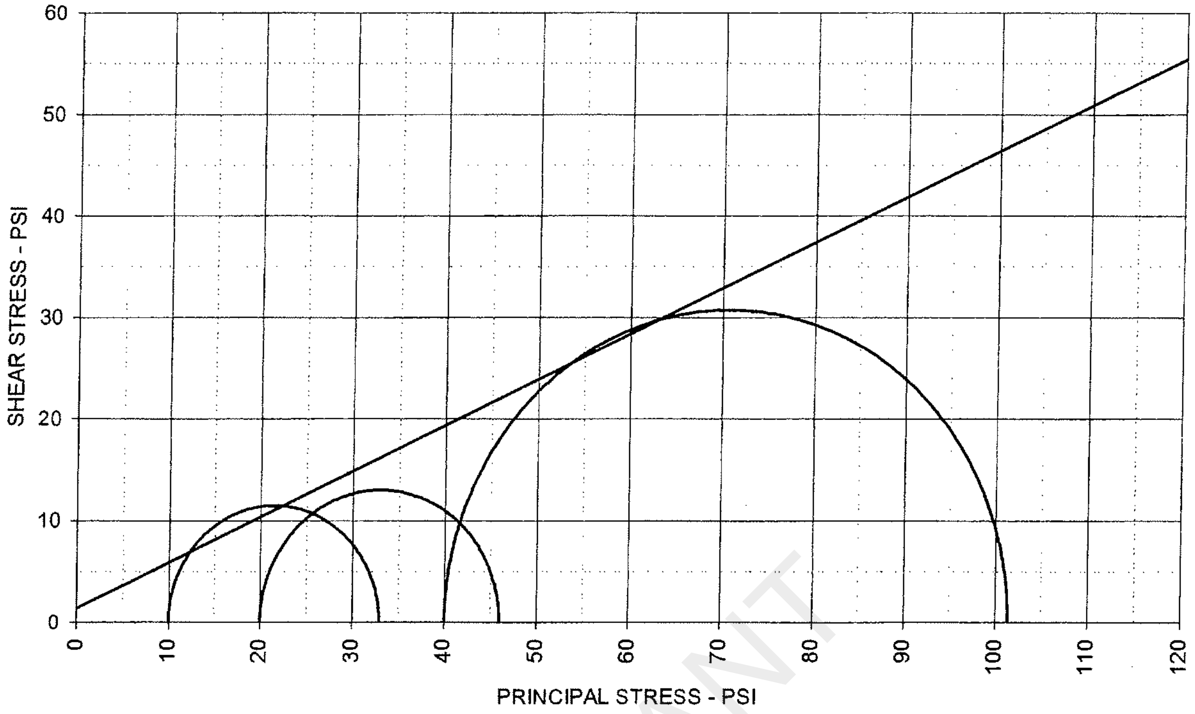




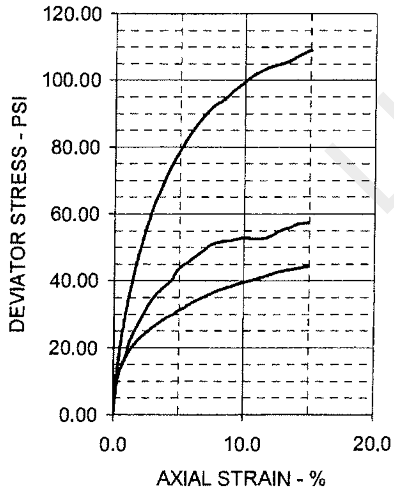
EFFECTIVE STRESS PARAMETERS	R^2 = 0.99	α (deg) = 19.7	a (psi) = 4.2
PROJECT: Luminant East Ash Disposal		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 2972 - 08		ETTL ENGINEERS & CONSULTANTS	PLATE: B.2
DESCRIPTION: Tan & Red Sandy Lean Clay w/ Roots			

G 2972-08, B-1, 3'-10' Fill

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 24.2 deg	c = 1.4 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	16.2	15.5	16.1	
Dry Density - pcf	113.6	113.1	113.3	
Diameter - inches	2.07	2.01	2.10	
Height - inches	4.23	4.25	4.28	
AT TEST				
Final Moisture - %	18.3	18.2	15.8	
Dry Density - pcf	115.2	115.3	115.5	
Calculated Diameter (in.)	2.08	1.99	2.08	
Height - Inches	4.24	4.21	4.22	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	22.94	25.99	61.42	
Total Pore Pressure - psi	53.7	55.5	47.3	
Strain Rate - Inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.4	3.0	3.0	
σ_1 Failure - psi	32.94	45.99	101.42	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Possible Fill Sample
DESCRIPTION: Tan & Red Sandy Lean Clay w/ Roots
Sampled on Site, B-1 3' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
Movember 2008

ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

PERMANENT DISPOSAL POND - 5

HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT: Luminant Martin Lake, PDP 1-3
CLIENT: TXU
CONTRACTOR: not given
JOB No. : **G 2810 - 08**

REPORT No.:
DATE SAMPLED: February 2008
SAMPLED BY: ETTL Drill Crew
LOCATION: MLSES
SAMPLE No. :
DESCRIPTION: Gray & Dark Gray Bottom Ash
TECHNICIAN: M. Thompson
DATE: 04/15/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**47.69**
% Retain	+0.05 mm	**99.26**
% Passing	0.05 to 2.0 mm	**51.57**
% Passing	0.002 to 0.05 mm	**0.72**
% Passing	> 0.002 mm	**0.02**

WEIGHT OF SAMPLE (AIR DRY)	100.00
WEIGHT OF SAMPLE (OVEN DRY)	99.90
PERCENT RETAINED ON # 10	47.69
SPECIFIC GRAVITY	2.563

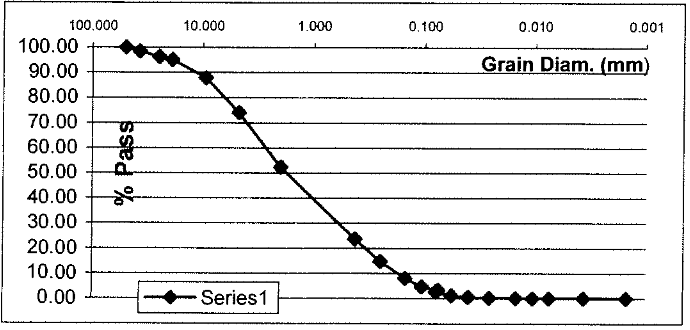
Mc Hydrom	
Tare Wt	29.89
Wet Wt.	68.94
Dry Wt	68.90
MC	0.1025%

SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	54.66	76.31	0.425	23.69
60	71.63	85.20	0.250	14.80
100	84.45	91.91	0.150	8.09
140	90.93	95.30	0.105	4.70
200	93.54	96.67	0.075	3.33

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
21.5	5.7	11.0	5.3	15.5	0.0141	1.02	0.5	0.0787	2.82
21.5	5.7	8.0	2.3	16	0.0141	1.02	1	0.0566	1.21
21.5	5.7	6.8	1.1	16.1	0.0141	1.02	2	0.0401	0.57
21.5	5.7	6.2	0.5	16.3	0.0141	1.02	5	0.0255	0.25
21.5	5.7	6.0	0.3	16.3	0.0141	1.02	15	0.0147	0.15
21.5	5.7	5.8	0.1	16.3	0.0141	1.02	30	0.0104	0.04
21.5	5.7	5.8	0.1	16.3	0.0141	1.02	60	0.0074	0.04
21.5	5.7	5.8	0.1	16.3	0.0141	1.02	250	0.0036	0.04
22.0	5.6	5.6	0.0	16.3	0.0140	1.02	1440	0.0015	0.02

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	100	10	188.06	686.13	22.5	99.90	747.18	21.5	**2.563**

	Sieve Size	Grams Retain	% Pass
Sieve % Pass	2"	0.00	100.00
	1-1/2"	89.00	98.47
Air Dry Start Wt.:	1"	215.04	96.31
5836.8	3/4"	288.14	95.06
Dry Start Wt.:	3/8"	709.78	87.83
5830.82	No 4	1510.97	74.09
	No 10	2780.46	52.31



Remarks:

HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT:	Luminant Martin Lake, PDP 1-3
CLIENT:	TXU
CONTRACTOR:	not given
JOB No. :	**G 2810 - 08**

REPORT No.:	
DATE SAMPLED:	February 2008
SAMPLED BY:	ETTL Drill Crew
LOCATION:	B-9, 1'-3'
SAMPLE No. :	
DESCRIPTION:	Gray Ash (Cementing)
TECHNICIAN:	H. Walka
DATE:	03/14/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**0.08**
% Retain	+0.05 mm	**41.35**
% Passing	0.05 to 2.0 mm	**41.27**
% Passing	0.002 to 0.05 mm	**56.63**
% Passing	> 0.002 mm	**2.02**

WEIGHT OF SAMPLE (AIR DRY)	100.00
WEIGHT OF SAMPLE (OVEN DRY)	99.73
PERCENT RETAINED ON # 10	0.08
SPECIFIC GRAVITY	2.761

Mc Hydrom	
Tare Wt	29.50
Wet Wt.	62.41
Dry Wt	62.32
MC	0.2742%

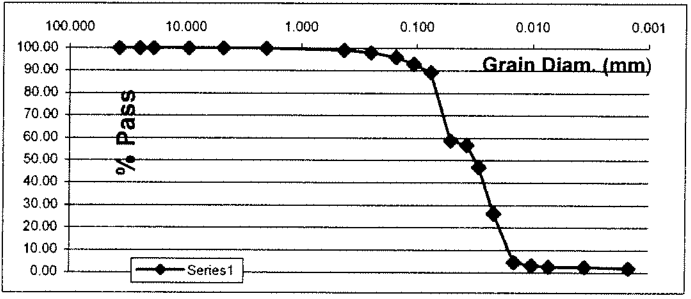
SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	0.92	1.00	0.425	99.00
60	1.92	2.00	0.250	98.00
100	3.90	3.99	0.150	96.01
140	7.07	7.16	0.105	92.84
200	10.67	10.77	0.075	89.23

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
23.0	5.2	65.0	59.8	6.6	0.0138	0.98	0.5	0.0502	58.67
23.0	5.2	63.0	57.8	7	0.0138	0.98	1	0.0365	56.71
23.0	5.2	53.0	47.8	8.6	0.0138	0.98	2	0.0286	46.89
23.0	5.2	32.0	26.8	12	0.0138	0.98	5	0.0214	26.27
22.5	5.4	10.0	4.6	15.6	0.0140	0.98	15	0.0142	4.51
22.5	5.4	8.5	3.1	15.8	0.0140	0.98	30	0.0101	3.04
22.5	5.4	8.0	2.6	16	0.0140	0.98	60	0.0072	2.55
22.0	5.6	8.0	2.4	16	0.0140	0.98	250	0.0035	2.39
22.0	5.6	7.5	1.9	16.1	0.0140	0.98	1440	0.0015	1.90

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	50	7	179.97	678.12	22.5	49.86	709.93	22.5	**2.761**

	Sieve Size	Grams Retain	% Pass
Sieve % Pass	1-1/2"	0.00	100.00
Air Dry Start Wt.:	1"	0.00	100.00
334.9	3/4"	0.00	100.00
Dry Start Wt.:	3/8"	0.00	100.00
333.98	No 4	0.00	100.00
	No 10	0.26	99.92

Remarks:



HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT: Luminant Martin Lake, PDP 1-3
CLIENT: TXU
CONTRACTOR: not given
JOB No. : **G 2810 - 08**

REPORT No.:
DATE SAMPLED: February 2008
SAMPLED BY: ETTL Drill Crew
LOCATION: B-7, 13'-15'
SAMPLE No. :
DESCRIPTION: Gray Ash
TECHNICIAN: H. Walka
DATE: 03/14/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**59.89**
% Retain	+0.05 mm	**92.28**
% Passing	0.05 to 2.0 mm	**32.39**
% Passing	0.002 to 0.05 mm	**4.63**
% Passing	> 0.002 mm	**3.09**

WEIGHT OF SAMPLE (AIR DRY)	50.00
WEIGHT OF SAMPLE (OVEN DRY)	49.81
PERCENT RETAINED ON # 10	59.89
SPECIFIC GRAVITY	2.655

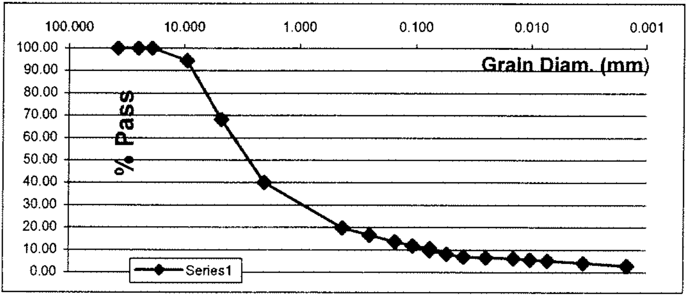
Mc Hydrom	
Tare Wt	30.03
Wet Wt.	45.86
Dry Wt	45.80
MC	0.3805%

SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	25.25	80.22	0.425	19.78
60	29.25	83.44	0.250	16.56
100	32.74	86.25	0.150	13.75
140	35.11	88.16	0.105	11.84
200	36.67	89.42	0.075	10.58

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
22.0	5.6	17.5	11.9	14.5	0.0140	1.00	0.5	0.0752	9.61
22.0	5.6	15.5	9.9	14.8	0.0140	1.00	1	0.0537	8.00
22.0	5.6	14.0	8.4	15	0.0140	1.00	2	0.0383	6.79
22.0	5.6	13.5	7.9	15.2	0.0140	1.00	5	0.0244	6.39
22.0	5.6	13.0	7.4	15.2	0.0140	1.00	15	0.0141	5.99
21.5	5.7	12.5	6.8	15.3	0.0141	1.00	30	0.0101	5.46
21.5	5.7	12.0	6.3	15.3	0.0141	1.00	60	0.0071	5.05
22.0	5.6	10.5	4.9	15.6	0.0140	1.00	250	0.0035	3.97
22.0	5.6	9.0	3.4	15.8	0.0140	1.00	1440	0.0015	2.77

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	25	4	179.25	677.26	22.5	24.91	692.79	22.5	**2.655**

	Sieve Size	Grams Retain	% Pass
Sieve % Pass	1-1/2"	0.00	100.00
Air Dry Start Wt.:	1"	0.00	100.00
243.3	3/4"	0.00	100.00
Dry Start Wt.:	3/8"	13.45	94.47
242.38	No 4	77.42	68.18
	No 10	145.71	40.11



Remarks:

HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT:	Luminant Martin Lake, PDP 1-3
CLIENT:	TXU
CONTRACTOR:	not given
JOB No. :	**G 2810 - 08**
REPORT No.:	
DATE SAMPLED:	February 2008
SAMPLED BY:	ETTL Drill Crew
LOCATION:	B-6, 18'-20'
SAMPLE No. :	
DESCRIPTION:	Tan Ash
TECHNICIAN:	H. Walka
DATE:	03/14/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**10.97**
% Retain	+0.05 mm	**18.74**
% Passing	0.05 to 2.0 mm	**7.77**
% Passing	0.002 to 0.05 mm	**77.39**
% Passing	> 0.002 mm	**3.87**

WEIGHT OF SAMPLE (AIR DRY)	50.00
WEIGHT OF SAMPLE (OVEN DRY)	49.81
PERCENT RETAINED ON # 10	10.97
SPECIFIC GRAVITY	2.732

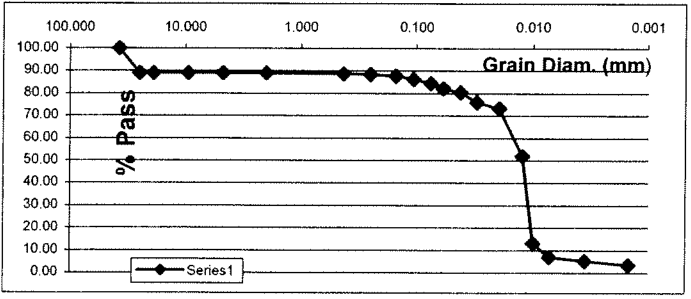
Mc Hydrom	
Tare Wt	29.86
Wet Wt.	51.33
Dry Wt	51.25
MC	0.3740%

SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	0.26	11.44	0.425	88.56
60	0.42	11.72	0.250	88.28
100	0.78	12.36	0.150	87.64
140	1.61	13.85	0.105	86.15
200	2.62	15.65	0.075	84.35

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
22.0	5.6	52.0	46.4	8.8	0.0140	0.99	0.5	0.0586	82.16
22.0	5.6	51.0	45.4	8.9	0.0140	0.99	1	0.0417	80.39
22.0	5.6	48.5	42.9	9.4	0.0140	0.99	2	0.0303	75.97
22.0	5.6	47.0	41.4	9.6	0.0140	0.99	5	0.0194	73.31
22.0	5.6	35.0	29.4	11.5	0.0140	0.99	15	0.0122	52.08
22.0	5.6	13.0	7.4	15.2	0.0140	0.99	30	0.0099	13.15
22.0	5.6	9.5	3.9	15.8	0.0140	0.99	60	0.0072	6.96
22.0	5.6	8.5	2.9	16	0.0140	0.99	250	0.0035	5.19
22.0	5.6	7.5	1.9	16.1	0.0140	0.99	1440	0.0015	3.42

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	50	3	179.93	678.11	22.5	49.81	709.70	22.5	**2.732**

	Sieve Size	Grams Retain	% Pass
Sieve % Pass	1-1/2"	0.00	100.00
Air Dry Start Wt.:	1"	28.83	89.03
262.8	3/4"	28.83	89.03
Dry Start Wt.:	3/8"	28.83	89.03
261.82	No 4	28.83	89.03
	No 10	28.83	89.03



Remarks:

HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT: Luminant Martin Lake, PDP 1-3
CLIENT: TXU
CONTRACTOR: not given
JOB No. : **G 2810 - 08**

REPORT No.:
DATE SAMPLED: February 2008
SAMPLED BY: ETTL Drill Crew
LOCATION: B-3, 5'-7'
SAMPLE No. :
DESCRIPTION: Black Ash
TECHNICIAN: H. Walka
DATE: 03/06/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**11.60**
% Retain	+0.05 mm	**76.50**
% Passing	0.05 to 2.0 mm	**64.91**
% Passing	0.002 to 0.05 mm	**21.88**
% Passing	> 0.002 mm	**1.62**

WEIGHT OF SAMPLE (AIR DRY)	50.00
WEIGHT OF SAMPLE (OVEN DRY)	49.53
PERCENT RETAINED ON # 10	11.60
SPECIFIC GRAVITY	2.561

	Mc Hydrom
Tare Wt	29.43
Wet Wt.	65.41
Dry Wt	65.07
MC	0.9540%

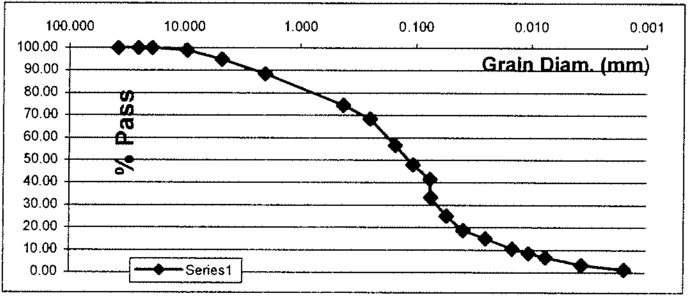
SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	7.81	25.54	0.425	74.46
60	11.21	31.61	0.250	68.39
100	17.82	43.41	0.150	56.59
140	22.64	52.01	0.105	47.99
200	26.25	58.45	0.075	41.55

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
20.0	6.2	24.5	18.3	13.3	0.0143	1.02	0.5	0.0738	33.31
20.0	6.2	20.0	13.8	14.2	0.0143	1.02	1	0.0539	25.11
20.0	6.2	16.5	10.3	14.7	0.0143	1.02	2	0.0388	18.74
20.0	6.2	14.5	8.3	15	0.0143	1.02	5	0.0248	15.10
20.0	6.2	12.0	5.8	15.5	0.0143	1.02	15	0.0145	10.55
19.5	6.4	11.0	4.6	15.6	0.0145	1.02	30	0.0104	8.44
19.5	6.4	10.0	3.6	15.8	0.0145	1.02	60	0.0074	6.62
20.0	6.2	8.0	1.8	16.1	0.0143	1.02	250	0.0036	3.27
19.5	6.4	7.0	0.6	16.3	0.0145	1.02	1440	0.0015	1.15

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	100	7	179.97	678.12	22.5	99.06	738.67	21.0	**2.561**

	Sieve Size	Grams Retain	% Pass
Sieve % Pass	1-1/2"	0.00	100.00
Air Dry Start Wt.:	1"	0.00	100.00
335.3	3/4"	0.00	100.00
Dry Start Wt.:	3/8"	3.42	98.98
332.13	No 4	17.17	94.88
	No 10	38.89	88.40

Remarks:



HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT: Luminant Martin Lake, PDP 1-3
CLIENT: TXU
CONTRACTOR: not given
JOB No. : **G 2810 - 08**

REPORT No.:
DATE SAMPLED: February 2008
SAMPLED BY: ETTL Drill Crew
LOCATION: B-2, 23'-25'
SAMPLE No. :
DESCRIPTION: Light Gray & Black Ash
TECHNICIAN: H. Walka
DATE: 03/06/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**0.76**
% Retain	+0.05 mm	**16.00**
% Passing	0.05 to 2.0 mm	**15.24**
% Passing	0.002 to 0.05 mm	**83.90**
% Passing	> 0.002 mm	**0.09**

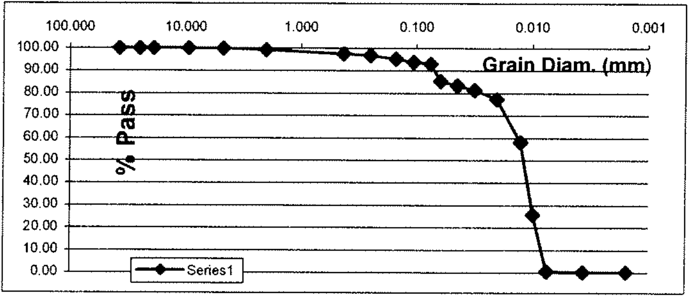
SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	0.89	2.56	0.425	97.44
60	1.22	3.22	0.250	96.78
100	2.01	4.82	0.150	95.18
140	2.67	6.15	0.105	93.85
200	3.07	6.96	0.075	93.04

			Mc Hydrom
WEIGHT OF SAMPLE (AIR DRY)	50.00	Tare Wt	29.91
WEIGHT OF SAMPLE (OVEN DRY)	49.16	Wet Wt.	55.02
PERCENT RETAINED ON # 10	0.76	Dry Wt	54.60
SPECIFIC GRAVITY	2.675	MC	1.7011%

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
20.0	6.2	48.5	42.3	9.4	0.0143	1.00	0.5	0.0620	85.37
20.0	6.2	47.5	41.3	9.6	0.0143	1.00	1	0.0443	83.35
20.0	6.2	46.5	40.3	9.7	0.0143	1.00	2	0.0315	81.33
20.0	6.2	44.5	38.3	10.1	0.0143	1.00	5	0.0203	77.30
20.0	6.2	35.0	28.8	11.7	0.0143	1.00	15	0.0126	58.12
20.0	6.2	19.0	12.8	14.3	0.0143	1.00	30	0.0099	25.83
20.0	6.2	6.5	0.3	16.3	0.0143	1.00	60	0.0075	0.59
20.0	6.2	6.3	0.1	16.3	0.0143	1.00	250	0.0037	0.19
19.5	6.4	6.4	0.0	16.3	0.0145	1.00	1440	0.0015	0.07

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	50	4	179.25	677.26	22.5	49.16	708.22	21.0	**2.675**

	Sieve Size	Grams Retain	% Pass
Sieve % Pass	1-1/2"	0.00	100.00
Air Dry Start Wt.:	1"	0.00	100.00
144.3	3/4"	0.00	100.00
Dry Start Wt.:	3/8"	0.00	100.00
141.89	No 4	0.10	99.93
	No 10	1.10	99.24



Remarks:

HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT:	Luminant Martin Lake, PDP 1-3
CLIENT:	TXU
CONTRACTOR:	not given
JOB No. :	**G 2810 - 08**
REPORT No.:	
DATE SAMPLED:	February 2008
SAMPLED BY:	ETTL Drill Crew
LOCATION:	B-1, 18'-20'
SAMPLE No. :	
DESCRIPTION:	Black, Tan & Gray Ash
TECHNICIAN:	H. Walka
DATE:	03/06/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**14.96**
% Retain	+0.05 mm	**64.42**
% Passing	0.05 to 2.0 mm	**49.46**
% Passing	0.002 to 0.05 mm	**35.29**
% Passing	> 0.002 mm	**0.29**

WEIGHT OF SAMPLE (AIR DRY)	50.00
WEIGHT OF SAMPLE (OVEN DRY)	49.29
PERCENT RETAINED ON # 10	14.96
SPECIFIC GRAVITY	2.608

Mc Hydrom	
Tare Wt	29.29
Wet Wt.	59.40
Dry Wt	58.97
MC	1.4488%

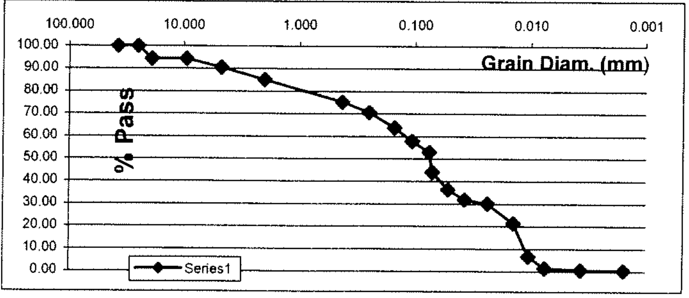
SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	5.76	24.90	0.425	75.10
60	8.38	29.42	0.250	70.58
100	12.31	36.20	0.150	63.80
140	15.78	42.19	0.105	57.81
200	18.60	47.05	0.075	52.95

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
20.0	6.2	31.5	25.3	12.2	0.0143	1.01	0.5	0.0707	44.08
20.0	6.2	27.0	20.8	13	0.0143	1.01	1	0.0516	36.24
20.0	6.2	24.5	18.3	13.3	0.0143	1.01	2	0.0369	31.88
20.0	6.2	23.5	17.3	13.5	0.0143	1.01	5	0.0235	30.14
20.0	6.2	18.5	12.3	14.3	0.0143	1.01	15	0.0140	21.43
20.0	6.2	10.0	3.8	15.8	0.0143	1.01	30	0.0104	6.61
20.0	6.2	7.0	0.8	16.3	0.0143	1.01	60	0.0075	1.38
20.0	6.2	6.5	0.3	16.3	0.0143	1.01	250	0.0037	0.51
19.5	6.4	6.5	0.1	16.3	0.0145	1.01	1440	0.0015	0.23

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	100	3	179.93	678.11	22.5	98.57	739.11	20.5	**2.608**

	Sieve Size	Grams Retain	% Pass
Sieve % Pass	1-1/2"	0.00	100.00
Air Dry Start Wt.:	1"	0.00	100.00
268.4	3/4"	15.10	94.37
Dry Start Wt.:	3/8"	15.10	94.37
264.57	No 4	25.58	90.47
	No 10	40.15	85.04

Remarks:



HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT:	Luminant Martin Lake, PDP 1-3
CLIENT:	TXU
CONTRACTOR:	not given
JOB No. :	**G 2810 - 08**
REPORT No.:	
DATE SAMPLED:	February 2008
SAMPLED BY:	ETTL Drill Crew
LOCATION:	MLSES
SAMPLE No. :	
DESCRIPTION:	Tan & Gray Econimizet Ash
TECHNICIAN:	M. Thompson
DATE:	04/15/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**41.02**
% Retain	+0.05 mm	**95.89**
% Passing	0.05 to 2.0 mm	**54.87**
% Passing	0.002 to 0.05 mm	**3.55**
% Passing	> 0.002 mm	**0.55**

WEIGHT OF SAMPLE (AIR DRY)	50.00
WEIGHT OF SAMPLE (OVEN DRY)	49.98
PERCENT RETAINED ON # 10	41.02
SPECIFIC GRAVITY	2.670

Mc Hydrom	
Tare Wt	30.27
Wet Wt.	62.43
Dry Wt	62.42
MC	0.0311%

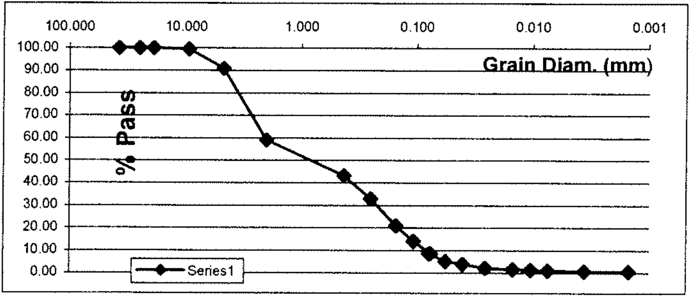
SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	13.34	56.76	0.425	43.24
60	22.12	67.12	0.250	32.88
100	32.26	79.09	0.150	20.91
140	38.01	85.87	0.105	14.13
200	42.66	91.36	0.075	8.64

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
21.5	5.7	13.0	7.3	15.2	0.0141	1.00	0.5	0.0780	8.58
21.5	5.7	10.0	4.3	15.6	0.0141	1.00	1	0.0558	5.04
21.5	5.7	9.0	3.3	15.8	0.0141	1.00	2	0.0397	3.86
21.5	5.7	7.5	1.8	16.1	0.0141	1.00	5	0.0254	2.09
21.5	5.7	7.0	1.3	16.1	0.0141	1.00	15	0.0146	1.50
21.5	5.7	6.8	1.1	16.1	0.0141	1.00	30	0.0104	1.27
21.5	5.7	6.5	0.8	16.3	0.0141	1.00	60	0.0074	0.91
21.5	5.7	6.3	0.6	16.3	0.0141	1.00	250	0.0036	0.68
22.0	5.6	6.0	0.4	16.3	0.0140	1.00	1440	0.0015	0.51

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	100	7	179.97	678.12	22.5	99.97	740.78	21.5	**2.670**

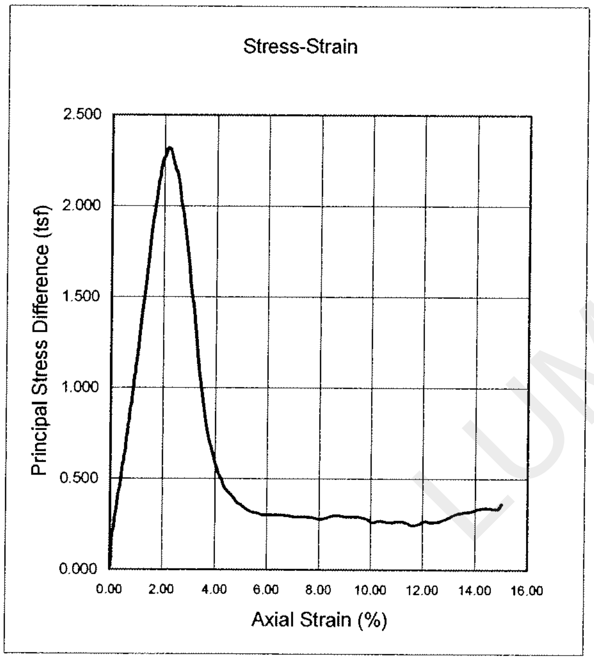
	Sieve Size	Grams Retain	% Pass
Sieve % Pass	1-1/2"	0.00	100.00
Air Dry Start Wt.:	1"	0.00	100.00
2182.9	3/4"	0.00	100.00
Dry Start Wt.:	3/8"	12.53	99.43
2182.22	No 4	200.01	90.83
	No 10	895.12	58.98

Remarks:



ASTM D 2850 Confined Compressive Strength of Cohesive Soil

Project: Luminant Martin Lake: PDP 1-3



Project No.:	G 2810-08	
Boring No.:	B-7	
Depth, ft.:	5'-7'	
Material:	Black Ash with Gravel	
Initial Height	5.706	Inches
Initial Diameter	2.767	Inches
Moisture Content:	22.9%	%
Dry Density:	97.5	lbs/cu ft
Specific Gravity (Assumed)	2.670	
Volume of Solids:	0.585	
Volume of Voids	0.415	
Void Ratio:	0.709	
Confining Pressure:	6.1	PSI
Pocket Penetr. Reading:	4.5	
Torvane (T)		
Rate of Strain: (%/ min)	1.0%	
Peak Strain:	**2.1**	%
Max Stress:	**2.32**	**TSF**
Date:	3/11/2008	

1/2 Stress (KSF) 2.321

Strain at 1/2 Stress (%) 0.99

Type of Specimen: Native

Remarks:

Secant Modulus (KSF) @ 1/2 Peak Stress 234

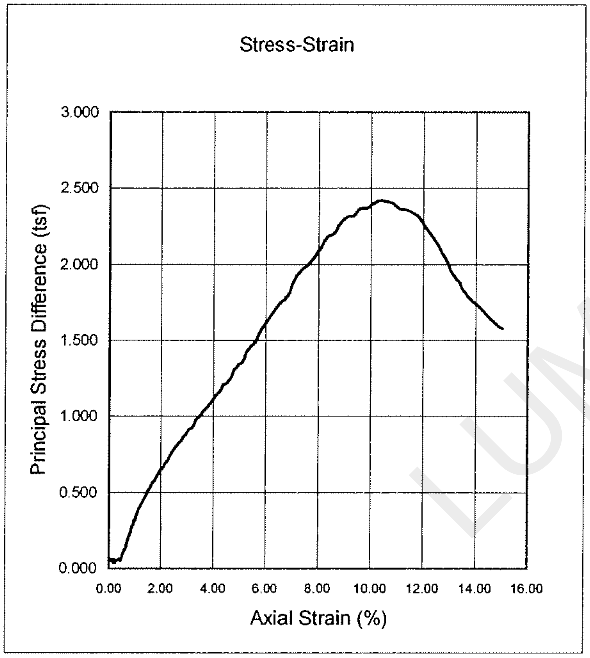
RQD Value: 100%

Angle of Fracture in Degrees: 65

Sketch of Fracture:

ASTM D 2850 Confined Compressive Strength of Cohesive Soil

Project: TXU PDP: Martin Lake, TX



Project No.: G 2810-08

Boring No.: B-4

Depth, ft.: 13'-15'

Material: Red & Gray Laminated Lean Clay

Initial Height 3.613 Inches

Initial Diameter 2.667 Inches

Moisture Content: 22.3% %

Dry Density: 99.4 lbs/cu ft

Specific Gravity (Assumed) 2.670

Volume of Solids: 0.596

Volume of Voids 0.404

Void Ratio: 0.677

Confining Pressure: 13 PSI

Pocket Penetr. Reading: 3.5

Torvane (T)

Rate of Strain: (%/ min) 1.0%

Peak Strain: **10.3** %

Max Stress: **2.42** **TSF**

Date: 5/12/2008

1/2 Stress (KSF) 2.416

Secant Modulus (KSF) @ 1/2 Peak Stress 61

Strain at 1/2 Stress (%) 3.94

RQD Value: 100%

Type of Specimen: Native

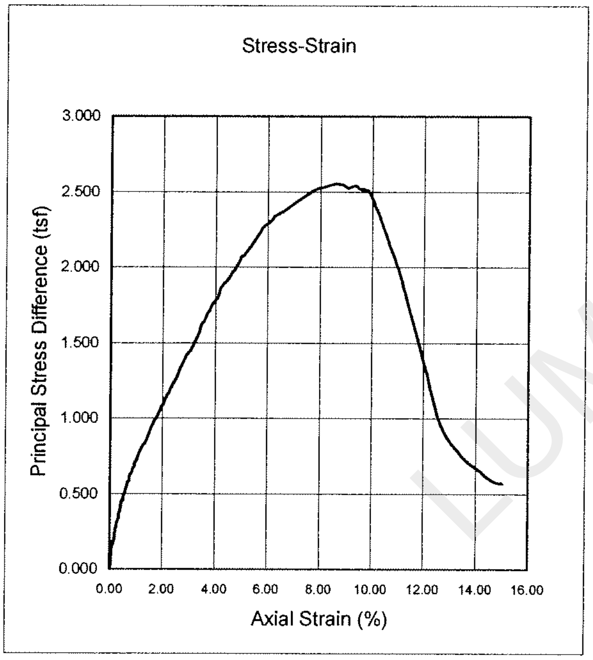
Angle of Fracture in Degrees: N/A

Remarks: undefined fracture

Sketch of Fracture:

ASTM D 2850 Confined Compressive Strength of Cohesive Soil

Project: Luminant Martin Lake: PDP 1-3



Project No.: G 2810-08

Boring No.: B-4

Depth, ft.: 13'-15'

Material: Light Gray & Red Slity Clayey Sand w/ Ferric seams

Initial Height 5.688 Inches

Initial Diameter 2.75 Inches

Moisture Content: 21.5% %

Dry Density: 104.6 lbs/cu ft

Specific Gravity (Assumed) 2.670

Volume of Solids: 0.628

Volume of Voids 0.372

Void Ratio: 0.593

Confining Pressure: 13 PSI

Pocket Penetr. Reading: 3.9

Torvane (T) 1.138

Rate of Strain: (%/ min) 1.0%

Peak Strain: **8.6** %

Max Stress: **2.55** **TSF**

Date: 4/11/2008

1/2 Stress (KSF) 2.552

Secant Modulus (KSF) @ 1/2 Peak Stress 100

Strain at 1/2 Stress (%) 2.54

RQD Value: 100%

Type of Specimen: Native

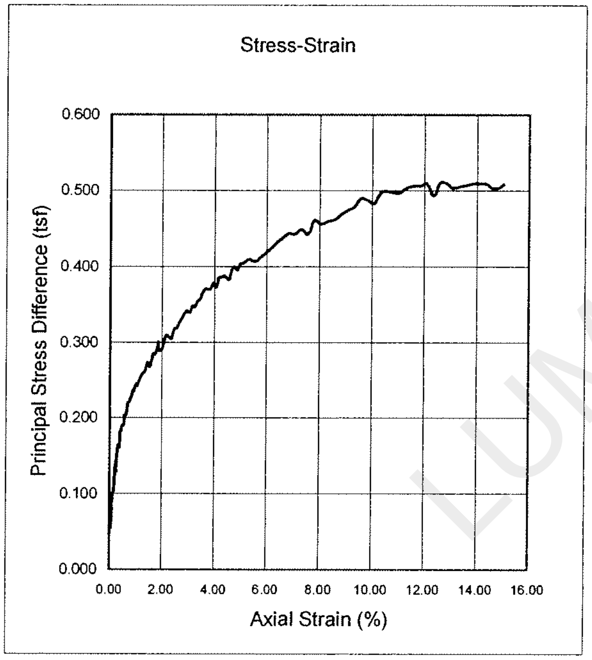
Angle of Break in Degrees: 60

Remarks:

Sketch of Fracture:

ASTM D 2850 Confined Compressive Strength of Cohesive Soil

Project: Luminant Martin Lake: PDP 1-3



Project No.:	G 2810-08	
Boring No.:	B-7	
Depth, ft.:	23'-25'	
Material:	Black, Red, Tan, & Gray Clay w/ gravel	
Initial Height	5.686	Inches
Initial Diameter	2.717	Inches
Moisture Content:	21.0%	%
Dry Density:	103.9	lbs/cu ft
Specific Gravity (Assumed)	2.670	
Volume of Solids:	0.624	
Volume of Voids	0.376	
Void Ratio:	0.603	
Confining Pressure:	21.7	PSI
Pocket Penetr. Reading:		
Torvane (T)		
Rate of Strain: (%/ min)	1.0%	
Peak Strain:	**12.8**	%
Max Stress:	**0.51**	**TSF**
Date:	3/11/2008	

1/2 Stress (KSF) 0.510

Secant Modulus (KSF) @ 1/2 Peak Stress 43

Strain at 1/2 Stress (%) 1.20

RQD Value: 100%

Type of Specimen: Native

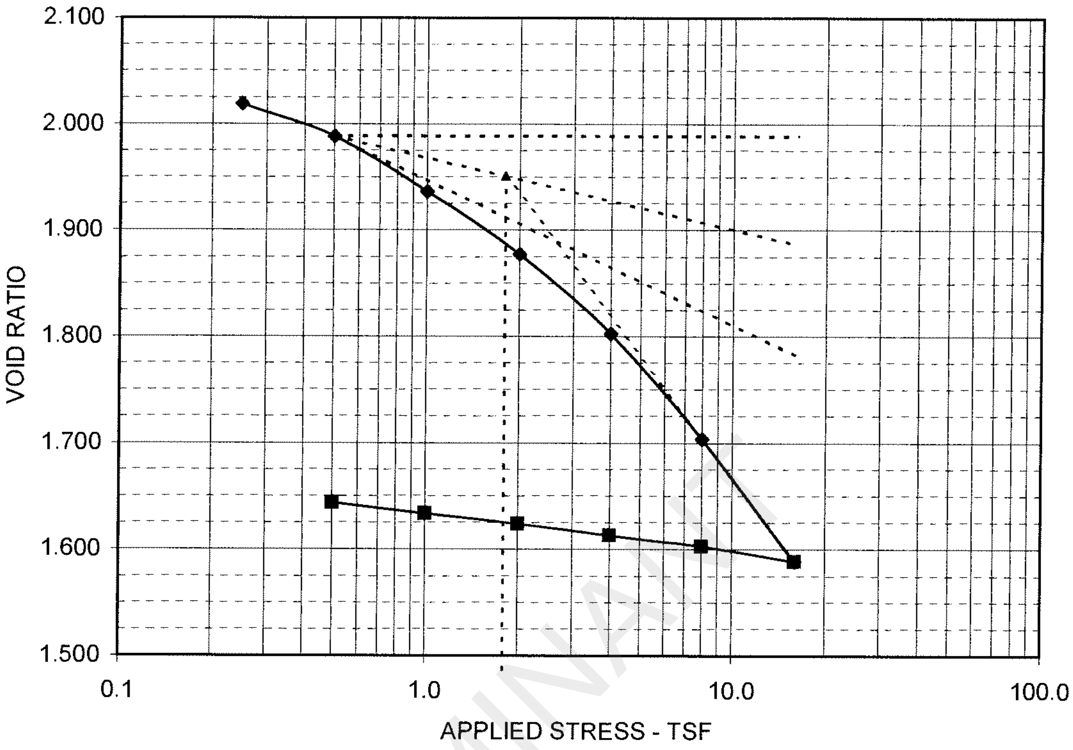
Angle of Break in Degrees: 53

Remarks: Not able to find a well defined fracture

Sketch of Fracture:

CONSOLIDATION TEST REPORT

ASTM D 2435



C_c = 0.381

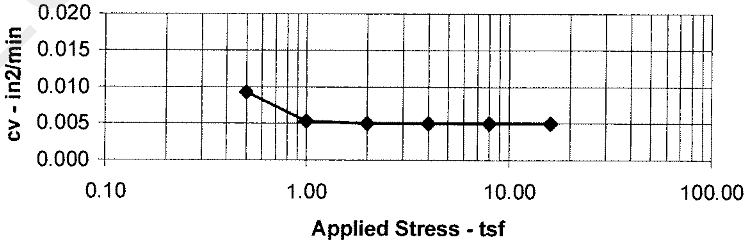
C_r = 0.033

e_0 = 2.0191

Pc (tsf) = 1.79

OCR = 10.2

LOAD tsf	c_v in^2/min	k in/min
Seating	NA	NA
0.50	9.34E-03	9.85E-07
1.00	5.36E-03	4.89E-07
2.00	5.03E-03	2.65E-07
4.00	5.04E-03	1.73E-07
8.00	5.03E-03	1.18E-07
16.00	5.03E-03	7.08E-08



c_v values calculated by Sivaram and Swamee's Method

SAMPLE AND TEST DATA

SAMPLE LOCATION: B-6, 3-5'
DESCRIPTION: Ash, black and dark gray

LL: NA PL: NA PI: NA -200:NA
ASSUMED SPECIFIC GRAVITY: 2.70
MC Initial: 58.1% MC Final: 47.2%
Dia. (in.) : 2.50 Height (in.) : 1.000
Initial Sat %: 70.2 Final Sat %: 100.0
DRY DENSITY (pcf): 55.8

PROJECT INFORMATION

PROJECT:	Luminant Martin Lake PDP 1-3
LOCATION:	Rusk, TX.
PROJECT NO.:	ETT08002-07
CLIENT:	ETTL Engineers & Consultants, Inc.
CLIENT NO.:	G2810-08
DATE:	4/24/2008

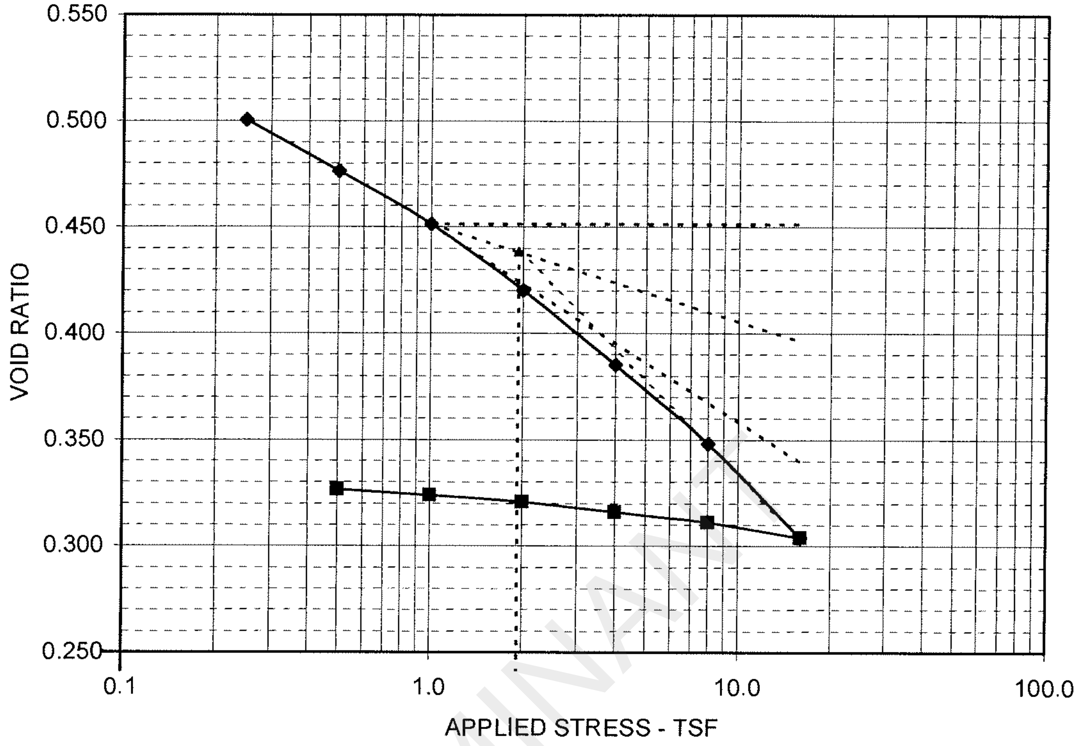
REMARKS: OCR calculated based on Pc and vertical overburden

GREGORY GEOTECHNICAL

PLATE B-CN.1

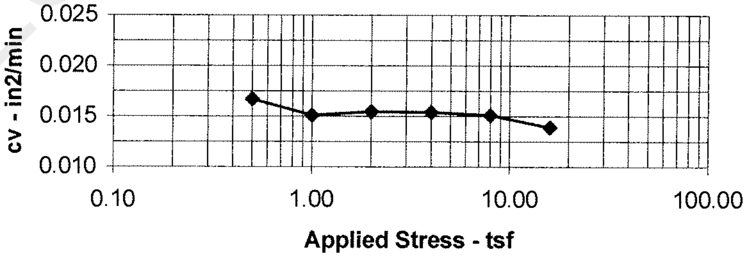
CONSOLIDATION TEST REPORT

ASTM D 2435



C_c = 0.146	C_r = 0.012	e_0 = 0.5597	**Pc (tsf) =** 1.93	**OCR =** 3.5

LOAD **tsf**	c_v in^2/min	**k** **in/min**
Seating	NA	NA
0.50	1.67E-02	2.82E-06
1.00	1.51E-02	1.33E-06
2.00	1.55E-02	8.75E-07
4.00	1.54E-02	5.00E-07
8.00	1.51E-02	2.67E-07
16.00	1.39E-02	1.50E-07



c_v values calculated by Sivaram and Swamee's Method

SAMPLE AND TEST DATA

SAMPLE LOCATION: B-4, 8-10'

DESCRIPTION: Clayey Sand , reddish brown with gray

LL: NA PL: NA PI: NA -200: NA

ASSUMED SPECIFIC GRAVITY: 2.70

MC Initial:	13.0%	MC Final:	19.6%
Dia. (in.) :	2.50	Height (in.) :	1.000
Initial Sat %:	70.2	Final Sat %:	100.0
DRY DENSITY (pcf):		108.0	

PROJECT INFORMATION

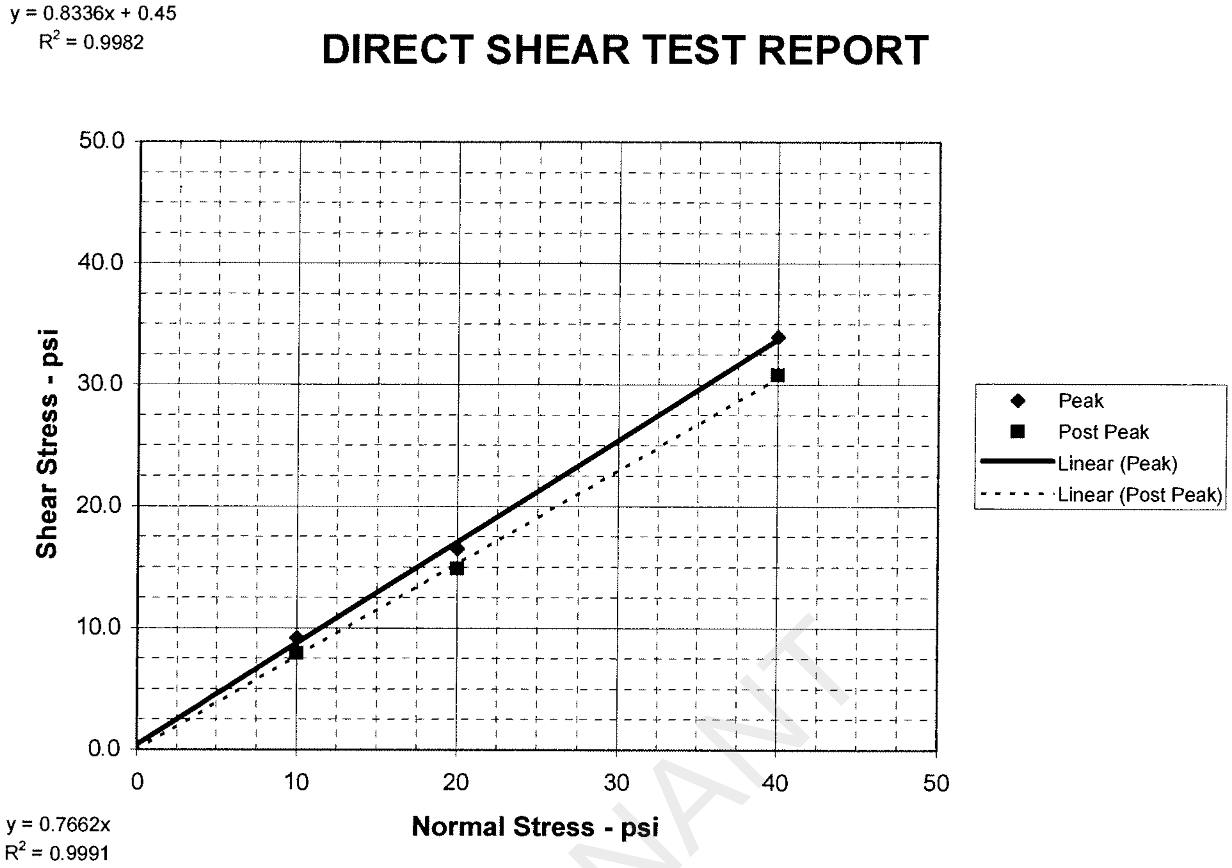
PROJECT:	Luminant Martin Lake PDP 1-3
LOCATION:	Rusk, TX.
PROJECT NO.:	ETT08002-07
CLIENT:	ETTL Engineers & Consultants, Inc.
CLIENT NO.:	G2810-08
DATE:	4/24/2008

REMARKS: OCR calculated based on Pc and vertical overburden

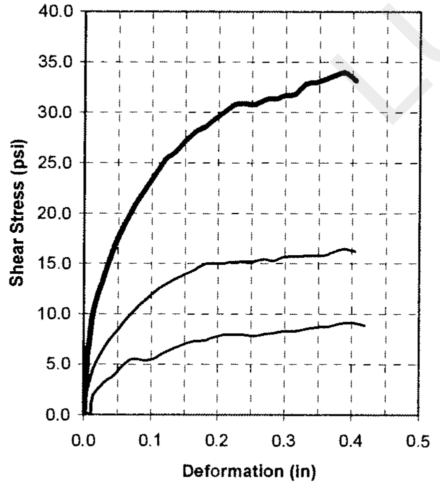
GREGORY GEOTECHNICAL

PLATE B-CN.2

DIRECT SHEAR TEST REPORT



PEAK STRENGTH PARAMETERS	ϕ =	39.8	deg	c =	0.5	psi
POST PEAK STRENGTH PARAMETERS	ϕ =	37.5	deg	c =	0.0	psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	52.1	29.3	21.2	
Dry Density - pcf	50.2	71.7	95.2	
Diameter - inches	2.50	2.50	2.50	
Height - inches	1.13	1.13	1.13	
AT TEST				
Final Moisture - %	64.3	25.0	31.6	
Dry Density - pcf	55.8	79.1	117.3	
Height-End of Consol. (in.)	1.02	1.03	0.92	
Height-End of Shear (in.)	0.97	0.99	0.89	
Normal Stress - psi	10.0	20.0	40.0	
Peak Failure Stress-psi	9.2	16.5	34.0	
Post Peak Failure Stress-psi	7.9	14.9	30.8	
Strain Rate - inches/min.	0.00300	0.00300	0.00300	
Peak Failure Strain - %	16.2	15.6	15.6	
Post Peak Failure Strain %	8.4	7.2	9.6	

Dry Density at test based on initial moisture and height at end of consolidation.

TEST DESCRIPTION

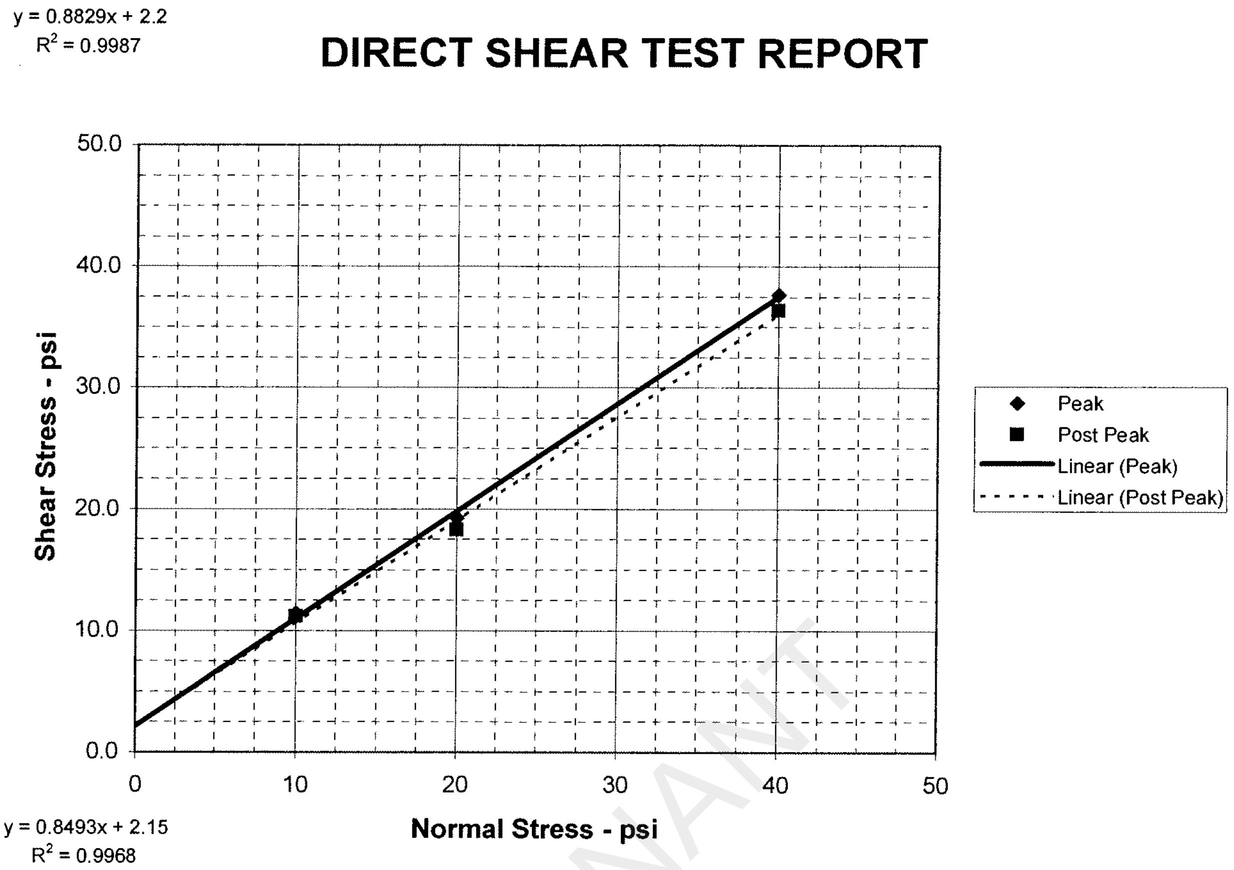
TYPE OF TEST & NO: CD-DS-1
SAMPLE TYPE: Shelby Tube
DESCRIPTION: Ash, black and gray
SAMPLE LOCATION: B-6, 3-5 ft
ASSUMED SPECIFIC GRAVITY: 2.65
LL: 35 PL: 19 PI: 16 Percent -200: 61
REMARKS: Multi-Specimen

PROJECT INFORMATION

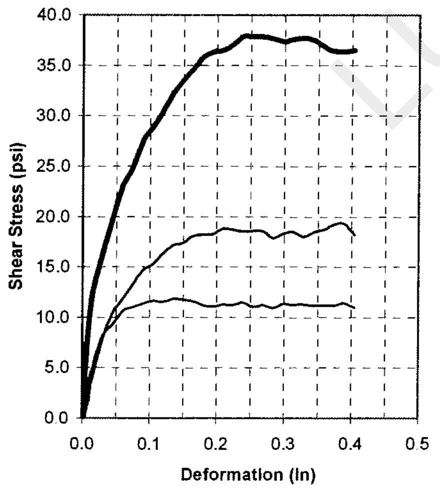
PROJECT: Luminant Martin Lake PDP 1-3
LOCATION: Rusk , TX
PROJECT NO: ETT08002-07 (G2810-08)
CLIENT : ETTL Engineers & Consultants, Inc
DATE:4/25/08

GREGORY GEOTECHNICAL PLATE: B-DS.1

DIRECT SHEAR TEST REPORT



PEAK STRENGTH PARAMETERS	ϕ = 41.4 deg	c = 2.2 psi
POST PEAK STRENGTH PARAMETERS	ϕ = 40.3 deg	c = 2.2 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	13.1	13.1	13.1	
Dry Density - pcf	71.8	71.7	71.7	
Diameter - inches	2.50	2.50	2.50	
Height - inches	1.00	1.00	1.00	
AT TEST				
Final Moisture - %	38.5	37.4	31.6	
Dry Density - pcf	73.6	73.7	75.8	
Height-End of Consol. (in.)	0.98	0.97	0.95	
Height-End of Shear (in.)	1.00	0.96	0.92	
Normal Stress - psi	10.0	20.0	40.0	
Peak Failure Stress-psi	11.4	19.3	37.7	
Post Peak Failure Stress-psi	11.2	18.3	36.4	
Strain Rate - inches/min.	0.00300	0.00300	0.00300	
Peak Failure Strain - %	15.6	15.6	13.2	
Post Peak Failure Strain %	13.8	12.0	15.0	

Dry Density at test based on initial moisture and height at end of consolidation.

TEST DESCRIPTION

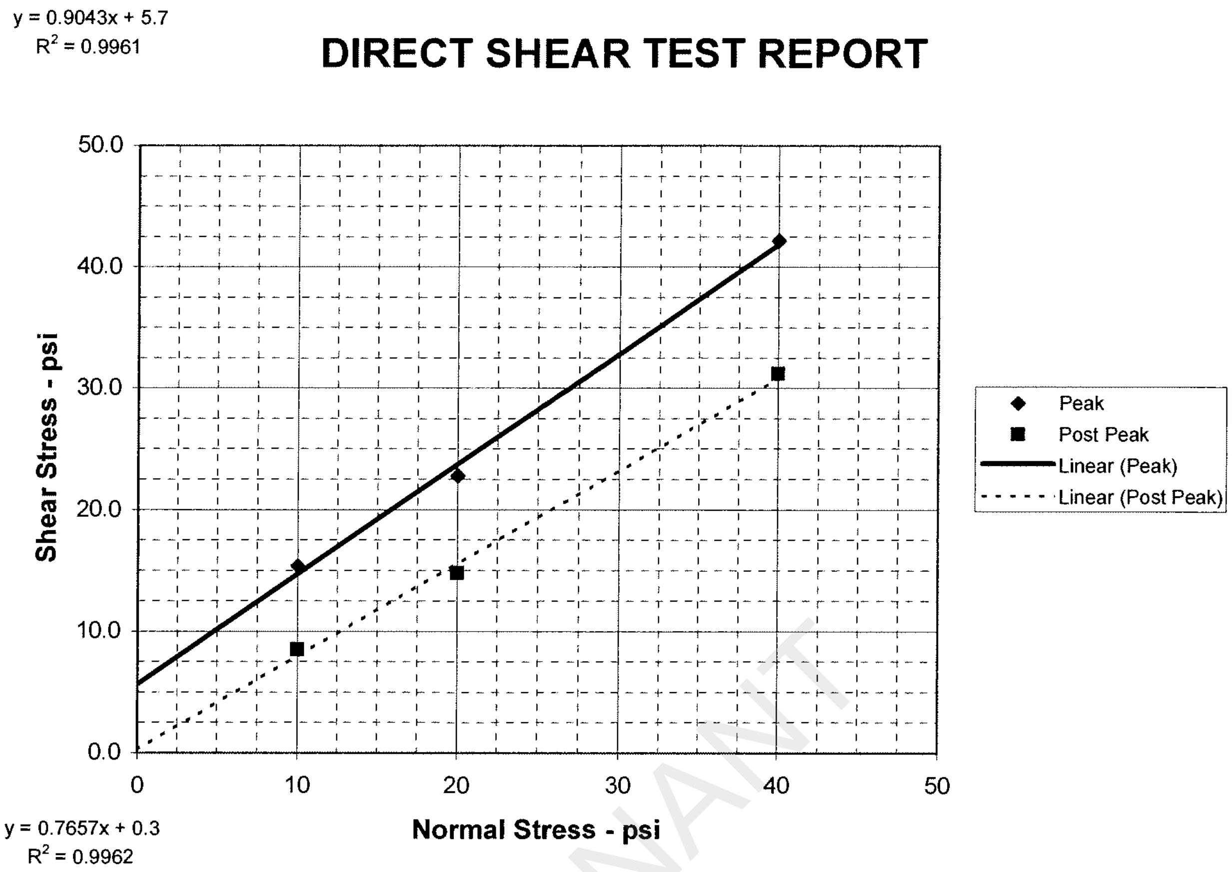
TYPE OF TEST & NO: CD-DS-2
SAMPLE TYPE: Re-Compacted
DESCRIPTION: Ash, black and dark gray
SAMPLE LOCATION: MLSES (Bulk)
SPECIFIC GRAVITY: 2.56
LL: NP PL: NP PI: NP Percent -200: 3.33
REMARKS: Multi-Specimen

PROJECT INFORMATION

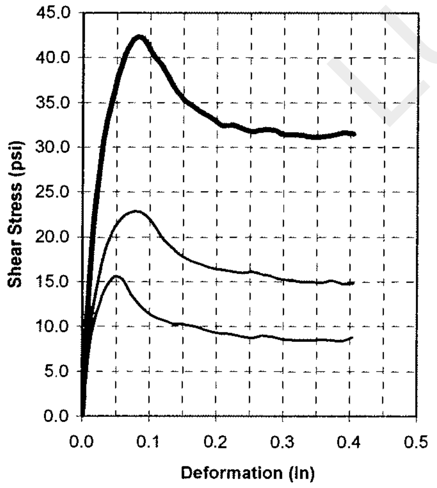
PROJECT: Luminant Martin Lake PDP 1-3
LOCATION: Rusk , TX
PROJECT NO: ETT08002-07 (G2810-08)
CLIENT : ETTL Engineers & Consultants, Inc
DATE:5/6/08

GREGORY GEOTECHNICAL PLATE: B-DS.2

DIRECT SHEAR TEST REPORT



PEAK STRENGTH PARAMETERS	ϕ =	42.1 deg	c =	5.7 psi
POST PEAK STRENGTH PARAMETERS	ϕ =	37.4 deg	c =	0.3 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	0.1	0.1	0.1	
Dry Density - pcf	71.7	71.7	71.7	
Diameter - inches	2.50	2.50	2.50	
Height - inches	1.00	1.00	1.00	
AT TEST				
Final Moisture - %	50.3	37.4	31.6	
Dry Density - pcf	73.4	73.1	73.1	
Height-End of Consol. (in.)	0.98	0.98	0.98	
Height-End of Shear (in.)	1.01	1.01	0.99	
Normal Stress - psi	10.0	20.0	40.0	
Peak Failure Stress-psi	15.4	22.8	42.2	
Post Peak Failure Stress-psi	8.5	14.8	31.2	
Strain Rate - inches/min.	0.00300	0.00300	0.00300	
Peak Failure Strain - %	17.6	3.0	3.6	
Post Peak Failure Strain %	15.0	15.6	13.8	

Dry Density at test based on initial moisture and height at end of consolidation.

TEST DESCRIPTION

TYPE OF TEST & NO: CD-DS-2
SAMPLE TYPE: Re-Compacted
DESCRIPTION: Economized Ash, tan and gray
SAMPLE LOCATION: MLSES (Bulk)
SPECIFIC GRAVITY: 2.67
LL: NP PL: NP PI: NP Percent -200: 8.64
REMARKS: Multi-Specimen

PROJECT INFORMATION

PROJECT: Luminant Martin Lake PDP 1-3
LOCATION: Rusk , TX
PROJECT NO: ETT08002-07 (G2810-08)
CLIENT : ETTL Engineers & Consultants, Inc
DATE:5/20/08

GREGORY GEOTECHNICAL PLATE: B-DS.3

PROJECT INFORMATION

PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

THIS COPY LICENSED TO:
ETTL ENGINEERS AND CONSULTANTS, INC.
1717 East Erwin
Tyler, TX 75702

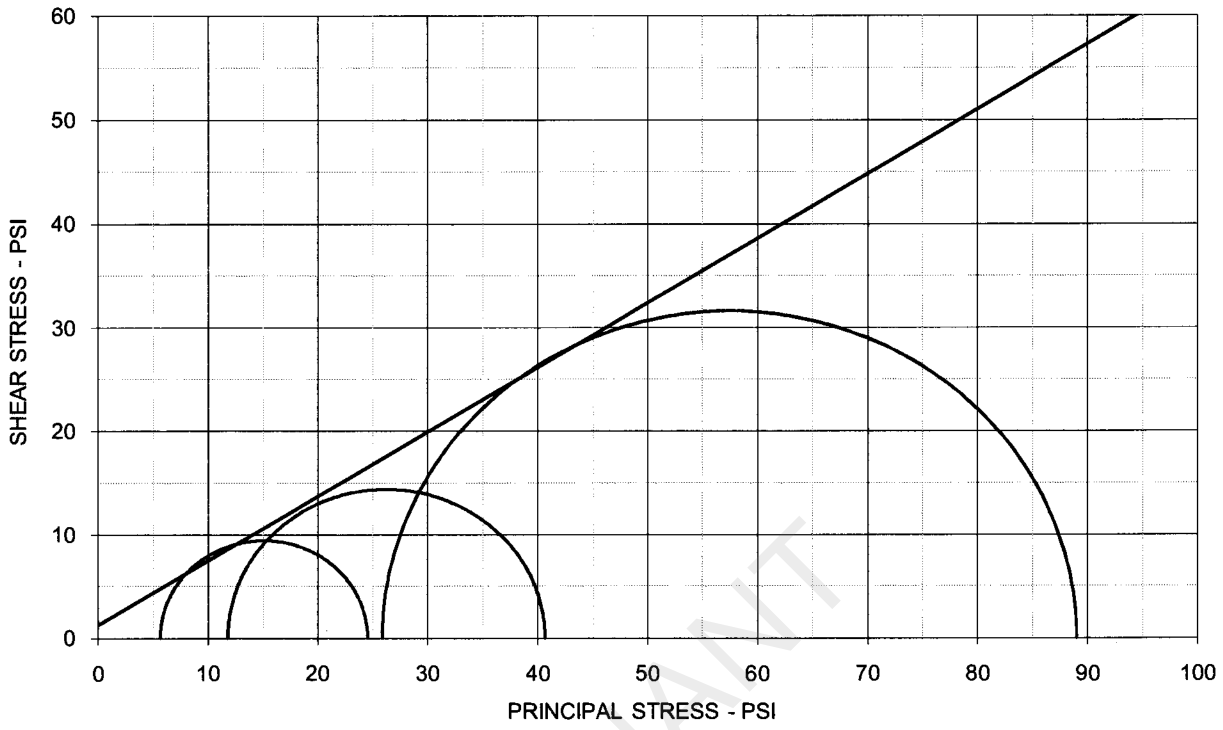
TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Shelby Tube Sample
DESCRIPTION: Tan w/ Red & Gray Clayey Sand
Sampled on Site, B-16 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

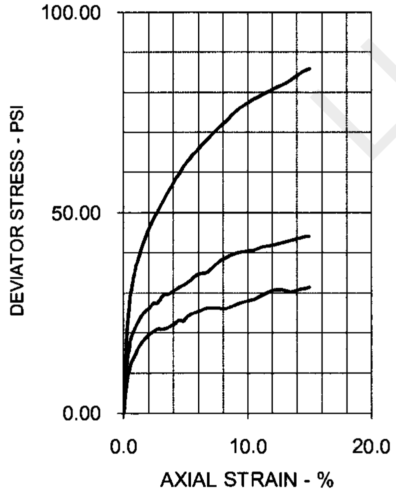
PLATE: B.1
PLATE: B.2
PLATE: B.3

Number of Specimens = 3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	φ ' =	31.9 deg	c' =	1.3 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	17.2	16.8	16.3	
Dry Density - pcf	112.6	114.4	115.0	
Diameter - inches	2.47	2.46	2.48	
Height - inches	4.98	4.97	5.00	
AT TEST				
Final Moisture - %	18.4	16.5	16.0	
Dry Density - pcf	113.1	115.3	116.9	
Calculated Diameter (in.)	2.47	2.46	2.50	
Height - inches	5.00	4.97	5.06	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	18.88	28.83	63.14	
Total Pore Pressure - psi	54.3	58.2	64.1	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.8	3.0	5.2	
σ_1' Failure - psi	24.54	40.64	89.01	
σ_3' Failure - psi	5.66	11.81	25.87	

TEST DESCRIPTION

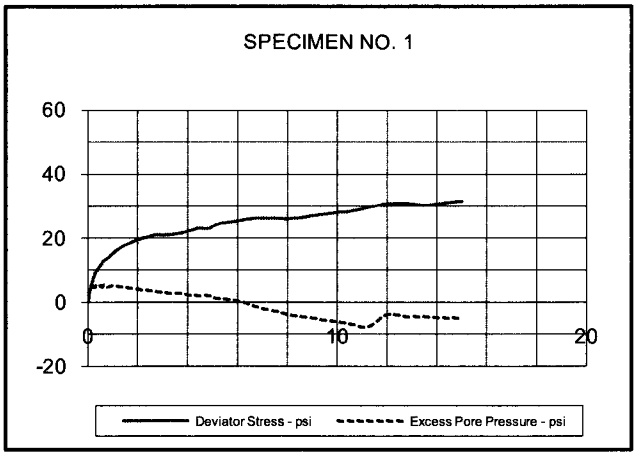
TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Shelby Tube Sample
DESCRIPTION: Tan w/ Red & Gray Clayey Sand
Sampled on Site, B-16 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

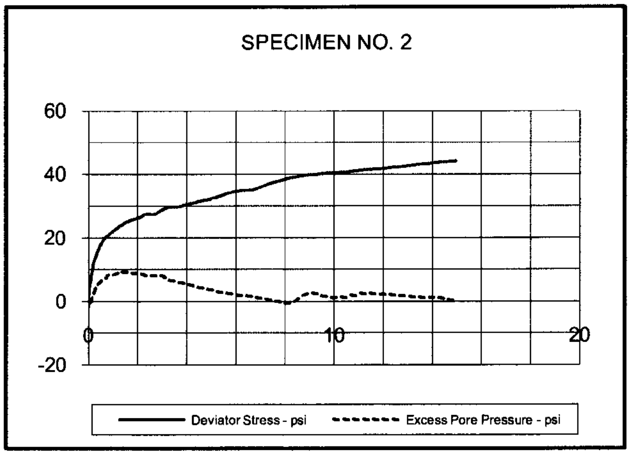
PROJECT INFORMATION

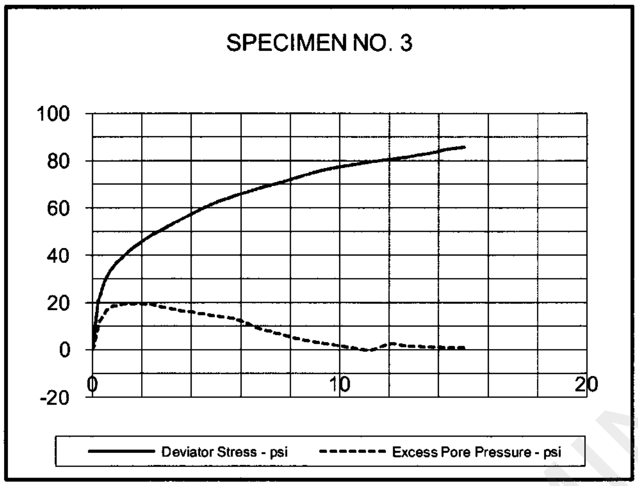
PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

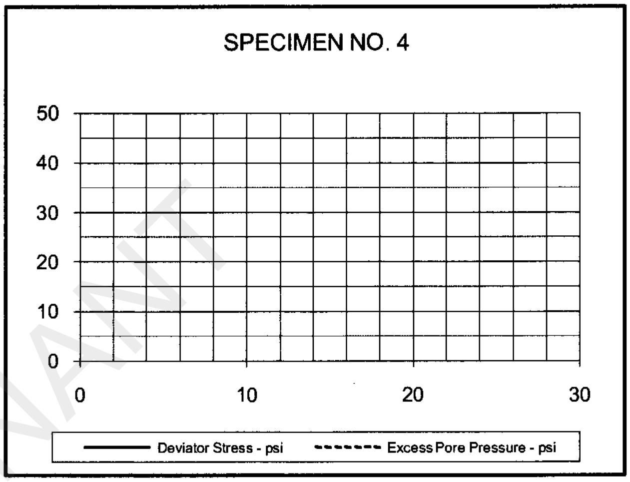
ETTL ENGINEERS & CONSULTANTS PLATE: B.1

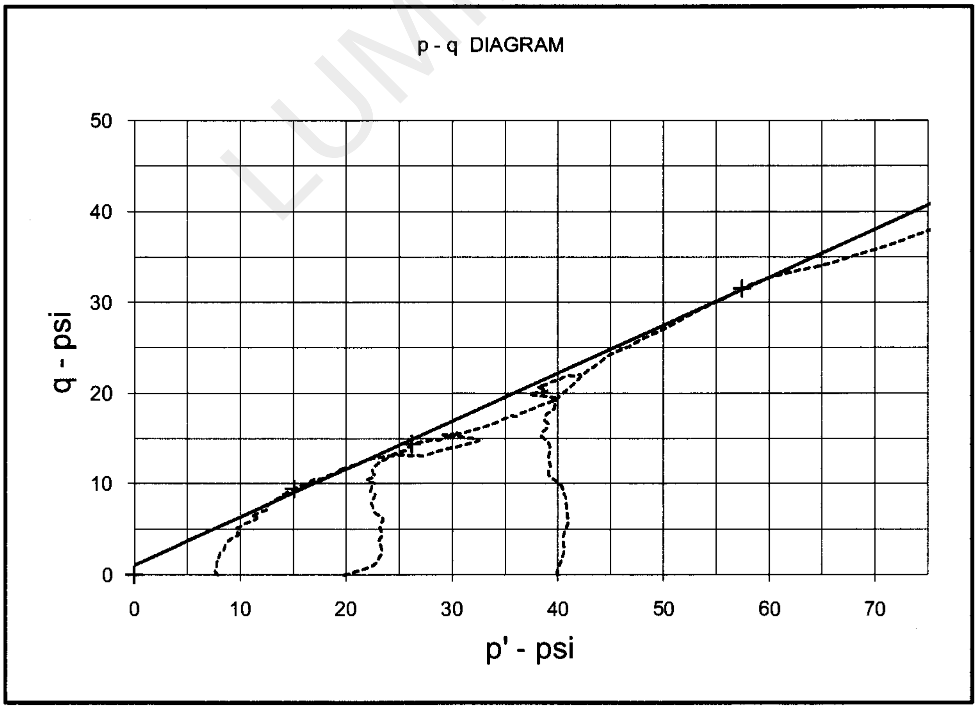
G 3219-09, B-16 8'-10' Native







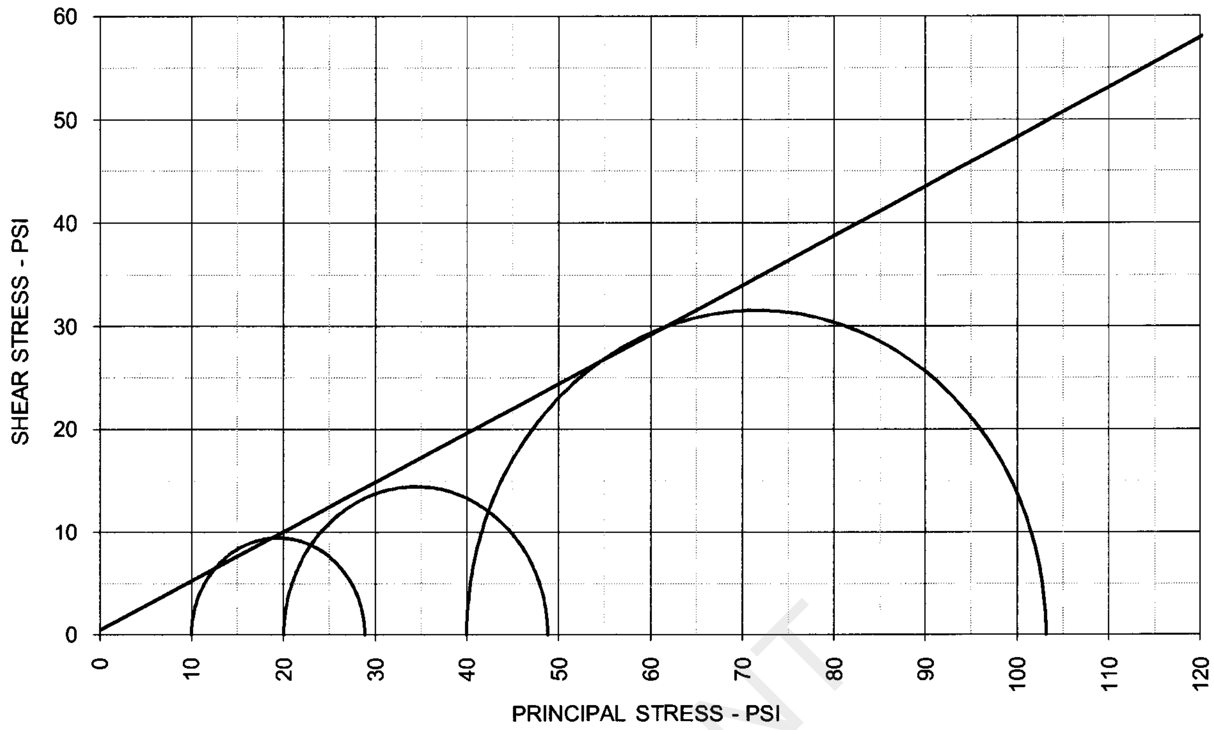




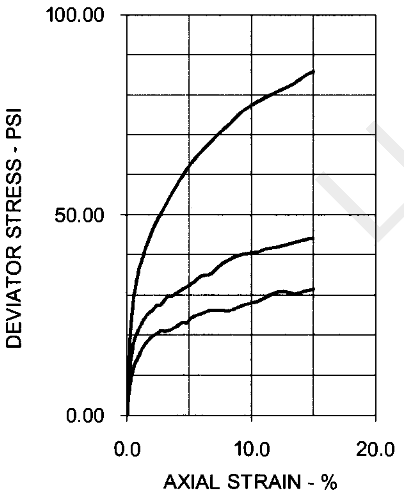
EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	α (deg) = 27.9	a (psi) = 1.1
PROJECT: Martin Lake PDP 1 - 3 Supplemental		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3219 - 09		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Tan w/ Red & Gray Clayey Sand			

G 3219-09, B-16 8'-10' Native

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 25.6 deg	c = 0.5 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	17.2	16.8	16.3	
Dry Density - pcf	112.6	114.4	115.0	
Diameter - inches	2.47	2.46	2.48	
Height - inches	4.98	4.97	5.00	
AT TEST				
Final Moisture - %	18.4	16.5	16.0	
Dry Density - pcf	113.1	115.3	116.9	
Calculated Diameter (in.)	2.47	2.46	2.50	
Height - inches	5.00	4.97	5.06	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	18.88	28.83	63.14	
Total Pore Pressure - psi	54.3	58.2	64.1	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.8	3.0	5.2	
σ_1 Failure - psi	28.88	48.83	103.14	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Shelby Tube Sample
DESCRIPTION: Tan w/ Red & Gray Clayey Sand
Sampled on Site, B-16 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

PROJECT INFORMATION

PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

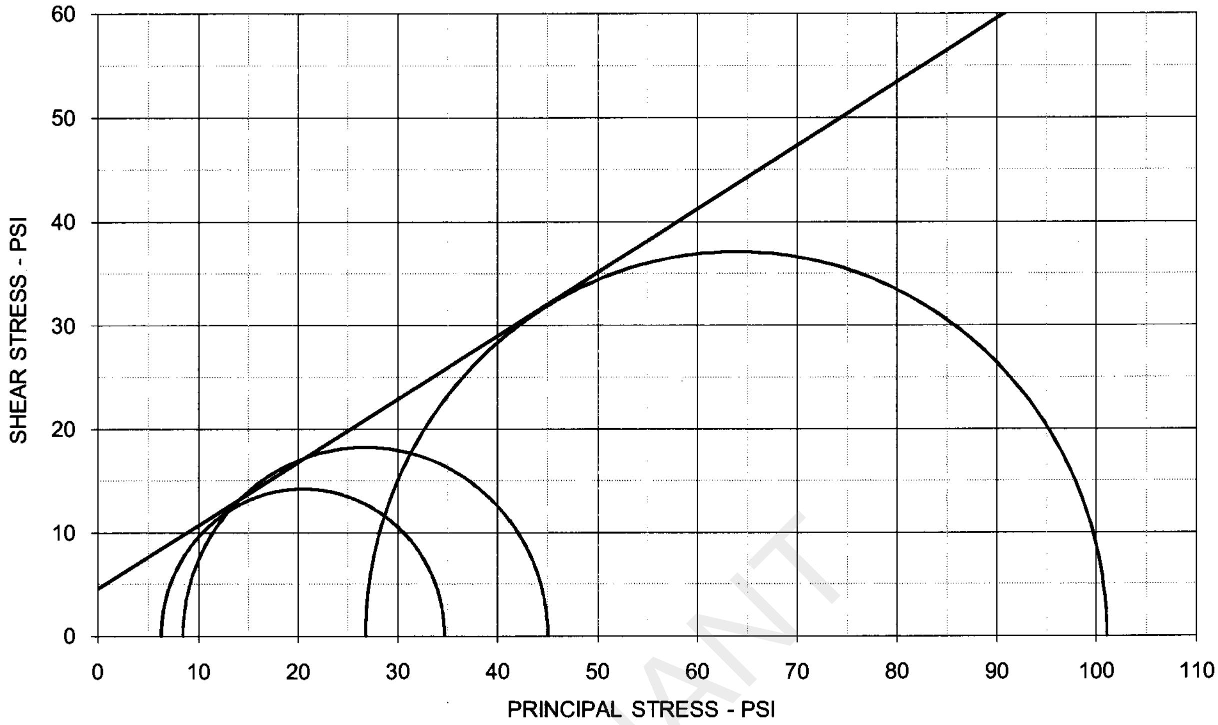
TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Shelby Tube Sample
DESCRIPTION: Tan & Red Sandy Lean Clay
Sampled on Site, B-17 3' to 7' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

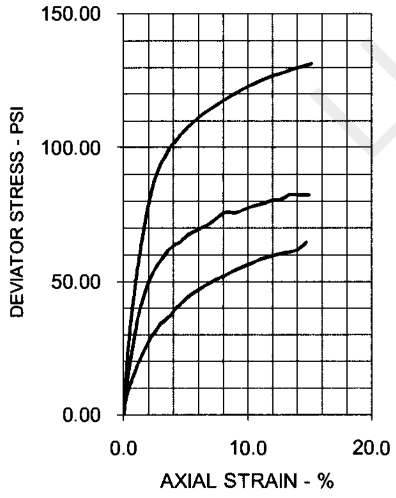
PLATE: B.1
PLATE: B.2
PLATE: B.3

Number of Specimens = 3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ' = 31.4 deg	c' = 4.6 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	16.2	13.3	13.9	
Dry Density - pcf	113.5	121.6	115.5	
Diameter - inches	2.49	2.49	2.50	
Height - inches	5.08	5.00	5.16	
AT TEST				
Final Moisture - %	18.1	14.7	16.3	
Dry Density - pcf	114.1	123.3	117.2	
Calculated Diameter (in.)	2.50	2.50	2.52	
Height - inches	5.10	5.04	5.22	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	28.40	36.54	74.24	
Total Pore Pressure - psi	53.7	61.5	63.2	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.8	3.5	1.8	
σ_1' Failure - psi	34.71	45.04	101.03	
σ_3' Failure - psi	6.31	8.50	26.79	

TEST DESCRIPTION

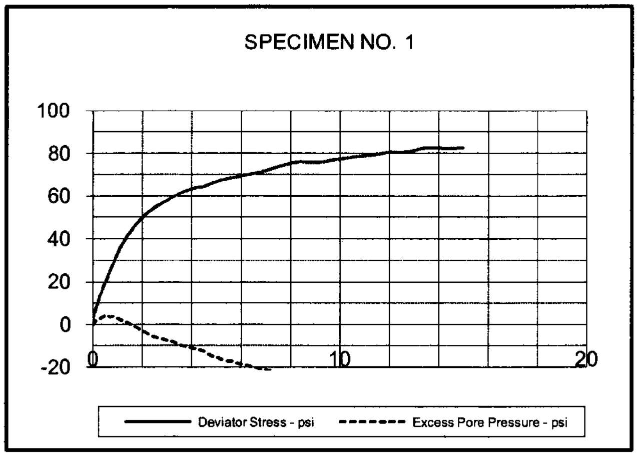
TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Shelby Tube Sample
DESCRIPTION: Tan & Red Sandy Lean Clay
Sampled on Site, B-17 3' to 7' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve
G 3219-09, B-17 3'-7' Native

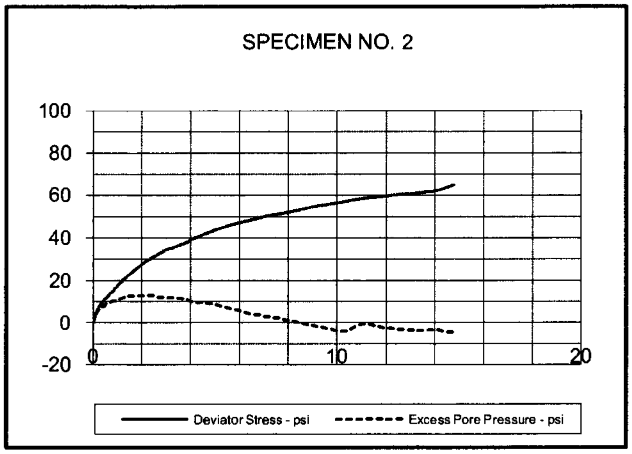
PROJECT INFORMATION

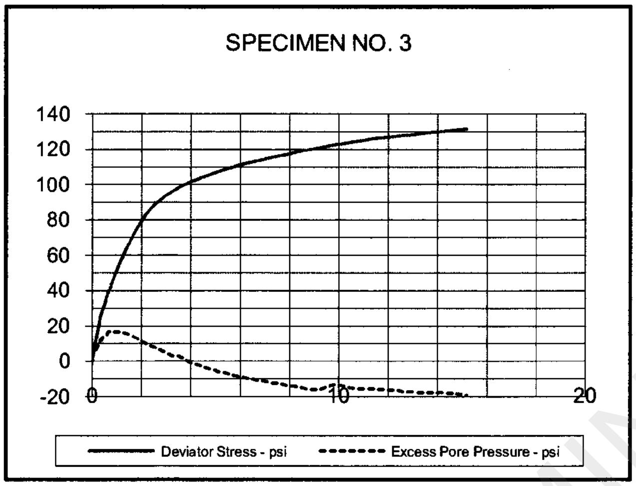
PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

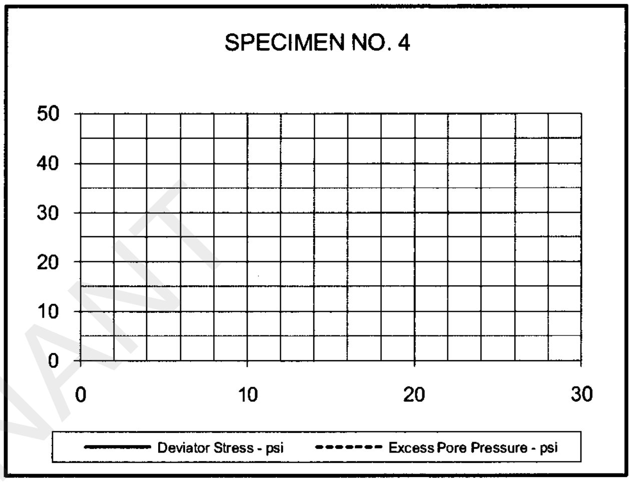
ETTL ENGINEERS & CONSULTANTS

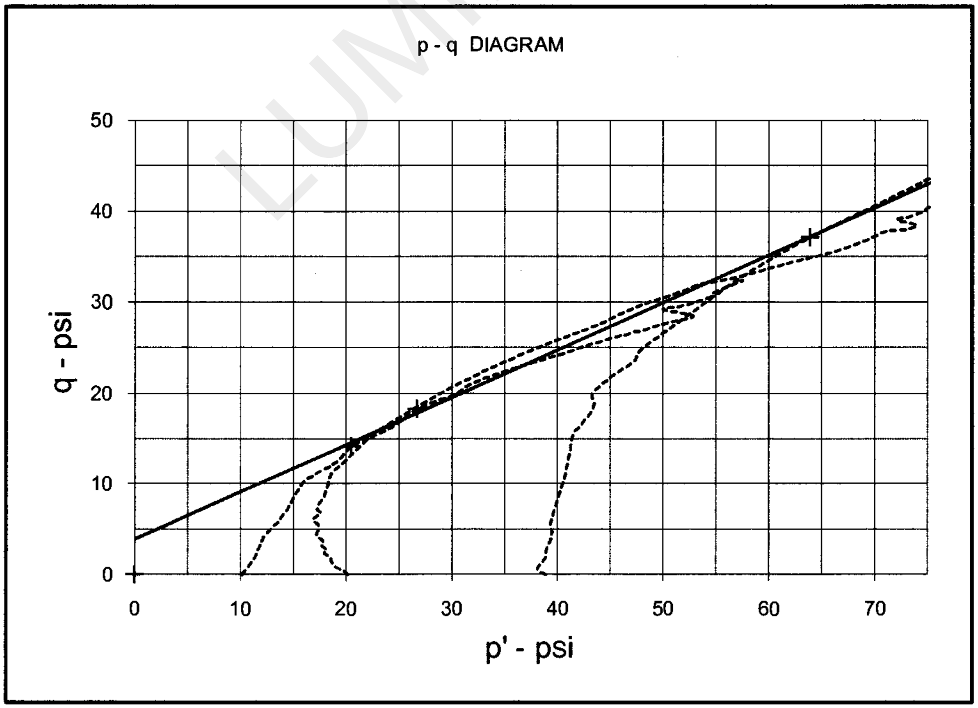
PLATE: B.1







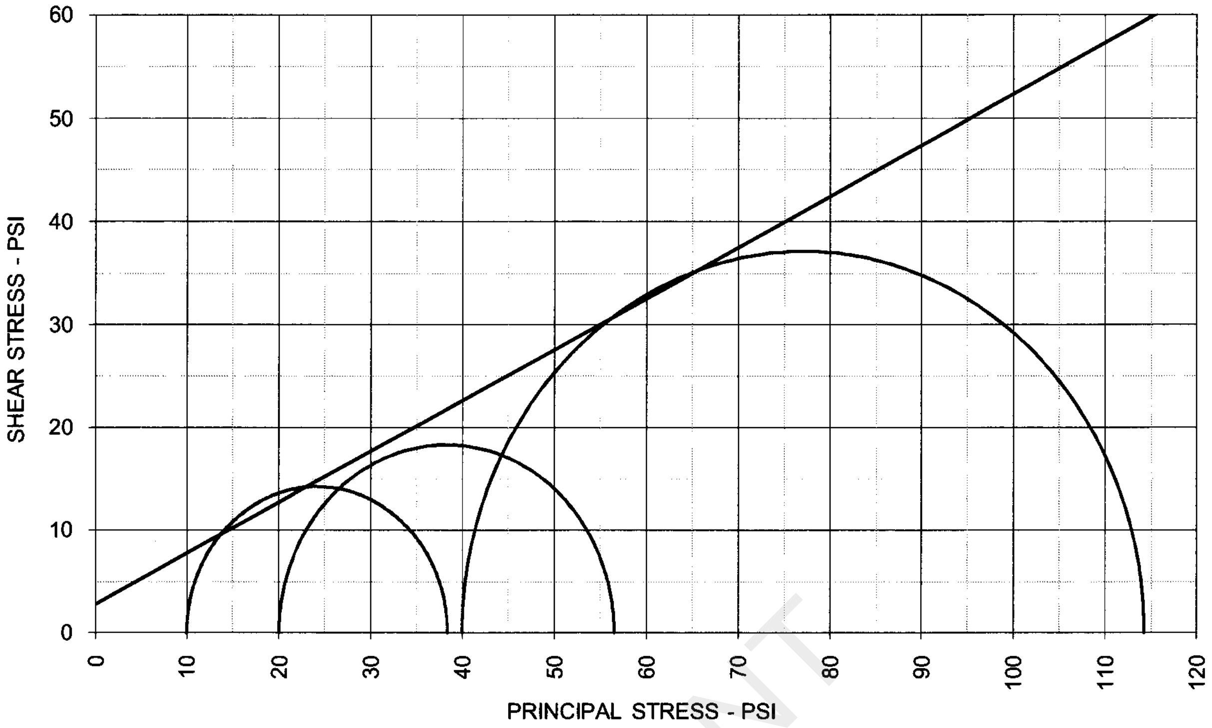




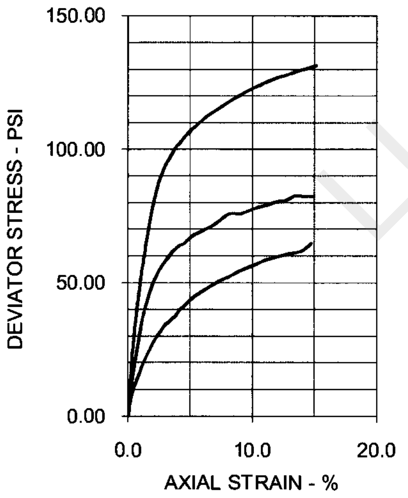
EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	α (deg) = 27.5	a (psi) = 3.9
PROJECT: Martin Lake PDP 1 - 3 Supplemental		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3219 - 09		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Tan & Red Sandy Lean Clay			

G 3219-09, B-17 3'-7' Native

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 26.4 deg	c = 2.8 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	16.2	13.3	13.9	
Dry Density - pcf	113.5	121.6	115.5	
Diameter - inches	2.49	2.49	2.50	
Height - inches	5.08	5.00	5.16	
AT TEST				
Final Moisture - %	18.1	14.7	16.3	
Dry Density - pcf	114.1	123.3	117.2	
Calculated Diameter (in.)	2.50	2.50	2.52	
Height - inches	5.10	5.04	5.22	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	28.40	36.54	74.24	
Total Pore Pressure - psi	53.7	61.5	63.2	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.8	3.5	1.8	
σ_1 Failure - psi	38.40	56.54	114.24	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Shelby Tube Sample
DESCRIPTION: Tan & Red Sandy Lean Clay
Sampled on Site, B-17 3' to 7' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

PROJECT INFORMATION

PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

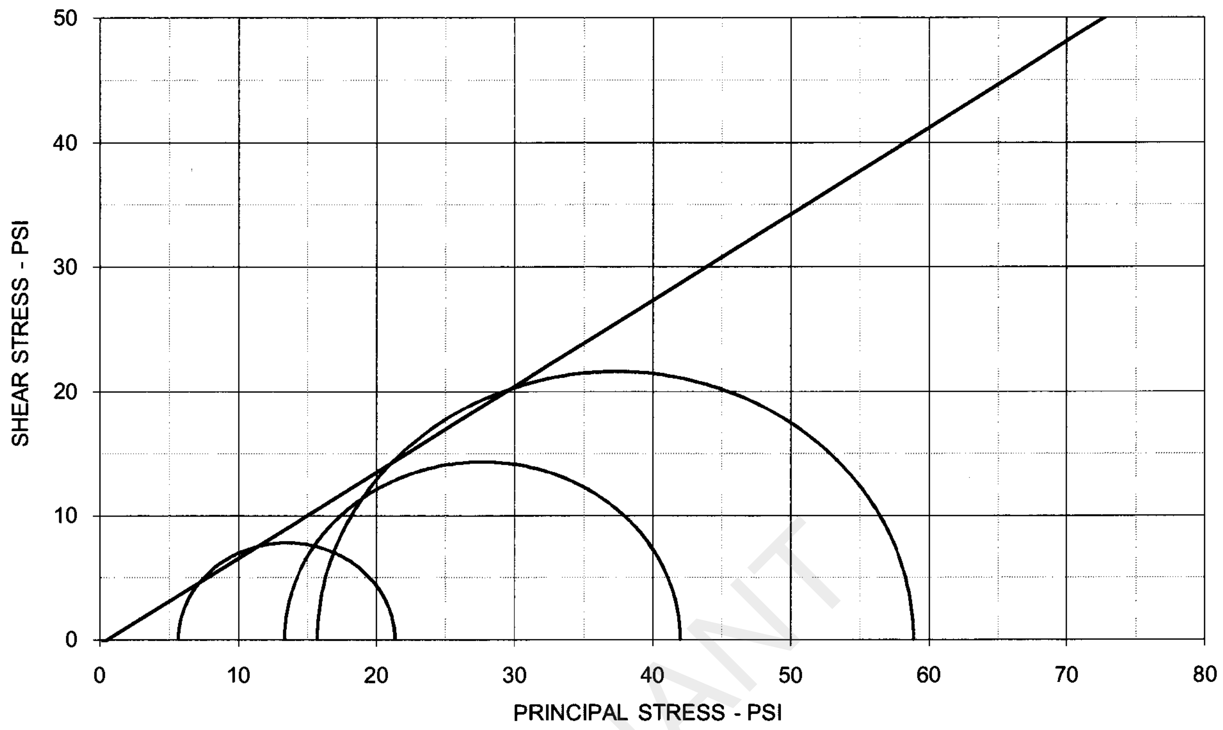
TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Lab Molded
DESCRIPTION: Tan & Reddish Tan Silty Sand
Sampled on Site, TP- 31 0' to 5' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve 2%
LL: 20 PL: 17 PI: 3 Percent -200: 27%
REMARKS: Both Ends Trimmed + # 4 Sieve 1%

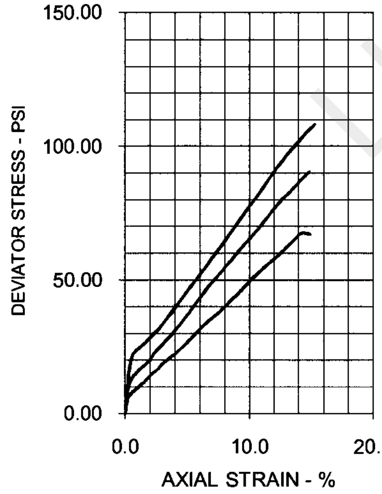
PLATE: B.1
PLATE: B.2
PLATE: B.3

Number of Specimens = 3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	φ ' =	34.7 deg	c' =	-0.4 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	17.3	17.2	17.4	
Dry Density - pcf	110.3	110.5	110.4	
Diameter - inches	2.87	2.87	2.85	
Height - inches	5.57	5.59	5.61	
AT TEST				
Final Moisture - %	17.2	16.7	16.5	
Dry Density - pcf	110.6	111.6	112.0	
Calculated Diameter (in.)	2.87	2.88	2.87	
Height - inches	5.58	5.62	5.66	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	15.65	28.63	43.17	
Total Pore Pressure - psi	54.3	56.7	74.3	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	2.4	3.5	4.6	
σ_1' Failure - psi	21.35	41.97	58.90	
σ_3' Failure - psi	5.70	13.34	15.73	

TEST DESCRIPTION

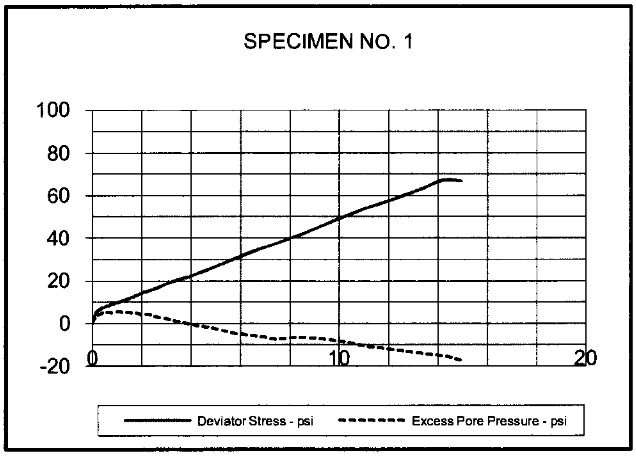
TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Lab Molded
DESCRIPTION: Tan & Reddish Tan Silty Sand
Sampled on Site, TP- 31 0' to 5' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve 2%
LL: 20 PL: 17 PI: 3 Percent -200: 27%
REMARKS: Both Ends Trimmed + # 4 Sieve 1%

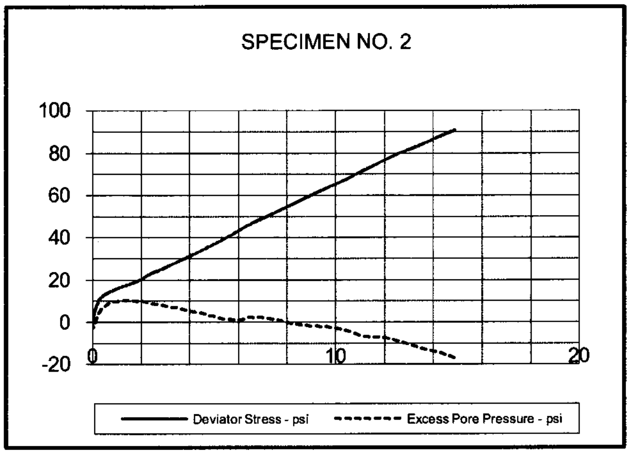
PROJECT INFORMATION

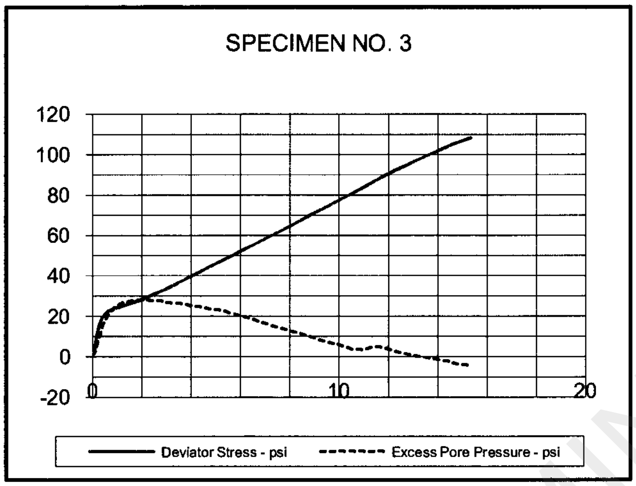
PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

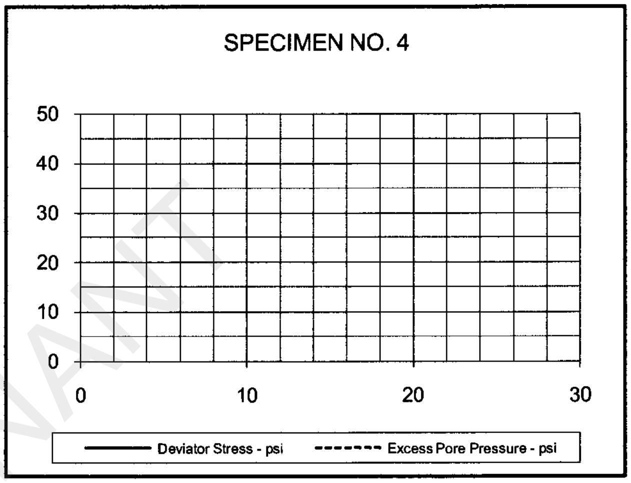
ETTL ENGINEERS & CONSULTANTS PLATE: B.1

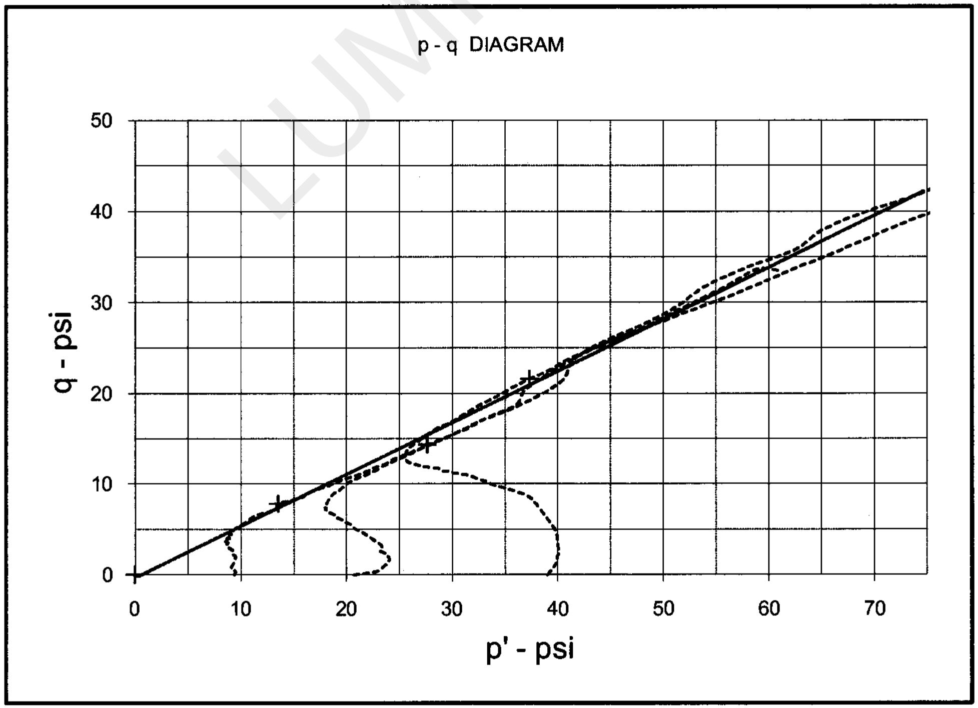
G 3219-09, TP-31 0'-5' Lab Molded







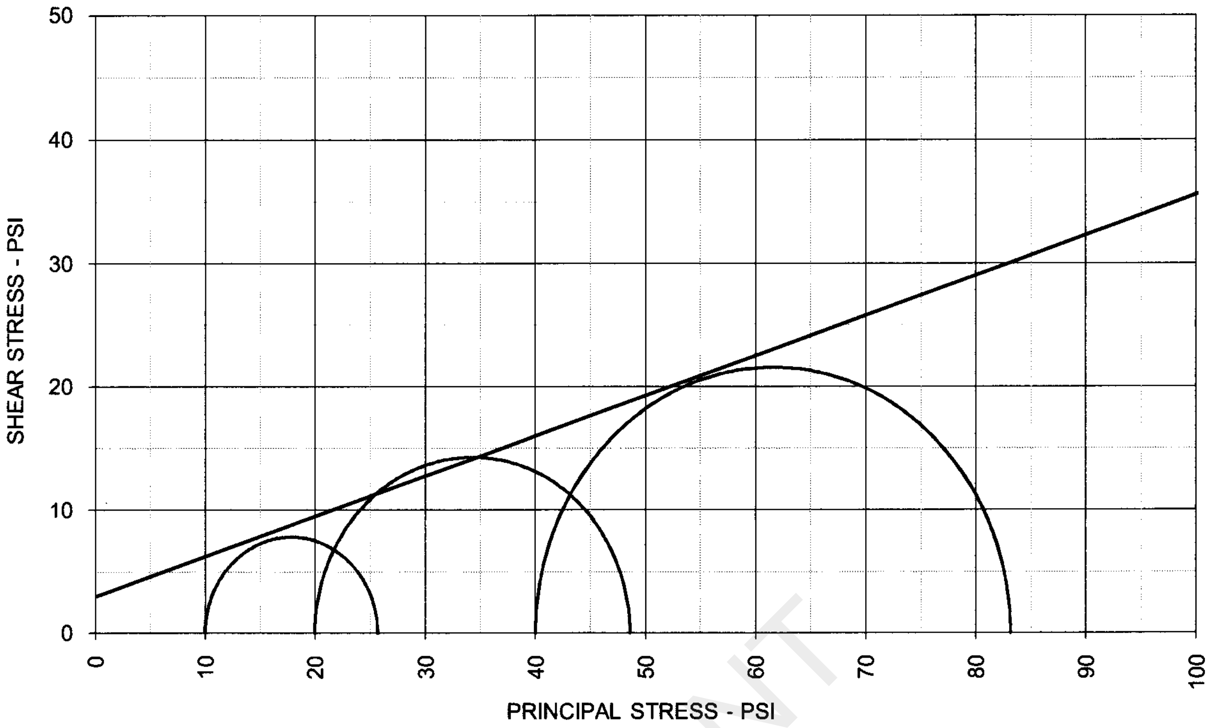




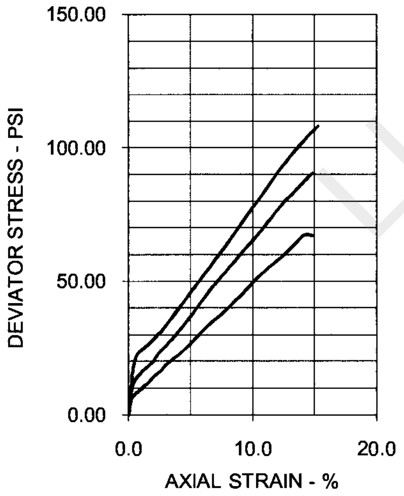
EFFECTIVE STRESS PARAMETERS	R^2 = 0.98	α (deg) = 29.7	a (psi) = -0.3
PROJECT: Martin Lake PDP 1 - 3 Supplemental		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3219 - 09		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Tan & Reddish Tan Silty Sand			

G 3219-09, TP-31 0'-5' Lab Molded

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 18.0 deg	c = 3.0 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	17.3	17.2	17.4	
Dry Density - pcf	110.3	110.5	110.4	
Diameter - inches	2.87	2.87	2.85	
Height - inches	5.57	5.59	5.61	
AT TEST				
Final Moisture - %	17.2	16.7	16.5	
Dry Density - pcf	110.6	111.6	112.0	
Calculated Diameter (in.)	2.87	2.88	2.87	
Height - inches	5.58	5.62	5.66	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	15.65	28.63	43.17	
Total Pore Pressure - psi	54.3	56.7	74.3	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	2.4	3.5	4.6	
σ_1 Failure - psi	25.65	48.63	83.17	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Lab Molded
DESCRIPTION: Tan & Reddish Tan Silty Sand
Sampled on Site, TP- 31 0' to 5' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve 2%
LL: 20 PL: 17 PI: 3 Percent -200: 27%
REMARKS: Both Ends Trimmed + # 4 Sieve 1%

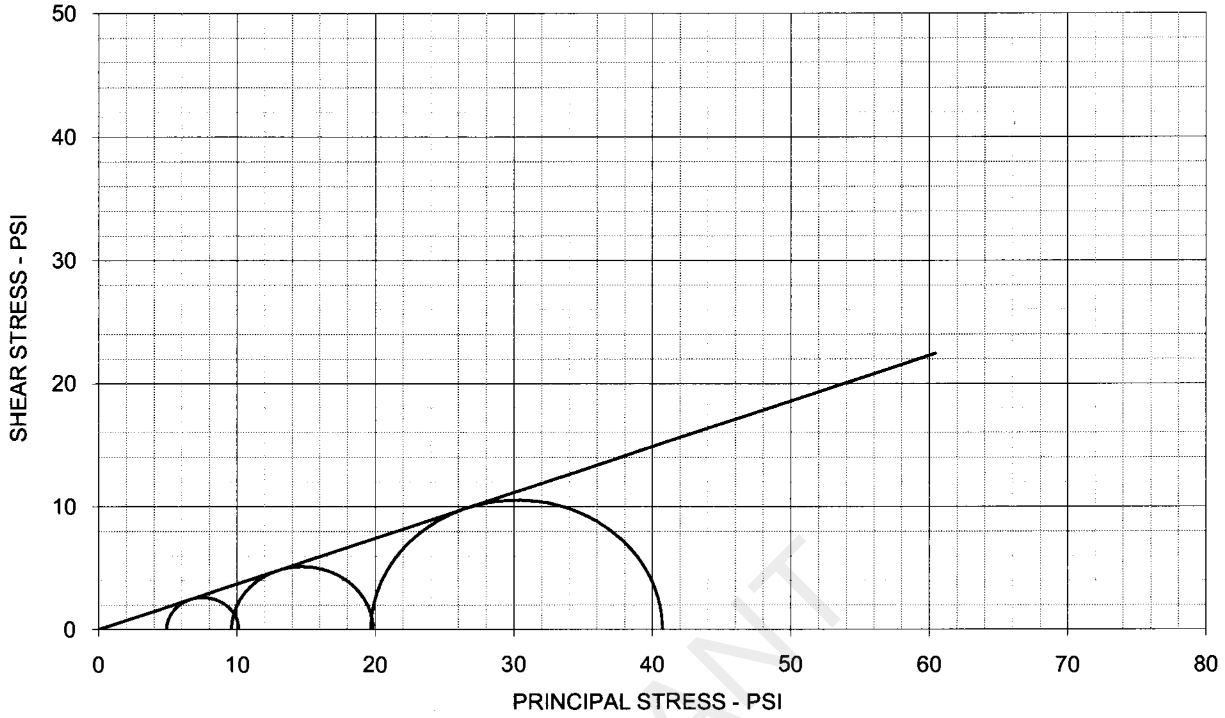
PROJECT INFORMATION

PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

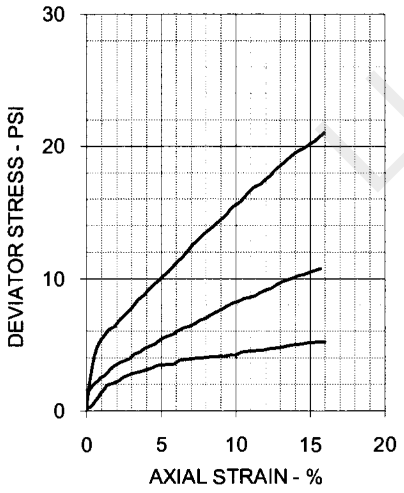
ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	φ ' = 20.4 deg	c' = 0.0 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	26.1	24.6	21.3	
Dry Density - pcf	94.3	95.8	101.6	
Diameter - inches	1.40	1.40	1.40	
Height - inches	2.81	2.85	3.20	
AT TEST				
Final Moisture - %	26.1	24.6	21.3	
Dry Density - pcf	94.3	97.0	101.6	
Calculated Diameter (in.)	1.40	1.40	1.40	
Height - inches	2.81	2.85	3.20	
Effect. Cell Pressure - psi	5.0	10.0	20.0	
Failure Stress - psi	5.21	10.25	21.03	
Total Pore Pressure - psi	20.0	20.0	20.0	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	15.6	14.2	15.9	
σ_1' Failure - psi	10.11	19.85	40.73	
σ_3' Failure - psi	4.90	9.60	19.70	

TEST DESCRIPTION

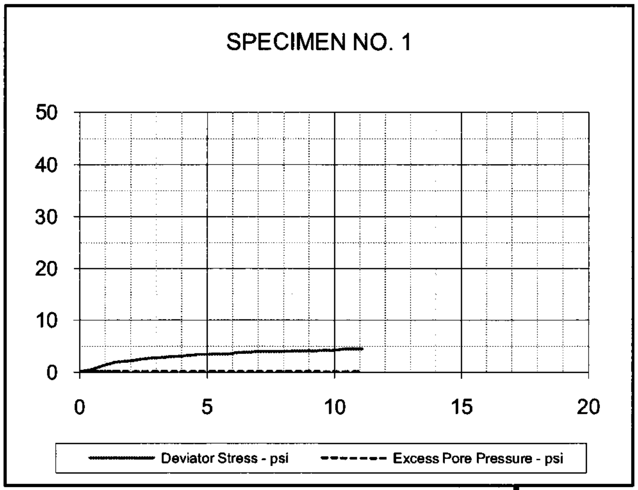
TYPE OF TEST & NO: CD Triaxial - CD-1
SAMPLE TYPE: SHELBY TUBE
DESCRIPTION:SANDY LEAN CLAY(CL), tan br w/ red br and gray
SAMPLE LOCATION: B-16, 3-5'
ASSUMED SPECIFIC GRAVITY: 2.70
LL: 43 PL: 14 PI: 29 Percent -200: 56
REMARKS: Tested in a fully softened remolded state

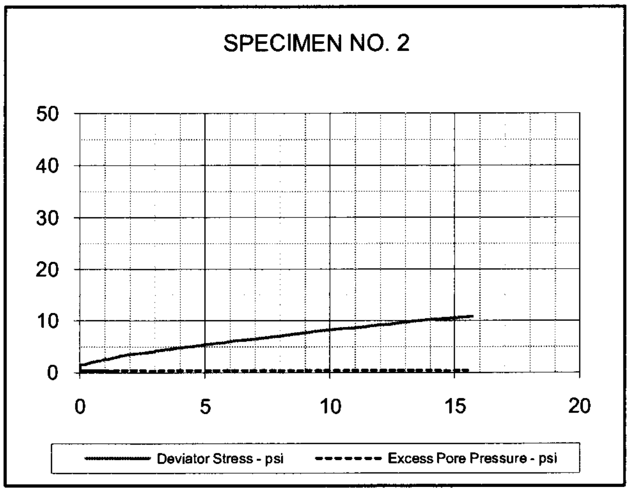
PROJECT INFORMATION

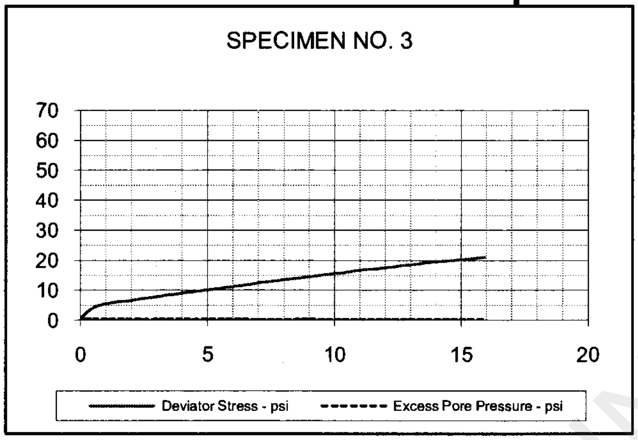
PROJECT: Luminant Martin Lake PDP 1-3 Vertical Expansion
LOCATION: Tatum, TX
PROJECT NO: ETT08002-11
CLIENT: ETTL Engineers & Consultants, Inc.
DATE: 9/15/09

GREGORY GEOTECHNICAL

PLATE: B-CD.1


SPECIMEN NO. 1


SPECIMEN NO. 2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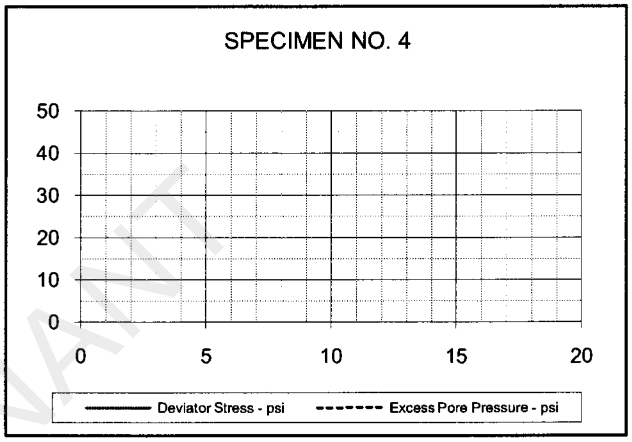
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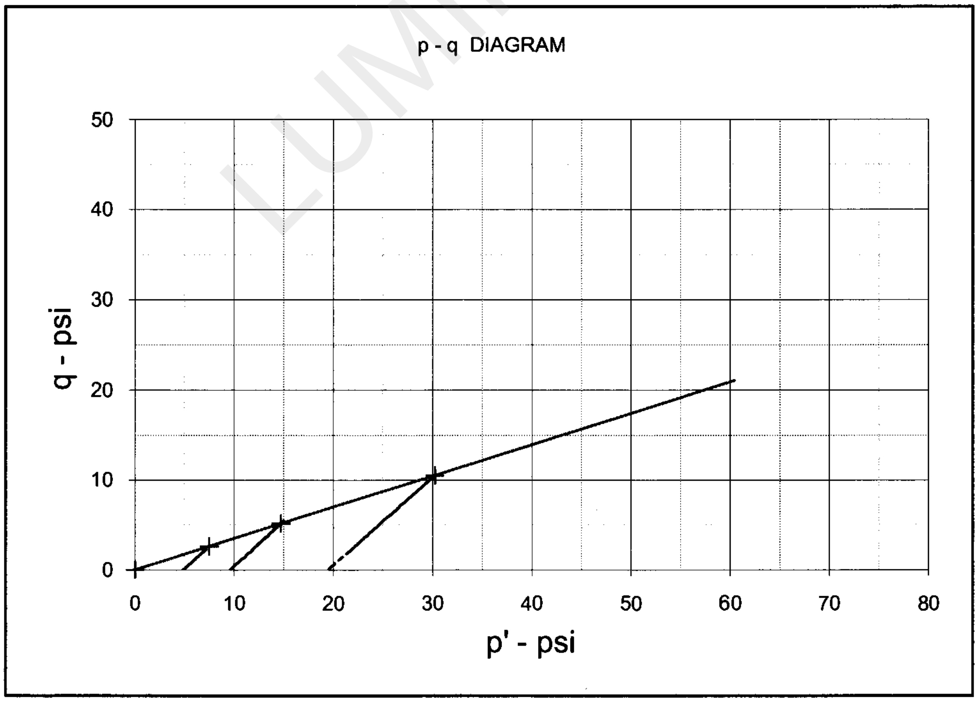
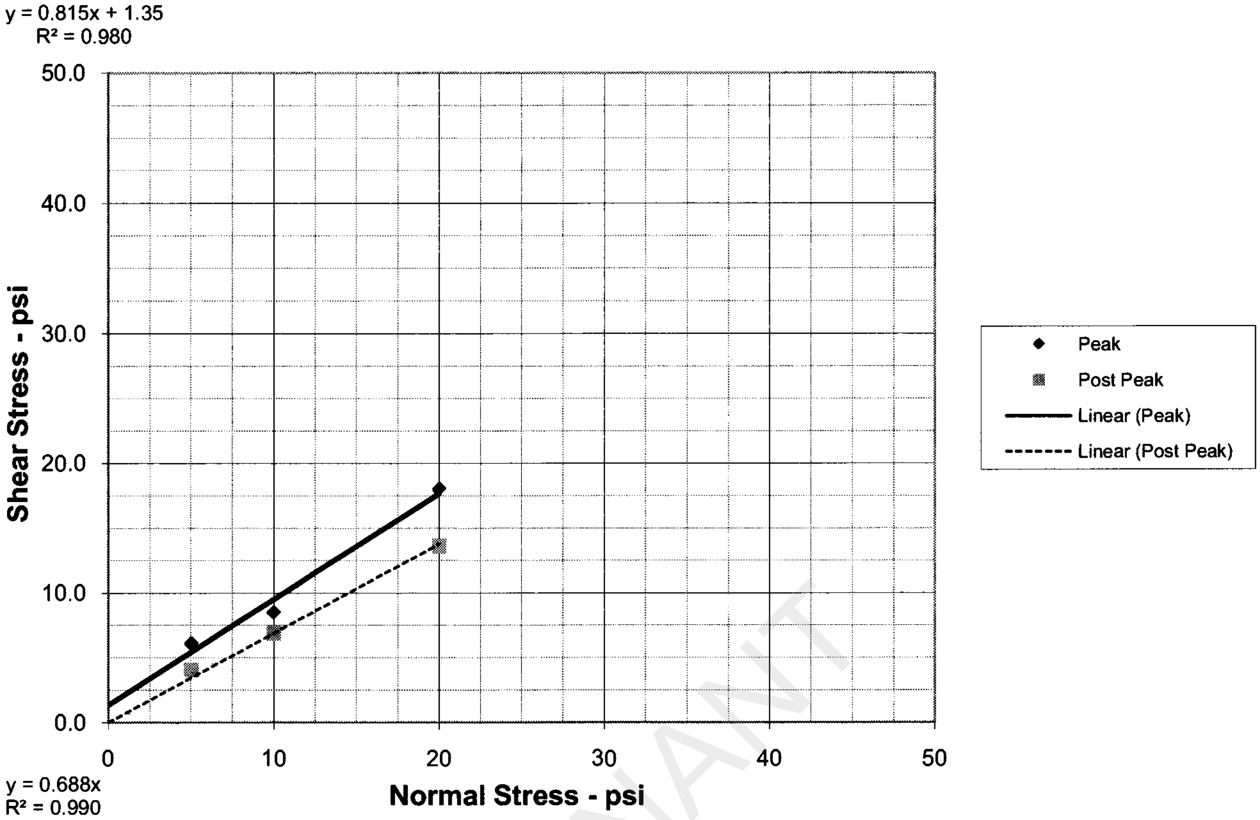
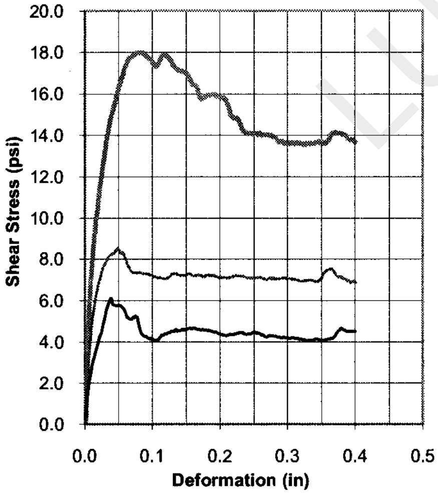

p - q DIAGRAM

EFFECTIVE STRESS PARAMETERS	R^2 = 1.000	α (deg) = 19.2	a (psi) = 0.0
PROJECT: Luminant Martin Lake PDP 1-3 Vertical Expansion		TYPE OF TEST & NO: CD Triaxial - CD-1	
PROJECT NO: ETT08002-11		**GREGORY GEOTECHNICAL**	PLATE: B-CD.2
DESCRIPTION:SANDY LEAN CLAY(CL), tan br w/ red br and gray			

DIRECT SHEAR TEST REPORT



PEAK STRENGTH PARAMETERS	ϕ =	39.2 deg	c =	1.4 psi
POST PEAK STRENGTH PARAMETERS	ϕ =	34.6 deg	c =	0.0 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	41.3	42.3	48.4	
Dry Density - pcf	78.9	72.5	72.9	
Diameter - inches	2.50	2.50	2.50	
Height - inches	1.00	1.00	1.00	
AT TEST				
Final Moisture - %	46.6	59.5	31.6	
Dry Density - pcf	81.0	74.2	73.0	
Height-End of Consol. (in.)	1.03	1.02	1.00	
Height-End of Shear (in.)	1.03	1.03	1.01	
Normal Stress - psi	5.0	10.0	20.0	
Peak Failure Stress-psi	6.1	8.5	18.0	
Post Peak Failure Stress-psi	4.1	6.9	13.6	
Strain Rate - inches/min.	0.00030	0.00030	0.00030	
Peak Failure Strain - %	1.6	1.9	3.1	
Post Peak Failure Strain %	4.3	12.7	11.8	

Dry Density at test based on initial moisture and height at end of consolidation.

TEST DESCRIPTION

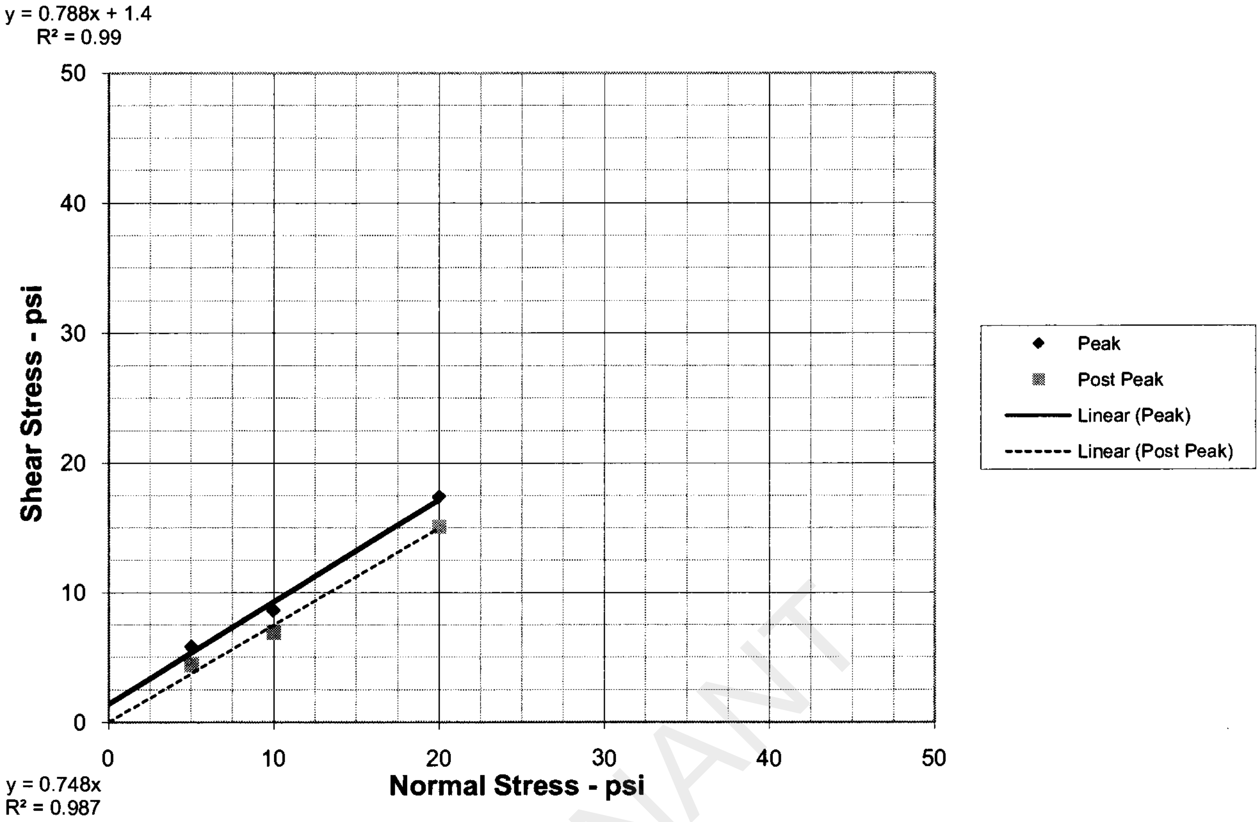
TYPE OF TEST & NO: CD-DS-1
SAMPLE TYPE: Shelby Tube
DESCRIPTION: SILT(MH), black (classification tests from 13-15 ft)
SAMPLE LOCATION: B-15, 18-20 ft
ASSUMED SPECIFIC GRAVITY: 2.65
LL: NP PL: NP PI: NP Percent -200: 95
REMARKS: Tested at natural MC

PROJECT INFORMATION

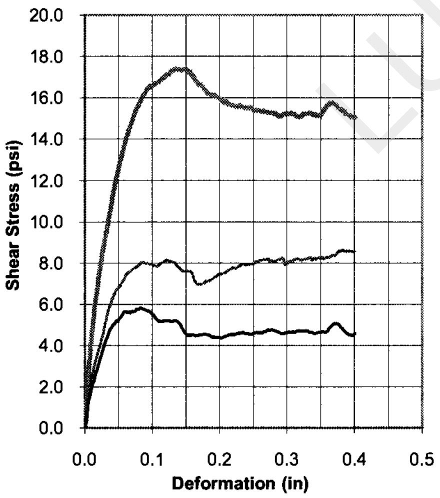
PROJECT: Luminant Martin Lake PDP 1-3 Vertical Expansion
LOCATION: Tatum, TX
PROJECT NO: ETT08002-11 (G3219-09)
CLIENT : ETTL Engineers & Consultants, Inc
DATE: 9/25/09

GREGORY GEOTECHNICAL PLATE: B-DS. 1

DIRECT SHEAR TEST REPORT



PEAK STRENGTH PARAMETERS	ϕ =	38.3 deg	c =	1.4 psi
POST PEAK STRENGTH PARAMETERS	ϕ =	36.8 deg	c =	0.0 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	47.2	47.5	46.5	
Dry Density - pcf	77.0	73.3	72.6	
Diameter - inches	2.50	2.50	2.50	
Height - inches	1.00	1.00	1.00	
AT TEST				
Final Moisture - %	47.2	47.5	31.6	
Dry Density - pcf	77.0	73.3	72.6	
Height-End of Consol. (in.)	1.00	1.00	1.00	
Height-End of Shear (in.)	0.98	0.98	0.99	
Normal Stress - psi	5.0	10.0	20.0	
Peak Failure Stress-psi	5.8	8.6	17.4	
Post Peak Failure Stress-psi	4.4	6.9	15.1	
Strain Rate - inches/min.	0.00030	0.00030	0.00030	
Peak Failure Strain - %	3.1	15.0	3.1	
Post Peak Failure Strain %	7.8	6.8	12.8	

Dry Density at test based on initial moisture and height at end of consolidation.

TEST DESCRIPTION

TYPE OF TEST & NO: CD-DS-2
SAMPLE TYPE: Shelby Tube
DESCRIPTION: SILT(MH), black (classification tests from 13-15 ft)
SAMPLE LOCATION: B-15, 18-20 ft
ASSUMED SPECIFIC GRAVITY: 2.65
LL: NP PL: NP PI: NP Percent -200: 95
REMARKS: Tested in a fully softened remolded state

PROJECT INFORMATION

PROJECT: Luminant Martin Lake PDP 1-3 Vertical Expansion
LOCATION: Tatum, TX
PROJECT NO: ETT08002-11 (G3219-09)
CLIENT : ETTL Engineers & Consultants, Inc
DATE: 9/23/09

GREGORY GEOTECHNICAL

PLATE: B-DS. 2

ETTL Engineers & Consultants Inc.

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HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : Martin Lake PDP 1 - 3 Supplemental, Tatum, Texas
Date: 8/26/2009 Panel Number : P 1 ; ASTM D 5084
Project No. : G 3219-09 Permometer Data

Boring No.:	B - 14	ap =	0.031416 cm2		Set Mercury to Pipet Rp at	Equilibrium	1.8	cm3
Sample:		aa =	0.767120 cm2			Pipet Rp	**6.7**	cm3
Depth (ft):	3' to 5'	M1 =	0.030180	C =	0.000414194	Annulus Ra	1.5	cm3
Other Location:		M2 =	1.040953	T =	0.203859738			

Material Description : Dark Gray Ash

SAMPLE DATA

Wet Wt. sample + ring or tare : 502.16 g
Tare or ring Wt. : 0.0 g
Wet Wt: of Sample : 502.16 g

Diameter :	2.85	in	7.24	cm2
Length :	2.80	in	7.12	cm
Area:	6.38	in^2	41.16	cm2
Volume :	17.88	in^3	292.92	cm3
Unit Wt.(wet):	**106.97**	pcf	**1.71**	g/cm^3
Unit Wt.(dry):	**68.77**	pcf	**1.10**	g/cm^3

Before Test		After Test	
Tare No.:	T 20	Tare No.:	T 22
Wet Wt.+tare:	522.84	Wet Wt.+tare:	625.95
Dry Wt.+tare:	393.34	Dry Wt.+tare:	480.79
Tare Wt:	160.27	Tare Wt:	140.47
Dry Wt.:	233.07	Dry Wt.:	340.32
Water Wt.:	129.5	Weter Wt.:	145.16
% moist.:	**55.6**	% moist.:	**42.7**

Specific Gravity: **2.60** Max Dry Density(pcf) = 68.7952 OMC = 55.5627065
% of max = 100.0 +/- OMC = 0.00
Calculated % saturation: 81.52 Void ratio (e) = **1.36** Porosity (n)= **0.58**

TEST READINGS

Z1(Mercury Height Difference @ t1): 5.1 cm Hydraulic Gradient = 9.04

Date	elapsed t (seconds)	Z (pipet @ t)	$\Delta Z\pi$ (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
8/26/2009	8	4.5	2.1553335	25	0.889	2.66E-05	7.55E-02	
8/26/2009	10	4.05	2.6053335	25	0.889	2.79E-05	7.91E-02	
8/26/2009	12	3.6	3.0553335	25	0.889	2.99E-05	8.48E-02	
8/26/2009	14	3.25	3.4053335	25	0.889	3.12E-05	8.84E-02	

SUMMARY

ka = 2.89E-05 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	2.66E-05	cm/sec	7.8	%
k2 =	2.79E-05	cm/sec	3.5	%
k3 =	2.99E-05	cm/sec	3.5	%
k4 =	3.12E-05	cm/sec	7.8	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**2.89E-05**	cm/sec	**8.19E-02**	ft/day
Void Ratio	e =	**1.36**			
Porosity	n =	**0.58**			
Bulk Density	γ =	**1.71**	g/cm3	**107.0**	pcf
Water Content	W =	**0.61**	cm3/cm3	(at 20 deg C)	
Intrinsic Permeability	kint =	**2.96E-10**	cm2	(at 20 deg C)	

Liquid Limit LL		
Plastic Limit PL		
Plasticity Index PI		
- 200 Sieve		%
+ No 40 Sieve		%
+ No 4 Sieve		%

Respectfully Submitted

Robert M. Duke, P.E.

ETTL Engineers & Consultants Inc.
GEOTECHNICAL ✱ MATERIALS ✱ ENVIRONMENTAL ✱ DRILLING ✱ LANDFILLS

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : Martin Lake PDP 1 - 3 Supplemental, Tatum, Texas
Date: 8/26/2009 Panel Number : P 2 ; ASTM D 5084
Project No. : G 3219-09 Permometer Data

Boring No.:	B - 14	ap =	0.031416 cm2	Set Mercury to Pipet Rp at		Equilibrium	1.8	cm3
Sample:		aa =	0.767120 cm2			Pipet Rp	**6.7**	cm3
Depth (ft):	16' to 17'	M1 =	0.030180	C =	0.000414194	Annulus Ra	1.5	cm3
Other Location:		M2 =	1.040953	T =	0.203859738			

Material Description : Dark Gray Ash

SAMPLE DATA

Wet Wt. sample + ring or tare :			457.47	g
Tare or ring Wt. :			0.0	g
Wet Wt: of Sample :			457.47	g
Diameter :	2.85	in	7.24	cm2
Length :	2.80	in	7.12	cm
Area:	6.38	in^2	41.16	cm2
Volume :	17.88	in^3	292.92	cm3
Unit Wt.(wet):	**97.45**	pcf	**1.56**	g/cm^3
Unit Wt.(dry):	**57.36**	pcf	**0.92**	g/cm^3

Before Test		After Test	
Tare No.:	T 18	Tare No.:	T 16
Wet Wt.+tare:	711.07	Wet Wt.+tare:	569.97
Dry Wt.+tare:	478.92	Dry Wt.+tare:	412.38
Tare Wt:	146.73	Tare Wt:	151.98
Dry Wt.:	332.19	Dry Wt.:	260.4
Water Wt.:	232.15	Water Wt.:	157.59
% moist.:	**69.9**	% moist.:	**60.5**

Specific Gravity:	**2.50**	Max Dry Density(pcf) =	57.38916	OMC =	69.8847045
		% of max =	100.0	+/- OMC =	0.00
Calculated % saturation:	87.92	Void ratio (e) =	**1.72**	Porosity (n)=	**0.63**

TEST READINGS

Z1(Mercury Height Difference @ t1): 5.1 cm Hydraulic Gradient = 9.04

Date	elapsed t (seconds)	Z (pipet @ t)	$\Delta Z\pi$ (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
8/26/2009	80	4.2	2.4553335	25	0.889	3.20E-06	9.06E-03	
8/26/2009	90	4.05	2.6053335	25	0.889	3.10E-06	8.79E-03	
8/26/2009	100	3.9	2.7553335	25	0.889	3.04E-06	8.61E-03	
8/26/2009	110	3.75	2.9053335	25	0.889	3.00E-06	8.52E-03	

SUMMARY

ka = 3.08E-06 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	3.20E-06	cm/sec	3.6	%
k2 =	3.10E-06	cm/sec	0.5	%
k3 =	3.04E-06	cm/sec	1.5	%
k4 =	3.00E-06	cm/sec	2.6	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**3.08E-06**	cm/sec	**8.74E-03**	ft/day
Void Ratio	e =	**1.72**			
Porosity	n =	**0.63**			
Bulk Density	γ =	**1.56**	g/cm3	**97.5**	pcf
Water Content	W =	**0.64**	cm3/cm3	(at 20 deg C)	
Intrinsic Permeability	kint =	**3.16E-11**	cm2	(at 20 deg C)	

Liquid Limit LL		
Plastic Limit PL		
Plasticity Index PI		
- 200 Sieve		%
+ No 40 Sieve		%
+ No 4 Sieve		%

Respectfully Submitted

Robert M. Duke, P.E.

ETTL Engineers & Consultants Inc.
GEOTECHNICAL ✶ MATERIALS ✶ ENVIRONMENTAL ✶ DRILLING ✶ LANDFILLS

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : Luminant Martin Lake Supplemental, TP-31, Tatum, Texas
Date: 9/9/2009 Panel Number : P 1 ; ASTM D 5084
Project No. : G 3219-09 Permometer Data

Boring No.:	TP- 31	ap =	0.031416 cm2		Set Mercury to Pipet Rp at	Equilibrium	1.8	cm3
Sample:	9228	aa =	0.767120 cm2			Pipet Rp	**6.7**	cm3
Depth (ft):	0' to 5'	M1 =	0.030180	C =	0.000414162	Annulus Ra	1.5	cm3
Other Location:		M2 =	1.040953	T =	0.203870442			

Material Description : Tan & Reddish Tan Silty Sand

SAMPLE DATA

Wet Wt. sample + ring or tare :			627.20	g				
Tare or ring Wt. :			0.0	g	Before Test		After Test	
Wet Wt: of Sample :			627.20	g	Tare No.:	T 6	Tare No.:	T 1
Diameter :	2.89	in	7.33	cm2	Wet Wt.+tare:	841.20	Wet Wt.+tare:	841.71
Length :	2.88	in	7.30	cm	Dry Wt.+tare:	749.54	Dry Wt.+tare:	741.72
Area:	6.55	in^2	42.23	cm2	Tare Wt:	217.39	Tare Wt:	217.29
Volume :	18.82	in^3	308.41	cm3	Dry Wt.:	532.15	Dry Wt.:	524.43
Unit Wt.(wet):	**126.90**	pcf	**2.03**	g/cm^3	Water Wt.:	91.66	Water Wt.:	99.99
Unit Wt.(dry):	**108.26**	pcf	**1.73**	g/cm^3	% moist.:	**17.2**	% moist.:	**19.1**

Specific Gravity:	**2.65**	Max Dry Density(pcf) =	108.3018	OMC =	17.2244668
		% of max =	100.0	+/- OMC =	0.00
Calculated % saturation:	95.65	Void ratio (e) =	**0.53**	Porosity (n)=	**0.35**

TEST READINGS

Z1(Mercury Height Difference @ t1): 5.1 cm Hydraulic Gradient = 8.81

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZπ (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
7/31/2009	600	5.3	1.3550759	25	0.889	1.98E-07	5.63E-04	
7/31/2009	720	5.1	1.5550759	25	0.889	1.95E-07	5.53E-04	
7/31/2009	840	5	1.6550759	25	0.889	1.80E-07	5.12E-04	
7/31/2009	960	4.8	1.8550759	25	0.889	1.82E-07	5.17E-04	

SUMMARY

ka = 1.89E-07 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	1.98E-07	cm/sec	5.0	%
k2 =	1.95E-07	cm/sec	3.2	%
k3 =	1.80E-07	cm/sec	4.5	%
k4 =	1.82E-07	cm/sec	3.6	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**1.89E-07**	cm/sec	**5.36E-04**	ft/day
Void Ratio	e =	**0.53**			
Porosity	n =	**0.35**			
Bulk Density	γ =	**2.03**	g/cm3	**126.9**	pcf
Water Content	W =	**0.30**	cm3/cm3	(at 20 deg C)	
Intrinsic Permeability	kint =	**1.94E-12**	cm2	(at 20 deg C)	

Liquid Limit LL	20	
Plastic Limit PL	17	
Plasticity Index PI	**3**	
- 200 Sieve	27	%
+ No 40 Sieve	2	%
+ No 4 Sieve	1	%

Respectfully Submitted

Robert M. Duke, P.E.

ETTL Engineers & Consultants Inc.

GEOTECHNICAL ✱ MATERIALS ✱ ENVIRONMENTAL ✱ DRILLING ✱ LANDFILLS

Project: Luminant Martin Lake Supplemental, Tatum, Texas
Client: HDR
Contractor:
Job No. **G 3219 - 09**

Sample No.: **9228** Date Sampled: 8/26/2009
Material Origin: TP- 31
Sampling Info. provided By: Jacob LeNoir
Location Sampled: TP- 31
Material Description: Tan & Reddish Tan Silty Sand
Sampled By: Jacob LeNoir
Technician: T. Sliger Date: 8/28/2009

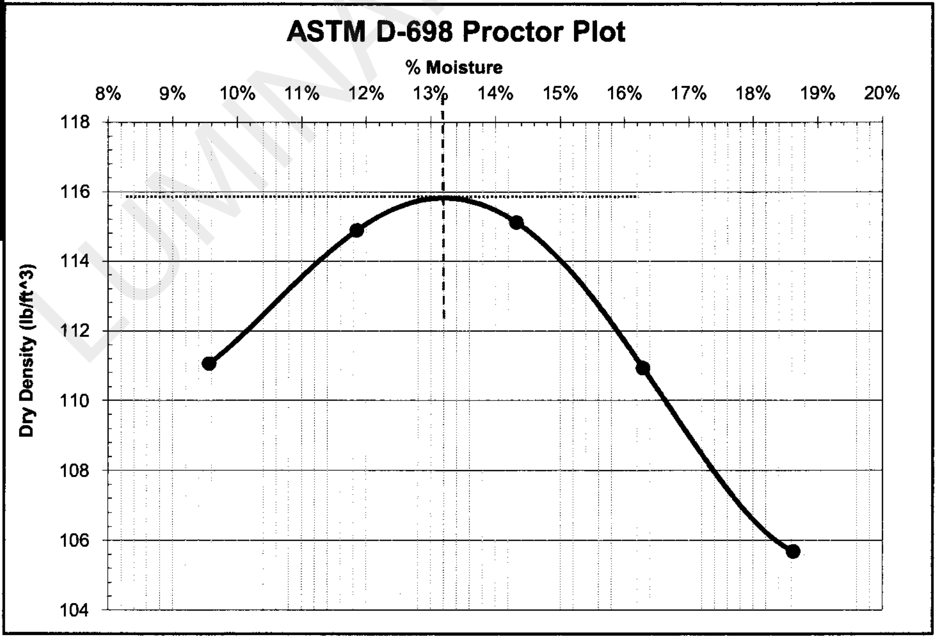
Maximum Dry Density: (ASTM D 698)	115.9	(lb/ft^3)
Optimum Moisture Content:	13.2	(%)

Classification

LL	20
PL	17
PI	3

-200 Sieve	27%
+40 Sieve	2%
+4 Sieve	1%

Proctor Points	
% Moisture	Dry Density (lb/ft^3)
9.6%	111.1
11.9%	114.9
14.3%	115.1
16.3%	110.9
18.6%	105.7



Respectfully Submitted

Robert M. Duke, P.E.

Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

Africa	+ 27 11 254 4800
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Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Inc.
500 Century Plaza Drive, Suite 190
Houston, TX 77073 USA
Tel: (281) 821-6868
Fax: (281) 821-6870

Golder Associates

Engineering Earth's Development, Preserving Earth's Integrity

APPENDIX F9 – SAFETY FACTOR ASSESSMENT

REPORT

SAFETY FACTOR ASSESSMENT REPORT

Martin Lake Steam Electric Station

Submitted To: Luminant
1601 Bryan Street
Dallas, TX 75201

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

10/10/16

STATE OF TEXAS
JEFFREY B. FASSETT
85675
LICENSED
PROFESSIONAL ENGINEER

Professional Engineering Firm
Registration Number F-2578

October 2016 **Project No. 164816402**

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1.0 INTRODUCTION

1.1 Purpose

The “Disposal of Coal Combustion Residuals (CCR) from Electric Utilities rule” (40 Code of Federal Regulations (40 CFR) Part 257), effective October 19, 2015, requires that existing CCR surface impoundments meeting the requirements of §257.73(b) conduct initial and periodic safety factor assessments in accordance with §257.73(e). This report provides the safety factor assessments for the Martin Lake Steam Electric Station’s (MLSES’s) CCR Impoundments, identified as the Bottom Ash Ponds (BAPs) – the West Ash Pond (WAP) and the East Ash Pond (EAP) – the New Scrubber Pond (NSP), and the Permanent Disposal Pond-5 (PDP-5).

1.2 Site Background

The MLSES generates bottom ash, fly ash, and flue gas desulfurization (FGD) material during electricity generation. The following surface impoundments, shown on Figure 1, are in operation at the MLSES and subject to the CCR rule.

1.2.1 The Bottom Ash Ponds (BAPs)

The BAPs include the West Ash Pond (WAP) and the East Ash Pond (EAP). The WAP and EAP receive sluice water from bottom ash dewatering bins and other process wastewater sources that typically include bottom ash fines. The BAPs were originally constructed in 1977 with a 2-feet thick compacted clay liner. In 1989, the WAP was relined with a 60-mil high density polyethylene (HDPE) geomembrane over 3 feet of clay on the sideslopes, and the floor with a double 60-mil HDPE geomembrane with a geonet leak detection layer overlying an 18-inch thick clay liner. Both the sideslopes and floor are overlain with a 4-inch thick concrete revetment mat. In 2010, the sideslopes and floor of the EAP were relined with a double 60-mil HDPE geomembrane with a geonet leak detection layer overlying an 18-inch thick clay layer. A geotextile layer was placed between the lower geomembrane and the clay. The liner system on the sideslopes and floor of the EAP are overlain with a 4-inch thick concrete revetment mat.

1.2.2 New Scrubber Pond (NSP)

The NSP, abutting the southeastern portion of the WAP and the southern portion of the EAP, is used to manage FGD wastes and discharge from the sludge thickener sumps, the plant yard sumps, and stormwater management areas. Water collecting in the NSP serves as wet-well make-up water as well as emergency make-up water in the scrubber area. The NSP was originally constructed with the BAPs and lined with clay liner. In 1989, the NSP was relined with a double 60-mil HDPE geomembrane with a geonet leak detection layer. A geotextile layer was placed between the lower geomembrane and the subgrade and a 4-inch thick concrete revetment mat covers the upper geomembrane.

1.2.3 Permanent Disposal Pond-5 (PDP-5)

PDP-5 is primarily used to manage excess liquids including stormwater and excess process wastewater from both the New Scrubber Pond and Bottom Ash Ponds. Recovered CCR wastewaters are received in PDP-5 during cleaning cycles. PDP-5 was constructed in 2010/2011, above PDP-1, PDP-2, and PDP-3, which were previously closed as landfills. PDF-5 is lined with a 3-foot thick clay liner on the sideslopes and a 2-foot thick clay liner on the floor, both overlain with a 0.5-foot thick protective cover soil layer.

1.3 Previous Slope Stability Evaluations

Golder and ETTL Engineers and Consultants (ETTL) have previously performed evaluations on the BAPs, the NSP and PDP-5 as part of the following reports submitted to Luminant:

- Ash and Scrubber Ponds and Permanent Disposal Pond #4, Stability Investigation Report, Luminant Martin Lake SES, Rusk County, Texas, Golder, dated December 2012.
- Geotechnical Investigation, Luminant Martin Lake SES, Reline East Ash Disposal Pond, Tatum, Texas, ETTL, dated December 2008.

The studies found the BAPs and NSP slopes to be adequately stable.

ETTL performed stability evaluations on PDP-5 in 2009, as presented in the following report:

- Geotechnical Investigation, Luminant Martin Lake SES, Vertical Expansion of Permanent Disposal Ponds 1, 2, and 3, Tatum, Texas. ETTL Engineers and Consultants Inc. Tyler, Texas, dated July 2008.
- Geotechnical Investigation, Luminant Martin Lake SES, Vertical Expansion of Permanent Disposal Ponds 1, 2, and 3, Tatum, Texas – Supplemental Seepage and Slope Stability. ETTL Engineers and Consultants Inc., dated October 2009.

The above reports found the design slopes of PDP-5 to be stable as long as drainage is functional, preventing the embankments from saturating.

2.0 SUBSURFACE CONDITIONS

The MLSES site is located in the Martin Creek area which is situated in the Sabine River Valley and lies on the west flank of the Sabine Uplift. The formations in the region comprise sedimentary deposits of continental and marine origin, mainly the lower Wilcox Group flanked by younger beds like the Carrizo Sand. In the Martin Creek area, the Wilcox formation is estimated to be about 650- to 700-feet thick and consists of sandy clays, silty sands, clays, and lignite in varying amounts. The Rockdale formation is the major component in the area among the sediments of the Wilcox group occupying approximately the middle four-fifths of the Wilcox Section. The Wilcox Group is underlain by the Paleocene Midway Group (containing Upper Willis and Lower Kincaid), which is estimated to be 900-feet thick around the site, and is composed mainly of silty clay and clay. The Midway Group overlies a section of Cretaceous Rocks that are approximately 7000-feet thick (Rone Engineers, 1984).

2.1 Site Geology

2.1.1 Bottom Ash Ponds and New Scrubber Pond

2.1.1.1 Subsurface Investigations and Laboratory Testing

Information from previous subsurface investigations was used to characterize the subsurface site conditions. In 2008, ETTL conducted a subsurface investigation for the EAP as part of an effort to reline the pond. ETTL drilled twelve borings along the crest of the EAP embankment at approximate elevation 330 feet – mean sea level (ft-msl). All borings were 40-feet deep except one which was 100-feet deep. The boring map and boring logs are presented in Appendix A. Geotechnical laboratory testing – moisture contents, Atterberg limits, grain size distribution, and consolidated-undrained (CU) triaxial compression tests - was conducted on selected samples. The soil index testing results presented as part of the boring logs, while the CU test results from ETTL are summarized in Appendix B.

Golder conducted a subsurface investigation for the WAP and NSP in December 2012. Golder completed eight, 50- to 60-foot deep borings along the crest of the pond embankments at approximate elevation 330 ft-msl. The boring map and boring logs are presented in Appendix A. As part of the investigation, laboratory testing was performed on selected samples in accordance with commonly accepted methods and practices. Undisturbed and disturbed soil samples were tested to determine water content, Atterberg limits, grain size distribution, and shear strength. Water content determination was performed in accordance with ASTM D2216; Atterberg limits were determined in accordance with ASTM D4318; and grain size distribution was performed in accordance with ASTM D422. Shear strength testing consisted of unconsolidated-undrained (UU) triaxial compression in general accordance with ASTM D2850. Laboratory test results are presented in Appendix B.

The findings from the above subsurface investigations were reviewed for their applicability to this study, and are summarized in the following sections.

2.1.1.2 Subsurface Site Conditions

The above borings consisted of fill and native soils. The soils encountered in the borings generally consisted of stiff to hard sandy clays and firm to very dense sands. The subsurface stratigraphy generally consisted of interchanging layers of clays, sandy clays, clayey sands and non-plastic sands. The clayey sand layers ranged in thickness from 2 to 16 feet where encountered. The sandy clay and clay layers are described as firm to hard, low to high plasticity clays and vary in thickness from 2 to 38 feet. Loose to very dense, silty or poorly graded sand was typically encountered beneath or interlayered with the sandy clay/clayey sand strata. The 100-foot boring by ETTL showed deeper layers of very dense silty sand with intermittent layers of hard low plasticity clay.

Water was encountered in each of the eight borings performed by Golder, ranging between El. 296.1 to 303.3 ft-msl. The average water elevation measured in the Golder boreholes, during drilling, was at El. 300.3 ft-msl. The ETTL borings measured the water level to range between El. 304 to 309 ft-msl, with an average water level of El. 306 ft-msl.

Groundwater levels measured in 2015, from wells surrounding the BAPs vary from approximately El. 304 ft-msl in the southeast corner to El. 307 ft-msl in the northwest corner.

2.1.2 Permanent Disposal Pond - 5

2.1.2.1 Subsurface Investigations and Laboratory Testing

In 2008, ETTL performed a pre-construction subsurface investigation for PDP-5 that included a total of eleven borings within the PDP-5 footprint. In addition, three cone penetrometer tests (CPTs) were performed. As part of a supplemental investigation in 2009, ETTL drilled four additional borings within the pond footprint. A map of borings, and boring and CPT logs are presented in Appendix A.

ETTL performed laboratory tests including natural moisture contents (ASTM D2216), Atterberg limits (ASTM D4318), particle size distributions (ASTM D 1140 and ASTM D422). Unconsolidated-undrained (UU) triaxial compression tests (ASTM D2850) were performed to determine the strength characteristics of cohesive substrata. Direct shear tests (ASTM D3080) were performed on coarser materials including remolded bulk ash samples. Consolidation tests (ASTM D2435) and permeability tests (ASTM D5084) were also performed but are not relevant to the current study. The results of the laboratory tests performed by ETTL are presented in Appendix B.

2.1.2.2 Subsurface Site Conditions

Most of the above borings were drilled through the bottom ash within closed PDP-1, 2, and 3. Based on particle size, the ash classifies as very loose to medium dense poorly graded sands in some locations, to silts in other locations and depths. The borings passing through existing embankments of PDP-1, 2, and 3 contained medium stiff to very stiff clay of low plasticity and/or high plasticity clay with clayey sand. Native soils were identified in deeper borings as very dense silt with hard low plasticity clay seams.

Since the subsurface investigations for the PDP-5 area were performed prior to construction of the PDP-5 embankment, there are no borings that pass through the embankment. However, ETTL (ETTL 2009) identified a site borrow source (characterized as sandy materials), soils from which were to be used in the construction of the embankment. Triaxial strength testing (CU tests) were also performed on these site soils, and hence, the embankment strength has been estimated.

Two borings located outside of the ash encountered water approximately between El. 355 to 368 ft-msl. Groundwater levels measured in 2015, from wells surrounding PDP-5, indicate that the groundwater level varies from approximately El. 355 ft-msl in the north to El. 375 ft-msl in the south.

3.0 STABILITY ANALYSIS - §257.73(e)

3.1 Safety Factor Assessment

According to the CCR rules, structural stability factors of safety need to be evaluated for the critical cross-section of each CCR facility under static and seismic loading for “Maximum Storage Pool” (2 feet of freeboard for this facility) and “Maximum Surcharge Pool” (no freeboard)conditions. Liquefaction potential analysis is only necessary when soil sampling, construction documentation or anecdotal evidence from personnel with knowledge about the facility, indicates that soils of the embankment are susceptible to liquefaction. Since ash classifying as sandy soil is present below portions of the PDP-5 embankment, liquefaction potential is considered for PDP-5 foundation soils.

The safety factor assessment [§257.73(e)] does not require evaluation of rapid-drawdown loading conditions; however, if the CCR unit has downstream slopes that can be inundated by an adjacent water body, the structural stability assessment requirements [§257.73(d)(1)(viii)] state that these slopes must be assessed. Since one of the cross-sections analyzed in this Safety Factor Assessment may be subjected to rapid draw-drawdown conditions, this condition was evaluated and presented herein. The results of the analysis are also reported in the Structural Stability Assessment Report (Golder, 2016).

Slope stability analyses were performed using a limit-equilibrium-based commercial computer program, Slide v7.0 by Rocscience. The analyses used a searching routine to identify the potential failure surface with minimum factor of safety for a given set of geometry, ground and groundwater conditions. The Spencer method of analysis was used in the analyses, while the Morgenstern Price method was used for verification. The factors of safety of numerous potential failure surfaces were computed to establish minimum factors of safety. Circular failure surfaces were considered for all cases. Stability analyses were performed for “Maximum Storage Pool” (freeboard of 2 feet) and “Maximum Surcharge Pool” (no freeboard) conditions for both the interior and exterior slopes of the ponds. In addition, the interior slopes were analyzed while the pond is empty. For each case, respective slopes were analyzed for both static and seismic loading conditions. The interior berms separating individual ponds were not analyzed since the failure of the interior berms will not result in any release of CCR materials beyond the embankment surrounding the BAPs and NSP.

3.2 Cross-Sections Analyzed

3.2.1 Bottom Ash Ponds and New Scrubber Pond

The BAPs and NSP are contiguous ponds surrounded by a continuous embankment that was built using the same site soils. Hence, the embankment is considered as one structure and a critical cross-section was identified after considering multiple cross-sections across the entire embankment. The geometry of the slopes, soil profile, loading conditions, and phreatic surface of each segment of the embankment were evaluated in identifying the critical cross-section. Cross-section (A-A'), located on the eastern slope of the EAP as shown on Figure 1, was identified as the critical cross-section for the BAPs and NSP and was selected for evaluation of factors of safety under the loading conditions identified in §257.74(e)(1)(i) - (iv).

3.2.2 Permanent Disposal Pond – 5

The geometry of the slopes, soil profile, loading conditions and phreatic surface of each segment of the embankment surrounding the PDP-5 was evaluated. Cross-Section B-B', located on the south side of PDP-5 as shown on Figure 1, was identified as the critical cross-section and was selected for evaluation of factors of safety under the loading conditions identified in §257.74(e)(1)(i) - (iv).

3.3 Material Properties

3.3.1 Bottom Ash Ponds and New Scrubber Pond – Cross Section A-A'

Based on the previous subsurface investigations, appropriate material properties were selected for use in the stability analysis. CU triaxial testing was performed on three samples on the BAP embankments, by ETTL (2008). The effective stress parameters from these three tests are averaged and used in the analysis. For the subsequent foundation soil layers, values of shear strength are chosen either based on testing of deeper samples by ETTL or by assuming typical, conservative values for sandy soils. Table 1 summarizes the material properties used in the stability analysis of Section A-A'.

Table 1: Soil Properties for Section A-A'

Soil Material	Description	Moist Unit Weight (lb/ft^3)	Saturated Unit Weight (lb/ft^3)	Drained Soil Properties	
				Cohesion, c' (lb/ft^2)	Friction Angle, ϕ' (°)
I	Fat Clay	120	125	542	23
II	Silty Sand	127	132	0	30
III	Clayey Sand	127	132	0	32
IV	Sand/Silty Sand	127	132	0	34

3.3.2 Permanent Disposal Pond – 5 – Cross Section B-B'

Based on the borings and CU tests performed as part of the 2009 investigation by ETTL, shear strength parameters were chosen for the soil layers for cross-section B-B'. For the deep sand layer, a conservative friction angle of 34° and zero cohesion was assumed. Table 2 summarizes the material properties used in the stability analysis of cross-section B-B'.

Table 2: Soil Properties for Section B-B’

Soil Material	Description	Moist Unit Weight (lb/ft^3)	Saturated Unit Weight (lb/ft^3)	Drained Soil Properties	
				Cohesion, c’ (lb/ft^2)	Friction Angle, ϕ’ (°)
I	New embankment	125	130	0	34.7
II	Clay liner	127	132	650	31.4
III	Old ash	90	95	0	34.6
IV	Native clay	127	132	175	31.9
V	Sandy Clay/Clayey Sand	127	132	650	31.4
VI	Deep sand	127	132	0	34

3.4 Phreatic Surface

3.4.1 Bottom Ash Ponds and New Scrubber Pond

For the purpose of this report, the phreatic surface is defined as the potential saturated zone within the embankment that could exist due to infiltration of water from the ponded CCR. As discussed earlier, measurements within the monitoring wells indicate groundwater levels across the BAPs and NSP vary between El. 304 to 307 ft-msl. At cross-section A-A’, the groundwater level is assumed to be El. 306 ft-msl. The interior slopes of the ponds have a clay liner, a double HDPE geomembrane layer, overlain by a concrete revetment. Hence, it is unlikely that the phreatic surface will extend into the embankment, or into the ground below on the floor of the ponds.

Drawdown of the water level in Martin Lake can potentially affect the stability of Section A-A’. Based on the historic water level data available from the Texas Water Development Board (TWDB 2016), the maximum drawdown was observed to be about 10 feet. This drawdown, however, was not instant but spread across a period of approximately one year. Hence, effective stress-transient drawdown analyses were conducted for the exterior slope at Section A-A’, for a 10-foot drawdown in water level at a uniform rate, over one year.

3.4.2 Permanent Disposal Pond – 5

As mentioned previously, groundwater levels measured in 2015, from wells surrounding PDP-5, indicate that the groundwater level around the pond varies from approximately El. 355 ft-msl in the north to El. 375 ft-msl in the south. Underlying PDP-5, the ash in PDP-1, 2 and 3 is at least partially saturated. A toe drain system keeps the water level within the ash below El. 380 feet. Therefore, the saturated zone within the ash is assumed to be at El. 380 ft-msl for cross-section B-B’ on the upstream side.

For the stability analysis of the exterior embankment slope, the location of the phreatic surface is estimated by allowing steady state seepage conditions to develop based on the water level within PDP-5 and the elevation of the saturated ash in PDP-1, 2 and 3.

Note that the phreatic surface elevations were conservatively assumed for stability analysis purposes -- they do not represent the elevation of the uppermost aquifer.

3.5 Seismic Loading

Based on the “US Seismic Hazard 2014 Map” prepared by the United States Geologic Survey (USGS) and the “2008 Interactive Deaggregations” (USGS), the peak ground acceleration (PGA) for a 2% probability of exceedance in 50 years (return period of 2,475 years) is 0.09g for the site location (including amplification factors for site soil conditions). Hence, a horizontal seismic load coefficient of 0.09g was used in the pseudostatic analysis.

3.6 Liquefaction Potential

Soil liquefaction describes a phenomenon whereby a saturated or partially saturated soil substantially loses strength and stiffness in response to an applied stress, usually earthquake shaking or other sudden change in stress condition, causing it to behave like a liquid. The phenomenon is most often observed in saturated, loose (low density or uncompacted), sandy soils.

3.6.1 Bottom Ash Ponds and New Scrubber Pond

The embankment soils of the BAPs and NSP are composed of clayey materials with significant fines content. The immediate foundation materials are composed of sandy clay and compact to dense sand. The subsurface investigations do not indicate the presence of any soils in the embankment or its foundation that are susceptible to liquefaction. Hence, failure of the pond slopes due to liquefaction is considered unlikely for the BAPs and NSP.

3.6.2 Permanent Disposal Pond - 5

Based on particle size, the bottom ash within PDP-1, 2, and 3 classifies as very loose to medium dense, poorly graded sand at some locations and silts at other locations and depths. Therefore, portions of the foundation soils for PDP-5 embankments are founded above potentially liquefiable material. Based on the above mentioned ETTL reports and the preparation of foundation materials during construction, the foundations and abutments are generally considered to be stable. Nevertheless, due to the classification of the some of the underlying ash as poorly graded sand, the potential for cyclic liquefaction of the ash was evaluated.

As part of the 2008 investigation by ETTL, CPTs were conducted within the ash underlying PDP-5. Golder conducted a liquefaction analysis based on this CPT data using the commercially available program, CLiq v.2.0.6.85 released by GeoLogismiki. The method prescribed by Robertson (2009) was adopted in the cyclic liquefaction analysis. The site earthquake information (magnitude and PGA) was estimated using the seismic hazard tool developed by USGS (USGS 2008).

The analysis showed that all three CPT locations showed a low likelihood for cyclic liquefaction with a factor of safety greater than the minimum factor of safety of 1.20 specified in §257.73(e)(iv). The results from the cyclic liquefaction analysis are presented in Appendix C.

3.7 Stability Analysis Results

Slope stability analyses were performed for long-term conditions for each of the critical cross-sections considered under static and seismic loading conditions. Both interior and exterior slopes were analyzed for “Maximum Storage Pool” (2 feet of freeboard) and “Maximum Surcharge Pool” (no freeboard) conditions. The interior slopes were analyzed for the condition where the pond is empty.

The results of the slope stability analyses cases are presented in Table 3 and Appendix D. The results indicate that the BAP, NSP, and PDP-5 pond slopes are sufficiently stable under all considered loading scenarios.

Table 3: Slope Stability Analysis Results

Pond(s)	Cross-Section	Case #	Slope Location	Pond Pool level	Loading Condition	Req'd Safety Factor (1)	Calculated Safety Factor
BAP and NSP	A-A'	1a	Exterior	Storage	Static	1.50	1.94
		1b			Pseudostatic	1.00	1.45
		1c			Rapid Drawdown	1.30(2)	1.61
		2a		Surcharge	Static	1.40	1.94
		2b			Pseudostatic	1.00	1.45
		3a	Interior	Storage	Static	1.50	6.43
		3b			Pseudostatic	1.00	4.22
		4a		Surcharge	Static	1.40	7.21
		4b			Pseudostatic	1.00	4.60
		5a		Empty	Static	1.50	2.54
		5b			Pseudostatic	1.00	1.91
PDP-5	B-B'	1a	Exterior	Storage	Static	1.50	1.67
		1b			Pseudostatic	1.00	1.13
		2a		Surcharge	Static	1.40	1.67
		2b			Pseudostatic	1.00	1.13
		3a	Interior	Storage	Static	1.50	2.05
		3b			Pseudostatic	1.00	1.31
		4a		Surcharge	Static	1.40	2.43
		4b			Pseudostatic	1.00	1.45
		5a		Empty	Static	1.50	2.31
		5b			Pseudostatic	1.00	1.73

Note: (1) Required safety factors per §257.73(e)(i)-(iii)
(2) Required factor safety per EM 1110–2–1902 (USACE 2003)

4.0 CONCLUSION

Based on our review of the information provided by Luminant, on information prepared by Golder Associates Inc., and on our analyses, the calculated factors of safety through the critical cross sections in the surface impoundments exceed the values listed in §257.73(e)(1)(i)-(iv).

Golder appreciates the opportunity to assist Luminant with this project. If you have any questions, or require further assistance from Golder, please contact the undersigned at (281) 821-6868.

GOLDER ASSOCIATES INC.

Jeffrey B. Fassett

Varenya Kumar Staff Engineer	Jeffrey B. Fassett, PE Associate Geotechnical Engineer

VK/JBF

5.0 CERTIFICATION

I hereby certify that this report has been prepared in general accordance with normally accepted civil engineering practices and in accordance with the requirements of 40 CFR 257.73(e).

STATE OF TEXAS
JEFFREY B. FASSETT
85675
LICENSED
PROFESSIONAL ENGINEER

10/10/16

Jeffrey B. Fassett, PE
Golder Associates Inc.
Firm Registration Number F-2578

6.0 REFERENCES

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REFERENCE(S)
AERIAL PHOTO SOURCED FROM GOOGLE EARTH PRO DATED: 2015-10-01

10/10/16

STATE OF TEXAS
JEFFREY B. FASSETT
85675
LICENSED PROFESSIONAL ENGINEER

Professional Engineering Firm
Registration Number F-2578

0 600 1200
1" = 1200' FEET

CLIENT
LUMINANT POWER
MARTIN LAKE

PROJECT
2016 COAL COMBUSTION RESIDUALS
ENGINEERING SERVICES

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-22
PREPARED	VK
DESIGNED	TNB
REVIEWED	MX
APPROVED	JBF

TITLE
GENERAL SITE MAP

PROJECT NO.	REV.	FIGURE
164816402	----	1

Path: \\houston\drafting_2016\164816402 - luminant martin lake\PRODUCTION\ | File Name: 164816402A002.dwg

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

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APPENDIX A

BORING LOCATION MAP & BORING LOGS

BOTTOM ASH PONDS AND SCRUBBER POND

NOTE: Figure Reference - Golder Associates Inc. 2012. Ash and Scrubber Ponds and Permanent Disposal Pond #4 – Stability Investigation Report, Luminant Martin Lake Power Plant, Rusk County, Texas.

LEGEND

● **BH-101** BORING LOCATION

REFERENCE

1.) AERIAL SHOWN LICENSED FROM GOOGLE EARTH PROFESSIONAL.

700 0 700

SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

LUMINANT - MARTIN LAKE
ASH & SCRUBBER POND SLOPE STABILITY INVESTIGATION REPORT
RUSK COUNTY, TEXAS

TITLE

BORING LOCATIONS

NJ Authorization #24GA28029100

Golder Associates
Mt. Laurel, New Jersey

PROJECT No.		123–94128	FILE No.	12394128A003
DESIGN	MGP	12/04/12	SCALE AS SHOWN	REV. 0
CADD	RG	12/04/12	**FIGURE 1**	
CHECK	MGP	12/04/12		
REVIEW	PCM	12/04/12		

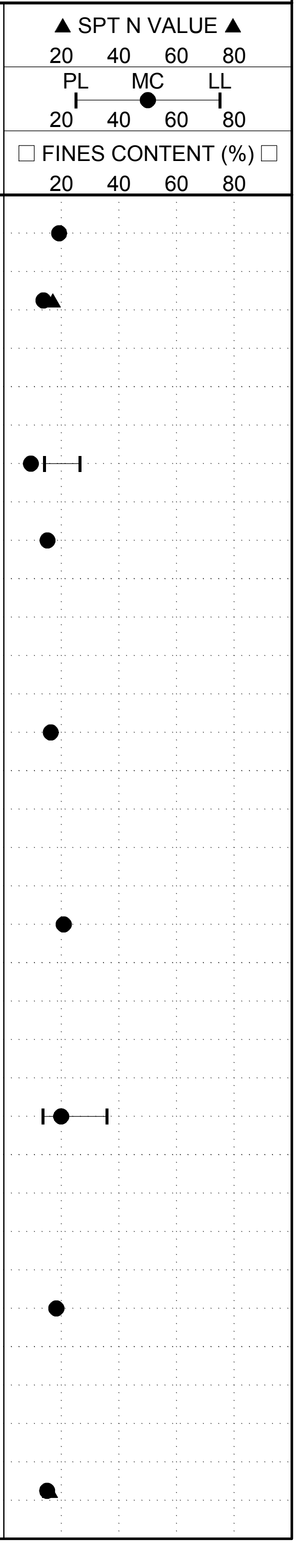
Drawing file: 12394128A003.dwg Dec 06, 2012 – 11:05am

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-201

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 10/28/12 **COMPLETED** 10/28/12
GROUND ELEVATION 330 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
∇ **AT TIME OF DRILLING** 28.30 ft / Elev 301.70 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	Remove 8" sandy gravel as road base					
	(CL) SILTY CLAY, low plasticity, some sand, trace gravels, red, dry, hard	SH 1	44		5.0	
	(SC) CLAYEY SAND, non-plastic, some silt, tan and gray, dry, compact	SS 2	58	15-10-7 (17)		
5	(CL) SANDY CLAY, low plasticity, some silt, red, tan, and gray, mottled, dry, stiff	SH 3	44		3.5	
	(SC) CLAYEY SAND, fine, subangular, non-plastic, little silt, tan and gray, mottled, dry	SH 4	38		1.5	
10	(CL) SANDY CLAY, low plasticity, little silt and gravel, red, tan, and gray, mottled, dry, hard	SH 5	42		4.5	
15	some silt, no gravel, very stiff at 13.0'	SH 6	58		3.5	
20	some sand veins at 18.0'	SH 7	38		3.0	
25	gray, moist at 23.0'	SH 8	58		2.5	
30	∇ (SC) CLAYEY SAND, fine, subangular, low plasticity, some to little silt	SH 9	71		2.0	
35	some silt, tan and gray, mottled, moist at 33.0'	SS 10	100	9-7-9 (16)		



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Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-201

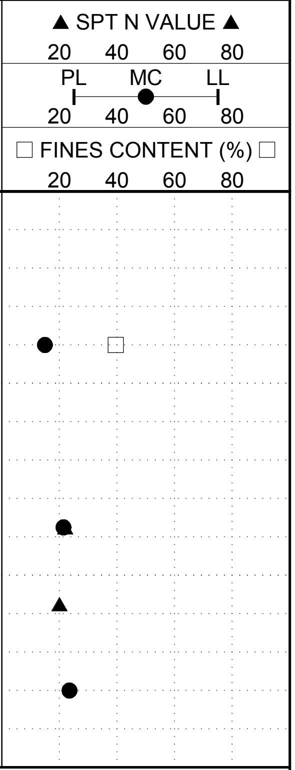
CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35							
		some silty sand veins at 38.0'	SH 11	50		2.0	
40							
		(SM) SILTY SAND, fine, subangular, non-plastic, little clay, tan and red, wet, compact	SS 12	100	11-11-11 (22)		
45							
		(SP) SAND, medium to fine, subangular, poorly graded, some silt, tan, wet, compact	SS 13	100	5-9-11 (20)		
50							



Bottom of borehole at 50.0 feet.

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-202

CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

DATE STARTED 10/29/12 **COMPLETED** 10/29/12

GROUND ELEVATION 330 ft **HOLE SIZE** 8 inches

DRILLING CONTRACTOR WEST Drilling

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

▽ **AT TIME OF DRILLING** 26.70 ft / Elev 303.30 ft

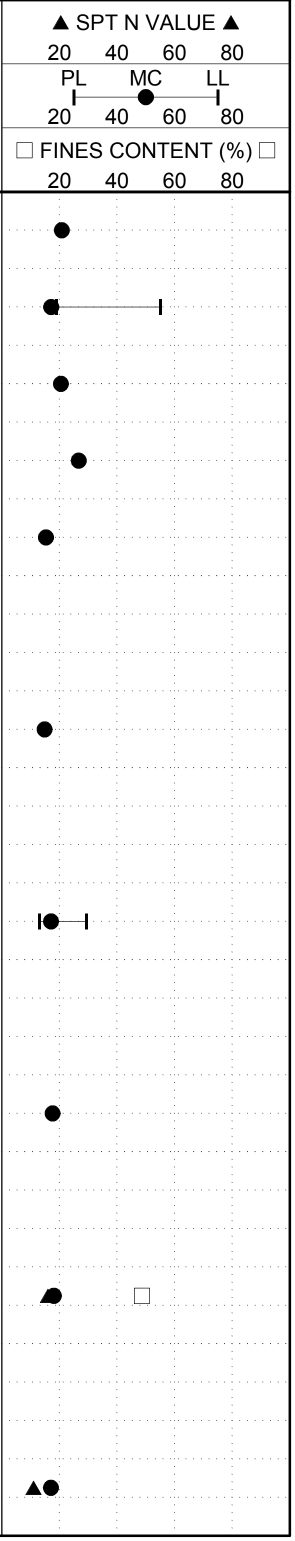
LOGGED BY FW **CHECKED BY** MP

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	Remove 6" sandy gravel from road bed					
	(CH) CLAY, medium to high plasticity, some silt, trace fine sand, tan and gray, dry, very stiff to hard some sand at 2.0'	SH 1	50		4.5	
		SH 2	63		3.5	
5		SH 3	50		5.0	
		SH 4	63		3.75	
	(CL) SANDY CLAY, low plasticity, some to little silt, tan and gray, mottled, moist, firm	SH 5	42		4.0	
10						
	some sand seams, very stiff at 13.0'	SH 6	42		3.0	
15						
	(CL) SILTY CLAY, medium to high plasticity, little find sand, brown, moist, firm	SH 7	58		1.0	
20						
	low plasticity, gray, moist at 23.0'	SH 8	71		5.0	
25	▽					
	(SM) SILTY SAND, fine, subangular, non-plastic, some clay, gray and tan, wet, compact	SS 9	83	7-7-9 (16)		
30						
	(SC) CLAYEY SAND, fine, subangular, low plasticity, some silt, tan and gray, wet, compact	SS 10	100	3-5-6 (11)		
35						



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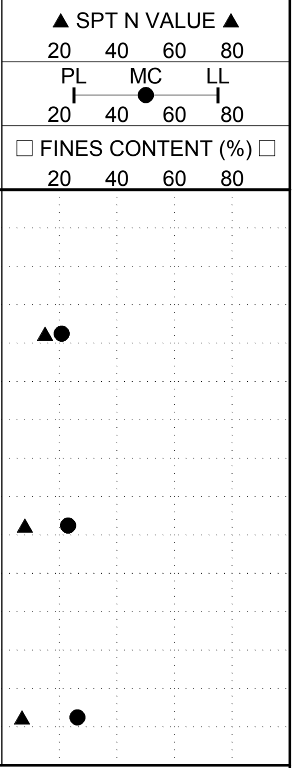
BORING NUMBER BH-202

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35							
		interbedded clay and sand seams at 38.0'	☒ SS 11	100	8-7-8 (15)		
40							
		no seams at 43.0'	☒ SS 12	89	4-4-4 (8)		
45							
		(SP) SAND, medium to fine, poorly graded, subangular, non-plastic, some silt and clay, wet, loose	☒ SS 13	100	2-3-4 (7)		
50							



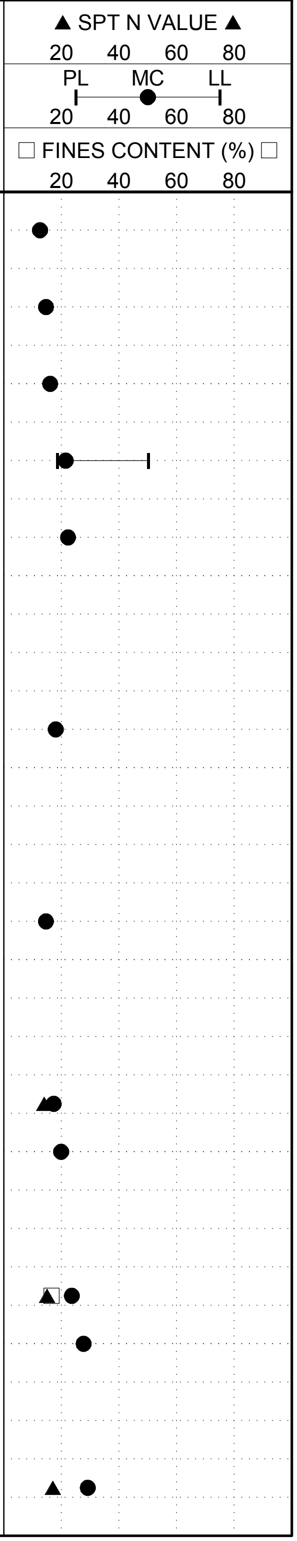
Bottom of borehole at 50.0 feet.

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-203

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 10/30/12 **COMPLETED** 10/30/12
GROUND ELEVATION 330 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 28.80 ft / Elev 301.20 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	remove 14" sandy GRAVEL as roadbed					
	(CL) SILTY CLAY, low plasticity, little sand, gray and tan, mottled, dry, very stiff	SH 1	44		2.75	
	(CL) SANDY CLAY, low plasticity, some silt, gray and tan, mottled, dry, stiff	SH 2	50		1.5	
5	low plasticity, some sand veins, soft	SH 3	42		1.25	
	(CL-CH) CLAY, low plasticity to medium plasticity, some silt, dark to light gray, dry, stiff	SH 4	67		1.75	
	very stiff at 8.0'	SH 5	50		3.25	
10						
	low plasticity, some silt and fine sand, little coarse sand and fine gravels, subrounded, red and tan, stiff at 13.0'	SH 6	38		1.5	
15						
	(CL) SANDY CLAY, low plasticity, some silt, tan and gray, mottled, dry, stiff	SH 7	44		2.0	
20						
	(SC) CLAYEY SAND, low plasticity, some silt, tan and gray, mottled, compact, moist	SS 8	94	3-7-7 (14)		
25						
	▽ low plasticity, with grey silty clay, some sand, tan at 28.0'	SS 9	94	4-7-8 (15)		
30						
	(SM) SILTY SAND, non-plastic, grading to sand, some silt, little to trace clay, gray, wet, compact	SS 10	100	3-8-9 (17)		
35						



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500 Century Plaza Drive, Suite 190
Houston, Texas 77073
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Fax: (281) 821-6870

BORING NUMBER BH-203

PAGE 2 OF 2

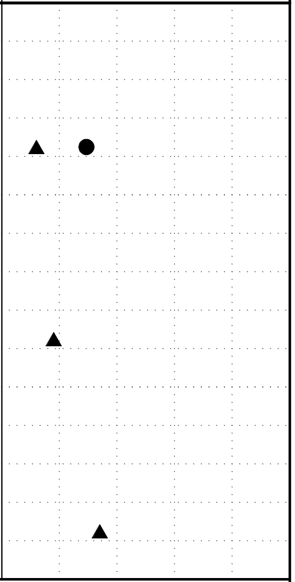
CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 ☐ FINES CONTENT (%) ☐ 20 40 60 80
35								
		some clay and silt veins, tan at 38.0'	SS 11	100	3-6-6 (12)			
40								
		(SC) CLAYEY SAND, low plasticity, some silt, tan and brown, wet, compact	SS 12	100	4-8-10 (18)			
45								
		(SM) SILTY SAND, non-plastic, trace clay, tan and gray, wet, dense	SS 13	100	8-14-20 (34)			
50								



Bottom of borehole at 50.0 feet.

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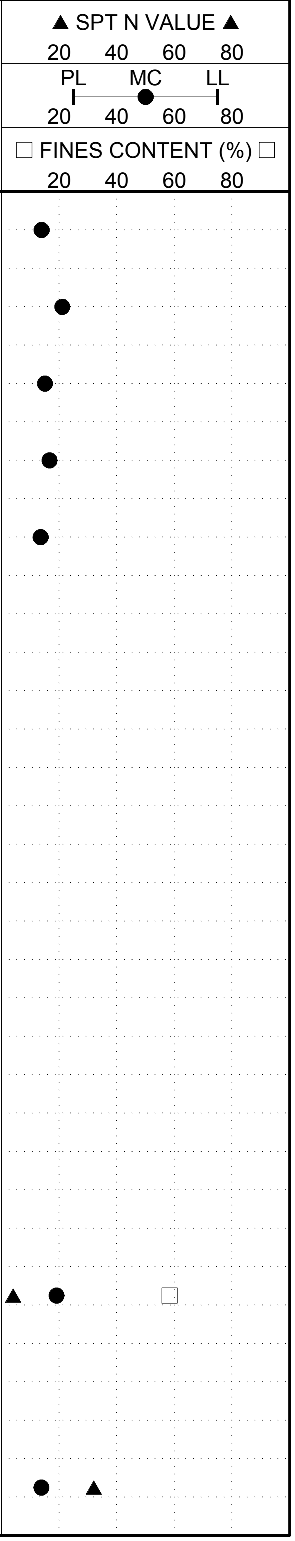
BORING NUMBER BH-204

PAGE 1 OF 2

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 10/30/12 **COMPLETED** 10/30/12
GROUND ELEVATION 330 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 31.80 ft / Elev 298.20 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	removed SANDY GRAVEL from roadbed					
	(CL) SILTY CLAY, low plasticity, some sand, tan and gray, mottled, dry, hard	SH 1	67		4.25	
	(CL) LEAN CLAY, low plasticity, some silt, sand, and sand veins, red and gray, dry, very stiff	SH 2	50		3.0	
5	(SC) CLAYEY SAND, low plasticity, some silt and black sandy gravel veins, tan and gray, dry	SH 3	33		5.0	
	(CL) SANDY CLAY, low plasticity, little silt, tan and gray, dry, stiff	SH 4	58		2.0	
10	(SC) CLAYEY SAND, non-plastic to low plasticity, little silty clay seam, tan, brown, with little gray, dry	SH 5	44		2.5	
15	(CL) LEAN CLAY, low to medium plasticity, some silt, trace fine sand, tan, brown, and gray, mottled, dry, stiff	SH 6	67		2.0	
20	some sand, little silt	SH 7	67		1.5	
25	(CL) SANDY CLAY, low plasticity, little silt, tan and gray, moist, very stiff	SH 8	46		3.0	
30	(ML) SANDY SILT, low plasticity to non-plastic, fine, subangular, some clay, tan and gray, moist, soft	SS 9	100	2-1-3 (4)		
▽						
35	(SM) SILTY SAND, low plasticity to non-plastic, fine, subangular, gray with little brown, dense	SS 10	94	11-14-18 (32)		



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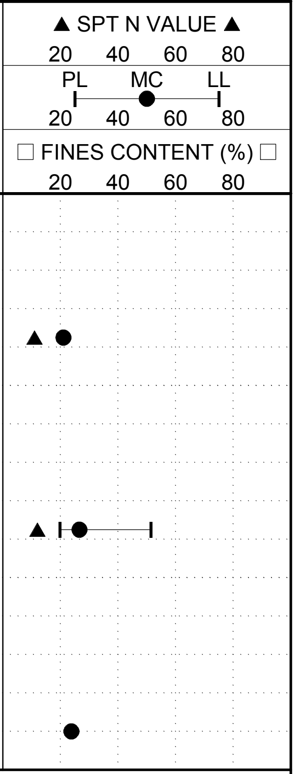
BORING NUMBER BH-204

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35							
		(SC) CLAYEY SAND, fine, subangular, interbedded with gray, silty sand, some clay, tan, wet, compact	SS 11	94	4-5-6 (11)		
40							
		(CH) CLAY, medium plasticity, little silt, trace fine sand, gray, wet, stiff	SS 12	100	3-5-7 (12)		
45							
			SH 13	75		2.0	
50							



Bottom of borehole at 50.0 feet.

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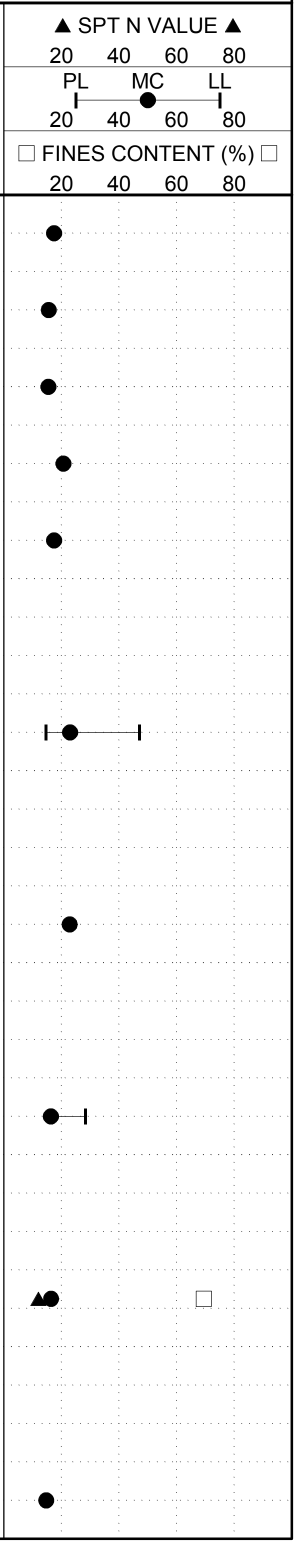
BORING NUMBER BH-205

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 10/30/12 **COMPLETED** 10/30/12
GROUND ELEVATION 330.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 29.40 ft / Elev 301.10 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
(CL) LEAN CLAY, medium plasticity, some silt, trace sand, tan and gray, mottled, dry, hard	SH 1	50		4.0	
with silty sand seams, very stiff at 2.0'	SH 2	60		3.5	
stiff at 4.0'	SH 3	40		1.25	
very stiff at 6.0'	SH 4	58		3.75	
	SH 5	44		3.5	
some to little silt at 13.0'	SH 6	42		3.0	
some clayey sand seams, stiff at 18.0'	SH 7	40		1.5	
(CL) SILTY CLAY, low plasticity, some sand, dark gray, moist, stiff	SH 8	67		1.75	
(CL) SANDY SILTY CLAY, low plasticity, little clay, light gray with little brown, moist, stiff ▽	SS 9	67	2-5-7 (12)		
(CL) SANDY CLAY, low plasticity, some silt, tan and gray, moist, very stiff	SH 10	60		3.0	



DEPTH (ft): 0, 5, 10, 15, 20, 25, 30, 35

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BORING NUMBER BH-205

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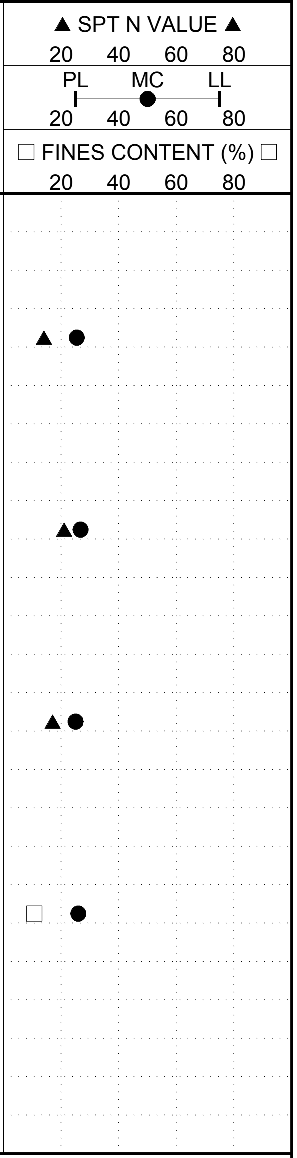
CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35							
		(SC) CLAYEY SAND, interbedded with gray silty SAND, fine, subangular, little clay, compact, wet	SS 11	100	3-6-8 (14)		
40							
		(SP) SAND, fine, subangular, non-plastic, some clay, little silt, tan and brown, wet, compact	SS 12	100	4-9-12 (21)		
45							
		medium to fine, tan at 48.0'	SS 13	100	3-6-11 (17)		
50							
		very loose at 53.0'	SS 14	33			
55							
60							



Bottom of borehole at 60.0 feet.

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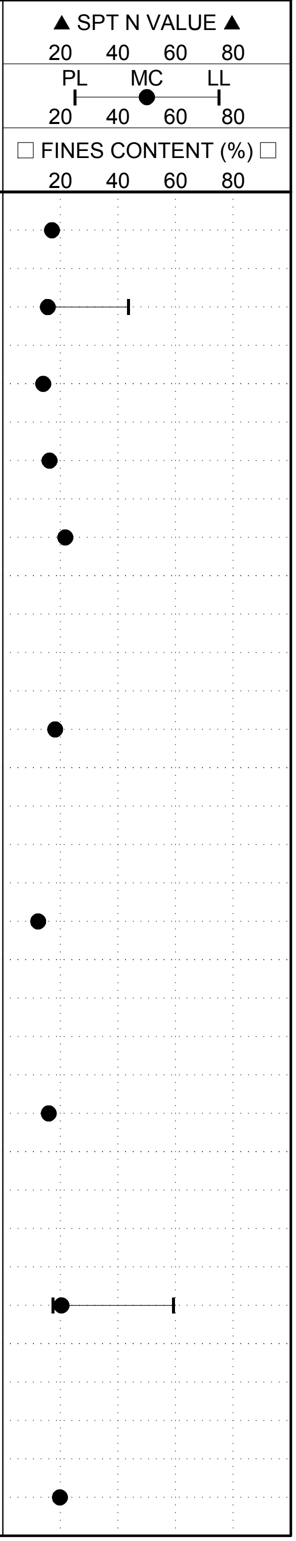
BORING NUMBER BH-206

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 10/30/12 **COMPLETED** 10/30/12
GROUND ELEVATION 330.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 30.20 ft / Elev 300.30 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(CL) SANDY CLAY, low plasticity, some silt, tan and gray, mottled, dry, stiff	SH 1	44		2.25	
	decreased sand content, very stiff at 2.0'	SH 2	67		3.5	
5	interbedded with silty clay layers, very stiff at 4.0'	SH 3	50		2.25	
	some silty sand veins, very stiff at 6.0'	SH 4	67		3.5	
10		SH 5	52		3.5	
15	trace organics, hard at 13.0'	SH 6	54		4.5	
20	with clayey sand veins, hard at 18.0'	SH 7	50		5.0	
25	some red, moist at 23.0'	SH 8	50		4.5	
30	(CH) SANDY CLAY, medium to high plasticity, some silt, tan and gray, very stiff ▽	SH 9	52		3.25	
35	increased sand and silt content, dark gray, stiff at 33.0'	SH 10	56		1.5	



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BORING NUMBER BH-206

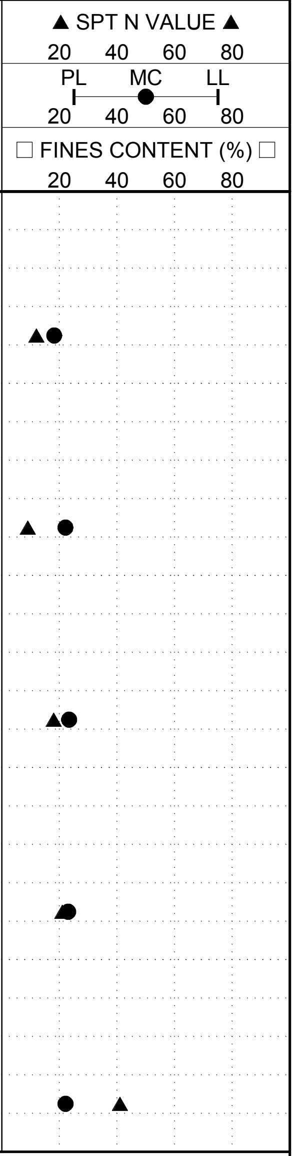
CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

DEPTH (ft) 35	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
40		(SC) CLAYEY SAND, fine, subangular, low plasticity, some to little silt, gray, tan, and red, mottled, wet, compact	SS 11	100	5-6-6 (12)		
45		(SM) SILTY SAND, fine, subangular, non-plastic, some clay, wet, loose	SS 12	100	3-4-5 (9)		
50		(SP) SAND, medium to fine, trace coarse, poorly graded, subangular, non-plastic, some silt, tan, wet, compact	SS 13	100	2-6-12 (18)		
55		no coarse, trace clay at 53.0'	SS 14	100	5-8-13 (21)		
60		dense at 58.0'	SS 15	100	9-18-23 (41)		



Bottom of borehole at 60.0 feet.

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BORING NUMBER BH-207

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CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

DATE STARTED 10/31/12 **COMPLETED** 10/31/12

GROUND ELEVATION 330.5 ft **HOLE SIZE** 8 inches

DRILLING CONTRACTOR WEST Drilling

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

▽ **AT TIME OF DRILLING** 34.40 ft / Elev 296.10 ft

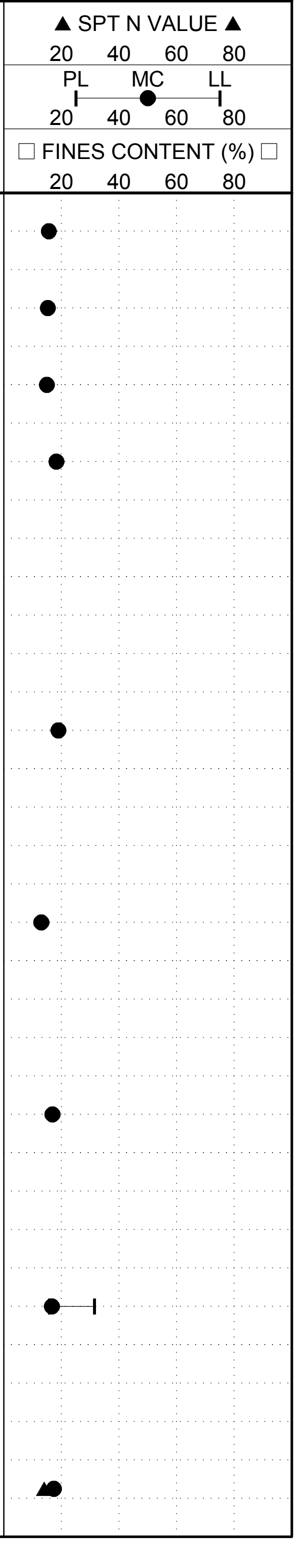
LOGGED BY FW **CHECKED BY** MP

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	remove 8" of SANDY GRAVEL from roadbed					
	(CL) SILTY CLAY, low plasticity, trace fine sand, gray, dry, hard	SH 1	33		5.0	
	(CL) SANDY CLAY, low plasticity, some silt and interbedded sand seams, tan and gray, mottled, dry, firm	SH 2	58		3.0	
5	(SP) SAND, poorly graded, non-plastic, some silt, clay, and gravel, black and tan, dry	SH 3	38		0.0	
	(CL) SANDY CLAY, low plasticity, some silt, gray and tan, dry, firm	SH 4	54		3.0	
10	hard at 8.0'	SH 5	50		5.0	
15	decrease sand content, stiff at 13.0'	SH 6	56		3.75	
20	some sand seams at 18.0'	SH 7	52		2.5	
25	(SM) SILTY SAND, non-plastic, fine, subangular, little clay, gray, moist	SH 8	33			
30	(CL) SILTY CLAY, non-plastic, some sand, gray, moist, hard	SH 9	60		5.0	
35	▽ (SM) SILTY SAND, non-plastic, fine, subangular, little clay, gray with little tan, moist, compact	SS 10	89	6-7-7 (14)		



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Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-207

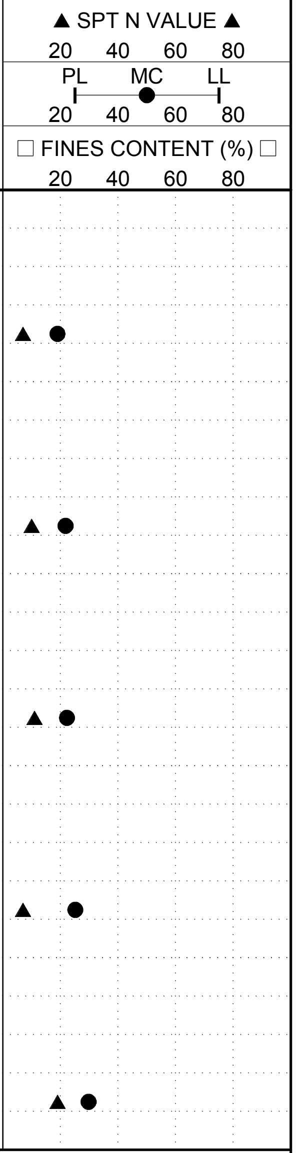
CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35							
40		(SC) CLAYEY SAND, non-plastic, fine, subangular, some silt, gray and tan, wet, loose	SS 11	67	2-3-4 (7)		
45		compact at 43.0'	SS 12	100	3-5-5 (10)		
50			SS 13	100	3-5-6 (11)		
55		(SP) SAND, medium to fine, non-plastic, some silt and clay, gray and tan, wet, loose	SS 14	89	2-2-5 (7)		
60		(CL) SILTY CLAY, low plasticity, trace fine sand, gray, wet, very stiff	SS 15	100	3-7-12 (19)		



Bottom of borehole at 60.0 feet.

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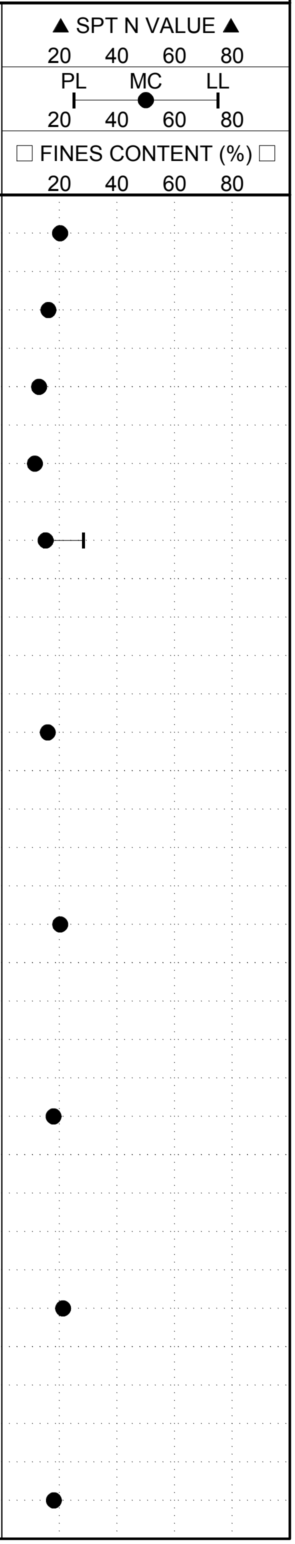
BORING NUMBER BH-208

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 10/31/12 **COMPLETED** 10/31/12
GROUND ELEVATION 330.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 30.00 ft / Elev 300.50 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		remove 12" of SANDY GRAVEL from roadbed					
		(CL) SANDY CLAY, low plasticity, some silt, tan and gray, dry, stiff	SH 1	44		3.5	
		stiff to very stiff at 2.0'	SH 2	50		4.0	
5		hard at 4.0'	SH 3	54		5.0	
		SILTY SAND, nonplastic, some clay, dry	SH 4	31		1.5	
10		(CL) SANDY CLAY, low plasticity, some silt, tan, gray, and red, dry, soft to firm	SH 5	50		2.0	
15			SH 6	40		2.5	
20		very stiff at 18.0'	SH 7	50		3.5	
25		hard at 23.0'	SH 8	46		5.0	
30	▽	some sand seams, moist, very stiff at 28.0'	SH 9	54		3.0	
35		(SC) CLAYEY SAND, fine, subangular, some silt, tan, gray, and red, moist	SH 10	60		2.5	



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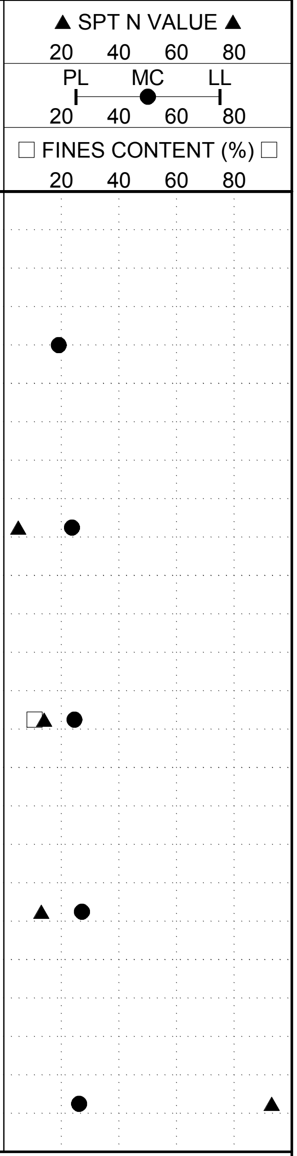
BORING NUMBER BH-208

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake

MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
wet at 38.0'	SH 11	50			
loose at 43.0'	SS 12	100	3-2-3 (5)		
(SP) SAND, fine, little medium, non-plastic, subangular, little clay, tan, compact	SS 13	72	1-6-8 (14)		
	SS 14	100	3-6-7 (13)		
(SC) CLAYEY SAND, medium, some silt, brown					
(SM) SILTY SAND, fine, subangular, non-plastic, little clay, gray, compact					
(CL) SILTY CLAY, low plasticity, dark gray, dense	SS 15	100	7-43-50 (93)		
SANDY GRAVEL, non-plastic, planar, lignite coal seam, black, hard					

Bottom of borehole at 60.0 feet.



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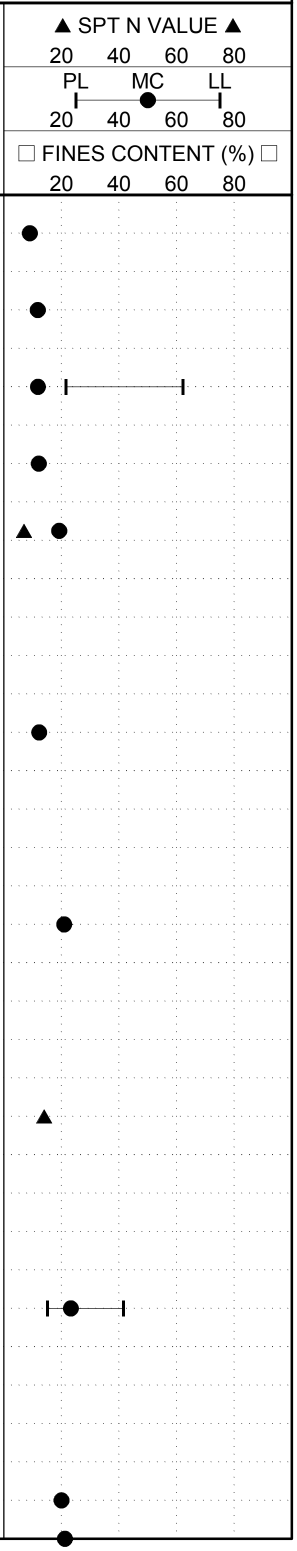
BORING NUMBER BH-209

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 11/1/12 **COMPLETED** 11/1/12
GROUND ELEVATION 360 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 46.20 ft / Elev 313.80 ft no reading, cave in at 46
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
(SC) CLAYEY SAND, fine, subangular, medium plasticity, some fine rounded gravel, red and brown, dry	SH 1	33		5.0	
trace fine rounded gravel, tan and gray, mottled at 2.0'	SH 2	38		5.0	
little silt, no gravel at 4.0'	SH 3	38		5.0	
some silt at 6.0'	SH 4	29		4.5	
(CL) SANDY CLAY, low plasticity, some silt, tan and gray, dry, firm	SS 5	33	2-2-5 (7)		
some red, hard at 13.0'	SH 6	21		5.0	
gray, moist, very stiff at 18.0'	SH 7	29		2.5	
(CL) LEAN CLAY, low plasticity, some silt, trace fine sand, gray and tan, moist, stiff	SS 8	67	4-6-8 (14)		
little silt, hard, gray at 28.0'	SH 9	50		5.0	
grading to clayey sand, very stiff at 33.0'	SH 10	42		3.0	



DEPTH (ft): 0, 5, 10, 15, 20, 25, 30, 35

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Fax: (281) 821-6870

BORING NUMBER BH-209

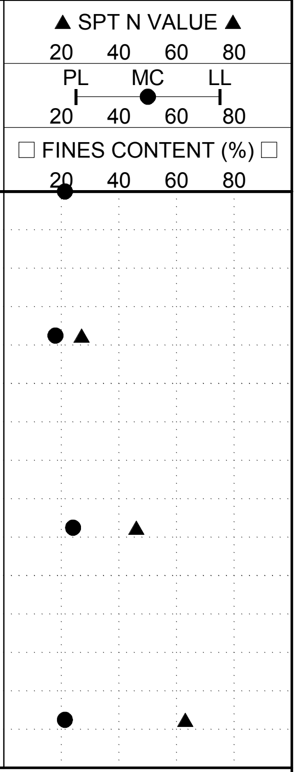
CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35							
		some silt and sand, gray, tan, and brown, hard at 38.0'	SS 11	100	7-13-14 (27)		
40							
		(CL) SILTY CLAY, low plasticity, dark gray, moist, hard	SS 12	100	12-20-26 (46)		
45							
		▽					
		(SM) SILTY SAND, fine, subangular, non-plastic, some clay, tan and gray, moist, very dense	SS 13	100	14-27-36 (63)		
50							



Bottom of borehole at 50.0 feet.

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-210

CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

DATE STARTED 11/1/12 **COMPLETED** 11/1/12

GROUND ELEVATION 360 ft **HOLE SIZE** 8 inches

DRILLING CONTRACTOR WEST Drilling

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

▽ **AT TIME OF DRILLING** 47.00 ft / Elev 313.00 ft no reading, cave in at 47

LOGGED BY FW **CHECKED BY** MP

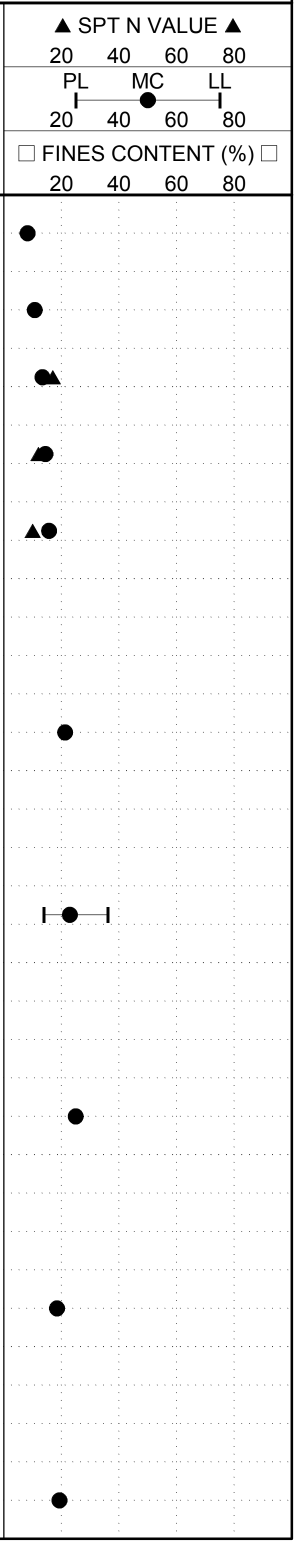
AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
(SC) CLAYEY SAND, fine, subangular, some silt, little fine rounded gravel, red, dry trace roots at 1.0'	SH 1	25		5.0	
tan, gray, and red, mottled at 2.0'	SH 2	21		5.0	
compact at 4.0'	SS 3	67	4-7-10 (17)		
	SS 4	39	3-6-6 (12)		
	SS 5	33	3-4-6 (10)		
(CL) SANDY CLAY, low to medium plasticity, little silt, red and gray, dry, very stiff	SH 6	21		3.0	
some silt and sand seams, gray and tan, moist, very stiff at 18.0'	SH 7	89		3.5	
little red, hard at 23.0'	SH 8	50		4.5	
trace subrounded fine gravels and coarse sand at 28.0'	SH 9	29		4.0	
(SC) CLAYEY SAND, fine, subangular, some silt, brown and tan, moist	SH 10	35		4.0	

DEPTH (ft): 0, 5, 10, 15, 20, 25, 30, 35



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500 Century Plaza Drive, Suite 190
Houston, Texas 77073
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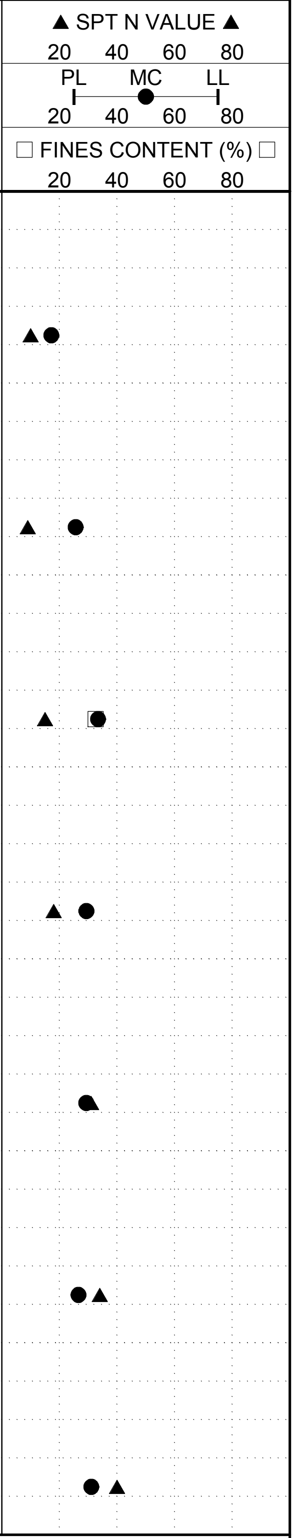
Fax: (281) 821-6870

BORING NUMBER BH-210

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35							
		(SM) SILTY SAND, fine, subangular, non-plastic, little clay, dark gray, moist, compact	SS 11	50	4-5-5 (10)		
40							
		(CL) SILTY CLAY, low plasticity, little fine sand, gray, moist, stiff	SS 12	94	2-4-5 (9)		
45							
	∇						
		(SM) SILTY SAND, fine, subangular, non-plastic, some clay, gray and tan, mottled, wet, compact	SS 13	100	4-7-8 (15)		
50							
			SS 14	89	5-9-9 (18)		
55							
		little tan, dense at 58.0'	SS 15	100	7-14-17 (31)		
60							
			SS 16	100	11-15-19 (34)		
65							
		some dark brown clay seams at 68.0'	SS 17	100	10-15-25 (40)		
70							



Bottom of borehole at 70.0 feet.

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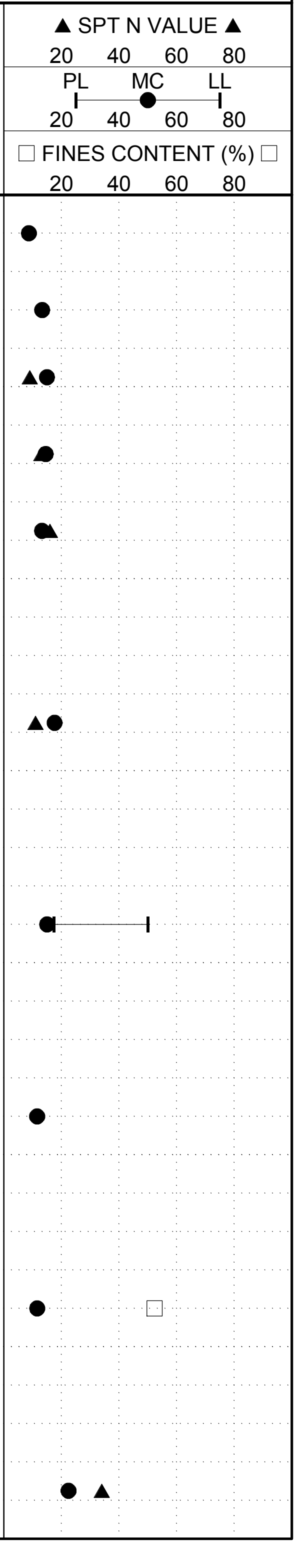
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-211

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake
DATE STARTED 11/2/12 **COMPLETED** 11/2/12
GROUND ELEVATION 360 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 60.20 ft / Elev 299.80 ft no reading, cave in at 60
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
(SC) CLAYEY SAND, some silt and fine rounded gravel, red, dry	SH 1	29		5.0	
fine, subangular, gray, tan, and red at 2.0'	SH 2	29		3.5	
trace fine gravels and coarse sand, loose at 4.0'	SS 3	50	2-3-6 (9)		
some sandy clay seams, compact at 6.0'	SS 4	39	4-5-8 (13)		
increase clay and silt content at 8.0'	SS 5	72	4-8-8 (16)		
(CL-CH) SANDY CLAY, low to medium plasticity, little silt, gray, tan, and red, dry, stiff	SS 6	33	2-5-6 (11)		
some silt at 18.0'	SH 7	50		3.25	
brown and tan at 23.0'	SH 8	44		5.0	
(ML) SANDY SILT, little clay, tan, moist	SH 9	25			
(SM) SILTY SAND, fine, subangular, some clay, tan and gray, dense	SS 10	67	7-15-19 (34)		



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Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

BORING NUMBER BH-211

PAGE 2 OF 2

CLIENT Luminant

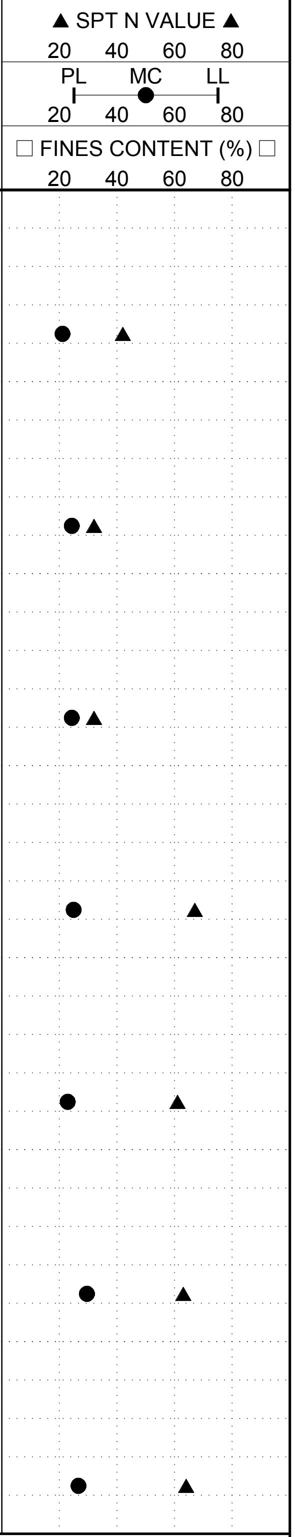
PROJECT NAME Pond Slope Stability

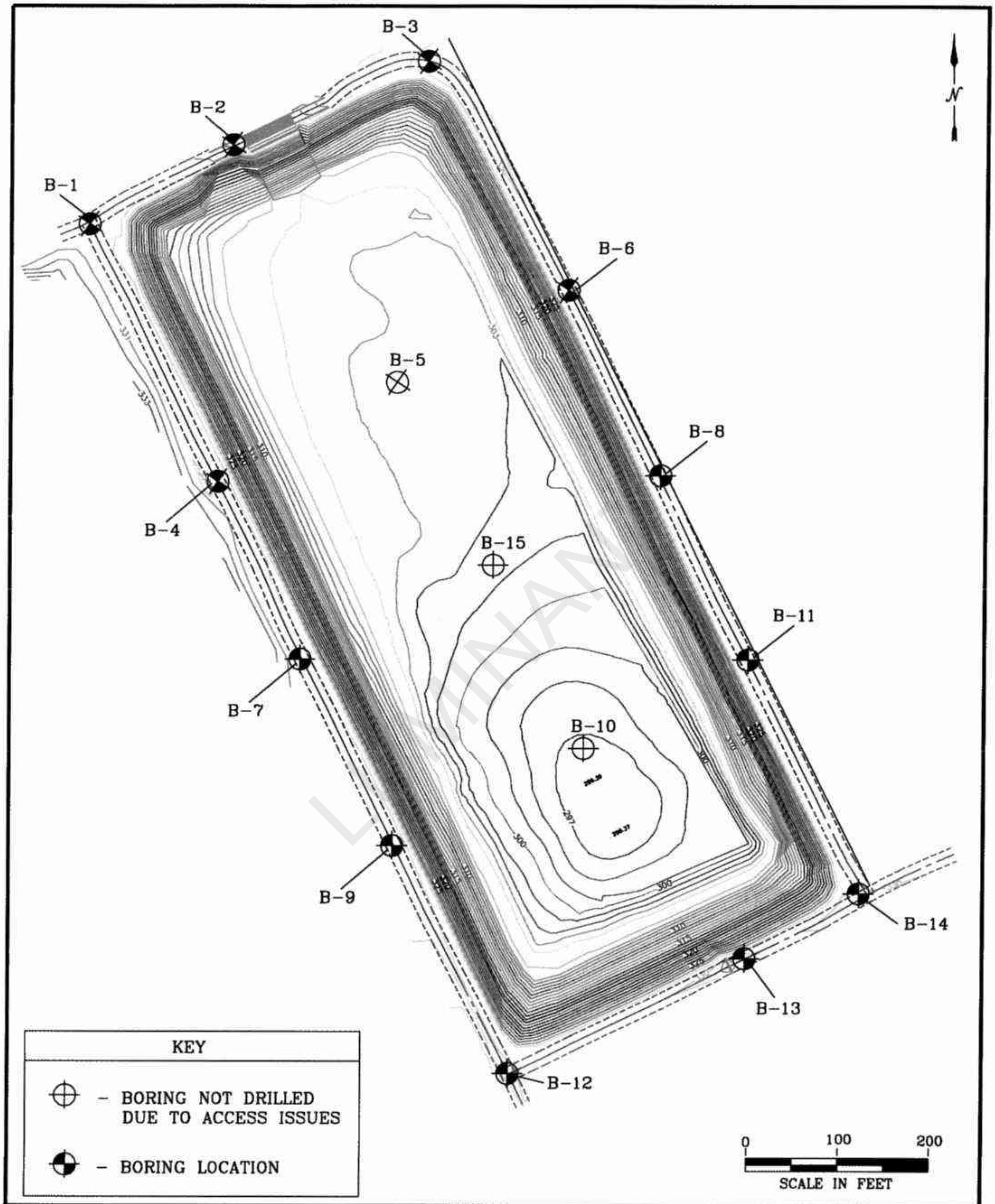
PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
35						
40		SS 11	89	9-17-25 (42)		
45		SS 12	100	10-14-18 (32)		
50	(SC) CLAYEY SAND, low plasticity, fine, subangular, some silt and lean clay, gray and tan, wet, dense	SS 13	89	9-14-18 (32)		
55	(SP) SAND, fine, subangular, non-plastic, some silt, little to trace clay, tan, wet, very dense	SS 14	100	17-29-38 (67)		
60	little medium at 58.0' ∇	SS 15	78	14-28-33 (61)		
65		SS 16	100	17-29-34 (63)		
70	(SM) SILTY SAND, fine, subangular, non-plastic, little to trace clay, gray and tan, wet, very dense	SS 17	72	18-27-37 (64)		

Bottom of borehole at 70.0 feet.





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MARTIN LAKE
LUMINANT
EAST ASH DISPOSAL POND
RUSK COUNTY, TEXAS

PLATE 1 - PLAN OF BORINGS

JOB NO.: G 2972-08

DATE: NOV. 2008

SCALE: AS SHOWN

APPROVED BY:

DRAWN BY:
K.C.R.

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1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

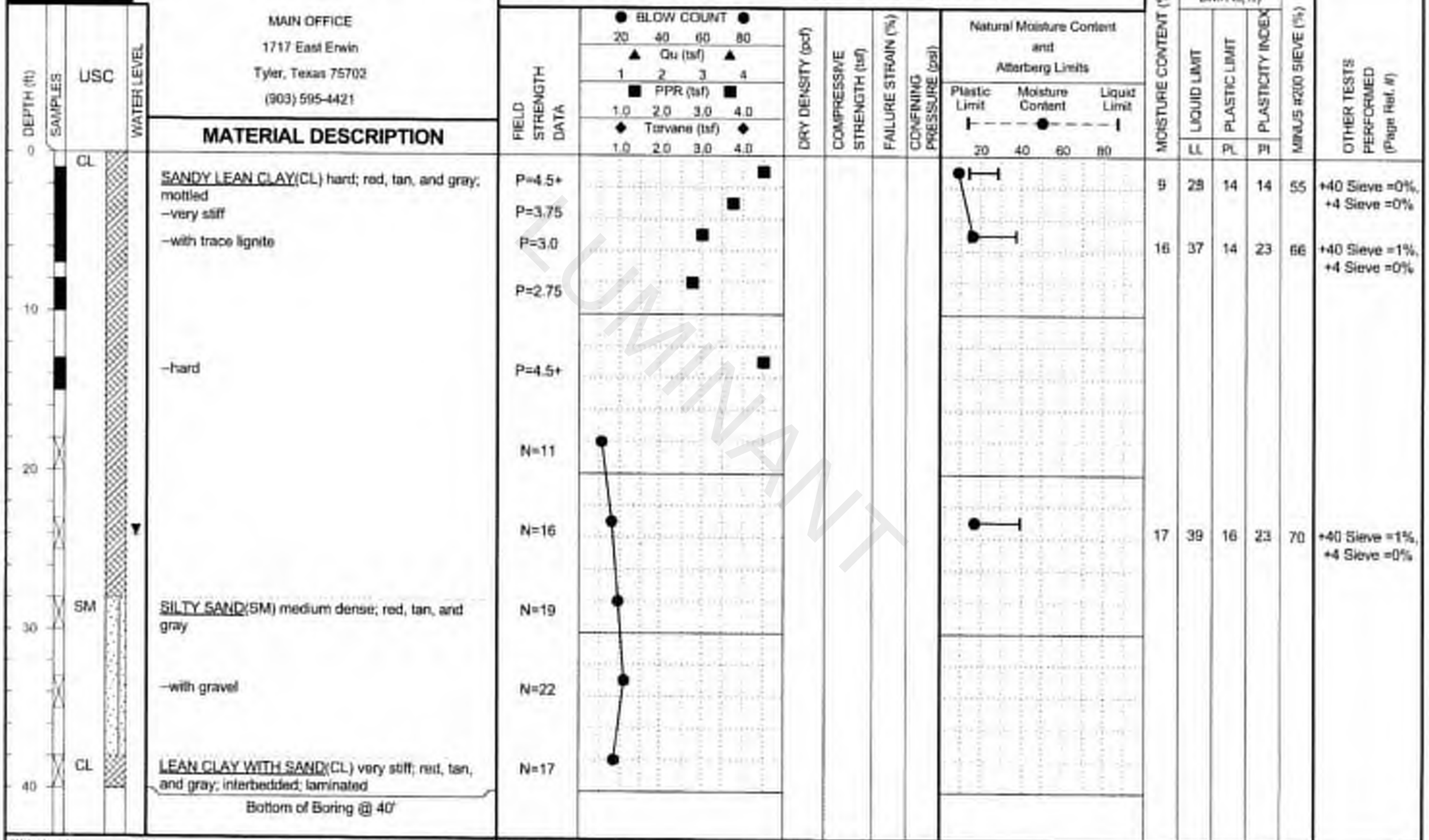
LOG OF BORING B-1

PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/8/08

SURFACE ELEVATION



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SANDY LEAN CLAY(CL) hard; red, tan, and gray; mottled	P=4.5+	9	28	14	14	55	+40 Sieve =0%, +4 Sieve =0%
–very stiff	P=3.75						
–with trace lignite	P=3.0	16	37	14	23	66	+40 Sieve =1%, +4 Sieve =0%
	P=2.75						
–hard	P=4.5+						
	N=11						
	N=16	17	39	16	23	70	+40 Sieve =1%, +4 Sieve =0%
SILTY SAND(SM) medium dense; red, tan, and gray	N=19						
–with gravel	N=22						
LEAN CLAY WITH SAND(CL) very stiff; red, tan, and gray; interbedded; laminated	N=17						
Bottom of Boring @ 40'							

Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 28' while drilling. Water level @ 26' and open to 33' upon completion. Water level @ 24' and open to 27' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.850', W 94°33.910'

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LOG OF BORING B-11

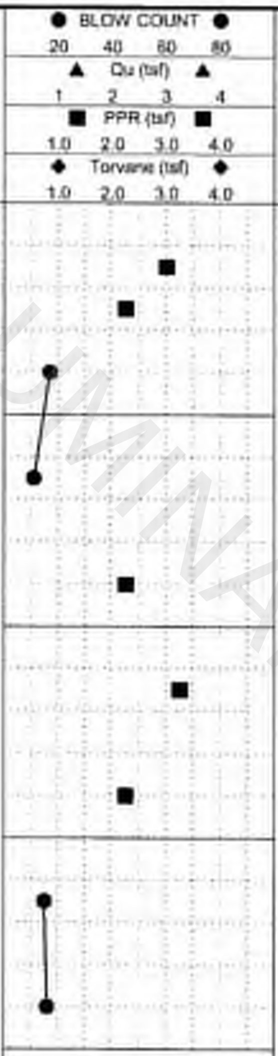
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/7/08

SURFACE ELEVATION

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SC	<u>CLAYEY SAND</u>(SC) tan, gray, and red; mottled; with gravel						6	28	12	16	33	+40 Sieve =28%, +4 Sieve =24%
		P=3.0										
		P=2.25										
CL	<u>SANDY LEAN CLAY</u>(CL) very stiff; tan, gray, and red; mottled	N=17					13	32	13	19	56	+40 Sieve =1%, +4 Sieve =0%
	--stiff	N=11										
		P=2.25										
		P=3.25					16	38	14	24	68	+40 Sieve =1%, +4 Sieve =0%
	--red and gray; mottled	P=2.25										
	--tan, red, and gray; mottled	N=15										
SM	<u>SILTY SAND</u>(SM) medium dense; gray	N=16										
	Bottom of Boring @ 40'											



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 38' while drilling. Water level @ 36' and open to 37' upon completion. Water level @ 21' and open to 22' on 10/8/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.773', W 94°33.782'

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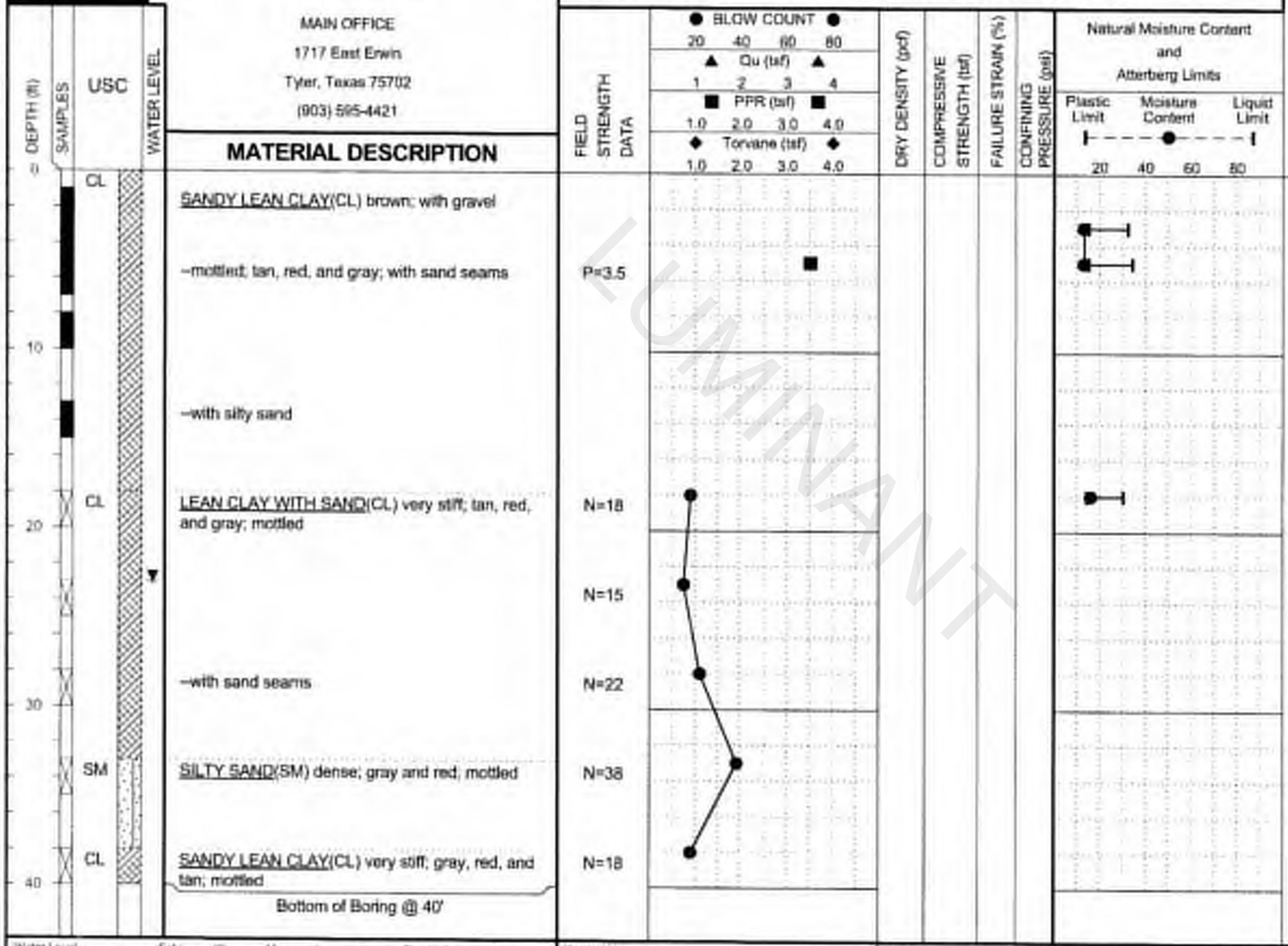
LOG OF BORING B-12

PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/9/08

SURFACE ELEVATION



DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	SANDY LEAN CLAY(CL) brown; with gravel							
				13	32	15	17	54	+40 Sieve =1%, +4 Sieve =0%
		–mottled; tan, red, and gray; with sand seams	P=3.5	13	34	15	19	57	+40 Sieve =0%, +4 Sieve =0%
10									
		–with silty sand							
	CL	LEAN CLAY WITH SAND(CL) very stiff; tan, red, and gray; mottled	N=18	16	30	14	16	75	+40 Sieve =1%, +4 Sieve =0%
20									
			N=15						
		–with sand seams	N=22						
30									
	SM	SILTY SAND(SM) dense; gray and red; mottled	N=38						
	CL	SANDY LEAN CLAY(CL) very stiff; gray, red, and tan; mottled	N=18						
40		Bottom of Boring @ 40'							

Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 33' while drilling. Water level @ 34' and open to 35' upon completion. Water level @ 23' and open to 31' on 10/10/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.896', W 94°33.830'

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1717 East Erwin
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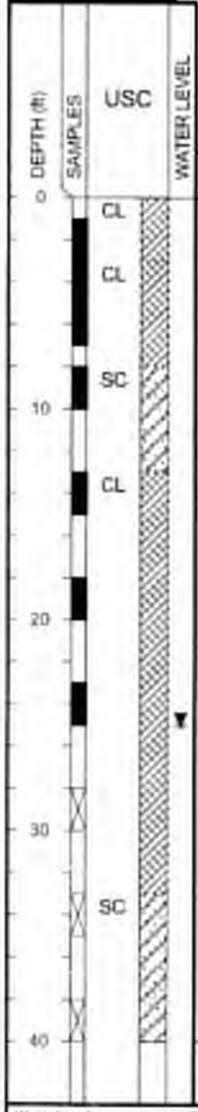
LOG OF BORING B-13

PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

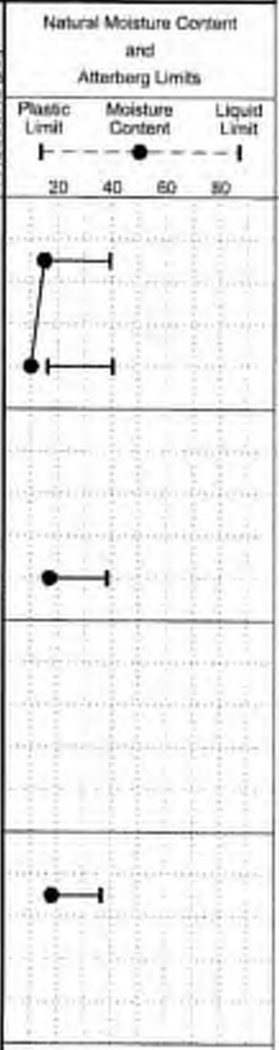
PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/7/08

SURFACE ELEVATION



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) very stiff; tan, gray, and red; mottled	P=3.25										
CL	LEAN CLAY WITH SAND(CL) very stiff; tan, gray, and red; mottled	P=3.0					15	39	16	23	70	+40 Sieve =6%
	–tan and brown	P=3.75										
SC	CLAYEY SAND(SC) dense; tan, brown, and red; with gravel	P=3.25					10	40	16	24	47	+40 Sieve =36%, +4 Sieve =33%
CL	LEAN CLAY WITH SAND(CL) very stiff; tan, brown, and red; with lignite	P=2.75										
	–red and tan	P=2.0					17	38	16	22	74	+40 Sieve =3%, +4 Sieve =0%
		P=2.25										
	–tan, red, and gray; mottled	N=18										
SC	CLAYEY SAND(SC) loose; tan, red, and gray; with trace gravel and ferric material	N=9					18	36	17	19	43	+40 Sieve =36%, +4 Sieve =25%
	–medium dense	N=18										
	Bottom of Boring @ 40'											



Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 37' while drilling. Water level @ 36' and open to 38' upon completion. Water level @ 25' and open to 26' on 10/8/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.713', W 94°33.777'

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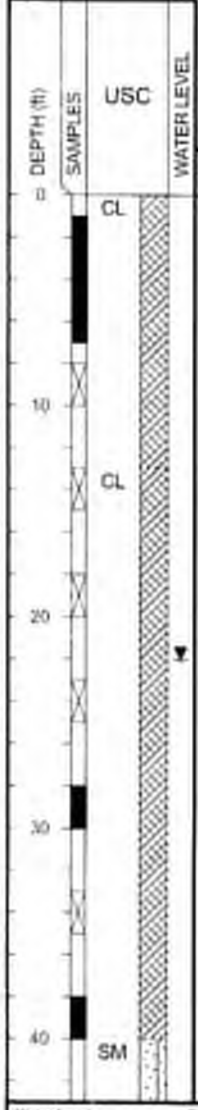
LOG OF BORING B-14

PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

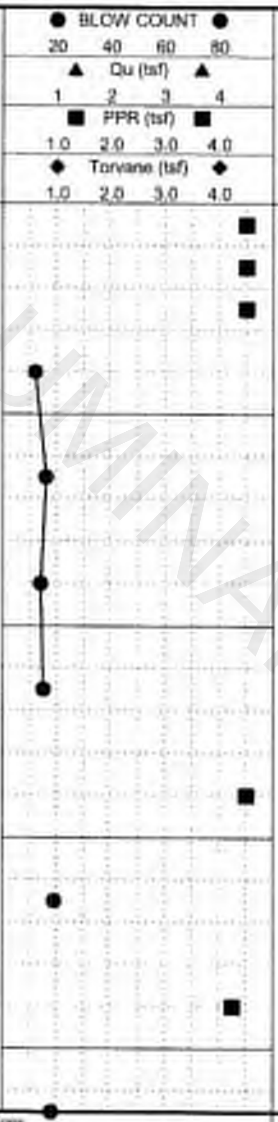
DATE 10/6/08

SURFACE ELEVATION

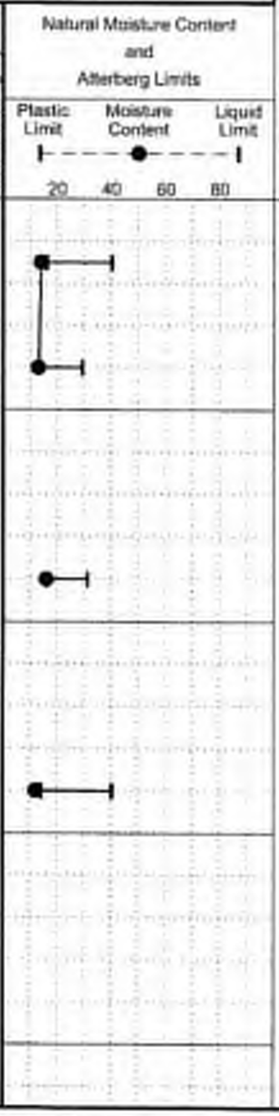


MATERIAL DESCRIPTION

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) hard; tan, gray, and red; mottled; with gravel	P=4.5+						
		P=4.5+	14	40	16	24	53	+40 Sieve =50%, +4 Sieve =49%
		P=4.5+ P=4.5+						
	--stiff	N=12	13	29	13	16	63	+40 Sieve =1%, +4 Sieve =0%
CL	SANDY LEAN CLAY(CL) very stiff; tan, gray, and red; mottled	N=16						
	--stiff; interbedded	N=14	16	31	16	15	58	+40 Sieve =2%, +4 Sieve =0%
		N=15						
	--hard; brown, tan, and red	P=4.5+	12	40	14	26	77	+40 Sieve =1%, +4 Sieve =0%
		N=19						
	--hard; with gray and brown silty sand	P=4.25						
SM	SILTY SAND(SM) medium dense; red and gray; saturated							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 22' and open to 89' upon completion. Water level @ 26' and open to 27' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.723', W 94°33.756'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

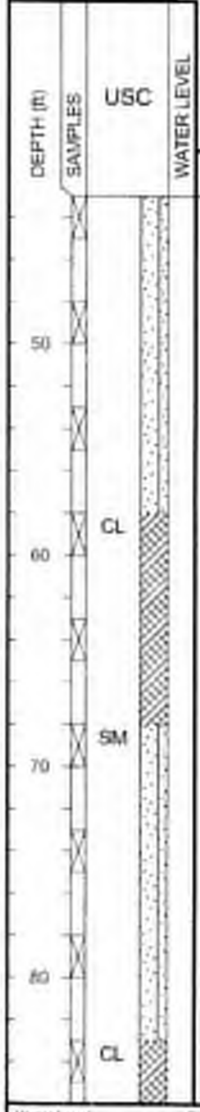
LOG OF BORING B-14

PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

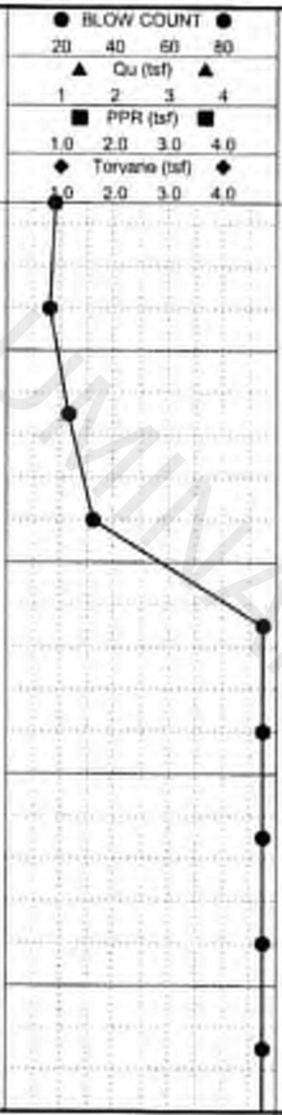
PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/6/08

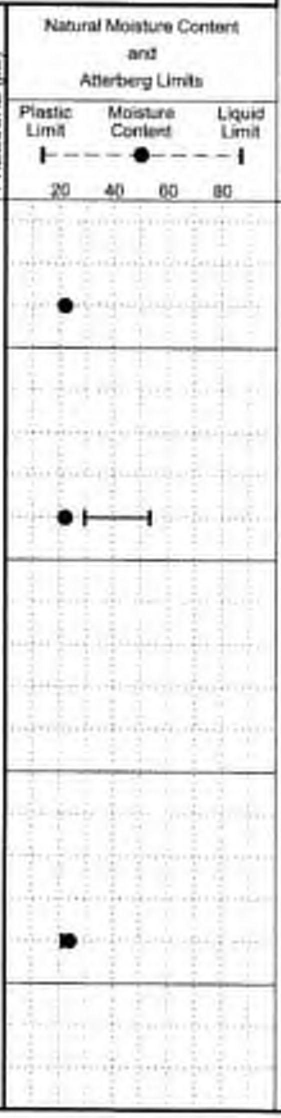
SURFACE ELEVATION



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
		N=18						
		N=16	22				25	+40 Sieve =1%, +4 Sieve =0%
	~red and tan	N=23						
CL	LEAN CLAY WITH SAND(CL) hard; red and tan; interbedded; laminated; with ferric material seams	N=32	22	53	29	24	77	+40 Sieve =3%, +4 Sieve =0%
	~with black lignite seams	N=50/3"						
SM	SILTY SAND(SM) very dense; gray; with fat clay partings	N=50/5.5"						
	~gray	N=50/5"						
		N=50/6"	24	24	21	3	41	+40 Sieve =0%, +4 Sieve =0%
CL	LEAN CLAY(CL) hard; gray	N=50/6"						



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 22' and open to 89' upon completion. Water level @ 26' and open to 27' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.723', W 94°33.756'

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LOG OF BORING B-14

PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

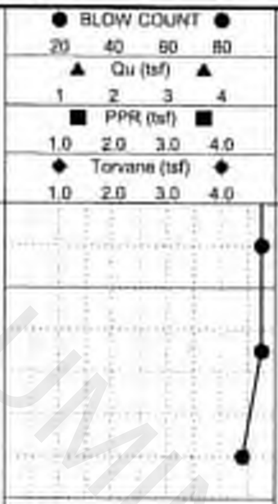
PROJECT NO.: G 2972-08

BORING TYPE: Flight Auger

DATE 10/6/08

SURFACE ELEVATION

DEPTH (ft)	SAMPLES	USC	WATER LEVEL	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
				–with black lignite	N=50/3.5"										
90															
				–dark brown; with silt seams; with lignite seam	N=50/6"										
					N=88										
100				Bottom of Boring @ 100'											



Natural Moisture Content and Atterberg Limits
Plastic Limit ⊢– – – –●– – – –⊣ Liquid Limit
Moisture Content
20 40 60 80

Water Level Est. ▽ Measured ▼ Perched ▼

Water Observations: Water level @ 22' and open to 89' upon completion. Water level @ 26' and open to 27' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.723', W 94°33.756'

LOG OF BORING B-2

ETTL
ENGINEERS &
CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

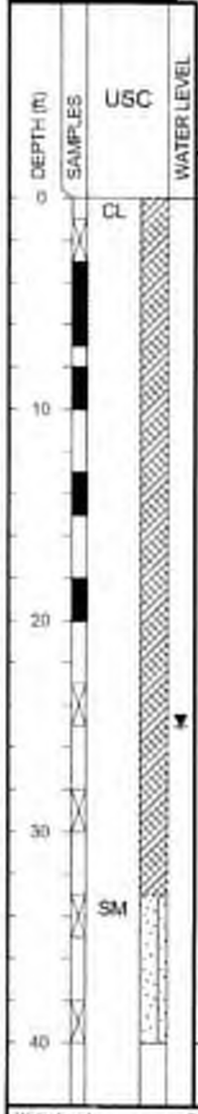
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

PROJECT NO.: G 2972-08

BORING TYPE: Flight Auger

DATE 10/8/08

SURFACE ELEVATION



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) very stiff; tan, red, and gray	N=19					8	32	14	18	50	+40 Sieve =0%, +4 Sieve =0%
	–hard; red, tan, and gray; mottled	P=4.25										
		P=3.75										
		P=4.0										
	–with some gravel	P=4.5+										
	–tan, red, and gray; mottled	N=1					17	28	15	13	63	+40 Sieve =1%, +4 Sieve =0%
	–gray, red, and tan; mottled	N=22					13	39	15	24	54	+40 Sieve =0%, +4 Sieve =0%
SM	SILTY SAND(SM) medium dense; red and gray; saturated	N=15										
		N=13										
	Bottom of Boring @ 40'											

Water Level Est. ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 32' while drilling. Water level @ 29' and open to 32' upon completion. Water level @ 25' and open to 25' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.860', W 94°33.890'

ETTL ENGINEERS & CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-3

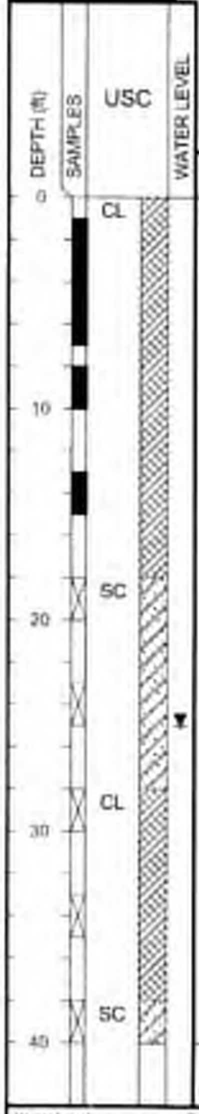
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

PROJECT NO.: G 2972-08

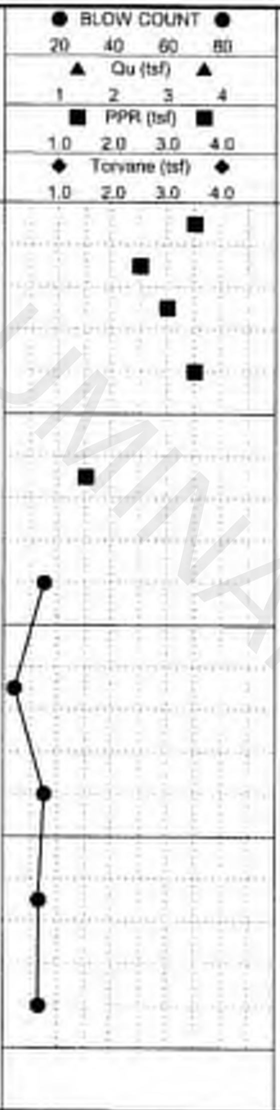
BORING TYPE: Flight Auger

DATE 10/8/08

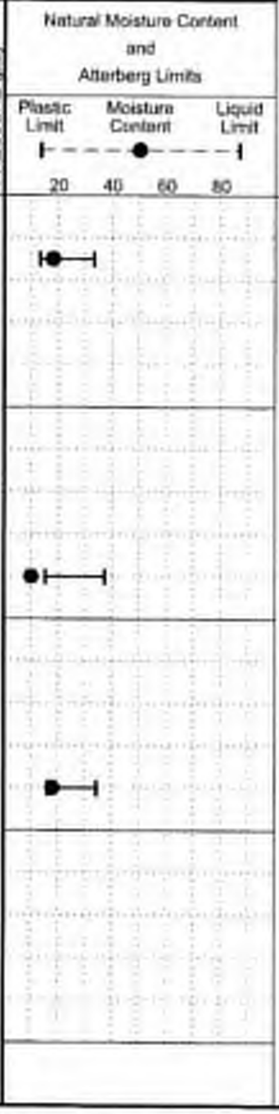
SURFACE ELEVATION



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) very stiff; tan, red, and gray; mottled	P=3.5						
		P=2.5	18	33	13	20	68	+40 Sieve =1%, +4 Sieve =0%
		P=3.0						
		P=3.5						
	–stiff	P=1.5						
SC	CLAYEY SAND(SC) medium dense; red	N=15	10	37	15	22	19	+40 Sieve =15%, +4 Sieve =7%
	–gray	N=4						
CL	LEAN CLAY WITH SAND(CL) stiff; red, tan, and gray; mottled	N=15	18	34	16	18	71	+40 Sieve =5%, +4 Sieve =0%
	–with sand seams	N=13						
SC	CLAYEY SAND(SC) medium dense; gray and red; mottled; with clay seams	N=13						
	Bottom of Boring @ 40'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 29' while drilling. Water level @ 28' and open to 34' upon completion. Water level @ 25' and open to 32' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.876', W 94°33.842'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-4

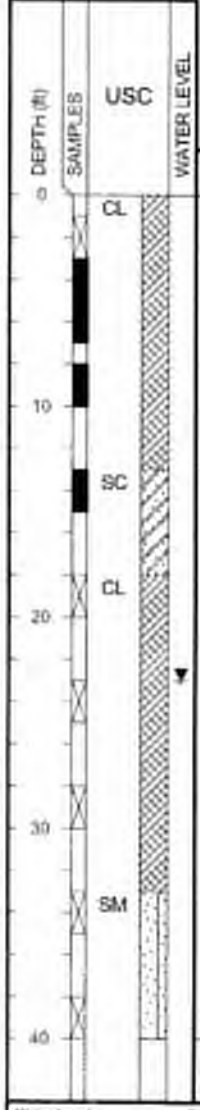
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

PROJECT NO.: G 2972-08

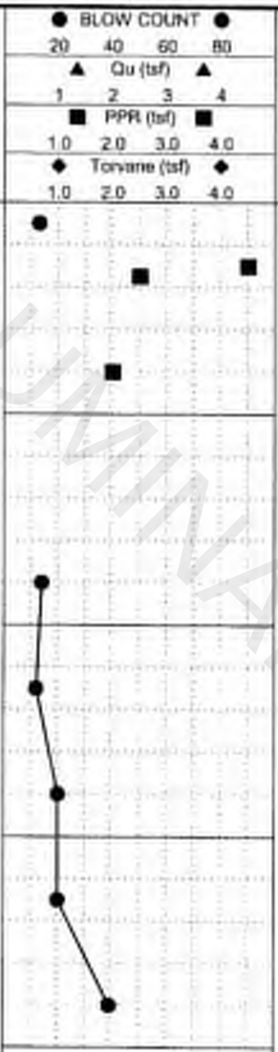
BORING TYPE: Flight Auger

DATE 10/8/08

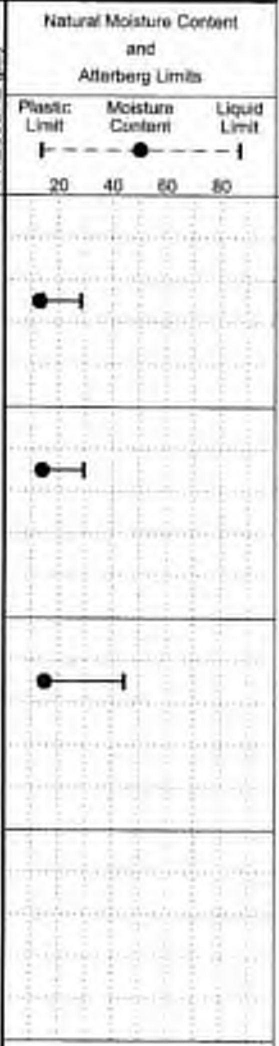
SURFACE ELEVATION



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) stiff; tan, red, and gray; mottled	N=13						
		P=2.5 P=4.5+						
			13	28	14	14	60	+40 Sieve =1%, +4 Sieve =0%
		P=2.0						
SC	CLAYEY SAND(SC) red, tan, and gray; mottled		14	29	14	15	36	+40 Sieve =0%, +4 Sieve =0%
CL	SANDY LEAN CLAY(CL) stiff; tan, red, and gray; mottled; with sand seams	N=14						
	–red and tan	N=12	15	44	15	29	67	+40 Sieve =0%, +4 Sieve =0%
	–with sand seams	N=20						
SM	SILTY SAND(SM) medium dense; red; saturated	N=20						
	–red and tan; with gravel	N=39						
	Bottom of Boring @ 40'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



ATTERBERG LIMITS(%)

Water Level Est. ▽ Measured ▼ Perched ▼

Water Observations: Seepage @ 28' while drilling. Water level @ 27' and open to 30' upon completion. Water level @ 23' and open to 28' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.804', W 94°33.891'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

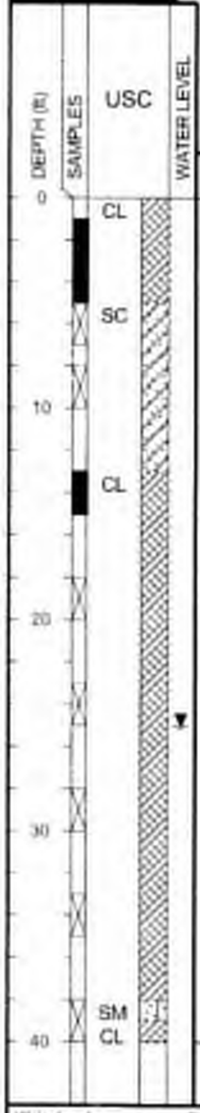
LOG OF BORING B-6

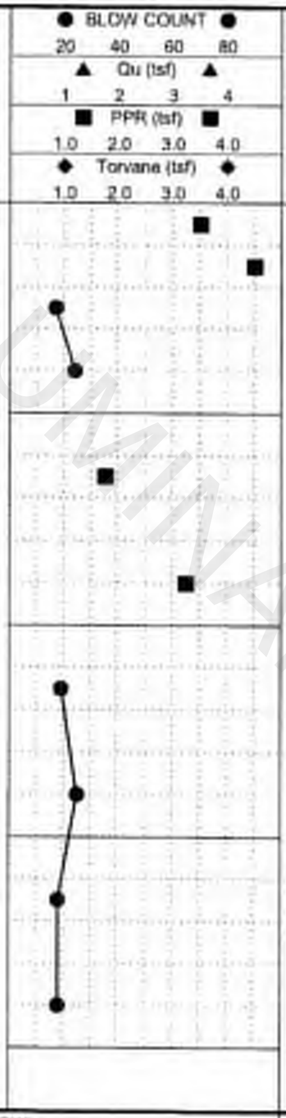
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

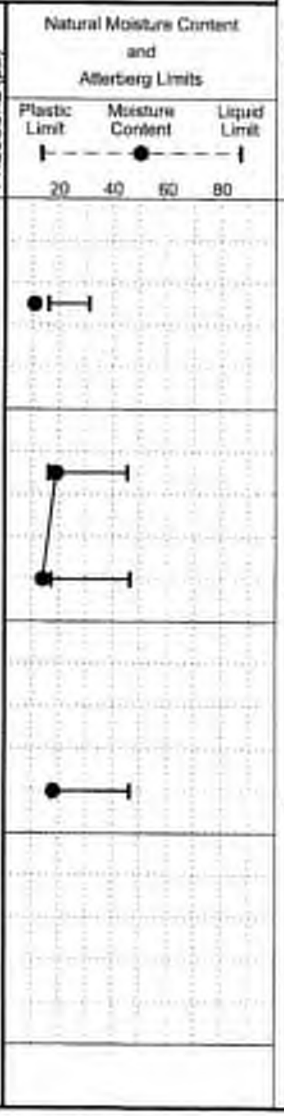
PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/7/08

SURFACE ELEVATION







USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) very stiff; tan, red, and gray; mottled	P=3.5										
		P=4.5+										
SC	CLAYEY SAND(SC) medium dense; tan, red, and gray; mottled	N=17					11	31	16	15	43	+40 Sieve =1%, +4 Sieve =0%
		N=24										
CL	LEAN CLAY(CL) stiff; tan, red, and gray; mottled	P=1.75					19	45	16	29	88	+40 Sieve =0%, +4 Sieve =0%
	–very stiff; brown, gray, and red; with sand; trace ferric material and lignite	P=3.25					14	46	17	29	74	+40 Sieve =0%, +4 Sieve =0%
	–with sand seams	N=19										
	–tan, red, and gray; mottled	N=25					18	46	17	29	84	+40 Sieve =8%, +4 Sieve =3%
	–tan and gray; mottled	N=18										
SM	SILTY SAND(SM) tan and gray	N=18										
CL	SANDY LEAN CLAY(CL) very stiff; tan and gray											
	Bottom of Boring @ 40'											

Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 28' while drilling. Water level @ 26' and open to 34' upon completion. Water level @ 25' and open to 27' on 10/8/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.833', W 94°33.814'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

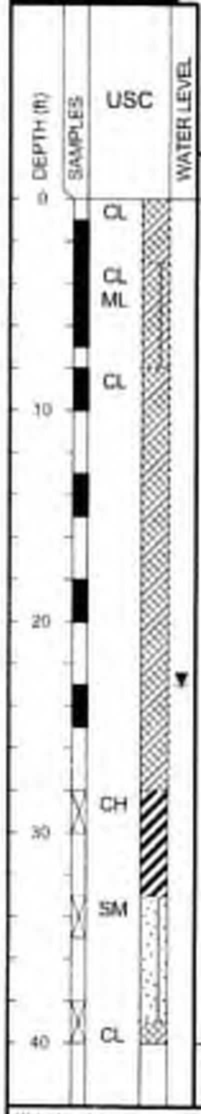
LOG OF BORING B-7

PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

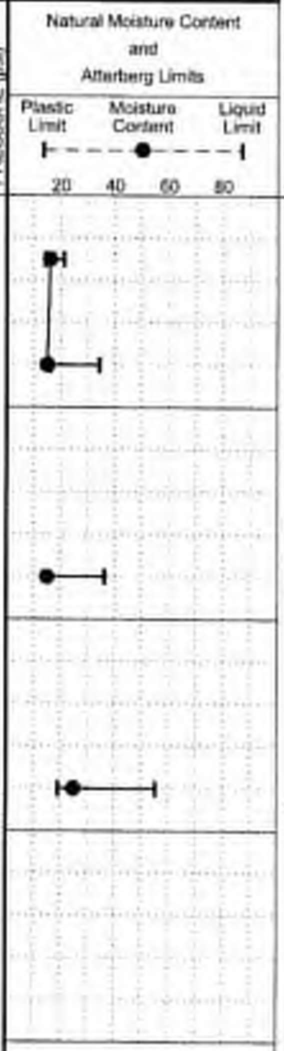
PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/8/08

SURFACE ELEVATION



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) hard; tan, red, and gray; mottled	P=4.0										
CL ML	SANDY SILTY CLAY(CL-ML) very stiff; tan, red, and gray; mottled	P=3.0 P=3.0					16	21	14	7	63	+40 Sieve =0%, +4 Sieve =0%
CL	LEAN CLAY WITH SAND(CL) very stiff; tan, red, and gray; mottled	P=3.25					15	34	16	18	74	+40 Sieve =1%, +4 Sieve =0%
	–stiff	P=1.5										
		P=1.5					15	36	15	21	72	+40 Sieve =0%, +4 Sieve =0%
CH	FAT CLAY(CH) stiff; gray, red, and tan; mottled	N=11					25	55	19	36	88	+40 Sieve =1%, +4 Sieve =0%
SM	SILTY SAND(SM) medium dense; tan, red, gray, mottled	N=10										
CL	SANDY LEAN CLAY(CL) very stiff; red, tan, and gray; mottled	N=20										
	Bottom of Boring @ 40'											



Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 33' while drilling. Water level @ 32' and open to 35' upon completion. Water level @ 23' and open to 27' on 10/9/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.775', W 94°33.875'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

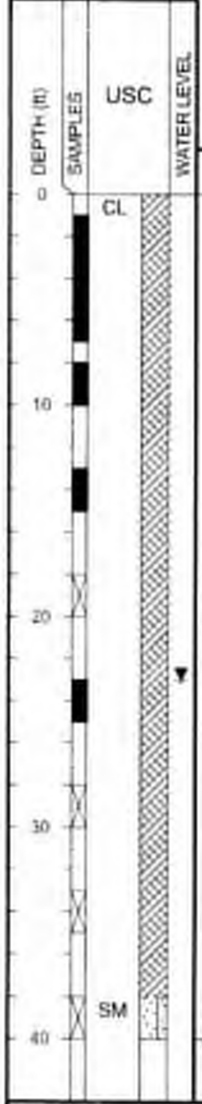
LOG OF BORING B-8

PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

PROJECT NO.: G 2972-08 **BORING TYPE:** Flight Auger

DATE 10/7/08

SURFACE ELEVATION



MATERIAL DESCRIPTION

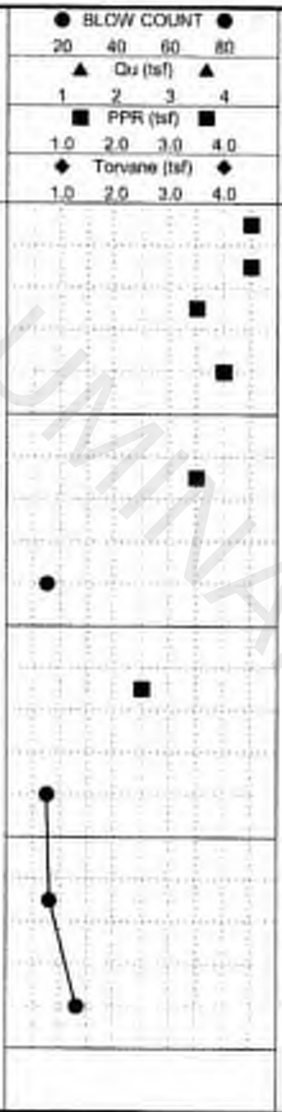
SANDY LEAN CLAY(CL) hard; tan, red, and gray; mottled

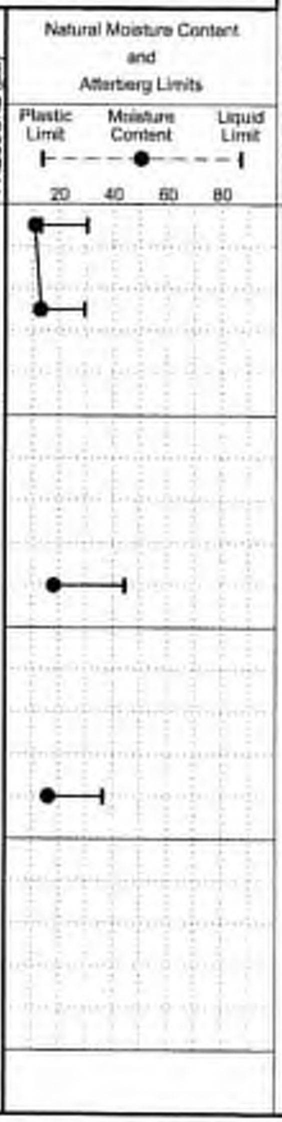
–very stiff

–red and gray; mottled

SILTY SAND(SM) dense; red, tan, and reddish gray; mottled; saturated

Bottom of Boring @ 40'





FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
P=4.5+					11	30	13	17	67	+40 Sieve =2%, +4 Sieve =0%
P=4.5+										
P=3.5					13	29	13	16	67	+40 Sieve =0%, +4 Sieve =0%
P=4.0										
P=3.5										
N=15					18	44	18	26	70	+40 Sieve =3%, +4 Sieve =0%
P=2.5										
N=15					16	38	16	20	63	+40 Sieve =9%, +4 Sieve =3%
N=16										
N=26										

Water Level Est: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 38' while drilling. Water level @ 35' and open to 36' upon completion. Water level @ 23' and open to 27' on 10/8/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.803', W 94°33.798'

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-9

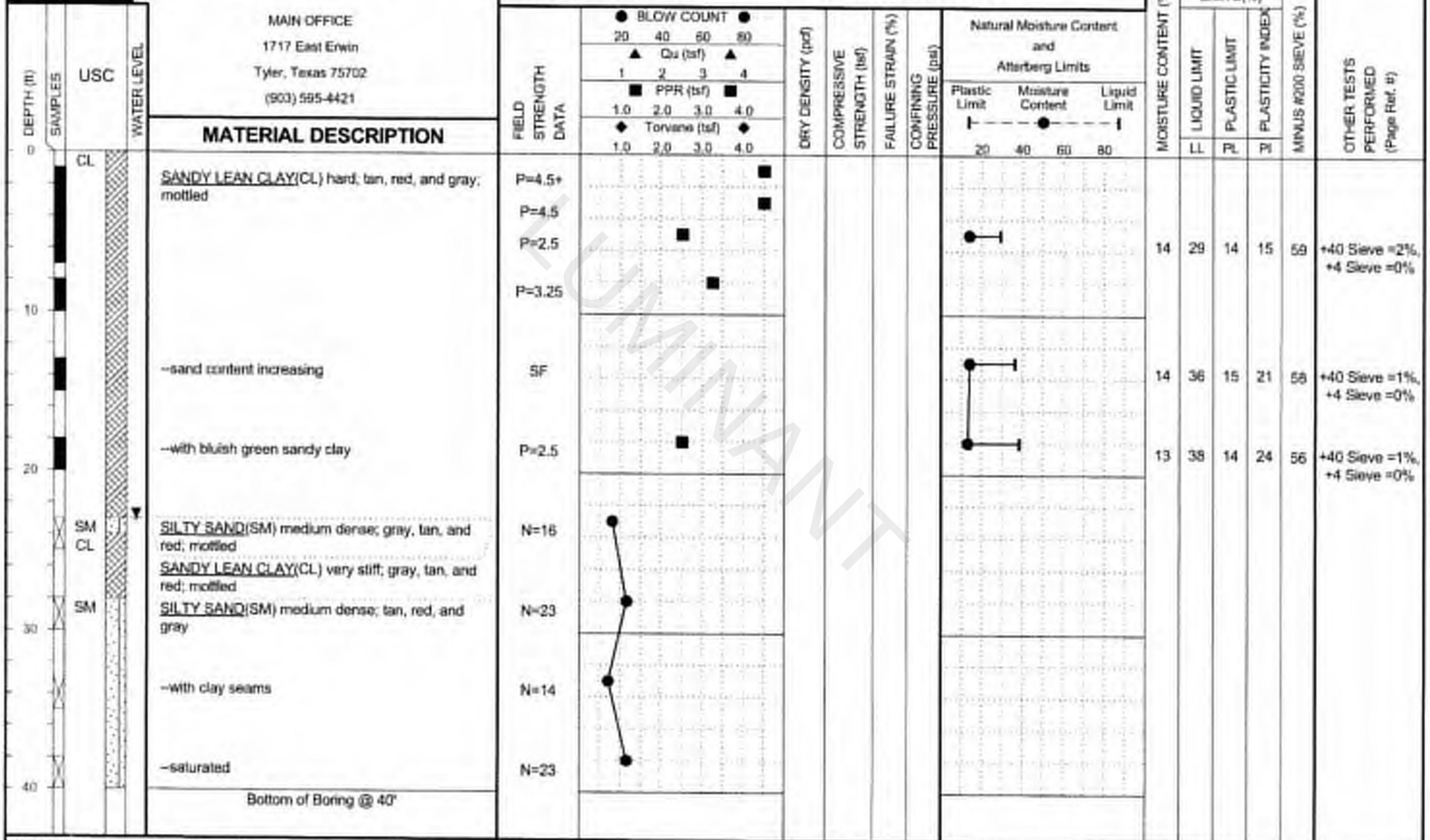
PROJECT: Martin Lake - Luminant East Ash Disposal
Rusk County, Texas

PROJECT NO.: G 2972-08

BORING TYPE: Flight Auger

DATE 10/9/08

SURFACE ELEVATION



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) hard; tan, red, and gray; mottled	P=4.5+						
		P=4.5						
		P=2.5	14	29	14	15	59	+40 Sieve =2%, +4 Sieve =0%
		P=3.25						
	--sand content increasing	SF	14	36	15	21	58	+40 Sieve =1%, +4 Sieve =0%
	--with bluish green sandy clay	P=2.5	13	38	14	24	56	+40 Sieve =1%, +4 Sieve =0%
SM	SILTY SAND(SM) medium dense; gray, tan, and red; mottled	N=16						
CL	SANDY LEAN CLAY(CL) very stiff; gray, tan, and red; mottled							
SM	SILTY SAND(SM) medium dense; tan, red, and gray	N=23						
	--with clay seams	N=14						
	--saturated	N=23						
	Bottom of Boring @ 40'							

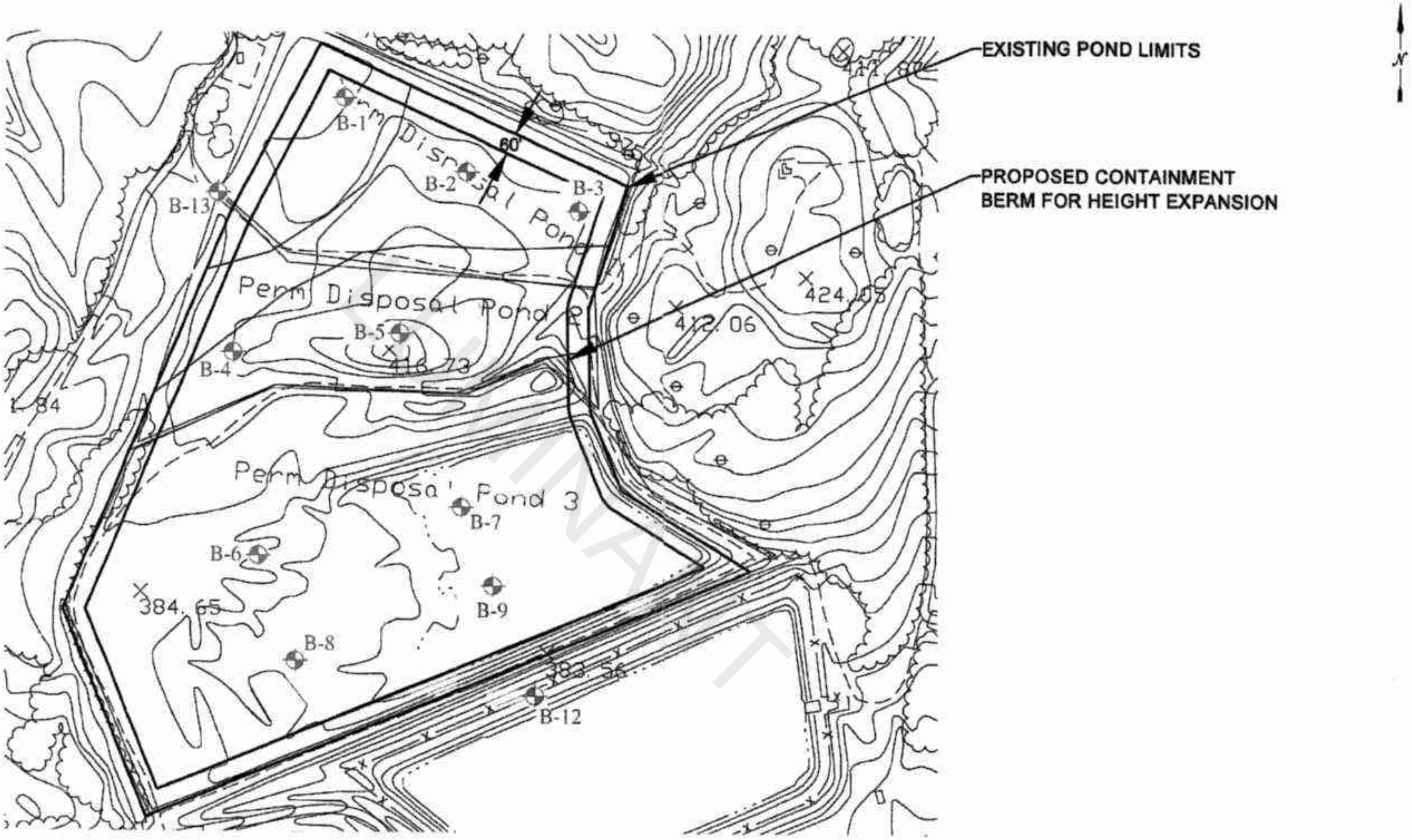
Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 28' while drilling. Water level @ 23' and open to 31' upon completion. Water level @ 23' and open to 29' on 10/10/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.745', W 94°33.857'

PERMANENT DISPOSAL POND - 5



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LUMINANT MARTIN LAKE
PDP 1-3
TATUM, TEXAS

PLATE 1 – PLAN OF BORINGS

JOB No.: G 2810-08

DATE: MARCH 2008

SCALE: N.T.S.

APPROVED BY:

DRAWN BY:
K.C.R.

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CONSULTANTS

MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

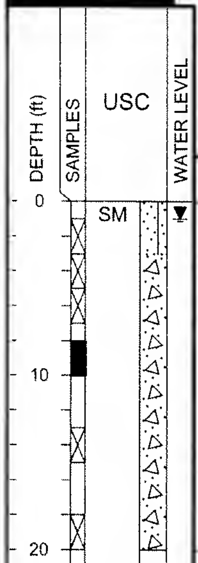
LOG OF BORING B-1

PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

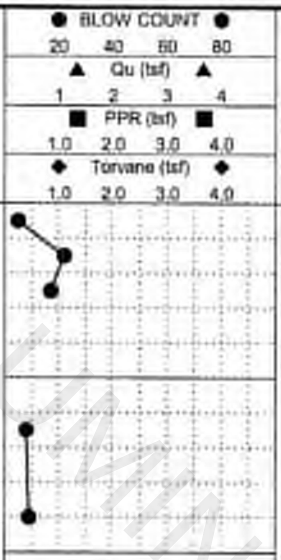
PROJECT NO.: G 2810-08 **BORING TYPE:** Flight Auger

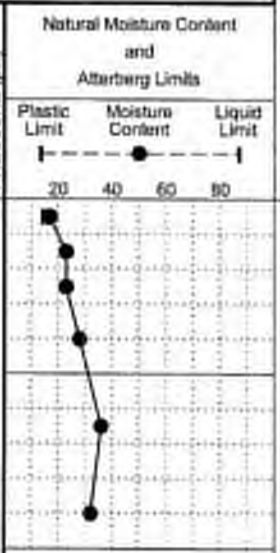
DATE 2/22/08

SURFACE ELEVATION 390'



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
<u>SILTY SAND</u>(SM) loose; tan; moist; with ferric oxide; with organics	N=5					17	16	14	2	34	+40 Sieve =6%, +4 Sieve =3%
<u>ASH SEDIMENT</u> medium dense; black and gray; coarse to very fine-grained sand	N=22	101				23					
	N=17					23					
–black		82				28				23	+40 Sieve =55%, +4 Sieve =26%
–loose; black and gray; coarse to very fine-grained sand	N=8					36					
	N=9					32				53	
Bottom of Boring @ 20'											





Water Level: Est.: ▽ Measured: ▼ Perched: ▽

Water Observations: Seepage @ 7' while drilling. Water level @ 1' and caved to 6' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.790', W 94°34.996'. Minus #200 Sieve (53%) @ 18' (Hydrometer - Specific Gravity 2.608). Dry Density (82) @ 8' (Hydraulic Conductivity K=2.79E-04 cm/sec).

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MAIN OFFICE
1717 East Erwin
Tyler, Texas 75702
(903) 595-4421

LOG OF BORING B-12

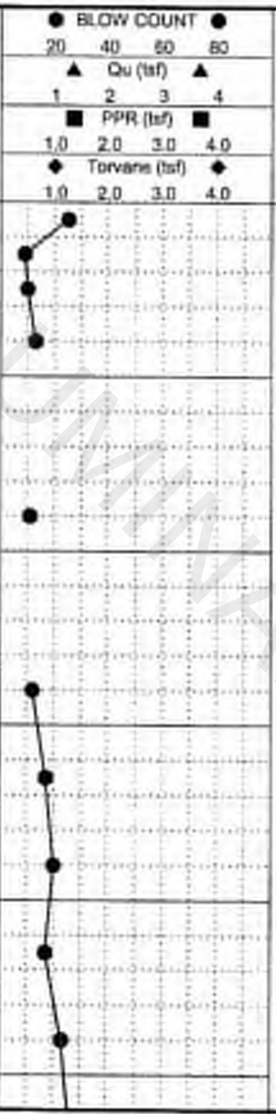
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

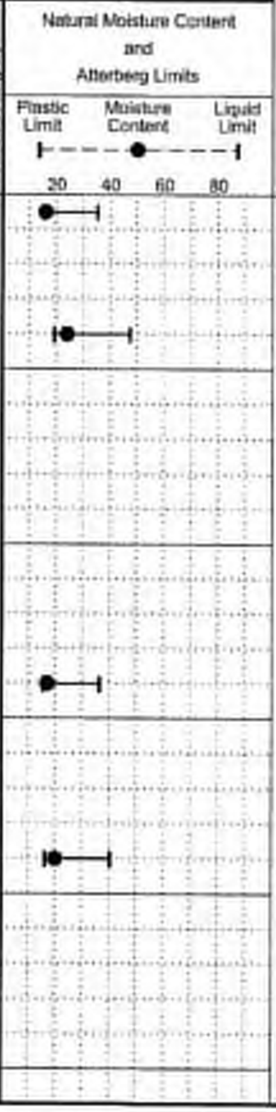
PROJECT NO.: G 2810-08 **BORING TYPE:** Rotary Wash

DATE 2/27/08

SURFACE ELEVATION 380'

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	SC	CLAYEY SAND(SC) medium dense; red and orange	N=25					16	35	15	20	37	+40 Sieve =10%, +4 Sieve =3%
		–loose; gray, red, and orange	N=9										
	CL	LEAN CLAY WITH SAND(CL) stiff; red, orange, and tan	N=10										
10		–gray and red	N=13					24	47	19	28	79	+40 Sieve =3%, +4 Sieve =0%
		–red and orange											
20	SC	CLAYEY SAND(SC) medium dense; red and orange	N=11										
30		–with iron oxide cemented sandstone gravel	N=12					17	36	15	21	44	+40 Sieve =21%, +4 Sieve =16%
	SM	SILTY SAND(SM) medium dense; gray, red, and orange	N=17										
40	CL	SANDY LEAN CLAY(CL) medium dense; red, orange, and gray	N=20					20	40	16	24	61	+40 Sieve =5%, +4 Sieve =3%
			N=17										
		–red and orange; with iron oxide cemented sandstone seam @ 45'											
50	SM	SILTY SAND(SM) medium dense; gray, orange, and tan	N=23										





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Dry and open to 25' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.513', W 94°34.904'.

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LOG OF BORING B-12

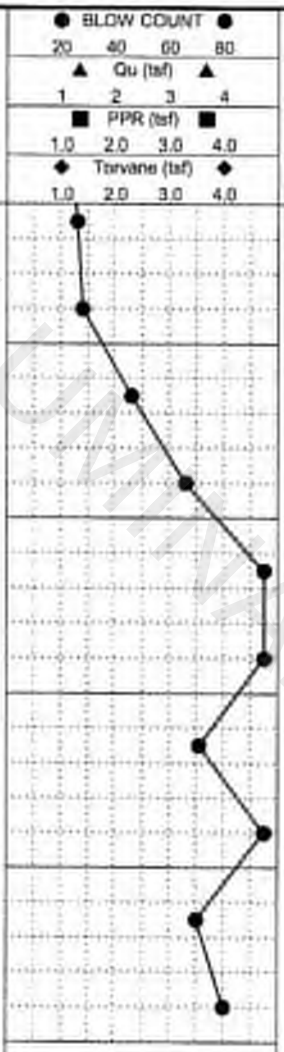
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

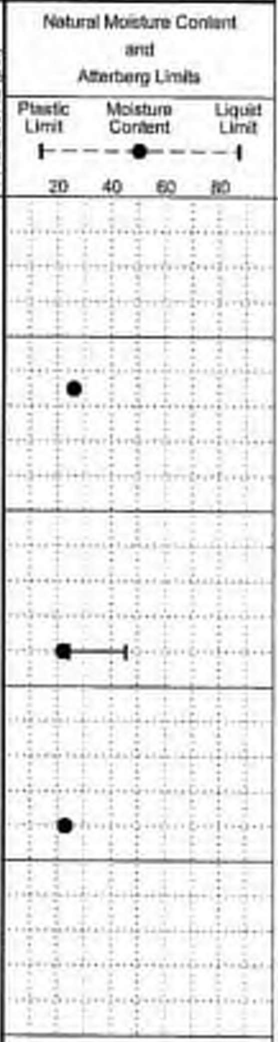
PROJECT NO.: G 2810-08 **BORING TYPE:** Rotary Wash

DATE 2/27/08

SURFACE ELEVATION 380'

DEPTH (ft)	SAMPLES	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	☒		-gray, red, brown	N=26										
60	☒		-gray and brown	N=28										
	☒	ML	SILT(ML) dense; brown and gray	N=46	99				26				96	+40 Sieve =2%, +4 Sieve =0%
70	☒		-very dense	N=66										
	☒	CL	LEAN CLAY WITH SAND(CL) hard; gray	N=50/3"										
80	☒			N=50/4"	102				22	45	24	21	73	+40 Sieve =24%, +4 Sieve =23%
	☒	ML	SILT(ML) very dense; gray	N=71										
90	☒			N=50/5"	107				23				94	+40 Sieve =2%, +4 Sieve =0%
	☒			N=70										
100	☒			N=80										
			Bottom of Boring @ 100'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Dry and open to 25' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.513', W 94°34.904'.

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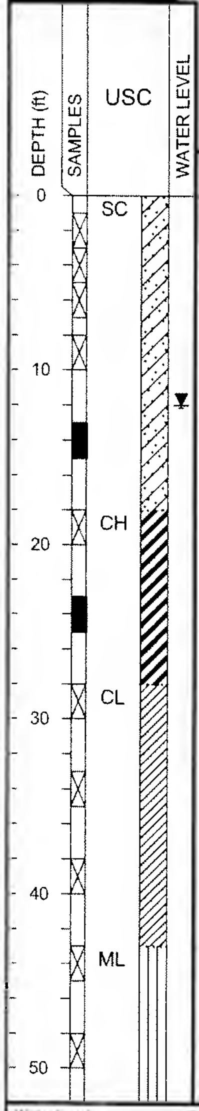
LOG OF BORING B-13

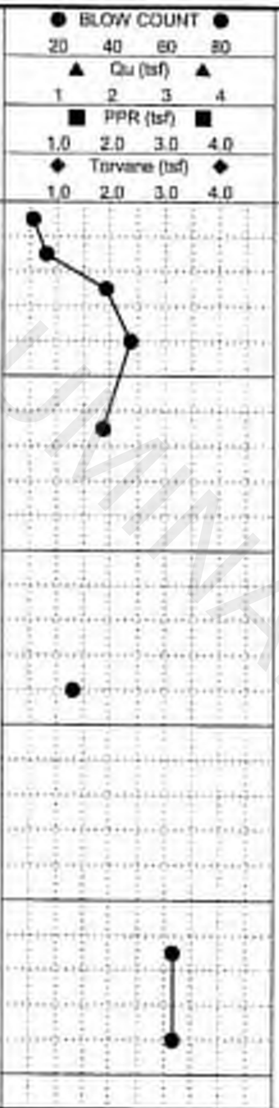
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

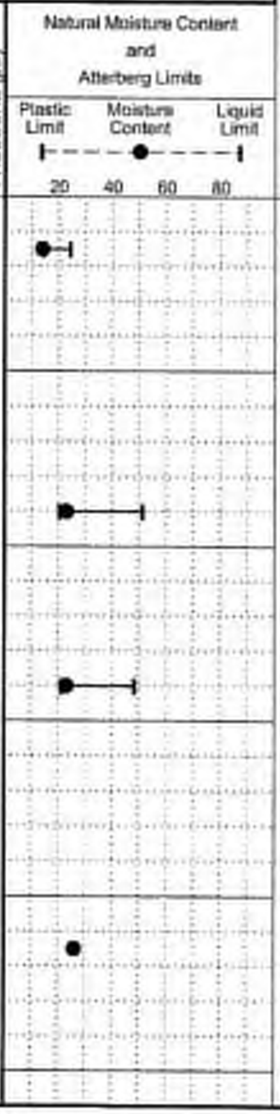
PROJECT NO.: G 2810-08 **BORING TYPE:** Rotary Wash

DATE 2/19/08

SURFACE ELEVATION 380'







MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CLAYEY SAND(SC) medium dense; red	N=11										
	N=16					14	24	14	10	46	+40 Sieve =3%, +4 Sieve =1%
–brown and gray	N=38										
–dense; red and tan	N=47										
–tan, red, and gray	N=37										
FAT CLAY(CH) stiff; red, gray, and tan	P=1.5					23	51	20	31	89	+40 Sieve =7%, +4 Sieve =1%
–with iron laminations	P=1.5 P=1.5										
LEAN CLAY(CL) very stiff; gray	N=26					23	48	21	27	94	+40 Sieve =2%, +4 Sieve =0%
–hard	P=4.5+										
–gray and brown; with iron oxide cemented sandstone seams	P=4.5+										
SANDY SILT(ML) very dense; gray; with clay seams	N=63					26				66	+40 Sieve =2%, +4 Sieve =0%
	N=63										

Water Level Est. ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 29' while drilling. Water level @ 28' and open upon completion. Water level @ 12' and caved to 14' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.752', W 94°35.072'.

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LOG OF BORING B-13

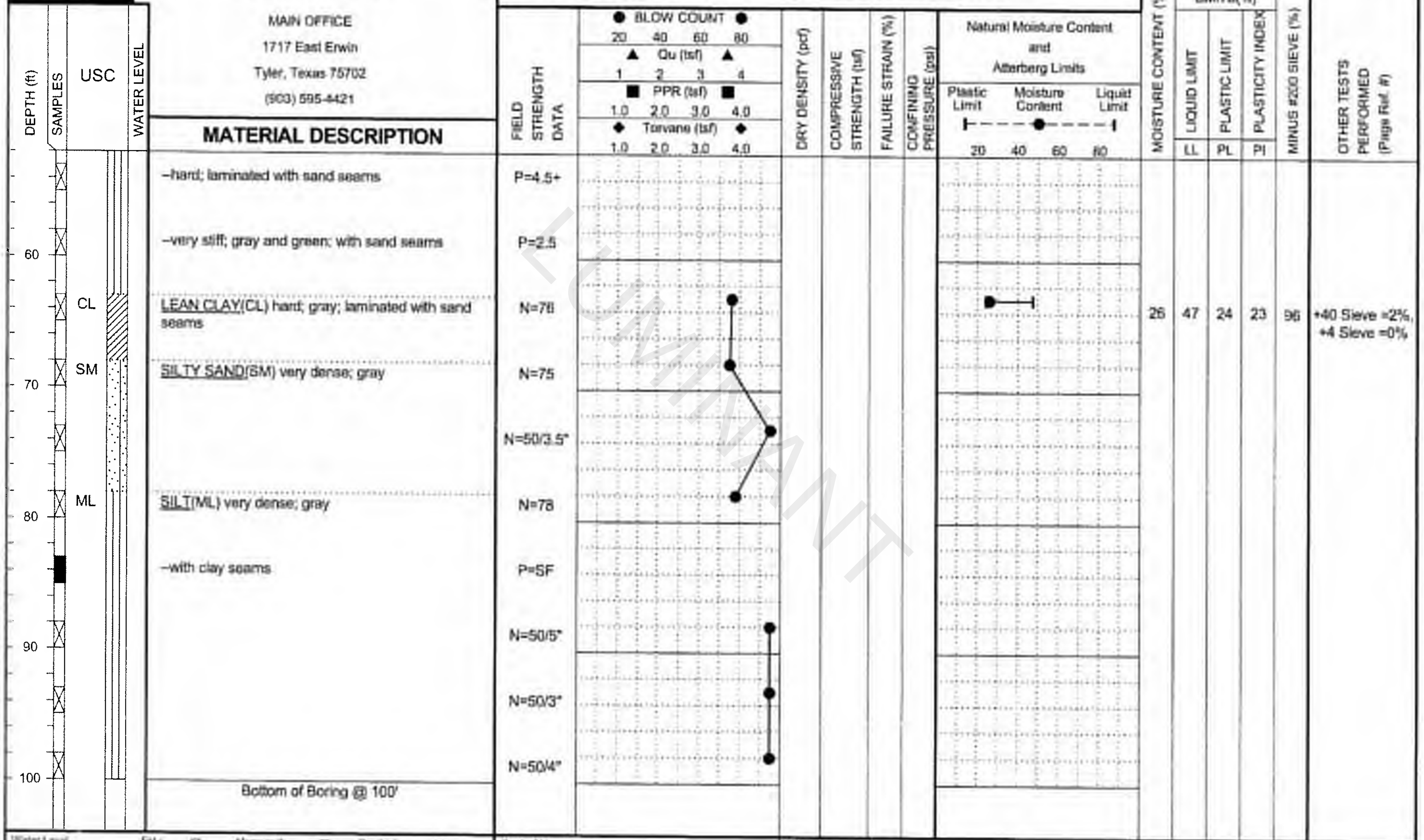
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

PROJECT NO.: G 2810-08

BORING TYPE: Rotary Wash

DATE 2/19/08

SURFACE ELEVATION 380'



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
	-hard; laminated with sand seams	P=4.5+						
	-very stiff; gray and green; with sand seams	P=2.5						
CL	LEAN CLAY(CL) hard; gray; laminated with sand seams	N=78	26	47	24	23	96	+40 Sieve =2%, +4 Sieve =0%
SM	SILTY SAND(SM) very dense; gray	N=75						
		N=50/3.5"						
ML	SILT(ML) very dense; gray	N=78						
	-with clay seams	P=SF						
		N=50/5"						
		N=50/3"						
		N=50/4"						
	Bottom of Boring @ 100'							

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 29' while drilling. Water level @ 28' and open upon completion. Water level @ 12' and caved to 14' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.752', W 94°35.072'.

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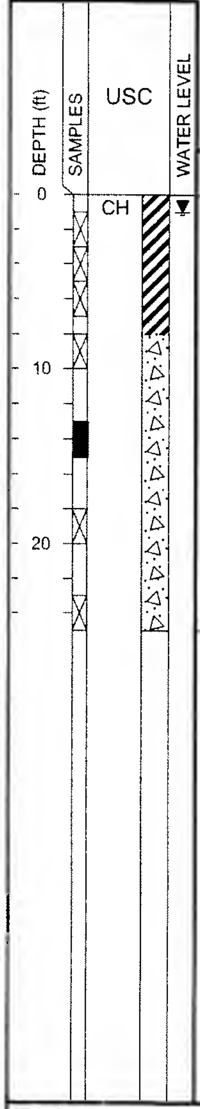
LOG OF BORING B-2

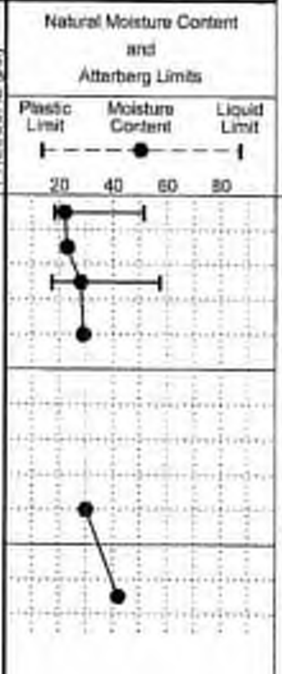
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

PROJECT NO.: G 2810-08 **BORING TYPE:** Flight Auger

DATE 2/22/08

SURFACE ELEVATION 390'





MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SANDY FAT CLAY(CH) stiff; red and orange	N=11					22	51	18	33	65	+40 Sieve =9%, +4 Sieve =6%
	N=11					23					
–with sand	N=12					28	57	17	40	78	+40 Sieve =2%, +4 Sieve =0%
ASH SEDIMENT medium dense; black	N=11					29				16	+40 Sieve =63%, +4 Sieve =40%
–very loose; with organic odor	N=3					30				39	+40 Sieve =36%, +4 Sieve =12%
–light gray						42				93	
Bottom of Boring @ 25'											

Water Level: Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 13' while drilling. Water level @ 1' and caved to 8' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.764', W 94°34.903'. Minus #200 Sieve (93%) @ 23' (Hydrometer - Specific Gravity 2.675).

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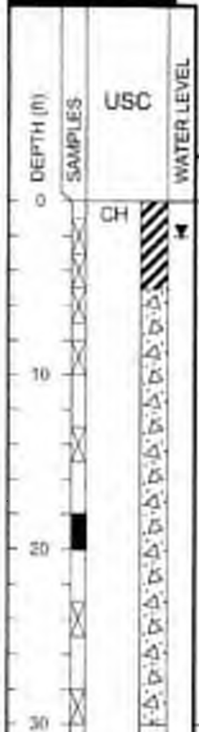
LOG OF BORING B-3

PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

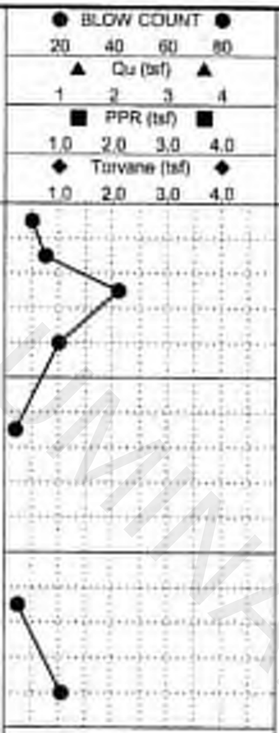
PROJECT NO.: G 2810-08 **BORING TYPE:** Flight Auger

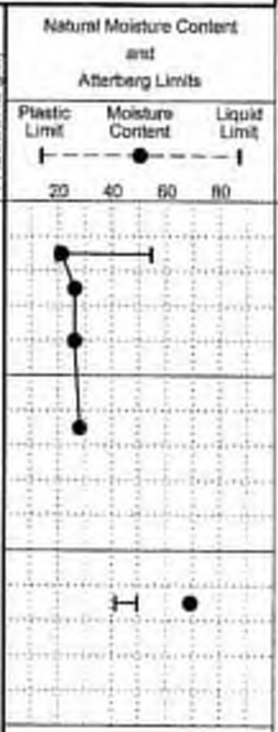
DATE 2/22/08

SURFACE ELEVATION 390'



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
<u>SANDY FAT CLAY</u>(CH) medium stiff; red and orange	N=10										
–stiff	N=15					21	54	19	35	69	+40 Sieve =5%, +4 Sieve =1%
<u>ASH SEDIMENT</u> dense; black	N=42					26				42	
–medium dense; black and gray; coarse-grained sand	N=20					26				10	+40 Sieve =60%, +4 Sieve =10%
–very loose; black; coarse to fine-grained sand	N=4					28				9	+40 Sieve =67%, +4 Sieve =35%
–no recovery											
–loose; light gray	N=5					69	49	41	8	100	+40 Sieve =0%, +4 Sieve =0%
–medium dense; black; with organic odor	N=21										
Bottom of Boring @ 30'											





Water Level: Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 8' while drilling. Water level @ 2' and caved to 8' on 2/29/08..

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.746', W 94°34.855'. Minus #200 Sieve (42%) @ 5' (Hydrometer - Specific Gravity 2.561).

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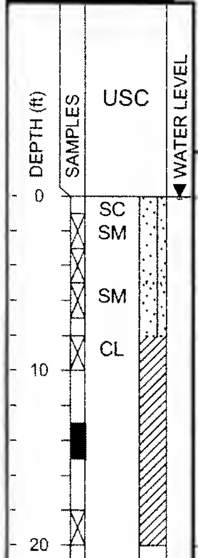
LOG OF BORING B-4

PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

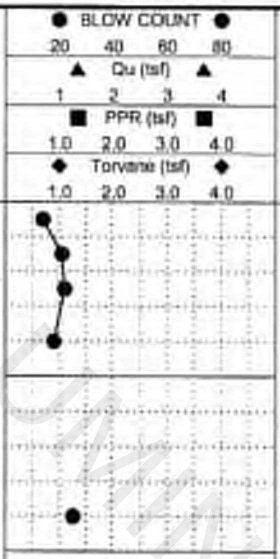
PROJECT NO.: G 2810-08 **BORING TYPE:** Flight Auger

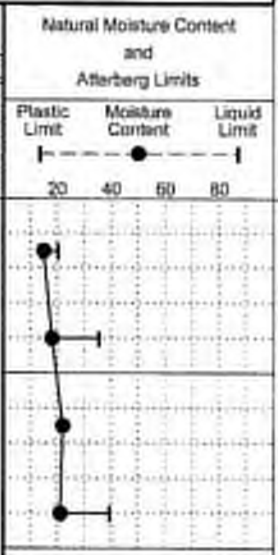
DATE 2/22/08

SURFACE ELEVATION 385'



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
SILTY CLAYEY SAND(SC-SM) medium dense; red and brown	N=14										
–very stiff; red and orange	N=21					15	20	14	6	42	+40 Sieve =1%, +4 Sieve =0%
SILTY SAND(SM) medium dense; red and tan	N=22										
LEAN CLAY(CL) very stiff; red, orange, and tan	N=18					18	35	18	17	85	+40 Sieve =5%, +4 Sieve =1%
–red, tan, and gray	P=3.5	99	2.40	10	13	22					
	N=25					21	39	21	18	61	+40 Sieve =0%, +4 Sieve =0%
Bottom of Boring @ 20'											





Water Level Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 3' while drilling. Water level @ Surface and caved to 15' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.675', W 94°35.083'.

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LOG OF BORING B-5

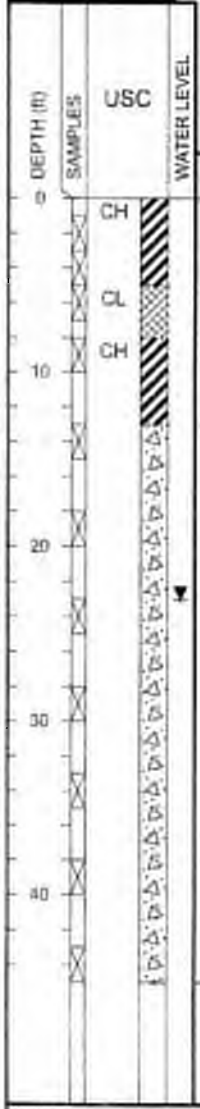
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

PROJECT NO.: G 2810-08

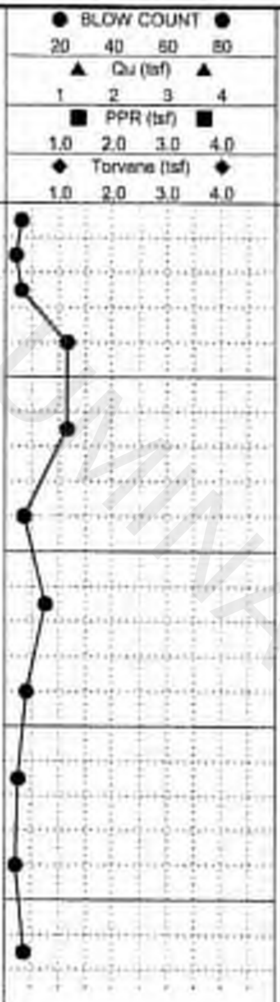
BORING TYPE: Flight Auger

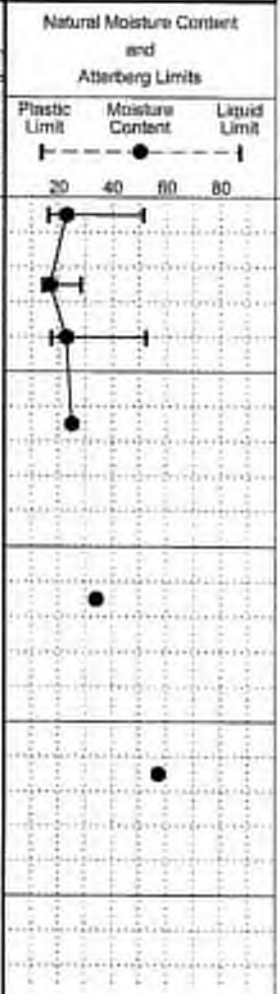
DATE 2/22/08

SURFACE ELEVATION 415'



USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CH	FAT CLAY WITH SAND(CH) medium stiff; red, orange, and gray	N=6					23	51	16	35	77	+40 Sieve =4%, +4 Sieve =1%
	–soft	N=4										
CL	SANDY LEAN CLAY(CL) medium stiff; red and orange	N=6					17	28	14	14	60	+40 Sieve =6%, +4 Sieve =1%
CH	FAT CLAY WITH SAND(CH) very stiff; red and orange	N=23					23	52	17	35	77	+40 Sieve =4%, +4 Sieve =1%
	ASH SEDIMENT medium dense; gray and black	N=23					25				16	+40 Sieve =54%, +4 Sieve =24%
	–loose	N=7										
	–medium dense	N=15	62				34				32	+40 Sieve =37%, +4 Sieve =16%
	–loose	N=8										
	–gray	N=5	62				57				99	+40 Sieve =1%, +4 Sieve =0%
	–very loose	N=4										
	–loose	N=7										
	Bottom of Boring @ 45'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 23' and caved to 26' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.667', W 94°34.936'.

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1717 East Erwin
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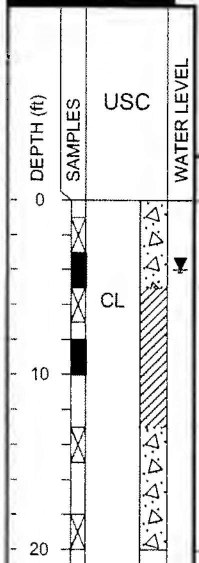
LOG OF BORING B-6

PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

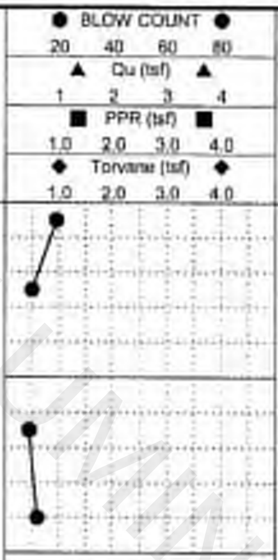
PROJECT NO.: G 2810-08 **BORING TYPE:** Flight Auger

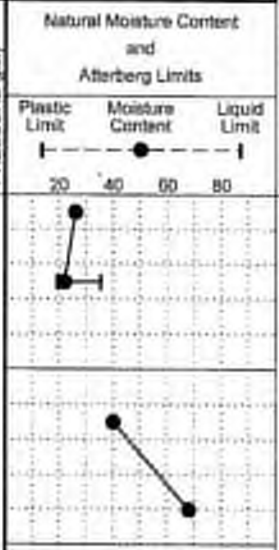
DATE 2/22/08

SURFACE ELEVATION 385'



MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	ATTERBERG LIMITS(%) PLASTIC LIMIT PL	ATTERBERG LIMITS(%) PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
ASH SEDIMENT medium dense; black and tan	N=19 P=SF					26				44	+40 Sieve =30%, +4 Sieve =13%
SANDY LEAN CLAY(CL) stiff; red and tan	N=10					22	35	19	16	61	+40 Sieve =7%, +4 Sieve =4%
–very stiff	P=2.5										
ASH SEDIMENT loose; black	N=9					40				61	+40 Sieve =5%, +4 Sieve =2%
–medium dense	N=12					68				84	
Bottom of Boring @ 20'											





Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 4' while drilling. Water level @ 4' and caved to 7' upon completion. Water level @ 1' and caved to 8' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.591', W 94°35.088'. Minus #200 Sieve (84) @ 18' (Hydrometer - Specific Gravity 2.732).

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(903) 595-4421

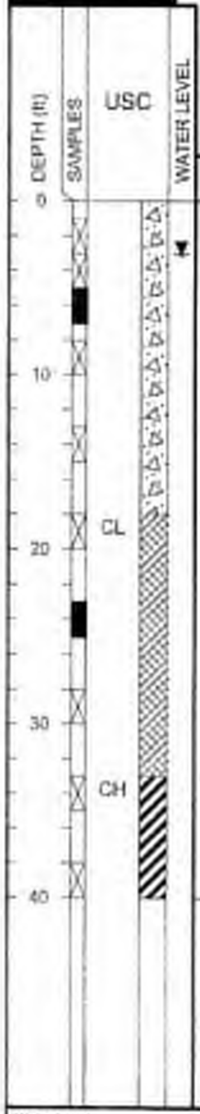
LOG OF BORING B-7

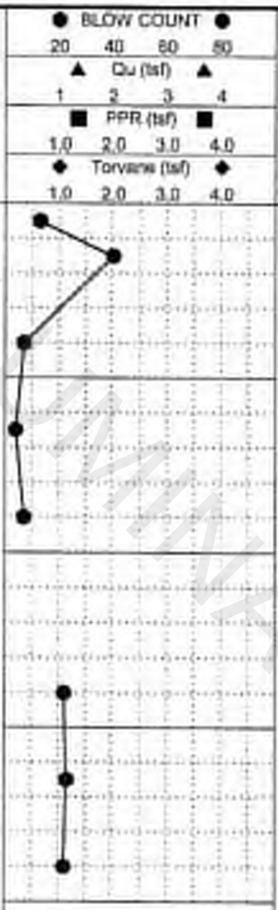
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

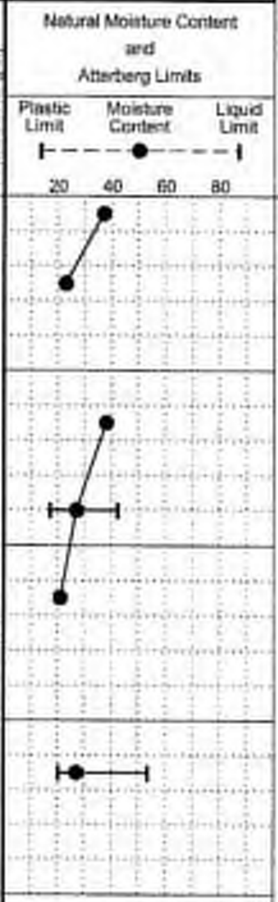
PROJECT NO.: G 2810-08 **BORING TYPE:** Rotary Wash

DATE 2/28/08

SURFACE ELEVATION 390'







MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
ASH SEDIMENT medium dense; black	N=13					37				16	+40 Sieve =49%, +4 Sieve =10%
–dense; black	N=40										
	P=4.5	98	2.30	2	6	23					
–loose	N=7										
–very loose	N=4					38				11	
LEAN CLAY WITH SAND(CL) medium stiff; orange and black	N=7					27	42	17	25	75	+40 Sieve =4%, +4 Sieve =0%
–tan and red		104	0.50	13	22	21					
–medium dense; red and orange	N=22										
SANDY FAT CLAY(CH) medium dense; red and orange	N=23					27	53	20	33	69	+40 Sieve =27%, +4 Sieve =22%
	N=22										
Bottom of Boring @ 40'											

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Water level @ 3' and caved to 24' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.646', W 94°34.870'. Minus #200 Sieve (11%) @ 13' (Hydrometer - Specific Gravity 2.655).

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LOG OF BORING B-8

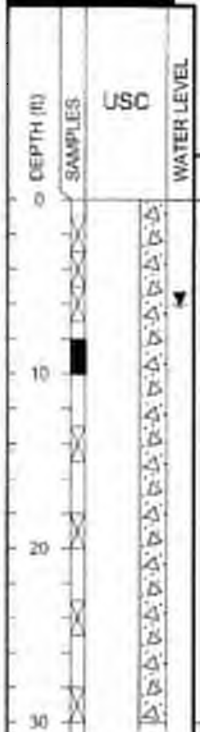
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

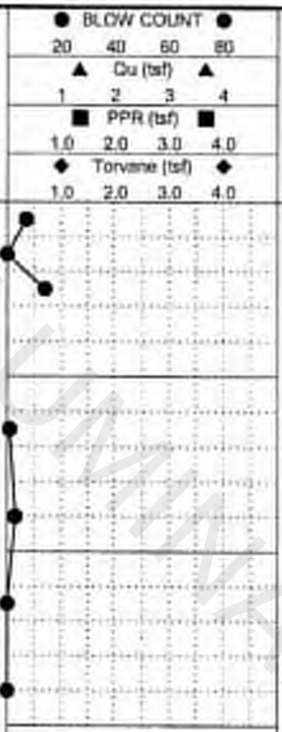
PROJECT NO.: G 2810-08

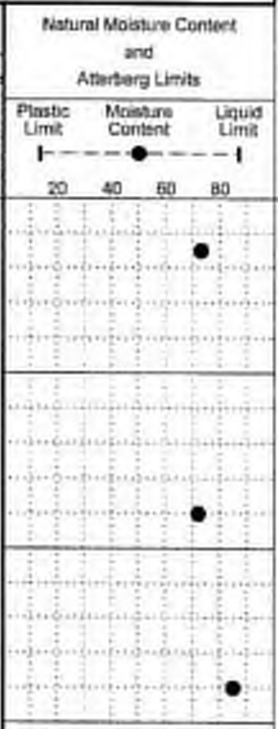
BORING TYPE: Flight Auger

DATE 2/20/08

SURFACE ELEVATION 390'







MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
ASH SEDIMENT loose; gray	N=7										
–very loose; gray and black	N=0					73				95	+40 Sieve =3%, +4 Sieve =0%
–medium dense; brown	N=14										
–very loose; black	N=1										
	N=3					72				96	+40 Sieve =1%, +4 Sieve =0%
	N=0										
–strong odor	N=0					85				99	+40 Sieve =0%, +4 Sieve =0%
Bottom of Boring @ 30'											

Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 4' while drilling. Water level @ 6' and caved to 17' upon completion. Dry and caved to 3' and on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.548', W 94°34.570'.

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LOG OF BORING B-9

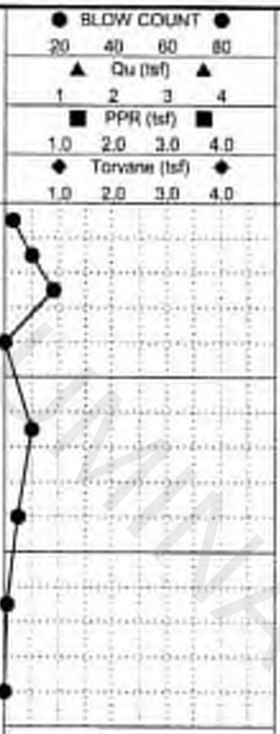
PROJECT: Luminant Martin Lake PDP 1-3
Tatum, Texas

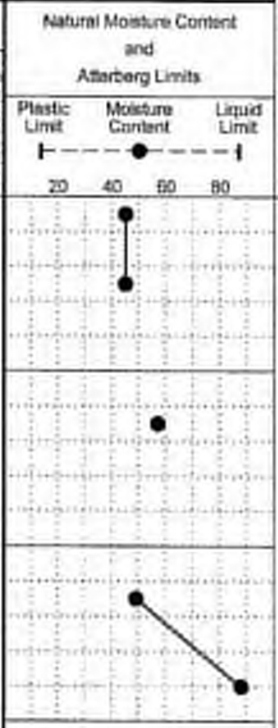
PROJECT NO.: G 2810-08 **BORING TYPE:** Flight Auger

DATE 2/20/08

SURFACE ELEVATION 390'

DEPTH (ft)	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LL	PL	PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	ASH SEDIMENT very loose; gray	N=3					45				89	
	–loose; black and gray	N=10										
	–medium dense	N=18					45				77	+40 Sieve =4%, +4 Sieve =0%
	–very loose; black	N=0										
10	–loose	N=10					57				94	+40 Sieve =3%, +4 Sieve =0%
		N=5										
20	–very loose	N=1					49				68	+40 Sieve =4%, +4 Sieve =0%
	–gray and black; strong odor	N=0					88				97	+40 Sieve =2%, +4 Sieve =0%
30	Bottom of Boring @ 30'											





Water Level: Est: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 4' while drilling. Water level @ 6' and caved to 18' upon completion. Dry and caved to 4' on 2/29/08.

Key to Abbreviations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32°15.556', W 94°34.913'. Minus #200 Sieve (89%) @ 1' (Hydrometer - Specific Gravity 2.761).

CPT Data

Job Number 04.1908-0020

CPT Number B-02

Location Tatum-Tx

Operator GLENN JOHNSON

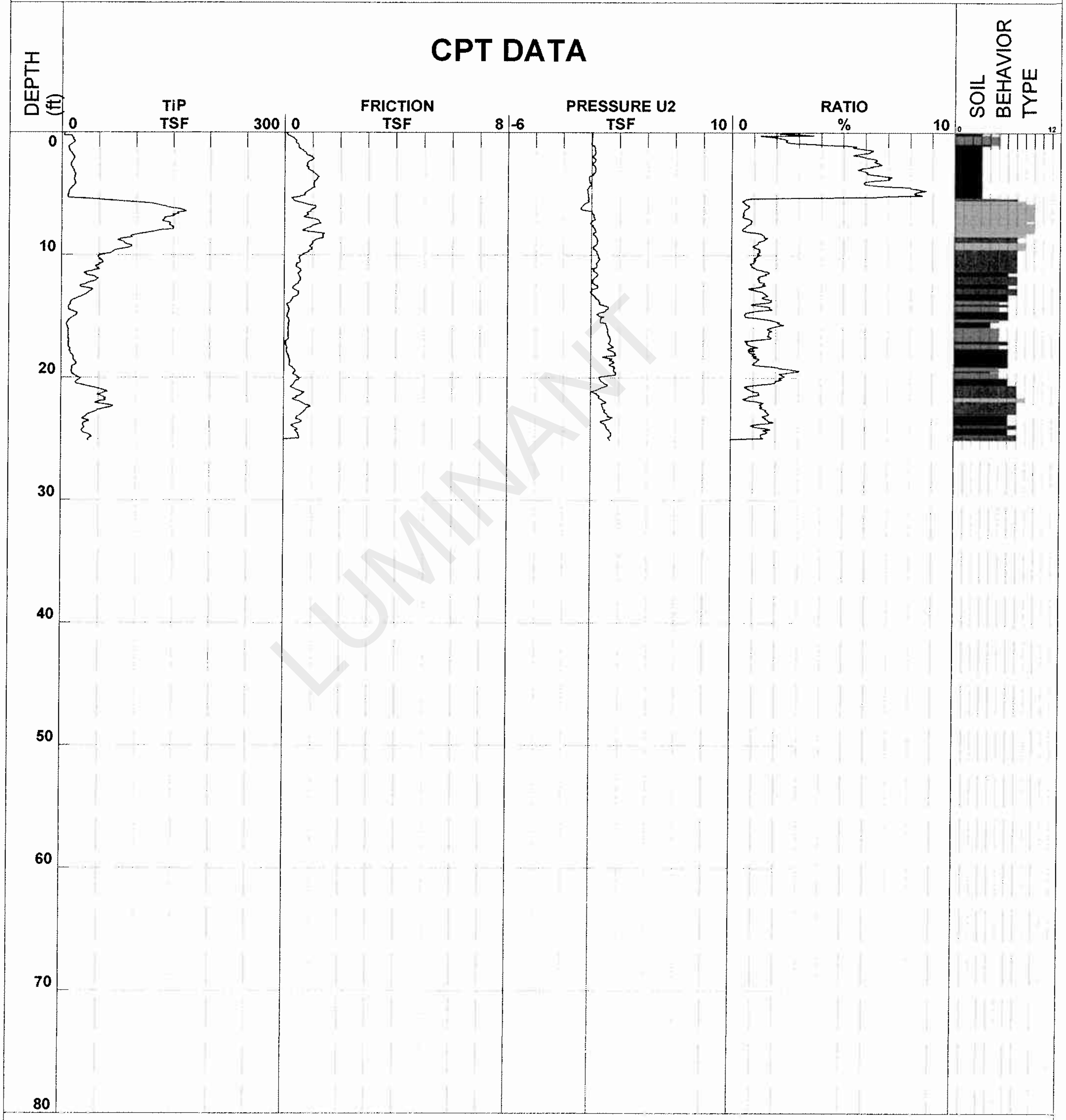
Date and T 16-Apr-2008 13:47:38

Cone Number F7.5CKEW2/B 1866

Client

Elevation

Water Table



▨ 1 - sensitive fine grained

■ 2 - organic material

■ 3 - clay

■ 4 - silty clay to clay

■ 5 - clayey silt to silty clay

■ 6 - sandy silt to clayey silt

■ 7 - silty sand to sandy silt

▨ 8 - sand to silty sand

▨ 9 - sand

■ 10 - gravelly sand to sand

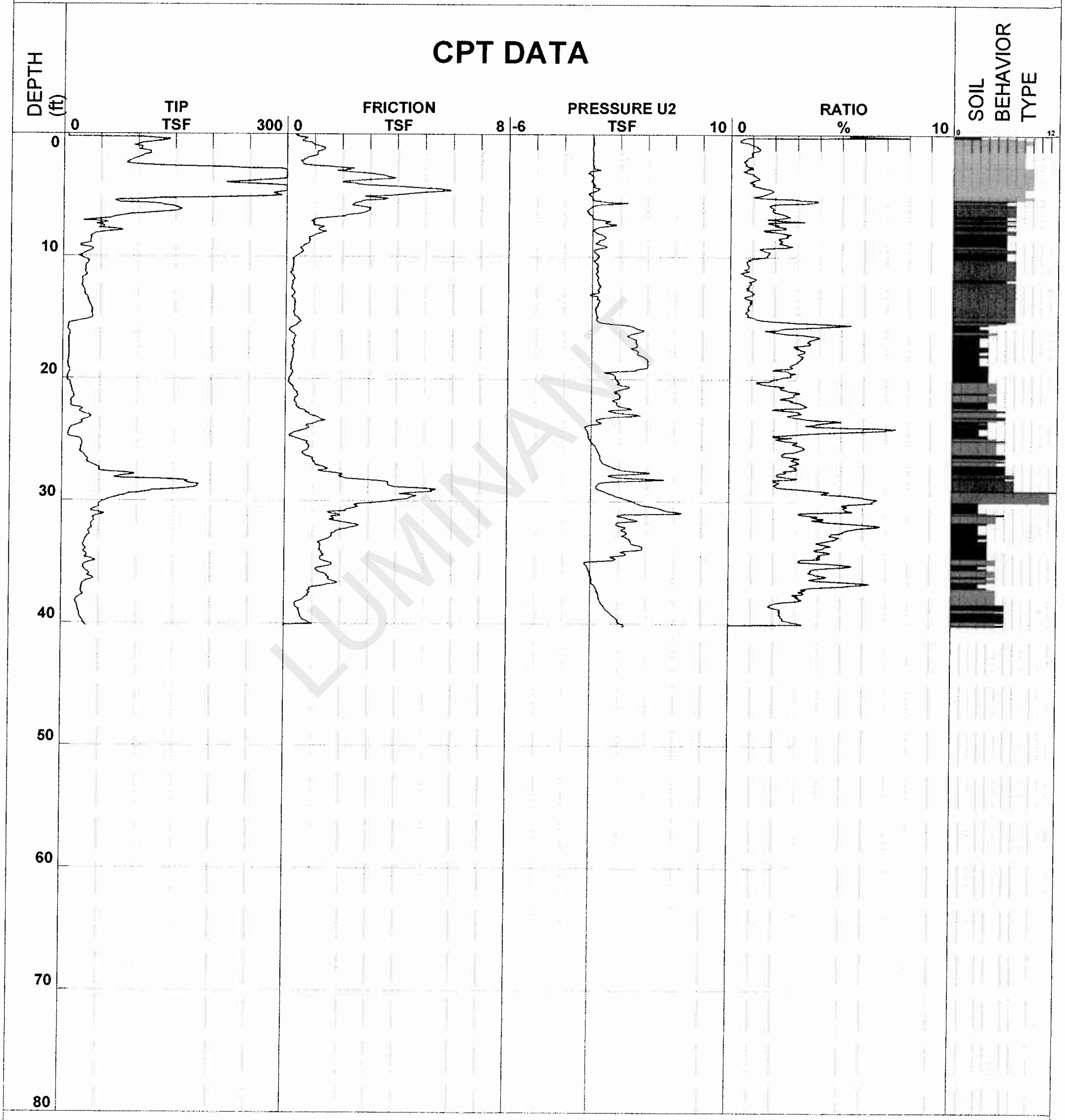
■ 11 - very stiff fine grained (*)

■ 12 - sand to clayey sand (*)

Robertson et al. 1986 * Overconsolidated or Cemented

CPT Data

Job Number 04.1908-0020
CPT Number B-07
Location Tatum-Tx
Operator GLENN JOHNSON
Date and T 16-Apr-2008 12:40:51
Cone Number F7.5CKEW2/B 1866
Client
Elevation
Water Table

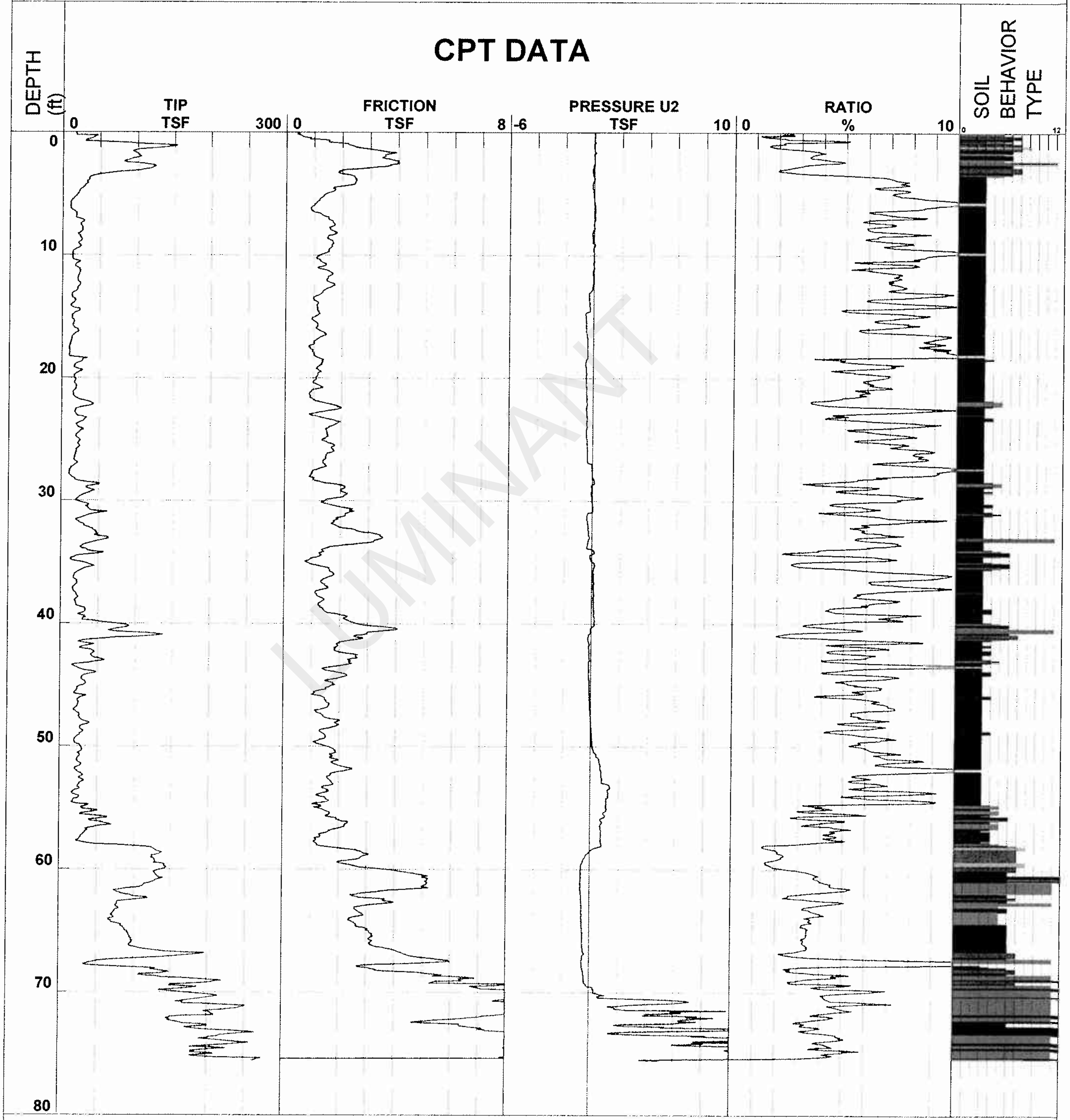


- ▨ 1 - sensitive fine grained
- ■ 2 - organic material
- ■ 3 - clay
- ■ 4 - silty clay to clay
- ■ 5 - clayey silt to silty clay
- ■ 6 - sandy silt to clayey silt
- ■ 7 - silty sand to sandy silt
- ▨ 8 - sand to silty sand
- ▨ 9 - sand
- ■ 10 - gravelly sand to sand
- ■ 11 - very stiff fine grained (*)
- ■ 12 - sand to clayey sand (*)

Robertson et al. 1986 * Overconsolidated or Cemented

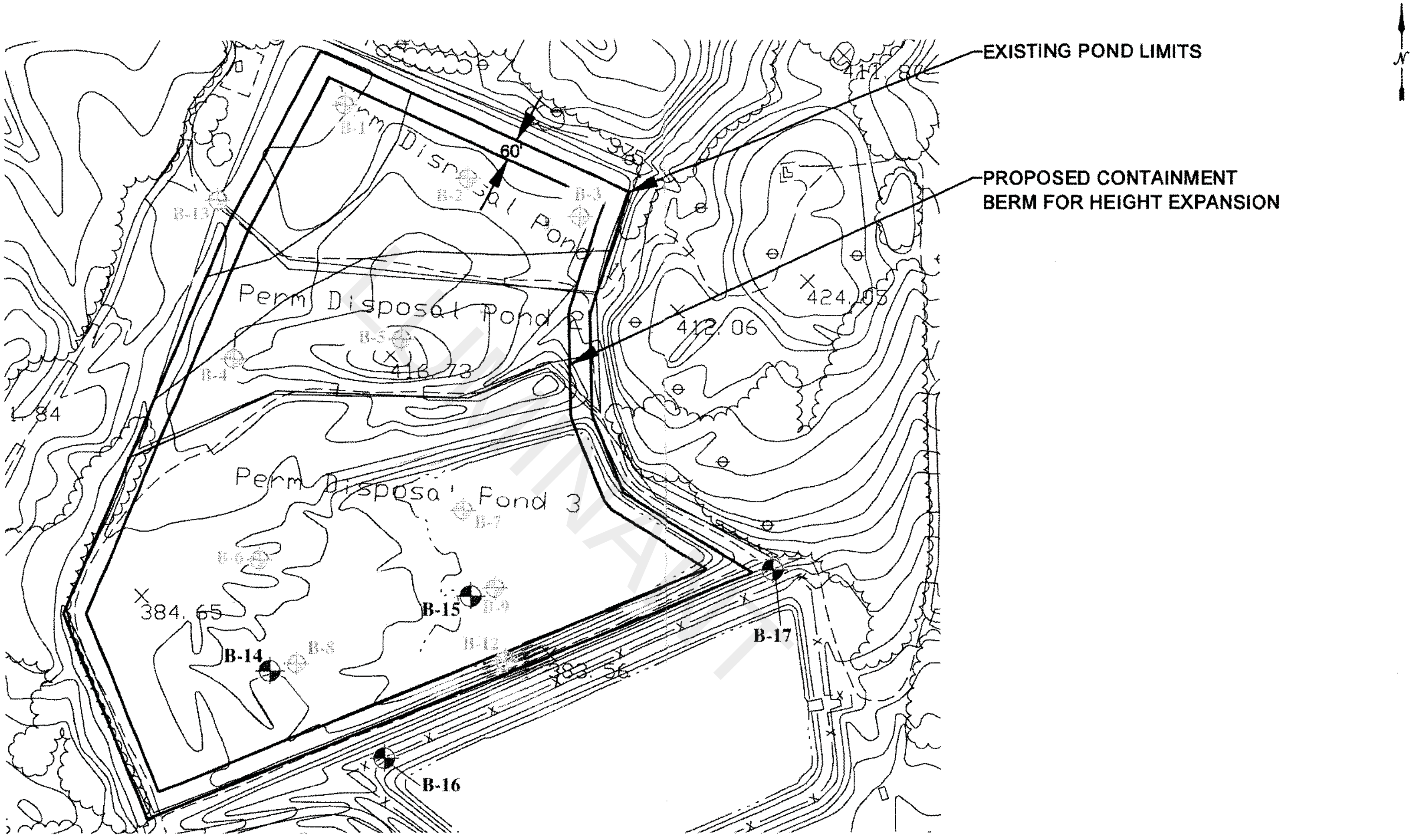
CPT Data

Job Number 04.1908-0020
CPT Number B-12
Location Tatum-Tx
Operator GLENN JOHNSON
Date and T 16-Apr-2008 10:58:47
Cone Number F7.5CKEW2/B 1866
Client
Elevation
Water Table



▨ 1 - sensitive fine grained
■ 2 - organic material
■ 3 - clay
■ 4 - silty clay to clay
■ 5 - clayey silt to silty clay
■ 6 - sandy silt to clayey silt
■ 7 - silty sand to sandy silt
▨ 8 - sand to silty sand
▨ 9 - sand
■ 10 - gravelly sand to sand
■ 11 - very stiff fine grained (*)
■ 12 - sand to clayey sand (*)

Robertson et al. 1986 * Overconsolidated or Cemented



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LUMINANT MARTIN LAKE
PDP 1-3
TATUM, TEXAS

PLATE 1 – PLAN OF BORINGS
JOB No.: G 3219-09
DATE: MARCH 2008
SCALE: N.T.S.
APPROVED BY:
DRAWN BY: K.C.R.

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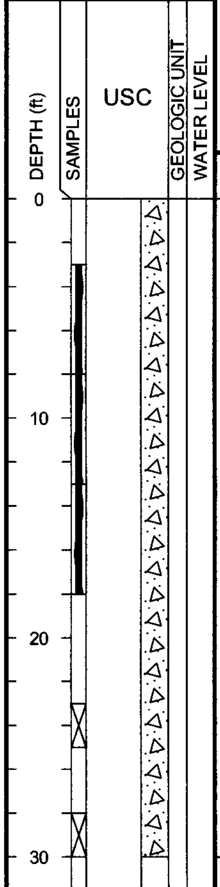
LOG OF BORING B-14

PROJECT: Luminant Martin Lake PDP 1-3 Supplemental
Tatum, Texas

PROJECT NO.: G3219-09 **BORING TYPE:** Rotary Wash

DATE 8/18/09

SURFACE ELEVATION



MATERIAL DESCRIPTION

ASH SEDIMENT black;

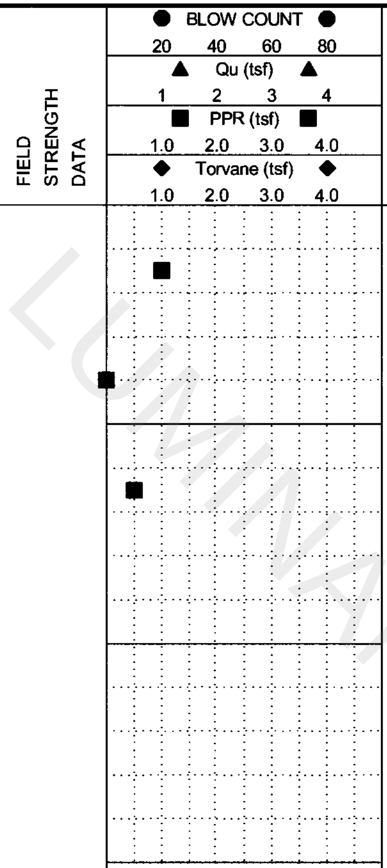
--dark gray; with silty clay

--black; with sand

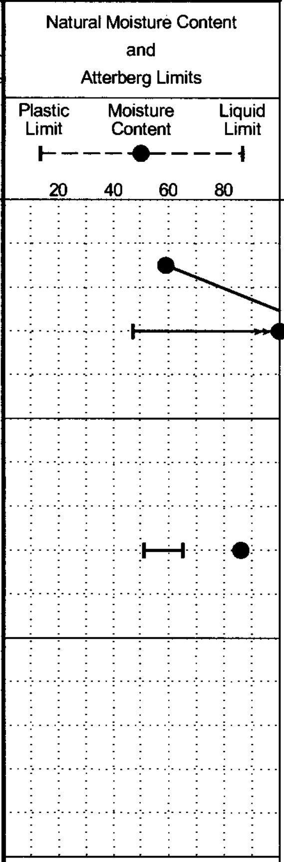
--gray

--black; with silt

Bottom of Boring @ 30'



DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)



MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
59				83	+40 Sieve=3%, +4 Sieve=0%
119	111	47	64	89	+40 Sieve=1%, +4 Sieve=0%
86	65	51	14	95	+40 Sieve=1%, +4 Sieve=0%

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 5' while drilling.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32° 15.549', W 94°34.971'

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LOG OF BORING B-15

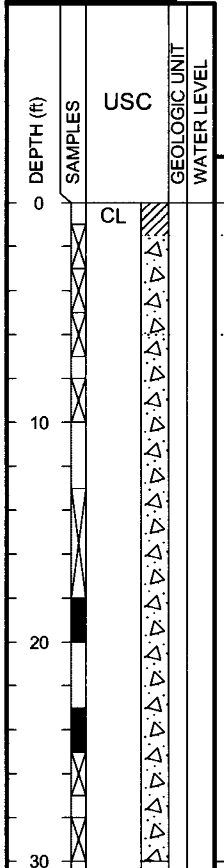
PROJECT: Luminant Martin Lake PDP 1-3 Supplemental
Tatum, Texas

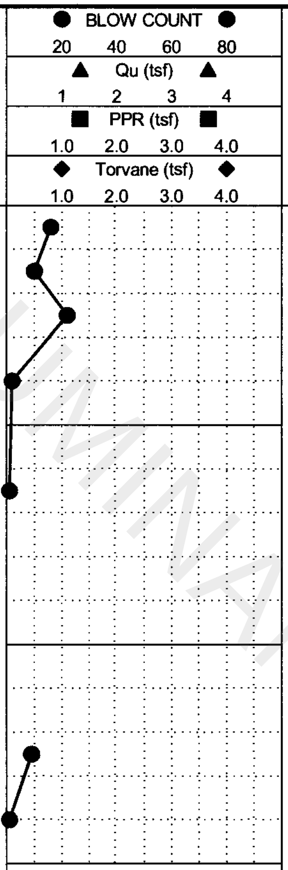
PROJECT NO.: G3219-09 **BORING TYPE:** Rotary Wash

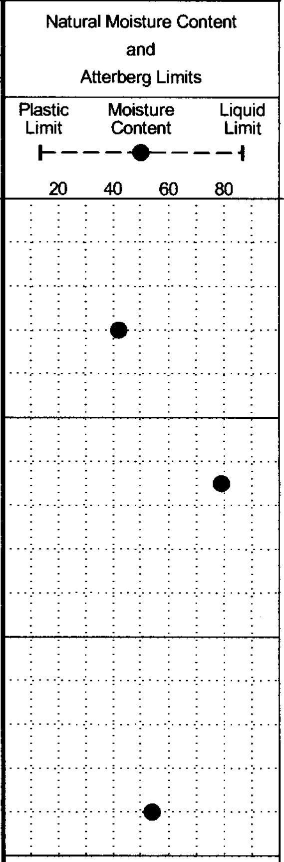
DATE 8/18/09

SURFACE ELEVATION

USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	LEAN CLAY(CL) tan, gray, and red											
	ASH SEDIMENT gray	N=16										
	--no recovery	N=10										
	--black; with clay and silt	N=22										
	ASH SEDIMENT gray; with sand; laminated						42				47	+40 Sieve=9%, +4 Sieve=1%
	--with silt	N=2										
	--with sand	N=1					79				95	+40 Sieve=2%, +4 Sieve=0%
	--full recovery											
	--no recovery											
	--black	N=9										
	--black and gray	N=1					54				85	+40 Sieve=7%, +4 Sieve=3%
	Bottom of Boring @ 30'											







Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations: Seepage @ 5' while drilling.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32° 15.556', W 94°34.913'

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LOG OF BORING B-16

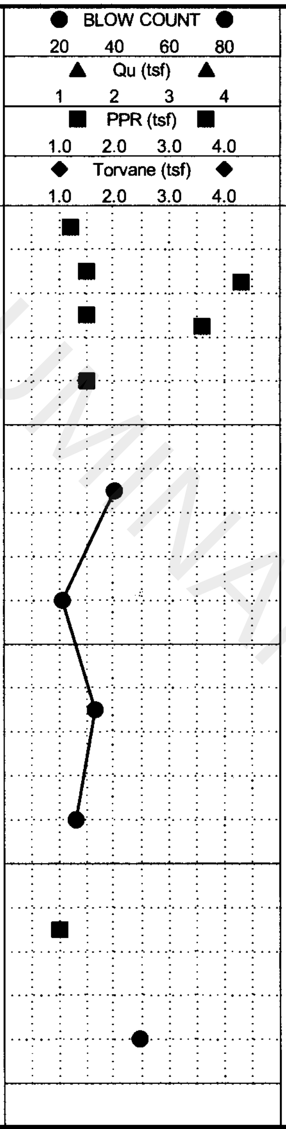
PROJECT: Luminant Martin Lake PDP 1-3 Supplemental
Tatum, Texas

PROJECT NO.: G3219-09 **BORING TYPE:** Rotary Wash

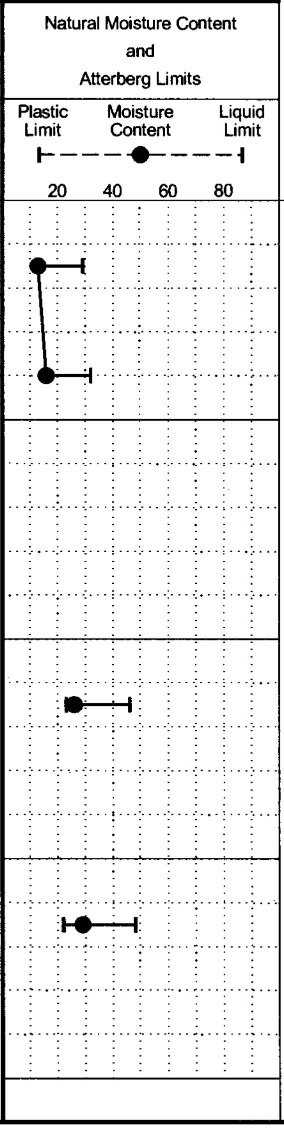
DATE 8/18/09

SURFACE ELEVATION

DEPTH (ft)	USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
0	CL	SANDY LEAN CLAY(CL) orange and tan	P=1.2						
		--tan and gray	P=1.5	13	29	14	15	34	+40 Sieve=1%, +4 Sieve=0%
			P=4.3						
		--orange and tan	P=1.25						
			P=3.6						
	SC	CLAYEY SAND(SC) gray and orange	P=1.5	16	32	16	16	37	+40 Sieve=0%, +4 Sieve=0%
10									
			N=40						
	ML	SANDY CLAYEY SILT(ML) orange and light gray	N=21						
20	CL	LEAN CLAY(CL) gray and reddish tan							
			N=33	26	46	23	23	82	+40 Sieve=4%, +4 Sieve=1%
		--orange and tan; with trace of lignite	N=26						
30									
	SC	CLAYEY SAND(SC) tan and brown	P=1.0	29	48	22	26	85	+40 Sieve=5%, +4 Sieve=0%
	SP	SAND(SP) gray	N=49						
40		Bottom of Boring @ 40'							



DRY DENSITY (pcf) | COMPRESSIVE STRENGTH (tsf) | FAILURE STRAIN (%) | CONFINING PRESSURE (psi)



Water Level Est.: ▽ Measured: ▼ Perched: ▼

Water Observations:

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32° 15.484', W 94°34.965'

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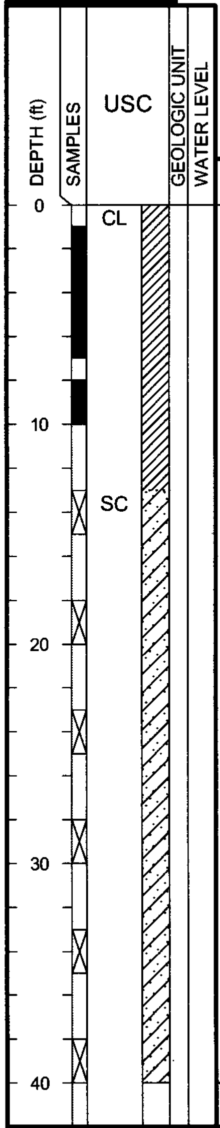
LOG OF BORING B-17

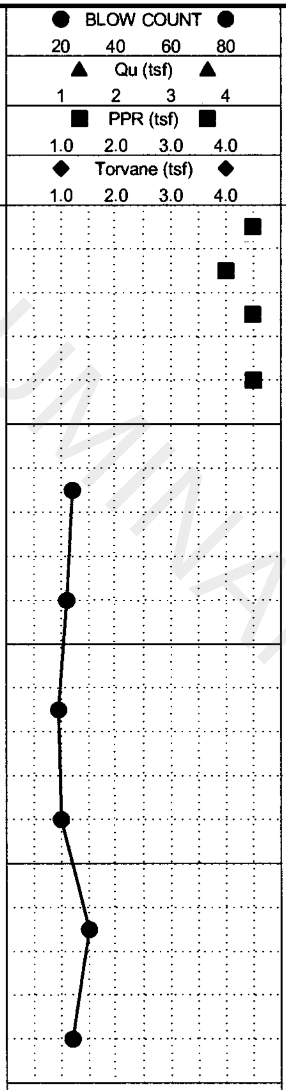
PROJECT: Luminant Martin Lake PDP 1-3 Supplemental
Tatum, Texas

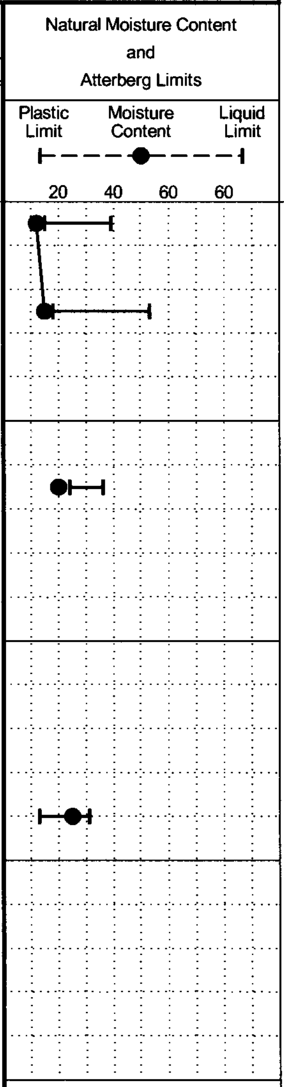
PROJECT NO.: G3219-09 **BORING TYPE:** Rotary Wash

DATE 8/18/09

SURFACE ELEVATION







USC	MATERIAL DESCRIPTION	FIELD STRENGTH DATA	DRY DENSITY (pcf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS(%) LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	MINUS #200 SIEVE (%)	OTHER TESTS PERFORMED (Page Ref. #)
CL	SANDY LEAN CLAY(CL) orange and tan	P=4.5+					12	39	15	24	60	+40 Sieve=7%, +4 Sieve=4%
	--orange and brown	P=4.0										
	--red, tan, and yellow	P=4.5					15	53	18	35	51	+40 Sieve=7%, +4 Sieve=1%
	--tan and gray	P=4.5+										
SC	CLAYEY SAND(SC) tan	N=40					20	36	24	12	52	+40 Sieve=0%, +4 Sieve=0%
	--tan and brown	N=22										
	--tan and gray; laminated	N=19										
	--gray and orange	N=20					25	31	13	18	39	+40 Sieve=0%, +4 Sieve=0%
	--tan	N=30										
	--tan and orange	N=24										
	Bottom of Boring @ 40'											

Water Level Est.: ∇ Measured: ▼ Perched: ▼

Water Observations: Bailed to 20' and open upon completion.

Key to Abbrevations:
N - SPT Data (Blows/Ft)
P - Pocket Penetrometer (tsf)
T - Torvane (tsf)
L - Lab Vane Shear (tsf)

Notes:
GPS Coordinates: N 32° 15.566', W 94°34.736'

APPENDIX B

LABORATORY TEST RESULTS

BOTTOM ASH PONDS AND SCRUBBER POND

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

SUMMARY OF LABORATORY RESULTS

CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
BH-201	0.0							19.2			
BH-201	2.0							13.7			
BH-201	6.0	26	14	12				9.4			
BH-201	8.0							15.1			
BH-201	13.0							16.3			
BH-201	18.0							20.8			
BH-201	23.0	36	14	22				19.9			
BH-201	28.0							18.2			
BH-201	33.0							15.0			
BH-201	38.0				0.85	40		14.9			
BH-201	43.0							21.4			
BH-201	48.0							23.5			
BH-202	0.0							20.8			
BH-202	2.0	55	19	36				17.1			
BH-202	4.0							20.5			
BH-202	6.0							26.7			
BH-202	8.0							15.3			
BH-202	13.0							14.9			
BH-202	18.0	29	13	16				17.1			
BH-202	23.0							17.6			
BH-202	28.0				0.85	49		18.1			
BH-202	33.0							17.0			
BH-202	38.0							20.8			
BH-202	43.0							23.0			
BH-202	48.0							26.2			
BH-203	0.0							12.6			
BH-203	2.0							14.6			
BH-203	4.0							16.1			
BH-203	6.0	50	19	31				21.5			
BH-203	8.0							22.3			
BH-203	13.0							18.0			
BH-203	18.0							14.6			
BH-203	23.0							17.3			
BH-203	25.0							19.9			
BH-203	28.0				2	17		23.6			
BH-203	30.0							27.7			
BH-203	33.0							29.1			
BH-203	38.0							29.4			
BH-204	0.0							13.9			
BH-204	2.0							21.1			
BH-204	4.0							15.0			
BH-204	6.0							16.6			
BH-204	8.0							13.5			

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

SUMMARY OF LABORATORY RESULTS

CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
BH-204	28.0				4.75	58		19.1			
BH-204	33.0							13.8			
BH-204	38.0							21.0			
BH-204	43.0	51	20	31				26.6			
BH-204	48.0							23.8			
BH-205	0.0							17.5			
BH-205	2.0							15.6			
BH-205	4.0							15.5			
BH-205	6.0							20.7			
BH-205	8.0							17.4			
BH-205	13.0	47	15	32				23.0			
BH-205	18.0							22.9			
BH-205	23.0	28	17	11				16.3			
BH-205	28.0				4.75	69		16.4			
BH-205	33.0							14.7			
BH-205	38.0							25.4			
BH-205	43.0							26.7			
BH-205	48.0							25.0			
BH-205	53.0				9.5	11		25.9			
BH-206	0.0							17.1			
BH-206	2.0	44	15	29				15.6			
BH-206	4.0							14.0			
BH-206	6.0							16.2			
BH-206	8.0							21.7			
BH-206	13.0							18.1			
BH-206	18.0							12.2			
BH-206	23.0							15.9			
BH-206	28.0	59	17	42				20.3			
BH-206	33.0							19.8			
BH-206	38.0							18.2			
BH-206	43.0							22.1			
BH-206	48.0							23.3			
BH-206	53.0							23.0			
BH-206	58.0							22.1			
BH-207	0.0							15.6			
BH-207	2.0							15.3			
BH-207	4.0							14.9			
BH-207	6.0							18.2			
BH-207	13.0							18.9			
BH-207	18.0							13.0			
BH-207	23.0							16.9			
BH-207	28.0	31	16	15				16.7			
BH-207	33.0							17.4			

SUMMARY OF LABORATORY RESULTS

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
BH-207	38.0							19.0			
BH-207	43.0							21.8			
BH-207	48.0							22.2			
BH-207	53.0							25.2			
BH-207	58.0							29.8			
BH-208	0.0							20.2			
BH-208	2.0							16.2			
BH-208	4.0							12.9			
BH-208	6.0							11.5			
BH-208	8.0	28	15	13				15.2			
BH-208	13.0							15.9			
BH-208	18.0							20.2			
BH-208	23.0							18.0			
BH-208	28.0							21.3			
BH-208	33.0							18.1			
BH-208	38.0							19.1			
BH-208	43.0							23.7			
BH-208	48.0				4.75	11		24.5			
BH-208	53.0							27.1			
BH-208	58.0							26.1			
BH-209	0.0							9.0			
BH-209	2.0							11.8			
BH-209	4.0	62	21	41				11.8			
BH-209	6.0							12.1			
BH-209	8.0							19.2			
BH-209	13.0							12.3			
BH-209	18.0							21.0			
BH-209	28.0	41	15	26				23.3			
BH-209	33.0							20.0			
BH-209	35.0							21.2			
BH-209	38.0							17.9			
BH-209	43.0							24.0			
BH-209	48.0							21.2			
BH-210	0.0							8.2			
BH-210	2.0							10.7			
BH-210	4.0							13.4			
BH-210	6.0							14.4			
BH-210	8.0							15.7			
BH-210	13.0							21.3			
BH-210	18.0	36	14	22				22.9			
BH-210	23.0							25.0			
BH-210	28.0							18.5			
BH-210	33.0							19.3			

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, Texas 77073
Telephone: (281) 821-6868
Fax: (281) 821-6870

SUMMARY OF LABORATORY RESULTS

CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Martin Lake

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
BH-210	38.0							17.2			
BH-210	43.0							25.6			
BH-210	48.0				9.5	33		33.4			
BH-210	53.0							29.3			
BH-210	58.0							29.3			
BH-210	63.0							26.6			
BH-210	68.0							31.1			
BH-211	0.0							8.7			
BH-211	2.0							13.3			
BH-211	4.0							15.0			
BH-211	6.0							14.5			
BH-211	8.0							13.2			
BH-211	13.0							17.6			
BH-211	18.0	50	17	33				15.0			
BH-211	23.0							11.6			
BH-211	28.0				9.5	52		11.6			
BH-211	33.0							22.5			
BH-211	38.0							21.1			
BH-211	43.0							24.3			
BH-211	48.0							24.3			
BH-211	53.0							24.9			
BH-211	58.0							22.9			
BH-211	63.0							29.5			
BH-211	68.0							26.6			

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Houston, Texas 77073
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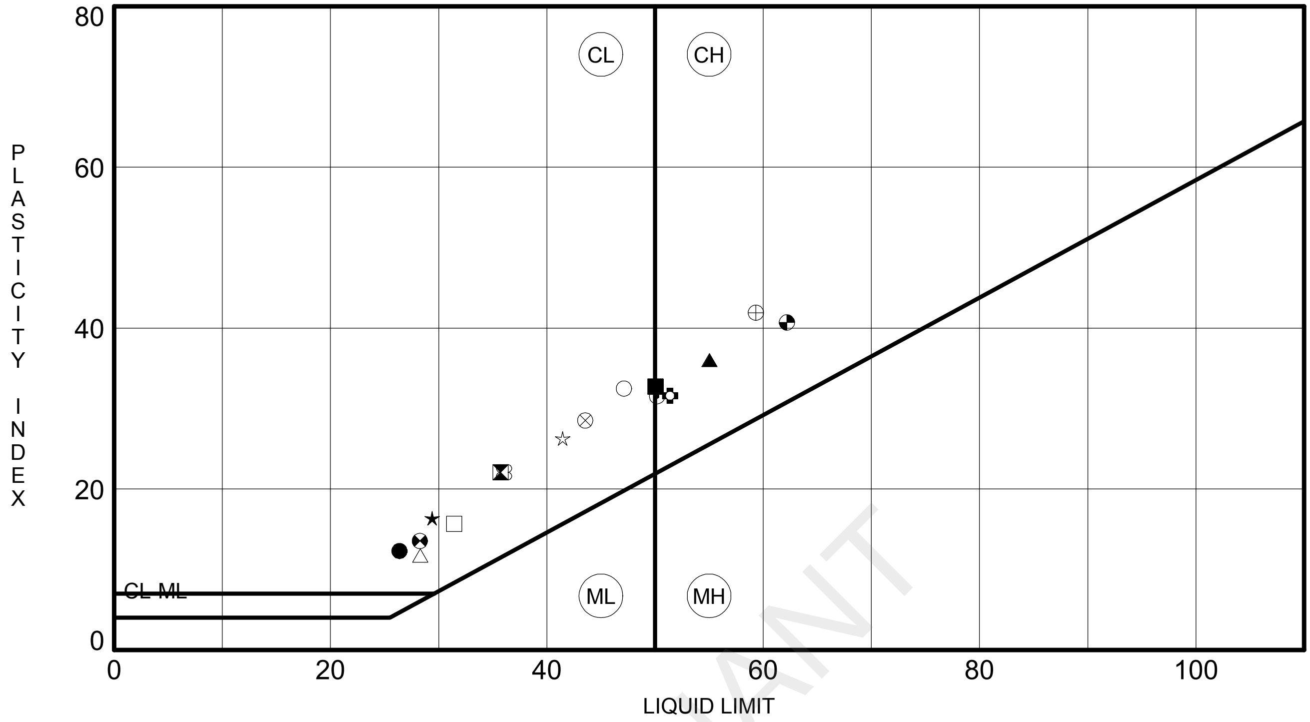
ATTERBERG LIMITS' RESULTS

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Martin Lake



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**BH-201**	**6.0**	**26**	**14**	**12**		
⧗	**BH-201**	**23.0**	**36**	**14**	**22**		
▲	**BH-202**	**2.0**	**55**	**19**	**36**		
★	**BH-202**	**18.0**	**29**	**13**	**16**		
⊙	**BH-203**	**6.0**	**50**	**19**	**31**		
✲	**BH-204**	**43.0**	**51**	**20**	**31**		
○	**BH-205**	**13.0**	**47**	**15**	**32**		
△	**BH-205**	**23.0**	**28**	**17**	**11**		
⊗	**BH-206**	**2.0**	**44**	**15**	**29**		
⊕	**BH-206**	**28.0**	**59**	**17**	**42**		
□	**BH-207**	**28.0**	**31**	**16**	**15**		
◍	**BH-208**	**8.0**	**28**	**15**	**13**		
◕	**BH-209**	**4.0**	**62**	**21**	**41**		
☆	**BH-209**	**28.0**	**41**	**15**	**26**		
❀	**BH-210**	**18.0**	**36**	**14**	**22**		
■	**BH-211**	**18.0**	**50**	**17**	**33**		

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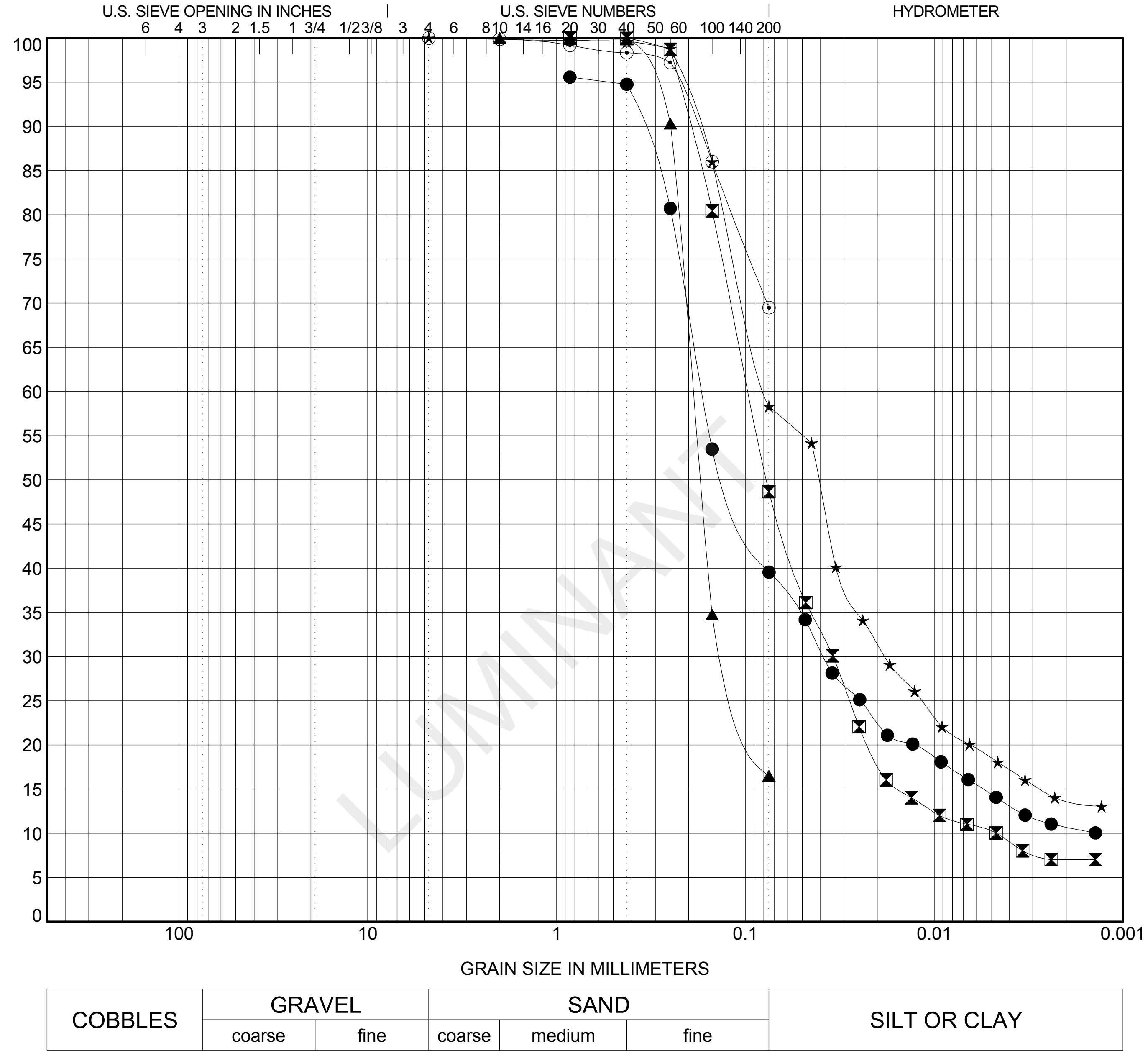
GRAIN SIZE DISTRIBUTION

CLIENT Luminant **PROJECT NAME** Pond Slope Stability

PROJECT NUMBER 123-94128 **PROJECT LOCATION** Martin Lake



	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**BH-201**	**38**						
⧗	**BH-202**	**28**					**2.63**	**20.54**
▲	**BH-203**	**28**						
★	**BH-204**	**28**						
⊙	**BH-205**	**28**						

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH-201**	**38**	**0.85**	**0.169**	**0.038**			**56.0**	**25.1**	**14.4**
⧗	**BH-202**	**28**	**0.85**	**0.096**	**0.034**	**0.005**	**0.0**	**51.3**	**38.4**	**10.2**
▲	**BH-203**	**28**	**2**	**0.189**	**0.125**		**0.0**	**83.5**	**16.5**	
★	**BH-204**	**28**	**4.75**	**0.078**	**0.018**		**0.0**	**41.7**	**39.8**	**18.5**
⊙	**BH-205**	**28**	**4.75**				**0.0**	**30.5**	**69.5**	

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Houston, Texas 77073
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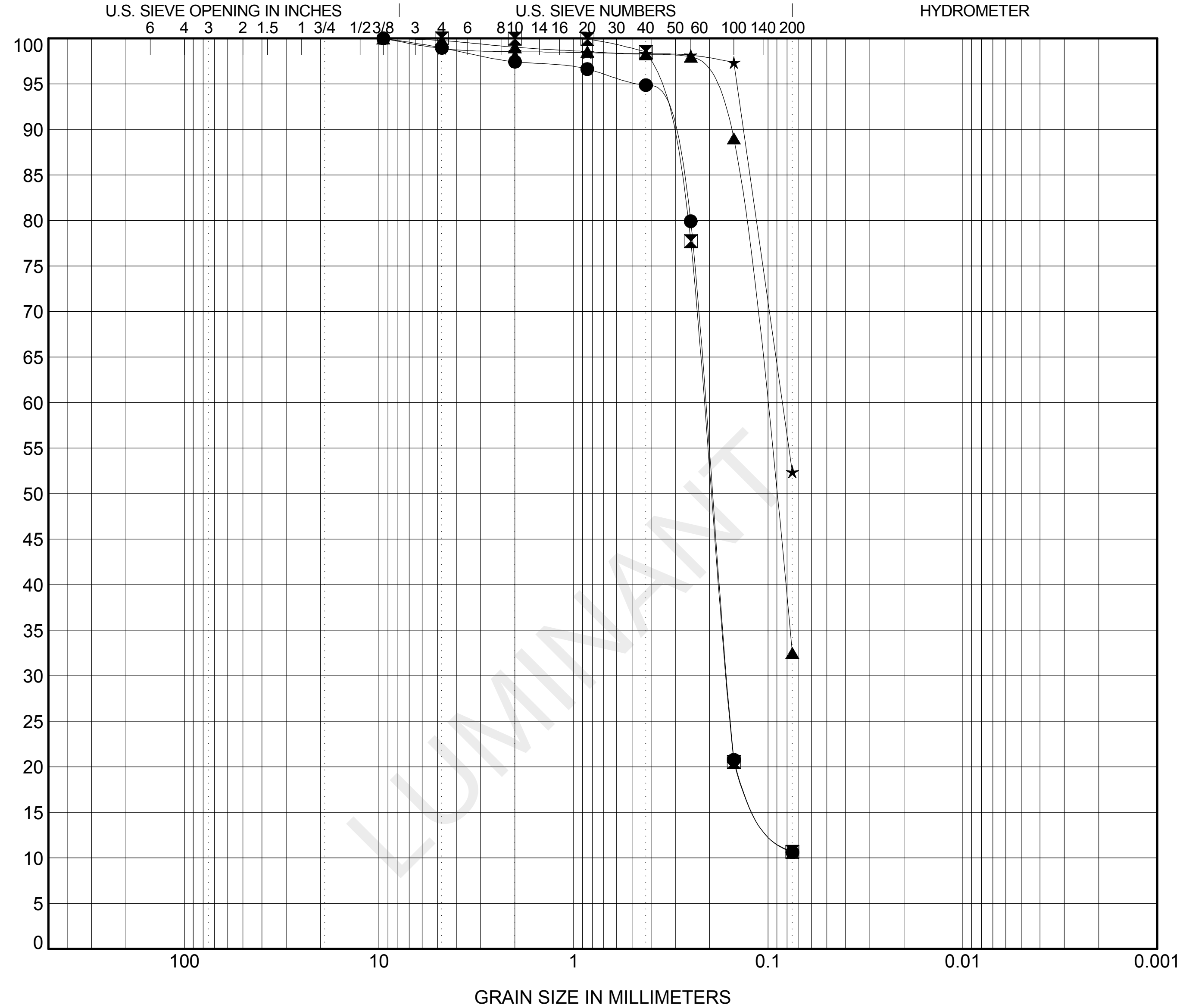
GRAIN SIZE DISTRIBUTION

CLIENT Luminant **PROJECT NAME** Pond Slope Stability

PROJECT NUMBER 123-94128 **PROJECT LOCATION** Martin Lake

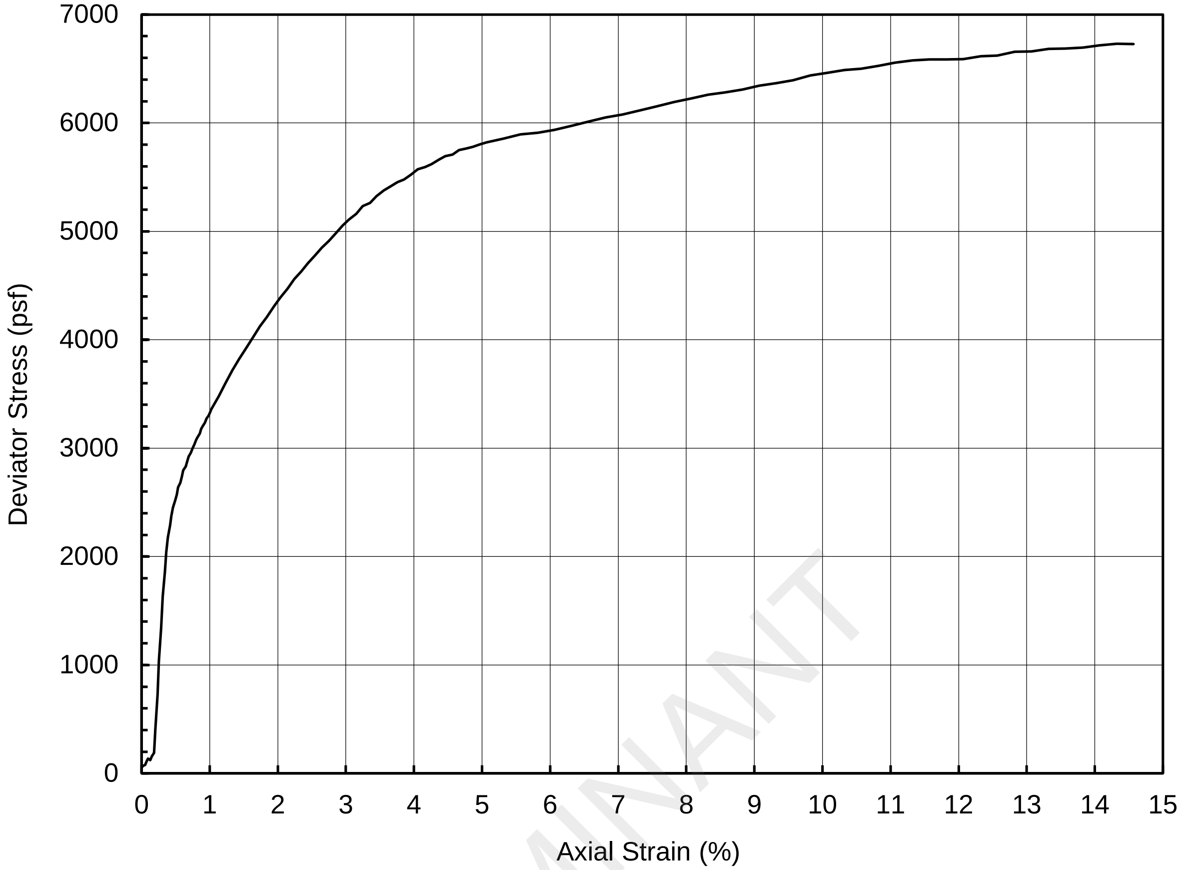


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**BH-205**	**53**					**1.74**	**2.93**
⧗	**BH-208**	**48**					**1.75**	**2.98**
▲	**BH-210**	**48**						
★	**BH-211**	**28**						

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH-205**	**53**	**9.5**	**0.21**	**0.162**		**1.1**	**88.3**	**10.6**	
⧗	**BH-208**	**48**	**4.75**	**0.213**	**0.163**		**0.0**	**89.3**	**10.7**	
▲	**BH-210**	**48**	**9.5**	**0.105**			**0.2**	**67.2**	**32.5**	
★	**BH-211**	**28**	**9.5**	**0.084**			**1.1**	**46.5**	**52.4**	

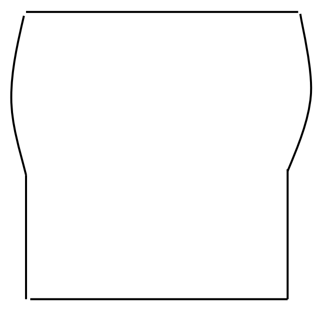
UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Yellow Clay (visual classification)						
LL		PI		LI		USCS	

Depth (ft)	4.0	Confining Pressure (psf)	617
Specimen Height (inch)	6.0	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	6732
Initial Specimen Weight (g)	1263.7	Axial Strain at Peak Stress (%)	14.3
Moist Unit Weight (pcf)	131.9		
Initial Water Content (%)	15		
Initial Dry Unit Weight (pcf)	114.6		

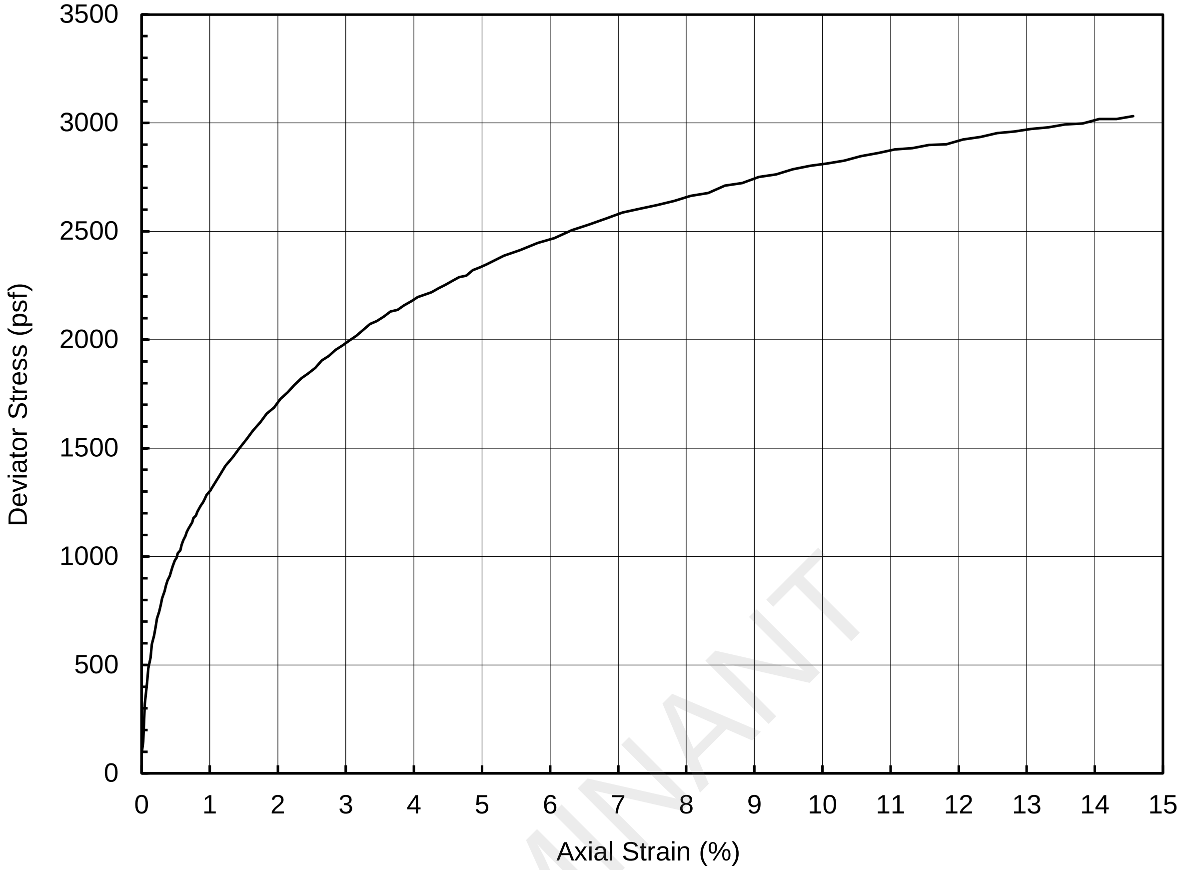
Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-201 TO-3
Comments	



Failure Sketch

Performed by	**PN**
Date	**12-Nov-12**
Check	**HR**
Review	**SBK**

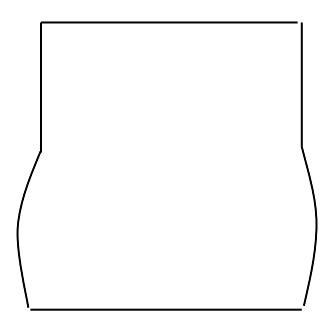
UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Yellow Clay (visual classification)						
LL		PI		LI		USCS	

Depth (ft)	18.0	Confining Pressure (psf)	2371
Specimen Height (inch)	5.9	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	3035
Initial Specimen Weight (g)	1232.8	Axial Strain at Peak Stress (%)	14.8
Moist Unit Weight (pcf)	132.4		
Initial Water Content (%)	19		
Initial Dry Unit Weight (pcf)	111.7		

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-202 TO-7
Comments	



Failure Sketch

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Performed by	**PN**
Date	**13-Nov-12**
Check	**HR**
Review	**SBK**

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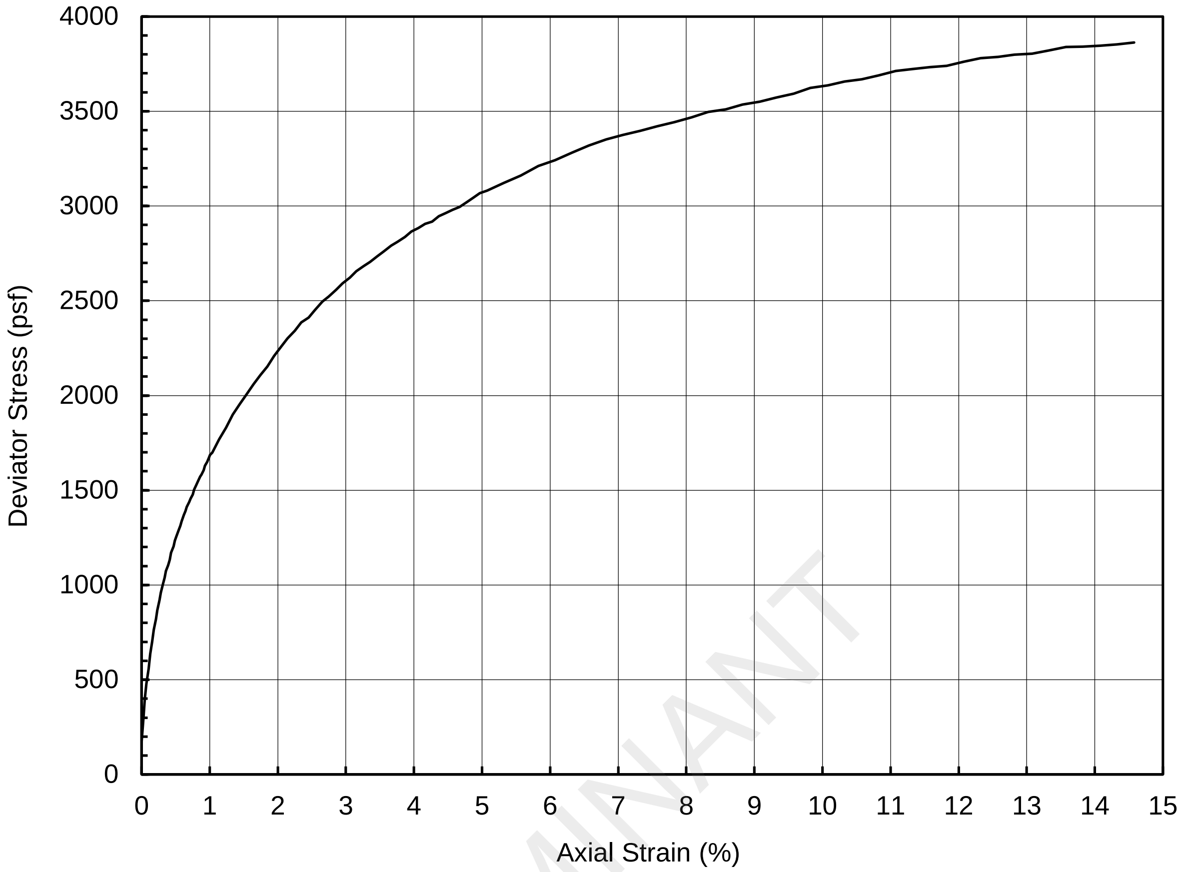
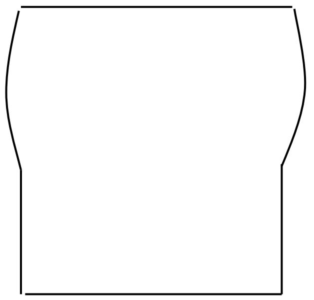
ASTM D 2850



Specimen Description	Reddish Gray Clay (visual classification)						
LL		PI		LI		USCS	

Depth (ft)	6.0	Confining Pressure (psf)	858
Specimen Height (inch)	6.0	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	3877
Initial Specimen Weight (g)	1199.6	Axial Strain at Peak Stress (%)	14.8
Moist Unit Weight (pcf)	124.7		
Initial Water Content (%)	21		
Initial Dry Unit Weight (pcf)	102.7		

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-203 TO-4
Comments	



Failure Sketch

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Date	**13-Nov-12**
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Review	**SBK**

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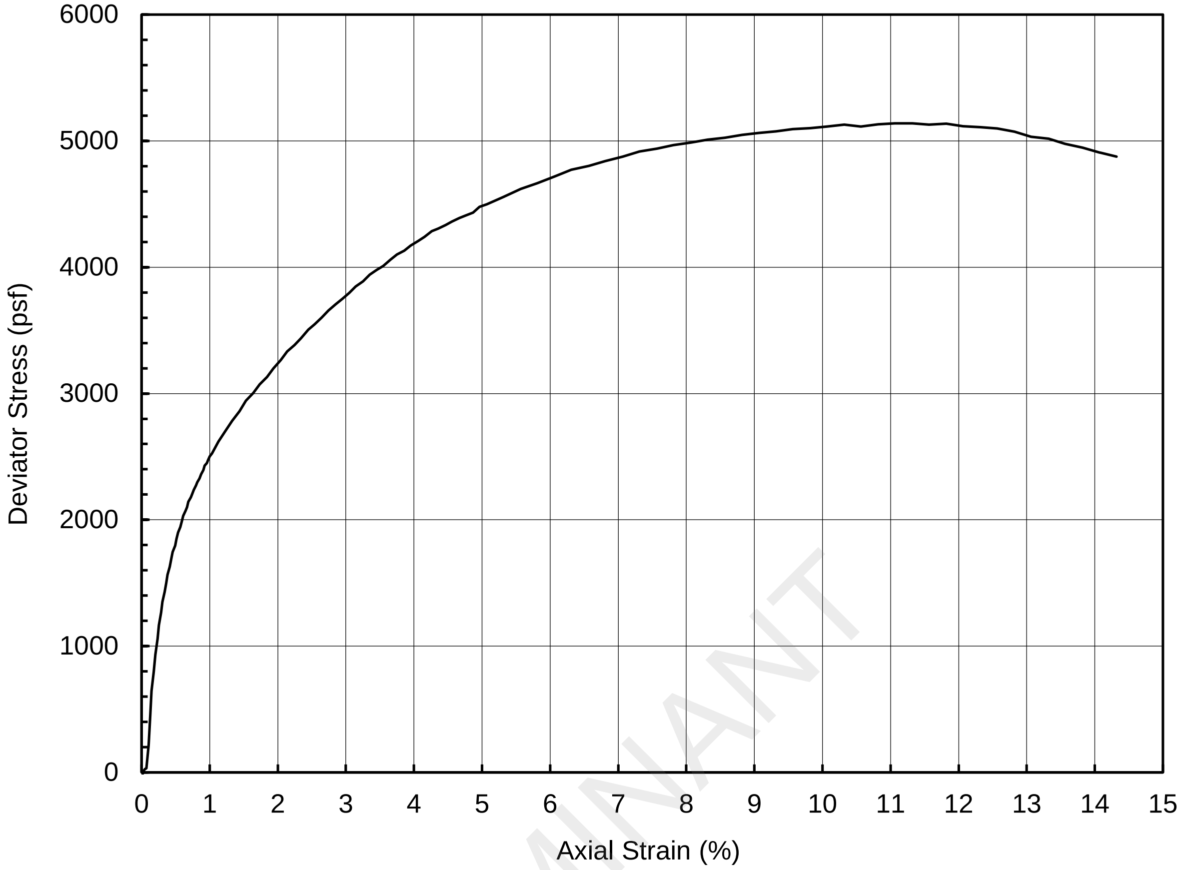
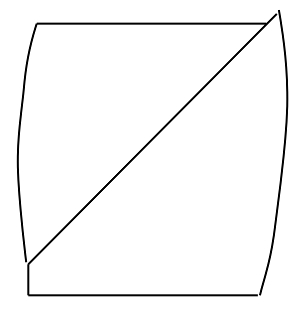
ASTM D 2850



Specimen Description	Reddish Gray Clay (visual classification)						
LL		PI		LI		USCS	

Depth (ft)	23.0	Confining Pressure (psf)	3008
Specimen Height (inch)	6.0	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	5139
Initial Specimen Weight (g)	1192.8	Axial Strain at Peak Stress (%)	11.3
Moist Unit Weight (pcf)	126.6		
Initial Water Content (%)	26		
Initial Dry Unit Weight (pcf)	100.9		



Failure Sketch

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-204 TO-8
Comments	

Performed by	**PN**
Date	**13-Nov-12**
Check	**HR**
Review	**SBK**

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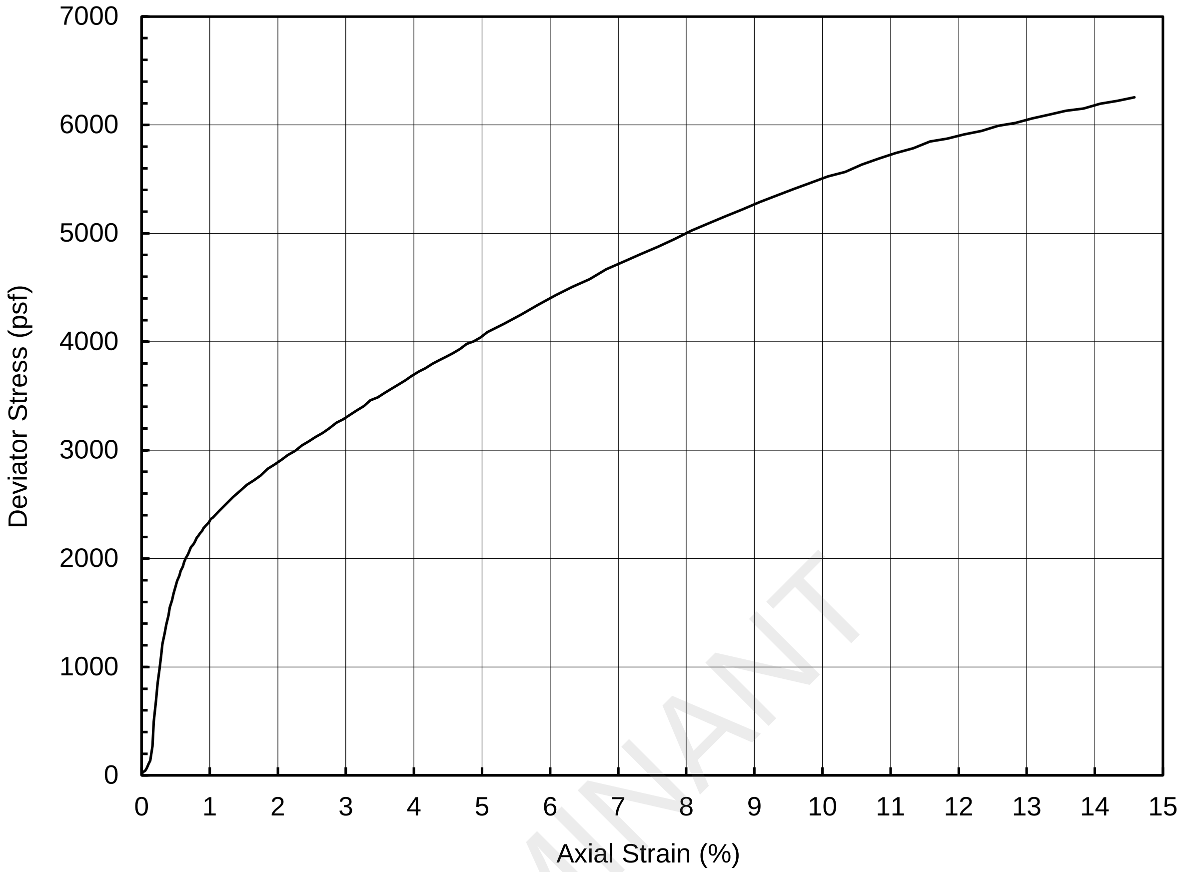
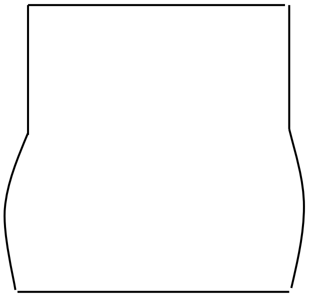
ASTM D 2850



Specimen Description	Reddish Yellow Clay (visual classification)						
LL		PI		LI		USCS	

Depth (ft)	13.0	Confining Pressure (psf)	1760
Specimen Height (inch)	5.9	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	6270
Initial Specimen Weight (g)	1252.5	Axial Strain at Peak Stress (%)	14.8
Moist Unit Weight (pcf)	131.9		
Initial Water Content (%)	27		
Initial Dry Unit Weight (pcf)	104.1		



Failure Sketch

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-205 TO-6
Comments	

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Performed by	**PN**
Date	**13-Nov-12**
Check	**HR**
Review	**SBK**

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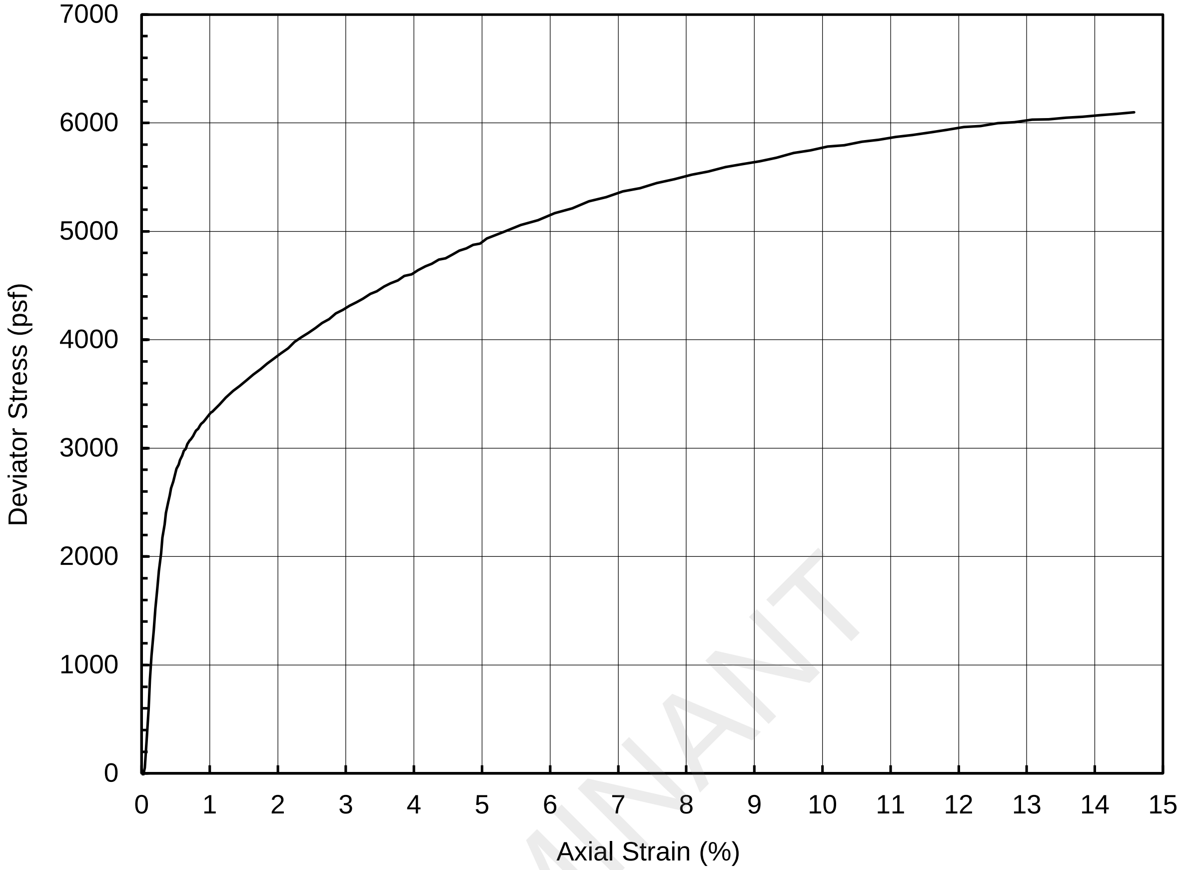
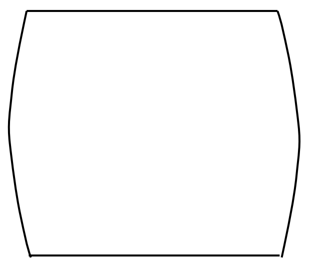
ASTM D 2850



Specimen Description	Grayish Brown Fat Clay						
LL	59	PI	42	LI	0.1	USCS	CH

Depth (ft)	28.0	Confining Pressure (psf)	3627
Specimen Height (inch)	5.9	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	6110
Initial Specimen Weight (g)	1219.7	Axial Strain at Peak Stress (%)	14.8
Moist Unit Weight (pcf)	127.5		
Initial Water Content (%)	20		
Initial Dry Unit Weight (pcf)	106.6		

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-206 TO-9
Comments	



Failure Sketch

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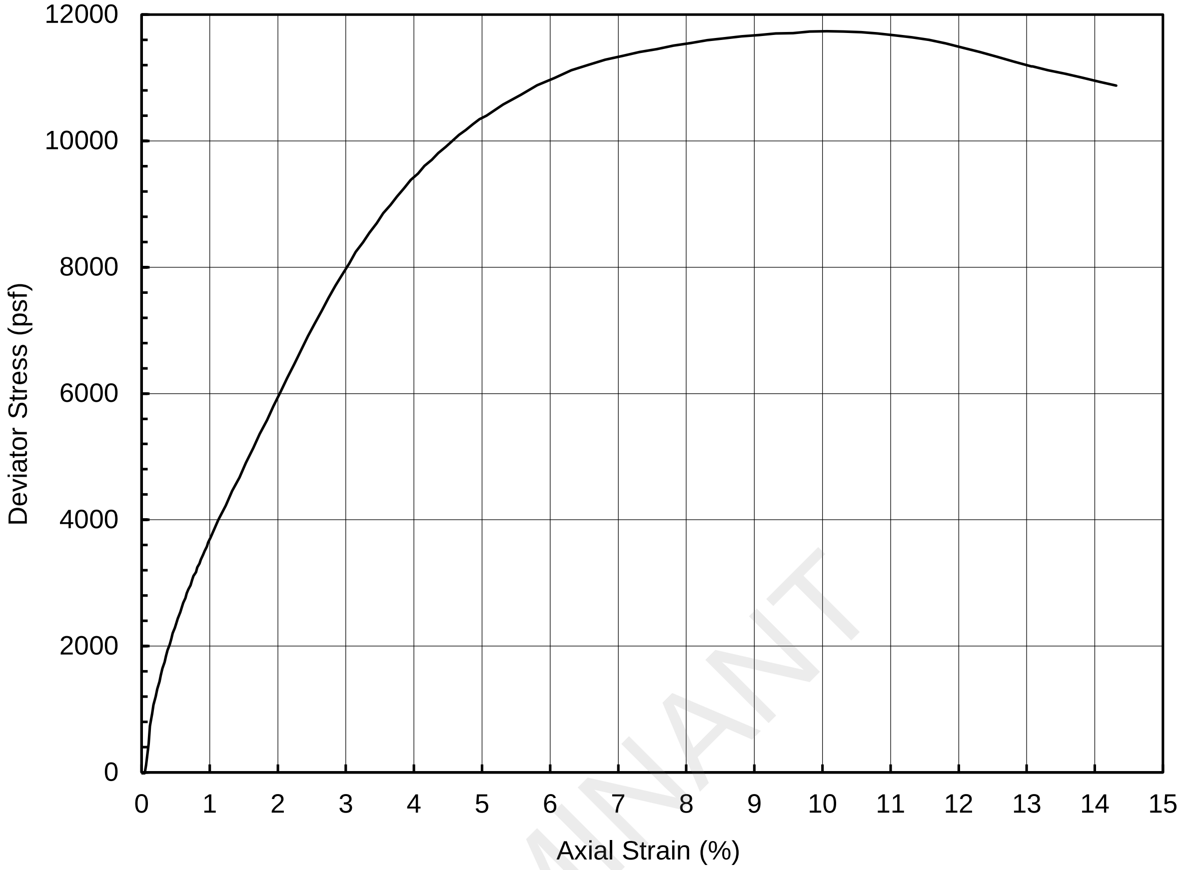
Performed by	**PN**
Date	**15-Nov-12**
Check	**HR**
Review	**JF**

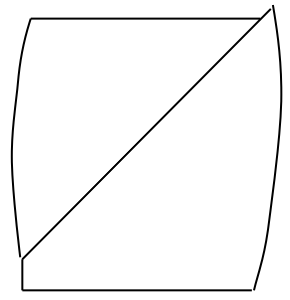
UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Grayish Brown Lean Clay						
LL	31	PI	15	LI	0.0	USCS	CL

Depth (ft)	28.0	Confining Pressure (psf)	3620
Specimen Height (inch)	5.9	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	11735
Initial Specimen Weight (g)	1251.9	Axial Strain at Peak Stress (%)	10.1
Moist Unit Weight (pcf)	127.7		
Initial Water Content (%)	16		
Initial Dry Unit Weight (pcf)	109.9		

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-207 TO-9
Comments	



Failure Sketch

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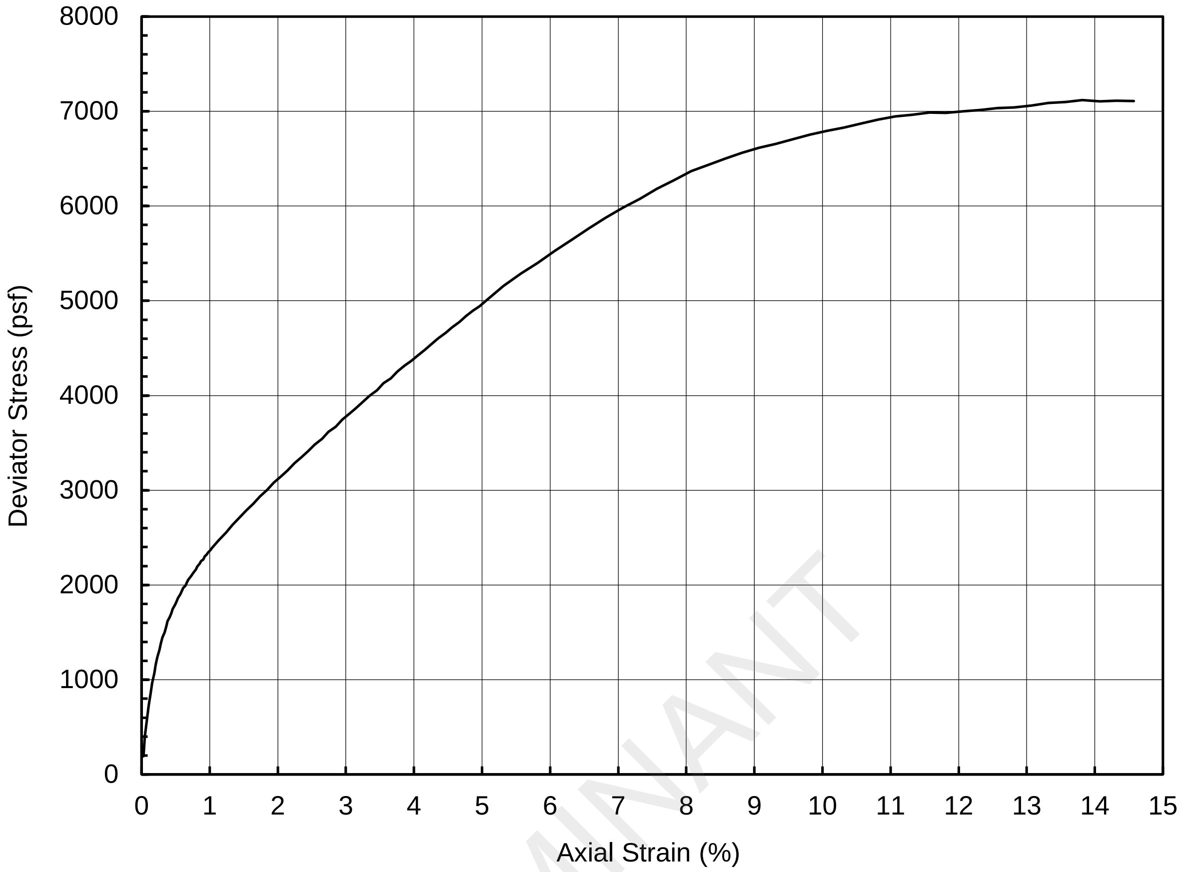
Performed by	**PN**
Date	**15-Nov-12**
Check	**HR**
Review	**JF**

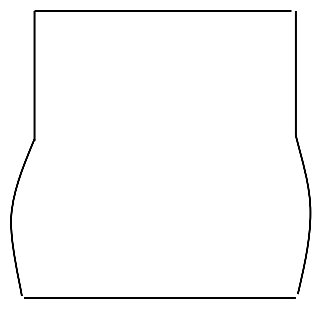
UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Yellow Lean Clay						
LL	28	PI	13	LI	0.0	USCS	CL

Depth (ft)	8.0	Confining Pressure (psf)	1046
Specimen Height (inch)	5.9	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	7118
Initial Specimen Weight (g)	1287.7	Axial Strain at Peak Stress (%)	13.8
Moist Unit Weight (pcf)	138.1		
Initial Water Content (%)	14		
Initial Dry Unit Weight (pcf)	120.7		

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-208 TO-5
Comments	



Failure Sketch

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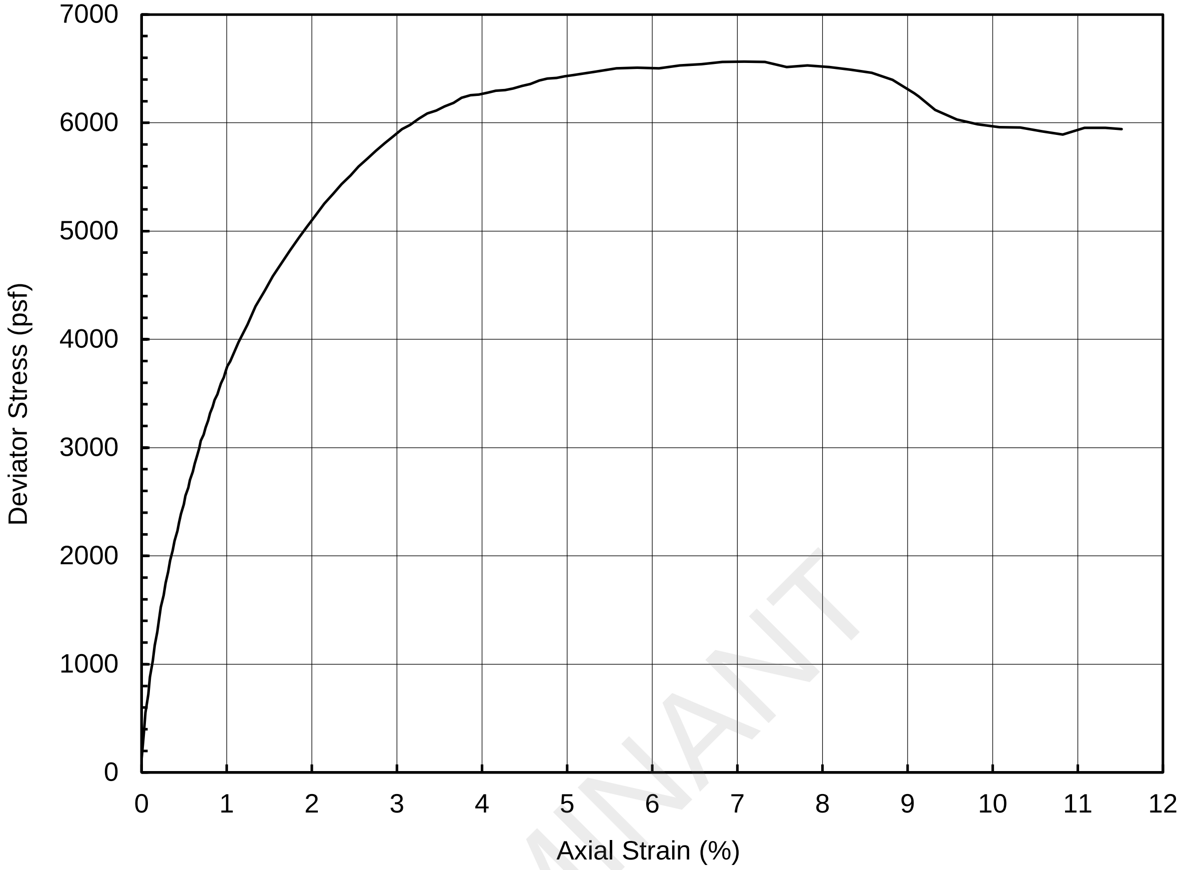
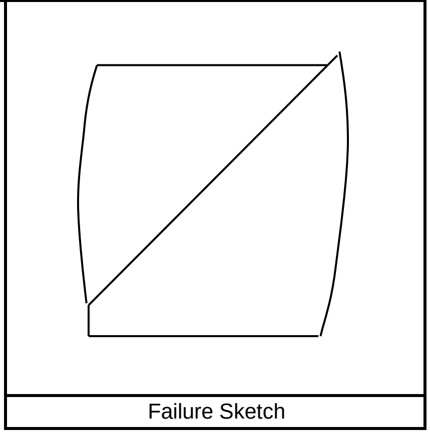
Date	**16-Nov-12**
Check	**HR**
Review	**JF**

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Grayish Brown Lean Clay						
LL	41	PI	26	LI	0.3	USCS	CL

Depth (ft)	28.0	Confining Pressure (psf)	3624
Specimen Height (inch)	6.0	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	6566
Initial Specimen Weight (g)	1202.8	Axial Strain at Peak Stress (%)	7.1
Moist Unit Weight (pcf)	128.0		
Initial Water Content (%)	22		
Initial Dry Unit Weight (pcf)	104.7		



Failure Sketch

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-209 TO-9
Comments	

Performed by	**PN**
Date	**16-Nov-12**
Check	**HR**
Review	**JF**

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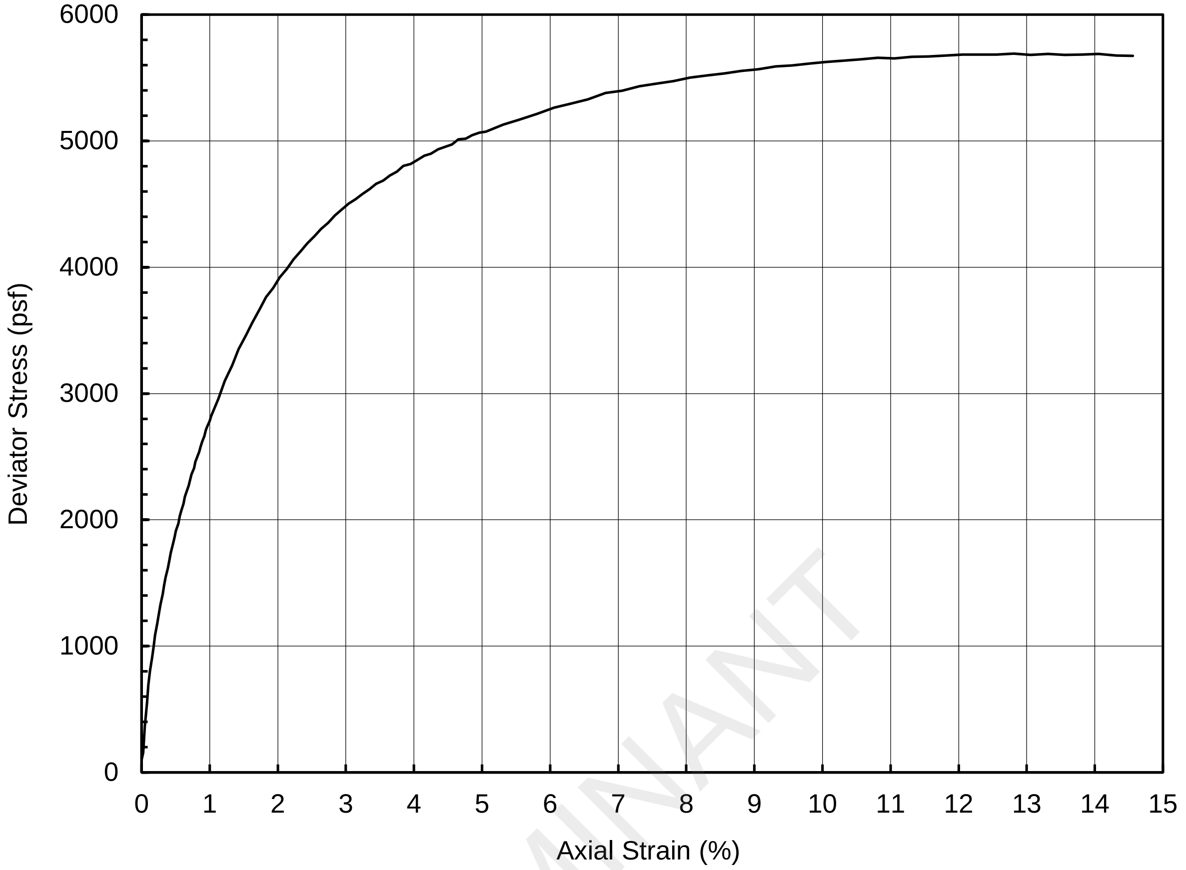
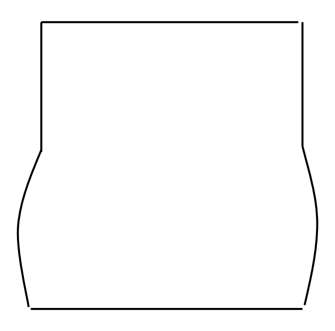
ASTM D 2850



Specimen Description	Reddish Gray Lean Clay						
LL	36	PI	22	LI	0.5	USCS	CL

Depth (ft)	18.0	Confining Pressure (psf)	2375
Specimen Height (inch)	6.0	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	5691
Initial Specimen Weight (g)	1192.0	Axial Strain at Peak Stress (%)	12.8
Moist Unit Weight (pcf)	126.7		
Initial Water Content (%)	24		
Initial Dry Unit Weight (pcf)	102.2		



Failure Sketch

Project Title	Luminant - Martin Lake Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-210 TO-7
Comments	

Golder Associates

Performed by	**PN**
Date	**16-Nov-12**
Check	**HR**
Review	**JF**

PROJECT INFORMATION

PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
November 2008

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

THIS COPY LICENSED TO:
ETTL ENGINEERS AND CONSULTANTS, INC.
1717 East Erwin
Tyler, TX 75702

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Possible Fill Sample
DESCRIPTION: Tan, Brown & Red Sandy Lean Clay
Sampled on Site: B-13 3' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

PLATE: B.1

PLATE: B.2

PLATE: B.3

Number of Specimens = 3

SPECIMEN DATA

SPECIMEN NO. 1

	initial		final		Diameter			Height		
Moist soil & Tare :	522.40	g	621.30	g	top	2.04	in	Ht 1	4.44	in
Dry soil and Tare :	459.70	g	544.40	g	mid	2.04	in	Ht 2	4.44	in
Tare :	129.80	g	119.40	g	bot	2.04	in	Ht 3	4.44	in
Moisture content :	[illegible]	%	[illegible]	%	Avg	2.04	in	Ht4	4.44	in
Weight:	406.1	g						Avg Ht	4.44	in

Change in Ht due to saturation :	-0.02	in	Initial specimen vol :	[illegible]	cc
Change in Ht due to consolidation :	-0.018	in	At test specimen vol :	[illegible]	cc
Change in pipet vol due to consolidation :	2.0	cc	Initial dry density :	[illegible]	pcf
Saturation Parameter " B " = 0.95			At test dry density:	[illegible]	pcf

Strain Rate (in/min) = 0.0005
Failure Strain % = 2.7
Effective Cell Pressure (psi) = 10.00
σ1' Failure (psi) = 20.41
σ1 Failure (psi) = [illegible]
Estimated ν = 0.35
σ3' Failure (psi) = 5.41
σ3 Failure (psi) = 10.00
Back Pressure (psi) = 50.0
ΔU = 4.6
Total Pore Pressure = 54.6
Cell Pressure (psi) = 60.0

SPECIMEN NO. 2

	initial		final		Diameter			Height		
Moist soil & Tare :	549.80	g	696.40	g	top	2.01	in	Ht 1	4.44	in
Dry soil and Tare :	482.20	g	560.20	g	mid	2.01	in	Ht 2	4.44	in
Tare :	121.20	g	139.10	g	bot	2.01	in	Ht 3	4.44	in
Moisture content :	[illegible]	%	[illegible]	%	Avg	2.01	in	Ht4	4.44	in
Weight:	406.0	g						Avg Ht	[illegible]	in

Change in Ht due to saturation :	-0.006	in	Initial specimen vol :	[illegible]	cc
Change in Ht due to consolidation :	-0.034	in	At test specimen vol :	[illegible]	cc
Change in pipet vol due to consolidation :	3.9	cc	Initial dry density :	[illegible]	pcf
Saturation Parameter " B " = 0.97			At test dry density:	[illegible]	pcf

Strain Rate (in/min) = 0.0005
Failure Strain % = 3.9
Effective Cell Pressure (psi) = [illegible]
σ1' Failure (psi) = 37.62
σ1 Failure (psi) = [illegible]
Estimated ν = 0.35
σ3' Failure (psi) = 12.02
σ3 Failure (psi) = [illegible]
Back Pressure (psi) = 50.0
ΔU = [illegible]
Total Pore Pressure = 58.0
Cell Pressure (psi) = 70.0

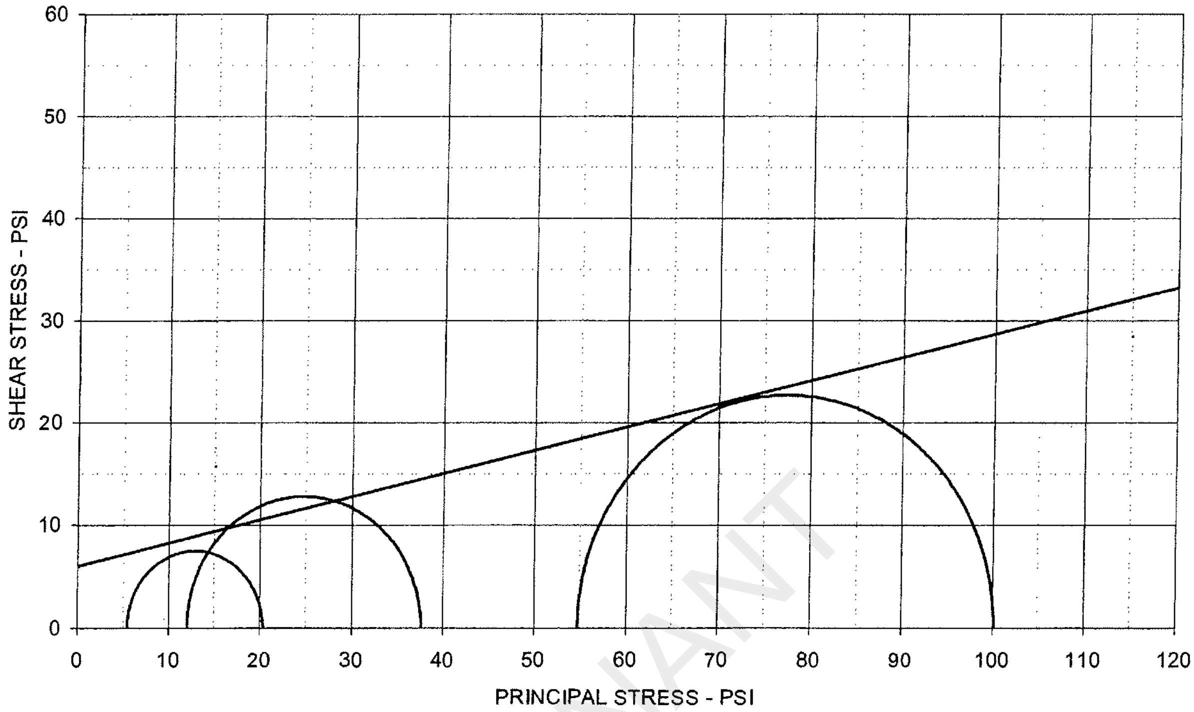
SPECIMEN NO. 3

	initial		final		Diameter			Height		
Moist soil & Tare :	594.60	g	656.60	g	top	2.06	in	Ht 1	4.54	in
Dry soil and Tare :	530.10	g	579.20	g	mid	2.06	in	Ht 2	4.54	in
Tare :	126.30	g	139.30	g	bot	2.06	in	Ht 3	4.54	in
Moisture content :	[illegible]	%	[illegible]	%	Avg	[illegible]	in	Ht4	4.54	in
Weight:	518.0	g						Avg Ht	[illegible]	in

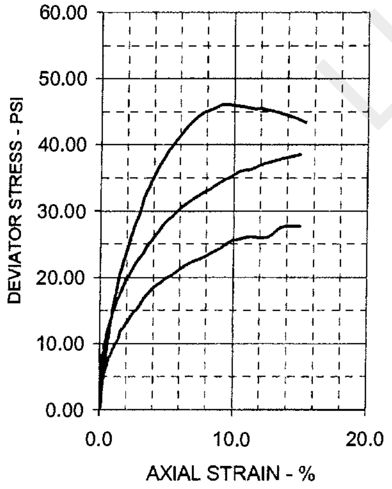
Change in Ht due to saturation :	-0.001	in	Initial specimen vol :	[illegible]	cc
Change in Ht due to consolidation :	-0.052	in	At test specimen vol :	[illegible]	cc
Change in pipet vol due to consolidation :	5.6	cc	Initial dry density :	[illegible]	pcf
Saturation Parameter " B " = 0.97			At test dry density:	[illegible]	pcf

Strain Rate (in/min) = 0.0005
Failure Strain % = 8.5
Effective Cell Pressure (psi) = [illegible]
σ1' Failure (psl) = 100.17
σ1 Failure (psi) = [illegible]
Estimated ν = 0.35
σ3' Failure (psi) = 54.77
σ3 Failure (psi) = [illegible]
Back Pressure (psi) = 50.0
ΔU = [illegible]
Total Pore Pressure = 35.2
Cell Pressure (psi) = 90.0

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ ' =	12.8 deg	c' =	6.0 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	15.8	16.6	15.9	
Dry Density - pcf	113.0	115.0	112.5	
Diameter - inches	2.04	2.01	2.06	
Height - Inches	4.44	4.44	4.54	
AT TEST				
Final Moisture - %	18.1	18.1	17.6	
Dry Density - pcf	114.0	116.9	115.1	
Calculated Diameter (in.)	2.02	2.00	2.04	
Height - Inches	4.40	4.40	4.49	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	15.00	25.60	45.40	
Total Pore Pressure - psi	54.6	58.0	35.2	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	2.7	3.9	8.5	
σ_1' Failure - psi	20.41	37.62	100.17	
σ_3' Failure - psi	5.41	12.02	54.77	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Possible Fill Sample
DESCRIPTION: Tan, Brown & Red Sandy Lean Clay
Sampled on Site, B-13 3' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

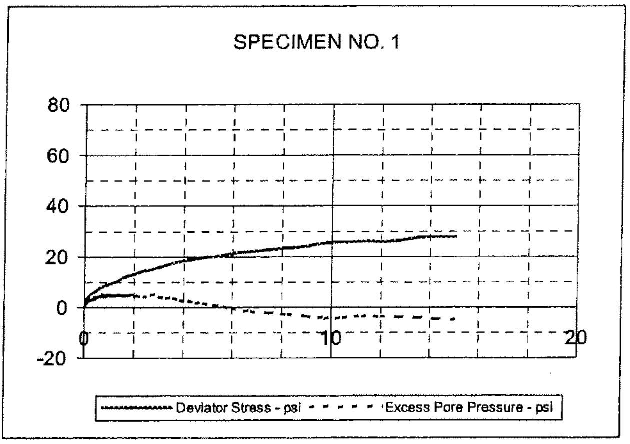
PROJECT INFORMATION

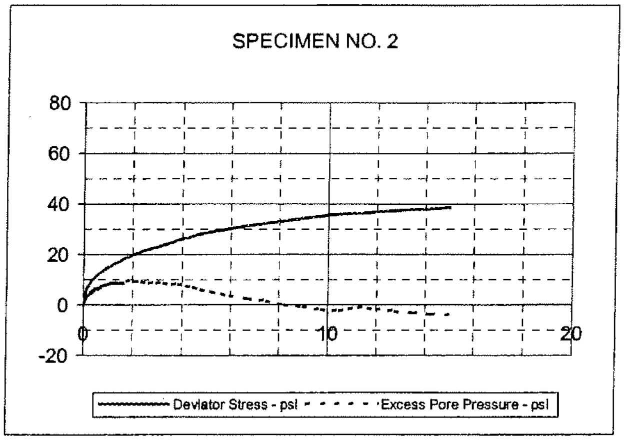
PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
Movember 2008

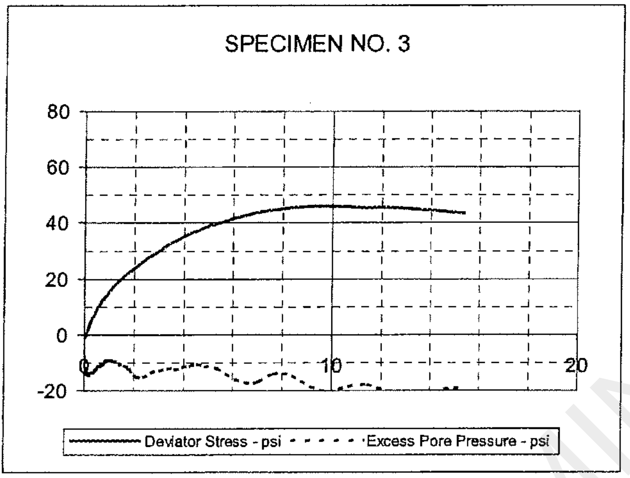
ETTL ENGINEERS & CONSULTANTS

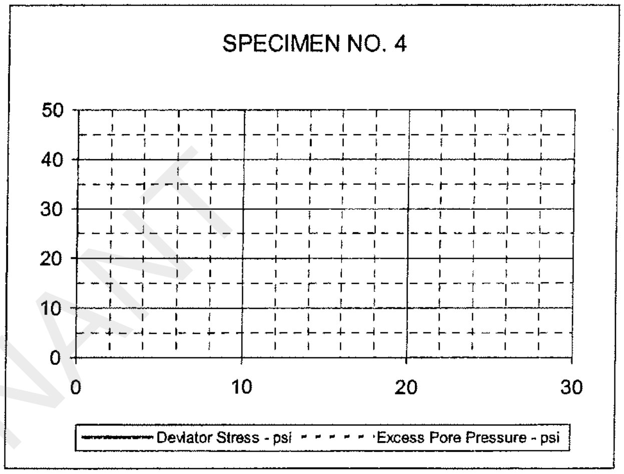
PLATE: B.1

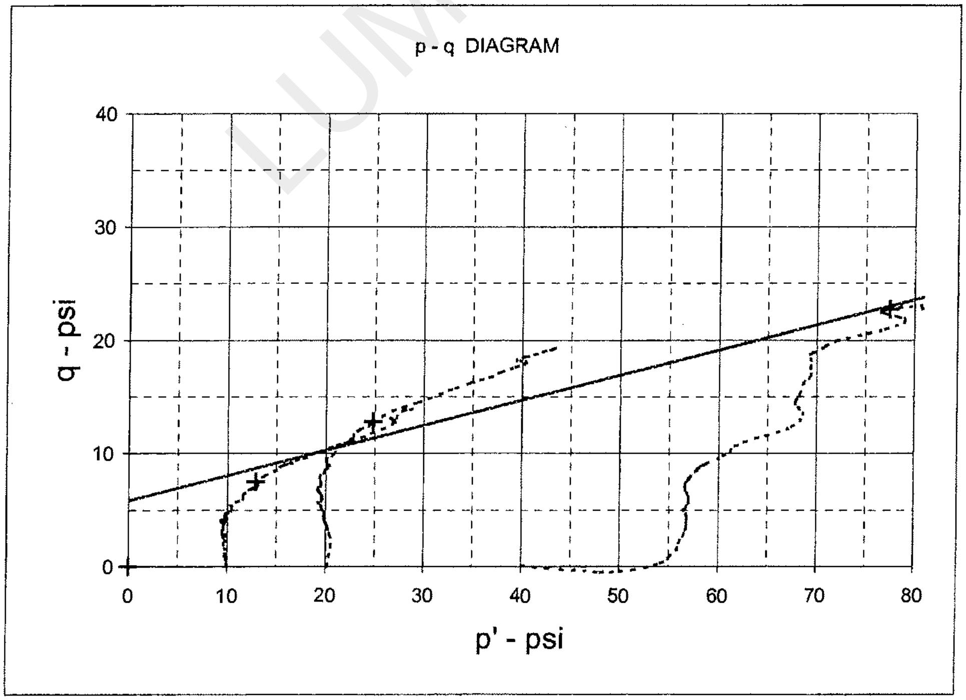
G 2972-08, B-13, 3'-10' Fill


SPECIMEN NO. 1


SPECIMEN NO. 2


SPECIMEN NO. 3

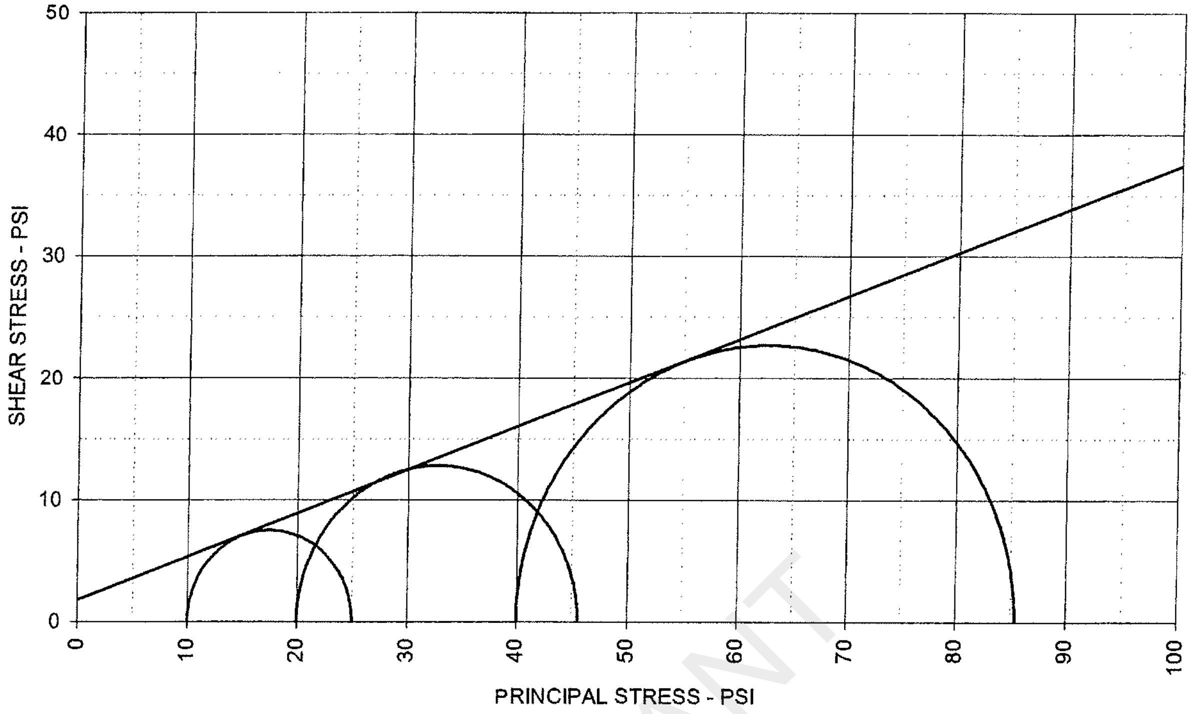

SPECIMEN NO. 4


p - q DIAGRAM

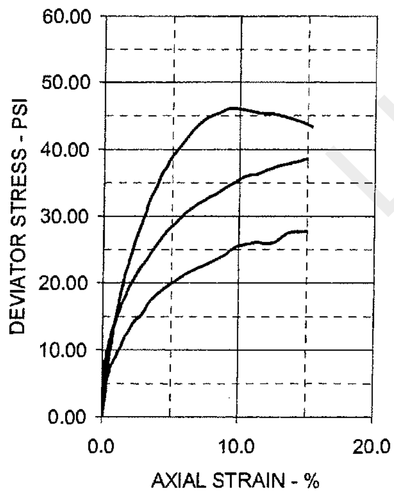
EFFECTIVE STRESS PARAMETERS	R^2 = 0.97	α (deg) = 12.5	a (psi) = 5.8
PROJECT: Luminant East Ash Disposal		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 2972 - 08		ETTL ENGINEERS & CONSULTANTS	PLATE: B.2
DESCRIPTION: Tan, Brown & Red Sandy Lean Clay			

G 2972-08, B-13, 3'-10' Fill

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ =	19.6 deg	c =	1.8 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	15.8	16.6	15.9	
Dry Density - pcf	113.0	115.0	112.5	
Diameter - inches	2.04	2.01	2.06	
Height - Inches	4.44	4.44	4.54	
AT TEST				
Final Moisture - %	18.1	18.1	17.6	
Dry Density - pcf	114.0	116.9	115.1	
Calculated Diameter (In.)	2.02	2.00	2.04	
Height - inches	4.40	4.40	4.49	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	15.00	25.60	45.40	
Total Pore Pressure - psi	54.6	58.0	35.2	
Strain Rate - Inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	2.7	3.9	8.5	
σ_1 Failure - psi	25.00	45.60	85.40	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Possible Fill Sample
DESCRIPTION: Tan, Brown & Red Sandy Lean Clay
Sampled on Site, B-13 3' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
Movember 2008

ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

PROJECT INFORMATION

PROJECT: Luminant Fast Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2872 - 08
CLIENT:
November 2008

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

THIS COPY LICENSED TO:
ETTL ENGINEERS AND CONSULTANTS, INC.
1717 East Erwin
Tyler, TX 75702

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Sample
DESCRIPTION: Gray, Tan & Redd. Br. Sandy Clay w/ some Gravel
Sampled on Site, B-2 - 8' to 20' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

PLATE: B.1

PLATE: B.2

PLATE: B.3

Number of Specimens = 3

SPECIMEN DATA

SPECIMEN NO. 1

	initial		final		Diameter			Height	
Moist soil & Tare :	479.30	g	630.20	g	top	2.08	in	Ht 1	4.25 in
Dry soil and Tare :	429.60	g	548.70	g	mid	2.08	in	Ht 2	4.25 in
Tare :	129.70	g	128.00	g	bot	2.08	in	Ht 3	4.25 in
Moisture content :	16.57	%	[illegible]	%	Avg	2.08	in	Ht4	4.25 in
Weight:	496.8	g						Avg Ht	4.25 in

Change in Ht due to saturation : -0.014 in
Change in Ht due to consolidation : 0.005 in
Change in pipet vol due to consolidation : 0.8 cc
Saturation Parameter " B " = 0.96
Initial specimen vol : [illegible] cc
At test specimen vol : [illegible] cc
Initial dry density : [illegible] pcf
At test dry density: [illegible] pcf

Strain Rate (in/min) = 0.0005
σ_1' Failure (psi) = 38.26
σ_3' Failure (psi) = 8.24
ΔU = 1.8
Failure Strain % = 2.4
σ_1 Failure (psi) = [illegible]
σ_3 Failure (psi) = [illegible]
Total Pore Pressure = 51.8
Effective Cell Pressure (psl) = 10.0
Estimated ν = 0.35
Back Pressure (psl) = 50.0
Cell Pressure (psi) = 60.0

SPECIMEN NO. 2

	initial		final		Diameter			Height	
Moist soil & Tare :	505.50	g	618.20	g	top	2.08	in	Ht 1	4.40 in
Dry soil and Tare :	451.40	g	837.80	g	mid	2.05	in	Ht 2	4.40 in
Tare :	114.00	g	102.60	g	bot	2.08	in	Ht 3	4.40 in
Moisture content :	16.03	%	[illegible]	%	Avg	[illegible]	in	Ht4	4.40 in
Weight:	511.6	g						Avg Ht	4.40 in

Change in Ht due to saturation : 0.01 in
Change in Ht due to consolidation : -0.048 in
Change in pipet vol due to consolidation : 7.0 cc
Saturation Parameter " B " = 0.98
Initial specimen vol : [illegible] cc
At test specimen vol : [illegible] cc
Initial dry density : [illegible] pcf
At test dry density: [illegible] pcf

Strain Rate (in/min) = 0.0005
σ_1' Failure (psi) = 48.53
σ_3' Failure (psi) = 13.88
ΔU = 8.1
Failure Strain % = 3.4
σ_1 Failure (psi) = [illegible]
σ_3 Failure (psi) = [illegible]
Total Pore Pressure = 58.1
Effective Cell Pressure (psi) = 20.0
Estimated ν = 0.35
Back Pressure (psi) = 50.0
Cell Pressure (psi) = 70.0

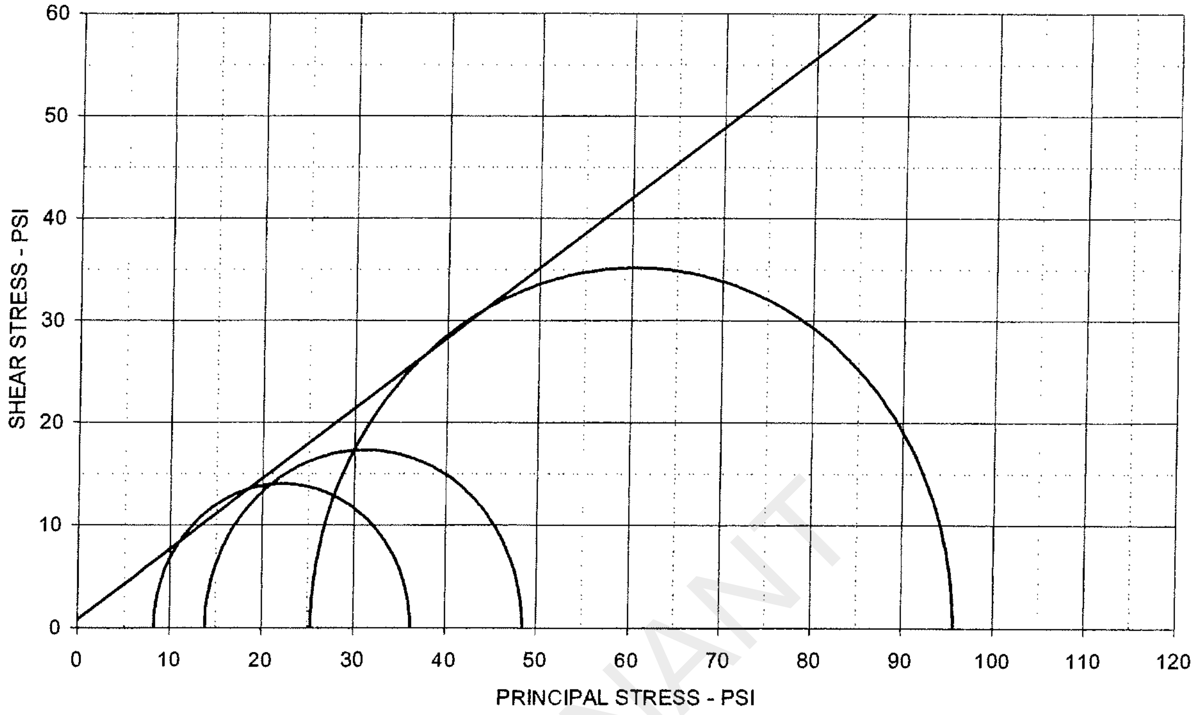
SPECIMEN NO. 3

	initial		final		Diameter			Height	
Moist soil & Tare :	414.70	g	721.60	g	top	2.11	in	Ht 1	4.62 in
Dry soil and Tare :	381.70	g	652.20	g	mid	2.11	in	Ht 2	4.62 in
Tare :	102.50	g	130.10	g	bot	2.11	in	Ht 3	4.62 in
Moisture content :	11.82	%	[illegible]	%	Avg	2.11	in	Ht4	4.62 in
Weight:	579.6	g						Avg Ht	4.62 in

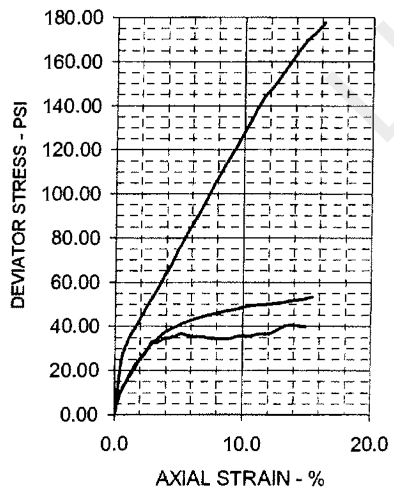
Change in Ht due to saturation : -0.021 in
Change in Ht due to consolidation : -0.018 in
Change in pipet vol due to consolidation : 5.4 cc
Saturation Parameter " B " = 0.99
Initial specimen vol : [illegible] cc
At test specimen vol : [illegible] cc
Initial dry density : [illegible] pcf
At test dry density: [illegible] pcf

Strain Rate (in/min) = 0.0005
σ_1' Failure (psi) = 95.68
σ_3' Failure (psi) = 25.40
ΔU = 14.6
Failure Strain % = 4.6
σ_1 Failure (psi) = [illegible]
σ_3 Failure (psi) = [illegible]
Total Pore Pressure = 64.6
Effective Cell Pressure (psi) = 40.0
Estimated ν = 0.35
Back Pressure (psi) = 50.0
Cell Pressure (psi) = 90.0

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	φ ' = 34.4 deg	c' = 0.8 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	16.6	16.0	11.8	
Dry Density - pcf	112.3	112.1	122.3	
Diameter - inches	2.08	2.08	2.11	
Height - inches	4.25	4.40	4.62	
AT TEST				
Final Moisture - %	19.4	18.1	13.5	
Dry Density - pcf	112.6	115.3	124.9	
Calculated Diameter (in.)	2.08	2.07	2.10	
Height - inches	4.24	4.37	4.58	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	28.02	34.65	70.28	
Total Pore Pressure - psi	51.8	56.1	64.6	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	2.4	3.4	4.6	
σ_1' Failure - psi	36.26	48.53	95.68	
σ_3' Failure - psi	8.24	13.88	25.40	

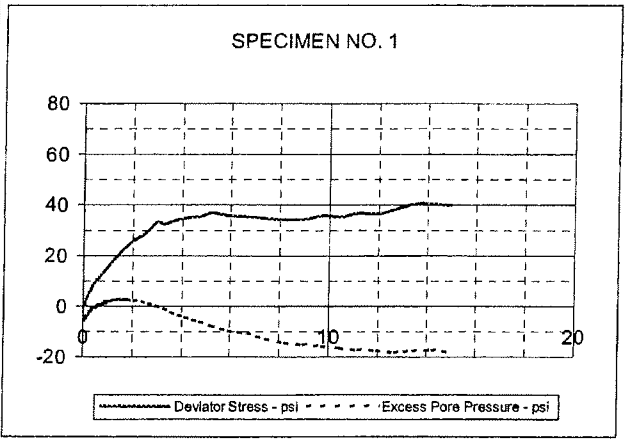
TEST DESCRIPTION

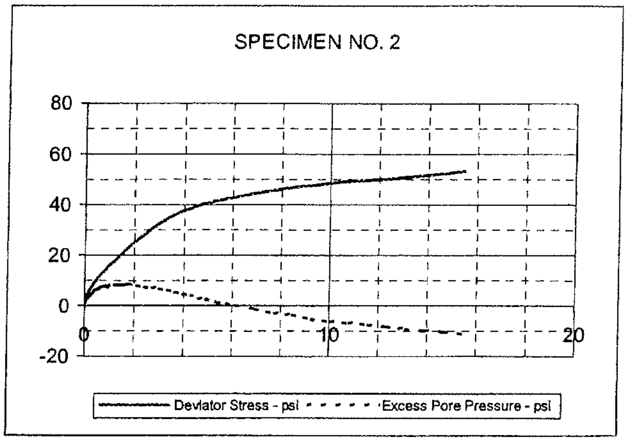
TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Sample
DESCRIPTION: Gray, Tan & Redd. Br Sandy Clay w/ some Gravel
Sampled on Site, B-2 8' to 20' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve
~~G 2972-08, B-2, 8'-20' Native~~

PROJECT INFORMATION

PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
Movember 2008

ETTL ENGINEERS & CONSULTANTS PLATE: B.1


SPECIMEN NO. 1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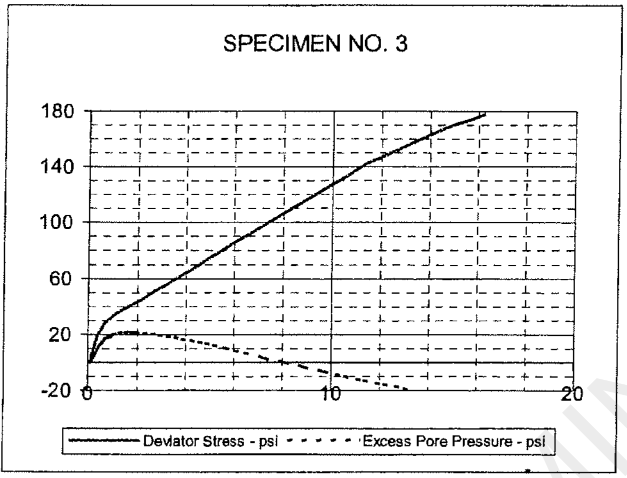
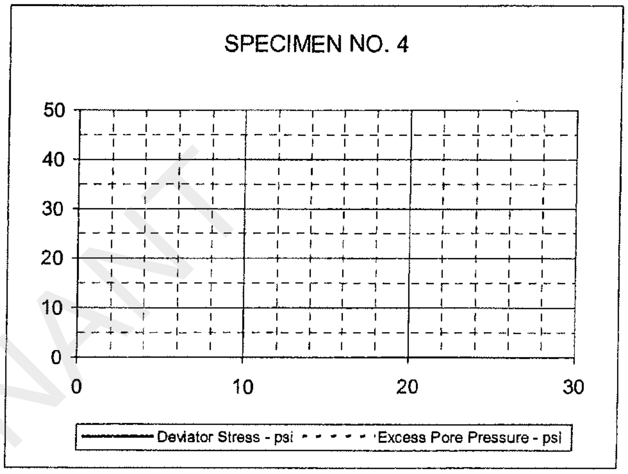
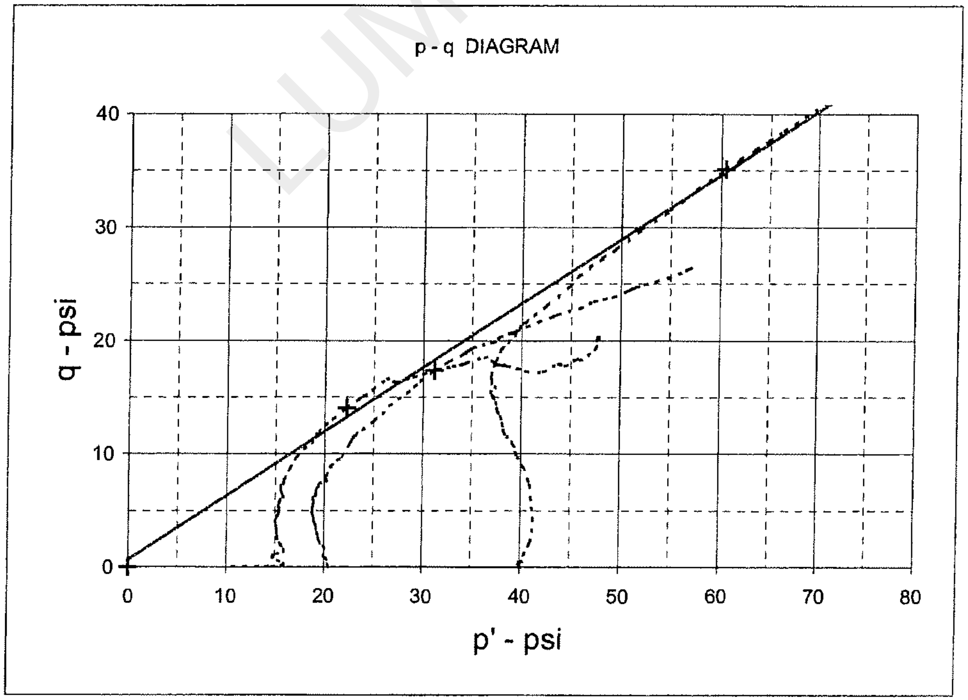

SPECIMEN NO. 3

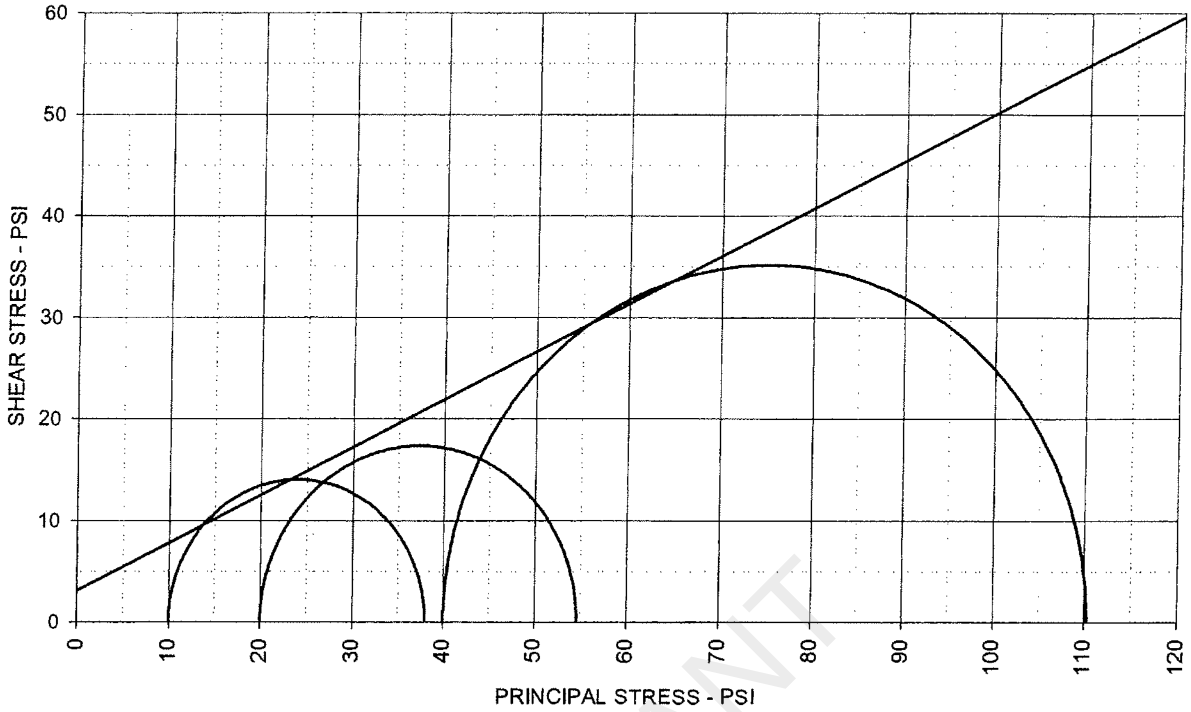

SPECIMEN NO. 4


p - q DIAGRAM

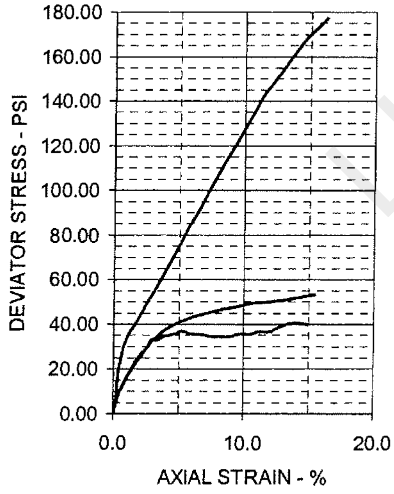
EFFECTIVE STRESS PARAMETERS	R^2 = 0.99	α (deg) = 29.5	a (psi) = 0.7
PROJECT: Luminant East Ash Disposal		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 2972 - 08		ETTL ENGINEERS & CONSULTANTS	PLATE: B.2
DESCRIPTION: Gray, Tan & Redd. Br Sandy Clay w/ some Gravel			

G 2972-08, B-2, 8'-20' Native

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 25.2 deg	c = 3.1 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	16.6	16.0	11.8	
Dry Density - pcf	112.3	112.1	122.3	
Diameter - inches	2.08	2.08	2.11	
Height - inches	4.25	4.40	4.62	
AT TEST				
Final Moisture - %	19.4	18.1	13.5	
Dry Density - pcf	112.6	115.3	124.9	
Calculated Diameter (in.)	2.08	2.07	2.10	
Height - inches	4.24	4.37	4.58	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	28.02	34.65	70.28	
Total Pore Pressure - psi	51.8	56.1	64.6	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	2.4	3.4	4.6	
σ_1 Failure - psi	38.02	54.65	110.28	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Sample
DESCRIPTION: Gray, Tan & Redd. Br Sandy Clay w/ some Gravel
Sampled on Site, B-2 8' to 20' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
Movember 2008

ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

PROJECT INFORMATION

PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
November, 2008

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

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1717 East Erwin
Tyler, TX 75702

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Possible Fill Sample
DESCRIPTION: Tan & Red Sandy Lean Clay w/ Rocks
Sampled on Site, B-1 3' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL PL PI Percent -200
REMARKS: Both Ends & Diameter Trimmed. + #4 Sieve

PLATE: B.1

PLATE: B.2

PLATE: B.3

Number of Specimens = 3

SPECIMEN DATA

SPECIMEN NO. 1

	initial		final		Diameter			Height	
Moist soil & Tare :	539.30	g	625.10	g	top	2.07	in	Ht 1	4.23 In
Dry soil and Tare :	462.00	g	548.00	g	mid	2.07	in	Ht 2	4.23 in
Tare :	127.40	g	126.90	g	bot	2.07	in	Ht 3	4.23 in
Moisture content :	[illegible]	%	[illegible]	%	Avg	2.07	in	Ht4	4.23 in
Weight:	493.2	g						Avg Ht	[illegible] in

Change in Ht due to saturation : 0.02 in

Change in Ht due to consolidation : -0.006 in

Change in pipet vol due to consolidation : 3.2 cc

Saturation Parameter " B " = 0.97

Initial specimen vol : [illegible] cc

At test specimen vol : [illegible] cc

Initial dry density : [illegible] pcf

At test dry density: [illegible] pcf

Strain Rate (in/min) = 0.0005

σ_1' Failure (psi) = 29.29

σ_3' Failure (psi) = 6.55

ΔU = 3.7

Failure Strain % = 1.4

σ_1 Failure (psi) = [illegible]

σ_3 Failure (psi) = [illegible]

Total Pore Pressure = 53.7

Effective Cell Pressure (psi) = 10.0

Estimated ν = 0.35

Back Pressure (psi) = 50.0

Cell Pressure (psi) = 60.0

SPECIMEN NO. 2

	initial		final		Diameter			Height	
Moist soil & Tare :	548.00	g	591.00	g	top	2.01	in	Ht 1	4.25 in
Dry soil and Tare :	492.70	g	519.10	g	mid	2.01	in	Ht 2	4.25 in
Tare :	136.60	g	124.60	g	bot	2.01	in	Ht 3	4.25 in
Moisture content :	[illegible]	%	[illegible]	%	Avg	[illegible]	in	Ht4	4.25 in
Weight:	462.2	g						Avg Ht	[illegible] in

Change in Ht due to saturation : -0.009 in

Change in Ht due to consolidation : -0.033 in

Change in pipet vol due to consolidation : 4.2 cc

Saturation Parameter " B " = 0.99

Initial specimen vol : [illegible] cc

At test specimen vol : [illegible] cc

Initial dry density : [illegible] pcf

At test dry density: [illegible] pcf

Strain Rate (in/min) = 0.0005

σ_1' Failure (psi) = 40.52

σ_3' Failure (psi) = 14.53

ΔU = 5.5

Failure Strain % = 3.0

σ_1 Failure (psi) = [illegible]

σ_3 Failure (psi) = [illegible]

Total Pore Pressure = 55.5

Effective Cell Pressure (psi) = [illegible]

Estimated ν = 0.35

Back Pressure (psi) = 50.0

Cell Pressure (psi) = 70.0

SPECIMEN NO. 3

	initial		final		Diameter			Height	
Moist soil & Tare :	431.00	g	628.40	g	top	2.10	in	Ht 1	4.28 in
Dry soil and Tare :	385.80	g	568.80	g	mid	2.10	in	Ht 2	4.28 in
Tare :	105.00	g	139.40	g	bot	2.10	in	Ht 3	4.28 in
Moisture content :	[illegible]	%	[illegible]	%	Avg	[illegible]	in	Ht4	4.28 in
Weight:	510.5	g						Avg Ht	[illegible] in

Change in Ht due to saturation : -0.017 in

Change in Ht due to consolidation : -0.039 in

Change in pipet vol due to consolidation : 4.6 cc

Saturation Parameter " B " = 0.97

Initial specimen vol : [illegible] cc

At test specimen vol : [illegible] cc

Initial dry density : [illegible] pcf

At test dry density: [illegible] pcf

Strain Rate (in/min) = 0.0005

σ_1' Failure (psi) = 104.13

σ_3' Failure (psi) = 42.71

ΔU = [illegible]

Failure Strain % = 3.0

σ_1 Failure (psi) = [illegible]

σ_3 Failure (psi) = 40.00

Total Pore Pressure = 47.3

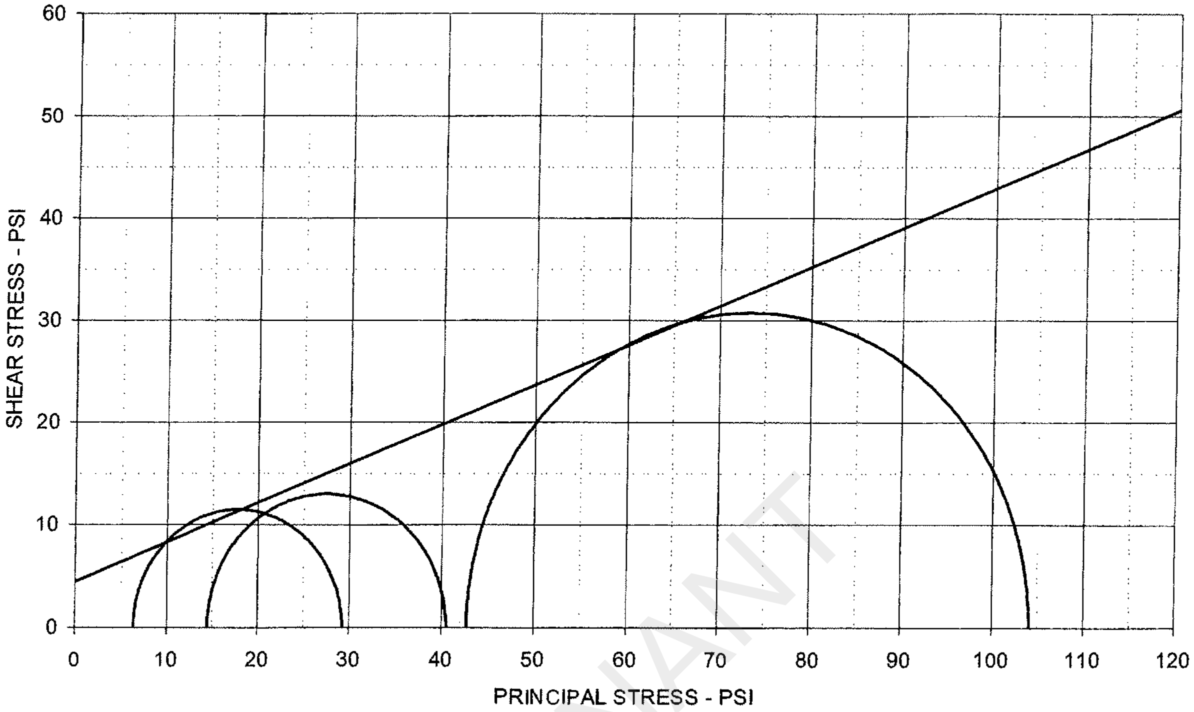
Effective Cell Pressure (psi) = [illegible]

Estimated ν = 0.35

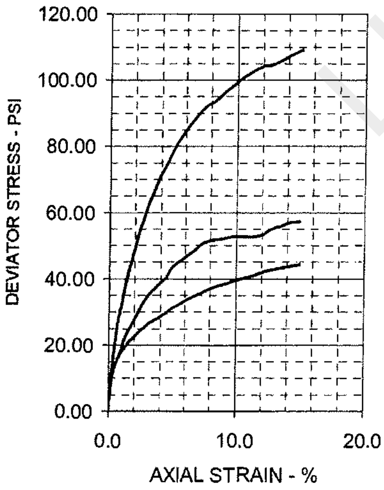
Back Pressure (psi) = 50.0

Cell Pressure (psi) = 90.0

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	φ ' = 21.0 deg	c' = 4.5 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	16.2	15.5	16.1	
Dry Density - pcf	113.6	113.1	113.3	
Diameter - Inches	2.07	2.01	2.10	
Height - Inches	4.23	4.25	4.28	
AT TEST				
Final Moisture - %	18.3	18.2	15.8	
Dry Density - pcf	115.2	115.3	115.5	
Calculated Diameter (in.)	2.08	1.99	2.08	
Height - inches	4.24	4.21	4.22	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	22.94	25.99	61.42	
Total Pore Pressure - psi	53.7	55.5	47.3	
Strain Rate - Inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.4	3.0	3.0	
σ_1' Failure - psi	29.29	40.52	104.13	
σ_3' Failure - psi	6.35	14.53	42.71	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP

SAMPLE TYPE: Possible Fill Sample

DESCRIPTION: Tan & Red Sandy Lean Clay w/ Roots

Sampled on Site, B-1 3' to 10' deep

ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve

LL: PL: PI: Percent -200:

REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: Luminant East Ash Disposal

LOCATION: Rusk County, Texas

PROJECT NO: G 2972 - 08

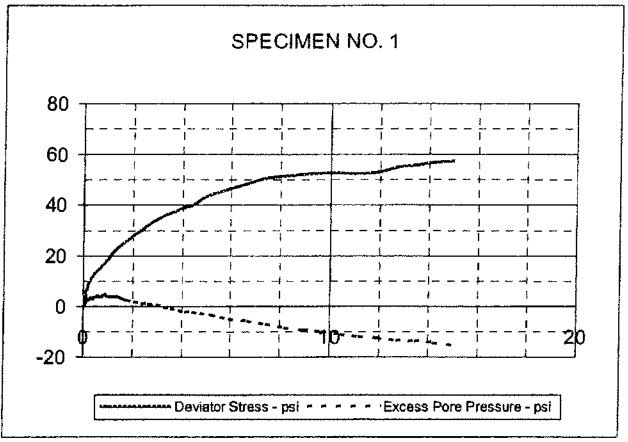
CLIENT:

Movember 2008

ETTL ENGINEERS & CONSULTANTS

PLATE: B.1

G 2972-08, B-1, 3'-10' Fill



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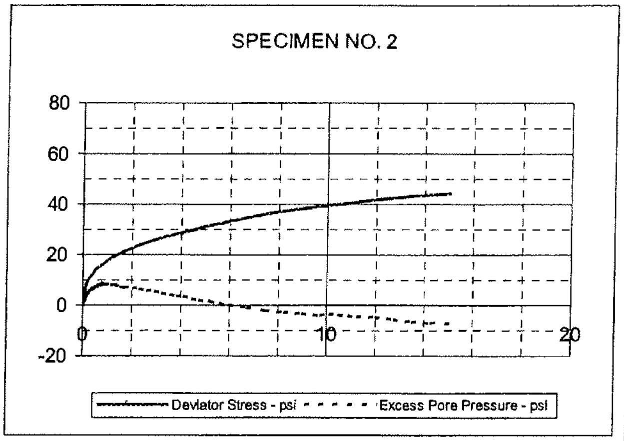

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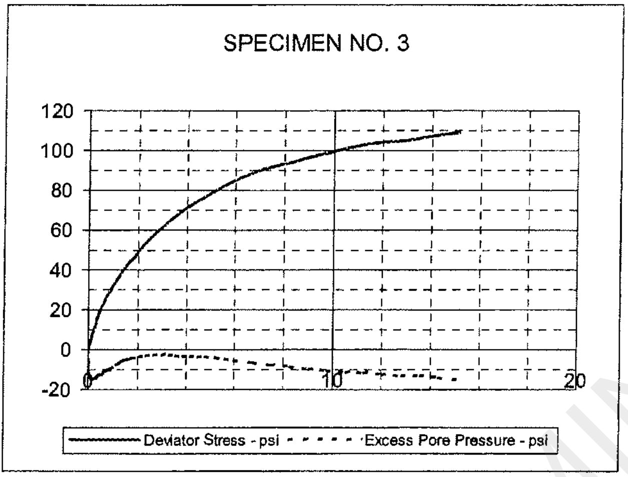

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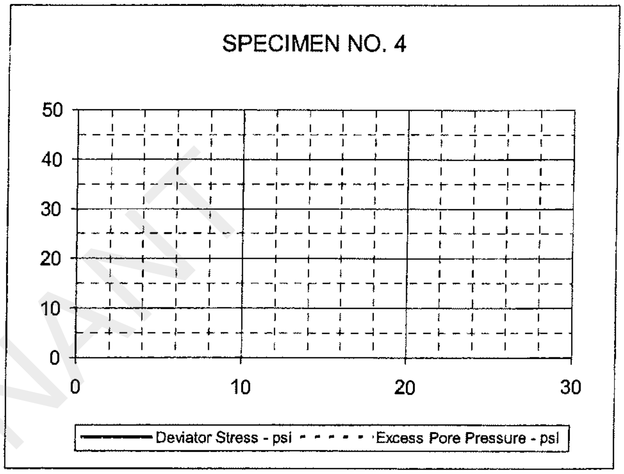

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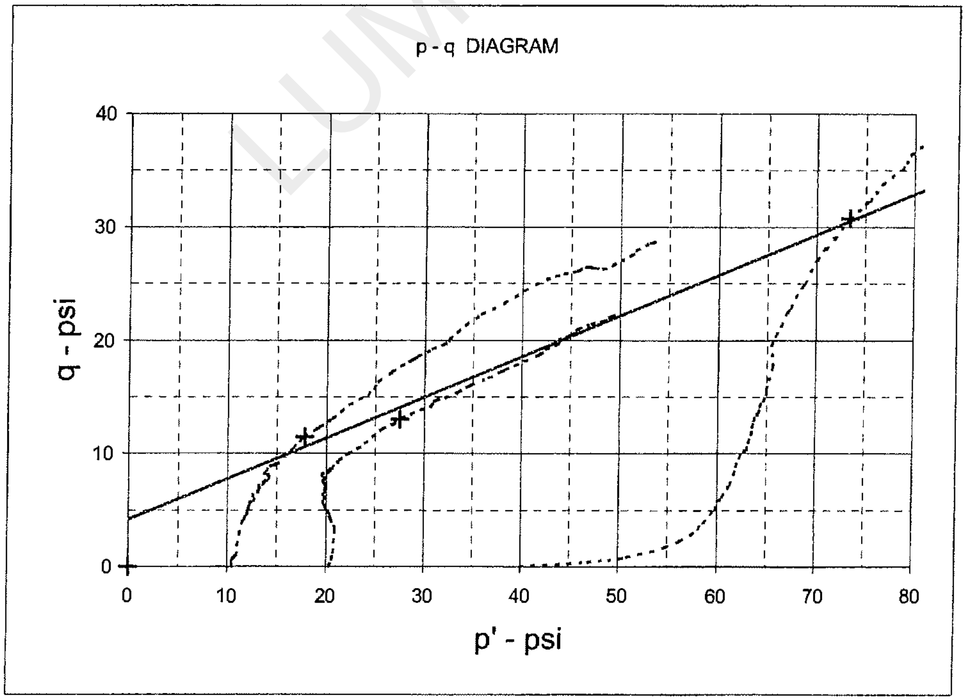
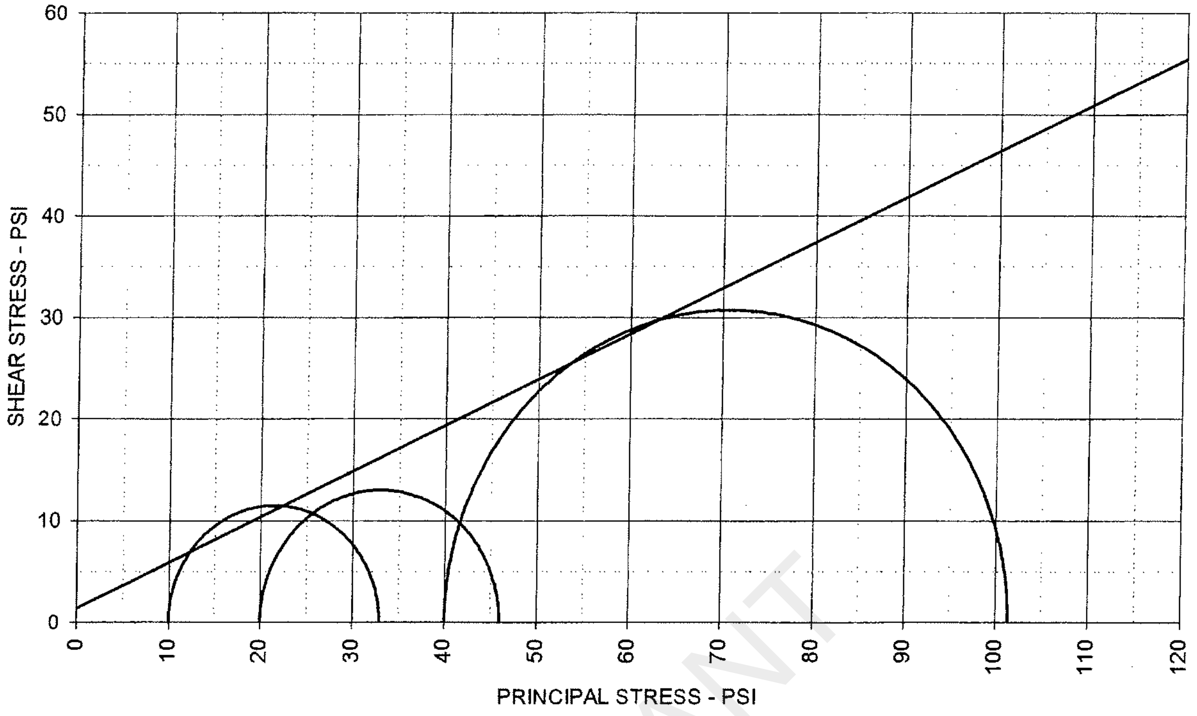


p - q DIAGRAM

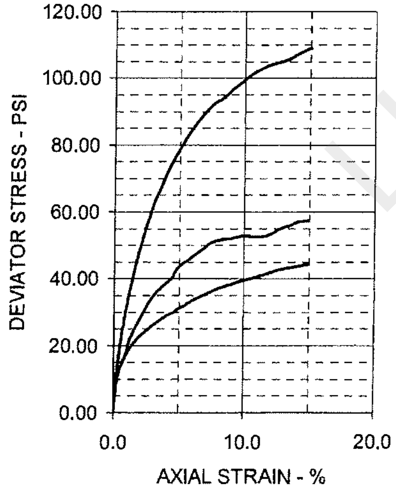
EFFECTIVE STRESS PARAMETERS	R^2 = 0.99	α (deg) = 19.7	a (psi) = 4.2
PROJECT: Luminant East Ash Disposal		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 2972 - 08		ETTL ENGINEERS & CONSULTANTS	PLATE: B.2
DESCRIPTION: Tan & Red Sandy Lean Clay w/ Roots			

G 2972-08, B-1, 3'-10' Fill

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 24.2 deg	c = 1.4 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	16.2	15.5	16.1	
Dry Density - pcf	113.6	113.1	113.3	
Diameter - inches	2.07	2.01	2.10	
Height - inches	4.23	4.25	4.28	
AT TEST				
Final Moisture - %	18.3	18.2	15.8	
Dry Density - pcf	115.2	115.3	115.5	
Calculated Diameter (in.)	2.08	1.99	2.08	
Height - Inches	4.24	4.21	4.22	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	22.94	25.99	61.42	
Total Pore Pressure - psi	53.7	55.5	47.3	
Strain Rate - Inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.4	3.0	3.0	
σ_1 Failure - psi	32.94	45.99	101.42	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Possible Fill Sample
DESCRIPTION: Tan & Red Sandy Lean Clay w/ Roots
Sampled on Site, B-1 3' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Both Ends & Diameter Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: Luminant East Ash Disposal
LOCATION: Rusk County, Texas
PROJECT NO: G 2972 - 08
CLIENT:
Movember 2008

ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

PERMANENT DISPOSAL POND - 5

HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT: Luminant Martin Lake, PDP 1-3
CLIENT: TXU
CONTRACTOR: not given
JOB No. : **G 2810 - 08**

REPORT No.:
DATE SAMPLED: February 2008
SAMPLED BY: ETTL Drill Crew
LOCATION: MLSES
SAMPLE No. :
DESCRIPTION: Gray & Dark Gray Bottom Ash
TECHNICIAN: M. Thompson
DATE: 04/15/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**47.69**
% Retain	+0.05 mm	**99.26**
% Passing	0.05 to 2.0 mm	**51.57**
% Passing	0.002 to 0.05 mm	**0.72**
% Passing	> 0.002 mm	**0.02**

WEIGHT OF SAMPLE (AIR DRY)	100.00
WEIGHT OF SAMPLE (OVEN DRY)	99.90
PERCENT RETAINED ON # 10	47.69
SPECIFIC GRAVITY	2.563

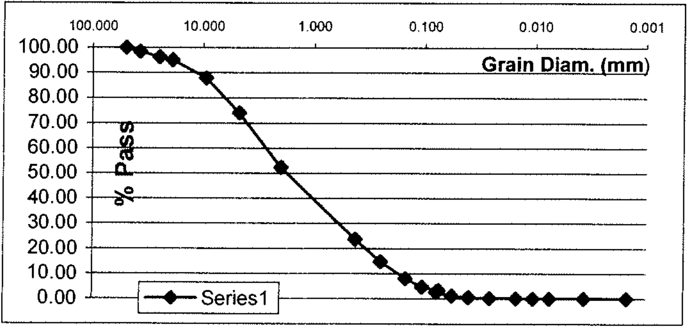
Mc Hydrom	
Tare Wt	29.89
Wet Wt.	68.94
Dry Wt	68.90
MC	0.1025%

SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	54.66	76.31	0.425	23.69
60	71.63	85.20	0.250	14.80
100	84.45	91.91	0.150	8.09
140	90.93	95.30	0.105	4.70
200	93.54	96.67	0.075	3.33

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
21.5	5.7	11.0	5.3	15.5	0.0141	1.02	0.5	0.0787	2.82
21.5	5.7	8.0	2.3	16	0.0141	1.02	1	0.0566	1.21
21.5	5.7	6.8	1.1	16.1	0.0141	1.02	2	0.0401	0.57
21.5	5.7	6.2	0.5	16.3	0.0141	1.02	5	0.0255	0.25
21.5	5.7	6.0	0.3	16.3	0.0141	1.02	15	0.0147	0.15
21.5	5.7	5.8	0.1	16.3	0.0141	1.02	30	0.0104	0.04
21.5	5.7	5.8	0.1	16.3	0.0141	1.02	60	0.0074	0.04
21.5	5.7	5.8	0.1	16.3	0.0141	1.02	250	0.0036	0.04
22.0	5.6	5.6	0.0	16.3	0.0140	1.02	1440	0.0015	0.02

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	100	10	188.06	686.13	22.5	99.90	747.18	21.5	**2.563**

	Sieve Size	Grams Retain	% Pass
Sieve % Pass	2"	0.00	100.00
	1-1/2"	89.00	98.47
Air Dry Start Wt.:	1"	215.04	96.31
5836.8	3/4"	288.14	95.06
Dry Start Wt.:	3/8"	709.78	87.83
5830.82	No 4	1510.97	74.09
	No 10	2780.46	52.31



Remarks:

HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT: Luminant Martin Lake, PDP 1-3
CLIENT: TXU
CONTRACTOR: not given
JOB No. : **G 2810 - 08**

REPORT No.:
DATE SAMPLED: February 2008
SAMPLED BY: ETTL Drill Crew
LOCATION: B-9, 1'-3'
SAMPLE No. :
DESCRIPTION: Gray Ash (Cementing)
TECHNICIAN: H. Walka
DATE: 03/14/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**0.08**
% Retain	+0.05 mm	**41.35**
% Passing	0.05 to 2.0 mm	**41.27**
% Passing	0.002 to 0.05 mm	**56.63**
% Passing	> 0.002 mm	**2.02**

WEIGHT OF SAMPLE (AIR DRY)	100.00
WEIGHT OF SAMPLE (OVEN DRY)	99.73
PERCENT RETAINED ON # 10	0.08
SPECIFIC GRAVITY	2.761

Mc Hydrom	
Tare Wt	29.50
Wet Wt.	62.41
Dry Wt	62.32
MC	0.2742%

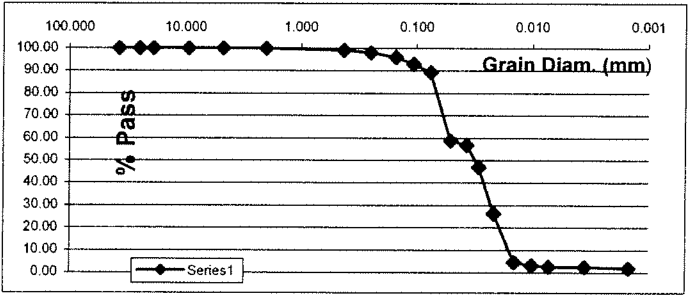
SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	0.92	1.00	0.425	99.00
60	1.92	2.00	0.250	98.00
100	3.90	3.99	0.150	96.01
140	7.07	7.16	0.105	92.84
200	10.67	10.77	0.075	89.23

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
23.0	5.2	65.0	59.8	6.6	0.0138	0.98	0.5	0.0502	58.67
23.0	5.2	63.0	57.8	7	0.0138	0.98	1	0.0365	56.71
23.0	5.2	53.0	47.8	8.6	0.0138	0.98	2	0.0286	46.89
23.0	5.2	32.0	26.8	12	0.0138	0.98	5	0.0214	26.27
22.5	5.4	10.0	4.6	15.6	0.0140	0.98	15	0.0142	4.51
22.5	5.4	8.5	3.1	15.8	0.0140	0.98	30	0.0101	3.04
22.5	5.4	8.0	2.6	16	0.0140	0.98	60	0.0072	2.55
22.0	5.6	8.0	2.4	16	0.0140	0.98	250	0.0035	2.39
22.0	5.6	7.5	1.9	16.1	0.0140	0.98	1440	0.0015	1.90

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Wate	WaterTemp	Specif. Grav
Air dry Sample(gr)	50	7	179.97	678.12	22.5	49.86	709.93	22.5	**2.761**

	Sieve Size	Grams Retain	% Pass
Sieve % Pass	1-1/2"	0.00	100.00
Air Dry Start Wt.:	1"	0.00	100.00
334.9	3/4"	0.00	100.00
Dry Start Wt.:	3/8"	0.00	100.00
333.98	No 4	0.00	100.00
	No 10	0.26	99.92

Remarks:



HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT:	Luminant Martin Lake, PDP 1-3
CLIENT:	TXU
CONTRACTOR:	not given
JOB No. :	**G 2810 - 08**
REPORT No.:	
DATE SAMPLED:	February 2008
SAMPLED BY:	ETTL Drill Crew
LOCATION:	B-7, 13'-15'
SAMPLE No. :	
DESCRIPTION:	Gray Ash
TECHNICIAN:	H. Walka
DATE:	03/14/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**59.89**
% Retain	+0.05 mm	**92.28**
% Passing	0.05 to 2.0 mm	**32.39**
% Passing	0.002 to 0.05 mm	**4.63**
% Passing	> 0.002 mm	**3.09**

WEIGHT OF SAMPLE (AIR DRY)	50.00
WEIGHT OF SAMPLE (OVEN DRY)	49.81
PERCENT RETAINED ON # 10	59.89
SPECIFIC GRAVITY	2.655

Mc Hydrom	
Tare Wt	30.03
Wet Wt.	45.86
Dry Wt	45.80
MC	0.3805%

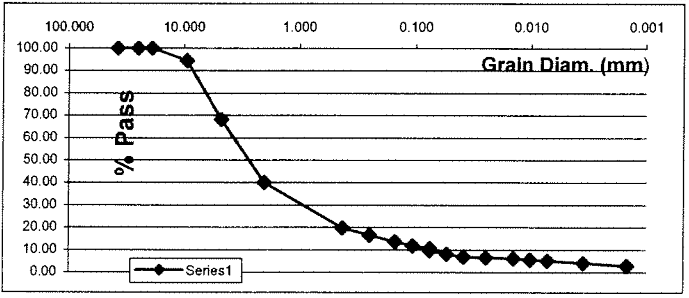
SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	25.25	80.22	0.425	19.78
60	29.25	83.44	0.250	16.56
100	32.74	86.25	0.150	13.75
140	35.11	88.16	0.105	11.84
200	36.67	89.42	0.075	10.58

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
22.0	5.6	17.5	11.9	14.5	0.0140	1.00	0.5	0.0752	9.61
22.0	5.6	15.5	9.9	14.8	0.0140	1.00	1	0.0537	8.00
22.0	5.6	14.0	8.4	15	0.0140	1.00	2	0.0383	6.79
22.0	5.6	13.5	7.9	15.2	0.0140	1.00	5	0.0244	6.39
22.0	5.6	13.0	7.4	15.2	0.0140	1.00	15	0.0141	5.99
21.5	5.7	12.5	6.8	15.3	0.0141	1.00	30	0.0101	5.46
21.5	5.7	12.0	6.3	15.3	0.0141	1.00	60	0.0071	5.05
22.0	5.6	10.5	4.9	15.6	0.0140	1.00	250	0.0035	3.97
22.0	5.6	9.0	3.4	15.8	0.0140	1.00	1440	0.0015	2.77

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	25	4	179.25	677.26	22.5	24.91	692.79	22.5	**2.655**

	Sieve Size	Grams Retain	% Pass
Sieve % Pass	1-1/2"	0.00	100.00
Air Dry Start Wt.:	1"	0.00	100.00
243.3	3/4"	0.00	100.00
Dry Start Wt.:	3/8"	13.45	94.47
242.38	No 4	77.42	68.18
	No 10	145.71	40.11

Remarks:



HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT: Luminant Martin Lake, PDP 1-3
CLIENT: TXU
CONTRACTOR: not given
JOB No. : **G 2810 - 08**

REPORT No.:
DATE SAMPLED: February 2008
SAMPLED BY: ETTL Drill Crew
LOCATION: B-6, 18'-20'
SAMPLE No. :
DESCRIPTION: Tan Ash
TECHNICIAN: H. Walka
DATE: 03/14/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**10.97**
% Retain	+0.05 mm	**18.74**
% Passing	0.05 to 2.0 mm	**7.77**
% Passing	0.002 to 0.05 mm	**77.39**
% Passing	> 0.002 mm	**3.87**

WEIGHT OF SAMPLE (AIR DRY)	50.00
WEIGHT OF SAMPLE (OVEN DRY)	49.81
PERCENT RETAINED ON # 10	10.97
SPECIFIC GRAVITY	2.732

Mc Hydrom	
Tare Wt	29.86
Wet Wt.	51.33
Dry Wt	51.25
MC	0.3740%

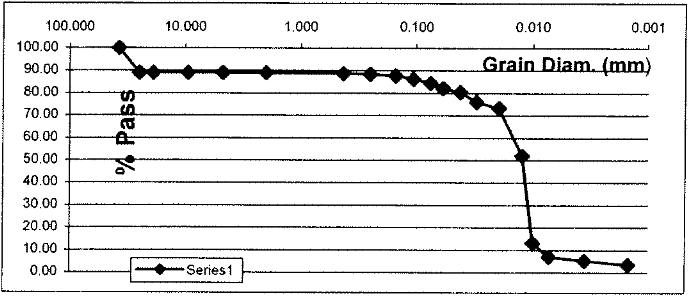
SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	0.26	11.44	0.425	88.56
60	0.42	11.72	0.250	88.28
100	0.78	12.36	0.150	87.64
140	1.61	13.85	0.105	86.15
200	2.62	15.65	0.075	84.35

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
22.0	5.6	52.0	46.4	8.8	0.0140	0.99	0.5	0.0586	82.16
22.0	5.6	51.0	45.4	8.9	0.0140	0.99	1	0.0417	80.39
22.0	5.6	48.5	42.9	9.4	0.0140	0.99	2	0.0303	75.97
22.0	5.6	47.0	41.4	9.6	0.0140	0.99	5	0.0194	73.31
22.0	5.6	35.0	29.4	11.5	0.0140	0.99	15	0.0122	52.08
22.0	5.6	13.0	7.4	15.2	0.0140	0.99	30	0.0099	13.15
22.0	5.6	9.5	3.9	15.8	0.0140	0.99	60	0.0072	6.96
22.0	5.6	8.5	2.9	16	0.0140	0.99	250	0.0035	5.19
22.0	5.6	7.5	1.9	16.1	0.0140	0.99	1440	0.0015	3.42

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	50	3	179.93	678.11	22.5	49.81	709.70	22.5	**2.732**

	Sieve Size	Grams Retain	% Pass
Sieve % Pass	1-1/2"	0.00	100.00
Air Dry Start Wt.:	1"	28.83	89.03
262.8	3/4"	28.83	89.03
Dry Start Wt.:	3/8"	28.83	89.03
261.82	No 4	28.83	89.03
	No 10	28.83	89.03

Remarks:



HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT:	Luminant Martin Lake, PDP 1-3
CLIENT:	TXU
CONTRACTOR:	not given
JOB No. :	**G 2810 - 08**
REPORT No.:	
DATE SAMPLED:	February 2008
SAMPLED BY:	ETTL Drill Crew
LOCATION:	B-3, 5'-7'
SAMPLE No. :	
DESCRIPTION:	Black Ash
TECHNICIAN:	H. Walka
DATE:	03/06/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**11.60**
% Retain	+0.05 mm	**76.50**
% Passing	0.05 to 2.0 mm	**64.91**
% Passing	0.002 to 0.05 mm	**21.88**
% Passing	> 0.002 mm	**1.62**

WEIGHT OF SAMPLE (AIR DRY)	50.00
WEIGHT OF SAMPLE (OVEN DRY)	49.53
PERCENT RETAINED ON # 10	11.60
SPECIFIC GRAVITY	2.561

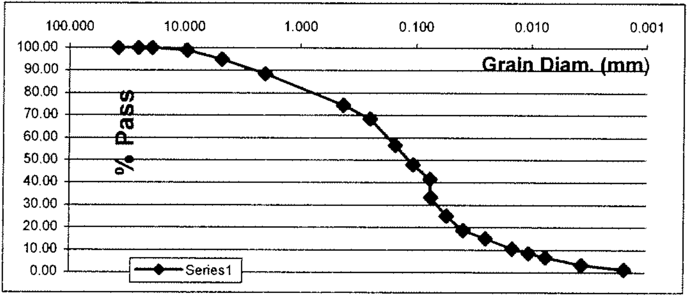
Mc Hydrom	
Tare Wt	29.43
Wet Wt.	65.41
Dry Wt	65.07
MC	0.9540%

SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	7.81	25.54	0.425	74.46
60	11.21	31.61	0.250	68.39
100	17.82	43.41	0.150	56.59
140	22.64	52.01	0.105	47.99
200	26.25	58.45	0.075	41.55

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
20.0	6.2	24.5	18.3	13.3	0.0143	1.02	0.5	0.0738	33.31
20.0	6.2	20.0	13.8	14.2	0.0143	1.02	1	0.0539	25.11
20.0	6.2	16.5	10.3	14.7	0.0143	1.02	2	0.0388	18.74
20.0	6.2	14.5	8.3	15	0.0143	1.02	5	0.0248	15.10
20.0	6.2	12.0	5.8	15.5	0.0143	1.02	15	0.0145	10.55
19.5	6.4	11.0	4.6	15.6	0.0145	1.02	30	0.0104	8.44
19.5	6.4	10.0	3.6	15.8	0.0145	1.02	60	0.0074	6.62
20.0	6.2	8.0	1.8	16.1	0.0143	1.02	250	0.0036	3.27
19.5	6.4	7.0	0.6	16.3	0.0145	1.02	1440	0.0015	1.15

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	100	7	179.97	678.12	22.5	99.06	738.67	21.0	**2.561**

	Sieve Size	Grams Retain	% Pass
Sieve % Pass	1-1/2"	0.00	100.00
Air Dry Start Wt.:	1"	0.00	100.00
335.3	3/4"	0.00	100.00
Dry Start Wt.:	3/8"	3.42	98.98
332.13	No 4	17.17	94.88
	No 10	38.89	88.40



Remarks:

HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT:	Luminant Martin Lake, PDP 1-3
CLIENT:	TXU
CONTRACTOR:	not given
JOB No. :	**G 2810 - 08**
REPORT No.:	
DATE SAMPLED:	February 2008
SAMPLED BY:	ETTL Drill Crew
LOCATION:	B-2, 23'-25'
SAMPLE No. :	
DESCRIPTION:	Light Gray & Black Ash
TECHNICIAN:	H. Walka
DATE:	03/06/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**0.76**
% Retain	+0.05 mm	**16.00**
% Passing	0.05 to 2.0 mm	**15.24**
% Passing	0.002 to 0.05 mm	**83.90**
% Passing	> 0.002 mm	**0.09**

WEIGHT OF SAMPLE (AIR DRY)	50.00
WEIGHT OF SAMPLE (OVEN DRY)	49.16
PERCENT RETAINED ON # 10	0.76
SPECIFIC GRAVITY	2.675

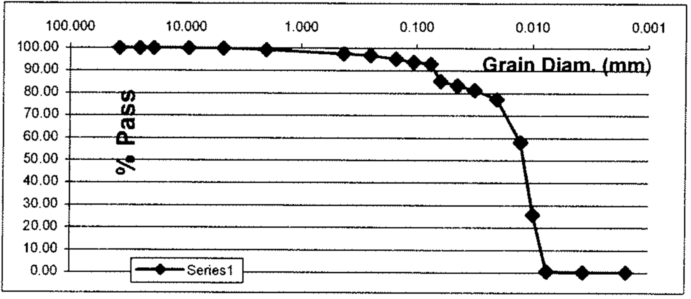
	Mc Hydrom
Tare Wt	29.91
Wet Wt.	55.02
Dry Wt	54.60
MC	1.7011%

SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	0.89	2.56	0.425	97.44
60	1.22	3.22	0.250	96.78
100	2.01	4.82	0.150	95.18
140	2.67	6.15	0.105	93.85
200	3.07	6.96	0.075	93.04

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
20.0	6.2	48.5	42.3	9.4	0.0143	1.00	0.5	0.0620	85.37
20.0	6.2	47.5	41.3	9.6	0.0143	1.00	1	0.0443	83.35
20.0	6.2	46.5	40.3	9.7	0.0143	1.00	2	0.0315	81.33
20.0	6.2	44.5	38.3	10.1	0.0143	1.00	5	0.0203	77.30
20.0	6.2	35.0	28.8	11.7	0.0143	1.00	15	0.0126	58.12
20.0	6.2	19.0	12.8	14.3	0.0143	1.00	30	0.0099	25.83
20.0	6.2	6.5	0.3	16.3	0.0143	1.00	60	0.0075	0.59
20.0	6.2	6.3	0.1	16.3	0.0143	1.00	250	0.0037	0.19
19.5	6.4	6.4	0.0	16.3	0.0145	1.00	1440	0.0015	0.07

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	50	4	179.25	677.26	22.5	49.16	708.22	21.0	**2.675**

	Sieve Size	Grams Retain	% Pass
Sieve % Pass	1-1/2"	0.00	100.00
Air Dry Start Wt.:	1"	0.00	100.00
144.3	3/4"	0.00	100.00
Dry Start Wt.:	3/8"	0.00	100.00
141.89	No 4	0.10	99.93
	No 10	1.10	99.24



Remarks:

HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT: Luminant Martin Lake, PDP 1-3
CLIENT: TXU
CONTRACTOR: not given
JOB No. : **G 2810 - 08**

REPORT No.:
DATE SAMPLED: February 2008
SAMPLED BY: ETTL Drill Crew
LOCATION: B-1, 18'-20'
SAMPLE No. :
DESCRIPTION: Black, Tan & Gray Ash
TECHNICIAN: H. Walka
DATE: 03/06/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**14.96**
% Retain	+0.05 mm	**64.42**
% Passing	0.05 to 2.0 mm	**49.46**
% Passing	0.002 to 0.05 mm	**35.29**
% Passing	> 0.002 mm	**0.29**

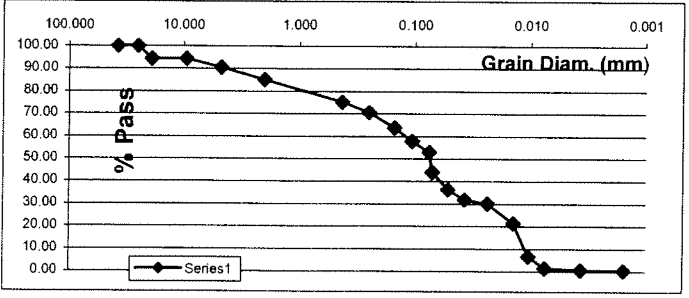
WEIGHT OF SAMPLE (AIR DRY)	50.00	
WEIGHT OF SAMPLE (OVEN DRY)	49.29	
PERCENT RETAINED ON # 10	14.96	
SPECIFIC GRAVITY	2.608	

		SIEVE	**WEIGHT**	**%RETAIN**	**GRAIN DIA**	**%PASSING**
Mc Hydrom		40	5.76	24.90	0.425	75.10
Tare Wt	29.29	60	8.38	29.42	0.250	70.58
Wet Wt.	59.40	100	12.31	36.20	0.150	63.80
Dry Wt	58.97	140	15.78	42.19	0.105	57.81
MC	1.4488%	200	18.60	47.05	0.075	52.95

TEMP (C)	**HYDROMETER CORRECTION**	**HYDROMETER READING**	**CORRECTED READING**	**L.Hydrom FACTOR**	**K. Diam. FACTOR**	**a. SP.GR. FACTOR**	**TIME (MIN)**	**GRAIN DIA (MM)**	**% SOIL PASSING**
20.0	6.2	31.5	25.3	12.2	0.0143	1.01	0.5	0.0707	44.08
20.0	6.2	27.0	20.8	13	0.0143	1.01	1	0.0516	36.24
20.0	6.2	24.5	18.3	13.3	0.0143	1.01	2	0.0369	31.88
20.0	6.2	23.5	17.3	13.5	0.0143	1.01	5	0.0235	30.14
20.0	6.2	18.5	12.3	14.3	0.0143	1.01	15	0.0140	21.43
20.0	6.2	10.0	3.8	15.8	0.0143	1.01	30	0.0104	6.61
20.0	6.2	7.0	0.8	16.3	0.0143	1.01	60	0.0075	1.38
20.0	6.2	6.5	0.3	16.3	0.0143	1.01	250	0.0037	0.51
19.5	6.4	6.5	0.1	16.3	0.0145	1.01	1440	0.0015	0.23

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	100	3	179.93	678.11	22.5	98.57	739.11	20.5	**2.608**

	Sieve Size	Grams Retain	% Pass
Sieve % Pass	1-1/2"	0.00	100.00
Air Dry Start Wt.:	1"	0.00	100.00
268.4	3/4"	15.10	94.37
Dry Start Wt.:	3/8"	15.10	94.37
264.57	No 4	25.58	90.47
	No 10	40.15	85.04



Remarks:

HYDROMETER AND MECHANICAL ANALYSIS OF SOIL BINDER, ASTM D422

PROJECT:	Luminant Martin Lake, PDP 1-3
CLIENT:	TXU
CONTRACTOR:	not given
JOB No. :	**G 2810 - 08**
REPORT No.:	
DATE SAMPLED:	February 2008
SAMPLED BY:	ETTL Drill Crew
LOCATION:	MLSES
SAMPLE No. :	
DESCRIPTION:	Tan & Gray Econimizet Ash
TECHNICIAN:	M. Thompson
DATE:	04/15/08

RESULTS

	Grain Diameter	
% Retain	+2.0 mm	**41.02**
% Retain	+0.05 mm	**95.89**
% Passing	0.05 to 2.0 mm	**54.87**
% Passing	0.002 to 0.05 mm	**3.55**
% Passing	> 0.002 mm	**0.55**

WEIGHT OF SAMPLE (AIR DRY)	50.00
WEIGHT OF SAMPLE (OVEN DRY)	49.98
PERCENT RETAINED ON # 10	41.02
SPECIFIC GRAVITY	2.670

Mc Hydrom	
Tare Wt	30.27
Wet Wt.	62.43
Dry Wt	62.42
MC	0.0311%

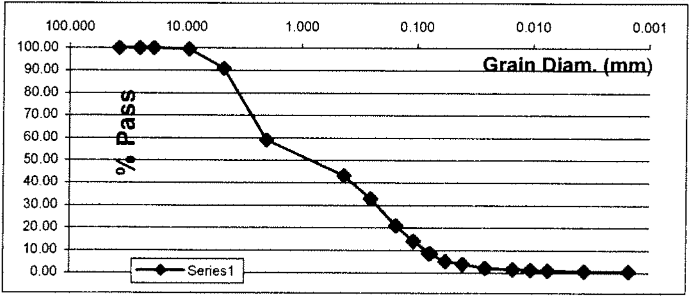
SIEVE	WEIGHT	%RETAIN	GRAIN DIA	%PASSING
40	13.34	56.76	0.425	43.24
60	22.12	67.12	0.250	32.88
100	32.26	79.09	0.150	20.91
140	38.01	85.87	0.105	14.13
200	42.66	91.36	0.075	8.64

TEMP (C)	HYDROMETER CORRECTION	HYDROMETER READING	CORRECTED READING	L.Hydrom FACTOR	K. Diam. FACTOR	a. SP.GR. FACTOR	TIME (MIN)	GRAIN DIA (MM)	% SOIL PASSING
21.5	5.7	13.0	7.3	15.2	0.0141	1.00	0.5	0.0780	8.58
21.5	5.7	10.0	4.3	15.6	0.0141	1.00	1	0.0558	5.04
21.5	5.7	9.0	3.3	15.8	0.0141	1.00	2	0.0397	3.86
21.5	5.7	7.5	1.8	16.1	0.0141	1.00	5	0.0254	2.09
21.5	5.7	7.0	1.3	16.1	0.0141	1.00	15	0.0146	1.50
21.5	5.7	6.8	1.1	16.1	0.0141	1.00	30	0.0104	1.27
21.5	5.7	6.5	0.8	16.3	0.0141	1.00	60	0.0074	0.91
21.5	5.7	6.3	0.6	16.3	0.0141	1.00	250	0.0036	0.68
22.0	5.6	6.0	0.4	16.3	0.0140	1.00	1440	0.0015	0.51

SPECIFIC GRAVITY		BOTTLE #	Bottle Wt	Bott & Water	WaterTemp	Corr.Soil	Bott, S & Water	WaterTemp	Specif. Grav
Air dry Sample(gr)	100	7	179.97	678.12	22.5	99.97	740.78	21.5	**2.670**

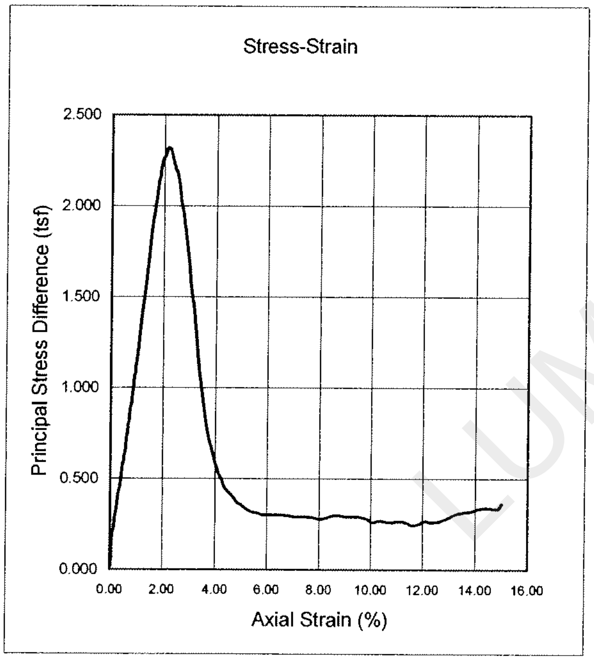
	Sieve Size	Grams Retain	% Pass
Sieve % Pass	1-1/2"	0.00	100.00
Air Dry Start Wt.:	1"	0.00	100.00
2182.9	3/4"	0.00	100.00
Dry Start Wt.:	3/8"	12.53	99.43
2182.22	No 4	200.01	90.83
	No 10	895.12	58.98

Remarks:



ASTM D 2850 Confined Compressive Strength of Cohesive Soil

Project: Luminant Martin Lake: PDP 1-3



Project No.: G 2810-08

Boring No.: B-7

Depth, ft.: 5'-7'

Material: Black Ash with Gravel

Initial Height 5.706 Inches

Initial Diameter 2.767 Inches

Moisture Content: 22.9% %

Dry Density: 97.5 lbs/cu ft

Specific Gravity (Assumed) 2.670

Volume of Solids: 0.585

Volume of Voids 0.415

Void Ratio: 0.709

Confining Pressure: 6.1 PSI

Pocket Penetr. Reading: 4.5

Torvane (T)

Rate of Strain: (%/ min) 1.0%

Peak Strain: **2.1** %

Max Stress: **2.32** **TSF**

Date: 3/11/2008

1/2 Stress (KSF) 2.321

Strain at 1/2 Stress (%) 0.99

Type of Specimen: Native

Remarks:

Secant Modulus (KSF) @ 1/2 Peak Stress 234

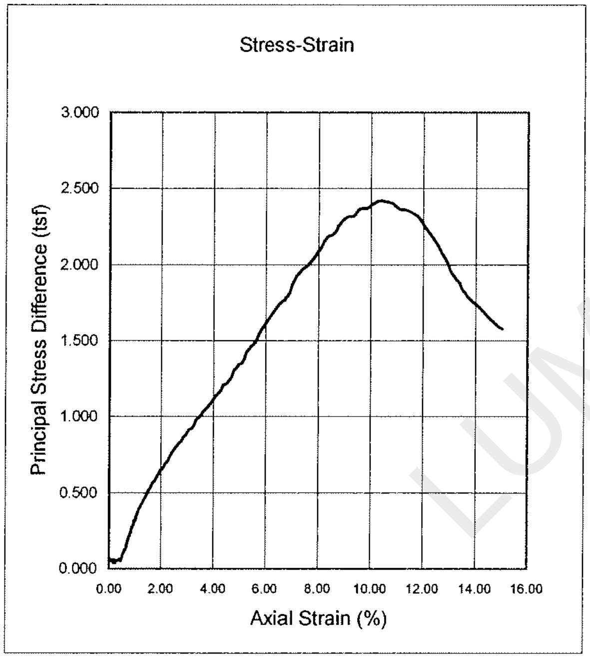
RQD Value: 100%

Angle of Fracture in Degrees: 65

Sketch of Fracture:

ASTM D 2850 Confined Compressive Strength of Cohesive Soil

Project: TXU PDP: Martin Lake, TX



Project No.: G 2810-08

Boring No.: B-4

Depth, ft.: 13'-15'

Material: Red & Gray Laminated Lean Clay

Initial Height 3.613 Inches

Initial Diameter 2.667 Inches

Moisture Content: 22.3% %

Dry Density: 99.4 lbs/cu ft

Specific Gravity (Assumed) 2.670

Volume of Solids: 0.596

Volume of Voids 0.404

Void Ratio: 0.677

Confining Pressure: 13 PSI

Pocket Penetr. Reading: 3.5

Torvane (T)

Rate of Strain: (%/ min) 1.0%

Peak Strain: **10.3** %

Max Stress: **2.42** **TSF**

Date: 5/12/2008

1/2 Stress (KSF) 2.416

Secant Modulus (KSF) @ 1/2 Peak Stress 61

Strain at 1/2 Stress (%) 3.94

RQD Value: 100%

Type of Specimen: Native

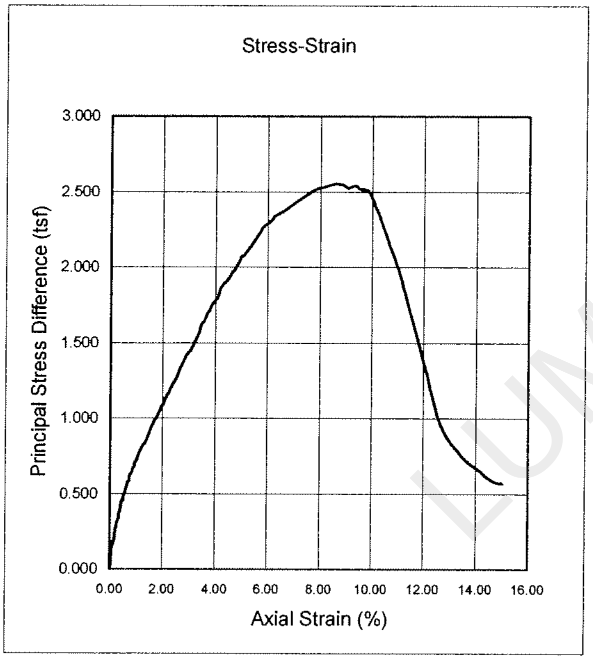
Angle of Fracture in Degrees: N/A

Remarks: undefined fracture

Sketch of Fracture:

ASTM D 2850 Confined Compressive Strength of Cohesive Soil

Project: Luminant Martin Lake: PDP 1-3



Project No.: G 2810-08

Boring No.: B-4

Depth, ft.: 13'-15'

Material: Light Gray & Red Slity Clayey Sand w/ Ferric seams

Initial Height 5.688 Inches

Initial Diameter 2.75 Inches

Moisture Content: 21.5% %

Dry Density: 104.6 lbs/cu ft

Specific Gravity (Assumed) 2.670

Volume of Solids: 0.628

Volume of Voids 0.372

Void Ratio: 0.593

Confining Pressure: 13 PSI

Pocket Penetr. Reading: 3.9

Torvane (T) 1.138

Rate of Strain: (%/ min) 1.0%

Peak Strain: **8.6** %

Max Stress: **2.55** **TSF**

Date: 4/11/2008

1/2 Stress (KSF) 2.552

Strain at 1/2 Stress (%) 2.54

Type of Specimen: Native

Remarks:

Secant Modulus (KSF) @ 1/2 Peak Stress 100

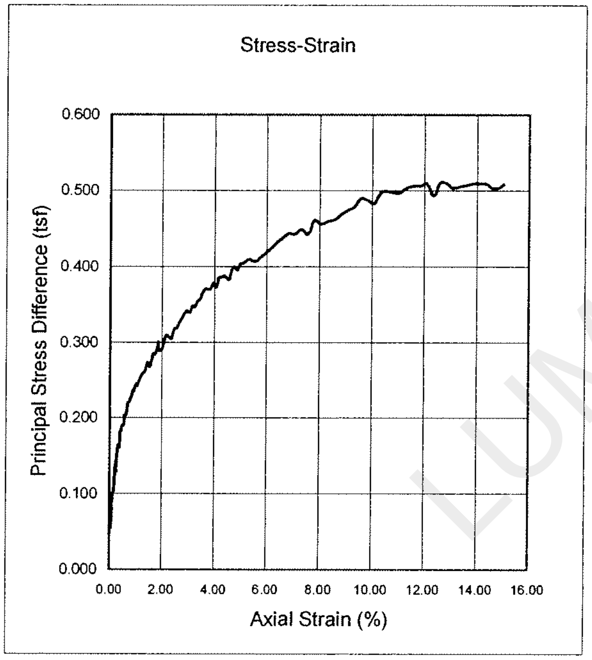
RQD Value: 100%

Angle of Break in Degrees: 60

Sketch of Fracture:

ASTM D 2850 Confined Compressive Strength of Cohesive Soil

Project: Luminant Martin Lake: PDP 1-3



Project No.:	G 2810-08	
Boring No.:	B-7	
Depth, ft.:	23'-25'	
Material:	Black, Red, Tan, & Gray Clay w/ gravel	
Initial Height	5.686	Inches
Initial Diameter	2.717	Inches
Moisture Content:	21.0%	%
Dry Density:	103.9	lbs/cu ft
Specific Gravity (Assumed)	2.670	
Volume of Solids:	0.624	
Volume of Voids	0.376	
Void Ratio:	0.603	
Confining Pressure:	21.7	PSI
Pocket Penetr. Reading:		
Torvane (T)		
Rate of Strain: (%/ min)	1.0%	
Peak Strain:	**12.8**	%
Max Stress:	**0.51**	**TSF**
Date:	3/11/2008	

1/2 Stress (KSF) 0.510

Strain at 1/2 Stress (%) 1.20

Type of Specimen: Native

Secant Modulus (KSF) @ 1/2 Peak Stress 43

RQD Value: 100%

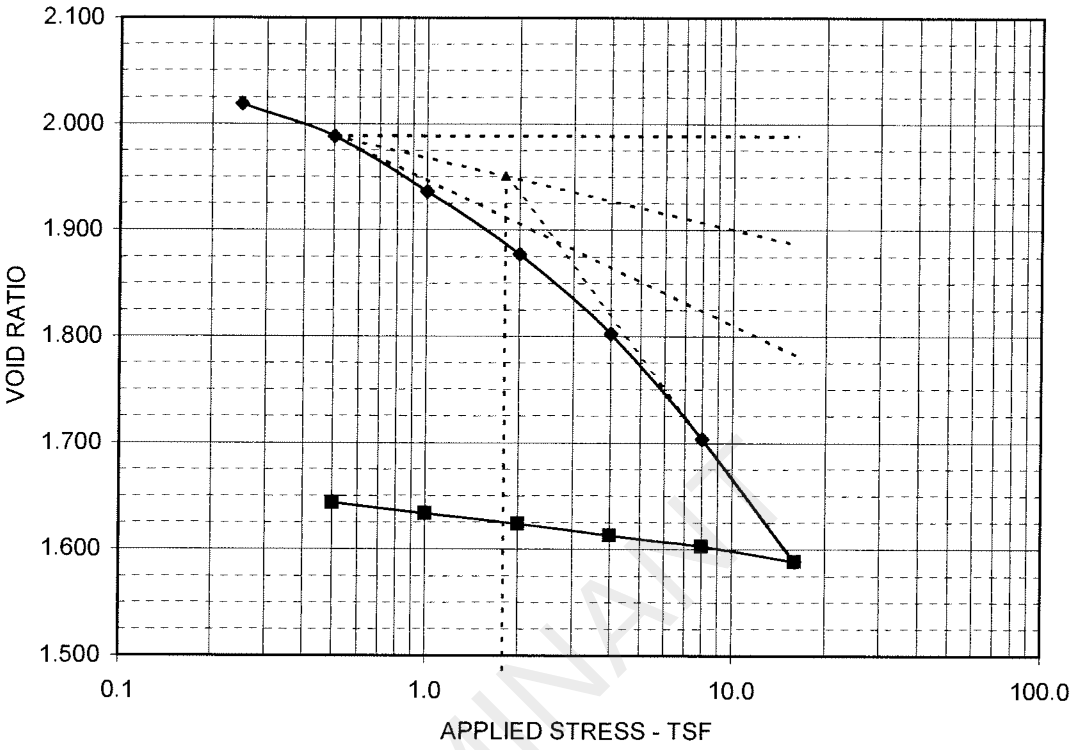
Angle of Break in Degrees: 53

Remarks: Not able to find a well defined fracture

Sketch of Fracture:

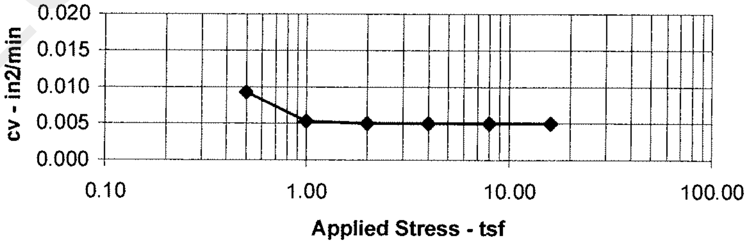
CONSOLIDATION TEST REPORT

ASTM D 2435



C_c = 0.381	C_r = 0.033	e_0 = 2.0191	**Pc (tsf) =** 1.79	**OCR =** 10.2

LOAD **tsf**	**c_v** **in^2/min**	**k** **in/min**
Seating	NA	NA
0.50	9.34E-03	9.85E-07
1.00	5.36E-03	4.89E-07
2.00	5.03E-03	2.65E-07
4.00	5.04E-03	1.73E-07
8.00	5.03E-03	1.18E-07
16.00	5.03E-03	7.08E-08



c_v values calculated by Sivaram and Swamee's Method

SAMPLE AND TEST DATA

SAMPLE LOCATION: B-6, 3-5'

DESCRIPTION: Ash, black and dark gray

LL: NA PL: NA PI: NA -200:NA

ASSUMED SPECIFIC GRAVITY: 2.70

MC Initial:	58.1%	MC Final:	47.2%
Dia. (in.) :	2.50	Height (in.) :	1.000
Initial Sat %:	70.2	Final Sat %:	100.0
DRY DENSITY (pcf):		55.8	

PROJECT INFORMATION

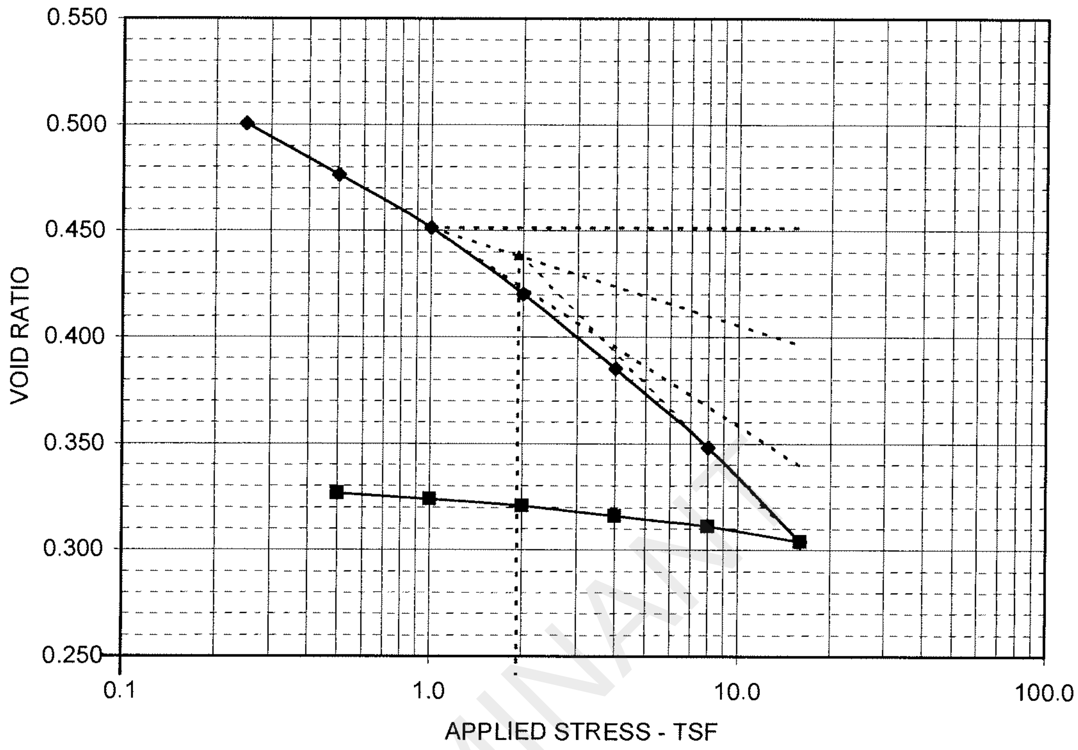
PROJECT:	Luminant Martin Lake PDP 1-3
LOCATION:	Rusk, TX.
PROJECT NO.:	ETT08002-07
CLIENT:	ETTL Engineers & Consultants, Inc.
CLIENT NO.:	G2810-08
DATE:	4/24/2008

REMARKS: OCR calculated based on Pc and vertical overburden

GREGORY GEOTECHNICAL PLATE B-CN.1

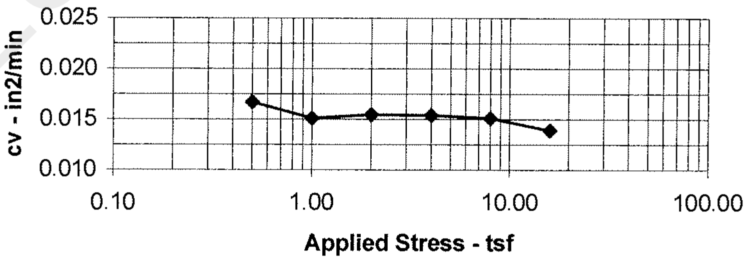
CONSOLIDATION TEST REPORT

ASTM D 2435



C_c = 0.146 | **C_r =** 0.012 | **e_0 =** 0.5597 | **Pc (tsf) =** 1.93 | **OCR =** 3.5

LOAD tsf	c_v in^2/min	k in/min
Seating	NA	NA
0.50	1.67E-02	2.82E-06
1.00	1.51E-02	1.33E-06
2.00	1.55E-02	8.75E-07
4.00	1.54E-02	5.00E-07
8.00	1.51E-02	2.67E-07
16.00	1.39E-02	1.50E-07



c_v values calculated by Sivaram and Swamee's Method

SAMPLE AND TEST DATA

SAMPLE LOCATION: B-4, 8-10'
DESCRIPTION: Clayey Sand , reddish brown with gray

LL: NA PL: NA PI: NA -200: NA
ASSUMED SPECIFIC GRAVITY: 2.70
MC Initial: 13.0% MC Final: 19.6%
Dia. (in.) : 2.50 Height (in.) : 1.000
Initial Sat %: 70.2 Final Sat %: 100.0
DRY DENSITY (pcf): 108.0

PROJECT INFORMATION

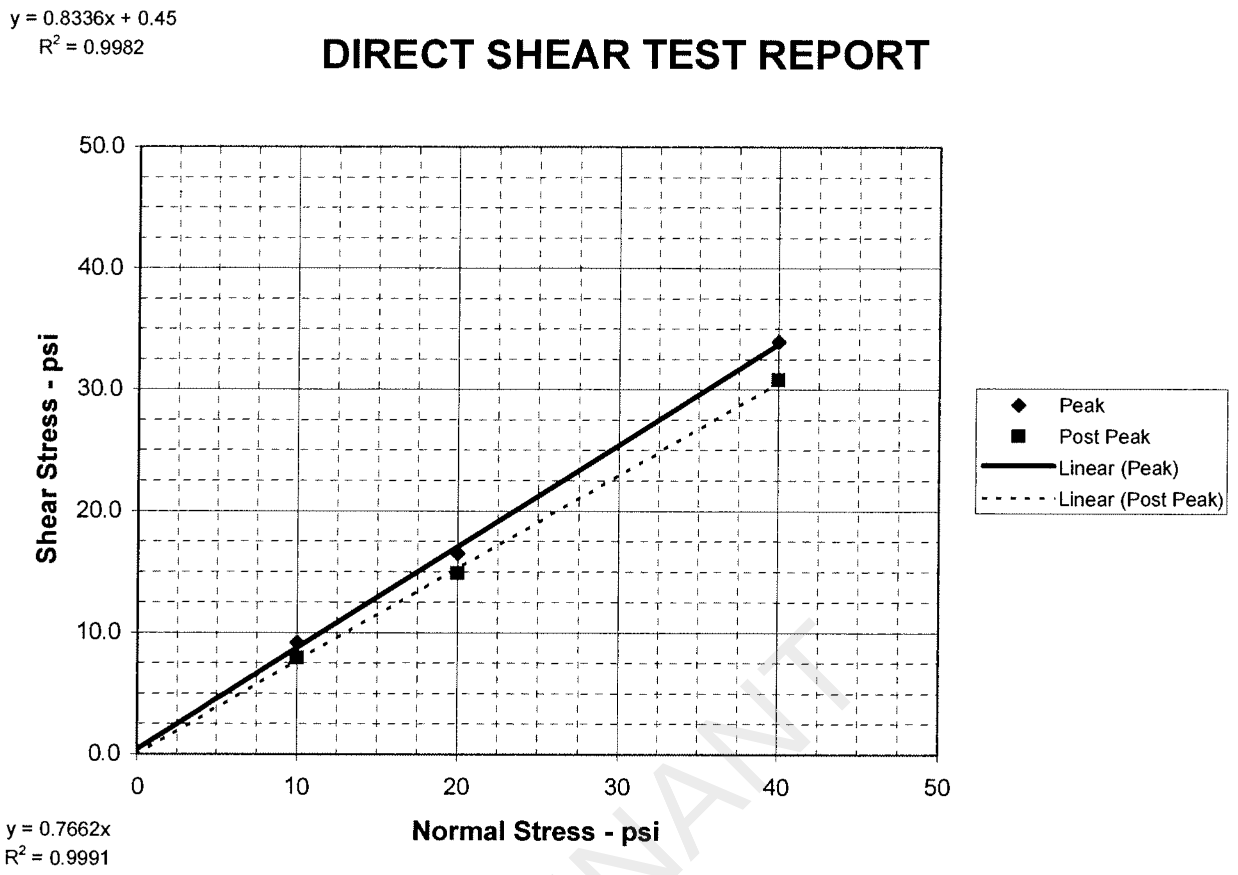
PROJECT:	Luminant Martin Lake PDP 1-3
LOCATION:	Rusk, TX.
PROJECT NO.:	ETT08002-07
CLIENT:	ETTL Engineers & Consultants, Inc.
CLIENT NO.:	G2810-08
DATE:	4/24/2008

REMARKS: OCR calculated based on Pc and vertical overburden

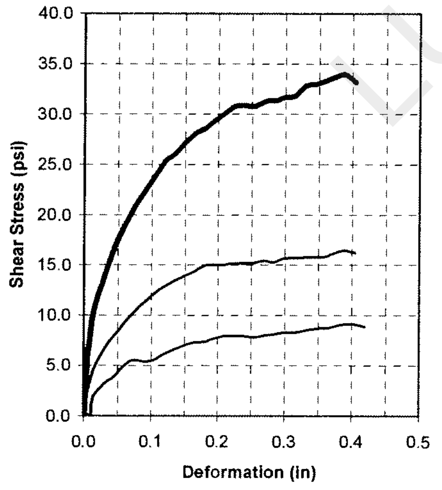
GREGORY GEOTECHNICAL

PLATE B-CN.2

DIRECT SHEAR TEST REPORT



PEAK STRENGTH PARAMETERS	ϕ =	39.8 deg	c =	0.5 psi
POST PEAK STRENGTH PARAMETERS	ϕ =	37.5 deg	c =	0.0 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	52.1	29.3	21.2	
Dry Density - pcf	50.2	71.7	95.2	
Diameter - inches	2.50	2.50	2.50	
Height - inches	1.13	1.13	1.13	
AT TEST				
Final Moisture - %	64.3	25.0	31.6	
Dry Density - pcf	55.8	79.1	117.3	
Height-End of Consol. (in.)	1.02	1.03	0.92	
Height-End of Shear (in.)	0.97	0.99	0.89	
Normal Stress - psi	10.0	20.0	40.0	
Peak Failure Stress-psi	9.2	16.5	34.0	
Post Peak Failure Stress-psi	7.9	14.9	30.8	
Strain Rate - inches/min.	0.00300	0.00300	0.00300	
Peak Failure Strain - %	16.2	15.6	15.6	
Post Peak Failure Strain %	8.4	7.2	9.6	

Dry Density at test based on initial moisture and height at end of consolidation.

TEST DESCRIPTION

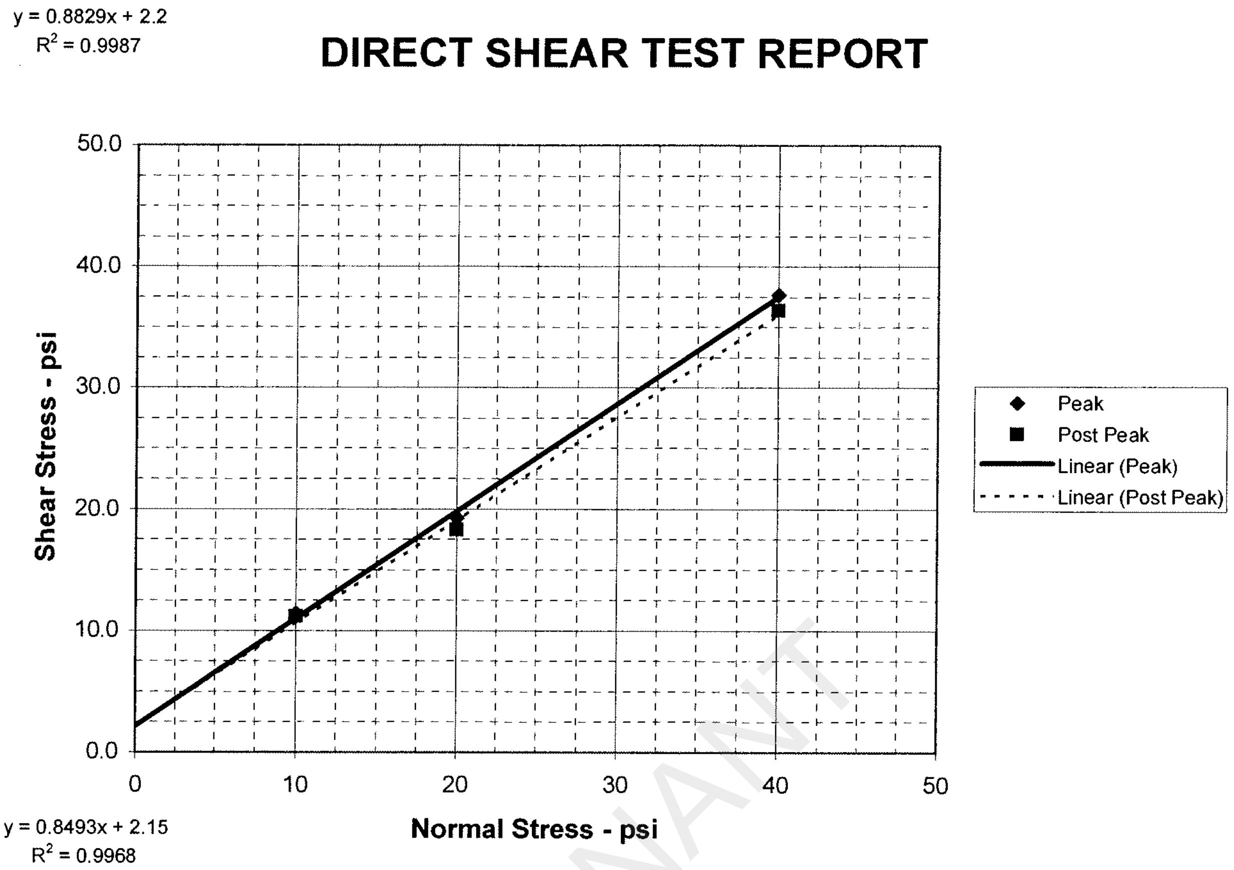
TYPE OF TEST & NO: CD-DS-1
SAMPLE TYPE: Shelby Tube
DESCRIPTION: Ash, black and gray
SAMPLE LOCATION: B-6, 3-5 ft
ASSUMED SPECIFIC GRAVITY: 2.65
LL: 35 PL: 19 PI: 16 Percent -200: 61
REMARKS: Multi-Specimen

PROJECT INFORMATION

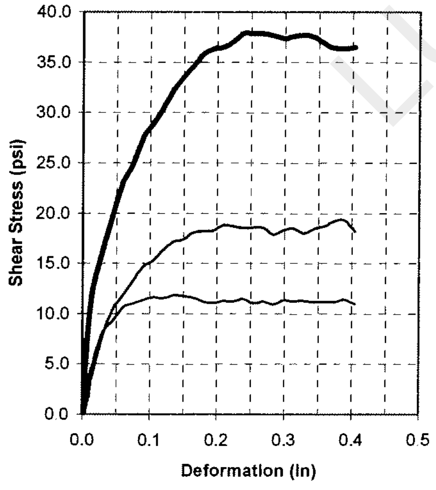
PROJECT: Luminant Martin Lake PDP 1-3
LOCATION: Rusk , TX
PROJECT NO: ETT08002-07 (G2810-08)
CLIENT : ETTL Engineers & Consultants, Inc
DATE:4/25/08

GREGORY GEOTECHNICAL PLATE: B-DS.1

DIRECT SHEAR TEST REPORT



PEAK STRENGTH PARAMETERS	ϕ = 41.4 deg	c = 2.2 psi
POST PEAK STRENGTH PARAMETERS	ϕ = 40.3 deg	c = 2.2 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	13.1	13.1	13.1	
Dry Density - pcf	71.8	71.7	71.7	
Diameter - inches	2.50	2.50	2.50	
Height - inches	1.00	1.00	1.00	
AT TEST				
Final Moisture - %	38.5	37.4	31.6	
Dry Density - pcf	73.6	73.7	75.8	
Height-End of Consol. (in.)	0.98	0.97	0.95	
Height-End of Shear (in.)	1.00	0.96	0.92	
Normal Stress - psi	10.0	20.0	40.0	
Peak Failure Stress-psi	11.4	19.3	37.7	
Post Peak Failure Stress-psi	11.2	18.3	36.4	
Strain Rate - inches/min.	0.00300	0.00300	0.00300	
Peak Failure Strain - %	15.6	15.6	13.2	
Post Peak Failure Strain %	13.8	12.0	15.0	

Dry Density at test based on initial moisture and height at end of consolidation.

TEST DESCRIPTION

TYPE OF TEST & NO: CD-DS-2
SAMPLE TYPE: Re-Compacted
DESCRIPTION: Ash, black and dark gray
SAMPLE LOCATION: MLSES (Bulk)
SPECIFIC GRAVITY: 2.56
LL: NP PL: NP PI: NP Percent -200: 3.33
REMARKS: Multi-Specimen

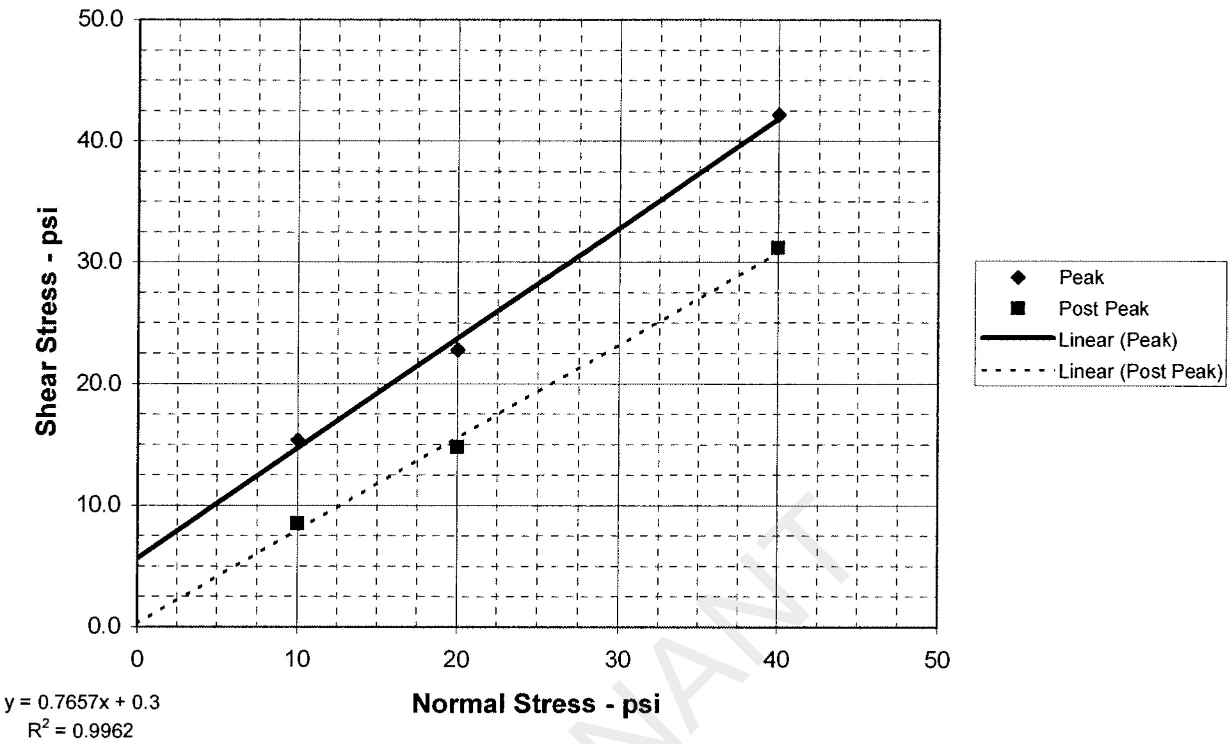
PROJECT INFORMATION

PROJECT: Luminant Martin Lake PDP 1-3
LOCATION: Rusk , TX
PROJECT NO: ETT08002-07 (G2810-08)
CLIENT : ETTL Engineers & Consultants, Inc
DATE:5/6/08

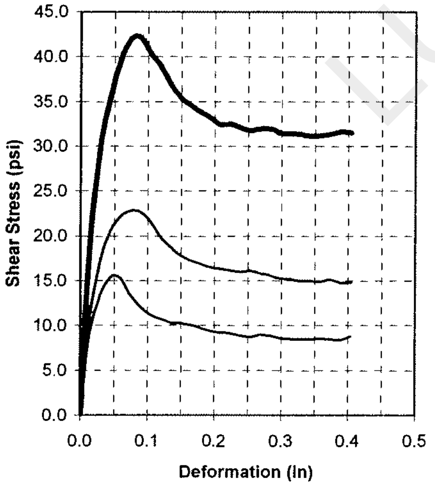
GREGORY GEOTECHNICAL PLATE: B-DS.2

y = 0.9043x + 5.7
R^2 = 0.9961

DIRECT SHEAR TEST REPORT



PEAK STRENGTH PARAMETERS	ϕ =	42.1 deg	c =	5.7 psi
POST PEAK STRENGTH PARAMETERS	ϕ =	37.4 deg	c =	0.3 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	0.1	0.1	0.1	
Dry Density - pcf	71.7	71.7	71.7	
Diameter - inches	2.50	2.50	2.50	
Height - inches	1.00	1.00	1.00	
AT TEST				
Final Moisture - %	50.3	37.4	31.6	
Dry Density - pcf	73.4	73.1	73.1	
Height-End of Consol. (in.)	0.98	0.98	0.98	
Height-End of Shear (in.)	1.01	1.01	0.99	
Normal Stress - psi	10.0	20.0	40.0	
Peak Failure Stress-psi	15.4	22.8	42.2	
Post Peak Failure Stress-psi	8.5	14.8	31.2	
Strain Rate - inches/min.	0.00300	0.00300	0.00300	
Peak Failure Strain - %	17.6	3.0	3.6	
Post Peak Failure Strain %	15.0	15.6	13.8	

Dry Density at test based on initial moisture and height at end of consolidation.

TEST DESCRIPTION

TYPE OF TEST & NO: CD-DS-2
SAMPLE TYPE: Re-Compacted
DESCRIPTION: Economized Ash, tan and gray
SAMPLE LOCATION: MLSES (Bulk)
SPECIFIC GRAVITY: 2.67
LL: NP PL: NP PI: NP Percent -200: 8.64
REMARKS: Multi-Specimen

PROJECT INFORMATION

PROJECT: Luminant Martin Lake PDP 1-3
LOCATION: Rusk , TX
PROJECT NO: ETT08002-07 (G2810-08)
CLIENT : ETTL Engineers & Consultants, Inc
DATE:5/20/08

GREGORY GEOTECHNICAL PLATE: B-DS.3

PROJECT INFORMATION

PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Shelby Tube Sample
DESCRIPTION: Tan w/ Red & Gray Clayey Sand
Sampled on Site, B-16 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

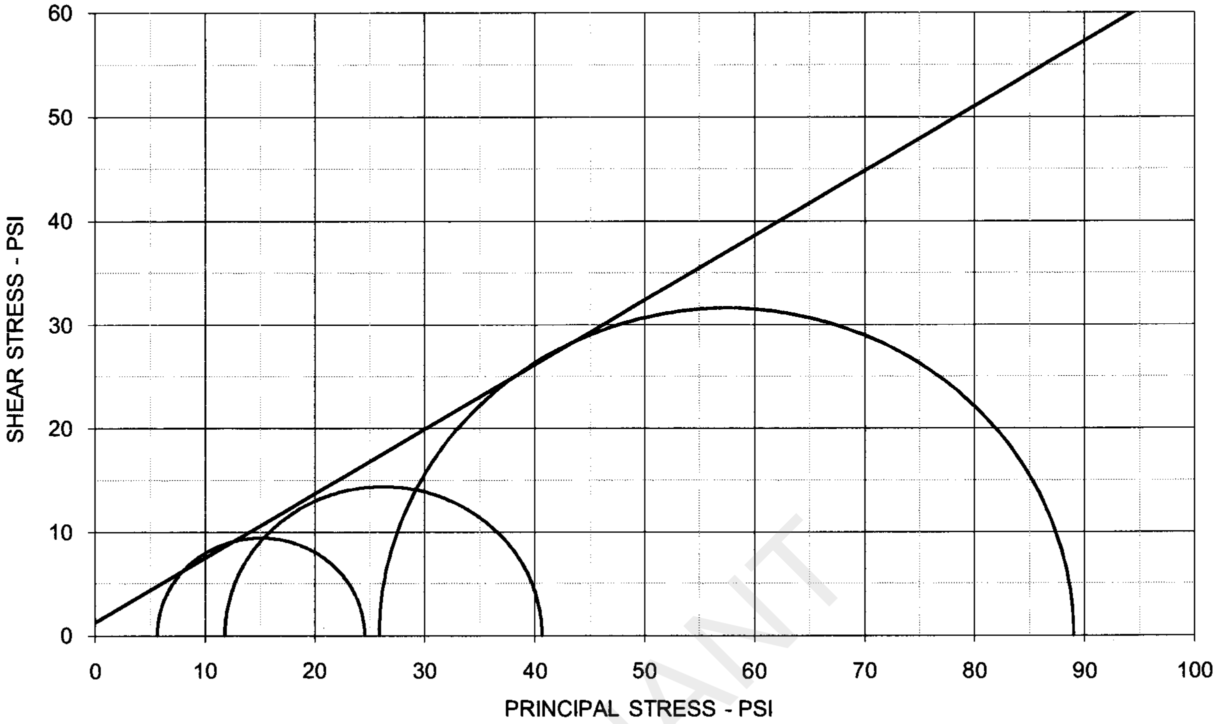
PLATE: B.1

PLATE: B.2

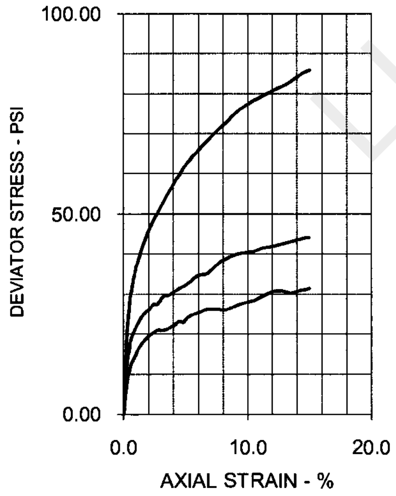
PLATE: B.3

Number of Specimens = 3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	φ ' = 31.9 deg	c' = 1.3 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	17.2	16.8	16.3	
Dry Density - pcf	112.6	114.4	115.0	
Diameter - inches	2.47	2.46	2.48	
Height - inches	4.98	4.97	5.00	
AT TEST				
Final Moisture - %	18.4	16.5	16.0	
Dry Density - pcf	113.1	115.3	116.9	
Calculated Diameter (in.)	2.47	2.46	2.50	
Height - inches	5.00	4.97	5.06	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	18.88	28.83	63.14	
Total Pore Pressure - psi	54.3	58.2	64.1	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.8	3.0	5.2	
σ_1' Failure - psi	24.54	40.64	89.01	
σ_3' Failure - psi	5.66	11.81	25.87	

TEST DESCRIPTION

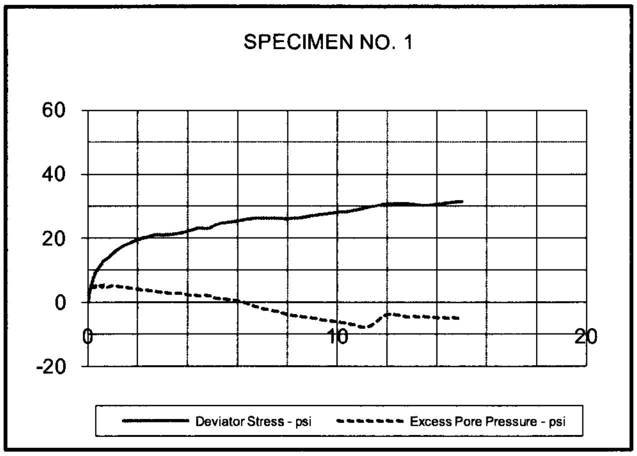
TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Shelby Tube Sample
DESCRIPTION: Tan w/ Red & Gray Clayey Sand
Sampled on Site, B-16 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

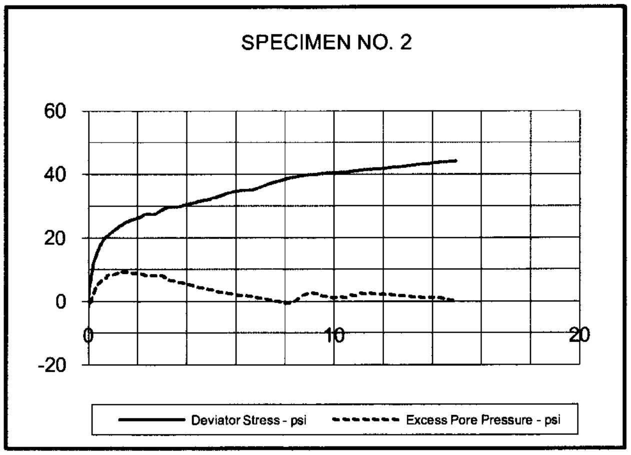
PROJECT INFORMATION

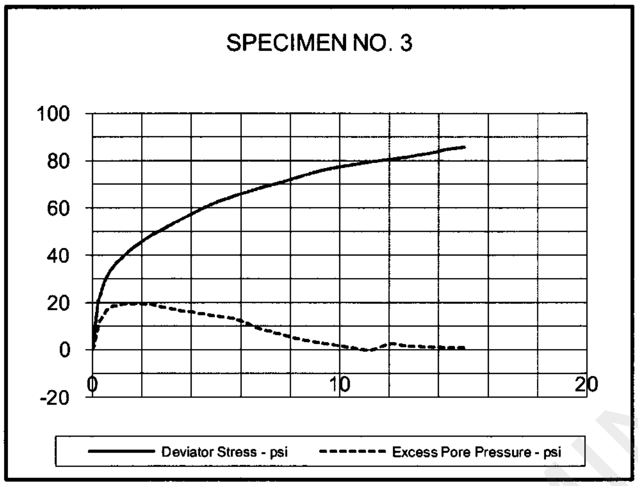
PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

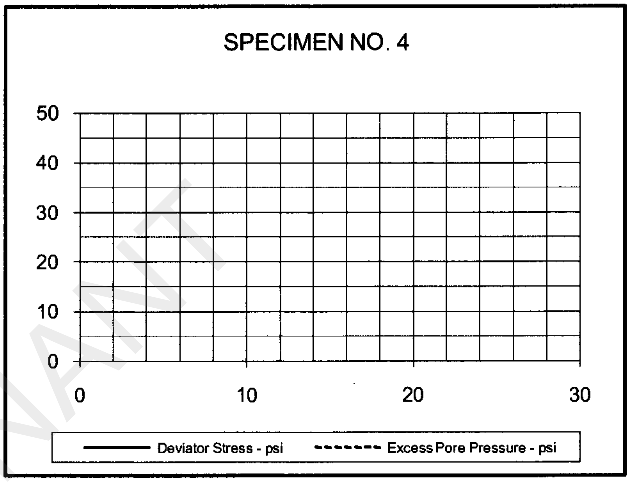
ETTL ENGINEERS & CONSULTANTS PLATE: B.1

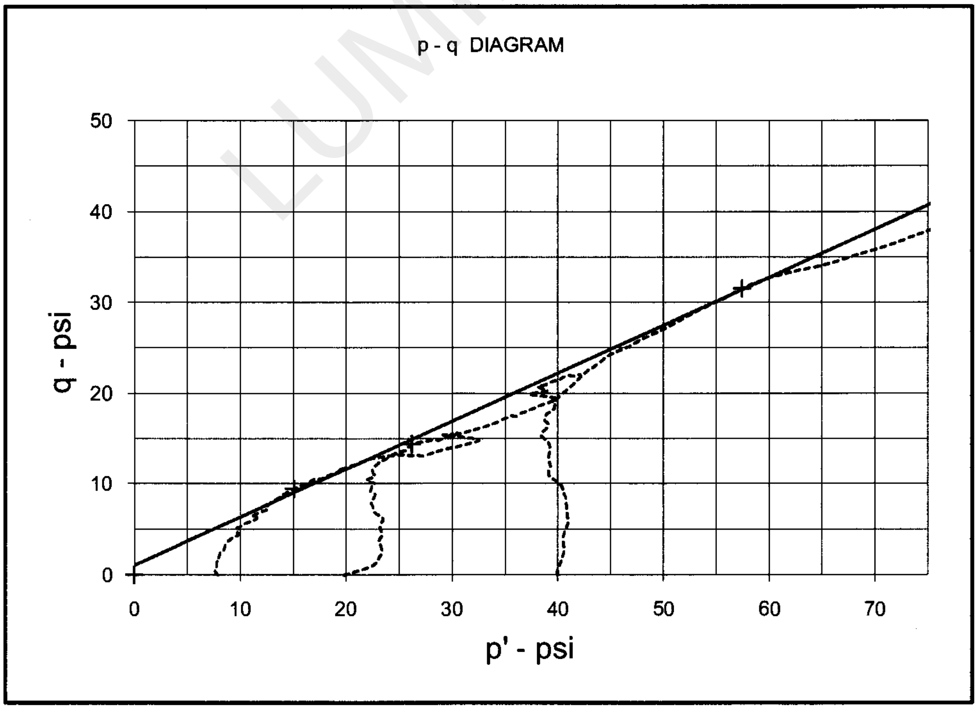
G 3219-09, B-16 8'-10' Native


SPECIMEN NO. 1


SPECIMEN NO. 2


SPECIMEN NO. 3

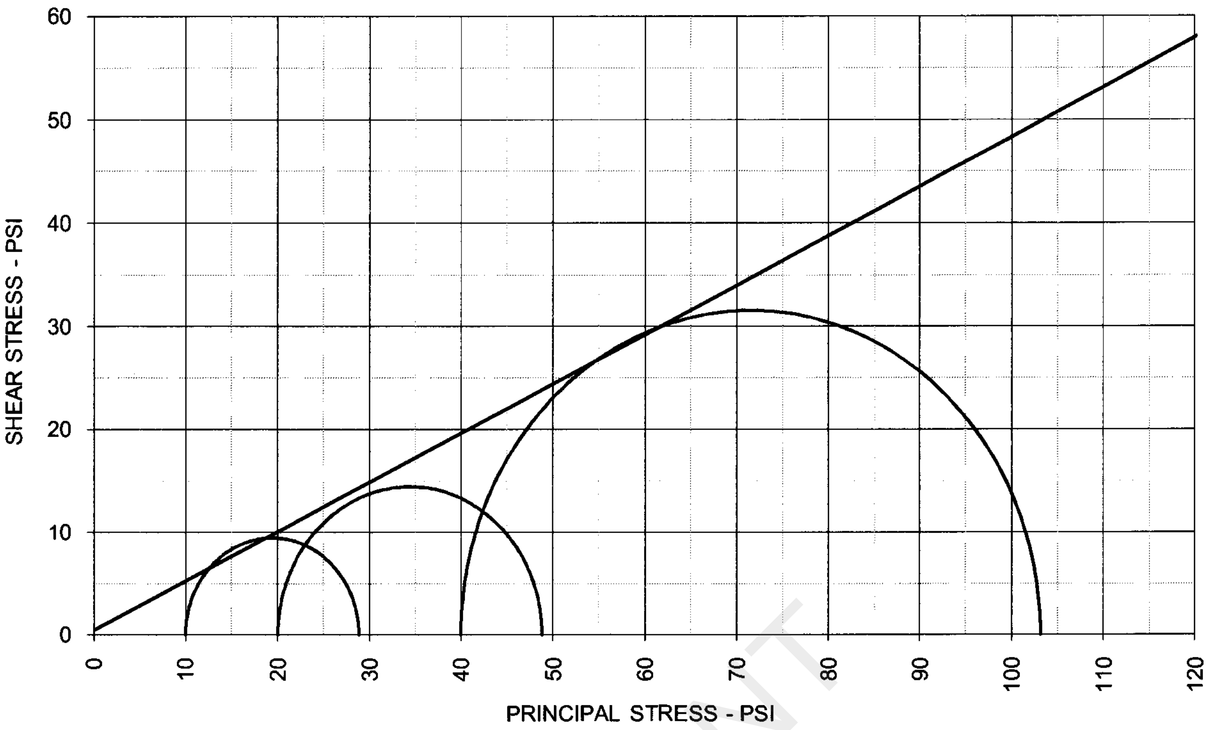

SPECIMEN NO. 4


p - q DIAGRAM

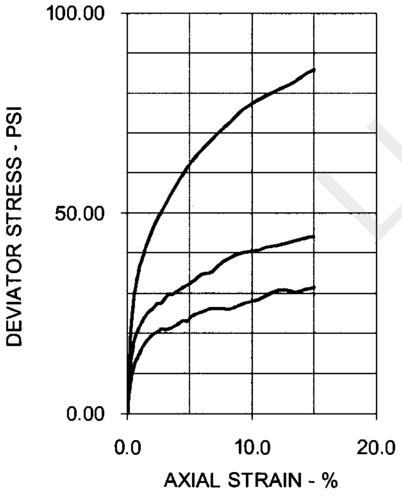
EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	α (deg) = 27.9	a (psi) = 1.1
PROJECT: Martin Lake PDP 1 - 3 Supplemental		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3219 - 09		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Tan w/ Red & Gray Clayey Sand			

G 3219-09, B-16 8'-10' Native

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 25.6 deg	c = 0.5 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	17.2	16.8	16.3	
Dry Density - pcf	112.6	114.4	115.0	
Diameter - inches	2.47	2.46	2.48	
Height - inches	4.98	4.97	5.00	
AT TEST				
Final Moisture - %	18.4	16.5	16.0	
Dry Density - pcf	113.1	115.3	116.9	
Calculated Diameter (in.)	2.47	2.46	2.50	
Height - inches	5.00	4.97	5.06	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	18.88	28.83	63.14	
Total Pore Pressure - psi	54.3	58.2	64.1	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	1.8	3.0	5.2	
σ_1 Failure - psi	28.88	48.83	103.14	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Shelby Tube Sample
DESCRIPTION: Tan w/ Red & Gray Clayey Sand
Sampled on Site, B-16 8' to 10' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

PROJECT INFORMATION

PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

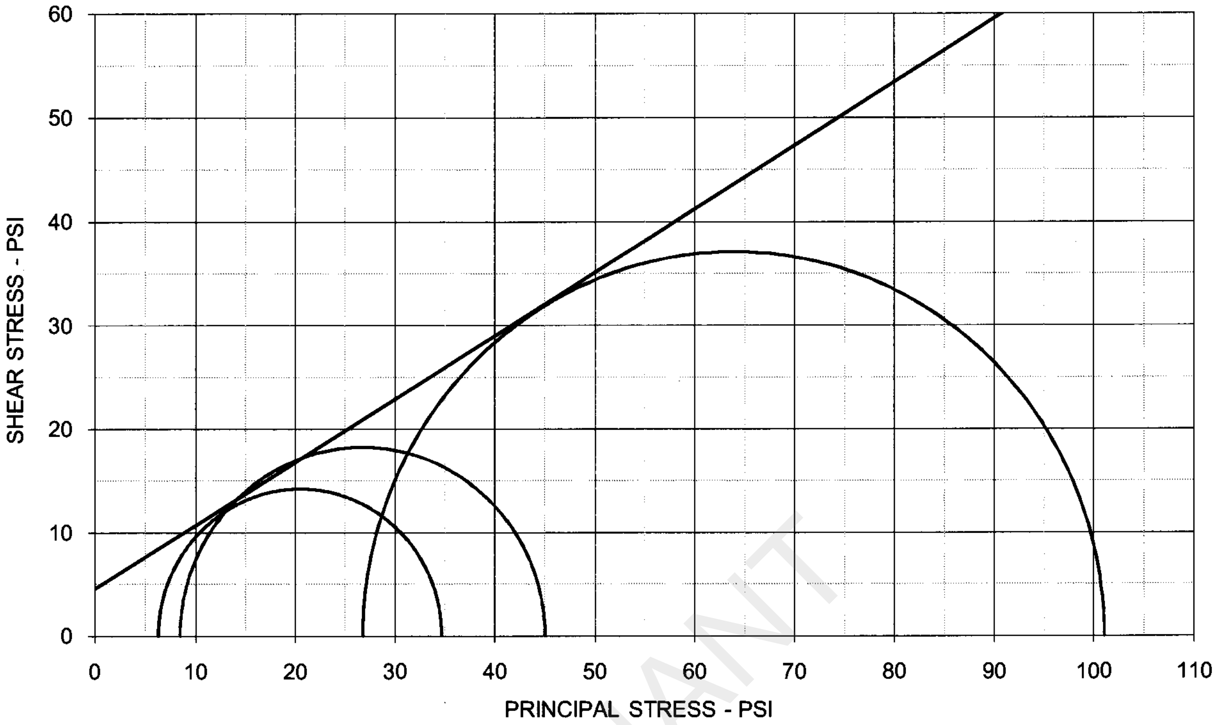
TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Shelby Tube Sample
DESCRIPTION: Tan & Red Sandy Lean Clay
Sampled on Site, B-17 3' to 7' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

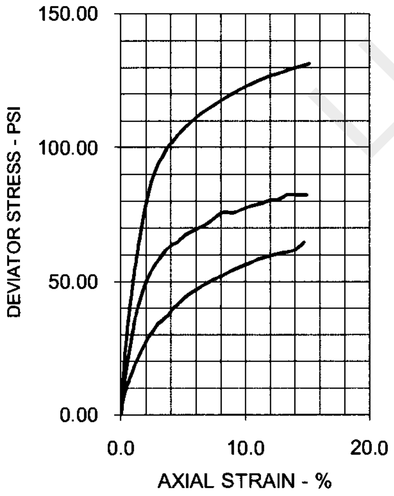
PLATE: B.1
PLATE: B.2
PLATE: B.3

Number of Specimens = 3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ' = 31.4 deg	c' = 4.6 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	16.2	13.3	13.9	
Dry Density - pcf	113.5	121.6	115.5	
Diameter - inches	2.49	2.49	2.50	
Height - inches	5.08	5.00	5.16	
AT TEST				
Final Moisture - %	18.1	14.7	16.3	
Dry Density - pcf	114.1	123.3	117.2	
Calculated Diameter (in.)	2.50	2.50	2.52	
Height - inches	5.10	5.04	5.22	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	28.40	36.54	74.24	
Total Pore Pressure - psi	53.7	61.5	63.2	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.8	3.5	1.8	
σ_1' Failure - psi	34.71	45.04	101.03	
σ_3' Failure - psi	6.31	8.50	26.79	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Shelby Tube Sample
DESCRIPTION: Tan & Red Sandy Lean Clay
Sampled on Site, B-17 3' to 7' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

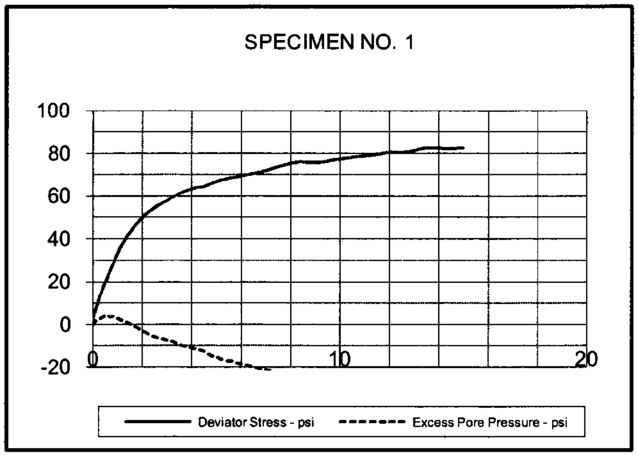
PROJECT INFORMATION

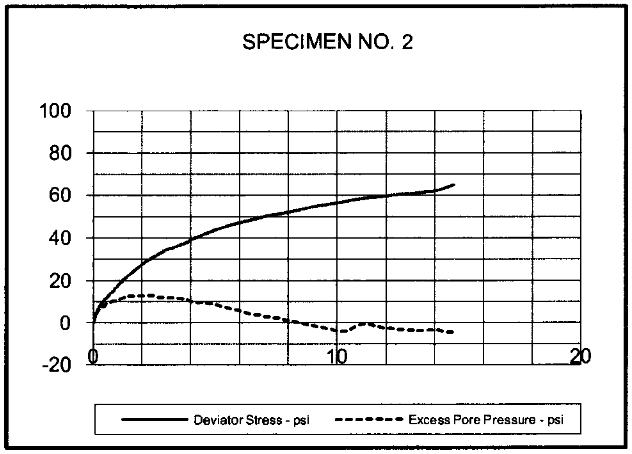
PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

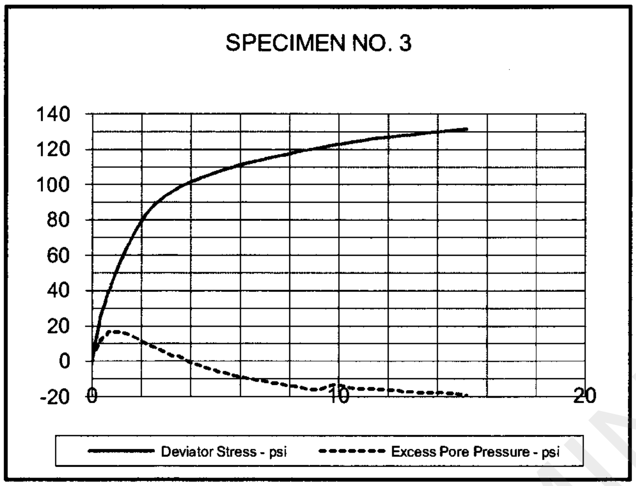
ETTL ENGINEERS & CONSULTANTS

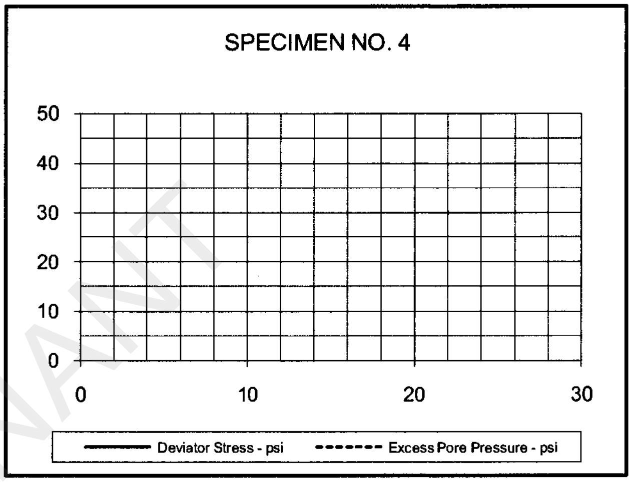
PLATE: B.1

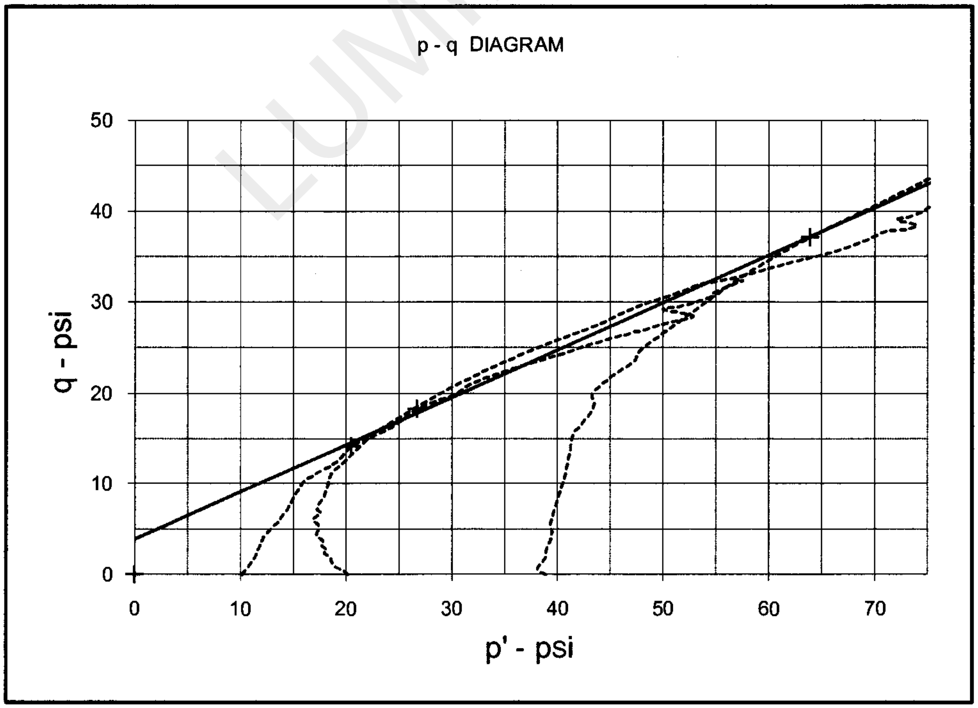
G 3219-09, B-17 3'-7' Native







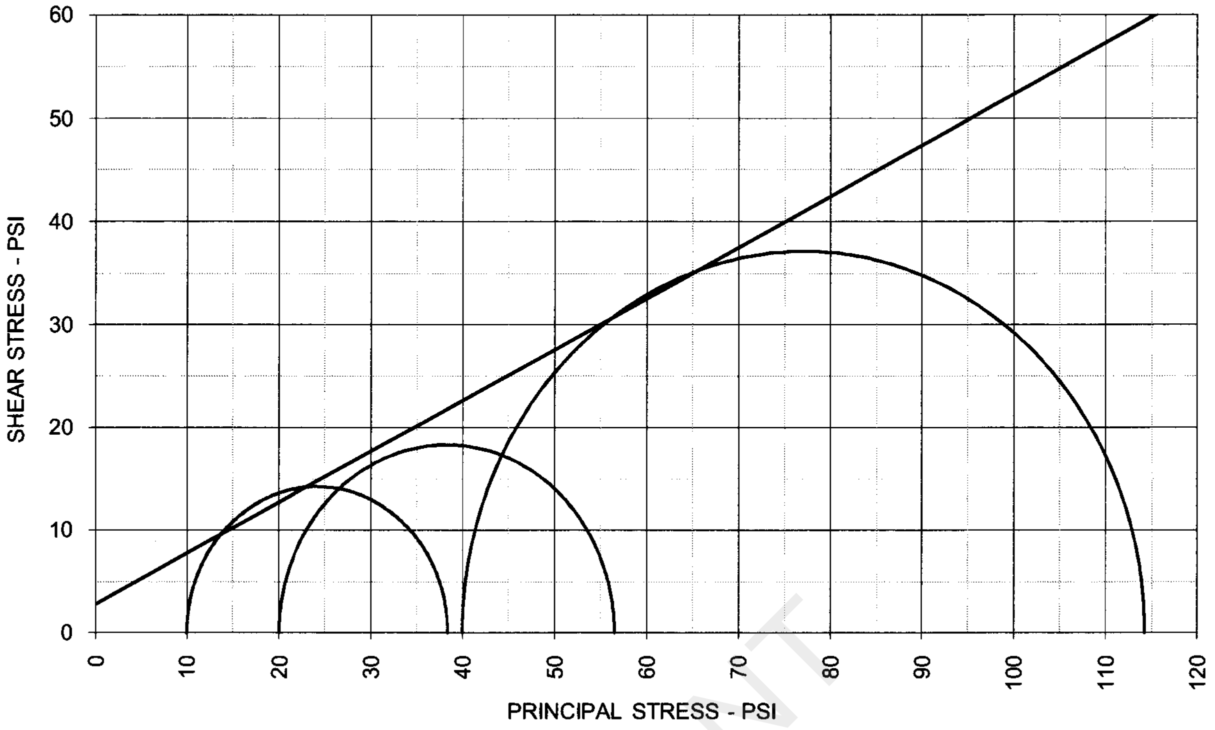




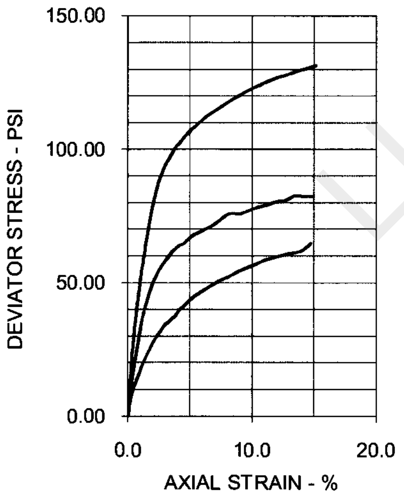
EFFECTIVE STRESS PARAMETERS	R^2 = 1.00	α (deg) = 27.5	a (psi) = 3.9
PROJECT: Martin Lake PDP 1 - 3 Supplemental		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3219 - 09		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Tan & Red Sandy Lean Clay			

G 3219-09, B-17 3'-7' Native

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS	ϕ = 26.4 deg	c = 2.8 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	16.2	13.3	13.9	
Dry Density - pcf	113.5	121.6	115.5	
Diameter - inches	2.49	2.49	2.50	
Height - inches	5.08	5.00	5.16	
AT TEST				
Final Moisture - %	18.1	14.7	16.3	
Dry Density - pcf	114.1	123.3	117.2	
Calculated Diameter (in.)	2.50	2.50	2.52	
Height - inches	5.10	5.04	5.22	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	28.40	36.54	74.24	
Total Pore Pressure - psi	53.7	61.5	63.2	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	0.8	3.5	1.8	
σ_1 Failure - psi	38.40	56.54	114.24	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Native Shelby Tube Sample
DESCRIPTION: Tan & Red Sandy Lean Clay
Sampled on Site, B-17 3' to 7' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve
LL: PL: PI: Percent -200:
REMARKS: Diameter and Both Ends Trimmed + # 4 Sieve

PROJECT INFORMATION

PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

ETTL ENGINEERS & CONSULTANTS PLATE: B.3

PROJECT INFORMATION

PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

TRIAXIAL TEST PROGRAM BY GARRY H. GREGORY, P.E.

VERSION 1.0 - AUGUST 1998 - REVISED MARCH 24, 1999

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Lab Molded
DESCRIPTION: Tan & Reddish Tan Silty Sand
Sampled on Site, TP- 31 0' to 5' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve 2%
LL: 20 PL: 17 PI: 3 Percent -200: 27%
REMARKS: Both Ends Trimmed + # 4 Sieve 1%

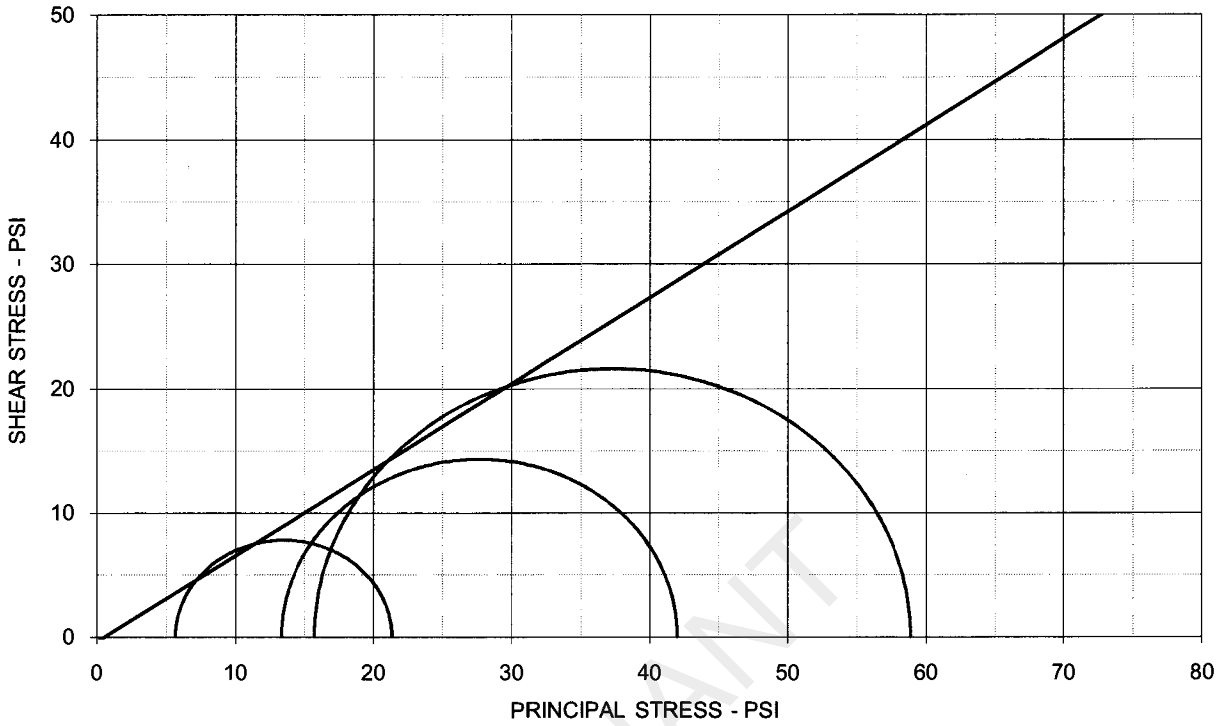
PLATE: B.1

PLATE: B.2

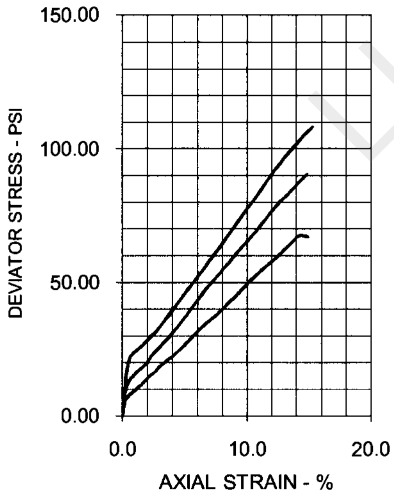
PLATE: B.3

Number of Specimens = 3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	φ ' =	34.7 deg	c' =	-0.4 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	17.3	17.2	17.4	
Dry Density - pcf	110.3	110.5	110.4	
Diameter - inches	2.87	2.87	2.85	
Height - inches	5.57	5.59	5.61	
AT TEST				
Final Moisture - %	17.2	16.7	16.5	
Dry Density - pcf	110.6	111.6	112.0	
Calculated Diameter (in.)	2.87	2.88	2.87	
Height - inches	5.58	5.62	5.66	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	15.65	28.63	43.17	
Total Pore Pressure - psi	54.3	56.7	74.3	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	2.4	3.5	4.6	
σ_1' Failure - psi	21.35	41.97	58.90	
σ_3' Failure - psi	5.70	13.34	15.73	

TEST DESCRIPTION

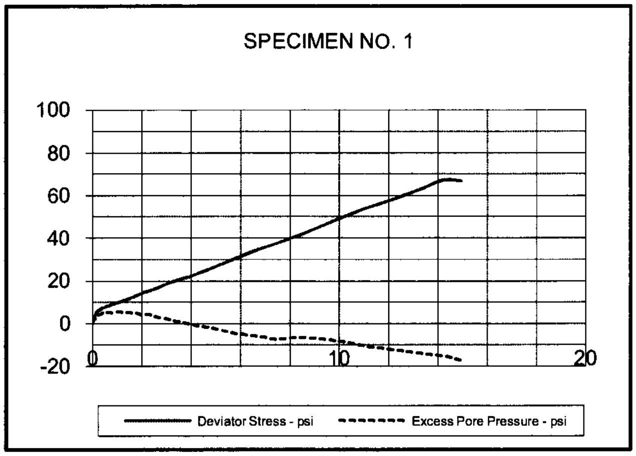
TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Lab Molded
DESCRIPTION: Tan & Reddish Tan Silty Sand
Sampled on Site, TP- 31 0' to 5' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve 2%
LL: 20 PL: 17 PI: 3 Percent -200: 27%
REMARKS: Both Ends Trimmed + # 4 Sieve 1%

PROJECT INFORMATION

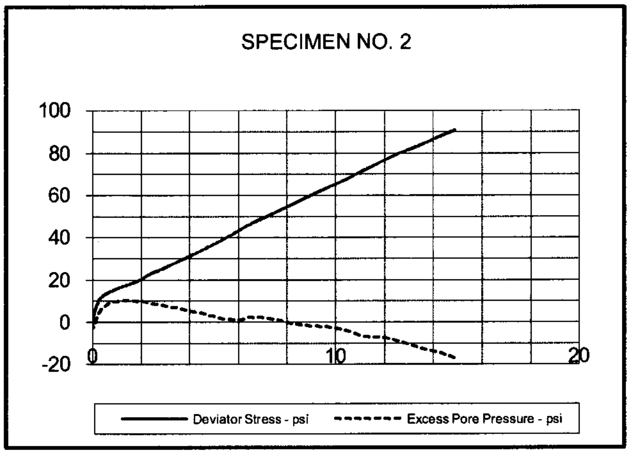
PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

ETTL ENGINEERS & CONSULTANTS PLATE: B.1

G 3219-09, TP-31 0'-5' Lab Molded



SPECIMEN NO. 1



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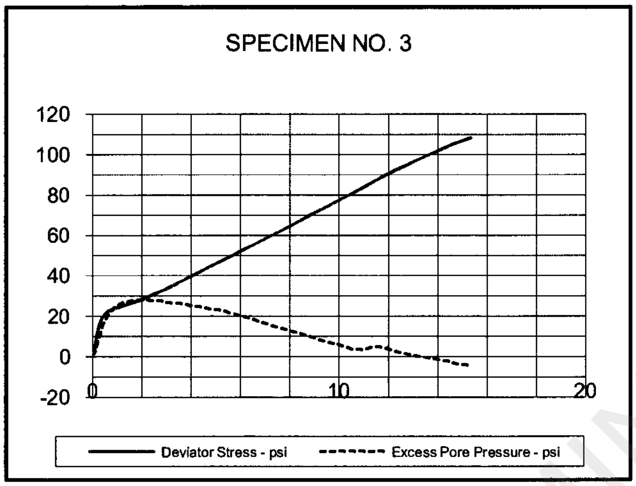
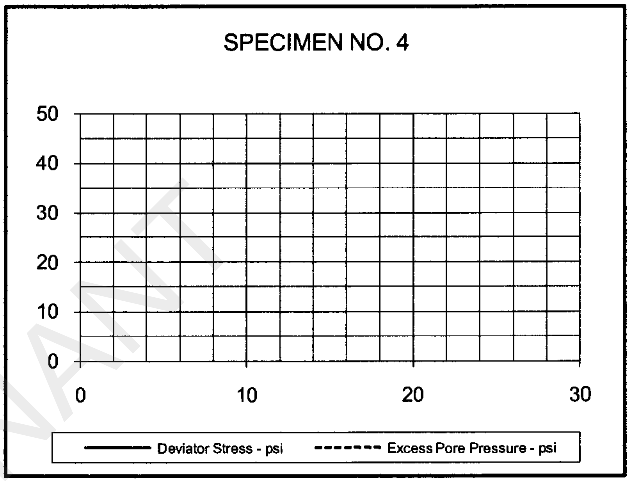
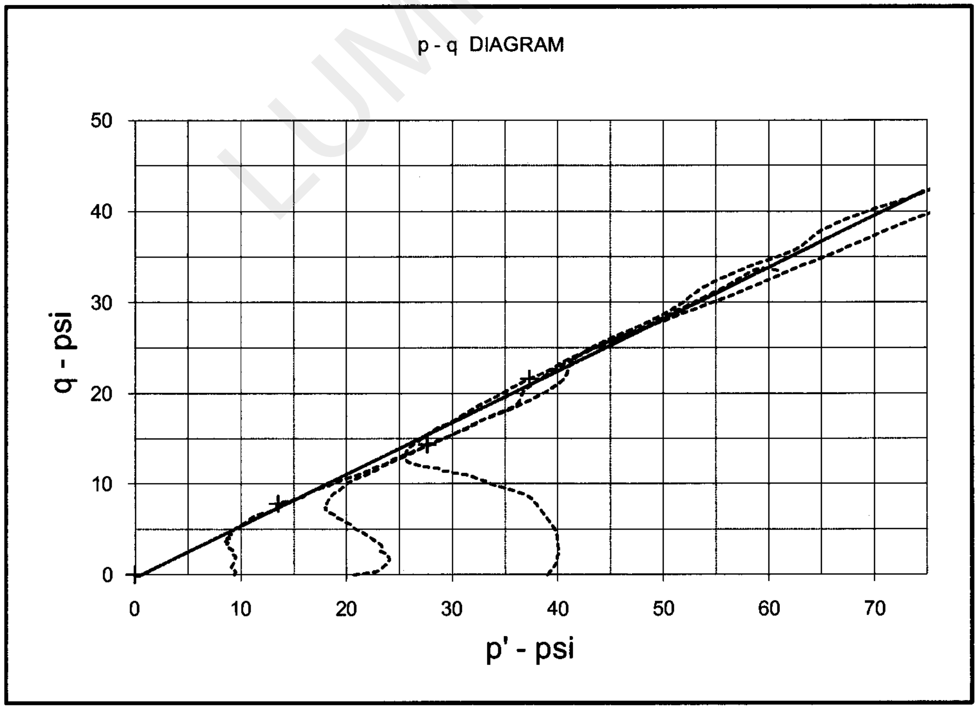


SPECIMEN NO. 3



SPECIMEN NO. 4

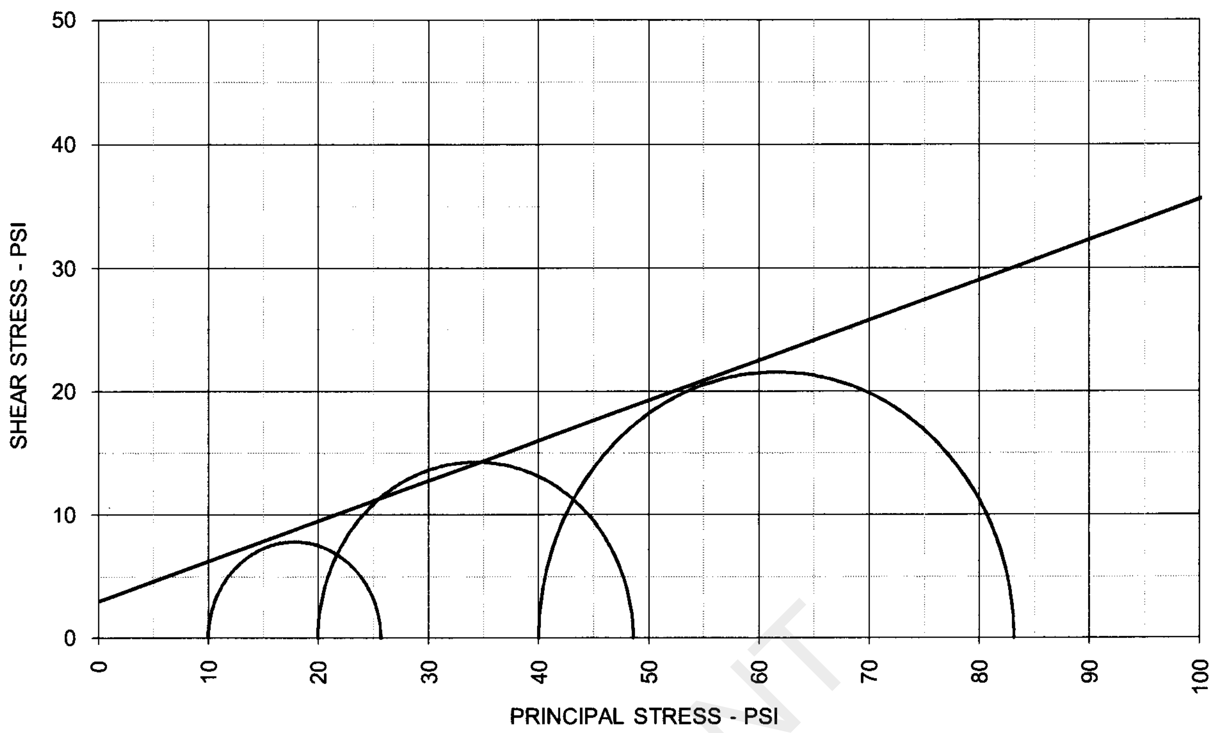


p - q DIAGRAM

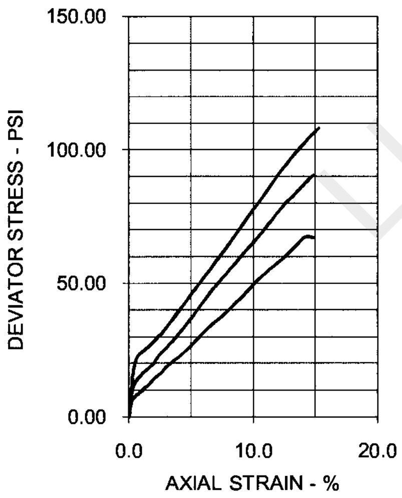
EFFECTIVE STRESS PARAMETERS	R^2 = 0.98	α (deg) = 29.7	a (psi) = -0.3
PROJECT: Martin Lake PDP 1 - 3 Supplemental		TYPE OF TEST & NO: CU with PP	
PROJECT NO: G 3219 - 09		**ETTL ENGINEERS & CONSULTANTS**	PLATE: B.2
DESCRIPTION: Tan & Reddish Tan Silty Sand			

G 3219-09, TP-31 0'-5' Lab Molded

TRIAXIAL SHEAR TEST REPORT



TOTAL STRESS PARAMETERS | ϕ = 18.0 deg | c = 3.0 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	17.3	17.2	17.4	
Dry Density - pcf	110.3	110.5	110.4	
Diameter - inches	2.87	2.87	2.85	
Height - inches	5.57	5.59	5.61	
AT TEST				
Final Moisture - %	17.2	16.7	16.5	
Dry Density - pcf	110.6	111.6	112.0	
Calculated Diameter (in.)	2.87	2.88	2.87	
Height - inches	5.58	5.62	5.66	
Effect. Cell Pressure - psi	10.0	20.0	40.0	
Failure Stress - psi	15.65	28.63	43.17	
Total Pore Pressure - psi	54.3	56.7	74.3	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	2.4	3.5	4.6	
σ_1 Failure - psi	25.65	48.63	83.17	
σ_3 Failure - psi	10.00	20.00	40.00	

TEST DESCRIPTION

TYPE OF TEST & NO: CU with PP
SAMPLE TYPE: Lab Molded
DESCRIPTION: Tan & Reddish Tan Silty Sand
Sampled on Site, TP- 31 0' to 5' deep
ASSUMED SPECIFIC GRAVITY: 2.7 + 40 Sieve 2%
LL: 20 PL: 17 PI: 3 Percent -200: 27%
REMARKS: Both Ends Trimmed + # 4 Sieve 1%

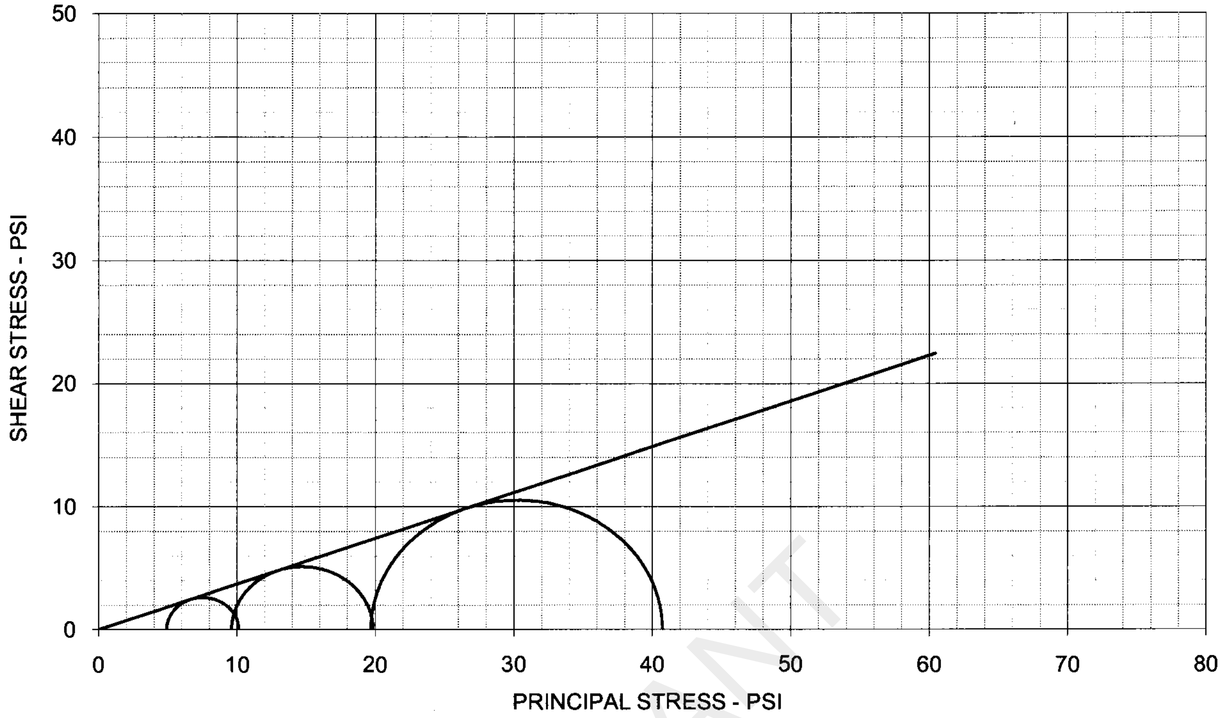
PROJECT INFORMATION

PROJECT: Martin Lake PDP 1 - 3 Supplemental
LOCATION:
PROJECT NO: G 3219 - 09
CLIENT: HDR
September 2009

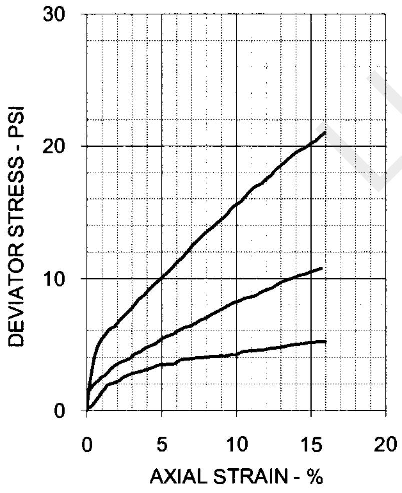
ETTL ENGINEERS & CONSULTANTS

PLATE: B.3

TRIAXIAL SHEAR TEST REPORT



EFFECTIVE STRESS PARAMETERS	ϕ ' = 20.4 deg	c' = 0.0 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	26.1	24.6	21.3	
Dry Density - pcf	94.3	95.8	101.6	
Diameter - inches	1.40	1.40	1.40	
Height - inches	2.81	2.85	3.20	
AT TEST				
Final Moisture - %	26.1	24.6	21.3	
Dry Density - pcf	94.3	97.0	101.6	
Calculated Diameter (in.)	1.40	1.40	1.40	
Height - inches	2.81	2.85	3.20	
Effect. Cell Pressure - psi	5.0	10.0	20.0	
Failure Stress - psi	5.21	10.25	21.03	
Total Pore Pressure - psi	20.0	20.0	20.0	
Strain Rate - inches/min.	0.00050	0.00050	0.00050	
Failure Strain - %	15.6	14.2	15.9	
σ_1' Failure - psi	10.11	19.85	40.73	
σ_3' Failure - psi	4.90	9.60	19.70	

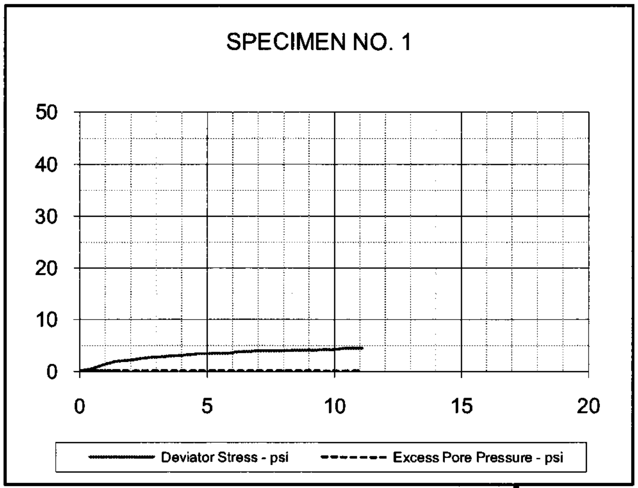
TEST DESCRIPTION

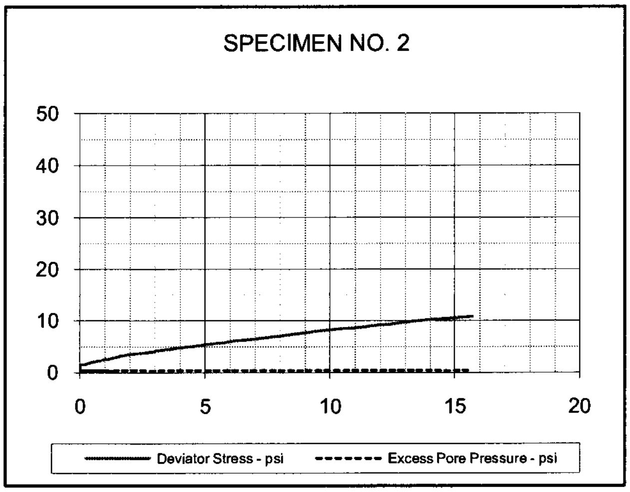
TYPE OF TEST & NO: CD Triaxial - CD-1
SAMPLE TYPE: SHELBY TUBE
DESCRIPTION:SANDY LEAN CLAY(CL), tan br w/ red br and gray
SAMPLE LOCATION: B-16, 3-5'
ASSUMED SPECIFIC GRAVITY: 2.70
LL: 43 PL: 14 PI: 29 Percent -200: 56
REMARKS: Tested in a fully softened remolded state

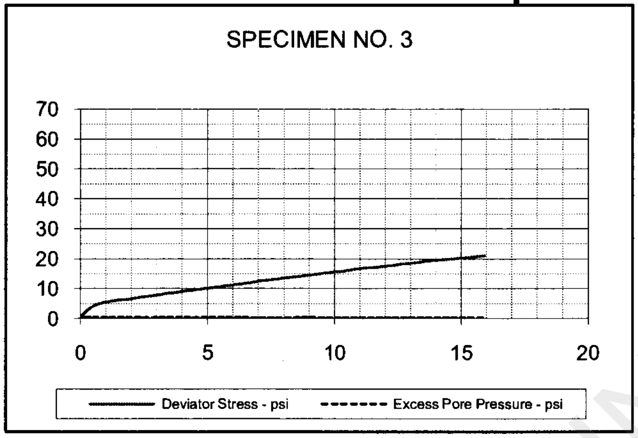
PROJECT INFORMATION

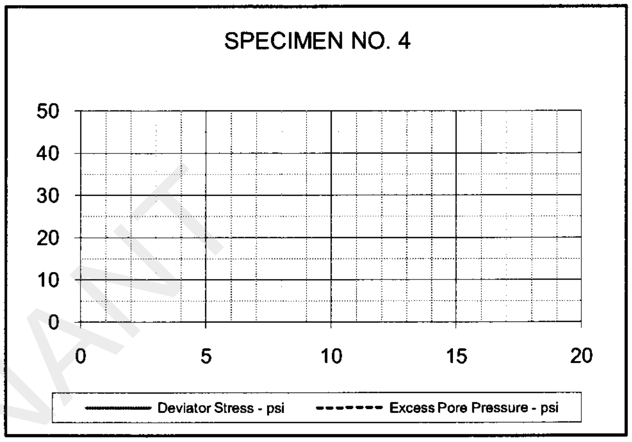
PROJECT: Luminant Martin Lake PDP 1-3 Vertical Expansion
LOCATION: Tatum, TX
PROJECT NO: ETT08002-11
CLIENT: ETTL Engineers & Consultants, Inc.
DATE: 9/15/09

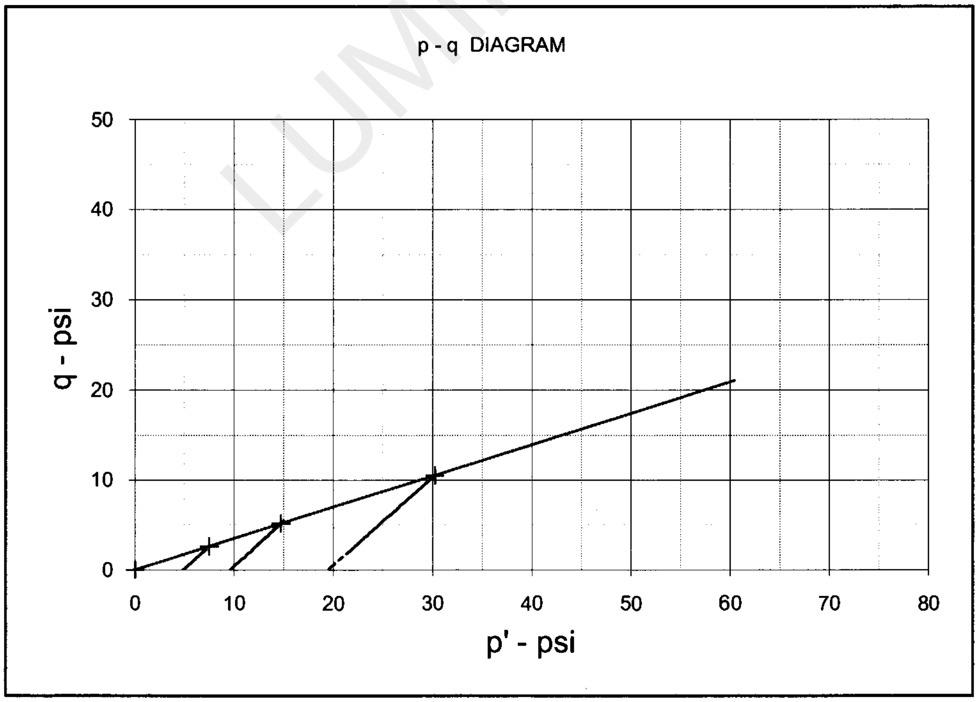
GREGORY GEOTECHNICAL PLATE: B-CD.1


SPECIMEN NO. 1


SPECIMEN NO. 2

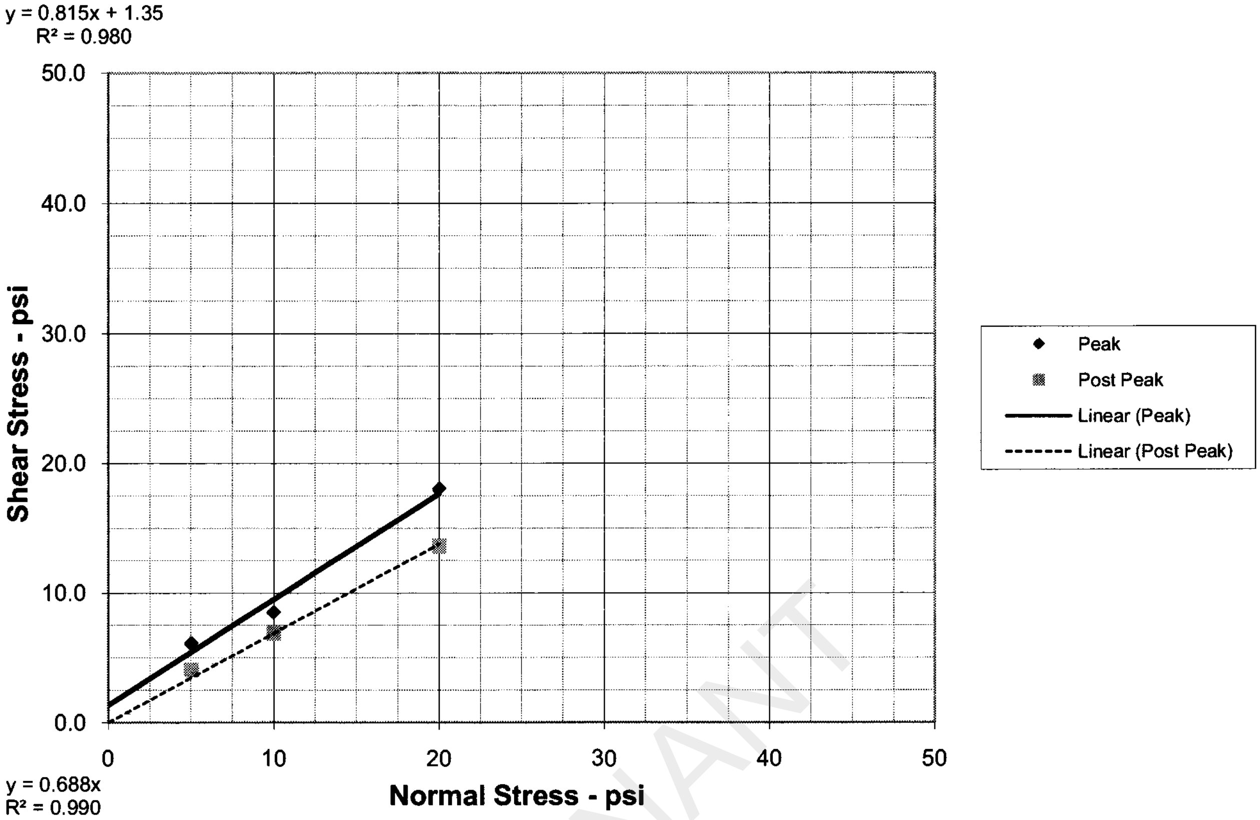

SPECIMEN NO. 3


SPECIMEN NO. 4

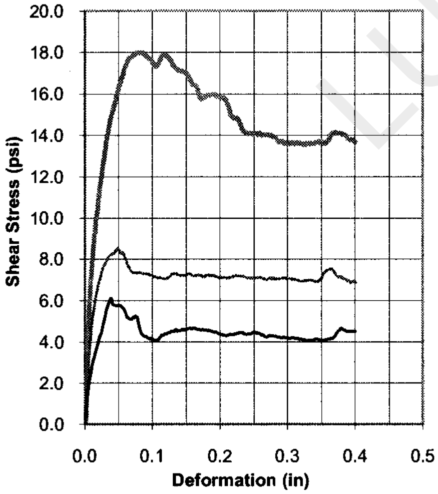

p - q DIAGRAM

EFFECTIVE STRESS PARAMETERS	R^2 = 1.000	α (deg) = 19.2	a (psi) = 0.0
PROJECT: Luminant Martin Lake PDP 1-3 Vertical Expansion		TYPE OF TEST & NO: CD Triaxial - CD-1	
PROJECT NO: ETT08002-11		***GREGORY GEOTECHNICAL***	PLATE: B-CD.2
DESCRIPTION:SANDY LEAN CLAY(CL), tan br w/ red br and gray			

DIRECT SHEAR TEST REPORT



PEAK STRENGTH PARAMETERS	φ =	39.2 deg	c =	1.4 psi
POST PEAK STRENGTH PARAMETERS	φ =	34.6 deg	c =	0.0 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	41.3	42.3	48.4	
Dry Density - pcf	78.9	72.5	72.9	
Diameter - inches	2.50	2.50	2.50	
Height - inches	1.00	1.00	1.00	
AT TEST				
Final Moisture - %	46.6	59.5	31.6	
Dry Density - pcf	81.0	74.2	73.0	
Height-End of Consol. (in.)	1.03	1.02	1.00	
Height-End of Shear (in.)	1.03	1.03	1.01	
Normal Stress - psi	5.0	10.0	20.0	
Peak Failure Stress-psi	6.1	8.5	18.0	
Post Peak Failure Stress-psi	4.1	6.9	13.6	
Strain Rate - inches/min.	0.00030	0.00030	0.00030	
Peak Failure Strain - %	1.6	1.9	3.1	
Post Peak Failure Strain %	4.3	12.7	11.8	

Dry Density at test based on initial moisture and height at end of consolidation.

TEST DESCRIPTION

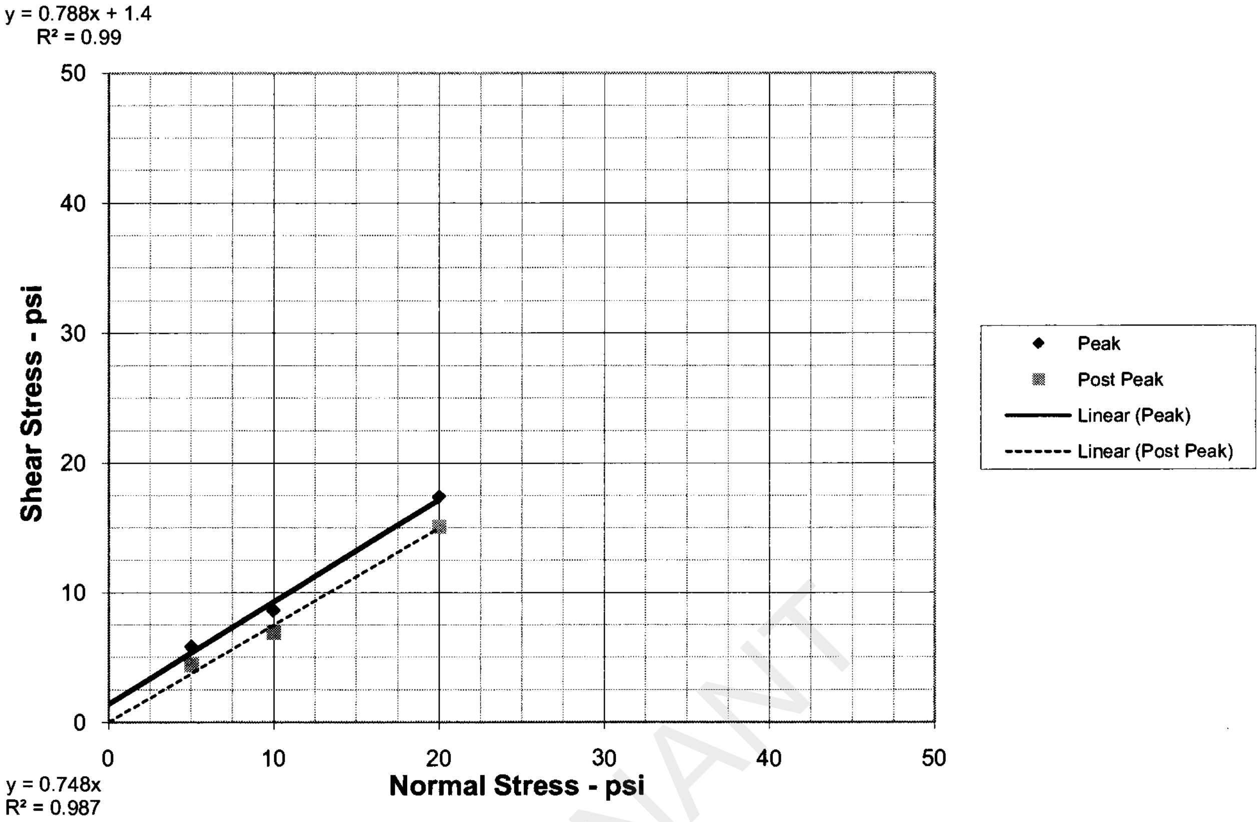
TYPE OF TEST & NO: CD-DS-1
SAMPLE TYPE: Shelby Tube
DESCRIPTION: SILT(MH), black (classification tests from 13-15 ft)
SAMPLE LOCATION: B-15, 18-20 ft
ASSUMED SPECIFIC GRAVITY: 2.65
LL: NP PL: NP PI: NP Percent -200: 95
REMARKS: Tested at natural MC

PROJECT INFORMATION

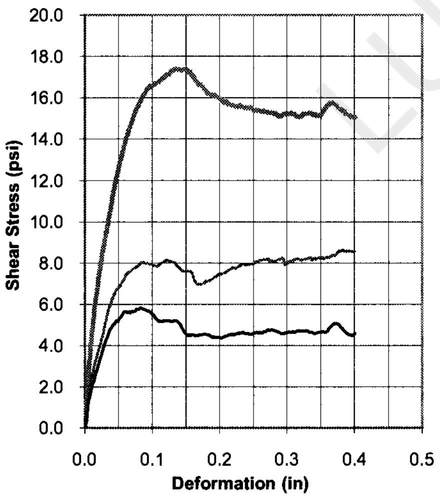
PROJECT: Luminant Martin Lake PDP 1-3 Vertical Expansion
LOCATION: Tatum, TX
PROJECT NO: ETT08002-11 (G3219-09)
CLIENT : ETTL Engineers & Consultants, Inc
DATE: 9/25/09

GREGORY GEOTECHNICAL PLATE: B-DS. 1

DIRECT SHEAR TEST REPORT



PEAK STRENGTH PARAMETERS	φ =	38.3 deg	c =	1.4 psi
POST PEAK STRENGTH PARAMETERS	φ =	36.8 deg	c =	0.0 psi



SPECIMEN NO.	1	2	3	4
INITIAL				
Moisture Content - %	47.2	47.5	46.5	
Dry Density - pcf	77.0	73.3	72.6	
Diameter - inches	2.50	2.50	2.50	
Height - inches	1.00	1.00	1.00	
AT TEST				
Final Moisture - %	47.2	47.5	31.6	
Dry Density - pcf	77.0	73.3	72.6	
Height-End of Consol. (in.)	1.00	1.00	1.00	
Height-End of Shear (in.)	0.98	0.98	0.99	
Normal Stress - psi	5.0	10.0	20.0	
Peak Failure Stress-psi	5.8	8.6	17.4	
Post Peak Failure Stress-psi	4.4	6.9	15.1	
Strain Rate - inches/min.	0.00030	0.00030	0.00030	
Peak Failure Strain - %	3.1	15.0	3.1	
Post Peak Failure Strain %	7.8	6.8	12.8	

Dry Density at test based on initial moisture and height at end of consolidation.

TEST DESCRIPTION

TYPE OF TEST & NO: CD-DS-2
SAMPLE TYPE: Shelby Tube
DESCRIPTION: SILT(MH), black (classification tests from 13-15 ft)
SAMPLE LOCATION: B-15, 18-20 ft
ASSUMED SPECIFIC GRAVITY: 2.65
LL: NP PL: NP PI: NP Percent -200: 95
REMARKS: Tested in a fully softened remolded state

PROJECT INFORMATION

PROJECT: Luminant Martin Lake PDP 1-3 Vertical Expansion
LOCATION: Tatum, TX
PROJECT NO: ETT08002-11 (G3219-09)
CLIENT : ETTL Engineers & Consultants, Inc
DATE: 9/23/09

GREGORY GEOTECHNICAL PLATE: B-DS. 2

ETTL Engineers & Consultants Inc.

GEOTECHNICAL ✶ MATERIALS ✶ ENVIRONMENTAL ✶ DRILLING ✶ LANDFILLS

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : Martin Lake PDP 1 - 3 Supplemental, Tatum, Texas

Date: 8/26/2009 Panel Number : P 1 ; ASTM D 5084

Project No. : G 3219-09 Permometer Data

Boring No.:	B - 14	ap =	0.031416 cm2		Set Mercury to Pipet Rp at	Equilibrium	1.8	cm3
Sample:		aa =	0.767120 cm2			Pipet Rp	**6.7**	cm3
Depth (ft):	3' to 5'	M1 =	0.030180	C =	0.000414194	Annulus Ra	1.5	cm3
Other Location:		M2 =	1.040953	T =	0.203859738			

Material Description : Dark Gray Ash

SAMPLE DATA

Wet Wt. sample + ring or tare :			502.16	g
Tare or ring Wt. :			0.0	g
Wet Wt: of Sample :			502.16	g
Diameter :	2.85	in	7.24	cm2
Length :	2.80	in	7.12	cm
Area:	6.38	in^2	41.16	cm2
Volume :	17.88	in^3	292.92	cm3
Unit Wt.(wet):	**106.97**	pcf	**1.71**	g/cm^3
Unit Wt.(dry):	**68.77**	pcf	**1.10**	g/cm^3

Before Test		After Test	
Tare No.:	T 20	Tare No.:	T 22
Wet Wt.+tare:	522.84	Wet Wt.+tare:	625.95
Dry Wt.+tare:	393.34	Dry Wt.+tare:	480.79
Tare Wt:	160.27	Tare Wt:	140.47
Dry Wt.:	233.07	Dry Wt.:	340.32
Water Wt.:	129.5	Weter Wt.:	145.16
% moist.:	**55.6**	% moist.:	**42.7**

Specific Gravity: **2.60** Max Dry Density(pcf) = 68.7952 OMC = 55.5627065

% of max = 100.0 +/- OMC = 0.00

Calculated % saturation: 81.52 Void ratio (e) = **1.36** Porosity (n)= **0.58**

TEST READINGS

Z1(Mercury Height Difference @ t1): 5.1 cm Hydraulic Gradient = 9.04

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZπ (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
8/26/2009	8	4.5	2.1553335	25	0.889	2.66E-05	7.55E-02	
8/26/2009	10	4.05	2.6053335	25	0.889	2.79E-05	7.91E-02	
8/26/2009	12	3.6	3.0553335	25	0.889	2.99E-05	8.48E-02	
8/26/2009	14	3.25	3.4053335	25	0.889	3.12E-05	8.84E-02	

SUMMARY

ka = 2.89E-05 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	2.66E-05	cm/sec	7.8	%
k2 =	2.79E-05	cm/sec	3.5	%
k3 =	2.99E-05	cm/sec	3.5	%
k4 =	3.12E-05	cm/sec	7.8	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**2.89E-05**	cm/sec	**8.19E-02**	ft/day
Void Ratio	e =	**1.36**			
Porosity	n =	**0.58**			
Bulk Density	γ =	**1.71**	g/cm3	**107.0**	pcf
Water Content	W =	**0.61**	cm3/cm3	(at 20 deg C)	
Intrinsic Permeability	kint =	**2.96E-10**	cm2	(at 20 deg C)	

Liquid Limit	LL		
Plastic Limit	PL		
Plasticity Index	**PI**		
- 200 Sieve			%
+ No 40 Sieve			%
+ No 4 Sieve			%

Respectfully Submitted

Robert M. Duke, P.E.

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : Martin Lake PDP 1 - 3 Supplemental, Tatum, Texas
Date: 8/26/2009 Panel Number : P 2 ; ASTM D 5084
Project No. : G 3219-09 Permometer Data

Boring No.:	B - 14	ap =	0.031416 cm2			Set Mercury to Pipet Rp at	Equilibrium	1.8 cm3
Sample:		aa =	0.767120 cm2				Pipet Rp	**6.7** cm3
Depth (ft):	16' to 17'	M1 =	0.030180	C =	0.000414194		Annulus Ra	1.5 cm3
Other Location:		M2 =	1.040953	T =	0.203859738			

Material Description : Dark Gray Ash

SAMPLE DATA

Wet Wt. sample + ring or tare :			457.47	g				
Tare or ring Wt. :			0.0	g		Before Test		After Test
Wet Wt: of Sample :			457.47	g	Tare No.:	T 18	Tare No.:	T 16
Diameter :	2.85	in	7.24	cm2	Wet Wt.+tare:	711.07	Wet Wt.+tare:	569.97
Length :	2.80	in	7.12	cm	Dry Wt.+tare:	478.92	Dry Wt.+tare:	412.38
Area:	6.38	in^2	41.16	cm2	Tare Wt:	146.73	Tare Wt:	151.98
Volume :	17.88	in^3	292.92	cm3	Dry Wt.:	332.19	Dry Wt.:	260.4
Unit Wt.(wet):	**97.45**	pcf	**1.56**	g/cm^3	Water Wt.:	232.15	Water Wt.:	157.59
Unit Wt.(dry):	**57.36**	pcf	**0.92**	g/cm^3	% moist.:	**69.9**	% moist.:	**60.5**

Specific Gravity:	**2.50**	Max Dry Density(pcf) =	57.38916	OMC =	69.8847045
		% of max =	100.0	+/- OMC =	0.00
Calculated % saturation:	87.92	Void ratio (e) =	**1.72**	Porosity (n)=	**0.63**

TEST READINGS

Z1(Mercury Height Difference @ t1): 5.1 cm Hydraulic Gradient = 9.04

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZπ (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
8/26/2009	80	4.2	2.4553335	25	0.889	3.20E-06	9.06E-03	
8/26/2009	90	4.05	2.6053335	25	0.889	3.10E-06	8.79E-03	
8/26/2009	100	3.9	2.7553335	25	0.889	3.04E-06	8.61E-03	
8/26/2009	110	3.75	2.9053335	25	0.889	3.00E-06	8.52E-03	

SUMMARY

ka = 3.08E-06 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	3.20E-06	cm/sec	3.6	%
k2 =	3.10E-06	cm/sec	0.5	%
k3 =	3.04E-06	cm/sec	1.5	%
k4 =	3.00E-06	cm/sec	2.6	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**3.08E-06**	cm/sec	**8.74E-03**	ft/day
Void Ratio	e =	**1.72**			
Porosity	n =	**0.63**			
Bulk Density	γ =	**1.56**	g/cm3	**97.5**	pcf
Water Content	W =	**0.64**	cm3/cm3	(at 20 deg C)	
Intrinsic Permeability	kint =	**3.16E-11**	cm2	(at 20 deg C)	

Liquid Limit LL		
Plastic Limit PL		
Plasticity Index PI		
- 200 Sieve		%
+ No 40 Sieve		%
+ No 4 Sieve		%

Respectfully Submitted

Robert M. Duke, P.E.

ETTL Engineers & Consultants Inc.

GEOTECHNICAL ✱ MATERIALS ✱ ENVIRONMENTAL ✱ DRILLING ✱ LANDFILLS

HYDRAULIC CONDUCTIVITY DETERMINATION
FLEXIBLE WALL PERMEAMETER - CONSTANT VOLUME
(Mercury Permometer Test)

Project : Luminant Martin Lake Supplemental, TP-31, Tatum, Texas
Date: 9/9/2009 Panel Number : P 1 ; ASTM D 5084
Project No. : G 3219-09 Permometer Data

Boring No.:	TP- 31	ap =	0.031416 cm2			Set Mercury to Pipet Rp at	Equilibrium	1.8	cm3
Sample:	9228	aa =	0.767120 cm2				Pipet Rp	**6.7**	cm3
Depth (ft):	0' to 5'	M1 =	0.030180	C =	0.000414162		Annulus Ra	1.5	cm3
Other Location:		M2 =	1.040953	T =	0.203870442				

Material Description : Tan & Reddish Tan Silty Sand

SAMPLE DATA

Wet Wt. sample + ring or tare :			627.20	g
Tare or ring Wt. :			0.0	g
Wet Wt: of Sample :			627.20	g
Diameter :	2.89	in	7.33	cm2
Length :	2.88	in	7.30	cm
Area:	6.55	in^2	42.23	cm2
Volume :	18.82	in^3	308.41	cm3
Unit Wt.(wet):	**126.90**	pcf	**2.03**	g/cm^3
Unit Wt.(dry):	**108.26**	pcf	**1.73**	g/cm^3

Before Test		After Test	
Tare No.:	T 6	Tare No.:	T 1
Wet Wt.+tare:	841.20	Wet Wt.+tare:	841.71
Dry Wt.+tare:	749.54	Dry Wt.+tare:	741.72
Tare Wt:	217.39	Tare Wt:	217.29
Dry Wt.:	532.15	Dry Wt.:	524.43
Water Wt.:	91.66	Water Wt.:	99.99
% moist.:	**17.2**	% moist.:	**19.1**

Specific Gravity: **2.65** Max Dry Density(pcf) = 108.3018 OMC = 17.2244668
% of max = 100.0 +/- OMC = 0.00
Calculated % saturation: 95.65 Void ratio (e) = **0.53** Porosity (n)= **0.35**

TEST READINGS

Z1(Mercury Height Difference @ t1): 5.1 cm Hydraulic Gradient = 8.81

Date	elapsed t (seconds)	Z (pipet @ t)	ΔZπ (cm)	temp (deg C)	α (temp corr)	k (cm/sec)	k (ft./day)	Reset = *
7/31/2009	600	5.3	1.3550759	25	0.889	1.98E-07	5.63E-04	
7/31/2009	720	5.1	1.5550759	25	0.889	1.95E-07	5.53E-04	
7/31/2009	840	5	1.6550759	25	0.889	1.80E-07	5.12E-04	
7/31/2009	960	4.8	1.8550759	25	0.889	1.82E-07	5.17E-04	

SUMMARY

ka = 1.89E-07 cm/sec Acceptance criteria = 25 %

ki			Vm	
k1 =	1.98E-07	cm/sec	5.0	%
k2 =	1.95E-07	cm/sec	3.2	%
k3 =	1.80E-07	cm/sec	4.5	%
k4 =	1.82E-07	cm/sec	3.6	%

$$Vm = \frac{|ka-ki|}{ka} \times 100$$

Hydraulic conductivity	k =	**1.89E-07**	cm/sec	**5.36E-04**	ft/day
Void Ratio	e =	**0.53**			
Porosity	n =	**0.35**			
Bulk Density	γ =	**2.03**	g/cm3	**126.9**	pcf
Water Content	W =	**0.30**	cm3/cm3	(at 20 deg C)	
Intrinsic Permeability	kint =	**1.94E-12**	cm2	(at 20 deg C)	

Liquid Limit	LL	20	
Plastic Limit	PL	17	
Plasticity Index	**PI**	**3**	
- 200 Sieve		27	%
+ No 40 Sieve		2	%
+ No 4 Sieve		1	%

Respectfully Submitted

Robert M. Duke, P.E.

ETTL Engineers & Consultants Inc.

GEOTECHNICAL ✱ MATERIALS ✱ ENVIRONMENTAL ✱ DRILLING ✱ LANDFILLS

Project: Luminant Martin Lake Supplemental, Tatum, Texas
Client: HDR
Contractor:
Job No. **G 3219 - 09**

Sample No.: **9228**
Date Sampled: 8/26/2009
Material Origin: TP- 31
Sampling Info. provided By: Jacob LeNoir
Location Sampled: TP- 31
Material Description: Tan & Reddish Tan Silty Sand
Sampled By: Jacob LeNoir
Technician: T. Sliger
Date: 8/28/2009

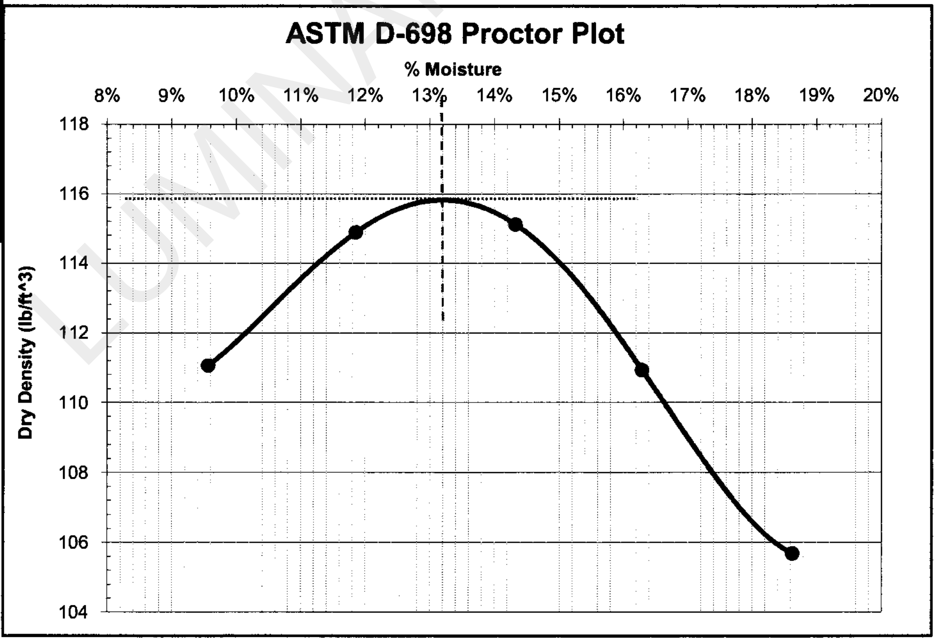
Maximum Dry Density: (ASTM D 698)	115.9	(lb/ft^3)
Optimum Moisture Content:	13.2	(%)

Classification

LL	20
PL	17
PI	3

-200 Sieve	27%
+40 Sieve	2%
+4 Sieve	1%

Proctor Points	
% Moisture	Dry Density (lb/ft^3)
9.6%	111.1
11.9%	114.9
14.3%	115.1
16.3%	110.9
18.6%	105.7



Respectfully Submitted

Robert M. Duke, P.E.

APPENDIX C

CPT-BASED LIQUEFACTION POTENTIAL ANALYSIS

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GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

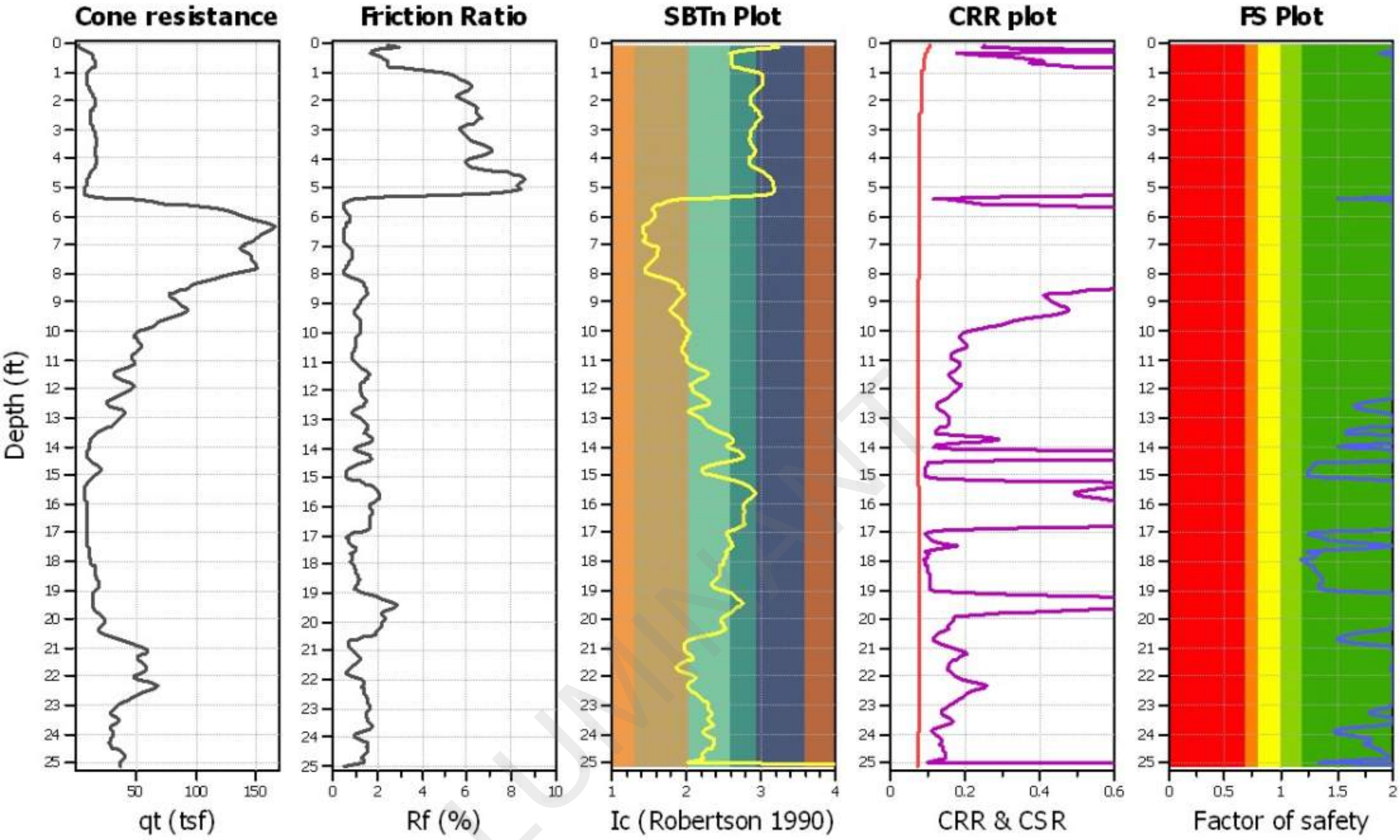
LIQUEFACTION ANALYSIS REPORT

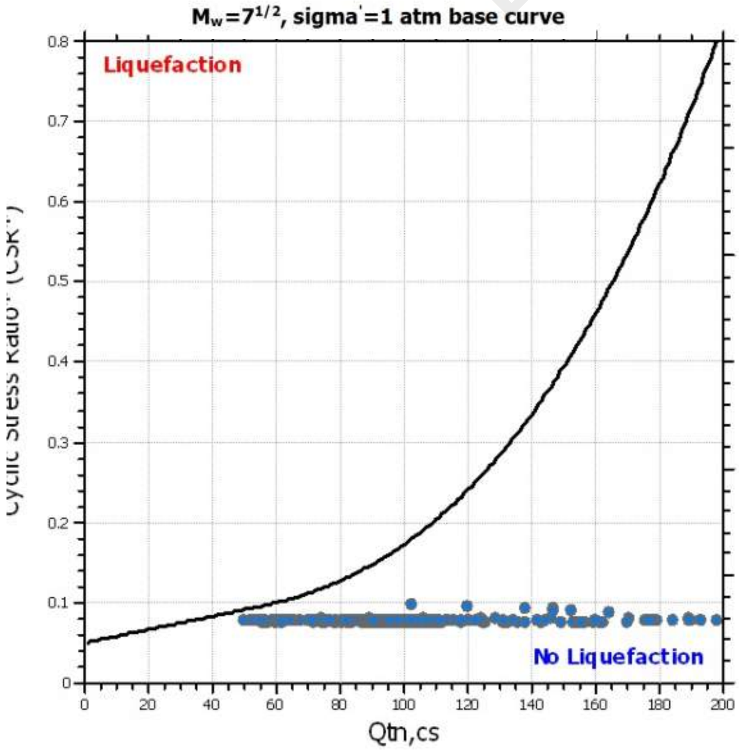
Project title : Martin Lake **Location : PDP-5**

CPT file : B-02

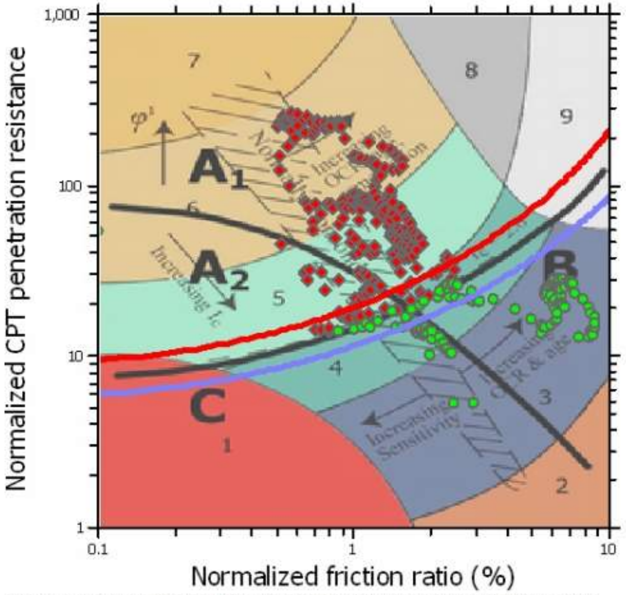
Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	1.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	0.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		





Summary of liquefaction potential



Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

:: Liquefaction Potential Index calculation data ::

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
0.07	2.00	0.00	9.99	0.06	0.00	0.13	2.00	0.00	9.98	0.06	0.00
0.20	2.00	0.00	9.97	0.07	0.00	0.26	2.00	0.00	9.96	0.06	0.00
0.33	1.88	0.00	9.95	0.07	0.00	0.39	2.00	0.00	9.94	0.06	0.00
0.46	2.00	0.00	9.93	0.07	0.00	0.52	2.00	0.00	9.92	0.06	0.00
0.59	2.00	0.00	9.91	0.07	0.00	0.66	2.00	0.00	9.90	0.07	0.00
0.72	2.00	0.00	9.89	0.06	0.00	0.79	2.00	0.00	9.88	0.07	0.00
0.85	2.00	0.00	9.87	0.06	0.00	0.92	2.00	0.00	9.86	0.07	0.00
0.98	2.00	0.00	9.85	0.06	0.00	1.05	2.00	0.00	9.84	0.07	0.00
1.12	2.00	0.00	9.83	0.07	0.00	1.18	2.00	0.00	9.82	0.06	0.00
1.25	2.00	0.00	9.81	0.07	0.00	1.31	2.00	0.00	9.80	0.06	0.00
1.38	2.00	0.00	9.79	0.07	0.00	1.44	2.00	0.00	9.78	0.06	0.00
1.51	2.00	0.00	9.77	0.07	0.00	1.57	2.00	0.00	9.76	0.06	0.00
1.64	2.00	0.00	9.75	0.07	0.00	1.71	2.00	0.00	9.74	0.07	0.00
1.77	2.00	0.00	9.73	0.06	0.00	1.84	2.00	0.00	9.72	0.07	0.00
1.90	2.00	0.00	9.71	0.06	0.00	1.97	2.00	0.00	9.70	0.07	0.00
2.03	2.00	0.00	9.69	0.06	0.00	2.10	2.00	0.00	9.68	0.07	0.00
2.16	2.00	0.00	9.67	0.06	0.00	2.23	2.00	0.00	9.66	0.07	0.00
2.30	2.00	0.00	9.65	0.07	0.00	2.36	2.00	0.00	9.64	0.06	0.00
2.43	2.00	0.00	9.63	0.07	0.00	2.49	2.00	0.00	9.62	0.06	0.00
2.56	2.00	0.00	9.61	0.07	0.00	2.62	2.00	0.00	9.60	0.06	0.00
2.69	2.00	0.00	9.59	0.07	0.00	2.76	2.00	0.00	9.58	0.07	0.00
2.82	2.00	0.00	9.57	0.06	0.00	2.89	2.00	0.00	9.56	0.07	0.00
2.95	2.00	0.00	9.55	0.06	0.00	3.02	2.00	0.00	9.54	0.07	0.00
3.08	2.00	0.00	9.53	0.06	0.00	3.15	2.00	0.00	9.52	0.07	0.00
3.21	2.00	0.00	9.51	0.06	0.00	3.28	2.00	0.00	9.50	0.07	0.00
3.35	2.00	0.00	9.49	0.07	0.00	3.41	2.00	0.00	9.48	0.06	0.00
3.48	2.00	0.00	9.47	0.07	0.00	3.54	2.00	0.00	9.46	0.06	0.00
3.61	2.00	0.00	9.45	0.07	0.00	3.67	2.00	0.00	9.44	0.06	0.00
3.74	2.00	0.00	9.43	0.07	0.00	3.80	2.00	0.00	9.42	0.06	0.00
3.87	2.00	0.00	9.41	0.07	0.00	3.94	2.00	0.00	9.40	0.07	0.00
4.00	2.00	0.00	9.39	0.06	0.00	4.07	2.00	0.00	9.38	0.07	0.00
4.13	2.00	0.00	9.37	0.06	0.00	4.20	2.00	0.00	9.36	0.07	0.00
4.26	2.00	0.00	9.35	0.06	0.00	4.33	2.00	0.00	9.34	0.07	0.00
4.40	2.00	0.00	9.33	0.07	0.00	4.46	2.00	0.00	9.32	0.06	0.00
4.53	2.00	0.00	9.31	0.07	0.00	4.59	2.00	0.00	9.30	0.06	0.00
4.66	2.00	0.00	9.29	0.07	0.00	4.72	2.00	0.00	9.28	0.06	0.00
4.79	2.00	0.00	9.27	0.07	0.00	4.85	2.00	0.00	9.26	0.06	0.00
4.92	2.00	0.00	9.25	0.07	0.00	4.99	2.00	0.00	9.24	0.07	0.00
5.05	2.00	0.00	9.23	0.06	0.00	5.12	2.00	0.00	9.22	0.07	0.00
5.18	2.00	0.00	9.21	0.06	0.00	5.25	2.00	0.00	9.20	0.07	0.00
5.31	2.00	0.00	9.19	0.06	0.00	5.38	1.50	0.00	9.18	0.07	0.00
5.44	1.85	0.00	9.17	0.06	0.00	5.51	2.00	0.00	9.16	0.07	0.00
5.58	2.00	0.00	9.15	0.07	0.00	5.64	2.00	0.00	9.14	0.06	0.00
5.71	2.00	0.00	9.13	0.07	0.00	5.77	2.00	0.00	9.12	0.06	0.00
5.84	2.00	0.00	9.11	0.07	0.00	5.90	2.00	0.00	9.10	0.06	0.00
5.97	2.00	0.00	9.09	0.07	0.00	6.04	2.00	0.00	9.08	0.07	0.00
6.10	2.00	0.00	9.07	0.06	0.00	6.17	2.00	0.00	9.06	0.07	0.00
6.23	2.00	0.00	9.05	0.06	0.00	6.30	2.00	0.00	9.04	0.07	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
6.36	2.00	0.00	9.03	0.06	0.00	6.43	2.00	0.00	9.02	0.07	0.00
6.49	2.00	0.00	9.01	0.06	0.00	6.56	2.00	0.00	9.00	0.07	0.00
6.63	2.00	0.00	8.99	0.07	0.00	6.69	2.00	0.00	8.98	0.06	0.00
6.76	2.00	0.00	8.97	0.07	0.00	6.82	2.00	0.00	8.96	0.06	0.00
6.89	2.00	0.00	8.95	0.07	0.00	6.95	2.00	0.00	8.94	0.06	0.00
7.02	2.00	0.00	8.93	0.07	0.00	7.08	2.00	0.00	8.92	0.06	0.00
7.15	2.00	0.00	8.91	0.07	0.00	7.22	2.00	0.00	8.90	0.07	0.00
7.28	2.00	0.00	8.89	0.06	0.00	7.35	2.00	0.00	8.88	0.07	0.00
7.41	2.00	0.00	8.87	0.06	0.00	7.48	2.00	0.00	8.86	0.07	0.00
7.54	2.00	0.00	8.85	0.06	0.00	7.61	2.00	0.00	8.84	0.07	0.00
7.68	2.00	0.00	8.83	0.07	0.00	7.74	2.00	0.00	8.82	0.06	0.00
7.81	2.00	0.00	8.81	0.07	0.00	7.87	2.00	0.00	8.80	0.06	0.00
7.94	2.00	0.00	8.79	0.07	0.00	8.00	2.00	0.00	8.78	0.06	0.00
8.07	2.00	0.00	8.77	0.07	0.00	8.13	2.00	0.00	8.76	0.06	0.00
8.20	2.00	0.00	8.75	0.07	0.00	8.27	2.00	0.00	8.74	0.07	0.00
8.33	2.00	0.00	8.73	0.06	0.00	8.40	2.00	0.00	8.72	0.07	0.00
8.46	2.00	0.00	8.71	0.06	0.00	8.53	2.00	0.00	8.70	0.07	0.00
8.59	2.00	0.00	8.69	0.06	0.00	8.66	2.00	0.00	8.68	0.07	0.00
8.72	2.00	0.00	8.67	0.06	0.00	8.79	2.00	0.00	8.66	0.07	0.00
8.86	2.00	0.00	8.65	0.07	0.00	8.92	2.00	0.00	8.64	0.06	0.00
8.99	2.00	0.00	8.63	0.07	0.00	9.05	2.00	0.00	8.62	0.06	0.00
9.12	2.00	0.00	8.61	0.07	0.00	9.18	2.00	0.00	8.60	0.06	0.00
9.25	2.00	0.00	8.59	0.07	0.00	9.32	2.00	0.00	8.58	0.07	0.00
9.38	2.00	0.00	8.57	0.06	0.00	9.45	2.00	0.00	8.56	0.07	0.00
9.51	2.00	0.00	8.55	0.06	0.00	9.58	2.00	0.00	8.54	0.07	0.00
9.64	2.00	0.00	8.53	0.06	0.00	9.71	2.00	0.00	8.52	0.07	0.00
9.77	2.00	0.00	8.51	0.06	0.00	9.84	2.00	0.00	8.50	0.07	0.00
9.91	2.00	0.00	8.49	0.07	0.00	9.97	2.00	0.00	8.48	0.06	0.00
10.04	2.00	0.00	8.47	0.07	0.00	10.10	2.00	0.00	8.46	0.06	0.00
10.17	2.00	0.00	8.45	0.07	0.00	10.23	2.00	0.00	8.44	0.06	0.00
10.30	2.00	0.00	8.43	0.07	0.00	10.36	2.00	0.00	8.42	0.06	0.00
10.43	2.00	0.00	8.41	0.07	0.00	10.50	2.00	0.00	8.40	0.07	0.00
10.56	2.00	0.00	8.39	0.06	0.00	10.63	2.00	0.00	8.38	0.07	0.00
10.69	2.00	0.00	8.37	0.06	0.00	10.76	2.00	0.00	8.36	0.07	0.00
10.82	2.00	0.00	8.35	0.06	0.00	10.89	2.00	0.00	8.34	0.07	0.00
10.96	2.00	0.00	8.33	0.07	0.00	11.02	2.00	0.00	8.32	0.06	0.00
11.09	2.00	0.00	8.31	0.07	0.00	11.15	2.00	0.00	8.30	0.06	0.00
11.22	2.00	0.00	8.29	0.07	0.00	11.28	2.00	0.00	8.28	0.06	0.00
11.35	2.00	0.00	8.27	0.07	0.00	11.41	2.00	0.00	8.26	0.06	0.00
11.48	2.00	0.00	8.25	0.07	0.00	11.55	2.00	0.00	8.24	0.07	0.00
11.61	2.00	0.00	8.23	0.06	0.00	11.68	2.00	0.00	8.22	0.07	0.00
11.74	2.00	0.00	8.21	0.06	0.00	11.81	2.00	0.00	8.20	0.07	0.00
11.87	2.00	0.00	8.19	0.06	0.00	11.94	2.00	0.00	8.18	0.07	0.00
12.00	2.00	0.00	8.17	0.06	0.00	12.07	2.00	0.00	8.16	0.07	0.00
12.14	2.00	0.00	8.15	0.07	0.00	12.20	2.00	0.00	8.14	0.06	0.00
12.27	2.00	0.00	8.13	0.07	0.00	12.33	2.00	0.00	8.12	0.06	0.00
12.40	1.89	0.00	8.11	0.07	0.00	12.46	1.78	0.00	8.10	0.06	0.00
12.53	1.71	0.00	8.09	0.07	0.00	12.60	1.65	0.00	8.08	0.07	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
12.66	1.66	0.00	8.07	0.06	0.00	12.73	1.76	0.00	8.06	0.07	0.00
12.79	1.87	0.00	8.05	0.06	0.00	12.86	1.97	0.00	8.04	0.07	0.00
12.92	2.00	0.00	8.03	0.06	0.00	12.99	2.00	0.00	8.02	0.07	0.00
13.05	2.00	0.00	8.01	0.06	0.00	13.12	2.00	0.00	8.00	0.07	0.00
13.19	2.00	0.00	7.99	0.07	0.00	13.25	2.00	0.00	7.98	0.06	0.00
13.32	1.93	0.00	7.97	0.07	0.00	13.38	1.78	0.00	7.96	0.06	0.00
13.45	1.65	0.00	7.95	0.07	0.00	13.51	1.59	0.00	7.94	0.06	0.00
13.58	1.57	0.00	7.93	0.07	0.00	13.64	2.00	0.00	7.92	0.06	0.00
13.71	2.00	0.00	7.91	0.07	0.00	13.78	2.00	0.00	7.90	0.07	0.00
13.84	2.00	0.00	7.89	0.06	0.00	13.91	2.00	0.00	7.88	0.07	0.00
13.97	1.58	0.00	7.87	0.06	0.00	14.04	1.52	0.00	7.86	0.07	0.00
14.10	2.00	0.00	7.85	0.06	0.00	14.17	2.00	0.00	7.84	0.07	0.00
14.24	2.00	0.00	7.83	0.07	0.00	14.30	2.00	0.00	7.82	0.06	0.00
14.37	2.00	0.00	7.81	0.07	0.00	14.43	2.00	0.00	7.80	0.06	0.00
14.50	2.00	0.00	7.79	0.07	0.00	14.56	1.31	0.00	7.78	0.06	0.00
14.63	1.29	0.00	7.77	0.07	0.00	14.69	1.27	0.00	7.76	0.06	0.00
14.76	1.26	0.00	7.75	0.07	0.00	14.83	1.25	0.00	7.74	0.07	0.00
14.89	1.24	0.00	7.73	0.06	0.00	14.96	1.22	0.00	7.72	0.07	0.00
15.02	1.23	0.00	7.71	0.06	0.00	15.09	1.26	0.00	7.70	0.07	0.00
15.15	1.73	0.00	7.69	0.06	0.00	15.22	2.00	0.00	7.68	0.07	0.00
15.28	2.00	0.00	7.67	0.06	0.00	15.35	2.00	0.00	7.66	0.07	0.00
15.42	2.00	0.00	7.65	0.07	0.00	15.48	2.00	0.00	7.64	0.06	0.00
15.55	2.00	0.00	7.63	0.07	0.00	15.61	2.00	0.00	7.62	0.06	0.00
15.68	2.00	0.00	7.61	0.07	0.00	15.74	2.00	0.00	7.60	0.06	0.00
15.81	2.00	0.00	7.59	0.07	0.00	15.88	2.00	0.00	7.58	0.07	0.00
15.94	2.00	0.00	7.57	0.06	0.00	16.01	2.00	0.00	7.56	0.07	0.00
16.07	2.00	0.00	7.55	0.06	0.00	16.14	2.00	0.00	7.54	0.07	0.00
16.20	2.00	0.00	7.53	0.06	0.00	16.27	2.00	0.00	7.52	0.07	0.00
16.33	2.00	0.00	7.51	0.06	0.00	16.40	2.00	0.00	7.50	0.07	0.00
16.47	2.00	0.00	7.49	0.07	0.00	16.53	2.00	0.00	7.48	0.06	0.00
16.60	2.00	0.00	7.47	0.07	0.00	16.66	2.00	0.00	7.46	0.06	0.00
16.73	2.00	0.00	7.45	0.07	0.00	16.79	2.00	0.00	7.44	0.06	0.00
16.86	2.00	0.00	7.43	0.07	0.00	16.92	1.96	0.00	7.42	0.06	0.00
16.99	1.33	0.00	7.41	0.07	0.00	17.06	1.24	0.00	7.40	0.07	0.00
17.12	1.29	0.00	7.39	0.06	0.00	17.19	1.38	0.00	7.38	0.07	0.00
17.25	1.40	0.00	7.37	0.06	0.00	17.32	1.56	0.00	7.36	0.07	0.00
17.38	1.82	0.00	7.35	0.06	0.00	17.45	2.00	0.00	7.34	0.07	0.00
17.52	1.88	0.00	7.33	0.07	0.00	17.58	1.48	0.00	7.32	0.06	0.00
17.65	1.23	0.00	7.31	0.07	0.00	17.71	1.33	0.00	7.30	0.06	0.00
17.78	1.29	0.00	7.29	0.07	0.00	17.84	1.29	0.00	7.28	0.06	0.00
17.91	1.18	0.00	7.27	0.07	0.00	17.97	1.23	0.00	7.26	0.06	0.00
18.04	1.23	0.00	7.25	0.07	0.00	18.11	1.25	0.00	7.24	0.07	0.00
18.17	1.27	0.00	7.23	0.06	0.00	18.24	1.29	0.00	7.22	0.07	0.00
18.30	1.30	0.00	7.21	0.06	0.00	18.37	1.31	0.00	7.20	0.07	0.00
18.43	1.34	0.00	7.19	0.06	0.00	18.50	1.36	0.00	7.18	0.07	0.00
18.56	1.36	0.00	7.17	0.06	0.00	18.63	1.36	0.00	7.16	0.07	0.00
18.70	1.37	0.00	7.15	0.07	0.00	18.76	1.36	0.00	7.14	0.06	0.00
18.83	1.34	0.00	7.13	0.07	0.00	18.89	1.34	0.00	7.12	0.06	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
18.96	1.35	0.00	7.11	0.07	0.00	19.02	1.52	0.00	7.10	0.06	0.00
19.09	2.00	0.00	7.09	0.07	0.00	19.16	2.00	0.00	7.08	0.07	0.00
19.22	2.00	0.00	7.07	0.06	0.00	19.29	2.00	0.00	7.06	0.07	0.00
19.35	2.00	0.00	7.05	0.06	0.00	19.42	2.00	0.00	7.04	0.07	0.00
19.48	2.00	0.00	7.03	0.06	0.00	19.55	2.00	0.00	7.02	0.07	0.00
19.61	2.00	0.00	7.01	0.06	0.00	19.68	2.00	0.00	7.00	0.07	0.00
19.75	2.00	0.00	6.99	0.07	0.00	19.81	2.00	0.00	6.98	0.06	0.00
19.88	2.00	0.00	6.97	0.07	0.00	19.94	2.00	0.00	6.96	0.06	0.00
20.01	2.00	0.00	6.95	0.07	0.00	20.07	2.00	0.00	6.94	0.06	0.00
20.14	2.00	0.00	6.93	0.07	0.00	20.20	2.00	0.00	6.92	0.06	0.00
20.27	1.99	0.00	6.91	0.07	0.00	20.34	2.00	0.00	6.90	0.07	0.00
20.40	1.90	0.00	6.89	0.06	0.00	20.47	1.69	0.00	6.88	0.07	0.00
20.53	1.62	0.00	6.87	0.06	0.00	20.60	1.54	0.00	6.86	0.07	0.00
20.66	1.50	0.00	6.85	0.06	0.00	20.73	1.52	0.00	6.84	0.07	0.00
20.80	1.62	0.00	6.83	0.07	0.00	20.86	1.77	0.00	6.82	0.06	0.00
20.93	1.97	0.00	6.81	0.07	0.00	20.99	2.00	0.00	6.80	0.06	0.00
21.06	2.00	0.00	6.79	0.07	0.00	21.12	2.00	0.00	6.78	0.06	0.00
21.19	2.00	0.00	6.77	0.07	0.00	21.25	2.00	0.00	6.76	0.06	0.00
21.32	2.00	0.00	6.75	0.07	0.00	21.39	2.00	0.00	6.74	0.07	0.00
21.45	2.00	0.00	6.73	0.06	0.00	21.52	2.00	0.00	6.72	0.07	0.00
21.58	2.00	0.00	6.71	0.06	0.00	21.65	2.00	0.00	6.70	0.07	0.00
21.71	1.99	0.00	6.69	0.06	0.00	21.78	1.99	0.00	6.68	0.07	0.00
21.84	2.00	0.00	6.67	0.06	0.00	21.91	2.00	0.00	6.66	0.07	0.00
21.98	2.00	0.00	6.65	0.07	0.00	22.04	2.00	0.00	6.64	0.06	0.00
22.11	2.00	0.00	6.63	0.07	0.00	22.17	2.00	0.00	6.62	0.06	0.00
22.24	2.00	0.00	6.61	0.07	0.00	22.30	2.00	0.00	6.60	0.06	0.00
22.37	2.00	0.00	6.59	0.07	0.00	22.44	2.00	0.00	6.58	0.07	0.00
22.50	2.00	0.00	6.57	0.06	0.00	22.57	2.00	0.00	6.56	0.07	0.00
22.63	2.00	0.00	6.55	0.06	0.00	22.70	2.00	0.00	6.54	0.07	0.00
22.76	2.00	0.00	6.53	0.06	0.00	22.83	2.00	0.00	6.52	0.07	0.00
22.89	2.00	0.00	6.51	0.06	0.00	22.96	2.00	0.00	6.50	0.07	0.00
23.03	2.00	0.00	6.49	0.07	0.00	23.09	1.96	0.00	6.48	0.06	0.00
23.16	1.86	0.00	6.47	0.07	0.00	23.22	1.81	0.00	6.46	0.06	0.00
23.29	1.78	0.00	6.45	0.07	0.00	23.35	1.86	0.00	6.44	0.06	0.00
23.42	1.98	0.00	6.43	0.07	0.00	23.48	2.00	0.00	6.42	0.06	0.00
23.55	2.00	0.00	6.41	0.07	0.00	23.62	2.00	0.00	6.40	0.07	0.00
23.68	1.93	0.00	6.39	0.06	0.00	23.75	1.69	0.00	6.38	0.07	0.00
23.81	1.53	0.00	6.37	0.06	0.00	23.88	1.47	0.00	6.36	0.07	0.00
23.94	1.49	0.00	6.35	0.06	0.00	24.01	1.58	0.00	6.34	0.07	0.00
24.08	1.70	0.00	6.33	0.07	0.00	24.14	1.81	0.00	6.32	0.06	0.00
24.21	1.80	0.00	6.31	0.07	0.00	24.27	1.77	0.00	6.30	0.06	0.00
24.34	1.73	0.00	6.29	0.07	0.00	24.40	1.80	0.00	6.28	0.06	0.00
24.47	1.84	0.00	6.27	0.07	0.00	24.53	1.87	0.00	6.26	0.06	0.00
24.60	1.89	0.00	6.25	0.07	0.00	24.67	1.90	0.00	6.24	0.07	0.00
24.73	1.93	0.00	6.23	0.06	0.00	24.80	1.96	0.00	6.22	0.07	0.00
24.86	1.96	0.00	6.21	0.06	0.00	24.93	1.61	0.00	6.20	0.07	0.00
24.99	1.34	0.00	6.19	0.06	0.00	25.06	2.00	0.00	6.18	0.07	0.00
25.12	2.00	0.00	6.17	0.06	0.00						

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI

Overall liquefaction potential: 0.00

LPI = 0.00 - Liquefaction risk very low
LPI between 0.00 and 5.00 - Liquefaction risk low
LPI between 5.00 and 15.00 - Liquefaction risk high
LPI > 15.00 - Liquefaction risk very high

Abbreviations

FS:	Calculated factor of safety for test point
F_L:	1 - FS
w_z:	Function value of the extend of soil liquefaction according to depth
d_z:	Layer thickness (ft)
LPI:	Liquefaction potential index value for test point

LIQUEFACTION ANALYSIS REPORT

Project title : Martin Lake **Location : PDP-5**

CPT file : B-07

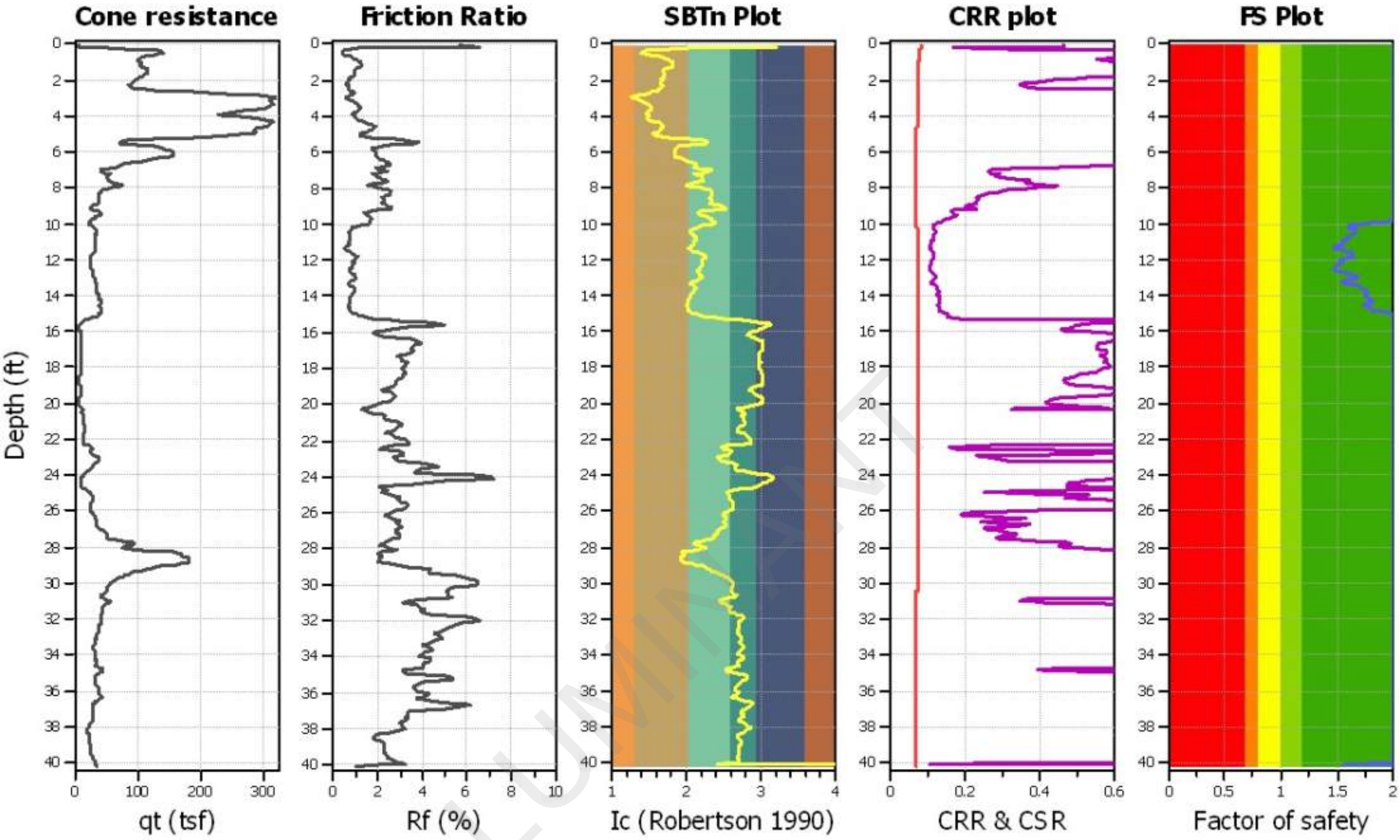
Input parameters and analysis data

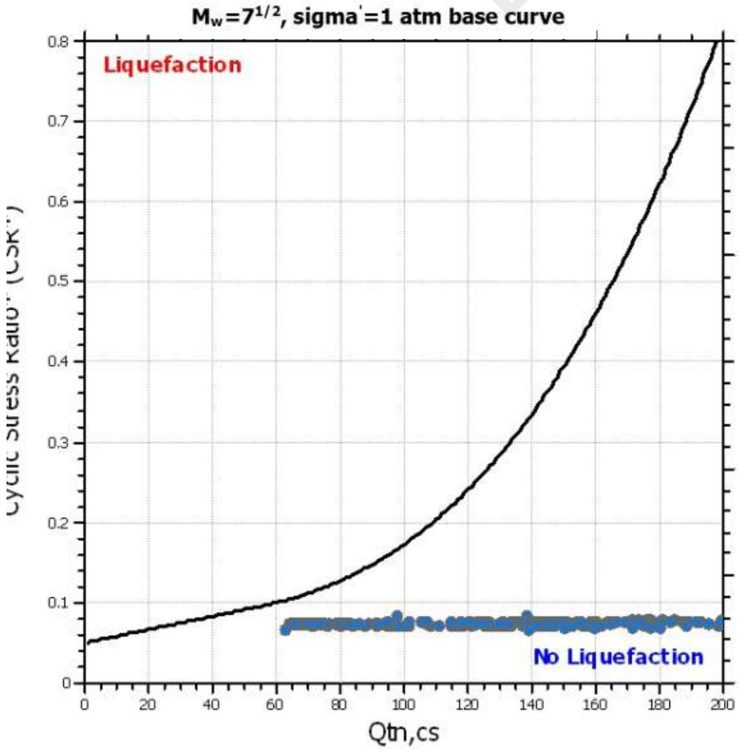
Analysis method: Robertson (2009)
Fines correction method: Robertson (2009)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.20
Peak ground acceleration: 0.09

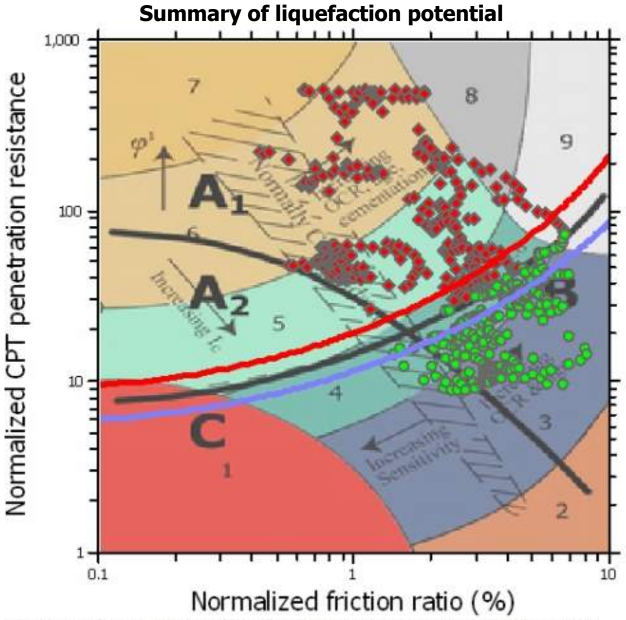
G.W.T. (in-situ): 1.00 ft
G.W.T. (earthq.): 0.00 ft
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT

Use fill: No
Fill height: N/A
Fill weight: N/A
Trans. detect. applied: No
K_σ applied: Yes

Clay like behavior applied: All soils
Limit depth applied: No
Limit depth: N/A
MSF method: Method based







Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

:: Liquefaction Potential Index calculation data ::

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
0.07	2.00	0.00	9.99	0.06	0.00	0.13	2.00	0.00	9.98	0.06	0.00
0.20	2.00	0.00	9.97	0.07	0.00	0.26	2.00	0.00	9.96	0.06	0.00
0.33	2.00	0.00	9.95	0.07	0.00	0.39	2.00	0.00	9.94	0.06	0.00
0.46	2.00	0.00	9.93	0.07	0.00	0.52	2.00	0.00	9.92	0.06	0.00
0.59	2.00	0.00	9.91	0.07	0.00	0.66	2.00	0.00	9.90	0.07	0.00
0.72	2.00	0.00	9.89	0.06	0.00	0.79	2.00	0.00	9.88	0.07	0.00
0.85	2.00	0.00	9.87	0.06	0.00	0.92	2.00	0.00	9.86	0.07	0.00
0.98	2.00	0.00	9.85	0.06	0.00	1.05	2.00	0.00	9.84	0.07	0.00
1.12	2.00	0.00	9.83	0.07	0.00	1.18	2.00	0.00	9.82	0.06	0.00
1.25	2.00	0.00	9.81	0.07	0.00	1.31	2.00	0.00	9.80	0.06	0.00
1.38	2.00	0.00	9.79	0.07	0.00	1.44	2.00	0.00	9.78	0.06	0.00
1.51	2.00	0.00	9.77	0.07	0.00	1.57	2.00	0.00	9.76	0.06	0.00
1.64	2.00	0.00	9.75	0.07	0.00	1.71	2.00	0.00	9.74	0.07	0.00
1.77	2.00	0.00	9.73	0.06	0.00	1.84	2.00	0.00	9.72	0.07	0.00
1.90	2.00	0.00	9.71	0.06	0.00	1.97	2.00	0.00	9.70	0.07	0.00
2.03	2.00	0.00	9.69	0.06	0.00	2.10	2.00	0.00	9.68	0.07	0.00
2.16	2.00	0.00	9.67	0.06	0.00	2.23	2.00	0.00	9.66	0.07	0.00
2.30	2.00	0.00	9.65	0.07	0.00	2.36	2.00	0.00	9.64	0.06	0.00
2.43	2.00	0.00	9.63	0.07	0.00	2.49	2.00	0.00	9.62	0.06	0.00
2.56	2.00	0.00	9.61	0.07	0.00	2.62	2.00	0.00	9.60	0.06	0.00
2.69	2.00	0.00	9.59	0.07	0.00	2.76	2.00	0.00	9.58	0.07	0.00
2.82	2.00	0.00	9.57	0.06	0.00	2.89	2.00	0.00	9.56	0.07	0.00
2.95	2.00	0.00	9.55	0.06	0.00	3.02	2.00	0.00	9.54	0.07	0.00
3.08	2.00	0.00	9.53	0.06	0.00	3.15	2.00	0.00	9.52	0.07	0.00
3.21	2.00	0.00	9.51	0.06	0.00	3.28	2.00	0.00	9.50	0.07	0.00
3.35	2.00	0.00	9.49	0.07	0.00	3.41	2.00	0.00	9.48	0.06	0.00
3.48	2.00	0.00	9.47	0.07	0.00	3.54	2.00	0.00	9.46	0.06	0.00
3.61	2.00	0.00	9.45	0.07	0.00	3.67	2.00	0.00	9.44	0.06	0.00
3.74	2.00	0.00	9.43	0.07	0.00	3.80	2.00	0.00	9.42	0.06	0.00
3.87	2.00	0.00	9.41	0.07	0.00	3.94	2.00	0.00	9.40	0.07	0.00
4.00	2.00	0.00	9.39	0.06	0.00	4.07	2.00	0.00	9.38	0.07	0.00
4.13	2.00	0.00	9.37	0.06	0.00	4.20	2.00	0.00	9.36	0.07	0.00
4.26	2.00	0.00	9.35	0.06	0.00	4.33	2.00	0.00	9.34	0.07	0.00
4.40	2.00	0.00	9.33	0.07	0.00	4.46	2.00	0.00	9.32	0.06	0.00
4.53	2.00	0.00	9.31	0.07	0.00	4.59	2.00	0.00	9.30	0.06	0.00
4.66	2.00	0.00	9.29	0.07	0.00	4.72	2.00	0.00	9.28	0.06	0.00
4.79	2.00	0.00	9.27	0.07	0.00	4.85	2.00	0.00	9.26	0.06	0.00
4.92	2.00	0.00	9.25	0.07	0.00	4.99	2.00	0.00	9.24	0.07	0.00
5.05	2.00	0.00	9.23	0.06	0.00	5.12	2.00	0.00	9.22	0.07	0.00
5.18	2.00	0.00	9.21	0.06	0.00	5.25	2.00	0.00	9.20	0.07	0.00
5.31	2.00	0.00	9.19	0.06	0.00	5.38	2.00	0.00	9.18	0.07	0.00
5.44	2.00	0.00	9.17	0.06	0.00	5.51	2.00	0.00	9.16	0.07	0.00
5.58	2.00	0.00	9.15	0.07	0.00	5.64	2.00	0.00	9.14	0.06	0.00
5.71	2.00	0.00	9.13	0.07	0.00	5.77	2.00	0.00	9.12	0.06	0.00
5.84	2.00	0.00	9.11	0.07	0.00	5.90	2.00	0.00	9.10	0.06	0.00
5.97	2.00	0.00	9.09	0.07	0.00	6.04	2.00	0.00	9.08	0.07	0.00
6.10	2.00	0.00	9.07	0.06	0.00	6.17	2.00	0.00	9.06	0.07	0.00
6.23	2.00	0.00	9.05	0.06	0.00	6.30	2.00	0.00	9.04	0.07	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
6.36	2.00	0.00	9.03	0.06	0.00	6.43	2.00	0.00	9.02	0.07	0.00
6.49	2.00	0.00	9.01	0.06	0.00	6.56	2.00	0.00	9.00	0.07	0.00
6.63	2.00	0.00	8.99	0.07	0.00	6.69	2.00	0.00	8.98	0.06	0.00
6.76	2.00	0.00	8.97	0.07	0.00	6.82	2.00	0.00	8.96	0.06	0.00
6.89	2.00	0.00	8.95	0.07	0.00	6.95	2.00	0.00	8.94	0.06	0.00
7.02	2.00	0.00	8.93	0.07	0.00	7.08	2.00	0.00	8.92	0.06	0.00
7.15	2.00	0.00	8.91	0.07	0.00	7.22	2.00	0.00	8.90	0.07	0.00
7.28	2.00	0.00	8.89	0.06	0.00	7.35	2.00	0.00	8.88	0.07	0.00
7.41	2.00	0.00	8.87	0.06	0.00	7.48	2.00	0.00	8.86	0.07	0.00
7.54	2.00	0.00	8.85	0.06	0.00	7.61	2.00	0.00	8.84	0.07	0.00
7.68	2.00	0.00	8.83	0.07	0.00	7.74	2.00	0.00	8.82	0.06	0.00
7.81	2.00	0.00	8.81	0.07	0.00	7.87	2.00	0.00	8.80	0.06	0.00
7.94	2.00	0.00	8.79	0.07	0.00	8.00	2.00	0.00	8.78	0.06	0.00
8.07	2.00	0.00	8.77	0.07	0.00	8.13	2.00	0.00	8.76	0.06	0.00
8.20	2.00	0.00	8.75	0.07	0.00	8.27	2.00	0.00	8.74	0.07	0.00
8.33	2.00	0.00	8.73	0.06	0.00	8.40	2.00	0.00	8.72	0.07	0.00
8.46	2.00	0.00	8.71	0.06	0.00	8.53	2.00	0.00	8.70	0.07	0.00
8.59	2.00	0.00	8.69	0.06	0.00	8.66	2.00	0.00	8.68	0.07	0.00
8.72	2.00	0.00	8.67	0.06	0.00	8.79	2.00	0.00	8.66	0.07	0.00
8.86	2.00	0.00	8.65	0.07	0.00	8.92	2.00	0.00	8.64	0.06	0.00
8.99	2.00	0.00	8.63	0.07	0.00	9.05	2.00	0.00	8.62	0.06	0.00
9.12	2.00	0.00	8.61	0.07	0.00	9.18	2.00	0.00	8.60	0.06	0.00
9.25	2.00	0.00	8.59	0.07	0.00	9.32	2.00	0.00	8.58	0.07	0.00
9.38	2.00	0.00	8.57	0.06	0.00	9.45	2.00	0.00	8.56	0.07	0.00
9.51	2.00	0.00	8.55	0.06	0.00	9.58	2.00	0.00	8.54	0.07	0.00
9.64	2.00	0.00	8.53	0.06	0.00	9.71	2.00	0.00	8.52	0.07	0.00
9.77	2.00	0.00	8.51	0.06	0.00	9.84	2.00	0.00	8.50	0.07	0.00
9.91	1.91	0.00	8.49	0.07	0.00	9.97	1.81	0.00	8.48	0.06	0.00
10.04	1.70	0.00	8.47	0.07	0.00	10.10	1.61	0.00	8.46	0.06	0.00
10.17	1.60	0.00	8.45	0.07	0.00	10.23	1.61	0.00	8.44	0.06	0.00
10.30	1.66	0.00	8.43	0.07	0.00	10.36	1.67	0.00	8.42	0.06	0.00
10.43	1.67	0.00	8.41	0.07	0.00	10.50	1.67	0.00	8.40	0.07	0.00
10.56	1.65	0.00	8.39	0.06	0.00	10.63	1.63	0.00	8.38	0.07	0.00
10.69	1.62	0.00	8.37	0.06	0.00	10.76	1.60	0.00	8.36	0.07	0.00
10.82	1.60	0.00	8.35	0.06	0.00	10.89	1.59	0.00	8.34	0.07	0.00
10.96	1.55	0.00	8.33	0.07	0.00	11.02	1.54	0.00	8.32	0.06	0.00
11.09	1.55	0.00	8.31	0.07	0.00	11.15	1.55	0.00	8.30	0.06	0.00
11.22	1.50	0.00	8.29	0.07	0.00	11.28	1.46	0.00	8.28	0.06	0.00
11.35	1.47	0.00	8.27	0.07	0.00	11.41	1.51	0.00	8.26	0.06	0.00
11.48	1.57	0.00	8.25	0.07	0.00	11.55	1.60	0.00	8.24	0.07	0.00
11.61	1.63	0.00	8.23	0.06	0.00	11.68	1.62	0.00	8.22	0.07	0.00
11.74	1.64	0.00	8.21	0.06	0.00	11.81	1.64	0.00	8.20	0.07	0.00
11.87	1.62	0.00	8.19	0.06	0.00	11.94	1.57	0.00	8.18	0.07	0.00
12.00	1.55	0.00	8.17	0.06	0.00	12.07	1.53	0.00	8.16	0.07	0.00
12.14	1.54	0.00	8.15	0.07	0.00	12.20	1.53	0.00	8.14	0.06	0.00
12.27	1.51	0.00	8.13	0.07	0.00	12.33	1.49	0.00	8.12	0.06	0.00
12.40	1.48	0.00	8.11	0.07	0.00	12.46	1.47	0.00	8.10	0.06	0.00
12.53	1.48	0.00	8.09	0.07	0.00	12.60	1.48	0.00	8.08	0.07	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
12.66	1.52	0.00	8.07	0.06	0.00	12.73	1.55	0.00	8.06	0.07	0.00
12.79	1.61	0.00	8.05	0.06	0.00	12.86	1.65	0.00	8.04	0.07	0.00
12.92	1.68	0.00	8.03	0.06	0.00	12.99	1.69	0.00	8.02	0.07	0.00
13.05	1.65	0.00	8.01	0.06	0.00	13.12	1.60	0.00	8.00	0.07	0.00
13.19	1.55	0.00	7.99	0.07	0.00	13.25	1.54	0.00	7.98	0.06	0.00
13.32	1.55	0.00	7.97	0.07	0.00	13.38	1.61	0.00	7.96	0.06	0.00
13.45	1.68	0.00	7.95	0.07	0.00	13.51	1.72	0.00	7.94	0.06	0.00
13.58	1.73	0.00	7.93	0.07	0.00	13.64	1.74	0.00	7.92	0.06	0.00
13.71	1.75	0.00	7.91	0.07	0.00	13.78	1.78	0.00	7.90	0.07	0.00
13.84	1.76	0.00	7.89	0.06	0.00	13.91	1.76	0.00	7.88	0.07	0.00
13.97	1.76	0.00	7.87	0.06	0.00	14.04	1.77	0.00	7.86	0.07	0.00
14.10	1.78	0.00	7.85	0.06	0.00	14.17	1.78	0.00	7.84	0.07	0.00
14.24	1.81	0.00	7.83	0.07	0.00	14.30	1.83	0.00	7.82	0.06	0.00
14.37	1.82	0.00	7.81	0.07	0.00	14.43	1.77	0.00	7.80	0.06	0.00
14.50	1.74	0.00	7.79	0.07	0.00	14.56	1.75	0.00	7.78	0.06	0.00
14.63	1.78	0.00	7.77	0.07	0.00	14.69	1.81	0.00	7.76	0.06	0.00
14.76	1.81	0.00	7.75	0.07	0.00	14.83	1.83	0.00	7.74	0.07	0.00
14.89	1.90	0.00	7.73	0.06	0.00	14.96	2.00	0.00	7.72	0.07	0.00
15.02	2.00	0.00	7.71	0.06	0.00	15.09	2.00	0.00	7.70	0.07	0.00
15.15	2.00	0.00	7.69	0.06	0.00	15.22	2.00	0.00	7.68	0.07	0.00
15.28	2.00	0.00	7.67	0.06	0.00	15.35	2.00	0.00	7.66	0.07	0.00
15.42	2.00	0.00	7.65	0.07	0.00	15.48	2.00	0.00	7.64	0.06	0.00
15.55	2.00	0.00	7.63	0.07	0.00	15.61	2.00	0.00	7.62	0.06	0.00
15.68	2.00	0.00	7.61	0.07	0.00	15.74	2.00	0.00	7.60	0.06	0.00
15.81	2.00	0.00	7.59	0.07	0.00	15.88	2.00	0.00	7.58	0.07	0.00
15.94	2.00	0.00	7.57	0.06	0.00	16.01	2.00	0.00	7.56	0.07	0.00
16.07	2.00	0.00	7.55	0.06	0.00	16.14	2.00	0.00	7.54	0.07	0.00
16.20	2.00	0.00	7.53	0.06	0.00	16.27	2.00	0.00	7.52	0.07	0.00
16.33	2.00	0.00	7.51	0.06	0.00	16.40	2.00	0.00	7.50	0.07	0.00
16.47	2.00	0.00	7.49	0.07	0.00	16.53	2.00	0.00	7.48	0.06	0.00
16.60	2.00	0.00	7.47	0.07	0.00	16.66	2.00	0.00	7.46	0.06	0.00
16.73	2.00	0.00	7.45	0.07	0.00	16.79	2.00	0.00	7.44	0.06	0.00
16.86	2.00	0.00	7.43	0.07	0.00	16.92	2.00	0.00	7.42	0.06	0.00
16.99	2.00	0.00	7.41	0.07	0.00	17.06	2.00	0.00	7.40	0.07	0.00
17.12	2.00	0.00	7.39	0.06	0.00	17.19	2.00	0.00	7.38	0.07	0.00
17.25	2.00	0.00	7.37	0.06	0.00	17.32	2.00	0.00	7.36	0.07	0.00
17.38	2.00	0.00	7.35	0.06	0.00	17.45	2.00	0.00	7.34	0.07	0.00
17.52	2.00	0.00	7.33	0.07	0.00	17.58	2.00	0.00	7.32	0.06	0.00
17.65	2.00	0.00	7.31	0.07	0.00	17.71	2.00	0.00	7.30	0.06	0.00
17.78	2.00	0.00	7.29	0.07	0.00	17.84	2.00	0.00	7.28	0.06	0.00
17.91	2.00	0.00	7.27	0.07	0.00	17.97	2.00	0.00	7.26	0.06	0.00
18.04	2.00	0.00	7.25	0.07	0.00	18.11	2.00	0.00	7.24	0.07	0.00
18.17	2.00	0.00	7.23	0.06	0.00	18.24	2.00	0.00	7.22	0.07	0.00
18.30	2.00	0.00	7.21	0.06	0.00	18.37	2.00	0.00	7.20	0.07	0.00
18.43	2.00	0.00	7.19	0.06	0.00	18.50	2.00	0.00	7.18	0.07	0.00
18.56	2.00	0.00	7.17	0.06	0.00	18.63	2.00	0.00	7.16	0.07	0.00
18.70	2.00	0.00	7.15	0.07	0.00	18.76	2.00	0.00	7.14	0.06	0.00
18.83	2.00	0.00	7.13	0.07	0.00	18.89	2.00	0.00	7.12	0.06	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
18.96	2.00	0.00	7.11	0.07	0.00	19.02	2.00	0.00	7.10	0.06	0.00
19.09	2.00	0.00	7.09	0.07	0.00	19.16	2.00	0.00	7.08	0.07	0.00
19.22	2.00	0.00	7.07	0.06	0.00	19.29	2.00	0.00	7.06	0.07	0.00
19.35	2.00	0.00	7.05	0.06	0.00	19.42	2.00	0.00	7.04	0.07	0.00
19.48	2.00	0.00	7.03	0.06	0.00	19.55	2.00	0.00	7.02	0.07	0.00
19.61	2.00	0.00	7.01	0.06	0.00	19.68	2.00	0.00	7.00	0.07	0.00
19.75	2.00	0.00	6.99	0.07	0.00	19.81	2.00	0.00	6.98	0.06	0.00
19.88	2.00	0.00	6.97	0.07	0.00	19.94	2.00	0.00	6.96	0.06	0.00
20.01	2.00	0.00	6.95	0.07	0.00	20.07	2.00	0.00	6.94	0.06	0.00
20.14	2.00	0.00	6.93	0.07	0.00	20.20	2.00	0.00	6.92	0.06	0.00
20.27	2.00	0.00	6.91	0.07	0.00	20.34	2.00	0.00	6.90	0.07	0.00
20.40	2.00	0.00	6.89	0.06	0.00	20.47	2.00	0.00	6.88	0.07	0.00
20.53	2.00	0.00	6.87	0.06	0.00	20.60	2.00	0.00	6.86	0.07	0.00
20.66	2.00	0.00	6.85	0.06	0.00	20.73	2.00	0.00	6.84	0.07	0.00
20.80	2.00	0.00	6.83	0.07	0.00	20.86	2.00	0.00	6.82	0.06	0.00
20.93	2.00	0.00	6.81	0.07	0.00	20.99	2.00	0.00	6.80	0.06	0.00
21.06	2.00	0.00	6.79	0.07	0.00	21.12	2.00	0.00	6.78	0.06	0.00
21.19	2.00	0.00	6.77	0.07	0.00	21.25	2.00	0.00	6.76	0.06	0.00
21.32	2.00	0.00	6.75	0.07	0.00	21.39	2.00	0.00	6.74	0.07	0.00
21.45	2.00	0.00	6.73	0.06	0.00	21.52	2.00	0.00	6.72	0.07	0.00
21.58	2.00	0.00	6.71	0.06	0.00	21.65	2.00	0.00	6.70	0.07	0.00
21.71	2.00	0.00	6.69	0.06	0.00	21.78	2.00	0.00	6.68	0.07	0.00
21.84	2.00	0.00	6.67	0.06	0.00	21.91	2.00	0.00	6.66	0.07	0.00
21.98	2.00	0.00	6.65	0.07	0.00	22.04	2.00	0.00	6.64	0.06	0.00
22.11	2.00	0.00	6.63	0.07	0.00	22.17	2.00	0.00	6.62	0.06	0.00
22.24	2.00	0.00	6.61	0.07	0.00	22.30	2.00	0.00	6.60	0.06	0.00
22.37	2.00	0.00	6.59	0.07	0.00	22.44	2.00	0.00	6.58	0.07	0.00
22.50	2.00	0.00	6.57	0.06	0.00	22.57	2.00	0.00	6.56	0.07	0.00
22.63	2.00	0.00	6.55	0.06	0.00	22.70	2.00	0.00	6.54	0.07	0.00
22.76	2.00	0.00	6.53	0.06	0.00	22.83	2.00	0.00	6.52	0.07	0.00
22.89	2.00	0.00	6.51	0.06	0.00	22.96	2.00	0.00	6.50	0.07	0.00
23.03	2.00	0.00	6.49	0.07	0.00	23.09	2.00	0.00	6.48	0.06	0.00
23.16	2.00	0.00	6.47	0.07	0.00	23.22	2.00	0.00	6.46	0.06	0.00
23.29	2.00	0.00	6.45	0.07	0.00	23.35	2.00	0.00	6.44	0.06	0.00
23.42	2.00	0.00	6.43	0.07	0.00	23.48	2.00	0.00	6.42	0.06	0.00
23.55	2.00	0.00	6.41	0.07	0.00	23.62	2.00	0.00	6.40	0.07	0.00
23.68	2.00	0.00	6.39	0.06	0.00	23.75	2.00	0.00	6.38	0.07	0.00
23.81	2.00	0.00	6.37	0.06	0.00	23.88	2.00	0.00	6.36	0.07	0.00
23.94	2.00	0.00	6.35	0.06	0.00	24.01	2.00	0.00	6.34	0.07	0.00
24.08	2.00	0.00	6.33	0.07	0.00	24.14	2.00	0.00	6.32	0.06	0.00
24.21	2.00	0.00	6.31	0.07	0.00	24.27	2.00	0.00	6.30	0.06	0.00
24.34	2.00	0.00	6.29	0.07	0.00	24.40	2.00	0.00	6.28	0.06	0.00
24.47	2.00	0.00	6.27	0.07	0.00	24.53	2.00	0.00	6.26	0.06	0.00
24.60	2.00	0.00	6.25	0.07	0.00	24.67	2.00	0.00	6.24	0.07	0.00
24.73	2.00	0.00	6.23	0.06	0.00	24.80	2.00	0.00	6.22	0.07	0.00
24.86	2.00	0.00	6.21	0.06	0.00	24.93	2.00	0.00	6.20	0.07	0.00
24.99	2.00	0.00	6.19	0.06	0.00	25.06	2.00	0.00	6.18	0.07	0.00
25.12	2.00	0.00	6.17	0.06	0.00	25.19	2.00	0.00	6.16	0.07	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
25.26	2.00	0.00	6.15	0.07	0.00	25.32	2.00	0.00	6.14	0.06	0.00
25.39	2.00	0.00	6.13	0.07	0.00	25.45	2.00	0.00	6.12	0.06	0.00
25.52	2.00	0.00	6.11	0.07	0.00	25.58	2.00	0.00	6.10	0.06	0.00
25.65	2.00	0.00	6.09	0.07	0.00	25.72	2.00	0.00	6.08	0.07	0.00
25.78	2.00	0.00	6.07	0.06	0.00	25.85	2.00	0.00	6.06	0.07	0.00
25.91	2.00	0.00	6.05	0.06	0.00	25.98	2.00	0.00	6.04	0.07	0.00
26.04	2.00	0.00	6.03	0.06	0.00	26.11	2.00	0.00	6.02	0.07	0.00
26.17	2.00	0.00	6.01	0.06	0.00	26.24	2.00	0.00	6.00	0.07	0.00
26.31	2.00	0.00	5.99	0.07	0.00	26.37	2.00	0.00	5.98	0.06	0.00
26.44	2.00	0.00	5.97	0.07	0.00	26.50	2.00	0.00	5.96	0.06	0.00
26.57	2.00	0.00	5.95	0.07	0.00	26.63	2.00	0.00	5.94	0.06	0.00
26.70	2.00	0.00	5.93	0.07	0.00	26.76	2.00	0.00	5.92	0.06	0.00
26.83	2.00	0.00	5.91	0.07	0.00	26.90	2.00	0.00	5.90	0.07	0.00
26.96	2.00	0.00	5.89	0.06	0.00	27.03	2.00	0.00	5.88	0.07	0.00
27.09	2.00	0.00	5.87	0.06	0.00	27.16	2.00	0.00	5.86	0.07	0.00
27.22	2.00	0.00	5.85	0.06	0.00	27.29	2.00	0.00	5.84	0.07	0.00
27.36	2.00	0.00	5.83	0.07	0.00	27.42	2.00	0.00	5.82	0.06	0.00
27.49	2.00	0.00	5.81	0.07	0.00	27.55	2.00	0.00	5.80	0.06	0.00
27.62	2.00	0.00	5.79	0.07	0.00	27.68	2.00	0.00	5.78	0.06	0.00
27.75	2.00	0.00	5.77	0.07	0.00	27.81	2.00	0.00	5.76	0.06	0.00
27.88	2.00	0.00	5.75	0.07	0.00	27.95	2.00	0.00	5.74	0.07	0.00
28.01	2.00	0.00	5.73	0.06	0.00	28.08	2.00	0.00	5.72	0.07	0.00
28.14	2.00	0.00	5.71	0.06	0.00	28.21	2.00	0.00	5.70	0.07	0.00
28.27	2.00	0.00	5.69	0.06	0.00	28.34	2.00	0.00	5.68	0.07	0.00
28.40	2.00	0.00	5.67	0.06	0.00	28.47	2.00	0.00	5.66	0.07	0.00
28.54	2.00	0.00	5.65	0.07	0.00	28.60	2.00	0.00	5.64	0.06	0.00
28.67	2.00	0.00	5.63	0.07	0.00	28.73	2.00	0.00	5.62	0.06	0.00
28.80	2.00	0.00	5.61	0.07	0.00	28.86	2.00	0.00	5.60	0.06	0.00
28.93	2.00	0.00	5.59	0.07	0.00	29.00	2.00	0.00	5.58	0.07	0.00
29.06	2.00	0.00	5.57	0.06	0.00	29.13	2.00	0.00	5.56	0.07	0.00
29.19	2.00	0.00	5.55	0.06	0.00	29.26	2.00	0.00	5.54	0.07	0.00
29.32	2.00	0.00	5.53	0.06	0.00	29.39	2.00	0.00	5.52	0.07	0.00
29.45	2.00	0.00	5.51	0.06	0.00	29.52	2.00	0.00	5.50	0.07	0.00
29.59	2.00	0.00	5.49	0.07	0.00	29.65	2.00	0.00	5.48	0.06	0.00
29.72	2.00	0.00	5.47	0.07	0.00	29.78	2.00	0.00	5.46	0.06	0.00
29.85	2.00	0.00	5.45	0.07	0.00	29.91	2.00	0.00	5.44	0.06	0.00
29.98	2.00	0.00	5.43	0.07	0.00	30.04	2.00	0.00	5.42	0.06	0.00
30.11	2.00	0.00	5.41	0.07	0.00	30.18	2.00	0.00	5.40	0.07	0.00
30.24	2.00	0.00	5.39	0.06	0.00	30.31	2.00	0.00	5.38	0.07	0.00
30.37	2.00	0.00	5.37	0.06	0.00	30.44	2.00	0.00	5.36	0.07	0.00
30.50	2.00	0.00	5.35	0.06	0.00	30.57	2.00	0.00	5.34	0.07	0.00
30.64	2.00	0.00	5.33	0.07	0.00	30.70	2.00	0.00	5.32	0.06	0.00
30.77	2.00	0.00	5.31	0.07	0.00	30.83	2.00	0.00	5.30	0.06	0.00
30.90	2.00	0.00	5.29	0.07	0.00	30.96	2.00	0.00	5.28	0.06	0.00
31.03	2.00	0.00	5.27	0.07	0.00	31.09	2.00	0.00	5.26	0.06	0.00
31.16	2.00	0.00	5.25	0.07	0.00	31.23	2.00	0.00	5.24	0.07	0.00
31.29	2.00	0.00	5.23	0.06	0.00	31.36	2.00	0.00	5.22	0.07	0.00
31.42	2.00	0.00	5.21	0.06	0.00	31.49	2.00	0.00	5.20	0.07	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
31.55	2.00	0.00	5.19	0.06	0.00	31.62	2.00	0.00	5.18	0.07	0.00
31.68	2.00	0.00	5.17	0.06	0.00	31.75	2.00	0.00	5.16	0.07	0.00
31.82	2.00	0.00	5.15	0.07	0.00	31.88	2.00	0.00	5.14	0.06	0.00
31.95	2.00	0.00	5.13	0.07	0.00	32.01	2.00	0.00	5.12	0.06	0.00
32.08	2.00	0.00	5.11	0.07	0.00	32.14	2.00	0.00	5.10	0.06	0.00
32.21	2.00	0.00	5.09	0.07	0.00	32.28	2.00	0.00	5.08	0.07	0.00
32.34	2.00	0.00	5.07	0.06	0.00	32.41	2.00	0.00	5.06	0.07	0.00
32.47	2.00	0.00	5.05	0.06	0.00	32.54	2.00	0.00	5.04	0.07	0.00
32.60	2.00	0.00	5.03	0.06	0.00	32.67	2.00	0.00	5.02	0.07	0.00
32.73	2.00	0.00	5.01	0.06	0.00	32.80	2.00	0.00	5.00	0.07	0.00
32.87	2.00	0.00	4.99	0.07	0.00	32.93	2.00	0.00	4.98	0.06	0.00
33.00	2.00	0.00	4.97	0.07	0.00	33.06	2.00	0.00	4.96	0.06	0.00
33.13	2.00	0.00	4.95	0.07	0.00	33.19	2.00	0.00	4.94	0.06	0.00
33.26	2.00	0.00	4.93	0.07	0.00	33.32	2.00	0.00	4.92	0.06	0.00
33.39	2.00	0.00	4.91	0.07	0.00	33.46	2.00	0.00	4.90	0.07	0.00
33.52	2.00	0.00	4.89	0.06	0.00	33.59	2.00	0.00	4.88	0.07	0.00
33.65	2.00	0.00	4.87	0.06	0.00	33.72	2.00	0.00	4.86	0.07	0.00
33.78	2.00	0.00	4.85	0.06	0.00	33.85	2.00	0.00	4.84	0.07	0.00
33.92	2.00	0.00	4.83	0.07	0.00	33.98	2.00	0.00	4.82	0.06	0.00
34.05	2.00	0.00	4.81	0.07	0.00	34.11	2.00	0.00	4.80	0.06	0.00
34.18	2.00	0.00	4.79	0.07	0.00	34.24	2.00	0.00	4.78	0.06	0.00
34.31	2.00	0.00	4.77	0.07	0.00	34.37	2.00	0.00	4.76	0.06	0.00
34.44	2.00	0.00	4.75	0.07	0.00	34.51	2.00	0.00	4.74	0.07	0.00
34.57	2.00	0.00	4.73	0.06	0.00	34.64	2.00	0.00	4.72	0.07	0.00
34.70	2.00	0.00	4.71	0.06	0.00	34.77	2.00	0.00	4.70	0.07	0.00
34.83	2.00	0.00	4.69	0.06	0.00	34.90	2.00	0.00	4.68	0.07	0.00
34.96	2.00	0.00	4.67	0.06	0.00	35.03	2.00	0.00	4.66	0.07	0.00
35.10	2.00	0.00	4.65	0.07	0.00	35.16	2.00	0.00	4.64	0.06	0.00
35.23	2.00	0.00	4.63	0.07	0.00	35.29	2.00	0.00	4.62	0.06	0.00
35.36	2.00	0.00	4.61	0.07	0.00	35.42	2.00	0.00	4.60	0.06	0.00
35.49	2.00	0.00	4.59	0.07	0.00	35.56	2.00	0.00	4.58	0.07	0.00
35.62	2.00	0.00	4.57	0.06	0.00	35.69	2.00	0.00	4.56	0.07	0.00
35.75	2.00	0.00	4.55	0.06	0.00	35.82	2.00	0.00	4.54	0.07	0.00
35.88	2.00	0.00	4.53	0.06	0.00	35.95	2.00	0.00	4.52	0.07	0.00
36.01	2.00	0.00	4.51	0.06	0.00	36.08	2.00	0.00	4.50	0.07	0.00
36.15	2.00	0.00	4.49	0.07	0.00	36.21	2.00	0.00	4.48	0.06	0.00
36.28	2.00	0.00	4.47	0.07	0.00	36.34	2.00	0.00	4.46	0.06	0.00
36.41	2.00	0.00	4.45	0.07	0.00	36.47	2.00	0.00	4.44	0.06	0.00
36.54	2.00	0.00	4.43	0.07	0.00	36.60	2.00	0.00	4.42	0.06	0.00
36.67	2.00	0.00	4.41	0.07	0.00	36.74	2.00	0.00	4.40	0.07	0.00
36.80	2.00	0.00	4.39	0.06	0.00	36.87	2.00	0.00	4.38	0.07	0.00
36.93	2.00	0.00	4.37	0.06	0.00	37.00	2.00	0.00	4.36	0.07	0.00
37.06	2.00	0.00	4.35	0.06	0.00	37.13	2.00	0.00	4.34	0.07	0.00
37.20	2.00	0.00	4.33	0.07	0.00	37.26	2.00	0.00	4.32	0.06	0.00
37.33	2.00	0.00	4.31	0.07	0.00	37.39	2.00	0.00	4.30	0.06	0.00
37.46	2.00	0.00	4.29	0.07	0.00	37.52	2.00	0.00	4.28	0.06	0.00
37.59	2.00	0.00	4.27	0.07	0.00	37.65	2.00	0.00	4.26	0.06	0.00
37.72	2.00	0.00	4.25	0.07	0.00	37.79	2.00	0.00	4.24	0.07	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
37.85	2.00	0.00	4.23	0.06	0.00	37.92	2.00	0.00	4.22	0.07	0.00
37.98	2.00	0.00	4.21	0.06	0.00	38.05	2.00	0.00	4.20	0.07	0.00
38.11	2.00	0.00	4.19	0.06	0.00	38.18	2.00	0.00	4.18	0.07	0.00
38.24	2.00	0.00	4.17	0.06	0.00	38.31	2.00	0.00	4.16	0.07	0.00
38.38	2.00	0.00	4.15	0.07	0.00	38.44	2.00	0.00	4.14	0.06	0.00
38.51	2.00	0.00	4.13	0.07	0.00	38.57	2.00	0.00	4.12	0.06	0.00
38.64	2.00	0.00	4.11	0.07	0.00	38.70	2.00	0.00	4.10	0.06	0.00
38.77	2.00	0.00	4.09	0.07	0.00	38.84	2.00	0.00	4.08	0.07	0.00
38.90	2.00	0.00	4.07	0.06	0.00	38.97	2.00	0.00	4.06	0.07	0.00
39.03	2.00	0.00	4.05	0.06	0.00	39.10	2.00	0.00	4.04	0.07	0.00
39.16	2.00	0.00	4.03	0.06	0.00	39.23	2.00	0.00	4.02	0.07	0.00
39.29	2.00	0.00	4.01	0.06	0.00	39.36	2.00	0.00	4.00	0.07	0.00
39.43	2.00	0.00	3.99	0.07	0.00	39.49	2.00	0.00	3.98	0.06	0.00
39.56	2.00	0.00	3.97	0.07	0.00	39.62	2.00	0.00	3.96	0.06	0.00
39.69	2.00	0.00	3.95	0.07	0.00	39.75	2.00	0.00	3.94	0.06	0.00
39.82	2.00	0.00	3.93	0.07	0.00	39.88	2.00	0.00	3.92	0.06	0.00
39.95	2.00	0.00	3.91	0.07	0.00	40.02	2.00	0.00	3.90	0.07	0.00
40.08	1.57	0.00	3.89	0.06	0.00	40.15	2.00	0.00	3.88	0.07	0.00
40.21	2.00	0.00	3.87	0.06	0.00						

Overall liquefaction potential: 0.00

LPI = 0.00 - Liquefaction risk very low
LPI between 0.00 and 5.00 - Liquefaction risk low
LPI between 5.00 and 15.00 - Liquefaction risk high
LPI > 15.00 - Liquefaction risk very high

Abbreviations

FS:	Calculated factor of safety for test point
F_L:	1 - FS
w_z:	Function value of the extend of soil liquefaction according to depth
d_z:	Layer thickness (ft)
LPI:	Liquefaction potential index value for test point

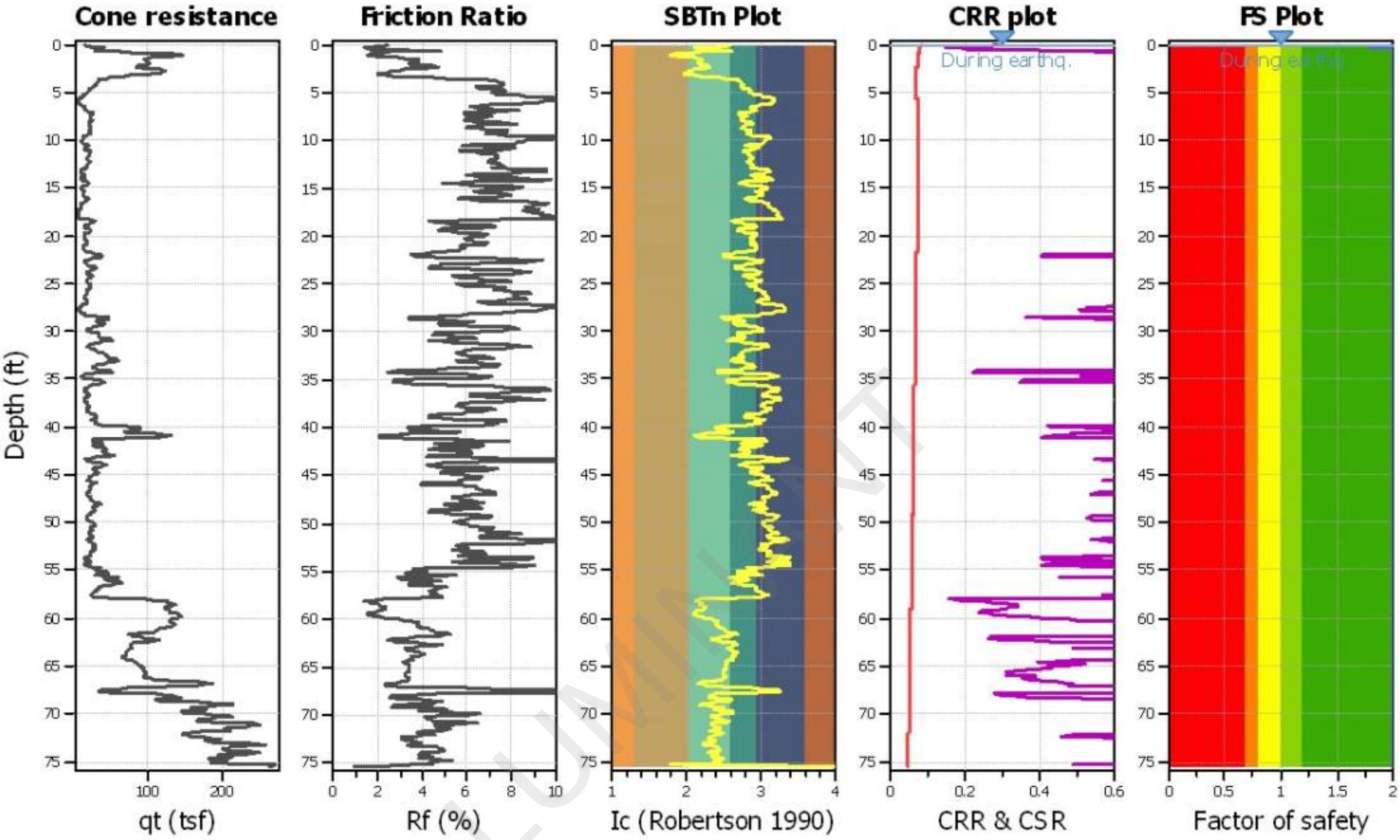
LIQUEFACTION ANALYSIS REPORT

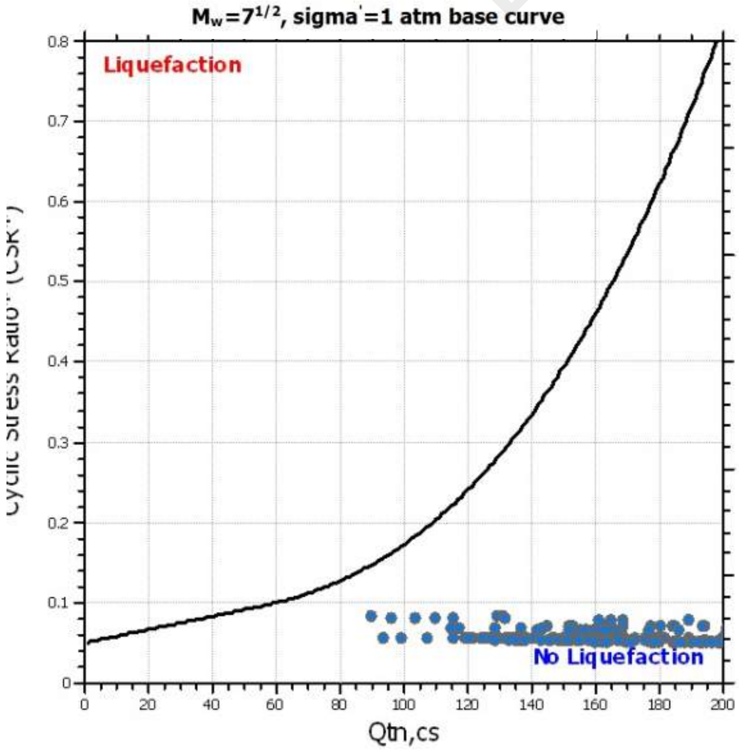
Project title : Martin Lake **Location : PDP-5**

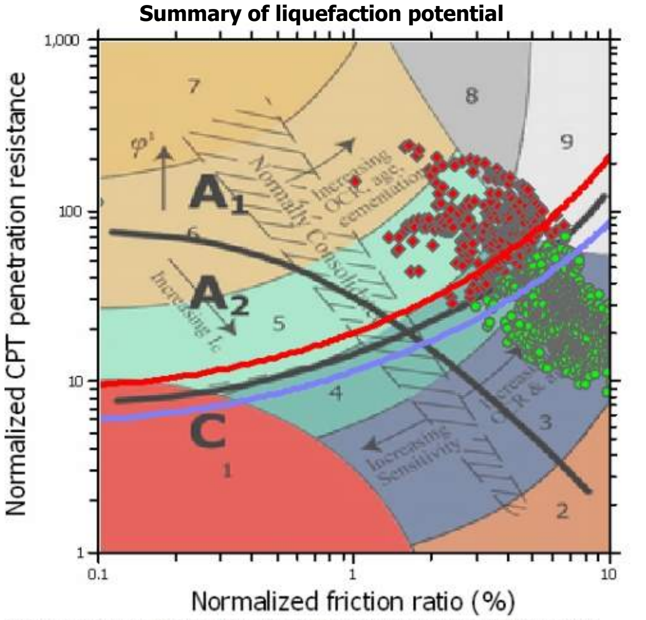
CPT file : B-12

Input parameters and analysis data

Analysis method:	Robertson (2009)	G.W.T. (in-situ):	1.00 ft	Use fill:	No	Clay like behavior applied:	All soils
Fines correction method:	Robertson (2009)	G.W.T. (earthq.):	0.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.20	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.09	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		







Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

:: Liquefaction Potential Index calculation data ::

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
0.07	2.00	0.00	9.99	0.06	0.00	0.13	2.00	0.00	9.98	0.06	0.00
0.20	1.80	0.00	9.97	0.07	0.00	0.26	2.00	0.00	9.96	0.06	0.00
0.33	2.00	0.00	9.95	0.07	0.00	0.39	2.00	0.00	9.94	0.06	0.00
0.46	2.00	0.00	9.93	0.07	0.00	0.52	2.00	0.00	9.92	0.06	0.00
0.59	2.00	0.00	9.91	0.07	0.00	0.66	2.00	0.00	9.90	0.07	0.00
0.72	2.00	0.00	9.89	0.06	0.00	0.79	2.00	0.00	9.88	0.07	0.00
0.85	2.00	0.00	9.87	0.06	0.00	0.92	2.00	0.00	9.86	0.07	0.00
0.98	2.00	0.00	9.85	0.06	0.00	1.05	2.00	0.00	9.84	0.07	0.00
1.12	2.00	0.00	9.83	0.07	0.00	1.18	2.00	0.00	9.82	0.06	0.00
1.25	2.00	0.00	9.81	0.07	0.00	1.31	2.00	0.00	9.80	0.06	0.00
1.38	2.00	0.00	9.79	0.07	0.00	1.44	2.00	0.00	9.78	0.06	0.00
1.51	2.00	0.00	9.77	0.07	0.00	1.57	2.00	0.00	9.76	0.06	0.00
1.64	2.00	0.00	9.75	0.07	0.00	1.71	2.00	0.00	9.74	0.07	0.00
1.77	2.00	0.00	9.73	0.06	0.00	1.84	2.00	0.00	9.72	0.07	0.00
1.90	2.00	0.00	9.71	0.06	0.00	1.97	2.00	0.00	9.70	0.07	0.00
2.03	2.00	0.00	9.69	0.06	0.00	2.10	2.00	0.00	9.68	0.07	0.00
2.16	2.00	0.00	9.67	0.06	0.00	2.23	2.00	0.00	9.66	0.07	0.00
2.30	2.00	0.00	9.65	0.07	0.00	2.36	2.00	0.00	9.64	0.06	0.00
2.43	2.00	0.00	9.63	0.07	0.00	2.49	2.00	0.00	9.62	0.06	0.00
2.56	2.00	0.00	9.61	0.07	0.00	2.62	2.00	0.00	9.60	0.06	0.00
2.69	2.00	0.00	9.59	0.07	0.00	2.76	2.00	0.00	9.58	0.07	0.00
2.82	2.00	0.00	9.57	0.06	0.00	2.89	2.00	0.00	9.56	0.07	0.00
2.95	2.00	0.00	9.55	0.06	0.00	3.02	2.00	0.00	9.54	0.07	0.00
3.08	2.00	0.00	9.53	0.06	0.00	3.15	2.00	0.00	9.52	0.07	0.00
3.21	2.00	0.00	9.51	0.06	0.00	3.28	2.00	0.00	9.50	0.07	0.00
3.35	2.00	0.00	9.49	0.07	0.00	3.41	2.00	0.00	9.48	0.06	0.00
3.48	2.00	0.00	9.47	0.07	0.00	3.54	2.00	0.00	9.46	0.06	0.00
3.61	2.00	0.00	9.45	0.07	0.00	3.67	2.00	0.00	9.44	0.06	0.00
3.74	2.00	0.00	9.43	0.07	0.00	3.80	2.00	0.00	9.42	0.06	0.00
3.87	2.00	0.00	9.41	0.07	0.00	3.94	2.00	0.00	9.40	0.07	0.00
4.00	2.00	0.00	9.39	0.06	0.00	4.07	2.00	0.00	9.38	0.07	0.00
4.13	2.00	0.00	9.37	0.06	0.00	4.20	2.00	0.00	9.36	0.07	0.00
4.26	2.00	0.00	9.35	0.06	0.00	4.33	2.00	0.00	9.34	0.07	0.00
4.40	2.00	0.00	9.33	0.07	0.00	4.46	2.00	0.00	9.32	0.06	0.00
4.53	2.00	0.00	9.31	0.07	0.00	4.59	2.00	0.00	9.30	0.06	0.00
4.66	2.00	0.00	9.29	0.07	0.00	4.72	2.00	0.00	9.28	0.06	0.00
4.79	2.00	0.00	9.27	0.07	0.00	4.85	2.00	0.00	9.26	0.06	0.00
4.92	2.00	0.00	9.25	0.07	0.00	4.99	2.00	0.00	9.24	0.07	0.00
5.05	2.00	0.00	9.23	0.06	0.00	5.12	2.00	0.00	9.22	0.07	0.00
5.18	2.00	0.00	9.21	0.06	0.00	5.25	2.00	0.00	9.20	0.07	0.00
5.31	2.00	0.00	9.19	0.06	0.00	5.38	2.00	0.00	9.18	0.07	0.00
5.44	2.00	0.00	9.17	0.06	0.00	5.51	2.00	0.00	9.16	0.07	0.00
5.58	2.00	0.00	9.15	0.07	0.00	5.64	2.00	0.00	9.14	0.06	0.00
5.71	2.00	0.00	9.13	0.07	0.00	5.77	2.00	0.00	9.12	0.06	0.00
5.84	2.00	0.00	9.11	0.07	0.00	5.90	2.00	0.00	9.10	0.06	0.00
5.97	2.00	0.00	9.09	0.07	0.00	6.04	2.00	0.00	9.08	0.07	0.00
6.10	2.00	0.00	9.07	0.06	0.00	6.17	2.00	0.00	9.06	0.07	0.00
6.23	2.00	0.00	9.05	0.06	0.00	6.30	2.00	0.00	9.04	0.07	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
6.36	2.00	0.00	9.03	0.06	0.00	6.43	2.00	0.00	9.02	0.07	0.00
6.49	2.00	0.00	9.01	0.06	0.00	6.56	2.00	0.00	9.00	0.07	0.00
6.63	2.00	0.00	8.99	0.07	0.00	6.69	2.00	0.00	8.98	0.06	0.00
6.76	2.00	0.00	8.97	0.07	0.00	6.82	2.00	0.00	8.96	0.06	0.00
6.89	2.00	0.00	8.95	0.07	0.00	6.95	2.00	0.00	8.94	0.06	0.00
7.02	2.00	0.00	8.93	0.07	0.00	7.08	2.00	0.00	8.92	0.06	0.00
7.15	2.00	0.00	8.91	0.07	0.00	7.22	2.00	0.00	8.90	0.07	0.00
7.28	2.00	0.00	8.89	0.06	0.00	7.35	2.00	0.00	8.88	0.07	0.00
7.41	2.00	0.00	8.87	0.06	0.00	7.48	2.00	0.00	8.86	0.07	0.00
7.54	2.00	0.00	8.85	0.06	0.00	7.61	2.00	0.00	8.84	0.07	0.00
7.68	2.00	0.00	8.83	0.07	0.00	7.74	2.00	0.00	8.82	0.06	0.00
7.81	2.00	0.00	8.81	0.07	0.00	7.87	2.00	0.00	8.80	0.06	0.00
7.94	2.00	0.00	8.79	0.07	0.00	8.00	2.00	0.00	8.78	0.06	0.00
8.07	2.00	0.00	8.77	0.07	0.00	8.13	2.00	0.00	8.76	0.06	0.00
8.20	2.00	0.00	8.75	0.07	0.00	8.27	2.00	0.00	8.74	0.07	0.00
8.33	2.00	0.00	8.73	0.06	0.00	8.40	2.00	0.00	8.72	0.07	0.00
8.46	2.00	0.00	8.71	0.06	0.00	8.53	2.00	0.00	8.70	0.07	0.00
8.59	2.00	0.00	8.69	0.06	0.00	8.66	2.00	0.00	8.68	0.07	0.00
8.72	2.00	0.00	8.67	0.06	0.00	8.79	2.00	0.00	8.66	0.07	0.00
8.86	2.00	0.00	8.65	0.07	0.00	8.92	2.00	0.00	8.64	0.06	0.00
8.99	2.00	0.00	8.63	0.07	0.00	9.05	2.00	0.00	8.62	0.06	0.00
9.12	2.00	0.00	8.61	0.07	0.00	9.18	2.00	0.00	8.60	0.06	0.00
9.25	2.00	0.00	8.59	0.07	0.00	9.32	2.00	0.00	8.58	0.07	0.00
9.38	2.00	0.00	8.57	0.06	0.00	9.45	2.00	0.00	8.56	0.07	0.00
9.51	2.00	0.00	8.55	0.06	0.00	9.58	2.00	0.00	8.54	0.07	0.00
9.64	2.00	0.00	8.53	0.06	0.00	9.71	2.00	0.00	8.52	0.07	0.00
9.77	2.00	0.00	8.51	0.06	0.00	9.84	2.00	0.00	8.50	0.07	0.00
9.91	2.00	0.00	8.49	0.07	0.00	9.97	2.00	0.00	8.48	0.06	0.00
10.04	2.00	0.00	8.47	0.07	0.00	10.10	2.00	0.00	8.46	0.06	0.00
10.17	2.00	0.00	8.45	0.07	0.00	10.23	2.00	0.00	8.44	0.06	0.00
10.30	2.00	0.00	8.43	0.07	0.00	10.36	2.00	0.00	8.42	0.06	0.00
10.43	2.00	0.00	8.41	0.07	0.00	10.50	2.00	0.00	8.40	0.07	0.00
10.56	2.00	0.00	8.39	0.06	0.00	10.63	2.00	0.00	8.38	0.07	0.00
10.69	2.00	0.00	8.37	0.06	0.00	10.76	2.00	0.00	8.36	0.07	0.00
10.82	2.00	0.00	8.35	0.06	0.00	10.89	2.00	0.00	8.34	0.07	0.00
10.96	2.00	0.00	8.33	0.07	0.00	11.02	2.00	0.00	8.32	0.06	0.00
11.09	2.00	0.00	8.31	0.07	0.00	11.15	2.00	0.00	8.30	0.06	0.00
11.22	2.00	0.00	8.29	0.07	0.00	11.28	2.00	0.00	8.28	0.06	0.00
11.35	2.00	0.00	8.27	0.07	0.00	11.41	2.00	0.00	8.26	0.06	0.00
11.48	2.00	0.00	8.25	0.07	0.00	11.55	2.00	0.00	8.24	0.07	0.00
11.61	2.00	0.00	8.23	0.06	0.00	11.68	2.00	0.00	8.22	0.07	0.00
11.74	2.00	0.00	8.21	0.06	0.00	11.81	2.00	0.00	8.20	0.07	0.00
11.87	2.00	0.00	8.19	0.06	0.00	11.94	2.00	0.00	8.18	0.07	0.00
12.00	2.00	0.00	8.17	0.06	0.00	12.07	2.00	0.00	8.16	0.07	0.00
12.14	2.00	0.00	8.15	0.07	0.00	12.20	2.00	0.00	8.14	0.06	0.00
12.27	2.00	0.00	8.13	0.07	0.00	12.33	2.00	0.00	8.12	0.06	0.00
12.40	2.00	0.00	8.11	0.07	0.00	12.46	2.00	0.00	8.10	0.06	0.00
12.53	2.00	0.00	8.09	0.07	0.00	12.60	2.00	0.00	8.08	0.07	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
12.66	2.00	0.00	8.07	0.06	0.00	12.73	2.00	0.00	8.06	0.07	0.00
12.79	2.00	0.00	8.05	0.06	0.00	12.86	2.00	0.00	8.04	0.07	0.00
12.92	2.00	0.00	8.03	0.06	0.00	12.99	2.00	0.00	8.02	0.07	0.00
13.05	2.00	0.00	8.01	0.06	0.00	13.12	2.00	0.00	8.00	0.07	0.00
13.19	2.00	0.00	7.99	0.07	0.00	13.25	2.00	0.00	7.98	0.06	0.00
13.32	2.00	0.00	7.97	0.07	0.00	13.38	2.00	0.00	7.96	0.06	0.00
13.45	2.00	0.00	7.95	0.07	0.00	13.51	2.00	0.00	7.94	0.06	0.00
13.58	2.00	0.00	7.93	0.07	0.00	13.64	2.00	0.00	7.92	0.06	0.00
13.71	2.00	0.00	7.91	0.07	0.00	13.78	2.00	0.00	7.90	0.07	0.00
13.84	2.00	0.00	7.89	0.06	0.00	13.91	2.00	0.00	7.88	0.07	0.00
13.97	2.00	0.00	7.87	0.06	0.00	14.04	2.00	0.00	7.86	0.07	0.00
14.10	2.00	0.00	7.85	0.06	0.00	14.17	2.00	0.00	7.84	0.07	0.00
14.24	2.00	0.00	7.83	0.07	0.00	14.30	2.00	0.00	7.82	0.06	0.00
14.37	2.00	0.00	7.81	0.07	0.00	14.43	2.00	0.00	7.80	0.06	0.00
14.50	2.00	0.00	7.79	0.07	0.00	14.56	2.00	0.00	7.78	0.06	0.00
14.63	2.00	0.00	7.77	0.07	0.00	14.69	2.00	0.00	7.76	0.06	0.00
14.76	2.00	0.00	7.75	0.07	0.00	14.83	2.00	0.00	7.74	0.07	0.00
14.89	2.00	0.00	7.73	0.06	0.00	14.96	2.00	0.00	7.72	0.07	0.00
15.02	2.00	0.00	7.71	0.06	0.00	15.09	2.00	0.00	7.70	0.07	0.00
15.15	2.00	0.00	7.69	0.06	0.00	15.22	2.00	0.00	7.68	0.07	0.00
15.28	2.00	0.00	7.67	0.06	0.00	15.35	2.00	0.00	7.66	0.07	0.00
15.42	2.00	0.00	7.65	0.07	0.00	15.48	2.00	0.00	7.64	0.06	0.00
15.55	2.00	0.00	7.63	0.07	0.00	15.61	2.00	0.00	7.62	0.06	0.00
15.68	2.00	0.00	7.61	0.07	0.00	15.74	2.00	0.00	7.60	0.06	0.00
15.81	2.00	0.00	7.59	0.07	0.00	15.88	2.00	0.00	7.58	0.07	0.00
15.94	2.00	0.00	7.57	0.06	0.00	16.01	2.00	0.00	7.56	0.07	0.00
16.07	2.00	0.00	7.55	0.06	0.00	16.14	2.00	0.00	7.54	0.07	0.00
16.20	2.00	0.00	7.53	0.06	0.00	16.27	2.00	0.00	7.52	0.07	0.00
16.33	2.00	0.00	7.51	0.06	0.00	16.40	2.00	0.00	7.50	0.07	0.00
16.47	2.00	0.00	7.49	0.07	0.00	16.53	2.00	0.00	7.48	0.06	0.00
16.60	2.00	0.00	7.47	0.07	0.00	16.66	2.00	0.00	7.46	0.06	0.00
16.73	2.00	0.00	7.45	0.07	0.00	16.79	2.00	0.00	7.44	0.06	0.00
16.86	2.00	0.00	7.43	0.07	0.00	16.92	2.00	0.00	7.42	0.06	0.00
16.99	2.00	0.00	7.41	0.07	0.00	17.06	2.00	0.00	7.40	0.07	0.00
17.12	2.00	0.00	7.39	0.06	0.00	17.19	2.00	0.00	7.38	0.07	0.00
17.25	2.00	0.00	7.37	0.06	0.00	17.32	2.00	0.00	7.36	0.07	0.00
17.38	2.00	0.00	7.35	0.06	0.00	17.45	2.00	0.00	7.34	0.07	0.00
17.52	2.00	0.00	7.33	0.07	0.00	17.58	2.00	0.00	7.32	0.06	0.00
17.65	2.00	0.00	7.31	0.07	0.00	17.71	2.00	0.00	7.30	0.06	0.00
17.78	2.00	0.00	7.29	0.07	0.00	17.84	2.00	0.00	7.28	0.06	0.00
17.91	2.00	0.00	7.27	0.07	0.00	17.97	2.00	0.00	7.26	0.06	0.00
18.04	2.00	0.00	7.25	0.07	0.00	18.11	2.00	0.00	7.24	0.07	0.00
18.17	2.00	0.00	7.23	0.06	0.00	18.24	2.00	0.00	7.22	0.07	0.00
18.30	2.00	0.00	7.21	0.06	0.00	18.37	2.00	0.00	7.20	0.07	0.00
18.43	2.00	0.00	7.19	0.06	0.00	18.50	2.00	0.00	7.18	0.07	0.00
18.56	2.00	0.00	7.17	0.06	0.00	18.63	2.00	0.00	7.16	0.07	0.00
18.70	2.00	0.00	7.15	0.07	0.00	18.76	2.00	0.00	7.14	0.06	0.00
18.83	2.00	0.00	7.13	0.07	0.00	18.89	2.00	0.00	7.12	0.06	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
18.96	2.00	0.00	7.11	0.07	0.00	19.02	2.00	0.00	7.10	0.06	0.00
19.09	2.00	0.00	7.09	0.07	0.00	19.16	2.00	0.00	7.08	0.07	0.00
19.22	2.00	0.00	7.07	0.06	0.00	19.29	2.00	0.00	7.06	0.07	0.00
19.35	2.00	0.00	7.05	0.06	0.00	19.42	2.00	0.00	7.04	0.07	0.00
19.48	2.00	0.00	7.03	0.06	0.00	19.55	2.00	0.00	7.02	0.07	0.00
19.61	2.00	0.00	7.01	0.06	0.00	19.68	2.00	0.00	7.00	0.07	0.00
19.75	2.00	0.00	6.99	0.07	0.00	19.81	2.00	0.00	6.98	0.06	0.00
19.88	2.00	0.00	6.97	0.07	0.00	19.94	2.00	0.00	6.96	0.06	0.00
20.01	2.00	0.00	6.95	0.07	0.00	20.07	2.00	0.00	6.94	0.06	0.00
20.14	2.00	0.00	6.93	0.07	0.00	20.20	2.00	0.00	6.92	0.06	0.00
20.27	2.00	0.00	6.91	0.07	0.00	20.34	2.00	0.00	6.90	0.07	0.00
20.40	2.00	0.00	6.89	0.06	0.00	20.47	2.00	0.00	6.88	0.07	0.00
20.53	2.00	0.00	6.87	0.06	0.00	20.60	2.00	0.00	6.86	0.07	0.00
20.66	2.00	0.00	6.85	0.06	0.00	20.73	2.00	0.00	6.84	0.07	0.00
20.80	2.00	0.00	6.83	0.07	0.00	20.86	2.00	0.00	6.82	0.06	0.00
20.93	2.00	0.00	6.81	0.07	0.00	20.99	2.00	0.00	6.80	0.06	0.00
21.06	2.00	0.00	6.79	0.07	0.00	21.12	2.00	0.00	6.78	0.06	0.00
21.19	2.00	0.00	6.77	0.07	0.00	21.25	2.00	0.00	6.76	0.06	0.00
21.32	2.00	0.00	6.75	0.07	0.00	21.39	2.00	0.00	6.74	0.07	0.00
21.45	2.00	0.00	6.73	0.06	0.00	21.52	2.00	0.00	6.72	0.07	0.00
21.58	2.00	0.00	6.71	0.06	0.00	21.65	2.00	0.00	6.70	0.07	0.00
21.71	2.00	0.00	6.69	0.06	0.00	21.78	2.00	0.00	6.68	0.07	0.00
21.84	2.00	0.00	6.67	0.06	0.00	21.91	2.00	0.00	6.66	0.07	0.00
21.98	2.00	0.00	6.65	0.07	0.00	22.04	2.00	0.00	6.64	0.06	0.00
22.11	2.00	0.00	6.63	0.07	0.00	22.17	2.00	0.00	6.62	0.06	0.00
22.24	2.00	0.00	6.61	0.07	0.00	22.30	2.00	0.00	6.60	0.06	0.00
22.37	2.00	0.00	6.59	0.07	0.00	22.44	2.00	0.00	6.58	0.07	0.00
22.50	2.00	0.00	6.57	0.06	0.00	22.57	2.00	0.00	6.56	0.07	0.00
22.63	2.00	0.00	6.55	0.06	0.00	22.70	2.00	0.00	6.54	0.07	0.00
22.76	2.00	0.00	6.53	0.06	0.00	22.83	2.00	0.00	6.52	0.07	0.00
22.89	2.00	0.00	6.51	0.06	0.00	22.96	2.00	0.00	6.50	0.07	0.00
23.03	2.00	0.00	6.49	0.07	0.00	23.09	2.00	0.00	6.48	0.06	0.00
23.16	2.00	0.00	6.47	0.07	0.00	23.22	2.00	0.00	6.46	0.06	0.00
23.29	2.00	0.00	6.45	0.07	0.00	23.35	2.00	0.00	6.44	0.06	0.00
23.42	2.00	0.00	6.43	0.07	0.00	23.48	2.00	0.00	6.42	0.06	0.00
23.55	2.00	0.00	6.41	0.07	0.00	23.62	2.00	0.00	6.40	0.07	0.00
23.68	2.00	0.00	6.39	0.06	0.00	23.75	2.00	0.00	6.38	0.07	0.00
23.81	2.00	0.00	6.37	0.06	0.00	23.88	2.00	0.00	6.36	0.07	0.00
23.94	2.00	0.00	6.35	0.06	0.00	24.01	2.00	0.00	6.34	0.07	0.00
24.08	2.00	0.00	6.33	0.07	0.00	24.14	2.00	0.00	6.32	0.06	0.00
24.21	2.00	0.00	6.31	0.07	0.00	24.27	2.00	0.00	6.30	0.06	0.00
24.34	2.00	0.00	6.29	0.07	0.00	24.40	2.00	0.00	6.28	0.06	0.00
24.47	2.00	0.00	6.27	0.07	0.00	24.53	2.00	0.00	6.26	0.06	0.00
24.60	2.00	0.00	6.25	0.07	0.00	24.67	2.00	0.00	6.24	0.07	0.00
24.73	2.00	0.00	6.23	0.06	0.00	24.80	2.00	0.00	6.22	0.07	0.00
24.86	2.00	0.00	6.21	0.06	0.00	24.93	2.00	0.00	6.20	0.07	0.00
24.99	2.00	0.00	6.19	0.06	0.00	25.06	2.00	0.00	6.18	0.07	0.00
25.12	2.00	0.00	6.17	0.06	0.00	25.19	2.00	0.00	6.16	0.07	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
25.26	2.00	0.00	6.15	0.07	0.00	25.32	2.00	0.00	6.14	0.06	0.00
25.39	2.00	0.00	6.13	0.07	0.00	25.45	2.00	0.00	6.12	0.06	0.00
25.52	2.00	0.00	6.11	0.07	0.00	25.58	2.00	0.00	6.10	0.06	0.00
25.65	2.00	0.00	6.09	0.07	0.00	25.72	2.00	0.00	6.08	0.07	0.00
25.78	2.00	0.00	6.07	0.06	0.00	25.85	2.00	0.00	6.06	0.07	0.00
25.91	2.00	0.00	6.05	0.06	0.00	25.98	2.00	0.00	6.04	0.07	0.00
26.04	2.00	0.00	6.03	0.06	0.00	26.11	2.00	0.00	6.02	0.07	0.00
26.17	2.00	0.00	6.01	0.06	0.00	26.24	2.00	0.00	6.00	0.07	0.00
26.31	2.00	0.00	5.99	0.07	0.00	26.37	2.00	0.00	5.98	0.06	0.00
26.44	2.00	0.00	5.97	0.07	0.00	26.50	2.00	0.00	5.96	0.06	0.00
26.57	2.00	0.00	5.95	0.07	0.00	26.63	2.00	0.00	5.94	0.06	0.00
26.70	2.00	0.00	5.93	0.07	0.00	26.76	2.00	0.00	5.92	0.06	0.00
26.83	2.00	0.00	5.91	0.07	0.00	26.90	2.00	0.00	5.90	0.07	0.00
26.96	2.00	0.00	5.89	0.06	0.00	27.03	2.00	0.00	5.88	0.07	0.00
27.09	2.00	0.00	5.87	0.06	0.00	27.16	2.00	0.00	5.86	0.07	0.00
27.22	2.00	0.00	5.85	0.06	0.00	27.29	2.00	0.00	5.84	0.07	0.00
27.36	2.00	0.00	5.83	0.07	0.00	27.42	2.00	0.00	5.82	0.06	0.00
27.49	2.00	0.00	5.81	0.07	0.00	27.55	2.00	0.00	5.80	0.06	0.00
27.62	2.00	0.00	5.79	0.07	0.00	27.68	2.00	0.00	5.78	0.06	0.00
27.75	2.00	0.00	5.77	0.07	0.00	27.81	2.00	0.00	5.76	0.06	0.00
27.88	2.00	0.00	5.75	0.07	0.00	27.95	2.00	0.00	5.74	0.07	0.00
28.01	2.00	0.00	5.73	0.06	0.00	28.08	2.00	0.00	5.72	0.07	0.00
28.14	2.00	0.00	5.71	0.06	0.00	28.21	2.00	0.00	5.70	0.07	0.00
28.27	2.00	0.00	5.69	0.06	0.00	28.34	2.00	0.00	5.68	0.07	0.00
28.40	2.00	0.00	5.67	0.06	0.00	28.47	2.00	0.00	5.66	0.07	0.00
28.54	2.00	0.00	5.65	0.07	0.00	28.60	2.00	0.00	5.64	0.06	0.00
28.67	2.00	0.00	5.63	0.07	0.00	28.73	2.00	0.00	5.62	0.06	0.00
28.80	2.00	0.00	5.61	0.07	0.00	28.86	2.00	0.00	5.60	0.06	0.00
28.93	2.00	0.00	5.59	0.07	0.00	29.00	2.00	0.00	5.58	0.07	0.00
29.06	2.00	0.00	5.57	0.06	0.00	29.13	2.00	0.00	5.56	0.07	0.00
29.19	2.00	0.00	5.55	0.06	0.00	29.26	2.00	0.00	5.54	0.07	0.00
29.32	2.00	0.00	5.53	0.06	0.00	29.39	2.00	0.00	5.52	0.07	0.00
29.45	2.00	0.00	5.51	0.06	0.00	29.52	2.00	0.00	5.50	0.07	0.00
29.59	2.00	0.00	5.49	0.07	0.00	29.65	2.00	0.00	5.48	0.06	0.00
29.72	2.00	0.00	5.47	0.07	0.00	29.78	2.00	0.00	5.46	0.06	0.00
29.85	2.00	0.00	5.45	0.07	0.00	29.91	2.00	0.00	5.44	0.06	0.00
29.98	2.00	0.00	5.43	0.07	0.00	30.04	2.00	0.00	5.42	0.06	0.00
30.11	2.00	0.00	5.41	0.07	0.00	30.18	2.00	0.00	5.40	0.07	0.00
30.24	2.00	0.00	5.39	0.06	0.00	30.31	2.00	0.00	5.38	0.07	0.00
30.37	2.00	0.00	5.37	0.06	0.00	30.44	2.00	0.00	5.36	0.07	0.00
30.50	2.00	0.00	5.35	0.06	0.00	30.57	2.00	0.00	5.34	0.07	0.00
30.64	2.00	0.00	5.33	0.07	0.00	30.70	2.00	0.00	5.32	0.06	0.00
30.77	2.00	0.00	5.31	0.07	0.00	30.83	2.00	0.00	5.30	0.06	0.00
30.90	2.00	0.00	5.29	0.07	0.00	30.96	2.00	0.00	5.28	0.06	0.00
31.03	2.00	0.00	5.27	0.07	0.00	31.09	2.00	0.00	5.26	0.06	0.00
31.16	2.00	0.00	5.25	0.07	0.00	31.23	2.00	0.00	5.24	0.07	0.00
31.29	2.00	0.00	5.23	0.06	0.00	31.36	2.00	0.00	5.22	0.07	0.00
31.42	2.00	0.00	5.21	0.06	0.00	31.49	2.00	0.00	5.20	0.07	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
31.55	2.00	0.00	5.19	0.06	0.00	31.62	2.00	0.00	5.18	0.07	0.00
31.68	2.00	0.00	5.17	0.06	0.00	31.75	2.00	0.00	5.16	0.07	0.00
31.82	2.00	0.00	5.15	0.07	0.00	31.88	2.00	0.00	5.14	0.06	0.00
31.95	2.00	0.00	5.13	0.07	0.00	32.01	2.00	0.00	5.12	0.06	0.00
32.08	2.00	0.00	5.11	0.07	0.00	32.14	2.00	0.00	5.10	0.06	0.00
32.21	2.00	0.00	5.09	0.07	0.00	32.28	2.00	0.00	5.08	0.07	0.00
32.34	2.00	0.00	5.07	0.06	0.00	32.41	2.00	0.00	5.06	0.07	0.00
32.47	2.00	0.00	5.05	0.06	0.00	32.54	2.00	0.00	5.04	0.07	0.00
32.60	2.00	0.00	5.03	0.06	0.00	32.67	2.00	0.00	5.02	0.07	0.00
32.73	2.00	0.00	5.01	0.06	0.00	32.80	2.00	0.00	5.00	0.07	0.00
32.87	2.00	0.00	4.99	0.07	0.00	32.93	2.00	0.00	4.98	0.06	0.00
33.00	2.00	0.00	4.97	0.07	0.00	33.06	2.00	0.00	4.96	0.06	0.00
33.13	2.00	0.00	4.95	0.07	0.00	33.19	2.00	0.00	4.94	0.06	0.00
33.26	2.00	0.00	4.93	0.07	0.00	33.32	2.00	0.00	4.92	0.06	0.00
33.39	2.00	0.00	4.91	0.07	0.00	33.46	2.00	0.00	4.90	0.07	0.00
33.52	2.00	0.00	4.89	0.06	0.00	33.59	2.00	0.00	4.88	0.07	0.00
33.65	2.00	0.00	4.87	0.06	0.00	33.72	2.00	0.00	4.86	0.07	0.00
33.78	2.00	0.00	4.85	0.06	0.00	33.85	2.00	0.00	4.84	0.07	0.00
33.92	2.00	0.00	4.83	0.07	0.00	33.98	2.00	0.00	4.82	0.06	0.00
34.05	2.00	0.00	4.81	0.07	0.00	34.11	2.00	0.00	4.80	0.06	0.00
34.18	2.00	0.00	4.79	0.07	0.00	34.24	2.00	0.00	4.78	0.06	0.00
34.31	2.00	0.00	4.77	0.07	0.00	34.37	2.00	0.00	4.76	0.06	0.00
34.44	2.00	0.00	4.75	0.07	0.00	34.51	2.00	0.00	4.74	0.07	0.00
34.57	2.00	0.00	4.73	0.06	0.00	34.64	2.00	0.00	4.72	0.07	0.00
34.70	2.00	0.00	4.71	0.06	0.00	34.77	2.00	0.00	4.70	0.07	0.00
34.83	2.00	0.00	4.69	0.06	0.00	34.90	2.00	0.00	4.68	0.07	0.00
34.96	2.00	0.00	4.67	0.06	0.00	35.03	2.00	0.00	4.66	0.07	0.00
35.10	2.00	0.00	4.65	0.07	0.00	35.16	2.00	0.00	4.64	0.06	0.00
35.23	2.00	0.00	4.63	0.07	0.00	35.29	2.00	0.00	4.62	0.06	0.00
35.36	2.00	0.00	4.61	0.07	0.00	35.42	2.00	0.00	4.60	0.06	0.00
35.49	2.00	0.00	4.59	0.07	0.00	35.56	2.00	0.00	4.58	0.07	0.00
35.62	2.00	0.00	4.57	0.06	0.00	35.69	2.00	0.00	4.56	0.07	0.00
35.75	2.00	0.00	4.55	0.06	0.00	35.82	2.00	0.00	4.54	0.07	0.00
35.88	2.00	0.00	4.53	0.06	0.00	35.95	2.00	0.00	4.52	0.07	0.00
36.01	2.00	0.00	4.51	0.06	0.00	36.08	2.00	0.00	4.50	0.07	0.00
36.15	2.00	0.00	4.49	0.07	0.00	36.21	2.00	0.00	4.48	0.06	0.00
36.28	2.00	0.00	4.47	0.07	0.00	36.34	2.00	0.00	4.46	0.06	0.00
36.41	2.00	0.00	4.45	0.07	0.00	36.47	2.00	0.00	4.44	0.06	0.00
36.54	2.00	0.00	4.43	0.07	0.00	36.60	2.00	0.00	4.42	0.06	0.00
36.67	2.00	0.00	4.41	0.07	0.00	36.74	2.00	0.00	4.40	0.07	0.00
36.80	2.00	0.00	4.39	0.06	0.00	36.87	2.00	0.00	4.38	0.07	0.00
36.93	2.00	0.00	4.37	0.06	0.00	37.00	2.00	0.00	4.36	0.07	0.00
37.06	2.00	0.00	4.35	0.06	0.00	37.13	2.00	0.00	4.34	0.07	0.00
37.20	2.00	0.00	4.33	0.07	0.00	37.26	2.00	0.00	4.32	0.06	0.00
37.33	2.00	0.00	4.31	0.07	0.00	37.39	2.00	0.00	4.30	0.06	0.00
37.46	2.00	0.00	4.29	0.07	0.00	37.52	2.00	0.00	4.28	0.06	0.00
37.59	2.00	0.00	4.27	0.07	0.00	37.65	2.00	0.00	4.26	0.06	0.00
37.72	2.00	0.00	4.25	0.07	0.00	37.79	2.00	0.00	4.24	0.07	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
37.85	2.00	0.00	4.23	0.06	0.00	37.92	2.00	0.00	4.22	0.07	0.00
37.98	2.00	0.00	4.21	0.06	0.00	38.05	2.00	0.00	4.20	0.07	0.00
38.11	2.00	0.00	4.19	0.06	0.00	38.18	2.00	0.00	4.18	0.07	0.00
38.24	2.00	0.00	4.17	0.06	0.00	38.31	2.00	0.00	4.16	0.07	0.00
38.38	2.00	0.00	4.15	0.07	0.00	38.44	2.00	0.00	4.14	0.06	0.00
38.51	2.00	0.00	4.13	0.07	0.00	38.57	2.00	0.00	4.12	0.06	0.00
38.64	2.00	0.00	4.11	0.07	0.00	38.70	2.00	0.00	4.10	0.06	0.00
38.77	2.00	0.00	4.09	0.07	0.00	38.84	2.00	0.00	4.08	0.07	0.00
38.90	2.00	0.00	4.07	0.06	0.00	38.97	2.00	0.00	4.06	0.07	0.00
39.03	2.00	0.00	4.05	0.06	0.00	39.10	2.00	0.00	4.04	0.07	0.00
39.16	2.00	0.00	4.03	0.06	0.00	39.23	2.00	0.00	4.02	0.07	0.00
39.29	2.00	0.00	4.01	0.06	0.00	39.36	2.00	0.00	4.00	0.07	0.00
39.43	2.00	0.00	3.99	0.07	0.00	39.49	2.00	0.00	3.98	0.06	0.00
39.56	2.00	0.00	3.97	0.07	0.00	39.62	2.00	0.00	3.96	0.06	0.00
39.69	2.00	0.00	3.95	0.07	0.00	39.75	2.00	0.00	3.94	0.06	0.00
39.82	2.00	0.00	3.93	0.07	0.00	39.88	2.00	0.00	3.92	0.06	0.00
39.95	2.00	0.00	3.91	0.07	0.00	40.02	2.00	0.00	3.90	0.07	0.00
40.08	2.00	0.00	3.89	0.06	0.00	40.15	2.00	0.00	3.88	0.07	0.00
40.21	2.00	0.00	3.87	0.06	0.00	40.28	2.00	0.00	3.86	0.07	0.00
40.34	2.00	0.00	3.85	0.06	0.00	40.41	2.00	0.00	3.84	0.07	0.00
40.48	2.00	0.00	3.83	0.07	0.00	40.54	2.00	0.00	3.82	0.06	0.00
40.61	2.00	0.00	3.81	0.07	0.00	40.67	2.00	0.00	3.80	0.06	0.00
40.74	2.00	0.00	3.79	0.07	0.00	40.80	2.00	0.00	3.78	0.06	0.00
40.87	2.00	0.00	3.77	0.07	0.00	40.93	2.00	0.00	3.76	0.06	0.00
41.00	2.00	0.00	3.75	0.07	0.00	41.07	2.00	0.00	3.74	0.07	0.00
41.13	2.00	0.00	3.73	0.06	0.00	41.20	2.00	0.00	3.72	0.07	0.00
41.26	2.00	0.00	3.71	0.06	0.00	41.33	2.00	0.00	3.70	0.07	0.00
41.39	2.00	0.00	3.69	0.06	0.00	41.46	2.00	0.00	3.68	0.07	0.00
41.52	2.00	0.00	3.67	0.06	0.00	41.59	2.00	0.00	3.66	0.07	0.00
41.66	2.00	0.00	3.65	0.07	0.00	41.72	2.00	0.00	3.64	0.06	0.00
41.79	2.00	0.00	3.63	0.07	0.00	41.85	2.00	0.00	3.62	0.06	0.00
41.92	2.00	0.00	3.61	0.07	0.00	41.98	2.00	0.00	3.60	0.06	0.00
42.05	2.00	0.00	3.59	0.07	0.00	42.12	2.00	0.00	3.58	0.07	0.00
42.18	2.00	0.00	3.57	0.06	0.00	42.25	2.00	0.00	3.56	0.07	0.00
42.31	2.00	0.00	3.55	0.06	0.00	42.38	2.00	0.00	3.54	0.07	0.00
42.44	2.00	0.00	3.53	0.06	0.00	42.51	2.00	0.00	3.52	0.07	0.00
42.57	2.00	0.00	3.51	0.06	0.00	42.64	2.00	0.00	3.50	0.07	0.00
42.71	2.00	0.00	3.49	0.07	0.00	42.77	2.00	0.00	3.48	0.06	0.00
42.84	2.00	0.00	3.47	0.07	0.00	42.90	2.00	0.00	3.46	0.06	0.00
42.97	2.00	0.00	3.45	0.07	0.00	43.03	2.00	0.00	3.44	0.06	0.00
43.10	2.00	0.00	3.43	0.07	0.00	43.16	2.00	0.00	3.42	0.06	0.00
43.23	2.00	0.00	3.41	0.07	0.00	43.30	2.00	0.00	3.40	0.07	0.00
43.36	2.00	0.00	3.39	0.06	0.00	43.43	2.00	0.00	3.38	0.07	0.00
43.49	2.00	0.00	3.37	0.06	0.00	43.56	2.00	0.00	3.36	0.07	0.00
43.62	2.00	0.00	3.35	0.06	0.00	43.69	2.00	0.00	3.34	0.07	0.00
43.76	2.00	0.00	3.33	0.07	0.00	43.82	2.00	0.00	3.32	0.06	0.00
43.89	2.00	0.00	3.31	0.07	0.00	43.95	2.00	0.00	3.30	0.06	0.00
44.02	2.00	0.00	3.29	0.07	0.00	44.08	2.00	0.00	3.28	0.06	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
44.15	2.00	0.00	3.27	0.07	0.00	44.21	2.00	0.00	3.26	0.06	0.00
44.28	2.00	0.00	3.25	0.07	0.00	44.35	2.00	0.00	3.24	0.07	0.00
44.41	2.00	0.00	3.23	0.06	0.00	44.48	2.00	0.00	3.22	0.07	0.00
44.54	2.00	0.00	3.21	0.06	0.00	44.61	2.00	0.00	3.20	0.07	0.00
44.67	2.00	0.00	3.19	0.06	0.00	44.74	2.00	0.00	3.18	0.07	0.00
44.80	2.00	0.00	3.17	0.06	0.00	44.87	2.00	0.00	3.16	0.07	0.00
44.94	2.00	0.00	3.15	0.07	0.00	45.00	2.00	0.00	3.14	0.06	0.00
45.07	2.00	0.00	3.13	0.07	0.00	45.13	2.00	0.00	3.12	0.06	0.00
45.20	2.00	0.00	3.11	0.07	0.00	45.26	2.00	0.00	3.10	0.06	0.00
45.33	2.00	0.00	3.09	0.07	0.00	45.40	2.00	0.00	3.08	0.07	0.00
45.46	2.00	0.00	3.07	0.06	0.00	45.53	2.00	0.00	3.06	0.07	0.00
45.59	2.00	0.00	3.05	0.06	0.00	45.66	2.00	0.00	3.04	0.07	0.00
45.72	2.00	0.00	3.03	0.06	0.00	45.79	2.00	0.00	3.02	0.07	0.00
45.85	2.00	0.00	3.01	0.06	0.00	45.92	2.00	0.00	3.00	0.07	0.00
45.99	2.00	0.00	2.99	0.07	0.00	46.05	2.00	0.00	2.98	0.06	0.00
46.12	2.00	0.00	2.97	0.07	0.00	46.18	2.00	0.00	2.96	0.06	0.00
46.25	2.00	0.00	2.95	0.07	0.00	46.31	2.00	0.00	2.94	0.06	0.00
46.38	2.00	0.00	2.93	0.07	0.00	46.45	2.00	0.00	2.92	0.07	0.00
46.51	2.00	0.00	2.91	0.06	0.00	46.58	2.00	0.00	2.90	0.07	0.00
46.64	2.00	0.00	2.89	0.06	0.00	46.71	2.00	0.00	2.88	0.07	0.00
46.77	2.00	0.00	2.87	0.06	0.00	46.84	2.00	0.00	2.86	0.07	0.00
46.90	2.00	0.00	2.85	0.06	0.00	46.97	2.00	0.00	2.84	0.07	0.00
47.04	2.00	0.00	2.83	0.07	0.00	47.10	2.00	0.00	2.82	0.06	0.00
47.17	2.00	0.00	2.81	0.07	0.00	47.23	2.00	0.00	2.80	0.06	0.00
47.30	2.00	0.00	2.79	0.07	0.00	47.36	2.00	0.00	2.78	0.06	0.00
47.43	2.00	0.00	2.77	0.07	0.00	47.49	2.00	0.00	2.76	0.06	0.00
47.56	2.00	0.00	2.75	0.07	0.00	47.63	2.00	0.00	2.74	0.07	0.00
47.69	2.00	0.00	2.73	0.06	0.00	47.76	2.00	0.00	2.72	0.07	0.00
47.82	2.00	0.00	2.71	0.06	0.00	47.89	2.00	0.00	2.70	0.07	0.00
47.95	2.00	0.00	2.69	0.06	0.00	48.02	2.00	0.00	2.68	0.07	0.00
48.09	2.00	0.00	2.67	0.07	0.00	48.15	2.00	0.00	2.66	0.06	0.00
48.22	2.00	0.00	2.65	0.07	0.00	48.28	2.00	0.00	2.64	0.06	0.00
48.35	2.00	0.00	2.63	0.07	0.00	48.41	2.00	0.00	2.62	0.06	0.00
48.48	2.00	0.00	2.61	0.07	0.00	48.54	2.00	0.00	2.60	0.06	0.00
48.61	2.00	0.00	2.59	0.07	0.00	48.68	2.00	0.00	2.58	0.07	0.00
48.74	2.00	0.00	2.57	0.06	0.00	48.81	2.00	0.00	2.56	0.07	0.00
48.87	2.00	0.00	2.55	0.06	0.00	48.94	2.00	0.00	2.54	0.07	0.00
49.00	2.00	0.00	2.53	0.06	0.00	49.07	2.00	0.00	2.52	0.07	0.00
49.13	2.00	0.00	2.51	0.06	0.00	49.20	2.00	0.00	2.50	0.07	0.00
49.27	2.00	0.00	2.49	0.07	0.00	49.33	2.00	0.00	2.48	0.06	0.00
49.40	2.00	0.00	2.47	0.07	0.00	49.46	2.00	0.00	2.46	0.06	0.00
49.53	2.00	0.00	2.45	0.07	0.00	49.59	2.00	0.00	2.44	0.06	0.00
49.66	2.00	0.00	2.43	0.07	0.00	49.73	2.00	0.00	2.42	0.07	0.00
49.79	2.00	0.00	2.41	0.06	0.00	49.86	2.00	0.00	2.40	0.07	0.00
49.92	2.00	0.00	2.39	0.06	0.00	49.99	2.00	0.00	2.38	0.07	0.00
50.05	2.00	0.00	2.37	0.06	0.00	50.12	2.00	0.00	2.36	0.07	0.00
50.18	2.00	0.00	2.35	0.06	0.00	50.25	2.00	0.00	2.34	0.07	0.00
50.32	2.00	0.00	2.33	0.07	0.00	50.38	2.00	0.00	2.32	0.06	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
50.45	2.00	0.00	2.31	0.07	0.00	50.51	2.00	0.00	2.30	0.06	0.00
50.58	2.00	0.00	2.29	0.07	0.00	50.64	2.00	0.00	2.28	0.06	0.00
50.71	2.00	0.00	2.27	0.07	0.00	50.77	2.00	0.00	2.26	0.06	0.00
50.84	2.00	0.00	2.25	0.07	0.00	50.91	2.00	0.00	2.24	0.07	0.00
50.97	2.00	0.00	2.23	0.06	0.00	51.04	2.00	0.00	2.22	0.07	0.00
51.10	2.00	0.00	2.21	0.06	0.00	51.17	2.00	0.00	2.20	0.07	0.00
51.23	2.00	0.00	2.19	0.06	0.00	51.30	2.00	0.00	2.18	0.07	0.00
51.37	2.00	0.00	2.17	0.07	0.00	51.43	2.00	0.00	2.16	0.06	0.00
51.50	2.00	0.00	2.15	0.07	0.00	51.56	2.00	0.00	2.14	0.06	0.00
51.63	2.00	0.00	2.13	0.07	0.00	51.69	2.00	0.00	2.12	0.06	0.00
51.76	2.00	0.00	2.11	0.07	0.00	51.82	2.00	0.00	2.10	0.06	0.00
51.89	2.00	0.00	2.09	0.07	0.00	51.96	2.00	0.00	2.08	0.07	0.00
52.02	2.00	0.00	2.07	0.06	0.00	52.09	2.00	0.00	2.06	0.07	0.00
52.15	2.00	0.00	2.05	0.06	0.00	52.22	2.00	0.00	2.04	0.07	0.00
52.28	2.00	0.00	2.03	0.06	0.00	52.35	2.00	0.00	2.02	0.07	0.00
52.41	2.00	0.00	2.01	0.06	0.00	52.48	2.00	0.00	2.00	0.07	0.00
52.55	2.00	0.00	1.99	0.07	0.00	52.61	2.00	0.00	1.98	0.06	0.00
52.68	2.00	0.00	1.97	0.07	0.00	52.74	2.00	0.00	1.96	0.06	0.00
52.81	2.00	0.00	1.95	0.07	0.00	52.87	2.00	0.00	1.94	0.06	0.00
52.94	2.00	0.00	1.93	0.07	0.00	53.01	2.00	0.00	1.92	0.07	0.00
53.07	2.00	0.00	1.91	0.06	0.00	53.14	2.00	0.00	1.90	0.07	0.00
53.20	2.00	0.00	1.89	0.06	0.00	53.27	2.00	0.00	1.88	0.07	0.00
53.33	2.00	0.00	1.87	0.06	0.00	53.40	2.00	0.00	1.86	0.07	0.00
53.46	2.00	0.00	1.85	0.06	0.00	53.53	2.00	0.00	1.84	0.07	0.00
53.60	2.00	0.00	1.83	0.07	0.00	53.66	2.00	0.00	1.82	0.06	0.00
53.73	2.00	0.00	1.81	0.07	0.00	53.79	2.00	0.00	1.80	0.06	0.00
53.86	2.00	0.00	1.79	0.07	0.00	53.92	2.00	0.00	1.78	0.06	0.00
53.99	2.00	0.00	1.77	0.07	0.00	54.05	2.00	0.00	1.76	0.06	0.00
54.12	2.00	0.00	1.75	0.07	0.00	54.19	2.00	0.00	1.74	0.07	0.00
54.25	2.00	0.00	1.73	0.06	0.00	54.32	2.00	0.00	1.72	0.07	0.00
54.38	2.00	0.00	1.71	0.06	0.00	54.45	2.00	0.00	1.70	0.07	0.00
54.51	2.00	0.00	1.69	0.06	0.00	54.58	2.00	0.00	1.68	0.07	0.00
54.65	2.00	0.00	1.67	0.07	0.00	54.71	2.00	0.00	1.66	0.06	0.00
54.78	2.00	0.00	1.65	0.07	0.00	54.84	2.00	0.00	1.64	0.06	0.00
54.91	2.00	0.00	1.63	0.07	0.00	54.97	2.00	0.00	1.62	0.06	0.00
55.04	2.00	0.00	1.61	0.07	0.00	55.10	2.00	0.00	1.60	0.06	0.00
55.17	2.00	0.00	1.59	0.07	0.00	55.24	2.00	0.00	1.58	0.07	0.00
55.30	2.00	0.00	1.57	0.06	0.00	55.37	2.00	0.00	1.56	0.07	0.00
55.43	2.00	0.00	1.55	0.06	0.00	55.50	2.00	0.00	1.54	0.07	0.00
55.56	2.00	0.00	1.53	0.06	0.00	55.63	2.00	0.00	1.52	0.07	0.00
55.69	2.00	0.00	1.51	0.06	0.00	55.76	2.00	0.00	1.50	0.07	0.00
55.83	2.00	0.00	1.49	0.07	0.00	55.89	2.00	0.00	1.48	0.06	0.00
55.96	2.00	0.00	1.47	0.07	0.00	56.02	2.00	0.00	1.46	0.06	0.00
56.09	2.00	0.00	1.45	0.07	0.00	56.15	2.00	0.00	1.44	0.06	0.00
56.22	2.00	0.00	1.43	0.07	0.00	56.29	2.00	0.00	1.42	0.07	0.00
56.35	2.00	0.00	1.41	0.06	0.00	56.42	2.00	0.00	1.40	0.07	0.00
56.48	2.00	0.00	1.39	0.06	0.00	56.55	2.00	0.00	1.38	0.07	0.00
56.61	2.00	0.00	1.37	0.06	0.00	56.68	2.00	0.00	1.36	0.07	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
56.74	2.00	0.00	1.35	0.06	0.00	56.81	2.00	0.00	1.34	0.07	0.00
56.88	2.00	0.00	1.33	0.07	0.00	56.94	2.00	0.00	1.32	0.06	0.00
57.01	2.00	0.00	1.31	0.07	0.00	57.07	2.00	0.00	1.30	0.06	0.00
57.14	2.00	0.00	1.29	0.07	0.00	57.20	2.00	0.00	1.28	0.06	0.00
57.27	2.00	0.00	1.27	0.07	0.00	57.33	2.00	0.00	1.26	0.06	0.00
57.40	2.00	0.00	1.25	0.07	0.00	57.47	2.00	0.00	1.24	0.07	0.00
57.53	2.00	0.00	1.23	0.06	0.00	57.60	2.00	0.00	1.22	0.07	0.00
57.66	2.00	0.00	1.21	0.06	0.00	57.73	2.00	0.00	1.20	0.07	0.00
57.79	2.00	0.00	1.19	0.06	0.00	57.86	2.00	0.00	1.18	0.07	0.00
57.93	2.00	0.00	1.17	0.07	0.00	57.99	2.00	0.00	1.16	0.06	0.00
58.06	2.00	0.00	1.15	0.07	0.00	58.12	2.00	0.00	1.14	0.06	0.00
58.19	2.00	0.00	1.13	0.07	0.00	58.25	2.00	0.00	1.12	0.06	0.00
58.32	2.00	0.00	1.11	0.07	0.00	58.38	2.00	0.00	1.10	0.06	0.00
58.45	2.00	0.00	1.09	0.07	0.00	58.52	2.00	0.00	1.08	0.07	0.00
58.58	2.00	0.00	1.07	0.06	0.00	58.65	2.00	0.00	1.06	0.07	0.00
58.71	2.00	0.00	1.05	0.06	0.00	58.78	2.00	0.00	1.04	0.07	0.00
58.84	2.00	0.00	1.03	0.06	0.00	58.91	2.00	0.00	1.02	0.07	0.00
58.97	2.00	0.00	1.01	0.06	0.00	59.04	2.00	0.00	1.00	0.07	0.00
59.11	2.00	0.00	0.99	0.07	0.00	59.17	2.00	0.00	0.98	0.06	0.00
59.24	2.00	0.00	0.97	0.07	0.00	59.30	2.00	0.00	0.96	0.06	0.00
59.37	2.00	0.00	0.95	0.07	0.00	59.43	2.00	0.00	0.94	0.06	0.00
59.50	2.00	0.00	0.93	0.07	0.00	59.57	2.00	0.00	0.92	0.07	0.00
59.63	2.00	0.00	0.91	0.06	0.00	59.70	2.00	0.00	0.90	0.07	0.00
59.76	2.00	0.00	0.89	0.06	0.00	59.83	2.00	0.00	0.88	0.07	0.00
59.89	2.00	0.00	0.87	0.06	0.00	59.96	2.00	0.00	0.86	0.07	0.00
60.02	2.00	0.00	0.85	0.06	0.00	60.09	2.00	0.00	0.84	0.07	0.00
60.16	2.00	0.00	0.83	0.07	0.00	60.22	2.00	0.00	0.82	0.06	0.00
60.29	2.00	0.00	0.81	0.07	0.00	60.35	2.00	0.00	0.80	0.06	0.00
60.42	2.00	0.00	0.79	0.07	0.00	60.48	2.00	0.00	0.78	0.06	0.00
60.55	2.00	0.00	0.77	0.07	0.00	60.61	2.00	0.00	0.76	0.06	0.00
60.68	2.00	0.00	0.75	0.07	0.00	60.75	2.00	0.00	0.74	0.07	0.00
60.81	2.00	0.00	0.73	0.06	0.00	60.88	2.00	0.00	0.72	0.07	0.00
60.94	2.00	0.00	0.71	0.06	0.00	61.01	2.00	0.00	0.70	0.07	0.00
61.07	2.00	0.00	0.69	0.06	0.00	61.14	2.00	0.00	0.68	0.07	0.00
61.21	2.00	0.00	0.67	0.07	0.00	61.27	2.00	0.00	0.66	0.06	0.00
61.34	2.00	0.00	0.65	0.07	0.00	61.40	2.00	0.00	0.64	0.06	0.00
61.47	2.00	0.00	0.63	0.07	0.00	61.53	2.00	0.00	0.62	0.06	0.00
61.60	2.00	0.00	0.61	0.07	0.00	61.66	2.00	0.00	0.60	0.06	0.00
61.73	2.00	0.00	0.59	0.07	0.00	61.80	2.00	0.00	0.58	0.07	0.00
61.86	2.00	0.00	0.57	0.06	0.00	61.93	2.00	0.00	0.56	0.07	0.00
61.99	2.00	0.00	0.55	0.06	0.00	62.06	2.00	0.00	0.54	0.07	0.00
62.12	2.00	0.00	0.53	0.06	0.00	62.19	2.00	0.00	0.52	0.07	0.00
62.25	2.00	0.00	0.51	0.06	0.00	62.32	2.00	0.00	0.50	0.07	0.00
62.39	2.00	0.00	0.49	0.07	0.00	62.45	2.00	0.00	0.48	0.06	0.00
62.52	2.00	0.00	0.47	0.07	0.00	62.58	2.00	0.00	0.46	0.06	0.00
62.65	2.00	0.00	0.45	0.07	0.00	62.71	2.00	0.00	0.44	0.06	0.00
62.78	2.00	0.00	0.43	0.07	0.00	62.85	2.00	0.00	0.42	0.07	0.00
62.91	2.00	0.00	0.41	0.06	0.00	62.98	2.00	0.00	0.40	0.07	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
63.04	2.00	0.00	0.39	0.06	0.00	63.11	2.00	0.00	0.38	0.07	0.00
63.17	2.00	0.00	0.37	0.06	0.00	63.24	2.00	0.00	0.36	0.07	0.00
63.30	2.00	0.00	0.35	0.06	0.00	63.37	2.00	0.00	0.34	0.07	0.00
63.44	2.00	0.00	0.33	0.07	0.00	63.50	2.00	0.00	0.32	0.06	0.00
63.57	2.00	0.00	0.31	0.07	0.00	63.63	2.00	0.00	0.30	0.06	0.00
63.70	2.00	0.00	0.29	0.07	0.00	63.76	2.00	0.00	0.28	0.06	0.00
63.83	2.00	0.00	0.27	0.07	0.00	63.89	2.00	0.00	0.26	0.06	0.00
63.96	2.00	0.00	0.25	0.07	0.00	64.03	2.00	0.00	0.24	0.07	0.00
64.09	2.00	0.00	0.23	0.06	0.00	64.16	2.00	0.00	0.22	0.07	0.00
64.22	2.00	0.00	0.21	0.06	0.00	64.29	2.00	0.00	0.20	0.07	0.00
64.35	2.00	0.00	0.19	0.06	0.00	64.42	2.00	0.00	0.18	0.07	0.00
64.49	2.00	0.00	0.17	0.07	0.00	64.55	2.00	0.00	0.16	0.06	0.00
64.62	2.00	0.00	0.15	0.07	0.00	64.68	2.00	0.00	0.14	0.06	0.00
64.75	2.00	0.00	0.13	0.07	0.00	64.81	2.00	0.00	0.12	0.06	0.00
64.88	2.00	0.00	0.11	0.07	0.00	64.94	2.00	0.00	0.10	0.06	0.00
65.01	2.00	0.00	0.09	0.07	0.00	65.08	2.00	0.00	0.08	0.07	0.00
65.14	2.00	0.00	0.07	0.06	0.00	65.21	2.00	0.00	0.06	0.07	0.00
65.27	2.00	0.00	0.05	0.06	0.00	65.34	2.00	0.00	0.04	0.07	0.00
65.40	2.00	0.00	0.03	0.06	0.00	65.47	2.00	0.00	0.02	0.07	0.00
65.53	2.00	0.00	0.01	0.06	0.00	65.60	2.00	0.00	0.00	0.07	0.00
65.67	2.00	0.00	0.00	0.00	0.00	65.73	2.00	0.00	0.00	0.00	0.00
65.80	2.00	0.00	0.00	0.00	0.00	65.86	2.00	0.00	0.00	0.00	0.00
65.93	2.00	0.00	0.00	0.00	0.00	65.99	2.00	0.00	0.00	0.00	0.00
66.06	2.00	0.00	0.00	0.00	0.00	66.13	2.00	0.00	0.00	0.00	0.00
66.19	2.00	0.00	0.00	0.00	0.00	66.26	2.00	0.00	0.00	0.00	0.00
66.32	2.00	0.00	0.00	0.00	0.00	66.39	2.00	0.00	0.00	0.00	0.00
66.45	2.00	0.00	0.00	0.00	0.00	66.52	2.00	0.00	0.00	0.00	0.00
66.58	2.00	0.00	0.00	0.00	0.00	66.65	2.00	0.00	0.00	0.00	0.00
66.72	2.00	0.00	0.00	0.00	0.00	66.78	2.00	0.00	0.00	0.00	0.00
66.85	2.00	0.00	0.00	0.00	0.00	66.91	2.00	0.00	0.00	0.00	0.00
66.98	2.00	0.00	0.00	0.00	0.00	67.04	2.00	0.00	0.00	0.00	0.00
67.11	2.00	0.00	0.00	0.00	0.00	67.17	2.00	0.00	0.00	0.00	0.00
67.24	2.00	0.00	0.00	0.00	0.00	67.31	2.00	0.00	0.00	0.00	0.00
67.37	2.00	0.00	0.00	0.00	0.00	67.44	2.00	0.00	0.00	0.00	0.00
67.50	2.00	0.00	0.00	0.00	0.00	67.57	2.00	0.00	0.00	0.00	0.00
67.63	2.00	0.00	0.00	0.00	0.00	67.70	2.00	0.00	0.00	0.00	0.00
67.77	2.00	0.00	0.00	0.00	0.00	67.83	2.00	0.00	0.00	0.00	0.00
67.90	2.00	0.00	0.00	0.00	0.00	67.96	2.00	0.00	0.00	0.00	0.00
68.03	2.00	0.00	0.00	0.00	0.00	68.09	2.00	0.00	0.00	0.00	0.00
68.16	2.00	0.00	0.00	0.00	0.00	68.22	2.00	0.00	0.00	0.00	0.00
68.29	2.00	0.00	0.00	0.00	0.00	68.36	2.00	0.00	0.00	0.00	0.00
68.42	2.00	0.00	0.00	0.00	0.00	68.49	2.00	0.00	0.00	0.00	0.00
68.55	2.00	0.00	0.00	0.00	0.00	68.62	2.00	0.00	0.00	0.00	0.00
68.68	2.00	0.00	0.00	0.00	0.00	68.75	2.00	0.00	0.00	0.00	0.00
68.81	2.00	0.00	0.00	0.00	0.00	68.88	2.00	0.00	0.00	0.00	0.00
68.95	2.00	0.00	0.00	0.00	0.00	69.01	2.00	0.00	0.00	0.00	0.00
69.08	2.00	0.00	0.00	0.00	0.00	69.14	2.00	0.00	0.00	0.00	0.00
69.21	2.00	0.00	0.00	0.00	0.00	69.27	2.00	0.00	0.00	0.00	0.00

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI
69.34	2.00	0.00	0.00	0.00	0.00	69.41	2.00	0.00	0.00	0.00	0.00
69.47	2.00	0.00	0.00	0.00	0.00	69.54	2.00	0.00	0.00	0.00	0.00
69.60	2.00	0.00	0.00	0.00	0.00	69.67	2.00	0.00	0.00	0.00	0.00
69.73	2.00	0.00	0.00	0.00	0.00	69.80	2.00	0.00	0.00	0.00	0.00
69.86	2.00	0.00	0.00	0.00	0.00	69.93	2.00	0.00	0.00	0.00	0.00
70.00	2.00	0.00	0.00	0.00	0.00	70.06	2.00	0.00	0.00	0.00	0.00
70.13	2.00	0.00	0.00	0.00	0.00	70.19	2.00	0.00	0.00	0.00	0.00
70.26	2.00	0.00	0.00	0.00	0.00	70.32	2.00	0.00	0.00	0.00	0.00
70.39	2.00	0.00	0.00	0.00	0.00	70.45	2.00	0.00	0.00	0.00	0.00
70.52	2.00	0.00	0.00	0.00	0.00	70.59	2.00	0.00	0.00	0.00	0.00
70.65	2.00	0.00	0.00	0.00	0.00	70.72	2.00	0.00	0.00	0.00	0.00
70.78	2.00	0.00	0.00	0.00	0.00	70.85	2.00	0.00	0.00	0.00	0.00
70.91	2.00	0.00	0.00	0.00	0.00	70.98	2.00	0.00	0.00	0.00	0.00
71.05	2.00	0.00	0.00	0.00	0.00	71.11	2.00	0.00	0.00	0.00	0.00
71.18	2.00	0.00	0.00	0.00	0.00	71.24	2.00	0.00	0.00	0.00	0.00
71.31	2.00	0.00	0.00	0.00	0.00	71.37	2.00	0.00	0.00	0.00	0.00
71.44	2.00	0.00	0.00	0.00	0.00	71.50	2.00	0.00	0.00	0.00	0.00
71.57	2.00	0.00	0.00	0.00	0.00	71.64	2.00	0.00	0.00	0.00	0.00
71.70	2.00	0.00	0.00	0.00	0.00	71.77	2.00	0.00	0.00	0.00	0.00
71.83	2.00	0.00	0.00	0.00	0.00	71.90	2.00	0.00	0.00	0.00	0.00
71.96	2.00	0.00	0.00	0.00	0.00	72.03	2.00	0.00	0.00	0.00	0.00
72.09	2.00	0.00	0.00	0.00	0.00	72.16	2.00	0.00	0.00	0.00	0.00
72.23	2.00	0.00	0.00	0.00	0.00	72.29	2.00	0.00	0.00	0.00	0.00
72.36	2.00	0.00	0.00	0.00	0.00	72.42	2.00	0.00	0.00	0.00	0.00
72.49	2.00	0.00	0.00	0.00	0.00	72.55	2.00	0.00	0.00	0.00	0.00
72.62	2.00	0.00	0.00	0.00	0.00	72.69	2.00	0.00	0.00	0.00	0.00
72.75	2.00	0.00	0.00	0.00	0.00	72.82	2.00	0.00	0.00	0.00	0.00
72.88	2.00	0.00	0.00	0.00	0.00	72.95	2.00	0.00	0.00	0.00	0.00
73.01	2.00	0.00	0.00	0.00	0.00	73.08	2.00	0.00	0.00	0.00	0.00
73.14	2.00	0.00	0.00	0.00	0.00	73.21	2.00	0.00	0.00	0.00	0.00
73.28	2.00	0.00	0.00	0.00	0.00	73.34	2.00	0.00	0.00	0.00	0.00
73.41	2.00	0.00	0.00	0.00	0.00	73.47	2.00	0.00	0.00	0.00	0.00
73.54	2.00	0.00	0.00	0.00	0.00	73.60	2.00	0.00	0.00	0.00	0.00
73.67	2.00	0.00	0.00	0.00	0.00	73.73	2.00	0.00	0.00	0.00	0.00
73.80	2.00	0.00	0.00	0.00	0.00	73.87	2.00	0.00	0.00	0.00	0.00
73.93	2.00	0.00	0.00	0.00	0.00	74.00	2.00	0.00	0.00	0.00	0.00
74.06	2.00	0.00	0.00	0.00	0.00	74.13	2.00	0.00	0.00	0.00	0.00
74.19	2.00	0.00	0.00	0.00	0.00	74.26	2.00	0.00	0.00	0.00	0.00
74.32	2.00	0.00	0.00	0.00	0.00	74.39	2.00	0.00	0.00	0.00	0.00
74.46	2.00	0.00	0.00	0.00	0.00	74.52	2.00	0.00	0.00	0.00	0.00
74.59	2.00	0.00	0.00	0.00	0.00	74.65	2.00	0.00	0.00	0.00	0.00
74.72	2.00	0.00	0.00	0.00	0.00	74.78	2.00	0.00	0.00	0.00	0.00
74.85	2.00	0.00	0.00	0.00	0.00	74.92	2.00	0.00	0.00	0.00	0.00
74.98	2.00	0.00	0.00	0.00	0.00	75.05	2.00	0.00	0.00	0.00	0.00
75.11	2.00	0.00	0.00	0.00	0.00	75.18	2.00	0.00	0.00	0.00	0.00
75.24	2.00	0.00	0.00	0.00	0.00	75.31	2.00	0.00	0.00	0.00	0.00
75.37	2.00	0.00	0.00	0.00	0.00	75.44	2.00	0.00	0.00	0.00	0.00
75.51	2.00	0.00	0.00	0.00	0.00						

:: Liquefaction Potential Index calculation data :: (continued)

Depth (ft)	FS	F_L	w_z	d_z	LPI	Depth (ft)	FS	F_L	w_z	d_z	LPI

Overall liquefaction potential: 0.00

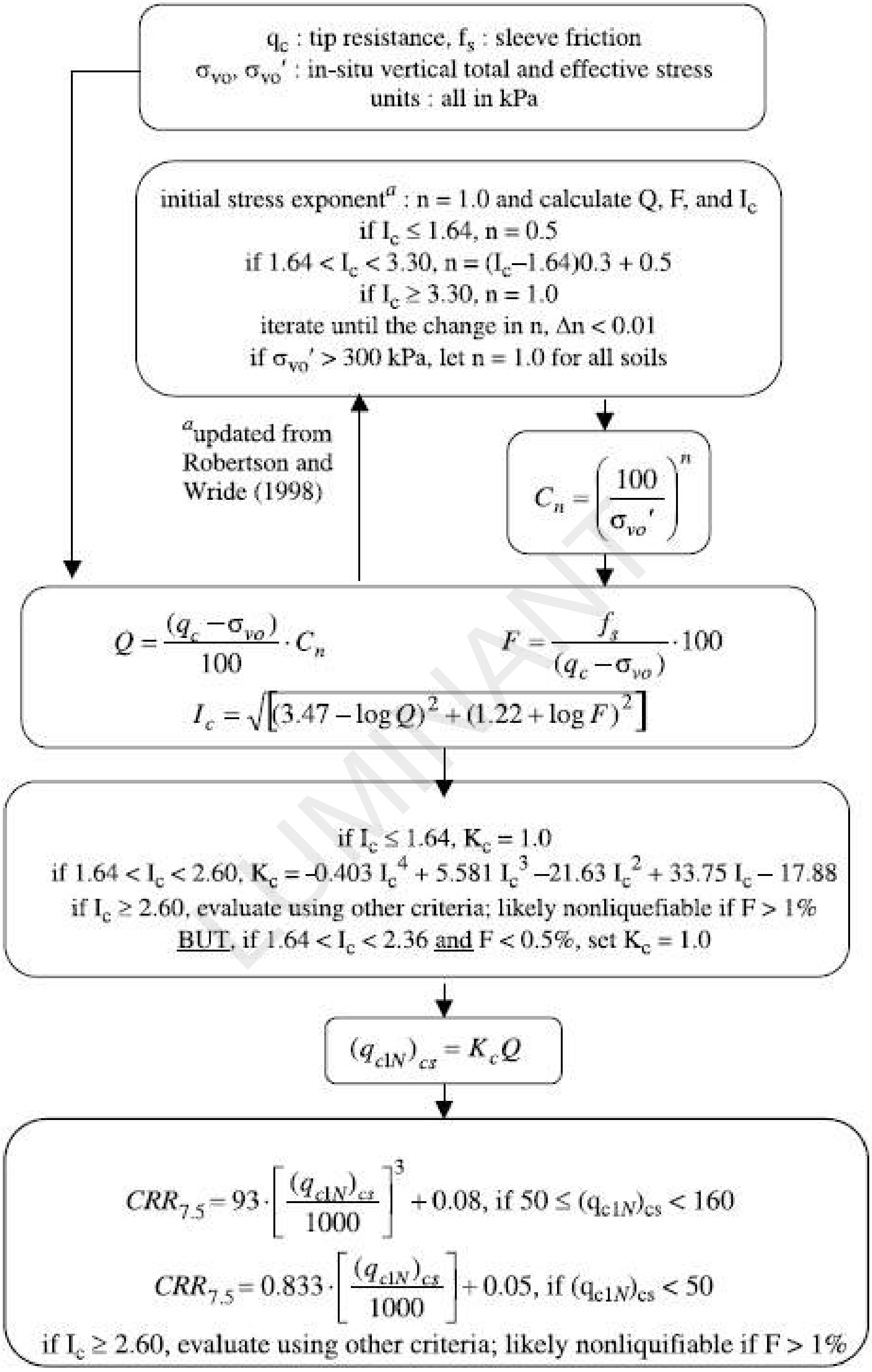
LPI = 0.00 - Liquefaction risk very low
LPI between 0.00 and 5.00 - Liquefaction risk low
LPI between 5.00 and 15.00 - Liquefaction risk high
LPI > 15.00 - Liquefaction risk very high

Abbreviations

FS:	Calculated factor of safety for test point
F_L:	1 - FS
w_z:	Function value of the extend of soil liquefaction according to depth
d_z:	Layer thickness (ft)
LPI:	Liquefaction potential index value for test point

Procedure for the evaluation of soil liquefaction resistance, NCEER (1998)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. The procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:



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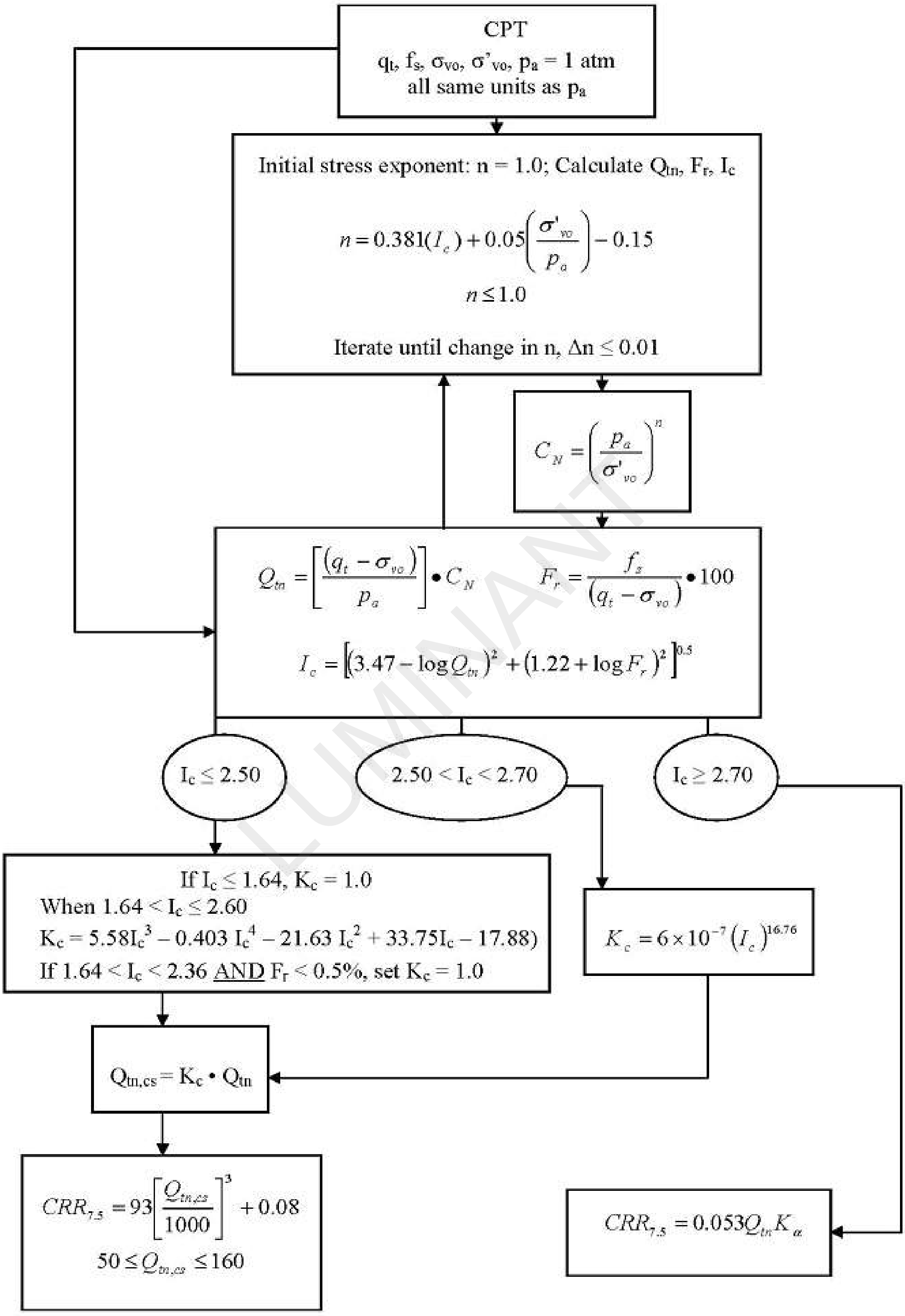
[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Procedure for the evaluation of soil liquefaction resistance (all soils), Robertson (2010)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:



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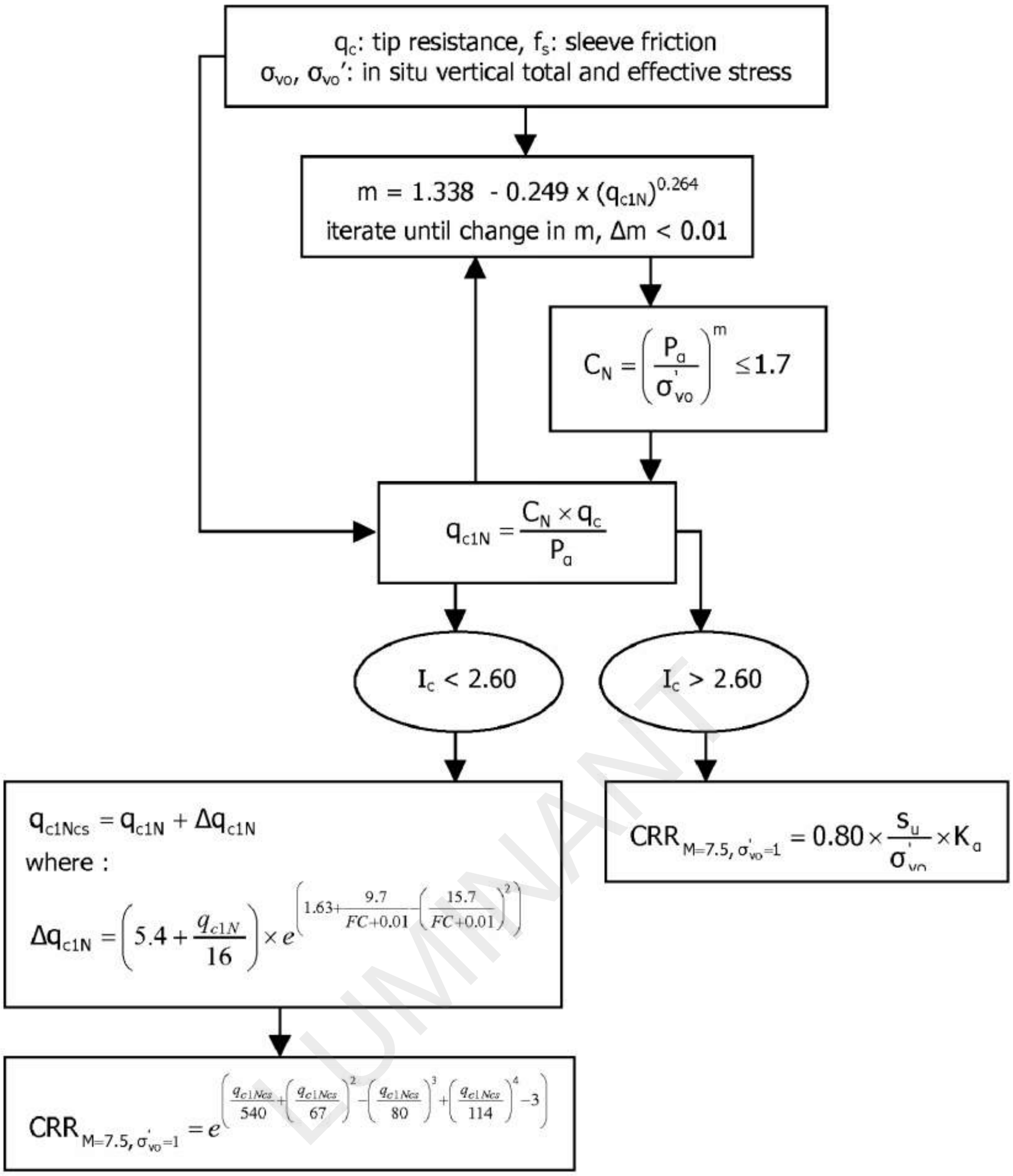
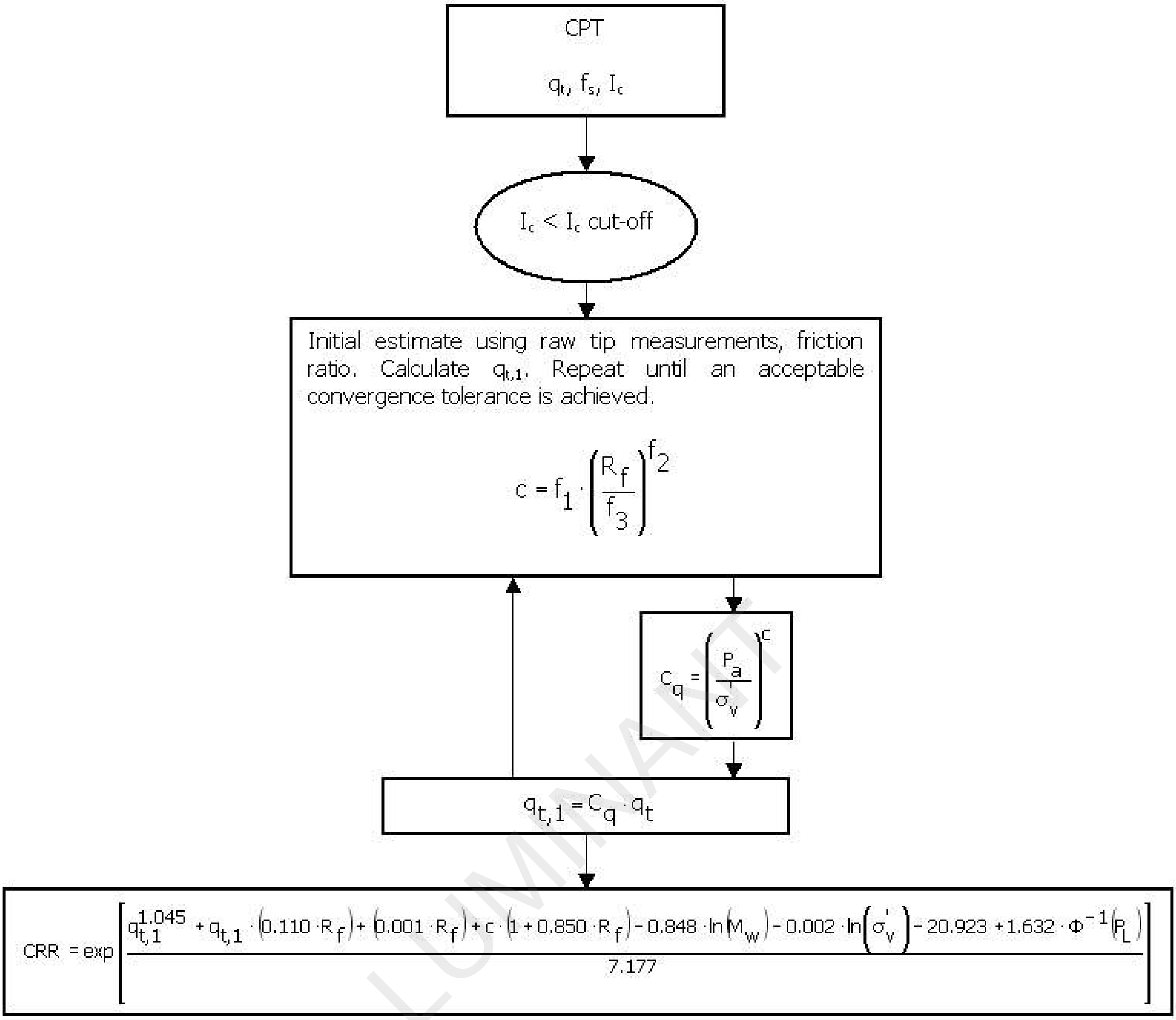
[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

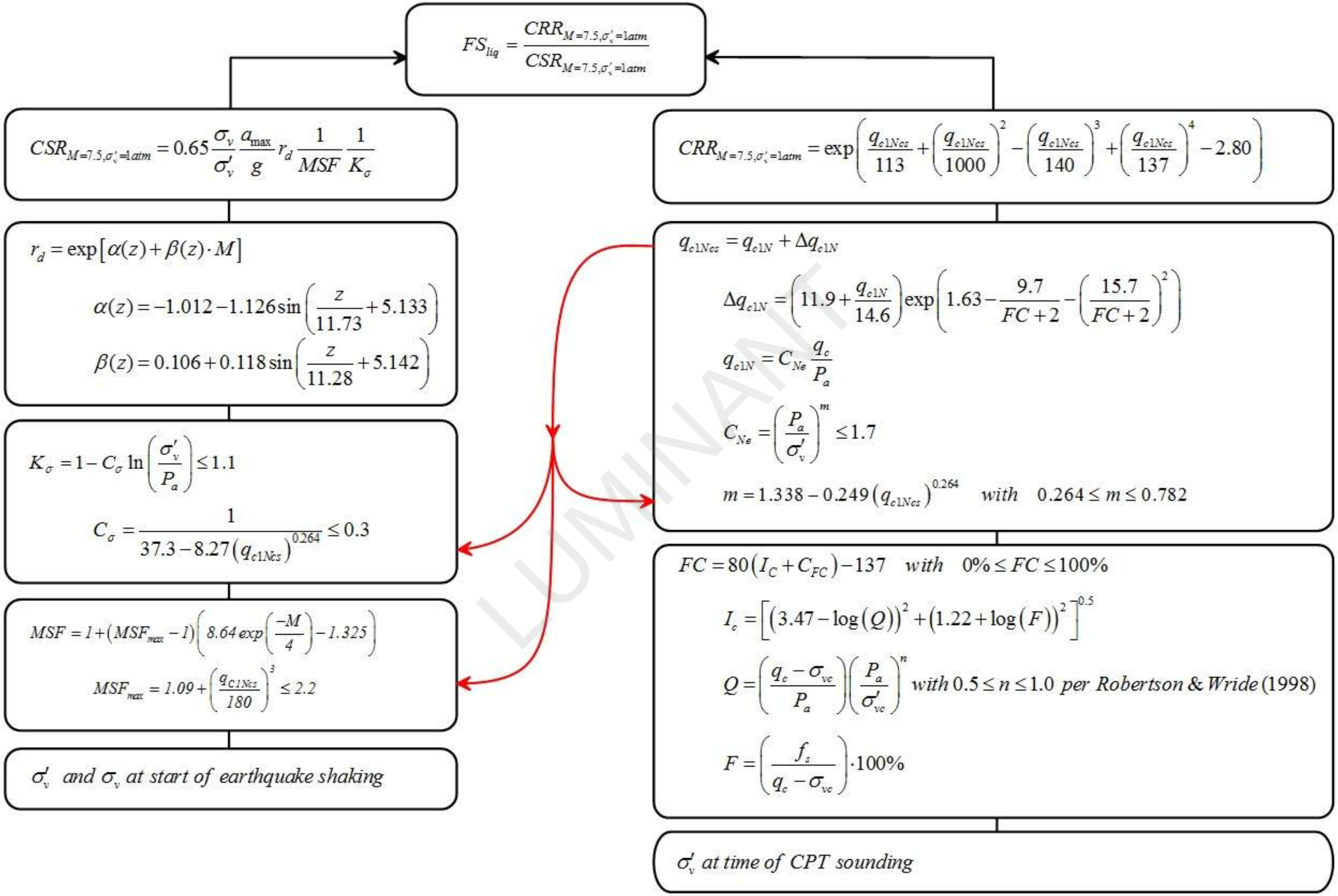
Procedure for the evaluation of soil liquefaction resistance, Idriss & Boulanger (2008)



Procedure for the evaluation of soil liquefaction resistance (sandy soils), Moss et al. (2006)



Procedure for the evaluation of soil liquefaction resistance, Boulanger & Idriss(2014)



$$FS_{liq} = \frac{CRR_{M=7.5,\sigma'_v=1atm}}{CSR_{M=7.5,\sigma'_v=1atm}}$$

$$CSR_{M=7.5,\sigma'_v=1atm} = 0.65\frac{\sigma_v}{\sigma'_v}\frac{a_{\max}}{g}r_d\frac{1}{MSF}\frac{1}{K_\sigma}$$

$$r_d = \exp\left[\alpha(z)+\beta(z)\cdot M\right]$$

$$\alpha(z) = -1.012-1.126\sin\left(\frac{z}{11.73}+5.133\right)$$

$$\beta(z) = 0.106+0.118\sin\left(\frac{z}{11.28}+5.142\right)$$

$$K_\sigma = 1-C_\sigma \ln\left(\frac{\sigma'_v}{P_a}\right) \le 1.1$$

$$C_\sigma = \frac{1}{37.3-8.27\left(q_{c1Ncs}\right)^{0.264}} \le 0.3$$

$$MSF = 1+(MSF_{max}-1)\left(8.64\exp\left(\frac{-M}{4}\right)-1.325\right)$$

$$MSF_{max} = 1.09+\left(\frac{q_{c1Ncs}}{180}\right)^3 \le 2.2$$

σ'_v and σ_v at start of earthquake shaking

$$CRR_{M=7.5,\sigma'_v=1atm} = \exp\left(\frac{q_{c1Ncs}}{113}+\left(\frac{q_{c1Ncs}}{1000}\right)^2-\left(\frac{q_{c1Ncs}}{140}\right)^3+\left(\frac{q_{c1Ncs}}{137}\right)^4-2.80\right)$$

$$q_{c1Ncs} = q_{c1N}+\Delta q_{c1N}$$

$$\Delta q_{c1N} = \left(11.9+\frac{q_{c1N}}{14.6}\right)\exp\left(1.63-\frac{9.7}{FC+2}-\left(\frac{15.7}{FC+2}\right)^2\right)$$

$$q_{c1N} = C_{Ne}\frac{q_c}{P_a}$$

$$C_{Ne} = \left(\frac{P_a}{\sigma'_v}\right)^m \le 1.7$$

$$m = 1.338-0.249\left(q_{c1Ncs}\right)^{0.264} \quad with \quad 0.264 \le m \le 0.782$$

$$FC = 80\left(I_C+C_{FC}\right)-137 \quad with \quad 0\% \le FC \le 100\%$$

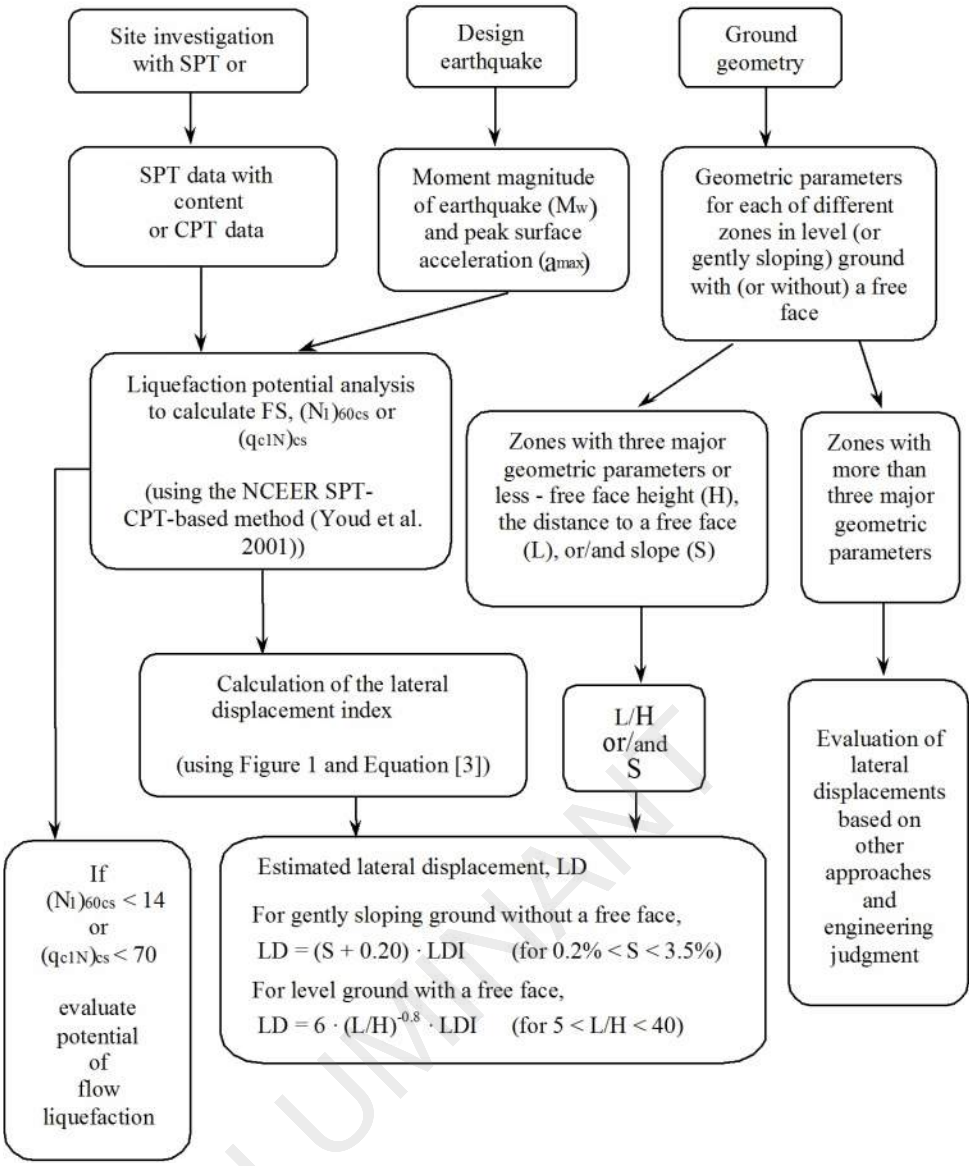
$$I_c = \left[\left(3.47-\log(Q)\right)^2+\left(1.22+\log(F)\right)^2\right]^{0.5}$$

$$Q = \left(\frac{q_c-\sigma_{vc}}{P_a}\right)\left(\frac{P_a}{\sigma'_{vc}}\right)^n \text{ with } 0.5 \le n \le 1.0 \text{ per Robertson \& Wride (1998)}$$

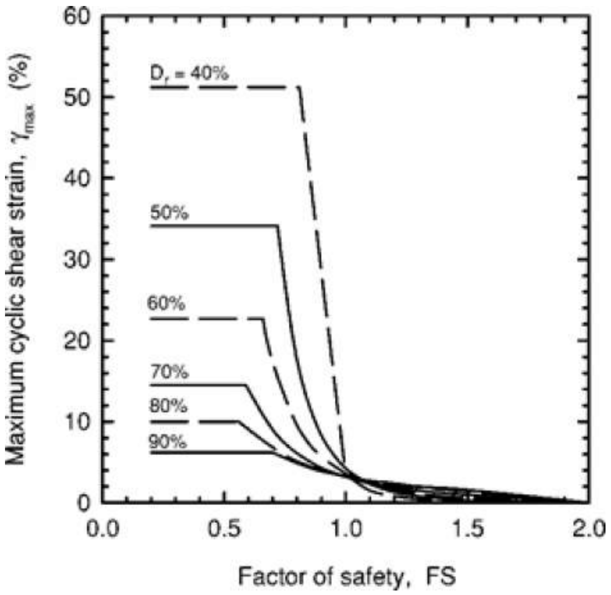
$$F = \left(\frac{f_s}{q_c-\sigma_{vc}}\right)\cdot 100\%$$

σ'_v at time of CPT sounding

Procedure for the evaluation of liquefaction-induced lateral spreading displacements



[1] Flow chart illustrating major steps in estimating liquefaction-induced lateral spreading displacements using the proposed approach



[1] **Figure 1**

$$LDI = \int_0^{Z_{max}} \gamma_{max} dz$$

[1] **Equation [3]**

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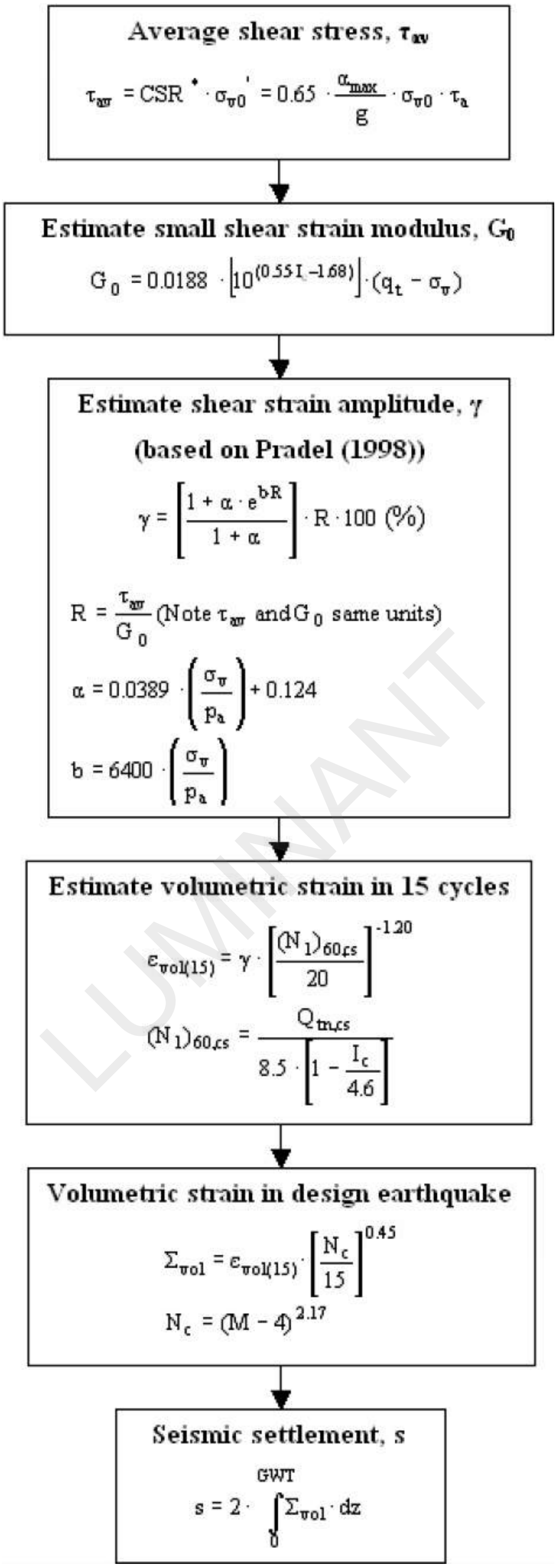
[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Procedure for the estimation of seismic induced settlements in dry sands



Average shear stress, τ_{av}

$$\tau_{av} = CSR^{*} \cdot \sigma_{v0}' = 0.65 \cdot \frac{\alpha_{max}}{g} \cdot \sigma_{v0} \cdot \tau_{a}$$

Estimate small shear strain modulus, G_0

$$G_0 = 0.0188 \cdot \left[10^{(0.55 I_c - 1.68)}\right] \cdot (q_t - \sigma_v)$$

Estimate shear strain amplitude, γ (based on Pradel (1998))

$$\gamma = \left[\frac{1 + \alpha \cdot e^{bR}}{1 + \alpha}\right] \cdot R \cdot 100 \ (\%)$$

$$R = \frac{\tau_{av}}{G_0} \text{ (Note } \tau_{av} \text{ and } G_0 \text{ same units)}$$

$$\alpha = 0.0389 \cdot \left(\frac{\sigma_v}{p_a}\right) + 0.124$$

$$b = 6400 \cdot \left(\frac{\sigma_v}{p_a}\right)$$

Estimate volumetric strain in 15 cycles

$$\varepsilon_{vol(15)} = \gamma \cdot \left[\frac{(N_1)_{60cs}}{20}\right]^{-1.20}$$

$$(N_1)_{60,cs} = \frac{Q_{tn,cs}}{8.5 \cdot \left[1 - \frac{I_c}{4.6}\right]}$$

Volumetric strain in design earthquake

$$\Sigma_{vol} = \varepsilon_{vol(15)} \cdot \left[\frac{N_c}{15}\right]^{0.45}$$

$$N_c = (M - 4)^{2.17}$$

Seismic settlement, s

$$s = 2 \cdot \int_{0}^{GWT} \Sigma_{vol} \cdot dz$$

Robertson, P.K. and Lisheng, S., 2010, “Estimation of seismic compression in dry soils using the CPT” FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, Symposium in honor of professor I. M. Idriss, San Diego, CA

Liquefaction Potential Index (LPI) calculation procedure

Calculation of the Liquefaction Potential Index (LPI) is used to interpret the liquefaction assessment calculations in terms of severity over depth. The calculation procedure is based on the methology developed by Iwasaki (1982) and is adopted by AFPS.

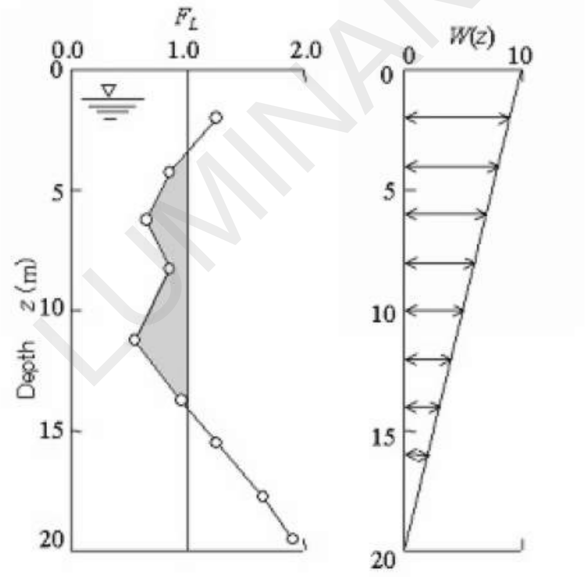
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$\textbf{LPI =} \int_{0}^{20} (10 - 0{,}5_{z}) \times F_{L} \times d_{z}$$

where:
F_L = 1 - F.S. when F.S. less than 1
F_L = 0 when F.S. greater than 1
z depth of measurment in meters

Values of LPI range between zero (0) when no test point is characterized as liquefiable and 100 when all points are characterized as susceptible to liquefaction. Iwasaki proposed four (4) discrete categories based on the numeric value of LPI:

- LPI = 0 : Liquefaction risk is very low
- 0 < LPI <= 5 : Liquefaction risk is low
- 5 < LPI <= 15 : Liquefaction risk is high
- LPI > 15 : Liquefaction risk is very high



Graphical presentation of the LPI calculation procedure

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- Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, *Symposium in honor of professor I. M. Idriss,* SAN diego, CA

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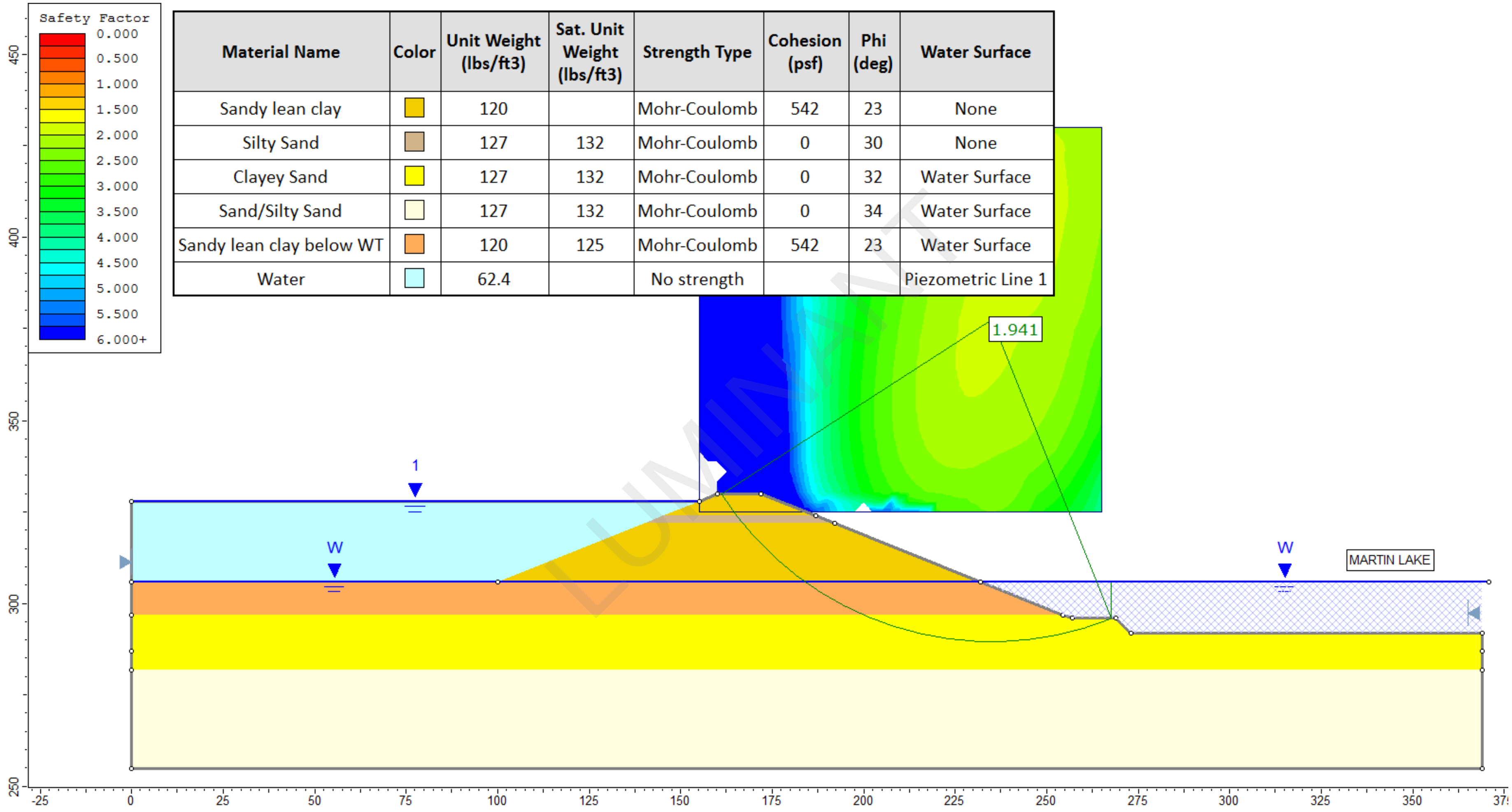
APPENDIX D

SLOPE STABILITY ANALYSIS RESULTS

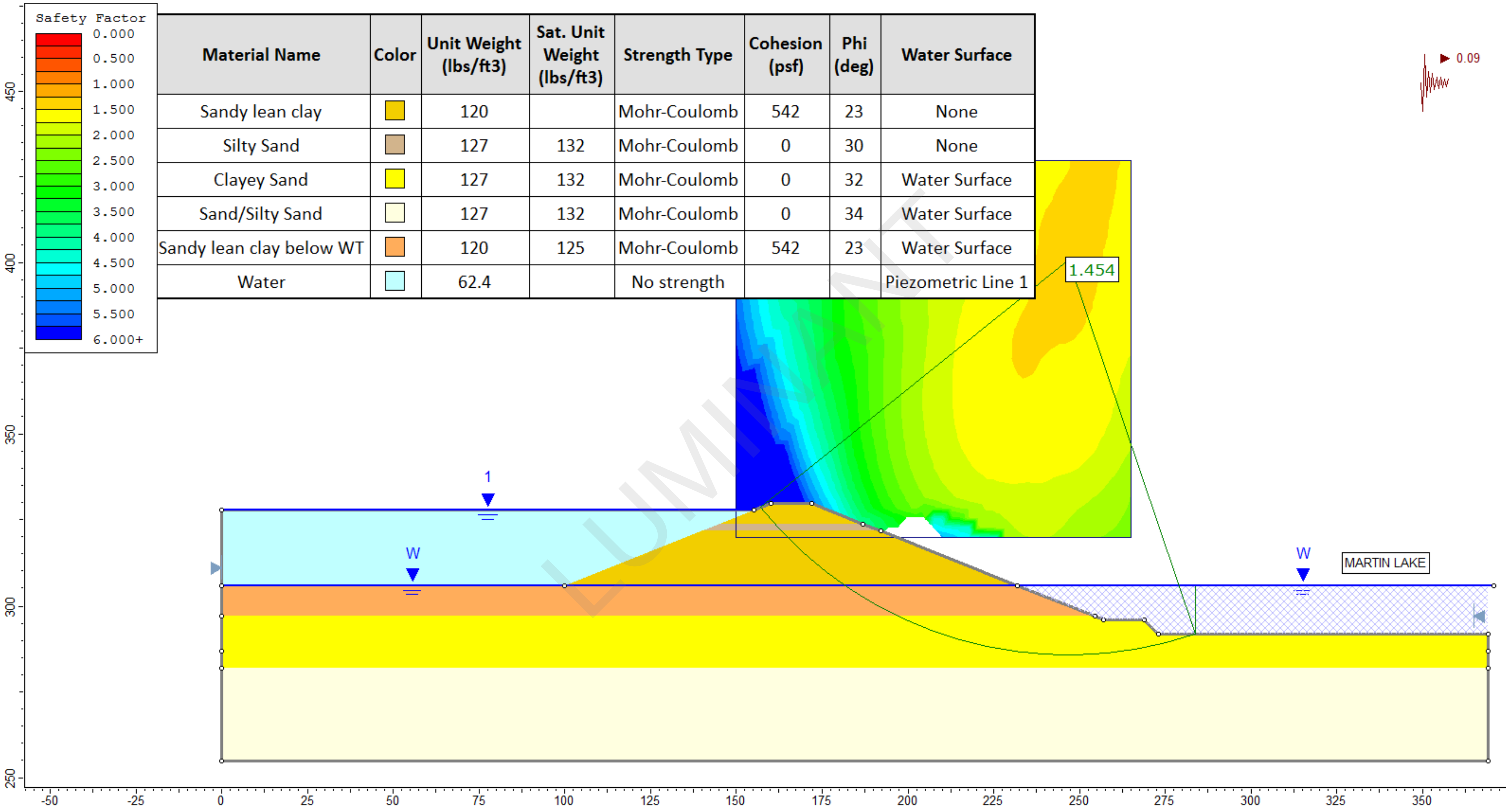


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Sandy lean clay	🟨	120		Mohr-Coulomb	542	23	None
Silty Sand	🟫	127	132	Mohr-Coulomb	0	30	None
Clayey Sand	🟨	127	132	Mohr-Coulomb	0	32	Water Surface
Sand/Silty Sand	⬜	127	132	Mohr-Coulomb	0	34	Water Surface
Sandy lean clay below WT	🟧	120	125	Mohr-Coulomb	542	23	Water Surface
Water	🟦	62.4		No strength			Piezometric Line 1

FIGURE **C.1**

Results of Stability Analysis – BAP–SP: A–A' – Case 1a

Stability and Safety Factor Assessment, Martin Lake SES

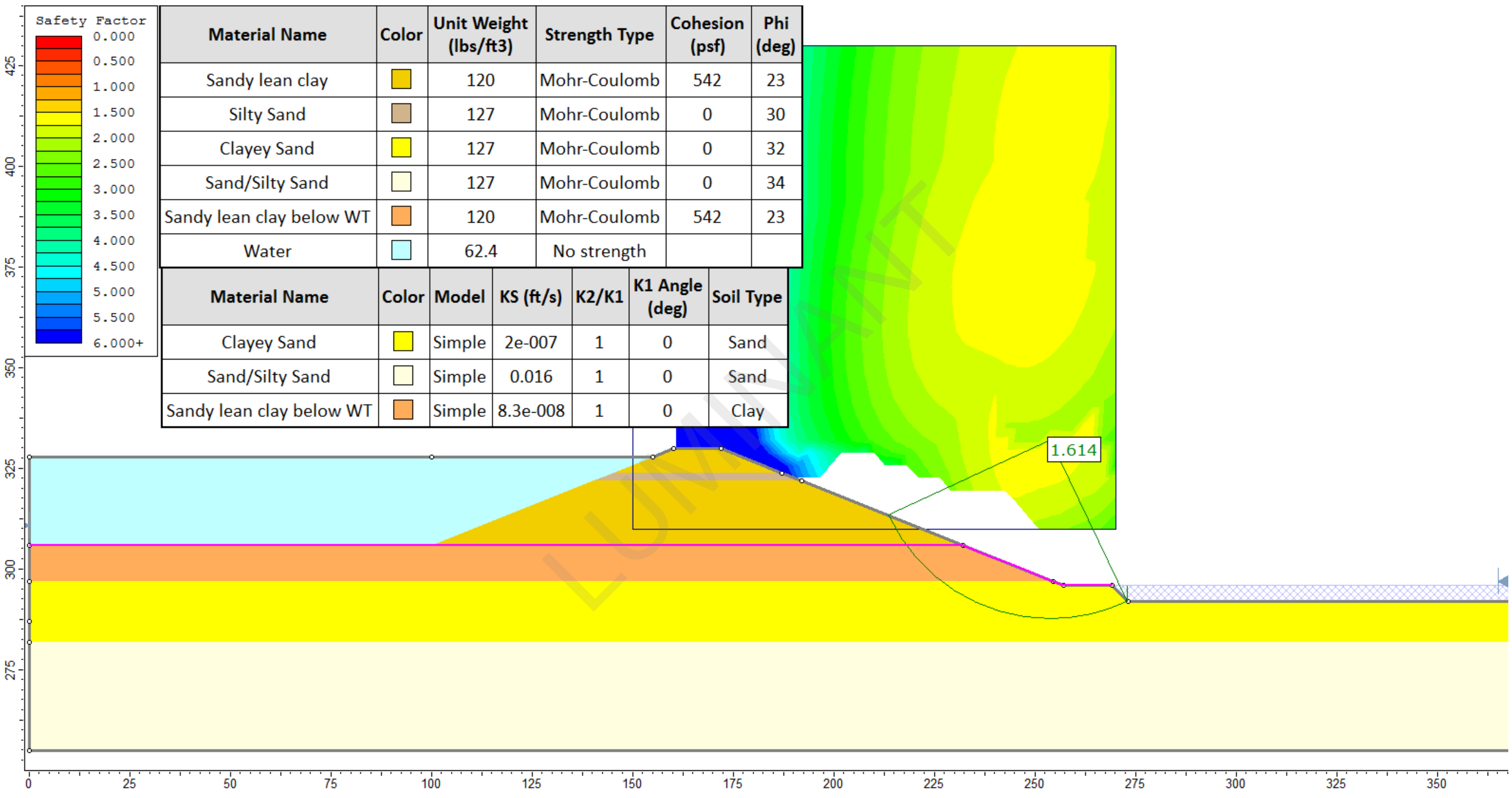


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Sandy lean clay	🟨	120		Mohr-Coulomb	542	23	None
Silty Sand	🟫	127	132	Mohr-Coulomb	0	30	None
Clayey Sand	🟨	127	132	Mohr-Coulomb	0	32	Water Surface
Sand/Silty Sand	⬜	127	132	Mohr-Coulomb	0	34	Water Surface
Sandy lean clay below WT	🟧	120	125	Mohr-Coulomb	542	23	Water Surface
Water	🟦	62.4		No strength			Piezometric Line 1

FIGURE **C.2**

Results of Stability Analysis – BAP–SP: A–A' – Case 1b

Stability and Safety Factor Assessment, Martin Lake SES



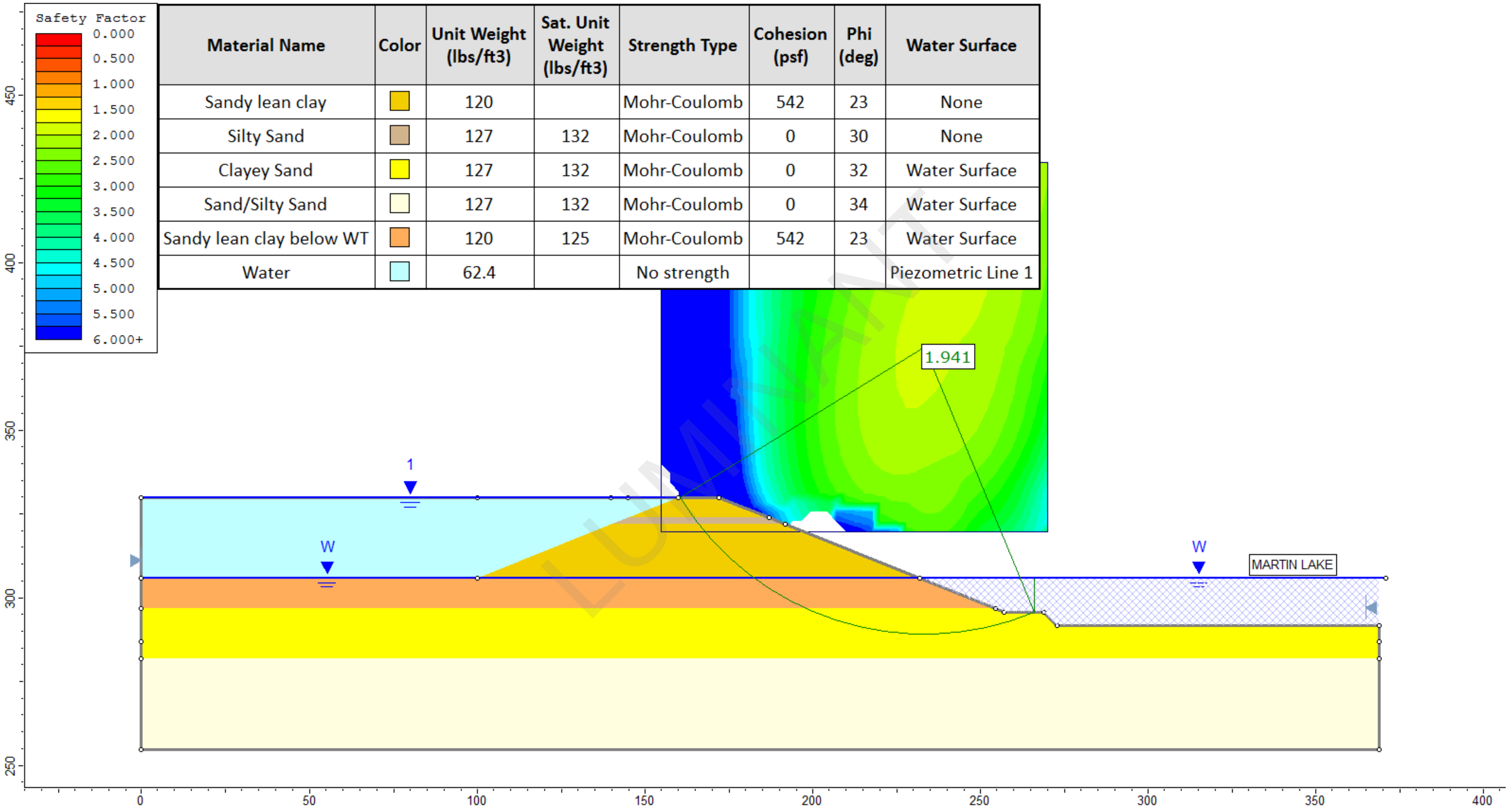
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sandy lean clay	🟨	120	Mohr-Coulomb	542	23
Silty Sand	🟫	127	Mohr-Coulomb	0	30
Clayey Sand	🟨	127	Mohr-Coulomb	0	32
Sand/Silty Sand	⬜	127	Mohr-Coulomb	0	34
Sandy lean clay below WT	🟧	120	Mohr-Coulomb	542	23
Water	🟦	62.4	No strength		

Material Name	Color	Model	KS (ft/s)	K2/K1	K1 Angle (deg)	Soil Type
Clayey Sand	🟨	Simple	2e-007	1	0	Sand
Sand/Silty Sand	⬜	Simple	0.016	1	0	Sand
Sandy lean clay below WT	🟧	Simple	8.3e-008	1	0	Clay

FIGURE **C.3**

Results of Stability Analysis – BAP–SP: A–A' – Case 1c

Stability and Safety Factor Assessment, Martin Lake SES

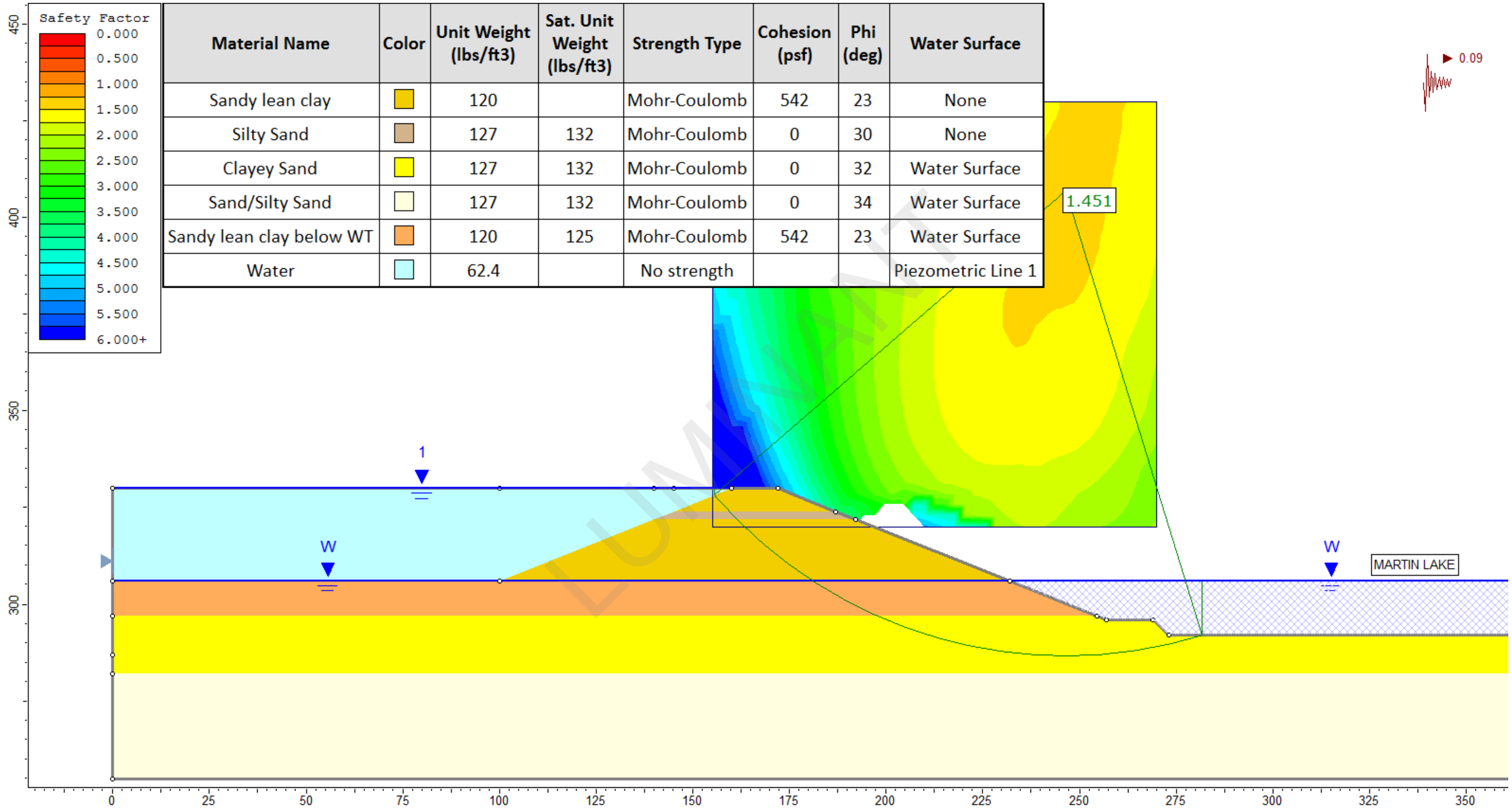


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Sandy lean clay	🟨	120		Mohr-Coulomb	542	23	None
Silty Sand	🟫	127	132	Mohr-Coulomb	0	30	None
Clayey Sand	🟨	127	132	Mohr-Coulomb	0	32	Water Surface
Sand/Silty Sand	⬜	127	132	Mohr-Coulomb	0	34	Water Surface
Sandy lean clay below WT	🟧	120	125	Mohr-Coulomb	542	23	Water Surface
Water	🟦	62.4		No strength			Piezometric Line 1

FIGURE **C.4**

Results of Stability Analysis − BAP−SP: A−A' − Case 2a

Stability and Safety Factor Assessment, Martin Lake SES

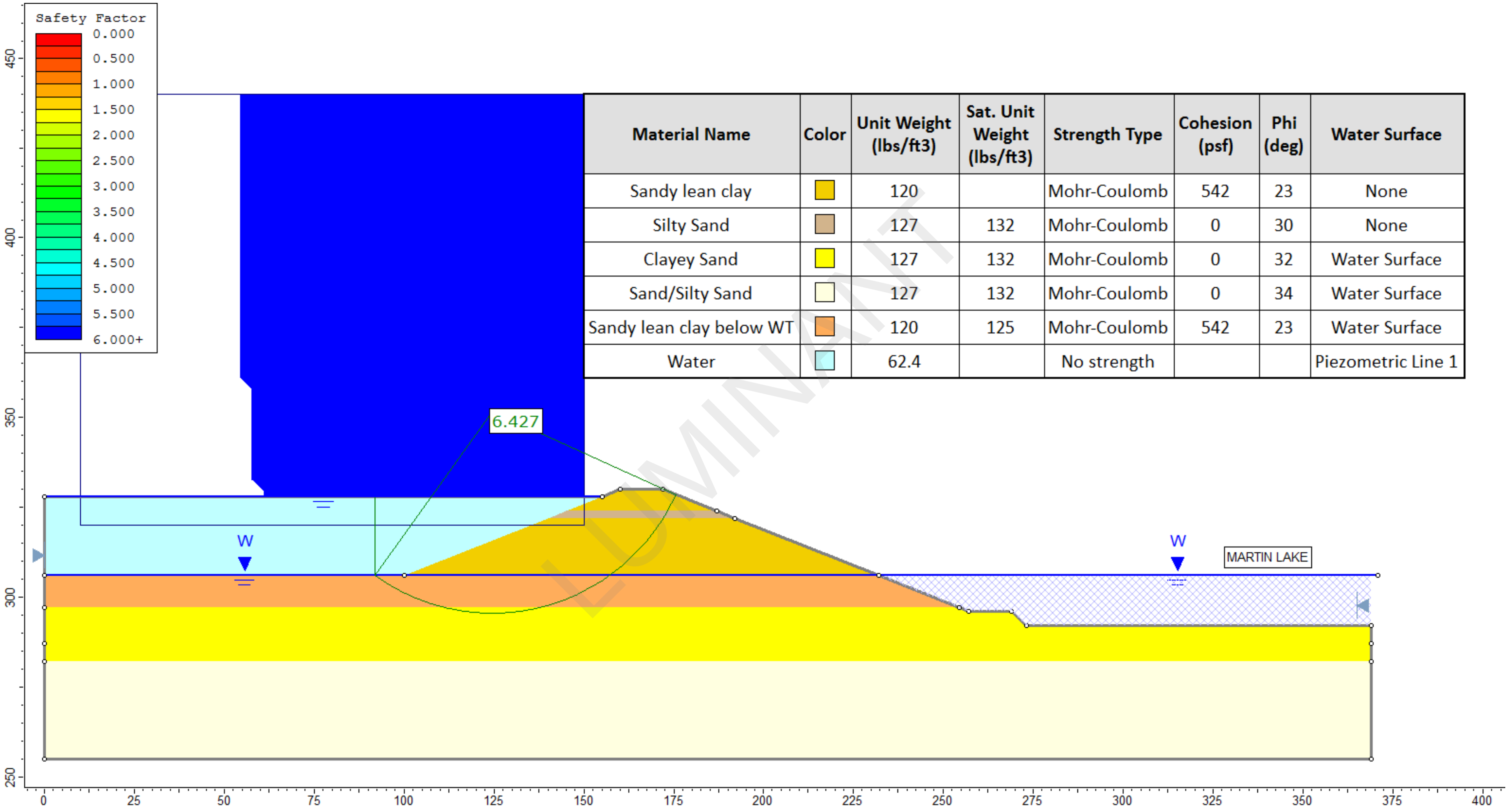


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Sandy lean clay	🟨	120		Mohr-Coulomb	542	23	None
Silty Sand	🟫	127	132	Mohr-Coulomb	0	30	None
Clayey Sand	🟨	127	132	Mohr-Coulomb	0	32	Water Surface
Sand/Silty Sand	⬜	127	132	Mohr-Coulomb	0	34	Water Surface
Sandy lean clay below WT	🟧	120	125	Mohr-Coulomb	542	23	Water Surface
Water	🟦	62.4		No strength			Piezometric Line 1

FIGURE **C.5**

Results of Stability Analysis – BAP–SP: A–A' – Case 2b

Stability and Safety Factor Assessment, Martin Lake SES

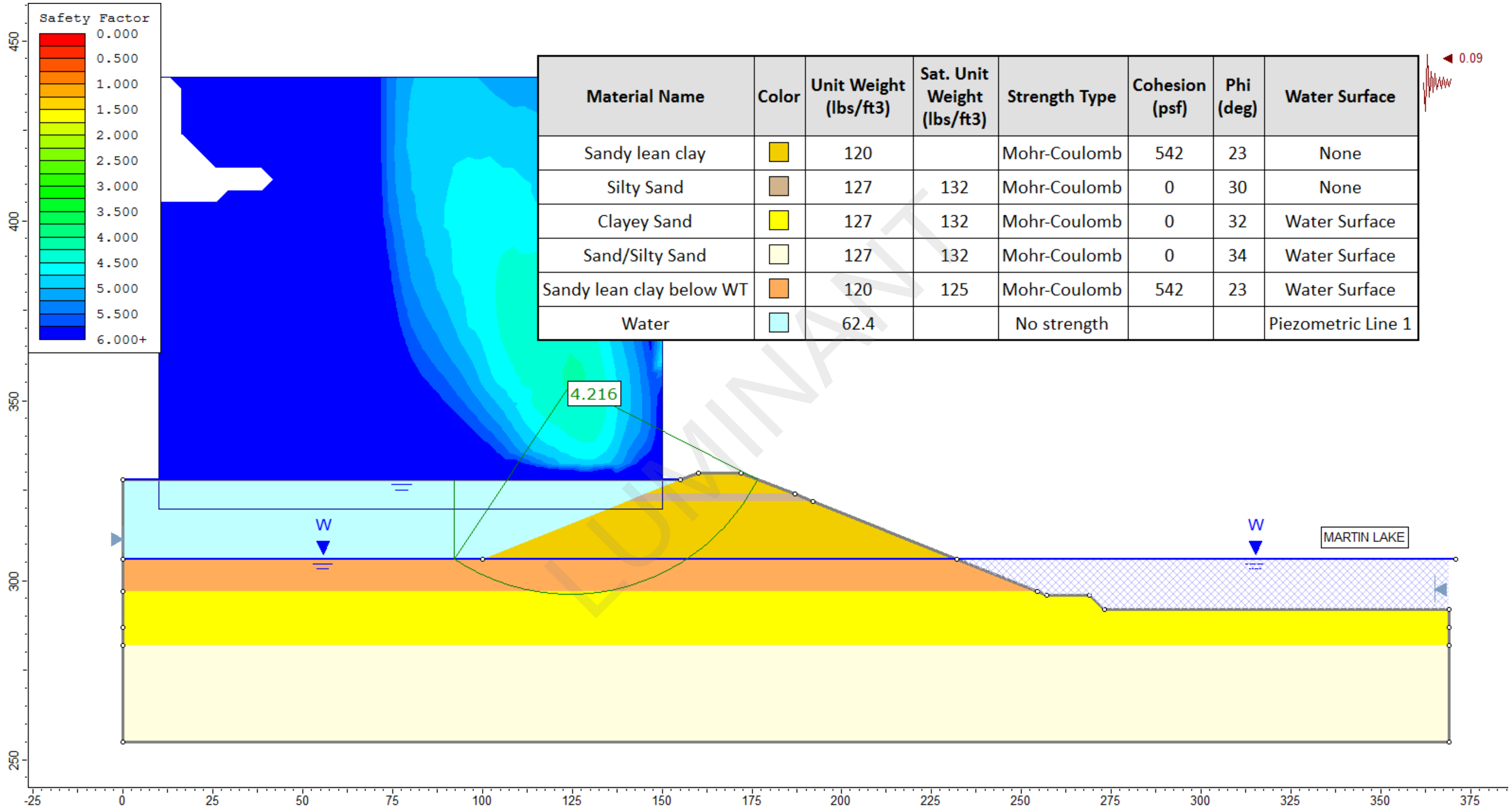


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Sandy lean clay	🟨	120		Mohr-Coulomb	542	23	None
Silty Sand	🟫	127	132	Mohr-Coulomb	0	30	None
Clayey Sand	🟨	127	132	Mohr-Coulomb	0	32	Water Surface
Sand/Silty Sand	⬜	127	132	Mohr-Coulomb	0	34	Water Surface
Sandy lean clay below WT	🟧	120	125	Mohr-Coulomb	542	23	Water Surface
Water	🟦	62.4		No strength			Piezometric Line 1

FIGURE **C.6**

Results of Stability Analysis − BAP−SP: A−A' − Case 3a

Stability and Safety Factor Assessment, Martin Lake SES

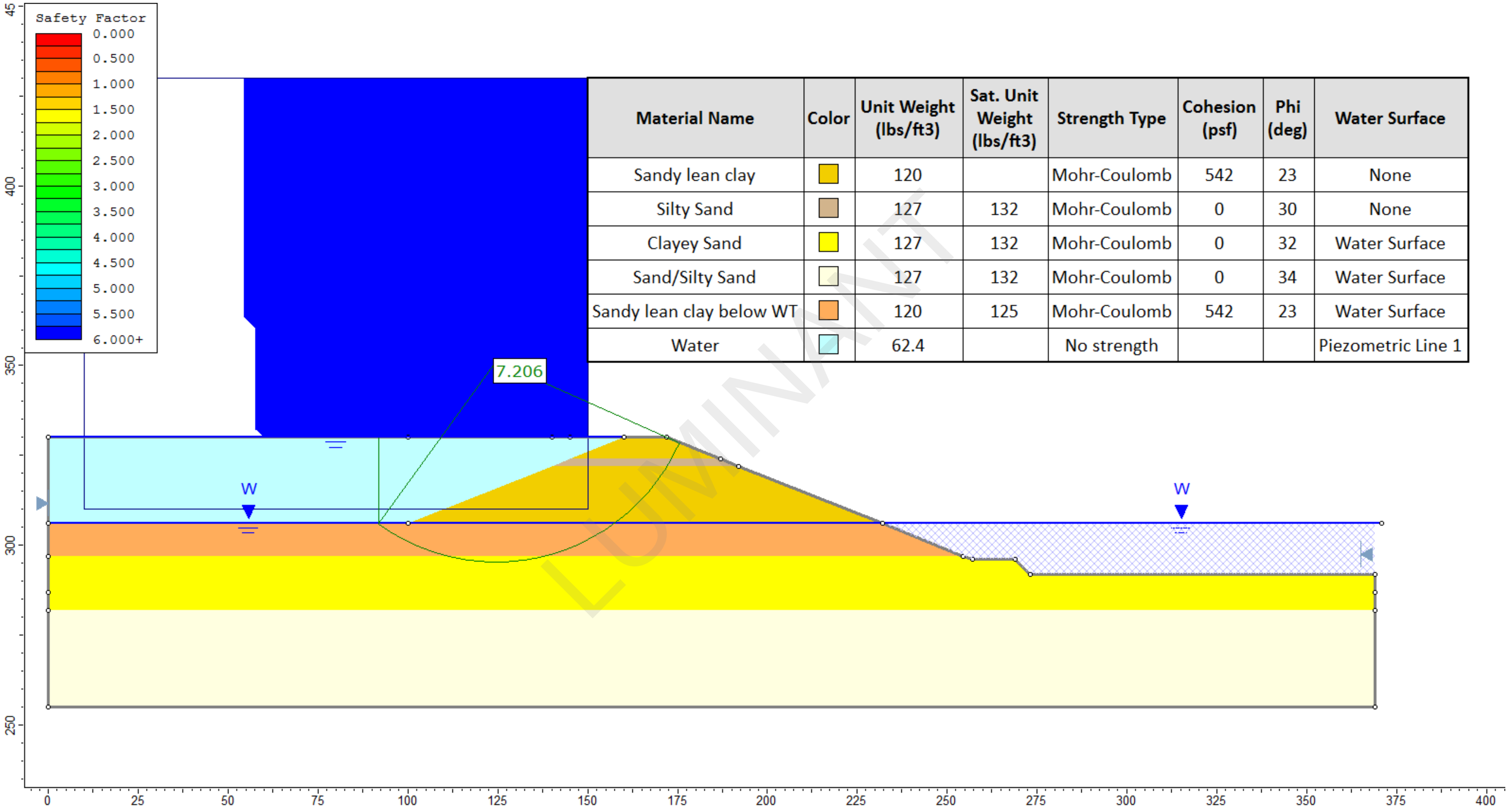


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Sandy lean clay	🟨	120		Mohr-Coulomb	542	23	None
Silty Sand	🟫	127	132	Mohr-Coulomb	0	30	None
Clayey Sand	🟨	127	132	Mohr-Coulomb	0	32	Water Surface
Sand/Silty Sand	⬜	127	132	Mohr-Coulomb	0	34	Water Surface
Sandy lean clay below WT	🟧	120	125	Mohr-Coulomb	542	23	Water Surface
Water	🟦	62.4		No strength			Piezometric Line 1

FIGURE **C.7**

Results of Stability Analysis – BAP–SP: A–A' – Case 3b

Stability and Safety Factor Assessment, Martin Lake SES

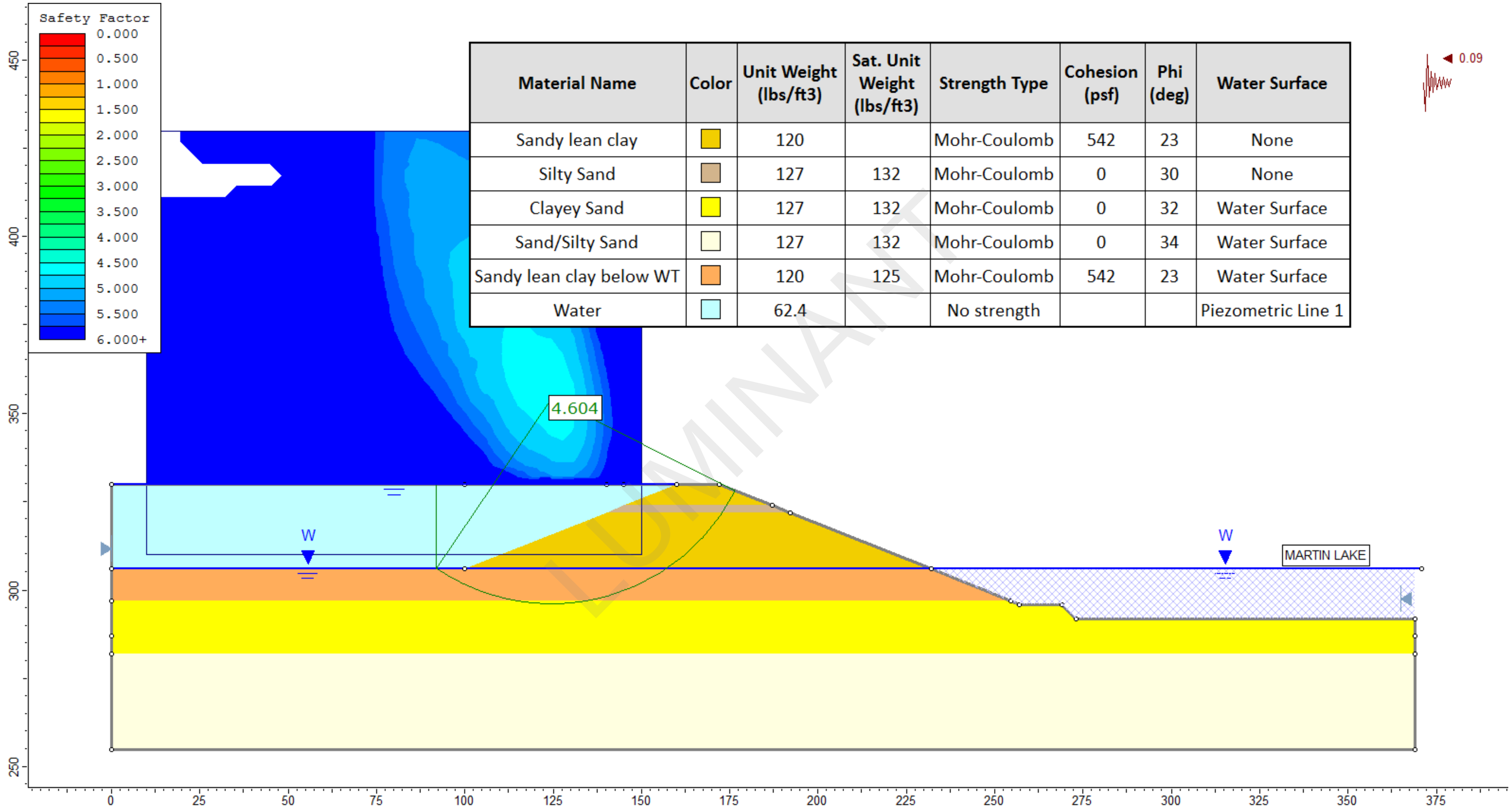


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Sandy lean clay	🟨	120		Mohr-Coulomb	542	23	None
Silty Sand	🟫	127	132	Mohr-Coulomb	0	30	None
Clayey Sand	🟨	127	132	Mohr-Coulomb	0	32	Water Surface
Sand/Silty Sand	⬜	127	132	Mohr-Coulomb	0	34	Water Surface
Sandy lean clay below WT	🟧	120	125	Mohr-Coulomb	542	23	Water Surface
Water	🟦	62.4		No strength			Piezometric Line 1

FIGURE **C.8**

Results of Stability Analysis – BAP–SP: A–A' – Case 4a

Stability and Safety Factor Assessment, Martin Lake SES

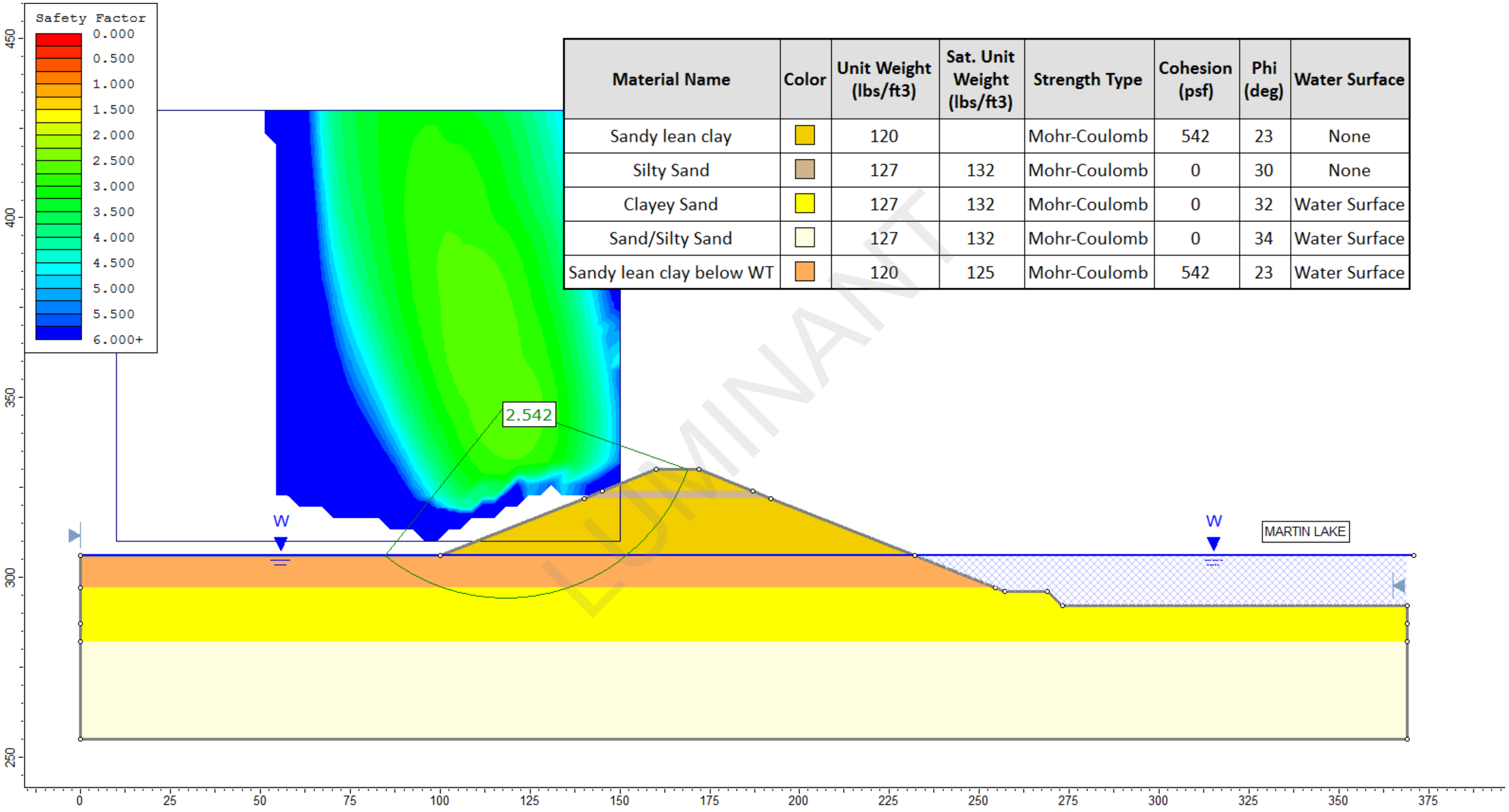


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Sandy lean clay	🟨	120		Mohr-Coulomb	542	23	None
Silty Sand	🟫	127	132	Mohr-Coulomb	0	30	None
Clayey Sand	🟨	127	132	Mohr-Coulomb	0	32	Water Surface
Sand/Silty Sand	⬜	127	132	Mohr-Coulomb	0	34	Water Surface
Sandy lean clay below WT	🟧	120	125	Mohr-Coulomb	542	23	Water Surface
Water	🟦	62.4		No strength			Piezometric Line 1

FIGURE **C.9**

Results of Stability Analysis – BAP–SP: A–A' – Case 4b

Stability and Safety Factor Assessment, Martin Lake SES

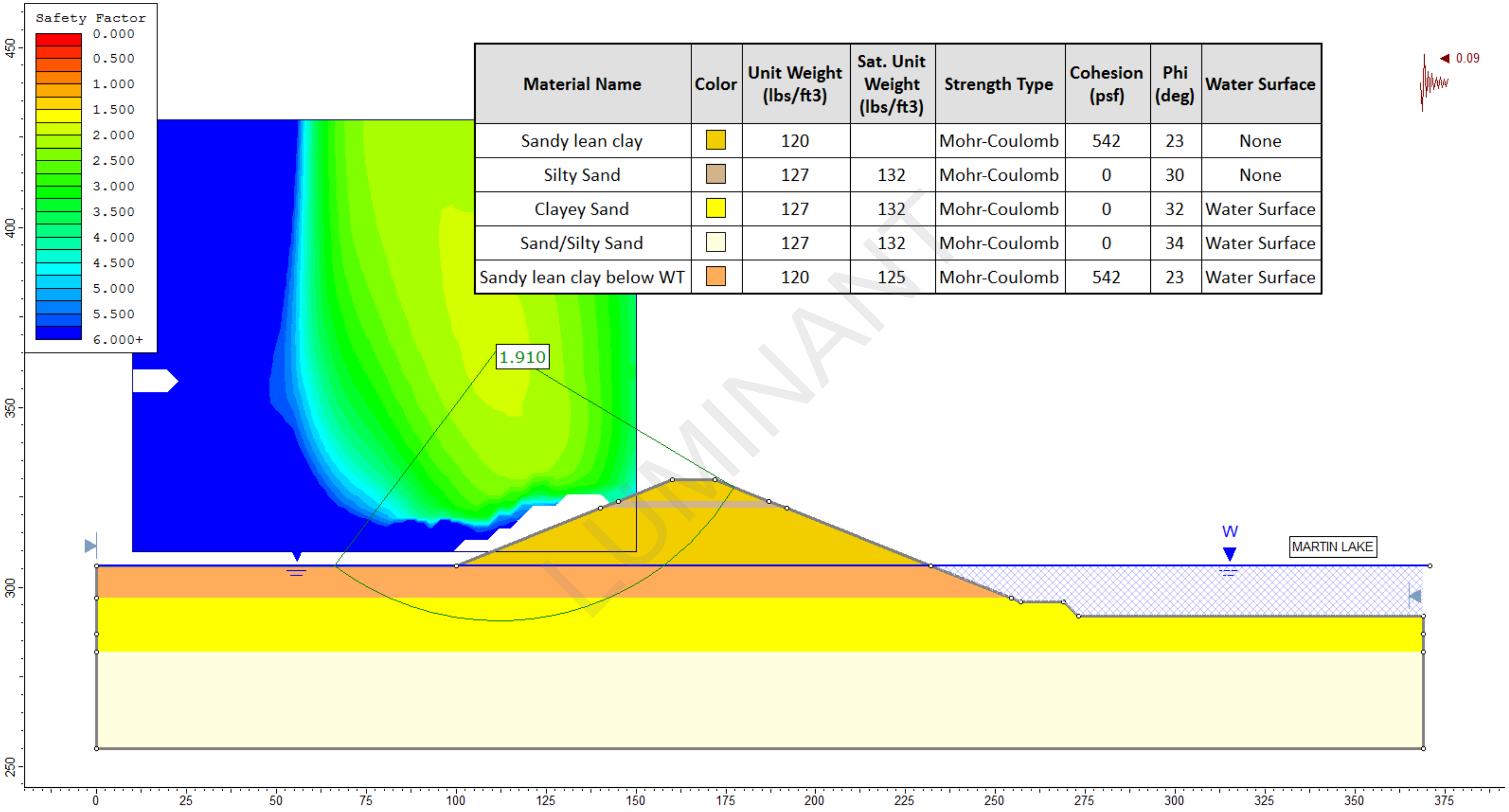


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Sandy lean clay	🟨	120		Mohr-Coulomb	542	23	None
Silty Sand	🟫	127	132	Mohr-Coulomb	0	30	None
Clayey Sand	🟨	127	132	Mohr-Coulomb	0	32	Water Surface
Sand/Silty Sand	⬜	127	132	Mohr-Coulomb	0	34	Water Surface
Sandy lean clay below WT	🟧	120	125	Mohr-Coulomb	542	23	Water Surface

FIGURE **C.10**

Results of Stability Analysis – BAP–SP: A–A' – Case 5a

Stability and Safety Factor Assessment, Martin Lake SES

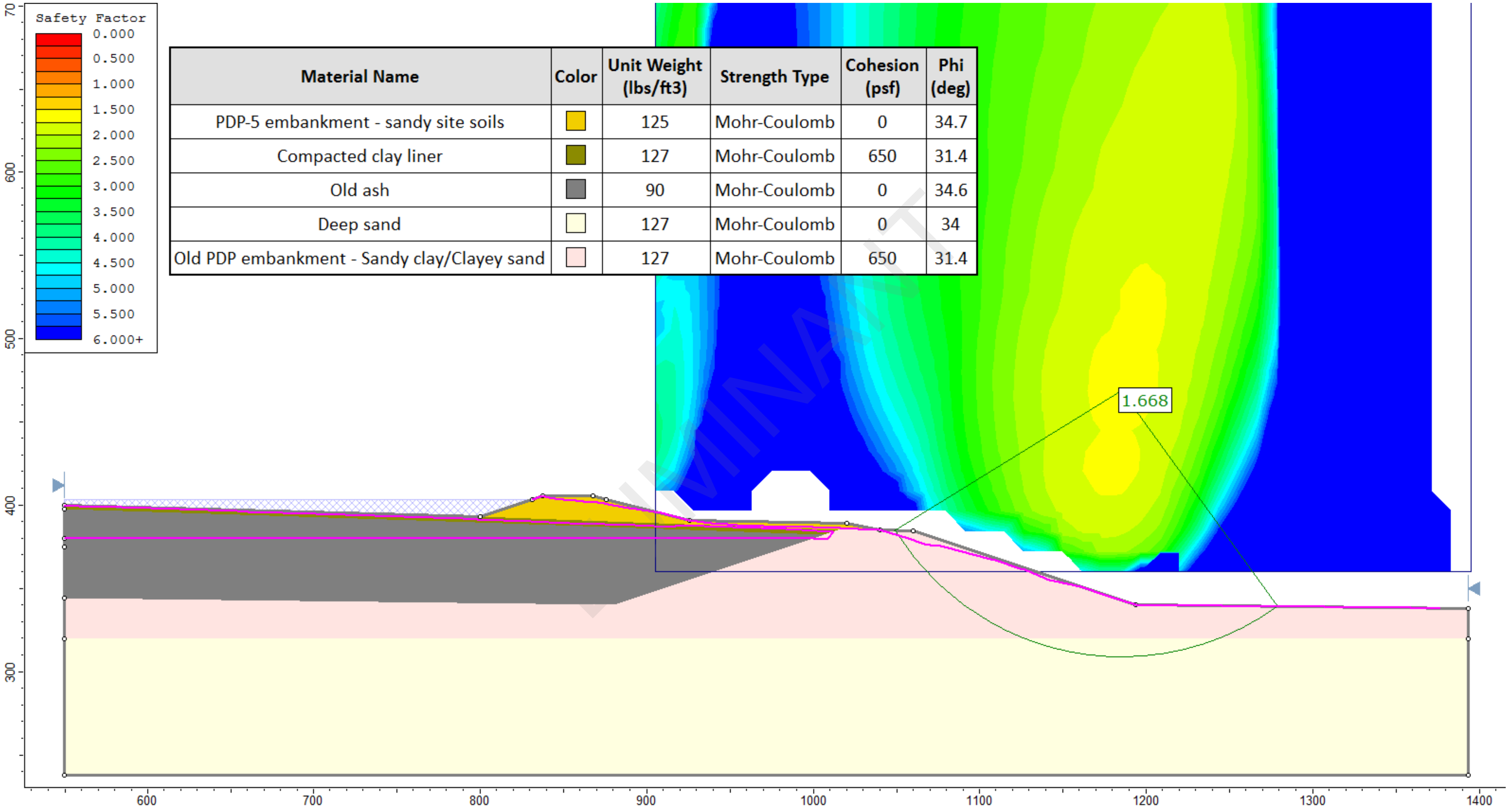


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Sandy lean clay	🟨	120		Mohr-Coulomb	542	23	None
Silty Sand	🟫	127	132	Mohr-Coulomb	0	30	None
Clayey Sand	🟨	127	132	Mohr-Coulomb	0	32	Water Surface
Sand/Silty Sand	⬜	127	132	Mohr-Coulomb	0	34	Water Surface
Sandy lean clay below WT	🟧	120	125	Mohr-Coulomb	542	23	Water Surface

FIGURE **C.11**

Results of Stability Analysis – BAP–SP: A–A' – Case 5b

Stability and Safety Factor Assessment, Martin Lake SES

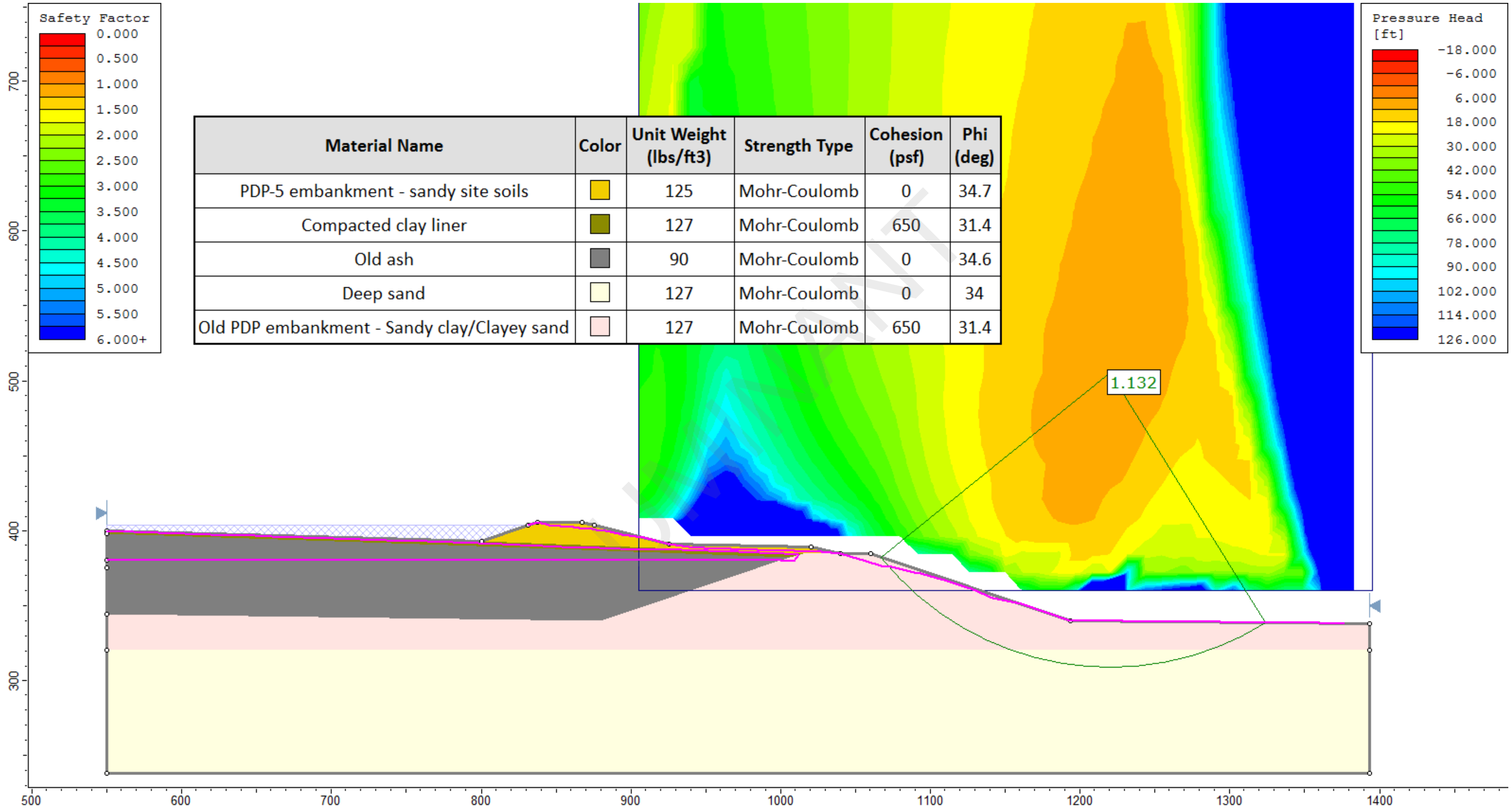


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
PDP-5 embankment - sandy site soils	🟨	125	Mohr-Coulomb	0	34.7
Compacted clay liner	🟫	127	Mohr-Coulomb	650	31.4
Old ash	⬛	90	Mohr-Coulomb	0	34.6
Deep sand	⬜	127	Mohr-Coulomb	0	34
Old PDP embankment - Sandy clay/Clayey sand	⬜	127	Mohr-Coulomb	650	31.4

FIGURE **C.12**

Results of Stability Analysis – PDP5: B–B' – Case 1a

Stability and Safety Factor Assessment, Martin Lake SES

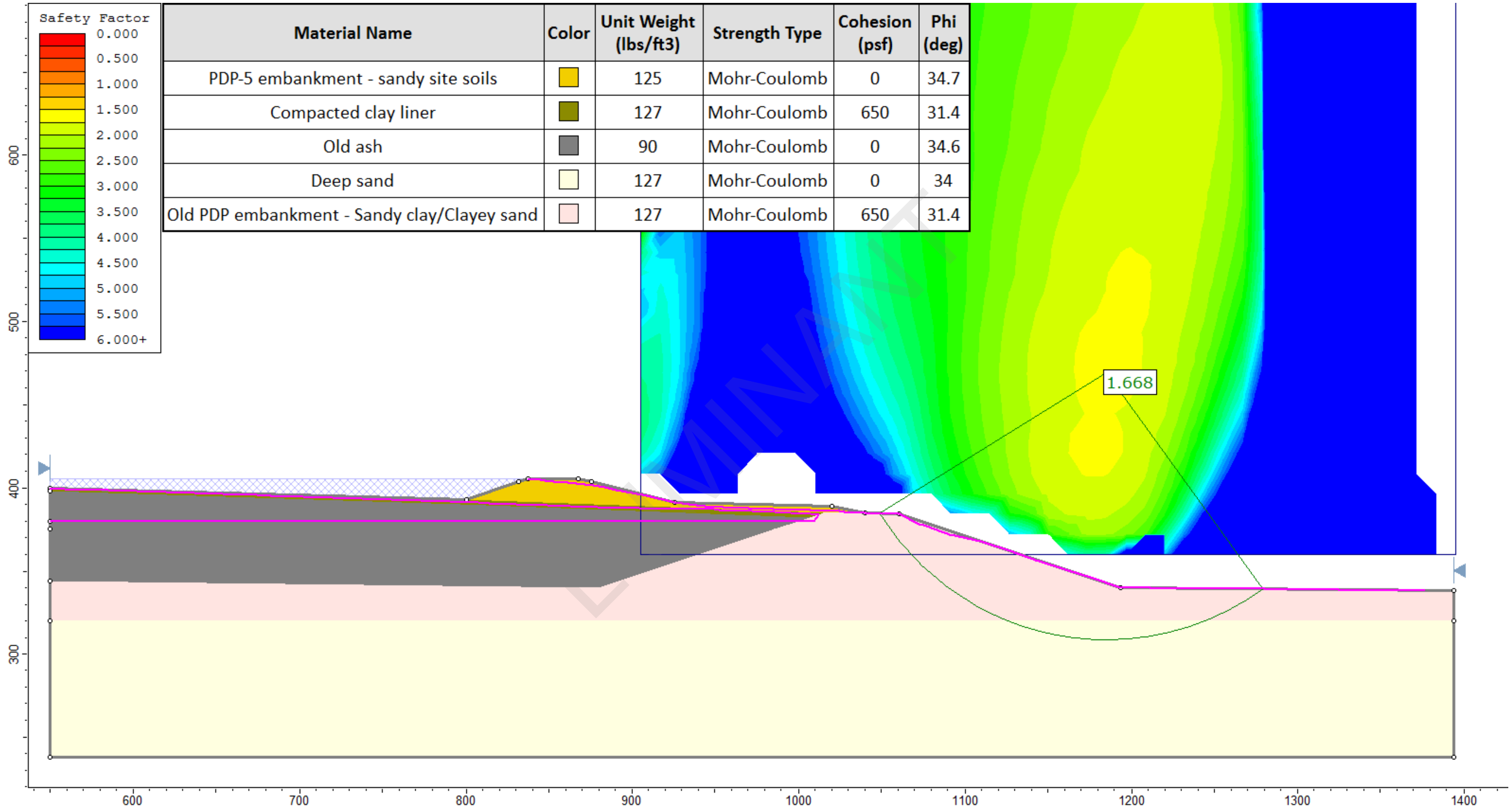


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
PDP-5 embankment - sandy site soils	🟨	125	Mohr-Coulomb	0	34.7
Compacted clay liner	🟫	127	Mohr-Coulomb	650	31.4
Old ash	⬛	90	Mohr-Coulomb	0	34.6
Deep sand	⬜	127	Mohr-Coulomb	0	34
Old PDP embankment - Sandy clay/Clayey sand	⬜	127	Mohr-Coulomb	650	31.4

FIGURE **C.13**

Results of Stability Analysis – PDP5: B–B' – Case 1b

Stability and Safety Factor Assessment, Martin Lake SES

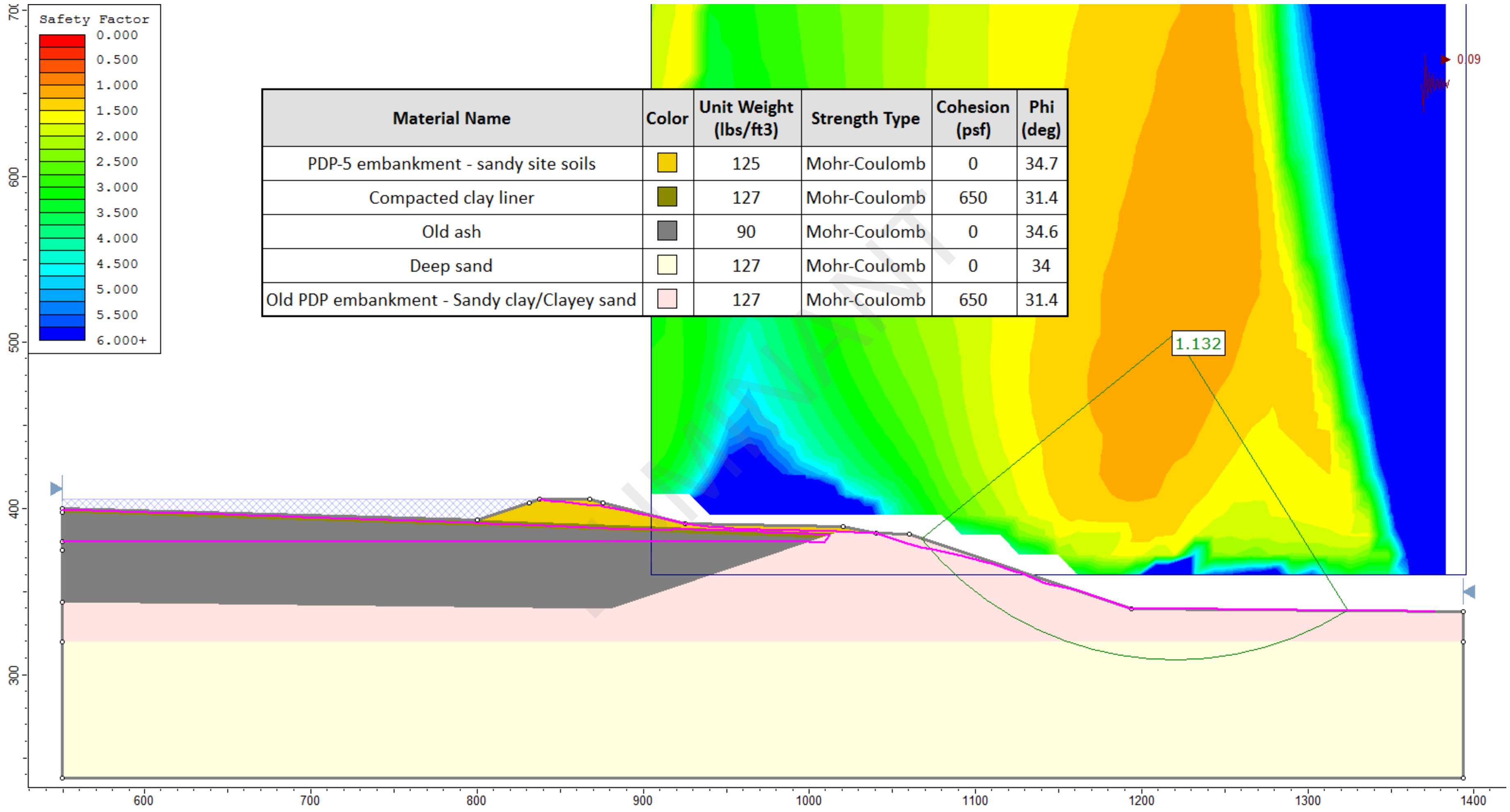


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
PDP-5 embankment - sandy site soils	🟨	125	Mohr-Coulomb	0	34.7
Compacted clay liner	🟫	127	Mohr-Coulomb	650	31.4
Old ash	⬛	90	Mohr-Coulomb	0	34.6
Deep sand	⬜	127	Mohr-Coulomb	0	34
Old PDP embankment - Sandy clay/Clayey sand	⬜	127	Mohr-Coulomb	650	31.4

FIGURE **C.14**

Results of Stability Analysis – PDP5: B–B' – Case 2a

Stability and Safety Factor Assessment, Martin Lake SES

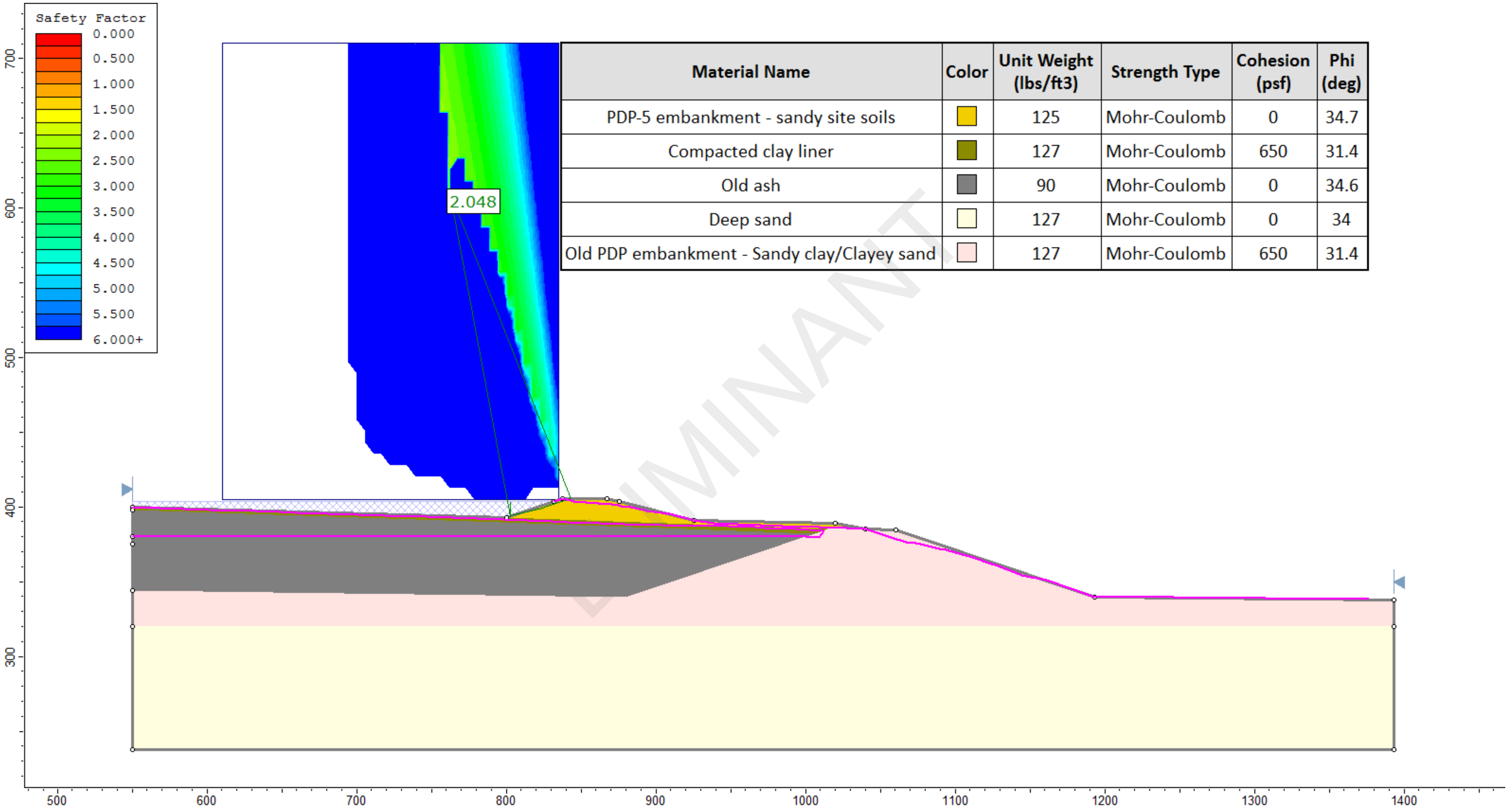


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
PDP-5 embankment - sandy site soils	🟨	125	Mohr-Coulomb	0	34.7
Compacted clay liner	🟫	127	Mohr-Coulomb	650	31.4
Old ash	⬛	90	Mohr-Coulomb	0	34.6
Deep sand	⬜	127	Mohr-Coulomb	0	34
Old PDP embankment - Sandy clay/Clayey sand	🟥	127	Mohr-Coulomb	650	31.4

FIGURE **C.15**

Results of Stability Analysis – PDP5: B–B' – Case 2b

Stability and Safety Factor Assessment, Martin Lake SES

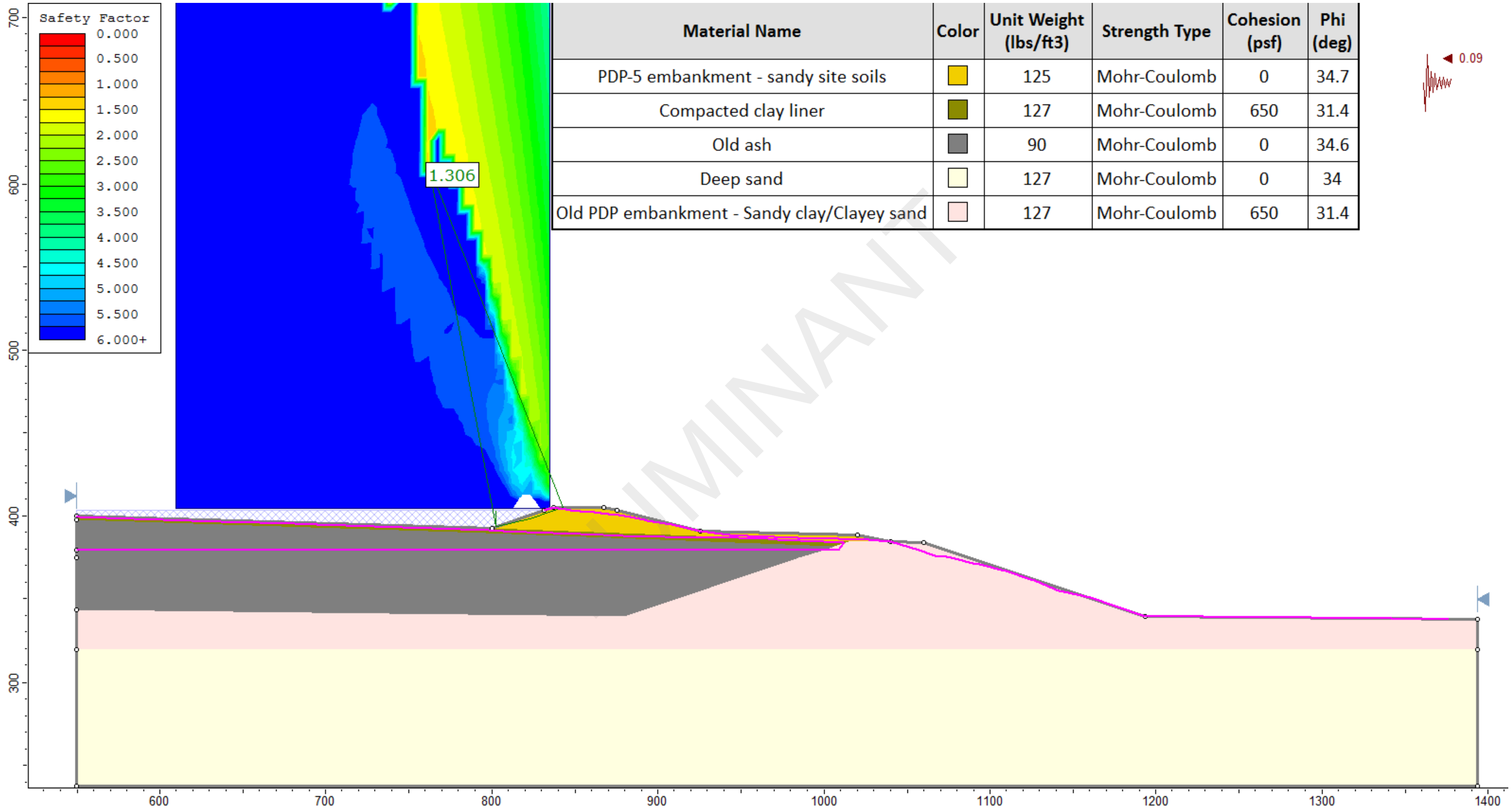


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
PDP-5 embankment - sandy site soils	🟨	125	Mohr-Coulomb	0	34.7
Compacted clay liner	🟫	127	Mohr-Coulomb	650	31.4
Old ash	⬛	90	Mohr-Coulomb	0	34.6
Deep sand	⬜	127	Mohr-Coulomb	0	34
Old PDP embankment - Sandy clay/Clayey sand	🟥	127	Mohr-Coulomb	650	31.4

FIGURE **C.16**

Results of Stability Analysis − PDP5: B−B' − Case 3a

Stability and Safety Factor Assessment, Martin Lake SES

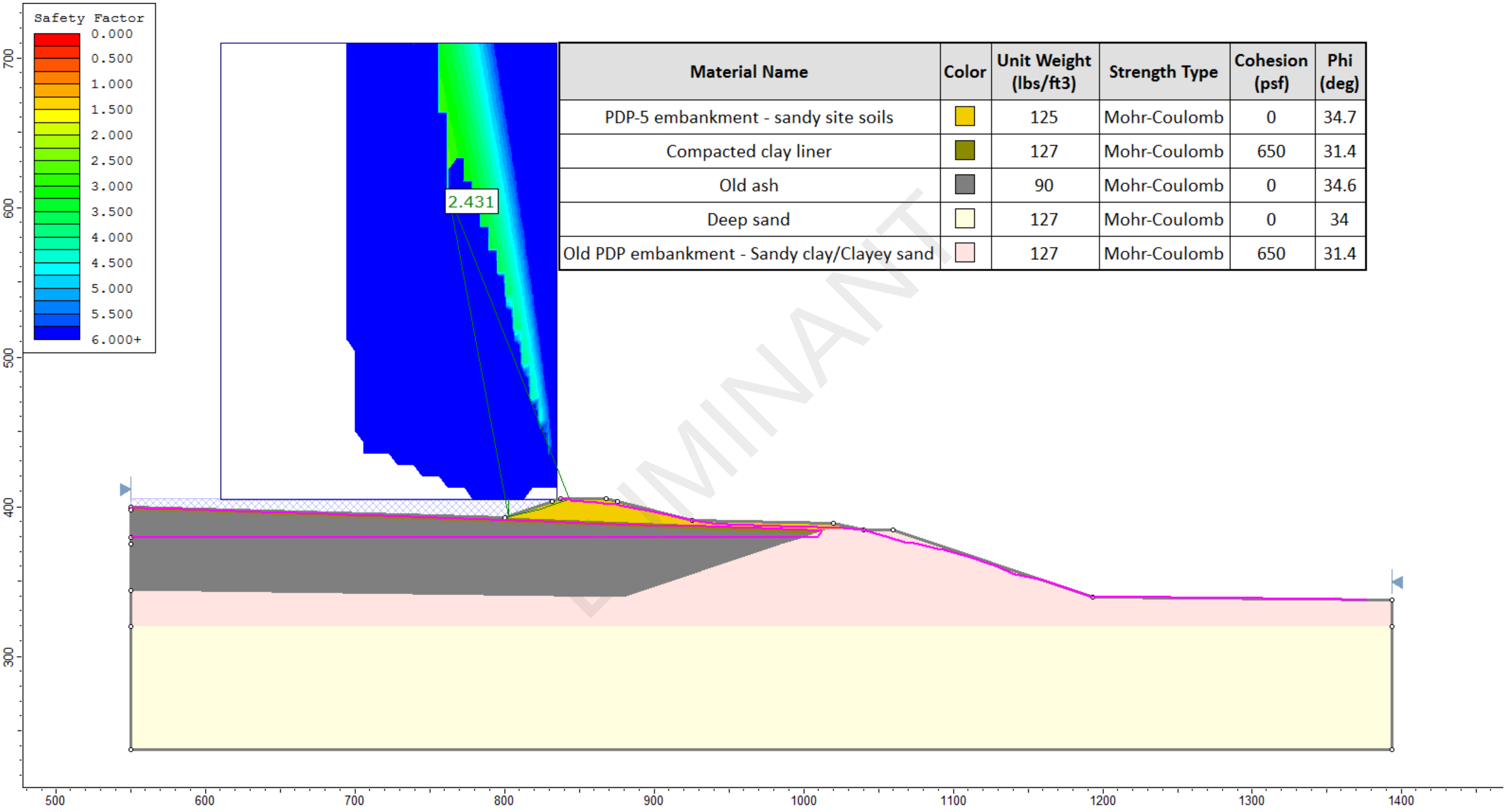


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
PDP-5 embankment - sandy site soils	🟨	125	Mohr-Coulomb	0	34.7
Compacted clay liner	🟫	127	Mohr-Coulomb	650	31.4
Old ash	⬛	90	Mohr-Coulomb	0	34.6
Deep sand	⬜	127	Mohr-Coulomb	0	34
Old PDP embankment - Sandy clay/Clayey sand	⬜	127	Mohr-Coulomb	650	31.4

FIGURE **C.17**

Results of Stability Analysis – PDP5: B–B' – Case 3b

Stability and Safety Factor Assessment, Martin Lake SES

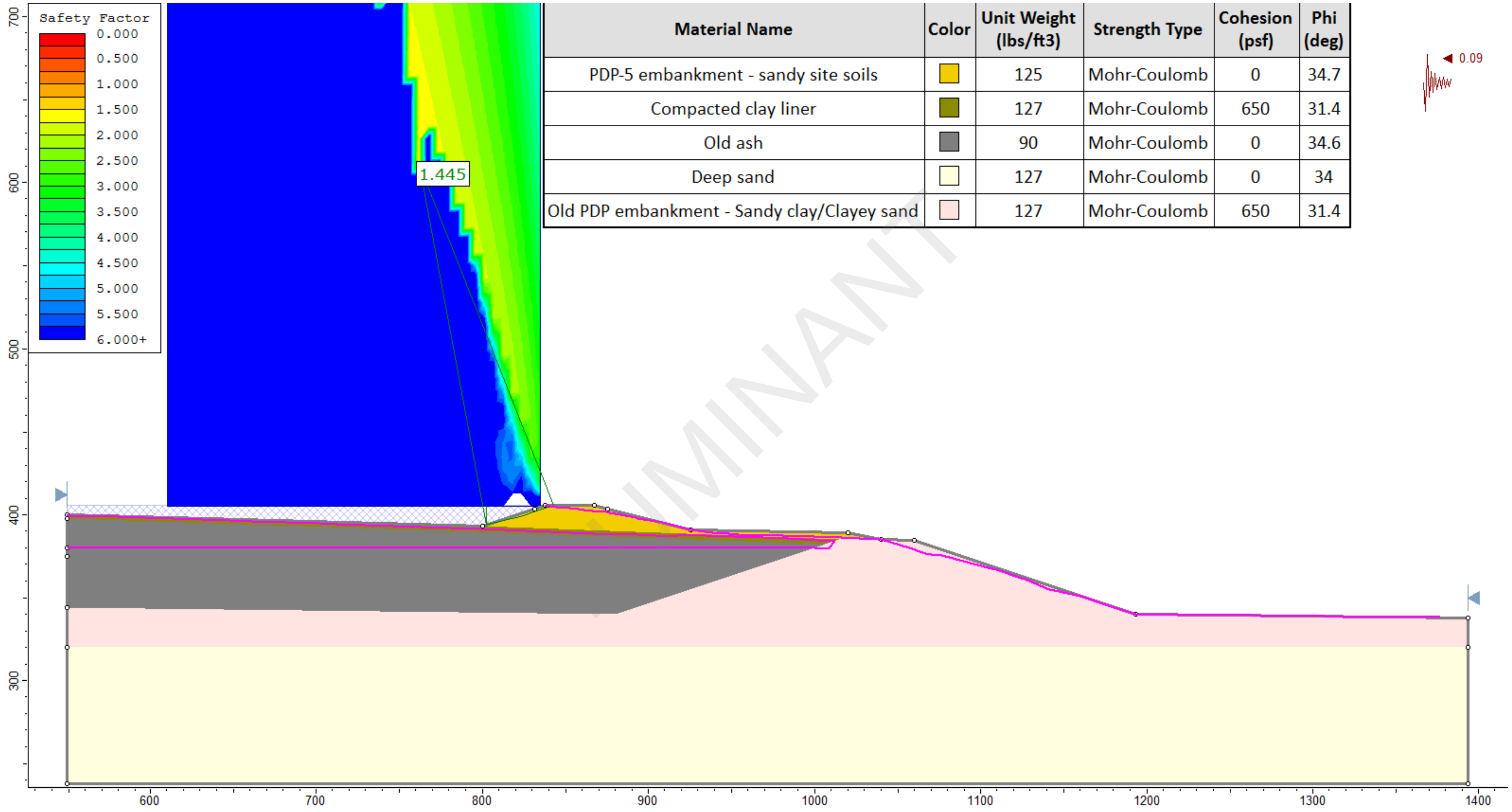


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
PDP-5 embankment - sandy site soils	🟨	125	Mohr-Coulomb	0	34.7
Compacted clay liner	🟫	127	Mohr-Coulomb	650	31.4
Old ash	⬛	90	Mohr-Coulomb	0	34.6
Deep sand	⬜	127	Mohr-Coulomb	0	34
Old PDP embankment - Sandy clay/Clayey sand	⬜	127	Mohr-Coulomb	650	31.4

FIGURE **C.18**

Results of Stability Analysis – PDP5: B–B' – Case 4a

Stability and Safety Factor Assessment, Martin Lake SES

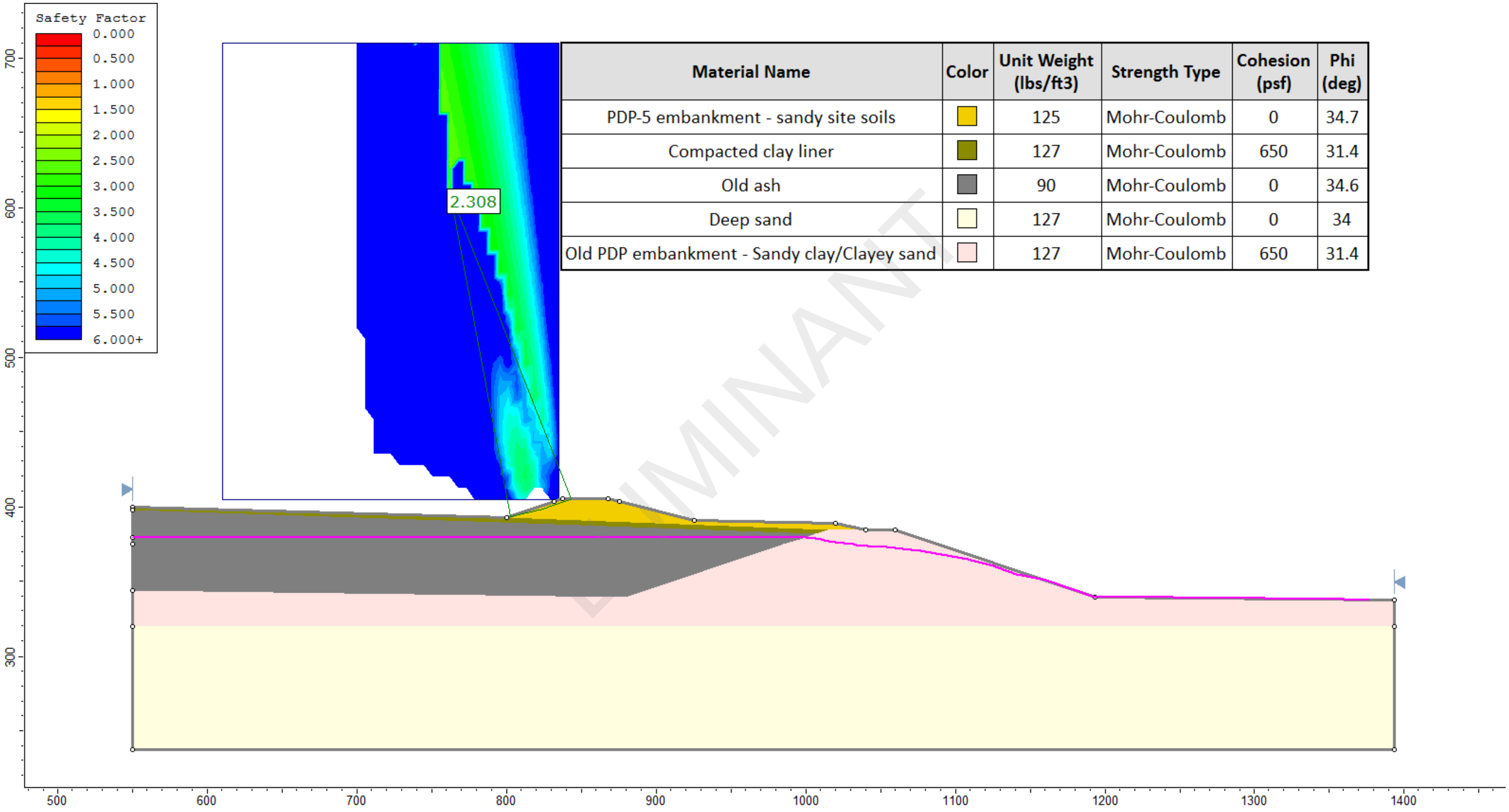


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
PDP-5 embankment - sandy site soils	🟨	125	Mohr-Coulomb	0	34.7
Compacted clay liner	🟫	127	Mohr-Coulomb	650	31.4
Old ash	⬛	90	Mohr-Coulomb	0	34.6
Deep sand	⬜	127	Mohr-Coulomb	0	34
Old PDP embankment - Sandy clay/Clayey sand	⬜	127	Mohr-Coulomb	650	31.4

FIGURE **C.19**

Results of Stability Analysis – PDP5: B–B' – Case 4b

Stability and Safety Factor Assessment, Martin Lake SES

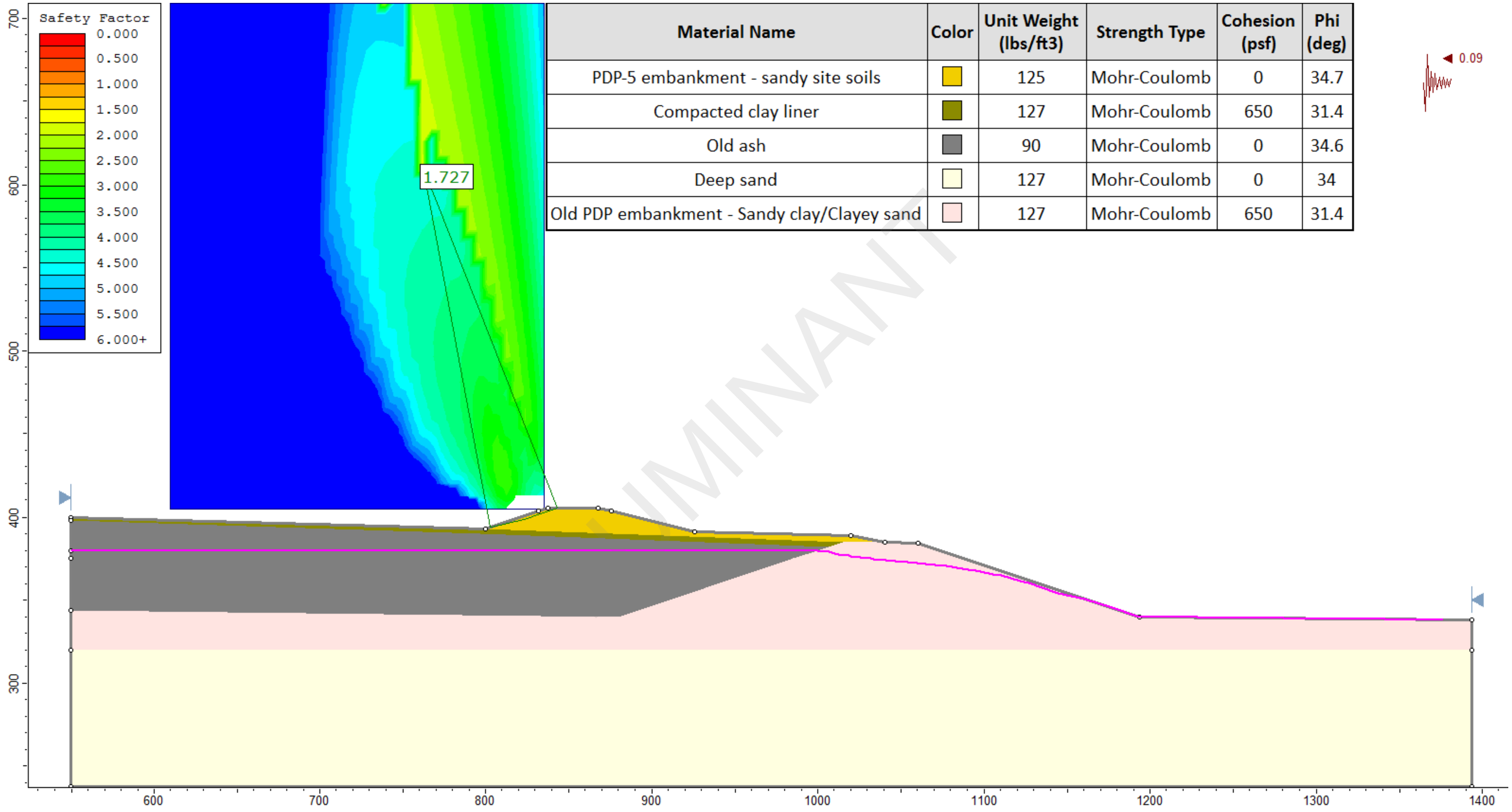


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
PDP-5 embankment - sandy site soils	🟨	125	Mohr-Coulomb	0	34.7
Compacted clay liner	🟫	127	Mohr-Coulomb	650	31.4
Old ash	⬛	90	Mohr-Coulomb	0	34.6
Deep sand	⬜	127	Mohr-Coulomb	0	34
Old PDP embankment - Sandy clay/Clayey sand	⬜	127	Mohr-Coulomb	650	31.4

FIGURE **C.20**

Results of Stability Analysis – PDP5: B–B' – Case 5a

Stability and Safety Factor Assessment, Martin Lake SES



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
PDP-5 embankment - sandy site soils	🟨	125	Mohr-Coulomb	0	34.7
Compacted clay liner	🟫	127	Mohr-Coulomb	650	31.4
Old ash	⬛	90	Mohr-Coulomb	0	34.6
Deep sand	⬜	127	Mohr-Coulomb	0	34
Old PDP embankment - Sandy clay/Clayey sand	🟥	127	Mohr-Coulomb	650	31.4

FIGURE **C.21**

Results of Stability Analysis − PDP5: B−B' − Case 5b

Stability and Safety Factor Assessment, Martin Lake SES

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South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Inc.
500 Century Plaza Drive, Suite 190
Houston, TX 77073 USA
Tel: (281) 821-6868
Fax: (281) 821-6870

Golder Associates

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Burns & McDonnell World Headquarters
9400 Ward Parkway
Kansas City, MO 64114
O 816-333-9400
F 816-333-3690
www.burnsmcd.com