Geotechnical Exploration Report

Northern Perimeter Dike Stability
West Ash Pond Closure
Allen Fossil Plant
Shelby County, Tennessee

Stantec Consulting Services Inc.
Design with community in mind
www.stantec.com

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

February 22, 2016

Stantec Consulting Services Inc.
601 Grassmere Park Road, Suite 22, Nashville, Tennessee 37211

February 22, 2016 rpt_001_17265015

Mr. Danny Stephens
Senior Manager
CCP Operations and Maintenance
Tennessee Valley Authority
400 West Summit Hill Drive, WT 11A-K
Knoxville, Tennessee 37902

Re: Geotechnical Exploration Report
Northern Perimeter Dike Stability
West Ash Pond Closure
Allen Fossil Plant
Shelby County, Tennessee

Dear Mr. Stephens:

As requested, Stantec Consulting Services Inc. (Stantec) has completed the geotechnical exploration and evaluation of slope stability of the Northern Perimeter Dike of the West Ash Pond at the Allen Fossil Plant located in Memphis, Shelby County, Tennessee. This report documents the subsurface conditions, results of laboratory testing, findings from historical document reviews, results of slope stability analyses, and conclusions and recommendations. These services were performed under Engineering Service Request ESR 909 in accordance with the terms and provisions established in our System-Wide Services Agreement dated December 22, 2008.

Stantec appreciates the opportunity to provide engineering services for this project. If you have any questions, or if we may be of further assistance, feel free to contact our office.

Sincerely,

STANTEC CONSULTING SERVICES INC.

Shaikh Z. Rahman, PE
Project Engineer

Jeff Dingrando, PE
Senior Geotechnical Engineer

TVA CONFIDENTIAL INFORMATION

Geotechnical Exploration Report
Northern Perimeter Dike Stability
West Ash Pond Closure
Allen Fossil Plant
Shelby County, Tennessee

Table of Contents

Section **Page No.**

Table of Contents

(Continued)

Section **Page No.**

List of Tables

Table **Page No.**

Table of Contents

(Continued)

List of Figures

List of Appendices

Geotechnical Exploration Report
Northern Perimeter Dike Stability
West Ash Pond Closure
Allen Fossil Plant
Shelby County, Tennessee

Executive Summary

Stantec Consulting Services Inc. (Stantec) has completed the geotechnical exploration and stability evaluation for the Northern Perimeter Dike (North Dike) of the West Ash Pond at the Tennessee Valley Authority's (TVA) Allen Fossil Plant. Stantec understands that TVA plans to permanently close the West Ash Pond. The purpose of the geotechnical study is to obtain information about subsurface conditions around the West Ash Pond and to evaluate stability of the Northern Perimeter Dike. Information from this study will be used for the future pond closing plans.

Stantec reviewed historic documentation to gain an understanding of the development and construction of the North Dike; performed a geotechnical exploration to obtain subsurface information; installed and monitored piezometers to develop an understanding of the piezometric surface; and performed slope stability and rapid drawdown analyses for the dike.

The analyses were focused on two cross-sections of the dike. Cross-section H-H' was selected at Station 13+33 (Figure 4) where the pond is filled with ash; hence, greater load on the dike. Cross-section I-I' was selected at Station 4+60 (Figure 5) as a representative cross-section of the dike with minimal backfill. The cross-sectional geometry and subsurface profiles were established using data from the drilling and laboratory testing and from historical documents such as design drawings and memoranda provided by TVA. Stantec estimated material properties such as unit weight, and shear strength based on the results of field and laboratory test data, published data, and experience with similar materials in similar settings and applications. The soil parameters selected for use in the slope stability analyses are provided in Section 4 of this report.

Only the exterior slopes of the dike (north slope) were evaluated. The interior slope of the dike at cross-section H-H' is covered with ash. The pond does not impound water. The upstream slope is shorter in height, only about 14 feet compared to the downstream slope which is about 28 feet. Hence, the stability of the exterior slope was considered critical. The analyses evaluated the stability of the North Dike exterior slope for the following conditions:

1. Long-term (effective stress) slope stability analysis with static piezometer levels at elevation 185;

2. Rapid drawdown analysis for the McKellar Lake level recedes from an assumed flood elevation of 228 feet to the normal pool elevation of185 feet;

The results of the slope stability analysis show that the exterior slope of the North Dike has a long-term factor of safety between 2.1 and 2.6. The factor of safety for rapid drawdown conditions ranged between 2.0 and 2.6. The calculated factors of safety meet the USACE criteria for slope stability for long-term and rapid drawdown conditions of 1.5 and 1.1, respectively.

Geotechnical Exploration Report
Northern Perimeter Dike Stability
West Ash Pond Closure
Allen Fossil Plant
Shelby County, Tennessee

1. Introduction

1.1. General

The Tennessee Valley Authority (TVA) is planning to cease coal burning operations at the Allen Fossil Plant (ALF) in 2018. The coal combustion residual (CCR) waste at ALF has historically been stored in two on-site facilities: the West Ash Pond and East Ash Pond. The closure of these two disposal areas is integral to the overall decommissioning process.

The purpose of this project is to close the West Ash Pond under a regulatory framework established with the Tennessee Department of Environment and Conservation's (TDEC) National Pollutant Discharge Elimination System (NPDES) program. In addition, the United States Environmental Protection Agency (USEPA) published new Coal Combustion Residual (CCR) Rules on April 17, 2015, which states that any disposal facilities that stop receiving CCRs, no longer contain water, and maintain or cap existing CCRs within the six months following rule publication are deemed "closed." The NPDES program prohibits the discharge of any substance into waters of the state. Therefore, TDEC requires a wastewater impoundment be closed to eliminate discharge potential to both surface and groundwater. The goal is to execute this closure project in a manner that supports the discontinuation of contributing flows to the West Ash Pond and integrates the closure with the overall plant master closure strategy.

As part of the closure plan, a geotechnical study was conducted for the West Ash Pond. The purpose of the geotechnical study was to obtain information about subsurface conditions at the West Ash Pond and to evaluate stability of the Northern Perimeter Dike for existing conditions. Stability analyses for the post closure configurations will be performed later as part of Phase II.

1.2. Plant Background

The Allen Fossil Plant is located in Shelby County, southwest of Memphis in southwestern Tennessee. The plant is located on the south bank of McKellar Lake and east of the Mississippi River, on low land protected from flooding by an existing levee system. Refer to Figure 1 for the Site Vicinity Map.

The plant was constructed in 1959 by Memphis Light, Gas & Water Division, and consisted of three coal-fired generating units. TVA began leasing the plant in 1965 and purchased it in 1984. The plant currently consumes approximately 7,200 tons of coal a day and produces approximately 5,160 million kilowatt-hours of electricity a year. CCR produced by the collective units includes approximately 85,000 dry tons of fly ash that is wet-sluiced to the East Ash Pond every year. The West Ash Pond has historically been utilized for intermittent CCR disposal during times of maintenance, and has not taken any significant CCR disposal since

about 1992. Since TVA is planning to cease coal burning operations at ALF in 2018, the West Ash Pond is scheduled to be closed in 2017 while the East Ash Pond is scheduled to be closed in 2020. For the purpose of this project, the West Ash Pond closure limits have been identified by the Joint Project Team (JPT) as indicated on the ALF Plant Overview in Figure 2.

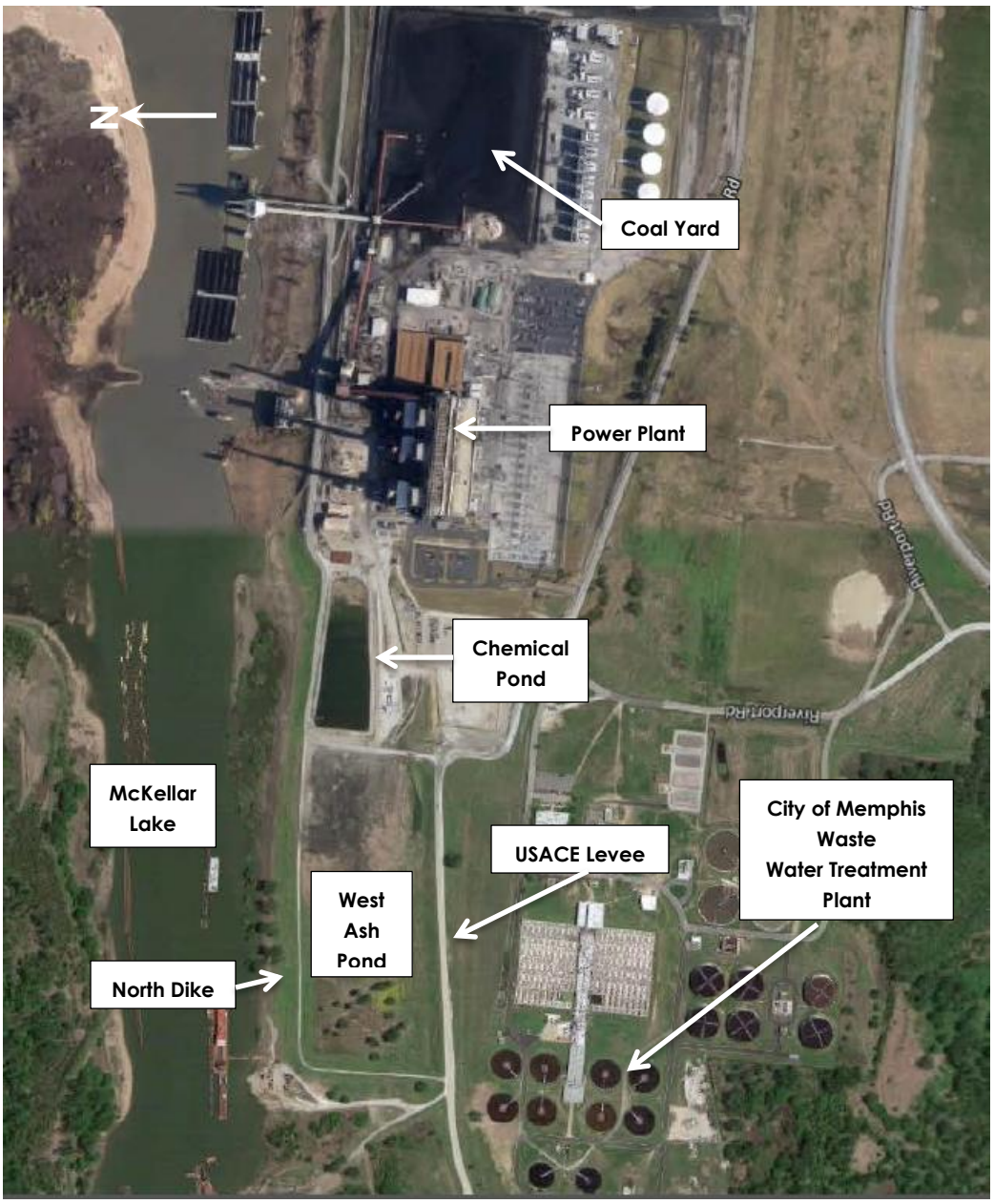


Figure 1. Overview of Allen Fossil Plant

1.2.1. West Ash Pond Background

The West Ash Pond is located to the west of the powerhouse. The pond was created within the floodplain of McKellar Lake, north of the USACE flood control levee, with the construction of perimeter dikes. The USACE levee forms the south dike of the pond. Early documentation is limited; however, aerial photography indicates that the West Ash Pond was constructed in the late 1950s or early 1960s. The following timeline summarizes the West Ash Pond milestones:

1960s: The West Ash Pond was in service by 1963, but was only receiving emergency dumps of heavy ash in the east end of the pond. In 1969, the West Ash Pond dikes were raised from seven to ten feet.

1970s: In 1976, the West Ash Pond dikes were raised to the current layout and elevation of 228 feet; and shortly thereafter in 1977, the Chemical Treatment Pond was constructed within the northeast corner of the original West Ash Pond footprint. Once the West Ash Pond dike improvements were complete, sluicing of fly ash was completely diverted to the West Ash Pond in 1976 so dike improvements could be completed at the East Ash Pond. Up to this point, very little fly ash had been pumped to the West Ash Pond. Once the East Ash Pond expansion was completed in 1978, all fly ash sluicing was continued back into the East Ash Pond.

1990s: In early 1991, approximately 173,000 cubic yards of ash was dry-hauled out of the West Ash Pond to be used for a USACE levee project. In May 1991, the West Ash Pond was reactivated and began receiving sluiced fly ash, while a repair project was completed at the East Ash Pond. After sluicing was diverted back to the East Ash Pond, the remaining sluice waters were pumped out of the West Ash Pond.

TVA drawing 10N223 shows the 1976 layout of the West Ash Pond. Drawing 10N224 shows the design cross-sections of the raised dikes. Based on the design cross-sections, the dikes were approximately 20 feet tall, with a 16-foot wide crest and 3H:1V (Horizontal:Vertical) embankment slopes. The crest elevation was approximately 228 feet above Mean Sea Level (MSL). Cross-section A-A on drawing 10N224 (Figure 3) shows the North Dike was built on top of an existing smaller dike along McKellar Lake. These drawings show the north dike was built with a 10-foot wide core zone. The rest of north dike was built with "shell" materials. Drawing 10N224 further indicates the interior slopes and bottom of the pond were lined with a 3-foot layer of "core" type material. Specifications for the "core" and "shell" type materials are provided in the TVA Memorandum "Allen Steam Plant – Ash Disposal Areas Dikes Raising – Construction Information" by G. L. Buchanan (Chief, Civil Engineering and Design Branch), July 24, 1975.

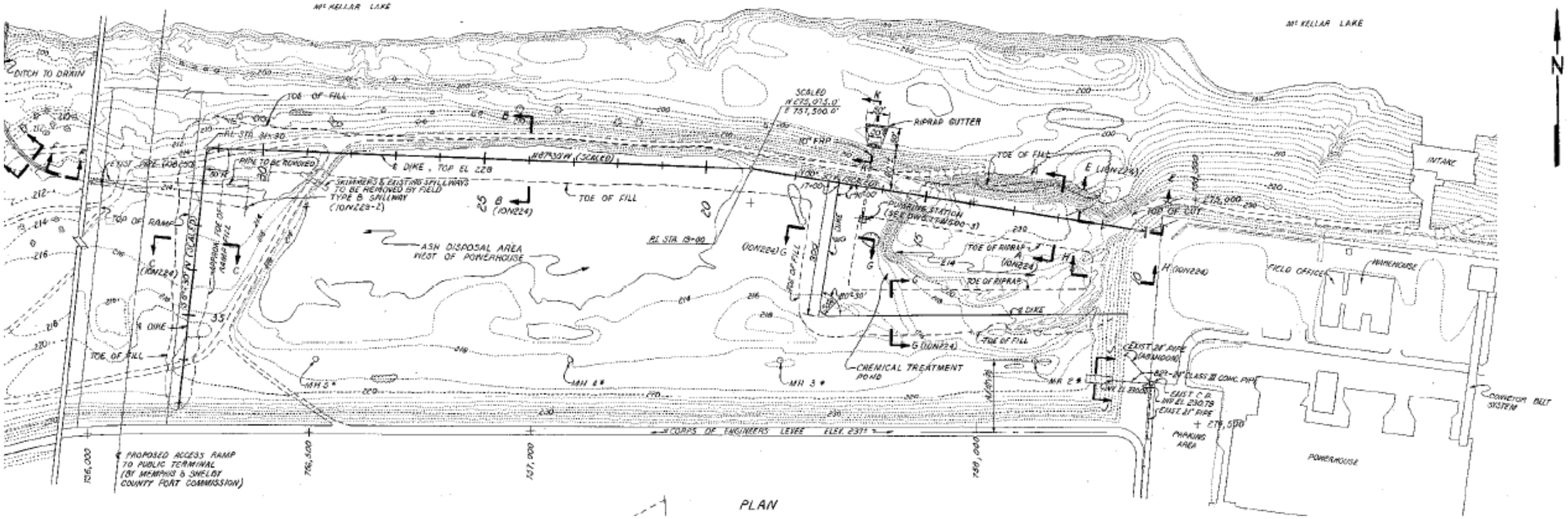


Figure 2. West Ash Pond Design Layout (TVA Drawing 10N223, R.2)

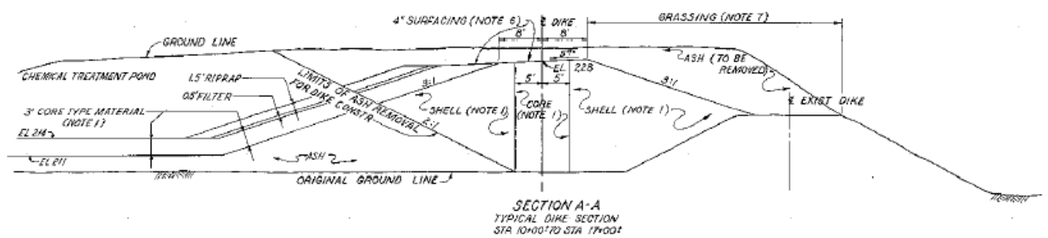


Figure 3. North Dike Design Cross-Section A-A from Drawing 10N224, R.1

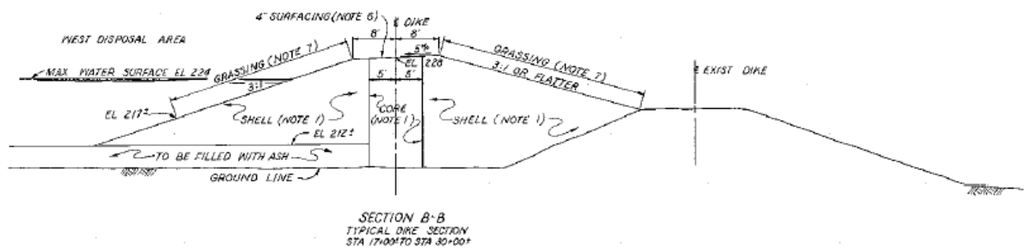


Figure 4. North Dike Design Cross-Section B-B from Drawing 10N224, R.1

Based on TVA memoranda, the soils used to construct the core should have consisted of low plasticity silts, lean clays, silty sands or sandy silts with at least 35% fines (i.e., silt and clay). To construct the core, these materials should have been compacted to at least 95 percent of the materials maximum standard Proctor dry density within ±3 percent optimum moisture content. Materials not satisfying the graduation requirements for "core" were used as "shell" type materials. Shell materials with more than 12% fines were compacted to the same requirements as core materials. Shell materials with less than 12% fines were compacted to an average relative density of at least 85 percent. Since the construction of the Chemical Pond, the West Pond areas to the west and south of the Chemical Pond have been backfilled. The area between the south dike of the Chemical Pond and the USACE Levee has been developed with the ammonia compound and a parking lot.

1.2.2. West Ash Pond Existing Conditions

The current West Ash Pond footprint is approximately 23 acres, approximately 18 acres of the pond is slated for closure. This West Ash Pond is considered an inactive CCR impoundment area as defined by NPDES (classified as a TVA Category 1). The West Ash Pond stopped receiving CCRs, no longer contains water, and caps existing CCRs within six months following the publication of the USEPA CCR Rules and is therefore classified as closed per USEPA CCR Rules. The original spillway and decant riser structure still exist at the west dike, where the discharge outfall penetrates the west dike and flows towards the Discharge Channel. The Condensing Cooling Water (CCW) Discharge Tunnel runs below the southern edge of the West Ash Pond and their manhole structures can be seen penetrating vertically through the bottom of the ash pond surface. The perimeter dike is approximately 20 feet in maximum height and is approximately 3/4 mile in total length. The 100-year and 500-year flood elevation for McKellar Lake are 225 feet and 232.5 feet above mean sea level, respectively. See Figure 2 for the West Ash Pond Overview.

1.2.3. West Ash Pond – Proposed Closure Plan

Various conceptual closure alternatives were considered for the West Ash Pond final closure. These alternatives include 'Do Nothing' to 'Excavate and Remove' all CCR materials from the pond. After evaluating these alternatives, the JPT selected the option of excavating and removing all CCR materials from the west side and stacking them on the east side of the pond. All CCR materials will be consolidated on the east side and capped for final closure. The west side of the pond will be left at its regraded state, free of CCR materials. The western portion of the north dike and the entire west dike will be lowered and the dike soils will be used for cap construction on the east side.

1.3. Scope of Work

This report addresses the geotechnical exploration performed to support Stantec's engineering evaluation of the Northern Perimeter Dike of the West Ash Pond. The work was performed as part of the future pond closure project. This report documents the Phase I geotechnical data collection and engineering analyses. Analyses for the future closure plan will be provided in Phase II of this project. As outlined in the proposal pro_001_172670P076, the scope of work for this effort included the following tasks:

- Review of available documentation to support the development of a work plan for the geotechnical exploration and engineering evaluation.

- Development, planning and execution of geotechnical exploration of the West Ash Pond.
- Installation of piezometers for monitoring water levels in the perimeter dikes and foundation soils.
- Perform laboratory testing of on-site soils to support engineering analyses.
- Perform slope stability analyses at two cross-sections of the dike for the current configuration.
- Development of a geotechnical report documenting the results of slope stability analyses.

This report provides the findings from the geotechnical exploration and laboratory test data and the results of slope stability analysis for the Northern Perimeter Dike. The JPT decided that the Chemical Pond will not be a part of the West Ash Pond closure plan. The detail closure plan has been submitted as part of the Phase I submittal.

2. Review of Available Information

2.1. General

As part of the closure plan, Stantec reviewed documents provided by TVA to learn about the development and history of the plant and CCR storage facilities. The documents reviewed include design drawings, design and construction memoranda, aerial photographs, survey/topographical data, and annual inspection reports. The following documents were reviewed as part of this particular assessment:

- Drawing No.1, Serial No. 16362, USACE, Memphis District: Dike Work, Memphis Harbor Project, Mississippi River, Item No. L-725, Sheet 1
- Drawing No. 10N223: Ash Disposal Area West of Powerhouse Sheet 1
- Drawing No. 10N224: Ash Disposal Area West of Powerhouse Sheet 2
- Site Survey – by TVA (2015)
- "Allen Steam Plant – Ash Disposal Areas Dikes Raising – Soil Investigation", TVA Memorandum by Gene Farmer (Chief, Construction Services Branch) to G. L. Buchanan (Chief, Civil Engineering and Design Branch) , May 2, 1975
- "Allen Steam Plant – Ash Disposal Areas Dikes Raising – Construction Information", TVA Memorandum by G. L. Buchanan to Gene Farmer, July 24, 1975
- Allen Fossil Plant Annual Ash Disposal Area Inspection Reports from 1967 to 2009 (Draft), except for 1990, 1991, and 1992 since they were not available
- Geologic map of the Fletcher Lake Quadrangle, Tennessee (1978)

2.2. Geologic Setting

Available geologic mapping, "Geologic Map of the Tennessee Portion of the Fletcher Lake Quadrangle, Tennessee", published by the Tennessee Department of Conservation, Division of Geology, 1978, indicates the plant and surrounding areas are underlain by artificial fills and Quaternary age alluvial deposits. The fill generally consists of alluvium dredged from the Mississippi River flood plain (or loess in select locations) and varies in thickness from a few feet beneath residential areas to tens of feet beneath industrial areas developed on the floodplain of the river. The alluvium consists of irregular lenses of fine sand, silt, and clay in the upper part, and coarse sands, gravelly sands, and sandy gravels in the lower part. Thickness of the alluvium varies from about 45 to 90 feet adjacent to the loess bluffs along the eastern edge of the quadrangle to as much as 175 feet in the flood plain. The mapping indicates the alluvium is underlain by a series of highly consolidated clays and dense sands comprising the Claiborne Group.

3. Subsurface Exploration

3.1. General

Stantec prepared a subsurface exploration program based on reviews of historic documents, experience based on previous subsurface explorations at the Chemical Pond and East Disposal Area, geologic mapping, aerial photography, and site observations. The boring locations were selected in the field by a Stantec engineer. The boring locations were surveyed by Buchanan Land Survey for TVA.

The subsurface exploration program consisted of drilling and sampling nineteen (19) soil test borings, seven (7) cone penetration test soundings, and five (5) test pits along the crest and exterior toe of the Northern Perimeter Dike, as well as within the pond. Details about the subsurface exploration program are provided below. A boring location diagram is provided in Appendix A.

3.2. Standard Penetration Test Borings

Seventeen Standard Penetration Test (SPT) borings (STN-29 through STN-45) were extended to depths of approximately 21.0 to 51.0 feet below the existing ground surface. Two offset borings (STN-33A and STN-38A) were drilled to obtain Shelby tube samples. The borings were drilled using both truck-mounted and track-mounted drill rigs between the months of September and October of 2015. Borings in the Northern Perimeter Dike crest, downstream bench/toe, and interior pond were advanced using 4.25-inch hollow stem augers. Drilling through the embankment and foundation soils was performed in general accordance with the guidelines presented in ER 1110-1-1807, "Procedures for Drilling in Earth Embankments" (USACE 2006) and Draft "TVA RO&R Guidelines for Drilling and Sampling in Dams" (TVA 2013). SPT sampling was performed in accordance with ASTM D1586 and undisturbed Shelby tube sampling was performed in accordance with ASTM D1587 "Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes."

Table 1. Summary of SPT Borings

Boring No.	Northing*	Easting*	Surface Elevation*	Boring Termination Depth	Bottom of Hole Elevation*
STN-29	275175.39	756255.52	209.8	21.0	188.8
STN-30	275111.62	756317.48	228.2	41.5	186.7
STN-31	275285.22	756655.03	197.3	36.0	161.3
STN-32	275170.55	756662.14	215.3	34.0	181.3
STN-33	275119.53	756661.46	228.2	51.0	177.2
STN-33A	275120.19*	756670.11*	227.9*	39.0	188.9*
STN-34	275219.61	757572.32	197.3	35.0	162.3
STN-35	275168.26	757560.32	201.9	34.0	167.9
STN-36	275070.03	757553.53	227.8	50.0	177.8
STN-37	275105.39	757084.79	227.9	35.5	192.4
STN-38	275032.20**	756654.10**	212.7**	37.5	175.2**
STN-38A	275032.45**	756662.98**	213.2**	37.5	175.7**
STN-39	275000.71	757068.83	227.7	33.0	194.7
STN-40	274960.06	757535.41	227.7	36.0	191.7
STN-41	274885.49	756401.22	214.9	22.5	192.4
STN-42	274774.68	756231.49	228.2	31.5	196.7
STN-43	274581.55	756525.54	218.5	30.0	188.5
STN-44	274692.75	756932.74	216.9	27.0	189.9
STN-45	274571.04	757472.72	222.1	28.5	193.6

*Coordinates and Elevations were provided by TVA. Horizontal Coordinates are referenced to NAD83 and Vertical Datum is NGVD 29.

**.*Preliminary survey data obtained by a Stantec field engineer using a GPS survey unit.

In general, continuous Standard Penetration Tests (SPTs) were performed in each of the borings to provide information as to the consistency or density of the dike and foundation materials and to obtain samples for subsequent laboratory testing. Thin-wall Shelby tube samples were also obtained at select locations within cohesive or moderately cohesive soils to obtain relatively undisturbed samples for laboratory permeability testing. A geotechnical engineer was on site full time with the drill rig to observe the drilling operations, prepare field logs, collect soil samples, document piezometer installation activities, and adjust the drilling and sampling program as warranted by site and subsurface conditions. The field engineer logged the materials obtained from SPT and Shelby tube sampling, paying particular attention to the texture, color, moisture content, plasticity, and consistency/density of the materials encountered. Typed boring logs are included in Appendix B.

The borings were advanced using an automatic hammer to perform SPTs. In SPTs, the number of blows required to advance a standard two-inch (outer diameter) split barrel sampler the last 12 inches of the typical total 18 inch penetration is the standard penetration resistance value (N). A standard 140 pound hammer with a free fall of 30 inches was used for

driving the split barrel sampler. This value is used to estimate the in-situ relative density of cohesionless soils and the consistency of cohesive materials. Standard correlations for SPTs have historically been based upon blow counts using a safety hammer (rope/cat-head) system, generally estimated to be about 60 percent efficient. Thus, most correlations report values termed as N_{60} data. The efficiency of the automatic hammers used for this exploration was estimated to be about 80 percent based on previous efficiency tests of Stantec drill rigs equipped with automatic hammers, thus requiring a correction for hammer efficiency. As such, Stantec used correlation factors to interpret the blow counts resulting from SPTs using the automatic hammer. The correction for hammer efficiency is a direct ratio of relative efficiencies as follows:

$$N_{60} = N_{80}\left(\frac{80}{60}\right) \qquad \textbf{Equation 1}$$

The N-values presented on the graphical boring logs in Appendix A and typed boring logs in Appendix B are the raw data and do not reflect corrections for hammer efficiency or overburden stress.

3.3. Cone Penetration Test Soundings

In addition to the SPT borings, seven (7) Cone Penetration Test soundings with pore pressure measurements were completed by ConeTec near companion SPT borings. A summary of CPT soundings is provided in Table 2, CPT logs are provided in Appendix B.

Table 2. Summary of CPT Sounding

CPT No.	Northing	Easting	Surface Elevation, ft	Termination Depth, ft	Bottom of Cone Elevation, ft	Static Water Level[2], ft
STN-46	275283.75	756659.96	197.5	35.9	161.6	181.5
STN-47	275177.52	757551.23	200.7	36.1	164.6	182.7
STN-49	275022.24	756645.53	213.5	23.0	190.5	N/A
STN-52	274888.39	756390.55	215.1	23.0	192.1	N/A
STN-55	274781.02	757485.69	228.1	36.1	192.0	193.1
STN-56	274581.78[1]	756521.61[1]	218.0[1]	29.5	188.5	189.0
STN-57	274688.84	756944.27	213.1	29.5	187.7	192.2

[1]Preliminary survey data obtained by a Stantec field engineer using a GPS survey unit.

[2]Dissippation test results

3.4. Test Pit Excavations

Five (5) test pits were excavated within the West Ash Pond to confirm the depth of fly ash within the pond. A summary of test pits is provided in Table 3, test pit logs are provided in Appendix B.

Table 3. Summary of Test Pits

Test Pit No.	Northing	Easting	Surface Elevation	Termination Depth	Bottom of Test Pit Elevation
STN-59	275029.76	756349.96	213.1	6.0	207.1
STN-60	275044.47	756806.43	216.6	8.0	208.6
STN-63	274837.56	756602.00	215.2	8.0	207.2
STN-64	274859.56	756920.08	215.7	7.0	208.7
STN-67	274667.54	756739.62	216.8	7.0	209.8

3.5. Piezometer Installations

Piezometers were installed at 3 boring locations to develop an understanding of the piezometric surface. At these locations, multiple vibrating wire transducers were installed at various depths, ranging from 18 to 46 feet below grade. Individual transducer elevations and readings are provided in Table 8. Piezometer locations are provided in Appendix A; installation logs are provided in Appendix C.

The vibrating wire transducers were taped to a 1-inch diameter Schedule 40 PVC riser pipe and lowered into the borehole to their intended elevations. A sacrificial measuring tape was attached to the riser pipe to ensure that each transducer was installed at the intended elevation. Once the transducers were in place in the borehole, the hole was fully grouted to just below the ground surface, leaving room for surface finish installations. The grout backfill was carefully mixed according to the design shown in Table 4 to closely mimic the stiffness of the surrounding in-situ medium.

Table 4. Grout Mix Design for Vibrating Wire Piezometers

Material	Weight/Volume	Ratio by Weight
Portland Cement	94 lb (1 bag)	1
Water	30 gallons	2.5
Granulated Bentonite	25 lb	0.3

The piezometer installations were completed with a PVC flush mount protective cover secured by a one square foot concrete pad.

3.6. Subsurface Conditions

Based on the results of the drilling program, subsurface conditions at the north dike can be generalized as outlined in Table 5 below. The subsurface lithology, SPT blow counts, and laboratory test data are shown on individual boring logs in Appendix B as well as graphic logs included in Appendix A. The descriptions of the soils indicated on the typed boring logs in Appendix B are in general accordance with the Unified Soil Classification System (USCS) and the group symbols are shown on the graphic boring logs depicted on the cross-section in Appendix A.

3.6.1. Assumptions

Soil materials within the north dike and foundation soils are identified based on the subsurface explorations, laboratory testing and historic documents. The key materials identified are summarized in Table 5.

Two cross-sections of the dike were selected for stability evaluations. Cross-section H-H' was selected at Station 13+33 (Figure 5) where the pond is filled with ash; hence, greater load on the dike. Cross-section I-I' was selected at Station 4+60 (Figure 6) as a representative cross-section of the dike with minimal backfill. Information from recent borings along the cross-sections and historical drawings was used to develop the subsurface profile at each cross-section. In particular, borings STN-34, -35, -36 and -40 were used for cross-section H-H', and borings STN-31, -32, -33 and -38 were used for cross-section I-I'. Topographic mapping and Shelby County GIS mapping were used to extend the profile beyond the surveyed area. The subsurface conditions between borings were assumed to be similar to what was encountered at these borings. Figure 5 and Figure 6 showed the cross-section used for slope stability analyses.

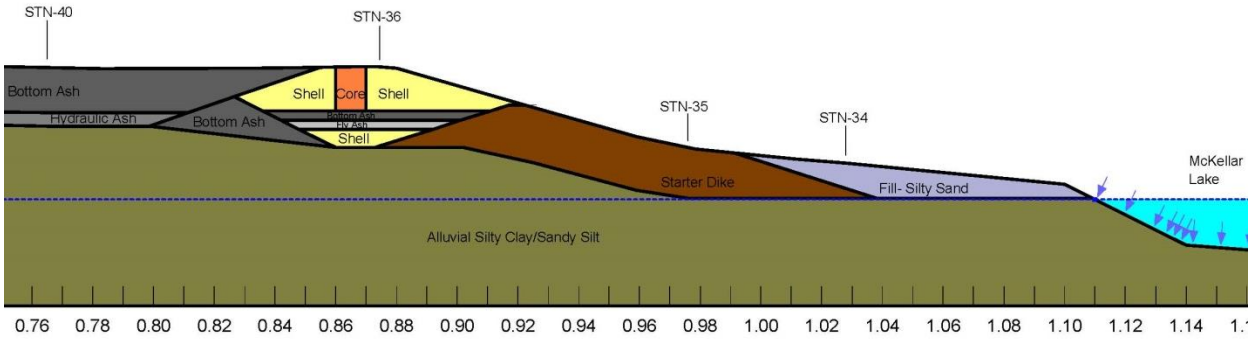


Figure 5. Subsurface Profile at Cross-Section H-H'

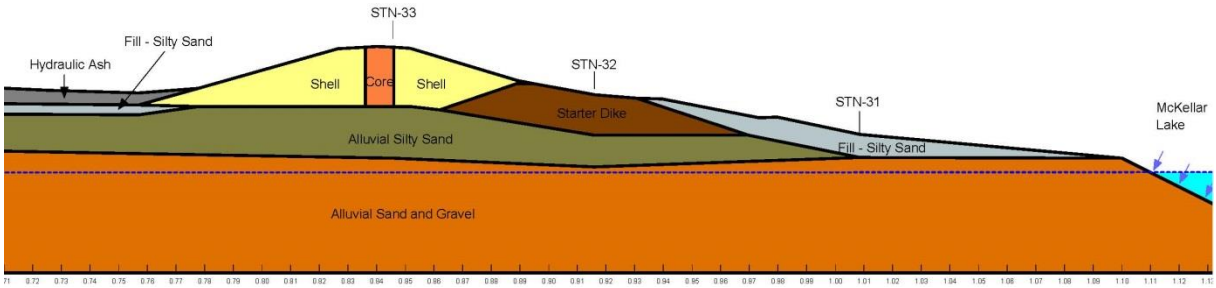


Figure 6. Subsurface Profile at Cross-Section I-I'

3.6.2. Generalized Subsurface Profile

The generalized subsurface profile consists of rolled earth fill over alluvial foundation soils. The foundation soils consisted of alluvial deposits with a mixture of sand, silt, clay and gravel. Relatively more silt and clay were encountered at borings on the eastern side of the pond. The borings along the western side of the pond encountered relatively more sand and gravel. Therefore, different profiles were used for cross-sections H-H' and I-I'. A summary of generalized subsurface profile and apparent consistency/density based on SPT data is provided in Table 5.

Table 5. Generalized Subsurface Profile

Materials	Approximate Elevation, ft	Consistency/Density
Shell/Core and Starter Dike Fill	El. 228 to El. 208	Medium Dense to Very Dense
Alluvial Silty Clay and Sandy Silt[1]	El. 209 to El. 185	Very Soft to Stiff
Alluvial Silty Sand[2]	El. 208 to El. 165	Very Loose to Dense
Alluvial Sand and Gravel[2]	El. 190 to El. 150 (termination depth)	Loose to Dense

[1]Used for section H-H' only
[2]Used for section I-I' only

3.6.3. Shell and Core

The embankment fill generally consists of brown to gray, fined-grained silty sand (SM) and sandy silt (ML). The SPT N_{80}-values within the dike range from 10 to 56 blows per foot (bpf) with and average value of 28 bpf. Based on N_{80}-values, the density of fill materials vary from medium dense to very dense.

3.6.4. Starter Dike

The starter dike also consists of brown to gray, fined-grained silty sand (SM) and sandy silt (ML). The SPT N_{80}-values within the dike range from 2 to 11 blows per foot (bpf) with a majority between 3 and 6 bpf. Based on N_{80}-values, the density of fill materials vary from very loose to medium dense.

3.6.5. Alluvial Silty Clay and Sandy Silt

The alluvial silty clay and sandy silt were encountered at borings STN-34, -35, -36 and -40. Hence, the silts were only modeled for cross-section H-H'. These soils generally consist of brown to gray sandy silt (ML), silty clay (CL-ML), lean clay (CL), and silt with sand (ML). The silt and clay typically exhibited very soft to stiff consistency based on most N_{80}-values in the range of 1 to 9 blows per foot. The thickness of alluvial clay and silt ranged from 2 to 18 feet.

3.6.6. Alluvial Silty Sand

The alluvial silty sand was encountered at borings STN-31, -32, -33 and -38. Hence, the alluvial sands were only modeled for cross-section I-I'. The alluvial silty sand generally consists of brown to gray, fine-grained silty sand (SM) and sand with silt (SP). The sand was very loose to

dense based on N_{80}-values in the range of 1 to 37 blows per foot. Gravel was occasionally encountered within the sand deposits, which inflated the recorded blow counts. Thickness of the sand layer typically varies from 11 to over 35 feet.

3.6.7. Alluvial Sand and Gravel

Beneath the alluvial silty sand, brown to gray sand and gravel (SP-SM, GW) was encountered at some borings extending to boring termination. For example, the sand and gravel zone was encountered at borings STN-31, -32 and -33 but was absent at borings STN-34, -35 and -36. Hence, the alluvial sand and gravel were only modeled for cross-section I-I'. The material ranges from medium to coarse-grained and poorly graded sand, to rounded and well graded gravel. The sand and gravel is typically medium dense to dense based on most N_{80}-values ranging from 10 to 40 blows per foot. Thickness of the sand and gravel layer typically varies from 2 to over 10 feet, extending to boring termination.

3.6.8. Fill - Silty Sand

Fill soils consisting of silty sand was encountered at borings STN-29, -31, -34 and -38. The material generally consists of brown to gray, fine-grained silty sand (SM) with trace or roots. The sand was very loose to medium dense based on N_{80}-values in the range of 2 to 13 blows per foot. Thickness of the sand layer typically varies from 3 to over 10 feet.

3.7. Laboratory Test Data

3.7.1. General

Laboratory testing was performed in accordance with applicable ASTM soil testing standards. The laboratory testing program consisted of natural moisture content determinations, sieve and hydrometer analyses, Atterberg limits, specific gravity determinations, and falling head permeability tests. The results of the testing program were used to select/derive appropriate parameters for the seepage and slope stability analyses. The results of these laboratory tests are provided in Appendix D and are depicted on the graphical boring logs presented in Appendix A.

3.7.2. Natural Moisture Content and Laboratory Classification Testing

Natural moisture content determinations (ASTM D 2216) were performed on all soil samples recovered from SPT sampling. The results of the natural moisture content tests are presented on the graphical boring logs in Appendix A and typed boring logs in Appendix B.

Soil classification tests consisting of sieve and hydrometer analyses (ASTM D 422) and Atterberg Limits (ASTM D 4318) were performed on select SPT and Shelby tube samples. Generalized soil classifications based on these test results are discussed in Section 3.6 of this report. The results of the natural moisture content and laboratory classification tests are summarized in Table 6.

Table 6. Summary of Natural Moisture Content and Classification Testing

Horizon	Predominant USCS Classification	Water Content Typical Range (percent)	Liquid Limit	Plasticity Index	Percent Passing No. 200 Sieve
Shell & Core	SM, ML	9 - 14	NP[1] - 20	NP[1] - 1	37 - 50
Starter Dike	SM, ML, CL	2 - 18	NP[1]	NP[1]	25
Alluvial Silty Clay & Sandy Silt	ML, CL	22 – 36	NP[1] - 26	NP[1] - 8	79
Alluvial Silty Sand	SP, SM	4 – 19	NP[1]	NP[1]	3 - 16
Alluvial Sand and Gravel	SP, SW	2 - 43	NP[1]	NP[1]	3 - 7
Fill – Silty Sand	SP	6 - 24	NP[1]	NP[1]	N/A
Fly Ash	ML	20 – 51	NP[1]	NP[1]	N/A
Bottom Ash	SW	2 – 12	NP[1]	NP[1]	N/A

[1] NP – Non Plastic

3.7.3. Falling Head Permeability Testing

Falling head permeability tests (ASTM D5084) were performed on select extruded tube specimens of dike fill and foundation materials. Table 7 below summarizes the permeability test results.

Table 7. Falling Head Permeability Test Results

Boring No.	Depth (ft)	Specific Gravity	In-Situ Water Content (%)	Initial Dry Unit Weight (pcf)	Textural Classification	Average Hydraulic Conductivity, k_v (cm/s)
STN-30	18.0 – 18.3	2.67	14.4	86.7	Shell – Sandy Silt	1.3E-05
STN-32	6.1 – 6.4	2.67	30.1	91.6	Starter Dike – Lean Clay	2.5E-06
STN-35	7.7 – 8.0	2.68	34.1	88.5	Starter Dike – Lean Clay	2.9E-05
STN-37	25.5 – 28.0	2.69	32.4	89.6	Foundation - Sandy Silt	5.3E-06
STN-33A	37.5 – 39.0	2.65	22.6	92.0	Foundation - Lean Clay	2.5E-05

3.8. Instrumentation Monitoring Program

Piezometer readings provide an estimate of the piezometric surface fluctuations at the site. Seven (7) fully grouted vibrating wire piezometers were installed along the Northern Dike of the West Ash Pond. Since their installation, four readings have been collected from the piezometers between October 8th and November 10th 2015. Barometric pressures, for the approximate time of each reading, were used in the calculation of the measured water elevations. A summary of the piezometer data is provided in Table 8. Individual piezometer data is provided in Appendix C.

Table 8. WAP Piezometer Data from October 8 to November 10, 2015

PZ No.	Surface Elevation (ft)	Depth of Transducer (ft)	Transducer Elevation (ft)	Measured Water Elevations (ft, MSL)			
				10/8/15	10/11/15	11/2/15	11/10/15
STN-30A	228.2	20.0	208.2	Dry[1]	Dry[1]	Dry[1]	Dry[1]
STN-30B		38.0	190.2	190.2	190.3	Dry[1]	190.5
STN-33A	228.2	30.0	198.2	199.1	198.6	Dry[1]	198.3
STN-33B		45.0	183.2	187.0	185.7	183.4	185.5
STN-36A	227.8	18.0	209.8	N/A[2]	Dry[1]	Dry[1]	Dry[1]
STN-36B		38.0	189.8	N/A[2]	Dry[1]	Dry[1]	Dry[1]
STN-36C		46.0	181.8	N/A[2]	185.5	182.9	184.3

[1]Water was apparently below the transducer elevation.

[2]Water level measurement was not taken.

For the duration of readings between October and November 2015, the measured water levels at STN-30, STN-33, and STN-36 were below the dike fill soils. This corresponds well to the low moisture contents of the dike fill materials provided in Table 6. The transducers located in the foundation soils showed the water level fluctuates between 182.9 and 199.1 feet during this period. The measured groundwater elevation at STN-38, drilled at the upstream toe of the dike, was 183.8 ft. The CPT Dissipation test results at the nearby STN-49 recorded dry above the termination elevation of 190.5 ft. The elevated readings in STN-30B and STN-33A are judged to reflect localized soil conditions and not representative of the site. Due to the proximity of McKellar Lake to the West Ash Pond, the piezometers with tips in sandy soils are expected to fluctuate with the lake water level. The lake water level fluctuated between 177.4 and 183.9 ft during this period. Therefore, a piezometer level of 185.0 ft was used for long-term slope stability analyses.

4. Engineering Properties of Soils

4.1. Assumptions

Laboratory test data was limited for various soil horizons at the West Ash Pond. For example, shear strength testing was not performed on any soil samples. However, test data on similar soils from historical explorations and correlated strength parameters using SPT data were used as needed to develop material parameters.

4.2. Density

Stability analyses require unit weight (density) for each material. Derived unit weights and void ratios for identified soil horizons are presented in Table 9. Laboratory water content test results were used to determine average water content for each horizon. Laboratory test results and published correlations based on SPT data were used to estimate void ratio (e), specific gravity (G_s), dry unit weight (γ_d), in-situ unit weight (γ_m), and saturated unit weight (γ_{sat}). The soil parameters used for the dike and foundation materials were derived using both current and historical laboratory test data (standard penetration test, permeability test) and Stantec's experience with these materials in similar applications.

The unit weight parameters were estimated from published correlations between SPT blow counts (N_{60}) and relative density. However, as discussed in Section 3.2, the SPTs were performed using an automatic hammer and were corrected prior to applying them in correlations with other soil index properties.

The calculated N_{60} values were also corrected for the effect of overburden pressure prior to using the data in conjunction with correlations for non-cohesive soil parameters. The N_{60} values were normalized to vertical effective overburden stresses of 2,000 pounds per-square foot. The relationship between the correction factor, C_N, and the effective overburden stress, σ', was based on a relationship proposed by Liao and Whitman as referenced in Seed and Harder [1990]:

$$C_N = \frac{1}{\sqrt{\sigma'}} \qquad \textbf{Equation 2}$$

Where:

C_N = correction factor for overburden stress
σ' = vertical effective overburden stress (tsf)

Consequently, the standardized corrected N-value, $(N_1)_{60}$ is equal to:

$$(N_1)_{60} = C_N N_{60} \qquad \textbf{Equation 3}$$

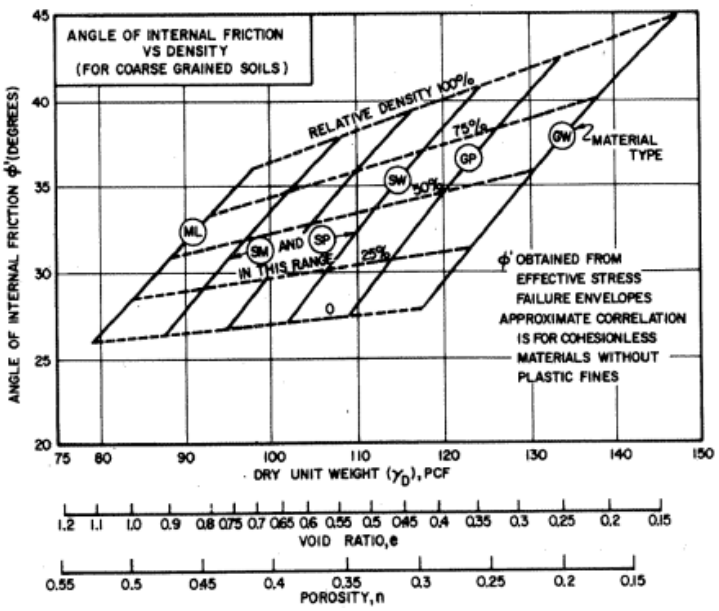
Where:

C_N = correction factor for overburden stress
$(N_1)_{60}$ = standardized N-value

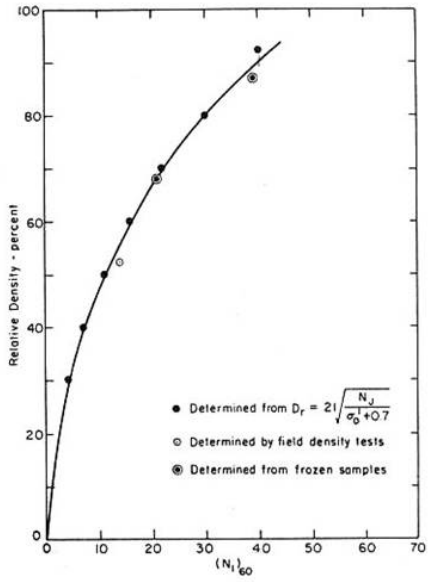
The $(N_1)_{60}$ values were used to obtain relative densities based on relationships developed by Tokimatsu and Seed (1988) as shown in Figure 7. NAVFAC (1982) presents a relationship using relative density and specific soil types to correlate angle of internal friction, unit weight, and void ratio as shown in Figure 7 below. Soil classifications for the correlations are based on laboratory test results and visual classifications performed by the on-site geotechnical engineer or geologist during the drilling process. Once the relationships for the angle of internal friction, unit weight, and void ratio were established, the in-situ unit weight and

effective stress friction angle were calculated based upon the natural moisture content. The N-values presented on the graphical boring logs in Appendix A and typed boring logs in Appendix B are the raw data and do not reflect corrections for hammer efficiency or overburden stress.

The soil parameters for the dike and generalized foundation soil horizons modeled in the slope stability analyses are summarized in Table 9.



From NAVFAC DM 7.01 (1986)



From Tokimatsu and Seed (1988)

Figure 7. Correlation between SPT N_{60}, Relative Density (D_r) and Friction Angle (ø')

Table 9. Selected Specific Gravity, Void Ratio, and Unit Weight

Soil Horizon	Sp. Gr, G_S	Void Ratio, e	WC (%)	γ_d (pcf)	γ_m (pcf)	γ_{sat}[1] (pcf)
Shell and Core	2.68	0.62	11	104	115	127
Starter Dike	2.68	0.79	16	94	108	121
Alluvial Silty Clay/Sandy Silt	2.69	0.87	32	90	118	119
Alluvial Silty Sand	2.69	0.71	11	98	108	124
Alluvial Sand & Gravel	2.68	0.47	13	114	129	134
Fill - Silty Sand	2.68	0.77	17	94	110	122
Hydraulic Ash	2.31	0.85	30	73	95	105
Bottom Ash	2.32	0.34	10	95	105	123

[1] Values are computed using assigned parameters for G_s and e

Shell and Core

The north dike design drawings (Figure 3) show a 10-foot core with outer shells. The core was supposed to be constructed with less permeable soils than the shells. However, based on the field and laboratory testing, we could not differentiate between these zones. Therefore, the same material parameters were used for both shell and core. The dry density and void ratio were estimated using correlated SPT N-values. The specific gravity, in-situ unit weight and saturated unit weight were calculated using dry density and void ratio.

Starter Dike

Relatively lower N-values were obtained within the Starter Dike fill than the raised dike (at borings STN-32 and STN-35). The dry density and void ratio were estimated using correlated SPT N-values. The specific gravity, in-situ unit weight and saturated unit weight were calculated using dry density and void ratio.

Alluvial Silty Clay/Sandy Silt

The dry density, specific gravity, and void ratio were obtained from a permeability test performed on a soil sample from STN-37. The in-situ unit weight and saturated unit weight were calculated using dry density and void ratio.

Alluvial Silty Sand

The dry density and void ratio were estimated using correlated SPT N-values. The specific gravity, in-situ unit weight and saturated unit weight were calculated using dry density and void ratio.

Alluvial Sand and Gravel

The dry density and void ratio were estimated using correlated SPT N-values. The specific gravity, in-situ unit weight and saturated unit weight were calculated using dry density and void ratio.

Hydraulic Fly Ash and Bottom Ash

Density parameters for ash are based on historical test results performed by AECOM and Law Engineering, Inc. for the TVA Fossil Plant at Kingston, Tennessee.

Fill - Silty Sand

The dry density and void ratio were estimated using correlated SPT N-values. The specific gravity, in-situ unit weight and saturated unit weight were calculated using dry density and void ratio.

4.3. Drained Shear Strengths for Static, Long-Term Conditions

The North Dike was originally constructed in the early 1960s. Hence, it is anticipated that excess pore pressures generated within the dike and underlying foundation soils during construction have had sufficient time to dissipate and fully drained conditions have developed within the dike. For long-term conditions, only soil unit weights and drained strength parameters (c' and Φ') are needed.

Drained shear strength (S_d) of the soil can be determined using the following equations:

$$S_d = c' + \sigma' \tan \phi' \qquad \textbf{Equation 4}$$

$$\sigma' = \sigma - u \qquad \textbf{Equation 5}$$

Where:

c' = the effective cohesion
ϕ' = the effective angle of internal friction
σ' = the effective stress
σ = the total stress and
u = the pore water pressure

Uncemented (granular) soils exhibit no strength at $\sigma'=0$, corresponding to c' = 0. In the case of unsaturated fine grained sands, suction results in apparent cohesion, but this component of strength is lost upon saturation. Over a large pressure range, most granular soils have a curved strength envelope. Fitting a straight line through segments of a curved failure envelope can result in c' > 0, but the values are applicable only over the specified range of effective stress.

For normally consolidated, saturated clays, the Mohr-Coulomb failure envelope exhibits c' equal to 0. At effective stresses below the pre-consolidation pressure, overconsolidated clays have a curved failure envelope that can be represented with a straight line having c' > 0. Overconsolidated clays in the field are often fissured and the in situ c' is significantly smaller than values determined from testing of small samples in the laboratory. To avoid progressive failures in overconsolidated, stiff fissured clays, remolded soil samples are recommended for testing; this generally results in "fully softened" strengths with c' = 0. Thus, in the absence of particle cementation/bonding, long-term (drained) shearing resistance related to c' > 0 is considered unreliable. In routine geotechnical design practice, values of c' = 0 are usually assumed for both normally and overconsolidated saturated clays, and for uncemented granular soils. Detailed testing and characterization of a particular soil, coupled with careful application of the fitted strength envelopes, are necessary where values of c' are used in a stability evaluation. For the analyses in this report, c' = 0 were used for drained strengths of all soils.

CU triaxial testing is generally used to determine the representative shear strength parameters of soil. CU testing was not performed on soil samples from the West Ash Pond. However, CU testing was performed on the dike and foundation soils from the nearby Chemical Pond (Stantec report No. rpt_001_172672010, October 17, 2012). Those test results were used to estimate strength parameters those soil horizons as discussed below. Values of friction angle (ϕ') and cohesion (c') were determined by drawing a line through p'-q failure points, so that about two-thirds of the data points were above the failure envelope. For the remaining soil horizons, SPT data was also used in the assessment of drained shear strength parameters. The selected drained shear strength parameters are summarized in Table 10.

Table 10. Selected Drained Shear Strength Parameters for Static Analysis

Soil Horizon	Effective Stress Parameters	
	Cohesion, c' (psf)	Friction Angle, ϕ' (degree)
Shell and Core	0	33
Starter Dike Fill	0	30
Alluvial Silt and Clay	0	31
Alluvial Silty Sand	0	31
Alluvial Sand & Gravel	0	35
Fill - Silty Sand	0	30
Hydraulic Fly Ash	0	25
Bottom Ash	0	34

Shell and Core

Three CU triaxial tests were performed on the north dike soils from the Chemical Pond. Those test results were used to determine shear strength parameters for the dike fill soils. The classification test results shown in Table 11 indicate the dike materials are similar to what was encountered at the West Pond.

Table 11. Test Results used to Determine Shear Strength Parameters for the Dike Fill

Borehole*	Sample	Depth (ft)	Classification Test Data*
STN-19A	ST-3	18 - 20	LL – NP, PI – NP, passing #200: 51.9%
STN-22A	ST-2	8 - 10	LL – NP, PI – NP, passing #200: 47.9%
STN-22A	ST-4	18 - 20	LL – NP, PI – NP, passing #200: 51.4%

* From the Chemical Pond north dike stability evaluation report

The strength envelope shown in Figure 8 indicates a friction angle of 33 degrees and cohesion of 200 psf. The effective cohesion was neglected in the slope stability model.

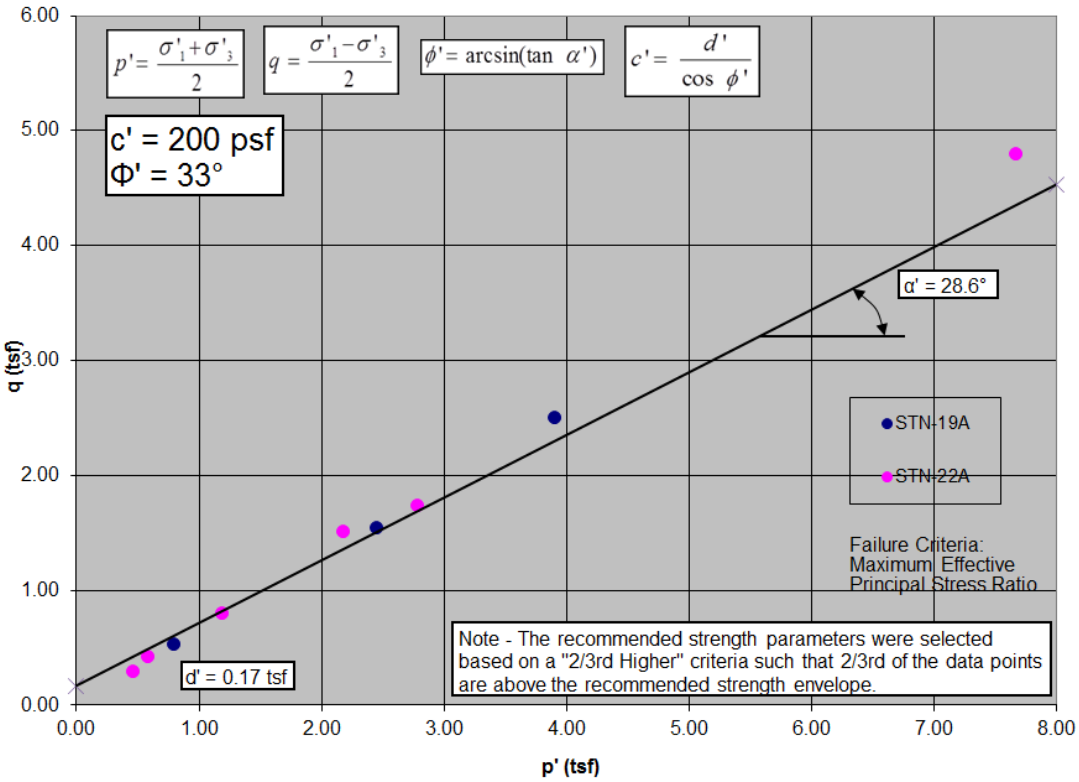


Figure 8. Effective Stress Strength Envelope from CU Triaxial Tests – Dike Fill (from the Chemical Pond report, Stantec October 17, 2012)

Starter Dike

Strength parameters were selected using an estimated average dry density of 94 pcf based on correlated SPT N-values. Relatively lower N-values were obtained within the Starter Dike fill (than the raised dike) at borings STN-32 and STN-35. An effective friction angle of 30 degrees was estimated using the NAVFAC chart (Figure 7). Effective cohesion was assumed to be zero.

Alluvial Silty Clay and Sandy Silt

One CU triaxial test was performed on an alluvial silty clay sample from STN-28, from the Chemical Pond. The test result was used to determine the shear strength parameters. The test was performed on sample ST-2, obtained from 40 to 42 feet below grade. The material was classified as ML with 94.1 percent passing #200 sieve.

The strength envelope shown in Figure 9 indicates a friction angle of 31 degrees and cohesion of 1,200 psf. The effective cohesion was not included in the slope stability model.

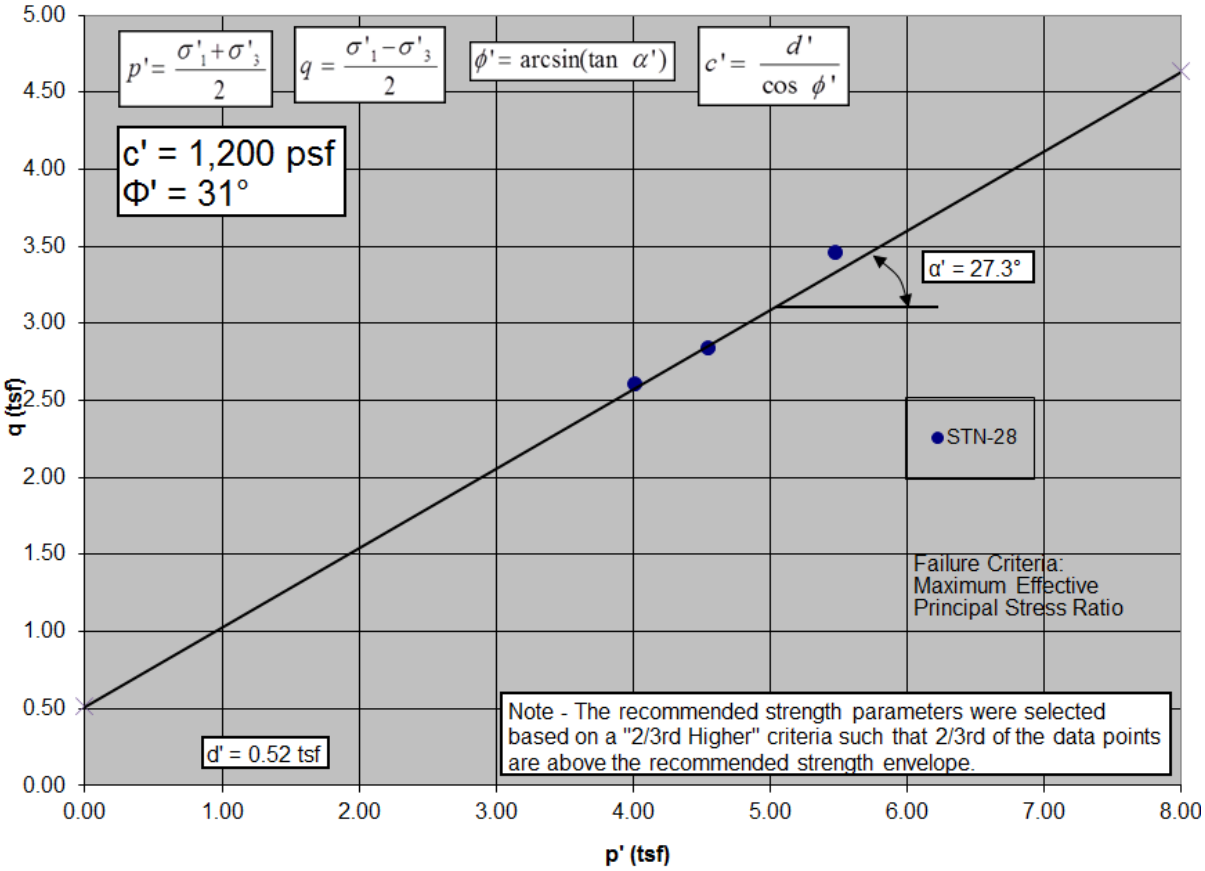


Figure 9. Effective Stress Strength Envelope from CU Triaxial Tests – Alluvial Silty Clay and Sandy Silt (from the Chemical Pond report, Stantec October 17, 2012)

Alluvial Silty Sand

Drained strength parameters were selected using an estimated dry density of 98 pcf based on correlated SPT N-values. An effective friction angle of 31 degrees was estimated using the NAVFAC chart (Figure 7). Effective cohesion was assumed to be zero.

Alluvial Sand and Gravel

An effective friction angle of 35 degrees was calculated for the alluvial sand and gravel using the NAVFAC chart (Figure 7) for an average dry density of 114 pcf. Effective cohesion was assumed to be zero.

Fill - Silty Sand

Drained strength parameters were estimated using an estimated dry density of 94 pcf based on correlated SPT N-values. An effective friction angle of 30 degrees was estimated using the NAVFAC chart (Figure 7). Effective cohesion was assumed to be zero.

Fly Ash and Bottom Ash

Drained strength parameters for hydraulic ash and bottom ash are based on historical test results performed by AECOM and Law Engineering, Inc. for similar materials at the TVA Fossil Plant at Kingston, Tennessee.

4.4. Undrained Shear Strengths for Static, Short-Term Conditions

Undrained strength parameters are required for rapid drawdown analysis. Undrained shear strength parameters for each identified material under static, short term conditions are summarized in Table 1Table 12. CU triaxial test results were used to determine undrained strength parameters for the dike fill and alluvial silty clay and sandy silt. The strength parameters for the remaining soil horizons were estimated using the CU test data and experience on similar soils from the dikes and foundation at the Allen Fossil Plant.

Table 12. Selected Undrained Shear Strength Parameters for Static Analysis

Soil Horizon	Total Stress Parameters	
	Cohesion, c (psf)	Friction Angle, ϕ (degree)
Shell and Core	200	28
Starter Dike Fill	200	28
Alluvial Silt and Clay	600	27
Alluvial Silty Sand	200	28
Alluvial Sand & Gravel	0	35
Fill - Silty Sand	200	28
Hydraulic Fly Ash	0	10
Bottom Ash	0	34

Shell and Core

The undrained strength parameters for the dike shell and core materials are determined from the CU test results performed on the north dike soils from the Chemical Pond. The strength envelope shown in Figure 10 indicates a friction angle of 28 degrees and cohesion of 200 psf. These values were used for stability analyses.

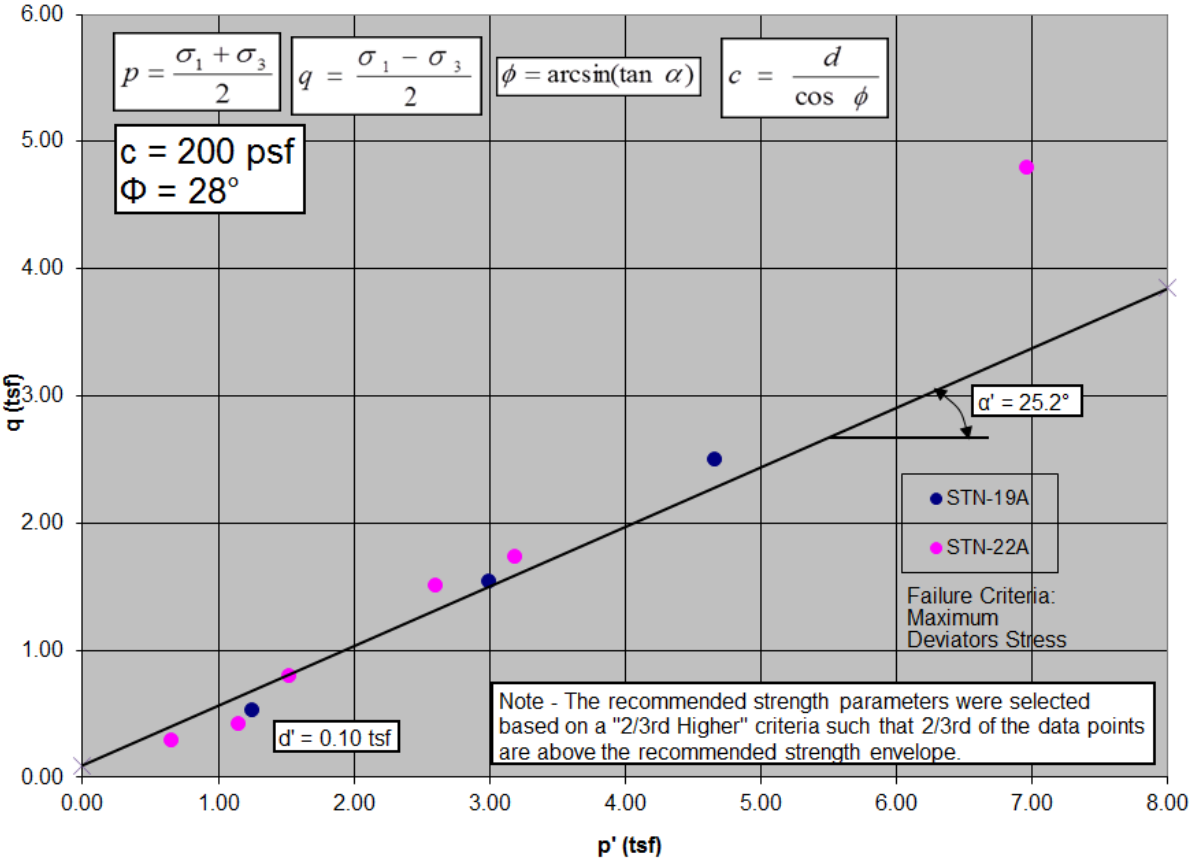


Figure 10. Total Stress Strength Envelope from CU Triaxial Tests – Dike Fill (from the Chemical Pond report, Stantec October 17, 2012)

Starter Dike

CU triaxial testing was not performed on the starter dike soil samples. Without test data, the undrained strength parameters for the starter dike were estimated to be equal to the shell and core materials.

Alluvial Silty Clay and Sandy Silt

The undrained strength parameters for the alluvial silty clay and sandy silt are determined from the CU test results performed on the north dike soils from the Chemical Pond. The strength envelope shown in Figure 11 indicates a friction angle of 27 degrees and cohesion of 600 psf. These values were used for stability analyses.

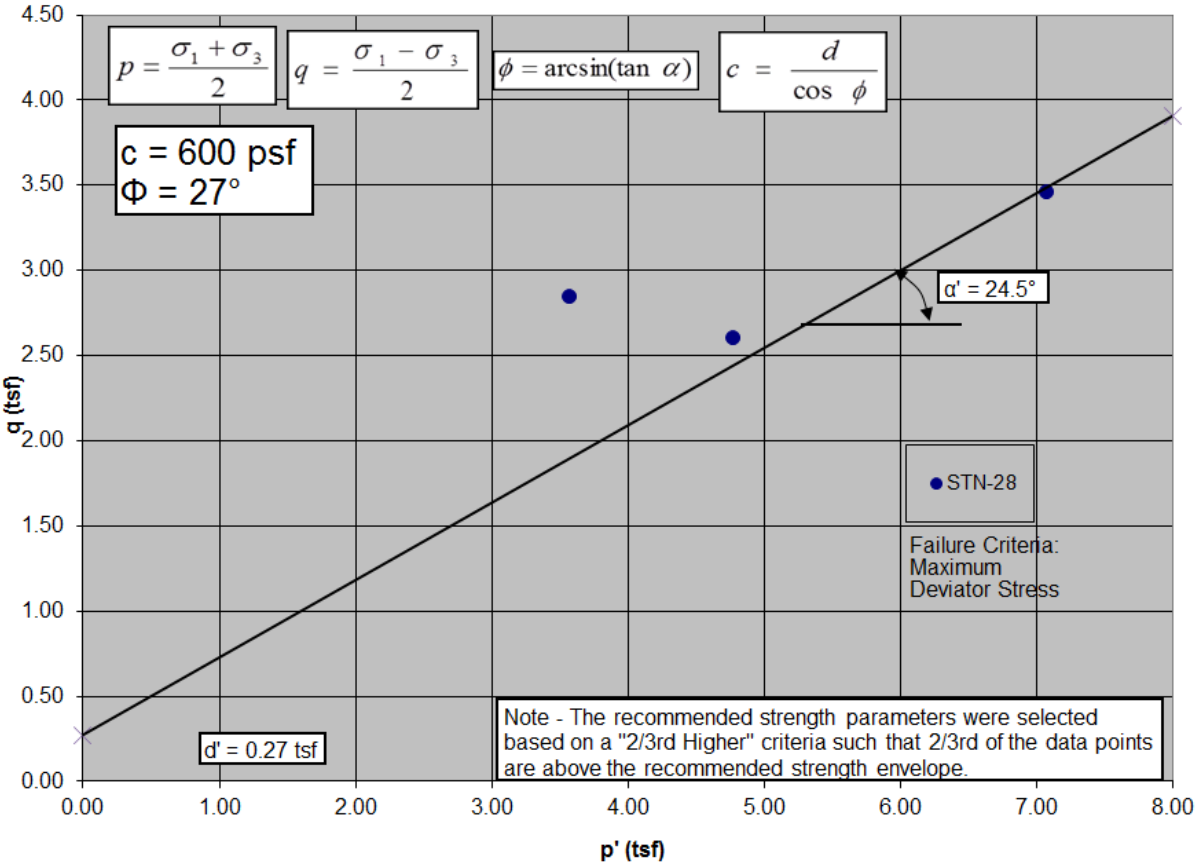


Figure 11. Total Stress Strength Envelope from CU Triaxial Tests – Alluvial Silty Clay and Sandy Silt (from the Chemical Pond report, Stantec October 17, 2012)

Alluvial Silty Sand

CU triaxial testing was not performed on alluvial silty sands. The undrained strength parameters for the shell and core were assigned to these soils.

Alluvial Sand and Gravel

The alluvial sand and gravel was assumed to be fully drained under each of the analyzed loading conditions. Hence, the undrained and drained strength envelopes and parameters are assumed to be the same (c = c' = 0 psf and $\phi = \phi' = 35°$).

Fill – Silty Sand

CU triaxial test was not performed on fill - silty sands. The undrained strength parameters for the shell and core were assigned to these soils.

Fly Ash and Bottom Ash

Strength parameters for hydraulic ash and bottom ash are based on historical test results performed by AECOM and Law Engineering, Inc. for similar materials at the TVA Fossil Plant at Kingston, Tennessee.

5. Engineering Analyses

5.1. General

Slope stability analyses were performed for 2 cross-sections of North Dike of the West Ash Pond. These are cross-section H-H' at Station 13+33 and I-I' at Station 4+60. The locations of these cross-sections are shown on the boring layout diagram provided in Appendix A. Only the exterior slopes of the dike (north slope) were evaluated. The interior slope of the dike at cross-section H-H' is buttressed with ash. The pond does not impound water. The upstream slope is shorter in height, only about 14 feet compared to the downstream slope which is about 28 feet. Hence, the stability of the exterior slope was only considered critical.

Stantec developed the surface geometry at each cross-section using survey data provided by TVA, design drawings, and site observations. The downstream contours beyond TVA survey limits were obtained from Shelby County GIS contours prepared in 2006. Therefore, these profiles should be considered accurate only to the degree by the means and methods used to prepare them.

Stantec developed the subsurface profile at each cross-section based on information from borings, laboratory test data and drawings for the dike construction. Design cross-sections for the North Dike are provided on drawing 10N224. Cross-sections A-A and B-B of this drawing were used to develop profiles at cross-sections H-H' and I-I', respectively. The design cross-sections are provided in Figure 3 and Figure 4, respectively. The design cross-sections were modified using the current survey data and information from the borings.

The North Dike stability was evaluated for the following loading conditions:

1. Long-term (effective stress) slope stability with static piezometer levels

2. Rapid drawdown analysis for the McKellar Lake level receding from an assumed flood elevation 228 feet to the normal pool elevation of 185 feet

Slope stability analyses were performed using the SLOPE/W module of the GeoStudio 7.23 software package developed by GEO-SLOPE International, Ltd. of Calgary, Alberta, Canada (www.geo-slope.com). These analyses were performed in accordance with the recommendations and criteria outlined in the USACE Design Manuals EM 1110-2-1902 "Slope Stability" and EM 1110-2-1913 "Design and Construction of Levees".

5.1.1. Water Elevations

A static piezometer level of 185.0 feet was used for long-term slope stability analyses based on piezometer data and McKellar Lake water level readings during the month of October and November 2015.

According to the USACE, Memphis District, the 500-year design flood elevation at McKellar Lake is 232.5 feet MSL, used for the design of the USACE Levee. This elevation is greater than the top-of-dike elevation for the North Dike. Therefore, the top-of-dike elevation of 228 feet was used for the lake elevation for rapid drawdown analysis. Based on the topographic survey and Shelby County GIS survey, the elevation at the exterior toe of the dike varies between 196 ft and 200 ft MSL. A drawdown to the normal pool elevation of 185 feet was selected for rapid drawdown scenario.

Stantec reviewed McKellar Lake water elevations between August 2008 and December 2009 to understand the fluctuations of water levels in the lake. During those months, the water level fluctuated between 170.05 ft and 213.85 ft. The water level receded from the peak elevation of 213.85 ft to 199.55 ft between May 24 and June 4 of 2009. The average rate of drawdown is about 1.2 ft per day. After June 4, the average rate of drawdown decreased to 0.5 ft per day. Therefore, considering a rapid drawdown to elevation 185 feet from elevation 228 feet, is a more conservative analysis than what has been historical observed.

Table 13. Static Water Levels for Slope Stability Analyses

Loading Conditions		Water Level (ft MSL)
Long-Term/Operation		185
Rapid Drawdown	Flood Level	228
	Drawdown Level	185

5.2. Slope Stability Analysis Methodology

The stability of the dike was evaluated using static limit equilibrium methods as implemented in the SLOPE/W module. Static piezometric levels were used for the slope stability analysis based on available piezometer data from the site. The unit weight and shear strength properties used in the stability analyses were discussed in Section 4 of this report.

5.2.1. Limit Equilibrium Methods in SLOPE/W

Limit equilibrium methods for slope stability analysis consider the static equilibrium of a soil mass above a potential failure surface. For a conventional two-dimensional method of slope stability analysis, the slide mass above a trial failure surface is split into a number of vertical slices. Stresses are calculated along the sides and base of each slice. The factor of safety against a slope failure (FS_{slope}) is defined as:

$$FS_{slope} = \frac{\textit{shear strength of soil}}{\textit{shear stress required for equilibrium}} \qquad \textbf{Equation 6}$$

The strengths and stresses are computed along a defined failure surface, on the base of the vertical slices. The shearing resistance at locations along the potential slip surface are computed, with appropriate strength parameters (cohesion and friction angle), as a function of the total or effective normal stress.

Spencer's solution procedure (1967), which satisfies both moment and force equilibrium, was used in this study. Spencer's procedure computes FS_{slope} for an assumed failure surface; a search must be performed to find the critical slip surface corresponding to the lowest FS_{slope}. Both circular and noncircular potential failure surfaces can be evaluated. The trial slip surfaces were subsequently optimized to find critical slip surface and corresponding critical factor of safety. Optimization was performed using an optimization routine in SLOPE/W that incrementally alters a portion of the slip surface, usually within a certain soil horizon for circular failure pattern, to optimize the solution generating non-circular, curved failure surface. The results of the slope stability analyses discussed in Section 5.2.3, and shown graphically on the cross-sections in Appendix A, represent factors of safety computed from the optimized, circular slip surface routine.

5.3. Long-Term Analyses

This analysis applies to the long-term stability of the embankment after sufficient time has passed since the construction of the proposed berm for all excess pore water pressures to have dissipated. The analysis was performed using drained, effective stress strength parameters. Only the downstream slopes were evaluated.

5.4. Rapid Drawdown Analyses

This analysis applies to the embankment slope stability after a sudden drawdown of water level in McKellar Lake. The water level was assumed to drop rapidly from a high flood level to a normal pool elevation of 185 feet. Static piezometric levels prior to and after the drawdown were used. Undrained, total stress stability analyses using the three-stage approach (Duncan and Wright, 2005) were performed for this load case.

5.5. Results of Slope Stability Analysis

Using the strength parameters listed in Section 4, the existing dike slopes were analyzed at the two referenced cross-sections of the North Dike. The failure surfaces were generated using both "Grid and Radius" and "Entry-Exit" methods. The results of the analyses are included in Appendix E and summarized in Table 13 below.

Where the surface of the slope is composed of cohesionless (c' = 0) materials, an infinite slope failure (shallow sliding parallel to the surface) will be critical. While solutions were obtained for this case, there is less concern for this potential failure mechanism. Suction pressures in unsaturated surface soils will often create enough apparent cohesion to prevent this type of failure. If shallow sliding does occur, the resulting deformations are unlikely to threaten the integrity of the dike and can be repaired. To force the search routine to evaluate deeper failure mechanisms, the surfaces were generated using a minimum depth of 10 feet for the slip surface.

Table 14. WAP North Dike - Factors of Safety for Slope Stability

Cross-Section	Long-Term		Rapid Drawdown	
	Shallow Failure	Deep Failure	Shallow Failure	Deep Failure
H – H'	2.1	2.2	2.1	2.1
I – I'	2.3	2.6	2.3	2.5

The term 'Shallow Failure' refers to relatively shallow slides (minimum 3-foot slide) that while not detrimental to the overall stability of the dike, could progress into failures that could threaten the pond if not repaired. The term 'Deep Failure' refers to deep seated (minimum 10-foot slide) failure circles that would threaten release of ash to the McKellar Lake. Based on discussions with TVA and to be in accordance with current prevailing practices, a minimum factor of safety of 1.5 was established for long-term conditions using the guidelines presented in USACE Manual EM 1110-2-1902 "Slope Stability". The minimum factor of safety for rapid drawdown conditions was established at 1.1, also based on USACE guideline from EM 1110-2-1902. The results of our stability analyses show that the North Dike slopes meet the established criteria for factor of safety.

6. Conclusions

The conclusions are based upon Stantec's understanding of the facility as outlined herein. This understanding was developed from reviews of historical information provided by TVA, discussions with TVA personnel throughout the course of this project, and results of the geotechnical exploration and engineering analyses.

The results of the slope stability analysis show that the exterior slope of the North Dike has a long-term factor of safety between 2.1 and 2.6. The factor of safety for rapid drawdown conditions ranged between 2.0 and 2.6. The calculated factors of safety meet the USACE criteria for slope stability for long-term and rapid drawdown conditions.

7. Limitations of Study

The scope of this evaluation was limited to consider only the potential risks to the Northern Perimeter Dike of the West Ash Pond from slope instability. This assessment did not consider the West Dike, the USACE levee or the portion of the North Dike of the Chemical Pond. It also excludes potential failure modes related to seepage or other possible mechanisms.

The stability of the dike during a potential earthquake was not analyzed. It should be noted that the seismic risk at this site (likelihood of experiencing a large magnitude earthquake) could be relatively high because of its proximity to the New Madrid Seismic Zone.

These conclusions are based on subsurface conditions encountered at the borings advanced as part of the geotechnical exploration using the degree of care and skill typically exercised under similar circumstances by competent members of the engineering profession. The boring logs provide subsurface conditions at the specific locations at the time of drilling. Subsurface conditions away from the boring locations may vary. The groundwater level may fluctuate over time along with the Lake water level and weather conditions. No warranties can be made regarding the continuity of conditions between borings.

It should be noted that construction records and as-built drawings were not available for review. As a result, consideration should be given to some of the generalizations made in this report with regards to dike construction and geometry prior to using this data in future evaluations.

8. References

As part of this study, various documents were reviewed with the objective of developing a better understanding of the history of the West Ash Pond. The following documents were reviewed as part of this assessment:

Duncan, J. M, and Wright, S. G. (2005). *Soil Strength and Slope Stability*. John Wiley and Sons, Hoboken, New Jersey.

Geotechnical Investigations, Department of the Army, US Army Corps of Engineers, Engineering Manual EM 1110-1-1804, January 1, 2001.

GEO-SLOPE International Ltd. (2010). *Seepage Modeling with SEEP/W 2007: An Engineering Methodology*. 4th ed., Calgary, Alberta, Canada.

Naval Facilities Engineering Command (NAVFAC) (1986). *Soil Mechanics.* Design Manual 7.01, Alexandria, Virginia, September.

Naval Facilities Engineering Command (NAVFAC) (1986). *Foundations and Earth Structures.* Design Manual 7.02, Alexandria, Virginia, September.

Seed, R. B., and Harder, L. F., Jr. (1990). "SPT-Based Analysis of Cyclic Pore Pressure Generation and Undrained Residual Strength." *Proc., H. B. Seed Memorial Symposium*, BiTech Pub., Vol. 2, pp.351-376.

Spencer, E. (1967), "A method of analysis of the stability of embankments assuming parallel inter-slice forces", *Geot*., 17, No. 1, pp. 11-26.

Stantec (2012), "Geotechnical Exploration Report, Northern Perimeter Dike Stability, Chemical Treatment Pond Closure, Allen Fossil Plant, Shelby County, Tennessee", prepared for *TVA*.

Terzaghi, K., Peck, R. B., and Mesri, G. (1996). *Soil Mechanics in Engineering Practice*. 3rd ed., John Wiley and Sons, Hoboken, New Jersey.

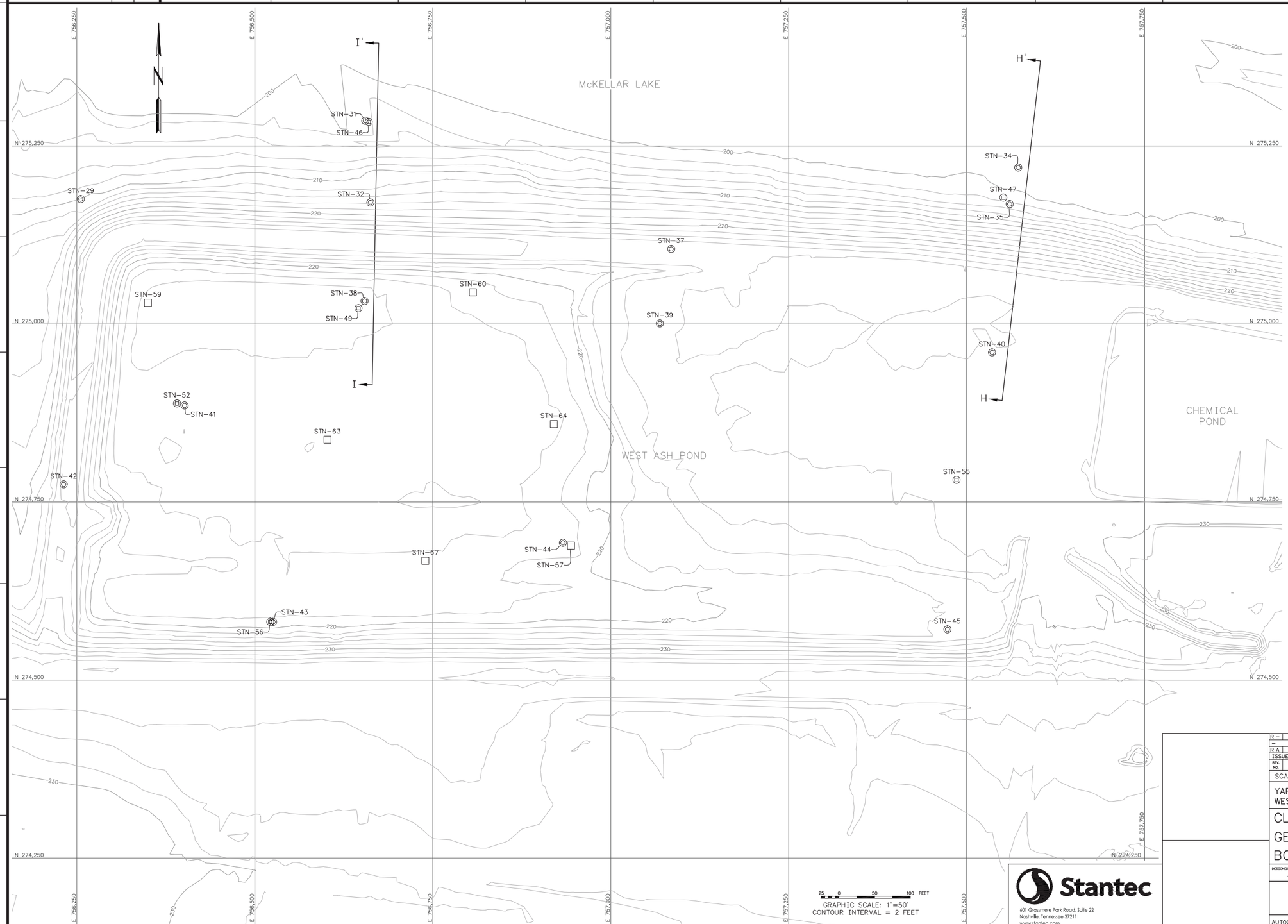
Tokimatsu, K., and Seed, H. B. (1987), "Evaluation of settlements in sands due to earthquake shaking", Journal of Geotechnical Engineering, ASCE, Vol. 113, No. 8, August, pp. 861-878.

U.S. Army Corps of Engineers (2004). "General Design and Construction Considerations for Earth and Rock-Fill Dams." EM 1110-2-2300, July 30.

U.S. Army Corps of Engineers (2003). "Slope Stability." EM 1110-2-1902, October 31.

Appendix A

Boring Layout and Cross Sections



SURVEY CONTROL NOTE:

A GLOBAL POSITIONING SYSTEM (GPS) BASE STATION HAS BEEN ESTABLISHED AND TRANSFORMATION PARAMETERS DETERMINED BY TVA USING SELECTED SURVEY CONTROL MONUMENTS. CONTACT WITH TVA SURVEYING DEPARTMENT (423)751-8416 OR (423)751-2571 SHALL BE MADE BEFORE ANY SURVEY OR CONSTRUCTION WORK IS COMMENCED. BASE STATION FREQUENCIES AND TRANSFORMATION PARAMETERS WILL BE PROVIDED TO THE CONTRACTOR FOR USE IN CONSTRUCTION ACTIVITIES AT THE SITE. PREVIOUSLY USED OR ESTABLISHED CONTROL POINTS AND MONUMENTS SHALL NOT BE USED BY THE CONTRACTOR WITHOUT PRIOR APPROVAL BY TVA SURVEYING DEPARTMENT.

NOTES:

1. THE TOPOGRAPHIC MAPPING PRESENTED ON THIS DRAWING WAS PROVIDED TO STANTEC BY TVA SURVEYING AND PROJECT SERVICES. THIS PLAN VIEW WAS PREPARED TO SUPPORT DEVELOPMENT OF THE GEOTECHNICAL EXPLORATION PROGRAM AND SHOULD NOT BE USED FOR CONSTRUCTION.
2. THE GEOTECHNICAL INFORMATION AND DATA FURNISHED HEREIN ARE NOT INTENDED AS REPRESENTATION OR WARRANTIES BUT ARE FURNISHED FOR INFORMATION ONLY. IT SHALL BE DISTINCTLY UNDERSTOOD THAT THE OWNER OR ENGINEER WILL NOT BE RESPONSIBLE FOR ANY DEDUCTION, INTERPRETATION OR CONCLUSION DRAWN THEREFROM. THE INFORMATION IS MADE AVAILABLE IN ORDER THAT THE CONTRACTOR MAY HAVE READY ACCESS TO THE SAME INFORMATION AVAILABLE TO THE OWNER AND THE ENGINEER AND IS NOT PART OF THIS CONTRACT.

BORING LOCATION TABLE

BORING	NORTHING	EASTING	ELEVATION (FEET)
STN-29	275,175.38	756,255.52	209.8
STN-31	275,285.22	756,655.03	197.3
STN-32	275,170.55	756,662.14	215.3
STN-34	275,219.61	757,572.32	197.3
STN-35	275,168.26	757,560.32	201.9
STN-37	275,105.39	757,084.79	227.9
STN-38	275,032.20	756,654.10	212.7
STN-39	275,000.71	757,068.83	227.7
STN-40	274,960.06	757,535.41	227.7
STN-41	274,885.49	756,401.22	214.9
STN-42	274,774.68	756,231.49	228.2
STN-43	274,581.55	756,525.54	218.5
STN-44	274,692.75	756,932.74	216.9
STN-45	274,571.04	757,472.72	222.1
STN-46	275,283.75	756,659.96	197.5
STN-47	275,177.52	757,551.23	200.7
STN-49	275,022.24	756,645.53	213.5
STN-52	274,888.39	756,390.55	215.1
STN-55	274,781.02	757,485.69	228.1
STN-56	274,581.78	756,521.61	218.0
STN-57	274,688.84	756,944.27	217.2
STN-59	275,029.76	756,349.96	213.1
STN-60	275,044.47	756,806.43	216.6
STN-63	274,837.56	756,602.00	215.2
STN-64	274,859.56	756,920.08	215.7
STN-67	274,667.54	756,739.62	216.8

LEGEND

- SOIL BORING WITH UNDISTURBED (SHELBY) TUBE SAMPLES AND/OR STANDARD PENETRATION TESTS
- CONE PENETRATION TESTS
- TEST PIT

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

PLOT DATE: 12/10/2015 USER: CLINEMEARD, ADAM
\\A\1726\7015\GEOTECH\CAD\DRAWING\SHEET_FILE\Y7015-101-BL1.DWG

R	–	–	–	–	–	–	–	–	–	–	–
R A	–	–	–	–	–	–	MST	JCK	–	–	–

ISSUED FOR REVIEW

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ☑	AS CONST	REV ☑

DISCIPLINE INTERFACE

SCALE: 1"=50' EXCEPT AS NOTED

YARD
WEST ASH POND

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
BORING LAYOUT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
–	–	–	–	–	M.S. TURNBOW	J.C. KAMMEYER

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

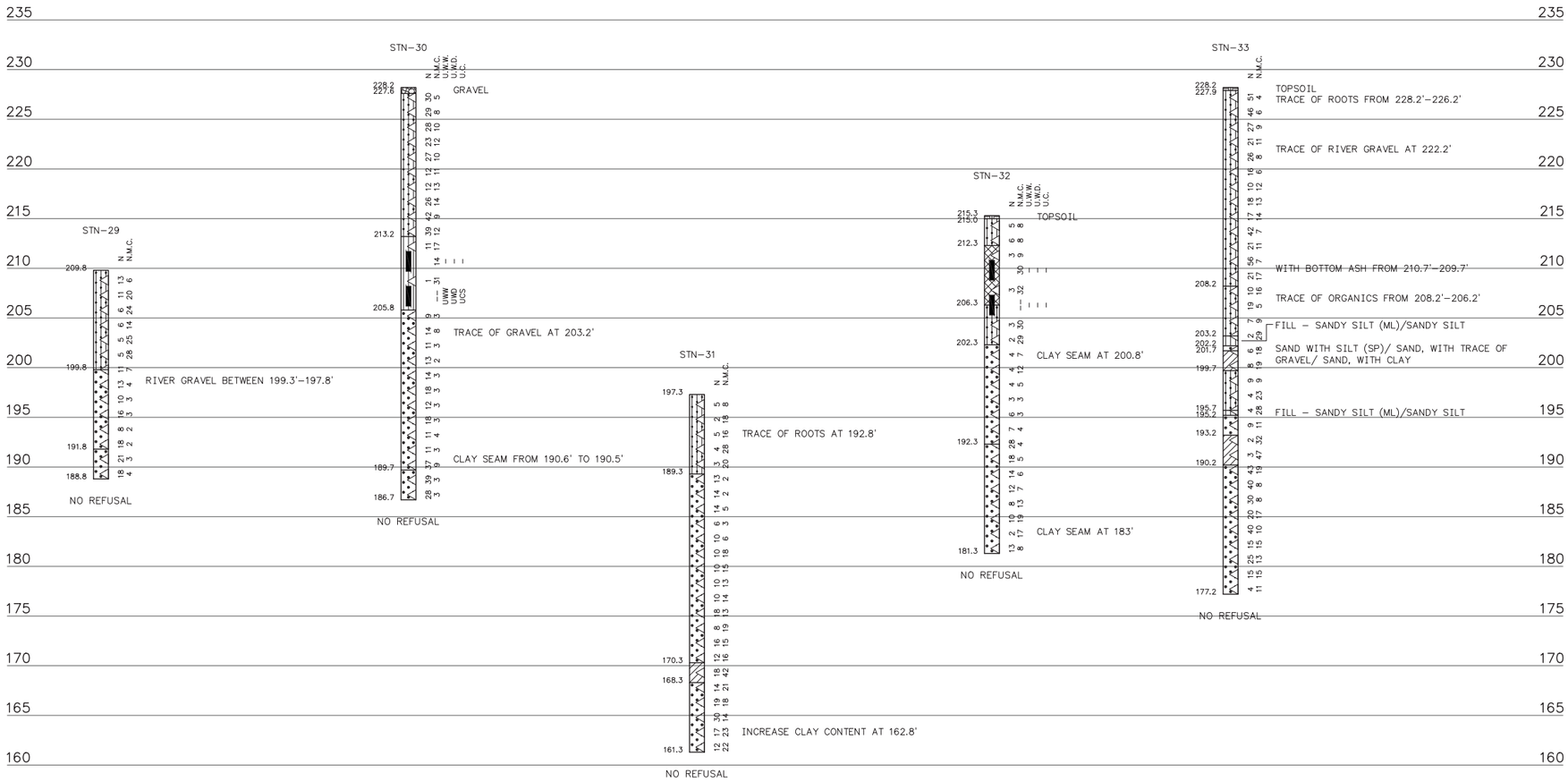
Stantec
601 Grassmere Park Road, Suite 22
Nashville, Tennessee 37211
www.stantec.com

AUTOCAD R 2010	DATE –	38	C	10WXXX-XX	R A

STANTEC	A
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



LEGEND

- TOPSOIL
- GRAVEL
- CRUSHED STONE BASE
- LEAN CLAY (CL)/ LEAN TO FAT CLAY/ FILL-LEAN CLAY/ SANDY CLAY
- FILL - LEAN CLAY
- FILL - GRAVEL (GW), WITH SAND
- FILL - SAND SILT (ML)/SANDY SILT
- CLAYEY SAND (SC)
- SILTY SAND (SM)/ FILL-SILTY SAND
- SAND WITH SILT (SP)/ SAND, WITH TRACE OF GRAVEL/ SAND, WITH CLAY
- SAND, WITH GRAVEL (SW)/ SAND AND GRAVEL

COAL COMBUSTION BY-PRODUCT

- "FLY ASH"
- "BOTTOM ASH"
- STANDARD PENETRATION TEST INTERVAL
- UNDISTURBED THIN-WALLED (SHELBY) TUBE SAMPLE
- N STANDARD PENETRATION TEST BLOW COUNT (BLOWS/FT.)
- N.M.C. NATURAL MOISTURE CONTENT (%)
- U.W.W. UNIT WEIGHT WET (LBS./CU. FT.)
- U.W.D. UNIT WEIGHT DRY (LBS./CU. FT.)
- U.C. UNCONFINED COMPRESSIVE STRENGTH (LBS./SQ. IN.)

NOTE:
THE BORING LOGS AND RELATED INFORMATION SHOWN ON THIS DRAWING DEPICT APPROXIMATE SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC BORING LOCATIONS NOTED AND AT THE TIME OF DRILLING. CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM THOSE OCCURRING AT THE BORING LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE SUBSURFACE CONDITIONS AT THE BORING LOCATIONS. ANY CORRELATIONS SHOWN BETWEEN BORINGS ARE GENERALLY BASED ON STRAIGHT LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN BORINGS ARE UNKNOWN AND MAY DIFFER FROM THOSE SHOWN.

PLOT DATE: 12/03/2015 USER: SHELTON, BEN
\\LT2K7505\GEOTECHNICAL\DRAWING\SHEET_FILES\7505-301-BH1.DWG

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R –	–	–	–	–	–	–	–	–	–	–
R A	–	–	BMS	–	–	–	MST	JCK	–	–
ISSUED FOR REVIEW										

DISCIPLINE INTERFACE
REV CD 1 2 3 4

SCALE: 1"=50' EXCEPT AS NOTED

YARD
WEST ASH POND

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
LOGS OF BORINGS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
–	B.M. SHELTON	–	–	–	M.S. TURNBOW	J.C. KAMMEYER

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

Stantec
1409 North Forbes Road
Lexington, Kentucky 40511-2024
www.stantec.com

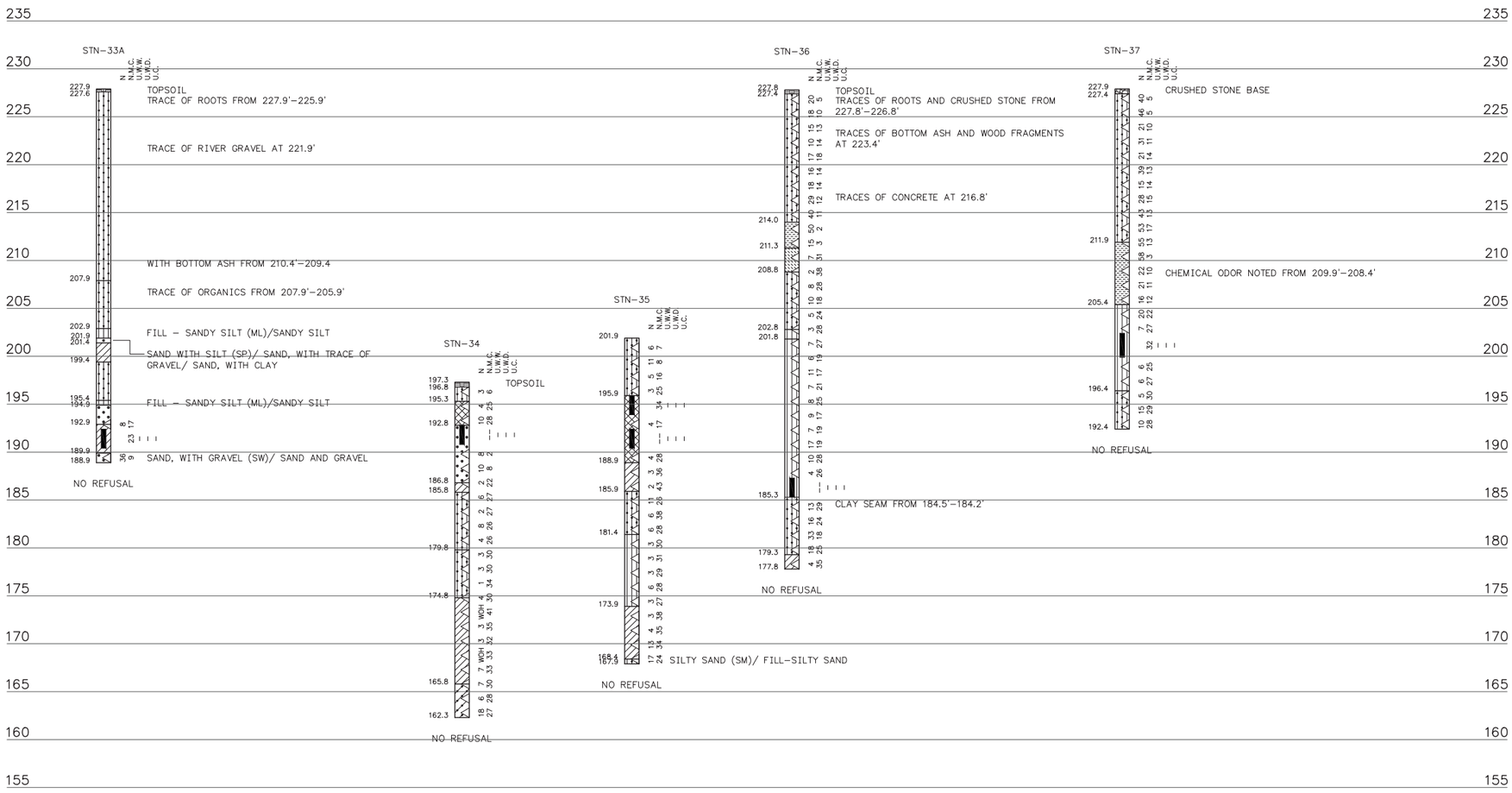
SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

AUTOCAD R 2010	DATE –	38	C	10WXXX-XX	R A

STANTEC	A
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



LEGEND

- TOPSOIL
- GRAVEL
- CRUSHED STONE BASE
- LEAN CLAY (CL)/ LEAN TO FAT CLAY/ FILL-LEAN CLAY/ SANDY CLAY
- FILL - LEAN CLAY
- FILL - GRAVEL (GW), WITH SAND
- FILL - SAND SILT (ML)/SANDY SILT
- CLAYEY SAND (SC)
- SILTY SAND (SM)/ FILL-SILTY SAND
- SAND WITH SILT (SP)/ SAND, WITH TRACE OF GRAVEL/ SAND, WITH CLAY
- SAND, WITH GRAVEL (SW)/ SAND AND GRAVEL

COAL COMBUSTION BY-PRODUCT

- "FLY ASH"
- "BOTTOM ASH"
- ◁ STANDARD PENETRATION TEST INTERVAL
- ■ UNDISTURBED THIN-WALLED (SHELBY) TUBE SAMPLE
- N STANDARD PENETRATION TEST BLOW COUNT (BLOWS/FT.)
- N.M.C. NATURAL MOISTURE CONTENT (%)
- U.W.W. UNIT WEIGHT WET (LBS./CU. FT.)
- U.W.D. UNIT WEIGHT DRY (LBS./CU. FT.)
- U.C. UNCONFINED COMPRESSIVE STRENGTH (LBS./SQ. IN.)

NOTE:
THE BORING LOGS AND RELATED INFORMATION SHOWN ON THIS DRAWING DEPICT APPROXIMATE SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC BORING LOCATIONS NOTED AND AT THE TIME OF DRILLING. CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM THOSE OCCURRING AT THE BORING LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE SUBSURFACE CONDITIONS AT THE BORING LOCATIONS. ANY CORRELATIONS SHOWN BETWEEN BORINGS ARE GENERALLY BASED ON STRAIGHT LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN BORINGS ARE UNKNOWN AND MAY DIFFER FROM THOSE SHOWN.

PLOT DATE: 12/03/2015 USER: SHELTON, BEN
G:\T\2675015\GEOTECHNICAL\DRAWING\SHEET_FILES\2015-30-B01.DWG

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R –	–	–	–	–	–	–	–	–	–	–
R A	–	–	BMS	–	–	–	MST	JCK	–	–

ISSUED FOR REVIEW

DISCIPLINE INTERFACE

SCALE: 1"=50' EXCEPT AS NOTED

YARD
WEST ASH POND

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
LOGS OF BORINGS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
–	B.M. SHELTON	–	–	–	M.S. TURNBOW	J.C. KAMMEYER

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2010 | DATE – | 38 | C | 10WXXX-XX | R A

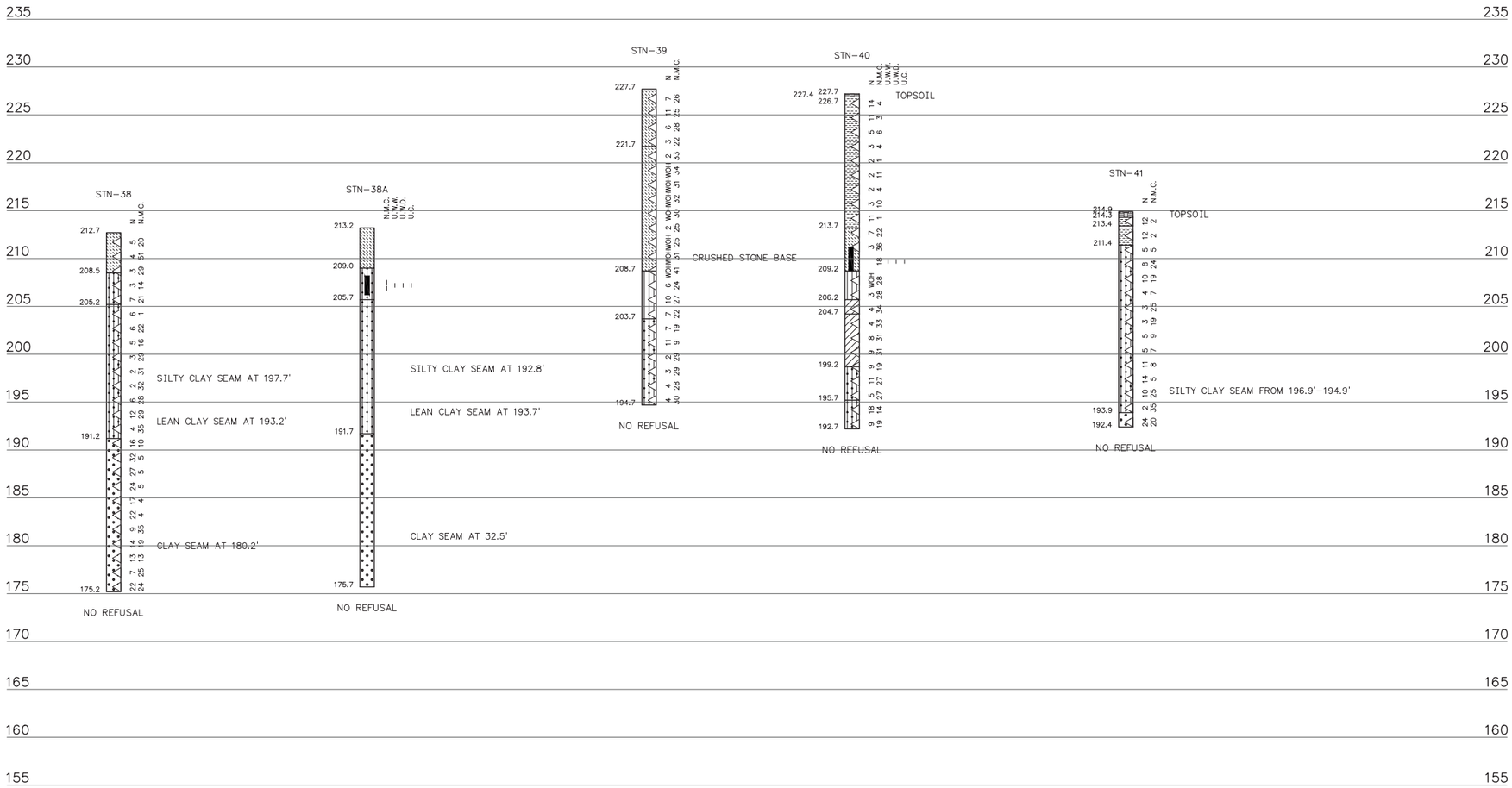
Stantec
1409 North Forbes Road
Lexington, Kentucky 40511-2024
www.stantec.com

SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

STANTEC	A
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



LEGEND

- TOPSOIL
- GRAVEL
- CRUSHED STONE BASE
- LEAN CLAY (CL)/ LEAN TO FAT CLAY/ FILL-LEAN CLAY/ SANDY CLAY
- FILL - LEAN CLAY
- FILL - GRAVEL (GW), WITH SAND
- FILL - SAND SILT (ML)/SANDY SILT
- CLAYEY SAND (SC)
- SILTY SAND (SM)/ FILL-SILTY SAND
- SAND WITH SILT (SP)/ SAND, WITH TRACE OF GRAVEL/ SAND, WITH CLAY
- SAND, WITH GRAVEL (SW)/ SAND AND GRAVEL

COAL COMBUSTION BY-PRODUCT

- "FLY ASH"
- "BOTTOM ASH"
- ◁ STANDARD PENETRATION TEST INTERVAL
- ■ UNDISTURBED THIN-WALLED (SHELBY) TUBE SAMPLE
- N STANDARD PENETRATION TEST BLOW COUNT (BLOWS/FT.)
- N.M.C. NATURAL MOISTURE CONTENT (%)
- U.W.W. UNIT WEIGHT WET (LBS./CU. FT.)
- U.W.D. UNIT WEIGHT DRY (LBS./CU. FT.)
- U.C. UNCONFINED COMPRESSIVE STRENGTH (LBS./SQ. IN.)

NOTE:
THE BORING LOGS AND RELATED INFORMATION SHOWN ON THIS DRAWING DEPICT APPROXIMATE SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC BORING LOCATIONS NOTED AND AT THE TIME OF DRILLING. CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM THOSE OCCURRING AT THE BORING LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE SUBSURFACE CONDITIONS AT THE BORING LOCATIONS. ANY CORRELATIONS SHOWN BETWEEN BORINGS ARE GENERALLY BASED ON STRAIGHT LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN BORINGS ARE UNKNOWN AND MAY DIFFER FROM THOSE SHOWN.

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

PLOT DATE: 13/03/2015 USER: SHELTON, BEN
U:\TVA\75015\GEOTECHNICAL\DRAWING\SHEET_FILES\75015-301-R01.DWG

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ED	AS CONST	REV ID
R –	–	–	–	–	–	–	–	–	–	–	–
R A	–	–	BMS	–	–	–	MST	JCK	–	–	–
ISSUED FOR REVIEW											

DISCIPLINE INTERFACE

SCALE: 1"=50' EXCEPT AS NOTED

YARD
WEST ASH POND

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
LOGS OF BORINGS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
–	B.M. SHELTON	–	–	–	M.S. TURNBOW	J.C. KAMMEYER

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

Stantec
1409 North Forbes Road
Lexington, Kentucky 40511-2024
www.stantec.com

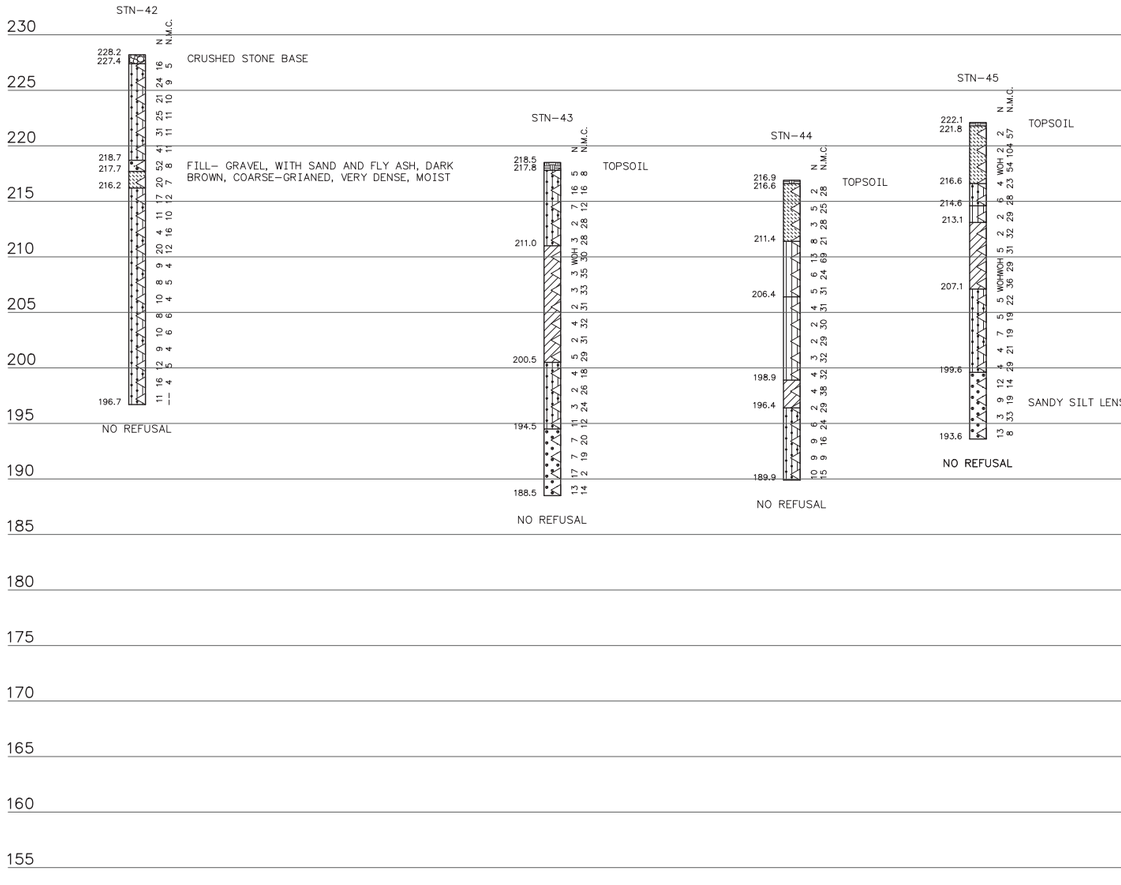
SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

AUTOCAD R 2010	DATE –	38	C	10WXXX-XX	R A

STANTEC	A
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



LEGEND

- TOPSOIL
- GRAVEL
- CRUSHED STONE BASE
- LEAN CLAY (CL)/ LEAN TO FAT CLAY/ FILL-LEAN CLAY/ SANDY CLAY
- FILL – LEAN CLAY
- FILL – GRAVEL (GW), WITH SAND
- FILL – SAND SILT (ML)/SANDY SILT
- CLAYEY SAND (SC)
- SILTY SAND (SM)/ FILL-SILTY SAND
- SAND WITH SILT (SP)/ SAND, WITH TRACE OF GRAVEL/ SAND, WITH CLAY
- SAND, WITH GRAVEL (SW)/ SAND AND GRAVEL

COAL COMBUSTION BY-PRODUCT

- "FLY ASH"
- "BOTTOM ASH"
- ◁ STANDARD PENETRATION TEST INTERVAL
- ■ UNDISTURBED THIN-WALLED (SHELBY) TUBE SAMPLE
- N STANDARD PENETRATION TEST BLOW COUNT (BLOWS/FT.)
- N.M.C. NATURAL MOISTURE CONTENT (%)
- U.W.W. UNIT WEIGHT WET (LBS./CU. FT.)
- U.W.D. UNIT WEIGHT DRY (LBS./CU. FT.)
- U.C. UNCONFINED COMPRESSIVE STRENGTH (LBS./SQ. IN.)

NOTE:
THE BORING LOGS AND RELATED INFORMATION SHOWN ON THIS DRAWING DEPICT APPROXIMATE SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC BORING LOCATIONS NOTED AND AT THE TIME OF DRILLING. CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM THOSE OCCURRING AT THE BORING LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE SUBSURFACE CONDITIONS AT THE BORING LOCATIONS. ANY CORRELATIONS SHOWN BETWEEN BORINGS ARE GENERALLY BASED ON STRAIGHT LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN BORINGS ARE UNKNOWN AND MAY DIFFER FROM THOSE SHOWN.

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

PLOT DATE: 13/OCT/2015 USER: SHELTON, BEN
G:\17\267505\GEOTECH\CAD\DRAWING\SHEET_FILES\267505-301-REV.DWG

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. CO
R –	–	–	–	–	–	–	–	–	–	–	–
R A	–	–	BMS	–	–	–	MST	JCK	–	–	–
ISSUED FOR REVIEW											

DISCIPLINE INTERFACE

SCALE: 1"=50' EXCEPT AS NOTED

YARD
WEST ASH POND

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
LOGS OF BORINGS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
–	B.M. SHELTON	–	–	–	M.S. TURNBOW	J.C. KAMMEYER

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

Stantec
1409 North Forbes Road
Lexington, Kentucky 40511-2024
www.stantec.com

SEE XXWXXX-XXX FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

AUTOCAD R 2010	DATE –	38	C	10WXX-XX	R A

STANTEC	A
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

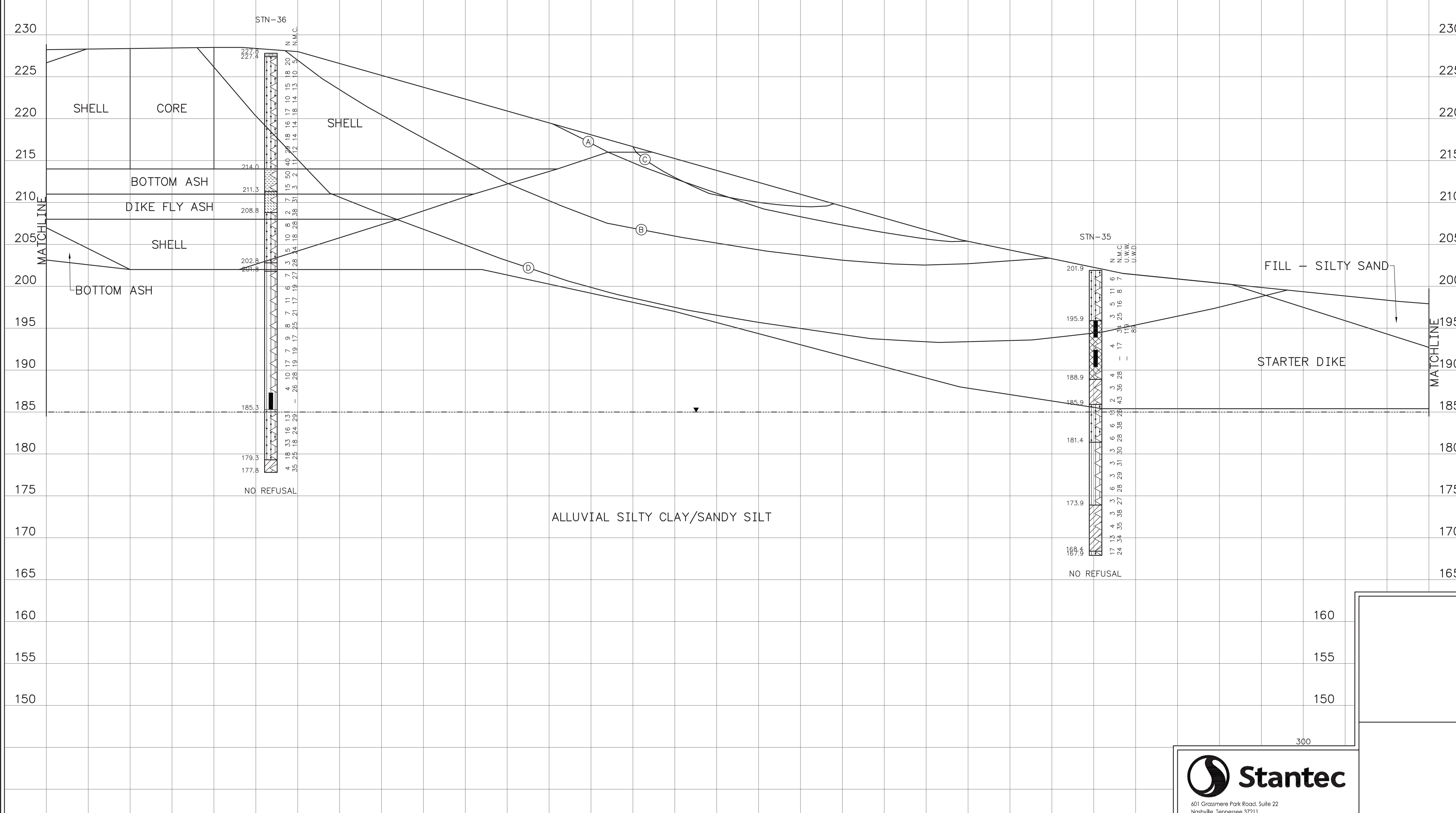
C.A.D. DRAWING
DO NOT ALTER MANUALLY

SUMMARY OF STABILITY ANALYSES

FAILURE SURFACE	FAILURE MODE	FACTOR OF SAFETY
A	SHALLOW FAILURE CIRCLE	2.1
B	DEEP FAILURE CIRCLE	2.2
C	SHALLOW FAILURE CIRCLE RAPID DRAW DOWN	2.2
D	DEEP FAILURE CIRCLE RAPID DRAW DOWN	2.0

PARAMETER TABLE

	DRAINED STRENGTH PARAMETERS			UNDRAINED STRENGTH PARAMETERS	
MATERIAL TYPE	SAT UNIT WT, γSAT	COHESION, $\bar{c}$	FRICTION ANGLE, $\bar{\Phi}$	COHESION, $\bar{c}$	FRICTION ANGLE, $\bar{\Phi}$
SHELL	127 PCF	0 PSF	33°	200 PSF	28°
CORE	127 PCF	0 PSF	33°	200 PSF	28°
STARTER DIKE	121 PCF	0 PSF	30°	200 PSF	28°
ALLUVIAL SILTY CLAY/SANDY SILT	119 PCF	0 PSF	31°	600 PSF	27°
DIKE FLY ASH	105 PCF	0 PSF	25°	0 PSF	10°
HYDRAULICALLY PLACED ASH	105 PCF	0 PSF	25°	0 PSF	10°
FILL – SILTY SAND	122 PCF	0 PSF	30°	200 PSF	28°
BOTTOM ASH	123 PCF	0 PSF	34°	0 PSF	34°



LEGEND

- TOPSOIL
- GRAVEL
- CRUSHED STONE BASE
- LEAN CLAY (CL)/ LEAN TO FAT CLAY/ FILL-LEAN CLAY/ SANDY CLAY
- FILL – LEAN CLAY
- FILL – GRAVEL (GW), WITH SAND
- FILL – SANDY SILT (ML)/SANDY SILT
- CLAYEY SAND (SC)
- SILTY SAND (SM)/ FILL-SILTY SAND
- SAND WITH SILT (SP)/ SAND, WITH TRACE OF GRAVEL/ SAND, WITH CLAY
- SAND, WITH GRAVEL (SW)/ SAND AND GRAVEL

COAL COMBUSTION BY-PRODUCT

- "FLY ASH"
- "BOTTOM ASH"
- STANDARD PENETRATION TEST INTERVAL
- UNDISTURBED THIN-WALLED (SHELBY) TUBE SAMPLE
- N — STANDARD PENETRATION TEST BLOW COUNT (BLOWS/FT.)
- N.M.C. — NATURAL MOISTURE CONTENT (%)
- U.W.W. — UNIT WEIGHT WET (LBS./CU. FT.)
- U.W.D. — UNIT WEIGHT DRY (LBS./CU. FT.)
- U.C. — UNCONFINED COMPRESSIVE STRENGTH (LBS./SQ. IN.)

NOTES:

1. THE BORING LOGS AND RELATED INFORMATION SHOWN ON THIS DRAWING DEPICT APPROXIMATE SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC BORING LOCATIONS NOTED AND AT THE TIME OF DRILLING. CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM THOSE OCCURRING AT THE BORING LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE SUBSURFACE CONDITIONS AT THE BORING LOCATIONS. ANY CORRELATIONS SHOWN BETWEEN BORINGS ARE GENERALLY BASED ON STRAIGHT LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN BORINGS ARE UNKNOWN AND MAY DIFFER FROM THOSE SHOWN.
2. THE SUBSURFACE INFORMATION AND DATA FURNISHED HEREIN ARE NOT INTENDED AS REPRESENTATION OR WARRANTIES BUT ARE FURNISHED FOR INFORMATION ONLY. IT SHALL BE DISTINCTLY UNDERSTOOD THAT THE OWNER, ENGINEER OR GEOTECHNICAL ENGINEER WILL NOT BE RESPONSIBLE FOR ANY DEDUCTION, INTERPRETATION OR CONCLUSION DRAWN THEREFROM BY THE CONTRACTOR. THE INFORMATION IS MADE AVAILABLE IN ORDER THAT THE CONTRACTOR MAY HAVE READY ACCESS TO THE SAME INFORMATION AVAILABLE TO THE OWNER, ENGINEER AND GEOTECHNICAL ENGINEER AND IS NOT PART OF THIS CONTRACT.

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

Stantec
601 Grassmere Park Road, Suite 22
Nashville, Tennessee 37211
www.stantec.com

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R –	–	–	–	–	–	–	–	–	–	–	–
R A	–	–	–	–	–	–	MST	JCK	–	–	–

ISSUED FOR REVIEW

SCALE: 1"=5' EXCEPT AS NOTED

YARD
–

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
STABILITY CROSS SECTION H–H'

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
–	–	–	–	–	M.S. TURNBOW	J.C. KAMMEYER

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2010 | DATE – | 38 | C | 10WXXX–XX | R A

STANTEC | A
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

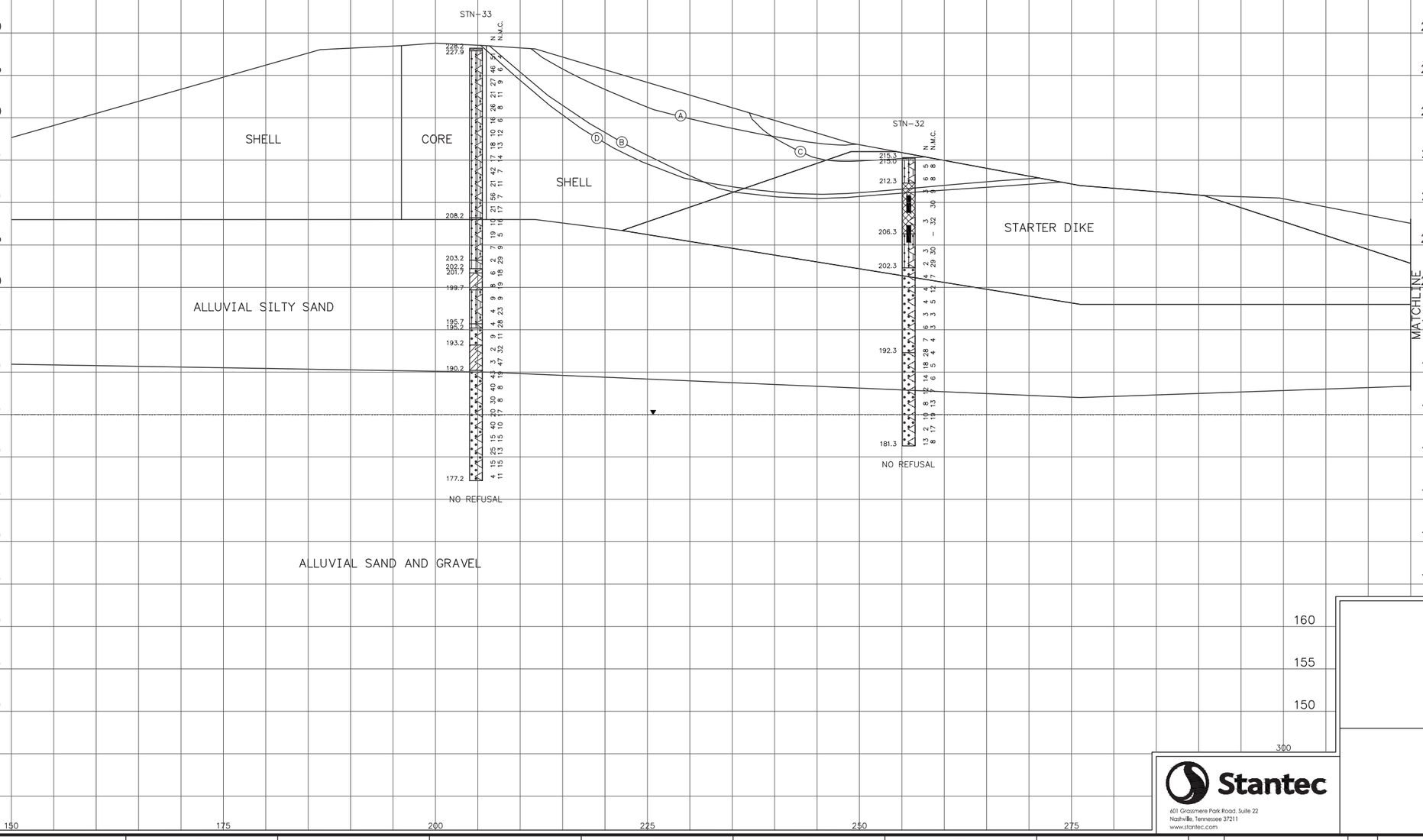
C.A.D. DRAWING DO NOT ALTER MANUALLY

SUMMARY OF STABILITY ANALYSES

FAILURE SURFACE	FAILURE MODE	FACTOR OF SAFETY
A	SHALLOW FAILURE CIRCLE	2.3
B	DEEP FAILURE CIRCLE	2.6
C	SHALLOW FAILURE CIRCLE RAPID DRAW DOWN	2.6
D	DEEP FAILURE CIRCLE RAPID DRAW DOWN	2.5

PARAMETER TABLE

MATERIAL TYPE	DRAINED STRENGTH PARAMETERS			UNDRAINED STRENGTH PARAMETERS	
	SAT UNIT WT, γSAT	COHESION, $\bar{c}$	FRICTION ANGLE, $\bar{\Phi}$	COHESION, $\bar{c}$	FRICTION ANGLE, $\bar{\Phi}$
SHELL	127 PCF	0 PSF	33°	200 PSF	28°
CORE	127 PCF	0 PSF	33°	200 PSF	28°
STARTER DIKE	121 PCF	0 PSF	30°	200 PSF	28°
ALLUVIAL SILTY SAND	124 PCF	0 PSF	31°	200 PSF	28°
ALLUVIAL SAND AND GRAVEL	134 PCF	0 PSF	35°	0 PSF	35°
HYDRAULICALLY PLACED ASH	105 PCF	0 PSF	25°	0 PSF	10°
FILL – SILTY SAND	122 PCF	0 PSF	30°	200 PSF	28°



LEGEND

- TOPSOIL
- GRAVEL
- CRUSHED STONE BASE
- LEAN CLAY (CL)/ LEAN TO FAT CLAY/ FILL-LEAN CLAY/ SANDY CLAY
- FILL – LEAN CLAY
- FILL – GRAVEL (GW), WITH SAND
- FILL – SANDY SILT (ML)/SANDY SILT
- CLAYEY SAND (SC)
- SILTY SAND (SM)/ FILL-SILTY SAND
- SAND WITH SILT (SP)/ SAND, WITH TRACE OF GRAVEL/ SAND, WITH CLAY
- SAND, WITH GRAVEL (SW)/ SAND AND GRAVEL

COAL COMBUSTION BY-PRODUCT

- "FLY ASH"
- "BOTTOM ASH"
- STANDARD PENETRATION TEST INTERVAL
- UNDISTURBED THIN-WALLED (SHELBY) TUBE SAMPLE
- N — STANDARD PENETRATION TEST BLOW COUNT (BLOWS/FT.)
- N.M.C. — NATURAL MOISTURE CONTENT (%)
- U.W.W. — UNIT WEIGHT WET (LBS./CU. FT.)
- U.W.D. — UNIT WEIGHT DRY (LBS./CU. FT.)
- U.C. — UNCONFINED COMPRESSIVE STRENGTH (LBS./SQ. IN.)

NOTES:

1. THE BORING LOGS AND RELATED INFORMATION SHOWN ON THIS DRAWING DEPICT APPROXIMATE SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC BORING LOCATIONS NOTED AND AT THE TIME OF DRILLING. CONDITIONS AT OTHER LOCATIONS MAY DIFFER FROM THOSE OCCURRING AT THE BORING LOCATIONS. ALSO, THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE SUBSURFACE CONDITIONS AT THE BORING LOCATIONS. ANY CORRELATIONS SHOWN BETWEEN BORINGS ARE GENERALLY BASED ON STRAIGHT LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN BORINGS ARE UNKNOWN AND MAY DIFFER FROM THOSE SHOWN.
2. THE SUBSURFACE INFORMATION AND DATA FURNISHED HEREIN ARE NOT INTENDED AS REPRESENTATION OR WARRANTIES BUT ARE FURNISHED FOR INFORMATION ONLY. IT SHALL BE DISTINCTLY UNDERSTOOD THAT THE OWNER, ENGINEER OR GEOTECHNICAL ENGINEER WILL NOT BE RESPONSIBLE FOR ANY DEDUCTION, INTERPRETATION OR CONCLUSION DRAWN THEREFROM BY THE CONTRACTOR. THE INFORMATION IS MADE AVAILABLE IN ORDER THAT THE CONTRACTOR MAY HAVE READY ACCESS TO THE SAME INFORMATION AVAILABLE TO THE OWNER, ENGINEER AND GEOTECHNICAL ENGINEER AND IS NOT PART OF THIS CONTRACT.

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

PLOT DATE: 11/20/2015 USER: CLDWENGARD, ADAM
G:\YR2015\GEOTECHNICAL\DRAWING\SHEET_FILES\2015-301-XS12.DWG

REV NO.	DATE	DSGN	DRAWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R –	–	–	–	–	–	–	–	–	–	–	–
R A	–	–	–	–	–	–	MST	JCK	–	–	–
ISSUED FOR REVIEW											DISCIPLINE INTERFACE

SCALE: 1"=5' EXCEPT AS NOTED

YARD
–

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
STABILITY CROSS SECTION I–I'

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
–	–	–	–	–	M.S. TURNBOW	J.C. KAMMEYER

ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE – | 38 | C | 10WXXX-XX | R A

Stantec
601 Grassmere Park Road, Suite 22
Nashville, Tennessee 37211
www.stantec.com

STANTEC	A
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Appendix B

Boring Logs

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B029-2015-LF-S2 | Stantec Boring No.: **STN-29**

Client: Tennessee Valley Authority | Boring Location: 275175.39 N, 756255.52 E

Project Number: 172675015 | Surface Elevation: 209.8 ft | Elevation Datum: NAVD 29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/22/15 | Completed: 9/22/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
209.8'	0.0'	Top of Hole							
		Fill - Silty Sand, brown, fine-grained, loose to medium dense, moist		SPT-1	0.0' - 1.5'	0.6'	12-8-5	6.2	
				SPT-2	1.5' - 3.0'	0.8'	4-5-6	20.3	
				SPT-3	3.0' - 4.5'	1.4'	6-4-2	23.9	
				SPT-4	4.5' - 6.0'	1.5'	5-4-2	14.0	
				SPT-5	6.0' - 7.5'	1.5'	2-2-3	24.8	
				SPT-6	7.5' - 9.0'	1.2'	2-2-3	27.8	
199.8'	10.0'			SPT-7	9.0' - 10.5'	1.5'	3-5-6	6.9	
		Sand, with silt, brown, fine-grained, loose to medium dense, moist		SPT-8	10.5' - 12.0'	1.2'	3-6-7	4.1	
				SPT-9	12.0' - 13.5'	1.0'	3-4-6	3.3	
		River gravel between 10.5' - 12.0'		SPT-10	13.5' - 15.0'	1.1'	10-7-9	2.8	
				SPT-11	15.0' - 16.5'	0.9'	3-4-4	2.3	
191.8'	18.0'			SPT-12	16.5' - 18.0'	1.1'	4-8-10	2.4	
		Sand, with gravel, brown, fine to medium-grained, medium dense, moist		SPT-13	18.0' - 19.5'	1.0'	5-10-11	2.8	
188.8'	21.0'			SPT-14	19.5' - 21.0'	1.0'	5-8-10	3.5	
		No Refusal / Bottom of Hole Boring was backfilled with cement and bentonite grout.							

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-P030-2015-LC-S2/U3 | Stantec Boring No. **STN-30**

Client: Tennessee Valley Authority | Boring Location: 275111.62 N, 756317.48 E

Project Number: 172675015 | Surface Elevation: 228.2 ft | Elevation Datum: NAVD 29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/29/15 | Completed: 9/29/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs and 3" STs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
228.2'	0.0'	Top of Hole							
227.6'	0.6'	Gravel							
		Fill - Silty Sand, brown to grayish brown, fine-grained, medium dense to dense, moist		SPT-1	0.0' - 1.5'	1.5'	6-13-17	4.7	
				SPT-2	1.5' - 3.0'	1.4'	23-25-4	7.8	
				SPT-3	3.0' - 4.5'	1.5'	5-13-15	10.1	
				SPT-4	4.5' - 6.0'	1.5'	3-13-10	11.6	
				SPT-5	6.0' - 7.5'	1.5'	14-12-15	9.8	%Silt = 28.2, %Clay = 12.2, %<#200 = 40.4
				SPT-6	7.5' - 9.0'	1.5'	4-6-6	11.4	
				SPT-7	9.0' - 10.5'	1.5'	5-6-6	12.9	
				SPT-8	10.5' - 12.0'	1.5'	5-7-19	13.7	
				SPT-9	12.0' - 13.5'	1.5'	10-21-21	8.5	
				SPT-10	13.5' - 15.0'	1.5'	16-20-19	11.7	
213.2'	15.0'								
		Fill - Sandy Silt, brown, very soft to stiff, moist to very moist		SPT-11	15.0' - 16.5'	1.5'	5-6-5	16.8	
				ST-1	16.5' - 18.5'	2.0'		14.4	%Silt = 9.0, %Clay = 2.0, %<#200 = 9.0
				SPT-12	18.5' - 20.0'	1.5'	WOH-WOH-1	31.2	

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-P030-2015-LC-S2/U3 | Stantec Boring No. **STN-30**

Client: Tennessee Valley Authority | Boring Location: 275111.62 N, 756317.48 E

Project Number: 172675015 | Surface Elevation: 228.2 ft | Elevation Datum: NAVD 29

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		Fill - Sandy Silt, brown, very soft to stiff, moist to very moist *(Continued)*		ST-2	20.0' - 22.0'	2.0'		--	
205.8'	22.4'								
		Sand, brown, fine to medium-grained, medium dense to dense, moist to very moist		SPT-13	22.0' - 23.5'	1.5'	3-4-5	2.5	
				SPT-14	23.5' - 25.0'	1.4'	5-7-7	7.6	
		Trace of gravel at 25.0'		SPT-15	25.0' - 26.5'	1.5'	3-4-7	3.1	
				SPT-16	26.5' - 28.0'	1.3'	5-6-7	2.4	
				SPT-17	28.0' - 29.5'	1.3'	4-6-8	2.5	
				SPT-18	29.5' - 31.0'	1.3'	4-8-10	2.8	
				SPT-19	31.0' - 32.5'	1.5'	7-7-5	3.0	
				SPT-20	32.5' - 34.0'	1.5'	4-8-10	3.1	
				SPT-21	34.0' - 35.5'	1.5'	3-5-6	4.1	
				SPT-22	35.5' - 37.0'	1.4'	4-6-5	3.2	
		Clay seam from 37.6' - 37.7'		SPT-23	37.0' - 38.5'	1.3'	6-16-21	9.3	
189.7'	38.5'								
		Sand and Gravel, brown, medium- to coarse-grained, dense, very moist to saturated		SPT-24	38.5' - 40.0'	1.4'	17-15-24	3.1	
				SPT-25	40.0' - 41.5'	1.1'	3-13-15	2.8	
186.7'	41.5'								

No Refusal /
Bottom of Hole

Two fully grouted vibrating wire piezometers installed at 20.0' and 38.0'. See piezometer installation log for detail.

Boring was backfilled with cement and bentonite grout.

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B031-2015-LF-S2 | Stantec Boring No.: **STN-31**

Client: Tennessee Valley Authority | Boring Location: 275285.22 N, 756655.03 E

Project Number: 172675015 | Surface Elevation: 197.3 ft | Elevation Datum: NAVD 29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/28/15 | Completed: 9/28/15

Project Location: Shelby County, Tennessee | Depth to Water: 15.0 ft | Date/Time: 9/28/15

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
197.3'	0.0'	Top of Hole							
		Fill - Silty Sand, brown, fine-grained, very loose to loose, moist		SPT-1	0.0' - 1.5'	1.5'	2-3-2	8.1	
				SPT-2	1.5' - 3.0'	0.8'	1-1-1	17.9	
				SPT-3	3.0' - 4.5'	1.3'	2-3-2	16.0	
		Trace of roots at 4.5'		SPT-4	4.5' - 6.0'	1.5'	1-2-2	27.8	
				SPT-5	6.0' - 7.5'	1.1'	1-2-1	19.8	
189.3'	8.0'								
		Sand, with gravel, brown to gray, fine- to coarse-grained, medium dense, moist to saturated		SPT-6	7.5' - 9.0'	1.5'	4-6-7	2.4	
				SPT-7	9.0' - 10.5'	1.2'	4-6-8	2.3	
				SPT-8	10.5' - 12.0'	1.2'	6-8-6	5.3	
				SPT-9	12.0' - 13.5'	1.1'	3-3-3	2.8	
				SPT-10	13.5' - 15.0'	1.1'	4-6-4	6.1	
				SPT-11	15.0' - 16.5'	1.3'	2-5-5	17.5	
				SPT-12	16.5' - 18.0'	1.3'	4-4-6	14.7	
				SPT-13	18.0' - 19.5'	1.5'	3-4-6	12.6	
				SPT-14	19.5' - 21.0'	1.5'	4-4-6	14.4	
				SPT-15	21.0' - 22.5'	1.5'	6-9-9	13.4	
				SPT-16	22.5' - 24.0'	1.2'	3-4-4	19.4	
				SPT-17	24.0' - 25.5'	1.5'	3-7-9	15.0	

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B031-2015-LF-S2 | Stantec Boring No. **STN-31**

Client: Tennessee Valley Authority | Boring Location: 275285.22 N, 756655.03 E

Project Number: 172675015 | Surface Elevation: 197.3 ft | Elevation Datum: NAVD 29

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
170.3'	27.0'			SPT-18	25.5' - 27.0'	1.2'	3-5-7	16.2	
168.3'	29.0'	Lean Clay, with sand, gray, very stiff, very moist		SPT-19	27.0' - 28.5'	1.5'	5-8-10	42.1	
		Sand, trace gravel, gray, medium-grained, medium dense to dense, very moist to saturated		SPT-20	28.5' - 30.0'	1.5'	5-7-7	21.3	
				SPT-21	30.0' - 31.5'	1.2'	3-7-12	18.0	
				SPT-22	31.5' - 33.0'	1.5'	6-13-17	14.4	
				SPT-23	33.0' - 34.5'	1.5'	6-8-9	22.8	
161.3'	36.0'	Increase clay content at 34.5'		SPT-24	34.5' - 36.0'	1.5'	2-5-7	21.8	

No Refusal /
Bottom of Hole
Boring was backfilled with cement and bentonite grout.

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B032-2015-LF-S2/U3 | Stantec Boring No. **STN-32**

Client: Tennessee Valley Authority | Boring Location: 275170.55 N, 756662.14 E

Project Number: 172675015 | Surface Elevation: 215.3 ft | Elevation Datum: NAVD 29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/28/15 | Completed: 9/28/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs and 3" STs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
215.3'	0.0'	Top of Hole							
215.0'	0.3'	Topsoil		SPT-1	0.0' - 1.5'	1.3'	2-2-3	7.9	
212.3'	3.0'	Fill - Silty Sand, trace roots, brown, fine-grained, loose, moist		SPT-2	1.5' - 3.0'	1.4'	3-3-3	8.1	
		Fill - Lean Clay, silty, gray, soft, moist to very moist		SPT-3	3.0' - 4.5'	1.3'	2-1-2	8.8	%Silt = 18.3, %Clay = 7.2, %<#200 = 25.5
				ST-1	4.5' - 6.5'	2.0'		30.1	
				SPT-4	6.5' - 8.0'	1.5'	WOH-1-2	32.0	%Silt = 66.9, %Clay = 25.5, %<#200 = 92.4, LL=36, PI=17
206.3'	9.0'			ST-2	8.0' - 10.0'	1.6'		--	
		Fill - Silty Sand, grayish brown, fine-grained, loose, moist to very moist		SPT-5	10.0' - 11.5'	1.5'	1-2-1	30.0	
202.3'	13.0'			SPT-6	11.5' - 13.0'	1.2'	1-1-1	29.0	
		Sand, with silt, brown, fine-grained, very loose to loose, moist		SPT-7	13.0' - 14.5'	1.5'	1-2-2	7.0	
		Clay seam at 14.5'		SPT-8	14.5' - 16.0'	1.5'	1-2-2	12.1	
				SPT-9	16.0' - 17.5'	1.3'	1-2-2	4.5	%Silt = 1.5, %Clay = 1.8, %<#200 = 3.3
				SPT-10	17.5' - 19.0'	1.5'	2-2-1	3.3	
				SPT-11	19.0' - 20.5'	1.5'	2-3-3	3.1	
				SPT-12	20.5' - 22.0'	1.4'	3-3-4	4.4	
192.3'	23.0'			SPT-13	22.0' - 23.5'	1.4'	5-12-16	3.8	
				SPT-14	23.5' - 25.0'	1.3'	6-9-9	5.0	

TVA CONFIDENTIAL INFORMATION

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B032-2015-LF-S2/U3 | Stantec Boring No. **STN-32**

Client: Tennessee Valley Authority | Boring Location: 275170.55 N, 756662.14 E

Project Number: 172675015 | Surface Elevation: 215.3 ft | Elevation Datum: NAVD 29

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		Sand and Gravel, brown, medium- to coarse-grained, very loose to medium dense, very moist *(Continued)*		SPT-15	25.0' - 26.5'	1.3'	7-7-7	6.4	%Silt = 1.4, %Clay = 1.5, %<#200 = 2.9
				SPT-16	26.5' - 28.0'	1.2'	5-6-6	6.9	
				SPT-17	28.0' - 29.5'	1.0'	3-4-4	13.0	
				SPT-18	29.5' - 31.0'	1.0'	2-4-6	19.2	
				SPT-19	31.0' - 32.5'	1.5'	3-1-1	16.5	
181.3'	34.0'	Clay seam at 32.3'		SPT-20	32.5' - 34.0'	1.5'	3-5-8	8.0	

No Refusal /
Bottom of Hole
Boring was backfilled with cement and bentonite grout.

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

Stantec

SUBSURFACE LOG

Client Borehole Identification	ALF6-P033-2015-LC-S2	Stantec Boring No.	**STN-33**
Client	Tennessee Valley Authority	Boring Location	275119.53 N, 756661.46 E
Project Number	172675015	Surface Elevation	228.2 ft
Elevation Datum	NAVD 29		
Project Name	Allen Fossil Plant - West Ash Pond	Date Started	10/6/15
Completed	10/6/15		
Project Location	Shelby County, Tennessee	Depth to Water	24.0 ft
Date/Time	10/6/15		
Inspector	Ty Gunter	Depth to Water	N/A
Date/Time	N/A		
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
228.2'	0.0'	Top of Hole							
227.9'	0.3'	Topsoil		SPT-1	0.0' - 1.5'	1.5'	8-27-24	3.9	
		Fill - Silty Sand, brown to grayish brown, fine-grained, medium dense to very dense, slightly moist to moist		SPT-2	1.5' - 3.0'	1.2'	26-28-18	5.9	
				SPT-3	3.0' - 4.5'	1.5'	6-16-11	9.0	
		Trace of roots from 0.0' - 2.0'		SPT-4	4.5' - 6.0'	1.5'	12-9-12	10.5	
		Trace of river gravel at 6.0'		SPT-5	6.0' - 7.5'	1.4'	8-11-15	7.6	%Silt = 37.3, %Clay = 13.1, %<#200 = 50.4, LL = 20, PI = 1
				SPT-6	7.5' - 9.0'	1.5'	8-9-7	6.1	
				SPT-7	9.0' - 10.5'	1.5'	5-5-5	11.8	
				SPT-8	10.5' - 12.0'	1.5'	10-10-8	12.7	
				SPT-9	12.0' - 13.5'	1.5'	10-9-8	13.9	
				SPT-10	13.5' - 15.0'	1.5'	8-20-22	6.8	%Silt = 27, %Clay = 10.4, %<#200 = 37.4
				SPT-11	15.0' - 16.5'	1.5'	4-10-11	10.6	
				SPT-12	16.5' - 18.0'	1.5'	12-26-30	6.9	
		With bottom ash from 17.5' - 18.5'		SPT-13	18.0' - 19.5'	1.5'	11-11-10	17.1	
208.2'	20.0'								
		Silty Sand, brown, fine-grained, loose to medium dense, moist		SPT-14	19.5' - 21.0'	2.0'	3-4-6	15.6	
				SPT-15	21.0' - 22.5'	1.5'	5-9-10	5.0	%Silt = 12.9, %Clay = 3.6, %<#200 = 16.5
		Trace of organics from 20.0' - 22.0'		SPT-16	22.5' - 24.0'	1.5'	3-4-3	9.2	
203.2'	25.0'			SPT-17	24.0' - 25.5'	1.5'	3-1-1	29.0	

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-P033-2015-LC-S2 | Stantec Boring No. **STN-33**

Client: Tennessee Valley Authority | Boring Location: 275119.53 N, 756661.46 E

Project Number: 172675015 | Surface Elevation: 228.2 ft | Elevation Datum: NAVD 29

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
202.2'	26.0'	Sandy Silt, grayish brown, soft, very moist		SPT-18	25.5' - 27.0'	1.1'	2-3-3	18.1	
201.7'	26.5'	Sand, with silt, brown, fine- to medium-grained, loose, moist		SPT-19	27.0' - 28.5'	1.5'	2-3-5	18.9	
199.7'	28.5'	Sandy Clay, brown, medium stiff to stiff, moist		SPT-20	28.5' - 30.0'	1.2'	3-4-5	9.1	
		Silty Sand, brown, fine-grained, loose, moist to very moist		SPT-21	30.0' - 31.5'	1.5'	2-2-2	22.6	
195.7'	32.5'			SPT-22	31.5' - 33.0'	1.5'	1-2-2	28.0	
195.2'	33.0'	Sandy Silt, gray, medium stiff, very moist		SPT-23	33.0' - 34.5'	1.0'	4-5-4	11.4	
193.2'	35.0'	Sand, with clay, reddish brown, medium-grained, very loose to medium dense, very moist		SPT-24	34.5' - 36.0'	1.2'	2-1-1	31.7	
				SPT-25	36.0' - 37.5'	1.2'	1-1-2	46.8	
190.2'	38.0'	Lean Clay, gray, soft, very moist		SPT-26	37.5' - 39.0'	1.5'	9-20-23	18.8	
		Sand and Gravel, brown, medium- to coarse-grained, medium dense to dense, very moist to saturated		SPT-27	39.0' - 40.5'	1.3'	10-19-21	8.0	%Silt = 2.4, %Clay = 1.2, %<#200 = 3.6
				SPT-28	40.5' - 42.0'	1.3'	14-16-14	7.8	
				SPT-29	42.0' - 43.5'	1.5'	5-12-8	16.6	
				SPT-30	43.5' - 45.0'	1.3'	17-18-22	10.3	
				SPT-31	45.0' - 46.5'	0.8'	4-7-8	14.5	
				SPT-32	46.5' - 48.0'	1.5'	9-15-10	13.4	
				SPT-33	48.0' - 49.5'	0.8'	5-7-8	14.6	
177.2'	51.0'			SPT-34	49.5' - 51.0'	1.5'	6-2-2	10.8	

No Refusal /
Bottom of Hole

Two fully grouted vibrating wire piezometers were installed at 30.0' and 45.0' below grade. See piezometer installation log for detail.

Boring was backfilled with cement and bentonite grout.

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

Stantec

SUBSURFACE LOG

Client Borehole Identification	ALF6-B33A-2015-LC-S2/U3	Stantec Boring No.	**STN-33A**
Client	Tennessee Valley Authority	Boring Location	275120.19 N, 756670.11 E
Project Number	172675015	Surface Elevation	227.9 ft
Elevation Datum	NGVD29		
Project Name	Allen Fossil Plant - West Ash Pond	Date Started	9/26/15
Completed	9/26/15		
Project Location	Shelby County, Tennessee	Depth to Water	N/A
Date/Time	N/A		
Inspector	Ty Gunter	Depth to Water	N/A
Date/Time	N/A		
Drilling Contractor	Stantec Consulting Services Inc.	Drill Rig Type and ID	CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs and 3" STs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
227.9'	0.0'	Top of Hole							
227.6'	0.3'	Topsoil							
		Fill - Silty Sand, brown to grayish brown, fine-grained, medium dense to very dense, slightly moist to moist Trace of roots from 0.0' - 2.0' Trace of river gravel at 6.0' With bottom ash from 17.5' - 18.5'							
207.9'	20.0'								
		Silty Sand, brown, fine-grained, loose to medium dense, moist Trace of organics from 20.0' - 22.0'							
202.9'	25.0'								

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B33A-2015-LC-S2/U3 | Stantec Boring No. **STN-33A**

Client: Tennessee Valley Authority | Boring Location: 275120.19 N, 756670.11 E

Project Number: 172675015 | Surface Elevation: 227.9 ft | Elevation Datum: NGVD29

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
201.9'	26.0'	Sandy Silt, grayish brown, soft, very moist							
201.4'	26.5'	Sand, with silt, brown, fine- to medium-grained, loose, moist							
199.4'	28.5'	Sandy Clay, brown, medium stiff to stiff, moist							
195.4'	32.5'	Silty Sand, brown, fine-grained, loose, moist to very moist							
194.9'	33.0'	Sandy Silt, gray, medium stiff, very moist							
192.9'	35.0'	Sand, with clay, reddish brown, medium-grained, very loose to medium dense, very moist		SPT-1	34.0' - 35.5'	1.5'	5-5-3	17.1	%Silt = 41.5, %Clay = 4.9, %<#200 = 46.4, LL = 26, PI = 8
				ST-1	35.5' - 37.5'	2.0'		22.6	
189.9'	38.0'	Lean Clay, gray, soft, very moist		SPT-2	37.5' - 39.0'	1.5'	12-16-20	9.3	
188.9'	39.0'	Sand and Gravel, brown, medium- to coarse-grained, dense, very moist							
		No Refusal / Bottom of Hole Boring was backfilled with cement and bentonite grout.							

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B034-2015-LF-S2/U3 | Stantec Boring No. **STN-34**

Client: Tennessee Valley Authority | Boring Location: 275219.61 N, 757572.32 E

Project Number: 172675015 | Surface Elevation: 197.3 ft | Elevation Datum: NAVD 29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/27/15 | Completed: 9/27/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs and 3" STs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
197.3'	0.0'	Top of Hole							
196.8'	0.5'	Topsoil		SPT-1	0.0' - 1.5'	1.3'	1-1-2	6.1	
195.3'	2.0'	Fill - Silty Sand, with bottom ash, brown, fine-grained, very loose, moist		SPT-2	1.5' - 3.0'	1.0'	4-2-2	24.6	
				SPT-3	3.0' - 4.5'	1.5'	3-3-7	27.8	
192.8'	4.5'	Fill - Lean Clay, silty, trace roots, grayish brown, medium stiff to stiff, moist		ST-1	4.5' - 6.5'	1.8'		--	
		Fill - Sand, with gravel, brown, medium- to coarse-grained, moist		SPT-4	6.5' - 8.0'	1.3'	3-4-4	2.3	
				SPT-5	8.0' - 9.5'	1.3'	5-5-5	8.2	
186.8'	10.5'			SPT-6	9.5' - 11.0'	1.2'	1-1-1	22.3	
185.8'	11.5'	Lean Clay, silty, gray, soft to medium stiff, moist		SPT-7	11.0' - 12.5'	1.5'	3-4-2	27.1	
		Silty Sand, brown to gray, fine-grained, very loose to loose, moist to very moist		SPT-8	12.5' - 14.0'	1.5'	1-1-1	27.0	%Silt = 25.4, %Clay = 8.4, %<#200 = 33.8
				SPT-9	14.0' - 15.5'	1.3'	3-3-5	26.1	
				SPT-10	15.5' - 17.0'	1.5'	2-3-1	26.3	
179.8'	17.5'			SPT-11	17.0' - 18.5'	1.5'	1-1-2	29.6	
		Silt with sand, brown to gray, very soft to medium stiff, moist to very moist		SPT-12	18.5' - 20.0'	1.5'	2-1-2	29.6	
				SPT-13	20.0' - 21.5'	1.5'	WOH-WOH-1	33.7	%Silt = 56.8, %Clay = 17.5, %<#200 = 74.3, LL = 28, PI = 5
174.8'	22.5'			SPT-14	21.5' - 23.0'	1.5'	2-3-1	29.9	
		Lean Clay, silty, gray, very soft to medium stiff, moist		SPT-15	23.0' - 24.5'	1.5'	WOH	41.3	

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B034-2015-LF-S2/U3 | Stantec Boring No. **STN-34**

Client: Tennessee Valley Authority | Boring Location: 275219.61 N, 757572.32 E

Project Number: 172675015 | Surface Elevation: 197.3 ft | Elevation Datum: NAVD 29

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		Lean Clay, silty, gray, very soft to medium stiff, moist *(Continued)*		SPT-16	24.5' - 26.0'	1.5'	1-1-2	34.6	
				SPT-17	26.0' - 27.5'	1.5'	WOH-1-2	31.8	
				SPT-18	27.5' - 29.0'	1.5'	WOH	32.6	
				SPT-19	29.0' - 30.5'	1.5'	WOH-1-6	32.8	
165.8'	31.5'			SPT-20	30.5' - 32.0'	1.5'	1-2-5	29.7	
		Clayey Sand, gray, fine- to coarse-grained, loose to medium dense, moist to very moist		SPT-21	32.0' - 33.5'	1.5'	2-2-4	28.1	
162.3'	35.0'			SPT-22	33.5' - 35.0'	1.5'	3-6-12	27.2	

No Refusal /
Bottom of Hole
Boring was backfilled with cement and bentonite grout.

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B035-2015-LF-S2/U3 | Stantec Boring No. **STN-35**

Client: Tennessee Valley Authority | Boring Location: 275168.26 N, 757560.32 E

Project Number: 172675015 | Surface Elevation: 201.9 ft | Elevation Datum: NAVD 29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/27/15 | Completed: 9/27/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs and 3" STs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
201.9'	0.0'	Top of Hole							
		Fill - Silty Sand, trace roots, bottom ash and organics, brown, fine-grained, very loose to medium dense, moist		SPT-1	0.0' - 1.5'	1.5'	2-2-4	7.2	
				SPT-2	1.5' - 3.0'	1.5'	5-6-5	8.0	
				SPT-3	3.0' - 4.5'	1.5'	2-3-2	16.2	
				SPT-4	4.5' - 6.0'	1.5'	2-1-2	24.8	
195.9'	6.0'								
		Fill - Lean Clay, with sand and gravel, grayish brown, medium stiff, moist		ST-1	6.0' - 8.0'	2.0'		34.1	%Silt = 64.2, %Clay = 6.0, %<#200 = 70.2
				SPT-5	8.0' - 9.5'	1.5'	3-1-3	16.8	
				ST-2	9.5' - 11.5'	1.6'		--	
				SPT-6	11.5' - 13.0'	1.5'	2-1-3	28.0	
188.9'	13.0'								
		Lean Clay, silty, gray, soft, very moist		SPT-7	13.0' - 14.5'	1.5'	2-2-1	36.0	
				SPT-8	14.5' - 16.0'	1.5'	WOH-WOH-2	42.7	
185.9'	16.0'								
		Silty Sand, gray, fine-grained, very loose to loose, moist to saturated		SPT-9	16.0' - 17.5'	1.5'	2-4-7	26.1	
				SPT-10	17.5' - 19.0'	1.5'	3-3-3	38.2	%Silt = 32.0, %Clay = 10.7, %<#200 = 42.7
				SPT-11	19.0' - 20.5'	1.5'	3-2-4	28.4	
181.4'	20.5'								
		Sandy Silt, gray, soft to medium stiff, moist to saturated		SPT-12	20.5' - 22.0'	1.5'	2-1-2	29.9	
				SPT-13	22.0' - 23.5'	1.3'	3-2-1	30.8	
				SPT-14	23.5' - 25.0'	1.5'	1-2-1	29.3	

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B035-2015-LF-S2/U3 | Stantec Boring No. **STN-35**

Client: Tennessee Valley Authority | Boring Location: 275168.26 N, 757560.32 E

Project Number: 172675015 | Surface Elevation: 201.9 ft | Elevation Datum: NAVD 29

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		Sandy Silt, gray, soft to medium stiff, moist to saturated *(Continued)*		SPT-15	25.0' - 26.5'	1.5'	1-3-3	28.2	
				SPT-16	26.5' - 28.0'	1.5'	WOH-2-1	26.5	
173.9'	28.0'								
		Lean Clay, silty, gray, soft to stiff, very moist		SPT-17	28.0' - 29.5'	1.5'	WOH-1-2	38.1	%Silt = 49.8, %Clay = 39.7, %<#200 = 89.5, LL = 48, PI = 28
				SPT-18	29.5' - 31.0'	1.5'	WOH-2-2	35.2	
				SPT-19	31.0' - 32.5'	1.5'	1-7-6	33.5	
168.4'	33.5'			SPT-20	32.5' - 34.0'	1.5'	6-9-8	23.7	
167.9'	34.0'	Silty Sand, gray, fine-grained, medium dense, very moist							
		No Refusal / Bottom of Hole Boring was backfilled with cement and bentonite grout.							

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

TVA CONFIDENTIAL INFORMATION

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-P036-2015-LC-S2/U3 | Stantec Boring No.: **STN-36**

Client: Tennessee Valley Authority | Boring Location: 275070.03 N, 757553.53 E

Project Number: 172675015 | Surface Elevation: 227.8 ft | Elevation Datum: NAVD 29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 10/7/15 | Completed: 10/7/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs and 3" STs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
227.8'	0.0'	Top of Hole							
227.4'	0.4'	Topsoil		SPT-1	0.0' - 1.5'	1.5'	3-10-10	5.0	
		Fill - Silty Sand, brown to gray, fine-grained, medium dense to dense, moist		SPT-2	1.5' - 3.0'	1.2'	8-10-8	9.9	
		Traces roots and crushed stone from 0.0' - 1.0'		SPT-3	3.0' - 4.5'	1.4'	3-6-9	12.9	
		Traces of bottom ash and wood fragments at 4.4'		SPT-4	4.5' - 6.0'	1.3'	1-4-6	14.4	
				SPT-5	6.0' - 7.5'	1.2'	4-8-9	18.3	
				SPT-6	7.5' - 9.0'	1.5'	4-8-8	13.8	
				SPT-7	9.0' - 10.5'	1.5'	3-8-10	14.0	
		Trace of concrete at 11.0'		SPT-8	10.5' - 12.0'	0.7'	5-13-16	11.5	
214.0'	13.8'			SPT-9	12.0' - 13.5'	1.5'	10-19-21	11.2	
		Fill - Bottom Ash, black, medium- to coarse-grained, medium dense to very dense, moist		SPT-10	13.5' - 15.0'	1.5'	7-28-22	1.5	
211.3'	16.5'			SPT-11	15.0' - 16.5'	1.5'	9-10-5	3.2	
		Fill - Fly Ash, gray, soft to medium stiff, moist to very moist		SPT-12	16.5' - 18.0'	1.5'	7-5-2	30.8	
208.8'	19.0'			SPT-13	18.0' - 19.5'	1.5'	WOH-1-1	37.6	
		Fill - Silty Sand, gray, fine-grained, loose to medium dense, moist		SPT-14	19.5' - 21.0'	1.5'	1-3-5	27.5	
				SPT-15	21.0' - 22.5'	1.0'	4-5-5	17.9	
				SPT-16	22.5' - 24.0'	1.5'	2-3-2	24.2	
202.8'	25.0'			SPT-17	24.0' - 25.5'	1.5'	1-2-1	28.2	

TVA CONFIDENTIAL INFORMATION

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-P036-2015-LC-S2/U3 | Stantec Boring No. **STN-36**

Client: Tennessee Valley Authority | Boring Location: 275070.03 N, 757553.53 E

Project Number: 172675015 | Surface Elevation: 227.8 ft | Elevation Datum: NAVD 29

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
201.8'	26.0'	Sandy Silt, brown, medium stiff, moist		SPT-18	25.5' - 27.0'	1.3'	1-3-4	26.8	Inserted drilling fluid at 24.3 feet due to increased sand content.
		Sandy Silt, brown to gray, medium stiff to very stiff, moist		SPT-19	27.0' - 28.5'	1.5'	1-3-3	18.5	
				SPT-20	28.5' - 30.0'	1.4'	3-5-6	17.3	
				SPT-21	30.0' - 31.5'	1.5'	3-3-4	20.6	
				SPT-22	31.5' - 33.0'	1.5'	WOH-4-4	24.9	%Silt = 49.5, %Clay = 13.0, %<#200 = 62.5
				SPT-23	33.0' - 34.5'	1.3'	5-5-4	16.6	
				SPT-24	34.5' - 36.0'	1.2'	4-4-3	19.3	
				SPT-25	36.0' - 37.5'	0.8'	4-9-8	18.8	
				SPT-26	37.5' - 39.0'	1.0'	3-5-5	27.9	
				SPT-27	39.0' - 40.5'	1.5'	3-2-2	25.7	
185.3'	42.5'			ST-1	40.5' - 42.5'	1.5'		--	
		Silty Sand, brown to gray, fine-grained, medium dense to dense, moist to very moist Clay seam from 43.3' - 43.6'		SPT-28	42.5' - 44.0'	1.5'	3-4-9	29.0	%Silt = 16.8, %Clay = 7.7, %<#200 = 24.5
				SPT-29	44.0' - 45.5'	1.5'	7-9-7	23.7	
				SPT-30	45.5' - 47.0'	1.2'	10-16-17	18.3	
179.3'	48.5'			SPT-31	47.0' - 48.5'	1.5'	9-9-9	25.4	
177.8'	50.0'	Lean to Fat Clay, gray, soft, moist		SPT-32	48.5' - 50.0'	1.5'	3-2-2	35.1	

No Refusal /
Bottom of Hole
Three fully grouted vibrating wire piezometers were installed at 18.0', 38.0', and 46.0' below grade. See piezometer installation log for detail.

Boring was backfilled with cement and bentonite grout.

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B037-2015-LC-S2/U3 | Stantec Boring No. **STN-37**

Client: Tennessee Valley Authority | Boring Location: 275105.39 N, 757084.79 E

Project Number: 172675015 | Surface Elevation: 227.9 ft | Elevation Datum: NAVD 29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/17/15 | Completed: 9/18/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Matt Chance | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-75, #712

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs and 3" STs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
227.9'	0.0'	Top of Hole							
227.4'	0.5'	Crushed Stone Base		SPT-1	0.0' - 1.5'	1.2'	8-16-24	5.0	
		Fill - Silty Sand, gray, fine-grained, medium dense to very dense, slightly moist to moist		SPT-2	1.5' - 3.0'	1.5'	34-28-18	4.6	
				SPT-3	3.0' - 4.5'	1.5'	8-11-10	10.1	
				SPT-4	4.5' - 6.0'	1.5'	10-12-19	10.7	
				SPT-5	6.0' - 7.5'	1.5'	5-10-11	14.3	
				SPT-6	7.5' - 9.0'	1.5'	9-18-21	12.5	
				SPT-7	9.0' - 10.5'	1.5'	6-10-15	13.9	
				SPT-8	10.5' - 12.0'	1.1'	13-13-15	15.3	
				SPT-9	12.0' - 13.5'	1.3'	15-21-24	13.3	
				SPT-10	13.5' - 15.0'	1.0'	8-24-29	16.9	
211.9'	16.0'			SPT-11	15.0' - 16.5'	1.5'	15-26-29	13.1	
		Fill - Bottom Ash, black, coarse-grained, medium dense to very dense, moist		SPT-12	16.5' - 18.0'	1.2'	22-24-34	2.9	
				SPT-13	18.0' - 19.5'	1.0'	9-11-11	9.6	
		Chemical odor noted from 18.0' - 19.5'		SPT-14	19.5' - 21.0'	1.3'	12-9-12	10.8	
				SPT-15	21.0' - 22.5'	1.0'	5-9-7	11.6	
205.4'	22.5'								
		Sandy Silt, brown, medium stiff to very stiff, moist to very moist		SPT-16	22.5' - 24.0'	0.8'	6-9-12	22.1	
				SPT-17	24.0' - 25.5'	0.8'	3-3-4	27.0	

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B037-2015-LC-S2/U3 | Stantec Boring No. **STN-37**

Client: Tennessee Valley Authority | Boring Location: 275105.39 N, 757084.79 E

Project Number: 172675015 | Surface Elevation: 227.9 ft | Elevation Datum: NAVD 29

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		Sandy Silt, brown, medium stiff to very stiff, moist to very moist *(Continued)*		ST-1	25.5' - 28.0'	2.4'		32.4	Osterberg sampler used at ST-1
				SPT-18	28.0' - 29.5'	0.8'	2-3-3	24.5	%Silt = 71.6, %Clay = 7.2, %<#200 = 78.8
				SPT-19	29.5' - 31.0'	0.6'	3-2-4	26.8	
196.4'	31.5'								
		Silty Sand, brown, fine-grained, medium dense, moist to saturated		SPT-20	31.0' - 32.5'	1.2'	4-3-2	29.8	
				SPT-21	32.5' - 34.0'	0.8'	6-5-10	29.2	
				SPT-22	34.0' - 35.5'	1.5'	4-4-6	27.9	
192.4'	35.5'								

No Refusal /
Bottom of Hole

Boring was backfilled with cement and bentonite grout.

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B038-2015-LP-S2 | Stantec Boring No.: **STN-38**

Client: Tennessee Valley Authority | Boring Location: 275032.20 N, 756654.10 E

Project Number: 172675015 | Surface Elevation: 212.7 ft | Elevation Datum: NAVD 29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/25/15 | Completed: 9/25/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
212.7'	0.0'	Top of Hole							
		Fill - Fly Ash, dark gray to brown, soft to medium stiff, moist		SPT-1	0.0' - 1.5'	1.5'	3-2-3	20.3	
				SPT-2	1.5' - 3.0'	0.8'	1-2-2	51.3	
208.5'	4.2'			SPT-3	3.0' - 4.5'	1.5'	2-1-2	28.8	
		Fill - Silty Sand, brown, fine-grained, loose, moist		SPT-4	4.5' - 6.0'	1.0'	1-2-1	14.0	
205.2'	7.5'			SPT-5	6.0' - 7.5'	1.0'	1-3-4	21.1	
		Silty Sand, brown, fine-grained, very loose to loose, moist to wet		SPT-6	7.5' - 9.0'	1.4'	2-4-2	16.8	
				SPT-7	9.0' - 10.5'	1.4'	2-4-2	22.3	
				SPT-8	10.5' - 12.0'	1.3'	2-3-2	16.4	
				SPT-9	12.0' - 13.5'	1.5'	2-2-1	28.8	
				SPT-10	13.5' - 15.0'	1.5'	1-1-1	30.6	
		Silty clay seam at 15.0'		SPT-11	15.0' - 16.5'	1.5'	1-1-1	31.6	
				SPT-12	16.5' - 18.0'	1.5'	1-3-3	27.8	
				SPT-13	18.0' - 19.5'	1.5'	1-6-6	29.1	
		Lean clay seam at 19.5'		SPT-14	19.5' - 21.0'	1.4'	1-2-2	35.2	
191.2'	21.5'								
		Sand and Gravel, brown to orange brown, fine- to coarse-grained, medium dense to dense, moist to saturated		SPT-15	21.0' - 22.5'	1.4'	8-8-8	10.2	
				SPT-16	22.5' - 24.0'	1.5'	4-16-16	5.2	
				SPT-17	24.0' - 25.5'	1.3'	6-14-13	4.6	

TVA CONFIDENTIAL INFORMATION

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B038-2015-LP-S2 | Stantec Boring No. **STN-38**

Client: Tennessee Valley Authority | Boring Location: 275032.20 N, 756654.10 E

Project Number: 172675015 | Surface Elevation: 212.7 ft | Elevation Datum: NAVD 29

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		Sand and Gravel, brown to orange brown, fine- to coarse-grained, medium dense to dense, moist to saturated *(Continued)*		SPT-18	25.5' - 27.0'	1.3'	10-14-10	4.6	
				SPT-19	27.0' - 28.5'	1.2'	6-7-10	3.9	
				SPT-20	28.5' - 30.0'	1.2'	7-11-11	4.1	
				SPT-21	30.0' - 31.5'	1.3'	4-5-4	35.0	
				SPT-22	31.5' - 33.0'	1.4'	5-7-7	18.8	
		Clay seam at 32.5'		SPT-23	33.0' - 34.5'	1.5'	2-6-7	13.0	
				SPT-24	34.5' - 36.0'	1.5'	7-4-3	25.0	
175.2'	37.5'			SPT-25	36.0' - 37.5'	1.5'	3-7-15	24.4	

No Refusal /
Bottom of Hole
Boring was backfilled with cement and bentonite grout.

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B38A-2015-LP-U3 | Stantec Boring No.: **STN-38A**

Client: Tennessee Valley Authority | Boring Location: 275032.45 N, 756662.98 E

Project Number: 172675015 | Surface Elevation: 213.2 ft | Elevation Datum: NGVD29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/26/15 | Completed: 9/26/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 3" STs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
213.2'	0.0'	Top of Hole							
209.0'	4.2'	Fill - Fly Ash, dark gray to brown, soft to medium stiff, moist		ST-1	5.0' - 7.0'	1.8'		--	
205.7'	7.5'	Fill - Silty Sand, brown, fine-grained, loose, moist							
		Silty Sand, brown, fine-grained, very loose to loose, moist to wet							
		Silty clay seam at 15.0'							
191.7'	21.5'	Lean clay seam at 19.5'							
		Sand and Gravel, brown to orange brown, fine- to coarse-grained, medium dense to dense, moist to saturated							

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B38A-2015-LP-U3 | Stantec Boring No. **STN-38A**

Client: Tennessee Valley Authority | Boring Location: 275032.45 N, 756662.98 E

Project Number: 172675015 | Surface Elevation: 213.2 ft | Elevation Datum: NGVD29

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		Sand and Gravel, brown to orange brown, fine- to coarse-grained, medium dense to dense, moist to saturated *(Continued)*							
		Clay seam at 32.5'							
175.7'	37.5'	No Refusal / Bottom of Hole Boring was backfilled with cement and bentonite grout.							

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

TVA CONFIDENTIAL INFORMATION

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B039-2015-LP-S2 | Stantec Boring No.: **STN-39**

Client: Tennessee Valley Authority | Boring Location: 275000.71 N, 757068.83 E

Project Number: 172675015 | Surface Elevation: 227.7 ft | Elevation Datum: NAVD 29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/25/15 | Completed: 9/25/15

Project Location: Shelby County, Tennessee | Depth to Water: 6.0 ft | Date/Time: 9/25/15

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
227.7'	0.0'	Top of Hole							
		Fill - Fly Ash, with organics, sand and bottom ash, dark gray, soft to stiff, moist		SPT-1	0.0' - 1.5'	1.1'	1-3-4	26.2	
				SPT-2	1.5' - 3.0'	1.7'	4-7-4	24.7	
				SPT-3	3.0' - 4.5'	1.5'	8-4-2	27.6	
221.7'	6.0'			SPT-4	4.5' - 6.0'	1.4'	2-1-2	22.1	
		Fill - Fly Ash, gray, very soft, moist to saturated		SPT-5	6.0' - 7.5'	1.2'	1-1-1	33.3	
				SPT-6	7.5' - 9.0'	1.5'	WOH	34.4	
				SPT-7	9.0' - 10.5'	1.5'	WOH	30.6	
				SPT-8	10.5' - 12.0'	1.5'	WOH	31.5	
				SPT-9	12.0' - 13.5'	1.5'	WOH	29.5	
				SPT-10	13.5' - 15.0'	1.5'	1-1-1	25.1	
				SPT-11	15.0' - 16.5'	1.5'	WOH	24.6	
				SPT-12	16.5' - 18.0'	1.5'	WOH	31.0	
208.7'	19.0'	Chemical odor noted at approximately 18.0'		SPT-13	18.0' - 19.5'	1.5'	WOH	40.7	
		Sandy Silt, grayish brown, medium stiff to stiff, moist		SPT-14	19.5' - 21.0'	1.1'	4-3-3	24.1	
				SPT-15	21.0' - 22.5'	1.4'	3-4-6	26.7	
203.7'	24.0'			SPT-16	22.5' - 24.0'	1.1'	2-2-5	22.1	
				SPT-17	24.0' - 25.5'	1.5'	3-3-4	19.3	

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B039-2015-LP-S2 | Stantec Boring No. **STN-39**

Client: Tennessee Valley Authority | Boring Location: 275000.71 N, 757068.83 E

Project Number: 172675015 | Surface Elevation: 227.7 ft | Elevation Datum: NAVD 29

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		Silty Sand, brown, fine-grained, very loose to medium dense, moist to very moist *(Continued)*		SPT-18	25.5' - 27.0'	1.5'	4-7-4	9.2	
				SPT-19	27.0' - 28.5'	1.5'	2-1-1	29.2	
				SPT-20	28.5' - 30.0'	1.5'	1-1-2	29.0	
				SPT-21	30.0' - 31.5'	1.5'	1-2-2	28.0	
194.7'	33.0'			SPT-22	31.5' - 33.0'	1.5'	2-2-2	29.6	

No Refusal /
Bottom of Hole

Boring was backfilled with cement and bentonite grout.

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B040-2015-LP-S2/U3 | Stantec Boring No. **STN-40**

Client: Tennessee Valley Authority | Boring Location: 274960.06 N, 757535.41 E

Project Number: 172675015 | Surface Elevation: 227.7 ft | Elevation Datum: NAVD 29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/26/15 | Completed: 9/26/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs and 3" STs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
227.7'	0.0'	Top of Hole							
227.4'	0.3'	Topsoil		SPT-1	0.0' - 1.5'	1.4'	5-8-6	3.7	
		Fill - Bottom Ash, black, medium to coarse-grained, very loose to medium dense, moist		SPT-2	1.5' - 3.0'	1.1'	6-7-4	2.6	
				SPT-3	3.0' - 4.5'	1.0'	3-3-2	5.6	
				SPT-4	4.5' - 6.0'	1.4'	2-2-1	3.9	
				SPT-5	6.0' - 7.5'	1.2'	1-1-1	1.0	
				SPT-6	7.5' - 9.0'	1.4'	WOH-1-1	11.2	
				SPT-7	9.0' - 10.5'	1.5'	1-1-1	3.8	
				SPT-8	10.5' - 12.0'	1.3'	1-2-1	10.2	
				SPT-9	12.0' - 13.5'	1.3'	3-5-6	0.8	
213.7'	14.0'								
		Fill - Fly Ash, dark brown to gray, soft to medium stuff, moist to very moist		SPT-10	13.5' - 15.0'	1.2'	5-5-2	22.2	
				SPT-11	15.0' - 16.5'	1.5'	1-2-1	36.2	
				ST-1	16.5' - 18.5'	1.8'		17.8	
209.2'	18.5'								
		Sandy Silt, brown, very soft, moist		SPT-12	18.5' - 20.0'	1.5'	WOH	28.0	
				SPT-13	20.0' - 21.5'	1.5'	WOH-1-2	28.0	
206.2'	21.5'								
204.7'	23.0'	Lean to Fat Clay, gray, medium stiff, moist		SPT-14	21.5' - 23.0'	1.5'	1-2-2	34.0	
		Lean Clay, silty, gray, medium stiff to stiff, moist		SPT-15	23.0' - 24.5'	1.5'	WOH-2-2	32.8	

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B040-2015-LP-S2/U3 | Stantec Boring No. **STN-40**

Client: Tennessee Valley Authority | Boring Location: 274960.06 N, 757535.41 E

Project Number: 172675015 | Surface Elevation: 227.7 ft | Elevation Datum: NAVD 29

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		Lean Clay, silty, gray, medium stiff to stiff, moist *(Continued)*		SPT-16	24.5' - 26.0'	1.4'	3-3-5	31.1	
				SPT-17	26.0' - 27.5'	1.4'	2-5-4	30.6	
199.2'	28.5'			SPT-18	27.5' - 29.0'	1.5'	2-3-6	19.2	
		Sandy Silt, grayish brown, medium stiff to stiff, moist		SPT-19	29.0' - 30.5'	1.5'	2-6-5	27.4	%Silt = 42.7, %Clay = 15.2, %<#200 = 57.9
195.7'	32.0'			SPT-20	30.5' - 32.0'	1.5'	3-3-2	27.4	
		Silty Sand, grayish brown, fine-grained, loose to medium dense, moist to very moist		SPT-21	32.0' - 33.5'	1.5'	6-10-8	13.8	
192.7'	35.0'			SPT-22	33.5' - 35.0'	1.5'	3-5-4	18.5	

No Refusal /
Bottom of Hole
Boring was backfilled with cement and bentonite grout.

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

TVA CONFIDENTIAL INFORMATION

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B041-2015-LP-S2 | Stantec Boring No.: **STN-41**

Client: Tennessee Valley Authority | Boring Location: 274885.49 N, 756401.22 E

Project Number: 172675015 | Surface Elevation: 214.9 ft | Elevation Datum: NAVD 29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/24/15 | Completed: 9/24/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
214.9'	0.0'	Top of Hole							
214.3'	0.6'	Topsoil		SPT-1	0.0' - 1.5'	1.1'	2-5-7	1.7	
213.4'	1.5'	Fill - Bottom Ash, with fly ash, brown, coarse-grained, medium dense, moist		SPT-2	1.5' - 3.0'	1.2'	6-5-7	1.8	
211.4'	3.5'	Fill - Bottom Ash, black, coarse-grained, medium dense, moist		SPT-3	3.0' - 4.5'	1.0'	2-3-2	5.3	
		Silty Sand, brown, fine-grained, very loose to medium dense, moist		SPT-4	4.5' - 6.0'	1.5'	2-3-5	24.2	
				SPT-5	6.0' - 7.5'	1.3'	4-6-4	19.4	
				SPT-6	7.5' - 9.0'	1.2'	3-2-2	6.7	
				SPT-7	9.0' - 10.5'	1.5'	1-1-2	24.5	
				SPT-8	10.5' - 12.0'	1.0'	1-1-2	19.3	
				SPT-9	12.0' - 13.5'	1.5'	2-2-3	8.6	
				SPT-10	13.5' - 15.0'	1.4'	2-3-2	6.9	
				SPT-11	15.0' - 16.5'	1.4'	2-4-7	7.8	
				SPT-12	16.5' - 18.0'	1.1'	3-7-7	5.3	
		Silty clay seam from 18.0' - 20.0'		SPT-13	18.0' - 19.5'	1.4'	4-5-5	25.1	

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B041-2015-LP-S2 | Stantec Boring No. **STN-41**

Client: Tennessee Valley Authority | Boring Location: 274885.49 N, 756401.22 E

Project Number: 172675015 | Surface Elevation: 214.9 ft | Elevation Datum: NAVD 29

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
193.9'	21.0'			SPT-14	19.5' - 21.0'	1.5'	2-1-1	35.1	
192.4'	22.5'	Sand, with gravel, gray, medium- to coarse-grained, medium dense, moist		SPT-15	21.0' - 22.5'	1.5'	2-6-18	20.0	
		No Refusal / Bottom of Hole							
		Boring was backfilled with cement and bentonite grout.							

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B042-2015-LC-S2 | Stantec Boring No. **STN-42**

Client: Tennessee Valley Authority | Boring Location: 274774.68 N, 756231.49 E

Project Number: 172675015 | Surface Elevation: 228.2 ft | Elevation Datum: NAVD 29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/22/15 | Completed: 9/22/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
228.2'	0.0'	Top of Hole							
227.4'	0.8'	Crushed Stone Base		SPT-1	0.0' - 1.5'	0.9'	6-7-9	5.2	
		Fill - Silty Sand, brown to grayish brown, fine-grained, medium dense to dense, moist		SPT-2	1.5' - 3.0'	1.0'	10-12-12	8.7	
				SPT-3	3.0' - 4.5'	1.5'	9-12-9	10.0	
				SPT-4	4.5' - 6.0'	1.1'	11-13-12	10.7	
				SPT-5	6.0' - 7.5'	1.2'	15-15-16	11.3	
				SPT-6	7.5' - 9.0'	1.5'	9-18-23	11.2	
218.7'	9.5'								
217.7'	10.5'	Fill - Gravel, with sand and fly ash, dark brown, coarse-grained, very dense, moist		SPT-7	9.0' - 10.5'	1.5'	19-27-25	8.1	
216.2'	12.0'			SPT-8	10.5' - 12.0'	1.1'	14-10-10	7.3	
		Fill - Fly Ash, dark gray, very stiff, moist		SPT-9	12.0' - 13.5'	1.0'	3-7-10	11.5	
		Silty Sand, brown, fine-grained, loose to medium dense, moist		SPT-10	13.5' - 15.0'	1.5'	3-5-6	10.1	
				SPT-11	15.0' - 16.5'	0.0'	4-2-2	16.0	
				SPT-12	16.5' - 18.0'	1.0'	3-8-12	12.2	
				SPT-13	18.0' - 19.5'	1.5'	5-5-4	4.1	
				SPT-14	19.5' - 21.0'	1.0'	5-3-5	5.4	
				SPT-15	21.0' - 22.5'	1.4'	6-5-5	4.1	
				SPT-16	22.5' - 24.0'	1.4'	5-5-3	5.8	
				SPT-17	24.0' - 25.5'	1.3'	9-5-5	6.4	

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B042-2015-LC-S2 | Stantec Boring No. **STN-42**

Client: Tennessee Valley Authority | Boring Location: 274774.68 N, 756231.49 E

Project Number: 172675015 | Surface Elevation: 228.2 ft | Elevation Datum: NAVD 29

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		Silty Sand, brown, fine-grained, loose to medium dense, moist *(Continued)*		SPT-18	25.5' - 27.0'	0.7'	9-4-5	3.5	
				SPT-19	27.0' - 28.5'	1.0'	3-5-7	5.2	
				SPT-20	28.5' - 30.0'	1.0'	7-9-7	3.8	
196.7'	31.5'			SPT-21	30.0' - 31.5'	0.6'	6-7-4	--	
		No Refusal / Bottom of Hole							
		Boring was backfilled with cement and bentonite grout.							

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B043-2015-LP-S2 | Stantec Boring No.: **STN-43**

Client: Tennessee Valley Authority | Boring Location: 274581.55 N, 756525.54 E

Project Number: 172675015 | Surface Elevation: 218.5 ft | Elevation Datum: NAVD 29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/24/15 | Completed: 9/24/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
218.5'	0.0'	Top of Hole							
217.8'	0.7'	Topsoil		SPT-1	0.0' - 1.5'	1.3'	2-2-3	8.1	
215.5'	3.0'	Fill - Fly Ash, brown, loose to medium dense, moist		SPT-2	1.5' - 3.0'	1.2'	5-8-8	15.5	
211.0'	7.5'	Fill - Silty Sand, brown, fine-grained, very loose to medium dense, moist to wet		SPT-3	3.0' - 4.5'	1.5'	3-4-3	11.7	
				SPT-4	4.5' - 6.0'	1.5'	1-1-1	28.4	
				SPT-5	6.0' - 7.5'	1.3'	1-1-2	27.5	
200.5'	18.0'	Lean Clay, silty, brown, very soft to medium stiff, moist to wet		SPT-6	7.5' - 9.0'	1.5'	WOH	29.8	
				SPT-7	9.0' - 10.5'	1.5'	1-1-2	35.2	
				SPT-8	10.5' - 12.0'	1.4'	2-2-1	32.6	
				SPT-9	12.0' - 13.5'	1.5'	1-1-1	30.8	
				SPT-10	13.5' - 15.0'	1.3'	WOH-2-2	32.3	
				SPT-11	15.0' - 16.5'	1.5'	WOH-1-1	31.3	
				SPT-12	16.5' - 18.0'	1.4'	WOH-2-3	29.3	
194.5'	24.0'	Silty Sand, brown, fine-grained, loose to medium dense, moist		SPT-13	18.0' - 19.5'	1.5'	2-2-2	17.6	
				SPT-14	19.5' - 21.0'	0.5'	WOH-1-1	25.9	
				SPT-15	21.0' - 22.5'	0.8'	WOH-1-2	23.7	
				SPT-16	22.5' - 24.0'	1.0'	3-5-6	12.4	
				SPT-17	24.0' - 25.5'	1.5'	3-4-3	19.8	

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B043-2015-LP-S2 | Stantec Boring No. **STN-43**

Client: Tennessee Valley Authority | Boring Location: 274581.55 N, 756525.54 E

Project Number: 172675015 | Surface Elevation: 218.5 ft | Elevation Datum: NAVD 29

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		Sand, with gravel, brown to reddish brown, medium-grained, loose to medium dense, moist *(Continued)*		SPT-18	25.5' - 27.0'	1.3'	1-3-4	18.5	
				SPT-19	27.0' - 28.5'	1.4'	6-9-8	2.0	
		Clay seam at 25.5'							
188.5'	30.0'	Clay seam at 28.5'		SPT-20	28.5' - 30.0'	1.1'	9-7-6	14.2	

No Refusal /
Bottom of Hole

Boring was backfilled with cement and bentonite grout.

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B044-2015-LP-S2 | Stantec Boring No. **STN-44**

Client: Tennessee Valley Authority | Boring Location: 274692.75 N, 756932.74 E

Project Number: 172675015 | Surface Elevation: 216.9 ft | Elevation Datum: NGVD29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/24/15 | Completed: 9/24/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
216.9'	0.0'	Top of Hole							
216.6'	0.3'	Topsoil							
		Fill - Fly Ash, gray, soft to medium stiff, moist		SPT-1	0.0' - 1.5'	1.5'	1-1-1	27.7	
				SPT-2	1.5' - 3.0'	1.3'	1-3-2	24.8	
				SPT-3	3.0' - 4.5'	1.5'	1-1-2	28.0	
211.4'	5.5'			SPT-4	4.5' - 6.0'	1.5'	1-4-4	21.2	
		Fill - Sandy Silt, with fly ash, brown, medium stiff to stiff, moist		SPT-5	6.0' - 7.5'	1.0'	3-6-7	69.1	
				SPT-6	7.5' - 9.0'	1.2'	2-3-3	23.8	
206.4'	10.5'			SPT-7	9.0' - 10.5'	1.5'	WOH-2-3	30.6	
		Sandy Silt, brown, soft to medium stiff, moist		SPT-8	10.5' - 12.0'	1.5'	1-2-2	31.2	
				SPT-9	12.0' - 13.5'	1.3'	WOH-1-1	29.5	
				SPT-10	13.5' - 15.0'	1.4'	WOH-1-1	29.2	
				SPT-11	15.0' - 16.5'	1.5'	WOH-1-2	31.8	
198.9'	18.0'			SPT-12	16.5' - 18.0'	1.5'	1-2-2	31.6	
		Lean Clay, silty, brown, soft to medium stiff, moist		SPT-13	18.0' - 19.5'	1.5'	WOH-2-2	38.0	
196.4'	20.5'			SPT-14	19.5' - 21.0'	1.5'	1-1-1	29.1	
		Silty Sand, brown, fine-grained, very loose to medium dense, moist		SPT-15	21.0' - 22.5'	1.3'	1-2-4	23.8	
				SPT-16	22.5' - 24.0'	1.5'	1-3-6	15.7	
				SPT-17	24.0' - 25.5'	1.4'	3-3-6	9.1	

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B044-2015-LP-S2 | Stantec Boring No. **STN-44**

Client: Tennessee Valley Authority | Boring Location: 274692.75 N, 756932.74 E

Project Number: 172675015 | Surface Elevation: 216.9 ft | Elevation Datum: NGVD29

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
189.9'	27.0'			SPT-18	25.5' - 27.0'	1.5'	5-5-5	15.2	

No Refusal /
Bottom of Hole

Boring was backfilled with cement and bentonite grout.

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B045-2015-LP-S2 | Stantec Boring No.: **STN-45**

Client: Tennessee Valley Authority | Boring Location: 274571.04 N, 757472.72 E

Project Number: 172675015 | Surface Elevation: 222.1 ft | Elevation Datum: NGVD29

Project Name: Allen Fossil Plant - West Ash Pond | Date Started: 9/25/15 | Completed: 9/25/15

Project Location: Shelby County, Tennessee | Depth to Water: N/A | Date/Time: N/A

Inspector: Ty Gunter | Depth to Water: N/A | Date/Time: N/A

Drilling Contractor: Stantec Consulting Services Inc. | Drill Rig Type and ID: CME-850 XR, #953

Overburden Drilling and Sampling Tools (Type and Size): 4.25" HSA with 2" SPTs

Rock Drilling and Sampling Tools (Type and Size): N/A

Sampler Hammer Type: Automatic | Weight: 140 lbs. | Drop: 30 inches | Efficiency: N/A

Borehole Azimuth: N/A (Vertical) | Borehole Inclination (from Vertical): Vertical

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
222.1'	0.0'	Top of Hole							
221.8'	0.3'	Topsoil		SPT-1	0.0' - 1.5'	1.5'	WOH-1-1	56.5	
		Fill - Fly Ash, with bottom ash, gravel, and organics, brown to dark gray, very soft to medium stiff, moist to wet		SPT-2	1.5' - 3.0'	1.1'	1-1-1	103.6	
				SPT-3	3.0' - 4.5'	0.8'	WOH	53.7	
216.6'	5.5'			SPT-4	4.5' - 6.0'	1.5'	WOH-2-2	22.6	
214.6'	7.5'	Fill - Silty Sand, brown, fine-grained, loose, very moist		SPT-5	6.0' - 7.5'	1.5'	3-2-4	28.4	
213.1'	9.0'	Sandy Silt, brown, soft, moist		SPT-6	7.5' - 9.0'	1.5'	1-1-1	29.2	
		Silty Clay, brown, very soft to medium stiff, moist to very moist		SPT-7	9.0' - 10.5'	1.5'	WOH-WOH-2	32.4	
				SPT-8	10.5' - 12.0'	1.5'	2-2-3	31.1	
				SPT-9	12.0' - 13.5'	1.5'	WOH	28.9	
207.1'	15.0'			SPT-10	13.5' - 15.0'	1.5'	WOH	36.3	
		Silty Sand, brown, fine-grained, loose, moist to very moist		SPT-11	15.0' - 16.5'	1.5'	WOH-2-3	22.1	
				SPT-12	16.5' - 18.0'	1.0'	3-2-3	18.8	
				SPT-13	18.0' - 19.5'	1.1'	3-4-3	18.7	
				SPT-14	19.5' - 21.0'	0.8'	WOH-2-2	21.3	
199.6'	22.5'			SPT-15	21.0' - 22.5'	1.4'	1-2-2	28.8	
				SPT-16	22.5' - 24.0'	1.2'	4-4-8	14.1	
				SPT-17	24.0' - 25.5'	1.0'	1-6-3	18.5	

TVA CONFIDENTIAL INFORMATION

Stantec

SUBSURFACE LOG

Client Borehole Identification: ALF6-B045-2015-LP-S2 | Stantec Boring No. **STN-45**

Client: Tennessee Valley Authority | Boring Location: 274571.04 N, 757472.72 E

Project Number: 172675015 | Surface Elevation: 222.1 ft | Elevation Datum: NGVD29

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		Sand, brown, fine- to medium-grained, medium dense, moist to very moist		SPT-18	25.5' - 27.0'	1.5'	WOH-1-2	32.6	
193.6'	28.5'	Sandy silt lense at 25.5' *(Continued)*		SPT-19	27.0' - 28.5'	1.3'	2-7-6	8.3	
		No Refusal / Bottom of Hole							
		Boring was backfilled with cement and bentonite grout.							

TVA RO BORING LOG ALF-WAP BORING LOGS_11-24-15.GPJ FMSM-GRAPHIC LOG.GDT 2/22/16

Test Pit Log

Stantec

Project Name	Allen Fossil Plant - WAP Closure
Project Number	172675015
Equipment Used	John Deere Backhoe
Date Excavated	9/30/2015
Total Depth (ft)	6

Surface Elevation: 213.1 feet above MSL

Test Pit No. STN-59

Remarks:

Depth (ft)	Lithologic Description
1	(0'-3') Fill - Fly Ash, grey, moist
2	
3	
4	(3'-6') Fill - Silty Sand, light grey to brown, fine grained.
5	
6	Terminated at 6 ft.

Test Pit Log

Stantec

Project Name	Allen Fossil Plant - WAP Closure
Project Number	172675015
Equipment Used	John Deere Backhoe
Date Excavated	9/30/2015
Total Depth (ft)	8

Surface Elevation: 216.6 feet above MSL

Test Pit No. STN-60

Remarks:

Depth (ft)	Lithologic Description
1	(0'-6.5') Fill - Fly Ash, dark brown to light brown, moist
2	
3	
4	
5	
6	
7	(6.5'-8') Fill - Bottom Ash, black, medium to coarse grained, moist
8	Terminated at 8 feet

Test Pit Log

Stantec

Project Name	Allen Fossil Plant - WAP Closure
Project Number	172675015
Equipment Used	John Deere Backhoe
Date Excavated	9/30/2015
Total Depth (ft)	8

Surface Elevation: 215.2 feet above MSL

Test Pit No. STN-63

Remarks:

Depth (ft)	Lithologic Description
1	(0'-1.5') Fill - Fly Ash, dark brown, moist
2	
3	(1.5'-3') Fill - Bottom Ash, dark brown, moist
4	
5	(3.0'-8) Silty Sand, brown, moist
6	
7	
8	Terminated at 8 feet

Test Pit Log

Stantec

Project Name	Allen Fossil Plant - WAP Closure
Project Number	172675015
Equipment Used	John Deere Backhoe
Date Excavated	9/30/2015
Total Depth (ft)	7

Surface Elevation: 215.7 feet above MSL

Test Pit No. STN-64

Remarks:

Depth (ft)	Lithologic Description
1	(0'-2') Fill - Fly Ash, black, moist
2	
3	
4	
5	(2' - 7.0') Fill - Fly Ash, dark brown and grey, moist
6	
7	

Terminated at 7 feet

Test Pit Log

Stantec

Project Name	Allen Fossil Plant - WAP Closure
Project Number	172675015
Equipment Used	John Deere Backhoe
Date Excavated	9/30/2015
Total Depth (ft)	7

Surface Elevation: 216.8 ft above MSL

Test Pit No. STN-67

Remarks:

Depth (ft)

1
2
3
4
5
6
7

Terminated at 7 feet

Lithologic Description

(0'-2') Fill - Fly Ash and Bottom Ash mixture, brown to light brown, moist

(2' - 7') Fill- Sandy Silt, grey, moist

PRESENTATION OF SITE INVESTIGATION RESULTS

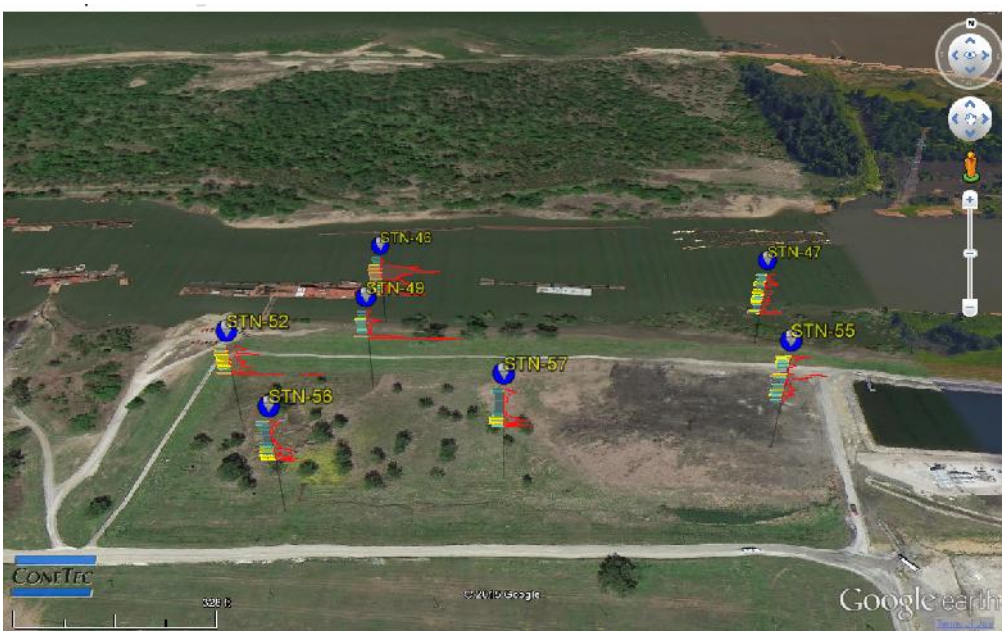
TVA Allen WAP Closure

Prepared for:

Stantec

ConeTec Job No: 15-54076

Project Start Date: 18-SEP-2015
Project End Date: 30-SEP-2015
Report Date: 13-OCT-2015



Prepared by:

ConeTec Inc.
606-S Roxbury Industrial Center
Charles City, VA 23030

Tel: (804) 966-5696
Fax: (804) 966-5697

Email: virginia@conetec.com
www.conetec.com
www.conetecdataservices.com

Introduction

The enclosed report presents the results of the site investigation program conducted by ConeTec, Inc. for Stantec at the TVA Allen Power Plant in Memphis, TN. The program consisted of cone penetration tests.

Project Information

Project	
Client	Stantec
Project	TVA Allen WAP Closure
ConeTec project number	15-54076

A map from Google earth including the CPT test locations is presented below.

Rig Description	Deployment System	Test Type
15 Ton CPT Tracked Rig	Integrated Ramset	CPTu

Coordinates		
Test Type	Collection Method	EPSG Number
CPTu	Handheld GPS	4326

Cone Penetration Test (CPT)	
Depth reference	Depths are referenced to the existing ground surface at the time of each test.
Tip and sleeve data offset	0.1 meter This has been accounted for in the CPT data files.
Additional comments	Phreatic surface depths used in empirical correlations based on limited pore pressure dissipation testing. These values should be considered as a first order estimation.

Cone Penetrometers Used for this Project						
Cone Description	Cone Number	Cross Sectional Area (cm^2)	Sleeve Area (cm^2)	Tip Capacity (bar)	Sleeve Capacity (bar)	Pore Pressure Capacity (psi)
367:T1500F15U500	AD367	15	225	1500	15	500
Cone AD367 was used for all CPT soundings.						

Interpretation Tables	
Additional information	The Soil Behaviour Type (SBT) classification chart (Robertson et al., 1986 presented by Lunne, Robertson and Powell, 1997) was used to classify the soil for this project.

Limitations

This report has been prepared for the exclusive use of Stantec (Client) for the project titled "TVA Allen WAP Closure". The report's contents may not be relied upon by any other party without the express written permission of ConeTec, Inc. (ConeTec). ConeTec has provided site investigation services, prepared the factual data reporting, and provided geotechnical parameter calculations consistent with current best practices. No other warranty, expressed or implied, is made.

The information presented in the report document and the accompanying data set pertain to the specific project, site conditions and objectives described to ConeTec by the Client. In order to properly understand the factual data, assumptions and calculations, reference must be made to the documents provided and their accompanying data sets, in their entirety.

CONE PENETRATION TEST

The cone penetration tests (CPTu) are conducted using an integrated electronic piezocone penetrometer and data acquisition system manufactured by Adara Systems Ltd. of Richmond, British Columbia, Canada.

ConeTec's piezocone penetrometers are compression type designs in which the tip and friction sleeve load cells are independent and have separate load capacities. The piezocones use strain gauged load cells for tip and sleeve friction and a strain gauged diaphragm type transducer for recording pore pressure. The piezocones also have a platinum resistive temperature device (RTD) for monitoring the temperature of the sensors, an accelerometer type dual axis inclinometer and a geophone sensor for recording seismic signals. All signals are amplified down hole within the cone body and the analog signals are sent to the surface through a shielded cable.

ConeTec penetrometers are manufactured with various tip, friction and pore pressure capacities in both 10 cm^2 and 15 cm^2 tip base area configurations in order to maximize signal resolution for various soil conditions. The specific piezocone used for each test is described in the CPT summary table presented in the first Appendix. The 15 cm^2 penetrometers do not require friction reducers as they have a diameter larger than the deployment rods. The 10 cm^2 piezocones use a friction reducer consisting of a rod adapter extension behind the main cone body with an enlarged cross sectional area (typically 44 mm diameter over a length of 32 mm with tapered leading and trailing edges) located at a distance of 585 mm above the cone tip.

The penetrometers are designed with equal end area friction sleeves, a net end area ratio of 0.8 and cone tips with a 60 degree apex angle.

All ConeTec piezocones can record pore pressure at various locations. Unless otherwise noted, the pore pressure filter is located directly behind the cone tip in the "u_2" position (ASTM Type 2). The filter is 6 mm thick, made of porous plastic (polyethylene) having an average pore size of 125 microns (90-160 microns). The function of the filter is to allow rapid movements of extremely small volumes of water needed to activate the pressure transducer while preventing soil ingress or blockage.

The piezocone penetrometers are manufactured with dimensions, tolerances and sensor characteristics that are in general accordance with the current ASTM D5778 standard. ConeTec's calibration criteria also meet or exceed those of the current ASTM D5778 standard. An illustration of the piezocone penetrometer is presented in Figure CPTu.

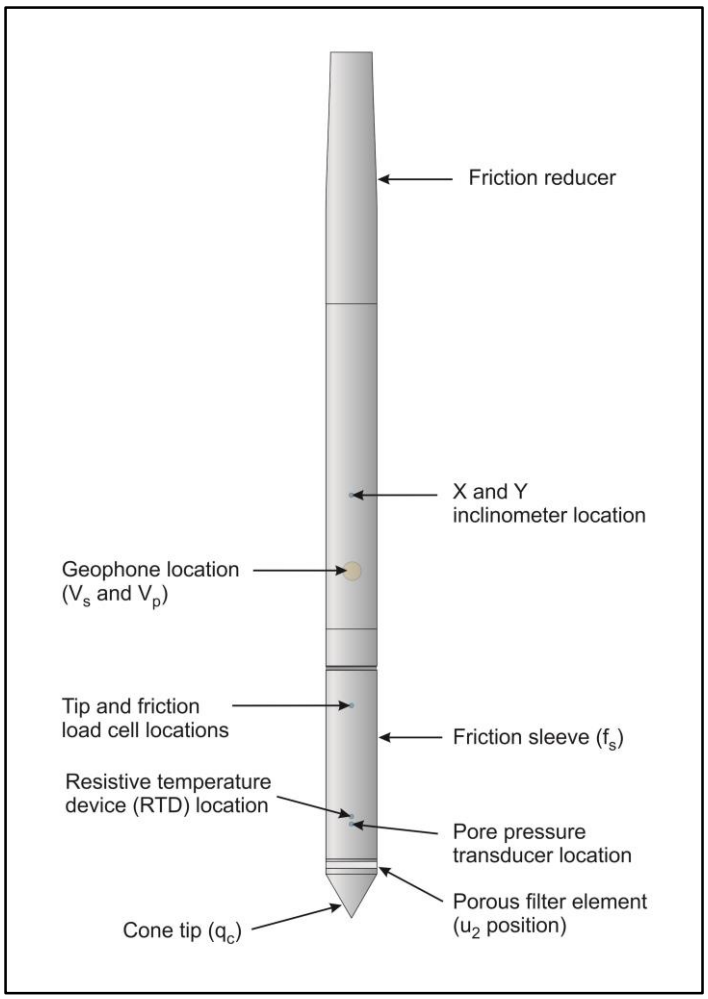


Figure CPTu. Piezocone Penetrometer (15 cm^2)

The ConeTec data acquisition systems consist of a Windows based computer and a signal conditioner and power supply interface box with a 16 bit (or greater) analog to digital (A/D) converter. The data is recorded at fixed depth increments using a depth wheel attached to the push cylinders or by using a spring loaded rubber depth wheel that is held against the cone rods. The typical recording intervals are either 2.5 cm or 5.0 cm depending on project requirements; custom recording intervals are possible. The system displays the CPTu data in real time and records the following parameters to a storage media during penetration:

- Depth
- Uncorrected tip resistance (q_c)
- Sleeve friction (f_s)
- Dynamic pore pressure (u)
- Additional sensors such as resistivity, passive gamma, ultra violet induced fluorescence, if applicable

All testing is performed in accordance to ConeTec's CPT operating procedures which are in general accordance with the current ASTM D5778 standard.

Prior to the start of a CPTu sounding a suitable cone is selected, the cone and data acquisition system are powered on, the pore pressure system is saturated with either glycerin or silicone oil and the baseline readings are recorded with the cone hanging freely in a vertical position.

The CPTu is conducted at a steady rate of 2 cm/s, within acceptable tolerances. Typically one meter length rods with an outer diameter of 1.5 inches are added to advance the cone to the sounding termination depth. After cone retraction final baselines are recorded.

Additional information pertaining to ConeTec's cone penetration testing procedures:

- Each filter is saturated in silicone oil or glycerin under vacuum pressure prior to use
- Recorded baselines are checked with an independent multi-meter
- Baseline readings are compared to previous readings
- Soundings are terminated at the client's target depth or at a depth where an obstruction is encountered, excessive rod flex occurs, excessive inclination occurs, equipment damage is likely to take place, or a dangerous working environment arises
- Differences between initial and final baselines are calculated to ensure zero load offsets have not occurred and to ensure compliance with ASTM standards

The interpretation of piezocone data for this report is based on the corrected tip resistance (q_t), sleeve friction (f_s) and pore water pressure (u). The interpretation of soil type is based on the correlations developed by Robertson (1990) and Robertson (2009). It should be noted that it is not always possible to accurately identify a soil type based on these parameters. In these situations, experience, judgment and an assessment of other parameters may be used to infer soil behavior type.

The recorded tip resistance (q_c) is the total force acting on the piezocone tip divided by its base area. The tip resistance is corrected for pore pressure effects and termed corrected tip resistance (q_t) according to the following expression presented in Robertson et al, 1986:

$$q_t = q_c + (1\text{-}a) \bullet u_2$$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the piezocone (0.8 for ConeTec probes)

The sleeve friction (f_s) is the frictional force on the sleeve divided by its surface area. As all ConeTec piezocones have equal end area friction sleeves, pore pressure corrections to the sleeve data are not required.

The dynamic pore pressure (u) is a measure of the pore pressures generated during cone penetration. To record equilibrium pore pressure, the penetration must be stopped to allow the dynamic pore pressures to stabilize. The rate at which this occurs is predominantly a function of the permeability of the soil and the diameter of the cone.

The friction ratio (Rf) is a calculated parameter. It is defined as the ratio of sleeve friction to the tip resistance expressed as a percentage. Generally, saturated cohesive soils have low tip resistance, high

friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

A summary of the CPTu soundings along with test details and individual plots are provided in the appendices. A set of interpretation files were generated for each sounding based on published correlations and are provided in Excel format in the data release folder. Information regarding the interpretation methods used is also included in the data release folder.

For additional information on CPTu interpretations, refer to Robertson et al. (1986), Lunne et al. (1997), Robertson (2009), Mayne (2013, 2014) and Mayne and Peuchen (2012).

The cone penetration test is halted at specific depths to carry out pore pressure dissipation (PPD) tests, shown in Figure PPD-1. For each dissipation test the cone and rods are decoupled from the rig and the data acquisition system measures and records the variation of the pore pressure (u) with time (t).

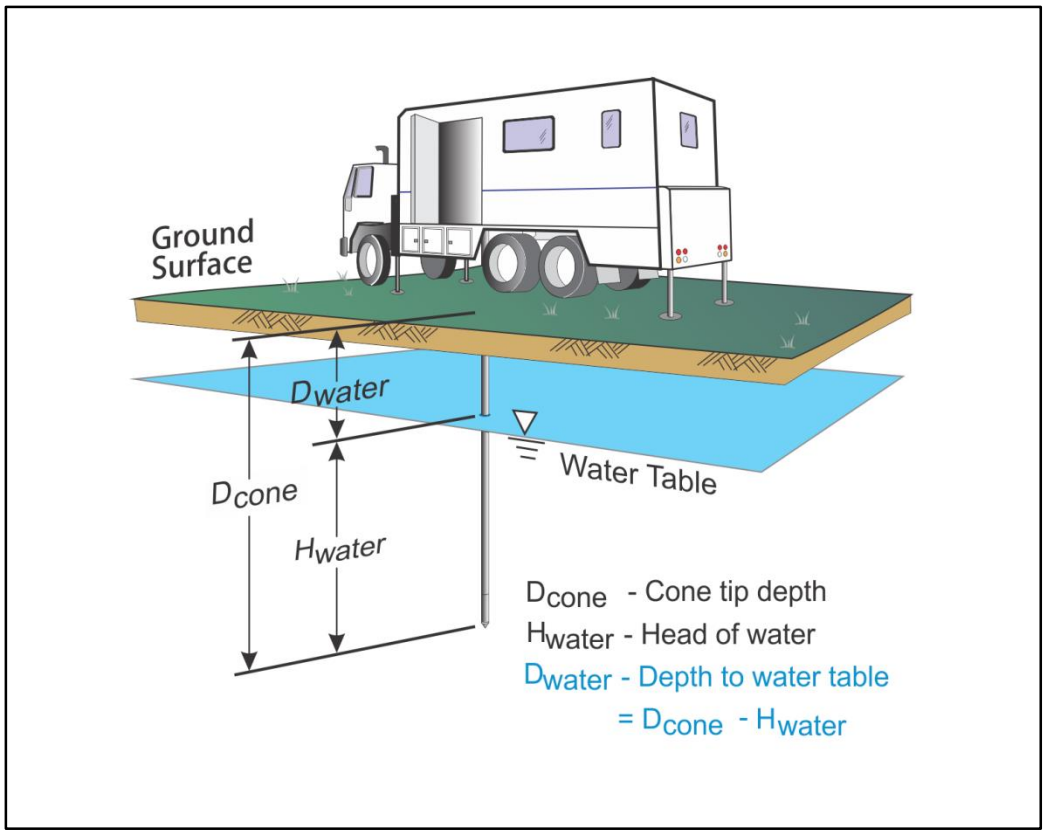


Figure PPD-1. Pore pressure dissipation test setup

Pore pressure dissipation data can be interpreted to provide estimates of ground water conditions, permeability, consolidation characteristics and soil behavior.

The typical shapes of dissipation curves shown in Figure PPD-2 are very useful in assessing soil type, drainage, in situ pore pressure and soil properties. A flat curve that stabilizes quickly is typical of a freely draining sand. Undrained soils such as clays will typically show positive excess pore pressure and have long dissipation times. Dilative soils will often exhibit dynamic pore pressures below equilibrium that then rise over time. Overconsolidated fine-grained soils will often exhibit an initial dilatory response where there is an initial rise in pore pressure before reaching a peak and dissipating.

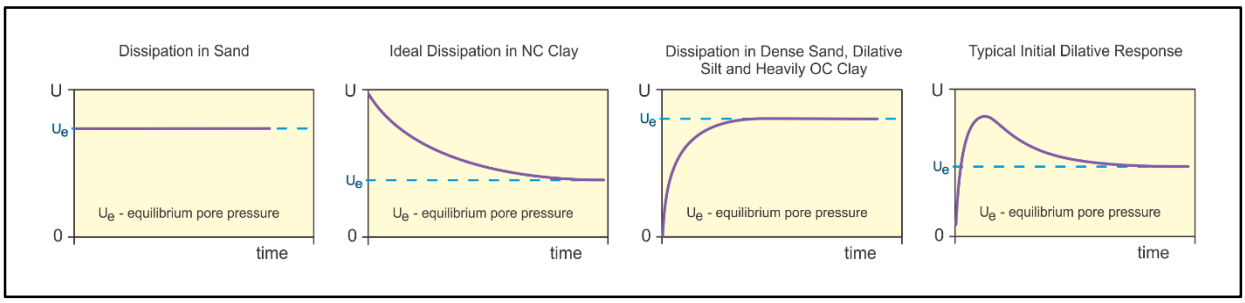


Figure PPD-2. Pore pressure dissipation curve examples

In order to interpret the equilibrium pore pressure (u_{eq}) and the apparent phreatic surface, the pore pressure should be monitored until such time as there is no variation in pore pressure with time as shown for each curve of Figure PPD-2.

In fine grained deposits the point at which 100% of the excess pore pressure has dissipated is known as t_{100}. In some cases this can take an excessive amount of time and it may be impractical to take the dissipation to t_{100}. A theoretical analysis of pore pressure dissipations by Teh and Houlsby (1991) showed that a single curve relating degree of dissipation versus theoretical time factor (T*) may be used to calculate the coefficient of consolidation (c_h) at various degrees of dissipation resulting in the expression for c_h shown below.

$$c_h = \frac{T^* \cdot a^2 \cdot \sqrt{I_r}}{t}$$

Where:

T* is the dimensionless time factor (Table Time Factor)
a is the radius of the cone
I_r is the rigidity index
t is the time at the degree of consolidation

Table Time Factor. T* versus degree of dissipation (Teh and Houlsby, 1991)

Degree of Dissipation (%)	20	30	40	50	60	70	80
T* (u_2)	0.038	0.078	0.142	0.245	0.439	0.804	1.60

The coefficient of consolidation is typically analyzed using the time (t_{50}) corresponding to a degree of dissipation of 50% (u_{50}). In order to determine t_{50}, dissipation tests must be taken to a pressure less than u_{50}. The u_{50} value is half way between the initial maximum pore pressure and the equilibrium pore pressure value, known as u_{100}. To estimate u_{50}, both the initial maximum pore pressure and u_{100} must be known or estimated. Other degrees of dissipations may be considered, particularly for extremely long dissipations.

At any specific degree of dissipation the equilibrium pore pressure (u at t_{100}) must be estimated at the depth of interest. The equilibrium value may be determined from one or more sources such as measuring the value directly (u_{100}), estimating it from other dissipations in the same profile, estimating the phreatic surface and assuming hydrostatic conditions, from nearby soundings, from client provided information, from site observations and/or past experience, or from other site instrumentation.

For calculations of c_h (Teh and Houlsby, 1991), t_{50} values are estimated from the corresponding pore pressure dissipation curve and a rigidity index (I_r) is assumed. For curves having an initial dilatory response in which an initial rise in pore pressure occurs before reaching a peak, the relative time from the peak value is used in determining t_{50}. In cases where the time to peak is excessive, t_{50} values are not calculated.

Due to possible inherent uncertainties in estimating I_r, the equilibrium pore pressure and the effect of an initial dilatory response on calculating t_{50}, other methods should be applied to confirm the results for c_h.

Additional published methods for estimating the coefficient of consolidation from a piezocone test are described in Burns and Mayne (1998, 2002), Jones and Van Zyl (1981), Robertson et al. (1992) and Sully et al. (1999).

A summary of the pore pressure dissipation tests and dissipation plots are presented in the relevant appendix.

REFERENCES

ASTM D5778-12, 2012, "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils", ASTM, West Conshohocken, US.

Burns, S.E. and Mayne, P.W., 1998, "Monotonic and dilatory pore pressure decay during piezocone tests", Canadian Geotechnical Journal 26 (4): 1063-1073.

Burns, S.E. and Mayne, P.W., 2002, "Analytical cavity expansion-critical state model cone dissipation in fine-grained soils", Soils & Foundations, Vol. 42(2): 131-137.

Jones, G.A. and Van Zyl, D.J.A., 1981, "The piezometer probe: a useful investigation tool", Proceedings, 10th International Conference on Soil Mechanics and Foundation Engineering, Vol. 3, Stockholm: 489-495.

Lunne, T., Robertson, P.K. and Powell, J. J. M., 1997, "Cone Penetration Testing in Geotechnical Practice", Blackie Academic and Professional.

Mayne, P.W., 2013, "Evaluating yield stress of soils from laboratory consolidation and in-situ cone penetration tests", Sound Geotechnical Research to Practice (Holtz Volume) GSP 230, ASCE, Reston/VA: 406-420.

Mayne, P.W., 2014, "Interpretation of geotechnical parameters from seismic piezocone tests", CPT'14 Keynote Address, Las Vegas, NV, May 2014.

Mayne, P.W. and Peuchen, J., 2012, "Unit weight trends with cone resistance in soft to firm clays", Geotechnical and Geophysical Site Characterization *4,* Vol. 1 (Proc. ISC-4, Pernambuco), CRC Press, London: 903-910.

Robertson, P.K., 1990, "Soil Classification Using the Cone Penetration Test", Canadian Geotechnical Journal, Volume 27: 151-158.

Robertson, P.K., 2009, "Interpretation of cone penetration tests – a unified approach", Canadian Geotechnical Journal, Volume 46: 1337-1355.

Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.

Robertson, P.K., Sully, J.P., Woeller, D.J., Lunne, T., Powell, J.J.M. and Gillespie, D.G., 1992, "Estimating coefficient of consolidation from piezocone tests", Canadian Geotechnical Journal, 29(4): 551-557.

Sully, J.P., Robertson, P.K., Campanella, R.G. and Woeller, D.J., 1999, "An approach to evaluation of field CPTU dissipation data in overconsolidated fine-grained soils", Canadian Geotechnical Journal, 36(2): 369-381.

Teh, C.I., and Houlsby, G.T., 1991, "An analytical study of the cone penetration test in clay", Geotechnique, 41(1): 17-34.

APPENDICES

The appendices listed below are included in the report:

- Cone Penetration Test Summary and Standard Cone Penetration Test Plots
- Pore Pressure Dissipation Summary and Pore Pressure Dissipation Plots

Cone Penetration Test Summary and Standard Cone Penetration Test Plots

Job No:	15-54076
Client:	Stantec
Project:	TVA Allen WAP Closure
Start Date:	18-Sep-2015
End Date:	30-Sep-2015

CONE PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Assumed Phreatic Surface (ft)	Final Depth (ft)	Shear Wave Velocity Tests	Latitude[2] (degrees)	Longitude (degrees)	Refer to Notation Number
STN-46	15-54076_CPSTN-46	09/29/15	367:T1500F15U500	16	35.9		35.075784	-90.156360	
STN-47	15-54076_CPSTN-47	09/29/15	367:T1500F15U500	18	36.1		35.07557	-90.15333	
STN-49	15-54076_CPSTN-49	09/29/15	367:T1500F15U500		23.0		35.07500	-90.15631	3
STN-52	15-54076_CPSTN-52	09/29/15	367:T1500F15U500		23.0		35.07464	-90.15718	3
STN-55	15-54076_CPSTN-55	09/30/15	367:T1500F15U500	35	36.1		35.07447	-90.15350	
STN-56	15-54076_CPSTN-56	09/30/15	367:T1500F15U500	29	29.5		35.07391	-90.15665	
STN-57	15-54076_CPSTN-57	09/30/15	367:T1500F15U500	25	29.5		35.07419	-90.15530	
Totals	7 soundings				213.09	0			

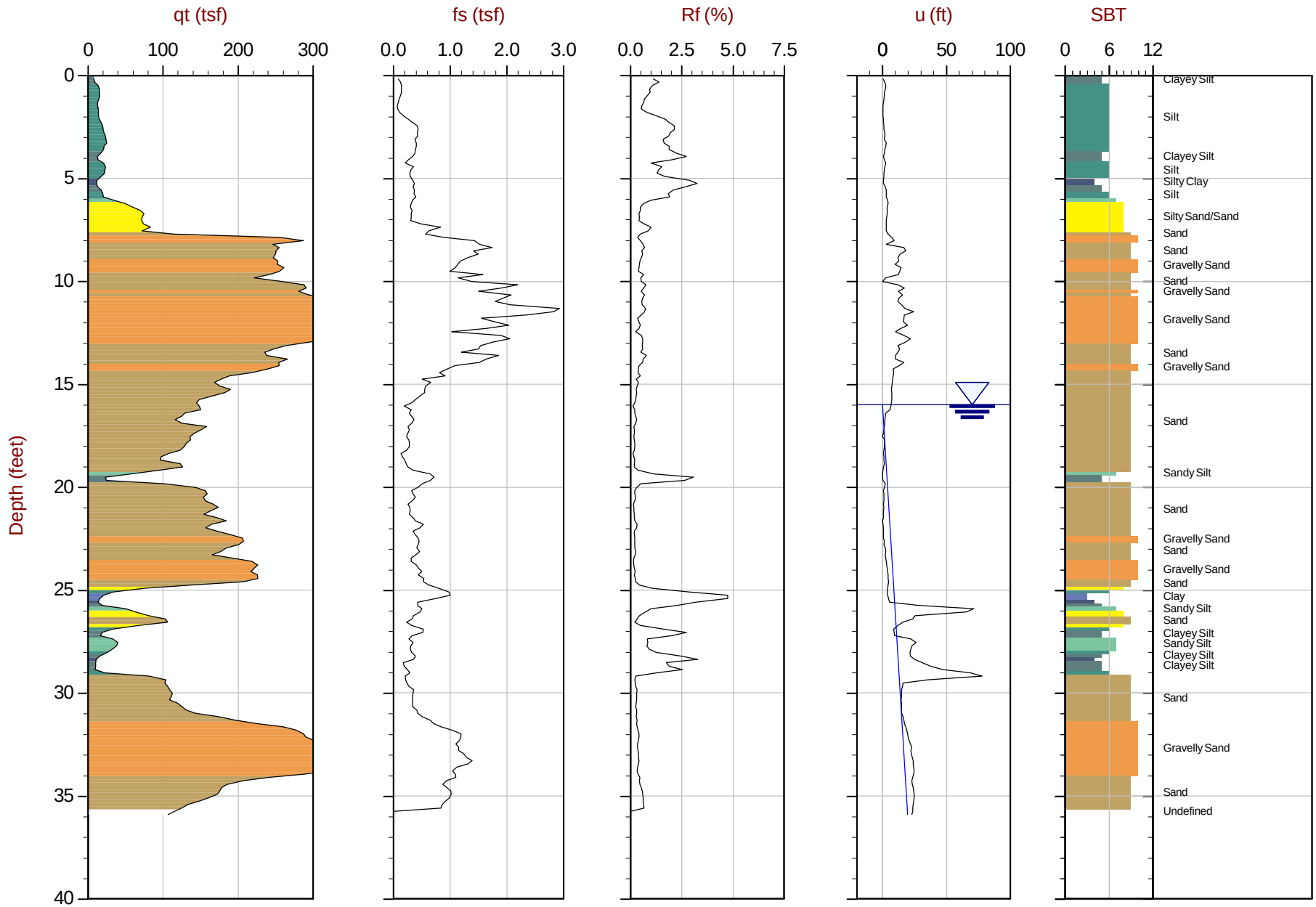
1. Phreatic surface estimated from pore pressure dissipation tests.
2. WGS 1984 Latitude/Longitude. Coordinates taken with handheld GPS and should be considered approximate.
3. Assumes phreatic surface deeper than sounding depth

CONETEC

Stantec

Job No: 15-54076
Date: 09:29:15 09:11
Site: TVA ALF WAP Closure

Sounding: STN-46
Cone: 367:T1500F15U500



Max Depth: 10.950 m / 35.92 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 15-54076_CPSTN-46.COR
Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986
Coords: Lat: 35.07578 Long: -90.15636

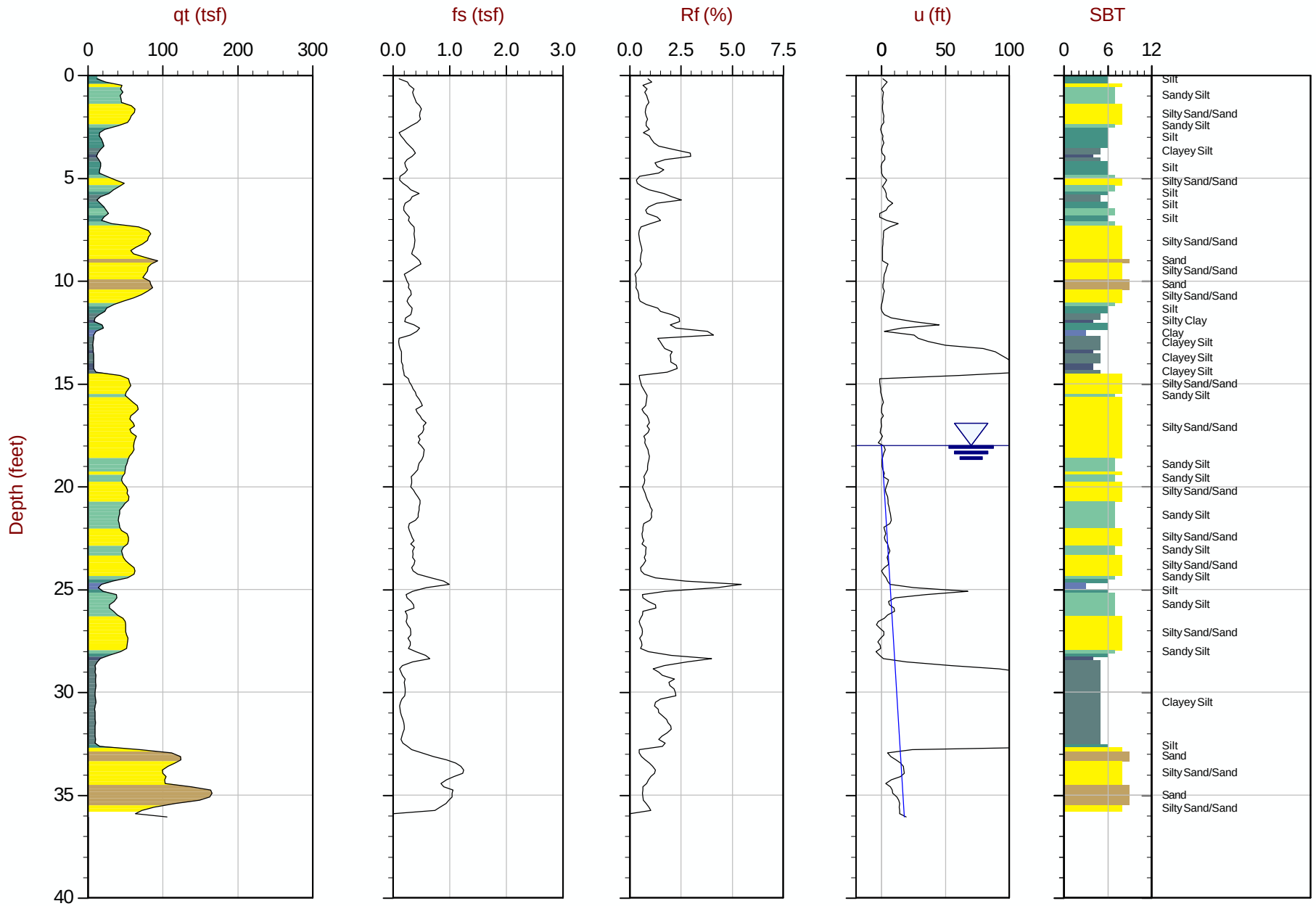
The reported coordinates were acquired from hand-held GPS equipment and are only approximate values. The coordinates should not be used for design purposes.

CONETEC

Stantec

Job No: 15-54076
Date: 09:29:15 10:36
Site: TVA ALF WAP Closure

Sounding: STN-47
Cone: 367:T1500F15U500



Max Depth: 11.000 m / 36.09 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 15-54076_CPSTN-47.COR
Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986
Coords: Lat: 35.07557 Long: -90.15333

TVA CONFIDENTIAL INFORMATION

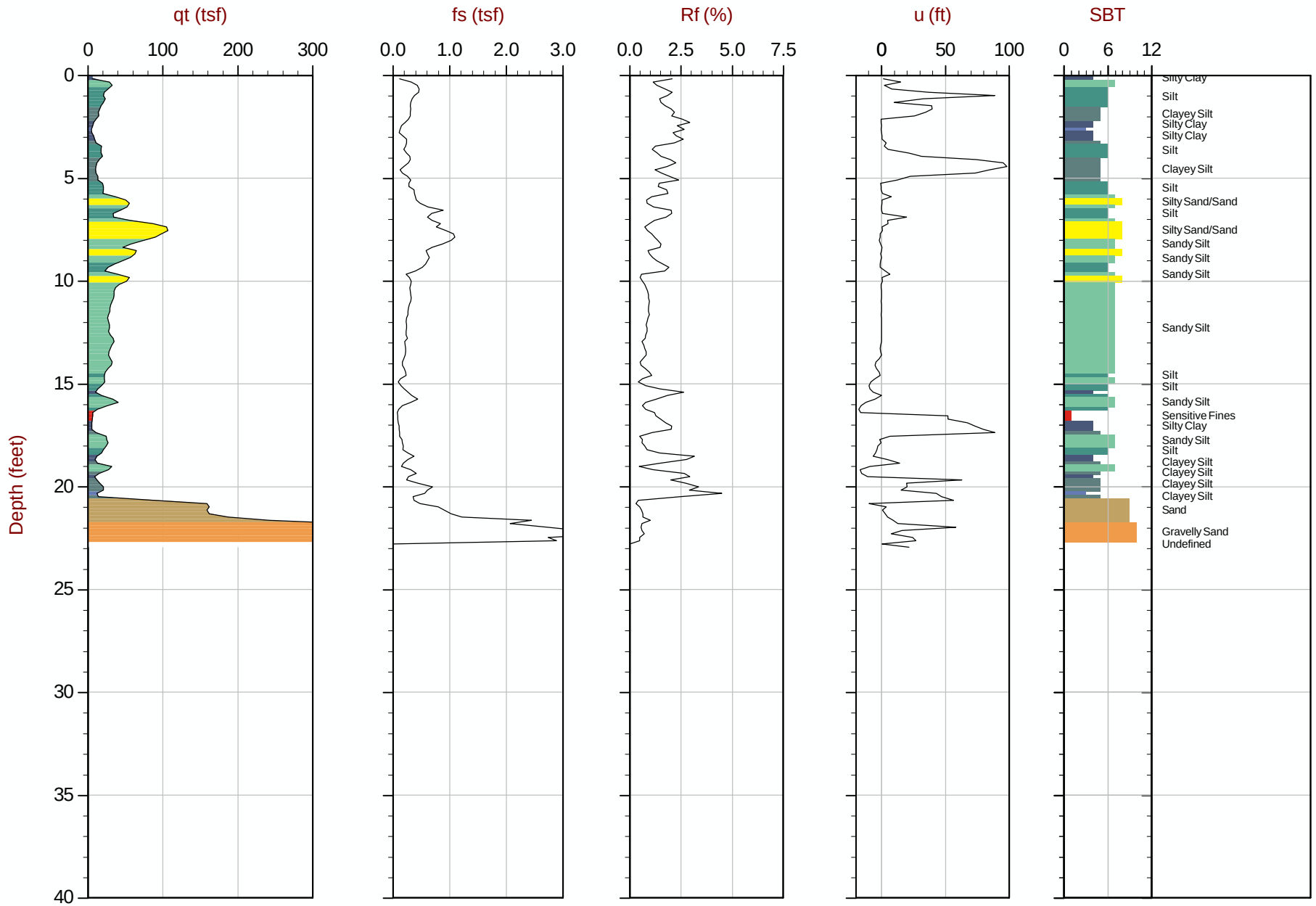
The reported coordinates were acquired from hand-held GPS equipment and are only approximate values. The coordinates should not be used for design purposes.

CONETEC

Stantec

Job No: 15-54076
Date: 09:29:15 13:25
Site: TVA ALF WAP Closure

Sounding: STN-49
Cone: 367:T1500F15U500



Max Depth: 7.000 m / 22.97 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 15-54076_CPSTN-49.COR
Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986
Coords: Lat: 35.07500 Long: -90.15631

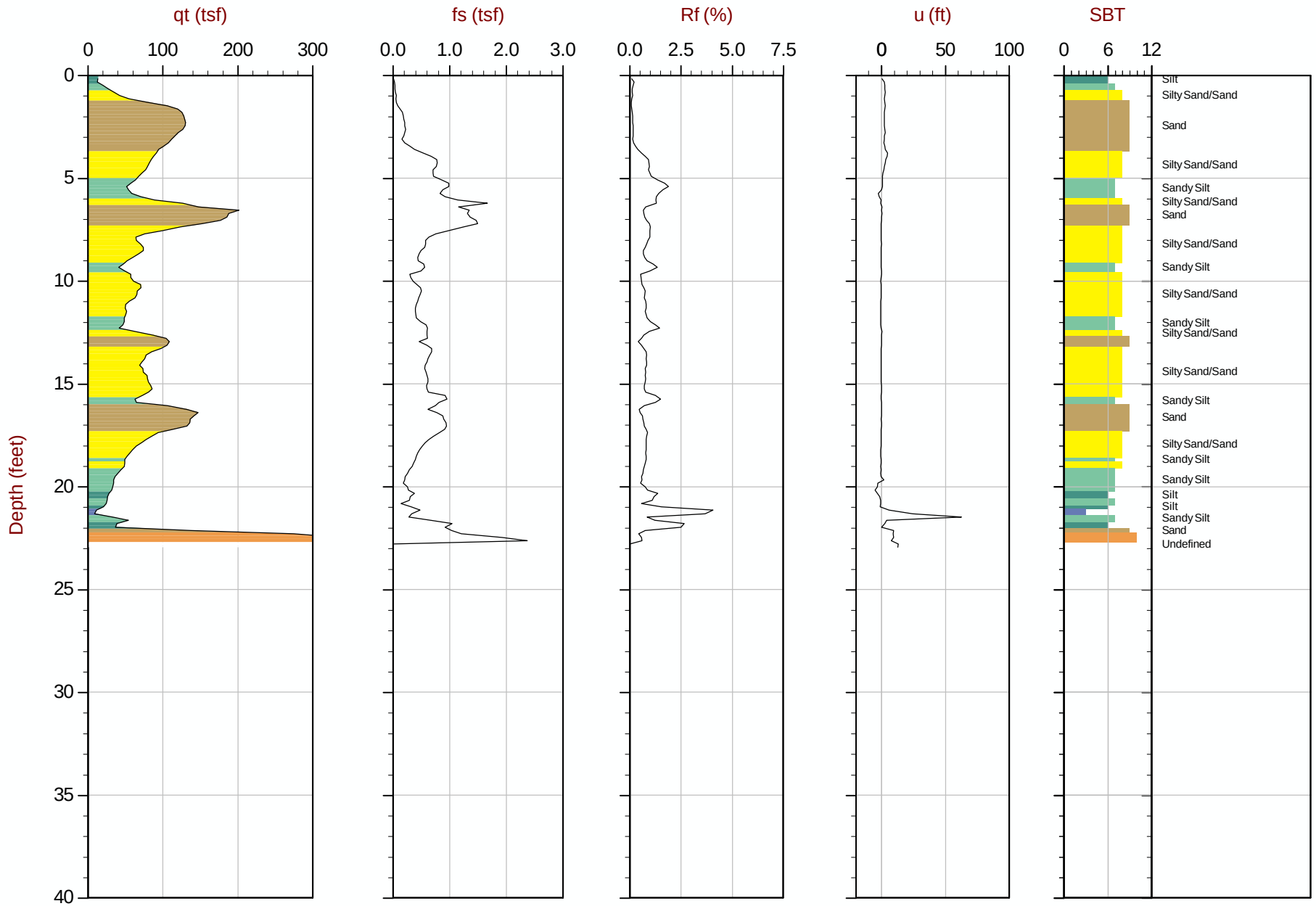
The reported coordinates were acquired from hand-held GPS equipment and are only approximate values. The coordinates should not be used for design purposes.

CONETEC

Stantec

Job No: 15-54076
Date: 09:29:15 12:00
Site: TVA ALF WAP Closure

Sounding: STN-52
Cone: 367:T1500F15U500



Max Depth: 7.000 m / 22.97 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 15-54076_CPSTN-52.COR
Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986
Coords: Lat: 35.07464 Long: -90.15718

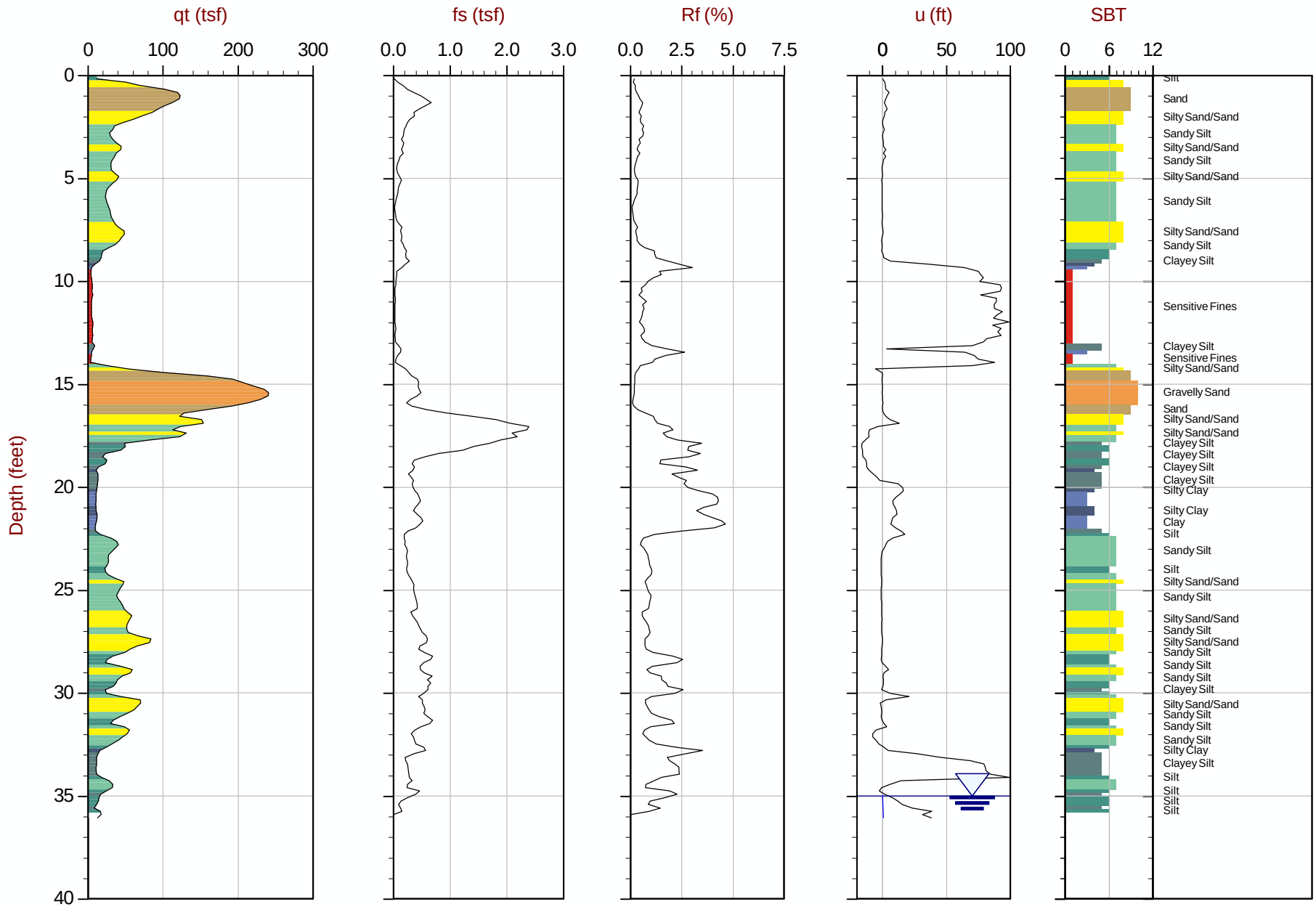
TVA CONFIDENTIAL INFORMATION

CONETEC

Stantec

Job No: 15-54076
Date: 09:30:15 07:47
Site: TVA ALF WAP Closure

Sounding: STN-55
Cone: 367:T1500F15U500



Max Depth: 11.000 m / 36.09 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 15-54076_CPSTN-55.COR
Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986
Coords: Lat: 35.07447 Long: -90.15350

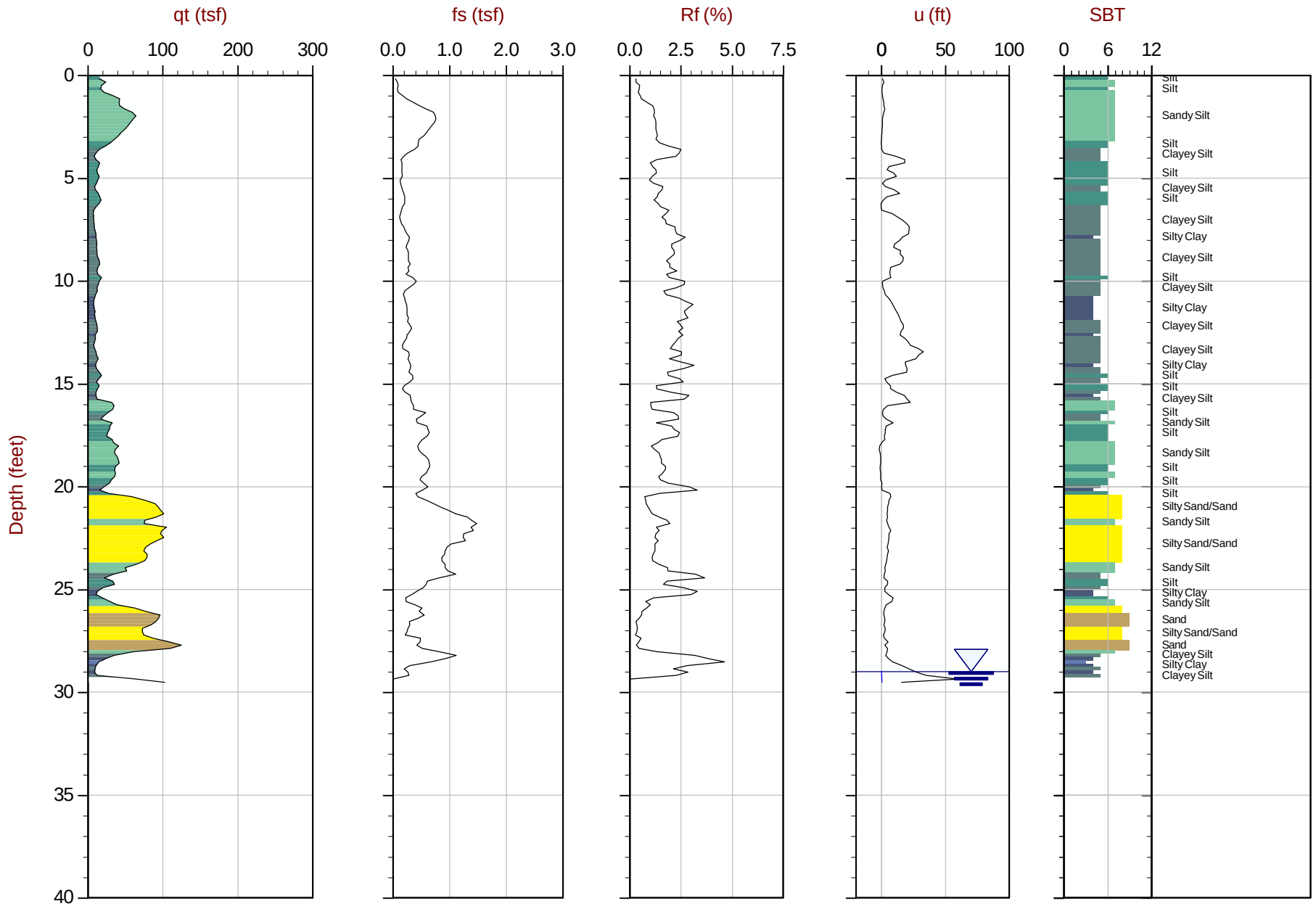
The reported coordinates were acquired from hand-held GPS equipment and are only approximate values. The coordinates should not be used for design purposes.

CONETEC

Stantec

Job No: 15-54076
Date: 09:30:15 11:34
Site: TVA ALF WAP Closure

Sounding: STN-56
Cone: 367:T1500F15U500



Max Depth: 9.000 m / 29.53 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 15-54076_CPSTN-56.COR
Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986
Coords: Lat: 35.07391 Long: -90.15665

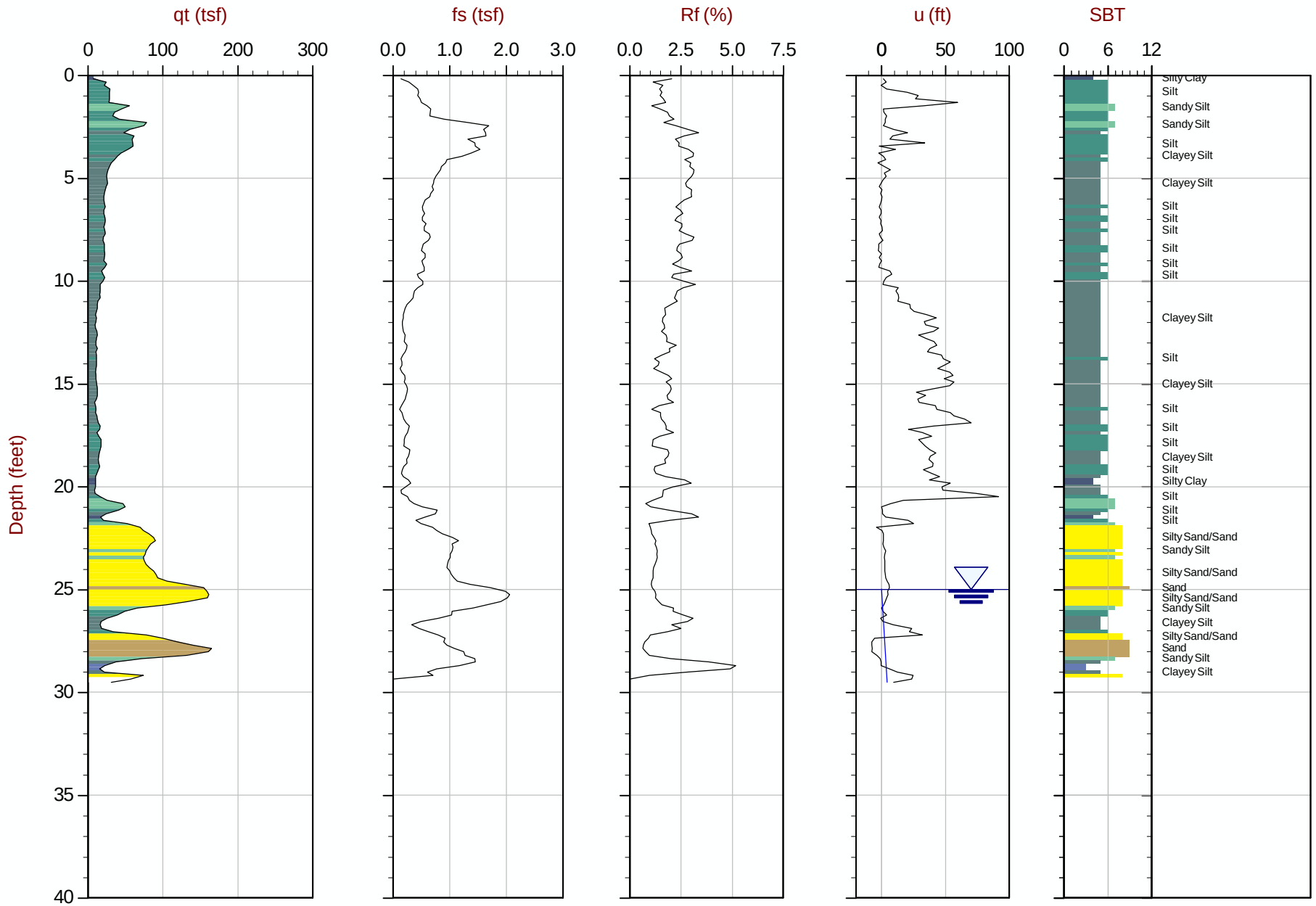
The reported coordinates were acquired from hand-held GPS equipment and are only approximate values. The coordinates should not be used for design purposes.

CONETEC

Stantec

Job No: 15-54076
Date: 09:30:15 10:32
Site: TVA ALF WAP Closure

Sounding: STN-57
Cone: 367:T1500F15U500



Max Depth: 9.000 m / 29.53 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 15-54076_CPSTN-57.COR
Unit Wt: SBT Zones

SBT: Robertson and Campanella, 1986
Coords: Lat: 35.07419 Long: -90.15530

TVA CONFIDENTIAL INFORMATION

The reported coordinates were acquired from hand-held GPS equipment and are only approximate values. The coordinates should not be used for design purposes.

Pore Pressure Dissipation Summary and

Pore Pressure Dissipation Plots

Job No:	15-54076
Client:	Stantec
Project:	TVA Allen- WAP Closure
Start Date:	18-Sep-2015
End Date:	30-Sep-2015

CPTu PORE PRESSURE DISSIPATION SUMMARY

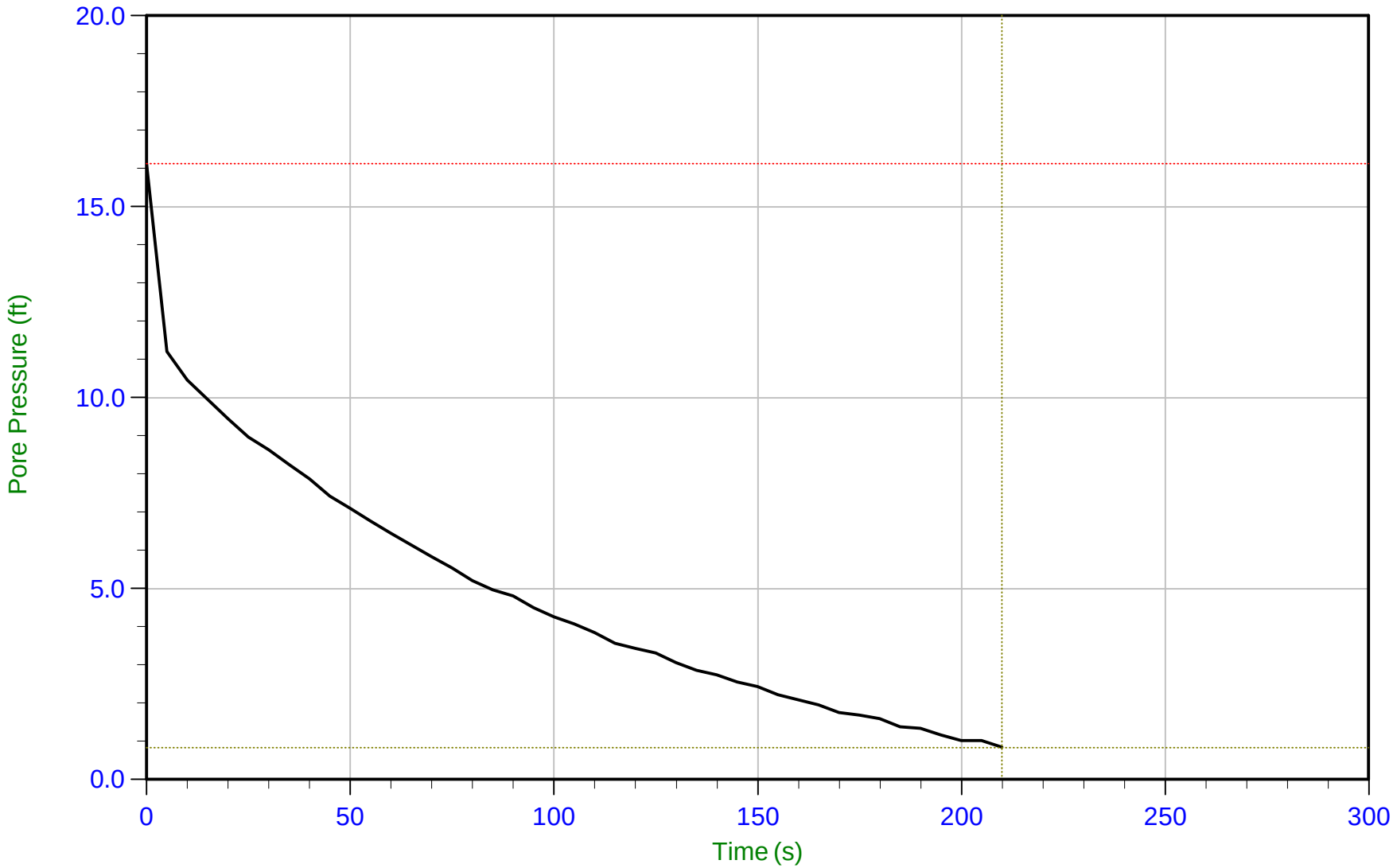
Sounding ID	File Name	Cone Area (cm^2)	Duration (s)	Test Depth (ft)	Estimated Equilibrium Pore Pressure U_{eq} (ft)	Calculated Phreatic Surface (ft)
STN-46	15-54076_CPSTN-46	15	210	9.7		
STN-46	15-54076_CPSTN-46	15	475	29.4	12.9	16
STN-47	15-54076_CPSTN-47	15	330	32.8	15.3	18
STN-49	15-54076_CPSTN-49	15	555	23.0		
STN-52	15-54076_CPSTN-52	15	715	23.0		
STN-55	15-54076_CPSTN-55	15	590	36.1	1.5	35
STN-56	15-54076_CPSTN-56	15	575	29.5	0.6	29
STN-57	15-54076_CPSTN-57	15	365	26.2	1.6	25
Totals			63.6 min			

CONETEC

Stantec

Job No: 15-54076
Date: 09/29/2015 09:11
Site: TVA ALF WAP Closure

Sounding: STN-46
Cone: 367:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-54076_CPSTN-46.PPD
Depth: 2.950 m / 9.678 ft
Duration: 210.0 s

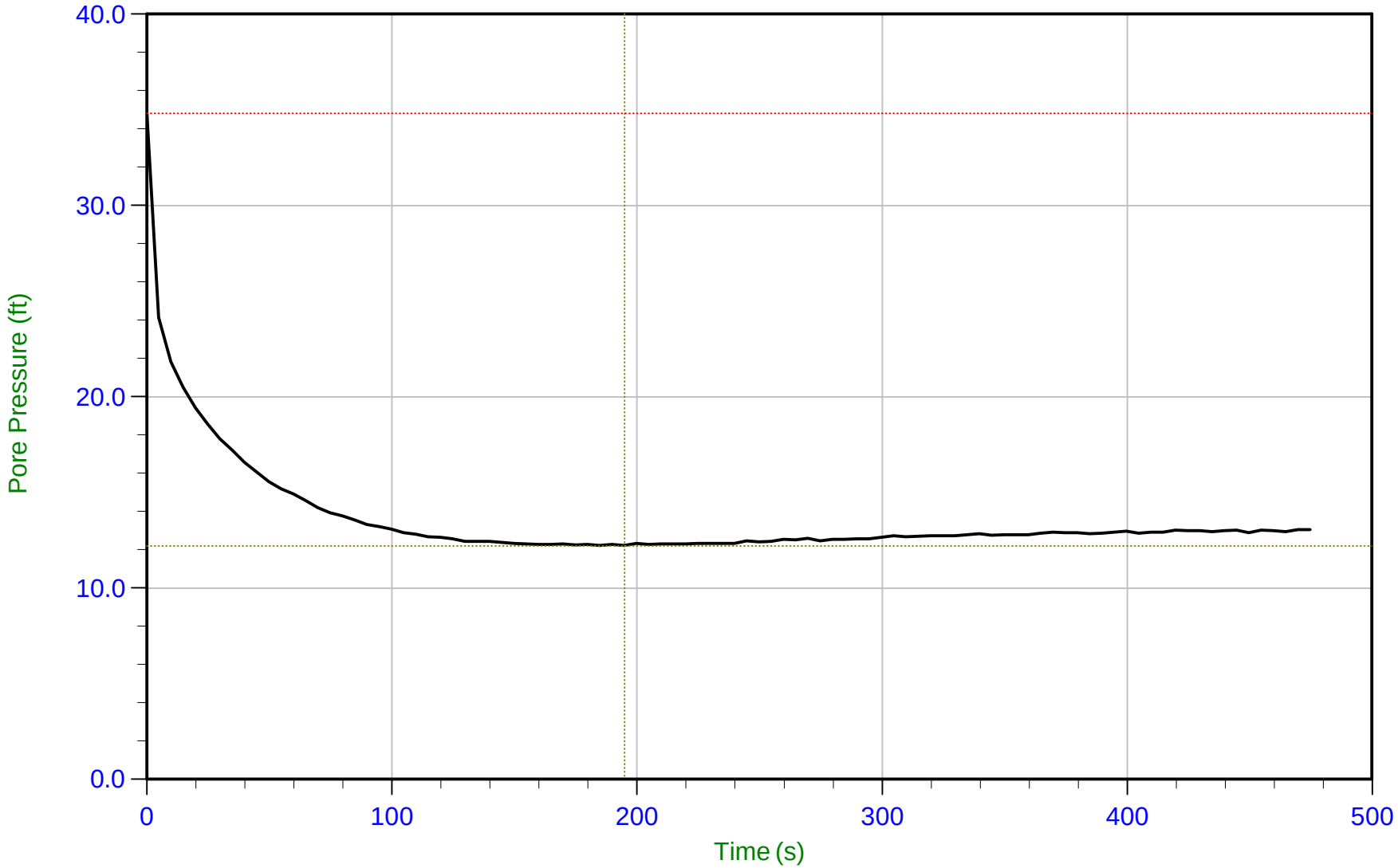
U Min: 0.8 ft
U Max: 16.1 ft

CONETEC

Stantec

Job No: 15-54076
Date: 09/29/2015 09:11
Site: TVA ALF WAP Closure

Sounding: STN-46
Cone: 367:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-54076_CPSTN-46.PPD
Depth: 8.950 m / 29.363 ft
Duration: 475.0 s

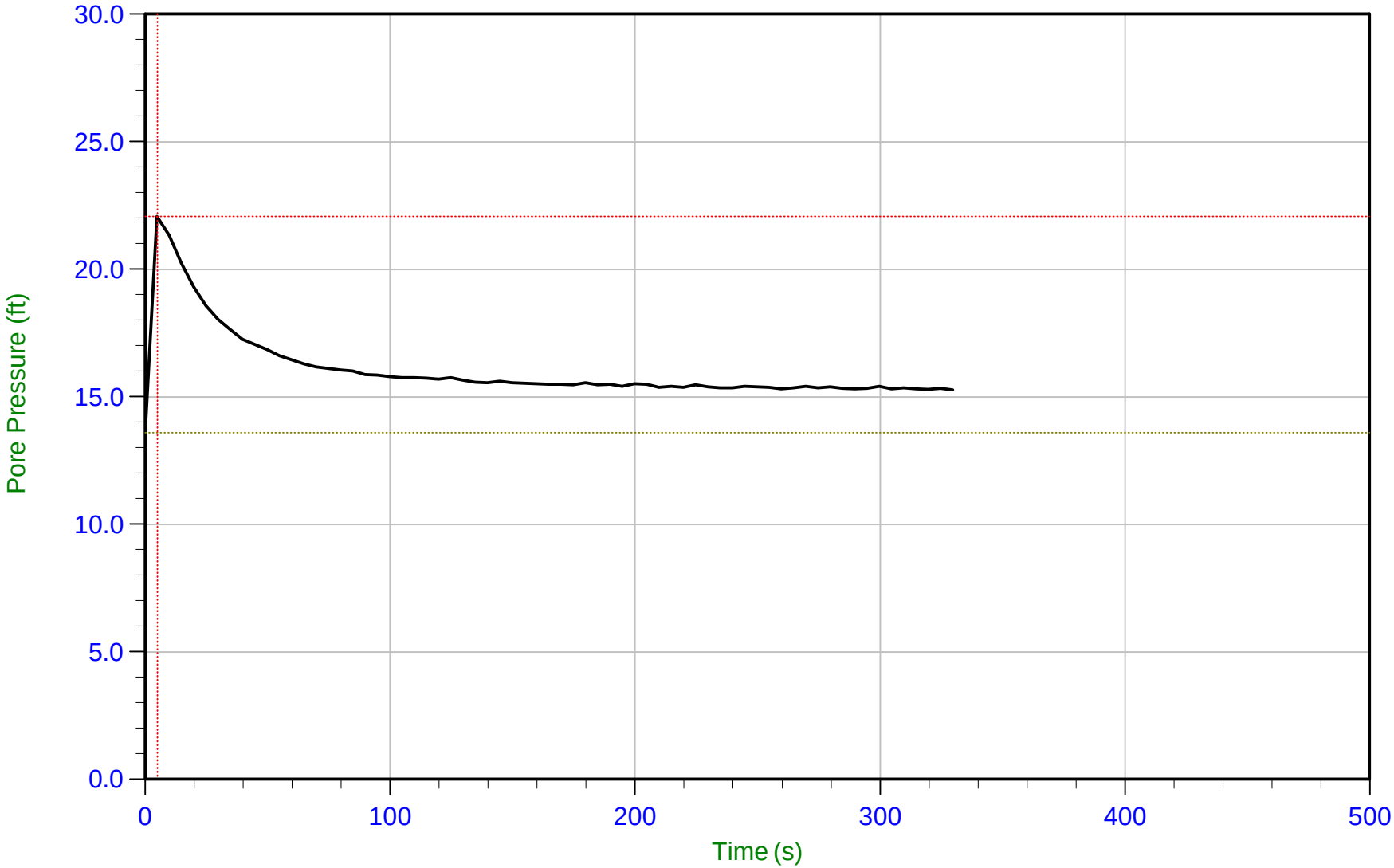
U Min: 12.2 ft
U Max: 34.8 ft

CONETEC

Stantec

Job No: 15-54076
Date: 09/29/2015 10:36
Site: TVA ALF WAP Closure

Sounding: STN-47
Cone: 367:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-54076_CPSTN-47.PPD
Depth: 10.000 m / 32.808 ft
Duration: 330.0 s

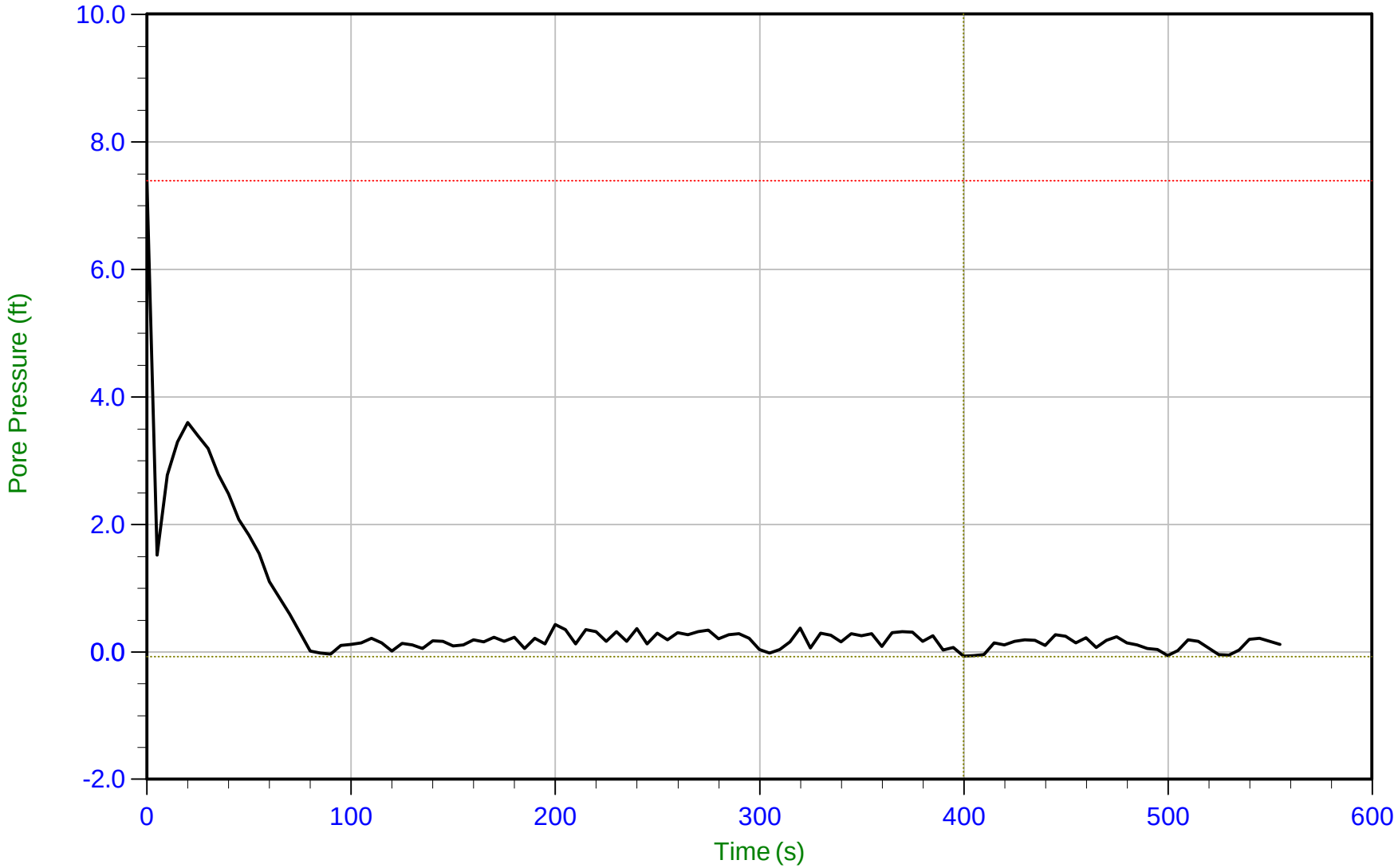
U Min: 13.6 ft
U Max: 22.1 ft

CONETEC

Stantec

Job No: 15-54076
Date: 09/29/2015 13:25
Site: TVA ALF WAP Closure

Sounding: STN-49
Cone: 367:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-54076_CPSTN-49.PPD
Depth: 7.000 m / 22.966 ft
Duration: 555.0 s

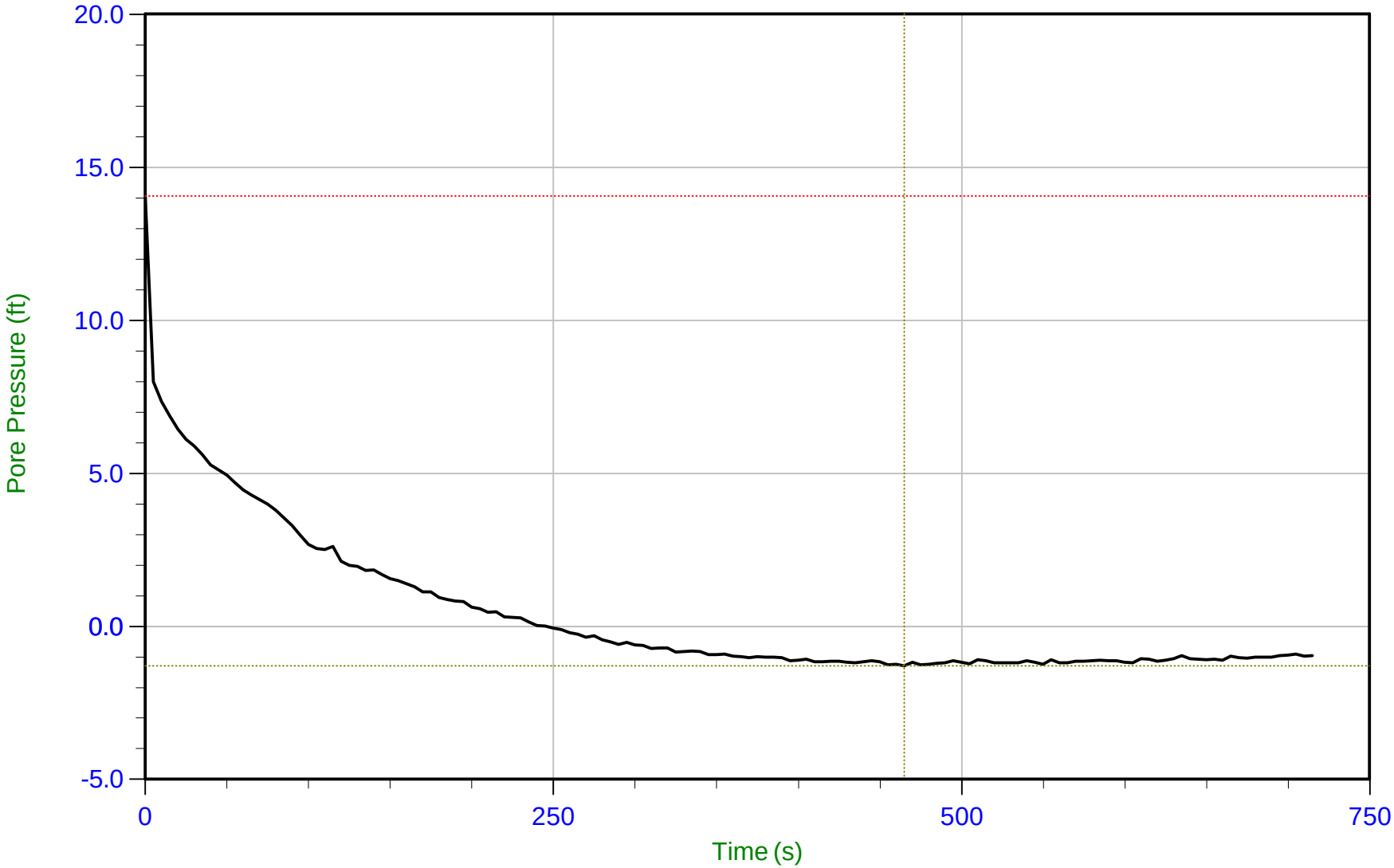
U Min: -0.1 ft
U Max: 7.4 ft

CONETEC

Stantec

Job No: 15-54076
Date: 09/29/2015 12:00
Site: TVA ALF WAP Closure

Sounding: STN-52
Cone: 367:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-54076_CPSTN-52.PPD
Depth: 7.000 m / 22.966 ft
Duration: 715.0 s

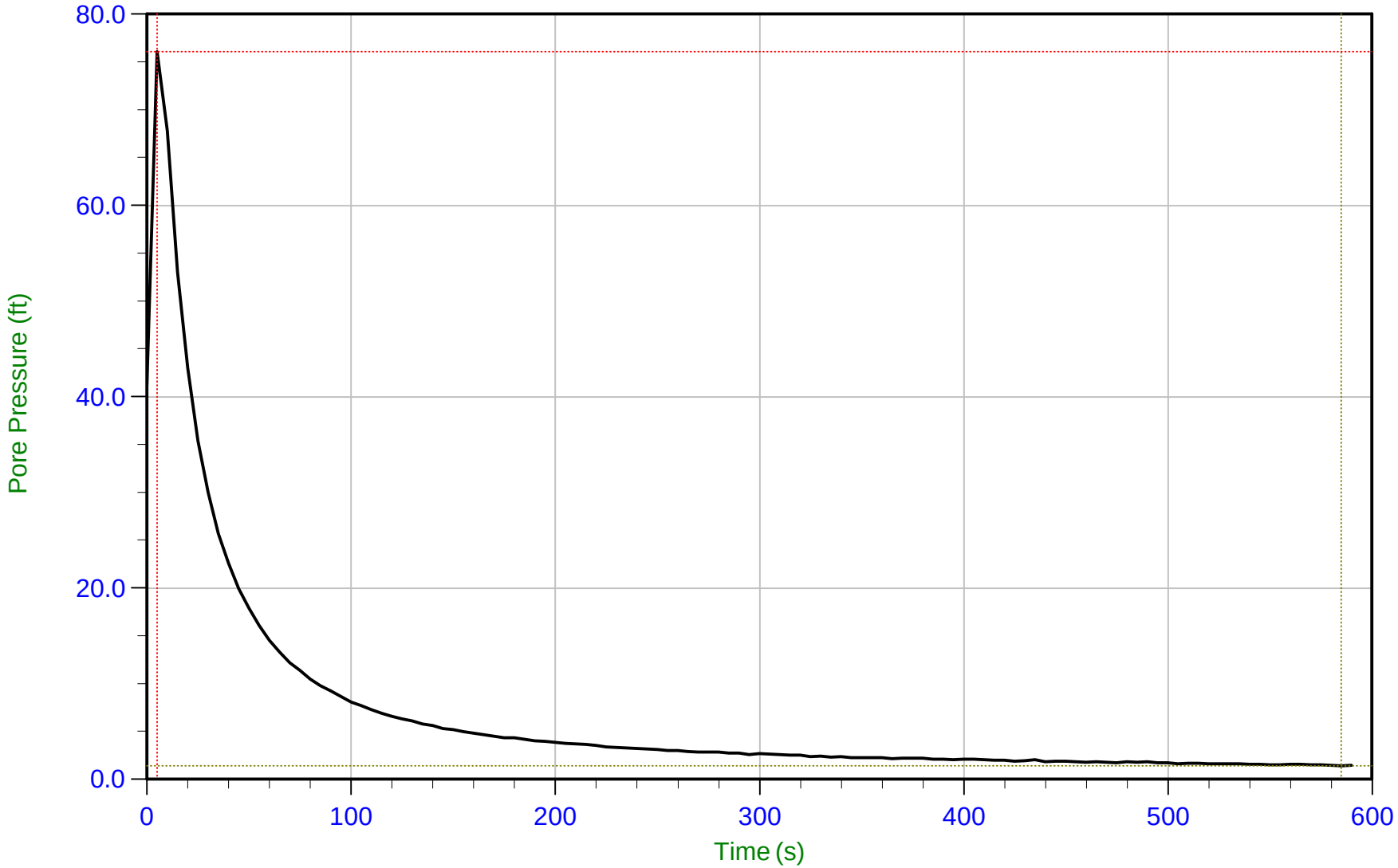
U Min: -1.3 ft
U Max: 14.1 ft

CONETEC

Stantec

Job No: 15-54076
Date: 09/30/2015 07:47
Site: TVA ALF WAP Closure

Sounding: STN-55
Cone: 367:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-54076_CPSTN-55.PPD
Depth: 11.000 m / 36.089 ft
Duration: 590.0 s

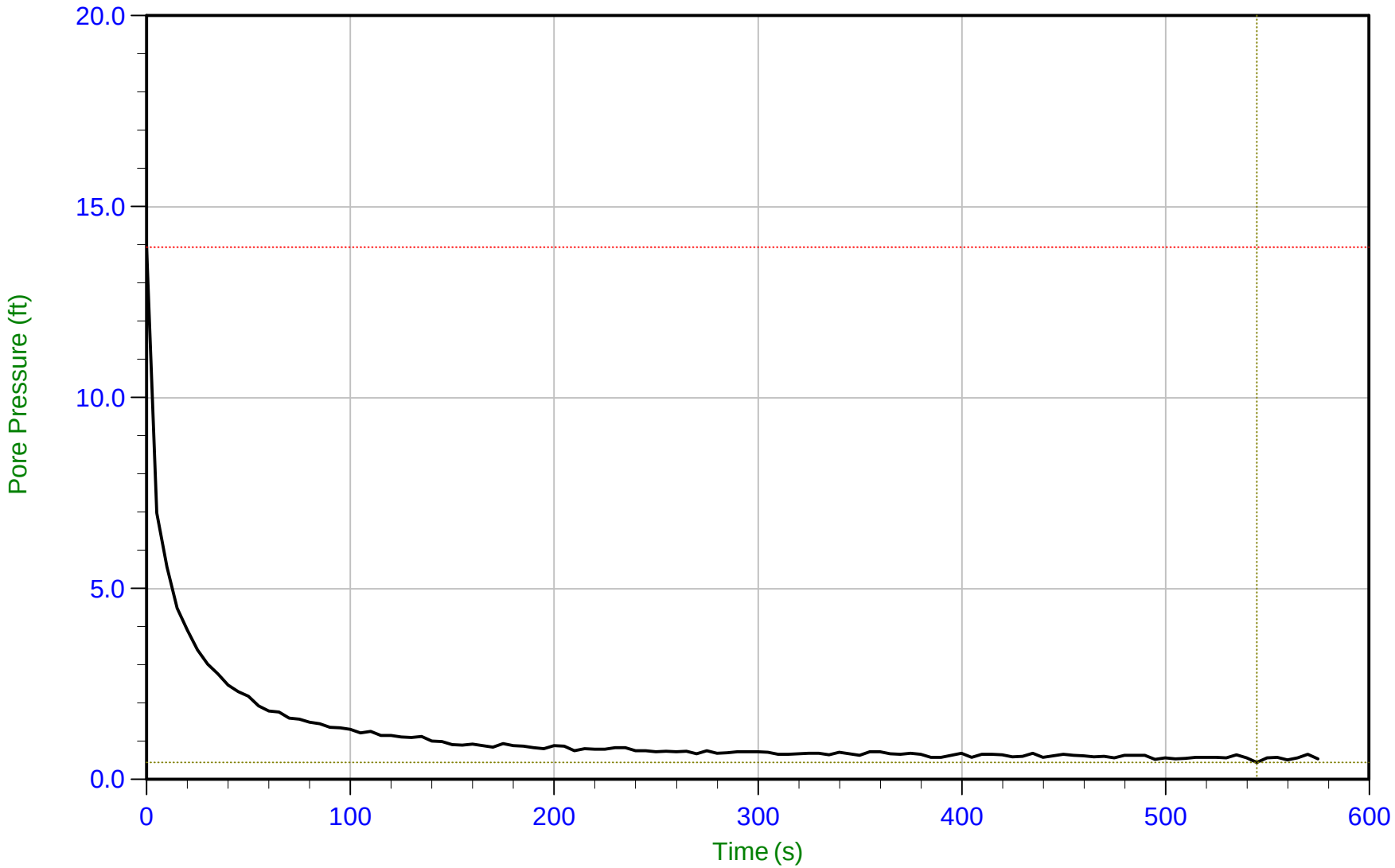
U Min: 1.4 ft
U Max: 76.1 ft

CONETEC

Stantec

Job No: 15-54076
Date: 09/30/2015 11:34
Site: TVA ALF WAP Closure

Sounding: STN-56
Cone: 367:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-54076_CPSTN-56.PPD
Depth: 9.000 m / 29.527 ft
Duration: 575.0 s

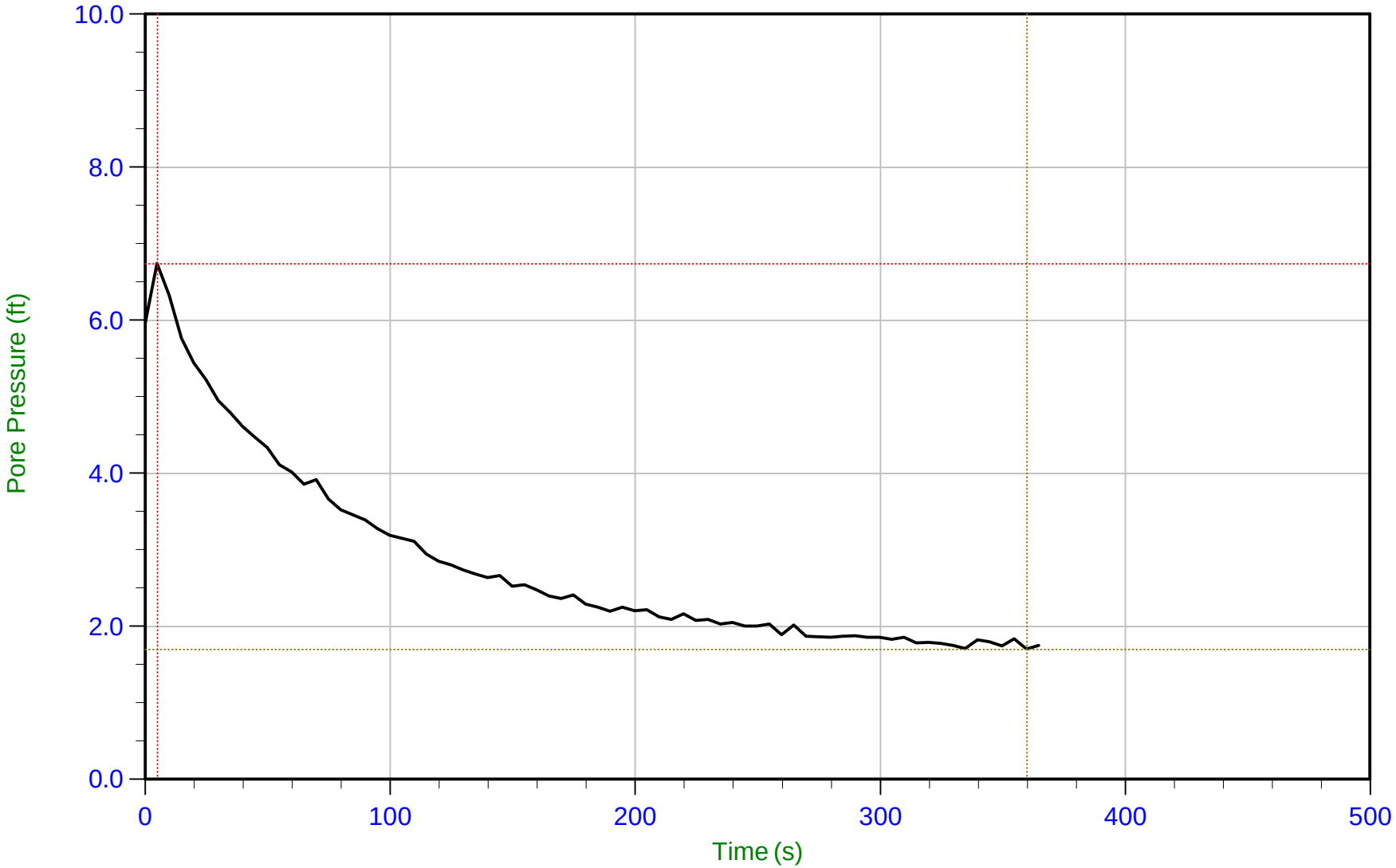
U Min: 0.5 ft
U Max: 14.0 ft

CONETEC

Stantec

Job No: 15-54076
Date: 09/30/2015 10:32
Site: TVA ALF WAP Closure

Sounding: STN-57
Cone: 367:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-54076_CPSTN-57.PPD
Depth: 8.000 m / 26.246 ft
Duration: 365.0 s

U Min: 1.7 ft
U Max: 6.7 ft

Appendix C

Instrumentation

SURVEY CONTROL NOTE:

A GLOBAL POSITIONING SYSTEM (GPS) BASE STATION HAS BEEN ESTABLISHED AND TRANSFORMATION PARAMETERS DETERMINED BY TVA USING SELECTED SURVEY CONTROL MONUMENTS. CONTACT WITH TVA SURVEYING DEPARTMENT (423)751-8416 OR (423)751-2571 SHALL BE MADE BEFORE ANY SURVEY OR CONSTRUCTION WORK IS COMMENCED. BASE STATION FREQUENCIES AND TRANSFORMATION PARAMETERS WILL BE PROVIDED TO THE CONTRACTOR FOR USE IN CONSTRUCTION ACTIVITIES AT THE SITE. PREVIOUSLY USED OR ESTABLISHED CONTROL POINTS AND MONUMENTS SHALL NOT BE USED BY THE CONTRACTOR WITHOUT PRIOR APPROVAL BY TVA SURVEYING DEPARTMENT.

NOTES:

1. THE TOPOGRAPHIC MAPPING PRESENTED ON THIS DRAWING WAS PROVIDED TO STANTEC BY TVA SURVEYING AND PROJECT SERVICES. THIS PLAN VIEW WAS PREPARED TO SUPPORT DEVELOPMENT OF THE GEOTECHNICAL EXPLORATION PROGRAM AND SHOULD NOT BE USED FOR CONSTRUCTION.

2. THE GEOTECHNICAL INFORMATION AND DATA FURNISHED HEREIN ARE NOT INTENDED AS REPRESENTATION OR WARRANTIES BUT ARE FURNISHED FOR INFORMATION ONLY. IT SHALL BE DISTINCTLY UNDERSTOOD THAT THE OWNER OR ENGINEER WILL NOT BE RESPONSIBLE FOR ANY DEDUCTION, INTERPRETATION OR CONCLUSION DRAWN THEREFROM. THE INFORMATION IS MADE AVAILABLE IN ORDER THAT THE CONTRACTOR MAY HAVE READY ACCESS TO THE SAME INFORMATION AVAILABLE TO THE OWNER AND THE ENGINEER AND IS NOT PART OF THIS CONTRACT.

INSTRUMENT LOCATION TABLE

INSTRUMENT	NORTHING	EASTING	ELEVATION (FEET)
STN-30	275,111.62	756,317.48	228.2
STN-33	275,119.53	756,661.46	228.2
STN-36	275,070.03	757,553.53	227.8

LEGEND

PIEZOMETER

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

PLOT DATE: 12/10/2015

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R –	–	–	–	–	–	–	–	–	–	–	–
R A (ISSUED FOR REVIEW)	–	–	–	–	–	–	MST	JCK	–	–	–

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1"=50' EXCEPT AS NOTED

YARD
WEST ASH POND

CLOSURE PLANS
GEOTECHNICAL EXPLORATION
INSTRUMENTATION LAYOUT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
–	–	–	–	–	M.S. TURNBOW	J.C. KAMMEYER

Stantec
601 Grassmere Park Road, Suite 22
Nashville, Tennessee 37211
www.stantec.com

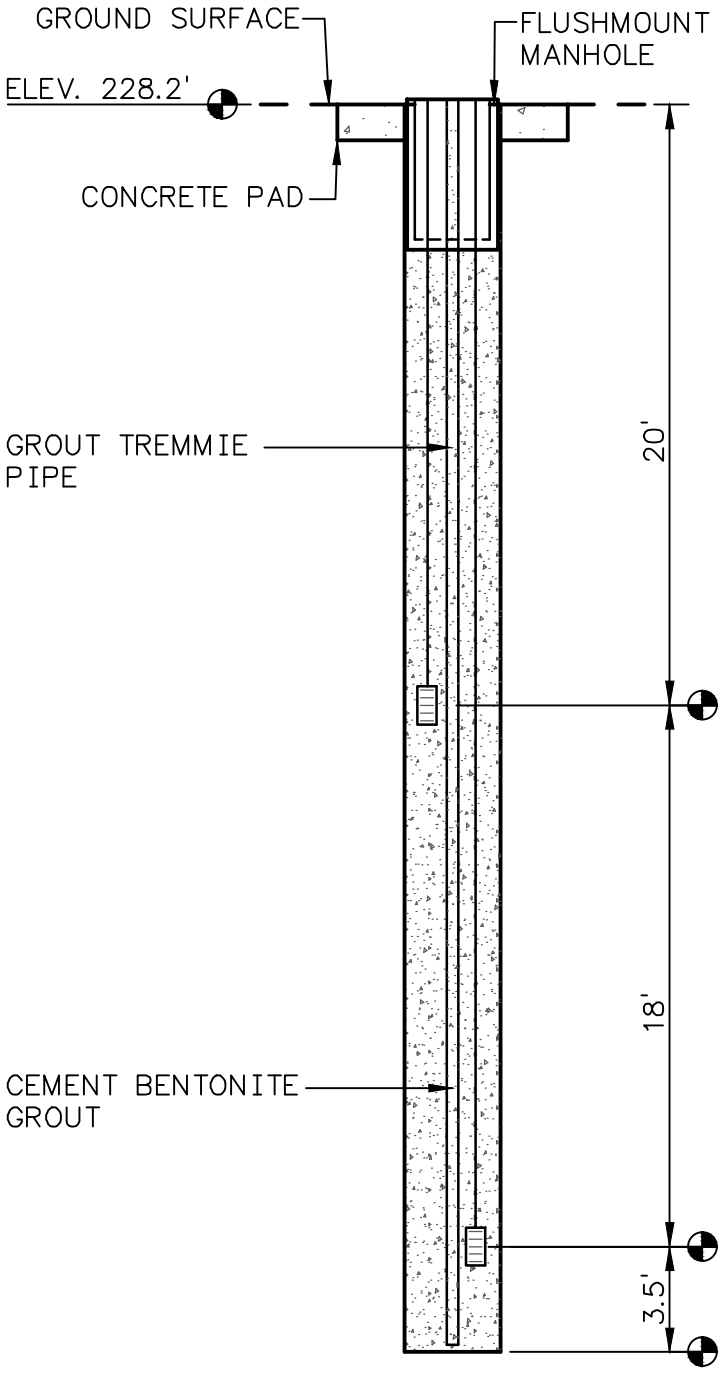
ALLEN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2010	DATE –	38	C	10WXXX-XX	R A

STANTEC	A
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



NOTES:

1. INSTALLED ON 09/29/2015. BORING ADVANCED WITH 4.25" (I.D.) HOLLOW STEM AUGERS.
2. REFER TO BORING LOG FOR OVERBURDEN STRATIGRAPHY.

LOCATION:

NORTHING: 275,111.62
EASTING: 756,317.48

LOCATIONS PROVIDED BY BUCHANAN LAND SURVEYING.
HORIZONTAL DATUM: NAD 27
VERTICAL DATUM: NGVD29

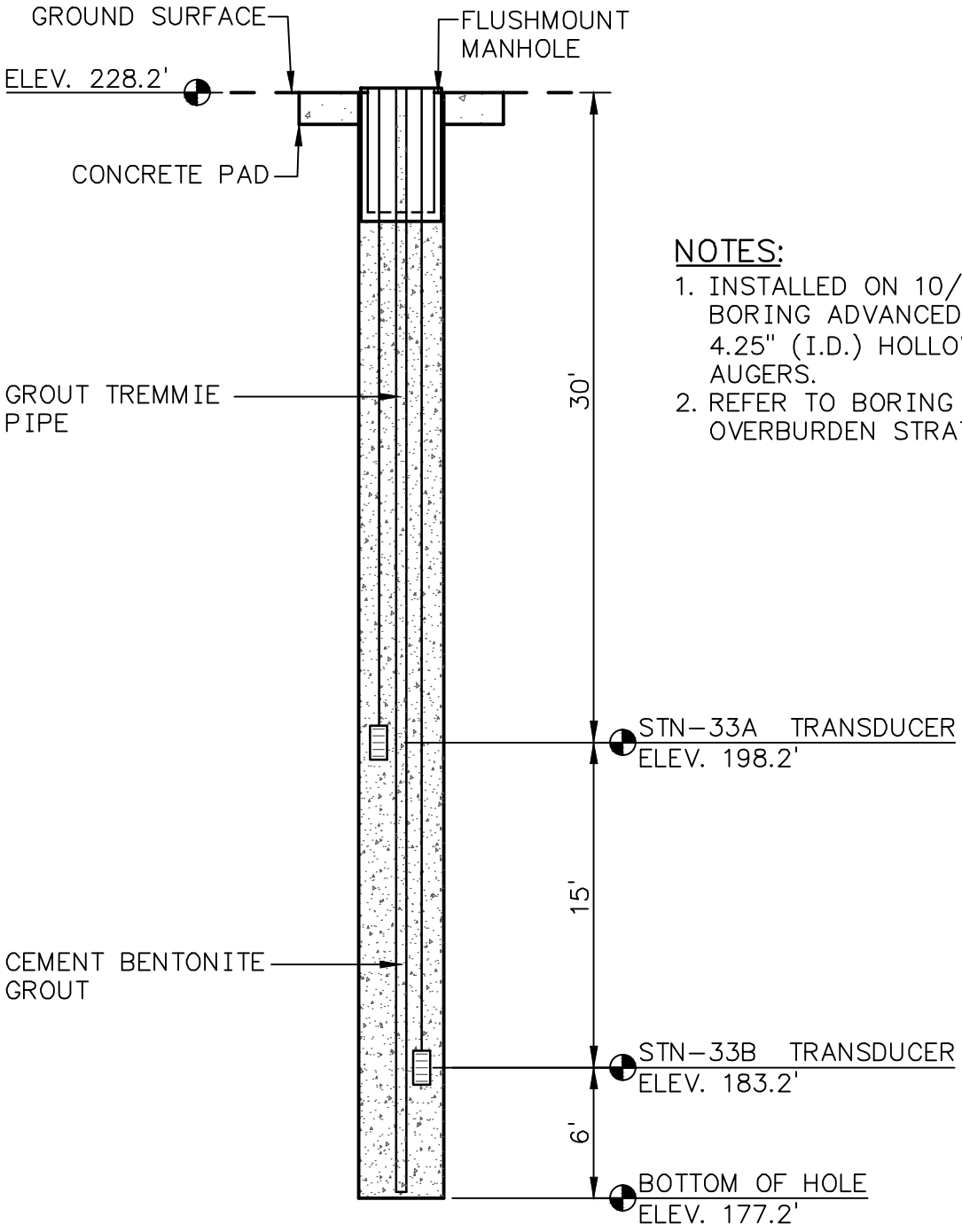
VIBRATING WIRE PIEZOMETER STN-30
ALLEN FOSSIL PLANT
MEMPHIS, TENNESSEE

Stantec
601 Grassmere Park Road, Suite 22
Nashville, Tennessee 37211
www.stantec.com

DRAWN BY	PS	DATE	11/20/2015
CHECKED BY	TG	PROJ. NO.	172675015
CHECKED BY	PJ	SCALE	NTS

REVISED				SHEET
1.	—	3.	—	1 OF 1
2.	—	4.	—	

PLOT DATE: 12/10/2015 USER: CLINKENBEARD, ADAM
U:\172675015\GEOTECHNICAL\DRAWING\SHEET_FILES\INSTRUMENT\STN-30.DWG



NOTES:

1. INSTALLED ON 10/06/2015. BORING ADVANCED WITH 4.25" (I.D.) HOLLOW STEM AUGERS.
2. REFER TO BORING LOG FOR OVERBURDEN STRATIGRAPHY.

LOCATION:

NORTHING: 275,119.53
EASTING: 756,661.46

LOCATIONS PROVIDED BY BUCHANAN LAND SURVEYING.
HORIZONTAL DATUM: NAD 27
VERTICAL DATUM: NGVD29

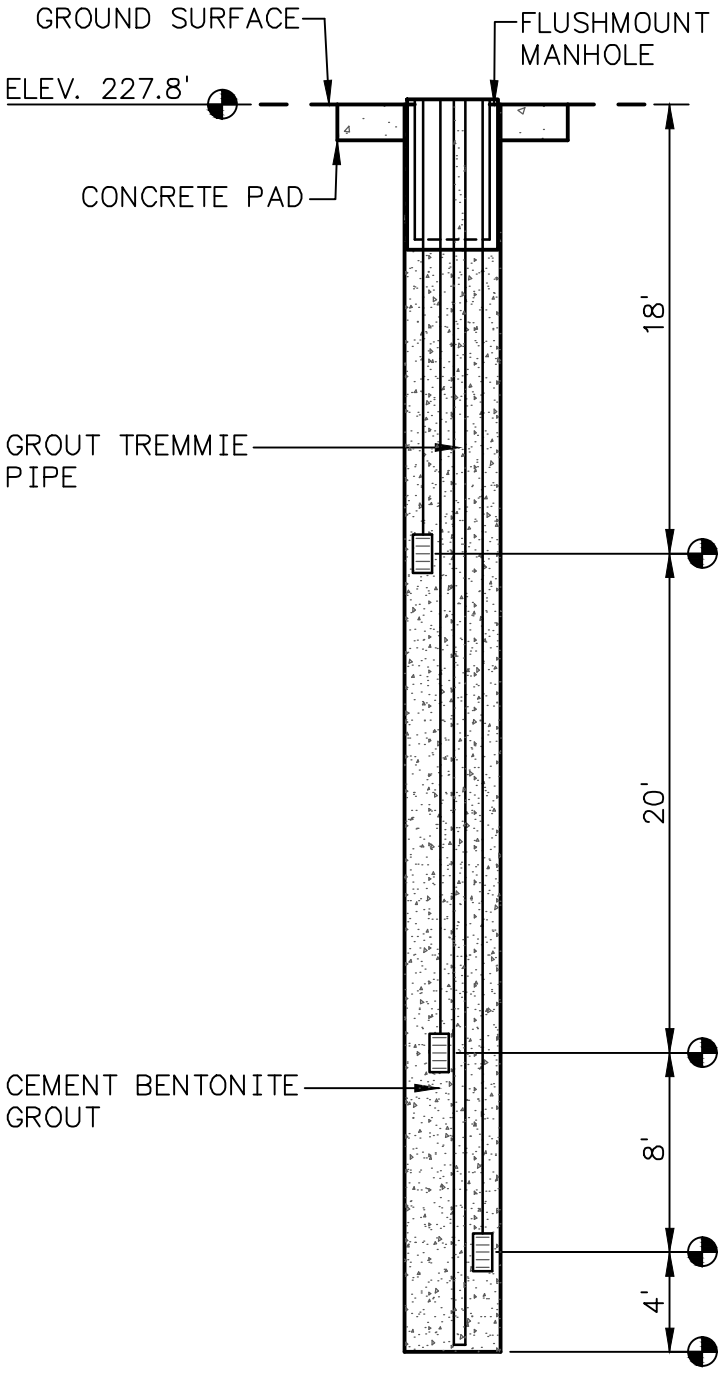
VIBRATING WIRE PIEZOMETER STN-33
ALLEN FOSSIL PLANT
MEMPHIS, TENNESSEE

Stantec
601 Grassmere Park Road, Suite 22
Nashville, Tennessee 37211
www.stantec.com

DRAWN BY	PS	DATE	11/20/2015
CHECKED BY	TG	PROJ. NO.	172675015
CHECKED BY	PJ	SCALE	NTS

REVISED				SHEET
1.	—	3.	—	1 OF 1
2.	—	4.	—	

PLOT DATE: 11/18/2015 USER: CLINKENBEARD, ADAM
U:\172675015\GEOTECHNICAL\DRAWING\SHEET_FILES\INSTRUMENT\STN-33.DWG



NOTES:

1. INSTALLED ON 10/07/2015. BORING ADVANCED WITH 4.25" (I.D.) HOLLOW STEM AUGERS.
2. REFER TO BORING LOG FOR OVERBURDEN STRATIGRAPHY.

LOCATION:

NORTHING: 275,070.03
EASTING: 757,553.53

LOCATIONS PROVIDED BY BUCHANAN LAND SURVEYING.
HORIZONTAL DATUM: NAD 27
VERTICAL DATUM: NGVD29

VIBRATING WIRE PIEZOMETER STN-36
ALLEN FOSSIL PLANT
MEMPHIS, TENNESSEE

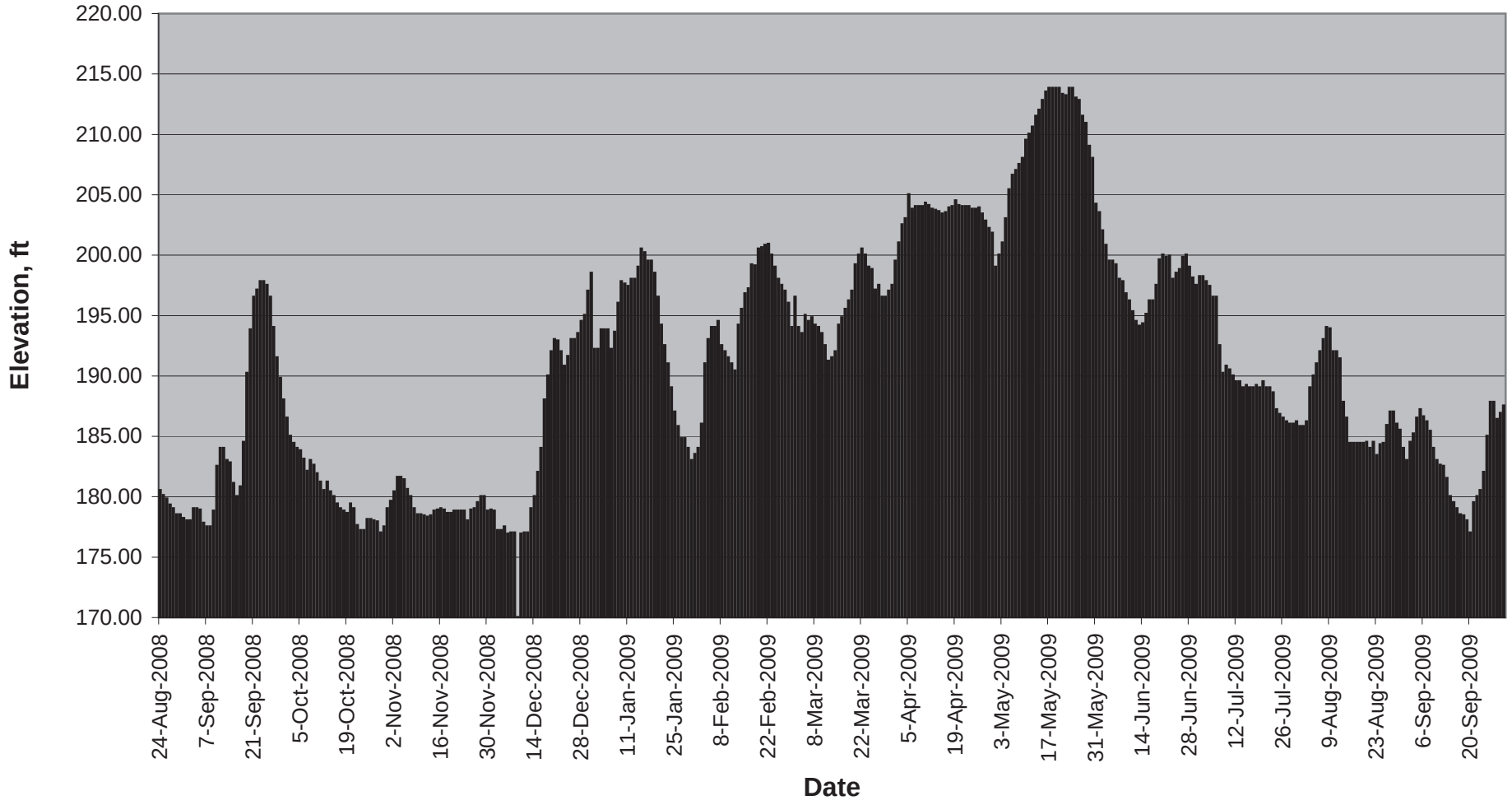
Stantec
601 Grassmere Park Road, Suite 22
Nashville, Tennessee 37211
www.stantec.com

DRAWN BY	PS	DATE	11/20/2015
CHECKED BY	TG	PROJ. NO.	172675015
CHECKED BY	PJ	SCALE	NTS

REVISED				SHEET
1.	—	3.	—	1 OF 1
2.	—	4.	—	

PLOT DATE: 11/18/2015 USER: CLINKENBEARD, ADAM
U:\172675015\GEOTECHNICAL\DRAWING\SHEET_FILES\INSTRUMENT\STN-36.DWG

McKellar Lake Water Elevation
At Ensley Engineer Yard Gauge MS 129
Source: US Army Corps of Engineers



Appendix D

Laboratory Testing Data

Appendix D.1

Natural Moisture Content Testing Results

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name ALF - West Ash Pond Complex Final Closure

Project Number 172675015

Tested By NW/AW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
STN-29, 0.0'-1.5'	1	11/3/15	Hom	3/4"			No	17.25	71.44	68.28	6.2
STN-29, 1.5'-3.0'	2	11/3/15	Hom	No. 10			Yes	20.00	82.74	72.14	20.3
STN-29, 3.0'-4.5'	3	11/3/15	Hom	No. 10			Yes	17.28	73.81	62.91	23.9
STN-29, 4.5'-6.0'	4	11/3/15	Hom	No. 10			Yes	20.66	85.60	77.64	14.0
STN-29, 6.0'-7.5'	5	11/3/15	Hom	No. 10			Yes	20.75	95.38	80.54	24.8
STN-29, 7.5'-9.0'	6	11/3/15	Hom	No. 10			Yes	20.74	91.03	75.76	27.8
STN-29, 9.0'-10.5'	7	11/3/15	Hom	No. 10			Yes	17.29	85.63	81.21	6.9
STN-29, 10.5'-12.0'	8	11/3/15	Hom	3/4"			No	22.17	86.58	84.05	4.1
STN-29, 12.0'-13.5'	9	11/3/15	Hom	No. 10			Yes	21.58	80.15	78.28	3.3
STN-29, 13.5'-15.0'	10	11/3/15	Hom	No. 10			Yes	21.55	71.42	70.08	2.8
STN-29, 15.0'-16.5'	11	11/3/15	Dist	No. 10			Yes	21.52	114.73	112.64	2.3
STN-29, 16.5'-18.0'	12	11/3/15	Dist	No. 10			Yes	21.23	116.19	114.00	2.4
STN-29, 18.0'-19.5'	13	11/3/15	Dist	No. 4			Yes	21.07	170.27	166.16	2.8
STN-29, 19.5'-21.0'	14	11/3/15	Dist	No. 4			Yes	20.74	127.93	124.33	3.5
STN-30, 0.0'-1.5'	15	11/3/15	Hom	3/4"			No	20.70	78.22	75.66	4.7
STN-30, 1.5'-3.0'	16	11/3/15	Hom	No. 10			Yes	17.22	83.80	78.99	7.8
STN-30, 3.0'-4.5'	17	11/3/15	Hom	No. 10			Yes	17.39	85.99	79.69	10.1
STN-30, 4.5'-6.0'	18	11/3/15	Hom	No. 10			Yes	17.28	82.62	75.85	11.6
STN-30, 6.0'-7.5'	19	11/3/15	Hom	No. 10			Yes	22.11	91.76	85.54	9.8
STN-30, 7.5'-9.0'	20	11/3/15	Hom	No. 10			Yes	21.87	107.77	98.99	11.4
STN-30, 9.0'-10.5'	21	11/3/15	Hom	No. 10			Yes	20.64	84.87	77.52	12.9
STN-30, 10.5'-12.0'	22	11/3/15	Hom	No. 10			Yes	19.80	94.02	85.07	13.7
STN-30, 12.0'-13.5'	23	11/3/15	Hom	No. 10			Yes	21.97	92.79	87.23	8.5
STN-30, 13.5'-15.0'	24	11/3/15	Hom	No. 10			Yes	17.23	84.90	77.82	11.7
STN-30, 15.0'-16.5'	25	11/3/15	Hom	No. 10			Yes	17.31	82.87	73.43	16.8
STN-30, 18.5'-20.0'	27	11/3/15	Hom	No. 10			Yes	21.60	100.22	81.53	31.2
STN-30, 22.0'-23.5'	29	11/3/15	Hom	No. 10			Yes	21.94	92.14	90.46	2.5
STN-30, 23.5'-25.0'	30	11/3/15	Hom	No. 10			Yes	17.34	100.51	94.60	7.6

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name ALF - West Ash Pond Complex Final Closure

Project Number 172675015

Tested By NW/AW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
STN-30, 25.0'-26.5'	31	11/3/15	Hom	3/8"			No	20.28	88.19	86.17	3.1
STN-30, 26.5'-28.0'	32	11/3/15	Hom	No. 10			Yes	17.30	86.09	84.49	2.4
STN-30, 28.0'-29.5'	33	11/3/15	Hom	3/8"			No	17.20	85.78	84.11	2.5
STN-30, 29.5'-31.0'	34	11/3/15	Hom	No. 10			Yes	21.64	88.66	86.81	2.8
STN-30, 31.0'-32.5'	35	11/3/15	Hom	No. 10			Yes	17.27	92.02	89.85	3.0
STN-30, 32.5'-34.0'	36	11/3/15	Hom	No. 10			Yes	17.26	98.45	96.00	3.1
STN-30, 34.0'-35.5'	37	11/3/15	Hom	No. 10			Yes	22.10	89.79	87.12	4.1
STN-30, 35.5'-37.0'	38	11/3/15	Hom	No. 10			Yes	21.05	85.52	83.54	3.2
STN-30, 37.0'-38.5'	39	11/3/15	Dist	No. 10			Yes	20.25	91.03	85.02	9.3
STN-30, 38.5'-40.0'	40	11/3/15	Hom	3/8"			No	17.20	99.03	96.55	3.1
STN-30, 40.0'-41.5'	41	11/3/15	Hom	3/8"			No	17.31	102.45	100.11	2.8
STN-31, 0.0'-1.5'	42	11/3/15	Dist	3/8"			No	16.37	89.74	84.27	8.1
STN-31, 1.5'-3.0'	43	11/3/15	Dist	3/8"			No	21.17	82.71	73.35	17.9
STN-31, 3.0'-4.5'	44	11/3/15	Hom	3/8"			No	17.26	87.69	77.99	16.0
STN-31, 4.5'-6.0'	45	11/3/15	Hom	No. 4			No	17.21	94.59	77.77	27.8
STN-31, 6.0'-7.5'	46	11/3/15	Hom	No. 4			No	21.12	97.74	85.07	19.8
STN-31, 7.5'-9.0'	47	11/3/15	Hom	No. 10			Yes	20.68	88.34	86.75	2.4
STN-31, 9.0'-10.5'	48	11/3/15	Hom	No. 4			No	20.49	98.47	96.74	2.3
STN-31, 10.5'-12.0'	49	11/3/15	Hom	3/8"			No	21.58	96.40	92.66	5.3
STN-31, 12.0'-13.5'	50	11/3/15	Hom	3/8"			No	17.32	107.60	105.18	2.8
STN-31, 13.5'-15.0'	51	11/3/15	Hom	No. 4			No	21.68	98.47	94.08	6.1
STN-31, 15.0'-16.5'	52	11/3/15	Hom	3/8"			No	17.27	97.40	85.49	17.5
STN-31, 16.5'-18.0'	53	11/3/15	Hom	No. 4			No	20.43	107.11	95.97	14.7
STN-31, 18.0'-19.5'	54	11/3/15	Hom	3/8"			No	20.62	125.73	114.00	12.6
STN-31, 19.5'-21.0'	55	11/3/15	Hom	3/8"			No	22.12	95.54	86.29	14.4
STN-31, 21.0'-22.5'	56	11/3/15	Hom	3/8"			No	17.34	96.63	87.26	13.4
STN-31, 22.5'-24.0'	57	11/3/15	Hom	3/8"			No	20.21	120.24	103.98	19.4
STN-31, 24.0'-25.5'	58	11/3/15	Hom	3/8"			No	20.55	103.78	92.95	15.0

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name ALF - West Ash Pond Complex Final Closure

Project Number 172675015

Tested By NW/AW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
STN-31, 25.5'-27.0'	59	11/3/15	Hom	3/8"			No	21.29	109.13	96.88	16.2
STN-31, 27.0'-28.5'	60	11/3/15	Hom	No. 10			Yes	17.33	88.92	67.70	42.1
STN-31, 28.5'-30.0'	61	11/3/15	Dist	No. 10			Yes	17.32	103.06	87.99	21.3
STN-31, 30.0'-31.5'	62	11/3/15	Hom	3/8"			No	17.20	109.99	95.85	18.0
STN-31, 31.5'-33.0'	63	11/3/15	Hom	3/8"			No	17.34	111.12	99.32	14.4
STN-31, 33.0'-34.5'	64	11/3/15	Hom	No. 4			No	16.47	113.85	95.78	22.8
STN-31, 34.5'-36.0'	65	11/3/15	Hom	No. 10			Yes	21.83	115.82	99.00	21.8
STN-32, 0.0'-1.5'	66	11/3/15	Hom	No. 10			Yes	20.62	63.99	60.82	7.9
STN-32, 1.5'-3.0'	67	11/3/15	Hom	No. 10			Yes	21.12	71.74	67.93	8.1
STN-32, 3.0'-4.5'	68	11/3/15	Hom	No. 10			Yes	17.29	77.37	72.52	8.8
STN-32, 6.5'-8.0'	70	11/3/15	Hom	No. 10			Yes	22.12	84.98	69.74	32.0
STN-32, 10.0'-11.5'	72	11/3/15	Hom	No. 10			Yes	21.55	104.85	85.61	30.0
STN-32, 11.5'-13.0'	73	11/3/15	Hom	No. 10			Yes	16.37	96.22	78.27	29.0
STN-32, 13.0'-14.5'	74	11/3/15	Hom	No. 10			Yes	17.27	82.44	78.20	7.0
STN-32, 14.5'-16.0'	75	11/3/15	Dist	No. 10			Yes	21.00	83.91	77.11	12.1
STN-32, 16.0'-17.5'	76	11/3/15	Hom	No. 10			Yes	17.38	78.49	75.86	4.5
STN-32, 17.5'-19.0'	77	11/3/15	Hom	No. 10			Yes	19.96	76.60	74.78	3.3
STN-32, 19.0'-20.5'	78	11/3/15	Hom	No. 10			Yes	22.02	75.70	74.11	3.1
STN-32, 20.5'-22.0'	79	11/3/15	Dist	No. 10			Yes	25.03	92.91	90.03	4.4
STN-32, 22.0'-23.5'	80	11/3/15	Dist	3/8"			No	32.31	117.45	114.37	3.8
STN-32, 23.5'-25.0'	81	11/3/15	Dist	3/4"			No	32.50	125.62	121.18	5.0
STN-32, 25.0'-26.5'	82	11/3/15	Dist	3/8"			No	32.49	129.74	123.89	6.4
STN-32, 26.5'-28.0'	83	11/3/15	Dist	3/8"			No	31.99	137.53	130.75	6.9
STN-32, 28.0'-29.5'	84	11/3/15	Dist	3/4"			No	20.78	128.41	116.03	13.0
STN-32, 29.5'-31.0'	85	11/3/15	Dist	3/4"			No	20.88	165.32	142.07	19.2
STN-32, 31.0'-32.5'	86	11/3/15	Dist	No. 4			No	25.27	122.84	109.04	16.5
STN-32, 32.5'-34.0'	87	11/3/15	Dist	No. 4			No	25.30	115.42	108.77	8.0
STN-33, 0.0'-1.5'	88	11/3/15	Hom	No. 4			No	31.80	99.95	97.39	3.9

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name ALF - West Ash Pond Complex Final Closure

Project Number 172675015

Tested By NW/AW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
STN-33, 1.5'-3.0' 1 of 2	89A	11/3/15	Hom	No. 4			No	32.12	108.21	103.95	5.9
STN-33, 3.0'-4.5'	90	11/4/15	Hom	No. 10			Yes	22.23	88.41	82.96	9.0
STN-33, 4.5'-6.0'	91	11/4/15	Hom	No. 10			Yes	21.97	80.45	74.91	10.5
STN-33, 6.0'-7.5'	92	11/4/15	Hom	No. 10			Yes	22.14	70.86	67.41	7.6
STN-33, 7.5'-9.0'	93	11/4/15	Hom	3/8"			No	21.08	82.74	79.22	6.1
STN-33, 9.0'-10.5'	94	11/4/15	Hom	No. 10			Yes	22.05	80.69	74.52	11.8
STN-33, 10.5'-12.0'	95	11/4/15	Hom	No. 4			No	17.29	86.19	78.41	12.7
STN-33, 12.0'-13.5'	96	11/4/15	Hom	No. 10			Yes	21.61	110.72	99.83	13.9
STN-33, 13.5'-15.0'	97	11/4/15	Hom	No. 10			Yes	22.08	80.75	76.99	6.8
STN-33, 15.0'-16.5'	98	11/4/15	Hom	No. 10			Yes	17.36	95.24	87.79	10.6
STN-33, 16.5'-18.0' 2 Jars	99	11/4/15	Str	3/8"			No	21.40	102.56	97.32	6.9
STN-33, 18.0'-19.5' 2 Jars	100	11/4/15	Hom	No. 10			Yes	14.06	75.82	66.80	17.1
STN-33, 19.5'-21.0' 2 Jars	101	11/4/15	Str	No. 10			Yes	13.93	86.48	76.69	15.6
STN-33, 21.0'-22.5' 2 Jars	102	11/4/15	Hom	No. 10			Yes	14.15	81.96	78.74	5.0
STN-33, 22.5'-24.0' 2 Jars	103	11/4/15	Str	No. 10			Yes	14.15	80.26	74.71	9.2
STN-33, 24.0'-25.5' 2 Jars	104	11/4/15	Str	No. 10			Yes	14.40	95.62	77.36	29.0
STN-33, 25.5'-27.0' 3 Jars	105	11/4/15	Str	No. 10			Yes	14.24	99.65	86.59	18.1
STN-33, 27.0'-28.5' 2 Jars	106	11/4/15	Str	No. 10			Yes	21.60	135.44	117.38	18.9
STN-33, 28.5'-30.0'	107	11/4/15	Hom	No. 10			Yes	21.51	112.71	105.08	9.1
STN-33, 30.0'-31.5'	108	11/4/15	Hom	No. 10			Yes	21.65	149.19	125.65	22.6
STN-33, 31.5'-33.0' 2 Jars	109	11/4/15	Str	No. 10			Yes	21.47	164.14	132.90	28.0
STN-33, 33.0'-34.5'	110	11/4/15	Dist	No. 10			Yes	21.65	125.51	114.92	11.4
STN-33, 34.5'-36.0' 2 Jars	111	11/4/15	Str	No. 10			Yes	21.67	137.17	109.34	31.7
STN-33, 36.0'-37.5'	112	11/4/15	Dist	No. 10			Yes	21.56	126.14	92.82	46.8
STN-33, 37.5'-39.0' 2 Jars	113	11/4/15	Str	3/4"			No	21.43	168.59	145.29	18.8
STN-33, 39.0'-40.5'	114	11/4/15	Hom	1 1/2"			No	21.18	149.95	140.43	8.0
STN-33, 40.5'-42.0'	115	11/4/15	Hom	3/4"			No	21.84	116.33	109.53	7.8
STN-33, 42.0'-43.5' 2 Jars	116	11/4/15	Str	1 1/2"			No	21.83	160.10	140.45	16.6

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name ALF - West Ash Pond Complex Final Closure

Project Number 172675015

Tested By NW/AW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
STN-33, 43.5'-45.0'	117	11/4/15	Dist	3/4"			No	21.98	144.42	133.03	10.3
STN-33, 45.0'-46.5'	118	11/4/15	Dist	1 1/2"			No	21.59	157.96	140.67	14.5
STN-33, 46.5'-48.0'	119	11/4/15	Dist	3/4"			No	21.64	155.50	139.72	13.4
STN-33, 48.0'-49.5'	120	11/4/15	Dist	1 1/2"			No	21.66	147.80	131.73	14.6
STN-33, 49.5'-51.0'	121	11/4/15	Dist	3/8"			No	21.47	153.81	140.96	10.8
STN-34, 0.0'-1.5'	122	11/4/15	Dist	No. 10			Yes	21.59	122.83	116.98	6.1
STN-34, 1.5'-3.0'	123	11/4/15	Dist	No. 10			Yes	21.34	120.31	100.79	24.6
STN-34, 3.0'-4.5'	124	11/4/15	Dist	No. 10			Yes	22.03	113.11	93.32	27.8
STN-34, 4.5'-6.0'	125	11/4/15	Dist	3/4"			No	21.79	130.16	127.76	2.3
STN-34, 8.0'-9.5'	127	11/4/15	Dist	3/4"			No	21.35	141.94	132.75	8.2
STN-34, 9.5'-11.0'	128	11/4/15	Dist	No. 10			Yes	21.22	124.01	105.29	22.3
STN-34, 11.0'-12.5'	129	11/4/15	Dist	No. 10			Yes	21.28	121.61	100.20	27.1
STN-34, 12.5'-14.0'	130	11/4/15	Dist	No. 10			Yes	21.15	132.65	108.97	27.0
STN-34, 14.0'-15.5'	131	11/4/15	Dist	No. 10			Yes	14.24	78.07	64.85	26.1
STN-34, 15.5'-17.0'	132	11/4/15	Dist	No. 10			Yes	14.36	79.78	66.15	26.3
STN-34, 17.0'-18.5'	133	11/4/15	Dist	No. 10			Yes	14.43	90.98	73.49	29.6
STN-34, 18.5'-20.0'	134	11/4/15	Dist	No. 10			Yes	13.88	87.79	70.92	29.6
STN-34, 20.0'-21.5'	135	11/4/15	Dist	No. 10			Yes	14.26	89.07	70.22	33.7
STN-34, 21.5'-23.0'	136	11/4/15	Dist	No. 10			Yes	21.75	126.48	102.39	29.9
STN-34, 23.0'-24.5'	137	11/4/15	Hom	No. 10			Yes	21.80	111.28	85.12	41.3
STN-34, 24.5'-26.0'	138	11/4/15	Hom	No. 10			Yes	21.60	115.96	91.72	34.6
STN-34, 26.0'-27.5'	139	11/4/15	Dist	No. 10			Yes	21.60	124.19	99.46	31.8
STN-34, 27.5'-29.0'	140	11/4/15	Dist	No. 10			Yes	21.32	126.00	100.24	32.6
STN-34, 29.0'-30.5'	141	11/4/15	Dist	No. 10			Yes	21.51	113.00	90.41	32.8
STN-34, 30.5'-32.0'	142	11/4/15	Dist	No. 10			Yes	21.63	179.84	143.61	29.7
STN-34, 32.0'-33.5'	143	11/4/15	Dist	No. 10			Yes	21.44	159.69	129.36	28.1
STN-34, 33.5'-35.0'	144	11/4/15	Dist	No. 10			Yes	21.27	144.67	118.30	27.2
STN-35, 0.0'-1.5'	145	11/4/15	Dist	No. 4			No	21.24	117.77	111.29	7.2

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name ALF - West Ash Pond Complex Final Closure

Project Number 172675015

Tested By NW/AW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
STN-35, 1.5'-3.0'	146	11/4/15	Dist	No. 10			Yes	21.40	136.97	128.42	8.0
STN-35, 3.0'-4.5'	147	11/4/15	Dist	No. 10			Yes	21.32	129.48	114.38	16.2
STN-35, 4.5'-6.0'	148	11/4/15	Dist	No. 10			Yes	21.49	126.34	105.49	24.8
STN-35, 8.0'-9.5'	150	11/4/15	Dist	No. 10			Yes	21.32	133.93	117.72	16.8
STN-35, 11.5'-13.0'	152	11/4/15	Dist	No. 10			Yes	21.60	125.17	102.51	28.0
STN-35, 13.0'-14.5'	153	11/4/15	Hom	No. 10			Yes	21.47	130.98	101.99	36.0
STN-35, 14.5'-16.0'	154	11/4/15	Hom	No. 10			Yes	21.71	124.90	94.04	42.7
STN-35, 16.0'-17.5'	155	11/4/15	Dist	No. 10			Yes	21.74	128.75	106.57	26.1
STN-35, 17.5'-19.0'	156	11/4/15	Dist	No. 10			Yes	21.73	138.08	105.89	38.2
STN-35, 19.0'-20.5'	157	11/4/15	Dist	No. 10			Yes	21.58	122.30	100.05	28.4
STN-35, 20.5'-22.0'	158	11/4/15	Dist	No. 10			Yes	21.49	149.32	119.90	29.9
STN-35, 22.0'-23.5'	159	11/4/15	Dist	No. 10			Yes	21.49	160.30	127.62	30.8
STN-35, 23.5'-25.0'	160	11/4/15	Dist	No. 10			Yes	21.51	140.86	113.81	29.3
STN-35, 25.0'-26.5'	161	11/4/15	Dist	No. 10			Yes	21.74	150.86	122.46	28.2
STN-35, 26.5'-28.0'	162	11/4/15	Dist	No. 10			Yes	13.95	98.38	80.69	26.5
STN-35, 28.0'-29.5'	163	11/4/15	Hom	No. 10			Yes	14.36	84.88	65.44	38.1
STN-35, 29.5'-31.0'	164	11/4/15	Hom	No. 10			Yes	14.26	104.43	80.95	35.2
STN-35, 31.0'-32.5'	165	11/4/15	Dist	No. 10			Yes	14.26	105.13	82.31	33.5
STN-35, 32.5'-34.0'	166	11/4/15	Dist	No. 10			Yes	14.15	94.58	79.18	23.7
STN-36, 0.0'-1.5'	167	11/4/15	Dist	3/4"			No	14.03	87.38	83.86	5.0
STN-36, 1.5'-3.0'	168	11/5/15	Dist	No. 10			Yes	32.53	134.53	125.32	9.9
STN-36, 3.0'-4.5'	169	11/5/15	Dist	No. 10			Yes	32.90	132.75	121.36	12.9
STN-36, 4.5'-6.0'	170	11/5/15	Dist	No. 10			Yes	32.54	130.93	118.56	14.4
STN-36, 6.0'-7.5'	171	11/5/15	Dist	No. 10			Yes	31.64	133.29	117.53	18.3
STN-36, 7.5'-9.0'	172	11/5/15	Dist	3/8"			No	33.15	144.05	130.61	13.8
STN-36, 9.0'-10.5'	173	11/5/15	Dist	No. 10			Yes	32.11	138.32	125.31	14.0
STN-36, 10.5'-12.0'	174	11/5/15	Dist	1 1/2"			No	32.63	137.93	127.11	11.5
STN-36, 12.0'-13.5'	175	11/5/15	Dist	3/8"			No	32.03	140.52	129.57	11.2

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name ALF - West Ash Pond Complex Final Closure

Project Number 172675015

Tested By NW/AW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
STN-36, 13.5'-15.0' Ash	176	11/5/15	Dist	No. 4			Yes	32.85	161.57	159.61	1.5
STN-36, 15.0'-16.5' Ash	177	11/5/15	Dist	3/8"			No	32.35	145.59	142.07	3.2
STN-36, 16.5'-18.0'	178	11/5/15	Dist	No. 10			Yes	32.18	137.11	112.43	30.8
STN-36, 18.0'-19.5'	179	11/5/15	Hom	No. 10			Yes	31.81	155.34	121.58	37.6
STN-36, 19.5'-21.0' 1 of 2	180A	11/5/15	Dist	No. 10			Yes	33.26	157.73	130.90	27.5
STN-36, 21.0'-22.5'	181	11/5/15	Dist	No. 10			Yes	31.66	146.37	128.93	17.9
STN-36, 22.5'-24.0'	182	11/5/15	Dist	No. 10			Yes	32.14	142.14	120.69	24.2
STN-36, 24.0'-25.5'	183	11/5/15	Dist	No. 10			Yes	31.82	157.40	129.79	28.2
STN-36, 25.5'-27.0' 1 of 2	184A	11/5/15	Hom	No. 10			Yes	32.45	145.80	121.85	26.8
STN-36, 27.0'-28.5'	185	11/5/15	Dist	No. 10			Yes	32.50	133.99	118.16	18.5
STN-36, 28.5'-30.0'	186	11/5/15	Dist	No. 10			Yes	32.29	148.91	131.70	17.3
STN-36, 30.0'-31.5'	187	11/5/15	Dist	No. 10			Yes	32.52	157.03	135.80	20.6
STN-36, 31.5'-33.0'	188	11/5/15	Dist	No. 10			Yes	31.90	171.94	143.98	24.9
STN-36, 33.0'-34.5'	189	11/5/15	Dist	No. 10			Yes	32.81	160.27	142.08	16.6
STN-36, 34.5'-36.0'	190	11/5/15	Dist	No. 10			Yes	21.03	132.92	114.85	19.3
STN-36, 36.0'-37.5'	191	11/5/15	Dist	No. 10			Yes	20.58	141.08	122.02	18.8
STN-36, 37.5'-39.0'	192	11/5/15	Dist	No. 10			Yes	31.74	173.54	142.58	27.9
STN-36, 39.0'-40.5' 1 of 2	193A	11/5/15	Dist	No. 10			Yes	32.60	144.74	121.84	25.7
STN-36, 42.5'-44.0' 1 of 2	195A	11/5/15	Hom	No. 10			Yes	20.63	130.44	105.78	29.0
STN-36, 44.0'-45.5'	196	11/5/15	Dist	No. 10			Yes	32.00	159.89	135.38	23.7
STN-36, 45.5'-47.0'	197	11/5/15	Dist	No. 10			Yes	32.22	146.30	128.62	18.3
STN-36, 47.0'-48.5'	198	11/5/15	Dist	No. 10			Yes	32.88	171.03	143.05	25.4
STN-36, 48.5'-50.0'	199	11/5/15	Dist	No. 10			Yes	32.68	184.98	145.44	35.1
STN-37, 0.0'-1.5'	200	11/5/15	Dist	1 1/2"			No	32.00	158.74	152.75	5.0
STN-37, 1.5'-3.0'	201	11/5/15	Dist	No. 10			Yes	32.45	150.98	145.74	4.6
STN-37, 3.0'-4.5'	202	11/5/15	Dist	No. 10			Yes	31.64	154.40	143.16	10.1
STN-37, 4.5'-6.0'	203	11/5/15	Dist	No. 10			Yes	32.95	148.73	137.50	10.7
STN-37, 6.0'-7.5'	204	11/5/15	Dist	No. 10			Yes	32.66	171.78	154.34	14.3

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name ALF - West Ash Pond Complex Final Closure

Project Number 172675015

Tested By NW/AW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
STN-37, 7.5'-9.0'	205	11/5/15	Dist	No. 10			Yes	20.85	158.47	143.20	12.5
STN-37, 9.0'-10.5'	206	11/5/15	Hom	No. 10			Yes	20.98	153.48	137.36	13.9
STN-37, 10.5'-12.0'	207	11/5/15	Hom	No. 10			Yes	25.21	142.03	126.50	15.3
STN-37, 12.0'-13.5'	208	11/5/15	Dist	No. 10			Yes	31.78	156.41	141.74	13.3
STN-37, 13.5'-15.0'	209	11/5/15	Dist	No. 10			Yes	31.78	144.15	127.88	16.9
STN-37, 15.0'-16.5'	210	11/5/15	Dist	No. 10			Yes	32.76	149.76	136.24	13.1
STN-37, 16.5'-18.0'	211	11/5/15	Dist	No. 4			Yes	31.69	158.52	154.99	2.9
STN-37, 18.0'-19.5'	212	11/5/15	Dist	3/8"			No	32.21	185.84	172.38	9.6
STN-37, 19.5'-21.0'	213	11/5/15	Dist	No. 4			Yes	31.76	179.79	165.35	10.8
STN-37, 21.0'-22.5'	214	11/5/15	Dist	No. 4			Yes	32.85	174.19	159.50	11.6
STN-37, 22.5'-24.0'	215	11/5/15	Dist	No. 4			No	31.70	137.82	118.58	22.1
STN-37, 24.0'-25.5'	216	11/5/15	Dist	No. 10			Yes	32.75	148.48	123.90	27.0
STN-37, 28.0'-29.5'	218	11/5/15	Dist	No. 10			Yes	32.15	103.51	89.47	24.5
STN-37, 29.5'-31.0'	219	11/5/15	Hom	No. 10			Yes	32.92	145.71	121.88	26.8
STN-37, 31.0'-32.5'	220	11/19/15	Hom	No. 10			Yes	21.60	131.53	106.28	29.8
STN-37, 32.5'-34.0'	221	11/9/15	Hom	No. 10			Yes	21.71	126.78	103.02	29.2
STN-37, 34.0'-35.5'	222	11/9/15	Lam	No. 10			Yes	21.70	124.42	101.99	27.9
STN-38, 0.0'-1.5'	223	11/9/15	Hom	No. 4			No	21.60	120.14	103.50	20.3
STN-38, 1.5'-3.0'	224	11/9/15	Lam	No. 10			Yes	21.45	101.09	74.08	51.3
STN-38, 3.0'-4.5'	225	11/9/15	Dist	No. 10			Yes	21.73	141.07	114.37	28.8
STN-38, 4.5'-6.0'	226	11/9/15	Hom	No. 4			No	21.66	128.09	115.00	14.0
STN-38, 6.0'-7.5'	227	11/9/15	Hom	No. 10			Yes	21.42	126.42	108.09	21.1
STN-38, 7.5'-9.0'	228	11/9/15	Dist	No. 10			Yes	21.90	115.18	101.79	16.8
STN-38, 9.0'-10.5'	229	11/9/15	Hom	No. 10			Yes	21.58	119.78	101.87	22.3
STN-38, 10.5'-12.0'	230	11/9/15	Dist	No. 10			Yes	21.70	131.61	116.12	16.4
STN-38, 12.0'-13.5'	231	11/9/15	Hom	No. 10			Yes	21.25	152.76	123.32	28.8
STN-38, 13.5'-15.0'	232	11/9/15	Hom	No. 10			Yes	21.70	128.37	103.38	30.6
STN-38, 15.0'-16.5'	233	11/9/15	Hom	No. 10			Yes	21.60	113.33	91.33	31.6

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name ALF - West Ash Pond Complex Final Closure

Project Number 172675015

Tested By NW/AW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
STN-38, 16.5'-18.0'	234	11/9/15	Hom	No. 10			Yes	21.44	136.01	111.10	27.8
STN-38, 18.0'-19.5'	235	11/9/15	Hom	No. 10			Yes	21.55	119.48	97.40	29.1
STN-38, 19.5'-21.0'	236	11/9/15	Hom	No. 4			No	21.36	125.41	98.33	35.2
STN-38, 21.0'-22.5'	237	11/9/15	Dist	3/8"			No	21.43	133.70	123.27	10.2
STN-38, 22.5'-24.0'	238	11/9/15	Dist	3/4"			No	21.65	127.11	121.91	5.2
STN-38, 24.0'-25.5'	239	11/9/15	Dist	3/4"			No	21.17	141.87	136.58	4.6
STN-38, 25.5'-27.0'	240	11/9/15	Dist	3/8"			No	21.58	140.07	134.90	4.6
STN-38, 27.0'-28.5'	241	11/9/15	Dist	3/8"			No	21.91	147.59	142.91	3.9
STN-38, 28.5'-30.0'	242	11/9/15	Dist	3/8"			No	21.75	149.09	144.13	4.1
STN-38, 30.0'-31.5'	243	11/9/15	Str	3/4"			No	21.75	125.66	98.71	35.0
STN-38, 31.5'-33.0' Coal	244	11/10/15	Dist	3/4"			No	32.09	176.73	153.80	18.8
STN-38, 33.0'-34.5'	245	11/10/15	Dist	3/8"			No	33.42	160.33	145.70	13.0
STN-38, 34.5'-36.0'	246	11/10/15	Str	No. 10			Yes	33.23	150.19	126.83	25.0
STN-38, 36.0'-37.5'	247	11/10/15	Dist	No. 10			Yes	32.20	148.20	125.46	24.4
STN-39, 0.0'-1.5'	248	11/10/15	Dist	3/4"			No	32.82	109.49	93.56	26.2
STN-39, 1.5'-3.0' Coal	249	11/10/15	Dist	3/4"			No	31.75	113.39	97.20	24.7
STN-39, 3.0'-4.5'	250	11/10/15	Dist	3/8"			No	33.26	115.16	97.46	27.6
STN-39, 4.5'-6.0'	251	11/10/15	Dist	No. 4			No	32.50	137.86	118.76	22.1
STN-39, 6.0'-7.5'	252	11/10/15	Dist	No. 10			Yes	32.02	137.18	110.90	33.3
STN-39, 7.5'-9.0'	253	11/10/15	Dist	No. 10			Yes	33.15	168.60	133.94	34.4
STN-39, 9.0'-10.5'	254	11/10/15	Dist	No. 10			Yes	32.34	158.95	129.31	30.6
STN-39, 10.5'-12.0'	255	11/10/15	Dist	No. 10			Yes	31.70	160.60	129.69	31.5
STN-39, 12.0'-13.5'	256	11/10/15	Dist	No. 10			Yes	33.13	170.96	139.58	29.5
STN-39, 13.5'-15.0'	257	11/10/15	Dist	No. 10			Yes	31.66	143.68	121.18	25.1
STN-39, 15.0'-16.5'	258	11/10/15	Dist	No. 10			Yes	31.65	161.78	136.07	24.6
STN-39, 16.5'-18.0'	259	11/10/15	Dist	No. 10			Yes	20.84	152.67	121.48	31.0
STN-39, 18.0'-19.5'	260	11/10/15	Dist	No. 10			Yes	31.87	119.97	94.48	40.7
STN-39, 19.5'-21.0'	261	11/10/15	Dist	No. 10			Yes	32.07	139.58	118.70	24.1

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name ALF - West Ash Pond Complex Final Closure

Project Number 172675015

Tested By NW/AW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
STN-39, 21.0'-22.5'	262	11/10/15	Dist	No. 10			Yes	31.97	144.37	120.65	26.7
STN-39, 22.5'-24.0'	263	11/10/15	Dist	No. 10			Yes	33.04	143.00	123.07	22.1
STN-39, 24.0'-25.5'	264	11/10/15	Dist	No. 10			Yes	31.95	141.75	124.02	19.3
STN-39, 25.5'-27.0'	265	11/10/15	Dist	No. 10			Yes	32.52	126.75	118.80	9.2
STN-39, 27.0'-28.5'	266	11/10/15	Hom	No. 10			Yes	32.55	177.42	144.64	29.2
STN-39, 28.5'-30.0'	267	11/10/15	Dist	No. 10			Yes	32.66	153.70	126.47	29.0
STN-39, 30.0'-31.5'	268	11/10/15	Dist	No. 10			Yes	34.41	147.32	122.62	28.0
STN-39, 31.5'-33.0'	269	11/10/15	Dist	No. 10			Yes	32.60	168.04	137.13	29.6
STN-40, 0.0'-1.5' Ash	270	11/10/15	Dist	3/8"			No	32.21	148.10	143.99	3.7
STN-40, 1.5'-3.0' Ash	271	11/10/15	Dist	No. 4			No	33.27	109.15	107.24	2.6
STN-40, 3.0'-4.5' Ash	272	11/10/15	Dist	3/4"			No	32.55	133.13	127.79	5.6
STN-40, 4.5'-6.0' Ash	273	11/10/15	Dist	No. 10			Yes	32.36	135.75	131.87	3.9
STN-40, 6.0'-7.5' Ash	274	11/10/15	Dist	3/4"			No	32.92	126.00	125.08	1.0
STN-40, 7.5'-9.0' Ash	275	11/10/15	Dist	No. 10			Yes	31.90	140.26	129.31	11.2
STN-40, 9.0'-10.5' Ash	276	11/10/15	Dist	No. 10			Yes	33.03	147.78	143.56	3.8
STN-40, 10.5'-12.0' Ash	277	11/10/15	Dist	3/4"			No	33.88	133.15	123.97	10.2
STN-40, 12.0'-13.5' Ash	278	11/10/15	Dist	3/8"			No	33.64	140.54	139.64	0.8
STN-40, 13.5'-15.0'	279	11/10/15	Dist	No. 4			No	32.87	147.83	126.94	22.2
STN-40, 15.0'-16.5'	280	11/10/15	Dist	No. 10			Yes	33.34	184.63	144.45	36.2
STN-40, 18.5'-20.0'	281	11/10/15	Dist	No. 10			Yes	32.43	134.18	104.33	41.5
STN-40, 20.0'-21.5'	283	11/10/15	Hom	No. 10			Yes	32.13	148.75	123.24	28.0
STN-40, 21.5'-23.0'	284	11/10/15	Hom	No. 10			Yes	32.59	138.00	111.26	34.0
STN-40, 23.0'-24.5'	285	11/10/15	Dist	No. 10			Yes	33.18	133.57	108.77	32.8
STN-40, 24.5'-26.0'	286	11/10/15	Hom	No. 10			Yes	33.22	148.91	121.44	31.1
STN-40, 26.0'-27.5'	287	11/10/15	Dist	No. 10			Yes	32.86	143.00	117.22	30.6
STN-40, 27.5'-29.0'	288	11/10/15	Dist	No. 10			Yes	32.32	151.54	132.35	19.2
STN-40, 29.0'-30.5'	289	11/10/15	Dist	No. 10			Yes	32.51	146.93	122.33	27.4
STN-40, 30.5'-32.0'	290	11/10/15	Dist	No. 10			Yes	32.96	150.74	125.43	27.4

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name ALF - West Ash Pond Complex Final Closure

Project Number 172675015

Tested By NW/AW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
STN-40, 32.0'-33.5'	291	11/10/15	Dist	No. 10			Yes	32.55	128.94	117.26	13.8
STN-40, 33.5'-35.0'	292	11/10/15	Dist	No. 10			Yes	32.55	171.27	148.66	19.5
STN-40, 35.0'-36.0' No Sample Material	293	11/10/15									
STN-41, 0.0'-1.5'	297	11/10/15	Dist	No. 4			Yes	33.55	144.02	142.22	1.7
STN-41, 1.5'-3.0' Ash	298	11/10/15	Dist	No. 4			Yes	31.74	144.36	142.40	1.8
STN-41, 3.0'-4.5' Ash	299	11/10/15	Dist	No. 10			Yes	32.77	134.80	129.64	5.3
STN-41, 4.5'-6.0'	300	11/10/15	Dist	No. 10			Yes	32.94	151.97	128.77	24.2
STN-41, 6.0'-7.5'	301	11/10/15	Dist	No. 10			Yes	32.88	149.26	130.32	19.4
STN-41, 7.5'-9.0'	302	11/10/15	Dist	No. 10			Yes	31.55	130.76	124.56	6.7
STN-41, 9.0'-10.5'	303	11/10/15	Dist	No. 10			Yes	31.99	139.32	118.23	24.5
STN-41, 10.5'-12.0'	304	11/10/15	Dist	No. 10			Yes	33.22	144.41	126.43	19.3
STN-41, 12.0'-13.5'	305	11/10/15	Dist	No. 10			Yes	32.52	137.42	129.12	8.6
STN-41, 13.5'-15.0'	306	11/10/15	Dist	No. 10			Yes	31.89	135.98	129.23	6.9
STN-41, 15.0'-16.5'	307	11/10/15	Dist	No. 10			Yes	25.03	127.76	120.31	7.8
STN-41, 16.5'-18.0'	308	11/10/15	Dist	No. 10			Yes	31.88	136.76	131.46	5.3
STN-41, 18.0'-19.5'	309	11/10/15	Dist	No. 10			Yes	32.59	155.46	130.81	25.1
STN-41, 19.5'-21.0'	310	11/10/15	Dist	No. 10			Yes	32.24	155.64	123.56	35.1
STN-41, 21.0'-22.5'	311	11/10/15	Dist	3/4"	1	3/4"	No	32.60	168.57	145.90	20.0
STN-42, 0.0'-1.5'	312	11/10/15	Dist	No. 4			No	32.43	121.50	117.13	5.2
STN-42, 1.5'-3.0'	313	11/10/15	Dist	3/8"	1	3/8"	No	32.81	139.45	130.91	8.7
STN-42, 3.0'-4.5'	314	11/10/15	Dist	No. 4			No	32.05	134.99	125.65	10.0
STN-42, 4.5'-6.0'	315	11/10/15	Dist	No. 4			No	21.12	126.36	116.19	10.7
STN-42, 6.0'-7.5'	316	11/10/15	Dist	No. 10			Yes	33.42	170.38	156.45	11.3
STN-42, 7.5'-9.0'	317	11/10/15	Dist	No. 10			Yes	33.13	149.85	138.07	11.2
STN-42, 9.0'-10.5'	318	11/10/15	Dist	3/8"	2	3/8"	No	33.65	158.30	148.92	8.1

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name ALF - West Ash Pond Complex Final Closure

Project Number 172675015

Tested By NW/AW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
STN-42, 10.5'-12.0'	319	11/11/15	Dist	No. 10			Yes	32.24	142.89	135.39	7.3
STN-42, 12.0'-13.5'	320	11/11/15	Dist	No. 10			Yes	32.85	129.01	119.06	11.5
STN-42, 13.5'-15.0'	321	11/11/15	Dist	No. 10			Yes	32.49	128.17	119.40	10.1
STN-42, 15.0'-16.5'	322	11/11/15	Dist	No. 10			Yes	20.77	130.32	115.25	16.0
STN-42, 16.5'-18.0'	323	11/11/15	Dist	No. 10			Yes	32.74	122.68	112.90	12.2
STN-42, 18.0'-19.5'	324	11/11/15	Dist	No. 10			Yes	32.47	127.52	123.74	4.1
STN-42, 19.5'-21.0'	325	11/11/15	Dist	No. 10			Yes	31.87	128.10	123.14	5.4
STN-42, 21.0'-22.5'	326	11/11/15	Dist	No. 10			Yes	32.65	138.51	134.34	4.1
STN-42, 22.5'-24.0'	327	11/11/15	Dist	No. 10			Yes	32.17	128.50	123.26	5.8
STN-42, 24.0'-25.5'	328	11/11/15	Dist	No. 10			Yes	32.01	128.92	123.11	6.4
STN-42, 25.5'-27.0'	329	11/11/15	Dist	No. 10			Yes	32.68	144.99	141.21	3.5
STN-42, 27.0'-28.5'	330	11/11/15	Dist	No. 10			Yes	32.86	124.87	120.35	5.2
STN-42, 28.5'-30.0'	331	11/11/15	Dist	No. 10			Yes	32.67	129.17	125.62	3.8
STN-43, 0.0'-1.5'	332	11/11/15	Dist	No. 4			No	31.71	127.28	120.14	8.1
STN-43, 1.5'-3.0'	333	11/11/15	Dist	No. 10			Yes	21.35	160.23	141.57	15.5
STN-43, 3.0'-4.5'	334	11/11/15	Dist	No. 10			Yes	33.64	127.33	117.54	11.7
STN-43, 4.5'-6.0'	335	11/11/15	Dist	No. 10			Yes	20.77	122.63	100.10	28.4
STN-43, 6.0'-7.5'	336	11/11/15	Dist	No. 10			Yes	21.08	127.18	104.32	27.5
STN-43, 7.5'-9.0'	337	11/11/15	Dist	No. 10			Yes	33.12	133.67	110.61	29.8
STN-43, 9.0'-10.5'	338	11/11/15	Dist	No. 10			Yes	32.56	118.84	96.40	35.2
STN-43, 10.5'-12.0'	339	11/11/15	Hom	No. 10			Yes	32.71	130.42	106.39	32.6
STN-43, 12.0'-13.5'	340	11/11/15	Hom	No. 10			Yes	31.94	130.26	107.10	30.8
STN-43, 13.5'-15.0'	341	11/11/15	Hom	No. 10			Yes	32.45	137.50	111.88	32.3
STN-43, 15.0'-16.5'	342	11/11/15	Hom	No. 10			Yes	31.71	145.87	118.64	31.3
STN-43, 16.5'-18.0'	343	11/11/15	Hom	No. 10			Yes	32.87	129.70	107.74	29.3
STN-43, 18.0'-19.5'	344	11/11/15	Hom	No. 10			Yes	32.99	124.06	110.44	17.6
STN-43, 19.5'-21.0'	345	11/11/15	Dist	No. 10			Yes	32.59	135.97	114.73	25.9
STN-43, 21.0'-22.5'	346	11/11/15	Dist	No. 10			Yes	32.69	148.34	126.15	23.7

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name ALF - West Ash Pond Complex Final Closure

Project Number 172675015

Tested By NW/AW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
STN-43, 22.5'-24.0'	347	11/11/15	Dist	No. 10			Yes	20.61	126.31	114.65	12.4
STN-43, 24.0'-25.5'	348	11/11/15	Dist	No. 10			Yes	21.08	127.59	109.96	19.8
STN-43, 25.5'-27.0'	349	11/11/15	Dist	No. 10			Yes	32.06	154.71	135.52	18.5
STN-43, 27.0'-28.5'	350	11/11/15	Dist	No. 4			Yes	20.78	147.21	144.74	2.0
STN-43, 28.5'-30.0'	351	11/11/15	Str	No. 4			Yes	32.69	154.94	139.70	14.2
STN-44, 0.0'-1.5'	352	11/11/15	Dist	No. 4			No	31.40	139.90	116.38	27.7
STN-44, 1.5'-3.0'	353	11/11/15	Dist	No. 4			No	32.48	150.87	127.37	24.8
STN-44, 3.0'-4.5'	354	11/11/15	Dist	No. 4			No	32.39	150.75	124.85	28.0
STN-44, 4.5'-6.0'	355	11/11/15	Dist	No. 4			No	32.64	143.00	123.66	21.2
STN-44, 6.0'-7.5'	356	11/11/15	Dist	No. 4			No	31.74	177.16	117.75	69.1
STN-44, 7.5'-9.0'	357	11/11/15	Dist	No. 4			Yes	21.48	145.63	121.75	23.8
STN-44, 9.0'-10.5'	358	11/11/15	Dist	No. 4			No	21.94	123.75	99.87	30.6
STN-44, 10.5'-12.0'	359	11/11/15	Hom	No. 4			No	21.31	130.54	104.56	31.2
STN-44, 12.0'-13.5'	360	11/11/15	Hom	No. 10			Yes	22.20	143.30	115.73	29.5
STN-44, 13.5'-15.0'	361	11/11/15	Hom	No. 10			Yes	21.50	152.81	123.13	29.2
STN-44, 15.0'-16.5'	362	11/11/15	Hom	No. 10			Yes	21.60	128.67	102.86	31.8
STN-44, 16.5'-18.0'	363	11/11/15	Hom	No. 10			Yes	21.49	144.97	115.32	31.6
STN-44, 18.0'-19.5'	364	11/11/15	Hom	No. 10			Yes	21.77	134.48	103.45	38.0
STN-44, 19.5'-21.0'	365	11/11/15	Hom	No. 10			Yes	21.46	149.99	120.99	29.1
STN-44, 21.0'-22.5'	366	11/11/15	Dist	No. 10			Yes	24.52	170.41	142.38	23.8
STN-44, 22.5'-24.0'	367	11/11/15	Dist	No. 10			Yes	21.39	144.96	128.22	15.7
STN-44, 24.0'-25.5'	368	11/11/15	Dist	No. 10			Yes	21.60	120.55	112.28	9.1
STN-44, 25.5'-27.0'	369	11/11/15	Dist	No. 10			Yes	21.86	146.63	130.14	15.2
STN-45, 0.0'-1.5'	370	11/11/15	Dist	No. 10			Yes	21.77	100.59	72.12	56.5
STN-45, 1.5'-3.0'	371	11/11/15	Dist	No. 10			Yes	21.93	122.11	71.13	103.6
STN-45, 3.0'-4.5'	372	11/11/15	Dist	No. 10			Yes	23.26	113.68	82.10	53.7
STN-45, 4.5'-6.0'	373	11/11/15	Dist	No. 10			Yes	21.30	144.11	121.49	22.6
STN-45, 6.0'-7.5'	374	11/11/15	Hom	No. 10			Yes	21.62	139.65	113.55	28.4

Stantec

Moisture Content of Soil

ASTM D 2216

Project Name ALF - West Ash Pond Complex Final Closure

Project Number 172675015

Tested By NW/AW

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous, Disturbed

Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
STN-45, 7.5'-9.0'	375	11/11/15	Hom	No. 10			Yes	21.31	139.57	112.81	29.2
STN-45, 9.0'-10.5'	376	11/11/15	Hom	No. 10			Yes	21.79	130.56	103.95	32.4
STN-45, 10.5'-12.0'	377	11/11/15	Hom	No. 10			Yes	21.56	132.36	106.06	31.1
STN-45, 12.0'-13.5'	378	11/11/15	Dist	No. 10			Yes	21.58	159.07	128.28	28.9
STN-45, 13.5'-15.0'	379	11/11/15	Hom	No. 10			Yes	21.51	135.23	104.94	36.3
STN-45, 15.0'-16.5'	380	11/11/15	Dist	No. 10			Yes	22.03	140.23	118.83	22.1
STN-45, 16.5'-18.0'	381	11/11/15	Dist	No. 10			Yes	22.04	123.42	107.40	18.8
STN-45, 18.0'-19.5'	382	11/11/15	Dist	No. 10			Yes	21.80	143.47	124.33	18.7
STN-45, 19.5'-21.0'	383	11/11/15	Dist	No. 10			Yes	21.72	146.57	124.61	21.3
STN-45, 21.0'-22.5'	384	11/11/15	Dist	No. 10			Yes	21.36	157.06	126.71	28.8
STN-45, 22.5'-24.0'	385	11/11/15	Dist	No. 10			Yes	21.19	131.79	118.09	14.1
STN-45, 24.0'-25.5'	386	11/11/15	Dist	No. 10			Yes	21.42	145.12	125.79	18.5
STN-45, 25.5'-27.0'	387	11/11/15	Dist	No. 10			Yes	22.28	166.69	131.19	32.6
STN-45, 27.0'-28.5'	388	11/11/15	Dist	No. 10			Yes	21.74	131.23	122.88	8.3
STN-33A, 34.0'-35.5'	389	11/11/15	Dist	No. 10			Yes	22.36	158.26	138.44	17.1
STN-33A, 37.5'-39.0'	391	11/11/15	Dist	3/8"	1	3/8"	No	21.69	137.41	127.55	9.3

Appendix D.2

Soil Classification Testing Results

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-30, 6.0'-7.5'	Lab ID	19
Sample Type	SPT	Date Received	10-28-15
		Date Reported	11-13-15

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 9.8

Particle Size Analysis

Preparation Method: ASTM D 2217

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 4	4.75	100.0
No. 10	2	99.7
No. 40	0.425	92.0
No. 200	0.075	40.4
	0.02	17.8
	0.005	12.2
	0.002	10.0
estimated	0.001	8.5

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.3
Coarse Sand	0.3	7.7
Medium Sand	7.7	---
Fine Sand	51.6	51.6
Silt	28.2	30.4
Clay	12.2	10.0

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Wet

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SM

Group Name: Silty sand

AASHTO Classification: A-4 (0)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name: ALF - West Ash Pond Complex Final Closure
Project Number: 172675015
Source: STN-30, 6.0'-7.5'
Lab ID: 19

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 2217

Particle Shape: Rounded
Particle Hardness: Hard and Durable

Tested By: JMB
Test Date: 11-02-2015
Date Received: 10-28-2015

Maximum Particle size: No. 4 Sieve

Sieve Size	% Passing
No. 4	100.0
No. 10	99.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

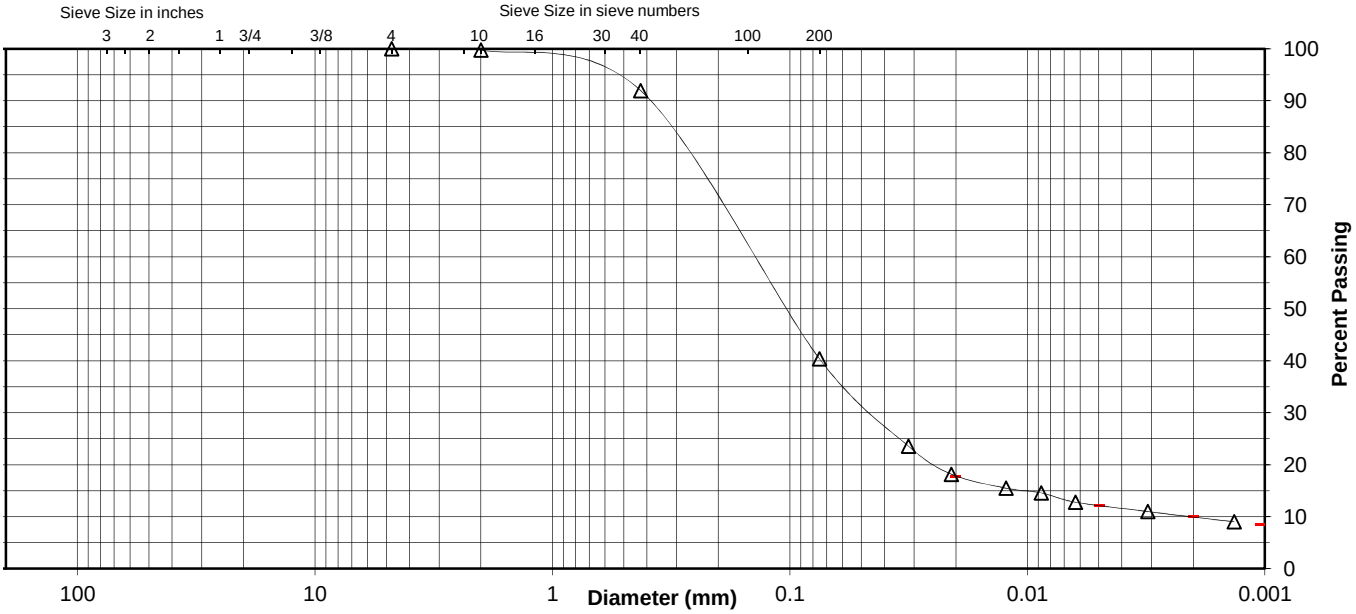
Specific Gravity: 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	92.0
No. 200	40.4
0.02 mm	17.8
0.005 mm	12.2
0.002 mm	10.0
0.001 mm	8.5

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.3	7.7	51.6	28.2	12.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.3			7.7	51.6	30.4	10.0



Comments

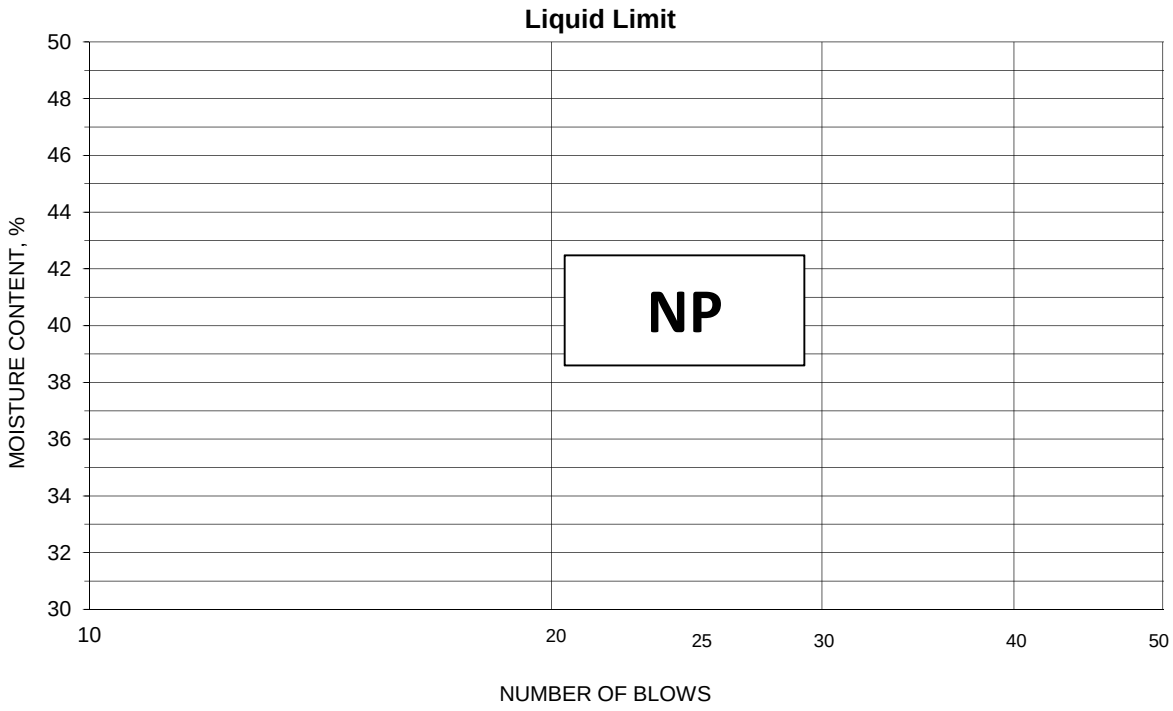
Reviewed By RHB

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-30, 6.0'-7.5'			Lab ID	19
				% + No. 40	8
Tested By	JMB	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-02-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-30, 17.6'-18.0'	Lab ID	26
Sample Type	ST	Date Received	10-28-15
		Date Reported	11-19-15

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 2217
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	88.5
No. 200	0.075	11.0
	0.02	2.4
	0.005	2.0
	0.002	2.0
estimated	0.001	2.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	11.5
Medium Sand	11.5	---
Fine Sand	77.5	77.5
Silt	9.0	9.0
Clay	2.0	2.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Wet

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SP-SM

Group Name: Poorly graded sand with silt

AASHTO Classification: A-2-4 (0)

Comments:

Reviewed By RJ

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name: ALF - West Ash Pond Complex Final Closure
Project Number: 172675015
Source: STN-30, 17.6'-18.0'
Lab ID: 26

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 2217

Particle Shape: N/A
Particle Hardness: N/A

Tested By: DB
Test Date: 11-10-2015
Date Received: 10-28-2015

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

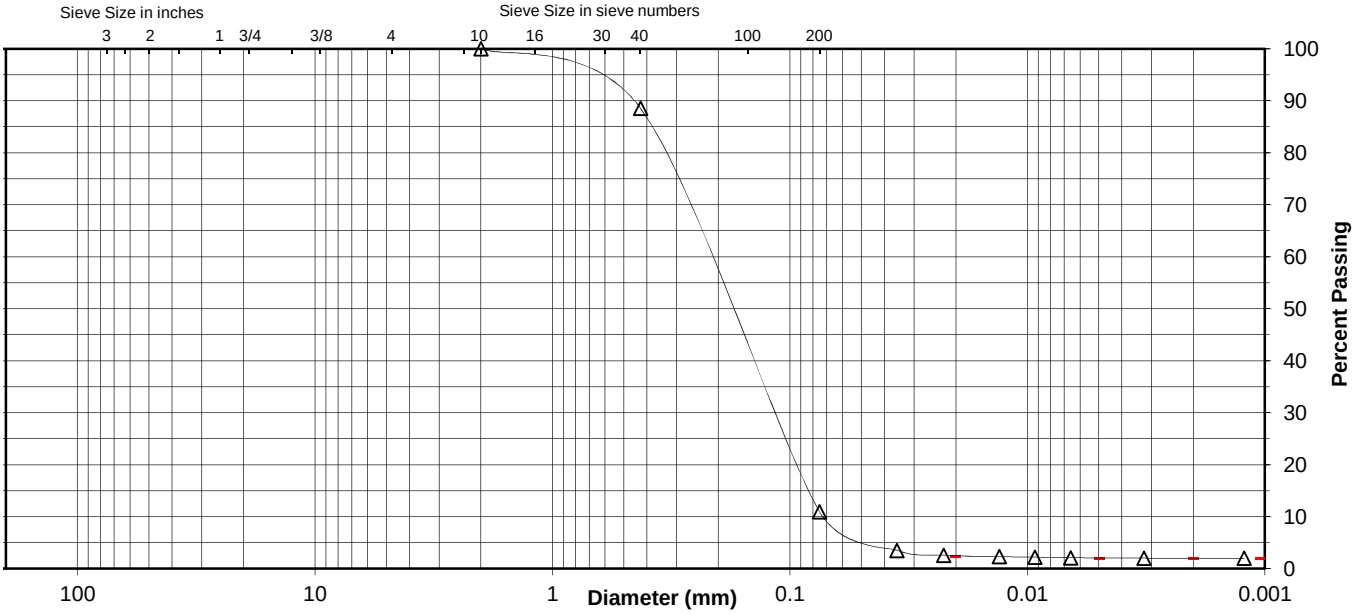
Specific Gravity: 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	88.5
No. 200	11.0
0.02 mm	2.4
0.005 mm	2.0
0.002 mm	2.0
0.001 mm	2.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	11.5	77.5	9.0	2.0
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			11.5	77.5	9.0	2.0



Comments

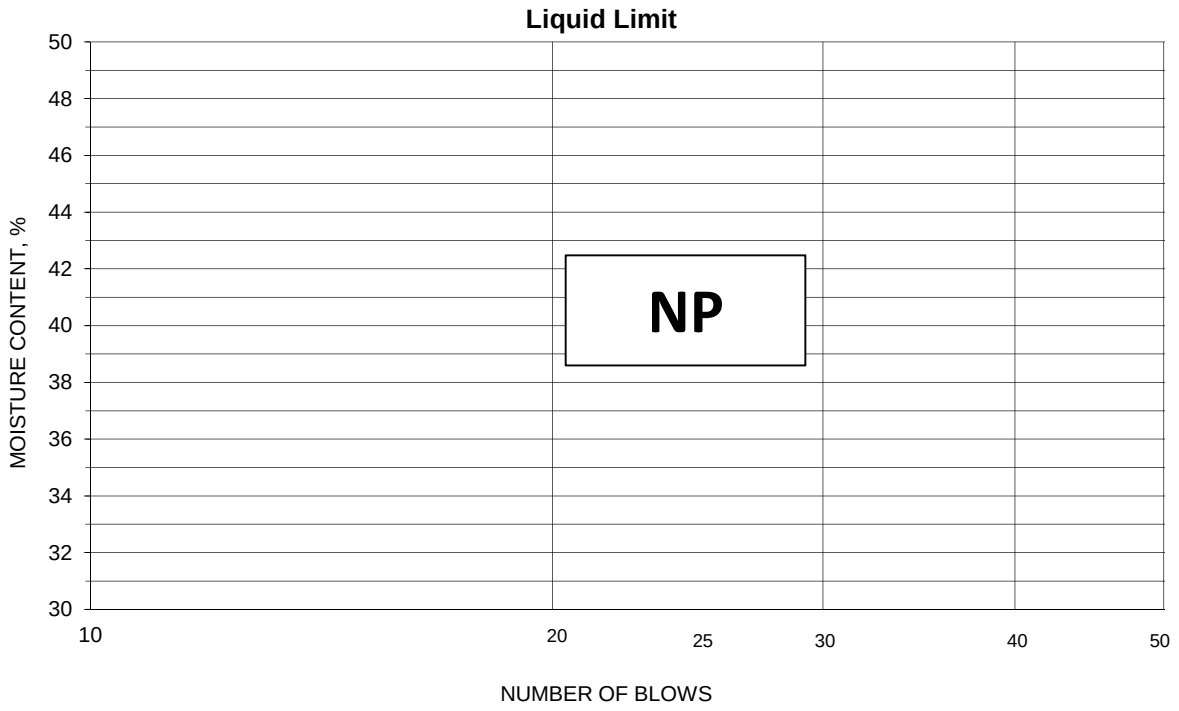
Reviewed By RJ

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-30, 17.6'-18.0'			Lab ID	26
				% + No. 40	11
Tested By	KG	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-03-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RJ

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-32, 3.0'-4.5'	Lab ID	68
Sample Type	SPT	Date Received	10-28-15
		Date Reported	11-13-15

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 8.8

Particle Size Analysis

Preparation Method: ASTM D 2217

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	97.8
No. 200	0.075	25.5
	0.02	11.3
	0.005	7.2
	0.002	6.3
estimated	0.001	5.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	2.2
Medium Sand	2.2	---
Fine Sand	72.3	72.3
Silt	18.3	19.2
Clay	7.2	6.3

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Wet

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SM

Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name: ALF - West Ash Pond Complex Final Closure
Project Number: 172675015
Source: STN-32, 3.0'-4.5'
Lab ID: 68

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 2217

Particle Shape: N/A
Particle Hardness: N/A

Tested By: JMB
Test Date: 11-02-2015
Date Received: 10-28-2015

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

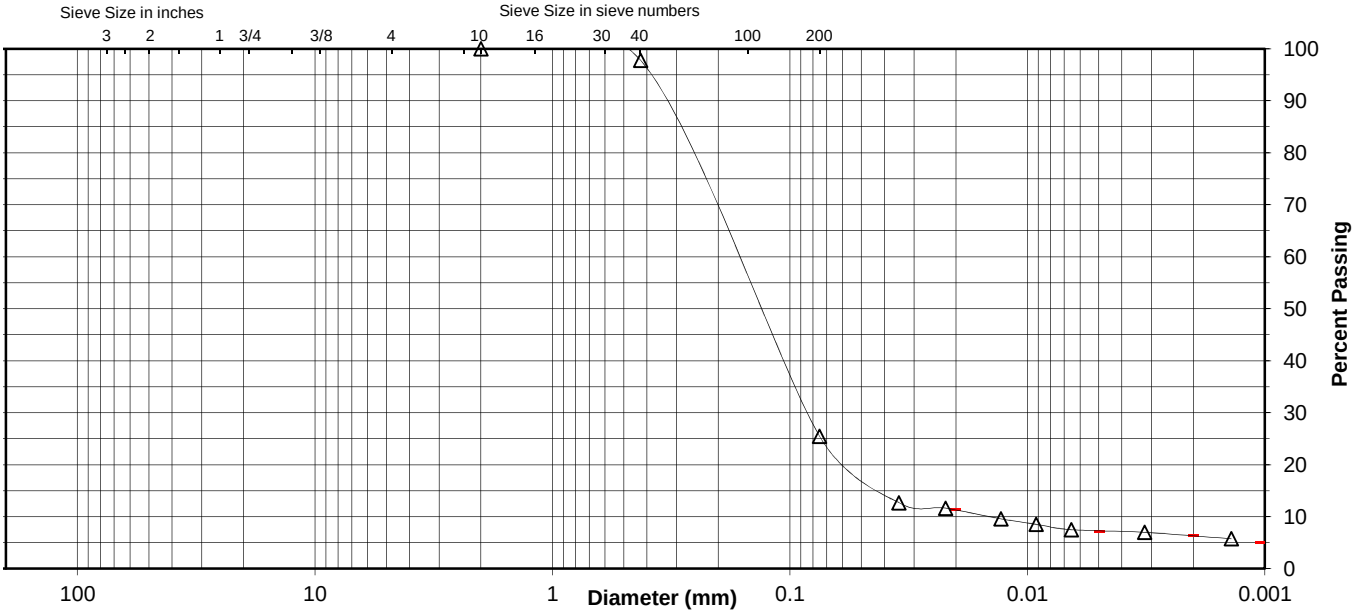
Specific Gravity: 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	97.8
No. 200	25.5
0.02 mm	11.3
0.005 mm	7.2
0.002 mm	6.3
0.001 mm	5.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	2.2	72.3	18.3	7.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			2.2	72.3	19.2	6.3



Comments

Reviewed By RHB

File: frm_172675015_sum_68.xlsm
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.
Louisville, Kentucky

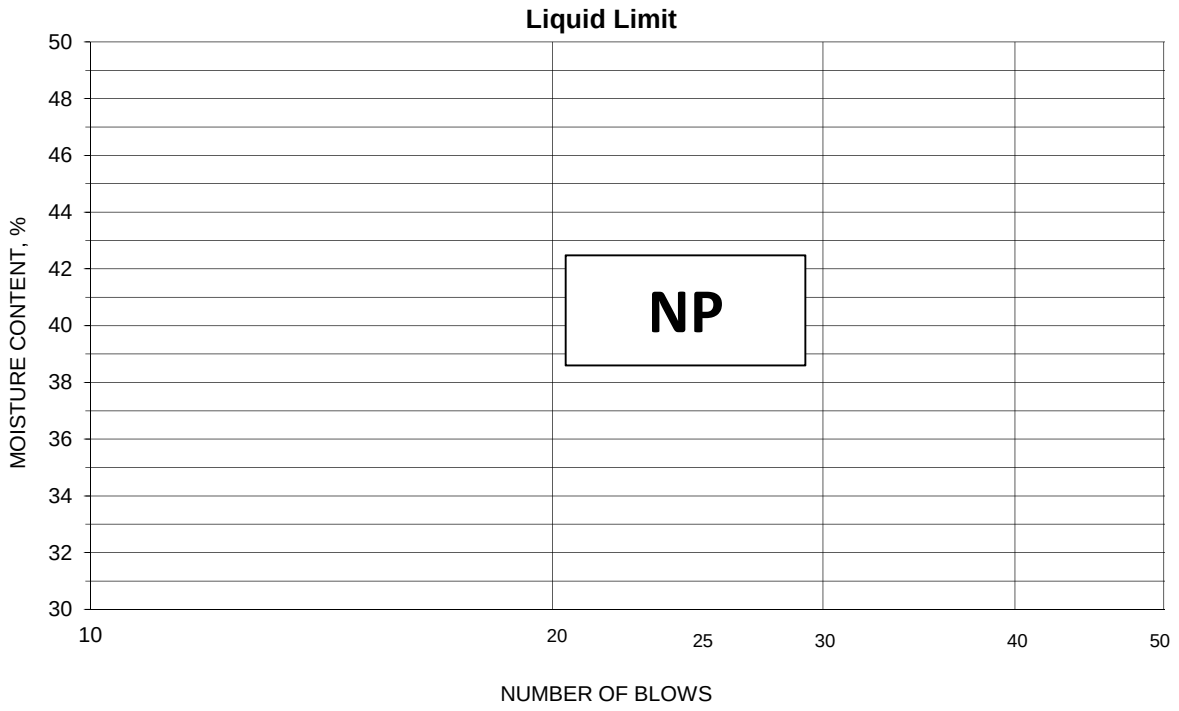
Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-32, 3.0'-4.5'			Lab ID	68
				% + No. 40	2
Tested By	JMB	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-02-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-32, 5.7'-6.1'	Lab ID	69
Sample Type	ST	Date Received	10-28-15
		Date Reported	11-19-15

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 2217
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	100.0
No. 200	0.075	92.4
	0.02	44.3
	0.005	25.5
	0.002	21.3
estimated	0.001	20.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.0
Medium Sand	0.0	---
Fine Sand	7.6	7.6
Silt	66.9	71.1
Clay	25.5	21.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Wet

Liquid Limit:	36
Plastic Limit:	19
Plasticity Index:	17
Activity Index:	0.81

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	CL
Group Name:	Lean clay
AASHTO Classification:	A-6 (16)

Comments:

Reviewed By RJ

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name: ALF - West Ash Pond Complex Final Closure
Project Number: 172675015
Source: STN-32, 5.7'-6.1'
Lab ID: 69

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 2217

Particle Shape: N/A
Particle Hardness: N/A

Tested By: DB
Test Date: 11-10-2015
Date Received: 10-28-2015

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

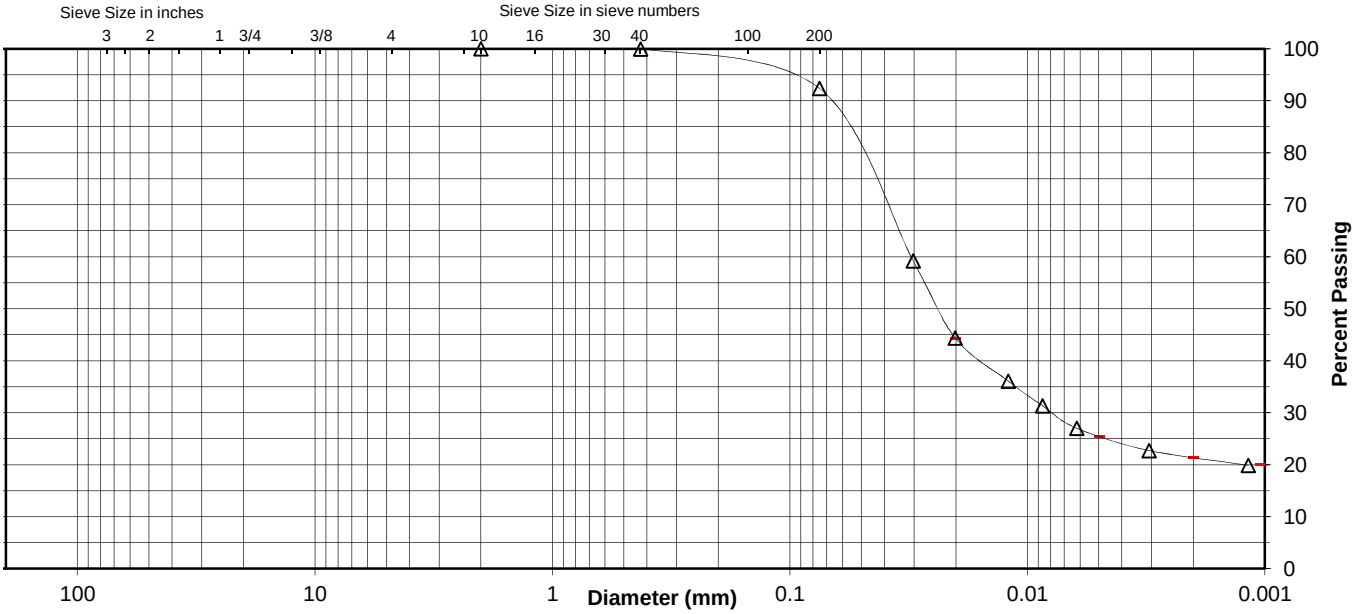
Specific Gravity: 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	100.0
No. 200	92.4
0.02 mm	44.3
0.005 mm	25.5
0.002 mm	21.3
0.001 mm	20.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.0	7.6	66.9	25.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.0	7.6	71.1	21.3



Comments

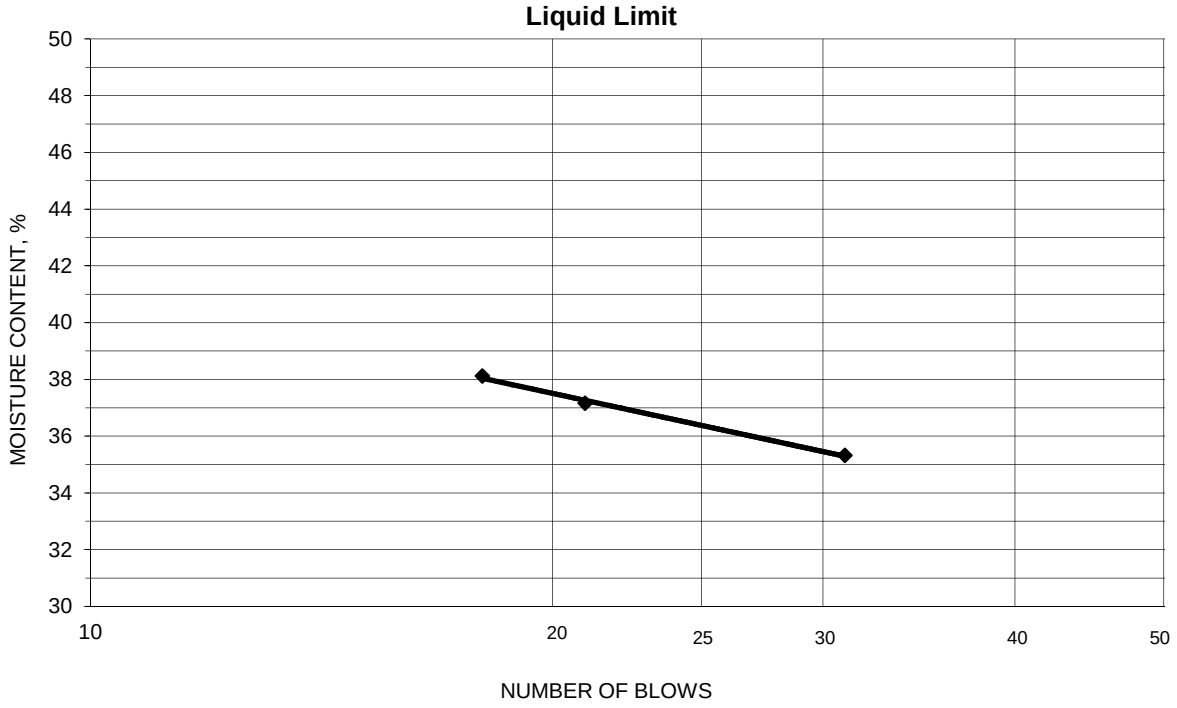
Reviewed By RJ

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-32, 5.7'-6.1'			Lab ID	69
				% + No. 40	0
Tested By	DB	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-12-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
21.17	18.56	11.17	31	35.3	
20.48	17.92	11.03	21	37.2	
21.12	18.49	11.59	18	38.1	36



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
17.24	16.24	10.92	18.8	19	17
18.99	17.83	11.70	18.9		

Remarks: _____

Reviewed By RJ

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-32, 16.0'-17.5'	Lab ID	76
Sample Type	SPT	Date Received	10-28-15
		Date Reported	11-13-15

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 4.5

Particle Size Analysis

Preparation Method: ASTM D 2217

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	83.3
No. 200	0.075	3.3
	0.02	2.5
	0.005	1.8
	0.002	1.8
estimated	0.001	1.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	16.7
Medium Sand	16.7	---
Fine Sand	80.0	80.0
Silt	1.5	1.5
Clay	1.8	1.8

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Wet

Liquid Limit: NP

Plastic Limit: NP

Plasticity Index: NP

Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A

Maximum Dry Density (kg/m^3): N/A

Optimum Moisture Content (%): N/A

Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A

Compacted Dry Density (lb/ft^3): N/A

Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10

Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SP

Group Name: Poorly graded sand

AASHTO Classification: A-3 (0)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name: ALF - West Ash Pond Complex Final Closure
Project Number: 172675015
Source: STN-32, 16.0'-17.5'
Lab ID: 76

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 2217

Particle Shape: N/A
Particle Hardness: N/A

Tested By: JMB/SK
Test Date: 11-03-2015
Date Received: 10-28-2015

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

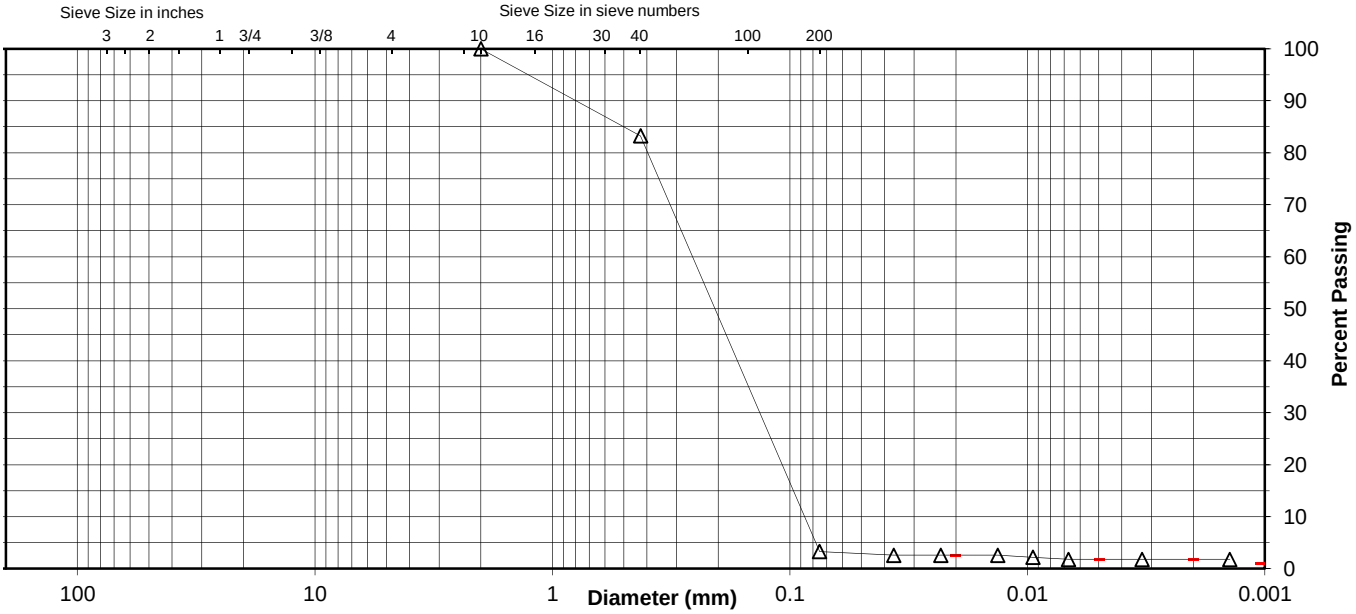
Specific Gravity: 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	83.3
No. 200	3.3
0.02 mm	2.5
0.005 mm	1.8
0.002 mm	1.8
0.001 mm	1.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	16.7	80.0	1.5	1.8
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			16.7	80.0	1.5	1.8



Comments:

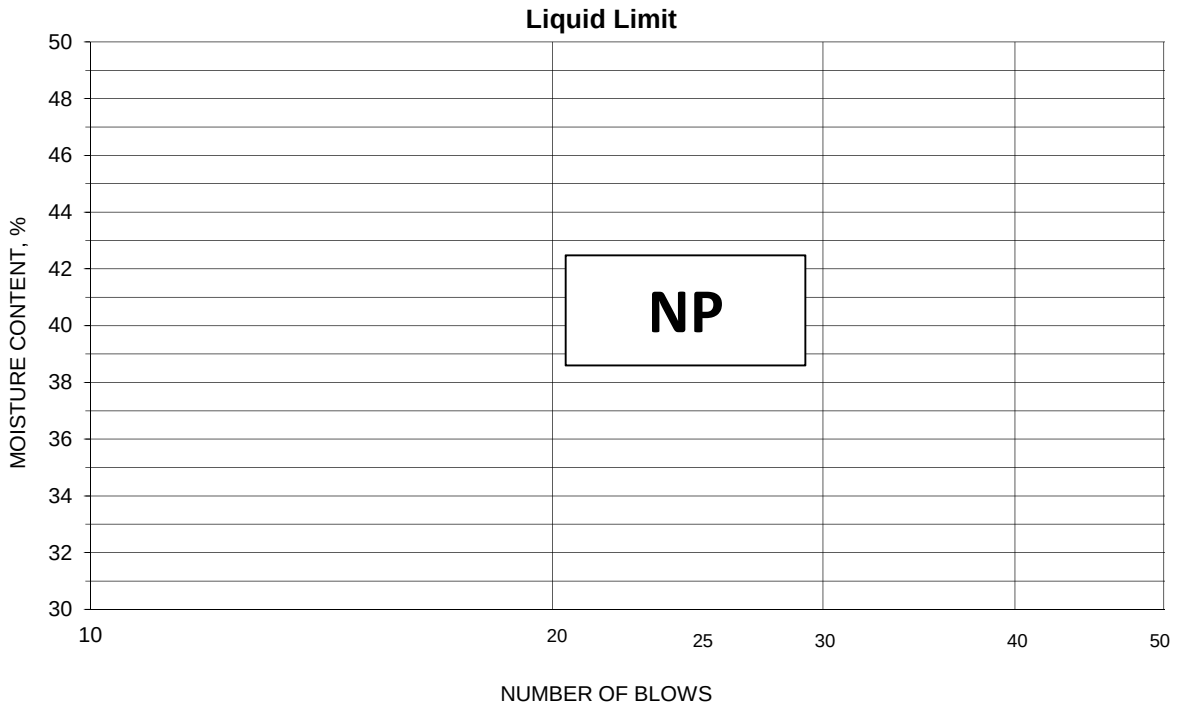
Reviewed By: RHB

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-32, 16.0'-17.5'			Lab ID	76
				% + No. 40	17
Tested By	SK	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-03-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-32, 25.0'-26.5'	Lab ID	82
Sample Type	SPT	Date Received	10-28-15
		Date Reported	11-13-15

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 6.4

Particle Size Analysis

Preparation Method: ASTM D 2217

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
3/4"	19	100.0
3/8"	9.5	83.7
No. 4	4.75	63.0
No. 10	2	40.1
No. 40	0.425	11.1
No. 200	0.075	2.9
	0.02	1.9
	0.005	1.5
	0.002	1.0
estimated	0.001	0.6

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	37.0	59.9
Coarse Sand	22.9	29.0
Medium Sand	29.0	---
Fine Sand	8.2	8.2
Silt	1.4	1.9
Clay	1.5	1.0

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Wet

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SP

Group Name: Poorly graded sand with gravel

AASHTO Classification: A-1-a (0)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-32, 25.0'-26.5'	Lab ID	82

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 2217
Particle Shape	Rounded
Particle Hardness:	Hard and Durable
Tested By	JMB
Test Date	11-06-2015
Date Received	10-28-2015

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3/4"	100.0
3/8"	83.7
No. 4	63.0
No. 10	40.1

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

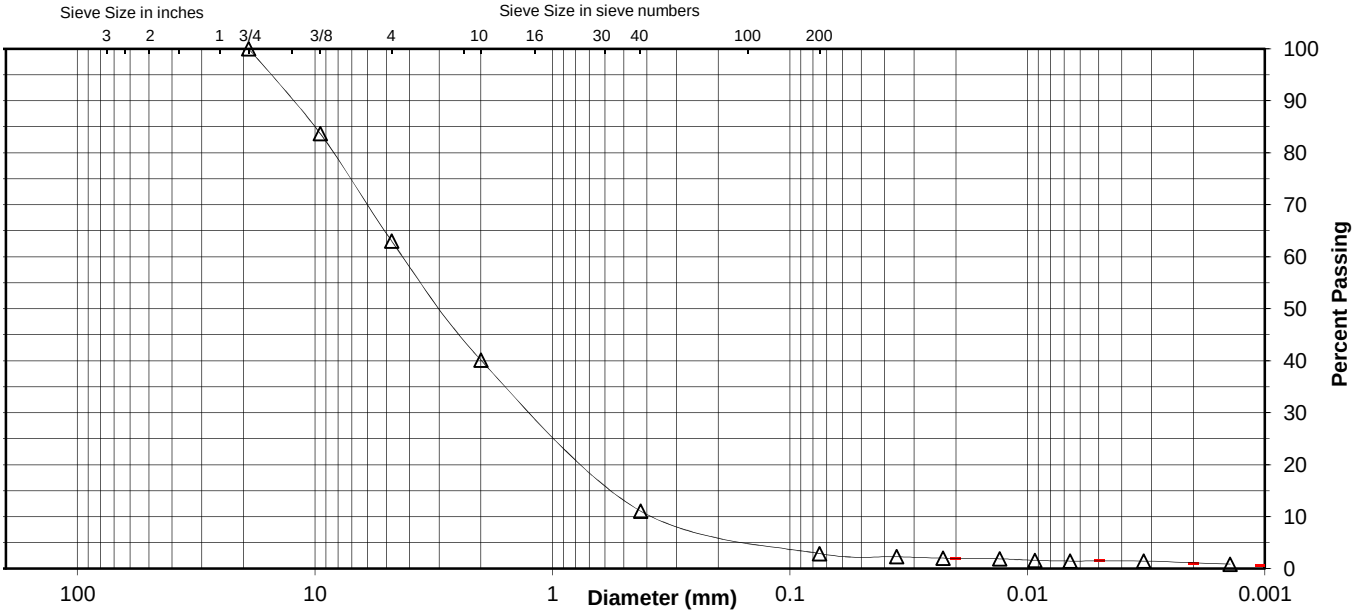
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	11.1
No. 200	2.9
0.02 mm	1.9
0.005 mm	1.5
0.002 mm	1.0
0.001 mm	0.6

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	37.0	22.9	29.0	8.2	1.4	1.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	59.9			29.0	8.2	1.9	1.0



Comments

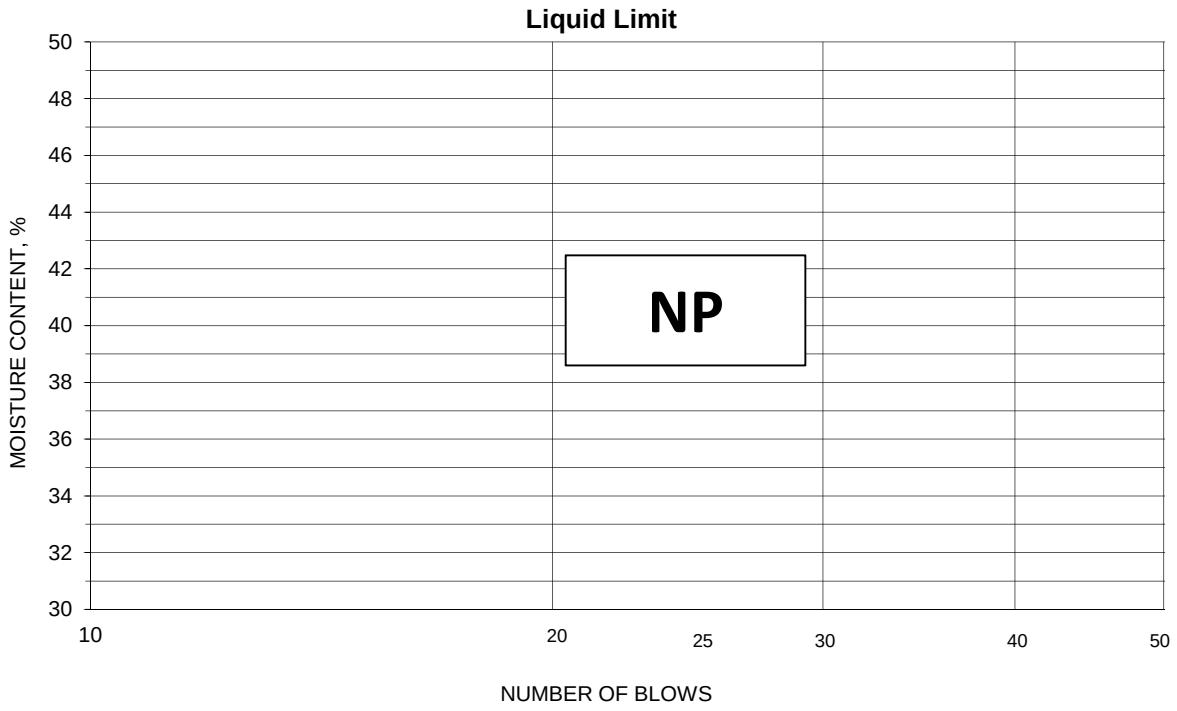
Reviewed By RHB

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-32, 25.0'-26.5'			Lab ID	82
				% + No. 40	89
Tested By	SK	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-04-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-33, 6.0'-7.5'	Lab ID	92
Sample Type	SPT	Date Received	10-28-15
		Date Reported	11-13-15

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 7.6

Particle Size Analysis

Preparation Method: ASTM D 2217

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	85.6
No. 200	0.075	50.4
	0.02	19.5
	0.005	13.1
	0.002	10.1
estimated	0.001	9.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	14.4
Medium Sand	14.4	---
Fine Sand	35.2	35.2
Silt	37.3	40.3
Clay	13.1	10.1

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Wet

Liquid Limit:	20
Plastic Limit:	19
Plasticity Index:	1
Activity Index:	0.10

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: ML

Group Name: Sandy silt

AASHTO Classification: A-4 (0)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name: ALF - West Ash Pond Complex Final Closure
Project Number: 172675015
Source: STN-33, 6.0'-7.5'
Lab ID: 92

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 2217

Particle Shape: N/A
Particle Hardness: N/A

Tested By: SK
Test Date: 11-03-2015
Date Received: 10-28-2015

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

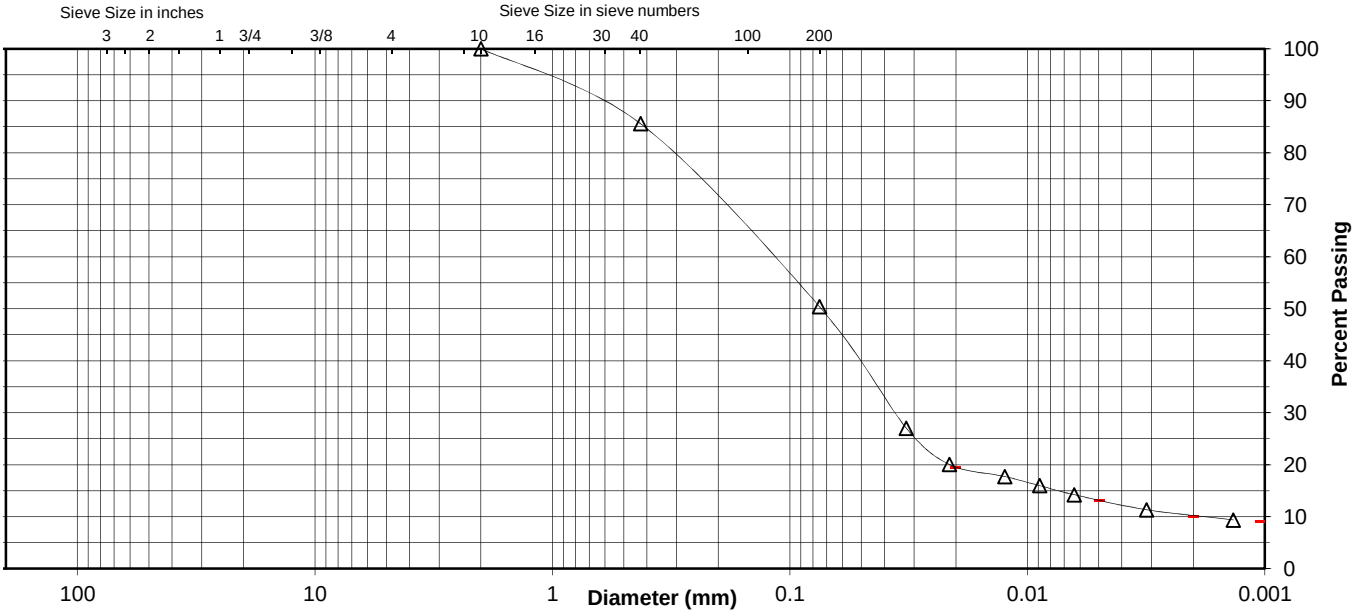
Specific Gravity: 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	85.6
No. 200	50.4
0.02 mm	19.5
0.005 mm	13.1
0.002 mm	10.1
0.001 mm	9.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	14.4	35.2	37.3	13.1
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			14.4	35.2	40.3	10.1



Comments:

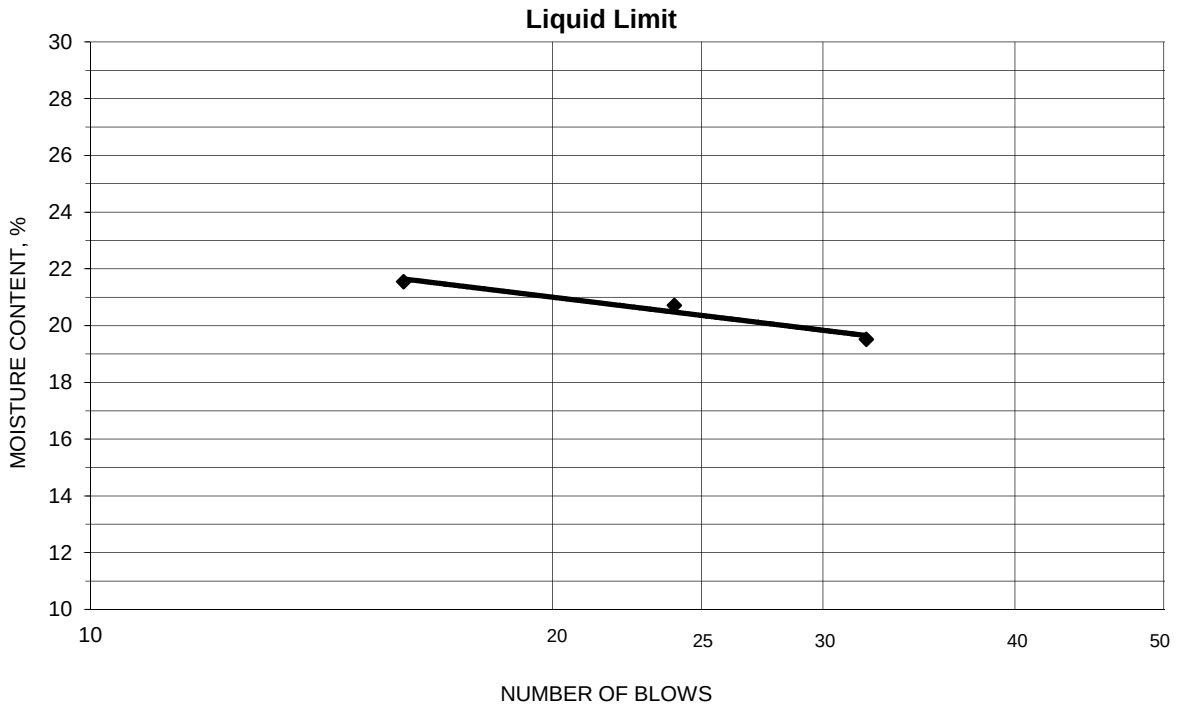
Reviewed By: RHB

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-33, 6.0'-7.5'			Lab ID	92
				% + No. 40	14
Tested By	JMB	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-05-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
10.73	9.68	4.30	32	19.5	
11.46	10.23	4.29	24	20.7	
13.75	12.08	4.33	16	21.5	20



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
12.10	10.88	4.32	18.6	19	1
12.15	10.85	4.32	19.9		

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-33, 13.5'-15.0'	Lab ID	97
Sample Type	SPT	Date Received	10-28-15
		Date Reported	11-13-15

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 6.8

Particle Size Analysis

Preparation Method: ASTM D 2217

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
3/8"	9.5	100.0
No. 4	4.75	99.6
No. 10	2	98.4
No. 40	0.425	86.5
No. 200	0.075	37.4
	0.02	18.0
	0.005	10.4
	0.002	8.5
estimated	0.001	7.8

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.4	1.6
Coarse Sand	1.2	11.9
Medium Sand	11.9	---
Fine Sand	49.1	49.1
Silt	27.0	28.9
Clay	10.4	8.5

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Wet

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SM

Group Name: Silty sand

AASHTO Classification: A-4 (0)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name: ALF - West Ash Pond Complex Final Closure
Project Number: 172675015
Source: STN-33, 13.5'-15.0'
Lab ID: 97

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 2217

Particle Shape: Rounded
Particle Hardness: Hard and Durable

Tested By: JMB
Test Date: 11-05-2015
Date Received: 10-28-2015

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3/8"	100.0
No. 4	99.6
No. 10	98.4

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

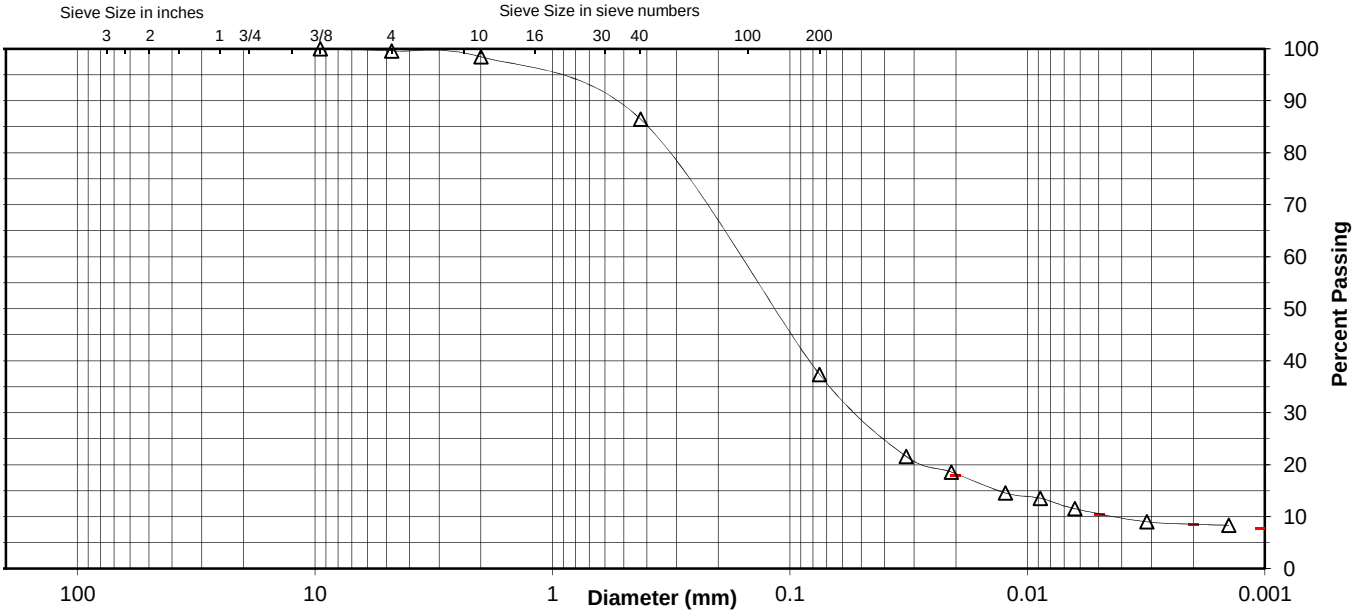
Specific Gravity: 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	86.5
No. 200	37.4
0.02 mm	18.0
0.005 mm	10.4
0.002 mm	8.5
0.001 mm	7.8

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.4	1.2	11.9	49.1	27.0	10.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	1.6			11.9	49.1	28.9	8.5



Comments

Reviewed By RHB

File: frm_172675015_sum_97.xlsm
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.
Louisville, Kentucky

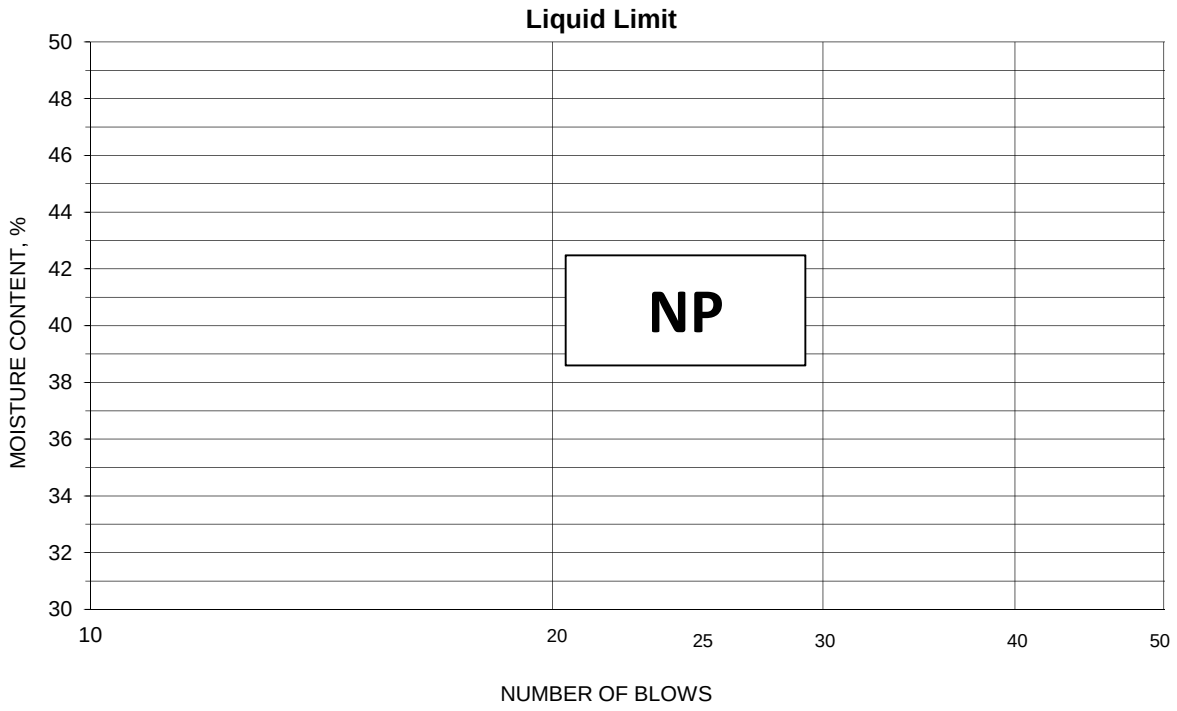
Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-33, 13.5'-15.0'			Lab ID	97
				% + No. 40	14
Tested By	JMB	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-05-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-33, 21.0'-22.5'	Lab ID	102
Sample Type	SPT	Date Received	10-28-15
		Date Reported	11-13-15

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 5.0

Particle Size Analysis

Preparation Method: ASTM D 2217

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	99.6
No. 200	0.075	16.5
	0.02	6.6
	0.005	3.6
	0.002	3.0
estimated	0.001	2.9

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.4
Medium Sand	0.4	---
Fine Sand	83.1	83.1
Silt	12.9	13.5
Clay	3.6	3.0

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Wet

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SM

Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-33, 21.0'-22.5'	Lab ID	102

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 2217
Particle Shape	N/A
Particle Hardness:	N/A
Tested By	SK
Test Date	11-04-2015
Date Received	10-28-2015

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

Specific Gravity 2.7

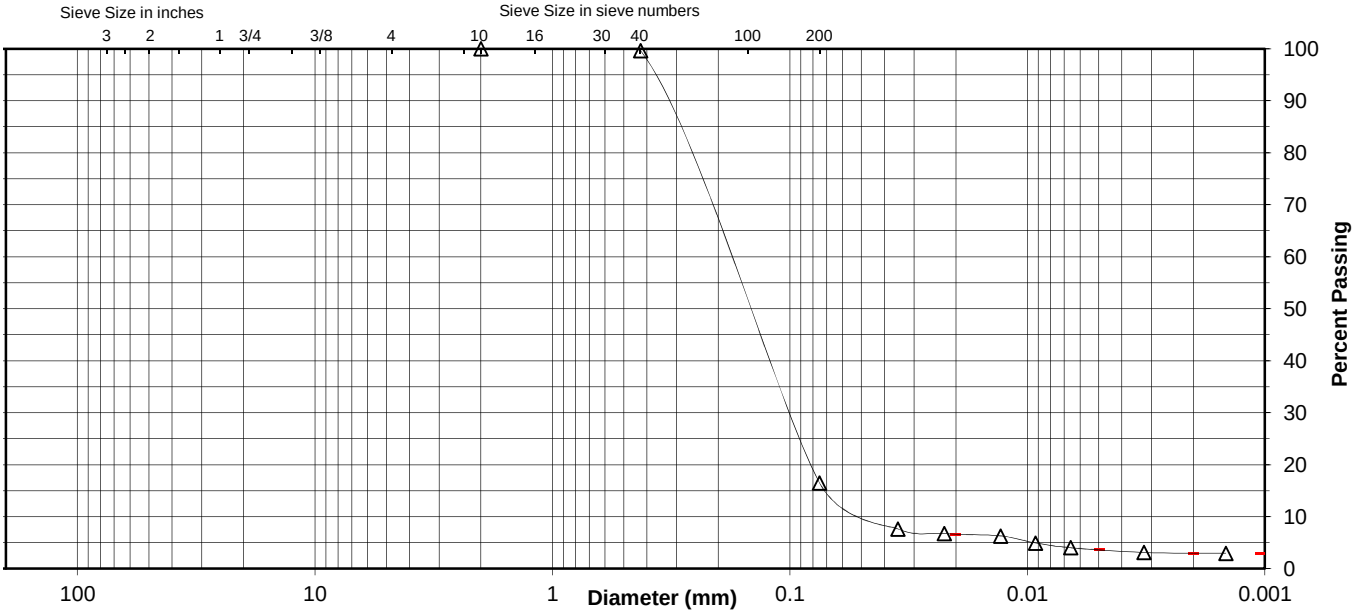
Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	99.6
No. 200	16.5
0.02 mm	6.6
0.005 mm	3.6
0.002 mm	3.0
0.001 mm	2.9

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.4	83.1	12.9	3.6

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.4	83.1	13.5	3.0



Comments

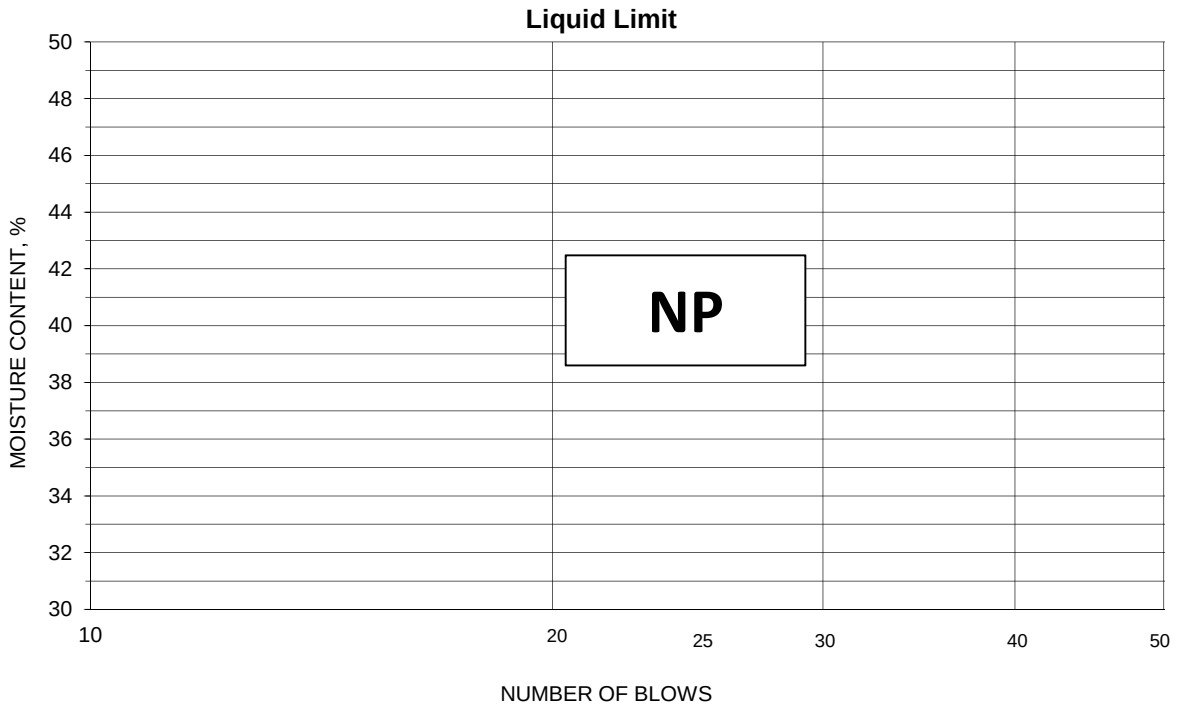
Reviewed By RHB

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-33, 21.0'-22.5'			Lab ID	102
				% + No. 40	0
Tested By	SK	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-04-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-33, 40.5'-42.0'	Lab ID	115
Sample Type	SPT	Date Received	10-28-15
		Date Reported	11-13-15

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 7.8

Particle Size Analysis

Preparation Method: ASTM D 2217

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
1 1/2"	37.5	100.0
1"	25	89.4
3/4"	19	89.4
3/8"	9.5	76.2
No. 4	4.75	61.1
No. 10	2	45.0
No. 40	0.425	15.6
No. 200	0.075	3.6
	0.02	2.1
	0.005	1.2
	0.002	1.0
estimated	0.001	0.8

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	38.9	55.0
Coarse Sand	16.2	29.4
Medium Sand	29.4	---
Fine Sand	12.0	12.0
Silt	2.4	2.6
Clay	1.2	1.0

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Wet

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SW

Group Name: Well-graded sand with gravel

AASHTO Classification: A-1-a (0)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-33, 40.5'-42.0'	Lab ID	115

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 2217
Particle Shape	Rounded
Particle Hardness:	Hard and Durable
Tested By	JMB
Test Date	11-05-2015
Date Received	10-28-2015

Maximum Particle size: 1 1/2" Sieve

Sieve Size	% Passing
1 1/2"	100.0
1"	89.4
3/4"	89.4
3/8"	76.2
No. 4	61.1
No. 10	45.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

Specific Gravity 2.7

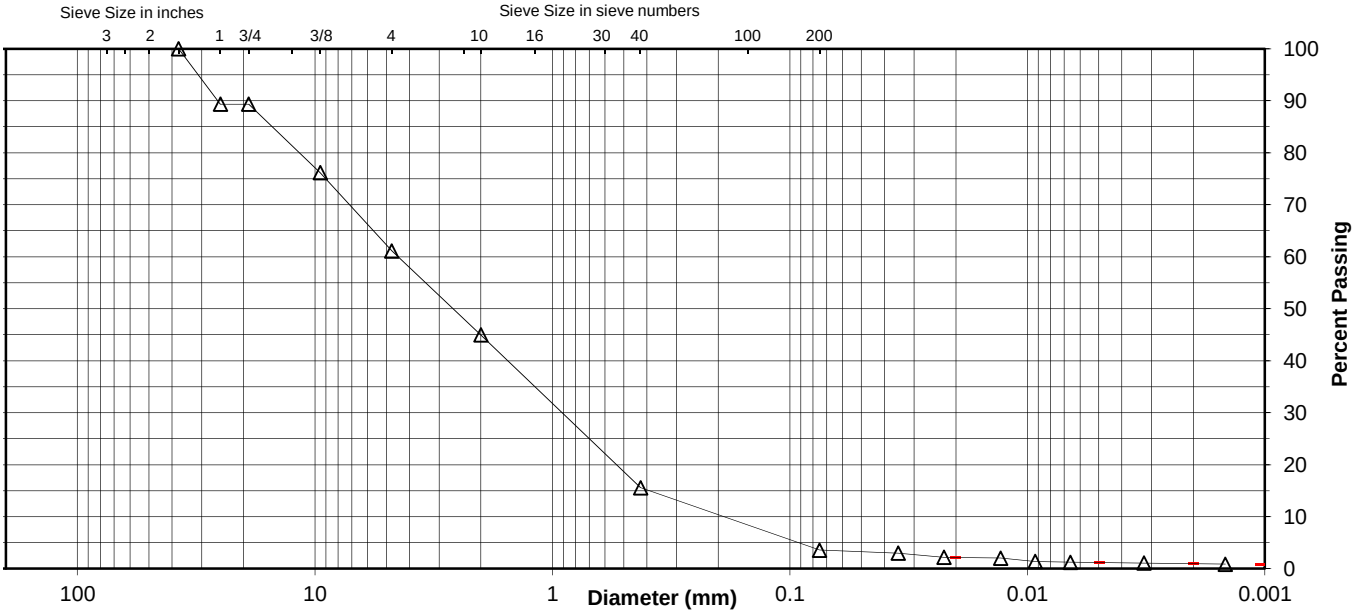
Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	15.6
No. 200	3.6
0.02 mm	2.1
0.005 mm	1.2
0.002 mm	1.0
0.001 mm	0.8

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	10.6	28.3	16.1	29.4	12.0	2.4	1.2

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	55.0	29.4	12.0	2.6	1.0



Comments

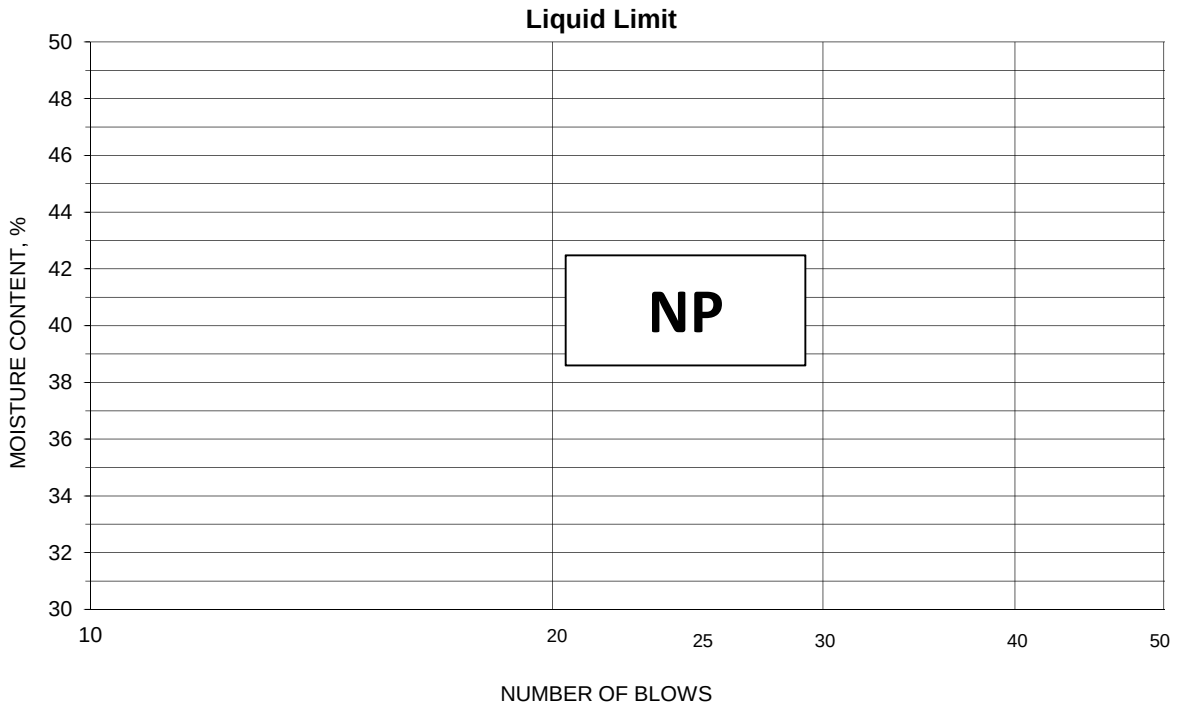
Reviewed By RHB

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-33, 40.5'-42.0'			Lab ID	115
				% + No. 40	84
Tested By	SK	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-06-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-34, 12.5'-14.0'	Lab ID	130
Sample Type	SPT	Date Received	10-28-15
		Date Reported	12-3-15

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 27.0

Particle Size Analysis

Preparation Method: ASTM D 2217

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	100.0
No. 200	0.075	33.8
	0.02	9.9
	0.005	8.4
	0.002	7.6
estimated	0.001	6.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.0
Medium Sand	0.0	---
Fine Sand	66.2	66.2
Silt	25.4	26.2
Clay	8.4	7.6

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Wet

Liquid Limit: NP

Plastic Limit: NP

Plasticity Index: NP

Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A

Maximum Dry Density (kg/m^3): N/A

Optimum Moisture Content (%): N/A

Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A

Compacted Dry Density (lb/ft^3): N/A

Compacted Moisture Content (%): N/A

Specific Gravity

Estimated

Particle Size: No. 10

Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SM

Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-34, 12.5'-14.0'	Lab ID	130

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 2217
Particle Shape	N/A
Particle Hardness:	N/A
Tested By	JMB
Test Date	11-30-2015
Date Received	10-28-2015

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

Specific Gravity 2.7

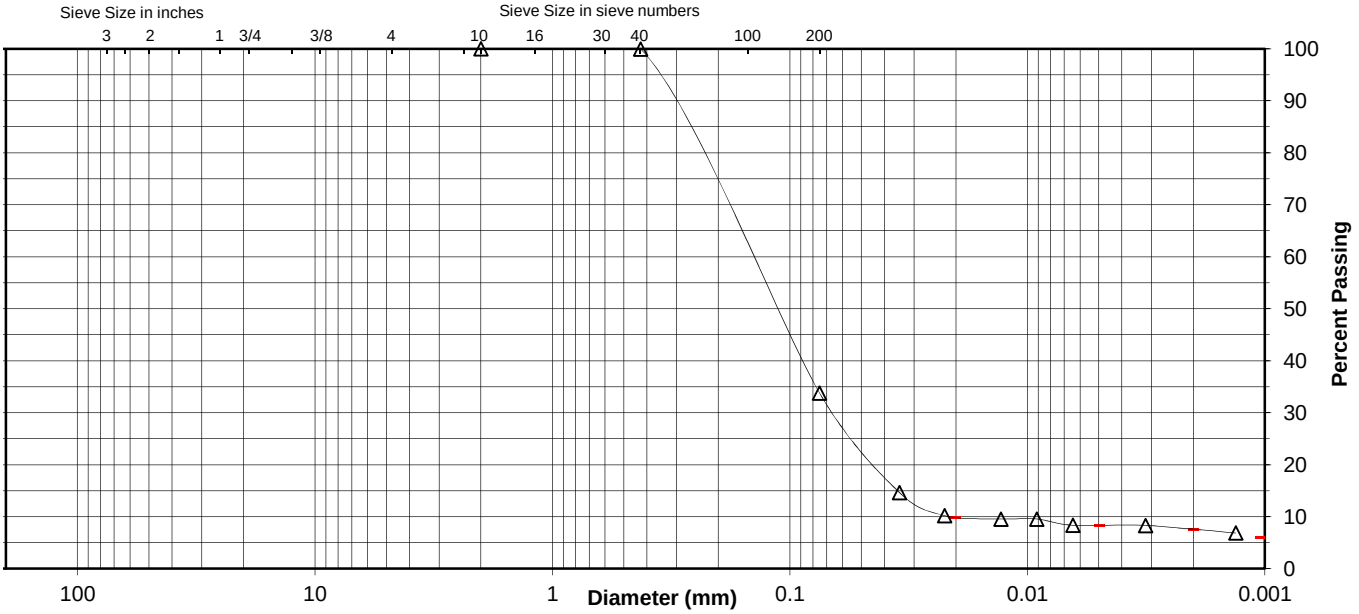
Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	100.0
No. 200	33.8
0.02 mm	9.9
0.005 mm	8.4
0.002 mm	7.6
0.001 mm	6.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.0	66.2	25.4	8.4

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.0	0.0	66.2	26.2	7.6



Comments

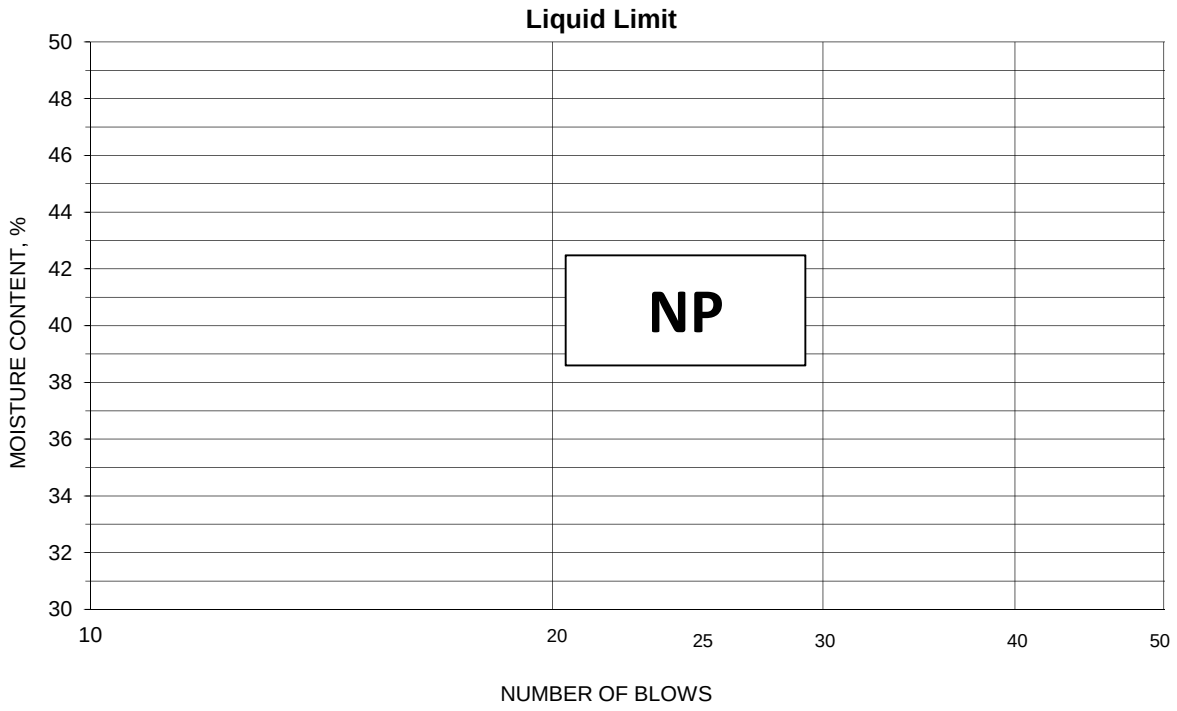
Reviewed By RHB

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-34, 12.5'-14.0'			Lab ID	130
				% + No. 40	0
Tested By	JMB	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-30-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-34, 20.0'-21.5'	Lab ID	135
Sample Type	SPT	Date Received	10-28-15
		Date Reported	12-3-15

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 33.7

Particle Size Analysis

Preparation Method: ASTM D 2217

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	100.0
No. 200	0.075	74.3
	0.02	27.4
	0.005	17.5
	0.002	15.0
estimated	0.001	13.4

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.0
Medium Sand	0.0	---
Fine Sand	25.7	25.7
Silt	56.8	59.3
Clay	17.5	15.0

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Wet

Liquid Limit:	28
Plastic Limit:	23
Plasticity Index:	5
Activity Index:	0.33

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	ML
Group Name:	Silt with sand
AASHTO Classification:	A-4 (3)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-34, 20.0'-21.5'	Lab ID	135

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 2217
Particle Shape	N/A
Particle Hardness:	N/A
Tested By	LC
Test Date	11-30-2015
Date Received	10-28-2015

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

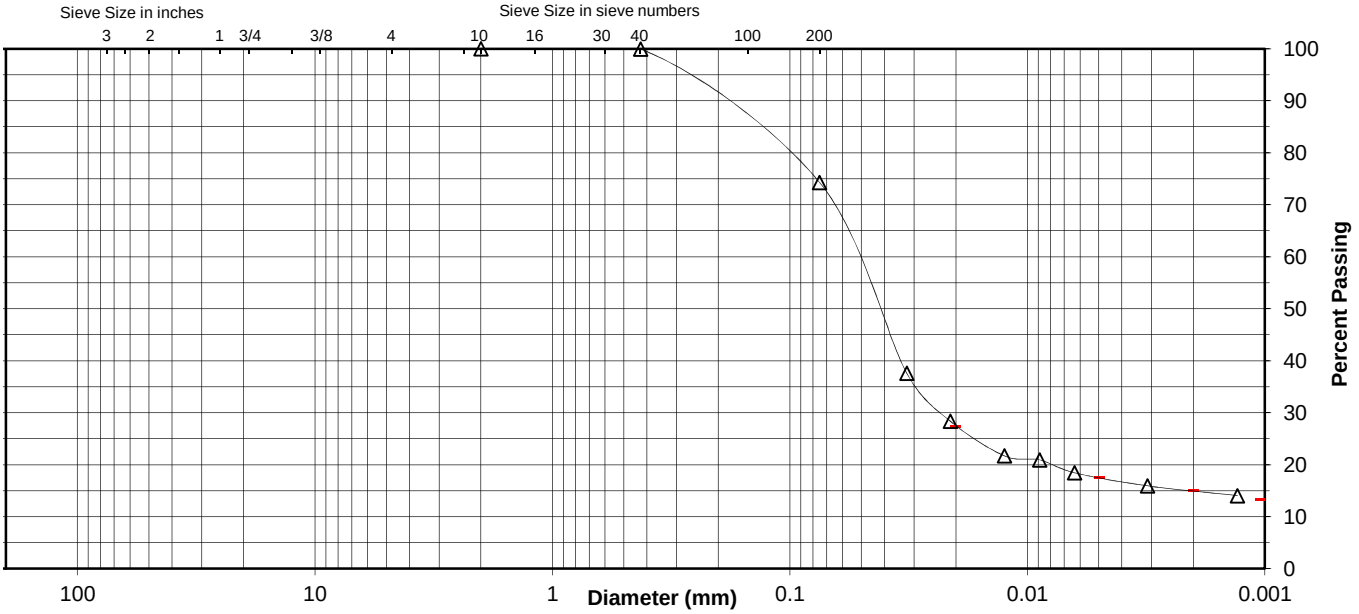
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	100.0
No. 200	74.3
0.02 mm	27.4
0.005 mm	17.5
0.002 mm	15.0
0.001 mm	13.4

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.0	25.7	56.8	17.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.0	25.7	59.3	15.0



Comments

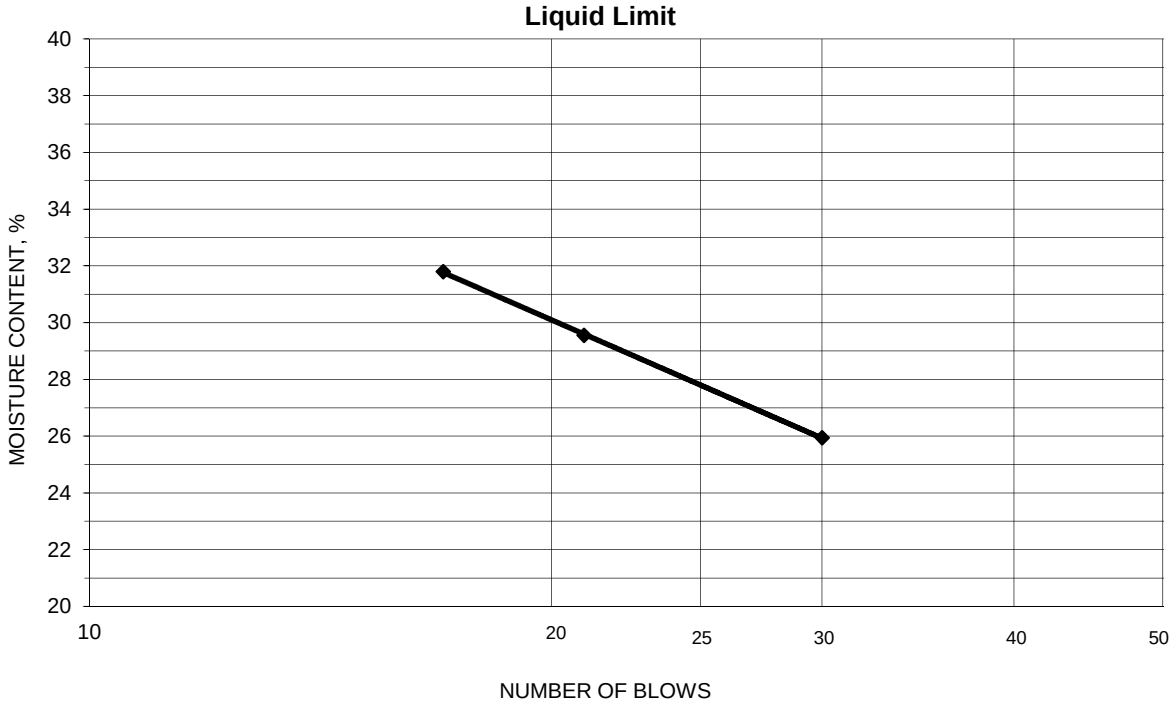
Reviewed By RHB

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-34, 20.0'-21.5'			Lab ID	135
				% + No. 40	0
Tested By	JMB	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	12-01-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
13.36	11.50	4.33	30	25.9	
14.05	11.81	4.23	21	29.6	
13.67	11.40	4.26	17	31.8	28



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
10.06	8.98	4.29	23.0	23	5
11.99	10.56	4.28	22.8		

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-35, 7.3'-7.7'	Lab ID	149
Sample Type	ST	Date Received	10-28-15
		Date Reported	11-19-15

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 2217
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	99.9
No. 200	0.075	70.2
	0.02	13.3
	0.005	6.0
	0.002	4.0
estimated	0.001	3.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.1
Medium Sand	0.1	---
Fine Sand	29.7	29.7
Silt	64.2	66.2
Clay	6.0	4.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Wet

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	ML
Group Name:	Silt with sand
AASHTO Classification:	A-4 (0)

Comments:

Reviewed By RJ

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-35, 7.3'-7.7'	Lab ID	149

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 2217
Particle Shape	N/A
Particle Hardness:	N/A
Tested By	DB
Test Date	11-10-2015
Date Received	10-28-2015

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

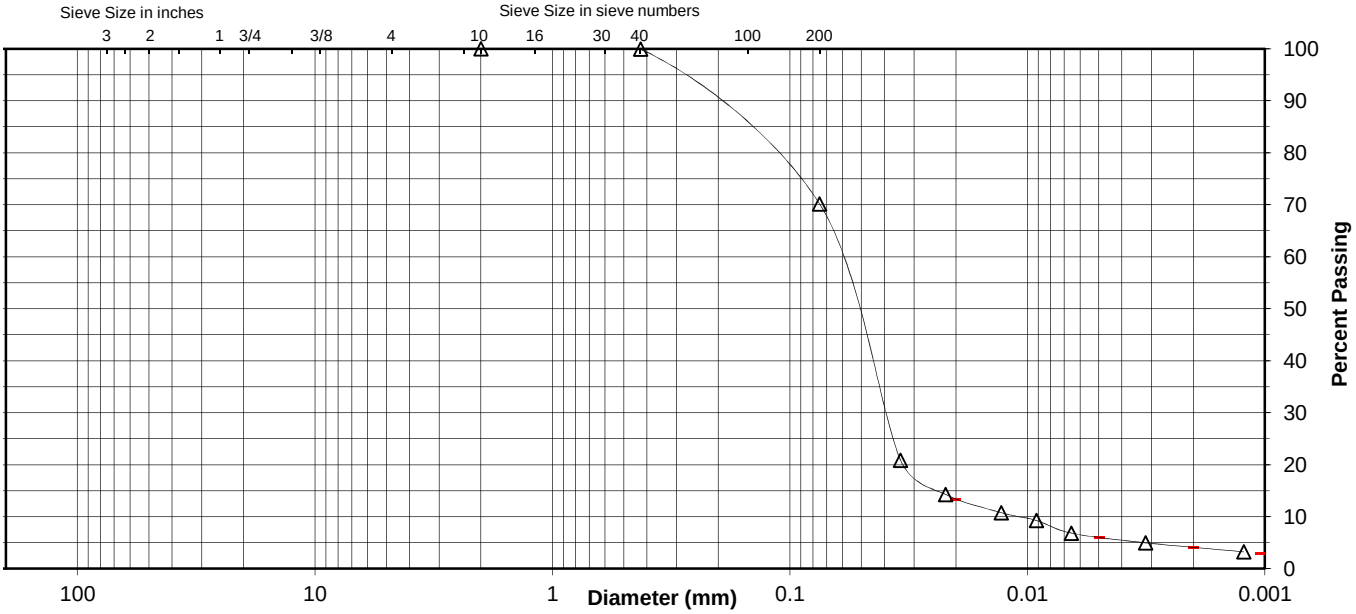
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	99.9
No. 200	70.2
0.02 mm	13.3
0.005 mm	6.0
0.002 mm	4.0
0.001 mm	3.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.1	29.7	64.2	6.0
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.1	29.7	66.2	4.0



Comments

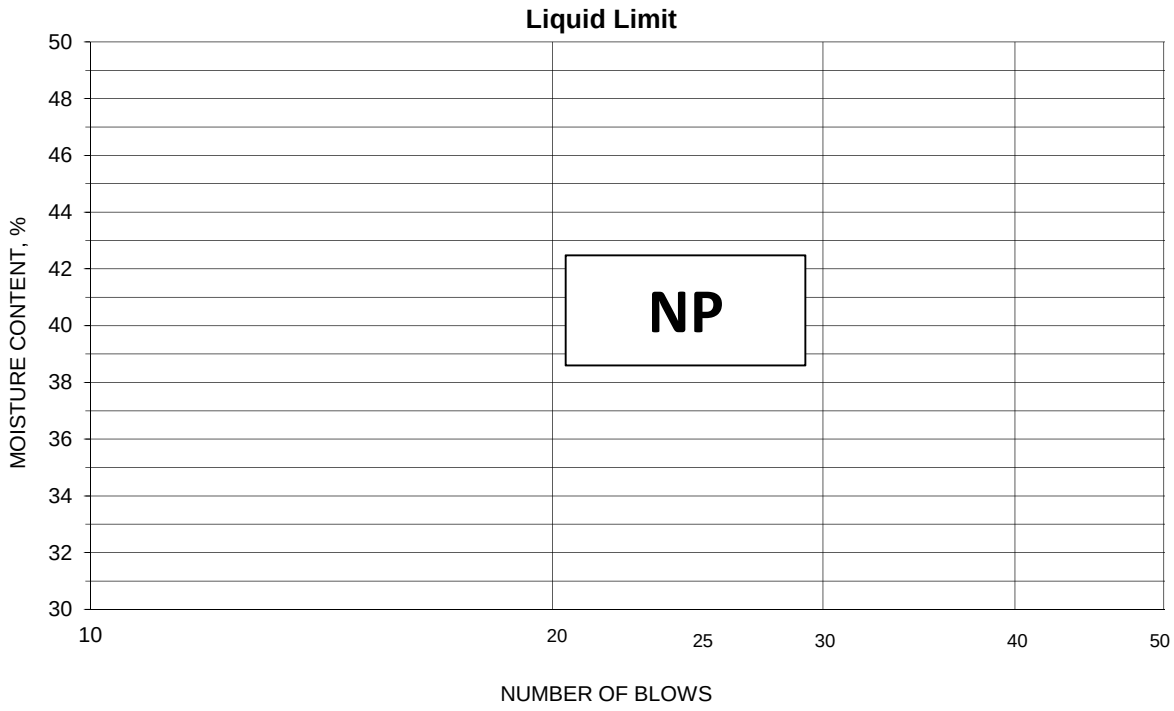
Reviewed By RJ

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-35, 7.3'-7.7'			Lab ID	149
				% + No. 40	0
Tested By	KG	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-03-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RJ

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-35, 17.5'-19.0'	Lab ID	156
Sample Type	SPT	Date Received	10-28-15
		Date Reported	12-3-15

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 38.2

Particle Size Analysis

Preparation Method: ASTM D 2217

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	100.0
No. 200	0.075	42.7
	0.02	17.1
	0.005	10.7
	0.002	9.0
estimated	0.001	8.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.0
Medium Sand	0.0	---
Fine Sand	57.3	57.3
Silt	32.0	33.7
Clay	10.7	9.0

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Dry

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: SM

Group Name: Silty sand

AASHTO Classification: A-4 (0)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-35, 17.5'-19.0'	Lab ID	156

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 2217
Particle Shape	N/A
Particle Hardness:	N/A
Tested By	LC
Test Date	11-30-2015
Date Received	10-28-2015

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

Specific Gravity 2.7

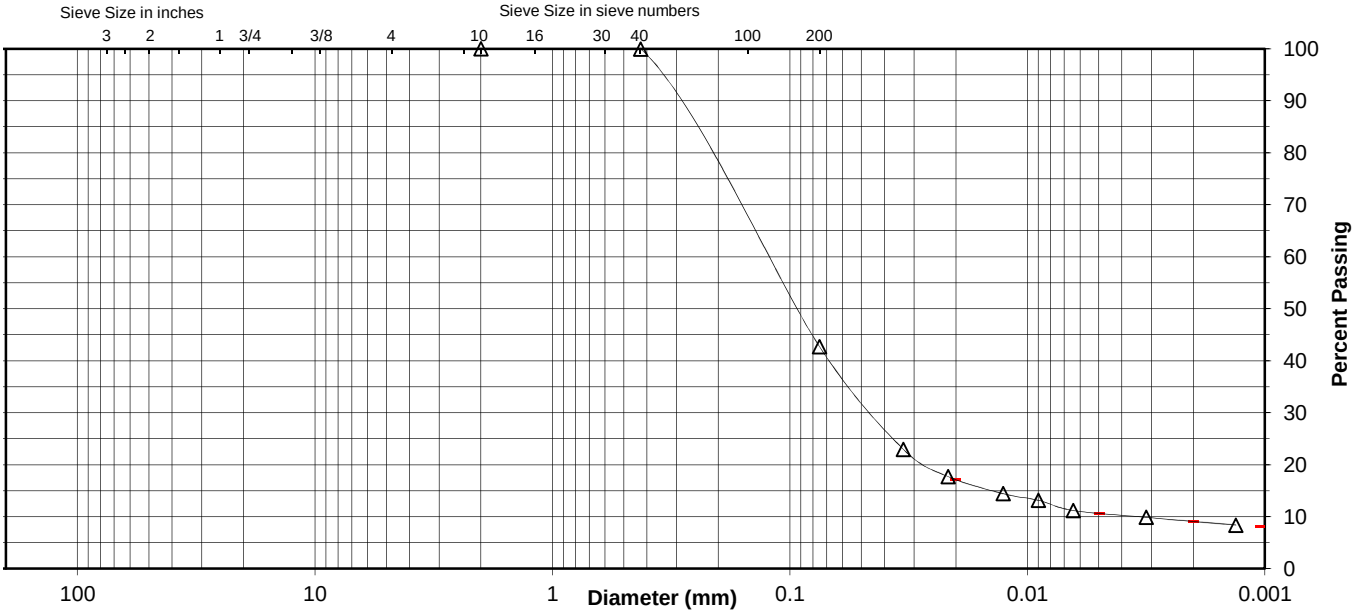
Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	100.0
No. 200	42.7
0.02 mm	17.1
0.005 mm	10.7
0.002 mm	9.0
0.001 mm	8.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.0	57.3	32.0	10.7

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.0	57.3	33.7	9.0



Comments

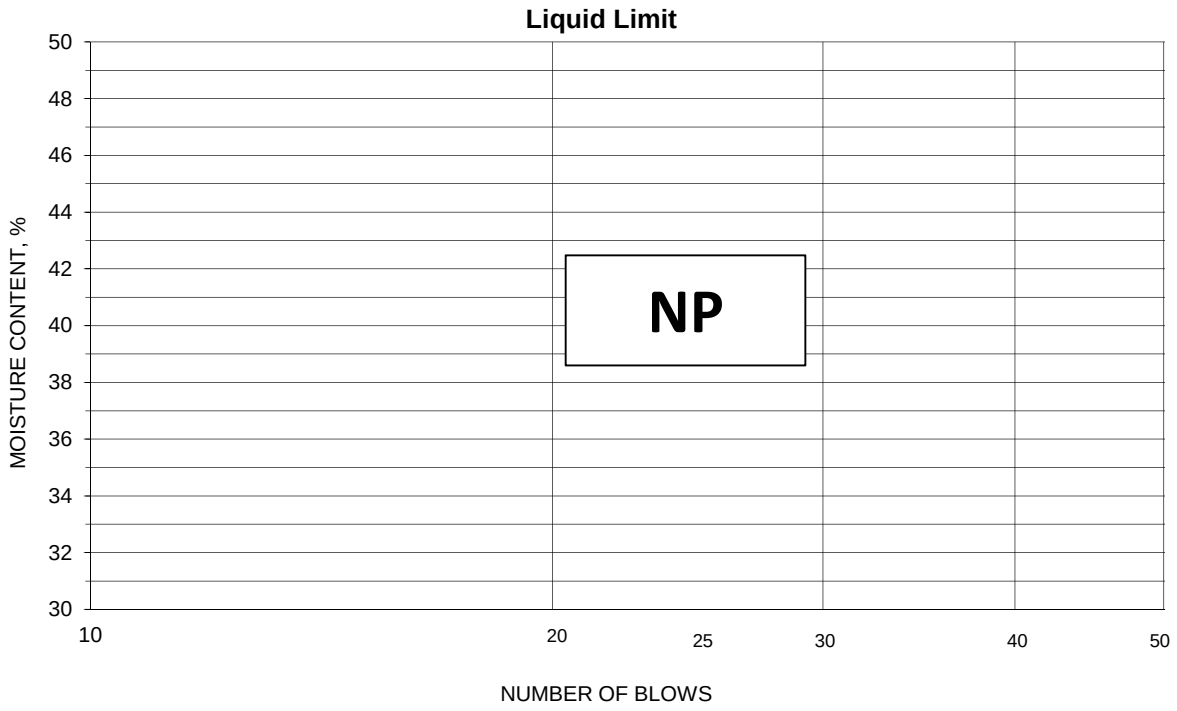
Reviewed By RHB

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-35, 17.5'-19.0'			Lab ID	156
				% + No. 40	0
Tested By	JMB	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-30-2015	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-35, 28.0'-29.5'	Lab ID	163
Sample Type	SPT	Date Received	10-28-15
		Date Reported	12-3-15

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 38.1

Particle Size Analysis

Preparation Method: ASTM D 2217

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	100.0
No. 200	0.075	89.5
	0.02	59.7
	0.005	39.7
	0.002	32.0
estimated	0.001	27.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.0
Medium Sand	0.0	---
Fine Sand	10.5	10.5
Silt	49.8	57.5
Clay	39.7	32.0

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Wet

Liquid Limit:	48
Plastic Limit:	20
Plasticity Index:	28
Activity Index:	0.88

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: CL

Group Name: Lean clay

AASHTO Classification: A-7-6 (27)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name: ALF - West Ash Pond Complex Final Closure
Project Number: 172675015
Source: STN-35, 28.0'-29.5'
Lab ID: 163

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 2217

Particle Shape: N/A
Particle Hardness: N/A

Tested By: JMB
Test Date: 11-30-2015
Date Received: 10-28-2015

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

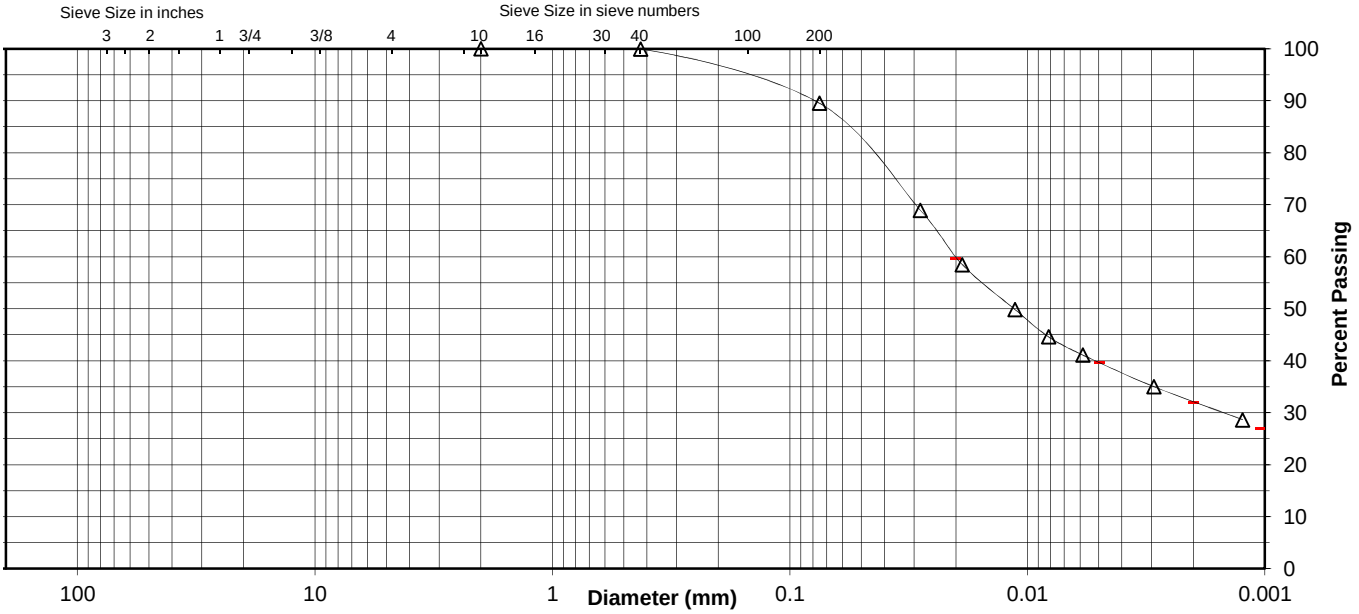
Specific Gravity: 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	100.0
No. 200	89.5
0.02 mm	59.7
0.005 mm	39.7
0.002 mm	32.0
0.001 mm	27.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.0	10.5	49.8	39.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.0	10.5	57.5	32.0



Comments

Reviewed By RHB

File: frm_172675015_sum_163.xlsm
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.
Louisville, Kentucky

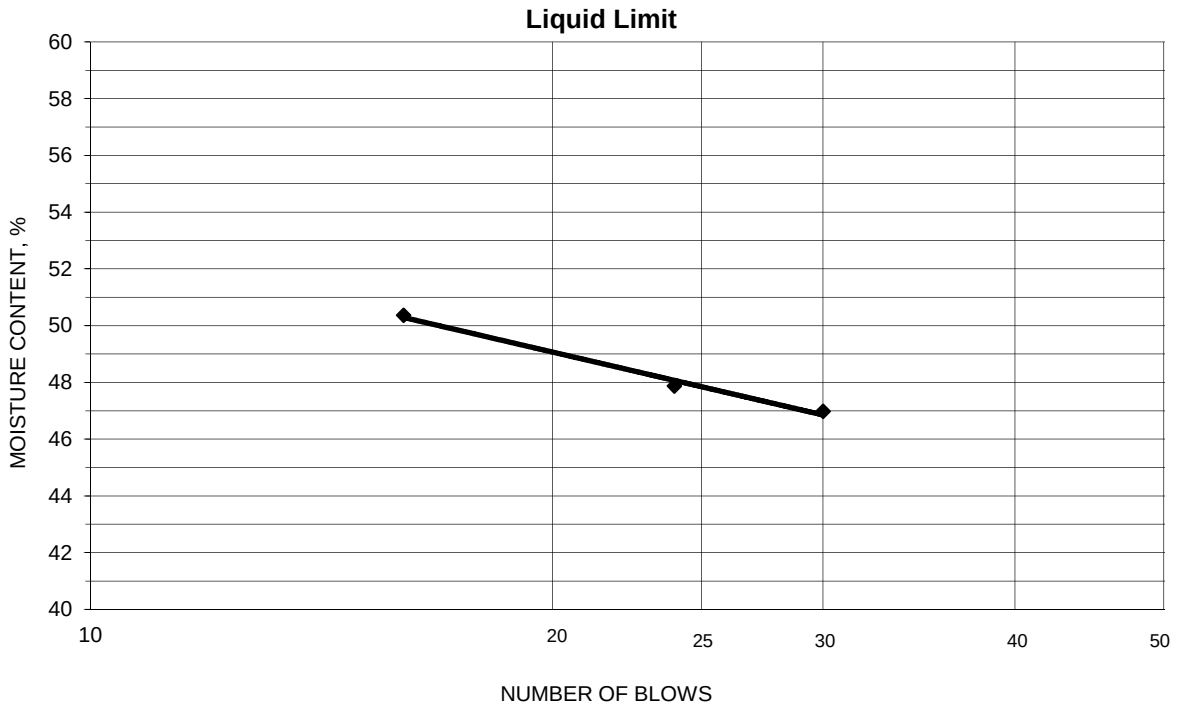
Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-35, 28.0'-29.5'			Lab ID	163
				% + No. 40	0
Tested By	JMB	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	12-01-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
11.13	8.95	4.31	30	47.0	
10.92	8.79	4.34	24	47.9	
12.64	9.84	4.28	16	50.4	48



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
11.80	10.58	4.36	19.6	20	28
12.12	10.85	4.30	19.4		

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-36, 31.5'-33.0'	Lab ID	188
Sample Type	SPT	Date Received	10-28-15
		Date Reported	12-3-15

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 24.9

Particle Size Analysis

Preparation Method: ASTM D 2217

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	99.9
No. 200	0.075	62.5
	0.02	18.6
	0.005	13.0
	0.002	11.2
estimated	0.001	9.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.1
Coarse Sand	0.1	0.0
Medium Sand	0.0	---
Fine Sand	37.4	37.4
Silt	49.5	51.3
Clay	13.0	11.2

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Wet

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: ML

Group Name: Sandy silt

AASHTO Classification: A-4 (0)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-36, 31.5'-33.0'	Lab ID	188

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 2217
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	LC
Test Date	11-30-2015
Date Received	10-28-2015

Maximum Particle size: No. 4 Sieve

Sieve Size	% Passing
No. 4	100.0
No. 10	99.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

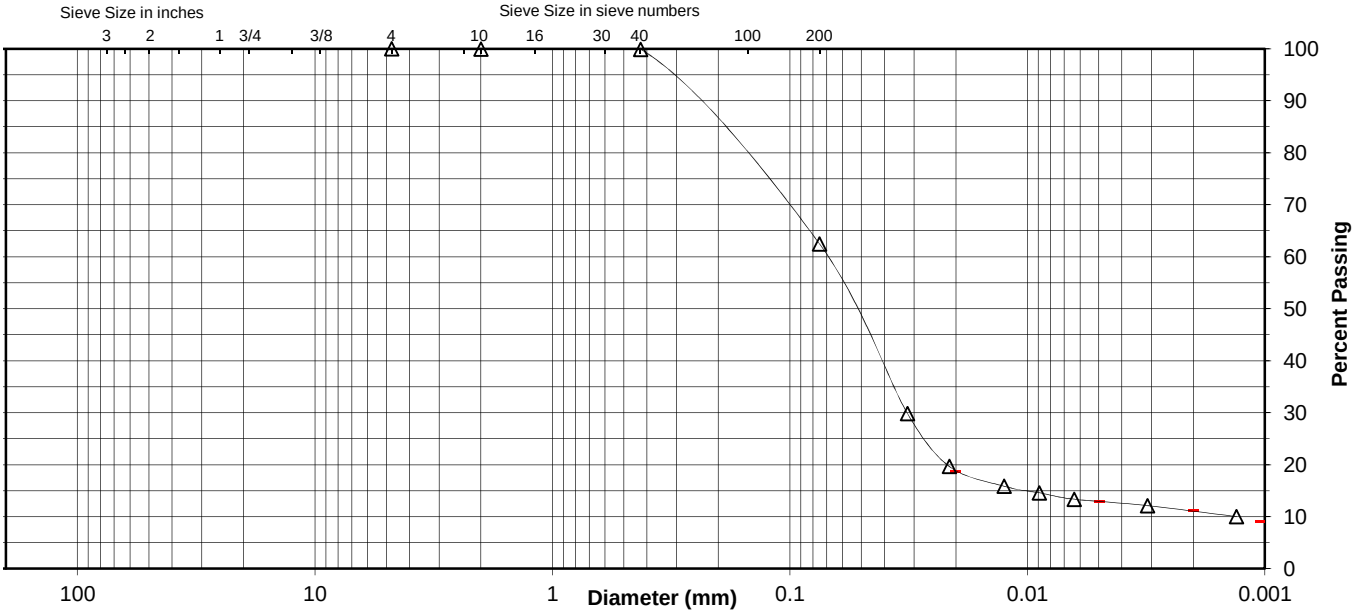
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	99.9
No. 200	62.5
0.02 mm	18.6
0.005 mm	13.0
0.002 mm	11.2
0.001 mm	9.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	0.0	37.4	49.5	13.0
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.1			0.0	37.4	51.3	11.2



Comments

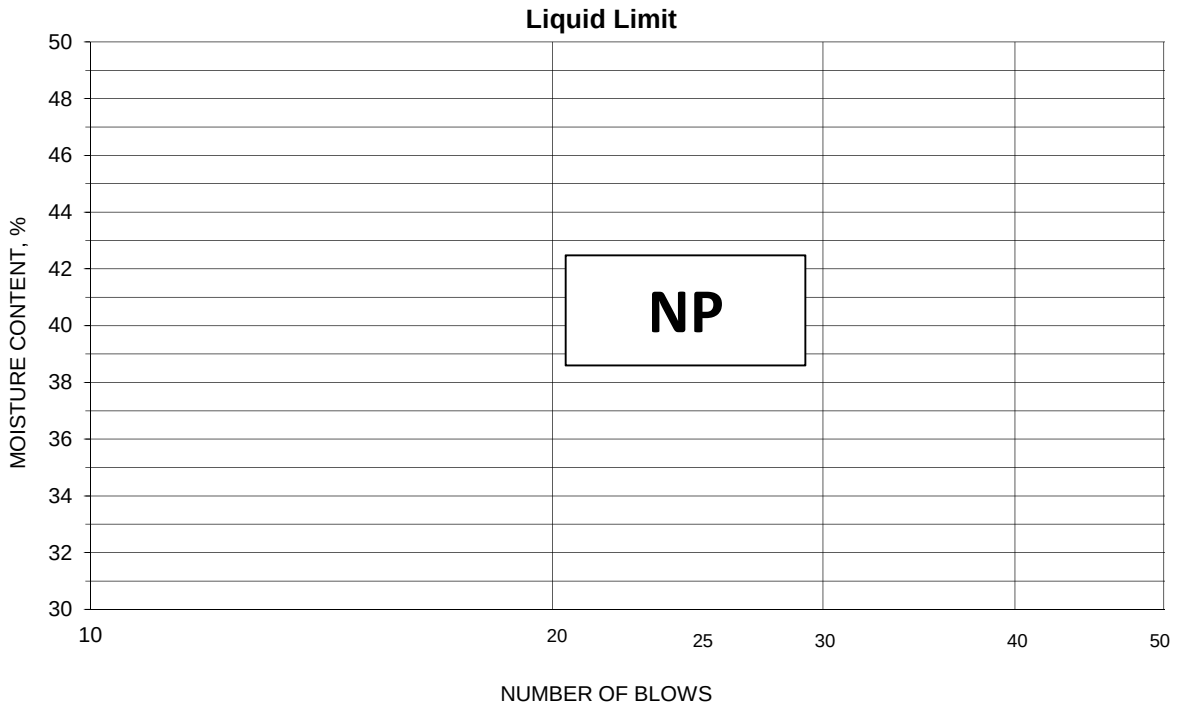
Reviewed By RHB

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-36, 31.5'-33.0'			Lab ID	188
				% + No. 40	0
Tested By	RHB	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-30-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-36, 42.5'-44.0'	Lab ID	195
Sample Type	SPT	Date Received	10-28-15
		Date Reported	12-3-15

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 2217
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	99.7
No. 200	0.075	24.5
	0.02	9.3
	0.005	7.7
	0.002	6.0
estimated	0.001	5.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.3
Medium Sand	0.3	---
Fine Sand	75.2	75.2
Silt	16.8	18.5
Clay	7.7	6.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Wet

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SM
Group Name:	Silty sand
AASHTO Classification:	A-2-4 (0)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-36, 42.5'-44.0'	Lab ID	195

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 2217
Particle Shape	N/A
Particle Hardness:	N/A
Tested By	JMB
Test Date	11-30-2015
Date Received	10-28-2015

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

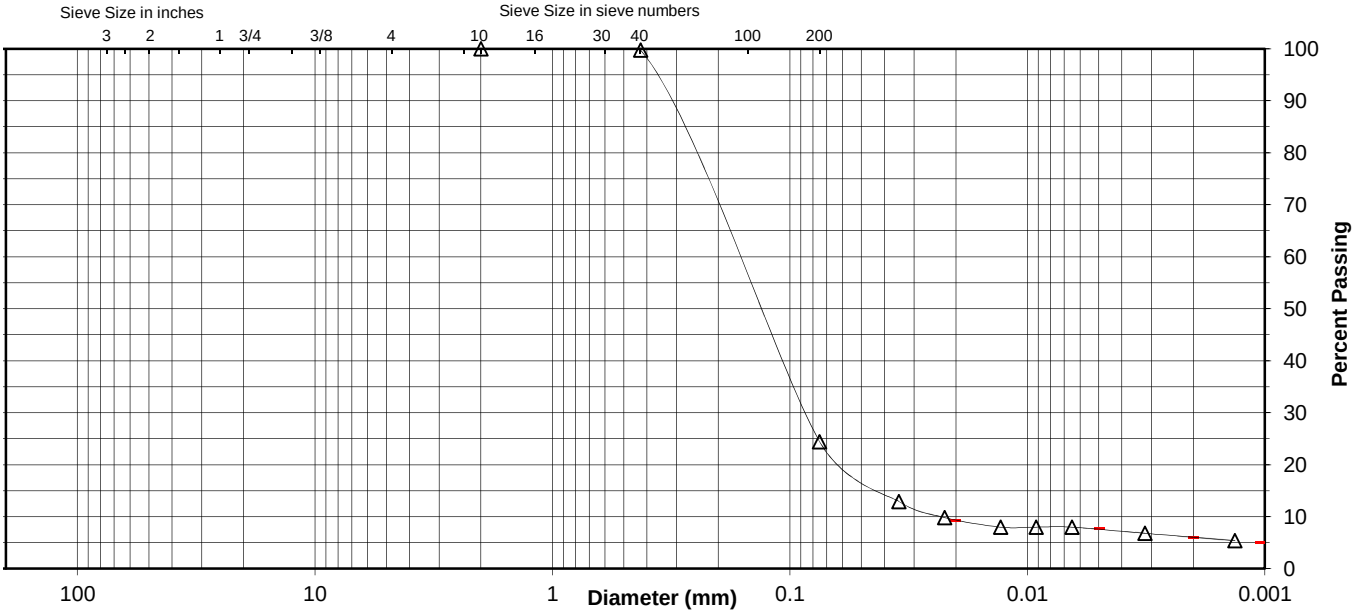
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	99.7
No. 200	24.5
0.02 mm	9.3
0.005 mm	7.7
0.002 mm	6.0
0.001 mm	5.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.3	75.2	16.8	7.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.3	75.2	18.5	6.0



Comments

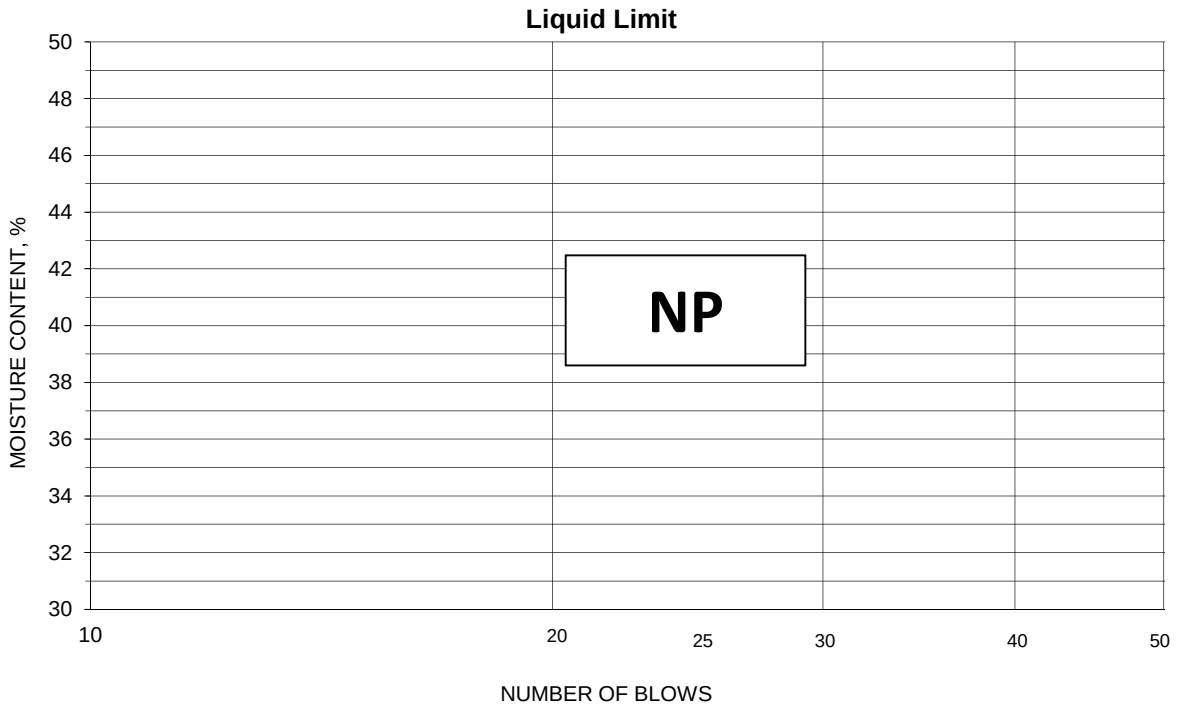
Reviewed By RHB

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-36, 42.5'-44.0'			Lab ID	195
				% + No. 40	0
Tested By	JMB	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-30-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-37, 26.7'-27.1'	Lab ID	217
Sample Type	ST	Date Received	10-28-15
		Date Reported	11-19-15

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 2217
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
3/4"	19	100.0
3/8"	9.5	99.2
No. 4	4.75	92.8
No. 10	2	88.2
No. 40	0.425	86.9
No. 200	0.075	78.8
	0.02	19.0
	0.005	7.2
	0.002	4.8
estimated	0.001	4.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	7.2	11.8
Coarse Sand	4.5	1.3
Medium Sand	1.3	---
Fine Sand	8.1	8.1
Silt	71.6	74.0
Clay	7.2	4.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Wet

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	ML
Group Name:	Silt with sand
AASHTO Classification:	A-4 (0)

Comments:

Reviewed By RJ

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-37, 26.7'-27.1'	Lab ID	217

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 2217
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	GW
Test Date	11-16-2015
Date Received	10-28-2015

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3/4"	100.0
3/8"	99.2
No. 4	92.8
No. 10	88.2

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

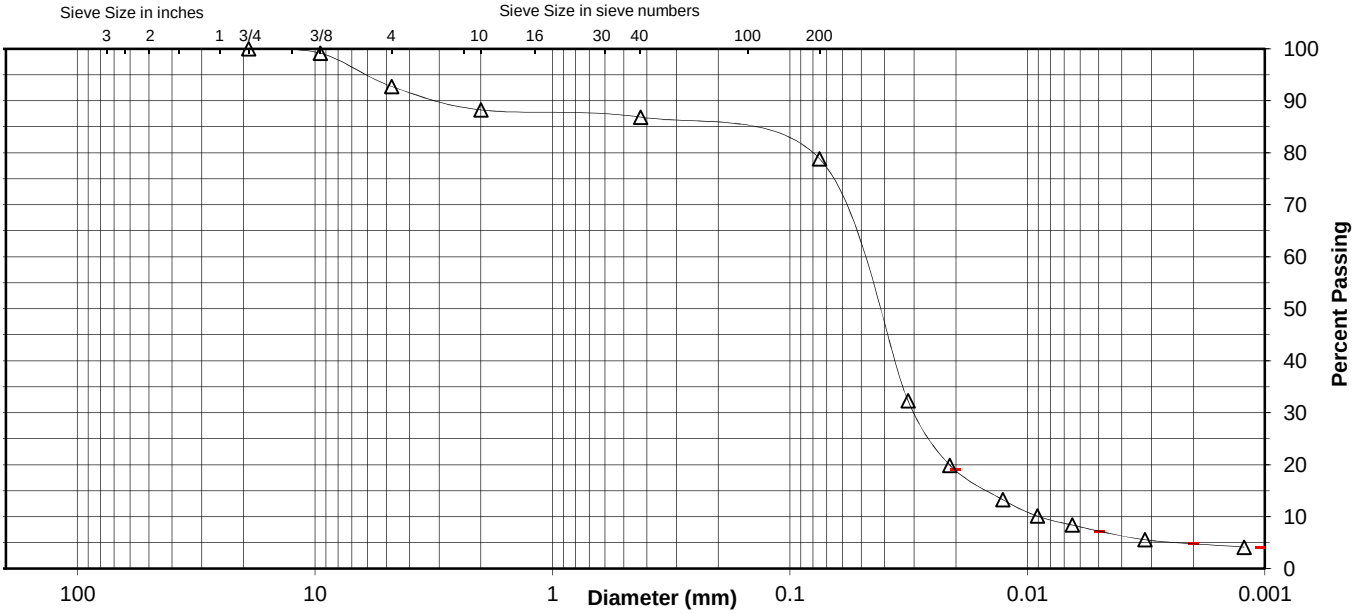
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	86.9
No. 200	78.8
0.02 mm	19.0
0.005 mm	7.2
0.002 mm	4.8
0.001 mm	4.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	7.2	4.6	1.3	8.1	71.6	7.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	11.8			1.3	8.1	74.0	4.8



Comments

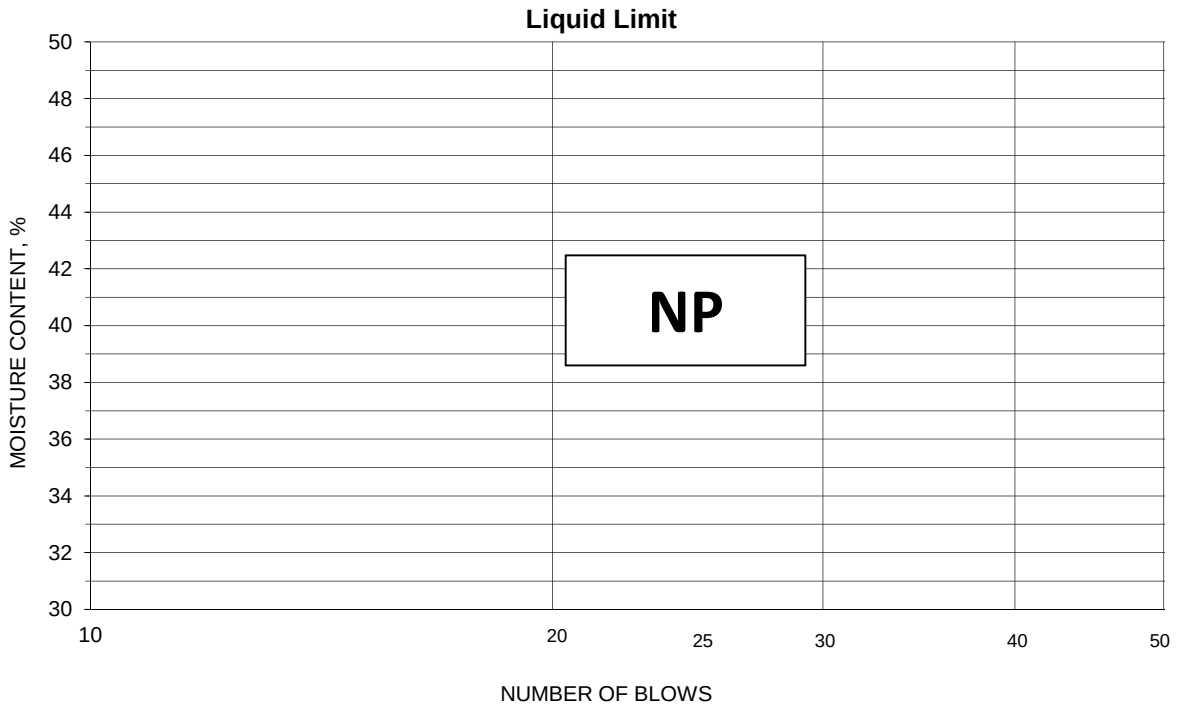
Reviewed By RJ

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-37, 26.7'-27.1'			Lab ID	217
				% + No. 40	13
Tested By	KG	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-03-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RJ

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-40, 29.0'-30.5'	Lab ID	289
Sample Type	SPT	Date Received	10-28-15
		Date Reported	12-3-15

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 27.4

Particle Size Analysis

Preparation Method: ASTM D 2217

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 4	4.75	100.0
No. 10	2	100.0
No. 40	0.425	99.8
No. 200	0.075	57.9
	0.02	25.7
	0.005	15.2
	0.002	12.5
estimated	0.001	11.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.2
Medium Sand	0.2	---
Fine Sand	41.9	41.9
Silt	42.7	45.4
Clay	15.2	12.5

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Wet

Liquid Limit:	NP
Plastic Limit:	NP
Plasticity Index:	NP
Activity Index:	N/A

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol: ML

Group Name: Sandy silt

AASHTO Classification: A-4 (0)

Comments:

Reviewed By RHB

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-40, 29.0'-30.5'	Lab ID	289

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 2217
Particle Shape	Angular
Particle Hardness:	Hard and Durable
Tested By	LC
Test Date	11-30-2015
Date Received	10-28-2015

Maximum Particle size: No. 4 Sieve

Sieve Size	% Passing
No. 4	100.0
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

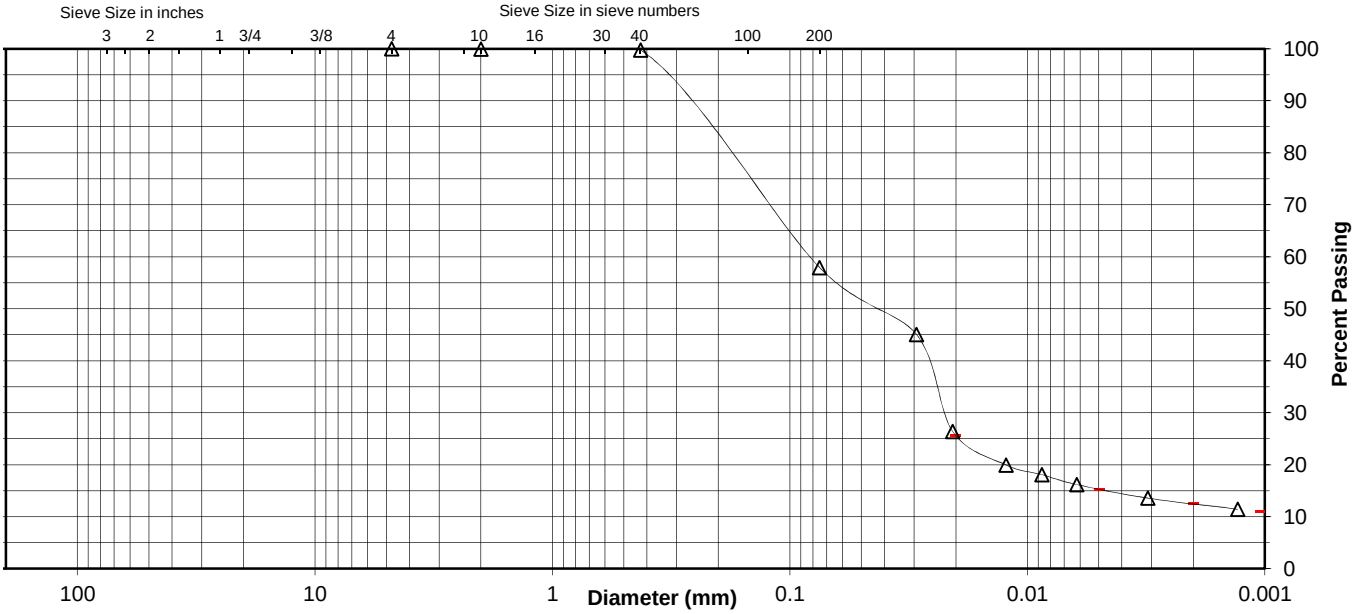
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	99.8
No. 200	57.9
0.02 mm	25.7
0.005 mm	15.2
0.002 mm	12.5
0.001 mm	11.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.2	41.9	42.7	15.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.2	41.9	45.4	12.5



Comments

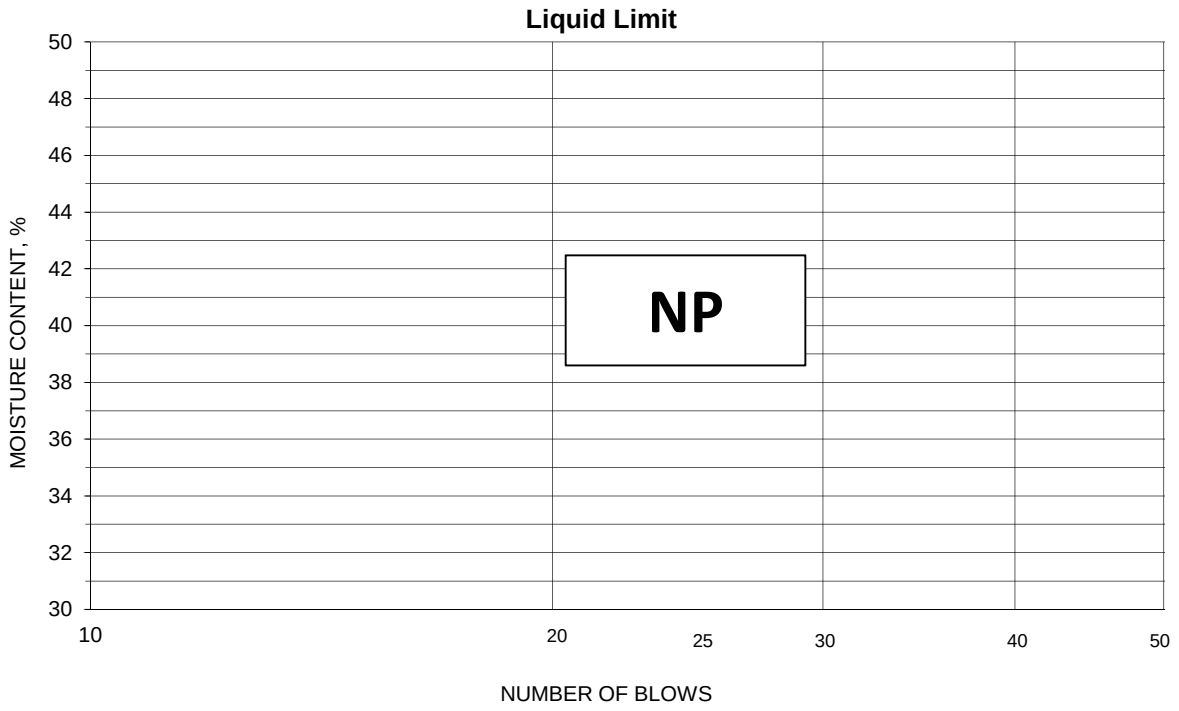
Reviewed By RHB

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-40, 29.0'-30.5'			Lab ID	289
				% + No. 40	0
Tested By	JMB	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-30-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks: _____

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-33A, 36.6'-37.0'	Lab ID	390
Sample Type	ST	Date Received	10-28-15
		Date Reported	11-19-15

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 2217
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
	N/A	
No. 10	2	100.0
No. 40	0.425	99.8
No. 200	0.075	46.4
	0.02	13.9
	0.005	4.9
	0.002	2.3
estimated	0.001	1.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.2
Medium Sand	0.2	---
Fine Sand	53.4	53.4
Silt	41.5	44.1
Clay	4.9	2.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Wet

Liquid Limit:	26
Plastic Limit:	18
Plasticity Index:	8
Activity Index:	4.00

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3):	N/A
Maximum Dry Density (kg/m^3):	N/A
Optimum Moisture Content (%):	N/A
Over Size Correction %:	N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%):	N/A
Compacted Dry Density (lb/ft^3):	N/A
Compacted Moisture Content (%):	N/A

Specific Gravity

Estimated

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.70

Classification

Unified Group Symbol:	SC
Group Name:	Clayey sand
AASHTO Classification:	A-4 (1)

Comments:

Reviewed By RJ

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name	ALF - West Ash Pond Complex Final Closure	Project Number	172675015
Source	STN-33A, 36.6'-37.0'	Lab ID	390

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method	ASTM D 422
Prepared using	ASTM D 2217
Particle Shape	N/A
Particle Hardness:	N/A
Tested By	DB
Test Date	11-10-2015
Date Received	10-28-2015

Maximum Particle size: No. 10 Sieve

Sieve Size	% Passing
No. 10	100.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on -3 inch fraction only

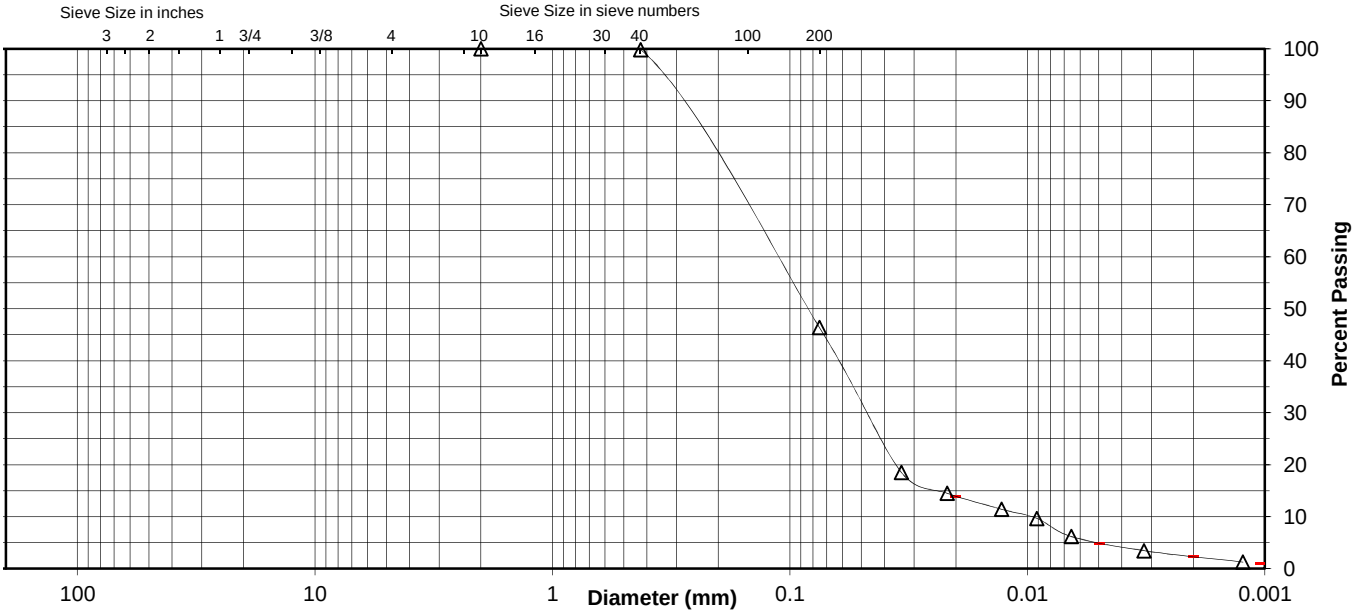
Specific Gravity 2.7

Dispersed using Apparatus A - Mechanical, for 1 minute

No. 40	99.8
No. 200	46.4
0.02 mm	13.9
0.005 mm	4.9
0.002 mm	2.3
0.001 mm	1.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.2	53.4	41.5	4.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.2	53.4	44.1	2.3



Comments

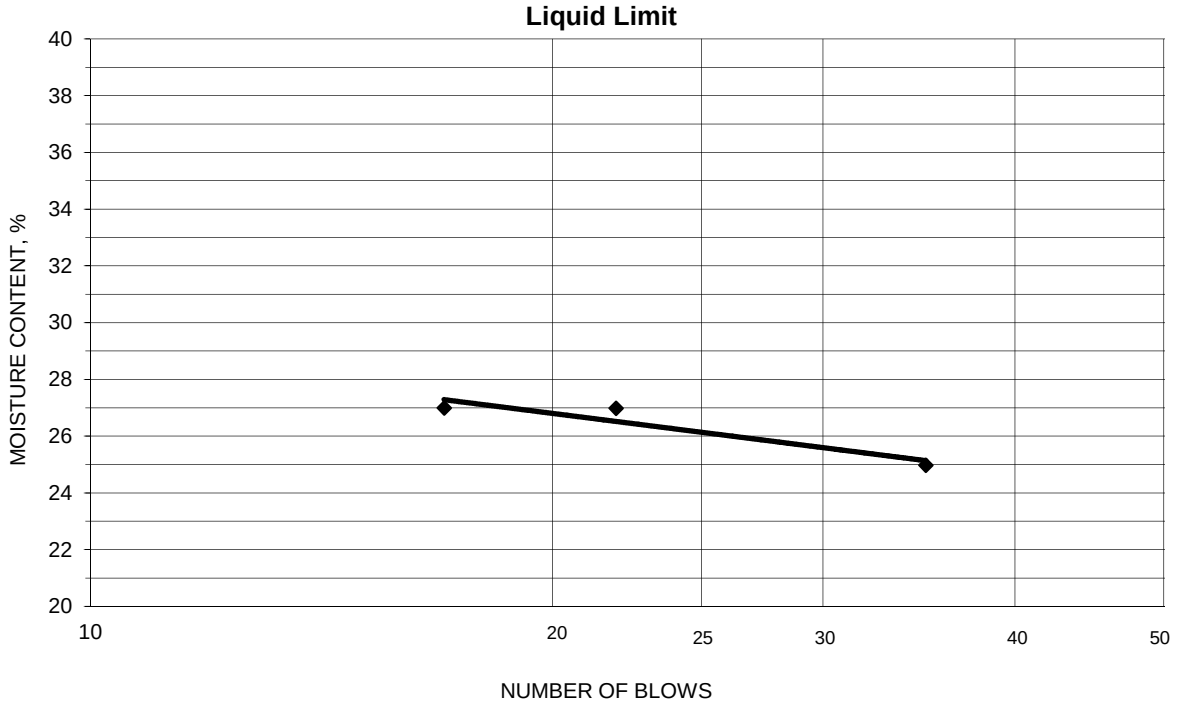
Reviewed By RJ

Stantec

ATTERBERG LIMITS

Project	ALF - West Ash Pond Complex Final Closure			Project No.	172675015
Source	STN-33A, 36.6'-37.0'			Lab ID	390
				% + No. 40	0
Tested By	KWS	Test Method	ASTM D 4318 Method A	Date Received	10-28-2015
Test Date	11-12-2015	Prepared	Wet		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
22.00	19.83	11.14	35	25.0	
18.73	17.09	11.01	22	27.0	
20.55	18.55	11.14	17	27.0	26



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
18.13	17.04	11.09	18.3	18	8
18.01	16.97	11.09	17.7		

Remarks: _____

Reviewed By RJ

Appendix D.3

Unit Weight Testing Results

Stantec

Unconfined Compressive Strength of Cohesive Soil

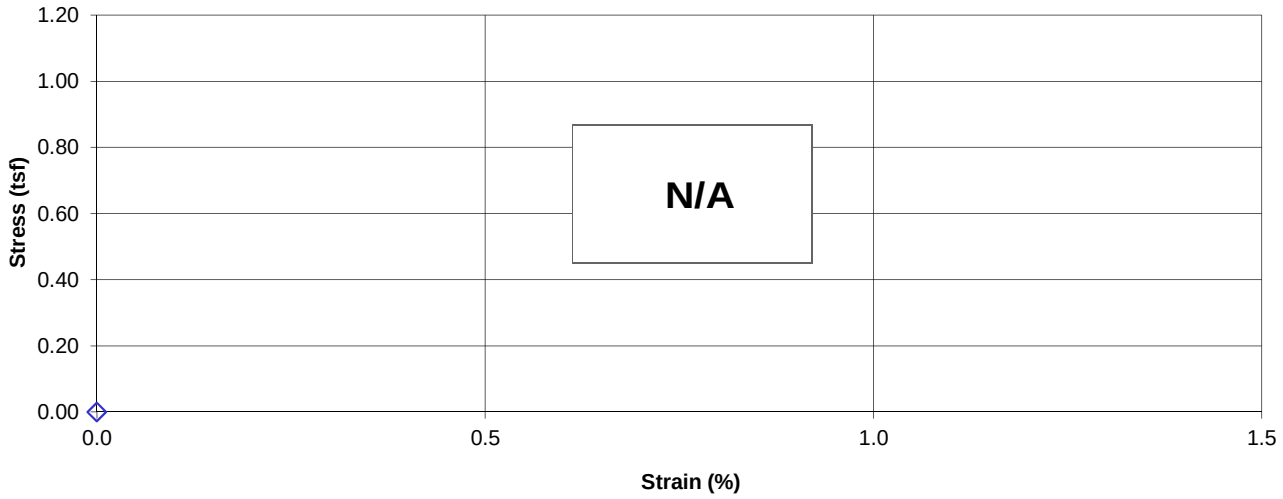
ASTM D 2166

Project Name: ALF - West Ash Pond Complex Final Closure
Project Number: 172675015
Source: STN-32, 8.0'-10.0'
Lab ID: 71
Visual Description: Sandy Lean Clay (CL), dark brown, moist, firm
Recovered: 1.4'
Test Interval: 8.2' - 8.7'

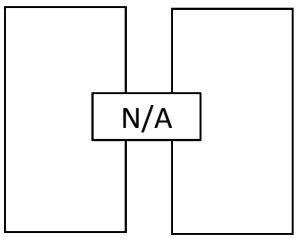
Specimen Type: Undisturbed
LL: N/A
PL: N/A
PI: N/A
Date Extruded: 11/03/2015
Date Tested: N/A

Initial Wet Density (pcf)	116.8		
Initial Moisture Content (%)	28.1	Initial MC Taken	Before Test, From Trimmings
Initial Dry Density (pcf)	91.2		
At Test Moisture Content (%)	N/A	At Test MC Taken	N/A
At Test Dry Density (pcf)	N/A		
Specific Gravity	N/A		
Degree of Saturation (%)	N/A	Unconfined Compressive Strength (tsf)	N/A
Average Height (in)	5.976	Undrained Shear Strength (tsf)	N/A
Average Diameter (in)	2.845	Strain at Maximum Stress (%)	N/A
Height to Diameter Ratio	2.1	Strain rate to failure (% / min.)	N/A

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf): N/A
Torvane Reading (kg/cm^2): N/A

Comments
2F
8.8'-9.4' Rough cut
8.8'-9.1' Lean Clay
9.1'-9.4' Sandy Silt
Saved in bag.

Reviewed By: RJ

Stantec

Unconfined Compressive Strength of Cohesive Soil

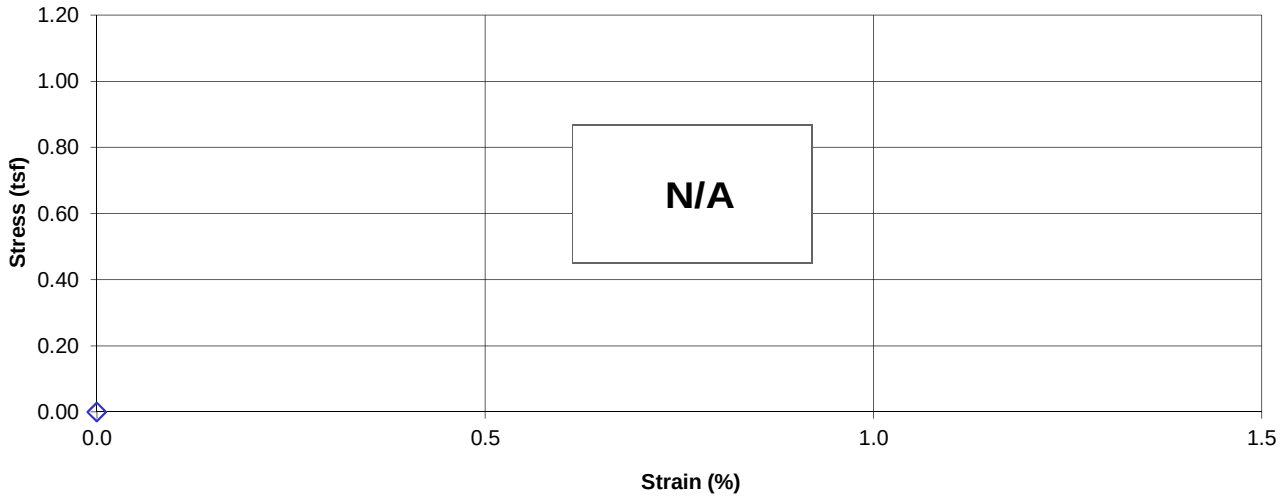
ASTM D 2166

Project Name: ALF - West Ash Pond Complex Final Closure
Project Number: 172675015
Source: STN-40, 16.5'-18.5'
Lab ID: 282
Visual Description: Lean Clay (CL), black, moist, firm (bottom ash)
Recovered: 1.6'
Test Interval: 16.9' - 17.4'

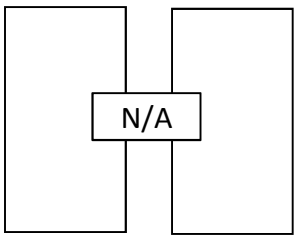
Specimen Type: Undisturbed
LL: N/A
PL: N/A
PI: N/A
Date Extruded: 11/03/2015
Date Tested: N/A

Initial Wet Density (pcf)	131.3		
Initial Moisture Content (%)	17.8	Initial MC Taken	Before Test, From Trimmings
Initial Dry Density (pcf)	111.4		
At Test Moisture Content (%)	N/A	At Test MC Taken	N/A
At Test Dry Density (pcf)	N/A		
Specific Gravity	N/A		
Degree of Saturation (%)	N/A	Unconfined Compressive Strength (tsf)	N/A
Average Height (in)	5.944	Undrained Shear Strength (tsf)	N/A
Average Diameter (in)	2.850	Strain at Maximum Stress (%)	N/A
Height to Diameter Ratio	2.1	Strain rate to failure (% / min.)	N/A

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf): N/A
Torvane Reading (kg/cm^2): N/A

Comments
2F
17.5' - 18.1' Rough cut
Broke at 17.8' due to bottom ash lense.
Saved in bag.

Reviewed By: RJ

Appendix D.4

Permeability Testing Results

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

ASTM D 5084

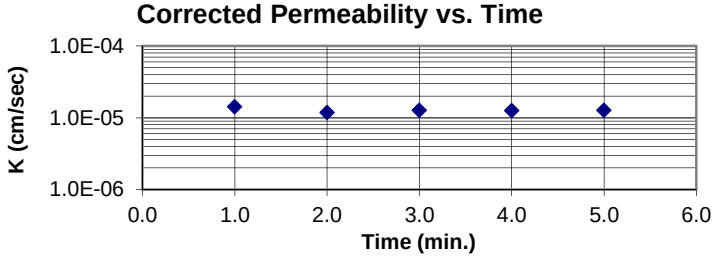
Project Name	ALF - West Ash Pond Complex Final Closure	Project No.	172675015
Source	STN-30, 18.0'-18.3'	Test ID	26
Visual Classification	Poorly Graded Sand with Silt (SP-SM), brown, moist, very soft	Prepared By	RC
Undisturbed	XX	Specific Gravity	2.67 ASTM D854-A
		Maximum Dry Density (pcf)	
Permeant:	De-aired tap water	LL NP PL NP	PI NP
Selection and Preparation Comments:			

Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 19 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data	Final Pressures (psi)	
Height (in.)	1.3885	1.3291	1.3290	Chamber	40
Diameter (in.)	2.7900		2.7770	Influent	30.2
Moisture Content (%)	14.4		28.8	Effluent	30
Dry Unit Weight (pcf)	86.7		91.4		
Void Ratio	0.923		0.824		
Degree of Saturation (%)	41.6		* 93.4		
Trimmings MC (%)	13.5				

Applied Head Difference (psi)	0.2
Back Pressure Saturated to (psi)	30
Maximum Effective Consolidation Stress (psi)	10
Minimum Effective Consolidation Stress (psi)	9.8

						Hydraulic Conductivity			
Date	Clock (24H:M)	Temp. ℉	Bottom Head	Top Head	Test Time (sec)	k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
11-11-15	13:18	72.0	21.63	3.92	0	---	---	---	---
11-11-15	13:19	72.0	21.45	4.12	6.00E+01	1.5E-07	1.5E-05	1.4E-07	1.4E-05
11-11-15	13:20	72.0	21.29	4.27	6.00E+01	1.2E-07	1.2E-05	1.2E-07	1.2E-05
11-11-15	13:21	72.0	21.13	4.44	6.00E+01	1.3E-07	1.3E-05	1.3E-07	1.3E-05
11-11-15	13:22	72.0	20.96	4.59	6.00E+01	1.3E-07	1.3E-05	1.2E-07	1.2E-05
11-11-15	13:23	72.0	20.80	4.75	6.00E+01	1.3E-07	1.3E-05	1.3E-07	1.3E-05



A gradient of approximately 4 was used for this test.

Average Hydraulic Conductivity @ 20°C (last 4 determinations)	m/s	1.24E-07	cm/s	1.24E-05
Average Hydraulic Conductivity @ 20°C (last run)	m/s	1.28E-07	cm/s	1.28E-05

Comments *Saturation has apparently decreased from 95 to 94 due to material loss during breakdown of the test.

Reviewed By KG

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

ASTM D 5084

Project Name	ALF - West Ash Pond Complex Final Closure	Project No.	172675015
Source	STN-32, 6.1'-6.4'	Test ID	69
Visual Classification	Lean Clay (CL), brown, moist, very soft	Prepared By	RC
Undisturbed	XX	Specific Gravity	2.67 ASTM D854-A
		Date	11-3-15
	Maximum Dry Density (pcf)	Percent of Maximum	
Permeant:	De-aired tap water	LL 36 PL 19 PI 17	

Selection and Preparation Comments:

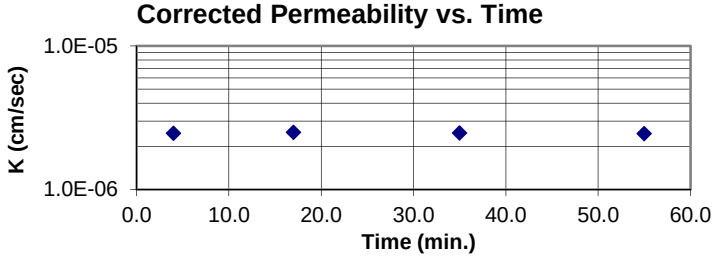
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 19 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	1.3885	1.3050	1.3051
Diameter (in.)	2.7900		2.7763
Moisture Content (%)	30.1		27.4
Dry Unit Weight (pcf)	91.6		98.5
Void Ratio	0.819		0.693
Degree of Saturation (%)	98.0		105.4
Trimmings MC (%)	30.6		

Final Pressures (psi)	
Chamber	50
Influent	40.5
Effluent	40

Applied Head Difference (psi)	0.5
Back Pressure Saturated to (psi)	40
Maximum Effective Consolidation Stress (psi)	10
Minimum Effective Consolidation Stress (psi)	9.5

						Hydraulic Conductivity			
Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
11-11-15	14:00	72.0	21.63	3.46	0	---	---	---	---
11-11-15	14:04	72.0	21.46	3.66	2.40E+02	2.6E-08	2.6E-06	2.5E-08	2.5E-06
11-11-15	14:17	72.0	20.86	4.25	7.80E+02	2.6E-08	2.6E-06	2.5E-08	2.5E-06
11-11-15	14:35	72.0	20.07	5.02	1.08E+03	2.6E-08	2.6E-06	2.5E-08	2.5E-06
11-11-15	14:55	72.0	19.26	5.83	1.20E+03	2.6E-08	2.6E-06	2.4E-08	2.4E-06



A gradient of approximately 10 was used for this test.

Average Hydraulic Conductivity @ 20°C (last 4 determinations)	m/s	2.47E-08	cm/s	2.47E-06
Average Hydraulic Conductivity @ 20°C (last run)	m/s	2.47E-08	cm/s	2.47E-06

Comments

Reviewed By KG

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

ASTM D 5084

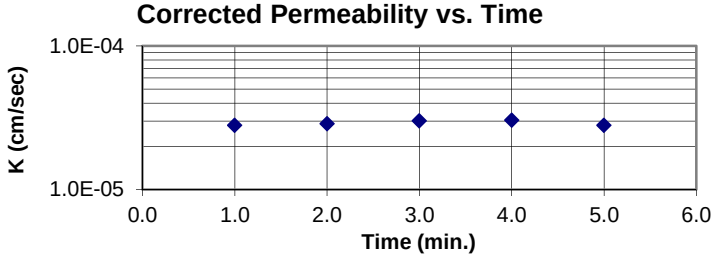
Project Name	ALF - West Ash Pond Complex Final Closure	Project No.	172675015
Source	STN-35, 7.7'-8.0'	Test ID	149
Visual Classification	Silt with Sand (ML), brown, wet, very soft	Prepared By	RC
Undisturbed	XX	Specific Gravity	2.68 ASTM D854-A
		Date	11-11-15
	Maximum Dry Density (pcf)	Percent of Maximum	
Permeant:	De-aired tap water	LL NP PL NP	PI NP

Selection and Preparation Comments:

Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 19 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data	Final Pressures (psi)	
Height (in.)	1.3885	1.1042	1.1042	Chamber	40
Diameter (in.)	2.7900		2.8239	Influent	30.2
Moisture Content (%)	34.1		24.7	Effluent	30
Dry Unit Weight (pcf)	88.5		108.6		
Void Ratio	0.891		0.541		
Degree of Saturation (%)	102.6		122.5		
Trimmings MC (%)	32.0				

						Hydraulic Conductivity			
Date	Clock (24H:M)	Temp. ℉	Bottom Head	Top Head	Test Time (sec)	k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
11-16-15	9:10	72.0	22.10	4.35	0	---	---	---	---
11-16-15	9:11	72.0	21.64	4.81	6.00E+01	2.9E-07	2.9E-05	2.8E-07	2.8E-05
11-16-15	9:12	72.0	21.18	5.26	6.00E+01	3.0E-07	3.0E-05	2.9E-07	2.9E-05
11-16-15	9:13	72.0	20.73	5.72	6.00E+01	3.2E-07	3.2E-05	3.0E-07	3.0E-05
11-16-15	9:14	72.0	20.29	6.16	6.00E+01	3.2E-07	3.2E-05	3.0E-07	3.0E-05
11-16-15	9:15	72.0	19.90	6.55	6.00E+01	3.0E-07	3.0E-05	2.8E-07	2.8E-05



A gradient of approximately 4 was used for this test.

Average Hydraulic Conductivity @ 20°C (last 4 det erminations)	m/s	2.93E-07	cm/s	2.93E-05
Average Hydraulic Conductivity @ 20°C (last run)	m /s	2.90E-07	cm/s	2.90E-05

Comments

Reviewed By KG

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

ASTM D 5084

Project Name	ALF - West Ash Pond Complex Final Closure	Project No.	172675015
Source	STN-37, 27.1'-27.4'	Test ID	217
Visual Classification	Silt with Sand (ML), gray black, wet, very soft	Prepared By	RC
Undisturbed	XX	Specific Gravity	2.69 ASTM D854-A
		Maximum Dry Density (pcf)	
Permeant:	De-aired tap water	LL NP PL NP	PI NP
Selection and Preparation Comments:			

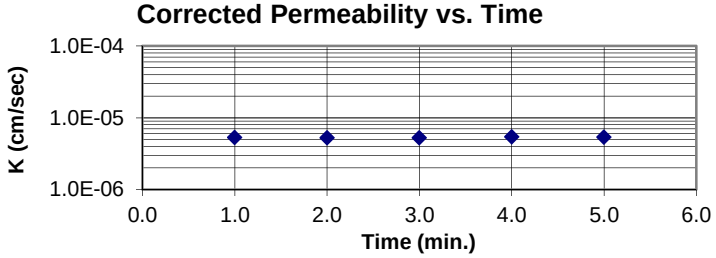
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 19 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	1.3885	1.3068	1.3082
Diameter (in.)	2.7900		2.7941
Moisture Content (%)	32.4		29.4
Dry Unit Weight (pcf)	89.6		94.9
Void Ratio	0.874		0.771
Degree of Saturation (%)	99.7		102.5
Trimmings MC (%)	32.4		

Final Pressures (psi)	
Chamber	40
Influent	32
Effluent	30

Applied Head Difference (psi)	2
Back Pressure Saturated to (psi)	30
Maximum Effective Consolidation Stress (psi)	10
Minimum Effective Consolidation Stress (psi)	8

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
11-17-15	10:04	72.0	21.44	2.44	0	---	---	---	---
11-17-15	10:05	72.0	21.21	2.68	6.00E+01	5.6E-08	5.6E-06	5.3E-08	5.3E-06
11-17-15	10:06	72.0	20.98	2.91	6.00E+01	5.5E-08	5.5E-06	5.2E-08	5.2E-06
11-17-15	10:07	72.0	20.75	3.14	6.00E+01	5.6E-08	5.6E-06	5.3E-08	5.3E-06
11-17-15	10:08	72.0	20.51	3.37	6.00E+01	5.7E-08	5.7E-06	5.4E-08	5.4E-06
11-17-15	10:09	72.0	20.29	3.61	6.00E+01	5.6E-08	5.6E-06	5.3E-08	5.3E-06



A gradient of approximately 39.9 was used for this test.

Average Hydraulic Conductivity @ 20°C (last 4 determinations)	m/s	5.31E-08	cm/s	5.31E-06
Average Hydraulic Conductivity @ 20°C (last run)	m/s	5.31E-08	cm/s	5.31E-06

Comments

Reviewed By KG

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

ASTM D 5084

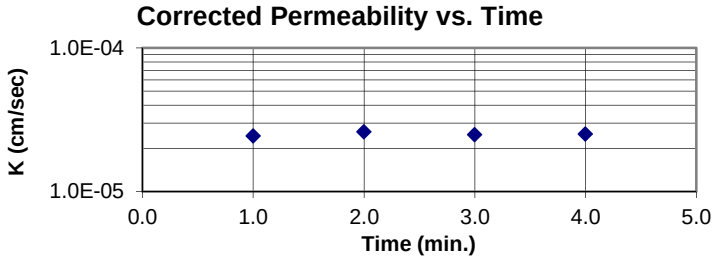
Project Name	ALF - West Ash Pond Complex Final Closure	Project No.	172675015
Source	STN-33A, 37.0'-37.3'	Test ID	390
Visual Classification	Clayey Sand (SC), gray, moist, very soft	Prepared By	RC
Undisturbed	XX	Specific Gravity	2.65 ASTM D854-A
		Maximum Dry Density (pcf)	
Permeant:	De-aired tap water	LL 26 PL 18 PI 8	
Selection and Preparation Comments:			

Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 19 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data	Final Pressures (psi)	
Height (in.)	1.3885	1.3081	1.3080	Chamber	40
Diameter (in.)	2.7900		2.7940	Influent	30.2
Moisture Content (%)	22.6		25.0	Effluent	30
Dry Unit Weight (pcf)	92.0		97.3		
Void Ratio	0.799		0.699		
Degree of Saturation (%)	75.0		94.9		
Trimmings MC (%)	21.6				

						Hydraulic Conductivity			
Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
11-16-15	8:59	72.0	19.46	6.14	0	---	---	---	---
11-16-15	9:00	72.0	19.16	6.38	6.00E+01	2.6E-07	2.6E-05	2.4E-07	2.4E-05
11-16-15	9:01	72.0	18.87	6.65	6.00E+01	2.7E-07	2.7E-05	2.6E-07	2.6E-05
11-16-15	9:02	72.0	18.60	6.90	6.00E+01	2.6E-07	2.6E-05	2.5E-07	2.5E-05
11-16-15	9:03	72.0	18.34	7.15	6.00E+01	2.7E-07	2.7E-05	2.5E-07	2.5E-05

Applied Head Difference (psi)	0.2
Back Pressure Saturated to (psi)	30
Maximum Effective Consolidation Stress (psi)	10
Minimum Effective Consolidation Stress (psi)	9.8



A gradient of approximately 4 was used for this test.

Average Hydraulic Conductivity @ 20°C (last 4 determinations)	m/s	2.51E-07	cm/s	2.51E-05
Average Hydraulic Conductivity @ 20°C (last run)	m/s	2.51E-07	cm/s	2.51E-05

Comments

Reviewed By KG

Appendix E

Results Slope Stability Analysis

Appendix E.1

Cross Section H-H' at Station 13+33 Static Slope Stability Analysis Results

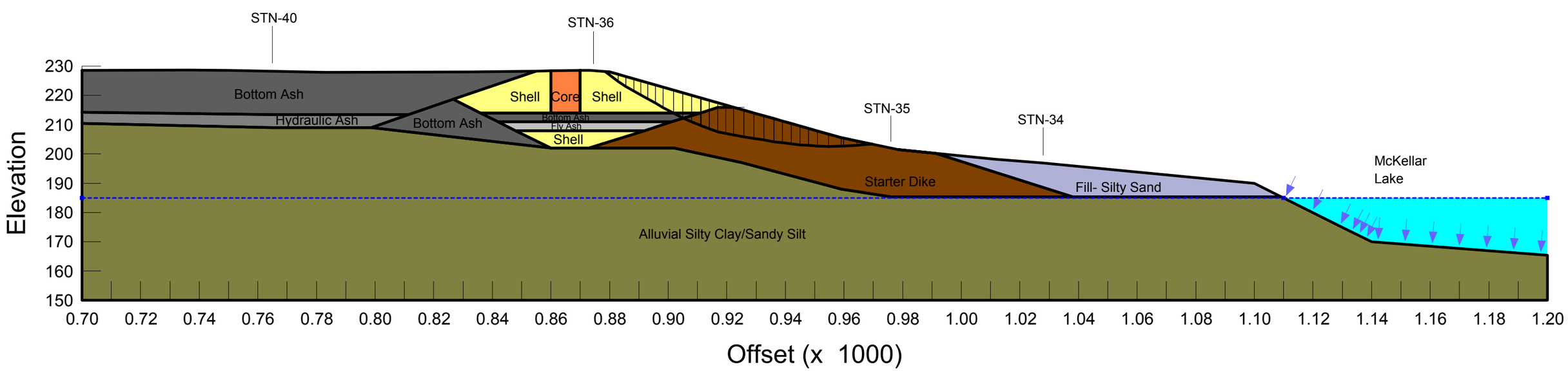
Tennessee Valley Authority
Allen Fossil Plant - West Ash Pond
Shelby County, Tennessee
Section H-H' at Station 13+33

Slope Stability Analysis
FS = 2.2
Deep Failure (10' Min)

Summer Pool - Normal Operation
Long-Term Conditions

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

		Drained Strength Parameters	
Material Type	Sat. Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)
Shell	127	33	0
Core	127	33	0
Starter Dike	121	30	0
Alluvial Silty Clay/Sandy Silt	119	31	0
Fly Ash	105	25	0
Hydraulically Ash	105	25	0
Fill - Silty Sand	122	30	0
Bottom Ash	123	34	0



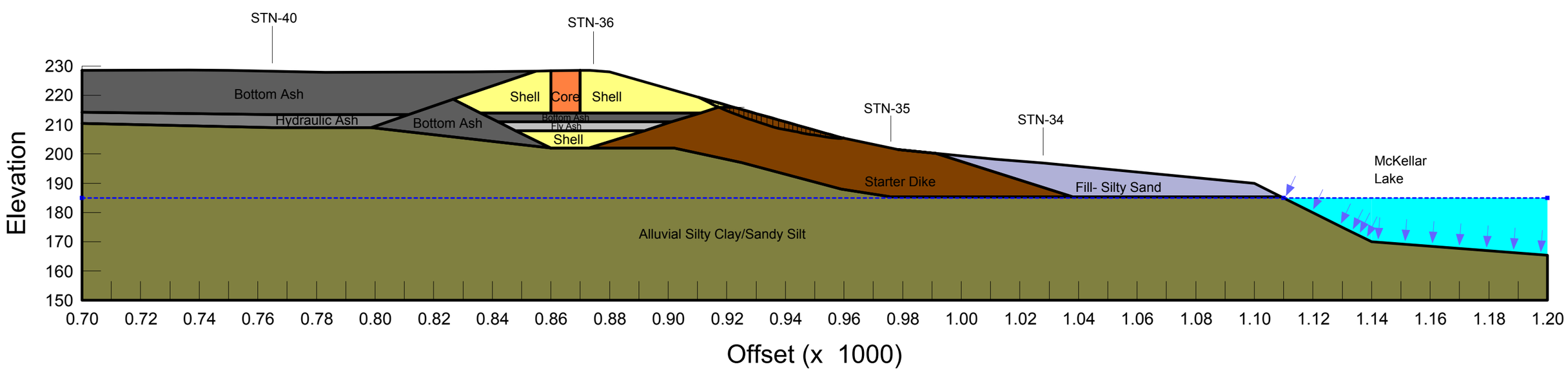
Tennessee Valley Authority
Allen Fossil Plant - West Ash Pond
Shelby County, Tennessee
Section H-H' at Station 13+33

Slope Stability Analysis
FS = 2.1
Shallow Failure (3' Min)

Summer Pool - Normal Operation
Long-Term Conditions

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

		Drained Strength Parameters	
Material Type	Sat. Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)
Shell	127	33	0
Core	127	33	0
Starter Dike	121	30	0
Alluvial Silty Clay/Sandy Silt	119	31	0
Fly Ash	105	25	0
Hydraulically Ash	105	25	0
Fill - Silty Sand	122	30	0
Bottom Ash	123	34	0



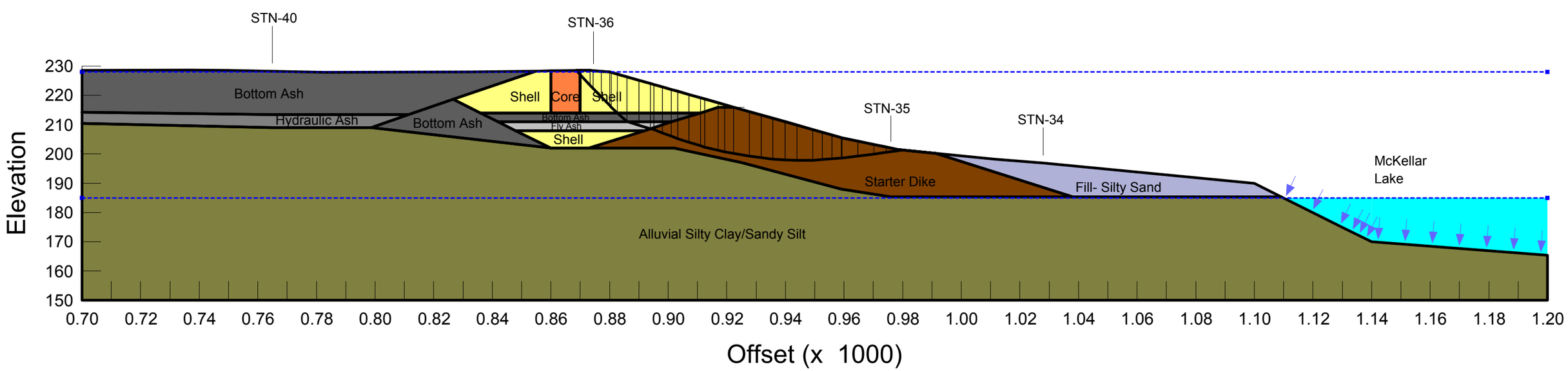
Tennessee Valley Authority
Allen Fossil Plant - West Ash Pond
Shelby County, Tennessee
Section H-H' at Station 13+33

Slope Stability Analysis
FS = 2.1
Deep Failure (10' Min)

Rapid Drawdown Conditions
From Flood Elv. 228 to Elv. 185 ft

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

		Drained Strength Parameters		**Undrained Strength Parameters**	
Material Type	Sat. Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)	Phi (deg.)	Cohesion (psf)
Shell	127	33	0	28	200
Core	127	33	0	28	200
Starter Dike	121	30	0	28	200
Alluvial Silty Clay/Sandy Silt	119	31	0	27	600
Fly Ash	105	25	0	10	0
Hydraulically Ash	105	25	0	10	0
Fill - Silty Sand	122	30	0	28	200
Bottom Ash	123	34	0	34	0



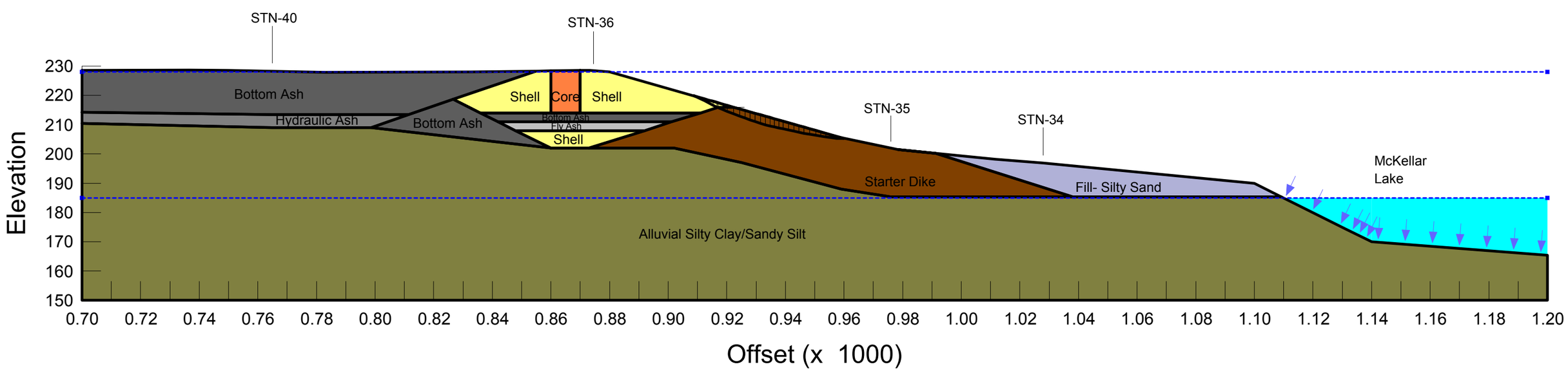
Tennessee Valley Authority
Allen Fossil Plant - West Ash Pond
Shelby County, Tennessee
Section H-H' at Station 13+33

Slope Stability Analysis
FS = 2.1
Shallow Failure (3' Min)

Rapid Drawdown Condition
From Flood Elv. 228 to Elv. 185 ft

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

		Drained Strength Parameters		Undrained Strength Parameters	
Material Type	Sat. Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)	Phi (deg.)	Cohesion (psf)
Shell	127	33	0	28	200
Core	127	33	0	28	200
Starter Dike	121	30	0	28	200
Alluvial Silty Clay/Sandy Silt	119	31	0	27	600
Fly Ash	105	25	0	10	0
Hydraulically Ash	105	25	0	10	0
Fill - Silty Sand	122	30	0	28	200
Bottom Ash	123	34	0	34	0



Appendix E.2

Cross Section I-I' at Station 4+60 Static Slope Stability Analysis Results

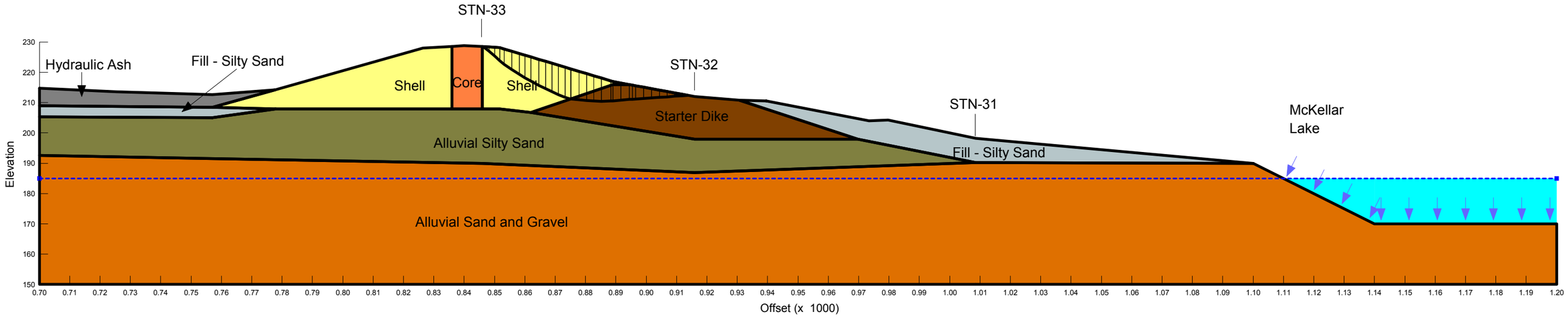
Tennessee Valley Authority
Allen Fossil Plant - West Ash Pond
Shelby County, Tennessee
Section I-I' at Station 4+60

Slope Stability Analysis
FS = 2.6
Deep Failure (10' Min)

Summer Pool - Normal Operation
Long-Term Conditions

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

		Drained Strength Parameters	
Material Type	Sat. Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)
Shell	127	33	0
Core	127	33	0
Starter Dike	121	30	0
Alluvial Silty Sand	124	31	0
Alluvial Sand and Gravel	134	35	0
Hydraulically Ash	105	25	0
Fill - Silty Sand	122	30	0



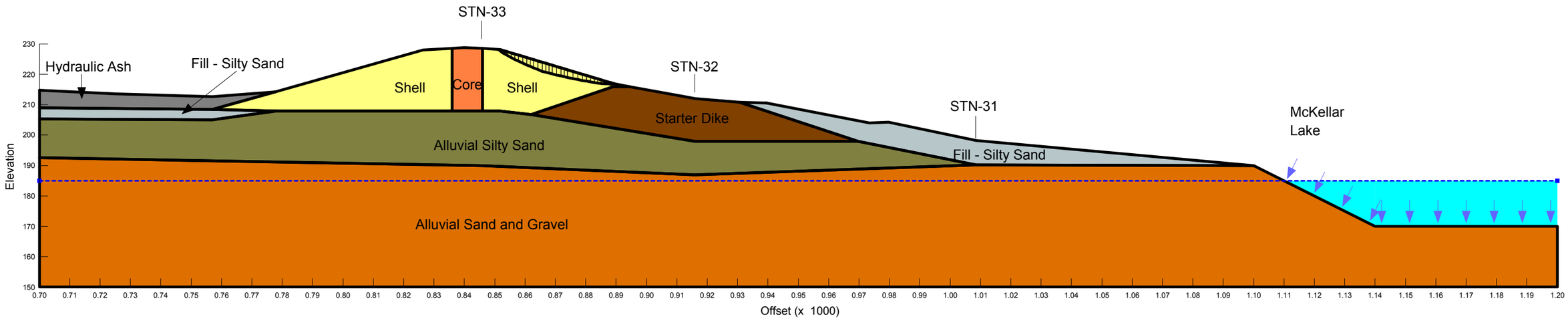
Tennessee Valley Authority
Allen Fossil Plant - West Ash Pond
Shelby County, Tennessee
Section I-I' at Station 4+60

Slope Stability Analysis
FS = 2.3
Shallow Failure (3' Min)

Summer Pool - Normal Operation
Long-Term Conditions

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

		Drained Strength Parameters	
Material Type	Sat. Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)
Shell	127	33	0
Core	127	33	0
Starter Dike	121	30	0
Alluvial Silty Sand	124	31	0
Alluvial Sand and Gravel	134	35	0
Hydraulically Ash	105	25	0
Fill - Silty Sand	122	30	0



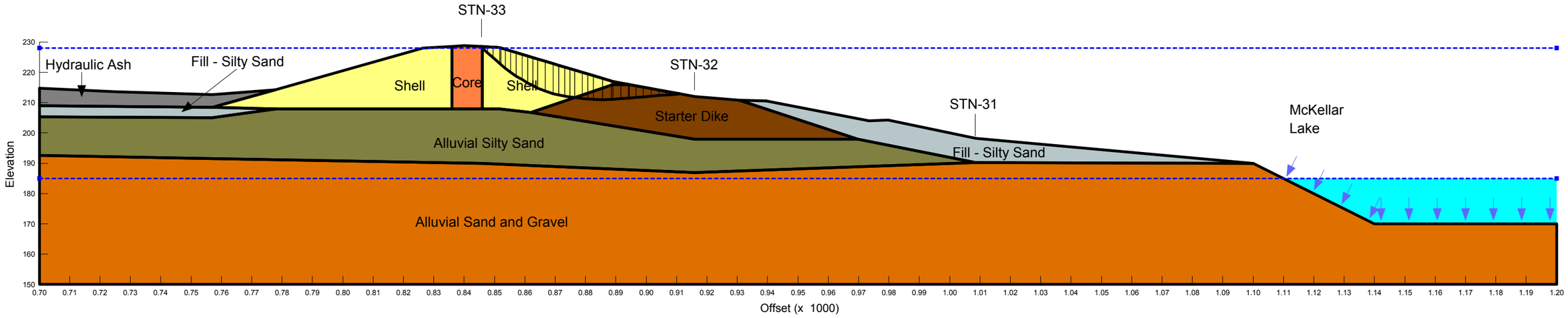
Tennessee Valley Authority
Allen Fossil Plant - West Ash Pond
Shelby County, Tennessee
Section I-I' at Station 4+60

Slope Stability Analysis
FS = 2.5
Deep Failure (10' Min)

Rapid Drawdown Condition
From Flood Elv. 228 to Elv. 185 ft

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

		Drained Strength Parameters		Undrained Strength Parameters	
Material Type	Sat. Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)	Phi (deg.)	Cohesion (psf)
Shell	127	33	0	28	200
Core	127	33	0	28	200
Starter Dike	121	30	0	28	200
Alluvial Silty Sand	124	31	0	28	200
Alluvial Sand and Gravel	134	35	0	35	0
Hydraulically Ash	105	25	0	10	0
Fill - Silty Sand	122	30	0	28	200



Tennessee Valley Authority
Allen Fossil Plant - West Ash Pond
Shelby County, Tennessee
Section I-I' at Station 4+60

Slope Stability Analysis
FS = 2.3
Shallow Failure (3' Min)

Rapid Drawdown Condition
From Flood Elv. 228 to Elv. 185 ft

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

		Drained Strength Parameters		Undrained Strength Parameters	
Material Type	Sat. Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)	Phi (deg.)	Cohesion (psf)
Shell	127	33	0	28	200
Core	127	33	0	28	200
Starter Dike	121	30	0	28	200
Alluvial Silty Sand	124	31	0	28	200
Alluvial Sand and Gravel	134	35	0	35	0
Hydraulically Ash	105	25	0	10	0
Fill - Silty Sand	122	30	0	28	200