Report of CCR Rule Stability Analyses AEP Clifty Creek Power Plant Boiler Slag Pond Dam and Landfill Runoff Collection Pond

Madison, Jefferson County, Indiana



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EXECUTIVE SUMMARY February 16, 2016

Executive Summary

The Clifty Creek Power Station's Boiler Slag Pond Dam, owned and operated by the Indiana and Kentucky Electric Corporation (IKEC), is located in the city of Madison, Indiana along the northern bank of the Ohio River. The Boiler Slag Pond currently serves as a settling facility for sluiced bottom ash produced at the plant. In addition to the process flows from the plant, approximately 510 acres drain to the facility. The pond is formed by natural grade to the north, east, and west; as well as a southern dike that runs along the bank of the Ohio River.

The Landfill Runoff Collection Pond serves as a collection pond for the Coal Combustion Byproducts Landfill. The pond is formed by natural grades to the north, east, and west; as well as a southern dam that runs along the bank of the Ohio River. The drainage area of the pond is approximately 443 acres. The Indiana Department of Natural Resources (IDNR) has designated this dam as No. 39-12, which was registered as a High Hazard Structure in 2010.

Stantec Consulting Services Inc. (Stantec) was contracted to perform a geotechnical exploration, stability analysis, and liquefaction assessment of the dike for these facilities in 2009 (Landfill Runoff Collection Pond) and in 2010 (Boiler Slag Pond Dam). The intent of the explorations was to develop subsurface data at cross-sections along the dike for the Boiler Slag Pond and the dam for the Landfill Collection Runoff Pond and to perform conventional seepage and stability analyses, assessing the performance of the facilities. The potential for liquefaction was to be evaluated according to simplified published methods. Reports from past geotechnical explorations were used to supplement subsurface data.

In response to the Coal Combustion Residual (CCR) rules mandated in the Federal Register on April 17, 2015, AEP contracted Stantec to perform stability analyses for the Boiler Slag Pond Dam and Landfill Runoff Collection Pond to estimate static, seismic, and liquefaction potential factors of safety. According to Section 257.73(e)(1)(i) through (iv), the factor of safety assessment CCR rules are:

- (i) The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.
- (ii) The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.
- (iii) The calculated seismic factor of safety must equal or exceed 1.00
- (iv) For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.



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The factors of safety obtained during the analyses for static and seismic load cases were greater than those required for Section 257.73 (e)(1)(i) through (iii). The average factor of safety for each soil horizon that was susceptible to liquefaction was greater than that required in Section 257.74 (e)(1)(iv).

The results of the 2010 analyses can be found in Section 6.1.1 for the Boiler Slag Pond Dam and Section 6.1.2 for the Landfill Runoff Collection Pond. The results of the 2015 CCR review can be found in Section 6.1.2 for the Boiler Slag Pond Dam and Section 6.2.2 for the Landfill Runoff Collection Pond.



INTRODUCTION February 16, 2016

1.0 INTRODUCTION

The Clifty Creek Power Station's Boiler Slag Pond Dam, owned and operated by the Indiana and Kentucky Electric Corporation (IKEC), is located in the city of Madison, Indiana along the northern bank of the Ohio River. The Boiler Slag Pond currently serves as a settling facility for sluiced bottom ash produced at the plant. In addition to the process flows from the plant, approximately 510 acres drain to the facility. The pond is formed by natural grade to the north, east, and west; as well as a southern dike that runs along the bank of the Ohio River.

The Landfill Runoff Collection Pond serves as a collection pond for the Coal Combustion Byproducts Landfill. The pond is formed by natural grades to the north, east, and west; as well as a southern dam that runs along the bank of the Ohio River. The drainage area of the pond is approximately 443 acres. The Indiana Department of Natural Resources (IDNR) has designated this dam as No. 39-12, which was registered as a High Hazard Structure in 2010.

Stantec Consulting Services Inc. (Stantec) was contracted to perform a geotechnical exploration, stability analysis, and liquefaction assessment of the dike for these facilities in 2009 (Landfill Runoff Collection Pond) and in 2010 (Boiler Slag Pond Dam). The intent of the explorations was to develop subsurface data at cross-sections along the dike for the Boiler Slag Pond and the dam for the Landfill Collection Runoff Pond and to perform conventional seepage and stability analyses, assessing the performance of the facilities. The potential for liquefaction was to be evaluated according to simplified published methods. Reports from past geotechnical explorations were used to supplement subsurface data.

In response to the Coal Combustion Residual (CCR) rules mandated in the Federal Register on April 17, 2015, AEP contracted Stantec to perform stability analyses for the Boiler Slag Pond Dam and Landfill Runoff Collection Pond to estimate static, seismic, and liquefaction potential factors of safety. According to Section 257.73(e)(1)(i) through (iv) of the CCR rules, the required factors of safety are as follows:

- (i) The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.
- (ii) The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.
- (iii) The calculated seismic factor of safety must equal or exceed 1.00
- (iv) For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.

Table 1 summarizes the geometric characteristics of the embankments.



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Facility Section	Height (feet)	Crest Width (feet)	Downstream Slope Grade	Upstream Slope Grade
Boiler Slag Pond Section A-A'	41	22	2.5H:1V*	1.75H:1V*
Boiler Slag Pond Section B-B'	31	30	2.5H:1V*	1.5H:1V*
Boiler Slag Pond Section C-C'	35	30	2H:1V*	2H:1V*
Landfill Runoff Collection Pond Section D-D'	61	20	2.5H:1V*	3H:1V*
Landfill Runoff Collection Pond Section E-E'	51	20	2.5H:1V*	4.5H:1V*

Table 1 Clifty Creek Facility Geometry

*Denotes horizontal to vertical ratio

2.0 GEOLOGY OF THE SITE

The site lies within the Muscatatuck Regional Slope Physiographic Region of Indiana. This gently sloping plain is made of bedrock that is mostly Devonian in age that has been dissected by streams. Along the Ohio River the uplands immediately to the north are rugged and stand in bold relief to the flood plain. The reaches of each drainageway typically contain accumulations of silt, clay, and sand that make up the flat-lying flood plains. The site topography is steep to moderately sloping toward natural drainage channels. Topographic relief between Clifty Creek Power Plant and the uplands to the north is on the order of 350 feet.

Published soils information for the site was obtained from the <u>Soil Survey of Jefferson County</u>, <u>Indiana</u>, (US Department of Agriculture [USDA], Natural Resources Conservation Service [NRCS], 1985). The soil survey indicated the side slopes of Devil's Backbone and the ridge flanks to the north of the site belong to the Eden-Caneyville complex (EgG). These soils are found on steep to very steep slopes ranging from 25 to 60 percent. The Eden-Caneyville complex consists of moderately deep and well-drained soils that formed on slopes facing the Ohio River and on back slopes facing adjacent to tributaries near the river.

Mapping of unconsolidated sediments obtained from <u>Regional Geologic Map, Louisville Sheet,</u> <u>Part B</u> (Indiana Department of Natural Resources [IDNR], 1972) indicates the lowland areas adjacent to the Ohio River are predominantly underlain by clay, silt, sand, and gravel deposited as alluvium, lacustrine and outwash deposits. The glacial deposits in the area are of the Illinoian and Wisconsinan Quaternary age and belong to the Atherton Formation. The overlying more recent alluvial deposits belong to the Martinsville Formation.



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The Atherton Formation consists of coarse- to fine-grained, well-sorted sediments that were deposited by glacial outwash (sand and gravel deposited by glacial meltwater streams), lake sediments and loess. The Martinsville Formation consists of alluvial sediments of non-glacial origin that have been deposited in modern flood plains along the major drainage ways. This formation varies in thickness from a few inches up to 30 feet near rivers.

Available geologic mapping from <u>Bedrock Geology of Indiana</u> (Indiana Geological Survey [IGS] Miscellaneous Map 48, IGS, 1987) shows the site to be underlain by bedrock of the Maquoketa Group. The Maquoketa Group in Indiana is a westward-thinning wedge, 1,000 feet thick in southeastern Indiana and 200 feet thick in northwestern Indiana. Overall, the group consists principally of shale (about 80 percent) and limestone (about 20 percent), although limestone is dominant in some areas. The lower part of the group is almost entirely shale, and the lower part of the shale is dark brown to nearly black. These rocks were deposited during the Upper Ordovician Period.

3.0 FIELD EXPLORATIONS AND SITE RECONNAISSANCE

The borings for the 2009 and 2010 geotechnical exploration were advanced using 3¼-inch inside-diameter hollow-stem augers powered by a truck-mounted drill rig. Standard penetration tests (SPTs) were performed at 2.5-foot intervals in accordance with ASTM D 1586. Undisturbed Shelby tube samples were performed at selected intervals to obtain samples for consolidated-undrained (CU) triaxial compression (ASTM D 4767) and permeability testing (ASTM D 5084-90). Sample depths and recovery amounts are presented on the boring logs. Additionally, disturbed bag samples were collected from auger cuttings obtained from the boreholes.

A Stantec geotechnical engineer directed the drill crews, logged the subsurface materials encountered during the exploration and collected soil samples. During field logging, particular attention was given to each material's color, texture, moisture content, and consistency or relative density.

Following the field explorations, the Shelby tubes and bag samples were transported to Stantec's (or certified vendor's) laboratory for testing. Natural moisture content and unit weight testing were performed on samples extruded from the tubes. Testing consisting of sieve and hydrometer analyses (ASTM D 422) and Atterberg limits (ASTM D 4318) was performed on representative samples in order to classify the soil according the Unified Soil Classification System (USCS). Consolidated undrained triaxial compression tests (ASTM D 4767) and falling head permeability tests (ASTM D 5084) were also performed on Shelby tube samples. Standard Proctor moisture-density testing (ASTM D 698) was performed on disturbed soil bag samples collected from the auger cuttings.



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3.1 BOILER SLAG POND DAM

3.1.1 2010 Geotechnical Exploration

Stantec advanced six borings at the dike of the Boiler Slag Pond Dam near the locations requested by AEP. The boring locations are shown in Appendix A. Borings B-1, B-3, and B-5 were positioned along the crest of the dike and Borings B-2, B-4, and B-6 were located along the downstream toe.

Upon completion of drilling, one-inch diameter standpipe piezometers were installed in four of the borings (Borings B-1, B-3, B-4, and B-5). In these, ten-foot long sections of polyvinyl chloride (PVC) well screen were placed in the borehole with the bottoms at approximate depths ranging from 30 to 40 feet. PVC riser tubing extended to the tops of the piezometers. Flush-mount well covers were installed along the crest of the dike (Borings B-1, B-3, and B-5) and an above-ground steel tube cover was used at the toe of the downstream slope (Boring B-4). Refer to Appendix C for piezometer installation details.

3.1.2 2015 CCR Mandate Site Reconnaissance

Representatives from Stantec visited the Boiler Slag Pond Dam for a site reconnaissance on August 25, 2015. The purpose of this visit was to confirm that physical conditions at the pond, such as geometry of the embankment, pool elevations, etc. had not changed since the completion of the analysis in 2010. The crest and exterior slopes of the pond were walked by Stantec personnel, while the interior slopes were observed from the crest. Evidence of alterations to the pond since 2010 were not observed during the reconnaissance.

3.2 LANDFILL RUNOFF COLLECTION POND DAM

3.2.1 Previous Explorations

Two historical exploration reports were used to develop subsurface profiles and engineering parameters for the onsite material. The <u>Fly Ash Dam Raising Feasibility Report</u> (AEP, 1985) was implemented to obtain geotechnical properties of the dams, dikes, and foundation material to perform a feasibility assessment of raising the dams by 30 feet. Approximately 22 borings with SPT sampling and 11 Cone Penetrometer Test (CPT) borings were performed for this study. This report was used to develop a subsurface profile of the dam and estimate soil properties and shear strength parameters.

The <u>Hydrogeologic Study Report</u> (Applied Geology and Environmental Science, Inc., 2006) summarized the piezometers and field permeability testing performed by various firms. This report was used to develop initial phreatic surfaces for the stability analyses, and the field



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permeability testing data were reviewed to assist in selecting hydraulic conductivity values for soil horizons in the seepage analysis.

A review of the existing data by Stantec revealed a lack of laboratory testing necessary to develop drained (long-term) shear strength parameters. Standard Proctor moisture-density testing was recommended to compare with in-situ total unit weights to estimate the apparent degree of compaction used during construction. The review of the existing data resulted in the additional exploration explained in Section 3.2.2.

3.2.2 2009 Geotechnical Exploration

Stantec advanced four additional borings along the southern dam on November 11 and 19, 2009 to collect undisturbed Shelby tube and disturbed bag samples for laboratory testing. The boring locations are shown in Appendix A. Borings B-7 and B-9 were positioned along the crest of the dam, and Borings B-8 and B-10 were located along the downstream toe of the dam embankment. The borings were numbered in sequence with the six borings drilled at the Boiler Slag Pond Dam, also advanced late in 2009.

3.2.3 2015 Geotechnical Exploration

An additional boring (B-12) was advanced on July 6-7, 2015 to confirm subsurface conditions. This boring was placed on the crest of the dam, between the two cross-sections. The location of the boring can be seen on the site plan in Appendix A. Standard Penetration Test samples were collected at five-foot intervals. These samples were taken to a Stantec laboratory for natural moisture content, hydrometer analyses, and Atterberg limits testing.

3.2.4 2015 CCR Mandate Site Reconnaissance

Representatives from Stantec visited the Landfill Runoff Collection Pond for a site reconnaissance on August 25, 2015. The purpose of this visit was to confirm that physical conditions at the pond, such as geometry of the embankment, pool elevations, etc. had not changed since the completion of the analysis in 2010. The crest and exterior slopes of the pond were walked by Stantec personnel, while the interior slopes were observed from the crest. Evidence of alterations to the pond since 2010 were not observed during the reconnaissance.

4.0 **RESULTS OF EXPLORATIONS**

Logs of borings are provided in Appendix B and shown graphically on stability analysis cross sections in Appendix I for the 2009 and 2010 explorations. Results of natural moisture content tests and SPTs are provided on the logs adjacent to the appropriate sample. Summaries of engineering classification tests are provided in Appendix D.



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4.1 BOILER SLAG POND DAM

4.1.1 2010 Geotechnical Exploration

4.1.1.1 Boring B-1

Boring B-1 was on the crest along cross-section A-A' of the Boiler Slag Pond Dam. The surface elevation of this boring was 473.4 feet.

Lean clay with sand was observed from the surface of the boring to a depth of 67.5 feet (Elevation 405.9 feet). From the surface of the boring to a depth of 37.5 feet (Elevation 435.9 feet), this material was described as light yellowish brown with light gray, damp to moist, and medium stiff to stiff. Natural moisture contents ranged from 15 to 23 percent and SPT N-values varied from 7 to 15 blows per foot (bpf). A liquid limit of 32 percent and a plasticity index of 13 percent were determined for a sample from this horizon. This sample was classified as CL, lean clay with sand, according to the Unified Soil Classification System (USCS) and A-6 (10) according to the Association of American State and Highway Transportation Officials (AASHTO) system. The average total unit weight of undisturbed samples was 131 pounds per cubic foot (pcf).

From a depth of 37.5 to 67.5 feet (Elevation 435.9 to 405.9 feet), the lean clay with sand was described as light yellowish brown with light gray, moist to wet, and very soft to medium stiff. Natural moisture contents ranged from 20 to 37 percent and SPT N-values varied from 2 to 7 blows per foot. A liquid limit of 28 percent and a plasticity index of 12 percent were determined for this soil. A Shelby tube sample yielded a total unit weight of 129 pounds per cubic foot. A representative sample from this layer classified as CL, lean clay with sand, according to the USCS and A-6 (8) according to the AASHTO system.

Bedrock, described as weathered gray shale, was encountered at a depth of 67.5 feet (Elevation 405.9 feet) and was augered to a boring termination depth of 71.5 feet (Elevation 401.9 feet). Groundwater was observed during the drilling at a depth of 40.0 feet (Elevation 433.4 feet) during drilling.

4.1.1.2 Boring B-2

Boring B-2 was advanced at the downstream toe along the same cross-section as Boring B-1 at a surface elevation of 444.0 feet.

From the surface of the boring to a depth of 51.5 feet (Elevation 392.5 feet), lean clay with sand was observed. The top 30 feet of this deposit was described as light yellowish brown with gray, moist to wet, and soft to very stiff. Moisture contents ranged from 17 to 32 percent and SPT N-values varied from 2 to 19 bpf, with an average of 7 blows per foot. The average total unit weight of the soil was 124 pounds per cubic foot.



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The lower 21.5 feet of the lean clay with sand was described as gray, moist to wet, and soft to medium stiff. Natural moisture contents ranged from 25 to 35 percent and SPT N-values varied from 2 to 6 blows per foot. A liquid limit of 33 percent and plasticity index of 18 percent was determined for this material. A representative sample of this soil classified as CL, lean clay with sand according to the USCS and A-6 (13) according to the AASHTO system. Total unit weights of 117 and 121 pcf were determined for Shelby tube samples.

From a depth of 51.5 to 55.5 feet (Elevation 392.5 to 388.5 feet), well-graded gravel with silt and sand was observed. Bedrock was encountered below this material, described as shale, gray, hard, and medium bedded. Groundwater was observed at a depth of 22.5 feet (Elevation 421.5 feet) during drilling.

4.1.1.3 Boring B-3

Boring B-3 was positioned on the crest of the dike along cross-section B-B'. The surface elevation of the boring was 471.6 feet.

Lean clay with sand, described as light yellowish brown with light gray, was observed from the boring surface to a depth of 37.5 feet (Elevation 434.1 feet). The soil was further described as damp to moist and medium-stiff to very stiff. Moisture contents ranged from 15 to 22 percent and SPT N-values varied from 8 to 17 blows per foot. The average total unit weight was 131 pounds per cubic foot.

Gray lean clay with sand was observed below the upper soil horizon to the termination depth of 71.5 feet (Elevation 400.1 feet). This soil was described as moist and soft to very stiff. Moisture contents ranged from 20 to 40 percent and SPT N-values varied from 2 to 18 bpf, with an average of 6 blows per foot. The average total unit weight was 126 pounds per cubic foot.

Groundwater was observed at a depth of 40.0 feet (Elevation 431.6 feet) during drilling. Bedrock was not encountered.

4.1.1.4 Boring B-4

Boring B-4 was located along the downstream toe of the dike, downhill from Boring B-3, at a surface elevation of 444.0 feet.

Brown to dark gray lean clay with sand was observed from the surface of the boring to a depth of 15.0 feet (Elevation 429.0 feet). The soil was described as damp to moist and medium stiff to very stiff. Natural moisture contents ranged from 14 to 22 percent and SPT N-values varied from 7 to 16 blows per foot.

Gray lean clay with sand was encountered below the upper soil horizon to a depth of 57.5 feet (Elevation 386.5 feet) and was described as moist to wet and soft to stiff. Moisture contents



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varied from 21 to 35 percent and SPT N-values varied from 3 to 9 blows per foot. A representative sample yielded a liquid limit of 25 percent and a plasticity index of 8 percent. This material classified as CL, lean clay with sand, according to the USCS and A-4 (4) according to the AASHTO system.

Underlying the lean clay with sand, well-graded gravel with silt and sand was observed to a termination depth of 71.5 feet (Elevation 372.5 feet). This material was described as gray, wet, and dense to very dense. Moisture contents ranged from 9 to 13 percent and SPT N-values varied from 39 to over 50 blows per foot. A representative sample of this material tested as non-plastic and classified as GW-GM, well-graded gravel with silt and sand, according to the USCS and A-1-a (1) according to the AASHTO system.

Bedrock was not encountered in the boring. Groundwater was observed at a depth of 22.5 feet (Elevation 421.5 feet) during drilling.

4.1.1.5 Boring B-5

Boring B-5 was advanced from the crest of the dike on cross-section C-C'. The surface elevation was 468.7 feet.

Lean clay with sand was observed from the surface of Boring B-5 to a depth of 40.0 feet (Elevation 428.7 feet). The soil was described as light yellowish brown with light gray, damp to moist, and medium stiff to very stiff. Natural moisture contents ranged from 15 to 25 percent and SPT N-values varied from 6 to 19 blows per foot. The average total unit weight of the soil was 128 pounds per cubic foot.

Additional lean clay with sand was encountered below the uppermost layer to a depth of 47.5 feet (Elevation 421.2 feet). This material was described as gray, moist to wet, and soft. Natural moisture contents ranged from 23 to 25 percent and SPT N-values varied between 3 and 4 blows per foot. The total unit weight was 119 pounds per cubic foot.

Below the lean clay with sand, sandy silt was observed to the termination depth of 71.5 feet (397.2 feet). The sandy silt was described as light yellowish brown to gray, wet, and soft to stiff. Moisture contents ranged from 22 to 30 and SPT N-values varied from 2 to 13 bpf, with an average of 7 blows per foot. A representative sample from this horizon tested as non-plastic and classified as ML, sandy silt, according to the USCS and A-4 (0) according to the AASHTO system.

Bedrock was not encountered in the boring. Groundwater was encountered at a depth of 45.0 feet (Elevation 423.7 feet) during drilling.



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4.1.1.6 Boring B-6

Boring B-6 was advanced from a surface elevation of 445.5 feet near the southeast toe of slope below Boring B-5.

Lean clay with sand was encountered from the surface to a depth of 27.5 feet (Elevation 418.0 feet). This material was described as brown to gray, damp to moist, and very soft to very stiff. Natural moisture contents ranged from 16 to 32 percent and SPT N-values varied from 0 to 18 bpf, with an average of 6 blows per foot. The average total unit weight was 117 pounds per cubic foot.

Sandy silt was observed below the lean clay with sand to the boring termination depth of 71.5 feet (Elevation 374.0 feet). This soil was described as gray, moist to wet, and very soft to stiff. Moisture contents ranged from 27 to 40 percent and SPT N-values varied from 1 to 11 bpf, with an average of 5 blows per foot. The total unit weight was 117 pounds per cubic foot.

Bedrock was not encountered in the boring. Groundwater was observed at a depth of 30.0 feet (Elevation 415.5 feet) during drilling.

4.1.1.7 Piezometers

Piezometers were installed on the crest in Borings B-1, B-3, and B-5, and at the downstream toe in Boring B-4. Details of piezometers installations are shown in Appendix C. Ten-foot long piezometers screens were installed with the tips at approximate depths of 40 feet along the crest and 30 feet at the downstream toe of slope. Table 2 summarizes the installations and first two readings performed on the piezometers.

Boring No.	Top of Piezometer (feet)	Tip of Piezometer (feet)	Piezometric Reading on 11/13/09 (feet)	Piezometric Reading on 02/01/10 (feet)
B-1	473.4	433.4	434.2	434.1
В-З	471.8	431.6	440.6	434.6
B-4	446.7	414.0	430.7	428.5
B-5	469.0	428.7	434.9	430.4

Table 2	Summary of Piezometer Elevations for the Boiler Slag Pond Dam
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4.2 LANDFILL RUNOFF COLLECTION POND

4.2.1 2009 Geotechnical Exploration

4.2.1.1 Boring B-7

Boring B-7 was advanced from the crest of the dam along cross-section D-D'. The surface elevation of the boring was 503.4 feet. Approximately 0.5 feet of asphalt pavement and gravel base was observed at the surface of the boring.

Below the pavement and gravel base, lean clay was observed to a boring termination depth of 29.0 feet (Elevation 474.4 feet). The lean clay was described as yellow and light gray, moist, and stiff. Three undisturbed Shelby tube samples were obtained from a depth of 23.0 to 29.0 feet (Elevation 480.4 to 474.4 feet). Natural moisture contents of those samples ranged from 18 to 24 percent, and total unit weights varied from 128 to 133 pounds per cubic foot. A representative sample yielded a liquid limit of 28 percent and a plasticity index of 8. This sample classified as CL, lean clay, according to the USCS and A-4 (7) according to the AASHTO system.

Neither bedrock nor groundwater was encountered during drilling.

4.2.1.2 Boring B-8

Boring B-8 was located at the toe of slope downstream of Boring B-7. The surface elevation of the boring was 441.5 feet. From the surface of the boring to a depth of 16.0 feet (Elevation 425.5 feet), the soil was visually described as yellow and light gray, damp to moist, silty clay.

Below the silty clay, lean clay was encountered to a depth of 29.0 feet (Elevation 412.5 feet). The lean clay was described as yellowish brown to light gray and moist. Two undisturbed Shelby tube samples were taken from this horizon at depths of between 25.0 and 29.0 feet (Elevation 416.5 to 412.5 feet). Natural moisture contents ranged from 24 to 27 percent, and total unit weights ranged from 124 to 130 pounds per cubic foot. A representative sample of this material yielded a liquid limit of 38 percent and a plasticity index of 17 percent. The sample classified as CL, lean clay according to the USCS and A-6 (15) according to the AASHTO system.

Soil described as lean clay with sand was observed beneath the lean clay to the boring termination depth of 31.0 feet (Elevation 410.5 feet). The lean clay with sand was further described as yellowish brown and light gray and moist. Shelby tube samples yielded moisture contents of 22 and 24 percent and total unit weights of 126 and 129 pounds per cubic foot. This soil had a liquid limit of 45 percent and a plasticity index of 25 percent. The soil classified as CL, lean clay with sand according to the USCS and A-7-6 (20) according to the AASHTO system.

Neither bedrock nor groundwater was encountered during drilling.



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4.2.1.3 Boring B-9

Boring B-9 was advanced along the crest of cross-section E-E' at a surface elevation of 504.3 feet. Asphalt pavement and gravel base was observed at the surface of the boring to a depth of 0.5 feet.

Lean clay was encountered below the pavement to the boring termination depth of 22.0 feet (Elevation 482.3 feet). The lean clay was described as yellow to light gray and damp to moist. Three undisturbed Shelby tube samples were obtained from a depth of 16.0 to 22.0 feet (Elevation 488.3 to 482.3 feet). Natural moisture contents ranged from 17 to 23 percent, and total unit weights varied from 119 to 135 pounds per cubic foot. A sample of this material yielded a liquid limit of 39 percent and a plasticity index of 19 percent. This sample classified as CL, lean clay, according to the USCS and A-6 (17) according to the AASHTO system.

Neither bedrock nor groundwater was encountered during drilling.

4.2.1.4 Boring B-10

Boring B-10 was positioned near the toe below Boring B-9. The surface elevation was 457.3 feet.

Silty clay with sand was observed from the surface of the boring to a depth of 13.2 feet (Elevation 444.1 feet) and from a depth of 16.0 feet to the termination depth of 18.0 feet (Elevation 441.3 to 439.3 feet). This soil was described as yellow to light gray and damp to moist. Two undisturbed Shelby tube samples were taken and natural moisture contents ranged from 21 to 28 percent. Total unit weights of the samples ranged from 116 to 124 pounds per cubic foot. A representative sample of this material yielded a liquid limit of 28 percent and a plasticity index of 7 percent. The sample classified as CL-ML, silty clay with sand according to the USCS and A-4 (5) according to the AASHTO system.

From a depth of 13.2 to 16.0 feet (Elevation 444.1 to 441.3 feet) a layer of silty sand was encountered and describe as gray-brown and damp to moist. One Shelby tube sample was taken from this layer. A representative sample of this soil classified as non-plastic SM, silty sand, according to the USCS and A-2-4 (0) according to the AASHTO system.

4.2.2 2015 Geotechnical Exploration

Boring B-12 was advanced on the crest of the dam between the analysis cross-sections. The ground surface elevation of the boring was estimated to be 503.9 feet. A layer of asphalt with gravel base was encountered at the surface of the boring to a depth of 0.4 feet (Elevation 503.5 feet).

Beneath the asphalt and gravel base, lean clay with sand was encountered to a depth of 40.0 feet (Elevation 463.9 feet). This material was described as gray, damp, and medium stiff to stiff.



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The natural moisture contents ranged from 18 to 28 percent and the SPT N-values varied from 7 to 15 blows per foot. The liquid limit of this material ranged from 31 to 43 percent and the plasticity index varied from 13 to 22 percent. The material classified as CL, lean clay with sand, according to the USCS and A-6 (7) or A-7-6 (15) according to the AASHTO system.

Silty clay with sand was observed beneath the lean clay with sand to a depth of 50.0 feet (Elevation 453.9 feet). This material was described as brown, moist, and medium stiff to very stiff. The natural moisture contents ranged from 16 to 19 percent and the SPT N-values varied from 8 to 16 blows per foot. A representative sample of this material yielded a liquid limit of 26 percent and a plasticity index of 7 percent. The material classified as CL-ML, silty clay with sand, according to the USCS and A-4 (4) according to the AASHTO system.

Cohesionless material was encountered beneath the silty clay with sand to the depth of 90.0 feet (Elevation 413.9 feet). This material was silt, silt with sand, silty sand, or sand; and was described as brown or gray, damp to wet, and loose to medium dense. The natural moisture contents ranged from 15 to 28 percent and the SPT N-values varied from 6 to 28 blows per foot. Samples from these materials tested as non-plastic. The material classified as ML (sandy silt, silt, or silt with sand) or SM (silty sand) according to the USCS and A-4 (0) according to the AASHTO system.

Beneath the cohesionless material, lean clay was encountered to the boring termination depth of 101.5 feet (402.4 feet). This material was described as gray, moist, and medium stiff to very stiff. The natural moisture content ranged from 23 to 27 percent and the SPT N-values varied from 8 to 19 blows per foot. A representative sample from this material yielded a liquid limit of 42 percent and a plasticity index of 23 percent. The sample classified as CL, lean clay, according to the USCS and A-7-6 (20) according to the AASHTO system.

5.0 LABORATORY TESTING

Laboratory tests in addition to the natural moisture content, classification tests, and unit weight tests mentioned in Section 4 were conducted on samples taken from the Boiler Slag Pond Dam (2010 Geotechnical Exploration) and Landfill Runoff Collection Pond (2009 Geotechnical Exploration). The results from the additional testing are summarized in the following sections.

5.1 BOILER SLAG POND DAM

5.1.1 Consolidated-Undrained Triaxial Compression Testing

Three consolidated-undrained (CU) triaxial compression tests were performed on undisturbed samples collected from the borings. These tests were performed in accordance with ASTM D



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4767, and detailed results of the tests are provided in Appendix E. The samples were described as lean clay with sand. Table 3 shows a summary of the CU triaxial tests performed.

Boring Nos.	Depth (feet)	Soil Description	Material	Effective Cohesion, c' (psf)	Effective Angle of Internal Friction, φ' (deg.)
B-3, B-5	8.1 – 11.2	Lean Clay with Sand	Embankment	330	33.2
B-2, B-4	18.2 – 24.3	Lean Clay with Sand	Foundation	320	27.2
B-1, B-3	43.1 – 48.7	Lean Clay with Sand	Foundation	170	30.2

 Table 3
 Summary of CU Triaxial Compression Testing for the Boiler Slag Pond Dam

5.1.2 Permeability Testing

Four permeability tests (ASTM D 5084, Falling-Head, Method C, Rising Tailwater) were performed on undisturbed samples. Detailed data sheets showing the results of the tests are provided in Appendix F. Vertical hydraulic conductivities ranged from 8.7x10-9 to 1.6x10-6 centimeters per second. The samples were described as lean clay with sand. Table 4 summarizes the results of the permeability tests.

 Table 4
 Summary of Permeability Testing for the Boiler Slag Pond Dam

Boring No.	Depth, feet	Soil Description	Material	Vertical Hydraulic Conductivity, cm/second
B-1	16.1 – 16.6	Lean Clay with Sand	Embankment	1.44x10 ⁻⁷
B-2	42.6 - 43.1	Lean Clay with Sand	Foundation	8.70x10 ⁻⁹
B-4	7.6 – 8.1	Lean Clay with Sand	Embankment	1.58x10 ⁻⁶
B-6	17.6 – 18.1	Lean Clay with Sand	Foundation	2.01x10 ⁻⁷

5.1.3 Moisture-Density Testing

Three standard Proctor moisture-density tests (ASTM D 698) were performed on bag samples taken from auger cuttings. The data sheets for these tests are provided in Appendix G.



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Maximum dry densities ranged from 113.0 to 117.4 pcf and optimum moisture contents varied from 13.4 to 15.8 percent. The samples were described as lean clay with sand. Table 5 summarizes the results of the tests.

Boring No.	Depth, feet	Material	Soil Description	Maximum Dry Density, pcf	Optimum Moisture Content, %
B-1	5.0 +/- 2.0	Embankment	Lean Clay with Sand	117.4	13.4
B-5	7.5 +/- 2.0	Embankment	Lean Clay with Sand	113.0	15.8

 Table 5
 Summary of Moisture-Density Testing for the Boiler Slag Pond Dam

These moisture-density tests were performed to compare with natural moisture contents and unit weights of the soils. Within the embankment soils, natural moisture contents ranged from 15 to 25 percent with an average of 19 percent. Dry densities of the embankment soil ranged from 106 to 115 pcf, with an average of 110 pounds per cubic foot. The results of these tests indicate that the average natural moisture content of the embankment soil is 3 to 5 percent above optimum moisture and that the average percent compaction of the embankment soil is on the order of 94 to 97 percent of the standard Proctor maximum density.

5.2 LANDFILL RUNOFF COLLECTION POND

5.2.1 Consolidated-Undrained Triaxial Testing

Four CU triaxial compression tests were performed on undisturbed samples collected from the borings. These tests were performed in accordance with ASTM D 4767, and detailed results of the tests are provided in Appendix E. The samples were described as lean clay, lean clay with sand, or sandy clay. Table 6 shows a summary of the CU triaxial tests performed.



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Boring No.	Depth (feet)	Soil Description	Material	Effective Cohesion, c' (psf)	Effective Angle of Internal Friction, φ' (deg.)
B-7	25.8 – 29.0	Lean Clay	Embankment	430	29.3
B-8	25.8 – 30.9	Lean Clay with Sand	Foundation	410	28.0
B-9	17.4 – 21.4	Lean Clay	Embankment	360	25.7
B-10	13.4 – 18.0	Sandy Clay	Foundation	300	35.1

Table 6Summary of CU Triaxial Compression Testing for the Landfill Runoff Collection
Pond

5.2.2 Permeability Testing

Four permeability tests (ASTM D 5084, Falling-Head, Method C, Rising Tailwater) were performed on undisturbed samples. Detailed data sheets showing the results of the tests are provided in Appendix F. Vertical hydraulic conductivities ranged from 3.4x10⁻⁸ to 1.4x10⁻⁷ centimeters per second. The samples were described as lean clay, lean clay with sand, or silt. Table 7 summarizes the results of the permeability tests.

Table 7	Summary of Permeability Testing for the Landfill Runoff Collection Pond
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Boring No.	Depth, feet	Material Soil Description		Vertical Hydraulic Conductivity, cm/second
B-7	27.4 – 27.7	Embankment	Lean Clay	8.4x10 ⁻⁸
B-8	29.7 – 30.9	Foundation	Silt	3.4x10 ⁻⁸
B-9	18.3 – 18.9	Embankment	Lean Clay	6.2x10 ⁻⁸
B-10	16.4 – 16.7	Foundation	Lean Clay with Sand	1.4x10 ⁻⁷

5.2.3 Moisture-Density Testing

One standard Proctor moisture-density test (ASTM D 698) was performed on a bag sample of embankment soil taken from auger cuttings. The data sheet for this test is provided in Appendix



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G. The maximum dry density was 110.6 pcf and the optimum moisture content was 16.9 percent. The sample was described as lean clay. Table 8 summarizes the results of the tests.

Boring No.	Depth, feet	Material	Soil Description	Maximum Dry Density, pcf	Optimum Moisture Content, %
B-7	7.0 +/- 2.0	Embankment	Lean Clay	110.6	16.9

The moisture-density test was performed to compare with in-situ natural moisture contents and unit weights of the soils. Within the embankment soils, natural moisture contents varied from 17 to 24 percent with an average of 20 percent. Dry densities of the embankment soil ranged from 99 to 114 pounds per cubic foot, with an average of 108 pounds per cubic foot. The results of these tests indicate that the average natural moisture content of the embankment soil is about 3 percent above optimum moisture and that the average percent compaction of the embankment soil is approximately 98 percent of the standard Proctor maximum density.

6.0 ENGINEERING ANALYSIS

6.1 BOILER SLAG POND DAM

Based on the review of available information, results of the geotechnical exploration and results of laboratory testing, Stantec performed engineering analyses of the Boiler Slag Pond Dam in 2010. This included liquefaction, seepage, and slope stability analysis of three cross sections. The procedures used and the results of the analyses are presented in the following paragraphs. The results of the liquefaction analysis are shown in Appendix H, and the cross section drawings showing the results of the seepage and stability analyses are provided in Appendix I. Appendix J provides an explanation of derivations of shear strength, seepage, and liquefaction analysis parameters.

6.1.1 Engineering Analyses Performed in 2015 as Part of CCR Mandate

6.1.1.1 Liquefaction Analysis

The liquefaction analysis conducted in 2010 was revisited as part of the CCR Mandate. The details for this analysis are contained in Appendix H. Similar to the analysis performed in 2010, a screening process was used to determine if the cohesive material encountered in the borings has the potential for liquefaction. The screening process was conducted for four samples which had liquid limits below 37 percent. According to the Seed et al and Bray and Sancio plots



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supplied in Appendix H, one sample could be labeled as susceptible to liquefaction and another could be labeled as moderately susceptible to liquefaction.

The remaining cohesionless material encountered in the critical cross-sections was tested for liquefaction as a coarse-grained analysis similar to the one conducted in 2010. According to the CCR Mandate, for dikes constructed of soils that have a susceptibility to liquefaction, the calculated factor of safety must equal or exceed 1.20. Test data from Borings B-1 and B-2, representative of cross-section A-A', Boring Nos. B-3 and B-4, representative of cross-section B-B', and B-5 and B-6, representative of cross-section C-C' was used. Soil characteristics (grain size, plasticity, etc.) from SPT and Shelby tube samples were summarized to assess liquefaction potential. The copies of the spreadsheets used for the calculations appear in Appendix H and provide the soil, test data, and calculations used in the assessment.

It was assumed during the screening process for potential liquefaction that the steady-state water elevation consistent with that developed during the stability analysis would be used as the groundwater elevation. Unsaturated soils above this elevation were considered not liquefiable. Also the dike embankment materials, consisting of engineered fill, were not considered liquefiable.

Factors of safety against liquefaction were estimated for soil layers predicted to be potentially liquefiable during the screening process. As a result of recent industry publications that attempted to update certain correlations that had larger uncertainty that are used in the calculations for the factor of safety, slight differences in the factors of safety were obtained than those reported in 2010. Inputs such as depth, material properties, seismic accelerations, etc. have not been altered. Ranges and averages of these factors of safety for the potentially liquefiable soil layers are summarized in Table 9.

Boring No.	Depth (feet)	Elevation (feet)	Unified Soil Classification	Liquefaction FS, Range	Liquefaction FS, Average
B-2	51.5 – 56.0	392.5 – 388.0	GW-GM	10.00	10.00
B-4	57.5 – 71.5	386.5 – 372.5	GW-GM	10.00	10.00
B-5	47.5 – 71.5	421.2 – 397.2	ML	1.60 – 3.52	2.41
B-6	27.5 – 71.5	418.0 – 374.0	ML	1.08 – 2.64	1.73

Table 9 Liquefaction Factor of Safety for the Boiler Slag Pond Dam, CCR Mandate

The range of factors of safety for each soil horizon represents factors of safety calculated from each individual corrected N-value at that specific depth and overburden pressure. Due to the variable and somewhat unreliable nature associated with the SPT, it is recommended that the



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liquefaction factors of safety be evaluated according to the average values shown in Table 9. The average liquefaction factors of safety against liquefaction ranged from 1.73 to 10.00 and are considered acceptable.

6.1.1.2 Seepage Analysis

The seepage analysis conducted in 2010 was reviewed as part of the CCR Mandate. The seepage models used in the SEEP/W product were calibrated to recent piezometric data and visual field operations. Changes to the material properties developed in Appendix J of this report were not deemed necessary.

The 2010 analysis used a normal pool elevation of 442 feet to establish the piezometric line. During the 2015 site reconnaissance with AEP personnel, it was learned that the normal pool elevation is currently 448 feet and is not expected to change. As a result, a piezometric line has been adjusted for the current normal pool elevation of 448 feet, and has been used during the CCR Mandate review. The seepage analysis conducted at the critical cross-sections of A-A', B-B', and C-C' were reviewed.

The results of the seepage analysis were used to revise the stability cross-sections.

6.1.1.3 Stability Analysis

The stability analysis conducted in 2010 was reviewed as part of the CCR Mandate, using the results of the seepage analysis review in Section 6.1.1.2. Similar to 2010, SLOPE/W was the software used during the analysis. The drained shear strength parameters developed in 2010, located in Appendix J, were maintained for the updated analysis. Undrained shear strength parameters were not derived in 2010. These parameters were determined by CU test data for the Embankment Fill and Lean Clay with Sand. Undrained shear strength parameters for cohesionless materials were taken to be identical to the drained shear strength parameters.

Table 10 summarizes the drained and undrained shear strength parameters used in the analysis.



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					ned Shear engths	
Material	Unit Weight (pcf)	φ' (deg.)	Effective Cohesion (psf)	φ (deg.)	Cohesion (psf)	
Embankment	130	33.2	165	13	600	
Lean Clay with Sand	119	27.2	160	5	1,200	
Gravel with Silt and Sand	130	35	0	35	0	
Bottom Ash	115	28	0	28	0	
Silty Sand	130	30	0	30	0	

Table 10 Shear Strength Parameters for CCR Mandate Review

The upstream and downstream slopes of each cross-section were analyzed, incorporating the auto locate and entry/exit search routines to locate the critical slip surface. Once the potential failure surface with the lowest factor of safety was identified, the optimization routine was run.

When the surface slope is composed of a material with low effective cohesion, an infinite slope failure (shallow sliding parallel to the surface) will be critical. A minimum failure depth of ten feet was specified for each section, to eliminate the evaluation of surficial sloughing and erosional types of instability.

For this review, SLOPE/W was used to investigate one normal pool elevation, considered the maximum steady-state pool, and one PMF pool elevation:

- Current normal pool level of 448 feet.
- 50 Percent PMF pool level of 468.4 feet, applied as a steady-state load condition within SLOPE/W.

Using the drained and undrained strength parameters listed in Table 10, the existing dam was analyzed at the three critical cross sections selected for the CCR review. The undrained materials strengths were used in the seismic analyses.

A summary of the factors of safety are presented in Table 13 at the end of this section and printouts of the GeoStudio runs are presented in Appendix I.



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6.2 LANDFILL RUNOFF COLLECTION POND

Based on the review of available information, results of geotechnical exploration and results of laboratory testing, Stantec performed engineering analyses of the Landfill Runoff Collection Pond in 2009. This included liquefaction, seepage, and slope stability analysis of two cross sections. The procedures used and the results of the analyses are presented in the following paragraphs. The results of the liquefaction analysis are shown in Appendix H, and the cross section drawings showing the results of the seepage and stability analyses are provided in Appendix I. Appendix J provides an explanation of derivations of shear strength, seepage, and liquefaction analysis parameters.

6.2.1 Engineering Analyses Performed in 2015 as Part of CCR Mandate

6.2.1.1 Liquefaction Analysis

The liquefaction analysis conducted in 2010 as part of the 2009 geotechnical exploration was revisited as part of the CCR Mandate. The details for this analysis are contained in Appendix H. Similar to the analysis performed in 2010, a screening process was used to determine if the cohesive material encountered in the borings has the potential for liquefaction. The screening process was conducted for nine samples, four of which had liquid limits below 37 percent. According to the Seed et al and Bray and Sancio plots supplied in Appendix H, none of the samples are considered susceptible to liquefaction.

The remaining cohesionless material encountered in the critical cross-sections was tested for liquefaction as a coarse-grained analysis similar to the one conducted in 2010. According to the CCR Mandate, for dikes constructed of soils that have a susceptibility to liquefaction, the calculated factor of safety must equal or exceed 1.20. Test data from historic Borings SS2-1 and SS2-4, representative of cross-section D-D' and historic Borings SI-1, SS3-1, and SS3-4, representative of cross-section E-E', were used. Soil characteristics (grain size, plasticity, etc.) from SPT and Shelby tube samples were summarized to assess liquefaction potential. The copies of the spreadsheets used for the calculations appear in Appendix H and provide the soil, test data, and calculations used in the assessment.

It was assumed during the screening process for potential liquefaction that the steady-state water elevation consistent with that developed during the stability analysis would be used as the groundwater elevation. Unsaturated soils above this elevation were considered not liquefiable. Also the dike embankment materials, consisting of engineered fill, were not considered liquefiable.

Factors of safety against liquefaction were estimated for soil layers predicted to be potentially liquefiable during the screening process. As a result of recent industry publications that attempted to update certain correlations that had larger uncertainty that are used in the



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calculations for the factor of safety, slight differences in the factors of safety were obtained than those reported in 2010. Inputs such as depth, material properties, seismic accelerations, etc. have not been altered. Ranges and averages of these factors of safety for the potentially liquefiable soil layers are summarized in Table 11.

Boring No.	Depth (feet)	Elevation (feet)	Unified Soil Classification	Liquefaction FS, Range	Liquefaction FS, Average
SI-1	14.0 – 26.0	442.6 - 430.6	ML	2.06 - 2.40	2.23
SI-1	26.0 - 36.0	430.6 – 420.6	SC	10.00	10.00
SI-1	36.0 - 41.0	420.6 – 415.6	SM	5.02	5.02
SI-1	41.0 – 79.5	415.6 – 377.1	ML	2.08 - 10.00*	4.87
SS2-1	61.0 – 66.0	443.5 – 438.5	ML	6.22	6.22
SS2-1	71.0 – 86.0	443.5 – 418.5	SM	2.41 - 10.00	6.31
SS2-4	16.0 – 21.0	423.8 - 418.8	SM	3.29	3.29
SS2-4	61.0 - 64.0	388.8 – 385.8	GC	3.50	3.50
SS3-1	36.0 – 46.0	468.5 – 458.5	ML	3.36 - 4.92	4.14
SS3-1	46.0 – 51.0	458.5 – 453.5	SP	5.34	5.34
SS3-1	51.0 – 56.0	453.5 – 448.5	SC	10.00	10.00
SS3-1	56.0 – 66.0	448.5 – 438.5	SP	3.28 – 3.84	3.56
SS3-1	66.0 – 71.0	438.5 – 433.5	SM	5.03	5.03
SS3-1	71.0 – 86.0	433.5 – 418.5	SP	2.93 - 10.00	6.25
SS3-1	86.0 – 96.0	418.5 – 408.5	SM	5.53 – 6.09	5.81
SS4-1	41.0 - 46.0	464.6 – 459.6	ML	3.28	3.28
SS4-1	46.0 - 66.0	459.6 – 439.6	SM	2.32 - 4.51	3.60
SS4-1	71.0 – 76.0	434.6 – 429.6	SC	1.83	1.83
SS4-1	76.0 – 94.0	429.6 – 411.6	ML	4.01 - 6.30	5.62

Table 11 Liquefaction Factor of Safety for the Boiler Slag Pond Dam, CCR Mandate

*Typical range is 2.08 – 2.93, typical average is 3.16



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6.2.1.2 Seepage Analysis

The seepage analysis conducted in 2010 as a part of the 2009 geotechnical exploration was reviewed as part of the CCR Mandate. The seepage models used in the SEEP/W product were calibrated to recent piezometric data and visual field operations. Changes to the material properties developed in Appendix J of this report and the piezometric lines developed were not deemed necessary. The seepage analysis conducted at the critical cross-sections of D-D' and E-E' were reviewed.

The results of the seepage analysis were used to revise the stability cross-sections.

6.2.1.3 Stability Analysis

The stability analysis conducted in 2010 was reviewed as part of the CCR Mandate, using the results of the seepage analysis review in Section 6.2.1.2. Similar to 2010, SLOPE/W was the software used during the analysis. The drained shear strength parameters developed in 2010, located in Appendix J, were maintained for the updated analysis. Undrained shear strength parameters were not derived in 2010. These parameters were determined by CU test data for the Embankment and Lean Clay with Sand. The undrained shear strength parameters for the silty clay with sand layer were taken from established typical value tables. Undrained shear strength parameters for cohesionless materials were taken to be identical to the drained shear strength parameters.

Table 12 summarizes the drained and undrained shear strength parameters used in the analysis.

		Drained Shear Strengths		Undrained Shear Strengths	
Material	Unit Weight (pcf)	φ' (deg.)	Effective Cohesion (psf)	φ (deg.)	Cohesion (psf)
Embankment	129	27.5	198	21	1,400
Lean Clay with Sand	127	28	206	17	1,200
Sandy Silt	125	30	0	30	0
Silty Sand	94	30	0	30	0
Clayey Gravel with Sand	130	35	0	35	0
Fly Ash	115	25	0	25	0
Silty Clay with Sand	118	34	152	20	1,000

 Table 12
 Shear Strength Parameters for CCR Mandate Review



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The upstream and downstream slopes of each cross-section were analyzed, incorporating the auto locate and entry/exit search routines to locate the critical slip surface. Once the potential failure surface with the lowest factor of safety was identified, the optimization routine was run.

When the surface slope is composed of a material with low effective cohesion, an infinite slope failure (shallow sliding parallel to the surface) will be critical. Failure was defined as any slip surface that begins in the crest with a reasonable depth of failure. A minimum failure depth was specified for each section, to eliminate the evaluation of surficial sloughing and erosional types of instability.

For this review, SLOPE/W was used to investigate one normal pool elevation and one PMF pool elevation:

- Current normal pool level of 485 feet.
- PMF pool level of 501.4 feet, applied as a surcharge load within SLOPE/W.

Using the drained and undrained strength parameters listed in Table 12, the existing dam was analyzed at the three critical cross sections selected for the CCR review. The undrained shear strength parameters were used in the seismic analyses.

A summary of the factors of safety are presented in Table 14 at the end of this section and printouts of the GeoStudio runs are presented in Appendix I.



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Table 13 Summary of Computed Factors of Safety for the West Boiler Slag Pond Dam, 2015 CCR Mandate

					Factor of Safety			
Headwater Pool	Drainage	Incipient Motion	Seismic Load Case	Acceptance Criteria	A-A'	B-B'	C-C'	
Normal Pool Elevation (448 feet)		Downstream	No	1.50	2.30	2.44	2.30	
Normal Pool Elevation (448 feet)	Drained	Upstream		1.50	1.88	1.63	2.73	
50% PMF Elevation(462.8 feet)		Downstream		1.40	2.30	2.44	2.18	
50% PMF Elevation (462.8 feet)		Upstream		1.40	2.13	1.95	3.88	
Normal Pool Elevation (448 feet)	Undrained	Downstream	Yes	1.00	1.35	1.30	1.53	
Normal Pool Elevation (448 feet)		Upstream		1.00	1.34	1.30	2.25	

Table 14 Summary of Computed Factors of Safety for the Landfill Runoff Collection Pond Dam, 2015 CCR Mandate

					Factor of Safety	
Headwater Pool	Drainage	Incipient Motion	Seismic Load Case	Acceptance Criteria	D-D'	E-E'
Normal Pool Elevation (485 feet)	- Drained	Downstream	No	1.50	1.85	1.99
Normal Pool Elevation (485 feet)		Upstream		1.50	2.73	3.51
PMF Elevation Surcharge (501.4 feet)		Downstream		1.40	1.81	1.99
PMF Elevation Surcharge (501.4 feet)		Upstream		1.40	3.47	4.51
Normal Pool Elevation (485 feet)	Undrained	Downstream	Yes	1.00	1.42	1.64
Normal Pool Elevation (485 feet)		Upstream		1.00	1.94	2.28

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7.0 CONCLUSIONS

7.1 PE CERTIFICATION

I, Stan Harris, being a Professional Engineer in good standing in the State of Indiana, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this certification is prepared in accordance with the accepted practice of engineering. I certify that pursuant to 40 CFR 257.73(e)(2), the safety factor assessment for the AEP Clifty Creek Power Plant's Boiler Slag Pond Dam and Landfill Runoff Collection Pond demonstrates compliance with the factors of safety specified in 40 CFR 257.73(e)(1)(i) through (iv).

SIGNATURE

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7.2 GENERAL

The analyses presented herein are based on information gathered (from various sources) using that degree of care and skill ordinarily exercised under similar circumstances by competent members of the engineering profession. Subsurface profiles are generally based on straight-line interpolation between borings and no warranties can be made regarding the continuity of subsurface conditions between the borings.

The boring logs and related information presented in this report 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. This report may not be applicable if the facility is modified from what is described in this report or if the site conditions are altered. This report may require updating to reflect the different, modified facility specifics and/or the altered site conditions.



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8.0 **REFERENCES**

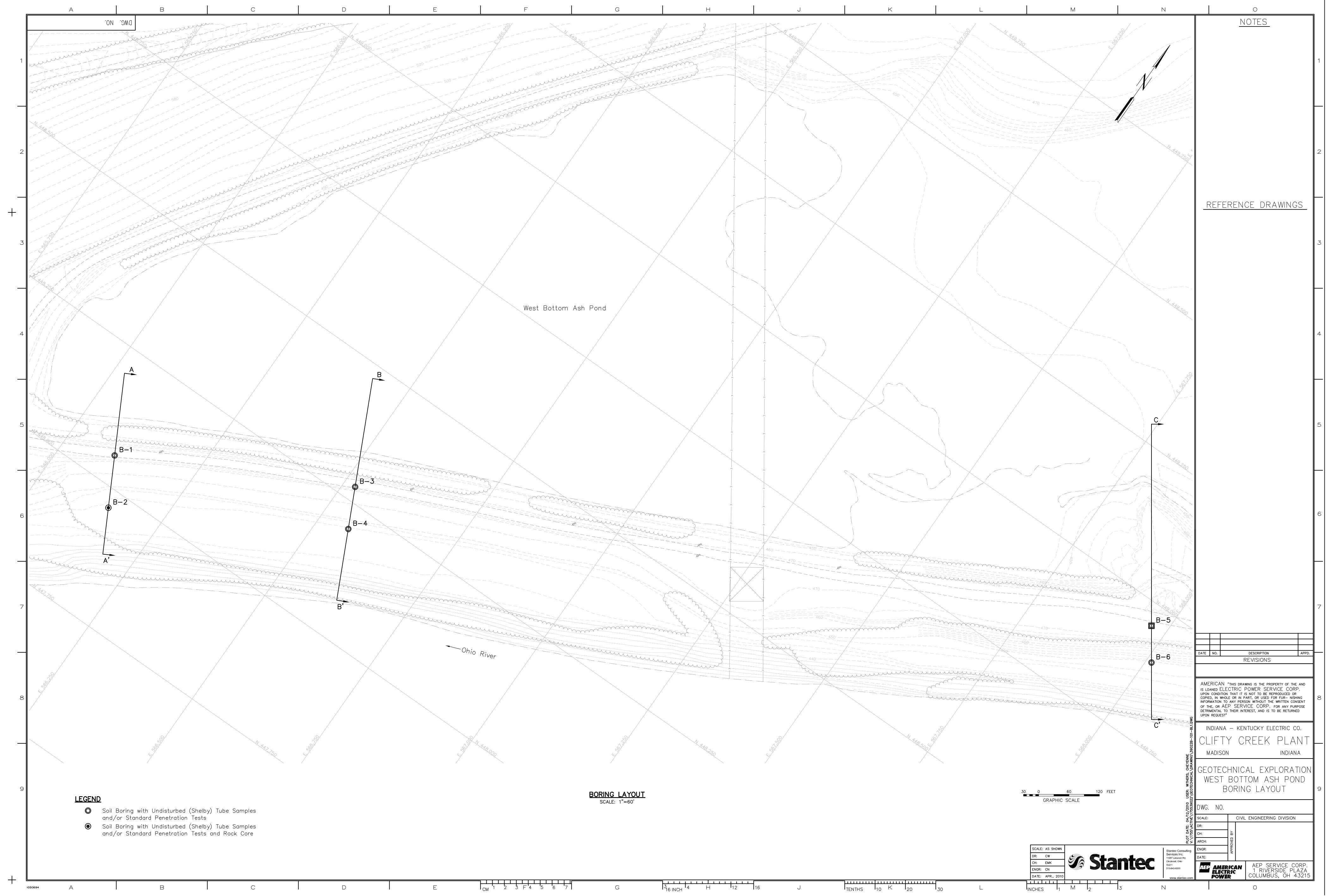
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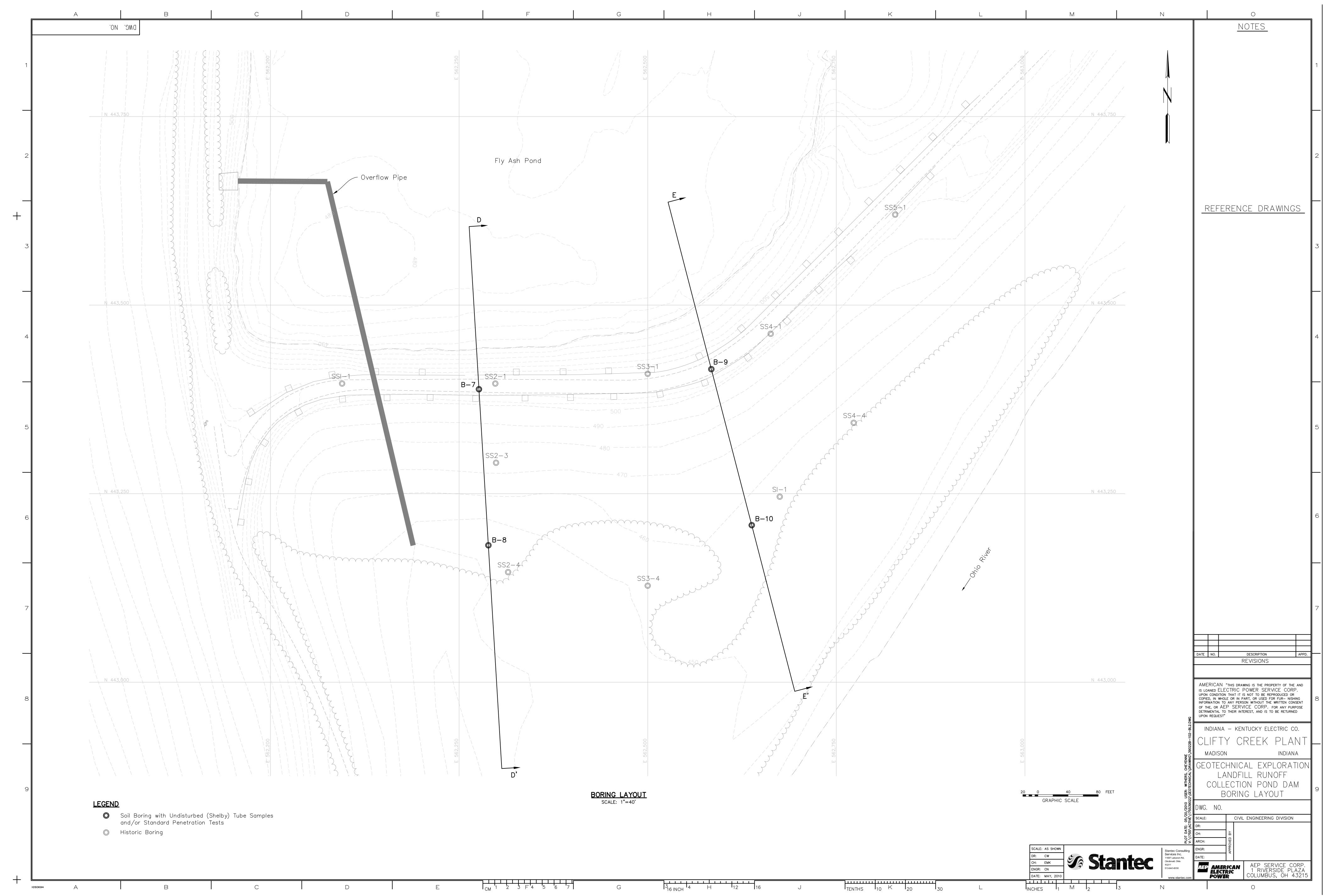
APPENDIX A

SITE PLANS

BOILER SLAG POND DAM



LANDFILL RUNOFF COLLECTION POND



APPENDIX B

BORING LOGS

BOILER SLAG POND DAM



Page: 1 of 2

Project Number	175539022			Location	V	/est Cres	t: West Pon	d Dam
Project Name	AEP Clifty Creek /	Ash Ponds		Boring No.	B-1		Total Dept	h71.5 ft
County	Jefferson, IN			Surface Elev	vation	47	3.4 ft	
Project Type	Geotechnical Expl	oration		Date Started	11	1/3/09	Completed	d <u>11/4/09</u>
Supervisor	C. Nisingizwe Dr	iller M. We	thington	Depth to Wa	ater 4	0.0 ft	Date/Time	11/4/09
Logged By	C. Nisingizwe			Depth to Wa	ater 3	9.2 ft	Date/Time	11/13/09
Lithology		Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
473.4' 0.0'	Top of Hole							
	Lean Clay With So yellowish brown w gray, damp to mo medium stiff to ve Fill	/ith light ist.	SPT-1	2.5 - 4.0	1.2	6-5-6	17	- N = 11 -
-			SPT-2	5.0 - 6.5	1.3	5-5-5	15	N = 10
-			ST-3	7.5 - 9.5	2.0		23	-
-			SPT-4	10.0 - 11.5	0.4	1-5-5	21	N = 10
-			SPT-5	12.5 - 14.0	1.3	2-2-5	17	N = 7
-			ST-6	15.0 - 17.0	2.0		20	-
-			SPT-7	17.5 - 19.0	1.5	5-6-9	19	N = 15
-			SPT-8	20.0 - 21.5	1.5	3-5-10	15	N = 15
-			SPT-9	22.5 - 24.0	1.5	3-7-7	17	N = 14
			SPT-10	25.0 - 26.5	1.2	3-3-5	17	N = 8
			SPT-11	27.5 - 29.0	1.3	3-4-8	20	N = 12
			SPT-12	30.0 - 31.5	1.4	4-4-7	19	N = 11
			SPT-13	32.5 - 34.0	1.3	2-4-5	18	N = 9
			SPT-14	35.0 - 36.5	1.1	2-5-5	17	N = 10
435.9' 37.5'			SPT-15	37.5 - 39.0	1.2	1-2-4	20	N = 6



-		175539022			Location			t: West Pone	
Project I	Name	AEP Clifty Creek /	Ash Ponds		Boring No.	<u>B-1</u>		Total Dept	h 71.5 ft
Litholo	ogy		Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
-		Lean Clay With S yellowish brown w gray, moist to wet	/ith light	SPT-16	40.0 - 41.5	1.3	1-2-3	24	N = 5
		soft to medium sti (Continued)	ff	ST-17	42.5 - 44.5	2.0		22	
-				SPT-18	45.0 - 46.5	1.5	1-1-1	30	N = 2
				SPT-19	47.5 - 49.0	1.5	1-1-2	23	N = 3
				SPT-20	50.0 - 51.5	1.1	1-1-3	28	N = 4
				SPT-21	52.5 - 54.0	1.5	1-1-1	27	N = 2
-				SPT-22	55.0 - 56.5	1.5	1-2-2	25	N = 4
				SPT-23	57.5 - 59.0	1.1	1-1-3	28	N = 4
-				SPT-24	60.0 - 61.5	1.4	1-2-3	28	N = 5
				SPT-25	62.5 - 64.0	1.3	1-2-4	37	N = 6
- 405.9'	67.5'			SPT-26	65.0 - 66.5	1.2	2-2-5	34	N = 7
100.0	01.0	Gray, Weathered Augered	Shale,	SPT-27	67.5 - 69.0	0.4	50+	14	50+
- 401.9'	71.5'			SPT-28	70.0 - 71.5	0.3	50+	5	50+
-		No Refusal / Bottom of Hole							



Page: 1 of 2

Project I	Number	175539022			Location	N	/est Toe:	West Pond	Dam
Project I	Name	AEP Clifty Creek /	Ash Ponds		Boring No.	B-2		Total Dept	h61.0 ft
County		Jefferson, IN			Surface Elev	vation	44	4.0 ft	
Project ⁻	Туре	Geotechnical Explo	oration		Date Started	d 1 [.]	1/12/09	Completed	l 11/12/09
Supervis	sor	C. Nisingizwe Dr	iller M. Wet	thington	Depth to Wa	ater 22	2.5 ft	Date/Time	11/12/09
Logged	By	C. Nisingizwe			Depth to Wa	ater N	/A	Date/Time	N/A
Litholo	ogy	_	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
444.0'	0.0'	Top of Hole							
	0.0	Lean Clay With Sa yellowish brown w moist to wet, soft stiff	vith gray,	SPT-1 SPT-2 SPT-3 ST-4 SPT-5 SPT-6	2.5 - 4.0 5.0 - 6.5 7.5 - 9.0 10.0 - 12.0 12.5 - 14.0 15.0 - 16.5	1.2 0.6 0.6 1.6 1.2 1.2	7-8-11 4-3-4 3-3-4 2-2-3 2-2-2	17 19 24 22 25 28	N = 19 N = 7 N = 7 N = 7 N = 5 N = 4
-				SPT-7	17.5 - 19.0	1.5	1-1-1	30	N = 2
-				SPT-8	20.0 - 21.5	1.5	1-2-2	32	N = 4
				ST-9	22.5 - 24.5	2.0		29	-
520/10 				SPT-10	25.0 - 26.5	1.5	2-2-2	29	N = 4
- 	30.0'			SPT-11	27.5 - 29.0	0.7	1-4-5	30	N = 9
K.GPJ FMSM-GRA		Lean Clay With Sa gray, moist to wet medium stiff		SPT-12	30.0 - 31.5	1.5	3-3-3	25	N = 6
178530022 CLIFTY CREEF				SPT-13	32.5 - 34.0	1.5	3-3-3	32	N = 6
				SPT-14	35.0 - 36.5	1.5	1-2-3	33	N = 5
STANTEC/FMSM_LEGACY				SPT-15	37.5 - 39.0	1.5	1-2-2	31	N = 4



SUBSURFACE LOG

	-				Location			West Pond	
Project I	Name	AEP Clifty Creek /	Ash Ponds		Boring No.	<u>B-2</u>		Total Dept	h 61.0 ft
Litholo	gy		Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		Lean Clay With S gray, moist to wet medium stiff <i>(Co</i>	, soft to	SPT-16	40.0 - 41.5	1.5	3-3-3	30	N = 6
				ST-17	42.5 - 44.5	1.5		33	
				SPT-18	45.0 - 46.5	1.5	1-1-1	35	N = 2
392.5'	51.5'			SPT-19	50.0 - 51.5	1.5	4-3-3	33	N = 6
		Gravel With Silt A gray, wet, very de							
388.5'	55.5'	Shale, gray, hard,	medium	SPT-20	55.0 - 55.5	0.4	11-50+	10	Began Core N = 50+
		bedded	medium						
000.01	04.01			45			400	01.0	
383.0'	61.0'	Bottom of Hole		45	5.5	5.5	100	61.0	
		Top of Rock = 56. Elevation (388.0')	.0'						



Page: 1 of 2

Project Numbe	r 175539022			Location	N	liddle Cre	st: West Po	nd Dam
Project Name	AEP Clifty Creek /	Ash Ponds		Boring No.	B-3		Total Dept	h71.5 ft
County	Jefferson, IN			Surface Ele	vation	47	′1.6 ft	
Project Type	Geotechnical Expl	oration		Date Started	11	1/4/09	Completed	11/5/09
Supervisor	C. Nisingizwe Di	riller M. We	thington	Depth to Wa	ater 4	0.0 ft	Date/Time	11/4/09
Logged By	C. Nisingizwe			Depth to Wa	ater 3	1.0 ft	Date/Time	11/13/09
Lithology		Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
471.6' 0.0'	Top of Hole							
-	Lean Clay With S yellowish brown v gray, damp to mo very stiff, Fill	vith light	SPT-1	2.5 - 4.0	0.7	4-5-6	15	N = 11
-			SPT-2	5.0 - 6.5	1.1	3-4-4	17	N = 8
-			SPT-3	7.5 - 9.0	1.1	3-3-7	16	N = 10
-			ST-4	10.0 - 12.0	2.0		16	-
-			SPT-5	12.5 - 14.0	1.5	4-4-5	22	N = 9
-			SPT-6	15.0 - 16.5	1.0	3-4-6	17	N = 10
-			SPT-7	17.5 - 19.0	1.3	3-5-7	18	N = 12
-			ST-8	20.0 - 22.0	2.0		18	-
-			SPT-9	22.5 - 24.0	1.5	3-5-7	17	N = 12
- -			SPT-10	25.0 - 26.5	1.3	3-4-5	18	N = 9
IIC LOG GDT 522			SPT-11	27.5 - 29.0	1.5	6-7-8	16	N = 15
PJ FMSM-GRAPF			SPT-12	30.0 - 31.5	1.5	5-5-5	18	N = 10
			SPT-13	32.5 - 34.0	1.5	4-7-10	17	N = 17
			SPT-14	35.0 - 36.5	1.5	5-7-9	22	N = 16
434.1' 37.5'			SPT-15	37.5 - 39.0	1.5	5-7-11	20	N = 18



Project I		175539022			Location			st: West Po	nd Dam
Project I	Name	AEP Clifty Creek /	Ash Ponds		Boring No.	B-3		Total Dept	h71.5 ft
Litholo	gy		Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		Lean Clay With S to light brown, mo very stiff to very s	ist to wet,	SPT-16	40.0 - 41.5	1.5	1-2-2	24	N = 4
		(Continued)		SPT-17	42.5 - 44.0	1.5	1-2-2	23	N = 4
				SPT-18	45.0 - 46.5	1.3	2-3-3	25	N = 6
				ST-19	47.5 - 49.5	2.0		23	
				SPT-20	50.0 - 51.5	1.5	1-2-2	25	N = 4
				SPT-21	52.5 - 54.0	1.5	1-1-1	25	N = 2
				SPT-22	55.0 - 56.5	1.5	1-2-3	24	N = 5
				SPT-23	57.5 - 59.0	1.5	1-1-1	40	N = 2
				SPT-24	60.0 - 61.5	1.5	3-4-4	28	N = 8
				SPT-25	62.5 - 64.0	1.5	1-2-4	33	N = 6
				SPT-26	65.0 - 66.5	1.5	1-3-4	34	N = 7
				SPT-27	67.5 - 69.0	1.5	2-4-5	29	N = 9
400.1'	71.5'			SPT-28	70.0 - 71.5	1.5	3-3-5	31	N = 8
		No Refusal / Bottom of Hole							



Page: 1 of 2

Project N	Number	175539022			Location	M	liddle Toe	: West Pon	d Dam
Project N	Name	AEP Clifty Creek /	Ash Ponds		Boring No.	B-4		Total Dept	h71.5 ft
County		Jefferson, IN			Surface Elev	vation	44	4.0 ft	
Project 7	Гуре	Geotechnical Expl	oration		Date Started	d _1	1/10/09	Completed	11/11/09
Supervis	sor	C. Nisingizwe Dr	iller <u>M. We</u>	thington	Depth to Wa	ater 2	2.5 ft	Date/Time	11/10/09
Logged	Ву	C. Nisingizwe			Depth to Wa	ater 1	6.0 ft	Date/Time	11/13/09
Litholo	gy		Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
_ 444.0'	0.0'	Top of Hole							
- - -		Lean Clay With So brown to dark gra to moist, medium very stiff	y, damp	SPT-1	2.5 - 4.0	1.3	8-8-8	14	N = 16
-				SPT-2	5.0 - 6.5	1.4	6-7-8	16	N = 15 _
-				ST-3	7.5 - 9.5	2.0			-
-				SPT-4	10.0 - 11.5	1.3	3-5-6	19	N = 11
- - 429.0'	15.0'			SPT-5	12.5 - 14.0	1.0	2-3-4	22	N = 7
-		Lean Clay With S gray, moist to wet stiff		SPT-6	15.0 - 16.5	1.2	2-2-3	26	N = 5
-				ST-7	17.5 - 19.5	2.0			-
-				SPT-8	20.0 - 21.5	1.5	2-2-2	26	N = 4
-				SPT-9	22.5 - 24.0	1.5	1-2-3	27	N = 5
				SPT-10	25.0 - 26.5	1.5	2-2-4	26	N = 6
HICLOG.GDT 5/				SPT-11	27.5 - 29.0	1.5	1-2-3	27	N = 5
3PJ FMSM-GRAF				SPT-12	30.0 - 31.5	1.5	1-1-2	28	N = 3
2 CLIFTY CREEK.				SPT-13	32.5 - 34.0	1.5	1-2-2	35	N = 4
EGACY 17553002				SPT-14	35.0 - 36.5	1.5	2-4-5	31	N = 9
STANTEC/FMSM_L				ST-15	37.5 - 39.5	2.0			



-		175539022			Location			: West Pon	
Project I	Name	AEP Clifty Creek /	Ash Ponds		Boring No.	<u>B-4</u>		Total Dept	h71.5 ft
Litholo	ogy		Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		Lean Clay With S gray, moist to wet stiff <i>(Continued)</i>		SPT-16	40.0 - 41.5	1.5	2-2-2	24	N = 4
				SPT-17	42.5 - 44.0	1.2	1-2-3	33	N = 5
				SPT-18	45.0 - 46.5	1.5	2-4-4	35	N = 8
				SPT-19	47.5 - 49.0	1.2	1-2-4	31	N = 6
				SPT-20	50.0 - 51.5	1.5	2-3-4	31	N = 7
				SPT-21	52.5 - 54.0	1.5	1-2-3	30	N = 5
386.5'	57.5'			SPT-22	55.0 - 56.5	1.5	2-3-4	21	N = 7
300.5	57.5	Gravel With Silt A gray, moist, dense		SPT-23	57.5 - 59.0	1.5	10-17-22	13	N = 39
		dense		SPT-24	60.0 - 61.5	1.5	16-28-18	9	N = 46
				SPT-25	65.0 - 66.5	0.7	26-50+	12	N = 50+
372.5'	71.5'			SPT-26	70.0 - 71.5	0.7	20-22-30	9	N = 52
		No Refusal / Bottom of Hole							



Page: 1 of 2

Project N	Number	175539022			Location	E	ast Crest	: West Pond	d Dam	
Project N	Name	AEP Clifty Creek /	Ash Ponds		Boring No.	B-5		Total Dept	:h71.5 ft	
County		Jefferson, IN			Surface Ele	vation	46	8.7 ft		
Project 7	Гуре	Geotechnical Expl	oration		Date Started	d <u>1</u> '	1/10/09	Completed	d <u>11/10/09</u>	
Supervis	sor	C. Nisingizwe Dr	iller M. We	thington	Depth to Wa	ater 4	5.0 ft	Date/Time	11/10/09	
Logged	Ву	C. Nisingizwe			Depth to Wa	ater 3	3.8 ft	Date/Time	11/13/09	
Litholo	gy		Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %		
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks	
468.7'	0.0'	Top of Hole								
-		Lean Clay With S yellowish brown w gray, damp to mo medium stiff to ve Fill	vith light ist,	SPT-1 SPT-2	2.5 - 4.0 5.0 - 6.5	1.5 1.5	6-9-10 4-4-5	15 17	N = 19 N = 9	
-				ST-3	7.5 - 9.5	1.6		17		
-				SPT-4	10.0 - 11.5	1.3	6-7-8	23	N = 15	
-				SPT-5	12.5 - 14.0	0.0	3-4-6		N = 10	
-				SPT-6	15.0 - 16.5	1.3	1-3-4	16	N = 7	
-				SPT-7	17.5 - 19.0	1.0	5-7-9	16	N = 16	
-				SPT-8	20.0 - 21.5	0.6	1-2-5	18	N = 7	
-				ST-9	22.5 - 24.5	1.8		19		
-				SPT-10	25.0 - 26.5	1.2	2-3-5	22	N = 8	
-				SPT-11	27.5 - 29.0	1.4	1-2-5	25	N = 7	
-				SPT-12	30.0 - 31.5	1.3	4-5-7	23	N = 12	
- -				SPT-13	32.5 - 34.0	1.5	2-3-5	19	N = 8	
- - 432.2'	36.5'			SPT-14	35.0 - 36.5	1.5	4-6-10	18	N = 16	
		Lean Clay With S gray, moist, soft	and,	SPT-15	37.5 - 39.0	1.5	2-3-3	21	N = 6	



-		175539022			Location			West Pond	
Project I	Name	AEP Clifty Creek /	Ash Ponds		Boring No.	B-5		Total Dept	h 71.5 ft
Litholo	gy		Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		Lean Clay With S gray, moist, soft <i>(Continued)</i>	and,	SPT-16	40.0 - 41.5	1.3	1-1-2	25	N = 3
		(, , , , , , , , , , , , , , , , , , ,		ST-17	42.5 - 44.5	2.0		23	
421.2'	47.5'			SPT-18	45.0 - 46.5	1.5	1-1-3	25	N = 4
4 21.2	47.5	Sandy Silt, light ye brown to gray, we		SPT-19	47.5 - 49.0	1.5	1-1-3	28	N = 4
		stiff		SPT-20	50.0 - 51.5	1.5	1-1-5	24	N = 6
				SPT-21	52.5 - 54.0	1.0	1-1-1	22	N = 2
				SPT-22	55.0 - 56.5	1.3	1-2-2	23	N = 4
				SPT-23	57.5 - 59.0	1.5	1-2-3	26	N = 5
				SPT-24	60.0 - 61.5	1.5	2-3-4	22	N = 7
				SPT-25	62.5 - 64.0	1.5	2-3-6	27	N = 9
				SPT-26	65.0 - 66.5	1.5	2-5-6	28	N = 11
				SPT-27	67.5 - 69.0	1.5	2-4-5	28	N = 9
397.2'	71.5'			SPT-28	70.0 - 71.5	1.5	3-5-8	30	N = 13
		No Refusal / Bottom of Hole							



Project Numb	er_175539022		Location	E	ast Toe: \	Nest Pond I	Dam
Project Name	AEP Clifty Creek / As	sh Ponds	Boring No.	B-6		Total Dept	h71.5 ft
County	Jefferson, IN		Surface Elev	vation	44	5.5 ft	
Project Type	Geotechnical Explora	ation	Date Started	1	1/19/09	Completed	11/19/09
Supervisor	C. Nisingizwe Drille	er Danny Jessie	Depth to Wa	ater 30	0.0 ft	Date/Time	11/19/09
Logged By	C. Nisingizwe		Depth to Wa	ater N	/A	Date/Time	N/A
Lithology		Overburden Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation Dept	Description	Rock Core RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
445.5' 0.0	Top of Hole						
	Lean Clay With San brown to gray, damp moist, stiff to very st	o to iff SPT-1 SPT-2 ST-3 SPT-4 SPT-4 SPT-5 SPT-6 ST-7 SPT-8 SPT-9	2.5 - 4.0 5.0 - 6.5 7.5 - 9.5 10.0 - 11.5 12.5 - 14.0 15.0 - 16.5 17.5 - 19.5 20.0 - 21.5 22.5 - 24.0 25.0 - 26.5	 1.0 1.0 2.0 1.2 1.1 1.3 1.2 1.5 1.5 1.5 1.5 	2-4-4 4-4-6 5-7-11 2-2-2 1-1-2 0-1-0 0-0-2 2-1-3	19 18 25 16 21 31 32 32 29 29 29	N = 8 N = 10 N = 18 N = 4 N = 3 N = 1 N = 2 N = 4 N = 4
[№] 418.0' 27.8	Sandy Silt, gray, mo		27.5 - 29.0	1.5	0-3-2	32	N = 5
	wet, very soft to stiff						-
PJ FMSM-GRA		SPT-12	30.0 - 31.5	1.5	0-0-3	32	N = 3
1 15538022 CLIFTY CREEK GP		SPT-13	32.5 - 34.0	1.5	0-1-2	33	N = 3
EGACY 17553922		SPT-14	35.0 - 36.5	1.5	0-0-1	35	N = 1
STANTECPHISM_L		SPT-15	37.5 - 39.0	1.5	0-0-1	30	N = 1



Project I	Number	175539022		Location	Ea	ast Toe: \	oe: West Pond Dam		
Project I	Name	AEP Clifty Creek /	Ash Ponds		Boring No.	B-6		Total Dept	n71.5 ft
Litholo	gy		Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		Sandy Silt, gray, r wet, very soft to s <i>(Continued)</i>	noist to liff	ST-16	40.0 - 42.0	1.1		31	
		(SPT-17	42.5 - 44.0	1.5	0-1-1	35	N = 2
				SPT-18	45.0 - 46.5	1.5	0-0-1	40	N = 1
				SPT-19	47.5 - 49.0	1.5	0-0-1	40	N = 1
				SPT-20	50.0 - 51.5	1.5	0-2-3	39	N = 5
				SPT-21	52.5 - 54.0	1.5	0-5-6	27	N = 11
				SPT-22	55.0 - 56.5	1.5	4-3-4	31	N = 7
				SPT-23	57.5 - 59.0	1.5	4-4-5	35	N = 9
				SPT-24	60.0 - 61.5	1.5	5-5-6	28	N = 11
				SPT-25	65.0 - 66.5	1.5	4-5-4	28	N = 9
374.0'	71.5'			SPT-26	70.0 - 71.5	0.0	5-5-5		N = 10
		No Refusal / Bottom of Hole							

LANDFILL RUNOFF COLLECTION POND: 2009 GEOTECHNICAL EXPLORATION



Project Number	175539022			Location		Crest: LRC	CP Dam	
Project Name	AEP Clifty Creek /	Ash Ponds		Boring No.	B	-7	Total Depth	29.0 ft
County	Jefferson, IN			Surface Elev	vation	50	3.4 ft	
Project Type	Geotechnical Expl	oration		Date Started	d	11/12/09	Completed	11/12/09
Supervisor	C. Nisingizwe Dr	iller M. We	thington	Depth to Wa	ater	Dry	Date/Time	11/12/09
Logged By	C. Nisingizwe			Depth to Wa	ater	N/A	Date/Time	N/A
Lithology		Overburden	Sample #	Depth	Rec. F	t. Blows	Mois.Cont. %	
Elevation Depth	Description	Rock Core	RQD	Run	Rec. F	t. Rec. %	Run Depth	Remarks
503.4' 0.0'	Top of Hole							
	Asphalt pavemen gravel base	t and	-					
-	Lean Clay, yellow gray, moist, stiff	and light						
-								
-								
-								
-								
-								
-								
-								
-								
-								
_								
-								
-								
·			ST-1	23.0 - 25.0	2.0			
-			ST-2	25.0 - 27.0	2.0		20	
474.4' 29.0'			ST-3	27.0 - 29.0	2.0		20	
_	No Refusal / Bottom of Hole							
-								
-								
-								
_								
-								
-								
-								



Page: 1 of 1

Project	Number	175539022	Location Toe: LRCP Dam						
Project I	Name	AEP Clifty Creek /	Ash Ponds		Boring No.	B-8	8	Total Depth	31.0 ft
County		Jefferson, IN			Surface Ele	vation_	44	1.5 ft	
Project ⁻	Туре	Geotechnical Expl	oration		Date Started	1	1/19/09	Completed	11/19/09
Supervi	sor	C. Nisingizwe Dr	iller Danny	Jessie	Depth to Wa	ater D	Dry	Date/Time	11/19/09
Logged	Ву	C. Nisingizwe			Depth to Wa	ater_N	I/A	Date/Time	N/A
Litholo	ogy		Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
441.5'	0.0'	Top of Hole							
425.5'	16.0'	Silty Clay, yellow a gray, damp to mo Lean Clay, yellow and light gray, mo	ist ish brown						
-				ST-1	25.0 - 27.0	2.0		25	
412.5'	29.0'			ST-2	27.0 - 29.0	2.0		26	
410.5'	31.0'	Lean Clay With S yellowish brown a ∖gray, moist		ST-3	29.0 - 31.0	2.0		23	
-		No Refusal / Bottom of Hole	/						



Page: 1 of 1

Project Number 175539022					Location	С	rest: LRC	P Dam	
Project N	Name	AEP Clifty Creek /	Ash Ponds		Boring No.	B-9		Total Depth	22.0 ft
County		Jefferson, IN			Surface Elevation 504.3 ft				
Project T	Гуре	Geotechnical Expl	oration		Date Started	d <u>1</u>	1/12/09	Completed	11/12/09
Supervis	sor	C. Nisingizwe Dr	iller <u>M.</u> Wet	hington	Depth to Wa	ater D	ry	Date/Time	11/12/09
Logged I	Ву	C. Nisingizwe			Depth to Wa	ater N	/A	Date/Time	N/A
Litholo	gy		Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
_ 504.3'	0.0'	Top of Hole							
503.8'	~_ 0.5' _⁄	Asphalt pavemen gravel base	t and						-
-		Lean Clay, yellow and light gray, da							-
- -		moist	·						-
-									-
_									_
-									_
-									—
-									_
-									-
-									_
-									
-				ST-1	16.0 - 18.0	2.0		22	-
-				ST-2	18.0 - 20.0	2.0		19	_
- 482.3'	22.0'			ST-3	20.0 - 22.0	2.0		20	-
		No Refusal /			1	I			
-		Bottom of Hole							-
F									



Project Number	175539022			Location		oe: LRCF	Dam	
Project Name	AEP Clifty Creek /	Ash Ponds		Boring No.	B- ′	0	Total Depth	18.0 ft
County	Jefferson, IN			Surface Elev	vation_	45	7.3 ft	
Project Type	Geotechnical Explo	oration		Date Started	d 1	1/19/09	Completed	11/19/07
Supervisor	C. Nisingizwe Dr	iller Danny	Jessie	Depth to Wa	ater [Dry	Date/Time	11/19/07
Logged By	C. Nisingizwe			Depth to Wa	ater N	I/A	 Date/Time	N/A
Lithology	_	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
457.3' 0.0'	Top of Hole							
	Silty Clay With Sa yellow and light gr to moist	nd, ay, damp						
444.1' 13.2'			ST-1	12.0 - 14.0	1.5		17	
	Silty Sand, gray to damp to moist	brown,	от о	14.0 16.0	2.0		10	
441.3' 16.0'			ST-2	14.0 - 16.0	2.0		10	
439.3' 18.0'	Silty Clay With Sa yellow and light gr ∖to moist	nd, ay, damp ⁄_	ST-3	16.0 - 18.0	2.0		25	
	No Refusal / Bottom of Hole							

LANDFILL RUNOFF COLLECTION POND: 2015 GEOTECHNICAL EXPLORATION



Page: 1 of 3

Project Numbe	175553022			Location	L	andfill Rur	noff Collection	on Pond Dam	
Project Name	CCR Rule - AEP Clifty	y Creek		Boring No.	B-1	2	Total Dept	n 101.5 ft	
County	Jefferson, IN			Surface Elev	vation	503	3.9 (estimated)		
Project Type	Geotechnical Exploration	tion		Date Started 7/6/15		Completed 7/7/15			
Supervisor	C. Nisingizwe Drille	er E. Cauc	dill	Depth to Water 60.0 ft		Date/Time	7/7/15		
Logged By	C. Nisingizwe			Depth to Wa	ater N	I/A	Date/Time	N/A	
Lithology	(Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %		
Elevation Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks	
_ 503.9 0.0	Top of Hole								
(estimated) 0.4	Asphalt and base							Pocket	
-	Lean Clay With Sand damp, medium stiff to	d, gray, o stiff	SPT-1	1.0 - 2.5	1.5	1-2-5	21	Penetrometer (PP) = 2.50 tsf	
-			SPT-2	5.0 - 6.5	1.5	3-3-4	20	PP = 2.50 tsf	
-			SPT-3	10.0 - 11.5	1.2	3-4-5	23	PP = 3.50 tsf	
-			SPT-4	15.0 - 16.5	1.0	3-3-5	19	PP = 2.50 tsf	
- - -			SPT-5	20.0 - 21.5	0.9	4-6-9	18	PP = 2.50 tsf	
			SPT-6	25.0 - 26.5	1.1	3-5-7	18	PP = 4.25 tsf	
			SPT-7	30.0 - 31.5	1.3	2-5-8	19	PP = 4.50 tsf	
				35.0 - 36.5	0.9	WOH-3-4	- 18	PP = 4.00 tsf	



SUBSURFACE LOG

Project I	Project Number 175553022				Location	La	andfill Rui	noff Collection	Pond Dam
Project Name		CCR Rule - AEP C	lifty Creek		Boring No.	B-1	2	Total Depth	101.5 ft
Litholo	ogy		Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
	40.0	Lean Clay With Sa damp, medium sti (Continued)	and, gray, ff to stiff						
	10.0	Silty Clay With Sar brown, moist, med to very stiff	nd, lium stiff	SPT-9	40.0 - 41.5	1.5	6-8-8	16	
				SPT-10	45.0 - 46.5	1.5	1-3-5	19	
	50.0	Silt With Sand, gra	yish light	SPT-11	50.0 - 51.5	1.5	2-3-3	22	
		brown, moist, med to stiff	lium stiff						
				SPT-12	55.0 - 56.5	1.0	2-5-8	20	
	58.0	Silty Sand, grayish brown, damp, very		_					
				SPT-13	60.0 - 61.5	1.4	3-11-17	15	
	63.5	Silt With Sand, gra brown, wet, stiff	iyish light	SPT-14	65.0 - 66.5	1.5	2-3-8	28	
	70.0			-					
		Sand, mottled gray brown, moist to we medium stiff to stif	et,	SPT-15	70.0 - 71.5	1.5	3-5-5	22	
				SPT-16	75.0 - 76.5	1.3	2-3-5	28	
	78.0								



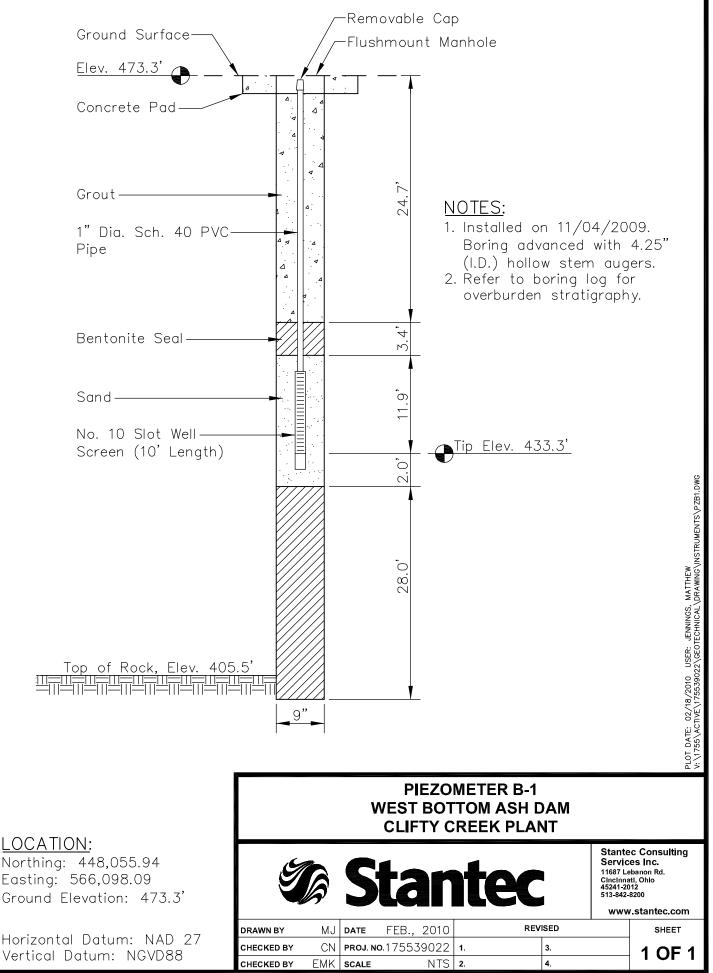
STANTEC/FMSM

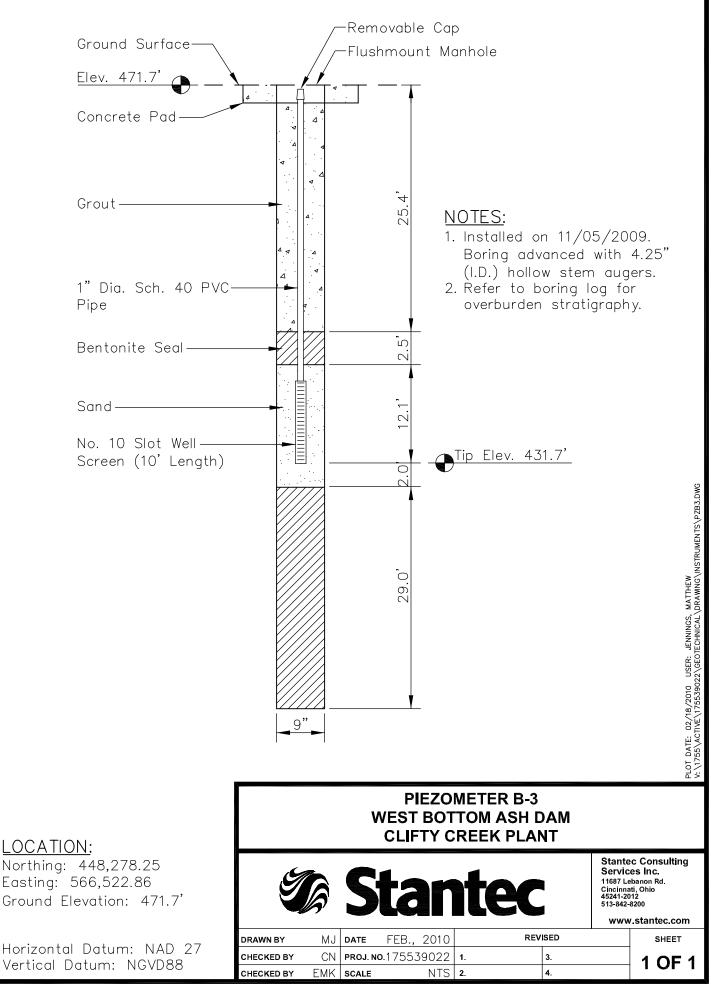
SUBSURFACE LOG

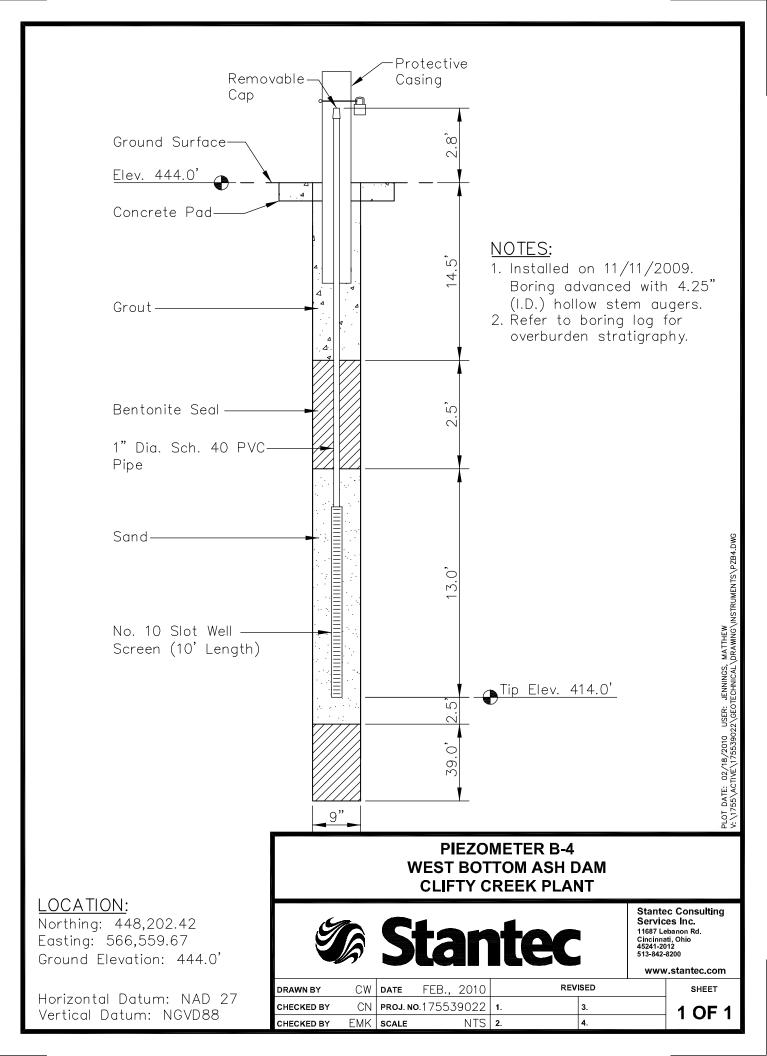
Project Number	175553022	Project Number 175553022			La	andfill Ru	noff Collectio	on Pond Dam
Project Name	CCR Rule - AEP Cli	fty Creek		Boring No.	B-1	2	Total Depth	n101.5 ft
Lithology		Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
	Silt, gray, moist to w medium stiff to stiff	vet,	SPT-17	80.0 - 81.5	1.5	6-9-6	26	
			SPT-18	85.0 - 86.5	1.5	2-3-5	28	
90.0	Lean Clay, gray, mo medium stiff to very	oist, ⁄ stiff	SPT-19	90.0 - 91.5	1.5	2-4-4	25	PP = 2.25 tsf
			SPT-20	95.0 - 96.5	1.5	5-8-11	23	PP = 3.75 tsf
101.5			SPT-21	100.0 - 101.5	1.5	4-6-8	27	PP = 3.50 tsf
	No Refusal / Bottom of Hole							

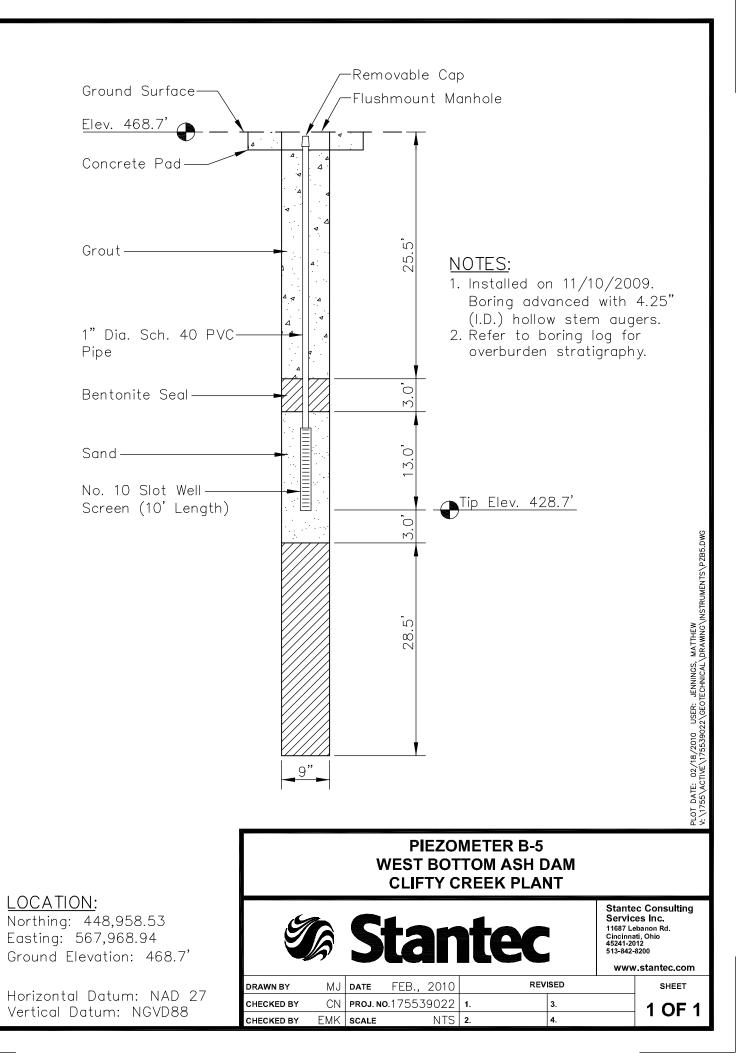
APPENDIX C PIEZOMETER DETAILS

BOILER SLAG POND DAM









APPENDIX D

SOIL CLASSIFICATION SUMMARIES

BOILER SLAG POND DAM



roject Name	AEP - Clifty Cre	ek - West Bottor	m Ash and Fly Ash Ponds Brobject Number	
ource	B-1, 10.0'-11.5',	12.5'-14.0'	Lab ID	
ounty	Jefferson, IN		Date Received	11-16-0
ample Type	SPT Comp		Date Reported	11-30-0
			Test Results	
	ral Moisture Co		Atterberg Limits	
	: ASTM D 2216		Test Method: ASTM D 4318 Method	A
Moistu	re Content (%):	19.1	Prepared: Dry	
			Liquid Limit:	
			Plastic Limit:	
	rticle Size Anal		Plasticity Index:	
Preparation Method: ASTM D 421 Gradation Method: ASTM D 422			Activity Index:	0.54
	Method: ASTM D			
Hydrometer	Method. AS I M	D 422	Moisture-Density Relation	ship
Parti	icle Size	%	Test Not Performed	
Sieve Size		Passing	Maximum Dry Density (lb/ft ³):	N/A
3"	75		Maximum Dry Density (kg/m ³):	N/A
2"	50		Optimum Moisture Content (%):	
<u>1 1/2"</u> 1"	37.5 25		Over Size Correction %:	N/A
3/4"	19			
3/4	9.5		California Bearing Rat	ia
No. 4	4.75	100.0	Test Not Performed	<u></u>
No. 10	2	99.8	Bearing Ratio (%):	N/A
No. 40	0.425	98.4		N/A
No. 200	0.425	84.0	Compacted Dry Density (lb/ft ³):	N/A
NO. 200	0.075	49.1	Compacted Moisture Content (%):	IN/A
	0.002	31.1		
	0.003	23.7	Specific Gravity	
estimated	0.002	22.1	Test Method: ASTM D 854	
estimated	0.001	22.1	Prepared: Dry	
Plus 3 in ma	aterial, not incluc	1ed: 0 (%)	Particle Size:	No 10
			Specific Gravity at 20° Celsius:	2.70
	ASTM	AASHTO		
Range	(%)	(%)		
Gravel	0.0	0.2	Classification	
Coarse San		1.4	Unified Group Symbol:	CL
Medium Sar			Group Name: Lean	
		14.4		
Silt				
			AASHTO Classification:	A-6(10)
Fine Sand		14.4 60.3 23.7	AASHTO Classification:	



Project Name	AEP - Clifty Creek - West Bottom Ash and Fly Ash Ponds sul	osurfac erevi ¢ect Number	175539022
Source	B-1, 10.0'-11.5', 12.5'-14.0'	Lab ID	4

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

Test Method:	ASTM D 422
Prepared using:	ASTM D 421

Particle Shape: Angular Particle Hardness: Hard and Durable

Tested By: KR Test Date: 11-20-2009 Date Received 11-16-2009
 Sieve Size
 Passing

 Image: Constraint of the system
 Image: Constraint of the system

 3"
 Image: Constraint of the system

 3"
 Image: Constraint of the system

 1 1/2"
 Image: Constraint of the system

 1 1/2"
 Image: Constraint of the system

 3/4"
 Image: Constraint of the system

 3/8"
 Image: Constraint of the system

 No. 4
 100.0

 No. 10
 99.8

%

Maximum Particle size: No. 4 Sieve

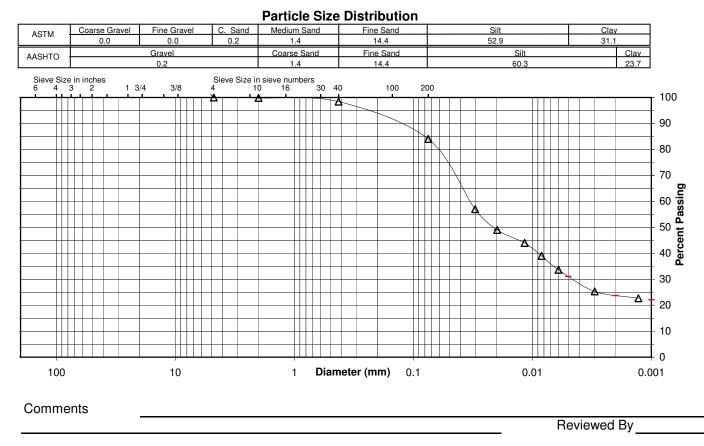
Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

he No. 10 Sieve							
No. 40	98.4						
No. 200	84.0						
0.02 mm	49.1						
0.005 mm	31.1						
0.002 mm	23.7						
0.001 mm	22.1						



File: frm_175539022_sum_4 Sheet: Hydro-Report Preparation Date: 1998 Revision Date: 1-2008

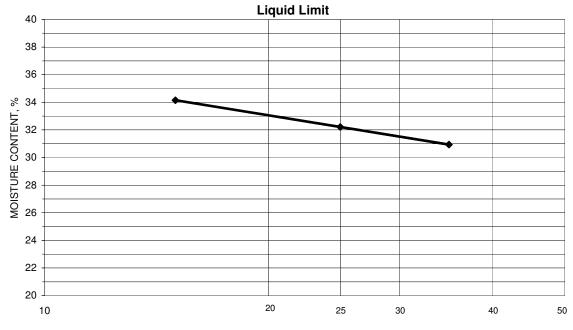
Stantec Consulting Services Inc.

Laboratory Document Prepared By: MW Approved BY: TLK

ATTERBERG LIMITS



Project	AEP - Clifty Creek -	West Bottom As	h and Fly Ash Pon	ds subsurface e:	Project No.	175539022
Source	B-1, 10.0'-11.5', 12.	5'-14.0'			Lab ID	4
			% + No. 40	2		
Tested By	RG	Test Method	ASTM D 4318 M	lethod A	Date Received	11-16-2009
Test Date	11-23-2009	Prepared	Dry	_	_	
	Wet Soil and	Dry Soil and				
	Tare Mass	Tare Mass	Tare Mass	Number of	Water Content	
	(g)	(g)	(g)	Blows	(%)	Liquid Limit
	22.20	19.41	11.24	15	34.1	
	20.53	18.13	10.68	25	32.2	
	22.58	19.87	11.11	35	30.9	32
	<u> </u>	1				



NUMBER OF BLOWS

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
24.73	22.56	11.06	18.9	19	13
24.53	22.36	11.08	19.2		

Remarks:

Reviewed By



oject Name AE	P - Clifty Cre	ek - West Bottom	h Ash and Fly Ash Ponds Brobject Number	17553902	
urce B-1	, 47.5'-49.0',	50.0'-51.5'	Lab ID	2	
ounty Jef	ferson, IN		Date Received	11-16-0	
mple Type SP			Date Reported	11-30-0	
			Test Results		
	Moisture Co	ontent	Atterberg Limits		
Test Method: AS			Test Method: ASTM D 4318 Method A		
Moisture (Content (%):	25.3	Prepared: Dry		
			Liquid Limit:		
			Plastic Limit:	16	
	le Size Anal		Plasticity Index:		
Preparation Met			Activity Index:	0.60	
Gradation Methe					
Hydrometer Met	thod: ASTM I	D 422			
	0.		Moisture-Density Relation	<u>ship</u>	
Particle		%	Test Not Performed		
Sieve Size	(mm)	Passing	Maximum Dry Density (lb/ft ³):	N/A	
3"	75		Maximum Dry Density (kg/m ³):	N/A	
2"	50		Optimum Moisture Content (%):	N/A	
1 1/2"	37.5		Over Size Correction %:		
1"	25				
3/4"	19				
3/8"	9.5	100.0	California Bearing Rati	0	
No. 4	4.75	100.0	Test Not Performed	-	
No. 10	2	99.9	Bearing Ratio (%):	N/A	
No. 40	0.425	99.7	Compacted Dry Density (lb/ft ³):	N/A	
No. 200	0.075	84.1	Compacted Moisture Content (%):	N/A	
	0.02	54.5		,	
	0.005	28.2			
		20.4	Specific Gravity		
	0.002				
estimated	0.002	17.1	Test Method: ASTM D 854		
estimated	0.002		Test Method: ASTM D 854		
	0.001	17.1	Test Method: ASTM D 854 Prepared: Dry	No. 10	
estimated Plus 3 in. mater	0.001	17.1	Test Method: ASTM D 854	No. 10 2.77	
	0.001	17.1	Test Method: ASTM D 854 Prepared: Dry Particle Size:	No. 10 2.77	
	0.001 ial, not includ	17.1 led: 0 (%)	Test Method: ASTM D 854 Prepared: Dry Particle Size:	No. 10 2.77	
Plus 3 in. mater	0.001 ial, not includ ASTM	17.1 led: 0 (%) AASHTO	Test Method: ASTM D 854 Prepared: Dry Particle Size: Specific Gravity at 20° Celsius: Classification	2.77	
Plus 3 in. mater Range	0.001 ial, not includ ASTM (%)	17.1 led: 0 (%) AASHTO (%)	Test Method: ASTM D 854 Prepared: Dry Particle Size: Specific Gravity at 20° Celsius: <u>Classification</u> Unified Group Symbol:	2.77 CL	
Plus 3 in. mater Range Gravel	0.001 ial, not includ ASTM (%) 0.0	17.1 led: 0 (%) AASHTO (%) 0.1	Test Method: ASTM D 854 Prepared: Dry Particle Size: Specific Gravity at 20° Celsius: <u>Classification</u> Unified Group Symbol:	2.77 CL	
Plus 3 in. mater Range Gravel Coarse Sand	0.001 ial, not includ ASTM (%) 0.0 0.1	17.1 led: 0 (%) AASHTO (%) 0.1 0.2	Test Method: ASTM D 854 Prepared: Dry Particle Size: Specific Gravity at 20° Celsius: Classification	2.77 CL	
Plus 3 in. mater Range Gravel Coarse Sand Medium Sand	0.001 ial, not includ ASTM (%) 0.0 0.1 0.2	17.1 led: 0 (%) AASHTO (%) 0.1 0.2 	Test Method: ASTM D 854 Prepared: Dry Particle Size: Specific Gravity at 20° Celsius: <u>Classification</u> Unified Group Symbol:	2.77 CL	



Project Name	AEP - Clifty Creek - West Bottom Ash and Fly Ash Ponds sub	osurfac erev i¢ect Number_	175539022
Source	B-1, 47.5'-49.0', 50.0'-51.5'	Lab ID	20

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

Test Method:	ASTM D 422
Prepared using:	ASTM D 421

Particle Shape: Angular Particle Hardness: Hard and Durable

Tested By: KR Test Date: 11-20-2009 Date Received 11-16-2009

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	100.0
No. 10	99.9

Maximum Particle size: 3/8" Sieve

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.77

Dispersed using: Apparatus A - Mechanical, for 1 minute

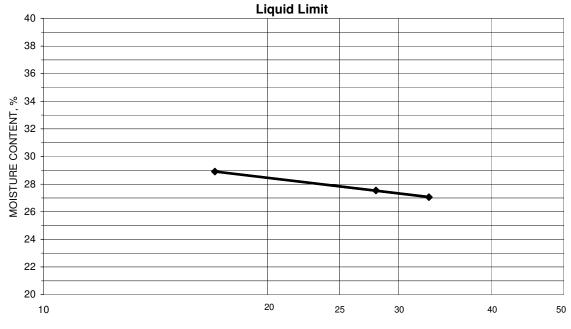
t	he No. 10 Sieve		
	No. 40	99.7	
	No. 200	84.1	
	0.02 mm	54.5	
	0.005 mm	28.2	
	0.002 mm	20.4	
	0.001 mm	17.1	

Particle Size Distribution Coarse Gravel Fine Gravel C. Sand Medium Sand Fine Sand Silt Clay ASTM 0.0 0.0 0.1 15.6 55.9 28.2 0.2 Clay Gravel Coarse Sand Fine Sand Silt AASHTO 0.1 0.2 15.6 63.7 20.4 Sieve Size in sieve numbers 4 10 16 30 40 Sieve Size in inches 6 4 3 2 3/8 100 3/4 200 100 90 A 80 70 Percent Passing A Δ Δ 30 A - 20 Δ 10 0 100 Diameter (mm) 0.01 10 1 0.1 0.001 Comments **Reviewed By**

File: frm_175539022_sum_20 Sheet: Hydro-Report Preparation Date: 1998 Revision Date: 1-2008 Laboratory Document Prepared By: MW Approved BY: TLK



Project	AEP - Clifty Creek -	West Bottom Asl	h and Fly Ash Pon	ds subsurface e:	Project No.	175539022
Source	B-1, 47.5'-49.0', 50.0	0'-51.5'			Lab ID	20
					% + No. 40	0
Tested By	RG	Test Method	ASTM D 4318 M	lethod A	Date Received	11-16-2009
Test Date	11-23-2009	Prepared	Dry	_	_	
		-				
	Wet Soil and	Dry Soil and				
	Tare Mass	Tare Mass	Tare Mass	Number of	Water Content	
	(g)	(g)	(g)	Blows	(%)	Liquid Limit
	23.68	21.01	11.14	33	27.1	
	23.20	20.50	11.16	17	28.9	
	23.78	21.05	11.14	28	27.5	28
		1 1				



NUMBER OF BLOWS

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
25.05	23.09	10.96	16.2	16	12
22.52	20.86	10.61	16.2		

Remarks:



oject Name	AEP - Clifty Cre	ek - West Botton	n Ash and Fly Ash Ponds Brobject Number	17553902		
urce	B-2, 32.5'-34.0', 35.0'-36.5' Lab ID					
ounty	Jefferson, IN		Date Received	11-16-0		
mple Type	SPT Comp		Date Reported	11-30-09		
			Test Results			
	ral Moisture Co	ontent	Atterberg Limits			
	: ASTM D 2216		Test Method: ASTM D 4318 Method	A		
Moistu	re Content (%):	32.1	Prepared: Dry			
			Liquid Limit:			
_			Plastic Limit:			
	rticle Size Anal		Plasticity Index:			
	Method: ASTM		Activity Index:	0.90		
	ethod: ASTM D					
Hydrometer I	Method: ASTM	D 422				
		<u> </u>	Moisture-Density Relation	ship		
-	icle Size	%	Test Not Performed			
Sieve Size	e (mm)	Passing	Maximum Dry Density (lb/ft ³):	N/A		
3"	75		Maximum Dry Density (kg/m ³):	N/A		
2"	50		Optimum Moisture Content (%):	N/A		
1 1/2"	37.5		Over Size Correction %:			
1"	25					
3/4"	19					
3/8"	9.5	100.0	California Bearing Rati	0		
No. 4	4.75	99.7	Test Not Performed	<u> </u>		
No. 10	2	99.7	Bearing Ratio (%):	N/A		
No. 40	0.425	98.7	Compacted Dry Density (lb/ft ³):			
No. 200	0.075	79.7	Compacted Moisture Content (%):	N/A		
110.200	0.02	50.6		11/73		
	0.005	28.1				
	0.002	19.7	Specific Gravity			
estimated	0.001	16.0	Test Method: ASTM D 854			
ootimatoa	0.001	10.0	Prepared: Dry			
Plus 3 in ma	aterial, not includ	led: 0 (%)	Particle Size:	No 10		
			Specific Gravity at 20° Celsius:	2.72		
	ASTM	AASHTO				
Range	(%)	(%)				
Gravel	0.3	0.3	Classification			
Coarse San		1.0	Unified Group Symbol:	CL		
Medium Sar			Group Name: Lean	clav with san		
Fine Sand		19.0		and the out		
Silt	51.6	60.0				
		19.7	AASHTO Classification:	Δ_{-6} (13)		
Clay	28.1	197				



Project Name	AEP - Clifty Creek - West Bottom Ash and Fly Ash Ponds sub	osurfac erexie ct Number_	175539022
Source	B-2, 32.5'-34.0', 35.0'-36.5'	Lab ID	43

Test Method:	ASTM D 422
Prepared using:	ASTM D 421

Particle Shape: Angular Particle Hardness: Hard and Durable

 Tested By:
 KR

 Test Date:
 11-20-2009

 Date Received
 11-16-2009

Sieve Size Passing 3" 2" 1 1/2" 1" 3/4" 3/8" 100.0 No. 4 99.7 No. 10 99.7

%

Maximum Particle size: 3/8" Sieve

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.72

Dispersed using: Apparatus A - Mechanical, for 1 minute

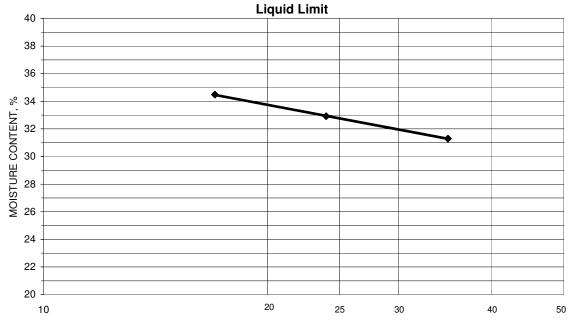
he No. 10 Sieve				
No. 40	98.7			
No. 200	79.7			
0.02 mm	50.6			
0.005 mm	28.1			
0.002 mm	19.7			
0.001 mm	16.0			

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.3	0.0	1.0	19.0	51.6	28.1
ASHTO		Gravel		Coarse Sand	Fine Sand	Silt	Clav
WOITIO		0.3		1.0	19.0	60.0	19.7
			4 1				
100		10		1 Diame	eter (mm) 0.1	0.01	0.00
comme	กเร					De	viewed By

Particle Size Distribution



Project	AEP - Clifty Creek -	EP - Clifty Creek - West Bottom Ash and Fly Ash Ponds subsurface e: Project No. 175539022						
Source	B-2, 32.5'-34.0', 35.0)'-36.5'			Lab ID	43		
					% + No. 40	1		
Tested By	KR	Test Method	ASTM D 4318 M	lethod A	Date Received	11-16-2009		
Test Date	11-23-2009	Prepared	Dry	_	-			
	Wet Soil and	Dry Soil and						
	Tare Mass	Tare Mass	Tare Mass	Number of	Water Content			
	(g)	(g)	(g)	Blows	(%)	Liquid Limit		
	23.26	20.15	11.13	17	34.5			
	23.44	20.29	10.72	24	32.9			
	24.86	21.58	11.10	35	31.3	33		
		1						



NUMBER OF BLOWS

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
21.11	19.78	10.98	15.1	15	18
21.07	19.72	10.97	15.4		

Remarks:

Reviewed By



oject Name AEF	- Clifty Cree	ek - West Bottor	n Ash and Fly Ash Ponds Brobject Number 17553902
	, 20.0'-21.5',		Lab ID 6
unty Jeff	erson, IN		Date Received 11-16-0
mple Type SP			Date Reported 11-30-0
			Test Results
	Moisture Co	ntent	Atterberg Limits
Test Method: ASTM D 2216 Moisture Content (%): 26.6			Test Method: ASTM D 4318 Method A
Moisture C	Content (%):	26.6	Prepared: Dry
			Liquid Limit: 25
		-	Plastic Limit: 17
	e Size Analy		Plasticity Index: 8
Preparation Met			Activity Index: 0.40
Gradation Metho			
Hydrometer Met	hod: ASTM [0 422	
			Moisture-Density Relationship
Particle	Size	%	Test Not Performed
Sieve Size	(mm)	Passing	Maximum Dry Density (lb/ft ³): N/A
3"	75		Maximum Dry Density (kg/m ³): N/A
2"	50		Optimum Moisture Content (%): N/A
1 1/2"	37.5		Over Size Correction %: N/A
1"	25		
3/4"	19		
3/8"	9.5		California Bearing Ratio
No. 4	4.75	100.0	Test Not Performed
No. 10	2	100.0	Bearing Ratio (%): N/A
No. 40	0.425	99.7	Compacted Dry Density (lb/ft ³): N/A
No. 200	0.075	80.7	Compacted Dry Density (10/17). N/A
110.200	0.02	52.0	
-	0.02	27.7	
-	0.002	19.5	Specific Gravity
estimated	0.001	15.1	Test Method: ASTM D 854
ootimatoa	0.001	10.1	Prepared: Dry
Plus 3 in. materi	al not includ	ed: 0 (%)	Particle Size: No. 10
			Specific Gravity at 20° Celsius: 2.60
Г	ASTM	AASHTO	
Range	(%)	(%)	
Gravel	0.0	0.0	Classification
Coarse Sand	0.0	0.3	Unified Group Symbol: CL
	0.3		Group Name: Lean clay with sar
Medium Sand	19.0	19.0	
Medium Sand Fine Sand	19.0		
Fine Sand Silt	53.0	61.2	



Project Name	AEP - Clifty Creek - West Bottom Ash and Fly Ash Ponds sub	surfac erex i∉ct Number	175539022
Source	B-4, 20.0'-21.5', 22.5'-24.0'	Lab ID	87

Test Method:	ASTM D 422
Prepared using:	ASTM D 421

Particle Shape: Angular Particle Hardness: Hard and Durable

Tested By: KR Test Date: 11-20-2009 Date Received 11-16-2009
 Sieve Size
 Passing

 3"

 3"

 1 1/2"

 1"

 3/4"

 3/8"

 No. 4
 100.0

 No. 10
 100.0

%

Maximum Particle size: No. 4 Sieve

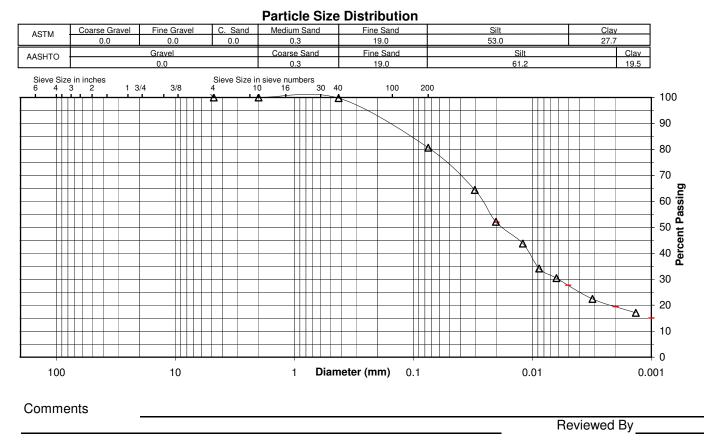
Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.6

Dispersed using: Apparatus A - Mechanical, for 1 minute

he No. 10 Sieve					
No. 40	99.7				
No. 200	80.7				
0.02 mm	52.0				
0.005 mm	27.7				
0.002 mm	19.5				
0.001 mm	15.1				

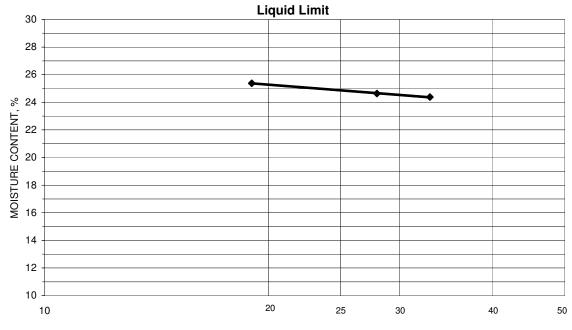


File: frm_175539022_sum_87 Sheet: Hydro-Report Preparation Date: 1998 Revision Date: 1-2008

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Project	AEP - Clifty Creek -	West Bottom As	Project No.	175539022		
Source	B-4, 20.0'-21.5', 22.	5'-24.0'			Lab ID	87
					% + No. 40	0
Tested By	RG	Test Method	ASTM D 4318 M	lethod A	Date Received	11-16-2009
Test Date	11-23-2009	Prepared	Dry	_	_	
	Wet Soil and	Dry Soil and				
	Tare Mass	Tare Mass	Water Content			
	(g)	(g)	(g)	Blows	(%)	Liquid Limit
	24.04	21.40	10.57	33	24.4	
	23.55	21.04	11.15	19	25.4	
	23.10	20.72	11.06	28	24.6	25
		1				



NUMBER OF BLOWS

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
24.08	22.17	11.08	17.2	17	8
25.29	23.10	10.68	17.6		

Remarks:



		n Ash and Fly Ash Ponds Brobject Number	
, 57.5'-59.0',	60.0'-61.5'	Lab ID	103
erson, IN		Date Received	11-16-09
		Date Reported	11-30-09
		Test Results	
Moisture Co	ontent	Atterberg Limits	
-		Test Method: ASTM D 4318 Method A	
Content (%):	10.9		
		Activity Index:	N/A
hod: ASTM I	D 422		
0:	0/		<u>קור</u>
	-		
(mm)	Passing		N/A
75		Maximum Dry Density (kg/m ³):	N/A
50		Optimum Moisture Content (%):	N/A
37.5	100.0	Over Size Correction %:	N/A
25	97.1		
19	92.5		
9.5	72.7	California Bearing Ratio	
4.75	46.1	Test Not Performed	
2	32.6	Bearing Ratio (%):	N/A
0.425	13.6	Compacted Dry Density (lb/ft ³):	N/A
0.075	5.7		N/A
0.02	2.9		
0.005	1.5		
0.002	1.1	Specific Gravity	
0.001	0.9	Test Method: ASTM D 854	
		Prepared: Dry	
al, not includ	led: 0 (%)	Particle Size:	No. 10
		Specific Gravity at 20° Celsius:	2.72
ASTM	AASHTO		
(%)	(%)		
13.5	19.0		
		Group Name: Well-graded gravel with s	ilt and sand
	7.9		
4.2	4.6		_
1.5	1.1	AASHTO Classification:	A-1-a(1)
	ferson, IN T Comp Moisture Co STM D 2216 Content (%): le Size Anal hod: ASTM D hod: ASTM D hod: ASTM D hod: ASTM D hod: ASTM D hod: ASTM D 10 10 10 10 10 10 10 10 10 10	ferson, IN T Comp Moisture Content STM D 2216 Content (%): 10.9 Le Size Analysis hod: ASTM D 421 Dot: ASTM D 422 Size % (mm) Passing 75 50 50 37.5 50 37.5 37.5 100.0 25 97.1 19 92.5 9.5 72.7 4.75 46.1 2 32.6 0.425 13.6 0.075 5.7 0.002 1.1 0.001 0.9 al, not included: 0 (%) ASTM ASTM AASHTO (%) (%) ASTM AASHTO (%) (%) ASTM AASHTO (%) (%) 4.2 4.6	Image: Normal State Product Date Received Date Reported Test Results Test Results Moisture Content STM D 2216 Content (%):



Project Name	AEP - Clifty Creek - West Bottom Ash and Fly Ash Ponds sub	surfac ₽rexie ct Number	175539022
Source	B-4, 57.5'-59.0', 60.0'-61.5'	Lab ID	103

Test Method:	ASTM D 422
Prepared using:	ASTM D 421

Particle Shape: Angular Particle Hardness: Hard and Durable

Tested By: KR Test Date: 11-20-2009 Date Received 11-16-2009

Maximum Particle size: 1 1/2" Sieve

Sieve Size	Passing
3"	
2"	
1 1/2"	100.0
1"	97.1
3/4"	92.5
3/8"	72.7
No. 4	46.1
No. 10	32.6

0/

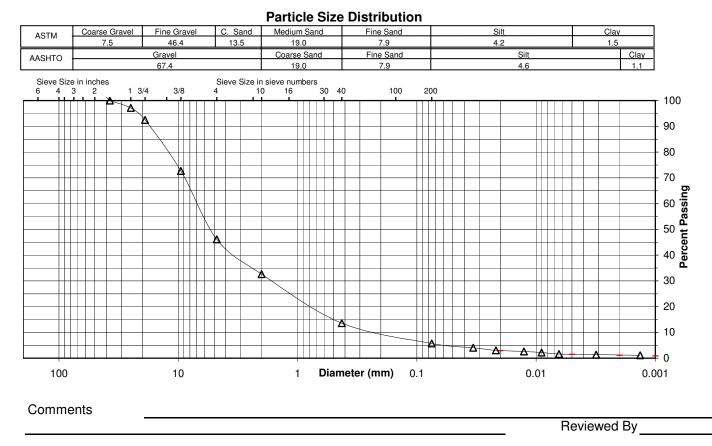
Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.72

Dispersed using: Apparatus A - Mechanical, for 1 minute

ne no. To Sieve					
No. 40	13.6				
No. 200	5.7				
0.02 mm	2.9				
0.005 mm	1.5				
0.002 mm	1.1				
0.001 mm	0.9				

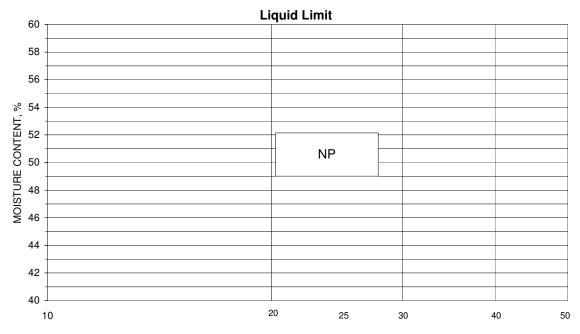


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Project	AEP - Clifty Creek -	West Bottom Asl	Project No.	175539022		
Source	B-4, 57.5'-59.0', 60.	0'-61.5'			Lab ID	103
					% + No. 40	86
Tested By	RG	Test Method	ASTM D 4318 M	lethod A	Date Received	11-16-2009
Test Date	11-23-2009	Prepared	Dry		-	
		-				
	Wet Soil and	Dry Soil and				
	Tare Mass Tare Mass Tare Mass Number of				Water Content	
	(g) (g) (g) Blows				(%)	Liquid Limit
						#VALUE!
	1					



NUMBER OF BLOWS

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
					#VALUE!

Remarks:

Reviewed By



			m Ash and Fly Ash Ponds Brobject Number	
ource <u>B-5</u>	, 55.0'-56.5',	57.5'-59.0'	Lab ID	129
ounty Jeff	erson, IN		Date Received	
mple Type SP	Г Сотр		Date Reported	11-30-0
			Test Results	
	Moisture Co	ontent	Atterberg Limits	
Test Method: AS			Test Method: ASTM D 4318 Method	A
Moisture C	Content (%):	24.9	Prepared: Dry	
			Liquid Limit:	
Death			Plastic Limit:	
	e Size Anal		Plasticity Index:	
Preparation Met			Activity Index:	IN/A
Gradation Metho				
Hydrometer Met	nou. As nin	J 422	Moisture-Density Relation	ship
Particle	Size	%	Test Not Performed	<u></u>
Sieve Size	(mm)	Passing	Maximum Dry Density (lb/ft ³):	N/A
3"	75		Maximum Dry Density (kg/m ³):	N/A
2"	50		Optimum Moisture Content (%):	N/A
1 1/2"	37.5		Over Size Correction %:	
1"	25			
3/4"	19			
3/8"	9.5	100.0	California Bearing Rati	0
No. 4	4.75	100.0	Test Not Performed	-
No. 10	2	100.0	Bearing Ratio (%):	N/A
No. 40	0.425	99.9	Compacted Dry Density (lb/ft ³):	N/A
No. 200	0.075	54.0	Compacted Moisture Content (%):	N/A
	0.02	26.2		,
l l l l l l l l l l l l l l l l l l l	0.005	16.7		
ľ	0.002	13.0	Specific Gravity	
estimated	0.001	10.5	Test Method: ASTM D 854	
			Prepared: Dry	
Plus 3 in. materi	al, not includ	led: 0 (%)	Particle Size:	No. 10
			Specific Gravity at 20° Celsius:	2.74
ſ	ASTM	AASHTO		
	(0()	(%)		
Range	(%)	(,,,)		
Range Gravel	(%) 0.0	0.0	<u>Classification</u>	
	. ,		Unified Group Symbol:	ML
Gravel	0.0	0.0	Unified Group Symbol:	ML Sandy si
Gravel Coarse Sand	0.0	0.0 0.1		
Gravel Coarse Sand Medium Sand	0.0 0.0 0.1	0.0 0.1 	Unified Group Symbol:	



Project Name	AEP - Clifty Creek - West Bottom Ash and Fly Ash Ponds sub	osurfac erexie ct Number_	175539022
Source	B-5, 55.0'-56.5', 57.5'-59.0'	Lab ID	129

Test Method:	ASTM D 422
Prepared using:	ASTM D 421

Particle Shape: Angular Particle Hardness: Hard and Durable

Tested By: KR Test Date: 11-20-2009 Date Received 11-16-2009

Sieve Size	Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	100.0
No. 10	100.0

Maximum Particle size: 3/8" Sieve

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.74

Dispersed using: Apparatus A - Mechanical, for 1 minute

ine No. 10 S	sieve
No. 40	99.9
No. 200	54.0
0.02 mm	26.2
0.005 mm	16.7
0.002 mm	13.0
0.001 mm	10.5

Particle Size Distribution Coarse Gravel Fine Gravel C. Sand Medium Sand Fine Sand Silt Clay ASTM 0.0 0.0 0.0 45.9 37.3 16.7 0.1 Clay Gravel Coarse Sand Fine Sand Silt AASHTO 0.0 0.1 45.9 41.0 13.0 Sieve Size in sieve numbers 10 16 30 40 Sieve Size in inches 6 4 3 2 3/8 100 3/4 200 100 90 80 70 Percent Passing A Δ 30 Δ ≱ 20 Δ Δ 10 0 100 Diameter (mm) 0.01 10 1 0.1 0.001 Comments **Reviewed By**

Laboratory Document Prepared By: MW Approved BY: TLK

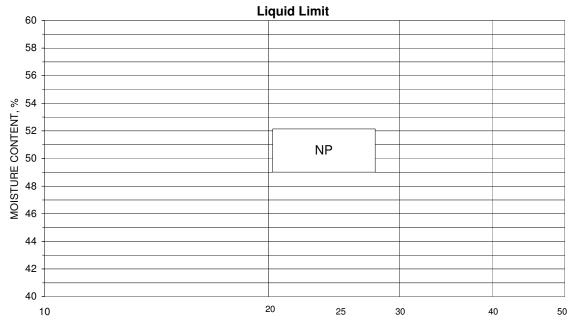
File: frm_175539022_sum_129 Sheet: Hydro-Report Preparation Date: 1998 Revision Date: 1-2008

Stantec Consulting Services Inc.





Project	AEP - Clifty Creek -	West Bottom As	h and Fly Ash Pon	ds subsurface e:	Project No.	175539022
Source	B-5, 55.0'-56.5', 57.	5'-59.0'			Lab ID	129
					% + No. 40	0
Tested By	RG	Test Method	ASTM D 4318 M	lethod A	Date Received	11-16-2009
Test Date	11-23-2009	Prepared	Dry	_	-	
	Wet Soil and	Dry Soil and				
	Tare Mass	Tare Mass	Tare Mass	Number of	Water Content	
	(g)	(g)	(g)	Blows	(%)	Liquid Limit
						#VALUE!
	ļ	1 1		1		



NUMBER OF BLOWS

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
					#VALUE!

Remarks:

LANDFILL RUNOFF COLLECTION POND: 2009 GEOTECNICAL EXPLORATION



GeoTesting Express

SPECIFIC GRAVITY TEST

(ASTM D854)

Project No.	GTX-1516	Tested By JM	Reviewed By MM
Project Name	Clifty Creek	Test Date 12/8/2009	Review Date 12/13/2009

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Boring No.	Depth	Sample No.	Lab No.	Flask No.	Temperature	Weight, WF	Weight, WFS	Weight of Soil	Weight, CWF	Weight, DS	Specific	Specific
	(ft)				(⁰ C)	(grams)	(grams)	(grams)	(grams)	(grams)	Gravity	Gravity
								(8)-(7)			(9)/[(10)-(11)+(9)]	at 20 ⁰ C
B-7	27.2-27.8	-		41	17	304.60	358.10	53.50	433.68	466.86	2.633	2.634
B-8	25.5-25.8	-	I	33	17	286.35	316.64	30.29	408.76	427.56	2.636	2.638
B-8	29.7-30.3	-		34	18	273.88	322.48	48.60	407.64	437.9	2.650	2.651
B-9	30.2-20.8	-		40	18	303.59	336.38	32.79	437.43	457.84	2.649	2.650
B-10	14.2-14.8	-		29	17	265.69	319.25	53.56	405.05	438.63	2.681	2.682
B-10	16.2-16.8	I		29	21	273.96	325.28	51.32	404.86	436.87	2.658	2.657

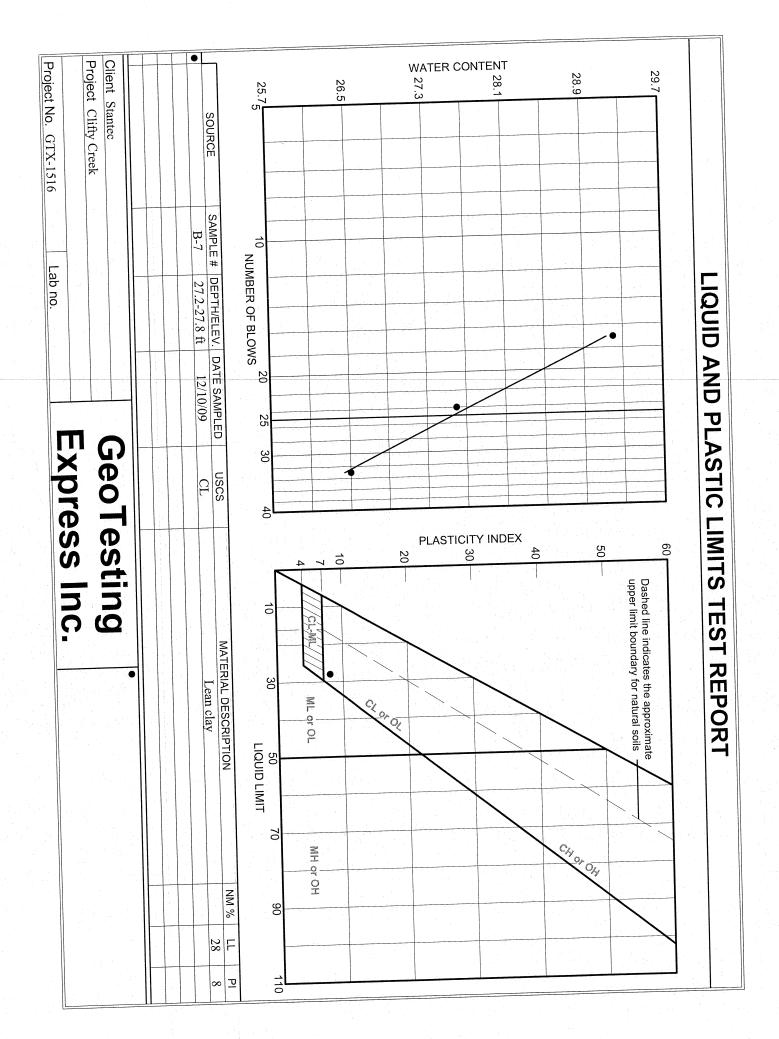
WF - Water and Flask

WFS - Water, Flask and Soil

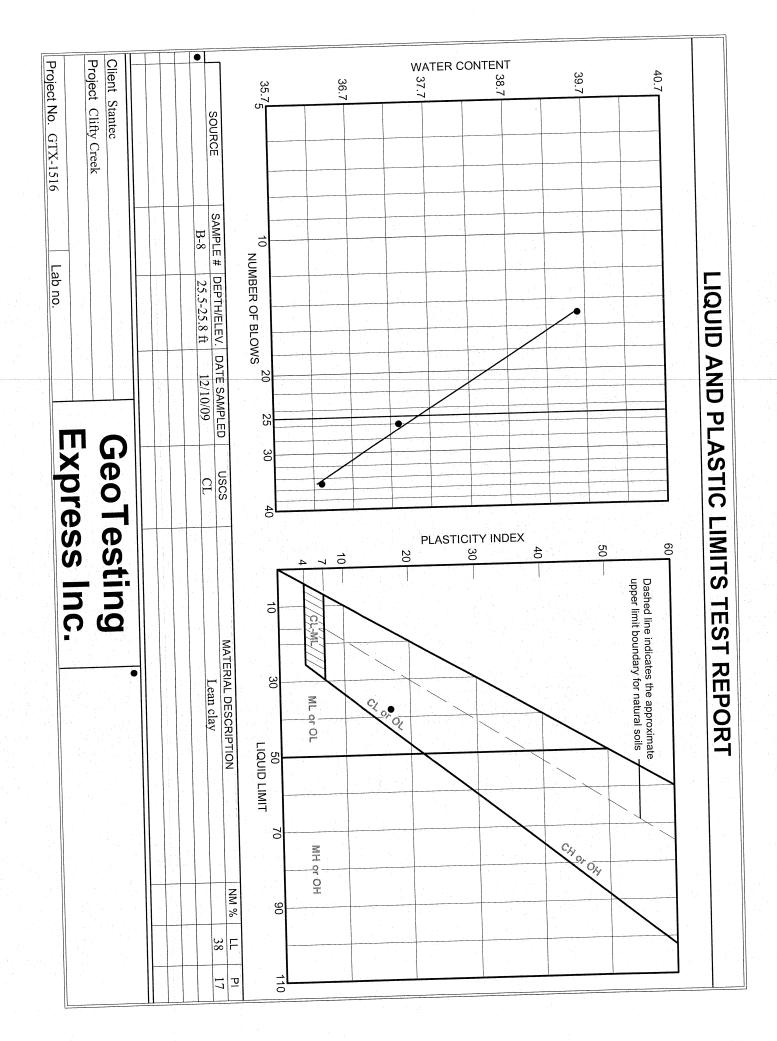
CWF - Calibration Water and Flask

DS - Deaired Sample

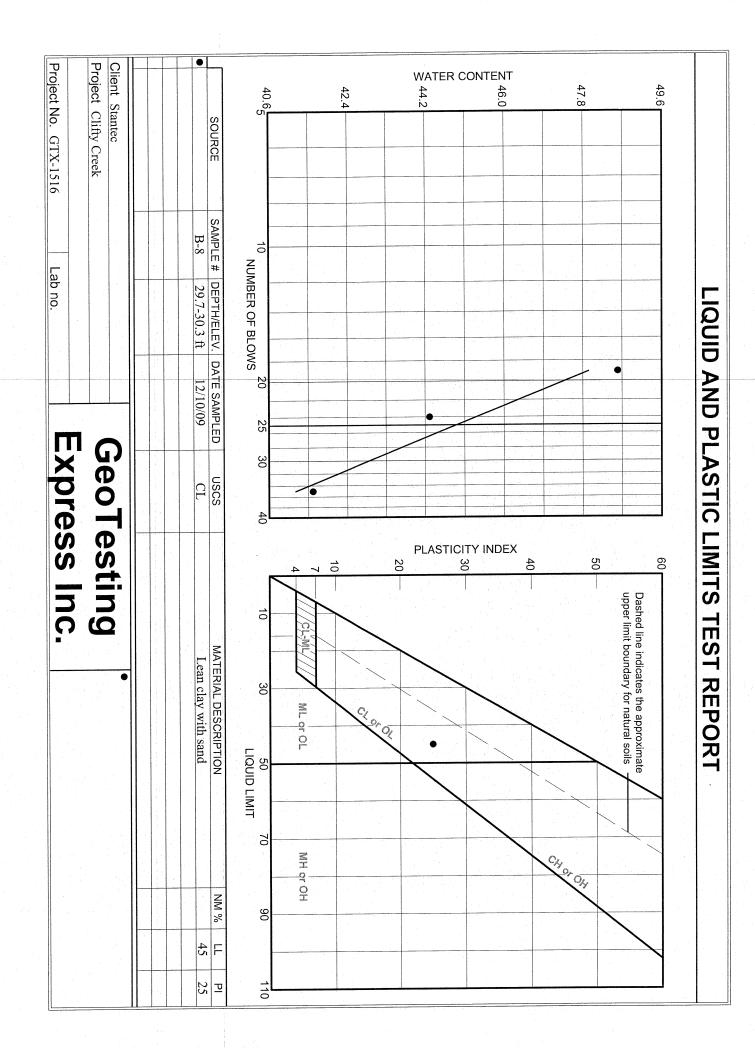
Particle Size Distribution Report A U.S. STANDARD SIEVE NUMBERS U.S. STANDARD SIEVE NUMBERS U.S. STANDARD SIEVE NUMBERS U.S. STANDARD SIEVE NUMBERS	Particle Size Di U.S. SIEVE OPENING IN INCHES U.S. SIEVE OPENING
S REVE OPENING IN INCHES S REVE OPENING IN INCHES S REVE OPENING IN INCHES S REVE OPENING IN INCHES U.S. STANDARD SIEVE NUMBERS O O O O O O O O O O O O O	Particle Size Distribution Report ASIM U422 SIEVE OPENNIG IN INCHES US STANDARD SIEVE ININEERS SIEVE OPENNIG IN INCHES



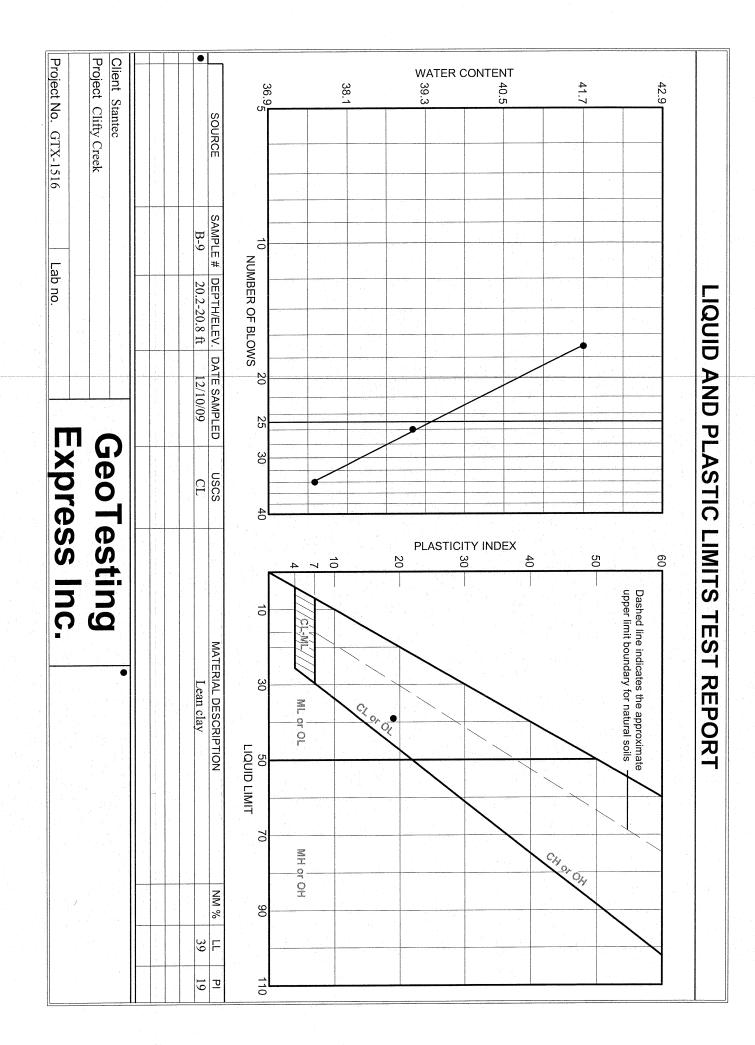
η σ σ						FINER I		GHT 2	80	90	100	
Client Stantec Project Clifty Creek Project No. GTX-1516	SOURCE	0 0 500 0.0 0.0	20	30	40	50	60					
Lab no.	SAMPLE # DEPTH/ELEV. DATE SAMPLED B-8 25.5-25.8 ft 12/10/09	100 10 % GRAVEL 0.0										Particle Size D
GeoTesting Express Inc.	CL	GRAIN SIZE IN MILLIMETERS % SAND 12.4										STANDARD SIEVE NUMBERS
	MATERIAL DESCRIPTION Lean clay	0.01 % SILT 71.3					~					ASTM D422 HYDROMETER
	NM % LL PL 38 21	0.001 100 % CLAY 16.3	90			SER BY		-	30 20 13d		10	



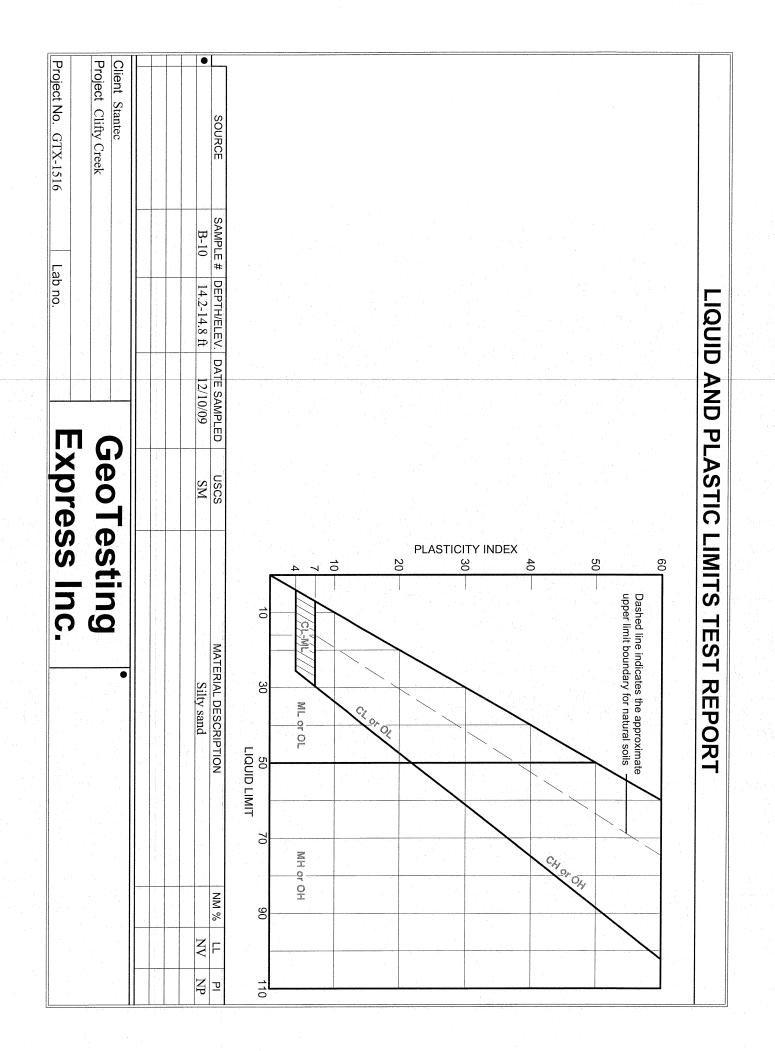
		0		10	20	8 8	40 40	50 S	e S	VEIGH 3 2		80	06	100	
Client Stantec Project Clifty Creek	SOURCE	% COBBLES 0.0	500												
	SAMPLE # DEPTH/ELEV. DATE SAMPLED B-8 29.7-30.3 ft 12/10/09	% GRAVEL 0.0	100 10												PENING IN INCHES
GeoTesting Express Inc	ED USCS CL	% SAND 21.0	GRAIN SIZE IN MILLIMETERS												U.S. STANDARD SIEVE NUMBERS
sting s Inc.	MAT	0 0	0.1 LLIMETERS												'E NUMBERS
	MATERIAL DESCRIPTION Lean clay with sand	% SILT 39.6	1 0.01							1	/				HYDROMETER
	NM % LL	% CLAY 39.4	0.001												METER



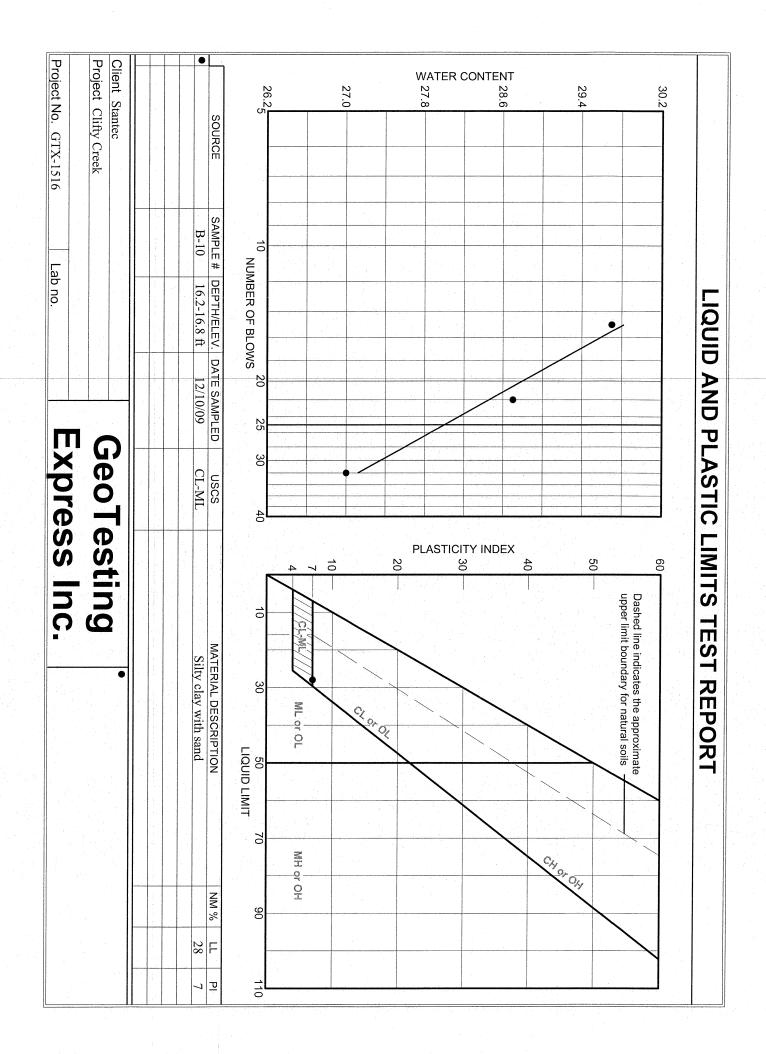
	No GTV-14/4 Jahon Incress USSTRIDURG NO SEVENUMBERS U.S. STANDARD SEVENUMA	Prc Prc			
S SIEVE OPENING IN INCHES S. SIEVE OPENING IN INCHES S. SIEVE OPENING IN INCHES U.S. STANDARD SIEVE NUMBERS U.S. STANDARD SIEVE S	S SEVE OPENING IN INCHES S SEVE OPENING IN INCHES S SEVE OPENING IN INCHES S SEVE OPENING IN INCHES S SEVE OPENING IN INCHES I S STANDARD SEVE NUMBERS I I I I I I I I I I I I I I I I I I I	Project Clifty Creek	SOURCE ent Stantec	6 COBBLES	
Seo Testing U.S. STANDARD SIEVE NUMBERS USCS CL 1.1 1.1 SAND 1.1 1.1 SAND 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.	US STANDARD SIEVE NUMBERS US STANDARD SIEVE NUMBERS	20	DEPTH/ELEV. 20.2-20.8 ft	% GRAVEL 0.0	S. SIEVE OPENING IN INCHES
		Express Inc.			U.S. STANDARD SIEVE NUMBERS



	Clie		0		_	10	Ň	2	PER(୪	CENT 8	FINE	ER BY	WEIG ମୁ	HT S	80	00	100		
Droigot No.	Client Stantec Project Clifty Creek			%			C										0		
1	untec lifty C	SOURCE	0.0	% COBBLES			:		1									-	
CTV 1516	reek	m		BLES														ი	
					8													L	
		B-																S SIE	
-		SAMPLE # B-10													1			VE OF	
		DEP 14.2		% GI	1					<u> </u>								U.S. SIEVE OPENING IN INCHES	
		DEPTH/ELEV. 14.2-14.8 ft	0.0	% GRAVEL															
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		DATE SAMPLED			-													S	
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Express Inc.	GeoTesting	SUS		GRAIN SIZE IN MILLIMETERS % SAND					a,									U.S. STANDARD SIEVE NUMBERS	
	O	USCS SM		SIZE	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1														
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		Silt						\nearrow										200	
		IAL DESCR Silty sand					1												
		MATERIAL DESCRIPTION Silty sand	2	%		1		n in the second se											
		Ž	25.5	% SILT															
				0.01	Į													HYI	
	andra († 1947) 1940 - Standard († 1947) 1940 - Standard († 1947) 1947 - Standard († 1947)				Ħ													DROM	
																		HYDROMETER	
		NM %						ana Thursday Na thur											
			3.3	% CLAY	-														
		NVF										2 · · · ·							
		Np P			100	00	ä		5	8	5 1 1 0	ядор Кодя	4 5	30	20	10	0		



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	tante Clift		SO			1														
	y Cr		SOURCE	0.0		-														
CTV 1516	eek				0													-	ת	
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200		10.		6	۹ ک													-	SIEVE OPENING IN INCHES	7
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			DATE SAMPLED																	SIZe
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Ĭ	О,	IVIL	S		SIZE	- 1 		3999 						-					AND	
Express Inc			·		GRAIN SIZE IN MILLIMETERS													Ĩ	U.S. STANDARD SIEVE NUMBERS	
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LANDFILL RUNOFF COLLECTION POND: 2015 GEOTECNICAL EXPLORATION



Summary of Soil Tests

Project Name	CCR Rule - AEI	P Clifty Creek	Project Number	175553022
Source	B-12, 10.0'-11.5	5'	Lab ID	3
Sample Type	SPT		Date Received	7-21-15
	0		Date Reported	
			Test Results	
Natu	ral Moisture Co	ontent	Atterberg Limits	
	: ASTM D 2216		Test Method: ASTM D 4318 Method	AŁ
Moistu	re Content (%):	23.1	Prepared: Dry	
			Liquid Limit:	43
Bo	rtiala Siza Anal	voio	Plastic Limit: Plasticity Index:	21 22
	r ticle Size Anal Method: ASTM		Activity Index:	
	ethod: ASTM D			1.05
	Method: ASTM			
i i yai olii otor i			Moisture-Density Relatio	nship
Parti	cle Size	%	Test Not Performed	i
Sieve Size	1	Passing	Maximum Dry Density (lb/ft ³):	N/A
	N/A	<u> </u>	Maximum Dry Density (kg/m ³):	
	N/A		Optimum Moisture Content (%):	
	N/A		Over Size Correction %:	
	N/A			
	N/A			
	N/A		California Bearing Ra	tio
No. 4	4.75	100.0	Test Not Performed	
No. 10	2	74.7	Bearing Ratio (%):	N/A
No. 40	0.425	74.1	Compacted Dry Density (lb/ft ³):	N/A
No. 200	0.075	71.7	Compacted Moisture Content (%):	N/A
	0.02	54.4		
	0.005	30.3		
	0.002	21.1	Specific Gravity	
estimated	0.001	17.0	Test Method: ASTM D 854	
Dluc 2 in mo	aterial, not includ	had: 0 (%)	Prepared: Dry Particle Size:	No. 10
F105 5 III. IIId			Specific Gravity at 20° Celsius:	
	ASTM	AASHTO		2.10
Range	(%)	(%)		
Gravel	0.0	25.3	Classification	
Coarse San		0.6	Unified Group Symbol:	
Medium Sar	nd 0.6		Group Name: Lean	
Fine Sand	2.4	2.4		
Silt	41.4	50.6		
Clay	30.3	21.1	AASHTO Classification:	A-7-6(15)
Comments:			┙└	
_			Reviewed By	K.
-				\bigcirc

Particle-Size Analysis of Soils

ASTM D 422

Project	Name						fty Cre	ek									Pro	ojec				75553022
Source		B-12	2, 10).0'-	11.	5													L	.ab II	ر 	3
			Si	eve	an	alysi	s for t	he l	Po	rtion	Coarse	er ti						9				
-				~										Sieve			%					
	est Metho					422								Size		Pas	sing)				
Pre	pared usin	g	A	SIN	ND	421							-					_				
Par	rticle Shap	е		An	gula	ar							-									
	e Hardnes		Hard			Ourab	le															
	Tested B Test Dat		JS		5													_				
Dat	te Receive																	_				
Du		a <u></u>			<u> </u>																	
Maximu	Im Particle	size:	No. 4	4 Si	ieve	;								No. 4	1	10	0.0					
													1	No. 10	0	74	4.7					
				Δ	nal	lvsis	for th	e po	orti	on F	iner th	an t	the	No. 1	10 S	ieve						
Analysis	s Based or	n -3 in	ch fr					• •		•				No. 4			4.1					
,						,								lo. 20			1.7					
Spe	cific Gravit	y	2.7	,										02 m		54	4.4					
-													0.0	005 n	nm	30).3					
Disp	ersed usin	g App	arat	us A	4 - I	Mech	anical	, for	11	ninut	e		0.0	002 n	nm	2	1.1					
													0.0	001 n	nm	17	7.0					
									. :_	- D:-												
							Partic	ଧe ଧ	SIZ	e Dis	tributio	on										
ASTM	Coarse Grave	I Fin	e Grave	el		Sand	Mediu	m Sano		-	Fine Sand	on	 		Sil					Clay		-
	Coarse Grave	Gra	0.0 vel	el		Sand 25.3	Mediu 0 Coars	m Sano .6 e Sano	d		Fine Sand 2.4 Fine Sand	on			Sil 41.	4 Silt				Clay 30.3	Clay	
AASHTO	0.0		0.0 vel	el			Mediu 0 Coars 0	m Sano .6 e Sano .6	b b		Fine Sand 2.4 Fine Sand 2.4	on				4						
AASHTO	0.0 Size in inches	Gra	0.0 vel	el			Medium 0 Coars 0 Sieve S	m Sano 6 6 6 size in s	b b	numbe	Fine Sand 2.4 Fine Sand 2.4		00			4 Silt					Clay	- 100
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3	el		25.3	Medium 0 Coars 0 Sieve S	m Sano 6 6 6 size in s	d d sieve	numbe	Fine Sand 2.4 Fine Sand 2.4		00			4 Silt					Clay	100
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3			25.3	Medium 0 Coars 0 Sieve S	m Sano 6 6 6 size in s	d d sieve	numbe	Fine Sand 2.4 Fine Sand 2.4		00			4 Silt					Clay	100 90
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3			25.3	Medium 0 Coars 0 Sieve S	m Sano 6 6 6 size in s	d d sieve	numbe	Fine Sand 2.4 Fine Sand 2.4		00			4 Silt					Clay	90
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3			11	Medium 0 Coars 0 Sieve S	m Sano 6 6 6 size in s	d sieve	40	Fine Sand 2.4 Fine Sand 2.4	20				4 Silt					Clay	+
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3			11	Mediuu 0 Coars 0 Sieve S 0 16	m Sano 6 6 6 size in s	d sieve	numbe	Fine Sand 2.4 Fine Sand 2.4	20	00			4 Silt					Clay	90 80 70
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3			11	Mediuu 0 Coars 0 Sieve S 0 16	m Sano 6 6 6 size in s	d sieve	40	Fine Sand 2.4 Fine Sand 2.4	20			41.	4 Silt					Clay	90 80 70
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3			11	Mediuu 0 Coars 0 Sieve S 0 16	m Sano 6 6 6 size in s	d sieve	40	Fine Sand 2.4 Fine Sand 2.4	20			<u>41.</u>	4 Silt 50.6					Clay	90 80 70
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3			11	Mediuu 0 Coars 0 Sieve S 0 16	m Sano 6 6 6 size in s	d sieve	40	Fine Sand 2.4 Fine Sand 2.4	20			<u>41.</u>	4 Silt 50.6					Clay	90 80 70
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3			11	Mediuu 0 Coars 0 Sieve S 0 16	m Sano 6 6 6 size in s	d sieve	40	Fine Sand 2.4 Fine Sand 2.4	20			<u>41.</u>	4 Silt 50.6	3 				Clay	90 80 70
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3			11	Mediuu 0 Coars 0 Sieve S 0 16	m Sano 6 6 6 size in s	d sieve	40	Fine Sand 2.4 Fine Sand 2.4	20			<u>41.</u>	4 Silt 50.6					Clay	00 90 80 70 70 70 90 90 90 90 90 90 90 90 90 90 90 90 90
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3			11	Mediuu 0 Coars 0 Sieve S 0 16	m Sano 6 6 6 size in s	d sieve	40	Fine Sand 2.4 Fine Sand 2.4	20			<u>41.</u>	4 Silt 50.6	3 				Clay	90 80 70
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3			11	Mediuu 0 Coars 0 Sieve S 0 16	m Sano 6 6 6 size in s	d sieve	40	Fine Sand 2.4 Fine Sand 2.4	20			<u>41.</u>	4 Silt 50.6	3 				Clay	00 90 80 70 70 70 90 90 90 90 90 90 90 90 90 90 90 90 90
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3			11	Mediuu 0 Coars 0 Sieve S 0 16	m Sano 6 6 6 size in s	d sieve	40	Fine Sand 2.4 Fine Sand 2.4	20			<u>41.</u>	4 Silt 50.6	3 				Clav 21.1	90 80 70 60 50 40 40 30
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3			11	Mediuu 0 Coars 0 Sieve S 0 16	m Sano 6 6 6 size in s	d sieve	40	Fine Sand 2.4 Fine Sand 2.4	20			<u>41.</u>	4 Silt 50.6	3 				Clav 21.1	90 80 70 60 50 40 40 30 20 10
AASHTO	0.0 Size in inches	Gra 25	0.0 vel .3			11	Mediuu 0 Coars 0 Sieve S 0 16	m Sanchar			Fine Sand 2.4 Fine Sand 2.4 's 100 	20			<u>41.</u>		3 				Clay 21.1	90 80 70 60 50 40 30 20
	0.0 Size in inches	Gra 25	0.0 yel 3 3/8 			11	Mediuu 0 Coars 0 Sieve S 0 16	m Sanchar		40	Fine Sand 2.4 Fine Sand 2.4 's 100 	20			<u>41.</u>						Clay 21.1	90 80 70 60 50 40 40 30 20 10 10 0

Stantec

Stantec Consulting Services Inc. Lexington, Kentucky





Project	CCR	Rule - AEP CI	ifty Creek			Project No.	175553022
Source	B-12,	10.0'-11.5'				Lab ID	3
_						% + No. 40	26
Tested By		kws		ASTM D 4318 N	/lethod A	Date Received	07-21-2015
Test Date	0	7-27-2015	Prepared	Dry	_		
г							
		et Soil and	Dry Soil and	- 14			
	I	are Mass	Tare Mass	Tare Mass	Number of	Water Content	Linusial Linusia
		(g)	(g)	(g)	Blows	(%)	Liquid Limit
		19.52	17.10	11.31	35	41.8	
		18.33	16.09	10.85	26	42.7	
		19.57	17.04	11.18	20	43.2	43
L							
				Liquid	Limit		
	50						
	48						
	40						
	46						
%	44						
MOISTURE CONTENT. %	42						
E E						•	
Ó	40						
E S E	38						
IDT.	30						
OIS	36						
Ž							
	34						
	32						
	52						
	30						
	1	10		20	25	30	40 50

NUMBER OF BLOWS

PLASTIC LIMIT	AND PL	ASTICITY INDEX

Wet Soil and	Dry Soil and		Water		
Tare Mass	Tare Mass	Tare Mass	Content		
(g)	(g)	(g)	(%)	Plastic Limit	Plasticity Index
18.01	16.88	11.47	20.9	21	22
17.57	16.44	11.11	21.2		

Remarks:





Summary of Soil Tests

	CCR Rule - AE		Project Number	175553022
Source	B-12, 30.0'-31.5)	Lab ID	1
Sample Type	SPT		Date Received	7-21-15
			Date Reported	8-3-15
			Test Results	
Nat	ural Moisture Co	ontent	Atterberg Limits	
	d: ASTM D 2216		Test Method: ASTM D 4318 Method	А
Moist	ure Content (%):	19.0	Prepared: Dry	04
			Liquid Limit: Plastic Limit:	31 18
P	article Size Anal	vsis	Plastic Limit.	13
	Method: ASTM		Activity Index:	
	Aethod: ASTM D			
Hydrometer	Method: ASTM	D 422		
			Moisture-Density Relation	iship
	ticle Size	%	Test Not Performed	
Sieve Siz	e (mm)	Passing	Maximum Dry Density (lb/ft ³):	N/A
	N/A		Maximum Dry Density (kg/m ³):	N/A
	N/A		Optimum Moisture Content (%):	N/A
	N/A		Over Size Correction %:	
	N/A			
3/4"	19	100.0		
3/8"	9.5	99.8	California Bearing Rat	io
No. 4	4.75	89.2	Test Not Performed	
No. 10	2	77.8	Bearing Ratio (%):	N/A
No. 40	0.425	77.3	Compacted Dry Density (lb/ft ³):	N/A
No. 200	0.075	71.4	Compacted Moisture Content (%):	N/A
	0.02	42.9		
	0.005	21.6		
	0.002	15.2	Specific Gravity	
estimated	0.001	12.0	Test Method: ASTM D 854	
Diuc 2 in m	aterial, not includ	4ad: 0 (%)	Prepared: Dry Particle Size:	No. 10
F 105 5 111. 111		ieu. 0 (78)	Specific Gravity at 20° Celsius:	
	ASTM	AASHTO		2.00
Range	(%)	(%)		
Gravel	· · · /	22.2	Classification	
Coarse Sa		0.5	Unified Group Symbol:	CL
Medium Sa			Group Name: Lean d	clay with sand
Fine San		5.9		
Silt	49.8	56.2		
Clay	21.6	15.2	AASHTO Classification:	A-6 (7)
Comments:			⊿ └	
			Reviewed By	<u> </u>
				\bigcirc

Particle-Size Analysis of Soils

Project Number 175553022 Lab ID

ASTM D 422

7

				is for the Por					
_						Sieve	<u>%</u>		
		ASTN				Size	Passing		
Pre	pared using	ASTM	1 D 421						
D -	wiele Oberes	Λ -					 		
		Ang					 		
Particle	e Hardness:	Hard and	d Durab	le					
	T (15	10							
	Tested By		_						
-	-	07-24-2015					100.0		
Dat	te Received	07-21-2015)			3/4"	100.0		
						3/8"	99.8		
Maximu	im Particle s	ize: 3/4" Siev	/e			No. 4	89.2		
						No. 10	77.8		
				for the ment	an Finan that	4ha No. 404			
A			-	for the porti	on Finer than				
Analysis	s based on	-3 inch fraction	on only			No. 40	77.3		
0		0.00				No. 200	71.4		
Spe	cific Gravity	2.68	_			0.02 mm			
Ξ.						0.005 mm			
Disp	ersed using	Apparatus A	- Mech	anical, for 1 n	ninute	0.002 mm			
						0.001 mm	12.0		
				Particle Size	Distribution				
ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	5	Silt	Clay	
	0.0	10.8 Gravel	11.4	0.5 Coarse Sand	5.9 Fine Sand	4	9.8 Silt	21.6 Clav	
AASHTO		22.2		0.5	5.9		56.2	15.2	
	Size in inches	2/4 0/0		Sieve Size in sieve		200			
	3 2 1 3	3/4 3/8 4	4 1	0 16 30 4	40 100 2	200		10	0
		2						90	
								80	
				<u>م</u>				80	
				\$		A		80	
				\$,		*		70	
				<u>م</u>					
				s				70	
				\$				70 60 50	ent Passing
				\$				70 60	ent Passing
				\$,			Δ	70 60 50 40	Percent Passing
				S				70 60 50	Percent Passing
				S			Δ	70 60 50 40	Percent Passing
				9				70 60 50 40 30	Percent Passing
				9				70 60 50 40 30 20	Percent Passing
				9				70 60 50 40 30 20 10	Percent Passing
								70 60 50 40 30 20 10 0	Percent Passing
100		10						70 60 50 40 30 20 10	Percent Passing
100		10						70 60 50 40 30 20 10 0	Percent Passing
	Comments	10					0.01	70 60 50 40 30 20 10 0.001	Percent Passing
	Comments	10					0.01	70 60 50 40 30 20 10 0	Percent Passing
	Comments	10					0.01	70 60 50 40 30 20 10 0.001	Percent Passing

Stantec

CCR Rule - AEP Clifty Creek B-12, 30.0'-31.5'

Project Name

Source

Lexington, Kentucky

Prepared By: MW Approved BY: TLK





Project	CCR	Rule - AEP CI	lifty Creek				Project No.	175553022
Source	B-12	, 30.0'-31.5'					Lab ID	7
							% + No. 40	23
Tested By		KG	Test Method		18 Metho	d A	Date Received	07-21-2015
Test Date	0	7-31-2015	Prepared	Dry				
							1	
		et Soil and	Dry Soil and					
		Tare Mass	Tare Mass	Tare Mas		mber of	Water Content	النصب المالية
		(g)	(g)	(g)		Blows	(%)	Liquid Limit
		19.80	17.75	10.92		29	30.0	
		19.72	17.68	11.03		23	30.7	
		20.84	18.48	11.04		19	31.7	31
							1	
				Liq	uid Limi	t		
	40	1						
	38							
	00							
	36	-						
	0.4	-						
8	34							
MOISTLIRE CONTENT %	32							
L L]	-						
Ő	5 30	-						
Ц С	28							
	5 20							
	26							
2	-							
	24	-						
	22							
		+						
	20	1						
		10		20)	25	30	40 50

NUMBER OF BLOWS

PLASTIC LIMIT	AND PLASTICITY INDE	х
		~

ĺ	Wet Soil and	Dry Soil and		Water		
	Tare Mass	Tare Mass	Tare Mass	Content		
	(g)	(g)	(g)	(%)	Plastic Limit	Plasticity Index
	19.95	18.61	11.11	17.9	18	13
	20.10	18.75	11.18	17.8		

Remarks:

Reviewed By





Summary of Soil Tests

oject Name C	CR Rule - AEI	P Clifty Creek	Project Number	175553022
urce B	-12, 45.0'-46.5	5'	Lab ID	10
mple Type S	PT		Date Received	7-21-15
<u> </u>	· ·		Date Reported	8-3-15
			Test Results	
Natura	I Moisture Co	ontent	Atterberg Limits	
Test Method: /			Test Method: ASTM D 4318 Method	А
Moisture	Content (%):	18.7	Prepared: Dry	
			Liquid Limit:	26
			Plastic Limit:	19
	cle Size Anal		Plasticity Index:	7
Preparation M			Activity Index:	0.64
Gradation Met				
Hydrometer M	ethod: ASTM	D 422	Maistan Danaita Dalatian	
Particl	o Sizo	%	Moisture-Density Relation	isnip
Sieve Size				N1/A
Sieve Size	(mm)	Passing	Maximum Dry Density (lb/ft ³):	N/A
	N/A		Maximum Dry Density (kg/m ³):	N/A
	N/A		Optimum Moisture Content (%):	
	N/A		Over Size Correction %:	N/A
	N/A			
	N/A			
	N/A	100.0	California Bearing Rat	<u>10</u>
No. 4	4.75	100.0	Test Not Performed	N1/A
No. 10	2	99.3	Bearing Ratio (%):	
No. 40	0.425	99.2	Compacted Dry Density (lb/ft ³):	
No. 200	0.075	82.2	Compacted Moisture Content (%):	N/A
	0.02	34.0		
	0.005	14.0 10.7	Specific Gravity	
estimated	0.002	10.7	Test Method: ASTM D 854	
Colimated	0.001	10.0	Prepared: Dry	
Plus 3 in. mate	erial. not includ	ded: 0 (%)	Particle Size:	No. 10
	,		Specific Gravity at 20° Celsius:	2.72
	ASTM	AASHTO		
Range	(%)	(%)		
Gravel	0.0	0.7	Classification	
Coarse Sand		0.1	Unified Group Symbol:	CL-ML
Medium Sand			Group Name: Silty	clay with sand
Fine Sand	17.0	17.0		
Silt	68.2	71.5		
Clay	14.0	10.7	AASHTO Classification:	A-4 (4)
Comments:			-4	
			Reviewed By	KJ
				/

Particle-Size Analysis of Soils

Project Number 175553022

Lab ID

ASTM D 422

10

	-	Sieve	analysi	is for the	e Poi	rtion C	oarser			10 Sie				
т	est Method	ASTA	1 D 422						eve ize	Pass				
Prepared using ASTM D 421									120	1 400	ng			
	<u> </u>													
Particle Shape Angular														
Particle Hardness: Hard and Durable														
	Tested By	JS												
		07-24-201	5											
Dat	e Received													
	-													
laximum Particle size: No. 4 Sieve									o. 4	100				
								No	o. 10	99.	3			
		Δ	nalvsis	for the	porti	on Fin	er than	the N	0. 10 9	Sieve				
Analysis	Based on				P 0 · 11	•	er triari		b. 40	99.	2			
									. 200	82.	2			
Specific Gravity 2.72									mm	34.				
									5 mm	14.				
Dispe	ersed using	Apparatus A	A - Mech	anical, f	or 1 r	ninute			2 mm	10.				
								0.00	1 mm	10.	0			
				Particle										7
ASTM	Coarse Gravel 0.0	Fine Gravel C. Sand 0.0 0.7		Medium Sand 0.1			Fine Sand 17.0		Silt 68.2			CI 14	-	
AASHTO		Gravel 0.7		Coarse S 0.1	and		e Sand 17.0			Silt 71.5			Clay 10.7	-
Sieve	Size in inches			Sieve Size	in sieve									-
:	3 2 1 3	3/8		0 16		40 24	100	200						T ¹⁰⁰
														90
														- 30
														- 80
														70
								++						ling -
														Percent Passing
														50 E
														40 8
										<u> </u>				_ `` &
														30
										A				20
														10
														+ 10 -
														1 o
100		10		1	Diam	neter (m	m) 0.1			0.0	11		0.	001
														0.
Comments											Reviewed By			
														\bigcirc
File: frm 17	5553022_sum_10.x	Ism		Stonto		noultin	g Servic	00 100					Labora	atory Document
Preparation Revision Da	Date: 1998						centuck						Pre	epared By: MW proved BY: TLK



CCR Rule - AEP Clifty Creek B-12, 45.0'-46.5'

Project Name

Source





ATTERBERG LIMITS

Project	CCR	Rule - AEP CI	ifty Creek				Project No.	175553022
Source	B-12,	45.0'-46.5'					Lab ID	10
-							% + No. 40	1
Tested By		TA	Test Method		8 Method	A	Date Received	07-21-2015
Test Date	0	7-30-2015	Prepared	Dry				
Г	١٨/	et Soil and	Dry Soil and					
		are Mass	Tare Mass	Tare Mass		nber of	Water Content	
		(g)	(g)	(g)		ows	(%)	Liquid Limit
ŀ		19.13	17.46	11.11		22	26.3	
-		21.65	19.32	10.87		18	27.6	
ŀ		22.47	20.32	11.55		31	24.5	26
-		22.47	20.32	11.55		31	24.3	20
-								
L								
				Lia	uid Limit			
	40	1						
	38	_						
	50							
	36							
	34							
%								
L N N	32							
ITNO	30							
0	50							
URE	28							
MOISTURE CONTENT, %	26							
0W	20							
	24							
	22							
	22							
	20							
	1	10		20		25	30	40 50
				NUMBE	R OF BLOV	VS		

PLASTIC LIMIT AND PLASTICITY INDEX

[Wet Soil and	Dry Soil and	Т М	Water		
	Tare Mass	Tare Mass	Tare Mass	Content		
	(g)	(g)	(g)	(%)	Plastic Limit	Plasticity Index
	17.45	16.47	11.42	19.4	19	7
	17.70	16.74	11.60	18.7		

Remarks:

Reviewed By





Summary of Soil Tests

Project Name	CCR Rule - AE	P Clifty Creek	Project Number	175553022
Source	B-12, 50.0'-51.5	5'	Lab ID	11
Sample Type	SPT		Date Received	7-21-15
Sample Type			Date Reported	
			Test Results	
Natu	ral Moisture Co	ontent	Atterberg Limits	
	I: ASTM D 2216		Test Method: ASTM D 4318 Method	A
	re Content (%):		Prepared: Dry	
	. ,		Liquid Limit:	NP
			Plastic Limit:	NP
	rticle Size Anal		Plasticity Index:	NP
	Method: ASTM		Activity Index:	N/A
	ethod: ASTM D Method: ASTM			
nyurometer	Method. AS I M	D 422	Moisture-Density Relation	nshin
Part	icle Size	%	Test Not Performed	
Sieve Size		Passing	Maximum Dry Density (lb/ft ³):	N/A
	N/A	i doonig	Maximum Dry Density (b/rt).	N/A
	N/A		Optimum Moisture Content (%):	
	N/A		Over Size Correction %:	
	N/A			IN/A
	N/A			
	N/A		California Bearing Rat	io
	N/A		Test Not Performed	
No. 10	2	100.0	Bearing Ratio (%):	N/A
No. 40	0.425	99.8	Compacted Dry Density (lb/ft ³):	N/A
No. 200	0.075	81.3	Compacted Moisture Content (%):	
	0.02	29.1		
	0.005	6.3		
	0.002	3.2	Specific Gravity	
estimated	0.001	1.0	Test Method: ASTM D 854	
Dlue 3 in m	aterial, not includ	ded: 0 (%)	Prepared: Dry Particle Size:	No. 10
1 103 5 11. 116		ieu. 0 (70)	Specific Gravity at 20° Celsius:	
	ASTM	AASHTO		2.00
Range	(%)	(%)		
Gravel	0.0	0.0	Classification	
Coarse Sar		0.2	Unified Group Symbol:	ML
Medium Sa			Group Name:	Silt with sand
Fine Sand		18.5		
Silt	75.0	78.1		A 4 (O)
Clay	6.3	3.2	AASHTO Classification:	A-4(U)
Comments:				
			Reviewed By	K.
				\bigcirc

Particle-Size Analysis of Soils

ASTM D 422

	Name	CCR Rule		ifty Creel	〈				Proje	ect Numb		
Source		B-12, 50.0	-51.5'						-	Lab	D	11
									-			
		Sieve	e analysi	is for the	e Porti	on Coarse				7		
-								Sieve	% Dessing			
	est Method							Size	Passing	-		
Pre	pared using	AST	VI D 421							-		
Par	rticle Shape		N/A							-		
	Hardness:		N/A							-		
										-		
	Tested By	JS								1		
	Test Date	07-24-201	5									
Dat	e Received	07-21-201	5									
	_											
Maximu	m Particle	size: No. 10	Sieve						100.0	-		
							ľ	lo. 10	100.0			
			Analysis	for the	oortio	n Finer tha	n the l	No 10 9	Sieve			
Analysis	Based on	-3 inch frac			portio			No. 40	99.8	٦		
·								o. 200	81.3	-		
Spe	cific Gravity	2.68)2 mm	29.1	1		
							0.0)05 mm	6.3			
Disp	ersed using	Apparatus	A - Mech	nanical, fo	or 1 mi	nute)02 mm				
							0.0)01 mm	1.0			
				Particle	Size	Distributio	n					
ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium S		Fine Sand			Silt	Cla	-	
AASHTO	0.0	0.0 Gravel	0.0	0.2 Coarse Sa	and	18.5 Fine Sand		7	5.0 Silt	6.3		
											Clav	
Sieve		0.0		0.2		18.5			78.1		3.2	
	Size in inches 3 2 1		4 1	Sieve Size		mbers	200					
		0.0 3/4 3/8	4 1		in sieve nu 30 40		200					100
			4 1	Sieve Size		mbers	200					100 90
			4 1	Sieve Size		mbers	200					90
				Sieve Size		mbers	200					
				Sieve Size		mbers	200					90 80 70
				Sieve Size		mbers	200					90 80 70
				Sieve Size		mbers	200					90 80 70
				Sieve Size		mbers	200					90 80 70
				Sieve Size		mbers	200					90 80 70
				Sieve Size		mbers	200					900 800 700 500 500 400 400
				Sieve Size		mbers	200					90 80 70
				Sieve Size		mbers						900 800 700 500 500 400 400
				Sieve Size		mbers			78.1			90 80 70 60 50 40 30 20
				Sieve Size		mbers						90 80 70 50 bercent Passing 40 30
		3/4 3/8		Sieve Size							3.2	 90 80 70 60 50 40 40 30 20 10 0
				Sieve Size			200		78.1			 90 80 70 60 50 40 40 30 20 10 0
		3/4 3/8		Sieve Size 0 16 0 16 0 10 0 10 0 10 0 10 0 10 0 10							3.2	 90 80 70 60 50 40 40 30 20 10 0
		3/4 3/8		Sieve Size 0 16 0 16 0 10 0 10 0 10 0 10 0 10 0 10					78.1		<u>3.2</u>	 90 80 70 60 50 40 40 30 20 10 0

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Page 3 of 3

ATTERBERG LIMITS

roject	CCR	Rule - AEP CI	ifty Creek			Project No.	175553022
ource	B-12	, 50.0'-51.5'				Lab ID	11
_						% + No. 40	0
ested By		TA		ASTM D 4318 N	lethod A	Date Received	07-21-2015
est Date	C	7-30-2015	Prepared	Dry	-		
г	14	et Soil and	Dry Soil and			I I	
		Fare Mass	Tare Mass	Tare Mass	Number of	Water Content	
		(g)	(g)	(g)	Blows	(%)	Liquid Limit
-		(9/	(9)	(9)	Diotic	(70)	Liquid Linin
_							
_							
-							
				Liquid	Limit		
	50	1					
	48	-					
	46						
. 0	44	-					
× -		-					
N U U	42						
INO	40				NP		
с щ				L			
rur	38						
MOISTURE CONTENT, %	36						
Ň		-					
	34						
	32						
	30	10		20			
		10		20	25	30	40 50

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



Laboratory Document Prepared By: MW Approved BY: TLK



Summary of Soil Tests

oject Name	CCR Rule - AE	P Clifty Creek	Project Number	175553022
•	B-12, 60.0'-61.5		Lab ID	13
imple Type	SPT		Date Received	7-21-15
			Date Reported	
			Test Results	
Natu	Iral Moisture Co	ontent	Atterberg Limits	
	: ASTM D 2216		Test Method: ASTM D 4318 Method	IA
Moistu	re Content (%):	14.8	Prepared: Dry	
			Liquid Limit:	NP
			Plastic Limit:	NP
Pa	rticle Size Anal	ysis	Plasticity Index:	NP
Preparation	Method: ASTM I	D 421	Activity Index:	N/A
Gradation M	lethod: ASTM D	422		
Hydrometer	Method: ASTM	D 422		
			Moisture-Density Relation	nship
	icle Size	%	Test Not Performed	
Sieve Size	()	Passing	Maximum Dry Density (lb/ft ³):	
	N/A		Maximum Dry Density (kg/m ³):	N/A
	N/A		Optimum Moisture Content (%):	N/A
	N/A		Over Size Correction %:	
	N/A			
	N/A			
	N/A		California Bearing Rat	io
No. 4	4.75	100.0	Test Not Performed	
No. 10	2	98.5	Bearing Ratio (%):	N/A
No. 40	0.425	95.7	Compacted Dry Density (lb/ft ³):	N/A
No. 200	0.075	36.1	Compacted Moisture Content (%):	
<u></u>	0.02	12.4		
	0.005	5.1		
	0.002	2.8	Specific Gravity	
estimated	0.001	1.0	Test Method: ASTM D 854	
			Prepared: Dry	
Plus 3 in. ma	aterial, not incluc	led: 0 (%)	Particle Size:	
			Specific Gravity at 20° Celsius:	2.75
_	ASTM	AASHTO		
Range	(%)	(%)		
Gravel	(%) 0.0	(%) 1.5	Classification	
Gravel Coarse Sa	(%) 0.0 nd 1.5	(%) 1.5 2.8	Unified Group Symbol:	
Gravel Coarse Sa Medium Sa	(%) 0.0 nd 1.5 nd 2.8	(%) 1.5 2.8 		
Gravel Coarse Sar Medium Sa Fine San	(%) 0.0 nd 1.5 nd 2.8 d 59.6	(%) 1.5 2.8 59.6	Unified Group Symbol:	
Gravel Coarse Sau Medium Sa Fine Sand Silt	(%) 0.0 nd 1.5 nd 2.8 d 59.6 31.0	(%) 1.5 2.8 59.6 33.3	Unified Group Symbol: Group Name:	Silty sand
Gravel Coarse Sar Medium Sa Fine San	(%) 0.0 nd 1.5 nd 2.8 d 59.6	(%) 1.5 2.8 59.6	Unified Group Symbol:	Silty sand
Gravel Coarse San Medium Sa Fine Sand Silt Clay	(%) 0.0 nd 1.5 nd 2.8 d 59.6 31.0 5.1	(%) 1.5 2.8 59.6 33.3	Unified Group Symbol: Group Name:	Silty sand
Gravel Coarse Sau Medium Sa Fine Sand Silt	(%) 0.0 nd 1.5 nd 2.8 d 59.6 31.0 5.1	(%) 1.5 2.8 59.6 33.3	Unified Group Symbol: Group Name:	Silty sand
Gravel Coarse San Medium Sa Fine Sand Silt Clay	(%) 0.0 nd 1.5 nd 2.8 d 59.6 31.0 5.1	(%) 1.5 2.8 59.6 33.3	Unified Group Symbol: Group Name:	Silty sand

Particle-Size Analysis of Soils

ASTM D 422

Project	Name	CCR	Rule	- A	EP CI	ifty Cr	eek								Proj	ect N	lumbe	er 17	75553	3022
Source		B-12,	60.0)'-61	.5'												Lab II	D		13
			Siev	e al	nalysi	is for	the	Port	ion (Coarse	er tl		he No.			-				
т	oot Mothod		A 67	-	1 1 1 1								ieve Size	% Door						
	est Method				0 422 0 421		-						lze	Pase	sing	-				
110	pared using		701		J 42 I		-													
Pai	rticle Shape		А	ngu	lar															
Particle	e Hardness:	H			Durab	ole	-													
	Tested By		JS	15												-				
Dat	Test Date te Received	-																		
Dai		012	.1 20	10												-				
Maximu	m Particle	size: N	o. 4 \$	Siev	е							N	o. 4	100	0.0					
												No	o. 10	98	.5					
						f (].							- 40 0							
Analysis	s Based on	-3 inc				for tr	ie p	ortio		ner th	an t		o. 10 S o. 40	95	7	٦				
/ maryon	buscu on	0 110	maa	01101	loniy								. 200	36						
Spe	cific Gravity	, 2	2.75										2 mm	12						
)5 mm	5.						
Disp	ersed using	Арра	ratus	s A -	Mech	nanica	l, for	1 m	inute))2 mm	2.						
												0.00)1 mm	1.	0					
		_								ributio	n									
ASTM	Coarse Gravel 0.0		Gravel .0	С	. Sand 1.5		um San 2.8	nd	F	ine Sand 59.6			<u>S</u>	ilt .0			<u>Clay</u> 5.1			
AASHTO		Grave 1.5	1				<u>se San</u> 2.8	d	F	ine Sand 59.6				Silt 33.3				Clay 2.8		
Sieve	Size in inches							sieve n	umbers											
	3 2 1	3/4	3/8	4		0 16	:	30 40		100	2	00							T ¹⁰⁰	
																			90	
					_							+++				+++				
																			80	
					_					\rightarrow									70	
																			60	sing
										+									ł	Jase
										`									50	ent F
																			40	Percent Passing
																			- 30	Γ
												+							30	
																			20	
													A		Δ,				10	
					_													Δ	0	
100			10				1 [Diame	eter (n	nm)	0.1			0.	01			0.0	+ 0 001	
							_	-		,										
	Comments														P	avie	wed B	W.	R	
	Comments													i.				J	0	



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		Rule - AEP Cl 60.0'-61.5'	ifty Creek			Project No. Lab ID	175553022 13
Tested By Test Date	07	DB 7-24-2015	Test Method A	ASTM D 4318 N Dry	lethod A	% + No. 40 Date Received	4 07-21-2015
-		et Soil and are Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
-							
L	50 -			Liquid	Limit	· · · ·	
	48 -						
	46 -						
~	44 -						
LNT,	42 -					7	
MOISTURE CONTENT, %	40 -				NP		
JRE 0	38 -						
IOIST	36 -						
2	34 -						
	32 -						
	30 -						
	1	0		20	25	30	40 50

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



Laboratory Document Prepared By: MW Approved BY: TLK



Summary of Soil Tests

Project Name	CCR Rule - AE	P Clifty Creek	Project Number	175553022
Source	B-12, 70.0'-71.5		Lab ID	15
			Dete Dessived	7 04 45
Sample Type	SPT		Date Received Date Reported	
			Date Reported	0-3-15
			Test Results	
Nat	ural Moisture Co	ontent	Atterberg Limits	
	d: ASTM D 2216		Test Method: ASTM D 4318 Method	IA
Moist	ure Content (%):	21.6	Prepared: Dry	
			Liquid Limit:	NP
		-	Plastic Limit:	NP
	article Size Anal		Plasticity Index:	
	Method: ASTM		Activity Index:	N/A
	Method: ASTM D			
Hydromete	r Method: ASTM	D 422	Maintana Danaita Dalatia	
Pa	rticle Size	%	Moisture-Density Relation	<u>isnip</u>
Sieve Siz				NI/A
Sieve Siz	()	Passing	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
	N/A			
	N/A			
	N/A		California Bearing Rat	io
	N/A		Test Not Performed	
No. 10	2	100.0	Bearing Ratio (%):	
No. 40	0.425	98.6	Compacted Dry Density (lb/ft ³):	
No. 200	0.075	56.5	Compacted Moisture Content (%):	N/A
	0.02	21.7		
	0.005	3.7		
	0.002	1.5	Specific Gravity	
estimated	0.001	1.0	Test Method: ASTM D 854	
			Prepared: Dry	
Plus 3 in. m	naterial, not inclue	ded: 0 (%)	Particle Size:	
			Specific Gravity at 20° Celsius:	2.71
5	ASTM	AASHTO		
Range		(%)		
Gravel		0.0	Classification	N 41
Coarse Sa		1.4	Unified Group Symbol:	ML Sandy silt
Medium Sa			Group Name:	Sandy slit
Fine San		42.1		
Silt	52.8	55.0		A 4 (O)
Clay	3.7	1.5	AASHTO Classification:	A-4 (0)
Comments				
			Reviewed By	PI

Particle-Size Analysis of Soils

ASTM D 422

Project	Name	CCR	Rul	e - A	EP C	lifty (Cree	k								F	Proj	ect l	Num	nber	17	7555	3022
Source		B-12	, 7 0.	0'-7	1.5'														Lab	b ID			15
															_								
			Sie	vea	analys	sis fo	or the	e Po	ortio	n C	oarse	r th			o. 10								
-														ieve		%							
	est Method												2	Size		ass	ing	_					
Prep	pared using		AS	o I IVI	D 421							-			_			-					
Par	rticle Shape			N/	Δ							-			_			-					
	e Hardness:			N/								-						-					
				,								-											
	Tested By				_																		
	Test Date				_																		
Dat	te Received	07-	21-2	015	_																		
				~ ~ .								-											
Maximu	m Particle	size: ľ	NO. 1	0 Si	eve							-	NL	- 10		400	0	-					
												L	IN	o. 10		100	.0						
				An	alysis	s for	the	por	tion	Fin	er tha	ın th	ne N	lo. 10	Sie	ve							
Analysis	s Based on	-3 ind	ch fra					•				Γ		o. 40		98.	6	1					
														. 200		56.	5						
Spe	cific Gravity	′ <u> </u>	2.71		_							-		2 mr	_	21.							
														05 mr	_	3.7							
Disp	ersed using	Appa	aratu	s A	- Mech	hanic	cal, f	or 1	mın	ute		-		02 mr	_	1.5		_					
												L	0.00	01 mr	n	1.0)						
									ze D		butio	n											
ASTM	Coarse Gravel		Gravel	_	<u>C. Sand</u> 0.0		edium S		ze D	Fine	e Sand	n			Silt 52.8					Clay 3.7			
ASTM AASHTO	Coarse Gravel 0.0	Grav	0.0 el		C. Sand 0.0	Me	edium S 1.4 parse S	and	ze D	Fine 4 Fine	e Sand 2.1 e Sand	n			52.8	Silt				3.7	Clay		
AASHTO	0.0		0.0 el			Co	edium S 1.4	and		Fine 4 Fine 2	e Sand 2.1	n			52.8	Silt 55.0				3.7	Clay 1.5		
AASHTO	0.0 Size in inches	Grav	0.0 el	4	0.0	Co	edium S 1.4 parse S 1.4	and	ve num 40	Fine 4 Fine 2	e Sand 2.1 e Sand	n 			52.8					3.7		F 100)
AASHTO	0.0 Size in inches	<u>Grav</u> 0.0	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size	and and in siev	/e num	Fine 4 Fine 2	e Sand 2.1 e Sand 42.1)		52.8					3.7		100)
AASHTO	0.0 Size in inches	Grav 0.0	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size	and and in siev	ve num 40	Fine 4 Fine 2	e Sand 2.1 e Sand 42.1				52.8					3.7		100)
AASHTO	0.0 Size in inches	Grav 0.0	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size	and and in siev	ve num 40	Fine 4 Fine 2	e Sand 2.1 e Sand 42.1				52.8					3.7		-)
AASHTO	0.0 Size in inches	Grav 0.0	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size	and and in siev	ve num 40	Fine 4 Fine 2	e Sand 2.1 e Sand 42.1				52.8					3.7		- 90 - 80)
AASHTO	0.0 Size in inches	Grav 0.0	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size	and and in siev	ve num 40	Fine 4 Fine 2	e Sand 2.1 e Sand 42.1				52.8					3.7		- 90	
AASHTO	0.0 Size in inches 3 2 1	Grav 0.0	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size	and and in siev	ve num 40	Fine 4 Fine 2	e Sand 2.1 e Sand 42.1				52.8					3.7		- 90 - 80	
AASHTO	0.0 Size in inches 3 2 1	Grav 0.0	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size	and and in siev	ve num 40	Fine 4 Fine 2	e Sand 2.1 e Sand 42.1				52.8					3.7		- 90 - 80 - 70 - 60	
AASHTO	0.0 Size in inches 3 2 1	Grav 0.0	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size	and and in siev	ve num 40	Fine 4 Fine 2	e Sand 2.1 e Sand 42.1				52.8					3.7		- 90 - 80 - 70 - 60 - 50	
AASHTO	0.0 Size in inches 3 2 1	Grav 0.0	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size	and and in siev	ve num 40	Fine 4 Fine 2	e Sand 2.1 e Sand 42.1				52.8					3.7		- 90 - 80 - 70 - 60	assing
AASHTO	0.0 Size in inches 3 2 1	Grav 0.0	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size	and and in siev	ve num 40	Fine 4 Fine 2	e Sand 2.1 e Sand 42.1				52.8					3.7		- 90 - 80 - 70 - 60 - 50 - 40	
AASHTO	0.0 Size in inches 3 2 1	Grav 0.0	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size	and and in siev	ve num 40	Fine 4 Fine 2	e Sand 2.1 e Sand 42.1									3.7		- 90 - 80 - 70 - 60 - 50 - 40 - 30	
AASHTO	0.0 Size in inches 3 2 1	Grav 0.0	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size	and and in siev	ve num 40	Fine 4 Fine 2	e Sand 2.1 e Sand 42.1				52.8	55.0				3.7		- 90 - 80 - 70 - 60 - 50 - 40	
AASHTO	0.0 Size in inches 3 2 1	<u>Grav</u> 0.0	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size	and and in siev	ve num 40	Fine 4 Fine 2	e Sand 2.1 e Sand 42.1					<u>55.0</u>				3.7		- 90 - 80 - 70 - 60 - 50 - 40 - 30	
AASHTO	0.0 Size in inches 3 2 1	<u>Grav</u> 0.0	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size	and and in siev	ve num 40	Fine 4 Fine 2	e Sand 2.1 e Sand 42.1					<u>55.0</u>				3.7		90 80 70 60 50 40 30 20 10	
AASHTO	0.0 Size in inches 3 2 1	3/4 3/4	0.0 el		0.0	Co	edium S 1.4 Darse S 1.4 ve Size		40 20		2 Sand 2.1 2 Sand 42.1 100 					<u>55.0</u>				3.7		90 80 70 60 50 40 30 20 10	
	0.0 Size in inches 3 2 1	3/4 3/4			0.0	Co	1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4		40 20	Fine 4 Fine 2	2 Sand 2.1 2 Sand 42.1 100 					<u>55.0</u>				3.7		90 80 70 60 50 40 30 20 10	
AASHTO	0.0 Size in inches 3 2 1	3/4 3/4 3/4			0.0	Co	1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4		40 20		2 Sand 2.1 2 Sand 42.1 100 					<u>55.0</u>)1					90 80 70 60 50 40 30 20 10	
AASHTO	0.0 Size in inches 3 2 1	3/4 3/4 3/4			0.0	Co	1.4 1.4 1.4 1.4 1.4 1.4 1.4 1.4		40 20		2 Sand 2.1 2 Sand 42.1 100 					<u>55.0</u>)1					90 80 70 60 50 40 30 20 10	

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Page 3 of 3

ATTERBERG LIMITS

roject (CCR	Rule - AEP Cl	lifty Creek	Project No.	175553022			
ource I	3-12,	70.0'-71.5'				Lab ID	15	
_						% + No. 40	1	
ested By		KDG	Test Method		B Method A	Date Received	07-21-2015	
est Date	0	7-31-2015	Prepared	Dry				
Г	14/					г г		
	Wet Soil and Tare Mass		Dry Soil and Tare Mass	Tare Mass	Number of	Water Content		
	'	(g)	(g)	(g)	Blows	(%)	Liquid Limit	
ŀ		(9)	(9)	(9)	Diows	(70)		
ŀ								
F								
-								
				1 :	al I insit			
	50	1		Liqu	id Limit			
	48							
	46							
%	44							
Ľ	42							
L L L					NP			
8	40							
JRE	38			L				
STL								
MOISTURE CONTENT, %	36							
-	34							
	32							
	30							
		0		20	25	30	40 50	
	30	0			25 R OF BLOWS	30	40	

PLASTIC LIMIT AND PLASTICITY INDEX

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

Remarks:

Reviewed By





Summary of Soil Tests

Project Name	CCR Rule - AEI	Clifty Creek	Project Number 175553022			
Source	B-12, 80.0'-81.5		Lab ID 17			
Sample Type	SPT		Date Received 7-21-15			
oumpio Type			Date Reported 8-3-15			
			Test Results			
Noti	wal Maiatura Ca	ntont				
	Iral Moisture Co 1: ASTM D 2216		<u>Atterberg Limits</u> Test Method: ASTM D 4318 Method A			
	re Content (%):		Prepared: Dry			
			Liquid Limit: NP			
			Plastic Limit: NP			
Pa	rticle Size Anal	<u>ysis</u>	Plasticity Index: NP			
Preparation	Method: ASTM	D 421	Activity Index: N/A			
Gradation M	lethod: ASTM D	422				
Hydrometer	Method: ASTM	D 422				
			Moisture-Density Relationship			
Particle Size %			Test Not Performed			
Sieve Size	e (mm)	Passing	Maximum Dry Density (lb/ft ³): N/A			
	N/A		Maximum Dry Density (kg/m ³): N/A			
	N/A		Optimum Moisture Content (%): N/A			
	N/A		Over Size Correction %: N/A			
	N/A					
	N/A					
	N/A		California Bearing Ratio			
No. 4	4.75	100.0	Test Not Performed			
No. 10	2	2 98.9 Bearing Ratio (%):				
No. 40	0.425	98.9	Compacted Dry Density (lb/ft ³): N/A			
No. 200	0.075	90.2	Compacted Moisture Content (%): N/A			
	0.02	28.8				
	0.005	5.6				
	0.002	1.4	Specific Gravity			
estimated	0.001	0.0	Test Method: ASTM D 854			
			Prepared: Dry			
Plus 3 in. ma	aterial, not includ	ied: 0 (%)	Particle Size: No. 10			
			Specific Gravity at 20° Celsius: 2.73			
Range	ASTM (%)	AASHTO (%)				
Gravel	0.0	(%)	Classification			
Coarse Sa		0.0	Unified Group Symbol: ML			
Medium Sa			Group Name:			
Fine Sand		8.7				
Silt	84.6	88.8				
Clay	5.6	1.4	AASHTO Classification: A-4 (0)			
	÷					
Comments:						
			Reviewed By			
			\bigcirc			

Particle-Size Analysis of Soils

ASTM D 422

Project Name CCR Rule - AEP Clifty Creek Source B-12, 80.0'-81.5'							Proje	ct Number Lab ID	175553022 17
								-	
		Sieve	analysi	s for the Por	tion Coarser tl				
т	est Method	ASTN	422 A N			Sieve Size	% Passing		
	pared using					0120	1 dooling		
- 1	5								
	rticle Shape		gular	<u>. </u>					
Particle	e Hardness:	Hard an	d Durab	le					
	Tested By	JS							
		07-24-2015	5						
Dat	e Received	07-21-2015	5						
Anvimu	m Dortiolo d	size: No. 4 Si	<u></u>			No. 4	100.0		
viaximu	m Panicie s	5120. INO. 4 SI	eve			No. 4 No. 10	100.0 98.9		
						110.10	00.0		
	Develo			for the portion	on Finer than t				
Analysis	s Based on	-3 inch fracti	on only			No. 40 No. 200	98.9 90.2		
Spe	cific Gravity	2.73				0.02 mm	28.8		
						0.005 mm	5.6		
Disp	ersed using	Apparatus A	A - Mech	anical, for 1 m	ninute	0.002 mm	1.4		
						0.001 mm	0.0		
					Distribution				
ASTM	Coarse Gravel 0.0	Fine Gravel 0.0	C. Sand 1.1	Medium Sand 0.0	Fine Sand 8.7	S 84	ilt .6	Clay 5.6	
				0 0 1	Fi 0 1				
AASHTO		Gravel 1.1		Coarse Sand 0.0	Fine Sand 8.7		Silt 88.8		lav .4
Sieve	Size in inches	1.1		0.0 Sieve Size in sieve r	8.7 numbers				
Sieve			4 1º	0.0 Sieve Size in sieve r 0 16 30 4	8.7 numbers 0 100 2	00			
Sieve		1.1	Δ	0.0 Sieve Size in sieve r 0 16 30 4	8.7 numbers 0 100 20				.4
Sieve		1.1	Δ	0.0 Sieve Size in sieve r 0 16 30 4	8.7 numbers 0 100 20				100 90
Sieve		1.1	Δ	0.0 Sieve Size in sieve r 0 16 30 4	8.7 numbers 0 100 20				100 90 80
Sieve	3 2 1	1.1	Δ	0.0 Sieve Size in sieve r 0 16 30 4	8.7 numbers 0 100 20				100 90 80 70
Sieve	3 2 1	1.1	Δ	0.0 Sieve Size in sieve r 0 16 30 4	8.7 numbers 0 100 20				100 90 80 70
Sieve	3 2 1	1.1	Δ	0.0 Sieve Size in sieve r 0 16 30 4	8.7 numbers 0 100 20				100 90 80 70
Sieve	3 2 1	1.1	Δ	0.0 Sieve Size in sieve r 0 16 30 4	8.7 numbers 0 100 20				100 90 80 70
Sieve	3 2 1	1.1	Δ	0.0 Sieve Size in sieve r 0 16 30 4	8.7 numbers 0 100 20				100 90 80 70 60 ssa
Sieve	3 2 1	1.1	Δ	0.0 Sieve Size in sieve r 0 16 30 4	8.7 numbers 0 100 20				100 90 80 70
Sieve	3 2 1	1.1	Δ	0.0 Sieve Size in sieve r 0 16 30 4	8.7 numbers 0 100 20				4 100 90 90 80 70 70 60 80 70 60 80 60 80 40 90 90 90 90 90 90 90 90 90 90 90 90 90
Sieve	3 2 1	1.1	Δ	0.0 Sieve Size in sieve r 0 16 30 4	8.7 numbers 0 100 20				100 90 80 70 60 50 40 30 20
Sieve	3 2 1	1.1	Δ	0.0 Sieve Size in sieve r 0 16 30 4	8.7 numbers 0 100 20				100 90 80 70 60 50 40 30 20 10
	3 2 1		Δ	0.0 Sieve Size in sieve 1 0 16 30 40 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	8.7 humbers 0 100 2 100 2				4 100 90 80 70 60 50 40 30 20 10 0
Sieve	3 2 1	1.1	Δ	0.0 Sieve Size in sieve 1 0 16 30 40 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	8.7 numbers 0 100 20				100 90 80 70 60 50 40 30 20 10
Sieve			Δ	0.0 Sieve Size in sieve 1 0 16 30 40 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	8.7 humbers 0 100 2 100 2		88.8		4 100 90 80 70 60 50 40 40 30 20 10 0 0.001
Sieve	3 2 1		Δ	0.0 Sieve Size in sieve 1 0 16 30 40 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	8.7 humbers 0 100 2 100 2		88.8		4 100 90 80 70 60 50 40 30 20 10 0 0.001



Project Name

Sour	ce	B-12, 80.0'-81.5'					
	-						
		Sieve analysis for the Portion Coarser tha					
	Test Method	ASTM D 422					

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Laboratory Document Prepared By: MW Approved BY: TLK



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ATTERBERG LIMITS

		Rule - AEP Cl , 80.0'-81.5'	ifty Creek			Project No. Lab ID	175553022 17
	21-12	, 00.0-01.3				% + No. 40	1
Tested By		KG	Test Method	ASTM D 4318 M	Aethod A	Date Received	07-21-2015
Test Date	0	7-24-2015	Prepared			0. 2. 20.0	
				,			
Г	W	et Soil and	Dry Soil and				
	Т	are Mass	Tare Mass	Tare Mass	Number of	Water Content	
		(g)	(g)	(g)	Blows	(%)	Liquid Limit
F							· ·
F			1				
ŀ			<u> </u>				
	50			Liquid	Limit		
	50						
	48						
	46						
	4.4						
%	44						
Ľ	42						
ШЦ Ц					ND		
Ő	40	-			NP		
če o	~~						
MOISTURE CONTENT, %	38						
<u>SIC</u>	36						
W		-					
	34						
	~ ~						
	32	1					
	30						
		10		20	25	30	40 50
				NUMBER	OF BLOWS		

PLASTIC LIMIT AND PLASTICITY INDEX

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

Remarks:

Reviewed By





Summary of Soil Tests

Project Name	CCR Rule - AE	P Clifty Creek	Project Number	175553022
Source	B-12, 95.0'-96.5		Lab ID	20
Sample Tures	SPT		Date Received	7 01 15
Sample Type	SFT		Date Reported	<u>7-21-15</u> 8-3-15
			Test Results	
	ural Moisture Co		Atterberg Limits	
	d: ASTM D 2216		Test Method: ASTM D 4318 Method	AL
IVIOIST	ure Content (%):	23.4	Prepared: Dry Liquid Limit:	42
			Plastic Limit:	19
De	article Size Anal	veie	Plastic Linit Plasticity Index:	
	Method: ASTM		Activity Index:	
	All			0.74
	r Method: ASTM			
riyarometer			Moisture-Density Relatio	nship
Par	ticle Size	%	Test Not Performed	
Sieve Siz		Passing	Maximum Dry Density (lb/ft ³):	N/A
	N/A	<u> </u>	Maximum Dry Density (kg/m ³):	
	N/A		Optimum Moisture Content (%):	
	N/A		Over Size Correction %:	N/A
	N/A N/A			
	N/A N/A		California Bearing Rat	tio
No. 4	4.75	100.0	Test Not Performed	.10
No. 10	2	92.9	Bearing Ratio (%):	N/A
No. 40	0.425	92.4	Compacted Dry Density (lb/ft ³):	
No. 200		86.2	Compacted Moisture Content (%):	N/A
	0.02	71.6 43.0		
	0.003	30.6	Specific Gravity	
estimated		26.0	Test Method: ASTM D 854	
estimated	0.001	20.0	Prepared: Dry	
Plus 3 in m	aterial, not includ	ded: 0 (%)	Particle Size:	No. 10
			Specific Gravity at 20° Celsius:	
	ASTM	AASHTO		
Range	(%)	(%)		
Gravel		7.1	Classification	
Coarse Sa		0.5	Unified Group Symbol:	CL
Medium Sa			Group Name:	Lean clay
Fine San	d 6.2	6.2		<u>_</u>
Silt	43.2	55.6		
Clay	43.0	30.6	AASHTO Classification:	A-7-6 (20)
Comments:				
			Reviewed By	RI
				0

Particle-Size Analysis of Soils

Project Number 175553022 Lab ID

ASTM D 422

20

	Sieve analysi	is for the Por	tion Coarser t				
				Sieve	%		
	ASTM D 422			Size	Passing		
Prepared using	ASTM D 421						
Dorticlo Shana	Angular						
Particle Shape Particle Hardness:							
Faille Flaidiless.							
Tested By	JS						
	07-24-2015						
Date Received	07-21-2015						
Maximum Particle s	ize: No. 4 Sieve			No. 4	100.0		
				No. 10	92.9		
	Analysis	for the portio	on Finer than t	the No. 10 S	Sieve		
Analysis Based on	-			No. 40	92.4		
				No. 200	86.2		
Specific Gravity	2.68			0.02 mm	71.6		
				0.005 mm	43.0		
Dispersed using	Apparatus A - Mech	anical, for 1 m	ninute	0.002 mm	30.6		
		·		0.001 mm	26.0		
		Particle Size	Distribution				
ASTM Coarse Gravel	Fine Gravel C. Sand	Medium Sand	Fine Sand	Si	lt	Clay	
0.0	0.0 7.1 Gravel	0.5 Coarse Sand	6.2 Fine Sand	43	.2 Silt	43.0 Clav	
AASHTO	7.1	0.5	6.2		55.6	30.6	
Sieve Size in inches 3 2 1 3	3/4 3/8 4 1	Sieve Size in sieve i 0 16 30 4		200			400
							100
		\$ <i>L</i>		•			- 90
							- 80
				A			- 60
					X		- 70
							Passing
							assi
							cen
							- 40 b
							- 30
							- 20
							- 10
							-
100	10	1 5.	01		0.01		0
100	10	¹ Diam	eter (mm) 0.1		0.01	0.0	
Comments					Revie	wed By	RI
						,	Ö
File: frm_175553022_sum_20.>	klsm	Stantec Cor	nsulting Service	es Inc.			ory Docume
Preparation Date: 1998 Revision Date: 1-2008			gton, Kentucky				oared By: M oved BY: Tl

Stantec

CCR Rule - AEP Clifty Creek B-12, 95.0'-96.5'

Project Name

Source





ATTERBERG LIMITS

Project	C	CR I	Rule - AEP Cl	ifty Creek	Project No.	17555302	22				
Source			95.0'-96.5'	-					Lab ID	20	
									% + No. 40	8	
Tested By			KDG	Test Method		18 Me	ethod A	4	Date Received	07-21-20	15
Test Date		07	7-31-2015	Prepared	Dry						
	_	14/	et Soil and						<u>г</u>		
			are Mass	Dry Soil and Tare Mass	Tare Mas		Num	per of	Water Content		
		1	(g)	(g)	(g)	55	Blo		(%)	Liquid Limit	
			23.24	19.63	11.14			2	42.5		
	-		20.15	17.36	10.98			6	43.7		
	_									10	
	_		21.03	18.17	11.09		3	5	40.4	42	
					1:	المأريد	i				
		50 -			LIC	quid l	_Imit				
		-									_
		48 -									
		46 -									_
		-									_
à	%	44 -		~							_
ŀ	MOISTURE CONTENT, %	42 -									
L		-									
Ċ	<u>.</u>	40 -							• •		_
L	Ц	- 38									
ŀ		-									_
Ç	Ş	36 -									_
•		- 34									
		-									_
		32 -									_
		20									_
	30 <u>10</u> 20 25						5	30	40	50	
											50
					NUME	BER OF	BLOW	S			

PLASTIC LIMIT AND PLASTICITY INDEX

ſ	Wet Soil and	Dry Soil and		Water		
	Tare Mass	Tare Mass	Tare Mass	Content		
	(g)	(g)	(g)	(%)	Plastic Limit	Plasticity Index
	17.59	16.51	10.80	18.9	19	23
	17.15	16.14	10.89	19.2		

Remarks:

Reviewed By

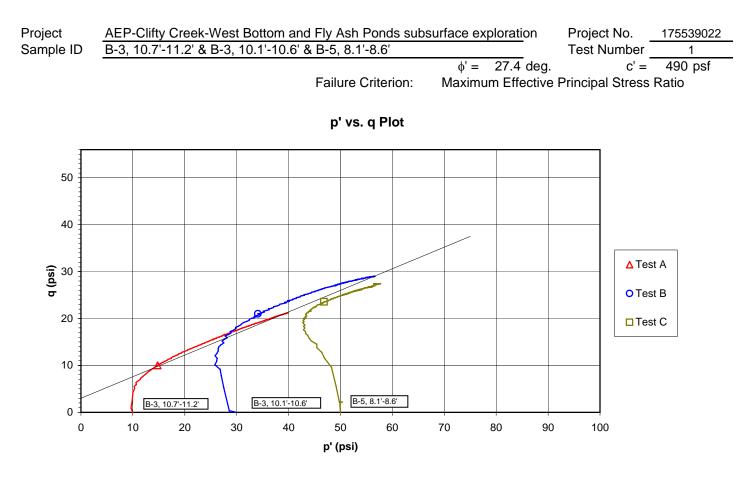


APPENDIX E

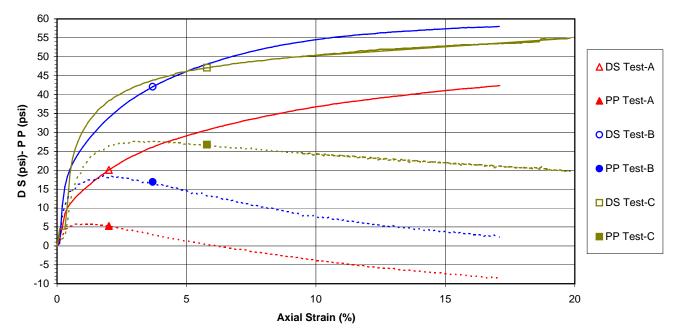
CONSOLIDATED-UNDRAINED TRIAXIAL TESTS

BOILER SLAG POND DAM

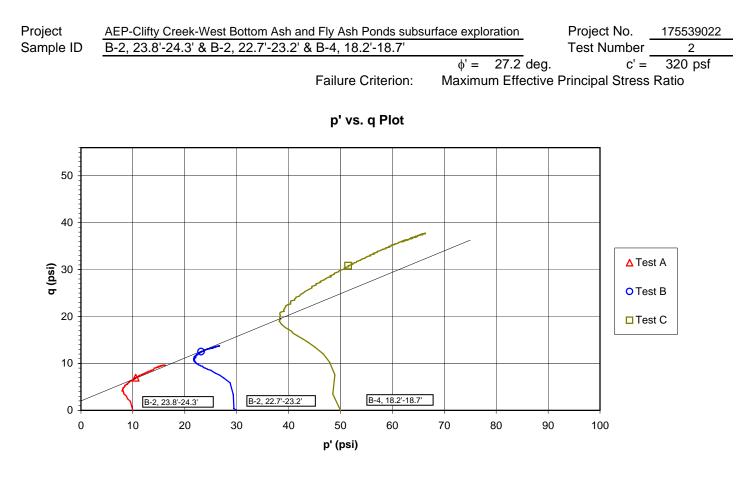




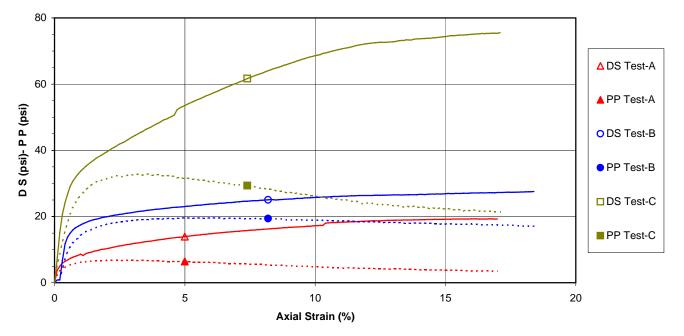
Deviator Stress and Induced Pore Pressure vs. Axial Strain



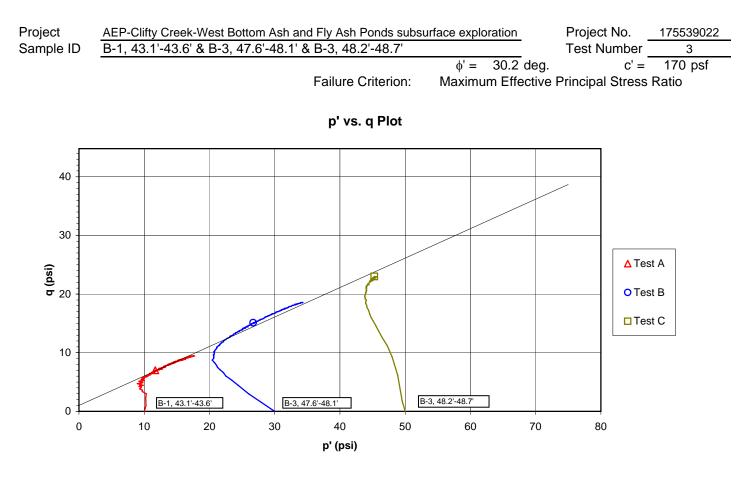




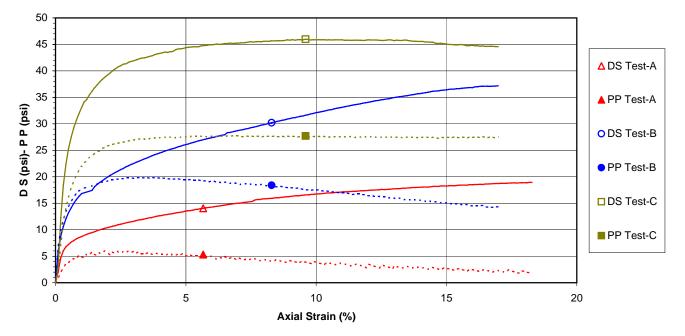
Deviator Stress and Induced Pore Pressure vs. Axial Strain



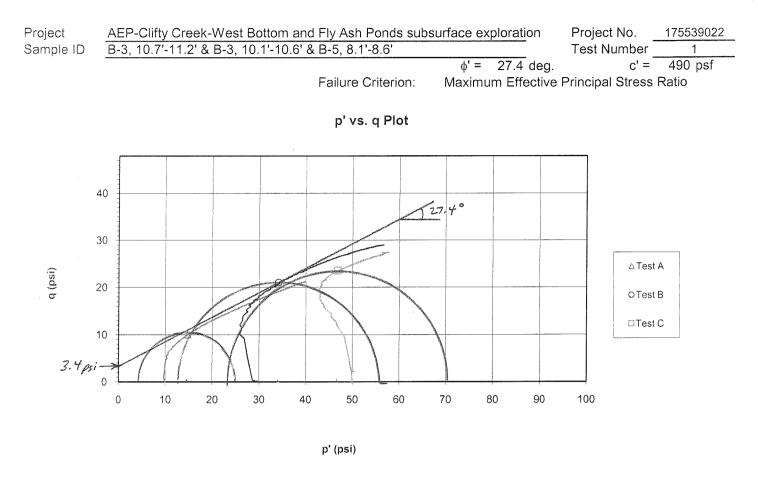


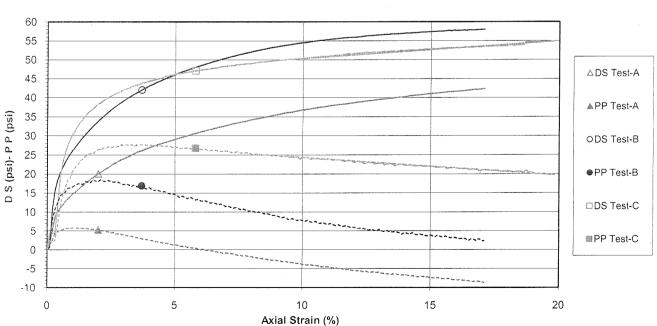


Deviator Stress and Induced Pore Pressure vs. Axial Strain



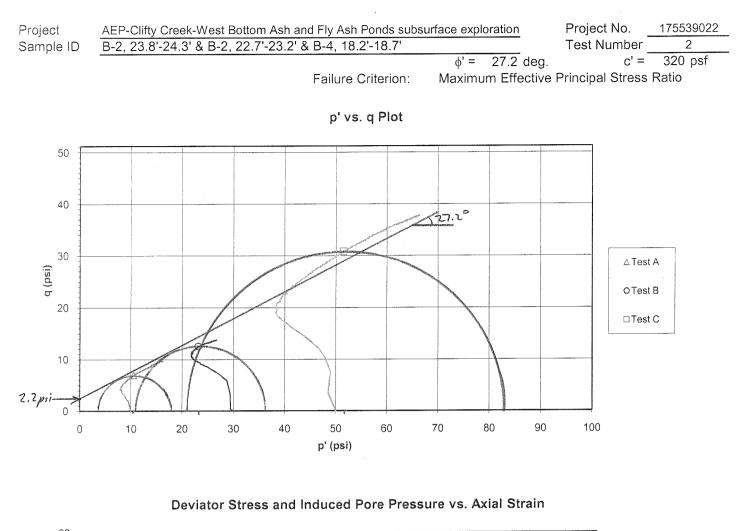


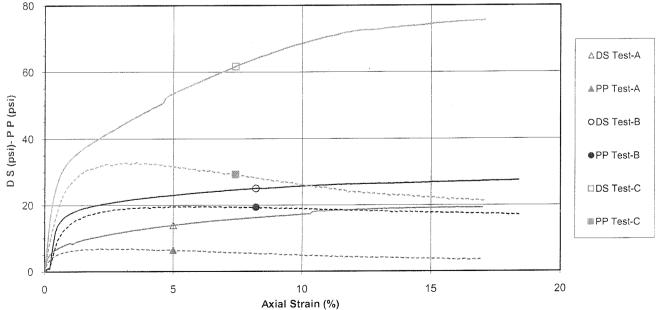




Deviator Stress and Induced Pore Pressure vs. Axial Strain





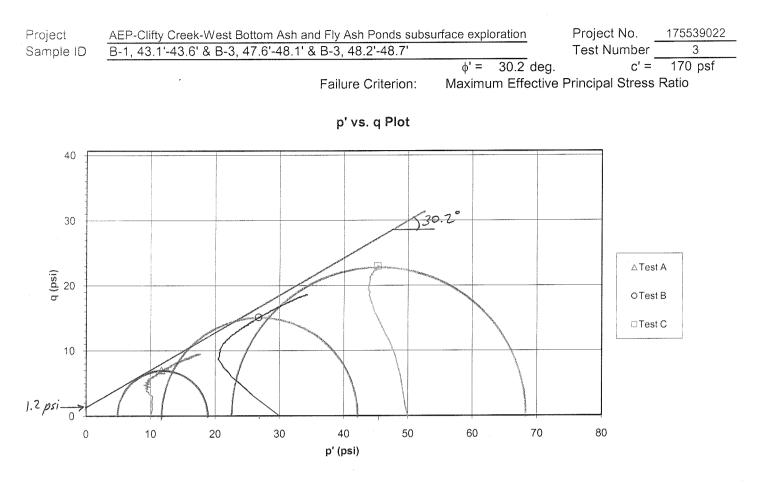


File: 175539022_CU-2emk.xls Sheet: Plots Preparation Date: 11-1998 Revision Date: 1-2008

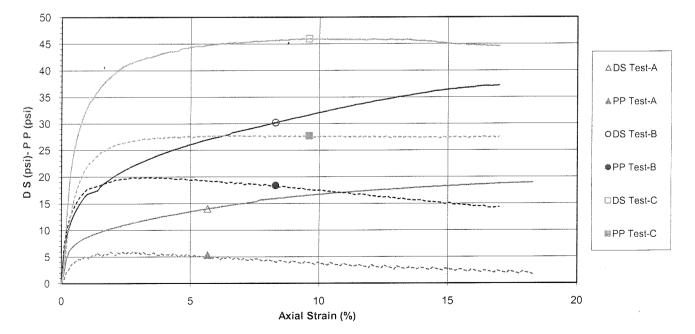
Stantec Consulting Services Inc.

Laboratory Document Prepared By: JW Approved By: TLK

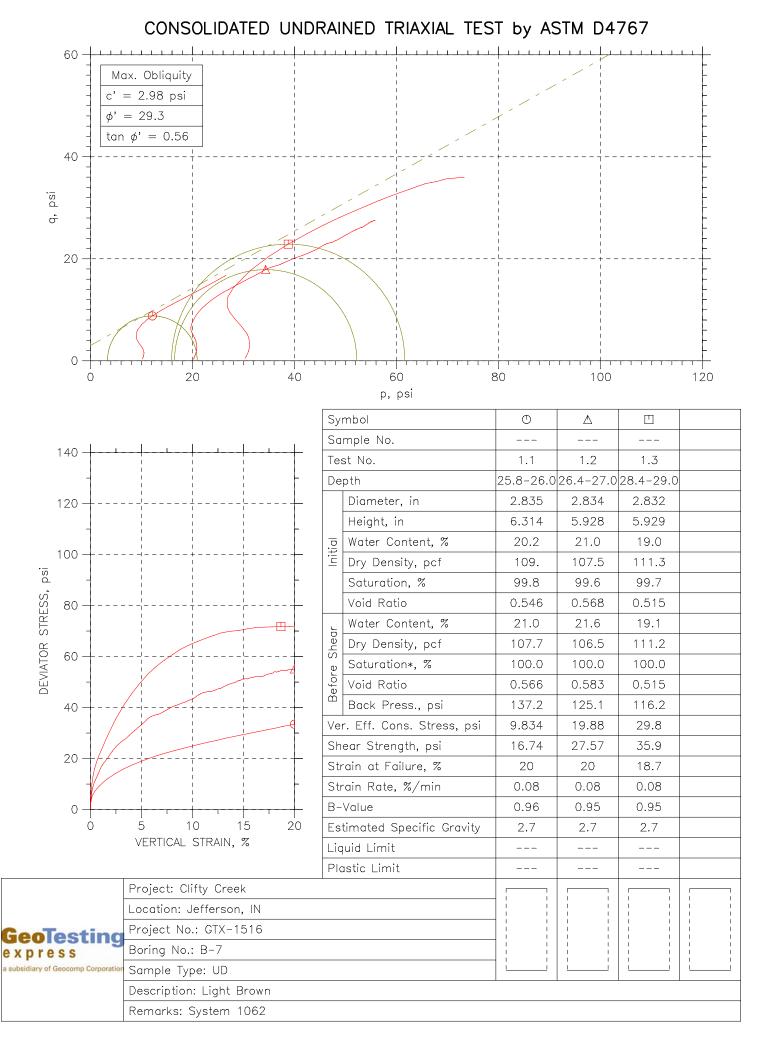


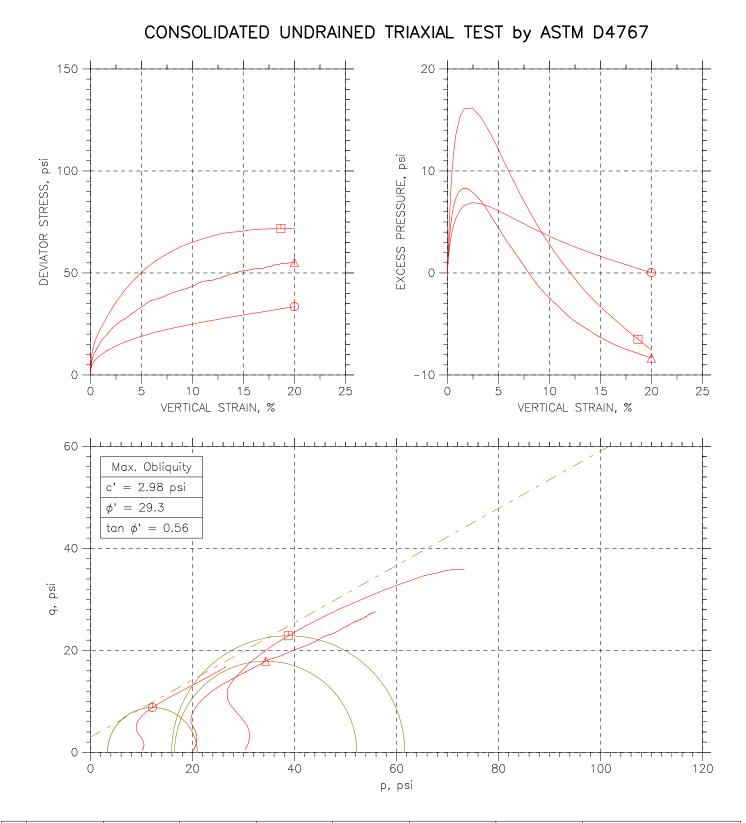


Deviator Stress and Induced Pore Pressure vs. Axial Strain



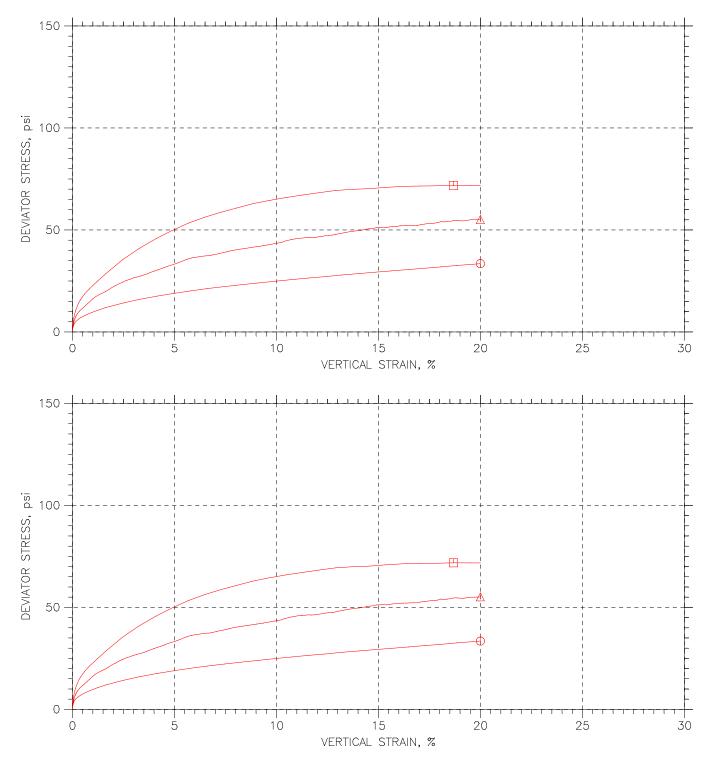
LANDFILL RUNOFF COLLECTION POND



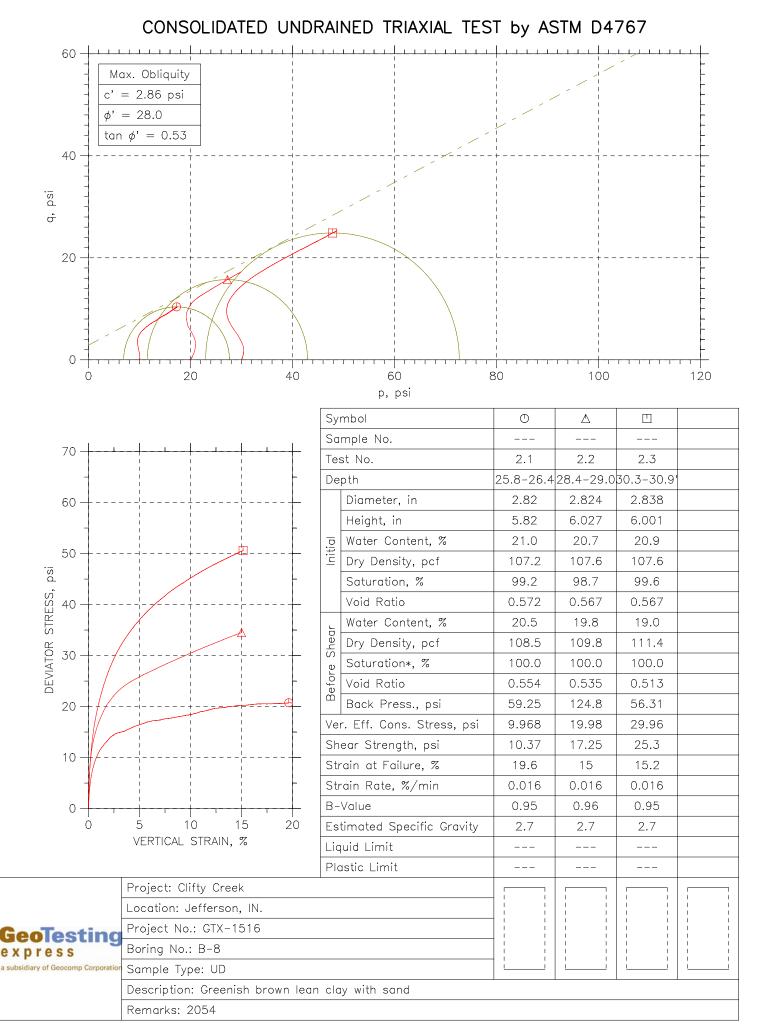


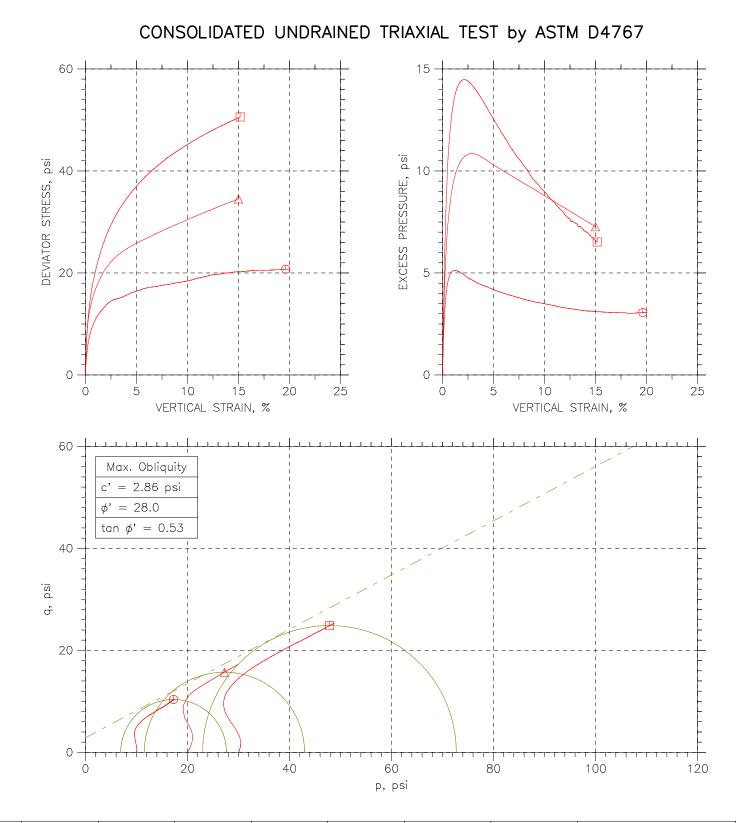
	Sample No.	Tes	t No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
Φ		1.1		25.8-26.0	jm	12/10/09	mm		1516-1.1.dat
Δ		1.2		26.4-27.0	jm	12/10/09	mm		1516-1.2.dat
		1.3		28.4-29.0	jm	12/9/09	mm		1516-1.3.dat
Ge	oTesti	eting Project		ject: Clifty Creek		Location: Je	fferson, IN	Projec	t No.: GTX-1516
	press	9	Boring 1	oring No.: B-7		Sample Type: UD			
	diary of Geocomp Corp	ooration	Descript	ion: Light Bro	own				
			Remarks: System 1062						

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767



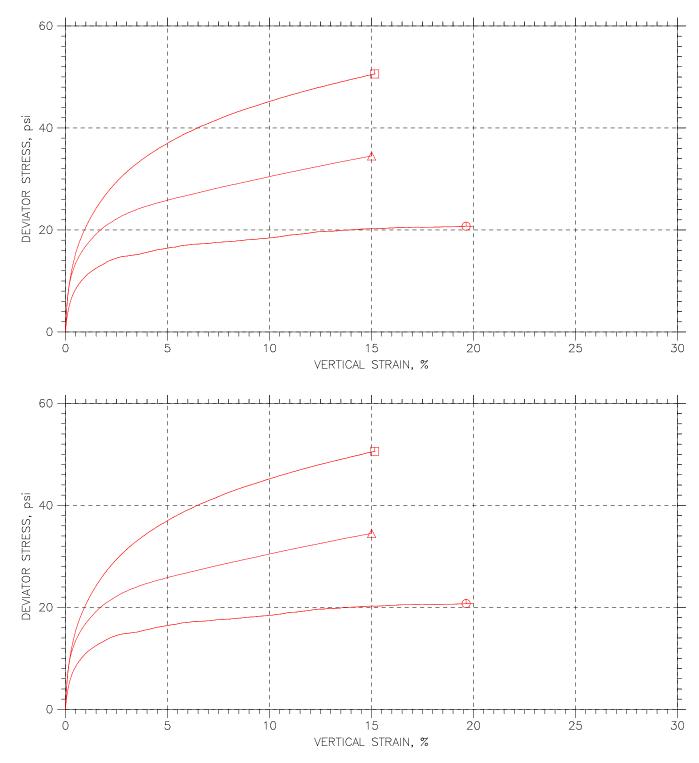
	Sample No.	Tes	t No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File	
Ο) 1			25.8-26.0	jm	12/10/09	mm		1516-1.1.dat	
Δ		1.2		26.4-27.0	jm	12/10/09	mm		1516-1.2.dat	
		1.3		28.4-29.0	jm	12/9/09	mm		1516-1.3.dat	
Ge	GeoTesting express		Project:	Clifty Creek		Location: Jefferson, IN			t No.: GTX-1516	
			Boring I	No.: B-7		Sample Type	e: UD			
	diary of Geocomp Corp	ooration	Description: Light Brown							
			Remarks: System 1062							



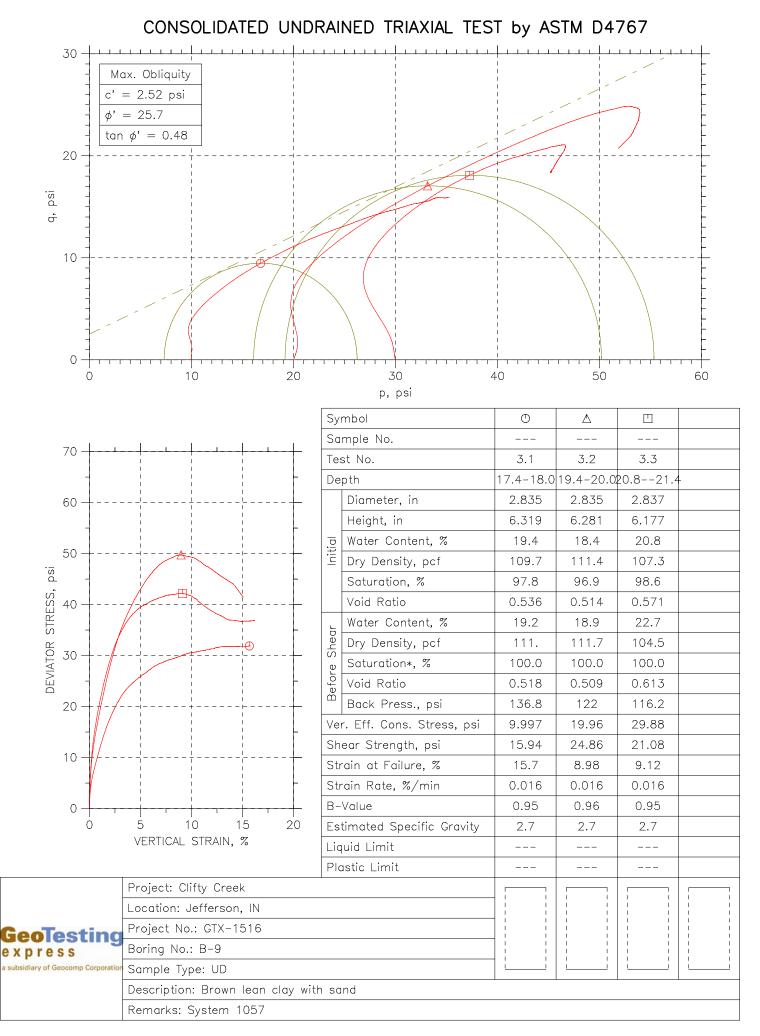


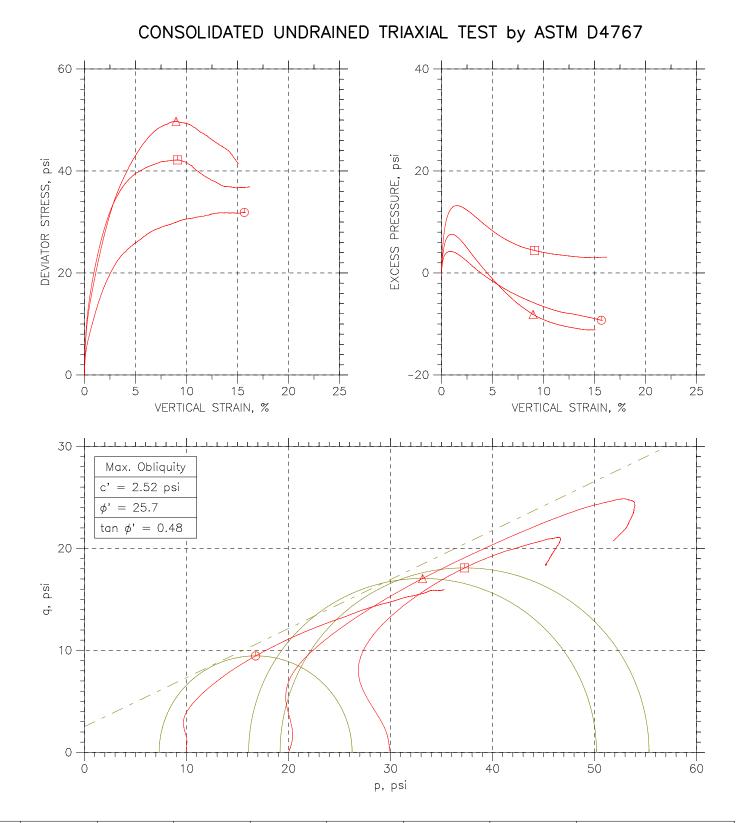
	Sample No.	Tes	t No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File				
• 2.1		2.1		25.8-26.4	jm	12/11/09	mm		1516-2.1.dat				
Δ		2.2		28.4-29.0	jm	12/11/09	mm		1516-2.2A.dat				
		2.3		30.3-30.9'	jm	12/09/09	mm		1516-2.3.dat				
Ge	GeoTesting express		Project:	t: Clifty Creek No.: B-8		Location: Je	fferson, IN.	Project	: No.: GTX-1516				
			Boring 1			Sample Type: UD							
-	diary of Geocomp Corp	ooration	Descript	Description: Greenish brown lean clay with sand									
			Remark	Remarks: 2054									

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767



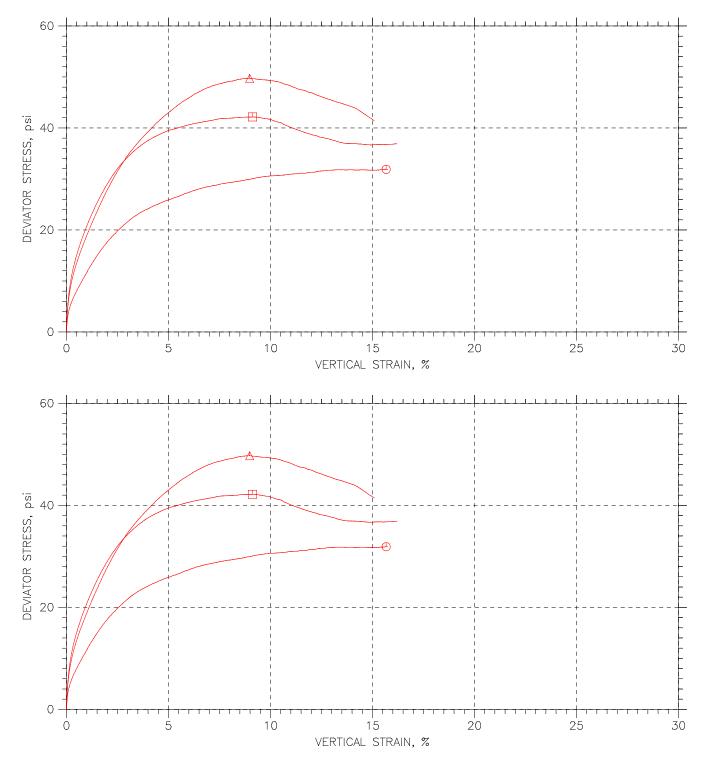
	Sample No. Tes		t No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File			
C		2.1		25.8-26.4	jm	12/11/09	mm		1516-2.1.dat			
\triangle		2.2		28.4-29.0	jm	12/11/09	mm		1516-2.2A.dat			
		2.3		30.3-30.9'	jm	12/09/09	mm		1516-2.3.dat			
G	GeoTesting express		Project:	: Clifty Creek		Location: Je	fferson, IN.	Project	t No.: GTX-1516			
			Boring I	No.: B−8		Sample Type	e: UD					
a subs	idiary of Geocomp Corp	ooration	Description: Greenish brown lean clay with sand									
			Remarks: 2054									



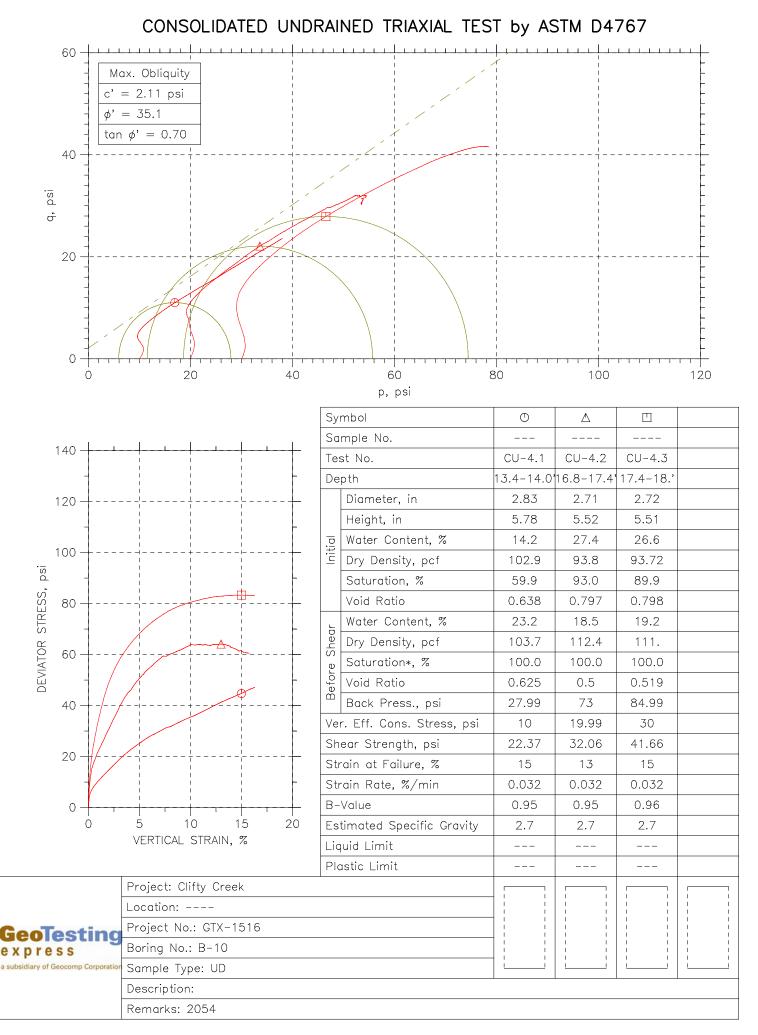


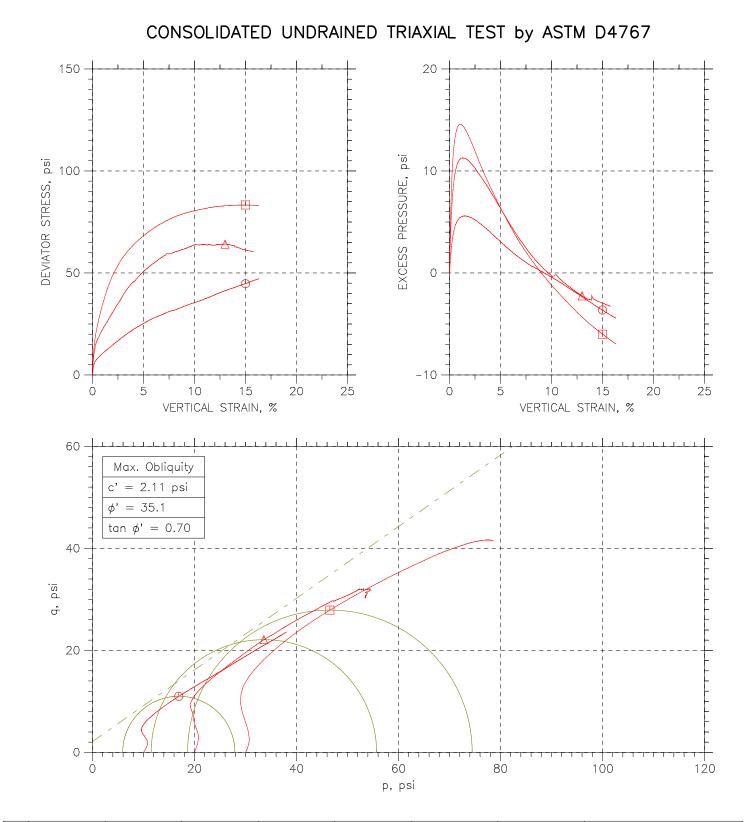
	Sample No.	Tes	t No.	Depth	Tested By	Test Date	Checked By	Check	Date	Test File			
Φ		3.1		17.4-18.0	jm	12/15/09	mm			1516-3.1.dat			
Δ		3.2		19.4-20.0	jm	12/16/09	mm			1516-3.2Adat.dat			
		3.3		20.821.4	jm	12/10/09	mm			1516-3.3.dat			
Ge	GeoTesting express		Project:	roject: Clifty Creek		Location: Jefferson, IN			Project	No.: GTX-1516			
ex			Boring I	No.: B-9		Sample Type	e: UD						
a subs	diary of Geocomp Corp	ooration	Description: Brown lean clay with sand										
			Remark	Remarks: System 1057									

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767



	Sample No.	Tes	t No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File		
Φ	•			17.4-18.0	jm	12/15/09	mm		1516-3.1.dat		
Δ	3.2			19.4-20.0	jm	12/16/09	mm		1516-3.2Adat.dat		
		3.3		20.821.4	jm	12/10/09	mm		1516-3.3.dat		
Ge	oTesti	na	Project:	: Clifty Creek		Location: Je	fferson, IN	Projec	t No.: GTX-1516		
	express		Boring 1	No.: B-9		Sample Type	e: UD				
a subsi	idiary of Geocomp Corp	ooration	Descript	Description: Brown lean clay with sand							
			Remarks: System 1057								

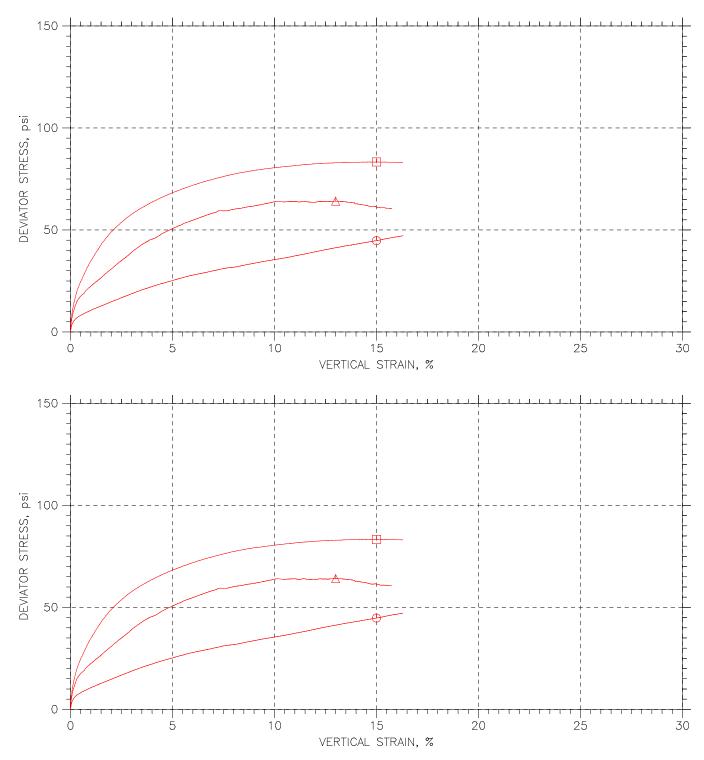




	Sample No. Tes		t No. Depth		Tested By	Test Date	Checked By	Check Date	Test File			
O		CU-		13.4-14.0'	JM	12/12/09	MM		1516-4.1.dat			
Δ		CU-4.2		16.8-17.4'	JM	12/13/09	MM		1516-4.2.dat			
		CU-4.3		17.4-18.'	JM	12/12/09	MM		1516-4.3.dat			
Ge	GeoTesting express		Project:	Clifty Creek		Location:		Projec	t No.: GTX-1516			
			Boring I	No.: B-10		Sample Type	e: UD					
a subsi	diary of Geocomp Corp	oration	Descript	ion:								
			Remarks: 2054									

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CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767



	Sample No.	Tes	t No.	Depth	Tested By	Test Date	Checked By	Check [Date	Test File
Ο		CU-	-4.1	13.4-14.0'	JM	12/12/09	MM			1516-4.1.dat
Δ		CU-	-4.2	16.8-17.4'	JM	12/13/09	MM			1516-4.2.dat
		CU-	-4.3	17.4-18.'	JM	12/12/09	MM			1516-4.3.dat
Ge	oTesti	resting		Clifty Creek		Location:		F	Project	No.: GTX-1516
	press			No.: B-10		Sample Type	e: UD			
a subs	a subsidiary of Geocomp Corpor		Descript	ion:						
			Remark	s: 2054						

APPENDIX F

PERMEABILITY TESTS

BOILER SLAB POND DAM



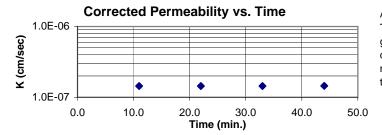
Project Name	AEP-Clifty C	reek-West Bottom Ash	and Fly Ash Ponds	subsurfac	e exploration	Project No.	175539022
Source	B-1, 15.0'-17	7.0', TI 16.1'-16.6'	Test ID	7A			
Visual Classifi	cation	Lean Clay (CL), brown,	moist, firm			Prepared By	CSM
Undisturbed	XX		Specific Gravity	2.72	ASTM D854-A	Date	12-9-09
			Maximum Dry De	ensity (pc	f)	Percent of Maximum	
Permeant:	De-aired tap	water					
	-	. .					

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 Pressur	es (psi)		
Height (in.)	1.4783	1.4675	1.4676	Chamber	75		
Diameter (in.)	2.8043		2.8179	Influent	70		
Moisture Content (%)	19.7		20.8	Effluent	65	Applied Head Difference (psi)	5
Dry Unit Weight (pcf)	109.5		109.2		Bac	k Pressure Saturated to (psi)	65
Void Ratio	0.551		0.555	Maxim	um Effecti	ve Consolidation Stress (psi)	10
Degree of Saturation (%)	97.3		101.9	Minim	um Effecti	ve Consolidation Stress (psi)	5
Trimmings MC (%)	19.6						

							Hydraulic (Conductivity	
	Clock			Тор	Test Time	k	k	k @ 20° C	k @ 20° C
Date	(24H:M)	Temp. °F	Bottom Head	Head	(sec)	(m/s)	(cm/s)	(m/s)	(cm/s)
12-21-09	10:24	73.0	15.02	8.57	0				
12-21-09	10:35	73.0	14.90	8.69	6.60E+02	1.5E-09	1.5E-07	1.4E-09	1.4E-07
12-21-09	10:46	73.0	14.78	8.81	6.60E+02	1.5E-09	1.5E-07	1.4E-09	1.4E-0
12-21-09	10:57	73.0	14.66	8.93	6.60E+02	1.5E-09	1.5E-07	1.4E-09	1.4E-07
12-21-09	11:08	73.0	14.54	9.05	6.60E+02	1.5E-09	1.5E-07	1.4E-09	1.4E-0



A gradient of approximately 93.4 was used for this test. This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration. Examination of the sample shows no signs of material loss or clogging that may affect test results.

Average Hydraulic Conductivity @ 20° C (last 4 determinations) Average Hydraulic Conductivity @ 20° C (last run) m/s <u>1.44E-09</u> m/s <u>1.44E-09</u>

cm/s 1.44E-07 cm/s 1.44E-07



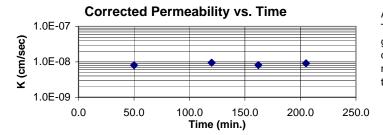
Project Name	AEP-Clifty C	Project No.	175539022				
Source	B-2, 42.5'-44	I.5', TI 42.6'-43.1'	Test ID	48A			
Visual Classifi	cation	Prepared By	CSM				
Undisturbed	XX	Specific Gravity 2.69 ASTM D854-A	Date	11-30-09			
		Maximum Dry Density (pcf) Percer	nt of Maximum				
Permeant:	ermeant: De-aired tap water						

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.)	1.4906	1.3473	1.3472	Chamber 75	
Diameter (in.)	2.8023		2.8480	Influent 70	
Moisture Content (%)	31.6		26.0	Effluent 65 Applied Head Difference	e (psi) 5
Dry Unit Weight (pcf)	91.6		98.1	Back Pressure Saturated to	o (psi) 65
Void Ratio	0.834		0.712	Maximum Effective Consolidation Stress	s (psi) 10
Degree of Saturation (%)	101.8		98.1	Minimum Effective Consolidation Stress	s (psi) 5
Trimmings MC (%)	30.9				

							Hydraulic (Conductivity	
	Clock			Тор	Test Time	k	k	k @ 20° C	k @ 20° C
Date	(24H:M)	Temp. °F	Bottom Head	Head	(sec)	(m/s)	(cm/s)	(m/s)	(cm/s)
12-22-09	8:20	70.0	22.26	3.46	0				
12-22-09	9:10	70.0	22.13	3.59	3.00E+03	8.3E-11	8.3E-09	8.1E-11	8.1E-09
12-22-09	10:20	70.0	21.92	3.81	4.20E+03	9.8E-11	9.8E-09	9.5E-11	9.5E-09
12-22-09	11:02	70.0	21.81	3.92	2.52E+03	8.4E-11	8.4E-09	8.1E-11	8.1E-09
12-22-09	11:45	70.0	21.68	4.04	2.58E+03	9.3E-11	9.3E-09	9.1E-11	9.1E-09



A gradient of approximately 92.6 was used for this test. This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration. Examination of the sample shows no signs of material loss or clogging that may affect test results.

Average Hydraulic Conductivity @ 20° C (last 4 determinations) Average Hydraulic Conductivity @ 20° C (last run) m/s 8.70E-11 m/s 8.70E-11 cm/s 8.70E-09 cm/s 8.70E-09



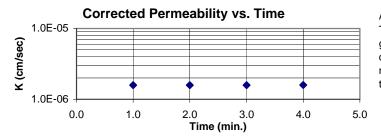
Project Name	AEP-Clifty C	reek- West Bottom Ash	and Fly Ash Ponds	subsurfa	ce exploration	Project No.	17553902
Source	B-4, 7.5'-9.5	', TI 7.6'-8.1'	Test ID	82A			
Visual Classifi	cation	Lean Clay (CL), brown,	, moist, firm, organic	odor :		Prepared By	CSM
Undisturbed	XX		Specific Gravity	2.7	ASTM D854-A	Date	12-9-0
			Maximum Dry De	ensity (po	if)	Percent of Maximum	
Permeant:	De-aired tap	water					
	Droportion (Commonto					

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 Pressure	es (psi)		
Height (in.)	1.4754	1.4631	1.4654	Chamber	75		
Diameter (in.)	2.8057		2.8200	Influent	70		
Moisture Content (%)	18.8		20.1	Effluent	65	Applied Head Difference (psi)	5
Dry Unit Weight (pcf)	110.0		109.6		Bac	k Pressure Saturated to (psi)	65
Void Ratio	0.532		0.537	Maxim	um Effecti	ve Consolidation Stress (psi)	10
Degree of Saturation (%)	95.6		100.8	Minim	um Effecti	ve Consolidation Stress (psi)	5
Trimmings MC (%)	19.1						

							Hydraulic (Conductivity	
	Clock			Тор	Test Time	k	k	k @ 20° C	k @ 20° C
Date	(24H:M)	Temp. °F	Bottom Head	Head	(sec)	(m/s)	(cm/s)	(m/s)	(cm/s)
12-21-09	11:25	73.0	15.06	10.34	0				
12-21-09	11:26	73.0	14.94	10.46	6.00E+01	1.7E-08	1.7E-06	1.6E-08	1.6E-06
12-21-09	11:27	73.0	14.82	10.58	6.00E+01	1.7E-08	1.7E-06	1.6E-08	1.6E-06
12-21-09	11:28	73.0	14.70	10.70	6.00E+01	1.7E-08	1.7E-06	1.6E-08	1.6E-06
12-21-09	11:29	73.0	14.58	10.82	6.00E+01	1.7E-08	1.7E-06	1.6E-08	1.6E-06



A gradient of approximately 93.5 was used for this test. This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration. Examination of the sample shows no signs of material loss or clogging that may affect test results.

Average Hydraulic Conductivity @ 20° C (last 4 determinations) Average Hydraulic Conductivity @ 20° C (last run) m/s <u>1.58E-08</u> m/s <u>1.58E-08</u>

cm/s 1.58E-06 cm/s 1.58E-06



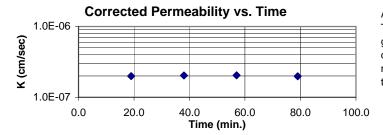
Project Name	AEP-Clifty	Creek-West Bottom	Ash and Fly Ash Ponds	subsurfa	ce exploration	Project No.	175539022				
Source	Source B-6, 17.5'-19.0', TI 17.6'-18.1'										
Visual Classif	ication	Lean Clay (CL), b	rown, moist, firm			Prepared By	CSM				
Undisturbed	XX		Specific Gravity	2.68	ASTM D854-A	Date	12-9-09				
		_	Maximum Dry D	ensity (po	f)	Percent of Maximum					
Permeant:	De-aired ta	p water				_					
	Description	0									

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 Pressure	es (psi)		
Height (in.)	1.4778	1.4443	1.4478	Chamber	75		
Diameter (in.)	2.8030		2.7955	Influent	70		
Moisture Content (%)	32.0		33.2	Effluent	65	Applied Head Difference (psi)	5
Dry Unit Weight (pcf)	87.1		89.4		Bac	k Pressure Saturated to (psi)	65
Void Ratio	0.921		0.872	Maximu	um Effecti	ve Consolidation Stress (psi)	10
Degree of Saturation (%)	93.1		102.1	Minimu	um Effecti	ve Consolidation Stress (psi)	5
Trimmings MC (%)	33.1						

							Hydraulic (Conductivity	
	Clock			Тор	Test Time	k	k	k @ 20° C	k @ 20° C
Date	(24H:M)	Temp. °F	Bottom Head	Head	(sec)	(m/s)	(cm/s)	(m/s)	(cm/s)
12-21-09	13:10	73.0	19.94	4.28	0				
12-21-09	13:29	73.0	19.65	4.56	1.14E+03	2.1E-09	2.1E-07	2.0E-09	2.0E-0
12-21-09	13:48	73.0	19.36	4.85	1.14E+03	2.2E-09	2.2E-07	2.0E-09	2.0E-0
12-21-09	14:07	73.0	19.07	5.14	1.14E+03	2.2E-09	2.2E-07	2.0E-09	2.0E-0
12-21-09	14:29	73.0	18.71	5.43	1.32E+03	2.1E-09	2.1E-07	2.0E-09	2.0E-0



A gradient of approximately 93.4 was used for this test. This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration. Examination of the sample shows no signs of material loss or clogging that may affect test results.

Average Hydraulic Conductivity @ 20° C (last 4 determinations) Average Hydraulic Conductivity @ 20° C (last run) m/s 2.01E-09 m/s 2.01E-09

cm/s 2.01E-07 cm/s 2.01E-07

LANDFILL RUNOFF COLLECTION POND

PERMEABILITY TEST (ASTM D5084 - 90) (Method C, Increasing Tailwater Level)

Project Number	GTX-151	6
Project Name	Clifty Cre	ek
Boring No.	B-7	
Sample No.		
Sample Depth	27.4-27.7	ft
Sample Descrip	otion	Lean clay

Tested By	JM
Test Date	12/12/10
Reviewed By	MM
Review Date	12/15/10
Lab No.	5



Sample Data

Length,	in	Diameter, in		Pan No.	CS-1
Location 1	2.831	Location 1	2.825	Dry Soil+Pan, grams	484.22
Location 2	2.830	Location 2	2.825	Pan Weight, grams	8.17
Location3	2.829	Location 3	2.825		
Average	2.830	Average	2.825	Moisture Content, %	24.6
		Wet Soil + Tare, grams	593.33	Wet Unit Weight, pcf	127.4
		Tare Weight, grams0.00		Dry Unit Weight, pcf	102.2

Chamber Pressu	re, psi	65
Back Pressure, p	si	60
Confining Press	ure, psi	5

Remarks:

Date	Date	Time	Time	Time	H _a	H_1	H _b	H_2	k	Temp	k
Start	Finish	Start	Finish	(sec)	(cm)	(cm)	(cm)	(cm)	cm/sec	(°C)	cm/sec
											at 20 °C
				2820	9.9	100.3	10.60	99.5	8.4E-08	22	8.1E-08
				6300	9.9	100.3	11.80	98.4	9.7E-08	24	8.8E-08
				9000	9.9	100.3	12.50	97.7	9.4E-08	24	8.5E-08
				14400	9.9	100.3	14.00	96.1	9.5E-08	24	8.6E-08
				27000	9.9	100.3	17.00	93	9.1E-08	24	8.3E-08

 $H_b = final inlet head in cm$

 $H_2 = final outlet head in cm$

No. of Trials	Sample	Max. Density	Compaction	Sample
	Type	(pcf)	%	Orientation
5	UD	102.2	N/A	Vertical

Avg. k at 20 °C

8.4E-08 cm/sec

a =	0.16	cm ²
A =	40.44	cm ²
L =	7.19	cm

 $a = area of burette in cm^2$ L = length of sample in cm $A = area of sample in cm^2$

Ha = initial inlet head in cm H_1 = initial outlet head in cm t = time in seconds



HYDRAULIC CONDUCTIVITY

Project No.	GTX-1516			
Project Name	Clifty Creek			
Boring No.	B-7			
Sample No.				
Sample Depth	27.4-27.7 ft			
Sample Description Lean clay				

 Tested By
 JM

 Test Date
 12/12/2010

 Reviewed By
 MM

 Review Date
 12/15/2010

 Lab No.
 5

Hydraulic Conductivity, cm/sec. @20 °C	8.4E-08
Compaction, %:	N/A
Dry Unit Weight, pcf:	102.2
Wet Unit Weight, pcf:	127.4
Initial Water Content, %:	24.6
Sample Orientation:	Vertical
Sample Type:	UD

ASTM D5084 - Falling Head (Method C RisingTail)

Remarks:

PERMEABILITY TEST (ASTM D5084 - 90) (Method C, Increasing Tailwater Level)

Project Number	r GTX-151	6	_
Project Name	Clifty Cre	ek	
Boring No.	B-8		-
Sample No.			-
Sample Depth	29.7-30.3	ft	-
Sample Descrip	otion	Lean clay	with sand

Tested By	JM
Test Date	12/12/10
Reviewed By	MM
Review Date	12/15/10
Lab No.	7



Sample Data

Length,	in	Diameter, in		Pan No.	A44
Location 1	2.841	Location 1	2.775	Dry Soil+Pan, grams	487.70
Location 2	2.843	Location 2	2.784	Pan Weight, grams	8.99
Location3	2.844	Location 3	2.788		
Average	2.843	Average	2.782	Moisture Content, %	23.5
		Wet Soil + Tare, grams	591.11	Wet Unit Weight, pcf	130.3
		Tare Weight, grams	0.00	Dry Unit Weight, pcf	105.5

Chamber Pressure, psi	65
Back Pressure, psi	60
Confining Pressure, psi	5

Remarks:

Date	Date	Time	Time	Time	Ha	H_1	H _b	H ₂	k	Temp	k
Start	Finish	Start	Finish	(sec)	(cm)	(cm)	(cm)	(cm)	cm/sec	(°C)	cm/sec
											at 20 °C
				3200	6.5	107.2	6.90	106.9	3.2E-08	22	3.1E-08
				6600	6.5	107.2	7.40	106.4	3.8E-08	24	3.4E-08
				11400	6.5	107.2	8.10	105.7	4.0E-08	24	3.7E-08
				18000	6.5	107.2	9.00	104.8	4.1E-08	24	3.7E-08
				30000	6.5	107.2	10.20	103.6	3.7E-08	24	3.3E-08

 $H_b = final inlet head in cm$

 $H_2 = final outlet head in cm$

Ν	o. of Trials	Sample	Max. Density	Compaction	Sample	
		Туре	(pcf)	%	Orientation	
	5	UD	105.5	N/A	Vertical	

Avg. k at 20 °C

3.4E-08 cm/sec

a =	0.16	cm ²
A =	39.23	cm ²
L =	7.22	cm

a = area of burette in cm²L = length of sample in cm A = area of sample in cm² Ha = initial inlet head in cm H₁ = initial outlet head in cm t = time in seconds



HYDRAULIC CONDUCTIVITY

Project No.	GTX-1516	Tested By	JM
Project Name	Clifty Creek	Test Date	12/12/2010
Boring No.	<i>B-8</i>	Reviewed By	MM
Sample No.		Review Date	12/15/2010
Sample Depth	29.7-30.3 ft	Lab No.	7
Sample Description	Lean clay with sand		

	<i>a</i> = <i>a</i> = <i>i</i>
Sample Type:	UD
Sample Orientation:	Vertical
Initial Water Content, %:	23.5
Wet Unit Weight, pcf:	130.3
Dry Unit Weight, pcf:	105.5
Compaction, %:	N/A
Hydraulic Conductivity, cm/sec. @20 °C	3.4E-08

ASTM D5084 - Falling Head (Method C RisingTail)

Remarks:

PERMEABILITY TEST (ASTM D5084 - 90) (Method C, Increasing Tailwater Level)

Project Number	GTX-151	6
Project Name	Clifty Cre	ek
Boring No.	B-9	
Sample No.		
Sample Depth	18.3-18.6	
Sample Descrip	otion	Lean clay

Tested By	JM
Test Date	12/12/10
Reviewed By	MM
Review Date	12/15/10
Lab No.	8



Sample Data

Length,	in	Diameter, in		Pan No.	a-18
Location 1	2.899	Location 1	2.872	Dry Soil+Pan, grams	541.33
Location 2	2.901	Location 2	2.877	Pan Weight, grams	9.11
Location3	2.905	Location 3	2.877		
Average	2.902	Average	2.875	Moisture Content, %	21.0
		Wet Soil + Tare, grams	644.22	Wet Unit Weight, pcf	130.3
		Tare Weight, grams	0.00	Dry Unit Weight, pcf	107.6

Chamber Pressure, psi	65	
Back Pressure, psi	60	
Confining Pressure, psi	5	

Remarks:

Date	Date	Time	Time	Time	H _a	H_1	H _b	H_2	k	Temp	k
Start	Finish	Start	Finish	(sec)	(cm)	(cm)	(cm)	(cm)	cm/sec	(°C)	cm/sec
											at 20 °C
				1800	5.3	100.4	5.70	100	6.6E-08	22	6.3E-08
				4800	5.3	100.4	6.40	99.3	6.9E-08	24	6.2E-08
				8400	5.3	100.4	7.20	98.5	6.8E-08	24	6.2E-08
				16200	5.3	100.4	8.80	96.9	6.6E-08	24	6.0E-08
				27000	5.3	100.4	11.00	94.7	6.7E-08	24	6.0E-08

 $H_b = final inlet head in cm$

 $H_2 = final outlet head in cm$

No. of Trials Sample		Max. Density	Compaction	Sample	
	Туре	(pcf)	%	Orientation	
5	UD	107.6	N/A	Vertical	

Avg. k at 20 °C

6.2E-08 cm/sec

 $a = 0.16 \text{ cm}^{2}$ $A = 41.89 \text{ cm}^{2}$ L = 7.37 cm

a = area of burette in cm²L = length of sample in cm A = area of sample in cm² Ha = initial inlet head in cm H₁ = initial outlet head in cm t = time in seconds



HYDRAULIC CONDUCTIVITY

Project No.	GTX-1516
Project Name	Clifty Creek
Boring No.	B-9
Sample No.	
Sample Depth	18.3-18.6
Sample Description	Lean clay

 Tested By
 JM

 Test Date
 12/12/2010

 Reviewed By
 MM

 Review Date
 12/15/2010

 Lab No.
 8

Hydraulic Conductivity, cm/sec. @20 °C	6.2E-08
Compaction, %:	N/A
Dry Unit Weight, pcf:	107.6
Wet Unit Weight, pcf:	130.3
Initial Water Content, %:	21.0
Sample Orientation:	Vertical
Sample Type:	UD

ASTM D5084 - Falling Head (Method C RisingTail)

Remarks:

PERMEABILITY TEST (ASTM D5084 - 90) (Method C, Increasing Tailwater Level)

Project Number	GTX-1516		
Project Name	Clifty Creek		
Boring No.	B-10		
Sample No.			
Sample Depth	16.4-16.7 ft		
Sample Descrip	tion Lean clay		

Tested By	JM
Test Date	12/12/10
Reviewed By	MM
Review Date	12/15/10
Lab No.	11



Sample Data

Length, in		Diameter, in		Pan No.	a-22
Location 1	3.121	Location 1	2.876	Dry Soil+Pan, grams	539.99
Location 2	3.203	Location 2	2.877	Pan Weight, grams	9.13
Location3	3.126	Location 3	2.877		
Average	3.150	Average	2.877	Moisture Content, %	21.1
		Wet Soil + Tare, grams	642.99	Wet Unit Weight, pcf	119.6
		Tare Weight, grams 0.00		Dry Unit Weight, pcf	98.8

Chamber Pressure, psi	65
Back Pressure, psi	60
Confining Pressure, psi	5

Remarks:

Date	Date	Time	Time	Time	H _a	H_1	H _b	H_2	k	Temp	k
Start	Finish	Start	Finish	(sec)	(cm)	(cm)	(cm)	(cm)	cm/sec	(°C)	cm/sec
											at 20 °C
				1800	7.7	99.3	8.50	98.5	1.5E-07	22	1.4E-07
				4800	7.7	99.3	9.90	97.1	1.6E-07	22	1.5E-07
				8400	7.7	99.3	11.20	94.7	1.7E-07	22	1.6E-07
				16200	7.7	99.3	13.00	92.9	1.3E-07	22	1.2E-07
				24000	7.7	99.3	15.00	90.9	1.2E-07	22	1.1E-07

 $H_b = final inlet head in cm$

 $H_2 = final outlet head in cm$

No. of Trials	Sample	Max. Density	Compaction	Sample	
	Туре	(pcf)	%	Orientation	
5	UD	107.6	N/A	Vertical	

Avg. k at 20 °C

1.4E-07 cm/sec

0.16 cm² a = 41.93 cm² A =L= 8.00 cm

 $a = area of burette in cm^2$ L = length of sample in cm $A = area of sample in cm^2$

Ha = initial inlet head in cm H_1 = initial outlet head in cm t = time in seconds



HYDRAULIC CONDUCTIVITY

Project No.	GTX-1516
Project Name	Clifty Creek
Boring No.	B-10
Sample No.	
Sample Depth	16.4-16.7 ft
Sample Description	Lean clay

 Tested By
 JM

 Test Date
 12/12/2010

 Reviewed By
 MM

 Review Date
 12/15/2010

 Lab No.
 11

UD
Vertical
21.1
119.6
98.8
N/A
1.4E-07

ASTM D5084 - Falling Head (Method C RisingTail)

Remarks:

APPENDIX G

STANDARD PROCTOR MOISTURE-DENSITY TESTS

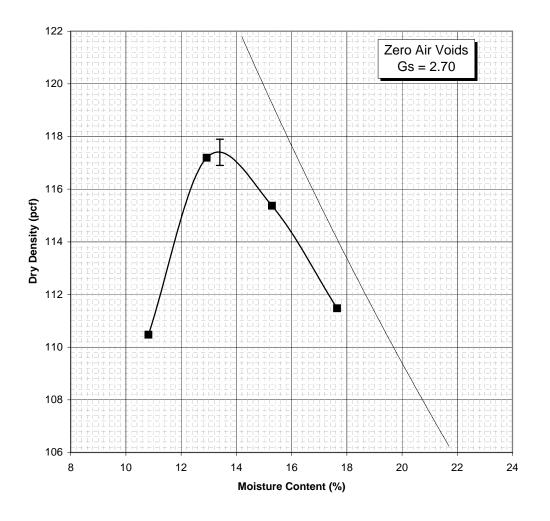
BOILER SLAG POND DAM



Moisture-Density Data Sheet

Project:AEP - Clifty Creek - West Bottom Ash PondProject No.:175539022Source:B-1, 5.0'Sample No.:319Sample Description:Brown lean clay with gravel, moistNmc:15.6 %Visual Notes:N/ATest Method:ASTM D 698 - Method APrepared:DryOversized Fraction:< 5 %</td>Rammer:Mechanical

Mold Weight	2041 grams					
		Wet Soil				
Wet Weight	Wet Weight	and Can	Dry Soil and		Water	Dry
plus Mold	minus Mold	Weight	Can Weight	Can Weight	Content	Density
(grams)	(grams)	(grams)	(grams)	(grams)	(%)	(pcf)
3879	1838	432.75	397.39	70.52	10.8	110.5
4028	1987	462.87	418.39	74.30	12.9	117.2
4038	1997	405.73	362.08	76.62	15.3	115.4
4010	1969	368.39	324.37	74.94	17.6	111.5



Maximum Dry Density 117.4 PCF Optimum Moisture Content 13.4 %



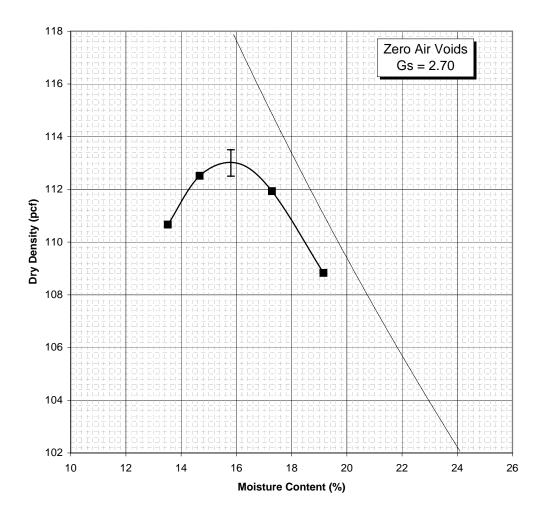
Moisture-Density Data Sheet

Sample No.: 320

Nmc: 18.2 %

Project: <u>AEP - Clifty Creek - West Bottom Ash Pond</u> Project No.: <u>175539022</u> Source: B-5, 7.5' Sample Description: brown lean clay, moist Visual Notes: N/A Test Method: ASTM D 698 - Method A Prepared: Dry Oversized Fraction: < 5 % Rammer: Mechanical Gs - Fines: Assumed

Mold Weight	2041 grams		Moisture Determination											
		Wet Soil												
Wet Weight	Wet Weight	and Can	Dry Soil and		Water	Dry								
plus Mold	minus Mold	Weight	Can Weight	Can Weight	Content	Density								
(grams)	(grams)	(grams)	(grams)	(grams)	(%)	(pcf)								
3927	1886	422.84	381.18	72.94	13.5	110.7								
3978	1937	388.97	348.78	74.79	14.7	112.5								
4012	1971	392.34	345.43	74.11	17.3	111.9								
3988	1947	409.73	355.79	74.24	19.2	108.8								



Maximum Dry Density 113.0 PCF **Optimum Moisture Content** 15.8 % LANDFILL RUNOFF COLLECTION POND



Moisture-Density Data Sheet

Project: AEP - Clifty Creek - South Fly Ash Pond

Source: B-7, 7.0'

Sample Description: brown lean clay, moist

Visual Notes: N/A

Prepared: Dry

Oversized Fraction: < 5 % Rammer: Mechanical

Test Method: ASTM D 698 - Method A

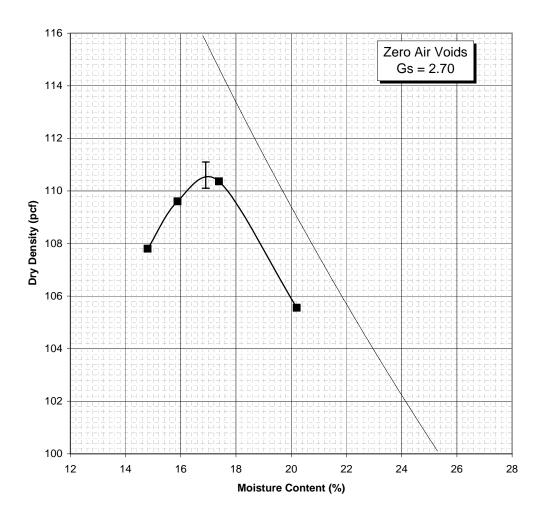
Gs - Fines: Assumed

Project No.: <u>175539022</u>

Sample No.: 321

Nmc: 20.5 %

Mold Weight	2041 grams					
		Wet Soil				
Wet Weight	Wet Weight	and Can	Dry Soil and		Water	Dry
plus Mold	minus Mold	Weight	Can Weight	Can Weight	Content	Density
(grams)	(grams)	(grams)	(grams)	(grams)	(%)	(pcf)
3899	1858	421.72	374.30	53.84	14.8	107.8
3948	1907	420.48	370.25	54.04	15.9	109.6
3986	1945	425.03	373.25	75.37	17.4	110.4
3946	1905	465.82	400.33	76.15	20.2	105.6



Maximum Dry Density 110.6 PCF **Optimum Moisture Content** 16.9 %

APPENDIX H

LIQUEFACTION ANALYSIS

BOILER SLAG POND DAM: 2015 CCR MANDATE

FINE-GRAINED ANALYSIS

Liquefaction Susceptibility of Fine-Grained Soils

Lab ID

4 20 43

87

103 129

Boring

B-1

B-1 B-2

B-4

B-4 B-5

Stantec Project Number:	175553022
Project Name:	AEP Clifty Creek
Site/Structure Name:	West Bottom Ash Dam

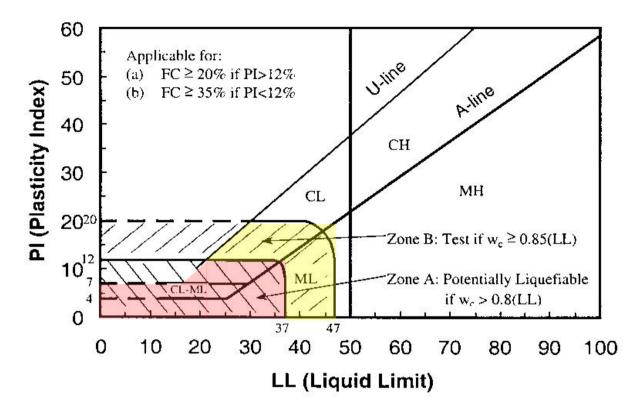
Depth(s)

10.0-11.5, 12.5-14.0

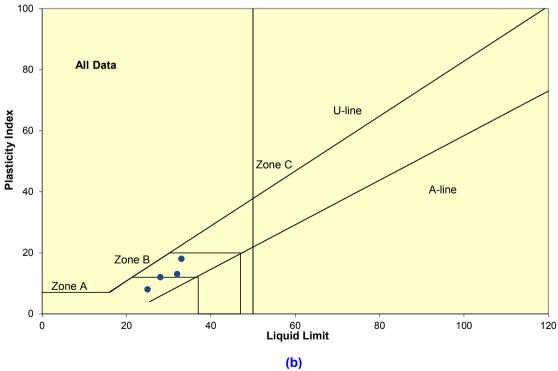
47.5-49.0, 50.0-51.5 32.5-34.0, 35.0-36.5

20.0-21.5, 22.5-24.0 57.5-59.0, 60.0-61.5 55.0-56.5, 57.5-59.0

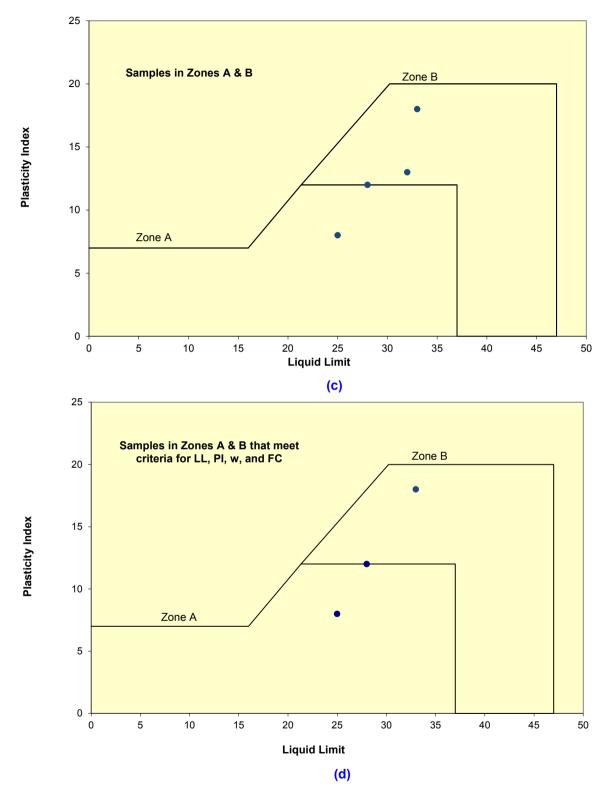
		1					Sand-like		y-like Beha	•			neet criteria on-plastic r Using (published and Boular	naterial) Criteria I by Idriss	-	ia published by	Overall Judgement based on 3 methods (sand-like or clay- like)	
Note: NP = Non-Plastic					lastic	Meets crite like be		Meet	s criteria for	clay-like bel	navior	Meets criteria for sand-like behavior	Meets criteria for clay-like behavior	Meets criteria for sand-like behavior	Meets criteria for clay-like behavior	Borderline soils (treat as sand-like)	ince)	
	Soil Classification	NMC (w _c) (%)	% Passing #200	% Passing #40	LL	PI	LL in Zone A (see plot)	PI in Zone A (see plot)	LL in Zone B (see plot)	PI in Zone B (see plot)	LL in Zone C (see plot)	PI in Zone C (see plot)	PI < 7	PI >= 7	PI <= 7	P200>=20%,	7 < PI < 10, or does not meet P40 or P200	
	CL	19.1	84	98.4	32	40		-1	32	13	4	-1	-1	13	-1	13	4	Olau lika
	CL	25.3	84.1	98.4 99.7	28	13 12	-1 28	12	-1	-1	-1	-1	-1	13	-1	13	-1 -1	Clay-like Clay-like
	CL	32.1	79.7	98.7	33	12	-1	-1	33	18	-1	-1	-1	12	-1	18	-1	Clay-like
	CL	26.6	80.7	99.7	25	8	25	8	-1	-1	-1	-1	-1	8	-1	-1	8	Sand-like
	GW-GM	10.9	5.7	13.6	NP	NP												Sand-like
	ML	24.9	54	99.9	NP	NP												Sand-like



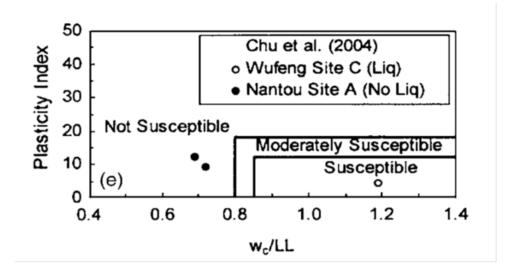
(a)

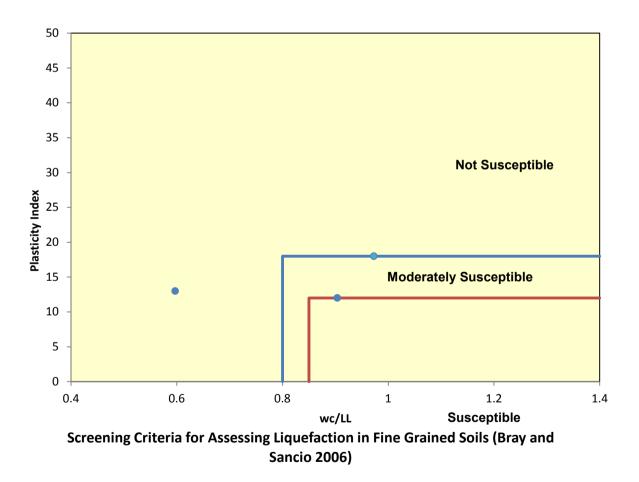


Screening Criteria for Liquefiable Fine-Grained Soils (Seed et al. 2003)



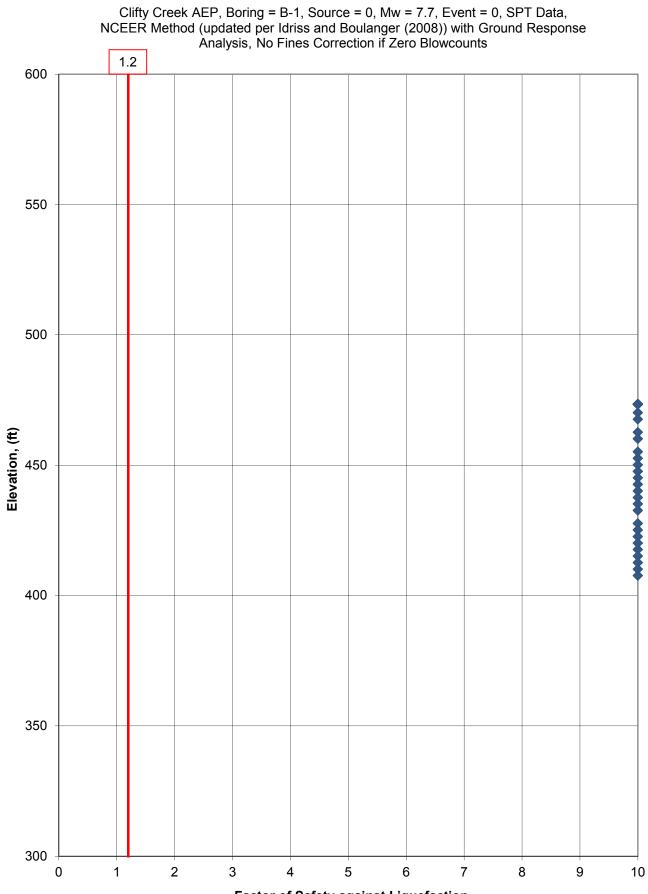
Screening Criteria for Liquefiable Fine-Grained Soils (Seed et al. 2003)



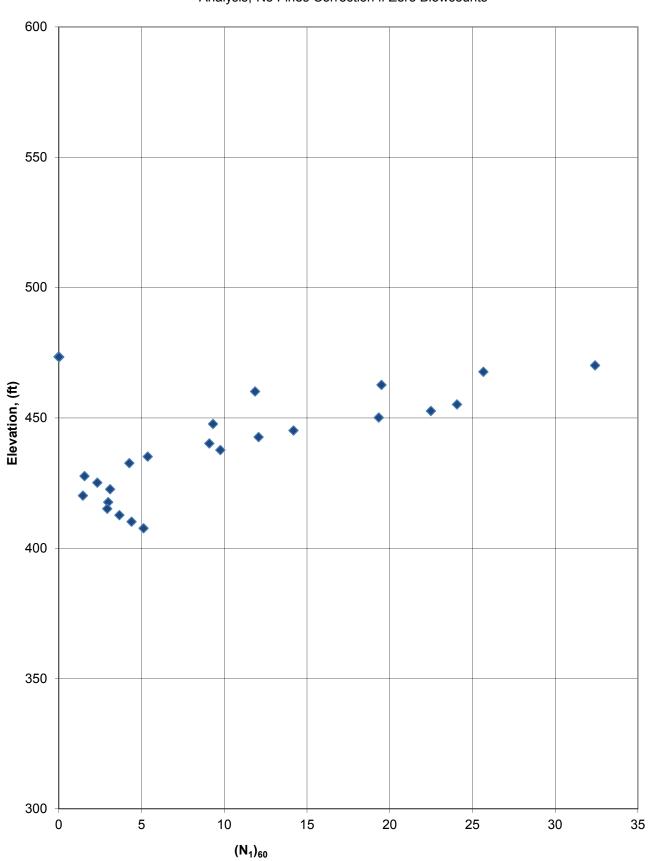


COARSE-GRAINED ANALYSIS

												EQ Source			I	Event (MCE, OBE, etc	c.)				Shake Stress	Curve Fit Parameters
												0				0					m4:	0
												a max (g)					•				m3:	0
Depth of	Vert. Total	Vert. Total	Static Pore		Vert. Eff.							0.085				EQ Motion File					m2:	0
Mid. Pt.	Stress	Stress	Pressure	Stress	Stress			Equivalent				EQ Mag (Mw)			01 117 1	0					m1:	0
of Sample	during EQ	during EQ w/ Fill (tsf)	during EQ (tsf)		during EQ w/ Fill (tsf)		C	Clean Sand N-Value				7.7 Mag. Scaling	CRR	Simplified Stress Reduction	Simplified CSR eq	Max. Shake Stress (psf)	Avg. Shake Stress (psf)	CSR eq	g SHAKE D: FS lig	FS liq	FS lig	Simplified FS lig
(ft.)	(tsf)	w/ Fill (tSI)	(151)	(tsf)	w/ Fill (tsi)							wag. Scaling			CSR eq	Stress (psi)	Stress (psi)			FS liq	FS liq	FS liq
z	σν	$\sigma_{v \text{ with fill}}$	u	σ'v	$\sigma'_{v \text{ with fill}}$	Alpha I	Beta I	(N1)60cs	CRR7.5	Ksigma	Kalpha	Factor (Cm)	Design EQ	Coeff., r _d	Design EQ	Design EQ	Design EQ	Design EQ	Design EQ	for plot	Design EQ	for plot
				Boring ID:	B-1							Note: A factor of	of safetv shown	as "NA" implies that t	he soil type is							
			Top of F	ill Elevation:	473.4									ng this methodology.								
				Fill Height:	0.0							soils classified	as CL, CH, CL-I	ML and MH. These so	oils should be							
				Unit Weight:	125									ne-grained soils. Also,								
			Fill	Total Stress:	0.00									alent clean sand N-va	alues greater tha	n 30						
		-										are resistant to	liquefaction.									
	totstr-top 0.16		u-top 0.00	effstr-top 0.16																		
3.3	0.16	0.20	0.00	0.16	0.20	NA	NA	NA	NA	NA	NA	0.95	NA	0.994	0.055	0	0	0.000	NA	10.0	NA	10.00
5.8	0.20	0.20	0.00	0.20	0.20	NA	NA	NA	NA	NA	NA	0.95	NA	0.989	0.055	0	0	0.000	NA	10.0	NA	10.00
10.8	0.67	0.67	0.00	0.67	0.67	NA	NA	NA	NA	NA	NA	0.95	NA	0.978	0.054	0	0	0.000	NA	10.0	NA	10.00
13.3	0.83	0.83	0.00	0.83	0.83	NA	NA	NA	NA	NA	NA	0.95	NA	0.972	0.054	0	0	0.000	NA	10.0	NA	10.00
18.3	1.14	1.14	0.00	1.14	1.14	NA	NA	NA	NA	NA	NA	0.95	NA	0.961	0.053	0	0	0.000	NA	10.0	NA	10.00
20.8	1.30	1.30	0.00	1.30	1.30	NA	NA	NA	NA	NA	NA	0.95	NA	0.955	0.053	0	0	0.000	NA	10.0	NA	10.00
23.3	1.45	1.45	0.00	1.45	1.45	NA	NA	NA	NA	NA	NA	0.95	NA	0.948	0.052	0	0	0.000	NA	10.0	NA	10.00
25.8	1.61	1.61	0.00	1.61	1.61	NA	NA	NA	NA	NA	NA	0.95	NA	0.939	0.052	0	0	0.000	NA	10.0	NA	10.00
28.3	1.77	1.77	0.00	1.77	1.77	NA	NA	NA	NA	NA	NA	0.95	NA	0.929	0.051	0	0	0.000	NA	10.0	NA	10.00
30.8	1.92	1.92	0.00	1.92	1.92	NA	NA	NA	NA	NA	NA	0.95	NA	0.917	0.051	0	0	0.000	NA	10.0	NA	10.00
33.3	2.08	2.08	0.00	2.08	2.08	NA	NA	NA	NA	NA	NA	0.95	NA	0.902	0.050	0	0	0.000	NA	10.0	NA	10.00
35.8	2.23	2.23	0.00	2.23	2.23	NA	NA	NA	NA	NA	NA	0.95	NA	0.885	0.049	0	0	0.000	NA	10.0	NA	10.00
38.3	2.39	2.39	0.04 0.12	2.35	2.35	NA NA	NA NA	NA NA	NA	NA	NA	0.95	NA	0.866	0.049	0	0	0.000	NA	10.0	NA NA	10.00 10.00
40.8 45.8	2.55 2.86	2.55 2.86	0.12	2.43 2.59	2.43 2.59	NA	NA	NA	NA NA	NA NA	NA NA	0.95 0.95	NA NA	0.844 0.796	0.049 0.049	0	0	0.000	NA NA	10.0 10.0	NA	10.00
45.6 48.3	3.02	2.00	0.27	2.59	2.59	NA	NA	NA	NA	NA	NA	0.95	NA	0.796	0.049	0	0	0.000	NA	10.0	NA	10.00
50.8	3.02	3.02	0.35	2.00	2.00	NA	NA	NA	NA	NA	NA	0.95	NA	0.745	0.048	0	0	0.000	NA	10.0	NA	10.00
53.3	3.33	3.33	0.51	2.82	2.82	NA	NA	NA	NA	NA	NA	0.95	NA	0.743	0.040	0	0	0.000	NA	10.0	NA	10.00
55.8	3.48	3.48	0.59	2.90	2.90	NA	NA	NA	NA	NA	NA	0.95	NA	0.696	0.046	ŏ	õ	0.000	NA	10.0	NA	10.00
58.3	3.64	3.64	0.66	2.98	2.98	NA	NA	NA	NA	NA	NA	0.95	NA	0.674	0.046	0	0	0.000	NA	10.0	NA	10.00
60.8	3.80	3.80	0.74	3.06	3.06	NA	NA	NA	NA	NA	NA	0.95	NA	0.653	0.045	0	0	0.000	NA	10.0	NA	10.00
63.3	3.95	3.95	0.82	3.13	3.13	NA	NA	NA	NA	NA	NA	0.95	NA	0.634	0.044	0	0	0.000	NA	10.0	NA	10.00
65.8	4.11	4.11	0.90	3.21	3.21	NA	NA	NA	NA	NA	NA	0.95	NA	0.617	0.044	0	0	0.000	NA	10.0	NA	10.00



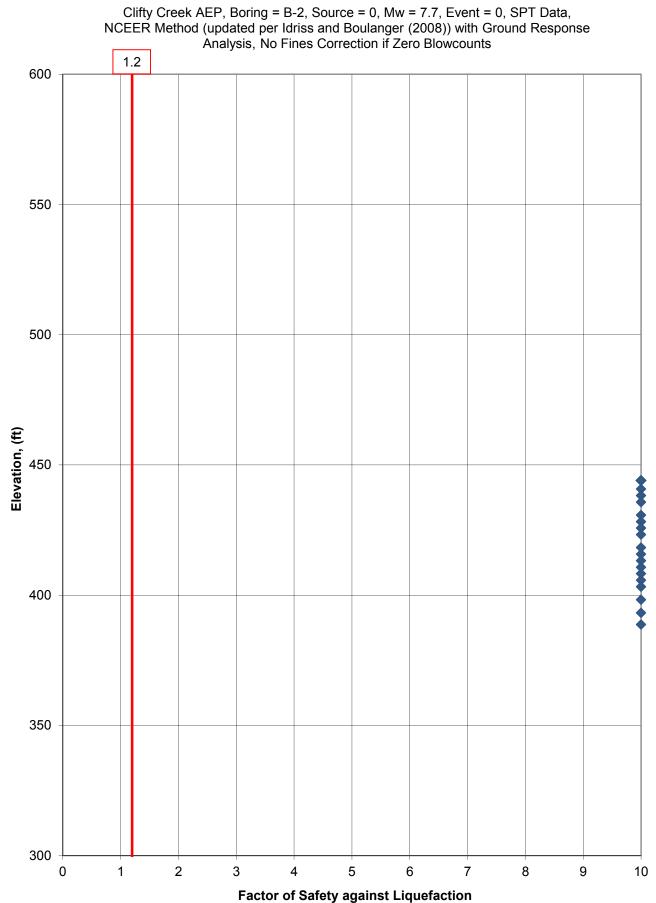
Factor of Safety against Liquefaction

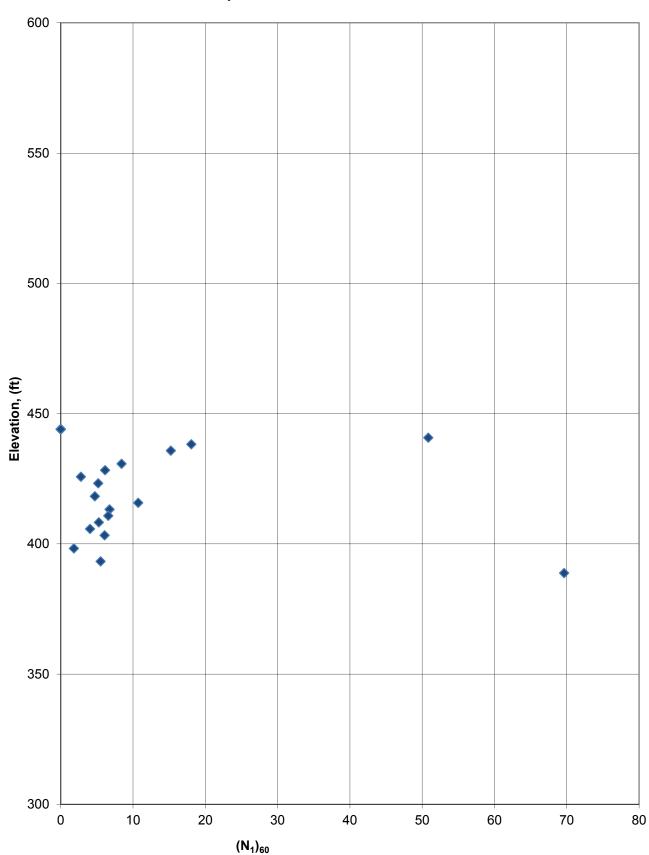


Clifty Creek AEP, Boring = B-1, Source = 0, Mw = 7.7, Event = 0, SPT Data, NCEER Method (updated per Idriss and Boulanger (2008)) with Ground Response Analysis, No Fines Correction if Zero Blowcounts

NCEER_Liq_SPT_B-2_M7.7.xlsx - part2

Image: Normal and the second of the	Depth of Mid. Pt. of Sample (ft.)	Vert. Total Stress during EQ (tsf)	Vert. Total Stress during EQ w/ Fill (tsf)	Static Pore Pressure during EQ (tsf)	Stress	Vert. Eff. Stress during EQ w/ Fill (tsf)			Equivalen Clean San N-Value				EQ Source 0 a max (g) 0.085 EQ Mag (Mw) 7.7 Mag. Scaling	CRR	Simplified Stress Reduction	Simplified CSR eq	Event (MCE, OBE, etc 0 EQ Motion File 0 Max. Shake Stress (psf)) Avg. Shake Stress (psf)	Usir CSR eq	ng SHAKE D FS liq	ata FS liq	Shake Stress m4: m3: m2: m1: FS liq	s Curve Fit Parameters 0 0 0 0 Simplified FS liq
Top of Fill Elevation. 444.0 Fill Height: 0.00 Fill Total INVegint: 10.00 Fill Total Stress: 0.00 0.00 0.00 0.00 0.00 No No 0.00 0.00 No No 0.00 0.00 No No No 0.00 0.00 No No No No No No <t< td=""><td>Z</td><td>σ_v</td><td>$\sigma_{v \text{ with fill}}$</td><td>u</td><td>σ',</td><td>$\sigma'_{v \text{ with fill}}$</td><td>Alpha I</td><td>Beta I</td><td>(N1)60cs</td><td>CRR7.5</td><td>Ksigma</td><td>Kalpha</td><td>Factor (Cm)</td><td>Design EQ</td><td>Coeff., r_d</td><td>Design EQ</td><td>Design EQ</td><td>Design EQ</td><td>Design EQ</td><td>Design EQ</td><td>for plot</td><td>Design EQ</td><td>for plot</td></t<>	Z	σ_v	$\sigma_{v \text{ with fill}}$	u	σ',	$\sigma'_{v \text{ with fill}}$	Alpha I	Beta I	(N1)60cs	CRR7.5	Ksigma	Kalpha	Factor (Cm)	Design EQ	Coeff., r _d	Design EQ	Design EQ	Design EQ	Design EQ	Design EQ	for plot	Design EQ	for plot
3.3 0.20 0.20 0.00 0.20 NA NA NA NA NA 0.95 NA 0.994 0.055 0 0 0.000 NA 10.0 NA 5.8 0.36 0.36 0.36 0.36 NA NA NA NA 0.955 NA 0.983 0.055 0 0 0.000 NA 10.0 NA 8.3 0.52 0.52 0.00 0.52 0.52 NA NA NA NA 0.955 NA 0.983 0.055 0 0 0.000 NA 10.0 NA 13.3 0.83 0.83 0.00 0.83 NA NA NA NA 0.955 NA 0.972 0.054 0 0.000 NA 10.0 NA 15.8 0.98 0.98 0.02 0.96 NA NA NA NA 0.955 NA 0.967 0.055 0 0 0.000 NA 10.0 NA 16.8 1.14 1.14 1.12 1.1	[totstr-top	1	Fill Total Fill	Fill Elevation: Fill Height: Unit Weight: Total Stress: effstr-top	444.0 0.0 125	5						not appropriate soils classified evaluated using coarse grained	ely evaluated usin as CL, CH, CL-N g methods for fin I soils with equive	ng this me ['] thodology. ML and MH. These so ne-grained soils. Also,	This applies to bils should be , "NA" implies tha							
5.8 0.36 0.36 0.36 0.36 0.36 0.36 0.4 NA NA NA NA NA NA NA 0.95 NA 0.989 0.055 0 0 0.000 NA 10.0 NA 8.3 0.52 0.52 0.00 0.52 0.52 NA NA NA NA NA NA NA NA 0.95 NA 0.983 0.054 0 0 0.000 NA 10.0 NA 13.3 0.83 0.03 0.03 NA NA NA NA 0.95 NA 0.972 0.054 0 0 0.000 NA 10.0 NA 15.8 0.98 0.92 0.96 0.96 NA NA NA NA 0.95 NA 0.967 0.055 0 0 0.000 NA 10.0 NA NA NA NA NA NA 0.95 NA 0.967 0.055 0 0 0.000 NA 10.0 NA NA NA NA <th></th> <th></th> <th>]</th> <th></th> <th></th> <th>]</th> <th></th> <th>10.0</th>]]																	10.0
8.3 0.52 0.52 0.00 0.52 0.52 NA NA NA 0.95 NA 0.983 0.054 0 0 0.000 NA 10.0 NA 13.3 0.83 0.83 0.00 0.83 0.83 NA NA NA NA 0.95 NA 0.972 0.054 0 0 0.000 NA 10.0 NA 15.8 0.98 0.92 0.96 NA NA NA NA 0.95 NA 0.967 0.055 0 0 0.000 NA 10.0 NA 18.3 1.14 1.14 0.10 1.04 NA NA NA NA 0.95 NA 0.961 0.055 0.01 0 0.000 NA 10.0 NA 20.8 1.30 1.30 0.18 1.12 1.12 NA NA NA NA 0.95 NA 0.939 0.066 0 0 0.000 NA 10.0 NA 28.3 1.77 1.77 0.41 1																	0	0					10.0
13.3 0.83 0.83 0.00 0.83 0.83 0.84 NA NA NA NA NA 0.95 NA 0.972 0.054 0 0 0.000 NA 10.0 NA 15.8 0.98 0.98 0.02 0.96 0.96 NA NA NA NA 0.95 NA 0.967 0.055 0 0 0.000 NA 10.0 NA 18.3 1.14 1.14 0.10 1.04 1.04 NA NA NA NA 0.95 NA 0.961 0.055 0 0 0.000 NA 10.0 NA 20.8 1.30 0.18 1.12 1.12 NA NA NA NA 0.955 NA 0.959 0.066 0 0 0.000 NA 10.0 NA 20.8 1.61 1.61 0.34 1.27 1.27 NA NA NA NA 0.955 NA 0.929 0.067 0 0 0.000 NA 10.0 NA																	0	0					10.0
15.8 0.98 0.98 0.02 0.96 0.96 NA NA NA NA 0.95 NA 0.055 0 0 0.000 NA 10.0 NA 18.3 1.14 1.14 0.10 1.04 1.04 NA NA NA NA 0.95 NA 0.961 0.058 0 0 0.000 NA 10.0 NA 20.8 1.30 0.18 1.12 1.12 NA NA NA NA 0.95 NA 0.955 0.061 0 0 0.000 NA 10.0 NA 25.8 1.61 1.61 0.34 1.27 1.27 NA NA NA NA 0.95 NA 0.955 0.061 0 0 0.000 NA 10.0 NA 25.8 1.61 1.61 0.34 1.23 NA NA NA NA NA 0.95 NA 0.917 0.067 0 0 0.000 NA 10.0 NA 30.8 1.92 1.92 <td></td> <td>0</td> <td>0</td> <td></td> <td></td> <td></td> <td></td> <td>10.0</td>																	0	0					10.0
18.3 1.14 1.14 0.10 1.04 1.04 NA NA NA 0.95 NA 0.961 0.058 0 0 0.000 NA 10.0 NA 20.8 1.30 1.30 0.18 1.12 1.12 NA NA NA NA 0.955 NA 0.955 0.061 0 0 0.000 NA 10.0 NA 25.8 1.61 1.61 0.34 1.27 1.27 NA NA NA NA 0.95 NA 0.939 0.066 0 0 0.000 NA 10.0 NA 28.3 1.77 1.77 0.41 1.35 1.35 NA NA NA NA 0.95 NA 0.929 0.067 0 0 0.000 NA 10.0 NA 30.8 1.92 1.92 0.49 1.43 1.43 NA NA NA 0.95 NA 0.917 0.068 0 0.000 NA 10.0 NA 33.3 2.08 0.57 <																	0	0					10.0
20.8 1.30 0.18 1.12 1.12 NA NA NA NA 0.95 NA 0.955 0.061 0 0 0.000 NA 10.0 NA 25.8 1.61 1.61 0.34 1.27 1.27 NA NA NA NA 0.95 NA 0.939 0.066 0 0 0.000 NA 10.0 NA 28.3 1.77 1.77 0.41 1.35 1.35 NA NA NA NA 0.95 NA 0.929 0.067 0 0 0.000 NA 10.0 NA 30.8 1.92 1.92 0.49 1.43 1.43 NA NA NA NA 0.95 NA 0.917 0.068 0 0 0.000 NA 10.0 NA 33.3 2.08 0.57 1.51 NA NA NA NA NA 0.95 NA 0.902 0.069 0 0 0.000 NA 10.0 NA 35.8 2.23 0.65 <td></td> <td>0</td> <td>0</td> <td></td> <td></td> <td></td> <td></td> <td>10.0</td>																	0	0					10.0
25.8 1.61 1.61 0.34 1.27 1.27 NA NA NA NA 0.95 NA 0.939 0.066 0 0 0.000 NA 10.0 NA 28.3 1.77 1.77 0.41 1.35 1.35 NA NA NA NA 0.95 NA 0.929 0.067 0 0.000 NA 10.0 NA 30.8 1.92 1.92 0.49 1.43 1.43 NA NA NA NA 0.95 NA 0.917 0.068 0 0 0.000 NA 10.0 NA 33.3 2.08 2.08 0.57 1.51 1.51 NA NA NA NA 0.95 NA 0.902 0.069 0 0.000 NA 10.0 NA 35.8 2.23 2.23 0.65 1.59 1.59 NA NA NA NA 0.95 NA 0.885 0.069 0 0.000 NA 10.0 NA 35.8 2.39 2.39																	0	0					10.0 10.0
28.3 1.77 1.77 0.41 1.35 1.35 NA NA NA NA NA 0.95 NA 0.929 0.067 0 0 0.000 NA 10.0 NA 30.8 1.92 1.92 0.49 1.43 1.43 NA NA NA NA NA NA 0.95 NA 0.917 0.068 0 0 0.000 NA 10.0 NA 33.3 2.08 0.57 1.51 1.51 NA NA NA NA NA 0.95 NA 0.902 0.069 0 0 0.000 NA 10.0 NA 33.3 2.08 0.57 1.51 1.51 NA NA NA NA 0.95 NA 0.902 0.069 0 0 0.000 NA 10.0 NA 35.8 2.23 0.65 1.59 1.67 NA NA NA NA 0.95 NA 0.866 0.069 0 0 0.000 NA 10.0 NA NA																	0	0					10.0
30.8 1.92 1.92 0.49 1.43 1.43 NA NA NA NA 0.95 NA 0.917 0.068 0 0 0.000 NA 10.0 NA 33.3 2.08 2.08 0.57 1.51 1.51 NA NA NA NA 0.95 NA 0.902 0.069 0 0 0.000 NA 10.0 NA 35.8 2.23 0.65 1.59 1.59 NA NA NA NA 0.95 NA 0.885 0.069 0 0 0.000 NA 10.0 NA 36.8 2.39 2.39 0.73 1.67 1.67 NA NA NA NA 0.95 NA 0.885 0.069 0 0 0.000 NA 10.0 NA 38.3 2.39 2.39 0.73 1.67 1.67 NA NA NA NA 0.95 NA 0.866 0.069 0 0 0.000 NA 10.0 NA NA NA 0.95 <td></td> <td>0</td> <td>0</td> <td></td> <td></td> <td></td> <td></td> <td>10.0</td>																	0	0					10.0
33.3 2.08 2.08 0.67 1.51 1.51 NA NA NA NA 0.95 NA 0.902 0.069 0 0.000 NA 10.0 NA 35.8 2.23 0.65 1.59 1.59 NA NA NA NA 0.95 NA 0.885 0.069 0 0 0.000 NA 10.0 NA 38.3 2.39 2.39 0.73 1.67 1.67 NA NA NA NA 0.95 NA 0.866 0.069 0 0 0.000 NA 10.0 NA 40.8 2.55 2.55 0.80 1.74 1.74 NA NA NA NA 0.95 NA 0.866 0.069 0 0 0.000 NA 10.0 NA 40.8 2.55 2.55 0.80 1.74 1.74 NA NA NA NA 0.95 NA 0.844 0.068 0 0 0.000 NA 10.0 NA																	0	0					10.0
35.8 2.23 0.65 1.59 1.59 NA NA NA NA 0.95 NA 0.885 0.069 0 0 0.000 NA 10.0 NA 38.3 2.39 2.39 0.73 1.67 1.67 NA NA NA NA 0.95 NA 0.866 0.069 0 0 0.000 NA 10.0 NA 40.8 2.55 2.55 0.80 1.74 1.74 NA NA NA NA 0.95 NA 0.866 0.069 0 0 0.000 NA 10.0 NA 40.8 2.55 2.55 0.80 1.74 1.74 NA NA NA 0.95 NA 0.844 0.068 0 0 0.000 NA 10.0 NA																	0	0					10.0
38.3 2.39 2.39 0.73 1.67 1.67 NA NA NA NA 0.95 NA 0.866 0.069 0 0 0.000 NA 10.0 NA 40.8 2.55 2.55 0.80 1.74 1.74 NA NA NA 0.95 NA 0.844 0.068 0 0 0.000 NA 10.0 NA																	0	0					10.0
40.8 2.55 2.55 0.80 1.74 1.74 NA NA NA NA NA NA 0.95 NA 0.844 0.068 0 0 0.000 NA 10.0 NA																	0	0					10.0
																	0	0					10.0
	45.8	2.86	2.86	0.96	1.90	1.90	NA	NA	NA	NA	NA	NA	0.95	NA	0.796	0.066	0	õ	0.000	NA	10.0	NA	10.0
																	0 0	õ					10.0
															••••		ů 0	0 0					10.0

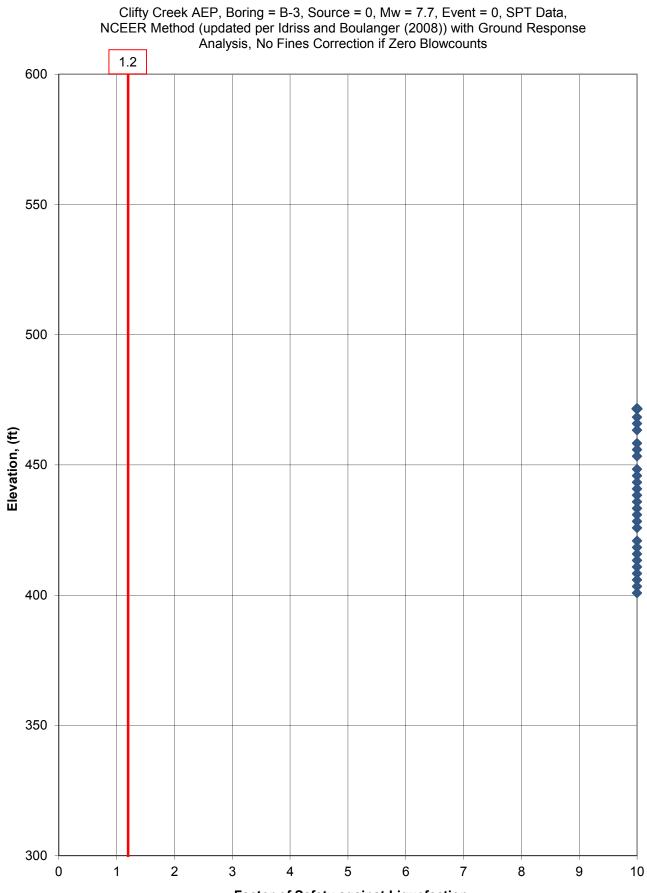




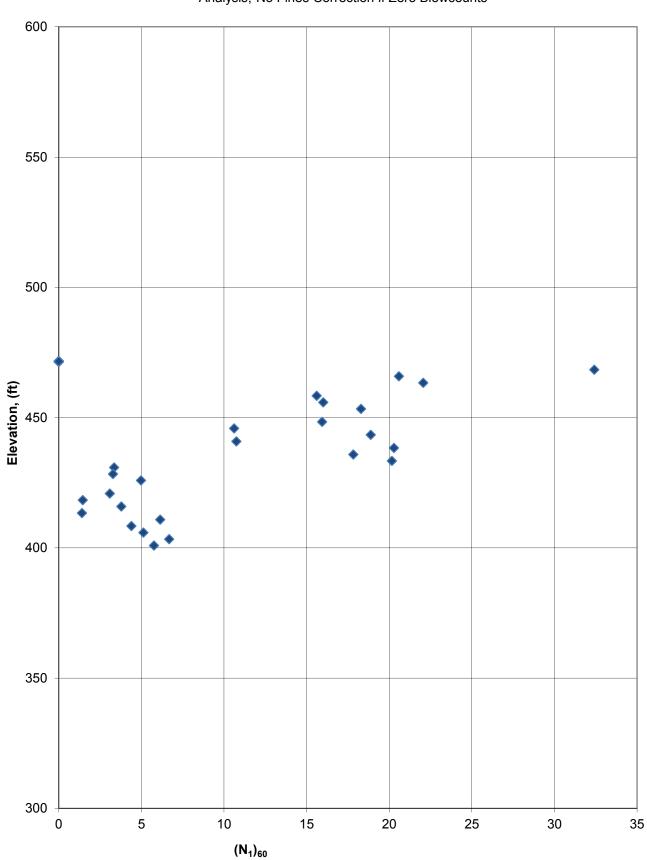
Clifty Creek AEP, Boring = B-2, Source = 0, Mw = 7.7, Event = 0, SPT Data, NCEER Method (updated per Idriss and Boulanger (2008)) with Ground Response Analysis, No Fines Correction if Zero Blowcounts

NCEER_Liq_SPT_B-3_M7.7.xlsx - part2

Depth of Mid. Pt. of Sample (ft.) z	Vert. Total Stress during EQ (tsf) σ _v	Vert. Total Stress during EQ w/ Fill (tsf) σ _{v with fill}	Static Pore Pressure during EQ (tsf) u	Vert. Eff. Stress during EQ (tsf) ơ' _v	Vert. Eff. Stress during EQ w/ Fill (tsf) σ' _{v with fill}	Alpha I	(Equivalent Clean Sanc N-Value (N1)60cs		Ksigma	Kalpha	EQ Source 0 a max (g) 0.085 EQ Mag (Mw) 7.7 Mag. Scaling Factor (Cm)	CRR Design EQ	Simplified Stress Reduction Coeff., r _d	Simplified CSR eq Design EQ	Event (MCE, OBE, etc 0 EQ Motion File 0 Max. Shake Stress (psf) Design EQ	2.) Avg. Shake Stress (psf) Design EQ	Usin CSR eq Design EQ	g SHAKE D FS liq Design EQ	FS liq	Shake Stress m4: m3: m2: m1: FS liq Design EQ	Curve Fit Parameters 0 0 0 Simplified FS liq for plot
			Top of I	Boring ID: Fill Elevation:	B-3 471.6									as "NA" implies that th ng this methodology. 1								
				Fill Height:	0.0									/L and MH. These so								
				Unit Weight:	125							•		e-grained soils. Also,	•							
			FIII	Total Stress:	0.00	1						are resistant to	,	alent clean sand N-va	iues greater thai	n 30						
]	totstr-top]	u-top	effstr-top									iqueluellen.									
	0.16		0.00	0.16																		
3.3	0.20	0.20	0.00	0.20	0.20	NA	NA	NA	NA	NA	NA	0.95	NA	0.994	0.055	0	0	0.000	NA	10.0	NA	10.00
5.8 8.3	0.36 0.52	0.36 0.52	0.00 0.00	0.36 0.52	0.36 0.52	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	0.95 0.95	NA NA	0.989 0.983	0.055 0.054	0	0	0.000 0.000	NA NA	10.0 10.0	NA NA	10.00 10.00
13.3	0.83	0.32	0.00	0.83	0.83	NA	NA	NA	NA	NA	NA	0.95	NA	0.972	0.054	0	0	0.000	NA	10.0	NA	10.00
15.8	0.98	0.98	0.00	0.98	0.98	NA	NA	NA	NA	NA	NA	0.95	NA	0.967	0.053	0	0	0.000	NA	10.0	NA	10.00
18.3	1.14	1.14	0.00	1.14	1.14	NA	NA	NA	NA	NA	NA	0.95	NA	0.961	0.053	0	0	0.000	NA	10.0	NA	10.00
23.3	1.45	1.45	0.00	1.45	1.45	NA	NA	NA	NA	NA	NA	0.95	NA	0.948	0.052	0	0	0.000	NA	10.0	NA	10.00
25.8	1.61	1.61	0.00	1.61	1.61	NA	NA	NA	NA	NA	NA	0.95	NA	0.939	0.052	0	0	0.000	NA	10.0	NA	10.00
28.3	1.77	1.77	0.00	1.77	1.77	NA	NA	NA	NA	NA	NA	0.95	NA	0.929	0.051	0	0	0.000	NA	10.0	NA	10.00
30.8	1.92 2.08	1.92 2.08	0.00 0.00	1.92	1.92 2.08	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	0.95 0.95	NA NA	0.917 0.902	0.051 0.050	0	0	0.000 0.000	NA NA	10.0 10.0	NA NA	10.00 10.00
33.3 35.8	2.08	2.08	0.00	2.08 2.23	2.08	NA	NA	NA	NA	NA	NA	0.95	NA	0.902	0.050	0	0	0.000	NA	10.0	NA	10.00
38.3	2.39	2.39	0.00	2.23	2.23	NA	NA	NA	NA	NA	NA	0.95	NA	0.866	0.049	0	0	0.000	NA	10.0	NA	10.00
40.8	2.55	2.55	0.15	2.40	2.40	NA	NA	NA	NA	NA	NA	0.95	NA	0.844	0.050	õ	0 0	0.000	NA	10.0	NA	10.00
43.3	2.70	2.70	0.23	2.48	2.48	NA	NA	NA	NA	NA	NA	0.95	NA	0.821	0.049	0	0	0.000	NA	10.0	NA	10.00
45.8	2.86	2.86	0.30	2.56	2.56	NA	NA	NA	NA	NA	NA	0.95	NA	0.796	0.049	0	0	0.000	NA	10.0	NA	10.00
50.8	3.17	3.17	0.46	2.71	2.71	NA	NA	NA	NA	NA	NA	0.95	NA	0.745	0.048	0	0	0.000	NA	10.0	NA	10.00
53.3	3.33	3.33	0.54	2.79	2.79	NA	NA	NA	NA	NA	NA	0.95	NA	0.720	0.047	0	0	0.000	NA	10.0	NA	10.00
55.8	3.48	3.48	0.62	2.87	2.87	NA	NA	NA	NA	NA	NA	0.95	NA	0.696	0.047	0	0	0.000	NA	10.0	NA	10.00
58.3	3.64	3.64	0.69	2.95	2.95	NA	NA	NA	NA	NA	NA	0.95	NA	0.674	0.046	0	0	0.000	NA	10.0	NA	10.00
60.8	3.80	3.80	0.77	3.02	3.02	NA NA	NA	NA	NA NA	NA	NA NA	0.95	NA NA	0.653	0.045 0.045	U	0	0.000	NA	10.0	NA	10.00
63.3 65.8	3.95 4.11	3.95 4.11	0.85 0.93	3.10 3.18	3.10 3.18	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	0.95 0.95	NA NA	0.634 0.617	0.045	0	0	0.000 0.000	NA NA	10.0 10.0	NA NA	10.00 10.00
68.3	4.11	4.11	1.01	3.16	3.18	NA	NA	NA	NA	NA	NA	0.95	NA	0.602	0.044	0	0	0.000	NA	10.0	NA	10.00
70.8	4.42	4.42	1.08	3.34	3.34	NA	NA	NA	NA	NA	NA	0.95	NA	0.588	0.043	õ	0	0.000	NA	10.0	NA	10.00



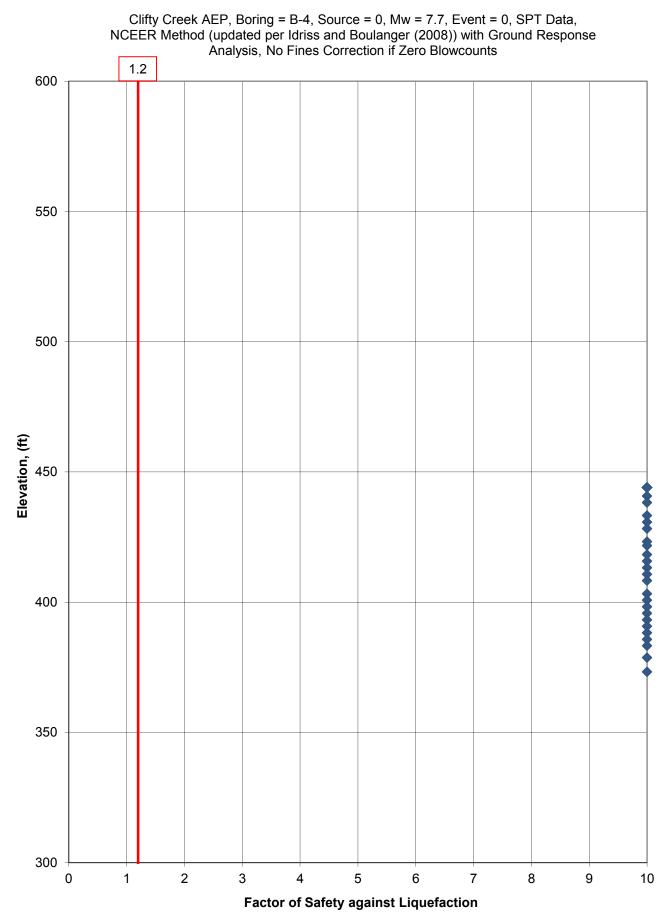
Factor of Safety against Liquefaction

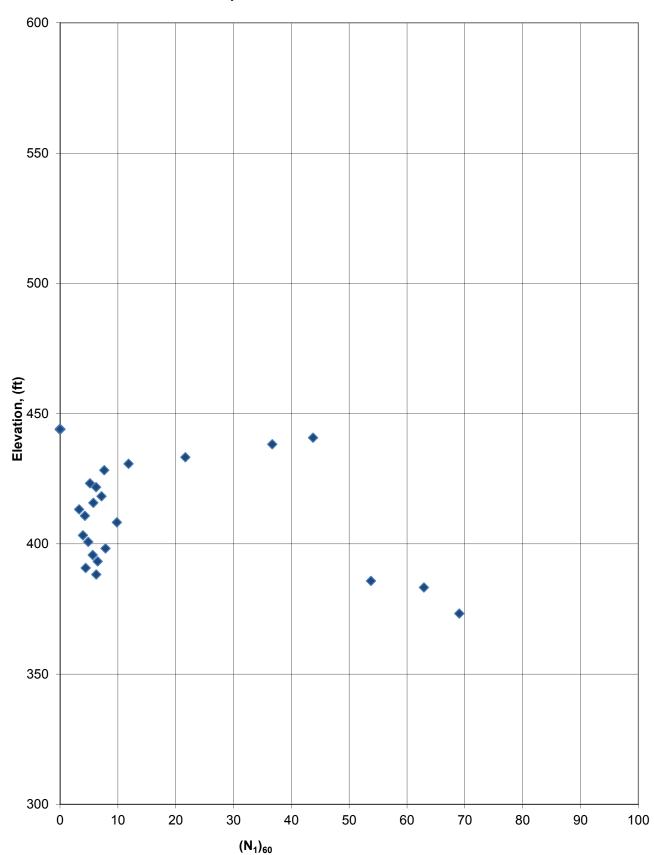


Clifty Creek AEP, Boring = B-3, Source = 0, Mw = 7.7, Event = 0, SPT Data, NCEER Method (updated per Idriss and Boulanger (2008)) with Ground Response Analysis, No Fines Correction if Zero Blowcounts

NCEER_Liq_SPT_B-4_M7.7.xlsx - part2

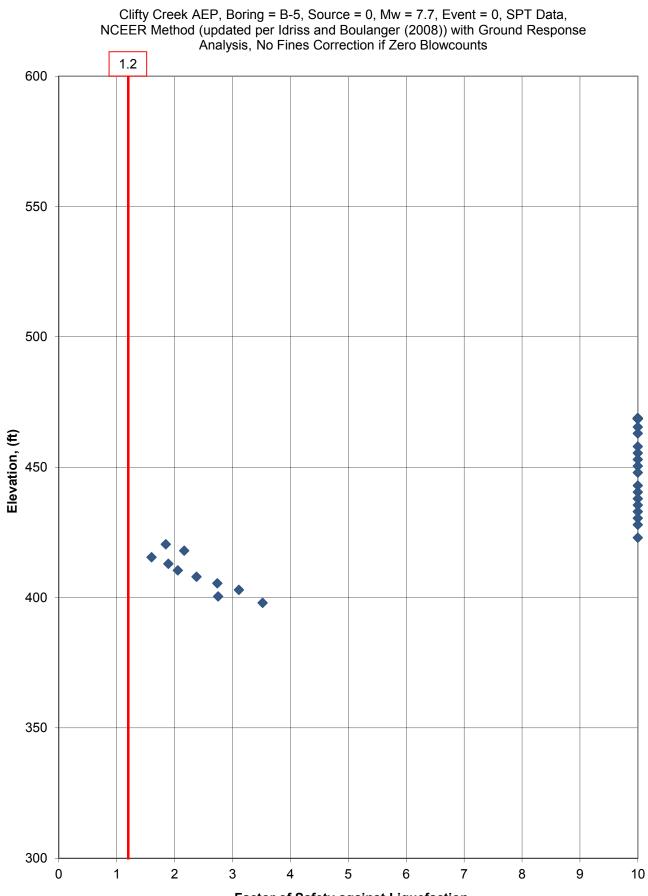
Depth of Mid. Pt. of Sample (ft.) z	Vert. Total Stress during EQ (tsf) σ _v	Vert. Total Stress during EQ w/ Fill (tsf) σ _{v with fill}	Static Pore Pressure during EQ (tsf) u	Vert. Eff. Stress during EQ (tsf) σ' _v Boring ID:	Vert. Eff. Stress during EQ w/ Fill (tsf) o' _{v with fill} B-4	Alpha I		Equivalent Clean Sanc N-Value (N1)60cs	CRR7.5	Ksigma	<u> </u>			Simplified Stress Reduction Coeff., r _d as "NA" implies that t	Simplified CSR eq Design EQ the soil type is	Event (MCE, OBE, etc 0 EQ Motion File 0 Max. Shake Stress (psf) Design EQ	c.) Avg. Shake Stress (psf) Design EQ	Usir CSR eq Design EQ	ng SHAKE D FS liq Design EQ	FS liq	Shake Stress m4: m3: m2: m1: FS liq Design EQ	Curve Fit Parameters 0 0 0 0 Simplified FS liq for plot
			Top of F	ill Elevation:	444.0									ng this methodology.								
			Fill Total	Fill Height: Unit Weight:	125								, - , -	/L and MH. These so e-grained soils. Also		t .						
				Total Stress:								•		alent clean sand N-va	· •							
г		т			1							are resistant to	liquefaction.									
	totstr-top 0.16		u-top 0.00	effstr-top 0.16																		
3.3	0.20	0.20	0.00	0.20	0.20	NA	NA	NA	NA	NA	NA	0.95	NA	0.994	0.055	0	0	0.000	NA	10.0	NA	10.00
5.8	0.36	0.36	0.00	0.36	0.36	NA	NA	NA	NA	NA	NA	0.95	NA	0.989	0.055	0	0	0.000	NA	10.0	NA	10.00
10.8	0.67	0.67	0.00	0.67	0.67	NA	NA	NA	NA	NA	NA	0.95	NA	0.978	0.054	0	0	0.000	NA	10.0	NA	10.00
13.3	0.83	0.83	0.00	0.83	0.83	NA	NA	NA	NA	NA	NA	0.95	NA	0.972	0.054	0	0	0.000	NA	10.0	NA	10.00
15.8	0.98	0.98	0.00	0.98	0.98	NA	NA	NA	NA	NA	NA	0.95	NA	0.967	0.053	0	0	0.000	NA	10.0	NA	10.00
20.8	1.30 1.39	1.30	0.15	1.15	1.15	NA	NA	NA	NA	NA	NA	0.95	NA	0.955	0.060	0	0	0.000	NA	10.0	NA	10.00
22.3 25.8	1.39	1.39 1.61	0.20 0.30	1.20 1.31	1.20 1.31	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	0.95 0.95	NA NA	0.951 0.939	0.061 0.064	0	0	0.000 0.000	NA NA	10.0 10.0	NA NA	10.00 10.00
25.8	1.01	1.01	0.30	1.31	1.31	NA	NA	NA	NA	NA	NA	0.95	NA	0.939	0.066	0	0	0.000	NA	10.0	NA	10.00
30.8	1.92	1.92	0.46	1.46	1.46	NA	NA	NA	NA	NA	NA	0.95	NA	0.929	0.067	0	0	0.000	NA	10.0	NA	10.00
33.3	2.08	2.08	0.54	1.54	1.54	NA	NA	NA	NA	NA	NA	0.95	NA	0.902	0.067	0	0	0.000	NA	10.0	NA	10.00
35.8	2.23	2.23	0.62	1.62	1.62	NA	NA	NA	NA	NA	NA	0.95	NA	0.885	0.068	0	0	0.000	NA	10.0	NA	10.00
40.8	2.55	2.55	0.77	1.77	1.77	NA	NA	NA	NA	NA	NA	0.95	NA	0.844	0.067	0	0	0.000	NA	10.0	NA	10.00
43.3	2.70	2.70	0.85	1.85	1.85	NA	NA	NA	NA	NA	NA	0.95	NA	0.821	0.066	0	0	0.000	NA	10.0	NA	10.00
45.8	2.86	2.86	0.93	1.93	1.93	NA	NA	NA	NA	NA	NA	0.95	NA	0.796	0.065	0	0	0.000	NA	10.0	NA	10.00
48.3	3.02	3.02	1.01	2.01	2.01	NA	NA	NA	NA	NA	NA	0.95	NA	0.771	0.064	0	0	0.000	NA	10.0	NA	10.00
50.8	3.17	3.17	1.08	2.09	2.09	NA	NA	NA	NA	NA	NA	0.95	NA	0.745	0.063	0	0	0.000	NA	10.0	NA	10.00
53.3	3.33	3.33	1.16	2.17	2.17	NA	NA	NA	NA	NA	NA	0.95	NA	0.720	0.061	0	0	0.000	NA	10.0	NA	10.00
55.8	3.48	3.48	1.24	2.24	2.24	NA	NA	NA	NA	NA	NA	0.95	NA	0.696	0.060	0	0	0.000	NA	10.0	NA	10.00
58.3	3.64	3.64	1.32	2.32	2.32	0.02	1.00	54	NA	0.764	1.000147	0.95	NA	0.674	0.058	0	0	0.000	NA	10.0	NA	10.00
60.8	3.80	3.80	1.40	2.40	2.40	0.02	1.00	63	NA	0.754	1.000147	0.95	NA	0.653	0.057	0	0	0.000	NA	10.0	NA	10.00
65.3	4.08	4.08	1.54	2.54	2.54	0.02	1.00	1354	NA	0.737	1.000147	0.95	NA	0.620	0.055	0	0	0.000	NA	10.0	NA	10.00
70.8	4.42	4.42	1.71	2.71	2.71	0.02	1.00	69	NA	0.717	1.000147	0.95	NA	0.588	0.053	0	0	0.000	NA	10.0	NA	10.00



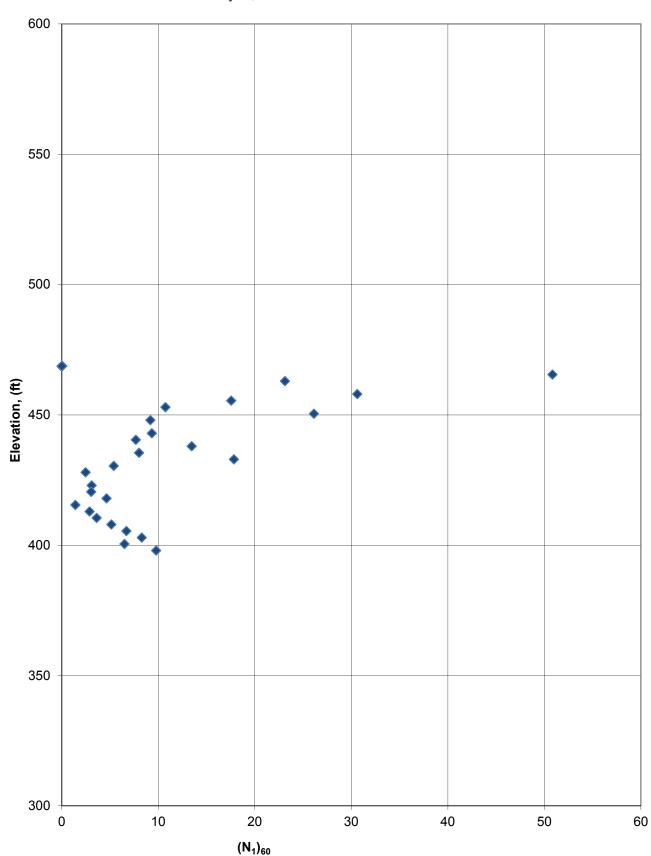


Clifty Creek AEP, Boring = B-4, Source = 0, Mw = 7.7, Event = 0, SPT Data, NCEER Method (updated per Idriss and Boulanger (2008)) with Ground Response Analysis, No Fines Correction if Zero Blowcounts

Depth of Mid. Pt. of Sample (ft.) z	Vert. Total Stress during EQ (tsf) _{ov}	Vert. Total Stress during EQ w/ Fill (tsf) o _{v with fill}	Static Pore Pressure during EQ (tsf) u	Stress	w/ Fill (tsf)	Alpha I	(Equivalent Clean Sand N-Value (N1)60cs	CRR7.5	Ksigma	Kalpha	EQ Source 0 a max (g) 0.085 EQ Mag (Mw) 7.7 Mag. Scaling Factor (Cm)	CRR Design EQ	Simplified Stress Reduction Coeff., r _d	Simplified CSR eq Design EQ	Event (MCE, OBE, et 0 EQ Motion File 0 Max. Shake Stress (psf) Design EQ	c.) Avg. Shake Stress (psf) Design EQ	CSR eq	ng SHAKE D FS liq Design EQ	FS liq	Shake Stress m4: m3: m2: m1: FS liq Design EQ	Curve Fit Parameters 0 0 0 0 Simplified FS liq for plot
			Fill Total	Boring ID: Fill Elevation: Fill Height: Unit Weight: Total Stress:	B-5 468.7 0.0 125 0.00							not appropriatel soils classified a evaluated using	y evaluated usi as CL, CH, CL-I methods for fin soils with equiva	as "NA" implies that i ng this methodology. ML and MH. These s le-grained soils. Also alent clean sand N-v.	. This applies to oils should be o, "NA" implies tha							
3.3 5.8	totstr-top 0.16 0.20 0.36	0.20 0.36	u-top 0.00 0.00 0.00	effstr-top 0.16 0.20 0.36	0.20 0.36	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	0.95 0.95	NA NA	0.994 0.989	0.055 0.055	0 0	0 0	0.000 0.000	NA NA	10.0 10.0	NA NA	10.0 10.0
10.8 13.3 15.8	0.67 0.83 0.98	0.67 0.83 0.98	0.00 0.00 0.00	0.67 0.83 0.98	0.67 0.83 0.98	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	0.95 0.95 0.95	NA NA NA	0.978 0.972 0.967	0.054 0.054 0.053	0 0 0	0 0 0	0.000 0.000 0.000	NA NA NA	10.0 10.0 10.0	NA NA NA	10.0 10.0 10.0
18.3 20.8 25.8	1.14 1.30 1.61	1.14 1.30 1.61	0.00 0.00 0.00	1.14 1.30 1.61	1.14 1.30 1.61	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	0.95 0.95 0.95	NA NA NA	0.961 0.955 0.939	0.053 0.053 0.052	0 0 0	0 0 0	0.000 0.000 0.000	NA NA NA	10.0 10.0 10.0	NA NA NA	10.0 10.0 10.0
28.3 30.8 33.3 35.8	1.77 1.92 2.08 2.23	1.77 1.92 2.08 2.23	0.00 0.00 0.00 0.00	1.77 1.92 2.08 2.23	1.77 1.92 2.08 2.23	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	0.95 0.95 0.95 0.95	NA NA NA	0.929 0.917 0.902 0.885	0.051 0.051 0.050 0.049	0 0 0	0 0 0	0.000 0.000 0.000 0.000	NA NA NA NA	10.0 10.0 10.0 10.0	NA NA NA	10.0 10.0 10.0 10.0
35.8 38.3 40.8 45.8	2.23 2.39 2.55 2.86	2.23 2.39 2.55 2.86	0.00 0.07 0.15 0.30	2.23 2.32 2.40 2.56	2.23 2.32 2.40 2.56	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	NA NA NA	0.95 0.95 0.95 0.95	NA NA NA	0.866 0.844 0.796	0.049 0.049 0.050 0.049	0	0 0 0	0.000 0.000 0.000 0.000	NA NA NA	10.0 10.0 10.0 10.0	NA NA NA	10.0 10.0 10.0 10.0
48.3 50.8 53.3	3.02 3.17 3.33	3.02 3.17 3.33	0.38 0.46 0.54	2.63 2.71 2.79	2.63 2.71 2.79	5.00 5.00 5.00	1.20 1.20 1.20	9 11 7	0.101 0.118 0.085	0.937 0.932 0.941	1.000 1.000 1.000	0.95 0.95 0.95	0.090 0.104 0.076	0.771 0.745 0.720	0.049 0.048 0.047	0 0 0	0 0 0	0.000 0.000 0.000	#DIV/0! #DIV/0! #DIV/0!	#DIV/0! #DIV/0! #DIV/0!	1.8 2.2 1.6	1.85 2.17 1.60
55.8 58.3 60.8	3.48 3.64 3.80	3.48 3.64 3.80	0.62 0.69 0.77	2.87 2.95 3.02	2.87 2.95 3.02	5.00 5.00 5.00	1.20 1.20 1.20	8 9 11	0.100 0.107 0.123	0.935 0.929 0.920	1.000 1.000003 1.000004	0.95 0.95 0.95	0.088 0.094 0.108	0.696 0.674 0.653	0.047 0.046 0.045	0 0 0	0 0 0	0.000 0.000 0.000	#DIV/0! #DIV/0! #DIV/0!	#DIV/0! #DIV/0! #DIV/0!	1.9 2.1 2.4	1.89 2.05 2.38
63.3 65.8 68.3 70.8	3.95 4.11 4.27 4.42	3.95 4.11 4.27 4.42	0.85 0.93 1.01 1.08	3.10 3.18 3.26 3.34	3.10 3.18 3.26 3.34	5.00 5.00 5.00 5.00	1.20 1.20 1.20 1.20	13 15 13 17	0.141 0.159 0.138 0.178	0.915 0.906 0.911 0.898	1.000006 1.000008 1.000006 1.00001	0.95 0.95 0.95 0.95	0.122 0.137 0.120 0.151	0.634 0.617 0.602 0.588	0.045 0.044 0.044 0.043	0 0 0	0 0 0	0.000 0.000 0.000 0.000	#DIV/0! #DIV/0! #DIV/0! #DIV/0!	#DIV/0! #DIV/0! #DIV/0! #DIV/0!	2.7 3.1 2.8 3.5	2.74 3.11 2.75 3.52



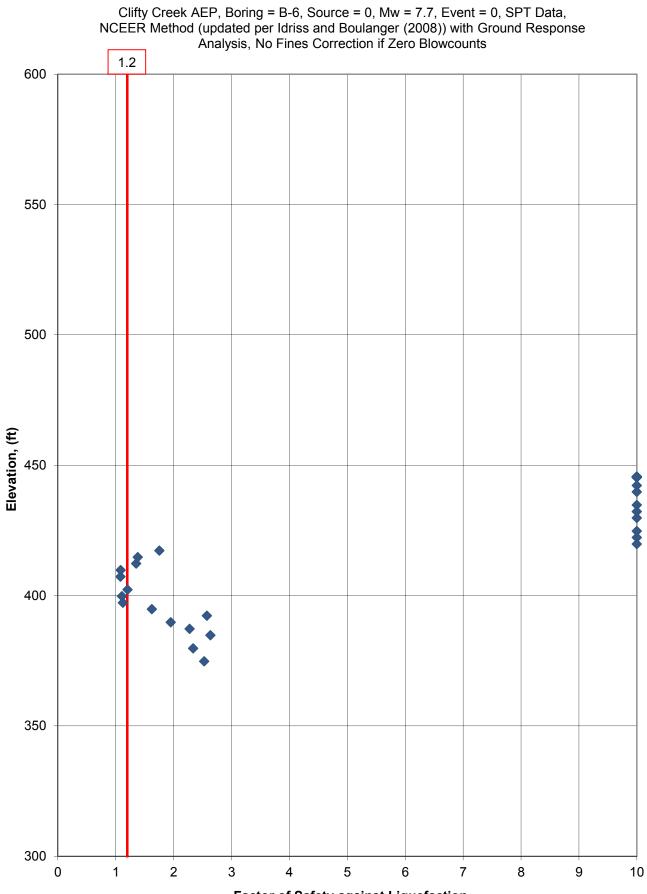
Factor of Safety against Liquefaction



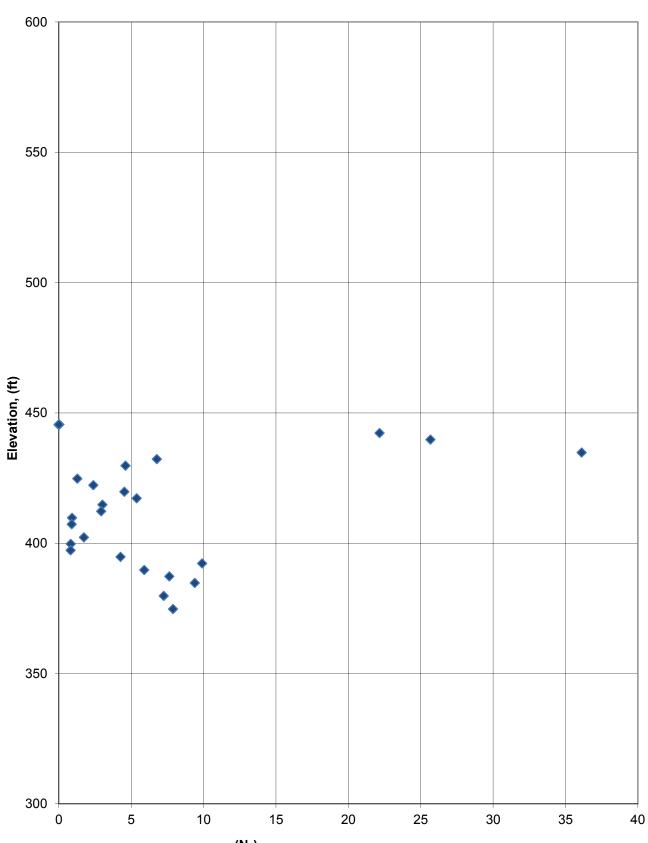
Clifty Creek AEP, Boring = B-5, Source = 0, Mw = 7.7, Event = 0, SPT Data, NCEER Method (updated per Idriss and Boulanger (2008)) with Ground Response Analysis, No Fines Correction if Zero Blowcounts

NCEER_Liq_SPT_B-6_M7.7.xlsx - part2

Depth of Mid. Pt. of Sample (ft.) z	Vert. Total Stress during EQ (tsf) σ _v	Vert. Total Stress during EQ w/ Fill (tsf) σ _{v with fill}	Static Pore Pressure during EQ (tsf) u	Vert. Eff. Stress during EQ (tsf) σ'ν	Vert. Eff. Stress during EQ w/ Fill (tsf) ơ' _{v with fill}	Alpha I	(Equivalent Clean Sand N-Value (N1)60cs		Ksigma	Kalpha	EQ Source 0 a max (g) 0.085 EQ Mag (Mw) 7.7 Mag. Scaling Factor (Cm)	CRR Design EQ	Simplified Stress Reduction Coeff., r _d	Simplified CSR eq Design EQ	Event (MCE, OBE, et 0 EQ Motion File 0 Max. Shake Stress (psf) Design EQ	c.) Avg. Shake Stress (psf) Design EQ	CSR eq	ing SHAKE [FS liq 2 Design EQ	FS liq	Shake Stress m4: m3: m2: m1: FS liq Design EQ	Curve Fit Parameters 0 0 0 Simplified FS liq for plot
			Top of F	Boring ID: ill Elevation:	B-6 445.5	5								as "NA" implies that th ag this methodology. T								
				Fill Height:	0.0)								IL and MH. These so								
				Unit Weight:	125							•		e-grained soils. Also,	•							
			Fill	Total Stress:	0.00)						coarse grained are resistant to		alent clean sand N-val	lues greater than 3	30						
	totstr-top]	u-top	effstr-top	1								ilquelaction.									
	0.16		0.00	0.16																		
3.3	0.20	0.20	0.00	0.20	0.20	NA	NA	NA	NA	NA	NA	0.95	NA	0.994	0.055	0	0	0.000	NA	10.0	NA	10.0
5.8	0.36 0.67	0.36 0.67	0.00 0.00	0.36 0.67	0.36 0.67	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	0.95 0.95	NA NA	0.989 0.978	0.055 0.054	0	0	0.000 0.000	NA NA	10.0 10.0	NA NA	10.0 10.0
10.8 13.3	0.83	0.83	0.00	0.87	0.87	NA	NA	NA	NA	NA	NA	0.95	NA	0.978	0.054	0	0	0.000	NA	10.0	NA	10.0
15.8	0.98	0.98	0.02	0.05	0.96	NA	NA	NA	NA	NA	NA	0.95	NA	0.967	0.055	0	0	0.000	NA	10.0	NA	10.0
20.8	1.30	1.30	0.18	1.12	1.12	NA	NA	NA	NA	NA	NA	0.95	NA	0.955	0.061	0	0	0.000	NA	10.0	NA	10.0
23.3	1.45	1.45	0.26	1.20	1.20	NA	NA	NA	NA	NA	NA	0.95	NA	0.948	0.064	0	0	0.000	NA	10.0	NA	10.0
25.8	1.61	1.61	0.34	1.27	1.27	NA	NA	NA	NA	NA	NA	0.95	NA	0.939	0.066	0	0	0.000	NA	10.0	NA	10.0
28.3	1.77	1.77	0.41	1.35	1.35	5.00	1.20	11	0.126	0.981	1.000	0.95	0.117	0.929	0.067	0	0	0.000	#DIV/0!	#DIV/0!	1.8	1.75
30.8	1.92	1.92	0.49	1.43	1.43	5.00	1.20	9	0.101	0.979	1.000	0.95	0.094	0.917	0.068	0	0	0.000	#DIV/0!	#DIV/0!	1.4	1.38
33.3	2.08	2.08	0.57	1.51	1.51	5.00	1.20	9	0.100	0.977	1.000	0.95	0.093	0.902	0.069	0	0	0.000	#DIV/0!	#DIV/0!	1.4	1.35
35.8	2.23	2.23	0.65	1.59	1.59	5.00	1.20	6 6	0.080	0.978	1.000	0.95	0.075	0.885	0.069	0	0	0.000	#DIV/0!	#DIV/0! #DIV/0!	1.1	1.08
38.3 43.3	2.39 2.70	2.39 2.70	0.73 0.88	1.67 1.82	1.67 1.82	5.00 5.00	1.20 1.20	6 7	0.080 0.088	0.976 0.967	1.000 1.000	0.95 0.95	0.074 0.081	0.866 0.821	0.069 0.067	0	0	0.000 0.000	#DIV/0! #DIV/0!	#DIV/0! #DIV/0!	1.1 1.2	1.08 1.20
45.8	2.86	2.86	0.88	1.02	1.90	5.00	1.20	6	0.088	0.967	1.000	0.95	0.073	0.796	0.066	0	0	0.000	#DIV/0! #DIV/0!	#DIV/0!	1.2	1.11
48.3	3.02	3.02	1.04	1.98	1.98	5.00	1.20	6	0.079	0.967	1.000	0.95	0.073	0.771	0.065	0	0	0.000	#DIV/0!	#DIV/0!	1.1	1.12
50.8	3.17	3.17	1.12	2.06	2.06	5.00	1.20	10	0.114	0.952	1.000	0.95	0.103	0.745	0.063	0	0	0.000	#DIV/0!	#DIV/0!	1.6	1.62
53.3	3.33	3.33	1.19	2.13	2.13	5.00	1.20	17	0.180	0.938	1.000	0.95	0.160	0.720	0.062	0	0	0.000	#DIV/0!	#DIV/0!	2.6	2.57
55.8	3.48	3.48	1.27	2.21	2.21	5.00	1.20	12	0.132	0.944	1.000	0.95	0.118	0.696	0.061	0	0	0.000	#DIV/0!	#DIV/0!	1.9	1.95
58.3	3.64	3.64	1.35	2.29	2.29	5.00	1.20	14	0.152	0.935	1.000008	0.95	0.135	0.674	0.059	0	0	0.000	#DIV/0!	#DIV/0!	2.3	2.27
60.8	3.80	3.80	1.43	2.37	2.37	5.00	1.20	16	0.173	0.928	1.000011	0.95	0.152	0.653	0.058	0	0	0.000	#DIV/0!	#DIV/0!	2.6	2.64
65.8	4.11	4.11	1.58	2.53	2.53	5.00	1.20	14	0.147	0.928	1.000007	0.95	0.130	0.617	0.055	0	0	0.000	#DIV/0!	#DIV/0!	2.3	2.34
70.8	4.42	4.42	1.74	2.68	2.68	5.00	1.20	14	0.155	0.922	1.000008	0.95	0.135	0.588	0.054	0	0	0.000	#DIV/0!	#DIV/0!	2.5	2.53



Factor of Safety against Liquefaction



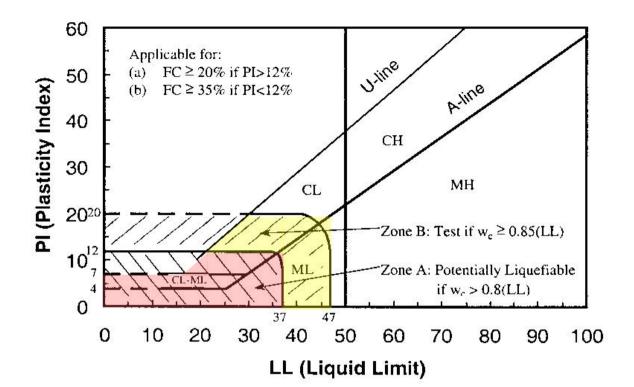
Clifty Creek AEP, Boring = B-6, Source = 0, Mw = 7.7, Event = 0, SPT Data, NCEER Method (updated per Idriss and Boulanger (2008)) with Ground Response Analysis, No Fines Correction if Zero Blowcounts

(N₁)₆₀

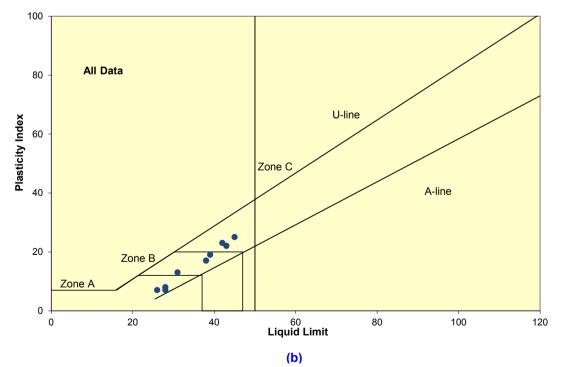
LANDFILL RUNOFF COLLECTION POND: 2015 CCR MANDATE

FINE-GRAINED ANALYSIS

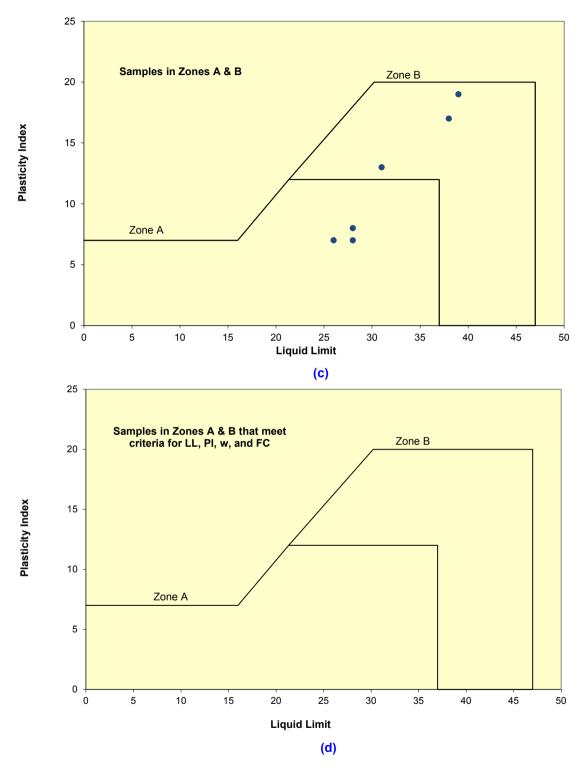
Liquefac	tion Susceptibili Stantec Project Numbe Project Name: Site/Structure Name:	r of Fine-Grained Soils r 175553022 AEP Citty Creek Landfill Runoff Collection Pond I	Dam					Sand-I	ke versus Cla	ay-like Behi	avior (-1 indi	icates resu		t meet crite r non-plastic		hading indic	ates result do	oes meet criteri	a, no results shown	Suscepti				itening (-1 indic riteria, no resu			criteria, green shading terials)
									Using Crit	teria publishe	ed by Seed et	t al (2003)			Criteria d by Idriss nger (2008)	Using criter	ia published by	y MSHA (2010)	Overall Judgement based on 3 methods (sand-like or clay-like)		teria published by I et al (2003)	Usi	ng Criteri	a published by E	ray and Sanc	cio (2006)	Overall Judgement based on 2 methods (susceptibility)
						Note: NP :	= Non-Plastic		iteria for sand- behavior	Meet	s criteria for c	clay-like beh	navior	Meets criteria for sand-like behavior	Meets criteria for clay-like behavior	Meets criteria for sand-like behavior	Meets criteria for clay-like behavior	Borderline soils (treat as sand-like)		and potent indicat susceptibl	iteria for B (clay-like tially liqueflable, -2 es zone A but e, -3 indicates not due to fines conten	Clay-lil suscept mee		Clay-like soil is not susceptible (must meet one or both)		ke soll is y susceptible	
Lab ID	Boring	Depth(s)	Soil Classification	NMC (w _c) (%)	% Passing #200	% Passing #40	LL PI		PI in Zone A (see plot)	LL in Zone B (see plot)	PI in Zone B (see plot)	LL in Zone C (see plot)	PI in Zone C (see plot)	PI < 7	PI >= 7	PI <= 7		7 < PI < 10, or does not meet P40 or P200		ш	PI	w _c /LL > 0.85	PI <= 12	w _c /LL PI > < 0.80 18	Intermediat e w _c /LL (see plot)	Intermediat e PI (see plot)	
	-																										
	B-7	27.2-27.8	CL	23.6	93.5	98	28 8	28	8	-1	-1	-1	-1	-1	8	-1	-1	8	Sand-like					0.71 17			
	B-8	25.5-25.8	CL	26.8	93.5	99.5	38 17		-1	38	17	-1	-1	-1		-1		-1	Clay-like	-1	-1	-1.00	-1			-1	Not Susceptible
	B-8 B-9	29.7-30.3 20.2-20.8	CL	23.5	79	99 99 9	45 25 39 19		-1	-1	-1	45	25	-1	25	-1	25	-1	Clay-like Clay-like	-1	-1	-1.00	-1	0.52 25		-1	Not Susceptible
	B-9 B-10	20.2-20.8 14.2-14.8	CL	20.2	89 100	99.9 29	39 19 NP NF		-1	39	19	-1	-1	-1	19	-1	19	-1	Clay-like Sand-like	-1	-1	-1.00	-1	0.52 19	-1.00	-1	Not Susceptible
	B-10 B-10	14.2-14.8 16.2-16.8	CL-ML	20.0	100	29	28 7	28	7	1	1	1	1	-1	7	7	1	1	Sand-like			-					
2	B-10 B-12	10.2-16.8	CL-ML CL	20.6	71.7	84 74 1	43 22		1	-	-1	43	- 1	-1	22	1	-1	-	Clav-like	1	4	-1.00	-1	0.54 22	-1.00	1	Not Susceptible
7	B-12 B-12	30.0-31.5	CL	19.0	71.4	74.1	31 13		-1	31	13	-1	-1	-1	13	1	13	-1	Clay-like	-1	-1	-1.00		0.61 13		-1	Not Susceptible
10	B-12 B-12	45.0-46.5	CL-ML	19.0	82.2	99.2	26 7		7	-1	-1			1	7	7	-1	-1	Sand-like		-1	1.00	-1	0.01 15			res cosceptible
11	B-12 B-12	50.0-51.5	ML	21.9	81.3	99.8	NP NF		1	- 1	-1	-1	-1	1			-1	-1	Sand-like								-
13	B-12 B-12	60.0-61.5	SM	14.8	36.1	95.7	NP NP							1					Sand-like								
15	B-12	70.0-71.5	MI	21.6	56.5	98.6	NP NF									1			Sand-like						-		
17	B-12	80.0-81.5	MI	25.7	90.2	98.9	NP NF							1					Sand-like								
20	B-12	95.0-96.5	CL	23.4	86.2	92.4	42 23	-1	-1	-1	-1	42	23	-1	23	-1	23	-1	Clay-like	-1	-1	-1.00	-1	0.56 23	-1.00	-1	Not Susceptible



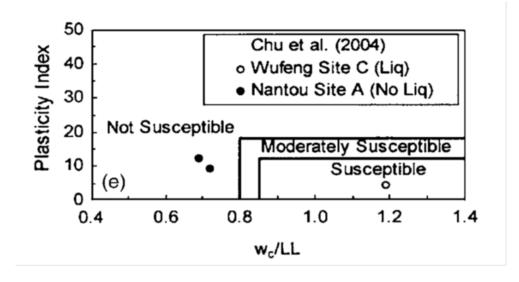
(a)

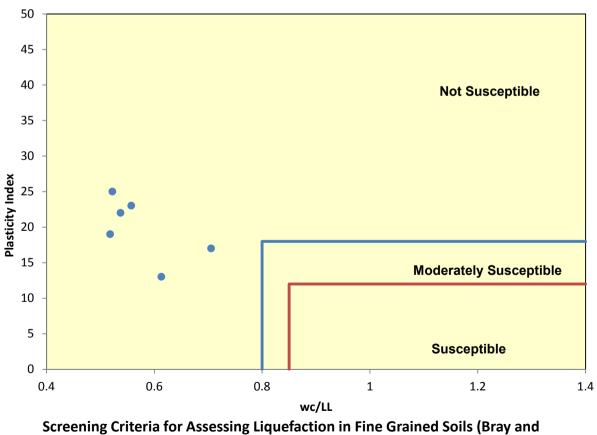


Screening Criteria for Liquefiable Fine-Grained Soils (Seed et al. 2003)



Screening Criteria for Liquefiable Fine-Grained Soils (Seed et al. 2003)

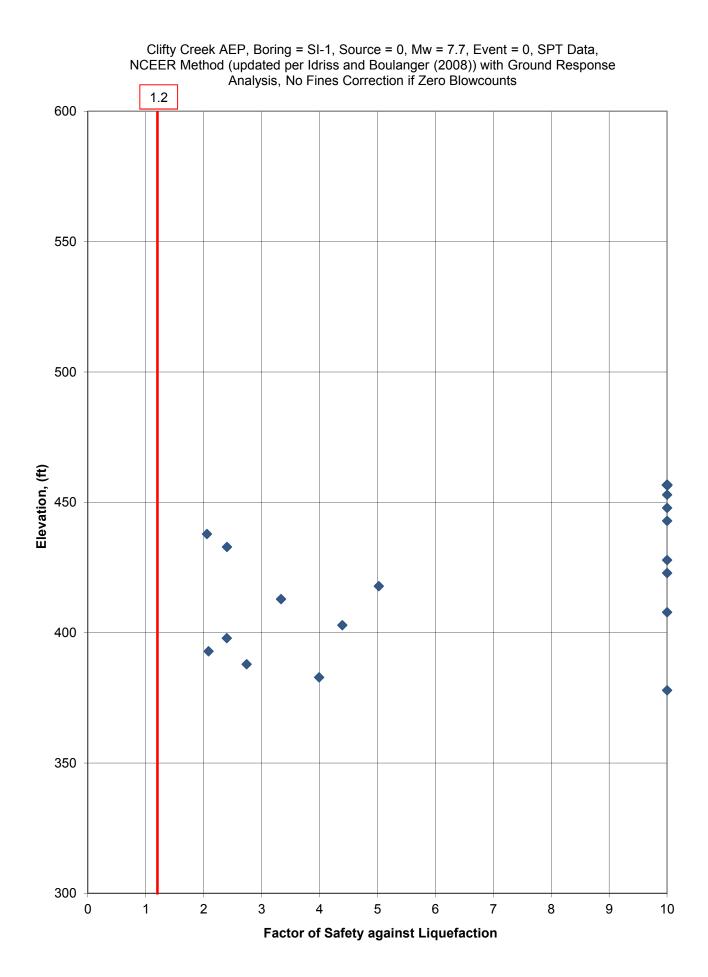


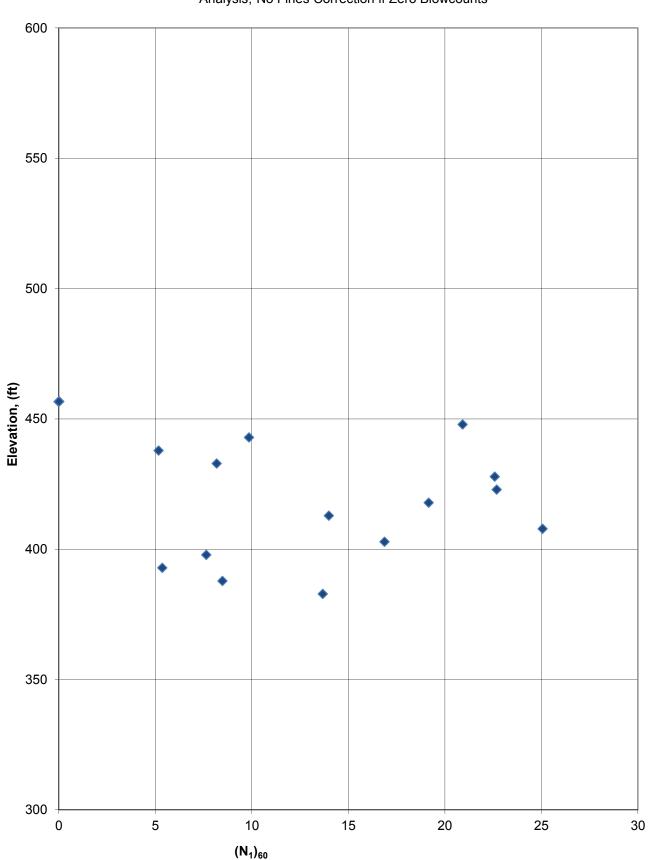


Screening Criteria for Assessing Liquefaction in Fine Grained Soils (Bray and Sancio 2006)

COARSE-GRAINED ANALYSIS

Depth of Mid. Pt. of Sample (ft.) Z	Vert. Total Stress during EQ (tsf) _{ov}	Vert. Total Stress during EQ w/ Fill (tsf) or with fill	Static Pore Pressure during EQ (tsf) u	Vert. Eff. Stress during EQ (tsf) ơ' _v	Vert. Eff. Stress during EQ w/ Fill (tsf) σ' _{v with fill}		C	Equivalen Clean San N-Value (N1)60cs		Ksigma	Kalpha	EQ Source 0 a max (g) 0.085 EQ Mag (Mw) 7.7 Mag. Scaling Factor (Cm)	CRR Design EQ	Simplified Stress Reduction Coeff., r _d	Simplified CSR eq Design EQ	Event (MCE, OBE, etc 0 EQ Motion File 0 Max. Shake Stress (psf) Design EQ	c.) Avg. Shake Stress (psf) Design EQ	CSR eq	ng SHAKE D FS liq Design EQ	FS liq	Shake Stress m4: m3: m2: m1: FS liq Design EQ	s Curve Fit Parameters
Г	totstr-top		Fill Total Fill u-top	Boring ID: Fill Elevation: Fill Height: Unit Weight: Total Stress: effstr-top	SI-1 456.6 0.0 125 0.00	5						not appropriate soils classified evaluated using	ly evaluated usi as CL, CH, CL-I g methods for fin soils with equive	as "NA" implies that t ing this methodology. ML and MH. These so e-grained soils. Also alent clean sand N-va	This applies to oils should be o, "NA" implies tha							
3.8	0.19 0.23	0.23	0.00	0.19 0.23	0.23	5.00	1.20	46	NA	1.000	1.000	0.95	NA	0.993	0.055	0	0	0.000	NA	10.0	NA	10.0
8.8	0.55	0.55	0.00	0.55	0.55	5.00	1.20	30	NA	1.000	1.000	0.95	NA	0.982	0.054	0	0	0.000	NA	10.0	NA	10.0
13.8	0.86	0.86	0.00	0.86	0.86	5.00	1.20	17	NA	1.000	1.000	0.95	NA	0.971	0.054	0	0	0.000	NA	10.0	NA	10.00
18.8 23.8	1.17 1.48	1.17 1.48	0.15 0.30	1.02 1.18	1.02 1.18	5.00 5.00	1.20 1.20	11	0.124 0.158	1.000 0.991	1.000 1.000	0.95 0.95	0.117	0.960 0.946	0.061 0.066	0	0	0.000	#DIV/0! #DIV/0!	#DIV/0! #DIV/0!	2.1 2.4	2.06 2.40
28.8	1.40	1.40	0.30	1.10	1.16	5.00	1.20	32	0.156 NA	0.991	1.000	0.95	0.149 NA	0.940	0.069	0	0	0.000	#DIV/0!	10.0	Z.4 NA	10.00
33.8	2.11	2.11	0.62	1.49	1.49	5.00	1.20	32	NA	0.950	1.000	0.95	NA	0.899	0.070	0	ő	0.000	NA	10.0	NA	10.00
38.8	2.42	2.42	0.77	1.65	1.65	5.00	1.20	28	0.369	0.943	1.000	0.95	0.330	0.862	0.070	0	0	0.000	#DIV/0!	#DIV/0!	5.0	5.02
43.8	2.73	2.73	0.93	1.81	1.81	5.00	1.20	22	0.239	0.945	1.000	0.95	0.214	0.816	0.068	0	0	0.000	#DIV/0!	#DIV/0!	3.3	3.34
48.8	3.05	3.05	1.08	1.96	1.96	5.00	1.20	35	NA	0.899	1.000	0.95	NA	0.765	0.066	0	0	0.000	NA	10.0	NA	10.00
53.8	3.36	3.36	1.24	2.12	2.12	5.00	1.20	25	0.297	0.920	1.000	0.95	0.259	0.715	0.063	0	0	0.000	#DIV/0!	#DIV/0!	4.4	4.39
58.8	3.67	3.67	1.40	2.28	2.28	5.00	1.20	14	0.152	0.936	1.000	0.95	0.135	0.670	0.060	0	0	0.000	#DIV/0!	#DIV/0!	2.4	2.40
63.8	3.98	3.98	1.55	2.43	2.43	5.00	1.20	11	0.126	0.937	1.000	0.95	0.112	0.631	0.057	0	0	0.000	#DIV/0!	#DIV/0!	2.1	2.08
68.8	4.30	4.30	1.71	2.59	2.59	5.00	1.20	15	0.162	0.923	1.000	0.95	0.142	0.599	0.055	0	0	0.000	#DIV/0!	#DIV/0!	2.7	2.74
73.8 78.8	4.61 4.92	4.61 4.92	1.86 2.02	2.75 2.90	2.75 2.90	5.00 5.00	1.20 1.20	21 62	0.234 NA	0.902 0.697	1.000 1.000	0.95 0.95	0.200 NA	0.573 0.553	0.053 0.052	0 0	0	0.000 0.000	#DIV/0! NA	#DIV/0! 10.0	4.0 NA	3.99 10.00

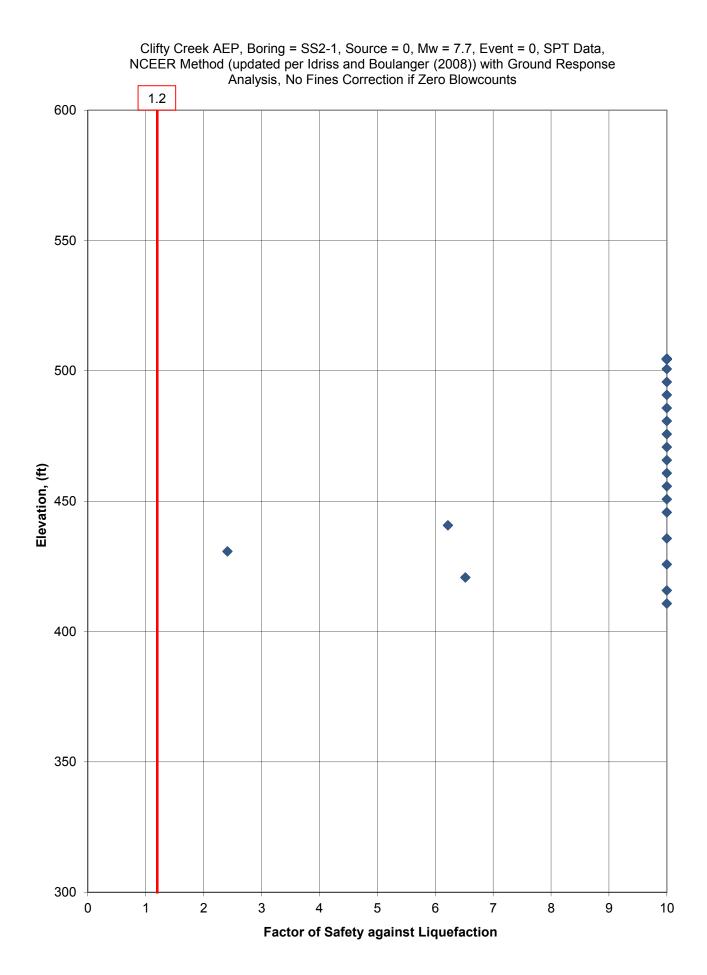


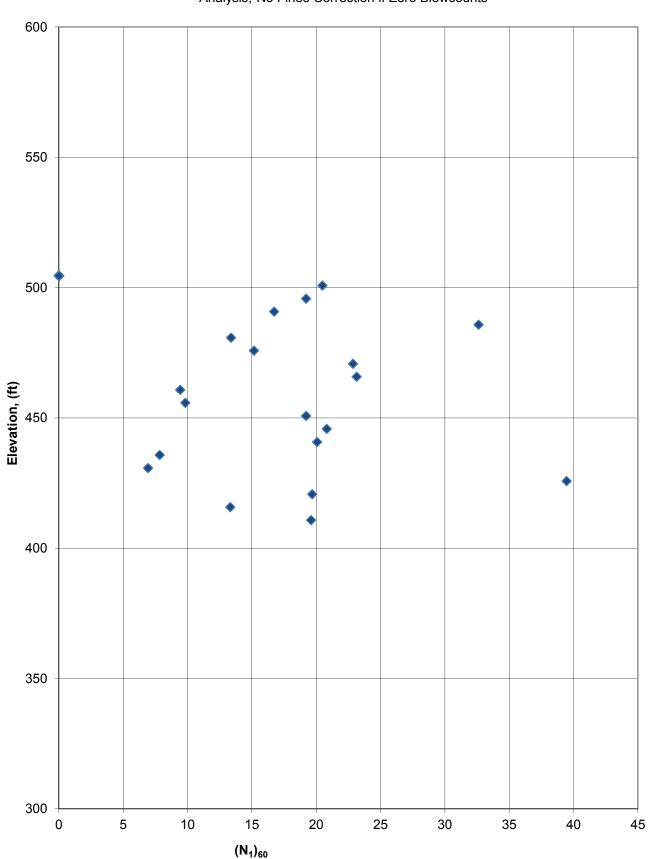


Clifty Creek AEP, Boring = SI-1, Source = 0, Mw = 7.7, Event = 0, SPT Data, NCEER Method (updated per Idriss and Boulanger (2008)) with Ground Response Analysis, No Fines Correction if Zero Blowcounts

NCEER_Liq_SPT_SS2-1_M7.7.xlsx - part2

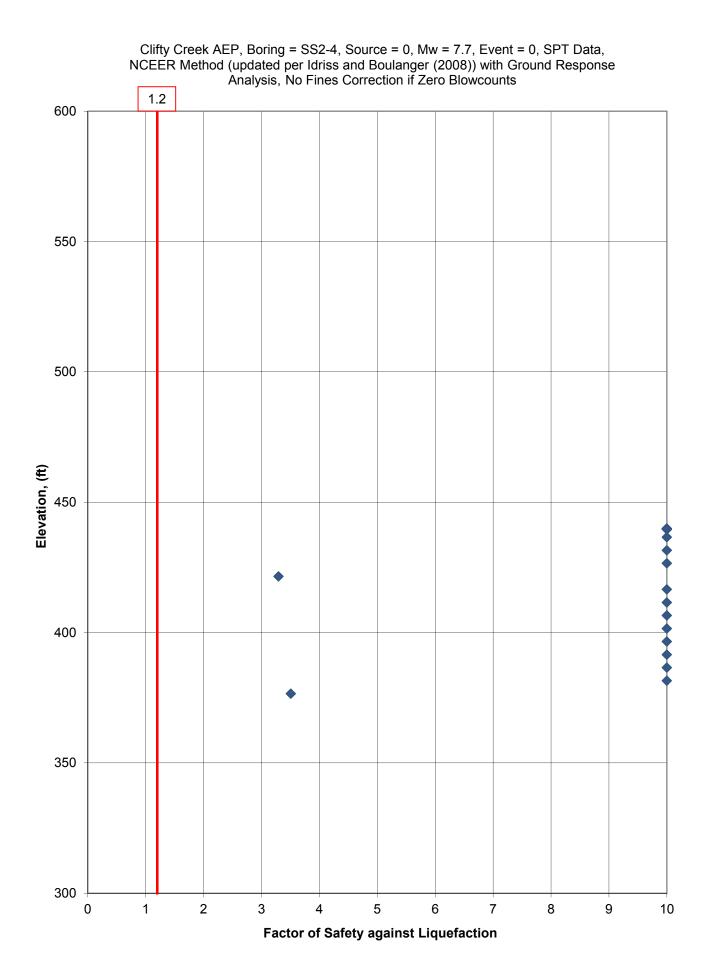
N	Depth of Vid. Pt. Sample (ft.) Z	Vert. Total Stress during EQ (tsf) _{ov}	Vert. Total Stress during EQ w/ Fill (tsf) G _{v with fil}	Static Pore Pressure during EQ (tsf) u	Vert. Eff. Stress during EQ (tsf) ơ'v	Vert. Eff. Stress during EQ w/ Fill (tsf) of'v with fill	Effective All-Around Stress during EQ (psf) o'm	Shear Modulus during EQ (ksf) G _{max}	Alpha I		Equivalent Clean Sano N-Value (N1)60cs	CRR7.5	Ksigma	Kalpha	EQ Source 0 a max (g) 0.085 EQ Mag (Mw) 7.7 Mag. Scaling Factor (Cm)	CRR Design EQ	Simplified Stress Reduction Coeff., r _d	Simplified CSR eq Design EQ	Event (MCE, OBE, et 0 EQ Motion File 0 Max. Shake Stress (psf) Design EQ	c.) Avg. Shake Stress (psf) Design EQ	CSR eq	ng SHAKE D: FS liq Design EQ	FS liq	Shake Stress m4: m3: m2: m1: FS liq Design EQ	s Curve Fit Parameters 0 0 0 Simplified FS liq for plot
	E		-	Fill Total U Fill 1	Boring ID: ill Elevation: Fill Height: Jnit Weight: Fotal Stress:	504.5 0.0 125 0.00					T hole elev.)			not appropriate soils classified evaluated using	ly evaluated usi as CL, CH, CL-I methods for fir soils with equiv	as "NA" implies that th ing this methodology. ML and MH. These so ne-grained soils. Also, ralent clean sand N-va	This applies to ils should be "NA" implies the							
		totstr-top 0.19		u-top 0.00	effstr-top 0.19																				
	3.8	0.23	0.23	0.00	0.23	0.23	312.50	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.993	0.055	0	0	0.000	NA	10.0	NA	10.00
	8.8	0.55	0.55	0.00	0.55	0.55	729.17	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.982	0.054	0	0	0.000	NA	10.0	NA	10.00
	13.8	0.86	0.86	0.12	0.74	0.74	989.83	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.971	0.062	0	0	0.000	NA	10.0	NA	10.00
	18.8	1.17	1.17	0.27	0.90	0.90	1198.50	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.960	0.069	0	0	0.000	NA	10.0	NA	10.00
	23.8	1.48	1.48	0.43	1.06	1.06	1407.17	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.946	0.074	0	0	0.000	NA	10.0	NA	10.00
	28.8	1.80	1.80	0.59	1.21	1.21	1615.83	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.927	0.076	0	0	0.000	NA	10.0	NA	10.00
	33.8	2.11	2.11	0.74	1.37	1.37	1824.50	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.899	0.077	0	0	0.000	NA	10.0	NA	10.00
	38.8	2.42	2.42	0.90	1.52	1.52	2033.17	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.862	0.076	0	0	0.000	NA	10.0	NA	10.00
	43.8	2.73	2.73	1.05	1.68	1.68	2241.83	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.816	0.073	0	0	0.000	NA	10.0	NA	10.00
	48.8	3.05	3.05	1.21	1.84	1.84	2450.50	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.765	0.070	0	0	0.000	NA	10.0	NA	10.00
	53.8	3.36	3.36	1.37	1.99	1.99	2659.17	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.715	0.067	0	0	0.000	NA	10.0	NA	10.00
	58.8	3.67	3.67	1.52	2.15	2.15	2867.83	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.670	0.063	0	0	0.000	NA	10.0	NA	10.00
	63.8	3.98	3.98	1.68	2.31	2.31	3076.50	#NUM!	5.00	1.20	29	0.414	0.896	1.000	0.95	0.352	0.631	0.060	0	0	0.000	#DIV/0!	#DIV/0!	6.2	6.22
	68.8	4.30	4.30	1.83	2.46	2.46	3285.17	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.599	0.058	0	0	0.000	NA	10.0	NA	10.00
	73.8	4.61	4.61	1.99	2.62	2.62	3493.83	#NUM!	5.00	1.20	13	0.144	0.928	1.000	0.95	0.126	0.573	0.056	0	0	0.000	#DIV/0!	#DIV/0!	2.4	2.41
	78.8	4.92	4.92	2.15	2.78	2.78	3702.50	#NUM!	5.00	1.20	52	NA	0.711	1.000	0.95	NA	0.553	0.054	0	0	0.000	NA	10.0	NA	10.00
	83.8	5.23	5.23	2.30	2.93	2.93	3911.17	#NUM!	5.00	1.20	29	0.393	0.869	1.000	0.95	0.324	0.536	0.053	0	0	0.000	#DIV/0!	#DIV/0!	6.5	6.52
	88.8	5.55	5.55	2.46	3.09	3.09	4119.83	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.522	0.052	0	0	0.000	NA	10.0	NA	10.00
	93.8	5.86	5.86	2.61	3.25	3.25	4328.50	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.511	0.051	0	0	0.000	NA	10.0	NA	10.00

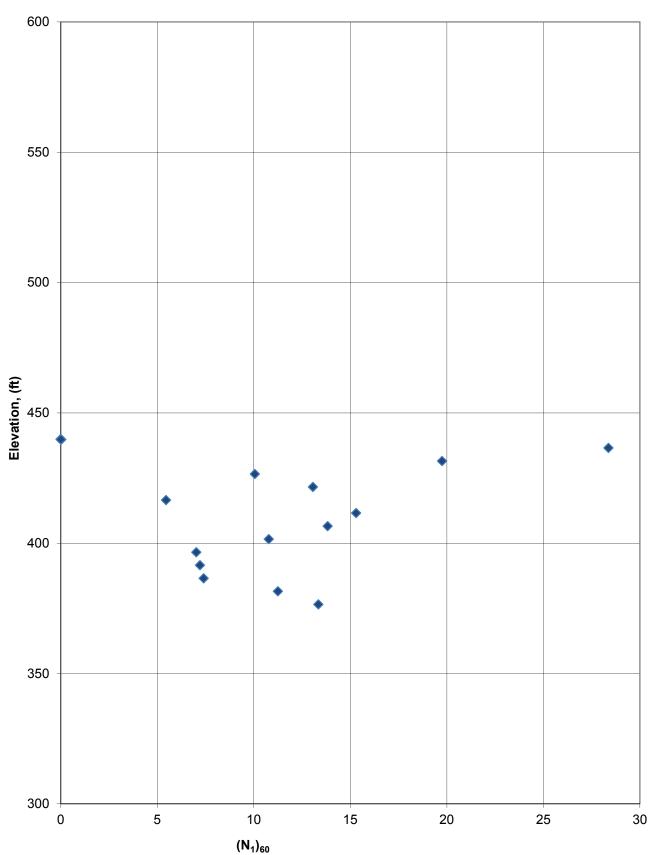




Clifty Creek AEP, Boring = SS2-1, Source = 0, Mw = 7.7, Event = 0, SPT Data, NCEER Method (updated per Idriss and Boulanger (2008)) with Ground Response Analysis, No Fines Correction if Zero Blowcounts

Depth of Mid. Pt. of Sample (ft.) Z	Vert. Total Stress during EQ (tsf) σ _v	Vert. Total Stress during EQ w/ Fill (tsf) o _{v with fill}	Static Pore Pressure during EQ (tsf) u	Vert. Eff. Stress during EQ (tsf) ơ'v	Vert. Eff. Stress during EQ w/ Fill (tsf) o' _{v with fill}		C	Equivalent Clean Sand N-Value (N1)60cs		Ksigma	Kalpha	EQ Source 0 a max (g) 0.085 EQ Mag (Mw) 7.7 Mag. Scaling Factor (Cm)	CRR Design EQ	Simplified Stress Reduction Coeff., r _d	Simplified CSR eq Design EQ	Event (MCE, OBE, etc 0 EQ Motion File 0 Max. Shake Stress (psf) Design EQ	c.) Avg. Shake Stress (psf) Design EQ	CSR eq	ng SHAKE D FS liq Design EQ	FS liq	Shake Stress m4: m3: m2: m1: FS liq Design EQ	s Curve Fit Parameters 0 0 0 0 5 5 5 5 5 6 6 6 6 6 6 6 6 6 6 6
			Fill Total	Boring ID: Fill Elevation: Fill Height: Unit Weight: Total Stress:	: 439.8 0.0	5						not appropriate soils classified evaluated using	ly evaluated usi as CL, CH, CL-I g methods for fir soils with equiv	as "NA" implies that ti ing this methodology. ML and MH. These so ne-grained soils. Also, alent clean sand N-va	This applies to bils should be "NA" implies tha							
	totstr-top 0.16		u-top 0.00	effstr-top 0.16	1								1									
3.3	0.20	0.20	0.00	0.20	0.20	NA	NA	NA	NA	NA	NA	0.95	NA	0.994	0.055	0	0	0.000	NA	10.0	NA	10.00
8.3	0.52	0.52	0.00	0.52	0.52	NA	NA	NA	NA	NA	NA	0.95	NA	0.983	0.054	0	0	0.000	NA	10.0	NA	10.00
13.3	0.83	0.83	0.10	0.73	0.73	NA	NA	NA	NA	NA	NA	0.95	NA	0.972	0.061	0	0	0.000	NA	10.0	NA	10.00
18.3	1.14	1.14	0.26	0.88	0.88	5.00	1.20	21	0.224	1.000	1.000	0.95	0.212	0.961	0.069	0	0	0.000	#DIV/0!	#DIV/0!	3.3	3.29
23.3	1.45	1.45	0.41	1.04	1.04	NA	NA	NA	NA	NA	NA	0.95	NA	0.948	0.073	0	0	0.000	NA	10.0	NA	10.00
28.3	1.77	1.77	0.57	1.20	1.20	NA	NA	NA	NA	NA	NA	0.95	NA	0.929	0.076	0	0	0.000	NA	10.0	NA	10.00
33.3	2.08	2.08	0.73	1.35	1.35	NA	NA	NA	NA	NA NA	NA	0.95 0.95	NA NA	0.902	0.077	0	0	0.000	NA	10.0	NA	10.00
38.3	2.39 2.70	2.39 2.70	0.88 1.04	1.51 1.67	1.51 1.67	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	0.95	NA NA	0.866 0.821	0.076 0.074	0	0	0.000	NA NA	10.0 10.0	NA NA	10.00 10.00
43.3 48.3	3.02	3.02	1.04	1.67	1.67	NA	NA	NA	NA	NA	NA	0.95	NA	0.821	0.074	0	0	0.000	NA	10.0	NA	10.00
40.3 53.3	3.33	3.33	1.19	1.02	1.02	NA	NA	NA	NA	NA	NA	0.95	NA	0.720	0.070	0	0	0.000	NA	10.0	NA	10.00
58.3	3.64	3.64	1.51	2.14	2.14	NA	NA	NA	NA	NA	NA	0.95	NA	0.674	0.063	0	0	0.000	NA	10.0	NA	10.00
63.3	3.95	3.95	1.66	2.29	2.29	5.00	1.20	21	0.228	0.920	1.000	0.95	0.199	0.634	0.060	0	0	0.000	#DIV/0!	#DIV/0!	3.5	3.50

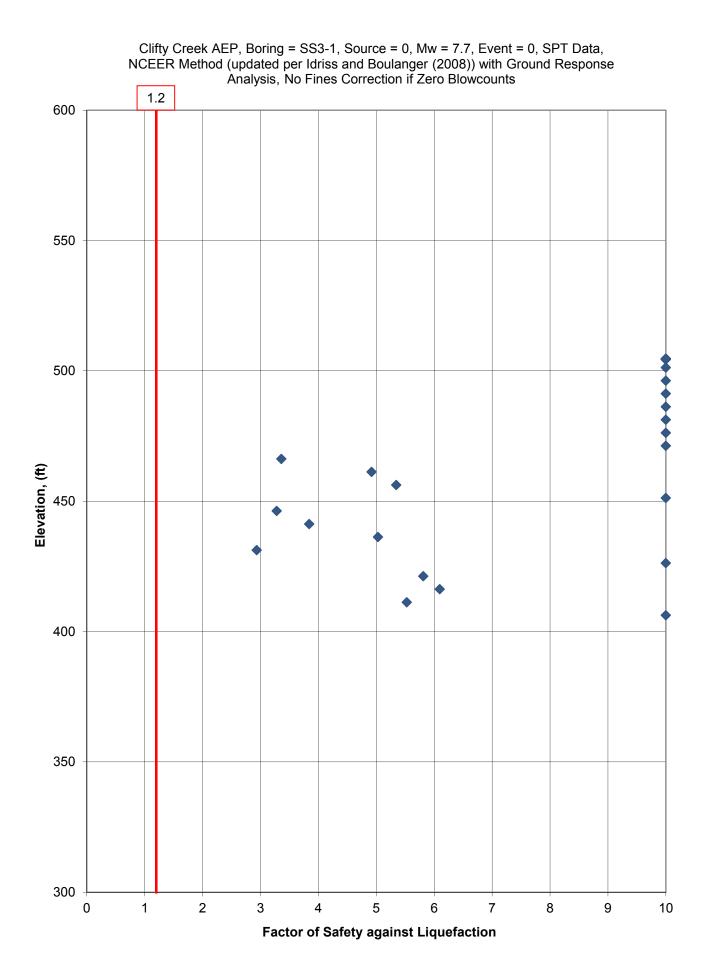


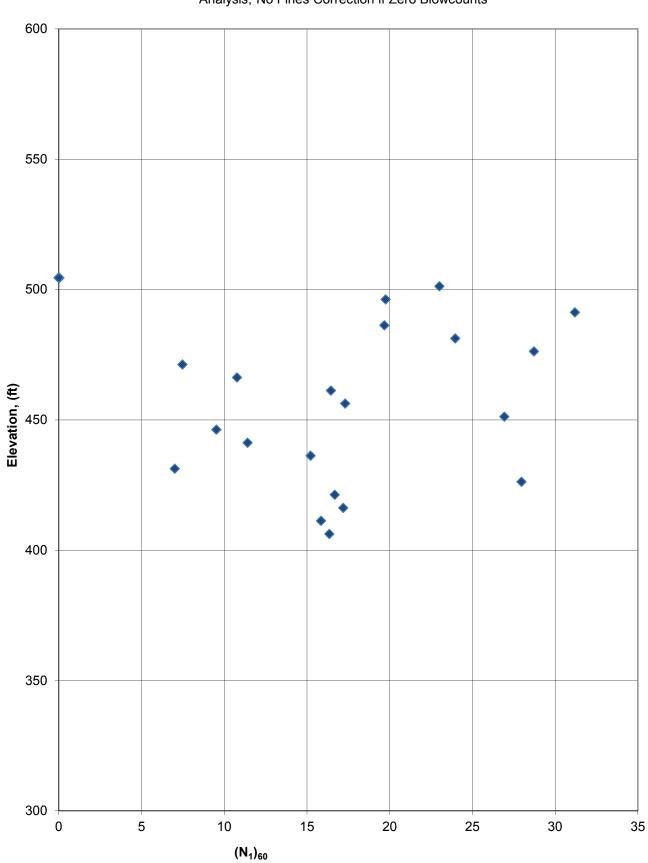


Clifty Creek AEP, Boring = SS2-4, Source = 0, Mw = 7.7, Event = 0, SPT Data, NCEER Method (updated per Idriss and Boulanger (2008)) with Ground Response Analysis, No Fines Correction if Zero Blowcounts

NCEER_Liq_SPT_SS3-1_M7.7.xlsx - part2

Depth of Mid. Pt. of Sample (ft.) z	Vert. Total Stress during EQ (tsf) σ _v	Vert. Total Stress during EQ w/ Fill (tsf) σ _{v with fil}	Static Pore Pressure during EQ (tsf) u	Vert. Eff. Stress during EQ (tsf) ơ'v	Vert. Eff. Stress during EQ w/ Fill (tsf) o' _{v with fil}	Effective All-Around Stress during EQ (psf) o'm	Shear Modulus during EQ (ksf) G _{max}	Alpha I		Equivalent Clean Sand N-Value (N1)60cs	CRR7.5	Ksigma	Kalpha	EQ Source 0 a max (g) 0.085 EQ Mag (Mw) 7.7 Mag. Scaling Factor (Cm)	CRR Design EQ	Simplified Stress Reduction Coeff., r _d	Simplified CSR eq Design EQ	Event (MCE, OBE, etc 0 EQ Motion File 0 Max. Shake Stress (psf) Design EQ	c.) Avg. Shake Stress (psf) Design EQ	CSR eq	ing SHAKE D FS liq Design EQ	ata FS liq for plot	Shake Stress m4: m3: m2: m1: FS liq Design EQ	s Curve Fit Parameters 0 0 Simplified FS liq for plot
	totstr-top	1	Fill Total	Boring ID: ill Elevation: Fill Height: Unit Weight: Total Stress: effstr-top	504.5					hole elev)			not appropriate soils classified evaluated using	ly evaluated usi as CL, CH, CL-N g methods for fin soils with equive	as "NA" implies that t ng this methodology. ML and MH. These so re-grained soils. Also, alent clean sand N-ve	This applies to pils should be , "NA" implies tha							
	0.16		0.00	0.16		270.83										0.994	0.055					10.0		10.00
3.3 8.3	0.20 0.52	0.20 0.52	0.00	0.20 0.52	0.20 0.52	687.50	#NUM! #NUM!	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	0.95 0.95	NA NA	0.994	0.055	0	0	0.000 0.000	NA NA	10.0	NA NA	10.00
13.3	0.83	0.83	0.00	0.32	0.82	1104.17	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.972	0.054	0	0	0.000	NA	10.0	NA	10.00
18.3	1.14	1.14	0.00	1.14	1.14	1520.83	#NUM!	5.00	1.20	29	NA	0.990	1.000	0.95	NA	0.961	0.053	õ	õ	0.000	NA	10.0	NA	10.00
23.3	1.45	1.45	0.00	1.45	1.45	1937.50	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.948	0.052	0	0	0.000	NA	10.0	NA	10.00
28.3	1.77	1.77	0.00	1.77	1.77	2354.17	#NUM!	5.00	1.20	39	NA	0.909	1.000	0.95	NA	0.929	0.051	0	0	0.000	NA	10.0	NA	10.00
33.3	2.08	2.08	0.10	1.98	1.98	2635.63	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.902	0.052	0	0	0.000	NA	10.0	NA	10.00
38.3	2.39	2.39	0.26	2.13	2.13	2844.30	#NUM!	5.00	1.20	18	0.191	0.935	1.000	0.95	0.169	0.866	0.054	0	0	0.000	#DIV/0!	#DIV/0!	3.4	3.36
43.3	2.70	2.70	0.41	2.29	2.29	3052.97	#NUM!	5.00	1.20	25	0.287	0.911	1.000	0.95	0.248	0.821	0.054	0	0	0.000	#DIV/0!	#DIV/0!	4.9	4.92
48.3	3.02	3.02	0.57	2.45	2.45	3261.63	#NUM!	5.00	1.20	26	0.308	0.904	1.000	0.95	0.264	0.771	0.052	0	0	0.000	#DIV/0!	#DIV/0!	5.3	5.34
53.3	3.33	3.33	0.73	2.60	2.60	3470.30	#NUM!	5.00	1.20	37	NA	0.847	1.000	0.95	NA	0.720	0.051	0	0	0.000	NA	10.0	NA	10.00
58.3	3.64	3.64	0.88	2.76	2.76	3678.97	#NUM!	5.00	1.20	16	0.175	0.915	1.000	0.95	0.152	0.674	0.049	0	0	0.000	#DIV/0!	#DIV/0!	3.3	3.28
63.3	3.95	3.95	1.04	2.92	2.92	3887.63	#NUM!	5.00	1.20	19	0.200	0.906	1.000	0.95	0.172	0.634	0.048	0	0	0.000	#DIV/0!	#DIV/0!	3.8	3.84
68.3	4.27	4.27	1.19	3.07	3.07	4096.30	#NUM!	5.00	1.20	23	0.261	0.882	1.000	0.95	0.218	0.602	0.046	0	0	0.000	#DIV/0!	#DIV/0!	5.0	5.03
73.3	4.58	4.58	1.35	3.23	3.23	4304.97	#NUM!	5.00	1.20	13	0.144	0.908	1.000	0.95	0.124	0.576	0.045	0	0	0.000	#DIV/0!	#DIV/0!	2.9	2.93
78.3	4.89	4.89	1.51	3.39	3.39	4513.63	#NUM!	5.00	1.20	39	NA	0.794	1.000	0.95	NA	0.555	0.044	0	0	0.000	NA	10.0	NA	10.00
83.3	5.20 5.52	5.20	1.66 1.82	3.54 3.70	3.54 3.70	4722.30 4930.97	#NUM! #NUM!	5.00	1.20 1.20	25 26	0.292	0.861 0.856	1.000 1.000	0.95 0.95	0.239	0.538 0.524	0.044 0.043	U	0	0.000	#DIV/0! #DIV/0!	#DIV/0! #DIV/0!	5.8	5.81 6.09
88.3	5.52 5.83	5.52 5.83	1.82	3.70	3.70	4930.97 5139.63	#NUM! #NUM!	5.00 5.00	1.20	26 24	0.305	0.856	1.000	0.95	0.247	0.524	0.043	0	0	0.000	#DIV/0! #DIV/0!	#DIV/0! #DIV/0!	6.1 5.5	6.09 5.53
93.3 98.3	5.83 6.14	5.83 6.14	2.13	3.85 4.01	3.85 4.01	5348.30	#NUM! #NUM!	5.00 NA	1.20 NA	Z4 NA	0.274 NA	0.857 NA	1.000 NA	0.95	0.222 NA	0.512	0.043	0	0	0.000	#DIV/0! NA	#DIV/0! 10.0	5.5 NA	5.53
98.3	0.14	0.14	2.13	4.01	4.01	5548.30	#INUIVI!	NA	INA	INA	INA	NA	NA	0.95	NA	0.502	0.042	0	0	0.000	NA	10.0	NA	10.00

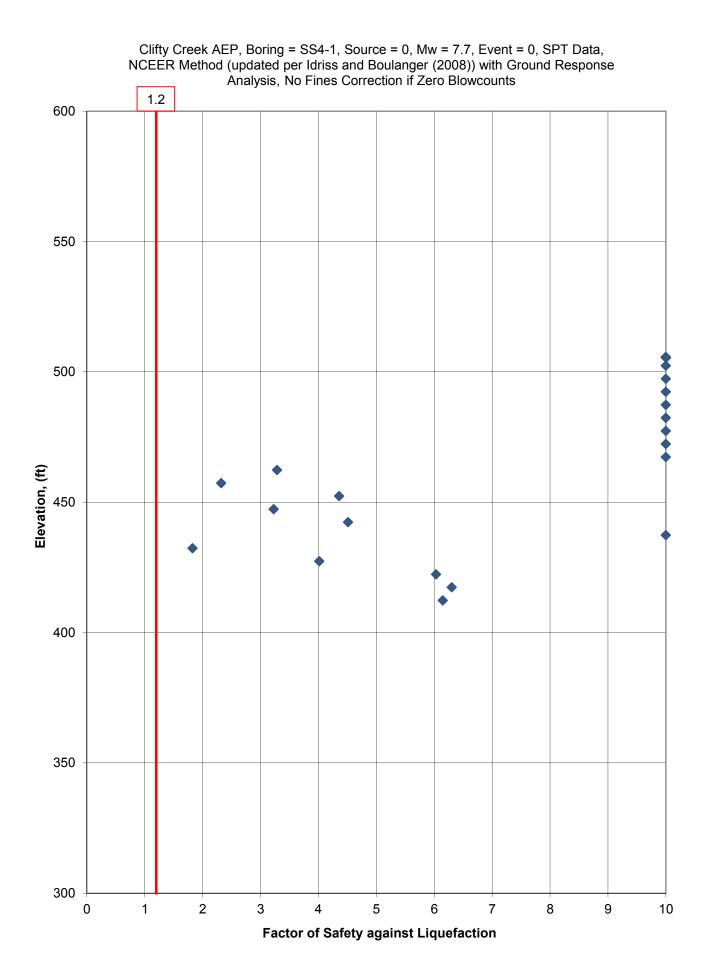


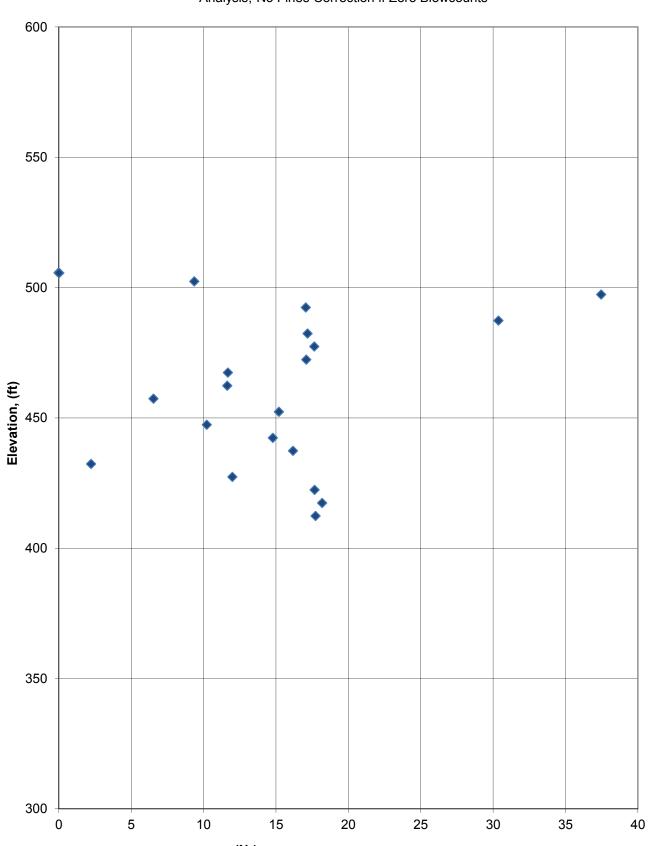


Clifty Creek AEP, Boring = SS3-1, Source = 0, Mw = 7.7, Event = 0, SPT Data, NCEER Method (updated per Idriss and Boulanger (2008)) with Ground Response Analysis, No Fines Correction if Zero Blowcounts

NCEER_Liq_SPT_SS4-1_M7.7.xlsx - part2

Depth of Mid. Pt. of Sample (ft.) Z	Vert. Total Stress during EQ (tsf) σ _v	Vert. Total Stress during EQ w/ Fill (tsf) G _{v with fil}	Static Pore Pressure during EQ (tsf) u	Vert. Eff. Stress during EQ (tsf) ơ' _v	Vert. Eff. Stress during EQ w/ Fill (tsf) σ' _{v with fil}	Effective All-Around Stress during EQ (psf) oʻm	Shear Modulus during EQ (ksf) G _{max}	Alpha I		Equivalent Clean Sano N-Value (N1)60cs	CRR7.5	Ksigma	Kalpha	EQ Source 0 a max (g) 0.085 EQ Mag (Mw) 7.7 Mag. Scaling Factor (Cm)	CRR Design EQ	Simplified Stress Reduction Coeff., r _d	Simplified CSR eq Design EQ	Event (MCE, OBE, et 0 EQ Motion File 0 Max. Shake Stress (psf) Design EQ	c.) Avg. Shake Stress (psf) Design EQ	CSR eq	ng SHAKE D FS liq Design EQ	ata FS liq	Shake Stres m4: m3: m2: m1: FS liq Design EQ	s Curve Fit Parameters 0 0 0 0 Simplified FS liq for plot
F			Fill Total L Fill T	otal Stress:	0.0 125 0.00					hole elev)			not appropriate soils classified evaluated using	ly evaluated usi as CL, CH, CL- g methods for fil soils with equiv	as "NA" implies that th ing this methodology. ML and MH. These so ne-grained soils. Also, ralent clean sand N-va	This applies to ils should be "NA" implies tha							
	totstr-top 0.16		u-top 0.00	effstr-top 0.16																				
3.3	0.20	0.20	0.00	0.10	0.20	270.83	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.994	0.055	0	0	0.000	NA	10.0	NA	10.00
8.3	0.52	0.52	0.00	0.52	0.52	687.50	#NUM!	5.00	1.20	50	NA	1.000	1.000	0.95	NA	0.983	0.054	0	0	0.000	NA	10.0	NA	10.00
13.3	0.83	0.83	0.00	0.83	0.83	1104.17	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.972	0.054	0	0	0.000	NA	10.0	NA	10.00
18.3	1.14	1.14	0.00	1.14	1.14	1520.83	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.961	0.053	0	0	0.000	NA	10.0	NA	10.00
23.3	1.45	1.45	0.00	1.45	1.45	1937.50	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.948	0.052	0	0	0.000	NA	10.0	NA	10.00
28.3	1.77	1.77	0.13	1.63	1.63	2177.37	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.929	0.055	0	0	0.000	NA	10.0	NA	10.00
33.3	2.08	2.08	0.29	1.79	1.79	2386.03	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.902	0.058	0	0	0.000	NA	10.0	NA	10.00
38.3	2.39	2.39	0.44	1.95	1.95	2594.70	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.866	0.059	0	0	0.000	NA	10.0	NA	10.00
43.3	2.70	2.70	0.60	2.10	2.10	2803.37	#NUM!	5.00	1.20	19	0.203	0.937	1.000	0.95	0.180	0.821	0.058	0	0	0.000	#DIV/0!	#DIV/0!	3.3	3.28
48.3	3.02	3.02	0.76	2.26	2.26	3012.03	#NUM!	5.00	1.20	13	0.139	0.940	1.000	0.95	0.124	0.771	0.057	0	0	0.000	#DIV/0!	#DIV/0!	2.3	2.32
53.3	3.33	3.33	0.91	2.42	2.42	3220.70	#NUM!	5.00	1.20	23	0.261	0.908	1.000	0.95	0.225	0.720	0.055	0	0	0.000	#DIV/0!	#DIV/0!	4.4	4.36
58.3	3.64	3.64	1.07	2.57	2.57	3429.37	#NUM!	5.00	1.20	17	0.184	0.918	1.000	0.95	0.160	0.674	0.053	0	0	0.000	#DIV/0!	#DIV/0!	3.2	3.22
63.3	3.95	3.95	1.22	2.73	2.73	3638.03	#NUM!	5.00	1.20	23	0.253	0.899	1.000	0.95	0.216	0.634	0.051	0	0	0.000	#DIV/0!	#DIV/0!	4.5	4.51
68.3	4.27	4.27	1.38	2.89	2.89	3846.70	#NUM!	NA	NA	NA	NA	NA	NA	0.95	NA	0.602	0.049	0	0	0.000	NA	10.0	NA	10.00
73.3	4.58	4.58	1.54	3.04	3.04	4055.37	#NUM!	5.00	1.20	8	0.093	0.931	1.000	0.95	0.082	0.576	0.048	0	0	0.000	#DIV/0!	#DIV/0!	1.8	1.83
78.3	4.89	4.89	1.69	3.20	3.20	4264.03	#NUM!	5.00	1.20	19	0.208	0.898	1.000	0.95	0.177	0.555	0.047	0	0	0.000	#DIV/0!	#DIV/0!	4.0	4.01
83.3	5.20	5.20	1.85	3.35	3.35	4472.70	#NUM!	5.00	1.20	26	0.318	0.867	1.000	0.95	0.261	0.538	0.046	0	0	0.000	#DIV/0!	#DIV/0!	6.0	6.03
88.3	5.52	5.52	2.00	3.51	3.51	4681.37	#NUM!	5.00	1.20	27	0.334	0.852	1.000	0.95	0.270	0.524	0.045	0	0	0.000	#DIV/0!	#DIV/0!	6.3	6.30
93.3	5.83	5.83	2.16	3.67	3.67	4890.03	#NUM!	5.00	1.20	26	0.320	0.857	1.000	0.95	0.260	0.512	0.045	0	0	0.000	#DIV/0!	#DIV/0!	6.1	6.15





Clifty Creek AEP, Boring = SS4-1, Source = 0, Mw = 7.7, Event = 0, SPT Data, NCEER Method (updated per Idriss and Boulanger (2008)) with Ground Response Analysis, No Fines Correction if Zero Blowcounts

(N₁)₆₀

APPENDIX I

STABILITY ANALYSIS

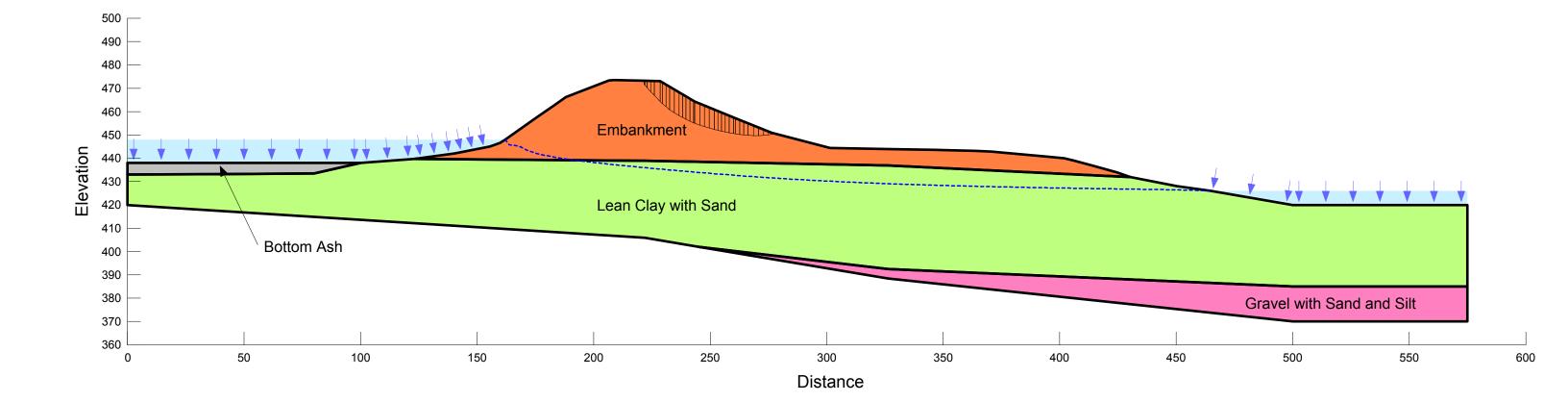
BOILER SLAG POND DAM: 2015 CCR MANDATE

			Drained Paramet	-
Material		Unit Weight (pcf)	Phi (deg.)	Cohesio (psf)
Embankmer	t (Drained)	130	33.2	165
Lean Clay w	ith Sand (Drained)	119	27.2	160
Gravel With	Silt and Sand (Drained)	130	35	0
Bottom Ash	(Drained)	115	28	0

L01_Normal Pool, Downstream Slope Failure Normal Pool Elevation: 448 Feet Drained Static Strengths Incipient Motion in the Downstream Direction Section A-A'

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.

No warranties can be made regarding the continuity of subsurface conditions.



Factor of Safety = 2.30

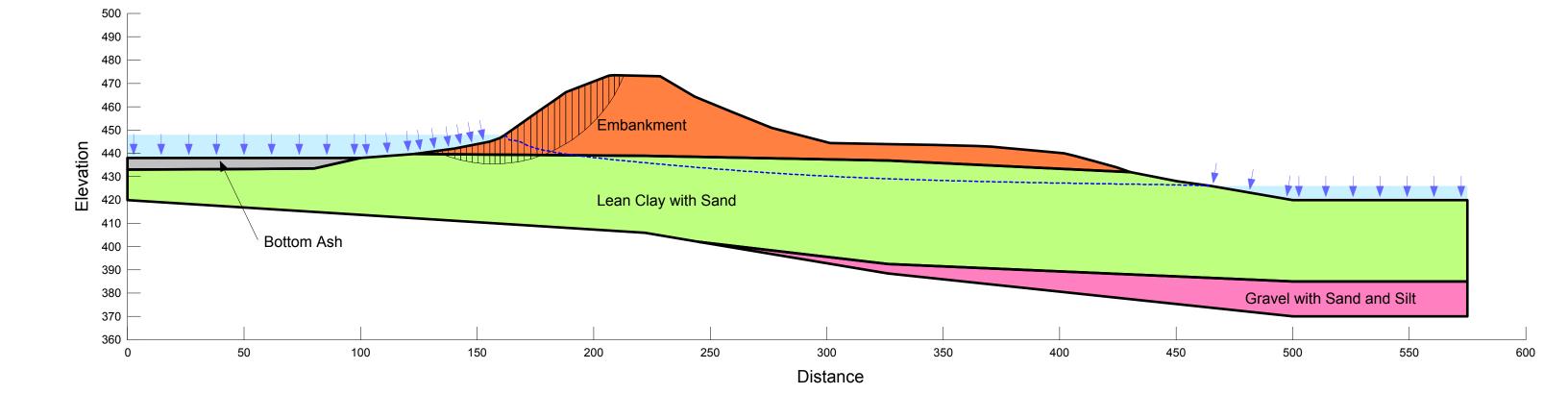
th

sion

Madison, Indiana			Drained Parame	Strength ters
CCR Mandate	Material	Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)
	Embankment (Drained)	130	33.2	165
L02_Normal Pool, Upstream Slope Failure Normal Pool Elevation: 448 Feet	Lean Clay with Sand (Drained)	119	27.2	160
Drained Static Strengths	Gravel With Silt and Sand (Drained)	130	35	0
Incipient Motion in the Upstream Direction Section A-A'	Bottom Ash (Drained)	115	28	0

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.

No warranties can be made regarding the continuity of subsurface conditions.



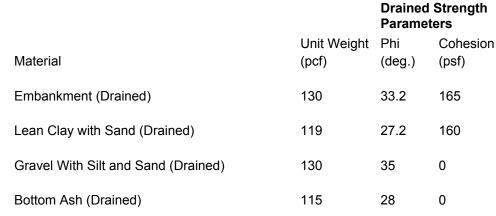
Factor of Safety = 1.88

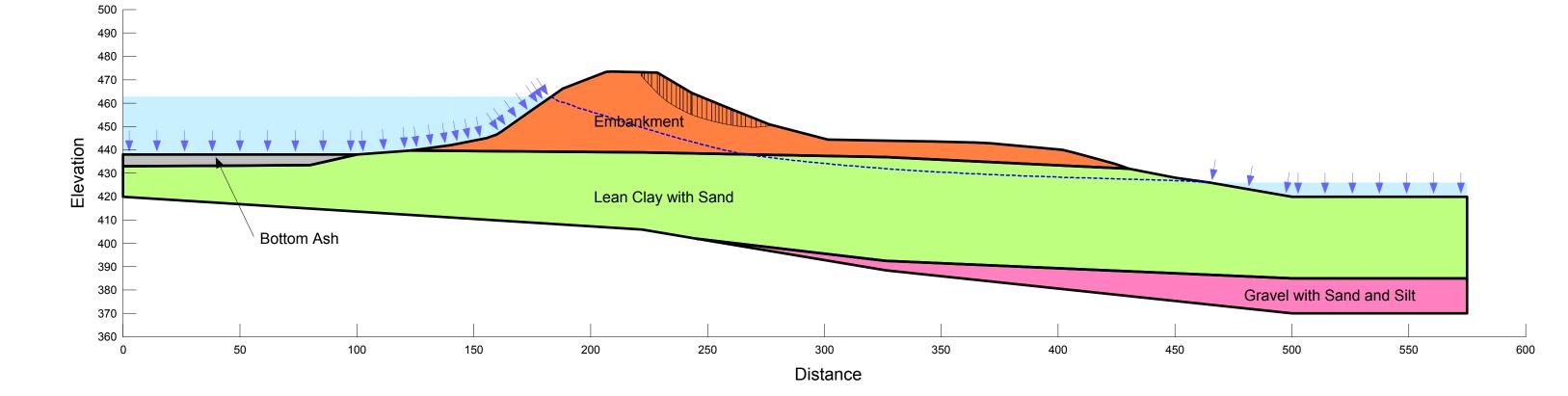
Section A-A'

	Material
	Embankment (Drained)
L03_50% PMF Pool, Downstream Slope Failure 50% PMF Pool Elevation: 462.8 Feet	Lean Clay with Sand (D
Drained Static Strengths Incipient Motion in the Downstream Direction	Gravel With Silt and Sa
Section A-A'	Bottom Ash (Drained)

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.

No warranties can be made regarding the continuity of subsurface conditions.



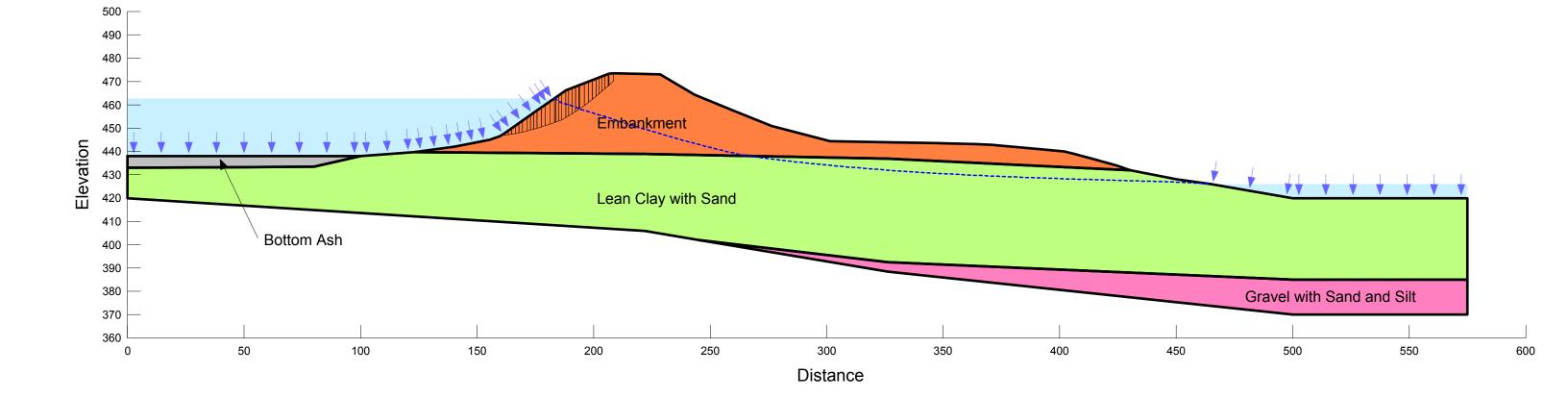


		Drained Paramet	-
Material	Unit Weight (pcf)	Phi (deg.)	Cohesi (psf)
Embankment (Drained)	130	33.2	165
Lean Clay with Sand (Drained)	119	27.2	160
Gravel With Silt and Sand (Drained)	130	35	0
Bottom Ash (Drained)	115	28	0

L04_50% PMF Pool, Upstream Slope Failure 50% PMF Pool Elevation: 462.8 Feet Drained Static Strengths Incipient Motion in the Upstream Direction Section A-A'

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.

No warranties can be made regarding the continuity of subsurface conditions.



Factor of Safety = 2.13

gth

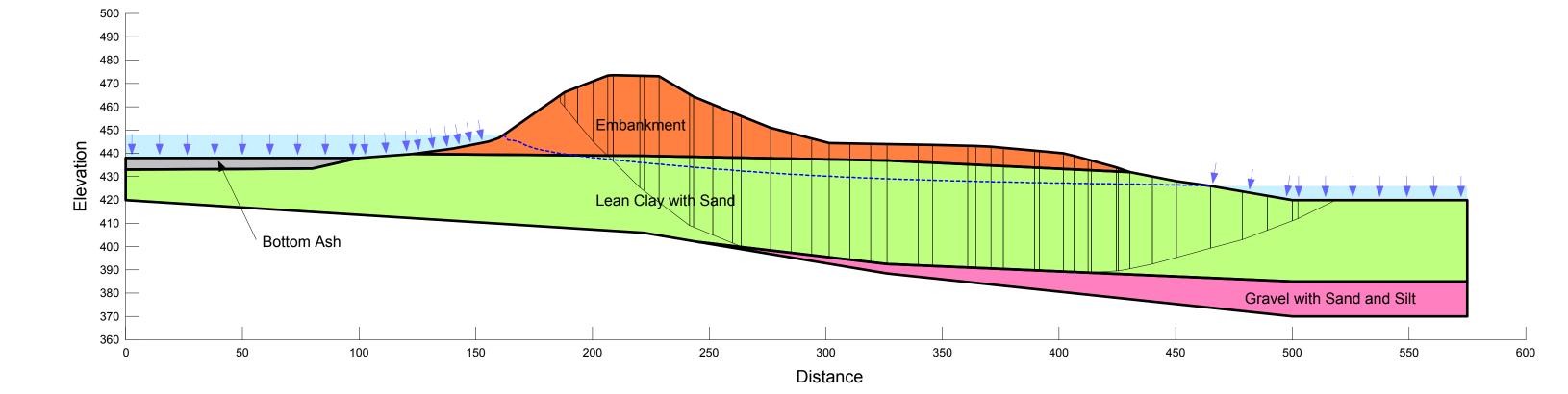
sion

L05_Seismic_Normal Pool, Downstream Slope Failure Normal Pool Elevation: 448 Feet Undrained Static Strengths Incipient Motion in the Downstream Direction Horizontal Acc: 0.085g Section A-A'

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.

No warranties can be made regarding the continuity of subsurface conditions.

		Drained Parame	Strength ters	Undrai Parame	ned Strength eters
Material	Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)	Phi (deg.)	Cohesion (psf)
Embankment (Seismic Undrained)	130	33.2	165	13	600
Lean Clay with Sand (Seismic Undrained)	119	27.2	160	5	1200
Gravel With Silt and Sand (Seismic Undrained)	130	35	0	35	0
Bottom Ash (Seismic Undrained)	115	28	0	28	0

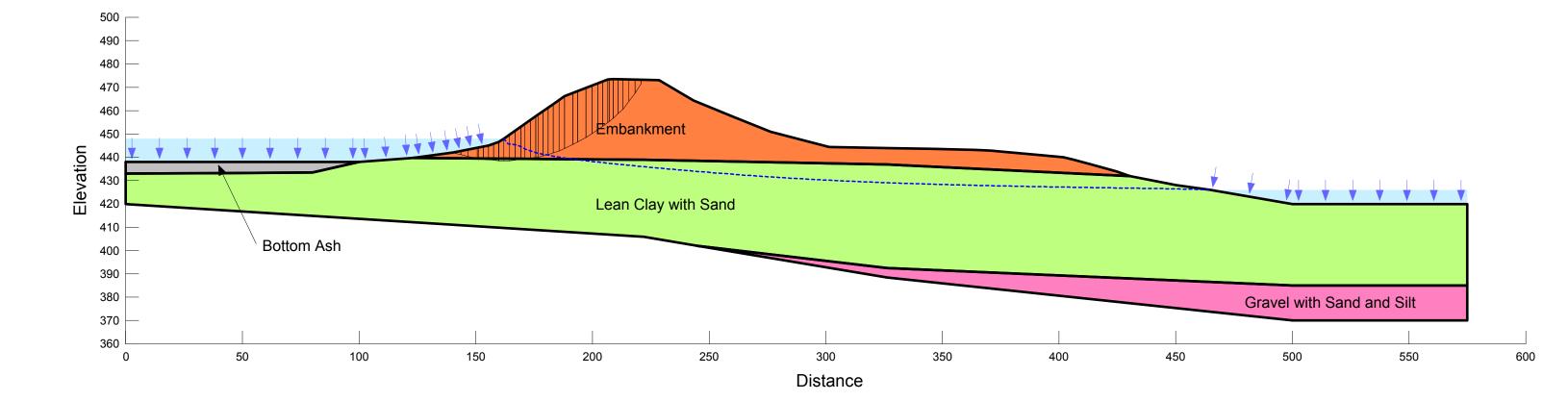


L06_Seismic_Normal Pool, Upstream Slope Failure Normal Pool Elevation: 448 Feet Undrained Static Strengths Incipient Motion in the Upstream Direction Horizontal Acc: 0.085g Section A-A'

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.

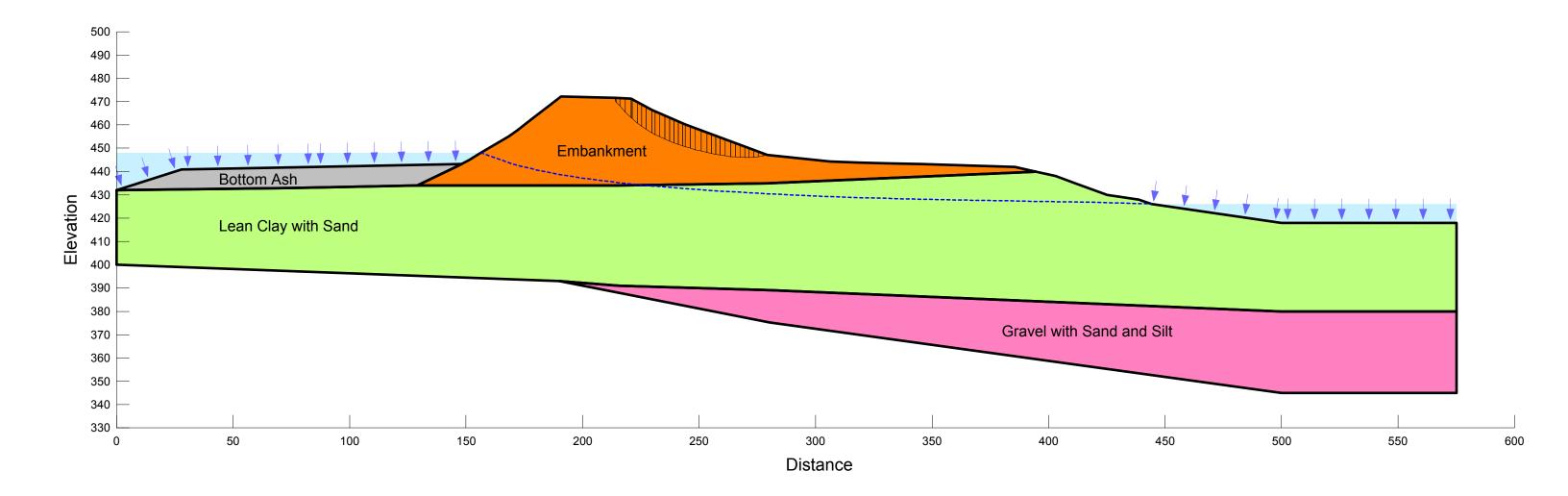
No warranties can be made regarding the continuity of subsurface conditions.

		Drained Parame	Strength ters	Undrair Parame	ned Strength eters
Material	Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)	Phi (deg.)	Cohesion (psf)
Embankment (Seismic Undrained)	130	33.2	165	13	600
Lean Clay with Sand (Seismic Undrained)	119	27.2	160	5	1200
Gravel With Silt and Sand (Seismic Undrained)	130	35	0	35	0
Bottom Ash (Seismic Undrained)	115	28	0	28	0



CCR Mandate		1.1	Pala
	Material	Unit Weight (pcf)	Phi (deg
L01_Normal Pool, Downstream Slope Failure Normal Pool Elevation: 448 Feet	Embankment (Drained)	130	33.2
Drained Static Strengths	Lean Clay With Sand (Drained)	119	27.2
Incipient Motion in the Downstream Direction Section B-B'	Gravel With Silt And Sand (Drained)	130	35
	Bottom Ash (Drained)	115	28

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.

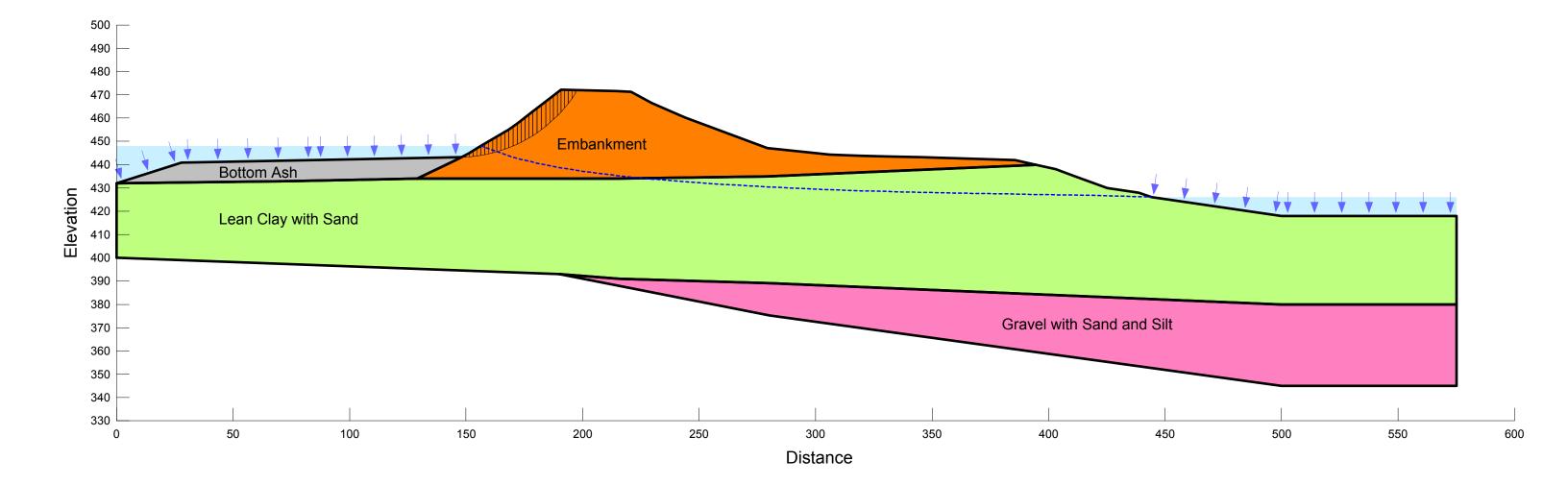


Drained Strength
Parameters

ni eg.)	Cohesion (psf)
8.2	165
.2	160
5	0
3	0

CCR Mandate	Material	Unit Weight (pcf)	Para Phi (deg
L02_Normal Pool, Upstream Slope Failure	Embankment (Drained)	130	33.2
Normal Pool Elevation: 448 Feet Drained Static Strengths Incipient Motion in the Upstream Direction Section B-B'	Lean Clay With Sand (Drained)	119	27.2
	Gravel With Silt And Sand (Drained)	130	35
	Bottom Ash (Drained)	115	28

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.

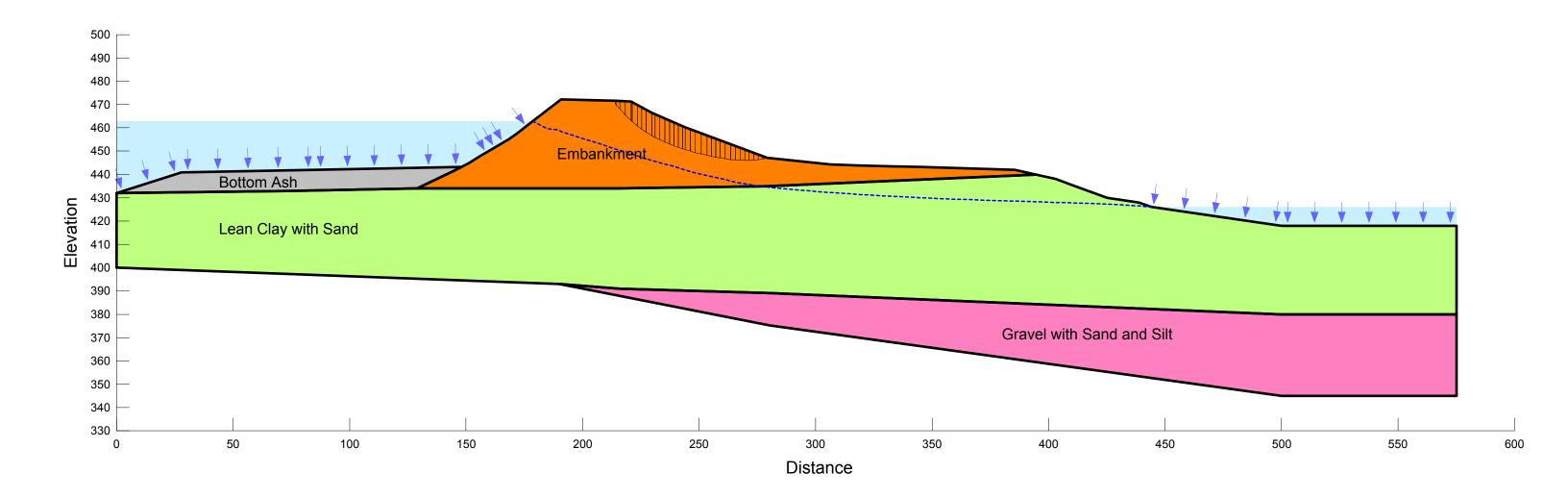


Drained Strength
Parameters

Phi (deg.)	Cohesion (psf)
33.2	165
27.2	160
35	0
28	0

CCR Manuale		Unit Weight	Phi
	Material	(pcf)	(deg
L03_50% PMF Pool, Downstream Slope Failure 50% PMF Pool Elevation: 462.8 Feet Drained Static Strengths Incipient Motion in the Downstream Direction Section B-B'	Embankment (Drained)	130	33.2
	Lean Clay With Sand (Drained)	119	27.2
	Gravel With Silt And Sand (Drained)	130	35
	Bottom Ash (Drained)	115	28

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.

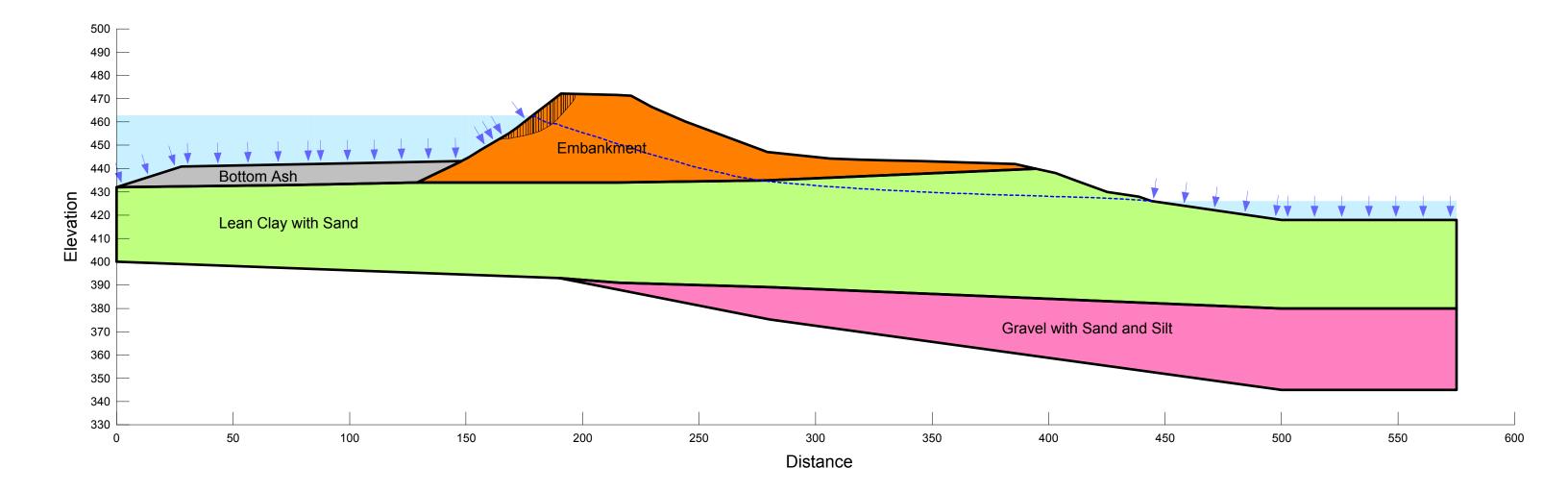


Drained Strength
Parameters

Phi (deg.)	Cohesion (psf)
33.2	165
27.2	160
35	0
28	0

CCR Mandate		Unit Weight	Phi
	Material	(pcf)	(deg
L04_50% PMF Pool, Upstream Slope Failure	Embankment (Drained)	130	33.2
50% PMF Pool Elevation: 462.8 Feet Drained Static Strengths	Lean Clay With Sand (Drained)	119	27.2
Incipient Motion in the Upstream Direction Section B-B'	Gravel With Silt And Sand (Drained)	130	35
	Bottom Ash (Drained)	115	28

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.



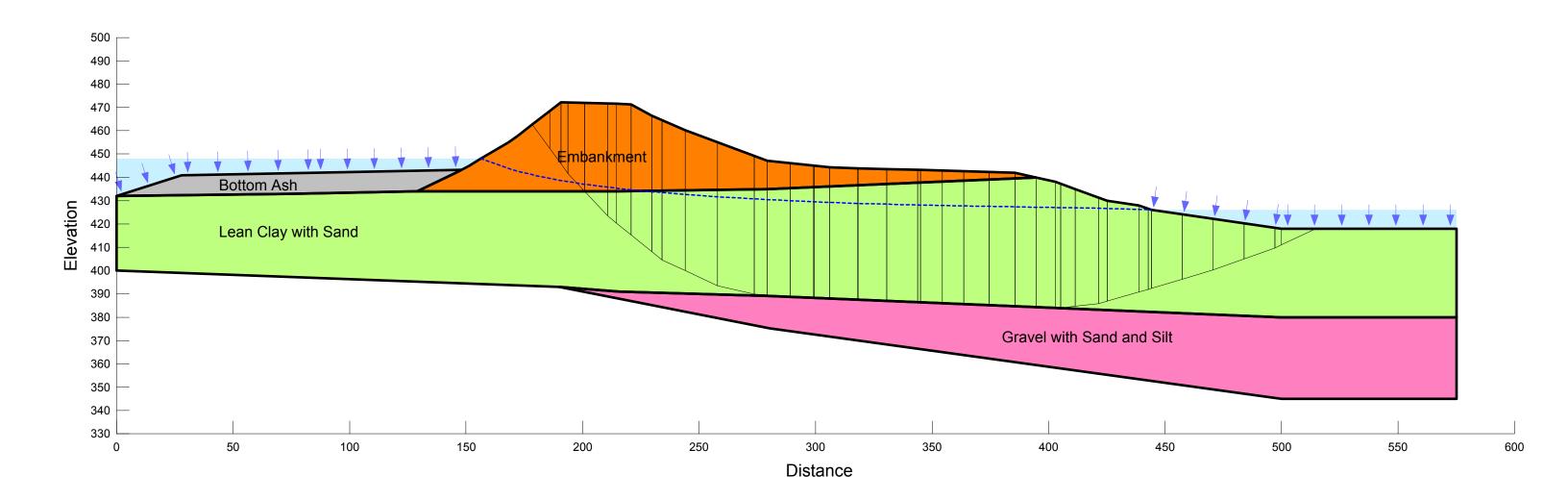
Drained Strength
Parameters

ni eg.)	Cohesion (psf)
8.2	165
.2	160
5	0
5	0

L05_Seismic_Normal Pool, Downstream Slope Failure Normal Pool Elevation: 448 Feet Undrained Static Strengths Incipient Motion in the Downstream Direction Horizontal Acc: 0.085g Section B-B'

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.

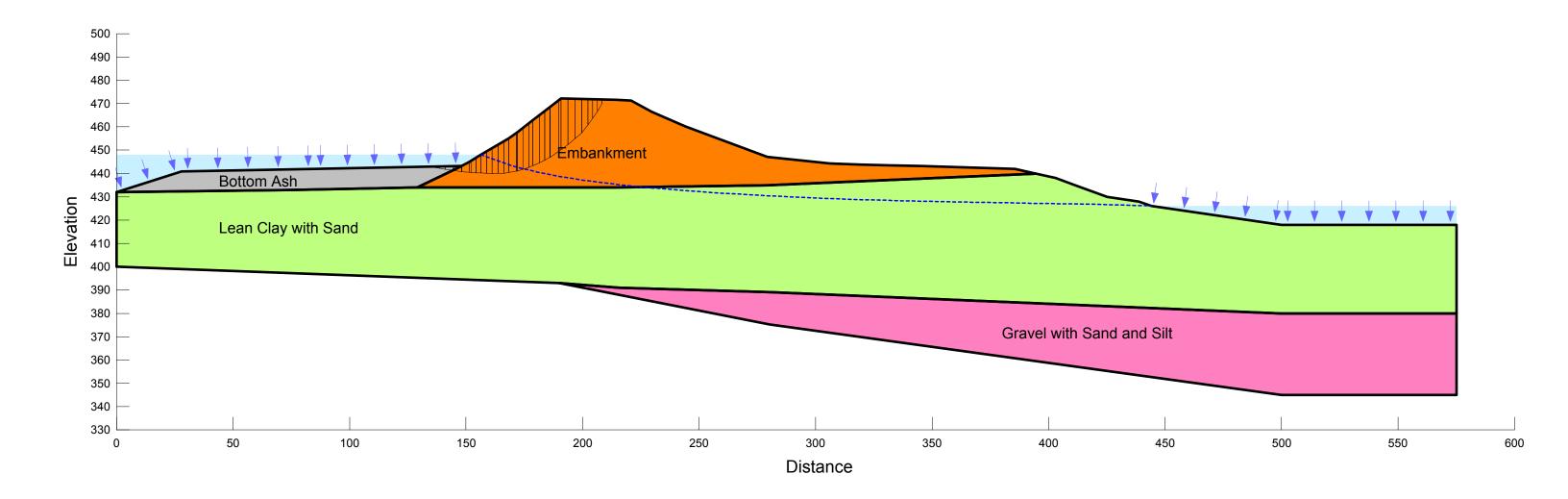
		Drained Strength Parameters		Undrained Strength Parameters	
Material	Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)	Phi (deg.)	Cohesion (psf)
Embankment (Seismic Undrained)	130	33.2	165	13	600
Lean Clay With Sand (Seismic Undrained)	119	27.2	160	5	1200
Gravel With Silt And Sand (Seismic Undrained)	130	35	0	35	0
Bottom Ash (Seismic Undrained)	115	28	0	28	0



L06_Seismic_Normal Pool, Upstream Slope Failure Normal Pool Elevation: 448 Feet Undrained Static Strengths Incipient Motion in the Upstream Direction Horizontal Acc: 0.085g Section B-B'

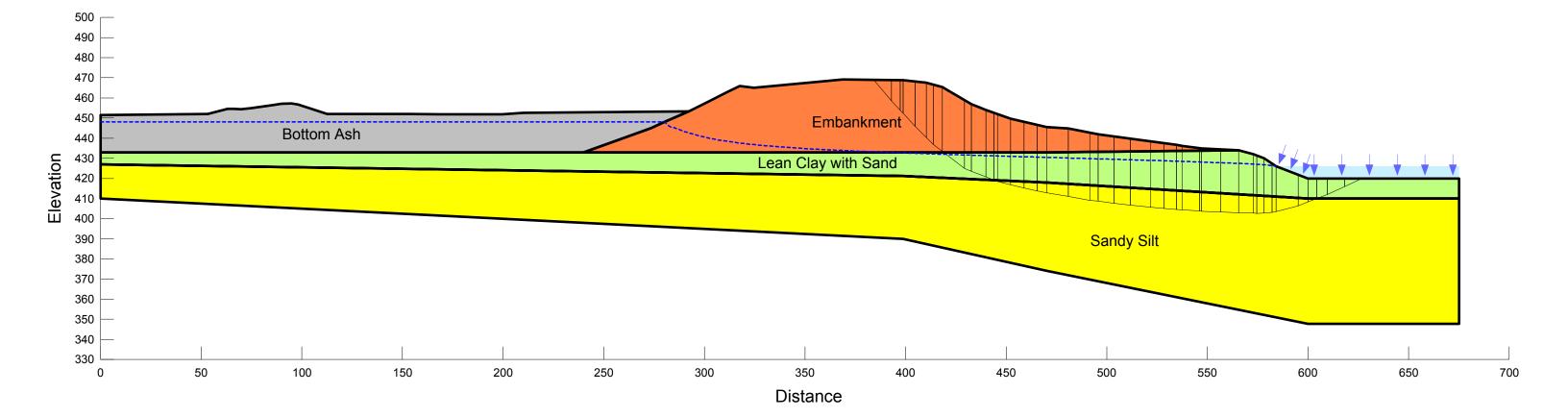
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.

	Unit Weight	Par Phi
Material	(pcf)	(de
Embankment (Seismic Undrained)	130	33.
Lean Clay With Sand (Seismic Undrained)	119	27.
Gravel With Silt And Sand (Seismic Undrained)	130	35
Bottom Ash (Seismic Undrained)	115	28



Drained Strength Parameters		Undrained Strength Parameters		
Phi (deg.)	Cohesion (psf)	Phi (deg.)	Cohesion (psf)	
33.2	165	13	600	
27.2	160	5	1200	
35	0	35	0	
28	0	28	0	

			Drained Parame
L01_Normal Pool, Downstream Slope Failure Normal Pool Elevation: 448 Feet Drained Static Strengths	Material	Unit Weight (pcf)	Phi (deg.)
Incipient Motion in the Downstream Direction Section C-C'	Embankment (Drained)	130	33.2
	Lean Clay with Sand (Drained)	119	27.2
	Sandy Silt (Drained)	130	30
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Bottom Ash (Drained)	115	28

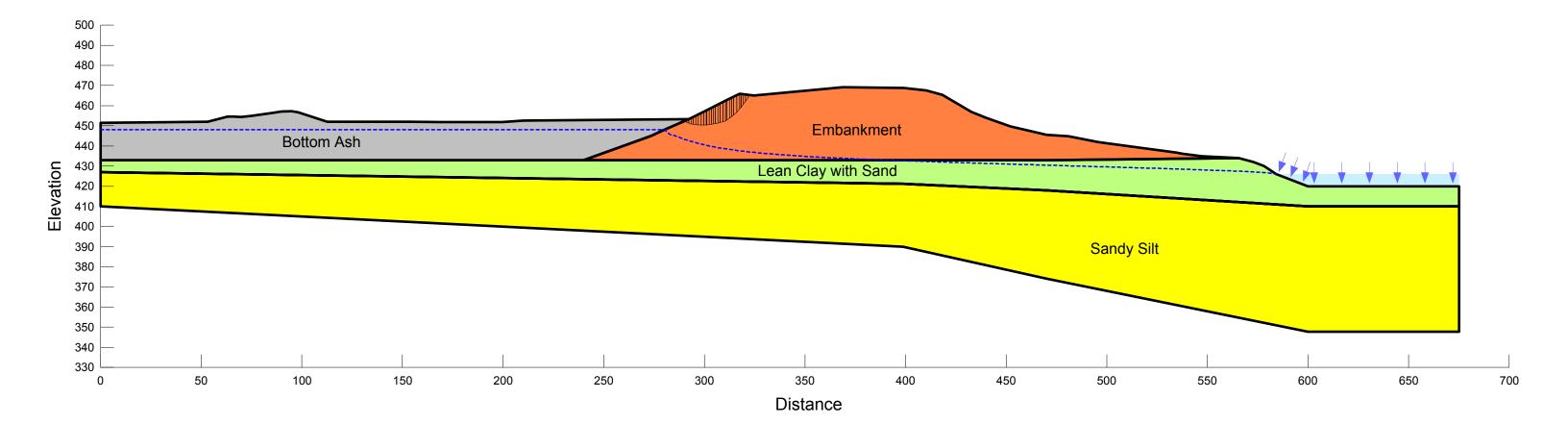


Factor of Safety = 2.30

ned Strength meters

Cohesion (psf)
165
160
0

100 Namuel Dael, Llastas em Olares Esilvas			Drained Parame
L02_Normal Pool, Upstream Slope Failure Normal Pool Elevation: 448 Feet Drained Static Strengths	Material	Unit Weight (pcf)	Phi (deg.)
Incipient Motion in the Upstream Direction	Embankment (Drained)	130	33.2
Section C-C'	Lean Clay with Sand (Drained)	119	27.2
	Sandy Silt (Drained)	130	30
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Bottom Ash (Drained)	115	28

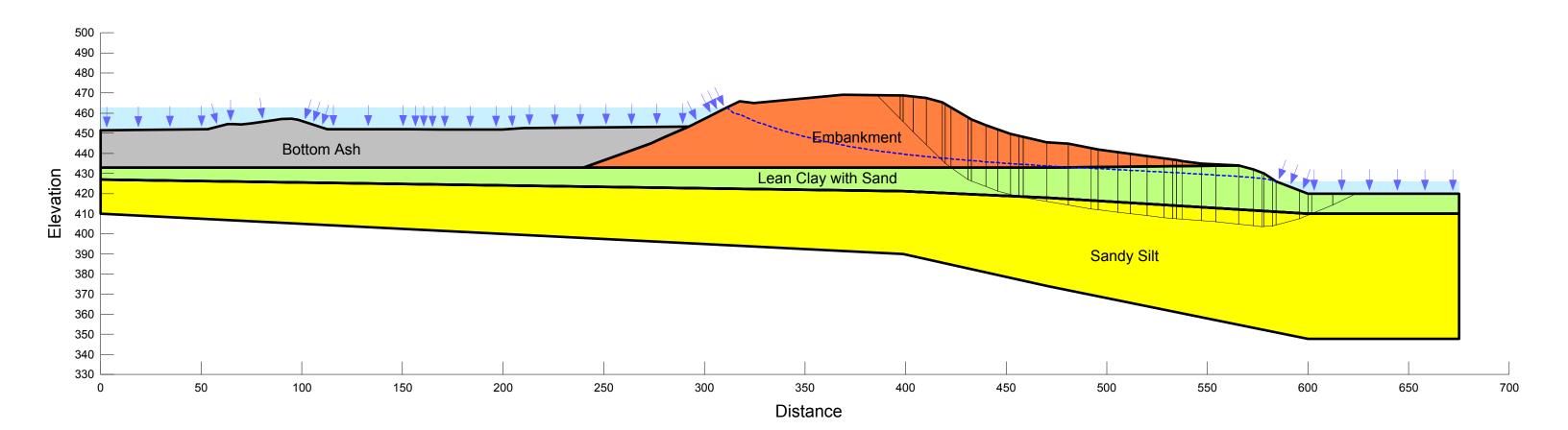


Factor of Safety = 2.73

ned Strength meters

Cohesion (psf)
165
160
0

102 50% DME Deel Deursetreers Clane Feilure			Drained Parame
L03_50% PMF Pool, Downstream Slope Failure 50% PMF Pool Elevation: 462.8 Feet Drained Static Strengths	Material	Unit Weight (pcf)	Phi (deg.)
Incipient Motion in the Downstream Direction	Embankment (Drained)	130	33.2
Section C-C'	Lean Clay with Sand (Drained)	119	27.2
	Sandy Silt (Drained)	130	30
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Bottom Ash (Drained)	115	28

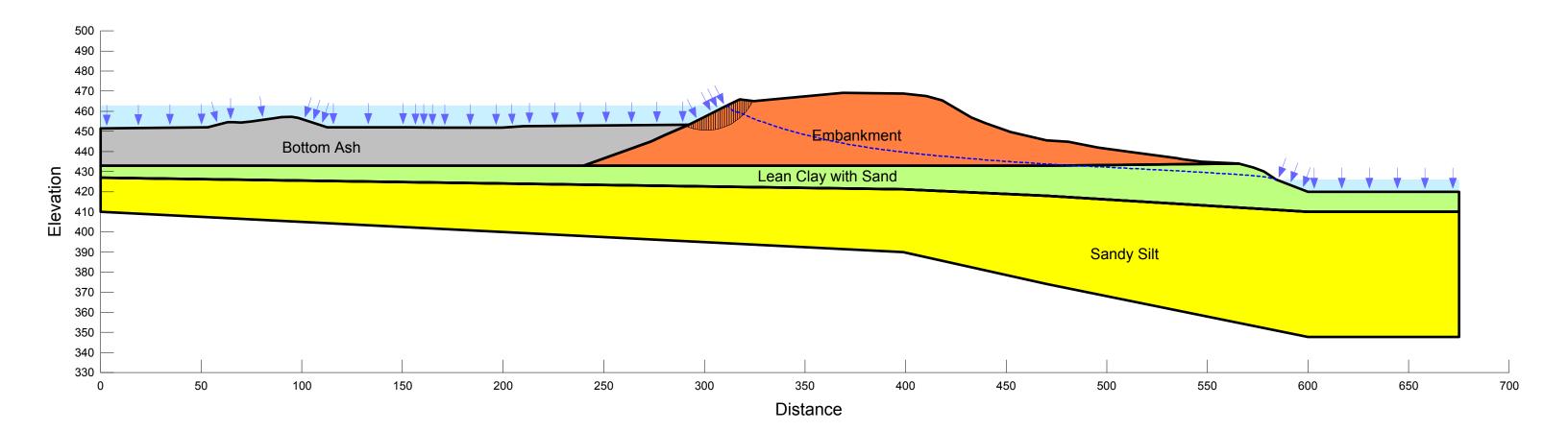


Factor of Safety = 2.18

ned Strength meters

Cohesion (psf)
165
160
0

	Drained Parame
0	Phi (deg.)
30	33.2
19	27.2
30	30
15	28
ро 3 1	cf) 30 9 30



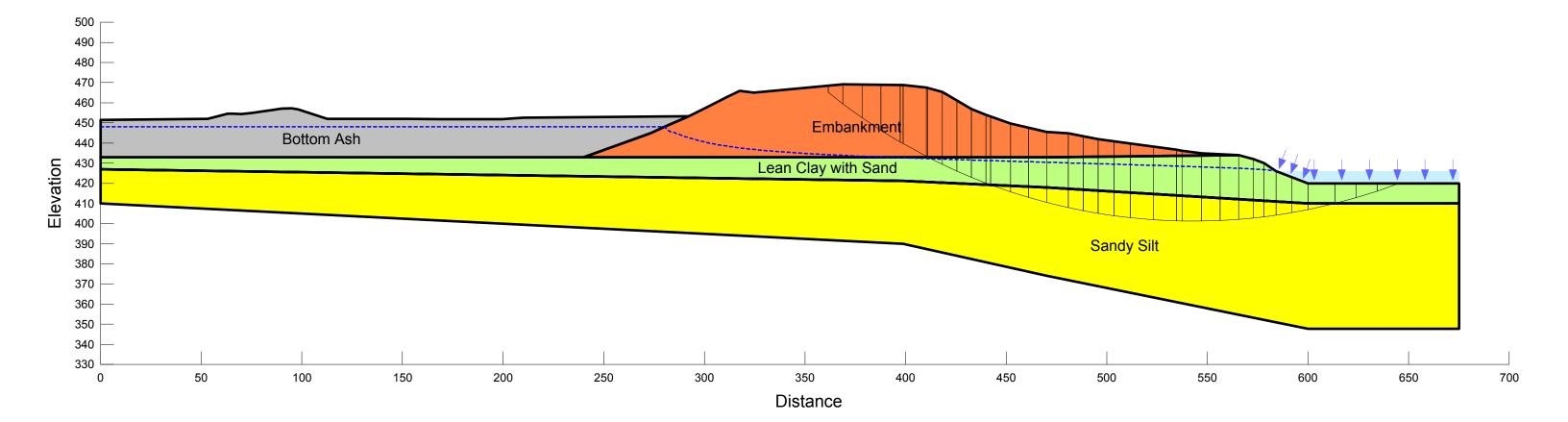
Factor of Safety = 3.88

ned Strength meters

Cohesion (psf)
165
160
0

L05_Seismic_Normal Pool, Downstream Slope Failure			Drained St Parameter
Normal Pool Elevation: 448 Feet Undrained Static Strengths Incipient Motion in the Downstream Direction	Material	Unit Weight (pcf)	Phi (deg.)
Horizontal Acc: 0.085g	Embankment (Seismic Undrained)	130	33.2
Section C-C'	Lean Clay with Sand (Seismic Undrained)	119	27.2
	Sandy Silt (Seismic Undrained)	130	30
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.	Bottom Ash (Seismic Undrained)	115	28

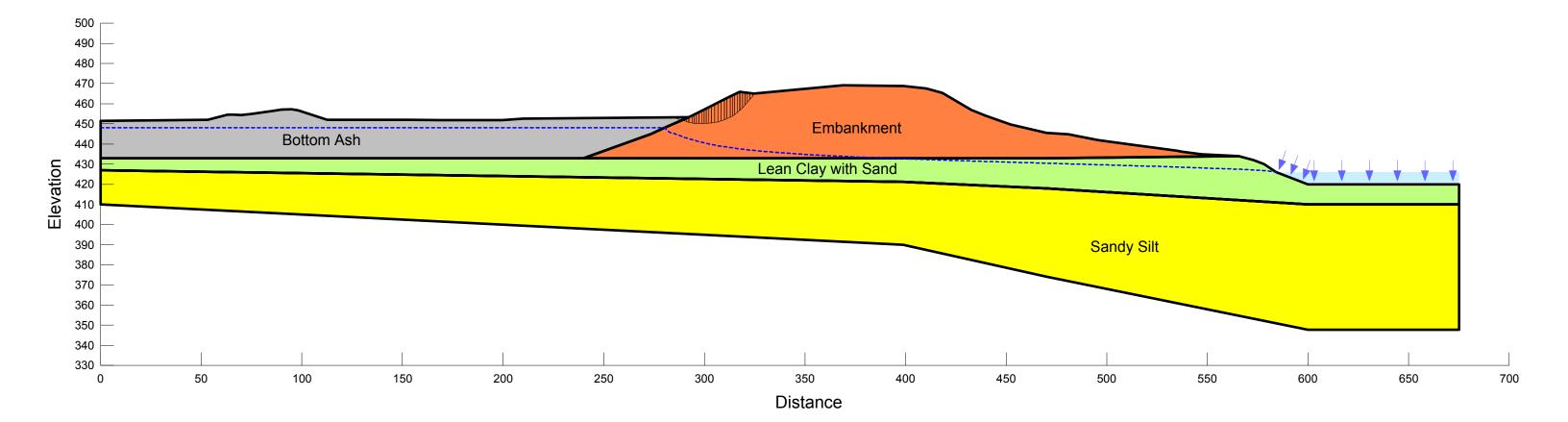
No warranties can be made regarding the continuity of subsurface conditions.



ned Strength meters		Undrained Strength Parameters		
)	Cohesion (psf)	Phi (deg.)	Cohesion (psf)	
	165	13	600	
	160	5	1200	
	0	30	0	
	0	28	0	

L06_Seismic_Normal Pool, Upstream Slope Failure			Drained S Parameter
Normal Pool Elevation: 448 Feet Undrained Static Strengths Incipient Motion in the Upstream Direction	Material	Unit Weight (pcf)	Phi (deg.)
Horizontal Acc: 0.085g	Embankment (Seismic Undrained)	130	33.2
Section C-C'	Lean Clay with Sand (Seismic Undrained)	119	27.2
	Sandy Silt (Seismic Undrained)	130	30
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.	Bottom Ash (Seismic Undrained)	115	28

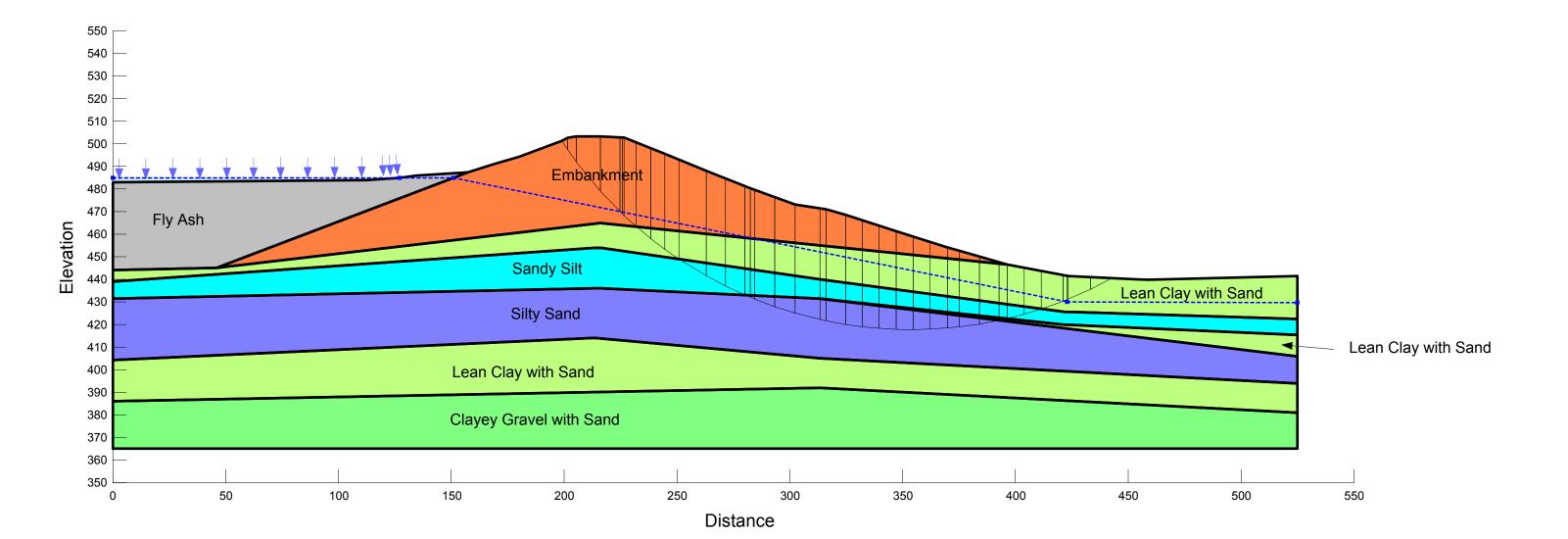
No warranties can be made regarding the continuity of subsurface conditions.



ned Strength meters		Undrained Strength Parameters		
)	Cohesion (psf)	Phi (deg.)	Cohesion (psf)	
	165	13	600	
	160	5	1200	
	0	30	0	
	0	28	0	

LANDFILL RUNOFF COLLECTION POND: 2015 CCR MANDATE

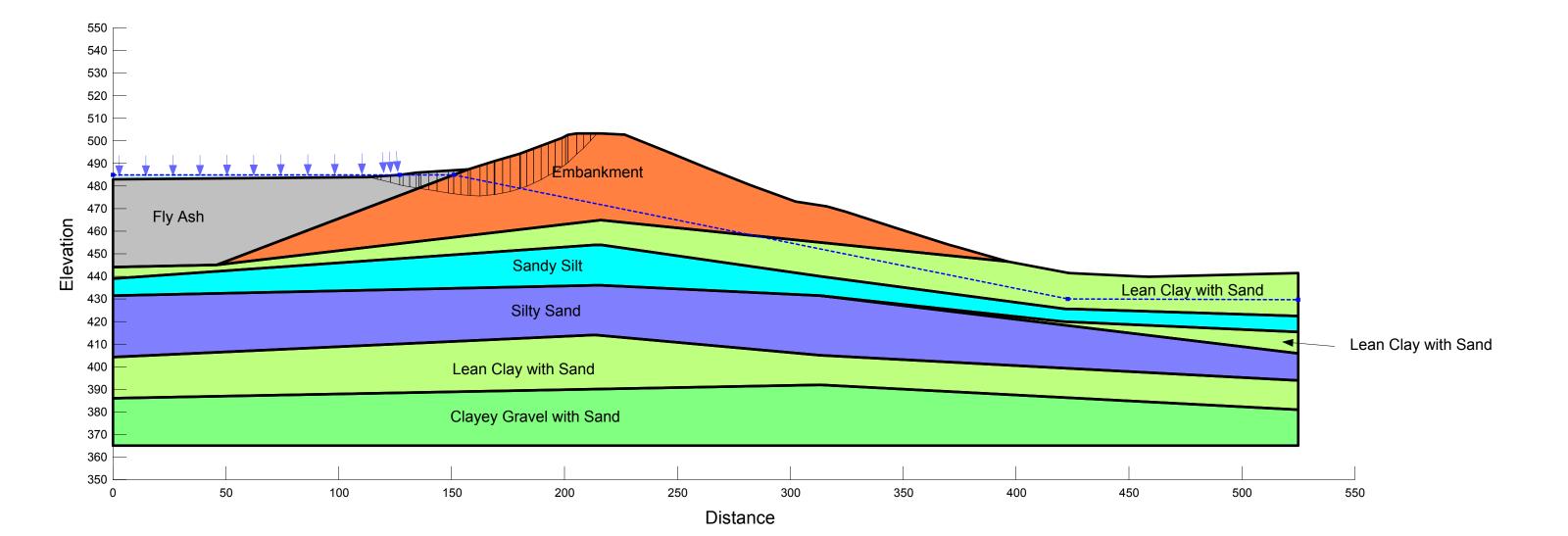
	Material	Unit Weigh (pcf)
L01_Normal Pool, Downstream Slope Failure Normal Pool Elevation: 485 Feet	Embankment (Drained)	129
Drained Static Strengths Incipient Motion in the Downstream Direction	Lean Clay with Sand (Drained)	127
Section D-D'	Sandy Silt (Drained)	125
	Silty Sand (Drained)	94
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical	Clayey Gravel with Sand (Drained)	130
drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Fly Ash (Drained)	115



Factor of Safety = 1.85

ht	Phi (deg.)	Cohesion (psf)
	27.5	198
	28	206
	30	0
	30	0
	35	0
	25	0

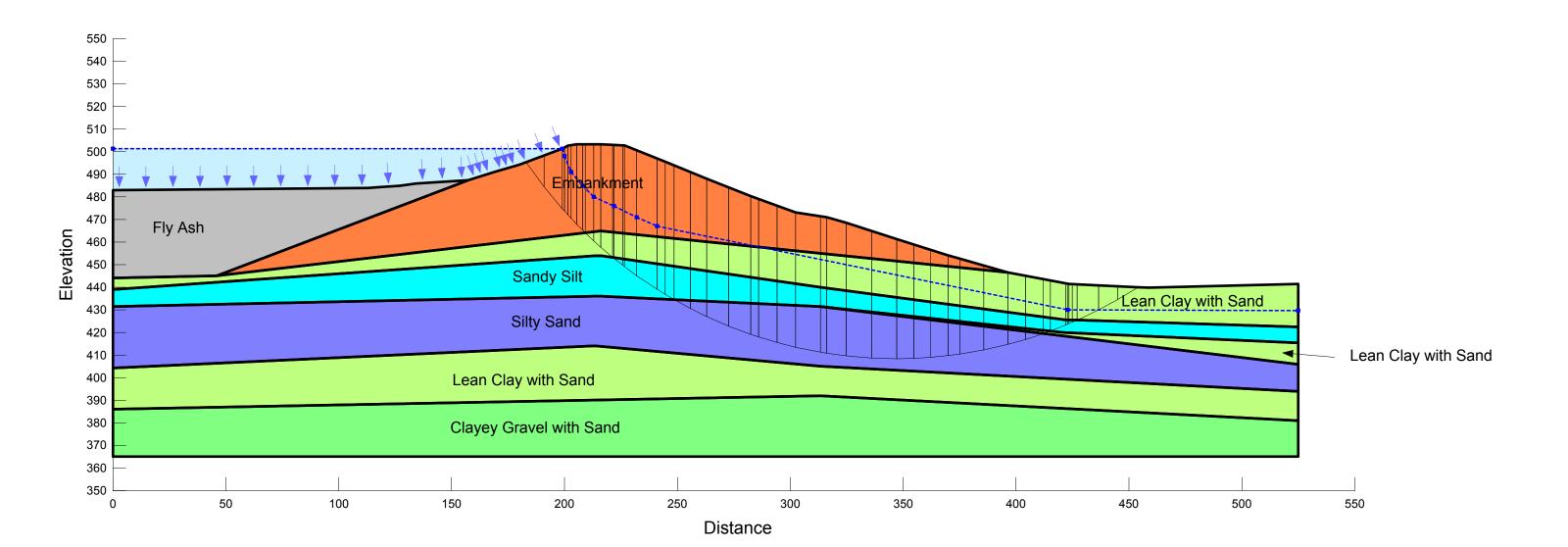
	Material	Unit Weigh (pcf)
L02_Normal Pool, Upstream Slope Failure Normal Pool Elevation: 485 Feet	Embankment (Drained)	129
Drained Static Strengths Incipient Motion in the Upstream Direction	Lean Clay with Sand (Drained)	127
Section D-D'	Sandy Silt (Drained)	125
	Silty Sand (Drained)	94
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical	Clayey Gravel with Sand (Drained)	130
drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Fly Ash (Drained)	115



Factor of Safety = 2.73

ht	Phi (deg.)	Cohesion (psf)
	27.5	198
	28	206
	30	0
	30	0
	35	0
	25	0

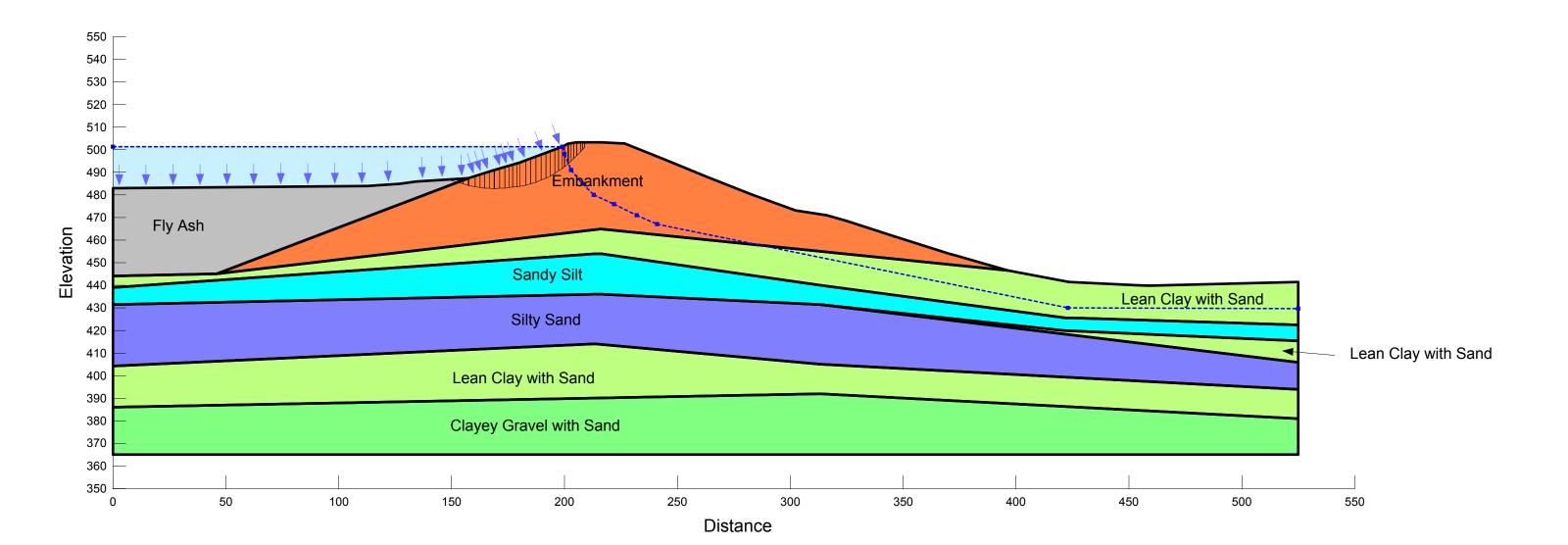
	Material	Unit Weigh (pcf)
L03_PMF Pool, Downstream Slope Failure PMF Pool Elevation: 501.4 Feet	Embankment (Drained)	129
Drained Static Strengths Incipient Motion in the Downstream Direction	Lean Clay with Sand (Drained)	127
Section D-D'	Sandy Silt (Drained)	125
	Silty Sand (Drained)	94
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical	Clayey Gravel with Sand (Drained)	130
drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Fly Ash (Drained)	115



Factor of Safety = 1.81

ht	Phi (deg.)	Cohesion (psf)
	27.5	198
	28	206
	30	0
	30	0
	35	0
	25	0

104 DME Deel Llastraera Clana Esilura	Material	Unit Weigh (pcf)
L04_PMF Pool, Upstream Slope Failure PMF Pool Elevation: 501.4 Feet	Embankment (Drained)	129
Drained Static Strengths Incipient Motion in the Upstream Direction	Lean Clay with Sand (Drained)	127
Section D-D'	Sandy Silt (Drained)	125
	Silty Sand (Drained)	94
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical	Clayey Gravel with Sand (Drained)	130
drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Fly Ash (Drained)	115

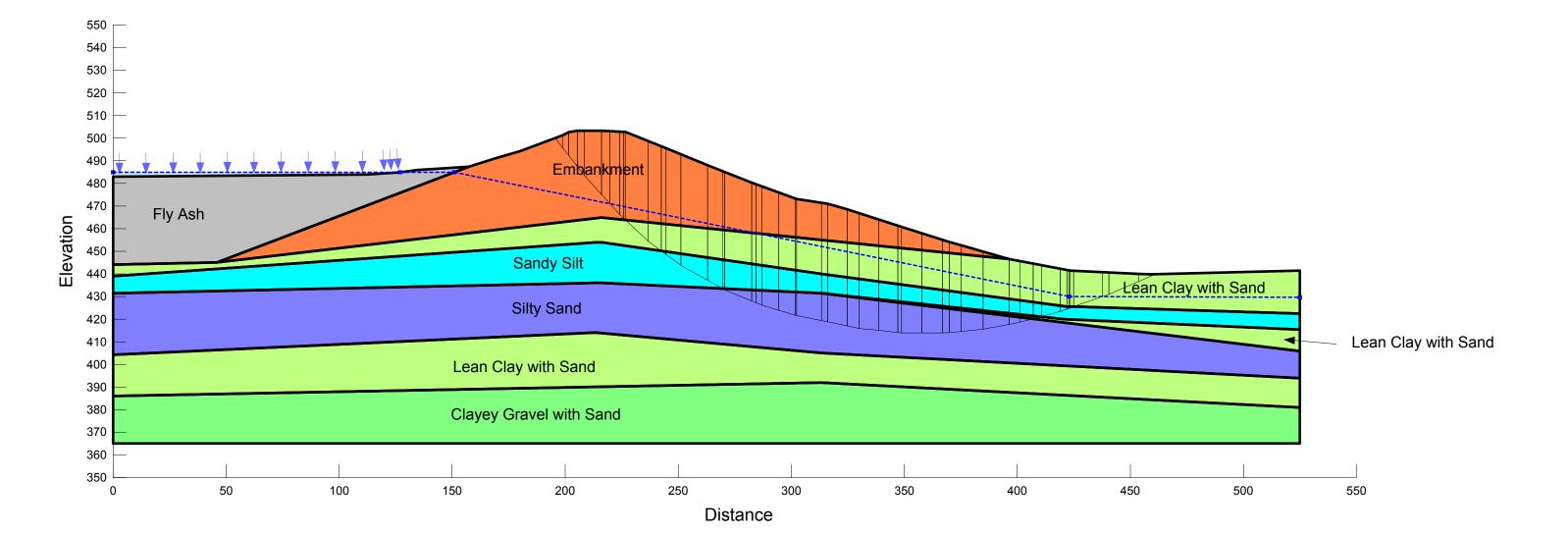


Factor of Safety = 3.47

ht	Phi (deg.)	Cohesion (psf)
	27.5	198
	28	206
	30	0
	30	0
	35	0
	25	0

L05_Seismic_Normal Pool, Downstream Slope Failure Normal Pool Elevation: 485 Feet Undrained Static Strengths Incipient Motion in the Downstream Direction Horizontal Acc: 0.085g Section D-D'

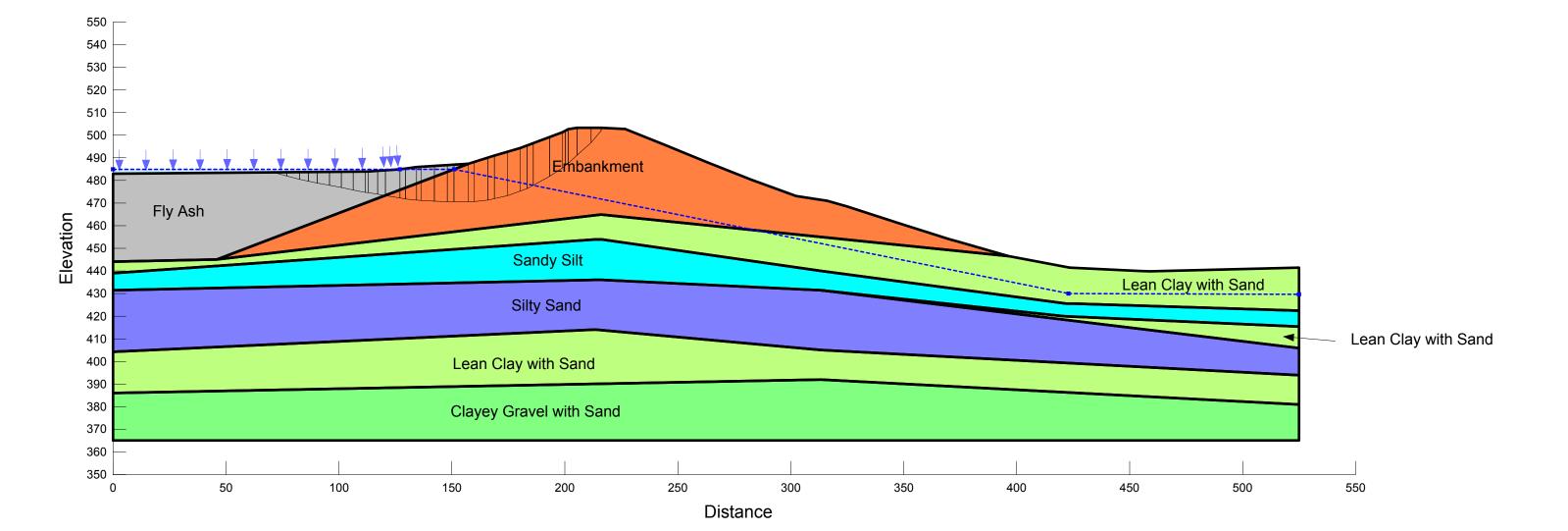
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions. MaterialUnit Weigh
(pcf)Embankment (Seismic Undrained)129Lean Clay with Sand (Seismic Undrained)127Sandy Silt (Seismic Undrained)125Silty Sand (Seismic Undrained)94Clayey Gravel with Sand (Seismic Undrained)130Fly Ash (Seismic Undrained)115



	Drained S Paramete	-	Undraine Paramete	d Strength rs
Iht	Phi (deg.)	Cohesion (psf)	Phi (deg.)	Cohesion (psf)
	27.5	198	21	1400
	28	206	17	1200
	30	0	30	0
	30	0	30	0
	35	0	35	0
	25	0	25	0

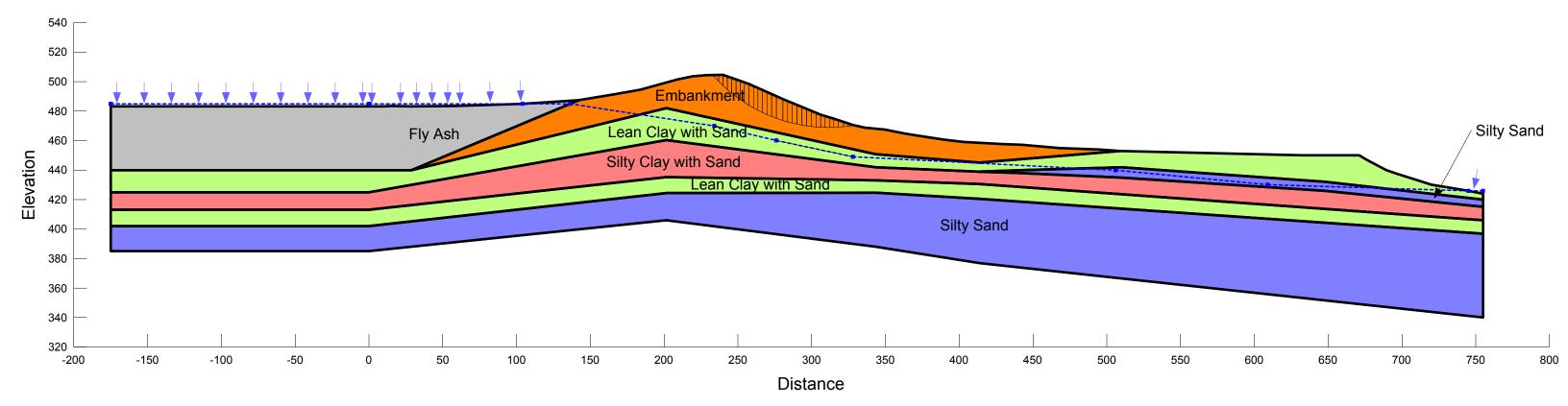
L06_Seismic_Normal Pool, Upstream Slope Failure Normal Pool Elevation: 485 Feet Undrained Static Strengths Incipient Motion in the Upstream Direction Horizontal Acc: 0.085g Section D-D'

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions. MaterialUnit Weigh
(pcf)Embankment (Seismic Undrained)129Lean Clay with Sand (Seismic Undrained)127Sandy Silt (Seismic Undrained)125Silty Sand (Seismic Undrained)94Clayey Gravel with Sand (Seismic Undrained)130Fly Ash (Seismic Undrained)115



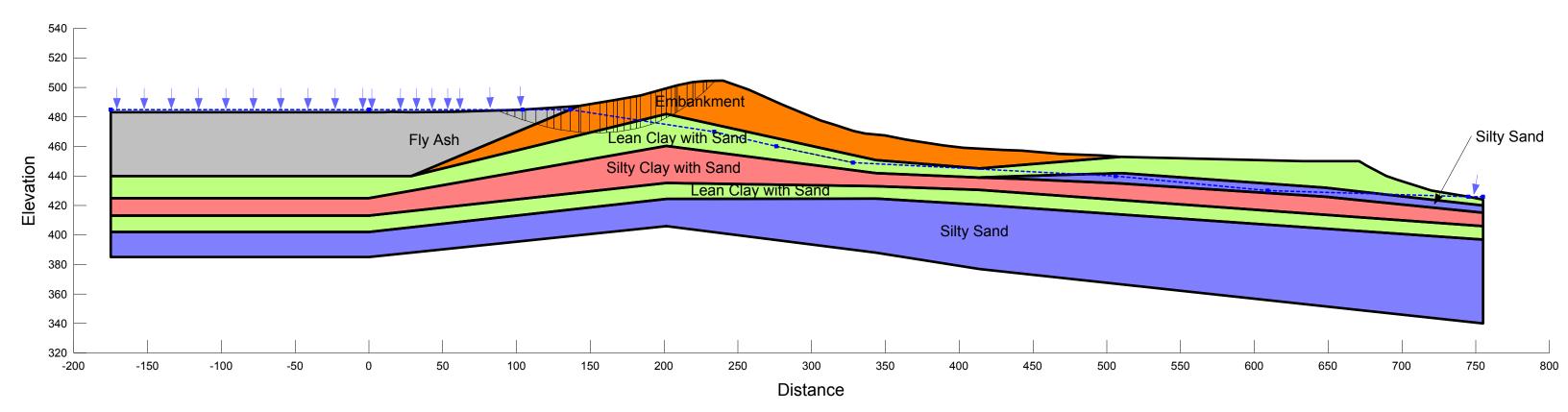
	Drained S Paramete	-	Undrained Strength Parameters		
jht	Phi (deg.)	Cohesion (psf)	Phi (deg.)	Cohesion (psf)	
	27.5	198	21	1400	
	28	206	17	1200	
	30	0	30	0	
	30	0	30	0	
	35	0	35	0	
	25	0	25	0	

L01_Normal Pool, Downstream Crest Loss Normal Pool Elevation: 485 Feet			Draine Parame	ed Strength eters
Drained Static Strengths Incipient Motion in the Downstream Direction	Material	Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)
Section E-E' Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Embankment (Drained)	129	27.5	198
	Lean Clay with Sand (Drained)	127	28	206
	Silty Sand (Drained)	94	30	0
	Fly Ash (Drained)	115	25	0
	Silty Clay with Sand (Drained)	118	34	152



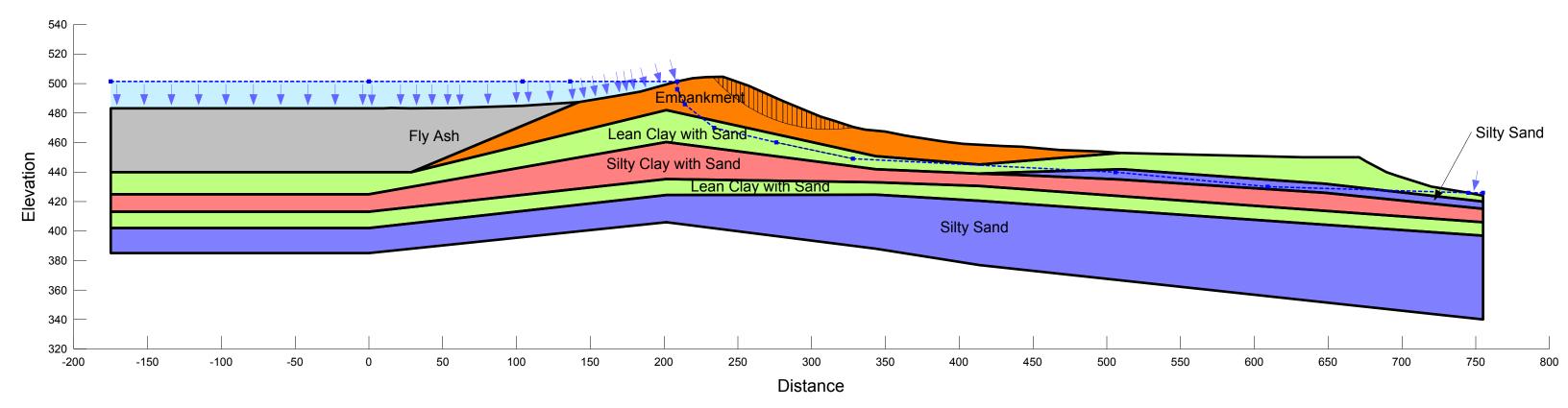
Factor of Safety = 1.99

—	Pool, Upstream Crest Loss Elevation: 485 Feet			Drainec Parame	d Strength eters
Drained Static Incipient Motic Section E-E'	c Strengths on in the Downstream Direction	Material	Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)
		Embankment (Drained)	129	27.5	198
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical	Lean Clay with Sand (Drained)	127	28	206	
• •	drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Silty Sand (Drained)	94	30	0
	Fly Ash (Drained)	115	25	0	
		Silty Clay with Sand (Drained)	118	34	152



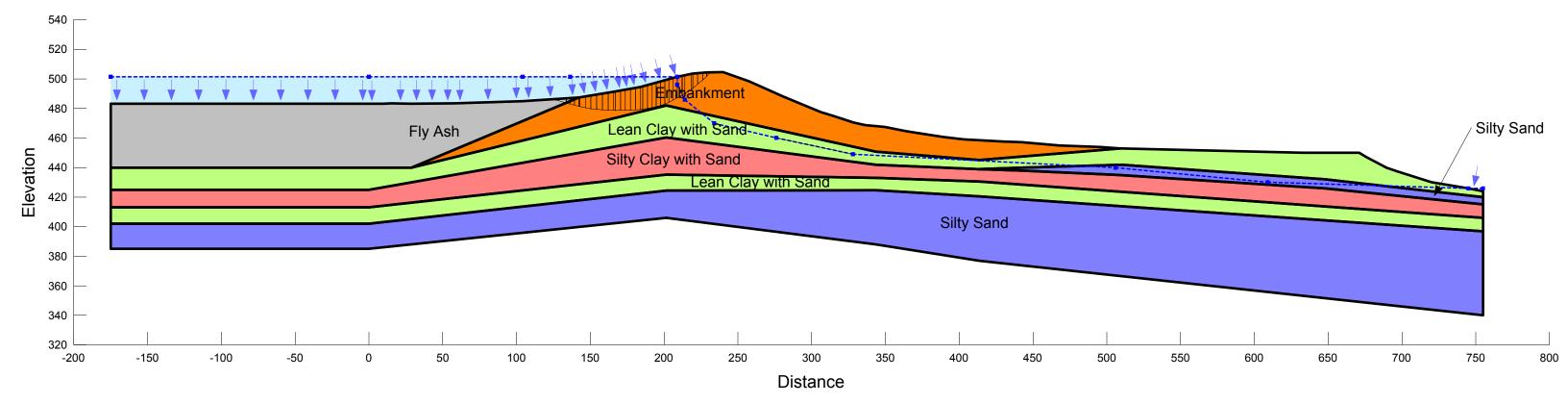
Factor of Safety = 3.51

L03_PMF Pool, Downstream Crest Loss PMF Pool Elevation: 501.4 Feet			Draine Parame	d Strength eters
Drained Static Strengths Incipient Motion in the Downstream Direction	Material	Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)
Section E-E' Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Embankment (Drained)	129	27.5	198
	Lean Clay with Sand (Drained)	127	28	206
	Silty Sand (Drained)	94	30	0
	Fly Ash (Drained)	115	25	0
	Silty Clay with Sand (Drained)	118	34	152



Factor of Safety = 1.99

L04_PMF Pool, Upstream Crest Loss PMF Pool Elevation: 501.4 Feet			Draineo Paramo	d Strength eters
Drained Static Strengths Incipient Motion in the Downstream Direction	Material	Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)
Section E-E'	Embankment (Drained)	129	27.5	198
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Lean Clay with Sand (Drained)	127	28	206
	Silty Sand (Drained)	94	30	0
	Fly Ash (Drained)	115	25	0
	Silty Clay with Sand (Drained)	118	34	152

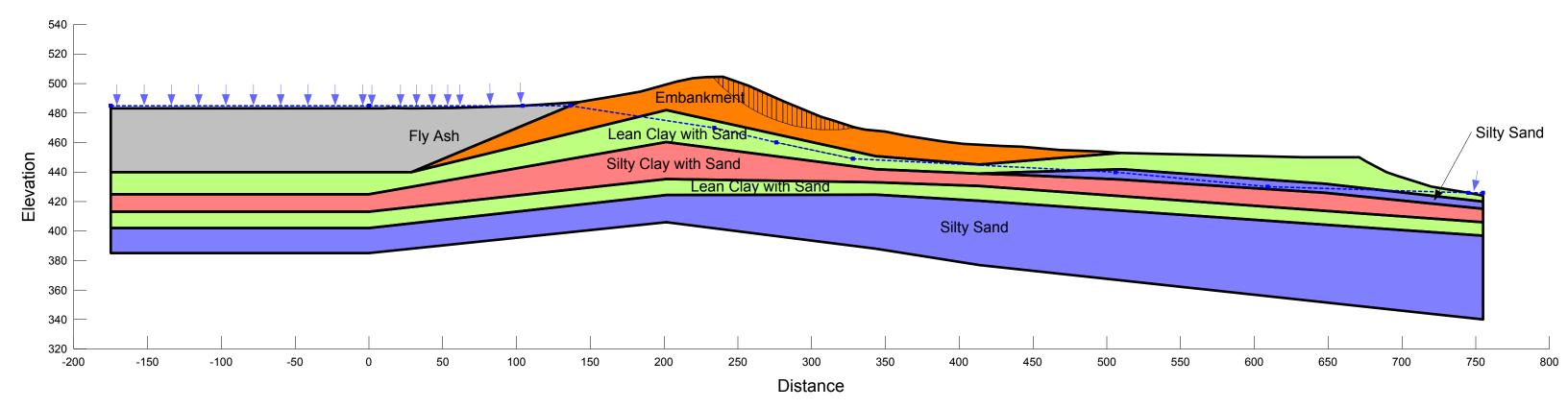


Factor of Safety = 4.51

L05_Seismic_Normal Pool, Downstream Crest Loss Normal Pool Elevation: 485 Feet Undrained Static Strengths Incipient Motion in the Downstream Direction Horizontal Acc: 0.085g Section E-E'

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.

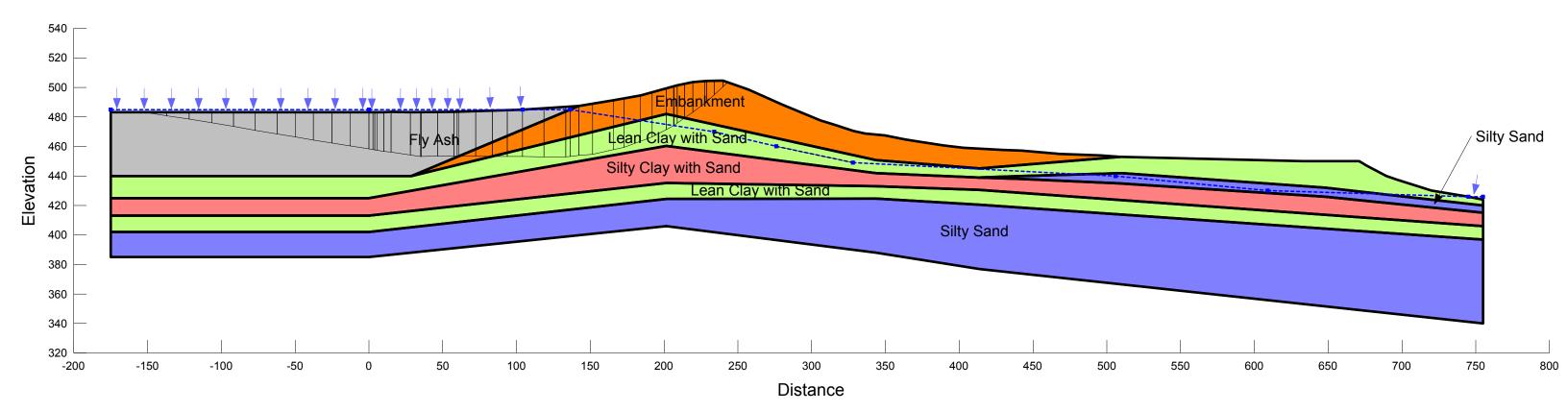
		Drained Strength Parameters		Undrained Strength Parameters	
Material	Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)	Phi (deg.)	Cohesion (psf)
Embankment (Seismic Undrained)	129	27.5	198	21	1400
Lean Clay with Sand (Seismic Undrained)	127	28	206	17	1200
Silty Sand (Seismic Undrained)	94	30	0	30	0
Fly Ash (Seismic Undrained)	115	25	0	25	0
Silty Clay with Sand (Seismic Undrained)	118	34	152	20	1000



L06_Seismic_Normal Pool, Upstream Crest Loss Normal Pool Elevation: 485 Feet Undrained Static Strengths Incipient Motion in the Upstream Direction Horizontal Acc: 0.085g Section E-E'

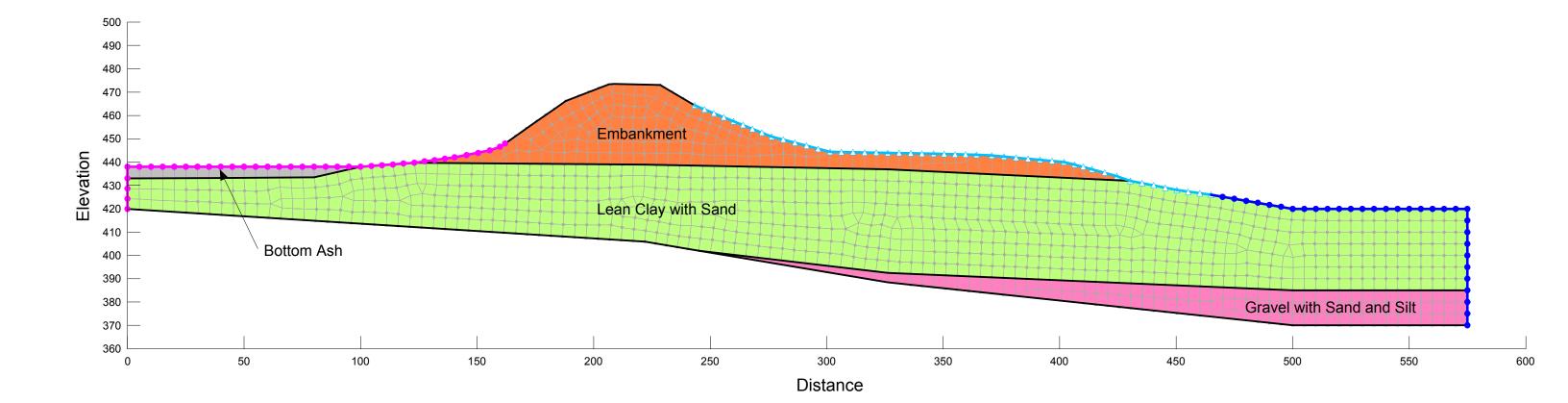
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.

		Drained Strength Parameters		Undrained Strength Parameters	
Material	Unit Weight (pcf)	Phi (deg.)	Cohesion (psf)	Phi (deg.)	Cohesion (psf)
Embankment (Seismic Undrained)	129	27.5	198	21	1400
Lean Clay with Sand (Seismic Undrained)	127	28	206	17	1200
Silty Sand (Seismic Undrained)	94	30	0	30	0
Fly Ash (Seismic Undrained)	115	25	0	25	0
Silty Clay with Sand (Seismic Undrained)	118	34	152	20	1000



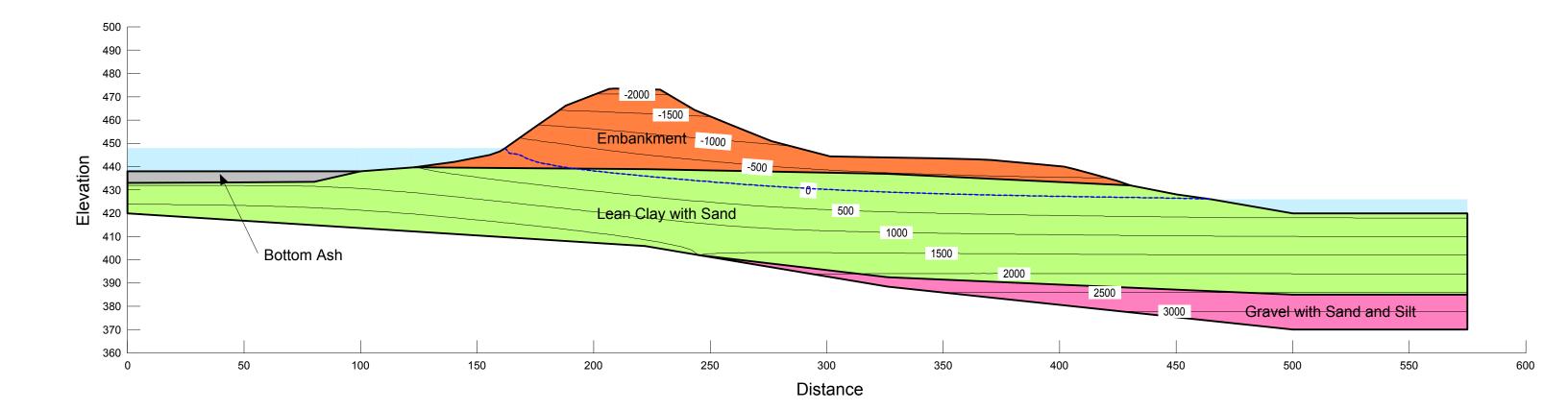
SEEP MODELS, 2015

SEEP Steady State Normal Pool Normal Pool Elevation: 448 Feet	Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3	Res. Water Content ft^3/ft^3
Drained Static Strengths Section A-A'	Embankment (Drained)	4.72e-008	0.1	0.38	0.109
	Lean Clay with Sand (Drained)	2.83e-007	0.1	0.41	0.09
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties.	Gravel With Silt and Sand (Drained)	0.00164	0.2	0.23	0.01
The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Bottom Ash (Drained)	0.0115	1	0.3548	0.027



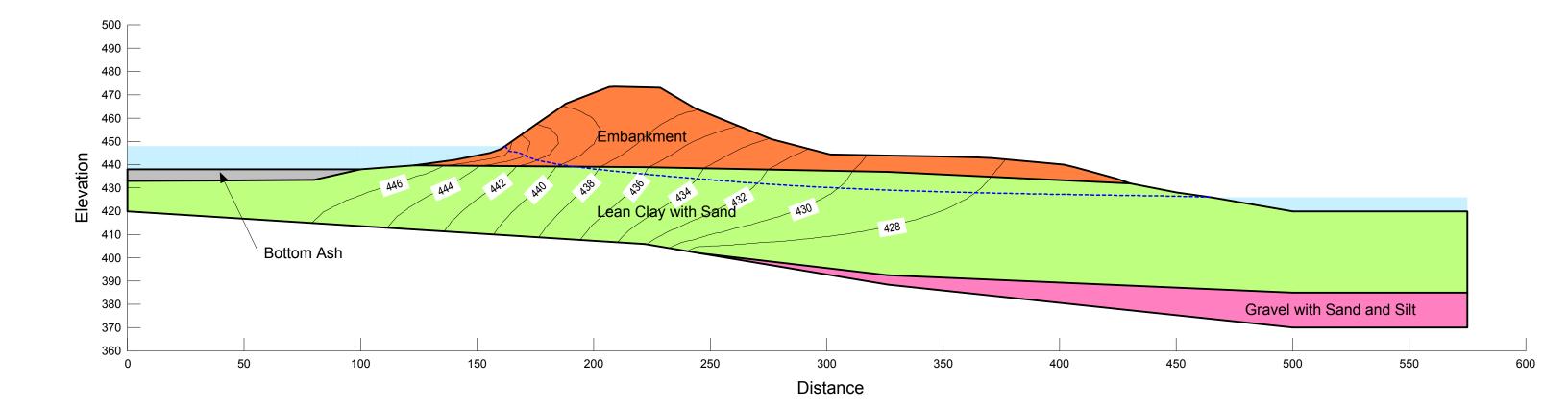
Seepage Analysis Boundary Condition and Mesh

SEEP Steady State Normal Pool Normal Pool Elevation: 448 Feet	Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3	Res. Water Content ft^3/ft^3
Drained Static Strengths Section A-A'	Embankment (Drained)	4.72e-008	0.1	0.38	0.109
	Lean Clay with Sand (Drained)	2.83e-007	0.1	0.41	0.09
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties.	Gravel With Silt and Sand (Drained)	0.00164	0.2	0.23	0.01
The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Bottom Ash (Drained)	0.0115	1	0.3548	0.027



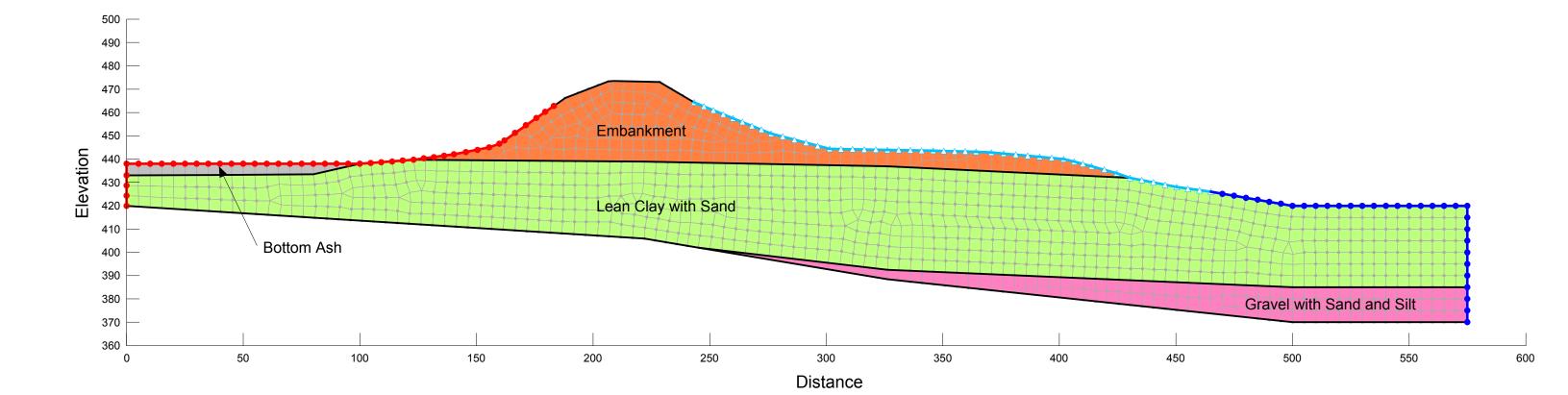
Seepage Analysis Pore Water Pressure Contour (psf)

SEEP Steady State Normal Pool Normal Pool Elevation: 448 Feet	Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3	Res. Water Content ft^3/ft^3
Drained Static Strengths Section A-A'	Embankment (Drained)	4.72e-008	0.1	0.38	0.109
	Lean Clay with Sand (Drained)	2.83e-007	0.1	0.41	0.09
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties.	Gravel With Silt and Sand (Drained)	0.00164	0.2	0.23	0.01
The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Bottom Ash (Drained)	0.0115	1	0.3548	0.027



Seepage Analysis Total Head Contour (feet)

SEEP Steady State 50% PMF Pool 50% PMF Pool Elevation: 462.8 Feet	Material	Kh-sat (ft/sec)	Kratio Kv/Kh
Drained Static Strengths Section A-A'	Embankment (Drained)	4.72e-008	0.1
	Lean Clay with Sand (Drained)	2.83e-007	0.1
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties.	Gravel With Silt and Sand (Drained)	0.00164	0.2
The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.	Bottom Ash (Drained)	0.0115	1



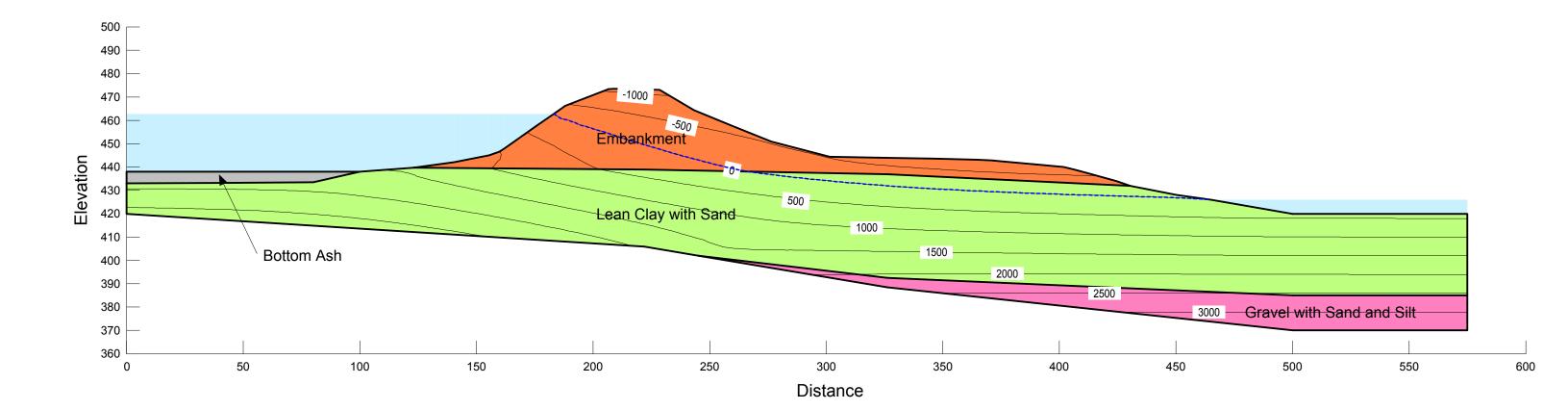
Seepage Analysis Boundary Condition and Mesh

Sat. Water Content ft^3/ft^3	Res. Water Content ft^3/ft^3
0.38	0.109
0.41	0.09
0.23	0.01
0.3548	0.027

SEEP Steady State 50% PMF Pool
50% PMF Pool Elevation: 462.8 Feet
Drained Static Strengths
Section A-A'

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.

Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3	Res. Water Content ft^3/ft^3
Embankment (Drained)	4.72e-008	0.1	0.38	0.109
Lean Clay with Sand (Drained)	2.83e-007	0.1	0.41	0.09
Gravel With Silt and Sand (Drained)	0.00164	0.2	0.23	0.01
Bottom Ash (Drained)	0.0115	1	0.3548	0.027



Seepage Analysis Pore Water Pressure Contour (psf)

SEEP Steady State 50% PMF Pool 50% PMF Pool Elevation: 462.8 Feet	Material	Kh-sat (ft/sec)
Drained Static Strengths Section A-A'	Embankment (Drained)	4.72e-008
	Lean Clay with Sand (Drained)	2.83e-007
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties.	Gravel With Silt and Sand (Drained)	0.00164
The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.	Bottom Ash (Drained)	0.0115

No warranties can be made regarding the continuity of subsurface conditions.

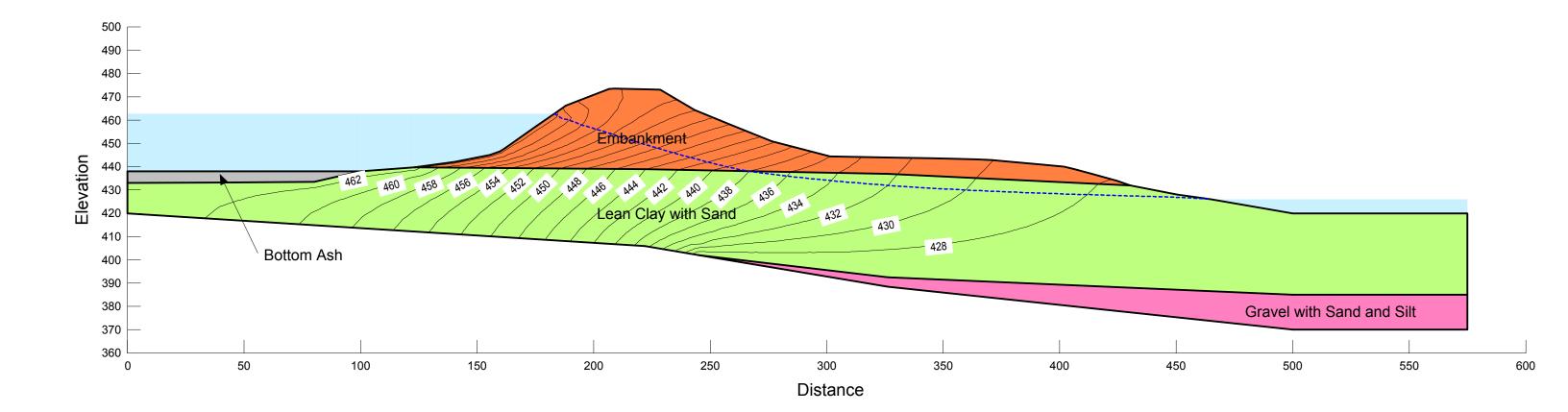


Kratio

Kv/Kh

0.1

0.1



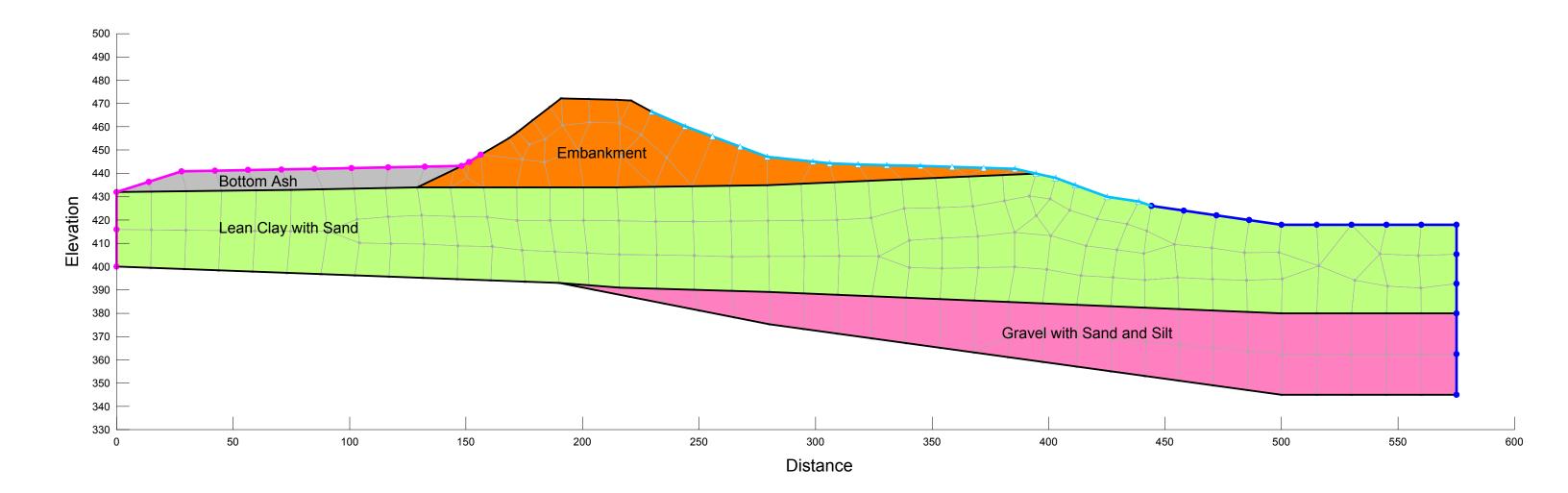
Seepage Analysis Total Head Contour (feet)

Sat. Water Content ft^3/ft^3	Res. Water Content ft^3/ft^3
0.38	0.109
0.41	0.09
0.23	0.01
0.3548	0.027

Seepage Analysis Boundary Condition and Mesh

SEEP Steady State Normal Pool Normal Pool Elevation: 448 Feet Drained Static Strengths Section B-B'

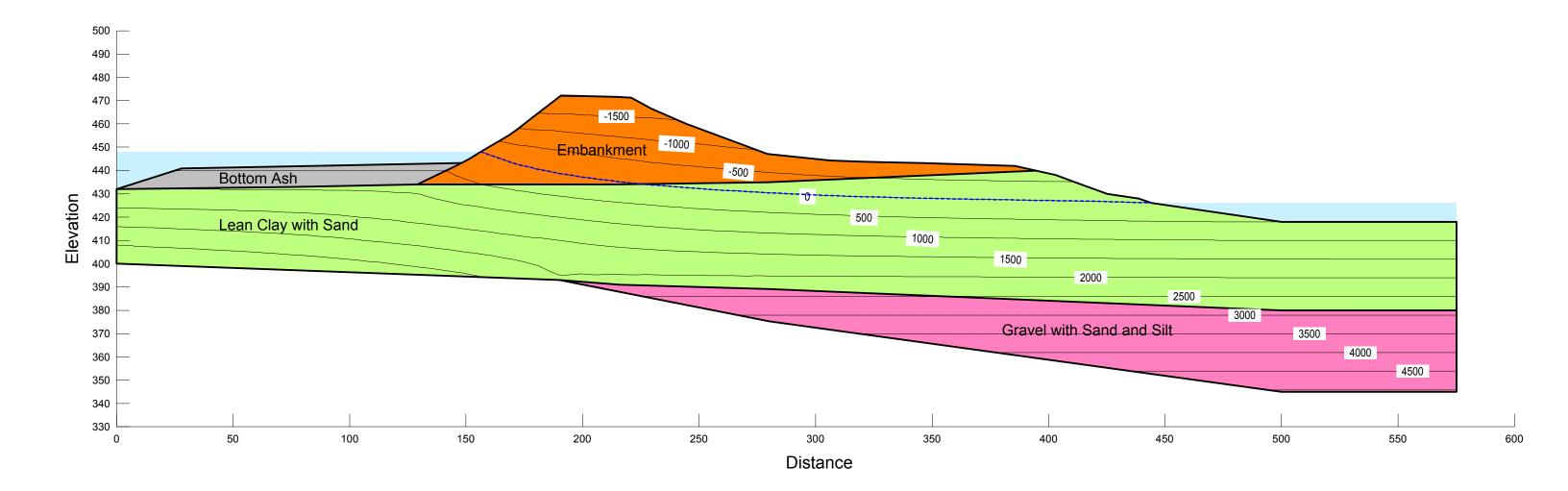
Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3	Res. Water Content ft^3/ft^3
Embankment (Drained)	4.72e-008	0.1	0.38	0.109
Lean Clay With Sand (Drained)	2.83e-007	0.1	0.38	0.09
Gravel With Silt And Sand (Drained)	0.00164	0.2	0.23	0.01
Bottom Ash (Drained)	0.0115	1	0.3548	0.027



Seepage Analysis Pore Water Pressure Contour (psf)

SEEP Steady State Normal Pool Normal Pool Elevation: 448 Feet Drained Static Strengths Section B-B'

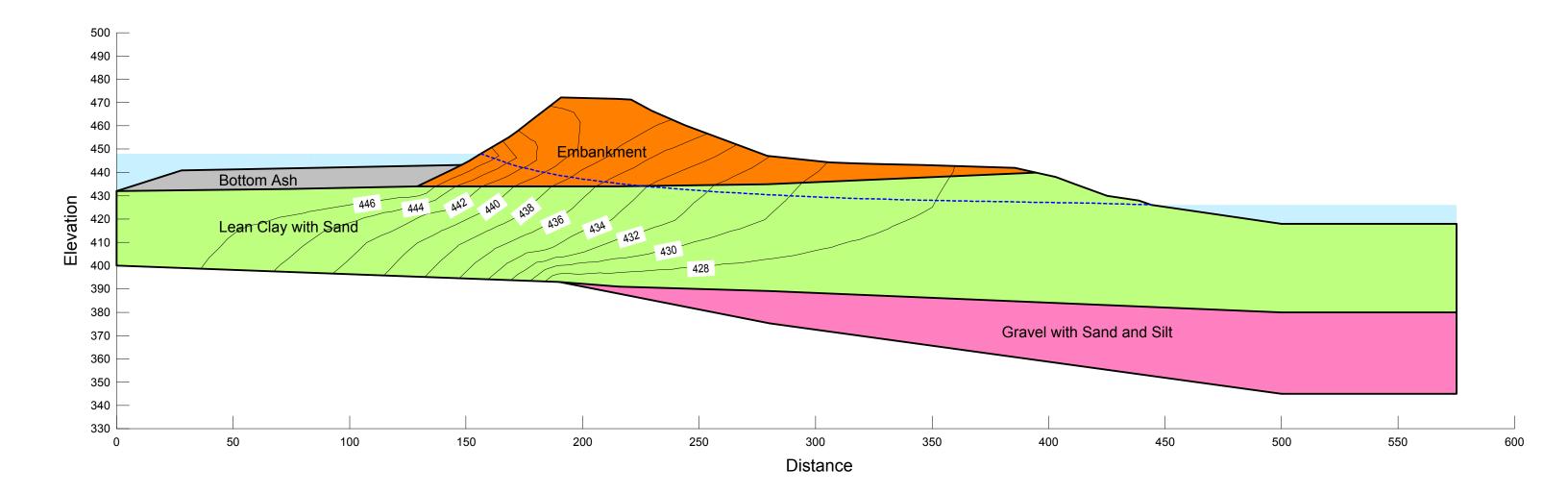
Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3	Res. Water Content ft^3/ft^3
Embankment (Drained)	4.72e-008	0.1	0.38	0.109
Lean Clay With Sand (Drained)	2.83e-007	0.1	0.38	0.09
Gravel With Silt And Sand (Drained)	0.00164	0.2	0.23	0.01
Bottom Ash (Drained)	0.0115	1	0.3548	0.027



Seepage Analysis **Total Head Contour (feet)**

SEEP Steady State Normal Pool Normal Pool Elevation: 448 Feet **Drained Static Strengths** Section B-B'

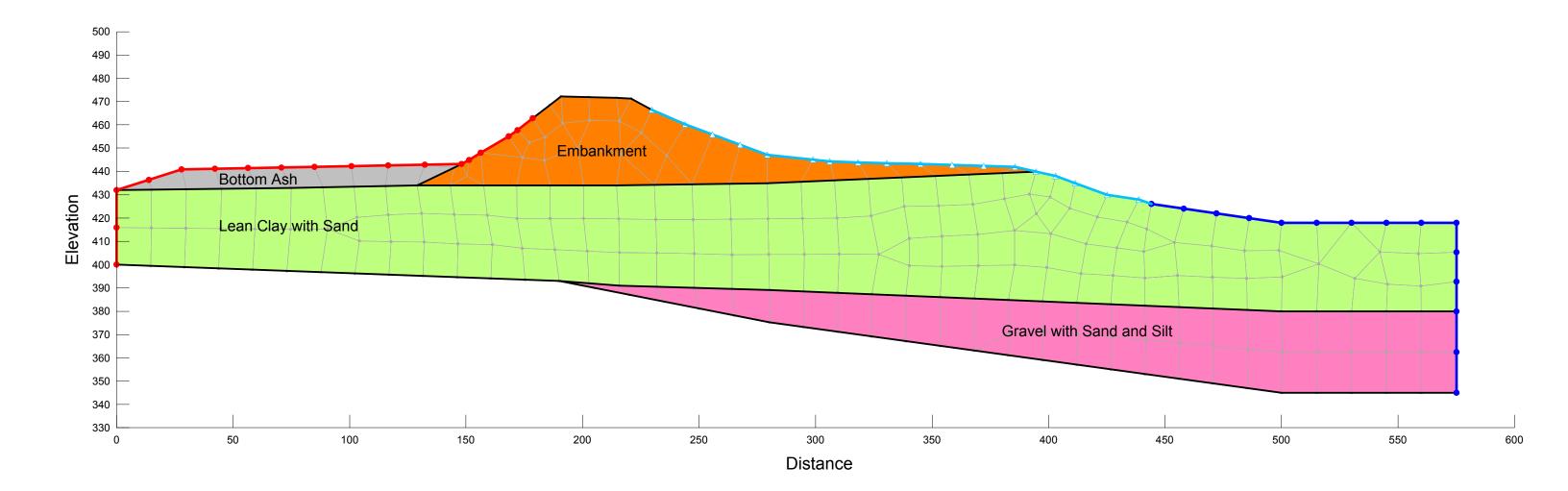
Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3	Res. Water Content ft^3/ft^3
Embankment (Drained)	4.72e-008	0.1	0.38	0.109
Lean Clay With Sand (Drained)	2.83e-007	0.1	0.38	0.09
Gravel With Silt And Sand (Drained)	0.00164	0.2	0.23	0.01
Bottom Ash (Drained)	0.0115	1	0.3548	0.027



Seepage Analysis Boundary Condition and Mesh

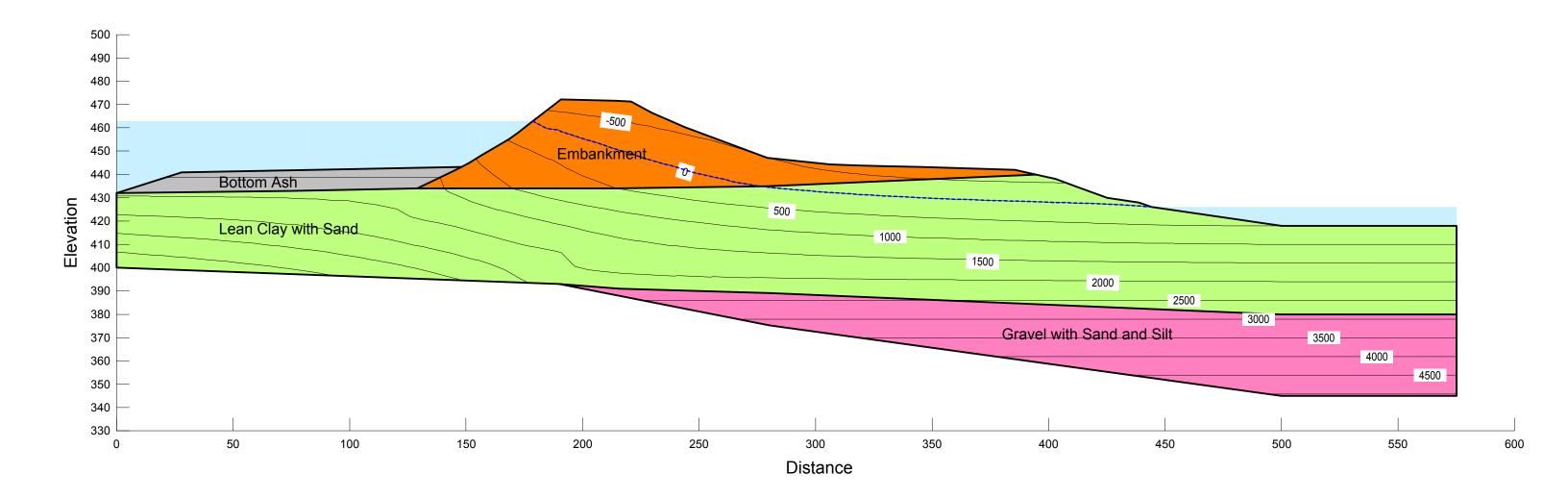
SEEP Steady State 50% PMF Pool 50% PMF Pool Elevation: 462.8 Feet Drained Static Strengths Section B-B'

Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3	Res. Water Content ft^3/ft^3
Embankment (Drained)	4.72e-008	0.1	0.38	0.109
Lean Clay With Sand (Drained)	2.83e-007	0.1	0.38	0.09
Gravel With Silt And Sand (Drained)	0.00164	0.2	0.23	0.01
Bottom Ash (Drained)	0.0115	1	0.3548	0.027



Seepage Analysis **Pore Water Pressure Contour (psf)**

SEEP Steady State 50% PMF Pool Kh-sat Kratio 50% PMF Pool Elevation: 462.8 Feet Material (ft/sec) Kv/Kh **Drained Static Strengths** Section B-B' Embankment (Drained) 0.1 4.72e-008 Lean Clay With Sand (Drained) 2.83e-007 0.1 Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. Gravel With Silt And Sand (Drained) 0.00164 0.2 The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. Bottom Ash (Drained) 0.0115 1 No warranties can be made regarding the continuity of subsurface conditions.

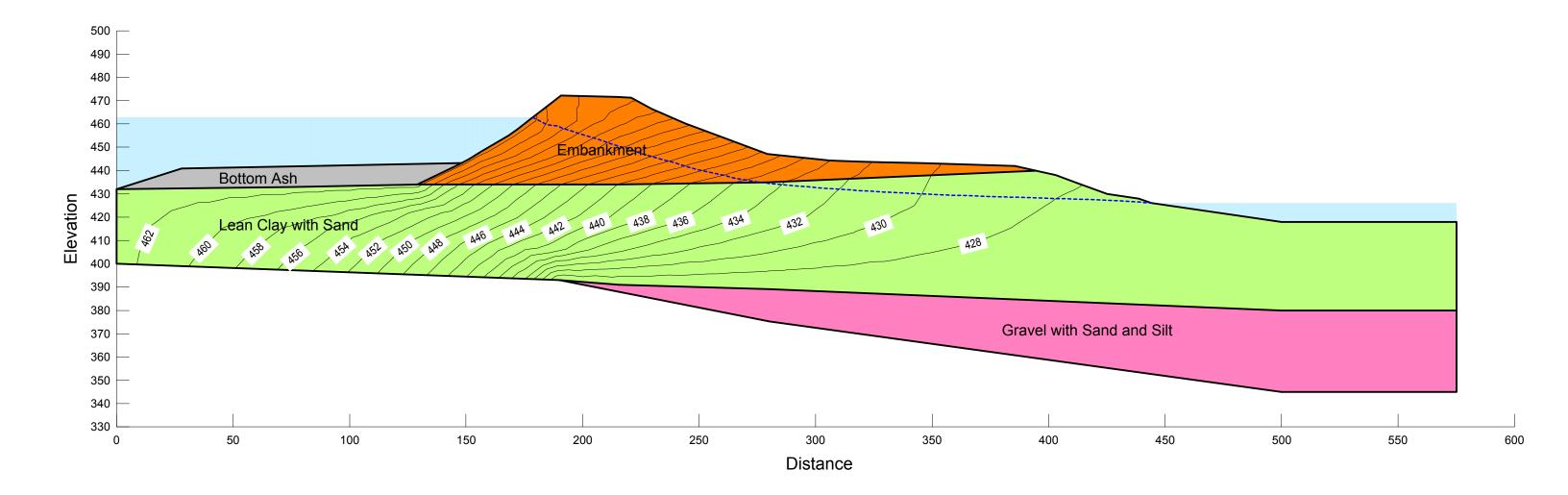


Sat. Water Content ft^3/ft^3	Res. Water Content ft^3/ft^3
0.38	0.109
0.38	0.09
0.23	0.01
0.3548	0.027

Seepage Analysis **Total Head Contour (feet)**

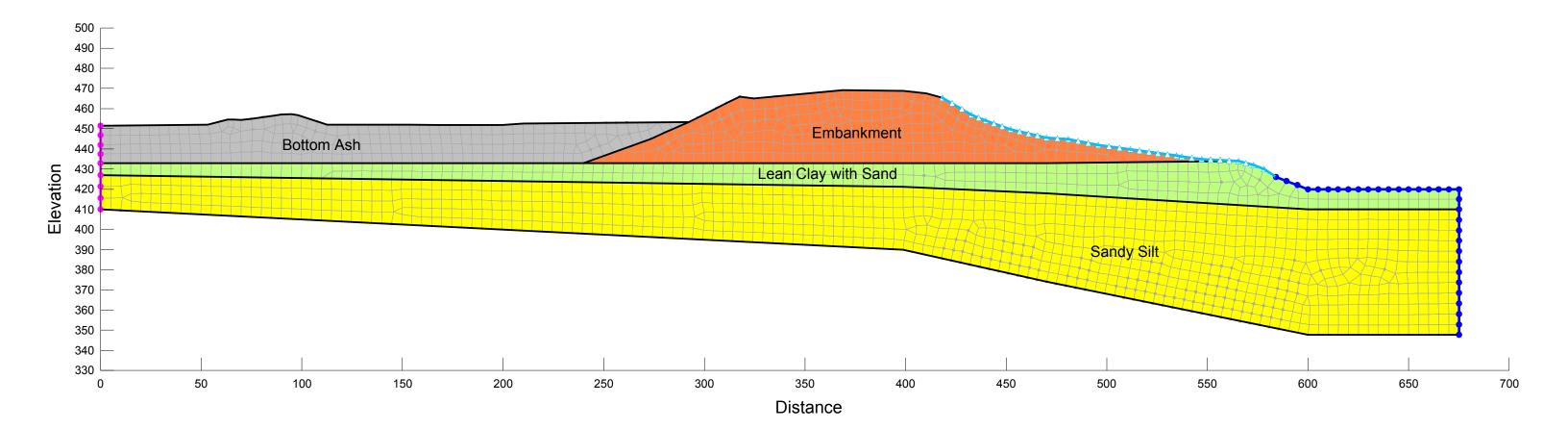
SEEP Steady State 50% PMF Pool 50% PMF Pool Elevation: 462.8 Feet **Drained Static Strengths** Section B-B'

Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3	Res. Water Content ft^3/ft^3
Embankment (Drained)	4.72e-008	0.1	0.38	0.109
Lean Clay With Sand (Drained)	2.83e-007	0.1	0.38	0.09
Gravel With Silt And Sand (Drained)	0.00164	0.2	0.23	0.01
Bottom Ash (Drained)	0.0115	1	0.3548	0.027



SEEP Steady State Normal Pool Normal Pool Elevation: 448 Feet	Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3
Drained Static Strengths Section C-C'	Embankment (Drained)	4.72e-008	0.1	0.38
	Lean Clay with Sand (Drained)	2.83e-007	0.1	0.41
	Sandy Silt (Drained)	1.64e-005	0.2	0.29
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.	Bottom Ash (Drained)	0.0115	1	0.3548

No warranties can be made regarding the continuity of subsurface conditions.



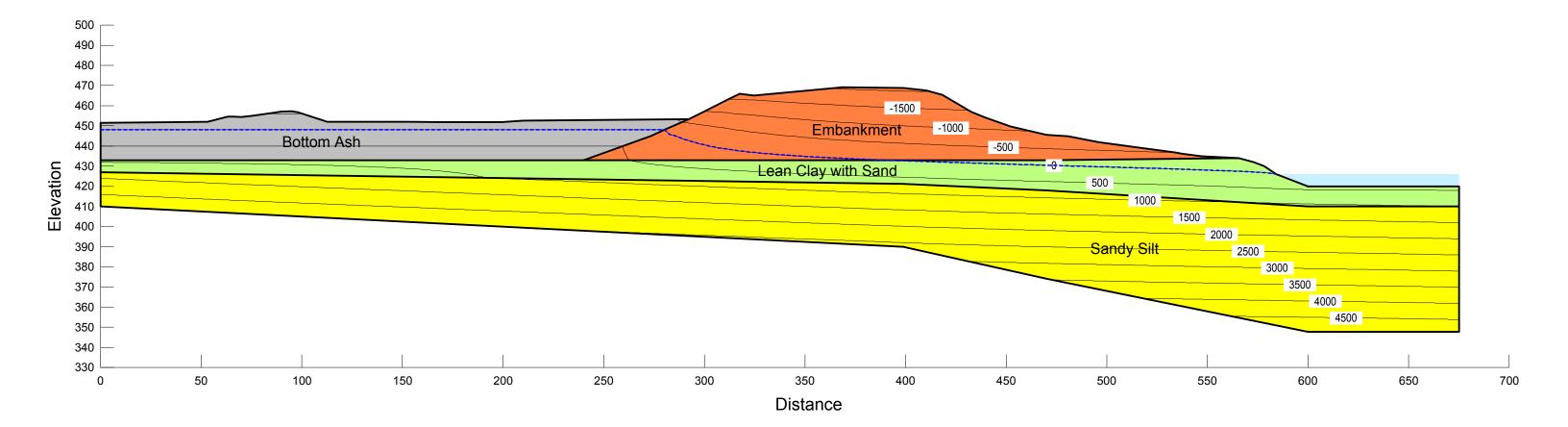
Seepage Analysis Boundary Condition and Mesh

Res. Water Content ft^3/ft^3

- 0.109
- 0.09
- 0.01
- 0.027

SEEP Steady State Normal Pool Normal Pool Elevation: 448 Feet	Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3
Drained Static Strengths Section C-C'	Embankment (Drained)	4.72e-008	0.1	0.38
	Lean Clay with Sand (Drained)	2.83e-007	0.1	0.41
N /	Sandy Silt (Drained)	1.64e-005	0.2	0.29
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.	Bottom Ash (Drained)	0.0115	1	0.3548

No warranties can be made regarding the continuity of subsurface conditions.



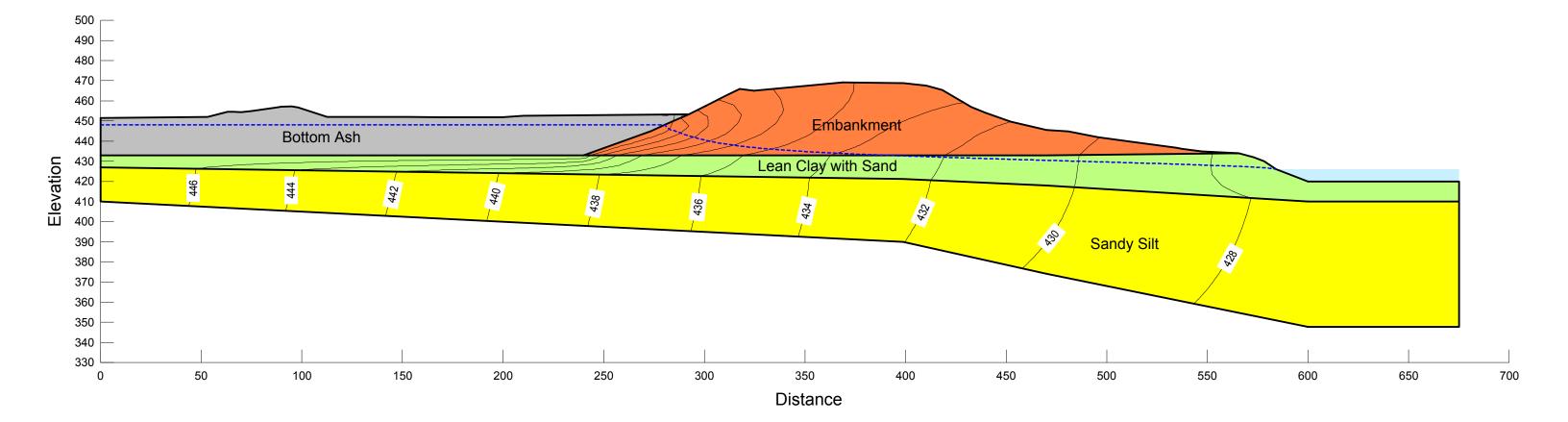
Seepage Analysis Pore Water Pressure Contour (psf)

Res. Water Content ft^3/ft^3

- 0.109
- 0.09
- 0.01
- 0.027

SEEP Steady State Normal Pool Normal Pool Elevation: 448 Feet	Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3
Drained Static Strengths Section C-C'	Embankment (Drained)	4.72e-008	0.1	0.38
	Lean Clay with Sand (Drained)	2.83e-007	0.1	0.41
	Sandy Silt (Drained)	1.64e-005	0.2	0.29
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.	Bottom Ash (Drained)	0.0115	1	0.3548

No warranties can be made regarding the continuity of subsurface conditions.



Seepage Analysis Total Head Contour (feet)

Res. Water Content ft^3/ft^3

0.109

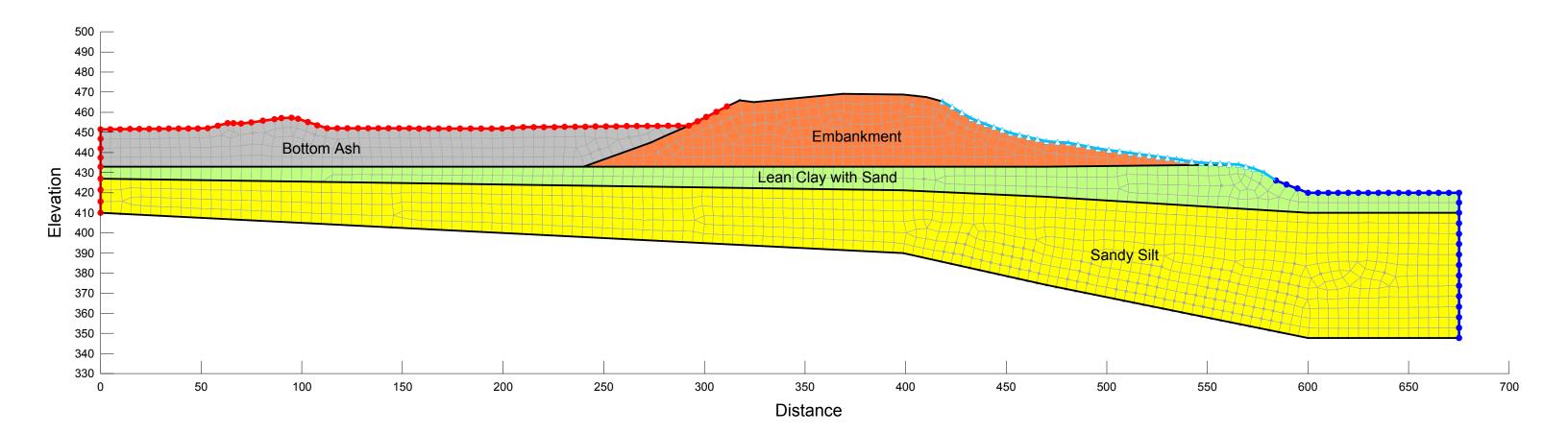
0.09

0.01

0.027

SEEP Steady State 50% PMF Pool 50% PMF Pool Elevation: 462.8 Feet	Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3
Drained Static Strengths Section C-C'	Embankment (Drained)	4.72e-008	0.1	0.38
	Lean Clay with Sand (Drained)	2.83e-007	0.1	0.41
	Sandy Silt (Drained)	1.64e-005	0.2	0.29
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.	Bottom Ash (Drained)	0.0115	1	0.3548

No warranties can be made regarding the continuity of subsurface conditions.



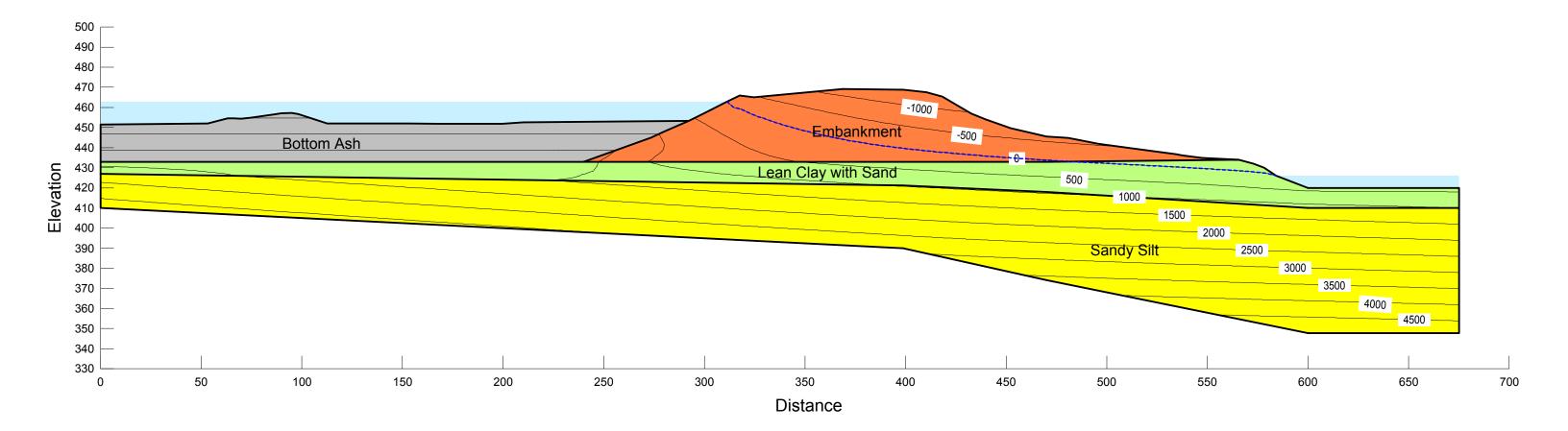
Seepage Analysis Boundary Condition and Mesh

Res. Water Content ft^3/ft^3

- 0.109
- 0.09
- 0.01
- 0.027

SEEP Steady State 50% PMF Pool 50% PMF Pool Elevation: 462.8 Feet	Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3
Drained Static Strengths Section C-C'	Embankment (Drained)	4.72e-008	0.1	0.38
	Lean Clay with Sand (Drained)	2.83e-007	0.1	0.41
	Sandy Silt (Drained)	1.64e-005	0.2	0.29
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.	Bottom Ash (Drained)	0.0115	1	0.3548

No warranties can be made regarding the continuity of subsurface conditions.



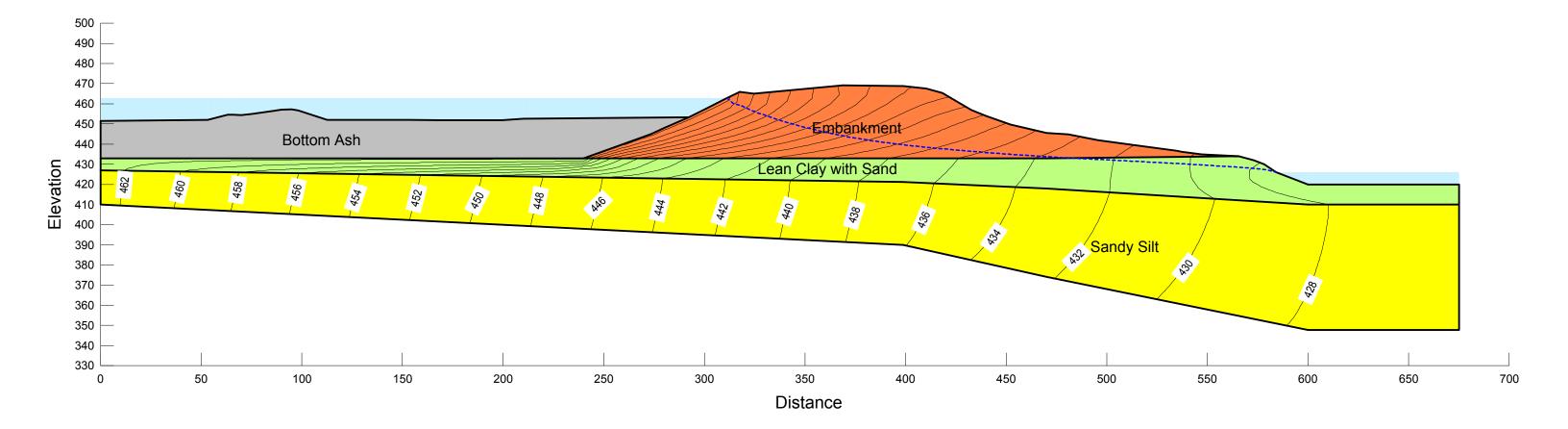
Seepage Analysis Pore Water Pressure Contour (psf)

Res. Water Content ft^3/ft^3

- 0.109
- 0.09
- 0.01
- 0.027

SEEP Steady State 50% PMF Pool 50% PMF Pool Elevation: 462.8 Feet	Material	Kh-sat (ft/sec)	Kratio Kv/Kh	Sat. Water Content ft^3/ft^3
Drained Static Strengths Section C-C'	Embankment (Drained)	4.72e-008	0.1	0.38
	Lean Clay with Sand (Drained)	2.83e-007	0.1	0.41
	Sandy Silt (Drained)	1.64e-005	0.2	0.29
Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling.	Bottom Ash (Drained)	0.0115	1	0.3548

No warranties can be made regarding the continuity of subsurface conditions.



Seepage Analysis Total Head Contour (feet)

Res. Water Content ft^3/ft^3

0.109

0.09

0.01

0.027

APPENDIX J PARAMETER DERIVATIONS

BOILER SLAG POND DAM: 2010 PARAMETER DERIVATIONS

WEST BOTTOM ASH DAM GEOTECHNICAL ANALYSIS

CALCULATION SHEET

I. Subsurface Exploration Program Development:

Three cross sections across the dam were analyzed with two borings on each section: On the crest and at the toe.

II. Laboratory Testing Program:

The program was developed based on visual classifications done in the field during subsurface exploration.

- USCS Soil Classification Tests
- CU Triaxial Compression Tests
- Permeability Tests.
- Moisture Density tests.

III. Geotechnical Analysis:

A soil tests summary was developed to select soil parameters to use in the geotechnical analysis. Engineering properties that were not directly tested were determined using typical soil parameter values from NAVFAC DM7-02 Foundations and Earth Structures (Table 1 on Page 39) and the Center For Geotechnical Practice and Research, Performance and Use of the Standard Penetration Test in Geotechnical Engineering Practice report (Figures 34 and 35 on pages 71 and 72 respectively). The two tables are attached at the end of the parameter derivation notes.

Permeability k values that were not tested in the laboratory were selected from typical values provided in the table below and those provided in NAVFAC DM7.02, table 1: Typical Properties of Compacted soils

Soil Type	k _v (cm/s)
Coarse Sand	>10
Fine Sand	10^{-1} to 10^{-3}
Silty Sand	10 ⁻³ to 10 ⁻⁵
Silt	-5 -7 10 to 10
Clay	-7 <10

Soils from the West Bottom Ash Dam were classified into 5 main soil layers.

The following table shows how pertinent parameters were selected and which sections they were applied to.

Soil name	USCS class	Classification Samples	Shear Strength Parameters	Permeability Parameters	Section
Embankment fill	CL	B-1,(10- 11.5)(12.5-14)	Triaxial Test No 1	Test ID 7A	A/B/C
Lean Clay with Sand	CL	B-2,(32.5-34)(35- 36.5)	Triaxial Test No 2	Average of test ID 48A & 82A	A/B/C
Gravel With Silt and Sand	GW- GM	B-4,(57.5-59)(60- 61.5)	Typical values *	Typical values	A/B
Sand Silt/ Silt with Sand	ML	B-5,(55- 56.5)(57.5-59)	Typical values *	Typical values	С
Bottom Ash		Averaged results from WBAP trench testing.**	Typical values *	Averaged results from WBAP trench testing.	A/B/C

* Typical values as determined from referenced tables. ** Table attached at end of appendix

Soil name	Unit Weight	С	ø	K _v (cm/sec)	K _h /K _v	g	е
Embankment fill	130	165	33	1.44 E- 07	10	2.72 (ST sample)	0.609 (ST sample)
Lean Clay with Sand	119	160	24	8.62 E- 07	10	2.69 (ST sample)	0.700 (ST sample
Gravel With Silt and Sand	130	0	35	1.00 E- 02	5	2.70	0.300
Sand Silt/ Silt with Sand	130	0	30	1.00 E- 04	5	2.70	0.400
Bottom Ash	115	0	28	3.5E-01	1		

1. <u>SEEPAGE ANALYSIS</u>.

Geoslope Seep W analysis was used to analyze the model for Seepage. Field piezometer readings were compared to the model's results. The model was calibrated to approximate field water elevations.

Residual and saturated water contents and coefficients of volume compressibility were assumed for all soil layers based on previous experiences and soils' normal values.

Water elevations used were:

- Existing (normal) water elevation in the pond: 442 feet.
- Maximum possible impounded water elevation (spillway highest grate): 457.7 feet
- Ohio River water elevation 426 feet.

Seepage analysis results were used in the slope stability analysis to model pore water pressures.

2. STABILITY ANALYSIS.

Geoslope Slope W was used for the slope stability analysis.

The Spencer Analysis Method was used.

Slip circle method and siding wedge method were modeled by the circular failure plane and the block specified; the circular failure plane produced lower Factors of Safety.

The peak ground acceleration used for the seismic analysis was obtained from US Geological Survey website. The PGA used is 0.08g (USGS indicates 0.07677g). The method selected to do the seismic analysis was the pseudostatic analysis per the project scope.

Loading conditions:

Static Slope Stability Loading Conditions:

- Steady state Seepage normal pool (upstream and downstream slopes): 442 feet
- Steady state seepage maximum pool (upstream and downstream slopes): 457.7 feet
- Rapid drawdown: normal pool steady-state seepage conditions with empty pond and dredged conditions above elevation 433 feet (upstream slope)
- PMF event (upstream and downstream slopes). The flood water was considered as a surcharge and the maximum pool steady state pore pressure line was used, as the water elevation selected for the PMF event is the result of a flood occurring while the dam had the maximum water pool. PMF event water elevation in the pond is: 468.4 feet.

Seismic Slope Stability Loading Conditions:

- Steady state seepage normal pool (upstream and downstream slopes): 442 feet
- Steady state seepage maximum pool (upstream and downstream slopes): 457.7 feet

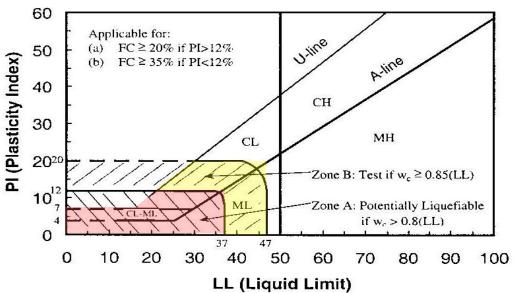
3. LIQUEFACTION ANALYSIS.

Research and methodology:

- Earthquake intensity: USGS website used to determine the Peak Ground Acceleration and earthquake intensity for an earthquake event of a mean return period of 2,475 years. PGA = 0.07677g, the value used in the analysis is 0.08g and $M_L = 7.7$.
- Groundwater table: Normal (current) steady state water elevations were considered as the groundwater elevation. Unsaturated soil located above the groundwater table will not liquefy.
- Soil Type:

The dam soil materials, being constructed of engineered fill located above the groundwater table, are not considered liquefiable.

Cohesionless materials are considered liquefiable. The majority of cohesive soils will not liquefy. Cohesive soils susceptible to liquefaction should fall in either zone A or zone B of the following chart.



Screening Criteria for Liquefiable Fine-Grained Soils (Seed et al. 2003)

 Soil relative density (Dr): Soils in a loose relative density state are susceptible to liquefaction. Soils with an SPT-N value of 30 or higher were considered not liquefiable.

Liquefaction Assessment

To assess liquefaction potential for the WBAD, the boring logs from the geotechnical borings and laboratory test data from Shelby tubes and SPT samples were used. The boring logs include the SPT blow counts and soil lithologic descriptions with depth.

Soil characteristics (grain size, plasticity, unit weight, moisture content) from SPT and Shelby tube samples obtained from the geotechnical borings were used in the liquefaction assessment.

Method Used: Simplified Method based on using correlations to blow counts from Standard Penetration Tests (SPTs) as set forth in Youd et al (2001) and discussed in NRC (1985).

The Simplified Method requires estimating the Cyclic Stress Ratio (CSR) and Cyclic Resistance Ratio (CRR) of the soil. The CRR can be estimated using information from SPT tests, corrected to account for various effects. To use the Simplified Method, the SPT N value is normalized to an overburden pressure of approximately 100 kiloPascals (kPa) and a hammer energy ratio of 60% and procedural effects (rod length, sample configuration and borehole diameter).

The $(N_1)_{60}$ may also be corrected for the percent of fines using the relationship:

$$\left(N_1\right)_{60cs} = \alpha + \beta \left(N_1\right)_{60}$$

It is important to note that the fines correction is an approximation and is only valid for nonplastic fines and with a fines content between 0 and 35%. This correction factor, although widely used, is considered as a rough approximation only.

Once the corrected value for $(N_1)_{60}$ is found, the CRR is calculated as:

$$CRR_{7.5} = \frac{1}{34 - (N_1)_{60}} + \frac{(N_1)_{60}}{135} + \frac{50}{[10*(N_1)_{60} + 45]^2} - \frac{1}{200}$$

Note that the value calculated is the CRR normalized to a 7.5 magnitude earthquake, hence the CRR_{7.5} notation. When evaluating the liquefaction potential of soil, the CRR_{7.5} must be corrected to the magnitude earthquake of interest.

The CSR is independent of soil properties and may be approximated using the equation:

$$CSR = 0.65(\frac{a_{\max}}{g})(\frac{\sigma_v}{\sigma'_v})r_d$$

where:

a_{max} is the maximum ground acceleration.

g is the acceleration of gravity.

 σ_v is the total vertical stress.

 σ_v is the effective vertical stress.

 $r_{\rm d}$ is a stress reduction coefficient.

Liquefaction potential for a soil unit is evaluated by dividing CRR_{7.5} by CSR and then correcting to the magnitude earthquake of interest, as:

$$FS = \frac{CRR_{7.5}}{CSR} * MSF$$

Field experience has shown that the Simplified Method is somewhat conservative; so many designers consider FS values close to unity as an indication of no liquefaction.

Elevation	Depth	Soil class	Ν	Remarks
470.2	3.25	CL	11	Not liquefiable.
467.7	5.75	CL	10	
462.7	10.75	CL	10	Embankment and
460.2	13.25	CL	7	located above
455.2	18.25	CL	15	ground water
452.7	20.75	CL	15	
450.2	23.25	CL	14	
447.7	25.75	CL	8	
445.2	28.25	CL	12	
442.7	30.75	CL	11	
440.2	33.25	CL	9	
437.7	35.75	CL	10	
435.2	38.25	CL	6	
432.7	40.75	CL	5	
427.7	45.75	CL	2	Evaluated for
425.2	48.25	CL	3	liquefaction
422.7	50.75	CL	4	
420.2	53.25	CL	2	
417.7	55.75	CL	4	
415.2	58.25	CL	4	
412.7	60.75	CL	5	
410.2	63.25	CL	6	
407.7	65.75	CL	7	

<u>B-1</u>

<u>B-2</u>

Elevation	Depth	Soil class	N-field	Remarks
440.8	3.25	CL	19	Not liquefiable
438.3	5.75	CL	7	as layer is
435.8	8.25	CL	7	above ground
430.8	13.25	CL	5	water
428.3	15.75	CL	4	
425.8	18.25	CL	2	Evaluated for
423.3	20.75	CL	4	liquefaction

418.3	25.75	CL	4	
415.8	28.25	CL	9	
413.3	30.75	CL	6	
410.8	33.25	CL	6	
408.3	35.75	CL	5	
405.8	38.25	CL	4	
403.3	40.75	CL	6	
398.3	45.75	CL	2	
393.3	50.75	GW - GM	50	Not liquefiable

<u>B-3</u>

Elevation	Depth	Soil class	N-field	Remarks
468.4	3.25	CL	11	Not liquefiable.
465.9	5.75	CL	8	
463.4	8.25	CL	10	Embankment
458.4	13.25	CL	9	and located
455.9	15.75	CL	10	above ground
453.4	18.25	CL	12	water
448.4	23.25	CL	12	
445.9	25.75	CL	9	
443.4	28.25	CL	15	
440.9	30.75	CL	10	
438.4	33.25	CL	17	
435.9	35.75	CL	16	
433.4	38.25	CL	18	
430.9	40.75	CL	4	Evaluated for
428.4	43.25	CL	4	liquefaction
425.9	45.75	CL	6	
420.9	50.75	CL	4	
418.4	53.25	CL	2	
415.9	55.75	CL	5	
413.4	58.25	CL	2	
410.9	60.75	CL	8	
408.4	63.25	CL	6	
405.9	65.75	CL	7	
403.4	68.25	CL	9	
400.9	70.75	CL	8	

<u>B-4</u>

Elevation	Depth	Soil class	N-field	Remarks
443.5	3.25	CL	16	Not liquefiable
441.0	5.75	CL	15	as located
436.0	10.75	CL	11	above ground
433.5	13.25	CL	7	water
431.0	15.75	CL	5	

426.0	20.75	CL	4	Evaluated for
424.5	22.25	CL 5		liquefaction
421.0	25.75	CL	6	
418.5	28.25	CL	5	
416.0	30.75	CL	3	
413.5	33.25	CL	4	
411.0	35.75	CL	9	
406.0	40.75	CL	4	
403.5	43.25	CL	5	
401.0	45.75	CL	8	
398.5	48.25	CL	6	
396.0	50.75	CL	7	
393.5	53.25	CL	5	
391.0	55.75	CL	7	
388.5	58.25	GW - GM	39	Not liquefiable
386.0	60.75	GW - GM	46	as layer is very
381.5	65.25	GW - GM	50	dense
376.0	70.75	GW - GM	52	

<u>B-5</u>

Elevation	Depth	Soil class	N-field	Remarks
465.5	3.25	CL	19	Not liquefiable.
463.0	5.75	CL	9	
458.0	10.75	CL	15	Embankment
455.5	13.25	CL	10	and located
453.0	15.75	CL	7	above ground
450.5	18.25	CL	16	water
448.0	20.75	CL	7	
443.0	25.75	CL	8	
440.5	28.25	CL	7	
438.0	30.75	CL	12	
435.5	33.25	CL	8	
433.0	35.75	CL	16	
430.5	38.25	CL	6	
428.0	40.75	CL	3	Evaluated for
423.0	45.75	CL	4	liquefaction
420.5	48.25	ML	4	Evaluated for
418.0	50.75	ML	6	liquefaction
415.5	53.25	ML	2	
413.0	55.75	ML	4	
410.5	58.25	ML	5	
408.0	60.75	ML	7	
405.5	63.25	ML	9	
403.0	65.75	ML	11	
400.5	68.25	ML	9	
398.0	70.75	ML	13]

<u>B-6</u>

Elevation	Depth	Soil class	N-field	Remarks
442.3	3.25	CL	8	Not liquefiable as layer is above ground water
439.8	5.75	CL	10	
434.8	10.75	CL	18	
432.3	13.25	CL	4	
429.8	15.75	CL	3	
424.8	20.75	CL	1	Evaluated for liquefaction
422.3	23.25	CL	2	
419.8	25.75	CL	4	
417.3	28.25	ML	5	Evaluated for liquefaction
414.8	30.75	ML	3	
412.3	33.25	ML	3	
409.8	35.75	ML	1	
407.3	38.25	ML	1	
402.3	43.25	ML	2	
399.8	45.75	ML	1	
397.3	48.25	ML	1	
394.8	50.75	ML	5	
392.3	53.25	ML	11	
389.8	55.75	ML	4	
387.3	58.25	ML	9	
384.8	60.75	ML	11	
379.8	65.75	ML	9	
374.8	70.75	ML	10	

					l Value of pression	Турі	cal Strength	Characterist	tics	
Group Symbol	Soil Туре	Range of Nextmum Dry Unit Weight, pof	Range of Optimum Moisture, Percent	At 1.4 tsf (20 pei)	At 3.6 tuf (50 p#f)	Cohesion (as com- pacted) paf	Constion (seturated) paf	(Effective Stress Envelope Degrees)	Tan Ø	Typics Coeffic of Perm bilit ft./mi
					of Original leight					
CNI	Well graded clean gravels, gravel-sand mixtures.	125 - 135	11 - 8	0,3	0.6	0	0	>38	>0.79	5 x 10
GP	Poorly graded clean gravels, gravel-sand mix	115 - 125	16 - 11	0.4	0.9	o	D	>37	>0.74	10+1
GM	Silty gravels, poorly graded gravel-sand-silt.	120 - 135	12 - 8	Q.5	1.1			>34	>0.67	>10-6
GC	Clayey gravels, poorly graded gravel-sand-clay.	115 - 130	14 - 9	0.7	1,6			>31	>0.60	>10-7
ŝW	Well graded clean mends, gravelly spuds,	110 - 130	16 - 9	0_6	1.2	o	0	38	0.79	>10=3
57	Foorly graded class sands, Sand-gravel mix.	100 - 120	21 - 12	0.0	1.4	0	Ð	37	0.74	>10-3
SM	Silty ands, poorly graded send-wilt wix.	110 - 125	16 - 11	0,8	1.6	1050	420	34	0.67	5 x >10.
sh-sc	Sand-silt clay mix with slightly plastic fines.	110 - 130	15 - 11	0.8	1.4	1050	3 00	33	0.66	2 x >10
SC	Clayey sands, poorly graded sand-clay-mix.	105 + 125	19 - 11	1.1	2,2	1550	230	31	0,60	5 x >10
HCL.	Inorganic silts and cleysy eilts.	95 - 120	24 - 12	0,9	1,7	1400	190	32	0.62	>10-5
ML-CL	Hixture of inorganic ailt and clay.	100 - 120	22 - 12	1.0	2.2	1350	460	3z	0.5Z	5 x >10
а,	Inorganic clays of low to medium plasticity.	95 - 120	24 - 12	1.3	2.5	1800	270	28	0.54	>10-7
01	Organic eilts and silt- claye, low plasticity.	80 - 100	33 - 21				•••••			•••••
MGL	inorganic clayey silta, élastic silts,	70 - 95	40 - 24	2.0	3.8	1500	420	25	0.47	5 x >10
CH	Inorganic clays of high plasticity	75 - 105	36 - 19	2,6	3.9	2150	230	19	0,35	>10-7
он	Organic clays and silty clays	65 - 100	45 - 21			•••••				

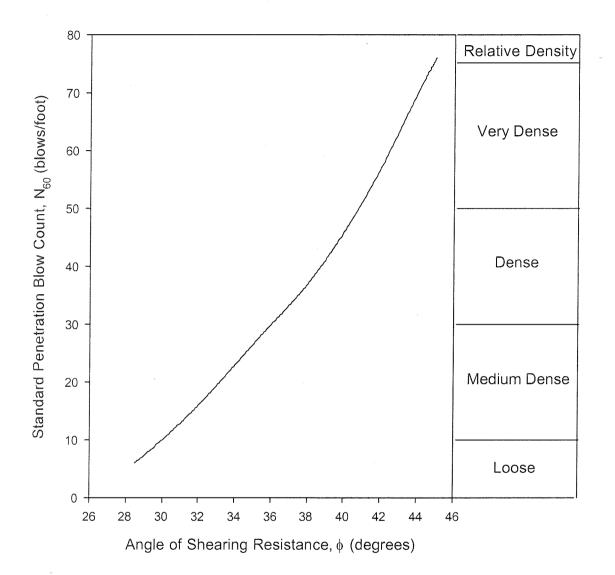
TABLE 1 Typical Properties of Compacted Soils

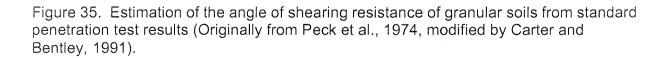
Notes:

- All properties are for condition of "Standard Proctor" maximum density, except values of k and CSR which are for "modified Proctor" maximum density.
- Typical stength characteristics are for effective strength envelopes and are obtained from USBR date.
- Compression values are for vertical loading with complete lateral confinement.
- 4. (>) indicates that typical property is greater than the value shown. (..) indicates insufficient data available for an estimate.

7.2-39

ypics1 efficient Permes- bility t,/min,	Range of CBR Values	Range of Subgrade Modulus k 1bs/cu in.
к 10 ⁻²	40 ~ 80	300 - 500
10+1	30 ~ 60	250 - 400
>10-6	20 - 60	100 - 400
×10-7	20 - 40	1 00 - 3 00
s10=3	20 - 40	200 - 300
s10-3	10 - 40	200 - 300
¢ >10~5	10 - 40	100 - 300
x >10 ⁻⁶	5 - 30	100 - 300
x >10 ⁻⁷	5 - 20	100 - 300
.10-5	15 ar less	100 - 200
x >10 ⁻⁷		
10-7	15 or less	50 - 200
	5 or Less	50 - 100
x >10 ⁻⁷	10 or less	50 - 100
10-7	15 or less	50 - 150
	5 or less	25 - 100
	·	





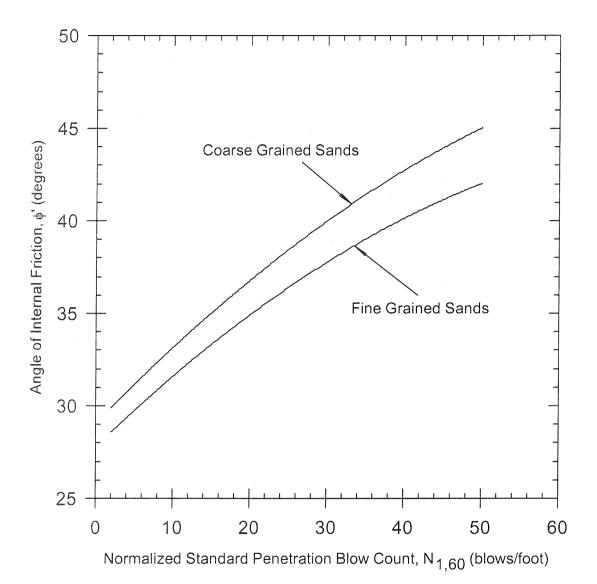


Figure 34. Empirical correlation between friction angle of sands and normalized standard penetration blow count (after Terzaghi et al., 1996)

WBAP Trench Testing (Bottom Ash Testing) ASTM D 422, C 136																						
								3"	1 1/2"	1"	3/4"	Sieve 3/8"	Size (% Pa No. 4	ssing) No. 10	No. 40	No. 200	Pan	% Gravel	% Sand	% Fines	K(cm/s)	Fines
Sample	Classification	œ (%)	D₁₀ (mm)	D₃₀ (mm)	Den (mm)	Cu	Cc	75	37.5	25.0	3/4 19.0	3/8 9.5	4.75	2	0.425	0.075	0.01	% Glaver	% Janu	76 FILLES		Classification
1	Well Graded Sand (SW) with Gravel	6.2	0.3798	1.1724	3.2161	8.47	1.13	100.0	100.0	96.9	95.0	84.8	74.1	42.9	11.8	1.8	0.0	25.9	72.2	1.7	4.1E-01	
2	Poorly Graded Sand (SP) with Gravel	5.6	0.5766	1.4565	3.4443	5.97	1.07	100.0	100.0	96.1	93.8	85.2	72.9	38.2	5.5	0.8	0.0	27.1	72.1	0.8	1.1E+00	
3	Well Graded Sand (SW)	7.5	0.3386	0.9936	2.6258	7.76	1.11	100.0	100.0	100.0	100.0	95.1	85.9	50.4	12.2	2.2	0.0	14.1	83.8	1.9	3.0E-01	
4	Poorly Graded Sand (SP) with Gravel	5.9	0.5081	1.2732	3.0405	5.98	1.05	100.0	100.0	100.0	95.9	89.7	78.9	42.5	7.3	1.3	0.0	21.1	77.6	1.2	5.9E-01	
5	Poorly Graded Sand (SP) with Gravel	6.0	0.5210	1.2514	2.9512	5.66	1.02	100.0	100.0	100.0	98.7	91.7	80.6	43.7	6.5	1.2	0.0	19.4	79.5	1.1	8.4E-01	
6	Well Graded Sand (SW) with Gravel	7.1	0.3792	1.0490	2.7409	7.23	1.06	100.0	100.0	97.7	94.4	90.1	81.6	47.6	11.0	2.2	0.0	18.4	79.3	2.1	3.6E-01	
7	Poorly Graded Sand (SP-SC) with Clay	23.1	0.0757	0.1599	0.5429	7.17	0.62	100.0	100.0	100.0	100.0	98.4	94.7	80.6	56.1	9.8	0.0	5.3	84.9	10.0	5.6E-02	
8	Well Graded Sand with Gravel (SW), gray	8.7	0.1868	0.8464	2.6959	14.44	1.42	100.0	100.0	100.0	99.5	94.8	84.4	47.1	17.1	2.1	0.0	15.6	82.4	2.1	3.0E-01	
9	Well Graded Sand (SW) with Gravel	5.4	0.3714	1.4341	3.9659	10.68	1.40	100.0	100.0	93.7	89.1	77.9	66.1	36.5	11.3	1.0	0.0	33.9	65.1	1.0	2.9E-01	
10	Well Graded Sand (SW) with Gravel	4.4	0.2954	1.3526	4.3012	14.56	1.44	100.0	100.0	94.8	87.9	76.3	63.1	36.3	12.3	1.4	0.0	36.9	61.7	1.4	1.7E-01	
11	Well Graded Sand (SW) with Gravel	4.4	0.3771	1.1624	3.2364	8.58	1.11	100.0	100.0	100.0	96.3	87.8	75.2	41.0	10.6	1.8	0.0	24.8	73.3	1.8	3.9E-01	
12	Poorly Graded Sand (SP) with Gravel	2.7	0.4552	1.1566	3.1130	6.84	0.94	100.0	100.0	97.9	96.4	86.8	76.9	42.4	8.5	1.4	0.0	23.1	75.5	1.4	4.7E-01	
13	Well Graded Sand (SW) with Gravel	12.5	0.1642	0.7368	2.4777	15.09	1.33	100.0	100.0	100.0	100.0	93.1	84.1	53.4	20.4	3.7	0.0	15.9	80.4	3.7	2.4E-01	
14	Well Graded Sand (SW-SC) with Clay and Gravel	14.0	0.1021	0.9001	3.1464	30.82	2.52	100.0	90.3	90.3	89.1	84.2	75.4	44.5	20.0	7.8	0.0	24.6	67.6	7.8	2.5E-01	CH
15		7.7	0.1110	0.6950	2.4690	22.24	1.76	100.0	100.0	100.0	99.1	93.7	83.3	53.8	21.7	6.6	0.0	16.7	76.7	6.6		
16		8.4	0.0934	0.6601	2.3445	25.10	1.99	100.0	100.0	100.0	100.0	95.3	86.1	54.9	22.4	8.4	0.0	13.9	77.7	8.4		
17		6.8	0.1413	0.7713	2.6062	18.44	1.62	100.0	100.0	100.0	98.3	93.1	81.3	51.6	20.1	6.1	0.0	18.7	75.2	6.1		
18	Silty Sand (SM), with Gravel	8.5						100.0	100.0	94.4	91.5	85.3	76.4	49.5	46.6	33.3	0.0	23.6	43.1	33.3	8.6E-02	
19		8.2	0.1425	0.7675	2.6682	18.72	1.55	100.0	100.0	100.0	98.5	90.6	81.2	50.8	19.8	6.1	0.0	18.8	75.1	6.1		
20	Silty Sand (SM), gray	13.3						100.0	100.0	100.0	100.0	94.3	87.5	61.4	30.9	14.3	0.0	12.5	73.2	14.3	1.9E-02	
21	Silty Sand (SM), gray	16.8						100.0	100.0	100.0	100.0	96.5	89.5	62.2	34.4	17.1	0.0	10.5	72.4	17.1	1.8E-02	
22	Well Graded Sand (SW-SM) with Silt and Gravel	5.8	0.1552	1.0052	2.9060	18.73	2.24	100.0	100.0	100.0	97.1	93.3	84.0	43.5	18.6	5.6	0.0	16.0	78.4	5.6		ML
23	Well Graded Sand (SW-SM) with Silt and Gravel	6.8	0.1053	0.6226	2.6016	24.71	1.42	100.0	100.0	100.0	97.0	89.4	81.0	52.3	23.5	6.7	0.0	19.0	74.3	6.7		ML
24	Well Graded Sand (SW-SM) with Silt	4.5	0.1541	0.8266	2.6141	16.96	1.70	100.0	100.0	100.0	97.7	92.9	86.8	49.2	19.4	5.3	0.0	13.2	81.5	5.3		ML
25	Well Graded Sand (SW-SM) with Silt and Gravel	6.8	0.0972	0.5461	2.4056	24.74	1.28	100.0	100.0	98.4	96.7	90.2	81.0	54.5	26.1	7.2	0.0	19.0	73.8	7.2		ML
	max		0.5766	1.4565	4.3012	30.82	2.52	100.0	100.0	100.0	100.0	98.4	94.7	80.6	56.1	33.3	0.0	36.9	84.9	33.3	1.1E+00	
	min		0.0757	0.1599	0.5429	5.66	0.62	100.0	90.3	90.3	87.9	76.3	63.1	36.3	5.5	0.8	0.0	5.3	43.1	0.8	1.8E-02	
	average		0.2605	0.9472	2.8233	14.50	1.40	100.0	99.6	98.4	96.5	90.0	80.5	49.2	19.8	6.2	0.0	19.5	74.3	6.2	3.5E-01	
	•																					

LANDFILL RUNOFF COLLECTION POND

FLY ASH DAM GEOTECHNICAL ANALYSIS

PARAMETER DERIVATION

I. Subsurface Exploration Program Development:

The scope determined two sections across the dam. Two borings will be drilled on each section, on the crest and at the toe, only Sheby tube samples were collected that will be used to supplement available historic borings data in the development of the soil profile.

II. Laboratory Testing Program:

The program was developed to provide additional soil data to available historic data.

- USCS Soil Classification Tests.
- Triaxial tests.
- Permeability tests
- Moisture-density tests.

III. Geotechnical Analysis:

A soil tests summary was developed to select soil parameters to use in the geotechnical analysis. Engineering properties that were not directly tested were determined using typical soil parameter values from NAVFAC DM7-02 Foundations and Earth Structures (Table 1 on Page 39) and the Center For Geotechnical Practice and Research, Performance and Use of the Standard Penetration Test in Geotechnical Engineering Practice report (Figures 34 and 35 on pages 72 and 77 respectively). The two tables are attached at the end of the parameter derivation notes.

Permeability k values that were not tested in the laboratory were selected from typical values provided in the table below and those provided in NAVFAC DM7.02, table 1: Typical Properties of Compacted soils

Soil Type	k _v (cm/s)
Coarse Sand	>10
Fine Sand	10^{-1} to 10^{-3}
Silty Sand	10^{-3} to 10^{-5}
Silt	⁻⁵ -7 10 to 10
Clay	<10-7

Historic boring and graphic logs were used to develop the dam's soil horizons for soil layers on which soil sampling was not done.

Soils from the Flay Ash Dam were classified into 7 main soil layers.

The following table shows how pertinent parameters were selected and which sections they were applied to.

Soil name	USGS class	Classification Samples	Shear results sample	Permeability k-value sample	Section
Embankment fill	CL	B-9 sample (20.2' – 20.8')	Average Triaxial Test B-7 & B-9	Average K tests B-7 & B-9	D/E
Lean Clay With Sand	CL	B-8 sample (25.5' – 25.8')	Average Triaxial Test B-8 & B-10	Permeability test B-8	D/E
Clayey Sand and Gravel	GC	Fly Ash Dam Raising report logs	Typical values *	Typical values *	D
Sandy Silts	ML	Fly Ash Dam Raising report logs	Typical values *	Typical values	D
Silty Clay With Sand	CL-ML	B-10 sample (16.2' – 16.8')	Typical values *	Permeability test B-10	E
Silty Sand	Ity Sand SM B-10 sample (14.2' – 14.8')		Typical values *		
Fly Ash	y Ash NA NA		Typical values *	Hydrogeologic study report	D/E

* Typical values as determined from referenced tables.

Soil name	Unit Weight	С	ф	kv (cm/sec)	Typical kh/kv	g	е
Embankment fill	129	198	27.5	7.30E-08	10	2.63 B-7 (27.2- 27.8)	0.609 (ST sample)
Lean Clay With Sand	127	205.92	28	3.40E-08	10	2.65 B-8 (29.7- 30.3)	0.700 (ST sample)
Clayey Sand and Gravel	130	0	35	1.00E-02	10	2.70	0.5
Sandy Silts	125	0	30	1.00E-04	5	2.65 B-8 (29.7- 30.3)	0.4
Silty Clay With Sand	118	151.92	34.1	1.40E-07	10	2.68 B-10 (14.2- 14.8)	0.43

Silty Sand	94	0	30	1.00E-04	5	2.66 B-10 (16.2- 16.8)	0.4
Fly Ash	115	0	25	4.75E-04	50	NA	NA

1. <u>SEEPAGE ANALYSIS</u>.

Geoslope Seep W analysis was used to analyze the model for seepage. Historic Field piezometer readings (Hydrogeologic Study Report, Clifty Creek Coal Ash Landfill, AGES. November 2006) were compared to the model's results. The model results were inconsistent with available piezometer readings. This was due to a lack of enough soil property data.

Water elevations used were:

- Existing (normal) water elevation in the pond: 485 feet.
- Ohio River water elevation 426 feet.

Seepage analysis results were not used in slope stability analyses.

2. STABILITY ANALYSIS.

Geoslope Slope W was used for the slope stability analysis.

The Spencer Analysis Method was used.

Slip circle method and siding wedge method were modeled by the circular failure plane and the block specified; the circular failure plane produced lower Factors of Safety.

The peak ground acceleration used for the seismic analysis was obtained from US Geological Survey website. The PGA used is 0.08g. The method selected to do the seismic analysis was the pseudostatic analysis per the project scope.

Loading conditions:

During a period from 2004 to 2006, groundwater readings from different piezometers and wells across the dam and toe area were taken. The results of these readings provide were used for steady state analysis. (Hydrogeologic Study Report, Clifty Creek Coal Ash Landfill, AGES. November 2006)

Static Slope Stability Loading Conditions:

- Steady state Seepage normal pool (upstream and downstream slopes): 485 feet
- PMF event (upstream and downstream slopes). The flood water was considered as a surcharge above the water pool for steady state. PMF event water elevation in the pond: 501.4 feet.

Seismic Slope Stability Loading Conditions:

• Steady state seepage normal pool (upstream and downstream slopes): 485 feet.

3. LIQUEFACTION ANALYSIS.

Research and methodology:

- Earthquake intensity: USGS website used to determine the Peak Ground Acceleration and earthquake intensity for an earthquake event of a mean return period of 2,475 years. PGA = 0.07677g (used 0.08g) and M_L = 7.7.
- Groundwater elevation date from 2004 through 2006 provide a steady state water elevation through the dam and the foundation soil materials. Unsaturated soil located above the groundwater table will not liquefy.
- Soil Type:

The dam soil materials, being constructed of engineered fill are not considered liquefiable.

Cohesionless materials are considered liquefiable. The majority of cohesive soils will not liquefy, cohesive soils susceptible to liquefy should have an liquid limit less than 37 and the water content of the soil must be greater than about 85% of the liquid limit.

Due to the absence of USCS classification laboratory results, cohesive foundation materials were considered potentially liquefiable and Factors of Safety against liquefaction were calculated.

• Soil relative density (Dr): Soils in a loose relative density state are susceptible to liquefaction. Soils with an SPT-N value of 30 or higher were considered not liquefiable.

Liquefaction Assessment

Data from nine historical borings (SI-1, SS1-1, SS2-1, SS2-4, SS3-1, SS3-4, SS4-1, SS4-4, and SS5-1) were used to assess liquefaction potential. These borings were drilled in 1984 as part of the AEP Fly Ash Dam Raising Feasibility Project (1985). Soil characteristics included on the borings include the visually-estimated soil classifications per the USCS and SPT N-values.

In order to analyze the dam and foundation materials against liquefaction, it was necessary to assume the percent fines, or percent silt and clay, for many of the soils due to lack of particle size distribution data for the historic borings. Correlating current laboratory classification results with historic logs was done and where data was not available, typical values were assumed based on the visual USCS classifications on the historical boring logs.

Method Used: Simplified Method based on using correlations to blow counts from Standard Penetration Tests (SPTs) as set forth in Youd et al (2001) and discussed in NRC (1985).

The Simplified Method requires estimating the Cyclic Stress Ratio (CSR) and Cyclic Resistance Ratio (CRR) of the soil. The CRR can be estimated using information from SPT tests, corrected to account for various effects. To use the Simplified Method, the SPT N value is normalized to an overburden pressure of approximately 100 kiloPascals (kPa) and a hammer energy ratio of 60% and procedural effects (rod length, sample configuration and borehole diameter).

The $(N_1)_{60}$ may also be corrected for the percent of fines using the relationship:

$$(N_1)_{60cs} = \alpha + \beta (N_1)_{60}$$

It is important to note that the fines correction is an approximation and is only valid for nonplastic fines and with a fines content between 0 and 35%. This correction factor, although widely used, is considered as a rough approximation only.

Once the corrected value for $(N_1)_{60}$ is found, the CRR is calculated as:

$$CRR_{7.5} = \frac{1}{34 - (N_1)_{60}} + \frac{(N_1)_{60}}{135} + \frac{50}{[10*(N_1)_{60} + 45]^2} - \frac{1}{200}$$

Note that the value calculated is the CRR normalized to a 7.5 magnitude earthquake, hence the CRR_{7.5} notation. When evaluating the liquefaction potential of soil, the CRR_{7.5} must be corrected to the magnitude earthquake of interest.

The CSR is independent of soil properties and may be approximated using the equation:

$$CSR = 0.65(\frac{a_{\max}}{g})(\frac{\sigma_v}{\sigma_v'})r_d$$

where:

 $\begin{array}{l} a_{max} \text{ is the maximum ground acceleration.} \\ g \text{ is the acceleration of gravity.} \\ \sigma_v \text{ is the total vertical stress.} \\ \sigma_v \text{ is the effective vertical stress.} \\ r_d \text{ is a stress reduction coefficient.} \end{array}$

Liquefaction potential for a soil unit is evaluated by dividing CRR_{7.5} by CSR and then correcting to the magnitude earthquake of interest, as:

$$FS = \frac{CRR_{7.5}}{CSR} * MSF$$

Field experience has shown that the Simplified Method is somewhat conservative; so many designers consider FS values close to unity as an indication of no liquefaction.

<u>SI-1</u>

Elevation	Depth	Soil class	Ν	Remarks
452.8	3.75	SC	16	Not liquefiable,
447.8	8.75	SC	13	above ground
442.8	13.75	ML	8	water.
437.8	18.75	ML	5	Evaluated for
432.8	23.75	ML	9	liquefaction
427.8	28.75	SC	23	
422.8	33.75	SC	24	
417.8	38.75	SM	22	
412.8	43.75	ML	18	
407.8	48.75	ML	28	
402.8	53.75	ML	22	
397.8	58.75	ML	12	
392.8	63.75	ML	9	
387.8	68.75	ML	14]
382.8	73.75	ML	21	
377.8	78.75	ML	50	

<u>SS1-1</u>

Elevation	Depth	Soil class	N-field	Remarks
502.3	3.25	CL	17	Not liquefiable
497.3	8.25	CL	12	Embankment
492.3	13.25	CL	17	as layer is
487.3	18.25	CL	15	above ground
482.3	23.25	CL-ML	17	water
477.3	28.25	CL	15	
472.3	33.25	CL	21	
467.3	38.25	CL	23	
462.3	43.25	ML	30	
457.3	48.25	ML	24	Evaluated for
452.3	53.25	CL	23	liquefaction
447.3	58.25	CL	35	
442.3	63.25	CL	27	
437.3	68.25	SC	8	
432.3	73.25	CL	20	
427.3	78.25	CL	24	
422.3	83.25	CL	30	
417.3	88.25	SC	46	

<u>SS2-1</u>

Elevation	Depth	Soil class	N-field	Remarks
500.7	3.75	CL	10	Not liquefiable.
495.7	8.75	CL	12	
490.7	13.75	CL	13	Embankment
485.7	18.75	CL-ML	26	and located
480.7	23.75	CL	14	above ground
475.7	28.75	CL	17	water
470.7	33.75	CL	24	
465.7	38.75	CL	25	
460.7	43.75	CL	13	
455.7	48.75	CL	14	Evaluated for
450.7	53.75	CL	24	liquefaction
445.7	58.75	CL	26	
440.7	63.75	ML	26	
435.7	68.75	CL	13	
430.7	73.75	SM	12	
425.7	78.75	SM	43	
420.7	83.75	SM	28]
415.7	88.75	CL	22	
410.7	93.75	CL	29	

<u>SS2-4</u>

Elevation	Depth	Soil class	N-field	Remarks
436.6	3.25	CL	13	Evaluated for
431.6	8.25	CL	12	liquefaction
426.6	13.25	CL	8	
421.6	18.25	SM	12	
416.6	23.25	CL	6	
411.6	28.25	CL	17	
406.6	33.25	CL	17	
401.6	38.25	CL	15	
396.6	43.25	CL	11	
391.6	48.25	CL	12	
386.6	53.25	CL	13	
381.6	58.25	CL	19	
376.6	63.25	GC	22	

<u>SS3-1</u>

Elevation	Depth	Soil class	N-field	Remarks
501.2	3.25	CL	11	Not liquefiable.
496.2	8.25	CL-ML	12	
491.2	13.25	CL	22	Embankment
486.2	18.25	ML	17	and located
481.2	23.25	CL	22	above ground water
476.2	28.25	SC	27	Evaluated for
471.2	33.25	CL	10	liquefaction
466.2	38.25	ML	15	
461.2	43.25	ML	22	
456.2	48.25	SP	24	
451.2	53.25	SC	33	
446.2	58.25	SP	17	
441.2	63.25	SP	20	
436.2	68.25	SM	25	
431.2	73.25	SP	14	
426.2	78.25	SP	37	
421.2	83.25	SP	28	
416.2	88.25	SM	29	
411.2	93.25	SM	28	
406.2	98.25	CL	29	

<u>SS3-4</u>

Elevation	Depth	Soil class	N-field	Remarks
448.1	3.75	CL	10	Not liquefiable,
443.1	8.75	CL	11	above ground water
438.1	13.75	SM	5	Evaluated for
433.1	18.75	SM	7	liquefaction
428.1	23.75	SC	2	
423.1	28.75	ML	11	
418.1	33.75	ML	9	
413.1	38.75	CL	2	
408.1	43.75	CL	19	
403.1	48.75	CL	22	
398.1	53.75	CL	15	
393.1	58.75	CL	16	
388.1	63.75	CL	19]
383.1	68.75	CL	21	
378.1	73.75	CL	20]
373.1	78.75	CL	34	

<u>SS4-1</u>

Elevation	Depth	Soil class	N-field	Remarks
502.4	3.25	CL	5	Not liquefiable.
497.4	8.25	ML	23	
492.4	13.25	CL	13	Embankment
487.4	18.25	CL	24	and above
482.4	23.25	CL	17	ground water
477.4	28.25	CL	19	
472.4	33.25	CL	20	
467.4	38.25	CL	16	Evaluated for
462.4	43.25	ML	17	liquefaction
457.4	48.25	SM	11	
452.4	53.25	SM	23	
447.4	58.25	SM	18	
442.4	63.25	SM	24	
437.4	68.25	CL	26	
432.4	73.25	SC	5	
427.4	78.25	ML	22	
422.4	83.25	ML	29	
417.4	88.25	ML	30	
412.4	93.25	ML	30	

<u>SS4-4</u>

Elevation	Depth	Soil class	N-field	Remarks
447.0	3.75	CL	13	Not liquefiable,
442.0	8.75	CL	7	above ground water
437.0	13.75	SM	2	Evaluated for
432.0	18.75	CL	4	liquefaction
427.0	23.75	GC	50	
422.0	28.75	GC	29	

<u>SS5-1</u>

Elevation	Depth	Soil class	N-field	Remarks
501.6	3.25	CL	8	Not liquefiable,
496.6	8.25	CL	20	Embankment
491.6	13.25	CL	20	and above
486.6	18.25	SC	22	ground water
481.6	23.25	SM	25	
476.6	28.25	SM	50	N-values more
471.6	33.25	SM	50	than 30.
466.6	38.25	SM	50	

					l Value of pression	Турі	Typical Strength Characteristics			
Group Symbol	Soil Туре	Range of Nextmum Dry Unit Weight, pof	Range of Optimum Moisture, Percent	At 1.4 tsf (20 pei)	At 3.6 tuf (50 p#f)	Cohesion (as com- pacted) paf	Constion (seturated) paf	(Effective Stress Envelope Degrees)	Tan Ø	Typics Coeffic of Perm bilit ft./mi
					of Original leight					
CNI	Well graded clean gravels, gravel-sand mixtures.	125 - 135	11 - 8	0,3	0.6	0	0	>38	>0.79	5 x 10
GP	Poorly graded clean gravels, gravel-sand mix	115 - 125	16 - 11	0.4	0.9	o	D	>37	>0.74	10+1
GM	Silty gravels, poorly graded gravel-sand-silt.	120 - 135	12 - 8	Q.5	1.1			>34	>0.67	>10-6
GC	Clayey gravels, poorly graded gravel-sand-clay.	115 - 130	14 - 9	0.7	1,6			>31	>0.60	>10-7
ŝW	Well graded clean mends, gravelly spuds,	110 - 130	16 - 9	0_6	1.2	o	0	38	0.79	>10=3
57	Foorly graded class sands, Sand-gravel mix.	100 - 120	21 - 12	0.0	1.4	0	Ð	37	0.74	>10-3
SM	Silty ands, poorly graded send-wilt wix.	110 - 125	16 - 11	0,8	1.6	1050	420	34	0.67	5 x >10.
sh-sc	Sand-silt clay mix with slightly plastic fines.	110 - 130	15 - 11	0.8	1.4	1050	3 00	33	0.66	2 x >10
SC	Clayey sands, poorly graded sand-clay-mix.	105 + 125	19 - 11	1.1	2,2	1550	230	31	0,60	5 x >10
HCL.	Inorganic silts and cleysy eilts.	95 - 120	24 - 12	0,9	1,7	1400	190	32	0.62	>10-5
ML-CL	Hixture of inorganic ailt and clay.	100 - 120	22 - 12	1.0	2.2	1350	460	3z	0.5Z	5 x >10
а,	Inorganic clays of low to medium plasticity.	95 - 120	24 - 12	1.3	2.5	1800	270	28	0.54	>10-7
01	Organic eilts and silt- claye, low plasticity.	80 - 100	33 - 21				•••••			•••••
MGL	inorganic clayey silta, élastic silts,	70 - 95	40 - 24	2.0	3.8	1500	420	25	0.47	5 x >10
CH	Inorganic clays of high plasticity	75 - 105	36 - 19	2,6	3.9	2150	230	19	0,35	>10-7
он	Organic clays and silty clays	65 - 100	45 - 21			•••••				

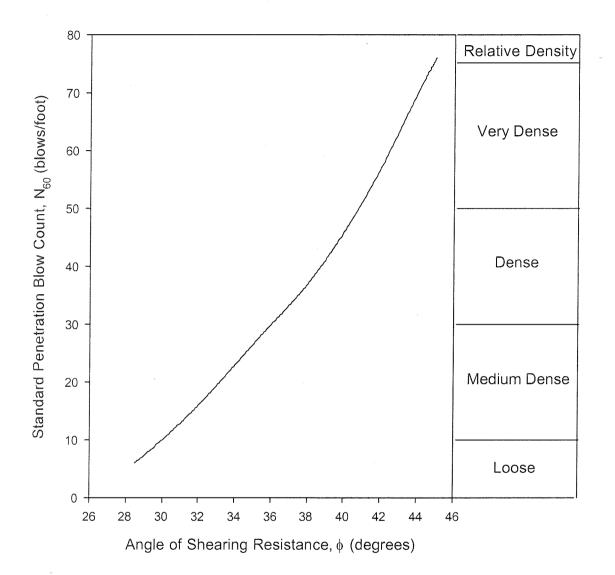
TABLE 1 Typical Properties of Compacted Soils

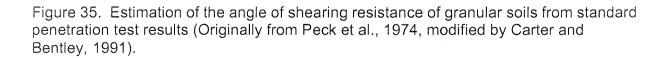
Notes:

- All properties are for condition of "Standard Proctor" maximum density, except values of k and CSR which are for "modified Proctor" maximum density.
- Typical stength characteristics are for effective strength envelopes and are obtained from USBR date.
- Compression values are for vertical loading with complete lateral confinement.
- 4. (>) indicates that typical property is greater than the value shown. (..) indicates insufficient data available for an estimate.

7.2-39

ypics1 efficient Permes- bility t,/min,	Range of CBR Values	Range of Subgrade Modulus k 1bs/cu in.
к 10 ⁻²	40 ~ 80	300 - 500
10+1	30 ~ 60	250 - 400
>10-6	20 - 60	100 - 400
×10-7	20 - 40	1 00 - 3 00
s10=3	20 - 40	200 - 300
s10-3	10 - 40	200 - 300
¢ >10~5	10 - 40	100 - 300
x >10 ⁻⁶	5 - 30	100 - 300
x >10 ⁻⁷	5 - 20	100 - 300
.10-5	15 or less	100 - 200
x >10 ⁻⁷		
10-7	15 or less	50 - 200
	5 or Less	50 - 100
x >10 ⁻⁷	10 or less	50 - 100
10-7	15 or less	50 - 150
	5 or less	25 - 100
	·	





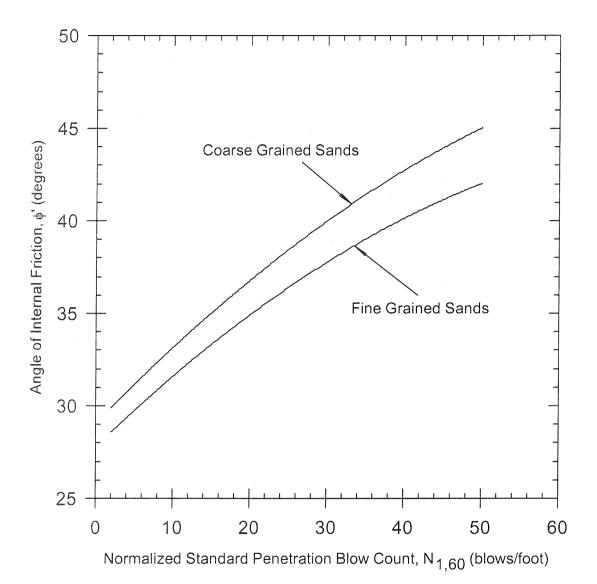
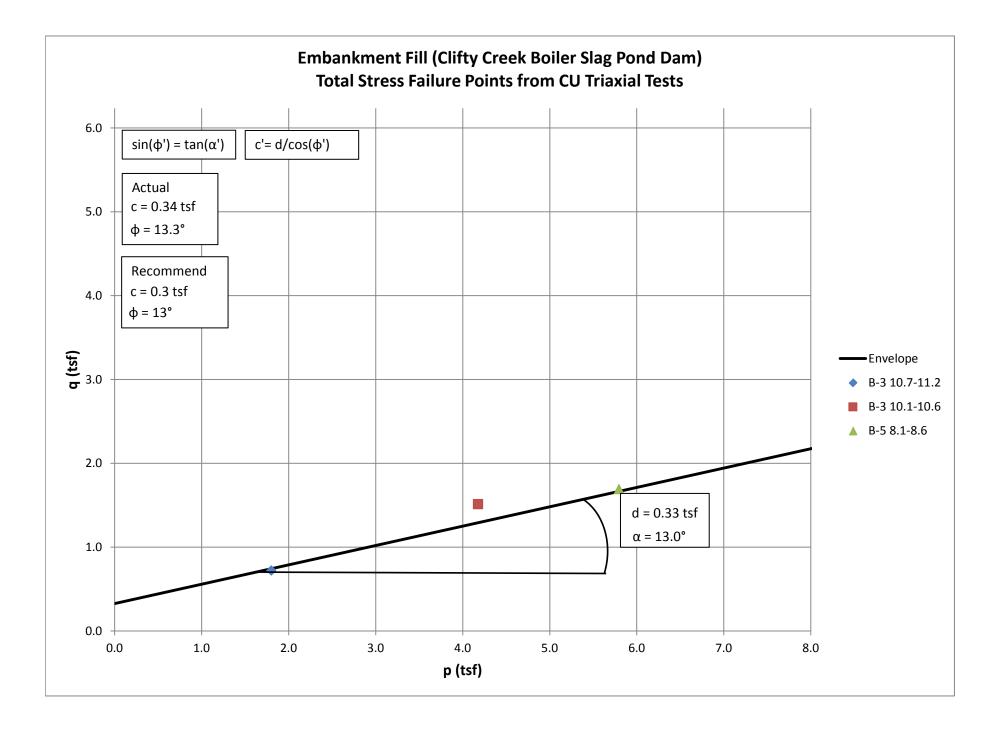
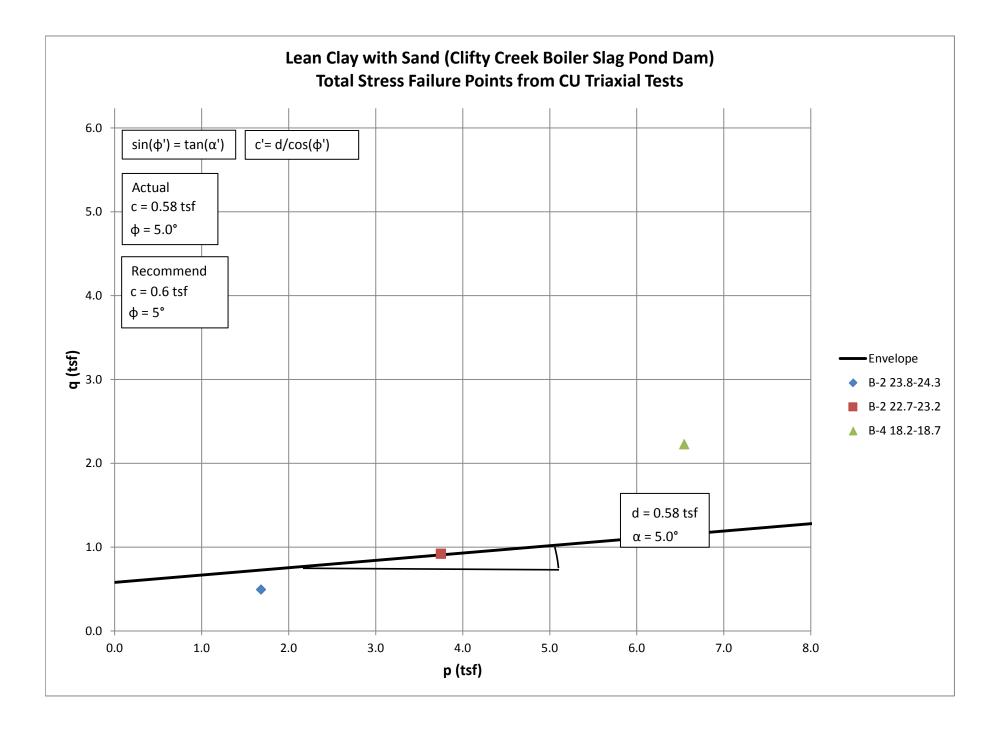


Figure 34. Empirical correlation between friction angle of sands and normalized standard penetration blow count (after Terzaghi et al., 1996)

UNDRAINED CALCULATIONS: BOILER SLAG POND DAM

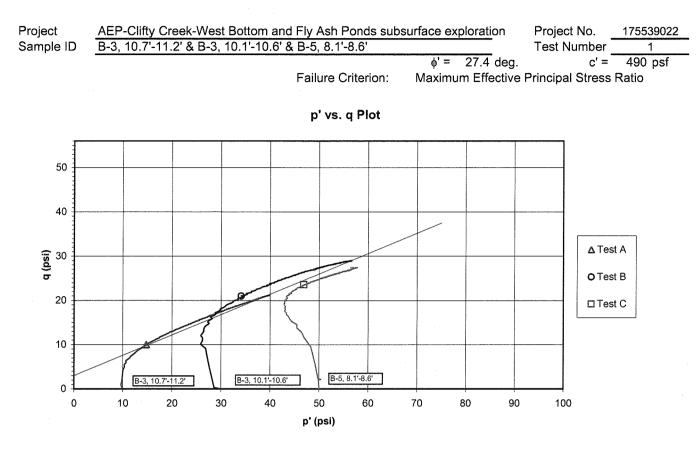




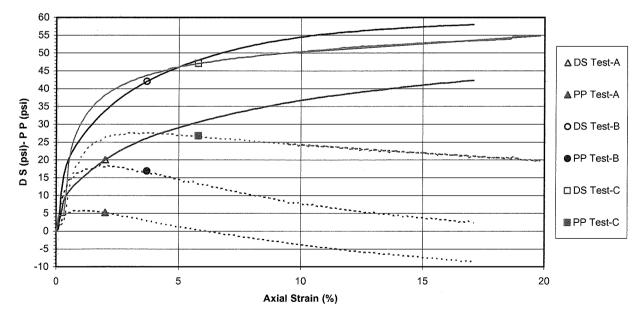
PLANT: CLIFTY CREEK FACILITY: BOILER SLAG POND DAM MATERIAL: EMBANKMENT FIL J. - J3 (plot) (psc) u(plot) 03 53' (los request) Oi' σ_{1} (psi) <u>(ps:)</u> (psi) (psc) (psi) 30 5 35 15 20 10 79 37 42 20 62 17 57 27 104 47 30 77 MATERIAL : LEAN CLAY W SAND u(plot) 0,'-03' (plot) 03' (lob request) 0.1 $\mathcal{O}_{\mathbf{i}}$ 0z (psi) (psi) (psi) (psi) (ps:) (psi) 7 31 14 24 17 10 19 39 46 65 26 20 92 60 30 30 122 62 ¢ CALCOLATED BY: J. SWINDLER



Consolidated Undrained Triaxial Test ASTM D4767-04



Deviator Stress and Induced Pore Pressure vs. Axial Strain



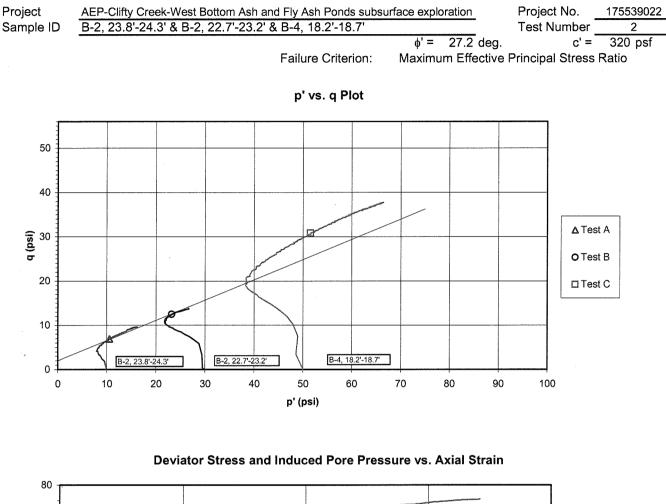
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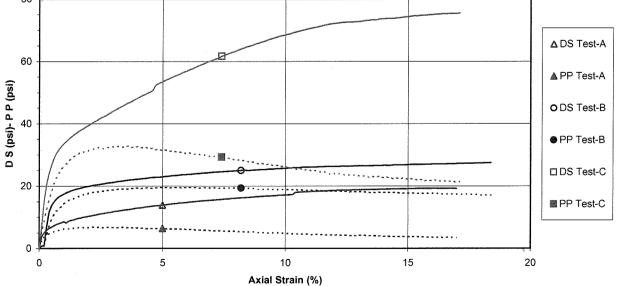
Stantec Consulting Services Inc.

Laboratory Document Prepared By: JW Approved By: TLK



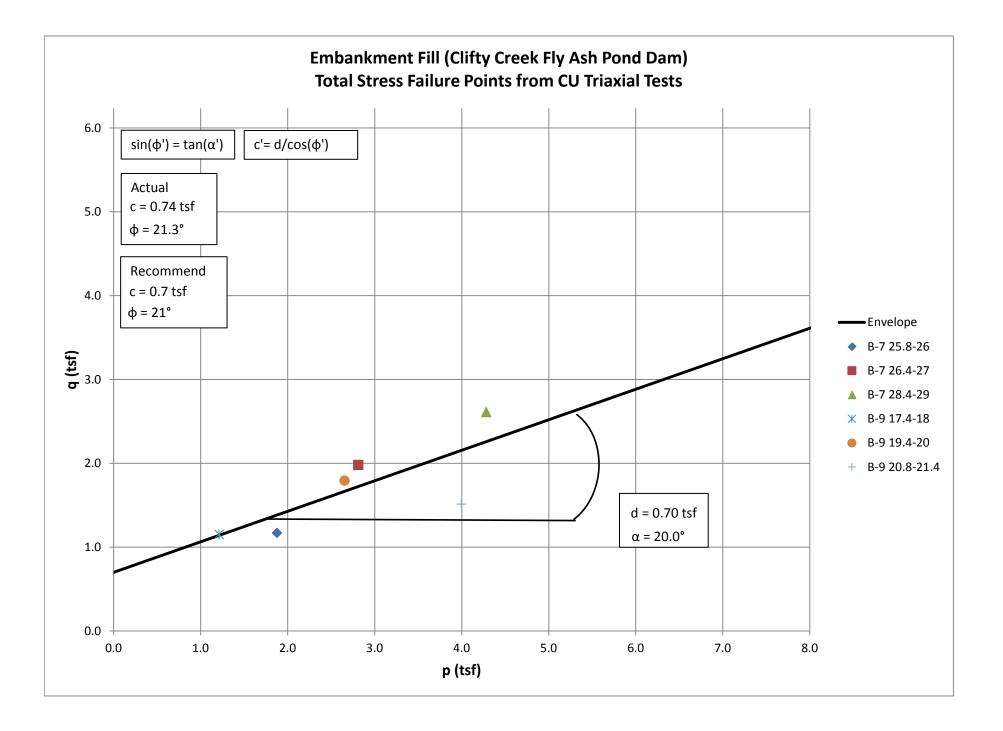
Consolidated Undrained Triaxial Test ASTM D4767-04

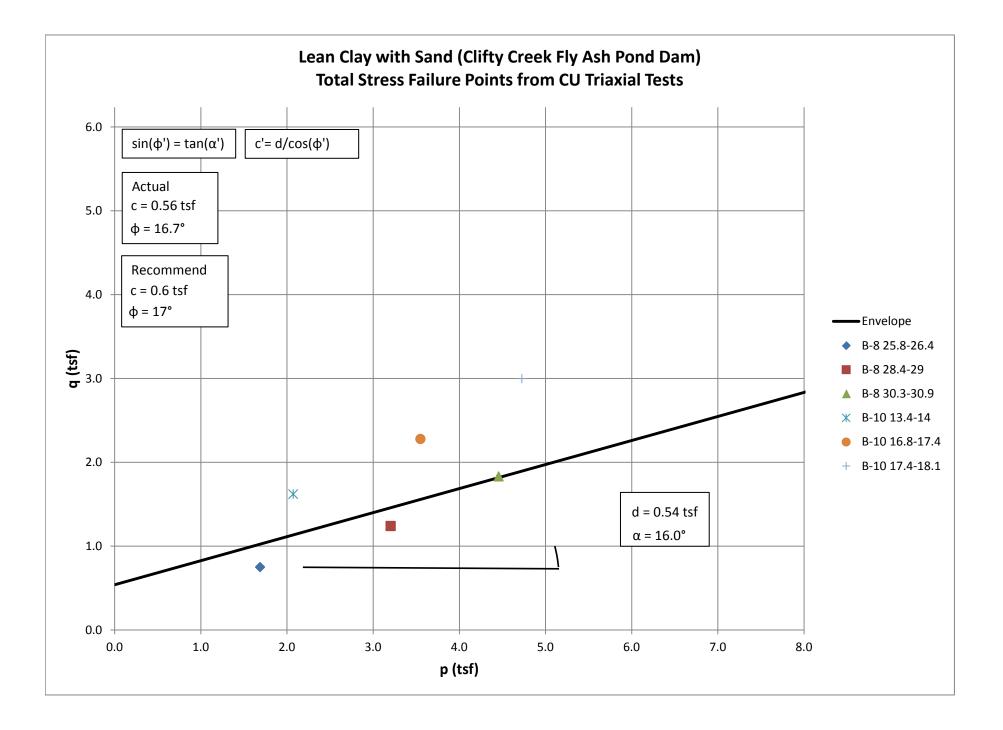




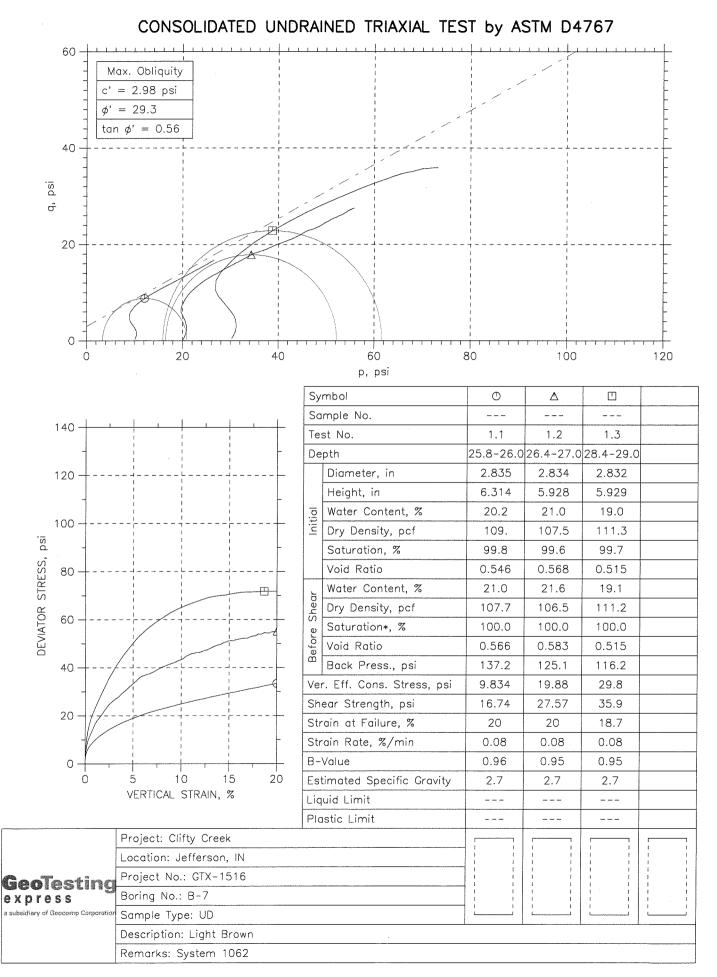
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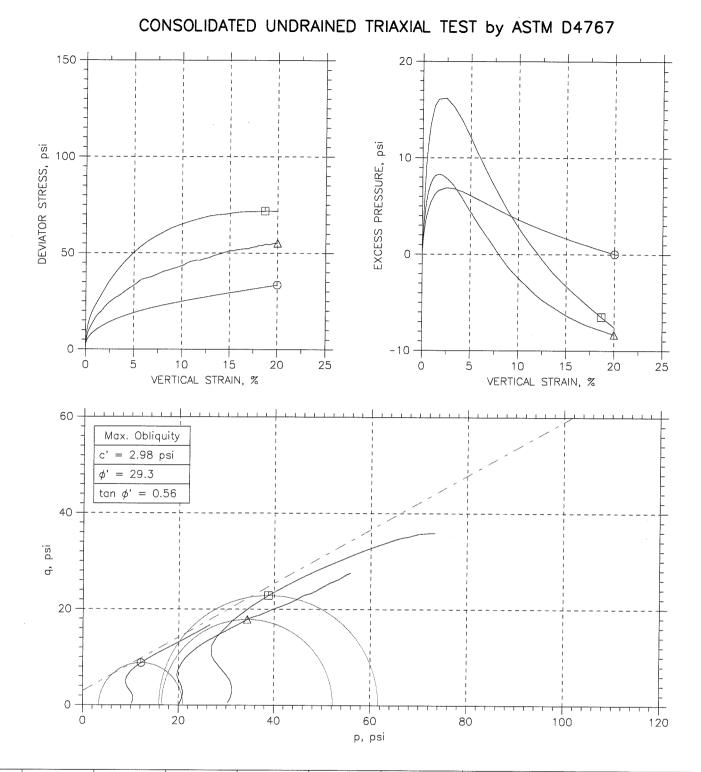
UNDRAINED CALCULATIONS: LANDFILL RUNOFF COLLECTION POND



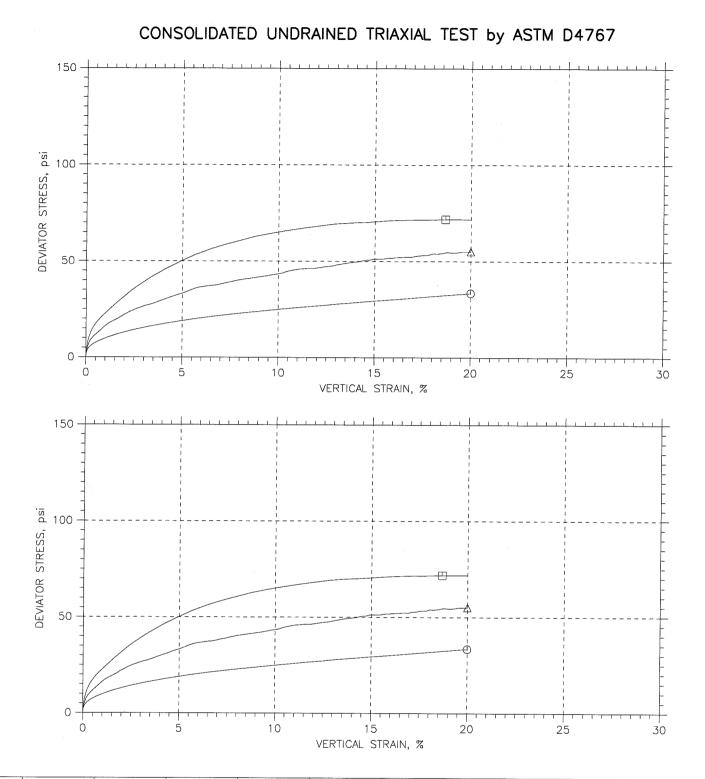


FAC	ILITY & LANDFI	LL KINDFF C	oulector			
M	ATERIAL : EMB.	anilment	(; ;, ;,,, _,, _	· · · · · · · · · · · · · · · · · · ·		
	;1-03' (plot)	Oz (toble)	σ,'	u(plot)	<u> </u>	03
	(psi)	<u>(psi)</u>	(psi)	<u>(p's:)</u>	<u>(ps:)</u>	(ps:)
B-7	32.50	9.83	42.33	0.00	42.33	9.83
8-7	55.00	19.88	74.88	-8.33	66.55	11.55
6-7	72.50	29.80	102.30	-657	95.73	23.23
B-9	32.00	00.00	42.00	-9.15	32.85	0,85
B-9	49.81	19.96	69.77	-9.00	61.77	11.96
B-9	42.00	29.80	71.8%	4,62	76.50	34.50
M	ATERIAL ! LEA	J CLAY WITH	SAND			
\wedge	:'-03'(plot)	03' (tesse)	O,	u(plot)	σı	03
	(psi)	(psi)	(psi)	(25:)	(ps:)	(osi)
0 0		9.97			s na iti	10 -0%
B-8	20.84	and a contract of the second sec	30:01	3.05	33.86	13.02
B-B	34.42	19,98	54.42	7.30	61.72	27.28
B-8	50.8%	29.96	80.34	6.50	87.34	36.46
B-10	45.00	10.00	55:00	- 3.72	57.28	6.23
B-10	63.26	19,99	83.25	-2.33	30.92	17.66
B-10	83.26	30.00	113.26	- 6.00	107.26	24.00
· · · · · · · · · · · · · · · · · · ·	-	· · · · · · · · · · · · · · · · · · ·	 		,	:
			······	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	······································
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		: 				
			CALC	ULATED 1	<u>By:</u> ,,	SUND

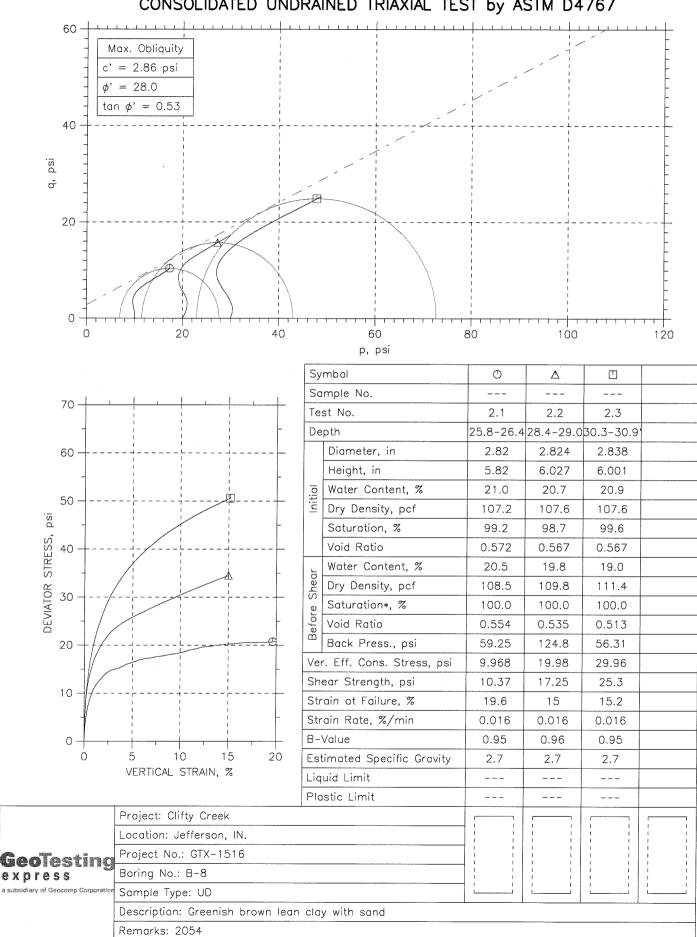




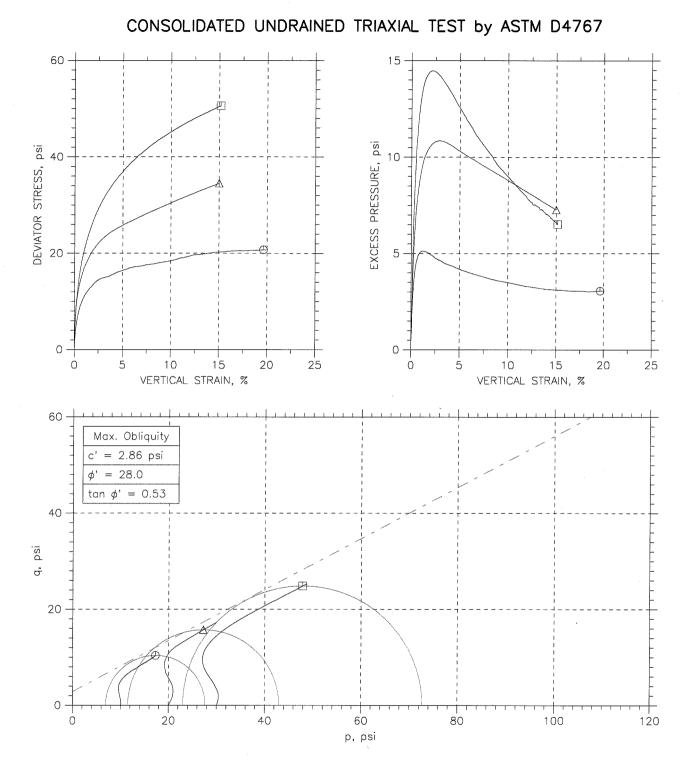
	Sample No.	Tes	t No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
0		1.1		25.8-26.0	jm	12/10/09	mm		1516-1.1.dat
Δ		1.2		26.4-27.0	jm	12/10/09	mm		1516-1.2.dat
		1.3		28.4-29.0	jm	12/9/09	mm		1516-1.3.dat
G	:o Testii	നഹ	Project	: Clifty Creek		Location: Je	efferson, IN	Projec	et No.: GTX-1516
	press		Boring	No.: B-7		Sample Type	e: UD		
a subs	idiary of Geocomp Corp	oration	Descrip	tion: Light Br	own	- -			
			Remark	s: System 10	62				······································



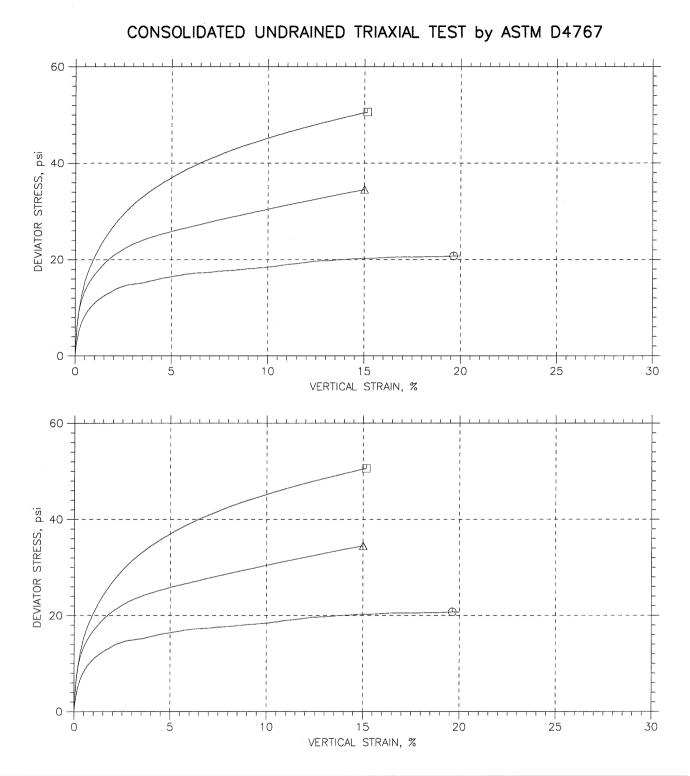
	Sample No.	Tes	t No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
O		1.1		25.8-26.0	jm	12/10/09	mm		1516-1.1.dat
Δ		1.2		26.4-27.0	jm	12/10/09	mm		1516-1.2.dat
		1.3		28.4-29.0	jm	12/9/09	mm		1516-1.3.dat
Ge	nTasti	nn	Project	: Clifty Creek	1	Location: Je	efferson, IN	Projec	t No.: GTX-1516
	oTesti	ng			1			Projec	t No.: GTX-1516
	press			No.: B-7		Sample Type	e: UD		
a subsi	diary of Geocomp Corp	oration	Descrip	tion: Light Br	own				
			Remark	s: System 10)62				



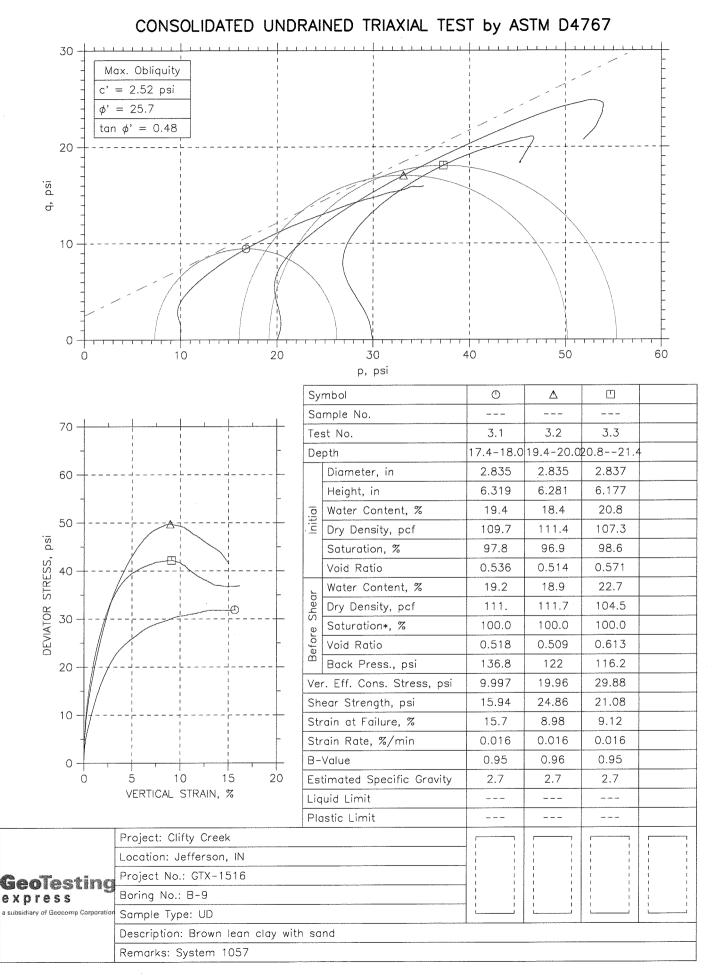
CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767

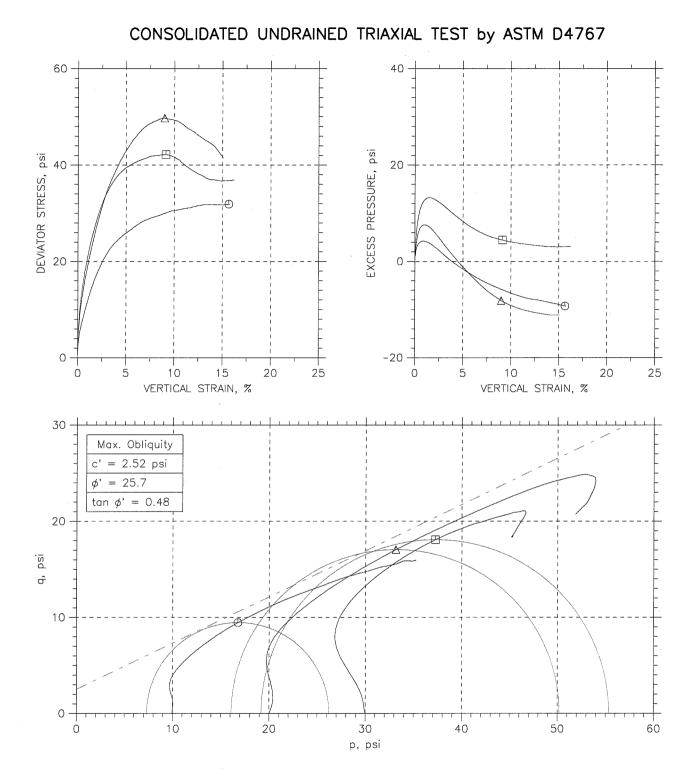


	Sample No.	Tes	t No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File			
0		2.1		25.8-26.4	jm	12/11/09	mm		1516-2.1.dat			
Δ	2.2			28.4-29.0	jm	12/11/09	mm		1516-2.2A.dat			
0	2.3			30.3-30.9'	jm	12/09/09	mm		1516-2.3.dat			
						-						
G	GeoTesting		Project: Clifty Creek			Location: Je	fferson, IN.	Projec	t No.: GTX-1516			
	press	8 12 12 19 19 19 19 19 19 19 19 19 19 19 19 19 1	Boring	No.: B-8		Sample Type	e: UD					
a subsi	idiary of Geocomp Corp	oration	Descript	Description: Greenish brown lean clay with sand								
			Remark	Remarks: 2054								

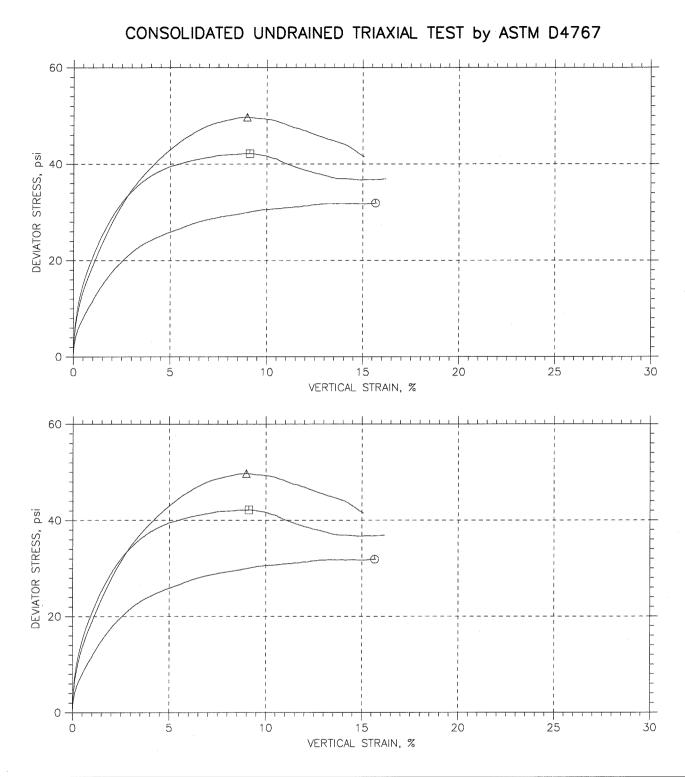


	Sample No.	Tes	t No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File			
Ο	0			25.8-26.4	jm	12/11/09	mm		1516-2.1.dat			
Δ		2.2		28.4-29.0	jm	12/11/09	mm		1516-2.2A.dat			
Ē		2.3		30.3-30.9'	jm	12/09/09	mm		1516-2.3.dat			
G	oTesti	നന	Project: Clifty Creek			Location: Je	on: Jefferson, IN.		ect No.: GTX-1516			
	press	119	Boring	No.: B-8		Sample Typ	e: UD					
	idiary of Geocomp Corp	poration	Descrip	Description: Greenish brown lean clay with sand								
			Remarks: 2054									

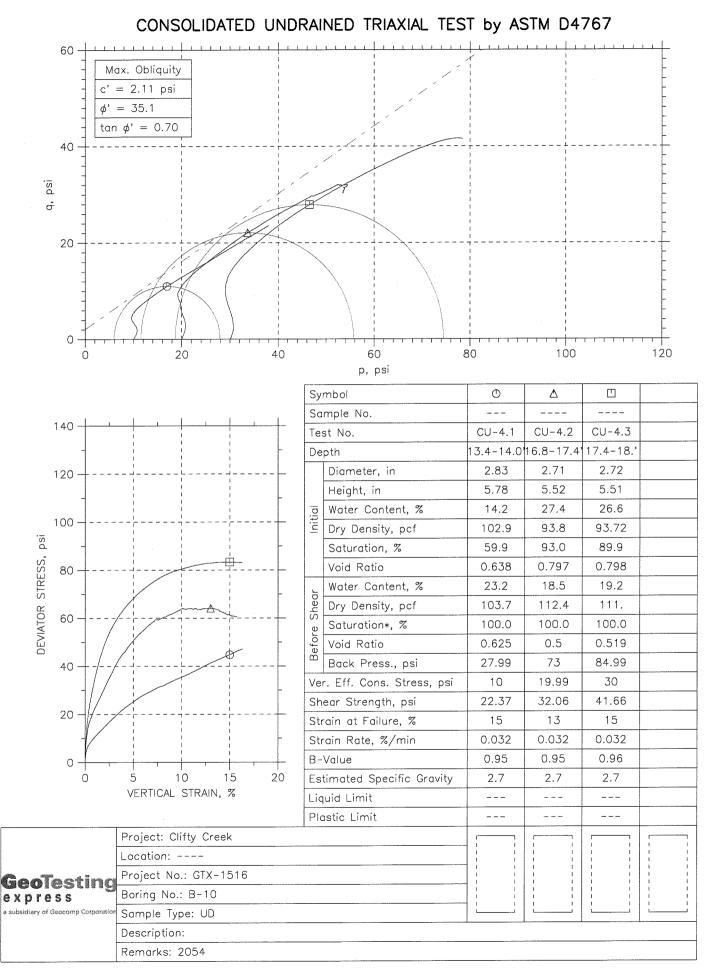




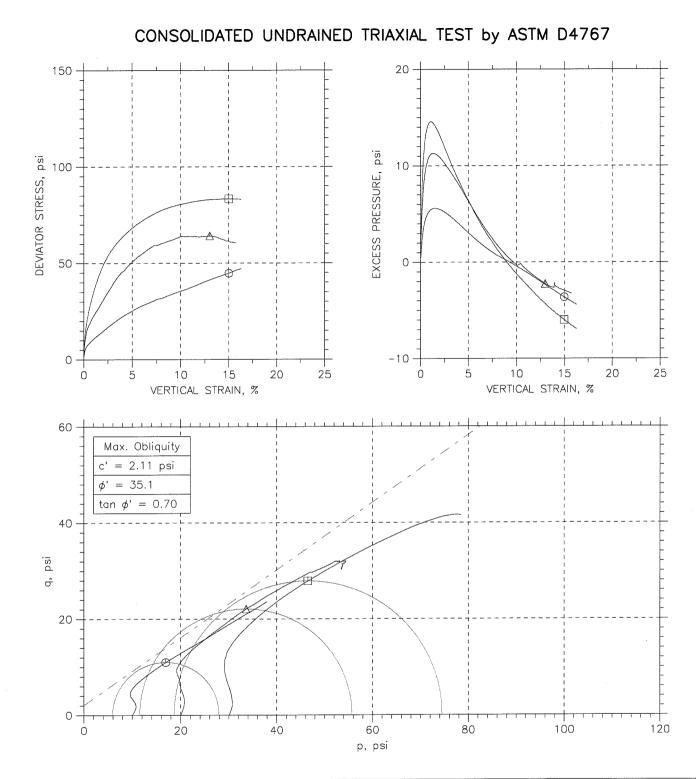
	Sample No.	Tes	t No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File			
O	0			17.4-18.0	jm	12/15/09	mm		1516-3.1.dat			
Δ		3.2		19.4-20.0	jm	12/16/09	mm		1516-3.2Adat.dat			
	3.3			20.821.4	jm	12/10/09	mm		1516-3.3.dat			
C.	• o Testi	nn	Project:	Clifty Creek		Location: Je	fferson, IN	Projec	t No.: GTX-1516			
	press		Boring I	No.: B-9		Sample Type	e: UD					
	idiary of Geocomp Corr	ooration	Descript	Description: Brown lean clay with sand								
Remarks: System 1057												



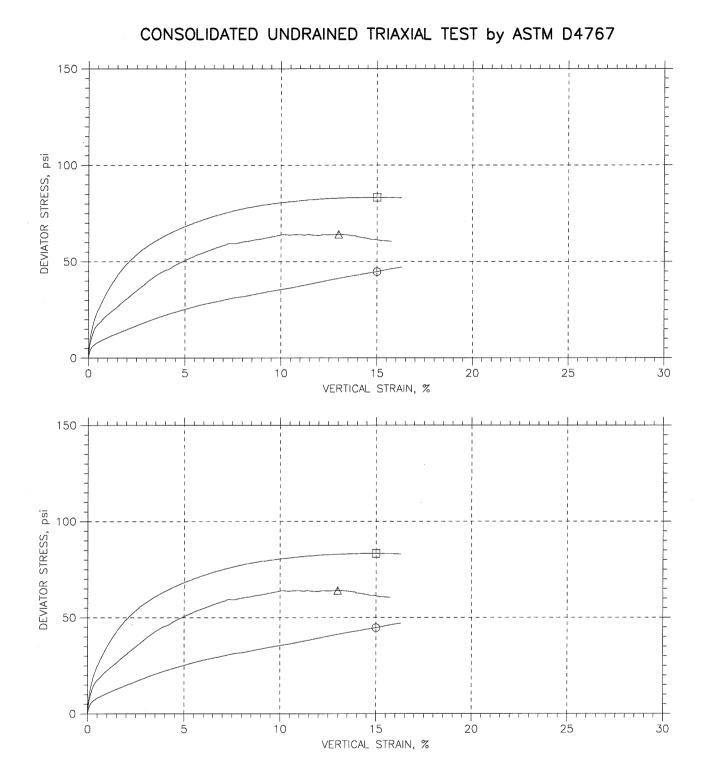
	Sample No.	Tes	t No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File		
O		3.1		17.4-18.0	jm	12/15/09	mm		1516-3.1.dat		
Δ	3.2			19.4-20.0	jm	12/16/09	mm		1516-3.2Adat.dat		
	3.3			20.821.4	jm	12/10/09	mm		1516-3.3.dat		
Ge	GeoTesting express		Project:	Clifty Creek		Location: Je	fferson, IN	Projec	ct No.: GTX-1516		
			Boring I	No.: B-9		Sample Type	e: UD				
a subsi	diary of Geocomp Con	poration	Description: Brown lean clay with sand								
	Remarks: System 1057										



Tue, 19-JAN-2010 11:56:28



	Sample No.	Tes	t No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
0		CU-4.1		13.4-14.0'	JM	12/12/09	MM		1516-4.1.dat
∆ C		CU-	-4.2	16.8-17.4'	JM	12/13/09	MM		1516-4.2.dat
Ľ		CU-	-4.3	17.4-18.'	JM	12/12/09	MM		1516-4.3.dat
<u>_</u>		, 	Projec	t: Clifty Creek		Location:		Proje	ct No.: GTX-1516
G	e o Testi	ng				Sample Type: UD			ct No.: GIX-1516
	press idiary of Geocomp Corp	ooration		No.: B-10					
	and the management of the second		000011	ks: 2054					



	Sample No.	Tes	t No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File			
Ð	•		-4.1	13.4-14.0'	JM	12/12/09	ММ		1516-4.1.dat			
Δ		CU-4.2		16.8-17.4'	JM	12/13/09	ММ		1516-4.2.dat			
	CU		U-4.3 17.4-18		JM	12/12/09	MM		1516-4.3.dat			
Ge	oTesti	nn	Project: Clifty Creek		Location:			Proje	ect No.: GTX-1516			
	press	123	Boring	No.: B-10		Sample Type: UD						
a subsi	diary of Geocomp Con	paration	Descrip	Description:								
	Remarks: 2054											