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Coal Combustion Residue Impoundment

Round 11 - Dam Assessment Report

Kingston Fossil Plant
Tennessee Valley Authority
Harriman, Tennessee

Prepared for:

United States Environmental Protection Agency
Office of Resource Conservation and Recovery

Prepared by:

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INTRODUCTION, SUMMARY CONCLUSIONS AND RECOMMENDATIONS

The release of over five million cubic yards from the Tennessee Valley Authority's Kingston, Tennessee facility in December 2008, which flooded more than 300 acres of land, damaging homes and property, is a wake-up call for diligence on coal combustion residue disposal units. We must marshal our best efforts to prevent such catastrophic failure and damage. A first step toward this goal is to assess the stability and functionality of the ash impoundments and other units, then quickly take any needed corrective measures.

This assessment of the stability and functionality of the two Kingston Fossil Plant Coal Combustion Residuals (CCR) management units: Ash Pond C and Flue Gas Desulfurization System Landfill (Gypsum Disposal Facility), is based on a review of available documents and on the site assessment conducted by Dewberry personnel on Wednesday, September 21, 2011. We found the supporting technical documentation inadequate (Section 1.1.3). As detailed in Section 1.2.1, this report recommends that a quantitative liquefaction analysis be performed for the Ash Pond C management unit.

In summary, the Ash Pond C is rated FAIR and the Gypsum Disposal Unit is SATISFACTORY for continued safe and reliable operation, with no recognized existing or potential management unit safety deficiencies.

PURPOSE AND SCOPE

The U.S. Environmental Protection Agency (EPA) is investigating the potential for catastrophic failure of Coal Combustion Surface Impoundments (i.e., management unit) from occurring at electric utilities in an effort to protect lives and property from the consequences of a dam failure or the improper release of impounded slurry. The EPA initiative is intended to identify conditions that may adversely affect the structural stability and functionality of a management unit and its appurtenant structures (if present); to note the extent of deterioration (if present), status of maintenance and/or a need for immediate repair; to evaluate conformity with current design and construction practices; and to determine the hazard potential classification for units not currently classified by the management unit owner or by a state or federal agency. The initiative will address management units that are classified as having a Less-than-Low, Low, Significant or High Hazard Potential ranking. (For Classification, see pp. 3-8 of the 2004 Federal Guidelines for Dam Safety)

In early 2009, the EPA sent a first wave of letters to coal-fired electric utilities seeking information on the safety of surface impoundments and similar facilities that receive liquid-borne material that store or dispose of coal combustion residue. This letter was issued under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104(e), to assist the Agency in assessing the structural stability and

functionality of such management units, including which facilities should be visited to perform a safety assessment of the berms, dikes, and dams used in the construction of these impoundments.

EPA requested that utility companies identify all management units including surface impoundments or similar diked or bermed management units or management units designated as landfills that receive liquid-borne material used for the storage or disposal of residuals or by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals. Utility companies provided information on the size, design, age and the amount of material placed in the units. The EPA used the information received from the utilities to determine preliminarily which management units had or potentially could have High Hazard Potential ranking.

The purpose of this report is **to evaluate the condition and potential of residue release from management units and to determine the hazard potential classification**. This evaluation included a site visit. Prior to conducting the site visit, a two-person team reviewed the information submitted to EPA, reviewed any relevant publicly available information from state or federal agencies regarding the unit hazard potential classification (if any) and accepted information provided via telephone communication with the management unit owner. Also, after the field visit, additional information was received by Dewberry & Davis LLC about Ash Pond C and the Gypsum Disposal Unit that were reviewed and used in preparation of this report.

Factors considered in determining the hazard potential classification of the management units(s) included the age and size of the impoundment, the quantity of coal combustion residuals or by-products that were stored or disposed of in these impoundments, its past operating history, and its geographic location relative to down gradient population centers and/or sensitive environmental systems.

This report presents the opinion of the assessment team as to the potential of catastrophic failure and reports on the condition of the management unit(s).

Note: The terms "embankment", "berm", "dike", and "dam" are used interchangeably within this report, as have the terms "pond", "basin", and "impoundment".

LIMITATIONS

The assessment of dam safety reported herein is based on field observations and review of readily available information provided by the owner/operator of the subject coal combustion residue management unit(s). Qualified Dewberry engineering personnel performed the field observations and review and made the assessment in conformance with the required scope of work and in accordance with reasonable and acceptable engineering practices. No other warranty, either written or implied, is made with regard to our assessment of dam safety.

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Doc 02: Construction drawings "Coal Combustion By-Products (Gypsum) Disposal Facility, Kingston Fossil Plant – Peninsula Site" TVA Drawing Numbers 10W428-1 through 10W428-22

Doc 03: TVA Spreadsheet "CCR Generation and Handling," dated September 27, 2011

Doc 04: *Tennessee Valley Authority (TVA) Routine Handling Operations and Maintenance (RHO&M) Operations Support Document, Kingston Fossil Plant,* July 2011

Doc 05: Stantec Consulting Services correspondence dated October 4, 2011 "Reference: Dam Safety Hazard Classification Review, Ash Disposal Area 2, Kingston Fossil Plant, Roane County, Tennessee"

Doc 06: "Plans for Construction, Diffuser Replacement Project, Stilling Pond Work Plan 6 (KIF-110503-WP-6) Kingston Fossil Plant" Drawing Numbers 81W403-01 through 81W403-07

Doc 07: Doc *2010 Annual Inspection of CCP Facilities and Ponds, Kingston Fossil Plant, Harriman, Tennessee*, Stantec Consulting Services, June 1, 2010

Doc 08: NPDES Permit No. TN0005452, TVA – Kingston Fossil Plant, Harriman, Roane County, Tennessee

Doc 09: NPDES Permit No. TN0080870, TVA – Kingston Fossil Plant – Flue Gas Desulfurization System Discharges, Harriman, Roane County, Tennessee

Doc 10: "Construction Drawings, Phase 1A Area, Gypsum Disposal Facility, Kingston Fossil Plant – Peninsula Site," Drawing Nos. 10WXXX-1 through 10WXXX-16, dated July, 2011, prepared by Geosyntec Consultants

Doc 11: *Report of Hydrologic and Hydraulic Analysis, Ash Pond and Stilling Pond, TVA Kingston Fossil Plant, Roans County, Tennessee,* Stantec Consulting Services, September 30, 2010

Doc 12: Stantec Consulting Services correspondence dated October 11, 2011 "Re: Addendum, September 30, 2010 H&H Report – KIF Ash Pond/Stilling Basin, Dam Safety Regulation – Spillway Capacity Evaluation"

Doc 13: Geosyntec Consultants Technical Memorandum, October 14, 2011, "Subject: Evaluating Stormwater Runoff in the Gypsum Disposal Area for the One-Third Probable Maximum Precipitation Event

Doc 14: Stantec Consulting Services correspondence dated October 5, 2011 "Re: Results of Seismic Slope Stability Analysis, Main Ash Pond, Stilling Pond, Dike C, Kingston Fossil Plant"

Doc 15: Geosyntec Consultants "Site response and Seismic Deformation Analyses, Kingston Peninsula Permit Modification," November 10, 2010

Doc 16: *Design Report for Dike C Buttress, Kingston Fossil Plant, Harriman, TN*, Stantec Consulting Services, Inc., March 1, 2011

Doc 17: *Seepage Action Plan (SAP), Kingston Fossil Plant, Harriman, Roans County, Tennessee,* Stantec Consulting Services, June 10, 2010

Doc 18: Stantec Consulting Services Memo dated August 8, 2011 "Reference: Dike C Slope Inclinometer Data Weekly Review"

Doc 19: Stantec Consulting Services Memo dated August 8, 2011, "Reference" Dike C Weekly Piezometer Data Review (Data from July 22, 2011 to August 5, 2011)"

Doc 20: Stantec Consulting Services Inc. correspondence dated February 15, 2012, Re: Results of Pseudostatic Slope Stability Analysis, Active CCP Disposal Facilities, BRF, COF, GAF, JSF, KIF, PAF, and WCF.

Doc 21: Geosyntec Consultants "Foundation Stability Analyses", Kingston Peninsula Permit Modification, October 29, 2010

Doc 22: Dewberry Memorandum, "Qualitative Assessment. Liquefaction Potential, TVA Fossil Plant CCR Impoundments, Dewberry Project No. 50047151", May 25, 2012.

APPENDIX B

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APPENDIX C

Figure C-1 Ash Pond C Components

Figure C – 2 Gypsum Disposal Facility

1.0 CONCLUSIONS AND RECOMMENDATIONS

1.1 CONCLUSIONS

Conclusions are based on visual observations from a one-day site visit, October 21, 2011, and review of technical documentation provided by the Tennessee Valley Authority (TVA).

1.1.1 Conclusions Regarding the Structural Soundness of the Management Unit(s)

Dike C impounding Ash Pond C and the dike impounding the Gypsum Disposal Facility appear to be structurally sound based on a review of the engineering data provided by the owner's technical staff and Dewberry's engineers' observations during the site visit. Remediation of Dike C was substantially complete in each area at the time of the site visit. However a 2009 geotechnical report indicated slope Factors of Safety less than the required minimum value of 1.5. The 2011 design report for the remediation measures includes updated slope stability analyses demonstrating the long term Factors of Safety were equal to or greater than 1.5.

No liquefaction evaluation was performed for the dikes of Ash Pond C or the Gypsum Disposal Facility. TVA stated during the site visit that they plan on performing such analyses upon closure of Ash Pond C, and Phase 1 of the Gypsum Disposal Facility. Phase 2 of the Gypsum Disposal Facility has been redesigned and is being constructed to accept dry product only.

Results of a Dewberry qualitative evaluation of liquefaction potential of - at the CCR impoundments identified a concern pertaining to the embankment and foundation soils at Ash Pond C. Without information concerning potential releases of CCR as a result of liquefaction under seismic conditions, for dikes that could fail, such as Ash Pond C, the dikes cannot be rated Satisfactory. No concerns were indentified for the embankments or underlying soils at the Gypsum Disposal Facility.

1.1.2 Conclusions Regarding the Hydrologic/Hydraulic Safety of the Management Unit(s)

Hydrologic and hydraulic analyses provided to Dewberry indicate that Ash Pond C has adequate impoundment capacity to contain the 1 percent

probability storm without overtopping either the Ash Pond or an adjacent Settling Pond. The analyses indicate that the 6-hour Probable Maximum Precipitation (PMP) event would result in overtopping the Ash Pond embankment. However, subsequent analyses indicate that the Ash Pond has adequate capacity to store one-half the 6-hour PMP event without overtopping. Capacity to store one-half the 6-hour PMP event meets the design requirements of the current Tennessee dam safety regulations for intermediate, significant hazard potential dams.

The Hydrologic and hydraulic analyses indicate the Gypsum Disposal Facility stormwater pond can retain the 1/3 – six-hour PMP event without overtopping which is the design event required by Tennessee dam safety regulations for Small, Significant hazard dams.

1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

The supporting technical documentation is inadequate, due to the lack of quantitative analysis of liquefaction potential. Engineering documentation reviewed is referenced in Appendix A.

1.1.4 Conclusions Regarding the Description of the Management Unit(s)

The description of the management unit provided by the owner was an accurate representation of what Dewberry observed in the field.

1.1.5 Conclusions Regarding the Field Observations

Dewberry staff was provided access to all areas in the vicinity of the management unit required to conduct a thorough field observation. The visible parts of the embankment dikes and outlet structure were observed to have no signs of overstress, significant settlement, shear failure, or other signs of instability although visual observations were hampered by the presence of thick vegetation in some areas. Embankments appear structurally sound. There are no apparent indications of unsafe conditions or conditions needing remedial action.

1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

The current maintenance and methods of operation appear to be adequate for Ash Pond C and the Gypsum Disposal Facility. There was no

evidence of significant embankment repairs or prior releases observed during the field inspection.

1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

The surveillance program appears to be adequate. The management unit dikes are instrumented.

The Ash Pond C embankments are monitored with piezometers and slope inclinometers. The Gypsum Disposal Facility is monitored with piezometers.

1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

The Ash Pond C is rated FAIR and the Gypsum Disposal Facility is rated SATISFACTORY for continued safe and reliable operation based on visual assessment and the pertinent technical documentation provided. Implementation of the recommendations described in 1.2 would help improve the ratings.

1.2 RECOMMENDATIONS

1.2.1 Recommendations Regarding Continued Safe and Reliable Operation

It is anticipated that both Ash Pond C and the Gypsum Disposal Facility will be considered SATISFACTORY for continued safe and reliable operations upon:

A determination that there is no liquefaction potential for soils and materials at the management units, particularly Ash Pond C, under the design seismic event.

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1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

John Dizer, TVA
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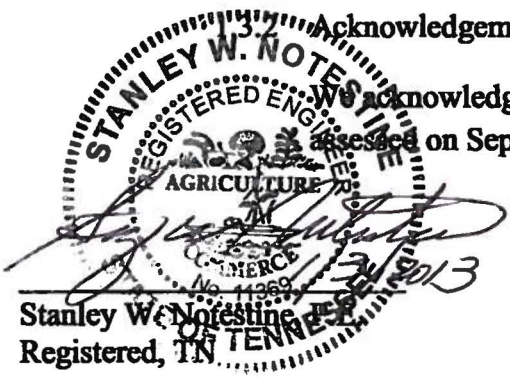
Jim Kohler, U.S. EPA Headquarters
Joe Klein, Dewberry
Stan Notestine, Dewberry

1.3.2 Acknowledgement and Signature

We acknowledge that the management unit referenced herein has been assessed on September 21, 2011



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2.0 DESCRIPTION OF THE COAL COMBUSTION RESIDUE MANAGEMENT UNIT(S)

2.1 LOCATION AND GENERAL DESCRIPTION

The Kingston Fossil Plant is located on the west side of Watts Bar Lake at the confluence of the Emory and Clinch Rivers, north of Kingston, Tennessee. Construction of the 1,723 MW plant began in 1951 and the plant went into commercial production in 1954. The Emory River and Watts Bar Lake border the site on the north, east and south sides. Pine Ridge, a local topographic feature borders the site to the west. The site location and area topography are shown on Figure 2.1-1.

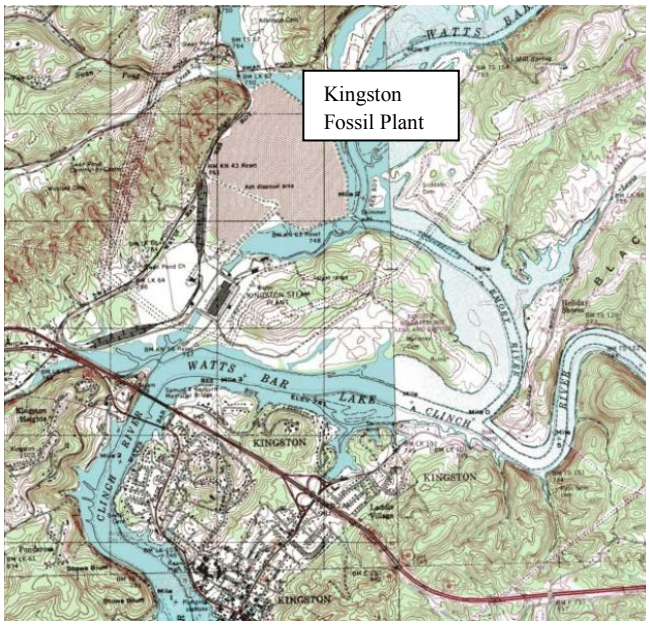

Figure 2.1-1: Kingston Fossil Plant Location Plan

At the time of Dewberry's site visit the plant had one active coal combustion residuals (CCR) impoundment and another under construction.

Ash Pond C

The active CCR management unit is designated Ash Pond C. Ash Pond C includes an ash storage area and a settling pond separated by an internal ash dike. Ash Pond C consists of the southern portion of the original 245 acre Main Ash Pond. Ash Pond C is impounded on the east, south and west sides by Dike C. Ash Pond C is separated from the northern portion of the original Main Ash Pond to the north by Dike D. The northern portion of the Main Ash Pond is designated for use as dredge

cells but is currently out of service during major restoration due to a 2008 breach in the dredge cell eastern embankment.

Flue Gas Desulfurization System Landfill

The Flue Gas Desulfurization System landfill (i.e., Gypsum Disposal Facility) is located on a peninsula to the east of the main generation plant. The landfill, under construction at the time of Dewberry's site visit, includes an impoundment for dry stacking gypsum, and a storm water pond abutting the west end of the gypsum stack impoundment. The gypsum stack cell encompasses about 50 acres, and the storm water pond encompasses about 6 acres. The height of storm water pond embankment is about 25 feet.

Table 2.1 provides a summary of the dimensions of the embankments. Figure 2.1-2 shows the location of the CCR facilities on the plant site.

Table 2.1: Summary of Dam Dimensions and Size

	Ash Pond C[1]	Flue Gas Desulfurization Landfill[2]	
		Gypsum Stack	Storm Water Pond
Dam Height (ft)	30	30	25
Crest Width (ft)	25	25	25
Length (ft)	6,000	6,000	2,200
Side Slopes (upstream) H:V	1.5(H):1(V) to 3.0(H):1(V)	3.0(H):1(V)	2.5(H):1(V) to (3.0:1(v)
Side Slopes (downstream) H:V	1.6(H):1.0(V)	3.0(H):1(V)	2.5(H):1(V) to (3.0):1(v)

[1] Based on information from *Report of Geotechnical Exploration and Slope Stability for Dike C, Kingston Fossil Plant, Harriman, Tennessee*, Stantec Consulting Services, August 3, 2009 (See Appendix A – Doc 01)

[2] Based on information from Drawings for the "Coal Combustion By Product (Gypsum) Disposal Facility, Kingston Fossil Plant – Peninsula Site", drawing numbers 10W428 -12 through 14 (See Appendix A – Doc 02).

Figure 2.1-2: CCR Impoundment on Kingston Plant Site (See Appendix C: "CCR Management Unit Aerial Photographs" for Facility Components)

2.2 COAL COMBUSTION RESIDUE HANDLING

Dewberry was provided general information regarding the type of equipment used in the handling, transportation and disposition of various coal combustion residuals (See Appendix A – Doc 03)

2.2.1 Fly Ash

Equipment used for the collection of fly ash included selective catalytic reductions (SCR) hoppers, economizer hoppers, precipitator hoppers, jet pumps, hydroveyors, air separator tanks and piping. SCR hoppers, economizer hoppers, precipitator hoppers are located inside the plant building. Other equipment is located outside.

2.2.2 Bottom Ash

Equipment used for the collections of bottom ash includes bottom ash hoppers, jet pumps and piping. The bottom ash hoppers are located inside the plant building. Other equipment is located outside.

2.2.3 Boiler Slag

Boiler slag is produced during coal combustion at the Kingston Fossil Plant and is handled with the bottom ash.

2.2.4 Flue Gas Desulfurization Sludge

Equipment used for the collection, handling and disposition of Flue Gas Desulfurization Sludge at Kingston Fossil Plant included limestone preparation facilities, absorbers, recycle pumps, area sump and piping. Equipment is outside the plant building.

2.3 SIZE AND HAZARD CLASSIFICATION

Ash Pond C

Dike C, which forms the perimeter of Ash Pond C on three sides, was constructed in three stages. The first stage consisted of a starter dike constructed in 1954 to a crest elevation of 746 feet. The starter dike was constructed of residual clay soil and bottom ash. In the second stage, constructed in 1974, the crest was raised about 1.5 feet by constructing a compacted bottom ash cap over the crest of the existing embankment. In the final stage, constructed in the late 1970s, Dike C was raised to a crest elevation of 765 feet by constructing a raised dike extending upward and inward from the inside edge of the Dike C starter dike cap. The three stage configuration of Dike C impounding Ash Pond C is about 30 feet high and 2,800 feet long.

Dike C abuts Dike D to the north on both the east and west sides of Ash Pond C. Ash Pond C impounds about 120 acres.

Flue Gas Desulfurization Landfill Storm Water Pond

The Flue Gas Desulfurization Landfill Storm Water Pond is a “V” shaped impoundment formed by a clay fill embankment abutting the west side of the first phase gypsum stack cell that was under construction at the time of Dewberry’s site visit. The embankment impounding the storm water pond is 2,200 feet long and about 25 feet high. The storm water pond impounds about 6 acres.

The classification for size, based on the height of the embankments and the impoundment storage capacity is “Intermediate” for Ash Pond C, and “Small” for the Flue Gas Desulfurization Landfill Storm Water Pond according to the USACE recommended guidelines for safety inspection of dams, ER 1110-2-106, as shown in Table 2.2a.

Table 2.2a: USACE ER 1110-2-106 Size Classification		
	Impoundment	
Category	Storage (Ac-ft)	Height (ft)
Small[2]	50 and < 1,000	25 and < 40
Intermediate[1]	1,000 and < 50,000	40 and < 100
Large	> 50,000	> 100

[1] Ash Pond C
[2] Flue Gas Desulfurization Landfill Storm Water Pond

Dewberry conducted a qualitative hazard classification based on Federal Guidelines for Dam Safety. The hazard assessment classifications are summarized in Table 2.2b.

Table 2.2b: FEMA Federal Guidelines for Dam Safety Hazard Classification		
	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None Expected	Low and generally limited to owner
Significant	None Expected	Yes
High	Probable. One or more expected	Yes (but not necessary for classification)

TVA commissioned a hazard classification study that was completed in October, 2011. The study concluded that a release from Ash Pond C due to failure or misoperation was not expected to result in the loss of human life, or damage critical infrastructure. However, a release is expected to impact off-site waters of the United States., including Watts Bar Reservoir. Therefore the study concluded that Ash Pond C represented a "Significant" hazard (See Appendix A – Doc 05).

As the Flue Gas Desulfurization landfill and storm water pond is about 200 feet from the Watts Bar Reservoir, it is likely that release due to a failure or misoperation would impact off-site waters of the United States. However a release is not expected to cause a loss of human life, or impact critical infrastructure.

As a release from either or both the Ash Pond C and/or the Flue Gas Desulfurization ash stack or stormwater pond is not expected to cause loss of human life, or damage to critical infrastructure, but is expected to cause potential environmental and economic losses beyond the plant boundaries, Dewberry evaluated both facilities as being a **Significant Hazard Potential.**

2.4 AMOUNT AND TYPE OF RESIDUALS CURRENTLY CONTAINED IN THE UNIT(S) AND MAXIMUM CAPACITY

Ash Pond C receives fly ash and bottom ash from the plant. The Gypsum Disposal Facility is currently empty and under reconstruction.

Table 2.3: Maximum Capacity of Unit

Ash Pond Name	Ash Pond C Complex[1]	Gypsum Disposal Facility[2]
Surface Area (acre)[1]	120	6
Current Storage Capacity (cubic yards)[1]	706,300	DNR[3]
Current Storage Capacity (acre-feet)	435	DNR
Total Storage Capacity (cubic yards)[1]	1,534,110	DNR
Total Storage Capacity (acre-feet)	950	DNR
Crest Elevation (feet)	765	769
Normal Pond Level (feet)[4]	760/754.4	759

[1] *Report of Hydrologic and Hydraulic Analysis, Ash Pond and Stilling Pond, Kingston Fossil Plant, Roane County, Tennessee*, Stantec Consulting Services, September 30, 2012 (See Appendix A – Doc 11)
[2] Construction drawings "Coal Combustion by Products (Gypsum) Disposal Facility, Kingston Fossil Plant Peninsula Site" (See Appendix A – Doc 02)
[3] DNR: Data Not Received
[4] Ash Pond C normal pool elevations for Ash Pond/Settling Pond

Although the data provided for review indicates that the capacity and height of Ash Pond C might allow it to be classified a "Small" impoundment, Dewberry concluded that based on the expected precision of the data it was appropriate to use the "Intermediate" classification. The Stantec report (Appendix A, Doc 05) also evaluated Ash Pond C as an "Intermediate" impoundment.

2.5 PRINCIPAL PROJECT STRUCTURES

2.5.1 Earth Embankment

Ash Pond C

The exterior perimeter of Ash Pond C is formed by Dike C. Dike C consists of a starter dike constructed in 1954 to a crest elevation of 746 feet. The starter dike was constructed of residual clay soil and bottom ash. In 1974 the crest was raised about 1.5 feet by construction of a compacted bottom ash cap over the crest of the existing embankment. In the late 1970s Dike C was raised to a crest elevation of 765 by constructing a

raised dike extending upward and inward from the inside edge of the Dike C ash cap. Dike C abuts Dike D to the north on both the east and west sides of Ash Pond C. Dike D separates Ash Pond C from the adjacent Dredge Dike. (See Appendix A – Doc 04). Dike C impounding Ash Pond C is about 2,800 feet long and about 30 feet high. Ash Pond C encompasses about 120 acres.

Gypsum Disposal Facility Storm Water Pond

Gypsum Disposal Facility Storm Water Pond is a "V" shaped impoundment formed by a clay fill embankment abutting the west side of the first phase ash stack cell that was under construction at the time of Dewberry's site visit. The embankment impounding the storm water pond is 2,200 feet long and about 25 feet high. The storm water pond impounds about 6 acres.

2.5.2 Outlet Structures

Ash Pond C

Outlet structures for Ash Pond C are located near the southeast corner of the stilling pond. The original outlet system consists of six 48-inch diameter, reinforced concrete pipe overflow risers with corrugated metal skimmers and trash racks. Each riser is connected to a 36-inch diameter ductile iron pipe that runs through the starter dike to a headwall near the outside toe. At the headwall, the discharge pipe is reduced to a 24-inch diameter pipe that discharges into the plant water intake channel from the Emory River. The original discharge pipe was ductile iron; however it was changed to 24-inch diameter HDPE pipe in conjunction with the addition of a new siphon system in 2011 (See Appendix A doc 06).

A siphon system was added to the outlet structure in 2011. The siphon system consists of four 24-inch diameter HDPE pipes located a short distance east of the overflow risers. The siphon pipes discharge at elevation 743, about two feet above the Emory River summer pool elevation.

Gypsum Disposal Facility

The Gypsum Disposal Facility is designed to receive sluiced gypsum from the plant into the lined gypsum cell. Sluice water and storm water seepage through the gypsum are collected in an under drain system and piped by

gravity to a lift station constructed on the outside slope of the embankment near the southeast corner of the gypsum cell. Water from the lift station is pumped to the adjacent Gypsum Disposal Facility storm water pond.

As the gypsum stack increases in elevation above the crest of the embankment, surface runoff is collected in a perimeter ditch that discharges into three drop inlets located in the northwest corner of the impoundment. A 91-inch diameter reinforced concrete pipe from each drop inlet carries water through the embankment into the landfill storm water pond.

The outlet structure for the storm water pond consists of a lift station that pumps water to the main plant water intake channel for recycling.

2.6 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

The plant site drains generally to the south into the bordering Watts Bar Reservoir portion of the Clinch River. Land down gradient of the plant is generally undeveloped woodland. Interstate Highway 40 is about 3,500 to 4,000 feet south of the plant site. The Hazard Classification report indicates that roadways in the area are either above the elevation of the impoundment or are at a distance that would permit dissipation of a breach wave prior to reaching them (See Appendix A – Doc 05).

3.0 SUMMARY OF RELEVANT REPORTS, PERMITS, AND INCIDENTS

TVA provided the 2010 annual inspection report prepared by Stantec Consulting Services for review (See Appendix A – Doc 07). The report does not indicate findings of significance for either Ash Pond C or the Flue Gas Desulfurization System landfill storm water pond. Recommendations presented in the report were generally related to routine maintenance issues including:

Ash Pond C

- Remove trees and bushes from embankment slopes
- Continue monitoring seepage areas in accordance with established inspection program
- Repair area of rutting and toe undercutting along a section of Dike C.

Gypsum Pond

- Repair areas of erosion along the interior of gypsum stack embankment
- Re-vegetate areas of the embankments lacking adequate ground cover.
- Check interior drainage pump station periodically for proper operation.

The 2011 annual inspection was scheduled for October, after Dewberry's site visit.

TVA provided Dewberry with copies of reports addressing the safe operation of Ash Pond C and the Gypsum Pond. These reports are provided in Appendix A.

3.1 SUMMARY OF LOCAL, STATE, AND FEDERAL ENVIRONMENTAL PERMITS

Tennessee dam safety laws and regulations are administered by the Department of Environment and Conservation. The law provides a waiver for projects approved by the federal government. As TVA is a federal entity, a state dam permit is not required.

Discharge from the impoundment is regulated by the Tennessee Department of Environment and Conservation. The Kingston Fossil Plant has been issued two National Pollutant Discharge Elimination System permits.

- Permit No. TN0005452 was issued September 1, 2003. The permitted discharges include fly ash and bottom ash sluice water. The permit expired August 31, 2008. TVA reported that it had submitted an application for renewal

prior to February 28, 2008. Review of the renewal application by the Tennessee Department of Environment and Conservation has not been completed. (See Appendix A – Doc 08).

- Permit No. TN00080870 was issued September 22, 2009. The permitted discharge is for the Flue Gas Desulfurization System storm water pond. The permit expires September 30, 2013. (See Appendix A – Doc 09).

3.2 SUMMARY OF SPILL/RELEASE INCIDENTS

Ash Pond C

As discussed in Section 4 of this report, the original 275-acre ash pond has been subdivided several times during its operation. Between 1987 and 1988 the original configuration was changed by the construction of Dike D that divided the ash pond into north and south sections. The south section received sluiced ash from the plant and provided a stilling pond for the sluice water. The north section was subdivided into cells that received ash dredged from the southern portion of the facility.

On December 22, 2008 the northwestern portion of the dredge cell area failed. The progressive failure impacted a section of the northeast corner of Ash Pond C, abutting the east side of Dike D. The failure resulted in a major release of CCR material into the Emory River and Clinch River. A major recovery effort was undertaken, and major reconstruction of the dredge cells was under construction at the time of Dewberry's site visit.

Gypsum Stack Landfill

Excavation and construction of the gypsum stack impoundment began in 2008. On December 15, 2010 during initial operation of Phase 1, a dropout occurred resulting in halting gypsum production until the cause of the problem was identified and repaired. The cause was determined to be the development of a sinkhole and further investigation revealed other potential sinkholes at the site. The facility has been redesigned and reconstruction was in progress at the time of Dewberry's site visit.

4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

4.1 SUMMARY OF CONSTRUCTION HISTORY

4.1.1 Original Construction

Construction of the Kingston Fossil Plant began in 1951. In 1954 the plant went on-line with a capacity of 1,723 megawatts. At the start of plant operations, ash slurry was discharged directly to slack water created by Watts Bar Reservoir. From 1954 to 1976 ash was sluiced to a pond formed by the hydraulically placed ash (See Appendix A – Doc 04).

Ash Pond

In 1958 construction of a 275-acre ash pond was impounded by the completion of Dike C which was constructed of native clay and bottom ash. The original crest elevation of Dike C was 746 feet (See Appendix A – Doc 04).

Gypsum Impoundment

Excavation and construction of the new Gypsum Pond began in 2008 as the management unit to collect gypsum produced by new plant scrubbers. During start-up of the first phase of the facility a sinkhole was encountered that required the pond to be taken out of service (See Appendix A – Doc 04).

4.1.2 Significant Changes/Modifications in Design since Original Construction

Ash Pond C (See Appendix A – Doc 04)

In 1974 Dike C was raised about 1.5 feet to provide additional freeboard for the ash pond. The dike was raised by using bottom ash to construct a cap along the inside slope and over the crest.

Between 1976 and 1978 Dike C was raised to a crest elevation of 765 by extending the existing dike inward beginning at the inside edge of the existing crest. The raised dike section was constructed largely over deposited ash.

In 1983 an interior dike was constructed to divide the ash pond into two halves, with the northern half being the planned dredge cell. In 1984 the interior dike failed as a result of undermining during dredging operations.

A replacement dike, designated Dike D, was constructed in its current location which is somewhat east of the original location. Dike D forms the boundary between Ash Pond C on the south and the dredge impoundment to the north.

Gypsum Disposal Facility (See Appendix A – Doc 04)

Due to the development of sinkholes in the gypsum stack impoundment during initial operations, significant design changes were made to the ash stack impoundment subgrade and interior drainage system. Construction implementing the design changes was underway at the time of Dewberry's site visit.

4.1.3 Significant Repairs/Rehabilitation since Original Construction

Ash Pond C (See Appendix A – Doc 04)

On December 22, 2008 an embankment failure occurred near the northwest corner of the dredge impoundment cell. The embankment failure impacted a large section of the north dike and the interior Dike D. A major repair/rehabilitation was begun immediately after the event and was continuing at the time of Dewberry's site visit. The work included construction of a buttress along Ash Pond C at the north end of the Dike D embankment, and repairs at the northeast corner of Ash Pond C adjacent to the failed embankment.

Gypsum Disposal Facility (See Appendix A – Doc 10)

Rehabilitation of the gypsum impoundment includes undercutting the stack impoundment subgrade by about 4 feet; proof-roll exposed subgrade; repair areas of potential sinkhole development, and replacement and re-compaction of the fill. Above the re-worked fill two layers of compacted clay and a multi-layer drainage system are being constructed. Construction of the gypsum stack impoundment drainage system was underway during Dewberry's site visit.

No need for rehabilitation of the stormwater pond has been identified.

4.2 SUMMARY OF OPERATIONAL PROCEDURES

4.2.1 Original Operational Procedures

Main Ash Pond

At the start of operations in 1954 ash handling at the Kingston Fossil Plant was to discharge ash slurry directly into Watts Bar Reservoir. In 1958 a 275-acre ash impoundment was completed and served as the ash pond disposal site.

Gypsum Disposal Facility

As a result of a drop out encountered in the ash stack impoundment during start-up, the gypsum impoundment was taken out of services before full scale operations. The gypsum stack impoundment was out of service at the time of Dewberry's site visit with rehabilitation construction and rehabilitation work under way.

The storm water pond is in service. In addition to direct runoff, stormwater and seepage from the gypsum stack impoundment is pumped to the stormwater pond. Water from the storm water pond is pumped to the plant water intake channel for recycling.

4.2.2 Significant Changes in Operational Procedures and Original Startup

Main Ash Pond

During 1977 to 1978, as part of the project to raise the Main Ash Pond elevation, a stilling pond was created by constructing an interior dike to separate the eastern section of the main ash pond. The stilling pond was located on the east side of the facility to allow for additional settling of ash particles before water was discharged to Watts Bar Reservoir.

In 1983 an interior ash dike, designated Dike D, was constructed to divide the pond into two halves as a precursor to transition to using the north side of the pond as dredge cells, and the south side to receive sluiced ash and detain it to allow ash to settle out of suspension. In 1984 Dike D failed and was reconstructed east of the original construction.

Sluiced ash was piped into the pond to the south of Dike D. The pond south of Dike D was designated Ash Pond C. Sluiced ash flowed through the ash in an interior ditch to a stilling area. Decant water from the stilling

pond flowed through a six pipe overflow riser system to the settling pond and then to the plant intake channel. In 2010-2011 a four pipe siphon spillway system from the stilling area to the Settling Pond was added.

Sedimented ash from Ash Pond C was dredged and stored in the north side dredge cell.

Gypsum Disposal Facility

The gypsum impoundment was undergoing subgrade reconstruction at the time of Dewberry's site visit and was out of service.

No CCR materials were stored in the impoundment at the time of site visit.

4.2.3 Current Operational Procedures

Ash Pond C

Fly ash and bottom ash are sluiced to Ash Pond C in five active spillway pipes. The sluiced ash is deposited in the northwest corner of Ash Pond C. Sluice water flows from the ash storage area of Ash Pond C into a stilling area. Decant water from the Ash Pond stilling area flows to the settling pond through spillway pipes located at the east end of an interior dike.

Gypsum Disposal Facility

The gypsum impoundment was not in operation at the time of Dewberry's site visit. Photograph 4.2.3-1 shows liner construction underway in progress at the time of Dewberry's site visit.

Figure 4.2.3-1: Gypsum Disposal Facility Liner Construction Underway at Time of Dewberry's Site Visit

4.2.4 Other Notable Events since Original Startup

On December 22, 2008 the northwestern portion of the dredge cell area failed. The progressive failure impacted a section of the northeast corner of Ash Pond C, abutting the east side of Dike D. The failure resulted in a major release of CCR material into the Emory River and Clinch River. A major recovery effort was undertaken, and major reconstruction of the dredge cells was under construction at the time of Dewberry's site visit.

5.0 FIELD OBSERVATIONS

5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

Dewberry personnel Stanley W. Notestine, P.E. and Joseph P. Klein, III, P.E. performed a site visit on Wednesday, September 21, 2011 in company with the participants.

The site visit began 9:00 AM. The weather was overcast with rain showers in the morning and clearing in the afternoon. Photographs were taken of conditions observed. Please refer to the Dam Inspection Checklist in Appendix B. Selected photographs are included here for ease of visual reference. All pictures were taken by Dewberry personnel during the site visit and provided to TVA at the conclusion of the site visit.

The overall assessment of the two CCR management units was that they are in satisfactory condition and no significant findings were noted.

5.2 ASH POND C

5.2.1 Crest

The exterior perimeter of Ash Pond C is formed by Dike C. The crest of Dike C is a 20- to 25-foot wide gravel and ash roadway. There are no significant signs of depressions, tension cracks, settlement, or shear failure along the crest. Photograph 5.2.1-1 shows representative conditions observed along the crest of Dike C.

Photograph 5.2.1-1: Ash Pond C Crest of South Embankment

5.2.2 Upstream/Inside Slope

The inside slopes of Dike C are vegetated with grass and weeds. Portions of the north end of the east embankment are covered with ash. There are no signs of slumps or slides in the visible portion of the slopes, and no significant erosion is visible. Photograph 5.2.2-1 shows a representative view of the inside slope of Dike C.

Photograph 5.2.2-1: Ash Pond C Inside Slope of South Embankment

5.2.3 Downstream/Outside Slope and Toe

The west and south outside slopes of Dike C are vegetated with grass and weeds. A crushed stone buttress has been added to the outside slope of the east embankment starter dike. There are no signs of slumps or slides in the visible portion of the slopes, and no significant erosion is visible. Photograph 5.2.3-1 shows a representative view of the outside slopes of Dike C.

Photograph 5.2.3-1: Ash Pond C East Embankment Starter Dike Outside Slope. Grassed Outside Slope of Raised Dike Is Visible on Left Side

5.2.4 Abutments and Groin Areas

There are no abutments in the portion of Dike C impounding Ash Pond C.

Exterior groins are vegetated, except for the southeast starter dike groin where a crushed stone buttress has been added. No signs of erosion or significant seepage are visible.

5.3 GYPSUM DISPOSAL FACILITY

5.3.1 Crest

The crest of the Gypsum Disposal Facility impoundment is a 20- to 25-foot wide, compacted clay and gravel roadway. There are no significant signs of depressions, tension cracks, settlement, or shear failure along the crest. Photograph 5.3.1-1 shows representative conditions observed along the crest of the east embankment of the Gypsum Disposal Facility impoundment.

Photograph 5.3.1-1: Gypsum Disposal Facility Impoundment Crest of East Embankment. East Side of Ash Stack Impoundment (Left Side of Photograph) Used as Lay Down Area for Liner Construction on West Side.

5.3.2 Upstream/Inside Slope

Inside slopes of the Gypsum Disposal Facility ash stack impoundment not exposed for construction of the liner and subdrainage system are vegetated with grass. The inside slopes of portions of the ash stack under construction for liner installation are exposed soil subgrade.

Inside slopes of the storm water pond are armored with riprap to protect against erosion from wind driven waves. There are no signs of slumps or slides in the visible portion of the slopes, and no significant erosion is visible. Photograph 5.3.2-1 shows a representative view of the inside slopes of the Gypsum Disposal Facility.

Photograph 5.3.2-1: Gypsum Disposal Facility Storm Water Pond Inside Slopes

5.3.3 Downstream/Outside Slope and Toe

The outside slopes of the ash stack portion of the Gypsum Disposal Facility are vegetated with grass. Small areas of standing water were visible along the toe of the South slope. However, as the ash stack impoundment was empty, the wet areas are expected to be the result of rain showers earlier in the day.

The outside slope of the storm water pond is protected with stone riprap.

There are no signs of slumps or slides in the visible portion of the slopes, and no significant erosion is visible. Photographs 5.3.3-1 and 5.3.3-2 show representative views of the outside slopes of the Gypsum Disposal Facility.

Photograph 5.3.3-1: Gypsum Disposal Facility Impoundment Outside Slope and Toe of South Embankment

Photograph 5.3.3-2: Gypsum Disposal Facility Storm Water Pond Outside Slope and Toe Area

5.3.4 Abutments and Groin Areas

The Gypsum Disposal Facility east and west embankment abut a hillside on the north side of the impoundment. A topographic knoll near the southeast corner of the impoundment intruded into the embankment alignment creating a saddle like abutment in the south embankment. Photograph 5.3.4-1 shows the east embankment abutment.

Figure 5.3.4-1: Gypsum Disposal Facility East Embankment Abutment at North End.

Except where liner construction is underway, ash stack impoundment groins are vegetated with grass. Storm water pond groins are armored with riprap.

No signs of erosion or significant seepage are visible.

5.4 OUTLET STRUCTURES

5.4.1 Overflow Structure

Ash Pond C

The Ash Pond C overflow structure from the Ash Pond stilling area to the Settling Pond consists of five 48-inch diameter corrugated metal risers with corrugated metal skimmers and trash racks. Figure 5.4.1-1 shows the spillway risers.

Figure 5.4.4-1: Ash Pond Overflow Spillway Risers

The overflow structure from the Settling Pond consists of six 36-inch diameter pipe risers protected with 48-inch diameter corrugated metal skimmers and trash racks. Figure 5.4.1-2 shows the spillway risers.

Figure 5.4.1-2 Settling Pond Overflow Spillway Risers

Gypsum Disposal

Facility

The original overflow structure from the gypsum stack to the storm water pond consists of a drop inlet located at the west side of the impoundment. The drop inlet receives surface runoff from an interior perimeter ditch. Design drawings for the construction in progress at the time of Dewberry's site visit indicate a new overflow structure consisting of three 91-inch diameter concrete risers hydraulically connected to the perimeter ditch and the new liner system (See Appendix A – Doc 10)

Ash stack interior drainage is piped to a lift station on the south side of the impoundment.

The storm water pond overflow structure consists of a reinforced concrete lift station shown in Figure 5.4.1-3.

Figure 5.4.1-3: Gypsum Disposal Facility Storm Water Pond Overflow Structure.

5.4.2 Outlet Conduit

Ash Pond C

The Ash Pond C Settling Pond spillway outlet conduits consist of six 36-inch diameter reinforced concrete pipes from the risers to a reducer located at the discharge structure headwall. At the headwall the outlet conduits are reduced to 24-inch diameter ductile iron pipes. The invert elevation of the conduits is below the normal pool elevation of the receiving plant water intake channel. Figure 5.4.2-1 shows the outlet conduits entering the plant intake water channel.

Figure 5.4.2-1: Ash Pond C Settling Pond Overflow Conduits to Plant Water Intake Channel

Gypsum Disposal Facility

The original outlet conduits for the ash stack drop overflow structure consist of three 48-inch diameter, reinforced concrete pipes (See Appendix A – Doc 02). The new outlet structure shown on the redesign drawings consist of three 91-inch diameter conduits (See Appendix A – Doc 10).

The ash stack interior drainage lift station outlet is a 4-inch diameter PVC pipe fed by a 200 gallon per minute submersible pump (See Appendix A – Doc 02). The lift station pumps water to the Gypsum Disposal Facility storm water pond.

The outlet from the storm water pond is pumped from a lift station at the south end of the pond to the plant intake water channel by three submersible turbine pumps, each linked to a 24-inch diameter discharge pipe.

5.4.3 Emergency Spillway

Ash Pond C

The Ash Pond C embankment does not have an emergency spillway.

Gypsum Disposal Facility

The Gypsum Disposal Facility storm water pond has a riprap lined emergency spillway in the central length of the south embankment. The spillway has a width of 15 feet, side slopes of 8(H):1(V) and a depth of 2-feet (See Appendix A – Doc 02). Figure 5.4.3-1 shows the emergency spillway.

Figure 5.4.3-1: Gypsum Disposal Facility Riprap Lined Emergency Spillway

5.4.4 Low Level Outlet

Ash Pond C

Ash Pond C has a newly constructed low level outlet consisting of a four pipe siphon system. Each siphon pipe is a 24-inch diameter HDPE installed inside a 30-inch diameter casing. The siphon system discharges to the plant's water intake channel for recycling. Figure 5.4.4-1 shows the siphon inlet and Figure 5.4.4-2 shows the outlet.

Figure 5.4.4-1: Ash Pond C Siphon System Inlet

Figure 5.4.4-2: Ash Pond C Siphon System Outlet.

6.0 HYDROLOGIC/HYDRAULIC SAFETY

6.1 SUPPORTING TECHNICAL DOCUMENTATION

6.1.1 Flood of Record

No documentation has been provided about the flood of record.

6.1.2 Inflow Design Flood

Although, as a federal entity, TVA is waved from compliance with Tennessee dam safety regulations, those regulations include criteria for evaluating the hydrologic and hydraulic safety of existing dams based on size and hazard rating. Dewberry classified both Ash Pond C and the Gypsum Disposal Facility as Significant hazards. The Tennessee hydrologic/hydraulic evaluation criteria are shown in Table 6.1.

Table 6.1: Tennessee Dam Safety Hydrologic/Hydraulic Criteria for Significant Hazard Dams Based on Size

Small	1/3 PMP
Intermediate	1/2 PMP
Large	PMP

Ash Pond C

TVA retained Stantec to conduct a hydrologic and hydraulic analysis of Ash Pond C. The analysis evaluated 24-hour peak storm events with recurrence intervals of 1, 10, 25, 50 and 100 years, and the 6-hour Probable Maximum Precipitation (PMP) (See Appendix A – Doc 11). The input parameters and results for the 24-hour, one percent probability (100-year storm) and the 6-hour PMP are shown in Table 6.2.

Table 6.2: Hydrologic and Hydraulic Analysis Summary Ash Pond C				
Section	**Embankment Crest Elevation**	**Normal Pool Elevation**	**Estimated Peak Pool Elevation**	
			100 Year 24-Hour Storm	**6-Hour PMP**
Ash Pond	765.0	760.0	761.4	**765.4**
Stilling Pond	765.0	754.4	755.6	761.0

The results indicate that Ash Pond C is capable of containing the 24-hour, one percent probability storm event without overtopping. However, the Ash Pond dike is overtopped by the 6-hour PMP.

Stantec conducted a supplemental hydrologic and hydraulic analysis using the Tennessee dam safety criteria of one-half the 6-hour PMP applicable to Intermediate, Significant Hazard dams. The results indicate that the estimated peak pool elevation in the Ash Pond is 764.4, thus the embankment is not overtopped (See Appendix A – Doc 12).

Gypsum Impoundment

TVA retained Geosyntec Consultants to conduct a hydrologic/hydraulic analysis of the Gypsum Disposal Facility. (See Appendix A – Doc 13). The analysis was conducted using the Tennessee dam safety criteria of one-third the 6-hour PMP event applicable to Small, Significant Hazard dams. The input parameters and results for the one-third 6-hour PMP are shown in Table 6.3.

Table 6.3: Hydrologic and Hydraulic Analysis Summary Gypsum Disposal Facility			
Area Section	**Embankment Crest Elevation**	**Normal Pool Elevation**	**Estimated Peak Pool Elevation**
Storm Water Pond	769	759.5	761
Gyp Pond Phase 1 A	780	756	759
Gyp Pond Phase 1B	770*	N/A	763

* Elevation of interior dike between Phase 1A and 1B

The results indicate the embankments will not be overtopped due to a one third 6-hour PMP event, nor would the pool elevation reach the invert of the stormwater pond emergency spillway.

6.1.3 Spillway Rating

Ash Pond C

The Stantec hydrologic and hydraulic analysis report provides ratings for two spillways (See Appendix A – Doc 11). The spillways are:

- Overflow spillway from Ash Pond C to Settling Pond rating of 600 cubic feet per second (cfs)
- Overflow spillway from Settling Pond to plant water intake channel rating of 800 cfs

Gypsum Disposal Area

Spillway rating data for the Gypsum Disposal Facility impoundments were not provided to Dewberry for review.

6.1.4 Downstream Flood Analysis

As part of the dam safety hazard classification review, Stantec Consultants conducted a qualitative evaluation of the downstream impacts of a release from Ash Pond C due to a failure or misoperation of the embankments. The review evaluated a failure along the east section of Dike C adjacent to the Emory River and Watts Bar Reservoir. The minimum reservoir width at the location evaluated was about 800 feet. Prior to 2008 there were a number of residential structures along the river bank across from Ash Pond C and the adjacent dredge cell. In response to the 2008 failure of the dredge cell embankment, TVA purchased most of those homes. Stantec reports that the three remaining homes are located a minimum of about 17 feet above the normal pool of the lake and were not expected to be impacted by a release from Ash Pond C (See Appendix A – Doc 05).

6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Supporting documentation reviewed by Dewberry is adequate.

6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

Based on the technical data provided to Dewberry for review, the hydrologic and hydraulic safety of Ash Pond C and the Gypsum Disposal Facility impoundments are considered SATISFACTORY.

7.0 STRUCTURAL STABILITY

7.1 SUPPORTING TECHNICAL DOCUMENTATION

7.1.1 Stability Analyses and Load Cases Analyzed

Ash Pond C

In 2009 TVA retained Stantec Consulting Services to perform a geotechnical exploration and slope stability analysis for Dike C (See Appendix A – Doc 01). Stantec performed field sampling, laboratory testing and static slope analyses for several sections along Dike C.

The stability of the slopes were evaluated under fully drained conditions (static, long-term, steady state seepage) using SLOPE/W software.

In the 2009 Stantec report, dike Factors of Safety for long term stability were less than the minimum required 1.5 (See Appendix A – Doc 1). In 2011 Stantec completed a buttress design report for structural modifications to the Ash Pond C dike. The 2011 report provided design drawings of the recommended modifications and resulting Factors of Safety (See Appendix A - Doc 16).

Based on discussions between TVA and EPA during the current assessment, TVA retained Stantec to conduct additional analyses to evaluate slope stability under seismic loading conditions (See Appendix A – Doc 14). The seismic analysis included a single cross-section. Ground motion used in the analysis was based on a peak ground acceleration with an exceedance probability of 10 percent in 50 years.

Based on further discussions between TVA and EPA additional seismic analyses were conducted using a peak ground acceleration with a probability of exceedance of two percent in 50 years (See Appendix A – Doc 20).

Gypsum Disposal Facility

TVA retained Geosyntec Consultants to conduct a seismic analysis of the Gypsum Disposal Facility (See Appendix A – Doc 15). Ground motion used in the analysis was based on a peak ground acceleration with an exceedance probability of 2 percent in 50 years.

During initial site development, evidence of karst features was observed. Due to the potential for sinkhole development in karst terrain, TVA revised the proposed operation of the gypsum stack to include dry disposal of waste materials, except for a portion of Phase I that will receive wet gypsum during the first year of operation. TVA retained Geosyntec to conduct additional slope stability analyses in conjunction with the revised design and operational plan (See Appendix A – Doc 21).

7.1.2 Design Parameters and Dam Materials

Ash Pond C

Documentation provided to Dewberry for review indicated the stability analyses for Dike C included 11 strata. The material properties used in the analyses are shown in Table 7.1. The long term, static analyses used drained soil shear strength parameters. The seismic loading analysis used undrained soil shear strength parameters.

Table 7.1: Summary of Soil Properties Used in Stability Analyses, Ash Pond C

Soil Strata	Static Analyses			Seismic Analysis		
	Unit Weight γ' (pcf)	Cohesion c' (psf)	Friction Angle $\emptyset'$	Unit Weight γ (pcf)	Cohesion c (psf)	Friction Angle $\emptyset$
Riprap Buttress	115	0	38	110	0	38
Starter Clay Dike	129	0	30	129	300	26
Raised Clay Dike	125	0	30	125	65	23
Constructed Ash	93	0	30	93	0	30
Hydraulically Placed Ash	96	0	25	96	0	10
Gravel to Clayed Gravel	120	0	32			
Sensitive Silt/Clay	127	0	28	127	c/p = 32	N/A
Lean Clay Foundation Soil	129	0	30			
Sandy Silt to Silty Sand	105 to 113	0	27 to 29	105	0	27
Fine Grained Sand to Sand with Silt	118 to 128	0	31 to 36	122	0	31
Rock				110	0	38

Gypsum Disposal Facility

Documentation provided to Dewberry for review indicated the static stability analyses included six strata (See Appendix A - Doc 21). The material properties used in the analyses are shown in Table 7.2

Table 7.2: Summary of Soil Properties Used in Stability Analyses, Gypsum Disposal Facility

Material	Unit Weight (pcf)	Effective Strength	
		Cohesion (psf)	Friction Angle (degrees)
Gypsum (Phase I)	100	0	30
Dry Fly Ash (Phase II)	100	0	30
Soil fill	117	0	30
Native Soil (N>4)[1]	120	0	34
Native Soil (N<4)[2]	105	0	25
Bedrock	155	10,000	30

1. N>4 refers to native soils exhibiting a Standard Penetration Resistance greater than 4 blow per foot.
2. N<4 refers to native exhibiting a Standard Penetration Resistance less than 4 blow per foot.

Documentation provided to Dewberry for review indicated the seismic stability analysis for the Gypsum Disposal Facility included six strata (See Appendix A – Doc 21). The material properties used in the analyses are shown in Table 7.3.

Table 7.3: Summary of Soil Properties Used in Seismic Analysis – Gypsum Disposal Facility

Strata	Unit Weight (pcf)	Shear Wave Velocity (ft/sec)
Landfill Cover	120	771
Fly Ash	100	600
Landfill Liner	125	984
Medium Stiff to Stiff Silty Clay	120	712
Soft Silty Clay	105	394
Crystalline Bedrock	155	2,500

7.1.3 Uplift and/or Phreatic Surface Assumptions

Ash Pond C

The stability documentation provided to Dewberry for review did not specifically identify uplift forces acting on the base of the embankment.

Embankment pore pressures for the long-term, static loading condition were obtained from the seepage analysis conducted as part of the geotechnical explorations (See Appendix A – Doc 01). Phreatic surface assumptions were made using the information developed by Stantec using their SEEP/W analysis program and also water levels obtained from piezometer readings. The SEEP/W program is discussed in detail in the Stantec geotechnical report.

Gypsum Disposal Facility

The stability documentation provided to Dewberry did not specifically identify uplift forces acting on the base of the embankment. Based on the identification of potential for sink hole development, the redesign of the gypsum impoundment included an extensive interior subgrade drainage system.

7.1.4 Factors of Safety and Base Stresses

Ash Pond C

The minimum safety factors computed for Ash Pond C, Dike C are summarized in Table 7.4.

Table 7.4: Summary of Slope Stability Factors of Safety Ash Pond C, Dike C

Location (Station No.)	Slope	Long Term Static Load		Rapid Draw Down Conditions	Seismic
		Minimum Required Safety Factor			
		1.5		1.3	1.0
		Initial Design	With Buttress	With Buttress	With Buttress
108+93	Starter Dike	1.42	1.80	1.93	
	Raised Dike	1.39	2.05		
	Deep Failure	1.66	1.93		
119+69	Starter Dike	1.18	1.50	1.72	
	Raised Dike	1.39	2.51		
	Deep Failure	1.47	1.68		
132+37	Starter Dike	1.24	1.76	1.75	1.0
	Raised Dike	1.22	2.25		
	Deep Failure	1.47	1.88		
138+27	Starter Dike	1.13	1.53	1.36	
	Raised Dike	1.38	2.29		
	Deep Failure	1.52	1.76		
149+14	Starter Dike	1.15		1.92	
	Raised Dike	1.35			
	Deep Failure	1.49	1.93		

The stability analyses for long term static conditions for both the initial design and with buttress slope configurations were reported to have been conducted using Geo-Slopes Slope/W software. The calculated Factors of Safety with buttressed slope are equal to or exceed the minimum required value of 1.5.

The rapid drawdown conditions were conducted using the UTEXAS4 software. The calculated Factors of Safety are equal to or exceed the minimum required value of 1.3.

The 2011 Stantec report (Appendix A, Document 14) also analyzed slope stability for undrained soil strength conditions. The analyses, conducted using UTEXAS4 software indicated Factors of Safety less than the required minimum value of 1.3 at Station 119+69 and 138+27. The report indicates the Factors of Safety at those locations were greater than 1.3 when the analyses were repeated using the Slope/W software. The report opines that the differences were due to "the inherent conservatisms in the UTEXAS4 model are influencing the model output". As construction of the buttresses was substantially complete at the time of Dewberry site

visit, and no indication of slope stability issues were observed, the issue of short-term stability during construction is not considered a concern.

The seismic analysis indicated a minimum calculated safety factor of 1.0 at Station 132+37 along Dike C. The computed safety factor is equal to the minimum recommended value of 1.0 for seismic loading conditions.

Gypsum Disposal Facility

The minimum safety factors computed for the Gypsum Disposal Facility are summarized in Table 7.5.

Table 7.5: Summary of Static Slope Stability Factors of Safety, Gypsum Disposal Facility

Location	Cross-Section	Minimum Required Factor of Safety	Minimum Calculated Factor of Safety	
			Drained Shear Strength	Undrained Shear Strength
Phase 1	1-1	1.5	1.75	3.39
Phase 1	2-2	1.5	1.73	4.08
Phase 2	3-3	1.5	1.78	3.01
Phase 2	4-4	1.5	1.74	3.30
Phase 2	5-5	1.5	1.73	3.19

The seismic analysis indicated a minimum calculated safety factor of 1.02 for the Gypsum Disposal Facility gypsum stack cell. The computed safety factor meets the minimum recommended value of 1.0 for seismic loading conditions.

7.1.5 Liquefaction Potential

No assessment of liquefaction potential was performed for the Ash Pond C, Dike C. A qualitative assessment by Dewberry of materials within and under Dike C indicates there is a potential for liquefaction of CCR and soils under seismic conditions (See Appendix A - Doc 22).

No assessment of liquefaction potential was performed for the Gypsum Disposal Facility. A qualitative assessment by Dewberry of material with and under the impoundment dikes did not identify a potential for liquefaction (See Appendix A - Doc 22).

7.1.6 Critical Geological Conditions

The Kingston Fossil Plant is located in the Valley and Ridge Physiographic province near the base of the Columbia Plateau. Numerous northeast to southwest trending faults have been mapped in the Valley and Ridge province. The Kingston Fossil Plant is mapped as being located between the Chattanooga Fault to the north and the Kingston Fault to the south.

The majority of the plant is underlain by the Conassauga Shale Formation consisting of clayey to silty shale with zones of shaley limestone.

A narrow band of Maynardville Limestone separates the main plant area from the Gypsum Disposal Facility peninsula. USGS maps show enclosed drainage basins which can be an indication of karst activity (i.e., sinkhole development).

The USGS National Seismic Risk Map for the Central and Eastern United States estimates the peak ground acceleration having a 2-percent probability of exceedance in 50 years of 0.2g.

7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Structural stability documentation of Ash Pond C and the Gypsum Disposal Facility is adequate. Liquefaction documentation is inadequate.

7.3 ASSESSMENT OF STRUCTURAL STABILITY

Overall the structural stability of the Ash Pond C appears to be **FAIR** based on the following observations:

- Implementation of recommendations made by Stantec to increase the slope stability of Ash Pond C, Dike C by construction of a riprap buttress for each area has been substantially completed.
- Liquefaction analyses of soils and materials with Ash Pond C and the Gypsum Disposal Facility have not been performed. A qualitative analysis indicated that Ash Pond C may be susceptible to liquefaction. The need for a quantitative liquefaction analysis of Ash Pond C is critical.

The Gypsum Disposal Facility is **SATISFACTORY**.

8.0 ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

8.1 OPERATING PROCEDURES

The operations and maintenance procedures for the Kingston CCR impoundments are defined in the *Tennessee Valley Authority (TVA) Routine Handling Operations and Maintenance (RHO&M) Operations Support Document, Kingston Fossil Plant*, July, 2011 (See Appendix A – Doc 04).

Ash Pond C

Ash Pond C is divided by an interior dike into two sections: the ash pond on the north side of the impoundment, and the stilling pond to the south. Ash from the plant is sluiced to and deposited into the northwest corner of the ash pond. Sluice water flows in a bottom ash drainage channel to the eastern portion where an overflow spillway connects to the stilling pond.

Ash from the drainage ditch is excavated and stacked in the ash pond.

The stilling pond discharges to the plant water intake channel through a newly installed siphon system, and an overflow spillway structure.

Gypsum Disposal Facility

The original design for the Gypsum Disposal Facility was to sluice gypsum to a cell in the ash stack impoundment. The receiving cell would include a settling pond. Water from the settling pond was to be pumped to the stormwater pond and from there pumped to the plant's intake channel. A cell adjacent to the receiving cell would be used to store gypsum excavated from the receiving cell.

Due to sinkhole development encountered during final construction of Phase 1, the facility is currently out of service pending completion of the redesigned facility.

8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

TVA has implemented a formal operations and maintenance program for Kingston Fossil Plant Ash Pond C and the Gypsum Disposal Facility when it returns to service. (See Appendix A – Doc 04). Specifically, a detailed program regarding coal combustion residue streams, coal combustion residue handling and disposal, compliance with government regulations, and roles and responsibilities is in place.

The 2010 annual inspection report provided to Dewberry for review identified potential embankment seepage, and tree growth on some embankments as the most significant maintenance issue (See Appendix A – Doc 07).

In response to the recommendations, TVA retained Stantec to prepare a maintenance plan addressing the seepage (See Appendix A – Doc 17)

8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATIONS

8.3.1 Adequacy of Operating Procedures

Based on the assessments of this report, operating procedures appear to be adequate.

8.3.2 Adequacy of Maintenance

Based on the assessments of this report, maintenance procedures appear to be adequate.

9.0 ADEQUACY OF SURVEILLANCE AND MONITORING PROGRAM

9.1 SURVEILLANCE PROCEDURES

The TVA surveillance procedures for Kingston Fossil Plant CCR management include written reports of daily, weekly, monthly, quarterly and annual inspections. Special inspections are required after significant storms; i.e. rain events exceeding the 10-year recurrence intensity, and after a significant earthquake (See Appendix A – Doc 04).

The 2010 annual inspection report was provided to Dewberry for review (See Appendix A – Doc. 07).

9.2 INSTRUMENTATION MONITORING

Ash Pond C

Dike C impounding Ash Pond C is instrumented with piezometers and slope inclinometers. The instrumentation points are monitored weekly. Dewberry was provided copies of the weekly reports of recent piezometer and slope inclinometer readings (See Appendix A – Docs 18 and 19, respectively). No significant changes in ground water elevations or indications of slope movement were reported.

Gypsum Disposal Facility

Piezometers are located along the toe of the south embankment of the ash stack impoundment. As the ash stack portion of the facility is out of service, the piezometers were not being monitored at the time of Dewberry's site visit.

9.3 ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM

9.3.1 Adequacy of Inspection Program

Based on the data reviewed by Dewberry, including observations during the site visit, the inspection program is adequate.

9.3.2 Adequacy of Instrumentation Monitoring Program

Based on the data reviewed by Dewberry, including observations during the site visit, the instrumentation program is adequate.

APPENDIX A

Document 1

Report of Geotechnical Exploration and Slope Stability for Dike C, Kingston Fossil Plant, Harriman, Tennessee, Stantec Consulting Services, August 3, 2009

Report of Geotechnical Exploration and Slope Stability for Dike C

Kingston Fossil Plant
Harriman, Tennessee

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Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

August 3, 2009

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August 3, 2009 rpt_001_175569042

Mr. Barry Snider
Tennessee Valley Authority
1101 Market Street
LP 2N
Chattanooga, Tennessee 37402

Re: Report of Geotechnical Exploration and Slope Stability for Dike C
Kingston Fossil Plant
Harriman, Tennessee

Dear Mr. Snider:

As requested, Stantec Consulting Services Inc. (Stantec) has completed our Report of Geotechnical Exploration and Slope Stability Evaluation for Dike C at the Kingston Fossil Plant. The report documents the subsurface conditions, results of laboratory testing, findings from the historical document reviews, results of our analyses and evaluation, and recommendations for the facility. These services were performed under Engineering Service Request ESR/TAO 650 in accordance with the terms and provisions established in our System-Wide Services Agreement dated December 22, 2008.

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

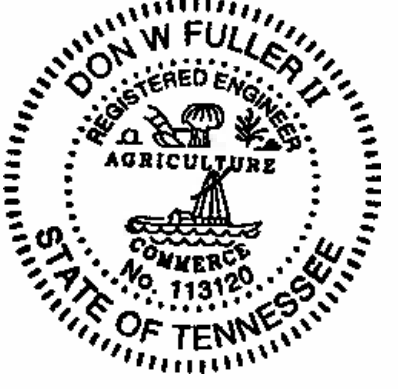
Sincerely,

STANTEC CONSULTING SERVICES INC.

Adam A. Crace, PE
Senior Project Engineer

Don W. Fuller, PE
Principal

/cmw



Report of Geotechnical Exploration and Slope Stability for Dike C

Kingston Fossil Plant
Harriman, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

August 3, 2009

Report of Geotechnical Exploration and Slope Stability for Dike C
Kingston Fossil Plant
Harriman, Tennessee

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Executive Summary

The purpose of this study was to evaluate the current stability of Dike C, the perimeter containment dike around the ash pond and stilling pond at Tennessee Valley Authority's Kingston Fossil Plant. Dike C, which includes the Road Dike, is located adjacent to the failed ash dredge cell and is underlain by similar geologic deposits. TVA is in the process of converting the Kingston plant systems to dry handling of fly ash. This will significantly reduce the fly ash combustion product storage role for the ash pond. It is anticipated that the Dike C structure and pond basin configuration will be modified in association with the conversion and reduced storage needs. The assessment of Dike C and the associated recommendations are based on this understanding of the plant setting.

The existing condition of Dike C was investigated in a subsurface exploration and laboratory testing program, and then assessed for geotechnical stability under static, long-term, steady-state conditions. Seepage and slope stability were evaluated using engineering analyses to quantify factors of safety.

The investigation began with a review of available geologic and historical project information provided by TVA. The site is underlain by alluvial and lacustrine deposits of sands, silts, and clays, with a weathered shale bedrock beneath. Dike C consists of two primary stages, with the lower, initial starter dike constructed in the 1950s to a crest elevation of about 748 ft. The dike crest was raised to an elevation of 765 in the 1970s, with the construction of the upper (clay) dike built over existing ash deposits using the upstream method of construction.

To collect additional subsurface data needed to support updated analyses, a field investigation program was undertaken in the spring of 2009. In total, 54 soil borings and 21 cone penetration tests were advanced at locations along the length of Dike C. Most of these test penetrations were advanced from the crest of the dike levee, or from a bench on the lower downstream face (crest of the original starter dike). Nine borings were completed through interior divider dikes within the ash pond. Instrumentation, consisting of slope inclinometers and piezometers, were installed in several of these borings to monitor conditions within the dike. Samples obtained from the site boring program were tested in the laboratory to establish key index properties, as well as permeability and strength parameters.

The data collected for the Dike C investigation was supplemented with subsurface information obtained by AECOM for the Root Cause Analysis of the dredge cell failure. Logs from AECOM borings (23 locations) in the ash pond, plus laboratory test data, provided additional information on the ash and soil materials within Dike C. AECOM's conclusions regarding the mechanisms that contributed to the dredge cell failure were also considered in the investigation and analysis of Dike C.

The engineering analyses focused on five cross sections through Dike C. Spaced at about 600 to 1200 ft apart, these cross sections were selected to represent the typical conditions in reaches of the perimeter dike. The cross sectional geometry, including the thickness and depth of various soil layers, was estimated using data from the site exploration program, the historical project drawings, and other information on the site development. The 2008 failure of the adjacent dredge cell deposited coal ash against the outslope of Dike C, mostly along the eastern reach. This accumulation of ash, which is primarily fluid in nature and highly erodible and will be removed during the cleanup, was ignored in the engineering analyses.

Eight soil horizons within and beneath Dike C were identified and described. Key properties, including unit weight, saturated hydraulic conductivity, horizontal to vertical permeability ratio, and drained shear strength parameters, were estimated for each soil horizon. These estimates were developed from the available laboratory data. Where needed, some soil parameters were estimated or adjusted based on typical values for similar soils. The soil parameter values selected for use in the stability analyses are tabulated and described in the report.

To understand the seepage conditions within the dike, a finite element seepage model was developed for each of the five cross sections through Dike C. The seepage model was based on the previously defined cross sectional geometry and the estimated hydraulic properties of the principal soil horizons. The applied boundary conditions represented the water levels in the ash pond or stilling pond, depending on the location, and the normal winter pool elevation of Watts Bar Lake. Steady-state seepage conditions were assumed, and a solution was obtained for the total hydraulic head at nodal points throughout the section. The seepage model was iteratively "calibrated" to match the existing field conditions. This was accomplished by varying the estimated hydraulic soil properties until the head at corresponding locations were in reasonable agreement with water levels measured in piezometers installed in the dike. Graphical results from the seepage analyses are presented in Appendix H of the report. The hydraulic pressures predicted with the seepage model were then mapped across the modeled sections to give the pore water pressures needed for the subsequent slope stability analyses.

The results from the seepage analyses were also examined to identify conditions where piping and erosion of soil might develop due to seepage forces. The model results indicated a shallow phreatic surface (ground water table) within the starter dike; these results are generally confirmed by the observation of shallow water in areas where trees and stumps have been removed from the starter dike. On four of the five cross sections, the model indicated seepage flows to the sloping downstream face of the starter dike. This condition creates the potential for the initiation of soil piping, as seepage water will tend to erode material from the dike face at these locations.

Upward, vertical exit gradients in the area of the dike toe were also evaluated. Factors of safety against piping, computed for the surficial 3 to 5 feet of soil in these areas, ranged from 1.3 to 2.7. Based on USACE design criteria for dams (EM 110-2-1901), target minimum factor of safety against piping is three. The results from the seepage model indicate that Dike C does not meet current criteria for soil piping due to seepage.

The stability of the Dike C slopes was evaluated using conventional, two-dimensional, limit equilibrium methods. Factors of safety for slope stability were computed using Spencer's method of analysis, circular and noncircular slip surfaces, and search routines that helped to identify critical (low safety factor) sliding mechanisms. Using pore water pressures predicted with the seepage model, the resistance to sliding was quantified using effective stresses and shear strength parameters determined on the basis of laboratory testing.

This analysis is limited to static, long-term, fully drained conditions within the existing dike. Dike C has existed in its current cross sectional geometry (slopes and crest elevation) for at least 30 years. Excess pore water pressures generated in the underlying soil during construction have had sufficient time to dissipate, and steady state seepage conditions have developed within the dike. Hence, for the current static conditions, the soils can be treated as

fully drained and the stability can be assessed using effective stress analyses. If stabilizing berms or other modifications to the dike cross section are built, then undrained, total stress stability analyses will be needed to assess stability during construction.

The slope stability calculations produced factors of safety against sliding along various potential failure mechanisms. In general, each cross section was evaluated for potential deep-seated slides that would impact the dike crest, plus critical slip surfaces that corresponded to minimum factors of safety. The potential for upstream sliding, into the ash pond or stilling pond, was also evaluated. The results of the stability analyses indicate global dike factors of safety ranging from 1.47 to 1.66. Current USACE criteria for the long-term stability of Dike C require a factor of safety for slope stability of at least 1.5. Considering only potential deep-seated or global failure mechanisms that would immediately impact the crest, the slope stability results show that Dike C meets this criteria. The difference between the minimum computed value of 1.47 and the required value of 1.5 is negligible, considering the inherent uncertainty and localized variability in the characterization of the soil strength. These results suggest that Dike C is stable with respect to the potential formation of large, deep-seated failures that would immediately compromise the retention of the ash pond.

The analysis also indicates that the controlling factors of safety are associated with smaller maintenance type sliding masses about 10 ft in thickness on the downstream face of the starter dike or the upper raised dike section depending on specific geometry present at that section. The projected potential for these shallow slides or slip surfaces occurs on the downstream face along the full length of Dike C (plus the upstream face in the vicinity of Sta. 132+37). The potential shallow slip surfaces occur in the slopes of both the lower starter dike and the upper raised dike (see the cross sections in Appendix F). The lowest factors of safety are currently found along the eastern branch of Dike C, where factors of safety less than 1.2 were computed. As directed by TVA, remedial design work plans are now underway to increase the long-term factors of safety against shallow sliding to achieve the target minimum value. The mitigation plan will incorporate specific interim risk reduction strategies and include both enhanced geotechnical instrumentation and construction of a dike embankment buttress and seepage control system.

Past shallow sliding of the downstream face of Dike C was reported in the project records, in an area along the perimeter of the dredge cell. This surficial slide was observed and repaired by TVA as part of their routine maintenance program. If additional shallow sliding were to develop again in Dike C, it is anticipated the slip surface would be initially confined to the sloping face of the dike. If not repaired and given enough time, these shallow slides could progress up the slope and endanger the ash pond. Because this progressive failure mechanism would be expected to take months or longer to impact the crest, a robust monitoring program can reduce the risk of dike breeching due to shallow sliding. Hence, in the interim while the permanent mitigation design and plant dry ash conversion process is developed, analyzed, and constructed, TVA should continue to monitor Dike C with routine inspections and instrument readings.

In conclusion, the current configuration of Dike C around the Kingston ponds does not exhibit acceptable factors of safety for long-term global stability. This does not imply that the dike is in immediate danger of failure, but TVA should undertake efforts to improve the safety of this facility in association with planned dry ash conversion process following the conclusions and recommendations presented herein.

Report of Geotechnical Exploration and Slope Stability for Dike C
Kingston Fossil Plant
Harriman, Tennessee

1. Introduction

In December, 2008, the Tennessee Valley Authority (TVA) requested that Stantec Consulting Services Inc. (Stantec) develop a geotechnical exploration plan to perform initial characterization and evaluation of Dike C. Dike C (also includes the Road Dike) is approximately 5,600 feet in length and provides perimeter containment for the ash pond and stilling pond. It is Stantec's understanding that TVA is in the process of converting Kingston Plant Systems to the dry handling of fly ash. This will significantly reduce fly ash combustion storage role for the ash pond. It is anticipated that the Dike C structure and pond basin will be modified in association with the conversion process. The assessment of Dike C and the recommendations reflect these planned operations for the pond. Stantec's scope of work associated with this assignment is defined in the document titled "*Revised Addendum to Work Plan for ESR/TAO Request 650*", dated June 17, 2009, submitted to TVA.

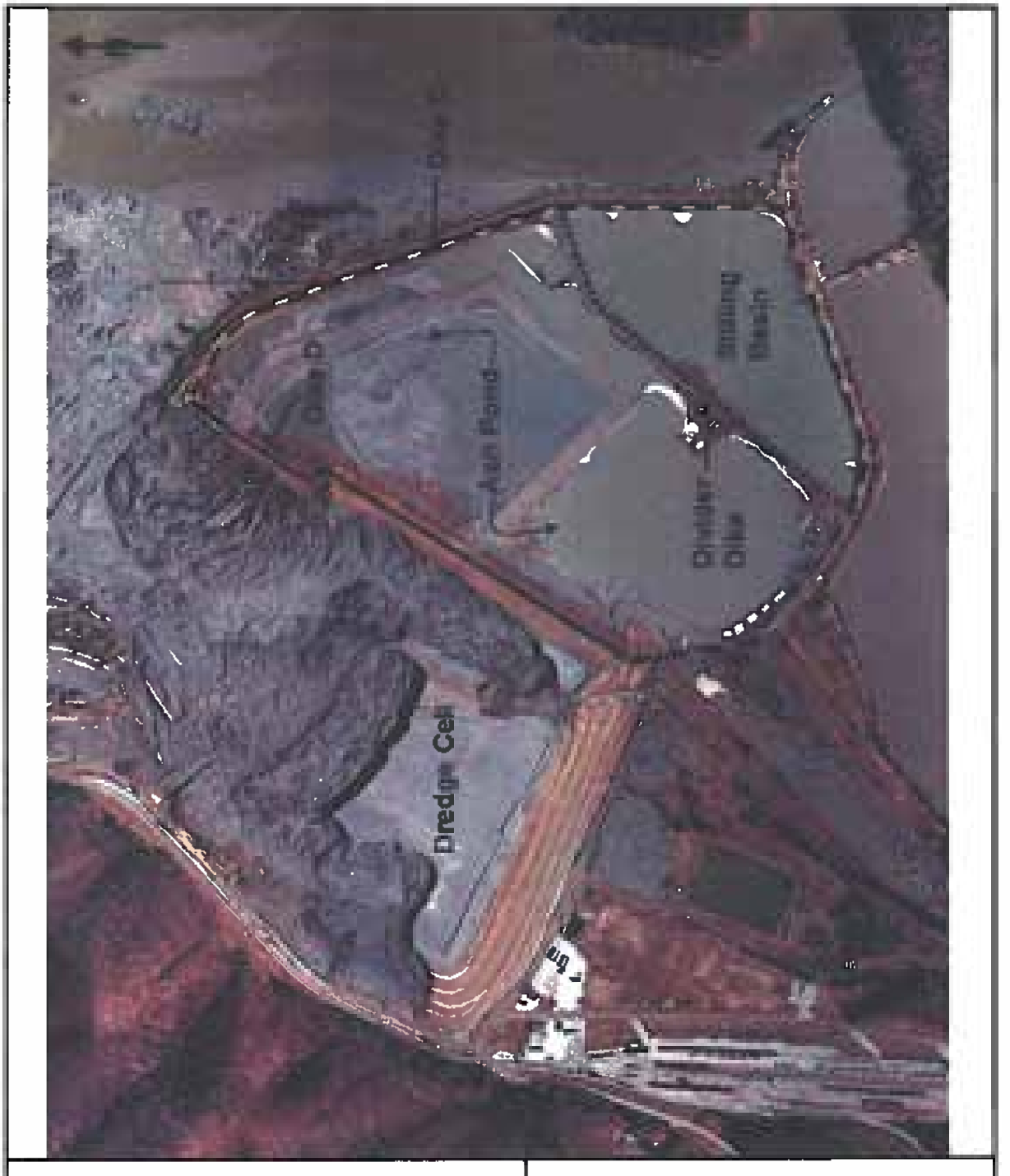
The results of initial geotechnical characterization are intended to supplement the historical data reviewed as a part of TVA's fossil group Facility Assessment Phase 1 program. This report presents the conclusions and recommendations of Stantec's evaluation along with general site geology and results of geotechnical exploration, laboratory testing and engineering analysis.

2. General Site Description and Geology

2.1. Location and Description

The Kingston Fossil Plant is located on the Watts Bar Reservoir, at the confluence of the Emory and Clinch Rivers, near Kingston, Tennessee approximately 35 miles southwest of Knoxville, Tennessee. The ash disposal area is centered approximately 4000 feet northeast of the plant's powerhouse. The disposal area (Figure 1) is bordered by the Emory River on the east and southeast with the excavated channel carrying intake condenser water present immediately south of the disposal area.

The ash pond and settling pond have a total surface area of approximately 120 acres and are enclosed to the south, east and north by Dike C, which is approximately 5,600 feet in length. The ash pond is enclosed to the west by Dike D. The top of the dike supports a gravel access road that is at approximate elevation 765 feet, which is approximately 28 feet above the winter pool elevation (737 feet) of Watts Bar Lake. The elevation of the crest from the starter dike crest is approximately 750 feet. Dike C, including the starter dike and the raised dike, have an overall constructed height that varies from 20 feet to 30 feet. The slope



Kingston Fossil Plant
Harriman, Tennessee

Figure 1. Kingston Fossil Plant Overview

Stantec

of the raised dike interior slope varies from 1.7H:1V to 2.8H:1V and the exterior slope varies from 1.5H:1V to 3H:1V. Based on historical documentation and some limited field observations it is estimated that the starter dike was constructed with 3H:1V interior slopes and 6H:1V exterior slopes. The slopes are vegetated with grass turf, with areas of mature trees at various locations around the perimeter near the pool level for Watts Bar Lake. Recent facility maintenance activities include removal of trees and replacement of rip rap armor within the vicinity of the Emory River/Watts Barr Lake water line between approximate Station 128+00 and Station 136+00.

2.2. Geology

The plant is situated on the western edge of the Valley and Ridge Physiographic province near the base of the Cumberland Plateau. Numerous faults, trending northeast to southwest as characteristic of the Valley and Ridge Province, are depicted on the geologic mapping. The plant is positioned between the Chattanooga Fault to the north, and the Kingston Fault to the south.

According to the USGS Geologic Map of the Harriman Quadrangle (1993), the plant is underlain by Lower Ordovician and Cambrian age limestone and shale bedrock formations. Although not depicted on the geologic mapping, previous drilling programs at the plant indicate that alluvial deposits consisting of fine sands, silty sands, and sandy silts are present at the site, as are commonly found adjacent to rivers.

The majority of the plant, including the majority of the ash disposal area, is underlain by the Conassauga Shale Formation, which consists of an argillaceous to silty shale with zones of shaley limestone scattered throughout. The geologic mapping indicates this formation is contorted, brecciated, and sheared throughout. The geologic mapping indicates Pine Ridge, just north of the plant, and the northern corner of the ash disposal area are underlain by the Rome Formation, consisting of arenaceous shale interbedded with very thin siltstone layers and thin beds of sandstone.

A narrow band of the Maynardville Limestone separates the mainland plant from the peninsula and does not underlie Dike C. The Maynardville Limestone Formation consists of fine grained, laminated to thinly bedded dolomite in the upper part and fine grained, thin to very thick bedded limestone with ribboned shale seams and dolomite laminate in the lower part. The peninsula is underlain by the Knox Group, consisting of siliceous dolomite with a few limestone beds in the upper part and scattered thin quartz sandstone beds and lenses. The Knox Group generally weathers to a thick residuum of red-orange soil with chert fragments and is known for karst activity. The USGS topographic map depicts a few enclosed drainage basins indicative of karst activity within the peninsula area.

3. Review of Available Information

3.1. General

As a part of the Phase 1 site assessment Stantec engineers reviewed documents provided by TVA pertaining to Dike C, Ash Pond, and the Stilling Pond. The main objective of the document review was to develop a historical knowledge base prior to beginning the field geotechnical exploration. The documents reviewed included record drawings, cross sections of dikes, aerial photographs, old contour maps, and annual dike stability reports. A complete listing of the reviewed documents is included in the Phase 1 report.

Of particular interest and use in this study are the following reports and geotechnical documents:

- "Root Cause Analysis of TVA Kingston Dredge Cell Pond Failure from December 22, 2008", AECOM, June 12, 2009

- "Kingston Fossil Plant Annual Ash Pond Dike Stability Inspection" TVA Engineering Design Services, 1967 to 2009

These studies included boring plans, driller's logs, and results from laboratory tests. The information gained from these reports was evaluated and used to supplement the information gathered from Stantec's geotechnical exploration. Logs from AECOM borings (23 locations) in the ash pond, plus laboratory test data, provided additional information on the ash and soil materials within Dike C. AECOM's conclusions regarding the failure mechanisms that contributed to the dredge cell failure were also considered in the investigation and analyses of Dike C.

3.2. Site History

Kingston Fossil Plant began construction in 1951 and was on-line during February 1954. At that time, ash slurry was discharged directly to slack water area created by Watts Bar Reservoir (Reservoir), which was filled in 1941. The August 1951 TVA design drawings of the ash pond show a gap between the East and North Dikes that formed the initial ash pond storage area and allowed ash to mix with waters of the Reservoir. TVA reports that by 1958 the northern 275-acre ash pond containment dike was completed with the construction of Dike C, which was constructed of residual clay and bottom ash to an elevation of 748 feet. The ash pond containment dike was comprised of a southern leg, which is referred to as the Road Dike, and a north to northeastern leg which is comprised of a portion of Dike C. This initial structure is referenced herein as the "starter dike".

After the initial ash disposal cell bounded by the North and East Dikes was filled in 1965 ash was directed into the main ash disposal cell where it deposited and progressively filled from south to north. From 1958 to 1977, water in the main ash disposal cell exited through a duel Dike C riser pipe system at the north end of the ash pond where it then reentered the Reservoir. In 1974, Dike C and the Road Dike underwent an interim raise of approximately 1.5 feet to provide additional freeboard for the ash pond and a deflector dike was created in the southwestern portion of the ash pond (near the current location of Dredge Cell 1). Between 1976 and 1978, major construction and operational changes took place with a major increase in the height of Dike C and the Road Dike and the creation of the stilling

pond. Dike C and the Road Dike were both raised, using upstream construction methodology, to an elevation of 765 feet to provide the additional freeboard when the stilling pond was created to allow the finer particles to settle out before the water reentered Watts Bar Lake. This upstream construction component of the dike is referenced herein as the "raised dike". The stilling pond was created in the southeastern most portion of the ash pond when an all ash divider dike was constructed in a northeastern to southwestern direction between Dike C and the Road Dike. This divider dike would allow the stilling pond to operate at a pool elevation of 754 to 755 feet while the main ash collection pond would be operating at elevation 760 to 761 feet.

As plant operations continued the ash pond transitioned into smaller subdivided cells formed with interior dikes. In 1983 an interior ash dike was constructed in a southwest to northeast direction that roughly reduced the size of the ash pond by half and is most likely the first effort in the planned transition to Dredge Cell operations. In 1984 TVA reported a failure of the interior ash dike associated with dredge maintenance undermining; this event did not result in any offsite releases, but it did establish the approximate location of future Dike D. The 1985 annual inspection report recognizes the limits of a contained "dredge area" along the western side of the pond designated as Dredge Cell 1. Between 1987 and 1988 Dredge Cells 2 and 3 were created in the northwestern portion of the ash pond. As the Dredge Cells began to fill an Intermediate Dredge Cell was created to the east of Dredge Cell Nos. 1, 2, and 3 and the eastern dike became what we now know as Dike D.

Prior to the dredge cell failure in 2008, the Kingston Fossil Plant operated by sluicing fly ash and bottom ash into a channel that drains into the ash pond. The bottom ash was excavated out of the sluice channels and the ash pond and then transported to the dredge cells. Sluice water from the ash pond flows into five 48-inch reinforced concrete pipe (RCP) riser pipe/weirs that discharge into the stilling basin. Once the particulates have settled out, water from the stilling basin flows into six 48-inch RCP pipe/weirs that discharge into the Emory River intake channel. Approximately 390,000 dry tons of fly ash and 95,000 dry tons of bottom ash is sluiced to the ash pond annually.

4. Scope of Exploration

In response to TVA Engineering Service Request (ESR) 650, Stantec submitted a work plan on February 18, 2009. TVA ESR 650 includes the Dike D buttress construction and support (submitted under a separate cover) and the ash pond stability (addressed under this cover). As the project continued and the scopes were better defined, Stantec submitted an Addendum to the original work plan on April 21, 2009. Finally, as the field exploration was completed and Stantec began to work through some preliminary slope stability analyses, and a Revised Addendum was submitted on June 17, 2009. The Revised Addendum included a slightly reduced scope that was agreed to by TVA and Stantec personnel and will be discussed in the following paragraphs. The reduced scope was a result of the information gained during the field exploration and the preliminary slope stability analyses.

Stantec personnel advanced 54 conventional sample borings using a combination of all terrain vehicle and truck-mounted drill rigs on approximately 200-foot intervals along the centerline of the starter dike, raised dike and select other locations (designated herein as STN-1 through STN-71) from March 17, 2009 to May 27, 2009. Selected borings were also advanced approximately 20 feet into bedrock using NQ-size (approximately two-inch diameter) rock coring equipment. The borings were advanced into bedrock to determine

general engineering characteristics of the uppermost geology. In addition, Stantec assessed the hydraulic conductivity properties of the encountered bedrock utilizing water pressure testing. In response to information provided by AECOM relative to the Root Cause Analysis (RCA), Stantec conducted eight borings with continuous Shelby tube sampling at selected intervals near the original ground line at four discrete locations along the perimeter dike. In addition, Stantec advanced 21 cone penetration test (CPT) borings.

Stantec's original boring plan submitted to TVA on April 21, 2009, identified 71 conventional sample borings that were to be advanced. Based on the results from the initial field exploration, review of TVA's hydrogeographic data and the preliminary slope stability analyses, Stantec removed 17 borings from the original program. STN-1, STN-7, STN-13, STN-17, STN-25, STN-30, STN-35, STN-40, and STN-46 were removed from the program because the preliminary slope stability analyses concluded that the critical failure mechanism was not anticipated to change based on the results of advancing those borings within Watts Bar Lake. STN-33, STN-39, STN-57, STN-58, STN-67, STN-69, and STN-70 were removed from the program because fairly uniform subsurface conditions were encountered in the nearby borings. STN-44 was removed from the program because it was scheduled to be advanced near a previously completed AECOM boring. At the conclusion of the field exploration, TVA personnel surveyed as-drilled boring locations and transmitted the information to Stantec.

The subsurface exploration was performed using 3¼ and 4¼ inch (ID) hollow stem augers equipped with a carbide-tipped tooth bit. Standard Penetration Testing (SPT) or undisturbed (Shelby) tube samples were performed in all 54 of the conventional sample borings at continuous intervals. A standard penetration test consists of dropping a 140-pound hammer to drive a split-spoon sampler 18 inches. The consistency or relative density of soil is estimated by the number of blows it takes to drive the spoon the last 12 inches. This method is typically used to obtain soil samples, estimate the consistency or relative density of the soil, and also to estimate the vertical limits of the subsurface soil horizons. In addition, undisturbed samples (Shelby Tubes) were obtained with a fixed head piston sampler from selected depth intervals within the cohesive materials to provide samples for subsequent laboratory strength testing. After completion of the drilling and sampling procedures, the boreholes were checked for subsurface water and backfilled with bentonite grout.

CPT borings were conducted at offset locations to borings as shown in the list of borings in Section 5. Cone penetration testing was performed by advancing an integrated electronic seismic piezo cone within the soil-like overburden materials to measure tip resistance, sleeve friction and dynamic pore pressure at roughly one-inch intervals. In addition, pore pressure dissipation testing was performed at selected intervals.

Based on encountered site conditions, Stantec installed six slope inclinometers as a part of the overall stability evaluation. The slope inclinometers were constructed by advancing the boring approximately 10 feet into bedrock, installing 2.75 inch slope inclinometer casing, and backfilling the annulus with a bentonite-cement grout that is mixed to a similar consistency as the surrounding soils. Flush-mounted or riser type protective covers were set in concrete to protect the slope inclinometers. These instruments are currently scheduled to be monitored once every week until mid-November 2009.

Stantec installed 20 piezometers within the starter dike and the raised dike as a part of the overall stability evaluation, to provide data on piezometric levels within the existing dikes. Piezometer construction consisted of one-inch diameter Schedule 40 PVC well screen (five

feet) and riser pipe. The annular backfill consisted of a sand filter pack to some distance above the screened interval followed by a minimum two-foot bentonite seal. After allowing the bentonite to hydrate, the remaining annulus was backfilled with bentonite grout tremmied into place. Flush-mounted or riser type protective covers were set in concrete to protect the piezometers. These instruments are currently scheduled to be monitored once every two weeks until mid-November 2009.

An engineer/geologist was present with each drill crew throughout the drilling operations. The engineer/geologist directed the drill crews, logged the subsurface materials encountered during the exploration and collected soil samples. Particular attention was given to the soil's color, texture, moisture content and consistency or relative density. The soil samples extracted from the borings were transported to Stantec laboratories for testing.

In the laboratory, SPT samples were subjected to natural moisture content determination in accordance with American Society of Testing and Materials (ASTM) D 2216 and No. 200 wash gradation (ASTM D 1140). Selected SPT samples were also combined and subjected to soil classification tests that included Atterberg limits testing (ASTM D 4318), specific gravity tests (ASTM D 854) and sieve and hydrometer analyses (ASTM D 422). Undisturbed samples were extruded and subjected to unit weight determination, unconfined compression (ASTM D 2166), unconsolidated undrained triaxial compression (ASTM D 2850), consolidated undrained triaxial compression with pore pressure measurements (ASTM D 4767), one-dimensional consolidation (ASTM D 2435), direct simple shear (ASTM D 2435) and permeability (ASTM D 5084) testing.

The results of the field and laboratory testing services were used to develop critical stability sections perpendicular to Dike C. As a part of the original scope that was submitted to TVA on April 21, 2009, Stantec projected 10 stability sections that were located approximately 500 feet apart along the perimeter of Dike C. Based on the results of the field exploration, cross-section geometry and the preliminary slope stability analyses Stantec reduced the total number of stability sections to five under the revised addendum that was submitted on June 17, 2009. Stantec performed seepage and slope stability analyses on five cross sections using as detailed later in the report.

5. Results of Geotechnical Exploration

5.1. Summary of Borings

Stantec developed a boring plan for the field exploration of Dike C at the Kingston Fossil Plant after a review of historical information and existing site conditions. TVA survey personnel established the boring locations and surface elevations in the field in accordance with Stantec's boring plan. A summary of the boring information is presented in Table 1, where all measurements are expressed in feet. Typed boring logs with the results of the water pressure testing are presented in Appendix A and the CPT results are included in Appendix B.

Table 1. Summary of Borings

Boring No.	Northing	Easting	Surface Elevation	Top of Rock Elevation	Refusal/ Begin Core Elevation	Boring Termination Depth	Bottom of Hole Elevation
STN-1	Not Drilled						
STN-2	556804.57	2442329.32	751.2	713.7	710.2	41.0	710.2
STN-2A	556806.57	2442329.32	751.2	--	NR(721.7)	29.5	721.7
STN-2B*	556801.29	2442323.04	751.0	--	--		
STN-3	556756.78	2442263.59	763.7	714.7	713.4	50.3	713.4
STN-3A	556761.99	2442259.75	763.9	--	NR(733.9)	30.0	733.9
STN-3B	556765.05	2442256.36	763.8	--	NR(713.8)	50.0	713.8
STN-3C	556763.50	2442257.42	763.8	--	NR(728.8)	35.0	728.8
STN-3D	556762.50	2442258.42	763.8	--	NR(728.8)	35.0	728.8
STN-3E*	556764.10	2442559.45	763.8	--	--		
STN-4**	556625.56	2442047.01	763.3	702.3	700.3	83.0	680.3
STN-5	556611.15	2442365.31	764.9	712.4	710.9	54.0	710.9
STN-6	556416.17	2442407.10	763.4	699.4	698.9	64.5	698.9
STN-7	Not Drilled						
STN-8**	556248.52	2442540.30	752.2	698.7	696.4	76.7	675.5
STN-8A*	556254.96	2442535.17	751.7	--	--		
STN-9	556233.82	2442499.72	764.8	702.3	701.4	63.4	701.4
STN-9A*	556234.82	2442499.81	764.8	--	--		
STN-10**	556162.76	2442251.63	765.0	705.5	704.0	81.0	684.0
STN-11	556034.83	2442535.05	763.2	704.7	701.2	62.0	701.2
STN-12	555873.09	2442622.48	765.1	704.1	703.1	62.0	703.1
STN-13	Not Drilled						
STN-14	555685.58	2442733.21	753.1	706.1	702.1	51.0	702.1
STN-14A	555687.58	2442734.21	753.1	--	NR(734.6)	18.5	734.6
STN-14B*	555690.29	2442730.41	753.0	--	--		
STN-15	555662.69	2442667.52	763.7	706.2	704.8	58.9	704.8
STN-15A	555669.72	2442691.43	765.3	--	NR(735.3)	30.0	735.3
STN-15B	555672.20	2442690.32	765.3	--	NR(707.3)	58.0	707.3
STN-15C	555671.50	5442690.88	765.3	--	NR(730.3)	35.0	730.3
STN-15D	555665.72	2442690.78	765.3	--	NR(730.3)	35.0	730.3
STN-15E*	555694.24	2442681.34	765.0	--	--		
STN-16	555501.40	2442725.94	764.5	706.5	706.0	58.5	706.0
STN-17	Not Drilled						
STN-18**	555204.87	2442894.11	751.0	702.5	700.5	71.5	679.5
STN-18A*	555204.57	2442886.00	751.8	--	--		
STN-19	555204.68	2442842.94	765.6	701.1	700.6	65.0	700.6
STN-19A*	555204.68	2442843.94	765.6	--	--		
STN-20	555168.84	2442666.59	762.9	703.9	701.9	61.0	701.9
STN-21**	555076.61	2442149.85	765.0	709.0	707.5	77.5	687.5
STN-22**	554990.27	2441723.40	765.0	707.0	706.0	79.0	686.0

Table 1. Summary of Borings

Boring No.	Northing	Easting	Surface Elevation	Top of Rock Elevation	Refusal/ Begin Core Elevation	Boring Termination Depth	Bottom of Hole Elevation
STN-23	555020.22	2442857.46	764.7	703.7	702.7	62.0	702.7
STN-24	554803.45	2442843.16	765.1	701.6	700.9	64.2	700.9
SNT-25	Not Drilled						
STN-26	554624.86	2442889.00	750.0	696.0	692.7	57.3	692.7
STN-26A	554604.66	2442904.17	750.0	--	NR(730.0)	20.0	730.0
STN-26B*	554604.57	2442896.12	751.0	--	--		
STN-27	554601.77	2442850.67	765.1	700.1	697.6	67.5	697.6
STN-27A	554600.64	2442840.21	765.0	--	NR(705.0)	60.0	705.0
STN-27B	554606.18	2442840.52	765.0	--	NR(729.0)	36.0	729.0
STN-27C*	554607.18	2442840.92	765.0	--	--		
STN-28	554406.25	2442841.10	764.8	700.5	700.2	64.6	700.2
STN-29	554155.15	2442854.72	764.7	697.2	697.0	67.7	697.0
STN-30	Not Drilled						
STN-31	553954.94	2442758.22	749.5	696.5	695.5	54.0	695.5
STN-31A*	553960.30	2442764.66	749.7	--	--		
STN-32	553994.90	2442746.44	764.8	696.3	695.8	69.0	695.8
STN-32A*	553996.72	2442757.13	764.8	--	--		
STN-33	Not Drilled						
STN-34	553853.66	2442184.35	764.7	699.7	688.7	76.0	688.7
STN-35	Not Drilled						
STN-36	553776.74	2442198.78	751.9	712.4	707.9	44.0	707.9
STN-36A	553766.08	2442199.97	751.9	--	NR(736.9)	15.0	736.9
STN-36B*	553753.47	2442155.66	751.5	--	--		
STN-37	553799.90	2442184.40	763.8	712.8	709.6	54.2	709.6
STN-37A	553799.38	2442182.40	763.8	--	NR(734.8)	29.0	734.8
STN-37B	553800.49	2442186.20	763.7	--	NR(711.7)	52.0	711.7
STN-37C	553798.81	2442171.01	763.6	--	NR(730.1)	33.5	730.1
STN-37D	553798.26	2442168.95	763.6	--	NR(730.6)	33.0	730.6
STN-37E*	553799.26	2442183.40	763.8	--	--		
STN-38	553730.83	2441988.70	764.1	715.1	712.8	51.3	712.8
STN-39	Not Drilled						
STN-40	Not Drilled						
STN-41**	553583.10	2441510.71	752.7	714.7	709.7	63.0	689.7
STN-41A*	553584.59	2441512.86	751.8	--	--		
STN-42	553623.48	2441513.69	764.7	713.7	713.2	51.5	713.2
STN-42A*	553624.48	2441512.69	764.7	--	--		
STN-43	554004.68	2441548.50	765.9	718.9	711.9	54.0	711.9
STN-43A*	554005.71	2441549.61	765.9	--	--		
STN-44	Not Drilled						
STN-45	553740.50	2441308.40	763.9	716.4	175.4	48.5	715.4
SNT-46	Not Drilled						
STN-47	553747.39	2441146.83	753.4	717.4	713.9	39.5	713.9

Table 1. Summary of Borings

Boring No.	Northing	Easting	Surface Elevation	Top of Rock Elevation	Refusal/ Begin Core Elevation	Boring Termination Depth	Bottom of Hole Elevation
STN-47A	553733.63	2441141.18	753.1	--	NR(745.6)	7.5	745.6
STN-47B*	553742.43	2441143.28	753.8	--	--		
STN-48	553773.29	2441154.53	765.3	716.3	711.3	54.0	711.3
STN-48A	553771.75	2441159.01	765.3	--	NR(742.8)	22.5	742.8
STN-48B	553769.40	2441163.30	765.3	--	NR(717.1)	48.2	717.1
STN-48C*	553770.51	2441164.28	765.3	--	--		
STN-49	553921.85	2441024.39	763.1	718.1	715.6	47.5	715.6
STN-50**	553631.96	2440496.85	741.6	705.9	704.6	57.0	684.6
STN-50A*	553632.98	2440497.85	741.6	--	--		
STN-51	553696.02	2440548.46	750.4	701.5	700.8	49.6	700.8
STN-52	553992.98	2440817.40	753.2	714.2	713.7	39.5	713.7
STN-53	554011.12	2440902.46	763.9	713.9	712.4	51.5	712.4
STN-53A*	554012.14	2440904.05	763.9	--	--		
STN-54	555263.94	2441476.12	765.0	707.0	706.0	59.0	706.0
STN-55	554943.73	2442287.49	764.1	703.1	699.9	64.2	699.9
STN-56**	554555.61	2441998.50	765.8	704.8	703.7	82.0	683.8
STN-57	Not Drilled						
STN-58	Not Drilled						
STN-59	556075.53	2442603.06	752.2	701.2	700.7	51.5	700.7
STN-60	555886.92	2442663.31	752.5	701.0	699.0	53.5	699.0
STN-61	555513.59	2442792.80	752.5	706.5	701.0	51.5	701.0
STN-62	555020.69	2442907.23	749.8	702.8	700.8	49.0	700.8
STN-63	554822.75	2442910.57	750.0	702.5	701.0	49.0	701.0
STN-64	554411.29	2442911.08	749.4	702.9	693.9	55.5	693.9
STN-65	554147.51	2442915.09	748.6	700.6	698.6	50.0	698.6
STN-66	553888.83	2442564.24	750.9	695.9	693.9	57.0	693.9
STN-67	Not Drilled						
STN-68	Not Drilled						
STN-69	553607.58	2441718.01	752.3	707.3	692.8	59.5	692.8
STN-70	Not Drilled						
STN-71	553840.20	2440981.04	752.0	717.0	706.5	45.5	706.5

* Denotes Cone Penetration Test (CPT) boring.

** Boring was advanced approximately 20 feet into bedrock utilizing rock coring techniques

NR indicates no refusal

5.2. Subsurface Soil Conditions

Based on a review of the information obtained from the borings performed, placed embankment fill forming Dike C can be separated into four major horizons. Additionally, three major horizons have been identified as the foundation soils for Dike C.

Beginning just above the foundation soil materials, a discontinuous layer of "Gravel to Clayey Gravel", approximately three-foot thick, was encountered. This layer is most likely associated with placement of subgrade stabilization materials for starter clay dike construction. It should be noted that starter clay dike construction appears to have occurred at times within the impounded slack water area of Swan Pond formed by Watts Bar Reservoir.

The "Starter Clay Dike" horizon extends from the original groundline up to elevation 748 feet. The material was used to construct the initial perimeter containment dike prior to 1954. The starter clay dike soils primarily have a Unified Soil Classification System (USCS) classification of CL with lesser occurrences of CH, SM, and SC. Textural classifications consisted mostly of sandy lean clay and clayey sand with gravel. The soil was described as damp to wet in moisture content and brown to gray in color. Based on SPT N-values and laboratory strength testing, the starter clay dike has strength consistencies ranging from soft to medium stiff.

Above the starter clay dike, the "Constructed Ash" horizon, extending from approximate elevation 748 feet to elevation 750 feet was encountered primarily on the eastern leg of Dike C. The constructed ash was placed as an interim raise in 1974, to provide additional freeboard for the ash pond. It should be noted that the constructed ash was denoted as a thicker layer with a maximum thickness of 13.5 feet in some areas on the boring logs. This greater thickness is most likely attributed to some interim use of available ash materials to form the starter dike. The material generally consists of bottom ash. The bottom ash was described as damp to wet in moisture content and gray to dark gray and black in color. Based on SPT N-values the constructed ash has strength consistencies ranging mostly from loose to dense.

From 1954 to 1976, ash sluiced into the pond formed the "Hydraulically Placed Ash" horizon that now lies below the third raising of Dike C. The hydraulically placed ash extends from the original ground surface to approximate elevation 745 feet. The material generally consists of bottom ash and fly ash in varying mixtures. Classification tests performed on a selected hydraulically placed ash samples resulted in a USCS classification of SM and a textural classification of silty sand with gravel. The hydraulically placed ash was described as damp to wet in moisture content and gray to dark gray and black in color. Based on SPT N-values the hydraulically placed ash has strength consistencies ranging from very loose to dense.

The "Raised Clay Dike," constructed between 1976 and 1978, extends from approximate elevation 745 feet to elevation 765 feet. The raised clay dike soils classified primarily as CL with areas of CH. The raised clay dike had textural descriptions of lean clay with sand, sandy lean clay, fat clay with sand, and sandy fat clay. The soil was described as damp to wet in moisture content and mostly brown in color. Based on SPT N-values and laboratory strength testing, the raised clay dike has strength consistencies ranging from very soft to very stiff.

The uppermost native foundation material encountered at the boring locations consists of a silt and clay material, which appears to be original ground lake sediment deposits associated with the Swan Pond embankment. The material designated herein as the "Sensitive Silt/Clay" horizon, approximately a half to one-foot in thickness, lies near the original ground surface. The sensitive silt/clay soils classified primarily as CL-ML with occurrences of CL and ML. The sensitive silt/clay horizon was usually described as having a silt or silty clay texture, light brown in color, and saturated in moisture content. Based on SPT N-values the sensitive silt/clay horizon has strength consistencies ranging from very soft to soft.

No material matching the "slime layer" as described in the Dredge Cell Root Cause Analysis report was noted to be encountered during this exploration. This is likely attributed to the subject study area being the most active portion of the historical ash pond operations. If the material had formed in this area, probably removed in association with periodic dredging operations.

There is an occasional "Lean Clay Foundation Soil" layer found below the sensitive silt/clay horizon ranging from about three to twelve feet in thickness. The lean clay foundation soil had a USCS classification of CL with textural descriptions of sandy lean clay and lean clay with sand. The soil was described as predominately saturated in moisture content and light brown in color. Based on SPT N-values the lean clay foundation soil has strength consistencies of very soft to medium stiff.

Below the sensitive silt/clay horizon, "Sandy Silt to Silty Sand" was encountered down to elevations ranging between 717 feet and 703 feet. The sandy silt to silty sand had USCS classifications of predominately SM with occasional occurrences of CL, ML, and CL-ML. Textural descriptions were mostly of silty sand and sandy silt with isolated pockets of clayey soils typical of alluvial deposits. The soil was described as brown to gray in color and moist to saturated in moisture content. Based on SPT N-values and laboratory strength testing, the sandy silt to silty sand has strength consistencies ranging mostly from very loose or very soft to medium dense or medium stiff.

Below the sandy silt to silty sand horizon, "Fine Grained Sand" was encountered down to bedrock having an elevation ranging from about elevation 717 feet to 700 feet. The fine grained sand horizon had a USCS classification of SM with a textural classification of sand. The soil was described as wet or saturated in moisture content and brown to gray in color. Based on SPT N-values the fine grained sand horizon has strength consistencies of loose to very dense.

5.3. Instrumentation

5.3.1. Piezometers

At select boring locations, piezometers were installed to measure pore water pressures within Dike C. In general, piezometer readings were obtained on four separate occasions spaced approximately two weeks apart, beginning with the initial reading on May 28, 2009. Based on Stantec's current scope, it is anticipated that these readings will continue every two weeks until the middle of November. This report includes the results up to the last reading date on July 9, 2009; future readings will be issued under a separate cover. Refer to appendixes C and D for piezometer installation details and the latest piezometer readings, respectively. Piezometer locations and tip elevations are summarized in Table 2 below.

Table 2. Summary of Piezometers

Boring No.	ID	Concrete Pad Elevation (Feet)	Piezometer Tip Elevation (Feet)
STN-2A	PZ-1	751.2	724.7
STN-3A	PZ-2 (U)	763.9	751.9
	PZ-3 (L)		737.9
STN-3B	PZ-4	763.8	718.8
STN-14A	PZ-5	753.1	737.6
STN-15A	PZ-6 (U)	765.3	753.3
	PZ-7 (L)		738.3
STN-15B	PZ-8	765.3	710.3
STN-26A	PZ-9	750.0	733.0
STN-27A	PZ-10 (U)	765.0	752.2
	PZ-11 (L)		735.2
STN-27B	PZ-12	765.0	708.2
STN-36A	PZ-13	751.9	738.4
STN-37A	PZ-14 (U)	763.8	752.9
	PZ-15 (L)		738.1
STN-37B	PZ-16	763.7	715.0
STN-47A	PZ-17	753.1	746.9
STN-48A	PZ-18 (U)	765.3	756.7
	PZ-19 (L)		746.1
STN-48B	PZ-20	765.3	720.1

U – Denotes upper piezometer within the same boring

L – Denotes lower piezometer within the same boring

In general, the water levels were fairly consistent, with slight increases in the water elevation reported for the crest borings and mostly decreases in the water level observed within the toe borings. These changes in the water level observed over the two months of readings are likely attributed to equalization of the water level within the piezometers over time. However, it should be noted that water levels can also fluctuate due to the seasons, precipitation events, variations in pool levels, and other factors.

5.3.2. Slope Inclinometers

Slope inclinometers were installed in borings STN-8, STN-18, STN-34, STN-64, STN-69, and STN-71 to monitor any future movement within Dike C. In general, slope inclinometer readings were obtained soon after installation of the slope inclinometer casing so that a baseline reading could be established. The readings were then taken on a weekly basis with other instruments that were installed as a part of separate projects. Based on Stantec's current scope, it is anticipated that these readings will continue every two weeks for the next six months. This report includes the results up to the last reading date on July 9, 2009; future readings will be issued under a separate cover. Based on the readings taken to date, there has been no significant movement in any of the slope inclinometers installed within Dike C. Refer to Appendixes C and D for slope inclinometer installation details and the latest slope inclinometer readings, respectively.

6. Laboratory Testing

6.1. General

Stantec performed laboratory testing in accordance with applicable ASTM soil testing specifications. Results from the laboratory tests are included in Appendix E. In particular, natural moisture content test results are shown on the attached boring logs in Appendix A and are also shown on the drafted sheets in Appendix F. No further discussion relative to the results of moisture content and classification testing are provided in this section. The discussion that follows is limited to the laboratory testing associated with evaluation of the laboratory strength test characteristics.

6.2. Testing of Cohesive Soils/Undisturbed (Shelby) Tube Testing

The borings drilled for the subject dike included 3-inch diameter undisturbed (Shelby) tube sampling within predominantly cohesive soil horizons. Stantec's soils laboratory extruded the tubes and trimmed six-inch long specimens. Lab personnel determined visual inspections, unit weights (wet and dry), and natural moisture for each six-inch specimen prior to submitting a summary of the extruded specimens to a geotechnical engineer for assignment of lab testing. Select 6-inch specimens extruded from Shelby tubes were subjected to unconfined compressive (UC) strength testing, consolidated-undrained (CU) triaxial testing, unconsolidated-undrained (UU) triaxial testing, direct simple shear (DSS), testing one-dimensional consolidation, and testing permeability testing. Selected tube specimens associated with continuous sampling at the pond base/original ground elevation were also subjected to longitudinal cutting, visual inspection and laboratory microscopic viewing to identify any suspect "slime" type materials. The results of these tests are included in Appendix E and discussed below.

6.2.1. Unconfined Compressive (UC) Strength Testing

Unconfined compressive strength testing was performed to provide information from which soil strength parameters could be estimated. The results of the unconfined compressive strength testing are presented next to the sample borings on the geotechnical drawings in Appendix F and are summarized in Table 3.

Table 3. Summary of Unconfined Compressive Strength Tests

Boring No.	Sample Interval (feet)	Dry (pcf)	Wet (pcf)	Moisture Content (%)	Unconfined Compressive Strength (psf)
STN-20	35.0 - 35.5	103.6	127.0	23.7	760
STN-55	42.6 - 43.1	106.1	128.0	20.4	2,020

6.2.2. Consolidated-Undrained (CU) Triaxial Testing

Stantec performed CU triaxial testing with pore pressure measurements on selected 6-inch long specimens extruded from 3-inch diameter Shelby tubes obtained during drilling. CU testing provides indicators of effective-stress shear-strength parameters. The results of the CU triaxial tests are presented on the stability section in Appendix F, and are summarized in Table 4. The stress path envelopes derived from CU triaxial testing are also presented in Appendix E.

Table 4. Summary of Consolidated – Undrained Triaxial Testing

Boring No.	Sample Interval (feet)	USCS Classification	CU Triaxial Strength	
			c' (psf)	ϕ' (degrees)
STN-28	38.3 - 38.9		103	32.3
	38.9 - 39.5	CL		
	46.3 - 46.9			
STN-29	60.2 - 60.8	CL	0	34.0
	60.8 - 61.4			
	61.4 - 62.0			
STN-26	20.0 - 20.5		125	37.8
STN-64	20.6 - 21.1	CL		
STN-27	30.3 - 30.8	CL-ML		
STN-31	33.6 - 34.1		345	32.6
STN-66	33.6 - 34.1			
STN-32	50.0 - 50.5			
STN-3D	31.0 - 31.6	CL-ML	113	35.6
	31.6 - 32.2			
STN-37D	31.6 - 32.8			
STN-37	13.5 - 14.0		40	41.1
	14.3 - 14.8	CH		
	20.0 - 20.3			

Table 4. Summary of Consolidated – Undrained Triaxial Testing

Boring No.	Sample Interval (feet)	USCS Classification	CU Triaxial Strength	
			c' (psf)	ϕ' (degrees)
STN-14	23.6 - 24.1		240	33.2
	24.2 - 24.7	CL-ML		
STN-61	23.0 - 23.5			
STN-2	9.0 - 9.5		400	34
	14.0 - 14.5	CL		
	14.6 - 15.1			
STN-50	20.0 - 20.5		80	36.6
	20.5 - 21.0	CL		
STN-51	23.5 - 24.0			
STN-3	10.5 - 11.0		600	21.1
	12.5 - 13.0	CH		
STN-5	11.3 - 11.8			

6.2.3. Direct Simple Shear (DSS) Testing

Stantec selected samples extruded from Shelby tubes for DSS testing to provide additional indicators of effective-stress shear-strength parameters. The results of the DSS tests are presented in the stability section in Appendix F, and are summarized in Table 5. The stress path envelopes are also presented in Appendix E.

Table 5. Summary of Direct Simple Shear Testing

Boring No.	Sample Interval (feet)	USCS Classification	DSS Strength	
			c' (psf)	ϕ' (degrees)
STN-15D	34.00 - 34.25	CL	170	21
STN-15D	34.25 - 34.50		210	24
STN-27B	33.20 - 33.45	CL	60	22
STN-27B	35.20 - 35.45	CL-ML	260	25
STN-27B	35.45 - 35.80		100	27

6.2.4. Unconsolidated – Undrained (UU) Triaxial Testing

Stantec performed UU triaxial testing on selected soil specimens to provide information for estimated total stress strength parameters for cohesive soil horizons. Table 6 summarizes the data obtained from this test. The Subsurface Data Sheets provided in Appendix F also depict the results of the UU testing adjacent to the appropriate graphical log. The laboratory testing results are also included in Appendix E.

Table 6. Summary of Unconsolidated – Undrained Triaxial Testing

Boring No.	Sample Interval (feet)	Confining Stress (psi)	UU Triaxial Strength (psf)	UU Triaxial Strength (tsf)
STN-2	20.5 - 21.0	14	1,224	0.61
STN-2	30.6 - 31.1	18	1,670	0.84
STN-5	38.5 - 39.0	24	660	0.33
STN-8	15.5 - 16.0	13	660	0.33
STN-18	25.5 - 26.0	15	1,670	0.84
STN-19	5.0 - 5.5	4	4,310	2.15
STN-19	39.7 - 40.2	25	880	0.44
STN-22	49.5 - 50.0	20	3,460	1.73
STN-27	12.6 - 13.1	10	2,580	1.29
STN-27	44.7 - 45.2	27	1,440	0.72
STN-31	20.5 - 21.0	10	600	0.30
STN-31	38.0 - 38.5	19	450	0.22
STN-32	5.3 - 5.8	3	2,510	1.25
STN-36	29.0 - 29.5	13	300	0.15
STN-41	15.1 - 15.6	12	1,340	0.67
STN-43	29.1 - 29.6	16	1,390	0.70
STN-48	33.5 - 34.0	21	3,840	1.92
STN-48	4.0 - 4.5	3	1,930	0.97
STN-50	9.0 - 9.5	7	490	0.24
STN-63	9.3 - 9.8	5	900	0.45
STN-64	20.0 - 20.5	11	490	0.25
STN-64	30.0 - 30.5	15	1,930	0.97
STN-65	13.5 - 14.0	10	2,220	1.11

6.2.5. One-Dimensional Consolidation Testing

Stantec selected samples extruded from Shelby tubes for one-dimensional consolidation testing to provide initial void ratio and consolidation parameter indicators for estimates of use in settlement analyses. The results of the consolidation tests are summarized in Table 7 and are presented in Appendix E.

Table 7. Summary of One Dimensional Consolidation Tests

Boring No.	Test Interval (feet)	Initial Void Ratio (e_o)	Compression Index (C_c)	Recompression Index (C_r)	Pre-Consolidation Pressure (Pc) (psf)
STN-2	31.4 - 31.9	0.589	0.182	0.025	5,000
STN-9	11.7 - 12.2	0.844	0.216	0.040	12,000
STN-14	24.8 - 25.3	0.534	0.145	0.025	4,000
STN-19	14.1 - 14.6	0.681	0.125	0.032	6,200
STN-32	14.0 - 14.5	0.700	0.175	0.035	6,000
STN-52	25.2 - 25.7	0.573	0.150	0.025	3,800
STN-63	15.2 - 15.7	0.785	0.110	0.020	1,600
STN-64	21.2 - 21.7	0.752	0.320	0.030	1,200
STN-65	33.8 - 34.3	0.815	0.225	0.033	3,400

6.3. Testing of Standard Penetration Test (SPT) Samples

In general, recovered soil specimens from SPT samples were subjected to natural moisture content determinations and select samples were combined for engineering classification testing. The engineering classification testing consisted of Atterberg limits, specific gravity, and sieve and hydrometer analyses. The results of the classification testing were used in conjunction with the N-values from SPT's to estimate soil strength based on published correlations of such data. The results of the moisture content tests are included on the boring logs and drawings in Appendixes A and F, respectively. The results of the engineering classifications are included on the drawings in Appendix F.

7. Engineering Analyses

7.1. General

Geotechnical engineering analyses included evaluations of strength and permeability parameters, seepage analyses, and slope stability analyses. Prior to beginning the analyses, the geotechnical data and cross sections were combined and the geometry of the existing dikes and soil horizons were approximated using current and historical information. Once the geometry of the sections was determined, each section was reviewed and evaluated to determine the critical cross section for analyses. The criteria for selecting the critical sections was based on the steepness of slopes, the geometry of the sections, and the phreatic surface, and soil conditions. Based on this evaluation, representative cross sections were selected for analyses. Results of the analyses and evaluations are summarized in the following paragraphs. Results of the seepage and slope stability analyses, along with the plan locations of the cross sections, are shown on the drawings included in Appendix F.

It should be noted that construction records indicating the methods used to construct the dikes, as-built dike configurations, etc. were not available for review. In addition, the variable nature of the historical and current strength data shows some signs of inconsistencies in the construction of the dikes. As a result, generalizations in soil parameters and dike geometry

were needed to construct the seepage and stability models. The 2008 failure of the adjacent dredge cell deposited coal ash against the slope of Dike C, mostly along the eastern reach. This accumulation of ash, which is highly erodible and will be removed during the cleanup, was ignored during the analyses.

7.2. Soil Horizons

Based on the results of the drilling, laboratory testing, historical documentation, and drawings, the materials on site were divided into different soil layers. Refer to the stability sections in Appendix F for locations of the soil horizons. For these analyses, the soil layers are as follows:

- *Starter Clay Dike*: This represents the material used for construction of the original perimeter dike. Based on historical information the interior slopes were constructed at a 3:1 (H:V) and the exterior slopes were constructed at a 6:1 (H:V).

- *Raised Clay Dike*: This represents the material that was used for the upstream raising of the original dike.

- *Constructed Ash*: This represents material encountered during the field exploration above the original starter dike between Station 127+00 and 160+00 on the eastern portion of the dike. This material appears to have been used for an interim raising of the starter dike or used for a repair. The material consists of a mixture of fly ash and bottom ash.

- *Hydraulically Placed Ash*: This represents the material that is contained by Dike C. It was encountered upstream of the starter dike and below and upstream of the raised dike.

- *Gravel to Clayey Gravels:* This represents a gravelly layer that is in place below the original dike construction. This material appears to have been used to stabilize the original dike construction.

- *Sensitive Silt/Clay:* This represents the uppermost and relatively recent slack water silt and clay sediment deposits associated with the Swan Pond embankment at the time of the initial ash pond construction. The results of the exploration indicate this material is generally very soft and exhibits relatively low shear strength.

- *Lean Clay Foundation Soil*: This represents a lean clay foundation layer that was encountered in several of the borings.

- *Sandy Silt to Silty Sand*: This represents a foundation layer that was encountered at varying thickness within all the borings.

- *Fine Grained Sand to a Sand with Silt*: This represents a foundation layer that was encountered in several of the borings with varying thickness as the borings were advanced near the top of bedrock.

7.3. Seepage Analysis

7.3.1. SEEP/W Model

An analysis of steady state seepage through the dike was needed to estimate the magnitude of seepage gradients (for the evaluation of potential piping) and pore water pressures within the soils (for the evaluation of slope stability). The numerical seepage model for Kingston Fossil Plant Dike C was developed using SEEP/W 2007 (Version 7.14), a finite element code tailored for modeling groundwater seepage problems in soil and rock. SEEP/W is distributed by GEO-SLOPE International, Ltd, of Calgary, Alberta, Canada (www.geo-slope.com).

SEEP/W uses soil properties, geometry, and boundary conditions provided by the user to compute the total hydraulic head at nodal points within the modeled cross section. Among other features, SEEP/W includes a graphical user interface, semi-automated mesh generation routines, iterative algorithms for solving unconfined flow problems, specialized boundary conditions (seepage faces, etc.), capabilities for steady-state or transient analyses, and features for visualizing model predictions. The code also includes material models that allow tracking both saturated and unsaturated flow, including the transition in seepage characteristics for soils that become saturated or unsaturated during the problem simulation.

Five cross sections through Dike C were modeled with SEEP/W, then subsequently evaluated for slope stability (Section 7.5). For the numerical analysis, each cross section was subdivided into a mesh of elements, consisting of first-order quadrilateral and triangular finite elements. For seepage problems, where the primary unknown (hydraulic head) is a scalar quantity, first-order elements provide for efficient, effective modeling. Given appropriate hydraulic conductivity properties and applied boundary conditions, the finite element method (as implemented in the SEEP/W code) was then used to simulate steady seepage across the mesh. The total hydraulic head is computed at each nodal location, from which pore water pressures and seepage gradients can be determined.

7.3.2. Boundary Conditions

Steady-state seepage was assumed for the analysis, with static water levels on the upstream and downstream sides of Dike C. For the cross sections at Station 108+93, 138+27, and 149+14, the ash pond was assumed to be at elevation 760 feet. The cross sections at Station 119+69 and 132+37 pass through the stilling basin, where the water levels were assumed to be at elevation 755 feet. On the downstream side, Watts Bar Lake was assumed to be at an elevation of 737 feet, corresponding to a normal winter pool. This lower pool elevation was selected to represent the more severe conditions for stability, with increased seepage gradients and lower external stabilizing pressures.

Boundary conditions for the SEEP/W analysis were assumed as follows. Along the vertical, upstream and downstream edges of the model, the hydraulic head at each node was constant with depth and equal to the pool elevation on that side of the dike. A total head equal to the pool level was also applied to all submerged nodes along the ground surface of the model. Other nodes along the ground surface were treated as potential seepage exits. At steps in the analysis, if water was flowing out of the mesh at these nodes, SEEP/W assigned a head equal to the elevation of the node. This routine effectively models the seepage of water out to the ground surface. The horizontal boundary at the base of the model (located within the shale bedrock) was modeled as a seepage barrier, with no vertical flow across the boundary nodes.

7.3.3. Seepage Properties

For each modeled cross section of the dike, a representative subsurface profile was compiled based on boring logs, available record drawings, and the known project history. Material properties were estimated based on available laboratory data and, if no data was available, based on typical values for similar soils. Material properties used in the seepage analysis are summarized in Table 8.

Table 8. Material Properties for SEEP/W Analysis

Soil Horizon	Saturated k_v (cm/s)	Ratio k_h / k_v	Specific Gravity G_s	Void Ratio e	Volumetric Water Content		Basis
					Saturated (%)	Residual (%)	
Hydraulically Placed Ash	3.0e-5	50	2.31	0.85	46	0.04	Available Laboratory Data (Test Trench #3)
Constructed Ash	3.0e-5	25	2.31	0.85	46	0.04	Available Laboratory Data (Test Trench #3)
Clay Raised Dike	1.2e-7	10	2.74	0.83	45	0.03	Available Laboratory Data (STN-27 & STN-48)
Clay Starter Dike	3.1e-8	10	2.69	0.61	38	0.02	Available Laboratory Data (STN-8)
Sensitive Silt/Clay	3.0e-5	50	2.31	0.85	46	0.04	Available Laboratory Data (Test Trench #3)
Lean Clay Foundation Soil	1.9e-8	20	2.70	0.61	38	0.02	Available Laboratory Data (STN-36)
Sandy Silt to Silty Sand	1.0e-5	50	2.70	0.65	39	0.01	Based on Typical Values
Gravel to Clayey Gravel	1.0e-3	50	2.70	0.65	39	0.01	Based on Typical Values
Fine Grained Sand to Sand with Soil	1.0e-5	50	2.70	0.65	39	0.01	Based on Typical Values s
Shale	1.0e-7	10	2.60	0.25	20	0.01	Based on Typical Values

Note: SEEP/W requires input parameters k_h and ratio of k_v/k_h

Significant engineering judgment is needed to select appropriate hydraulic properties for earth materials. Unlike other key properties, hydraulic conductivity can vary over several orders of magnitude for a range of soils, often with substantial anisotropy for seepage in horizontal versus vertical directions. Laboratory test samples often do not represent important variations within a larger soil deposit. For Dike C, an iterative process of parametric

calibration (Section 7.3.4) was used to arrive at final estimates of the seepage properties. Results from trial simulations were compared to field data (measured piezometric levels and the depth to groundwater in borings). The material parameters were then varied until the solutions reasonably matched the field data on all five cross sections. The final set of parameters (Table 8) resulted in the comparisons presented in Section 7.3.4.

Hydraulic conductivities for vertical seepage through saturated materials (k_v) were estimated using available laboratory data. As indicated in Table 8, typical values for similar soils (obtained from various published sources) were used where laboratory data were not available. The value of k_v selected for the alluvial sandy silt to silty sand foundation deposit is one example where engineering judgment was critical to the selection of appropriate material properties. Laboratory permeability tests were conducted on Shelby tube samples of cohesive soils within this deposit; however, the global conductivity of this layer will be closer to that of the more predominant sandy materials.

The ratio of horizontal hydraulic conductivity (k_h) to vertical hydraulic conductivity (k_v) was estimated based on placement of the material. An isotropic material would have $k_h/k_v = 1$, while deposits of horizontally layered soils might have values as high as $k_h/k_v = 100$. For Dike C, relatively high ratios ($k_h/k_v = 50$) were assumed for the hydraulically placed ash and the silty sand to sandy silt, in both cases reflective of periodic deposition of materials with different gradations. Such deposits typically exhibit much greater permeability in the horizontal direction than in the vertical direction. More modest values ($k_h/k_v = 10$) were assumed for the dike materials, which would have been constructed in horizontal lifts.

The governing equations in SEEP/W are formulated to consider seepage through unsaturated soils. In the simulations for Dike C, this formulation is used to locate the phreatic surface for unconfined seepage through the dike cross sections. To represent the change in hydraulic conductivity due to de-saturation of each soil, SEEP/W implements a model based on two curves, a hydraulic conductivity function and a volumetric water content function. Three parameters are needed to define this behavior: the saturated hydraulic conductivity, saturated water content, and residual water content (water content of air dried soil). Of these, only the residual water contents were not previously estimated for each soil. Values were estimated (Table 8) based on typical values for similar soils. Parametric variations, wherein the hydraulic conductivity of the surficial soils were held constant for all saturation levels, indicated that the simulation results were not sensitive to these model selections.

7.3.4. Comparison to Field Observations

After the initial seepage parameters were estimated, results from the SEEP/W model were compared to pore water pressures measured in piezometers installed in Dike D. Data from 12 piezometers, at locations on three of the five modeled cross sections, were used in this evaluation. Nodes were placed in the model at the same location as the piezometer tip was installed in the field, then the total head predicted at the node was compared to the corresponding piezometer reading.

Considering the results for all 12 piezometers, the material properties in each modeled cross section were varied until a reasonable match was obtained between the predictions and field data. Specifically, the saturated hydraulic conductivity of the sandy silt to silty sand and the gravel to clayey gravel were varied, as was the k_h/k_v ratio for all materials. After several iterations, the final soil parameters were within expected ranges, based on soil type and laboratory data, and calibrated to give model predictions consistent with field measurements.

The comparison between the field measurements and SEEP/W predictions at each piezometer are plotted in Figure 2. The maximum difference between the predictions and measurements is 7.3 feet (a PZ9), while most differ by less than 3 feet. These differences are acceptable in a seepage model, given the typical differences between the modeled cross section and unknown details within the subsurface soil conditions.

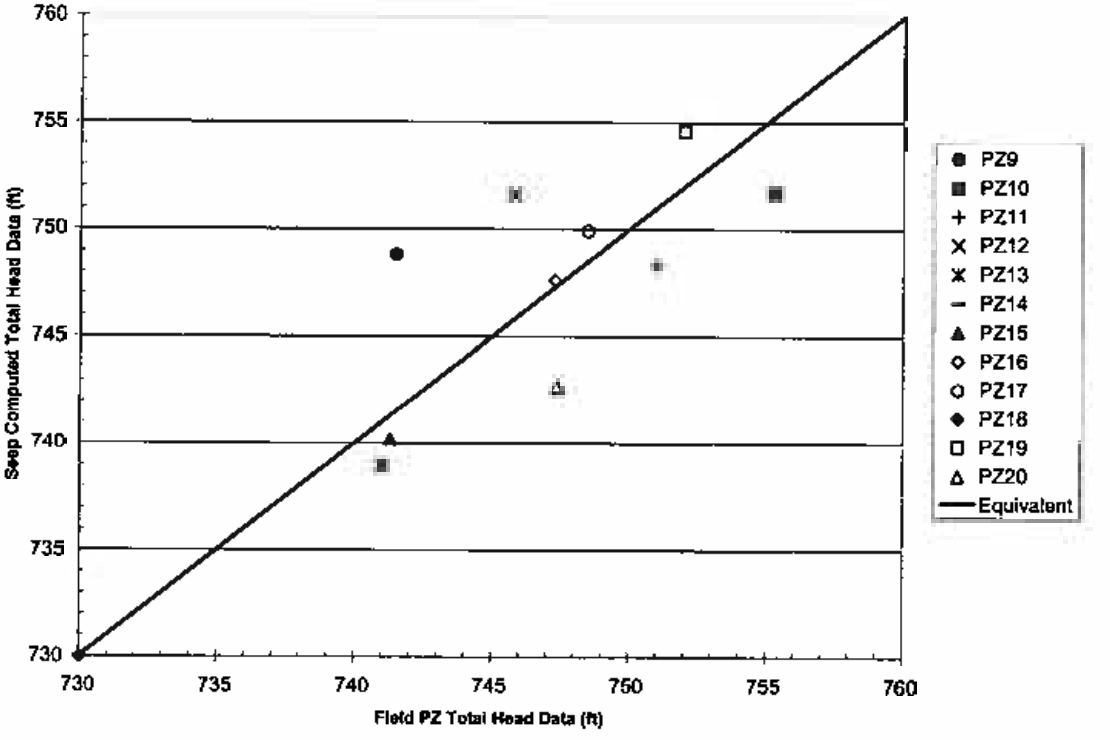


Figure 2. Comparison between the Field Piezometer Readings and Pore Water Pressures predicted in the SEEP/W Model

The results from the seepage model can also be compared to observations of water on the ground surface and within boreholes in the field. Following the recent removal of trees along the starter dike, standing water has been observed in areas where the tree stumps have been removed. The SEEP/W results (see plots in Appendix H) indicate seepage near the ground surface in these areas, consistent with these field observations. In Figure 3, the elevation of water in the 2009 boreholes are compared to the elevation of the phreatic surface (ground water table) predicted with the seepage model at the same location. With a couple of exceptions, the observed water levels are below the predicted phreatic surface. This may result from having insufficient time for the borehole water levels to reach equilibrium, as well as intercepting subsurface strata with varying piezometric levels.

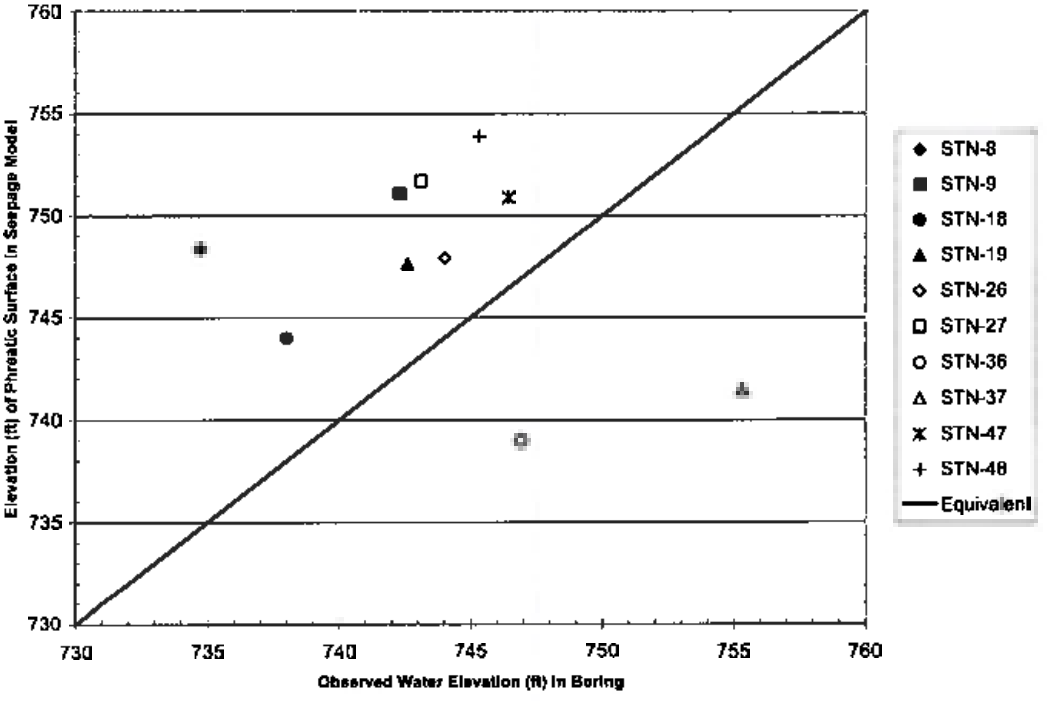


Figure 3. Comparison between the borehole water levels and the phreatic surface predicted in the SEEP/W Model

7.3.5. Results from Seepage Analyses

Plots from the SEEP/W analyses of the five cross sections through Dike C are presented in Appendix H. The plots show the finite element mesh, material zones, and boundary conditions used in each analysis. The results are depicted in contour plots of total head, pore water pressure, and seepage gradients. For the slope stability analyses (Section 7.5), the pore water pressures along the considered slip surfaces were determined by interpolation between the nodal pore pressures predicted with he SEEP/W model. The seepage gradients were assessed for maximum exit gradients and the potential for soil piping (Section 8.1).

The phreatic surface (groundwater table or line of zero pore water pressure) is shown on the plots in Appendix H. In several cases, the shape of the phreatic line may not meet one's initial expectations, particularly where more pervious materials are found below the dike zones near the ground surface. In SEEP/W, the location of the phreatic surface is found by interpolation between positive pore water pressures in the upper areas of saturated soil and negative or suction pore pressures in the unsaturated soil zone above. In the SEEP/W formulation, seepage flows are tracked in both the saturated and unsaturated zones. Hence, the top flow line in the SEEP/W results will be above the phreatic line. In more traditional seepage analyses, where unsaturated flows are ignored, the top flow line and the phreatic

surface coincide. Hence, while the more complete unsaturated flow formulation in SEEP/W gives a reasonable prediction of the phreatic surface location and shape, the results are often different than would be obtained with a solution that considers only saturated flow. Furthermore, the pore water pressures in the stability analysis are determined from the full finite element solution, and not just from the depth below phreatic surface.

7.3.6. Critical Exit Gradients

Seepage forces, resulting from hydrodynamic drag on the soil particles, can destabilize earthen structures. Excessive hydraulic gradients near the ground surface can lead to the initiation of soil erosion and piping, which has caused numerous dam failures in the past. Hydraulic gradients, computed where seepage flows to the ground surface, can be evaluated to understand the potential severity of this problem.

Where upward seepage through a uniform soil exits to the ground surface, the factor of safety with respect to soil piping (FS_{piping}) is defined as:

$$FS_{piping} = \frac{i_{crit}}{i} \qquad \textbf{Eqn. 1}$$

where i is the vertical gradient in the soil at the exit point. The critical gradient (i_{crit}) is related to the submerged unit weight of the soil, and can be computed as:

$$i_{crit} = \frac{\gamma_{sub}}{\gamma_w} = \frac{G_s - 1}{1 + e} \qquad \textbf{Eqn. 2}$$

where γ_{sub} is the submerged unit weight of the soil, γ_w is the unit weight of water, G_s is the specific gravity of the soil particles, and e is the void ratio. For nearly all soils, the critical gradient is between about 0.6 and 1.4, with a typical value near 1.0.

Where FS_{piping} = 1, the effective stress is zero and the near-surface soils are subject to piping or heaving. Note that Eqn. 1 is valid only if for vertical seepage that exits to the ground surface. If the phreatic surface is buried, then the FS_{piping} will be greater than 1.0 even when $i=i_{crit}$.

7.4. Strength Parameter Selection

The static stability of Dike C around the ash pond and stilling pond at the Kingston Fossil Plant were evaluated using the limit equilibrium slope stability methods. The soil parameters used in these stability analyses were established as follows.

Dike C was originally constructed in the mid 1950s and was raised in the mid 1970s. The dike has existed in its current cross sectional geometry (slopes and crest elevation) for at least 30 years. Hence, excess pore pressures generated in the underlying soil during construction have had sufficient time to dissipate and steady state seepage conditions have developed within the dike. In addition, the current analyses will focus only on static conditions (no earthquake or other dynamic loads). For these conditions, only soil unit weights and drained strength parameters (c' and ϕ') are needed. If stabilizing berms or other modifications to the dike cross section are built, then undrained, total stress stability analyses will be needed to assess stability during construction.

The soil parameters used for the dikes and existing foundation materials were derived using both current and historical data from laboratory consolidated undrained triaxial tests, direct simple shear tests, cone penetration data, standard penetration test data and classification test data. In addition, the strength parameters selected were further refined by comparisons with the strength parameters used in the historical design reports reviewed.

To select the representative strengths for each horizon, the methodology outlined in the US Army Corps of Engineers Engineer Manual EM 1110-2-1902 was used as a guide. Failure stresses measured in the laboratory tests were expressed in terms of "p'-q" values $[p' = 0.5(\sigma_1' + \sigma_3'), q = 0.5(\sigma_1' - \sigma_3')]$, then envelopes were conservatively fit through the data. In general, the selected strength parameters represent a failure envelope where about two-thirds of the test data falls above the envelope.

7.4.1. Drained Soil Parameters

Excess (or deficient) pore water pressures, generated by changes in mean stress or shearing stress, will dissipate under static, long term conditions. Pore pressures within a soil can then be computed assuming hydrostatic conditions or from a solution for steady state seepage. As long as the distribution of pore pressure within the cross section can be quantified, effective stresses can be computed and the drained shear strength (S_d) of the soil can be determined from effective stress strength parameters (c' and ϕ'):

$$S_d = c' + \sigma' \tan \phi' \qquad \textbf{Eqn. 3}$$

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

The Mohr-Coulomb failure envelope for normally consolidated, saturated clays exhibits $c' = 0$. At effective stresses below the preconsolidation pressure, overconsolidated clays have a curved failure envelope that can be represented with a straight line having $c' > 0$. However, overconsolidated clays in the field are often fissured and the in situ c' is significantly smaller than values determined from testing of small samples in the laboratory. To avoid progressive failures in overconsolidated, stiff fissured clays, remolded soil samples are recommended for testing; this generally results in "fully softened" strengths with $c' \approx 0$.

Thus, in the absence of particle cementation/bonding, long term (drained) shearing resistance related to $c' > 0$ is considered unreliable. In routine geotechnical design practice, values of $c' = 0$ are usually assumed for both normally and overconsolidated saturated clays, and for uncemented granular soils. Detailed testing and characterization of a particular soil, coupled with careful application of the fitted strength envelopes, are necessary where values of c' are used in a stability evaluation.

When surficial soils have c' = 0, shallow sliding parallel to the ground surface will be the critical failure mechanism (lowest factor of safety) found in a slope stability analysis. However, apparent cohesion in unsaturated soils and/or weak cementation is often sufficient to prevent shallow sliding. This mode of failure, which might require periodic regrading and maintenance, is considered to be less critical in a stability analysis. For deep seated failures, the assumption of c' = 0 is routinely used for all soils.

7.4.2. Soil Parameters for Dike C

The shear strength parameters were conservatively estimated based on site-specific geotechnical data, published data/information and our experience with these materials in similar applications. Discussions regarding selection of the shear strength parameters are provided in the following paragraphs. Refer to Table 9 below for a summary of derived soil parameters.

The starter clay dike, raised clay dike, and lean clay foundation primarily consist of lean clay materials with occasional occurrences of fat clays. The cohesive soils sampled during the field exploration were subjected to CU triaxial tests. The results of triaxial testing were evaluated and effective stress p' versus q scatter plots were prepared using all of the data points. Failure was assumed to occur at the point of the maximum effective principal stress ratio (σ_1'/σ_3') Once the p' versus q plots were prepared, a failure envelope was then selected such that about two-thirds of the plotted values were above the envelope. The p' versus q plots and selection of the failure envelope are shown for each soil horizon on the graphs presented in Appendix G. The resulting strength parameters were rounded down to the nearest degree for ϕ' and to the nearest 50 pounds per square foot for the cohesion intercept. Consistent with the discussions in Section 7.4.1, the measured cohesion intercept was neglected (assumed c'=0) in evaluating the dike stability. The unit wet weight was determined by taking the average unit weight of the samples that are included within a soil horizon.

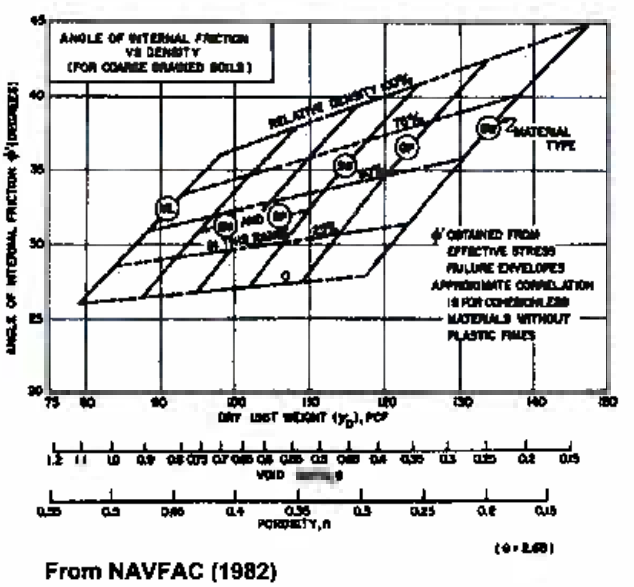
The constructed ash materials were primarily encountered in the upper portion of the eastern most starter dike. The material consists of a mix of fly ash and bottom ash. As a part of the Kingston Dredge Cell Closure Project, Stantec performed CU triaxial tests and the results were plotted on a scatter (Appendix G) plot as described above. The results compacted on samples of this material indicate that the ϕ' for the constructed ash is on the order of 38°. However, those tests were completed assuming the ash will be constructed using typical construction techniques with controlled compaction requirements associated with an engineered fill. The constructed ash material encountered in Dike C around the Ash Pond were placed several years ago and there is a lack of documentation on how the material was placed. Assuming this ash was not adequately compacted when placed in Dike C, it is prudent to assign a lower strength of ϕ' = 30°, which would be typical for an ML type material at medium density. The unit wet weight was determined by taking the results of the standard Proctor compaction tests conducted by Stantec and AECOM as a part of the projects associated with the dredge cell. It was then estimated that the material exists at a density corresponding to 90-percent of the standard Proctor maximum (75 pcf) and was near the optimum moisture content (24%).

The hydraulically placed ash materials were primarily encountered upstream of the starter dike and below the raised dike. As a part of the RCA, AECOM performed 25 triaxial compression tests with various consolidation techniques. In addition, six additional triaxial tests were completed by Law Engineering, Inc. in 1995, as a part of a testing program on ponded ash materials in Dredge Cell I and III. There results were plotted on a scatter plot (Appendix G), materials which indicate that ϕ' for the hydraulically placed ash is on the order of 25°. The unit wet weight was estimated using a dry unit weight at 90-percent of the standard Proctor maximum (75 pcf) and adjusting it based on the average in place moisture content (28%) of the hydraulically placed ash.

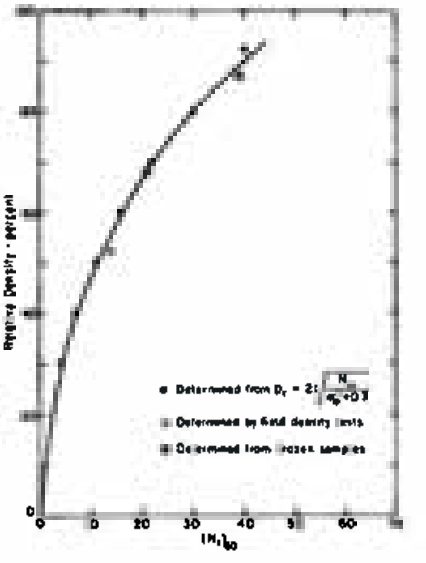
The gravel to clayey gravel layer was modeled just below the original dike. The layer was encountered during the field exploration and may have been placed below water levels as a working platform layer during initial construction of the starter dike. Strength and unit weight properties for this soil were estimated using correlations with measured SPT blowcounts. For a value of $(N_1)_{60} = 8$ in this soil horizon, the correlations in Figure 4 suggest $\phi' = 32°$.

The sensitive silt/clay was modeled near the top of original ground. The layer was identified as a result of the RCA performed by AECOM and the results of Stantec's field exploration program. Under the direction of AECOM, the University of Massachusetts (UMass) Amherst performed 12 direct simple shear (DSS) tests on thin-walled tube specimens obtained within the Dredge Cell. In addition, Geotesting Express (under the direction of Stantec) performed five DSS tests on thin-walled tube specimens obtained within the Dredge Cell. There results were plotted on a scatter plot as described above and a value of $\phi' = 28°$ was determined. The unit wet weight was determined by taking the average unit weight of the DSS test specimens obtained by Stantec.

The sandy silt to silty sand and fine grained sands were modeled at varying thicknesses within the foundation alluvium. Based on the results of the drilling program there appears to be variability in the results of the SPT N-values for these non-cohesive soil horizons. Therefore, the soil parameters were derived utilizing the SPT N-values encountered within the borings advanced for individual stability sections. The strength and unit weight parameters for these non-cohesive soil horizons were determined from published correlations between corrected blowcounts $(N_1)_{60}$, relative density and ϕ'. The corrected N-values were utilized to obtain relative densities based on relationships developed by Tokimatsu and Seed (1988) as shown in Figure 4 below. NAVFAC (1982) presents a relationship using relative density and of specific soil types to correlate angle of internal friction, unit weight, and void ratio as shown in Figure 4 below. The sandy silt to silty sand horizon contained SPT blowcounts in the range of weight of the sampling rods to 16, the unit weight of this soil horizon was estimated to vary between 105 to 113 pcf with a drained friction angle of 27° to 29°. The fine grained sand horizon contained SPT blowcounts in range of 4 to 60, the unit weight of this soil horizon was estimated to vary between 118 to 128 pcf with a drained friction angle of 31° to 36°.



From NAVFAC (1982)



From Tokimatsu and Seed (1988)

Figure 4. Charts Used to Correlate $(N_1)_{60}$ to ϕ'

Soil classifications for the correlations are based on laboratory testing results and field classifications performed during the drilling process. Once the relationships for the angle of internal friction, unit weight, and void ratio were established, the in situ unit weight was calculated based upon the natural moisture content. Refer to Table 9 below for a summary of derived soil parameters. Since a range is included for the sandy silt to silty sand and the fine grained sand layer refer to stability sections in Appendix F for specific alluvial deposit parameters.

Table 9. Selected Strength Parameters for Stability Analysis

Soil Horizon	Unit Weight (pcf)	Effective Stress Strength Parameters	
		c' (psf)	ϕ' (degrees)
Starter Clay Dike	129	0	30
Raised Clay Dike	125	0	30
Constructed Ash	93	0	30
Hydraulically Placed Ash	96	0	25
Gravel to Clayey Gravel	120	0	32
Sensitive Silt/Clay	127	0	28
Lean Clay Foundation Soil	129	0	30
Sandy Silt to Silty Sand	105 to 113	0	27 to 29
Fine Grained Sand to Sand with Silt	118 to 128	0	31 to 36

7.5. Slope Stability Analysis

The stability of the perimeter Dike C was evaluated using limit equilibrium methods as implemented in the SLOPE/W software, which is available from GEO-SLOPE International, Ltd., of Calgary, Alberta, Canada (www.geo-slope.com). Analyses were completed for static, long-term conditions with steady-state. SLOPE/W is a special-purpose computer code designed to analyze the stability of earth slopes using two-dimensional, limit equilibrium methods. With SLOPE/W, the distribution of pore water pressures within the earth mass can be mapped directly from a SEEP/W solution. In this study, steady-state pore pressures were obtained from the SEEP/W model described in Section 7.3. The unit weight and shear strength properties used in the stability analyses are detailed in Table 9 above.

7.5.1. Limit Equilibrium Methods in SLOPE/W

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

$$FS_{slope} = \frac{\text{shear strength of soil}}{\text{shear stress required for equilibrium}} \qquad \textbf{Eqn. 4}$$

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

Spencer's solution procedure (Spencer 1967; USACE 2003; Duncan and Wright 2005), which satisfies all of the conditions of equilibrium for each slice, was used in this study. Spencer's procedure computes FS_{slope} for an assumed failure surface; a search must be made to find the critical slip surface corresponding to the lowest FS_{slope}. Both circular and noncircular potential failure surfaces can be evaluated.

7.5.2. Slope Stability of Dike C

The slope stability analyses were carried out using SLOPE/W 2007 on the upstream and downstream face of Dike C, as applicable. SLOPE/W incorporates various search routines to locate the critical slip surface; for the analyses presented here, the "Grid and Radius" method and the "Entrance and Exit" method were employed. Center points for the trial circles were confined to a specified range above the slope surface, while the trial radii were varied based on tangent horizontal lines within the soil. The minimum and maximum range for the center points and tangent lines were parametrically varied over a wide range to determine the likely solution region for the critical circle. In subsequent runs, the search was refined by narrowing the range and spacing for the candidate center points.

Where the surface slope is composed of cohesionless (c' = 0) materials, an infinite slope failure (shallow sliding parallel to the surface) will be critical. While solutions were obtained for this case, as reported below, there is less concern for this potential failure mechanism. Suction pressures in unsaturated surface soils will often create enough apparent cohesion to

prevent this type of failure. If shallow sliding does occur, the resulting deformations are unlikely to threaten the integrity of the dike and can be repaired. To force the search routine to evaluate deeper failure mechanisms, the "Entrance and Exit" method was employed to force the slip surface to enter at a point that was approximately 15 feet from the pond.

The upstream surface of Dike C was evaluated at Station 119+69 and Station 132+37, where the dike slope was immediately adjacent to the stilling pond. For these analyses, the "Grid and Radius" method was used to determine the minimum factor of safety with a minimum depth of slice depth equal to 10 feet. At the other sections along the dike, the ash in the pond has accumulated to a height approaching the crest of Dike C. At those locations, the upstream dike face is supported by the ash and there is negligible risk for an upstream failure. Therefore, the upstream stability of Dike C along the ash pond was not analyzed further.

8. Results

8.1. Seepage Gradients

Contour plots of the hydraulic gradients computed from the SEEP/W solutions are shown for each modeled cross section in Appendix H. Large gradients and significant seepage can be seen at various locations within the cross sections, but the concern is for areas where these gradients can initiate the erosion or piping of material. In general, areas of potential concern are where water seeps laterally out onto a sloping ground surface, or where vertical, upward seepage occurs at the ground surface. Away from the ground surface, the potential movement of material due to seepage forces is arrested by the adjacent soil. Hence, the evaluation of seepage gradients within Dike C is focused on areas near the ground surface on the downstream side of the dike.

Considering the SEEP/W results in Appendix H, the predicted phreatic surface is observed to intersect the sloping ground surface above the lake level near the toe of the starter dike. With the exception of Station 119+69, this condition is predicted for all cross sections analyzed. Ground water seeping through the saturated dike materials may be flowing out to the ground surface, even though direct observations might be obscured by vegetation, evaporation, or the submerged ground surface. In these locations, the seepage forces associated with the hydraulic exit gradients are acting in the same direction as gravity. Because of the high potential for initiating the movement of soil particles and piping, a condition of groundwater seeping to the sloping surface of the downstream face is usually considered unacceptable in the evaluation of earth dams.

The potential for piping due to vertical seepage to the ground surface was also evaluated using the factor of safety defined in Section 7.3.6. First, contour plots of vertical gradient (Appendix H) were examined to determine the general location of the maximum vertical exit gradient. In all five cross sections, the maximum upward gradient occurs near the toe of the starter dike.

For the factor of safety calculations, average vertical gradients were determined over a depth of 3 to 5 feet just below the ground surface. On the sections at Station 108+93, 119+69, and 149+14, these gradients were computed across the upper few feet of the foundation soil deposit. In the other two sections that were modeled, at Station 132+37 and 138+27, the maximum computed gradients occur at the very toe of the clay starter dike. The model

geometry converges to a sharp point at this location, such that the computed gradients in this small area are not reflective of the actual conditions in the field. However, to evaluate the potential for heaving of the dike toe in this area, gradients were taken across a thickness of no less than 3 feet.

The factors of safety against piping (Section 7.3.6), computed based on the exit gradients computed in the SEEP/W and the critical gradients determined from the soil properties, are summarized in Table 10. The lowest computed factor of safety is 1.3 on the section at Station 132+37. TVA does not currently have guidelines for FS piping. United States Army Corps of Engineers (USACE) design criteria (EM 1110-2-1901) indicates factors of safety against piping should be at least three. Hence, at some location on all five modeled cross sections, Dike C does not meet the design criteria for piping at the seepage exits.

Table 10. Summary of Computed Exit Gradients and Factors of Safety against Piping

Cross Section*	Vertical Gradient (i_y) at Critical Exit Point	Location of Critical Exit Point	Material	Critical Gradient (i_{crit})	FS_{piping}
108+93	0.15 – 0.38	Toe	Silty Sand to Sandy Silt	1.03	2.7
119+69	0.70 – 0.74	Toe	Lean Clay	1.05	1.4
132+37	0.73 – 0.84	Toe	Clay Starter Dike	1.05	1.3
138+27	0.30 – 0.42	Toe	Constructed Ash	0.71	1.7
149+14	0.45 – 0.50	Toe	Silty Sand to Sandy Silt	1.03	2.1

*Refer to Appendix F for Plan View of site with project baseline

8.2. Slope Stability Results

Using the strength parameters selected (c' and ϕ') listed in Table 9, in conjunction with the results of the seepage analyses, the existing dike configuration was analyzed at each of the five cross sections. Geo-Slope's Slope/W computer program was used for the analyses with pore pressures imported from the seepage analyses. Long term (effective stress), steady state seepage conditions were analyzed using Spencer's method. For the Spencer's method analyses, circular failure surfaces with optimization were conducted. Minor details of the geometry, such as various rip rap zones, were not represented in the stability model.

The stability analyses focused on the potential for failure in the upstream slope and downstream dike face. SLOPE/W failure surfaces from these analyses are presented on the drafted sheets in Appendix F. The results are summarized in Table 10 below.

Table 11. Summary of Computed Factors of Safety for Slope Stability

Location*	Deep Seated Slide	Shallow Slide in Starter Dike	Shallow Slide in Raised Dike	Upstream Slide
108+93	1.66	1.42	1.39	N/A
119+69	1.48	1.25	1.39	1.78
132+37	1.47	1.24	1.22	1.33
138+27	1.52	1.13	1.38	N/A
149+14	1.49	1.15	1.35	N/A

*Refer to Appendix F for plan view of site with project baseline

The Tennessee Department of Environment and Conservation (TDEC) "Rules and Regulations Applied to the Safe Dams Act of 1973" provides guidance and standards with regards to existing dams. The standards do not specifically address target factors of safety for slope stability, but instead merely indicate that the dam shall be "stable". Based on discussions with TVA and to be in accordance with current prevailing practice a minimum factor of safety of 1.5 was established for long term conditions using the guidelines presented in USACE Manual EM 1110-2-1902 "Slope Stability".

Considering only potential deep-seated failure mechanisms that would immediately impact the crest, the slope stability results show that Dike C meets this criteria. The surfaces were generated using the "Entrance and Exit" method to force the slip surface to enter the dike approximately 15 feet from the ponds. The difference between the minimum computed value of 1.47 and the required value of 1.5 is negligible, considering the uncertainty in the characterization of the soil strength. These results suggest that Dike C is stable with respect to the potential formation of large, deep-seated failures that would immediately compromise the retention of the ash pond. The critical slip surfaces are depicted in Appendix F.

At the same time, the results clearly show factors of safety less than 1.5 for shallow sliding on the downstream face along the full length of Dike C (plus the upstream face in the vicinity of Station 132+37). The shallow potential failure surfaces, which are generally about 10 ft below the ground surface, occur in the slopes of both the lower starter dike and the upper dike raise (see the cross sections in Appendix F). The lowest factors of safety are currently found along the eastern branch of Dike C, where factors of safety less than 1.2 were computed. Based on established design criteria, remedial measures are needed to increase the long-term factors of safety against shallow sliding to values of at least 1.5. Mitigation is needed on the downstream face (both the lower starter dike and the upper dike raise) along nearly the full length of Dike C, and in more limited areas on the upstream (pond side) slope.

Past shallow sliding of the downstream face of Dike C was reported in the project records, in an area along the perimeter of the dredge cell. This surficial slide was observed and repaired by TVA as part of their routine maintenance program. If additional shallow sliding were to develop again in Dike C, the failure would be initially confined to the sloping face of the dike. If not repaired and given enough time, these shallow slides could progress up the slope and endanger the ash pond. Because this progressive failure mechanism would be expected to

take months or longer to impact the crest, a robust monitoring program can reduce the risk of failure due to shallow sliding. Hence, in the interim while a permanent mitigation plan is developed, analyzed, and constructed, TVA should continue to monitor Dike C with routine inspections and instrument readings.

There was no indication in the slope stability analyses that a noncircular failure surface would give a factor of safety lower than obtained for circular surfaces. Overall, the geometry of the dike cross section and the foundation stratigraphy do not appear to be susceptible to sliding along a planar surface. The optimization scheme available within SLOPE/W was used to consider noncircular, curved slip surfaces. The results in Table 11 and Appendix F represent factors of safety computed from the optimized, circular slip surface routine.

A review of the stability analysis results indicates that while none of the projected failure surfaces represent true global failures of the dike system, it is likely that some of the modeled failures would subsequently progress toward the pond and could result in an eventual breach. Remedial engineering designs will need to be implemented to improve dike slope stability to meet USACE design criteria.

8.2.1. Conceptual Mitigation Evaluation

To aid in identifying potential mitigation options available for enhancing stability of the dike system, preliminary analyses of a slope buttress system were performed on each cross section. These preliminary analyses were performed to provide some indication of the level of mitigation needed to achieve factors of safety greater than or equal to 1.5 at each of the sections analyzed. The concept involved adding various thicknesses of rock to the outslopes on the starter dike and raised dike.

Based on the results of this conceptual mitigation analyses, achieving a factors of safety greater than or equal to 1.5 will ultimately require placement of a zone of a of rock blanket. The rock blanket starting from the crest of the raised could have a maximum regrade of 2½:1 (H:V) on the downstream face of the raised dike. It would then transition to a horizontal bench near the crest of the starter dike and extend to the river bank.

9. Limitations of Study

The scope of this evaluation was limited to consider only the potential risks at Dike C due to excessive seepage and slope instability. This assessment did not consider potential failure modes related to spillway capacity and overtopping, seepage along penetrations through the embankment (including the buried spillway pipes), erosion due to wave action or flood stage flows, vegetation on the dike face, performance of the internal divider dikes, or other possible mechanisms. The risks associated with these potential failure modes will be addressed in a Phase 2 facility assessment that is currently underway.

The stability of Dike C during a potential earthquake was not specifically analyzed. Data from the site explorations indicate low penetration resistance (low density) in saturated, sandy alluvium. In a strong earthquake, these foundation soils will be prone to liquefaction, which would undermine the stability of the dike. However, the seismic risk at this site (likelihood of experiencing a large magnitude earthquake) is quite low while the pond is in the conversion process to dry ash handling.

Stability analyses were not performed for rapid drawdown conditions:

- On the upstream side, a rapid drawdown condition would correspond to a failure of the ash pond, perhaps due to a breach in the dike or failure of the spillway. While the upstream dike slope may be vulnerable to sliding due to rapid drawdown, this mechanism would result from, and not cause, a pond failure. Hence, there is no need to evaluate the upstream slope for rapid drawdown.

- On the downstream side, rapid drawdown conditions would correspond to changes in the elevation of Watts Bar Lake. Preliminary information on the river conditions indicate that the lake might rise 11 ft, from a normal winter pool to 100-year flood stage, over a period of one to two days. Per the operational plan for Watts Bar Lake, the flood pool would then be drawn down over a period of seven days. Hence, high water conditions would not persist long enough to fully charge the dike slopes, and a fully undrained, rapid drawdown loading condition is unlikely to develop.

- Watts Bar Lake is also subject to annual drawdown from the normal summer pool (elevation 742 feet) to the normal winter pool (elevation 737 feet). Because the outslopes do not currently meet design criteria for long-term conditions, this rapid drawdown case was not analyzed in this study. Future engineering work to support the design of dike improvements should consider and evaluate the possibility of a rapid drawdown failure.

10. Conclusions

The conclusions and recommendations that follow are based upon Stantec's understanding of the facility as outlined herein. This understanding of the facility developed from reviews of historical information provided by TVA and discussions with TVA personnel throughout the course if this work and results of the geotechnical exploration and stability analysis.

The results from the seepage analyses were examined to identify conditions were piping and erosion of soil might develop due to seepage forces. The model results indicated a shallow phreatic surface (ground water table) within the starter dike; these results are generally confirmed by the observation of shallow water in areas were trees and stumps have been removed from the starter dike. On four of the five cross sections, the model indicated seepage flows to the sloping downstream face of the starter dike. This condition creates the potential for the initiation of soil piping, as seepage water will tend to erode material from the dike face at these locations.

Upward, vertical exit gradients in the area of the dike toe were also found to be excessive. Factors of safety against piping, computed for the surficial 3 to 5 feet of soil in these areas, ranged from 1.3 to 2.7. Based on USACE design criteria (EM 1110-2-1901), factors of safety against piping should be no less than three. The results from the seepage model thus demonstrate that Dike C does not meet current criteria for preventing soil piping due to seepage.

Current criteria for the long-term stability of Dike C requires a factor of safety for slope stability of at least 1.5. Considering only potential deep-seated failure mechanisms that would immediately impact the crest, the slope stability results show that Dike C meets this criteria. The difference between the minimum computed value of 1.47 and the required value of 1.5 is negligible, considering the uncertainty in the characterization of the soil strength. These results suggest that Dike C is stable with respect to the potential formation of large, deep-seated failures that would immediately compromise the retention of the ash pond.

At the same time, the results clearly show factors of safety less than 1.5 for shallow sliding on the downstream face along the full length of Dike C (plus the upstream face in the vicinity of Station 132+37). The shallow potential failure surfaces, which are generally about 10 ft below the ground surface, occur in the slopes of both the lower starter dike and the upper dike raise (see the cross sections in Appendix F). The lowest factors of safety are currently found along the eastern branch of Dike C, where factors of safety less than 1.2 were computed. Based on established design criteria, remedial measures are needed to increase the long-term factors of safety against shallow sliding to values of at least 1.5. Mitigation is needed on the downstream face (both the lower starter dike and the upper dike raise) along nearly the full length of Dike C, and in more limited areas on the upstream (pond side) slope.

Past shallow sliding of the downstream face of Dike C was reported in the project records, in an area along the perimeter of the dredge cell. This surficial slide was observed and repaired by TVA as part of their routine maintenance program. If additional shallow sliding were to develop again in Dike C, the failure would be initially confined to the sloping face of the dike. If not repaired and given enough time, these shallow slides could progress up the slope and endanger the ash pond. Because this progressive failure mechanism would be expected to take months or longer to impact the crest, a robust monitoring program can reduce the risk of failure due to shallow sliding. Hence, in the interim while a permanent mitigation plan is developed, analyzed, and constructed, TVA should continue to monitor Dike C with routine inspections and instrument readings.

Based on the design criteria, remedial measures are needed to increase the factors of safety against shallow sliding on the downstream face along nearly the full length of Dike C. The lowest factors of safety are currently found along the eastern branch of Dike C, where factors of safety less than 1.2 were computed for sliding about 10 ft below the surface of the starter dike (see the cross sections in Appendix F). Along the southern reaches of the dike, marginal factors of safety against shallow sliding were computed on the downstream face of the dike raise.

11. Recommendations

The current configuration of the pond dikes do not exhibit acceptable factors of safety for long-term stability. While this does not imply that the dike is in immediate danger of failure, TVA should undertake specific efforts to improve the safety of this facility. The following specific actions are recommended:

11.1. To improve the long-term stability of Dike C, TVA should initiate a mitigation design and construction program as soon as possible. The mitigation project should involve the placement of stabilizing berms on the downstream face of the dike, along the full length, and continued monitoring to ensure the structure's safety while permanent improvements are being completed.

11.2. Consistent with USACE design criteria, the berm dimensions should be selected to obtain factors of safety greater than 1.5 for sliding under long-term, drained conditions. For the period immediately after such construction, undrained stability analyses will be needed to demonstrate a factor of safety of at least 1.3 for short-term conditions.

11.3. The berm should also be designed to provide protection against seepage and piping failures, and increase the factor of safety against piping to meet the design guideline value of 3. Where the berm is built over areas subject to exit seepage (crest and downstream face of the starter dike), the gradation of the berm should be selected to filter the underlying material.

11.4. The outer surface of the berm should be stone rip rap, which will provide protection against erosion from surface runoff and wave action along the water line of Watts Bar Lake. A zoned berm cross section, consisting of multiple layers of sand to stone, may be needed to meet filter criteria for protecting the slope toe against piping.

11.5. Between now and the completion of the stabilizing berms, TVA should implement engineering solutions to reduce the risk of failure in Dike C. This should include continuation of the daily inspection program and instrumentation monitoring program, with renewed focus on identifying the initiation of potential surface slides. Additional inclinometers should be installed in critical areas of Dike C, positioned on the basis of the slope stability analyses reported herein. The inclinometers should be read on a weekly basis. This monitoring program be continued until permanent improvements to the dike have been completed to address long term stability.

11.6. Lowering the water levels in the ash pond and stilling basin would lessen the potential for failure due to seepage and piping under the dike, and might improve slope stability. Operating the ponds at lower water levels should be considered as an option in the overall mitigation plan for Dike C.

11.7. The surface of the dike faces, especially along the mid-slope bench (crest of the initial starter dike) should be re-graded to improve drainage and prevent the accumulation of surface water on the dike.

12. Closure

12.1. These conclusions and recommendations are based on data and subsurface conditions from the borings advanced during this investigation using that degree of care and skill ordinarily exercised under similar circumstances by competent members of the engineering profession. No warranties can be made regarding the continuity of conditions between borings.

12.2. 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. Also, the passage of time may result in a change in the subsurface conditions at the boring locations.

12.3. It should be noted that construction records indicating the methods used to construct the dikes, as-built dike configurations, etc. were not available for review. In addition, the variable nature of the historical and current data shows some signs of inconsistencies in the construction of the dikes. As a result, consideration should be given to some of the generalizations made in this report with regards to dike construction and geometry prior to using this data in future evaluations.

13. References

The following is a list of historical documents that were used to evaluate the stability of Dike C and the Road Dike:

Root Cause Analysis of TVA Kingston Dredge Cell Pond Failure from December 22, 2008, AECOM, June 12, 2009

Kingston Fossil Plant Annual Ash Pond Dike Stability Inspection, TVA Engineering Design Services, 1967 to 2009

Additional Documents:

Slope Stability, Department of the Army, US Army Corps of Engineers, Engineering Manual EM 1110-2-1902, October 31, 2003.

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

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

Soil Mechanic Design Manual 7.1, Department of the Navy – Navy Facilities Engineering Command, May 1982

Lambe, T.W and Whitman, R.V. Soil Mechanics. 3rd ed. New York: John Wiley and Sons. 1969

Rawls, W. J., Brakensiek, D. L., and Saxton, K. E. (1982). "Estimation of soil water properties," Transactions of the American Society of Agricultural Engineers. pp. 1316-1320.

Salgado, R. The Engineering of Foundations. Boston: McGraw Hill. 2008.

Appendix A

Typed Boring Logs

SUBSURFACE LOG

Project No.	175569042	Location	N 556804.57, E 2442329.32 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-2
Location	Kingston, Tennessee	Total Depth	41.0 ft
Project Type	Geotechnical Exploration	Surface Elevation	751.2 ft. (NGVD29)
Supervisor	Ben Halada	Driller Kent Clements	Date Started 4/14/09 Completed 4/14/09
Depth to Water	18.0 ft	Date/Time	4/14/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
751.2'	0.0'	Top of Hole							
		LEAN CLAY (Fill), red brown, moist, medium stiff		SPT-1	0.0 - 1.5	1.0	2-3-4	28	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.1	4-5-5	19	
747.7'	3.5'								
747.2'	4.0'	BOTTOM ASH (Fill), black, moist, medium dense		SPT-3	3.0 - 4.5	1.1	11-13-17	14	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
745.7'	5.5'			SPT-4	4.5 - 6.0	1.3	8-11-15	19	
744.7'	6.5'	FAT CLAY (Fill), red brown, moist, medium stiff		SPT-5	6.0 - 7.5	1.1	10-9-9	15	
		BOTTOM ASH (Fill), black, moist, medium dense		SPT-6	7.5 - 9.0	1.3	9-9-11	20	
		LEAN CLAY (Fill), light brown, moist, soft to medium stiff, some fine grained sand		ST-1	9.0 - 11.0	1.6		--	
739.2'	12.0'			SPT-7	11.0 - 12.5	1.1	1-2-3	23	
		LEAN CLAY, red brown, moist, soft, trace silt, some fine grained sand		SPT-8	12.5 - 14.0	1.0	1-3-4	21	
				ST-2	14.0 - 16.0	1.8		--	
				SPT-9	16.0 - 17.5	1.2	1-2-2	17	
732.2'	19.0'			SPT-10	17.5 - 19.0	1.2	2-2-3	23	
		LEAN CLAY, light brown, saturated, very soft to soft, some silt		SPT-11	19.0 - 20.5	1.0	3-2-4	22	
				ST-3	20.5 - 22.5	2.0		--	
				SPT-12	22.5 - 24.0	1.3	1-2-2	28	
				SPT-13	24.0 - 25.5	1.1	WOH-1-2	27	
				SPT-14	25.5 - 27.0	1.4	WOH-2-2	24	
				SPT-15	27.0 - 28.5	1.2	2-3-2	28	
				SPT-16	28.5 - 30.0	1.3	WOH-WOH-WOH	28	
719.2'	32.0'			ST-4	30.0 - 32.0	2.0		--	ST-4: sand in bottom of tube
		SAND, light gray to gray, saturated, very loose to medium dense, fine to medium grained, trace silt		SPT-17	32.0 - 33.5	1.0	WOR-WOR-WOH	19	
				SPT-18	33.5 - 35.0	1.1	3-2-1	21	
				SPT-19	35.0 - 36.5	0.2	7-11-13	16	

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SUBSURFACE LOG

Project No. 175569042 Location N 556804.57, E 2442329.32 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-2** Total Depth 41.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
713.7'	37.5'			SPT-20	36.5 - 38.0	1.1	21-25-27	20	SPT-20: shale in tip of spoon
713.2'	38.0'	Sandstone, (Augered)		SPT-21	38.0 - 39.5	1.0	13-23-38	--	Boring backfilled with bentonite cement grout from 0.0 ft to 41.0 ft
710.2'	41.0'	Shale, (Augered)		SPT-22	39.5 - 40.4	0.8	31-50/0.4	--	

Auger Refusal / Bottom of Hole

WOH = Weight of Hammer
WOR = Weight of Rods

Split Samples: SPT-3 and 4

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SUBSURFACE LOG

Project No.	175569042	Location	N 556806.57, E 2442329.32 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-2A** Total Depth 29.5 ft
Location	Kingston, Tennessee	Surface Elevation	751.2 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/16/09 Completed 4/16/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	N/A Date/Time N/A
Logged By	Ben Halada	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
751.2'	0.0'	Top of Hole							
		OVERBURDEN, See log for STN-2							Boring advanced using 3 1/4 " Hollow Stem Augers
721.7'	29.5'	No Refusal / Bottom of Hole							

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SUBSURFACE LOG

Project No.	175569042	Location	N 556806.57, E 2442329.32 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-2A** Total Depth 29.5 ft

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	

PZ Installed, tip at elevation 724.7'

Flushmount well cover and concrete pad installed.

DRILL SUBSEQUENT RECORD FOR MULTIPLE INSTALLATIONS

SUBSURFACE LOG

Project No.	175569042	Location	N 556756.78, E 2442263.59 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-3
Location	Kingston, Tennessee	Total Depth	50.3 ft
Project Type	Geotechnical Exploration	Surface Elevation	763.7 ft. (NGVD29)
Supervisor	Ben Halada	Driller Sam Wilks	Date Started 4/14/09 Completed 4/15/09
Logged By	Briggs Evans	Depth to Water	19.5 ft Date/Time 4/15/09
		Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
763.7'	0.0'	Top of Hole							
763.2'	0.5'	CLAYEY GRAVEL (Fill), brown red yellow, dry to moist, stiff to very stiff, some gravel		SPT-1	0.0 - 1.5	1.0	17-19-22	12	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.0	8-18-18	13	
		BOTTOM ASH (Fill), dark gray, moist to wet, dense to medium dense, some fly ash		SPT-3	3.0 - 4.5	0.8	13-8-9	18	Wet at 4ft bgs
757.4'	6.3'			SPT-4	4.5 - 6.0	1.0	9-7-7	21	
		FAT CLAY (Fill), red brown, moist, medium stiff, some chert, some gravel, medium plasticity		SPT-5	6.0 - 7.5	1.0	6-6-6	23	
				SPT-6	7.5 - 9.0	0.8	2-3-4	31	
				SPT-7	9.0 - 10.5	1.0	2-3-5	22	
				ST-1	10.5 - 12.5	2.0		--	
749.7'	14.0'			ST-2	12.5 - 14.5	2.0		--	
		BOTTOM ASH (Fill), dark gray, moist, medium dense, some coal refuse		SPT-8	14.5 - 16.0	1.5	13-39-25	15	
746.7'	17.0'			SPT-9	16.0 - 17.5	1.5	3-4-17	21	
		BOTTOM ASH (Fill), dark gray to olive green, wet to saturated, loose to very loose, some fly ash		SPT-10	17.5 - 19.0	1.5	8-7-8	22	
				SPT-11	19.0 - 20.5	1.0	5-5-5	20	Saturated at 19.5 ft bgs
				SPT-12	20.5 - 22.0	1.5	2-2-2	18	
				SPT-13	22.0 - 23.5	1.2	4-3-2	27	Began adding water to limit blow-back
				SPT-14	23.5 - 25.0	1.4	6-5-3	30	
				SPT-15	25.0 - 26.5	0.8	3-4-2	18	
				SPT-16	26.5 - 28.0	1.2	3-2-3	20	
735.0'	28.8'			SPT-17	28.0 - 29.5	1.5	2-4-4	24	
		SANDY CLAY, brown, wet, soft to medium stiff, homogeneous		SPT-18	29.5 - 31.0	1.5	WOH-2-2	21	
732.5'	31.3'			SPT-19	31.0 - 32.5	1.5	2-2-3	22	
		LEAN CLAY, brown, saturated, soft, mottled		SPT-20	32.5 - 34.0	1.5	WOH-WOH-3	26	
729.7'	34.0'			SPT-21	34.0 - 35.5	1.5	WOH-1-2	19	
				SPT-22	35.5 - 37.0	1.5	WOH-1-2	21	

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SUBSURFACE LOG

Project No. 175569042 Location N 556756.78, E 2442263.59 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-3** Total Depth 50.3 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
726.7'	37.0'	SILTY SAND, tan, saturated, loose to very loose, fine to medium grained, well graded, trace clay *(Continued)*		SPT-23	37.0 - 38.5	1.5	WOH-1-1	20	
				SPT-24	38.5 - 40.0	1.5	WOH-1-2	18	
		SAND, light brown, saturated, loose to very loose, fine grained, trace silt, homogeneous		SPT-25	40.0 - 41.5	1.5	WOR-WOR-WOR	20	
				SPT-26	41.5 - 43.0	1.5	2-2-2	21	
				SPT-27	43.0 - 44.5	1.5	WOR-2-2	18	
				SPT-28	44.5 - 46.0	1.5	3-3-4	21	
				SPT-29	46.0 - 47.5	1.5	WOR-WOR-WOR	20	
714.7'	49.0'			SPT-30	47.5 - 48.5		4-50+/0.4	69	Wood fragments - 48.0 to 48.3 ft
713.4'	50.3'			SPT-31	49.0 - 50.3	0.8	40-44-16/0.3	--	
		Shale, (Augered)							
		Auger Refusal / Bottom of Hole							Boring backfilled with bentonite grout from 50.3ft to surface
		Top of Rock = 49.0' Elevation (714.7')							

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SUBSURFACE LOG

Project No.	175569042	Location	N 556761.99, E 2442259.75 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-3A** Total Depth 30.0 ft
Location	Kingston, Tennessee	Surface Elevation	763.9 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/27/09 Completed 5/1/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Adam Smith	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
763.9'	0.0'	Top of Hole							
		OVERBURDEN, (Augered without sampling) See Log for STN-3							Boring advanced using 4 1/4 " Hollow Stem Augers
733.9'	30.0'	No Refusal / Bottom of Hole							

7/15/09

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SUBSURFACE LOG

Project No.	175569042	Location	N 556761.99, E 2442259.75 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-3A Total Depth 30.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks

Two PZ's installed, tip at elevation 751.9' and 737.9'

Protective well cover and concrete pad installed.

SUBSURFACE LOG

Project No.	175569042	Location	N 556765.05, E 2442256.36 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-3B** Total Depth 50.0 ft
Location	Kingston, Tennessee	Surface Elevation	763.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/27/09 Completed 5/1/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Adam Smith	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
763.8'	0.0'	Top of Hole							
		OVERBURDEN, (Augered without sampling) See Log for STN-3							Boring advanced using 4 1/4 " Hollow Stem Augers Revert used to keep augers clear

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SUBSURFACE LOG

Project No.	175569042	Location	N 556765.05, E 2442256.36 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-3B Total Depth 50.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		OVERBURDEN, (Augered without sampling) See Log for STN-3 *(Continued)*							
713.8'	50.0'	No Refusal / Bottom of Hole							

PZ Installed, tip at elevation 718.8'

Flushmount well cover and concrete pad installed.

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SUBSURFACE LOG

Project No.	175569042	Location	N 556763.50, E 2442257.42 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-3C Total Depth 35.0 ft
Location	Kingston, Tennessee	Surface Elevation	763.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/1/09 Completed 5/1/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Adam Smith	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
763.8'	0.0'	Top of Hole							
		Overburden, (Augered without sampling)							Boring advanced using 4 1/4 " Hollow Stem Augers Revert used to keep augers clear Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
738.8'	25.0'								
736.8'	27.0'	Bottom Ash, black, saturated		ST-1	25.0 - 27.0	0.5		--	ST-1: bottom ash fell out upon retrieval, should have had 1.5' recovery
		SILTY CLAY, light brown and red brown, moist, soft		ST-2	27.0 - 29.0	1.5		--	
				ST-3	29.0 - 31.0	2.0		24	Boring backfilled with bentonite cement grout from 0.0 ft to 35.0 ft
				ST-4	31.0 - 33.0	2.0		22	
728.8'	35.0'			ST-5	33.0 - 35.0	2.0		24	
		No Refusal / Bottom of Hole							

FINAL LEGACY 175569117 KINGSTON ASH POND.GPJ PRELIMLOT 7/14/09

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SUBSURFACE LOG

Project No.	175569042	Location	N 556762.50, E 2442258.42 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-3D Total Depth 35.0 ft
Location	Kingston, Tennessee	Surface Elevation	763.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/4/09 Completed 5/4/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Brad Smiley	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
763.8'	0.0'	Top of Hole							
		Overburden, (Augered without sampling)							Boring advanced using 4 1/4 " Hollow Stem Augers Revert used to keep augers clear Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
738.8'	25.0'								
736.8'	27.0'	Bottom Ash, black, saturated		ST-1	25.0 - 27.0			--	
		SILTY CLAY, light brown and red brown, moist, soft		ST-2	27.0 - 29.0			--	
				ST-3	29.0 - 31.0			--	
				ST-4	31.0 - 33.0			--	Boring backfilled with bentonite cement grout from 0.0 ft to 35.0 ft
728.8'	35.0'			ST-5	33.0 - 35.0			--	
		No Refusal / Bottom of Hole							

PARA GEOLOGY 175569042 KINGSTON ASH POND.GPJ PARA.GDT 7/16/09

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SUBSURFACE LOG

Project No.	175569042	Location	N 556625.56, E 2442047.01 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-4 Total Depth 83.0 ft
Location	Kingston, Tennessee	Surface Elevation	763.3 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/16/09 Completed 4/17/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	16.0 ft Date/Time 4/16/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
763.3'	0.0'	Top of Hole							
		BOTTOM ASH (Fill), black, moist, loose to medium dense		SPT-1	0.0 - 1.5	1.3	8-18-18	25	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.3	14-18-19	22	
				SPT-3	3.0 - 4.5	1.4	6-15-13	22	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
				SPT-4	4.5 - 6.0	1.3	4-7-11	24	
				SPT-5	6.0 - 7.5	1.5	14-15-12	23	
				SPT-6	7.5 - 9.0	1.2	5-11-10	24	
				SPT-7	9.0 - 10.5	1.3	4-9-9	26	
				SPT-8	10.5 - 12.0	1.5	9-8-7	28	
				SPT-9	12.0 - 13.5	1.5	4-7-7	29	
749.3'	14.0'								
		FLY ASH (Fill), light gray to black, moist to saturated, very loose		SPT-10	13.5 - 15.0	1.5	2-2-5	28	
				SPT-11	15.0 - 16.5	1.5	1-1-WOH	41	
				SPT-12	16.5 - 18.0	1.3	WOR-WOR-WOH	29	
				SPT-13	18.0 - 19.5	1.5	WOR-1-1	31	
				SPT-14	19.5 - 21.0	1.4	WOR-WOH-2	35	
				SPT-15	21.0 - 22.5	1.5	2-2-WOH	32	
				SPT-16	22.5 - 24.0	1.4	WOR-WOH-WOH	32	
738.3'	25.0'			SPT-17	24.0 - 25.5	1.3	WOR-WOH-WOH	24	Water added at 24.0 ft to keep augers clear
		FAT CLAY, brown, saturated, very soft, some sandy silt		ST-1	25.5 - 27.5	2.0		--	
				SPT-18	27.5 - 29.0	1.3	WOR-WOR-1	23	
				SPT-19	29.0 - 30.5	1.5	2-3-2	22	
731.8'	31.5'			SPT-20	30.5 - 32.0	1.5	1-2-3	22	
		SILTY SAND, brown, moist to saturated, very loose, fine to medium grained, trace clay		SPT-21	32.0 - 33.5	1.2	1-1-2	21	
				SPT-22	33.5 - 35.0	0.9	WOR-WOH-1	22	
				SPT-23	35.0 - 36.5	1.1	1-2-1	24	

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SUBSURFACE LOG

Project No. 175569042 Location N 556625.56, E 2442047.01 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-4** Total Depth 83.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SILTY SAND, brown, moist to saturated, very loose, fine to medium grained, trace clay *(Continued)*		SPT-24	36.5 - 38.0	1.1	3-3-2	21	
				SPT-25	38.0 - 39.5	0.0	WOR-WOR-WOR	--	
				SPT-26	39.5 - 41.0	1.0	WOR-1-1	21	
				SPT-27	41.0 - 42.5	1.2	3-1-2	27	
				SPT-28	42.5 - 44.0	1.3	3-1-1	21	
				SPT-29	44.0 - 45.5	1.1	1-1-2	21	
				SPT-30	45.5 - 47.0	1.1	WOR-WOH-1	25	
				SPT-31	47.0 - 48.5	1.1	WOH-1-1	20	
				SPT-32	48.5 - 50.0	1.0	WOR-WOH-1	21	
				SPT-33	50.0 - 51.5	1.2	WOH-1-1	22	
				SPT-34	51.5 - 53.0	1.5	4-6-4	23	
709.3'	54.0'			SPT-35	53.0 - 54.5	1.4	5-7-11	23	
		SAND, light gray, moist, medium dense, fine to medium grained		SPT-36	54.5 - 56.0	1.3	5-6-6	23	
				SPT-37	56.0 - 57.5	1.5	4-4-4	24	
				SPT-38	57.5 - 59.0	1.4	3-5-4	22	
				SPT-39	59.0 - 60.5	1.2	5-7-5	22	
702.3'	61.0'			SPT-40	60.5 - 61.4	0.8	50-50/0.4	--	SPT-40: shale in tip of spoon
700.3'	63.0'	Shale, (Augered)							Began Core
		Shale, gray, soft, thin bedded, close fracture spacing, 30°, interbedded with very thin to thin limestone layers		0%	3.5	1.2	34	66.5	
				0%	6.5	3.2	49	73.0	
				0%	3.5	3.0	86	76.5	

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SUBSURFACE LOG

Project No.	175569042	Location	N 556625.56, E 2442047.01 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-4
		Total Depth	83.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
				55%	2.0	1.2	60	78.5	
680.3'	83.0'	Shale, gray, soft, thin bedded, close fracture spacing, 30°, interbedded with very thin to thin limestone layers *(Continued)*		0%	4.5	2.9	64	83.0	Boring backfilled with bentonite cement grout from 0.0 ft to 83.0 ft

Bottom of Hole

Top of Rock = 61.0'
Elevation (702.3')

WOH = Weight of Hammer
WOR = Weight of Rods

Split Samples: SPT-10, 17, 20, 35

Stantec

Project 171468117 Kingston Ash Pond
Sheet No. 1 of 1 Date 4/17/2009
Hole # STN-4 Rig # 710

Northing 556,625.56 Surface Elevation (ft.) 763.3 Crew Kent Clements / Greg Wilson

Easting 2,442,047.01 Top of Rock Elev. (ft.) 702.3 Inspector Benjamin A. Halada

Boring Size 3 1/4 Hollow Stem Augers Pump Capacity 21 gpm Meter Type Sensus 5/8" SR II

Test Method US Bureau of Reclamation Static Water Level 16' Meter # 67290595

Test Section		Gauge Reading (PSI)	Time of Test			Meter Reading		Total Water (Gal / Cu Ft)	CFM
Top Depth	Bottom Depth		Start	End	Interval (min-sec)	Start of Test	End of Test		
64.5	73.0	35	0:00	1:00	1:00	256.63	256.63	0.00	0.00
		35	1:00	2:00	1:00	256.63	256.63	0.00	0.00
		35	2:00	3:00	1:00	256.63	256.63	0.00	0.00
		35	3:00	4:00	1:00	256.63	256.63	0.00	0.00
		35	4:00	5:00	1:00	256.63	256.63	0.00	0.00
73.0	83.0	40	0:00	1:00	1:00	257.11	257.11	0.00	0.00
		40	1:00	2:00	1:00	257.11	257.11	0.00	0.00
		40	2:00	3:00	1:00	257.11	257.11	0.00	0.00
		40	3:00	4:00	1:00	257.11	257.11	0.00	0.00
		40	4:00	5:00	1:00	257.11	257.11	0.00	0.00
						257.11	257.11	0.00	0.00

Project # 171468117 Hole # STN-4 Inspector Benjamin A. Halada Date 4/17/2009

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SUBSURFACE LOG

Project No.	175569042	Location	N 556611.15, E 2442365.31 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-5** Total Depth 54.0 ft
Location	Kingston, Tennessee	Surface Elevation	764.9 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/29/09 Completed 4/29/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	20.0 ft Date/Time 4/29/09
Logged By	Greg Budd	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
764.9'	0.0'	Top of Hole							
		LEAN CLAY (Fill), brown, dry, stiff, with abundant tan chert, low plasticity		SPT-1	0.0 - 1.5	0.9	12-10-10	22	Boring advanced using 3 1/4" hollow stem augers
				SPT-2	1.5 - 3.0	0.9	10-11-11	28	
				SPT-3	3.0 - 4.5	1.5	6-7-14	30	
				ST-1	4.5 - 6.5	1.3			
				SPT-4	6.5 - 8.0	1.0	8-10-11	29	
				SPT-5	8.0 - 9.5	1.0	8-10-11	29	
				SPT-6	9.5 - 11.0	0.9	8-10-11	22	
				ST-2	11.0 - 13.0	1.7		–	
				SPT-7	13.0 - 14.5	1.1	4-4-5	25	
748.4'	16.5'			SPT-8	14.5 - 16.0	1.3	7-9-10	25	
747.4'	17.5'	BOTTOM ASH (Fill), gray to black, dry, medium dense		SPT-9	16.0 - 17.5	1.0	5-7-9	23	
		BOTTOM ASH (Fill), brown to gray, moist, medium dense, loose		SPT-10	17.5 - 19.0	0.8	7-12-14	23	
744.4'	20.5'			SPT-11	19.0 - 20.5	1.1	10-8-6	25	Water added at 20 feet to keep augers clean
		BOTTOM ASH (Fill), gray to black, saturated, loose, and fly ash		SPT-12	20.5 - 22.0	0.2	3-3-4	29	
				SPT-13	22.0 - 23.5	0.9	4-4-5	19	
				SPT-14	23.5 - 25.0	0.6	6-5-5	20	
738.4'	26.5'			SPT-15	25.0 - 26.5	1.0	5-6-6	19	
736.9'	28.0'	SANDY SILT, brown to gray, saturated, loose, mottled		SPT-16	26.5 - 28.0	0.4	5-4-1	21	
		LEAN CLAY, brown to gray, saturated, soft, with, trace very fine grained sand		SPT-17	28.0 - 29.5	1.5	2-3-3	20	
733.9'	31.0'			SPT-18	29.5 - 31.0	1.0	1-1-1	23	
		SILTY CLAY, brown, saturated, soft		SPT-19	31.0 - 32.5	1.2	2-3-4	22	
				SPT-20	32.5 - 34.0	1.0	WOR-WOR-WOR	23	
				SPT-21	34.0 - 35.5	1.5	3-3-5	26	
				SPT-22	35.5 - 37.0	1.5	4-3-4	26	

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SUBSURFACE LOG

Project No. 175569042 Location N 556611.15, E 2442365.31 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-5** Total Depth 54.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SILTY CLAY, brown, saturated, soft *(Continued)*		SPT-23	37.0 - 38.5	1.5	2-3-5	23	
				ST-3	38.5 - 40.5	2.0		--	
724.4'	40.5'	SILTY SAND, brown to grey, saturated, very loose to loose, fine to very fine grained		SPT-24	40.5 - 42.0	1.1	3-3-4	19	
				SPT-25	42.0 - 43.5	1.5	4-4-5	23	
				SPT-26	43.5 - 45.0	1.1	5-4-3	23	
				SPT-27	45.0 - 46.5	1.2	3-3-3	20	
				SPT-28	46.5 - 48.0	1.0	4-3-2	23	
				SPT-29	48.0 - 49.5	1.5	WOR-WOR-6	26	
				SPT-30	49.5 - 51.0	1.5	8-5-6	25	Boring backfilled with bentonite cement grout from 0.0 to 54.0 feet
712.4'	52.5'			SPT-31	51.0 - 52.5	0.7	WOR-WOR-WOR	27	
710.9'	54.0'			SPT-32	52.5 - 53.5	1.0	34-50/0.5	--	
		Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rod

FARM LEGACY 175569117 KINGSTON ASH POND.GPJ FLEX.GDT 7/16/09

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SUBSURFACE LOG

Project No.	175569042	Location	N 556416.17, E 2442407.10 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-6** Total Depth 64.5 ft
Location	Kingston, Tennessee	Surface Elevation	763.4 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/30/09 Completed 5/1/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	N/A Date/Time N/A
Logged By	Briggs Evans	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
763.4'	0.0'	Top of Hole							
761.9'	1.5'	LEAN CLAY (Fill), dark brown red, dry, stiff, grading to gray and black, bottom ash and coal refuse		SPT-1	0.0 - 1.5	1.0	6-6-40	19	Boring advanced using 3.25" hollow stem augers
				SPT-2	1.5 - 2.0	0.2	50/0.2	19	
758.9'	4.5'	FLY ASH (Fill), black to gray, dry, dense, with red, stiff, silty, clay		SPT-3	3.0 - 4.5	0.6	10-15-27	19	
		SANDY SILT (Fill), brown, dry, medium stiff		SPT-4	4.5 - 6.0	1.0	33-33-27	22	
				SPT-5	6.0 - 7.5	0.8	6-6-7	23	
				SPT-6	7.5 - 9.0	1.0	5-3-4	25	
				SPT-7	9.0 - 10.5	0.7	5-4-5.	25	
				SPT-8	10.5 - 12.0	0.6	6-4-4	28	Water added at 11.0 ft. to keep augers clear
				SPT-9	12.0 - 13.5	1.1	3-5-5	28	
748.4'	15.0'			SPT-10	13.5 - 15.0	0.5	2-3-5	26	
		BOTTOM ASH (Fill), black to gray, saturated, dense to loose, with fly ash and coarse coal refuse		SPT-11	15.0 - 16.5	1.0	13-13-15	21	
				SPT-12	16.5 - 18.0	1.5	25-40-27	26	
				SPT-13	18.0 - 19.5	0.6	12-20-26	25	
				SPT-14	19.5 - 21.0	1.0	7-12-13	25	
				SPT-15	21.0 - 22.5	0.9	15-17-10	21	
				SPT-16	22.5 - 24.0	0.9	10-19-13	31	
				SPT-17	24.0 - 25.5	1.2	4-4-4	31	
				SPT-18	25.5 - 27.0	1.0	3-2-2	32	
				SPT-19	27.0 - 28.5	0.4	2-2-1	27	
				SPT-20	28.5 - 30.0	0.7	3-2-3	34	
731.9	31.5'			SPT-21	30.0 - 31.5	1.5	10-15-10	21	
		FLY ASH (Fill), gray to brown, saturated, loose, very fine grained, silty		SPT-22	31.5 - 33.0	0.7	4-3-2	18	
				SPT-23	33.0 - 34.5	1.5	2-2-2	34	
				SPT-24	34.5 - 36.0	0.8	1-1-1	20	

RASSI_LEGACY 171468117 KINGSTON ASH POND.GPJ 7/16/09

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SUBSURFACE LOG

Project No. 175569042 Location N 556416.17, E 2442407.10 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-6** Total Depth 64.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
725.9'	37.5'			SPT-25	36.0 - 37.5	1.2	5-4-2	27	
		SANDY SILT, brown, saturated, loose, very fine grained, mottled		SPT-26	37.5 - 39.0	0.8	4-6-6	19	
722.9'	40.5'			SPT-27	39.0 - 40.5	1.0	4-4-4	20	
		SILTY CLAY, gray to brown, saturated, soft to very soft, with trace very fine sand		SPT-28	40.5 - 42.0	1.5	WOH-2-2	22	
				SPT-29	42.0 - 43.5	1.0	3-2-3	27	
718.4'	45.0'			SPT-30	43.5 - 45.0	1.0	5-5-5	25	
		SANDY SILT, gray, saturated, soft		SPT-31	45.0 - 46.5	1.5	2-2-2	27	
				SPT-32	46.5 - 48.0	1.3	4-4-4	18	
				SPT-33	48.0 - 49.5	1.1	3-3-3	17	
712.4'	51.0'			SPT-34	49.5 - 51.0	1.5	WOH-3-3	19	
710.9'	52.5'	SILTY SAND, gray to brown, saturated, loose, fine grained, mottled		SPT-35	51.0 - 52.5	1.1	5-6-6	20	
				SPT-36	52.5 - 54.0	0.9	5-6-5	23	
		SAND, brown, saturated, medium dense to dense, fine grained, well rounded, well graded		SPT-37	54.0 - 55.5	1.1	6-8-10	23	
				SPT-38	55.5 - 57.0	1.0	6-12-14	22	
				SPT-39	57.0 - 58.5	1.5	10-32-50	22	
				SPT-40	58.5 - 60.0	1.2	10-14-10	23	
				SPT-41	60.0 - 61.5	1.5	4-5-6	23	Boring backfilled using bentonite cement grout from 0.0 to 64.5 feet
				SPT-42	61.5 - 63.0	1.5	7-15-20	24	
699.4'	64.0'			SPT-43	63.0 - 64.2	0.5	33-44-23/0.2	14	
698.9'	64.5'	Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

SUBSURFACE LOG

Project No.	175569042	Location	N 556248.52, E 2442540.30 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-8 Total Depth 76.7 ft
Location	Kingston, Tennessee	Surface Elevation	752.2 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/13/09 Completed 4/13/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	17.5 ft Date/Time 4/13/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
752.2'	0.0'	Top of Hole							
		LEAN CLAY (Fill), red brown, moist, stiff		SPT-1	0.0 - 1.5	1.0	4-6-5	18	Boring advanced using 3 1/4 " Hollow Stem Augers
749.7'	2.5'			SPT-2	1.5 - 3.0	0.7	4-8-10	16	
749.2'	3.0'	BOTTOM ASH (Fill), black, moist, medium dense		SPT-3	3.0 - 4.5	1.5	9-16-22	17	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
748.2'	4.0'			SPT-4	4.5 - 6.0	1.3	6-11-13	13	
746.7'	5.5'	LEAN CLAY (Fill), red brown, moist, very stiff		SPT-5	6.0 - 7.5	1.0	11-13-14	14	
		BOTTOM ASH (Fill), black, moist, medium dense		SPT-6	7.5 - 9.0	1.0	11-15-14	16	
		LEAN CLAY (Fill), brown, moist, very stiff, some fine grained sand, some gravel		ST-1	9.0 - 11.0	1.2		--	ST-1: sandy clay in bottom of tube
741.2'	11.0'			SPT-7	11.0 - 12.5	1.2	WOR-WOH-WOH	20	
		SAND, light brown, dry, very loose, fine to medium grained, some silt		SPT-8	12.5 - 14.0	1.1	2-3-2	17	
738.2'	14.0'			SPT-9	14.0 - 15.5	1.1	1-1-2	21	
		LEAN CLAY, light red brown, moist, very soft, some fine grained sand		ST-2	15.5 - 17.5	2.0		--	
734.7'	17.5'			SPT-10	17.5 - 19.0	1.3	WOR-1-1	20	
		SAND, light brown, saturated, very loose, fine grained, trace clayey silt		SPT-11	19.0 - 20.5	1.1	WOR-WOH-1	18	
				SPT-12	20.5 - 22.0	1.3	WOH-1-1	21	
				SPT-13	22.0 - 23.5	1.1	1-WOH-WOH	17	
				SPT-14	23.5 - 25.0	1.4	1-WOH-WOH	21	
				SPT-15	25.0 - 26.5	1.3	1-1-WOH	22	
				SPT-16	26.5 - 28.0	1.1	WOH-WOH-1	24	
				SPT-17	28.0 - 29.5	1.3	1-1-1	20	
				SPT-18	29.5 - 31.0	1.2	1-WOH-1	19	
				SPT-19	31.0 - 32.5	1.1	WOH-WOH-WOH	17	
				SPT-20	32.5 - 34.0	1.0	WOH-1-1	21	
				SPT-21	34.0 - 35.5	1.3	1-2-3	24	
				SPT-22	35.5 - 37.0	1.0	1-2-1	21	

FORM LEGACY 175569112 KINGSTON ASH POND.GPJ 7/15/09

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SUBSURFACE LOG

Project No. 175569042 Location N 556248.52, E 2442540.30 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-8** Total Depth 76.7 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec %	Mois.Cont. % / Run Depth	Remarks
		SAND, light brown, saturated, very loose, fine grained, trace clayey silt *(Continued)*		SPT-23	37.0 - 38.5	1.3	1-1-1	18	
				SPT-24	38.5 - 40.0	1.3	WOR-WOH-WOH	19	
711.2'	41.0'			SPT-25	40.0 - 41.5	1.2	WOR-WOH-2	19	
		SAND, light gray, saturated, medium dense, fine grained		SPT-26	41.5 - 43.0	1.4	4-3-4	17	
				SPT-27	43.0 - 44.5	1.1	WOR-WOH-3	19	
				SPT-28	44.5 - 46.0	1.2	2-3-5	16	
				SPT-29	46.0 - 47.5	1.1	4-3-2	19	
703.2'	49.0'			SPT-30	47.5 - 49.0	1.3	2-3-6	21	
		SAND, light brown to brown, moist, very dense, fine to medium grained, some medium to coarse gravel		SPT-31	49.0 - 50.5	1.3	6-11-22	21	
				SPT-32	50.5 - 52.0	1.0	18-17-12	21	
698.7'	53.5'			SPT-33	52.0 - 53.5	1.1	6-7-13	22	
				SPT-34	53.5 - 53.9	0.4	50/0.4	--	
696.4'	55.8'	Shale, (Augered)		SPT-35	55.0 - 55.3	0.3	50/0.3	--	Began Core
		Shale, gray, fine grained, very thin bedded, 45° bedding angle		0%	5.9	0.5	8	61.7	
				0%	5.0	2.0	40	66.7	
				0%	4.5	1.8	40	71.2	
675.5'	76.7'			0%	5.5	2.3	42	76.7	Boring backfilled with bentonite cement grout from 0.0 ft to 76.7 ft
		Bottom of Hole							

FORM LEGACY 175569042 KINGSTON ASH POND.GPJ FORM LOG.GDT 7/18/09

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SUBSURFACE LOG

Project No.	175569042	Location	N 556248.52, E 2442540.30 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-8
		Total Depth	76.7 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		Top of Rock = 53.5' Elevation (698.7')							
		WOH = Weight of Hammer WOR = Weight of Rods							
		Split Samples: SPT 2, 3, 4 and 25							
		Slope Indicator (76.7 ft of pipe) installed with a concrete pad and flushmount cover							

7/16/09

Stantec

Project 171468117 Kingston Ash Pond
Sheet No. 1 of 1 Date 4/13/2009
Hole # STN-8 Rig # 710

Northing 556,248.52 Surface Elevation (ft.) 752.2 Crew Kent Clements / Greg Wilson

Easting 2,442,540.30 Top of Rock Elev. (ft.) 698.7 Inspector Benjamin A. Halada

Boring Size 3 1/4 Hollow Stem Augers Pump Capacity 21 gpm Meter Type Sensus 5/8" SR II

Test Method US Bureau of Reclamation Static Water Level 17.5 Meter # 67290595

Test Section		Gauge Reading (PSI)	Time of Test			Meter Reading		Total Water (Gal / Cu Ft)	CFM
Top Depth	Bottom Depth		Start	End	Interval (min-sec)	Start of Test	End of Test		
58.7	66.7	30	0:00	1:00	1:00	244.45	244.49	0.04	0.04
		30	1:00	2:00	1:00	244.49	244.52	0.03	0.03
		30	2:00	3:00	1:00	244.52	244.55	0.03	0.03
		30	3:00	4:00	1:00	244.55	244.55	0.00	0.00
		30	4:00	5:00	1:00	244.55	244.55	0.00	0.00
66.7	76.7	35	0:00	1:00	1:00	246.67	246.67	0.00	0.00
		35	1:00	2:00	1:00	246.67	246.67	0.00	0.00
		35	2:00	3:00	1:00	246.67	246.67	0.00	0.00
		35	3:00	4:00	1:00	246.67	246.67	0.00	0.00
		35	4:00	5:00	1:00	246.67	246.67	0.00	0.00

Project # 171468117 Hole # STN-8 Inspector Benjamin A. Halada Date 4/13/2009

SUBSURFACE LOG

Project No.	175569042	Location	N 556233.82, E 2442499.72 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-9** Total Depth 63.4 ft
Location	Kingston, Tennessee	Surface Elevation	764.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/15/09 Completed 4/16/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	22.5 ft Date/Time 4/15/09
Logged By	Briggs Evans	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
764.8'	0.0'	Top of Hole							
		LEAN CLAY (Fill), red, dry to moist, stiff to very stiff, little chert, trace gravel		SPT-1	0.0 - 1.5	1.0	7-7-10	19	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.2	9-12-16	21	
				SPT-3	3.0 - 4.5	1.2	10-7-8	20	
				ST-1	4.5 - 6.5	2.0		--	
				SPT-4	6.5 - 8.0	1.5	6-8-11	29	
				SPT-5	8.0 - 9.5	0.5	4-5-6	26	
				SPT-6	9.5 - 11.0	0.5	7-11-14	23	
				ST-2	11.0 - 13.0	2.0		--	
				SPT-7	13.0 - 14.5	1.5	4-7-13	27	
				SPT-8	14.5 - 16.0	1.5	4-7-8	25	
				SPT-9	16.0 - 17.5	1.5	5-5-7	23	
746.5'	18.3'			SPT-10	17.5 - 19.0	1.5	10-12-8	22	
		BOTTOM ASH (Fill), dark grey, moist to wet, loose, some fly ash		SPT-11	19.0 - 20.5	1.0	4-8-5	26	
				SPT-12	20.5 - 22.0	1.5	8-8-7	22	
				SPT-13	22.0 - 23.5	1.0	6-2-WOH	20	Saturated at 22.5ft
740.5'	24.3'			SPT-14	23.5 - 25.0	1.5	6-4-4	17	
		SILTY SAND (Fill), brown, saturated, loose		SPT-15	25.0 - 26.5	1.0	3-4-5	20	Begin adding water at 25ft bgs to control blow-back
				SPT-16	26.5 - 28.0	0.8	3-4-3	19	
				SPT-17	28.0 - 29.5	1.5	WOH-2-2	21	
733.8'	31.0'			SPT-18	29.5 - 31.0	1.5	WOH-WOH-WOH	22	
		SILTY SAND, brown, wet, medium dense to very loose, fine to medium grained, little clay		SPT-19	31.0 - 32.5	1.5	WOH-WOH-WOH	19	
				SPT-20	32.5 - 34.0	1.5	WOH-1-2	29	
				SPT-21	34.0 - 35.5	1.5	1-1-1	22	
				SPT-22	35.5 - 37.0	1.0	2-2-3	22	

2486 LEGACY ASH&LI1\KINGSTON ASH POND.GPJ ROSALGT 7/16/09

7/16/09

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SUBSURFACE LOG

Project No. 175569042 Location N 556233.82, E 2442499.72 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-9** Total Depth 63.4 ft

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
		SILTY SAND, brown, wet, medium dense to very loose, fine to medium grained, little clay *(Continued)*		SPT-23	37.0 - 38.5	1.5	2-2-3	22	
				SPT-24	38.5 - 40.0	1.5	WOH-WOH-1	21	
				SPT-25	40.0 - 41.5	1.5	WOH-WOH-1	20	
				SPT-26	41.5 - 43.0	1.5	3-3-4	20	
				SPT-27	43.0 - 44.5	1.5	3-1-1	18	
				SPT-28	44.5 - 46.0	1.5	3-1-1	19	
				SPT-29	46.0 - 47.5	1.5	3-3-4	22	
				SPT-30	47.5 - 49.0	1.5	4-4-5	22	
				SPT-31	49.0 - 50.5	0.8	WOR-WOR-WOR	22	
				SPT-32	50.5 - 52.0	1.5	4-6-6	19	
				SPT-33	52.0 - 53.5	1.5	WOR-WOR-WOR	23	
710.2'	54.6'			SPT-34	53.5 - 55.0	1.5	5-8-9	19	
		SAND, brown, saturated, loose to medium dense, fine grained, trace silt		SPT-35	55.0 - 56.5	1.5	4-5-2	20	
				SPT-36	56.5 - 58.0	1.5	8-8-9	24	
				SPT-37	58.0 - 59.5	1.0	12-14-17	22	
				SPT-38	59.5 - 61.0	1.0	6-4-12	20	
702.3'	62.5'			SPT-39	61.0 - 62.5	1.0	8-8-8	23	Boring backfilled with bentonite grout from 0.0 ft to 63.4 ft.
701.4'	63.4'			SPT-40	62.5 - 63.4		44-50/0.4	--	
		Shale, (Augered)							
		Auger Refusal / Bottom of Hole							
		Top of Rock = 62.5' Elevation (702.3')							

7/16/08

SUBSURFACE LOG

Project No.	175569042	Location	N 556162.76, E 2442251.63 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-10 Total Depth 81.0 ft
Location	Kingston, Tennessee	Surface Elevation	765.0 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/20/09 Completed 4/21/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	9.0 ft Date/Time 4/20/09
Logged By	Greg Budd	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
765.0'	0.0'	Top of Hole							
763.5'	1.5'	BOTTOM ASH (Fill), black gray, dry, loose		SPT-1	0.0 - 1.5	1.0	2-2-2	26	Boring advanced using 3 1/4" hollow stem augers
762.0'	3.0'	BOTTOM ASH (Fill), black gray, dry, loose		SPT-2	1.5 - 3.0	0.5	1-2-1	24	
		FLY ASH (Fill), gray, moist to saturated, soft		SPT-3	3.0 - 4.5	1.0	1-1-1	37	
				SPT-4	4.5 - 6.0	1.0	1-1-1	40	
				SPT-5	6.0 - 7.5	1.1	1-1-1	35	
				SPT-6	7.5 - 9.0	1.5	WOH-WOH-WOH	32	
				SPT-7	9.0 - 10.5	1.5	WOH-WOH-1	32	Water added at 9.0 feet to keep augers clear
				SPT-8	10.5 - 12.0	1.5	WOR-WOR-WOR	31	
				SPT-9	12.0 - 13.5	1.5	WOR-WOR-WOR	34	
				SPT-10	13.5 - 15.0	1.5	WOR-WOR-WOR	31	
748.5'	16.5'			SPT-11	15.0 - 16.5	1.5	WOR-WOR-WOR	28	
		FLY ASH (Fill), black gray, saturated, soft, with trace black bottom ash		SPT-12	16.5 - 18.0	1.5	WOR-WOR-WOR	29	
				SPT-13	18.0 - 19.5	1.5	1-1-1	25	
				SPT-14	19.5 - 21.0	1.5	WOR-WOR-WOR	26	
742.5'	22.5'			SPT-15	21.0 - 22.5	0.8	1-1-1	27	
		FLY ASH (Fill), black gray, saturated, soft, with some gray and black fine grained sand		SPT-16	22.5 - 24.0	1.5	1-1-2	27	
				SPT-17	24.0 - 25.5	0.5	WOH-WOH-WOH	25	
				SPT-18	25.5 - 27.0	0.5	WOR-WOR-WOR	30	
				SPT-19	27.0 - 28.5	1.5	WOR-WOR-WOR	30	
				SPT-20	29.5 - 31.0	1.0	WOR-WOR-WOR	28	
				SPT-21	31.0 - 32.5	1.5	WOR-WOR-WOR	33	
731.0'	34.0'			SPT-22	32.5 - 34.0	1.5	WOR-WOR-WOR	28	
		FLY ASH (Fill), light brown gray, saturated, soft, with some clayey silt, mottled		SPT-23	34.0 - 35.5	1.5	3-1-1	20	
				SPT-24	35.5 - 37.0	1.5	WOR-	19	

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SUBSURFACE LOG

Project No. 175569042 Location N 556162.76, E 2442251.63 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-10** Total Depth 81.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		FLY ASH (Fill), light brown gray, saturated, soft, with some clayey silt, mottled *(Continued)*		SPT-25	37.0 - 38.5	1.5	WOR-WOR 4-4-4	18	
				SPT-26	38.5 - 40.0	1.0	WOR-WOR-WOR	20	
725.0'	40.0'								
		SILTY CLAY, light brown gray, saturated, soft, with trace fine grained sand, mottled		SPT-27	40.0 - 41.5	1.0	4-6-6	21	
				SPT-28	41.5 - 43.0	1.5	6-6-6	20	
				SPT-29	43.0 - 44.5	1.0	3-3-3	21	
				SPT-30	44.5 - 46.0	1.5	2-2-3	25	
				SPT-31	46.0 - 47.5	1.5	3-2-1	27	
				SPT-32	47.5 - 49.0	1.0	WOR-WOR-WOR	19	
				SPT-33	49.0 - 50.5	1.0	WOR-WOR-WOR	18	
713.0'	52.0'			SPT-34	50.5 - 52.0	1.0	4-5-7	18	
		SILTY SAND, gray, wet, loose		SPT-35	52.0 - 53.5	1.3	4-5-7	23	
				SPT-36	53.5 - 55.0	1.5	3-3-4	29	
709.5'	55.5'								
708.5'	56.5'	SILTY SAND, gray, wet, medium dense, fine grained, rounded, well graded		SPT-37	55.0 - 56.5	1.5	3-3-4	20	
707.0'	58.0'			SPT-38	56.5 - 58.0	0.6	5-6-8	20	
705.5'	59.5'	SAND, gray, wet, medium dense, fine grained, rounded, well graded		SPT-39	58.0 - 59.5	0.9	12-20-14	22	
		SAND, tan gray, wet, medium dense, fine grained, rounded, well graded, with Red, soft, clay at 59.5 feet, and gray weathered shale at 61 feet		SPT-40	59.5 - 60.4	0.5	12-50/0.4	27	Began Core
699.0'	66.0'			0%	5.0	0.3	6	66.0	
		Sandstone, brown, fine grained, hard, thin bedded, quartz		0%	2.0	2.0	100	68.0	
		Shale, gray, very fine grained, very soft, thin bedded, argillaceous		0%	3.0	3.0	100	71.0	Artesian flow conditions
				0%	5.0	5.0	100	76.0	
									Boring backfilled with bentonite cement

7/16/09

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SUBSURFACE LOG

Project No. 175569042 Location N 556162.76, E 2442251.63 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-10** Total Depth 81.0 ft

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
									grout from 0.0 feet to 81.0 feet
684.0'	81.0'			0%	5.0	5.0	100	81.0	

Bottom of Hole

Top of Rock = 59.5'
Elevation (705.5')

WOH = Weight of Hammer
WOR = Weight of Rod

7/16/09

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Project 171468117 Kingston Ash Pond
Sheet No. 1 of 1 Date 4/21/2009
Hole # STN-10 Rig # 705

Northing 556,162.76 Surface Elevation (ft.) 765.0 Crew Wilks / Clements

Easting 2,442,251.63 Top of Rock Elev. (ft.) 705.5 Inspector Greg Budd

Boring Size 3 1/4 Hollow Stem Augers Pump Capacity 21 gpm Meter Type Sensus 5/8" SR II

Test Method US Bureau of Reclamation Static Water Level 9.0' Meter # 67290595

Test Section		Gauge Reading (PSI)	Time of Test			Meter Reading		Total Water (Gal / Cu Ft)	CFM
Top Depth	Bottom Depth		Start	End	Interval (min-sec)	Start of Test	End of Test		
62.5	71.0	35	0:00	1:00	1:00	278.18	278.60	0.42	0.42
		35	1:00	2:00	1:00	278.60	279.02	0.42	0.42
		35	2:00	3:00	1:00	279.02	279.46	0.44	0.44
		35	3:00	4:00	1:00	279.46	279.82	0.36	0.36
		35	4:00	5:00	1:00	279.82	280.23	0.41	0.41
		35	5:00	6:00	1:00	280.23	280.64	0.41	0.41
		35	6:00	7:00	1:00	280.64	281.04	0.40	0.40
		35	7:00	8:00	1:00	281.04	281.44	0.40	0.40
		35	8:00	9:00	1:00	281.44	281.86	0.42	0.42
		35	9:00	10:00	1:00	281.86	282.16	0.30	0.30
		35	10:00	11:00	1:00	282.16	282.47	0.31	0.31
		35	11:00	12:00	1:00	282.47	282.77	0.30	0.30
		35	12:00	13:00	1:00	282.77	283.06	0.29	0.29
		35	13:00	14:00	1:00	283.06	283.35	0.29	0.29
		35	14:00	15:00	1:00	283.35	283.65	0.30	0.30
71.0	81.0	35	0:00	1:00	1:00	283.45	283.56	0.11	0.11
		35	1:00	2:00	1:00	283.56	283.66	0.10	0.10
		35	2:00	3:00	1:00	283.66	283.75	0.09	0.09
		35	3:00	4:00	1:00	283.75	283.86	0.11	0.11
		35	4:00	5:00	1:00	283.86	283.96	0.10	0.10

Project # 171468117 Hole # STN-10 Inspector Greg Budd Date 4/21/2009

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SUBSURFACE LOG

Project No.	175569042	Location	N 556034.83, E 2442535.05 (NAD27)		
Project Name	Kingston Ash Pond	Boring No.	STN-11	Total Depth	62.0 ft
Location	Kingston, Tennessee	Surface Elevation	763.2 ft. (NGVD29)		
Project Type	Geotechnical Exploration	Date Started	5/12/09	Completed	5/13/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	18.5 ft	Date/Time	5/12/09
Logged By	Brad Smiley	Automatic Hammer ☒	Safety Hammer ☐	Other ☐	

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
763.2'	0.0'	Top of Hole							
761.7'	1.5'	FAT CLAY (Fill), red brown, moist, stiff, some cobbles		SPT-1	0.0 - 1.5	1.5	7-11-12	19	Boring advanced using 4 1/4 " Hollow Stem Augers
		FLY ASH (Fill), dark gray to black, moist, dense to very dense		SPT-2	1.5 - 2.9	1.4	21-46-33/0.4	17	
				SPT-3	3.0 - 4.5	1.5	20-19-20	18	
				SPT-4	4.5 - 6.0	0.9	5-12-12	19	
755.7'	7.5'			SPT-5	6.0 - 7.5	1.2	8-8-11	22	
		LEAN CLAY (Fill), red brown, moist, stiff		SPT-6	7.5 - 9.0	1.3	3-6-7	24	
				SPT-7	9.0 - 10.5	1.2	4-6-6	25	
				SPT-8	10.5 - 12.0	1.4	3-5-4	25	
750.2'	13.0'			SPT-9	12.0 - 13.5	1.4	9-14-10	20	
748.2'	15.0'	BOTTOM ASH (Fill), black, saturated, dense		SPT-10	13.5 - 15.0	1.3	5-20-24	18	
		FLY ASH (Fill), gray to black, saturated, dense to very dense		SPT-11	15.0 - 16.5	1.3	16-10-19	24	Water added at 15.0 ft to keep augers clear
				SPT-12	16.5 - 18.0	1.4	11-16-21	22	
				SPT-13	18.0 - 19.5	1.5	5-11-13	19	
				SPT-14	19.5 - 21.0	1.3	2-5-6	23	
				SPT-15	21.0 - 22.5	1.1	5-12-8	24	
				SPT-16	22.5 - 24.0	1.4	2-3-6	25	
737.7'	25.5'			SPT-17	24.0 - 25.5	0.8	2-1-4	23	
		BOTTOM ASH (Fill), black, saturated, very loose to loose		SPT-18	25.5 - 27.0	0.5	1-2-2	21	
				SPT-19	27.0 - 28.5	1.2	4-6-4	24	
				SPT-20	28.5 - 30.0	0.8	2-1-WOH	38	
				SPT-21	30.0 - 31.5	0.3	WOR-WOR-WOR	23	
730.2'	33.0'			SPT-22	31.5 - 33.0	0.9	3-4-2	36	
		SILTY SAND with Clay, brown, saturated, loose to very loose, some clay		SPT-23	33.0 - 34.5	1.1	1-1-1	27	
				SPT-24	34.5 - 36.0	1.0	1-1-1	29	

7/15/09

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SUBSURFACE LOG

Project No. 175569042 Location N 556034.83, E 2442535.05 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-11** Total Depth 62.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		SILTY SAND with Clay, brown, saturated, loose to very loose, some clay *(Continued)*		SPT-25	36.0 - 37.5	0.7	1-1-WOH	20	
				SPT-26	37.5 - 39.0	1.3	WOH-WOH-WOH	20	
				SPT-27	39.0 - 40.5	1.5	WOH-WOH-WOH	24	
				SPT-28	40.5 - 42.0	1.5	WOR-WOR-WOR	23	
				SPT-29	42.0 - 43.5	1.5	WOH-WOH-WOH	21	
				SPT-30	43.5 - 45.0	1.2	WOH-WOH-WOH	18	
				SPT-31	45.0 - 46.5	1.0	WOH-WOH-WOH	23	
				SPT-32	46.5 - 48.0	1.5	WOH-WOH-WOH	24	
				SPT-33	48.0 - 49.5	1.5	WOR-WOR-2	22	
				SPT-34	49.5 - 51.0	1.5	WOR-WOR-WOH	22	
711.2'	52.0'			SPT-35	51.0 - 52.5	1.5	WOH-WOH-4	19	
		SAND, brown, saturated, medium dense to dense, fine to medium grained		SPT-36	52.5 - 54.0	1.0	4-8-6	20	
				SPT-37	54.0 - 55.5	1.5	4-6-9	23	
				SPT-38	55.5 - 57.0	1.5	2-3-2	22	
704.7'	58.5'			SPT-39	57.0 - 58.5	1.5	3-7-7	--	Boring backfilled with bentonite cement grout from 0.0 ft to 62.0 ft
		Sandstone (Augered)		SPT-40	58.5 - 60.0	1.5	4-14-19	--	
701.7'	61.5'			SPT-41	60.0 - 61.5	1.5	27-30-34	--	
701.2'	62.0'	Shale (Augered)		SPT-42	61.5 - 62.0	0.3	50-10/0.0	--	

Auger Refusal / Bottom of Hole

WOH = Weight of Hammer
WOR = Weight of Rods

SUBSURFACE LOG

Project No.	175569042	Location	N 555873.09, E 2442622.48 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-12 Total Depth 62.0 ft
Location	Kingston, Tennessee	Surface Elevation	765.1 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/12/09 Completed 5/12/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Brad Smiley	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
765.1'	0.0'	Top of Hole							
764.6'	0.5'	GRAVEL (Fill)		SPT-1	0.0 - 1.5	1.0	8-9-12	18	Boring advanced using 4 1/4 " Hollow Stem Augers
		FAT CLAY (Fill), red brown to brown, moist, medium stiff to stiff, some chert		SPT-2	1.5 - 3.0	0.7	12-16-15	19	
				SPT-3	3.0 - 4.5	1.5	10-14-12	27	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
				SPT-4	4.5 - 6.0	0.9	9-8-7	24	
				SPT-5	6.0 - 7.5	1.5	9-11-10	28	
				SPT-6	7.5 - 9.0	0.3	3-4-5	22	
				SPT-7	9.0 - 10.5	1.2	11-11-12	27	
				SPT-8	10.5 - 12.0	1.2	2-5-6	20	
				ST-1	12.0 - 14.0	1.0		--	
				SPT-9	14.0 - 15.5	0.7	1-5-6	25	
				SPT-10	15.5 - 17.0	1.5	12-11-11	26	
				SPT-11	17.0 - 18.5	1.4	6-4-6	29	
				SPT-12	18.5 - 20.0	1.1	4-5-4	27	
				SPT-13	20.0 - 21.5	0.9	3-2-2	25	
				SPT-14	21.5 - 23.0	1.5	2-2-3	28	
740.6'	24.5'			SPT-15	23.0 - 24.5	1.4	7-10-11	23	SPT-15: bottom ash in tip of spoon
		SAND (Fill), dark gray, moist to saturated, medium dense, fine grained, some clay, some silt		SPT-16	24.5 - 26.0	1.5	2-3-8	30	
				SPT-17	26.0 - 27.5	1.5	10-9-9	22	
				SPT-18	27.5 - 29.0	1.5	6-3-3	21	
				ST-2	29.0 - 31.0	0.0		--	
				SPT-19	31.0 - 32.5	1.3	2-1-1	21	
				SPT-20	32.5 - 34.0	1.1	1-WOR-WOR	18	
729.6'	35.5'			SPT-21	34.0 - 35.5	1.5	WOR-1-3	20	Water added at 35.0 ft to keep augers clear
				SPT-22	35.5 - 37.0	1.5	3-5-6	21	

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SUBSURFACE LOG

Project No. 175569042 Location N 555873.09, E 2442622.48 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-12** Total Depth 62.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SILTY CLAY, brown to gray, saturated, soft to medium stiff, some fine grained sand *(Continued)*		SPT-23	37.0 - 38.5	1.5	3-5-7	23	
				SPT-24	38.5 - 40.0	1.5	WOR-3-3	21	
				SPT-25	40.0 - 41.5	1.5	3-4-5	23	
				SPT-26	41.5 - 43.0	1.5	3-4-4	24	
				SPT-27	43.0 - 44.5	1.5	3-3-4	19	
				SPT-28	44.5 - 46.0	1.5	WOH-WOH-WOH	20	
				SPT-29	46.0 - 47.5	1.5	WOH-WOH-WOH	23	
716.1'	49.0'			SPT-30	47.5 - 49.0	1.2	3-4-4	22	
		SAND, brown to light brown, saturated, loose, fine to coarse grained, some, clay		SPT-31	49.0 - 50.5	1.5	WOR-WOR-WOR	20	
				SPT-32	50.5 - 52.0	1.5	WOH-WOH-WOH	19	
				SPT-33	52.0 - 53.5	1.5	WOR-WOR-2	19	
710.6'	54.5'			SPT-34	53.5 - 55.0	1.4	WOR-WOR-4	18	
709.6'	55.5'	SAND with Silt, dark gray, saturated, very loose		SPT-35	55.0 - 56.5	1.5	7-11-12	20	
		SAND, brown to gray, saturated, medium dense, medium to coarse grained, some cobbles		SPT-36	56.5 - 58.0	1.3	7-11-13	21	Boring backfilled with bentonite cement grout from 0.0 ft to 62.0 ft
				SPT-37	58.0 - 59.5	1.5	3-5-9	20	
704.1'	61.0'			SPT-38	59.5 - 61.0	0.8	7-7-7	19	
703.1'	62.0'			SPT-39	61.0 - 62.0	0.5	16-50/0.3	14	
		Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

7/16/09

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SUBSURFACE LOG

Project No.	175569042	Location	N 555685.58, E 2442733.21 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-14 Total Depth 51.0 ft
Location	Kingston, Tennessee	Surface Elevation	753.1 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/9/09 Completed 4/9/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	17.0 ft Date/Time 4/9/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
753.1'	0.0'	Top of Hole							
		LEAN CLAY (Fill), red brown, moist, medium stiff		SPT-1	0.0 - 1.5	1.0	3-3-4	20	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.0	3-5-9	19	
748.6'	4.5'			SPT-3	3.0 - 4.5	1.2	4-9-9	22	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
		BOTTOM ASH (Fill), black, saturated, medium dense		SPT-4	4.5 - 6.0	1.3	4-19-28	13	
746.6'	6.5'			SPT-5	6.0 - 7.5	1.0	17-15-15	16	
		LEAN CLAY (Fill), light brown, moist, stiff, trace fine grained sand		SPT-6	7.5 - 9.0	0.8	10-11-12	19	
744.1'	9.0'								
		LEAN CLAY (Fill), light brown, moist, soft, trace fine grained sand		ST-1	9.0 - 11.0	1.0		–	
				SPT-7	11.0 - 12.5	0.5	1-1-2	21	
				SPT-8	12.5 - 14.0	0.5	1-2-1	22	
				ST-2	14.0 - 16.0	1.0		–	
				SPT-9	16.0 - 17.5	1.0	WOH-1-2	25	
735.1'	18.0'								
734.1'	19.0'	SAND, light brown, saturated, very loose, fine grained		SPT-10	17.5 - 19.0	0.7	WOH-2-1	19	
				SPT-11	19.0 - 20.5	1.0	WOR-WOH-WOH	21	
732.1'	21.0'	SAND, light brown, saturated, very loose, fine grained, some clayey silt		SPT-12	20.5 - 22.0	1.3	1-2-3	25	
				SPT-13	22.0 - 23.5	1.3	1-2-2	24	
		SILTY CLAY, brown, moist, soft, some fine grained sand		ST-3	23.5 - 25.5	2.0		–	ST-3: sand in bottom of tube
728.1'	25.0'								Water added at 25.0 ft to keep augers clear
		SAND, light brown, saturated, very loose to loose, fine to medium grained, trace silt		SPT-14	25.5 - 27.0	1.2	WOH-2-3	19	
				SPT-15	27.0 - 28.5	1.1	WOH-1-1	21	
				SPT-16	28.5 - 30.0	1.3	1-1-1	20	
				SPT-17	30.0 - 31.5	1.2	WOR-WOH-1	22	
				SPT-18	31.5 - 33.0	1.1	WOH-1-1	20	
				SPT-19	33.0 - 34.5	1.0	WOR-WOH-2	22	
				SPT-20	34.5 - 36.0	1.1	WOH-1-1	24	

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SUBSURFACE LOG

Project No. 175569042 Location N 555685.58, E 2442733.21 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-14** Total Depth 51.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SAND, light brown, saturated, very loose to loose, fine to medium grained, trace silt *(Continued)*		SPT-21	36.0 - 37.5	1.2	2-4-3	19	
				SPT-22	37.5 - 39.0	1.3	1-3-4	20	
				SPT-23	39.0 - 40.5	1.3	WOH-2-3	20	
				SPT-24	40.5 - 42.0	0.9	WOH-1-2	22	
				SPT-25	42.0 - 43.5	1.0	2-3-2	26	
				SPT-26	43.5 - 45.0	0.8	2-1-5	22	
				SPT-27	45.0 - 46.5	1.3	2-6-11	20	SPT-27: sandstone in tip of spoon SPT-29: shale in tip of spoon
706.1'	47.0'			SPT-28	46.5 - 48.0	1.4	22-39-29	--	
703.6'	49.5'	Sandstone, (Augered)		SPT-29	48.0 - 49.5	0.1	16-25-35	--	Boring backfilled with bentonite cement grout from 0.0 ft to 51.0 ft
702.1'	51.0'			SPT-30	49.5 - 50.9	1.2	29-49-50/0.4	--	
		Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

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SUBSURFACE LOG

Project No.	175569042	Location	N 555687.58, E 2442734.21 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-14A** Total Depth 18.5 ft
Location	Kingston, Tennessee	Surface Elevation	753.1 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/16/09 Completed 4/16/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	N/A Date/Time N/A
Logged By	Ben Halada	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
753.1'	0.0'	Top of Hole							
		OVERBURDEN, See log for STN-14							Boring advanced using 3 1/4 " Hollow Stem Augers
734.6'	18.5'	No Refusal / Bottom of Hole							

PZ Installed, tip at elevation 737.6'

Flushmount well cover and concrete pad installed.

7/15/09

SUBSURFACE LOG

Project No.	175569042	Location	N 555662.69, E 2442667.52 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-15 Total Depth 58.9 ft
Location	Kingston, Tennessee	Surface Elevation	763.7 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/16/09 Completed 4/17/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	15.0 ft Date/Time 4/16/09
Logged By	Briggs Evans	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
763.7'	0.0'	Top of Hole							
763.2'	0.5'	LEAN CLAY (Fill), red brown, dry to moist, stiff to very stiff, little chert, trace gravel		SPT-1	0.0 - 1.5	1.2	6-31-40	18	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 1.9	0.4	50/0.4	18	
		FLY ASH (Fill), dark grey, dry to moist, dense		SPT-3	3.0 - 4.4	1.0	22-45-33/0.4	18	
				SPT-4	4.5 - 6.0	1.0	12-31-31	19	
757.0'	6.8'			SPT-5	6.0 - 7.5	1.5	6-6-21	16	
756.2'	7.5'	LEAN CLAY (Fill), red brown, moist, stiff, little chert, trace gravel		SPT-6	7.5 - 9.0	1.5	5-5-5	18	
754.7'	9.0'	FLY ASH (Fill), dark gray, moist, dense		SPT-7	9.0 - 10.5	0.8	4-4-4	22	
		FAT CLAY (Fill), red, moist, stiff, little chert, trace gravel		SPT-8	10.5 - 12.0	1.2	4-7-9	31	
				ST-1	12.0 - 14.0	2.0		--	
749.2'	14.5'			SPT-9	14.0 - 15.5	1.5	21-43-36	16	
		BOTTOM ASH (Fill), dark gray, wet to saturated, medium dense to loose, some fly ash		SPT-10	15.5 - 17.0	1.5	6-13-13	17	
				SPT-11	17.0 - 18.5	1.5	13-15-8	28	
				SPT-12	18.5 - 20.0	1.5	WOH-2-3	29	Saturated at 20ft bgs
				SPT-13	20.0 - 21.5	1.5	2-3-3	30	
				SPT-14	21.5 - 23.0	1.0	1-1-1	26	Begin adding water at 21.5ft bgs to control blow-back
				SPT-15	23.0 - 24.5	1.5	3-3-4	26	
				SPT-16	24.5 - 26.0	0.5	3-1-2	35	
				SPT-17	26.0 - 27.5	1.5	3-1-2	39	
				SPT-18	27.5 - 29.0	1.0	10-6-8	21	
733.7'	30.0'			SPT-19	29.0 - 30.5	1.5	7-5-5	21	
733.2'	30.5'	SANDY SILT, brown, saturated, soft to very soft, with fine grained sand		SPT-20	30.5 - 32.0	1.0	2-3-3	22	
				SPT-21	32.0 - 33.5	0.8	3-2-2	20	
730.2'	33.5'	SILTY SAND, brown, wet, medium dense to very loose, fine to medium grained, trace clay		SPT-22	33.5 - 35.0	1.0	3-3-5	22	
				SPT-23	35.0 - 36.5	1.5	5-5-7	21	

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SUBSURFACE LOG

Project No. 175569042 Location N 555662.69, E 2442667.52 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-15** Total Depth 58.9 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SANDY SILT, brown, saturated, soft to medium stiff, with fine grained sand, trace clay *(Continued)*		SPT-24	36.5 - 38.0	1.5	5-5-7	19	
724.2'	39.5'			SPT-25	38.0 - 39.5	1.5	3-3-5	17	
		SAND, brown, saturated, loose to very loose, fine grained, some silt		SPT-26	39.5 - 41.0	1.5	4-3-1	18	
				SPT-27	41.0 - 42.5	1.5	4-3-2	20	
				SPT-28	42.5 - 44.0	1.5	4-4-3	22	
				SPT-29	44.0 - 45.5	1.5	4-5-7	21	
				SPT-30	45.5 - 47.0	1.5	3-3-7	22	
				SPT-31	47.0 - 48.5	1.5	3-5-5	23	
				SPT-32	48.5 - 50.0	1.5	WOR-WOR-WOR	23	
712.7'	51.0'			SPT-33	50.0 - 51.5	1.5	8-9-8	24	
		SAND, brown, saturated, loose to medium dense, fine grained, trace silt		SPT-34	51.5 - 53.0	0.8	5-5-4	21	
				SPT-35	53.0 - 54.5	0.8	29-27-18	21	Sandstone layer 53.5 to 53.6 ft bgs
				SPT-36	54.5 - 56.0	1.0	7-12-10	23	
706.2'	57.5'			SPT-37	56.0 - 57.4	1.4	7-30-50/0.4	15	Sandstone layers - 57.0 to 57.1 & 57.3 to 57.4 ft bgs
704.8'	58.9'			SPT-38	57.5 - 58.9	1.4	33-40-27/0.4	–	
		Sandstone, (Augered)							
		Auger Refusal / Bottom of Hole							Boring backfilled with bentonite grout from 58.9ft to surface
		Top of Rock = 57.5' Elevation (706.2')							

7/15/09

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SUBSURFACE LOG

Project No.	175569042	Location	N 555669.72, E 2442691.43 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-15A** Total Depth 30.0 ft
Location	Kingston, Tennessee	Surface Elevation	765.3 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/29/09 Completed 5/1/09
Supervisor	Ben Hafada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Adam Smith	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
765.3'	0.0'	Top of Hole							
		OVERBURDEN, (Augered without sampling) See Log for STN-15							Boring advanced using 4 1/4 " Hollow Stem Augers
735.3'	30.0'	No Refusal / Bottom of Hole							

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SUBSURFACE LOG

Project No.	175569042	Location	N 555669.72, E 2442691.43 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-15A** Total Depth 30.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks

Two PZ's installed, tip at elevation 753.3' and 738.3'

Flushmount well cover and concrete pad installed.

SUBSURFACE LOG

Project No.	175569042	Location	N 555672.20, E 2442690.32 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-15B** Total Depth 58.0 ft
Location	Kingston, Tennessee	Surface Elevation	765.3 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/29/09 Completed 5/1/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Adam Smith	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
765.3'	0.0'	Top of Hole							
		OVERBURDEN, (Augered without sampling) See Log for STN-15							

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SUBSURFACE LOG

Project No. 175569042 Location N 555672.20, E 2442690.32 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-15B** Total Depth 58.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		OVERBURDEN, (Augered without sampling)							
		See Log for STN-15 *(Continued)*							
707.3'	58.0'	No Refusal / Bottom of Hole							
		PZ Installed, tip at elevation 710.3'							
		Flushmount well cover and concrete pad installed.							

DWN_LEGACY 175569117 KINGSTON ASH POND 2010 PROJECT 7/16/09

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SUBSURFACE LOG

Project No.	175569042	Location	N 555671.50, E 2442690.88 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-15C** Total Depth 35.0 ft
Location	Kingston, Tennessee	Surface Elevation	765.3 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/7/09 Completed 5/7/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Brad Smiley	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
765.3'	0.0'	Top of Hole							
		OVERBURDEN, (Augered without sampling) See Log for STN-15							Boring advanced using 4 1/4 " Hollow Stem Augers Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
740.3'	25.0'								
		SILT, dark brown to red brown, saturated, soft, some fine grained sand, some clay		ST-1	25.0 - 27.0	1.1		–	
				ST-2	27.0 - 29.0	2.0		–	
				ST-3	29.0 - 31.0	2.0		--	
734.3'	31.0'								
		LEAN CLAY, dark gray to brown, saturated, soft, some silt, trace fine grained sand		ST-4	31.0 - 33.0	1.7		–	Boring backfilled with bentonite cement grout from 0.0 ft to 35.0 ft
				ST-5	33.0 - 35.0	2.0		--	
730.3'	35.0'								
		No Refusal / Bottom of Hole							

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SUBSURFACE LOG

Project No.	175569042	Location	N 555665.72, E 244289.78 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-15D** Total Depth 35.0 ft
Location	Kingston, Tennessee	Surface Elevation	765.3 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/8/09 Completed 5/8/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Brad Smiley	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. %	Blows	Mois.Cont. % / Run Depth	Remarks
765.3'	0.0'	Top of Hole							
		OVERBURDEN, (Augered without sampling) See Log for STN-15							Boring advanced using 4 1/4 " Hollow Stem Augers Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
740.3'	25.0'								
		Bottom Ash, black, saturated, loose		ST-1	25.0 - 27.0	0.7		–	
736.3'	29.0'			ST-2	27.0 - 29.0	1.7		–	
		LEAN CLAY, gray to dark brown, saturated, soft, some silt		ST-3	29.0 - 31.0	1.7		–	
				ST-4	31.0 - 33.0	2.0		–	Boring backfilled with bentonite cement grout from 0.0 ft to 35.0 ft
730.3'	35.0'			ST-5	33.0 - 35.0	2.0		–	
		No Refusal / Bottom of Hole							

7/16/09

Stantec

SUBSURFACE LOG

Project No.	175569042	Location	N 555501.40, E 2442725.94 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-16** Total Depth 58.5 ft
Location	Kingston, Tennessee	Surface Elevation	764.5 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/12/09 Completed 5/13/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	21.0 ft Date/Time 5/13/09
Logged By	Greg Budd	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
764.5'	0.0'	Top of Hole							
764.3'	0.2'	GRAVEL (Fill), light gray, dry, road material		SPT-1	0.0 - 1.5	0.9	3-9-32	23	
763.5'	1.0'	LEAN CLAY (Fill), red, dry, very stiff, hard		SPT-2	1.5 - 1.9	0.2	50/0.4	19	
				SPT-3	3.0 - 4.5	0.5	10-13-27	19	
		BOTTOM ASH (Fill), gray black, dry, loose to medium dense, with fly ash		SPT-4	4.5 - 6.0	0.5	14-14-20	18	
758.0'	6.5'			SPT-5	6.0 - 7.5	1.0	3-4-5	25	
		FAT CLAY (Fill), red, stiff, with tan and white chert, dry to moist		SPT-6	7.5 - 9.0	1.0	6-6-10	27	
				SPT-7	9.0 - 10.5	1.5	7-8-8	30	
				SPT-8	10.5 - 12.0	1.3	10-12-13	32	
				SPT-9	12.0 - 13.5	0.6	3-3-5	23	
				SPT-10	13.5 - 15.0	0.8	10-10-10	27	
				SPT-11	15.0 - 16.2	0.0	35-32-33/0.2	–	
746.0'	18.5'			SPT-12	16.5 - 17.9	0.1	49-44-7/0.4	22	
		BOTTOM ASH (Fill), black gray, saturated, loose to medium dense, with fly ash, and gravel size coal refuse		SPT-13	18.0 - 19.5	0.1	4-3-8	20	
				SPT-14	19.5 - 21.0	0.1	WOR-WOR-WOR	18	
				SPT-15	21.0 - 22.5	1.5	5-4-4	25	
				SPT-16	22.5 - 24.0	1.5	4-3-3	22	
				SPT-17	24.0 - 25.5	0.7	2-2-2	18	
				SPT-18	25.5 - 27.0	0.5	5-4-3	16	
				SPT-19	27.0 - 28.5	1.0	4-3-3	19	
734.0'	30.5'			SPT-20	28.5 - 30.0	1.0	5-5-5	18	
		SAND, light brown, saturated, loose, fine grained, well rounded, well graded, trace silt		SPT-21	30.0 - 31.5	1.5	4-4-6	25	
731.5'	33.0'			SPT-22	31.5 - 33.0	1.1	3-4-5	21	
		SILTY SAND, light brown, saturated, soft to medium dense, with fine grained sand		SPT-23	33.0 - 34.5	1.5	3-5-5	20	
				SPT-24	34.5 - 36.0	0.7	3-5-6	19	

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SUBSURFACE LOG

Project No. 175569042 Location N 555501.40, E 2442725.94 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-16** Total Depth 58.5 ft

Lithology		Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
Elevation	Depth								
		SILTY SAND, light brown, saturated, soft to medium dense, with fine grained sand *(Continued)*		SPT-25	36.0 - 37.5	1.5	3-3-5	17	
				SPT-26	37.5 - 39.0	1.2	3-4-5	20	
				ST-ST-1	39.0 - 41.0	2.0		–	
723.5'	41.0'								
		SAND, brown, saturated, loose to very dense, fine grained, well rounded, well graded, trace silt		SPT-27	41.0 - 42.5	1.5	3-2-4	18	
				SPT-28	42.5 - 44.0	1.5	1-1-2	20	
				SPT-29	44.0 - 45.5	1.5	5-8-9	20	
				SPT-30	45.5 - 47.0	1.5	8-8-9	21	
				SPT-31	47.0 - 48.5	1.5	5-5-6	22	
				SPT-32	48.5 - 50.0	1.5	5-6-6	24	
				SPT-33	50.0 - 51.5	1.5	10-15-12	22	
				SPT-34	51.5 - 53.0	1.5	6-8-10	21	
				SPT-35	53.0 - 54.5	1.5	7-9-11	20	
				SPT-36	54.5 - 56.0	1.5	11-15-17	22	
				SPT-37	56.0 - 57.5	1.5	9-12-14	22	
706.5'	58.0'			SPT-38	57.5 - 58.5	1.0	49-50/0.5	–	
706.0'	58.5'	Sandstone, (augered)							
		Auger Refusal / Bottom of Hole							

Stantec

SUBSURFACE LOG

Project No.	175569042	Location	N 555204.87, E 2442894.11 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-18 Total Depth 71.5 ft
Location	Kingston, Tennessee	Surface Elevation	751.0 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/14/09 Completed 4/15/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	13.0 ft Date/Time 4/15/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
751.0'	0.0'	Top of Hole							
		LEAN CLAY (Fill), red brown, moist, soft to medium stiff		SPT-1	0.0 - 1.5	1.1	4-4-4	23	Boring advanced using 3 1/4 " Hollow Stem Augers
748.5'	2.5'			SPT-2	1.5 - 3.0	1.2	9-10-22	18	
		BOTTOM ASH 65% / FLY ASH 35% (Fill), black, moist to saturated, loose to medium dense		SPT-3	3.0 - 4.5	1.0	10-11-11	13	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
				SPT-4	4.5 - 6.0	1.1	3-7-6	9	
				SPT-5	6.0 - 7.5	1.0	3-7-15	7	
				SPT-6	7.5 - 9.0	1.0	5-7-13	12	
				SPT-7	9.0 - 10.5	1.1	3-4-3	9	
				SPT-8	10.5 - 12.0	1.0	6-6-7	13	
				SPT-9	12.0 - 13.5	1.0	3-4-4	14	
				SPT-10	13.5 - 15.0	0.9	2-3-3	16	
735.0'	16.0'			SPT-11	15.0 - 16.5	0.9	4-3-1	26	
		SAND, light brown, saturated, very loose, fine grained, trace silt		SPT-12	16.5 - 18.0	1.2	1-WOH-WOH	18	
				SPT-13	18.0 - 19.5	0.2	1-WOH-WOH	18	Water added at 18.0 ft to keep augers clear
				SPT-14	19.5 - 21.0	0.9	1-WOH-1	17	
				SPT-15	21.0 - 22.5	1.0	1-WOH-WOH	17	
727.0'	24.0'			SPT-16	22.5 - 24.0	1.1	2-1-1	16	
		SILTY CLAY, light brown, saturated, very soft, some fine grained sand, some silt		SPT-17	24.0 - 25.5	0.3	2-WOH-1	23	
723.5'	27.5'			ST-1	25.5 - 27.5	2.0		–	
		SAND, light brown, saturated, loose, fine to medium grained, trace silt		SPT-18	27.5 - 29.0	1.5	2-3-3	18	
				SPT-19	29.0 - 30.5	1.4	2-5-4	22	
719.0'	32.0'			SPT-20	30.5 - 32.0	1.1	4-5-4	19	
		SAND, brown, saturated, loose, fine grained, some silt, some clay		SPT-21	32.0 - 33.5	1.2	4-4-3	20	
717.0'	34.0'			SPT-22	33.5 - 35.0	1.3	WOH-WOH-WOH	19	
		SAND, light gray to gray, saturated, very loose, fine grained, some silt		SPT-23	35.0 - 36.5	1.0	WOH-WOH-WOH	19	

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SUBSURFACE LOG

Project No. 175569042 Location N 555204.87, E 2442894.11 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-18** Total Depth 71.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SAND, light gray to gray, saturated, very loose, fine grained, some silt *(Continued)*		SPT-24	36.5 - 38.0	1.5	WOH-1-1	18	
				SPT-25	38.0 - 39.5	1.0	1-2-2	18	
				SPT-26	39.5 - 41.0	1.1	2-3-1	18	
				SPT-27	41.0 - 42.5	0.7	1-3-1	18	
707.0'	44.0'			SPT-28	42.5 - 44.0	0.8	2-3-4	21	
		SAND, light gray to gray, moist, dense to very dense, fine grained, some fine to medium gravel		SPT-29	44.0 - 45.5	1.1	4-12-16	12	
				SPT-30	45.5 - 47.0	0.9	33-32-31	12	SPT-30: sandstone in tip of spoon
				SPT-31	47.0 - 48.5	1.1	25-27-30	12	
702.5'	48.5'			SPT-32	48.5 - 49.0	0.5	50-10/0.0	8	
700.5'	50.5'	Shale, (Augered)							Began Core
		Shale, dark gray, very fine to fine grained, very soft, very thin bedded, with very thin to thin limestone layers, 30° to 45° bedding angle		0%	6.0	0.7	12	56.5	
				0%	5.0	1.3	26	61.5	
				0%	5.0	0.0	0	66.5	
									Boring backfilled with bentonite cement grout from 0.0 ft to 71.5 ft
679.6'	71.5'			8%	5.0	1.4	28	71.5	
		Bottom of Hole Top of Rock = 48.5' Elevation (702.5')							

DATA LEGACY 175569042 KINGSTON ASH POND.GPJ 7/16/09

Stantec

SUBSURFACE LOG

Project No.	175569042	Location	N 555204.87, E 2442894.11 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-18 Total Depth 71.5 ft

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	

WOH = Weight of Hammer
WOR = Weight of Rods

Split Samples: SPT-2, 11 and 22

Slope Indicator (60 ft of pipe) installed with a concrete pad and flushmount cover

Stantec

Project 171468117 Kingston Ash Pond
Sheet No. 1 of 1 Date 4/15/2009
Hole # STN-18 Rig # 710

Northing 555,204.87 Surface Elevation (ft.) 751.0 Crew Kent Clements / Greg Wilson

Easting 2,442,894.11 Top of Rock Elev. (ft.) 702.5 Inspector Benjamin A. Halada

Boring Size 3 1/4 Hollow Stem Augers Pump Capacity 21 gpm Meter Type Sensus 5/8" SR II

Test Method US Bureau of Reclamation Static Water Level 13.0' Meter # 67290595

Test Section		Gauge Reading (PSI)	Time of Test			Meter Reading		Total Water (Gal / Cu Ft)	CFM
Top Depth	Bottom Depth		Start	End	Interval (min-sec)	Start of Test	End of Test		
52.0	61.5	30	0:00	1:00	1:00	246.20	246.64	0.44	0.44
		30	1:00	2:00	1:00	246.64	247.07	0.43	0.43
		30	2:00	3:00	1:00	247.07	247.49	0.42	0.42
		30	3:00	4:00	1:00	247.49	247.91	0.42	0.42
		30	4:00	5:00	1:00	247.91	248.34	0.43	0.43
		30	5:00	6:00	1:00	248.34	248.76	0.42	0.42
		30	6:00	7:00	1:00	248.76	249.25	0.49	0.49
		30	7:00	8:00	1:00	249.25	249.78	0.53	0.53
		30	8:00	9:00	1:00	249.78	250.28	0.50	0.50
		30	9:00	10:00	1:00	250.28	250.79	0.51	0.51
		30	10:00	11:00	1:00	250.79	251.29	0.50	0.50
		30	11:00	12:00	1:00	251.29	251.79	0.50	0.50
		30	12:00	13:00	1:00	251.79	252.29	0.50	0.50
		30	13:00	14:00	1:00	252.29	252.80	0.51	0.51
		30	14:00	15:00	1:00	252.80	253.30	0.5	0.5
61.5	71.5	35	0:00	1:00	1:00	253.15	253.15	0.00	0.00
		35	1:00	2:00	1:00	253.15	253.16	0.01	0.01
		35	2:00	3:00	1:00	253.16	253.16	0.00	0.00
		35	3:00	4:00	1:00	253.16	253.16	0.00	0.00
		35	4:00	5:00	1:00	253.16	253.17	0.01	0.01

Project # Hole # STN-18 Inspector Benjamin A. Halada Date 4/15/2009

Stantec

SUBSURFACE LOG

Project No.	175569042	Location	N 555204.68, E 2442842.94 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-19 Total Depth 65.0 ft
Location	Kingston, Tennessee	Surface Elevation	765.6 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/1/09 Completed 4/1/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	23.0 ft Date/Time 4/1/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
765.6'	0.0'	Top of Hole							
765.1'	0.5'	GRAVEL (Fill)							
764.1'	1.5'	BOTTOM ASH (Fill), black, moist, loose		SPT-1	0.5 - 2.0	1.1	5-7-10	20	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	2.0 - 3.5	1.1	5-5-5	7	
		LEAN CLAY (Fill), red brown, moist, medium stiff, some chert		SPT-3	3.5 - 5.0	1.4	5-6-8	25	All ST samples recovered using a fixed head piston sampler
				ST-1	5.0 - 7.0	2.0		–	
				SPT-4	7.0 - 8.5	1.0	6-8-11	25	
				SPT-5	8.5 - 10.0	0.3	4-4-7	18	
				SPT-6	10.0 - 11.5	1.0	4-3-4	29	
				SPT-7	11.5 - 13.0	1.1	2-4-4	28	
				ST-2	13.0 - 15.0	1.5		–	
				SPT-8	15.0 - 16.5	0.2	4-6-4	24	
				SPT-9	16.5 - 18.0	0.0	10-15-16	–	
747.1'	18.5'								
746.6'	19.0'	GRAVEL (Fill), gray, moist, dense		SPT-10	18.0 - 19.5	1.3	11-18-20	12	
		Bottom Ash 65% / Fly Ash 35% (Fill), black, saturated, medium dense		SPT-11	19.5 - 21.0	1.1	6-10-13	12	
743.6'	22.0'			SPT-12	21.0 - 22.5	1.0	9-10-14	13	Water added at 22.0 ft to keep augers clear
		BOTTOM ASH (Fill), black, saturated, very loose to loose		SPT-13	22.5 - 24.0	1.2	6-6-5	22	
				SPT-14	24.0 - 25.5	1.1	3-5-6	19	
739.1'	26.5'			SPT-15	25.5 - 27.0	1.1	4-3-2	24	
		SAND, light brown, saturated, very loose to loose, fine grained		SPT-16	27.0 - 28.5	0.8	3-2-4	25	
				SPT-17	28.5 - 30.0	1.0	4-5-5	21	
				SPT-18	30.0 - 31.5	1.1	3-3-1	22	
				SPT-19	31.5 - 33.0	1.2	3-2-3	23	
731.6'	34.0'			SPT-20	33.0 - 34.5	1.1	WOR-WOR-WOR	17	
730.6'	35.0'	SAND, light brown, saturated, very loose, fine grained, trace silty clay		SPT-21	34.5 - 36.0	1.0	WOR-WOH-1	20	

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SUBSURFACE LOG

Project No. 175569042 Location N 555204.68, E 2442842.94 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-19** Total Depth 65.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
728.1'	37.5'	SAND, light brown, saturated, very loose, fine grained, clayey sand *(Continued)*		SPT-22	36.0 - 37.5	1.2	WOH-WOH-WOH	18	
				SPT-23	37.5 - 39.0	1.5	WOH-WOH-WOH	23	
724.6'	41.0'	SILTY CLAY, light red brown, saturated, very soft, trace fine grained sand		ST-3	39.0 - 41.0	2.0		–	ST-3: sand in bottom to tube
				SPT-24	41.0 - 42.5	1.2	WOR-4-5	19	
722.6'	43.0'	SAND, light brown, saturated, very loose, fine grained		SPT-25	42.5 - 44.0	1.1	2-4-5	17	
		SAND, light brown, saturated, loose, fine grained, clayey silt		SPT-26	44.0 - 45.5	1.0	1-2-3	19	
				SPT-27	45.5 - 47.0	1.3	1-2-2	18	
				SPT-28	47.0 - 48.5	1.2	2-4-4	19	
716.6'	49.0'			SPT-29	48.5 - 50.0	1.2	6-9-3	20	
714.6'	51.0'	SAND, light brown, saturated, loose, fine grained, trace silt		SPT-30	50.0 - 51.5	1.3	1-2-2	19	
		SAND, light brown, saturated, loose, fine grained		SPT-31	51.5 - 53.0	1.0	2-3-5	20	
				SPT-32	53.0 - 54.5	0.2	WOH-WOH-WOH	22	
710.6'	55.0'			SPT-33	54.5 - 56.0	1.0	WOH-WOH-WOH	21	
		SAND, light brown, saturated, loose, fine grained, trace silt		SPT-34	56.0 - 57.5	1.0	WOR-1-1	21	SPT-35: sandstone in tip of spoon
707.6'	58.0'			SPT-35	57.5 - 59.0	1.2	4-4-34	23	
		SAND, dark gray, saturated, dense, fine to coarse grained, some fine to coarse gravel		SPT-36	59.0 - 60.5	1.2	6-35-50	18	SPT-36: shale in tip of spoon
				SPT-37	60.5 - 62.0	1.1	13-24-28	14	
				SPT-38	62.0 - 63.5	1.1	19-22-24	16	Boring backfilled with bentonite cement grout from 0.0 ft to 65.0 ft
701.1'	64.5'			SPT-39	63.5 - 64.9	0.9	14-28-50/0.4	11	
700.6'	65.0'	Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

PWM_LEGACY 1711881177 KINGSTON ASH POND.GPJ ENGLISH.GDT 7/14/09

Stantec

SUBSURFACE LOG

Project No.	175569042	Location	N 555168.84, E 2442666.59 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-20 Total Depth 61.0 ft
Location	Kingston, Tennessee	Surface Elevation	762.9 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	3/19/09 Completed 3/20/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	6.0 ft Date/Time 3/19/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
762.9'	0.0'	Top of Hole							
760.9'	2.0'	OVERBURDEN (Fill), consisted of gravel, clay, sand and ash		SPT-1	0.0 - 1.5	0.1	3-8-6	18	Boring advanced using 3 1/4 " Hollow Stem Augers
		FLY ASH (Fill), gray, moist, loose to medium dense, some coarse gravel, non-plastic		SPT-2	1.5 - 3.0	1.1	7-15-19	14	
				SPT-3	3.0 - 4.5	1.3	10-5-6	15	
756.9'	6.0'			SPT-4	4.5 - 6.0	0.7	9-9-8	21	
		Bottom Ash 55% / Fly Ash 45% (Fill), dark gray, saturated, very loose to loose, non-plastic		SPT-5	6.0 - 7.5	0.1	5-5-6	27	
				SPT-6	7.5 - 9.0	1.1	3-2-1	19	
				SPT-7	9.0 - 10.5	0.5	1-1-1	21	
				SPT-8	10.5 - 12.0	1.3	WOH-1-1	29	
750.4'	12.5'								
749.9'	13.0'	GRAVEL (Fill), gray, saturated, medium dense, coarse grained		SPT-9	12.0 - 13.5	1.2	3-15-16	23	
		FLY ASH (Fill), gray, saturated, very loose to medium dense, non-plastic		SPT-10	13.5 - 15.0	0.0	9-12-13	–	
				SPT-11	15.0 - 16.5	0.5	9-10-10	17	
				SPT-12	16.5 - 18.0	0.8	7-8-11	28	
				SPT-13	18.0 - 19.5	0.8	5-4-4	29	
				SPT-14	19.5 - 21.0	1.3	2-3-4	28	
				SPT-15	21.0 - 22.5	1.3	6-6-5	26	
				SPT-16	22.5 - 24.0	1.2	1-2-2	30	
				SPT-17	24.0 - 25.5	1.3	1-1-1	29	
				SPT-18	25.5 - 27.0	1.5	3-2-2	31	
				SPT-19	27.0 - 28.5	0.4	2-2-2	23	
733.9'	29.0'								
		SAND, light brown, saturated, very loose, fine grained		SPT-20	28.5 - 30.0	0.7	WOR-WOR-WOR	19	
731.9'	31.0'			SPT-21	30.0 - 31.5	0.9	1-WOH-WOH	19	
		SILT, light brown, saturated, very soft, some sand		SPT-22	31.5 - 33.0	1.2	WOH-1-1	18	
				SPT-23	33.0 - 34.5	1.1	WOR-WOR-WOR	23	
727.9'	35.0'								
				ST-1	35.0 - 37.0	2.0		–	

SUBSURFACE LOG

Project No. 175569042 Location N 555168.84, E 2442666.59 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-20** Total Depth 61.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		LEAN CLAY, light brown, saturated, very soft to soft, some fine grained sand, some silt *(Continued)*		ST-2	37.0 - 39.0	1.7		–	
				SPT-24	39.0 - 40.5	1.3	2-5-6	21	
721.9'	41.0'			SPT-25	40.5 - 42.0	1.4	3-5-6	18	
		SAND, light brown, saturated, loose, fine grained, some silt		SPT-26	42.0 - 43.5	0.9	3-5-6	17	
				SPT-27	43.5 - 45.0	1.3	3-2-2	21	
716.9'	46.0'			SPT-28	45.0 - 46.5	1.0	WOR-1-1	21	
		SAND, light gray, saturated, very loose, fine grained		SPT-29	46.5 - 48.0	1.3	WOR-WOR-WOH	19	
713.9'	49.0'			SPT-30	48.0 - 49.5	1.4	WOR-WOR-WOR	20	
		SAND, light brown, saturated, very loose to medium dense, fine grained, some silt		SPT-31	49.5 - 51.0	1.2	WOH-1-1	22	
				SPT-32	51.0 - 52.5	1.3	WOR-WOR-WOR	22	
				SPT-33	52.5 - 54.0	0.3	WOR-22-27	13	
707.9'	55.0'			SPT-34	54.0 - 55.5	0.5	9-6-7	18	
		SAND, light gray, saturated, loose to medium dense, fine grained, some fine to medium gravel		SPT-35	55.5 - 57.0	1.0	3-1-2	20	SPT-37: shale in tip of spoon
				SPT-36	57.0 - 58.5	1.1	15-18-20	17	
703.9'	59.0'			SPT-37	58.5 - 58.9	0.4	50/0.4	11	Boring backfilled with bentonite cement grout from 0.0 ft to 61.0 ft
701.9'	61.0'	Shale, (Augered)							

Auger Refusal / Bottom of Hole

WOH = Weight of Hammer
WOR = Weight of Rods

7/16/09

SUBSURFACE LOG

Project No.	175569042	Location	N 555076.61, E 2442149.85 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-21 Total Depth 77.5 ft
Location	Kingston, Tennessee	Surface Elevation	765.0 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/23/09 Completed 4/24/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	11.0 ft Date/Time 4/23/09
Logged By	Greg Budd	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
765.0'	0.0'	Top of Hole							
		BOTTOM ASH (Fill), gray black, dry, very dense, with gray fine fly ash		SPT-1	0.0 - 1.5	1.0	1-14-17	24	Boring advanced using 3.25" hollow stem augers
				SPT-2	1.5 - 3.0	1.0	17-19-25	25	
				SPT-3	3.0 - 4.5	0.8	24-28-26	29	
759.0'	6.0'			SPT-4	4.5 - 6.0	0.8	8-12-14	26	
		FLY ASH (Fill), gray, dry, very dense		SPT-5	6.0 - 7.5	1.0	18-19-22	25	
756.0'	9.0'			SPT-6	7.5 - 9.0	1.0	12-14-16	28	
		FLY ASH (Fill), gray, wet, loose, and bottom ash		SPT-7	9.0 - 10.5	1.1	2-2-3	31	
754.0'	11.0'			SPT-8	10.5 - 12.0	1.2	3-4-4	32	Water added at 11.0 ft. to keep augers clear
		BOTTOM ASH (Fill), gray black, saturated, loose to very loose, and fine fly ash		SPT-9	12.0 - 13.5	1.0	2-2-3	30	
				SPT-10	13.5 - 15.0	1.0	3-3-2	32	
				SPT-11	15.0 - 16.5	0.8	3-3-2	28	
747.0'	18.0'			SPT-12	16.5 - 18.0	1.1	2-1-1	24	
		FLY ASH (Fill), gray, saturated, very loose, with some fine grained black bottom ash		SPT-13	18.0 - 19.5	1.1	WOR-WOR-WOR	34	
744.0'	21.0'			SPT-14	19.5 - 21.0	0.7	WOR-WOR-WOR	33	
		FLY ASH (Fill), gray, saturated, very loose		SPT-15	21.0 - 22.5	0.2	WOR-WOR-WOR	38	
				SPT-16	22.5 - 24.0	1.2	WOR-WOR-WOR	28	
				SPT-17	24.0 - 25.5	1.5	2-1-1	26	
				SPT-18	25.5 - 27.0	1.1	3-3-4	28	
				SPT-19	27.0 - 28.5	1.5	2-1-WOH	29	
				SPT-20	28.5 - 30.0	1.5	WOR-WOR-WOR	29	
733.5'	31.5'			SPT-21	30.0 - 31.5	1.5	WOR-WOR-WOR	27	
		FLY ASH (Fill), brown gray, wet, very loose, clayey		SPT-22	31.5 - 33.0	1.2	WOR-WOR-WOR	24	
				SPT-23	33.0 - 34.5	0.4	WOR-WOR-WOR	27	
729.0'	36.0'			SPT-24	34.5 - 36.0	0.8	1-2-2	24	

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SUBSURFACE LOG

Project No. 175569042 Location N 555076.61, E 2442149.85 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-21** Total Depth 77.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
727.0'	38.0'	SILTY CLAY, red brown, wet, soft *(Continued)*		ST-1	36.0 - 38.0	0.0		-	
		SILTY SAND, tan and red brown, wet, soft, mottled very fine to fine grained		SPT-25	38.0 - 39.5	1.2	WOR-WOR-WOR	20	
				SPT-26	39.5 - 41.0	1.1	7-7-8	18	
				SPT-27	41.0 - 42.5	1.1	7-5-3	18	
				SPT-28	42.5 - 44.0	1.5	3-3-4	20	
719.5'	45.5'			SPT-29	44.0 - 45.5	1.5	3-1-1	19	
		SILT, gray, wet, very soft, with fine grained sand		SPT-30	45.5 - 47.0	0.8	WOR-WOR-WOR	16	
				SPT-31	47.0 - 48.5	0.9	WOR-WOR-WOR	20	
				SPT-32	48.5 - 50.0	0.7	WOR-WOR-WOR	17	
				SPT-33	50.0 - 51.5	0.7	WOR-WOR-WOR	21	
712.0'	53.0'			SPT-34	51.5 - 53.0	0.6	WOR-WOR-WOR	21	
710.5'	54.5'	SAND, gray, wet, loose, fine grained		SPT-35	53.0 - 54.5	1.0	8-8-3	22	
709.0'	56.0'	SAND, gray, dense, fine to medium grained, rounded, with gravel sandstone fragments		SPT-36	54.5 - 56.0	1.5	8-12-25	21	
									Began Core
		Sandstone, gray, fine grained, hard, thin bedded		0%	5.0	1.8	36	62.5	
		Shale, gray, very fine grained, soft, argillaceous, weathered grading to hard gray shale with quartzite veins from 67.5 to 73.5		0%	5.0	2.7	54	67.5	
691.5'	73.5'			0%	6.0	3.0	50	73.5	Boring backfilled using bentonite cement grout from 0.0 to 77.5 feet
		Shale, gray, clay-like, very soft							
687.5'	77.5'			0%	4.0	3.2	80	77.5	

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SUBSURFACE LOG

Project No.	175569042	Location	N 555076.61, E 2442149.85 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-21 Total Depth 77.5 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		Bottom of Hole							
		Top of Rock = 56.0' Elevation (709.0')							
		WOH = Weight of Hammer WOR = Weight of Rod							

Stantec

Project 171468117 Kingston Ash Pond
Sheet No. 1 of 1 Date 4/24/2009
Hole # STN-21 Rig # 705

Northing 555,076.61 Surface Elevation (ft.) 765.0 Crew Wilks / Clements

Easting 2,442,149.85 Top of Rock Elev. (ft.) 709.0 Inspector Greg Budd

Boring Size 3 1/4 Hollow Stem Augers Pump Capacity 21 gpm Meter Type Sensus 5/8" SR II

Test Method US Bureau of Reclamation Static Water Level 11.0' Meter # 67290595

Test Section		Gauge Reading (PSI)	Time of Test			Meter Reading		Total Water (Gal / Cu Ft)	CFM
Top Depth	Bottom Depth		Start	End	Interval (min-sec)	Start of Test	End of Test		
59.0	67.5	32	0:00	1:00	1:00	287.91	289.56	1.65	1.65
		32	1:00	2:00	1:00	289.56	291.12	1.56	1.56
		32	2:00	3:00	1:00	291.12	292.76	1.64	1.64
		32	3:00	4:00	1:00	292.76	294.37	1.61	1.61
		32	4:00	5:00	1:00	294.37	295.99	1.62	1.62
		32	5:00	6:00	1:00	295.99	297.61	1.62	1.62
		32	6:00	7:00	1:00	297.61	299.26	1.65	1.65
		32	7:00	8:00	1:00	299.26	300.89	1.63	1.63
		32	8:00	9:00	1:00	300.89	302.54	1.65	1.65
		32	9:00	10:00	1:00	302.54	304.18	1.64	1.64
		32	10:00	11:00	1:00	304.18	305.83	1.65	1.65
		32	11:00	12:00	1:00	305.83	307.47	1.64	1.64
		32	12:00	13:00	1:00	307.47	309.12	1.65	1.65
		32	13:00	14:00	1:00	309.12	310.78	1.66	1.66
		32	14:00	15:00	1:00	310.78	312.38	1.60	1.60
67.5	77.5	37	0:00	1:00	1:00	312.97	313.51	0.54	0.54
		37	1:00	2:00	1:00	313.51	314.04	0.53	0.53
		37	2:00	3:00	1:00	314.04	314.56	0.52	0.52
		37	3:00	4:00	1:00	314.56	315.08	0.52	0.52
		37	4:00	5:00	1:00	315.08	315.60	0.52	0.52
		37	5:00	6:00	1:00	315.60	316.12	0.52	0.52
		37	6:00	7:00	1:00	316.12	316.63	0.51	0.51
		37	7:00	8:00	1:00	316.63	317.40	0.77	0.77
		37	8:00	9:00	1:00	317.40	318.22	0.82	0.82
		37	9:00	10:00	1:00	318.22	319.04	0.82	0.82
		37	10:00	11:00	1:00	319.04	319.86	0.82	0.82
		37	11:00	12:00	1:00	319.86	320.68	0.82	0.82
		37	12:00	13:00	1:00	320.68	321.50	0.82	0.82
		37	13:00	14:00	1:00	321.50	322.33	0.83	0.83
		37	14:00	15:00	1:00	322.33	323.14	0.81	0.81

Project # 171468117 Hole # STN-21 Inspector Greg Budd Date 4/24/2009

SUBSURFACE LOG

Project No.	175569042	Location	N 554990.27, E 2441723.40 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-22 Total Depth 79.0 ft
Location	Kingston, Tennessee	Surface Elevation	765.0 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/27/09 Completed 4/28/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	9.5 ft Date/Time 4/27/09
Logged By	Greg Budd	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
765.0'	0.0'	Top of Hole							
763.5'	1.5'	BOTTOM ASH (Fill), gray black, dry, medium dense		SPT-1	0.0 - 1.5	1.2	3-6-5	35	Boring advanced using 3 1/4" hollow stem augers
762.0'	3.0'	BOTTOM ASH (Fill), gray black, dry, medium dense		SPT-2	1.5 - 3.0	1.0	6-9-8	32	
		FLY ASH (Fill), gray, dry, medium dense, very fine grained		SPT-3	3.0 - 4.5	0.7	8-9-9	30	
759.0'	6.0'			SPT-4	4.5 - 6.0	0.7	7-3-4	31	
		FLY ASH (Fill), gray, wet, very loose, very fine grained, silty		SPT-5	6.0 - 7.5	1.0	WOR-1-1	36	
756.0'	9.0'			SPT-6	7.5 - 9.0	0.9	2-2-3	36	
		FLY ASH (Fill), gray, saturated, very loose, very fine grained		SPT-7	9.0 - 10.5	1.5	1-1-1	36	Water aded at 9.0 feet to keep augers clean
				SPT-8	10.5 - 12.0	1.5	1-WOR-WOR	34	
				SPT-9	12.0 - 13.5	1.5	WOR-WOR-WOR	33	
				SPT-10	13.5 - 15.0	1.1	WOR-WOR-WOR	32	
				SPT-11	15.0 - 16.5	1.5	WOR-WOR-WOR	27	
				SPT-12	16.5 - 18.0	1.5	WOR-WOR-WOR	36	
				SPT-13	18.0 - 19.5	1.5	1-WOR-WOR	31	
				SPT-14	19.5 - 21.0	1.5	WOR-WOR-WOR	30	
				SPT-15	21.0 - 22.5	0.5	WOR-WOR-WOR	34	
				SPT-16	22.5 - 24.0	1.0	WOH-WOH-WOH	32	
				SPT-17	24.0 - 25.5	0.8	WOR-WOR-WOR	28	
738.0'	27.0'			SPT-18	25.5 - 27.0	0.9	WOR-3-3	28	
		FLY ASH (Fill), black gray, saturated, very loose to loose, with bottom ash and gravel size coal, coal refuse		SPT-19	27.0 - 28.5	1.0	WOR-1-1	29	
				SPT-20	28.5 - 30.0	0.5	1-1-1	31	
				SPT-21	30.0 - 31.5	0.8	3-2-1	26	
				SPT-22	31.5 - 33.0	1.0	1-1-WOH	26	
				SPT-23	33.0 - 34.5	0.9	WOR-WOR-WOR	32	
				SPT-24	34.5 - 36.0	0.9	WOR-WOR-WOR	28	

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SUBSURFACE LOG

Project No. 175569042 | Location N 554990.27, E 2441723.40 (NAD27)

Project Name Kingston Ash Pond | Boring No. **STN-22** | Total Depth 79.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
727.5'	37.5'			SPT-25	36.0 - 37.5	1.0	WOR-WOR-WOR	30	
		FLY ASH (Fill), gray, saturated, very loose, very fine grained, silty		SPT-26	37.5 - 39.0	0.3	WOR-WOR-WOR	25	
				SPT-27	39.0 - 40.5	0.9	WOR-WOR-1	32	
				SPT-28	40.5 - 42.0	1.5	2-1-1	26	
721.5'	43.5'			SPT-29	42.0 - 43.5	1.2	7-5-8	19	
		CLAYEY FLY ASH, brown gray, saturated, medium stiff, compacted, mottled		SPT-30	43.5 - 45.0	1.0	5-5-6	21	
719.0'	46.0'			SPT-31	45.0 - 46.5	0.7	5-8-10	20	
		LEAN CLAY, gray brown, saturated, stiff, mottled		SPT-32	46.5 - 48.0	0.9	5-7-6	23	
				SPT-33	48.0 - 49.5	1.5	5-6-7	21	
				ST-1	49.5 - 51.5	1.3		--	
713.5'	51.5'								
		SILTY SAND, gray, saturated, loose, fine grained		SPT-34	51.5 - 53.0	1.0	6-4-2	19	
710.5'	54.5'			SPT-35	53.0 - 54.5	0.9	WOR-WOR-WOR	20	
		SAND, gray, saturated, very loose, fine grained		SPT-36	54.5 - 56.0	0.3	WOR-WOR-WOR	22	
				SPT-37	56.0 - 57.5	0.6	2-2-5	23	
707.0'	58.0'			SPT-38	57.5 - 58.0	0.4	50/0.4	17	
									Began Core
		Sandstone, gray, fine grained, very hard, thin to medium bedded, quartz, grading to gray, soft, weathered, shale		0%	5.0	0.6	12	64.0	
697.5'	67.5'			0%	3.5	3.1	89	67.5	
		Shale, gray, soft, grading to weathered, brittle, soft, gray, shale to 67.5 feet. No recovery from 67.5 to 69 feet		0%	1.5	0.0	0	69.0	
		Limestone, gray, fine grained, very hard, thin to medium bedded		0%	5.0	0.3	5	74.0	
									Boring backfilled using bentonite cement grout from 0.0 feet to 79.0 feet

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SUBSURFACE LOG

Project No. 175569042 Location N 554990.27, E 2441723.40 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-22** Total Depth 79.0 ft

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
686.0'	79.0'			0%	5.0	0.0	0	79.0	

Bottom of Hole

Top of Rock = 58.0'
Elevation (707.0')

WOH = Weight of Hammer
WOR = Weight of Rod

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Project 171468117 Kingston Ash Pond
Sheet No. 1 of 1 Date 4/28/2009
Hole # STN-22 Rig # 705

Northing 564,990.27 Surface Elevation (ft.) 765.0 Crew Wilks / Clements

Easting 2,441,723.40 Top of Rock Elev. (ft.) 707.0 Inspector Greg Budd

Boring Size 3 1/4 Hollow Stem Augers Pump Capacity 21 gpm Meter Type Sensus 5/8" SR II

Test Method US Bureau of Reclamation Static Water Level 9.0' Meter # 67290595

Test Section		Gauge Reading (PSI)	Time of Test			Meter Reading		Total Water (Gal / Cu Ft)	CFM
Top Depth	Bottom Depth		Start	End	Interval (min-sec)	Start of Test	End of Test		
63.0	69.0	35	0:00	1:00	1:00	322.97	322.99	0.02	0.02
		35	1:00	2:00	1:00	322.99	323.00	0.01	0.01
		35	2:00	3:00	1:00	323.00	323.01	0.01	0.01
		35	3:00	4:00	1:00	323.01	323.01	0.00	0.00
		35	4:00	5:00	1:00	323.01	323.01	0.00	0.00
69.0	79.0	39	0:00	1:00	1:00	325.66	325.96	0.30	0.30
		39	1:00	2:00	1:00	325.96	326.26	0.30	0.30
		39	2:00	3:00	1:00	326.26	326.54	0.28	0.28
		39	3:00	4:00	1:00	326.54	326.74	0.20	0.20
		39	4:00	5:00	1:00	326.74	326.90	0.16	0.16
		39	5:00	6:00	1:00	326.90	326.97	0.07	0.07
		39	6:00	7:00	1:00	326.97	327.19	0.22	0.22
		39	7:00	8:00	1:00	327.19	327.33	0.14	0.14
		39	8:00	9:00	1:00	327.33	327.40	0.07	0.07
		39	9:00	10:00	1:00	327.40	327.63	0.23	0.23
		39	10:00	11:00	1:00	327.63	327.72	0.09	0.09
		39	11:00	12:00	1:00	327.72	328.12	0.40	0.40
		39	12:00	13:00	1:00	328.12	328.53	0.41	0.41
		39	13:00	14:00	1:00	328.53	328.95	0.42	0.42
		39	14:00	15:00	1:00	328.95	329.39	0.44	0.44
				*** NOTE: Pressure gauge broke at minute 9:00					

Project # 171468117 Hole # STN-22 Inspector Greg Budd Date 4/28/2009

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SUBSURFACE LOG

Project No.	175569042	Location	N 555020.22, E 2442857.46 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-23 Total Depth 62.0 ft
Location	Kingston, Tennessee	Surface Elevation	764.7 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/11/09 Completed 5/12/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	8.0 ft Date/Time 5/11/09
Logged By	Briggs Evans	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. %	Blows / Run Depth	Mois.Cont. %	Remarks
764.7'	0.0'	Top of Hole							
764.5'	0.2'	GRAVEL (Fill), light gray, dry, road material		SPT-1	0.0 - 1.5	0.5	19-17-10	14	
763.2'	1.5'	BOTTOM ASH (Fill), gray black, dry, dense		SPT-2	1.5 - 3.0	0.9	9-7-7	27	
		LEAN CLAY (Fill), red brown, dry, stiff, with chert		SPT-3	3.0 - 4.5	0.9	7-7-7	26	
				SPT-4	4.5 - 6.0	0.4	4-4-5	24	
				SPT-5	6.0 - 7.5	1.0	6-6-4	26	
				SPT-6	7.5 - 9.0	0.3	8-8-8	22	
				SPT-7	9.0 - 10.5	0.7	7-7-7	28	
				SPT-8	10.5 - 12.0	0.7	6-6-10	25	
				SPT-9	12.0 - 13.5	0.4	3-4-9	19	
				SPT-10	13.5 - 15.0	0.9	7-7-8	28	
				SPT-11	15.0 - 16.5	1.0	3-8-8	22	
				SPT-12	16.5 - 18.0	1.3	8-8-9	25	
				SPT-13	18.0 - 19.5	1.0	8-8-9	28	
				SPT-14	19.5 - 21.0	0.2	5-5-4	16	
				SPT-15	21.0 - 22.5	1.0	6-6-6	27	
741.7'	23.0'			SPT-16	22.5 - 24.0	1.5	8-13-13	25	
739.7'	25.0'	BOTTOM ASH (Fill), black gray, saturated, dense, with fly ash		SPT-17	24.0 - 25.5	0.9	13-11-13	17	
		SAND (Fill), brown gray, saturated, dense, fine grained, well rounded, well graded, with trace silt		SPT-18	25.5 - 27.0	1.5	14-16-14	16	
737.2'	27.5'			SPT-19	27.0 - 28.5	1.5	9-9-6	20	
734.7'	30.0'	BOTTOM ASH (Fill), black, saturated, medium dense, fine to coarse grained		SPT-20	28.5 - 30.0	1.5	2-4-4	24	
733.2'	31.5'	SAND, gray brown, saturated, very loose, fine grained, with fly ash, silty		SPT-21	30.0 - 31.5	0.2	1-1-1	20	
				SPT-22	31.5 - 33.0	1.0	1-WOH-WOH	17	
				SPT-23	33.0 - 34.5	1.0	1-1-1	17	
		SAND, light brown, saturated, very loose, fine grained, well rounded, well graded, with trace silt		SPT-24	34.5 - 36.0	1.5	2-2-2	18	
728.7'	36.0'								

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SUBSURFACE LOG

Project No. 175569042 Location N 555020.22, E 2442857.46 (NAD27)

Project Name Kingston Ash Pond Boring No. STN-23 Total Depth 62.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SAND, brown, saturated, very loose, fine grained, well rounded, well graded, with trace silt and gravelly *(Continued)*		SPT-25	36.0 - 37.5	1.5	1-1-1	17	
				SPT-26	37.5 - 39.0	1.5	WOR-WOR-WOR	20	
724.2'	40.5'			SPT-27	39.0 - 40.5	1.5	3-2-2	23	
		SILTY CLAY, brown gray, saturated, soft, mottled		SPT-28	40.5 - 42.0	1.5	WOR-WOR-2	26	
				SPT-29	42.0 - 43.5	1.0	3-3-4	25	
719.7'	45.0'			ST-1	43.5 - 45.5	2.0		--	
		SILTY SAND, brown gray, saturated, very loose, fine grained, well rounded		SPT-30	45.5 - 47.0	1.0	WOH-WOH-5	16	
716.2'	48.5'			SPT-31	47.0 - 48.5	1.0	WOR-WOR-WOR	20	
		SANDY SILT, gray, saturated, very soft		SPT-32	48.5 - 50.0	1.5	WOH-WOH-WOH	21	
713.2'	51.5'			SPT-33	50.0 - 51.5	1.5	WOR-WOR-WOR	22	
		SAND, gray, saturated, very loose to loose, fine grained, well rounded, well graded, with, trace silt		SPT-34	51.5 - 53.0	1.0	WOR-WOR-WOR	22	
				SPT-35	53.0 - 54.5	1.0	2-2-2	21	
				SPT-36	54.5 - 56.0	1.0	3-1-WOH	20	
				SPT-37	56.0 - 57.5	1.5	1-2-5	22	
				SPT-38	57.5 - 59.0	1.1	WOH-4-5	20	
				SPT-39	59.0 - 60.5	1.0	6-2-3	24	
703.7'	61.0'								
~~703.2'~~	~~61.5'~~			SPT-40	60.5 - 61.9	1.4	12-25-50/0.4	--	
702.7'	62.0'	Sandstone, (augered)							
		Shale, (augered)							
		Auger Refusal / Bottom of Hole							

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SUBSURFACE LOG

Project No.	175569042	Location	N 554803.45, E 2442843.16 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-24 Total Depth 64.2 ft
Location	Kingston, Tennessee	Surface Elevation	765.1 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/7/09 Completed 5/11/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	18.0 ft Date/Time 5/7/09
Logged By	Briggs Evans	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. %	Blows / Mois.Cont. % / Run Depth	Remarks
765.1'	0.0'	Top of Hole						
764.4'	0.8'	CRUSHED STONE (Fill)		SPT-1	0.0 - 1.5	1.8	14-12-7 / 9	Boring advanced using 3 1/4" hollow stem augers
		LEAN CLAY (Fill), red, dry to moist, soft to very stiff, some chert, trace gravel		SPT-2	1.5 - 3.0	0.8	9-8-4 / 20	
				SPT-3	3.0 - 4.5	0.5	9-9-10 / 21	
				SPT-4	4.5 - 6.0	1.0	5-6-7 / 28	
				SPT-5	6.0 - 7.5	1.4	15-15-15 / 22	
				SPT-6	7.5 - 9.0	1.1	6-5-4 / 28	
				SPT-7	9.0 - 10.5	0.8	8-9-11 / 23	
				SPT-8	10.5 - 12.0	0.8	5-7-9 / 24	
				SPT-9	12.0 - 13.5	1.5	11-11-9 / 26	
				SPT-10	13.5 - 15.0	1.0	3-4-6 / 24	
				SPT-11	15.0 - 16.5	1.3	7-9-10 / 30	
747.7'	17.4'			SPT-12	16.5 - 18.0	1.0	7-9-11 / 25	
		BOTTOM ASH (Fill), dark gray, wet to saturated, loose to dense, with fly ash		SPT-13	18.0 - 19.5	1.2	16-10-4 / 25	Wet at 18 ft bgs
				SPT-14	19.5 - 21.0	1.2	22-26-21 / 26	
				SPT-15	21.0 - 22.5	0.0	WOR-WOR-2 / –	Begin adding water to control blowback
				SPT-16	22.5 - 24.0	0.5	3-3-3 / 24	
				SPT-17	24.0 - 25.5	1.0	6-7-9 / 21	
738.1'	27.0'			SPT-18	25.5 - 27.0	1.2	8-8-11 / 21	
736.7'	28.4'	GRAVELLY BOTTOM ASH (Fill), dark gray, saturated, medium dense		SPT-19	27.0 - 28.5	1.5	10-12-14 / 13	
		SAND, brown, wet, loose to very loose, fine to medium grained, some silt		SPT-20	28.5 - 30.0	1.0	4-4-7 / 20	
				SPT-21	30.0 - 31.5	0.5	1-1-2 / 19	
				SPT-22	31.5 - 33.0	1.0	4-4-6 / 22	
730.6'	34.5'			SPT-23	33.0 - 34.5	1.3	1-WOH-WOH / 17	
729.1'	36.0'	SANDY SILT, brown, saturated, very soft, with fine grained sand		SPT-24	34.5 - 36.0	1.5	WOH-WOH-WOH / 20	

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SUBSURFACE LOG

Project No. 175569042 Location N 554803.45, E 2442843.16 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-24** Total Depth 64.2 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SILTY SAND, tan, wet to saturated, very loose to loose, fine to medium grained, well graded, little silt, homogeneous *(Continued)*		SPT-25	36.0 - 37.5	1.5	1-WOH-WOH	12	
				SPT-26	37.5 - 39.0	1.5	WOR-WOR-WOR	19	
				SPT-27	39.0 - 40.5	1.5	WOR-3-2	17	
				SPT-28	40.5 - 42.0	1.0	WOH-WOH-WOH	18	
				SPT-29	42.0 - 43.5	1.3	5-5-9	18	
				SPT-30	43.5 - 45.0	1.5	5-4-2	19	
				SPT-31	45.0 - 46.5	1.5	5-6-8	20	
				SPT-32	46.5 - 48.0	1.0	4-5-5	18	
				SPT-33	48.0 - 49.5	1.5	WOH-WOH-2	20	
				SPT-34	49.5 - 51.0	1.2	WOR-WOR-WOR	18	
				SPT-35	51.0 - 52.5	1.5	2-1-1	19	
				SPT-36	52.5 - 54.0	1.0	WOR-WOR-WOR	17	
				SPT-37	54.0 - 55.5	1.5	WOR-WOR-WOR	17	
				SPT-38	55.5 - 57.0	1.5	WOR-WOR-WOR	20	
				SPT-39	57.0 - 58.5	1.5	WOR-WOR-WOR	21	
				SPT-40	58.5 - 60.0	1.5	WOR-9-10	25	
				SPT-41	60.0 - 61.5	1.5	14-14-10	21	
				SPT-42	61.5 - 63.0	1.5	3-3-4	20	
701.6'	63.5'			SPT-43	63.0 - 63.7	0.7	7-50/0.2	19	
700.9'	64.2'	Sandstone, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rod

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SUBSURFACE LOG

Project No.	175569042	Location	N 554624.86, E 2442889.00 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-26 Total Depth 57.3 ft
Location	Kingston, Tennessee	Surface Elevation	750.0 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	3/23/09 Completed 3/23/09
Supervisor	Ben Hafada Driller Kent Clements	Depth to Water	6.0 ft Date/Time 3/23/09
Logged By	Ben Hafada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
750.0'	0.0'	Top of Hole							
748.0'	2.0'	LEAN CLAY (Fill), red brown to brown, moist, soft		SPT-1	0.0 - 1.5	1.2	2-3-4	24	Boring advanced using 3 1/4 " Hollow Stem Augers
		Bottom Ash 60% / Fly Ash 40% (Fill), dark gray, saturated, dense to very dense		SPT-2	1.5 - 3.0	1.3	45-15-20	16	
				SPT-3	3.0 - 4.5	1.2	30-31-20	19	
				SPT-4	4.5 - 6.0	1.1	10-12-10	21	
743.0'	7.0'			SPT-5	6.0 - 7.5	1.0	10-9-8	18	
		LEAN CLAY (Fill), light brown to red brown, saturated, soft to medium stiff, some silt		SPT-6	7.5 - 9.0	0.8	3-3-4	22	
				ST-1	9.0 - 11.0	1.0		–	
				SPT-7	11.0 - 12.5	1.1	3-3-4	18	
				SPT-8	12.5 - 14.0	1.0	4-5-6	20	
				SPT-9	14.0 - 15.5	1.3	3-4-6	20	
				SPT-10	15.5 - 17.0	0.2	WOH-WOH-WOH	19	
				SPT-11	17.0 - 18.5	1.3	WOH-WOH-WOH	21	
730.0'	20.0'			SPT-12	18.5 - 20.0	1.1	WOH-WOH-WOH	21	
		LEAN CLAY with Silt, dark gray, saturated, very soft		ST-2	20.0 - 22.0	2.0		–	
727.0'	23.0'			SPT-13	22.0 - 23.5	1.4	WOH-WOH-WOH	24	
		SILTY SAND with Clay, brown, saturated, very soft, some fine grained sand		SPT-14	23.5 - 25.0	0.2	WOR-WOH-WOH	23	
				SPT-15	25.0 - 26.5	1.4	WOR-WOH-1	23	
				SPT-16	26.5 - 28.0	1.1	1-1-1	22	
				SPT-17	28.0 - 29.5	1.4	WOH-WOH-2	22	
				SPT-18	29.5 - 31.0	1.1	WOH-WOH-WOH	24	
				SPT-19	31.0 - 32.5	1.3	WOH-2-2	25	
716.0'	34.0'			SPT-20	32.5 - 34.0	1.0	WOH-1-2	25	
		SAND, gray, saturated, very loose, some silt		SPT-21	34.0 - 35.5	1.2	WOH-WOH-WOH	18	
				SPT-22	35.5 - 37.0	1.2	WOH-	19	

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SUBSURFACE LOG

Project No. 175569042 Location N 554624.86, E 2442889.00 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-26** Total Depth 57.3 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SAND, gray, saturated, very loose, some silt *(Continued)*		SPT-23	37.0 - 38.5	1.3	WOH-WOH WOH-1-1	20	
				SPT-24	38.5 - 40.0	1.1	WOH-WOH-1	19	
				SPT-25	40.0 - 41.5	1.1	WOR-WOH-WOH	20	
				SPT-26	41.5 - 43.0	1.1	WOR-WOH-1	21	
706.0'	44.0'			SPT-27	43.0 - 44.5	1.3	2-2-6	21	
		SAND, light gray, saturated, very loose to loose, fine grained, trace fine to medium grained gravel		SPT-28	44.5 - 46.0	1.4	3-2-3	27	
				SPT-29	46.0 - 47.5	1.0	3-4-5	26	
701.0'	49.0'			SPT-30	47.5 - 49.0	1.4	3-3-4	33	SPT-30: wood fragments in sample
		SAND, light gray, saturated, loose to medium dense, fine to coarse grained, some fine to medium gravel		SPT-31	49.0 - 50.5	1.1	3-4-4	19	
				SPT-32	50.5 - 52.0	1.5	5-6-7	23	
				SPT-33	52.0 - 53.5	1.1	6-12-8	15	SPT-34: shale in spoon
696.0'	54.0'			SPT-34	53.5 - 55.0	1.1	14-15-15	12	Boring backfilled with bentonite cement grout from 0.0 ft to 57.3 ft
		Shale, (Augered)		SPT-35	55.0 - 55.9	0.9	23-50/0.4	12	
692.7'	57.3'								

Auger Refusal / Bottom of Hole

WOH = Weight of Hammer
WOR = Weight of Rods

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SUBSURFACE LOG

Project No.	175569042	Location	N 554604.66, E 2442904.17 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-26A Total Depth 20.0 ft
Location	Kingston, Tennessee	Surface Elevation	750.0 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/16/09 Completed 4/16/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	N/A Date/Time N/A
Logged By	Ben Halada	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
750.0'	0.0'	Top of Hole							
		OVERBURDEN, See log for STN-26							Boring advanced using 3 1/4 " Hollow Stem Augers
730.0'	20.0'	No Refusal / Bottom of Hole							

PZ Installed, tip at elevation 733'

Flushmount well cover and concrete pad installed.

SUBSURFACE LOG

Project No.	175569042	Location	N 554601.77, E 2442850.67 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-27 Total Depth 67.5 ft
Location	Kingston, Tennessee	Surface Elevation	765.1 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	3/30/09 Completed 3/30/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	22.0 ft Date/Time 3/30/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
765.1'	0.0'	Top of Hole							
764.6'	0.5'	GRAVEL (Fill), gray, moist, loose		SPT-1	0.0 - 1.5	1.3	10-7-9	13	Boring advanced using 3 1/4 " Hollow Stem Augers
		LEAN CLAY (Fill), red brown, moist, medium stiff to stiff, some chert		SPT-2	1.5 - 3.0	1.1	6-7-12	22	
				SPT-3	3.0 - 4.5	1.1	13-11-17	24	All ST samples recovered using a fixed head piston sampler
				ST-1	4.5 - 6.5	1.5		--	
				SPT-4	6.5 - 8.0	1.3	4-5-7	23	
				SPT-5	8.0 - 9.5	1.3	10-10-12	28	
				SPT-6	9.5 - 11.0	1.3	3-5-5	27	
				SPT-7	11.0 - 12.5	0.9	7-6-8	25	
				ST-2	12.5 - 14.5	1.5		--	
				SPT-8	14.5 - 16.0	1.2	2-5-5	29	
				SPT-9	16.0 - 17.5	1.3	6-7-9	23	
				SPT-10	17.5 - 19.0	1.0	1-2-3	29	
				ST-3	19.0 - 21.0	1.3		--	
743.1'	22.0'			SPT-11	21.0 - 22.5	1.1	2-4-7	25	
		Bottom Ash 60% / Fly Ash 40% (Fill), dark gray, saturated, loose		SPT-12	22.5 - 24.0	1.3	4-3-6	21	
				SPT-13	24.0 - 25.5	1.1	7-5-9	16	
				SPT-14	25.5 - 27.0	1.1	4-6-9	21	
737.1'	28.0'			SPT-15	27.0 - 28.5	1.1	7-9-9	20	
735.6'	29.5'	SAND (Fill), brown, saturated, loose, fine to medium grained		SPT-16	28.5 - 30.0	1.3	5-4-2	25	
		SILT with clay (Fill), dark gray, saturated, soft, some fine grained sand		ST-4	30.0 - 32.0	1.0		--	ST-4: sand in bottom of tube
733.1'	32.0'			SPT-17	32.0 - 33.5	1.2	WOH-2-3	20	
		Bottom Ash 70% / Fly Ash 30% (Fill), dark gray, saturated, very loose		SPT-18	33.5 - 35.0	1.1	3-3-2	19	
730.6'	34.5'								
730.1'	35.0'	SAND, brown, saturated, very loose, fine grained		SPT-19	35.0 - 36.5	1.4	1-1-1	25	

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SUBSURFACE LOG

Project No. 175569042 Location N 554601.77, E 2442850.67 (NAD27)

Project Name Kingston Ash Pond Boring No. STN-27 Total Depth 67.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SILT, dark gray, saturated, very soft to soft, trace clay *(Continued)*		SPT-20	38.5 - 38.0	1.2	WOH-1-1	27	
				SPT-21	38.0 - 39.5	1.1	WOR-WOR-WOR	25	
				SPT-22	39.5 - 41.0	1.4	WOH-WOH-WOH	25	
				SPT-23	41.0 - 42.5	1.0	WOH-1-1	20	
721.1'	44.0'			SPT-24	42.5 - 44.0	1.3	WOH-1-WOH	22	
		SAND, light brown, saturated, very loose to loose, fine grained		ST-5	44.0 - 46.0	1.3		--	ST-5: sand in tube
718.1'	47.0'			SPT-25	46.0 - 47.5	1.3	1-1-WOH	20	Water added at 45.0 ft to keep sand out of augers
		SILT, gray, saturated, very soft, some fine grained sand		SPT-26	47.5 - 49.0	1.3	WOH-WOH-1	20	
				SPT-27	49.0 - 50.5	1.0	WOH-WOH-WOH	21	
				SPT-28	50.5 - 52.0	1.1	WOR-WOR-WOR	21	
				SPT-29	52.0 - 53.5	1.2	WOR-WOR-WOR	21	
				SPT-30	53.5 - 55.0	1.2	WOR-WOR-WOR	21	
				SPT-31	55.0 - 56.5	1.1	WOR-WOR-WOH	20	
				SPT-32	56.5 - 58.0	1.3	WOR-WOH-1	20	
706.1'	59.0'			SPT-33	58.0 - 59.5	1.1	WOR-WOR-WOR	25	
		SAND, light gray, saturated, loose, fine grained, some fine to coarse gravel		SPT-34	59.5 - 61.0	1.1	WOR-2-2	21	
				SPT-35	61.0 - 62.5	1.3	3-2-5	26	SPT-35, 36, 37: wood fragments
				SPT-36	62.5 - 64.0	1.1	WOR-2-5	38	
700.1'	65.0'			SPT-37	64.0 - 65.5	1.0	WOH-6-26	25	Boring backfilled with bentonite cement grout from 0.0 ft to 67.5 ft
				SPT-38	65.5 - 66.2	0.6	80-20/0.2	--	
697.6'	67.5'	Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

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SUBSURFACE LOG

Project No.	175569042	Location	N 554601.77, E 2442850.67 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-27 Total Depth 67.5 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks

Boring located 8 ft toward center of dike from river side of dike

SUBSURFACE LOG

Project No.	175569042	Location	N 554600.64, E 2442840.21 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-27A Total Depth 60.0 ft
Location	Kingston, Tennessee	Surface Elevation	765.0 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/6/09 Completed 5/6/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Brad Smiley	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
765.0'	0.0'	Top of Hole							
		OVERBURDEN, (Augered without sampling) See Log for STN-27							Boring advanced using 4 1/4 " Hollow Stem Augers Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
737.0'	28.0'			ST-1	26.0 - 28.0	1.4		–	
		FLY ASH, dark gray, saturated, dense		ST-2	28.0 - 30.0	2.0		–	
				ST-3	30.0 - 32.0	1.9		–	
731.0'	34.0'			ST-4	32.0 - 34.0	2.0		–	
		CLAY, gray brown to tan, moist, medium stiff, some silty sand		ST-5	34.0 - 36.0	2.0		–	

FMDL LEGACY 1714981\17 KINGSTON ASH POND\GPJ\ FMDL.GDT 7/16/09

SUBSURFACE LOG

Project No.	175569042	Location	N 554600.64, E 2442840.21 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-27A Total Depth 60.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
727.0'	38.0'	(Augered without sampling) See Log for STN-27							
705.0'	60.0'	No Refusal / Bottom of Hole							

Two PZ's installed, tip at elevation 752.2' and 708.2'

Flushmount well cover and concrete pad installed.

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SUBSURFACE LOG

Project No.	175569042	Location	N 554606.18, E 2442840.52 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-27B Total Depth 36.0 ft
Location	Kingston, Tennessee	Surface Elevation	765.0 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/6/09 Completed 5/6/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Brad Smiley	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. %	Blows	Mois.Cont. % / Run Depth	Remarks
765.0'	0.0'	Top of Hole							
		OVERBURDEN, (Augered without sampling) See Log for STN-27							Boring advanced using 4 1/4 " Hollow Stem Augers Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
739.0'	26.0'								
		FLY ASH, gray to dark gray, saturated, loose, some silt		ST-1	26.0 - 28.0	1.6		--	
				ST-2	28.0 - 30.0	1.4		--	
733.0'	32.0'			ST-3	30.0 - 32.0	1.7		--	
		FAT CLAY, gray brown to brown, moist, medium stiff, some sand		ST-4	32.0 - 34.0	1.9		--	
729.0'	36.0'			ST-5	34.0 - 36.0	1.9		--	

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SUBSURFACE LOG

Project No.	175569042	Location	N 554606.18, E 2442840.52 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-27B Total Depth 36.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		No Refusal / Bottom of Hole							
		PZ Installed, tip at elevation 735.2'							
		Flushmount well cover and concrete pad installed.							

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SUBSURFACE LOG

Project No.	175569042	Location	N 554406.25, E 2442841.10 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-28 Total Depth 64.6 ft
Location	Kingston, Tennessee	Surface Elevation	764.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/5/09 Completed 5/7/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	20.5 ft Date/Time 5/6/09
Logged By	Briggs Evans	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. %	Blows	Mois.Cont. % / Run Depth	Remarks
764.8'	0.0'	Top of Hole							
764.3'	0.5'	CRUSHED STONE (Fill)		SPT-1	0.0 - 1.5	1.0	25-12-10	19	Boring advanced using 3 1/4" hollow stem augers
		LEAN CLAY (Fill), red brown, dry to moist, soft to very stiff, some chert, trace gravel, medium plasticity		SPT-3	3.0 - 4.5	0.8	6-8-8	22	
				SPT-4	4.5 - 6.0	0.5	18-7-7	20	
				SPT-5	6.0 - 7.5	0.3	9-8-9	25	
				SPT-6	7.5 - 9.0	1.3	5-5-6	25	
				SPT-7	9.0 - 10.5	1.2	8-8-9	25	
				SPT-8	10.5 - 12.0	1.0	9-14-13	25	
				SPT-9	12.0 - 13.5	0.0	3-5-5	24	
				SPT-10	13.5 - 15.0	0.5	3-5-5	–	
				SPT-11	15.0 - 16.5	1.0	8-7-8	28	
747.1'	17.7'			SPT-12	16.5 - 18.0	1.5	5-16-30	27	
		BOTTOM ASH (Fill), dark gray to gray, moist to saturated, loose to very dense, with fly ash		SPT-13	18.0 - 19.0	0.8	35-50/0.4	17	
				SPT-14	19.5 - 21.0	1.2	26-18-18	23	Wet at 20.5 ft
				SPT-15	21.0 - 22.5	1.0	6-8-4	20	Begin adding water to control blow-back
741.3'	23.5'			SPT-16	22.5 - 24.0	1.5	7-8-4	22	
		FLY ASH (Fill), gray to light gray, wet to saturated, loose to medium dense, some bottom ash, some silt		SPT-17	24.0 - 25.5	1.3	15-19-20	24	
				SPT-18	25.5 - 27.0	1.0	9-12-12	24	
				SPT-19	27.0 - 28.5	1.5	7-9-12	32	
				SPT-20	28.5 - 30.0	1.5	8-8-7	30	
				SPT-21	30.0 - 31.5	1.5	17-15-15	27	Very soft, saturated layer 30.3 to 31.0
731.8'	33.0'			SPT-22	31.5 - 33.0	1.5	3-3-3	25	
		LEAN CLAY, brown, wet to saturated, soft to very soft, with fine to medium grained sand, mottled		SPT-23	33.0 - 34.5	1.5	2-3-4	28	
				SPT-24	34.5 - 36.0	1.5	2-4-3	28	
									Saturated layer with

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SUBSURFACE LOG

Project No. 175569042 Location N 554406.25, E 2442841.10 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-28** Total Depth 64.6 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		LEAN CLAY, brown, wet to saturated, soft to very soft, with fine to medium grained sand, mottled *(Continued)*		SPT-25	36.0 - 37.5	1.5	1-1-1	28	bottom ash and fly ash
				ST-1	37.5 - 39.5	2.0		--	
				SPT-26	39.5 - 41.0	1.5	3-2-3	26	
				SPT-27	41.0 - 42.5	1.5	3-2-3	26	
				SPT-28	42.5 - 44.0	1.5	2-1-1	31	
				SPT-29	44.0 - 45.5	1.5	3-3-3	26	
				ST-2	45.5 - 47.5	2.0		--	
716.5'	48.3'			SPT-30	47.5 - 49.0	1.5	3-2-2	25	
		SILTY SAND, gray to brown, wet to saturated, loose to very loose, fine to medium grained, well graded, some silt, some		SPT-31	49.0 - 50.5	0.5	2-1-1	19	
				SPT-32	50.5 - 52.0	1.5	WOR-WOR-WOR	25	
711.3'	53.5'			SPT-33	52.0 - 53.5	1.5	WOR-WOR-WOR	20	Wood fragments at 53.5
		CLAYEY SAND, brown, saturated, very loose to loose, fine to medium grained		SPT-34	53.5 - 55.0	0.5	1-WOH-WOH	19	
				SPT-35	55.0 - 56.5	1.5	WOH-WOH-WOH	23	
706.8'	58.0'			SPT-36	56.5 - 58.0	1.5	3-2-3	22	Wood 57 to 57.2
		SAND, gray, saturated, loose, fine grained, trace silt		SPT-37	58.0 - 59.5	1.2	4-4-6	27	Wood 59 to 59.2
				SPT-38	59.5 - 61.0	1.5	4-6-7	27	Wood 60.5 to 61.0
				SPT-39	61.0 - 62.5	1.5	3-4-6	52	Boring backfilled with bentonite grout from 0.0 ft to 64.6 ft
700.5'	64.3'			SPT-40	62.5 - 64.0	1.5	2-3-4	25	
				SPT-41	64.0 - 64.3	0.3	50/0.3	25	
700.2'	64.6'	Shale (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

SUBSURFACE LOG

Project No.	175569042	Location	N 554155.15, E 2442854.72 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-29 Total Depth 67.7 ft
Location	Kingston, Tennessee	Surface Elevation	764.7 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/4/09 Completed 5/12/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	27.0 ft Date/Time 5/5/09
Logged By	Briggs Evans	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. %	Blows	Mois.Cont. % / Run Depth	Remarks
764.7'	0.0'	Top of Hole							
		CRUSHED STONE (Fill)		SPT-1	0.0 - 1.5	0.8	15-19-22	5	Boring advanced using 3 1/4" hollow stem augers
761.7'	3.0'			SPT-2	1.5 - 3.0	0.8	22-25-12	12	
		LEAN CLAY (Fill), red brown, dry to moist, soft to very stiff, some chert, trace gravel, medium plasticity		SPT-3	3.0 - 4.5	1.0	12-9-5	22	Perched water at the gravel - clay interface
				ST-1	4.5 - 6.5	1.2		--	
				SPT-4	6.5 - 8.0	1.0	12-12-15	26	
				SPT-5	8.0 - 9.5	1.5	7-9-10	22	
				SPT-6	9.5 - 11.0	1.5	11-12-14	23	
				ST-2	11.0 - 13.0	1.0		--	
				SPT-7	13.0 - 14.5	1.3	5-8-9	30	
				SPT-8	14.5 - 16.0	1.3	5-7-8	24	
				SPT-9	16.0 - 17.5	1.2	9-12-13	27	
				ST-3	17.5 - 19.5	1.2		--	
				SPT-10	19.5 - 21.0	1.2	1-3-4	29	Water at 20 ft
				SPT-11	21.0 - 22.5	1.0	1-3-4	28	
741.7'	23.0'			SPT-12	22.5 - 24.0	1.3	2-3-1	27	
		BOTTOM ASH (Fill), dark gray, wet to saturated, loose to medium dense, with fly ash		ST-4	24.0 - 26.0	1.0		--	
				SPT-13	26.0 - 27.5	1.5	20-20-21	20	Begin adding water to control blowback
				SPT-14	27.5 - 29.0	1.5	8-7-8	33	Coal fragments at 27.5 ft
				SPT-15	29.0 - 30.5	1.5	10-10-11	25	
				SPT-16	30.5 - 32.0	1.0	12-14-16	35	
				SPT-17	32.0 - 33.5	1.5	7-9-10	34	
729.9'	34.8'			SPT-18	33.5 - 35.0	1.5	1-1-3	32	
				SPT-19	35.0 - 36.5	0.9	2-2-3	24	

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SUBSURFACE LOG

Project No. 175569042 Location N 554155.15, E 2442854.72 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-29** Total Depth 67.7 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SANDY SILT, brown, wet to saturated, soft to very soft, with fly ash, with bottom ash *(Continued)*		SPT-20	38.5 - 38.0	1.0	1-3-4	21	
725.7'	39.0'			SPT-21	38.0 - 39.5	1.0	WOH-1-2	22	
		SILT, dark gray, moist, very soft, with fine grained sand, some wood		SPT-22	39.5 - 41.0	1.0	3-3-3	25	
				SPT-23	41.0 - 42.5	1.5	WOR-WOR-WOR	28	
				SPT-24	42.5 - 44.0	1.2	WOH-WOH-WOH	26	
				ST-5	44.0 - 46.0	1.5		--	
717.7'	47.0'			SPT-25	46.0 - 47.5	0.5	WOR-WOR-WOR	24	
		LEAN CLAY, brown to gray, moist, very soft, with manganese, mottled		SPT-26	47.5 - 49.0	1.5	10-9-7	21	
				SPT-27	49.0 - 50.5	1.5	7-9-11	22	
				SPT-28	50.5 - 52.0	1.0	7-6-6	27	
				ST-6	52.0 - 54.0	1.0		--	
				SPT-29	54.0 - 55.5	1.3	3-3-4	24	
				SPT-30	55.5 - 57.0	1.5	WOR-WOR-WOR	25	
				SPT-31	57.0 - 58.5	1.5	WOR-2-3	26	
				SPT-32	58.5 - 60.0	1.5	WOR-3-4	32	
702.9'	61.8'			ST-7	60.0 - 62.0	2.0		--	Wood 63.1 to 63.4 ft
		SAND, gray, wet, loose to medium dense, fine to medium grained, well graded, some silt, some wood		SPT-33	62.0 - 63.5	1.3	7-7-7	54	
				SPT-34	63.5 - 65.0	1.4	9-9-7	28	Boring backfilled with bentonite grout from 0.0 ft to 67.7 ft
				SPT-35	65.0 - 66.5	1.0	11-12-14	18	
697.2'	67.5'			SPT-36	66.5 - 67.7	1.2	10-14-50/0.2	18	
697.0'	67.7'	Shale, (augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

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SUBSURFACE LOG

Project No.	175569042	Location	N 553954.94, E 2442758.22 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-31 Total Depth 54.0 ft
Location	Kingston, Tennessee	Surface Elevation	749.5 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	3/24/09 Completed 3/25/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	8.0 ft Date/Time 3/25/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
749.5'	0.0'	Top of Hole							
		Overburden (Fill), consisted of gravel, clay, sand and ash		SPT-1	0.0 - 1.5	1.1	5-12-16	18	Boring advanced using 3 1/4 " Hollow Stem Augers
746.5'	3.0'			SPT-2	1.5 - 3.0	1.3	15-10-23	15	
746.0'	3.5'	Overburden (Fill), Auger advancement difficult - possible concrete slab		SPT-3	3.5 - 5.0	0.8	11-12-6	8	
		GRAVEL (Fill), gray, moist, medium dense		SPT-4	5.0 - 6.5	0.0	5-3-4	--	
				SPT-5	6.5 - 8.0	0.1	6-17-14	2	
				SPT-6	8.0 - 9.5	0.1	6-3-3	18	
739.5'	10.0'			SPT-7	9.5 - 11.0	0.5	3-1-4	39	
		FAT CLAY (Fill), light brown and red brown, moist, very soft, some fine to coarse gravel		SPT-8	11.0 - 12.5	1.3	2-1-3	43	
				ST-1	12.5 - 14.5	1.3		--	
				SPT-9	14.5 - 16.0	0.3	1-1-3	22	
				SPT-10	16.0 - 17.5	0.8	1-2-2	39	
				SPT-11	17.5 - 19.0	1.1	1-2-3	31	
				SPT-12	19.0 - 20.5	1.4	1-1-2	38	
				ST-2	20.5 - 22.5	1.0		--	
				SPT-13	22.5 - 24.0	1.2	WOH-1-1	37	
724.5'	25.0'			SPT-14	24.0 - 25.5	1.5	1-1-2	29	
		SILT, gray and brown, saturated, very soft, some clay, some fine grained sand		SPT-15	25.5 - 27.0	1.3	WOR-WOH-1	25	
				SPT-16	27.0 - 28.5	1.3	WOH-WOH-WOH	23	
				SPT-17	28.5 - 30.0	1.1	WOH-WOH-WOH	28	
				SPT-18	30.0 - 31.5	1.3	WOH-WOH-WOH	26	
717.5'	32.0'			SPT-19	31.5 - 33.0	1.1	1-2-4	23	
		LEAN CLAY, light brown, saturated, soft to medium stiff, some fine grained sand		ST-3	33.0 - 35.0	2.0		--	
				SPT-20	35.0 - 36.5	1.3	2-2-7	22	

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SUBSURFACE LOG

Project No. 175569042 Location N 553954.94, E 2442758.22 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-31** Total Depth 54.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		LEAN CLAY, light brown, saturated, soft to medium stiff, some fine grained sand *(Continued)*		SPT-21	36.5 - 38.0	1.2	3-3-5	23	
				ST-4	38.0 - 40.0	2.0		–	
				SPT-22	40.0 - 41.5	1.3	4-4-4	25	
707.0'	42.5'			SPT-23	41.5 - 43.0	1.2	1-1-3	29	
		SILT, dark gray, saturated, soft, some clay		SPT-24	43.0 - 44.5	1.3	WOH-WOH-WOH	27	
				SPT-25	44.5 - 46.0	1.1	1-3-2	28	
				SPT-26	46.0 - 47.5	1.2	4-3-3	33	
				SPT-27	47.5 - 49.0	1.1	3-3-4	38	
				SPT-28	49.0 - 50.5	1.3	2-2-2	36	SPT-29: sand/gravel in tip of spoon
				SPT-29	50.5 - 52.0	1.0	WOH-2-2	31	Boring backfilled with bentonite cement grout from 0.0 ft to 54.0 ft
697.0'	52.5'			SPT-30	52.0 - 53.2	1.1	5-13-50	16	
~~696.5'~~	~~53.0'~~	SAND, light brown, saturated, dense, medium to coarse grained, some fine to medium gravel							
695.5'	54.0'								
		Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

7/16/09

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SUBSURFACE LOG

Project No.	175569042	Location	N 553994.90, E 2442746.44 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-32 Total Depth 69.0 ft
Location	Kingston, Tennessee	Surface Elevation	764.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/1/09 Completed 4/1/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	20.0 ft Date/Time 4/1/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
764.8'	0.0'	Top of Hole							
763.3'	1.5'	GRAVEL (Fill), gray, moist, dense		SPT-1	0.0 - 1.5	1.2	18-24-30	4	Boring advanced using 3 1/4 " Hollow Stem Augers
		LEAN CLAY (Fill), red brown, moist, soft to medium stiff, chert		SPT-2	1.5 - 3.0	1.0	3-5-7	23	
				SPT-3	3.0 - 4.5	1.2	8-10-10	27	
				ST-1	4.5 - 6.5	1.5		--	All ST samples recovered using a fixed head piston sampler
				SPT-4	6.5 - 8.0	0.1	3-4-3	18	
				SPT-5	8.0 - 9.5	1.2	4-6-8	21	
				SPT-6	9.5 - 11.0	1.1	4-6-7	25	
				SPT-7	11.0 - 12.5	1.3	9-10-12	29	
				SPT-8	12.5 - 14.0	1.0	8-10-11	31	
				ST-2	14.0 - 16.0	1.5		--	
746.8'	18.0'			SPT-9	16.0 - 17.5	1.2	7-7-6	34	
		FAT CLAY (Fill), dark red brown, moist, soft, some clay		SPT-10	17.5 - 19.0	1.2	4-3-5	24	
				SPT-11	19.0 - 20.5	1.0	2-2-2	29	SPT-12: ash in tip of spoon
742.3'	22.5'			SPT-12	20.5 - 22.0	1.1	2-1-2	29	
		Bottom Ash 55% / Fly Ash 45% (Fill), black, saturated, very loose to loose		SPT-13	22.0 - 23.5	0.8	6-13-10	14	
				SPT-14	23.5 - 25.0	0.8	6-4-4	21	
737.8'	27.0'			SPT-15	25.0 - 26.5	0.8	3-2-2	24	SPT-16: gravel in tip of spoon
		FAT CLAY (Fill), brown, saturated, very soft to soft		SPT-16	26.5 - 28.0	1.0	2-5-4	30	
				SPT-17	28.0 - 29.5	0.2	WOH-WOH-2	28	
				SPT-18	29.5 - 31.0	0.1	5-5-5	18	
				SPT-19	31.0 - 32.5	0.1	5-4-3	24	SPT-19: rock and wood in tip of spoon
				SPT-20	32.5 - 34.0	0.2	5-3-4	44	
				SPT-21	34.0 - 35.5	0.0	4-1-2	--	
				SPT-22	35.5 - 37.0	0.0	3-1-1	--	

SUBSURFACE LOG

Project No. 175569042 Location N 553994.90, E 2442746.44 (NAD27)

Project Name Kingston Ash Pond Boring No. STN-32 Total Depth 69.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		FAT CLAY (Fill), brown, saturated, very soft to soft *(Continued)*		SPT-23	37.0 - 38.5	0.2	2-1-1	38	
				SPT-24	38.5 - 40.0	1.0	WOR-WOR-1	34	
723.8'	41.0'			SPT-25	40.0 - 41.5	1.0	1-2-1	38	
		SILT, dark gray, saturated, very soft, trace clay, trace fine grained sand		SPT-26	41.5 - 43.0	1.5	WOR-2-2	25	
721.8'	43.0'			SPT-27	43.0 - 44.5	1.2	WOR-WOR-WOR	27	
		SILT, light brown, saturated, very soft, some clay		SPT-28	44.5 - 46.0	1.2	WOH-WOH-WOH	30	
				SPT-29	46.0 - 47.5	1.1	2-2-2	25	
717.3'	47.5'			SPT-30	47.5 - 49.0	1.3	2-1-1	25	
		LEAN CLAY, gray, saturated, very soft to medium stiff, trace fine grained sand, trace silt		ST-3	49.0 - 51.0	2.0		–	
				SPT-31	51.0 - 52.5	1.2	1-2-2	20	
				SPT-32	52.5 - 54.0	1.3	5-4-5	22	
				SPT-33	54.0 - 55.5	1.2	7-7-8	23	
706.8'	56.0'			SPT-34	55.5 - 57.0	1.2	4-4-6	26	
		SILT, gray, saturated, very soft to soft, some clay		SPT-35	57.0 - 58.5	1.1	WOR-1-1	26	
				SPT-36	58.5 - 60.0	1.5	WOH-WOH-WOH	29	
703.3'	61.5'			SPT-37	60.0 - 61.5	1.2	2-2-2	29	
		SILT, dark gray, saturated, soft, trace clay, some fine grained sand		SPT-38	61.5 - 63.0	1.1	4-2-1	33	Sand lenses at 61.5 ft to bottom. Very thin, < 0.05 ft
				SPT-39	63.0 - 64.5	1.2	4-4-4	43	
				SPT-40	64.5 - 66.0	1.5	2-2-3	34	
				SPT-41	66.0 - 67.5	1.1	4-5-6	40	Boring backfilled with bentonite cement grout from 0.0 ft to 69.0 ft
698.8'	66.0'			SPT-42	67.5 - 68.5	1.0	30-50/0.5	18	
696.3'	68.5'	SAND, dark grey, saturated, medium dense, fine to coarse grained, some fine to medium gravel							
695.8'	69.0'								
		Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer

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SUBSURFACE LOG

Project No.	175569042	Location	N 553994.90, E 2442746.44 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-32 Total Depth 69.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks

WOR = Weight of Rods

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SUBSURFACE LOG

Project No.	175569042	Location	N 553853.66, E 2442184.35 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-34 Total Depth 76.0 ft
Location	Kingston, Tennessee	Surface Elevation	764.7 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/20/09 Completed 5/21/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	21.0 ft Date/Time 5/20/09
Logged By	Brad Smiley	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
764.7'	0.0'	Top of Hole							
		FAT CLAY (Fill), red brown, moist, medium stiff, some chert		SPT-1	0.0 - 1.5	0.8	2-2-2	24	Boring advanced using 4 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	0.8	2-3-4	27	
				SPT-3	3.0 - 4.5	0.9	3-4-4	27	
				SPT-4	4.5 - 6.0	0.9	2-2-2	32	
				SPT-5	6.0 - 7.5	1.0	2-4-6	27	
				SPT-6	7.5 - 9.0	1.2	5-4-6	29	
				SPT-7	9.0 - 10.5	1.1	5-6-5	27	
				SPT-8	10.5 - 12.0	1.4	4-6-6	27	
				SPT-9	12.0 - 13.5	1.5	6-10-10	30	
				SPT-10	13.5 - 15.0	1.3	7-8-8	25	
				SPT-11	15.0 - 16.5	1.3	3-5-4	29	
				SPT-12	16.5 - 18.0	1.2	4-5-4	33	
				SPT-13	18.0 - 19.3	0.7	5-10-50/0.3	3	
745.2'	19.5'								
		BOTTOM ASH (Fill), black, saturated, medium dense		SPT-14	19.5 - 21.0	0.9	3-5-2	21	Water added at 20.0 ft to keep sand out of augers
				SPT-15	21.0 - 22.5	0.8	3-7-7	19	
				SPT-16	22.5 - 24.0	0.9	7-8-8	13	
739.2'	25.5'			SPT-17	24.0 - 25.5	1.3	4-4-4	21	
737.7'	27.0'	FLY ASH (Fill), black, saturated, loose		SPT-18	25.5 - 27.0	0.9	3-3-3	21	
		SAND (Fill), dark gray, moist, medium dense, fine to medium grained, some silty clay		SPT-19	27.0 - 28.5	0.4	3-8-19	7	
				SPT-20	28.5 - 30.0	0.5	3-7-5	24	
732.7'	32.0'			ST-1	30.0 - 32.0	0.0		--	
		BOTTOM ASH (Fill), dark gray, saturated, medium dense to dense		SPT-21	32.0 - 33.5	1.2	31-16-6	12	
				SPT-22	33.5 - 35.0	1.0	7-16-10	17	
				SPT-23	35.0 - 36.5	0.4	13-16-11	11	

4:\BM LEGACY (TEMP)\1 KINGSTON ASH POND\[PU ASH POND] ALL.GDT 7/16/09

7/16/09

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SUBSURFACE LOG

Project No. 175569042 Location N 553853.66, E 2442184.35 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-34** Total Depth 76.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		BOTTOM ASH (Fill), dark gray, saturated, medium dense to dense *(Continued)*		SPT-24	38.5 - 38.0	0.9	13-10-11	14	
725.2'	39.5'			SPT-25	38.0 - 39.5	0.9	4-6-5	19	
		LEAN CLAY, gray to brown, moist, soft, some clay, trace fine grained sand		SPT-26	39.5 - 41.0	0.7	4-2-2	22	
				SPT-27	41.0 - 42.5	0.0	2-2-4	–	
				SPT-28	42.5 - 44.0	0.7	2-4-4	22	
719.2'	45.5'			SPT-29	44.0 - 45.5	1.5	4-6-7	25	
		SAND, light brown, saturated, loose to medium dense, fine grained, some clay		SPT-30	45.5 - 47.0	0.4	1-2-4	30	
				SPT-31	47.0 - 48.5	1.4	6-6-8	24	
714.7'	50.0'			SPT-32	48.5 - 50.0	1.1	4-6-6	26	
		SAND, gray to dark grey, saturated, loose to medium dense, medium to coarse grained, some clay		SPT-33	50.0 - 51.5	1.5	WOR-WOR-WOR	19	
				SPT-34	51.5 - 53.0	0.8	1-1-3	22	
				SPT-35	53.0 - 54.5	1.3	2-3-3	19	
				SPT-36	54.5 - 56.0	0.9	2-2-2	21	
				SPT-37	56.0 - 57.5	1.2	3-3-7	20	
				SPT-38	57.5 - 59.0	1.4	3-3-3	21	
				SPT-39	59.0 - 60.5	1.2	4-3-4	24	
				SPT-40	60.5 - 62.0	1.3	4-5-11	25	
701.2'	63.5'			SPT-41	62.0 - 63.5	1.2	7-7-8	21	
699.7'	65.0'	SAND, dark gray, saturated, dense, medium grained, some coarse gravel		SPT-42	63.5 - 65.0	1.3	7-19-31	21	
				SPT-43	65.0 - 66.2	1.1	17-42-41/0.2	–	
		Shale (Augered)							
									Boring backfilled with bentonite cement grout from 0.0 ft to 76.0 ft
688.7'	76.0'								
		Auger Refusal / Bottom of Hole							

PWA LEGACY 175569042 REPORTS ASH PONDS.GPJ PWA.GDT 7/16/09

SUBSURFACE LOG

Project No.	175569042	Location	N 553853.66, E 2442184.35 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-34** Total Depth 76.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks

WOH = Weight of Hammer
WOR = Weight of Rods

Slope Indicator (79 ft of pipe) installed with a concrete pad and protective cover

SUBSURFACE LOG

Project No.	175569042	Location	N 553776.74, E 2442198.78 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-36 Total Depth 44.0 ft
Location	Kingston, Tennessee	Surface Elevation	751.9 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	3/24/09 Completed 3/24/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	5.0 ft Date/Time 3/24/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
751.9'	0.0'	Top of Hole							
750.9'	1.0'	LEAN CLAY (Fill), red brown, moist, stiff		SPT-1	0.0 - 1.5	1.3	5-7-18	20	Boring advanced using 3 1/4 " Hollow Stem Augers
750.7'	1.2'	BOTTOM ASH (Fill), dark gray, moist, medium dense		SPT-2	1.5 - 3.0	1.3	22-14-12	11	
		LEAN CLAY (Fill), light brown to gray, moist, medium stiff to stiff, some coarse gravel		SPT-3	3.0 - 4.5	1.0	9-10-12	15	
				SPT-4	4.5 - 6.0	0.4	3-4-4	17	
				SPT-5	6.0 - 7.5	0.5	10-7-8	15	
				SPT-6	7.5 - 9.0	0.0	6-6-12	--	
742.4'	9.5'								SPT-7: gravel in tip of spoon
741.9'	10.0'	GRAVEL (Fill), gray, moist, medium dense		SPT-7	9.0 - 10.5	1.3	12-8-15	10	
		LEAN CLAY (Fill), light brown, moist, medium stiff, some shale		SPT-8	10.5 - 12.0	1.0	8-28-17	12	
738.4'	13.5'			SPT-9	12.0 - 13.5	0.0	12-8-8	--	
		GRAVEL (Fill), gray, moist, medium dense, boulders		SPT-10	13.5 - 15.0	0.0	21-35-10	--	
				SPT-11	15.0 - 16.5	0.6	2-2-3	10	
733.9'	18.0'			SPT-12	16.5 - 18.0	0.8	5-3-2	22	
		SILTY CLAY, dark gray, saturated, very soft to soft		SPT-13	18.0 - 19.5	1.1	3-2-1	27	
730.4'	21.5'			SPT-14	19.5 - 21.0	1.3	1-1-1	24	
		LEAN CLAY, light brown, moist, soft to medium stiff, some fine grained sand		SPT-15	21.0 - 22.5	1.2	1-2-2	25	
				ST-1	22.5 - 24.5	2.0		--	
				SPT-16	24.5 - 26.0	1.5	3-5-6	24	
				SPT-17	26.0 - 27.5	1.5	4-6-7	19	
				SPT-18	27.5 - 29.0	1.1	4-6-8	21	
721.4'	30.5'			ST-2	29.0 - 31.0	2.0		--	
		SAND, brown, saturated, very loose, fine to medium grained		SPT-19	31.0 - 32.5	1.3	1-1-2	23	ST-2: sand in bottom of tube
718.9'	33.0'			SPT-20	32.5 - 34.0	1.3	3-13-21	15	
		SAND, brown, saturated, loose to medium dense, fine to medium grained, some fine to coarse gravel		SPT-21	34.0 - 35.5	1.3	13-20-25	11	
				SPT-22	35.5 - 37.0	0.5	8-7-5	20	

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SUBSURFACE LOG

Project No. 175569042 Location N 553776.74, E 2442198.78 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-36** Total Depth 44.0 ft

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
				SPT-23	37.0 - 38.5	1.1	7-8-11	14	
712.4'	39.5'			SPT-24	38.5 - 40.0	1.4	7-13-13	32	
		Shale, (Augered)		SPT-25	40.0 - 41.5	1.3	6-29-31	17	Boring backfilled with bentonite cement grout from 0.0 ft to 44.0 ft
				SPT-26	41.5 - 43.0	0.8	27-31-38	18	
707.9'	44.0'								

Auger Refusal / Bottom of Hole

WOH = Weight of Hammer
WOR = Weight of Rods

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SUBSURFACE LOG

Project No.	175569042	Location	N 553766.08, E 2442199.97 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-36A** Total Depth 15.0 ft
Location	Kingston, Tennessee	Surface Elevation	751.9 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/30/09 Completed 4/30/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	N/A Date/Time N/A
Logged By	Greg Budd	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
751.9'	0.0'	Top of Hole							
		OVERBURDEN, (Augered without sampling)							Boring advanced using 3 1/4 " Hollow Stem Augers
736.9'	15.0'	No Refusal / Bottom of Hole							

PZ Installed, tip at elevation 738.4'

Protective well cover and concrete pad installed.

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SUBSURFACE LOG

Project No.	175569042	Location	N 553799.90, E 2442184.40 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-37 Total Depth 54.2 ft
Location	Kingston, Tennessee	Surface Elevation	763.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	3/25/09 Completed 3/26/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	8.5 ft Date/Time 3/26/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
763.8'	0.0'	Top of Hole							
762.8'	1.0'	GRAVEL (Fill), gray, moist, dense		SPT-1	0.0 - 1.5	1.0	15-6-7	5	Boring advanced using 3 1/4 " Hollow Stem Augers
		LEAN CLAY (Fill), red brown, moist, soft to stiff, some chert, some ash		SPT-2	1.5 - 3.0	1.3	6-7-9	23	
				SPT-3	3.0 - 4.5	1.3	11-11-11	24	
				SPT-4	4.5 - 6.0	1.1	8-4-5	22	
				SPT-5	6.0 - 7.5	0.9	8-6-10	28	
754.8'	9.0'			SPT-6	7.5 - 9.0	1.1	5-7-9	22	
		FAT CLAY (Fill), red brown, moist, soft to stiff, some chert		SPT-7	9.0 - 10.5	1.0	4-6-6	27	
				SPT-8	10.5 - 12.0	1.1	2-2-3	33	
				SPT-9	12.0 - 13.5	1.3	4-5-7	27	
				ST-1	13.5 - 15.5	2.0		–	
				SPT-10	15.5 - 17.0	1.2	3-3-3	24	
				SPT-11	17.0 - 18.5	1.1	1-3-7	28	
				SPT-12	18.5 - 20.0	1.0	2-3-3	23	
				ST-2	20.0 - 22.0	1.7		–	
				SPT-13	22.0 - 23.5	1.3	2-2-3	22	
738.8'	25.0'			SPT-14	23.5 - 25.0	1.0	3-3-4	20	
		CLAYEY GRAVEL (Fill), gray, moist, medium dense, some shale		SPT-15	25.0 - 26.5	0.2	9-11-12	16	
735.8'	28.0'			SPT-16	26.5 - 28.0	0.2	4-10-11	19	
		LEAN CLAY, light brown, saturated, very soft to soft		SPT-17	28.0 - 29.5	0.3	4-2-1	25	
				SPT-18	29.5 - 31.0	1.3	1-1-2	26	
				SPT-19	31.0 - 32.5	1.2	1-3-5	23	
729.3'	34.5'			ST-3	32.5 - 34.5	1.0		–	
				SPT-20	34.5 - 36.0	1.2	WOH-2-3	21	

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SUBSURFACE LOG

Project No.	175569042	Location	N 553799.90, E 2442184.40 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-37 Total Depth 54.2 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SAND, light brown, saturated, loose to medium dense, fine to medium grained, some silty clay *(Continued)*		SPT-21	36.0 - 37.5	1.1	2-3-4	21	
				SPT-22	37.5 - 39.0	1.1	6-8-8	22	
				SPT-23	39.0 - 40.5	1.3	5-4-4	18	
				SPT-24	40.5 - 42.0	1.0	WOH-3-4	24	
				SPT-25	42.0 - 43.5	1.4	5-15-18	22	
				SPT-26	43.5 - 45.0	1.1	10-14-18	20	Water added at 44.0 ft to keep sand out of augers
717.3'	46.5'			SPT-27	45.0 - 46.5	1.0	1-5-15	17	
		Shale, (Augered)		SPT-28	46.5 - 48.0	1.1	5-20-20	16	
				SPT-29	48.0 - 49.5	1.1	10-30-33	14	
				SPT-30	49.5 - 51.0	1.1	17-34-32	21	
				SPT-31	51.0 - 52.0	1.0	37-50/0.5	16	Boring backfilled with bentonite cement grout from 0.0 ft to 54.2 ft
709.6'	54.2'								
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

SUBSURFACE LOG

Project No.	175569042	Location	N 553799.38, E 2442182.40 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-37A** Total Depth 29.0 ft
Location	Kingston, Tennessee	Surface Elevation	763.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/22/09 Completed 4/22/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Adam Smith	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
763.8'	0.0'	Top of Hole							
		OVERBURDEN, See log for STN-37							Boring advanced using 3 1/4 " Hollow Stem Augers
734.8'	29.0'	No Refusal / Bottom of Hole							

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SUBSURFACE LOG

Project No.	175569042	Location	N 553799.38, E 2442182.40 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-37A** Total Depth 29.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks

Two PZ's installed, tip at elevation 753.1' and 738.1'

Flushmount well cover and concrete pad installed.

Stantec

SUBSURFACE LOG

Project No.	175569042	Location	N 553800.49, E 2442186.20 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-37B Total Depth 52.0 ft
Location	Kingston, Tennessee	Surface Elevation	763.7 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/22/09 Completed 4/22/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Adam Smith	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
763.7'	0.0'	Top of Hole							
		OVERBURDEN, See log for STN-37							Boring advanced using 3 1/4 " Hollow Stem Augers

Stantec

SUBSURFACE LOG

Project No.	175569042	Location	N 553800.49, E 2442186.20 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-37B** Total Depth 52.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		OVERBURDEN, See log for STN-37 *(Continued)*							
711.7'	52.0'	No Refusal / Bottom of Hole							
		PZ installed, tip at elevation 715'							
		Flushmount well cover and concrete pad installed.							

SUBSURFACE LOG

Project No.	175569042	Location	N 553798.81, E 2442171.01 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-37C** Total Depth 33.5 ft
Location	Kingston, Tennessee	Surface Elevation	763.6 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/30/09 Completed 4/30/09
Supervisor	Ben Haiada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Adam Smith	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
763.6'	0.0'	Top of Hole							
		OVERBURDEN, (Augered without sampling)							Boring advanced using 4 1/4 " Hollow Stem Augers Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
740.8'	22.8'								
		FAT CLAY, red to dark brown, moist, stiff, with chert		ST-1	22.8 - 24.8	1.8		--	Chert boulder present at 25.3' ST-2: tube crushed, no recovery
				ST-2	24.8 - 26.8	0.0		--	Gravelly zone from 25.3' to 29.5'. Attempted to clear gravelly zone to 27.5'
736.8'	26.8'								
736.1'	27.5'	(Auger without sample)							ST-3: tube crushed, no recovery
		GRAVELLY FAT CLAY, dark gray, moist, very stiff, cobbles greater then 3"		ST-3	27.5 - 29.5	0.0		--	Boring backfilled with bentonite cement grout from 0.0 ft to 33.5 ft
734.1'	29.5'			ST-4	29.5 - 31.5	1.5		--	
		LEAN CLAY with sand, light brown to tan, moist, soft		ST-5	31.5 - 33.5	1.7		--	
730.1'	33.5'								
		No Refusal / Bottom of Hole							

SUBSURFACE LOG

Project No.	175569042	Location	N 553798.26, E 2442168.95 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-37D Total Depth 33.0 ft
Location	Kingston, Tennessee	Surface Elevation	763.6 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/30/09 Completed 5/1/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Adam Smith	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
763.6'	0.0'	Top of Hole							
		OVERBURDEN, (Augered without sampling)							Boring advanced using 4 1/4 " Hollow Stem Augers Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
740.9'	22.7'								
		FAT CLAY, dark brown to red, moist, stiff		ST-1	22.7 - 24.7	2.0		-	ST-2: tube crushed, no recovery
738.1'	25.5'			ST-2	24.7 - 25.6	0.9		-	Gravelly zone from 25.5' to 31.0'
		LEAN CLAY with gravel, dark gray, moist, stiff, some cobbles							ST-3: cobbles, no recovery
				ST-3	28.0 - 28.4	0.0		-	
732.6'	31.0'								Boring backfilled with bentonite cement grout from 0.0 ft to 33.0 ft
		LEAN CLAY with sand, light brown, wet, soft		ST-4	31.0 - 33.0	2.0		-	
730.6'	33.0'								
		No Refusal / Bottom of Hole							

FORM LEGACY (11-98) IT KINGSTON ASH POND.GPJ PHILLGDT 7/15/09

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SUBSURFACE LOG

Project No.	175569042	Location	N 553730.83, E 2441988.70 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-38 Total Depth 51.3 ft
Location	Kingston, Tennessee	Surface Elevation	764.1 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/21/09 Completed 5/22/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	30.0 ft Date/Time 5/21/09
Logged By	Brad Smiley	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
764.1'	0.0'	Top of Hole							
763.4'	0.7'	GRAVEL (Fill)		SPT-1	0.0 - 1.5	1.2	8-6-6	15	Boring advanced using 4 1/4 " Hollow Stem Augers
		LEAN CLAY (Fill), red brown, moist, medium stiff, some chert		SPT-2	1.5 - 3.0	1.4	6-8-12	20	
				SPT-3	3.0 - 4.5	1.2	12-12-10	18	
				SPT-4	4.5 - 6.0	0.5	6-4-5	30	
				SPT-5	6.0 - 7.5	1.0	6-7-9	23	
				SPT-6	7.5 - 9.0	1.0	9-10-11	22	
				SPT-7	9.0 - 10.5	0.9	9-11-11	26	
				SPT-8	10.5 - 12.0	0.9	3-3-9	21	
				SPT-9	12.0 - 13.5	0.0	9-10-13	--	
				SPT-10	13.5 - 15.0	0.1	13-16-14	26	
				SPT-11	15.0 - 16.5	1.2	2-3-3	31	
				SPT-12	16.5 - 18.0	1.1	3-4-4	23	
				SPT-13	18.0 - 19.5	1.5	3-4-4	33	
				SPT-14	19.5 - 21.0	1.5	2-3-4	32	
				SPT-15	21.0 - 22.5	1.5	3-4-5	35	
				SPT-16	22.5 - 24.0	1.5	4-5-6	28	
				SPT-17	24.0 - 25.5	0.9	3-4-3	26	
				SPT-18	25.5 - 27.0	0.8	1-1-4	24	
735.6'	28.5'			SPT-19	27.0 - 28.5	1.4	2-3-4	23	
		FAT CLAY, light brown, moist, medium stiff, some fly ash		SPT-20	28.5 - 30.0	1.1	3-4-4	26	
				SPT-21	30.0 - 31.5	1.5	4-5-7	26	Water added at 30.0 ft to keep sand out of augers
731.1'	33.0'			SPT-22	31.5 - 33.0	1.5	6-7-9	25	
		SILTY SAND, light brown, saturated, loose to medium dense, fine to medium grained, some clay		SPT-23	33.0 - 34.5	1.5	7-9-7	20	
				SPT-24	34.5 - 36.0	1.2	1-2-4	20	

7/16/09

SUBSURFACE LOG

Project No. 175569042 Location N 553730.83, E 2441988.70 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-38** Total Depth 51.3 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		SILTY SAND, light brown, saturated, loose to medium dense, fine to medium grained, some clay *(Continued)*		SPT-25	36.0 - 37.5	1.3	4-5-4	23	
				SPT-26	37.5 - 39.0	1.5	1-1-2	21	
				SPT-27	39.0 - 40.5	1.2	4-6-4	22	
				SPT-28	40.5 - 42.0	0.9	WOH-WOH-1	23	
				SPT-29	42.0 - 43.5	1.0	WOR-2-4	22	
				SPT-30	43.5 - 45.0	1.0	WOR-2-4	23	
717.6'	46.5'			SPT-31	45.0 - 46.5	1.2	3-5-5	20	
		SAND, light gray, saturated, dense, fine to medium grained, trace gravel		SPT-32	46.5 - 48.0	1.2	5-7-11	20	Boring backfilled with bentonite cement grout from 0.0 ft to 51.3 ft
715.1'	49.0'			SPT-33	48.0 - 49.5	1.0	21-22-12	18	
		Shale (Augered)		SPT-34	49.5 - 51.0	1.3	8-9-8	–	
712.8'	51.3'			SPT-35	51.0 - 51.3	0.3	50/0.3	–	

Auger Refusal / Bottom of Hole

WOH = Weight of Hammer
WOR = Weight of Rods

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SUBSURFACE LOG

Project No.	175569042	Location	N 553583.10, E 2441510.71 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-41 Total Depth 63.0 ft
Location	Kingston, Tennessee	Surface Elevation	752.7 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/21/09 Completed 4/21/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	15.0 ft Date/Time 4/21/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
752.7'	0.0'	Top of Hole							
		FAT CLAY (Fill), red brown, moist, soft		SPT-1	0.0 - 1.5	1.0	2-4-4	28	Boring advanced using 3 1/4 " Hollow Stem Augers
750.2'	2.5'			SPT-2	1.5 - 3.0	1.3	5-6-6	23	
749.7'	3.0'	BOTTOM ASH (Fill), black, moist, medium dense		SPT-3	3.0 - 4.5	1.3	11-12-7	19	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling SPT-4: gravel in spoon
		FAT CLAY (Fill), red brown and brown, moist, stiff to very stiff, some gravel		SPT-4	4.5 - 6.0	0.2	6-6-11	15	
				SPT-5	6.0 - 7.5	1.0	9-8-7	16	
				SPT-6	7.5 - 9.0	1.3	17-34-26	13	
743.7'	9.0'								
		LEAN CLAY (Fill), red brown and brown, moist, medium stiff, some gravel		SPT-7	9.0 - 10.5	1.1	4-5-5	19	
740.7'	12.0'			SPT-8	10.5 - 12.0	1.1	2-4-6	17	SPT-8: gravel in spoon
		FAT CLAY, brown, moist, soft, some fine grained sand		SPT-9	12.0 - 13.5	1.2	9-11-8	19	
				SPT-10	13.5 - 15.0	1.3	2-2-2	21	
				ST-1	15.0 - 17.0	1.0		–	ST-1: sand in bottom of tube
735.7'	17.0'								Water added at 17.0 ft to keep augers clear
		SAND, gray, saturated, very loose, fine to medium grained, some clay		SPT-11	17.0 - 18.5	1.0	1-1-1	18	
				SPT-12	18.5 - 20.0	1.3	WOH-WOH-1	19	
				SPT-13	20.0 - 21.5	1.0	WOH-WOH-WOH	23	
				SPT-14	21.5 - 23.0	1.5	WOH-1-1	21	
				SPT-15	23.0 - 24.5	1.3	WOH-1-2	20	
				SPT-16	24.5 - 26.0	1.4	WOH-1-1	18	
				SPT-17	26.0 - 27.5	1.3	WOH-1-1	23	
				SPT-18	27.5 - 29.0	1.4	WOH-1-1	20	
				SPT-19	29.0 - 30.5	1.5	1-WOH-1	19	
720.7'	32.0'			SPT-20	30.5 - 32.0	1.3	1-1-1	24	
		SAND, light gray, saturated, medium dense, medium grained		SPT-21	32.0 - 33.5	1.3	4-5-5	18	
				SPT-22	33.5 - 35.0	1.3	4-4-6	19	
				SPT-23	35.0 - 36.5	1.3	1-3-5	20	

7/16/09

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SUBSURFACE LOG

Project No. 175569042 Location N 553583.10, E 2441510.71 (NAD27)

Project Name Kingston Ash Pond Boring No. STN-41 Total Depth 63.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
714.7'	38.0'			SPT-24	36.5 - 38.0	0.0	4-5-9	23	SPT-24: shale in tip of spoon
				SPT-25	38.0 - 39.5	1.0	9-12-21	--	
		Shale, (Augered)		SPT-26	39.5 - 41.0	1.1	11-16-23	--	
709.7'	43.0'								Began Core
		Shale, dark gray, silty, very soft, very thin bedded, with very thin to thin limestone layers		0%	3.7	0.7	19	46.7	
				0%	6.3	0.8	13	53.0	
									Boring backfilled with bentonite cement grout from 0.0 ft to 63.0 ft
689.7'	63.0'			0%	10.0	2.0	20	63.0	

Bottom of Hole

Top of Rock = 38.0'
Elevation (714.7')

WOH = Weight of Hammer
WOR = Weight of Rods

Split Samples: SPT-2

7/16/09

Stantec

Project 171468117 Kingston Ash Pond
Sheet No. 1 of 1 Date 4/21/2009
Hole # STN-41 Rig # 710

Northing 553,583.10 Surface Elevation (ft.) 752.7 Crew Kent Clements/Clayton Miller

Easting 2,441,510.71 Top of Rock Elev. (ft.) 714.7 Inspector Benjamin A. Halada

Boring Size 3 1/4 Hollow Stem Augers Pump Capacity 21 gpm Meter Type Sensus 5/8" SR II

Test Method US Bureau of Reclamation Static Water Level 15.0' Meter # 67290595

Test Section		Gauge Reading (PSI)	Time of Test			Meter Reading		Total Water (Gal / Cu Ft)	CFM
Top Depth	Bottom Depth		Start	End	Interval (min-sec)	Start of Test	End of Test		
45.0	53.0	25	0:00	1:00	1:00	256.99	257.05	0.06	0.06
		25	1:00	2:00	1:00	257.05	257.06	0.01	0.01
		25	2:00	3:00	1:00	257.06	257.07	0.01	0.01
		25	3:00	4:00	1:00	257.07	257.08	0.01	0.01
		25	4:00	5:00	1:00	257.08	257.08	0.00	0.00
53.0	63.0	31	0:00	1:00	1:00	261.50	262.60	1.10	1.10
		31	1:00	2:00	1:00	262.60	263.70	1.10	1.10
		31	2:00	3:00	1:00	263.70	264.70	1.00	1.00
		31	3:00	4:00	1:00	264.70	265.68	0.98	0.98
		31	4:00	5:00	1:00	265.68	266.70	1.02	1.02
		31	5:00	6:00	1:00	266.70	267.70	1.00	1.00
		31	6:00	7:00	1:00	267.70	268.71	1.01	1.01
		31	7:00	8:00	1:00	268.71	269.70	0.99	0.99
		31	8:00	9:00	1:00	269.70	270.70	1.00	1.00
		31	9:00	10:00	1:00	270.70	271.69	0.99	0.99
		31	10:00	11:00	1:00	271.69	272.68	0.99	0.99
		31	11:00	12:00	1:00	272.68	273.67	0.99	0.99
		31	12:00	13:00	1:00	273.67	274.71	1.04	1.04
		31	13:00	14:00	1:00	274.71	275.64	0.93	0.93
		31	14:00	15:00	1:00	275.64	276.61	0.97	0.97

Project # 171468117 Hole # STN-41 Inspector Benjamin A. Halada Date 4/21/2009

SUBSURFACE LOG

Project No.	175569042	Location	N 553623.48, E 2441513.69 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-42 Total Depth 51.5 ft
Location	Kingston, Tennessee	Surface Elevation	764.7 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/16/09 Completed 4/17/09
Supervisor	Ben Phillips Driller Steve Bradford	Depth to Water	27.0 ft Date/Time 4/16/09
Logged By	Ben Phillips	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
764.7'	0.0'	Top of Hole							
763.4'	1.3'	GRAVEL (Fill), Gravel		SPT-1	0.0 - 1.5	1.1	3-5-7	20	Boring advanced using 3 1/4 " Hollow Stem Augers
		FAT CLAY (Fill), brown, moist, medium stiff to stiff, some silt		SPT-2	1.5 - 3.0	1.3	8-10-11	17	
				SPT-3	3.0 - 4.5	1.1	8-8-8	21	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
				SPT-4	4.5 - 6.0	1.2	3-4-5	19	
				SPT-5	6.0 - 7.5	1.1	6-8-10	23	
				SPT-6	7.5 - 9.0	0.5	6-8-8	25	
				SPT-7	9.0 - 10.5	1.5	8-10-13	28	
				SPT-8	10.5 - 12.0	1.5	10-13-18	19	
				ST-1	12.0 - 14.0	1.6		–	
				SPT-9	14.0 - 15.5	1.5	3-4-4	28	
				SPT-10	15.5 - 17.0	1.5	3-5-5	29	
746.3'	18.4'			SPT-11	17.0 - 18.5	1.0	3-5-5	22	
		BOTTOM ASH (Fill), black, moist, medium dense		SPT-12	18.5 - 20.0	1.3	1-2-2	23	
				SPT-13	20.0 - 21.5	1.5	9-11-6	16	
742.7'	22.0'			SPT-14	21.5 - 23.0	1.5	6-27-9	31	
741.7'	23.0'	FLY ASH (Fill), black, wet, very loose		SPT-15	23.0 - 24.5	1.5	5-7-7	24	
739.5'	25.2'	BOTTOM ASH (Fill), black, saturated, medium dense		SPT-16	24.5 - 26.0	1.5	3-2-1	14	
738.2'	26.5'	FLY ASH (Fill), black, saturated, very loose		SPT-17	26.0 - 27.5	1.3	3-4-4	22	
		SAND with Clay, brown, wet, loose, some silt		SPT-18	27.5 - 29.0	1.5	3-3-3	23	
				SPT-19	29.0 - 30.5	1.4	2-4-2	19	
				SPT-20	30.5 - 32.0	1.3	3-4-4	20	
731.4'	33.3'			SPT-21	32.0 - 33.5	1.5	2-3-3	23	
		SAND, brown, wet, loose to very dense		SPT-22	33.5 - 35.0	1.5	3-4-5	23	
				SPT-23	35.0 - 36.5	1.5	5-6-6	23	

EARTH LEGACY 175569042 KINGSTON ASH POND.GPJ Portrait.GDT 7/16/09

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SUBSURFACE LOG

Project No. 175569042 Location N 553623.48, E 2441513.69 (NAD27)

Project Name Kingston Ash Pond Boring No. STN-42 Total Depth 51.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SAND, brown, wet, loose to very dense *(Continued)*		SPT-24	36.5 - 38.0	1.5	3-4-4	21	
				SPT-25	38.0 - 39.5	1.5	4-3-2	23	
				SPT-26	39.5 - 41.0	1.5	2-4-6	22	
				SPT-27	41.0 - 42.5	1.5	4-5-5	22	
				SPT-28	42.5 - 44.0	1.5	9-3-2	22	
				SPT-29	44.0 - 45.5	1.5	4-5-5	20	
				SPT-30	45.5 - 47.0	1.5	3-4-4	22	
				SPT-31	47.0 - 48.5	1.5	14-22-27	22	Boring backfilled with bentonite cement grout from 0.0 ft to 51.5 ft
				SPT-32	48.5 - 50.0	1.5	20-32-45	21	
713.7'	51.0'			SPT-33	50.0 - 51.5	1.5	11-27-40	21	
713.2'	51.5'	Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

7/16/09

SUBSURFACE LOG

Project No.	175569042	Location	N 554004.68, E 2441548.50 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-43 Total Depth 54.0 ft
Location	Kingston, Tennessee	Surface Elevation	765.9 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/6/09 Completed 4/7/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	11.0 ft Date/Time 4/7/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
765.9'	0.0'	Top of Hole							
765.7'	0.2'	GRAVEL (Fill), gray, moist, dense		SPT-1	0.0 - 1.5	1.3	15-26-25	12	Boring advanced using 3 1/4 " Hollow Stem Augers
763.4'	2.5'	Overburden (Fill), mix of clay, ash, gravel and sand		SPT-2	1.5 - 3.0	1.1	25-14-9	14	
762.4'	3.5'	BOTTOM ASH (Fill), black, moist, medium dense, some fine grained sand		SPT-3	3.0 - 4.5	1.3	5-4-11	21	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
761.4'	4.5'			SPT-4	4.5 - 6.0	1.1	4-14-19	10	
		FAT CLAY (Fill), red brown, moist, medium stiff, some chert		SPT-5	6.0 - 6.8	0.8	50-50/0.3	12	
		BOTTOM ASH 55% / FLY ASH 45% (Fill), black, saturated, medium dense to dense		SPT-6	7.5 - 9.0	1.5	14-35-34	21	
				SPT-7	9.0 - 10.5	1.4	15-17-19	20	
				SPT-8	10.5 - 12.0	1.4	6-8-19	17	
				SPT-9	12.0 - 13.5	1.2	12-15-14	23	
				SPT-10	13.5 - 15.0	1.1	3-8-7	19	
				SPT-11	15.0 - 16.5	1.1	7-5-3	26	
				SPT-12	16.5 - 18.0	1.0	2-2-2	28	
				SPT-13	18.0 - 19.5	1.3	1-2-2	24	
744.9'	21.0'			SPT-14	19.5 - 21.0	0.5	3-2-1	24	
		FLY ASH (Fill), black, saturated, very loose		SPT-15	21.0 - 22.5	1.3	2-1-2	29	SPT-15: wood fragments in sample
				SPT-16	22.5 - 24.0	0.4	WOH-WOH-2	30	
				SPT-17	24.0 - 25.5	0.6	4-2-1	23	
				SPT-18	25.5 - 27.0	0.0	WOH-WOH-WOH	--	
737.9'	28.0'			SPT-19	27.0 - 28.5	1.2	1-2-3	30	SPT-19: wood fragments in sample
		SILTY CLAY, brown, moist, soft		ST-1	28.5 - 30.5	2.0		--	
733.9'	32.0'			SPT-20	30.5 - 32.0	0.8	WOH-WOH-WOH	27	
		FAT CLAY, brown, moist, very soft to soft, some fine grained sand		SPT-21	32.0 - 33.5	1.4	WOH-1-1	23	
				SPT-22	33.5 - 35.0	1.0	4-4-3	23	
				SPT-23	35.0 - 36.5	1.0	1-1-1	22	

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SUBSURFACE LOG

Project No. 175569042 Location N 554004.68, E 2441548.50 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-43** Total Depth 54.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		FAT CLAY, brown, moist, very soft to soft, some fine grained sand *(Continued)*		SPT-24	36.5 - 38.0	1.0	3-4-4	23	
				ST-2	38.0 - 40.0	1.7		--	ST-2: sand in bottom to tube
725.9'	40.0'								
		SAND, light brown, saturated, loose, fine grained, trace clay		SPT-25	40.0 - 41.5	1.3	1-1-2	22	
				SPT-26	41.5 - 43.0	1.0	4-4-3	21	
				SPT-27	43.0 - 43.5	0.5	50-10/0.0	25	SPT-27: sandstone in tip of spoon
				SPT-28	44.5 - 46.0	1.0	11-30-35	18	
718.9'	47.0'			SPT-29	46.0 - 47.4	1.3	4-50-46/0.4	14	
				SPT-30	47.5 - 49.0	0.5	13-14-15	24	SPT-30: shale in tip of spoon
716.9'	49.0'	Sandstone, (Augered)		SPT-31	49.0 - 50.5	0.5	5-14-15	--	
				SPT-32	50.5 - 52.0	1.3	7-14-16	--	Boring backfilled with bentonite cement grout from 0.0 ft to 54.0 ft
		Shale, (Augered)		SPT-33	52.0 - 53.5	1.1	13-16-18	--	
711.9'	54.0'								
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

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SUBSURFACE LOG

Project No.	175569042	Location	N 553740.50, E 2441308.40 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-45** Total Depth 48.5 ft
Location	Kingston, Tennessee	Surface Elevation	763.9 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/12/09 Completed 5/13/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	8.0 ft Date/Time 5/12/09
Logged By	Greg Budd	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
763.9'	0.0'	Top of Hole							
763.7'	0.2'	GRAVEL (Fill), light gray, dry, road material		SPT-1	0.0 - 1.5	0.9	6-7-20	22	
762.9'	1.0'	LEAN CLAY (Fill), red, dry, stiff, with chert		SPT-2	1.5 - 3.0	1.0	12-20-13	22	
760.4'	3.5'	BOTTOM ASH (Fill), gray black, dry, dense, with Fly ash		SPT-3	3.0 - 4.5	1.5	7-3-3	22	
758.4'	5.5'	LEAN CLAY (Fill), brown, dry, soft to stiff, with chert		SPT-4	4.5 - 6.0	0.8	8-7-12	21	
757.4'	6.5'	BOTTOM ASH (Fill), gray black, dry, dense		SPT-5	6.0 - 7.5	1.5	25-45-24	19	
		LEAN CLAY (Fill), red brown, dry, stiff, with chert		SPT-6	7.5 - 9.0	0.9	20-8-7	19	
751.4'	12.5'	BOTTOM ASH (Fill), gray black, saturated, loose to very dense, with fly ash		SPT-7	9.0 - 10.5	0.7	6-4-8	30	
				SPT-8	10.5 - 12.0	0.5	2-2-2	33	
				SPT-9	12.0 - 13.5	1.5	4-8-15	26	
				SPT-10	13.5 - 14.9	1.4	32-40-28/0.4	20	
746.9'	17.0'	FLY ASH (Fill), gray, saturated, loose to medium dense, silty, very fine grained		SPT-11	15.0 - 16.5	1.5	20-20-16	26	
				SPT-12	16.5 - 18.0	1.5	15-19-21	25	
				SPT-13	18.0 - 19.5	0.5	4-5-10	26	
				SPT-14	19.5 - 21.0	0.9	6-6-6	29	
741.9'	22.0'	BOTTOM ASH (Fill), gray black, saturated, medium dense, with some coarse black coal refuse		SPT-15	21.0 - 22.5	1.0	5-8-7	32	
				SPT-16	22.5 - 24.0	0.8	5-8-7	27	
738.9'	25.0'	FLY ASH (Fill), gray, saturated, loose to medium dense, very fine grained, silty with coarse black coal refuse		SPT-17	24.0 - 25.5	1.5	3-1-2	32	
				SPT-18	25.5 - 27.0	1.5	3-4-5	33	
735.4'	28.5'	SILT, light brown, saturated, soft, trace fine grained sand		SPT-19	27.0 - 28.5	1.5	6-7-7	23	
733.9'	30.0'	LEAN CLAY with Silt, brown, saturated, soft to medium stiff		SPT-20	28.5 - 30.0	0.4	5-4-2	25	
				SPT-21	30.0 - 31.5	1.5	6-6-6	24	
				SPT-22	31.5 - 33.0	1.5	5-7-6	23	
				SPT-23	33.0 - 34.5	1.5	5-4-3	26	
				ST-1	34.5 - 36.5	2.0		--	

SUBSURFACE LOG

Project No. 175569042 Location N 553740.50, E 2441308.40 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-45** Total Depth 48.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		LEAN CLAY with Silt, brown, saturated, soft to medium stiff *(Continued)*		SPT-24	36.5 - 38.0	1.5	2-3-4	25	
				SPT-25	38.0 - 39.5	1.5	WOH-WOH-6	26	
723.9'	40.0'			SPT-26	39.5 - 41.0	1.5	WOH-7-6	24	
		SILTY SAND, brown, saturated, loose to dense, fine grained, well rounded, well graded, with manganese stained sandstone, fragments from 45.5 to 47.0		SPT-27	41.0 - 42.5	0.5	3-5-5	22	
				SPT-28	42.5 - 44.0	1.0	5-7-7	22	
				SPT-29	44.0 - 45.5	0.8	7-5-7	25	
				SPT-30	45.5 - 47.0	0.5	18-28-18	19	
716.4	47.5'			SPT-31	47.0 - 48.4	0.3	20-50-30/0.4	--	
715.4'	48.5'								
		Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

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SUBSURFACE LOG

Project No.	175569042	Location	N 553747.39, E 2441146.83 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-47 Total Depth 39.5 ft
Location	Kingston, Tennessee	Surface Elevation	753.4 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	3/30/09 Completed 3/31/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	7.0 ft Date/Time 3/31/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
753.4'	0.0'	Top of Hole							
751.9'	1.5'	LEAN CLAY (Fill), red brown, moist, medium stiff		SPT-1	0.0 - 1.5	1.2	1-7-10	18	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.5	19-19-19	18	
749.9'	3.5'	Bottom Ash 40% / Fly Ash 60% (Fill), black, moist, medium dense		SPT-3	3.0 - 4.5	1.2	4-7-11	18	
749.4'	4.0'	LEAN CLAY (Fill), light brown, moist, medium stiff							All ST samples recovered using a fixed head piston sampler
748.9'	4.5'			SPT-4	4.5 - 6.0	1.0	5-7-7	16	
		BOTTOM ASH (Fill), black, moist, medium dense		SPT-5	6.0 - 7.5	1.1	5-7-8	17	
745.9'	7.5'								
745.4'	8.0'	LEAN CLAY (Fill), light brown, moist, medium stiff		SPT-6	7.5 - 9.0	1.3	32-16-9	8	
		GRAVEL (Fill), gray, moist, dense		ST-1	9.0 - 11.0	1.0		--	
740.9'	12.5'	LEAN CLAY, light brown, saturated, soft, some fine grained sand, some gravel		SPT-7	11.0 - 12.5	1.1	3-2-2	17	
		SAND, light brown, saturated, very loose to loose, fine grained, trace clay		SPT-8	12.5 - 14.0	1.5	WOH-1-1	19	
				SPT-9	14.0 - 15.5	1.1	2-2-2	18	
				SPT-10	15.5 - 17.0	1.2	1-1-1	19	
				SPT-11	17.0 - 18.5	1.3	WOH-1-1	17	
				SPT-12	18.5 - 20.0	1.3	WOH-1-1	20	
				SPT-13	20.0 - 21.5	1.4	WOH-1-1	18	
				SPT-14	21.5 - 23.0	1.2	WOR-WOH-1	20	
				SPT-15	23.0 - 24.5	1.3	1-1-1	18	
				SPT-16	24.5 - 26.0	1.4	1-1-1	19	
				SPT-17	26.0 - 27.5	1.1	1-1-1	19	
725.4'	28.0'			SPT-18	27.5 - 29.0	1.3	1-3-2	21	
		SAND, light brown and gray, saturated, very loose, fine grained		SPT-19	29.0 - 30.5	1.2	1-3-3	21	
				SPT-20	30.5 - 32.0	1.3	1-2-2	18	
720.4'	33.0'			SPT-21	32.0 - 33.5	1.2	2-3-3	20	
		SAND, light gray, saturated, very loose to medium dense, fine to medium grained		SPT-22	33.5 - 35.0	0.1	WOH-2-3	21	
717.4'	36.0'			SPT-23	35.0 - 36.5	1.2	2-9-12	23	Boring backfilled with bentonite cement grout from 0.0 ft to

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SUBSURFACE LOG

Project No. 175569042 Location N 553747.39, E 2441146.83 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-47** Total Depth 39.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
				SPT-24	36.5 - 38.0	1.1	10-12-30	–	39.5 ft
				SPT-25	38.0 - 38.9	0.8	12-50/0.4	–	
713.9'	39.5'	Shale, (Augered) *(Continued)*							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

SUBSURFACE LOG

Project No.	175569042	Location	N 553733.63, E 2441141.18 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-47A** Total Depth 7.5 ft
Location	Kingston, Tennessee	Surface Elevation	753.1 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/30/09 Completed 4/30/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	N/A Date/Time N/A
Logged By	Greg Budd	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
753.1'	0.0'	Top of Hole							
		OVERBURDEN, (Augered without sampling)							Boring advanced using 3 1/4 " Hollow Stem Augers
745.6'	7.5'	No Refusal / Bottom of Hole							

PZ Installed, tip at elevation 746.9'

Flushmount well cover and concrete pad installed.

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SUBSURFACE LOG

Project No.	175569042	Location	N 553771.75, E 2441159.01 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-48A** Total Depth 22.5 ft
Location	Kingston, Tennessee	Surface Elevation	765.3 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/21/09 Completed 4/21/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Adam Smith	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
765.3'	0.0'	Top of Hole							
		Overburden, See log for STN-48							Boring advanced using 3 1/4 " Hollow Stem Augers
742.8'	22.5'	No Refusal / Bottom of Hole							

Two PZ's Installed, tip at elevation 757.1' and 746.1'

Flushmount well cover and concrete pad installed.

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SUBSURFACE LOG

Project No.	175569042	Location	N 553769.40, E 2441163.30 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-48B** Total Depth 48.2 ft
Location	Kingston, Tennessee	Surface Elevation	765.3 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/21/09 Completed 4/21/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Adam Smith	Automatic Hammer ☐	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
765.3'	0.0'	Top of Hole							
		Overburden, See log for STN-48							Boring advanced using 3 1/4 " Hollow Stem Augers

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SUBSURFACE LOG

Project No. 175569042 Location N 553769.40, E 2441163.30 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-48B** Total Depth 48.2 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		Overburden, See log for STN-48 *(Continued)*							
717.1'	48.2'	No Refusal / Bottom of Hole							

PZ Installed, tip at elevation 720.1'

Protective well cover and concrete pad installed.

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SUBSURFACE LOG

Project No.	175569042	Location	N 553773.29, E 2441154.53 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-48** Total Depth 54.0 ft
Location	Kingston, Tennessee	Surface Elevation	765.3 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	3/31/09 Completed 3/31/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	20.0 ft Date/Time 3/31/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
765.3'	0.0'	Top of Hole							
		LEAN CLAY (Fill), red brown, moist, medium stiff, some chert		SPT-1	0.0 - 1.5	1.2	1-3-3	25	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.4	3-4-5	22	
				SPT-3	3.0 - 4.5	1.1	5-6-7	21	All ST samples recovered using a fixed head piston sampler
				ST-1	4.5 - 6.5	1.7		--	
				SPT-4	6.5 - 8.0	1.3	5-7-7	24	
755.8'	9.5'			SPT-5	8.0 - 9.5	1.2	3-5-7	25	
		FAT CLAY (Fill), red brown, saturated, very soft, little chert		SPT-6	9.5 - 11.0	1.1	3-5-5	28	
				SPT-7	11.0 - 12.5	1.3	3-7-5	31	
				SPT-8	12.5 - 14.0	1.0	6-6-7	28	
				ST-2	14.0 - 16.0	1.0		--	
				SPT-9	16.0 - 17.5	0.8	WOR-1-2	30	
				SPT-10	17.5 - 19.0	1.2	WOR-2-2	32	
745.3'	20.0'			ST-3	19.0 - 21.0	1.0		--	ST-3: refused at 1.0 ft, ash in bottom of tube
		Bottom Ash 60% / Fly Ash 40% (Fill), black, saturated, loose		SPT-11	20.0 - 21.5	1.3	6-7-7	25	
				SPT-12	21.5 - 23.0	1.2	7-9-3	29	
741.3'	24.0'			SPT-13	23.0 - 24.5	1.1	1-WOH-WOH	24	
		LEAN CLAY, light brown, saturated, very soft, some silt, some fine grained sand		SPT-14	24.5 - 26.0	1.4	WOR-WOR-WOR	21	SPT-14: roots in tip of spoon
737.8'	27.5'			SPT-15	26.0 - 27.5	1.0	WOR-1-2	23	
		SAND with Clay, light brown, saturated, very loose to loose, some silt		SPT-16	27.5 - 29.0	1.1	2-2-2	22	
				SPT-17	29.0 - 30.5	1.4	3-1-2	21	
				SPT-18	30.5 - 32.0	1.2	2-2-3	21	
				SPT-19	32.0 - 33.5	0.9	WOR-1-1	20	
				ST-4	33.5 - 35.5	1.8		--	ST-4: sand in bottom of tube
				SPT-20	35.5 - 37.0	1.3	1-1-1	19	

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SUBSURFACE LOG

Project No. 175569042 Location N 553773.29, E 2441154.53 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-48** Total Depth 54.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
728.3'	37.0'	SAND, light brown, saturated, very loose, fine grained, trace clay		SPT-21	37.0 - 38.5	1.3	WOR-WOR-WOR	21	Water added at 38.0 ft to keep augers clear
				SPT-22	38.5 - 40.0	1.1	WOR-WOH-1	23	
				SPT-23	40.0 - 41.5	1.3	1-2-2	21	
				SPT-24	41.5 - 43.0	1.2	1-1-2	23	
				SPT-25	43.0 - 44.5	1.3	WOR-1-1	21	
719.8'	45.5'			SPT-26	44.5 - 46.0	1.2	5-6-10	21	
		SAND, light gray, saturated, loose, fine grained		SPT-27	46.0 - 47.5	1.1	4-5-5	24	SPT-28: sandstone in tip of spoon
				SPT-28	47.5 - 48.3	0.8	6-50	19	
716.3'	49.0'								
				SPT-29	49.0 - 50.5	1.0	9-11-17	--	
		Shale, (Augered)		SPT-30	50.5 - 52.0	1.0	15-18-17	--	Boring backfilled with bentonite cement grout from 0.0 ft to 54.0 ft
				SPT-31	52.0 - 52.9	0.6	35-50/0.4	--	
711.3'	54.0'	Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

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SUBSURFACE LOG

Project No.	175569042	Location	N 553921.85, E 2441024.39 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-49** Total Depth 47.5 ft
Location	Kingston, Tennessee	Surface Elevation	763.1 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/14/09 Completed 5/15/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	9.0 ft Date/Time 5/14/09
Logged By	Brad Smiley	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
763.1'	0.0'	Top of Hole							
761.6'	1.5'	GRAVEL (Fill)		SPT-1	0.0 - 1.5	1.5	8-10-14	16	Boring advanced using 4 1/4 " Hollow Stem Augers
		FLY ASH (Fill), dark gray to black, moist, medium dense to dense		SPT-2	1.5 - 3.0	1.2	11-12-14	21	
				SPT-3	3.0 - 4.5	1.1	17-15-12	15	
				SPT-4	4.5 - 6.0	1.0	7-6-7	19	
				SPT-5	6.0 - 7.5	1.0	7-7-7	17	
				SPT-6	7.5 - 9.0	1.1	7-7-7	14	
752.6'	10.5'			SPT-7	9.0 - 10.5	1.3	3-5-2	18	
		FAT CLAY (Fill), brown, moist, soft		SPT-8	10.5 - 12.0	0.2	1-1-1	22	Water added at 12.0 ft to keep augers clear
749.6'	13.5'			SPT-9	12.0 - 13.5	1.0	1-5-8	21	
		BOTTOM ASH (Fill), black, moist, medium dense		SPT-10	13.5 - 15.0	1.3	9-11-16	17	
				SPT-11	15.0 - 16.5	0.7	2-4-8	22	
				SPT-12	16.5 - 18.0	0.8	5-4-2	22	
743.6'	19.5'			SPT-13	18.0 - 19.5	1.1	1-1-2	25	
		FLY ASH (Fill), black, moist, medium dense, trace clay		SPT-14	19.5 - 21.0	1.5	7-6-5	32	
740.6'	22.5'			SPT-15	21.0 - 22.5	0.6	7-7-7	32	
		BOTTOM ASH (Fill), black, moist, loose to medium dense		SPT-16	22.5 - 24.0	1.0	7-6-6	26	
737.6'	25.5'			SPT-17	24.0 - 25.5	0.6	3-2-1	27	
		LEAN CLAY, brown, moist, very soft to medium stiff		SPT-18	25.5 - 27.0	1.5	1-1-1	22	
				SPT-19	27.0 - 28.5	0.6	WOR-WOR-WOR	21	
				SPT-20	28.5 - 30.0	1.2	2-3-5	25	
				SPT-21	30.0 - 31.5	1.4	4-5-6	24	
				SPT-22	31.5 - 33.0	1.4	4-7-9	22	
				SPT-23	33.0 - 34.5	1.1	2-4-6	23	
				SPT-24	34.5 - 36.0	1.5	3-4-5	24	

7/16/09

RAGN_LEGACY_175569117\KINGSTON_ASH_POND.GPJ FALEN.GDT 7/16/09

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SUBSURFACE LOG

Project No. 175569042 Location N 553921.85, E 2441024.39 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-49** Total Depth 47.5 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
724.1'	39.0'	LEAN CLAY, brown, moist, very soft to medium stiff *(Continued)*		SPT-25	36.0 - 37.5	1.5	4-5-4	24	
				SPT-26	37.5 - 39.0	1.5	4-5-4	25	
721.1'	42.0'	SAND, brown, moist, loose, fine to medium grained, some clay		SPT-27	39.0 - 40.5	1.5	3-5-6	21	SPT-31: sandstone in tip of spoon
				SPT-28	40.5 - 42.0	1.5	3-3-3	20	
718.1'	45.0'	SAND, brown, saturated, medium dense, fine to medium grained		SPT-29	42.0 - 43.5	1.5	3-4-8	21	Boring backfilled with bentonite cement grout from 0.0 ft to 47.5 ft
				SPT-30	43.5 - 45.0	1.5	4-5-6	22	
716.6'	46.5'	Sandstone (Augered)		SPT-31	45.0 - 46.5	1.4	27-20-25	--	
715.6'	47.5'	Shale (Augered)		SPT-32	46.5 - 47.5	0.5	26-50/0.5	--	

Auger Refusal /
Bottom of Hole

WOH = Weight of Hammer
WOR = Weight of Rods

SUBSURFACE LOG

Project No.	175569042	Location	N 553631.96, E 2440496.85 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-50 Total Depth 57.0 ft
Location	Kingston, Tennessee	Surface Elevation	741.6 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/15/09 Completed 4/16/09
Supervisor	Ben Phillips Driller Steve Bradford	Depth to Water	4.6 ft Date/Time 4/15/09
Logged By	Ben Phillips	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Uthology Elevation	Uthology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
741.6'	0.0'	Top of Hole							
		FAT CLAY (Fill), brown, moist, soft, some fine grained sand		SPT-1	0.0 - 1.5	1.2	3-5-5	48	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	0.9	2-2-3	22	
				SPT-3	3.0 - 4.5	1.1	3-2-3	23	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
				SPT-4	4.5 - 6.0	0.6	2-3-4	16	
				SPT-5	6.0 - 7.5	1.2	1-3-3	17	
733.1'	8.5'			SPT-6	7.5 - 9.0	0.7	WOH-WOH-WOH	23	
		FLY ASH (Fill), black, moist, very loose		ST-1	9.0 - 11.0	1.3		--	
				SPT-7	11.0 - 12.5	1.5	WOH-WOH-WOH	26	
729.1'	12.5'			SPT-8	12.5 - 14.0	1.3	3-4-3	22	
727.6'	14.0'	LEAN CLAY (Fill), brown, wet, soft		SPT-9	14.0 - 15.5	1.0	WOH-WOH-2	24	
		FLY ASH (Fill), black, wet, very loose		SPT-10	15.5 - 17.0	1.5	WOH-WOH-WOH	26	
723.6'	18.0'			SPT-11	17.0 - 18.5	1.5	3-4-5	27	
		LEAN CLAY, brown, wet, soft, some fine grained sand and silt		SPT-12	18.5 - 20.0	1.5	WOH-WOH-3	32	
				ST-2	20.0 - 22.0	1.8		--	
				SPT-13	22.0 - 23.5	1.5	3-3-3	30	
718.1'	23.5'			SPT-14	23.5 - 25.0	1.2	WOH-WOH-WOH	27	
		SAND, gray, saturated, loose, some silt		SPT-15	25.0 - 26.5	0.7	WOH-WOH-WOH	27	
				SPT-16	26.5 - 28.0	1.5	1-1-1	20	
				SPT-17	28.0 - 29.5	1.5	2-4-5	22	
				SPT-18	29.5 - 31.0	1.5	3-6-5	17	
				SPT-19	31.0 - 32.5	1.5	1-5-7	17	
				SPT-20	32.5 - 34.0	1.5	WOR-2-4	21	
				SPT-21	34.0 - 35.5	1.5	3-4-4	19	
705.9'	35.7'			SPT-22	35.5 - 37.0	1.5	25-20-10	--	

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SUBSURFACE LOG

Project No. 175569042 Location N 553631.96, E 2440496.85 (NAD27)

Project Name Kingston Ash Pond Boring No. STN-50 Total Depth 57.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
									Began Core
		Limestone, gray, fine grained, hard, with shale partings, 35° to 45° bedding angle *(Continued)*		0%	4.0	0.6	15	41.0	
				0%	5.0	2.4	48	46.0	
695.4'	46.2'								
		Shale, gray, soft, with occasional limestone partings, slickensides throughout, 35° to 45° bedding angle		0%	5.0	3.5	70	51.0	
				0%	6.0	3.9	65	57.0	Boring backfilled with bentonite cement grout from 0.0 ft to 57.0 ft
684.6'	57.0'								

Bottom of Hole

Top of Rock = 35.7'
Elevation (705.9')

WOH = Weight of Hammer
WOR = Weight of Rods

DATA LEGACY 175569117 KINGSTON ASH POND.GPJ PASA.GDT 7/16/09

Stantec

Project 171468117 Kingston Ash Pond
Sheet No. 1 of 1 Date 4/15/2009
Hole # STN-50 Rig # 813

Northing 553,631.96 Surface Elevation (ft.) 741.6 Crew Bradford / Criswell

Easting 2,440,496.85 Top of Rock Elev. (ft.) 705.9 Inspector Ben Phillips

Boring Size 3 1/4 Hollow Stem Augers Pump Capacity 21 gpm Meter Type Sensus 5/8" SR II

Test Method US Bureau of Reclamation Static Water Level 4.6' Meter # 67290595

Test Section		Gauge Reading (PSI)	Time of Test			Meter Reading		Total Water (Gal / Cu Ft)	CFM
Top Depth	Bottom Depth		Start	End	Interval (min-sec)	Start of Test	End of Test		
41.5	46	23	0:00	1:00	1:00	255.81	255.81	0.00	0.00
		23	1:00	2:00	1:00	255.81	255.81	0.00	0.00
		23	2:00	3:00	1:00	255.81	255.81	0.00	0.00
		23	3:00	4:00	1:00	255.81	255.81	0.00	0.00
		23	4:00	5:00	1:00	255.81	255.81	0.00	0.00
47	57	28	0:00	1:00	1:00	256.41	256.41	0.00	0.00
		29	1:00	2:00	1:00	256.41	256.41	0.00	0.00
		30	2:00	3:00	1:00	256.41	256.41	0.00	0.00
		31	3:00	4:00	1:00	256.41	256.41	0.00	0.00
		32	4:00	5:00	1:00	256.41	256.41	0.00	0.00
								0.00	0.00

Project # Hole # STN-50 Inspector Ben Phillips Date 4/15/2009

SUBSURFACE LOG

Project No.	175569042	Location	N 553696.02, E 2440548.46 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-51 Total Depth 49.6 ft
Location	Kingston, Tennessee	Surface Elevation	750.4 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/14/09 Completed 4/15/09
Supervisor	Ben Phillips Driller Steve Bradford	Depth to Water	N/A Date/Time N/A
Logged By	Ben Phillips	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
750.4'	0.0'	Top of Hole							
		GRAVEL (Fill)		SPT-1	0.0 - 1.5	1.0	2-2-3	6	Boring advanced using 3 1/4 " Hollow Stem Augers
748.3'	2.1'			SPT-2	1.5 - 3.0	1.2	6-6-7	11	
		FAT CLAY (Fill), brown, moist, medium stiff, some chert fragments		SPT-3	3.0 - 4.5	1.5	4-6-6	21	
				SPT-4	4.5 - 6.0	0.7	6-3-3	26	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
				SPT-5	6.0 - 7.5	0.9	5-4-6	27	
				SPT-6	7.5 - 9.0	0.7	2-2-5	29	
740.7'	9.7'			SPT-7	9.0 - 10.5	1.2	7-7-7	20	
		LEAN CLAY (Fill), brown, moist, medium stiff, silty, some areas of fly ash		SPT-8	10.5 - 12.0	1.1	5-6-5	17	
				ST-1	12.0 - 13.5	0.0		--	
				SPT-9	13.5 - 15.0	0.5	3-4-3	21	
				SPT-10	15.0 - 16.5	0.7	3-4-3	25	
				SPT-11	16.5 - 18.0	1.1	4-13-4	20	
				ST-2	18.0 - 20.0	1.1		--	
				SPT-12	20.0 - 21.5	1.3	1-3-3	21	
				SPT-13	21.5 - 23.0	1.1	3-6-8	21	
725.4'	25.0'			ST-3	23.0 - 25.0	2.0		--	
		FAT CLAY, brown, moist, soft to medium stiff, sandy		SPT-14	25.0 - 26.5	1.3	2-1-4	25	
				SPT-15	26.5 - 28.0	1.5	5-4-5	25	
				SPT-16	28.0 - 29.5	1.3	2-3-3	25	
				SPT-17	29.5 - 31.0	1.5	2-4-5	23	
719.0'	31.4'			SPT-18	31.0 - 32.5	1.2	2-2-2	20	
		SILTY SAND, brown, saturated, very loose		SPT-19	32.5 - 34.0	1.5	WOR-WOR-WOR	20	
				SPT-20	34.0 - 35.5	1.5	1-1-2	23	
				SPT-21	35.5 - 37.0	1.5	WOH-	20	

7/15/09

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SUBSURFACE LOG

Project No. 175569042 Location N 553696.02, E 2440548.46 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-51** Total Depth 49.6 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SILTY SAND, brown, saturated, very loose *(Continued)*		SPT-22	37.0 - 38.5	1.5	WOH-WOH-WOH-WOH	24	
				SPT-23	38.5 - 40.0	1.5	WOH-WOH-WOH-WOH	25	
709.9'	40.5'								
		SAND, gray, saturated, very loose to medium dense, with silt		SPT-24	40.0 - 41.5	1.5	WOR-5-9	22	
				SPT-25	41.5 - 43.0	1.1	4-3-3	26	
				SPT-26	43.0 - 44.5	1.3	4-7-7	28	
				SPT-27	44.5 - 46.0	1.5	4-25-13	21	
				SPT-28	46.0 - 47.5	0.6	4-3-2	23	Boring backfilled with bentonite cement grout from 0.0 ft to 49.6 ft
701.5'	48.9'			SPT-29	47.5 - 49.0	1.5	14-22-28	22	
700.8'	49.6'			SPT-30	49.0 - 49.6		29-50/0.1	–	
		Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

7/16/09

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SUBSURFACE LOG

Project No.	175569042	Location	N 553992.98, E 2440817.40 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-52** Total Depth 39.5 ft
Location	Kingston, Tennessee	Surface Elevation	753.2 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/20/09 Completed 4/20/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	15.0 ft Date/Time 4/20/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
753.2'	0.0'	Top of Hole							
		GRAVEL (Fill), gray, moist, loose to medium dense		SPT-1	0.0 - 1.5	0.1	4-6-5	9	Boring advanced using 3 1/4 " Hollow Stem Augers
750.2'	3.0'			SPT-2	1.5 - 3.0	0.0	5-9-7	--	
748.7'	4.5'	LEAN CLAY with Gravel (Fill), brown, moist, medium stiff, with ash		SPT-3	3.0 - 4.5	1.2	6-5-4	20	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
		SAND with Gravel and Clay (Fill), light brown, moist, loose		SPT-4	4.5 - 6.0	1.2	3-2-3	27	
				SPT-5	6.0 - 7.5	1.0	5-9-5	14	
				SPT-6	7.5 - 9.0	1.0	4-6-7	17	
742.2'	11.0'			SPT-7	9.0 - 10.5	1.3	11-9-4	15	
		SAND, brown, moist, very loose to loose, fine to medium grained, some clay		SPT-8	10.5 - 12.0	0.8	5-3-3	22	
				SPT-9	12.0 - 13.5	1.3	1-2-2	19	
738.2'	15.0'			SPT-10	13.5 - 15.0	1.2	2-1-1	19	
		SAND, brown, saturated, very loose, fine to medium grained, trace clay		SPT-11	15.0 - 16.5	1.0	2-1-2	21	Water added at 16.0 ft to keep augers clear
				SPT-12	16.5 - 18.0	1.2	WOH-WOH-1	24	
				SPT-13	18.0 - 19.5	1.5	WOH-WOH-WOH	25	
				SPT-14	19.5 - 21.0	1.2	WOH-WOH-1	22	
				SPT-15	21.0 - 22.5	0.2	WOH-WOH-WOH	21	
729.2'	24.0'			SPT-16	22.5 - 24.0	0.5	WOH-1-1	22	
		LEAN CLAY, light brown, moist, very soft, some fine to medium grained sand		ST-1	24.0 - 26.0	2.0		--	
				SPT-17	26.0 - 27.5	1.2	WOR-WOH-WOH	21	
724.2'	29.0'			SPT-18	27.5 - 29.0	1.3	WOH-WOH-1	21	
		SAND, brown, moist, very loose, fine to medium grained, some clay		SPT-19	29.0 - 30.5	1.2	WOR-WOR-WOH	22	
				SPT-20	30.5 - 32.0	1.0	WOR-WOH-1	22	
				SPT-21	32.0 - 33.5	1.2	WOH-1-1	22	
719.2'	34.0'			SPT-22	33.5 - 35.0	1.2	WOH-4-3	19	
		SAND, light gray, moist, loose, fine to medium grained		SPT-23	35.0 - 36.5	1.2	2-3-5	26	Boring backfilled with

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SUBSURFACE LOG

Project No.	175569042	Location	N 553992.98, E 2440817.40 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-52** Total Depth 39.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SAND, light gray, moist, loose, fine to medium grained		SPT-24	36.5 - 38.0	1.2	2-1-2	18	bentonite cement grout from 0.0 ft to 39.5 ft
714.2'	39.0'	*(Continued)*		SPT-25	38.0 - 39.5	1.3	22-24-37	11	
713.7'	39.5'	Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

Split Samples: SPT-25

Stantec

SUBSURFACE LOG

Project No.	175569042	Location	N 554011.12, E 2440902.46 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-53 Total Depth 51.5 ft
Location	Kingston, Tennessee	Surface Elevation	763.9 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/21/09 Completed 4/21/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	6.0 ft Date/Time 4/21/09
Logged By	Adam Smith	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
763.9'	0.0'	Top of Hole							
		BOTTOM ASH (Fill), black, moist to saturated, dense		SPT-1	0.0 - 1.5	1.2	9-9-8	23	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.3	14-17-22	17	
				SPT-3	3.0 - 4.5	1.1	20-22-14	13	
				SPT-4	4.5 - 6.0	1.2	6-9-6	19	
757.3'	6.6'			SPT-5	6.0 - 7.5	1.2	4-3-3	26	
		FAT CLAY (Fill), red to dark brown, moist, soft, some sand		SPT-6	7.5 - 9.0	1.0	1-2-2	27	
				SPT-7	9.0 - 10.5	0.6	2-3-1	34	
				SPT-8	10.5 - 12.0	1.1	2-4-2	30	
				ST-1	12.0 - 14.0	1.2		--	
749.3'	14.6'			SPT-9	14.0 - 15.5	1.2	4-6-6	22	
		BOTTOM ASH (Fill), black, moist, dense		SPT-10	15.5 - 17.0	1.1	14-22-32	18	
				SPT-11	17.0 - 18.5	1.2	14-22-41	23	
				SPT-12	18.5 - 20.0	1.0	1-2-18	19	
				SPT-13	20.0 - 21.5	1.5	6-18-32	21	
740.9'	23.0'			SPT-14	21.5 - 23.0	0.2	1-4-16	18	
		SILTY SAND, gray, moist to wet, loose		SPT-15	23.0 - 24.5	1.1	2-1-1	24	
				SPT-16	24.5 - 26.0	0.9	WOH-WOH-2	20	
				SPT-17	26.0 - 27.5	1.3	2-3-3	22	
				SPT-18	27.5 - 29.0	0.8	7-5-5	25	
				SPT-19	29.0 - 30.5	1.4	6-2-3	23	
				SPT-20	30.5 - 32.0	1.2	2-3-3	22	
				SPT-21	32.0 - 33.5	1.3	2-5-3	23	
				SPT-22	33.5 - 35.0	0.8	3-4-4	23	
				SPT-23	35.0 - 36.5	0.8	3-4-3	23	

7/16/09

SUBSURFACE LOG

Project No. 175569042 Location N 554011.12, E 2440902.46 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-53** Total Depth 51.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
725.9'	38.0'			SPT-24	36.5 - 38.0	1.0	2-4-6	23	
		SAND, light brown, saturated, loose to dense, fine to medium grained, well graded		SPT-25	38.0 - 39.5	1.1	1-2-5	22	
				SPT-26	39.5 - 41.0	0.7	6-8-8	21	
				SPT-27	41.0 - 42.5	0.7	3-1-1	17	
				SPT-28	42.5 - 44.0	1.0	1-1-2	20	
				SPT-29	44.0 - 45.5	1.0	6-8-10	30	
				SPT-30	45.5 - 47.0	0.5	4-8-16	22	
				SPT-31	47.0 - 48.5	0.7	3-19-10	19	Boring backfilled with bentonite cement grout from 0.0 ft to 51.5 ft
713.9'	50.0'			SPT-32	48.5 - 50.0	1.0	14-15-12	19	SPT-32: shale in tip of spoon
712.4'	51.5'			SPT-33	50.0 - 51.5	0.2	16-15-20	–	
		Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

Elevation is an estimate, need to be surveyed

7/16/09

Stantec

SUBSURFACE LOG

Project No.	175569042	Location	N 555263.94, E 2441476.12 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-54** Total Depth 59.0 ft
Location	Kingston, Tennessee	Surface Elevation	765.0 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/22/09 Completed 4/22/09
Supervisor	Ben Halada Driller Sam Wilks	Depth to Water	9.0 ft Date/Time 4/22/09
Logged By	Greg Budd	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
765.0'	0.0'	Top of Hole							
763.5'	1.5'	BOTTOM ASH (Fill), black gray, moist, loose		SPT-1	0.0 - 1.5	1.0	1-4-4	37	Boring advanced using 3 1/4" hollow stem augers
		FLY ASH (Fill), gray, wet, loose, silty		SPT-2	1.5 - 3.0	1.0	4-6-7	31	
				SPT-3	3.0 - 4.5	0.7	7-7-6	31	
				SPT-4	4.5 - 6.0	0.9	3-2-2	34	
				SPT-5	6.0 - 7.5	0.9	2-2-5	31	
756.0'	9.0'			SPT-6	7.5 - 9.0	1.3	6-6-5	31	
		FLY ASH (Fill), gray, saturated, loose to very loose, silty		SPT-7	9.0 - 10.5	1.2	2-2-2	28	Water added at 9.0 feet to keep augers clean
				SPT-8	10.5 - 12.0	1.2	2-2-3	29	
				SPT-9	12.0 - 13.5	1.5	2-1-1	28	
				SPT-10	13.5 - 15.0	1.0	WOR-WOR-1	33	
				SPT-11	15.0 - 16.5	1.5	WOH-WOH-1	30	
				SPT-12	16.5 - 18.0	1.5	WOH-WOH-WOH	28	
				SPT-13	18.0 - 19.5	1.0	WOR-WOR-WOR	29	
				SPT-14	19.5 - 21.0	1.5	WOR-WOR-WOR	27	
				SPT-15	21.0 - 22.5	1.5	1-WOH-WOH	27	
				SPT-16	22.5 - 24.0	1.0	3-4-3	27	
				SPT-17	24.0 - 25.5	1.5	6-5-4	25	
738.0'	27.0'			SPT-18	25.5 - 27.0	1.3	1-1-2	25	
		FLY ASH (Fill), gray, saturated, loose, with, trace black bottom ash		SPT-19	27.0 - 28.5	1.0	2-2-3	25	
735.0'	30.0'			SPT-20	28.5 - 30.0	0.8	3-3-3	24	
		FLY ASH (Fill), black gray, saturated, loose to very loose, with, some fine to coarse bottom ash		SPT-21	30.0 - 31.5	0.8	3-3-2	25	
				SPT-22	31.5 - 33.0	1.5	1-WOH-WOH	25	
				SPT-23	33.0 - 34.5	1.0	WOH-WOH-2	32	
730.0'	35.0'			SPT-24	34.5 - 36.0	1.4	2-2-1	26	

FORM LEGACY 175569042 KINGSTON ASH POND.GPJ 7/16/2009 FORM

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SUBSURFACE LOG

Project No. 175569042 Location N 555263.94, E 2441476.12 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-54** Total Depth 59.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
727.5'	37.5'	FLY ASH (Fill), tan gray, saturated, loose, with, some clayey silt *(Continued)*		SPT-25	36.0 - 37.5	0.9	WOR-WOR-WOR	25	
				SPT-26	37.5 - 39.0	1.5	6-6-7	20	
		LEAN CLAY, tan gray, saturated, soft, orange brown and tan grey, mottled		ST-1	39.0 - 41.0	2.0		--	
				SPT-27	41.0 - 42.5	0.9	3-3-5	21	
721.0'	44.0'			SPT-28	42.5 - 44.0	1.5	3-3-4	22	
		SILT with Sand, brown gray, saturated, loose to very loose, brown and gray, with trace fine grained sand, mottled		SPT-29	44.0 - 45.5	1.5	3-3-3	18	
				SPT-30	45.5 - 47.0	1.5	3-2-1	19	
716.5'	48.5'			SPT-31	47.0 - 48.5	1.5	3-1-2	19	
		SILTY SAND, gray, saturated, very loose to medium dense, with, some fine grained sand		SPT-32	48.5 - 50.0	1.5	WOR-WOR-WOR	19	
				SPT-33	50.0 - 51.5	1.5	WOR-WOR-WOR	19	
				SPT-34	51.5 - 53.0	0.8	2-1-1	17	
				SPT-35	53.0 - 54.5	1.0	WOR-WOH-2	16	Boring backfilled with bentonite cement grout from 0.0 feet to 59.0 feet
				SPT-36	54.5 - 56.0	1.2	4-4-4	17	
				SPT-37	56.0 - 57.5	0.0	7-12-12	34	
707.0'	58.0'			SPT-38	57.5 - 58.0	0.3	50/0.3	17	
706.0'	59.0'	Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rod

7/16/09

SUBSURFACE LOG

Project No.	175569042	Location	N 554943.73, E 2442287.49 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-55 Total Depth 64.2 ft
Location	Kingston, Tennessee	Surface Elevation	764.1 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	3/20/09 Completed 3/20/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	4.0 ft Date/Time 3/20/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
764.1'	0.0'	Top of Hole							
762.6'	1.5'	OVERBURDEN (Fill), consisted of gravel, clay, sand and ash		SPT-1	0.0 - 1.5	1.3	6-12-19	18	Boring advanced using 3 1/4 " Hollow Stem Augers
		Bottom Ash 55% / Fly Ash 45% (Fill), dark gray, moist, loose to medium dense, non-plastic		SPT-2	1.5 - 3.0	1.1	20-18-16	17	
				SPT-3	3.0 - 4.5	1.2	12-10-10	26	
758.6'	5.5'			SPT-4	4.5 - 6.0	1.4	8-9-3	26	
		FLY ASH (Fill), dark gray, saturated, very loose to medium dense, non-plastic		SPT-5	6.0 - 7.5	1.1	3-2-2	27	
				SPT-6	7.5 - 9.0	1.1	11-14-30	27	
				SPT-7	9.0 - 10.5	1.1	7-14-23	24	
753.1'	11.0'			SPT-8	10.5 - 12.0	1.2	4-9-15	26	
752.6'	11.5'	LEAN CLAY (Fill), dark red brown, moist, stiff to very stiff, trace chert		SPT-9	12.0 - 13.5	1.3	18-20-20	25	
		Bottom Ash 55% / Fly Ash 45% (Fill), dark gray, saturated, medium dense to very loose, non-plastic		SPT-10	13.5 - 15.0	1.4	4-3-2	24	
				SPT-11	15.0 - 16.5	1.1	2-2-2	28	
				SPT-12	16.5 - 18.0	1.0	2-2-2	24	
				SPT-13	18.0 - 19.5	1.0	3-2-4	26	
744.1'	20.0'			SPT-14	19.5 - 21.0	1.1	4-5-6	35	
		FLY ASH (Fill), gray, saturated, very loose to loose, non-plastic. Layer placed by sedimentation		SPT-15	21.0 - 22.5	1.2	5-7-5	35	
				SPT-16	22.5 - 24.0	1.2	3-2-3	32	
				SPT-17	24.0 - 25.5	1.0	4-4-4	27	
				SPT-18	25.5 - 27.0	0.9	3-3-4	38	
				SPT-19	27.0 - 28.5	1.1	5-5-7	34	
				SPT-20	28.5 - 30.0	1.3	4-5-6	31	
				SPT-21	30.0 - 31.5	1.2	2-2-3	34	
				SPT-22	31.5 - 33.0	1.1	2-1-1	30	
				SPT-23	33.0 - 34.5	1.1	2-1-1	31	
				SPT-24	34.5 - 36.0	1.1	WOR-WOH-1	33	

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SUBSURFACE LOG

Project No. 175569042 Location N 554943.73, E 2442287.49 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-55** Total Depth 64.2 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
				SPT-25	36.0 - 37.5	1.3	WOH-1-1	39	
726.1'	38.0'			SPT-26	37.5 - 39.0	1.3	WOH-WOH-WOH	41	
		SILT, dark brown, saturated, very soft to soft, some clay		SPT-27	39.0 - 40.5	1.4	WOR-WOH-1	30	
724.1'	40.0'			SPT-28	40.5 - 42.0	1.2	WOR-WOR-WOR	21	
		LEAN CLAY, light gray and brown, saturated, very soft to soft, some silt, some fine grained sand		ST-1	42.0 - 44.0	2.0		--	
				ST-2	44.0 - 46.0	2.0		--	
				SPT-29	46.0 - 47.5	1.1	4-4-4	21	
				SPT-30	47.5 - 49.0	1.3	2-2-1	24	
				SPT-31	49.0 - 50.5	1.1	WOH-1-2	23	
				SPT-32	50.5 - 52.0	1.2	WOH-1-2	24	
				SPT-33	52.0 - 53.5	0.9	WOH-WOH-WOH	20	
709.1'	55.0'			SPT-34	53.5 - 55.0	1.1	WOR-WOH-1	21	
		SAND, gray, saturated, loose, fine grained, trace clayey silt		SPT-35	55.0 - 56.5	1.4	1-2-3	23	
706.1'	58.0'			SPT-36	56.5 - 58.0	1.3	3-8-10	24	
		SILTY SAND with Gravel, gray, saturated, loose, fine grained, trace clayey silt, medium to coarse angular gravel		SPT-37	58.0 - 59.4	1.1	10-44-46/0.4	17	
				SPT-38	59.5 - 60.2	0.7	20-50/0.2	12	
703.1'	61.0'			SPT-39	60.5 - 61.4	0.9	50-50/0.4	12	Boring backfilled with bentonite cement grout from 0.0 ft to 64.2 ft
				SPT-40	62.0 - 63.1	1.1	44-50 6/0.1	9	
699.9'	64.2'	Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

7/16/09

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SUBSURFACE LOG

Project No.	175569042	Location	N 554555.61, E 2441998.50 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-56 Total Depth 82.0 ft
Location	Kingston, Tennessee	Surface Elevation	765.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	3/17/09 Completed 3/18/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	7.0 ft Date/Time 3/17/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
765.8'	0.0'	Top of Hole							
763.3'	2.5'	OVERBURDEN (Fill), consisted of gravel, clay, sand and ash		SPT-1	0.0 - 1.5	1.2	5-8-8	20	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.0	9-17-20	15	
759.8'	6.0'	Bottom Ash 55% / Fly Ash 45% (Fill), dark gray to black, moist, medium dense, non-plastic		SPT-3	3.0 - 4.5	1.1	10-19-19	19	
				SPT-4	4.5 - 6.0	1.3	8-13-15	16	
755.8'	10.0'	Bottom Ash (Fill), dark gray, moist, medium dense to very dense, non-plastic		SPT-5	6.0 - 7.5	1.0	11-19-17	15	
				SPT-6	7.5 - 8.9	1.4	13-44-43/0.4	21	
				SPT-7	9.0 - 9.7	0.7	25-50/0.2	20	
752.3'	13.5'	Bottom Ash 55% / Fly Ash 45% (Fill), black, saturated, medium dense to dense, non-plastic		SPT-8	10.5 - 12.0	1.0	18-27-35	19	
				SPT-9	12.0 - 13.5	1.3	12-12-15	26	
745.3'	20.5'	Bottom Ash (Fill), dark gray, saturated, medium dense to very loose, non-plastic		SPT-10	13.5 - 15.0	1.3	10-14-11	21	
				SPT-11	15.0 - 16.5	1.1	4-3-2	19	
				SPT-12	16.5 - 18.0	1.2	WOH-1-WOH	24	
				SPT-13	18.0 - 19.5	0.5	WOR-WOR-WOR	22	
		Fly Ash (Fill), dark gray, saturated, very loose to loose, non-plastic		SPT-14	19.5 - 21.0	1.2	10-3-2	32	
				SPT-15	21.0 - 22.5	1.0	WOR-WOH-2	33	
				SPT-16	22.5 - 24.0	1.5	3-2-2	32	
				SPT-17	24.0 - 25.5	1.1	1-2-3	31	
				SPT-18	25.5 - 27.0	1.0	4-5-7	28	
				SPT-19	27.0 - 28.5	1.0	3-4-4	35	
				SPT-20	28.5 - 30.0	1.3	1-1-2	43	
				SPT-21	30.0 - 31.5	1.3	2-2-3	40	
				SPT-22	31.5 - 33.0	1.5	4-5-6	37	
				SPT-23	33.0 - 34.5	1.5	2-2-3	34	
				SPT-24	34.5 - 36.0	1.3	WOR-WOH-WOH	31	

7/16/09

SUBSURFACE LOG

Project No. 175569042 Location N 554555.61, E 2441998.50 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-56** Total Depth 82.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		Fly Ash (Fill), dark gray, saturated, very loose to loose, non-plastic *(Continued)*		SPT-25	36.0 - 37.5	1.5	WOR-WOR-2	30	
				SPT-26	37.5 - 39.0	1.5	WOH-1-1	26	
725.6'	40.0'			SPT-27	39.0 - 40.5	1.5	WOH-WOH-WOH	28	40 ft - augering brought up water that has remained
		SILTY CLAY, gray, saturated, soft, some fine grained sand		SPT-28	40.5 - 42.0	1.0	WOR-WOH-1	21	
722.8'	43.0'			SPT-29	42.0 - 43.5	1.0	4-5-6	21	
		SILTY SAND, gray with brown, saturated, loose		SPT-30	43.5 - 45.0	1.0	3-4-3	21	
719.8'	46.0'			SPT-31	45.0 - 46.5	1.0	2-4-5	19	
		SAND, light gray to brown, saturated, loose to medium dense, fine to medium grained, some silt		SPT-32	46.5 - 48.0	1.0	WOH-WOH-1	24	
				SPT-33	48.0 - 49.5	1.0	WOR-WOR-WOH	23	
				SPT-34	49.5 - 51.0	1.0	1-1-1	19	
				SPT-35	51.0 - 52.5	1.4	WOH-WOH-WOH	21	
				SPT-36	52.5 - 54.0	1.0	2-2-2	19	
				SPT-37	54.0 - 55.5	1.2	WOH-1-1	22	
				SPT-38	55.5 - 57.0	1.1	3-3-3	19	
				SPT-39	57.0 - 58.5	1.3	2-4-5	19	
				SPT-40	58.5 - 60.0	1.3	3-2-3	20	SPT-42: shale in tip of spoon
704.8'	61.0'			SPT-41	60.0 - 61.5	1.3	4-3-7	22	
703.7'	62.1'	SAND, light gray, saturated, loose to medium dense, fine grained, some medium grained sand, some fine to medium rounded gravel		SPT-42	61.5 - 62.1	0.6	5-50/0.1	11	Began Core
				0%	2.2	2.2	100	64.3	
				0%	2.4	2.3	95	66.7	
		Shale, dark gray, very fine grained, very soft, thin bedded, highly weathered, calcareous, 45 deg to 60 deg bedding angle		0%	2.3	2.2	96	69.0	
693.6'	72.2'			0%	3.0	2.8	93	72.0	
691.8'	74.0'			0%	2.3	2.1	91	74.3	
		Limestone, light gray, fine to medium grained, hard, thin bedded, moderately weathered, 45 deg to 60 deg bedding angle		0%	1.5	1.2	80	75.8	

7/16/09

SUBSURFACE LOG

Project No. 175569042 Location N 554555.61, E 2441998.50 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-56** Total Depth 82.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
				13%	3.2	3.0	94	79.0	Boring backfilled with bentonite cement grout from 0.0 ft to 82.0 ft
683.8'	82.0'	Shale, dark gray, very fine grained, very soft, thin bedded, moderately to highly weathered, calcareous, 45 deg to 60 deg bedding angle 0.5' of limestone at 79.0 ft *(Continued)*		0%	3.0	2.9	97	82.0	
		Bottom of Hole Top of Rock = 61.0' Elevation (704.8') WOH = Weight of Hammer WOR = Weight of Rods							

Stantec

Project 171468117 Kingston Ash Pond
Sheet No. 1 of 1 Date 3/18/2009
Hole # STN-56 Rig # 710

Northing 554,555.61 Surface Elevation (ft.) 765.8 Crew Kent Clements / Jake Miller

Easting 2,441,998.50 Top of Rock Elev. (ft.) 704.8 Inspector Benjamin A. Halada

Boring Size 3 1/4 Hollow Stem Augers Pump Capacity 23 GPM Meter Type Sensus 5/8" SRII

Test Method US Bureau of Reclamation Static Water Level 7.0' Meter # 67290595

Test Section		Gauge Reading (PSI)	Time of Test			Meter Reading		Total Water (Cu Ft)	CFM
Top Depth	Bottom Depth		Start	End	Interval (min:sec)	Start	End		
64.0	72.0	35	0:00	1:00	1:00	236.04	236.04	0.00	0.00
		35	1:00	2:00	1:00	236.04	236.04	0.00	0.00
		35	2:00	3:00	1:00	236.04	236.04	0.00	0.00
		35	3:00	4:00	1:00	236.04	236.04	0.00	0.00
		35	4:00	5:00	1:00	236.04	236.04	0.00	0.00
72.0	82.0	40	0:00	1:00	1:00	236.79	236.84	0.05	0.05
		40	1:00	2:00	1:00	236.84	236.88	0.04	0.04
		40	2:00	3:00	1:00	236.88	236.92	0.04	0.04
		40	3:00	4:00	1:00	236.92	236.97	0.05	0.05
		40	4:00	5:00	1:00	236.97	236.99	0.02	0.02

Project # 171468117 Hole # STN-56 Inspector Benjamin A. Halada Date 3/18/2009

Stantec

SUBSURFACE LOG

Project No.	175569042	Location	N 556075.53, E 2442603.06 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-59 Total Depth 51.5 ft
Location	Kingston, Tennessee	Surface Elevation	752.2 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/27/09 Completed 5/27/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	17.0 ft Date/Time 5/27/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
752.2'	0.0'	Top of Hole							
		FAT CLAY (Fill), red brown, moist, medium stiff		SPT-1	0.0 - 1.5	1.2	3-3-4	19	Boring advanced using 3 1/4 " Hollow Stem Augers
749.2'	3.0'			SPT-2	1.5 - 3.0	1.0	3-7-11	18	SPT-2: ash in tip of spoon
748.7'	3.5'	BOTTOM ASH (Fill), black, moist, medium dense		SPT-3	3.0 - 4.5	1.3	12-13-25	13	
748.2'	4.0'			SPT-4	4.5 - 6.0	1.0	5-14-12	13	
747.2'	5.0'	FAT CLAY (Fill), red brown, moist, medium stiff		SPT-5	6.0 - 7.5	1.3	8-10-12	16	
		BOTTOM ASH (Fill), black, moist, medium dense		SPT-6	7.5 - 9.0	0.7	11-13-11	18	
		LEAN CLAY (Fill), light gray to brown, moist, soft to medium stiff		ST-1	9.0 - 11.0	2.0		–	
				SPT-7	11.0 - 12.5	1.2	3-3-4	20	
				SPT-8	12.5 - 14.0	0.7	1-2-5	17	
738.2'	14.0'								
		SAND, light brown to dark gray, moist, medium dense, fine to medium grained, trace silty clay		SPT-9	14.0 - 15.5	1.3	WOH-WOH-WOH	21	
736.2'	16.0'			SPT-10	15.5 - 17.0	1.3	WOH-WOH-WOH	20	
		SILTY SAND, red brown, moist, medium dense, with some clay		SPT-11	17.0 - 18.5	1.5	1-2-3	22	
				SPT-12	18.5 - 20.0	1.3	1-2-4	22	
				SPT-13	20.0 - 21.5	1.2	1-1-3	24	
				SPT-14	21.5 - 23.0	1.0	3-3-5	19	
				SPT-15	23.0 - 24.5	1.3	WOH-WOH-2	20	
726.2'	26.0'			SPT-16	24.5 - 26.0	1.0	2-1-1	20	
		SAND, light brown, moist, very loose to loose, fine to medium grained, some clay		SPT-17	26.0 - 27.5	1.2	WOH-1-1	20	Water added to 26.0 ft to keep augers clear
				SPT-18	27.5 - 29.0	1.4	WOH-1-1	22	
				SPT-19	29.0 - 30.5	1.0	WOR-WOR-WOR	20	
				SPT-20	30.5 - 32.0	1.3	WOR-WOR-1	21	
				SPT-21	32.0 - 33.5	1.4	WOR-WOR-1	26	
				SPT-22	33.5 - 35.0	1.1	WOR-WOH-WOH	22	
				SPT-23	35.0 - 36.5	1.2	WOH-1-1	21	

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SUBSURFACE LOG

Project No. 175569042 Location N 556075.53, E 2442603.06 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-59** Total Depth 51.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SAND, light brown, moist, very loose to loose, fine to medium grained, some clay *(Continued)*		SPT-24	36.5 - 38.0	1.5	WOH-1-1	21	
712.7'	39.5'			SPT-25	38.0 - 39.5	1.0	WOH-WOH-1	22	
		LEAN CLAY, light brown and gray, moist, medium stiff, some fine to medium grained sand		SPT-26	39.5 - 41.0	1.0	2-2-3	20	
711.2'	41.0'			SPT-27	41.0 - 42.5	1.2	2-1-3	19	SPT-27: light gray sand in tip of spoon
		SAND, light brown, moist, very loose to loose, fine to medium grained, some clay		SPT-28	42.5 - 44.0	1.2	3-7-9	22	
708.2'	44.0'			SPT-29	44.0 - 45.5	1.3	WOH-6-11	23	
		SAND, brown to red brown, moist, dense, fine to coarse grained		SPT-30	45.5 - 47.0	1.3	2-6-11	24	
				SPT-31	47.0 - 48.5	1.5	9-13-21	24	Boring backfilled with bentonite cement grout from 0.0 ft to 51.5 ft
				SPT-32	48.5 - 50.0	1.2	1-6-8	26	
701.2'	51.0'			SPT-33	50.0 - 51.5	1.4	10-13-32	22	
700.7'	51.5'								
		Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

Split Samples: SPT-3, 4 and 33

7/15/09

SUBSURFACE LOG

Project No.	175569042	Location	N 555886.92, E 2442663.31 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-60 Total Depth 53.5 ft
Location	Kingston, Tennessee	Surface Elevation	752.5 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/26/09 Completed 5/26/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	20.0 ft Date/Time 5/26/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
752.5'	0.0'	Top of Hole							
		FAT CLAY (Fill), red brown, moist, medium stiff		SPT-1	0.0 - 1.5	1.0	5-4-3	22	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.1	3-8-12	18	SPT-2: ash in tip of spoon
748.5'	4.0'			SPT-3	3.0 - 4.5	1.2	12-13-20	15	
747.5'	5.0'	BOTTOM ASH (Fill), black, moist, dense		SPT-4	4.5 - 6.0	1.1	6-8-11	15	
		LEAN CLAY (Fill), red brown to brown, moist, medium stiff, some fine gravel		SPT-5	6.0 - 7.5	1.3	13-15-16	16	
				SPT-6	7.5 - 9.0	1.2	16-15-19	18	
				ST-1	9.0 - 11.0	2.0		--	
				SPT-7	11.0 - 12.5	1.3	4-6-9	19	
738.5'	14.0'			SPT-8	12.5 - 14.0	1.0	5-8-11	17	
		LEAN CLAY, light brown to brown, moist, soft, some fine grained sand		SPT-9	14.0 - 15.5	1.1	2-2-2	20	
				SPT-10	15.5 - 17.0	1.0	2-3-3	19	
734.5'	18.0'			SPT-11	17.0 - 18.5	1.2	3-8-11	20	
		SAND, dark gray, moist, medium, fine to medium grained, some clay		SPT-12	18.5 - 20.0	0.0	7-5-2	--	
732.5'	20.0'			SPT-13	20.0 - 21.5	0.9	WOH-1-2	21	
		LEAN CLAY, light brown, moist, soft, some silt, some fine grained sand		SPT-14	21.5 - 23.0	1.5	WOH-WOH-2	23	
				ST-2	23.0 - 25.0	1.0		--	
				SPT-15	25.0 - 26.5	1.4	WOH-2-3	22	
726.0'	26.5'								
		SILTY SAND, brown, moist, very loose to loose		SPT-16	26.5 - 28.0	1.3	WOH-2-4	23	
				SPT-17	28.0 - 29.5	1.3	WOH-2-3	21	
				SPT-18	29.5 - 31.0	1.4	WOH-1-3	22	
				SPT-19	31.0 - 32.5	1.5	1-1-3	22	
				SPT-20	32.5 - 34.0	1.3	WOH-3-5	21	
				SPT-21	34.0 - 35.5	1.3	WOH-WOH-1	23	
				SPT-22	35.5 - 37.0	1.1	3-6-5	21	SPT-22: fine sand in

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SUBSURFACE LOG

Project No. 175569042 Location N 555886.92, E 2442663.31 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-60** Total Depth 53.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
									tip of spoon
715.5'	37.0'	SAND, light brown and gray, moist, medium dense, fine to medium grained, some clay		SPT-23	37.0 - 38.5	1.5	2-3-4	21	
712.5'	40.0'			SPT-24	38.5 - 40.0	0.5	WOR-WOH-1	24	SPT-24: fine to medium sand in tip of spoon
		SAND, light gray, saturated, medium dense, fine to medium grained		SPT-25	40.0 - 41.5	1.3	1-2-2	21	Water added to 40.0 ft to keep augers clear
				SPT-26	41.5 - 43.0	1.5	1-2-2	19	
				SPT-27	43.0 - 44.5	0.5	WOH-2-3	20	
				SPT-28	44.5 - 46.0	1.0	WOH-6-8	27	
				SPT-29	46.0 - 47.5	1.5	6-8-17	19	
704.5'	48.0'			SPT-30	47.5 - 49.0	1.1	17-13-15	22	SPT-31: sandstone in tip of spoon
		SAND, light brown, moist, medium dense to dense, fine to coarse grained		SPT-31	49.0 - 50.5	0.1	9-8-12	9	Boring backfilled with bentonite cement grout from 0.0 ft to 53.5 ft
701.0'	51.5'			SPT-32	50.5 - 52.0	1.3	9-11-13	19	
				SPT-33	52.0 - 53.4	0.4	31-38-31/0.4	--	
699.0'	53.5'	Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

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SUBSURFACE LOG

Project No.	175569042	Location	N 555513.59, E 2442792.80 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-61 Total Depth 51.5 ft
Location	Kingston, Tennessee	Surface Elevation	752.5 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/15/09 Completed 4/15/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	15.0 ft Date/Time 4/15/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
752.5'	0.0'	Top of Hole							
		FAT CLAY (Fill), red brown, moist, medium stiff		SPT-1	0.0 - 1.5	1.0	3-3-3	20	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.1	4-6-7	18	
				SPT-3	3.0 - 4.5	1.1	4-7-7	32	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling ST-1: refused at 1.5 ft
746.5'	6.0'			ST-1	4.5 - 6.0	1.0		--	
		BOTTOM ASH 60% / FLY ASH 40% (Fill), black, moist to saturated, loose to medium dense		SPT-4	6.0 - 7.5	1.3	9-14-13	21	
				SPT-5	7.5 - 9.0	1.1	4-7-7	8	
				SPT-6	9.0 - 10.5	1.3	15-16-10	10	
				SPT-7	10.5 - 12.0	1.0	2-5-7	13	
				SPT-8	12.0 - 13.5	0.8	4-5-5	18	
				SPT-9	13.5 - 15.0	0.7	1-3-1	16	
				SPT-10	15.0 - 16.5	0.8	1-5-3	21	
735.5'	17.0'								
734.5'	18.0'	SAND, light brown, saturated, very loose, fine grained, trace silt		SPT-11	16.5 - 18.0	1.4	3-WOH-WOH	19	
				SPT-12	18.0 - 19.5	1.0	WOR-WOH-WOH	21	
		LEAN CLAY, light brown, moist, very soft, trace fine grained sand, some silt		SPT-13	19.5 - 21.0	1.1	WOR-WOH-WOH	23	
				SPT-14	21.0 - 22.5	1.3	3-2-1	22	Water added at 21.0 ft to keep augers clear
				ST-2	22.5 - 24.5	2.0		--	
				SPT-15	24.5 - 26.0	1.3	WOR-WOH-1	18	
725.5'	27.0'			SPT-16	26.0 - 27.5	1.3	3-2-1	18	
		SAND, brown, saturated, loose to medium dense, fine grained, trace silt		SPT-17	27.5 - 29.0	1.3	1-2-1	16	
				SPT-18	29.0 - 30.5	1.3	WOR-WOH-2	19	
				SPT-19	30.5 - 32.0	1.0	1-3-2	19	
				SPT-20	32.0 - 33.5	1.1	3-1-1	19	
				SPT-21	33.5 - 35.0	0.9	1-1-1	20	
				SPT-22	35.0 - 36.5	1.4	2-1-2	20	

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SUBSURFACE LOG

Project No. 175569042 Location N 555513.59, E 2442792.80 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-61** Total Depth 51.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SAND, brown, saturated, loose to medium dense, fine grained, trace silt *(Continued)*		SPT-23	36.5 - 38.0	1.5	4-5-4	19	
				SPT-24	38.0 - 39.5	1.0	5-6-4	21	
				SPT-25	39.5 - 41.0	1.1	4-3-5	23	
				SPT-26	41.0 - 42.5	1.2	4-6-5	19	
				SPT-27	42.5 - 44.0	1.1	6-11-10	20	
				SPT-28	44.0 - 45.5	0.5	3-4-5	24	SPT-29: sandstone in tip of spoon
706.5'	46.0'			SPT-29	45.5 - 46.9	1.4	29-37-34/0.4	--	SPT-31: shale in tip of spoon
		Sandstone, (Augered)		SPT-30	47.0 - 48.4	1.4	37-42-21/0.4	--	Boring backfilled with bentonite cement grout from 0.0 ft to 51.5 ft
702.5'	50.0'			SPT-31	48.5 - 50.0	0.3	17-22-50	--	
701.0'	51.5'			SPT-32	50.0 - 50.8	0.8	17-50/0.3	--	
		Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

Split Samples: SPT-11 and 16

SUBSURFACE LOG

Project No.	175569042	Location	N 555020.69, E 2442907.23 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-62** Total Depth 49.0 ft
Location	Kingston, Tennessee	Surface Elevation	749.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/8/09 Completed 4/9/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	10.5 ft Date/Time 4/8/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
749.8'	0.0'	Top of Hole							
		FAT CLAY (Fill), red brown, moist, medium stiff, some chert		SPT-1	0.0 - 1.5	1.0	2-3-5	24	Boring advanced using 3 1/4 " Hollow Stem Augers
747.3'	2.5'			SPT-2	1.5 - 3.0	1.2	7-15-13	17	
746.8'	3.0'	GRAVEL (Fill), gray, moist, dense		SPT-3	3.0 - 4.5	1.5	4-5-6	19	
		BOTTOM ASH 60% / FLY ASH 40% (Fill), black, moist to saturated, loose to medium dense		SPT-4	4.5 - 6.0	1.3	7-14-15	14	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
				SPT-5	6.0 - 7.5	1.0	9-6-6	8	
				SPT-6	7.5 - 9.0	1.0	5-8-6	8	
				SPT-7	9.0 - 10.5	1.1	4-5-5	13	
				SPT-8	10.5 - 12.0	1.1	3-4-4	15	
				SPT-9	12.0 - 13.5	0.8	4-3-3	12	
734.8'	15.0'			SPT-10	13.5 - 15.0	0.2	3-2-2	14	
		SAND, light brown, saturated, very loose, fine grained		SPT-11	15.0 - 16.5	1.5	3-1-1	20	
				SPT-12	16.5 - 18.0	1.3	WOH-WOH-WOH	20	
729.8'	20.0'			SPT-13	18.0 - 19.5	1.0	WOR-WOR-WOR	18	
		SAND, light brown, saturated, very loose, fine grained, some silt		SPT-14	19.5 - 21.0	1.0	WOR-1-1	20	
				SPT-15	21.0 - 22.5	1.1	WOR-WOR-1	21	
				SPT-16	22.5 - 24.0	1.1	WOH-WOH-WOH	23	
724.8'	25.0'			SPT-17	24.0 - 25.5	1.1	WOH-WOH-WOH	24	
		LEAN CLAY, light brown and gray, moist, very soft, some fine grained sand		SPT-18	25.5 - 27.0	1.1	WOH-1-1	23	
				SPT-19	27.0 - 28.5	1.2	WOH-1-2	25	
				ST-1	28.5 - 30.5	2.0		–	
				SPT-20	30.5 - 32.0	1.4	WOH-1-1	22	
716.8'	33.0'			SPT-21	32.0 - 33.5	1.1	4-3-2	25	
715.3'	34.5'	SAND, light brown and light gray, saturated, very loose, fine grained, some clay		SPT-22	33.5 - 35.0	1.3	WOH-WOH-WOH	26	Water added at 35.0 ft to keep augers clear
				SPT-23	35.0 - 36.5	1.1	WOH-WOH-WOH	24	

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SUBSURFACE LOG

Project No. 175569042 Location N 555020.69, E 2442907.23 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-62** Total Depth 49.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SAND, light gray, saturated, very loose, fine grained, some silt *(Continued)*		SPT-24	36.5 - 38.0	1.1	WOH-WOH-WOH	20	
				SPT-25	38.0 - 39.5	1.3	WOH-WOH-1	20	
				SPT-26	39.5 - 41.0	1.3	2-2-2	21	
				SPT-27	41.0 - 42.5	1.3	WOH-1-1	21	
705.8'	44.0'			SPT-28	42.5 - 44.0	1.3	WOH-1-2	22	
		SAND, gray, saturated, medium dense, fine grained, trace silt		SPT-29	44.0 - 45.5	1.1	7-9-15	19	SPT-30: shale in tip of spoon
702.8'	47.0'			SPT-30	45.5 - 47.0	0.8	40-32-25	16	Boring backfilled with bentonite cement grout from 0.0 ft to 49.0 ft
				SPT-31	47.0 - 47.9	0.7	45-50/0.4	–	
700.8'	49.0'	Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

SUBSURFACE LOG

Project No.	175569042	Location	N 554822.75, E 2442910.57 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-63 Total Depth 49.0 ft
Location	Kingston, Tennessee	Surface Elevation	750.0 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/2/09 Completed 4/2/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	10.0 ft Date/Time 4/2/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
750.0'	0.0'	Top of Hole							
748.0'	2.0'	LEAN CLAY (Fill), red brown, moist, medium stiff		SPT-1	0.0 - 1.5	1.1	1-4-9	17	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.3	8-16-14	18	
		BOTTOM ASH (Fill), black, moist, medium dense		SPT-3	3.0 - 4.5	1.3	10-21-14	13	
				SPT-4	4.5 - 6.0	1.1	5-6-12	13	All ST samples recovered using a fixed head piston sampler
743.0'	7.0'			SPT-5	6.0 - 7.5	1.1	7-9-11	18	
		LEAN CLAY (Fill), light brown, moist, soft to medium stiff, some		SPT-6	7.5 - 9.0	0.9	5-6-6	24	
				ST-1	9.0 - 11.0	1.2		--	
				SPT-7	11.0 - 12.5	0.7	1-1-2	24	
				SPT-8	12.5 - 14.0	0.7	1-2-2	24	
734.0'	16.0'			ST-2	14.0 - 16.0	2.0		--	ST-2: sand in bottom to tube
		SAND, gray, saturated, very loose, fine grained		SPT-9	16.0 - 17.5	0.4	WOR-WOR-WOR	30	
				SPT-10	17.5 - 19.0	1.0	WOR-WOH-1	25	
				SPT-11	19.0 - 20.5	1.3	WOR-WOR-WOR	21	
728.0'	22.0'			SPT-12	20.5 - 22.0	0.0	WOH-WOH-WOH	--	
		SILT, brown, saturated, very soft, some fine grained sand, trace clay		SPT-13	22.0 - 23.5	1.1	WOH-1-1	21	
726.0'	24.0'			SPT-14	23.5 - 25.0	1.0	WOR-WOR-1	19	Water added at 23.5 ft to keep augers clear
725.0'	25.0'	SAND, light brown, saturated, very loose, fine grained		SPT-15	25.0 - 26.5	1.3	1-1-1	23	
		SAND, light brown to brown, saturated, very loose, fine grained, some clay		SPT-16	26.5 - 28.0	1.2	WOH-1-1	20	
				SPT-17	28.0 - 29.5	1.1	WOR-WOR-WOR	24	
719.5'	30.5'			SPT-18	29.5 - 31.0	1.1	WOR-WOH-2	27	
		SILT, dark gray, saturated, very soft, trace clay		SPT-19	31.0 - 32.5	1.1	WOH-WOH-WOH	23	
716.0'	34.0'			SPT-20	32.5 - 34.0	0.5	WOH-WOH-WOH	25	
		SAND, brown, saturated, very loose, fine grained, some silt		SPT-21	34.0 - 35.5	1.0	WOH-WOH-2	27	
714.0'	36.0'			SPT-22	35.5 - 37.0	1.4	WOH-	23	

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SUBSURFACE LOG

Project No. 175569042 Location N 554822.75, E 2442910.57 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-63** Total Depth 49.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SAND, light gray, saturated, very loose, fine grained, trace silt *(Continued)*		SPT-23	37.0 - 38.5	1.1	WOH-WOH WOH-WOH-WOH	22	
				SPT-24	38.5 - 40.0	1.1	WOR-WOR-WOR	19	
				SPT-25	40.0 - 41.5	1.4	WOR-WOH-1	22	
				SPT-26	41.5 - 43.0	1.1	WOR-WOH-2	25	
				SPT-27	43.0 - 44.5	1.1	1-3-7	32	SPT-28: sandstone in tip of spoon
				SPT-28	44.5 - 46.0	1.3	3-5-14	27	SPT-29: shale in tip of spoon
702.5'	47.5'			SPT-29	46.0 - 47.5	1.1	10-24-28	18	Boring backfilled with bentonite cement grout from 0.0 ft to 49.0 ft
701.0'	49.0'			SPT-30	47.5 - 48.9	0.9	20-44-36/0.4	--	
		Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

7/15/08

SUBSURFACE LOG

Project No.	175569042	Location	N 554411.29, E 2442911.08 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-64** Total Depth 55.5 ft
Location	Kingston, Tennessee	Surface Elevation	749.4 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/3/09 Completed 4/6/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	8.0 ft Date/Time 4/6/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
749.4'	0.0'	Top of Hole							
		FAT CLAY (Fill), red brown, moist, soft to medium stiff, some gravel		SPT-1	0.0 - 1.5	0.7	2-2-3	24	Boring advanced using 3 1/4 " Hollow Stem Augers
746.4'	3.0'			SPT-2	1.5 - 3.0	1.1	3-5-5	23	
		FAT CLAY (Fill), light brown, moist, soft, some bottom ash		SPT-3	3.0 - 4.5	1.1	5-6-6	20	
743.4'	6.0'			SPT-4	4.5 - 6.0	1.0	5-3-4	21	Slope indicator installed with a concrete pad and protective cover, 60.0 ft total (5.0 ft stickup)
		BOTTOM ASH (Fill), black, saturated, loose		SPT-5	6.0 - 7.5	1.2	8-6-5	17	
741.4'	8.0'			SPT-6	7.5 - 9.0	0.5	2-2-2	24	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
		LEAN CLAY (Fill), light brown, moist, soft to very soft, some fine grained sand		SPT-7	9.0 - 10.5	1.0	WOH-1-2	23	
				SPT-8	10.5 - 12.0	1.1	2-2-3	20	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
				SPT-9	12.0 - 13.5	1.0	2-2-5	21	
				ST-1	13.5 - 15.5	1.5		–	
				SPT-10	15.5 - 17.0	0.4	WOH-WOH-WOH	23	
				SPT-11	17.0 - 18.5	1.2	WOH-WOH-WOH	25	
				SPT-12	18.5 - 20.0	1.1	WOH-WOH-WOH	27	
				ST-2	20.0 - 22.0	2.0		–	
726.4'	23.0'			SPT-13	22.0 - 23.5	1.1	WOH-1-1	33	
		SILT, dark gray, saturated, very soft, trace clay		SPT-14	23.5 - 25.0	1.4	WOH-1-2	29	
724.4'	25.0'			SPT-15	25.0 - 26.5	1.1	WOH-WOH-WOH	26	
		LEAN CLAY, gray and brown, saturated, very soft, some silt		SPT-16	26.5 - 28.0	1.1	WOH-1-2	27	
				SPT-17	28.0 - 29.5	1.4	1-2-3	27	
				ST-3	29.5 - 31.5	2.0		–	Water added to 30.0 ft to keep augers clear
				SPT-18	31.5 - 33.0	1.3	1-2-2	25	
				SPT-19	33.0 - 34.5	1.1	1-2-1	22	
714.4'	35.0'			SPT-20	34.5 - 36.0	1.0	WOH-WOH-WOH	21	
		SAND, gray, saturated, loose to very loose, fine grained, trace silt							

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SUBSURFACE LOG

Project No. 175569042 Location N 554411.29, E 2442911.08 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-64** Total Depth 55.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SAND, gray, saturated, loose to very loose, fine grained, trace silt *(Continued)*		SPT-21	36.0 - 37.5	1.1	WOH-WOH-WOH	20	
				SPT-22	37.5 - 39.0	1.2	WOR-WOR-WOR	22	
				SPT-23	39.0 - 40.5	1.1	2-1-2	19	
				SPT-24	40.5 - 42.0	1.1	WOH-WOH-WOH	20	
				SPT-25	42.0 - 43.5	1.1	2-1-1	22	
				SPT-26	43.5 - 45.0	1.2	2-2-3	28	
				SPT-27	45.0 - 46.5	1.4	5-6-6	22	SPT-26, 27: wood fragments in sample
702.9'	46.5'			SPT-28	46.5 - 46.8	0.3	50/0.3	--	SPT-28: wood fragments in sample, shale in tip of spoon
		Shale, (Augered)		SPT-29	50.0 - 50.5	0.5	50-10/0.0	--	
693.9'	55.5'								Boring backfilled with bentonite cement grout from 0.0 ft to 55.5 ft

Auger Refusal / Bottom of Hole

WOH = Weight of Hammer
WOR = Weight of Rods

7/16/09

SUBSURFACE LOG

Project No.	175569042	Location	N 554147.51, E 2442915.09 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-65** Total Depth 50.0 ft
Location	Kingston, Tennessee	Surface Elevation	748.6 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/7/09 Completed 4/7/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	12.0 ft Date/Time 4/7/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
748.6'	0.0'	Top of Hole							
747.1'	1.5'	GRAVEL (Fill), gray, moist, dense, with clay		SPT-1	0.0 - 1.5	0.2	5-4-7	10	Boring advanced using 3 1/4 " Hollow Stem Augers
		BOTTOM ASH 40% / FLY ASH 60% (Fill), black, saturated, loose		SPT-2	1.5 - 3.0	1.2	8-13-16	20	
				SPT-3	3.0 - 4.5	1.2	9-11-13	18	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
				SPT-4	4.5 - 6.0	1.3	8-7-5	20	
				SPT-5	6.0 - 7.5	1.1	5-7-11	15	
740.1'	8.5'			SPT-6	7.5 - 9.0	1.1	4-6-11	21	
		LEAN CLAY (Fill), brown, moist, very soft to soft		SPT-7	9.0 - 10.5	0.3	3-5-4	19	
				SPT-8	10.5 - 12.0	1.0	5-4-3	20	
				SPT-9	12.0 - 13.5	1.0	4-3-3	19	
				ST-1	13.5 - 15.5	1.9		--	
				SPT-10	15.5 - 17.0	1.2	2-1-1	22	
				SPT-11	17.0 - 18.5	1.0	1-1-2	25	
				ST-2	18.5 - 20.5	1.8		--	
				SPT-12	20.5 - 22.0	1.3	WOH-1-1	25	
				SPT-13	22.0 - 23.5	1.3	WOH-WOH-2	26	SPT-13: wood fragments in sample
724.1'	24.5'			SPT-14	23.5 - 25.0	1.3	WOR-WOH-1	24	
		SILT, gray, moist, very soft		SPT-15	25.0 - 26.5	1.2	WOH-WOH-2	27	
722.1'	26.5'			SPT-16	26.5 - 28.0	1.1	WOH-2-1	29	
		SILT, brown, saturated, very soft, some clay		SPT-17	28.0 - 29.5	1.1	WOH-WOH-WOH	26	SPT-17: wood fragments in sample
719.1'	29.5'			SPT-18	29.5 - 31.0	1.0	WOH-WOH-1	28	
		LEAN CLAY, light brown to brown, moist, very soft		SPT-19	31.0 - 32.5	1.1	4-2-3	29	
				ST-3	32.5 - 34.5	2.0		--	
				SPT-20	34.5 - 36.0	1.0	WOH-WOH-WOH	29	

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SUBSURFACE LOG

Project No. 175569042 Location N 554147.51, E 2442915.09 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-65** Total Depth 50.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		LEAN CLAY, light brown to brown, moist, very soft *(Continued)*		SPT-21	35.0 - 37.5	1.3	WOH-WOH-WOH	27	
				SPT-22	37.5 - 39.0	1.2	WOH-WOH-WOH	27	
				SPT-23	39.0 - 40.5	1.5	WOH-WOH-1	25	
				SPT-24	40.5 - 42.0	1.3	WOH-WOH-WOH	29	
				SPT-25	42.0 - 43.5	1.4	WOH-WOH-WOH	27	SPT-26: sand in tip of spoon
703.6'	45.0'			SPT-26	43.5 - 45.0	1.1	WOR-WOR-WOR	30	SPT-27: wood fragments in sample
		SAND, light gray, saturated, very loose to loose, fine to medium grained, some fine to medium gravel		SPT-27	45.0 - 46.5	1.1	WOR-2-4	52	SPT-28: wood fragments in sample; shale in tip of spoon
700.6'	48.0'			SPT-28	46.5 - 48.0	1.4	WOH-WOH-WOH	25	Boring backfilled with bentonite cement grout from 0.0 ft to 50.0 ft
				SPT-29	48.0 - 48.7	0.5	20-50/0.2	-	
698.6'	50.0'	Shale, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

7/16/09

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SUBSURFACE LOG

Project No.	175569042	Location	N 553888.83, E 2442564.24 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-66** Total Depth 57.0 ft
Location	Kingston, Tennessee	Surface Elevation	750.9 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	4/8/09 Completed 4/8/09
Supervisor	Ben Halada Driller Kent Clements	Depth to Water	10.0 ft Date/Time 4/8/09
Logged By	Ben Halada	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
750.9'	0.0'	Top of Hole							
		FAT CLAY (Fill), red brown, moist, very soft to soft, some chert		SPT-1	0.0 - 1.5	1.0	5-3-3	15	Boring advanced using 3 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.2	4-2-3	24	
				SPT-3	3.0 - 4.5	1.3	3-5-4	30	Piston sampler and sucker rods were utilized to obtain recovery during Shelby Tube sampling
				ST-1	4.5 - 6.5	1.0		--	
				SPT-4	6.5 - 8.0	1.0	6-4-4	28	
				SPT-5	8.0 - 9.5	1.3	2-3-4	31	
				SPT-6	9.5 - 11.0	1.0	2-3-3	32	
				SPT-7	11.0 - 12.5	1.2	5-5-5	28	
				SPT-8	12.5 - 14.0	1.1	1-2-1	28	
735.9'	15.0'			SPT-9	14.0 - 15.5	0.8	WOH-1-1	34	
		LEAN CLAY (Fill), brown, moist, soft, some gravel, some		SPT-10	15.5 - 17.0	0.5	2-2-4	15	
				SPT-11	17.0 - 18.5	0.8	2-3-4	17	
				SPT-12	18.5 - 20.0	0.5	2-3-12	20	SPT-12: shale in tip of spoon
729.9'	21.0'			SPT-13	20.0 - 21.5	0.5	2-2-2	26	
727.9'	23.0'	FAT CLAY, light brown, saturated, very soft		SPT-14	21.5 - 23.0	0.4	1-1-2	30	
		SILT, gray, saturated, very soft, some clay		SPT-15	23.0 - 24.5	1.1	WOH-WOH-WOH	31	
				SPT-16	24.5 - 26.0	1.2	WOH-WOH-1	27	
723.4'	27.5'			SPT-17	26.0 - 27.5	1.1	WOH-1-2	25	
		SAND, light brown, saturated, very loose, fine grained, some clayey silt		SPT-18	27.5 - 29.0	1.2	1-1-2	22	Water added at 28.0 ft to keep augers clear
				SPT-19	29.0 - 30.5	1.2	WOH-WOH-1	25	
				SPT-20	30.5 - 32.0	1.3	5-4-4	22	
				SPT-21	32.0 - 33.5	1.0	WOH-1-2	22	
715.9'	35.0'			ST-2	33.5 - 35.5	2.0		--	ST-2: sand in bottom to tube
		SAND, brown, saturated, very loose, fine grained, trace silt		SPT-22	35.5 - 37.0	1.5	WOH-1-1	21	

LEGACY_175569042\KINGSTON ASH POND.GPJ FUGRO.GDT 7/16/09

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SUBSURFACE LOG

Project No. 175569042 Location N 553888.83, E 2442564.24 (NAD27)

Project Name Kingston Ash Pond Boring No. **STN-66** Total Depth 57.0 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SAND, brown, saturated, very loose, fine grained, trace silt *(Continued)*		SPT-23	37.0 - 38.5	1.4	WOR-WOH-1	20	
711.9'	39.0'			SPT-24	38.5 - 40.0	1.3	WOR-WOH-WOH	21	
		SAND, light gray to gray, saturated, very loose to loose, fine grained, trace silt		SPT-25	40.0 - 41.5	1.3	WOR-WOH-WOH	20	
				SPT-26	41.5 - 43.0	1.2	WOH-WOH-WOH	19	
				SPT-27	43.0 - 44.5	1.3	WOH-WOH-WOH	22	
				SPT-28	44.5 - 46.0	1.2	1-2-1	19	
				SPT-29	46.0 - 47.5	1.3	1-WOH-1	21	Wood fragments present in SPT-30, 31, 32 and 34
				SPT-30	47.5 - 49.0	1.0	2-1-1	29	
				SPT-31	49.0 - 50.5	1.4	2-3-3	45	SPT-31: silt lenses
				SPT-32	50.5 - 52.0	1.5	WOR-3-4	36	
				SPT-33	52.0 - 53.5	1.2	WOR-2-2	30	
				SPT-34	53.5 - 55.0	1.2	WOH-2-3	35	Boring backfilled with bentonite cement grout from 0.0 ft to 57.0 ft
695.9'	55.0'			SPT-35	55.0 - 55.5	0.4	50-10/0.0	--	
693.9'	57.0'	Sandstone, (Augered)							
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

7/16/09

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SUBSURFACE LOG

Project No.	175569042	Location	N 553607.58, E 2441718.01 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-69** Total Depth 59.5 ft
Location	Kingston, Tennessee	Surface Elevation	752.3 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	5/18/09 Completed 5/20/09
Supervisor	Ben Halada Driller Steve Bradford	Depth to Water	19.5 ft Date/Time 5/18/09
Logged By	Brad Smiley	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
752.3'	0.0'	Top of Hole							
		FAT CLAY with Gravel (Fill), red brown, moist, medium stiff, some gravel, trace		SPT-1	0.0 - 1.5	0.8	3-5-6	22	Boring advanced using 4 1/4 " Hollow Stem Augers
				SPT-2	1.5 - 3.0	1.0	5-6-4	23	
				SPT-3	3.0 - 4.5	1.2	4-8-6	29	
				SPT-4	4.5 - 6.0	1.2	3-3-5	21	
				SPT-5	6.0 - 7.4	0.8	4-50-46/0.4	18	
744.8'	7.5'			SPT-6	7.5 - 7.7	0.2	50/0.2	3	
		LEAN CLAY (Fill), light gray to dark gray, moist, stiff, some shale		SPT-7	9.0 - 10.5	1.3	23-16-16	8	
				SPT-8	10.5 - 12.0	1.1	10-16-8	10	
				SPT-9	12.0 - 13.5	1.0	6-8-11	19	
738.8'	13.5'			SPT-10	13.5 - 15.0	0.4	5-6-5	17	
		LEAN CLAY, red to brown, moist, medium stiff, some chert		SPT-11	15.0 - 16.5	1.2	1-2-3	22	
				SPT-12	16.5 - 18.0	1.5	2-3-4	21	
				SPT-13	18.0 - 19.5	1.5	2-3-3	22	
732.8'	19.5'			SPT-14	19.5 - 21.0	1.2	1-2-2	21	
		SAND, light brown to brown, saturated, loose to medium dense, fine to medium grained, some clay		SPT-15	21.0 - 22.5	1.2	1-1-1	22	
				SPT-16	22.5 - 24.0	1.5	1-1-2	20	
				SPT-17	24.0 - 25.5	1.0	1-1-3	16	Water added at 24.0 ft to keep sand out of augers
				SPT-18	25.5 - 27.0	0.8	1-1-2	24	
				SPT-19	27.0 - 28.5	1.3	WOR-1-2	17	
				SPT-20	28.5 - 30.0	1.0	1-1-1	23	
				SPT-21	30.0 - 31.5	0.9	1-1-1	18	
				SPT-22	31.5 - 33.0	1.2	4-5-5	20	
717.8'	34.5'			SPT-23	33.0 - 34.5	1.5	2-2-4	18	
				SPT-24	34.5 - 36.0	1.5	2-2-5	20	

RUSH_LEGACY 175569117 KINGSTON ASH POND.GPJ RSMLEGDT 7/16/09

7/16/09

SUBSURFACE LOG

Project No.	175569042	Location	N 553607.58, E 2441718.01 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-69** Total Depth 59.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		SAND, brown, moist, medium dense to dense, fine to medium grained *(Continued)*		SPT-25	36.0 - 37.5	1.3	5-8-16	18	
				SPT-26	37.5 - 39.0	1.5	14-8-9	19	
				SPT-27	39.0 - 40.5	0.3	8-9-11	18	
				SPT-28	40.5 - 42.0	1.4	11-17-15	19	
				SPT-29	42.0 - 43.5	1.5	6-5-1	20	
707.3'	45.0'			SPT-30	43.5 - 45.0	1.3	2-2-10	36	
		Shale (Augered)		SPT-31	45.0 - 46.5	0.6	2-8-13	–	
				SPT-32	46.5 - 48.0	0.8	27-28-38	–	
				SPT-33	48.0 - 49.3	0.8	38-47-15/0.3	–	
692.8'	59.5'								Boring backfilled with bentonite cement grout from 0.0 ft to 59.5 ft
		Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

Slope Indicator (62.5 ft of pipe) installed with a concrete pad and protective cover

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7/16/08

SUBSURFACE LOG

Project No.	175569042	Location	N 553840.20, E 2440981.04 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	STN-71
Location	Kingston, Tennessee	Total Depth	45.5 ft
Project Type	Geotechnical Exploration	Surface Elevation	752.0 ft. (NGVD29)
Supervisor	Ben Halada	Driller Steve Bradford	Date Started 5/13/09 Completed 5/14/09
Logged By	Brad Smiley	Depth to Water	13.0 ft Date/Time 5/13/09
		Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. FL	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
752.0'	0.0'	Top of Hole							
750.5'	1.5'	TOPSOIL (Fill)		SPT-1	0.0 - 1.5	1.5	3-4-5	23	Boring advanced using 4 1/4 " Hollow Stem Augers
749.0'	3.0'	SAND (Fill), brown, moist, medium dense, fine to coarse grained, some silt		SPT-2	1.5 - 3.0	0.9	8-6-6	16	
		LEAN CLAY with Gravel (Fill), red brown and gray, moist, soft to medium stiff		SPT-3	3.0 - 4.5	1.4	4-5-4	18	
				SPT-4	4.5 - 6.0	1.4	3-3-2	19	
				SPT-5	6.0 - 7.5	1.5	8-7-9	15	
743.0'	9.0'			SPT-6	7.5 - 9.0	1.4	7-11-9	18	
		FAT CLAY, brown, saturated, soft, some fine to coarse gravel		SPT-7	9.0 - 10.5	1.4	9-11-10	17	
				SPT-8	10.5 - 12.0	1.1	1-1-1	21	
				SPT-9	12.0 - 13.5	1.5	1-1-2	21	
737.0'	15.0'			SPT-10	13.5 - 15.0	1.5	1-4-1	22	
		SILTY SAND, brown, saturated, very loose to loose, fine to medium grained, some clay		SPT-11	15.0 - 16.5	1.5	1-1-1	20	Water added at 15.0 ft to keep augers clear
				SPT-12	16.5 - 18.0	1.5	WOR-1-1	21	
				SPT-13	18.0 - 19.5	1.5	WOR-1-1	20	
				SPT-14	19.5 - 21.0	1.4	1-1-1	19	
				SPT-15	21.0 - 22.5	1.5	1-1-2	20	
				SPT-16	22.5 - 24.0	0.8	1-1-2	25	
				SPT-17	24.0 - 25.5	1.5	1-1-WOH	22	
				SPT-18	25.5 - 27.0	1.5	1-2-3	20	
				SPT-19	27.0 - 28.5	0.7	WOR-WOR-3	19	
				SPT-20	28.5 - 30.0	1.5	2-3-5	20	
				SPT-21	30.0 - 31.5	1.4	2-5-3	20	SPT-24: sandstone in tip of spoon
719.0'	33.0'			SPT-22	31.5 - 33.0	1.5	4-11-4	19	
717.0'	35.0'	SAND, brown, saturated, dense, fine to medium grained		SPT-23	33.0 - 34.5	1.5	11-15-13	19	
				SPT-24	34.5 - 36.0	1.4	5-20-22	--	
715.5'	36.5'			SPT-25	36.0 - 36.8	0.8	26-50/0.3	--	

SUBSURFACE LOG

Project No.	175569042	Location	N 553840.20, E 2440981.04 (NAD27)
Project Name	Kingston Ash Pond	Boring No.	**STN-71** Total Depth 45.5 ft

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
		Sandstone, (Augered)							
		Shale, (Augered) *(Continued)*							Boring backfilled with bentonite cement grout from 0.0 ft to 45.5 ft
706.5'	45.5'	Auger Refusal / Bottom of Hole							

WOH = Weight of Hammer
WOR = Weight of Rods

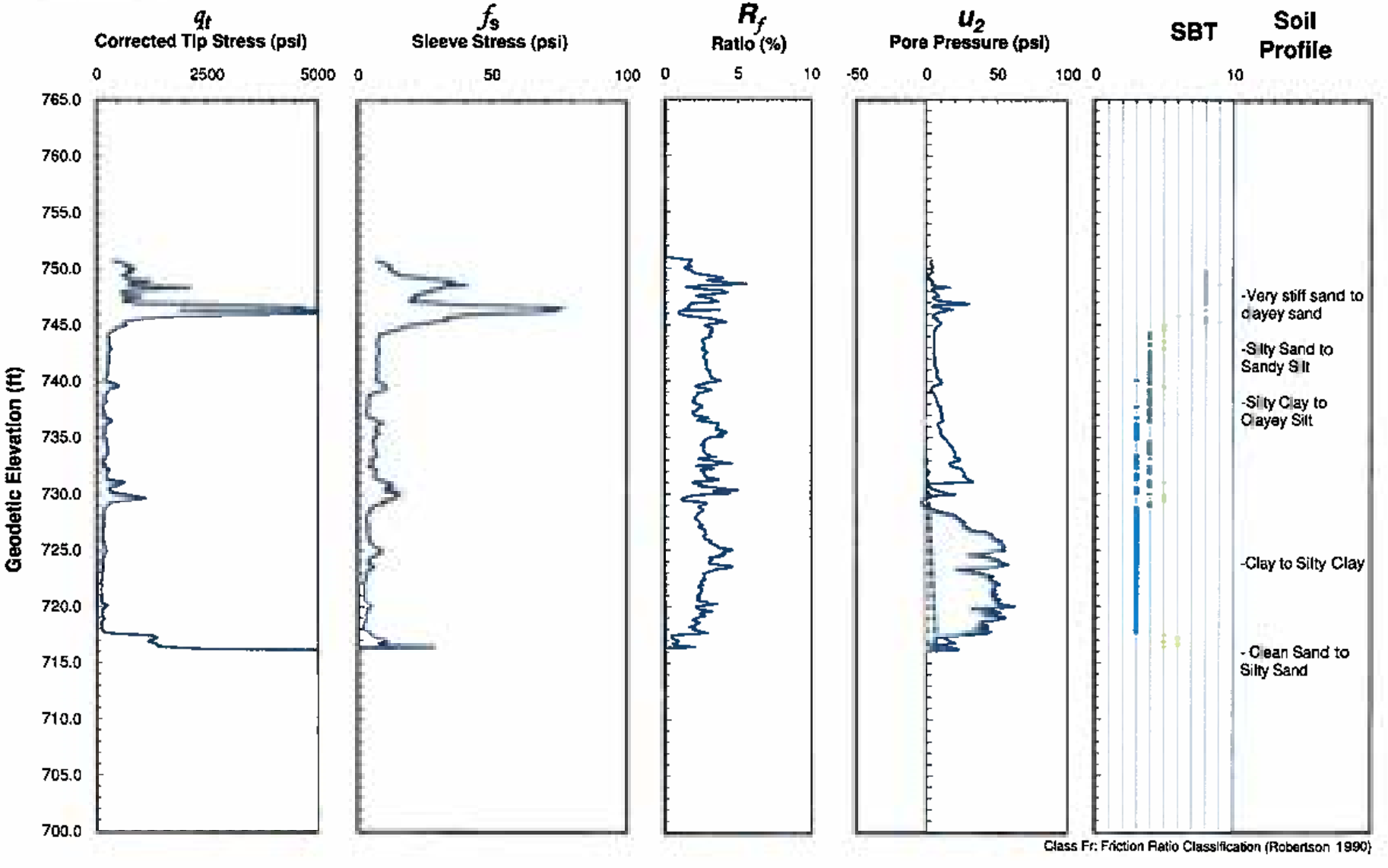
Slope Indicator (45.5 ft of pipe) installed with a concrete pad and protective cover

7/16/09

Appendix B

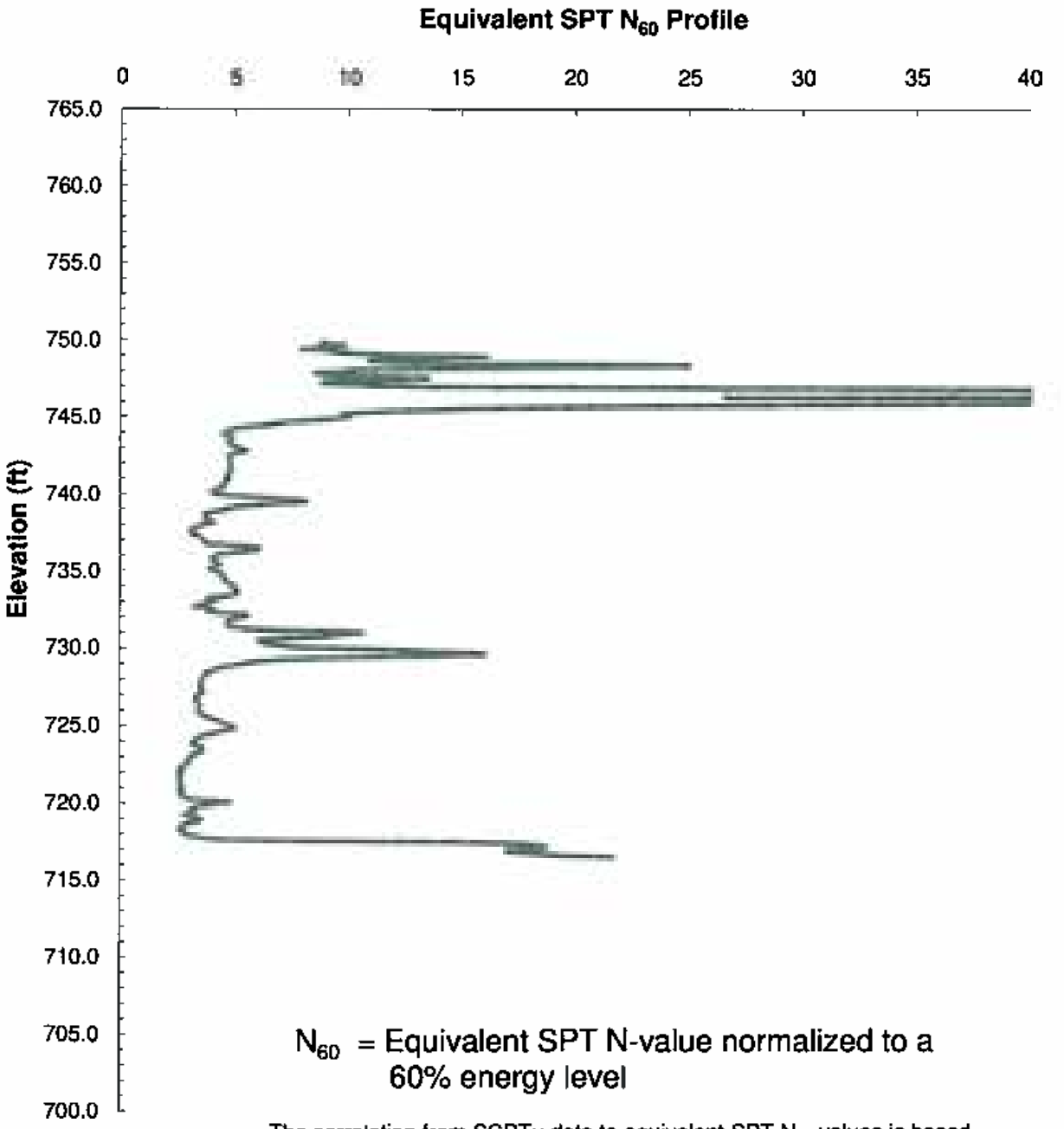
CPT Boring Plots

Stantec Consulting Inc.	Elevation: 751.00 ft SCPTu Start Elevation: 751.00 ft Groundwater Elevation: 733.20 ft	Test Date: May 22, 2009 Project No. 175569042	STN-2B
	Client: TVA Project: Kingston Ash Pond		



SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

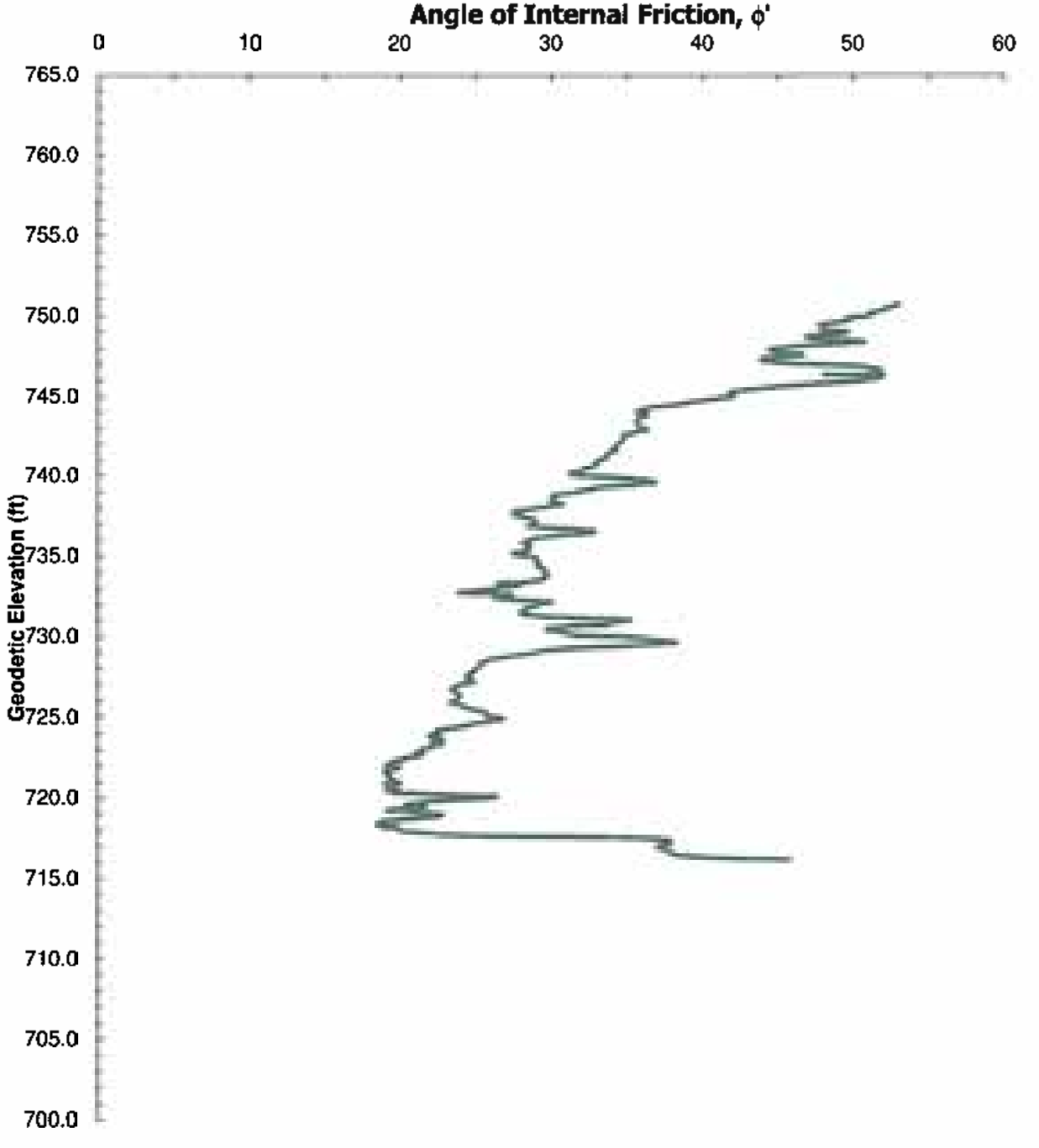
Project No. 175569042

STN-2B

Stantec

SCPTu RESULTS

Effective Angle of Internal Friction

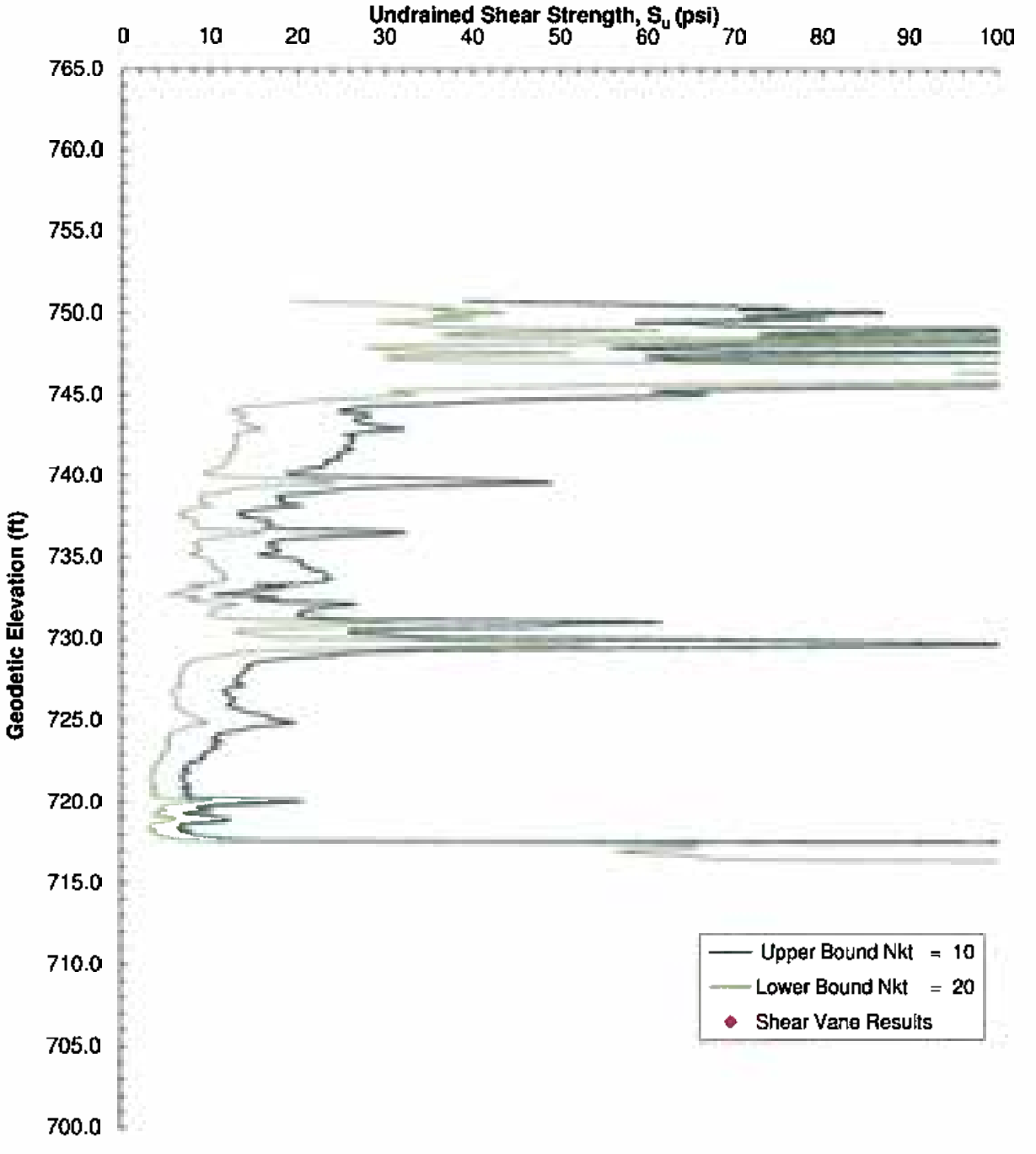


Project No. 175569042

STN-2B

SCPTu RESULTS

Undrained Shear Strength, S_u



Project No. 175569042

STN-2B

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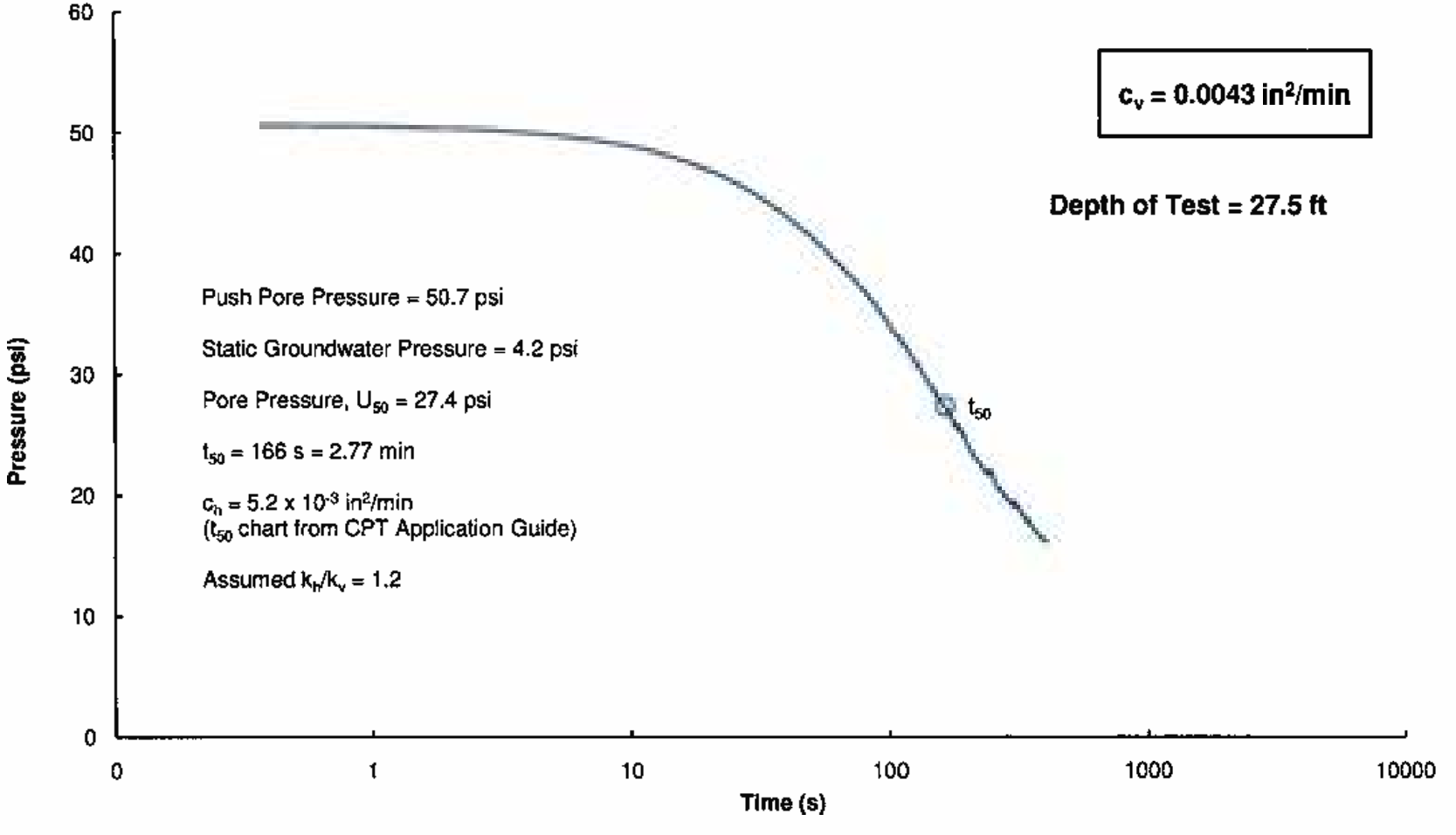
Stantec Consulting Inc.

SCPTu DISSIPATION RESULTS
Coefficient of Consolidation



c_v = 0.0043 in²/min

Depth of Test = 27.5 ft

Push Pore Pressure = 50.7 psi

Static Groundwater Pressure = 4.2 psi

Pore Pressure, U_{50} = 27.4 psi

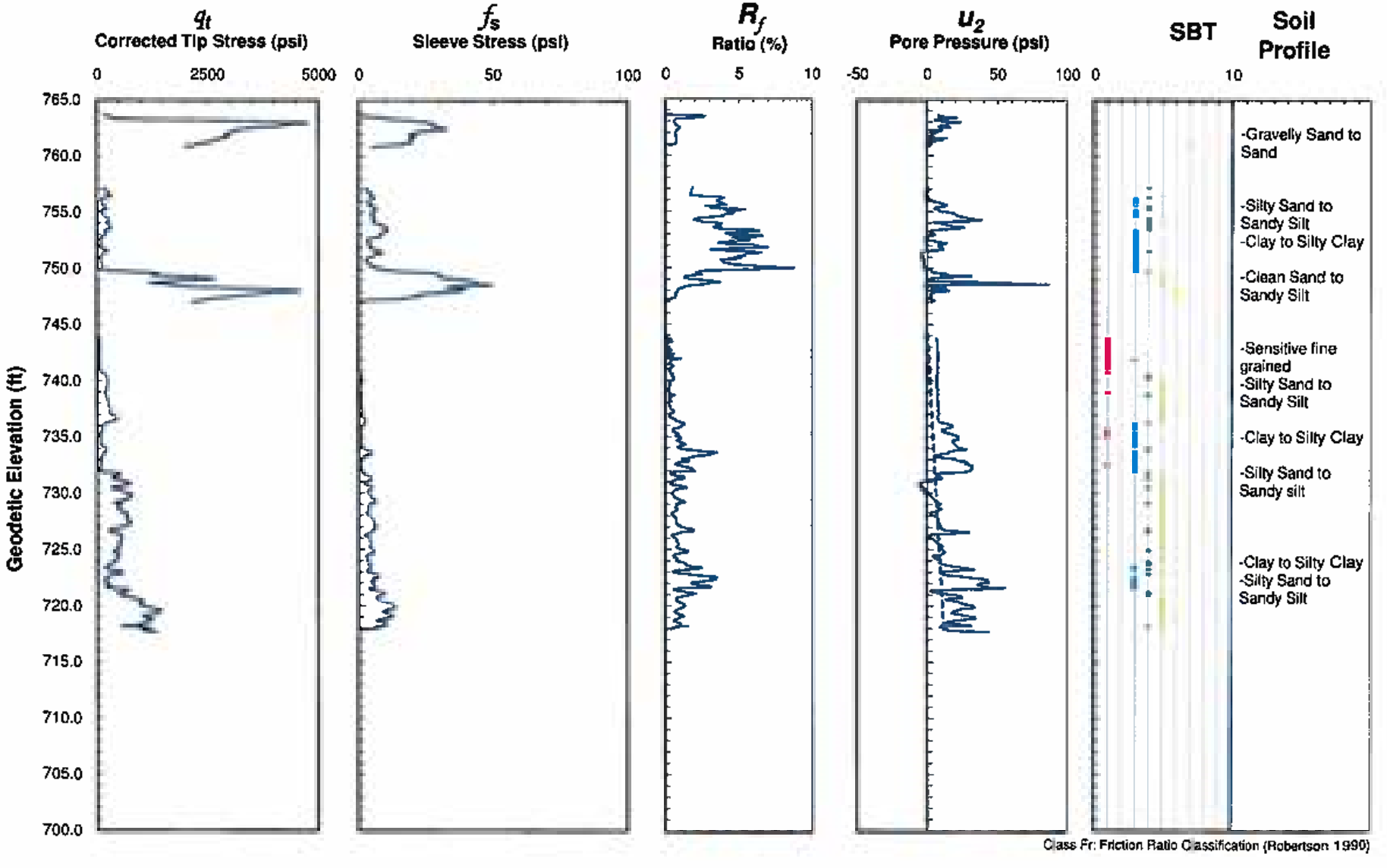
t_{50} = 166 s = 2.77 min

c_h = 5.2 x 10^{-3} in²/min
(t_{50} chart from CPT Application Guide)

Assumed k_h/k_v = 1.2

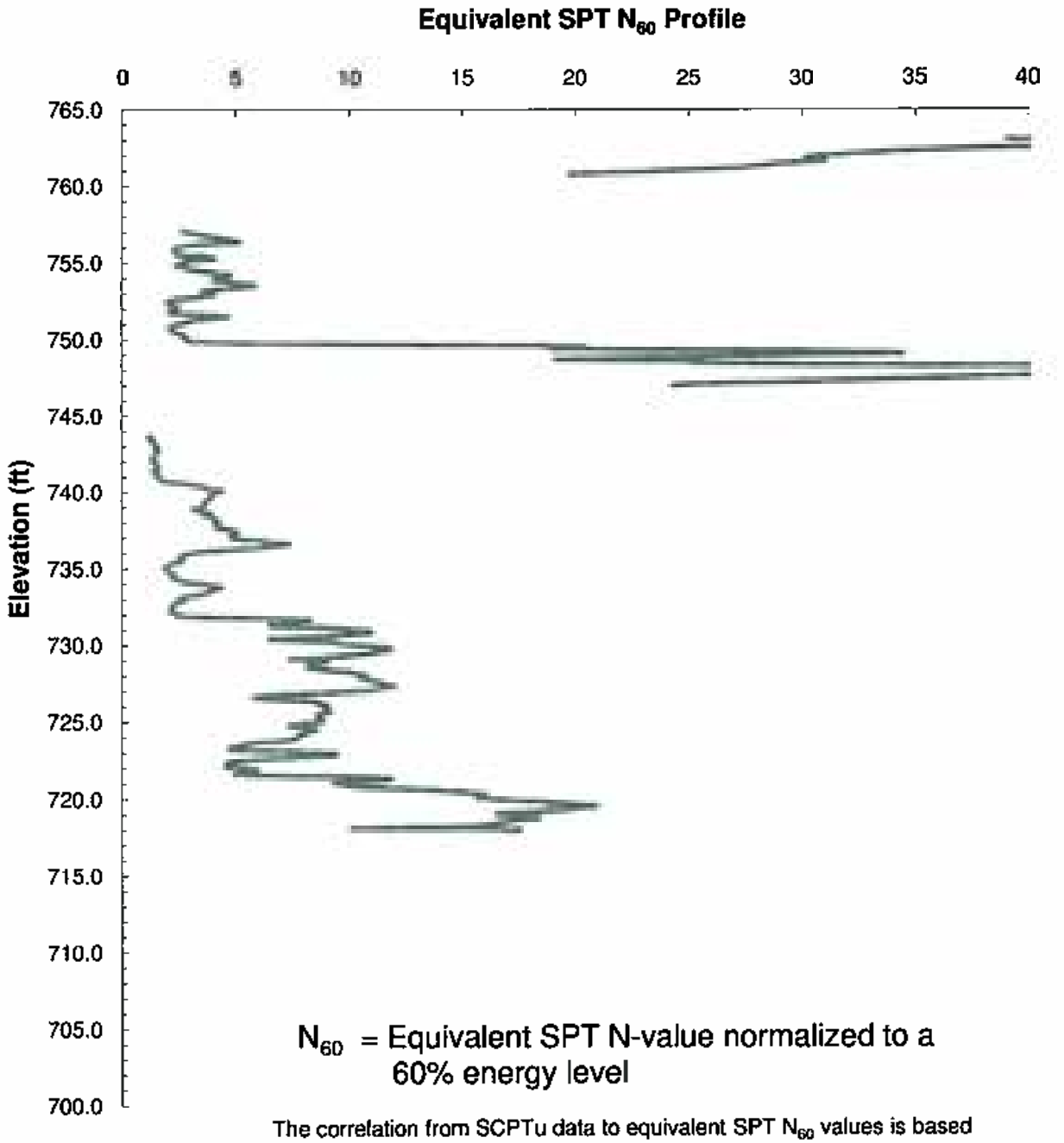
Project No. 175569042
STN-2B

Stantec Consulting Inc.	Elevation: 763.80 ft SCPTu Start Elevation: 763.80 ft Groundwater Elevation: 744.20 ft	Test Date: May 19, 2009 Project No. 175569042	STN-3E
	Client: TVA Project: Kingston Ash Pond		



SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

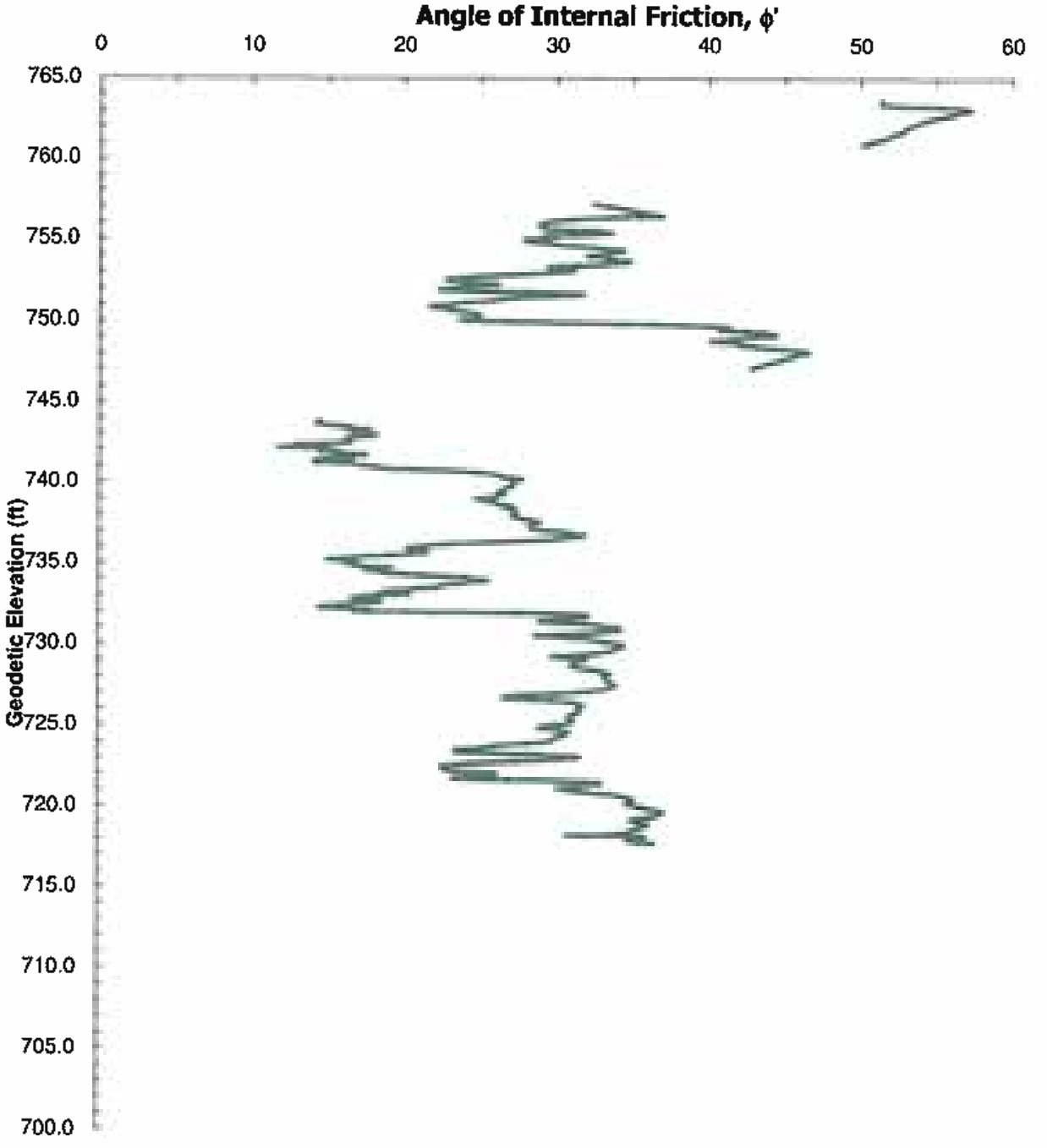
Project No. 175569042

STN-3E

Stantec

SCPTu RESULTS

Effective Angle of Internal Friction

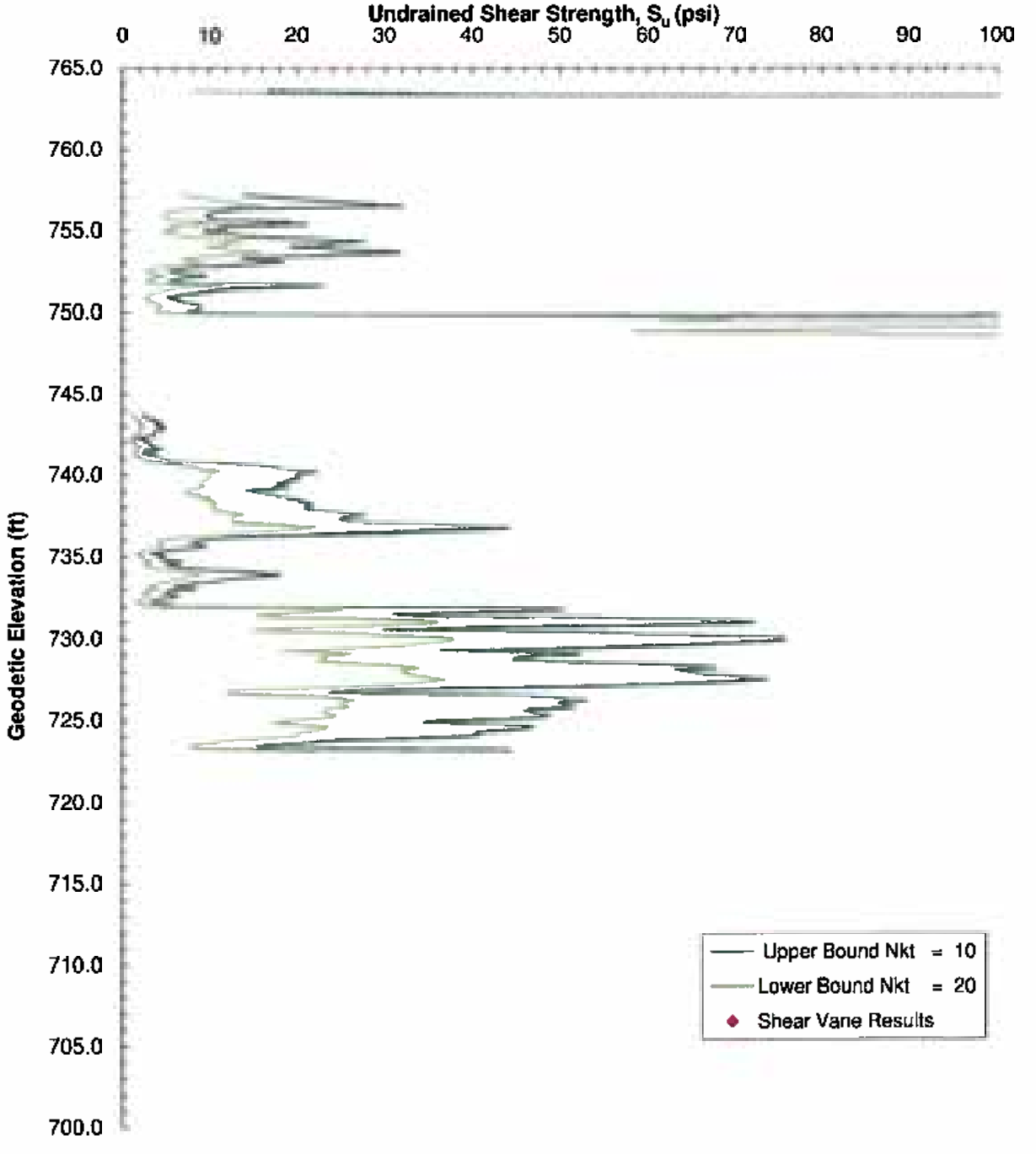


Project No. 175569042

STN-3E

SCPTu RESULTS

Undrained Shear Strength, S_u



Project No. 175569042

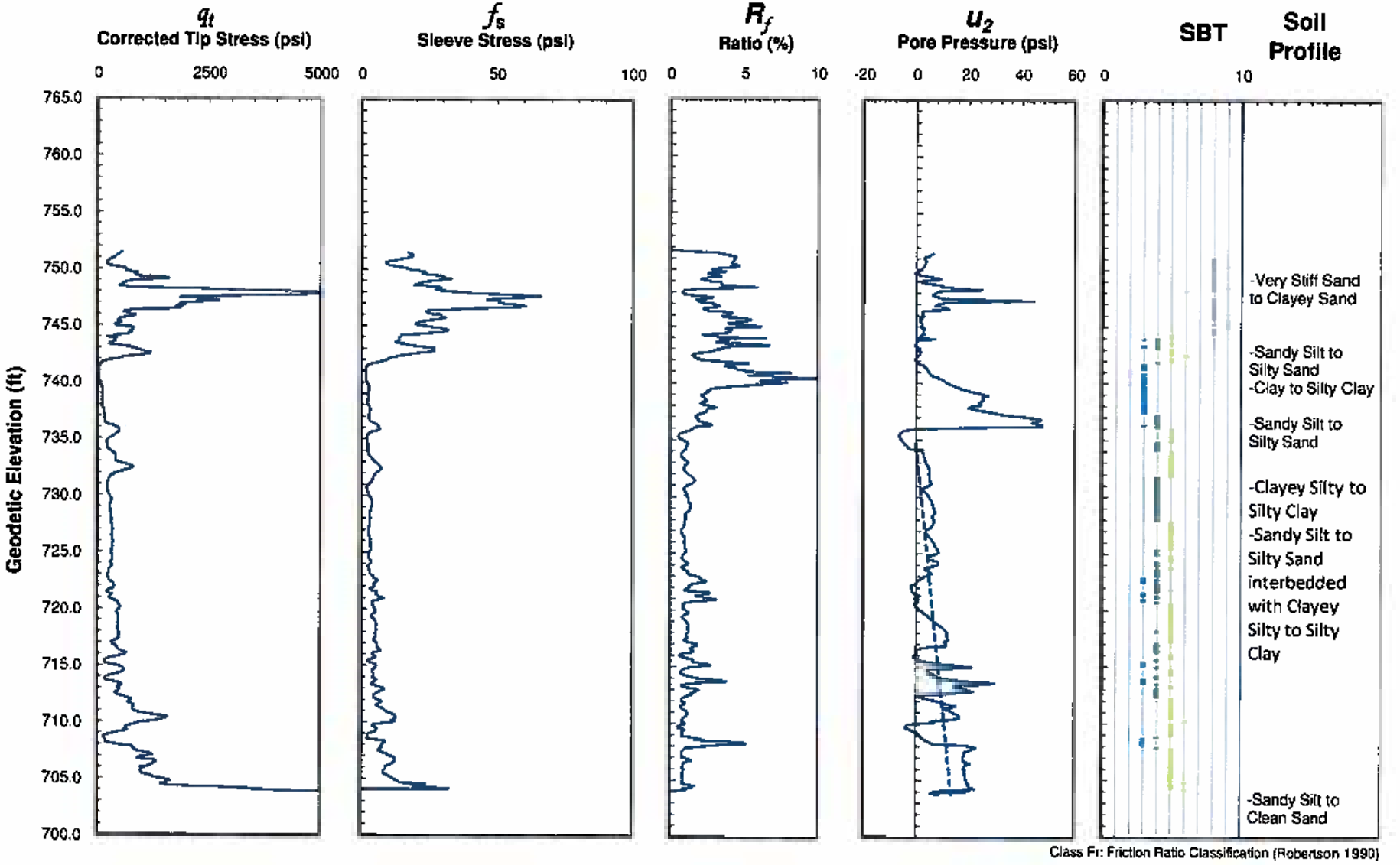
STN-3E

Stantec Consulting Inc.

Elevation:	751.70 ft	Test Date: May 22, 2009	STN-8A
SCPTu Start Elevation:	751.70 ft	Project No. 175569042	
Groundwater Elevation:	734.70 ft		

Client: TVA

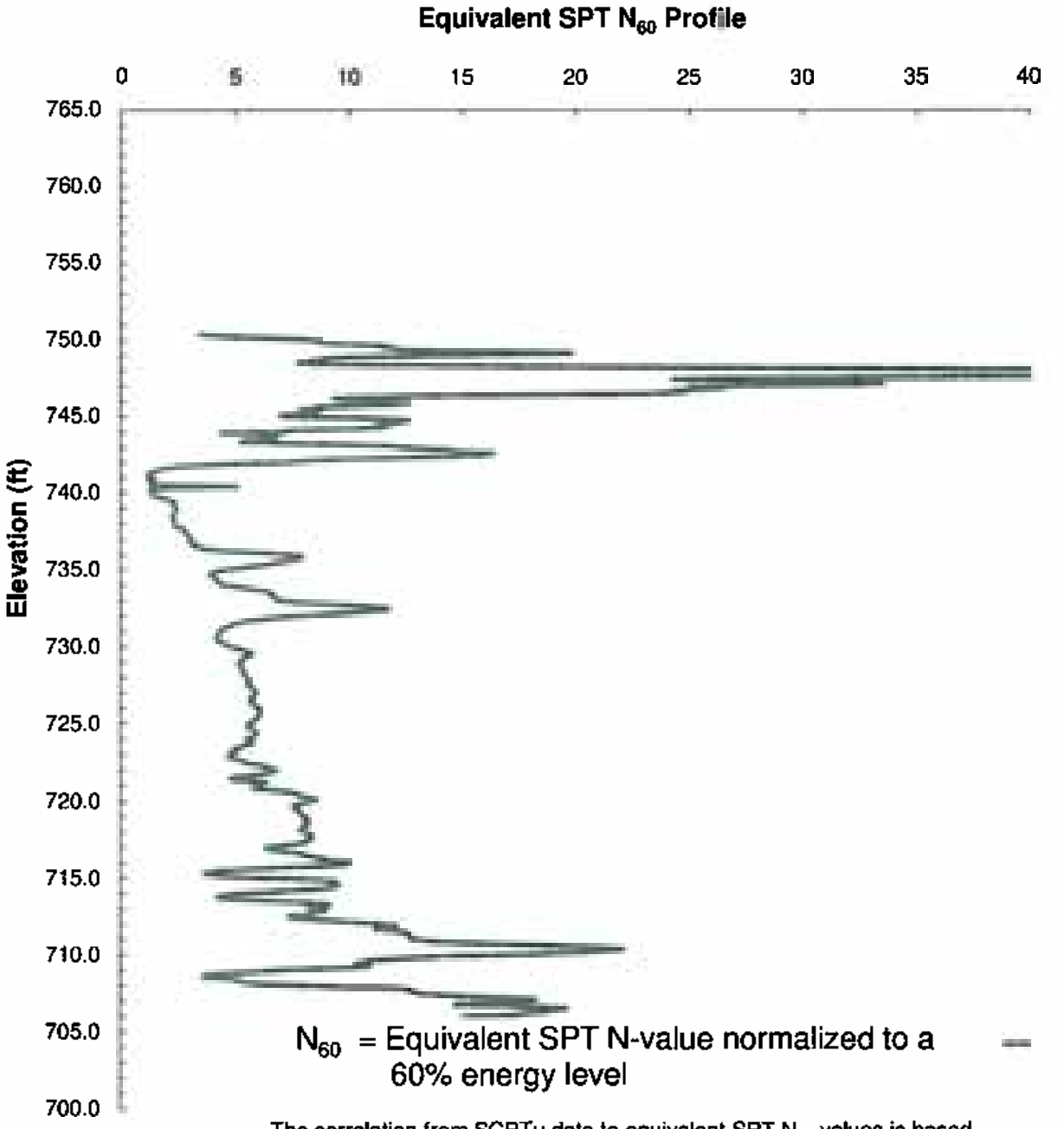
Project: Kingston Ash Pond



Stantec

SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

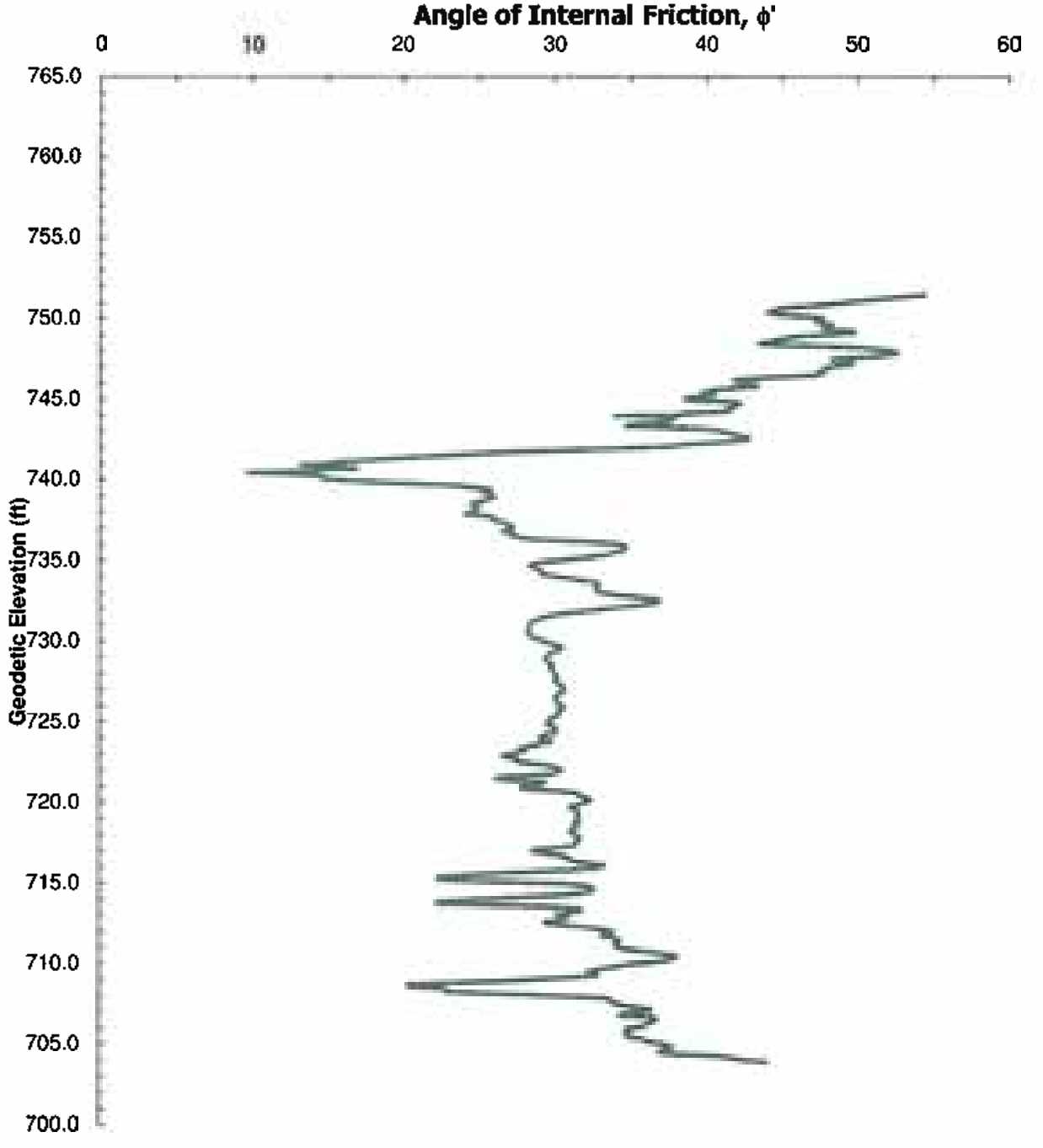
The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

Project No. 175569042

STN-8A

SCPTu RESULTS

Effective Angle of Internal Friction

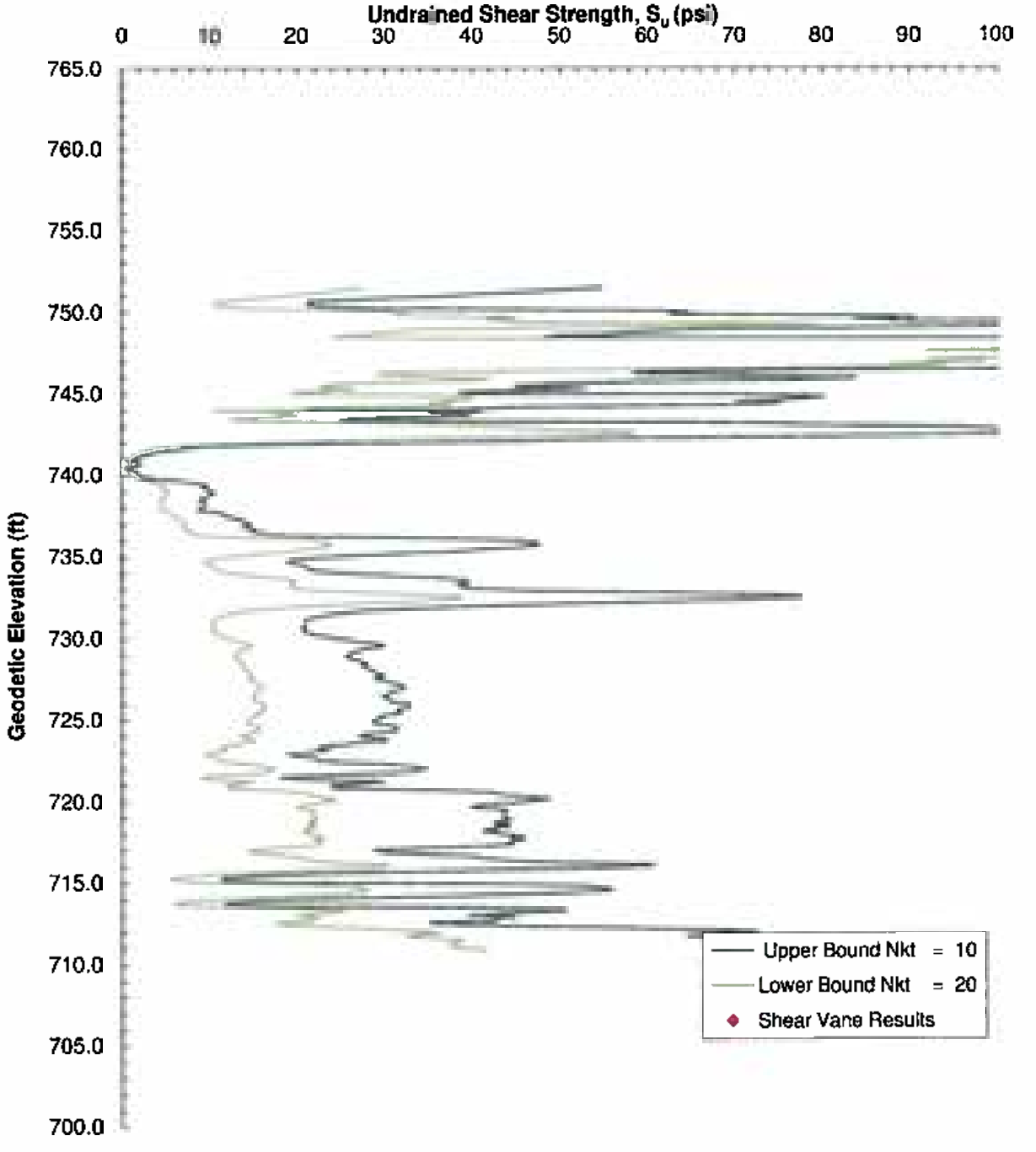


Project No. 175569042

STN-8A

SCPTu RESULTS

Undrained Shear Strength, S_u



Project No. 175569042

STN-8A

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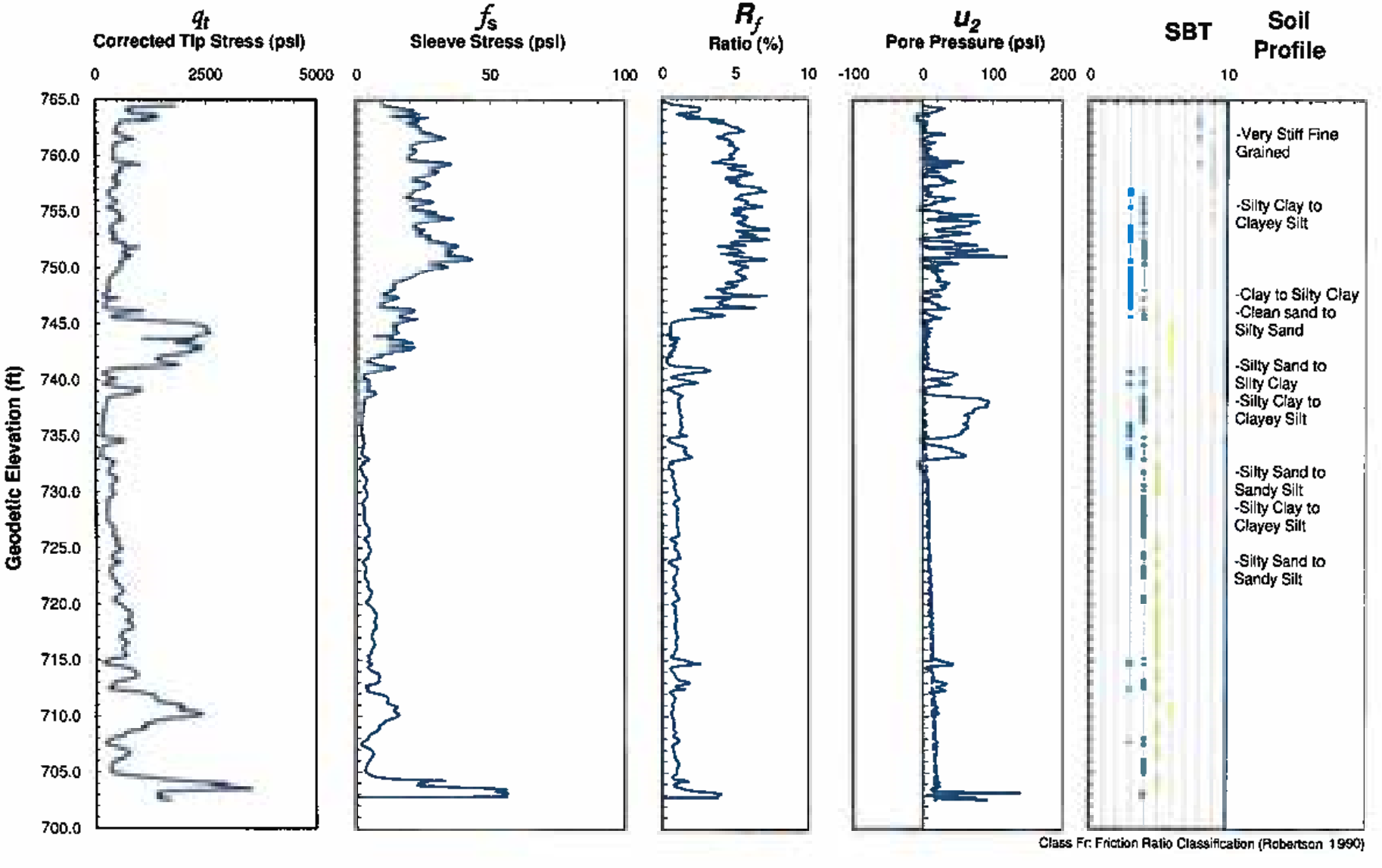
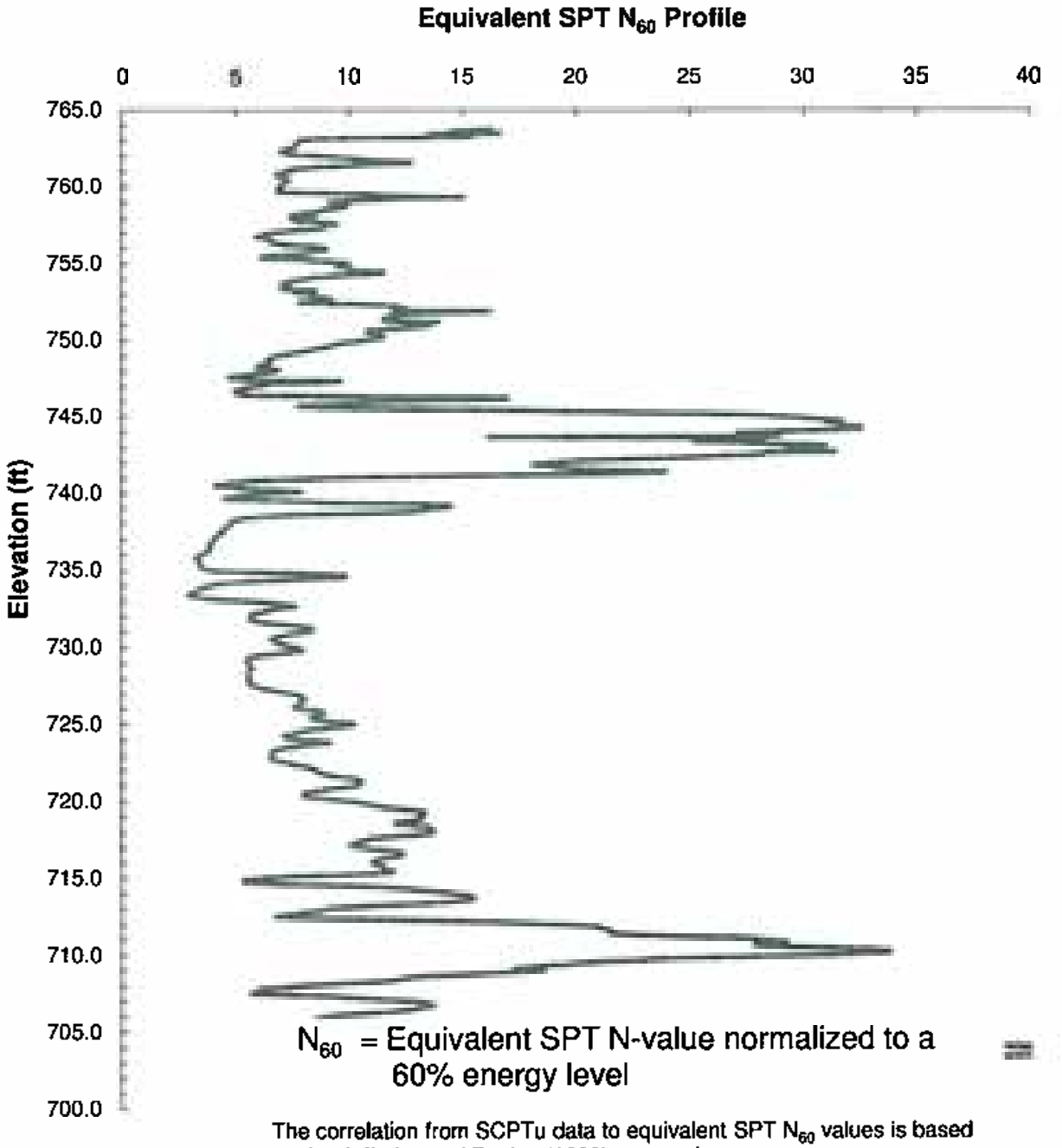
Stantec Consulting Inc.	Elevation: 764.80 ft SCPTu Start Elevation: 764.80 ft Groundwater Elevation: 742.30 ft	Test Date: May 20, 2009 Project No. 175569042	STN-9A
	Client: TVA Project: Kingston Ash Pond		



Class Fr: Friction Ratio Classification (Robertson 1990)

SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

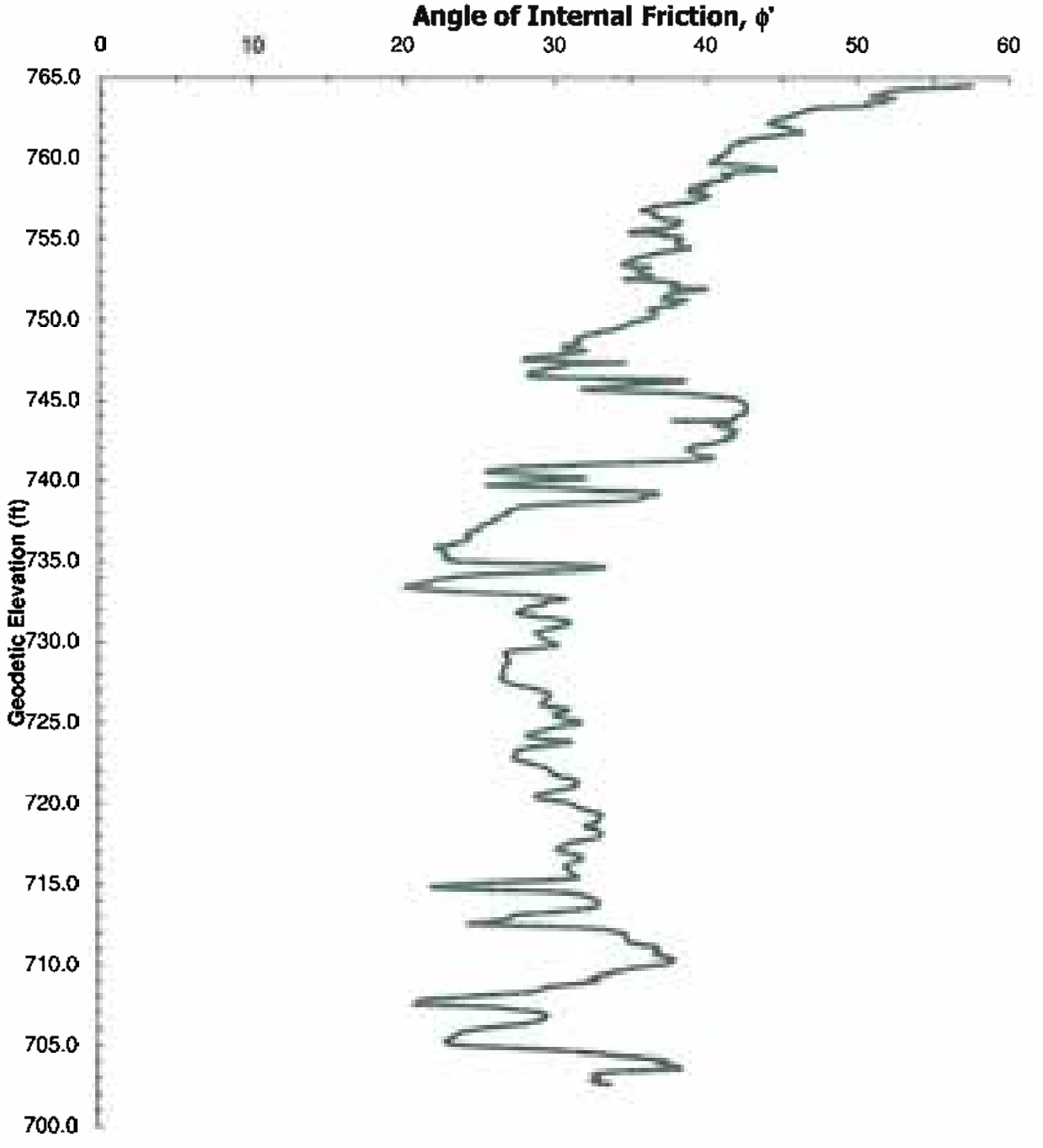
The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

Project No. 175569042

STN-9A

SCPTu RESULTS

Effective Angle of Internal Friction



Project No. 175569042

STN-9A

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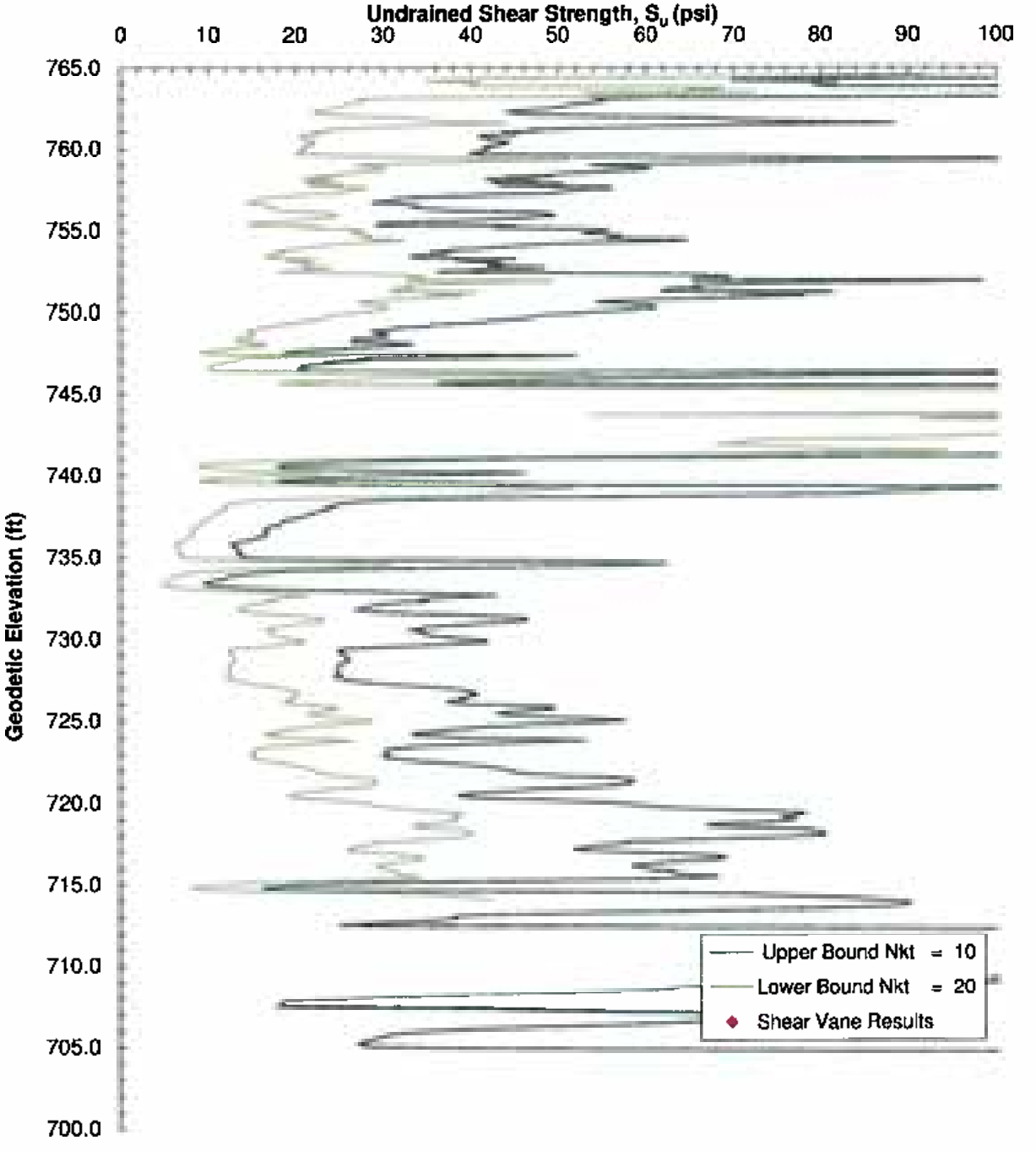
SCPTu RESULTS

Undrained Shear Strength, S_u



Project No. 175569042

STN-9A

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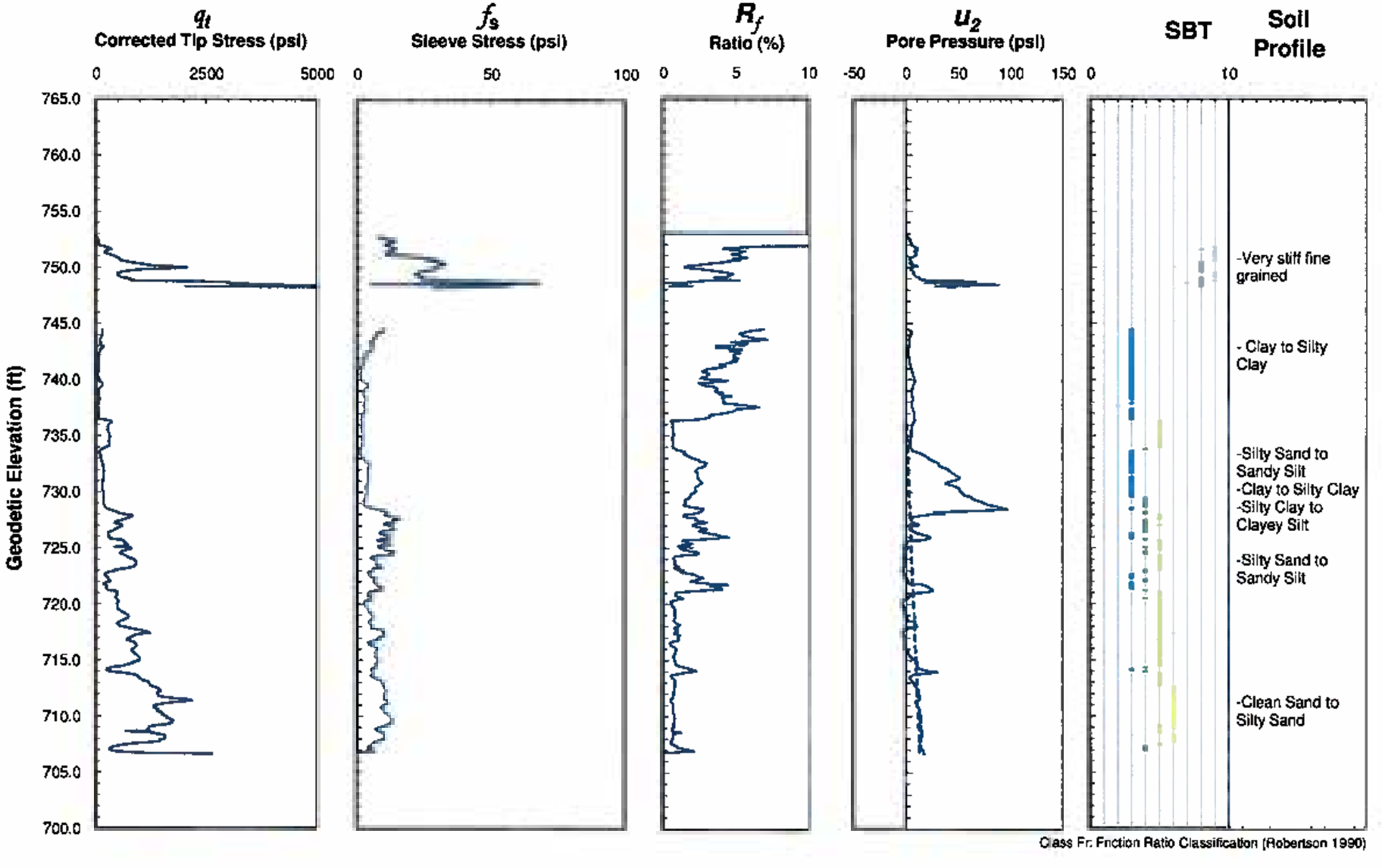
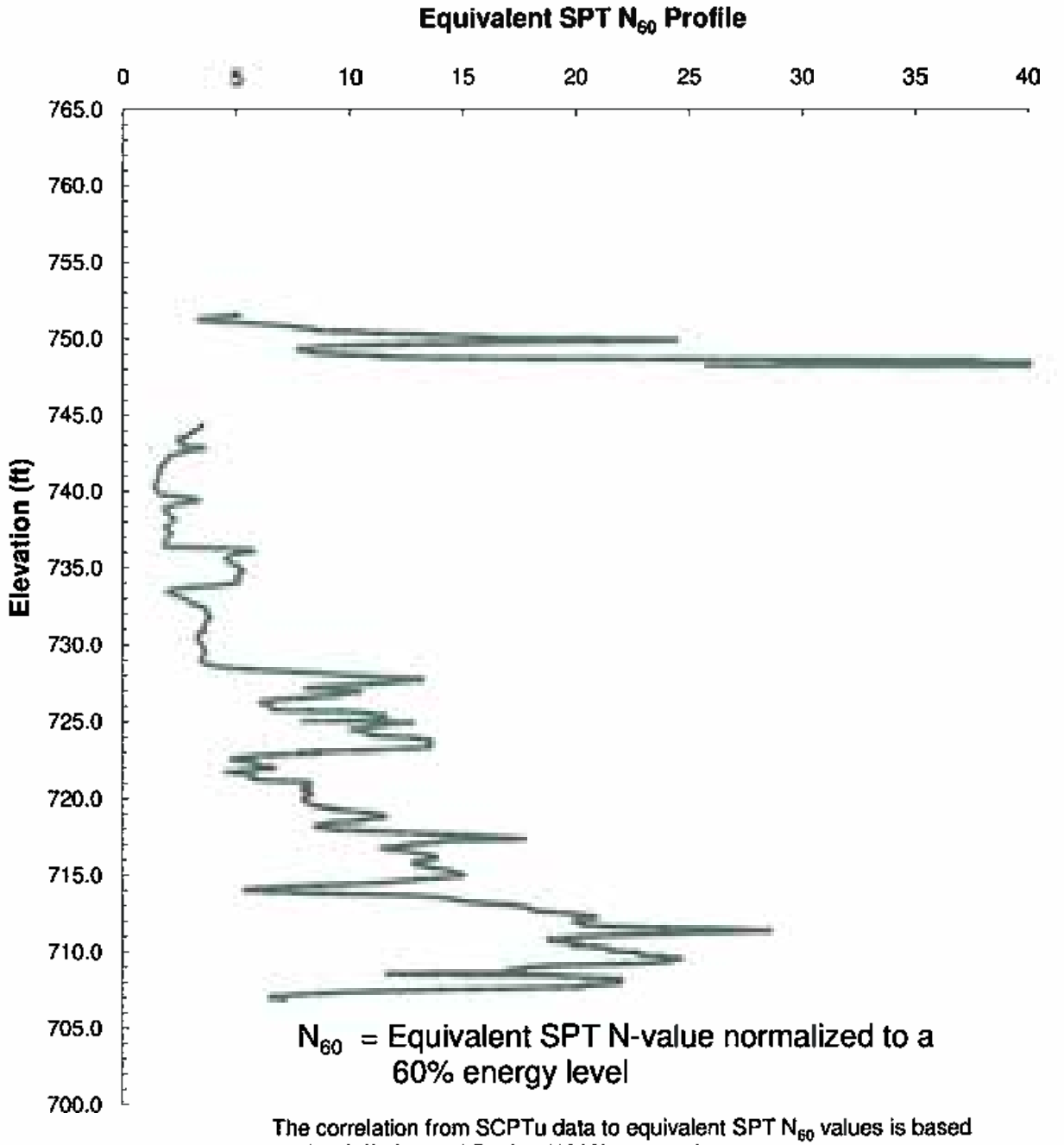
Stantec Consulting Inc.	Elevation: 753.00 ft SCPTu Start Elevation: 753.00 ft Groundwater Elevation: 736.10 ft	Test Date: May 22, 2009 Project No. 175569042	STN-14B
	Client: TVA Project: Kingston Ash Pond		



SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

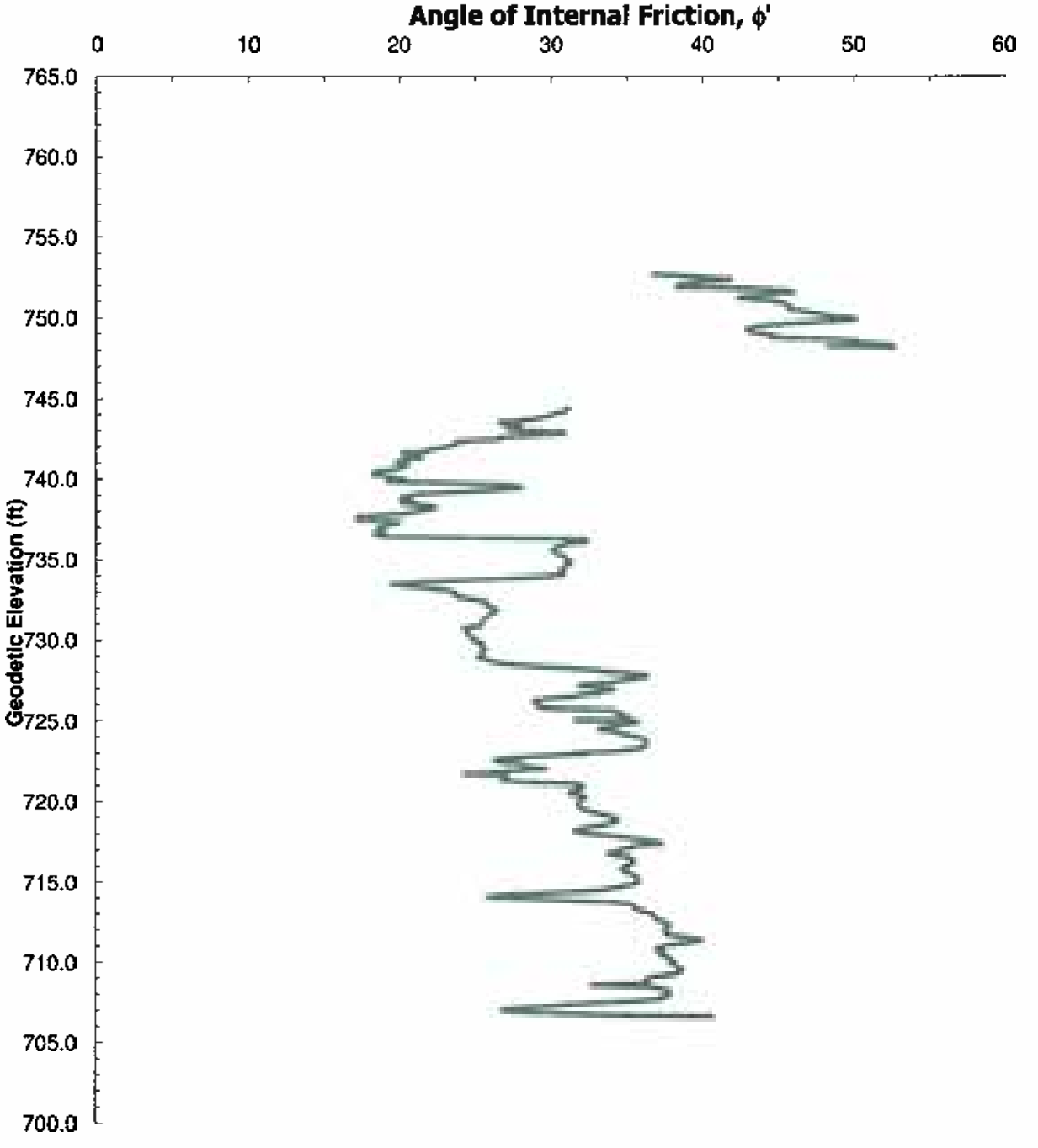
The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

Project No. 175569042

STN-14B

SCPTu RESULTS

Effective Angle of Internal Friction

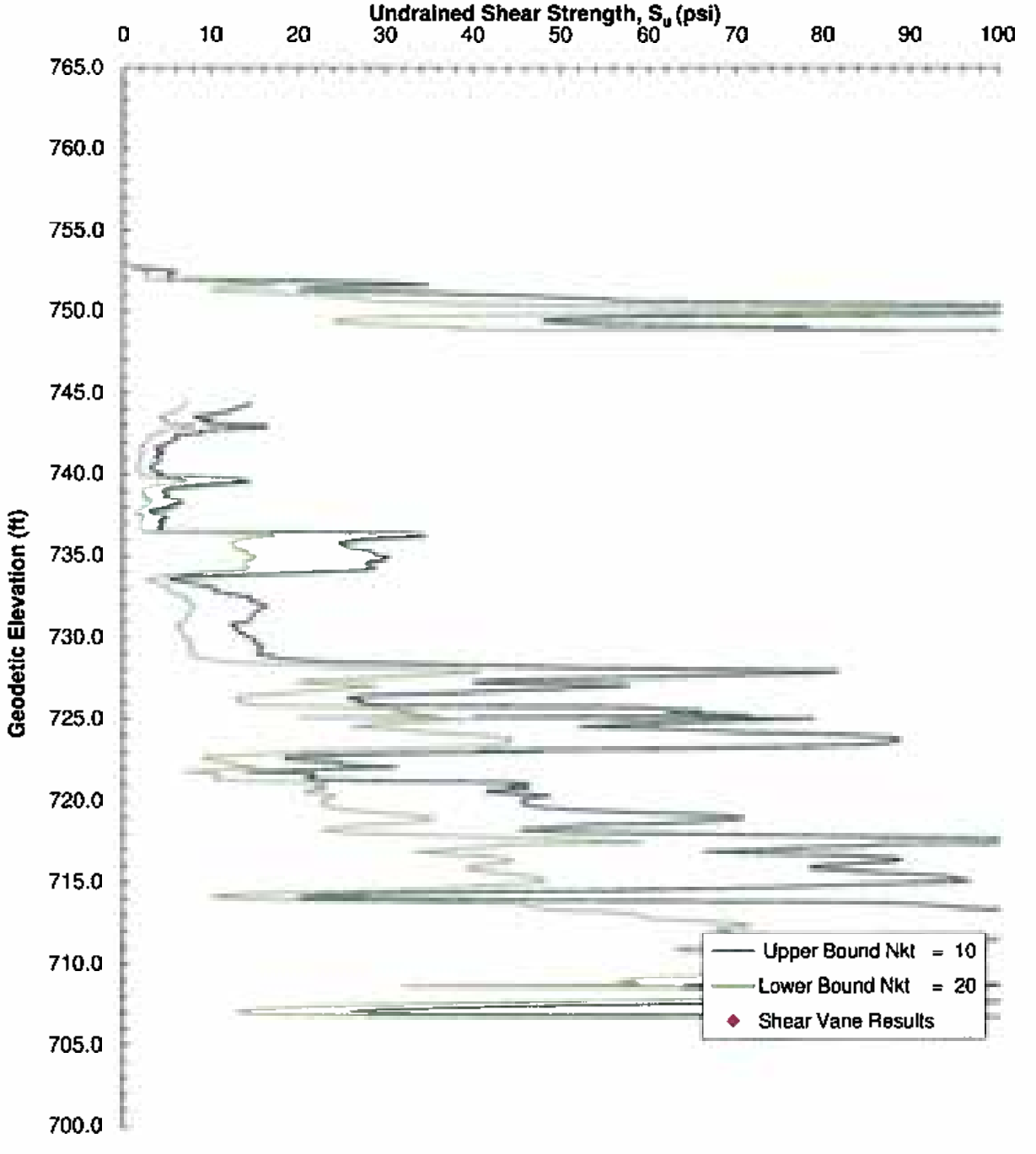


Project No. 175569042

STN-14B

SCPTu RESULTS

Undrained Shear Strength, S_u



Project No. 175569042

STN-14B

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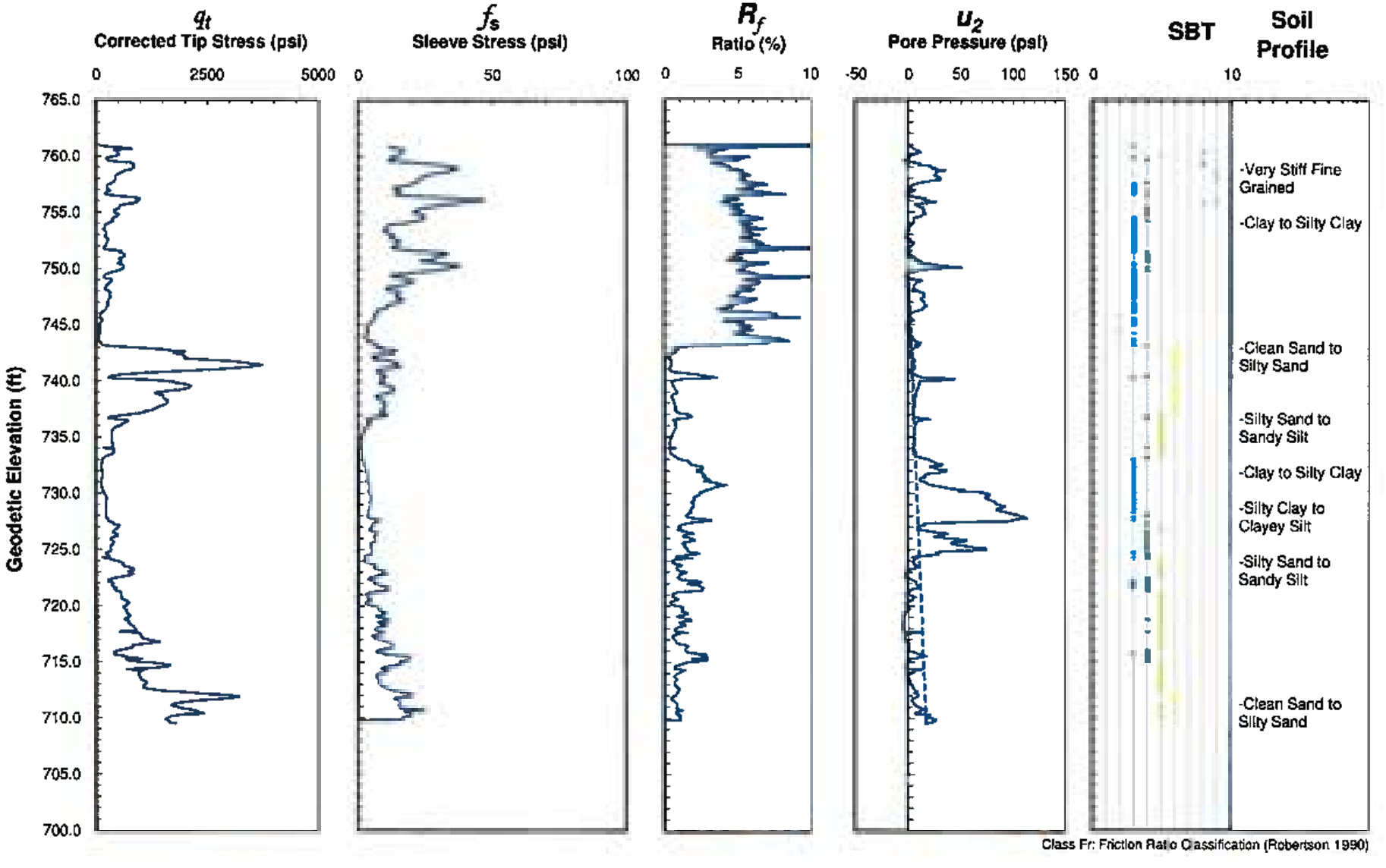
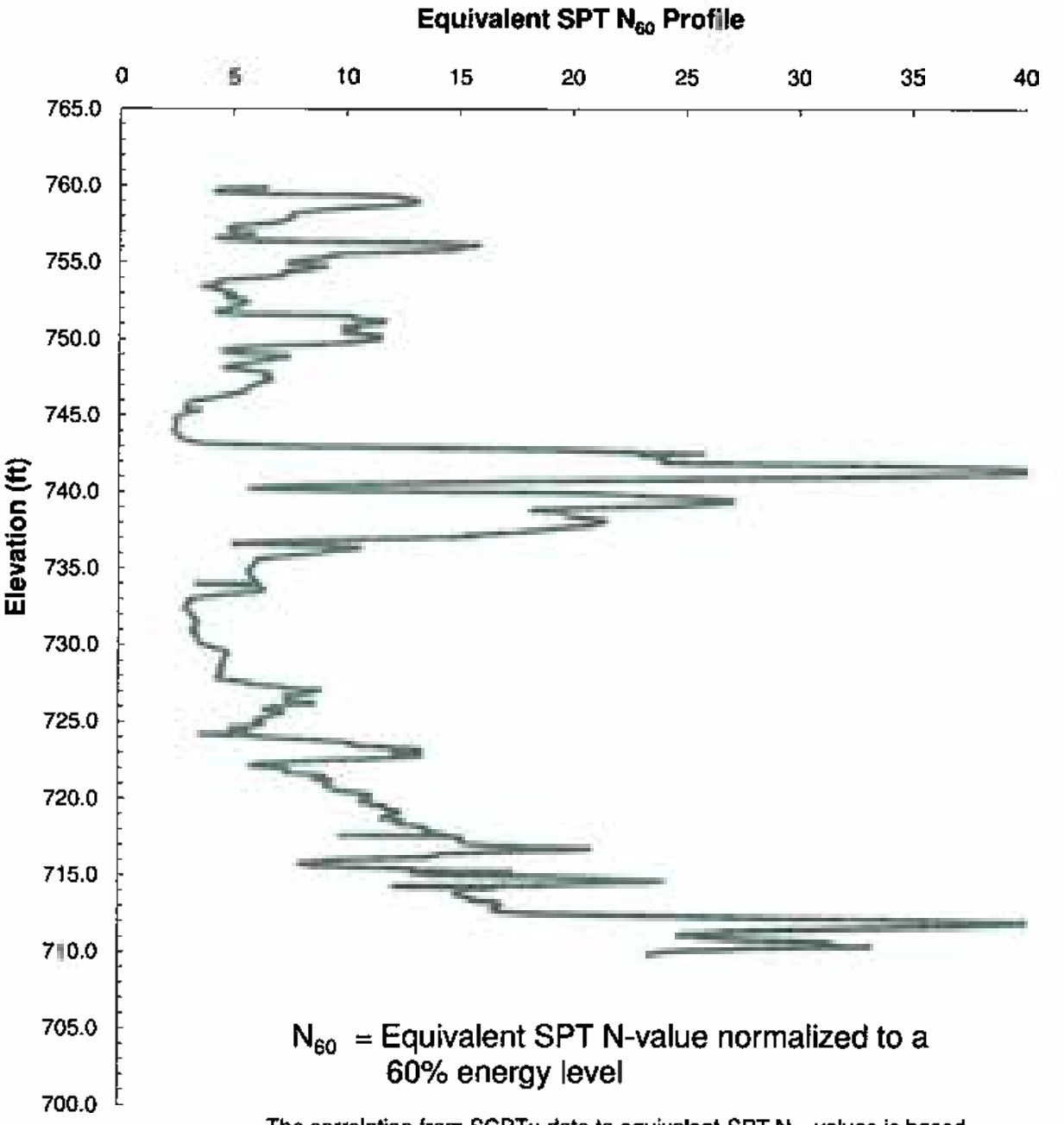
Stantec Consulting Inc.	Elevation: 765.00 ft SCPTu Start Elevation: 761.00 ft Groundwater Elevation: 748.70 ft	Test Date: May 20, 2009 Project No. 175569042	STN-15E
	Client: TVA Project: Kingston Ash Pond		



Class Fr: Friction Ratio Classification (Robertson 1990)

SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

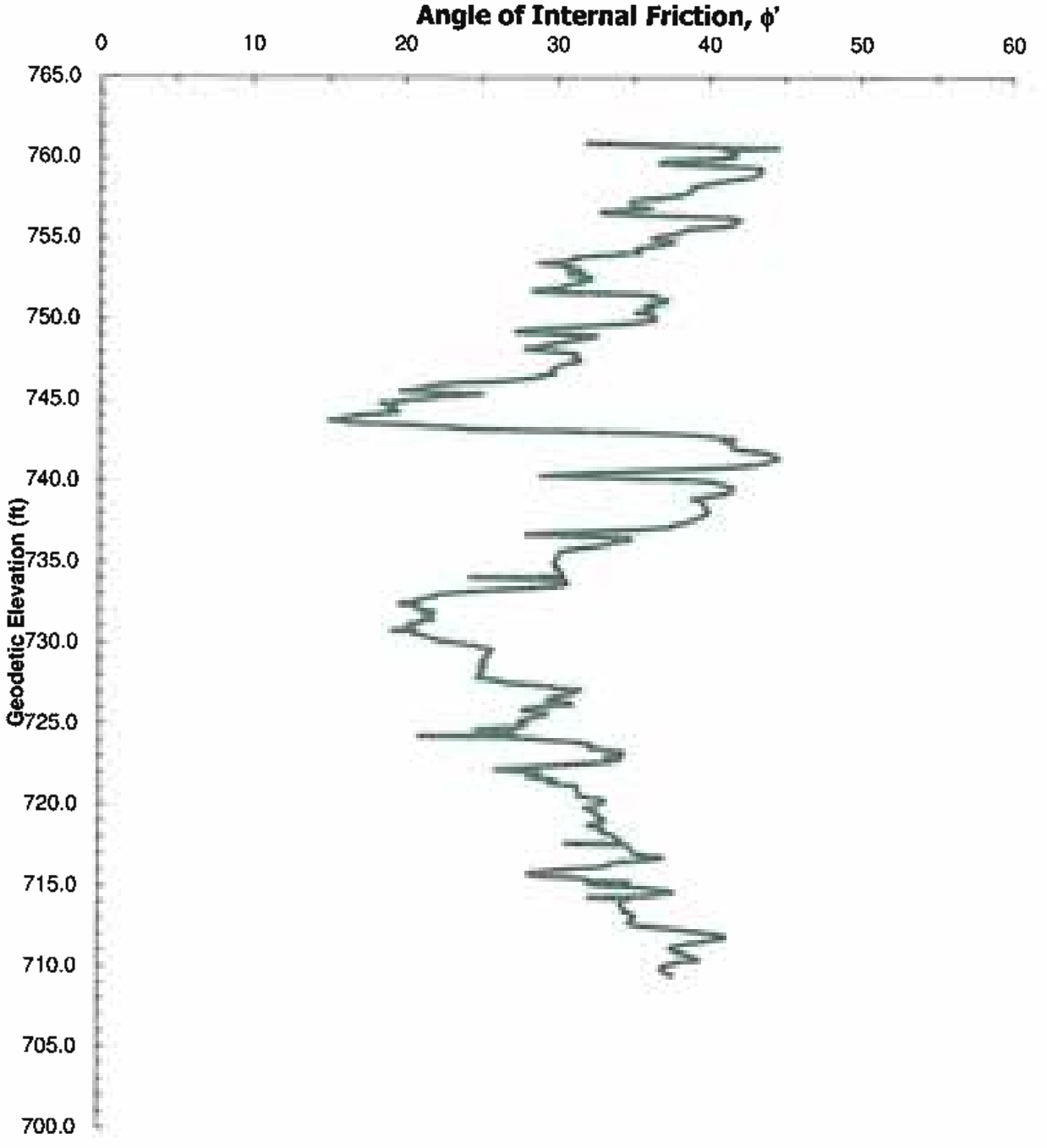
The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

Project No. 175569042

STN-15E

SCPTu RESULTS

Effective Angle of Internal Friction

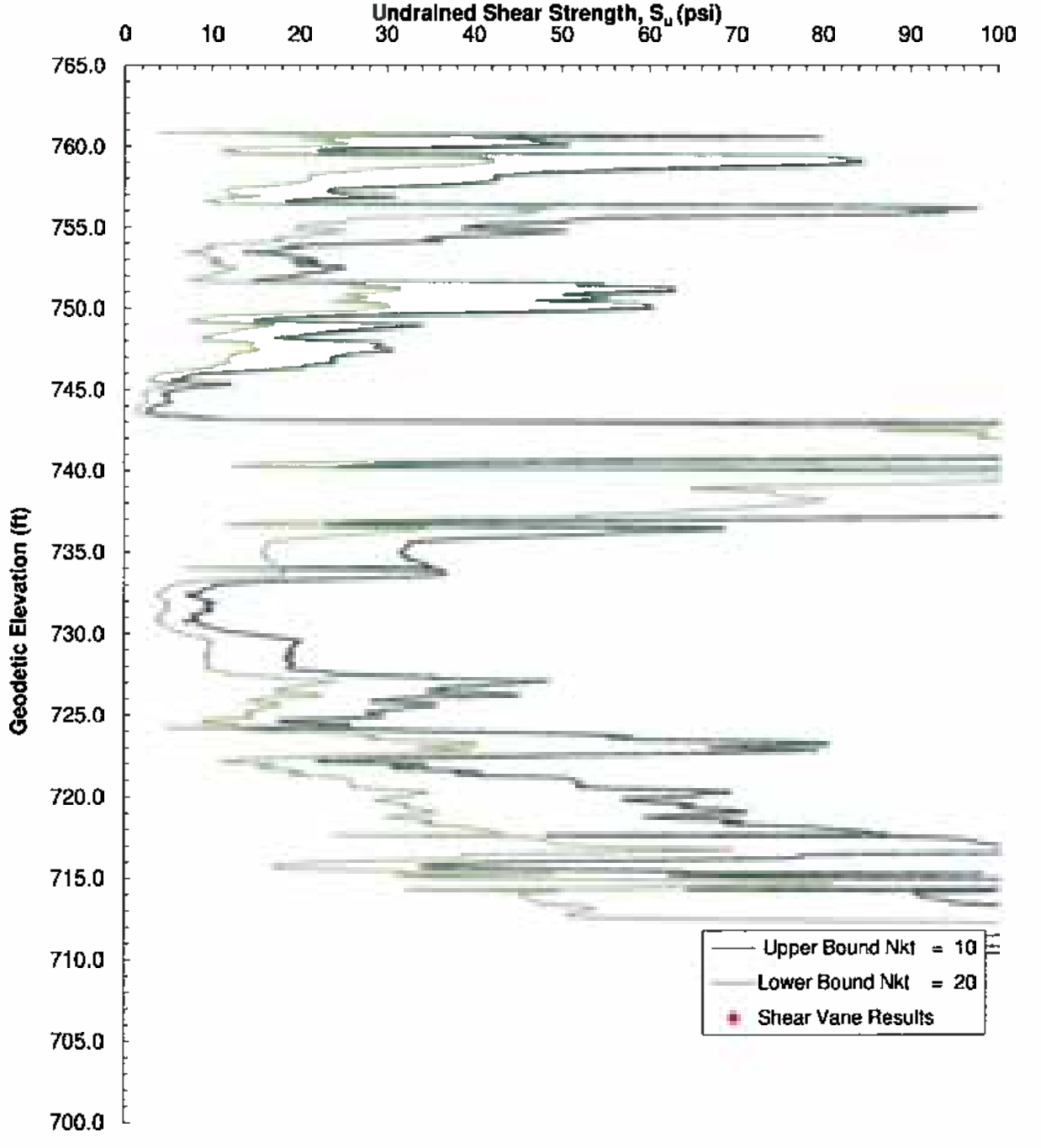


Project No. 175569042

STN-15E

SCPTu RESULTS

Undrained Shear Strength, S_u



Project No. 175569042

STN-15E

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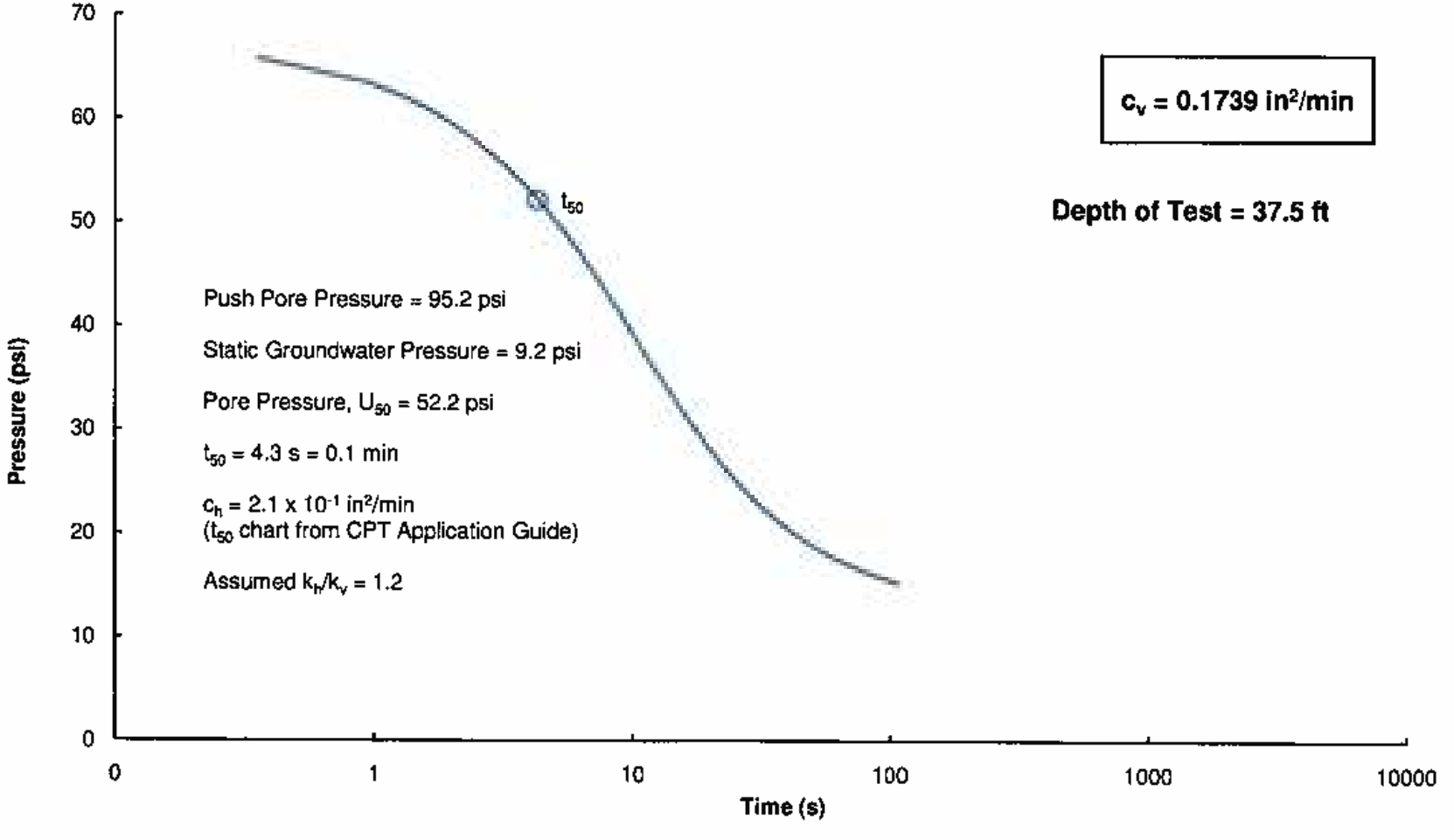
Stantec Consulting Inc.

SCPTu DISSIPATION RESULTS
Coefficient of Consolidation

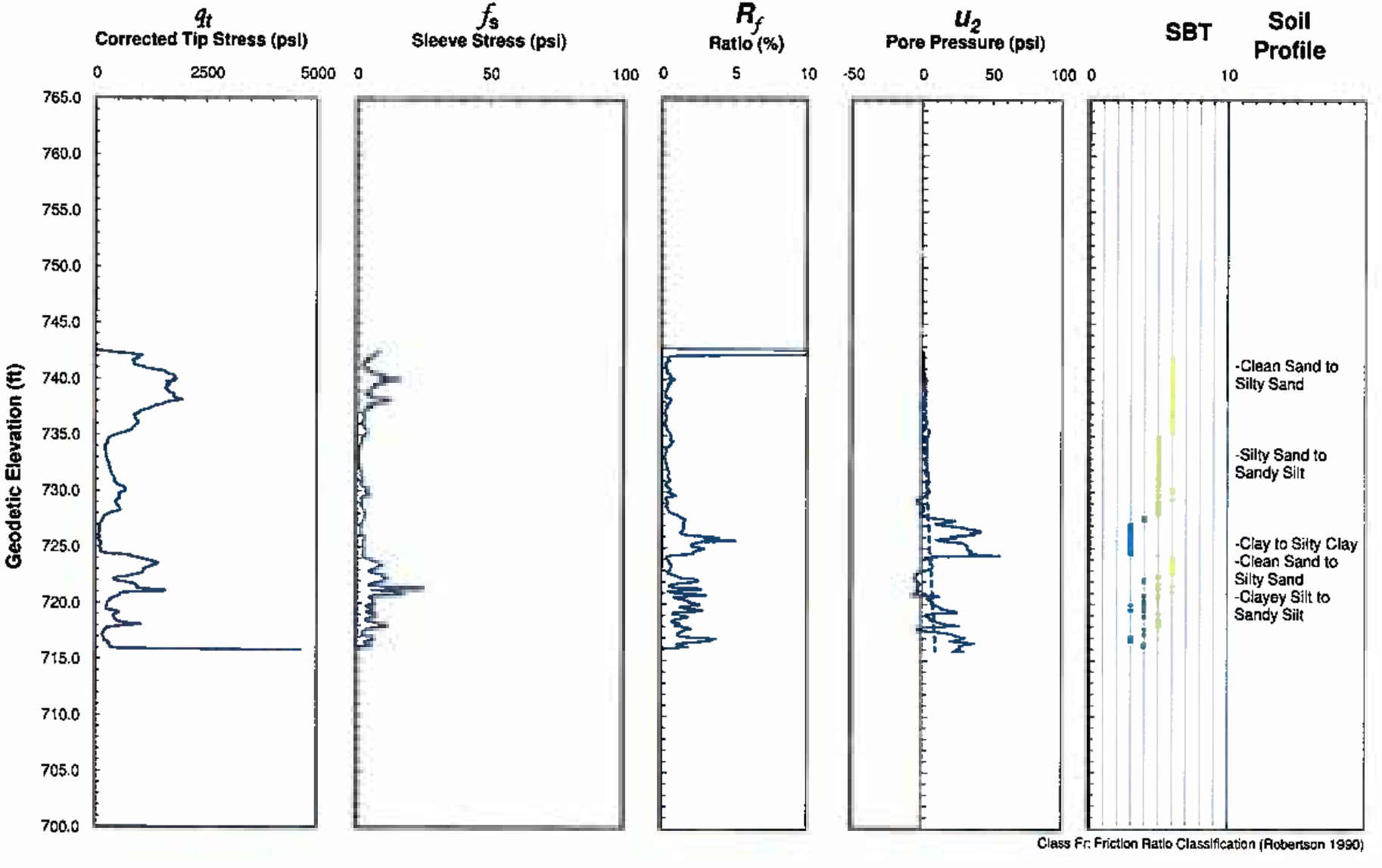


c_v = 0.1739 in²/min

Depth of Test = 37.5 ft

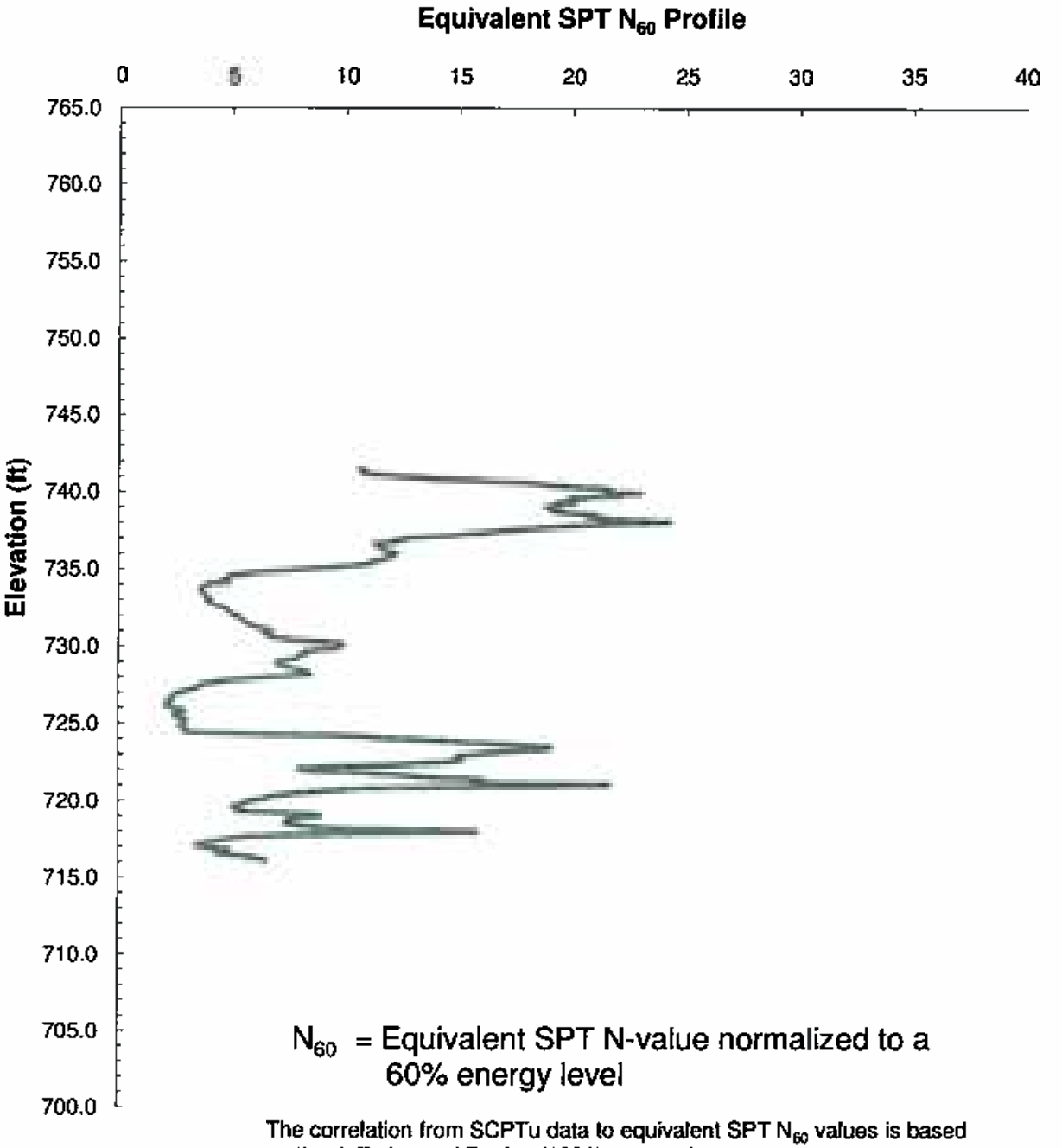
Project No. 175569042
STN-15E

Stantec Consulting Inc.	Elevation: 751.80 ft SCPTu Start Elevation: 742.80 ft Groundwater Elevation: 738.00 ft	Test Date: May 21, 2009 Project No. 175569042	STN-18A
	Client: TVA Project: Kingston Ash Pond		



SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

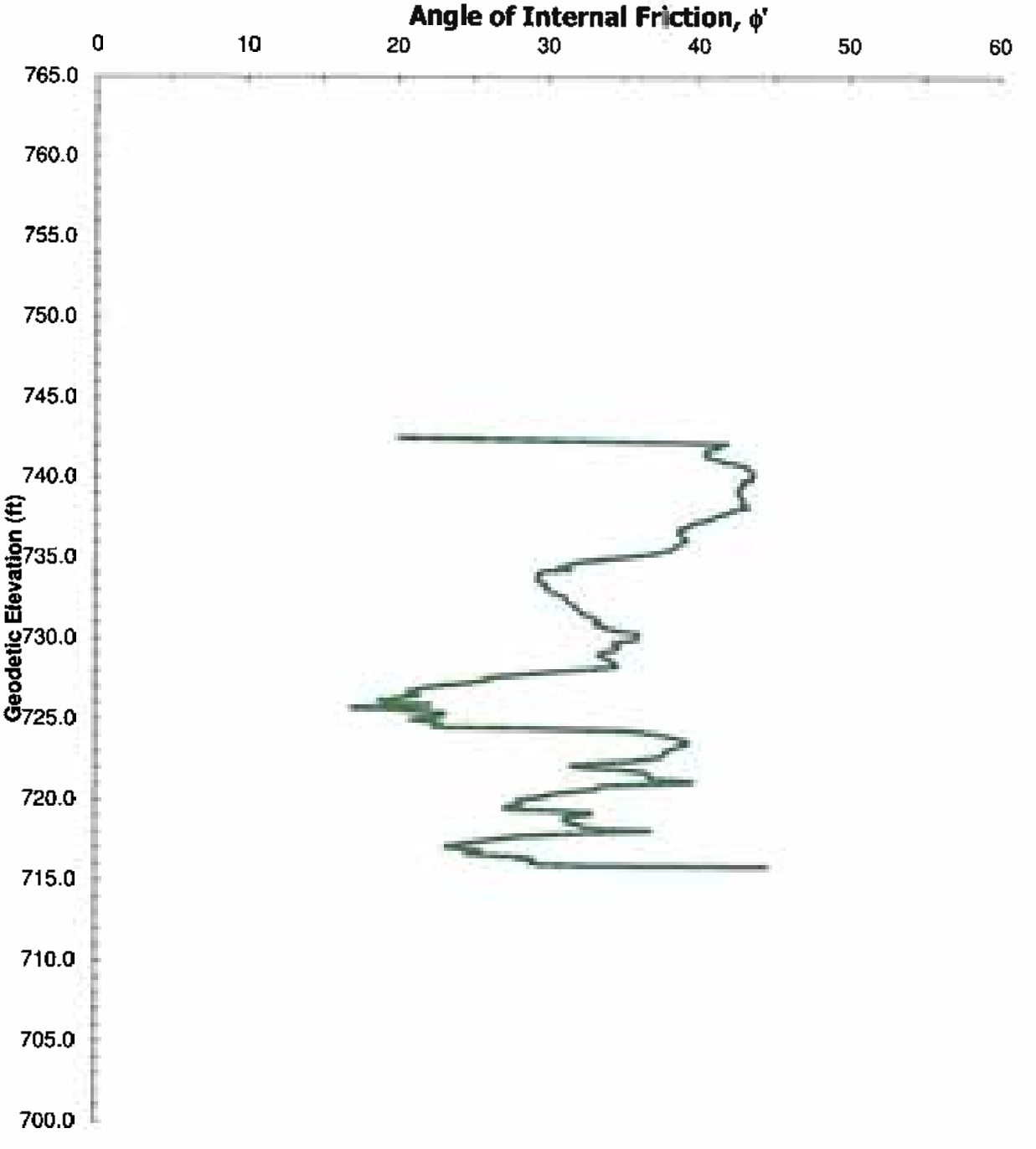
Project No. 175569042

STN-18A

Stantec

SCPTu RESULTS

Effective Angle of Internal Friction



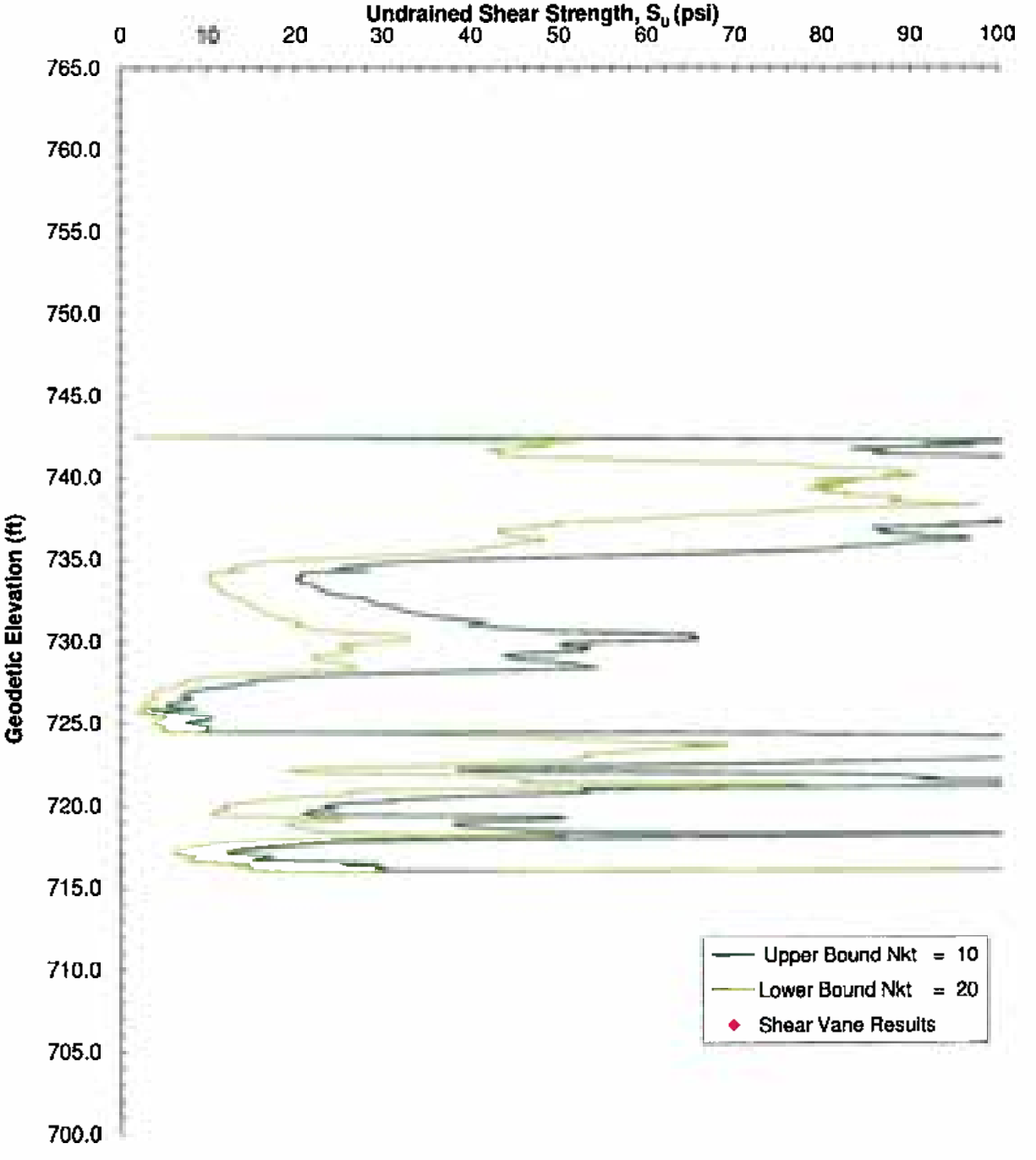
Project No. 175569042

STN-18A

Stantec

SCPTu RESULTS

Undrained Shear Strength, S_u



Project No. 175569042

STN-18A

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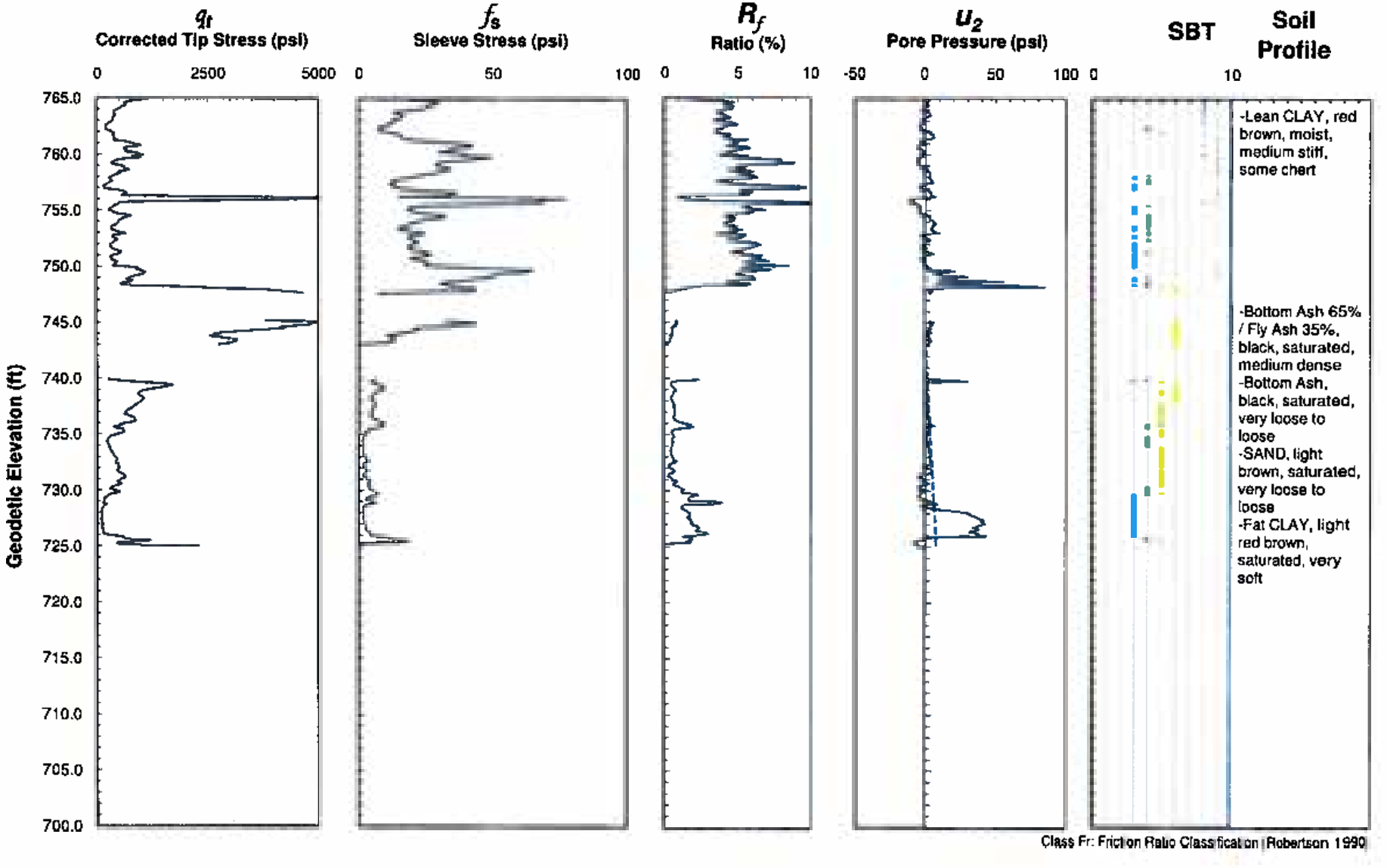
Stantec Consulting Inc.

Elevation:	765.60 ft	Test Date: May 7, 2009	STN-19A
SCPTu Start Elevation:	765.60 ft	Project No. 175569042	
Groundwater Elevation:	742.60 ft		

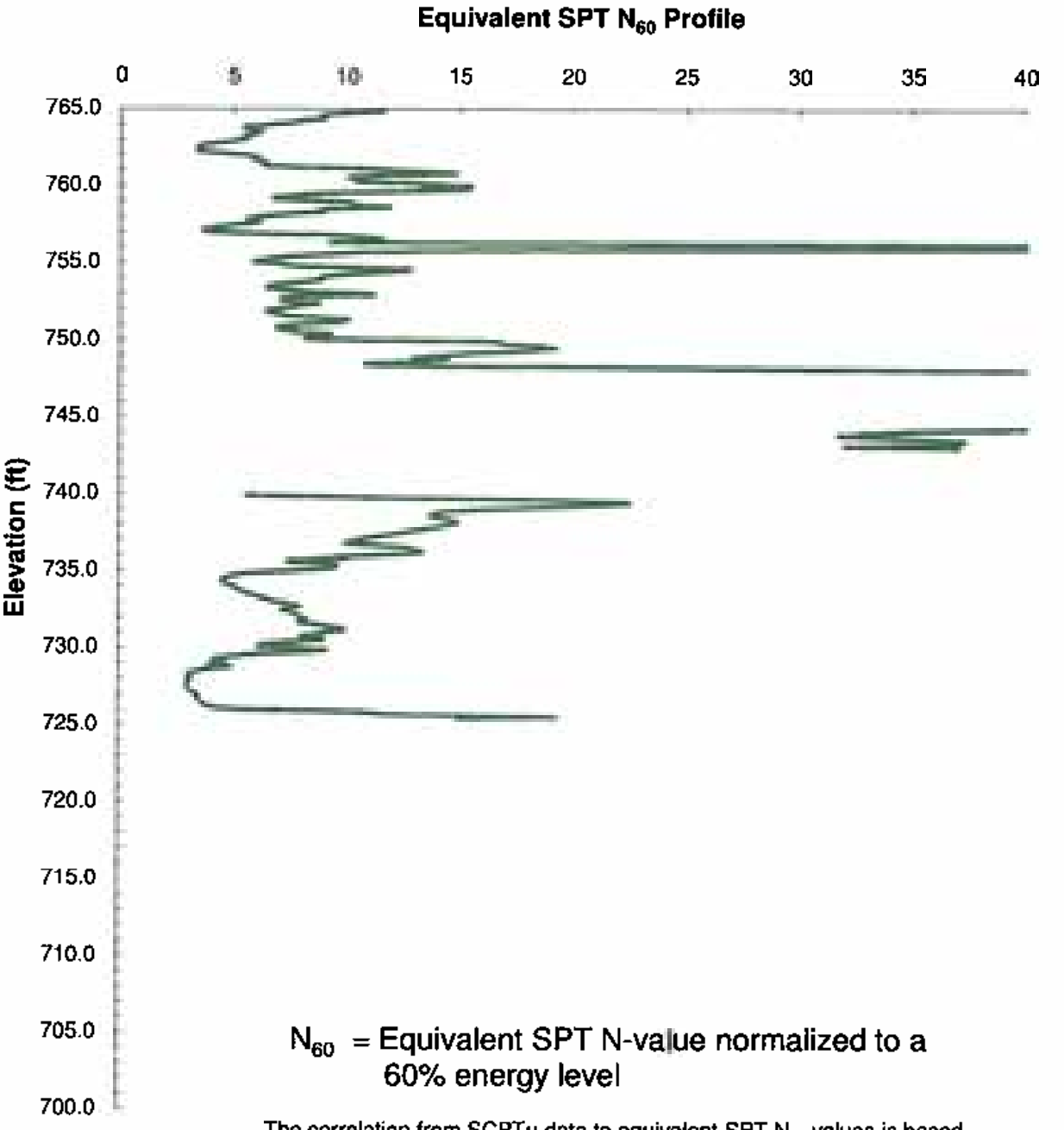
Client: TVA

Project: Kingston Ash Pond



SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

Project No. 175569042

STN-19A

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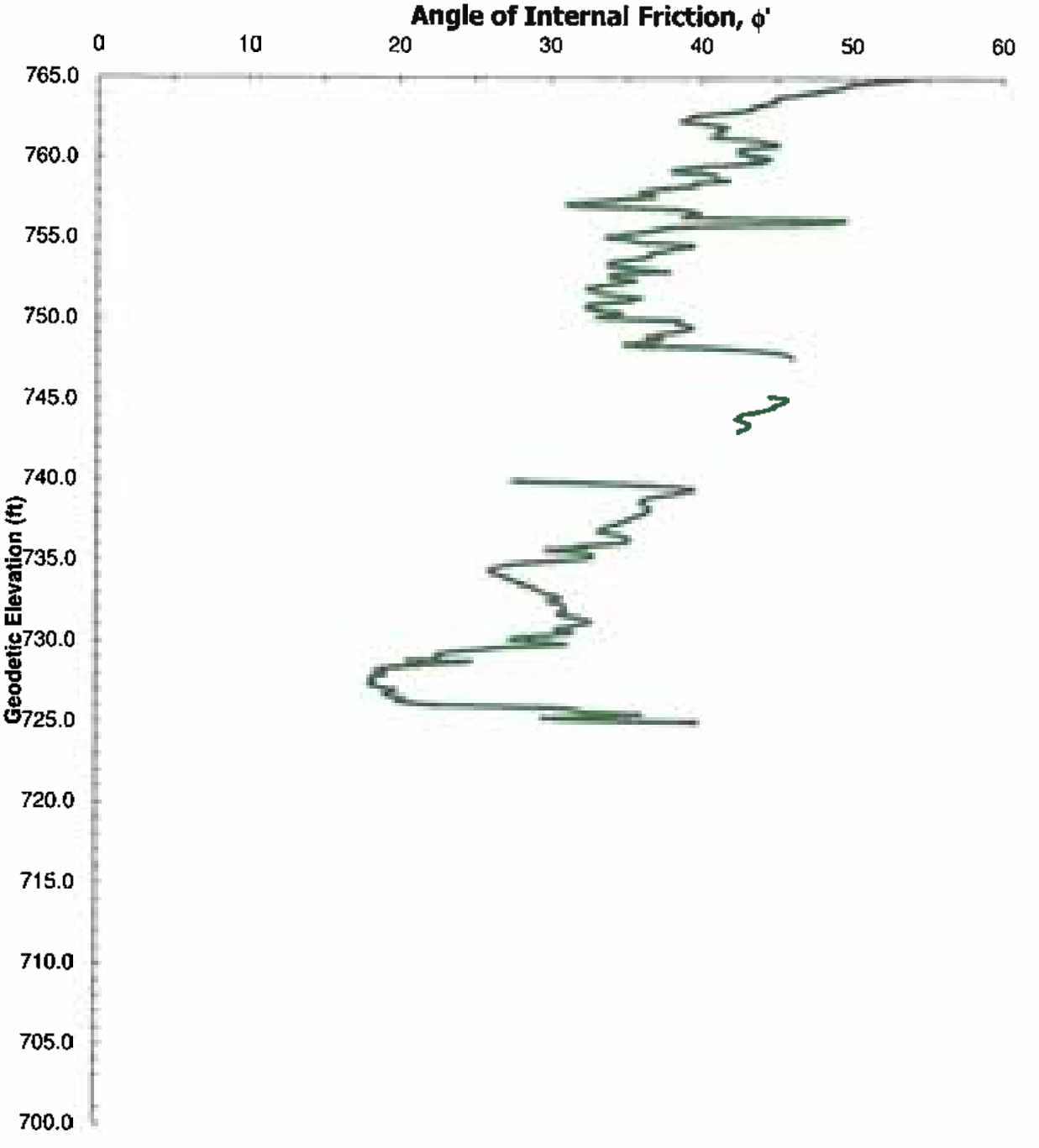
Stantec

SCPTu RESULTS

Effective Angle of Internal Friction

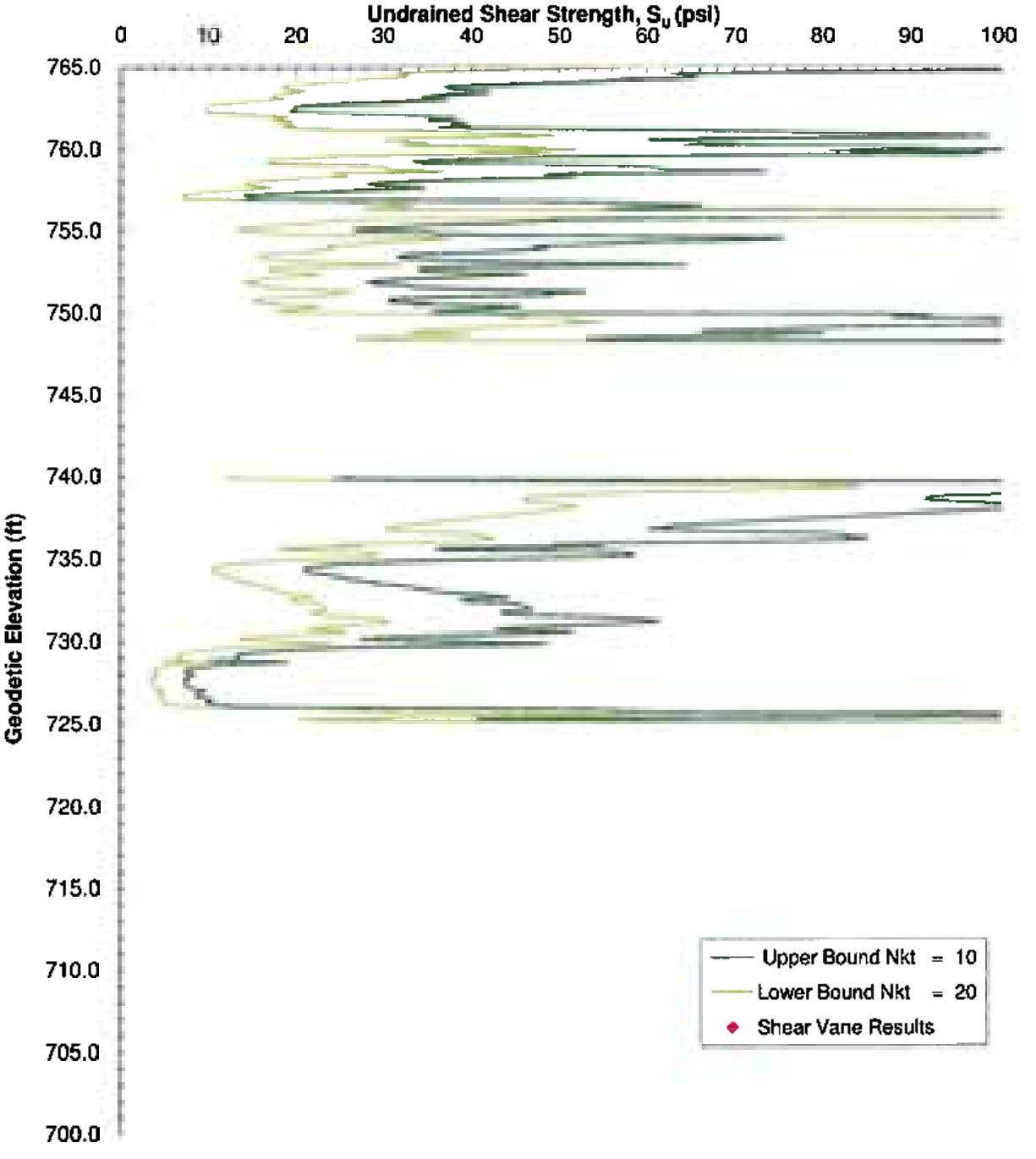


Project No. 175569042

STN-19A

SCPTu RESULTS

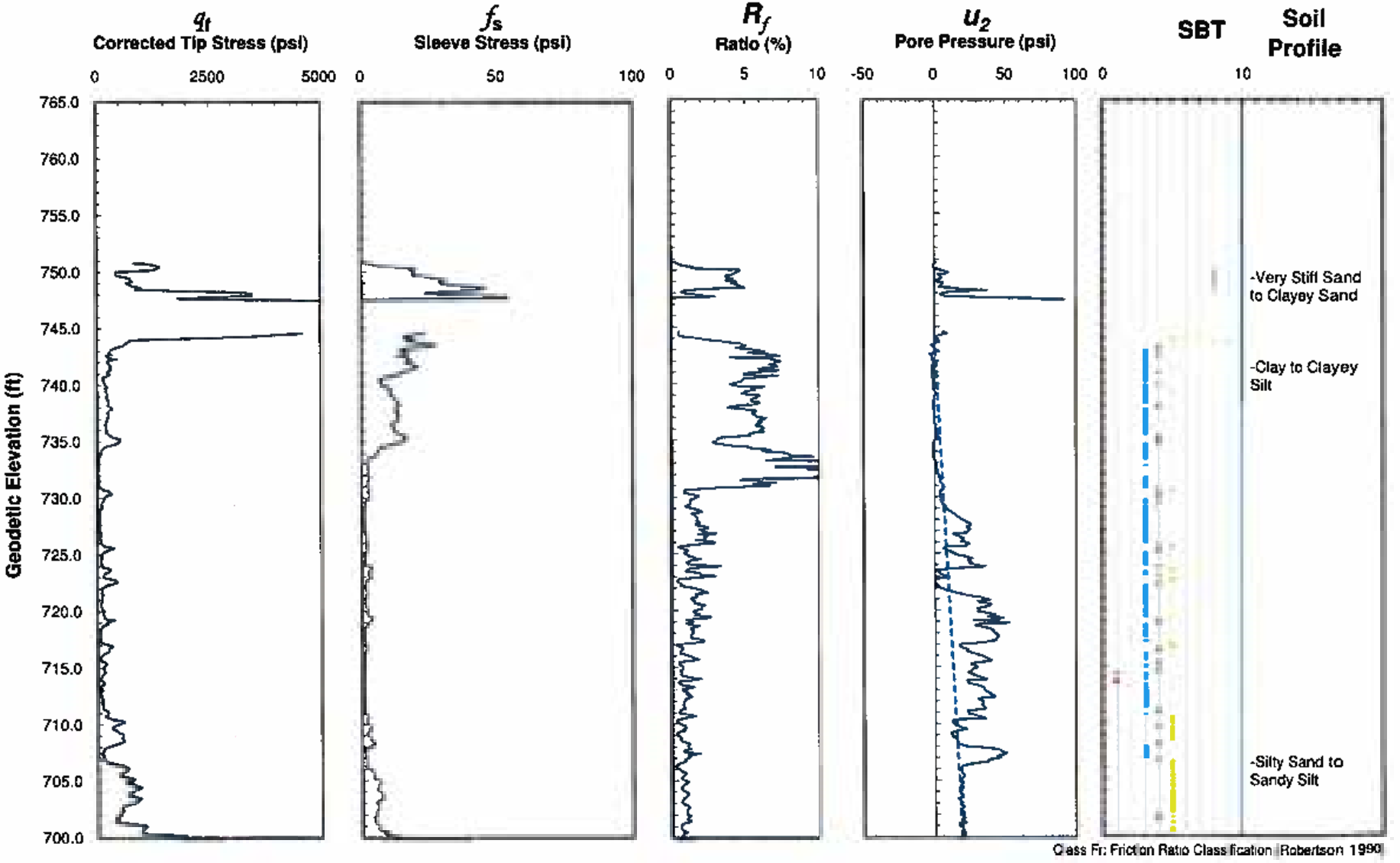
Undrained Shear Strength, S_u



Project No. 175569042

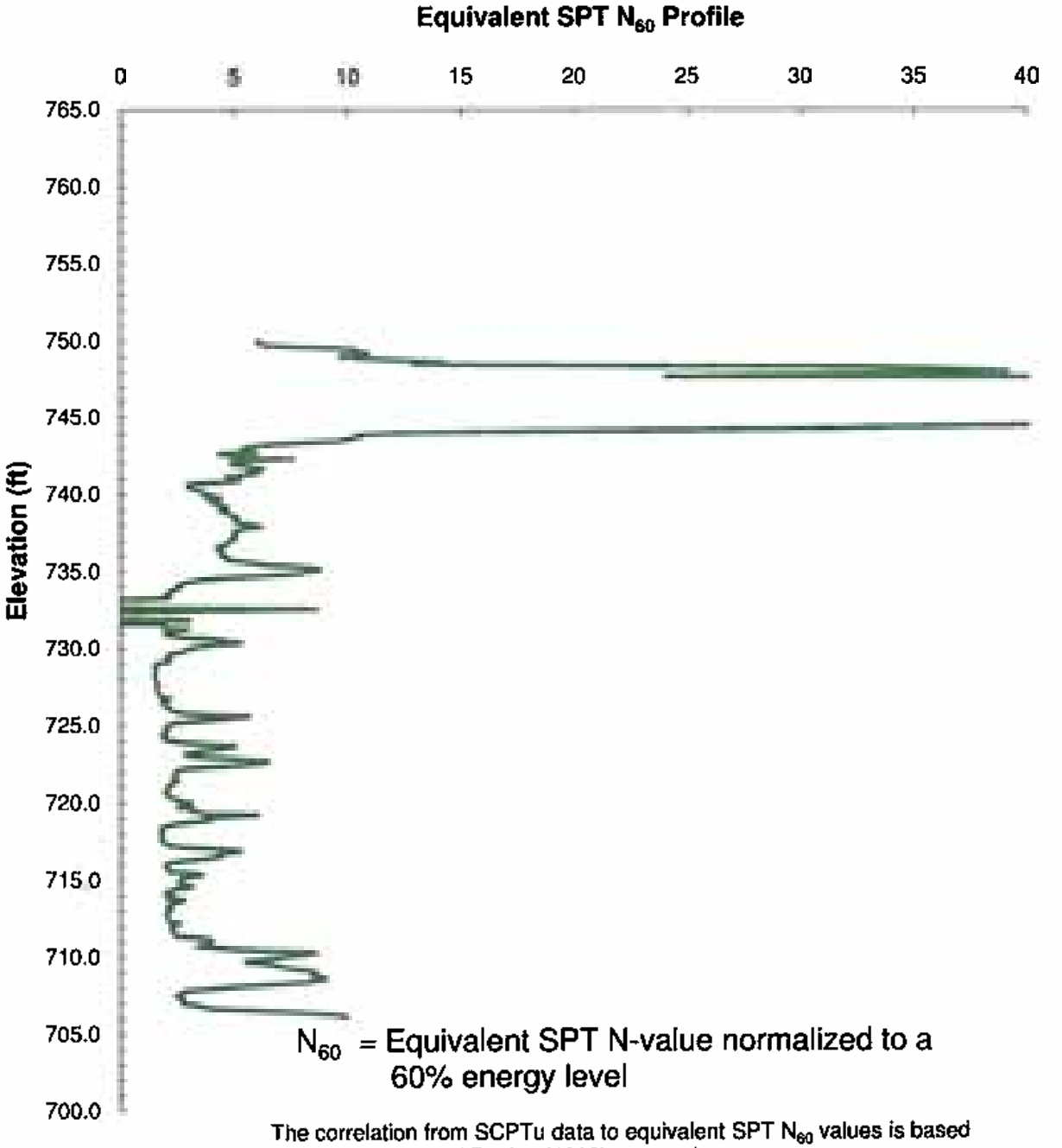
STN-19A

Stantec Consulting Inc.	Elevation: 751.00 ft SCPTu Start Elevation: 751.00 ft Groundwater Elevation: 744.00 ft	Test Date: May 21, 2009 Project No. 175569042	STN-26B
	Client: TVA Project: Kingston Ash Pond		



SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

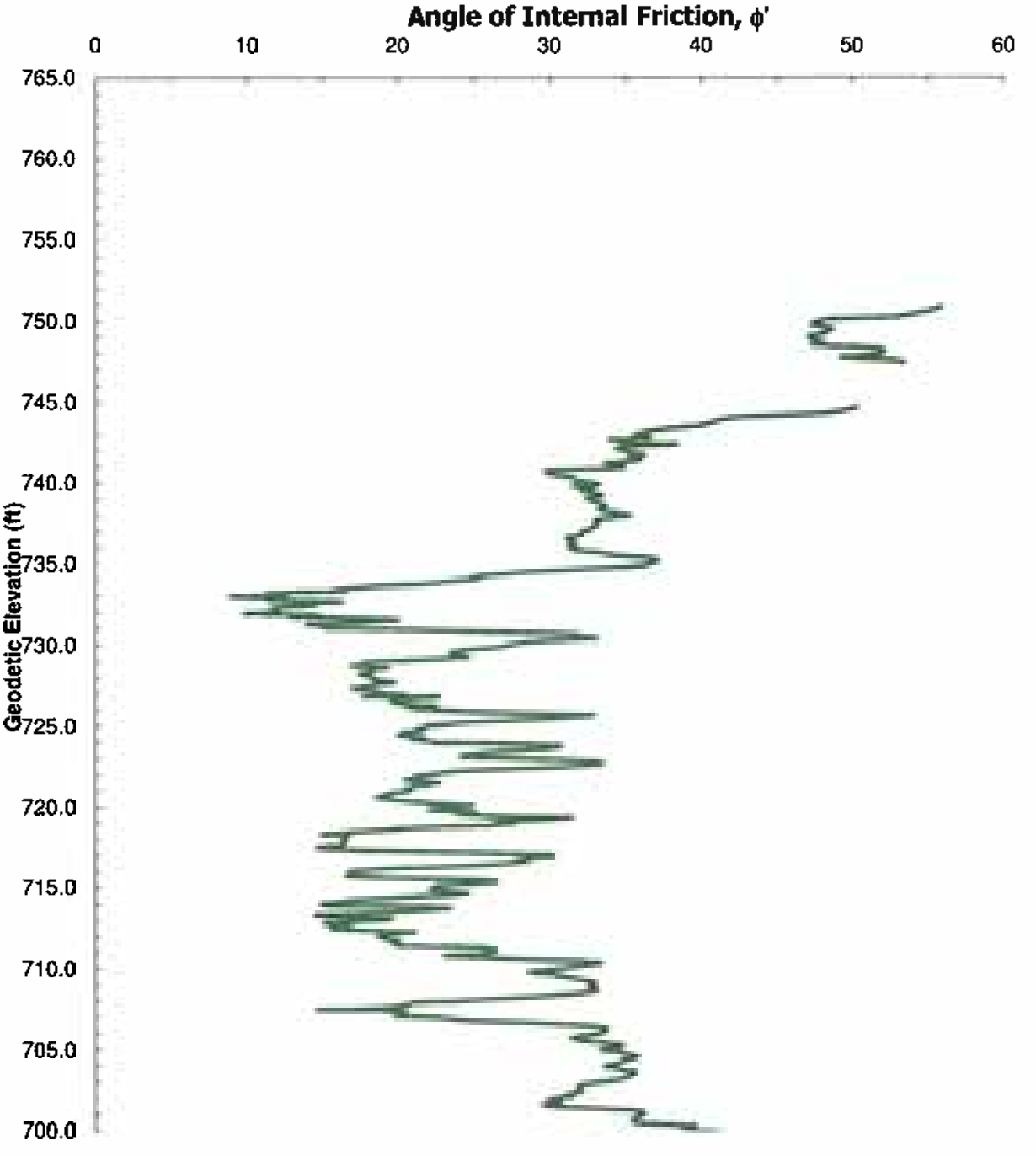
The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

Project No. 175569042

STN-26B

SCPTu RESULTS

Effective Angle of Internal Friction



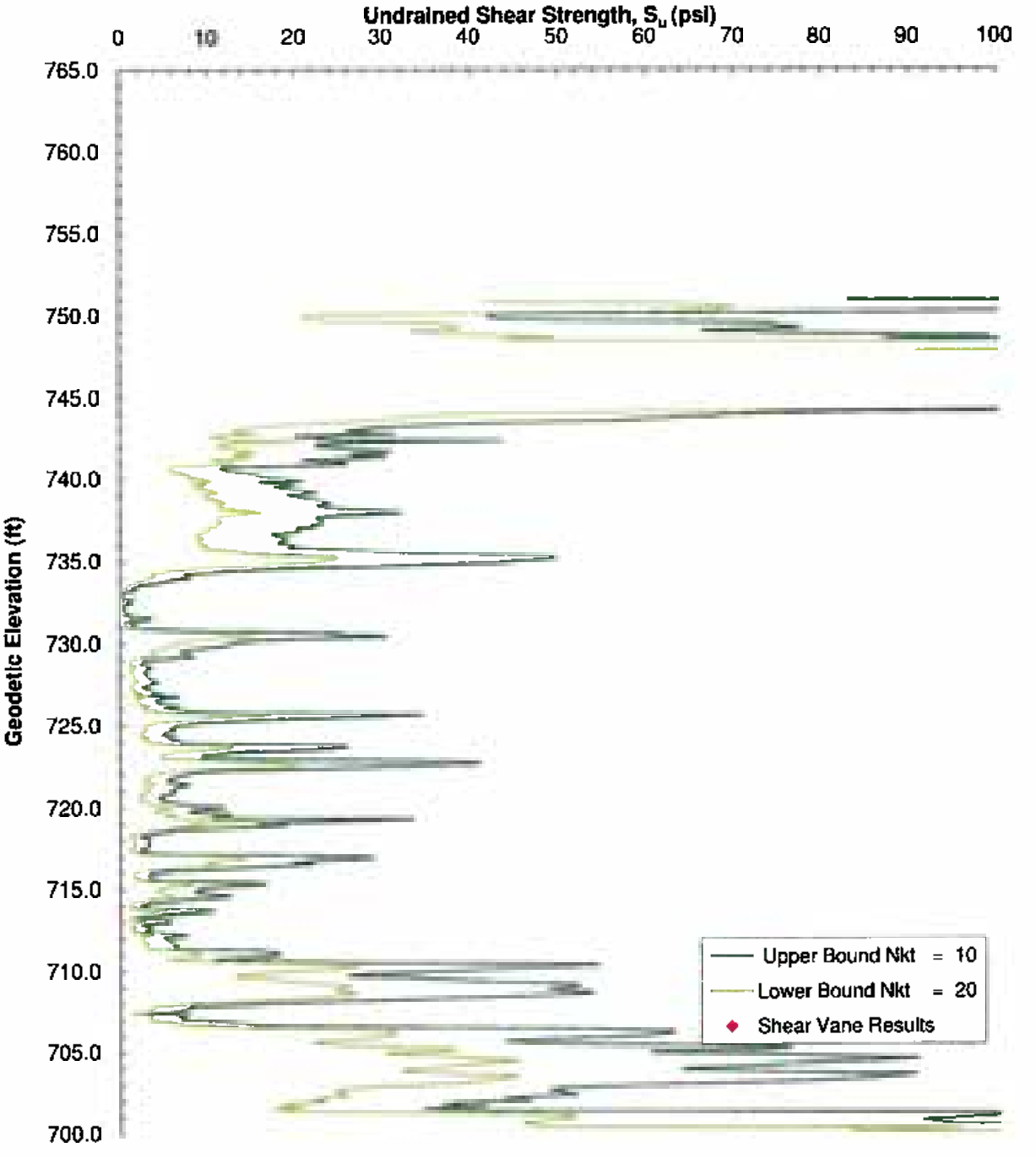
Project No. 175569042

STN-26B

C:\ashpond\week 2009-05-22\CPT26.xlsm

SCPTu RESULTS

Undrained Shear Strength, S_u



Project No. 175569042

STN-26B

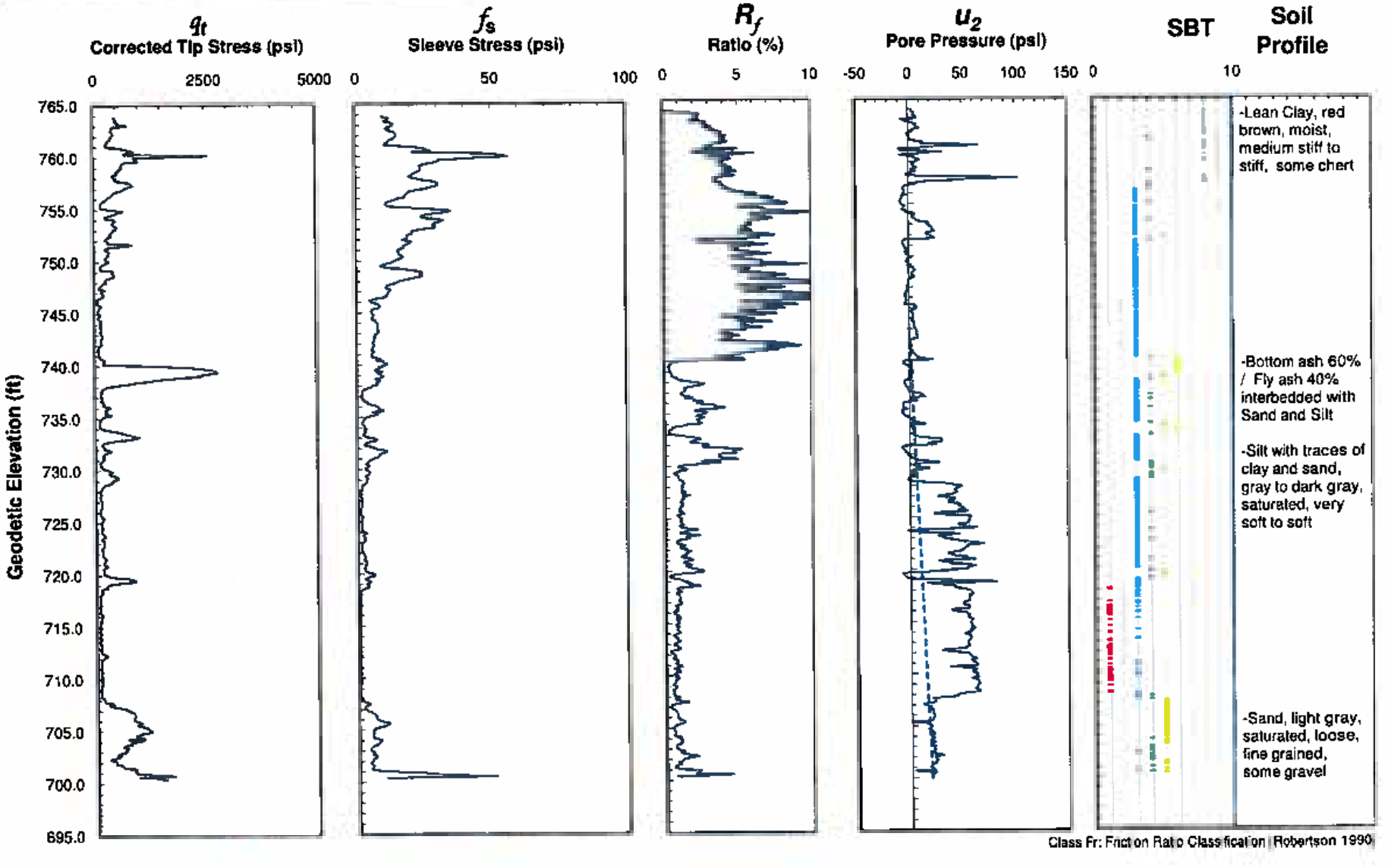
C:\ashpond\week 2009-05-22\CPT26.xlsm

Stantec Consulting Inc.

Elevation:	765.00 ft	Test Date: May 4, 2009	STN-27C
SCPTu Start Elevation:	764.00 ft	Project No. 175569042	
Groundwater Elevation:	743.10 ft		

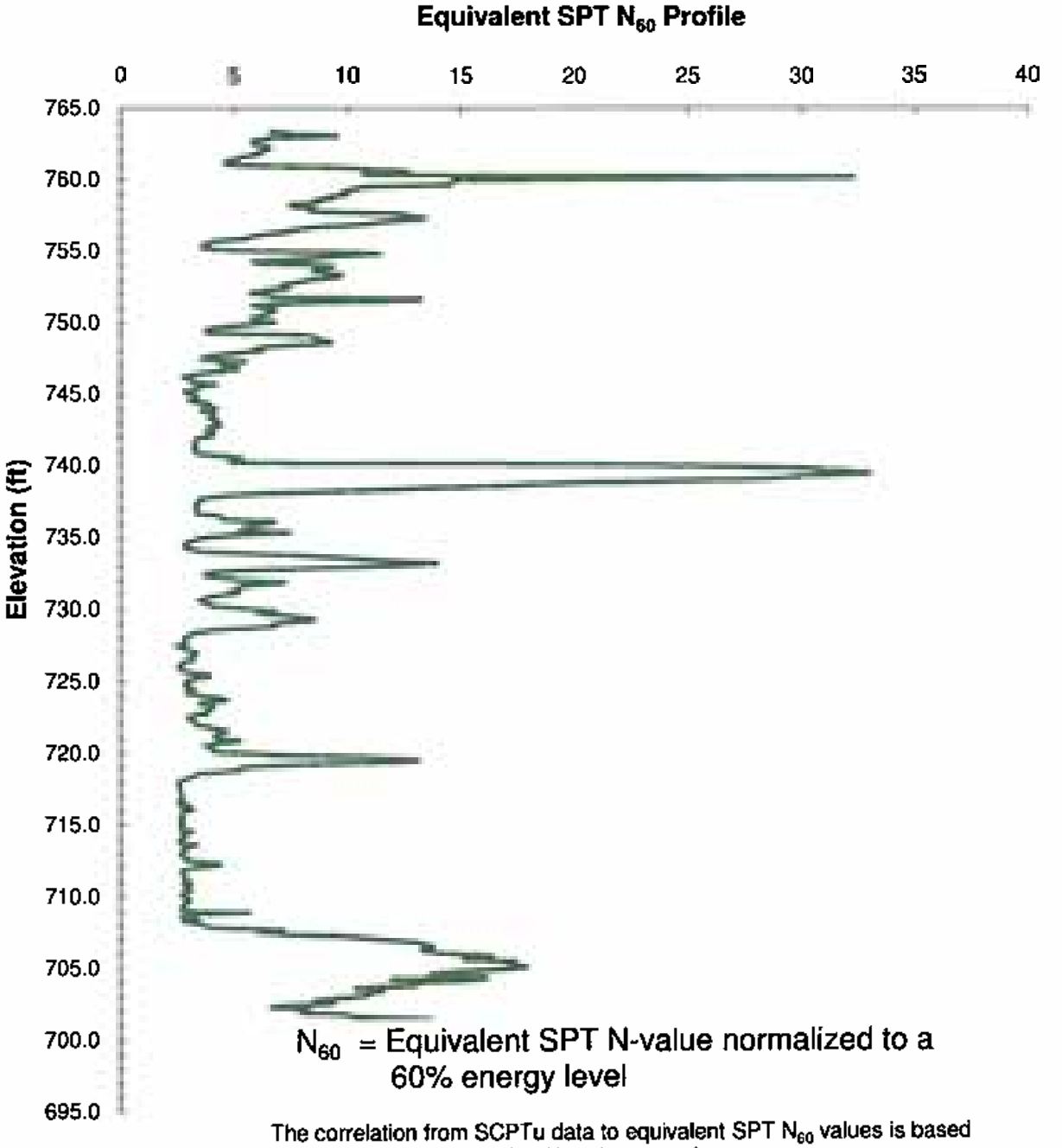
Client: TVA

Project: Kingston Ash Pond



SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

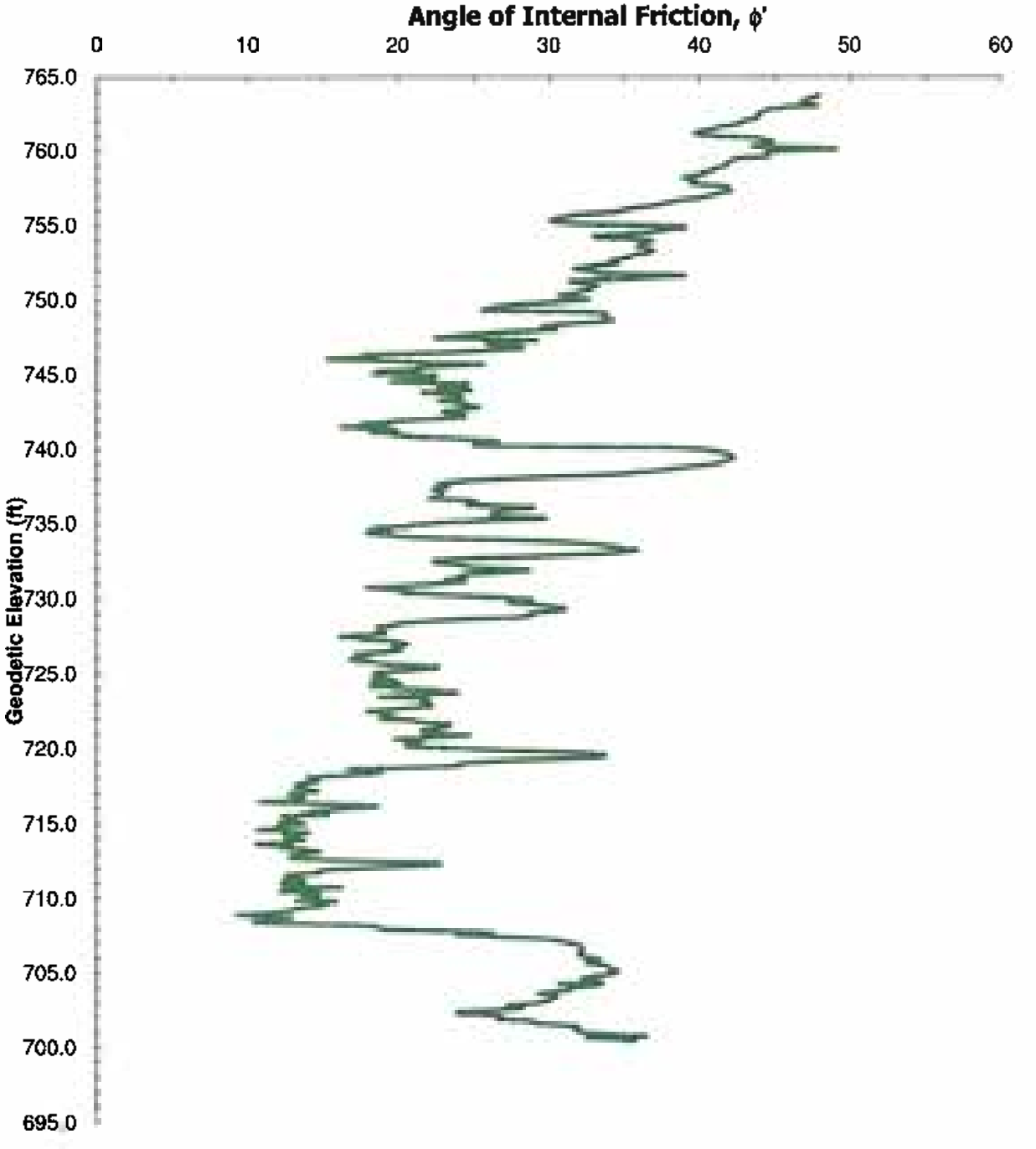
Project No. 175569042

STN-27C

Stantec

SCPTu RESULTS

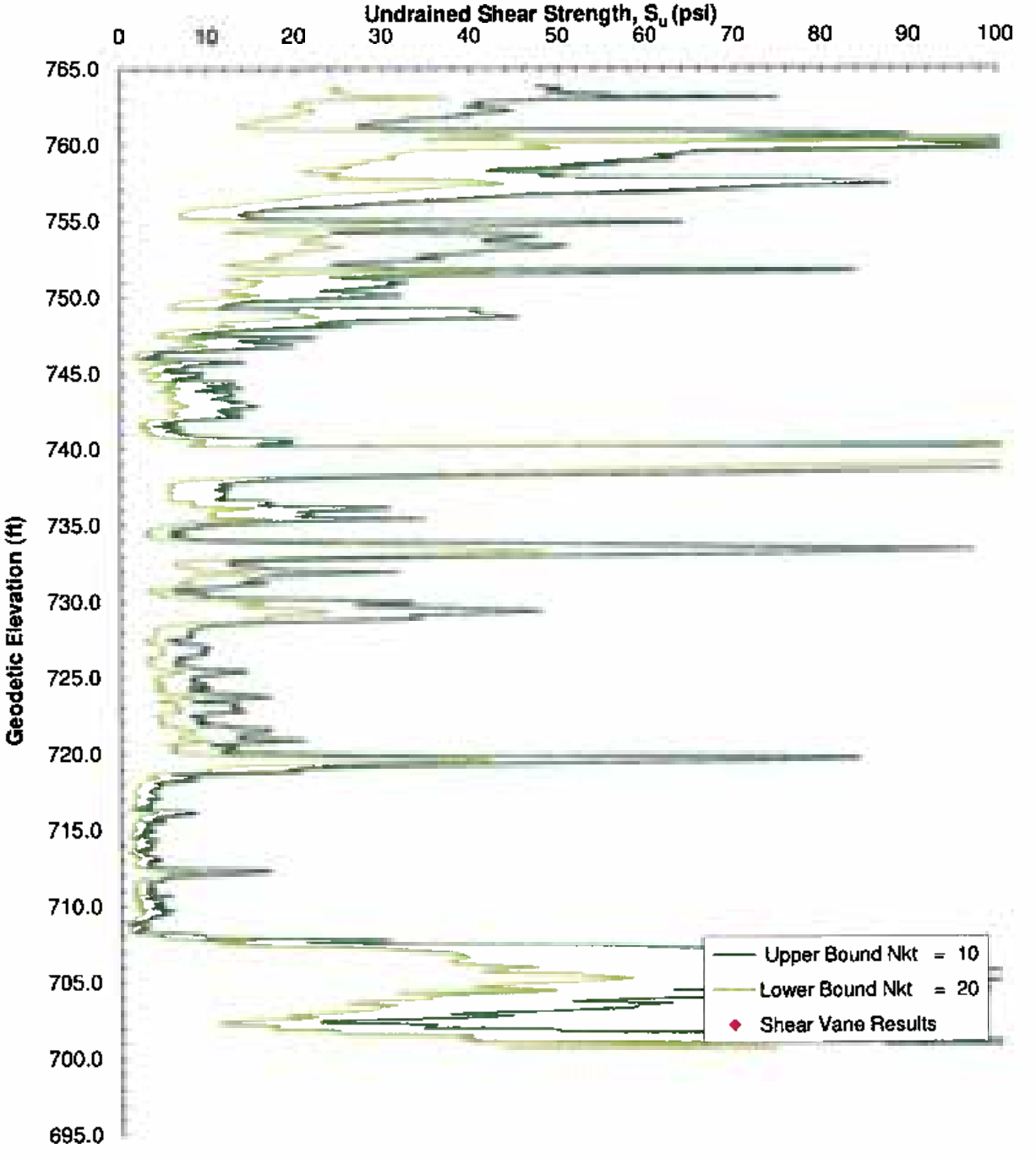
Effective Angle of Internal Friction



Project No. 175569042

STN-27C

C:\ashpond\CPT27.xlsm



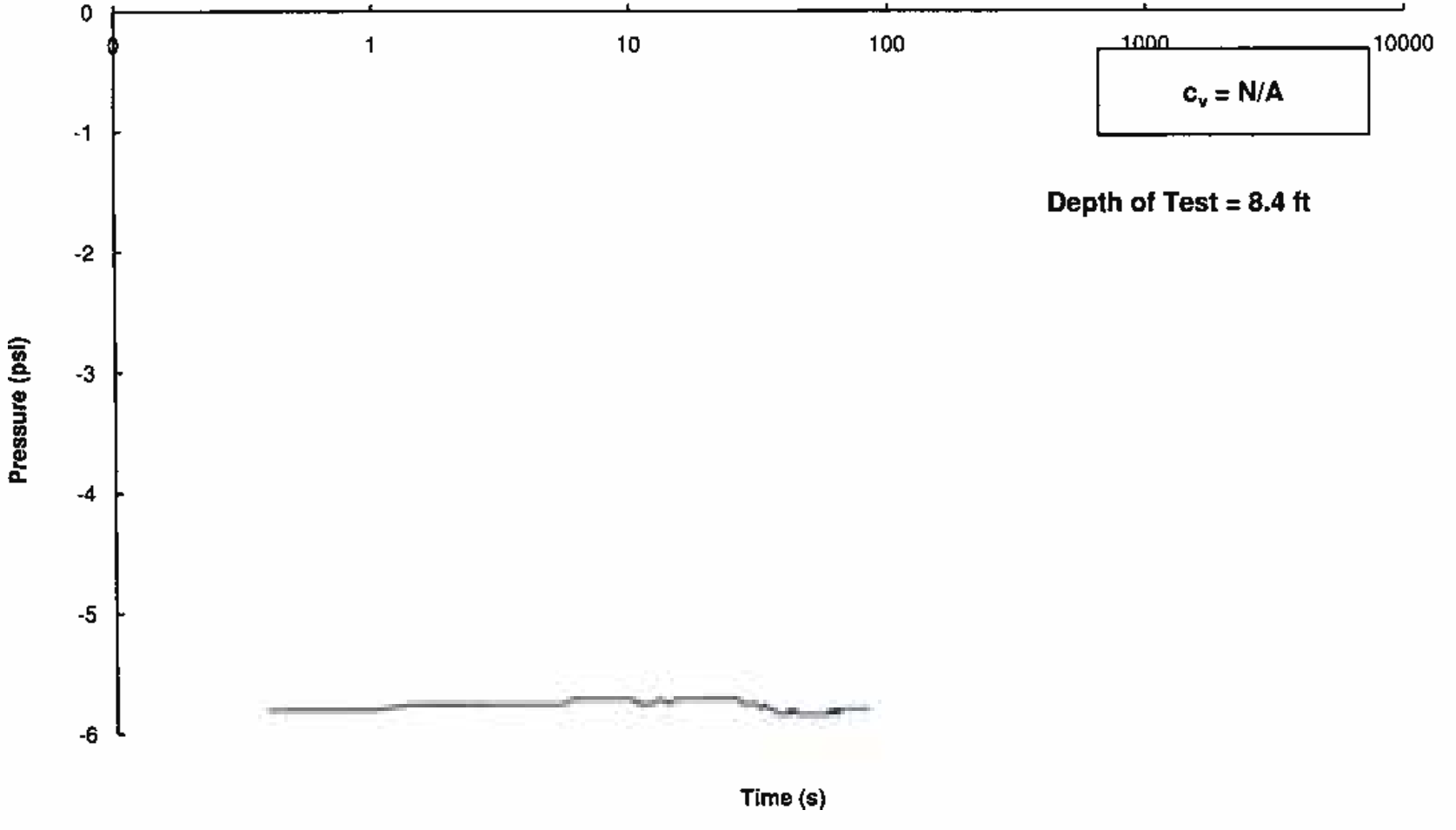
Project No. 175569042

STN-27C

C:\ashpond\CPT27.xlsm

Stantec Consulting Inc.

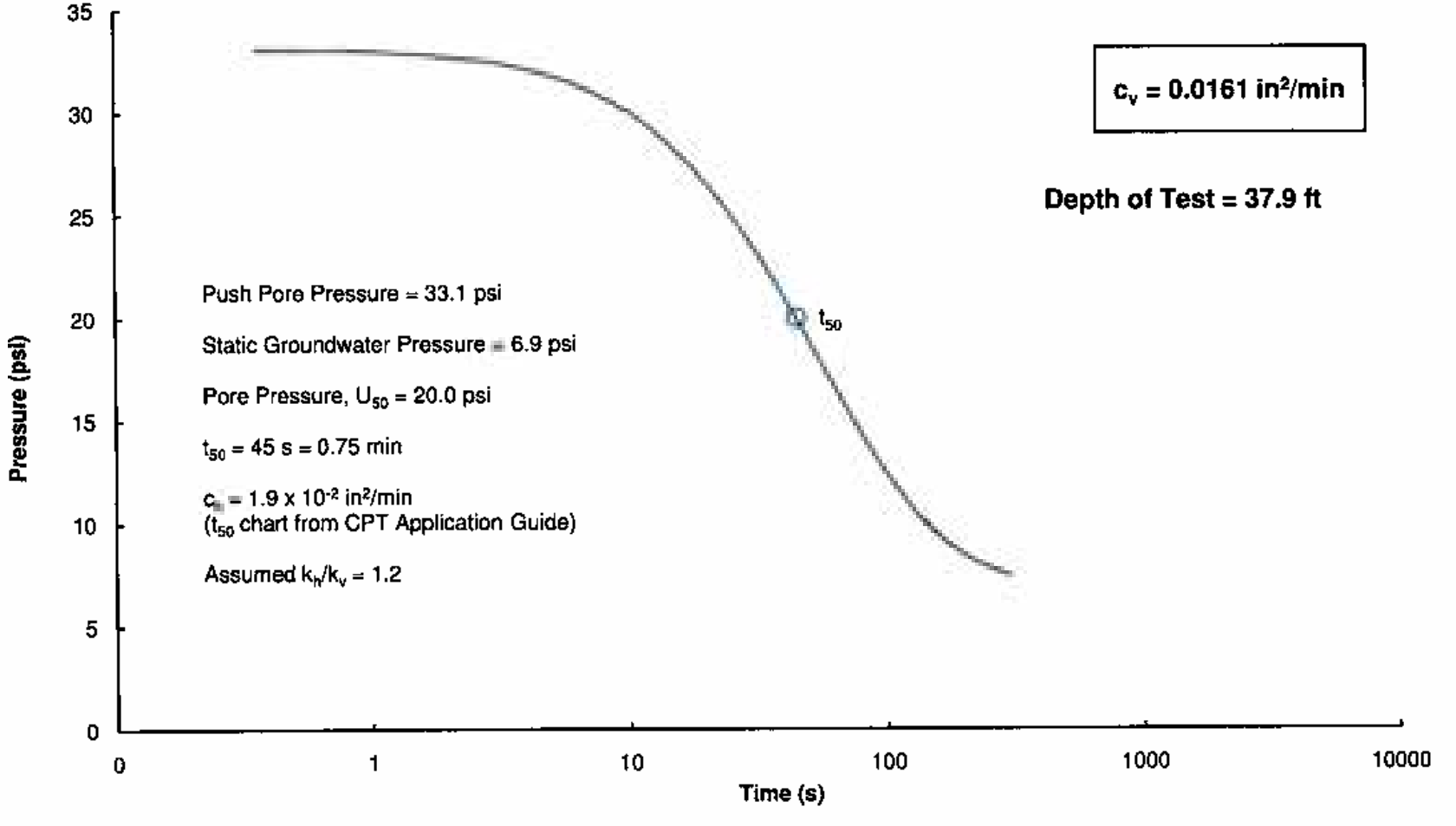
SCPTu DISSIPATION RESULTS
Coefficient of Consolidation



Project No. 175569042
STN-27C

Stantec Consulting Inc.

SCPTu DISSIPATION RESULTS
Coefficient of Consolidation



c_v = 0.0161 in²/min

Depth of Test = 37.9 ft

Project No. 175569042
STN-27C

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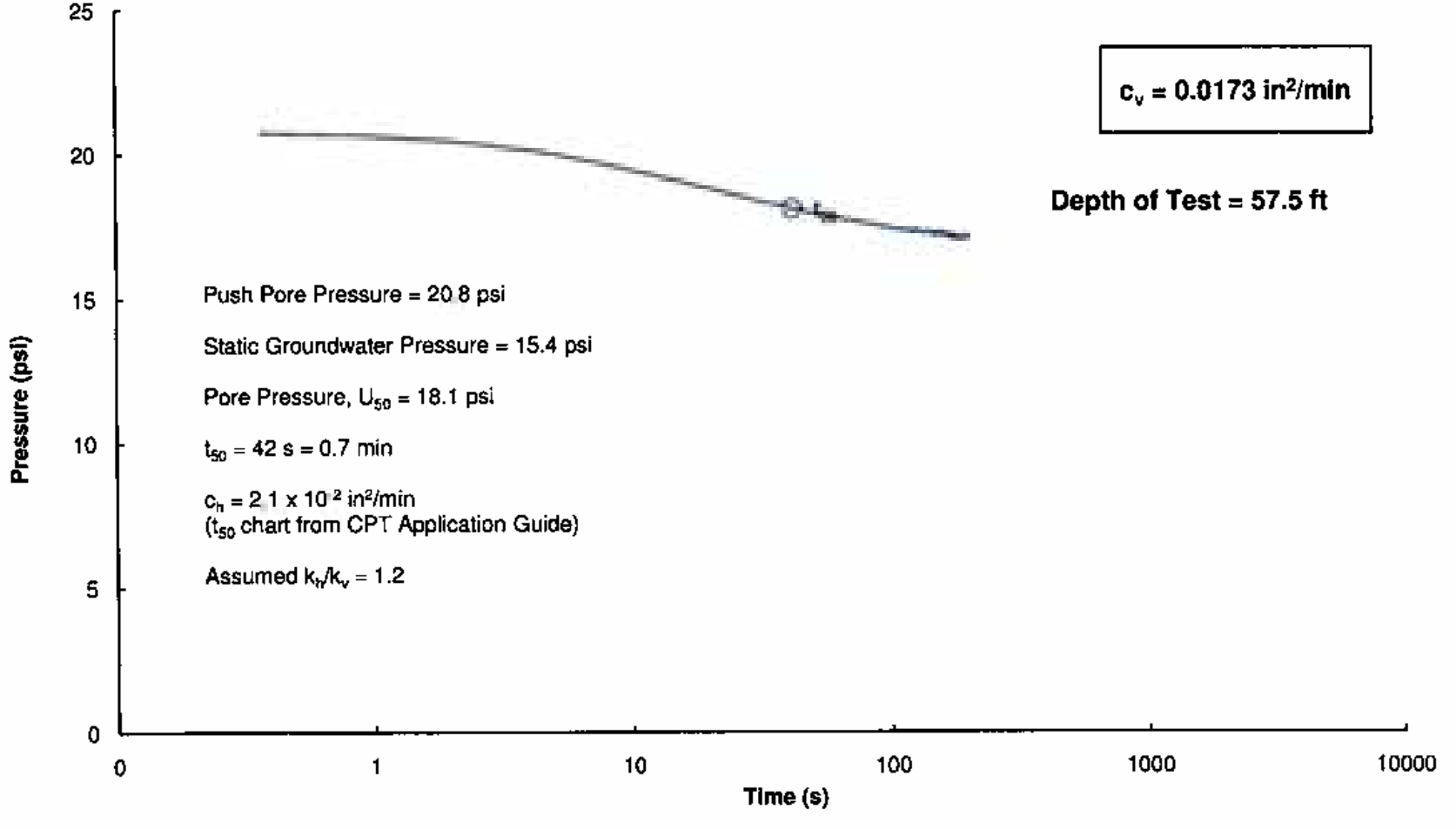
Stantec Consulting Inc.

SCPTu DISSIPATION RESULTS
Coefficient of Consolidation



c_v = 0.0173 in²/min

Depth of Test = 57.5 ft

Push Pore Pressure = 20.8 psi

Static Groundwater Pressure = 15.4 psi

Pore Pressure, U_{50} = 18.1 psi

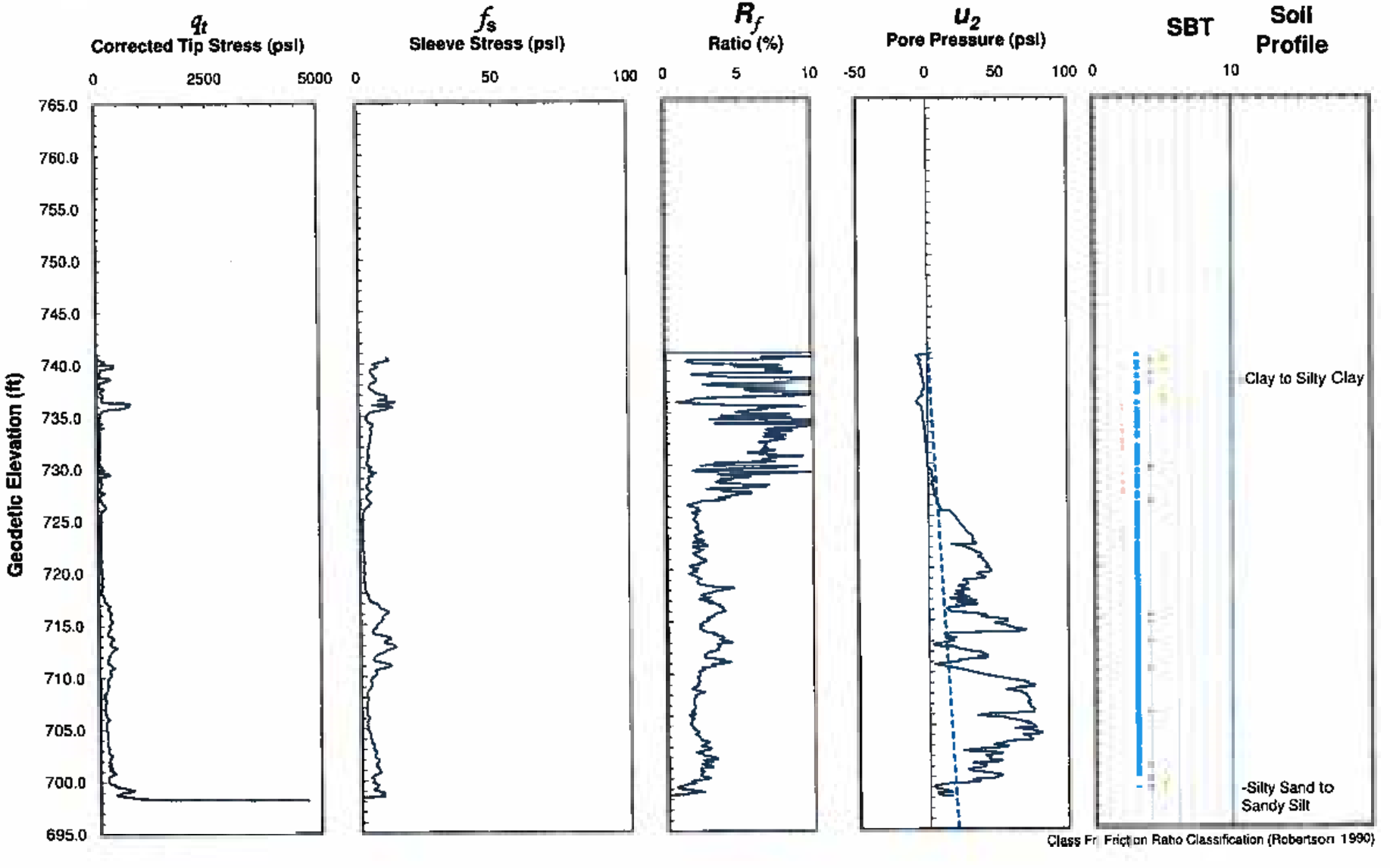
t_{50} = 42 s = 0.7 min

$c_h = 2.1 \times 10^{-2}$ in²/min
(t_{50} chart from CPT Application Guide)

Assumed k_h/k_v = 1.2

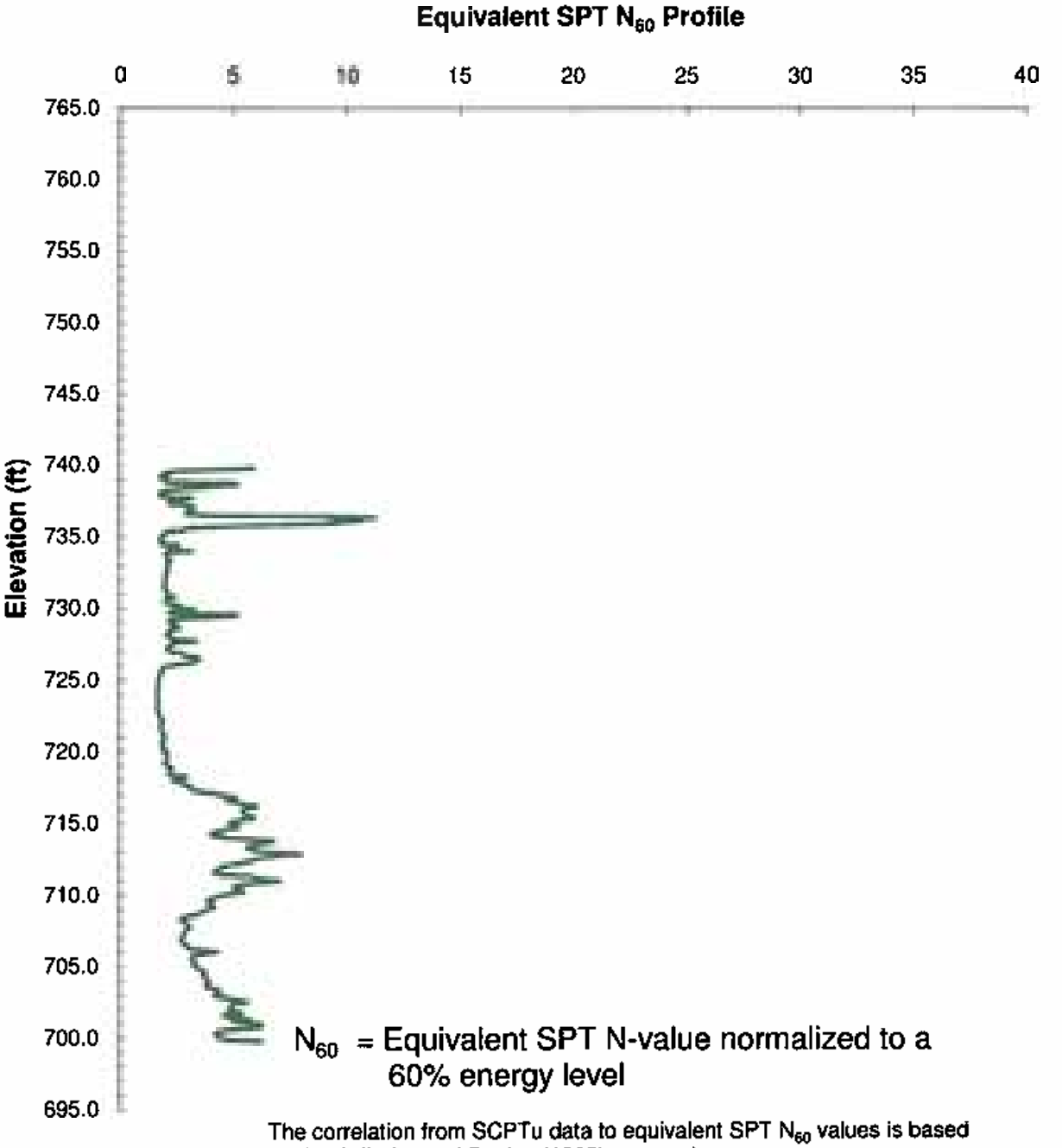
Project No. 175569042
STN-27C

Stantec Consulting Inc.	Elevation: 749.70 ft SCPTu Start Elevation: 740.70 ft Groundwater Elevation: 741.50 ft	Test Date: May 21, 2009 Project No. 175569042	STN-31A
	Client: TVA Project: Kingston Ash Pond		



SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

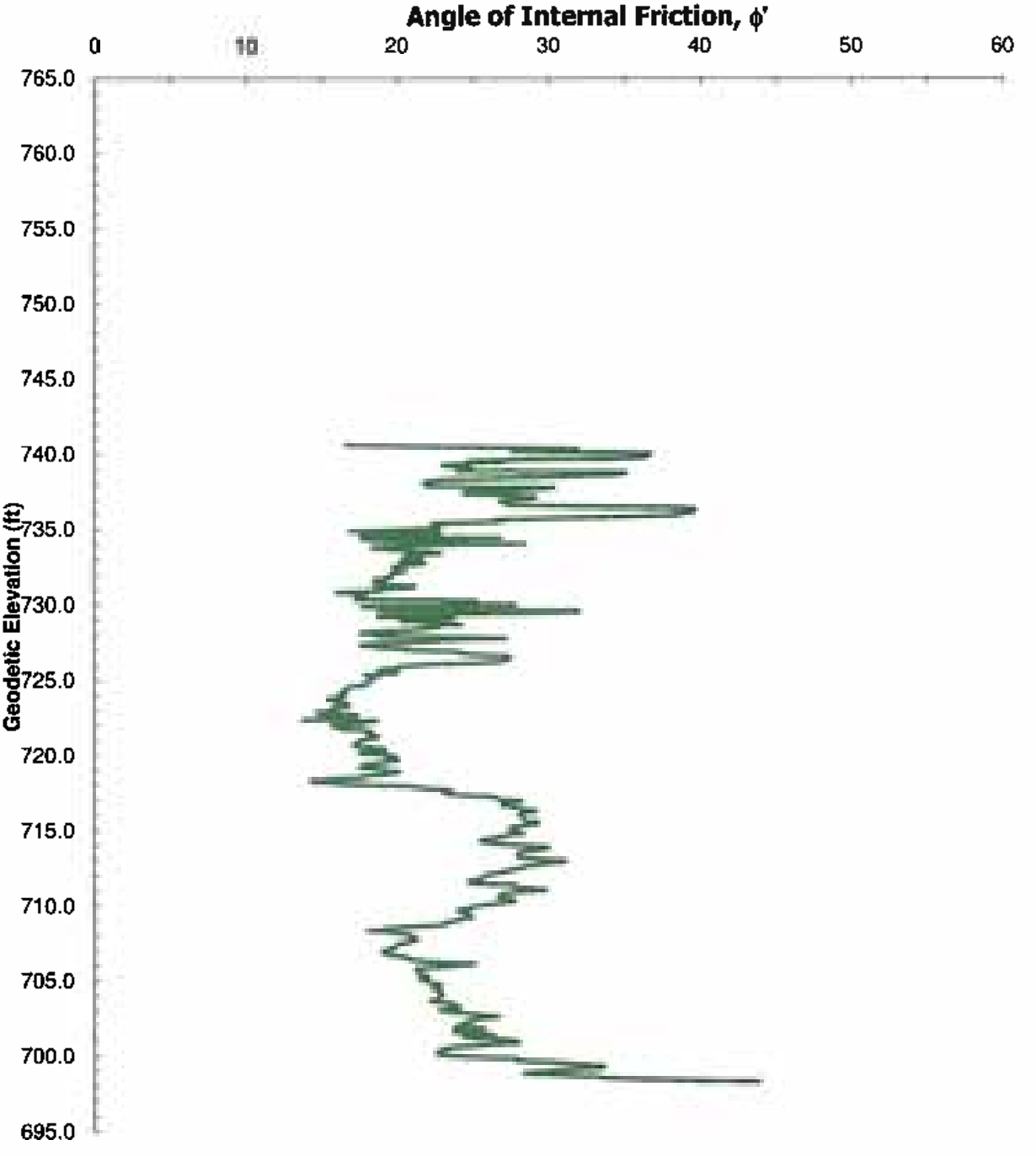
Project No. 175569042

STN-31A

Stantec

SCPTu RESULTS

Effective Angle of Internal Friction



Project No. 175569042

STN-31A

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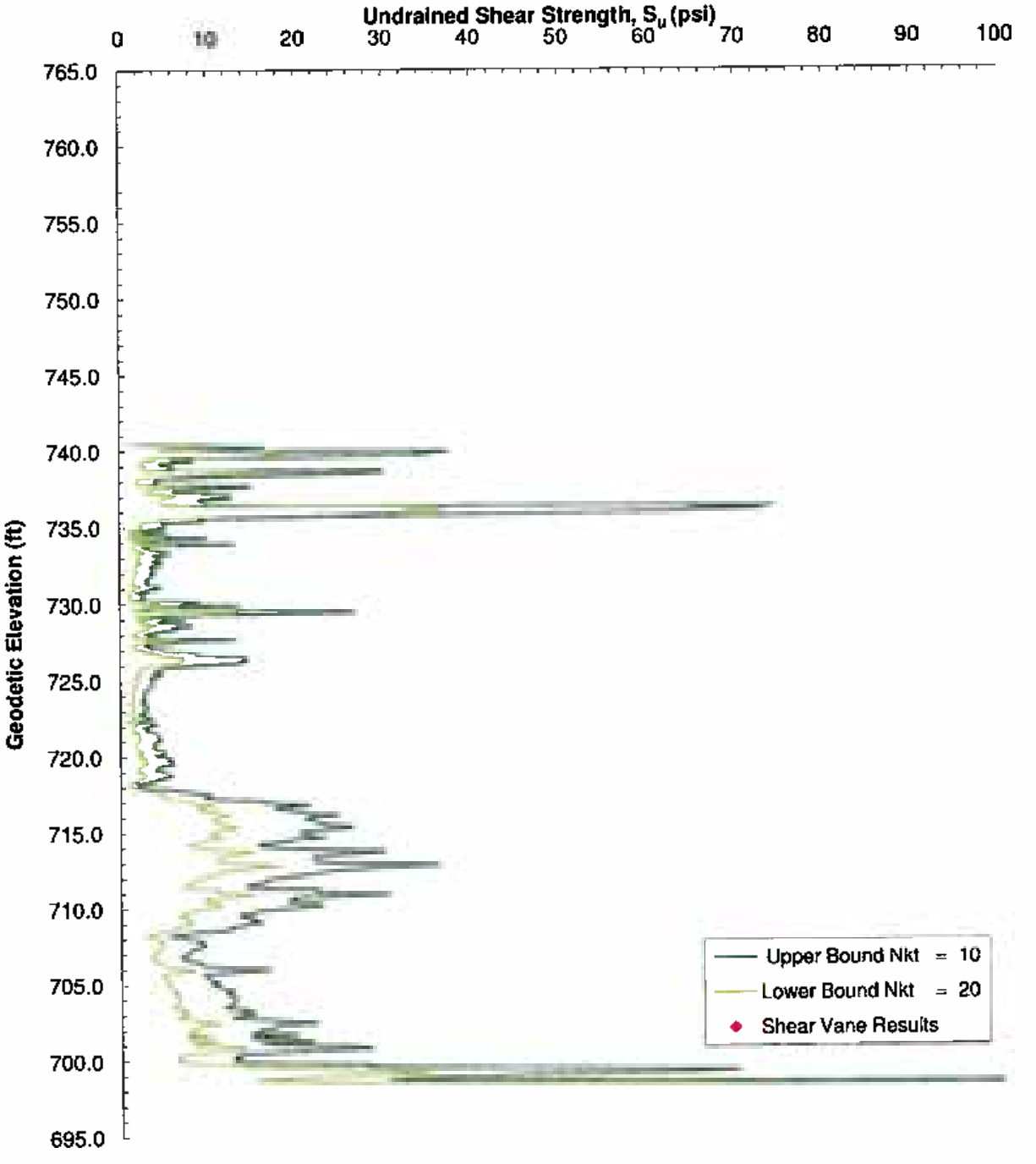
Stantec

SCPTu RESULTS

Undrained Shear Strength, S_u



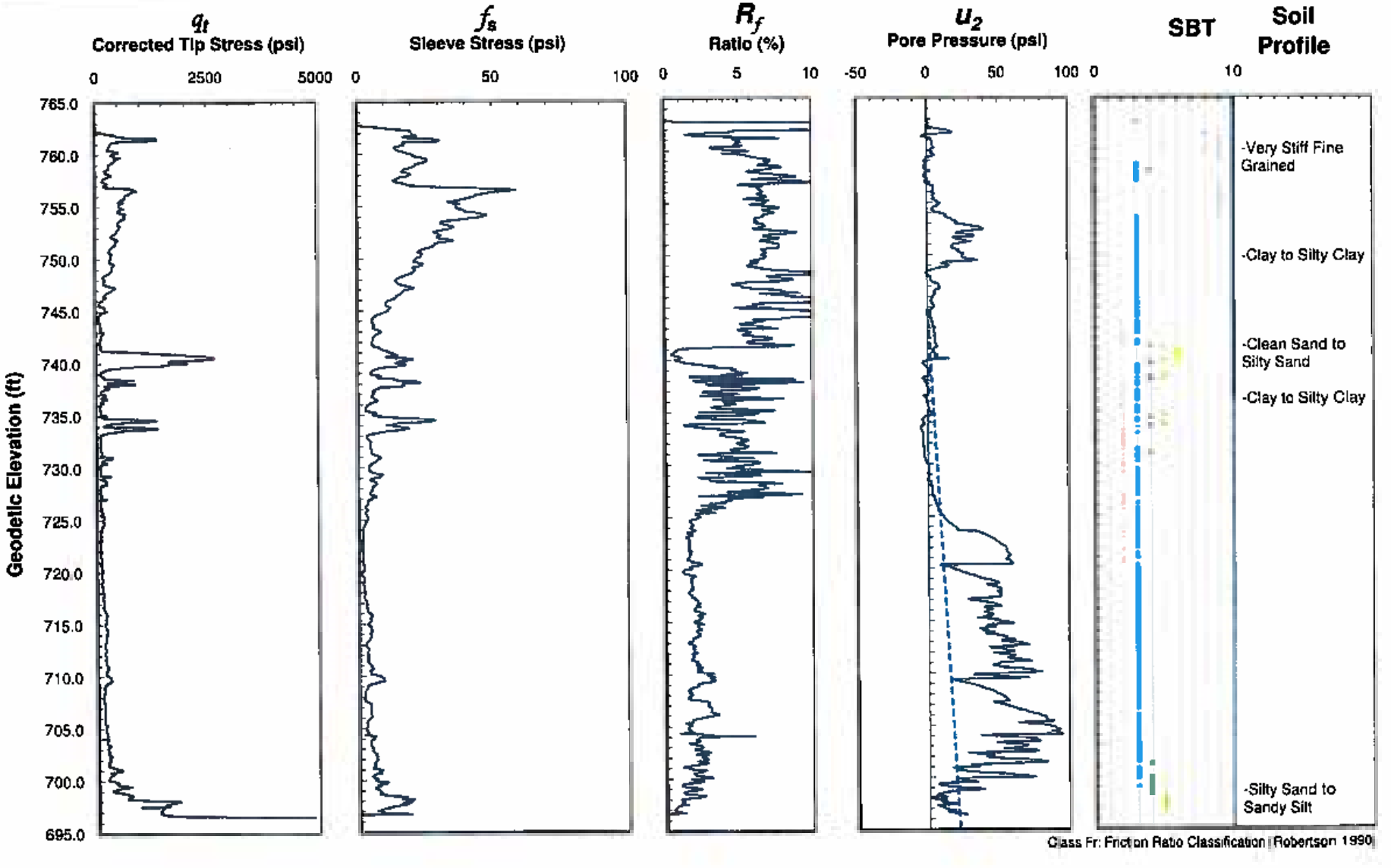
Project No. 175569042

STN-31A

C:\ashpond\week 2009-05-22\CPT31.xlsm

Stantec Consulting Inc.

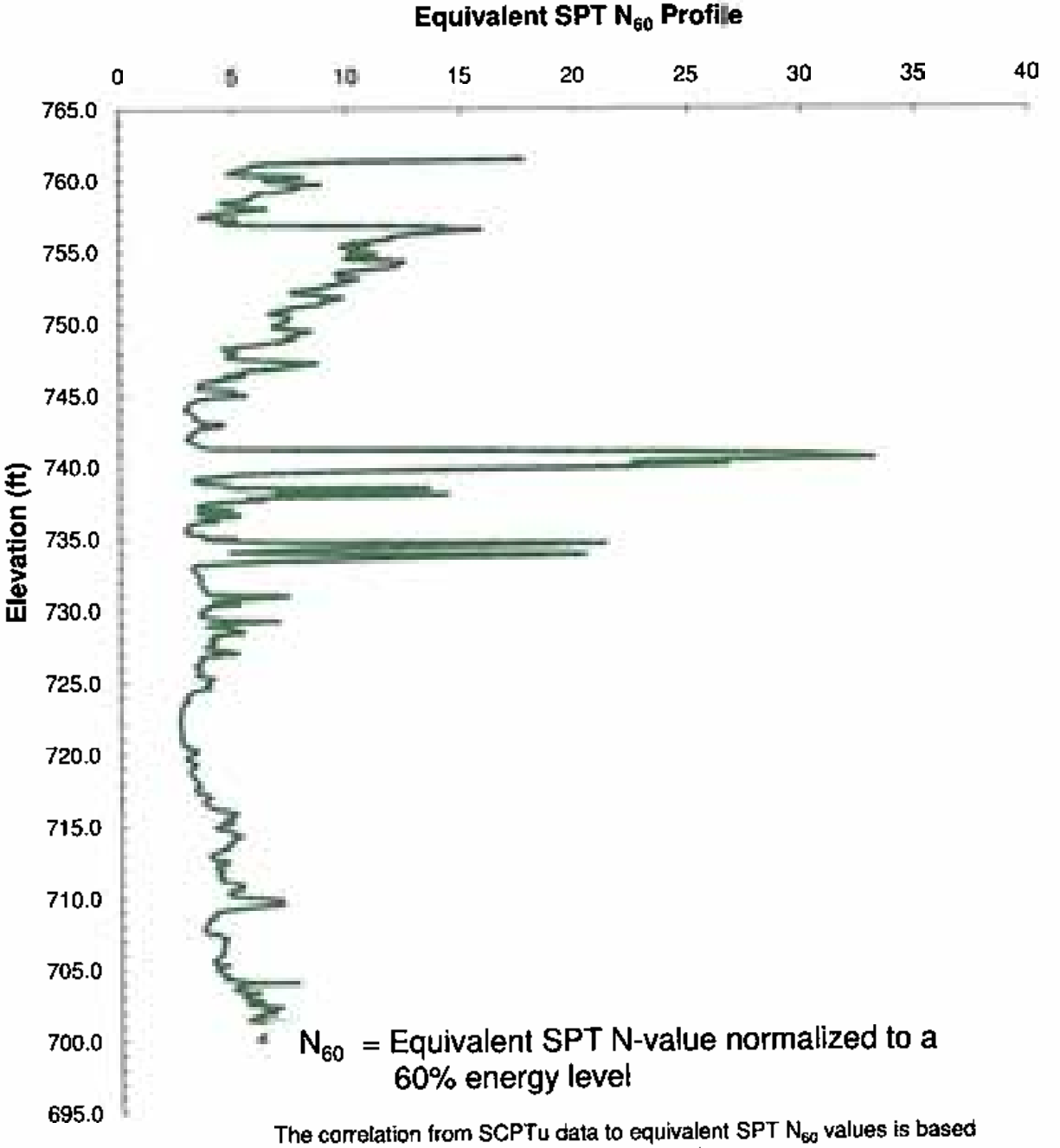
Elevation: 764.80 ft SCPTu Start Elevation: 762.80 ft Groundwater Elevation: 744.80 ft	Test Date: May 21, 2009 Project No. 175569042	STN-32A
Client: TVA Project: Kingston Ash Pond		



Stantec

SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

Project No. 175569042

STN-32A

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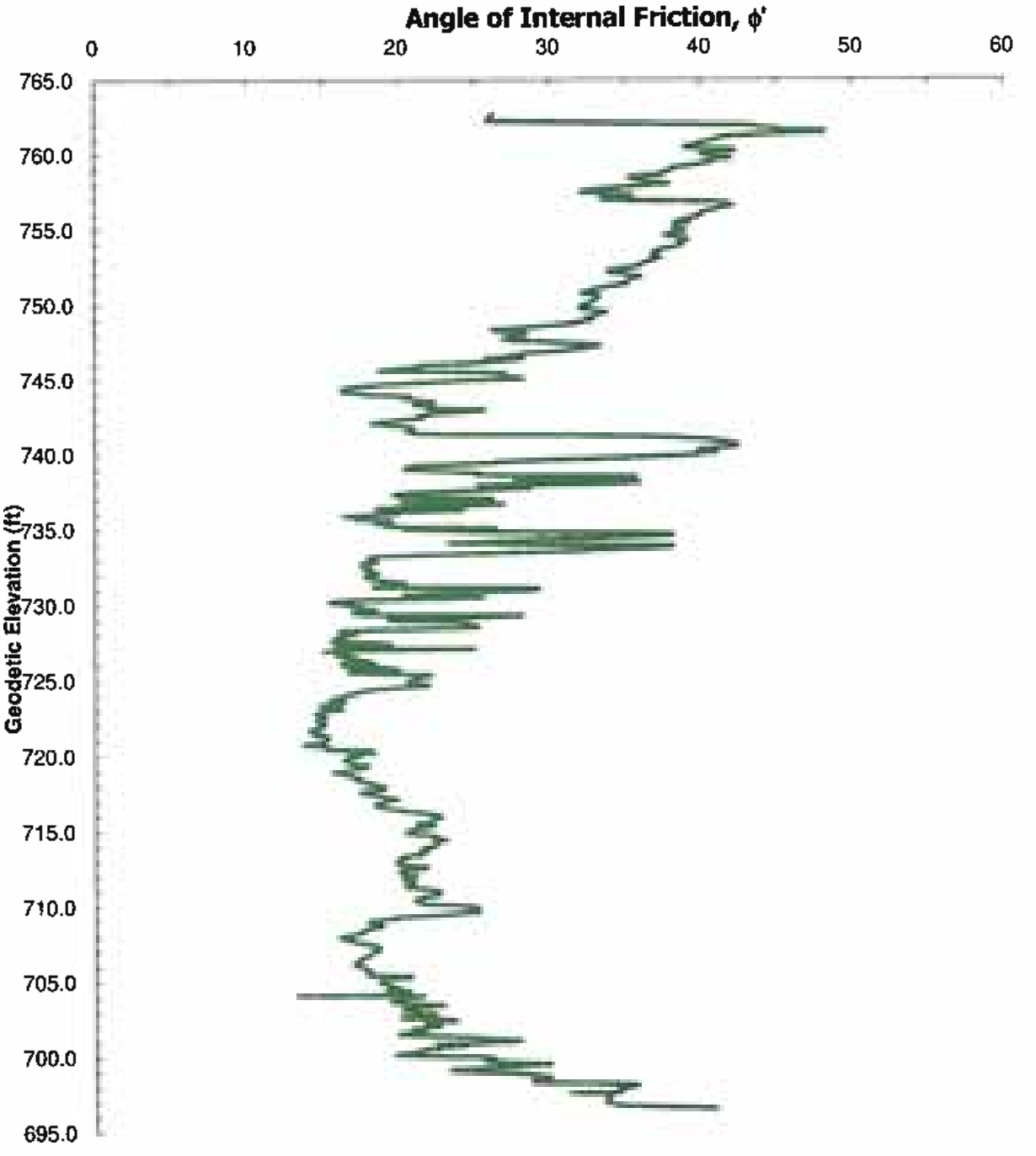
Stantec

SCPTu RESULTS

Effective Angle of Internal Friction



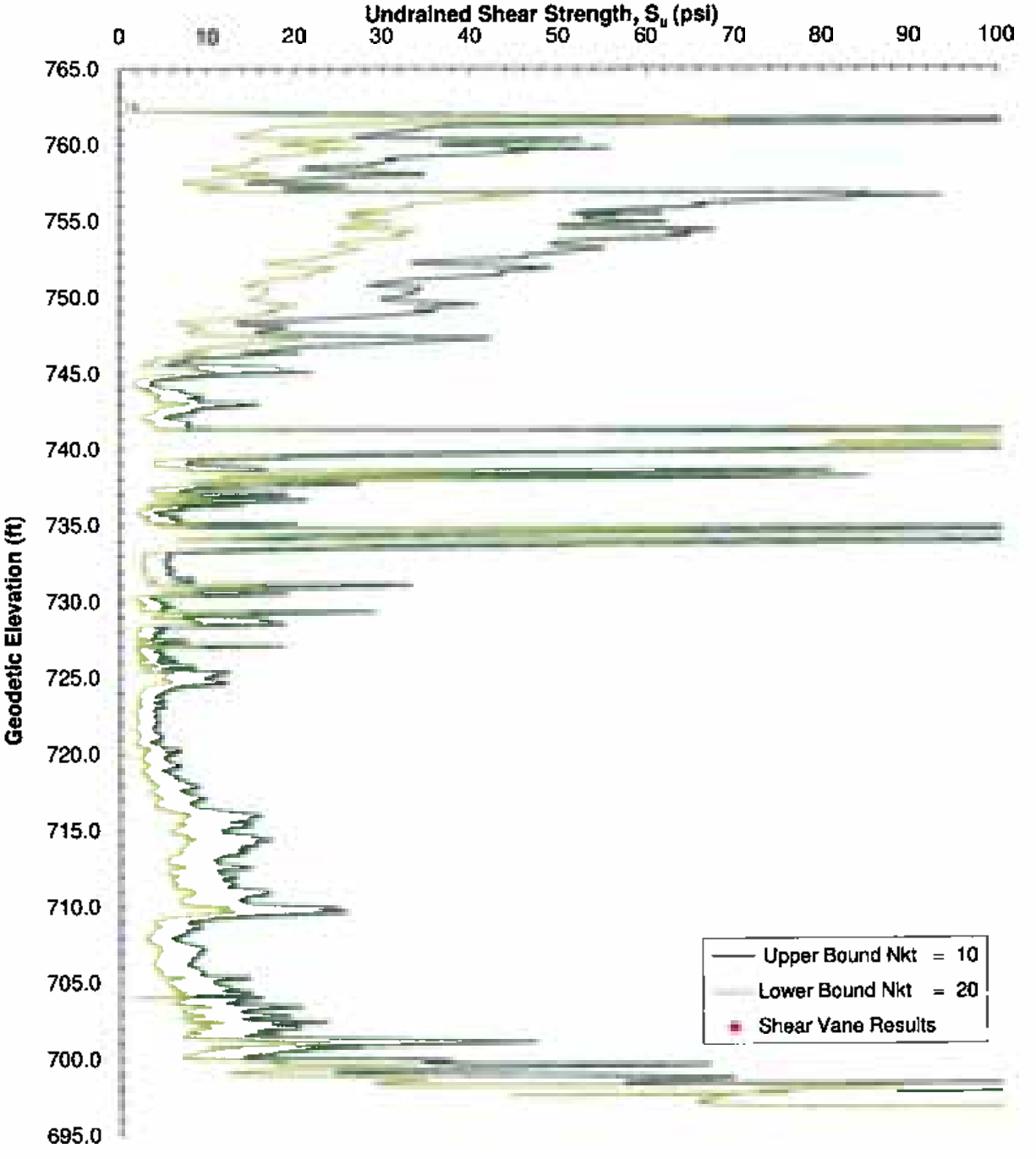
Project No. 175569042

STN-32A

C:\ashpond\week 2009-05-22\CPT32.xlsm

SCPTu RESULTS

Undrained Shear Strength, S_u



Project No. 175569042

STN-32A

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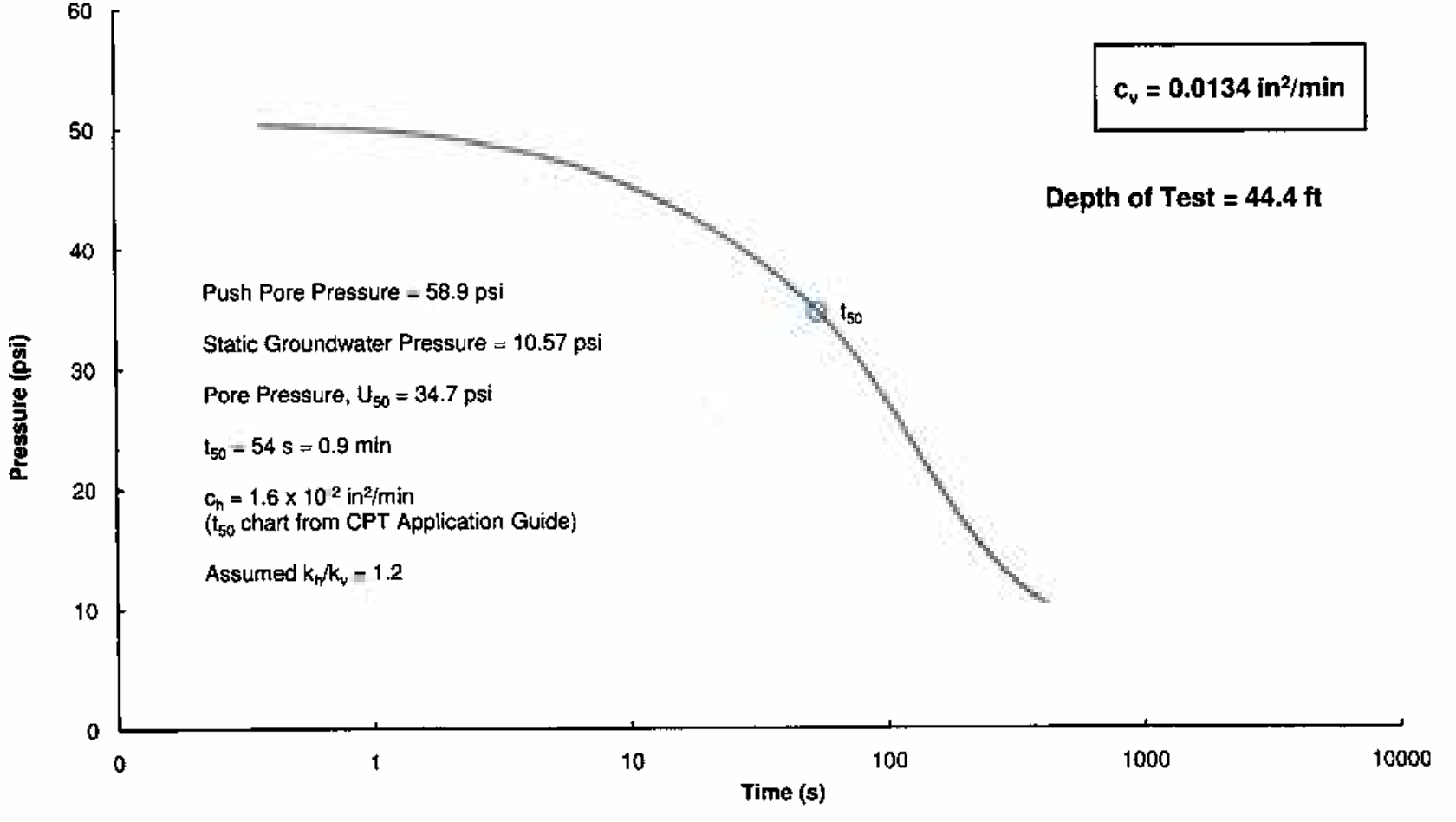
Stantec Consulting Inc.

SCPTu DISSIPATION RESULTS
Coefficient of Consolidation



c_v = 0.0134 in²/min

Depth of Test = 44.4 ft

Push Pore Pressure = 58.9 psi

Static Groundwater Pressure = 10.57 psi

Pore Pressure, U_{50} = 34.7 psi

t_{50} = 54 s = 0.9 min

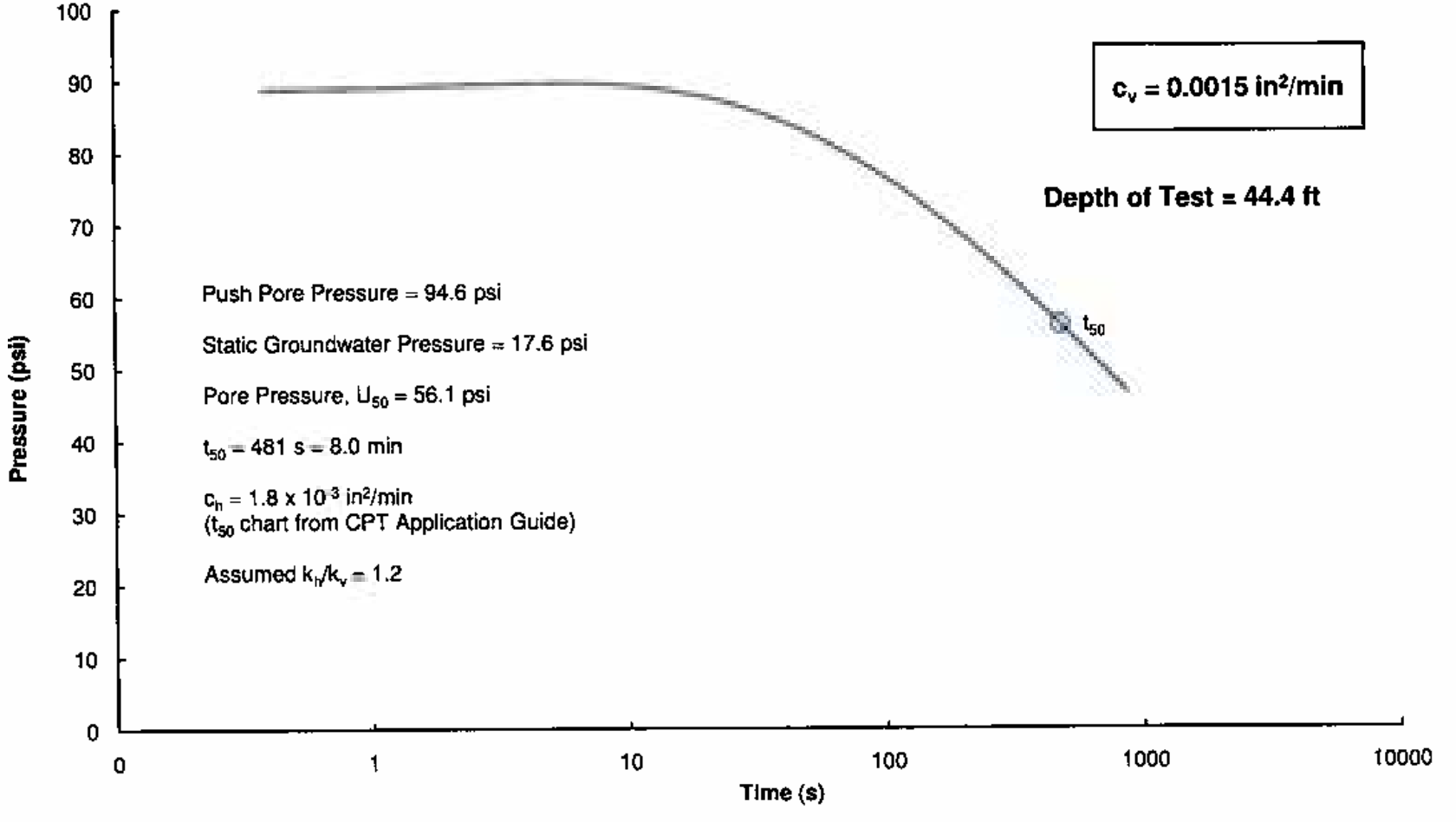
$c_h = 1.6 \times 10^{-2}$ in²/min
(t_{50} chart from CPT Application Guide)

Assumed k_h/k_v = 1.2

Project No. 175569042
STN-32A

Stantec Consulting Inc.

SCPTu DISSIPATION RESULTS
Coefficient of Consolidation



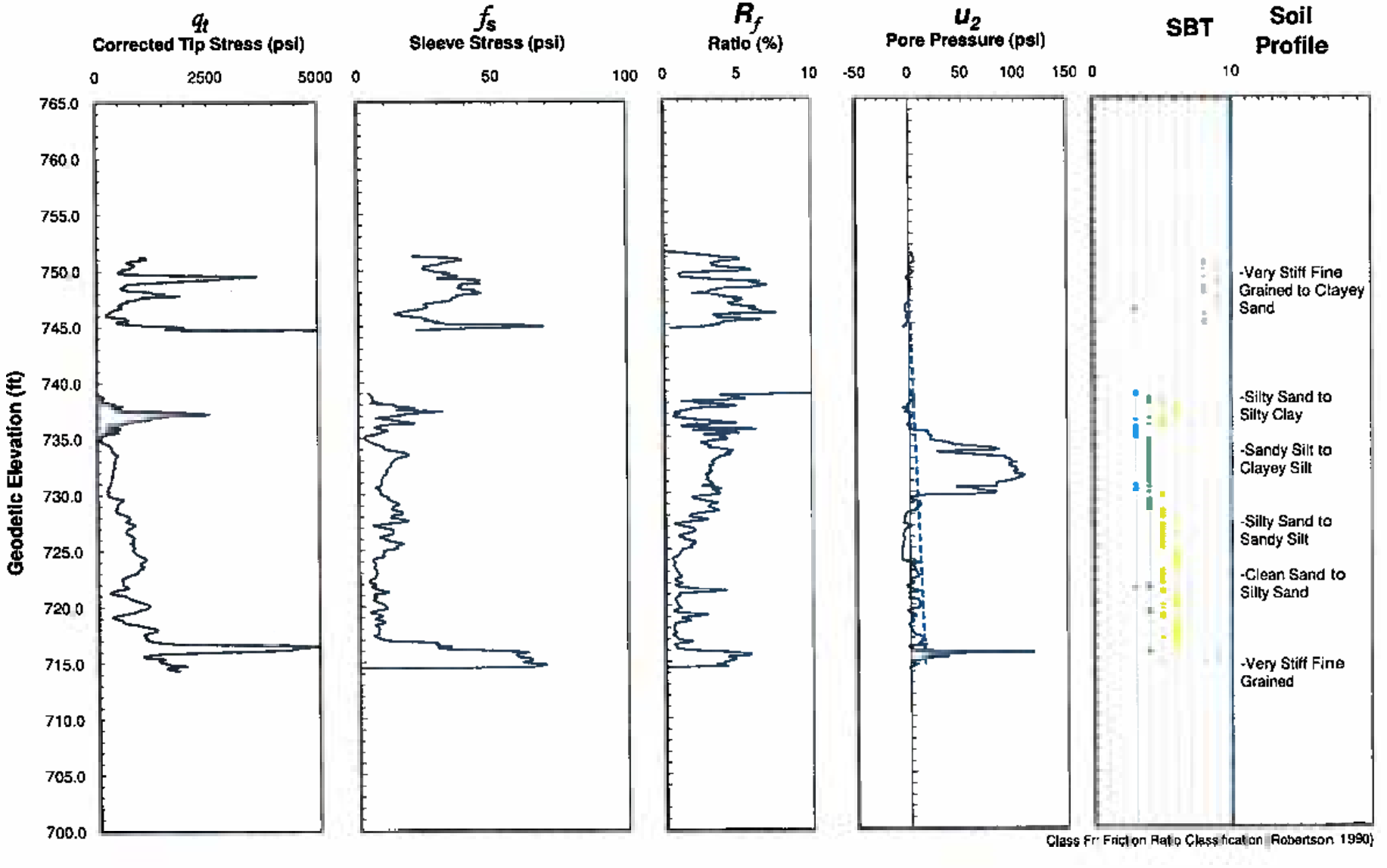
Project No. 175569042
STN-32A

Stantec Consulting Inc.

Elevation:	751.50 ft	Test Date: May 20, 2009	STN-36B
SCPTu Start Elevation:	751.50 ft	Project No. 175569042	
Groundwater Elevation:	746.90 ft		

Client: TVA

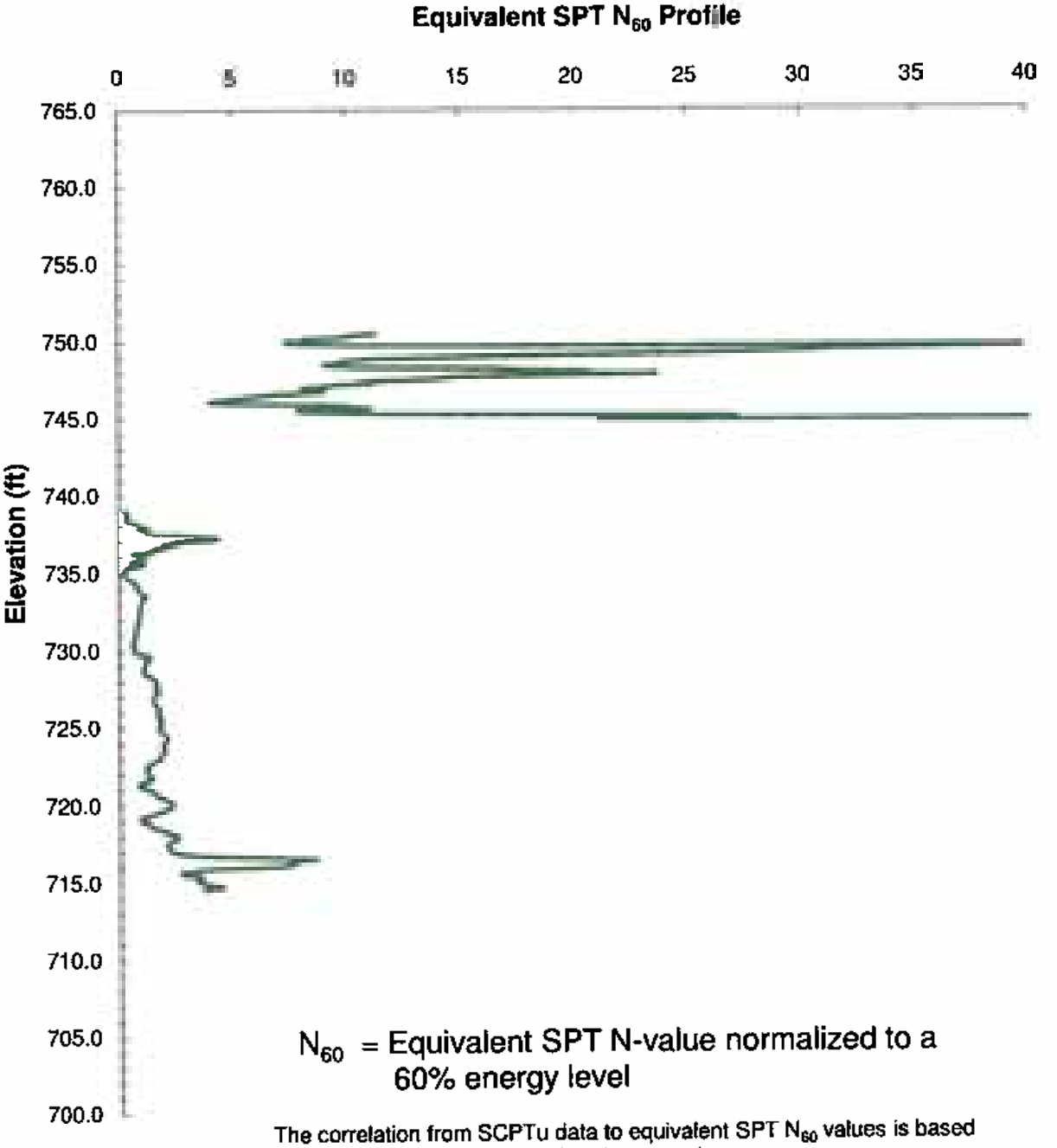
Project: Kingston Ash Pond



Stantec

SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

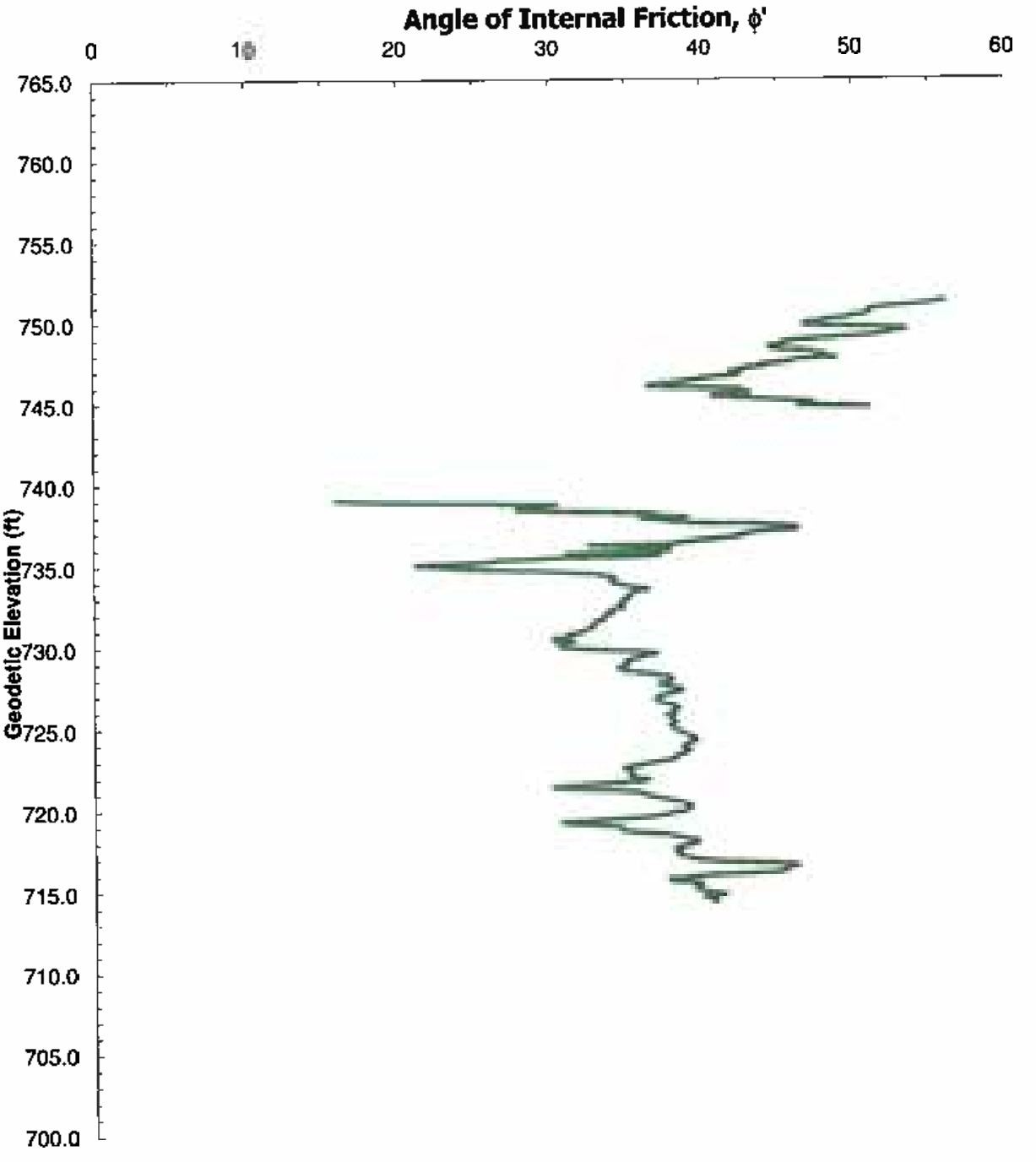
Project No. 175569042

STN-36B

Stantec

SCPTu RESULTS

Effective Angle of Internal Friction



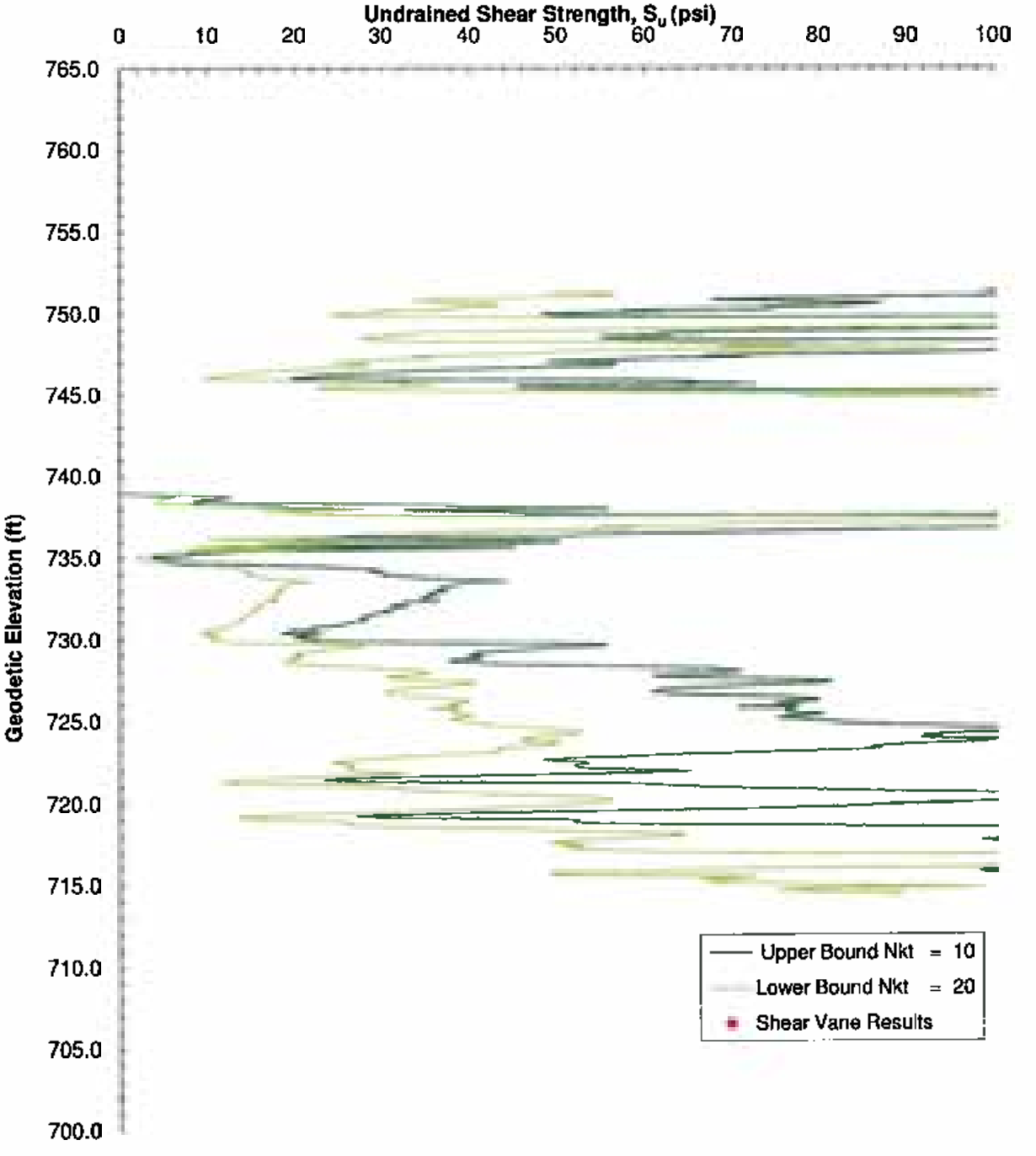
Project No. 175569042

STN-36B

Stantec

SCPTu RESULTS

Undrained Shear Strength, S_u



Project No. 175569042

STN-36B

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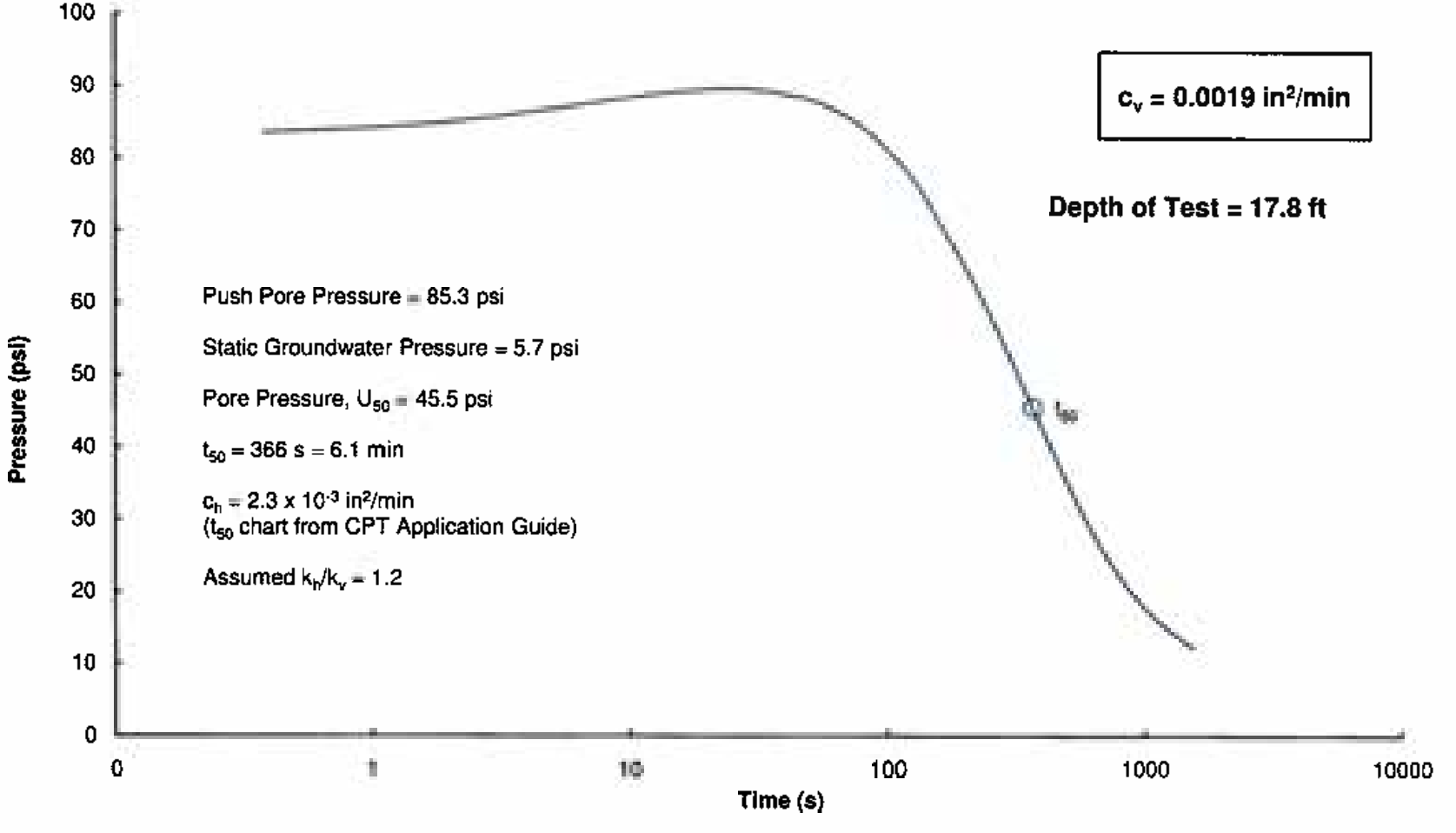
Stantec Consulting Inc.

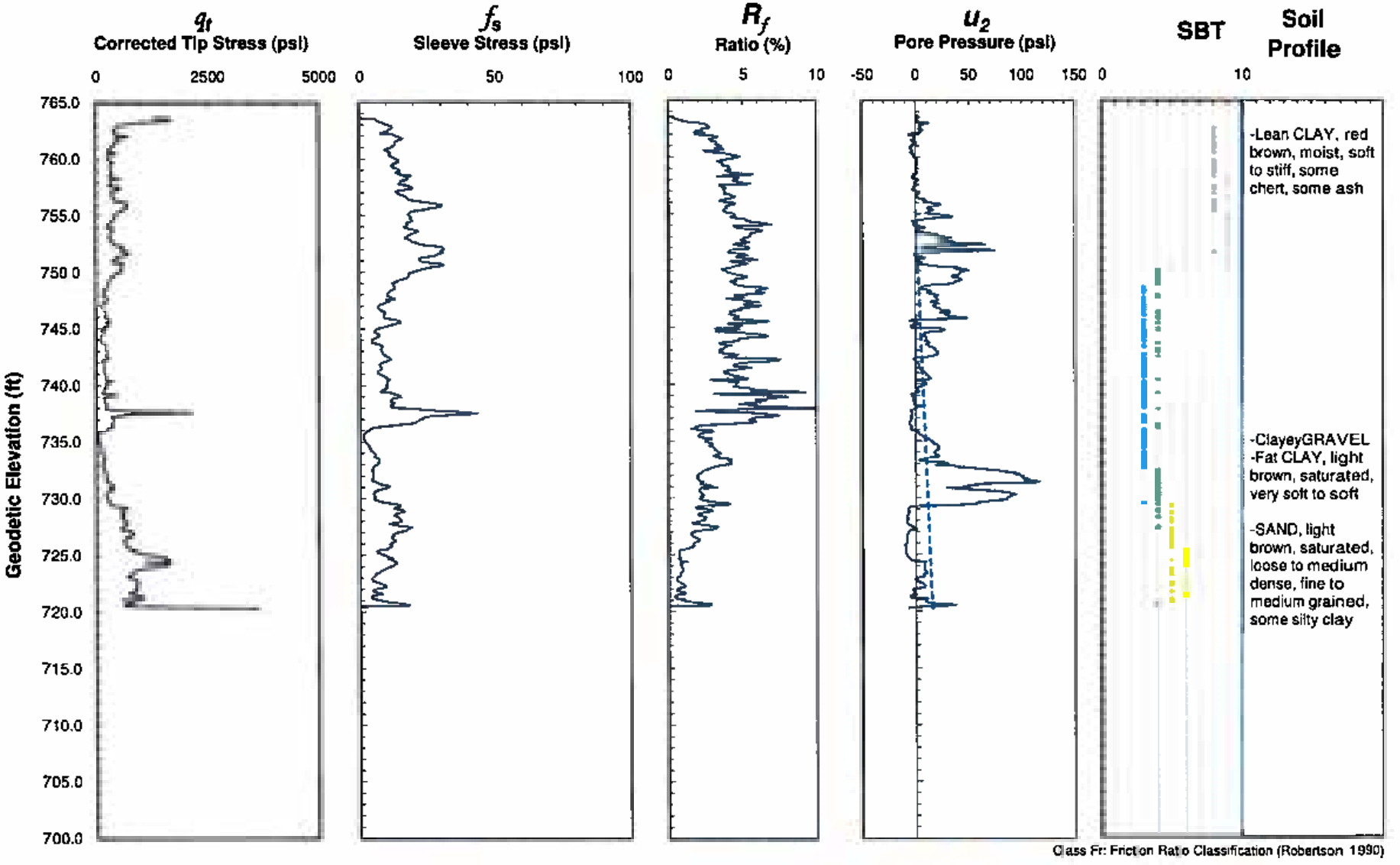
SCPTu DISSIPATION RESULTS
Coefficient of Consolidation



Project No. 175569042
STN-36B

Stantec Consulting Inc.

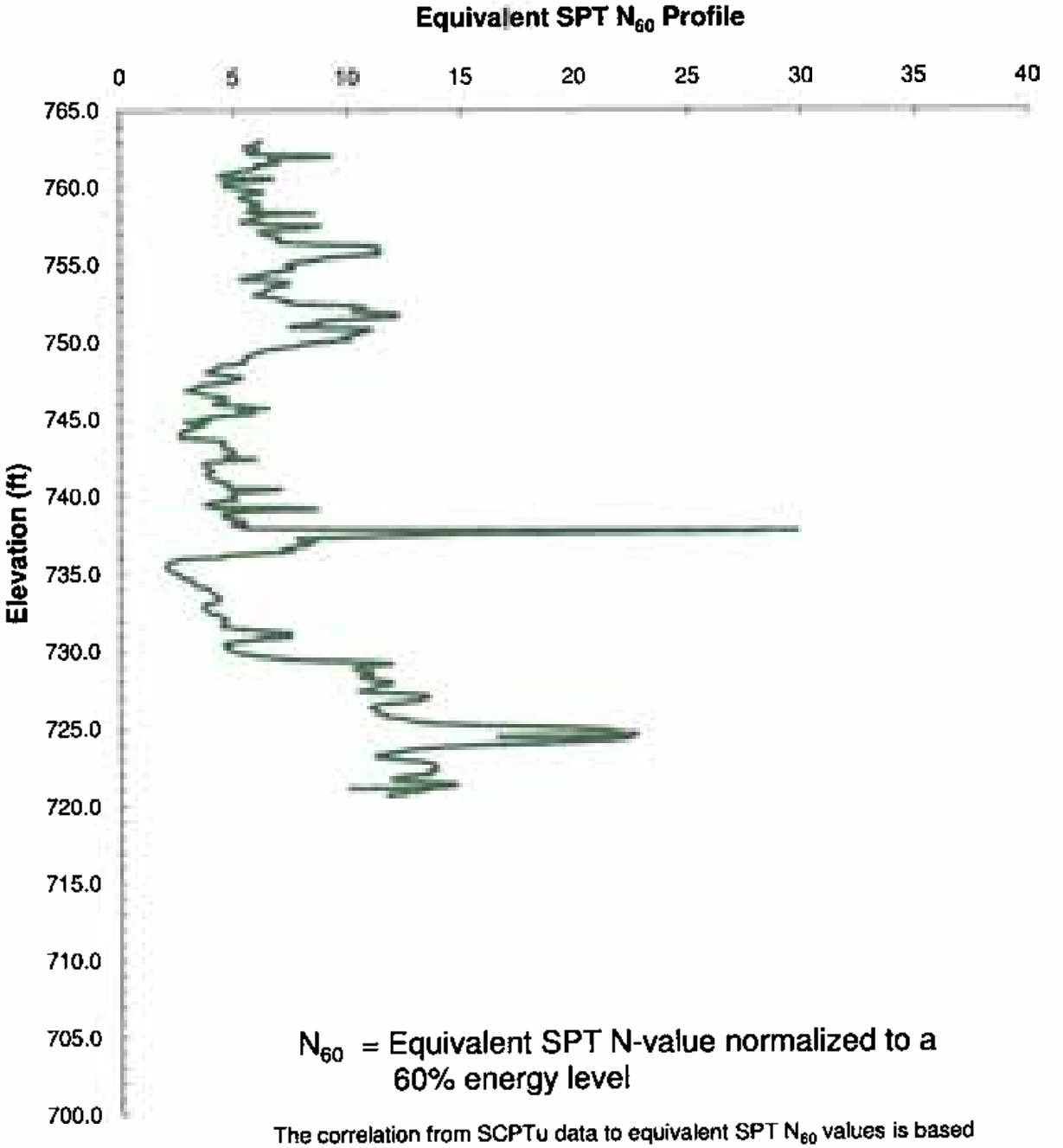
Elevation: 763.80 ft SCPTu Start Elevation: 763.80 ft Groundwater Elevation: 755.30 ft	Test Date: May 7, 2009 Project No. 175569042	STN-37E
Client: TVA Project: Kingston Ash Pond		



Stantec

SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

Project No. 175569042

STN-37E

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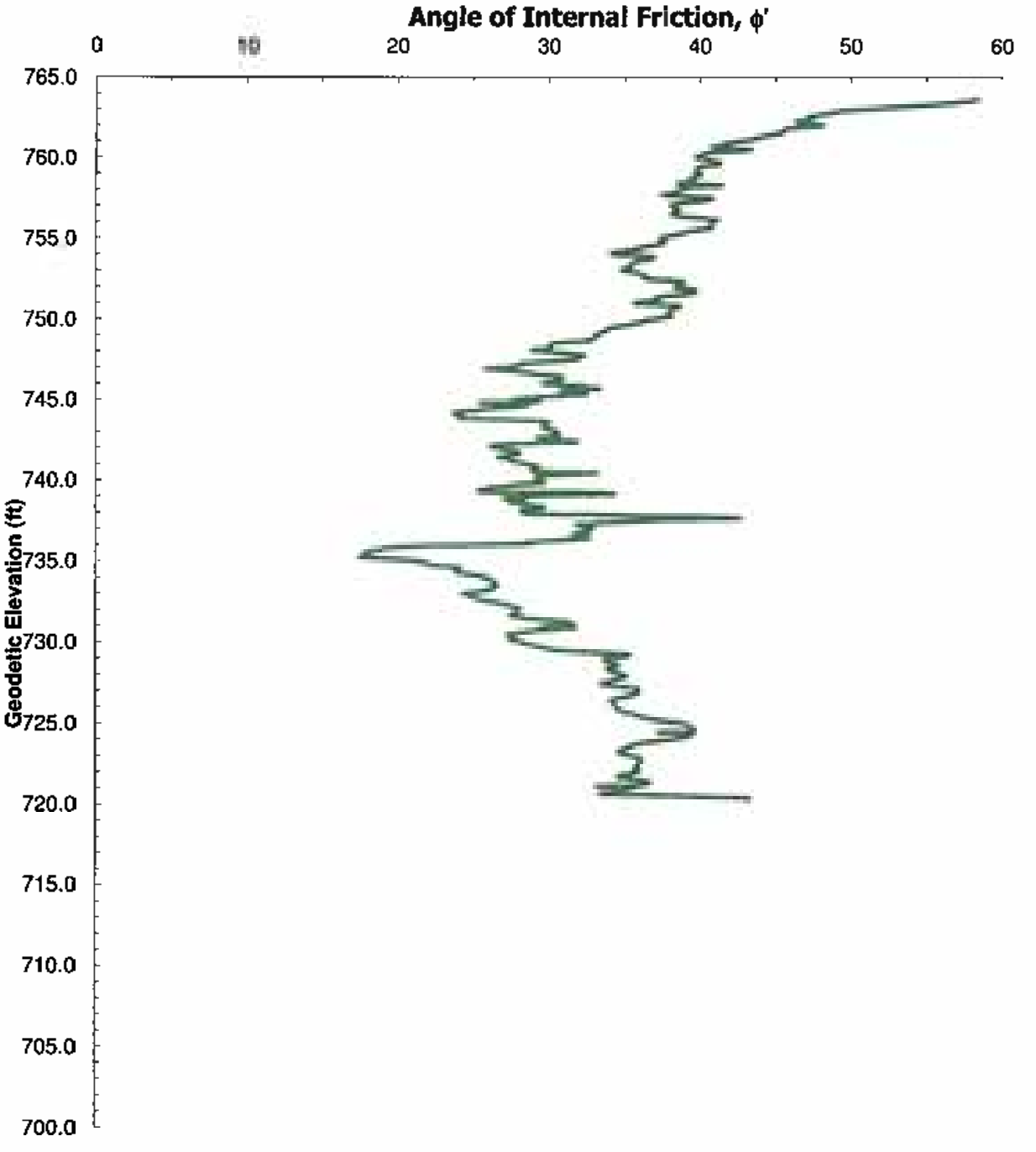
SCPTu RESULTS

Effective Angle of Internal Friction

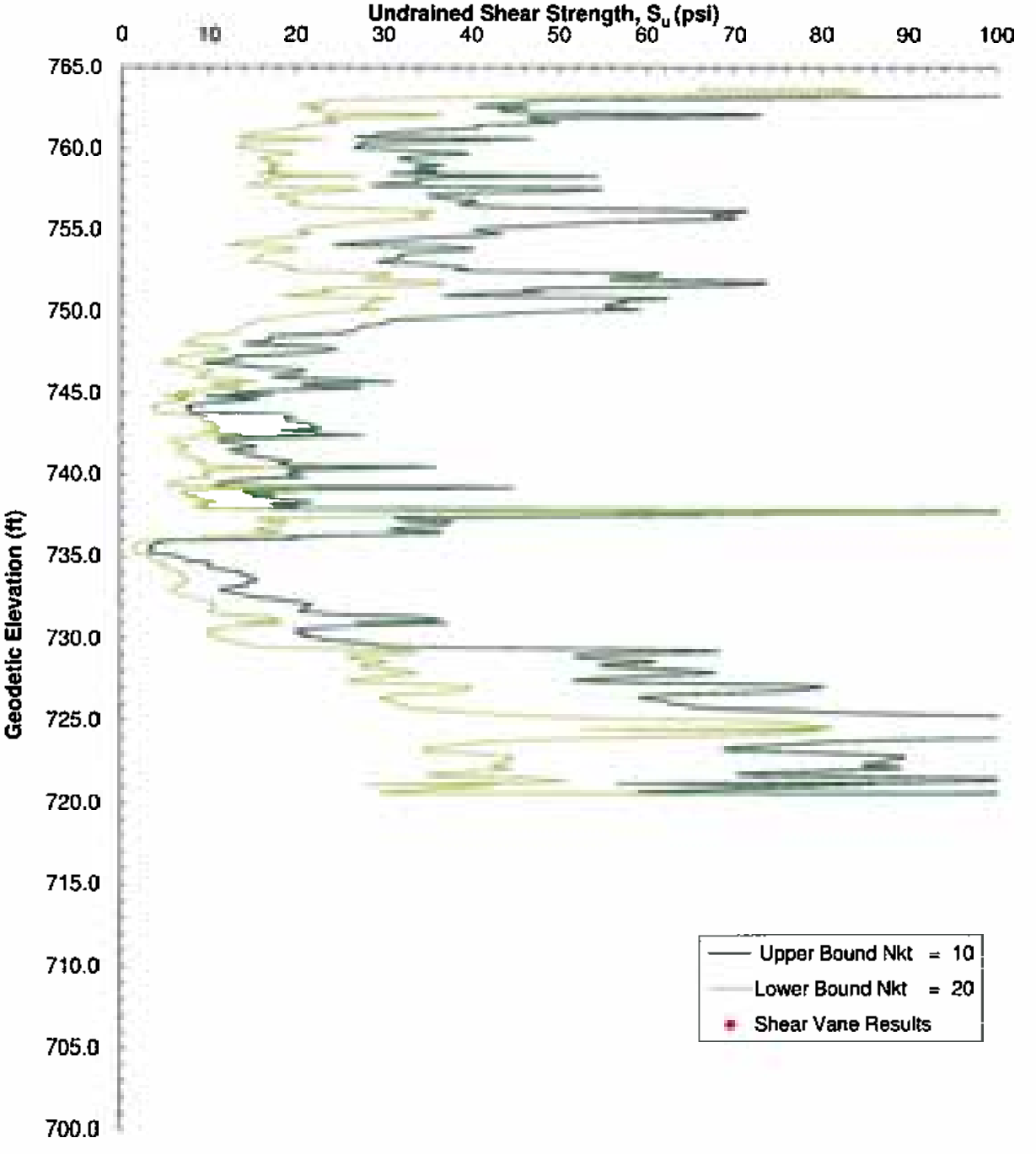


Project No. 175569042

STN-37E

SCPTu RESULTS

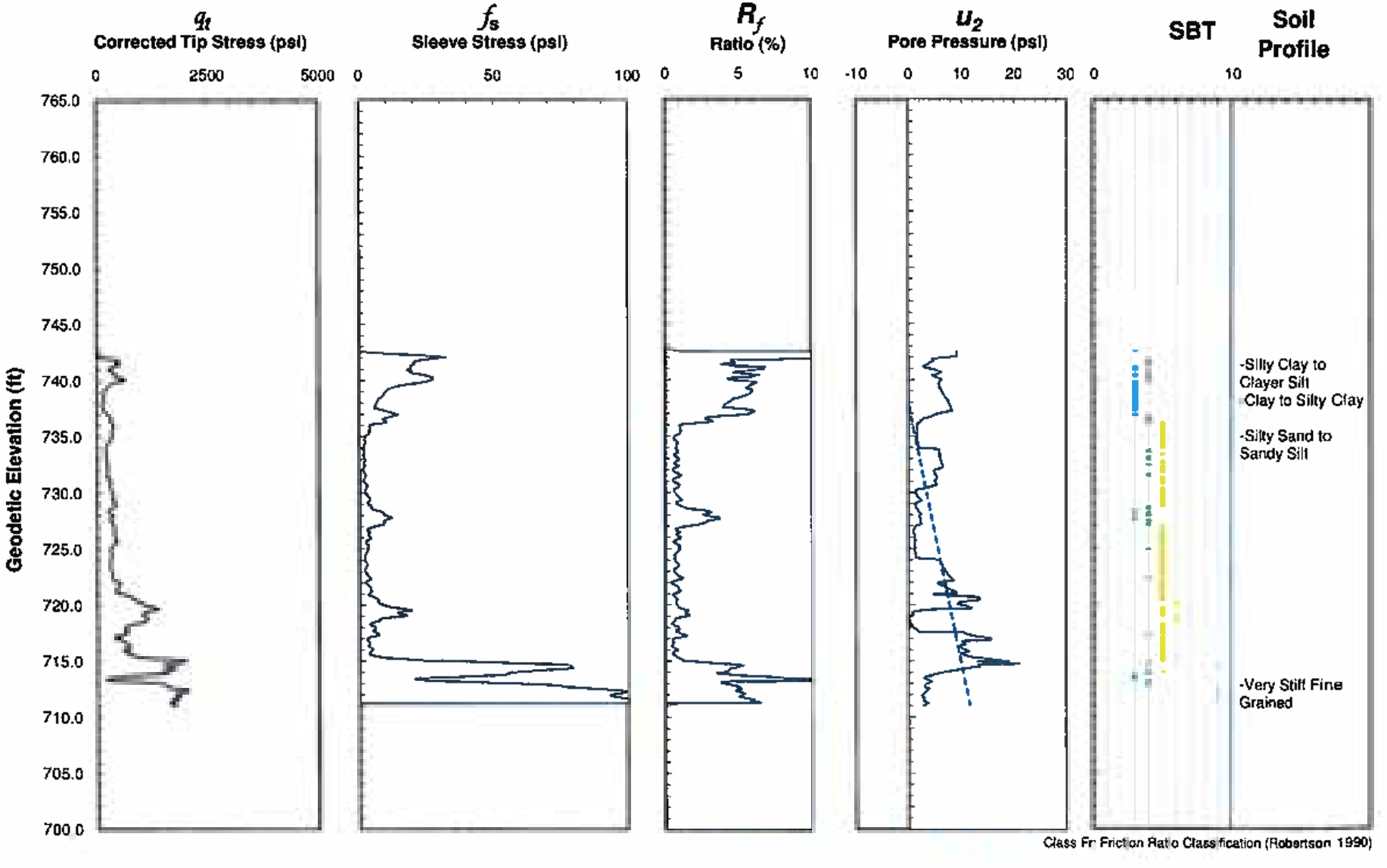
Undrained Shear Strength, S_u



Project No. 175569042

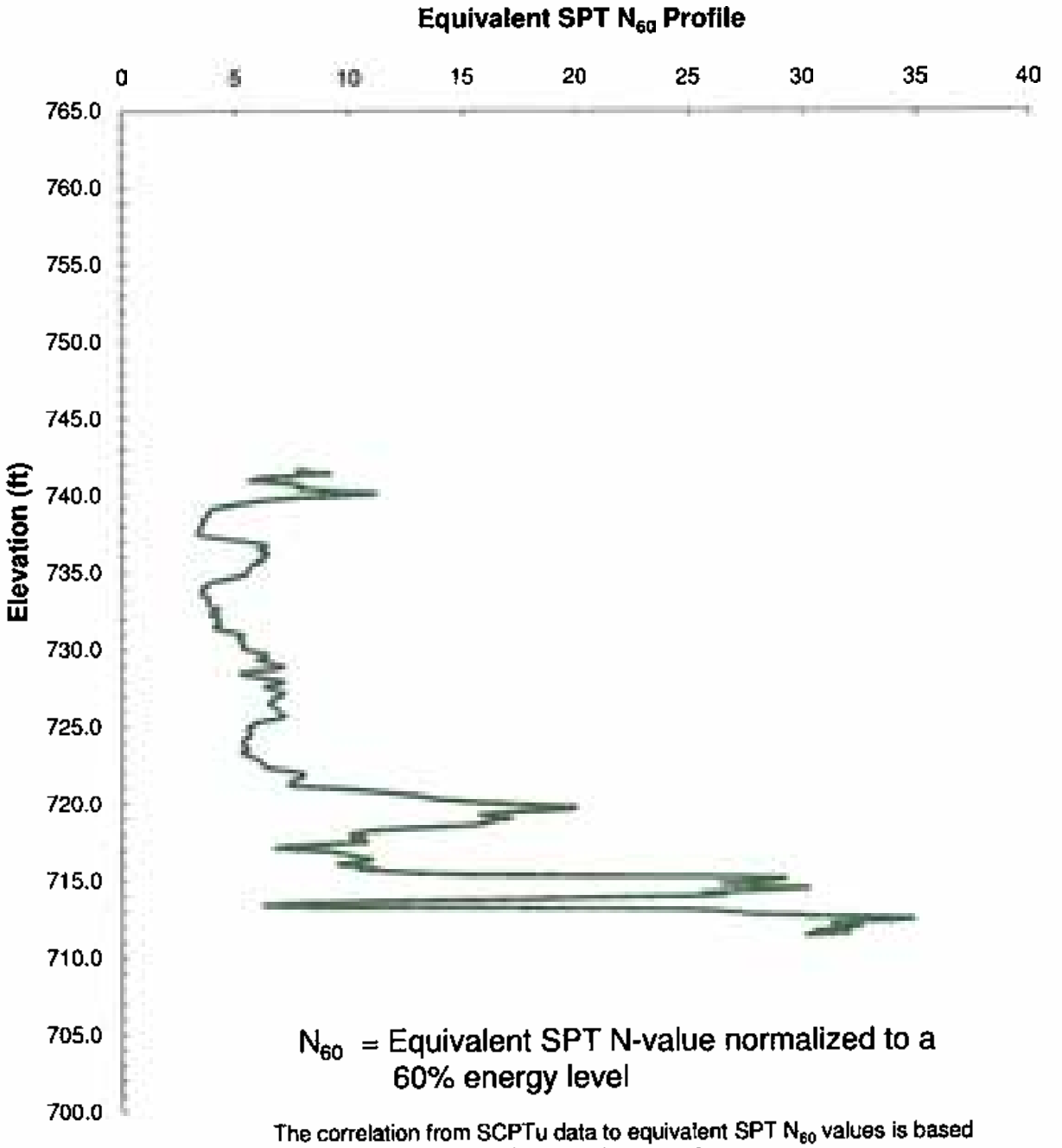
STN-37E

Stantec Consulting Inc.	Elevation: 751.80 ft SCPTu Start Elevation: 742.80 ft Groundwater Elevation: 737.70 ft	Test Date: May 20, 2009 Project No. 175569042	STN-41A
	Client: TVA Project: Kingston Ash Pond		



SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

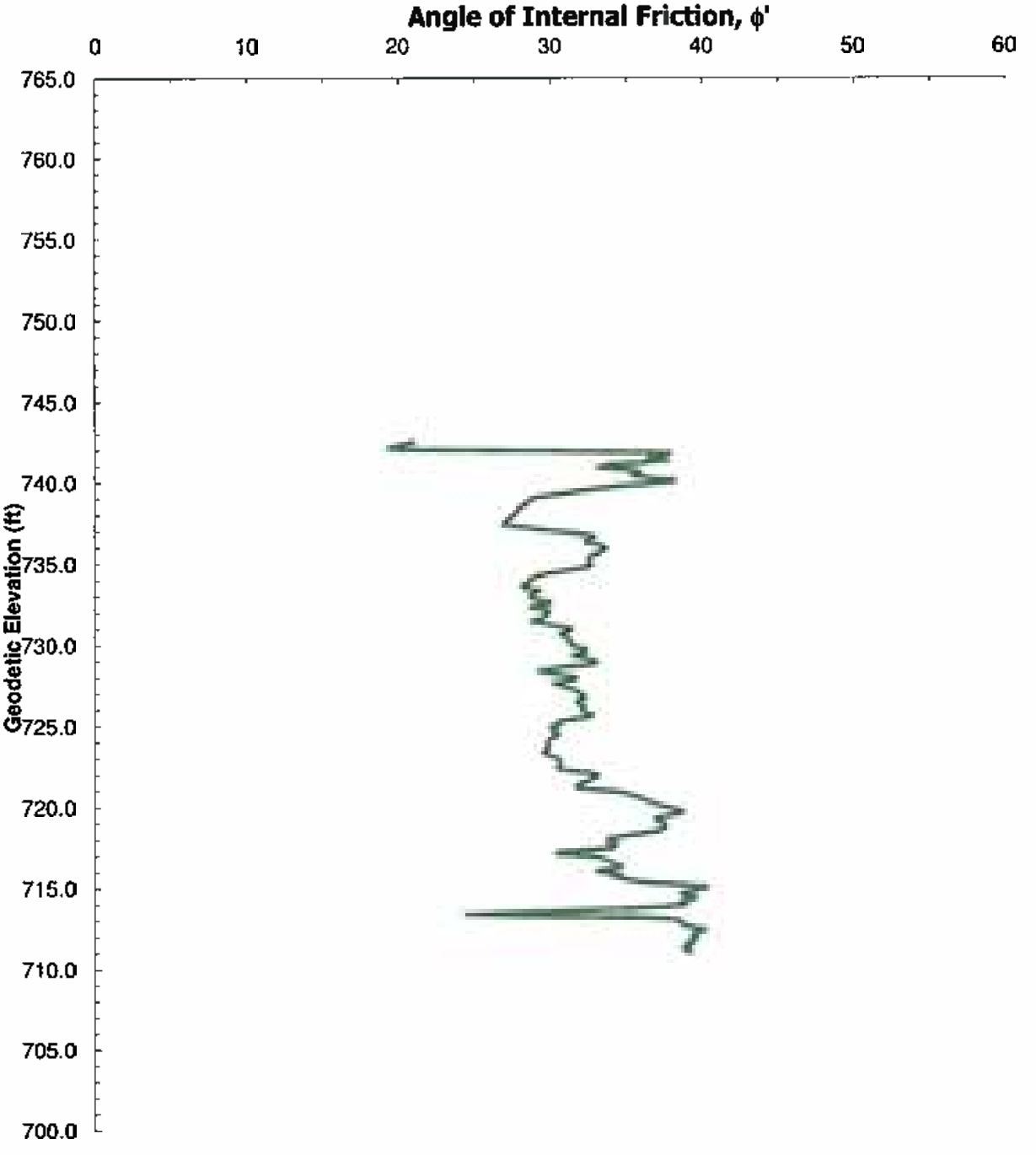
Project No. 175569042

STN-41A

Stantec

SCPTu RESULTS

Effective Angle of Internal Friction



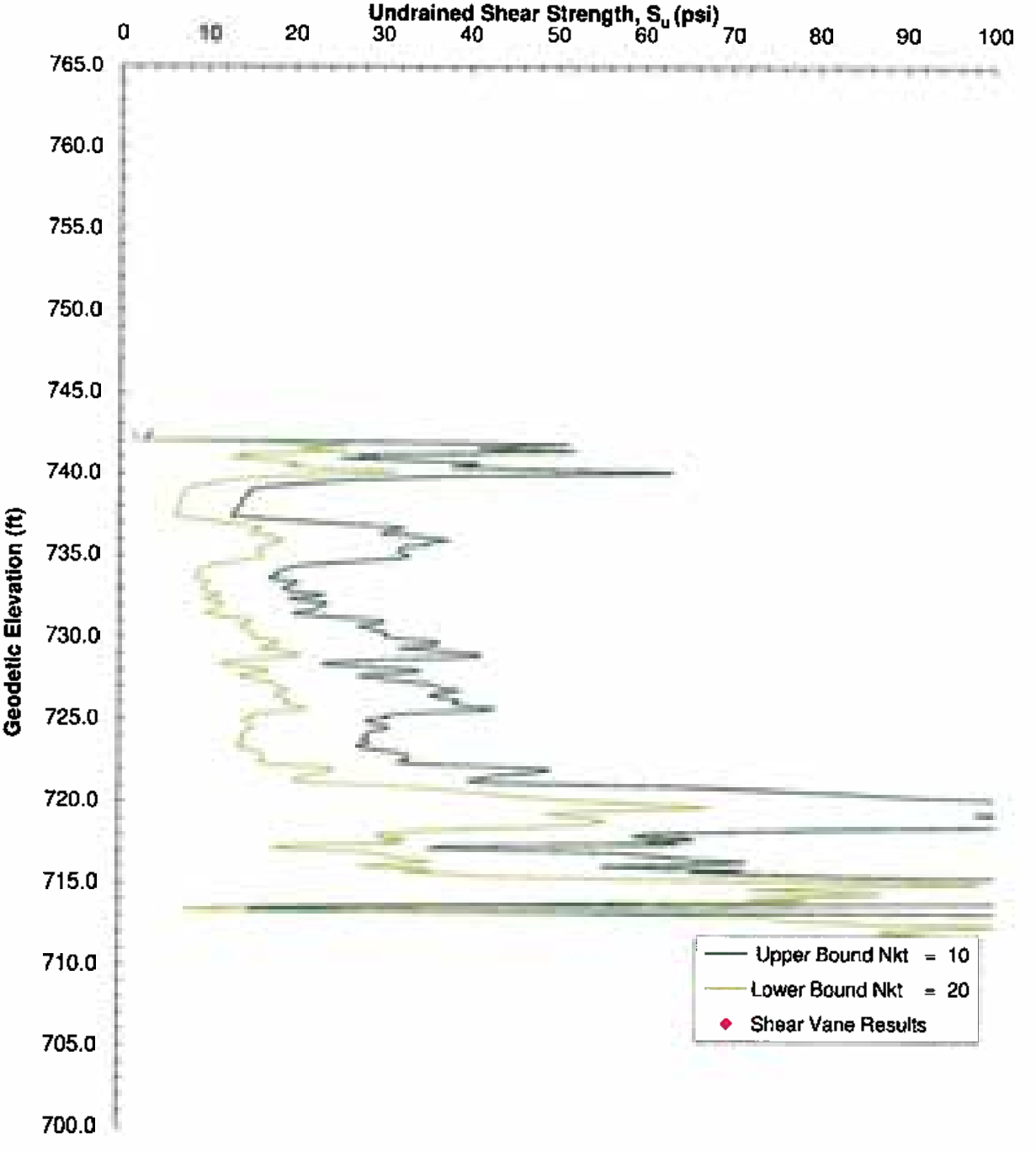
Project No. 175569042

STN-41A

Stantec

SCPTu RESULTS

Undrained Shear Strength, S_u



Project No. 175569042

STN-41A

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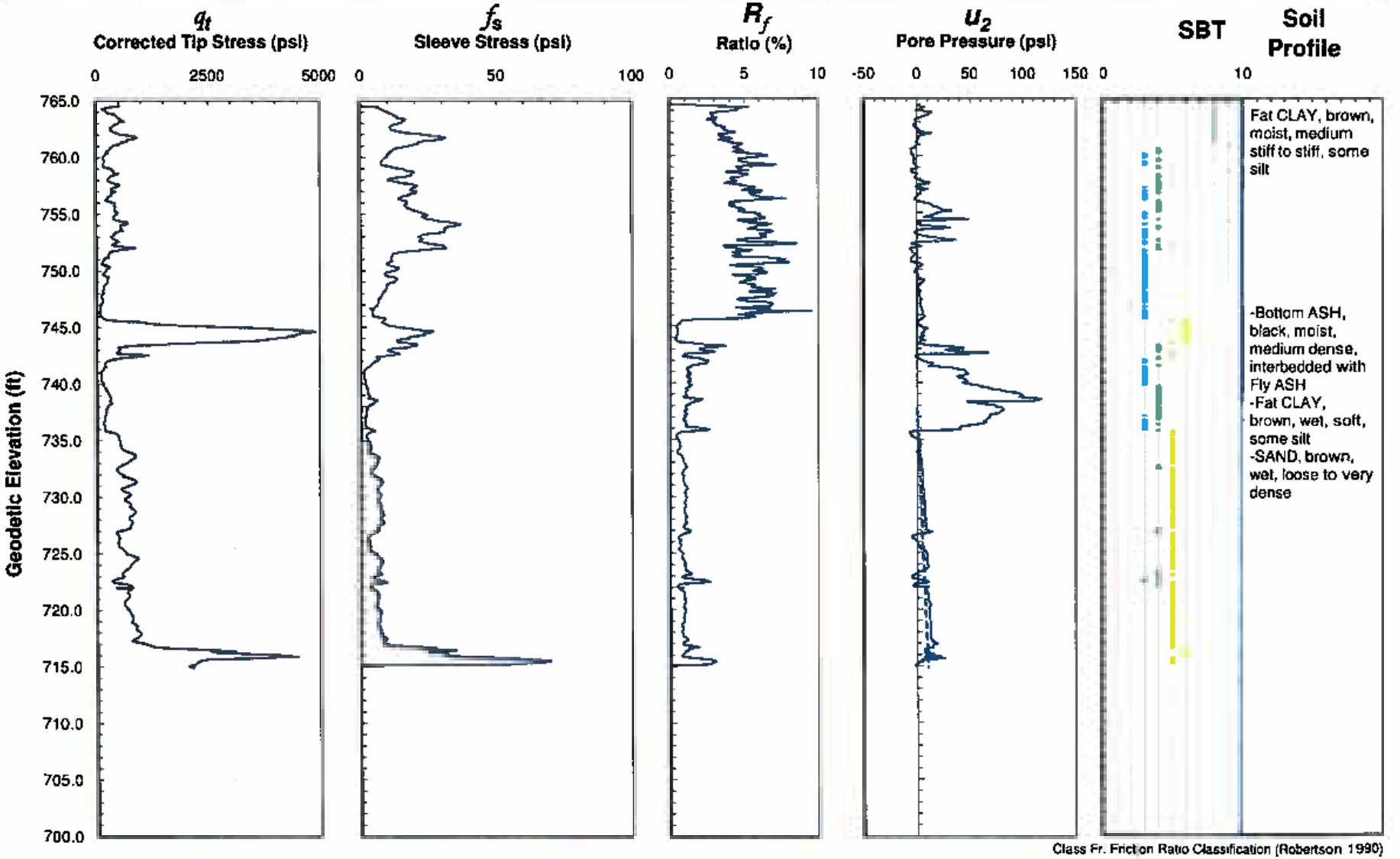
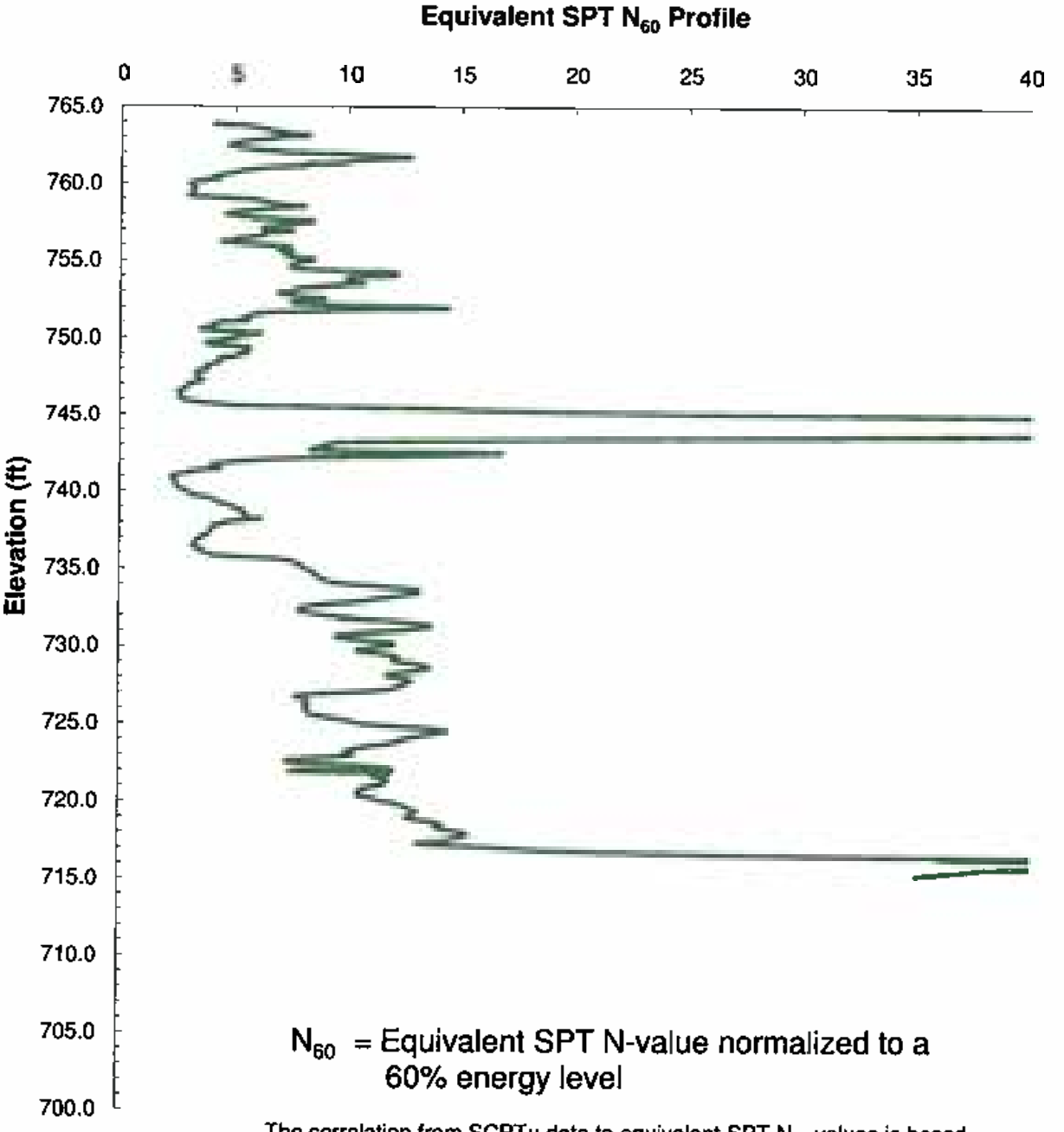
Stantec Consulting Inc.	Elevation: 764.70 ft SCPTu Start Elevation: 764.70 ft Groundwater Elevation: 737.70 ft	Test Date: May 7, 2009 Project No. 175569042	STN-42A
	Client: TVA Project: Kingston Ash Pond		



SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

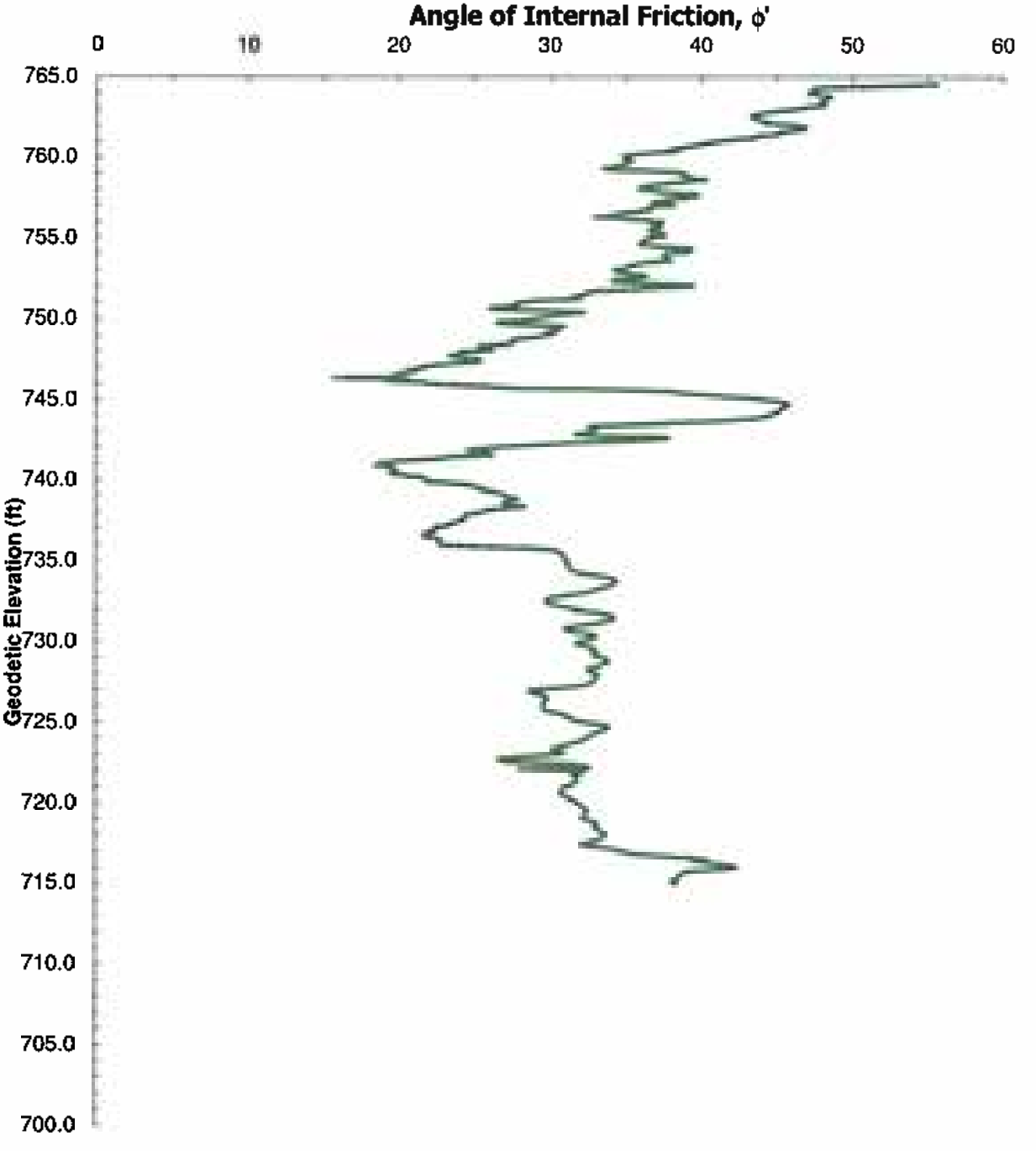
Project No. 175569042

STN-42A

Stantec

SCPTu RESULTS

Effective Angle of Internal Friction



Project No. 175569042

STN-42A

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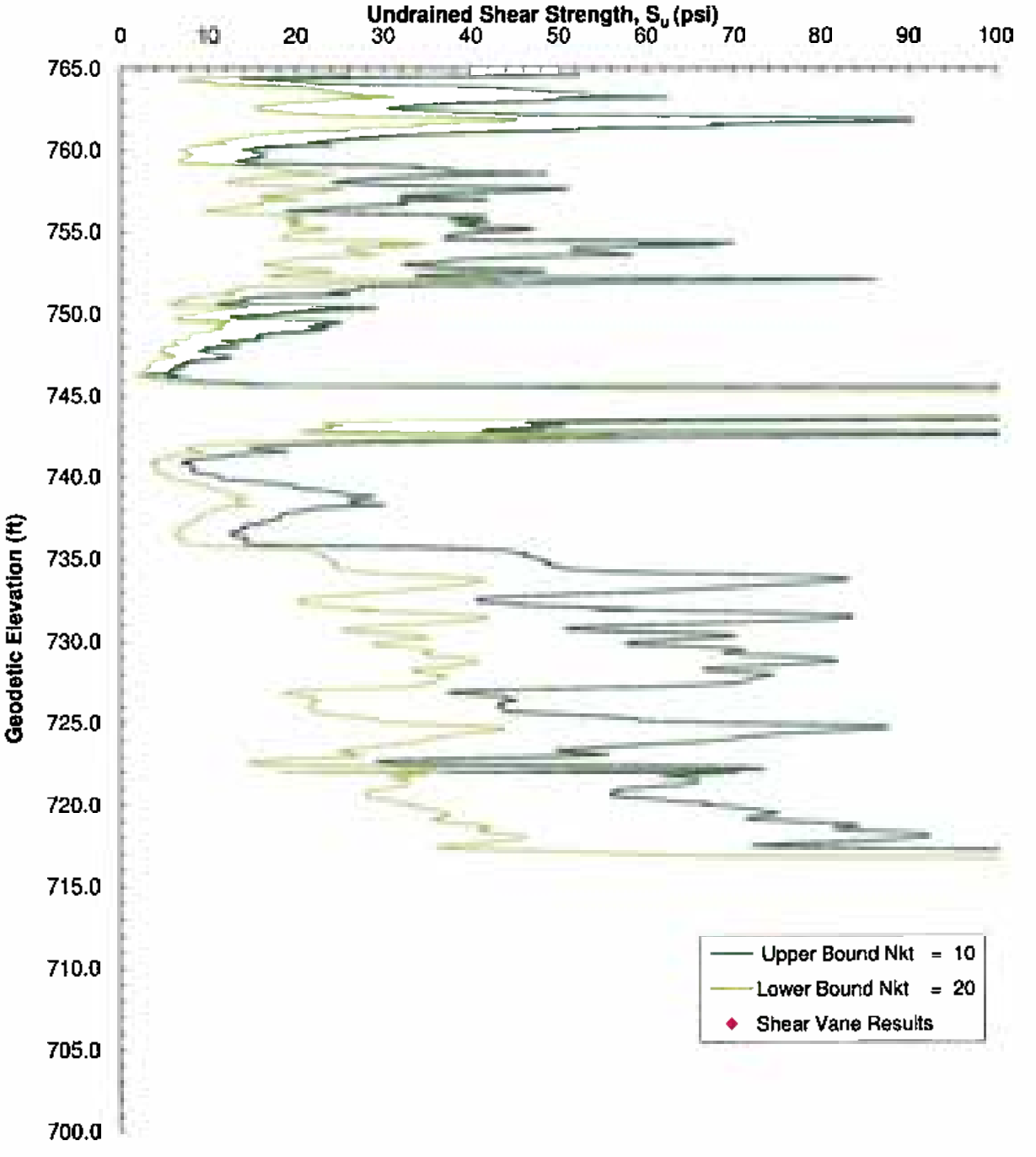
SCPTu RESULTS

Undrained Shear Strength, S_u



Project No. 175569042

STN-42A

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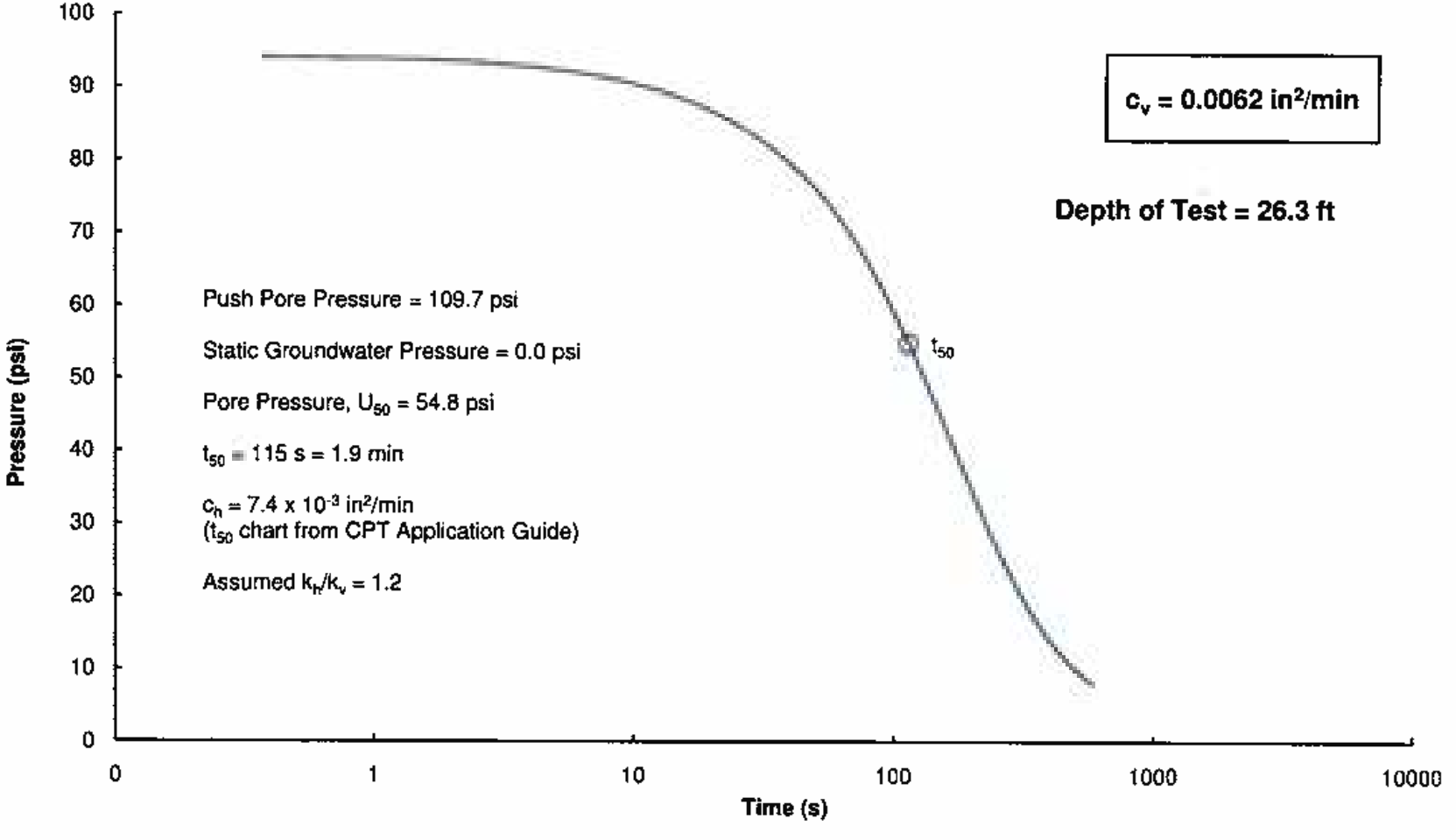
Stantec Consulting Inc.

SCPTu DISSIPATION RESULTS
Coefficient of Consolidation



c_v = 0.0062 in²/min

Depth of Test = 26.3 ft

Push Pore Pressure = 109.7 psi

Static Groundwater Pressure = 0.0 psi

Pore Pressure, U_{50} = 54.8 psi

t_{50} = 115 s = 1.9 min

$c_h = 7.4 \times 10^{-3}$ in²/min
(t_{50} chart from CPT Application Guide)

Assumed $k_h/k_v = 1.2$

Project No. 175569042
STN-42A

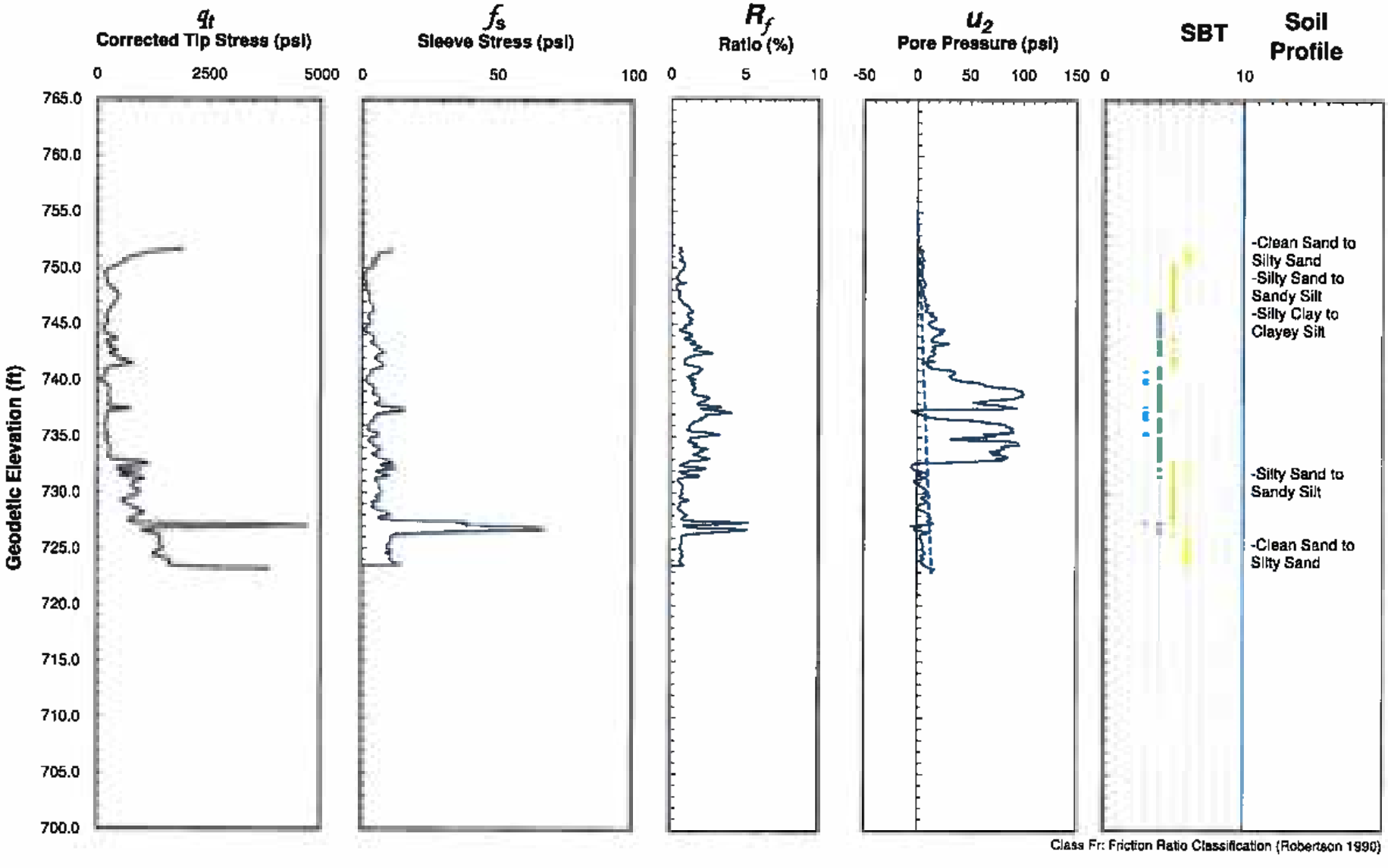
C:\ashpond\CPT42.xlsm

Stantec Consulting Inc.

Elevation:	765.90 ft	Test Date: May 20, 2009	STN-43A
SCPTu Start Elevation:	751.90 ft	Project No. 175569042	
Groundwater Elevation:	754.90 ft		

Client: TVA

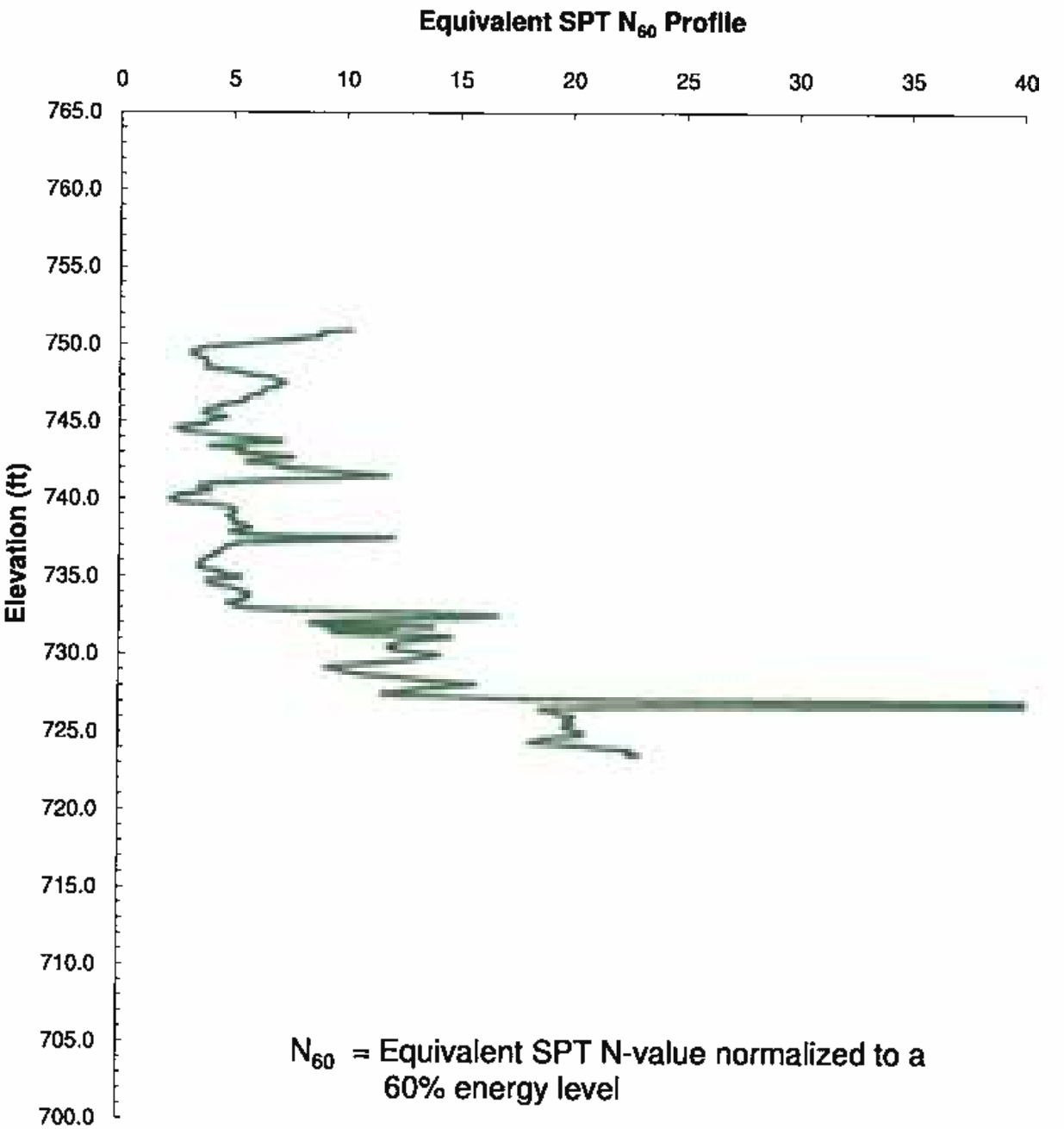
Project: Kingston Ash Pond



Class Fr: Friction Ratio Classification (Robertson 1990)

SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

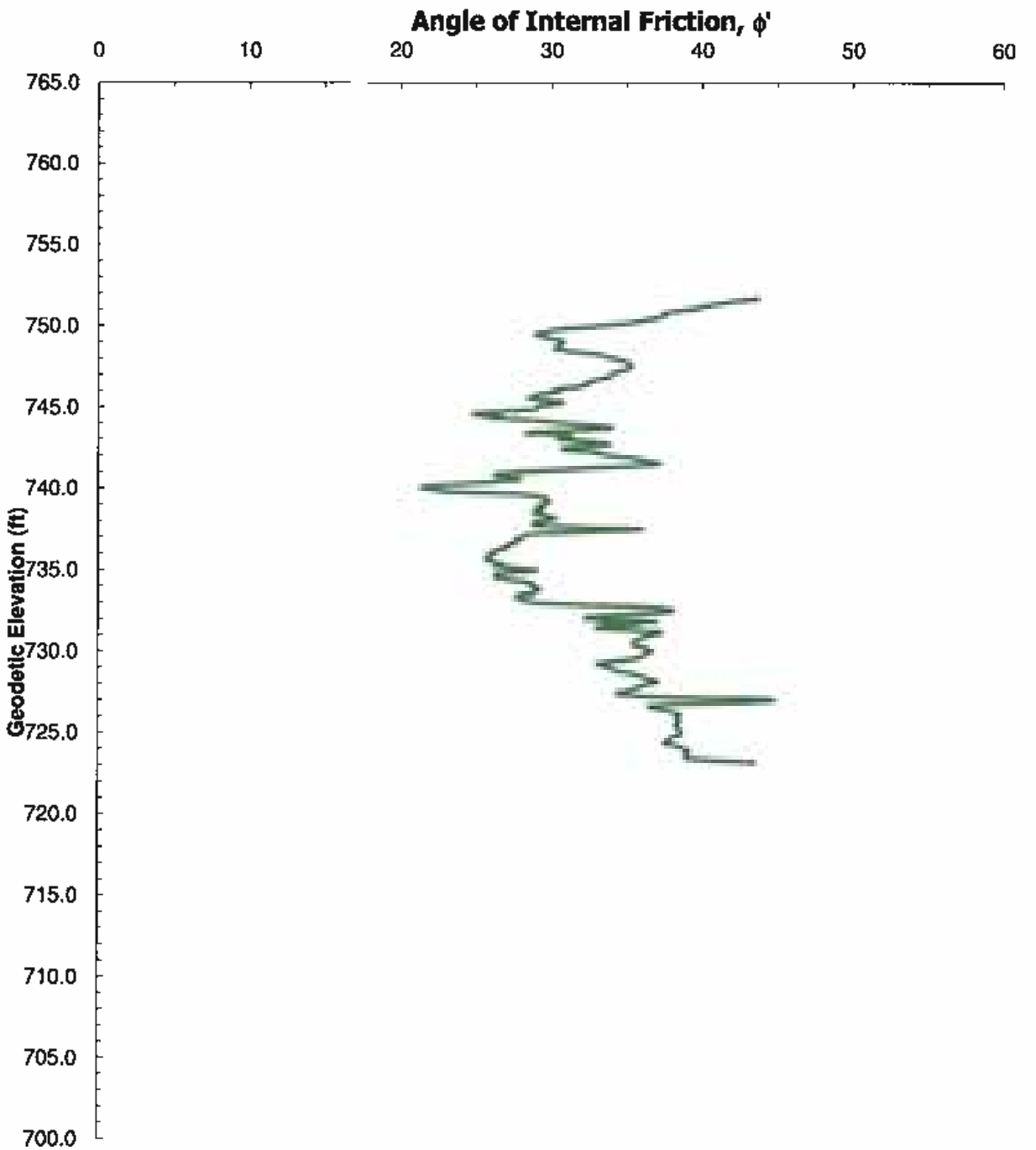
Project No. 175569042

STN-43A

Stantec

SCPTu RESULTS

Effective Angle of Internal Friction

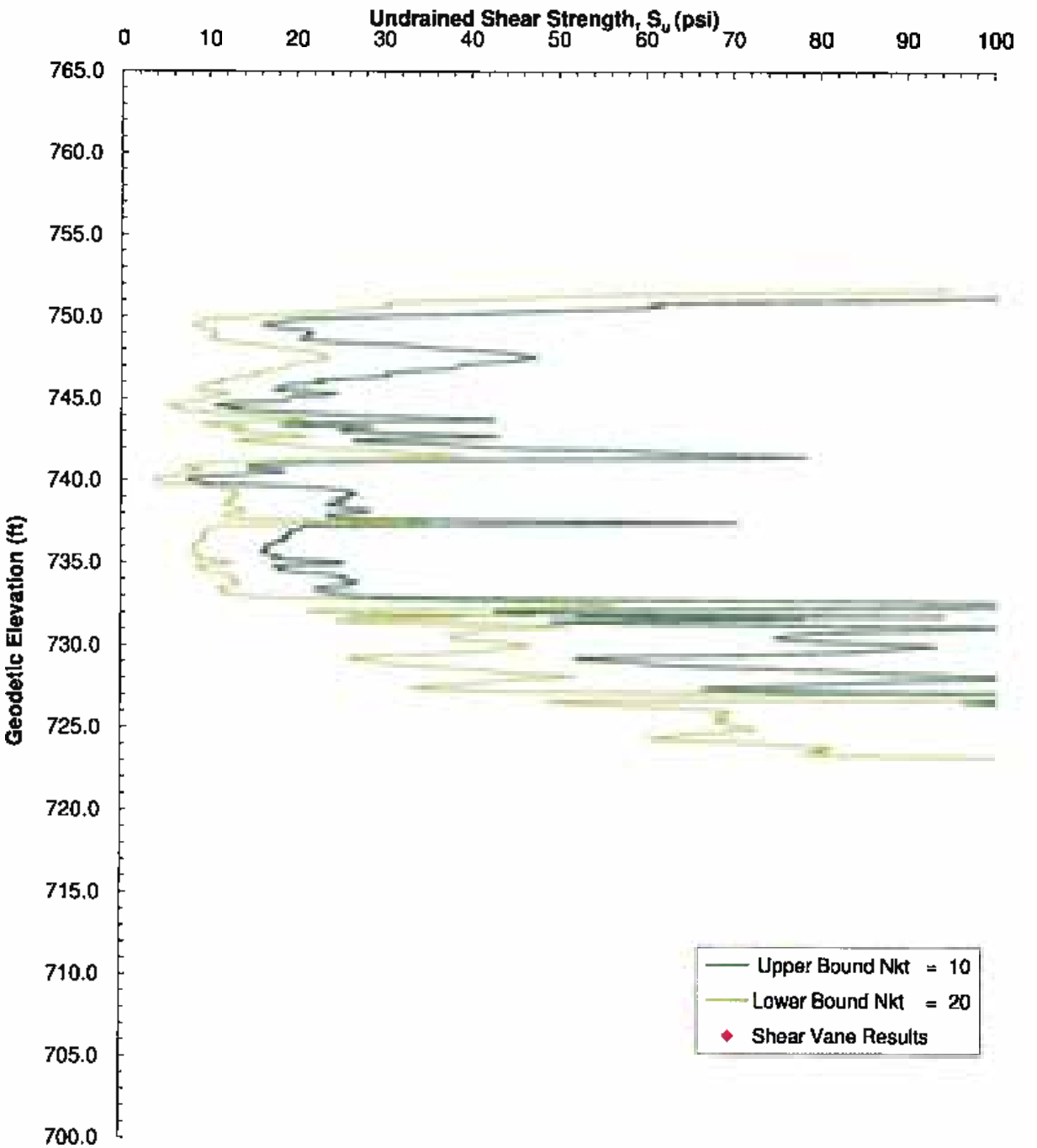


Project No. 175569042

STN-43A

SCPTu RESULTS

Undrained Shear Strength, S_u



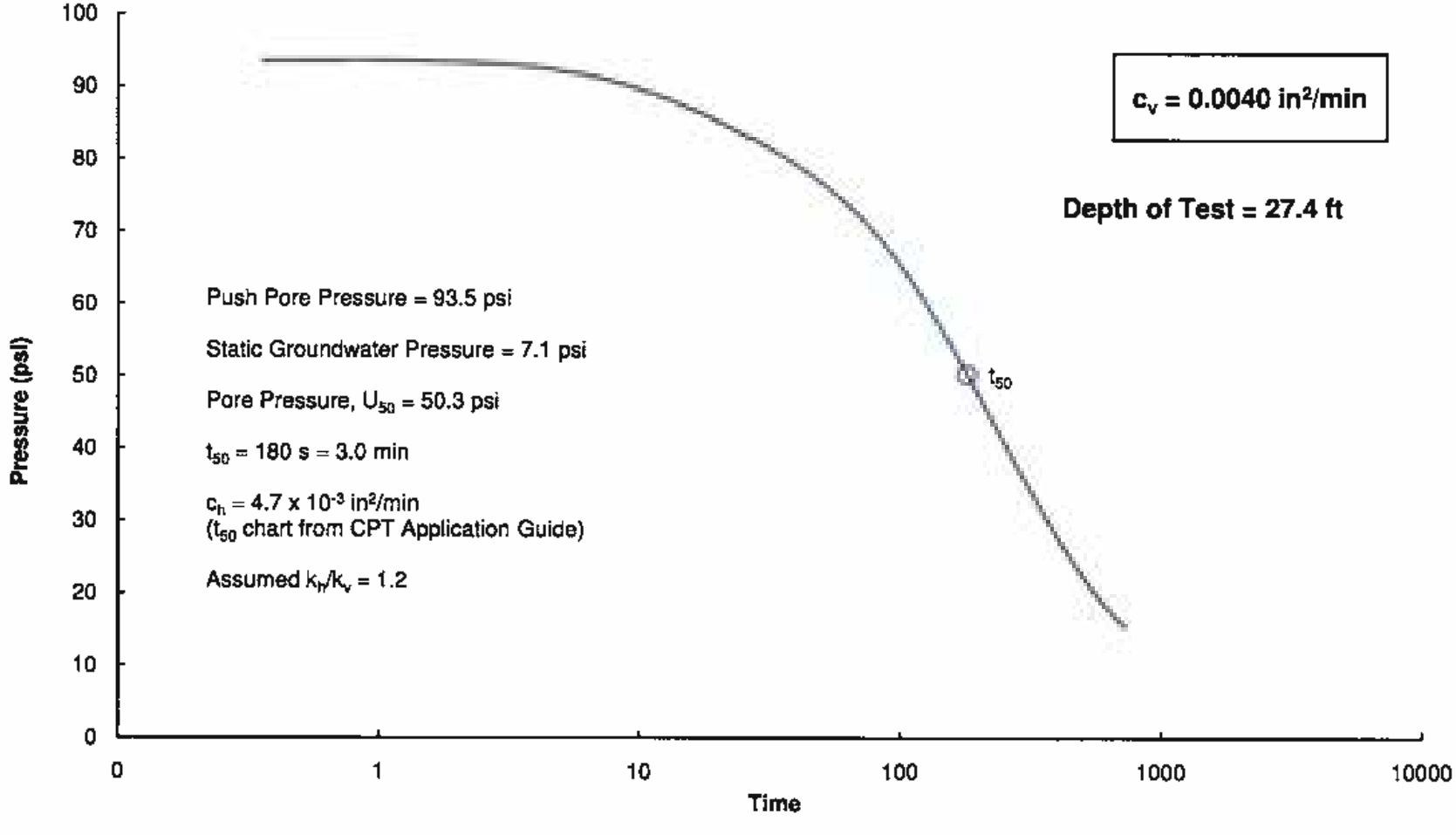
Project No. 175569042

STN-43A

C:\ashpond\week 2009-05-22\CPT43.xlsm

Stantec Consulting Inc.

SCPTu DISSIPATION RESULTS
Coefficient of Consolidation



c_v = 0.0040 in²/min

Depth of Test = 27.4 ft

Push Pore Pressure = 93.5 psi

Static Groundwater Pressure = 7.1 psi

Pore Pressure, U_{50} = 50.3 psi

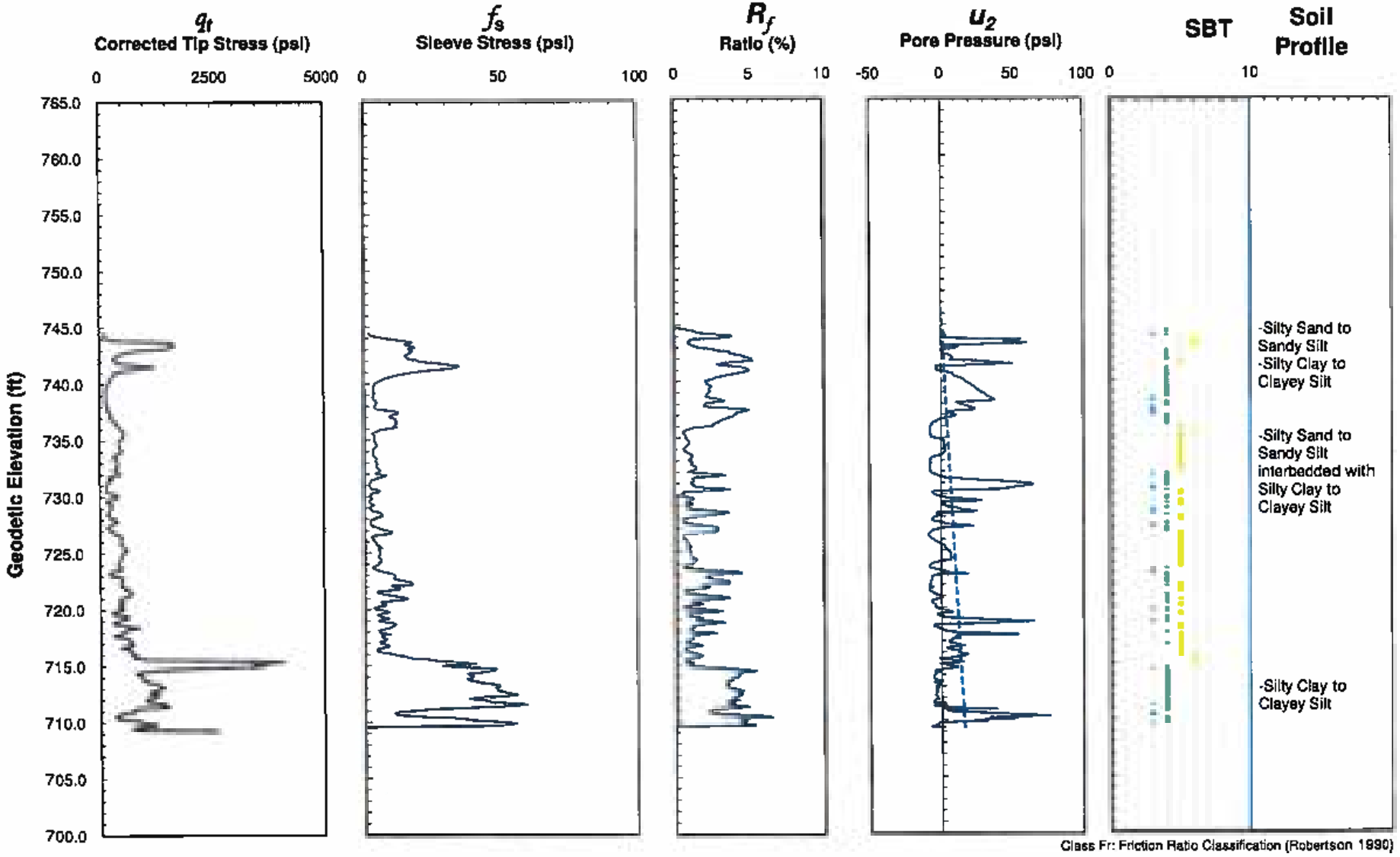
t_{50} = 180 s = 3.0 min

c_h = 4.7 x 10^{-3} in²/min
(t_{50} chart from CPT Application Guide)

Assumed k_h/k_v = 1.2

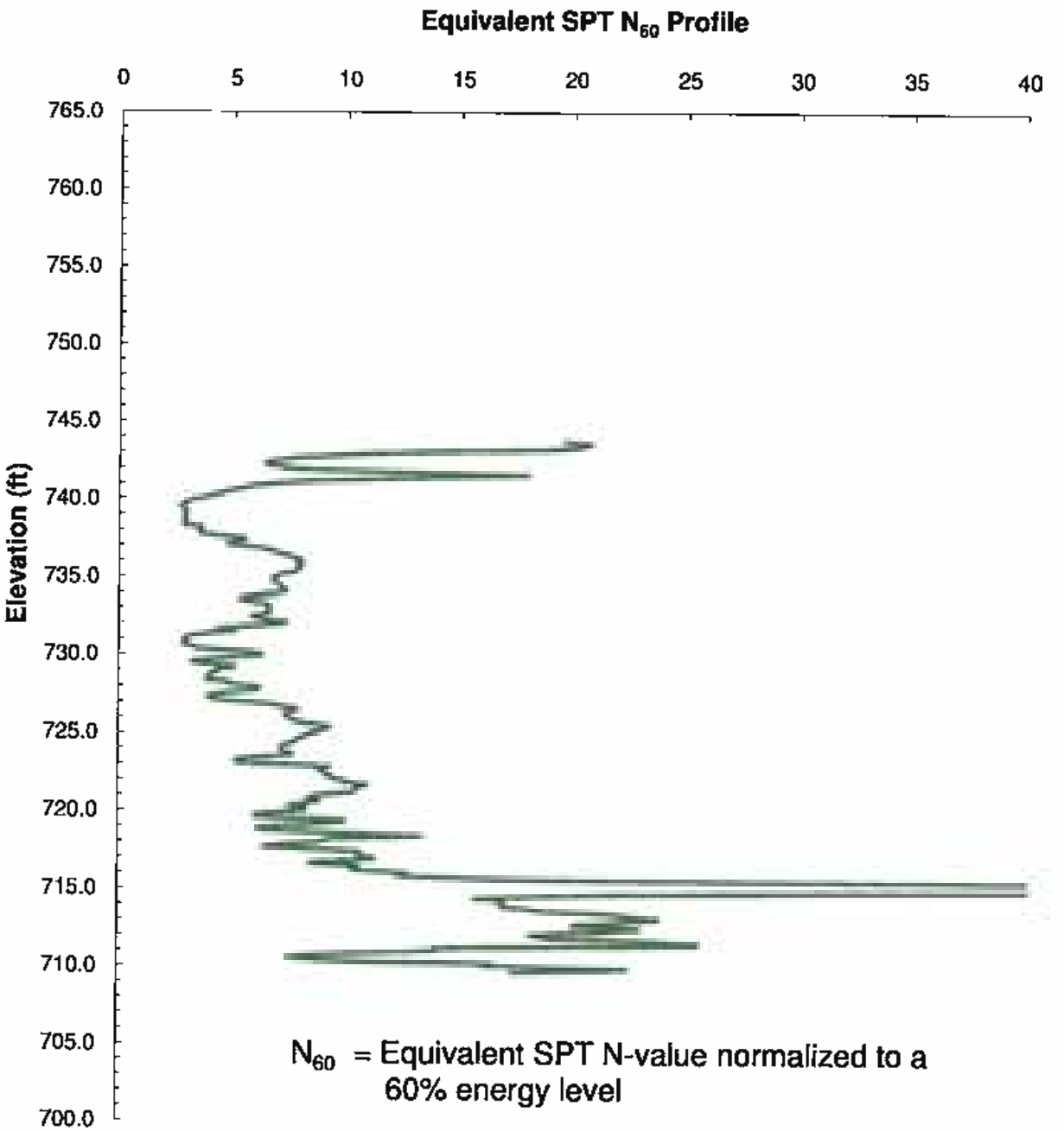
Project No. 175569042
STN-43A

Stantec Consulting Inc.	Elevation: 753.80 ft SCPTu Start Elevation: 744.80 ft Groundwater Elevation: 746.40 ft	Test Date: May 20, 2009 Project No. 175669015	STN-47B
	Client: TVA Project: Kingston Ash Pond		



SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

Project No. 175669015

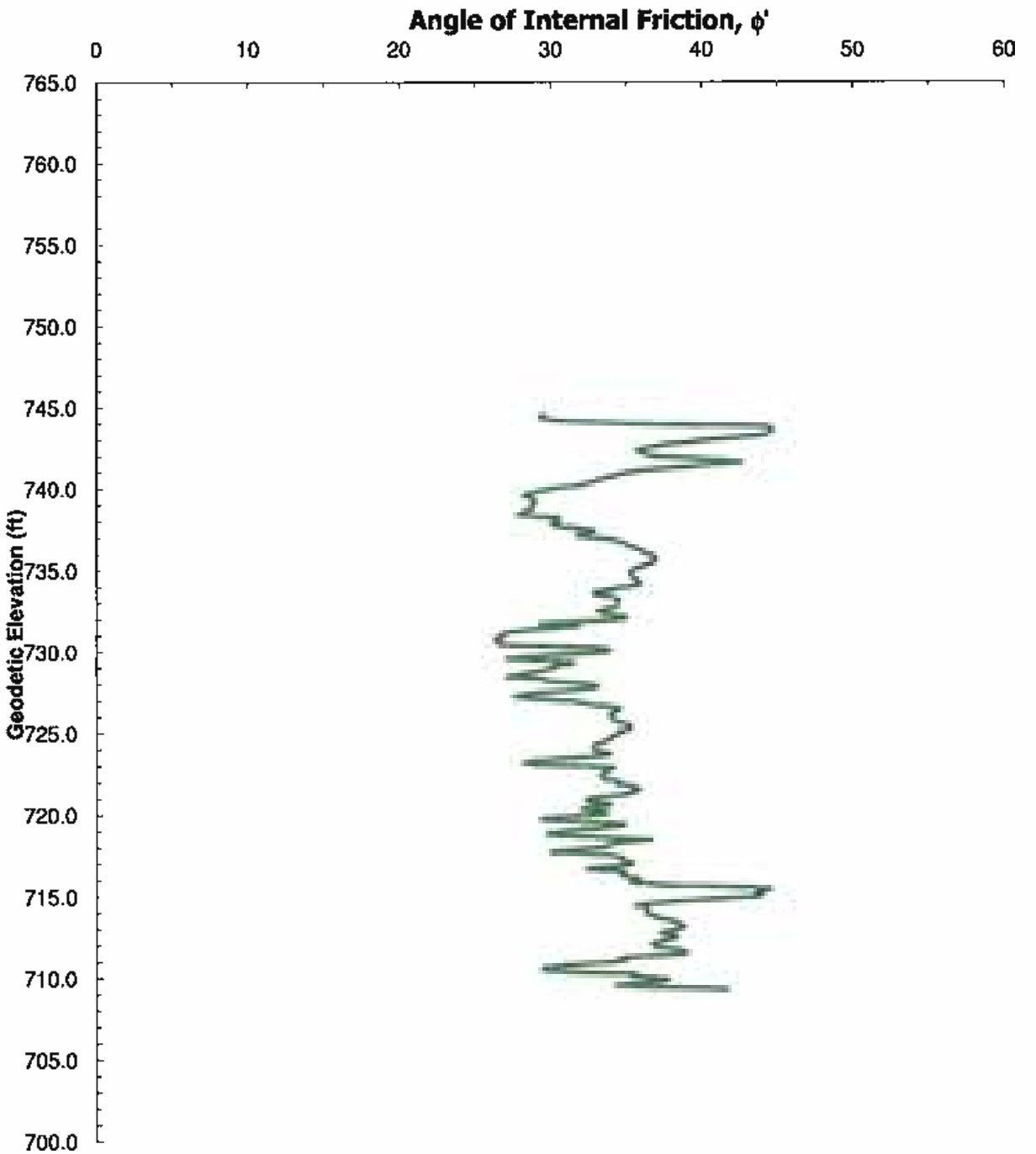
STN-47B

C:\ashpond\week 2009-05-22\CPT47.xlsm

Stantec

SCPTu RESULTS

Effective Angle of Internal Friction

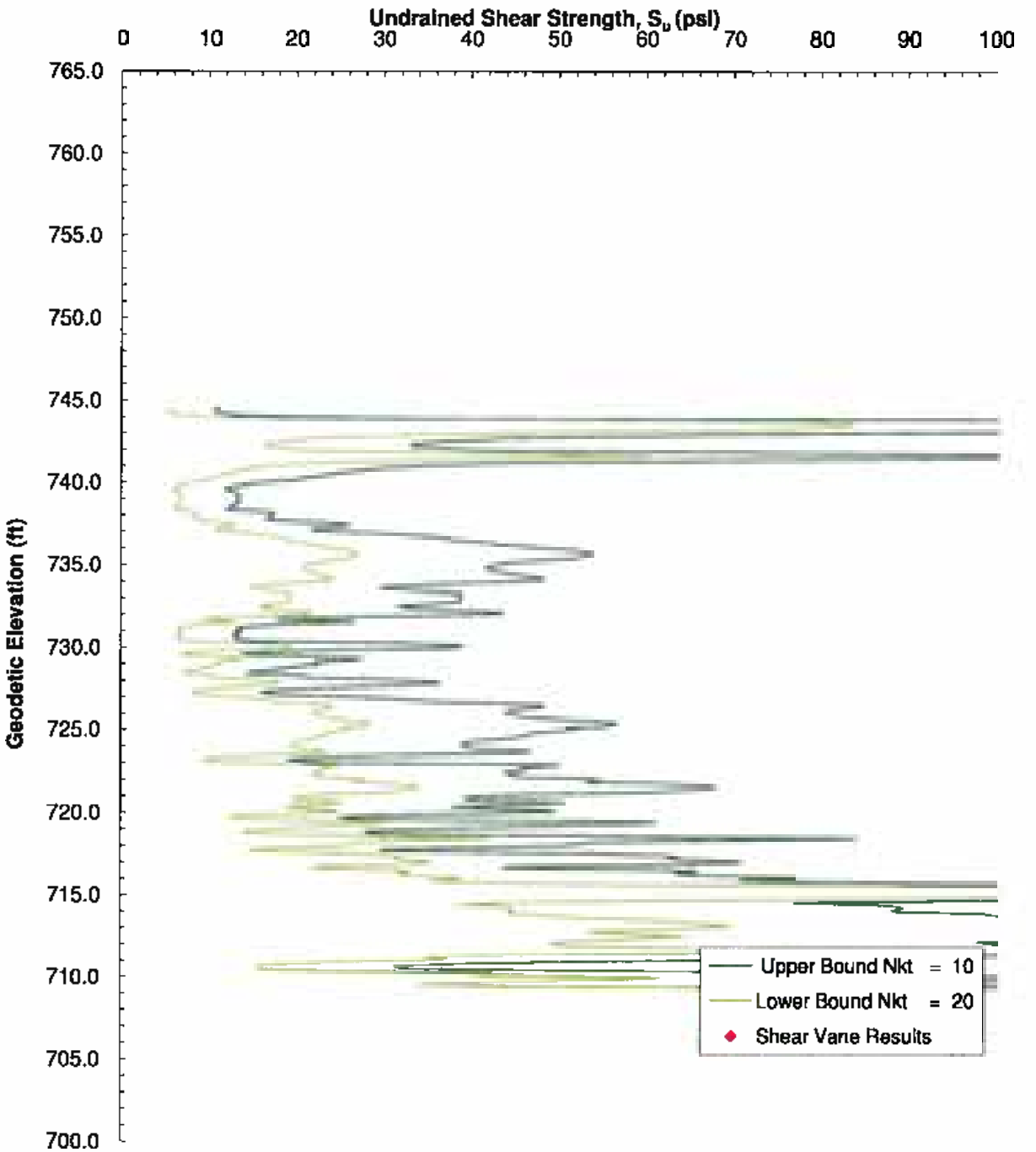


Project No. 175669015

STN-47B

SCPTu RESULTS

Undrained Shear Strength, S_u



Project No. 175669015

STN-47B

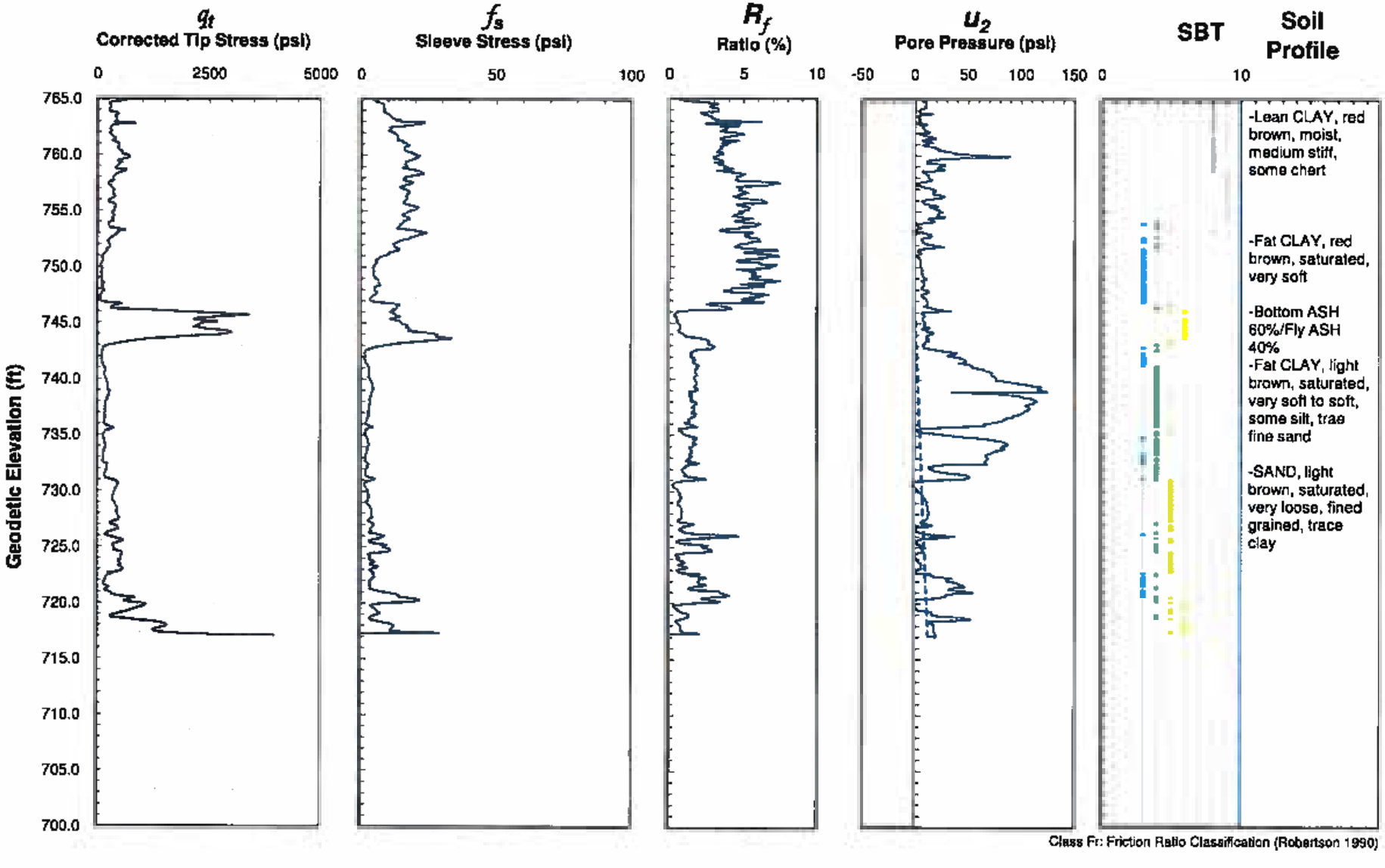
C:\ashpond\week 2009-05-22\CPT47.xlsm

Stantec Consulting Inc.

Elevation:	765.30 ft	Test Date: May 7, 2009	STN-48C
SCPTu Start Elevation:	765.30 ft	Project No. 175569042	
Groundwater Elevation:	745.30 ft		

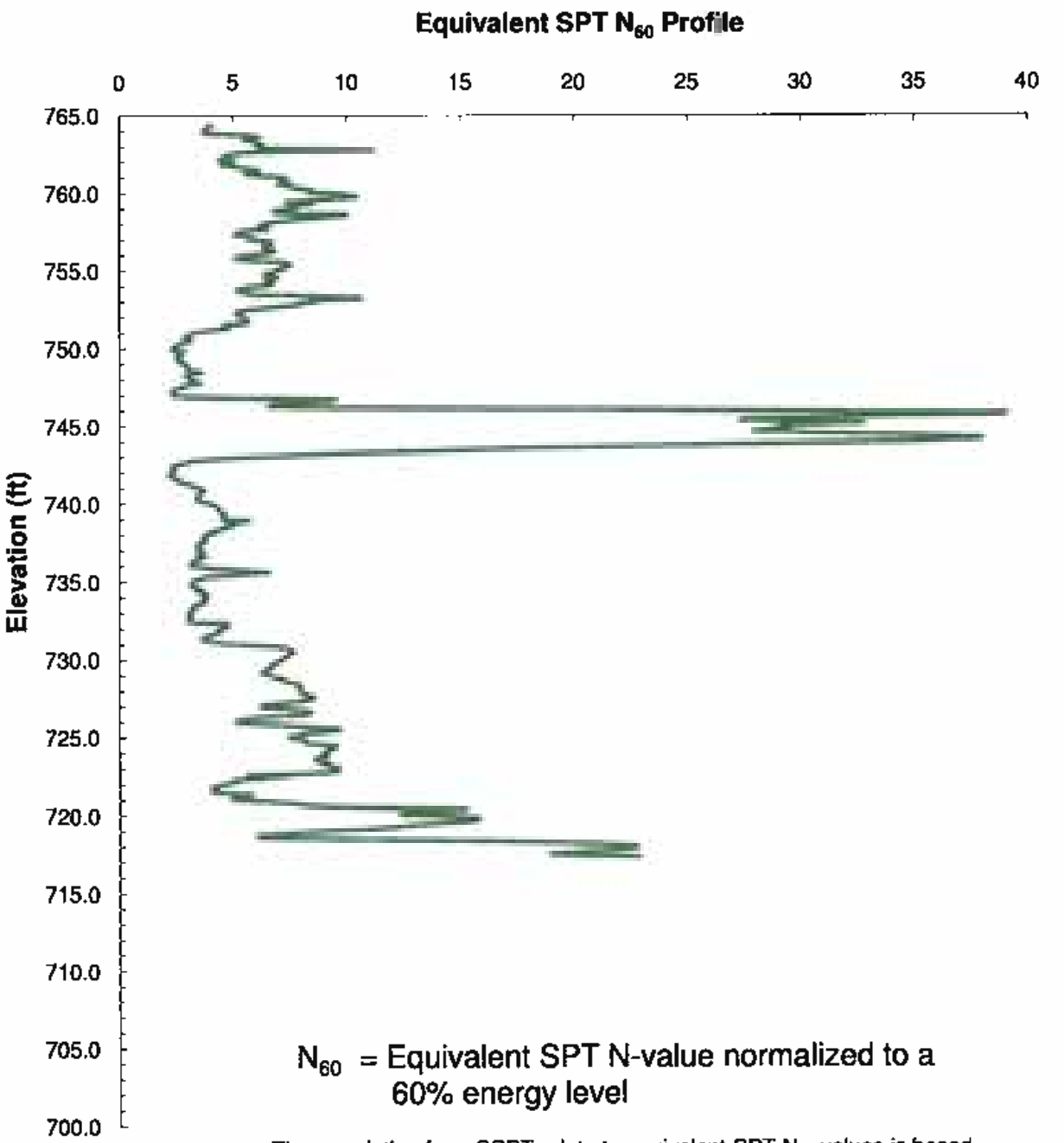
Client: TVA

Project: Kingston Ash Pond



SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

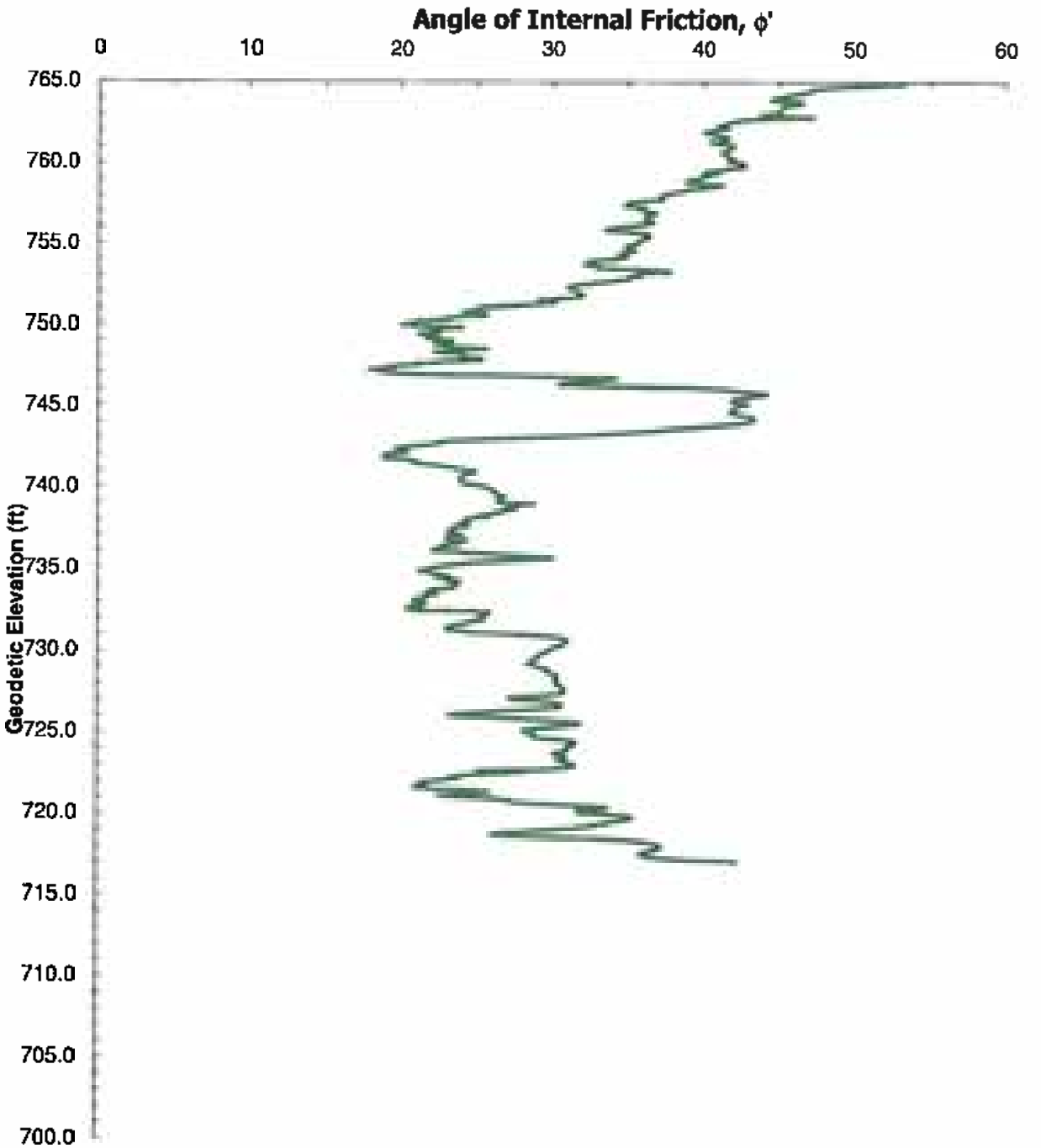
The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

Project No. 175569042

STN-48C

SCPTu RESULTS

Effective Angle of Internal Friction

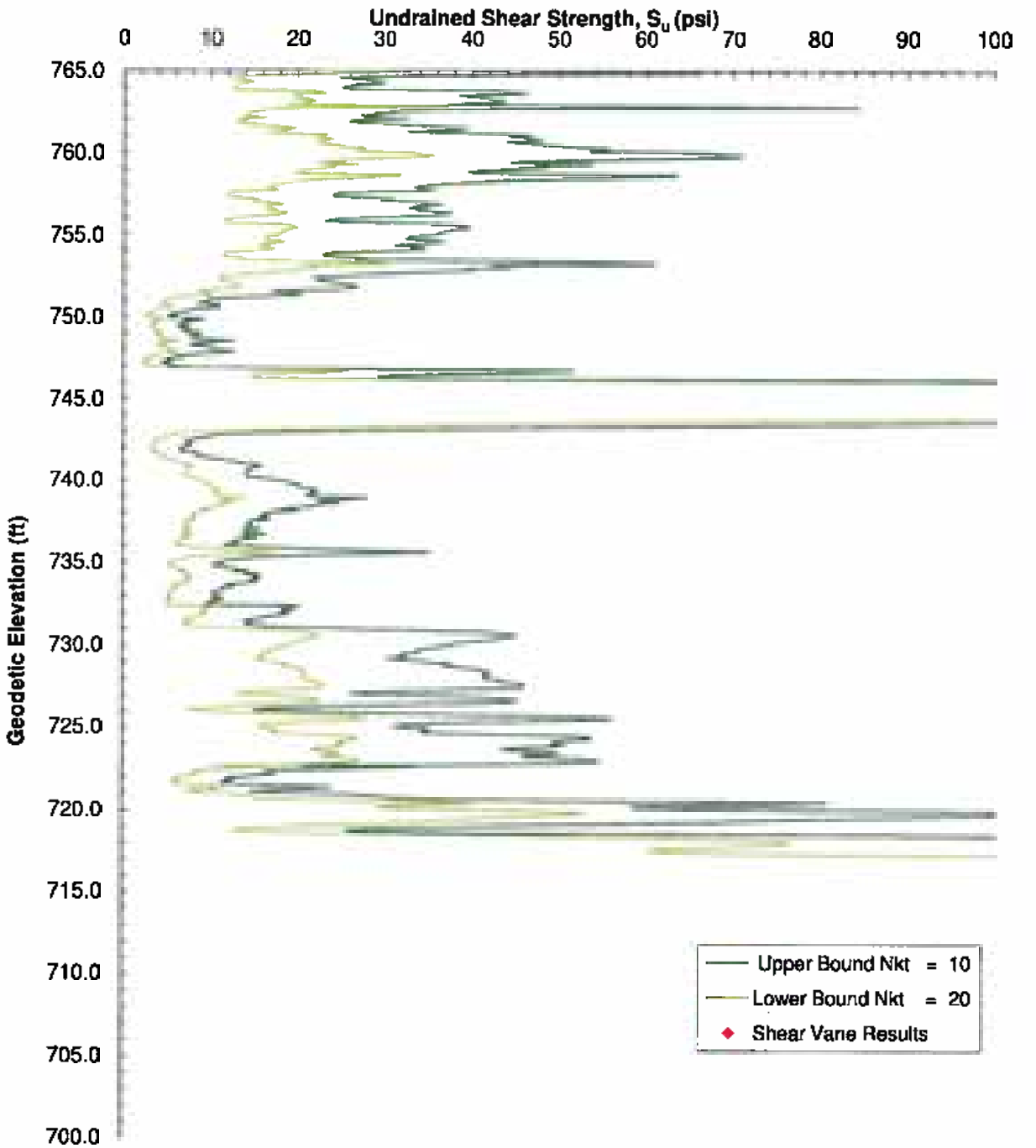


Project No. 175569042

STN-48C

SCPTu RESULTS

Undrained Shear Strength, S_u

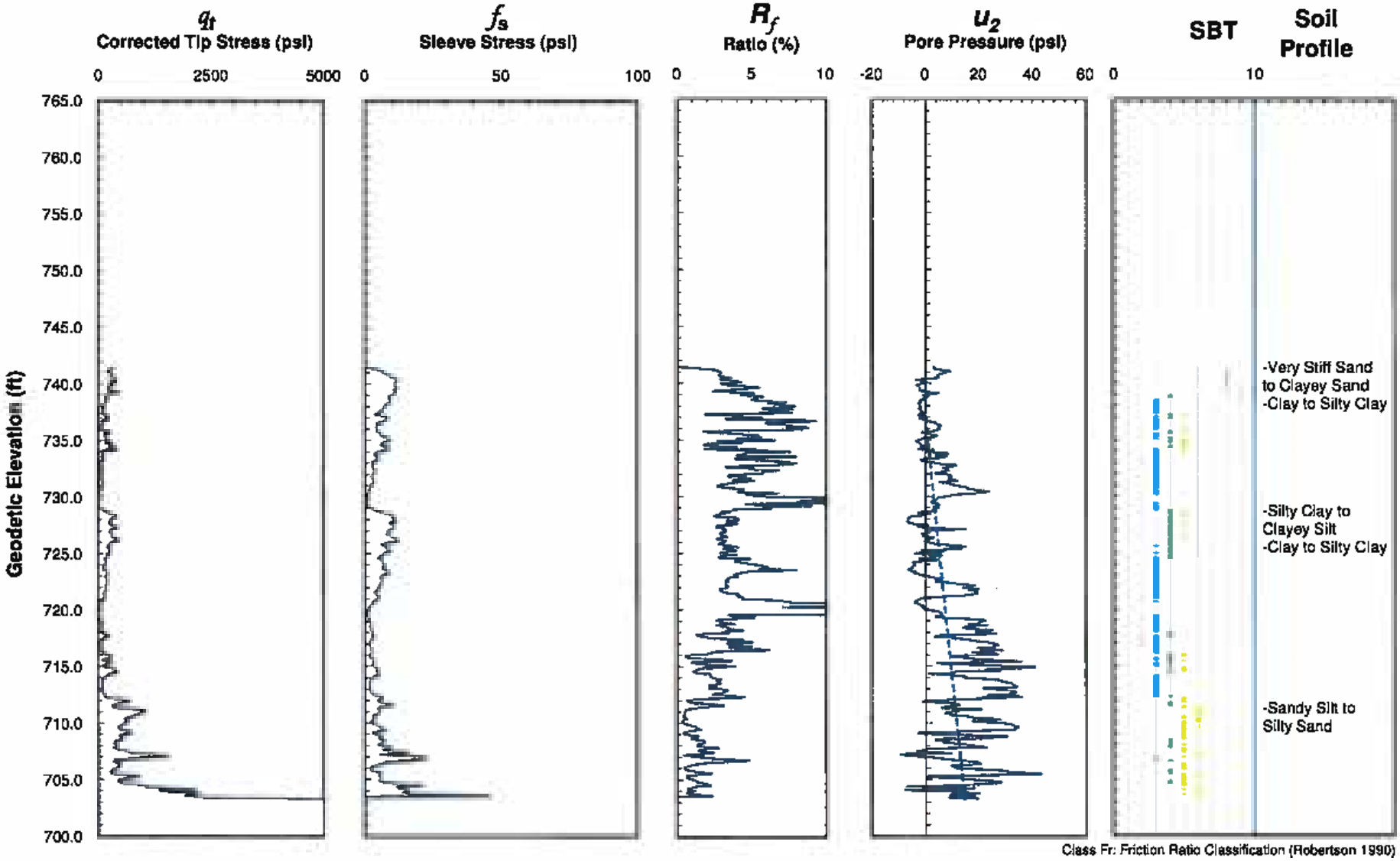


Project No. 175569042

STN-48C

C:\ashpond\CPT48.xlsm

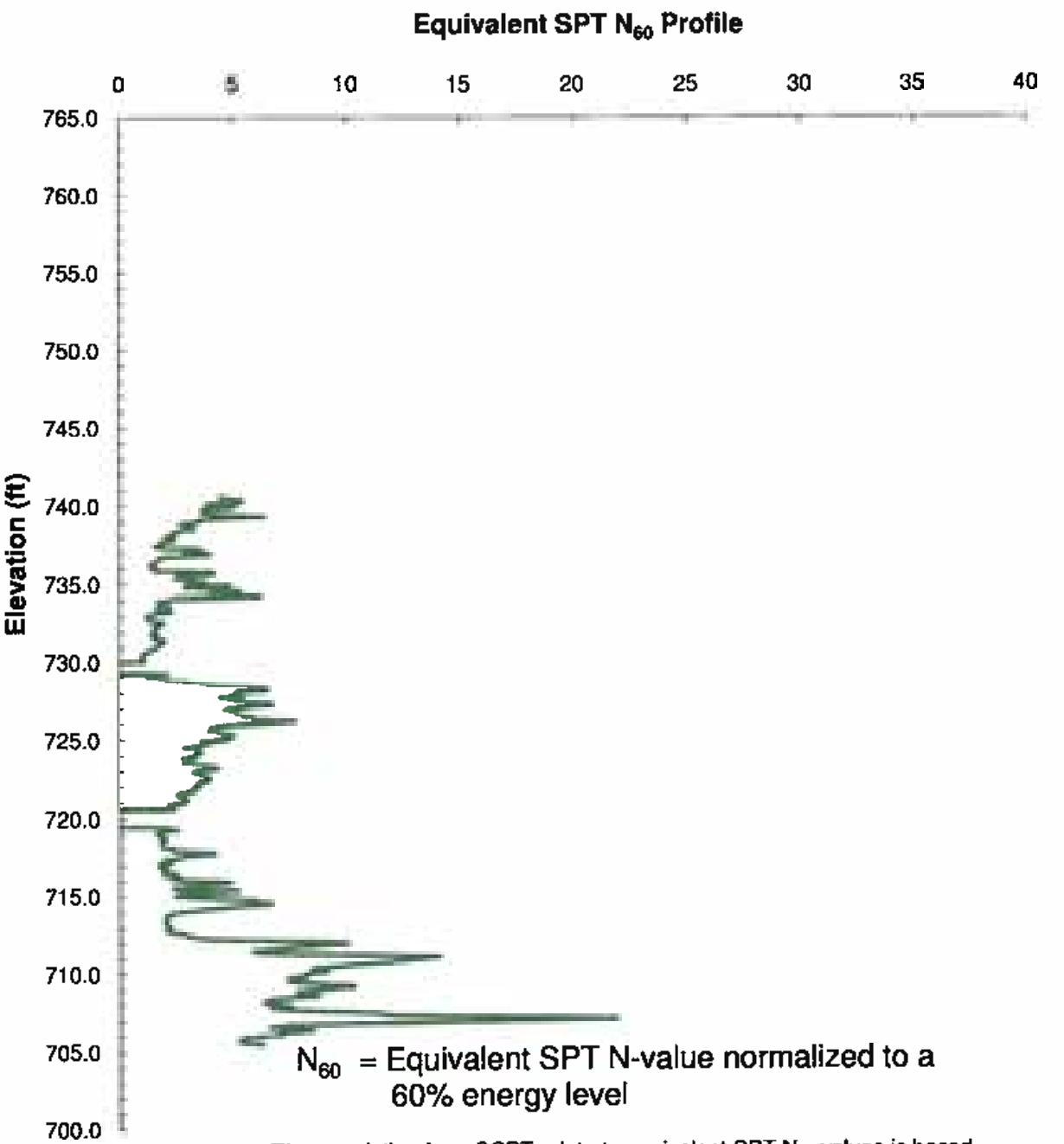
Stantec Consulting Inc.	Elevation: 741.60 ft SCPTu Start Elevation: 741.60 ft Groundwater Elevation: 737.00 ft	Test Date: May 19, 2009 Project No. 175569042	STN-50A
	Client: TVA Project: Kingston Ash Pond		



Class Fr: Friction Ratio Classification (Robertson 1990)

SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

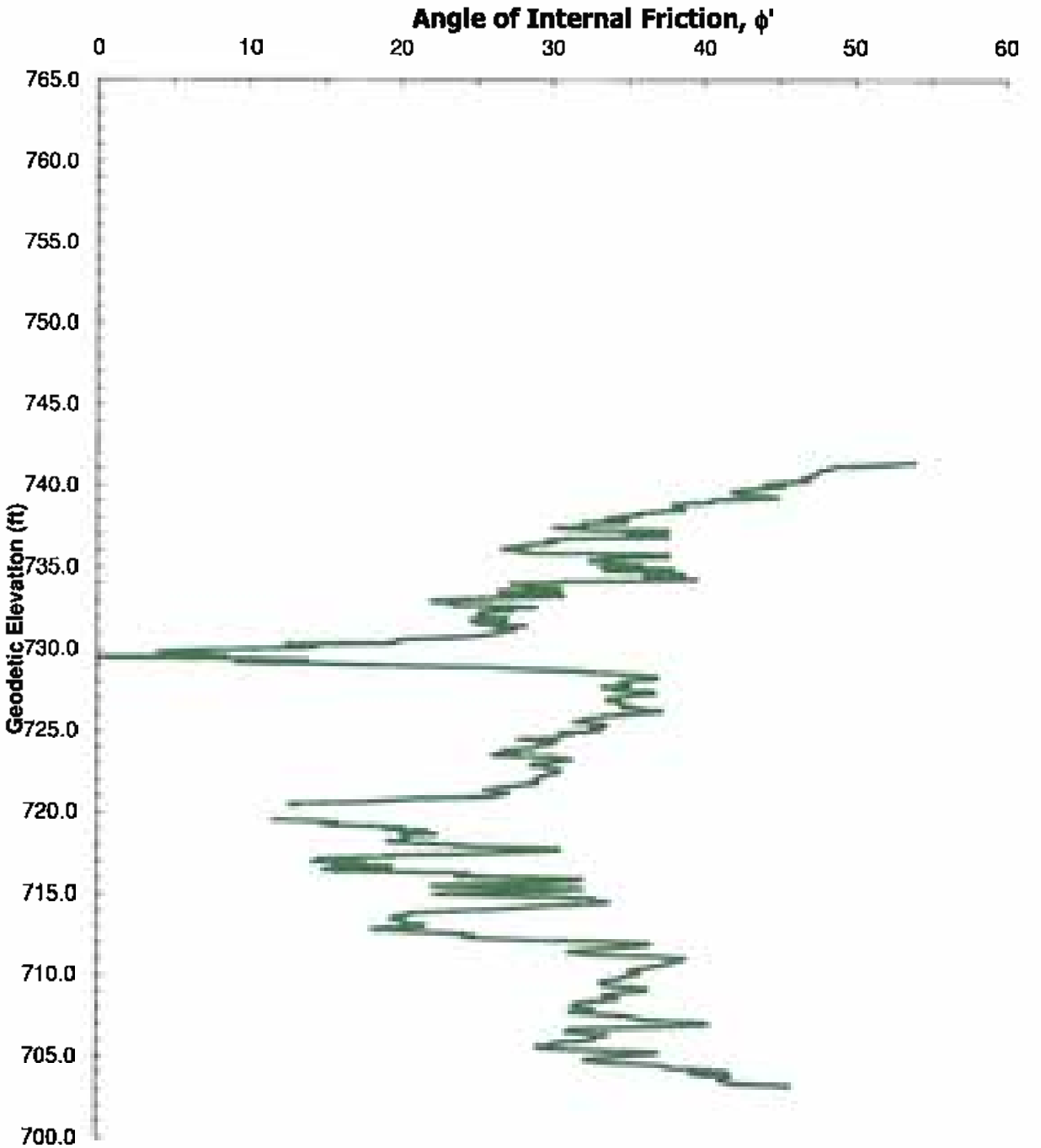
The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

Project No. 175569042

STN-50A

SCPTu RESULTS

Effective Angle of Internal Friction

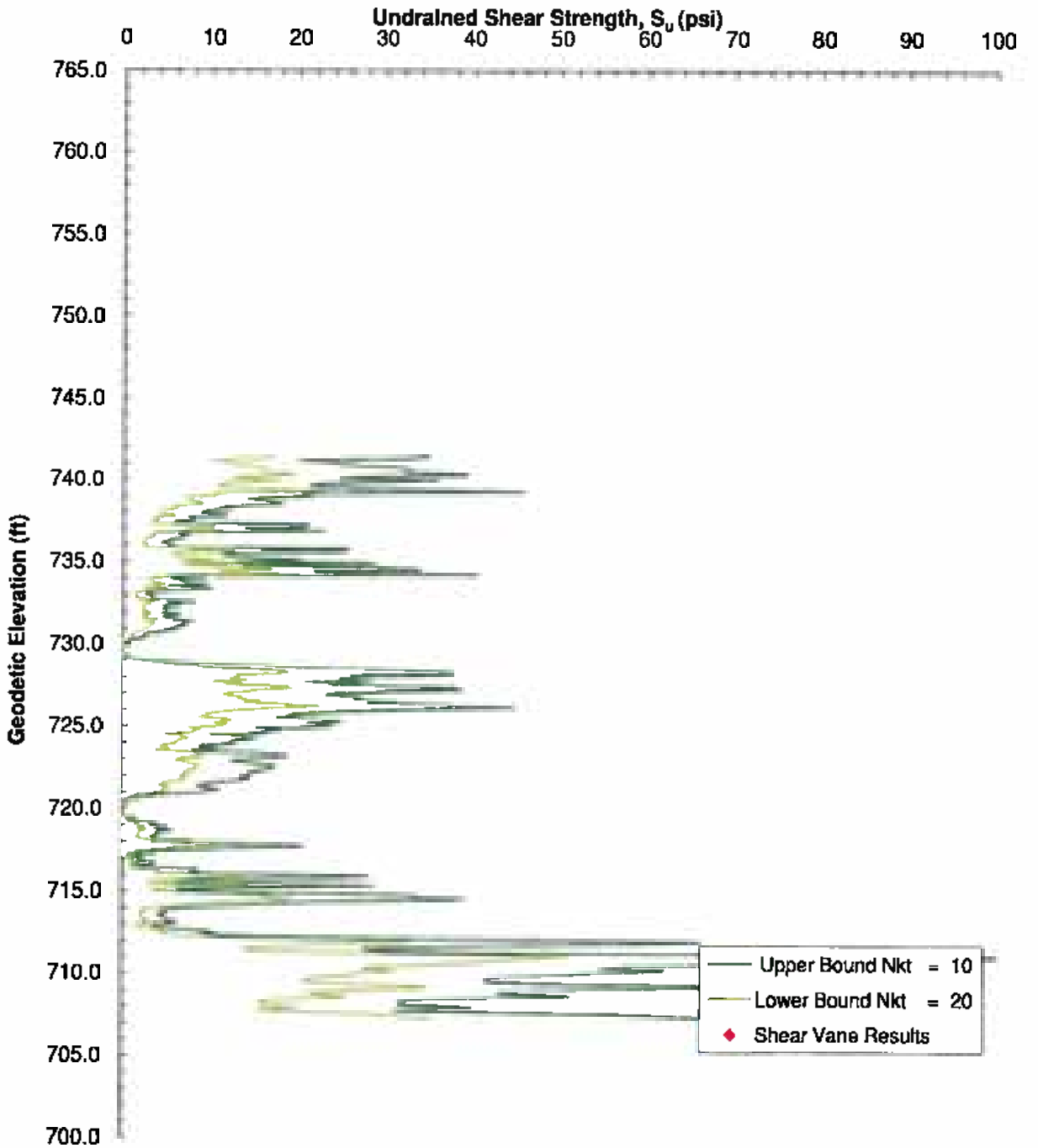


Project No. 175569042

STN-50A

SCPTu RESULTS

Undrained Shear Strength, S_u



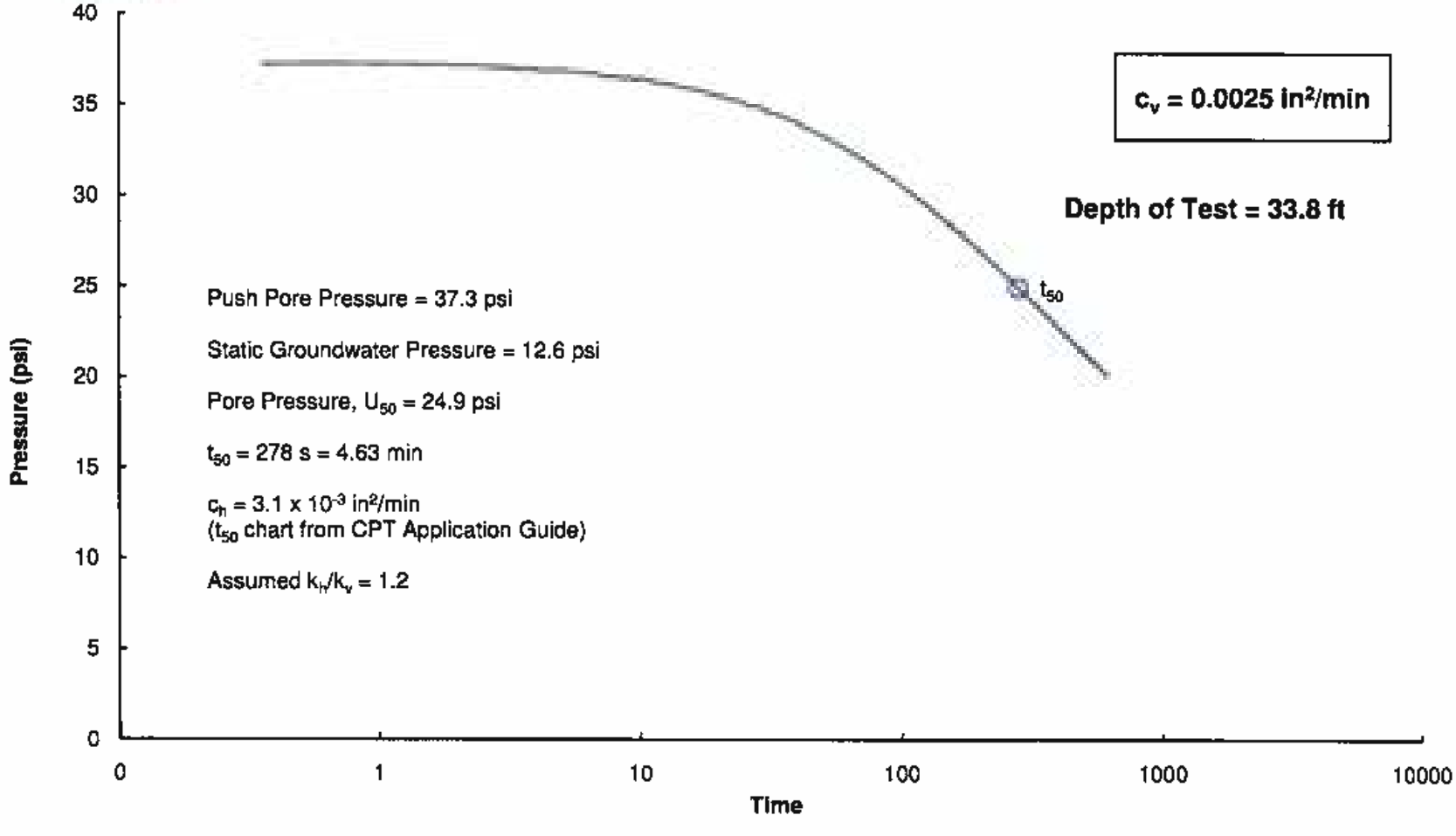
Project No. 175569042

STN-50A

C:\ashpond\week 2009-05-22\CPT50.xlsm

Stantec Consulting Inc.

SCPTu DISSIPATION RESULTS
Coefficient of Consolidation



c_v = 0.0025 in²/min

Depth of Test = 33.8 ft

Push Pore Pressure = 37.3 psi

Static Groundwater Pressure = 12.6 psi

Pore Pressure, U_{50} = 24.9 psi

t_{50} = 278 s = 4.63 min

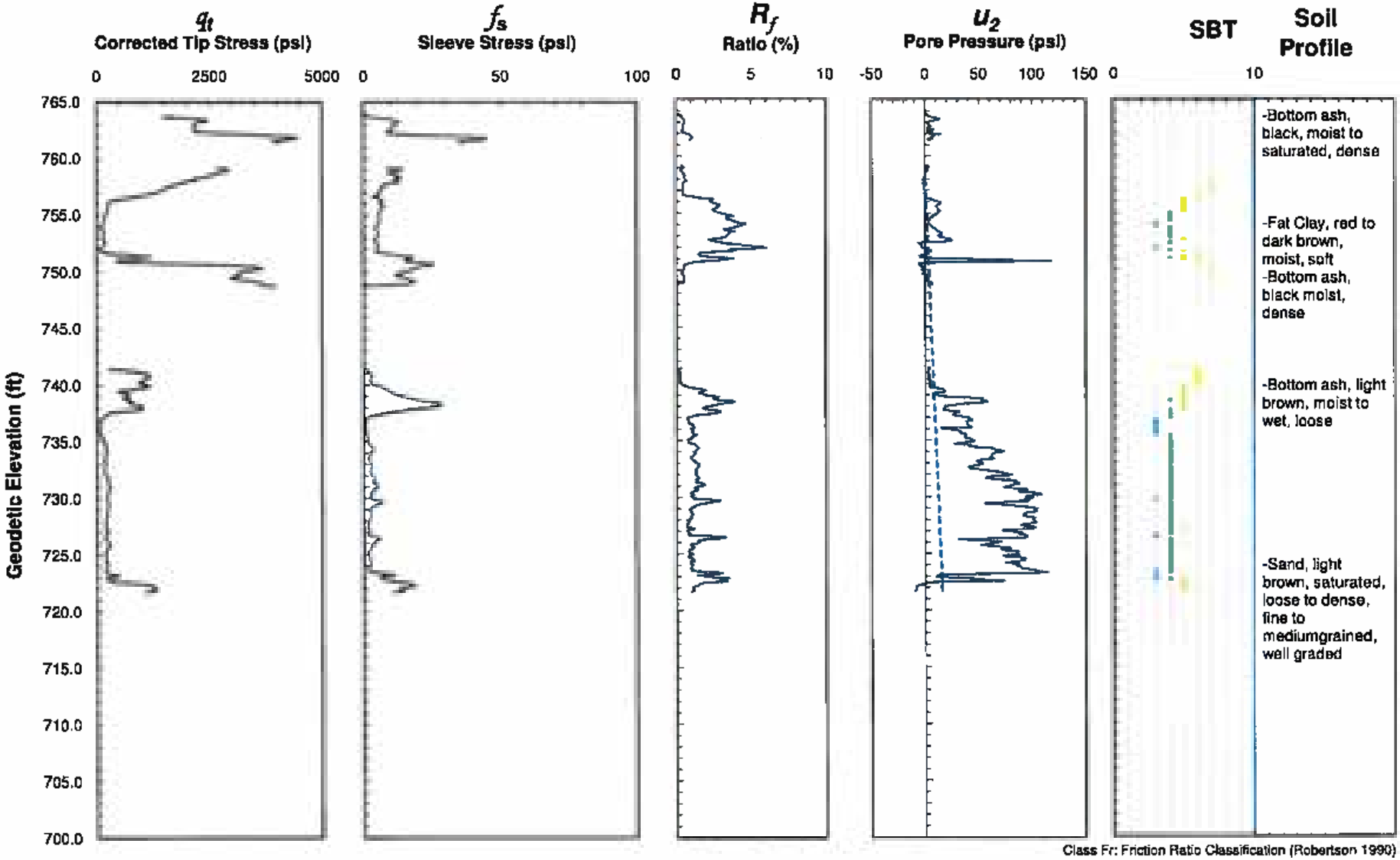
c_h = 3.1 x 10^{-3} in²/min
(t_{50} chart from CPT Application Guide)

Assumed k_h/k_v = 1.2

Project No. 175569042
STN-50A

C:\ashpond\week 2009-05-22\CPT50.xlsm

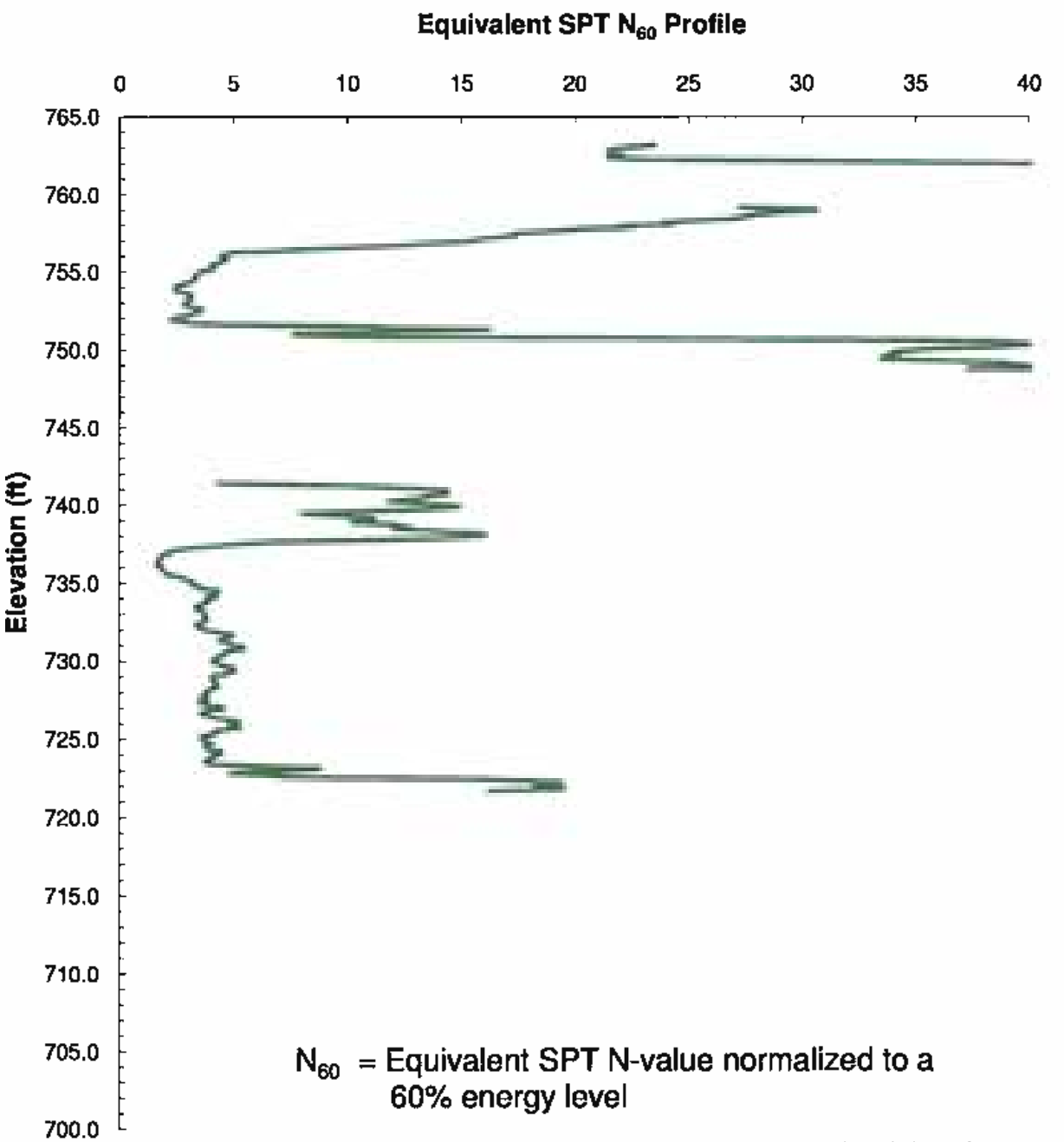
Stantec Consulting Inc.	Elevation: 763.90 ft SCPTu Start Elevation: 763.90 ft Groundwater Elevation: 757.90 ft	Test Date: May 6, 2009 Project No. 175569042	STN-53A
	Client: TVA Project: Kingston Ash Pond		



Class Fr: Friction Ratio Classification (Robertson 1990)

SCPTu Results

SCPTu N_{60} Values



N_{60} = Equivalent SPT N-value normalized to a 60% energy level

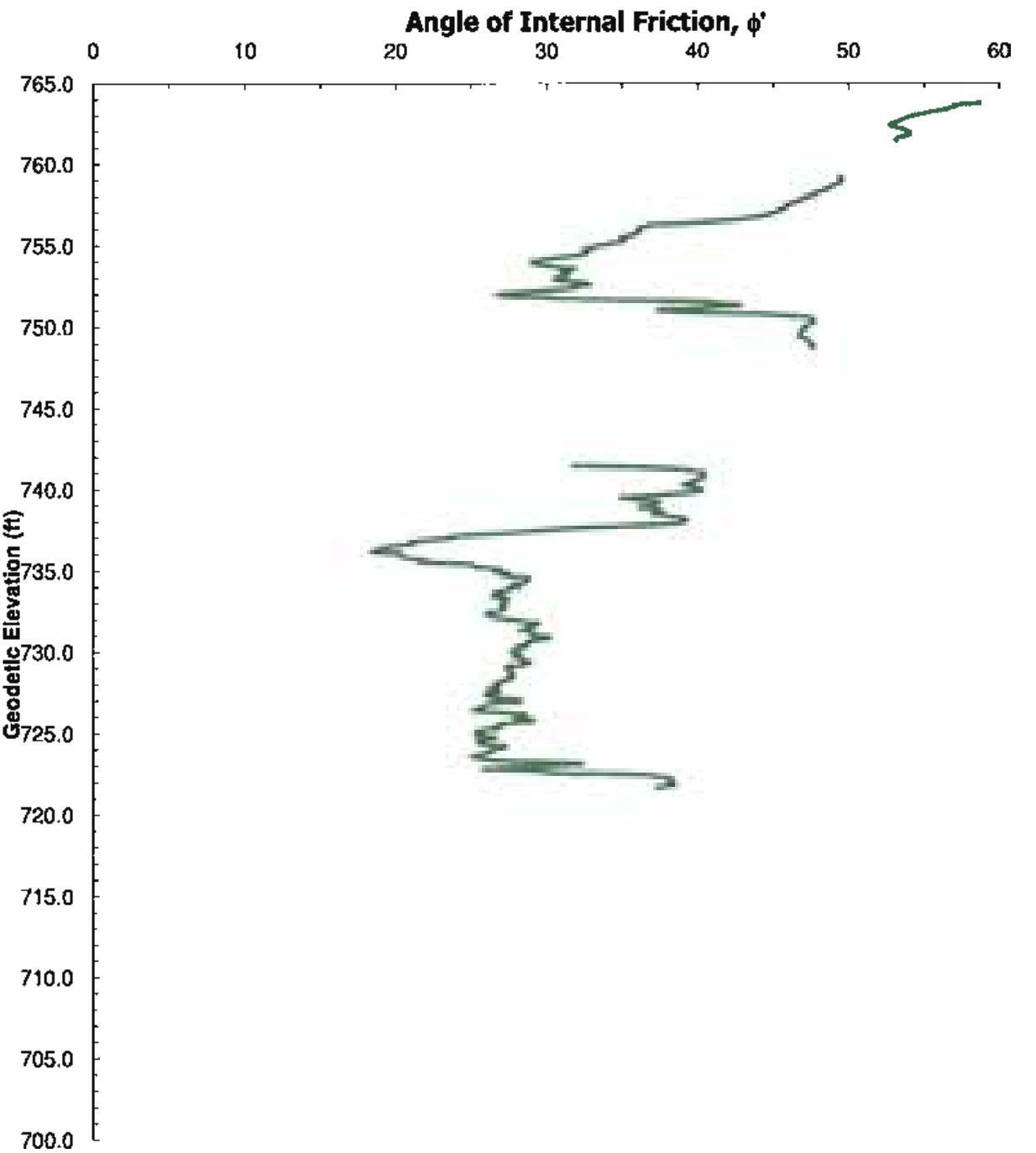
The correlation from SCPTu data to equivalent SPT N_{60} values is based on the Jefferies and Davies (1993) approach.

Project No. 175569042

STN-53A

SCPTu RESULTS

Effective Angle of Internal Friction

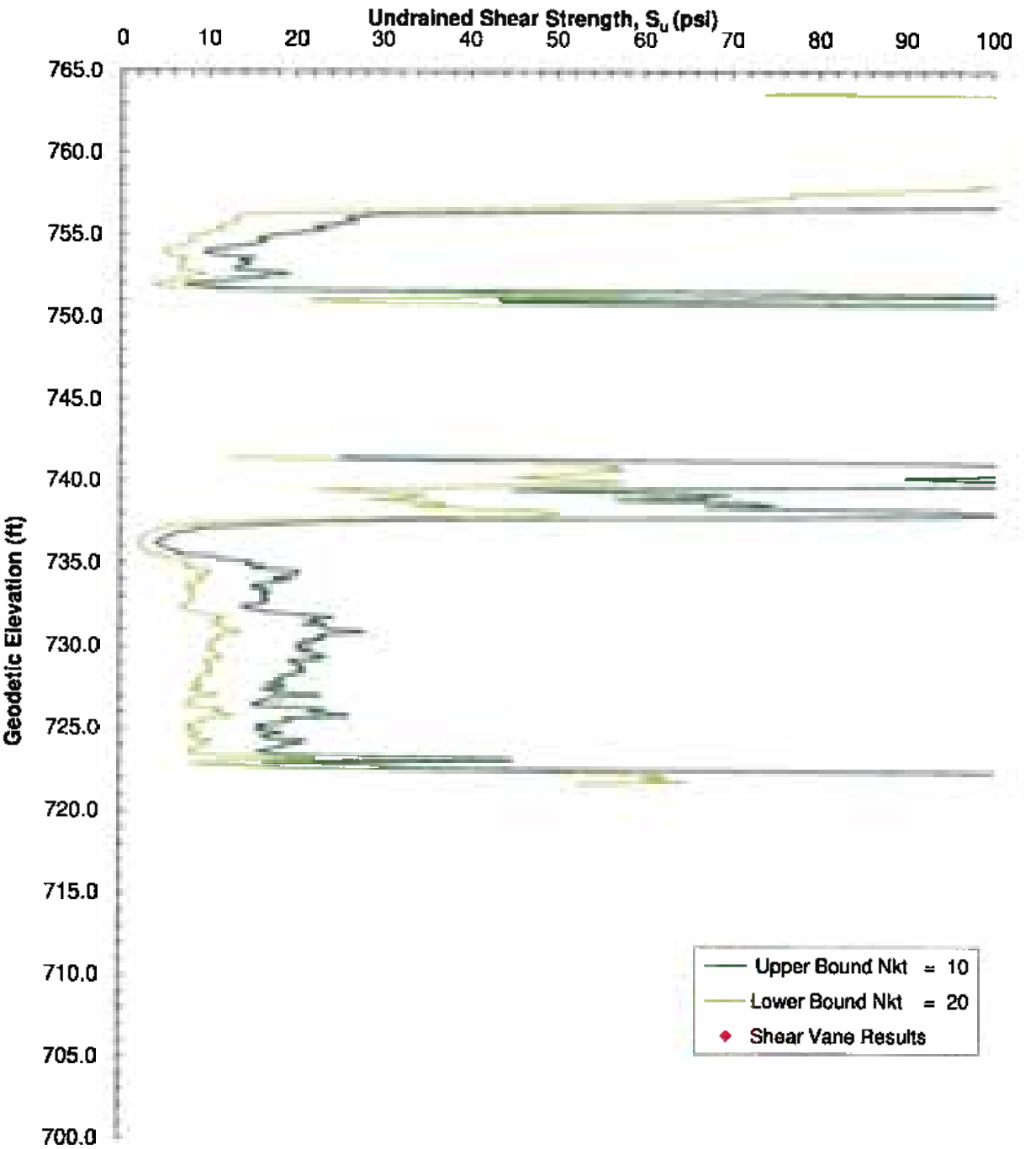


Project No. 175569042

STN-53A

SCPTu RESULTS

Undrained Shear Strength, S_u



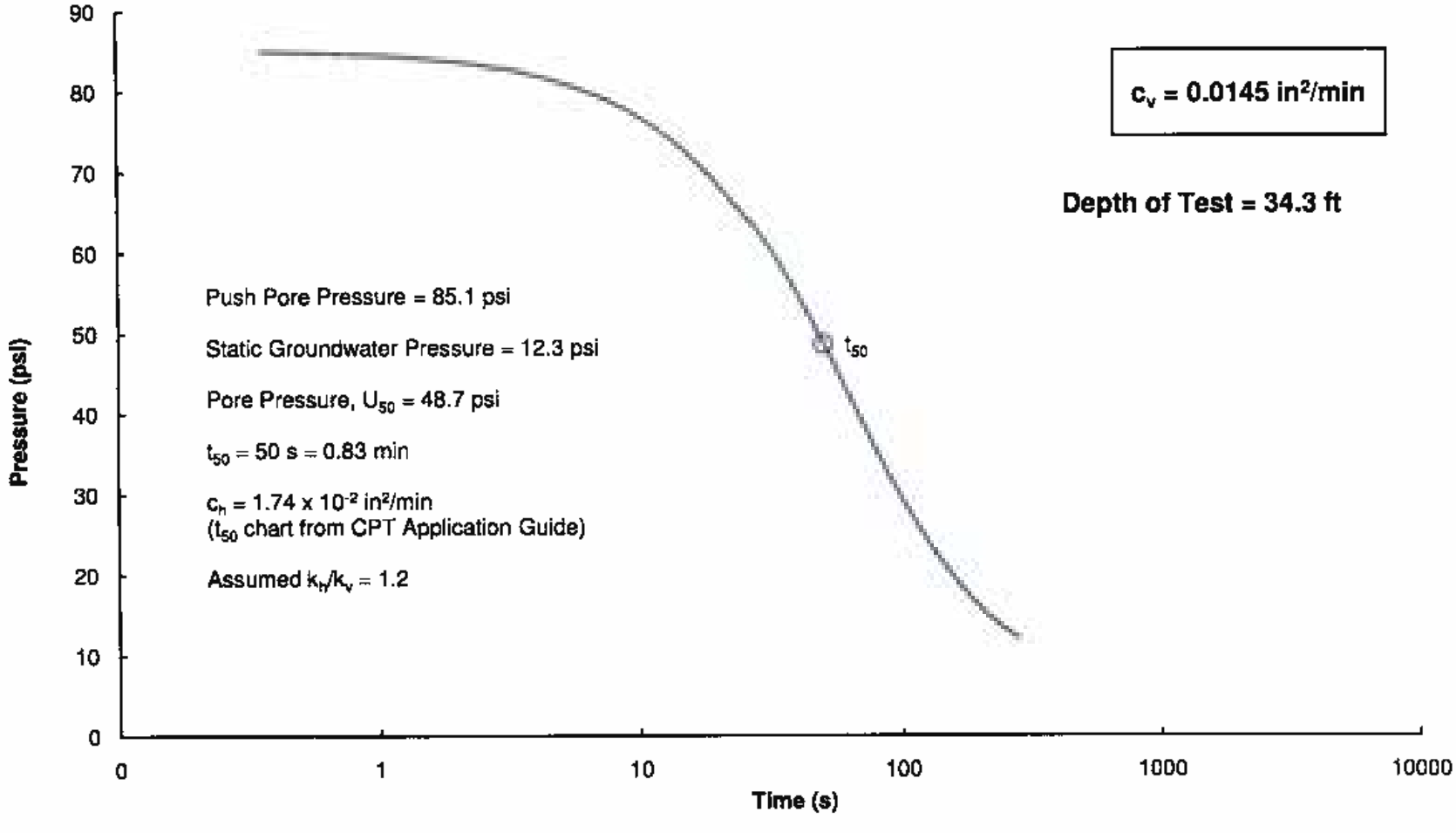
Project No. 175569042

STN-53A

C:\ashpond\CPT53.xlsm

Stantec Consulting Inc.

SCPTu DISSIPATION RESULTS
Coefficient of Consolidation



c_v = 0.0145 in²/min

Depth of Test = 34.3 ft

Push Pore Pressure = 85.1 psi

Static Groundwater Pressure = 12.3 psi

Pore Pressure, U_{50} = 48.7 psi

t_{50} = 50 s = 0.83 min

$c_h = 1.74 \times 10^{-2}$ in²/min
(t_{50} chart from CPT Application Guide)

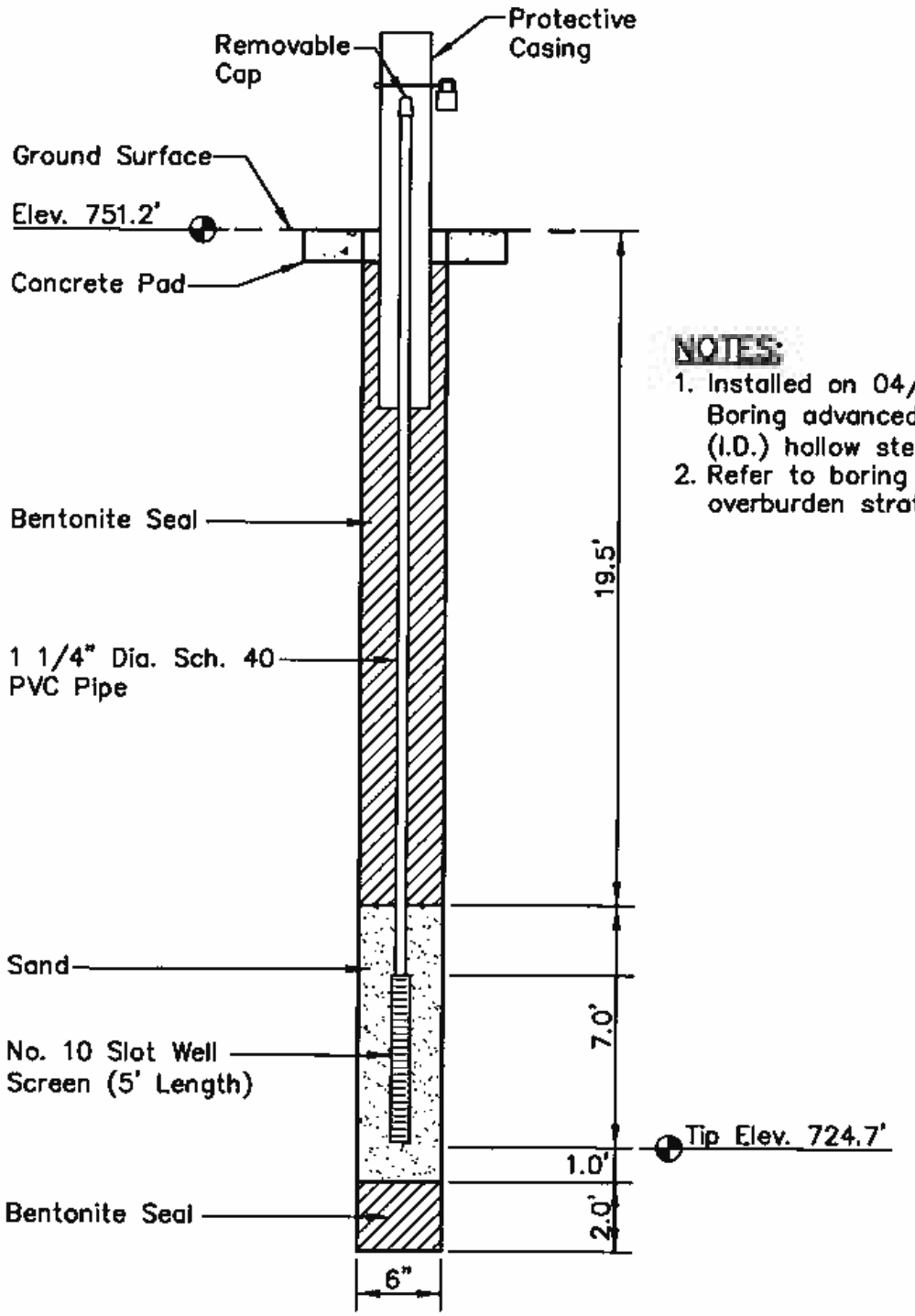
Assumed k_h/k_v = 1.2

Project No. 175569042
STN-53A

C:\ashpond\CPT53.xlsm

Appendix C

Instrumentation Installation Details



NOTES:

1. Installed on 04/16/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 07/15/2009 USER: FLYNN, RENEE
V:\1755\ACTIVE\175569042\GEOTECHNICAL\DRAWING\INSTRUMENTS\69042C-KIF-301-PZ2A.DWG

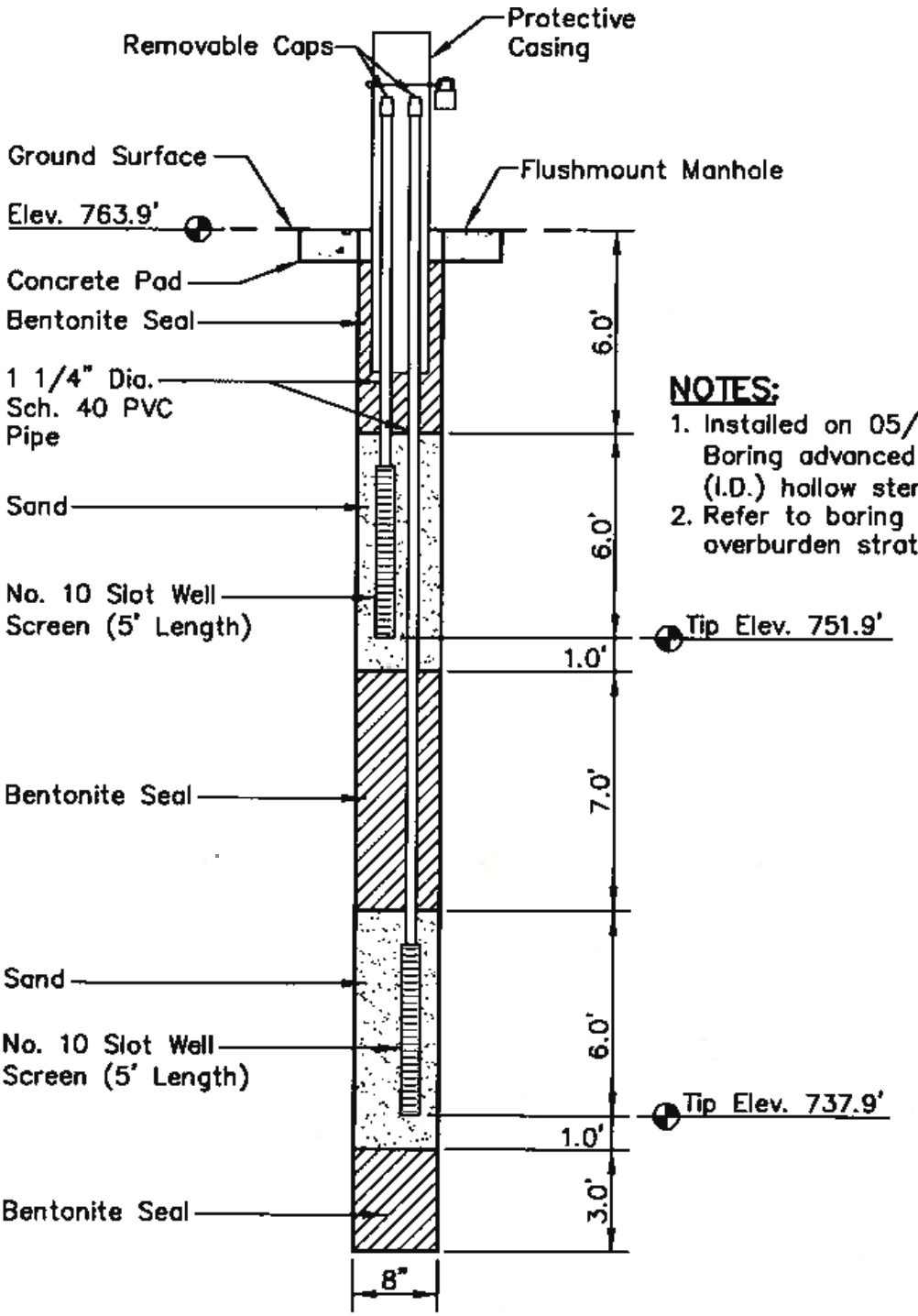
LOCATION:
Northing: 556,806.57
Easting: 2,442,329.32
Ground Elevation: 751.2 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PIEZOMETER STN-2A
ASH POND STABILITY
KINGSTON FOSSIL PLANT

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

DRAWN BY	TJ	DATE	JUNE, 2009	REVISED	SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1. 3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2. 4.	



NOTES:

1. Installed on 05/01/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

LOCATION:

Northing: 556,761.99
Easting: 2,442,259.75
Ground Elevation: 763.9 feet

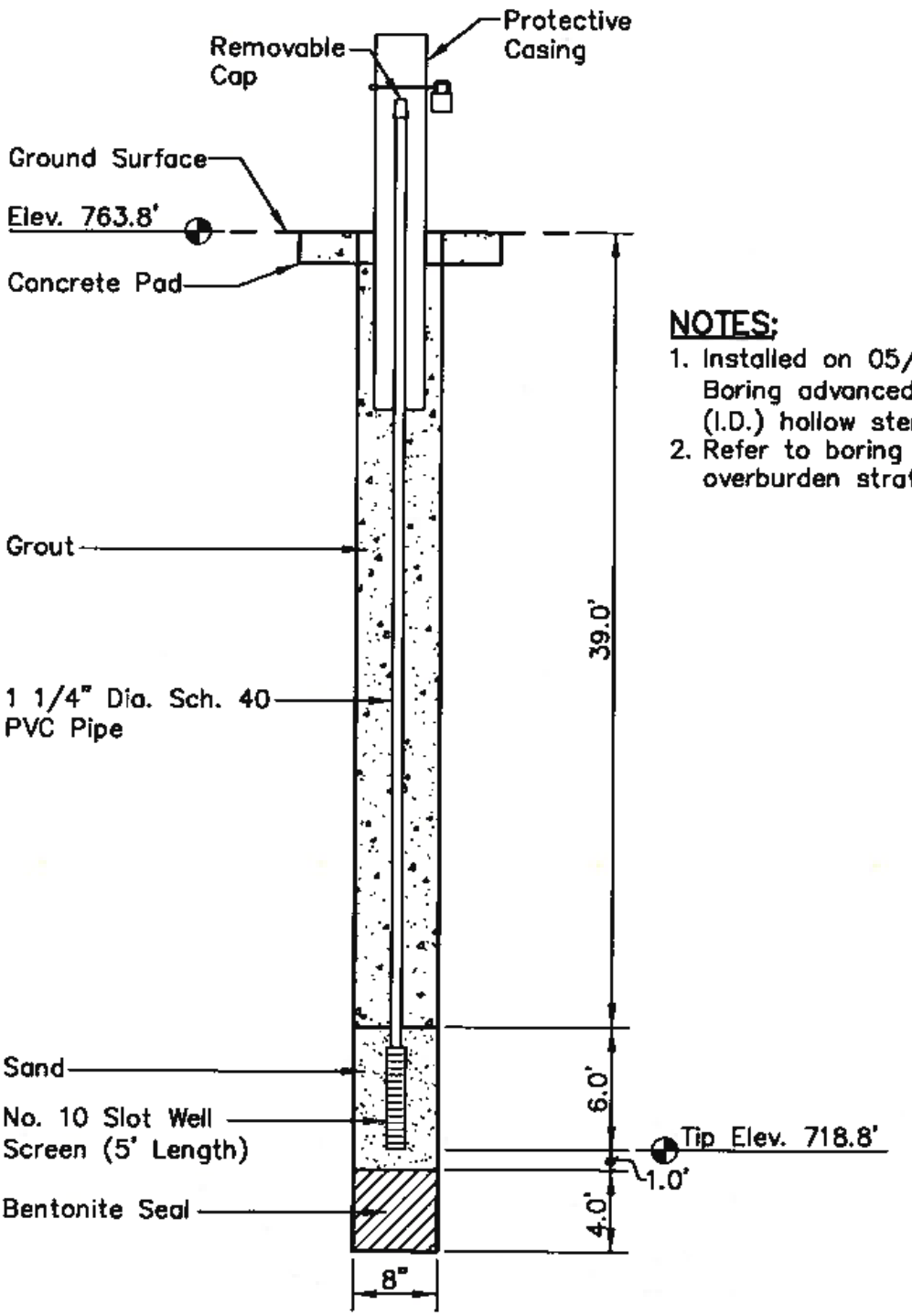
Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PIEZOMETER STN-3A
ASH POND STABILITY
KINGSTON FOSSIL PLANT

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

DRAWN BY	TJ	DATE	JUNE, 2009	REVISED	SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1. 3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2. 4.	

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
N:\755\ACTIVE\175569042\GEOTECHNICAL\DRAWING\INSTRUMENTS\689426-KIF-301-PZ3A.DWG



NOTES:

1. Installed on 05/01/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

LOCATION:

Northing: 556,765.05
Easting: 2,442,256.36
Ground Elevation: 763.8 feet

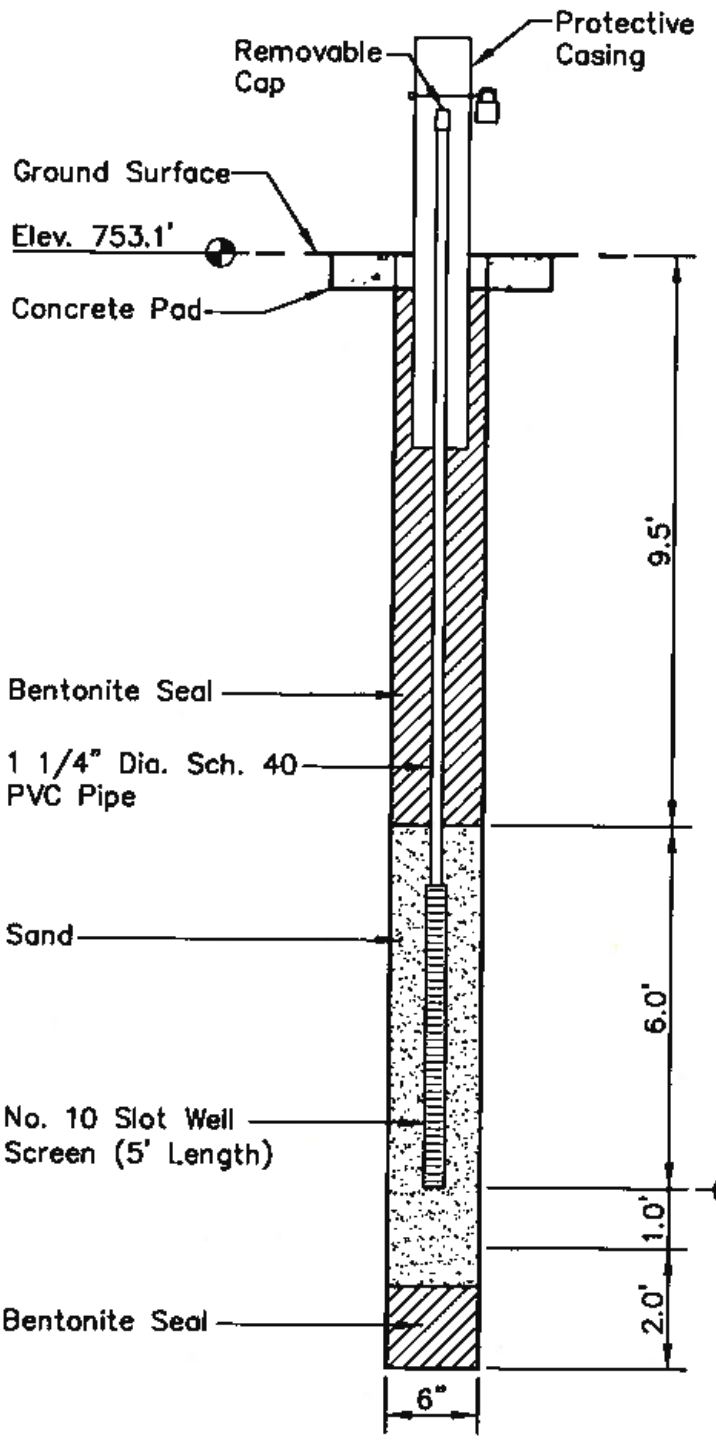
Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PIEZOMETER STN-3B
ASH POND STABILITY
KINGSTON FOSSIL PLANT

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

DRAWN BY	TJ	DATE	JUNE, 2009	REVISED	SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1. 3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2. 4.	

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
K:\1755\ACTIVE\175569042\GEOTECHNICAL\DRAWING\INSTRUMENTS\69042C-KIF-301-P238.DWG



NOTES:

1. Installed on 04/16/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

LOCATION:

Northing: 555,687.58
Easting: 2,442,734.21
Ground Elevation: 753.1 feet

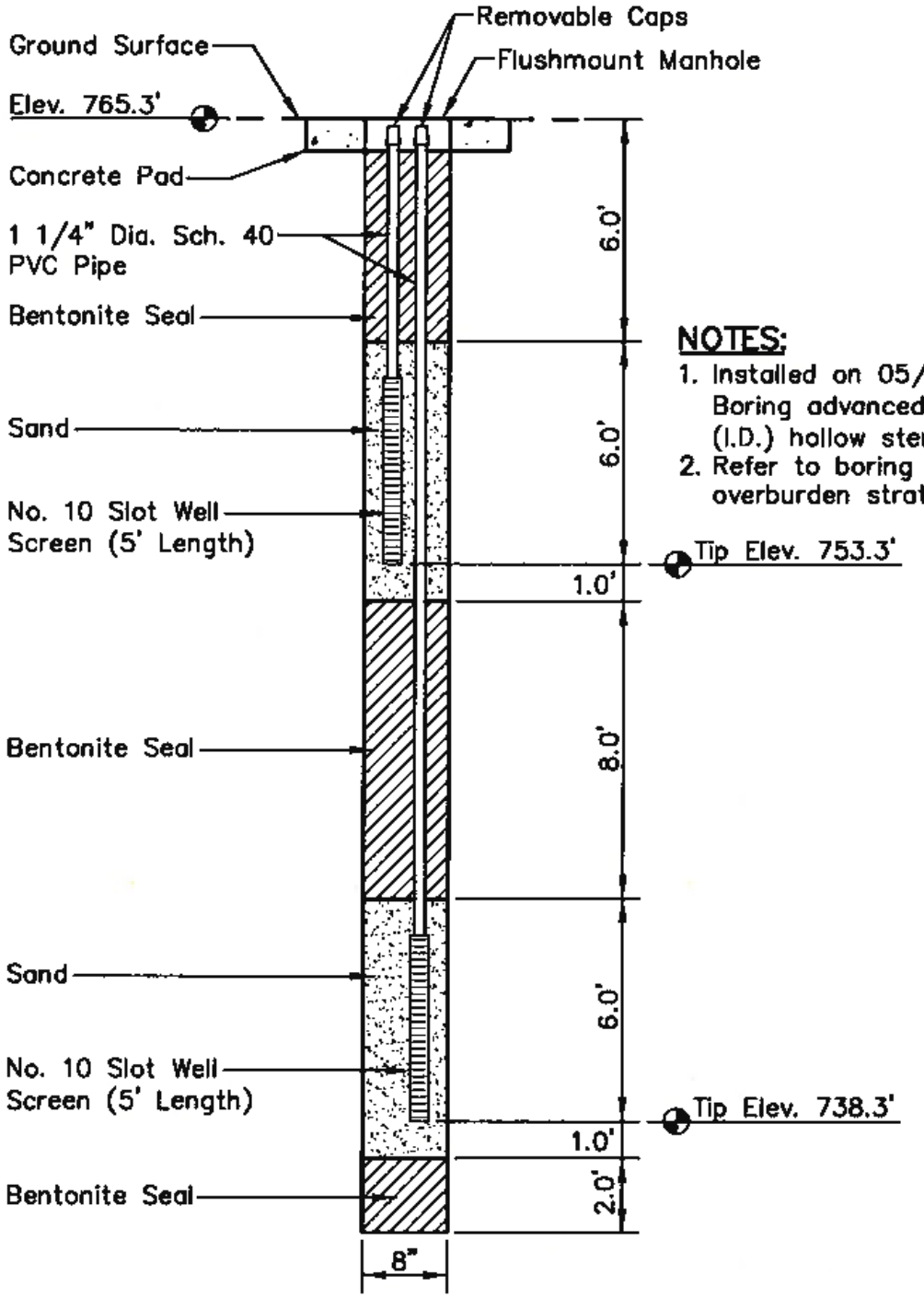
Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PIEZOMETER STN-14A
ASH POND STABILITY
KINGSTON FOSSIL PLANT

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

DRAWN BY	TJ	DATE	JUNE, 2009	REVISED		SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1.	3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2.	4.	

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
V:\1755\ACTIVE\175569042\GEOTECHNICAL\DRAWING\INSTRUMENTS\69042C-KIF-301-PZ14A.DWG



NOTES:

1. Installed on 05/01/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

LOCATION:

Northing: 555,669.72
Easting: 2,442,691.43
Ground Elevation: 765.3 feet

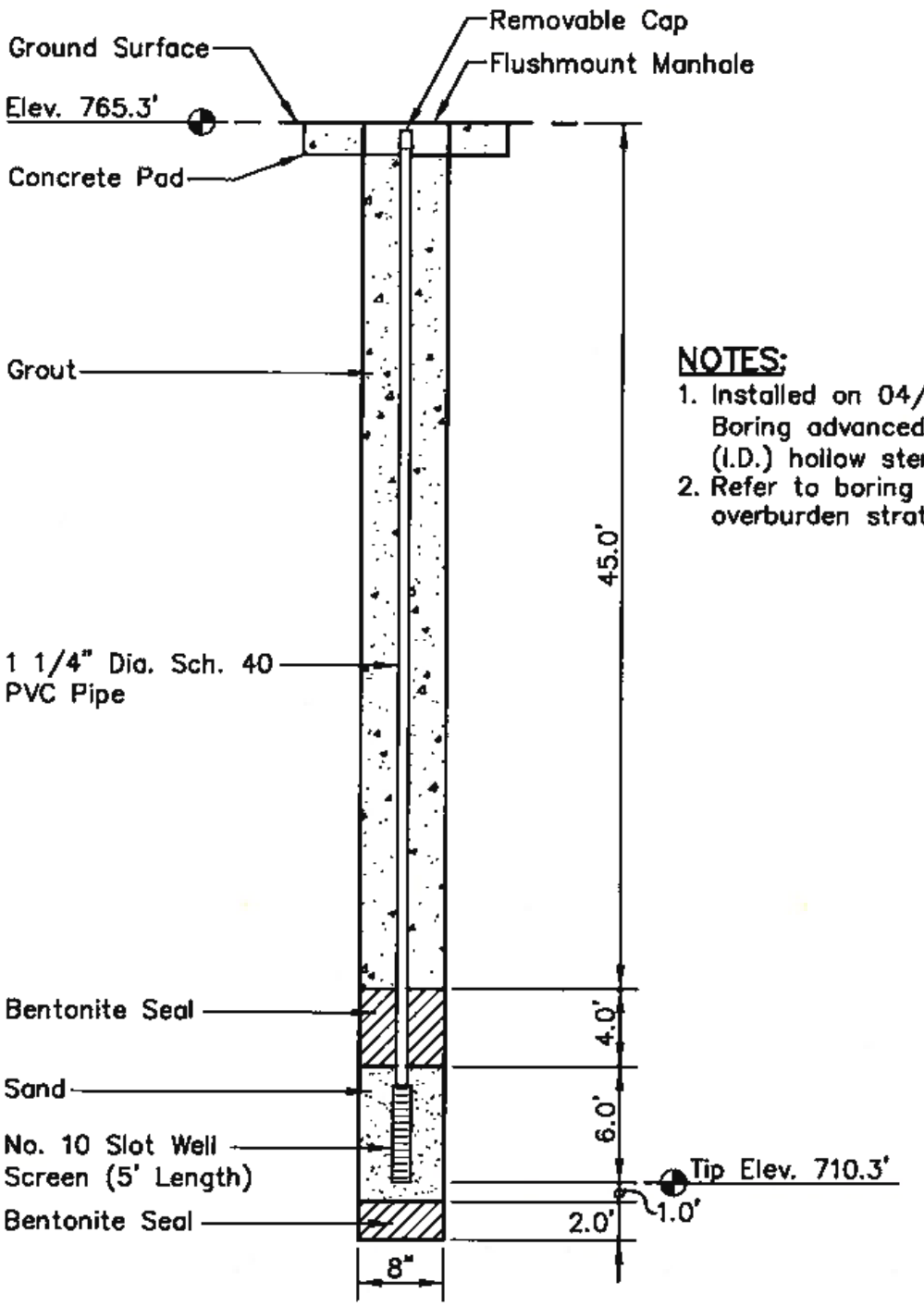
Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PIEZOMETER STN-15A
ASH POND STABILITY
KINGSTON FOSSIL PLANT

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

DRAWN BY	TJ	DATE	JUNE, 2009	REVISED		SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1.	3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2.	4.	

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
K:\1755\ACTIVE\175569042\GEOTECHNICAL\DRAWING\INSTRUMENTS\890426-KIF-301-PZ15A.DWG



NOTES:

1. Installed on 04/29/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

LOCATION:

Northing: 555,672.20
Easting: 2,442,690.32
Ground Elevation: 765.3 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PIEZOMETER STN-15B
ASH POND STABILITY
KINGSTON FOSSIL PLANT

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

DRAWN BY	TJ	DATE	JUNE, 2009	REVISED		SHEET	
CHECKED BY	ZCM	PROJ. NO.	175569042	1.	3.	1 OF 1	
CHECKED BY	AAC	SCALE	NTS	2.	4.		

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
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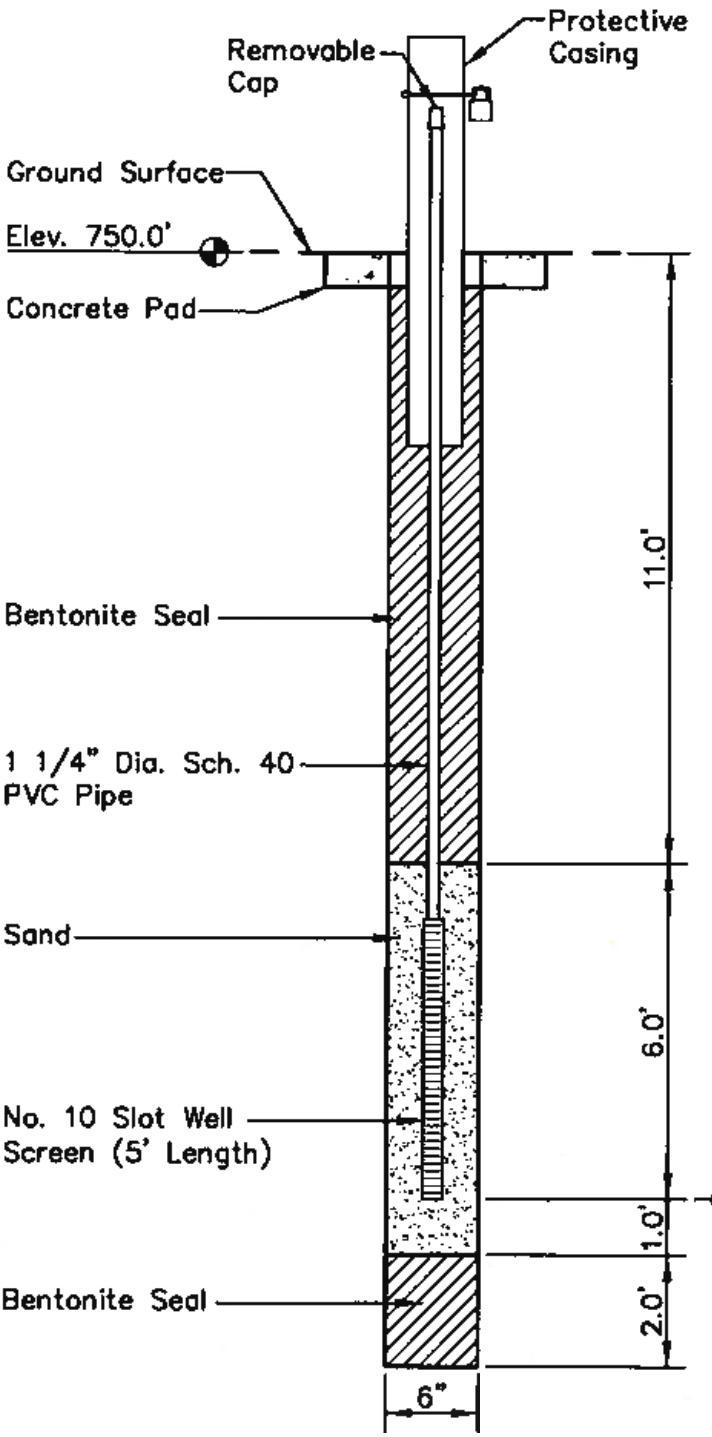


NOTES:

1. Installed on 04/16/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

LOCATION:

Northing: 554,604.66
Easting: 2,442,904.17
Ground Elevation: 757.0 feet

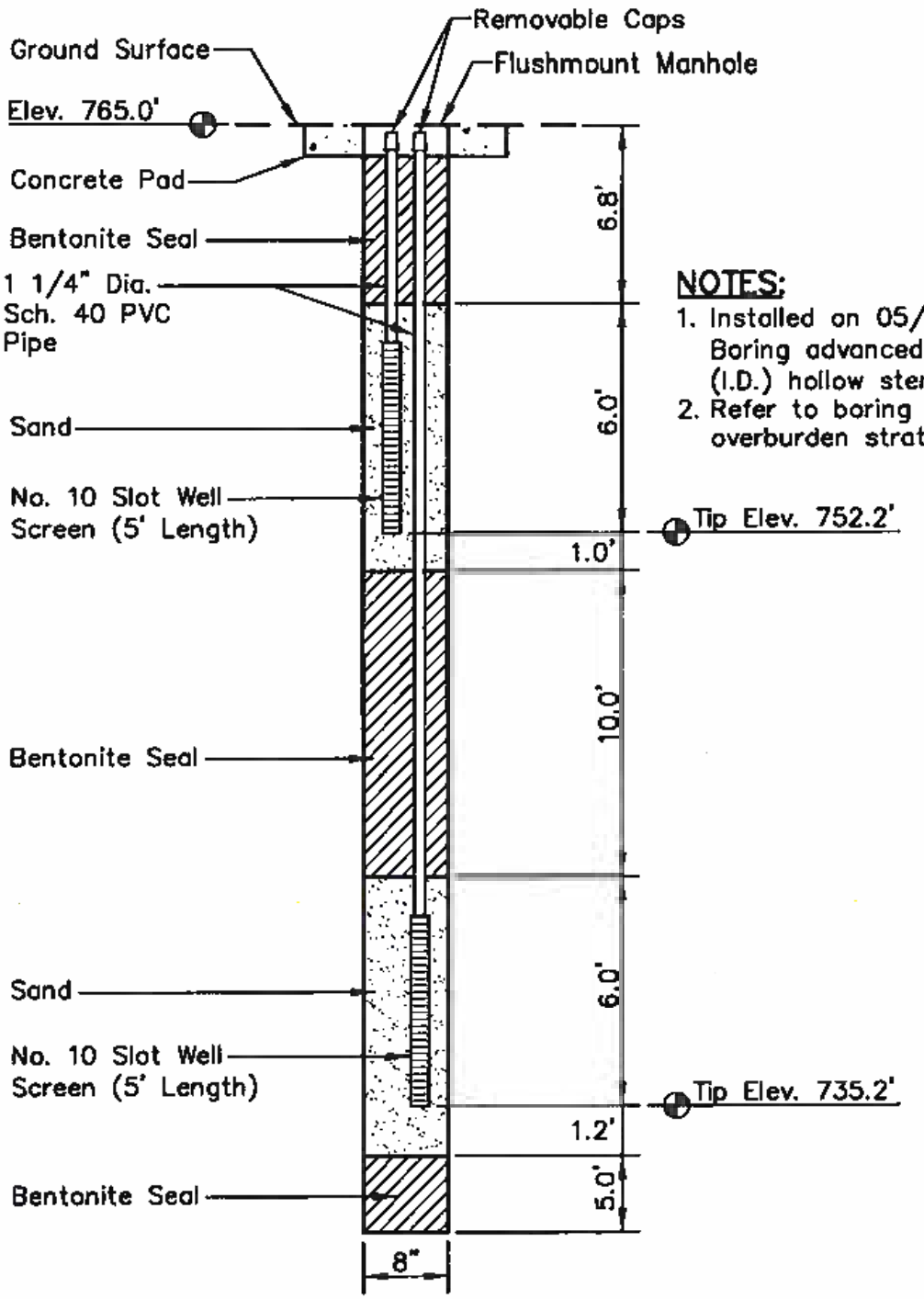
Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PIEZOMETER STN-26A
ASH POND STABILITY
KINGSTON FOSSIL PLANT

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

DRAWN BY	TJ	DATE	JUNE, 2009	REVISED		SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1.	3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2.	4.	

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
V:\1755\ACTIVE\175569042\GEOTECHNICAL\DRAWING\INSTRUMENTS\690426-KIF-301-P226A.DWG



NOTES:

1. Installed on 05/06/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

LOCATION:

Northing: 554,606.18
Easting: 2,442,840.52
Ground Elevation: 765.0 feet

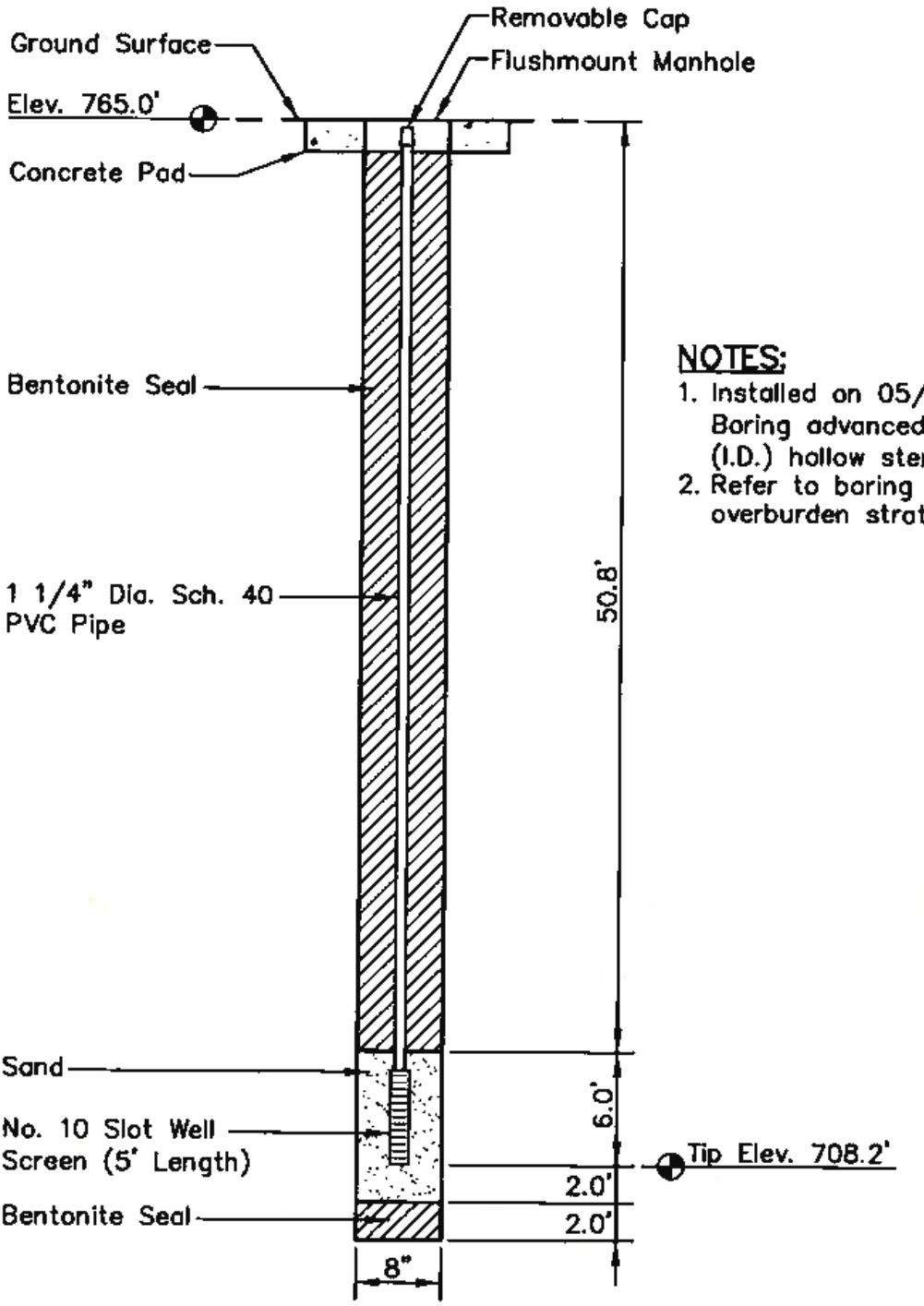
Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PLOT DATE: 07/10/2009 USER: FLYNN, RENEE
V:\1755\ACTIVE\175569042\GEOTECHNICAL\DRAWING\INSTRUMENTS\569042C-KIF-301-PZ27A.DWG

PIEZOMETER STN-27A
ASH POND STABILITY
KINGSTON FOSSIL PLANT

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
www.stantec.com

DRAWN BY	TJ	DATE	JUNE, 2009	REVISED	SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1. 3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2. 4.	



NOTES:

1. Installed on 05/06/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

LOCATION:

Northing: 554,600.64
Easting: 2,442,840.21
Ground Elevation: 765.0 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PIEZOMETER STN-27B
ASH POND STABILITY
KINGSTON FOSSIL PLANT

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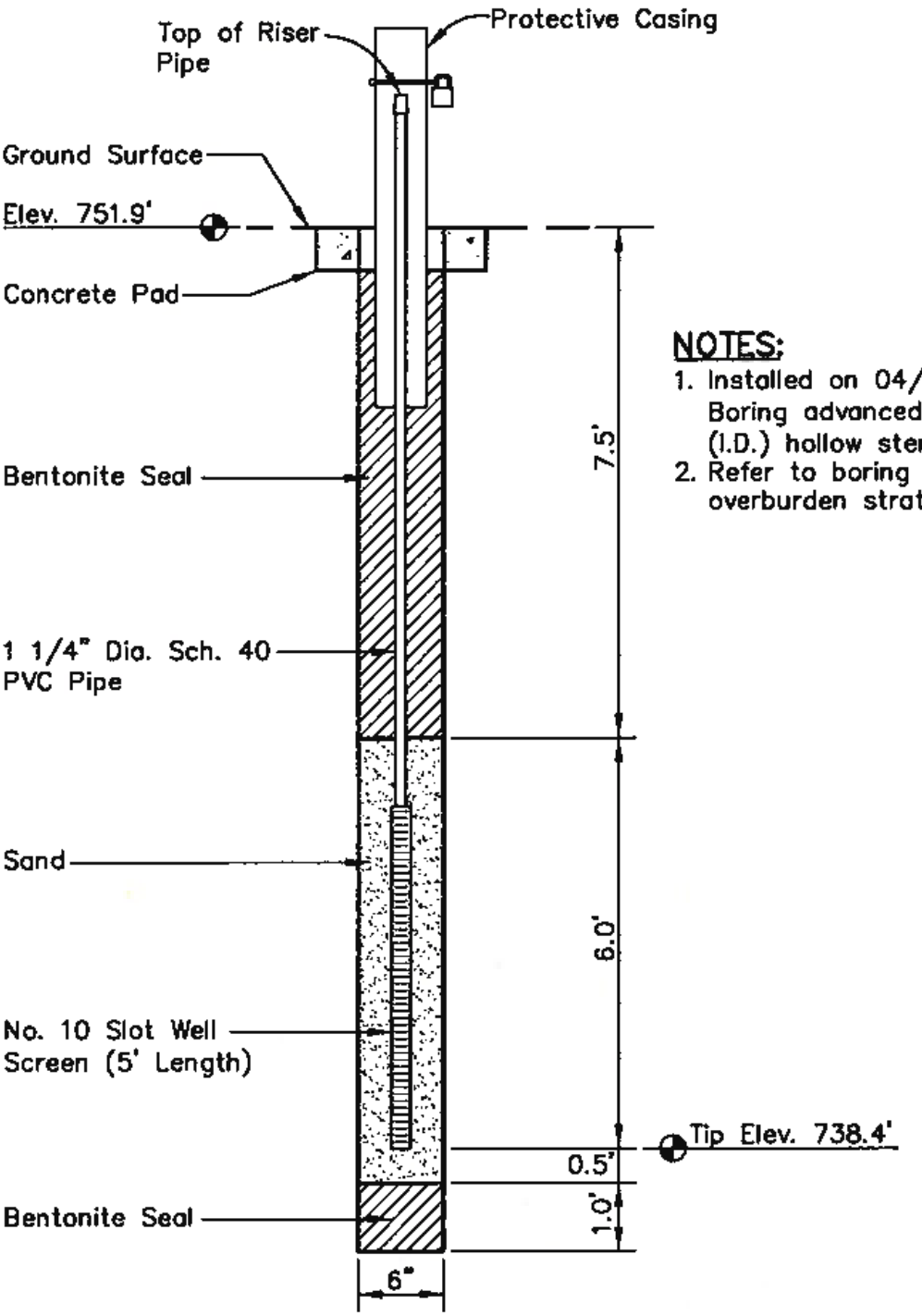
DRAWN BY	TJ	DATE	JUNE, 2009	REVISED		SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1.	3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2.	4.	

PLOT DATE: 07/10/2009 USER: FLYNN, RENEE
V:\1755\ACTIVE\175569042\GEOTECHNICAL\DRAWING\INSTRUMENTS\69042C-KIF-301-PZ27B.DWG



NOTES:

1. Installed on 04/30/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
V:\1755\ACTIVE\175569042\GEOTECHNICAL\DRAWING\INSTRUMENTS\69042C-KIF-301-PZ36A.DWG

LOCATION:
Northing: 553,766.08
Easting: 2,442,199.97
Ground Elevation: 751.9 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PIEZOMETER STN-36A
ASH POND STABILITY
KINGSTON FOSSIL PLANT

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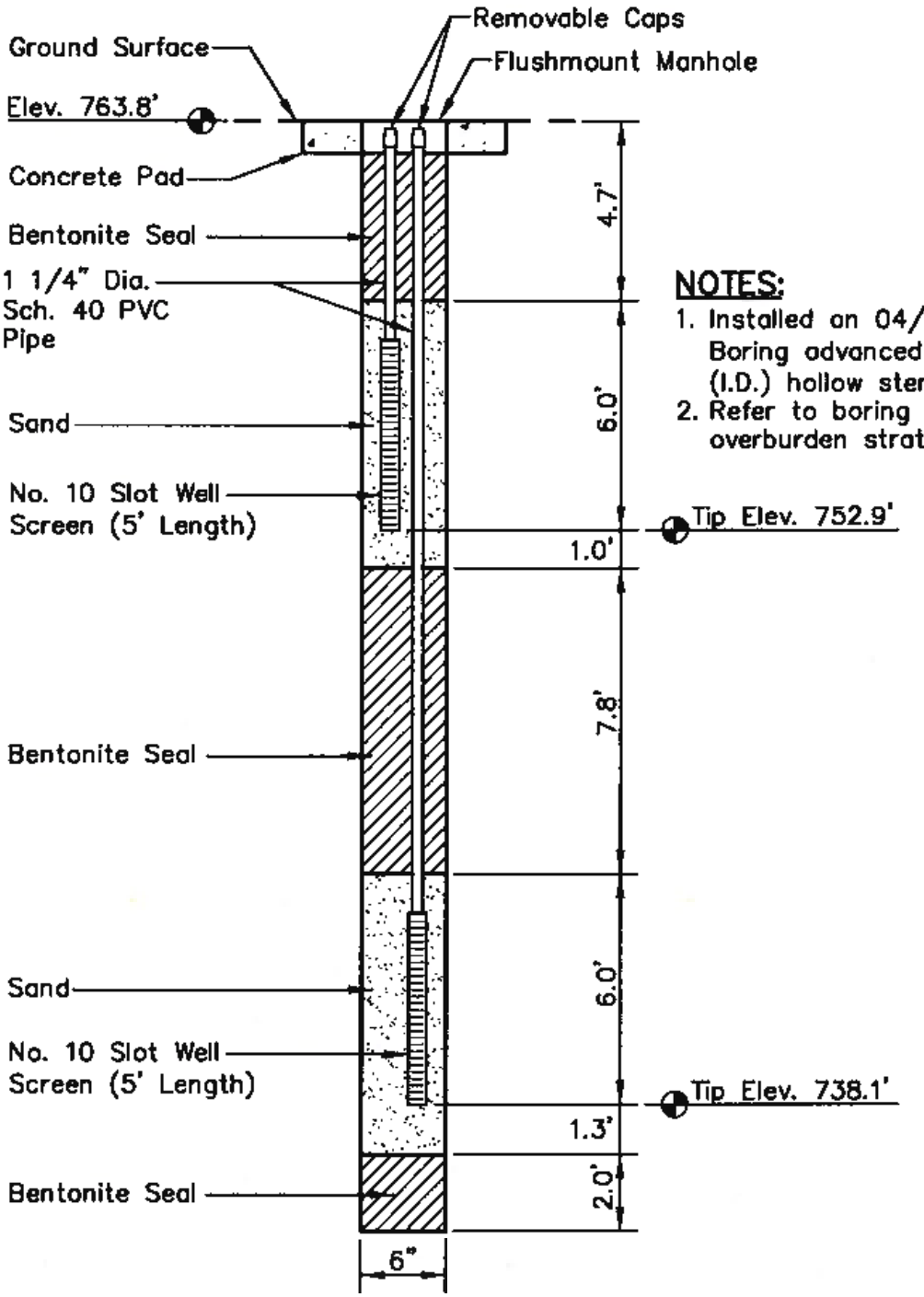
DRAWN BY	TJ	DATE	JUNE, 2009	REVISED		SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1.	3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2.	4.	



NOTES:

1. Installed on 04/22/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

LOCATION:

Northing: 553,799.38
Easting: 2,442,182.40
Ground Elevation: 763.8 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PIEZOMETER STN-37A
ASH POND STABILITY
KINGSTON FOSSIL PLANT

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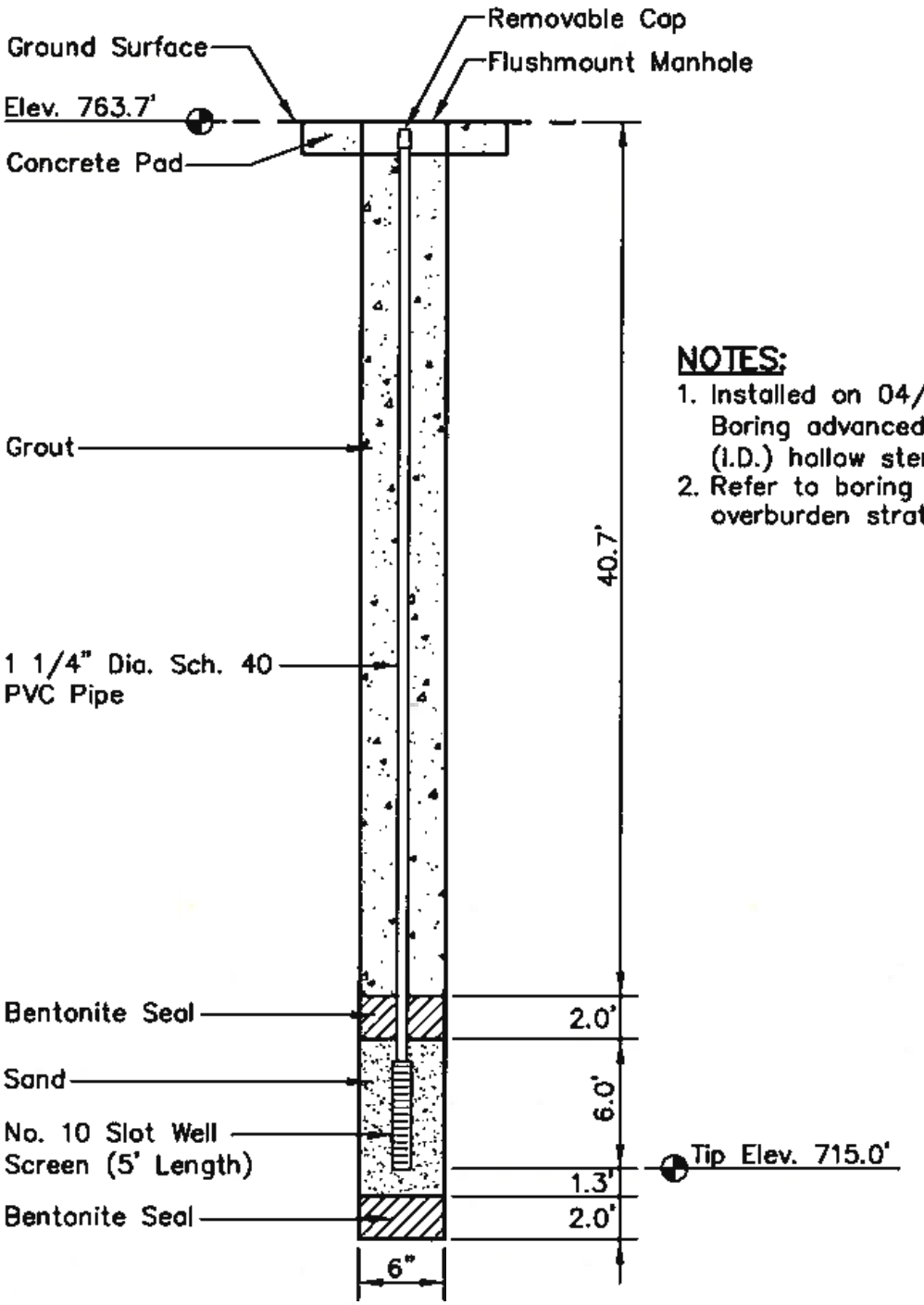
DRAWN BY	TJ	DATE	JUNE, 2009	REVISED	SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1. 3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2. 4.	

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
Y:\1755\ACTIVE\175569042\GEOTECHNICAL\DRAWINGS\INSTRUMENTS\69042C-KIF-301-PZ37A.DWG



NOTES:

1. Installed on 04/22/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
V:\1755\ACTIVE\175569042\GEOTECHNICAL\DRAWINGS\INSTRUMENTS\69042C-KIF-301-P2378.DWG

LOCATION:
Northing: 553,800.49
Easting: 2,442,186.20
Ground Elevation: 763.7 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PIEZOMETER STN-37B
ASH POND STABILITY
KINGSTON FOSSIL PLANT

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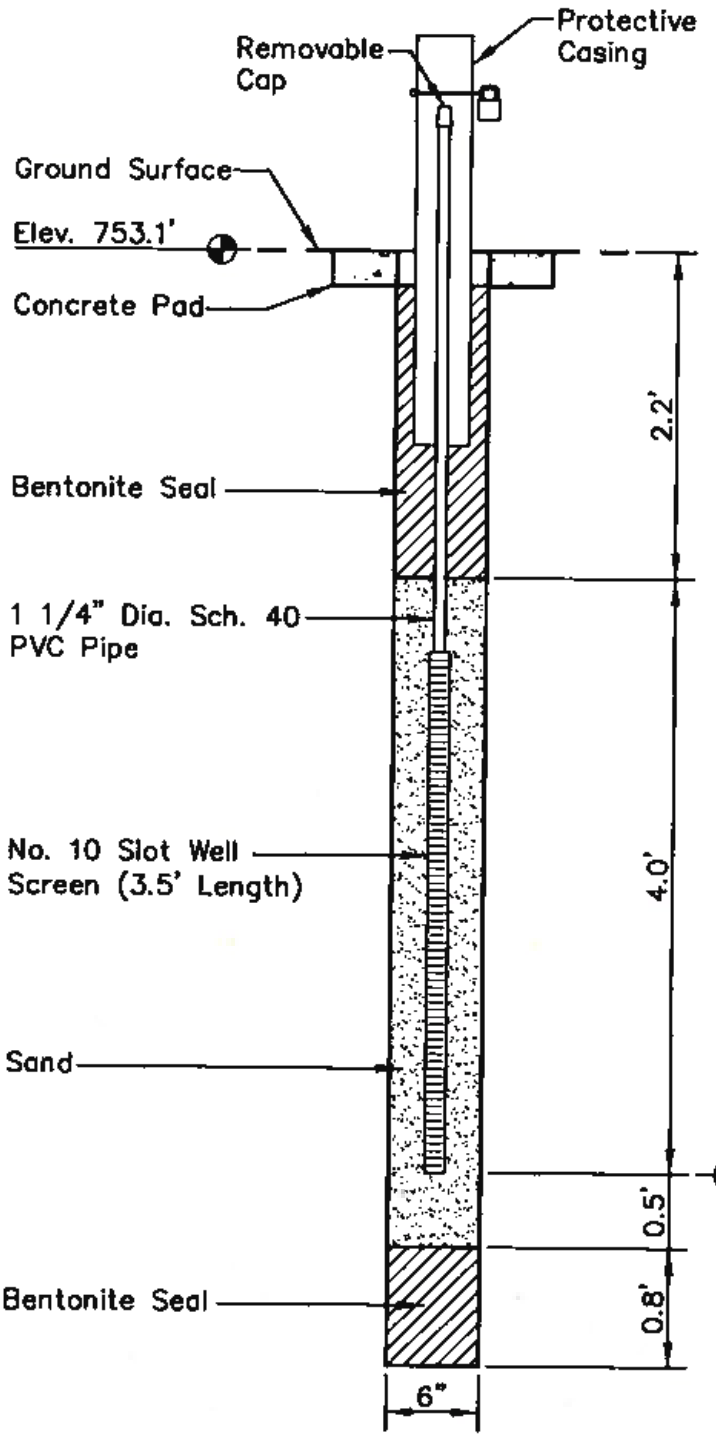
DRAWN BY	TJ	DATE JUNE, 2009	REVISED		SHEET
CHECKED BY	ZCM	PROJ. NO. 175569042	1.	3.	1 OF 1
CHECKED BY	AAC	SCALE NTS	2.	4.	



NOTES:

1. Installed on 04/30/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

LOCATION:

Northing: 553,733.63
Easting: 2,441,141.18
Ground Elevation: 753.1 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PIEZOMETER STN-47A
ASH POND STABILITY
KINGSTON FOSSIL PLANT

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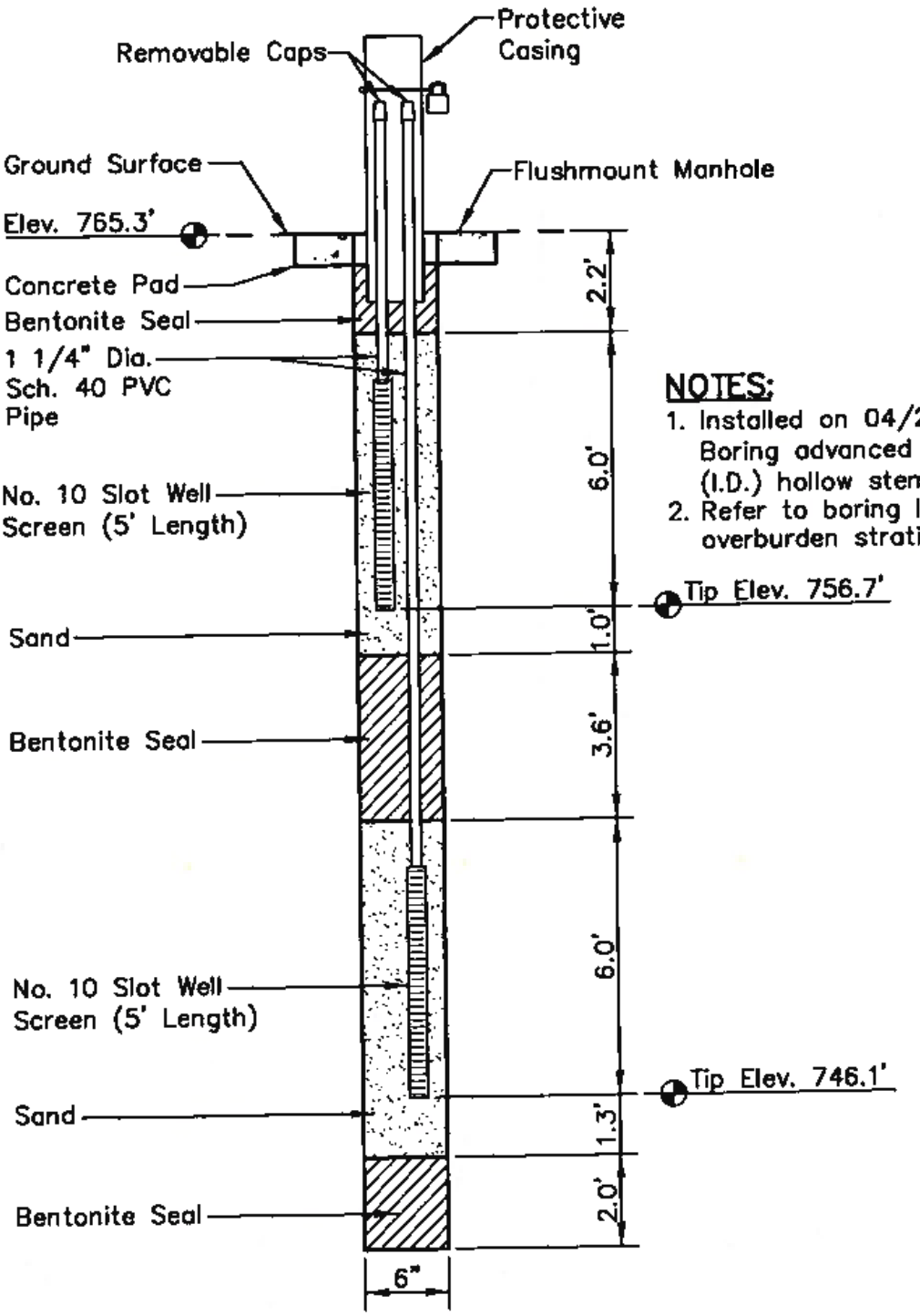
DRAWN BY	TJ	DATE	JUNE, 2009	REVISED		SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1.	3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2.	4.	

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
W:\1755\ACTIVE\175569042\GEOTECHNICAL\DRAWING\INSTRUMENTS\690420-KIF-301-PZ47A.DWG



NOTES:

1. Installed on 04/21/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

LOCATION:

Northing: 553,771.75
Easting: 2,441,159.01
Ground Elevation: 765.3 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PIEZOMETER STN-48A
ASH POND STABILITY
KINGSTON FOSSIL PLANT

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Lexington, Kentucky
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DRAWN BY	TJ	DATE	JUNE, 2009	REVISED	SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1. 3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2. 4.	

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
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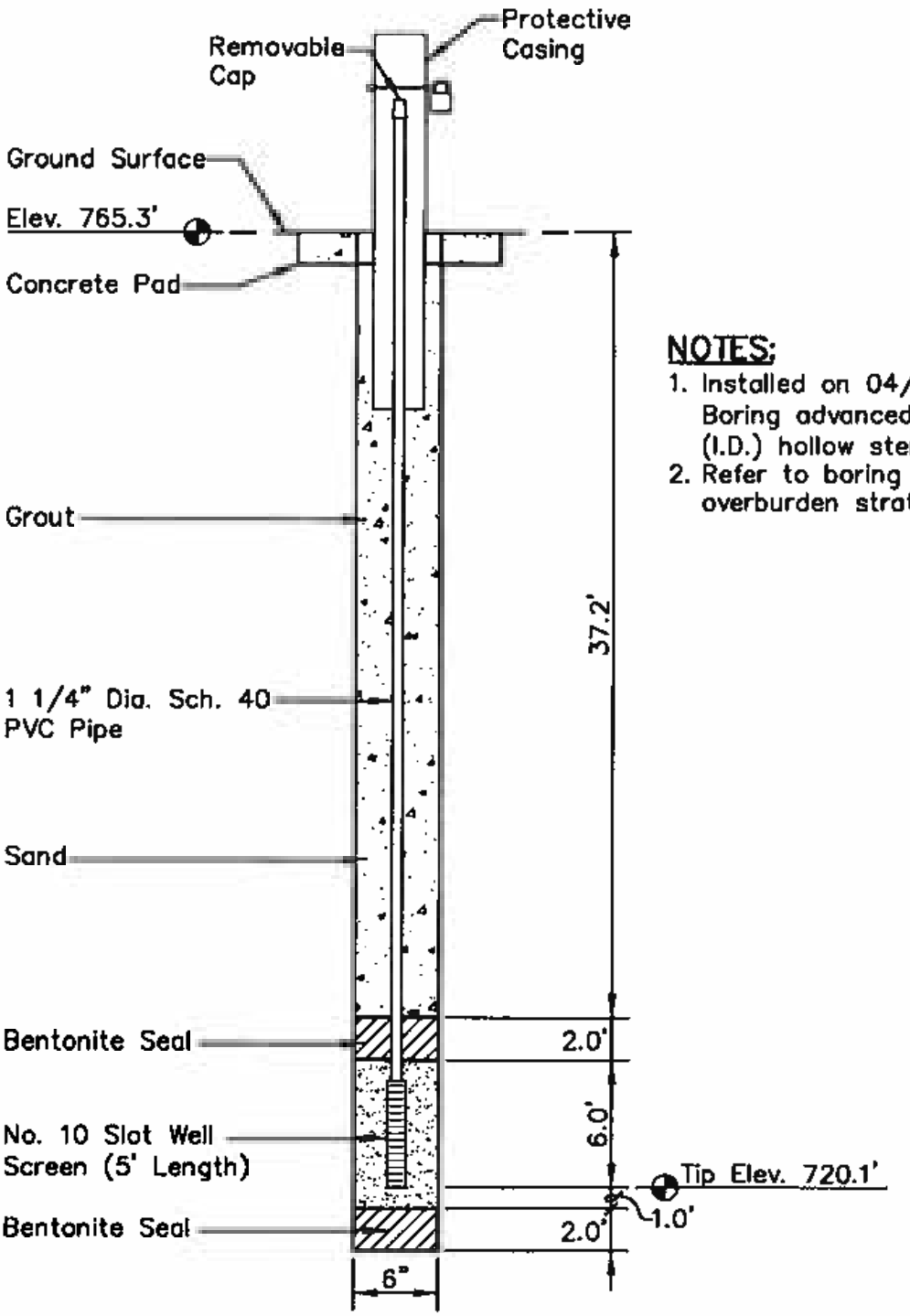

NOTES:

1. Installed on 04/21/2009. Boring advanced with 3.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden stratigraphy.

LOCATION:

Northing: 553,769.40
Easting: 2,441,163.30
Ground Elevation: 765.3 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

PIEZOMETER STN-48B
ASH POND STABILITY
KINGSTON FOSSIL PLANT

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1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000
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DRAWN BY	TJ	DATE	JUNE, 2009	REVISED	SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1. 3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2. 4.	

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
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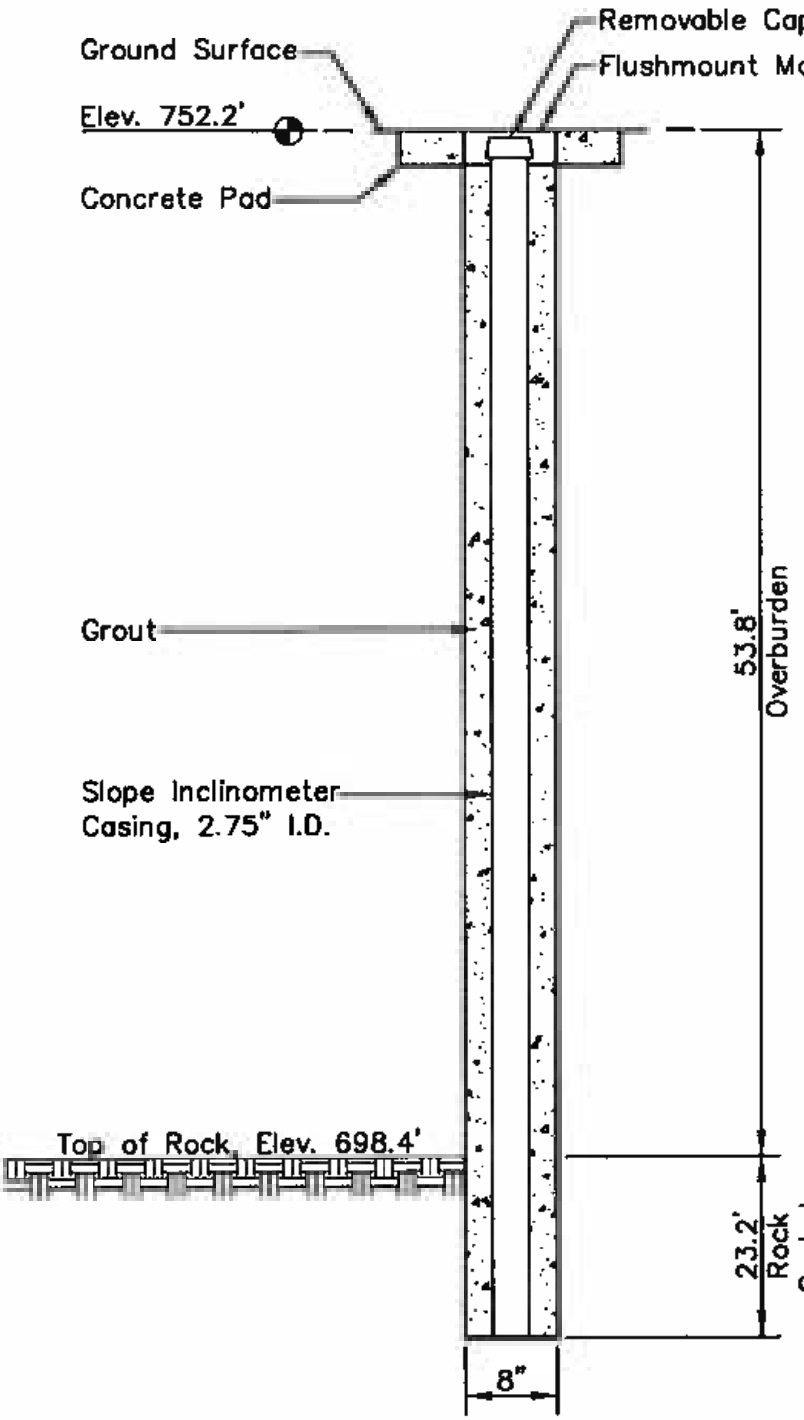

NOTES:

1. Installed on 04/13/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden and rock stratigraphy.

LOCATION:

Northing: 556,298.52
Easting: 2,442,540.30
Ground Elevation: 752.2 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

SLOPE INCLINOMETER STN-8
ASH POND STABILITY
KINGSTON FOSSIL PLANT

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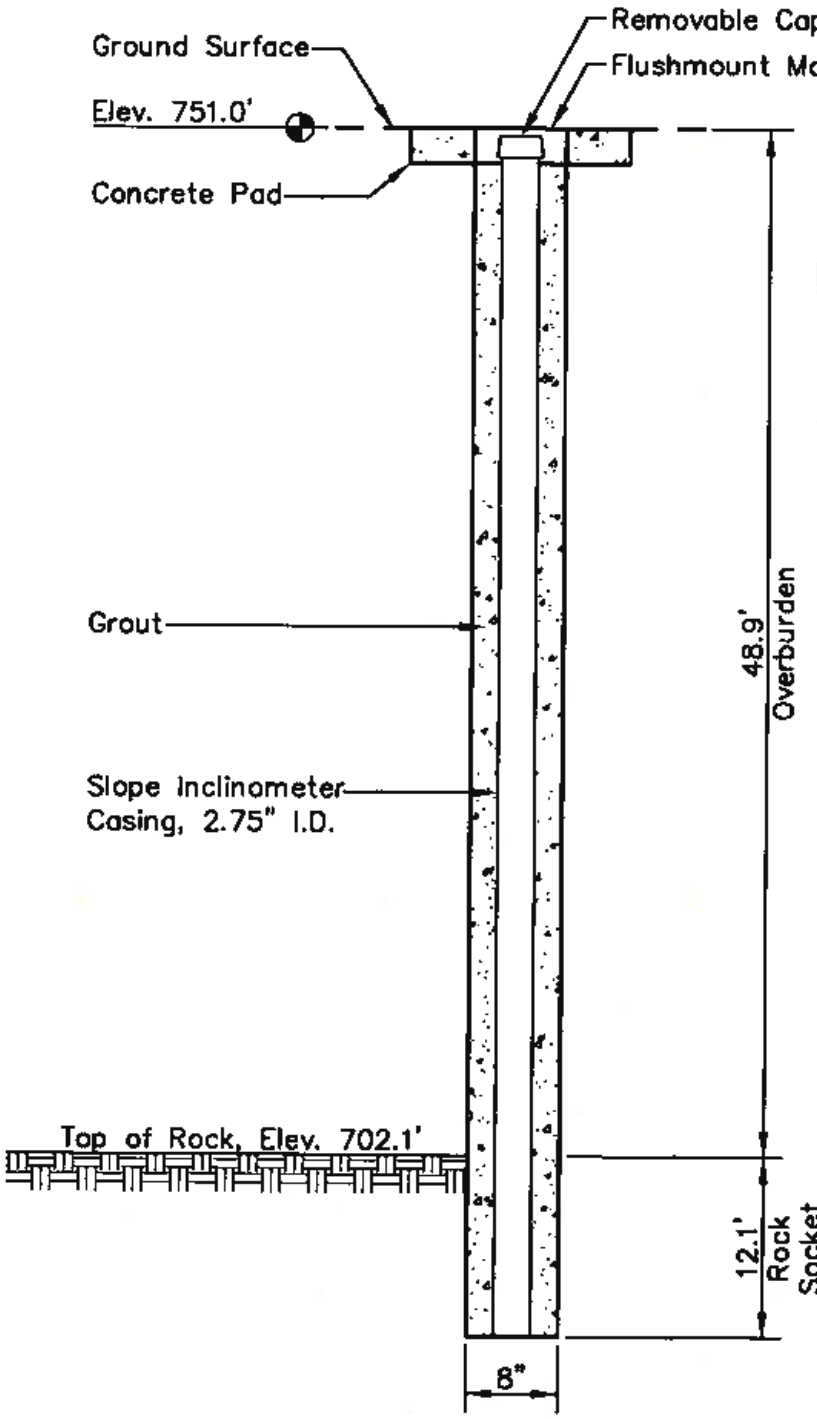
DRAWN BY	TJ	DATE	JUNE, 2009	REVISED	SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1. 3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2. 4.	

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
V:\1755\ACTIVE\175569042\GEOTECHNICAL\DRAWING\INSTRUMENTS\69042C-KIF-301-STN8.DWG



NOTES:

1. Installed on 04/14/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden and rock stratigraphy.

LOCATION:

Northing: 555,204.87
Easting: 2,442,894.11
Ground Elevation: 751.0 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

SLOPE INCLINOMETER STN-18
ASH POND STABILITY
KINGSTON FOSSIL PLANT

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Lexington, Kentucky
40511-2050
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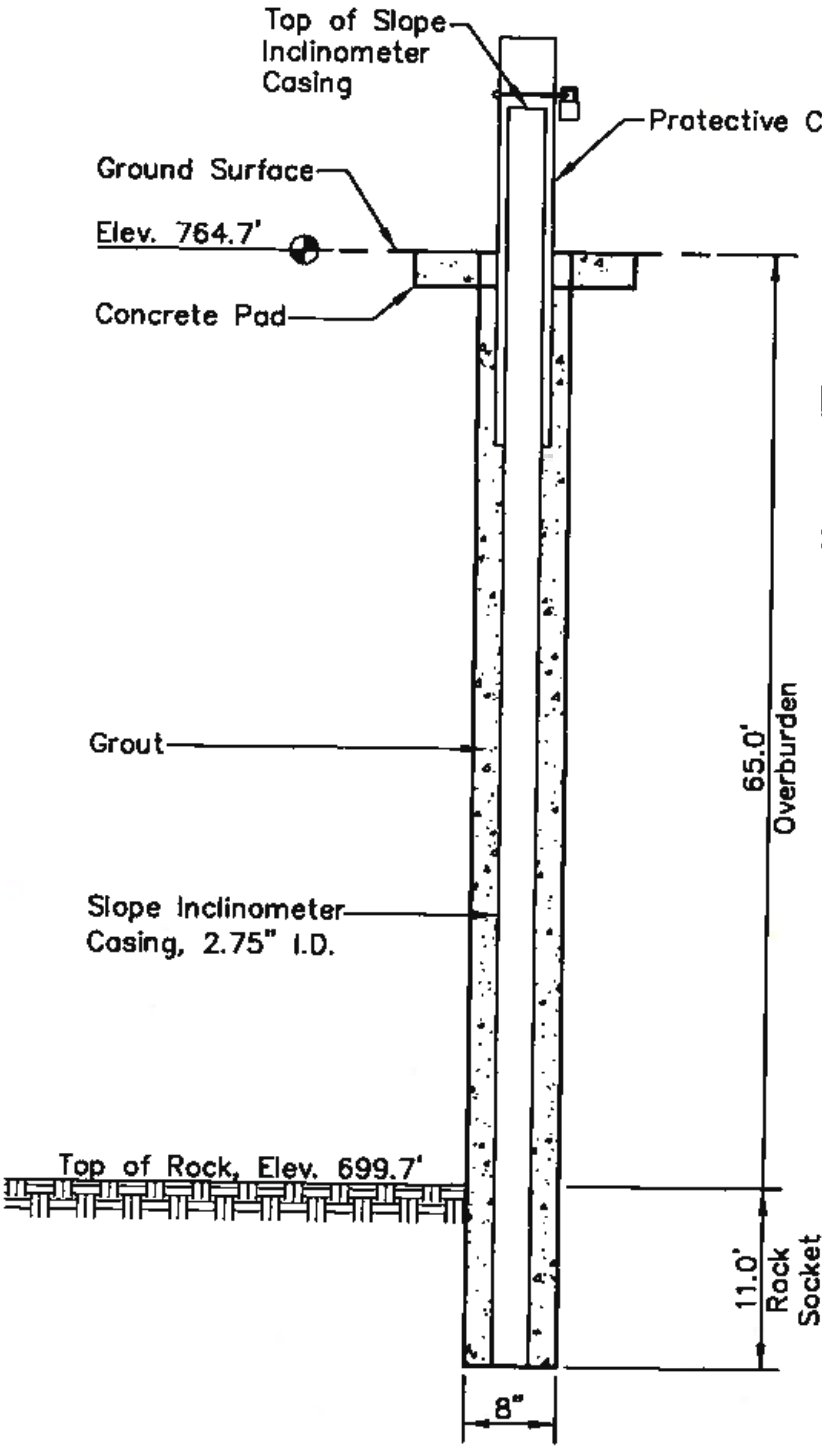
DRAWN BY	TJ	DATE JUNE, 2009	REVISED		SHEET
CHECKED BY	ZCM	PROJ. NO. 175569042	1.	3.	1 OF 1
CHECKED BY	AAC	SCALE NTS	2.	4.	

PLOT DATE: 08/30/2009 USER: FLYNN, RENEE
V:\1755\ACTIVE\175569042\GEOTECHNICAL\DRAWING\INSTRUMENTS\69042C-KIF-301-STN18.DWG



NOTES:

1. Installed on 05/31/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden and rock stratigraphy.

LOCATION:

Northing: 553,853.66
Easting: 2,442,184.35
Ground Elevation: 764.7 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

SLOPE INCINOMETER STN-34
ASH POND STABILITY
KINGSTON FOSSIL PLANT

Stantec Consulting Services Inc.
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Lexington, Kentucky
40511-2050
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DRAWN BY	TJ	DATE	JUNE, 2009	REVISED	SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1. 3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2. 4.	

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
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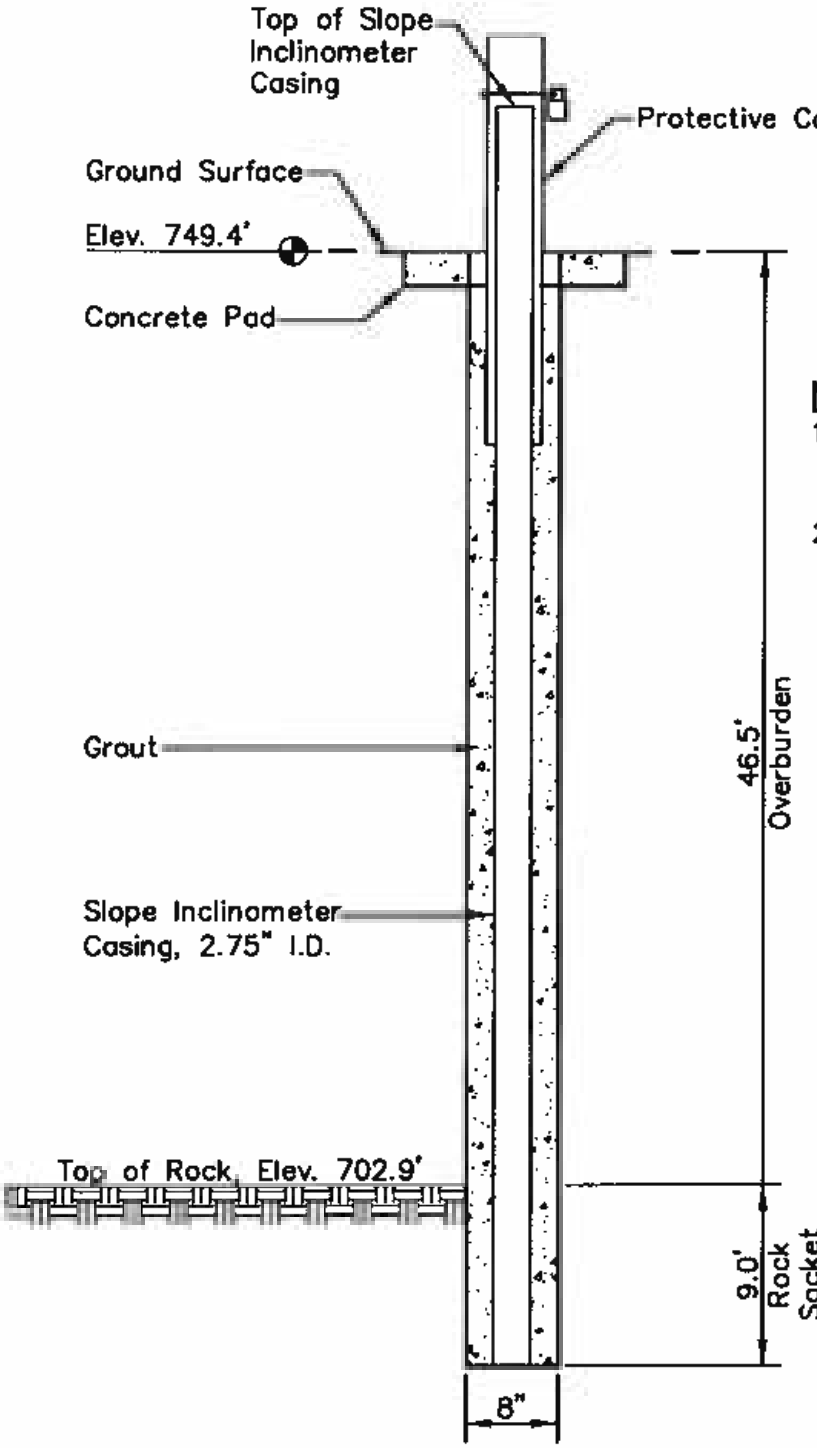

NOTES:

1. Installed on 04/06/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden and rock stratigraphy.

LOCATION:

Northing: 554,411.29
Easting: 2,442,911.08
Ground Elevation: 749.4 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

SLOPE INCLINOMETER STN-64
ASH POND STABILITY
KINGSTON FOSSIL PLANT

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40511-2050
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DRAWN BY	TJ	DATE	JUNE, 2009	REVISED		SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1.	3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2.	4.	

PLOT DATE: 07/14/2009 USER: FLYNN, RENEE
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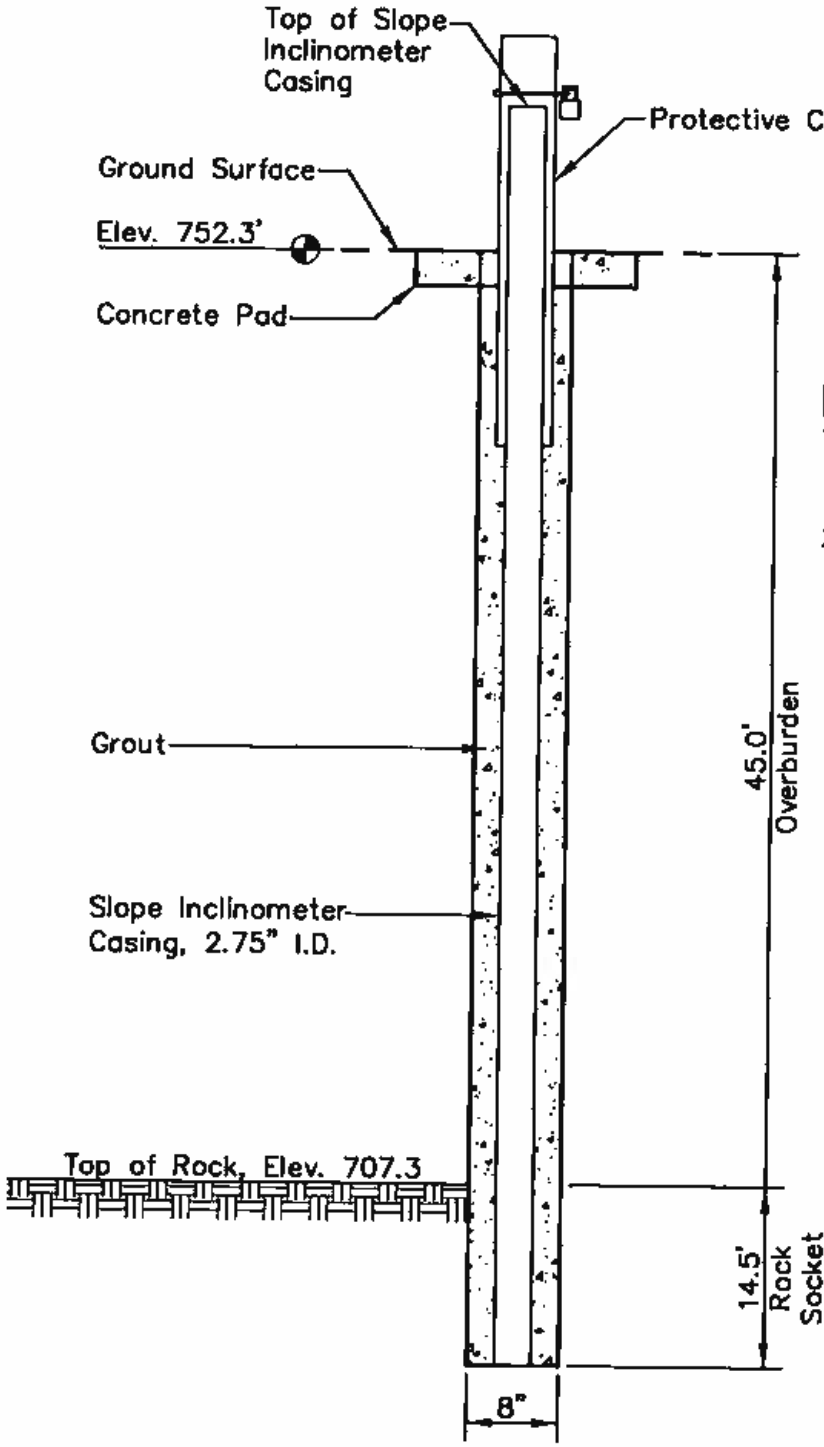

NOTES:

1. Installed on 05/20/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden and rock stratigraphy.

LOCATION:

Northing: 553,607.58
Easting: 2,441,718.01
Ground Elevation: 752.3 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

SLOPE INCLINOMETER STN-69
ASH POND STABILITY
KINGSTON FOSSIL PLANT

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DRAWN BY	TJ	DATE	JUNE, 2009	REVISED		SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1.	3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2.	4.	

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
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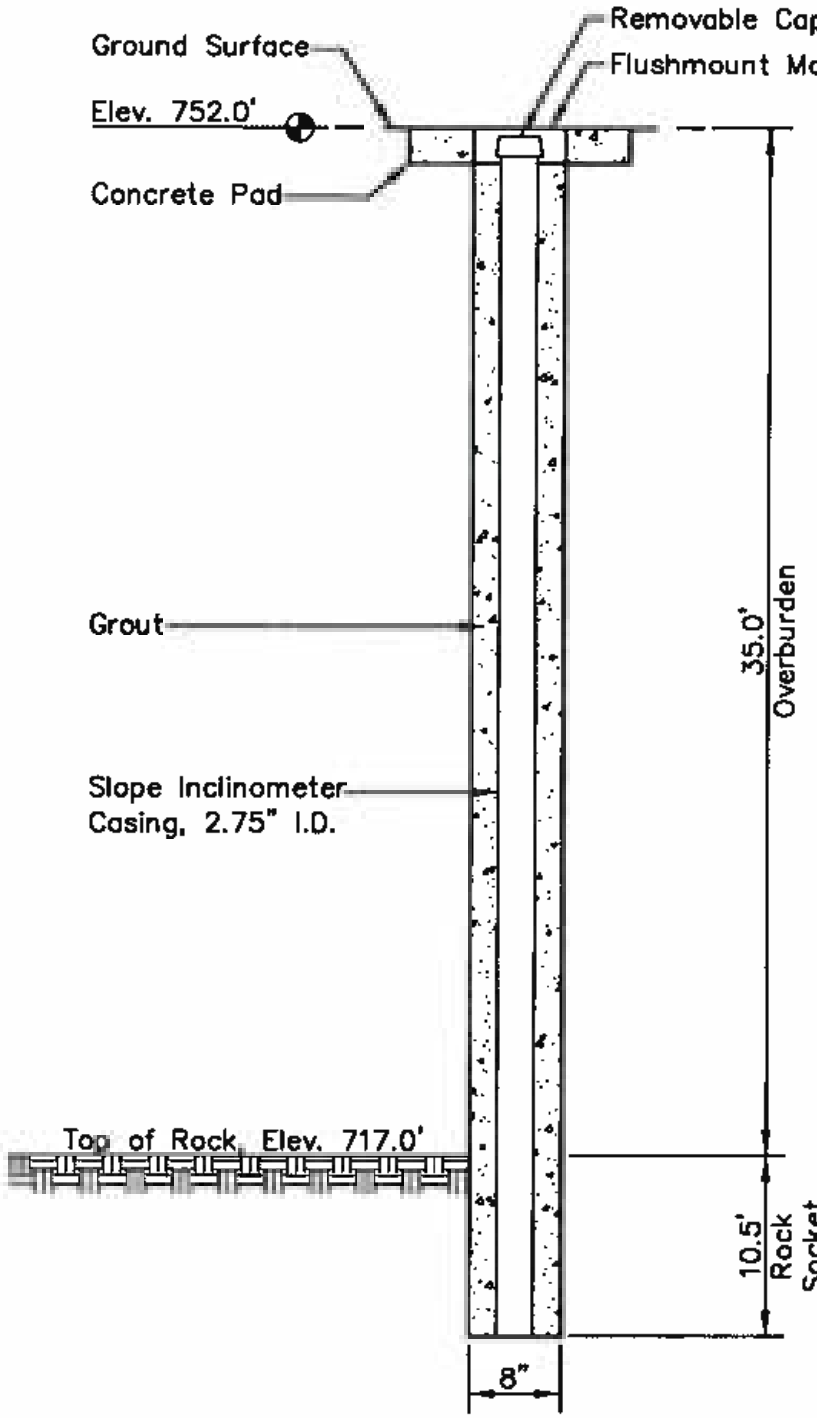

NOTES;

1. Installed on 05/14/2009. Boring advanced with 4.25" (I.D.) hollow stem augers.
2. Refer to boring log for overburden and rock stratigraphy.

LOCATION;

Northing: 553,840.20
Easting: 2,440,981.04
Ground Elevation: 752.0 feet

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

SLOPE INCLINOMETER STN-71
ASH POND STABILITY
KINGSTON FOSSIL PLANT

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Lexington, Kentucky
40511-2050
859-422-3000
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DRAWN BY	TJ	DATE	JUNE, 2009	REVISED		SHEET
CHECKED BY	ZCM	PROJ. NO.	175569042	1.	3.	1 OF 1
CHECKED BY	AAC	SCALE	NTS	2.	4.	

PLOT DATE: 06/30/2009 USER: FLYNN, RENEE
K:\1755\ACTIVE\175569042\GEOTECHNICAL\DRAWING\INSTRUMENTS\89042C-KF-301-STN71.DWG

Appendix D

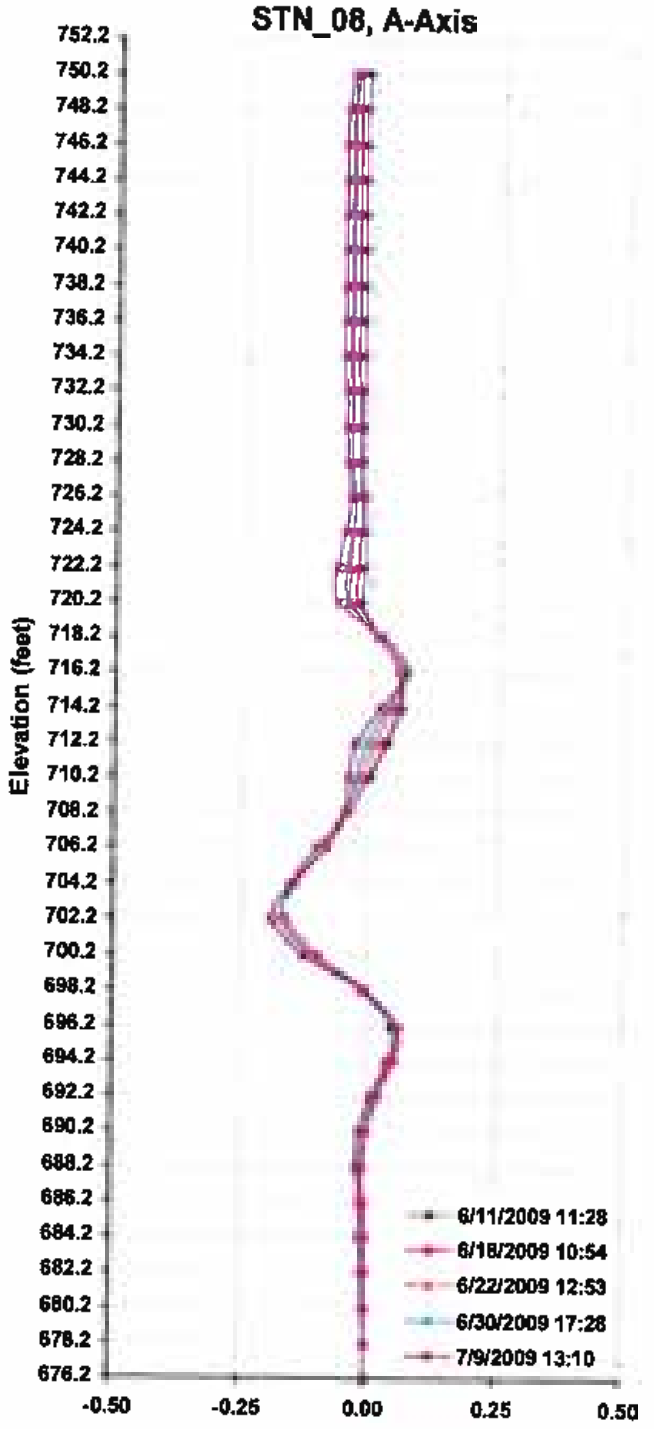
Instrumentation Results

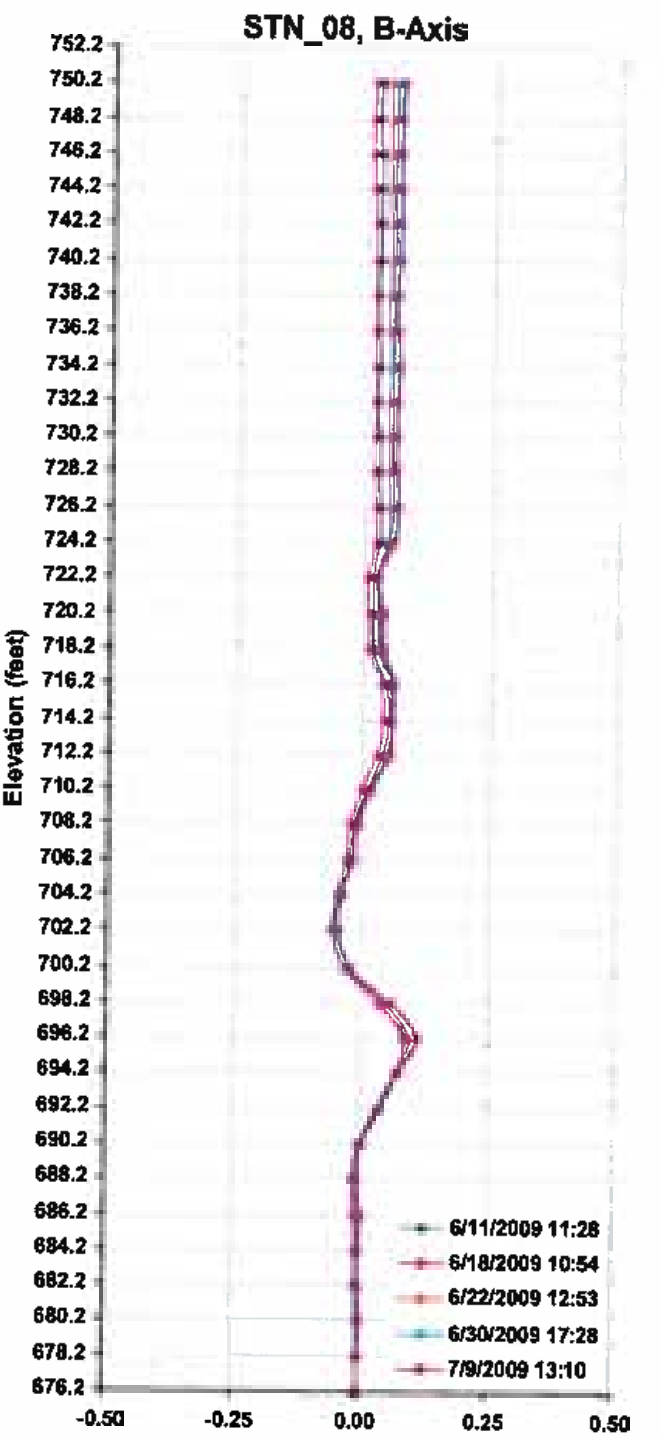
Stantec

PIEZOMETER

Kingston
Kingston,TN
175569042

Piezometer	Location	Surface Elevation (ft)	Stickup (ft)	5/28/2009		6/11/2009		6/22/2009		7/9/2009	
				Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)	Depth Measurement (ft)	Water Elevation (ft)
STN-2A	PZ-1	751.20	2.90	8.30	745.80	8.50	745.60	8.50	745.60	8.70	745.40
STN-3A	PZ-2 (U)	763.90	3.30	10.50	756.70	10.80	756.40	10.80	756.40	11.10	756.10
STN-3A	PZ-3 (L)	763.90	3.30	7.90	759.30	8.00	759.20	8.00	759.20	8.10	759.10
STN-3B	PZ-4	763.80	3.40	16.80	750.40	17.30	749.90	17.20	750.00	17.76	749.44
STN-14A	PZ-5	753.10	3.10	13.30	742.90	13.20	743.00	13.40	742.80	13.47	742.73
STN-15A	PZ-6 (U)	765.30	0.00	8.10	757.20	9.80	755.50	10.20	755.10	9.74	755.56
STN-15A	PZ-7 (L)	765.30	0.00	15.10	750.20	17.50	747.80	17.50	747.80	17.54	747.76
STN-15B	PZ-8	765.30	0.00	21.30	744.00	21.20	744.10	21.20	744.10	21.53	743.77
STN-26A	PZ-9	750.00	2.80	20.60	732.20	11.30	741.50	11.50	741.30	11.70	741.10
STN-27A	PZ-10 (U)	765.00	0.00	9.00	756.00	9.70	755.30	9.80	755.20	9.94	755.06
STN-27A	PZ-11 (L)	765.00	0.00	14.10	750.90	13.90	751.10	13.80	751.20	13.84	751.16
STN-27B	PZ-12	765.00	0.00	19.40	745.60	19.20	745.80	19.40	745.60	19.32	745.68
STN-36A	PZ-13	751.90	3.40	14.40	740.90	14.10	741.20	14.30	741.00	14.31	740.99
STN-37A	PZ-14 (U)	763.80	0.00	11.00	752.80	11.00	752.80	11.00	752.80	10.95	752.85
STN-37A	PZ-15 (L)	763.80	0.00	22.70	741.10	22.40	741.40	22.50	741.30	22.45	741.35
STN-37B	PZ-16	763.70	0.00	16.60	747.10	16.40	747.30	16.40	747.30	16.27	747.43
STN-47A	PZ-17	753.10	4.50	8.70	748.90	9.30	748.30	8.70	748.90	9.31	748.29
STN-48A	PZ-18 (U)	765.30	3.60	21.20	747.70	21.20	747.70	12.20	756.70	12.23	756.67
STN-48A	PZ-19 (L)	765.30	3.60	17.20	751.70	17.10	751.80	16.90	752.00	16.97	751.93
STN-48B	PZ-20	765.30	3.50	21.90	746.90	21.50	747.30	21.50	747.30	21.52	747.28





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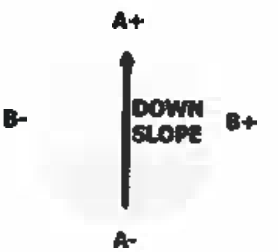
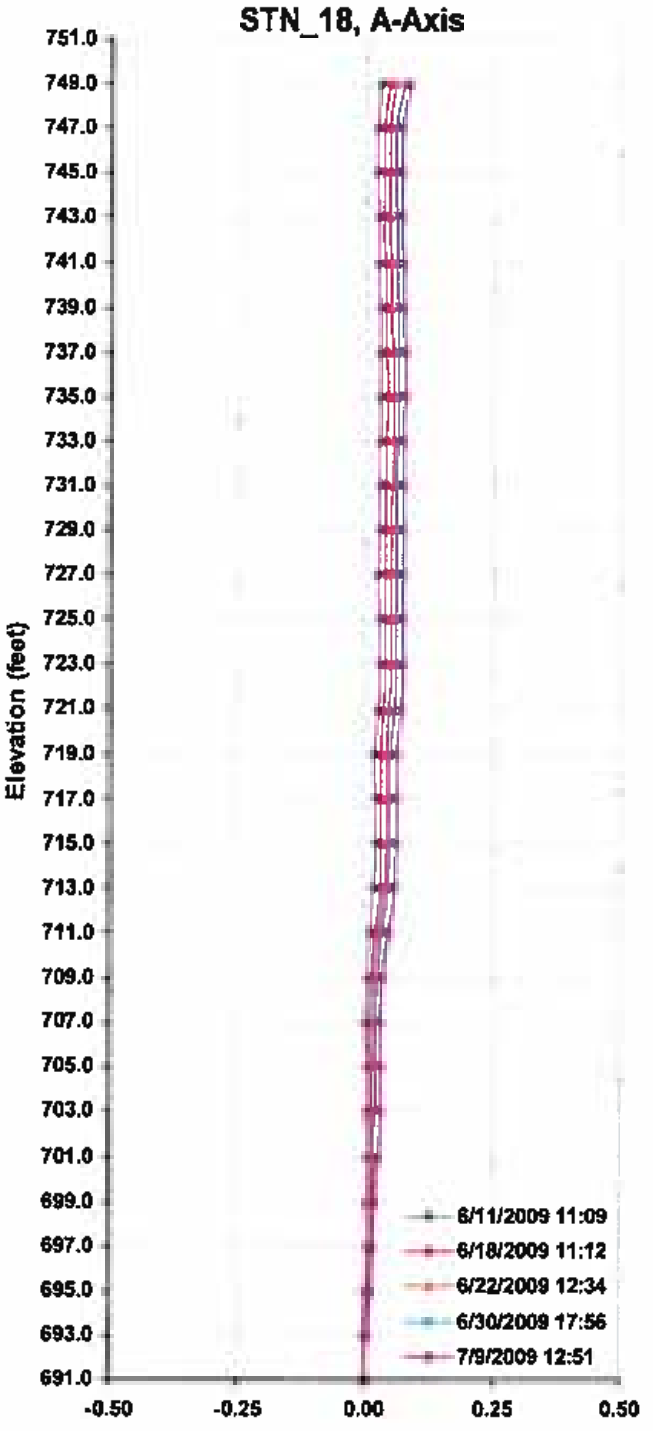
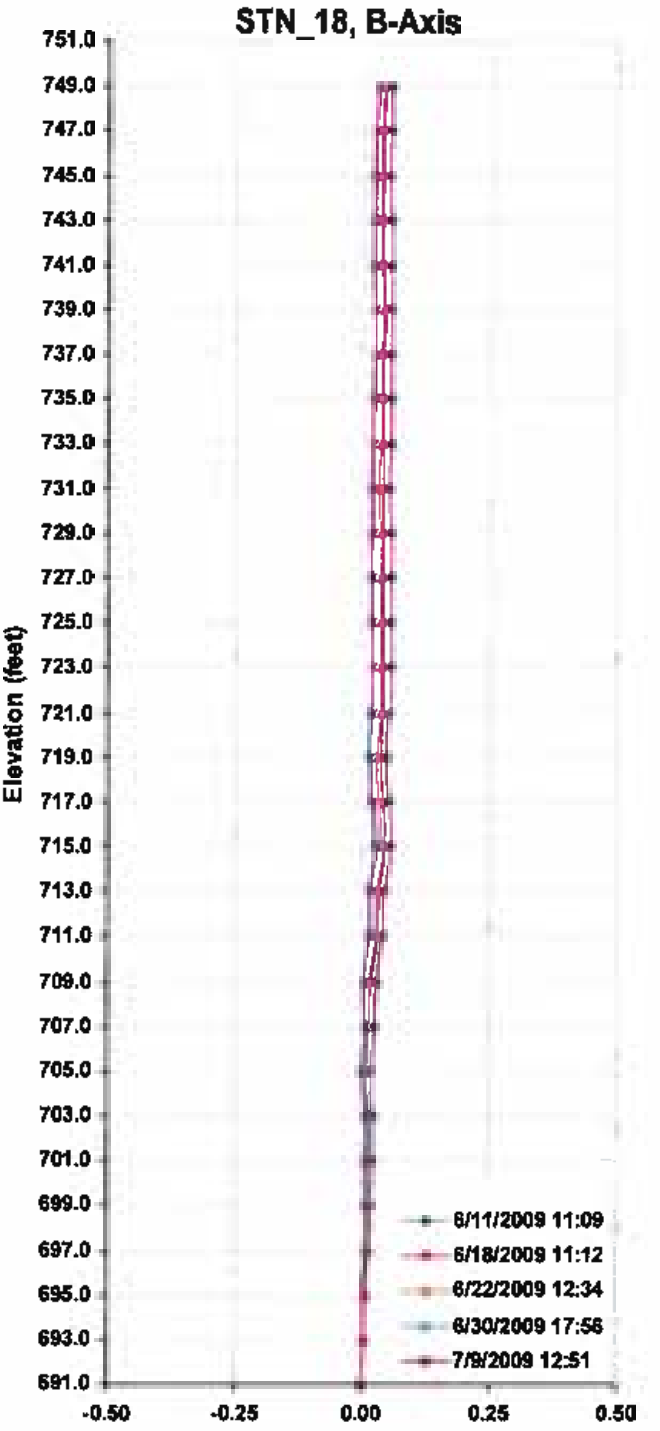


Kingston Fossil Plant
Ash Pond Stability
Kingston, TN
175569042
7/10/2009





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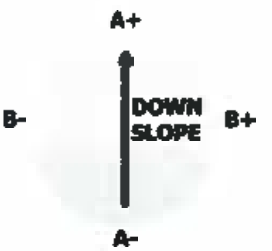
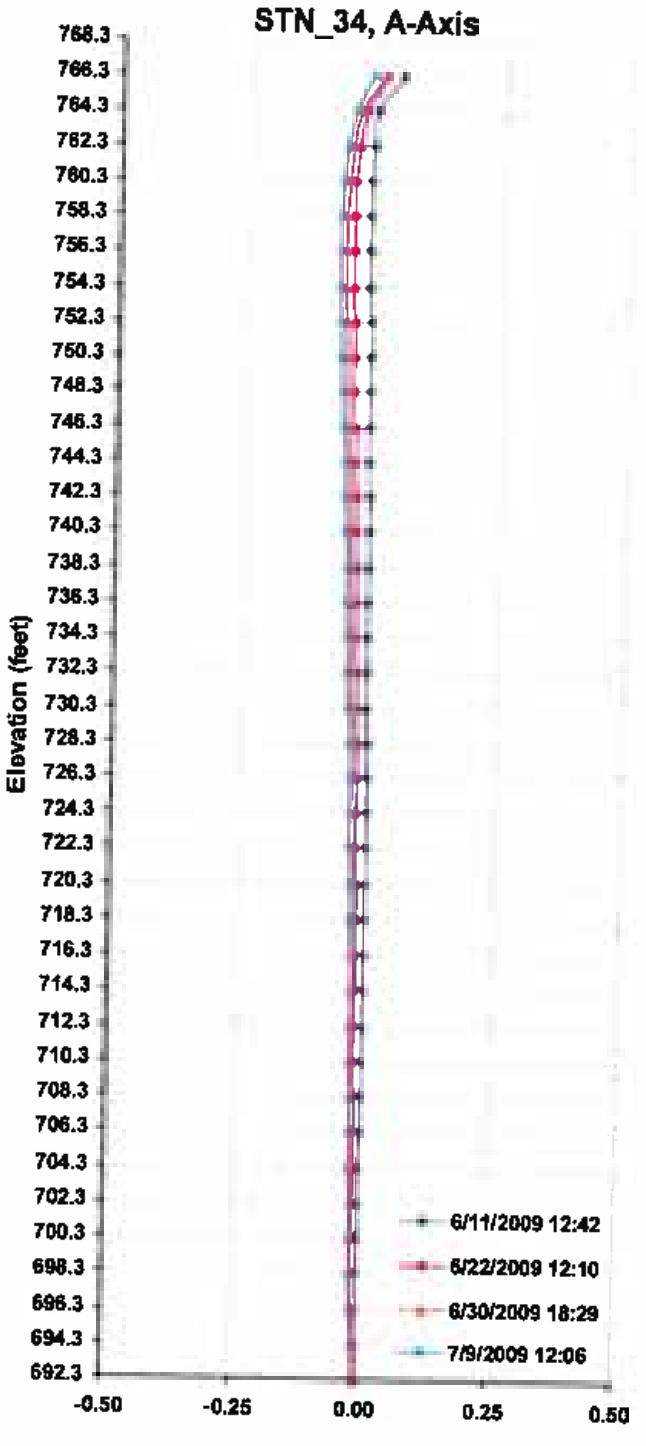
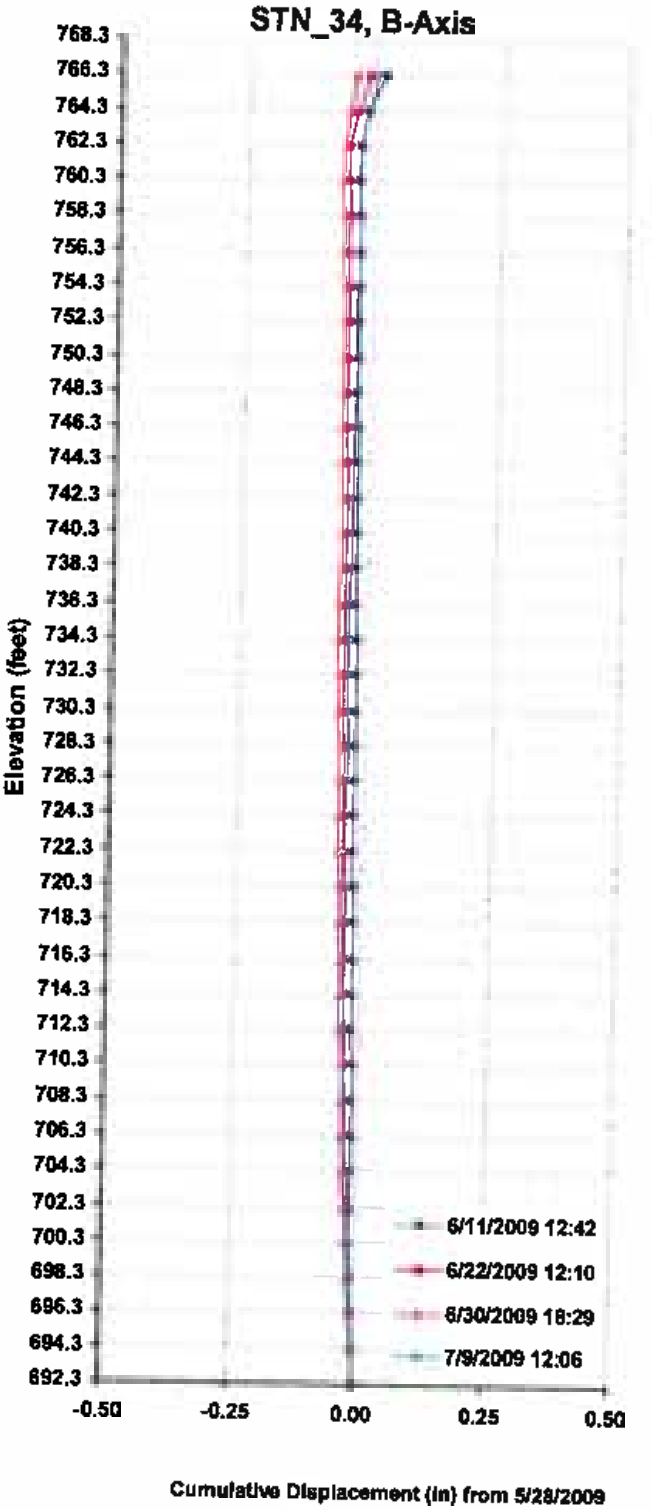


Kingston Fossil Plant
Ash Pond Stability
Kingston, TN
175569042
7/10/2009





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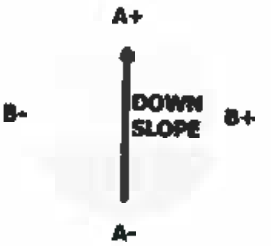
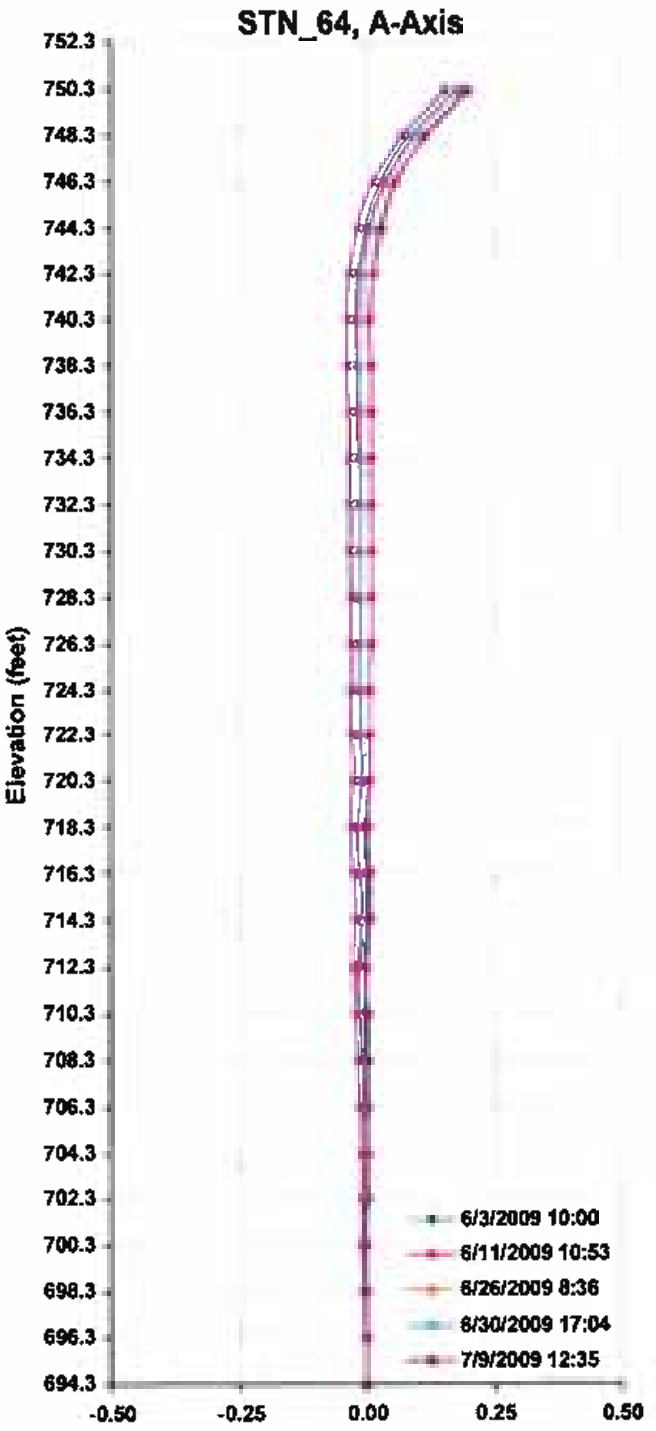
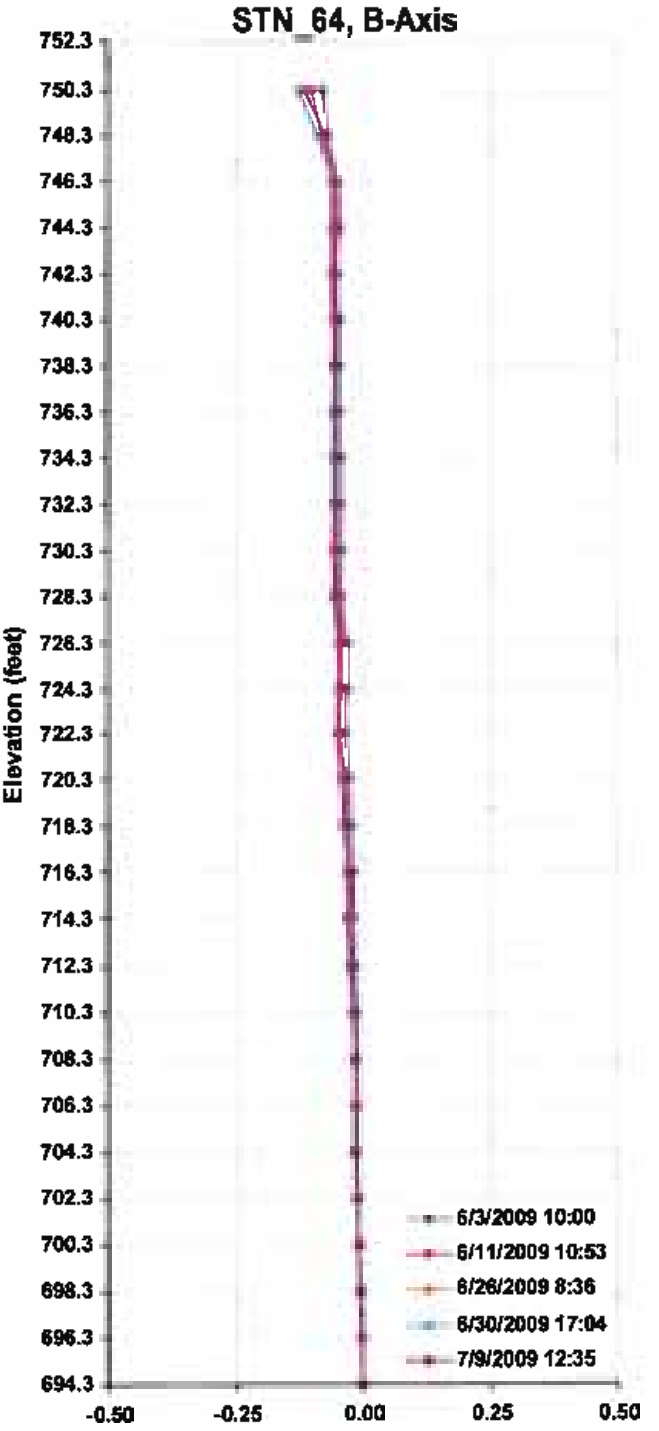


Kingston Fossil Plant
Ash Pond Stability
Kingston, TN
175569042
7/10/2009





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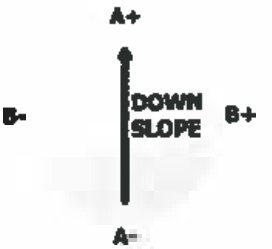
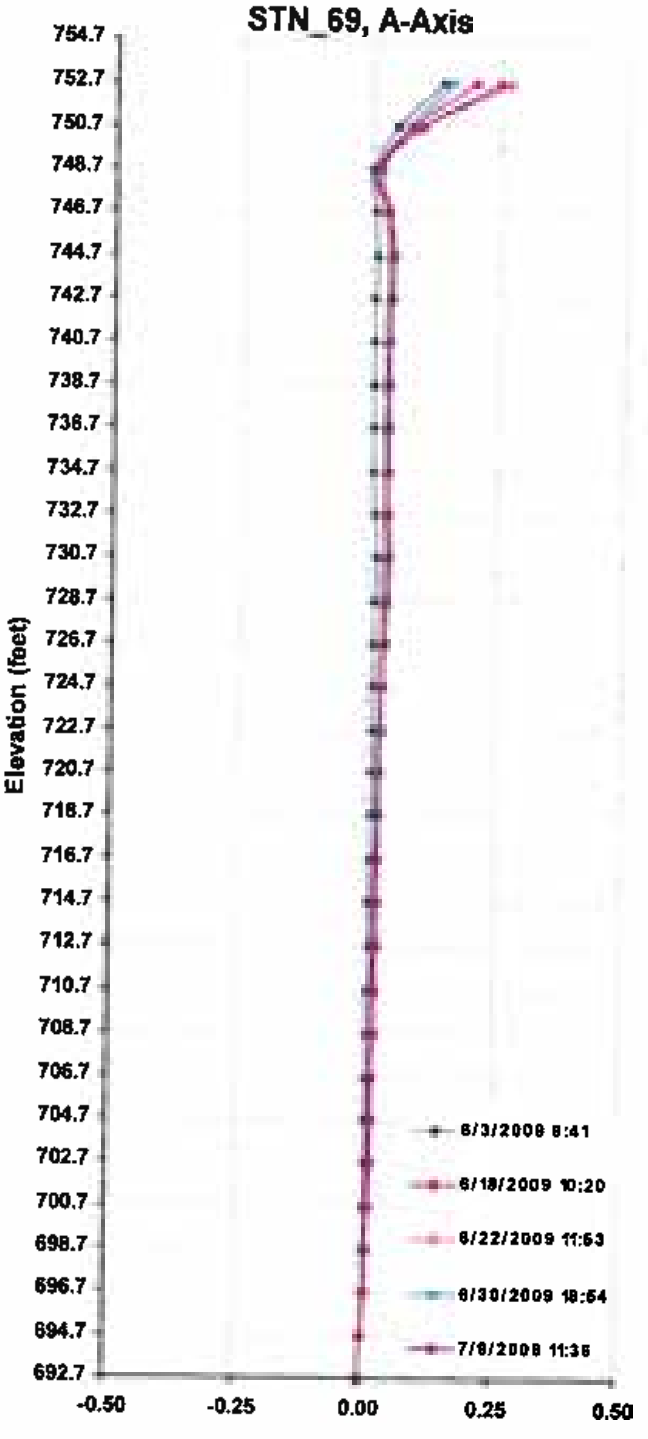
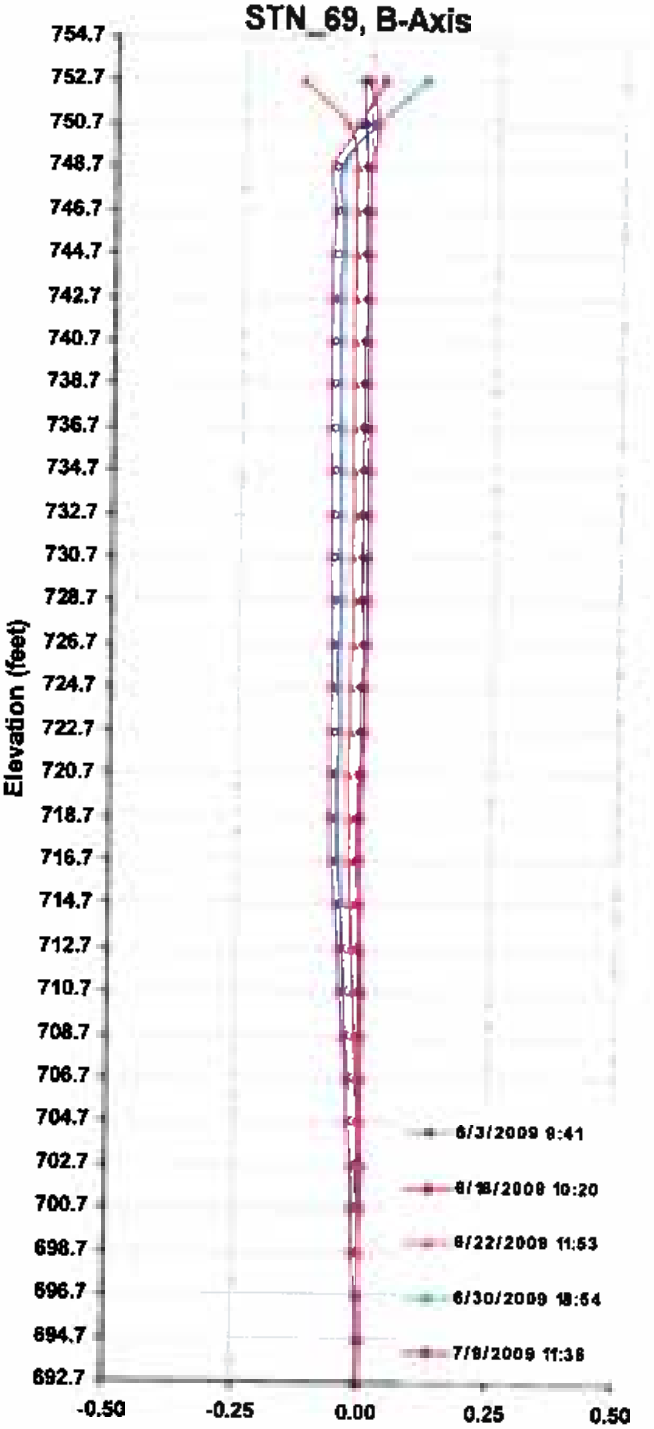


Kingston Fossil Plant
Ash Pond Stability
Kingston, TN
175569042
7/10/2009

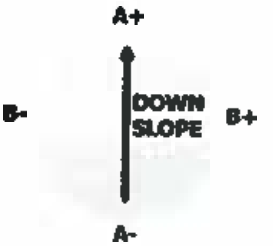


Cumulative Displacement (in) from 5/28/2009

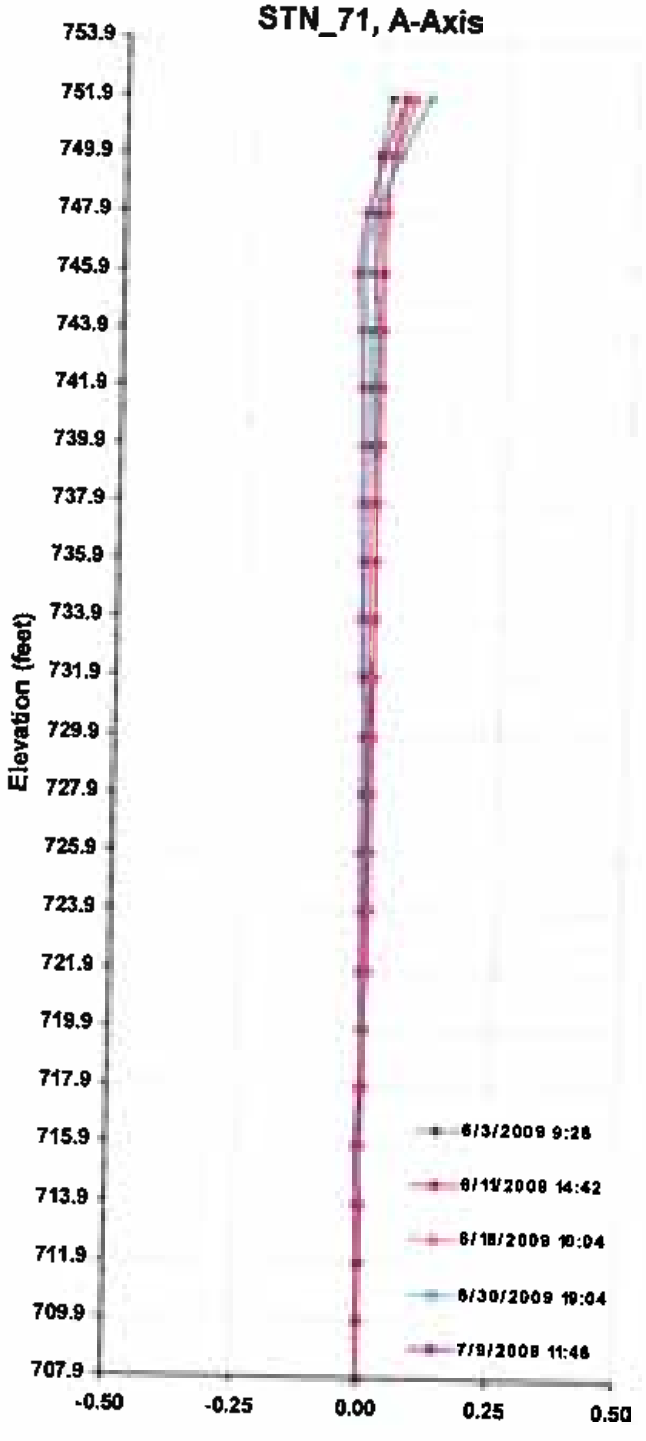


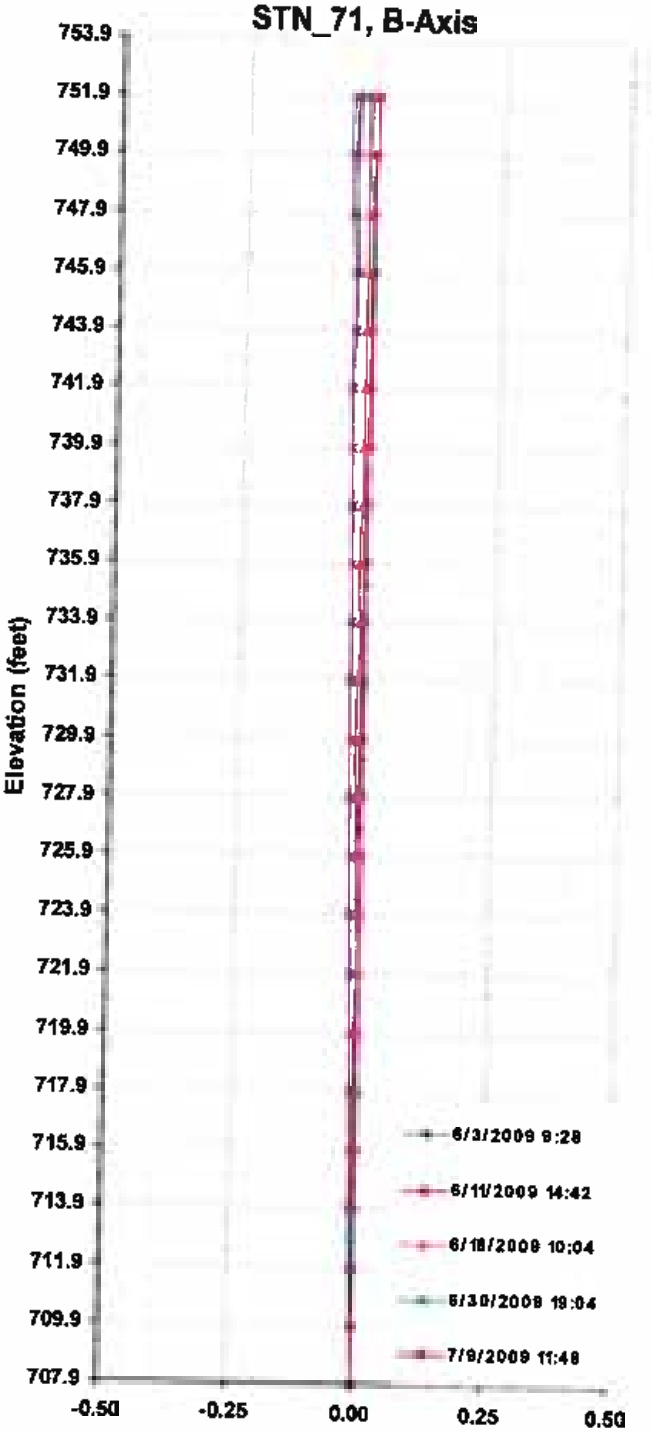
Cumulative Displacement (in) from 5/28/2009

Stantec

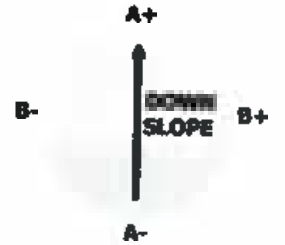


Kingston Fossil Plant
Ash Pond Stability
Kingston, TN
175569042
7/13/2009





Stantec



Kingston Fossil Plant

Kingston, TN

7/13/2009

Appendix E

Laboratory Testing

Unconsolidated Undrained Triaxial Test Results

Stantec

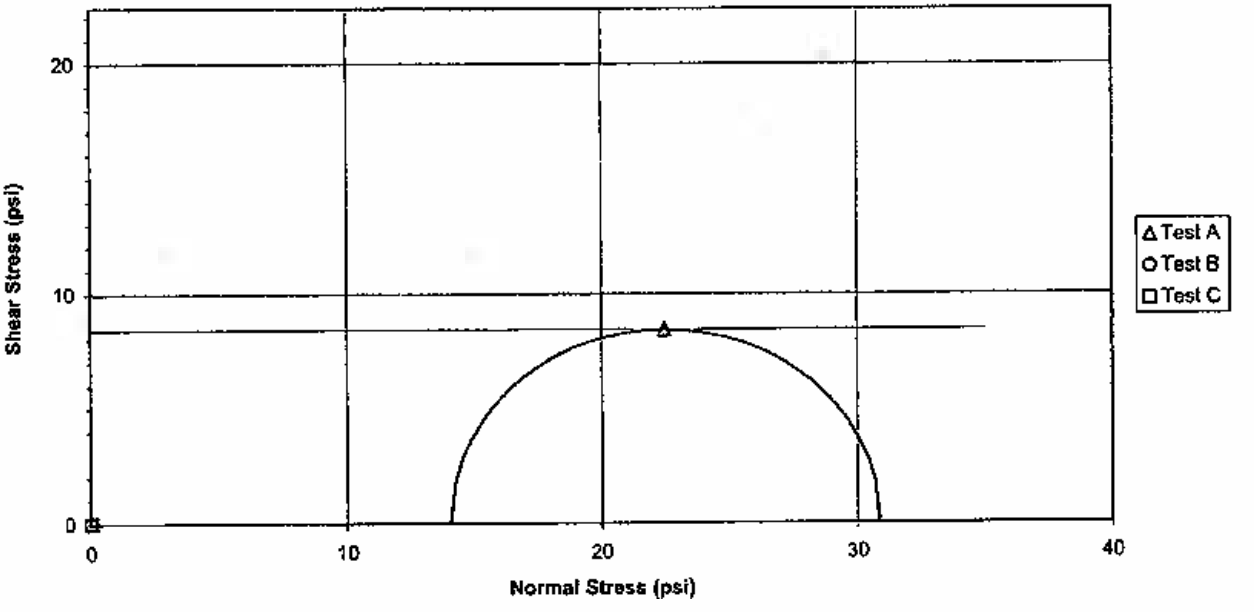
Unconsolidated Undrained Triaxial Test
ASTM D 2850-03a

Project	Kingston Ash Pond	Project No.	175569042
Sample ID	STN-2, 20.5' - 21.0'	Test Number	531

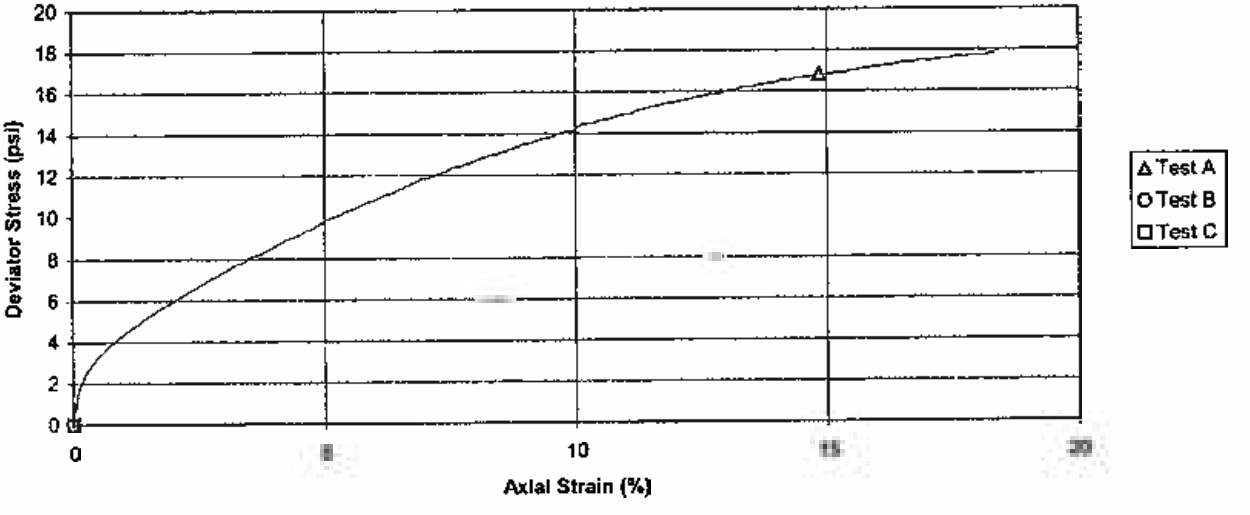
ϕ = 0.0 deg. c = 8.5 psi

Failure Criterion: Maximum Deviator Stress

Mohr Failure Envelope



Deviator Stress vs. Axial Strain



Stantec

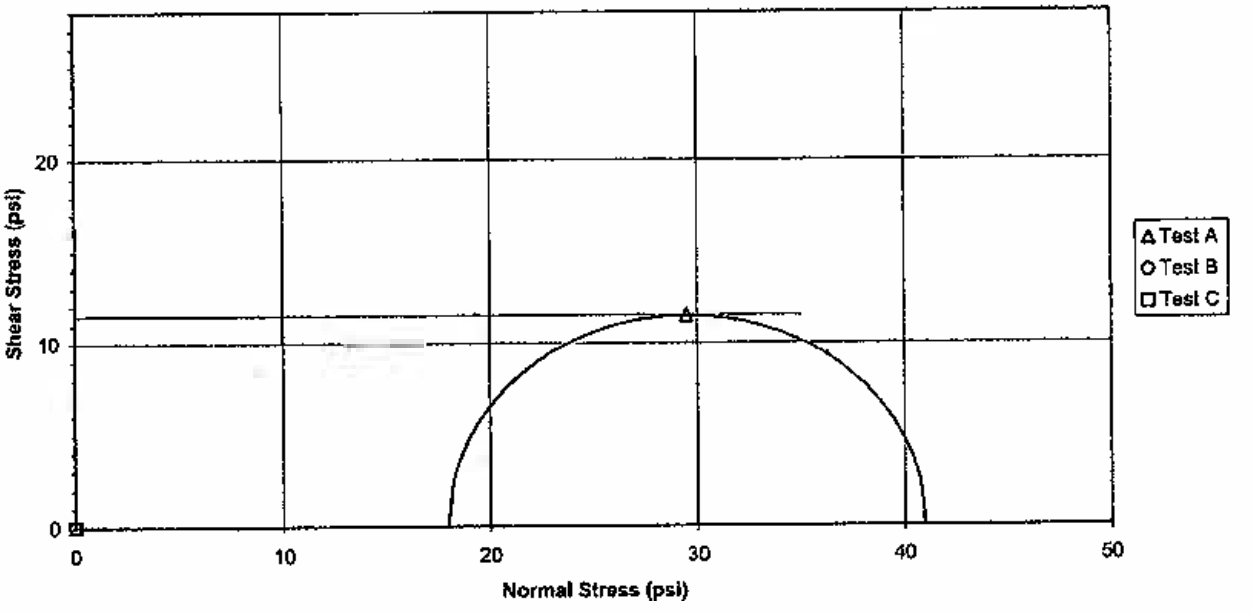
Unconsolidated Undrained Triaxial Test
ASTM D 2850-03a

Project	Kingston Ash Pond	Project No.	175569042
Sample ID	STN-2, 30.6' - 31.1'	Test Number	535

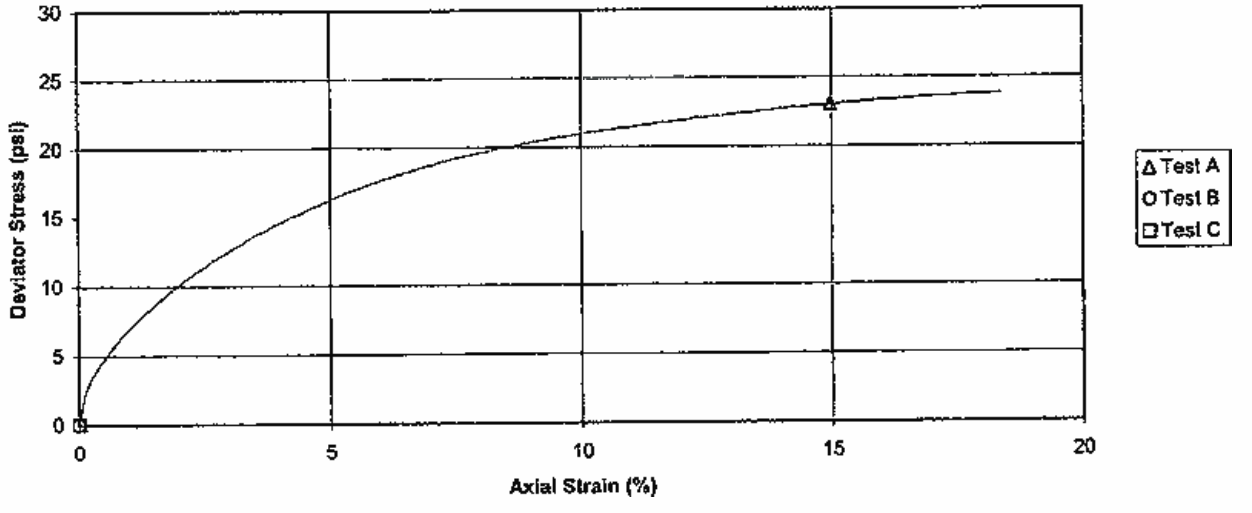
ϕ = 0.0 deg. c = 11.6 psi

Failure Criterion: Maximum Deviator Stress

Mohr Failure Envelope



Deviator Stress vs. Axial Strain



Stantec

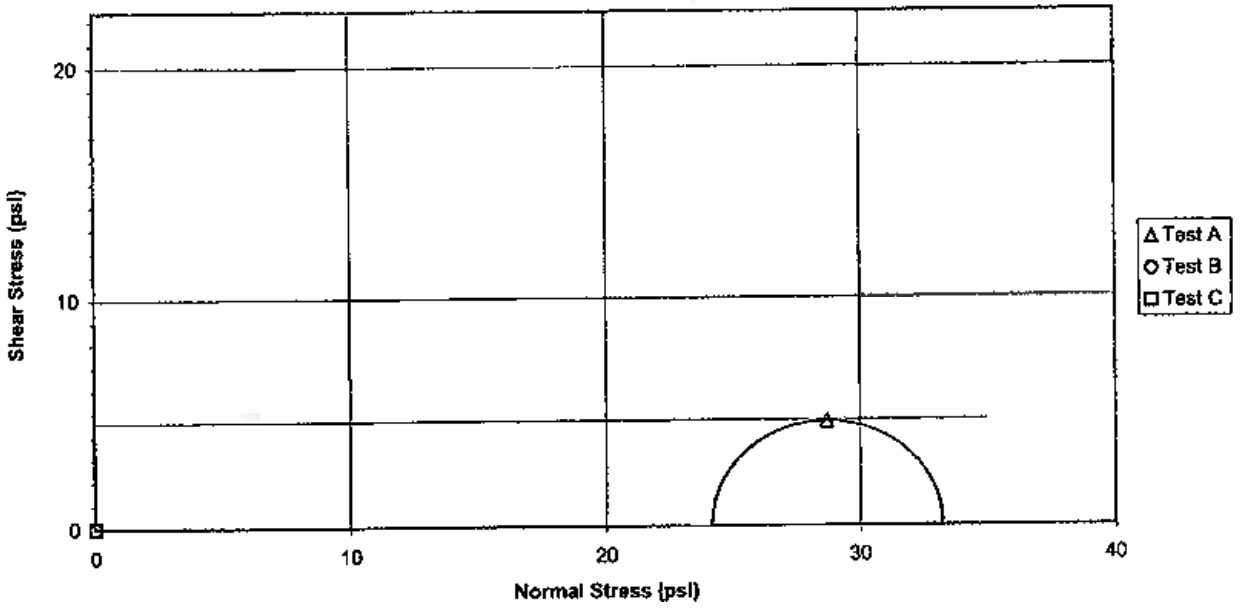
Unconsolidated Undrained Triaxial Test
ASTM D 2850-03a

Project	Kingston Ash Pond	Project No.	175569042
Sample ID	STN-5, 38.5' - 39.0'	Test Number	543
		c =	4.6 psi

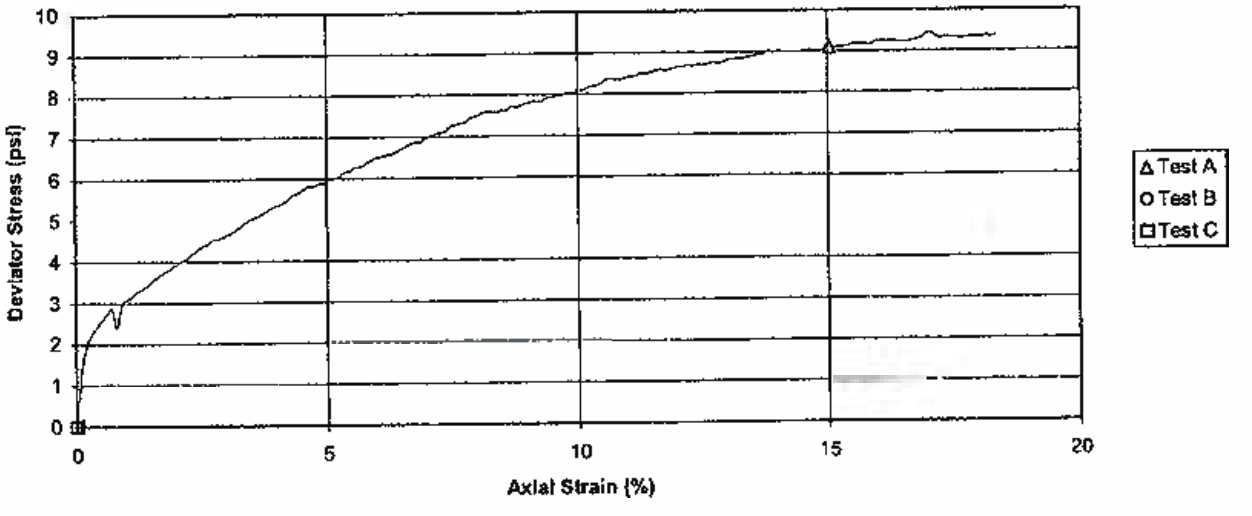
ϕ = 0.0 deg.

Failure Criterion: Maximum Deviator Stress

Mohr Failure Envelope



Deviator Stress vs. Axial Strain



Stantec

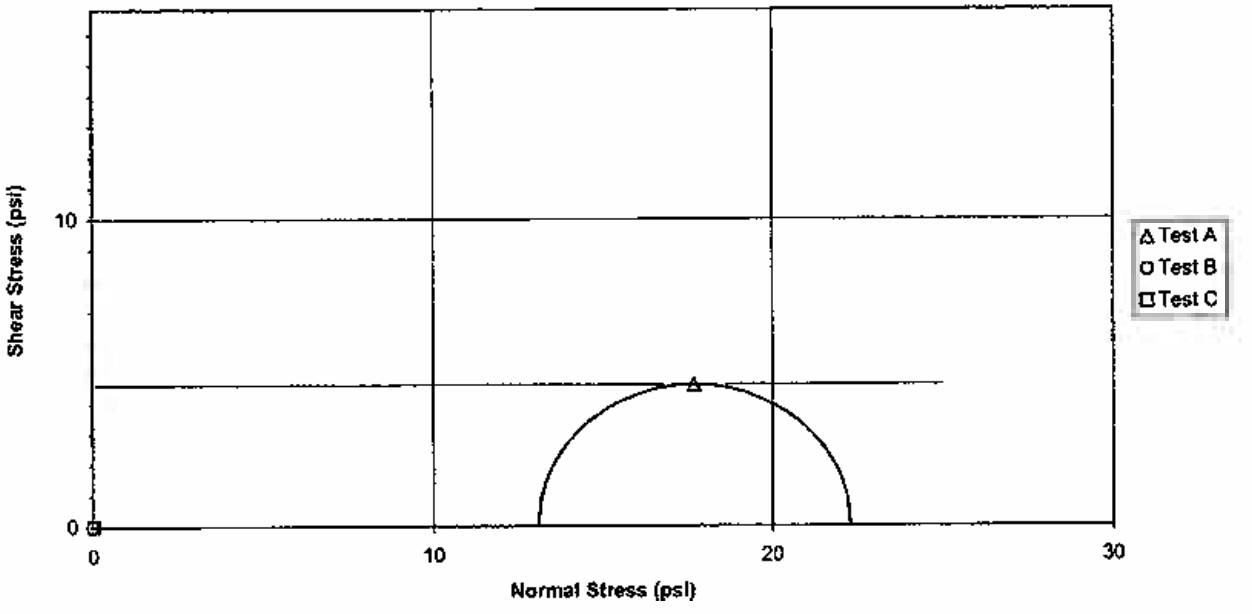
Unconsolidated Undrained Triaxial Test
ASTM D 2850-03a

Project	Kingston Ash Pond	Project No.	175569042
Sample ID	STN-8, 15.5' - 16.0'	Test Number	555

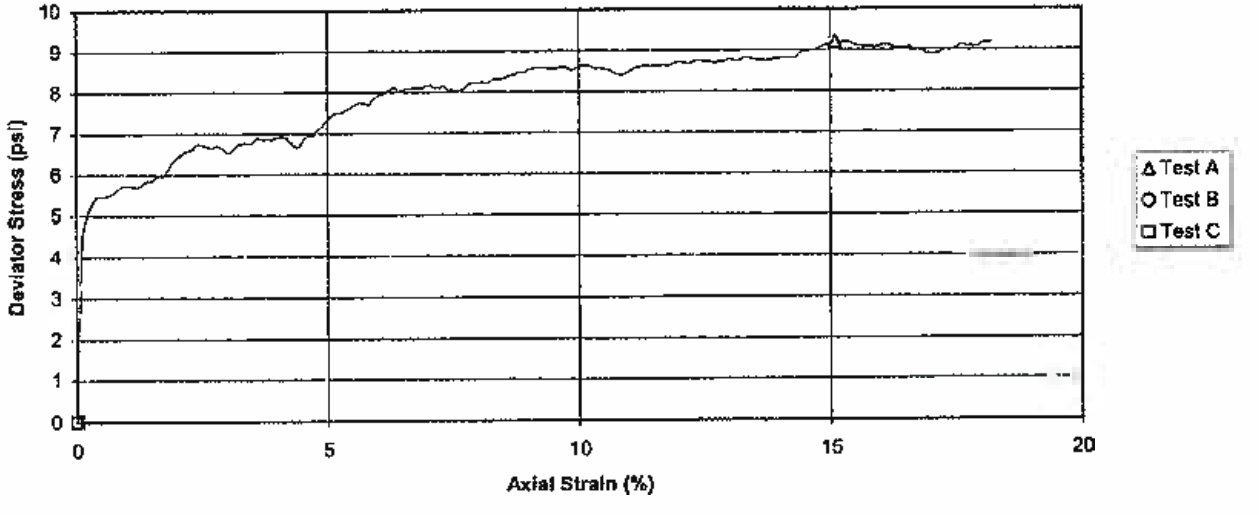
ϕ = 0.0 deg. c = 4.6 psi

Failure Criterion: Maximum Deviator Stress

Mohr Failure Envelope



Deviator Stress vs. Axial Strain



Stantec

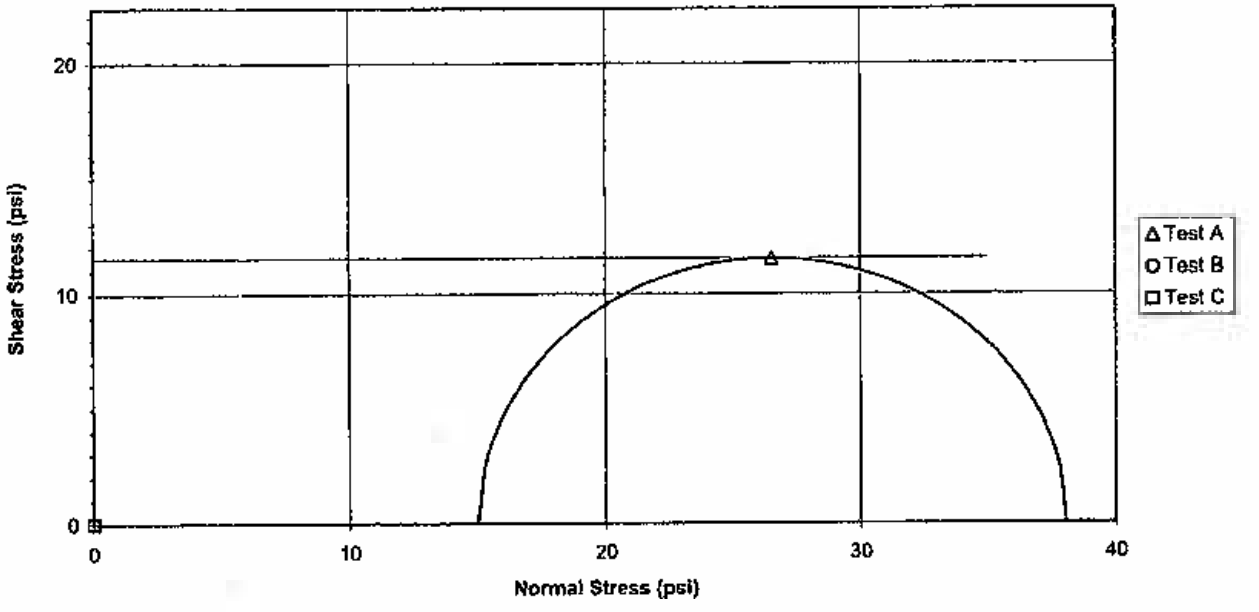
Unconsolidated Undrained Triaxial Test
ASTM D 2850-03a

Project	Kingston Ash Pond	Project No.	175569042
Sample ID	STN-18, 25.5' - 26.0'	Test Number	521

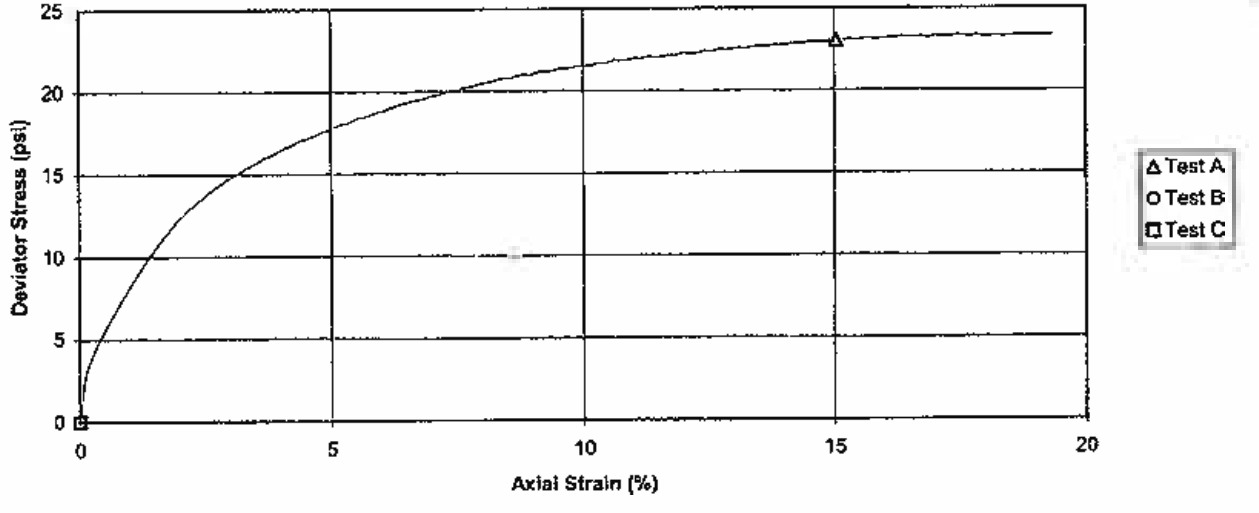
ϕ = 0.0 deg. c = 11.6 psi

Failure Criterion: Maximum Deviator Stress

Mohr Failure Envelope



Deviator Stress vs. Axial Strain



Stantec

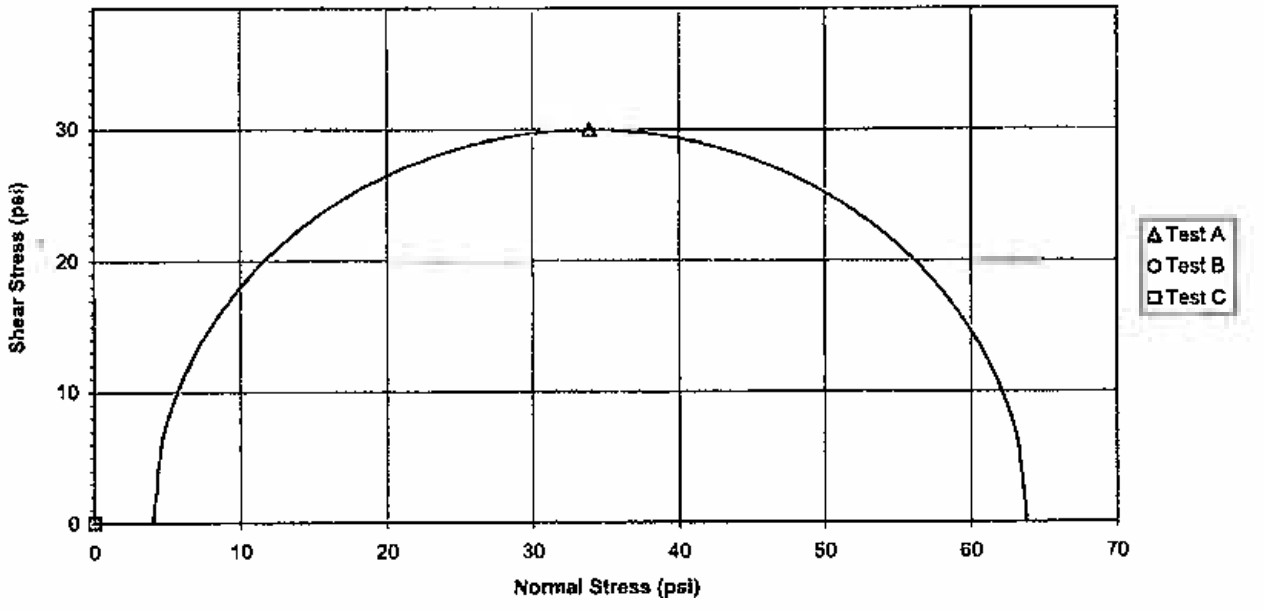
Unconsolidated Undrained Triaxial Test
ASTM D 2850-03a

Project	Kingston Ash Pond	Project No.	175569042
Sample ID	STN-19, 5.0' - 5.5'	Test Number	515

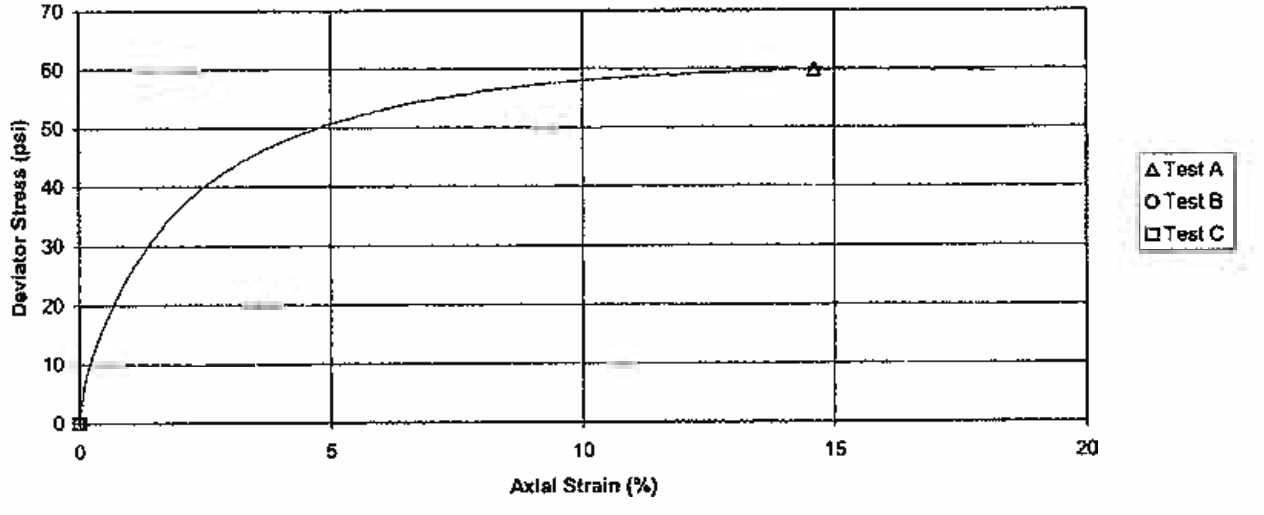
ϕ = 0.0 deg. c = 29.9 psi

Failure Criterion: Maximum Deviator Stress

Mohr Failure Envelope



Deviator Stress vs. Axial Strain



Stantec

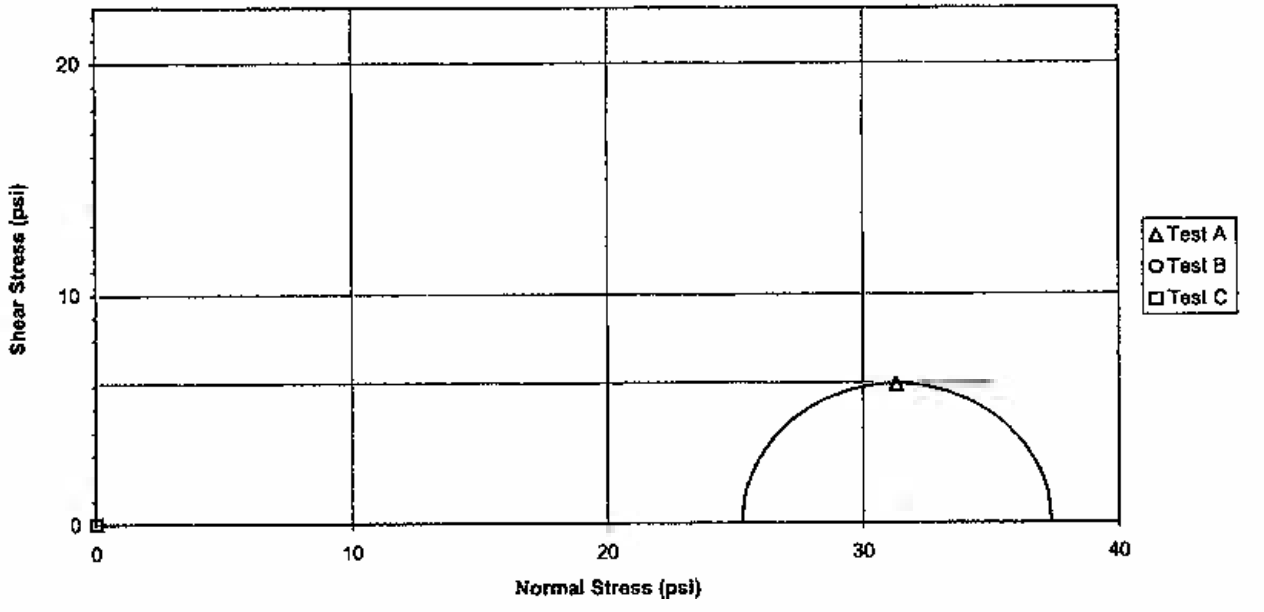
Unconsolidated Undrained Triaxial Test
ASTM D 2850-03a

Project	Kingston Ash Pond	Project No.	175569042
Sample ID	STN-19, 39.7' - 40.2'	Test Number	518

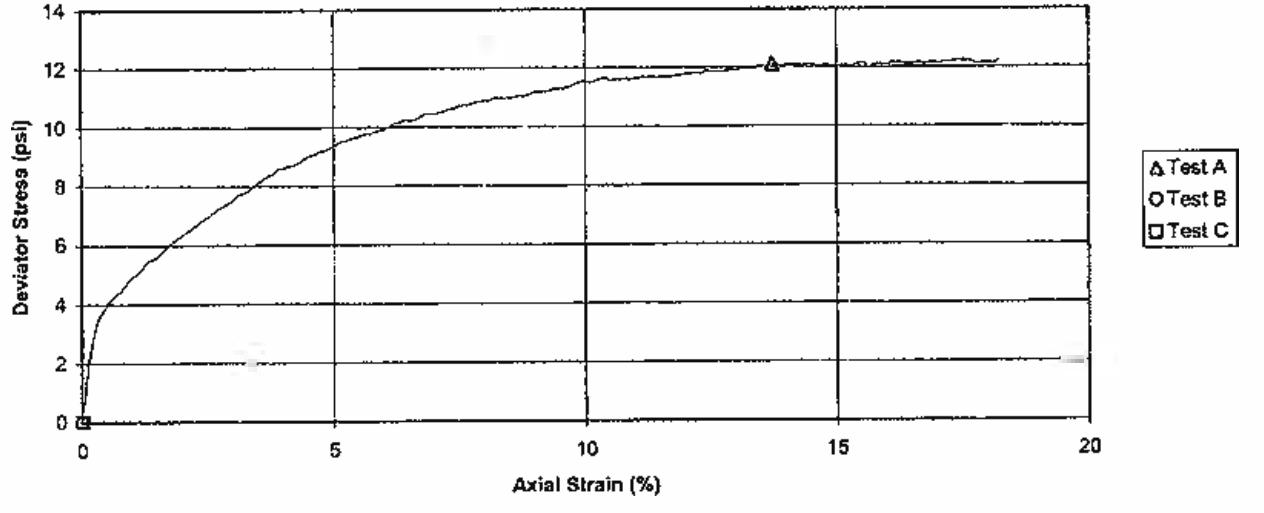
ϕ = 0.0 deg. c = 6.1 psi

Failure Criterion: Maximum Deviator Stress

Mohr Failure Envelope



Deviator Stress vs. Axial Strain



Stantec

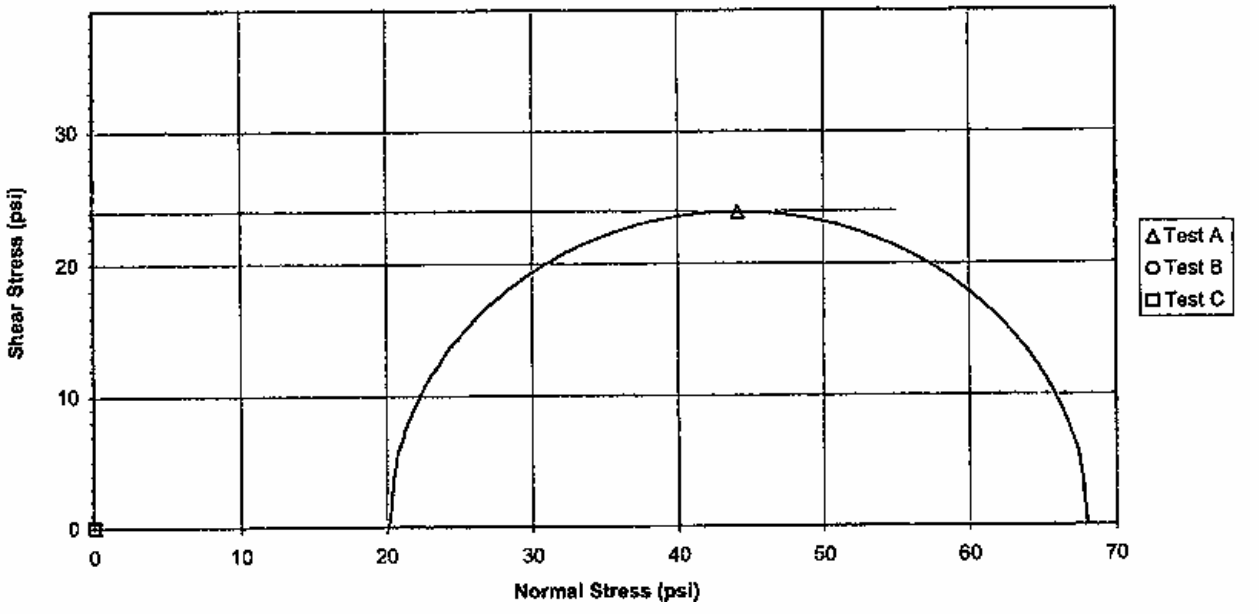
Unconsolidated Undrained Triaxial Test
ASTM D 2850-03a

Project	Kingston Ash Pond	Project No.	175569042
Sample ID	STN-22, 49.5' - 50.0'	Test Number	560

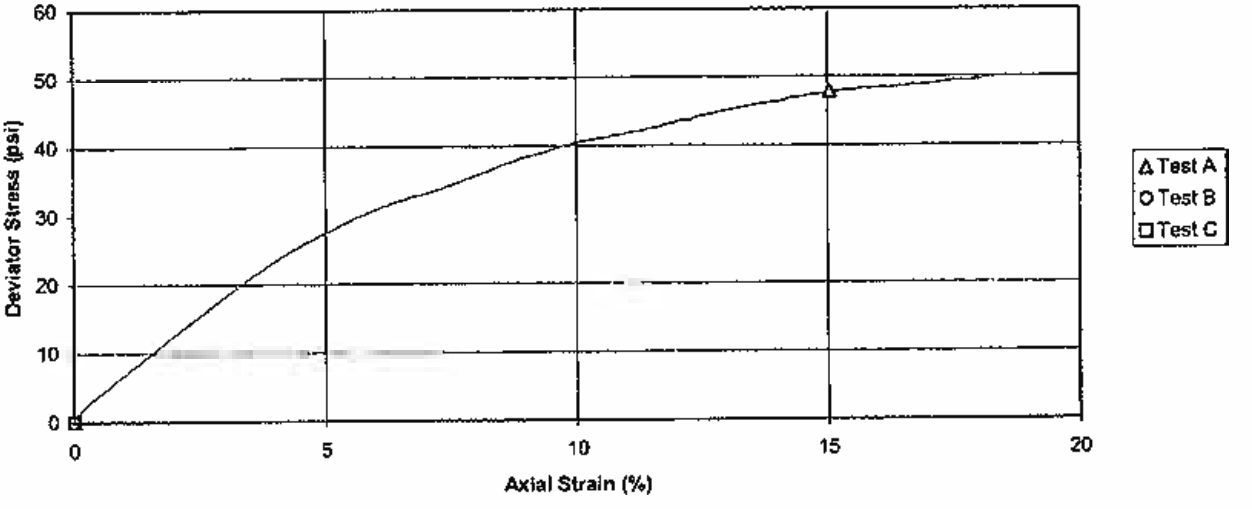
ϕ = 0.0 deg. c = 24.0 psi

Failure Criterion: Maximum Deviator Stress

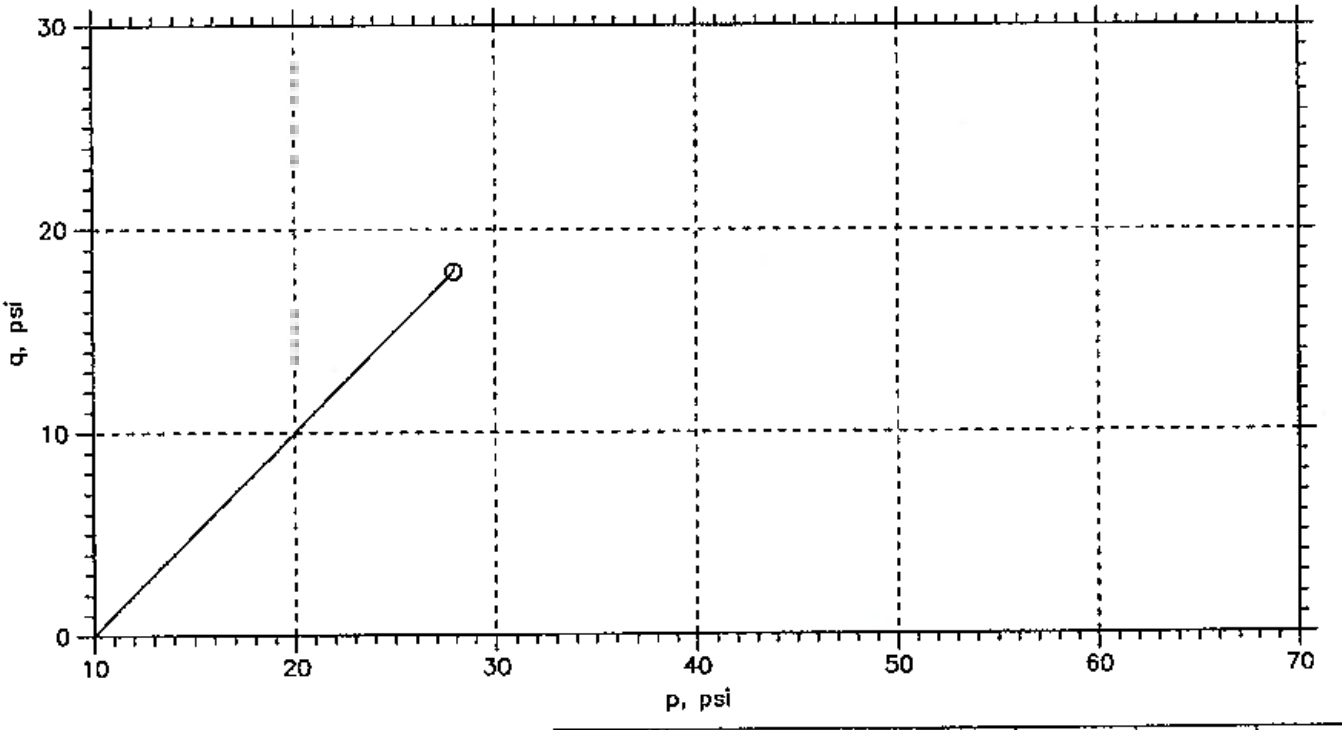
Mohr Failure Envelope

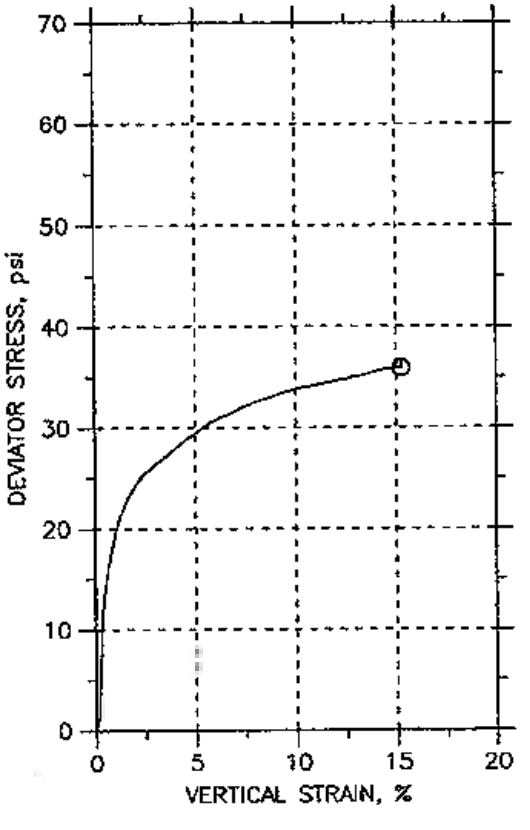


Deviator Stress vs. Axial Strain



UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





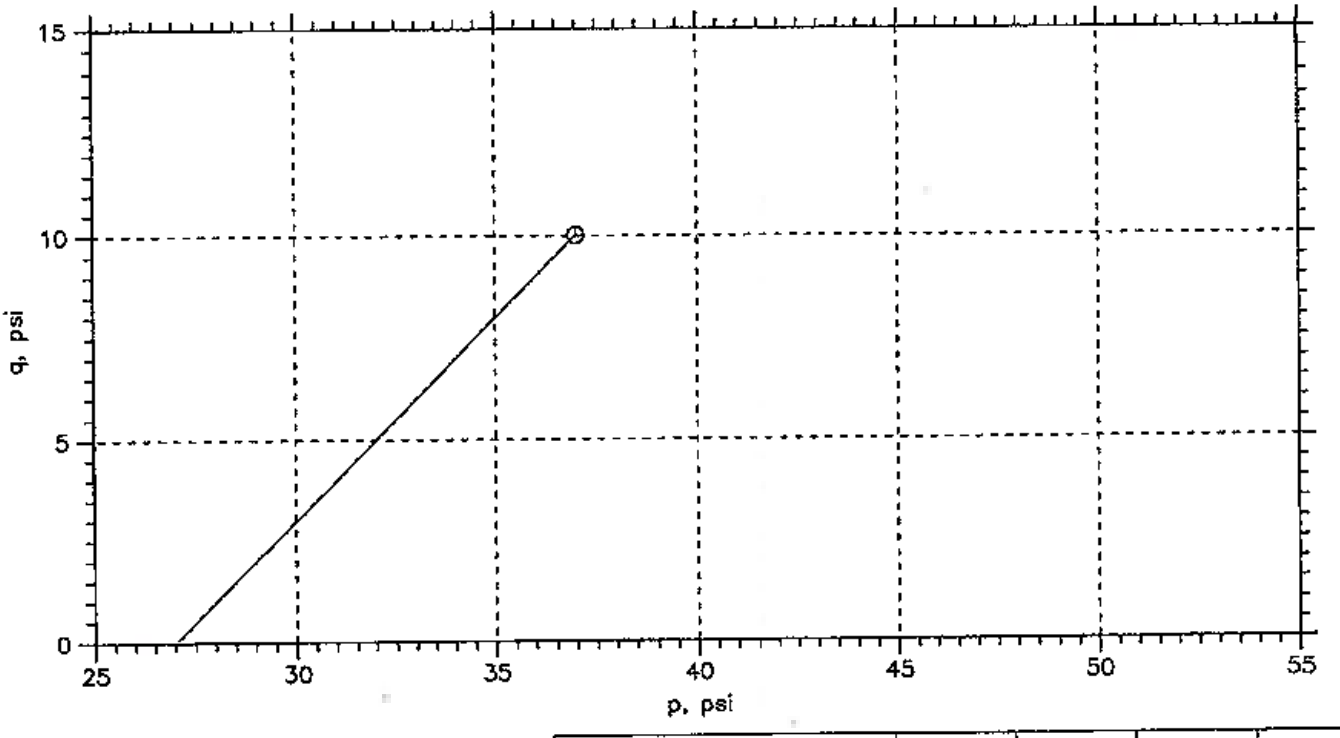
Symbol	⊙			
Sample No.	---			
Test No.	UU13.1			
Depth	12.6-13.1			
Tested by	MM			
Test Date	5/16/09			
Checked by	JM			
Check Date				
Diameter, in	2.834			
Height, in	5.927			
Water Content, %	23.2			
Dry Density, pcf	103.1			
Saturation, %	101.6			
Void Ratio	0.605			
Confining Stress, psi	10			
Undrained Strength, psi	17.95			
Max. Dev. Stress, psi	35.89			
Strain at Failure, %	15.3			
Strain Rate, %/min	1			
Measured Specific Gravity	2.65			
Liquid Limit	0			
Plastic Limit	0			
Plasticity Index	0			

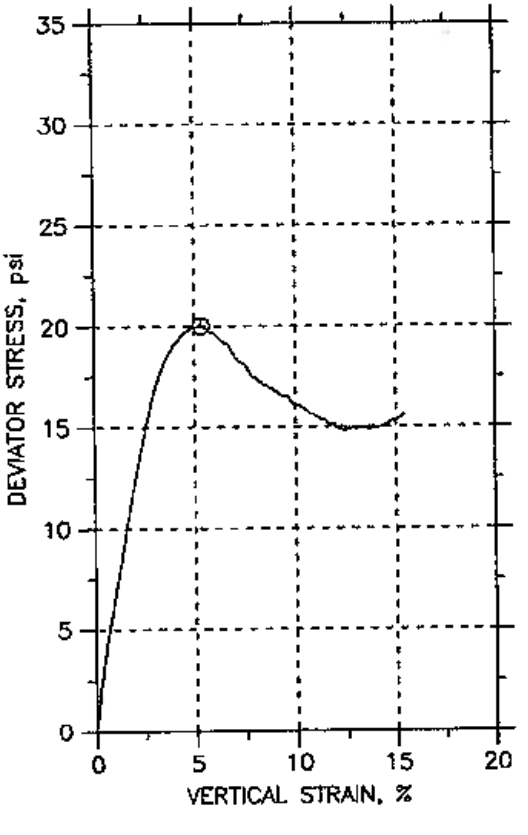
GeoTesting express
a subsidiary of Geocomp Corporation

Project: Kingson Ash Pond
Location: Roane, TN
Project No.: GTX-1464
Boring No.: STN-27
Sample Type: tube
Description: Brown lean clay with sand
Remarks: 2054

Phase calculations based on start and end of test.

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





Symbol	⊙			
Sample No.	---			
Test No.	UU7.1			
Depth	44.7-45.2			
Tested by	MM			
Test Date	5/16/09			
Checked by	JM			
Check Date				
Diameter, in	2.854			
Height, in	5.94			
Water Content, %	20.6			
Dry Density, pcf	106.2			
Saturation, %	97.8			
Void Ratio	0.558			
Confining Stress, psi	27			
Undrained Strength, psi	10.01			
Max. Dev. Stress, psi	20.02			
Strain at Failure, %	5.35			
Strain Rate, %/min	1			
Measured Specific Gravity	2.65			
Liquid Limit	0			
Plastic Limit	0			
Plasticity Index	0			

GeoTesting express
a subsidiary of Geocomp Corporation

Project: Kingson Ash Pond

Location: Roane, TN

Project No.: GTX-1464

Boring No.: STN-27

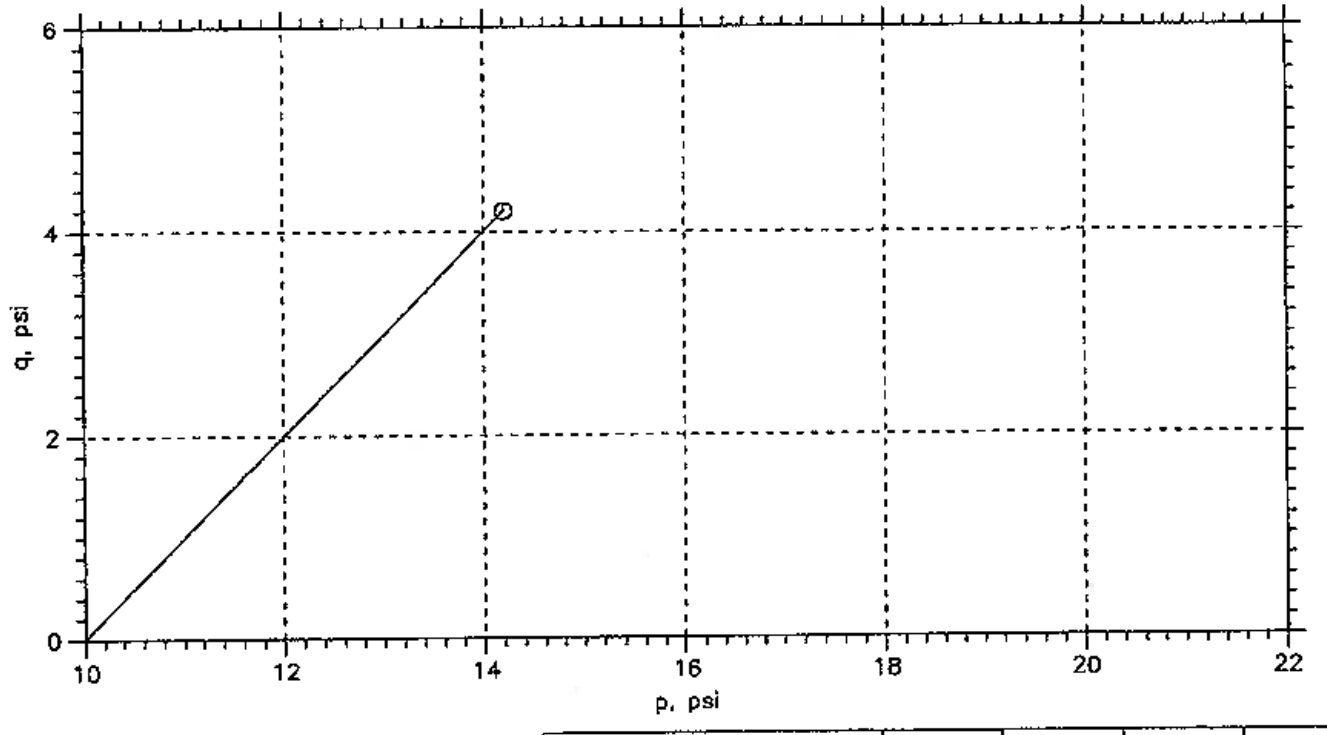
Sample Type: tube

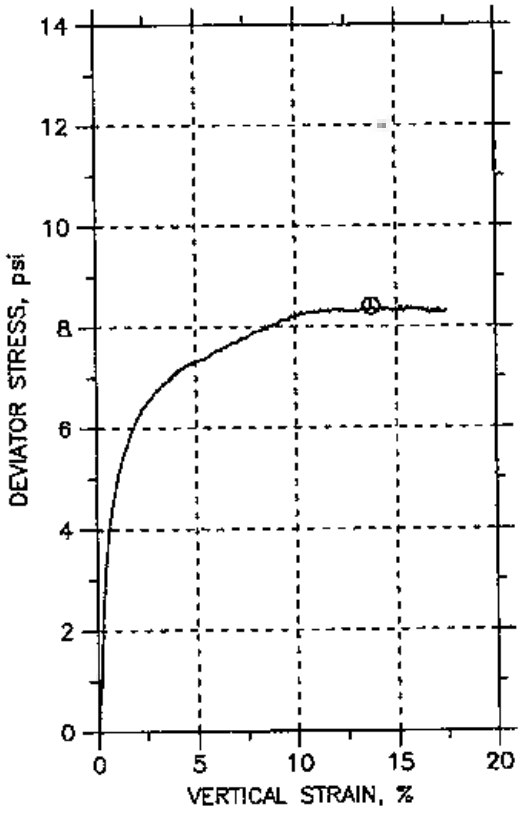
Description: Gray Sandy lean clay

Remarks: 2054

Phase calculations based on start and end of test

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





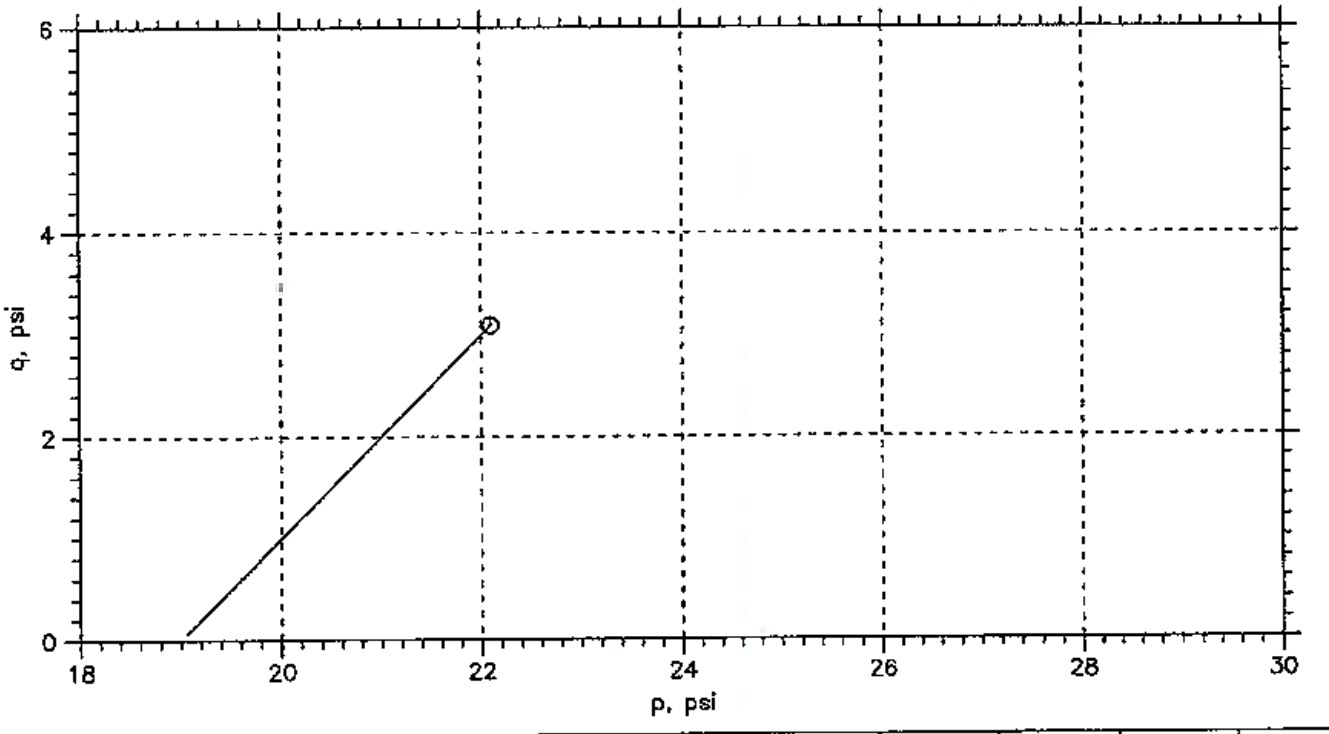
Symbol	⊙			
Sample No.	---			
Test No.	UU2.1			
Depth	20.5-21 ft			
Tested by	MM			
Test Date	5/13/09			
Checked by	JM			
Check Date				
Diameter, in	2.847			
Height, in	6.023			
Water Content, %	35.9			
Dry Density, pcf	85.32			
Saturation, %	101.4			
Void Ratio	0.939			
Confining Stress, psi	10			
Undrained Strength, psi	4.203			
Max. Dev. Stress, psi	8.405			
Strain at Failure, %	13.8			
Strain Rate, %/min	1			
Measured Specific Gravity	2.65			
Liquid Limit	0			
Plastic Limit	0			
Plasticity Index	0			

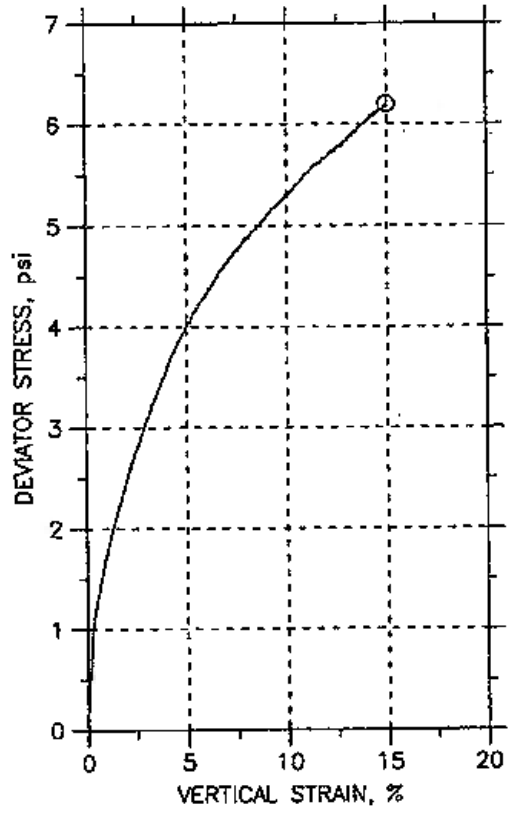
GeoTesting express
a subsidiary of Geocomp Corporation

Project: Klngson Ash Pond
Location: Roane, TN
Project No.: GTX-1464
Boring No.: STN-31
Sample Type: tube
Description: Brown sandy silt
Remarks: 2054

Phase calculations based on start and end of test.

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





Symbol	⊙			
Sample No.	---			
Test No.	UU3.1			
Depth	38-38.5 ft			
Tested by	MM			
Test Date	5/13/09			
Checked by	JM			
Check Date				
Diameter, in	2.903			
Height, in	5.811			
Water Content, %	22.5			
Dry Density, pcf	103.5			
Saturation, %	99.6			
Void Ratio	0.599			
Confining Stress, psi	19			
Undrained Strength, psi	3.1			
Max. Dev. Stress, psi	6.2			
Strain at Failure, %	15			
Strain Rate, %/min	0.5			
Measured Specific Gravity	2.65			
Liquid Limit	42			
Plastic Limit	22			
Plasticity Index	20			

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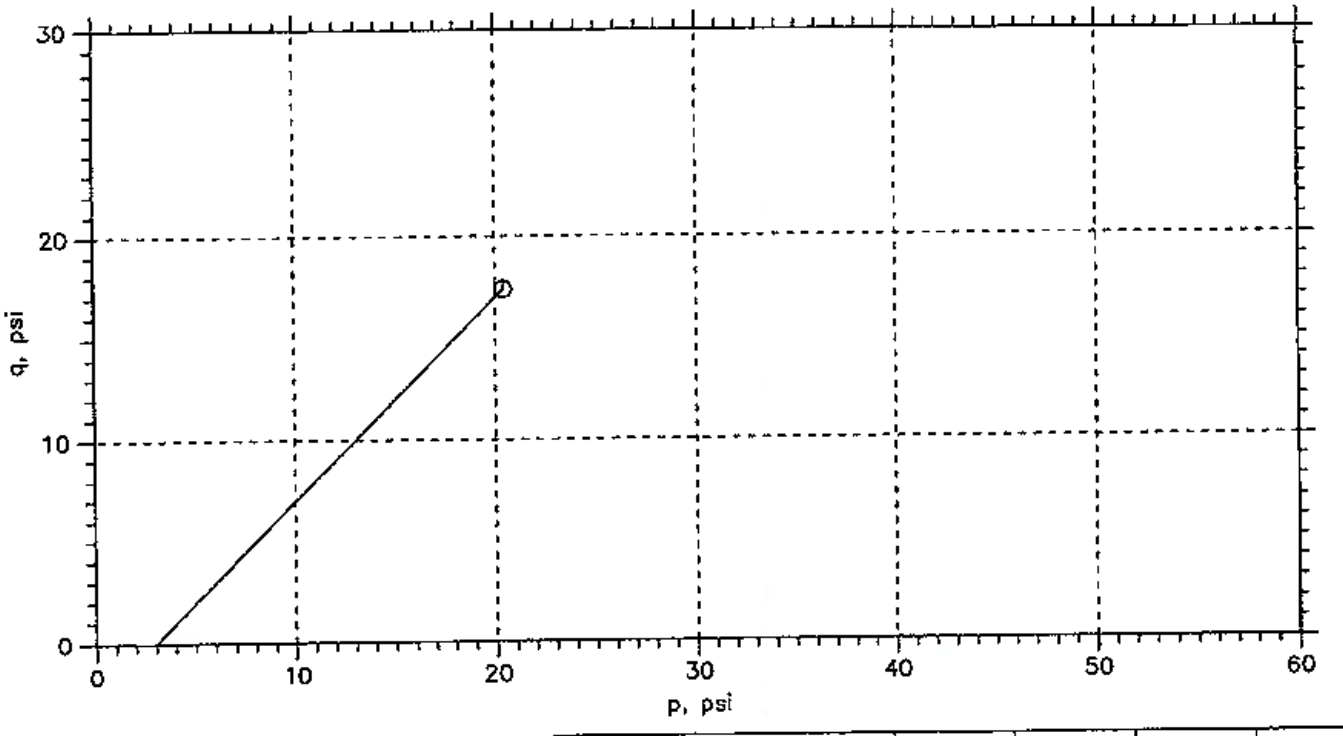
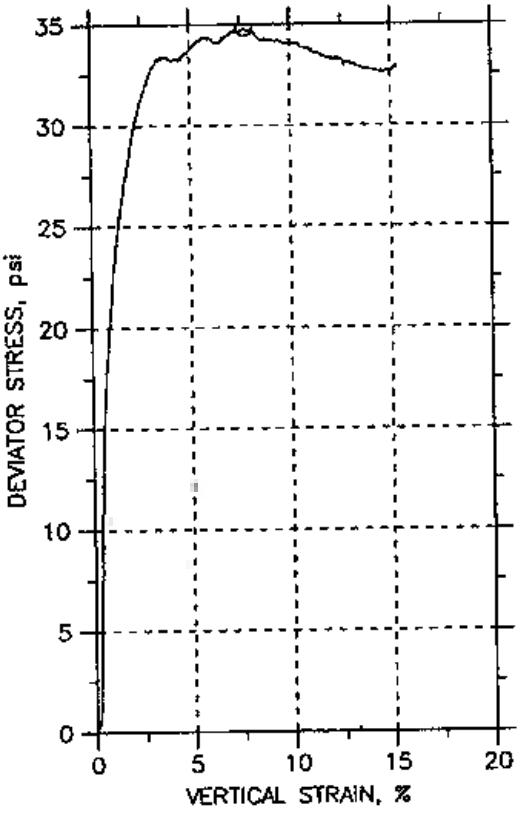
Project: Kingson Ash Pond
Location: Roane, TN
Project No.: GTX-1464
Boring No.: STN-31
Sample Type: tube
Description: Gray-Brown Lean clay
Remarks: 2054

Phase calculations based on start and end of test

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





Symbol	⊙			
Sample No.	---			
Test No.	UU10.1			
Depth	5.3-5.8 ft			
Tested by	MM			
Test Date	5/16/09			
Checked by	JM			
Check Date				
Diameter, in	2.83			
Height, in	5.962			
Water Content, %	23.6			
Dry Density, pcf	101.1			
Saturation, %	98.2			
Void Ratio	0.637			
Confining Stress, psi	3			
Undrained Strength, psi	17.42			
Max. Dev. Stress, psi	34.84			
Strain at Failure, %	7.75			
Strain Rate, %/min	1			
Measured Specific Gravity	2.65			
Liquid Limit	36			
Plastic Limit	19			
Plasticity Index	17			

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Project: Kingson Ash Pond

Location: Roane, TN

Project No.: GTX-1464

Boring No.: STN-32

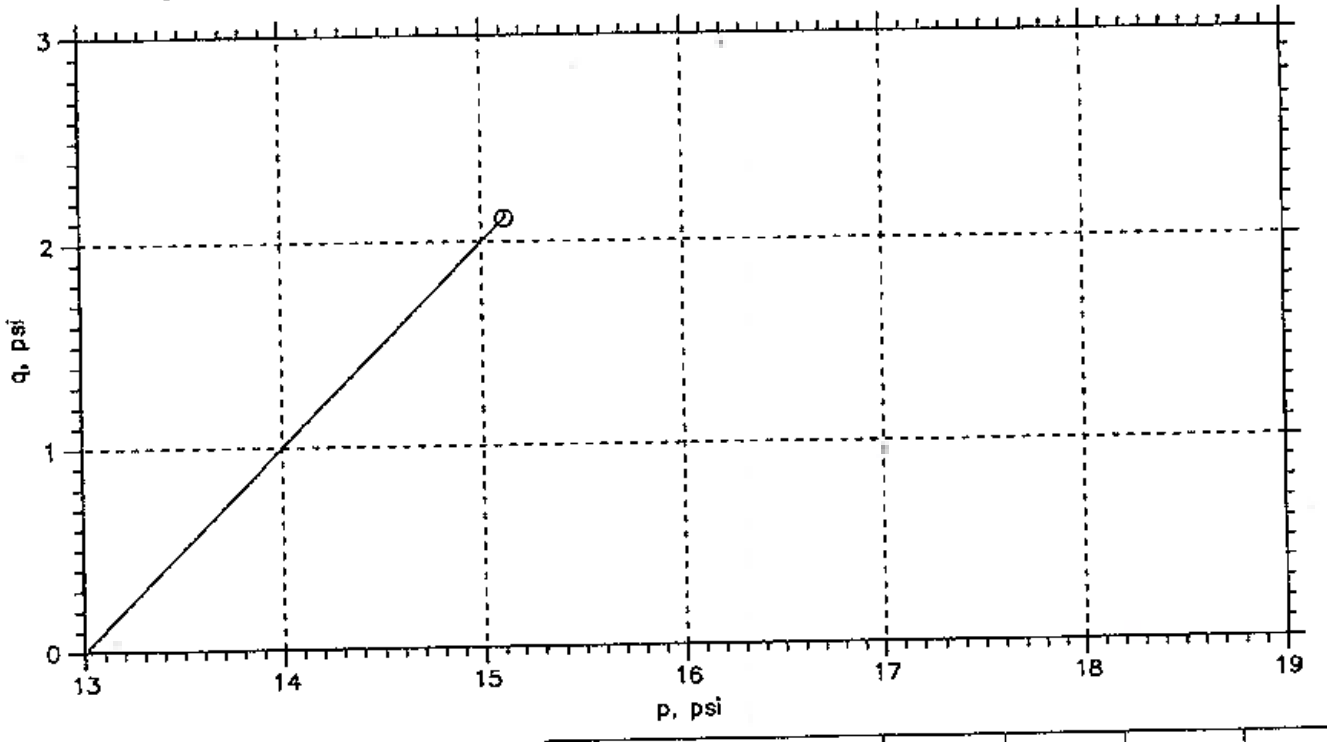
Sample Type: tube

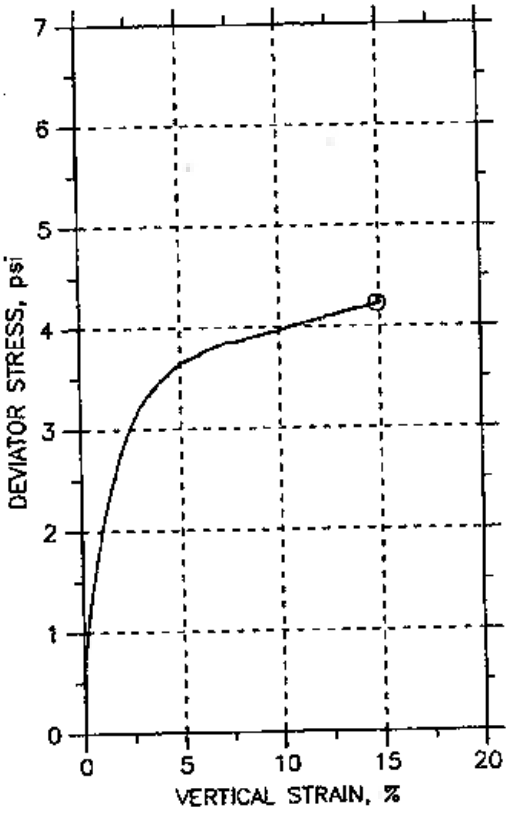
Description: Gray-Brown Lean clay with sand

Remarks: 2054

Phase calculations based on start and end of test.

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





Symbol	⊙			
Sample No.	---			
Test No.	UU1.1			
Depth	29-29.5 ft			
Tested by	MM			
Test Date	5/13/09			
Checked by	JM			
Check Date				
Diameter, in	2.901			
Height, in	6.037			
Water Content, %	28.0			
Dry Density, pcf	93.56			
Saturation, %	96.7			
Void Ratio	0.768			
Confining Stress, psi	13			
Undrained Strength, psi	2.114			
Max. Dev. Stress, psi	4.229			
Strain at Failure, %	14.9			
Strain Rate, %/min	0.3			
Measured Specific Gravity	2.65			
Liquid Limit	38			
Plastic Limit	23			
Plasticity Index	15			

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Project: Kingson Ash Pond

Location: Roane, TN

Project No.: GTX-1464

Boring No.: STN-36

Sample Type: tube

Description: Gray-Brown Lean clay with sand

Remarks: 2054

Phase calculations based on start and end of test.

Stantec

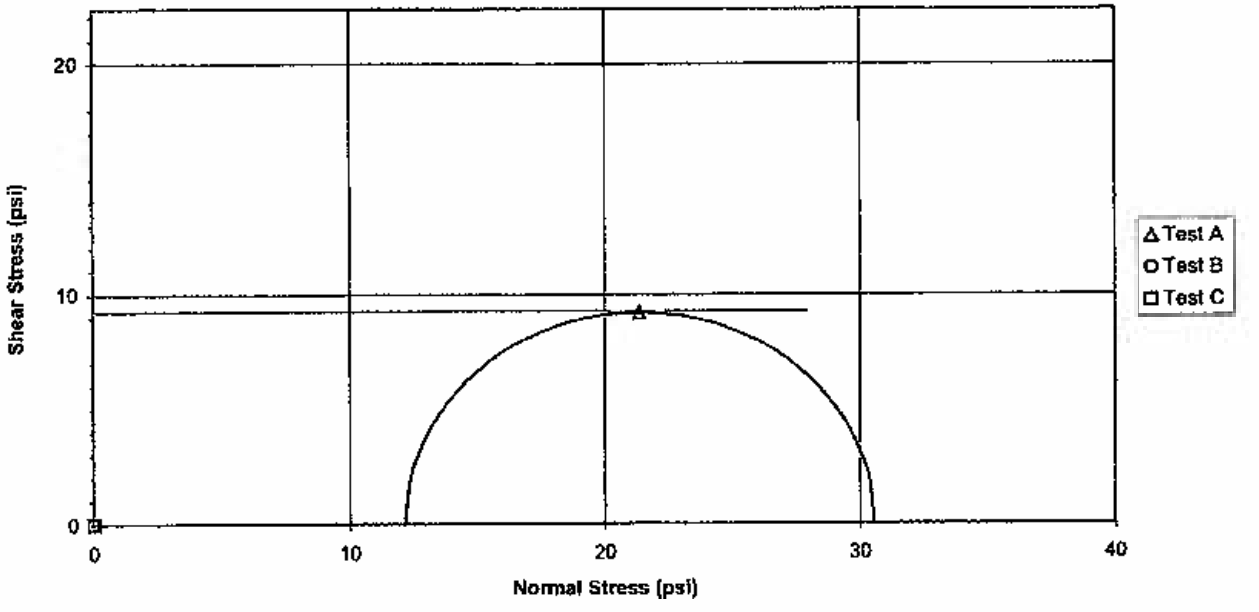
Unconsolidated Undrained Triaxial Test
ASTM D 2850-03a

Project	Kingston Ash Pond	Project No.	175569042
Sample ID	STN-41, 15.1' - 15.6'	Test Number	563

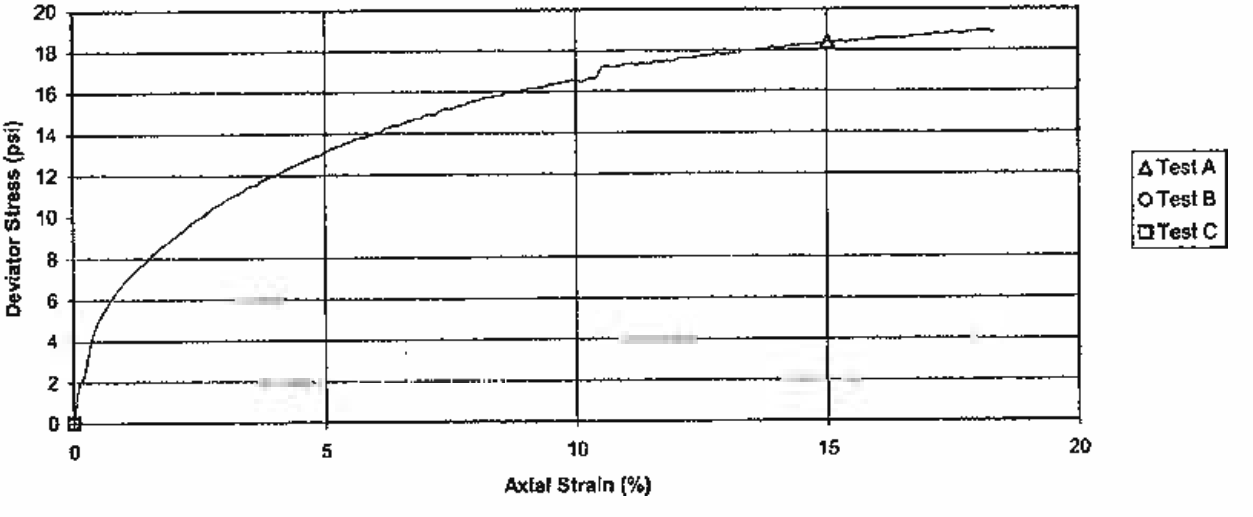
ϕ = 0.0 deg. c = 9.3 psi

Failure Criterion: Maximum Deviator Stress

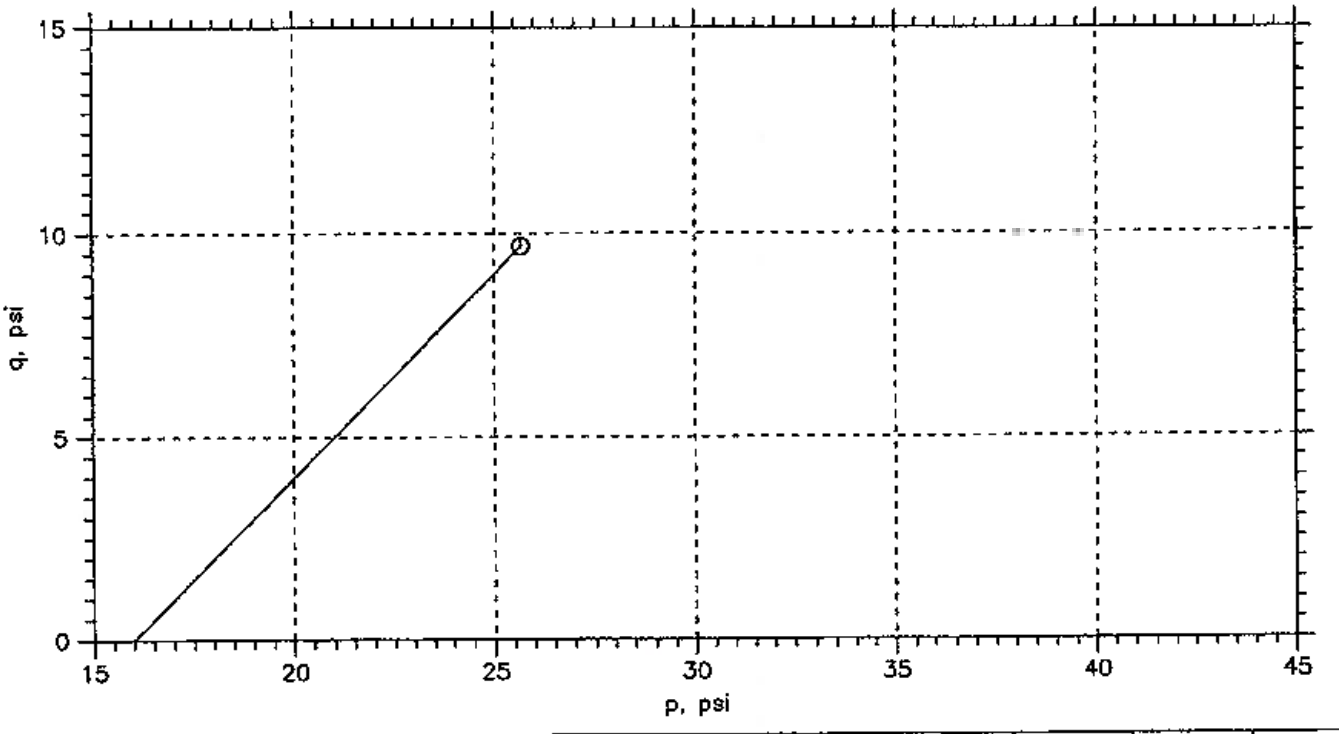
Mohr Failure Envelope

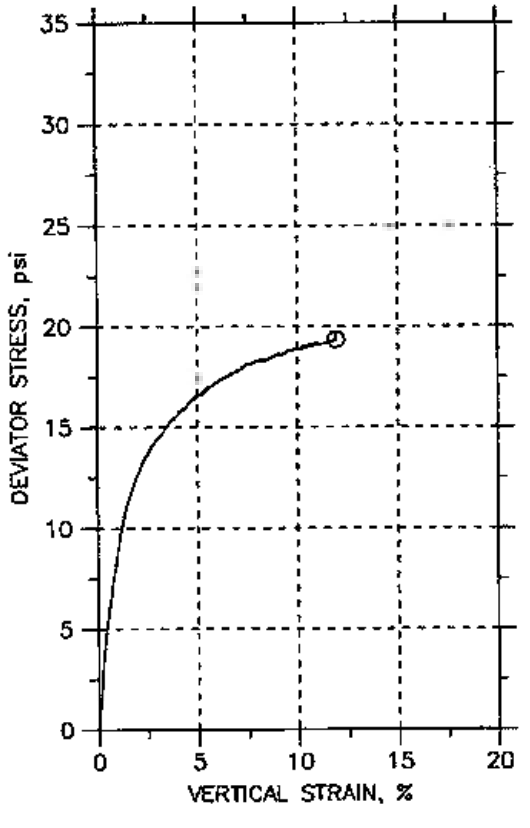


Deviator Stress vs. Axial Strain



UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





Symbol	⊙			
Sample No.	---			
Test No.	UU6.1			
Depth	29.1-29.6			
Tested by	MM			
Test Date	5/13/09			
Checked by	JM			
Check Date				
Diameter, in	2.828			
Height, in	5.928			
Water Content, %	20.6			
Dry Density, pcf	110.6			
Saturation, %	110.2			
Void Ratio	0.495			
Confining Stress, psi	16			
Undrained Strength, psi	9.678			
Max. Dev. Stress, psi	19.36			
Strain at Failure, %	11.9			
Strain Rate, %/min	1			
Measured Specific Gravity	2.65			
Liquid Limit	27			
Plastic Limit	20			
Plasticity Index	7			

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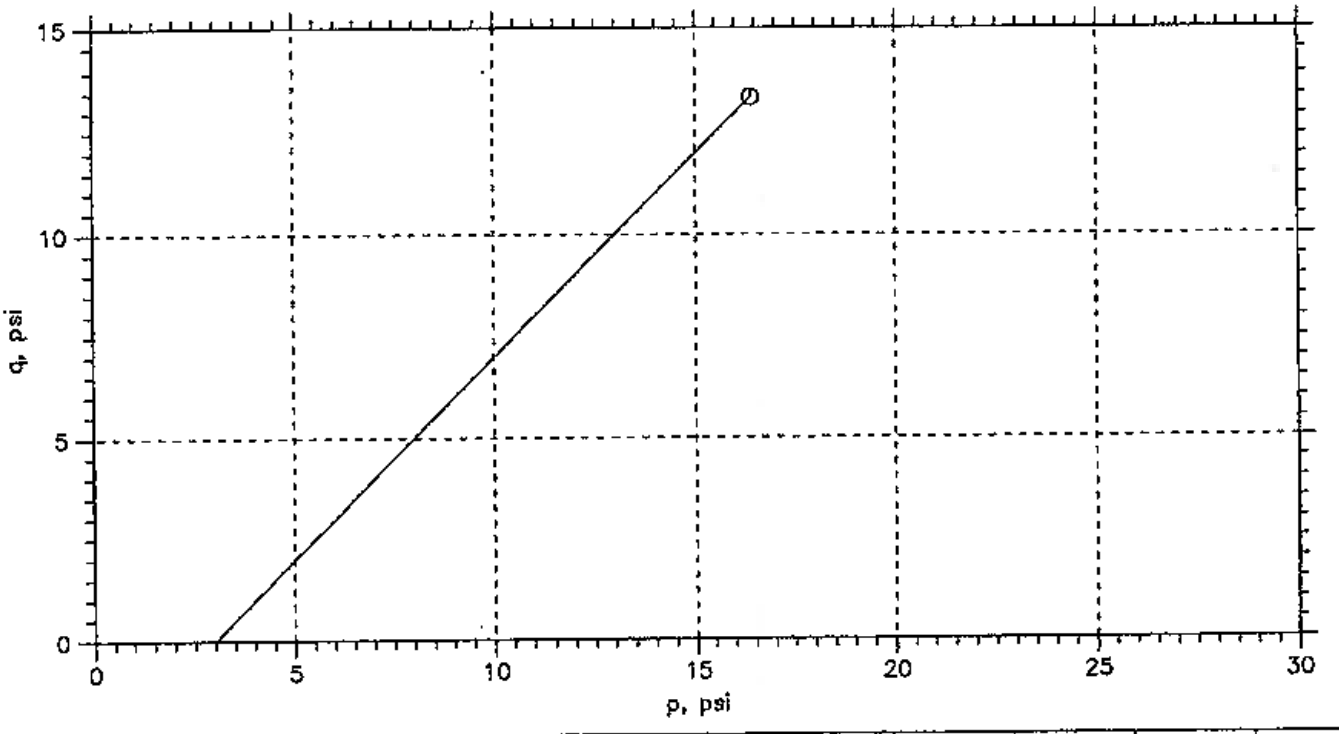
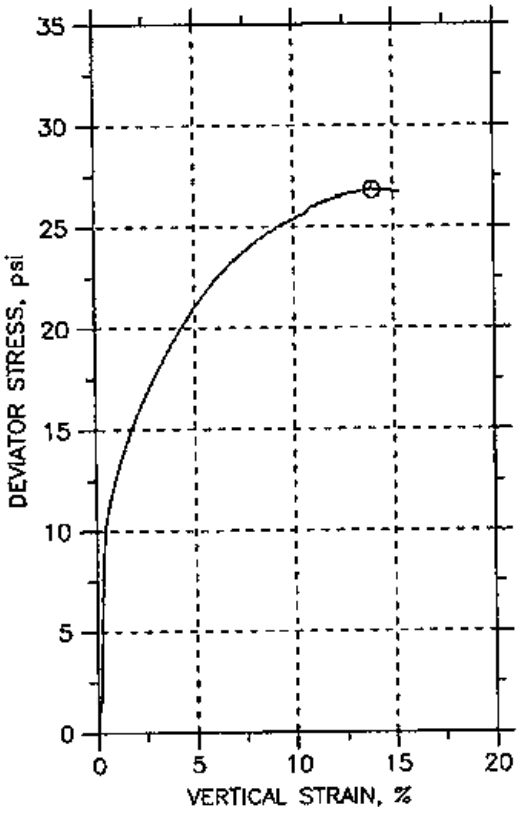
Project: Kingson Ash Pond
Location: Roane, TN
Project No.: GTX-1464
Boring No.: STN-43
Sample Type: tube
Description: Gray-Brown Sandy silty clay
Remarks: 2054

Phase calculations based on start and end of test

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





Symbol	⊙			
Sample No.	---			
Test No.	UU9.1			
Depth	4-5.5 ft			
Tested by	MM			
Test Date	5/13/09			
Checked by	JM			
Check Date				
Diameter, in	2.853			
Height, in	5.963			
Water Content, %	24.8			
Dry Density, pcf	102.8			
Saturation, %	107.7			
Void Ratio	0.61			
Confining Stress, psi	3			
Undrained Strength, psi	13.41			
Max. Dev. Stress, psi	26.82			
Strain at Failure, %	13.9			
Strain Rate, %/min	1			
Measured Specific Gravity	2.65			
Liquid Limit	39			
Plastic Limit	19			
Plasticity Index	20			

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Project: Kingson Ash Pond

Location: Roane, TN

Project No.: GTX-1464

Boring No.: STN-48

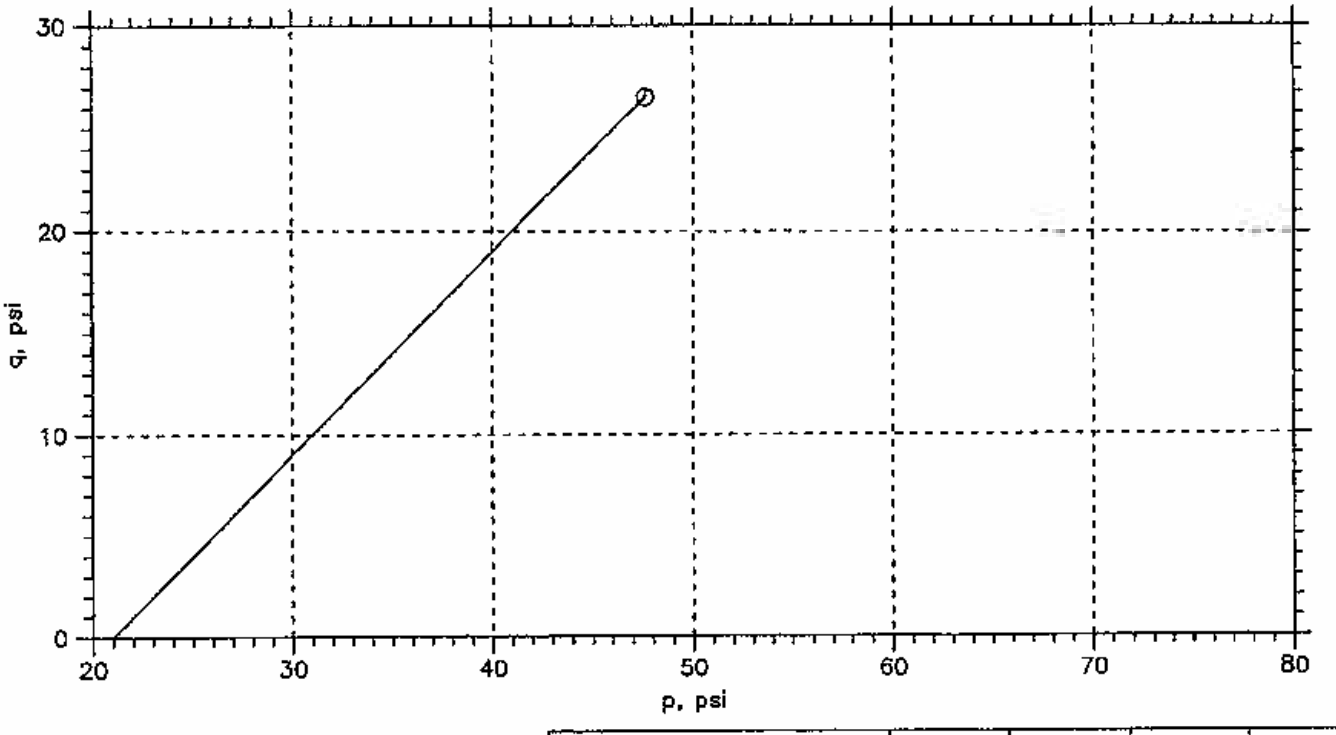
Sample Type: tube

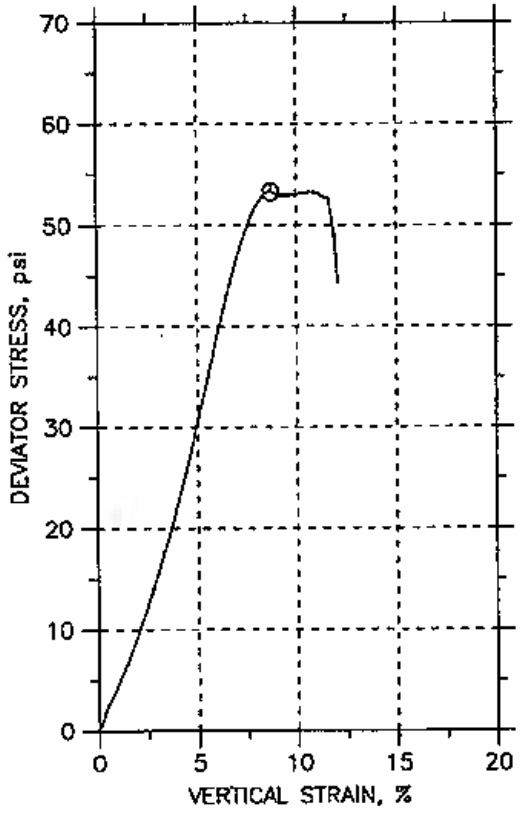
Description: Gray-Brown lean clay with sand

Remarks: 2054

Phase calculations based on start and end of test

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





Symbol	⊙			
Sample No.	---			
Test No.	UU11.1			
Depth	33.5-34 ft			
Tested by	MM			
Test Date	5/16/09			
Checked by	JM			
Check Date				
Diameter, in	2.86			
Height, in	5.785			
Water Content, %	17.0			
Dry Density, pcf	111.6			
Saturation, %	93.4			
Void Ratio	0.482			
Confining Stress, psi	21			
Undrained Strength, psi	26.65			
Max. Dev. Stress, psi	53.3			
Strain at Failure, %	8.72			
Strain Rate, %/min	1			
Measured Specific Gravity	2.65			
Liquid Limit	0			
Plastic Limit	0			
Plasticity Index	0			

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Project: Kingson Ash Pond

Location: Roane, TN

Project No.: GTX-1464

Boring No.: STN-48

Sample Type: tube

Description: Brown silty sand (Sample Crumbled @ approx.12% strain test shut down)

Remarks: 2054

Deviations based on start and end of test

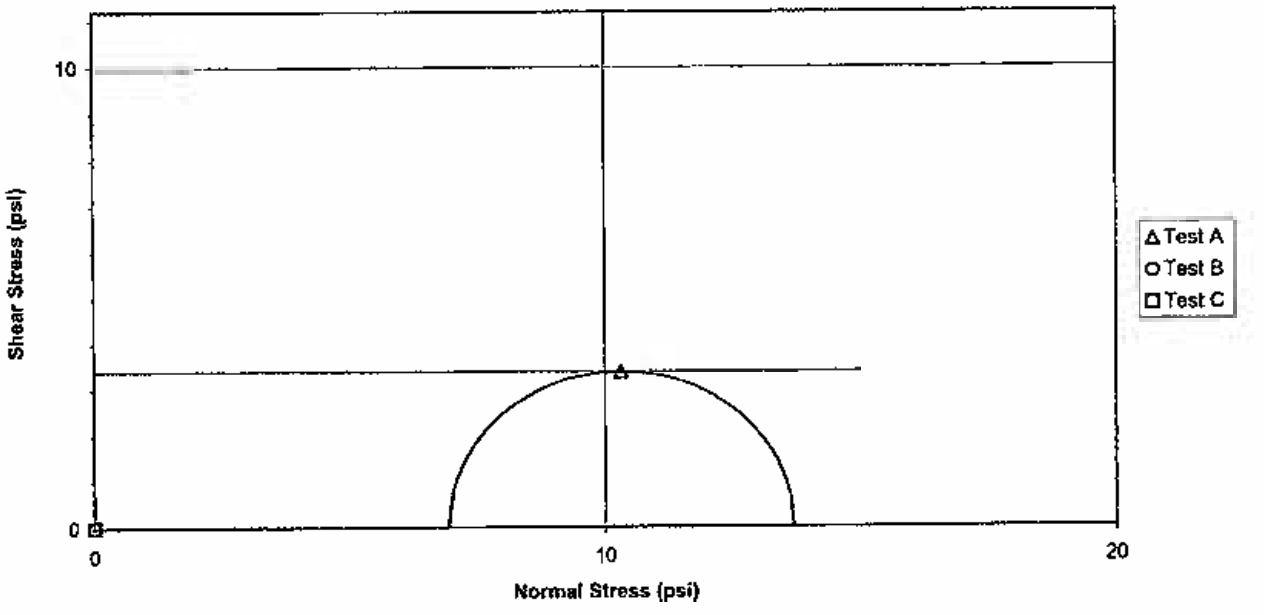
Stantec

Unconsolidated Undrained Triaxial Test
ASTM D 2850-03a

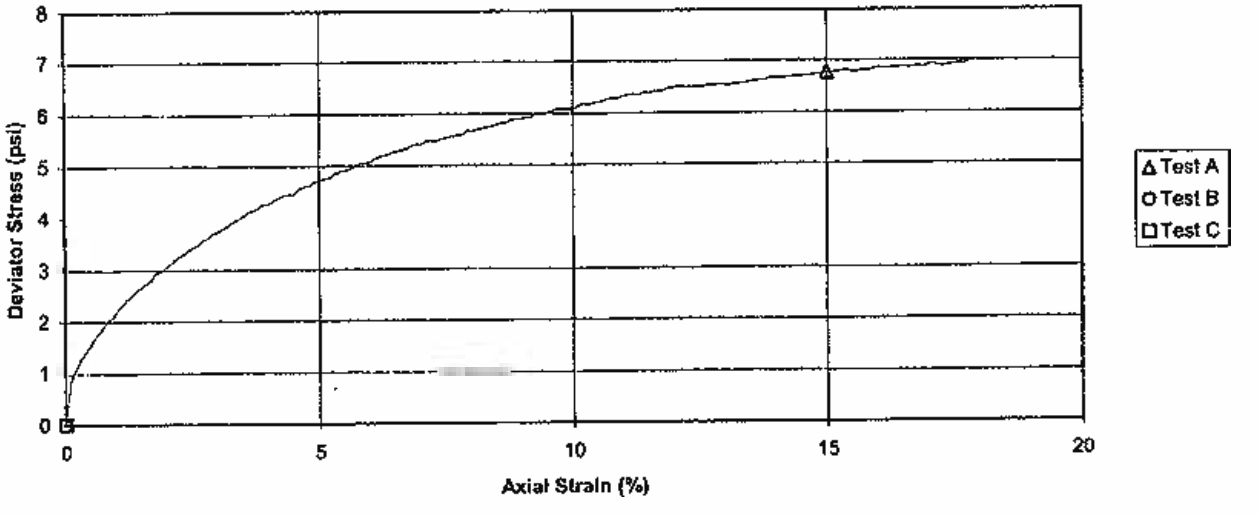
Project	Kingston Ash Pond	Project No.	175569042
Sample ID	STN-50, 9.0' - 9.5'	Test Number	545
		ϕ = 0.0 deg.	c = 3.4 psi

Failure Criterion: Maximum Deviator Stress

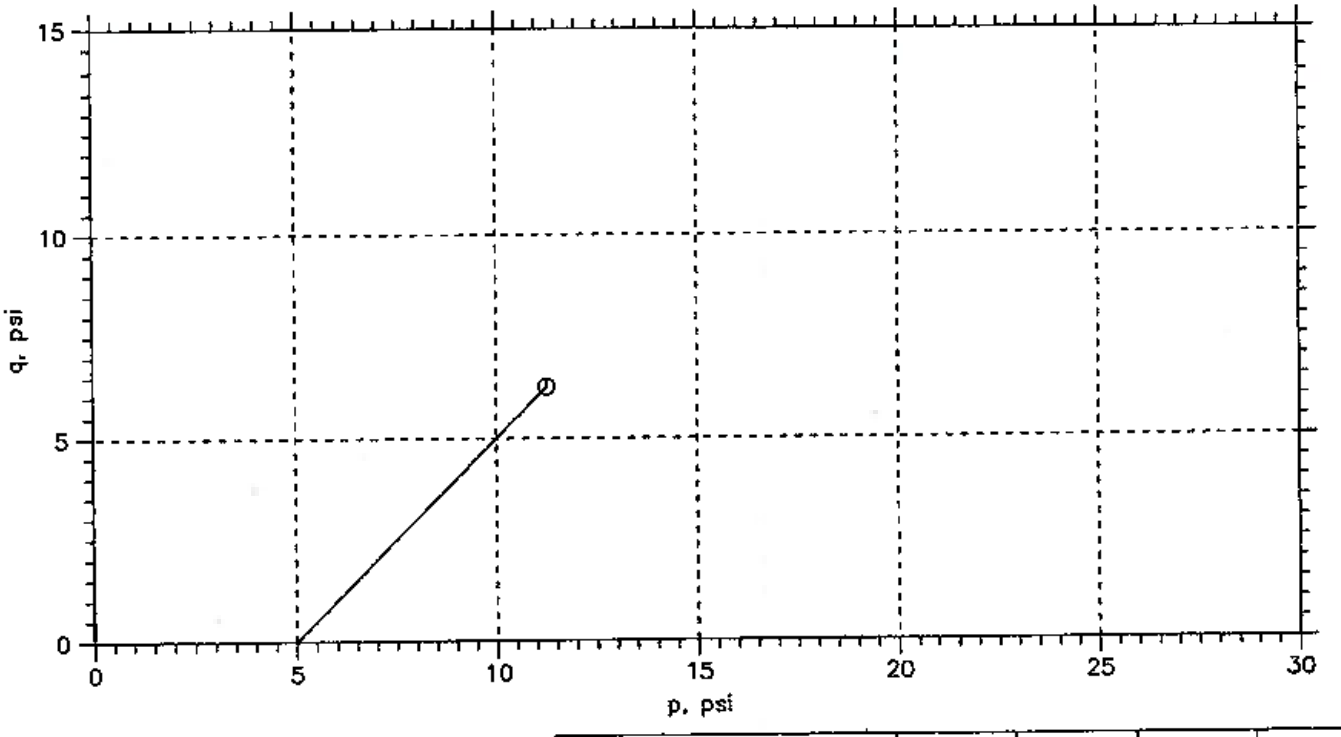
Mohr Failure Envelope

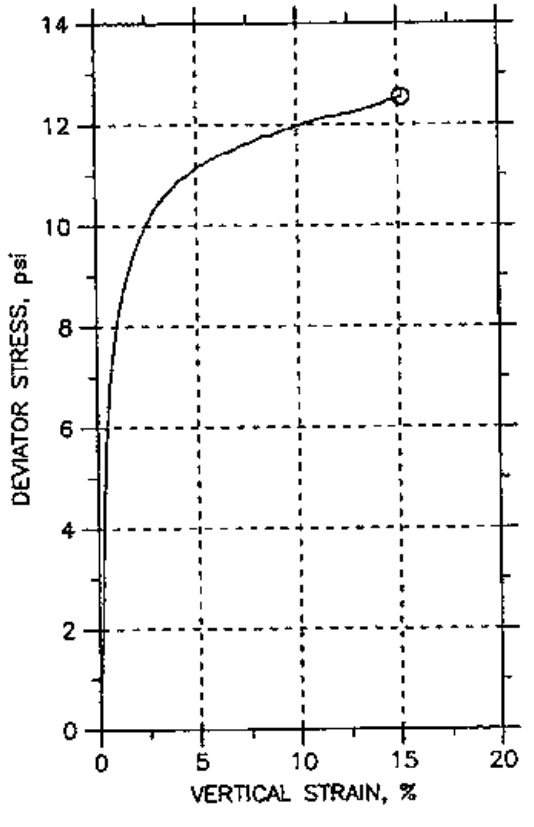


Deviator Stress vs. Axial Strain



UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





Symbol	⊙			
Sample No.	---			
Test No.	UU12.1			
Depth	9.3-9.8 ft			
Tested by	MM			
Test Date	5/16/09			
Checked by	JM			
Check Date				
Diameter, in	2.874			
Height, in	6.021			
Water Content, %	21.2			
Dry Density, pcf	104.9			
Saturation, %	97.6			
Void Ratio	0.577			
Confining Stress, psi	5			
Undrained Strength, psi	6.269			
Max. Dev. Stress, psi	12.54			
Strain at Failure, %	15.2			
Strain Rate, %/min	1			
Measured Specific Gravity	2.65			
Liquid Limit	0			
Plastic Limit	0			
Plasticity Index	0			

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Project: Kingson Ash Pond

Location: Roane, TN

Project No.: GTX-1464

Boring No.: STN-63

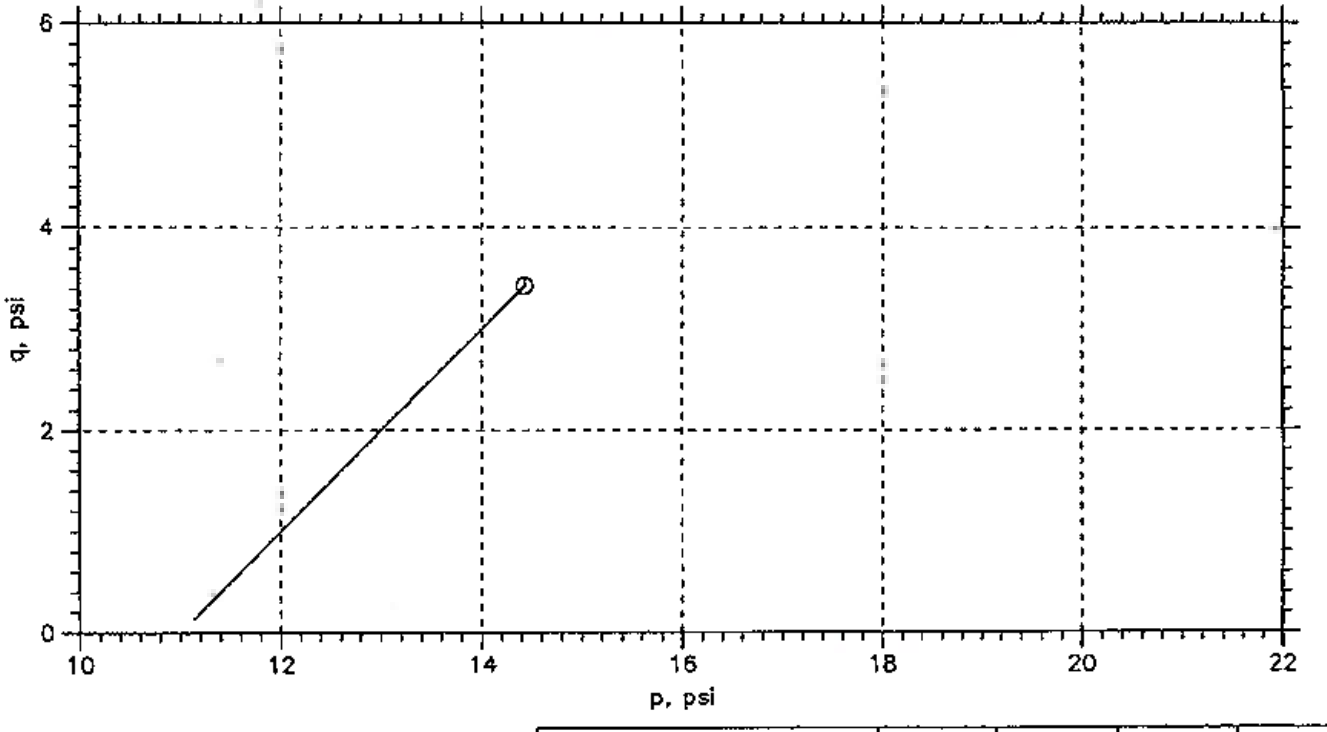
Sample Type: tube

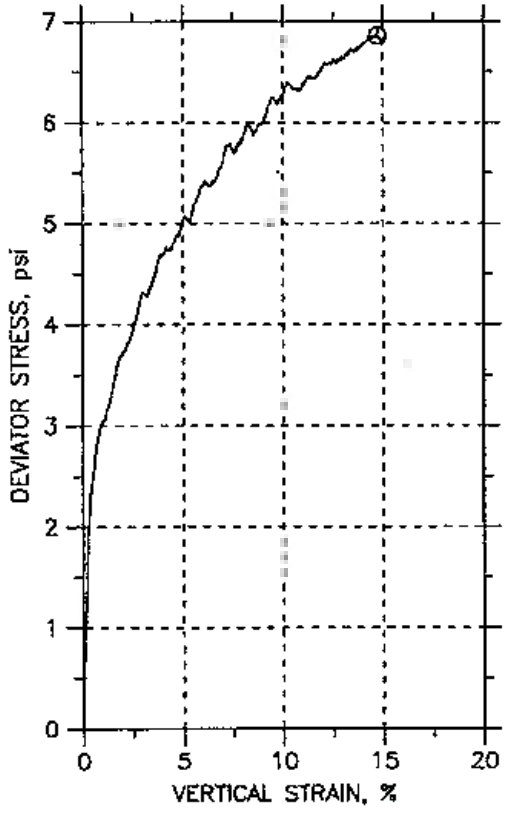
Description: Gray Sandy lean clay

Remarks: 2054

Phase calculations based on start and end of test.

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





Symbol	⏀			
Sample No.	---			
Test No.	UU4.1			
Depth	20-20.5 ft			
Tested by	MM			
Test Date	5/16/09			
Checked by	JM			
Check Date				
Diameter, in	2.834			
Height, in	5.994			
Water Content, %	24.8			
Dry Density, pcf	102.7			
Saturation, %	107.4			
Void Ratio	0.611			
Confining Stress, psi	11			
Undrained Strength, psi	3.43			
Max. Dev. Stress, psi	6.86			
Strain at Failure, %	14.8			
Strain Rate, %/min	1			
Measured Specific Gravity	2.65			
Liquid Limit	0			
Plastic Limit	0			
Plasticity Index	0			

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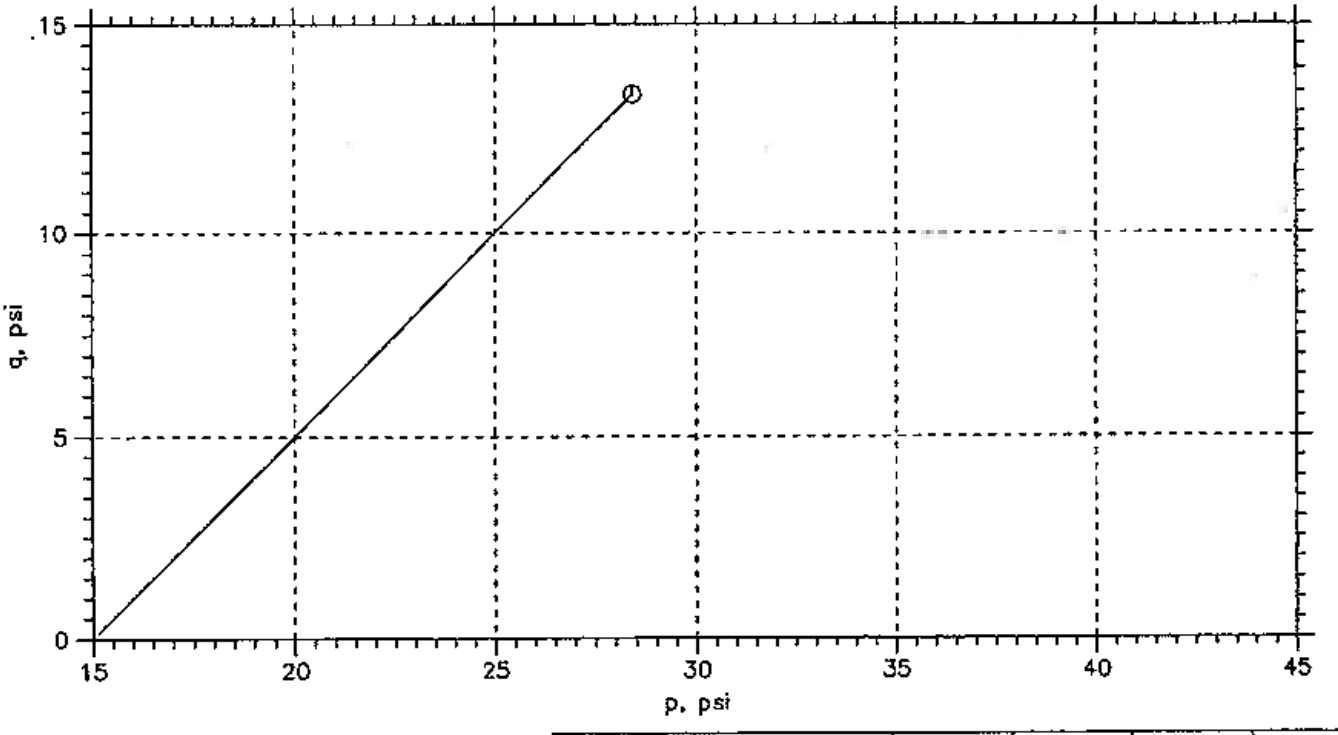
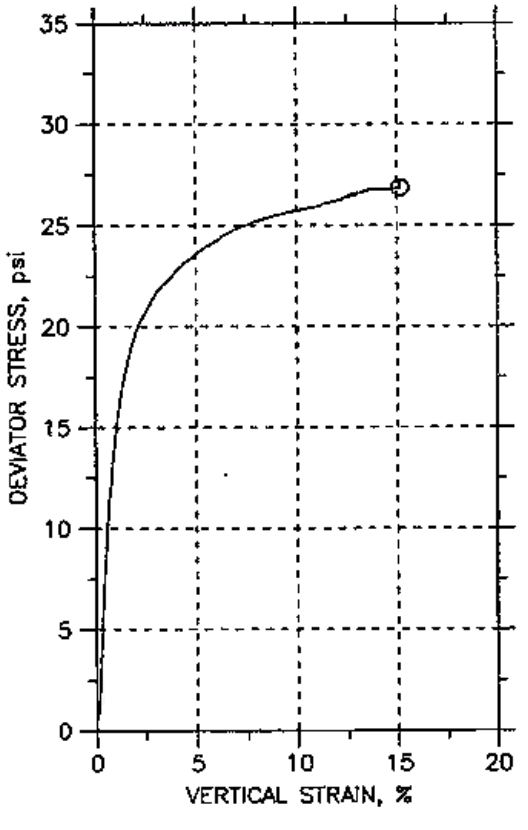
Project: Kingson Ash Pond				
Location: Roane, TN				
Project No.: GTX-1464				
Boring No.: STN-64				
Sample Type: tube				
Description: Gray sandy lean clay				
Remarks: 2054				

Phase calculations based on start and end of test.

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





Symbol	⊙			
Sample No.	---			
Test No.	UU5.1			
Depth	30-30.5 ft			
Tested by	MM			
Test Date	5/16/09			
Checked by	JM			
Check Date				
Diameter, in	2.843			
Height, in	5.977			
Water Content, %	23.8			
Dry Density, pcf	103.6			
Saturation, %	105.4			
Void Ratio	0.597			
Confining Stress, psi	15			
Undrained Strength, psi	13.42			
Max. Dev. Stress, psi	26.84			
Strain at Failure, %	15.2			
Strain Rate, %/min	1			
Measured Specific Gravity	2.65			
Liquid Limit	0			
Plastic Limit	0			
Plasticity Index	0			

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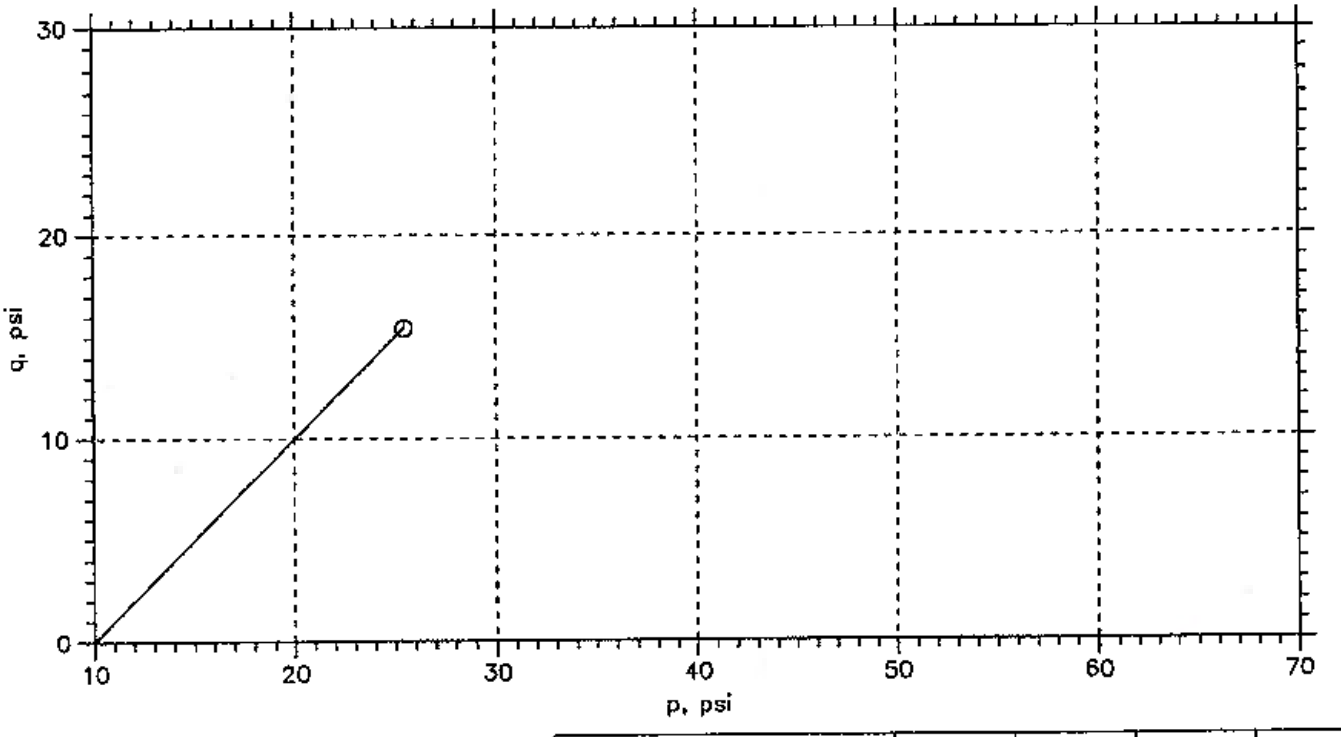
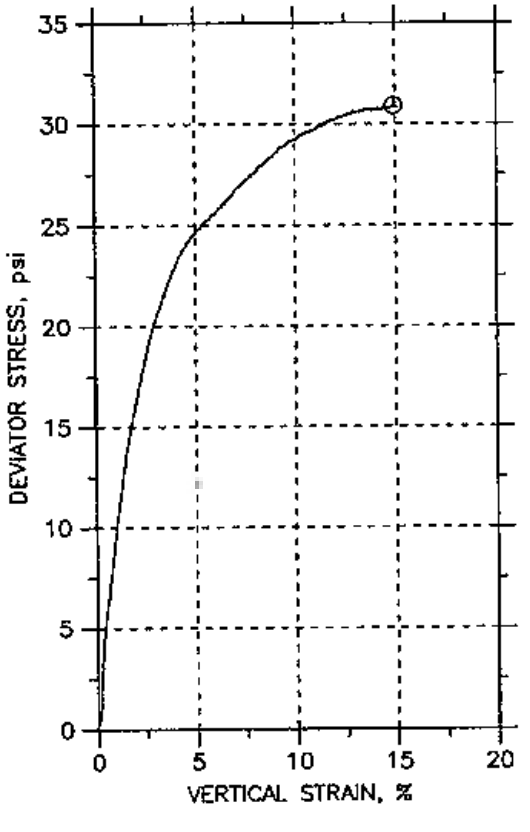
Project: Kingson Ash Pond
Location: Roane, TN
Project No.: GTX-1464
Boring No.: STN-64
Sample Type: tube
Description: Brown silty sand
Remarks: 2054

Phase calculations based on start and end of test

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





Symbol	⊙			
Sample No.	---			
Test No.	UU8.1			
Depth	13.5-14 ft			
Tested by	MM			
Test Date	5/13/09			
Checked by	JM			
Check Date				
Diameter, in	2.852			
Height, in	5.996			
Water Content, %	18.6			
Dry Density, pcf	113.			
Saturation, %	106.4			
Void Ratio	0.463			
Confining Stress, psi	10			
Undrained Strength, psi	15.45			
Max. Dev. Stress, psi	30.9			
Strain at Failure, %	14.9			
Strain Rate, %/min	0.3			
Measured Specific Gravity	2.65			
Liquid Limit	30			
Plastic Limit	22			
Plasticity Index	8			

GeoTesting express

Project: Kingson Ash Pond

Location: Roone, TN

Project No.: GTX-1464

Boring No.: STN-65

Sample Type: tube

Description: Gray-Brown Lean clay with sand

Remarks: 2054

Phase calculations based on start and end of test

Unconfined Compressive Strength Test Results

Stantec

Unconfined Compressive Strength of Cohesive Soil

KM 64-522

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-20 / ST-1, 35.0'-35.5'
Lab ID: 185A
Visual Description: Lean Clay with Sand (CL), brown, moist, firm
Recovered: 1.4'
Test Interval: 35.0' - 35.5'

Specimen Type: Undisturbed

LL	28
PL	17
PI	11

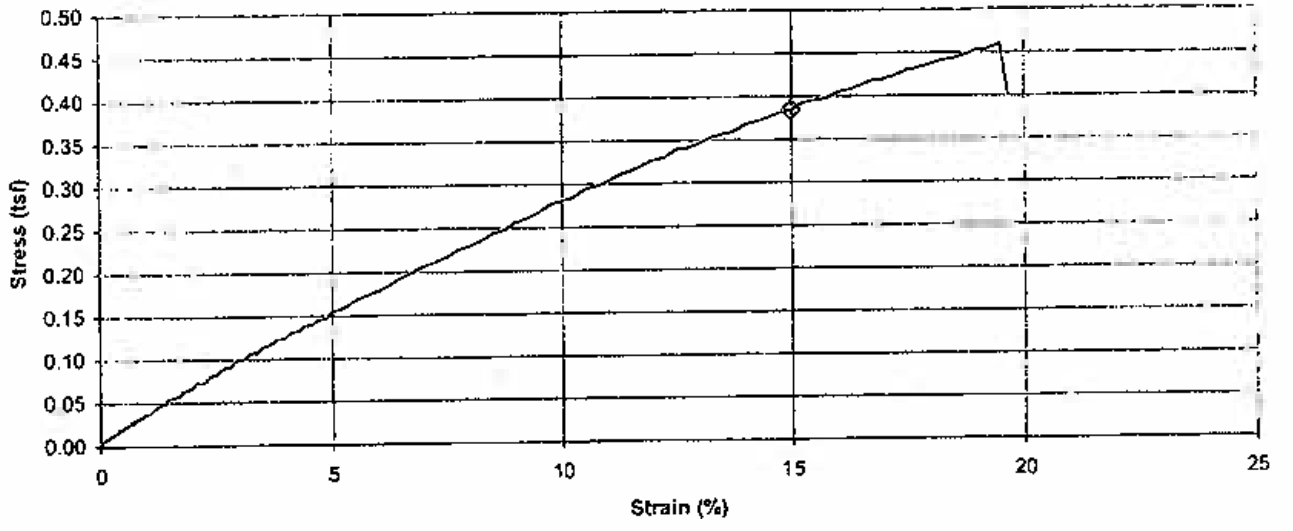
Date Extruded: 04/07/2009
Date Tested: 04/20/2009

Initial Wet Density (pcf)	127.0
Initial Dry Density (pcf)	103.6
Initial Moisture Content (%)	23.7
At Test Moisture Content (%)	22.5
Specific Gravity	2.69
Degree of Saturation (%)	100.3
Average Height (in)	6.001
Average Diameter (in)	2.885
Height to Diameter Ratio	2.1

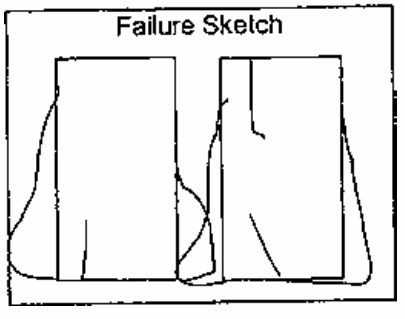
Initial MC Taken: Before Test, From Trimmings
At Test MC Taken: After Test, From Center of Specimen

Unconfined Compressive Strength (tsf)	0.38
Undrained Shear Strength (tsf)	0.19
Strain at Maximum Stress (%)	15.0
Strain rate to failure (% / min.)	1.00

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf): .25
Torvane Reading (kg/cm^2): N/A

Comments

Reviewed By

Stantec

Unconfined Compressive Strength of Cohesive Soil

ASTM D 2166

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-55 / ST-2, 44.0'-46.0'
Lab ID: 188B
Visual Description: Lean Clay with Sand (CL), brown, moist, firm
Recovered: 1.3'
Test Interval: 44.6' - 45.1'

Specimen Type: Undisturbed

LL	N/A
PL	N/A
PI	N/A

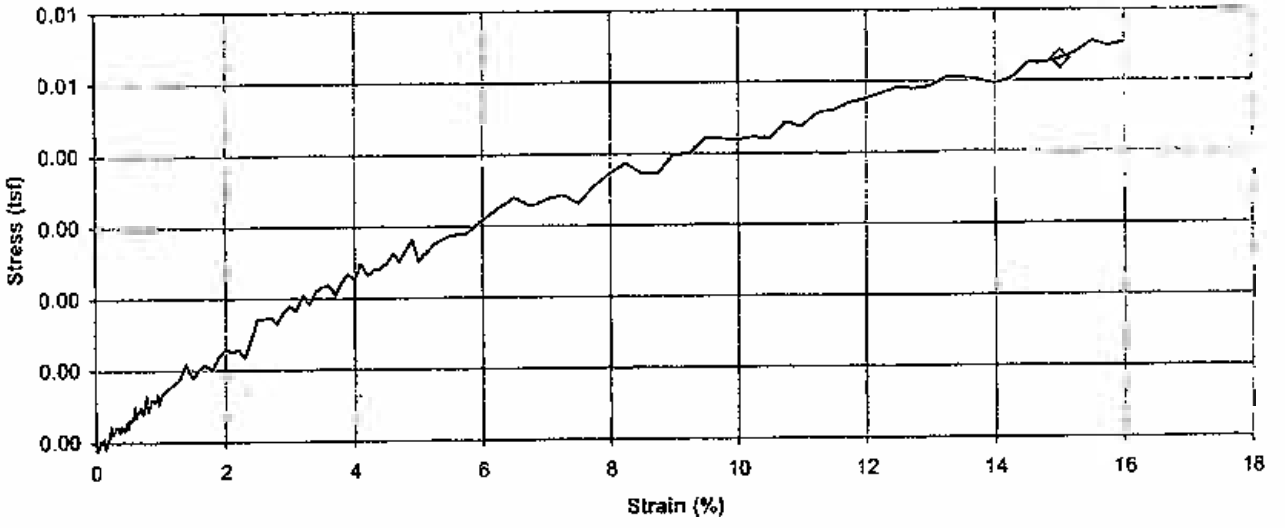
Date Extruded: 04/07/2009
Date Tested: 04/20/2009

Initial Wet Density (pcf)	126.6
Initial Dry Density (pcf)	101.6
Initial Moisture Content (%)	24.7
At Test Moisture Content (%)	24.7
Specific Gravity	N/A
Degree of Saturation (%)	N/A
Average Height (in)	5.968
Average Diameter (in)	2.884
Height to Diameter Ratio	2.1

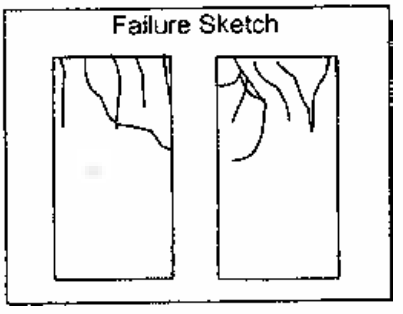
Initial MC Taken: Before Test, From Trimmings
At Test MC Taken: After Test, From Center of Specimen

Unconfined Compressive Strength (tsf)	0.01
Undrained Shear Strength (tsf)	0.00
Strain at Maximum Stress (%)	15.0
Strain rate to failure (% / min.)	1.00

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf): .25
Torvane Reading (kg/cm^2): N/A

Comments

Reviewed By

Stantec

Unconfined Compressive Strength of Cohesive Soil

KM 64-522

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-55 / ST-1, 42.6'-43.1'
Lab ID: 187B
Visual Description: Sandy Lean Clay (CL), brown, moist, firm
Recovered: 1.4'
Test Interval: 42.6' - 43.1'

Specimen Type: Undisturbed

LL	27
PL	18
PI	9

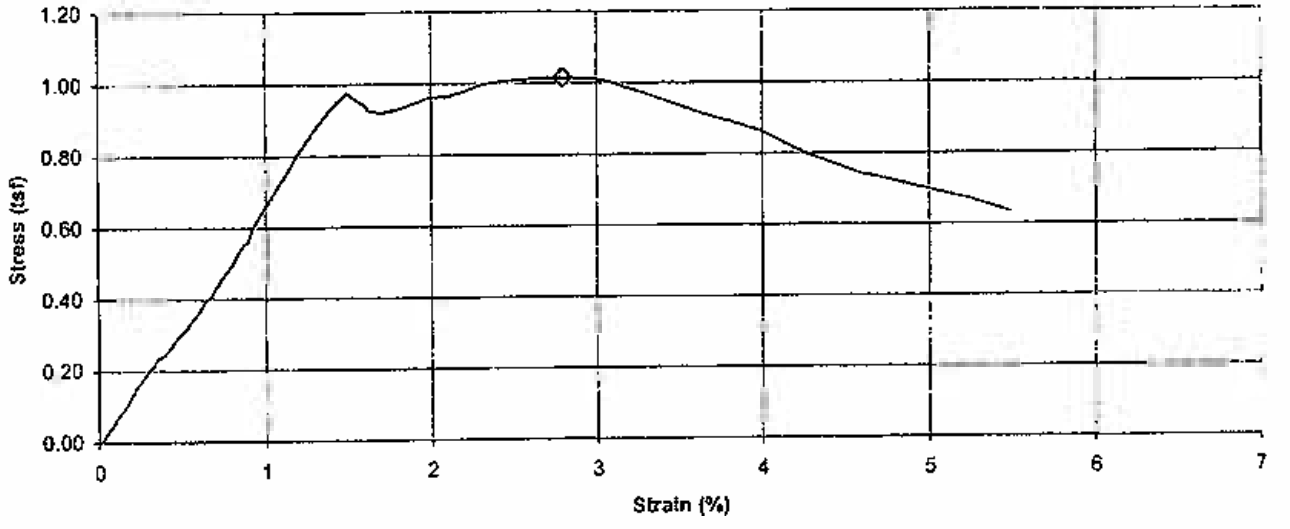
Date Extruded: 04/07/2009
Date Tested: 04/20/2009

Initial Wet Density (pcf)	128.0
Initial Dry Density (pcf)	106.1
Initial Moisture Content (%)	20.4
At Test Moisture Content (%)	20.7
Specific Gravity	2.69
Degree of Saturation (%)	94.6
Average Height (in)	6.016
Average Diameter (in)	2.880
Height to Diameter Ratio	2.1

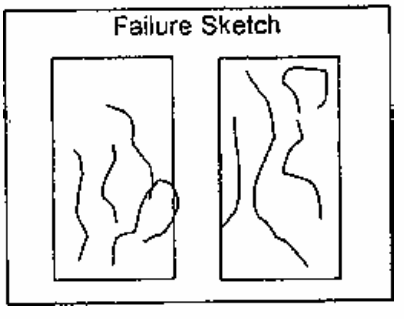
Initial MC Taken: Before Test, From Trimmings
At Test MC Taken: After Test, From Center of Specimen

Unconfined Compressive Strength (tsf)	1.01
Undrained Shear Strength (tsf)	0.51
Strain at Maximum Stress (%)	2.8
Strain rate to failure (% / min.)	1.00

Stress vs. Strain



Failure Sketch



Pocket Penetrometer Reading (tsf): 3.75
Torvane Reading (kg/cm^2): N/A

Comments

Reviewed By

Classification Test Results

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	175569042
Source	STN-2, 14.0'-14.5'	Lab ID	529
County	Kingston, Tennessee	Date Received	5-27-09
Sample Type	UD	Date Reported	7-1-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 18.5

Particle Size Analysis

Preparation Method: ASTM D 421

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.6
No. 200	0.075	58.7
	0.02	38.2
	0.005	25.7
	0.002	21.1
estimated	0.001	18.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.4
Medium Sand	0.4	—
Fine Sand	40.9	40.9
Silt	33.0	37.6
Clay	25.7	21.1

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Dry

Liquid Limit: 23

Plastic Limit: 15

Plasticity Index: 8

Activity Index: 0.38

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A

Maximum Dry Density (kg/m^3): N/A

Optimum Moisture Content (%): N/A

Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A

Compacted Dry Density (lb/ft^3): N/A

Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854

Prepared: Dry

Particle Size: No. 10

Specific Gravity at 20° Celsius: 2.68

Classification

Unified Group Symbol: CL

Group Name: Sandy lean clay

AASHTO Classification: A-4 (2)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-2, 14.0'-14.5'

Project Number: 175569042
Lab ID: 529

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: DB
Test Date: 06-26-2009
Date Received: 05-27-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

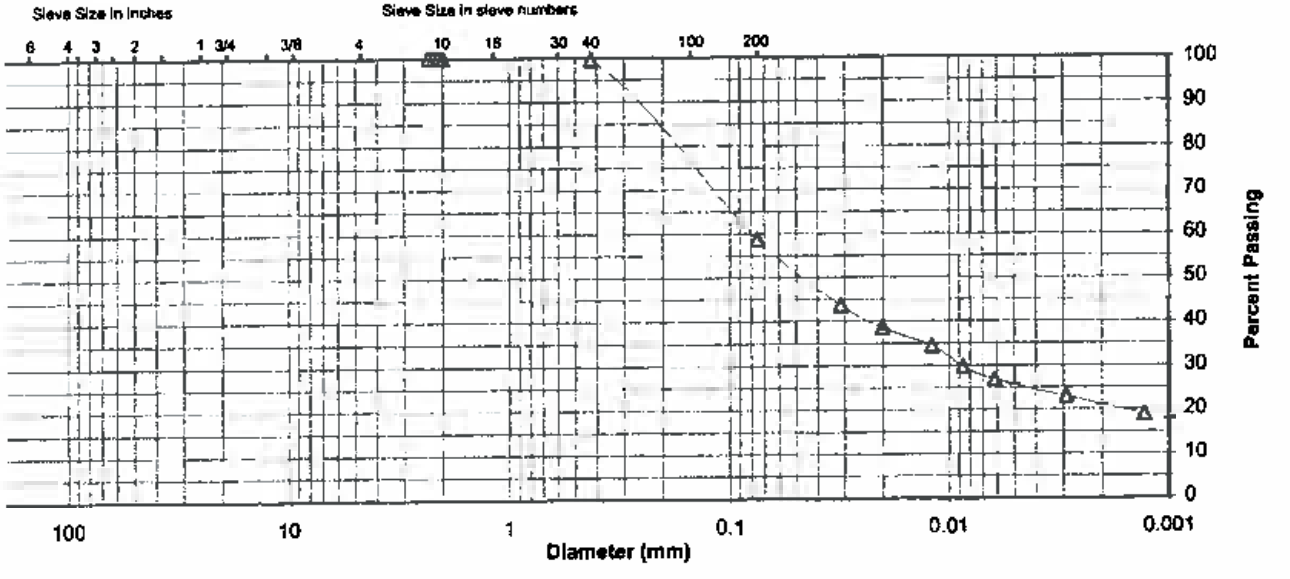
Specific Gravity: 2.68

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.6
No. 200	58.7
0.02 mm	38.2
0.005 mm	25.7
0.002 mm	21.1
0.001 mm	18.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.4	40.9	33.0	25.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.4	40.9	37.5	21.1



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	175569042
Source	STN-3, 12.5'-13.0'	Lab ID	538
County	Kingston, Tennessee	Date Received	5-27-09
Sample Type	UD	Date Reported	6-30-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 25.4

Particle Size Analysis

Preparation Method: ASTM D 421

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.6
No. 10	2	97.7
No. 40	0.425	94.5
No. 200	0.075	82.9
	0.02	72.8
	0.005	60.0
	0.002	55.5
estimated	0.001	52.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.4	2.3
Coarse Sand	1.9	3.2
Medium Sand	3.2	—
Fine Sand	11.6	11.6
Silt	22.9	27.4
Clay	60.0	55.5

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Dry

Liquid Limit: 56

Plastic Limit: 19

Plasticity Index: 37

Activity Index: 0.66

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A

Maximum Dry Density (kg/m^3): N/A

Optimum Moisture Content (%): N/A

Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A

Compacted Dry Density (lb/ft^3): N/A

Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854

Prepared: Dry

Particle Size: No. 10

Specific Gravity at 20° Celsius: 2.71

Classification

Unified Group Symbol: CH

Group Name: Fat clay with sand

AASHTO Classification: A-7-6 (32)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-3, 12.5'-13.0'

Project Number: 175569042
Lab ID: 538

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: RM
Test Date: 06-23-2009
Date Received: 05-27-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.6
No. 10	97.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

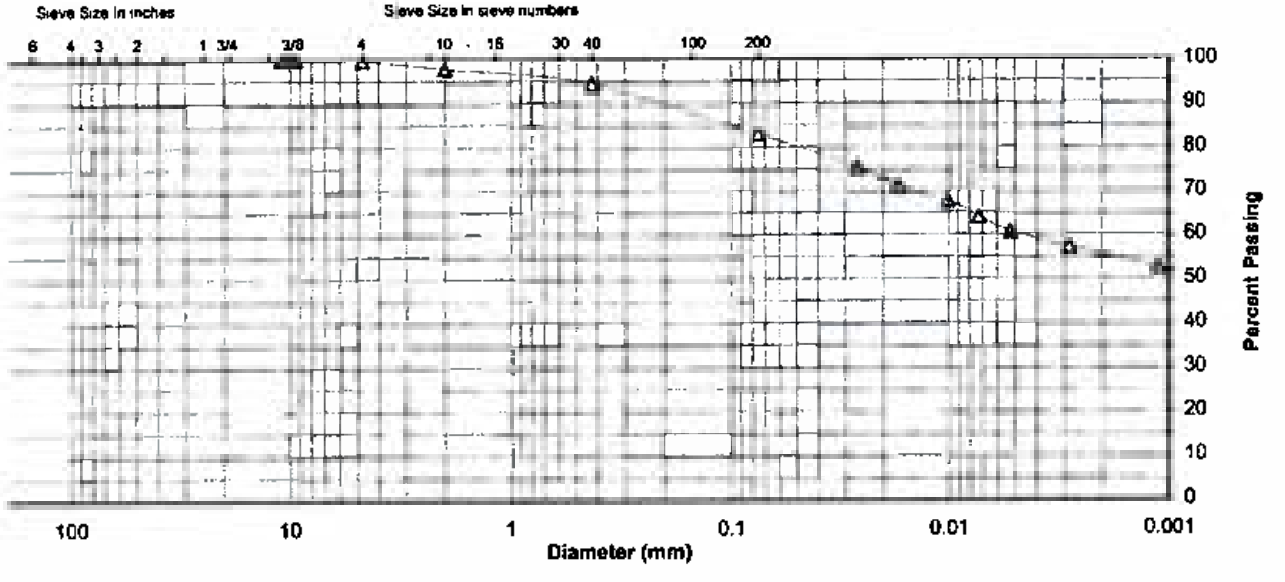
Specific Gravity: 2.71

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	94.5
No. 200	82.9
0.02 mm	72.8
0.005 mm	60.0
0.002 mm	55.5
0.001 mm	52.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.4	1.9	3.2	11.6	22.9	60.0
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	2.3			3.2	11.8	27.4	55.5



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-3, 31.0'-32.5', 32.5'-34.0'	Lab ID	977
County	Roane (TN)	Date Received	4-23-09
Sample Type	SPT Comp	Date Reported	5-13-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.8
No. 10	2	99.8
No. 40	0.425	99.4
No. 200	0.075	59.2
	0.02	32.2
	0.005	22.0
	0.002	18.0
estimated	0.001	17.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.2	0.2
Coarse Sand	0.0	0.4
Medium Sand	0.4	---
Fine Sand	40.2	40.2
Silt	37.2	41.2
Clay	22.0	18.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	25
Plastic Limit:	17
Plasticity Index:	8
Activity Index:	0.44

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.68

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay

AASHTO Classification: A-4 (2)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-3, 31.0'-32.5', 32.5'-34.0'

Project Number: 171468117
Lab ID: 977

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

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

Particle Shape: Rounded
Particle Hardness: Hard and Durable

Tested By: RHB
Test Date: 04-29-2009
Date Received: 04-23-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.8
No. 10	99.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.68

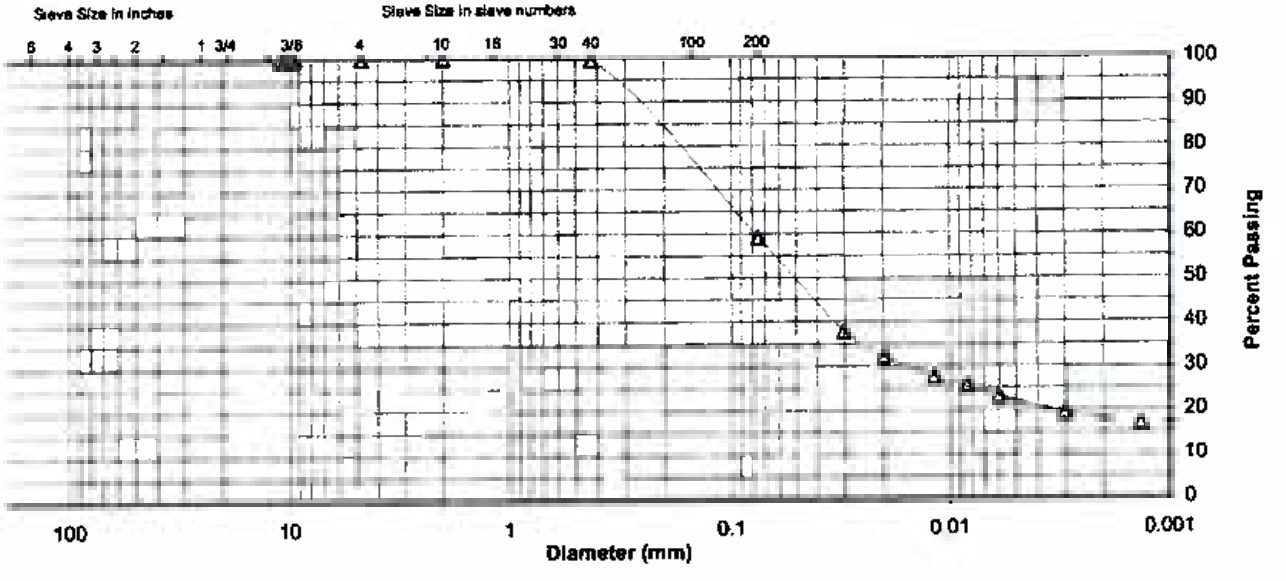
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.4
No. 200	59.2
0.02 mm	32.2
0.005 mm	22.0
0.002 mm	18.0
0.001 mm	17.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.2	0.0	0.4	40.2	37.2	22.0

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.2	0.4	40.2	41.2	18.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-3, 40.0'-41.5', 41.5'-43.0'	Lab ID	984
County	Roane (TN)	Date Received	4-23-09
Sample Type	SPT Comp	Date Reported	5-13-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.8
No. 10	2	99.8
No. 40	0.425	99.7
No. 200	0.075	37.5
	0.02	17.0
	0.005	11.0
	0.002	8.0
estimated	0.001	7.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.2	0.2
Coarse Sand	0.0	0.1
Medium Sand	0.1	---
Fine Sand	62.2	62.2
Silt	26.5	29.5
Clay	11.0	8.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-3, 40.0'-41.5', 41.5'-43.0'

Project Number: 171468117
Lab ID: 984

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

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

Particle Shape: Rounded
Particle Hardness: Hard and Durable

Tested By: RHB
Test Date: 05-04-2009
Date Received: 04-23-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.8
No. 10	99.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.67

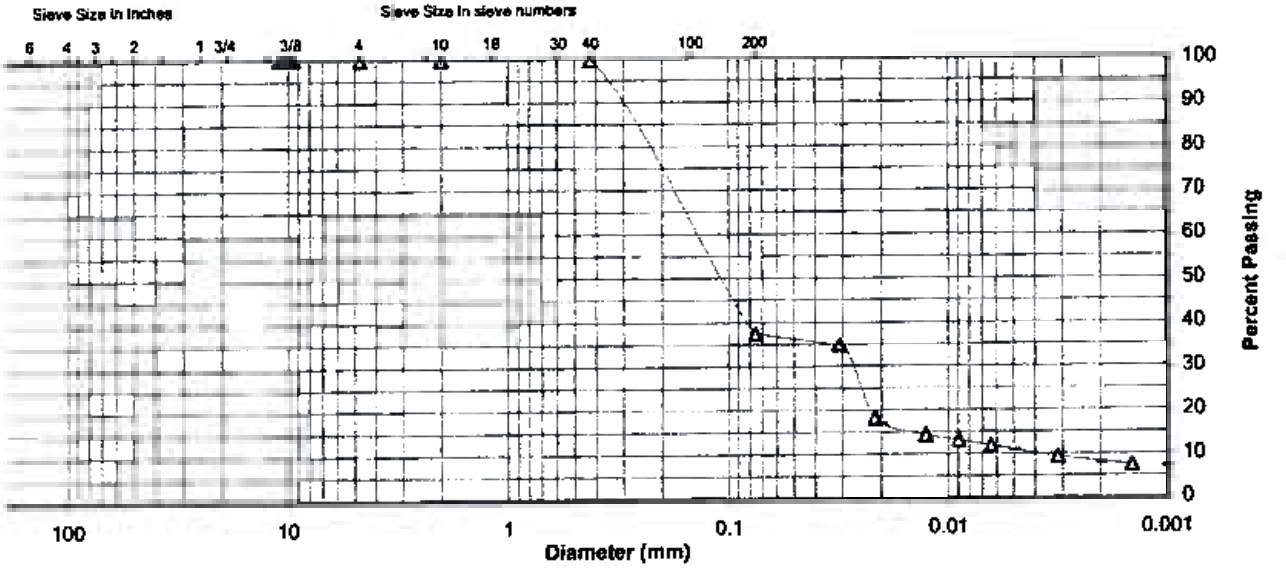
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.7
No. 200	37.5
0.02 mm	17.0
0.005 mm	11.0
0.002 mm	8.0
0.001 mm	7.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.2	0.0	0.1	62.2	26.5	11.0

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.2	0.1	62.2	29.5	8.0



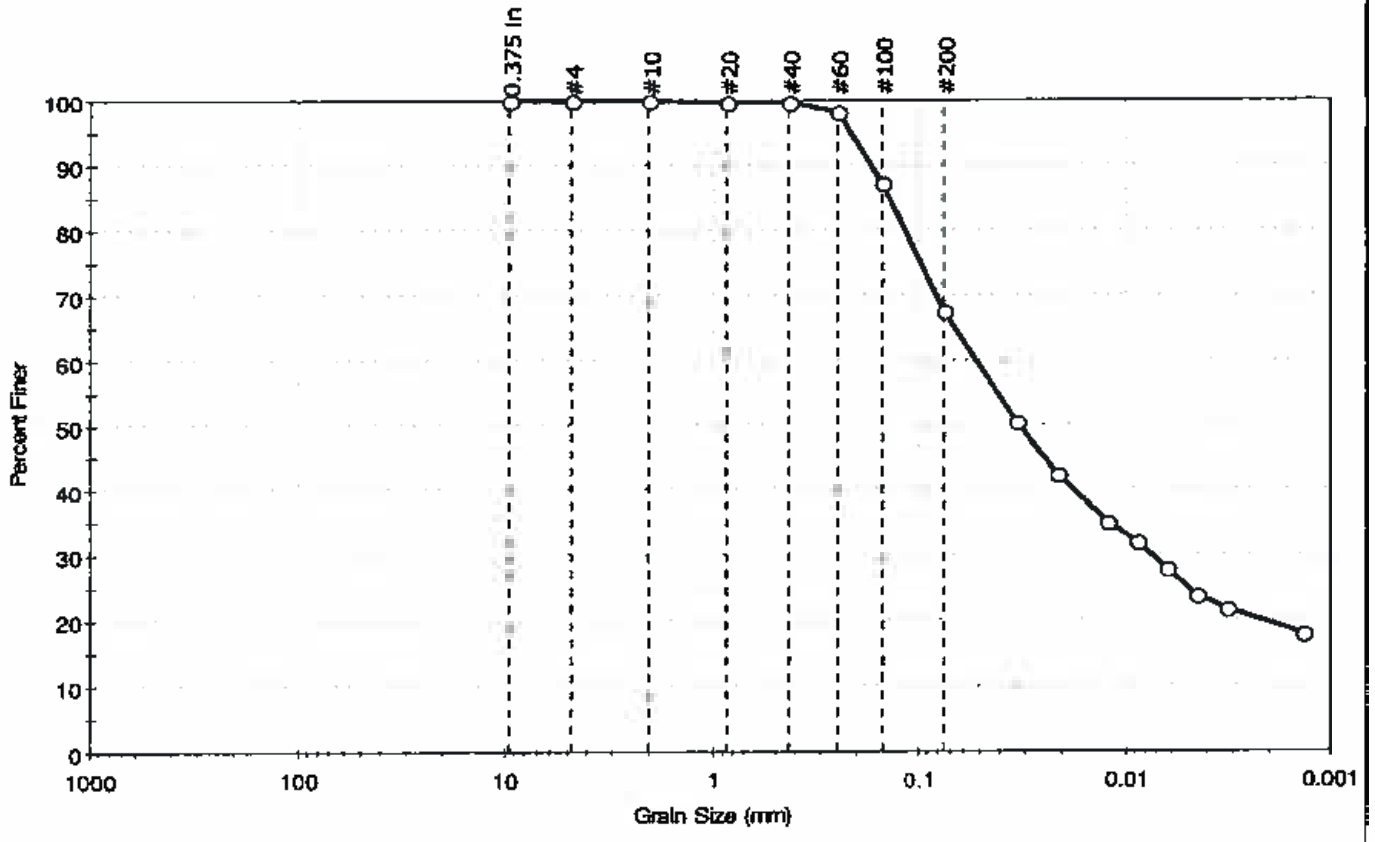
Comments

Reviewed By

GeoTesting express
a subsidiary of Geocomp Corporation

Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond		
Location:	Roane, TN	Project No:	GTX-9015
Boring ID:	STN-3D	Sample Type: tube	Tested By: jbr
Sample ID:	ST-4	Test Date: 05/17/09	Checked By: jdt
Depth :	31.0-31.6 ft	Test Id: 152284	
Test Comment:	---		
Sample Description:	Moist, olive brown sandy silty clay		
Sample Comment:	---		

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



%Cobble	%Gravel	%Sand	%Silt & Clay Size
---	0.1	32.4	67.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	98		
#100	0.15	87		
#200	0.075	67		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0332	51		
---	0.0210	42		
---	0.0134	35		
---	0.0088	32		
---	0.0063	28		
---	0.0045	24		
---	0.0032	22		
---	0.001[illegible]	18		

Coefficients

D_{85} =0.1379 mm D_{30} =0.0074 mm
D_{60} =0.0524 mm D_{15} =N/A
D_{50} =0.0322 mm D_{10} =N/A
C_u =N/A C_c =N/A

Classification

ASTM Sandy silty clay (CL-ML)

AASHTO Silty Soils (A-4 (1))

Remarks/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---

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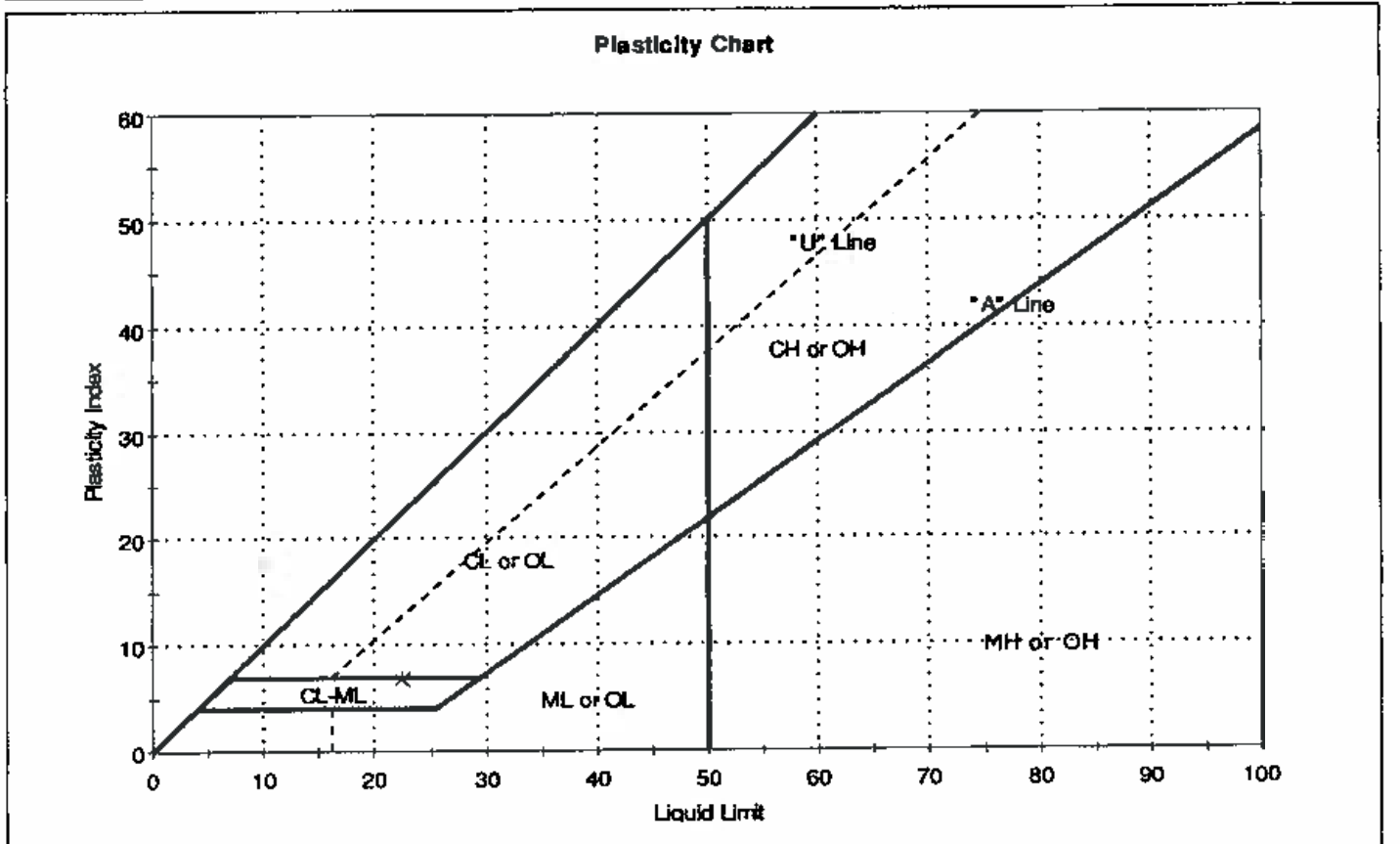
GeoTesting express
a subsidiary of Geocomp Corporation

Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond		
Location:	Roane, TN	Project No:	GTX-9015
Boring ID:	STN-3D	Sample Type: tube	Tested By: cam
Sample ID:	ST-4	Test Date: 05/18/09	Checked By: jdt
Depth :	31.0-31.6 ft	Test Id: 152283	
Test Comment:	---		
Sample Description:	Holst, olive brown sandy silty clay		
Sample Comment:	---		

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	ST-4	STN-3D	31.0-31.6 ft	19	22	16	6	1	Sandy silty clay (CL-ML)

Sample Prepared using the WET method
0% Retained on #40 Sieve
Dry Strength: HIGH
Dilentancy: SLOW
Toughness: LOW

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Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-4, 42.5'-44.0', 44.0'-45.5'	Lab ID	1023
County	Roane (TN)	Date Received	4-23-09
Sample Type	SPT Comp	Date Reported	5-13-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	100.0
No. 200	0.075	19.6
	0.02	7.4
	0.005	4.1
	0.002	3.1
estimated	0.001	3.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.0
Medium Sand	0.0	—
Fine Sand	80.4	80.4
Silt	15.5	16.5
Clay	4.1	3.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.65

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-4, 42.5'-44.0', 44.0'-45.5'

Project Number: 171468117
Lab ID: 1023

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: RHB
Test Date: 04-28-2009
Date Received: 04-23-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.65

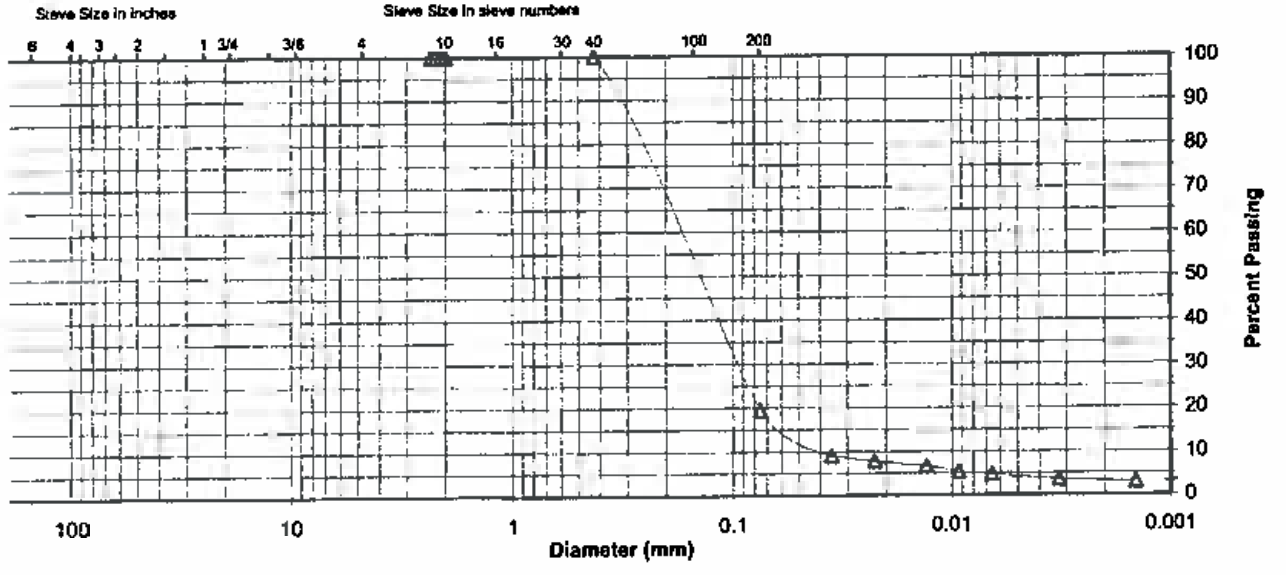
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	100.0
No. 200	19.6
0.02 mm	7.4
0.005 mm	4.1
0.002 mm	3.1
0.001 mm	3.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.0	80.4	15.5	4.1

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.0	0.0	80.4	16.5	3.1



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-5, 6.5'-8.0', 8.0'-9.5'	Lab ID	1713
County	Roane (TN)	Date Received	5-8-09
Sample Type	SPT Comp	Date Reported	6-5-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	99.2
No. 4	4.75	98.4
No. 10	2	97.5
No. 40	0.425	93.2
No. 200	0.075	82.0
	0.02	76.4
	0.005	61.3
	0.002	55.1
estimated	0.001	51.9

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	1.6	2.5
Coarse Sand	0.9	4.3
Medium Sand	4.3	—
Fine Sand	11.2	11.2
Silt	20.7	26.9
Clay	61.3	55.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	61
Plastic Limit:	24
Plasticity Index:	37
Activity Index:	0.67

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.72

Classification

Unified Group Symbol: CH
Group Name: Fat clay with sand

AASHTO Classification: A-7-6 (32)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-5, 6.5'-8.0', 8.0'-9.5'

Project Number: 171468117
Lab ID: 1713

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: BWT
Test Date: 05-20-2009
Date Received: 05-08-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	99.2
No. 4	98.4
No. 10	97.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.72

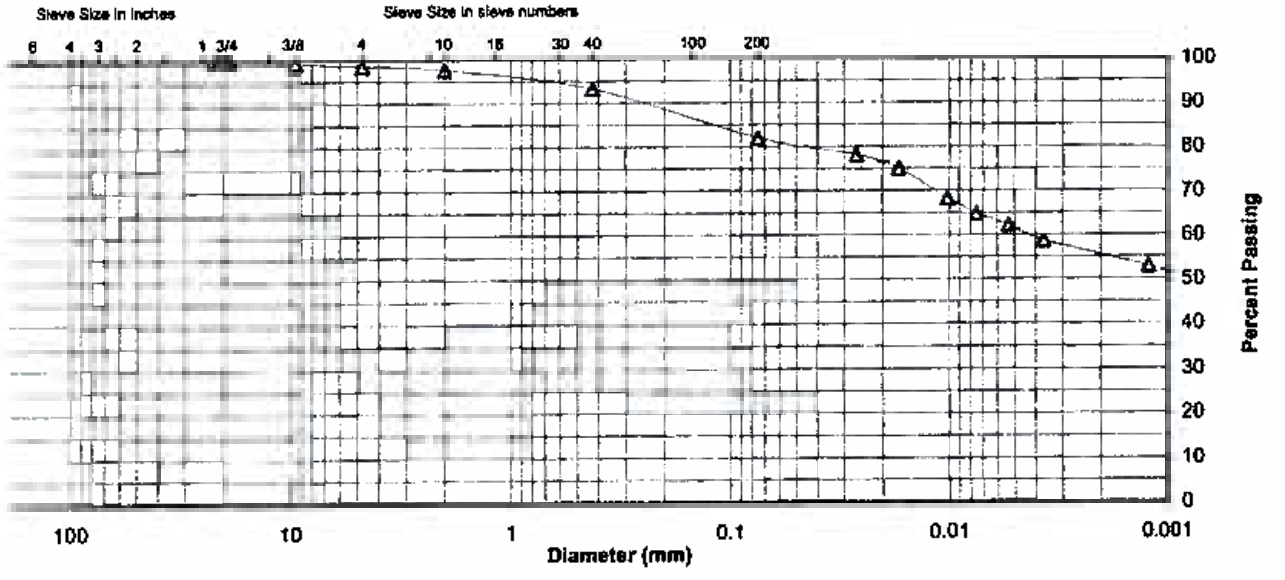
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	93.2
No. 200	82.0
0.02 mm	76.4
0.005 mm	61.3
0.002 mm	55.1
0.001 mm	51.9

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	1.6	0.9	4.3	11.2	20.7	61.3

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	2.5	4.3	11.2	26.9	55.1



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-5, 29.5'-31.0', 31.0'-32.5'	Lab ID	1728
County	Roane (TN)	Date Received	5-8-09
Sample Type	SPT Comp	Date Reported	6-5-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.9
No. 10	2	99.8
No. 40	0.425	99.5
No. 200	0.075	61.9
	0.02	41.1
	0.005	25.2
	0.002	20.8
estimated	0.001	17.2

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.1	0.2
Coarse Sand	0.1	0.3
Medium Sand	0.3	—
Fine Sand	37.6	37.6
Silt	36.7	41.1
Clay	25.2	20.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	26
Plastic Limit:	17
Plasticity Index:	9
Activity Index:	0.43

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.66

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay

AASHTO Classification: A-4 (3)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-5, 29.5'-31.0', 31.0'-32.5'

Project Number: 171468117
Lab ID: 1728

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: BWT
Test Date: 05-20-2009
Date Received: 05-08-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.9
No. 10	99.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

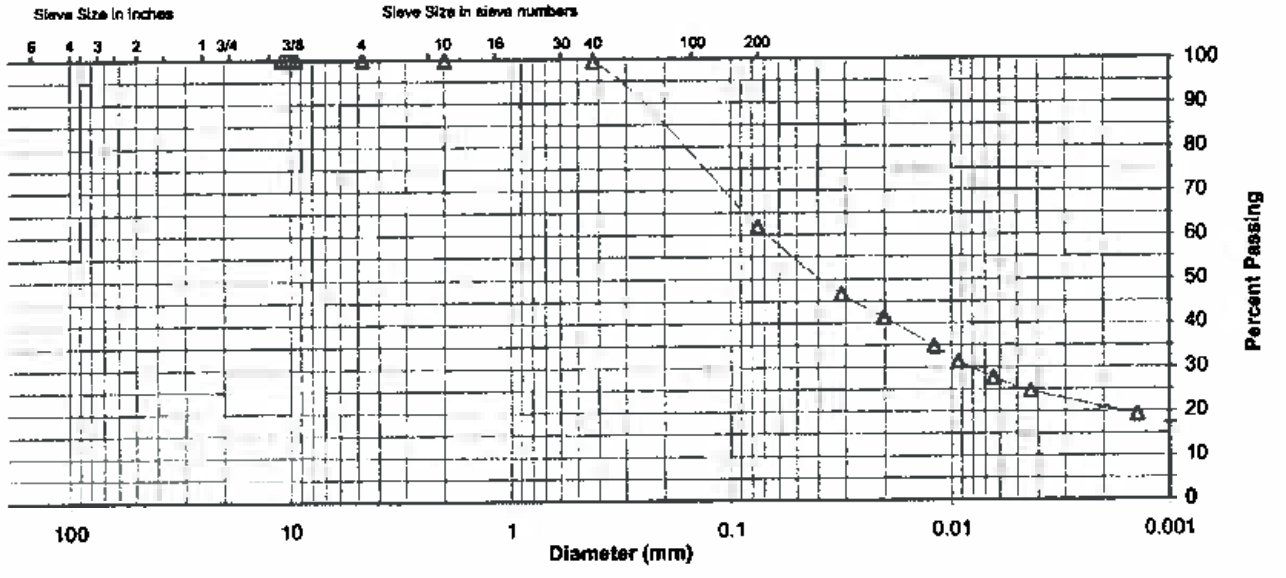
Specific Gravity: 2.66

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.5
No. 200	61.9
0.02 mm	41.1
0.005 mm	25.2
0.002 mm	20.8
0.001 mm	17.2

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.1	0.1	0.3	37.6	36.7	25.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.2			0.3	37.6	41.1	20.8



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-5, 40.5'-42.0', 42.0'-43.5'	Lab ID	1735
County	Roane (TN)	Date Received	5-8-09
Sample Type	SPT Comp	Date Reported	6-5-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	100.0
No. 40	0.425	99.0
No. 200	0.075	31.3
	0.02	15.8
	0.005	9.9
	0.002	7.6
estimated	0.001	6.0

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

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.0
Coarse Sand	0.0	1.0
Medium Sand	1.0	—
Fine Sand	67.7	67.7
Silt	21.4	23.7
Clay	9.9	7.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.65

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-5, 40.5'-42.0', 42.0'-43.5'

Project Number: 171468117
Lab ID: 1735

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: BWT
Test Date: 05-20-2009
Date Received: 05-08-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

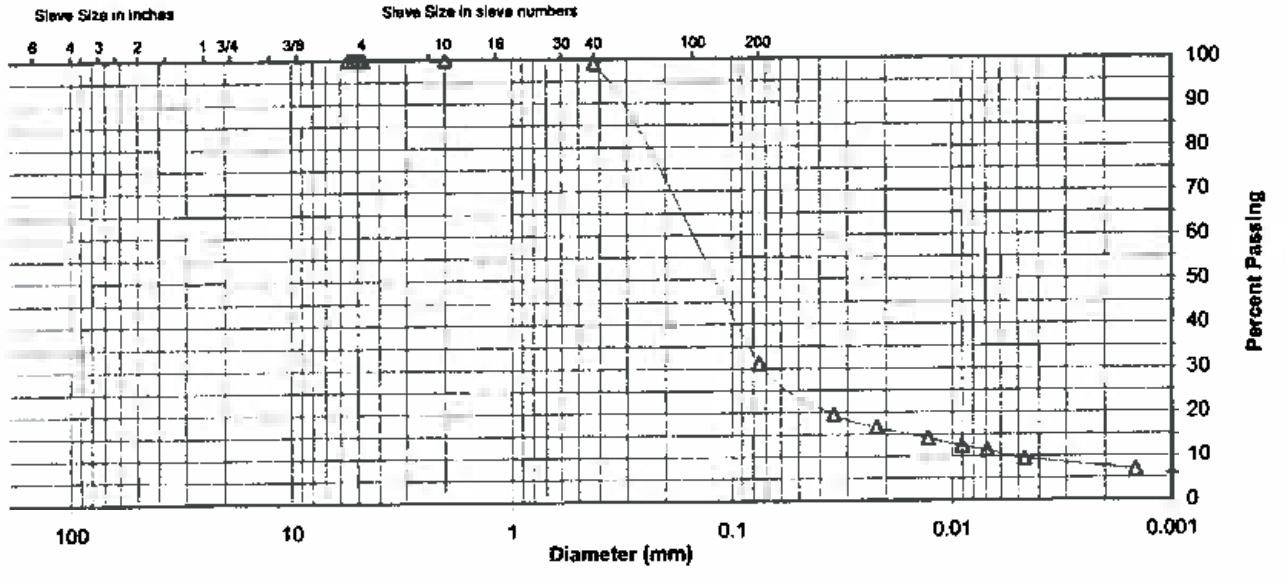
Specific Gravity: 2.65

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.0
No. 200	31.3
0.02 mm	15.8
0.005 mm	9.9
0.002 mm	7.6
0.001 mm	6.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	1.0	67.7	21.4	9.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			1.0	67.7	23.7	7.6



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-6, 6.0'-7.5', 7.5'-9.0'	Lab ID	1788
County	Roane (TN)	Date Received	5-8-09
Sample Type	SPT Comp	Date Reported	6-5-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	98.3
No. 4	4.75	96.0
No. 10	2	91.6
No. 40	0.425	79.9
No. 200	0.075	57.4
	0.02	33.4
	0.005	12.2
	0.002	8.2
estimated	0.001	6.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	4.0	8.4
Coarse Sand	4.4	11.7
Medium Sand	11.7	---
Fine Sand	22.5	22.5
Silt	45.2	49.2
Clay	12.2	8.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.40

Classification

Unified Group Symbol: ML
Group Name: Sandy silt

AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-6, 6.0'-7.5', 7.5'-9.0'

Project Number: 171468117
Lab ID: 1788

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: BWT
Test Date: 05-20-2009
Date Received: 05-08-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	98.3
No. 4	96.0
No. 10	91.6

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

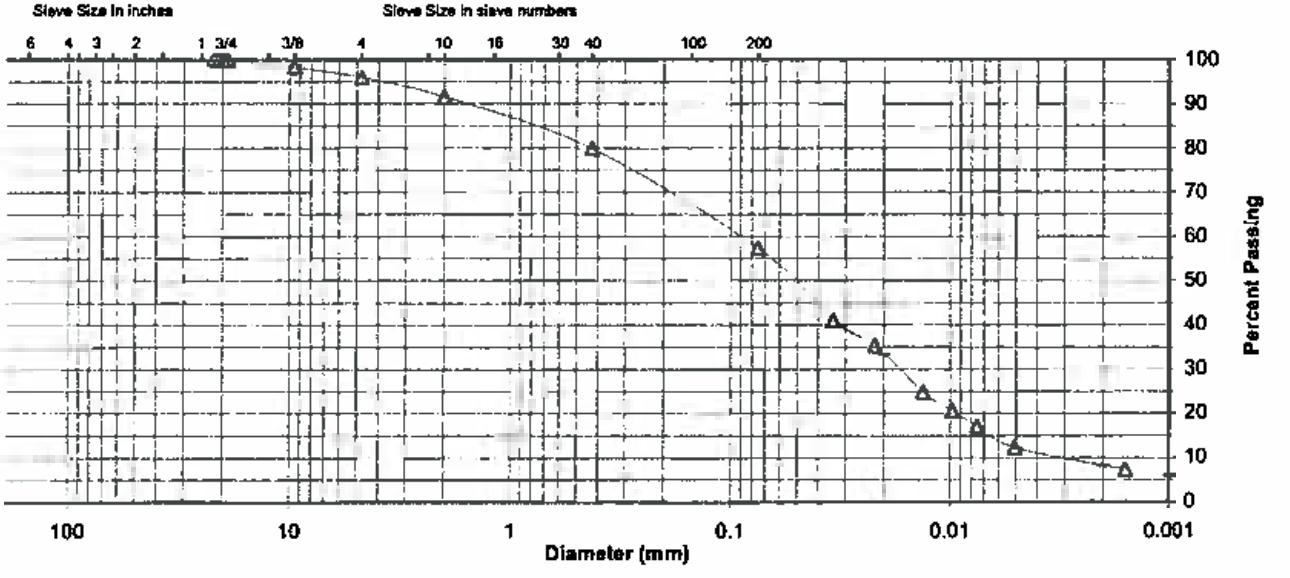
Specific Gravity: 2.4

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	79.9
No. 200	57.4
0.02 mm	33.4
0.005 mm	12.2
0.002 mm	8.2
0.001 mm	6.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	4.0	4.4	11.7	22.5	45.2	12.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	8.4			11.7	22.5	49.2	8.2



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-6, 46.5'-48.0', 48.0'-49.5'	Lab ID	1816
County	Roane (TN)	Date Received	5-8-09
Sample Type	SPT Comp	Date Reported	6-5-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.7
No. 10	2	99.5
No. 40	0.425	99.2
No. 200	0.075	51.9
	0.02	30.4
	0.005	19.9
	0.002	15.7
estimated	0.001	13.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.3	0.5
Coarse Sand	0.2	0.3
Medium Sand	0.3	—
Fine Sand	47.3	47.3
Silt	32.0	36.2
Clay	19.9	15.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	18
Plastic Limit:	15
Plasticity Index:	3
Activity Index:	0.19

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No.10
Specific Gravity at 20° Celsius:	2.63

Classification

Unified Group Symbol: ML

Group Name: Sandy silt

AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-6, 46.5'-48.0', 48.0'-49.5'

Project Number: 171468117
Lab ID: 1816

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: BWT
Test Date: 05-20-2009
Date Received: 05-08-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.7
No. 10	99.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

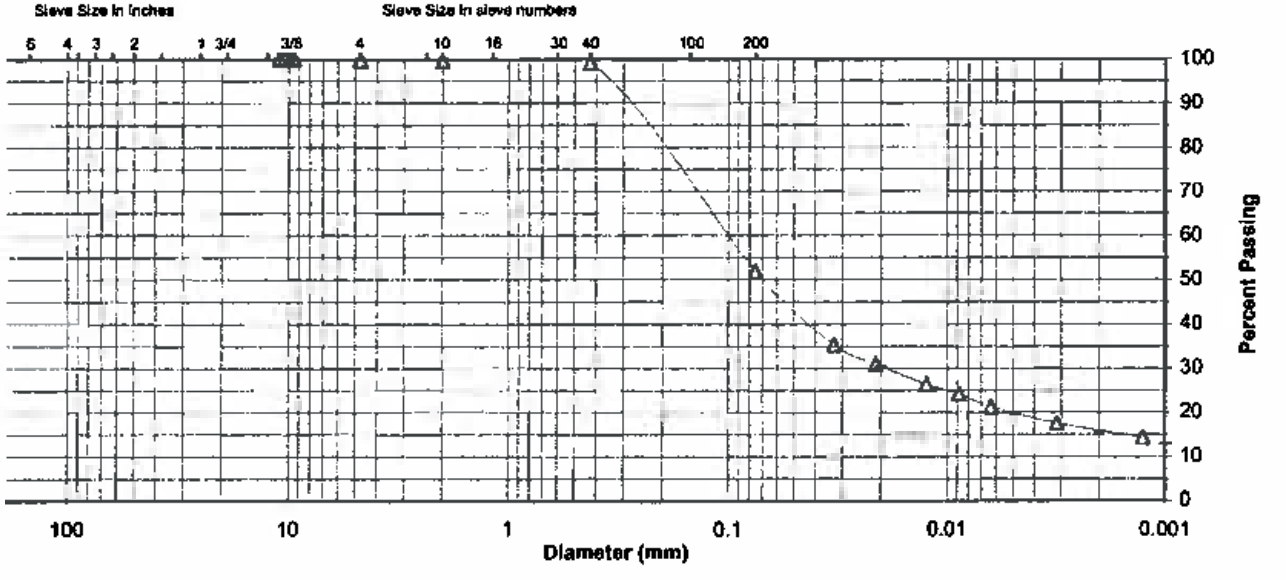
Specific Gravity: 2.63

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.2
No. 200	51.9
0.02 mm	30.4
0.005 mm	19.9
0.002 mm	15.7
0.001 mm	13.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.3	0.2	0.3	47.3	32.0	19.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.5			0.3	47.3	36.2	15.7



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	175569042
Source	STN-8, 15.5'-16.0'	Lab ID	555
County	Kingston, Tennessee	Date Received	5-27-09
Sample Type	UD	Date Reported	6-30-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 20.6

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.8
No. 10	2	99.8
No. 40	0.425	99.4
No. 200	0.075	63.1
	0.02	37.7
	0.005	25.9
	0.002	20.9
estimated	0.001	17.0

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

Range	ASTM (%)	AASHTO (%)
Gravel	0.2	0.2
Coarse Sand	0.0	0.4
Medium Sand	0.4	—
Fine Sand	36.3	36.3
Silt	37.2	42.2
Clay	25.9	20.9

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 23
Plastic Limit: 15
Plasticity Index: 8
Activity Index: 0.38

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay

AASHTO Classification: A-4 (2)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-8, 15.5'-16.0'

Project Number: 175569042
Lab ID: 555

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

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

Particle Shape: Rounded
Particle Hardness: Hard and Durable

Tested By: BWT
Test Date: 06-09-2009
Date Received: 05-27-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.8
No. 10	99.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

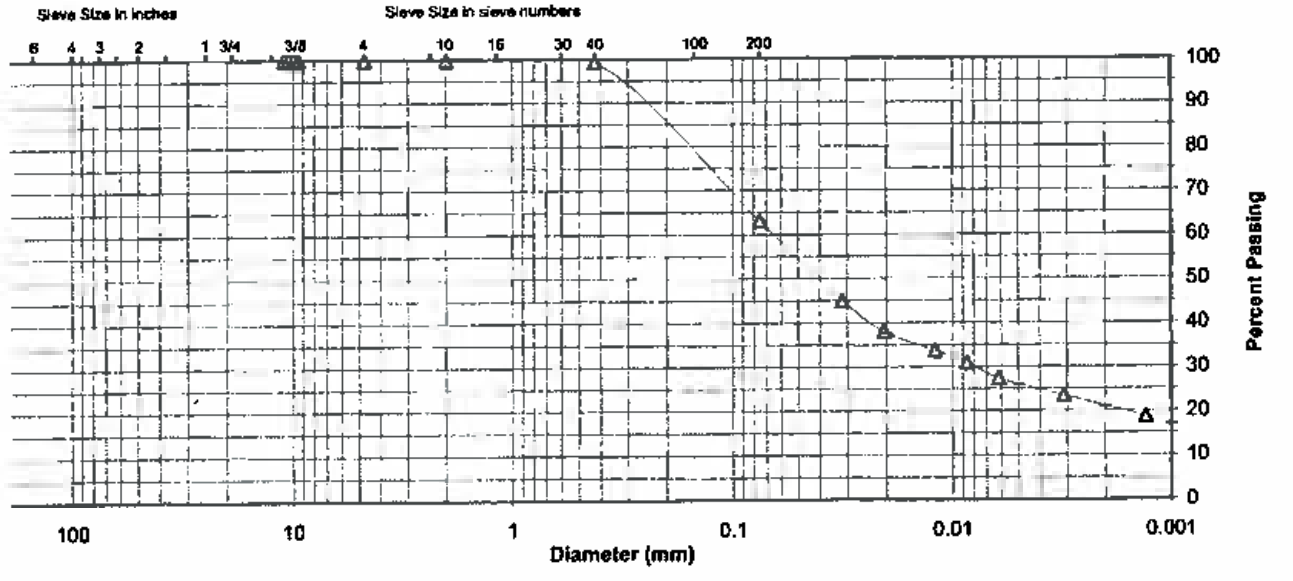
Specific Gravity: 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.4
No. 200	63.1
0.02 mm	37.7
0.005 mm	25.9
0.002 mm	20.9
0.001 mm	17.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.2	0.0	0.4	36.3	37.2	25.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.2			0.4	36.3	42.2	20.9



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-8, 22.0'-23.5', 23.5'-25.0'
Project Number: 171468117
Lab ID: 1177

County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-23-09
Date Reported: 5-13-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.6
No. 200	0.075	19.4
	0.02	8.6
	0.005	6.4
	0.002	5.2
estimated	0.001	5.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.4
Medium Sand	0.4	—
Fine Sand	80.2	80.2
Silt	13.0	14.2
Clay	6.4	5.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.73

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-8, 22.0'-23.5', 23.5'-25.0'

Project Number: 171468117
Lab ID: 1177

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: RHB
Test Date: 04-29-2009
Date Received: 04-23-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.73

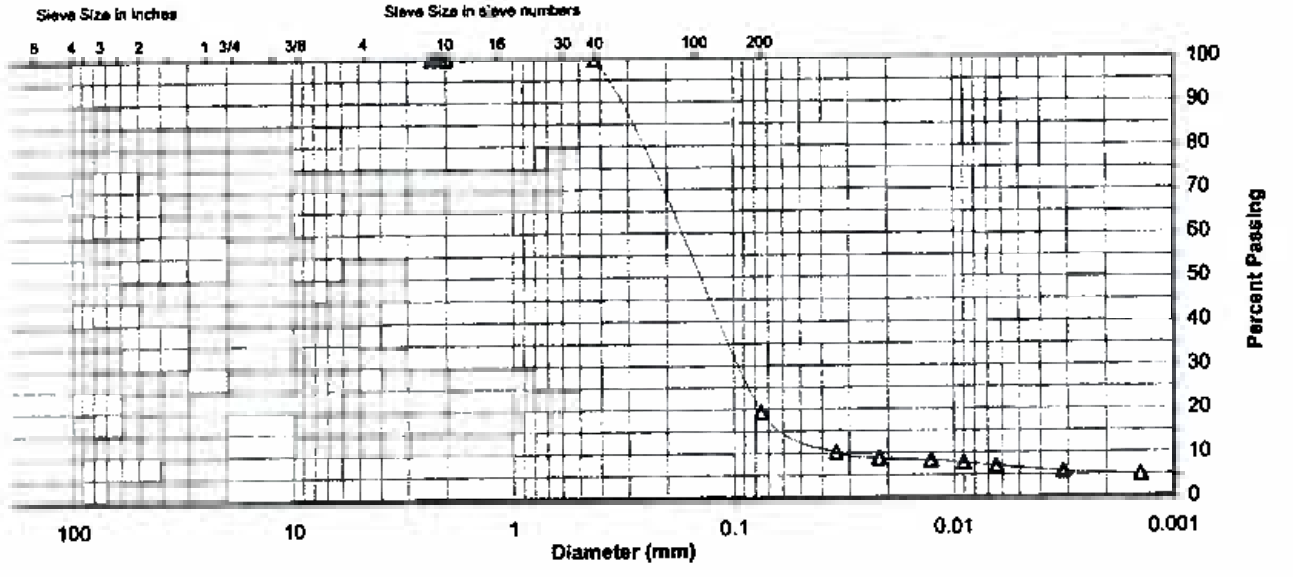
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.6
No. 200	19.4
0.02 mm	8.6
0.005 mm	6.4
0.002 mm	5.2
0.001 mm	5.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.4	80.2	13.0	6.4

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.0	0.4	80.2	14.2	5.2



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-8, 49.0'-50.5', 50.5'-52.0'
County: Roane (TN)
Sample Type: SPT Comp

Project Number: 171468117
Lab ID: 1196
Date Received: 4-23-09
Date Reported: 5-13-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	93.2
No. 4	4.75	91.1
No. 10	2	89.4
No. 40	0.425	83.1
No. 200	0.075	11.6
	0.02	4.1
	0.005	3.3
	0.002	2.7
estimated	0.001	2.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	8.9	10.6
Coarse Sand	1.7	6.3
Medium Sand	6.3	---
Fine Sand	71.5	71.5
Silt	8.3	8.9
Clay	3.3	2.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.68

Classification

Unified Group Symbol: SP-SM
Group Name: Poorly graded sand with silt
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-8, 49.0'-50.5', 50.5'-52.0'

Project Number: 171468117
Lab ID: 1196

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

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

Particle Shape: Rounded and Angular
Particle Hardness: Hard and Durable

Tested By: RHB
Test Date: 05-05-2009
Date Received: 04-23-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	93.2
No. 4	91.1
No. 10	89.4

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

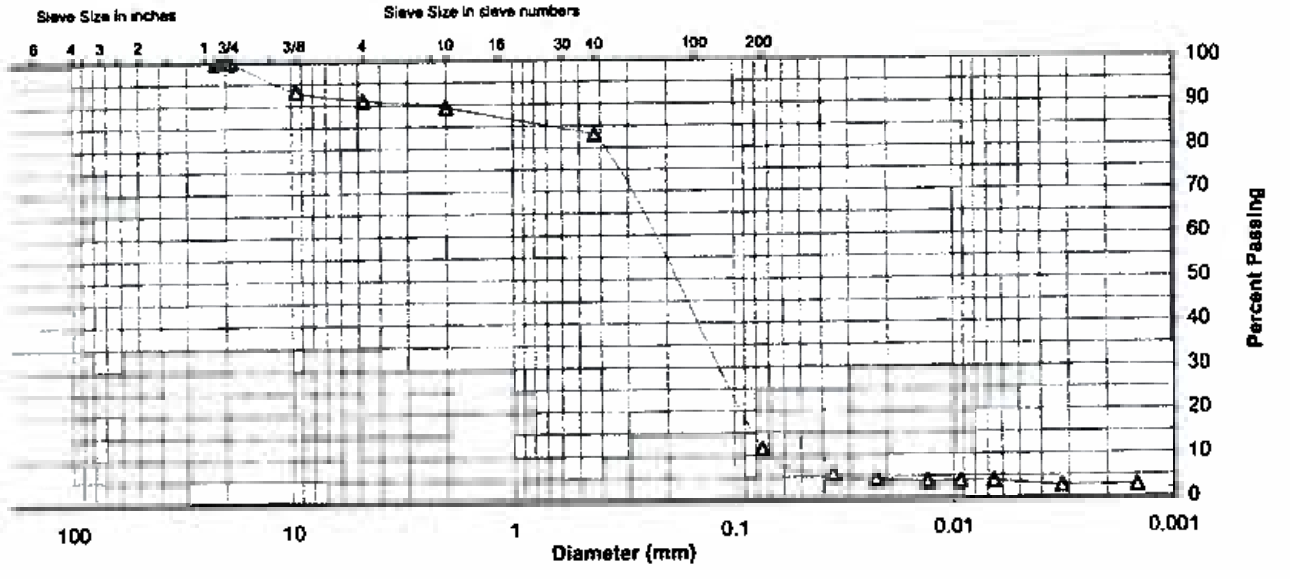
Specific Gravity: 2.68

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	83.1
No. 200	11.6
0.02 mm	4.1
0.005 mm	3.3
0.002 mm	2.7
0.001 mm	2.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	8.9	1.7	6.3	71.5	8.3	3.3
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	10.6			6.3	71.5	8.9	2.7



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-9, 25.0'-26.5', 26.5'-28.0'
Project Number: 171468117
Lab ID: 1216
County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-23-09
Date Reported: 5-14-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	95.7
No. 4	4.75	91.1
No. 10	2	88.9
No. 40	0.425	85.7
No. 200	0.075	34.1
	0.02	15.3
	0.005	9.1
	0.002	7.7
estimated	0.001	7.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	8.9	11.1
Coarse Sand	2.2	3.2
Medium Sand	3.2	—
Fine Sand	51.6	51.6
Silt	25.0	26.4
Clay	9.1	7.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.63

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-9, 25.0'-26.5', 26.5'-28.0'

Project Number: 171468117
Lab ID: 1216

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: RHB
Test Date: 05-05-2009
Date Received: 04-23-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	95.7
No. 4	91.1
No. 10	88.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

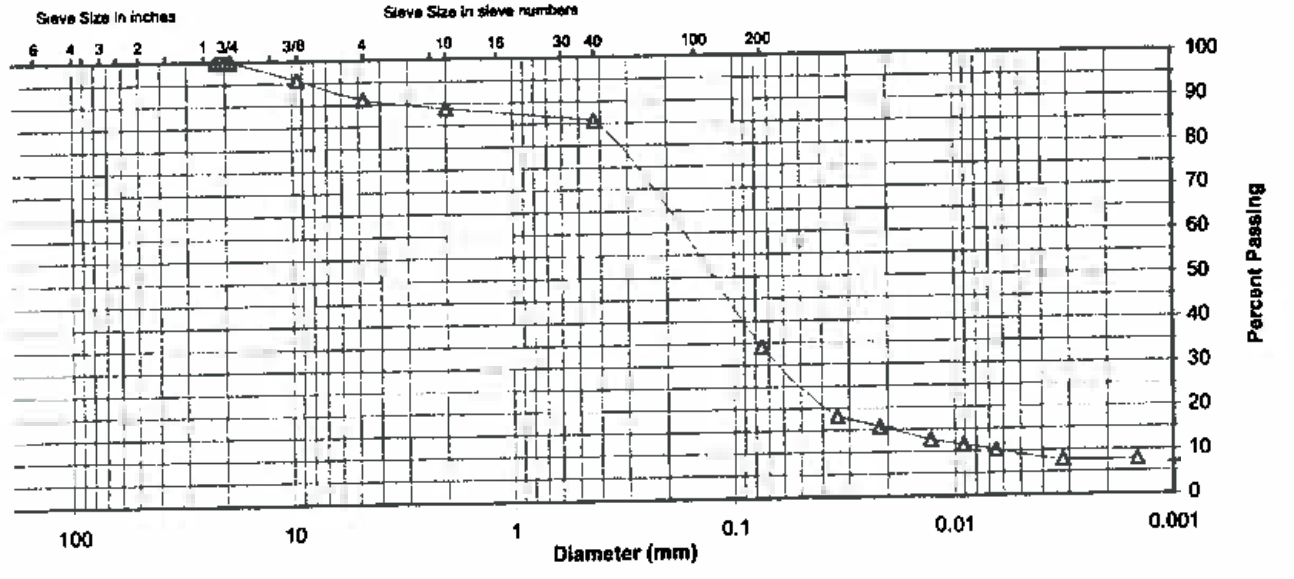
Specific Gravity: 2.63

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	85.7
No. 200	34.1
0.02 mm	15.3
0.005 mm	9.1
0.002 mm	7.7
0.001 mm	7.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	8.9	2.2	3.2	51.8	25.0	9.1
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	11.1			3.2	51.8	26.4	7.7



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-9, 49.0'-50.5', 50.5'-52.0', 52.0'-53.5'	Lab ID	1233
County	Roane (TN)	Date Received	4-23-09
Sample Type	SPT Comp	Date Reported	5-13-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	100.0
No. 40	0.425	99.7
No. 200	0.075	19.7
	0.02	8.6
	0.005	6.0
	0.002	4.4
estimated	0.001	4.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.3
Medium Sand	0.3	—
Fine Sand	80.0	80.0
Silt	13.7	15.3
Clay	6.0	4.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.65

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-9, 49.0'-50.5', 50.5'-52.0', 52.0'-53.5'

Project Number: 171468117
Lab ID: 1233

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: RHB
Test Date: 04-29-2009
Date Received: 04-23-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

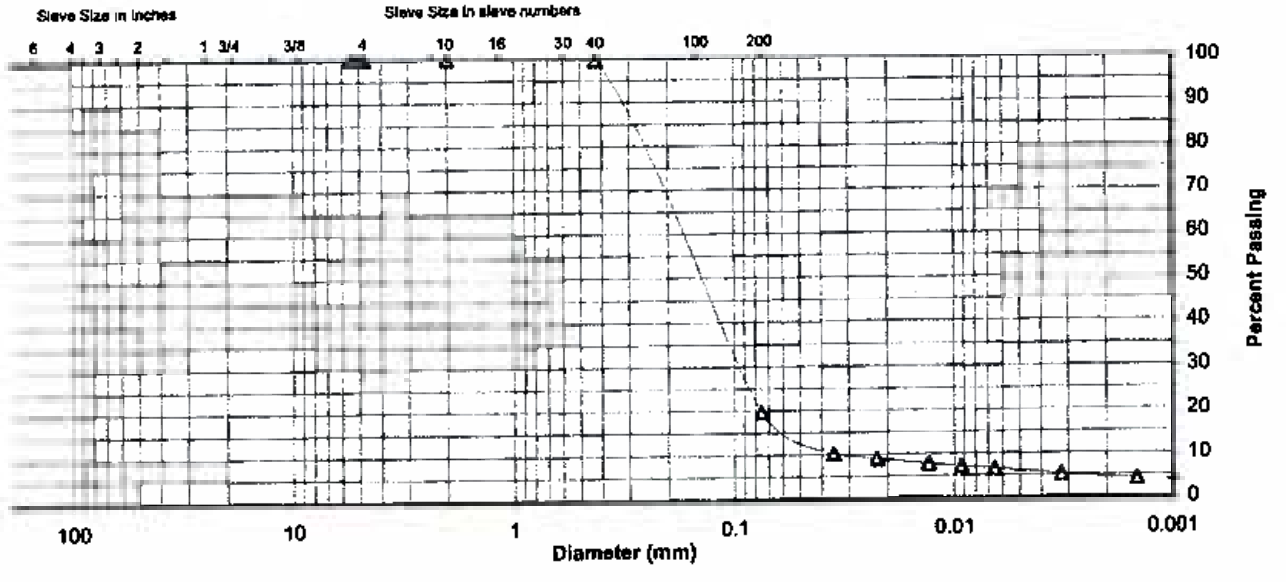
Specific Gravity: 2.65

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.7
No. 200	19.7
0.02 mm	8.6
0.005 mm	6.0
0.002 mm	4.4
0.001 mm	4.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.3	80.0	13.7	6.0
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.3	80.0	15.3	4.4



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-10, 43.0'-44.5', 44.5'-46.0'	Lab ID	1620
County	Roane (TN)	Date Received	5-8-09
Sample Type	SPT Comp	Date Reported	6-5-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	100.0
No. 40	0.425	99.3
No. 200	0.075	58.3
	0.02	31.9
	0.005	18.4
	0.002	14.2
estimated	0.001	12.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.7
Medium Sand	0.7	—
Fine Sand	41.0	41.0
Silt	39.9	44.1
Clay	18.4	14.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 21
Plastic Limit: 16
Plasticity Index: 5
Activity Index: 0.36

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.68

Classification

Unified Group Symbol: CL-ML
Group Name: Sandy silty clay

AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-10, 43.0'-44.5', 44.5'-46.0'

Project Number: 171468117
Lab ID: 1620

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

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

Particle Shape: Rounded
Particle Hardness: Hard and Durable

Tested By: CM
Test Date: 05-19-2009
Date Received: 05-08-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

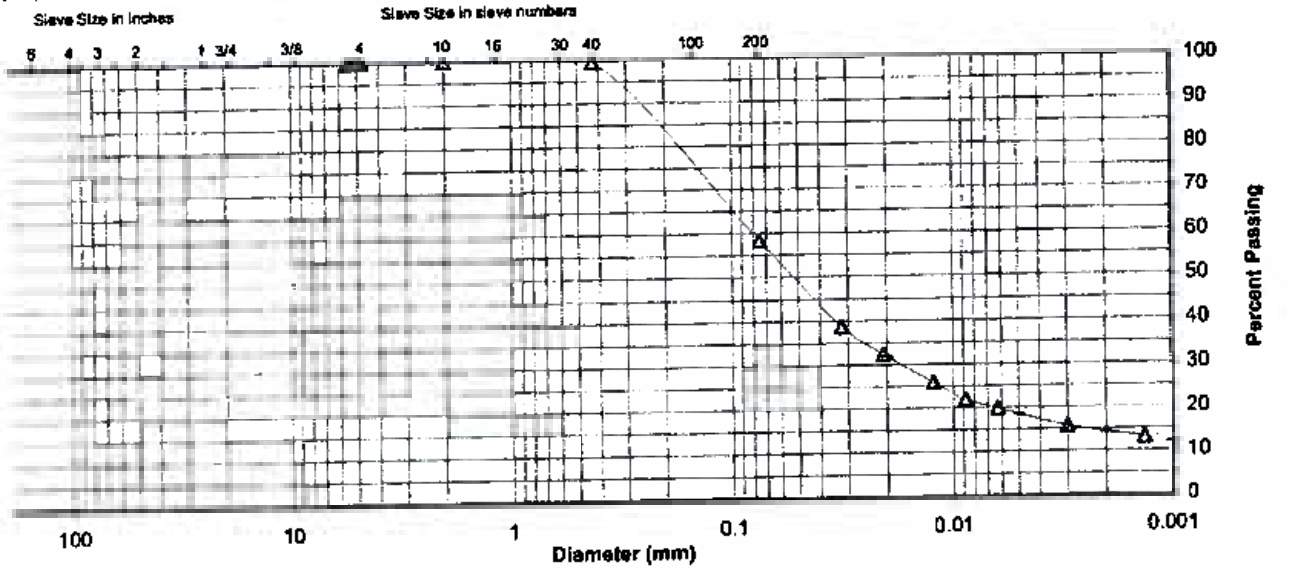
Specific Gravity: 2.68

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.3
No. 200	58.3
0.02 mm	31.9
0.005 mm	18.4
0.002 mm	14.2
0.001 mm	12.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.7	41.0	39.9	18.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.7	41.0	44.1	14.2



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-10, 52.0'-53.5', 53.5'-55.0'	Lab ID	1627
County	Roane (TN)	Date Received	5-8-09
Sample Type	SPT Comp	Date Reported	6-5-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	100.0
No. 40	0.425	99.4
No. 200	0.075	41.1
	0.02	23.2
	0.005	13.2
	0.002	10.0
estimated	0.001	9.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.6
Medium Sand	0.6	—
Fine Sand	58.3	58.3
Silt	27.9	31.1
Clay	13.2	10.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.62

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-10, 52.0'-53.5', 53.5'-55.0'

Project Number: 171468117
Lab ID: 1627

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: Soft

Tested By: CM
Test Date: 05-19-2009
Date Received: 05-08-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

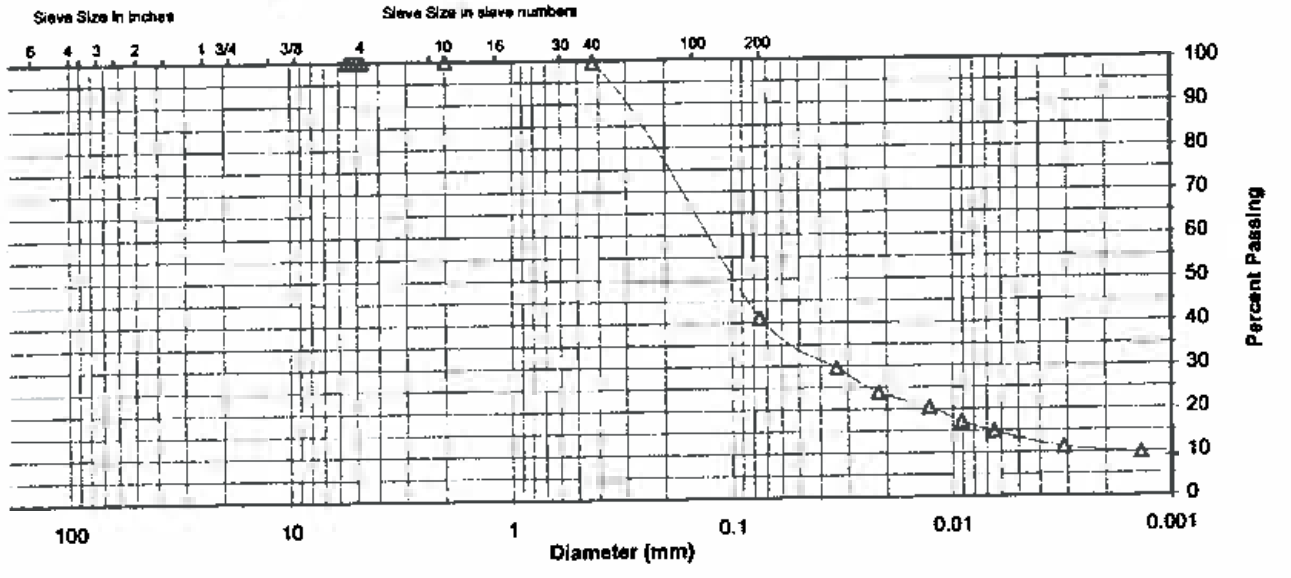
Specific Gravity: 2.62

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.4
No. 200	41.1
0.02 mm	23.2
0.005 mm	13.2
0.002 mm	10.0
0.001 mm	9.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.6	58.3	27.9	13.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.6	58.3	31.1	10.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	175569042
Source	STN-11, 9.0'-10.5', 10.5'-12.0'	Lab ID	91
County	Kingston, Tennessee	Date Received	5-22-09
Sample Type	SPT Comp	Date Reported	6-5-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	99.7
No. 4	4.75	98.2
No. 10	2	96.9
No. 40	0.425	91.1
No. 200	0.075	76.3
	0.02	64.9
	0.005	51.1
	0.002	43.3
estimated	0.001	40.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	1.8	3.1
Coarse Sand	1.3	5.8
Medium Sand	5.8	—
Fine Sand	14.8	14.8
Silt	25.2	33.0
Clay	51.1	43.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	46
Plastic Limit:	18
Plasticity Index:	28
Activity Index:	0.65

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.68

Classification

Unified Group Symbol: CL

Group Name: Lean clay with sand

AASHTO Classification: A-7-6 (20)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-11, 9.0'-10.5', 10.5'-12.0'

Project Number: 175569042
Lab ID: 91

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: BWT
Test Date: 05-26-2009
Date Received: 05-22-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	99.7
No. 4	98.2
No. 10	96.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

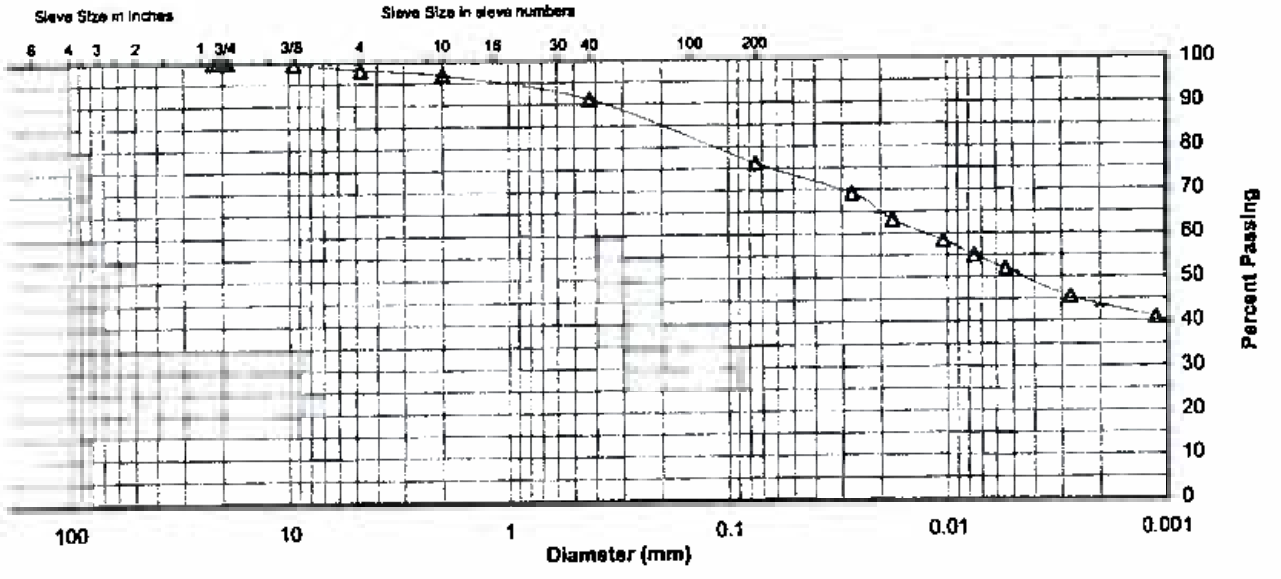
Specific Gravity: 2.68

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	91.1
No. 200	76.3
0.02 mm	64.9
0.005 mm	51.1
0.002 mm	43.3
0.001 mm	40.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	1.8	1.3	5.8	14.8	25.2	51.1
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	3.1			5.8	14.8	33.0	43.3



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 175569042
Source: STN-11, 37.5'-39.0', 39.0'-40.5'
Lab ID: 111
County: Kingston, Tennessee
Date Received: 5-22-09
Sample Type: SPT Comp
Date Reported: 6-5-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.9
No. 10	2	99.7
No. 40	0.425	99.2
No. 200	0.075	43.8
	0.02	22.0
	0.005	15.3
	0.002	11.8
estimated	0.001	10.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.1	0.3
Coarse Sand	0.2	0.5
Medium Sand	0.5	—
Fine Sand	55.4	55.4
Silt	28.5	32.0
Clay	15.3	11.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-11, 37.5'-39.0', 39.0'-40.5'

Project Number: 175569042
Lab ID: 111

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: CM
Test Date: 05-28-2009
Date Received: 05-22-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.9
No. 10	99.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

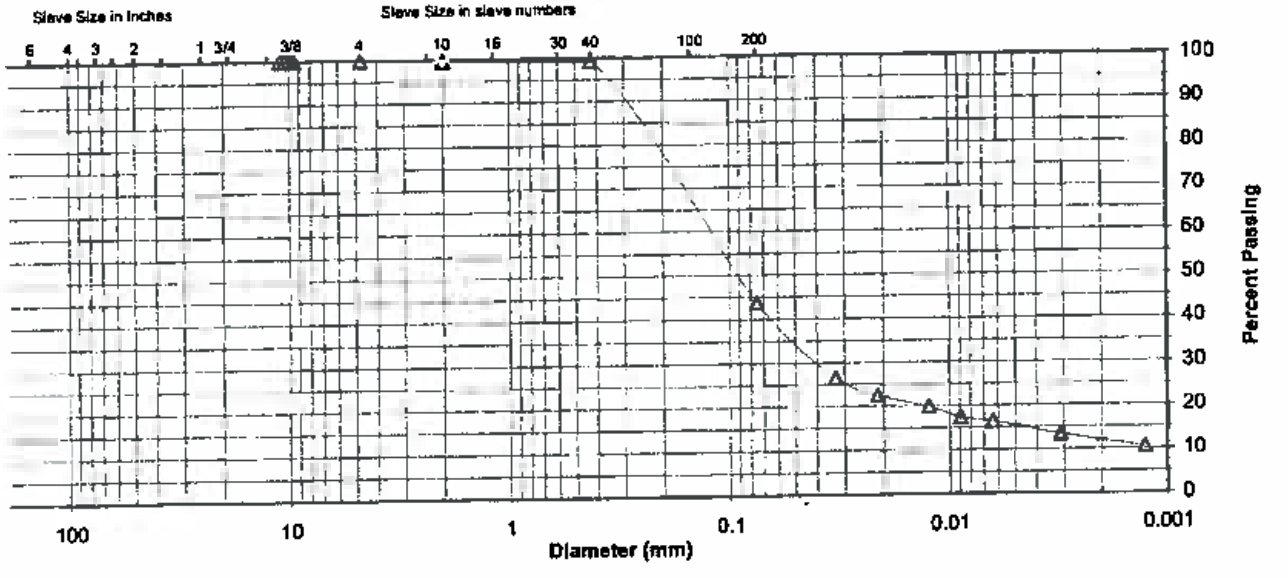
Specific Gravity: 2.66

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.2
No. 200	43.8
0.02 mm	22.0
0.005 mm	15.3
0.002 mm	11.8
0.001 mm	10.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.1	0.2	0.5	55.4	28.5	15.3
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.3			0.5	55.4	32.9	11.8



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 175569042
Source: STN-12, 4.5'-6.0', 6.0'-7.5', 7.5'-9.0'
Lab ID: 132
County: Kingston, Tennessee
Date Received: 5-22-09
Sample Type: SPT Comp
Date Reported: 6-5-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	100.0
3/4"	19	94.9
3/8"	9.5	91.2
No. 4	4.75	86.3
No. 10	2	79.3
No. 40	0.425	75.0
No. 200	0.075	65.1
	0.02	56.7
	0.005	46.9
	0.002	39.9
estimated	0.001	36.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	13.7	20.7
Coarse Sand	7.0	4.3
Medium Sand	4.3	—
Fine Sand	9.9	9.9
Silt	18.2	25.2
Clay	46.9	39.9

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 51
Plastic Limit: 20
Plasticity Index: 31
Activity Index: 0.78

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.71

Classification

Unified Group Symbol: CH/CL
Group Name: Sandy fat clay
AASHTO Classification: A-7-6 (18)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-12, 4.5'-6.0', 6.0'-7.5', 7.5'-9.0'

Project Number: 175569042
Lab ID: 132

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: CM
Test Date: 05-28-2009
Date Received: 05-22-2009

Maximum Particle size: 1" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	100.0
3/4"	94.9
3/8"	91.2
No. 4	86.3
No. 10	79.3

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

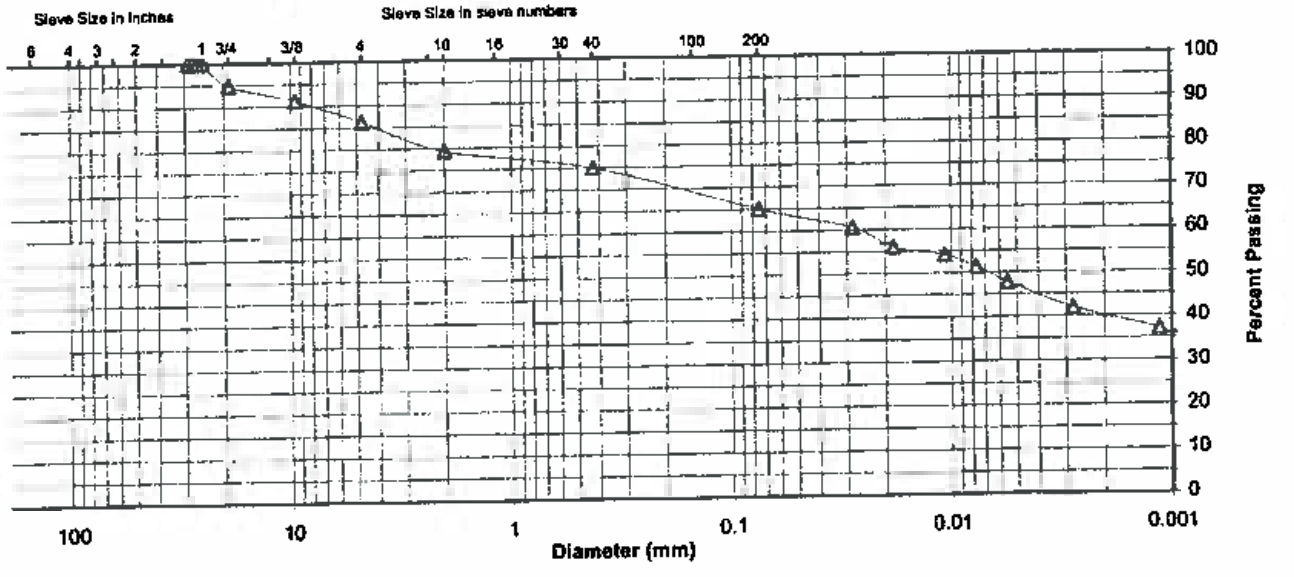
Specific Gravity: 2.71

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	75.0
No. 200	65.1
0.02 mm	56.7
0.005 mm	46.9
0.002 mm	39.9
0.001 mm	36.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	5.1	8.6	7.0	4.3	9.9	18.2	46.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	20.7			4.3	9.9	25.2	39.9



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-12, 40.0'-41.5', 41.5'-43.0'
Project Number: 175569042
Lab ID: 154
County: Kingston, Tennessee
Sample Type: SPT Comp
Date Received: 5-22-09
Date Reported: 6-5-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	99.3
No. 200	0.075	62.0
	0.02	35.0
	0.005	23.9
	0.002	18.0
estimated	0.001	16.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.1
Coarse Sand	0.1	0.6
Medium Sand	0.6	---
Fine Sand	37.3	37.3
Silt	38.1	44.0
Clay	23.9	18.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 24
Plastic Limit: 18
Plasticity Index: 6
Activity Index: 0.33

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: CL-ML
Group Name: Sandy silty clay
AASHTO Classification: A-4 (1)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-12, 40.0'-41.5', 41.5'-43.0'

Project Number: 175569042
Lab ID: 154

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: DG
Test Date: 05-27-2009
Date Received: 05-22-2009

Maximum Particle size: 3/8" Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.66

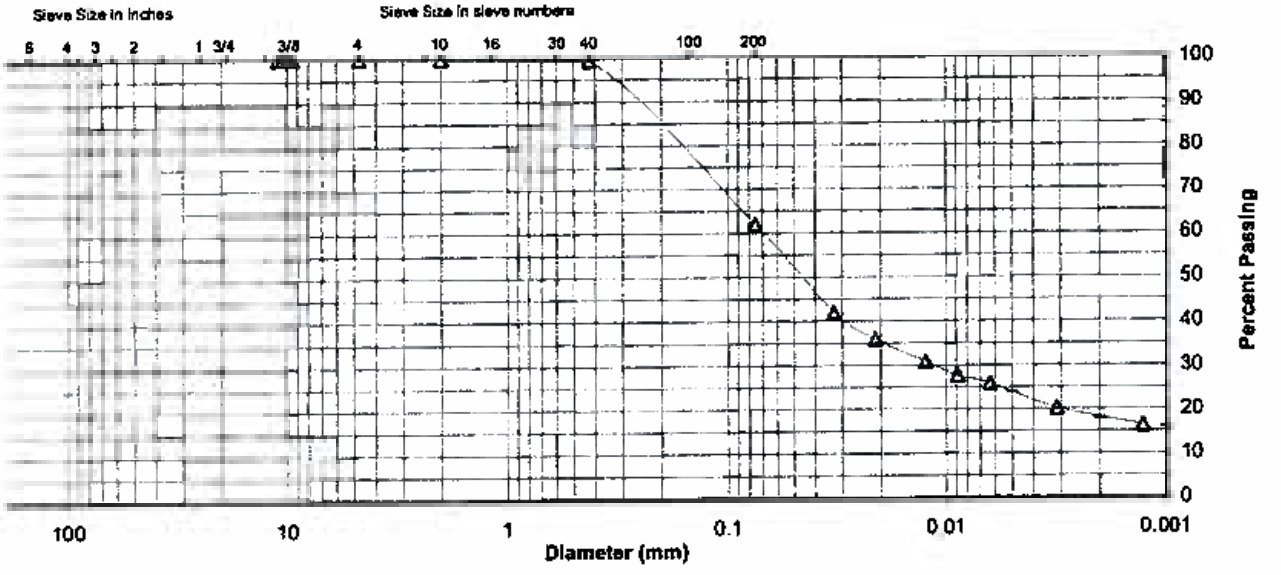
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.3
No. 200	62.0
0.02 mm	35.0
0.005 mm	23.9
0.002 mm	18.0
0.001 mm	16.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	0.6	37.3	38.1	23.9

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.1	0.6	37.3	44.0	18.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-12, 50.5'-52.0', 52.0'-53.5'
Project Number: 175569042
Lab ID: 162

County: Kingston, Tennessee
Sample Type: SPT Comp
Date Received: 5-22-09
Date Reported: 6-5-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.7
No. 200	0.075	31.7
	0.02	15.0
	0.005	11.1
	0.002	8.9
estimated	0.001	7.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.3
Medium Sand	0.3	—
Fine Sand	68.0	68.0
Silt	20.6	22.8
Clay	11.1	8.9

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-12, 50.5'-52.0', 52.0'-53.5'

Project Number: 175569042
Lab ID: 162

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: DG
Test Date: 05-27-2009
Date Received: 05-22-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.66

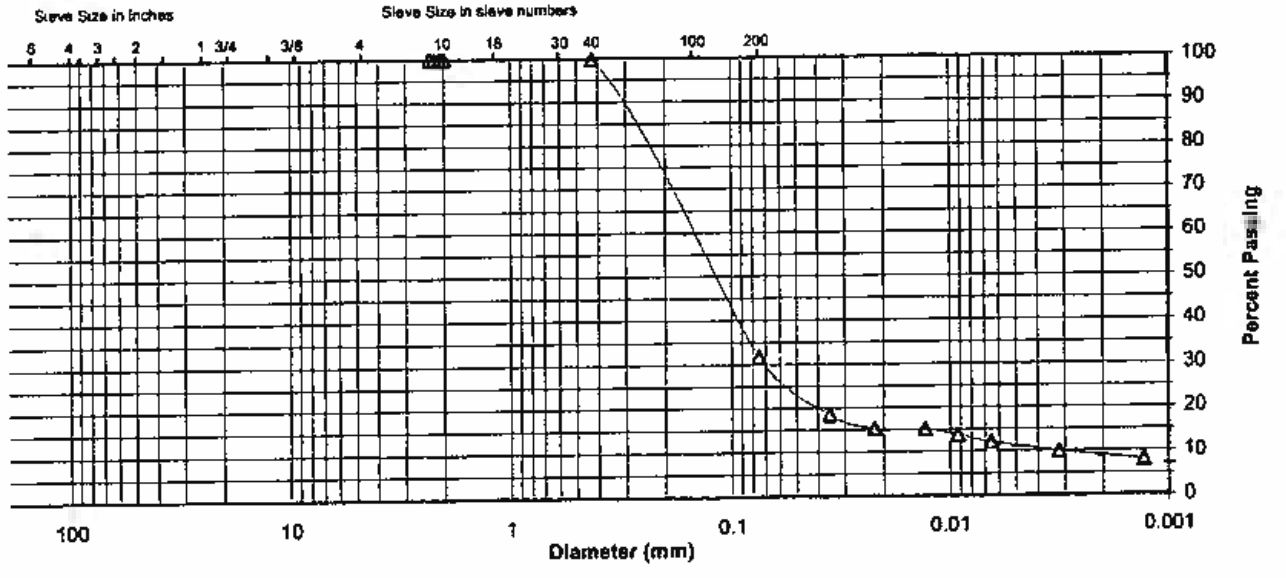
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.7
No. 200	31.7
0.02 mm	15.0
0.005 mm	11.1
0.002 mm	8.9
0.001 mm	7.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.3	68.0	20.6	11.1

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.3	68.0	22.8	8.9



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-14, 1.5'-3.0', 3.0'-4.5'	Lab ID	802
County	Roane (TN)	Date Received	4-14-09
Sample Type	SPT Comp	Date Reported	5-11-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	98.4
No. 4	4.75	94.8
No. 10	2	89.0
No. 40	0.425	74.2
No. 200	0.075	57.6
	0.02	43.7
	0.005	30.1
	0.002	24.7
estimated	0.001	22.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	5.2	11.0
Coarse Sand	5.8	14.8
Medium Sand	14.8	—
Fine Sand	16.6	16.6
Silt	27.5	32.9
Clay	30.1	24.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 41
Plastic Limit: 21
Plasticity Index: 20
Activity Index: 0.80

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

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

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay

AASHTO Classification: A-7-6 (9)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-14, 1.5'-3.0', 3.0'-4.5'

Project Number: 171468117
Lab ID: 802

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: BWT
Test Date: 04-27-2009
Date Received: 04-14-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	98.4
No. 4	94.8
No. 10	89.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

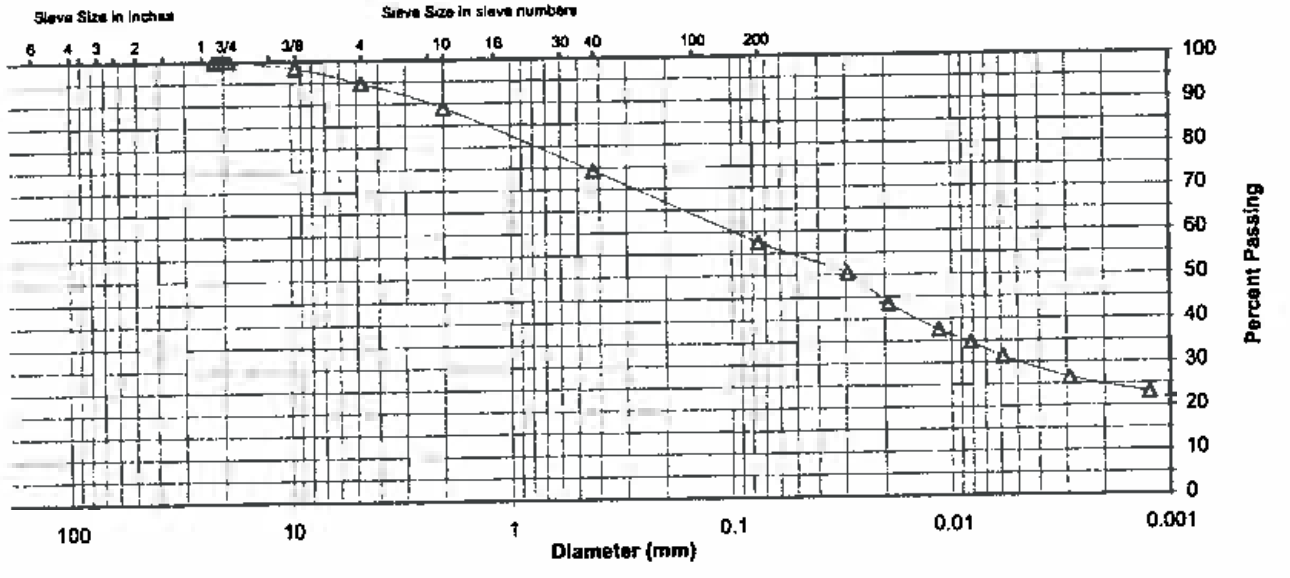
Specific Gravity: 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	74.2
No. 200	57.6
0.02 mm	43.7
0.005 mm	30.1
0.002 mm	24.7
0.001 mm	22.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	5.2	5.8	14.6	16.8	27.5	30.1
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	11.0			14.8	16.6	32.9	24.7



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-14, 24.2'-24.7'
Project Number: 175569042
Lab ID: 513
County: Kingston, Tennessee
Sample Type: UD
Date Received: 5-27-09
Date Reported: 6-30-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 19.2

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.3
No. 200	0.075	65.2
	0.02	39.0
	0.005	22.5
	0.002	17.1
estimated	0.001	13.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.7
Medium Sand	0.7	---
Fine Sand	34.1	34.1
Silt	42.7	48.1
Clay	22.5	17.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 22
Plastic Limit: 17
Plasticity Index: 5
Activity Index: 0.29

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: CL-ML
Group Name: Sandy silty clay
AASHTO Classification: A-4 (1)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-14, 24.2'-24.7'

Project Number: 175569042
Lab ID: 513

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: CSM
Test Date: 06-17-2009
Date Received: 05-27-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.67

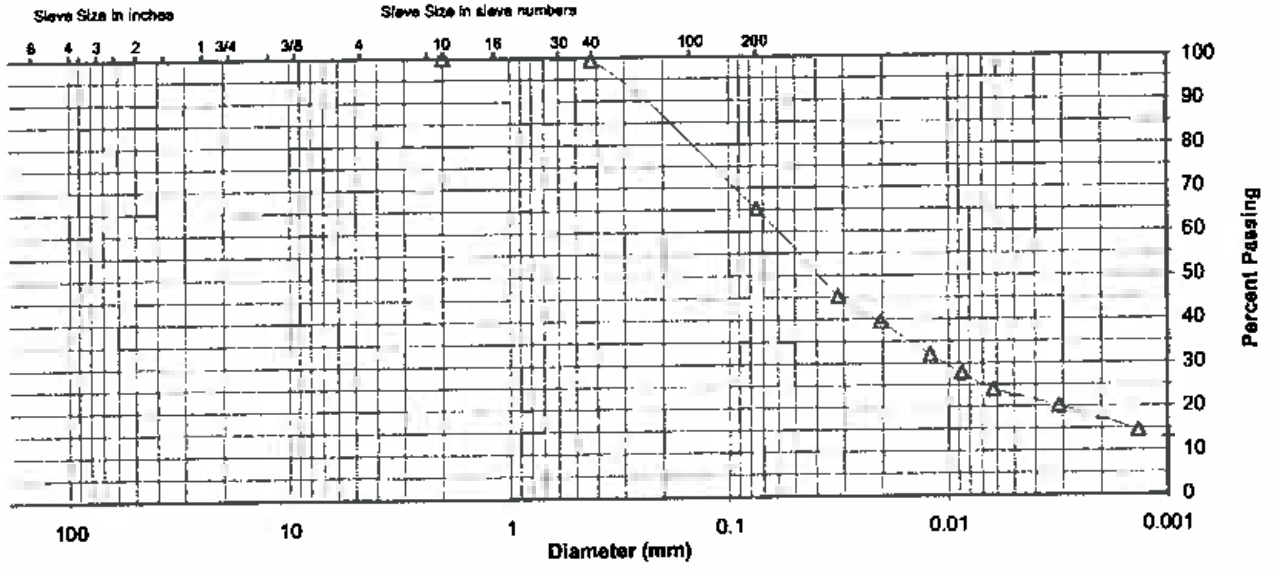
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.3
No. 200	65.2
0.02 mm	39.0
0.005 mm	22.5
0.002 mm	17.1
0.001 mm	13.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.7	34.1	42.7	22.5

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.7	34.1	48.1	17.1



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-14, 31.5'-33.0', 33.0'-34.5'	Lab ID	819
County	Roane (TN)	Date Received	4-14-09
Sample Type	SPT Comp	Date Reported	5-11-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.2
No. 200	0.075	24.9
	0.02	12.4
	0.005	10.1
	0.002	8.3
estimated	0.001	7.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.8
Medium Sand	0.8	---
Fine Sand	74.3	74.3
Silt	14.8	16.6
Clay	10.1	8.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-14, 31.5'-33.0', 33.0'-34.5'

Project Number: 171468117
Lab ID: 819

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 04-27-2009
Date Received: 04-14-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

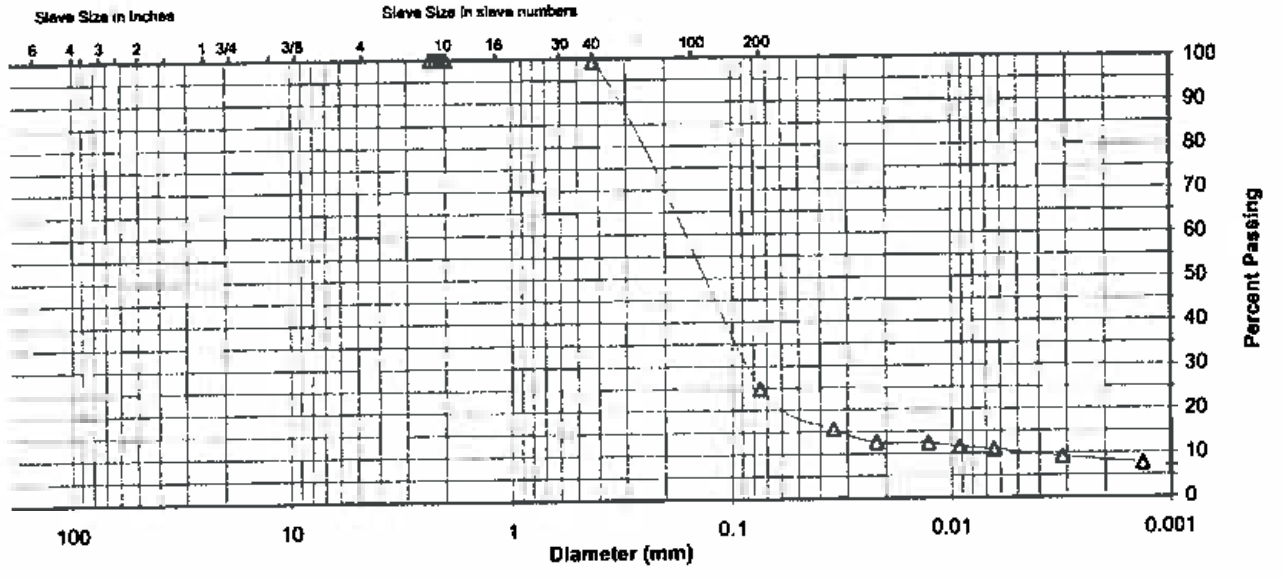
Specific Gravity: 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.2
No. 200	24.9
0.02 mm	12.4
0.005 mm	10.1
0.002 mm	8.3
0.001 mm	7.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.8	74.3	14.8	10.1
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.8	74.3	16.6	8.3



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 175569042
Source: STN-15, 12.0'-12.5'
Lab ID: 511
County: Kingston, Tennessee
Date Received: 5-27-09
Sample Type: UD
Date Reported: 6-30-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 30.3

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	99.8
No. 4	4.75	97.6
No. 10	2	73.1
No. 40	0.425	68.4
No. 200	0.075	62.1
	0.02	56.7
	0.005	47.6
	0.002	40.3
estimated	0.001	38.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	2.4	26.9
Coarse Sand	24.5	4.7
Medium Sand	4.7	—
Fine Sand	6.3	6.3
Silt	14.5	21.8
Clay	47.6	40.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 55
Plastic Limit: 23
Plasticity Index: 32
Activity Index: 0.80

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.71

Classification

Unified Group Symbol: CH
Group Name: Sandy fat clay
AASHTO Classification: A-7-6 (18)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-15, 12.0'-12.5'

Project Number: 175569042
Lab ID: 511

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: CP
Test Date: 06-16-2009
Date Received: 05-27-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	99.8
No. 4	97.6
No. 10	73.1

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

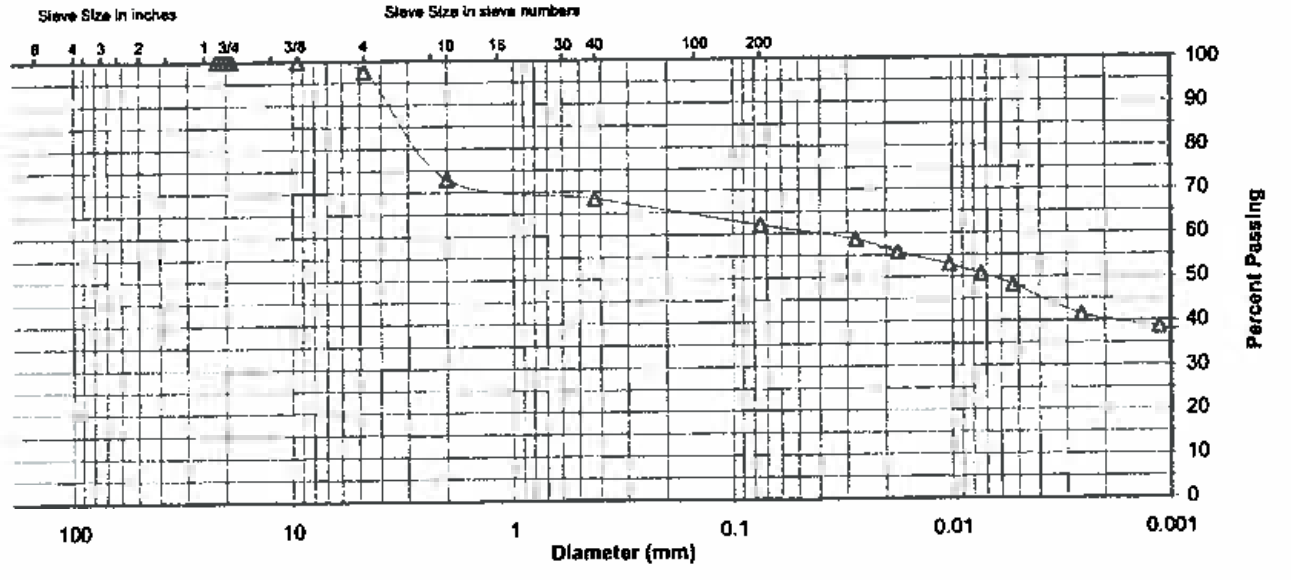
Specific Gravity: 2.71

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	68.4
No. 200	62.1
0.02 mm	56.7
0.005 mm	47.6
0.002 mm	40.3
0.001 mm	38.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	2.4	24.5	4.7	6.3	14.5	47.6
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	26.9			4.7	6.3	21.8	40.3



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-15, 30.5'-32.0', 32.0'-33.5'	Lab ID	879
County	Roane (TN)	Date Received	4-23-09
Sample Type	SPT Comp	Date Reported	5-13-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	97.5
No. 4	4.75	93.6
No. 10	2	91.7
No. 40	0.425	87.7
No. 200	0.075	36.2
	0.02	18.2
	0.005	8.2
	0.002	3.9
estimated	0.001	2.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	6.4	8.3
Coarse Sand	1.9	4.0
Medium Sand	4.0	—
Fine Sand	51.5	51.5
Silt	28.0	32.3
Clay	8.2	3.9

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.69

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-15, 30.5'-32.0', 32.0'-33.5'

Project Number: 171468117
Lab ID: 879

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: RHB
Test Date: 04-29-2009
Date Received: 04-23-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	97.5
No. 4	93.6
No. 10	91.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.69

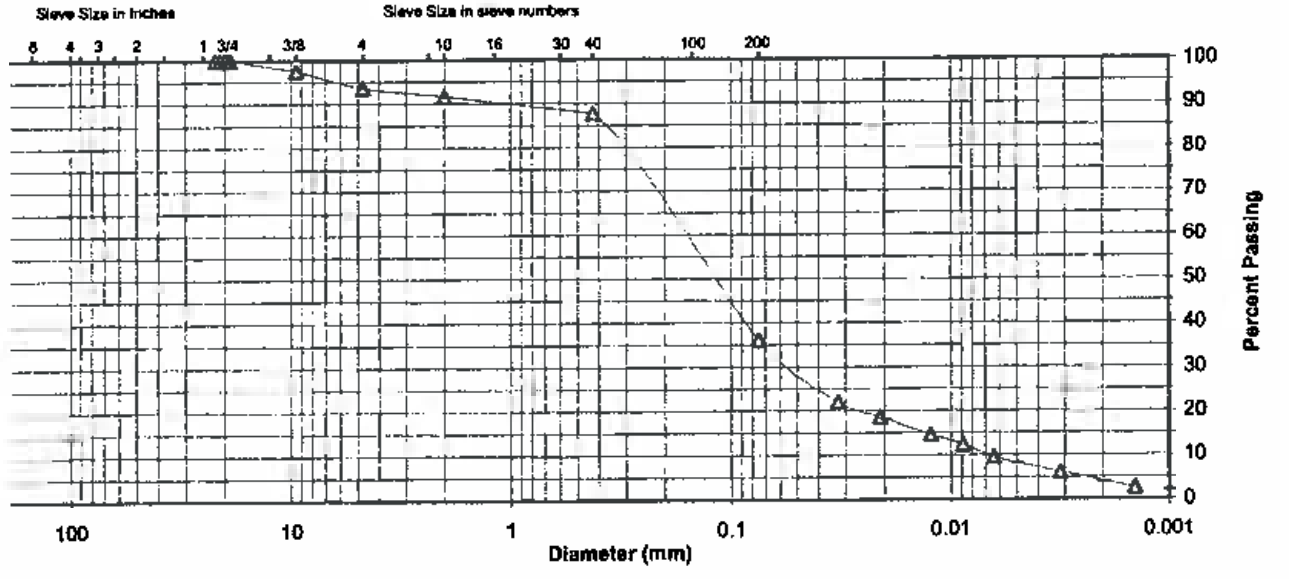
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	87.7
No. 200	36.2
0.02 mm	18.2
0.005 mm	8.2
0.002 mm	3.9
0.001 mm	2.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	6.4	1.9	4.0	51.5	28.0	8.2

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	8.3	4.0	51.5	32.3	3.9



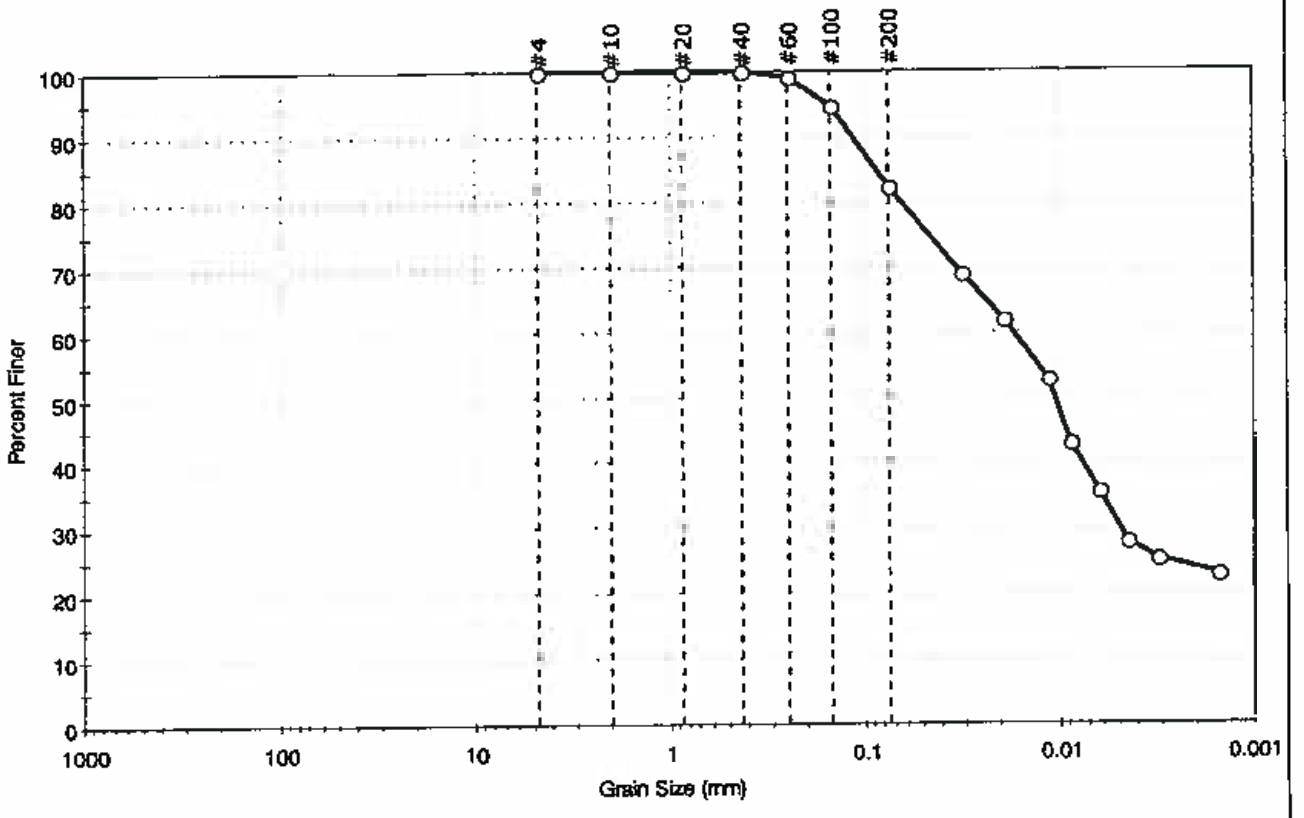
Comments

Reviewed By

GeoTesting express
a subsidiary of Geocomp Corporation

Client:	Stantec Consulting Services				
Project:	Kingston Ash Pond				
Location:	Roane, TN			Project No:	GTX-9015
Boring ID:	ST-15D	Sample Type:	tube	Tested By:	jbr
Sample ID:	ST-5	Test Date:	05/19/09	Checked By:	jdt
Depth :	--- 33.0' - 35.0'	Test Id:	152414		
Test Comment:	---				
Sample Description:	Moist, yellowish brown clay with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	17.6	82.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	99		
#100	0.15	95		
#200	0.075	82		
—	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0321	69		
---	0.0191	62		
---	0.0113	53		
---	0.0087	43		
---	0.0063	36		
---	0.0045	28		
---	0.0031	25		
---	0.0015	23		

Coefficients

D_{85} =0.0869 mm	D_{30} =0.0049 mm
D_{60} =0.0172 mm	D_{15} =N/A
D_{50} =0.0105 mm	D_{10} =N/A
C_u =N/A	C_c =N/A

Classification

ASTM lean clay with sand (CL)

AASHTO Clayey Soils (A-6 (8))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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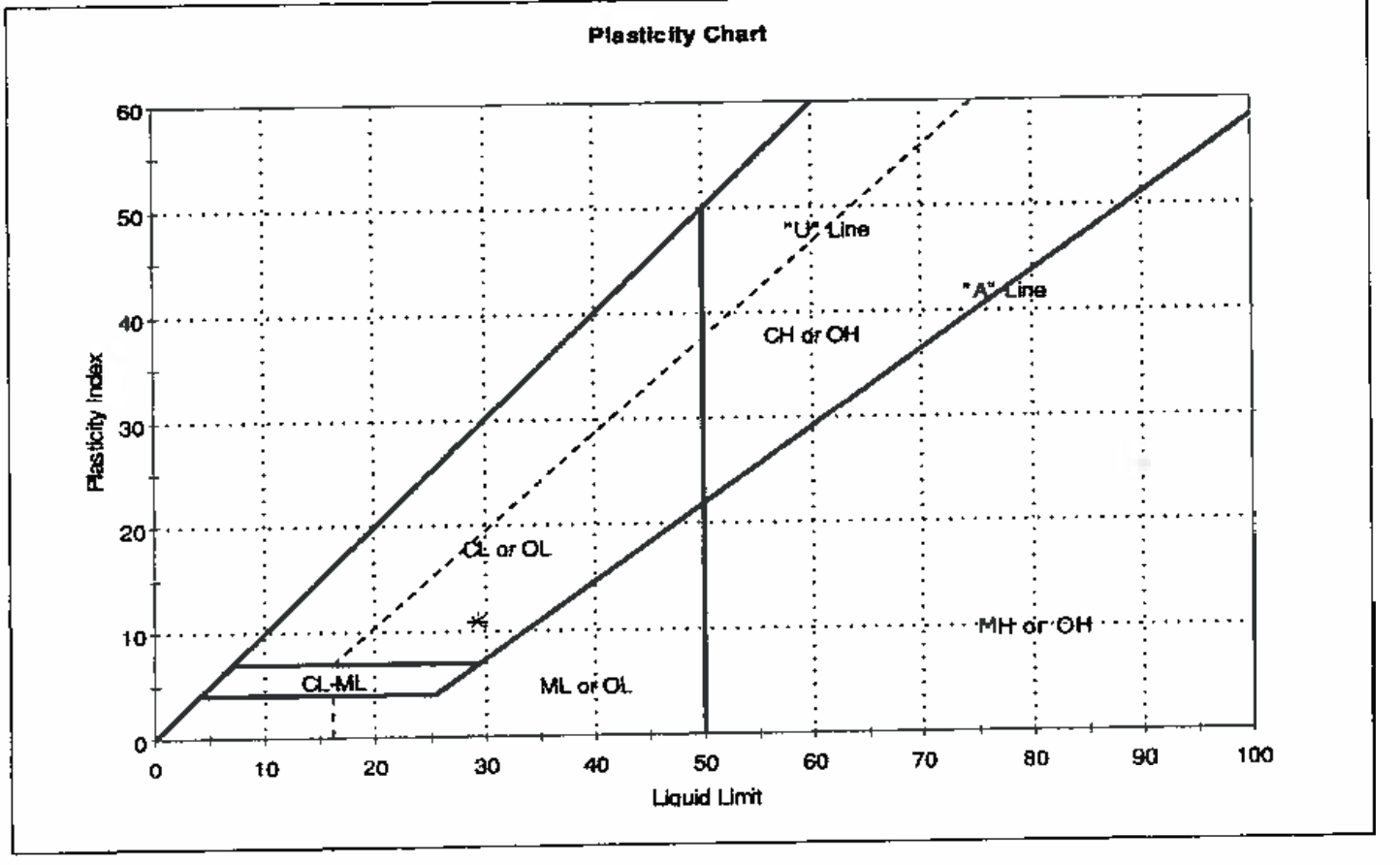
GeoTesting express
a subsidiary of Geocomp Corporation

Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond		
Location:	Roane, TN	Project No:	GTX-9015
Boring ID:	ST-15D	Sample Type: tube	Tested By: cam
Sample ID:	ST-5	Test Date: 05/18/09	Checked By: jdt
Depth :	--- 33.0' - 35.0'	Test Id: 152411	
Test Comment:	---		
Sample Description:	Moist, yellowish brown clay with sand		
Sample Comment:	---		

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	ST-5	ST-15D	33.0' - 35.0'	24	29	18	11	1	lean clay with sand (CL)

Sample Prepared using the WET method
0% Retained on #40 Sieve
Dry Strength: HIGH
Dilentancy: NONE
Toughness: LOW

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Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-16, 9.0'-10.5', 10.5'-12.0'
County: Kingston, Tennessee
Sample Type: SPT Comp

Project Number: 175569042
Lab ID: 241
Date Received: 5-26-09
Date Reported: 6-24-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	99.8
No. 4	4.75	99.4
No. 10	2	98.3
No. 40	0.425	94.0
No. 200	0.075	79.8
	0.02	68.9
	0.005	57.7
	0.002	51.8
estimated	0.001	47.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.6	1.7
Coarse Sand	1.1	4.3
Medium Sand	4.3	---
Fine Sand	14.2	14.2
Silt	22.1	28.0
Clay	57.7	51.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 65
Plastic Limit: 24
Plasticity Index: 41
Activity Index: 0.79

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.73

Classification

Unified Group Symbol: CH
Group Name: Fat clay with sand
AASHTO Classification: A-7-6 (35)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-16, 9.0'-10.5', 10.5'-12.0'

Project Number: 175569042
Lab ID: 241

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: TLK
Test Date: 06-05-2009
Date Received: 05-26-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	99.8
No. 4	99.4
No. 10	98.3

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.73

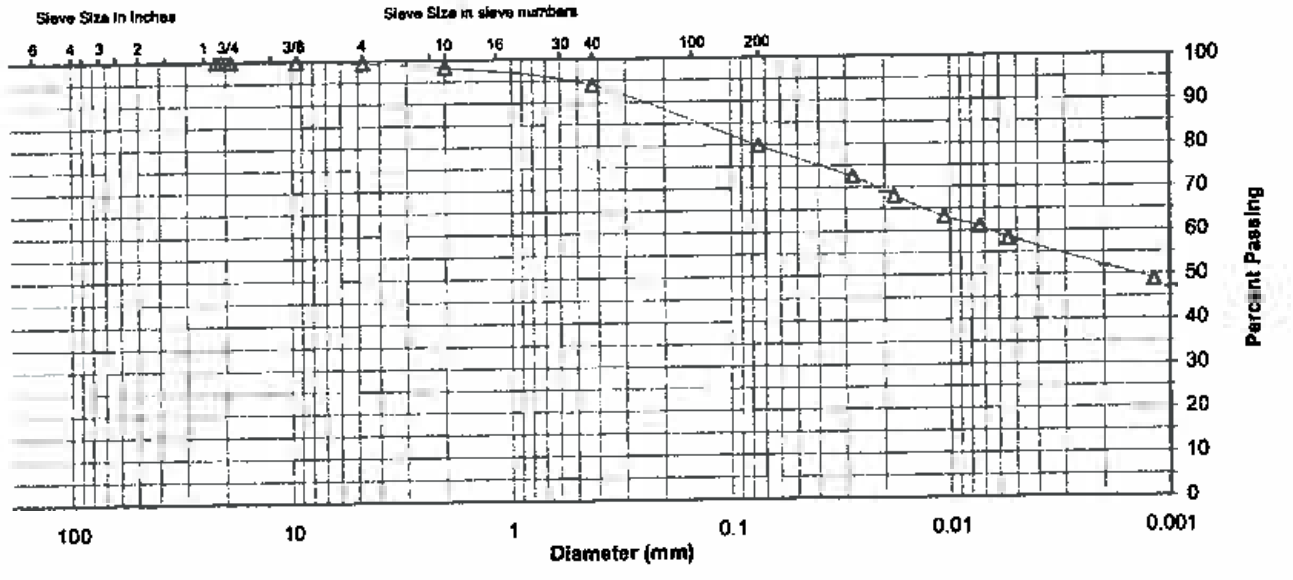
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	94.0
No. 200	79.8
0.02 mm	68.9
0.005 mm	57.7
0.002 mm	51.8
0.001 mm	47.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.6	1.1	4.3	14.2	22.1	57.7

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	1.7	4.3	14.2	28.0	51.8



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-16, 34.5'-36.0', 36.0'-37.5', 37.5'-39.0'
Project Number: 175569042
Lab ID: 259

County: Kingston, Tennessee
Sample Type: SPT Comp
Date Received: 5-26-09
Date Reported: 6-24-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	98.8
No. 200	0.075	46.4
	0.02	25.8
	0.005	15.7
	0.002	12.1
estimated	0.001	9.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.1
Coarse Sand	0.1	1.1
Medium Sand	1.1	—
Fine Sand	52.4	52.4
Silt	30.7	34.3
Clay	15.7	12.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 15
Plastic Limit: 15
Plasticity Index: 0
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-16, 34.5'-36.0', 36.0'-37.5', 37.5'-39.0'

Project Number: 175569042
Lab ID: 259

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: BWT
Test Date: 06-04-2009
Date Received: 05-26-2009

Maximum Particle size: 3/8" Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

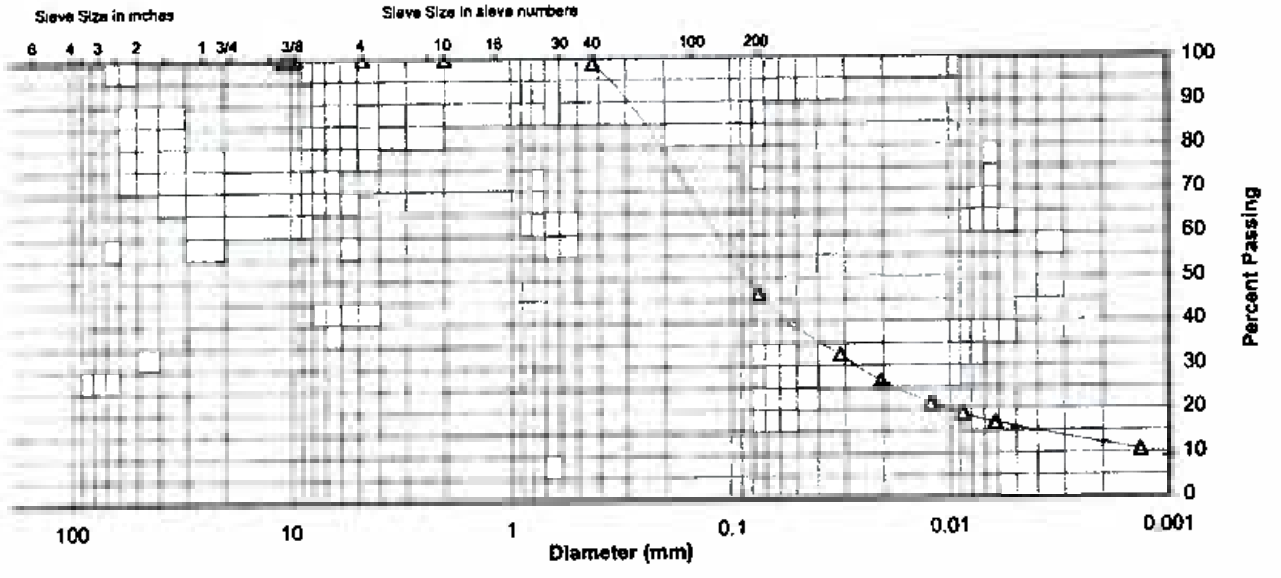
Specific Gravity: 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.8
No. 200	46.4
0.02 mm	25.8
0.005 mm	15.7
0.002 mm	12.1
0.001 mm	9.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.1	1.1	52.4	30.7	15.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.1			1.1	52.4	34.3	12.1



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-18, 36.5'-38.0', 38.0'-39.5'
Project Number: 171468117
Lab ID: 925

County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-23-09
Date Reported: 5-13-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	98.4
No. 4	4.75	98.1
No. 10	2	97.9
No. 40	0.425	92.1
No. 200	0.075	23.5
	0.02	11.0
	0.005	5.5
	0.002	3.6
estimated	0.001	3.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	1.9	2.1
Coarse Sand	0.2	5.8
Medium Sand	5.8	---
Fine Sand	68.6	68.6
Silt	18.0	19.9
Clay	5.5	3.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-18, 36.5'-38.0', 38.0'-39.5'

Project Number: 171468117
Lab ID: 925

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

Particle Shape: Rounded and Angular
Particle Hardness: Hard and Durable

Tested By: RHB
Test Date: 04-29-2009
Date Received: 04-23-2009

Maximum Particle size: 3/4" Sieve

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

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	98.4
No. 4	98.1
No. 10	97.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

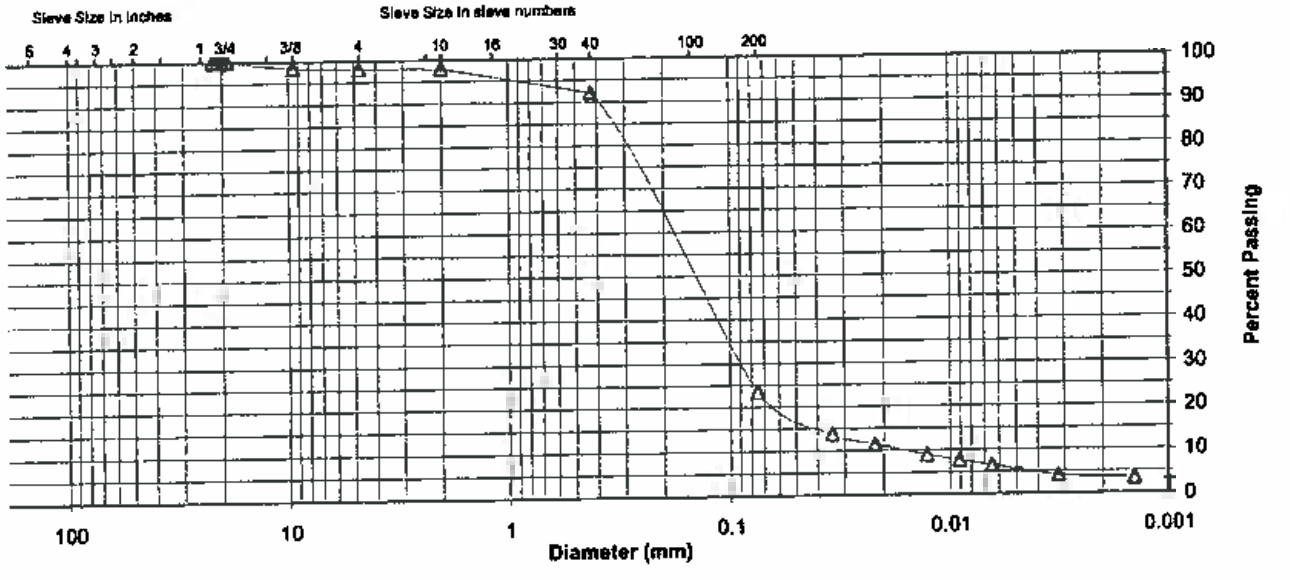
Specific Gravity: 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	92.1
No. 200	23.5
0.02 mm	11.0
0.005 mm	5.5
0.002 mm	3.6
0.001 mm	3.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	1.9	0.2	5.8	68.6	18.0	5.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	2.1			5.8	68.6	19.9	3.6



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-19 / SPT-17, 28.5'-30.0' & STN-19 / SPT-18, 30.0'-31.5'
Lab ID: 496
County: Roane (TN)
Date Received: 4-6-09
Sample Type: SPT Comp
Date Reported: 4-30-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	100.0
3/4"	19	95.5
3/8"	9.5	81.9
No. 4	4.75	78.3
No. 10	2	76.0
No. 40	0.425	74.4
No. 200	0.075	16.5
	0.02	6.7
	0.005	4.9
	0.002	3.8
estimated	0.001	3.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	21.7	24.0
Coarse Sand	2.3	1.6
Medium Sand	1.6	—
Fine Sand	57.9	57.9
Silt	11.6	12.7
Clay	4.9	3.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.65

Classification

Unified Group Symbol: SM
Group Name: Silty sand with gravel
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-19 / SPT-17, 28.5'-30.0' & STN-19 / SPT-18, 30.0'-31.5'

Project Number: 171468117
Lab ID: 496

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

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

Particle Shape: Rounded
Particle Hardness: Hard and Durable

Tested By: DRB
Test Date: 04-16-2009
Date Received: 04-06-2009

Maximum Particle size: 1" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	100.0
3/4"	95.5
3/8"	81.9
No. 4	78.3
No. 10	76.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.65

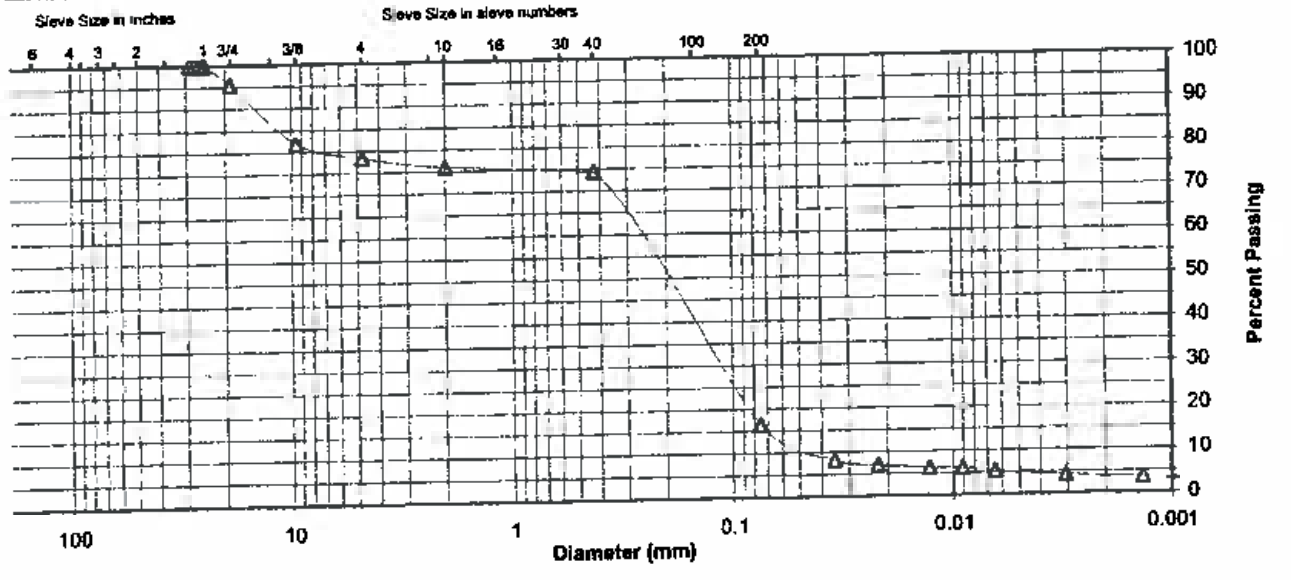
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	74.4
No. 200	16.5
0.02 mm	6.7
0.005 mm	4.9
0.002 mm	3.8
0.001 mm	3.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	4.5	17.2	2.3	1.6	57.9	11.6	4.9

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	24.0	1.6	57.9	12.7	3.8



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	175569042
Source	STN-19, 39.7'-40.2'	Lab ID	518
County	Kingston, Tennessee	Date Received	5-27-09
Sample Type	UD	Date Reported	6-30-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216

Moisture Content (%): 22.0

Particle Size Analysis

Preparation Method: ASTM D 421

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	100.0
No. 40	0.425	99.7
No. 200	0.075	58.7
	0.02	34.4
	0.005	22.0
	0.002	17.4
estimated	0.001	14.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.3
Medium Sand	0.3	—
Fine Sand	41.0	41.0
Silt	36.7	41.3
Clay	22.0	17.4

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Dry

Liquid Limit: 23

Plastic Limit: 17

Plasticity Index: 6

Activity Index: 0.35

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A

Maximum Dry Density (kg/m^3): N/A

Optimum Moisture Content (%): N/A

Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A

Compacted Dry Density (lb/ft^3): N/A

Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854

Prepared: Dry

Particle Size: No. 10

Specific Gravity at 20° Celsius: 2.69

Classification

Unified Group Symbol: CL-ML

Group Name: Sandy silty clay

AASHTO Classification: A-4 (1)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-19, 39.7'-40.2'

Project Number: 175569042
Lab ID: 518

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: BWT
Test Date: 06-09-2009
Date Received: 05-27-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.69

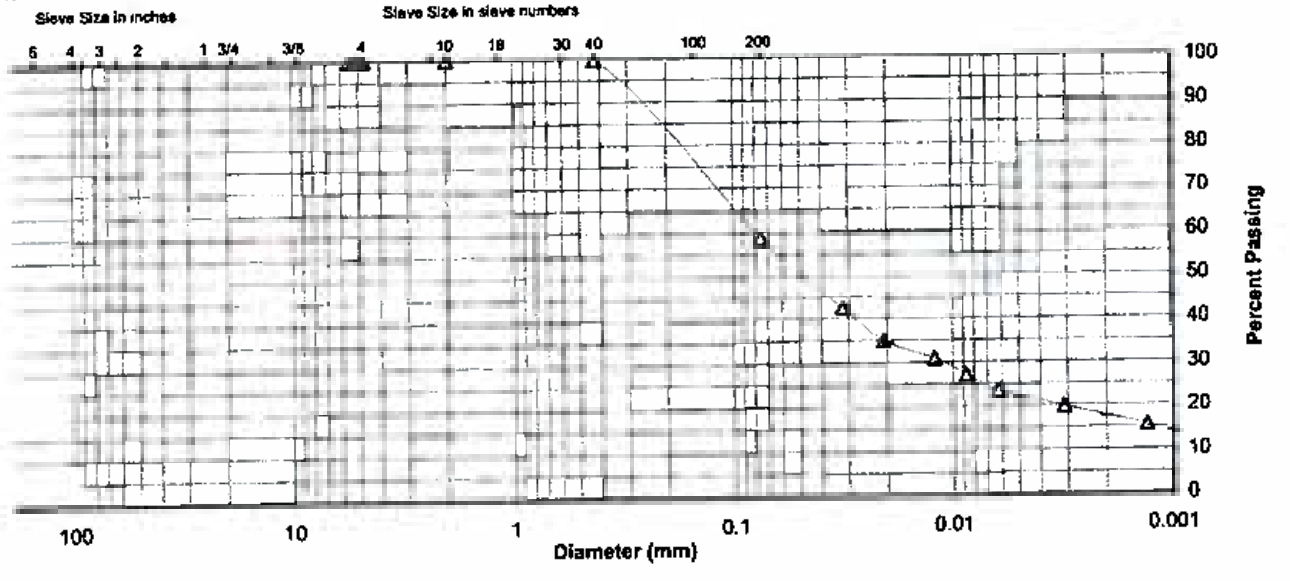
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.7
No. 200	58.7
0.02 mm	34.4
0.005 mm	22.0
0.002 mm	17.4
0.001 mm	14.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.3	41.0	38.7	22.0

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.3	41.0	41.3	17.4



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-19 / SPT-27, 45.5'-47.0' & STN-19 / SPT-28, 47.0'-48.5'
Lab ID: 507
County: Roane (TN)
Date Received: 4-6-09
Sample Type: SPT Comp
Date Reported: 5-1-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.5
No. 200	0.075	39.6
	0.02	19.8
	0.005	12.9
	0.002	9.6
estimated	0.001	9.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.5
Medium Sand	0.5	—
Fine Sand	59.9	59.9
Silt	26.7	30.0
Clay	12.9	9.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.65

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-19 / SPT-27, 45.5'-47.0' & STN-19 / SPT-28, 47.0'-48.5'

Project Number: 171468117
Lab ID: 507

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: DRB
Test Date: 04-16-2009
Date Received: 04-06-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.65

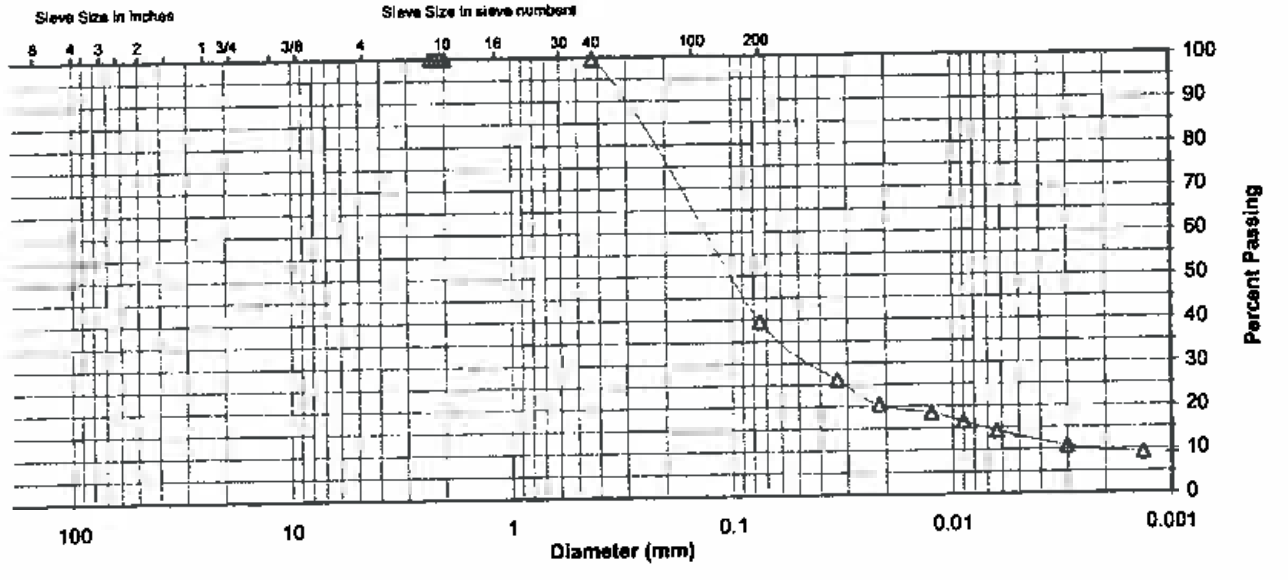
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.5
No. 200	39.6
0.02 mm	19.8
0.005 mm	12.9
0.002 mm	9.6
0.001 mm	9.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.5	59.9	26.7	12.9

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.5	59.9	30.0	9.6



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-19 / SPT-37, 60.5'-62.0' & STN-19 / SPT-38, 62.0'-63.5'
Lab ID: 520

County: Roane (TN)
Date Received: 4-6-09
Sample Type: SPT Comp
Date Reported: 5-1-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	100.0
1"	25	89.4
3/4"	19	81.4
3/8"	9.5	69.7
No. 4	4.75	63.9
No. 10	2	58.1
No. 40	0.425	50.2
No. 200	0.075	14.1
	0.02	7.9
	0.005	4.8
	0.002	3.7
estimated	0.001	3.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	36.1	41.9
Coarse Sand	5.8	7.9
Medium Sand	7.9	—
Fine Sand	36.1	36.1
Silt	9.3	10.4
Clay	4.8	3.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: SM
Group Name: Silty sand with gravel

AASHTO Classification: A-1-b (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-19 / SPT-37, 60.5'-62.0' & STN-19 / SPT-38, 62.0'-63.5'

Project Number: 171468117
Lab ID: 520

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

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

Particle Shape: Rounded
Particle Hardness: Hard and Durable

Tested By: DRB
Test Date: 04-16-2009
Date Received: 04-06-2009

Maximum Particle size: 1 1/2" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	100.0
1"	89.4
3/4"	81.4
3/8"	69.7
No. 4	63.9
No. 10	58.1

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

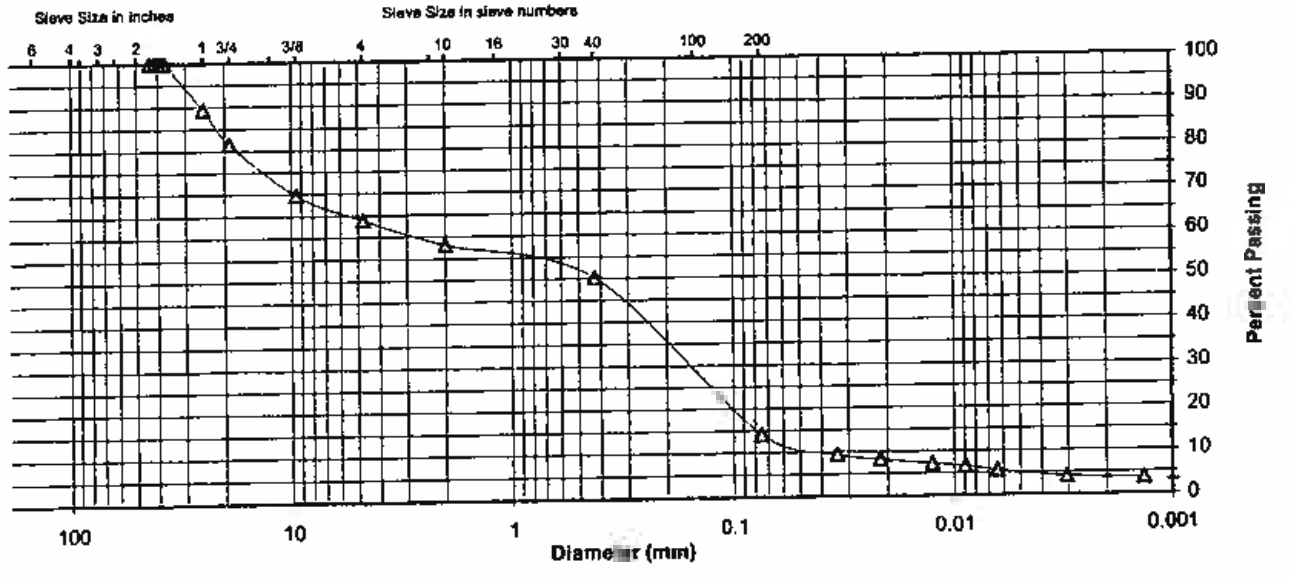
Specific Gravity: 2.66

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	50.2
No. 200	14.1
0.02 mm	7.9
0.005 mm	4.8
0.002 mm	3.7
0.001 mm	3.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	18.6	17.5	5.8	7.9	36.1	9.3	4.8
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	41.9			7.9	36.1	10.4	3.7



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-20 / SPT-6, 7.5'-9.0' & STN-20 / SPT-7, 9.0'-10.5'
Project Number: 171468117
Lab ID: 103
County: Roane (TN)
Sample Type: SPT Comp
Date Received: 3-24-09
Date Reported: 4-22-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	100.0
1"	25	94.9
3/4"	19	94.1
3/8"	9.5	87.3
No. 4	4.75	81.1
No. 10	2	73.1
No. 40	0.425	55.7
No. 200	0.075	31.5
	0.02	12.0
	0.005	3.4
	0.002	0.5
estimated	0.001	0.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	18.9	26.9
Coarse Sand	8.0	17.4
Medium Sand	17.4	—
Fine Sand	24.2	24.2
Silt	28.1	31.0
Clay	3.4	0.5

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.32

Classification

Unified Group Symbol: SM
Group Name: Silty sand with gravel
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-20 / SPT-6, 7.5'-9.0' & STN-20 / SPT-7, 9.0'-10.5'

Project Number: 171468117
Lab ID: 103

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: BWT
Test Date: 04-09-2009
Date Received: 03-24-2009

Maximum Particle size: 1 1/2" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	100.0
1"	94.9
3/4"	94.1
3/8"	87.3
No. 4	81.1
No. 10	73.1

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

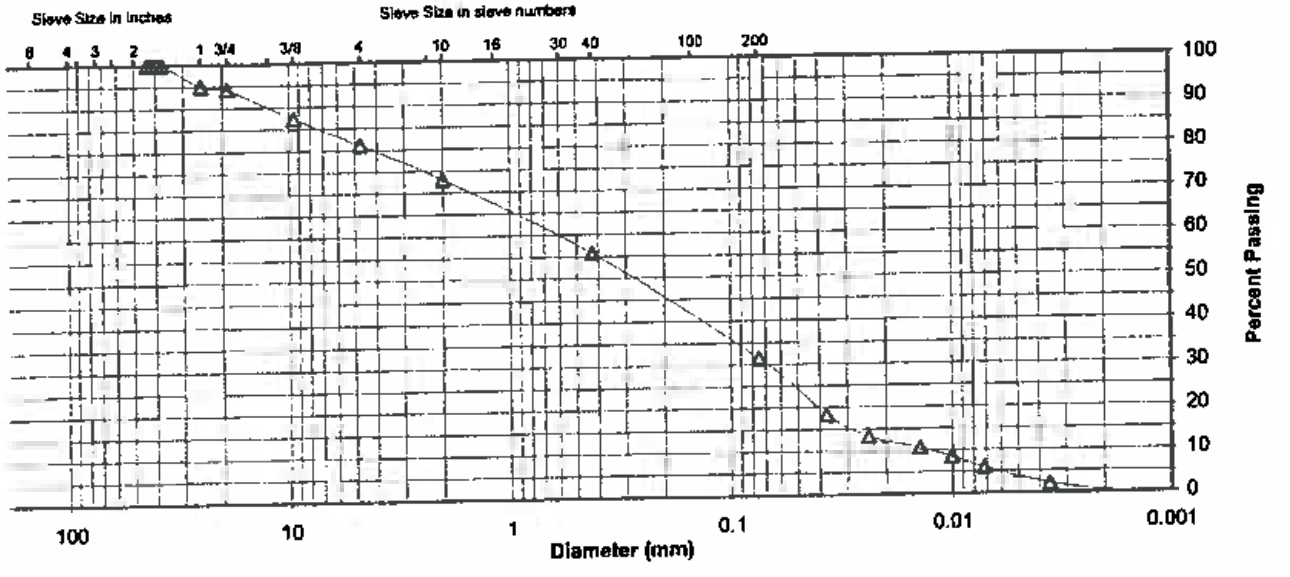
Specific Gravity: 2.32

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	55.7
No. 200	31.5
0.02 mm	12.0
0.005 mm	3.4
0.002 mm	0.5
0.001 mm	0.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	5.9	13.0	8.0	17.4	24.2	25.1	3.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	26.9			17.4	24.2	31.0	0.5



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-20 / SPT-12, 16.5'-18.0' & STN-20 / SPT-13, 18.0'-19.5'
Lab ID: 111
County: Roane (TN)
Date Received: 3-24-09
Sample Type: SPT Comp
Date Reported: 4-22-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	100.0
1"	25	93.4
3/4"	19	93.4
3/8"	9.5	93.4
No. 4	4.75	92.9
No. 10	2	92.5
No. 40	0.425	91.8
No. 200	0.075	85.7
	0.02	50.6
	0.005	9.5
	0.002	0.0
estimated	0.001	0.0

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

Range	ASTM (%)	AASHTO (%)
Gravel	7.1	7.5
Coarse Sand	0.4	0.7
Medium Sand	0.7	---
Fine Sand	6.1	6.1
Silt	76.2	85.7
Clay	9.5	0.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.25

Classification

Unified Group Symbol: ML
Group Name: Silt
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-20 / SPT-12, 16.5'-18.0' & STN-20 / SPT-13, 18.0'-19.5'

Project Number: 171468117
Lab ID: 111

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: BWT
Test Date: 04-09-2009
Date Received: 03-24-2009

Maximum Particle size: 1 1/2" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	100.0
1"	93.4
3/4"	93.4
3/8"	93.4
No. 4	92.9
No. 10	92.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.25

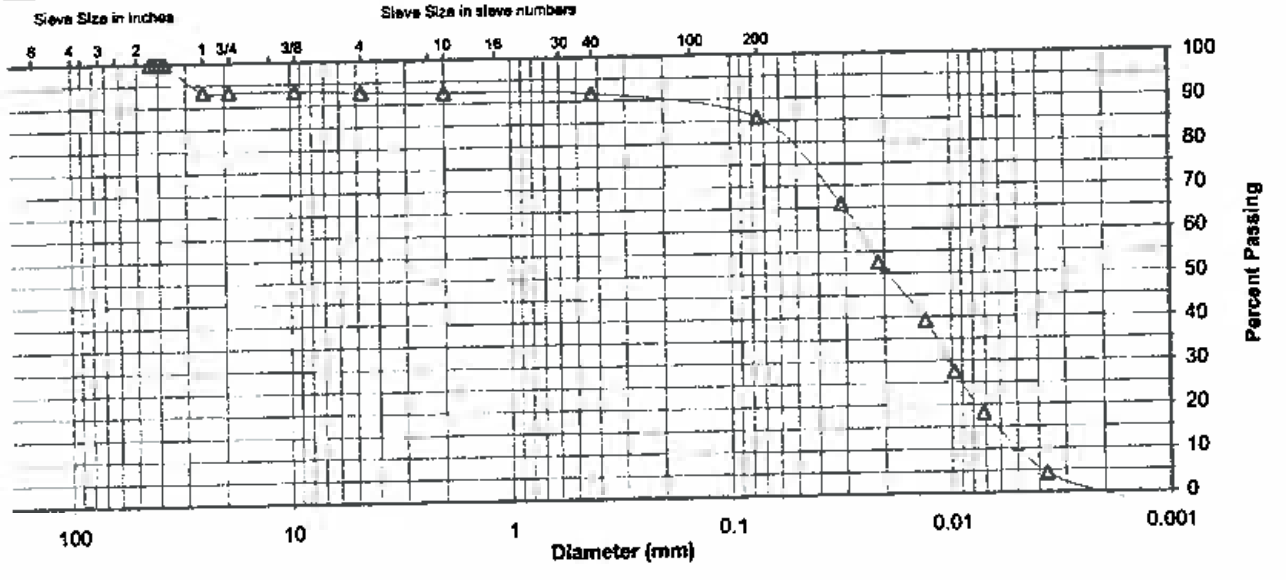
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	91.8
No. 200	85.7
0.02 mm	50.6
0.005 mm	9.5
0.002 mm	0.0
0.001 mm	0.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	6.8	0.5	0.4	0.7	6.1	76.2	9.5

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	7.5	0.7	6.1	85.7	0.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-20 / SPT-22, 31.5'-33.0' & STN-20 / SPT-23, 33.0'-34.5'
Project Number: 171468117
Lab ID: 122
County: Roane (TN)
Sample Type: SPT Comp
Date Received: 3-24-09
Date Reported: 4-22-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	100.0
No. 40	0.425	99.9
No. 200	0.075	56.4
	0.02	29.9
	0.005	18.5
	0.002	13.6
estimated	0.001	11.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.1
Medium Sand	0.1	---
Fine Sand	43.5	43.5
Silt	37.9	42.8
Clay	18.5	13.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 19
Plastic Limit: 16
Plasticity Index: 3
Activity Index: 0.21

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.68

Classification

Unified Group Symbol: ML
Group Name: Sandy silt
AASHTO Classification: A-4 (0)

Comments:

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-20 / SPT-22, 31.5'-33.0' & STN-20 / SPT-23, 33.0'-34.5'

Project Number: 171468117
Lab ID: 122

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: BWT
Test Date: 04-09-2009
Date Received: 03-24-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.68

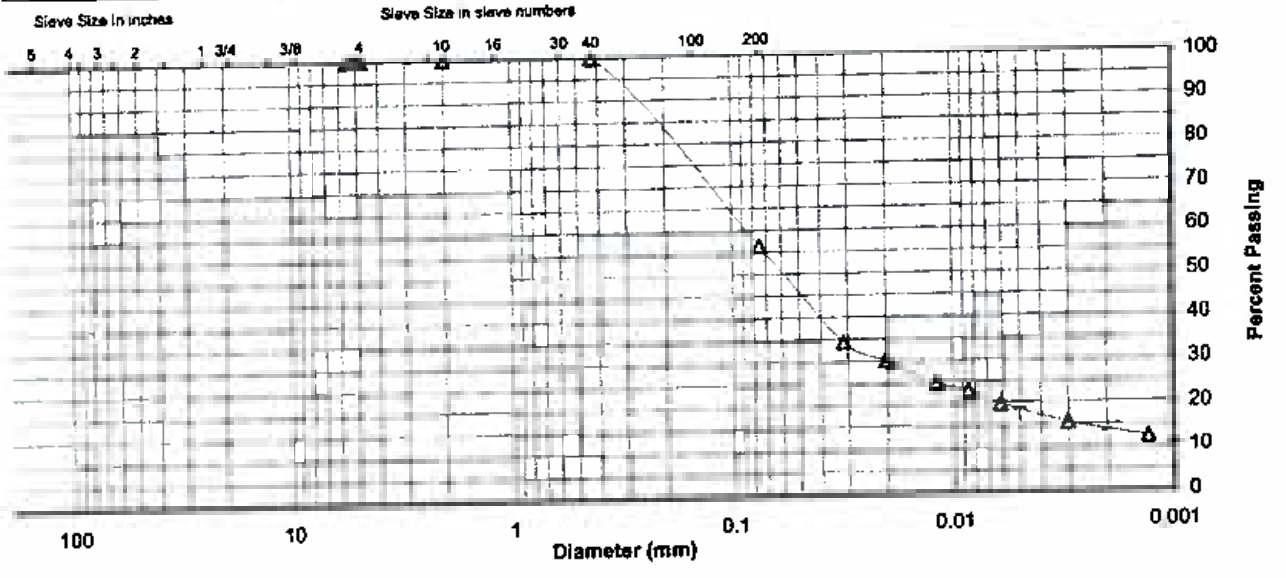
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.9
No. 200	56.4
0.02 mm	29.9
0.005 mm	18.5
0.002 mm	13.6
0.001 mm	11.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.1	43.5	37.9	18.5

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.1	43.5	42.8	13.6



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-20 / ST-1, 35.0'-35.5'
Project Number: 171468117
Lab ID: 185A
County: Roane (TN)
Sample Type: ST
Date Received: 3-24-09
Date Reported: 5-20-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 22.5

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	99.8
No. 4	4.75	99.8
No. 10	2	99.8
No. 40	0.425	99.6
No. 200	0.075	71.7
	0.02	51.6
	0.005	31.1
	0.002	25.4
estimated	0.001	21.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.2	0.2
Coarse Sand	0.0	0.2
Medium Sand	0.2	—
Fine Sand	27.9	27.9
Silt	40.6	46.3
Clay	31.1	25.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 28
Plastic Limit: 17
Plasticity Index: 11
Activity Index: 0.44

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.69

Classification

Unified Group Symbol: CL
Group Name: Lean clay with sand
AASHTO Classification: A-6 (6)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-20 / ST-1, 35.0'-35.5'

Project Number: 171468117
Lab ID: 185A

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: DG
Test Date: 04-22-2009
Date Received: 03-24-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	99.8
No. 4	99.8
No. 10	99.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.69

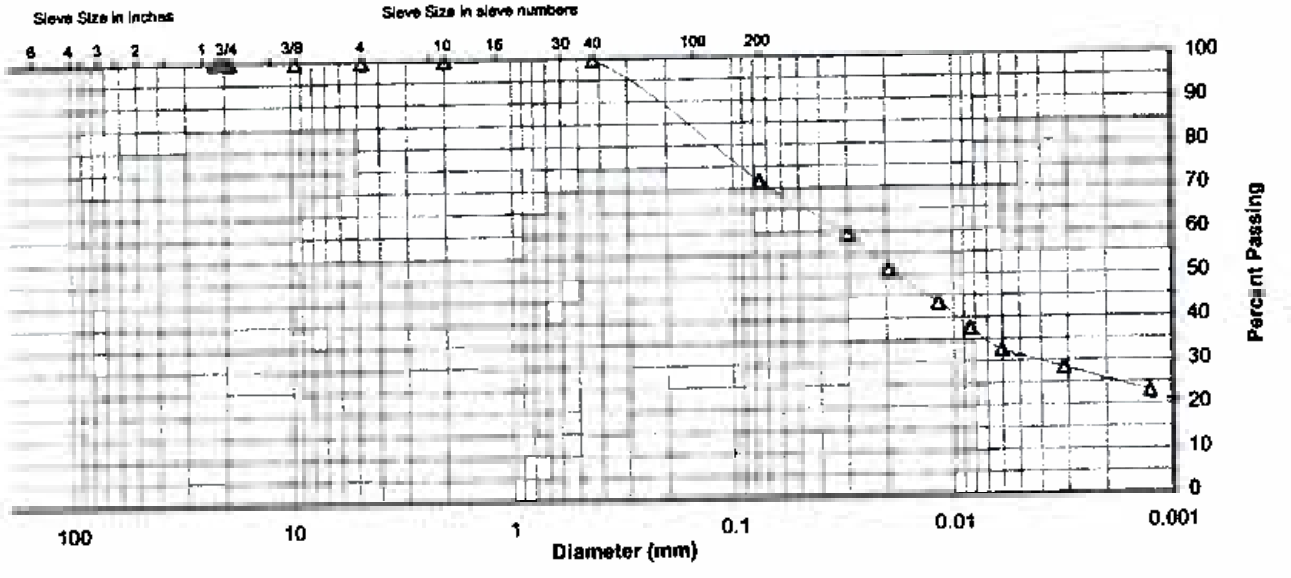
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.6
No. 200	71.7
0.02 mm	51.6
0.005 mm	31.1
0.002 mm	25.4
0.001 mm	21.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.2	0.0	0.2	27.9	40.6	31.1

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.2	0.2	27.9	46.3	25.4



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-20 / SPT-32, 51.0'-52.5' & STN-20 / SPT-33, 52.5'-54.0'
Project Number: 171468117
Lab ID: 134
County: Roane (TN)
Sample Type: SPT Comp
Date Received: 3-24-09
Date Reported: 4-22-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	98.7
No. 200	0.075	23.8
	0.02	10.0
	0.005	6.6
	0.002	5.0
estimated	0.001	3.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	1.3
Medium Sand	1.3	—
Fine Sand	74.9	74.9
Silt	17.2	18.8
Clay	6.6	5.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-20 / SPT-32, 51.0'-52.5' & STN-20 / SPT-33, 52.5'-54.0'

Project Number: 171468117
Lab ID: 134

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 04-09-2008
Date Received: 03-24-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

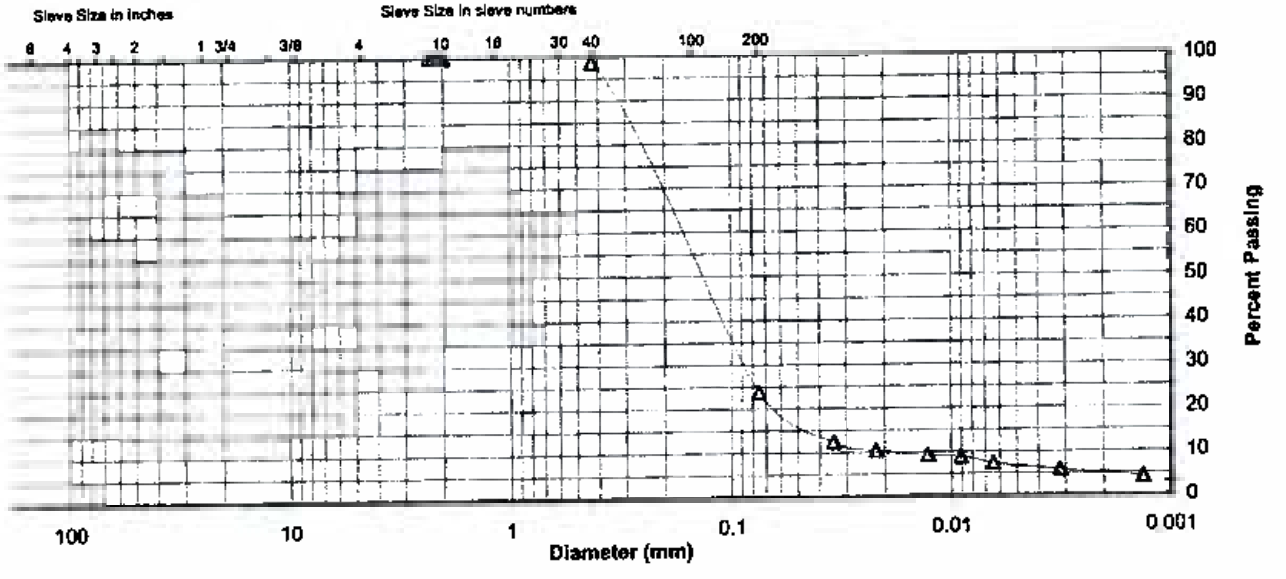
Specific Gravity: 2.66

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.7
No. 200	23.8
0.02 mm	10.0
0.005 mm	6.6
0.002 mm	5.0
0.001 mm	3.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	1.3	74.9	17.2	6.6
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			1.3	74.9	18.8	5.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-21, 39.5'-41.0', 41.0'-42.5'
Project Number: 171468117
Lab ID: 1659
County: Roane (TN)
Sample Type: SPT Comp
Date Received: 5-8-09
Date Reported: 6-5-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	98.9
No. 200	0.075	33.9
	0.02	19.7
	0.005	12.1
	0.002	9.4
estimated	0.001	7.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	1.1
Medium Sand	1.1	—
Fine Sand	65.0	65.0
Silt	21.8	24.5
Clay	12.1	9.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-21, 39.5'-41.0', 41.0'-42.5'

Project Number: 171468117
Lab ID: 1659

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: CM
Test Date: 05-19-2009
Date Received: 05-08-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.67

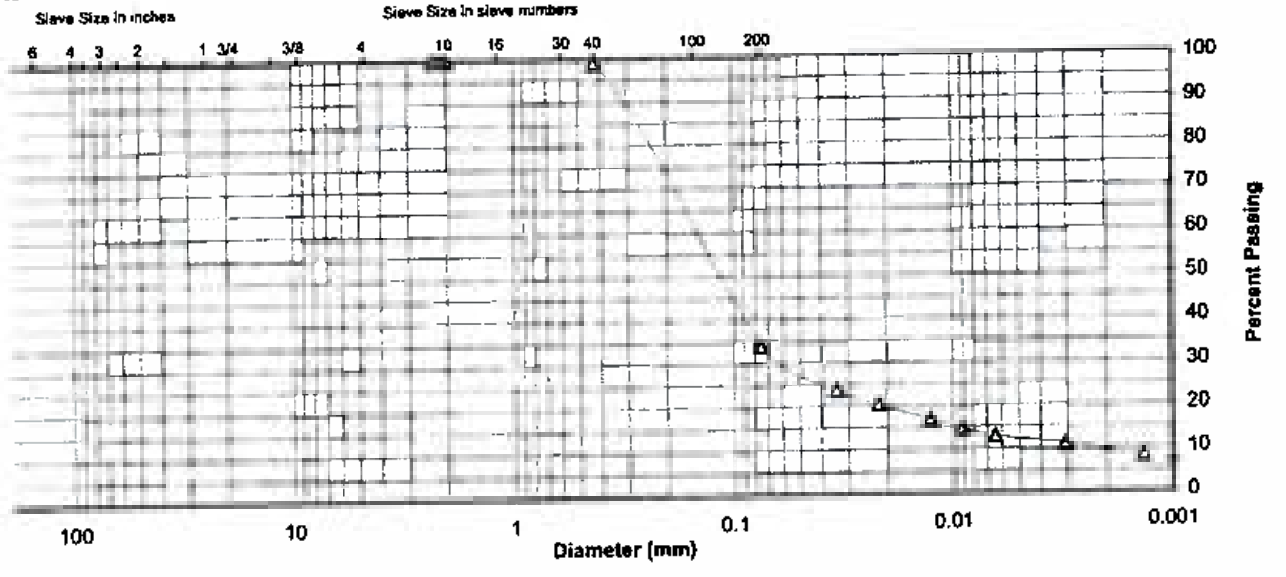
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.9
No. 200	33.9
0.02 mm	19.7
0.005 mm	12.1
0.002 mm	9.4
0.001 mm	7.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	1.1	65.0	21.8	12.1

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	1.1	65.0	24.5	9.4



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-22, 51.5'-53.0', 53.0'-54.5'
Project Number: 171468117
Lab ID: 1704

County: Roane (TN)
Sample Type: SPT Comp
Date Received: 5-8-09
Date Reported: 6-5-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.9
No. 10	2	99.9
No. 40	0.425	99.2
No. 200	0.075	29.9
	0.02	18.0
	0.005	10.6
	0.002	7.9
estimated	0.001	7.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.1	0.1
Coarse Sand	0.0	0.7
Medium Sand	0.7	---
Fine Sand	69.3	69.3
Silt	19.3	22.0
Clay	10.6	7.9

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.64

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-22, 51.5'-53.0', 53.0'-54.5'

Project Number: 171468117
Lab ID: 1704

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: BWT
Test Date: 05-20-2009
Date Received: 05-08-2009

Maximum Particle size: 3/8" Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

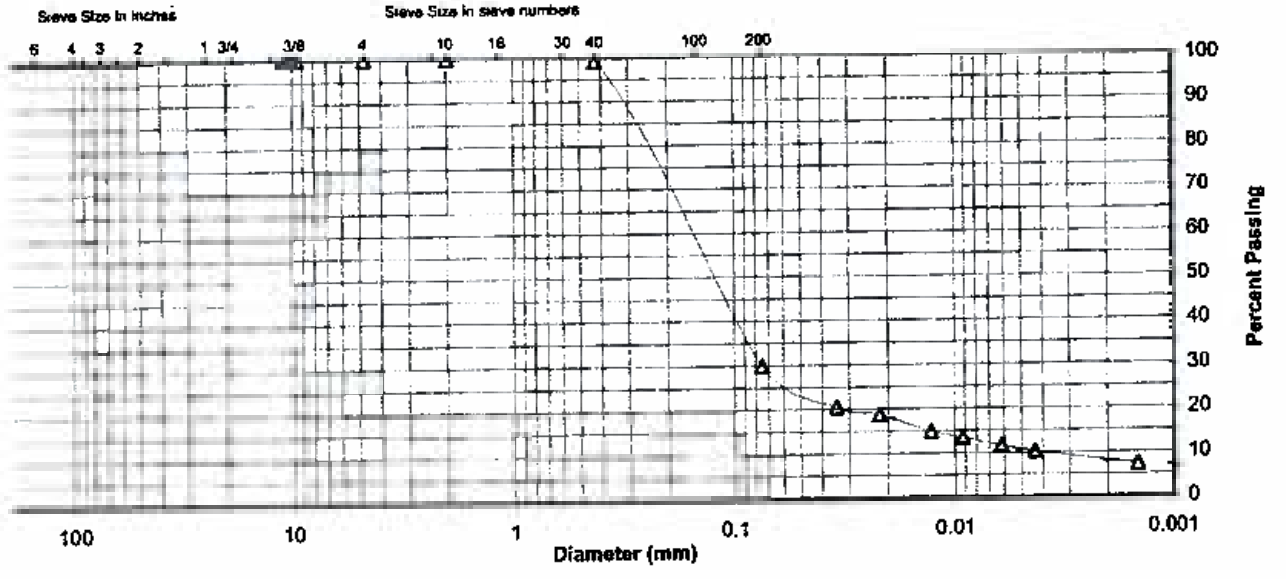
Specific Gravity: 2.64

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.2
No. 200	29.9
0.02 mm	18.0
0.005 mm	10.6
0.002 mm	7.9
0.001 mm	7.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.1	0.0	0.7	69.3	19.3	10.6
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.1			0.7	69.3	22.0	7.9



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-23, 9.0'-10.5', 10.5'-12.0', 12.0'-13.5'
Project Number: 175569042
Lab ID: 281
County: Kingston, Tennessee
Sample Type: SPT Comp
Date Received: 5-26-09
Date Reported: 6-24-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	100.0
1"	25	94.6
3/4"	19	94.6
3/8"	9.5	93.7
No. 4	4.75	93.0
No. 10	2	91.1
No. 40	0.425	86.2
No. 200	0.075	72.5
	0.02	60.9
	0.005	48.8
	0.002	43.6
estimated	0.001	41.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	7.0	8.9
Coarse Sand	1.9	4.9
Medium Sand	4.9	—
Fine Sand	13.7	13.7
Silt	23.7	28.9
Clay	48.8	43.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 47
Plastic Limit: 19
Plasticity Index: 28
Activity Index: 0.64

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.74

Classification

Unified Group Symbol: CL
Group Name: Lean clay with sand
AASHTO Classification: A-7-6 (19)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-23, 9.0'-10.5', 10.5'-12.0', 12.0'-13.5'

Project Number: 175569042
Lab ID: 281

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: BWT
Test Date: 06-05-2009
Date Received: 05-26-2009

Maximum Particle size: 1 1/2" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	100.0
1"	94.6
3/4"	94.6
3/8"	93.7
No. 4	93.0
No. 10	91.1

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

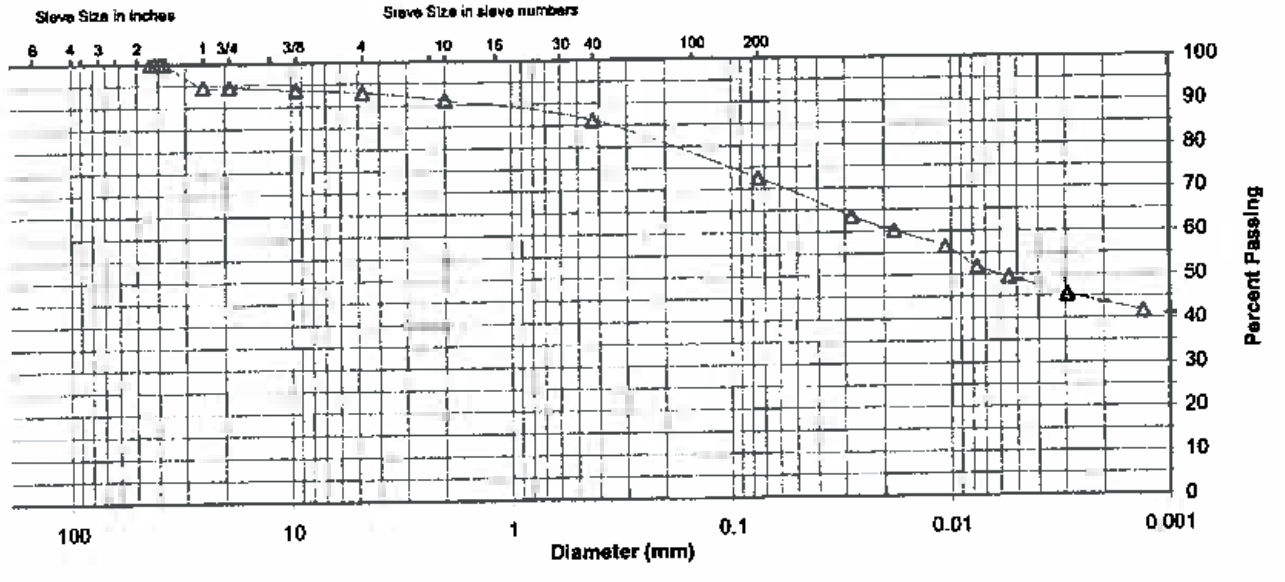
Specific Gravity: 2.74

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	86.2
No. 200	72.5
0.02 mm	60.9
0.005 mm	48.8
0.002 mm	43.6
0.001 mm	41.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	5.4	1.6	1.9	4.9	13.7	23.7	48.8
AASHTO	Gravel 8.9			Coarse Sand 4.9	Fine Sand 13.7	Silt 28.9	Clay 43.6



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-23, 48.5'-50.0', 50.0'-51.5'
County: Kingston, Tennessee
Sample Type: SPT Comp

Project Number: 175569042
Lab ID: 307
Date Received: 5-26-09
Date Reported: 6-24-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.9
No. 200	0.075	54.3
	0.02	27.0
	0.005	14.1
	0.002	9.8
estimated	0.001	8.0

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

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.1
Medium Sand	0.1	—
Fine Sand	45.6	45.6
Silt	40.2	44.5
Clay	14.1	9.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 16
Plastic Limit: 17
Plasticity Index: -1
Activity Index: -0.10

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: ML
Group Name: Sandy silt
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-23, 48.5'-50.0', 50.0'-51.5'

Project Number: 175569042
Lab ID: 307

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 06-05-2009
Date Received: 05-26-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.67

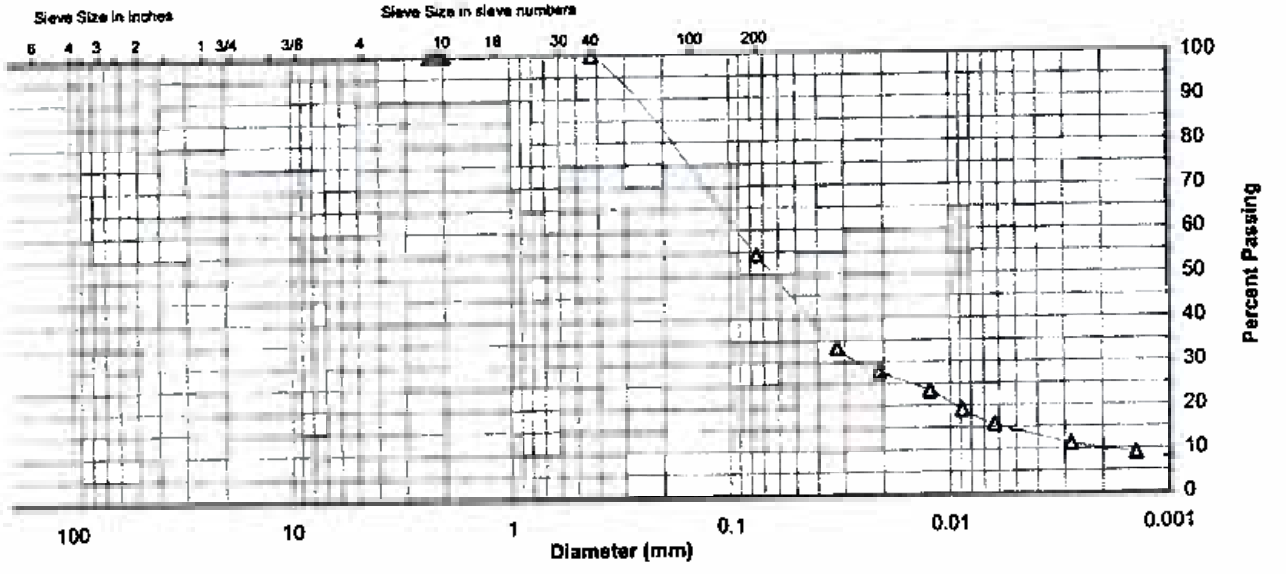
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.9
No. 200	54.3
0.02 mm	27.0
0.005 mm	14.1
0.002 mm	9.8
0.001 mm	8.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.1	45.8	40.2	14.1

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.1	45.8	44.5	9.8



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-24, 43.5'-45.0', 45.0'-46.5'
County: Kingston, Tennessee
Sample Type: SPT Comp

Project Number: 175569042
Lab ID: 346
Date Received: 5-26-09
Date Reported: 6-24-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.6
No. 200	0.075	39.4
	0.02	19.9
	0.005	12.1
	0.002	9.2
estimated	0.001	8.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.4
Medium Sand	0.4	---
Fine Sand	60.2	60.2
Silt	27.3	30.2
Clay	12.1	9.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-24, 43.5'-45.0', 45.0'-46.5'

Project Number: 175569042
Lab ID: 346

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 06-08-2009
Date Received: 05-26-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

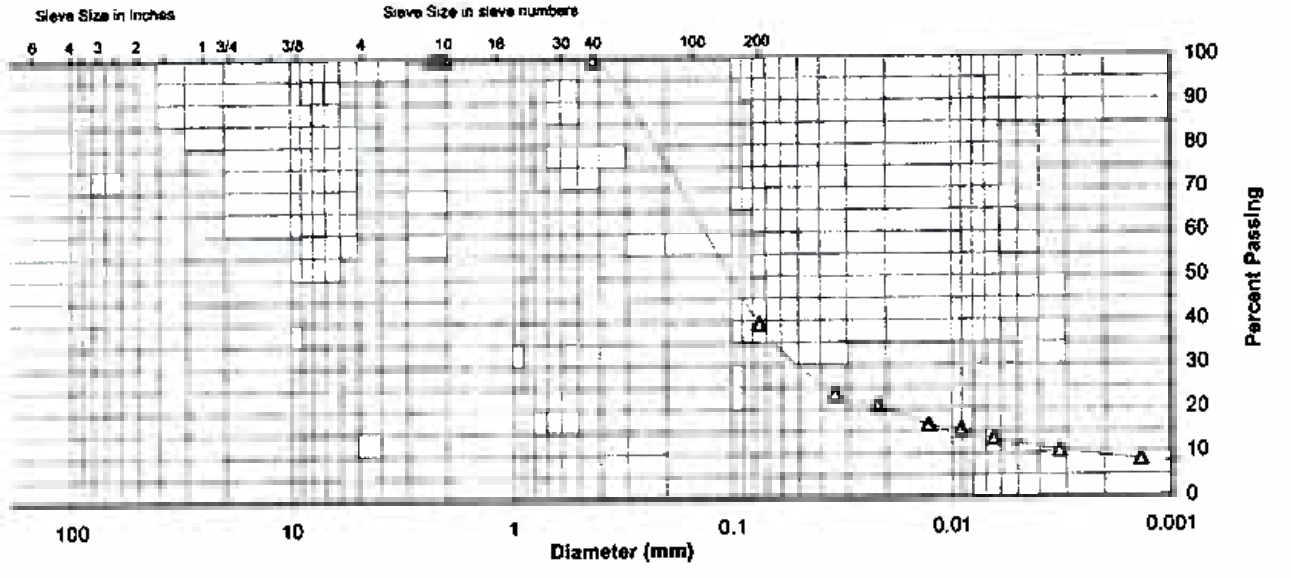
Specific Gravity: 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.6
No. 200	39.4
0.02 mm	19.9
0.005 mm	12.1
0.002 mm	9.2
0.001 mm	8.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.4	60.2	27.3	12.1
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.4	60.2	30.2	9.2



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-26 /SPT-9, 14.0'-15.5' & STN-26 /SPT-10, 15.5'-17.0' & STN-26 /SPT-11, 17.0'-18.5'
Lab ID: 199

County: Roane (TN)
Date Received: 3-30-09
Sample Type: SPT Comp
Date Reported: 4-30-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.6
No. 10	2	98.9
No. 40	0.425	97.6
No. 200	0.075	56.3
	0.02	31.2
	0.005	25.6
	0.002	21.8
estimated	0.001	17.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.4	1.1
Coarse Sand	0.7	1.3
Medium Sand	1.3	—
Fine Sand	41.3	41.3
Silt	30.7	34.5
Clay	25.6	21.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 26
Plastic Limit: 16
Plasticity Index: 10
Activity Index: 0.45

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.68

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay

AASHTO Classification: A-4 (3)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-26 /SPT-9, 14.0'-15.5' & STN-26 /SPT-10, 15.5'-17.0' & STN-26 /SPT-11, 17.0'-18.5'

Project Number: 171468117
Lab ID: 199

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

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

Particle Shape: Rounded
Particle Hardness: Weathered and Friable

Tested By: DRB
Test Date: 04-16-2009
Date Received: 03-30-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.6
No. 10	98.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

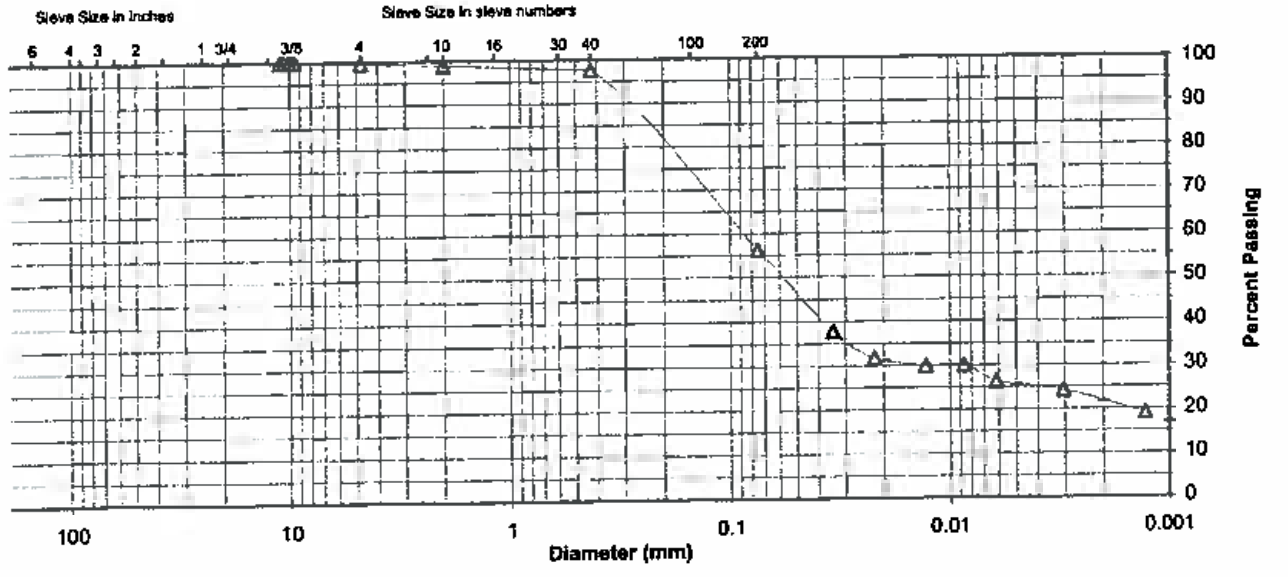
Specific Gravity: 2.68

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	97.6
No. 200	56.3
0.02 mm	31.2
0.005 mm	25.6
0.002 mm	21.8
0.001 mm	17.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.4	0.7	1.3	41.3	30.7	25.6
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	1.1			1.3	41.3	34.5	21.6



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-26 / SPT-16, 26.5'-28.0' & STN-26 / SPT-17, 28.0'-29.5'
Lab ID: 208
County: Roane (TN)
Date Received: 3-30-09
Sample Type: SPT Comp
Date Reported: 4-30-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.8
No. 200	0.075	49.6
	0.02	24.2
	0.005	16.3
	0.002	12.7
estimated	0.001	9.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.2
Medium Sand	0.2	—
Fine Sand	50.2	50.2
Silt	33.3	36.9
Clay	16.3	12.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 20
Plastic Limit: 18
Plasticity Index: 2
Activity Index: 0.15

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-26 / SPT-16, 26.5'-28.0' & STN-26 / SPT-17, 28.0'-29.5'

Project Number: 171468117
Lab ID: 208

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: DRB
Test Date: 04-16-2009
Date Received: 03-30-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

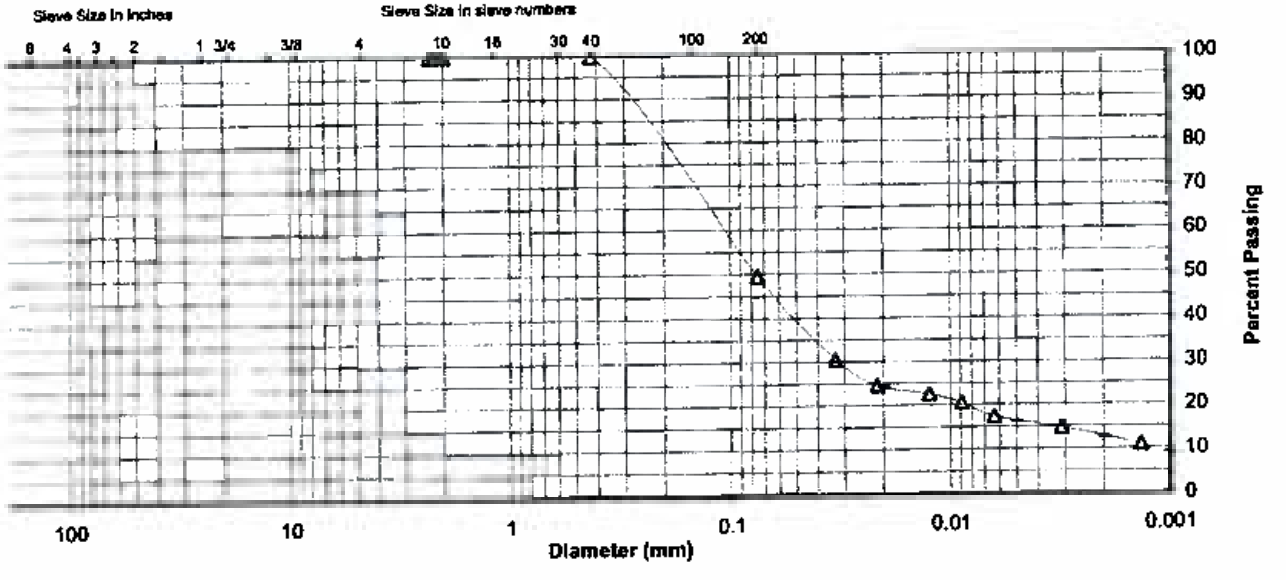
Specific Gravity: 2.66

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.8
No. 200	49.6
0.02 mm	24.2
0.005 mm	16.3
0.002 mm	12.7
0.001 mm	9.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.2	50.2	33.3	16.3
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.2	50.2	36.9	12.7



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-26 / SPT-25, 40.0'-41.5' & STN-26 / SPT-26, 41.5'-43.0'
Lab ID: 218
County: Roane (TN)
Date Received: 3-30-09
Sample Type: SPT Comp
Date Reported: 4-30-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.9
No. 200	0.075	44.7
	0.02	22.2
	0.005	13.3
	0.002	9.4
estimated	0.001	8.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.1
Medium Sand	0.1	—
Fine Sand	55.2	55.2
Silt	31.4	35.3
Clay	13.3	9.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.65

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-26 / SPT-25, 40.0'-41.5' & STN-26 / SPT-26, 41.5'-43.0'

Project Number: 171468117
Lab ID: 218

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: DRB
Test Date: 04-16-2009
Date Received: 03-30-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.65

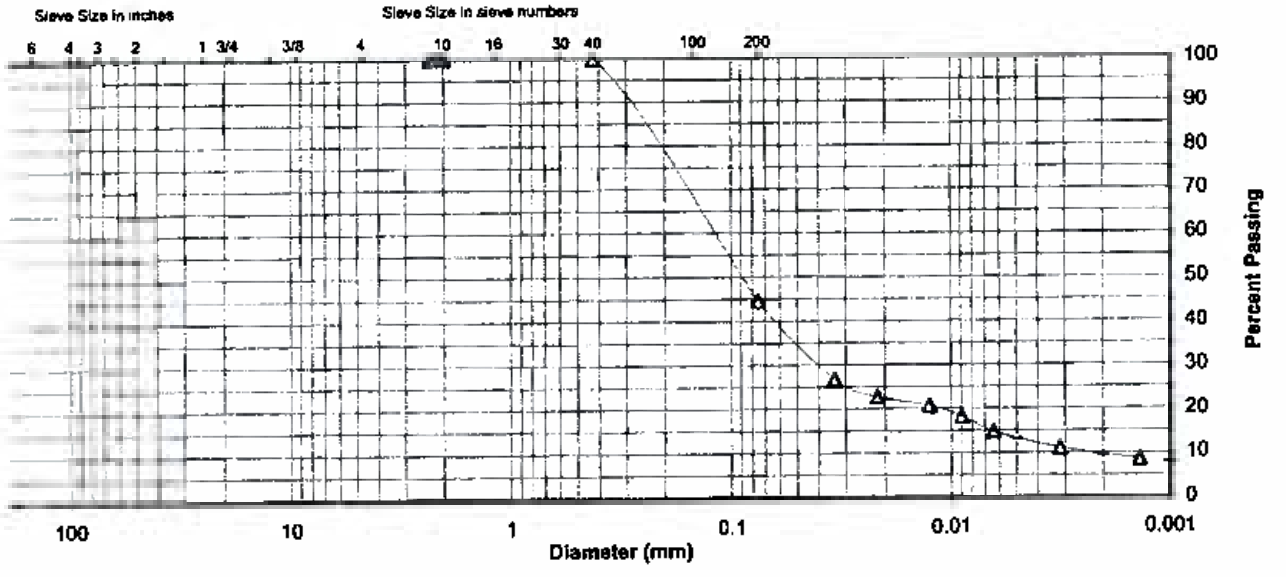
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.9
No. 200	44.7
0.02 mm	22.2
0.005 mm	13.3
0.002 mm	9.4
0.001 mm	8.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.1	55.2	31.4	13.3

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.0	0.1	55.2	35.3	9.4



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-27 / SPT-5, 8.0'-9.5' & STN-27 / SPT-6, 9.5'-11.0'
Lab ID: 368

County: Roane (TN)
Date Received: 4-6-09
Sample Type: SPT Comp
Date Reported: 4-30-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	98.0
No. 4	4.75	95.2
No. 10	2	90.8
No. 40	0.425	85.4
No. 200	0.075	72.9
	0.02	58.9
	0.005	50.2
	0.002	45.0
estimated	0.001	40.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	4.8	9.2
Coarse Sand	4.4	5.4
Medium Sand	5.4	—
Fine Sand	12.5	12.5
Silt	22.7	27.9
Clay	50.2	45.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 56
Plastic Limit: 21
Plasticity Index: 35
Activity Index: 0.78

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.72

Classification

Unified Group Symbol: CH
Group Name: Fat clay with sand
AASHTO Classification: A-7-6 (25)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-27 / SPT-5, 8.0'-9.5' & STN-27 / SPT-6, 9.5'-11.0'

Project Number: 171468117
Lab ID: 368

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: Weathered and Friable

Tested By: DRB
Test Date: 04-16-2009
Date Received: 04-06-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	98.0
No. 4	95.2
No. 10	90.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

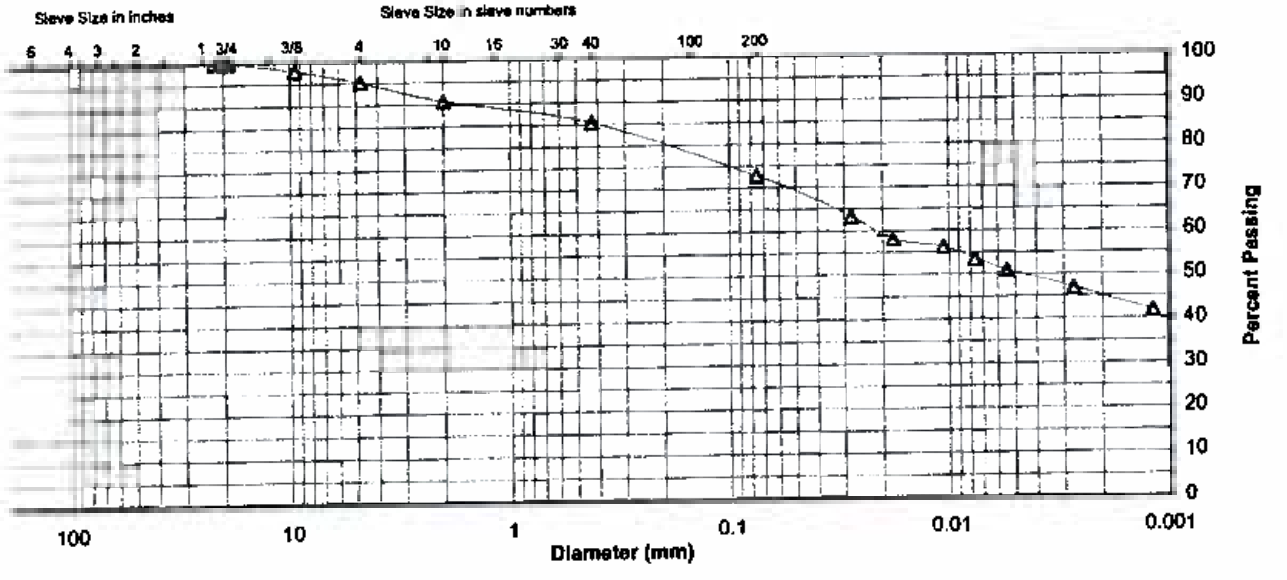
Specific Gravity: 2.72

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	85.4
No. 200	72.9
0.02 mm	58.9
0.005 mm	50.2
0.002 mm	45.0
0.001 mm	40.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	4.8	4.4	5.4	12.5	22.7	50.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	9.2			5.4	12.5	27.9	45.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-27 / SPT-12, 22.5'-24.0' & STN-27 / SPT-13, 24.0'-25.5'	Lab ID	377
County	Roane (TN)	Date Received	4-6-09
Sample Type	SPT Comp	Date Reported	4-30-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	88.1
No. 4	4.75	76.8
No. 10	2	64.4
No. 40	0.425	47.7
No. 200	0.075	25.1
	0.02	7.8
	0.005	1.6
	0.002	0.3
estimated	0.001	0.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	23.2	35.6
Coarse Sand	12.4	16.7
Medium Sand	16.7	—
Fine Sand	22.6	22.6
Silt	23.5	24.8
Clay	1.6	0.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.42

Classification

Unified Group Symbol: SM
Group Name: Silty sand with gravel

AASHTO Classification: A-1-b (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-27 / SPT-12, 22.5'-24.0' & STN-27 / SPT-13, 24.0'-25.5'

Project Number: 171468117
Lab ID: 377

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: KWS
Test Date: 04-15-2009
Date Received: 04-06-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	88.1
No. 4	76.8
No. 10	64.4

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

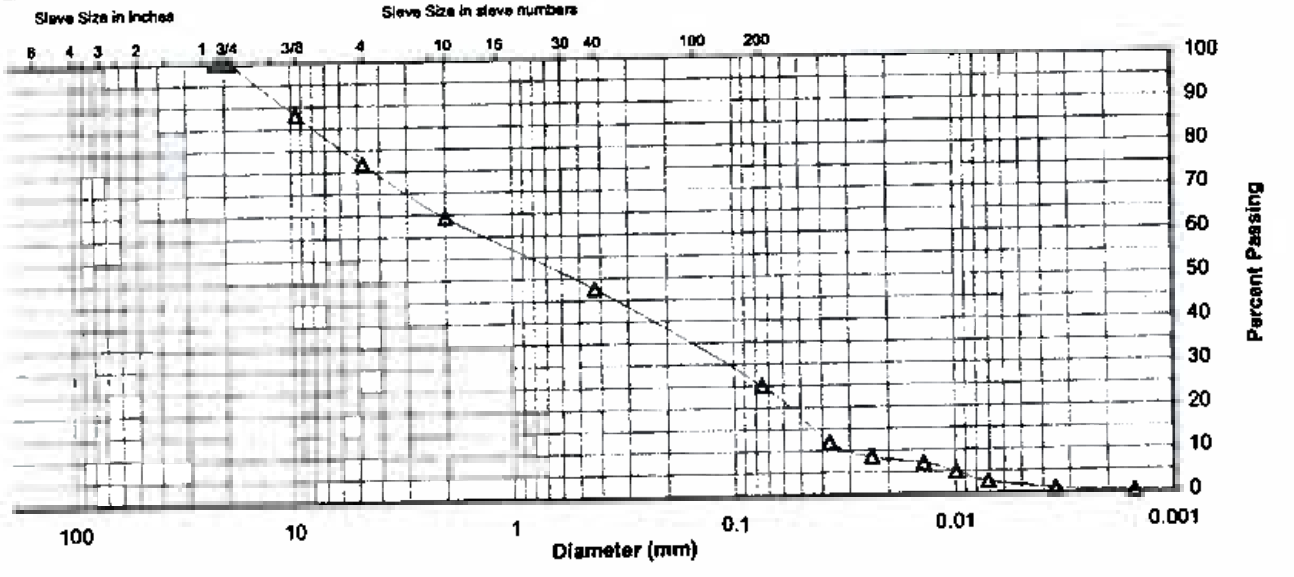
Specific Gravity: 2.42

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	47.7
No. 200	25.1
0.02 mm	7.8
0.005 mm	1.6
0.002 mm	0.3
0.001 mm	0.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	23.2	12.4	16.7	22.6	23.5	1.6
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	35.6			16.7	22.5	24.8	0.3



Comments

Reviewed By

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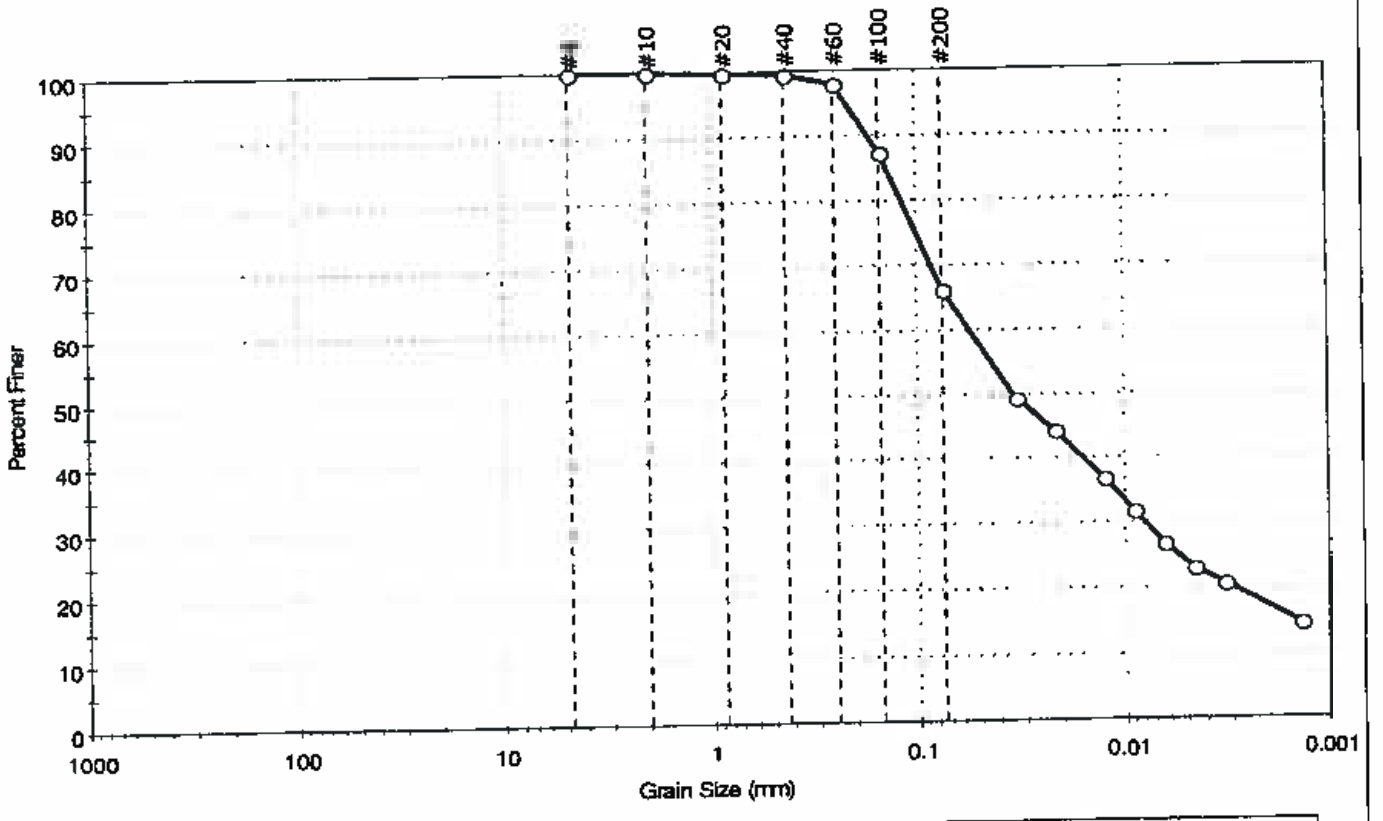
Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond	Project No:	GTX-9015
Location:	Roane, TN		
Boring ID:	STN-27	Sample Type: tube	Tested By: jbr
Sample ID:	S #348	Test Date: 05/17/09	Checked By: jdt
Depth :	30.3-30.8 ft	Test Id: 152225	
Test Comment:	---		
Sample Description:	Moist, olive brown sandy silty clay		
Sample Comment:	---		

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



%Cobble	%Gravel	%Sand	%Silt & Clay Size
---	0.0	33.9	66.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	98		
#100	0.15	87		
#200	0.075	66		
---	Particle Size mm	Percent Finer	Spec. Percent	Complies
---	0.0335	49		
---	0.0216	44		
---	0.0126	37		
---	0.0090	32		
---	0.0064	27		
---	0.0046	23		
---	0.0033	21		
---	0.0014	14		

Coefficients

D_{85} =0.1391 mm	D_{30} =0.0079 mm
D_{60} =0.0559 mm	D_{15} =0.0015 mm
D_{50} =0.0345 mm	D_{10} =0.0008 mm
C_u =N/A	C_c =N/A

Classification

ASTM Sandy silty clay (CL-ML)

AASHTO Silty Soils (A-4 (1))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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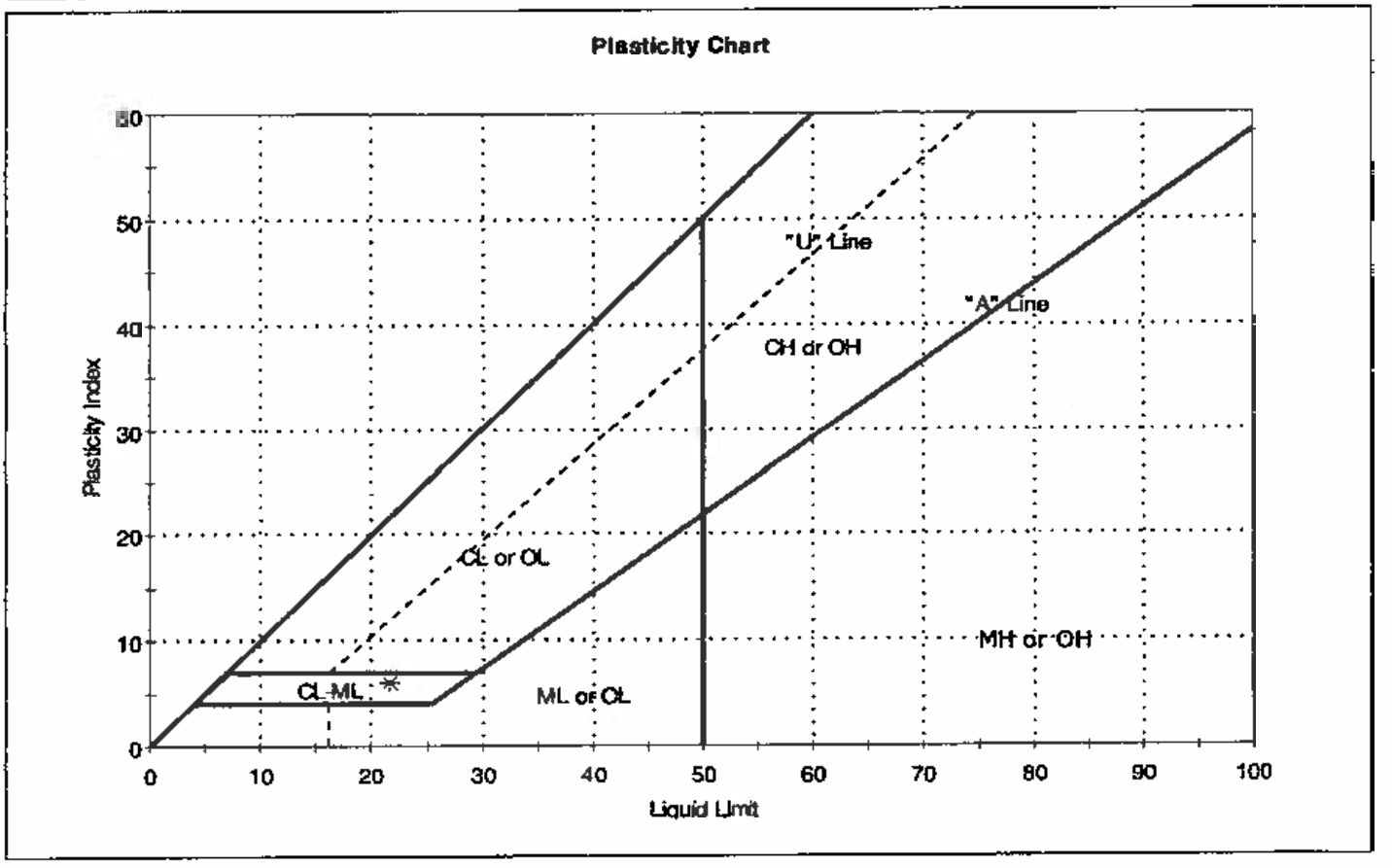
Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond		
Location:	Roane, TN	Project No:	GTX-9015
Boring ID:	STN-27	Sample Type: tube	Tested By: cam
Sample ID:	S #348	Test Date: 05/13/09	Checked By: jdt
Depth :	30.3-30.8 ft	Test Id: 152222	
Test Comment:	---		
Sample Description:	Moist, olive brown sandy silty clay		
Sample Comment:	---		

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	S #348	STN-27	30.3-30.8 ft	19	22	16	6	1	Sandy silty clay (CL-ML)

Sample Prepared using the WET method
0% Retained on #40 Sieve
Dry Strength: HIGH
Dilentancy: SLOW
Toughness: LOW

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Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-27 / SPT-28, 50.5'-52.0' & STN-27 / SPT-29, 52.0'-53.5'
Lab ID: 398

County: Roane (TN)
Date Received: 4-6-09
Sample Type: SPT Comp
Date Reported: 4-30-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	100.0
No. 40	0.425	99.9
No. 200	0.075	56.5
	0.02	27.0
	0.005	19.3
	0.002	13.8
estimated	0.001	10.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.1
Medium Sand	0.1	---
Fine Sand	43.4	43.4
Silt	37.2	42.7
Clay	19.3	13.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 19
Plastic Limit: 18
Plasticity Index: 1
Activity Index: 0.07

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: ML
Group Name: Sandy silt

AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-27 / SPT-28, 50.5'-52.0' & STN-27 / SPT-29, 52.0'-53.5'

Project Number: 171468117
Lab ID: 398

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: Weathered and Friable

Tested By: KWS
Test Date: 04-15-2009
Date Received: 04-06-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.66

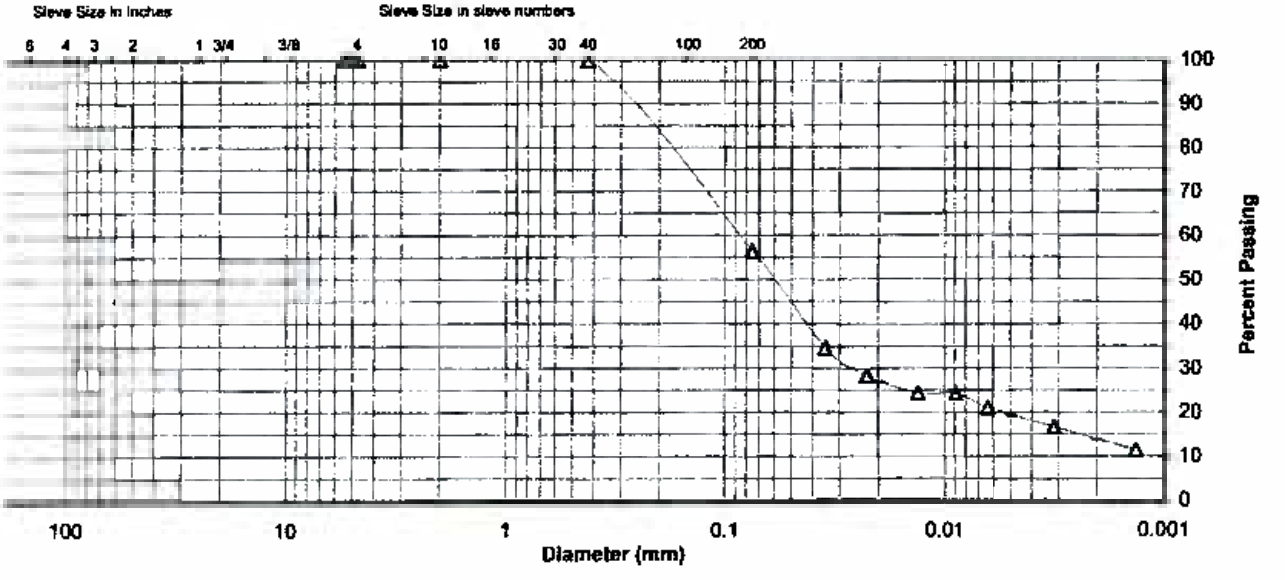
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.9
No. 200	56.5
0.02 mm	27.0
0.005 mm	19.3
0.002 mm	13.8
0.001 mm	10.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.1	43.4	37.2	19.3

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.0	0.1	43.4	42.7	13.8



Comments

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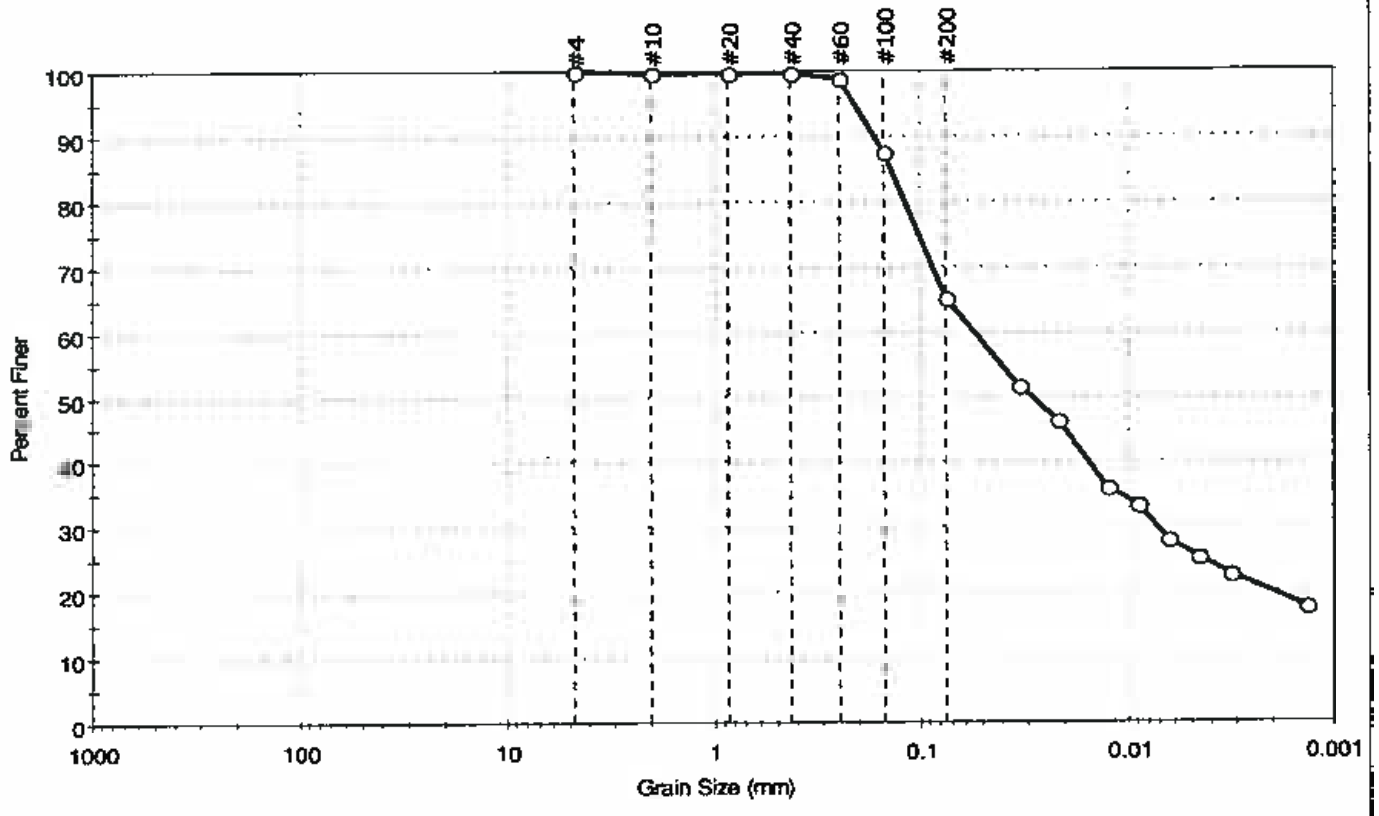
Client:	Stantec Consulting Services				
Project:	Kingston Ash Pond				
Location:	Roane, TN			Project No:	GTX-9015
Boring ID:	ST-27B	Sample Type:	tube	Tested By:	jbr
Sample ID:	ST-4	Test Date:	05/17/09	Checked By:	jdt
Depth :	32.0-34.0 ft	Test Id:	152290		
Test Comment:	---				
Sample Description:	Moist, olive gray sandy clay				
Sample Comment:	---				

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



%Cobble	%Gravel	%Sand	%Silt & Clay Size
---	0.0	34.9	65.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	99		
#100	0.15	87		
#200	0.075	65		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0337	51		
---	0.0216	46		
---	0.0127	36		
---	0.0090	33		
---	0.0064	28		
---	0.0046	25		
---	0.0033	23		
---	0.0018	18		

Coefficients

D_{85} =0.1390 mm	D_{30} =0.0073 mm
D_{60} =0.0555 mm	D_{15} =N/A
D_{50} =0.0297 mm	D_{10} =N/A
C_u =N/A	C_c =N/A

Classification

ASTM Sandy lean clay (CL)

AASHTO Clayey Soils (A-6 (4))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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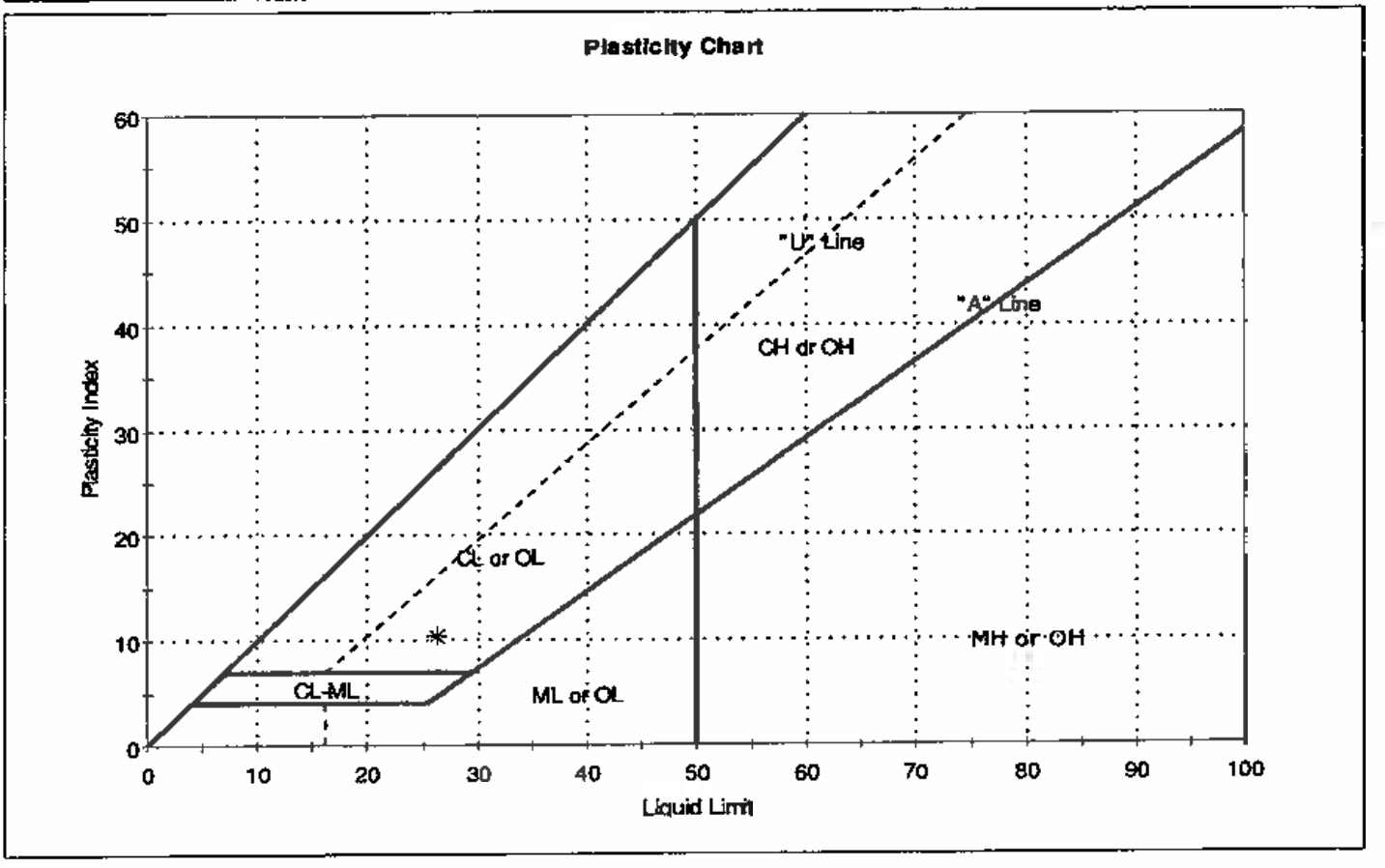
Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond		
Location:	Roane, TN	Project No:	GTX-9015
Boring ID:	STN-27B	Sample Type: tube	Tested By: cam
Sample ID:	ST-4	Test Date: 05/13/09	Checked By: jdt
Depth:	32.0-34.0 ft	Test Id: 152286	
Test Comment:	---		
Sample Description:	Moist, olive gray sandy clay		
Sample Comment:	---		

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	ST-4	STN-27B	32.0-34.0 ft	24	26	16	10	1	Sandy lean clay (CL)

Sample Prepared using the WET method
0% Retained on #40 Sieve
Dry Strength: VERY HIGH
Dilentancy: SLOW
Toughness: LOW

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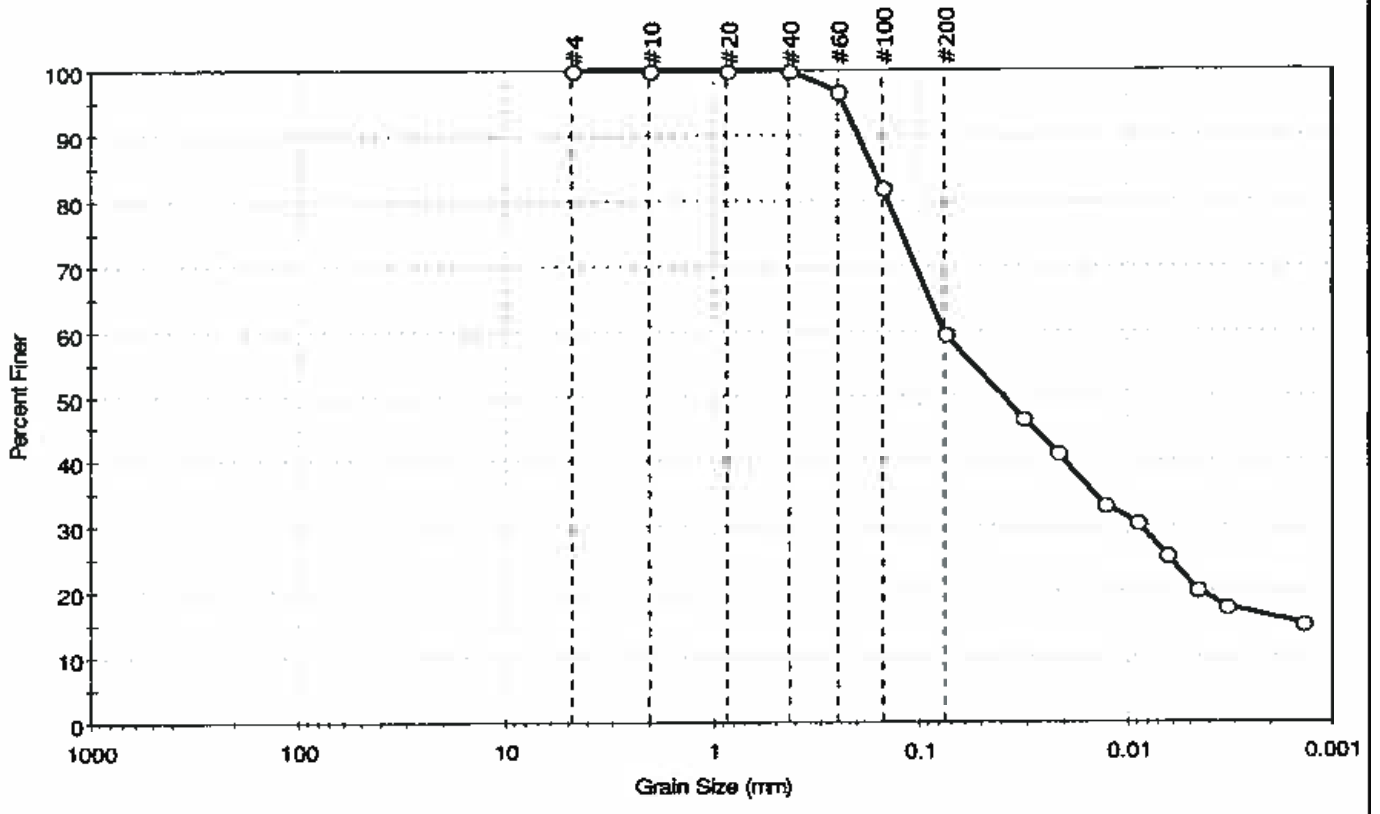
Client:	Stantec Consulting Services				
Project:	Kingston Ash Pond				
Location:	Roane, TN			Project No:	GTX-9015
Boring ID:	STN-27B	Sample Type:	tube	Tested By:	jbr
Sample ID:	ST-5	Test Date:	05/17/09	Checked By:	jdt
Depth :	34.0-36.0 ft	Test Id:	152291		
Test Comment:	---				
Sample Description:	Moist, yellowish brown sandy silty clay				
Sample Comment:	---				

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



%Cobble	%Gravel	%Sand	%Silt & Clay Size
—	0.0	40.5	59.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	97		
#100	0.15	82		
#200	0.075	59		
—	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0319	47		
---	0.0219	41		
---	0.0128	33		
---	0.0090	31		
---	0.0065	26		
---	0.0046	20		
---	0.0033	18		
---	0.0014	15		

Coefficients

D_{85} =0.1668 mm	D_{30} =0.0086 mm
D_{60} =0.0763 mm	D_{15} =N/A
D_{50} =0.0401 mm	D_{10} =N/A
C_u =N/A	C_c =N/A

Classification

ASTM Sandy silty clay (CL-ML)

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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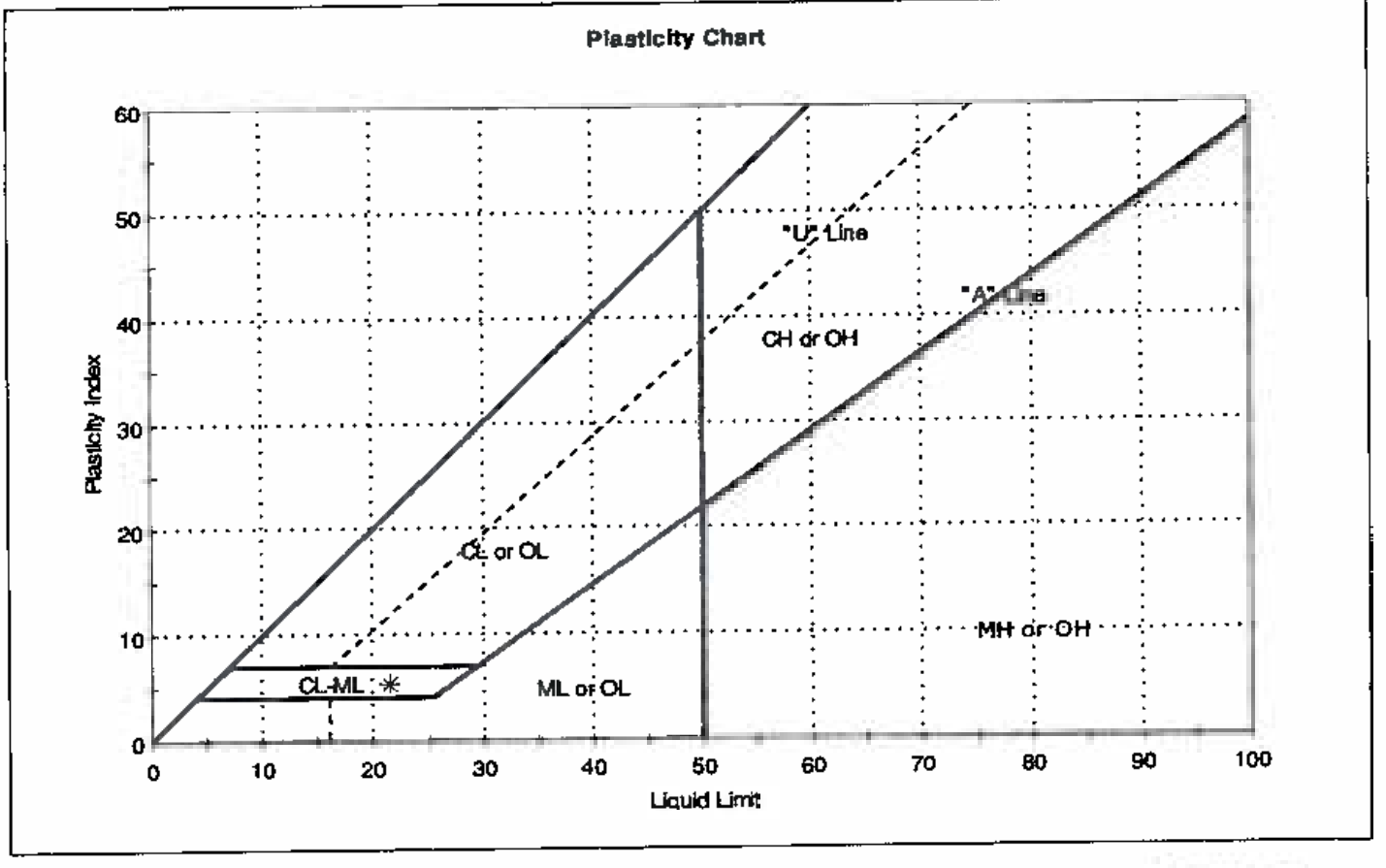
Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond		
Location:	Roane, TN	Project No:	GTX-9015
Boring ID:	STN-27B	Sample Type: tube	Tested By: cam
Sample ID:	ST-5	Test Date: 05/15/09	Checked By: jdt
Depth :	34.0-36.0 ft	Test Id: 152287	
Test Comment:	---		
Sample Description:	Moist, yellowish brown sandy silty clay		
Sample Comment:	---		

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	ST-5	STN-27B	34.0-36.0 ft	19	21	16	5	1	Sandy silty clay (CL-ML)

Sample Prepared using the WET method
0% Retained on #40 Sieve
Dry Strength: VERY HIGH
Dilentancy: NONE
Toughness: LOW

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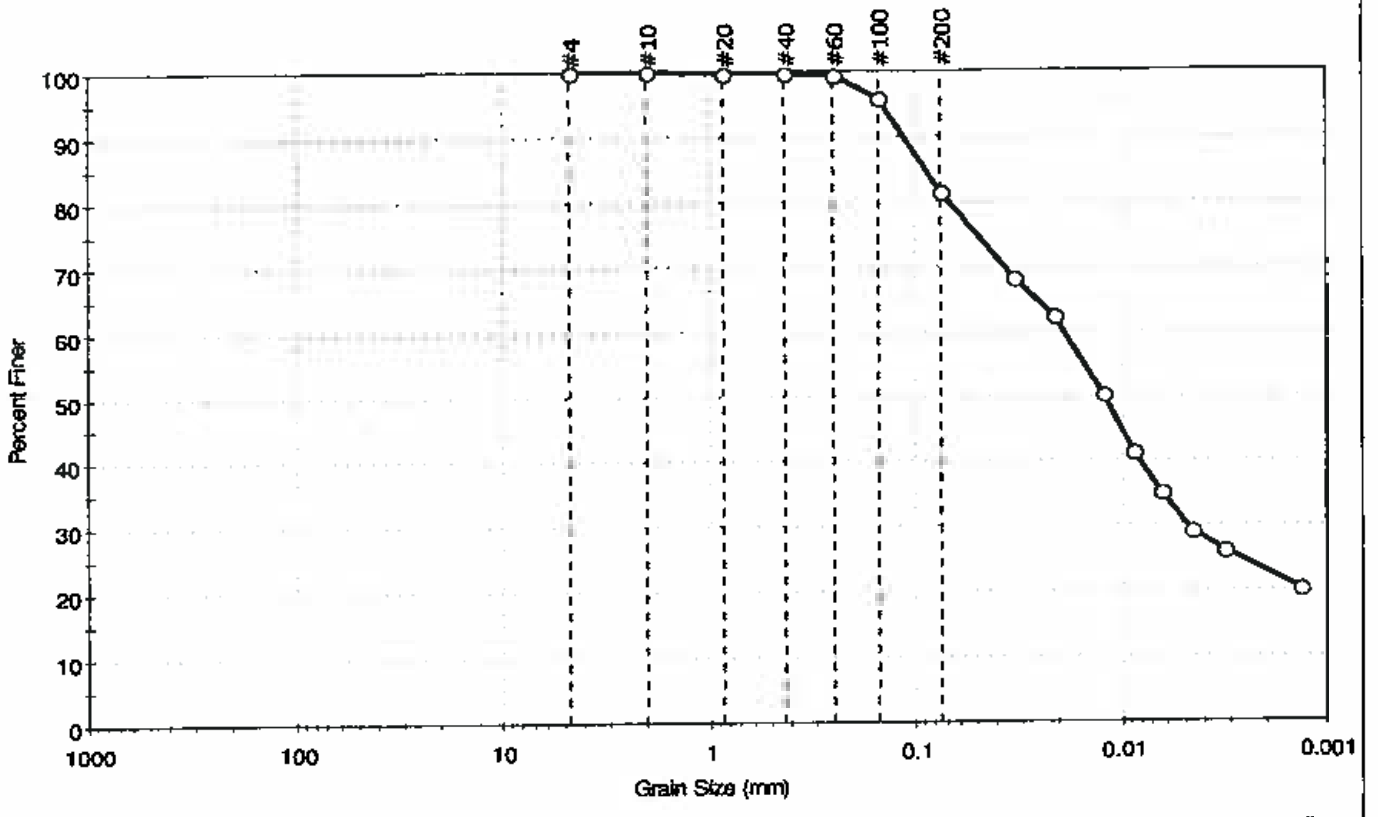
Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond		
Location:	Roane, TN	Project No:	GTX-9015
Boring ID:	ST-28	Sample Type: tube	Tested By: jbr
Sample ID:	ST-1	Test Date: 05/17/09	Checked By: jdt
Depth :	37.5-39.5 ft	Test Id: 152415	
Test Comment:	---		
Sample Description:	Moist, dark olive gray clay with sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



%Cobble	%Gravel	%Sand	%Silt & Clay Size
--	0.0	18.7	81.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	99		
#100	0.15	96		
#200	0.075	81		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0334	68		
---	0.0211	62		
---	0.0124	50		
---	0.0088	41		
---	0.0064	35		
---	0.0046	29		
---	0.0033	26		
---	0.0014	20		

Coefficients

D_{85} =0.0894 mm	D_{30} =0.0048 mm
D_{60} =0.0191 mm	D_{15} =N/A
D_{50} =0.0123 mm	D_{10} =N/A
C_u =N/A	C_c =N/A

Classification

ASTM lean clay with sand (CL)

AASHTO Clayey Soils (A-6 (12))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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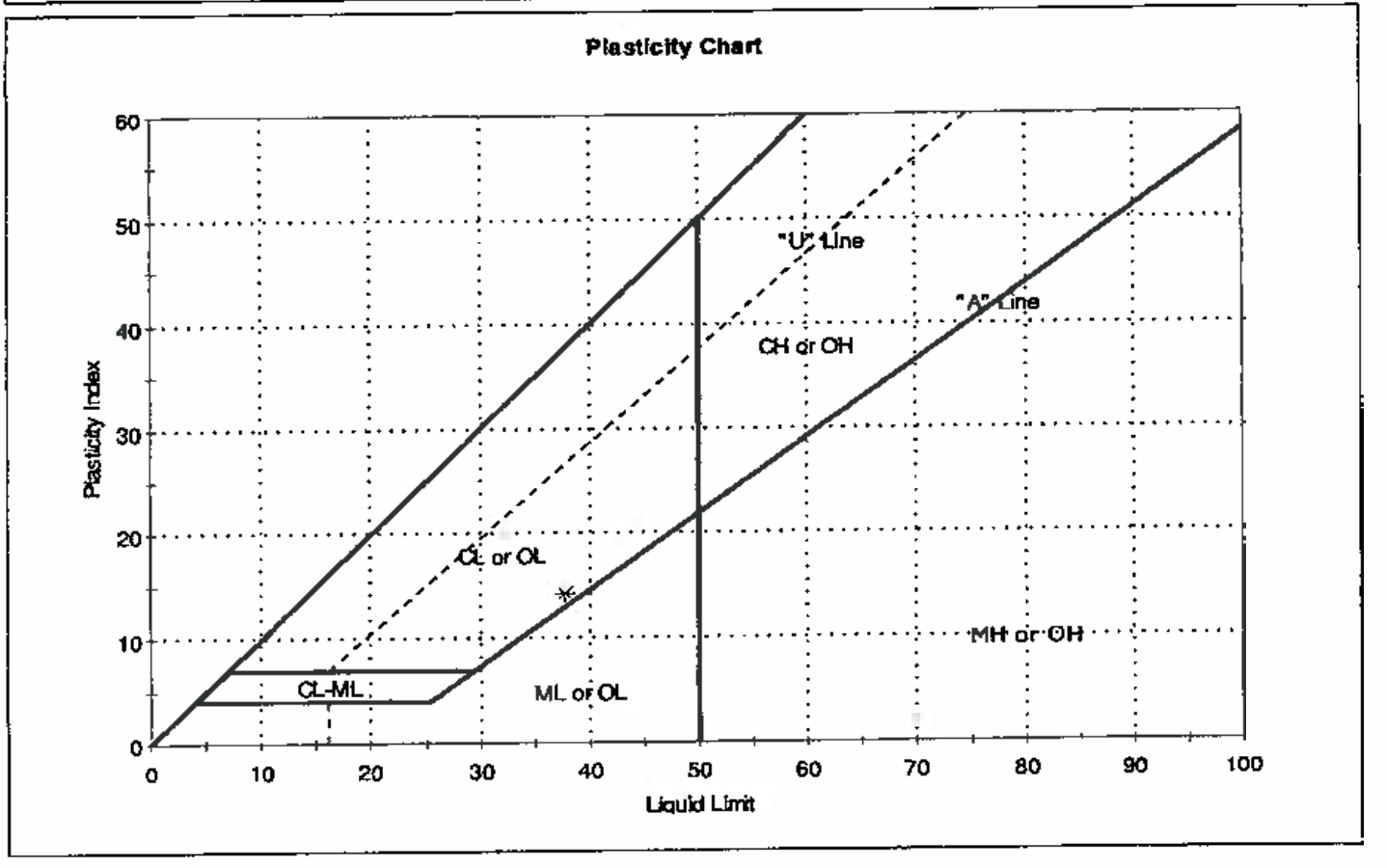
Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond		
Location:	Roane, TN		Project no: GTX-9015
Boring ID: ST-28	Sample Type: tube		Tested By: cam
Sample ID:ST-1	Test Date: 05/18/09		Checked By: jdt
Depth : 37.5-39.5 ft	Test Id: 152412		
Test Comment: ---			
Sample Description: Moist, dark olive gray clay with sand			
Sample Comment: ---			

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	ST-1	ST-28	37.5-39.5 ft	37	38	23	15	1	lean clay with sand (CL)

Sample Prepared using the WET method
0% Retained on #40 Sieve
Dry Strength: VERY HIGH
Dilatancy: SLOW
Toughness: LOW

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Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	175569042
Source	STN-28, 50.5'-52.0', 52.0'-53.5'	Lab ID	32
County	Kingston, Tennessee	Date Received	5-12-09
Sample Type	SPT Comp	Date Reported	6-1-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	100.0
No. 40	0.425	98.3
No. 200	0.075	46.1
	0.02	25.9
	0.005	16.9
	0.002	13.1
estimated	0.001	11.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	1.7
Medium Sand	1.7	—
Fine Sand	52.2	52.2
Silt	29.2	33.0
Clay	16.9	13.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 16
Plastic Limit: 17
Plasticity Index: -1
Activity Index: -0.08

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.64

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-28, 50.5'-52.0', 52.0'-53.5'

Project Number: 175569042
Lab ID: 32

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: BWT
Test Date: 05-21-2009
Date Received: 05-12-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

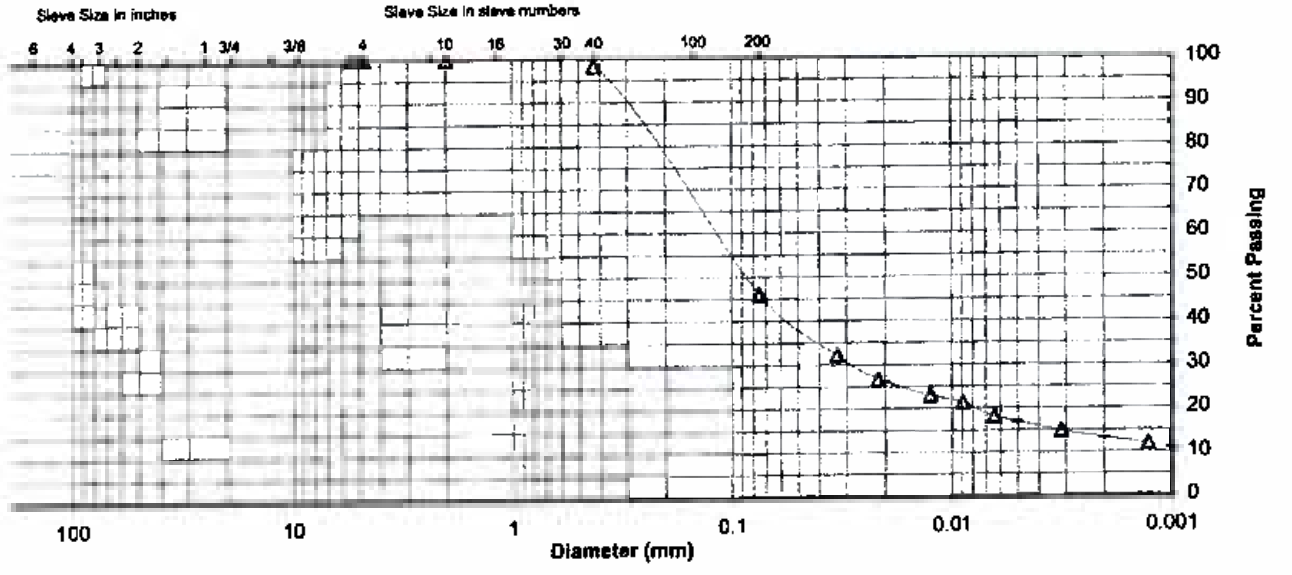
Specific Gravity: 2.64

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.3
No. 200	46.1
0.02 mm	25.9
0.005 mm	16.9
0.002 mm	13.1
0.001 mm	11.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	1.7	52.2	29.2	16.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			1.7	52.2	33.0	13.1



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	175569042
Source	STN-29, 47.5'-49.0', 49.0'-50.5'	Lab ID	68
County	Kingston, Tennessee	Date Received	5-12-09
Sample Type	SPT Comp	Date Reported	6-1-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	100.0
No. 40	0.425	98.3
No. 200	0.075	80.5
	0.02	51.4
	0.005	30.6
	0.002	22.7
estimated	0.001	17.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	1.7
Medium Sand	1.7	—
Fine Sand	17.8	17.8
Silt	49.9	57.8
Clay	30.6	22.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 28
Plastic Limit: 18
Plasticity Index: 10
Activity Index: 0.43

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.65

Classification

Unified Group Symbol: CL
Group Name: Lean clay with sand

AASHTO Classification: A-4 (6)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-29, 47.5'-49.0', 49.0'-50.5'

Project Number: 175569042
Lab ID: 68

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: BWT
Test Date: 05-21-2009
Date Received: 05-12-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.65

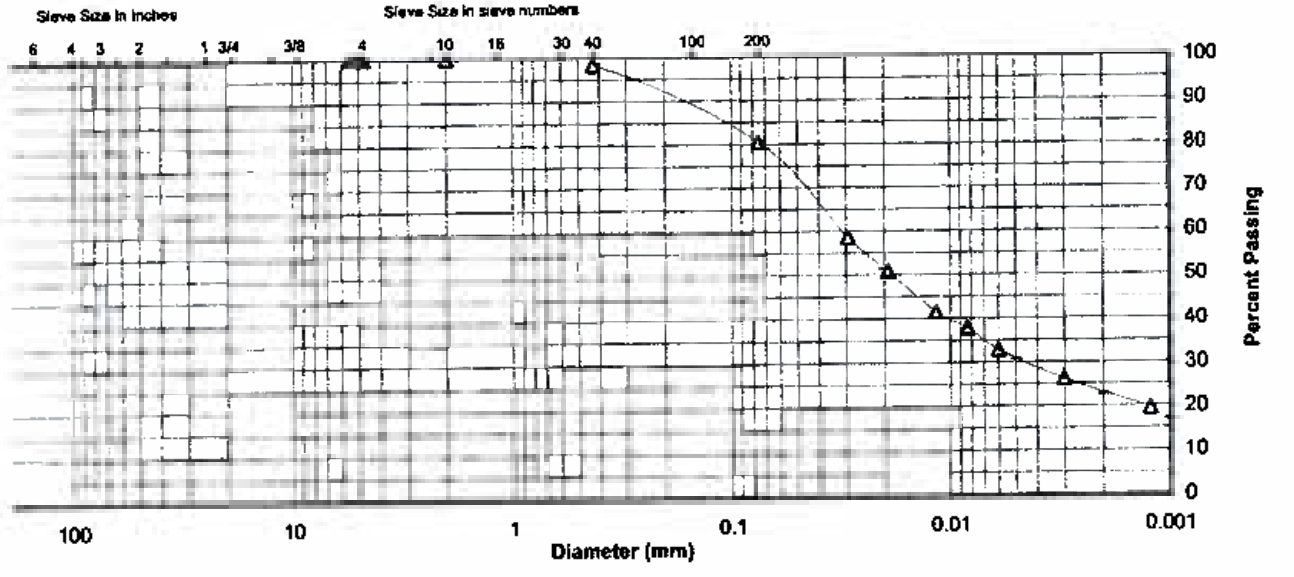
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.3
No. 200	80.5
0.02 mm	51.4
0.005 mm	30.6
0.002 mm	22.7
0.001 mm	17.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	1.7	17.8	49.9	30.6

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.0	1.7	17.8	57.8	22.7



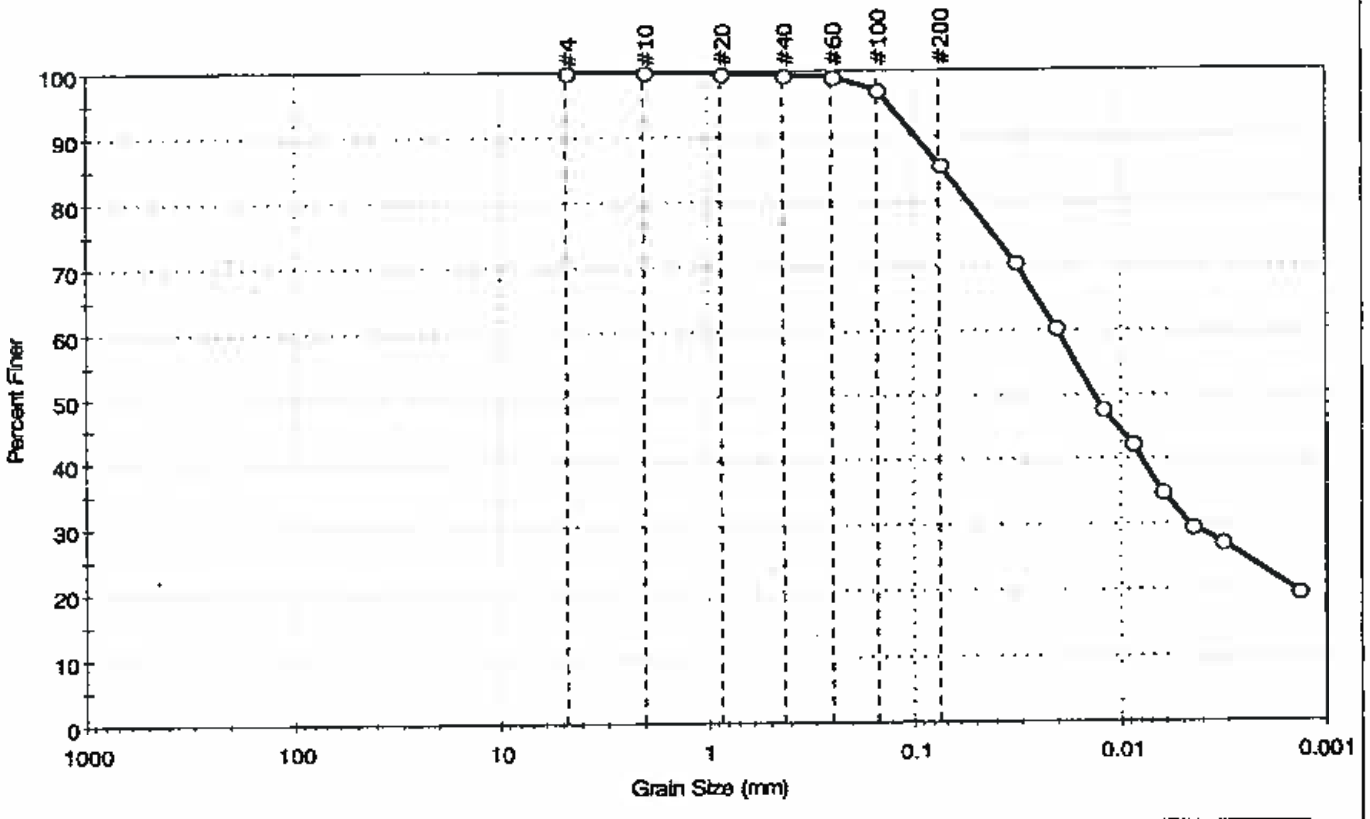
Comments

Reviewed By

GeoTesting express
a subsidiary of Geocomp Corporation

Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond		
Location:	Roane, TN	Project No:	GTX-9015
Boring ID:	ST-29	Sample Type: tube	Tested By: jbr
Sample ID:	ST-7	Test Date: 05/17/09	Checked By: jdt
Depth :	60.0-62.0 ft	Test Id: 152416	
Test Comment:	---		
Sample Description:	Moist, dark olive gray clay		
Sample Comment:	---		

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	14.5	85.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	99		
#100	0.15	97		
#200	0.075	85		
—	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
—	0.0326	71		
---	0.0206	60		
---	0.0123	48		
---	0.0088	43		
---	0.0063	35		
---	0.0045	30		
---	0.0032	27		
---	0.0014	20		

Coefficients

D_{85} =0.0731 mm	D_{30} =0.0046 mm
D_{60} =0.0204 mm	D_{15} =N/A
D_{50} =0.0135 mm	D_{10} =N/A
C_u =N/A	C_c =N/A

Classification

ASTM lean clay (CL)

AASHTO Clayey Soils (A-6 (15))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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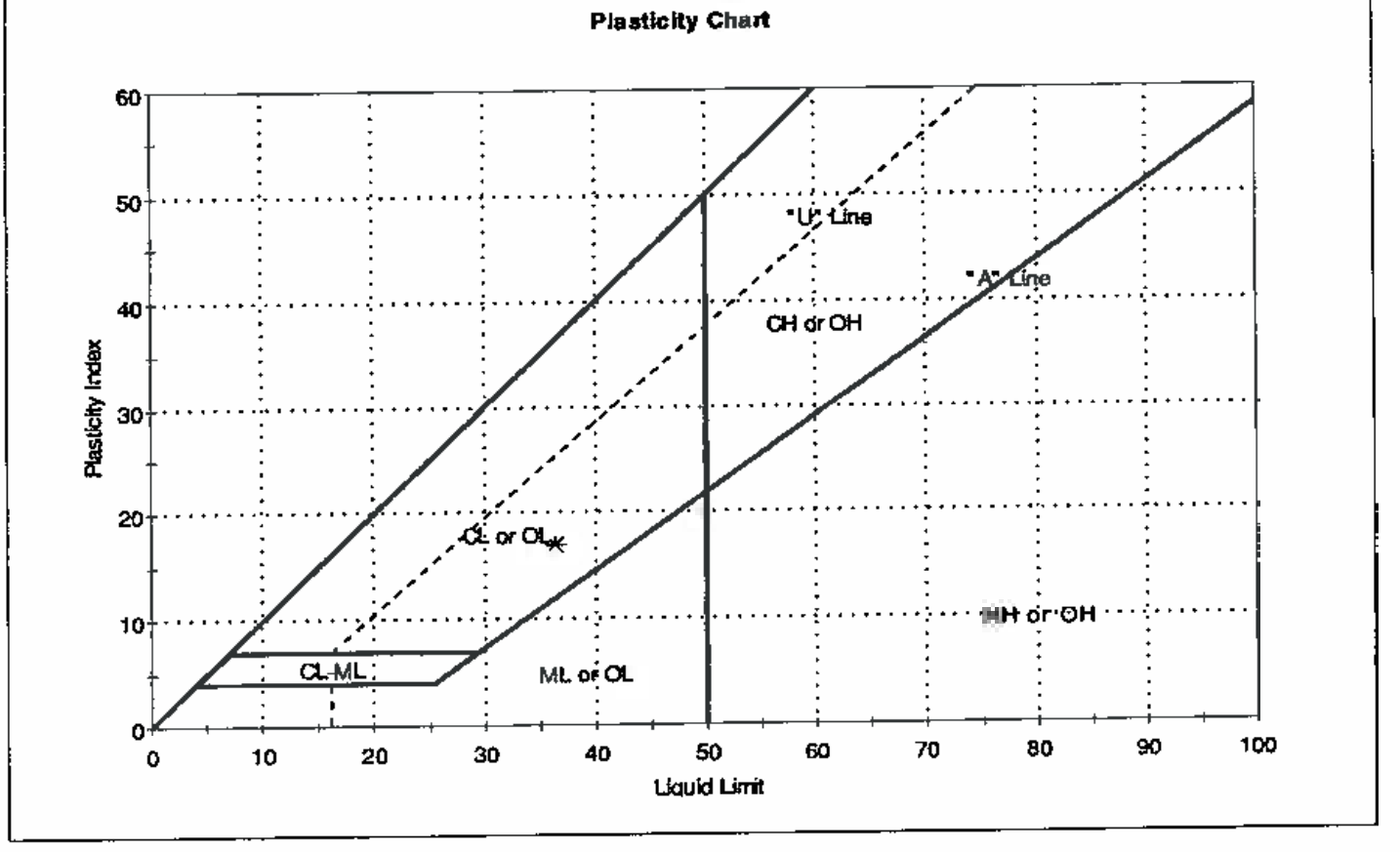
GeoTesting express
a subsidiary of Geocomp Corporation

Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond		
Location:	Roane, TN	Project No:	GTX-9015
Boring ID:	ST-29	Sample Type: tube	Tested By: cam
Sample ID:	ST-7	Test Date: 05/18/09	Checked By: jdt
Depth :	60.0-62.0 ft	Test Id: 152413	
Test Comment:	---		
Sample Description:	Moist, dark olive gray clay		
Sample Comment:	---		

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	USCS Classification
*	ST-7	ST-29	60.0-62.0 ft	26	36	19	17	0	lean clay (CL)

Sample Prepared using the WET method
1% Retained on #40 Sieve
Dry Strength: HIGH
Dilentancy: SLOW
Toughness: LOW

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-29, 62.0'-63.5', 63.5'-65.0'
Project Number: 175569042
Lab ID: 76
County: Kingston, Tennessee
Sample Type: SPT Comp
Date Received: 5-12-09
Date Reported: 6-1-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	100.0
3/4"	19	95.2
3/8"	9.5	92.0
No. 4	4.75	87.0
No. 10	2	83.7
No. 40	0.425	60.9
No. 200	0.075	15.3
	0.02	8.3
	0.005	5.5
	0.002	3.9
estimated	0.001	2.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	13.0	16.3
Coarse Sand	3.3	22.8
Medium Sand	22.8	—
Fine Sand	45.6	45.6
Silt	9.8	11.4
Clay	5.5	3.9

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.56

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-29, 62.0'-63.5', 63.5'-65.0'

Project Number: 175569042
Lab ID: 76

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: BWT
Test Date: 05-21-2009
Date Received: 05-12-2009

Maximum Particle size: 1" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	100.0
3/4"	95.2
3/8"	92.0
No. 4	87.0
No. 10	83.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

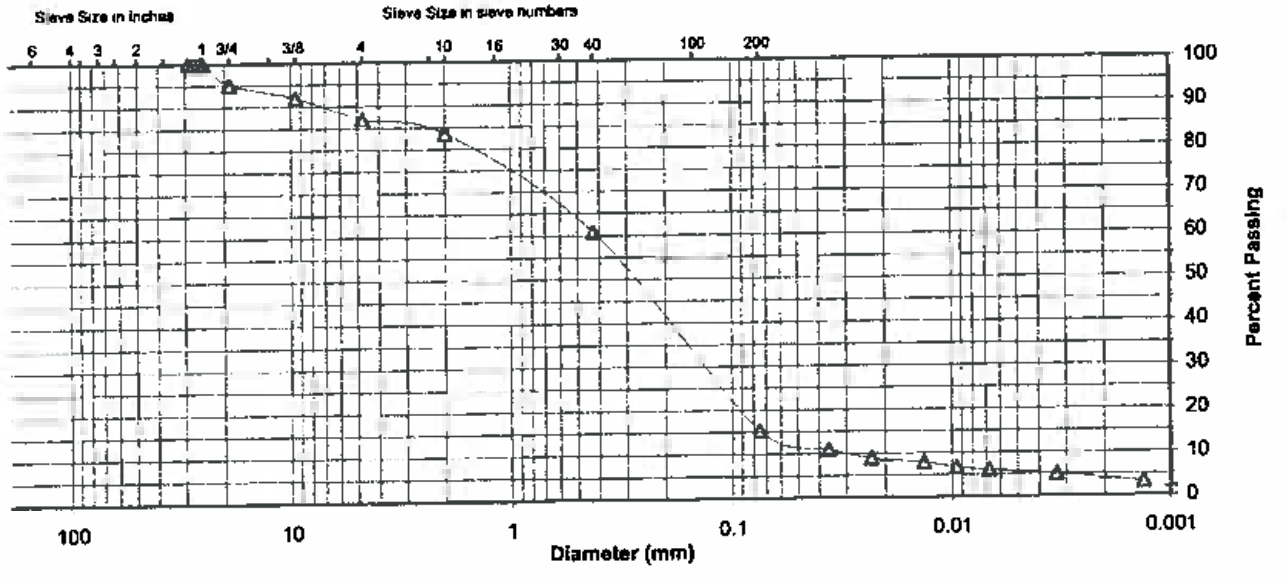
Specific Gravity: 2.56

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	60.9
No. 200	15.3
0.02 mm	8.3
0.005 mm	5.5
0.002 mm	3.9
0.001 mm	2.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	4.8	8.2	3.3	22.8	45.6	9.8	5.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	16.3			22.8	45.6	11.4	3.9



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-31 / SPT-15, 25.5'-27.0' & STN-31 / SPT-16, 27.0'-28.5'
Lab ID: 281
County: Roane (TN)
Date Received: 3-30-09
Sample Type: SPT Comp
Date Reported: 4-30-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	100.0
No. 40	0.425	99.9
No. 200	0.075	55.6
	0.02	29.9
	0.005	20.9
	0.002	16.4
estimated	0.001	14.0

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

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.1
Medium Sand	0.1	—
Fine Sand	44.3	44.3
Silt	34.7	39.2
Clay	20.9	16.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 22
Plastic Limit: 18
Plasticity Index: 4
Activity Index: 0.25

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.65

Classification

Unified Group Symbol: CL-ML
Group Name: Sandy silty clay
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-31 / SPT-15, 25.5'-27.0' & STN-31 / SPT-16, 27.0'-28.5'

Project Number: 171468117
Lab ID: 281

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: BWT
Test Date: 04-17-2009
Date Received: 03-30-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

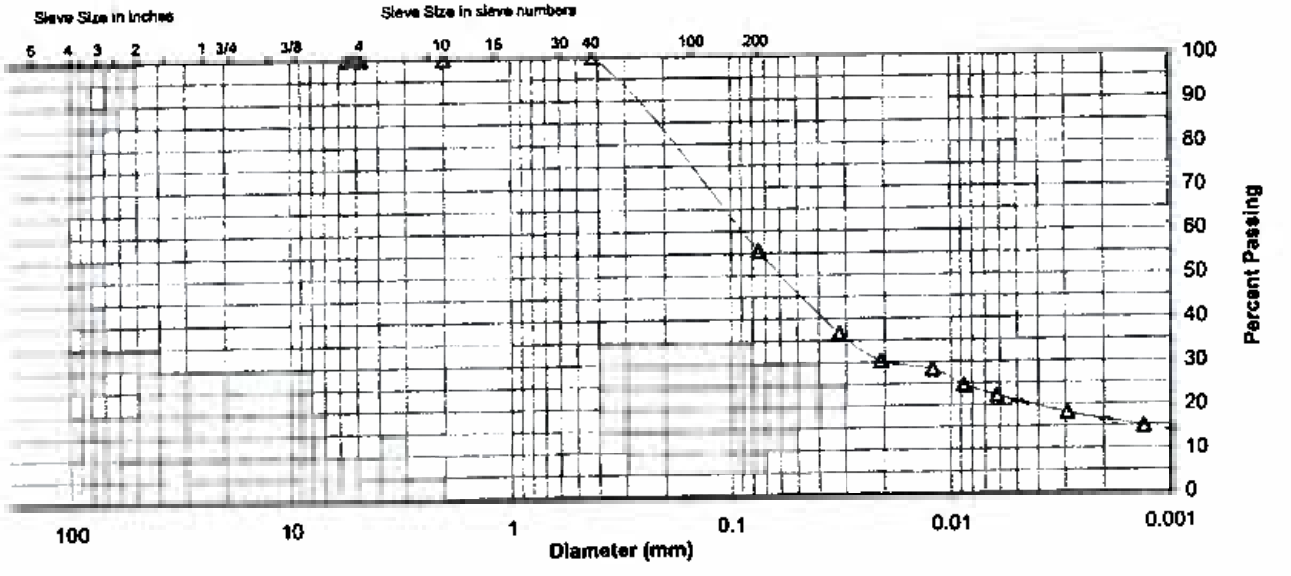
Specific Gravity: 2.65

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.9
No. 200	55.6
0.02 mm	29.9
0.005 mm	20.9
0.002 mm	16.4
0.001 mm	14.0

Particle Size Distribution

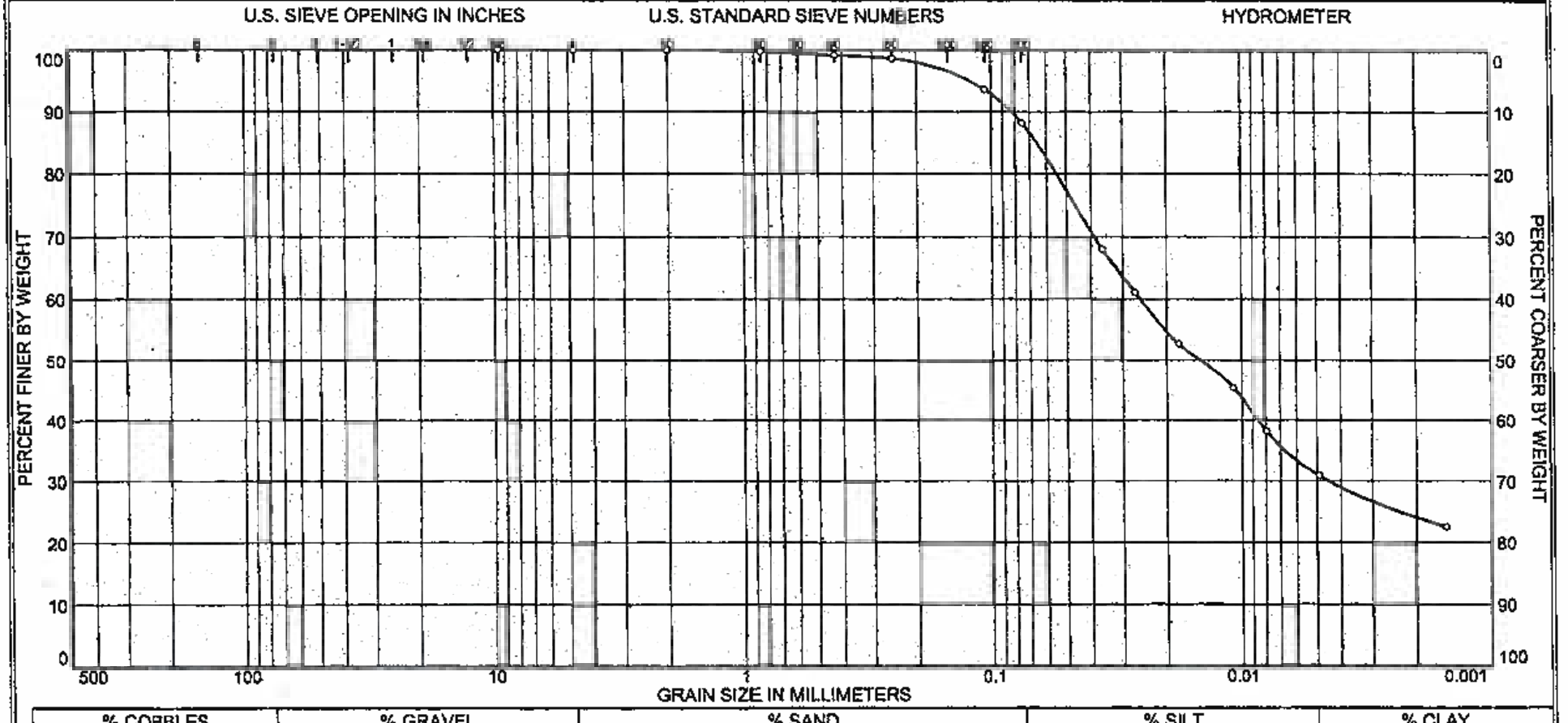
ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.1	44.3	34.7	20.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.1	44.3	39.2	16.4



Comments

Reviewed By

Particle Size Distribution Report ASTM D422/ASTM D1140



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	11.8	57.1	31.1

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
	STN-31	38-38.5 ft	May 09	CL	Gray Brown Lean clay		42	22

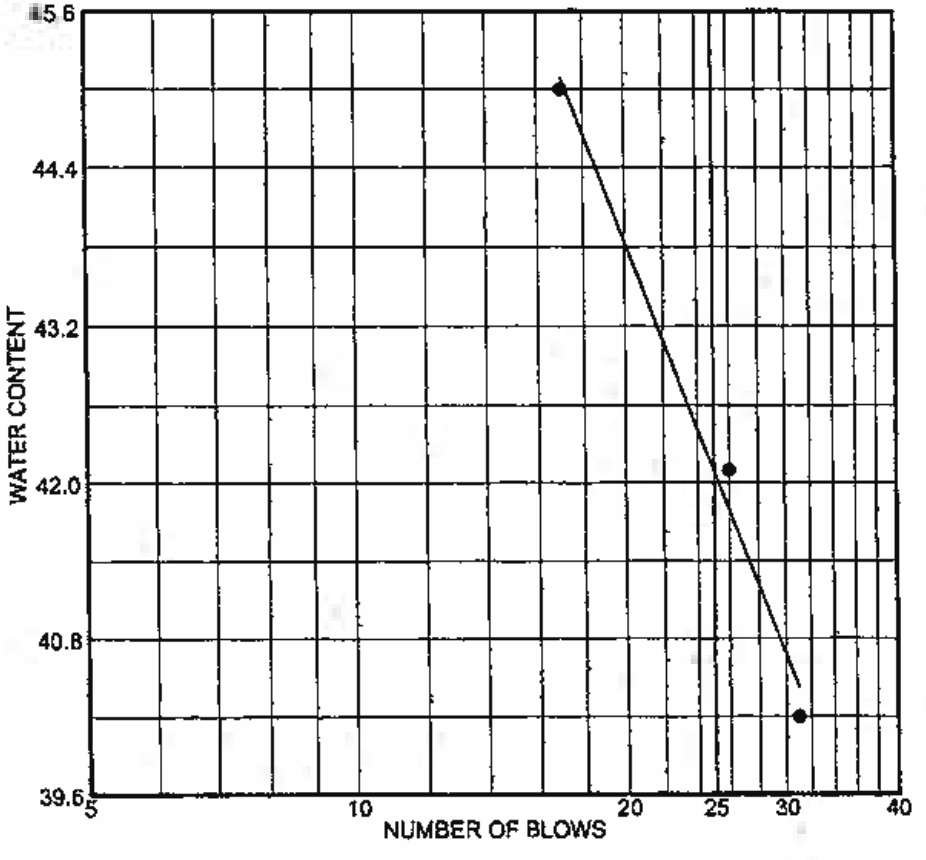
Client STANTEC

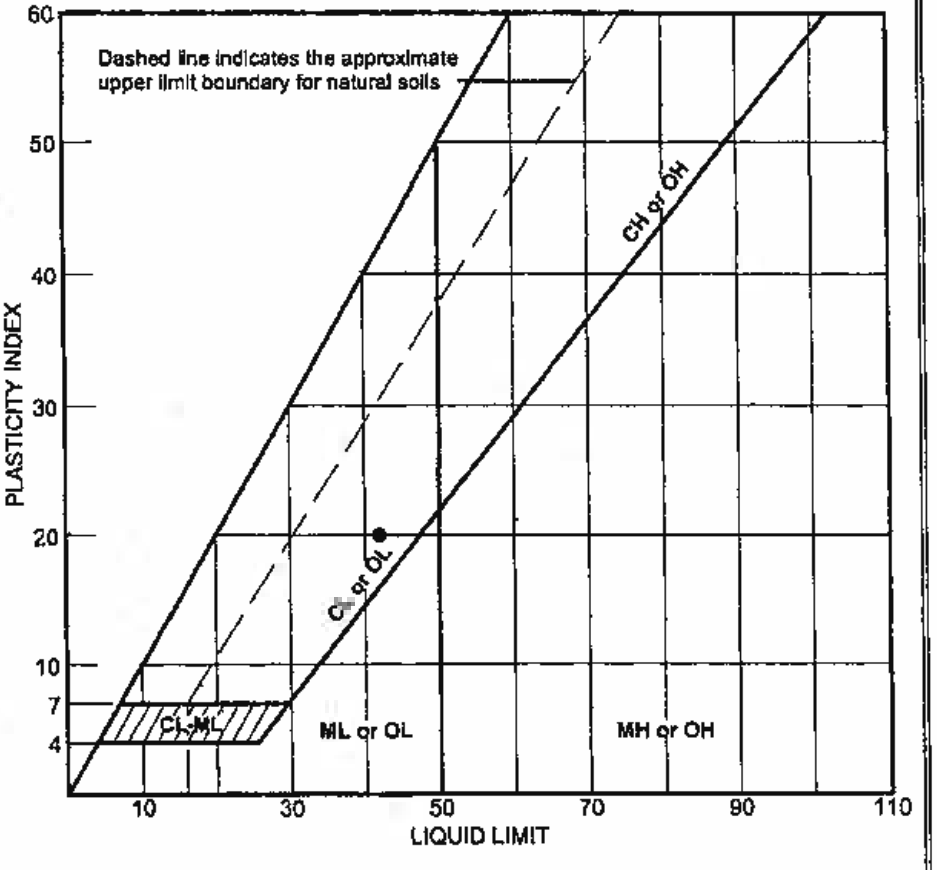
Project Kingston Ash Pond

Project No. GTX-1464 | Lab no.

GeoTesting Express Inc.

LIQUID AND PLASTIC LIMITS TEST REPORT





SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
	STN-31	38-38.5 ft	May 09	CL	Gray Brown Lean clay		42	20

Client STANTEC

Project Kingston Ash Pond

Project No. GTX-1464 | Lab no.

GeoTesting Express Inc.

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-31 / SPT-26, 46.0'-47.5' & STN-31 / SPT-27, 47.5'-49.0'	Lab ID	293
County	Roane (TN)	Date Received	3-30-09
Sample Type	SPT Comp	Date Reported	4-30-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.8
No. 200	0.075	73.4
	0.02	44.5
	0.005	24.1
	0.002	17.2
estimated	0.001	12.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.2
Medium Sand	0.2	—
Fine Sand	26.4	26.4
Silt	49.3	56.2
Clay	24.1	17.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 30
Plastic Limit: 23
Plasticity Index: 7
Activity Index: 0.41

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.57

Classification

Unified Group Symbol: ML
Group Name: Silt with sand

AASHTO Classification: A-4 (4)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-31 / SPT-26, 46.0'-47.5' & STN-31 / SPT-27, 47.5'-49.0'

Project Number: 171468117
Lab ID: 293

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 04-21-2009
Date Received: 03-30-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.57

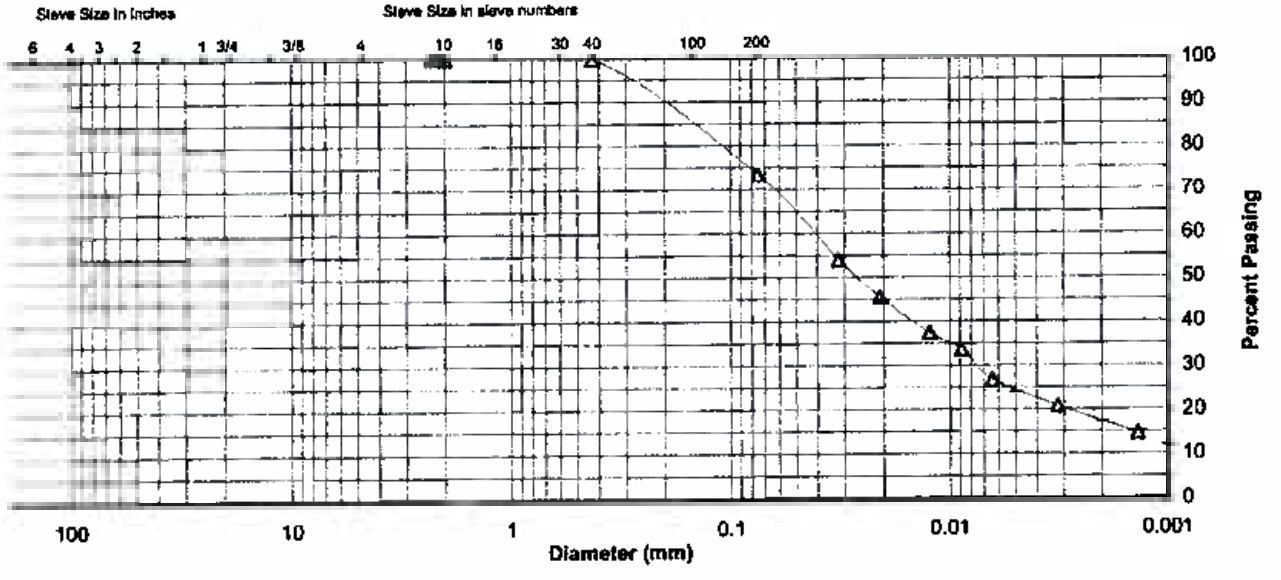
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.8
No. 200	73.4
0.02 mm	44.5
0.005 mm	24.1
0.002 mm	17.2
0.001 mm	12.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.2	26.4	49.3	24.1

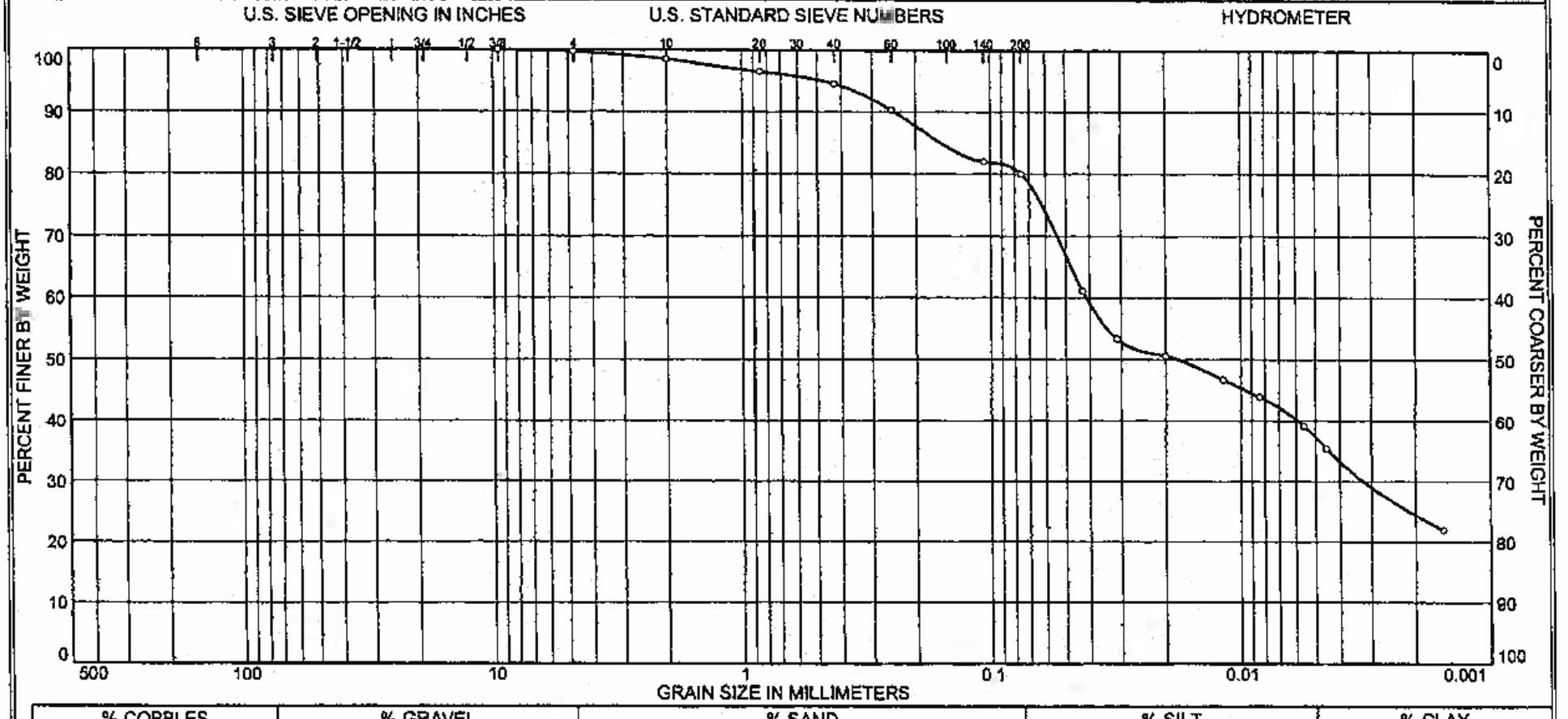
AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.0	0.2	26.4	56.2	17.2



Comments

Reviewed By

Particle Size Distribution Report ASTM D422/ASTM D1140



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.3	19.7	42.8	37.2

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
	STN-32	~~5.2-5.8 ft~~ 5.3 - 5.8 ft.	May 09	CL	Gray Brown Lean clay with sand		36	19

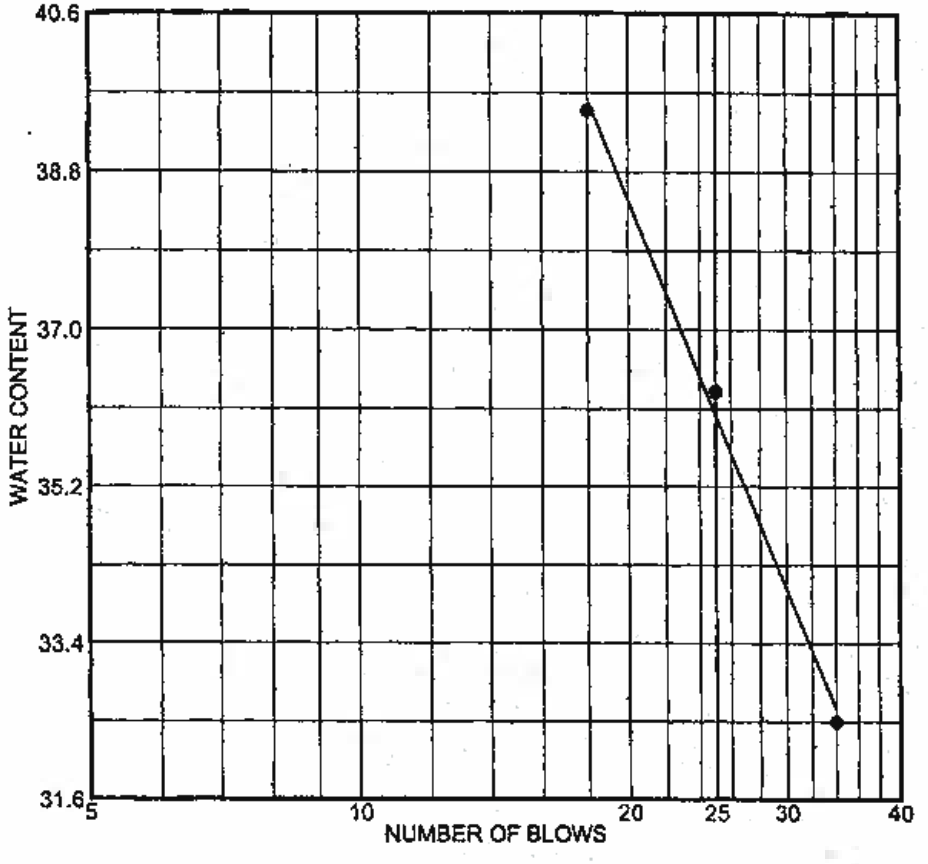
Client STANTEC

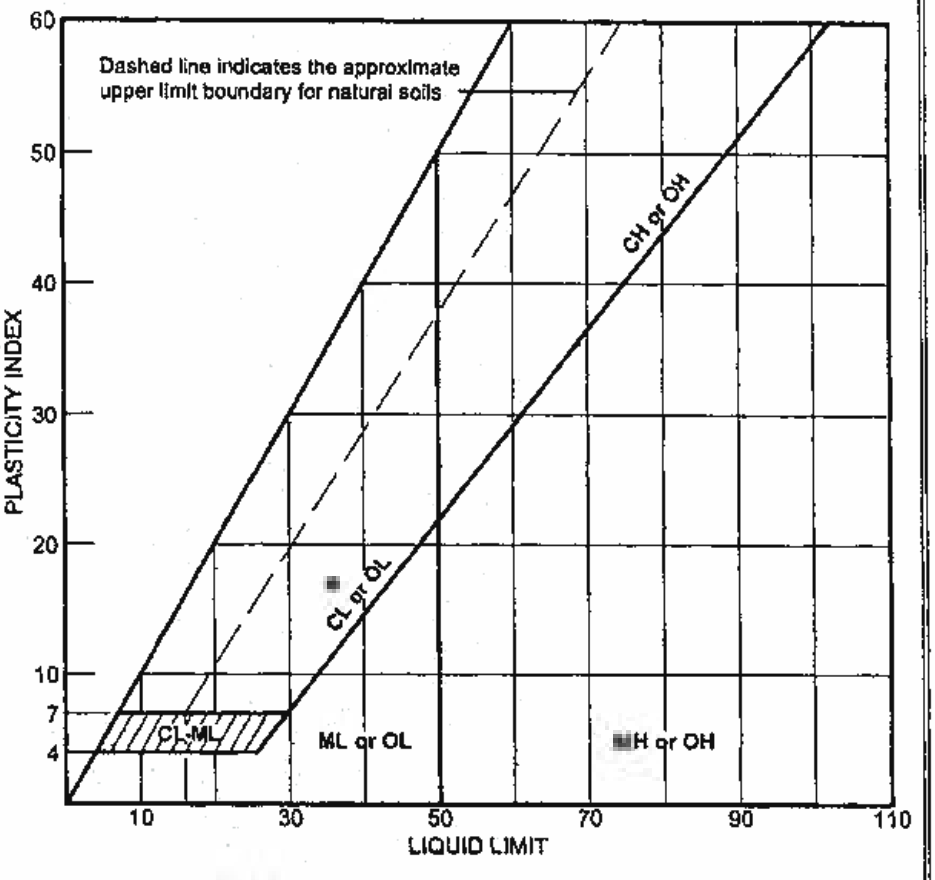
Project Kingston Ash Pond

Project No. GTX-1464 Lab no.

GeoTesting Express Inc.

LIQUID AND PLASTIC LIMITS TEST REPORT





SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
	STN-32	~~5.2-5.8 ft~~ 5.3 - 5.8 ft.	May 09	CL	Gray Brown Lean clay with sand		36	17

Client STANTEC

Project Kingston Ash Pond

Project No. GTX-1464 | Lab no.

GeoTesting Express Inc.

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-32 / SPT-11, 19.0'-20.5' & STN-32 / SPT-12, 20.5'-22.0'
Lab ID: 534

County: Roane (TN)
Date Received: 4-6-09
Sample Type: SPT Comp
Date Reported: 5-1-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	99.0
No. 4	4.75	98.5
No. 10	2	97.4
No. 40	0.425	94.5
No. 200	0.075	78.3
	0.02	65.0
	0.005	58.3
	0.002	54.0
estimated	0.001	51.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	1.5	2.6
Coarse Sand	1.1	2.9
Medium Sand	2.9	—
Fine Sand	16.2	16.2
Silt	20.0	24.3
Clay	58.3	54.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 59
Plastic Limit: 20
Plasticity Index: 39
Activity Index: 0.72

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.73

Classification

Unified Group Symbol: CH
Group Name: Fat clay with sand

AASHTO Classification: A-7-6 (31)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-32 / SPT-11, 19.0'-20.5' & STN-32 / SPT-12, 20.5'-22.0'

Project Number: 171468117
Lab ID: 534

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: BWT
Test Date: 04-20-2009
Date Received: 04-06-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	99.0
No. 4	98.5
No. 10	97.4

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

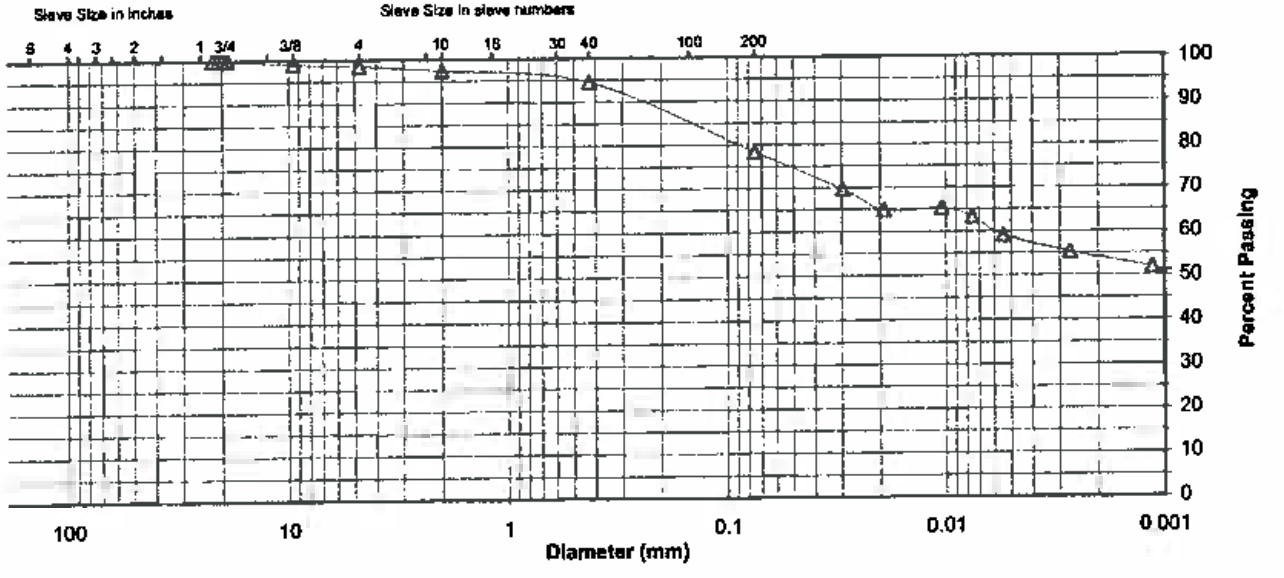
Specific Gravity: 2.73

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	94.5
No. 200	78.3
0.02 mm	65.0
0.005 mm	58.3
0.002 mm	54.0
0.001 mm	51.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	1.5	1.1	2.9	16.2	20.0	58.3
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	2.6			2.9	16.2	24.3	54.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-32 /SPT-24, 38.5'-40.0' & STN-32 /SPT-25A, 40.0'-41.0'
Lab ID: 546
County: Roane (TN)
Date Received: 4-6-09
Sample Type: SPT Comp
Date Reported: 5-1-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	65
Plastic Limit:	23
Plasticity Index:	42
Activity Index:	0.89

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	100.0
3/4"	19	98.6
3/8"	9.5	92.5
No. 4	4.75	86.3
No. 10	2	83.4
No. 40	0.425	78.7
No. 200	0.075	72.3
	0.02	66.5
	0.005	55.9
	0.002	46.9
estimated	0.001	43.0

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

Range	ASTM (%)	AASHTO (%)
Gravel	13.7	16.6
Coarse Sand	2.9	4.7
Medium Sand	4.7	—
Fine Sand	6.4	6.4
Silt	16.4	25.4
Clay	55.9	46.9

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No.10
Specific Gravity at 20° Celsius:	2.73

Classification

Unified Group Symbol: CH
Group Name: Fat clay with sand
AASHTO Classification: A-7-6 (30)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-32 /SPT-24, 38.5'-40.0' & STN-32 /SPT-25A, 40.0'-41.0'

Project Number: 171468117
Lab ID: 546

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: BWT
Test Date: 04-17-2009
Date Received: 04-06-2009

Maximum Particle size: 1" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	100.0
3/4"	98.6
3/8"	92.5
No. 4	86.3
No. 10	83.4

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

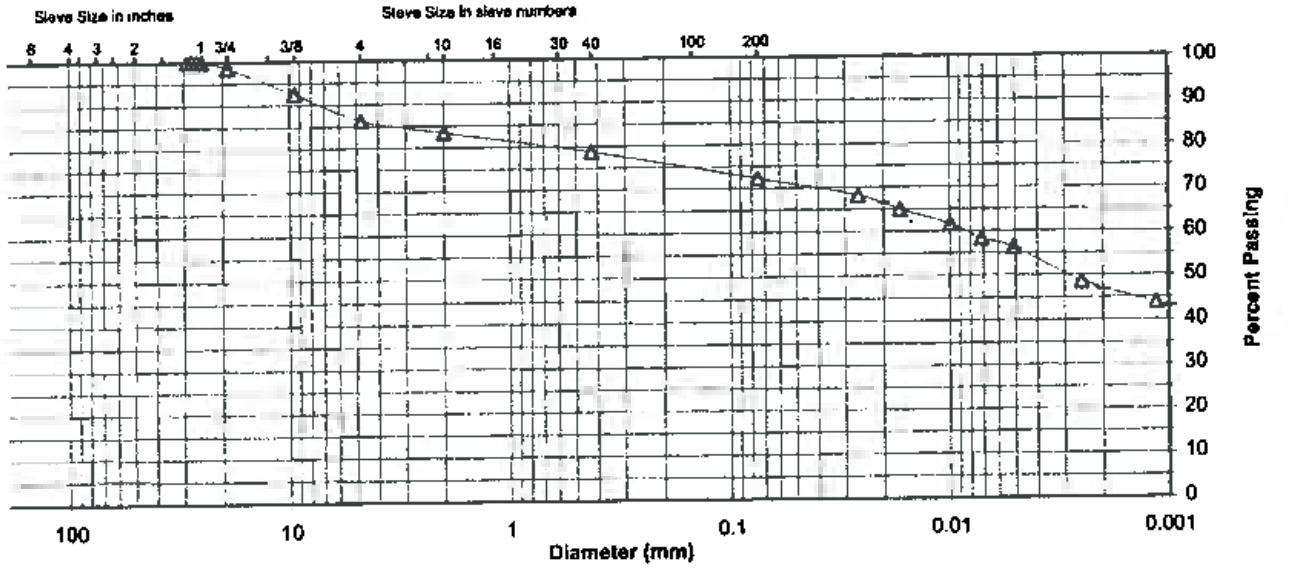
Specific Gravity: 2.73

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	78.7
No. 200	72.3
0.02 mm	66.5
0.005 mm	55.9
0.002 mm	46.9
0.001 mm	43.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	1.4	12.3	2.9	4.7	6.4	16.4	55.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	16.6			4.7	6.4	25.4	46.9



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	175569042
Source	STN-34, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'	Lab ID	366
County	Kingston, Tennessee	Date Received	5-26-09
Sample Type	SPT Comp	Date Reported	6-24-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	98.2
No. 4	4.75	97.3
No. 10	2	96.6
No. 40	0.425	92.4
No. 200	0.075	69.4
	0.02	58.4
	0.005	49.4
	0.002	43.9
estimated	0.001	40.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	2.7	3.4
Coarse Sand	0.7	4.2
Medium Sand	4.2	—
Fine Sand	23.0	23.0
Silt	20.0	25.5
Clay	49.4	43.9

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	52
Plastic Limit:	20
Plasticity Index:	32
Activity Index:	0.73

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.74

Classification

Unified Group Symbol: CH
Group Name: Sandy fat clay

AASHTO Classification: A-7-6 (21)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-34, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'

Project Number: 175569042
Lab ID: 366

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: BWT
Test Date: 06-08-2009
Date Received: 05-26-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	98.2
No. 4	97.3
No. 10	96.6

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

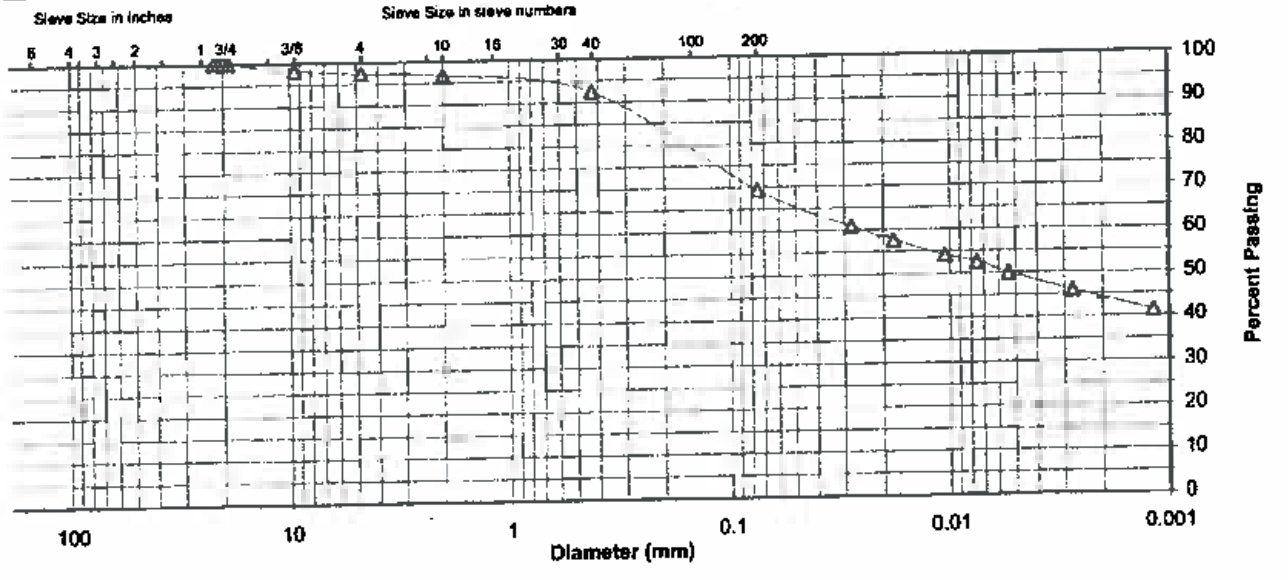
Specific Gravity: 2.74

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	92.4
No. 200	69.4
0.02 mm	58.4
0.005 mm	49.4
0.002 mm	43.9
0.001 mm	40.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	2.7	0.7	4.2	23.0	20.0	49.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	3.4			4.2	23.0	25.5	43.9



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-34, 42.5'-44.0', 44.0'-45.5'
Project Number: 175569042
Lab ID: 389

County: Kingston, Tennessee
Sample Type: SPT Comp
Date Received: 5-26-09
Date Reported: 6-24-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	99.3
No. 4	4.75	98.0
No. 10	2	97.2
No. 40	0.425	91.4
No. 200	0.075	73.4
	0.02	44.4
	0.005	26.9
	0.002	20.1
estimated	0.001	15.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	2.0	2.8
Coarse Sand	0.8	5.8
Medium Sand	5.8	—
Fine Sand	18.0	18.0
Silt	46.5	53.3
Clay	26.9	20.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 28
Plastic Limit: 18
Plasticity Index: 10
Activity Index: 0.50

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.71

Classification

Unified Group Symbol: CL
Group Name: Lean clay with sand
AASHTO Classification: A-4 (5)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-34, 42.5'-44.0', 44.0'-45.5'

Project Number: 175569042
Lab ID: 389

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: BWT
Test Date: 06-09-2009
Date Received: 05-26-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	99.3
No. 4	98.0
No. 10	97.2

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

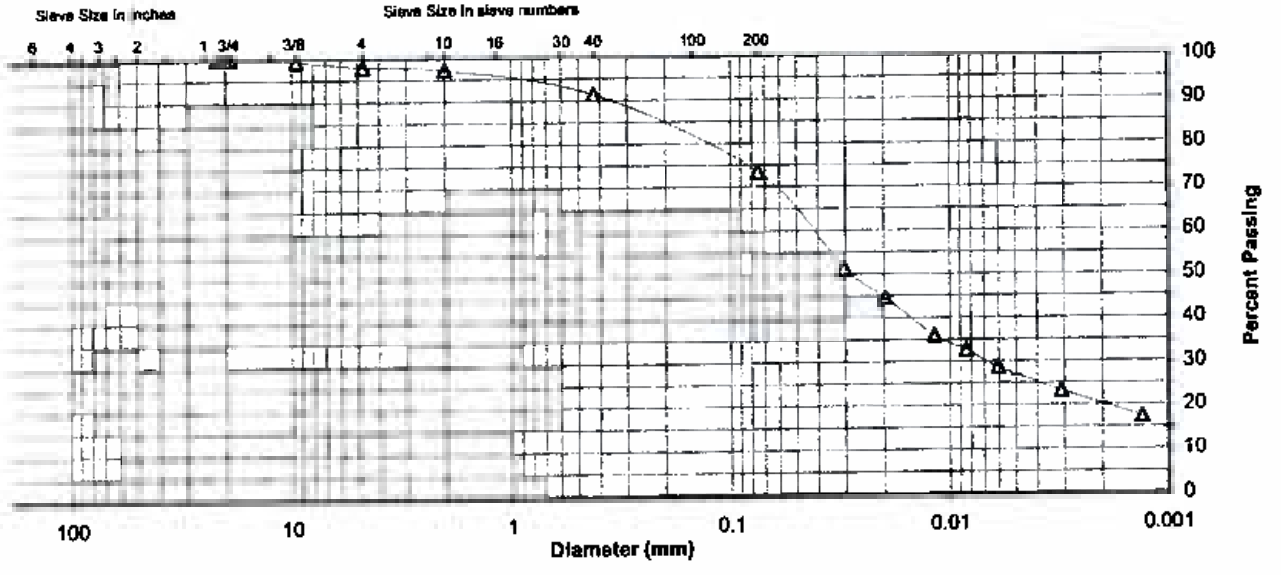
Specific Gravity: 2.71

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	91.4
No. 200	73.4
0.02 mm	44.4
0.005 mm	26.9
0.002 mm	20.1
0.001 mm	15.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	2.0	0.8	5.8	18.0	46.5	26.9
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	2.8			5.8	18.0	53.3	20.1



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-36 /SPT-3, 3.0'-4.5' & STN-36 /SPT-4, 4.5'-6.0' & STN-36 /SPT-5, 6.0'-7.5'	Lab ID	236
County	Roane (TN)	Date Received	3-30-09
Sample Type	SPT Comp	Date Reported	4-30-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	88.8
No. 4	4.75	78.2
No. 10	2	69.2
No. 40	0.425	53.2
No. 200	0.075	38.6
	0.02	28.7
	0.005	19.2
	0.002	14.6
estimated	0.001	13.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	21.8	30.8
Coarse Sand	9.0	16.0
Medium Sand	16.0	---
Fine Sand	14.6	14.6
Silt	19.4	24.0
Clay	19.2	14.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	35
Plastic Limit:	21
Plasticity Index:	14
Activity Index:	0.93

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.75

Classification

Unified Group Symbol: SC

Group Name: Clayey sand with gravel

AASHTO Classification: A-6 (2)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-36 /SPT-3, 3.0'-4.5' & STN-36 /SPT-4, 4.5'-6.0' & STN-36 /SPT-5, 6.0'-7.5'

Project Number: 171468117
Lab ID: 236

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: BWT
Test Date: 04-17-2009
Date Received: 03-30-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	88.8
No. 4	78.2
No. 10	69.2

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

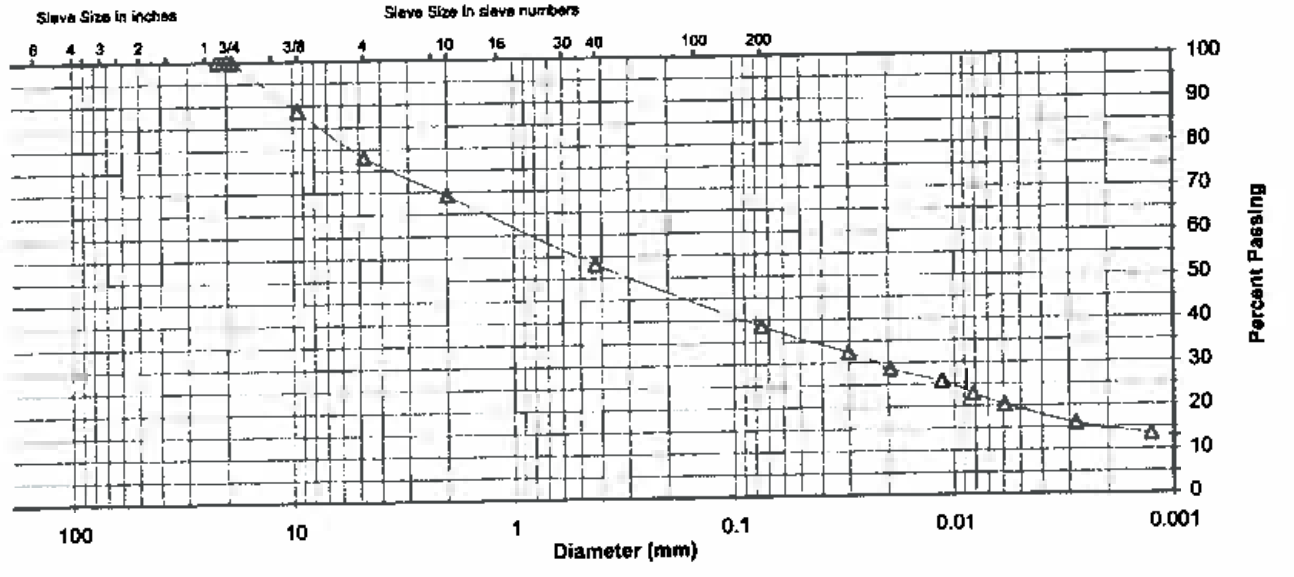
Specific Gravity: 2.75

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	53.2
No. 200	38.6
0.02 mm	28.7
0.005 mm	19.2
0.002 mm	14.6
0.001 mm	13.0

Particle Size Distribution

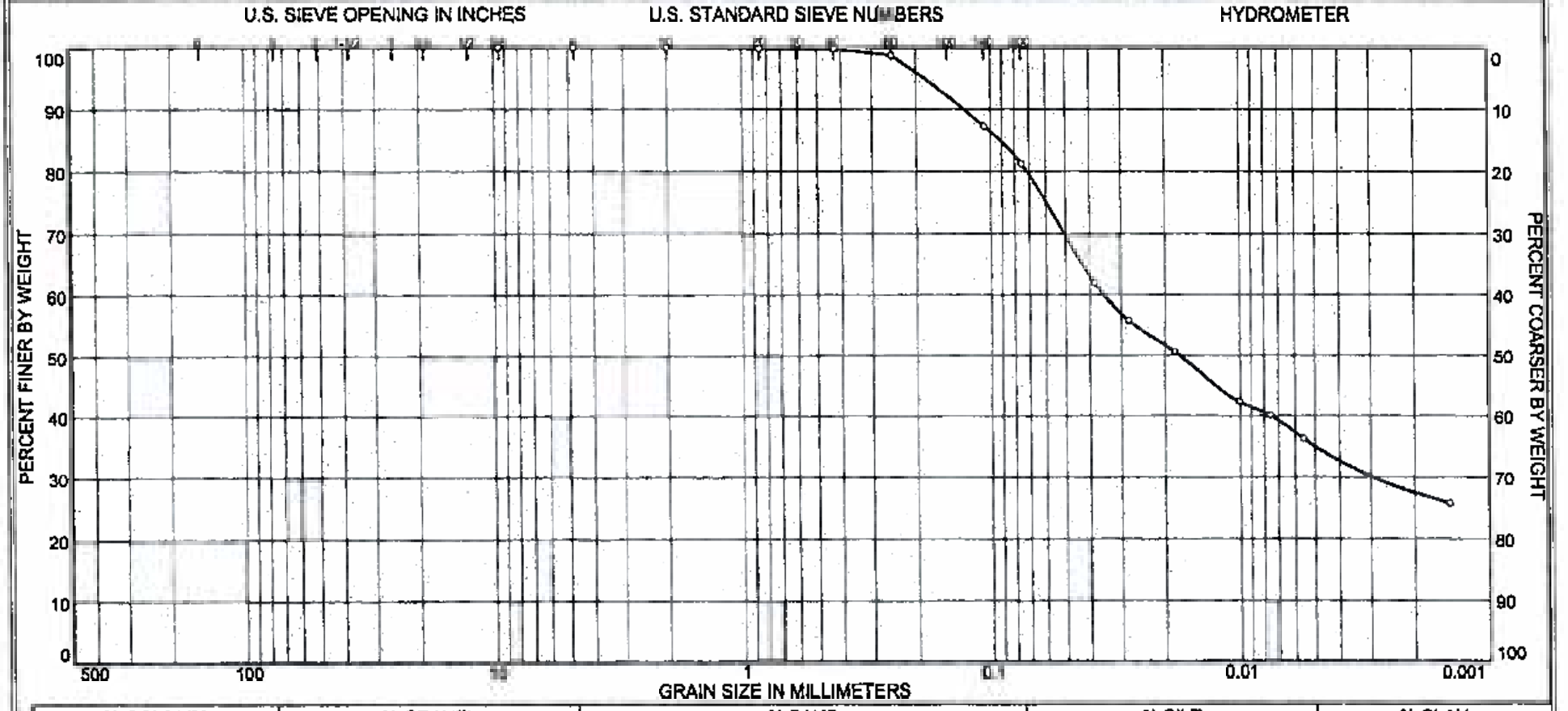
ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	21.8	9.0	16.0	14.6	18.4	19.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	30.8			16.0	14.6	24.0	14.6



Comments

Reviewed By

Particle Size Distribution Report ASTM D422/ASTM D1140



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	18.8	46.2	35.0

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
	STN-36	~~20.5-21 ft~~ 29.0 - 29.5 ft.	May 09	CL	Gray-Brown Lean clay with sand		38	23

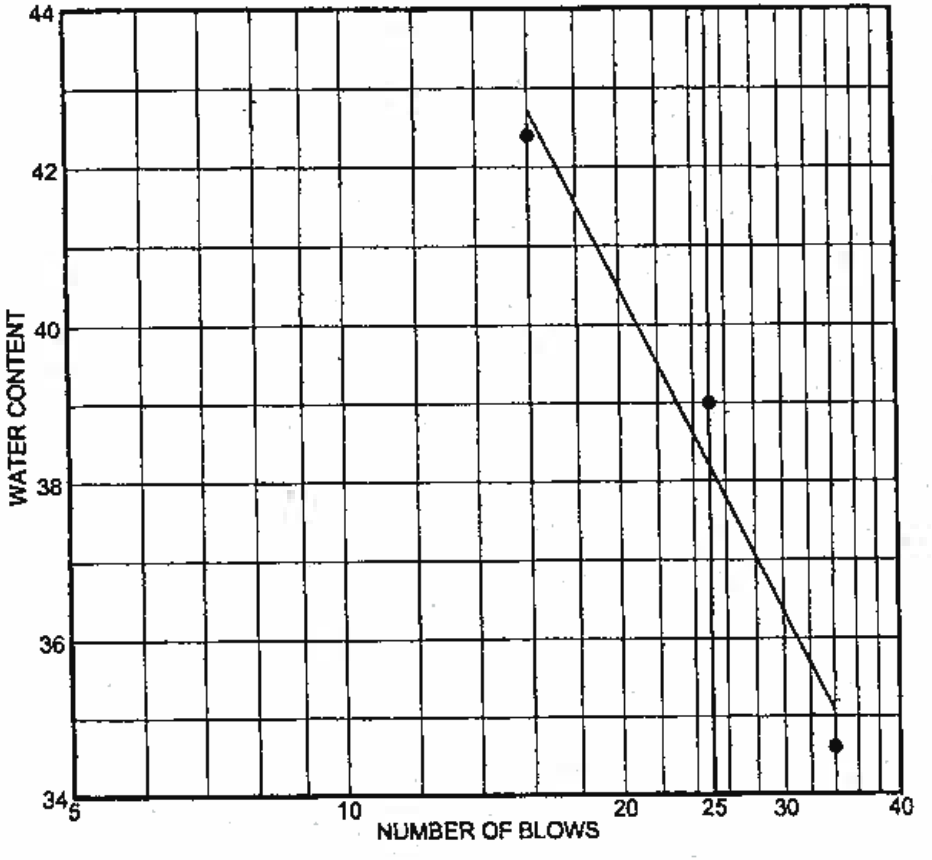
Client STANTEC

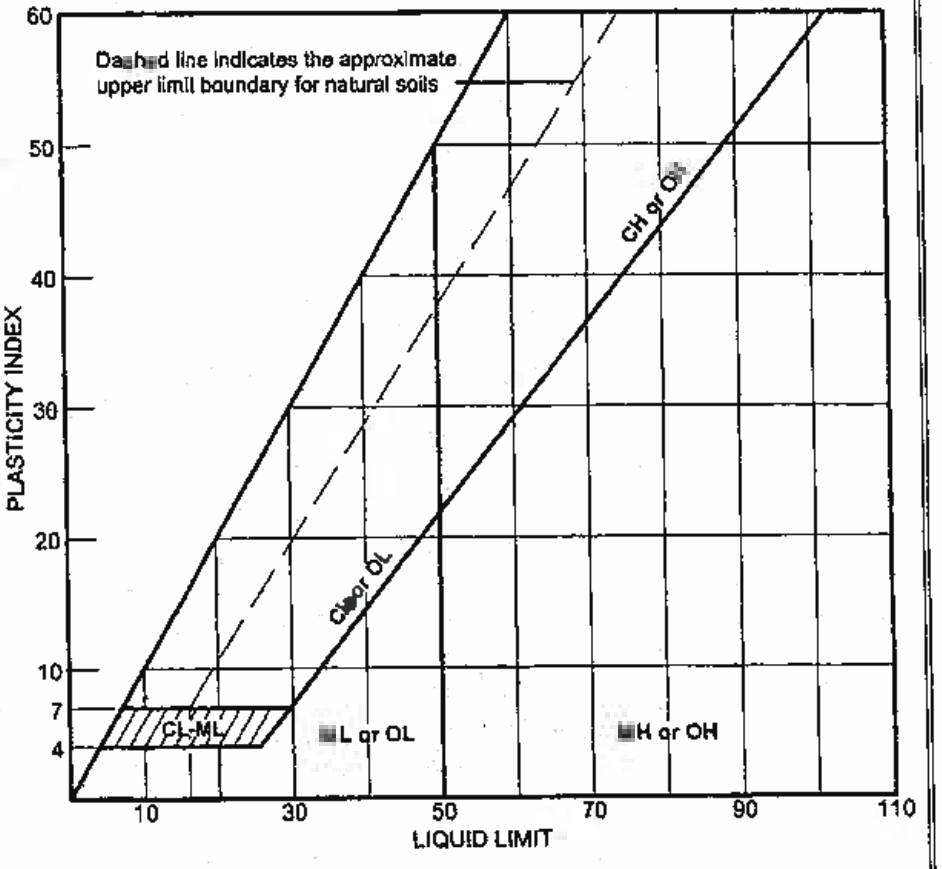
Project Kingston Ash Pond

Project No. GTX-1464 | Lab no.

GeoTesting Express Inc.

LIQUID AND PLASTIC LIMITS TEST REPORT





SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
	STN-36	~~20.5-21 ft~~ 29.0 - 29.5 ft.	May 09	CL	Gray-Brown Lean clay with sand		38	15

Client STANTEC

Project Kingston Ash Pond

Project No. GTX-1464 | Lab no.

GeoTesting Express Inc.

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-36 / SPT-21, 34.0'-35.5' & STN-36 / SPT-22, 35.5'-37.0'
Lab ID: 259
County: Roane (TN)
Date Received: 3-30-09
Sample Type: SPT Comp
Date Reported: 4-30-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	93.0
No. 4	4.75	83.9
No. 10	2	77.3
No. 40	0.425	69.8
No. 200	0.075	17.9
	0.02	12.2
	0.005	6.0
	0.002	4.3
estimated	0.001	3.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	16.1	22.7
Coarse Sand	6.6	7.5
Medium Sand	7.5	---
Fine Sand	51.9	51.9
Silt	11.9	13.6
Clay	6.0	4.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand with gravel
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-36 / SPT-21, 34.0'-35.5' & STN-36 / SPT-22, 35.5'-37.0'

Project Number: 171468117
Lab ID: 259

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

Particle Shape: Angular
Particle Hardness: Soft

Tested By: DG
Test Date: 04-21-2009
Date Received: 03-30-2009

Maximum Particle size: 3/4" Sieve

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

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	93.0
No. 4	83.9
No. 10	77.3

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

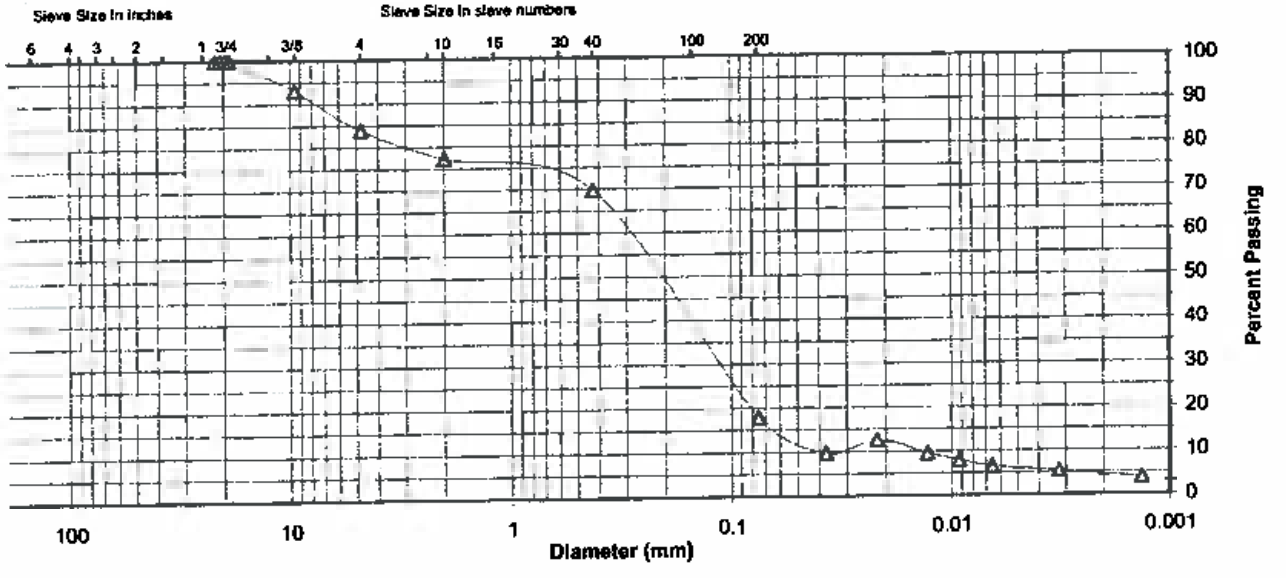
Specific Gravity: 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	69.8
No. 200	17.9
0.02 mm	12.2
0.005 mm	6.0
0.002 mm	4.3
0.001 mm	3.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	16.1	6.6	7.5	51.9	11.9	6.0
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	22.7			7.5	51.9	13.6	4.3



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-37 / SPT-3, 3.0'-4.5' & STN-37 / SPT-4, 4.5'-6.0'
Lab ID: 301
County: Roane (TN)
Date Received: 3-30-09
Sample Type: SPT Comp
Date Reported: 4-30-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	95.2
No. 4	4.75	91.7
No. 10	2	84.7
No. 40	0.425	84.4
No. 200	0.075	59.8
	0.02	43.9
	0.005	31.1
	0.002	25.6
estimated	0.001	22.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	8.3	15.3
Coarse Sand	7.0	0.3
Medium Sand	0.3	--
Fine Sand	24.6	24.6
Silt	28.7	34.2
Clay	31.1	25.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 45
Plastic Limit: 18
Plasticity Index: 27
Activity Index: 1.04

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.71

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay
AASHTO Classification: A-7-6 (13)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-37 / SPT-3, 3.0'-4.5' & STN-37 / SPT-4, 4.5'-6.0'

Project Number: 171468117
Lab ID: 301

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: BWT
Test Date: 04-21-2009
Date Received: 03-30-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	95.2
No. 4	91.7
No. 10	84.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

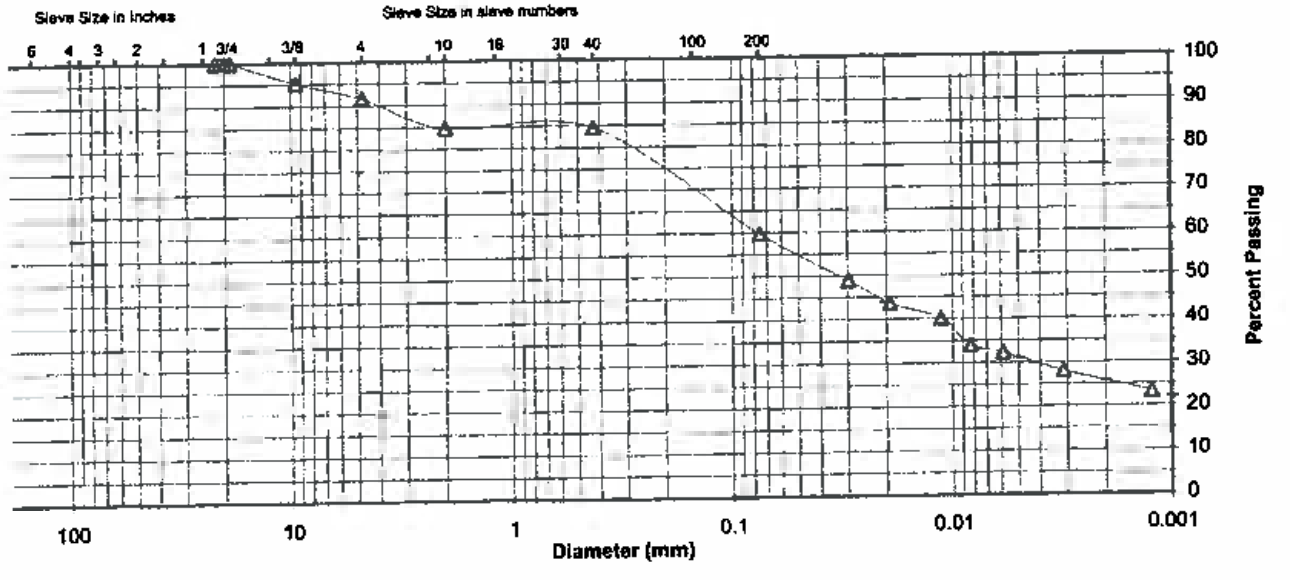
Specific Gravity: 2.71

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	84.4
No. 200	59.8
0.02 mm	43.9
0.005 mm	31.1
0.002 mm	25.6
0.001 mm	22.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	8.3	7.0	0.3	24.6	28.7	31.1
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	15.3			0.3	24.6	34.2	25.6



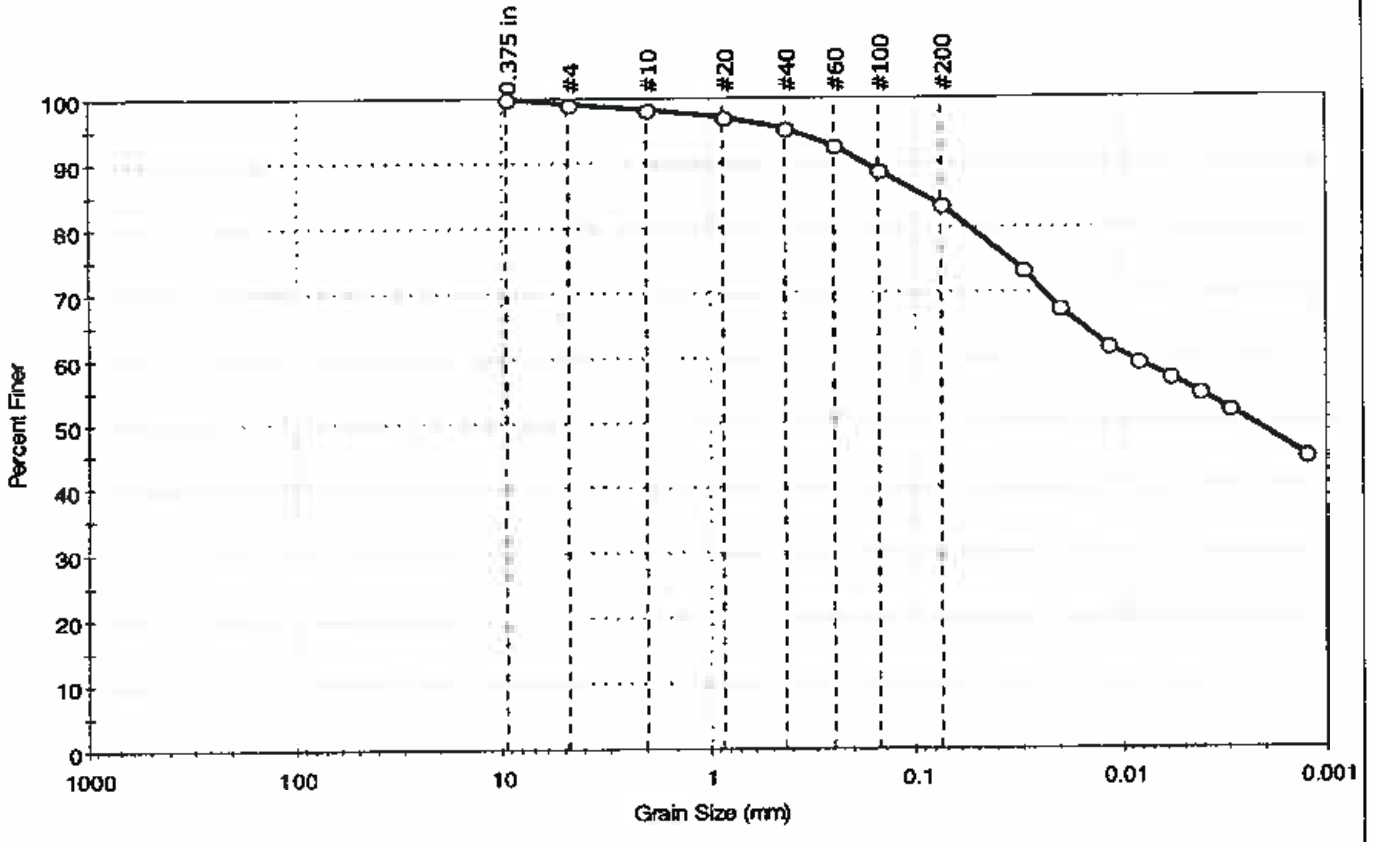
Comments

Reviewed By

GeoTesting express
a subsidiary of Geocomp Corporation

Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond		
Location:	Roane, TN	Project No:	GTX-9015
Boring ID:	STN-37	Sample Type: tube	Tested By: jbr
Sample ID:	S #3 2B	Test Date: 05/17/09	Checked By: jdt
Depth :	14.3-14.8 ft	Test Id: 152223	
Test Comment:	---		
Sample Description:	Moist, reddish yellow clay with sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



%Cobble	%Gravel	%Sand	%Silt & Clay Size
--	0.8	15.6	83.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	99		
#10	2.00	98		
#20	0.85	97		
#40	0.42	95		
#60	0.25	93		
#100	0.15	89		
#200	0.075	84		
--	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
--	0.0300	71		
--	0.0200	68		
--	0.0116	62		
--	0.0083	59		
--	0.0059	57		
--	0.0042	54		
--	0.0030	52		
--	0.0013	45		

Coefficients

D_{85} = 0.0900 mm	D_{30} = N/A
D_{60} = 0.0093 mm	D_{15} = N/A
D_{50} = 0.0023 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM fat clay with sand (CH)

AASHTO Clayey Soils (A-7-6 (31))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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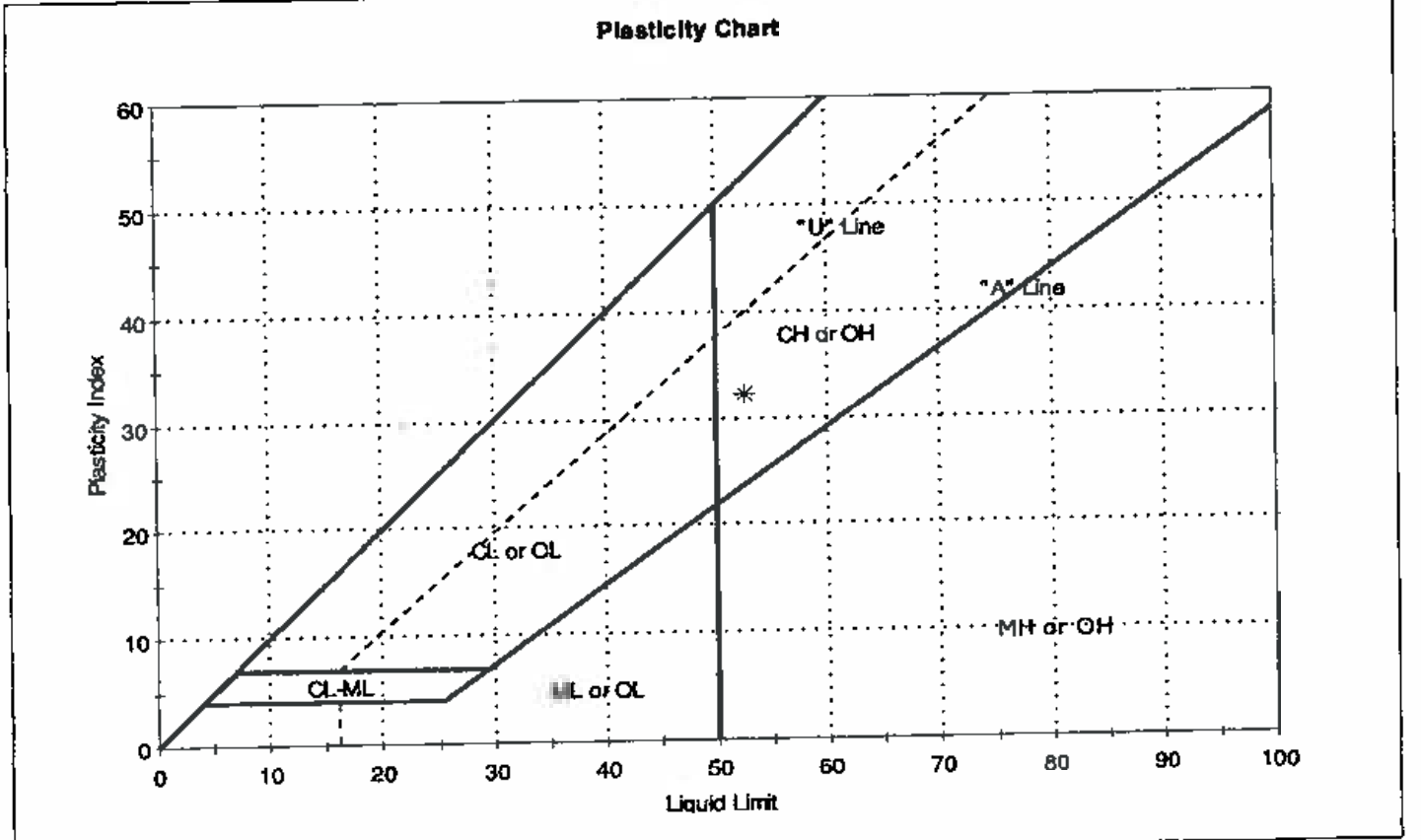
GeoTesting express
a subsidiary of Geocomp Corporation

Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond	Project No:	GTX-9015
Location:	Roane, TN		
Boring ID:	STN-37	Sample Type: tube	Tested By: cam
Sample ID:	S #342B	Test Date: 05/18/09	Checked By: jdt
Depth :	14.3-14.8 ft	Test Id: 152220	
Test Comment:	---		
Sample Description:	Moist, reddish yellow clay with sand		
Sample Comment:	---		

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
■	S #342B	STN-37	14.3-14.8 ft	27	52	20	32	0	fat clay with sand (CH)

Sample Prepared using the WET method
5% Retained on #40 Sieve
Dry Strength: HIGH
Dilentancy: SLOW
Toughness: LOW

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Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-37 / SPT-18, 29.5'-31.0' & STN-37 / SPT-19, 31.0'-32.5'
Lab ID: 317
County: Roane (TN)
Date Received: 3-30-09
Sample Type: SPT Comp
Date Reported: 4-30-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	99.7
No. 4	4.75	99.7
No. 10	2	99.4
No. 40	0.425	99.2
No. 200	0.075	70.4
	0.02	52.6
	0.005	37.0
	0.002	31.1
estimated	0.001	26.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.3	0.6
Coarse Sand	0.3	0.2
Medium Sand	0.2	—
Fine Sand	28.8	28.8
Silt	33.4	39.3
Clay	37.0	31.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 31
Plastic Limit: 17
Plasticity Index: 14
Activity Index: 0.45

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.68

Classification

Unified Group Symbol: CL
Group Name: Lean clay with sand
AASHTO Classification: A-6 (8)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-37 / SPT-18, 29.5'-31.0' & STN-37 / SPT-19, 31.0'-32.5'

Project Number: 171468117
Lab ID: 317

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: Soft

Tested By: DG
Test Date: 04-22-2009
Date Received: 03-30-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	99.7
No. 4	99.7
No. 10	99.4

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

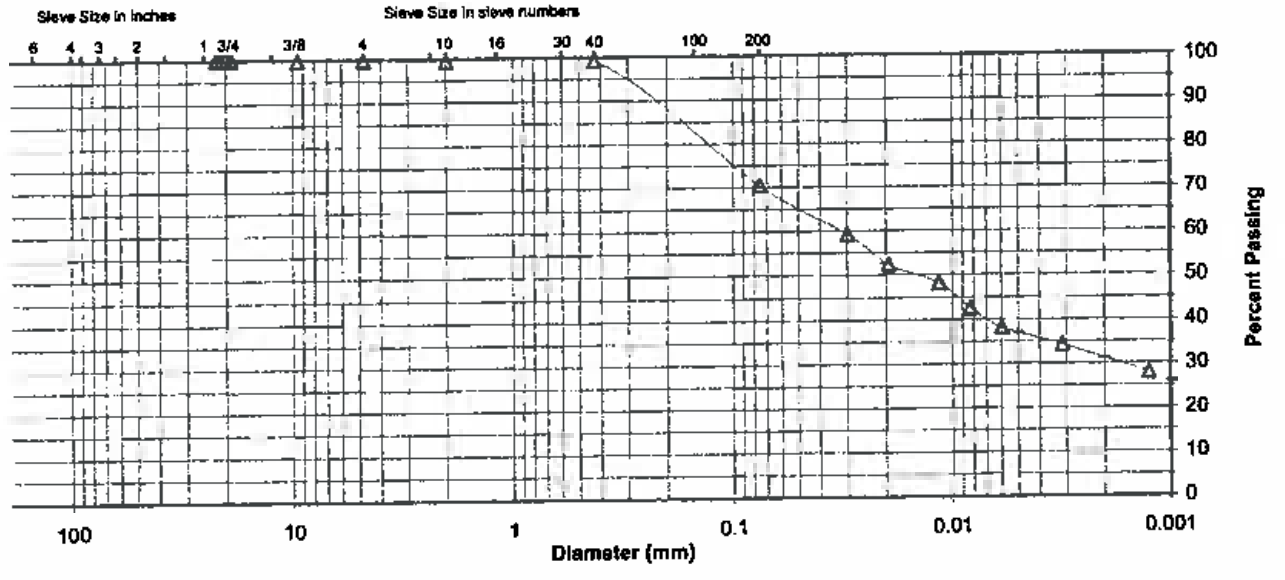
Specific Gravity: 2.68

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.2
No. 200	70.4
0.02 mm	52.6
0.005 mm	37.0
0.002 mm	31.1
0.001 mm	26.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.3	0.3	0.2	28.8	33.4	37.0
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.6			0.2	28.8	39.3	31.1



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-37 / SPT-25, 42.0'-43.5' & STN-37 / SPT-26, 43.5'-45.0'
Project Number: 171468117
Lab ID: 325
County: Roane (TN)
Sample Type: SPT Comp
Date Received: 3-30-09
Date Reported: 4-30-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	100.0
1"	25	—
3/4"	19	92.4
3/8"	9.5	88.3
No. 4	4.75	87.6
No. 10	2	85.9
No. 40	0.425	81.9
No. 200	0.075	13.9
	0.02	8.4
	0.005	7.2
	0.002	5.8
estimated	0.001	4.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	12.4	14.1
Coarse Sand	1.7	4.0
Medium Sand	4.0	—
Fine Sand	68.0	68.0
Silt	6.7	8.1
Clay	7.2	5.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.65

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-37 / SPT-25, 42.0'-43.5' & STN-37 / SPT-26, 43.5'-45.0'

Project Number: 171468117
Lab ID: 325

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: DG
Test Date: 04-22-2009
Date Received: 03-30-2009

Maximum Particle size: 1 1/2" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	100.0
1"	---
3/4"	92.4
3/8"	88.3
No. 4	87.6
No. 10	85.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

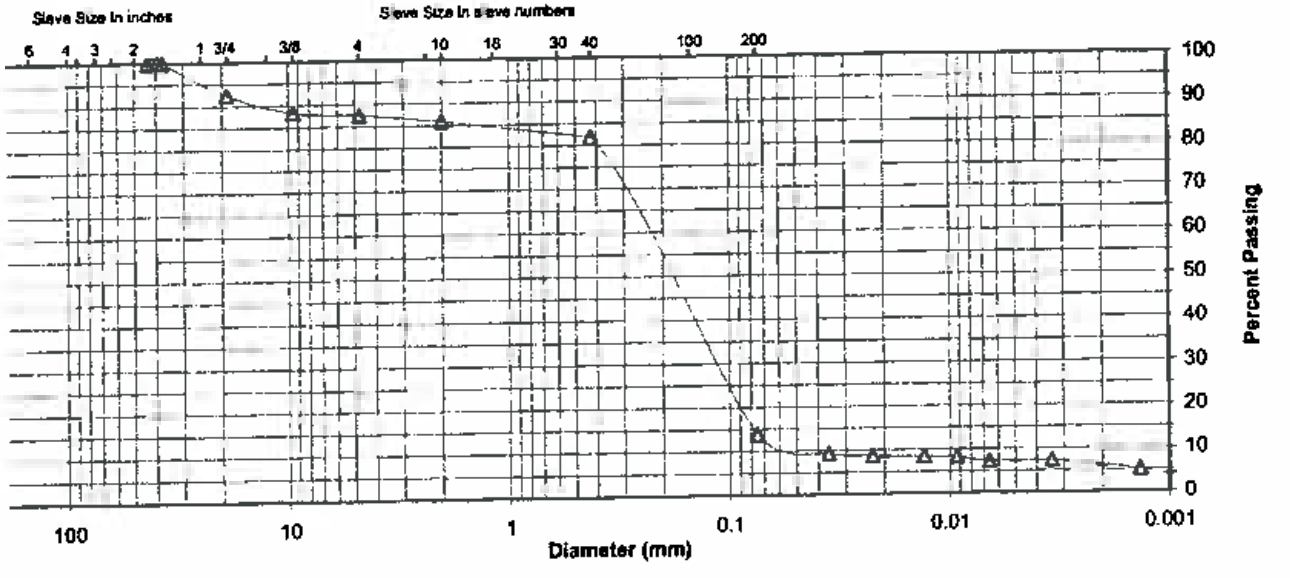
Specific Gravity: 2.65

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	81.9
No. 200	13.9
0.02 mm	8.4
0.005 mm	7.2
0.002 mm	5.8
0.001 mm	4.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	7.6	4.8	1.7	4.0	68.0	6.7	7.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	14.1			4.0	68.0	8.1	5.8



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	175569042
Source	STN-38, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'	Lab ID	411
County	Kingston, Tennessee	Date Received	5-26-09
Sample Type	SPT Comp	Date Reported	6-24-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	97.9
No. 4	4.75	94.8
No. 10	2	91.5
No. 40	0.425	83.8
No. 200	0.075	69.6
	0.02	59.4
	0.005	49.5
	0.002	43.4
estimated	0.001	40.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	5.2	8.5
Coarse Sand	3.3	7.7
Medium Sand	7.7	---
Fine Sand	14.2	14.2
Silt	20.1	26.2
Clay	49.5	43.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 47
Plastic Limit: 20
Plasticity Index: 27
Activity Index: 0.63

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.75

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay

AASHTO Classification: A-7-6 (18)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-38, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'

Project Number: 175569042
Lab ID: 411

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: BWT
Test Date: 06-09-2009
Date Received: 05-26-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	97.9
No. 4	94.8
No. 10	91.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

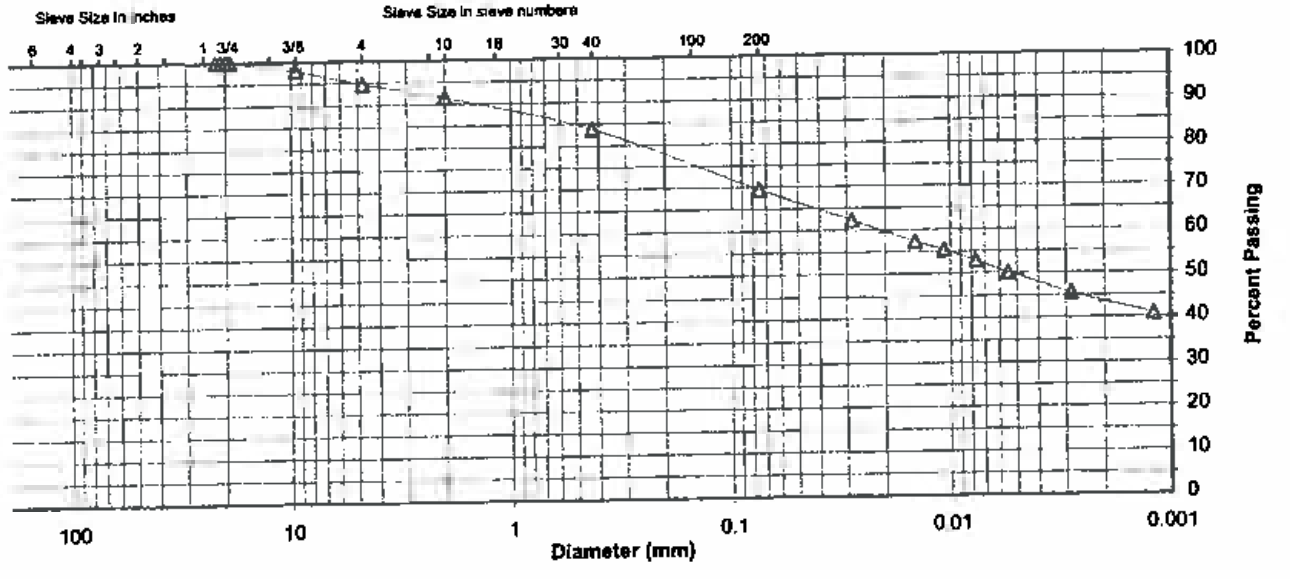
Specific Gravity: 2.75

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	83.8
No. 200	69.6
0.02 mm	59.4
0.005 mm	49.5
0.002 mm	43.4
0.001 mm	40.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	5.2	3.3	7.7	14.2	20.1	49.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	8.5			7.7	14.2	26.2	43.4



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	175569042
Source	STN-38, 42.0'-43.5', 43.5'-45.0'	Lab ID	435
County	Kingston, Tennessee	Date Received	5-26-09
Sample Type	SPT Comp	Date Reported	6-24-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.8
No. 200	0.075	26.6
	0.02	13.7
	0.005	9.8
	0.002	6.8
estimated	0.001	5.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.2
Medium Sand	0.2	—
Fine Sand	73.2	73.2
Silt	16.8	19.8
Clay	9.8	6.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-38, 42.0'-43.5', 43.5'-45.0'

Project Number: 175569042
Lab ID: 435

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 06-09-2009
Date Received: 05-26-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.67

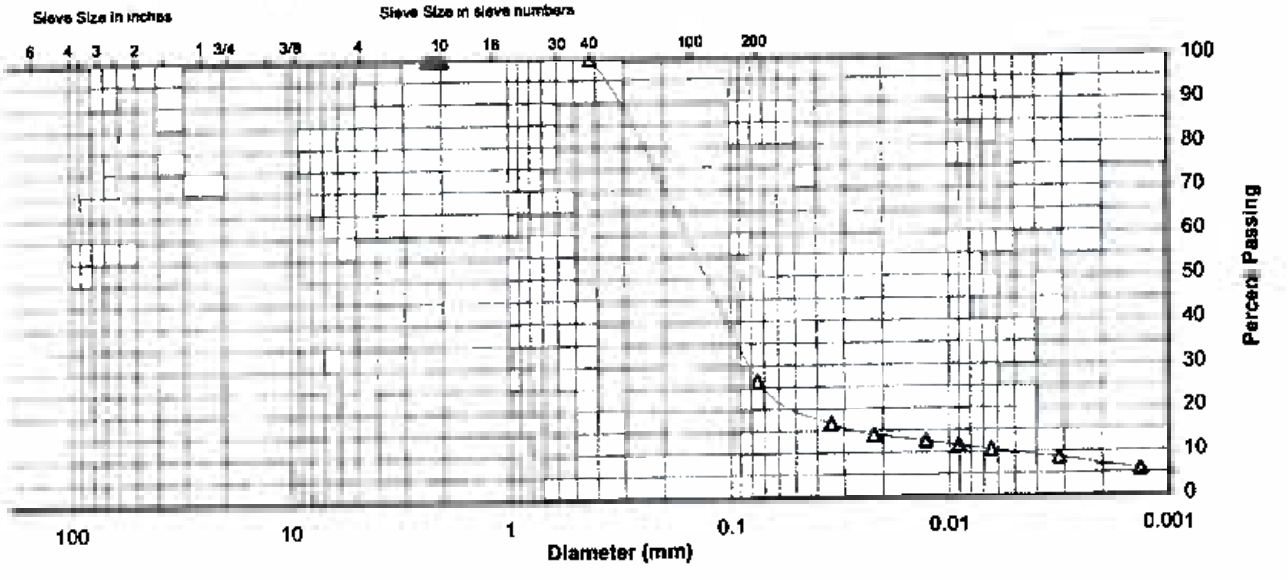
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.8
No. 200	26.6
0.02 mm	13.7
0.005 mm	9.8
0.002 mm	6.8
0.001 mm	5.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.9	0.2	73.2	16.8	9.8

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.2	73.2	19.8	6.8



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-41, 15.1'-15.6'
Project Number: 175569042
Lab ID: 563
County: Kingston, Tennessee
Sample Type: UD
Date Received: 5-27-09
Date Reported: 6-30-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 20.4

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	97.3
No. 4	4.75	93.9
No. 10	2	88.5
No. 40	0.425	80.9
No. 200	0.075	57.5
	0.02	44.2
	0.005	36.1
	0.002	30.4
estimated	0.001	27.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	6.1	11.5
Coarse Sand	5.4	7.6
Medium Sand	7.6	---
Fine Sand	23.4	23.4
Silt	21.4	27.1
Clay	36.1	30.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 34
Plastic Limit: 18
Plasticity Index: 16
Activity Index: 0.53

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.74

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay
AASHTO Classification: A-6 (6)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-41, 15.1'-15.6'

Project Number: 175569042
Lab ID: 563

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: BWT
Test Date: 06-15-2009
Date Received: 05-27-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	97.3
No. 4	93.9
No. 10	88.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

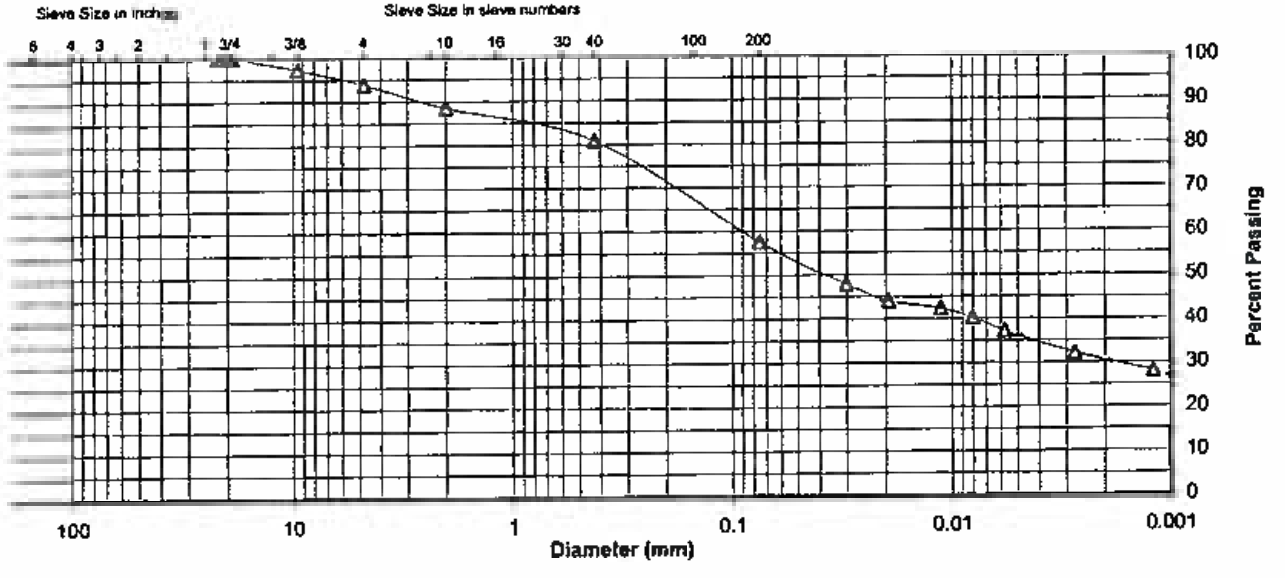
Specific Gravity: 2.74

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	80.9
No. 200	57.5
0.02 mm	44.2
0.005 mm	36.1
0.002 mm	30.4
0.001 mm	27.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	6.1	5.4	7.6	23.4	21.4	36.1
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	11.5			7.6	23.4	27.1	30.4



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-41, 26.0'-27.5', 27.5'-29.0'	Lab ID	1261
County	Roane (TN)	Date Received	4-27-09
Sample Type	SPT Comp	Date Reported	5-18-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.7
No. 200	0.075	23.4
	0.02	13.4
	0.005	9.2
	0.002	7.4
estimated	0.001	6.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.3
Medium Sand	0.3	—
Fine Sand	76.3	76.3
Silt	14.2	16.0
Clay	9.2	7.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-41, 26.0'-27.5', 27.5'-29.0'

Project Number: 171468117
Lab ID: 1261

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 05-08-2009
Date Received: 04-27-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.67

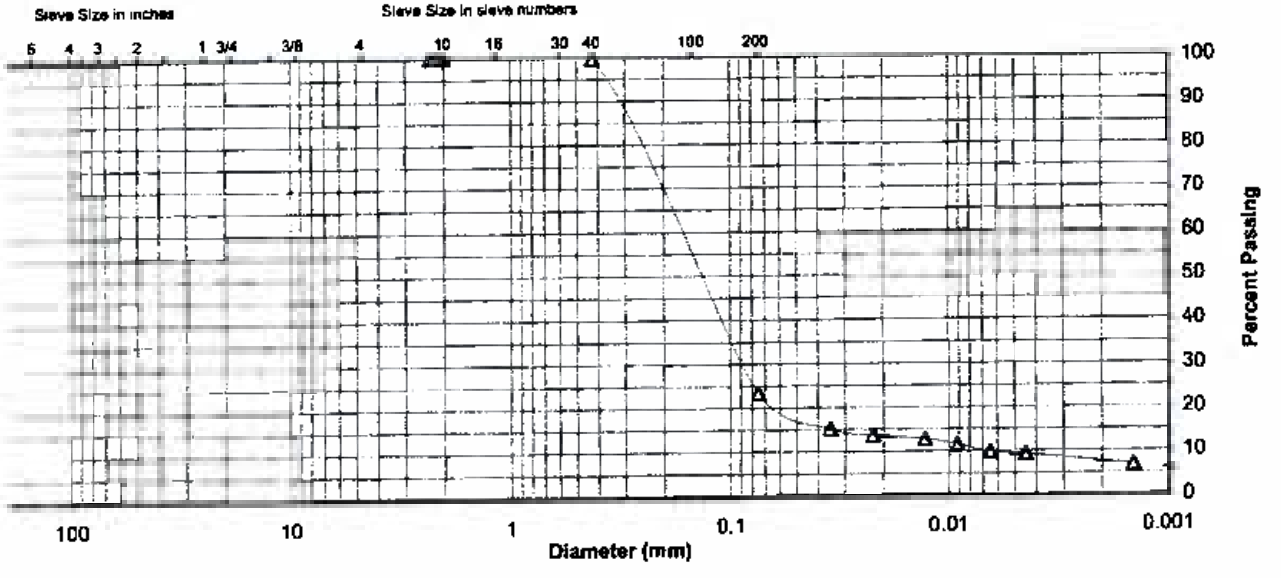
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.7
No. 200	23.4
0.02 mm	13.4
0.005 mm	9.2
0.002 mm	7.4
0.001 mm	6.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.3	76.3	14.2	9.2

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.3	76.3	16.0	7.4



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-42, 27.5'-29.0', 29.0'-30.5'
Project Number: 171468117
Lab ID: 1055

County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-23-09
Date Reported: 5-12-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.9
No. 200	0.075	40.3
	0.02	23.2
	0.005	17.0
	0.002	14.4
estimated	0.001	14.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.1
Medium Sand	0.1	--
Fine Sand	59.6	59.6
Silt	23.3	25.9
Clay	17.0	14.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 18
Plastic Limit: 17
Plasticity Index: 1
Activity Index: 0.07

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.68

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-42, 27.5'-29.0', 29.0'-30.5'

Project Number: 171468117
Lab ID: 1055

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: RHB
Test Date: 05-06-2009
Date Received: 04-23-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.68

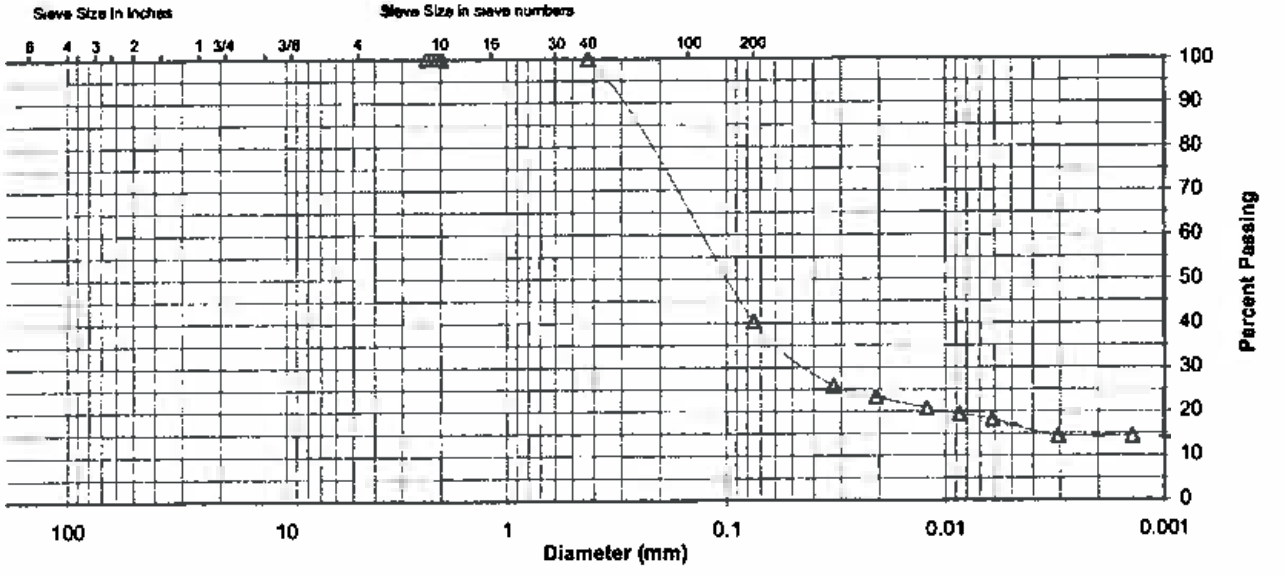
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.9
No. 200	40.3
0.02 mm	23.2
0.005 mm	17.0
0.002 mm	14.4
0.001 mm	14.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.1	59.8	23.3	17.0

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.0	0.1	59.8	25.9	14.4



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-42, 41.0'-42.5', 42.5'-44.0'	Lab ID	1065
County	Roane (TN)	Date Received	4-23-09
Sample Type	SPT Comp	Date Reported	5-13-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	100.0
No. 40	0.425	98.5
No. 200	0.075	16.9
	0.02	7.6
	0.005	5.5
	0.002	4.3
estimated	0.001	4.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	1.5
Medium Sand	1.5	—
Fine Sand	81.6	81.6
Silt	11.4	12.6
Clay	5.5	4.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-42, 41.0'-42.5', 42.5'-44.0'

Project Number: 171468117
Lab ID: 1065

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: RHB
Test Date: 05-05-2009
Date Received: 04-23-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.66

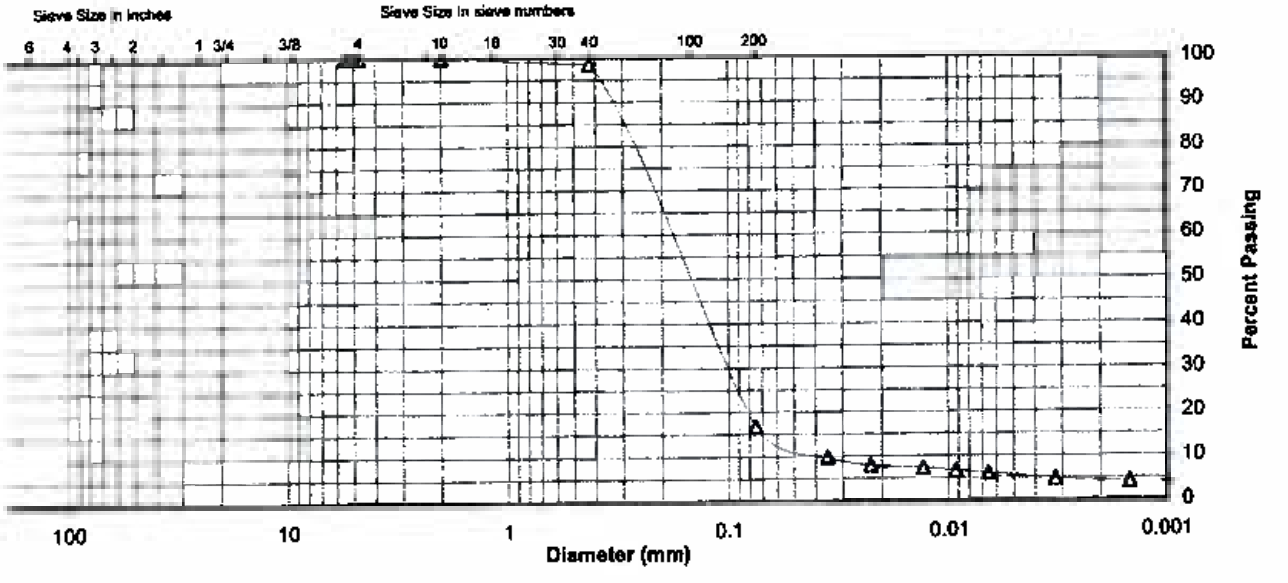
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.5
No. 200	16.9
0.02 mm	7.6
0.005 mm	5.5
0.002 mm	4.3
0.001 mm	4.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	1.5	81.6	11.4	5.5

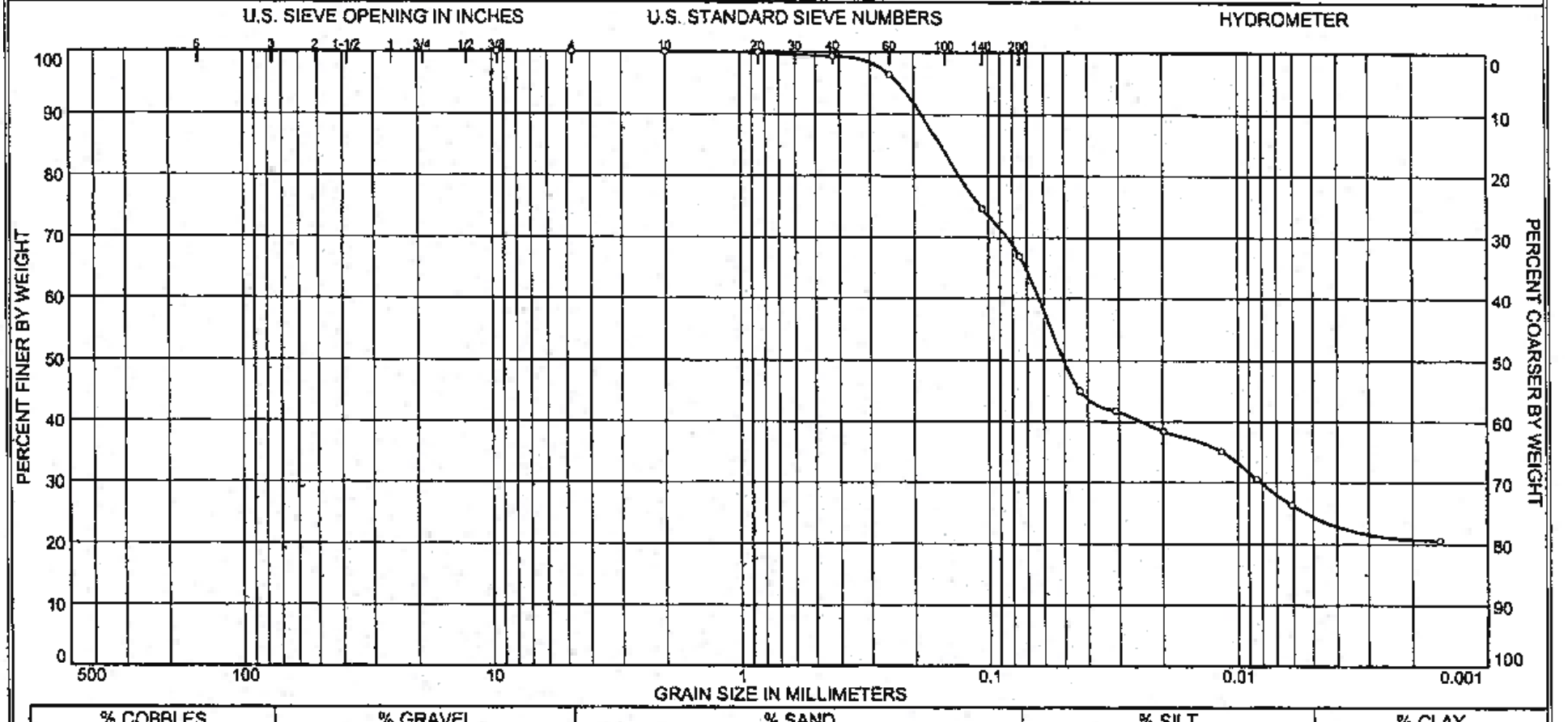
AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.0	1.5	81.6	12.8	4.3



Comments

Reviewed By

Particle Size Distribution Report ASTM D422/ASTM D1140



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	33.1	42.5	24.4

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
	~~STN-48~~ STN-43	29.1-29.6 ft	May 09	CL-ML	Gray Brown Sandy silty clay		27	20

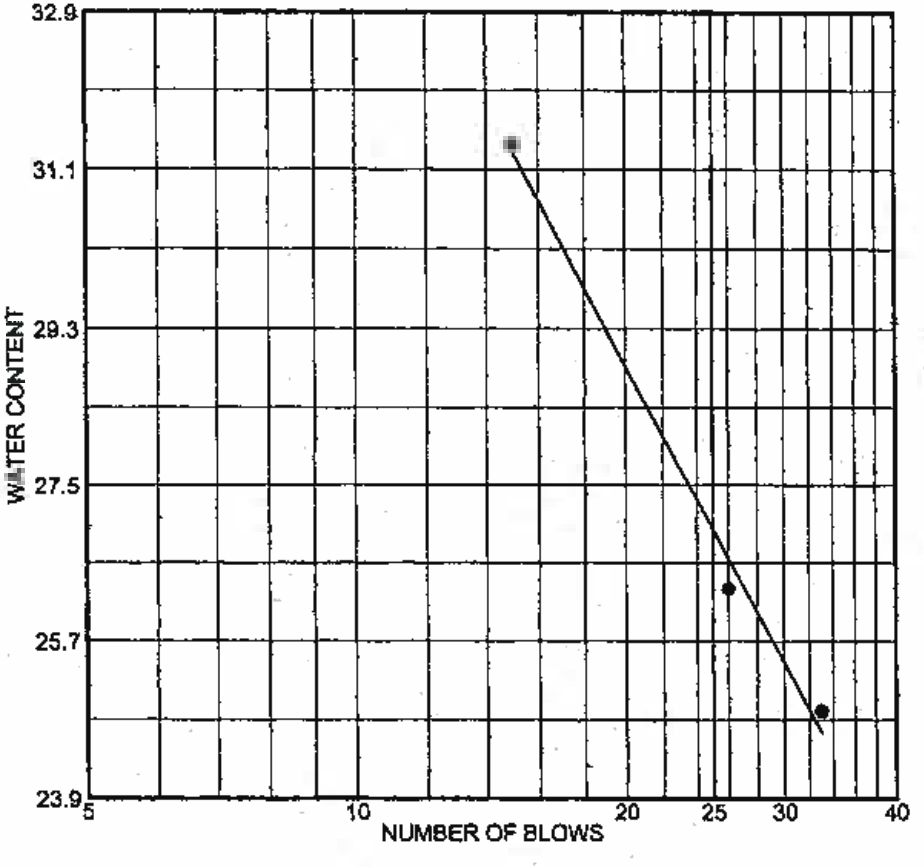
Client STANTEC

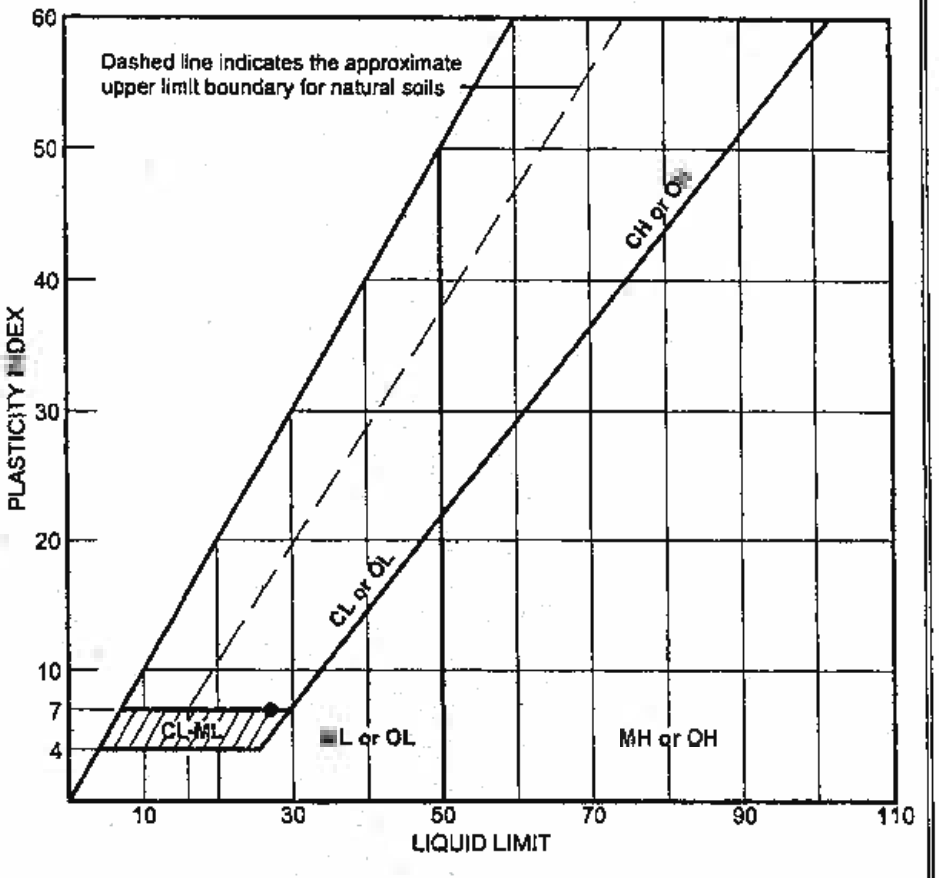
Project Kingston Ash Pond

Project No. GTX-1464 | Lab no

GeoTesting Express Inc.

LIQUID AND PLASTIC LIMITS TEST REPORT





SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
	~~STN-48~~ STN-43	29.1-29.6 ft	May 09	CL-ML	Gray Brown Sandy silty clay		27	7

Client STANTEC

Project Kingston Ash Pond

Project No. GTX-1464 | Lab no.

GeoTesting Express Inc.

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-43, 40.0'-41.5', 41.5'-43.0'
Project Number: 171468117
Lab ID: 682

County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-14-09
Date Reported: 5-11-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.5
No. 200	0.075	19.7
	0.02	12.2
	0.005	7.9
	0.002	6.0
estimated	0.001	4.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.5
Medium Sand	0.5	—
Fine Sand	79.8	79.8
Silt	11.8	13.7
Clay	7.9	6.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.64

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-43, 40.0'-41.5', 41.5'-43.0'

Project Number: 171468117
Lab ID: 682

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 04-17-2009
Date Received: 04-14-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.64

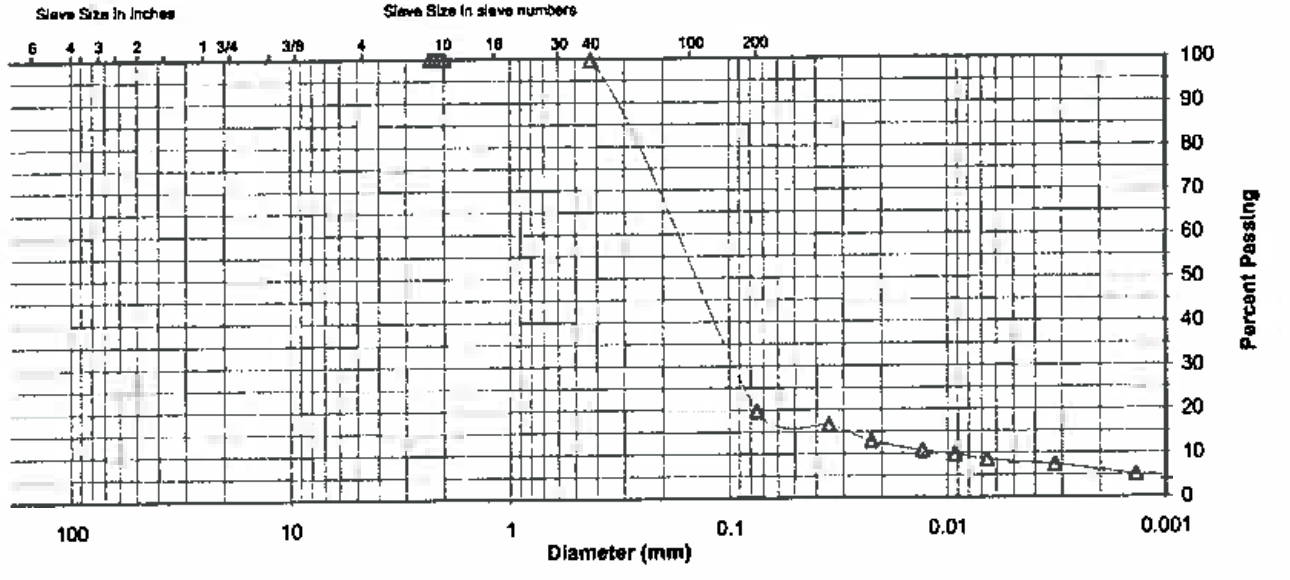
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.5
No. 200	19.7
0.02 mm	12.2
0.005 mm	7.9
0.002 mm	6.0
0.001 mm	4.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.5	79.8	11.8	7.9

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.0	0.5	79.8	13.7	6.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	175569042
Source	STN-45, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'	Lab ID	448
County	Kingston, Tennessee	Date Received	5-26-09
Sample Type	SPT Comp	Date Reported	6-24-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	96.4
No. 4	4.75	94.3
No. 10	2	91.8
No. 40	0.425	85.2
No. 200	0.075	70.5
	0.02	55.4
	0.005	43.7
	0.002	37.1
estimated	0.001	33.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	5.7	8.2
Coarse Sand	2.5	6.6
Medium Sand	6.6	—
Fine Sand	14.7	14.7
Silt	26.8	33.4
Clay	43.7	37.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	40
Plastic Limit:	20
Plasticity Index:	20
Activity Index:	0.54

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.64

Classification

Unified Group Symbol: CL

Group Name: Lean clay with sand

AASHTO Classification: A-6 (12)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-45, 7.5'-9.0', 9.0'-10.5', 10.5'-12.0'

Project Number: 175569042
Lab ID: 448

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: BWT
Test Date: 06-10-2009
Date Received: 05-26-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	96.4
No. 4	94.3
No. 10	91.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

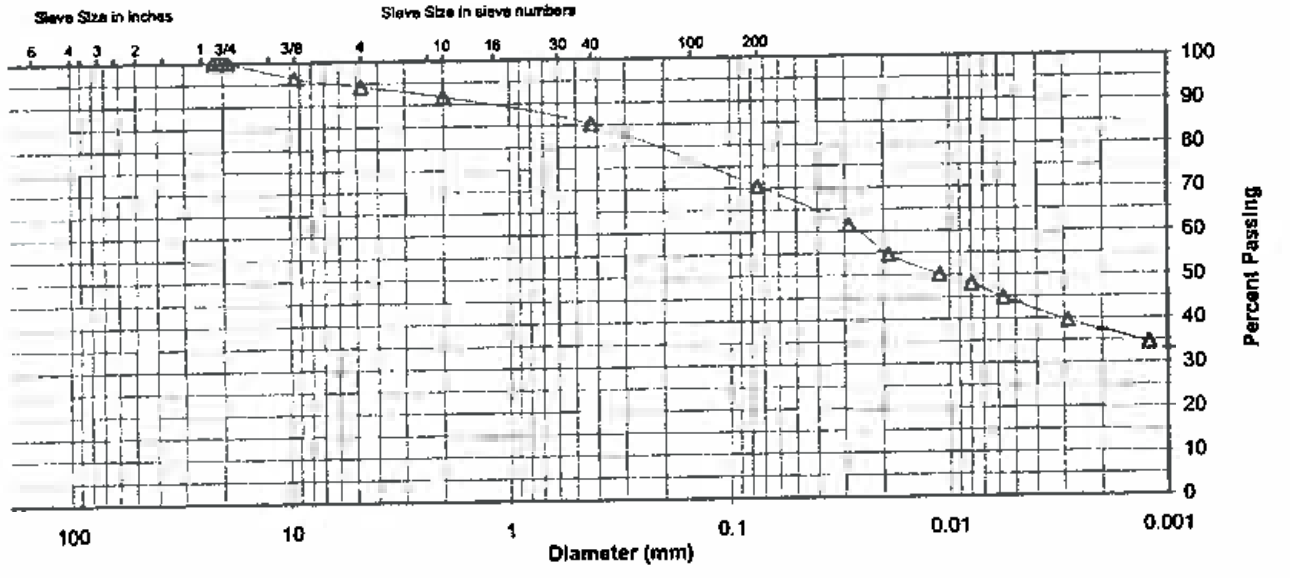
Specific Gravity: 2.64

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	85.2
No. 200	70.5
0.02 mm	55.4
0.005 mm	43.7
0.002 mm	37.1
0.001 mm	33.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	5.7	2.5	6.8	14.7	26.8	43.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	8.2			5.6	14.7	33.4	37.1



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	175569042
Source	STN-45, 30.0'-31.5', 31.5'-33.0'	Lab ID	464
County	Kingston, Tennessee	Date Received	5-26-09
Sample Type	SPT Comp	Date Reported	6-24-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	100.0
No. 10	2	99.8
No. 40	0.425	99.3
No. 200	0.075	72.7
	0.02	44.6
	0.005	30.8
	0.002	24.8
estimated	0.001	22.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.2
Coarse Sand	0.2	0.5
Medium Sand	0.5	—
Fine Sand	26.6	26.6
Silt	41.9	47.9
Clay	30.8	24.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	30
Plastic Limit:	18
Plasticity Index:	12
Activity Index:	0.48

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.68

Classification

Unified Group Symbol: CL

Group Name: Lean clay with sand

AASHTO Classification: A-6 (7)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-45, 30.0'-31.5', 31.5'-33.0'

Project Number: 175569042
Lab ID: 464

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: BWT
Test Date: 06-15-2009
Date Received: 05-26-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	100.0
No. 10	99.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

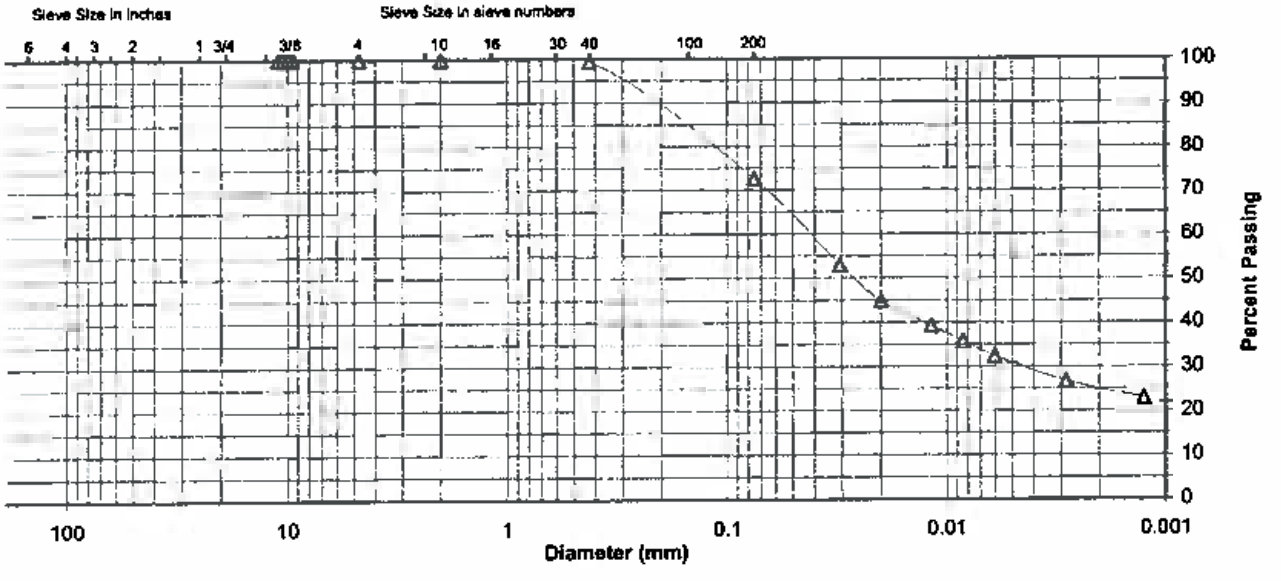
Specific Gravity: 2.68

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.3
No. 200	72.7
0.02 mm	44.6
0.005 mm	30.8
0.002 mm	24.8
0.001 mm	22.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.2	0.5	26.6	41.9	30.8
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.2			0.5	26.6	47.9	24.8



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-47 / SPT-11, 17.0'-18.5' & STN-47 / SPT-12, 18.5'-20.0'	Lab ID	423
County	Roane (TN)	Date Received	4-6-09
Sample Type	SPT Comp	Date Reported	4-30-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.9
No. 200	0.075	39.1
	0.02	16.5
	0.005	13.6
	0.002	11.6
estimated	0.001	10.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.1
Medium Sand	0.1	—
Fine Sand	60.8	60.8
Silt	25.5	27.5
Clay	13.6	11.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-47 / SPT-11, 17.0'-18.5' & STN-47 / SPT-12, 18.5'-20.0'

Project Number: 171468117
Lab ID: 423

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: KWS
Test Date: 04-15-2009
Date Received: 04-06-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

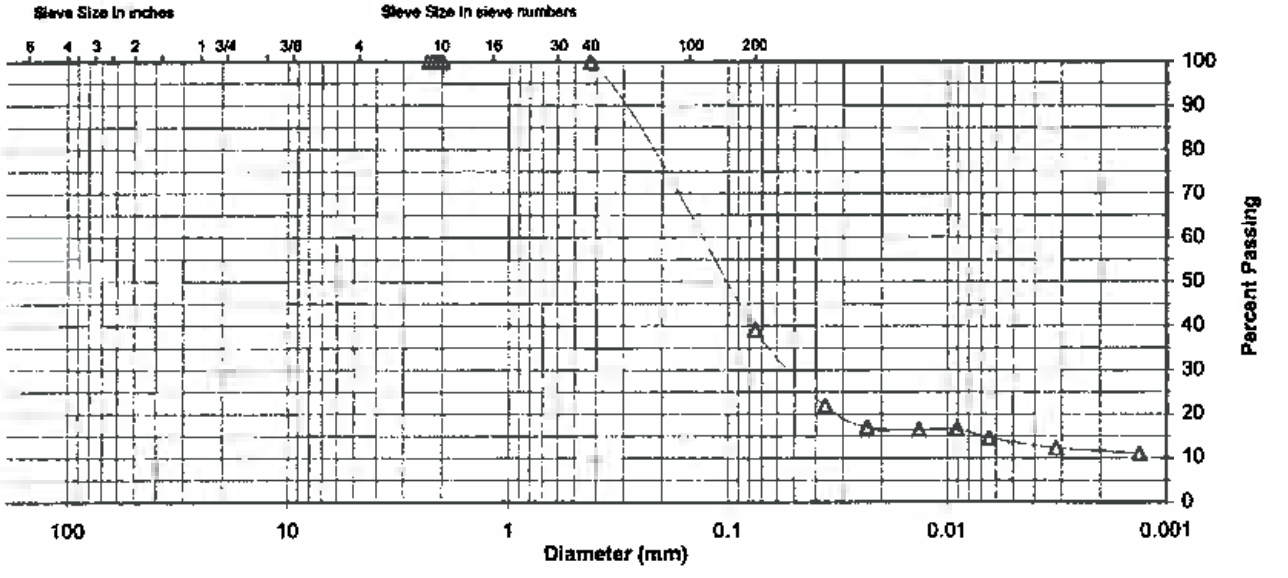
Specific Gravity: 2.66

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.9
No. 200	39.1
0.02 mm	16.5
0.005 mm	13.6
0.002 mm	11.6
0.001 mm	10.0

Particle Size Distribution

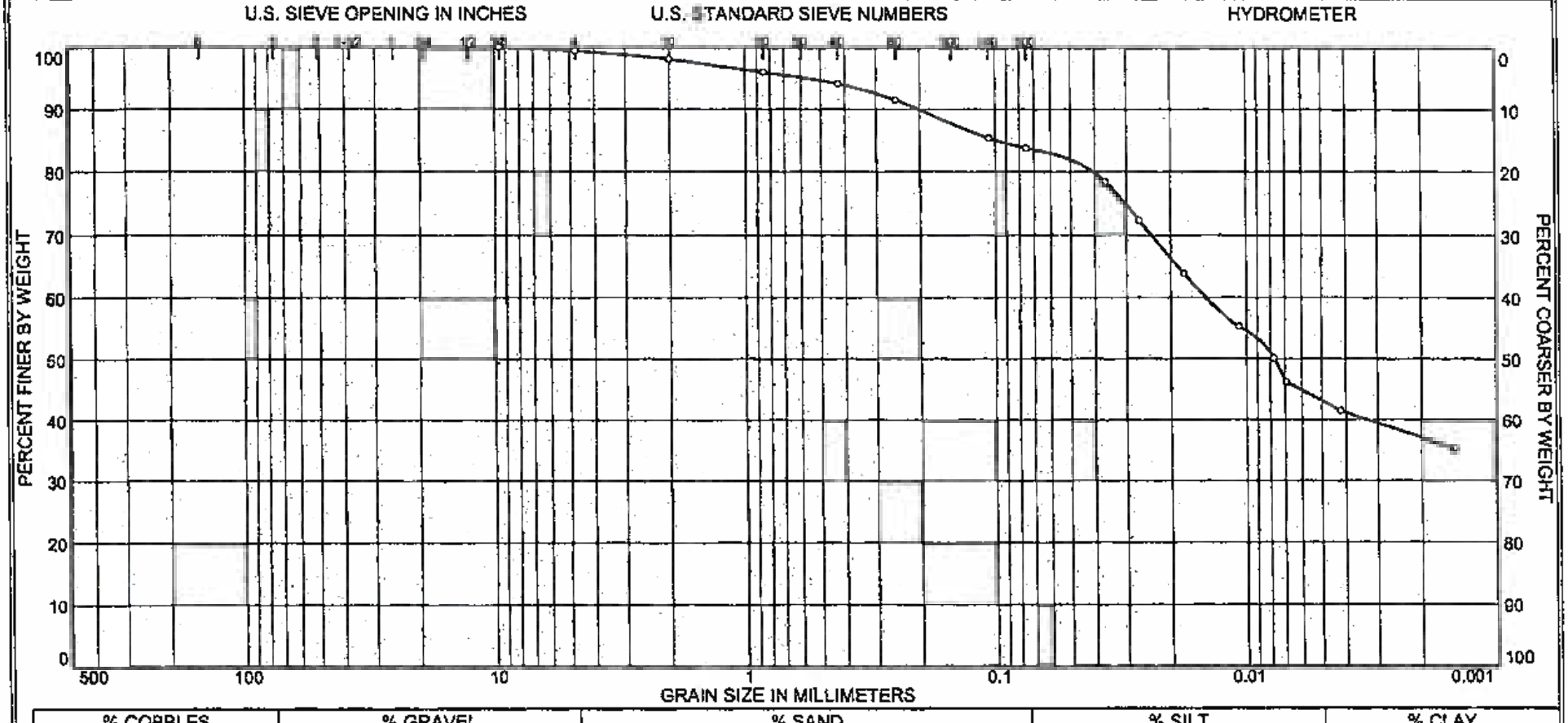
ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.1	60.8	25.5	13.6
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.1	60.8	27.5	11.6



Comments

Reviewed By

Particle Size Distribution Report ASTM D422/ASTM D1140



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.6	15.6	40.7	43.1

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
	STN-48	4.5-5 ft	May 09	CL	Gray Brown Lean clay with sand		39	19

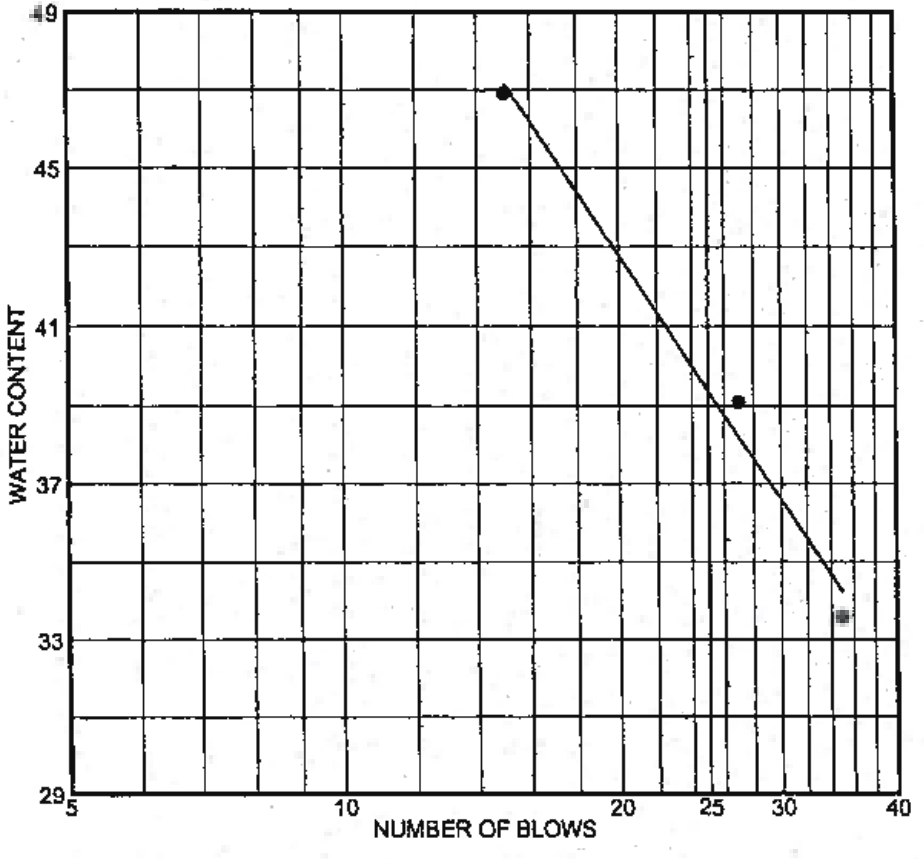
Client STANTEC

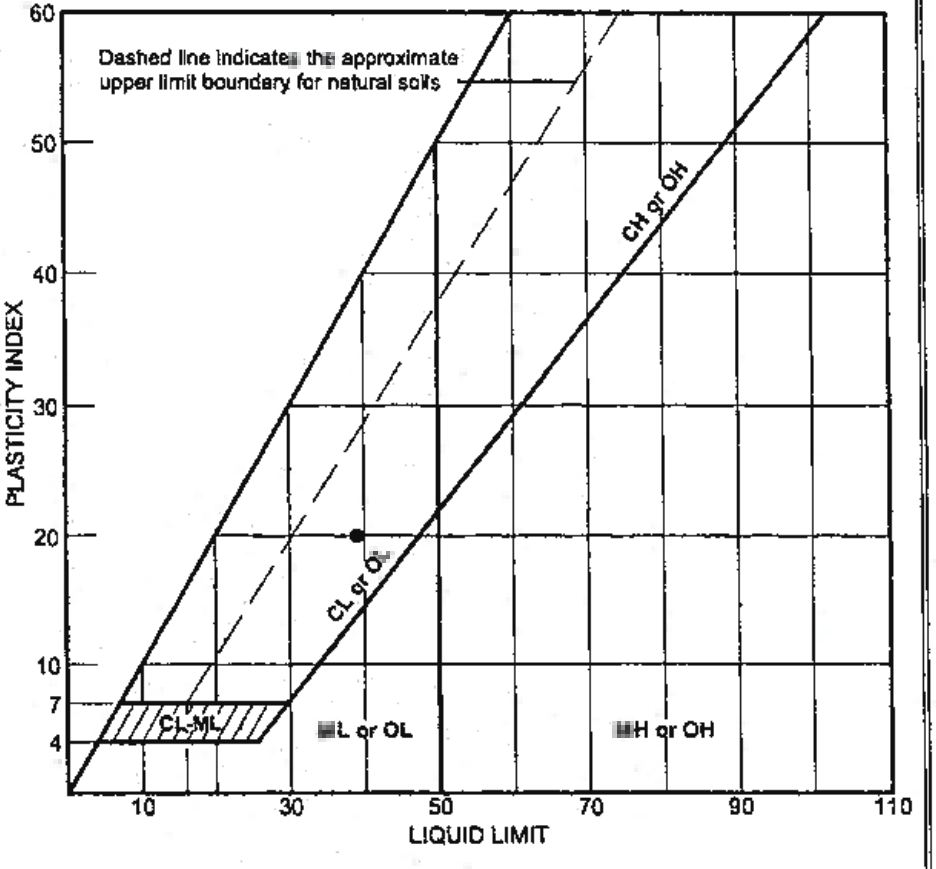
Project Kingston Ash Pond

Project No. GTX-1464 | Lab no.

GeoTesting Express Inc.

LIQUID AND PLASTIC LIMITS TEST REPORT





SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
	STN-48	4.5-5 ft	May 09	CL	Gray Brown Lean clay with sand		39	20

Client STANTEC

Project Kingston Ash Pond

Project No. GTX-1464 | Lab no.

GeoTesting Express Inc.

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-48 / SPT-6, 9.5'-11.0' & STN-48 / SPT-7, 11.0'-12.5'
Lab ID: 447

County: Roane (TN)
Date Received: 4-6-09
Sample Type: SPT Comp
Date Reported: 4-30-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.0
No. 10	2	97.7
No. 40	0.425	94.2
No. 200	0.075	82.7
	0.02	71.6
	0.005	63.9
	0.002	58.6
estimated	0.001	55.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	1.0	2.3
Coarse Sand	1.3	3.5
Medium Sand	3.5	—
Fine Sand	11.5	11.5
Silt	18.8	24.1
Clay	63.9	58.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 69
Plastic Limit: 32
Plasticity Index: 37
Activity Index: 0.63

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.74

Classification

Unified Group Symbol: CH
Group Name: Fat clay with sand

AASHTO Classification: A-7-5 (35)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-48 / SPT-6, 9.5'-11.0' & STN-48 / SPT-7, 11.0'-12.5'

Project Number: 171468117
Lab ID: 447

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: Soft

Tested By: BWT
Test Date: 04-20-2009
Date Received: 04-06-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.0
No. 10	97.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.74

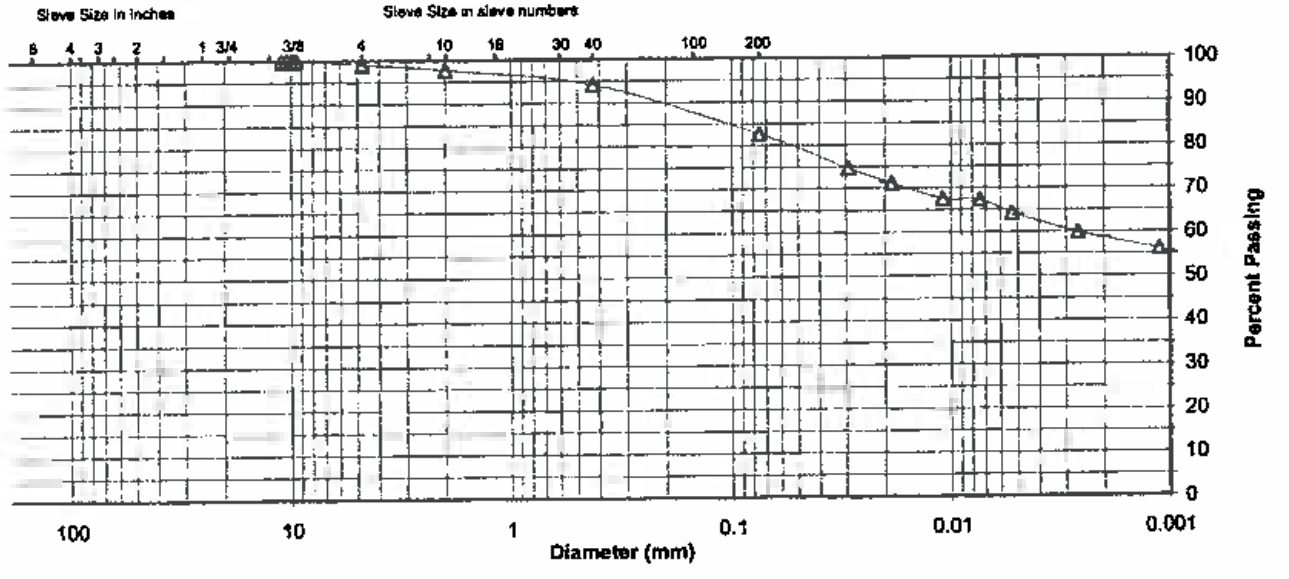
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	94.2
No. 200	82.7
0.02 mm	71.6
0.005 mm	63.9
0.002 mm	58.6
0.001 mm	55.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	1.0	1.3	3.5	11.5	18.8	63.9

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	2.3	3.5	11.5	24.1	58.6



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-48 / SPT-14, 24.5'-26.0' & STN-48 / SPT-15, 26.0'-27.5'
Lab ID: 457

County: Roane (TN)
Date Received: 4-6-09
Sample Type: SPT Comp
Date Reported: 4-30-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.6
No. 200	0.075	50.1
	0.02	35.2
	0.005	27.7
	0.002	25.1
estimated	0.001	24.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.4
Medium Sand	0.4	---
Fine Sand	49.5	49.5
Silt	22.4	25.0
Clay	27.7	25.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 26
Plastic Limit: 14
Plasticity Index: 12
Activity Index: 0.48

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay

AASHTO Classification: A-6 (3)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-48 / SPT-14, 24.5'-26.0' & STN-48 / SPT-15, 26.0'-27.5'

Project Number: 171468117
Lab ID: 457

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: DRB
Test Date: 04-16-2009
Date Received: 04-06-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.66

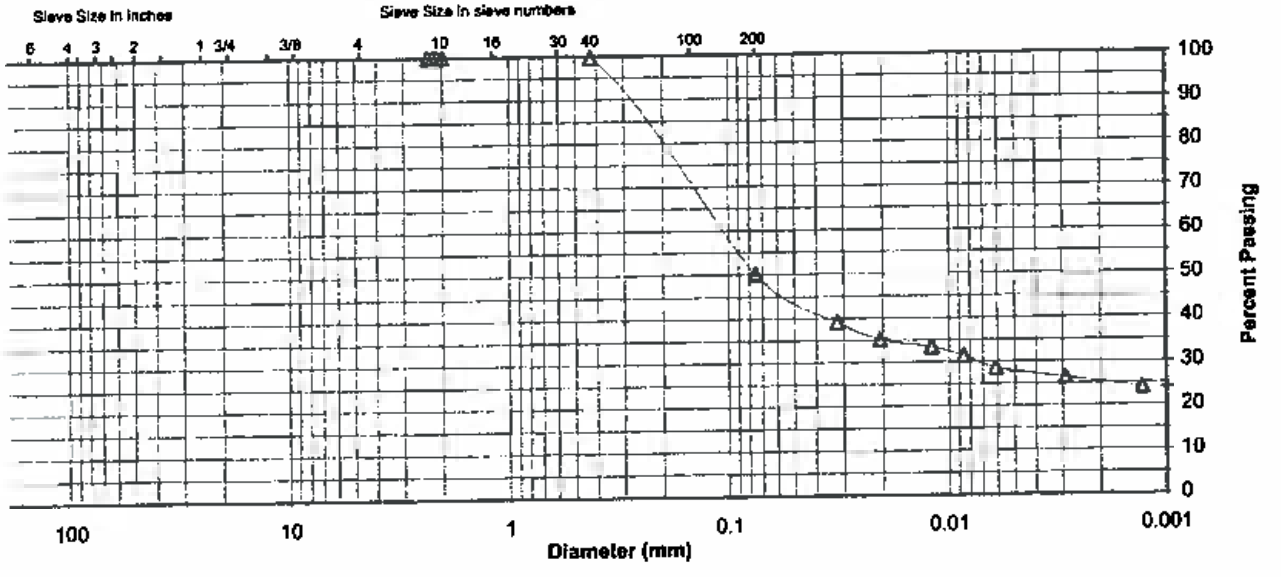
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.6
No. 200	50.1
0.02 mm	35.2
0.005 mm	27.7
0.002 mm	25.1
0.001 mm	24.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.4	49.5	22.4	27.7

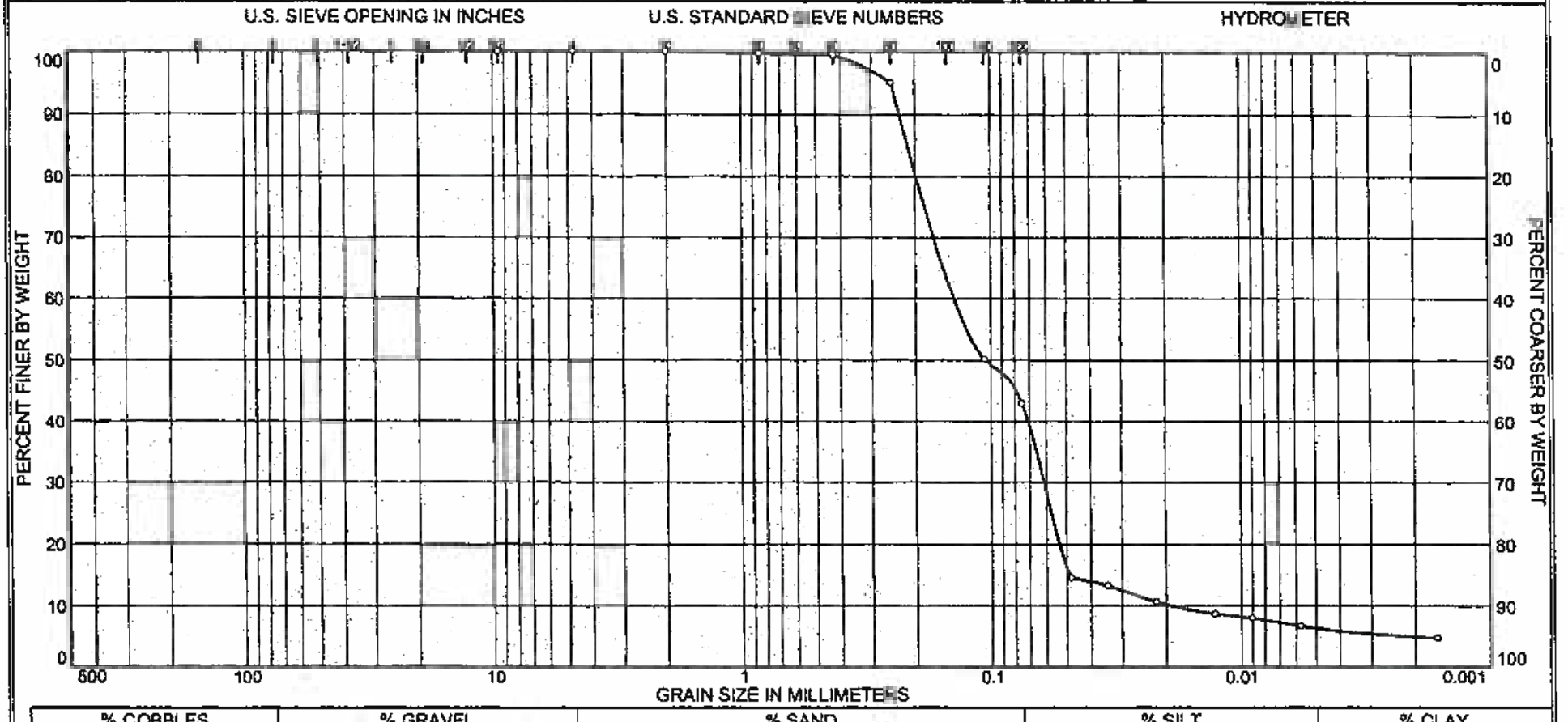
	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.4	49.5	25.0	25.1



Comments

Reviewed By

Particle Size Distribution Report ASTM D422/ASTM D1140



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	57.0	36.7	6.3

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
	STN-48	33 5-34 ft	May 09	SM	Gray Silty sand		NV	NP

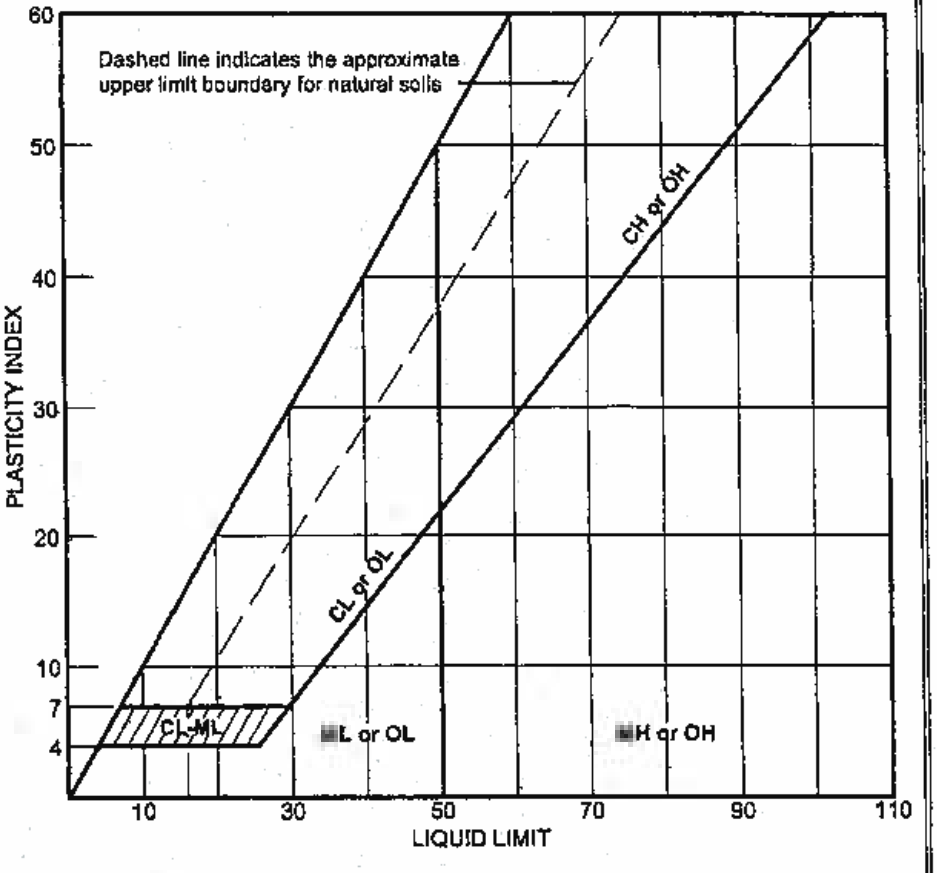
Client STANTEC

Project Kingston Ash Pond

Project No. GTX-1464 Lab no.

GeoTesting Express Inc.

LIQUID AND PLASTIC LIMITS TEST REPORT



SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
	STN-48	33.5-34 ft	May 09	SM	Gray Silty sand		NV	NP

Client STANTEC

Project Kingston Ash Pond

Project No. GTX-1464 | Lab no.

GeoTesting Express Inc.

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 171468117
Source: STN-48 / SPT-24, 41.5'-43.0' & STN-48 / SPT-25, 43.0'-44.5'
Lab ID: 468

County: Roane (TN)
Date Received: 4-6-09
Sample Type: SPT Comp
Date Reported: 4-30-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	98.8
No. 200	0.075	37.0
	0.02	19.0
	0.005	15.7
	0.002	11.6
estimated	0.001	7.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	1.2
Medium Sand	1.2	---
Fine Sand	61.8	61.8
Silt	21.3	25.4
Clay	15.7	11.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-48 / SPT-24, 41.5'-43.0' & STN-48 / SPT-25, 43.0'-44.5'

Project Number: 171468117
Lab ID: 468

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 04-17-2009
Date Received: 04-06-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

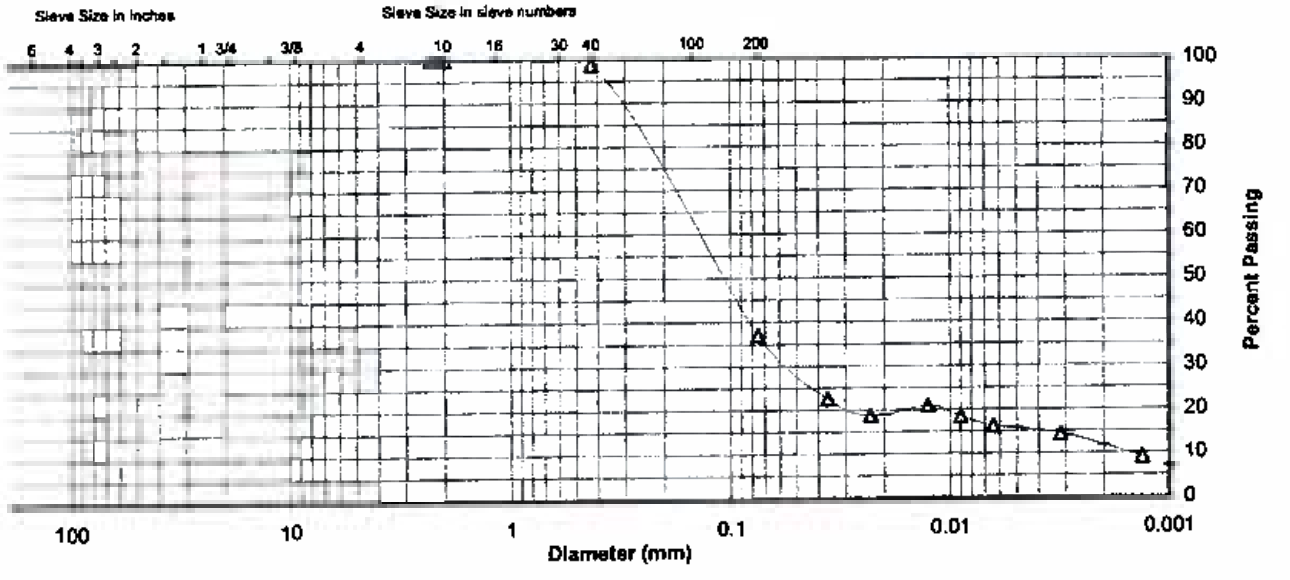
Specific Gravity: 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.8
No. 200	37.0
0.02 mm	19.0
0.005 mm	15.7
0.002 mm	11.6
0.001 mm	7.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	1.2	61.8	21.3	15.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			1.2	61.8	25.4	11.6



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Project Number: 175569042
Source: STN-49, 30.0'-31.5', 31.5'-33.0'
Lab ID: 191
County: Kingston, Tennessee
Date Received: 5-22-09
Sample Type: SPT Comp
Date Reported: 6-5-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	99.8
No. 40	0.425	97.3
No. 200	0.075	65.8
	0.02	40.0
	0.005	28.1
	0.002	22.0
estimated	0.001	19.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.2
Coarse Sand	0.2	2.5
Medium Sand	2.5	—
Fine Sand	31.5	31.5
Silt	37.7	43.8
Clay	28.1	22.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 30
Plastic Limit: 19
Plasticity Index: 11
Activity Index: 0.50

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay
AASHTO Classification: A-6 (5)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-49, 30.0'-31.5', 31.5'-33.0'

Project Number: 175569042
Lab ID: 191

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

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

Particle Shape: Rounded
Particle Hardness: Hard and Durable

Tested By: CM
Test Date: 05-28-2009
Date Received: 05-22-2009

Maximum Particle size: No. 4 Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	
No. 4	100.0
No. 10	99.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

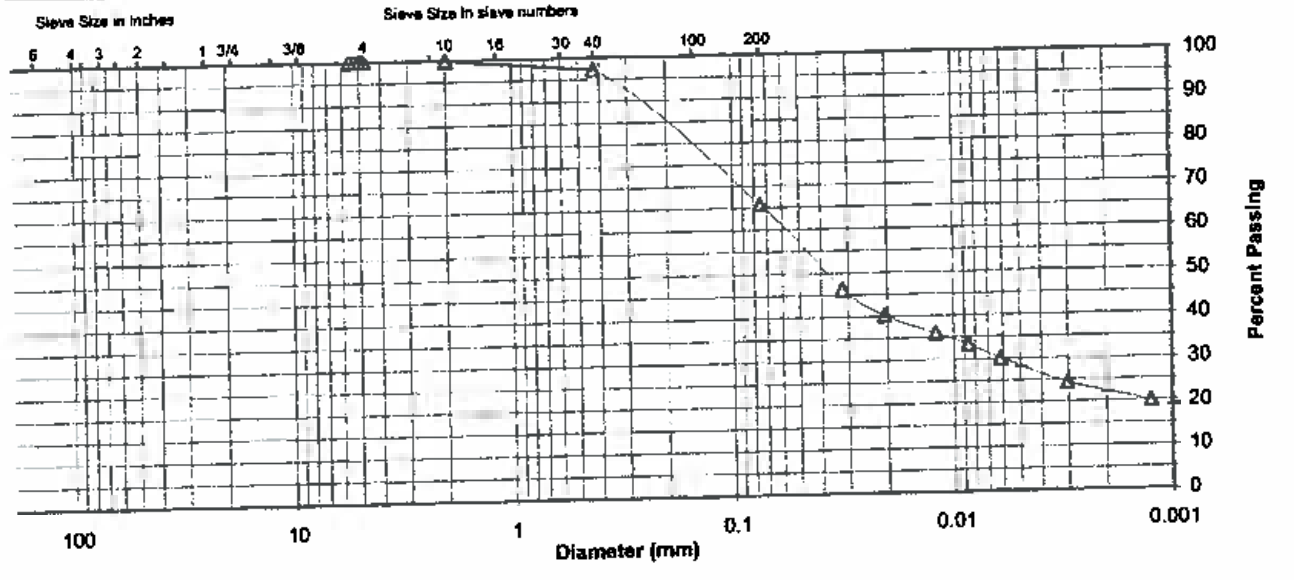
Specific Gravity: 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	97.3
No. 200	65.8
0.02 mm	40.0
0.005 mm	28.1
0.002 mm	22.0
0.001 mm	19.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.2	2.5	31.5	37.7	28.1
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.2			2.5	31.5	43.8	22.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-50, 20.5'-21.0'
Project Number: 175569042
Lab ID: 547
County: Kingston, Tennessee
Sample Type: UD
Date Received: 5-27-09
Date Reported: 6-30-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 24.7

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	99.3
No. 4	4.75	94.5
No. 10	2	90.0
No. 40	0.425	78.5
No. 200	0.075	59.2
	0.02	39.0
	0.005	23.7
	0.002	18.2
estimated	0.001	15.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	5.5	10.0
Coarse Sand	4.5	11.5
Medium Sand	11.5	---
Fine Sand	19.3	19.3
Silt	35.5	41.0
Clay	23.7	18.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 26
Plastic Limit: 17
Plasticity Index: 9
Activity Index: 0.50

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.72

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay
AASHTO Classification: A-4 (3)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-50, 20.5'-21.0'

Project Number: 175569042
Lab ID: 547

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: RM
Test Date: 06-23-2009
Date Received: 05-27-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	99.3
No. 4	94.5
No. 10	90.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

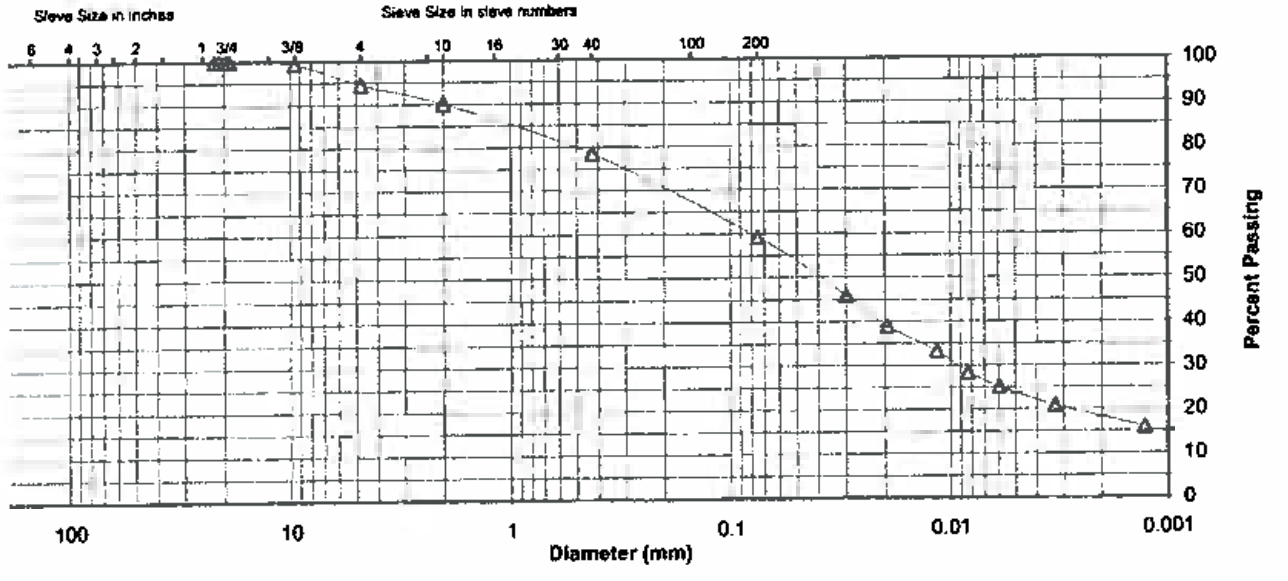
Specific Gravity: 2.72

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	78.5
No. 200	59.2
0.02 mm	39.0
0.005 mm	23.7
0.002 mm	18.2
0.001 mm	15.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	5.5	4.5	11.5	19.3	35.5	23.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	10.0			11.5	19.3	41.0	18.2



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-50, 28.0'-29.5', 29.5'-31.0'	Lab ID	1089
County	Roane (TN)	Date Received	4-23-09
Sample Type	SPT Comp	Date Reported	5-14-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	98.8
No. 200	0.075	39.3
	0.02	18.7
	0.005	11.3
	0.002	7.7
estimated	0.001	6.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.1
Coarse Sand	0.1	1.1
Medium Sand	1.1	---
Fine Sand	59.5	59.5
Silt	28.0	31.6
Clay	11.3	7.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit:	17
Plastic Limit:	15
Plasticity Index:	2
Activity Index:	0.25

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size:	No. 10
Specific Gravity at 20° Celsius:	2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-50, 28.0'-29.5', 29.5'-31.0'

Project Number: 171468117
Lab ID: 1089

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: RHB
Test Date: 04-29-2009
Date Received: 04-23-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

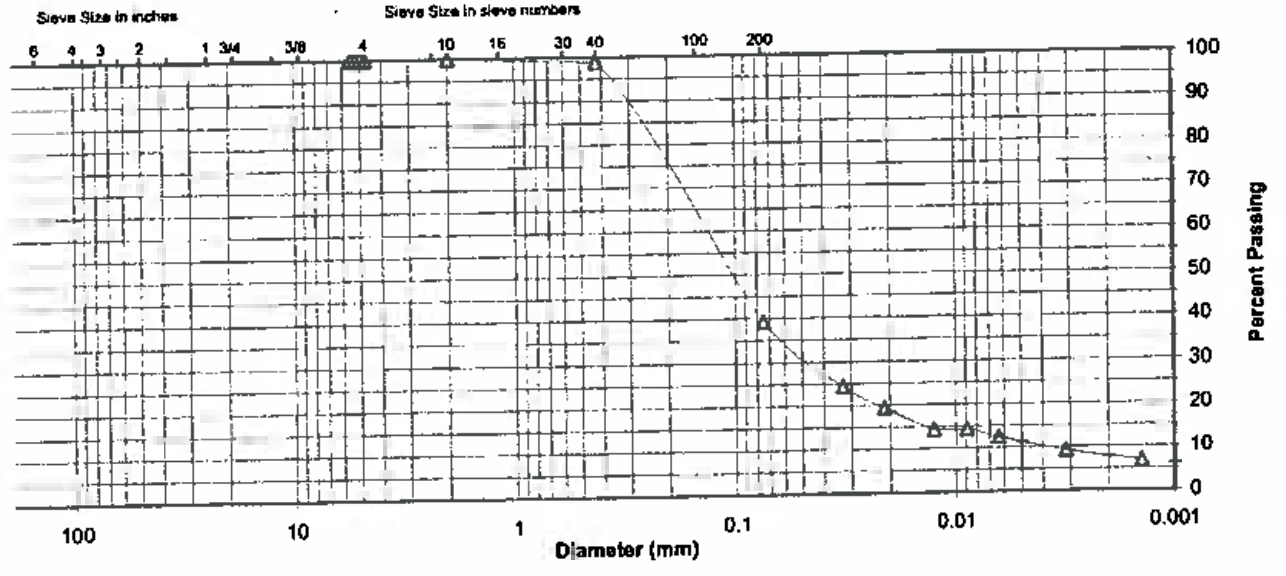
Specific Gravity: 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.8
No. 200	39.3
0.02 mm	18.7
0.005 mm	11.3
0.002 mm	7.7
0.001 mm	6.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	1.1	59.5	28.0	11.3
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.1			1.1	59.5	31.5	7.7



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-51, 3.0'-4.5', 4.5'-6.0'	Lab ID	1098
County	Roane (TN)	Date Received	4-23-09
Sample Type	SPT Comp	Date Reported	5-13-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	94.0
No. 4	4.75	89.3
No. 10	2	85.4
No. 40	0.425	78.0
No. 200	0.075	62.3
	0.02	53.4
	0.005	45.5
	0.002	38.8
estimated	0.001	35.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	10.7	14.6
Coarse Sand	3.9	7.4
Medium Sand	7.4	---
Fine Sand	15.7	15.7
Silt	16.8	23.5
Clay	45.5	38.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 56
Plastic Limit: 21
Plasticity Index: 35
Activity Index: 0.90

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.74

Classification

Unified Group Symbol: CH
Group Name: Sandy fat clay

AASHTO Classification: A-7-6 (19)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-51, 3.0'-4.5', 4.5'-6.0'

Project Number: 171468117
Lab ID: 1098

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: RHB
Test Date: 05-05-2009
Date Received: 04-23-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	94.0
No. 4	89.3
No. 10	85.4

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

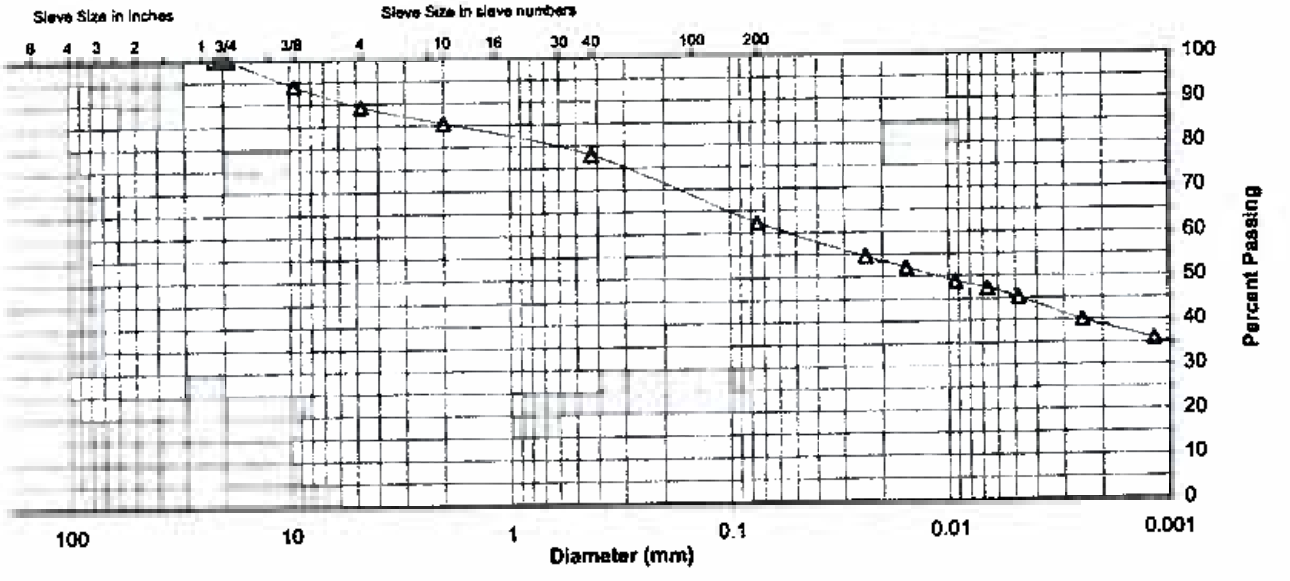
Specific Gravity: 2.74

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	78.0
No. 200	62.3
0.02 mm	53.4
0.005 mm	45.5
0.002 mm	38.8
0.001 mm	35.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	10.7	3.9	7.4	15.7	16.8	45.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	14.6			7.4	15.7	23.5	38.8



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-51, 43.0'-44.5', 44.5'-46.0'	Lab ID	1122
County	Roane (TN)	Date Received	4-23-09
Sample Type	SPT Comp	Date Reported	5-13-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.5
No. 10	2	99.0
No. 40	0.425	96.2
No. 200	0.075	10.5
	0.02	4.0
	0.005	3.2
	0.002	2.9
estimated	0.001	3.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.5	1.0
Coarse Sand	0.5	2.8
Medium Sand	2.8	—
Fine Sand	85.7	85.7
Silt	7.3	7.6
Clay	3.2	2.9

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.68

Classification

Unified Group Symbol: SP-SM
Group Name: Poorly graded sand with silt

AASHTO Classification: A-3 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-51, 43.0'-44.5', 44.5'-46.0'

Project Number: 171468117
Lab ID: 1122

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: RHB
Test Date: 05-05-2009
Date Received: 04-23-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.5
No. 10	99.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

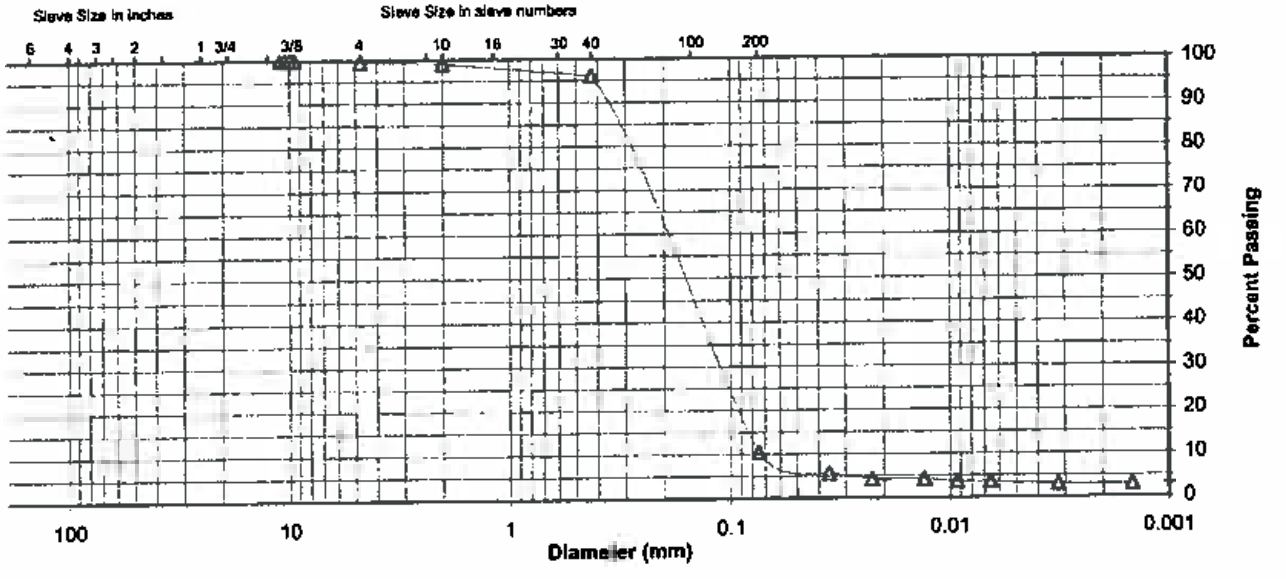
Specific Gravity: 2.68

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	96.2
No. 200	10.5
0.02 mm	4.0
0.005 mm	3.2
0.002 mm	2.9
0.001 mm	3.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.5	0.5	2.8	85.7	7.3	3.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	1.0			2.8	85.7	7.8	2.9



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-52, 4.5'-6.0', 6.0'-7.5'
Project Number: 171468117
Lab ID: 1275

County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-27-09
Date Reported: 5-18-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	100.0
3/4"	19	82.0
3/8"	9.5	74.4
No. 4	4.75	66.6
No. 10	2	58.8
No. 40	0.425	42.4
No. 200	0.075	29.1
	0.02	21.4
	0.005	10.4
	0.002	5.1
estimated	0.001	1.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	33.4	41.2
Coarse Sand	7.8	16.4
Medium Sand	16.4	—
Fine Sand	13.3	13.3
Silt	18.7	24.0
Clay	10.4	5.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 40
Plastic Limit: 26
Plasticity Index: 14
Activity Index: 2.80

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.85

Classification

Unified Group Symbol: SM
Group Name: Silty sand with gravel
AASHTO Classification: A-2-6 (1)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-52, 4.5'-6.0', 6.0'-7.5'

Project Number: 171468117
Lab ID: 1275

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: BWT
Test Date: 05-08-2009
Date Received: 04-27-2009

Maximum Particle size: 1" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	100.0
3/4"	82.0
3/8"	74.4
No. 4	66.6
No. 10	58.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

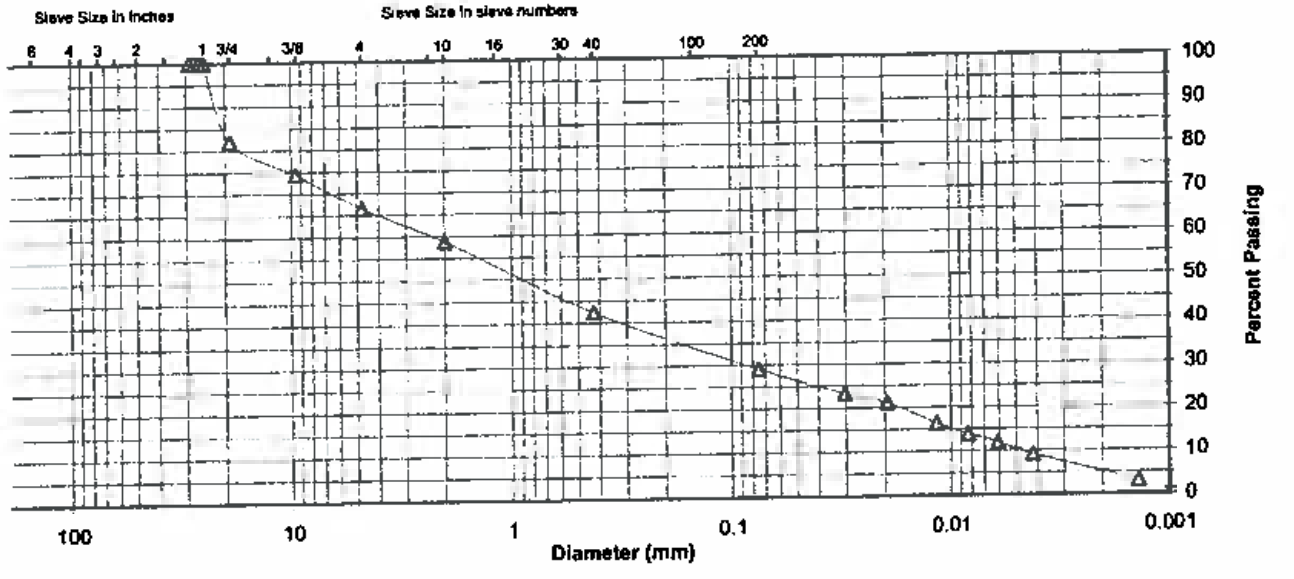
Specific Gravity: 2.65

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	42.4
No. 200	29.1
0.02 mm	21.4
0.005 mm	10.4
0.002 mm	5.1
0.001 mm	1.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	18.0	15.4	7.6	18.4	13.3	18.7	10.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	41.2			18.4	13.3	24.0	5.1



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-52, 16.5'-18.0', 18.0'-19.5'	Lab ID	1284
County	Roane (TN)	Date Received	4-27-09
Sample Type	SPT Comp	Date Reported	5-18-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.5
No. 10	2	99.4
No. 40	0.425	98.4
No. 200	0.075	20.3
	0.02	11.3
	0.005	8.0
	0.002	6.0
estimated	0.001	5.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.5	0.6
Coarse Sand	0.1	1.0
Medium Sand	1.0	—
Fine Sand	78.1	78.1
Silt	12.3	14.3
Clay	8.0	6.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.68

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-52, 16.5'-18.0', 18.0'-19.5'

Project Number: 171468117
Lab ID: 1284

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: BWT
Test Date: 05-11-2009
Date Received: 04-27-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.5
No. 10	99.4

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

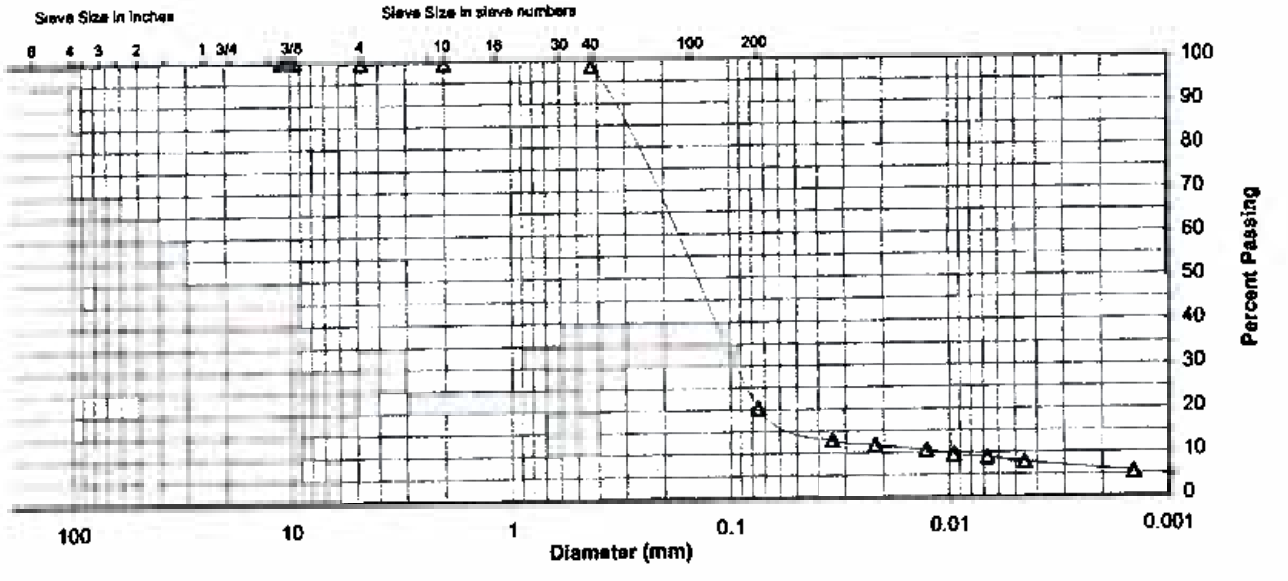
Specific Gravity: 2.68

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.4
No. 200	20.3
0.02 mm	11.3
0.005 mm	8.0
0.002 mm	6.0
0.001 mm	5.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.5	0.1	1.0	78.1	12.3	8.0
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.6			1.0	78.1	14.3	6.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-53, 41.0'-42.5', 42.5'-44.0', 44.0'-45.5'
Project Number: 171468117
Lab ID: 1326

County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-27-09
Date Reported: 5-18-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	98.0
No. 200	0.075	34.7
	0.02	21.2
	0.005	12.3
	0.002	8.9
estimated	0.001	6.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.1
Coarse Sand	0.1	1.9
Medium Sand	1.9	—
Fine Sand	63.3	63.3
Silt	22.4	25.8
Clay	12.3	8.9

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-53, 41.0'-42.5', 42.5'-44.0', 44.0'-45.5'

Project Number: 171468117
Lab ID: 1326

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: BWT
Test Date: 05-08-2009
Date Received: 04-27-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

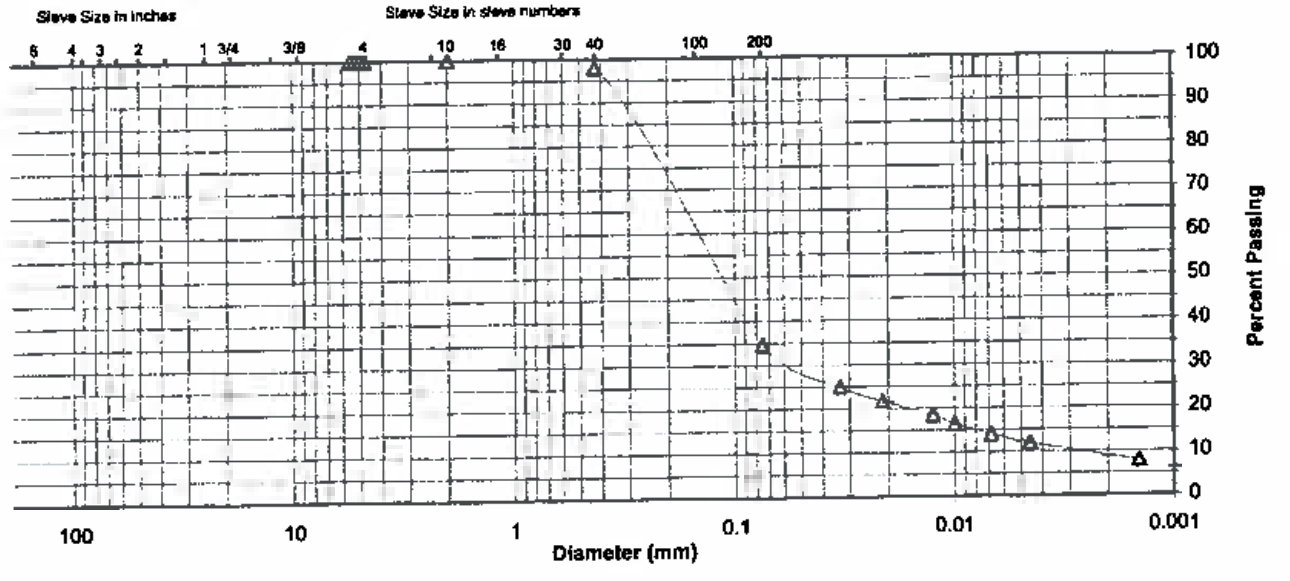
Specific Gravity: 2.66

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.0
No. 200	34.7
0.02 mm	21.2
0.005 mm	12.3
0.002 mm	8.9
0.001 mm	6.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	1.9	63.3	22.4	12.3
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.1			1.9	63.3	25.8	8.9



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-54, 53.0'-54.5', 54.5'-56.0'
Project Number: 171468117
Lab ID: 1779
County: Roane (TN)
Sample Type: SPT Comp
Date Received: 5-8-09
Date Reported: 6-5-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.9
No. 10	2	99.9
No. 40	0.425	99.3
No. 200	0.075	31.7
	0.02	15.5
	0.005	10.5
	0.002	8.3
estimated	0.001	7.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.1	0.1
Coarse Sand	0.0	0.6
Medium Sand	0.6	—
Fine Sand	67.6	67.6
Silt	21.2	23.4
Clay	10.5	8.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.64

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-54, 53.0'-54.5', 54.5'-56.0'

Project Number: 171468117
Lab ID: 1779

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: BWT
Test Date: 05-22-2009
Date Received: 05-08-2009

Maximum Particle size: 3/8" Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.64

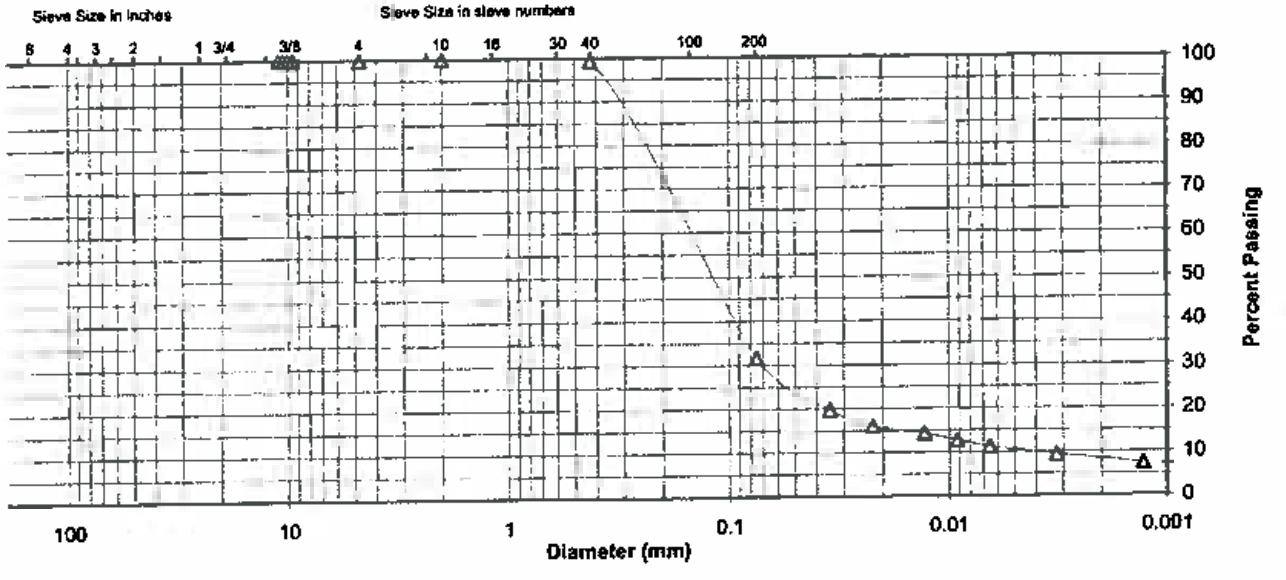
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.3
No. 200	31.7
0.02 mm	15.5
0.005 mm	10.5
0.002 mm	8.3
0.001 mm	7.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.1	0.0	0.6	67.5	21.2	10.5

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.1	0.6	57.6	23.4	8.3



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-55 / ST-1, 42.6'-43.1'
Project Number: 171468117
Lab ID: 187B
County: Roane (TN)
Sample Type: ST
Date Received: 3-24-09
Date Reported: 5-20-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 20.7

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	92.7
No. 200	0.075	65.3
	0.02	42.1
	0.005	25.4
	0.002	18.5
estimated	0.001	14.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	7.3
Medium Sand	7.3	—
Fine Sand	27.4	27.4
Silt	39.9	46.8
Clay	25.4	18.5

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 27
Plastic Limit: 18
Plasticity Index: 9
Activity Index: 0.50

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.69

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay
AASHTO Classification: A-4 (4)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-55 / ST-1, 42.6'-43.1'

Project Number: 171468117
Lab ID: 187B

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: CM
Test Date: 04-23-2009
Date Received: 03-24-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

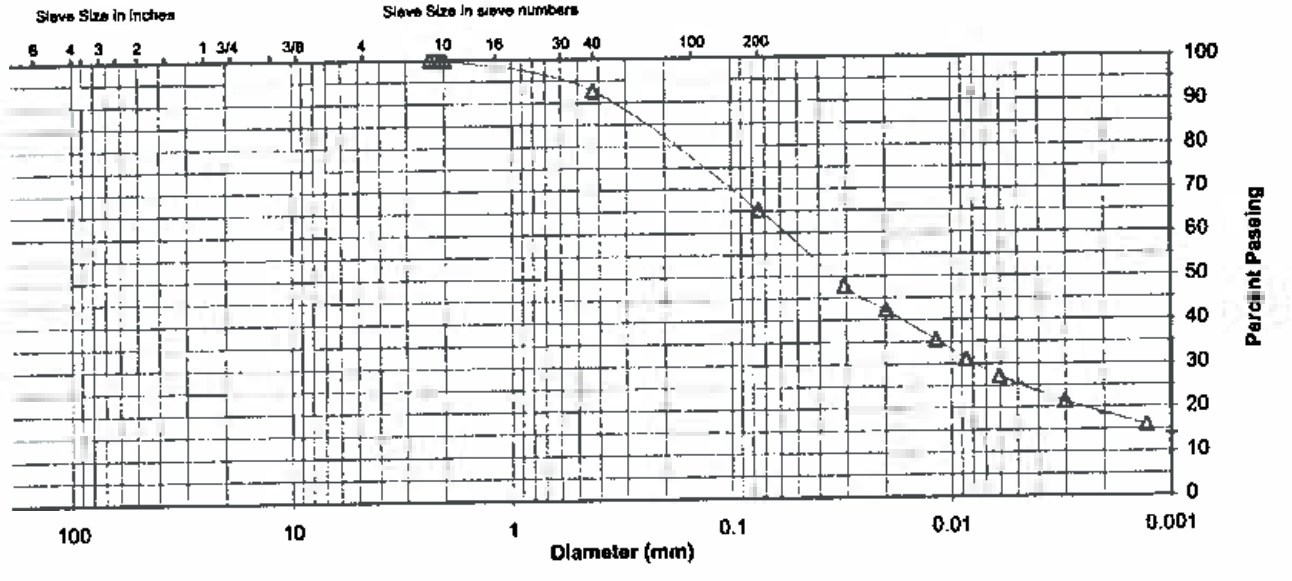
Specific Gravity: 2.69

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	92.7
No. 200	65.3
0.02 mm	42.1
0.005 mm	25.4
0.002 mm	18.5
0.001 mm	14.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	7.3	27.4	39.9	25.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			7.3	27.4	46.8	18.5



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-55 / SPT-30, 47.5'-49.0' & STN-55 / SPT-31, 49.0'-50.5'	Lab ID	172
County	Roane (TN)	Date Received	3-24-09
Sample Type	SPT Comp	Date Reported	4-22-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421

Gradation Method: ASTM D 422

Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	99.6
No. 200	0.075	61.3
	0.02	33.7
	0.005	18.8
	0.002	13.9
estimated	0.001	12.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.1
Coarse Sand	0.1	0.3
Medium Sand	0.3	—
Fine Sand	38.3	38.3
Silt	42.5	47.4
Clay	18.8	13.9

Atterberg Limits

Test Method: ASTM D 4318 Method A

Prepared: Dry

Liquid Limit: 22

Plastic Limit: 15

Plasticity Index: 7

Activity Index: 0.50

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A

Maximum Dry Density (kg/m^3): N/A

Optimum Moisture Content (%): N/A

Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A

Compacted Dry Density (lb/ft^3): N/A

Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854

Prepared: Dry

Particle Size: No. 10

Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: CL-ML

Group Name: Sandy silty clay

AASHTO Classification: A-4 (1)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-55 / SPT-30, 47.5'-49.0' & STN-55 / SPT-31, 49.0'-50.5'

Project Number: 171468117
Lab ID: 172

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: Soft

Tested By: DG
Test Date: 04-10-2019
Date Received: 03-24-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.66

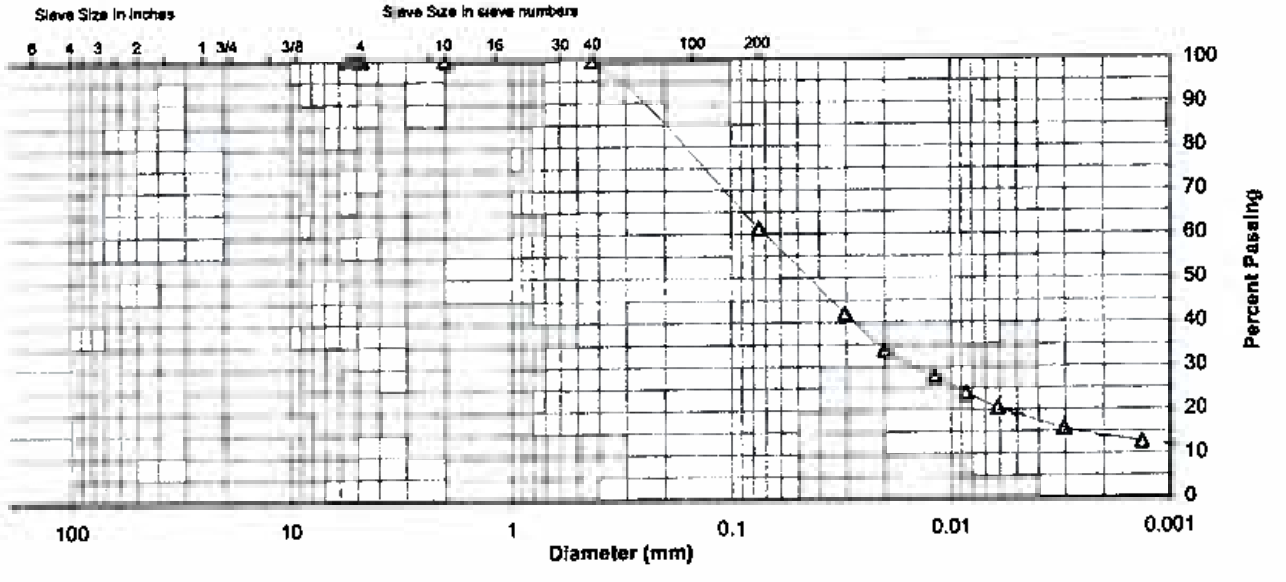
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.6
No. 200	61.3
0.02 mm	33.7
0.005 mm	18.8
0.002 mm	13.9
0.001 mm	12.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	0.3	38.3	42.5	18.8

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.1	0.3	38.3	47.4	13.9



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-55 / SPT-37, 58.0'-59.5' & STN-55 / SPT-38, 59.5'-60.2'	Lab ID	180
County	Roane (TN)	Date Received	3-24-09
Sample Type	SPT Comp	Date Reported	4-22-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	100.0
1"	25	---
3/4"	19	85.7
3/8"	9.5	76.6
No. 4	4.75	72.2
No. 10	2	67.3
No. 40	0.425	63.4
No. 200	0.075	15.4
	0.02	5.0
	0.005	3.4
	0.002	2.1
estimated	0.001	1.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	27.8	32.7
Coarse Sand	4.9	3.9
Medium Sand	3.9	—
Fine Sand	48.0	48.0
Silt	12.0	13.3
Clay	3.4	2.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.62

Classification

Unified Group Symbol: SM
Group Name: Silty sand with gravel

AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-55 / SPT-37, 58.0'-59.5' & STN-55 / SPT-38, 59.5'-60.2'

Project Number: 171468117
Lab ID: 180

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: DG
Test Date: 04-10-2009
Date Received: 03-24-2009

Maximum Particle size: 1 1/2" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	100.0
1"	---
3/4"	85.7
3/8"	76.6
No. 4	72.2
No. 10	67.3

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

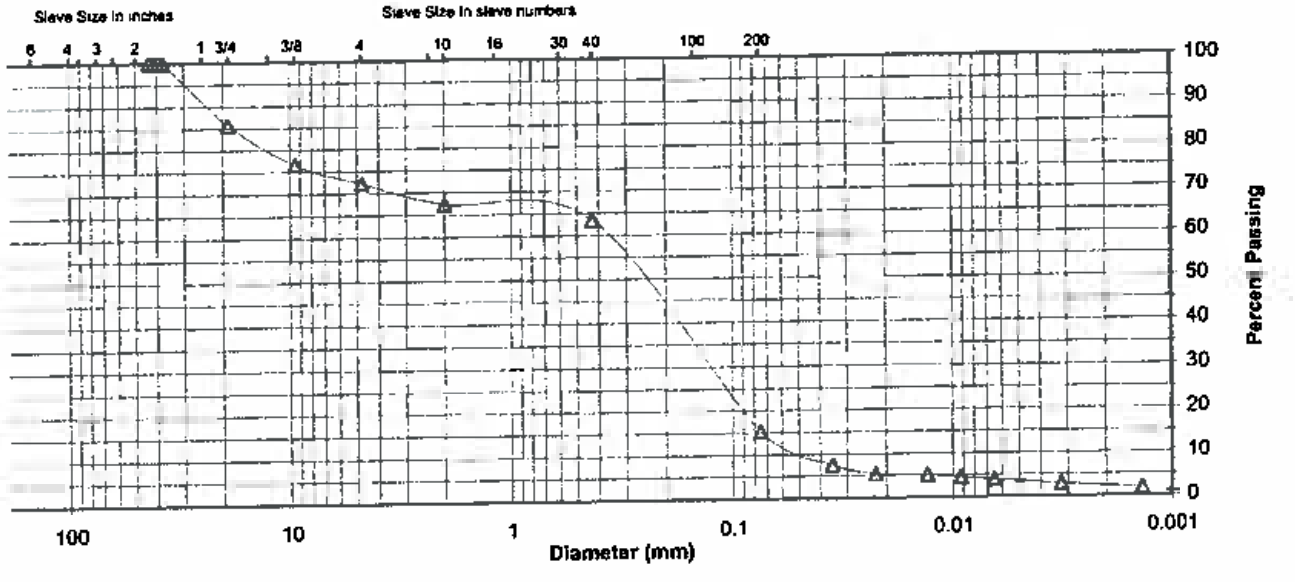
Specific Gravity: 2.62

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	63.4
No. 200	15.4
0.02 mm	5.0
0.005 mm	3.4
0.002 mm	2.1
0.001 mm	1.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	14.3	13.5	4.9	3.9	48.0	12.0	3.4
	Gravel			Coarse Sand	Fine Sand	Silt	Clay
AASHTO	32.7			3.9	45.0	13.3	2.1



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-56 / SPT-28, 40.5'-42.0' & STN-56 / SPT-29, 42.0'-43.5'	Lab ID	80
County	Roane (TN)	Date Received	3-24-09
Sample Type	SPT Comp	Date Reported	4-22-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.1
No. 200	0.075	61.3
	0.02	34.8
	0.005	20.4
	0.002	14.1
estimated	0.001	11.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.9
Medium Sand	0.9	---
Fine Sand	37.8	37.8
Silt	40.9	47.2
Clay	20.4	14.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 22
Plastic Limit: 17
Plasticity Index: 5
Activity Index: 0.36

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.65

Classification

Unified Group Symbol: CL-ML
Group Name: Sandy silty clay

AASHTO Classification: A-4 (1)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-56 / SPT-28, 40.5'-42.0' & STN-56 / SPT-29, 42.0'-43.5'

Project Number: 171468117
Lab ID: 80

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 04-09-2009
Date Received: 03-24-2009

Maximum Particle size: No. 10 Sieve

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

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

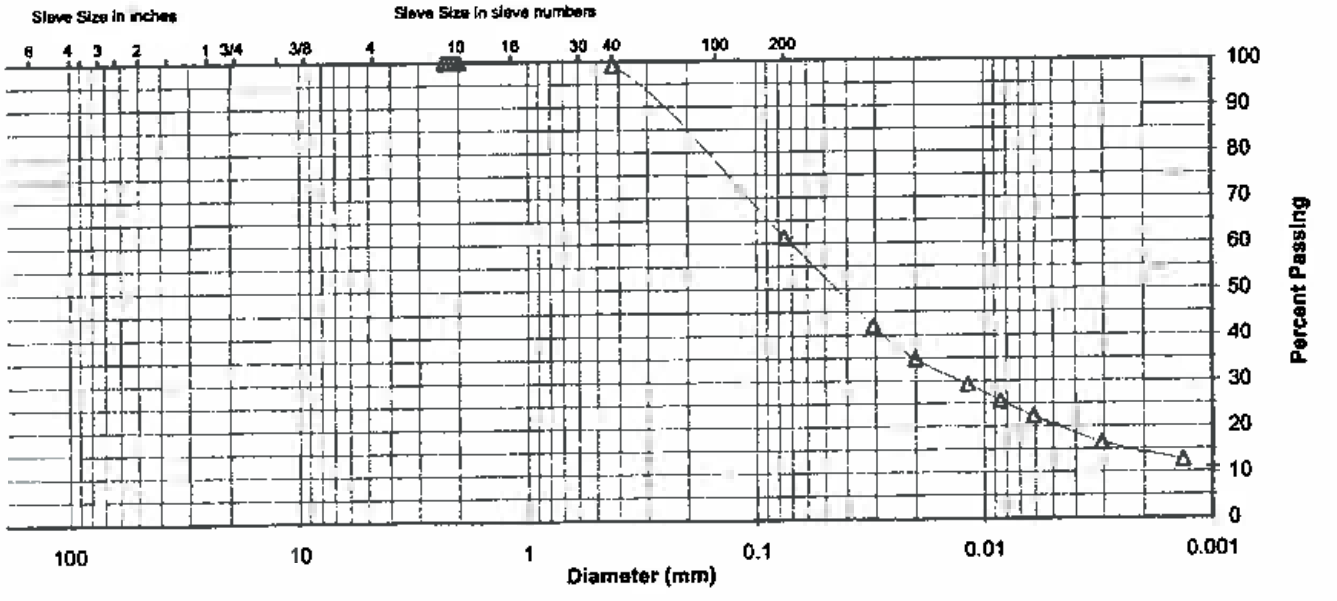
Specific Gravity: 2.65

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.1
No. 200	61.3
0.02 mm	34.8
0.005 mm	20.4
0.002 mm	14.1
0.001 mm	11.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.9	37.8	40.9	20.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.9	37.8	47.2	14.1



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-56 / SPT-30, 43.5'-45.0' & STN-56 / SPT-31, 45.0'-46.5'	Lab ID	83
County	Roane (TN)	Date Received	3-24-09
Sample Type	SPT Comp	Date Reported	4-22-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.5
No. 200	0.075	45.5
	0.02	23.9
	0.005	14.6
	0.002	11.1
estimated	0.001	8.0

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

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.5
Medium Sand	0.5	---
Fine Sand	54.0	54.0
Silt	30.9	34.4
Clay	14.6	11.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 20
Plastic Limit: 19
Plasticity Index: 1
Activity Index: 0.09

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-56 / SPT-30, 43.5'-45.0' & STN-56 / SPT-31, 45.0'-46.5'

Project Number: 171468117
Lab ID: 83

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 04-09-2009
Date Received: 03-24-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

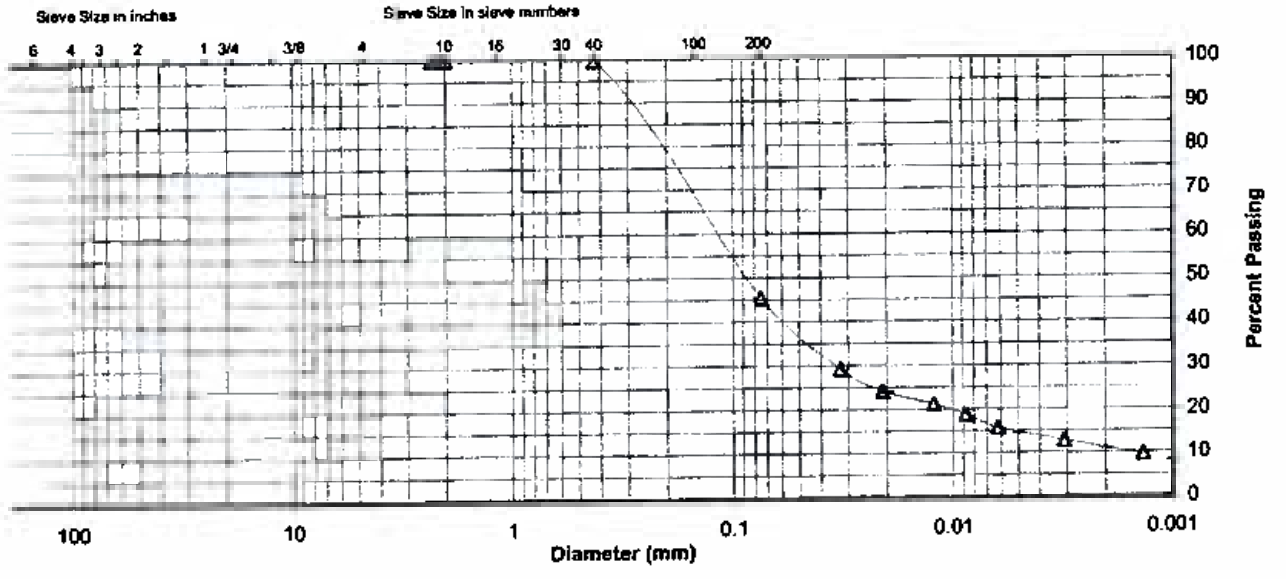
Specific Gravity: 2.66

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.5
No. 200	45.5
0.02 mm	23.9
0.005 mm	14.6
0.002 mm	11.1
0.001 mm	8.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.5	54.0	30.9	14.6
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.5	54.0	34.4	11.1



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-56 / SPT-37, 54.0'-55.5' & STN-56 / SPT-38, 55.5'-57.0'
Project Number: 171468117
Lab ID: 91
County: Roane (TN)
Sample Type: SPT Comp
Date Received: 3-24-09
Date Reported: 4-22-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.6
No. 200	0.075	23.8
	0.02	10.2
	0.005	5.1
	0.002	3.2
estimated	0.001	2.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.4
Medium Sand	0.4	—
Fine Sand	75.8	75.8
Silt	18.7	20.6
Clay	5.1	3.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.61

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-56 / SPT-37, 54.0'-55.5' & STN-56 / SPT-38, 55.5'-57.0'

Project Number: 171468117
Lab ID: 91

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 04-09-2009
Date Received: 03-24-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.61

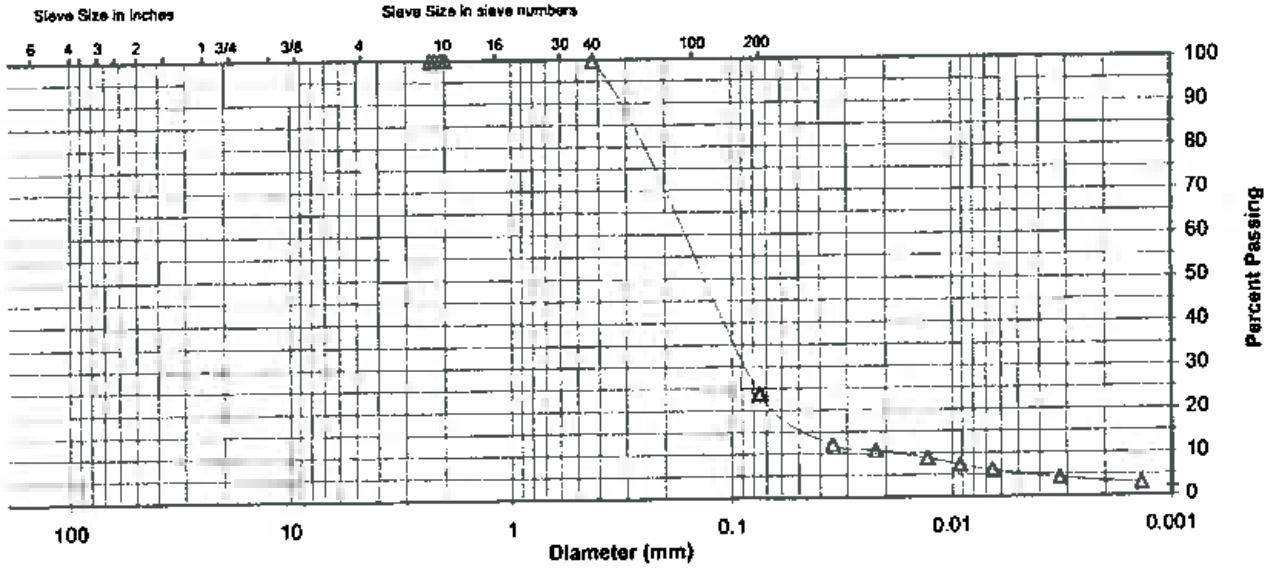
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.6
No. 200	23.8
0.02 mm	10.2
0.005 mm	5.1
0.002 mm	3.2
0.001 mm	2.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.4	75.8	18.7	5.1

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.4	75.8	20.6	3.2



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-59, 18.5'-20.0', 20.0'-21.5'
Project Number: 175569042
Lab ID: 578

County: Kingston, Tennessee
Sample Type: SPT Comp
Date Received: 6-3-09
Date Reported: 6-24-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.4
No. 200	0.075	40.3
	0.02	23.9
	0.005	18.6
	0.002	15.9
estimated	0.001	15.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.6
Medium Sand	0.6	---
Fine Sand	59.1	59.1
Silt	21.7	24.4
Clay	18.6	15.9

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-59, 18.5'-20.0', 20.0'-21.5'

Project Number: 175569042
Lab ID: 578

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: CSM
Test Date: 06-16-2009
Date Received: 06-03-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.67

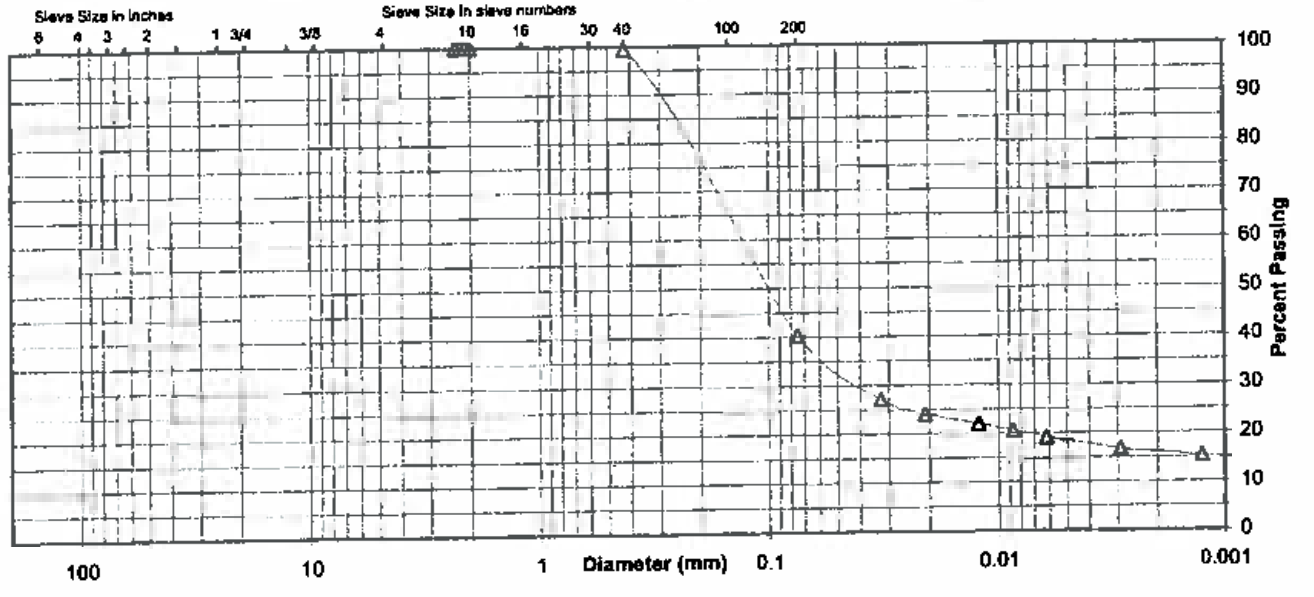
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.4
No. 200	40.3
0.02 mm	23.9
0.005 mm	18.6
0.002 mm	15.9
0.001 mm	15.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.6	59.1	21.7	18.6

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.6	59.1	24.4	15.9



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-59, 30.5'-32.0', 32.0'-33.5'
Project Number: 175569042
Lab ID: 587
County: Kingston, Tennessee
Sample Type: SPT Comp
Date Received: 6-3-09
Date Reported: 6-24-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	100.0
No. 200	0.075	30.5
	0.02	16.2
	0.005	11.2
	0.002	8.4
estimated	0.001	7.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.0
Medium Sand	0.0	---
Fine Sand	69.5	69.5
Silt	19.3	22.1
Clay	11.2	8.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-59, 30.5'-32.0', 32.0'-33.5'

Project Number: 175569042
Lab ID: 587

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: CSM
Test Date: 06-16-2009
Date Received: 06-03-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

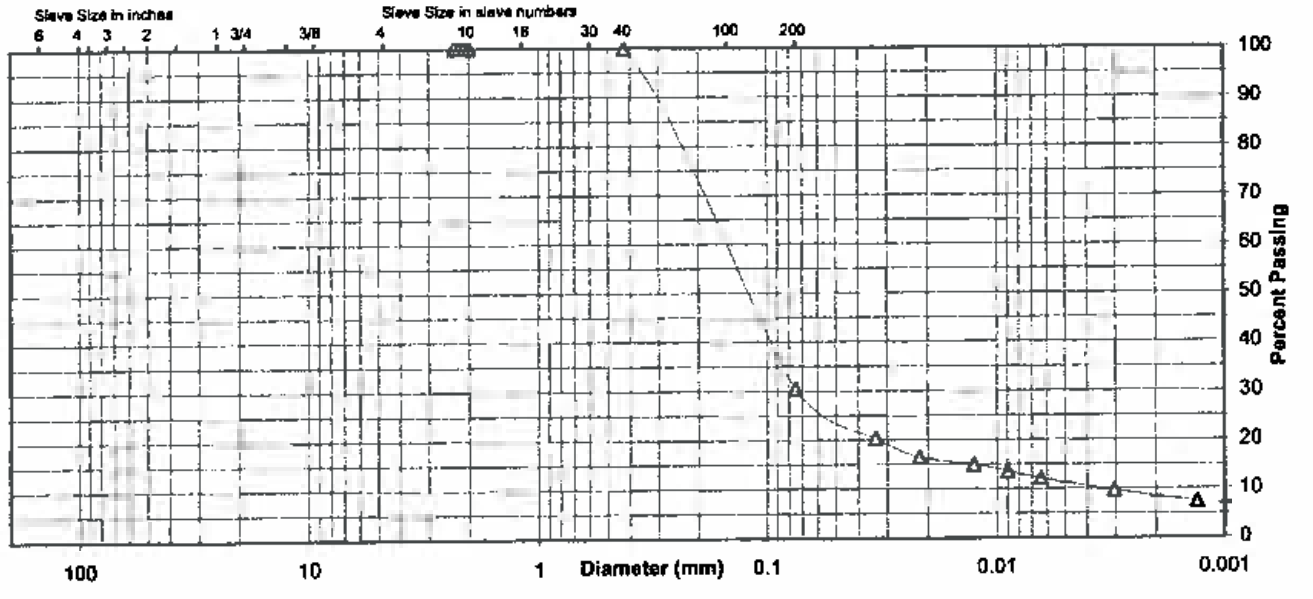
Specific Gravity: 2.66

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	100.0
No. 200	30.5
0.02 mm	16.2
0.005 mm	11.2
0.002 mm	8.4
0.001 mm	7.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.0	69.5	19.3	11.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.0	69.5	22.1	8.4



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-60, 14.0'-15.5', 15.5'-17.0'
County: Kingston, Tennessee
Sample Type: SPT Comp

Project Number: 175569042
Lab ID: 610
Date Received: 6-3-09
Date Reported: 6-24-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	99.7
No. 200	0.075	68.1
	0.02	44.8
	0.005	30.0
	0.002	25.3
estimated	0.001	22.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.1
Coarse Sand	0.1	0.2
Medium Sand	0.2	—
Fine Sand	31.6	31.6
Silt	38.1	42.8
Clay	30.0	25.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 31
Plastic Limit: 18
Plasticity Index: 13
Activity Index: 0.52

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay

AASHTO Classification: A-6 (7)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-60, 14.0'-15.5', 15.5'-17.0'

Project Number: 175569042
Lab ID: 610

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: BWT
Test Date: 06-15-2009
Date Received: 06-03-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

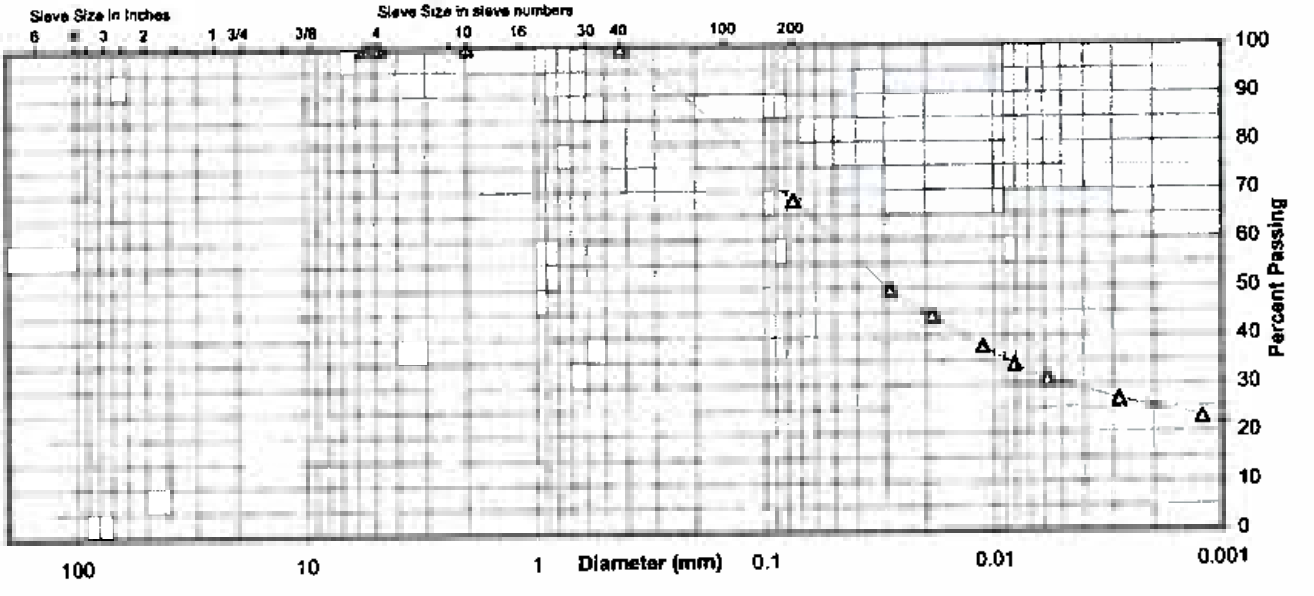
Specific Gravity: 2.66

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.7
No. 200	68.1
0.02 mm	44.8
0.005 mm	30.0
0.002 mm	25.3
0.001 mm	22.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	0.2	31.6	35.1	30.0
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.1			0.2	31.6	42.8	25.3



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	175569042
Source	STN-60, 28.0'-29.5', 29.5'-31.0'	Lab ID	619
County	Kingston, Tennessee	Date Received	6-3-09
Sample Type	SPT Comp	Date Reported	6-24-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.8
No. 200	0.075	48.4
	0.02	26.8
	0.005	18.4
	0.002	15.3
estimated	0.001	13.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.2
Medium Sand	0.2	—
Fine Sand	51.4	51.4
Silt	30.0	33.1
Clay	18.4	15.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 21
Plastic Limit: 18
Plasticity Index: 3
Activity Index: 0.20

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-60, 28.0'-29.5', 29.5'-31.0'

Project Number: 175569042
Lab ID: 619

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 06-15-2009
Date Received: 06-03-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

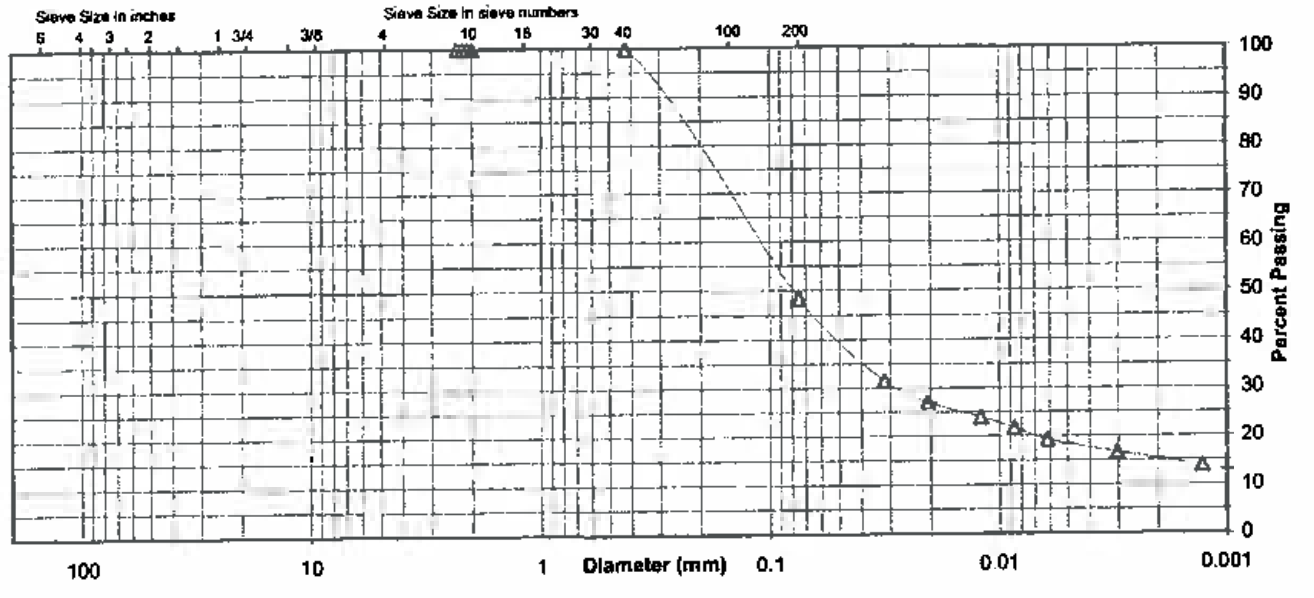
Specific Gravity: 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.8
No. 200	48.4
0.02 mm	26.8
0.005 mm	18.4
0.002 mm	15.3
0.001 mm	13.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.2	51.4	30.0	18.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.2	51.4	33.1	15.3



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-62, 6.0'-7.5', 7.5'-9.0'	Lab ID	771
County	Roane (TN)	Date Received	4-14-09
Sample Type	SPT Comp	Date Reported	5-11-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	89.9
No. 4	4.75	76.4
No. 10	2	56.5
No. 40	0.425	34.3
No. 200	0.075	14.6
	0.02	3.4
	0.005	1.4
	0.002	0.9
estimated	0.001	0.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	23.6	43.5
Coarse Sand	19.9	22.2
Medium Sand	22.2	---
Fine Sand	19.7	19.7
Silt	13.2	13.7
Clay	1.4	0.9

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.79

Classification

Unified Group Symbol: SM
Group Name: Silty sand with gravel

AASHTO Classification: A-1-b (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-62, 6.0'-7.5', 7.5'-9.0'

Project Number: 171468117
Lab ID: 771

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: CM
Test Date: 04-23-2009
Date Received: 04-14-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	89.9
No. 4	76.4
No. 10	56.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

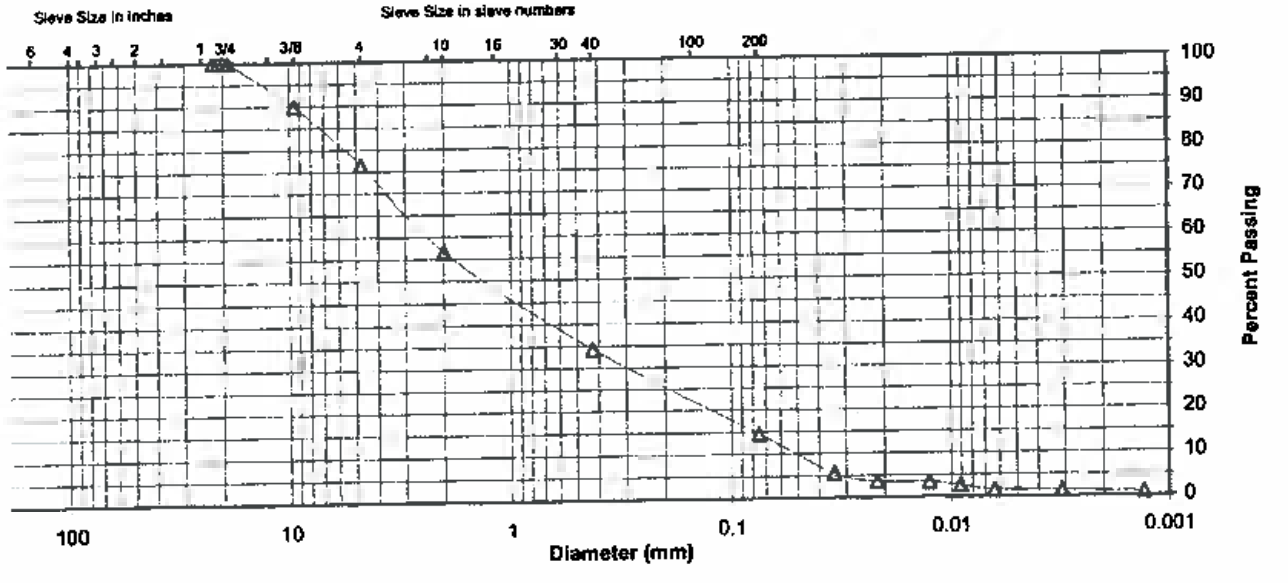
Specific Gravity: 2.79

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	34.3
No. 200	14.6
0.02 mm	3.4
0.005 mm	1.4
0.002 mm	0.9
0.001 mm	0.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	23.6	19.9	22.2	19.7	13.2	1.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	43.5			22.2	19.7	13.7	0.9



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-62, 21.0'-22.5', 22.5'-24.0'	Lab ID	782
County	Roane (TN)	Date Received	4-14-09
Sample Type	SPT Comp	Date Reported	5-11-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.7
No. 200	0.075	43.1
	0.02	23.0
	0.005	14.8
	0.002	12.2
estimated	0.001	11.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.3
Medium Sand	0.3	—
Fine Sand	56.6	56.6
Silt	28.3	30.9
Clay	14.8	12.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

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

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-62, 21.0'-22.5', 22.5'-24.0'

Project Number: 171468117
Lab ID: 782

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 04-27-2009
Date Received: 04-14-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

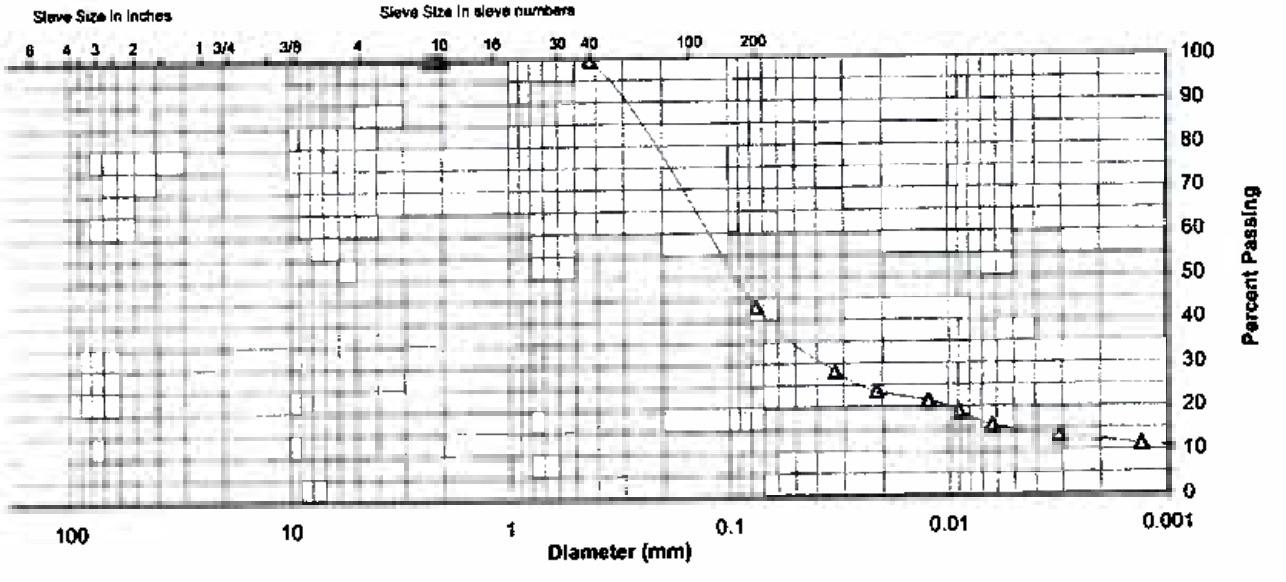
Specific Gravity: 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.7
No. 200	43.1
0.02 mm	23.0
0.005 mm	14.8
0.002 mm	12.2
0.001 mm	11.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.3	56.6	28.3	14.8
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.3	56.6	30.9	12.2



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-62, 39.5'-41.0', 41.0'-42.5'	Lab ID	794
County	Roane (TN)	Date Received	4-14-09
Sample Type	SPT Comp	Date Reported	5-11-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	99.5
No. 200	0.075	25.9
	0.02	13.2
	0.005	9.6
	0.002	7.6
estimated	0.001	5.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.1
Coarse Sand	0.1	0.4
Medium Sand	0.4	---
Fine Sand	73.6	73.6
Silt	16.3	18.3
Clay	9.6	7.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.69

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-62, 39.5'-41.0', 41.0'-42.5'

Project Number: 171468117
Lab ID: 794

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: BWT
Test Date: 04-27-2009
Date Received: 04-14-2009

Maximum Particle size: 3/8" Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.69

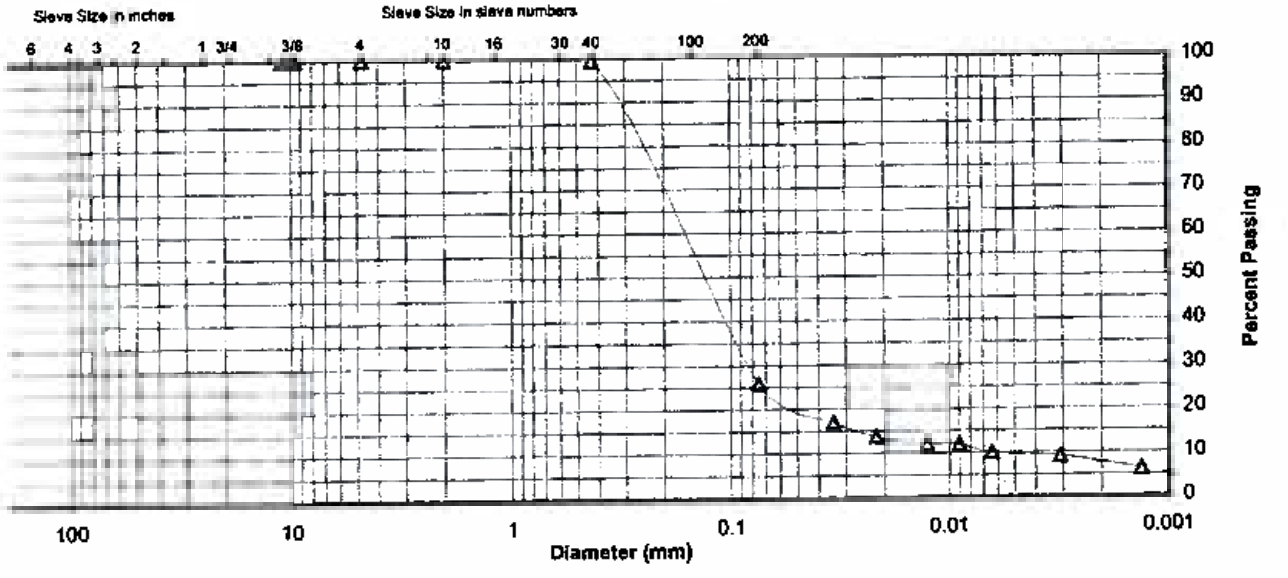
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.5
No. 200	25.9
0.02 mm	13.2
0.005 mm	9.6
0.002 mm	7.6
0.001 mm	5.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	0.4	73.6	18.3	9.6

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.1	0.4	73.6	18.3	7.6



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-63 / SPT-10, 17.5'-19.0' & STN-63 / SPT-11, 19.0'-20.5'	Lab ID	582
County	Roane (TN)	Date Received	4-6-09
Sample Type	SPT Comp	Date Reported	5-1-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	98.7
No. 200	0.075	22.5
	0.02	12.6
	0.005	8.2
	0.002	6.2
estimated	0.001	6.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.1
Coarse Sand	0.1	1.2
Medium Sand	1.2	—
Fine Sand	76.2	76.2
Silt	14.3	16.3
Clay	8.2	6.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.64

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-63 / SPT-10, 17.5'-19.0' & STN-63 / SPT-11, 19.0'-20.5'

Project Number: 171468117
Lab ID: 582

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: BWT
Test Date: 04-17-2009
Date Received: 04-06-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.64

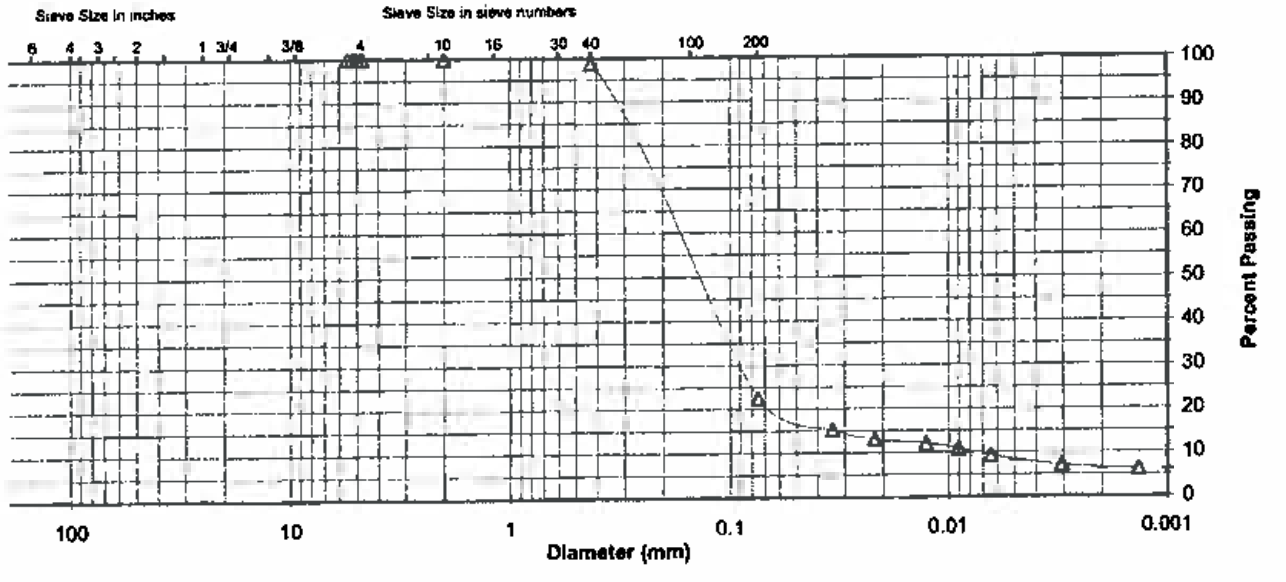
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.7
No. 200	22.5
0.02 mm	12.6
0.005 mm	8.2
0.002 mm	6.2
0.001 mm	6.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	1.2	76.2	14.3	8.2

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.1	1.2	76.2	15.3	6.2



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-63 /SPT-17, 28.0'-29.5' & STN-63 /SPT-18A, 29.5'-30.5'
Project Number: 171468117
Lab ID: 590
County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-6-09
Date Reported: 5-1-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.6
No. 200	0.075	44.8
	0.02	24.0
	0.005	17.6
	0.002	14.3
estimated	0.001	11.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.4
Medium Sand	0.4	—
Fine Sand	54.8	54.8
Silt	27.2	30.5
Clay	17.6	14.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-63 /SPT-17, 28.0'-29.5' & STN-63 /SPT-18A, 29.5'-30.5'

Project Number: 171468117
Lab ID: 590

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 04-17-2009
Date Received: 04-06-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

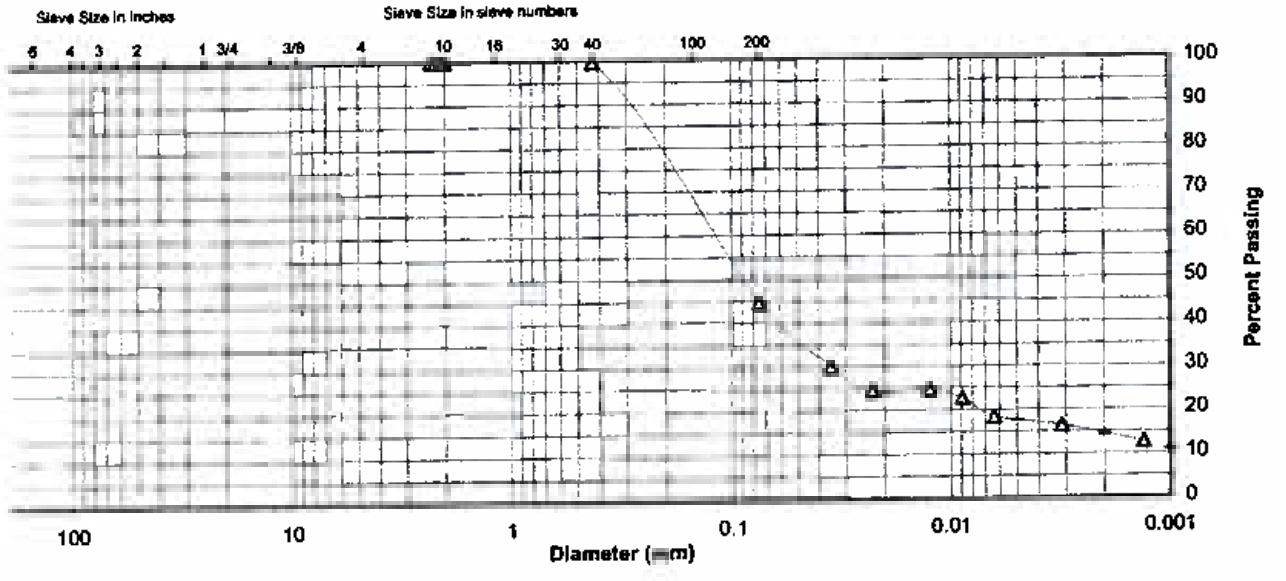
Specific Gravity: 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.6
No. 200	44.8
0.02 mm	24.0
0.005 mm	17.6
0.002 mm	14.3
0.001 mm	11.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.4	54.8	27.2	17.6
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.4	54.8	30.5	14.3



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-64, 3.0'-4.5', 4.5'-6.0'
Project Number: 171468117
Lab ID: 623

County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-14-09
Date Reported: 5-11-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	97.5
No. 4	4.75	86.6
No. 10	2	70.9
No. 40	0.425	52.2
No. 200	0.075	27.8
	0.02	14.4
	0.005	11.4
	0.002	9.0
estimated	0.001	5.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	13.4	29.1
Coarse Sand	15.7	18.7
Medium Sand	18.7	—
Fine Sand	24.4	24.4
Silt	16.4	18.8
Clay	11.4	9.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.69

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-64, 3.0'-4.5', 4.5'-6.0'

Project Number: 171468117
Lab ID: 623

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: DRB
Test Date: 04-16-2009
Date Received: 04-14-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	97.5
No. 4	86.6
No. 10	70.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

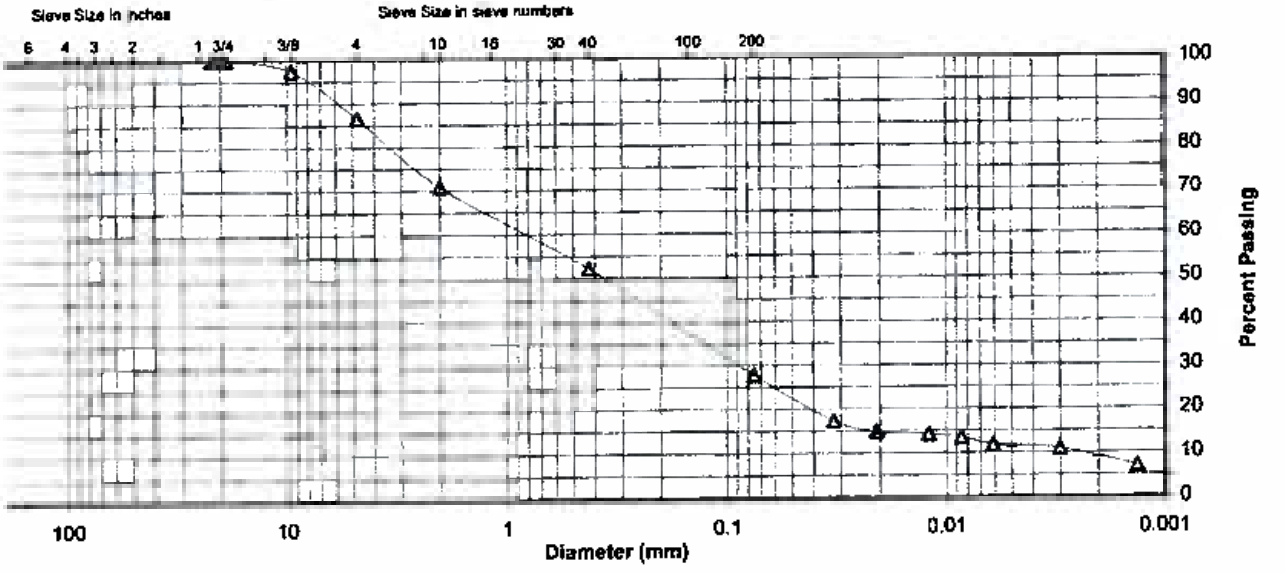
Specific Gravity: 2.69

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	52.2
No. 200	27.8
0.02 mm	14.4
0.005 mm	11.4
0.002 mm	9.0
0.001 mm	5.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	13.4	15.7	18.7	24.4	16.4	11.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	29.1			18.7	24.4	18.8	9.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-64, 9.0'-10.5', 10.5'-12.0'
Project Number: 171468117
Lab ID: 628

County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-14-09
Date Reported: 5-11-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	99.4
No. 4	4.75	99.0
No. 10	2	98.3
No. 40	0.425	96.8
No. 200	0.075	64.4
	0.02	39.3
	0.005	28.1
	0.002	23.3
estimated	0.001	20.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	1.0	1.7
Coarse Sand	0.7	1.5
Medium Sand	1.5	—
Fine Sand	32.4	32.4
Silt	36.3	41.1
Clay	28.1	23.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 28
Plastic Limit: 15
Plasticity Index: 13
Activity Index: 0.57

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay
AASHTO Classification: A-6 (6)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-64, 9.0'-10.5', 10.5'-12.0'

Project Number: 171468117
Lab ID: 628

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: DRB
Test Date: 04-16-2009
Date Received: 04-14-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	99.4
No. 4	99.0
No. 10	98.3

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

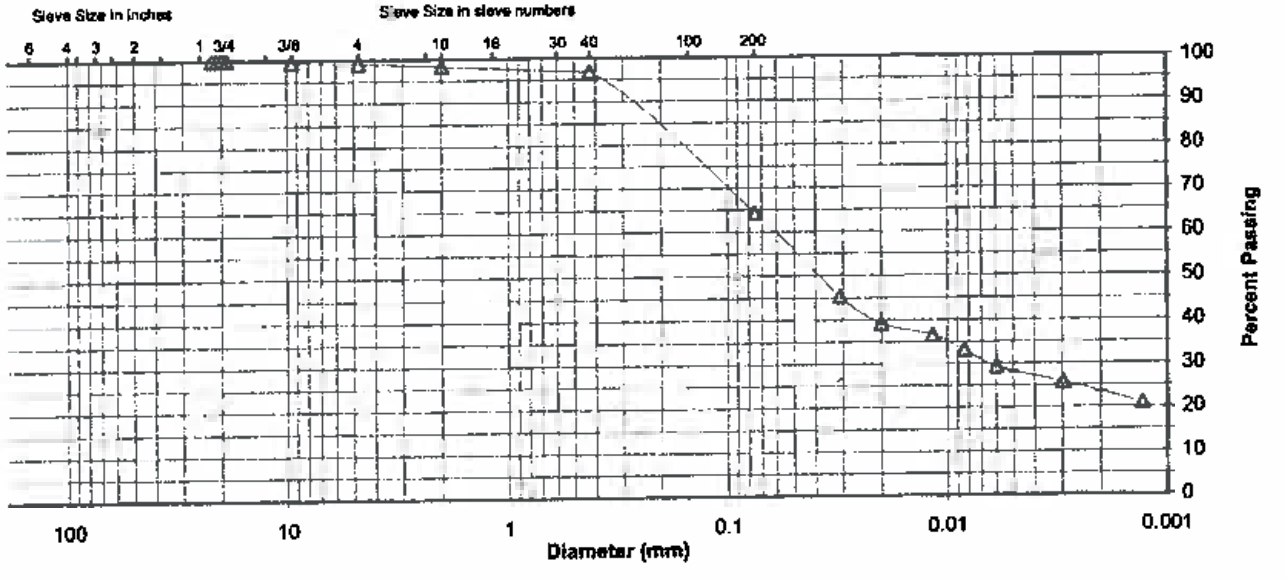
Specific Gravity: 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	96.8
No. 200	64.4
0.02 mm	39.3
0.005 mm	28.1
0.002 mm	23.3
0.001 mm	20.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	1.0	0.7	1.5	32.4	36.3	28.1
	Gravel			Coarse Sand	Fine Sand	Silt	Clay
AASHTO	1.7			1.5	32.4	41.1	23.3



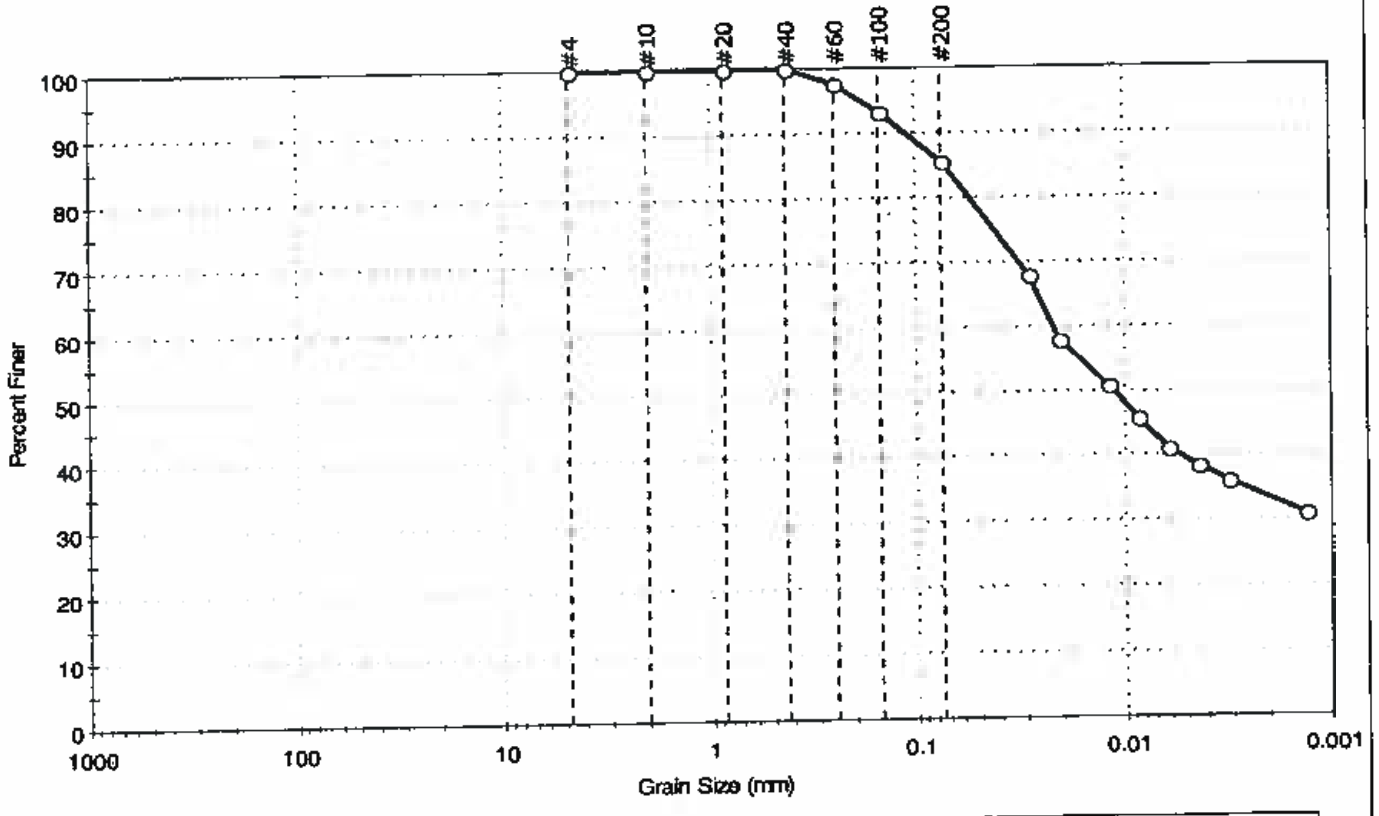
Comments

Reviewed By

GeoTesting express
a subsidiary of Geocomp Corporation

Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond	Project No:	GTX-9015
Location:	Roane, TN		
Boring ID:	STN-64	Sample Type: tube	Tested By: jbr
Sample ID:	S #608B	Test Date: 05/17/09	Checked By: jdt
Depth :	20.6-21.1 ft	Test Id: 151224	
Test Comment:	---		
Sample Description:	Moist, reddish yellow clay		
Sample Comment:	---		

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



%Cobble	%Gravel	%Sand	%Silt & Clay Size
--	0.0	14.6	85.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	98		
#100	0.15	93		
#200	0.075	85		
	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0291	68		
---	0.0206	58		
---	0.0121	51		
---	0.0087	46		
---	0.0062	41		
---	0.0044	38		
---	0.0031	36		
---	0.0013	31		

Coefficients

D_{85} = 0.0733 mm	D_{30} = N/A
D_{60} = 0.0221 mm	D_{15} = N/A
D_{50} = 0.0116 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM lean clay (CL)

AASHTO Clayey Soils (A-6 (16))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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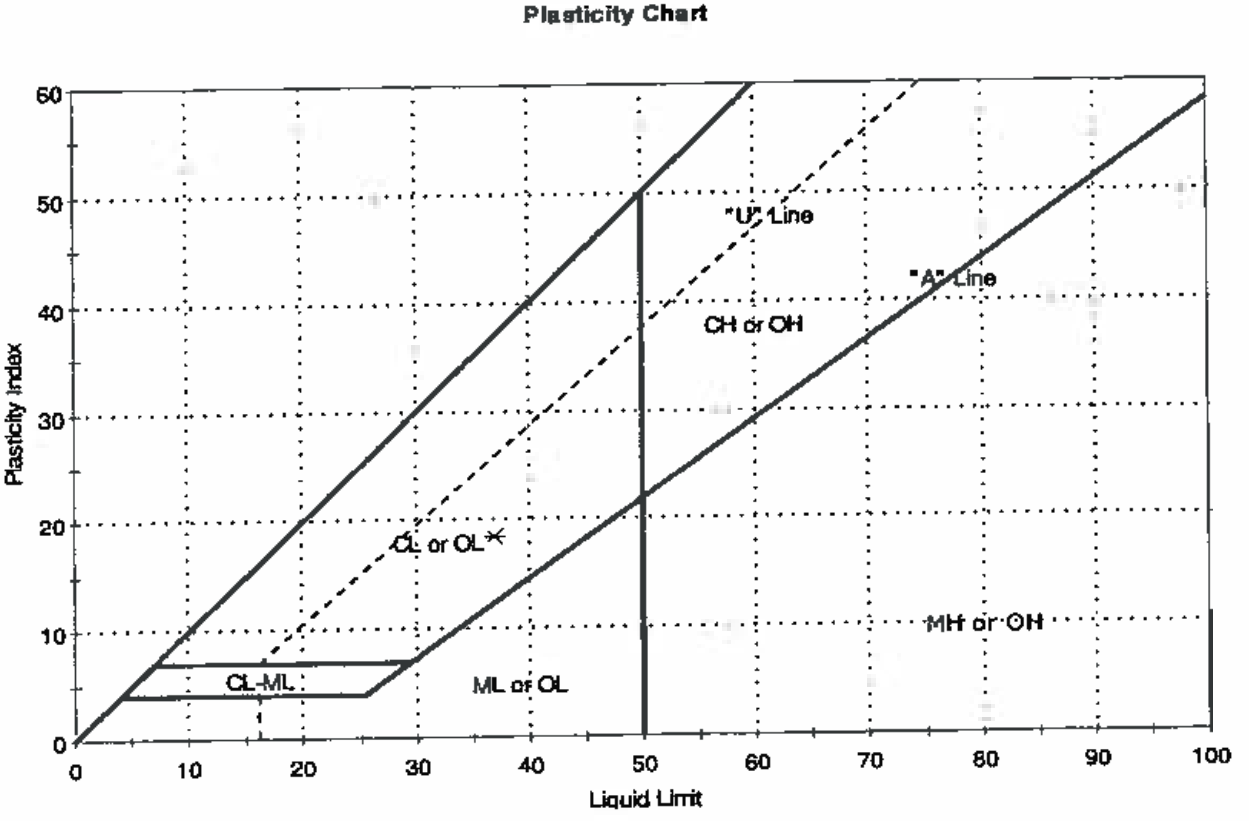
GeoTesting express
a subsidiary of Geocomp Corporation

Client:	Stantec Consulting Services		
Project:	Kingston Ash Pond	Project No:	GTX-9015
Location:	Roane, TN		
Boring ID:	STN-64	Sample Type: tube	Tested By: cam
Sample ID:	S #6088	Test Date: 05/14/09	Checked By: jdt
Depth :	20.6-21.1 ft	Test Id: 152221	
Test Comment:	---		
Sample Description:	Moist, reddish yellow clay		
Sample Comment:	---		

Atterberg Limits - ASTM D 4318-05



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
*	S #6088	STN-64	20.6-21.1 ft	27	37	19	18	0	lean clay (CL)

Sample Prepared using the WET method
0% Retained on #40 Sieve
Dry Strength: VERY HIGH
Dilentancy: SLOW
Toughness: LOW

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Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-64, 39.0'-40.5', 40.5'-42.0'	Lab ID	646
County	Roane (TN)	Date Received	4-14-09
Sample Type	SPT Comp	Date Reported	5-11-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	97.3
No. 200	0.075	35.1
	0.02	17.0
	0.005	9.7
	0.002	7.5
estimated	0.001	6.0

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

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.0
Coarse Sand	0.0	2.7
Medium Sand	2.7	—
Fine Sand	62.2	62.2
Silt	25.4	27.6
Clay	9.7	7.5

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.65

Classification

Unified Group Symbol: SM
Group Name: Silty sand

AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-64, 39.0'-40.5', 40.5'-42.0'

Project Number: 171468117
Lab ID: 646

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: DRB
Test Date: 04-16-2009
Date Received: 04-14-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

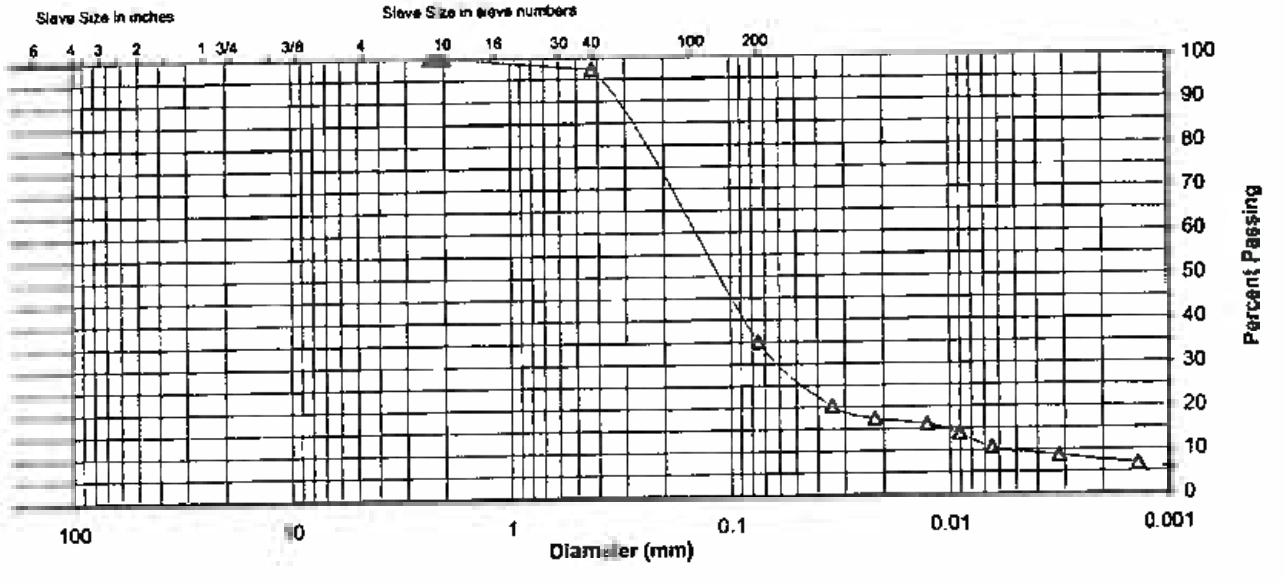
Specific Gravity: 2.65

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	97.3
No. 200	35.1
0.02 mm	17.0
0.005 mm	9.7
0.002 mm	7.5
0.001 mm	6.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	2.7	62.2	25.4	9.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			2.7	62.2	27.6	7.5



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-65, 4.5'-6.0', 6.0'-7.5'
Project Number: 171468117
Lab ID: 695
County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-14-09
Date Reported: 5-11-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	92.1
No. 4	4.75	79.9
No. 10	2	63.5
No. 40	0.425	43.5
No. 200	0.075	21.7
	0.02	10.2
	0.005	5.0
	0.002	3.2
estimated	0.001	2.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	20.1	36.5
Coarse Sand	16.4	20.0
Medium Sand	20.0	—
Fine Sand	21.8	21.8
Silt	16.7	18.5
Clay	5.0	3.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand with gravel
AASHTO Classification: A-1-b (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-65, 4.5'-6.0', 6.0'-7.5'

Project Number: 171466117
Lab ID: 695

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: BWT
Test Date: 04-20-2009
Date Received: 04-14-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	92.1
No. 4	79.9
No. 10	63.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

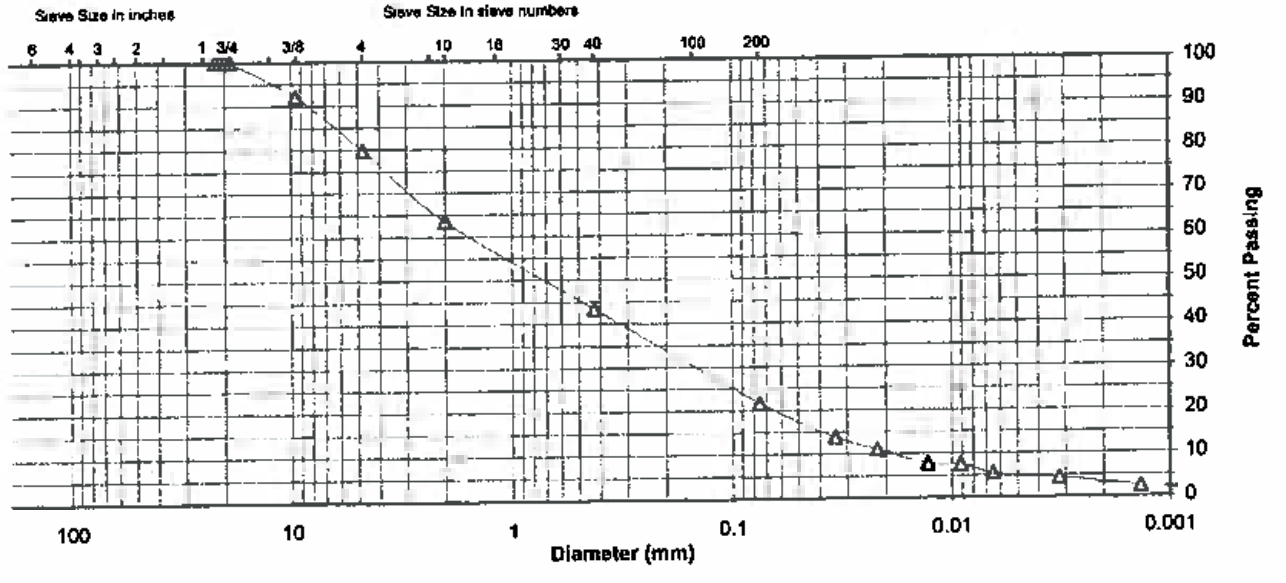
Specific Gravity: 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	43.5
No. 200	21.7
0.02 mm	10.2
0.005 mm	5.0
0.002 mm	3.2
0.001 mm	2.0

Particle Size Distribution

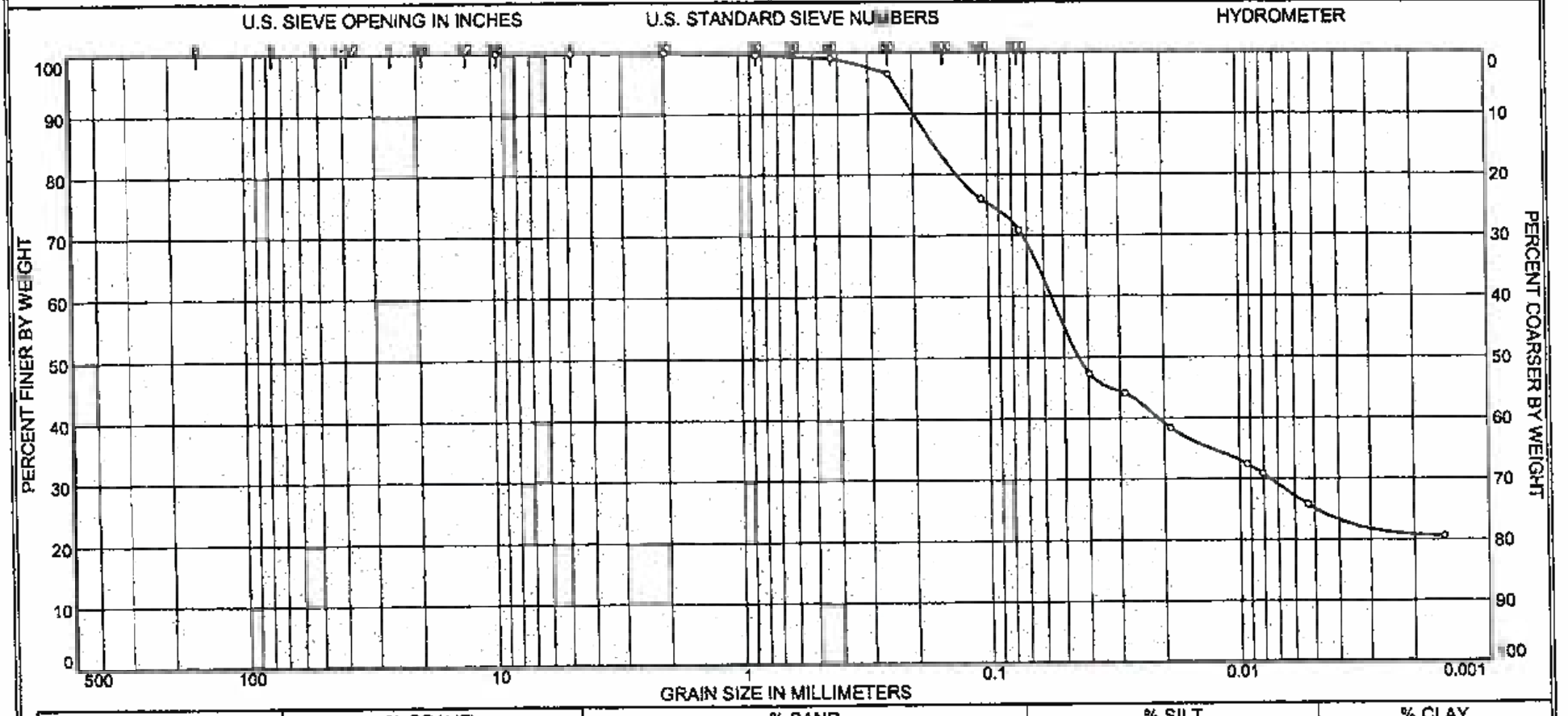
ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	20.1	16.4	20.0	21.8	16.7	5.0
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	36.5			20.0	21.8	18.5	3.2



Comments

Reviewed By

Particle Size Distribution Report ASTM D422/ASTM D1140



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	29.2	45.7	25.1

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
	STN-65	13.5-14 ft	May 09	CL	Gray Brown Lean clay with sand		30	22

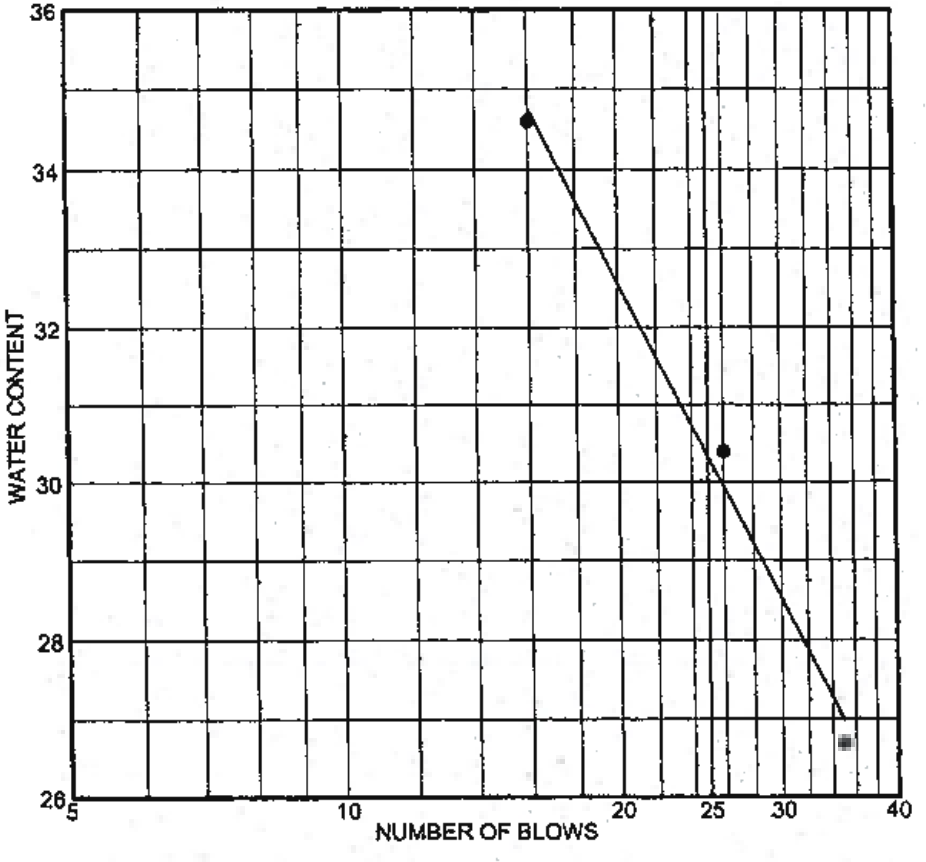
Client STANTEC

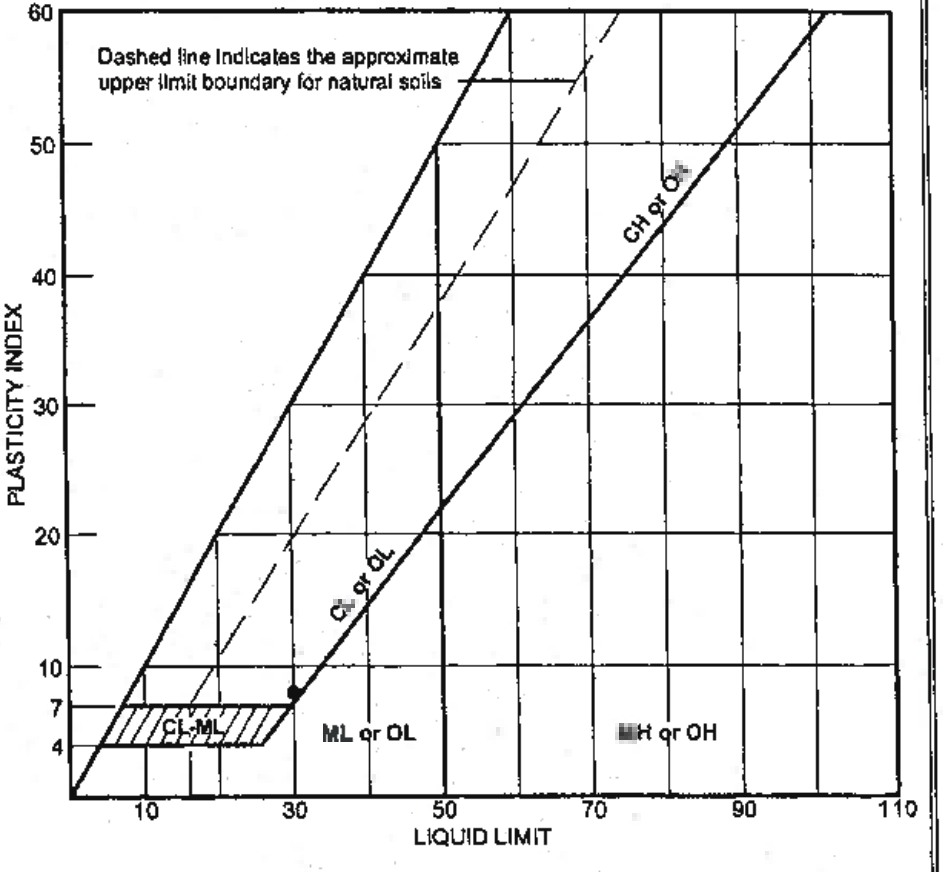
Project Kingston Ash Pond

Project No. GTX-1464 | Lab no.

GeoTesting Express Inc.

LIQUID AND PLASTIC LIMITS TEST REPORT





SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PI
	STN-65	13.5-14 ft	May 09	CL	Gray Brown Lean clay with sand		30	8

Client STANTEC

Project Kingston Ash Pond

Project No. GTX-1464 | Lab no.

GeoTesting Express Inc.

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-65, 40.5'-42.0', 42.0'-43.5'
Project Number: 171468117
Lab ID: 718

County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-14-09
Date Reported: 5-11-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	99.8
No. 200	0.075	83.3
	0.02	57.0
	0.005	32.9
	0.002	22.7
estimated	0.001	19.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.1
Coarse Sand	0.1	0.1
Medium Sand	0.1	---
Fine Sand	16.5	16.5
Silt	50.4	60.6
Clay	32.9	22.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 30
Plastic Limit: 19
Plasticity Index: 11
Activity Index: 0.48

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.69

Classification

Unified Group Symbol: CL
Group Name: Lean clay with sand
AASHTO Classification: A-6 (8)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-65, 40.5'-42.0', 42.0'-43.5'

Project Number: 171468117
Lab ID: 718

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: BWT
Test Date: 04-17-2009
Date Received: 04-14-2009

Maximum Particle size: No. 4 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.69

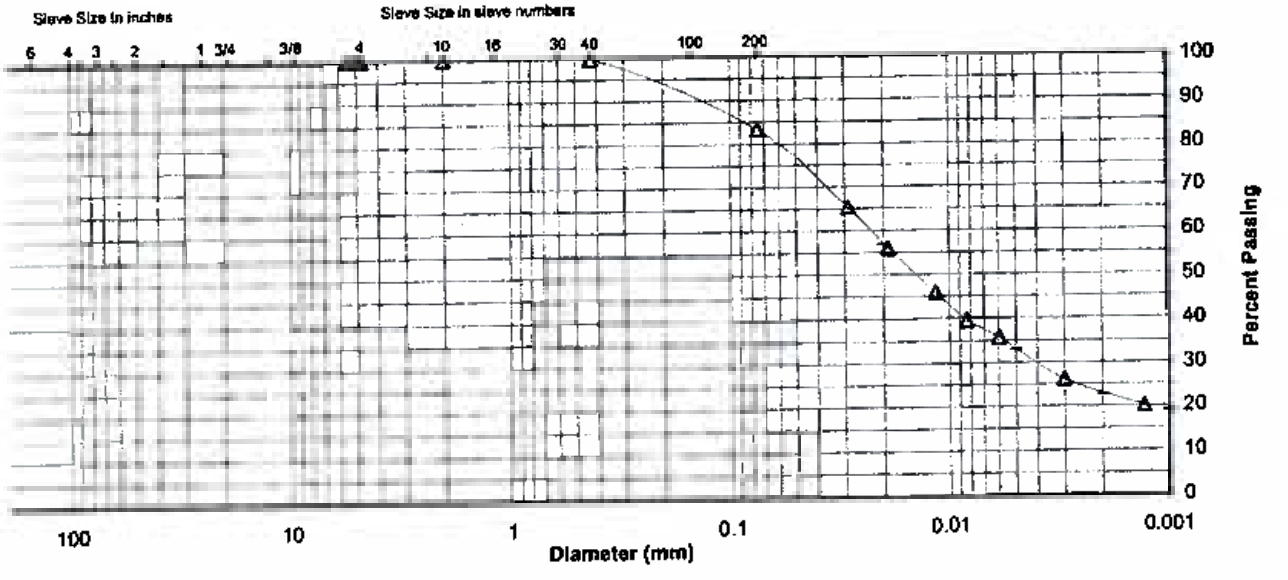
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.8
No. 200	83.3
0.02 mm	57.0
0.005 mm	32.9
0.002 mm	22.7
0.001 mm	19.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.1	0.1	16.5	50.4	32.9

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.1	0.1	16.5	60.6	22.7



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-65, 45.0'-46.5', 46.5'-48.0'
Project Number: 171468117
Lab ID: 722

County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-14-09
Date Reported: 5-11-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	97.5
No. 4	4.75	95.2
No. 10	2	92.6
No. 40	0.425	77.3
No. 200	0.075	31.8
	0.02	21.8
	0.005	13.2
	0.002	7.7
estimated	0.001	5.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	4.8	7.4
Coarse Sand	2.6	15.3
Medium Sand	15.3	---
Fine Sand	45.5	45.5
Silt	18.6	24.1
Clay	13.2	7.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.53

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-65, 45.0'-46.5', 46.5'-48.0'

Project Number: 171468117
Lab ID: 722

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: BWT
Test Date: 04-20-2009
Date Received: 04-14-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	97.5
No. 4	95.2
No. 10	92.6

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

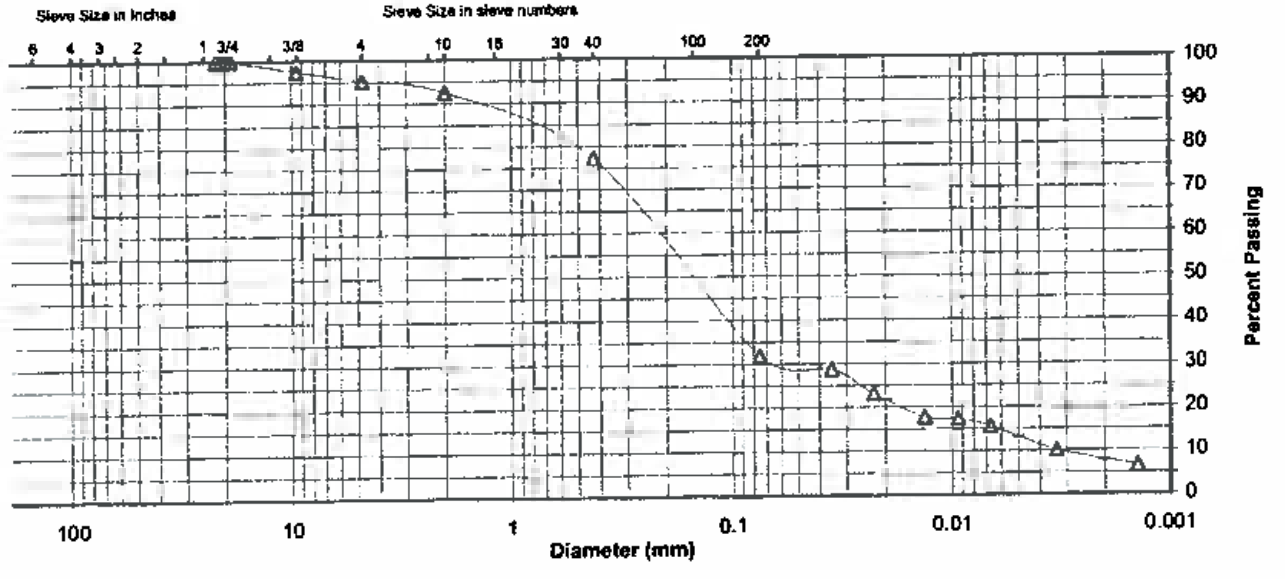
Specific Gravity: 2.53

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	77.3
No. 200	31.8
0.02 mm	21.8
0.005 mm	13.2
0.002 mm	7.7
0.001 mm	5.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	4.8	2.6	15.3	45.5	18.6	13.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	7.4			15.3	45.5	24.1	7.7



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-66, 15.5'-17.0', 17.0'-18.5', 18.5'-20.0'
Project Number: 171468117
Lab ID: 735
County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-14-09
Date Reported: 5-11-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	100.0
3/4"	19	96.4
3/8"	9.5	76.6
No. 4	4.75	61.2
No. 10	2	45.1
No. 40	0.425	24.4
No. 200	0.075	13.4
	0.02	9.7
	0.005	6.4
	0.002	4.3
estimated	0.001	4.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	38.8	54.9
Coarse Sand	16.1	20.7
Medium Sand	20.7	---
Fine Sand	11.0	11.0
Silt	7.0	9.1
Clay	6.4	4.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 26
Plastic Limit: 18
Plasticity Index: 8
Activity Index: 2.00

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.77

Classification

Unified Group Symbol: SC
Group Name: Clayey sand with gravel
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-66, 15.5'-17.0', 17.0'-18.5', 18.5'-20.0'

Project Number: 171468117
Lab ID: 735

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: BWT
Test Date: 04-20-2009
Date Received: 04-14-2009

Maximum Particle size: 1" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	100.0
3/4"	96.4
3/8"	76.6
No. 4	61.2
No. 10	45.1

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

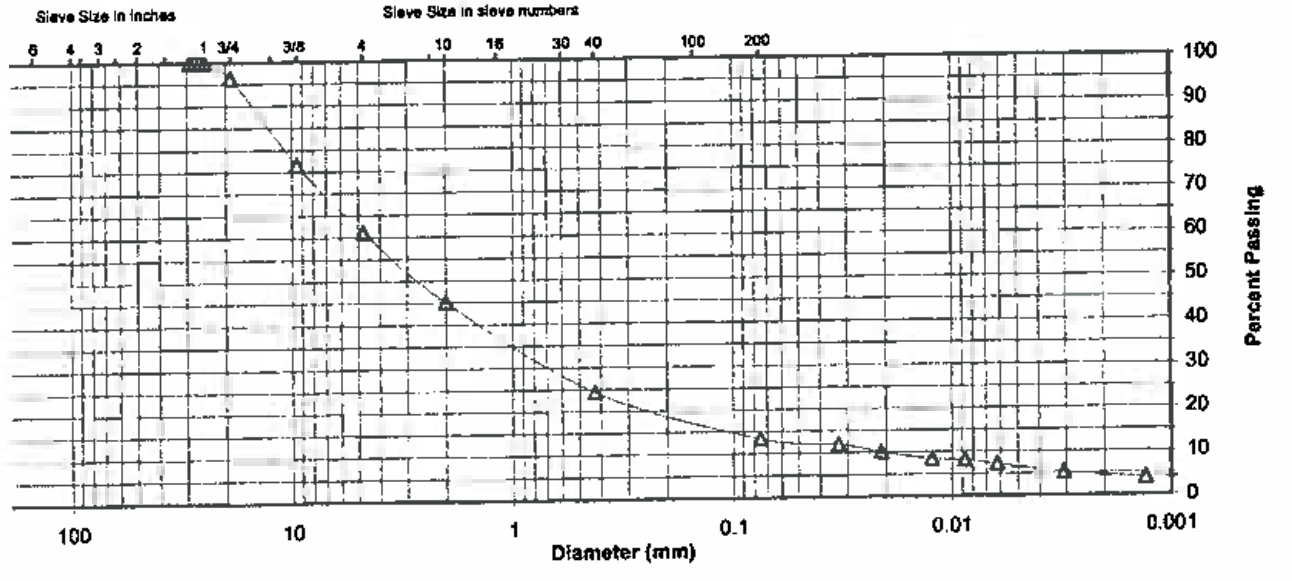
Specific Gravity: 2.77

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	24.4
No. 200	13.4
0.02 mm	9.7
0.005 mm	6.4
0.002 mm	4.3
0.001 mm	4.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	3.6	35.2	16.1	20.7	11.0	7.0	6.4
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	54.9			20.7	11.0	9.1	4.3



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-66, 27.5'-29.0', 29.0'-30.5'
Project Number: 171468117
Lab ID: 744

County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-14-09
Date Reported: 5-11-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.6
No. 200	0.075	48.0
	0.02	24.3
	0.005	16.8
	0.002	12.8
estimated	0.001	9.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.4
Medium Sand	0.4	--
Fine Sand	51.6	51.6
Silt	31.2	35.2
Clay	16.8	12.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 21
Plastic Limit: 19
Plasticity Index: 2
Activity Index: 0.15

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-66, 27.5'-29.0', 29.0'-30.5'

Project Number: 171468117
Lab ID: 744

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 04-17-2009
Date Received: 04-14-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.66

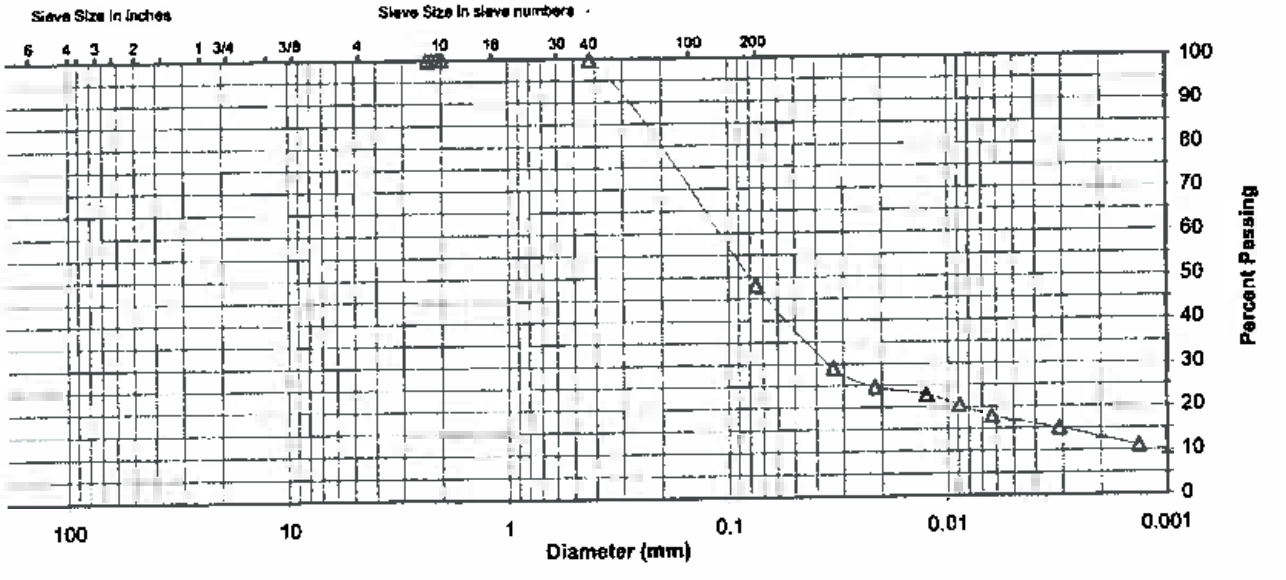
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.6
No. 200	48.0
0.02 mm	24.3
0.005 mm	16.8
0.002 mm	12.8
0.001 mm	9.0

Particle Size Distribution

	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
ASTM	0.0	0.0	0.0	0.4	51.6	31.2	16.8

	Gravel	Coarse Sand	Fine Sand	Silt	Clay
AASHTO	0.0	0.4	51.8	35.2	12.8



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name	Kingston Ash Pond	Project Number	171468117
Source	STN-66, 39.0'-40.0', 40.0'-41.5'	Lab ID	752
County	Roane (TN)	Date Received	4-14-09
Sample Type	SPT Comp	Date Reported	5-11-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.7
No. 200	0.075	54.9
	0.02	33.8
	0.005	18.7
	0.002	13.2
estimated	0.001	12.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.3
Medium Sand	0.3	—
Fine Sand	44.8	44.8
Silt	36.2	41.7
Clay	18.7	13.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed

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

California Bearing Ratio

Test Not Performed

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

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No.10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: ML
Group Name: Sandy silt

AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-66, 39.0'-40.0', 40.0'-41.5'

Project Number: 171468117
Lab ID: 752

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: BWT
Test Date: 04-21-2009
Date Received: 04-14-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

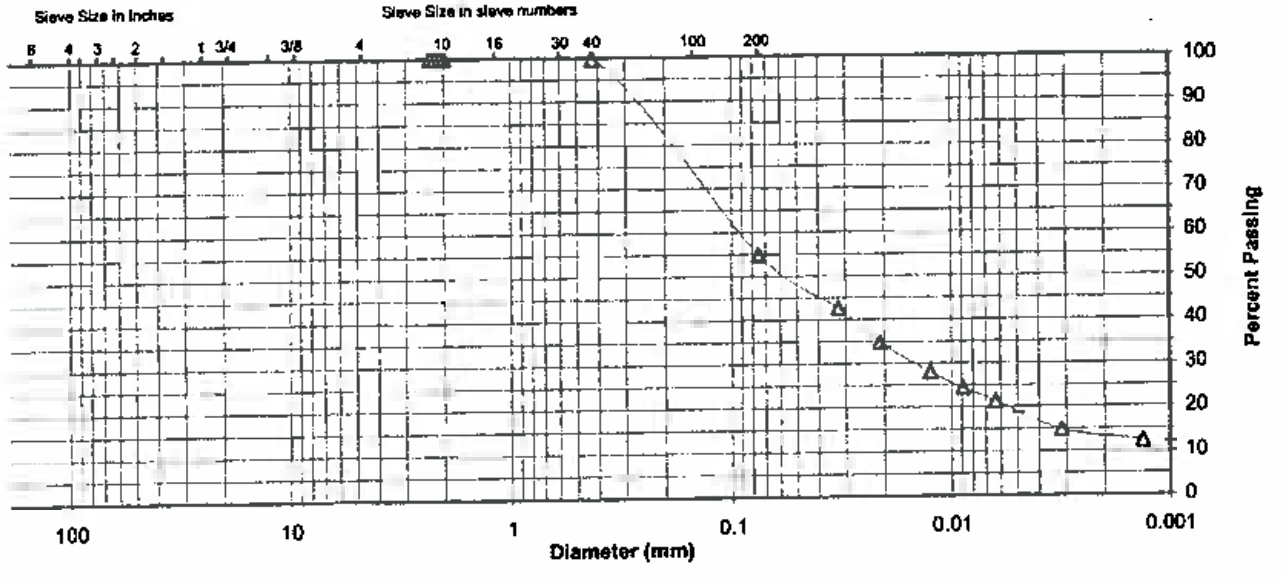
Specific Gravity: 2.66

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.7
No. 200	54.9
0.02 mm	33.8
0.005 mm	18.7
0.002 mm	13.2
0.001 mm	12.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.3	44.8	36.2	18.7
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.3	44.8	41.7	13.2



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-66, 50.5'-52.0', 52.0'-53.5'
Project Number: 171468117
Lab ID: 761

County: Roane (TN)
Sample Type: SPT Comp
Date Received: 4-14-09
Date Reported: 5-11-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	99.9
No. 4	4.75	99.9
No. 10	2	99.8
No. 40	0.425	98.4
No. 200	0.075	43.5
	0.02	29.6
	0.005	17.2
	0.002	10.6
estimated	0.001	7.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.1	0.2
Coarse Sand	0.1	1.4
Medium Sand	1.4	—
Fine Sand	54.9	54.9
Silt	26.3	32.9
Clay	17.2	10.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No.10
Specific Gravity at 20° Celsius: 2.57

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-66, 50.5'-52.0', 52.0'-53.5'

Project Number: 171468117
Lab ID: 761

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: BWT
Test Date: 04-21-2009
Date Received: 04-14-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	99.9
No. 4	99.9
No. 10	99.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

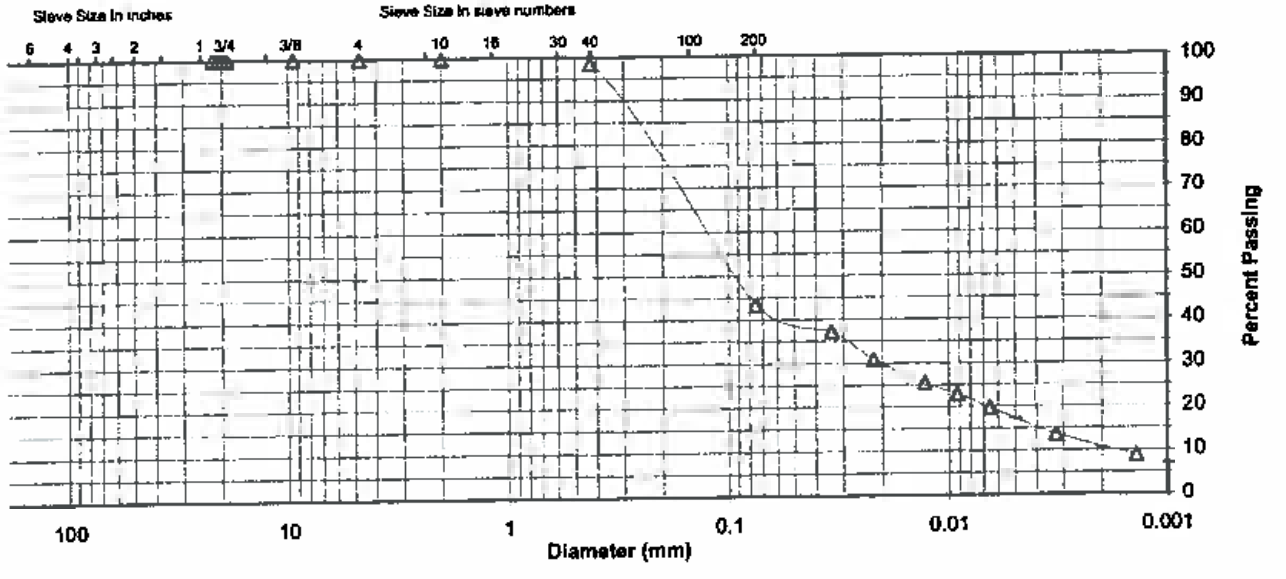
Specific Gravity: 2.57

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.4
No. 200	43.5
0.02 mm	29.6
0.005 mm	17.2
0.002 mm	10.6
0.001 mm	7.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.1	0.1	1.4	54.9	26.3	17.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.2			1.4	54.9	32.9	10.6



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-69, 3.0'-4.5', 4.5'-6.0'
Project Number: 175569042
Lab ID: 478
County: Kingston, Tennessee
Sample Type: SPT Comp
Date Received: 5-26-09
Date Reported: 6-24-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	100.0
1"	25	95.4
3/4"	19	91.1
3/8"	9.5	78.3
No. 4	4.75	70.8
No. 10	2	53.8
No. 40	0.425	41.6
No. 200	0.075	31.8
	0.02	24.7
	0.005	17.2
	0.002	13.4
estimated	0.001	11.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	29.2	46.2
Coarse Sand	17.0	12.2
Medium Sand	12.2	---
Fine Sand	9.8	9.8
Silt	14.6	18.4
Clay	17.2	13.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 44
Plastic Limit: 26
Plasticity Index: 18
Activity Index: 1.38

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.79

Classification

Unified Group Symbol: SC
Group Name: Clayey sand with gravel
AASHTO Classification: A-2-7 (1)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-69, 3.0'-4.5', 4.5'-6.0'

Project Number: 175569042
Lab ID: 478

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: CP
Test Date: 06-16-2009
Date Received: 05-26-2009

Maximum Particle size: 1 1/2" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	100.0
1"	95.4
3/4"	91.1
3/8"	78.3
No. 4	70.8
No. 10	53.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

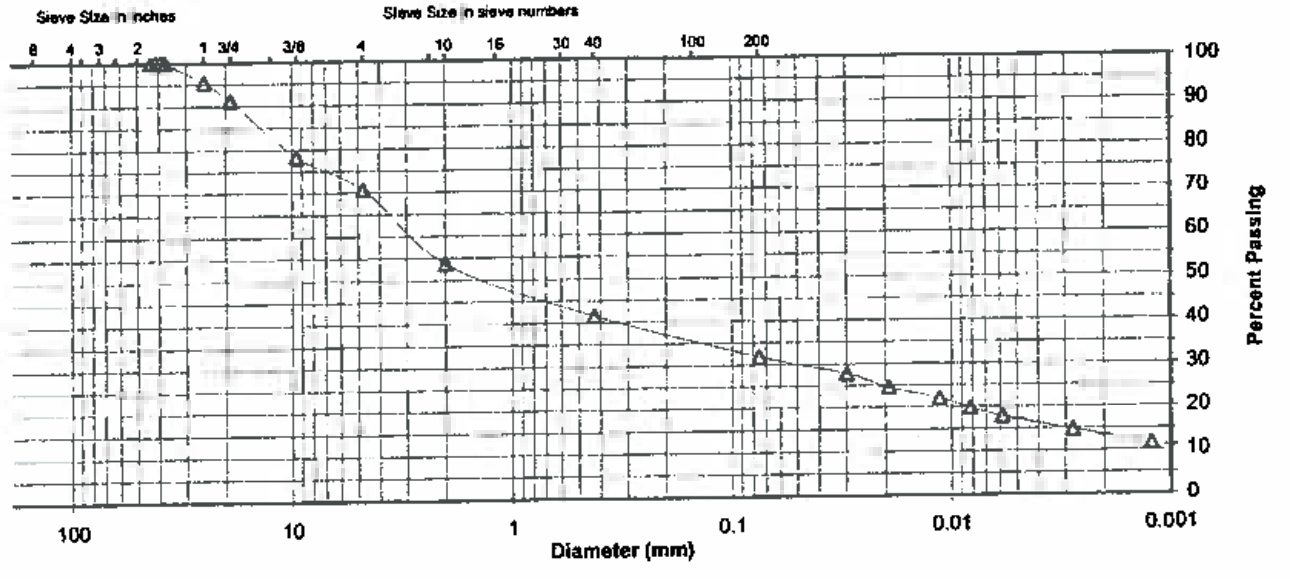
Specific Gravity: 2.79

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	41.6
No. 200	31.8
0.02 mm	24.7
0.005 mm	17.2
0.002 mm	13.4
0.001 mm	11.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	8.9	20.3	17.0	12.2	9.8	14.6	17.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	46.2			12.2	9.8	18.4	13.4



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-69, 15.0'-16.5', 16.5'-18.0'
Project Number: 175569042
Lab ID: 487

County: Kingston, Tennessee
Sample Type: SPT Comp
Date Received: 5-26-09
Date Reported: 6-24-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	100.0
3/4"	19	98.0
3/8"	9.5	96.5
No. 4	4.75	95.9
No. 10	2	95.5
No. 40	0.425	94.9
No. 200	0.075	65.6
	0.02	42.6
	0.005	32.5
	0.002	28.4
estimated	0.001	25.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	4.1	4.5
Coarse Sand	0.4	0.6
Medium Sand	0.6	—
Fine Sand	29.3	29.3
Silt	33.1	37.2
Clay	32.5	28.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 29
Plastic Limit: 16
Plasticity Index: 13
Activity Index: 0.46

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.68

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay
AASHTO Classification: A-6 (6)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-69, 15.0'-16.5', 16.5'-18.0'

Project Number: 175569042
Lab ID: 487

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: CSM
Test Date: 06-16-2009
Date Received: 05-26-2009

Maximum Particle size: 1" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	100.0
3/4"	98.0
3/8"	96.5
No. 4	95.9
No. 10	95.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

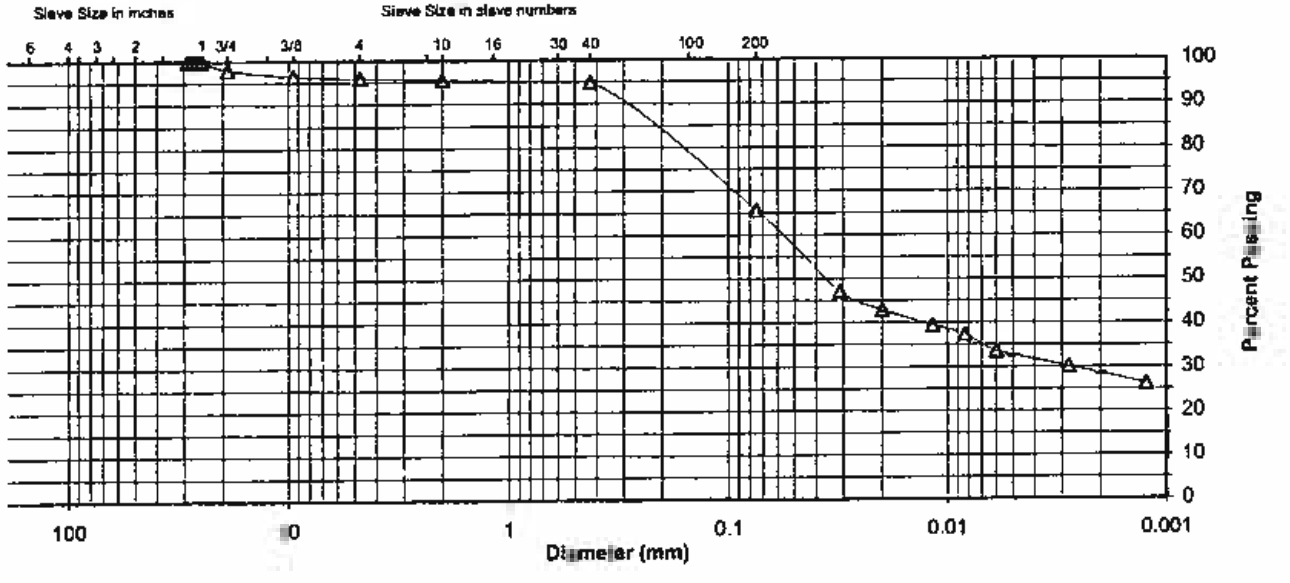
Specific Gravity: 2.68

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	94.9
No. 200	65.6
0.02 mm	42.6
0.005 mm	32.5
0.002 mm	28.4
0.001 mm	25.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	2.0	2.1	0.4	0.6	29.3	33.1	32.5
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	4.5			0.6	29.3	37.2	28.4



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-71, 4.5'-6.0', 6.0'-7.5'
County: Kingston, Tennessee
Sample Type: SPT Comp

Project Number: 175569042
Lab ID: 207
Date Received: 5-22-09
Date Reported: 6-5-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	100.0
3/4"	19	98.3
3/8"	9.5	90.1
No. 4	4.75	80.2
No. 10	2	60.1
No. 40	0.425	46.8
No. 200	0.075	33.4
	0.02	24.1
	0.005	17.2
	0.002	14.0
estimated	0.001	12.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	19.8	39.9
Coarse Sand	20.1	13.3
Medium Sand	13.3	--
Fine Sand	13.4	13.4
Silt	16.2	19.4
Clay	17.2	14.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 36
Plastic Limit: 20
Plasticity Index: 16
Activity Index: 1.14

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.75

Classification

Unified Group Symbol: SC
Group Name: Clayey sand with gravel
AASHTO Classification: A-2-6 (1)

Comments:

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-71, 4.5'-6.0', 6.0'-7.5'

Project Number: 175569042
Lab ID: 207

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: CM
Test Date: 05-28-2009
Date Received: 05-22-2009

Maximum Particle size: 1" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	100.0
3/4"	98.3
3/8"	90.1
No. 4	80.2
No. 10	60.1

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

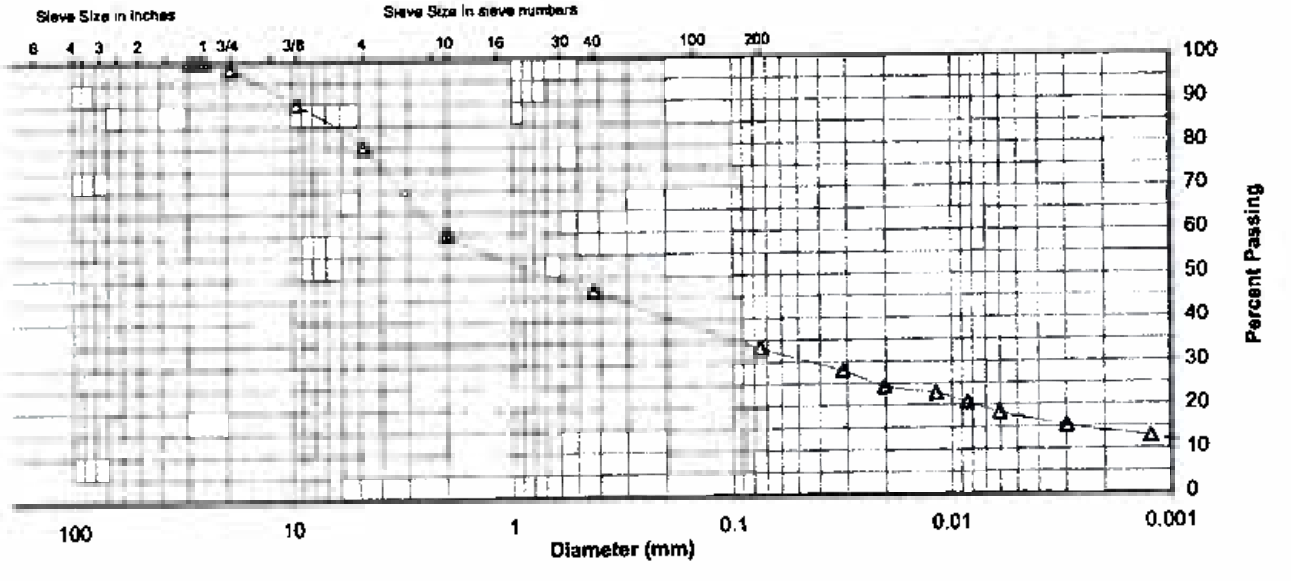
Specific Gravity: 2.75

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	46.8
No. 200	33.4
0.02 mm	24.1
0.005 mm	17.2
0.002 mm	14.0
0.001 mm	12.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	1.7	18.1	20.1	13.3	13.4	16.2	17.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	39.9			13.3	13.4	19.4	14.0



Comments

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Kingston Ash Pond
Source: STN-71, 22.5'-24.0', 24.0'-25.5'
Project Number: 175569042
Lab ID: 220

County: Kingston, Tennessee
Sample Type: SPT Comp
Date Received: 5-22-09
Date Reported: 6-5-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	
No. 10	2	100.0
No. 40	0.425	99.1
No. 200	0.075	26.2
	0.02	15.0
	0.005	10.0
	0.002	8.0
estimated	0.001	6.0

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

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.0	0.0
Coarse Sand	0.0	0.9
Medium Sand	0.9	—
Fine Sand	72.9	72.9
Silt	16.2	18.2
Clay	10.0	8.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Kingston Ash Pond
Source: STN-71, 22.5'-24.0', 24.0'-25.5'

Project Number: 175569042
Lab ID: 220

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

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

Particle Shape: N/A
Particle Hardness: N/A

Tested By: CM
Test Date: 05-28-2009
Date Received: 05-22-2009

Maximum Particle size: No. 10 Sieve

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

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

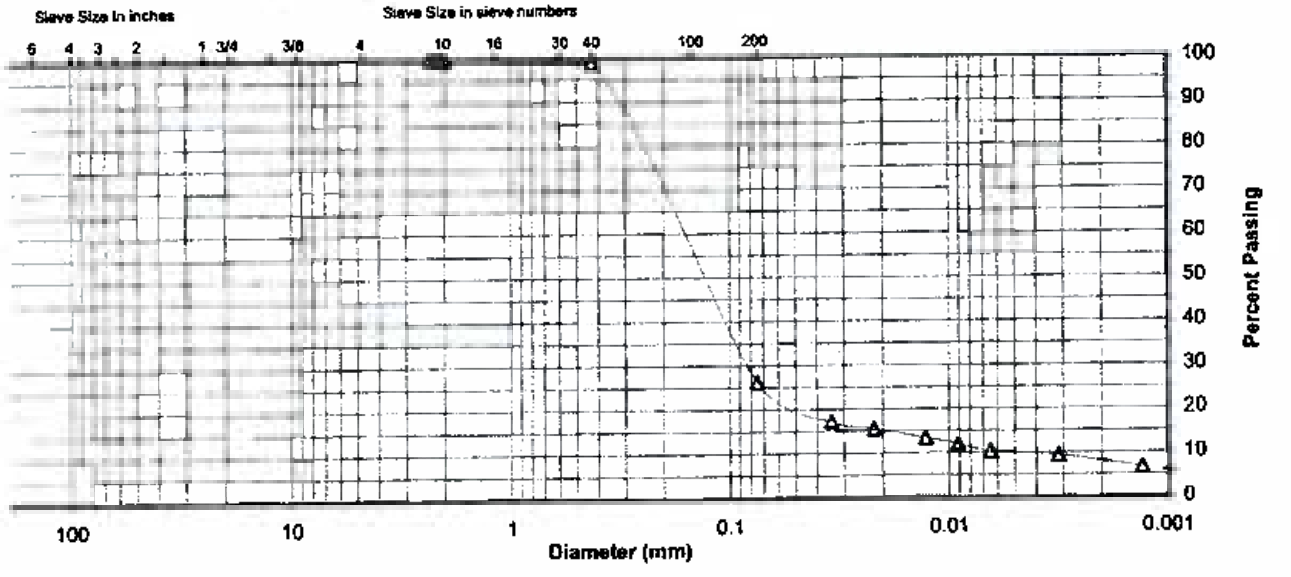
Specific Gravity: 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	99.1
No. 200	26.2
0.02 mm	15.0
0.005 mm	10.0
0.002 mm	8.0
0.001 mm	6.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.0	0.9	72.9	16.2	10.0
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.0			0.9	72.9	18.2	8.0



Comments

Reviewed By

Direct Simple Shear Test Results

GeoTesting express
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Consolidated Undrained Direct Simple Shear Test of Cohesive Soil by ASTM D 6528

Client:	GeoTesting of Georgia	GTX#:	9015
Project Name:	Kingston Ash Pond	Test Date:	05/15/09
Project Location:	TN		

Boring ID:	ST-15D
Sample ID:	ST-5
Depth, ft:	34-34.5 ft

Visual Description: Moist, yellowish brown clay with sand

Test Equipment: Top and bottom box (circular) = 2.62 in diameter. Load cells and LVDT's connected to data acquisition system for shear force, normal load, horizontal and vertical displacement; surface area = 5.39 in^2, soil height = 1 inch

Test Condition: Inundated

Sample Type and Preparation: Extruded from tube, cut, trimmed and placed into apparatus at as-received density and moisture content.

Parameter	Point 1	Point 2	Point 3	Point 4	Point 5
Test No.	DSS-4	DSS-5			
Initial Moisture Content, %	23.3	21.1			
Initial Dry Density, pcf	101	107			
Nominal Rate of Shear Strain, %/min	0.0008	0.0008			
Vertical Consolidation Stress, psi	15.0	15.0			
Final Moisture Content, %	24.7	21.5			
Measured Peak Shear Stress, psi	4.498	6.176			
Shear Strain at Peak Shear Stress, %	6.87	11.17			
Membrane Correction, psi	0.18	0.28			
Corrected Peak Shear Stress, psi	4.318	5.896			
S / σ'_{vc}	0.29	0.39			

Comments: Tested By: njh Checked By: jdt

Notes: These results apply only to the sample tested for the specific test conditions. The test procedures employed follow accepted industry practice and the indicated test method. GeoTesting Express has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

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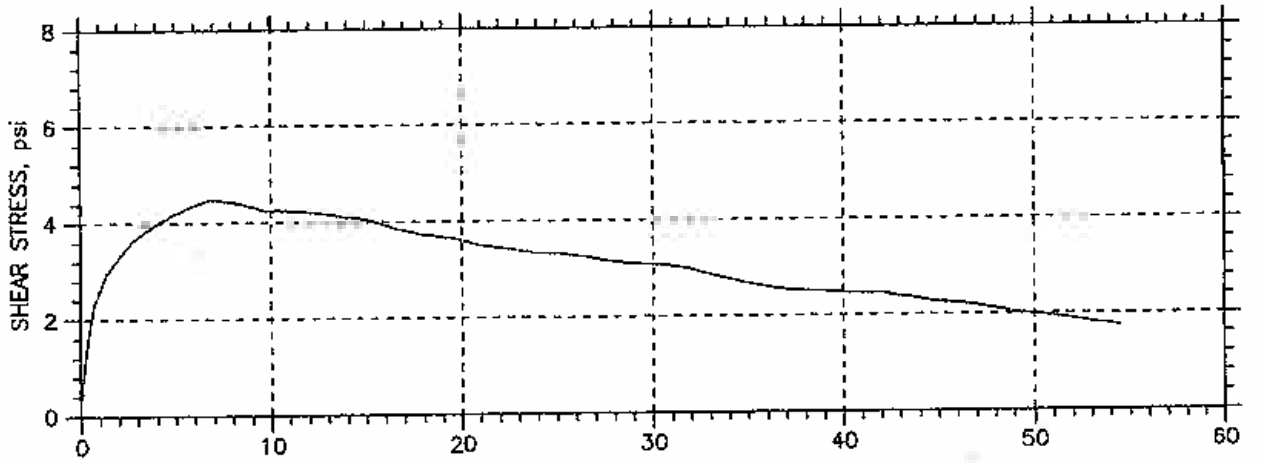
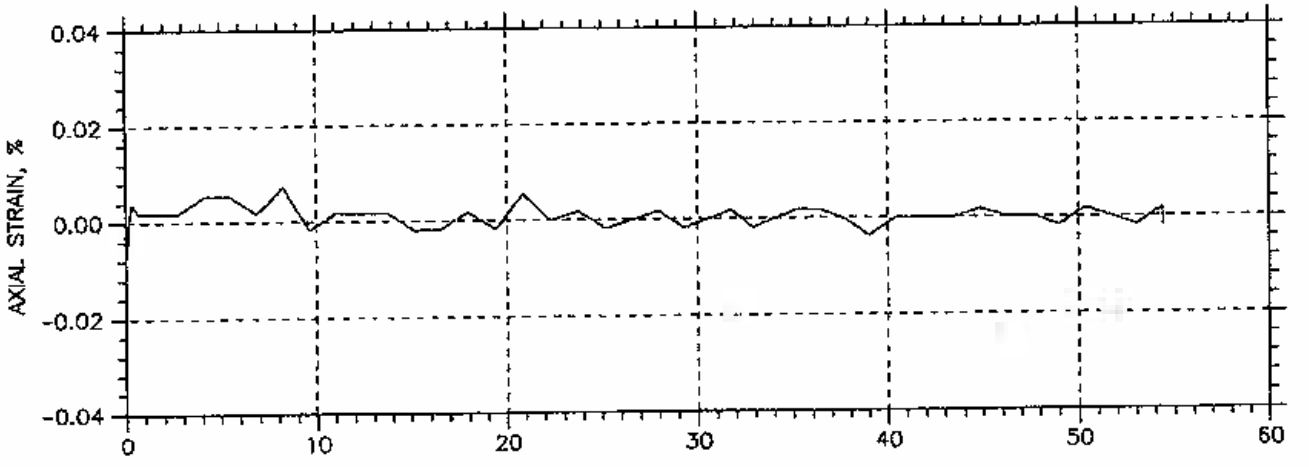
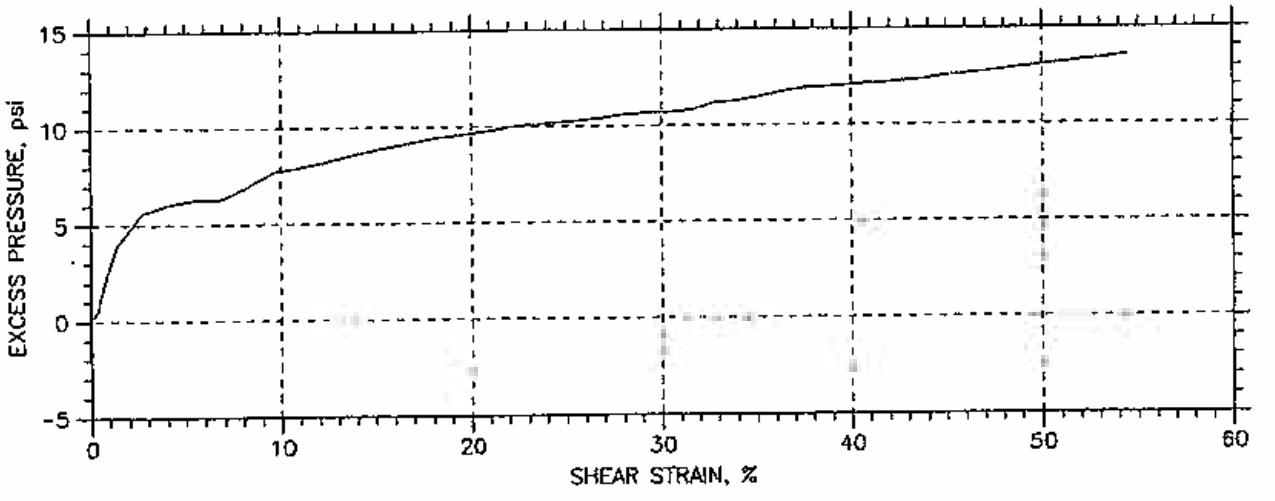
DIRECT SIMPLE SHEAR TEST







Project: Kingston Ash Pond	Location: Roane, TN	Project No.: GTX-9015
Boring No.: ST-15 D	Tested By: md	Checked By: jdt
Sample No.: ST-5	Test Date: 05/15/09	Depth: 34-34.5
Test No.: DSS-4	Sample Type: core	Elevation: ---
Description: Moist, yellowish brown clay with sand		
Remarks: System J - 1.0 membrane		
File: \\Geocompdb1\projects\Gtx9015\dss\9015-DSS-4n.dat		

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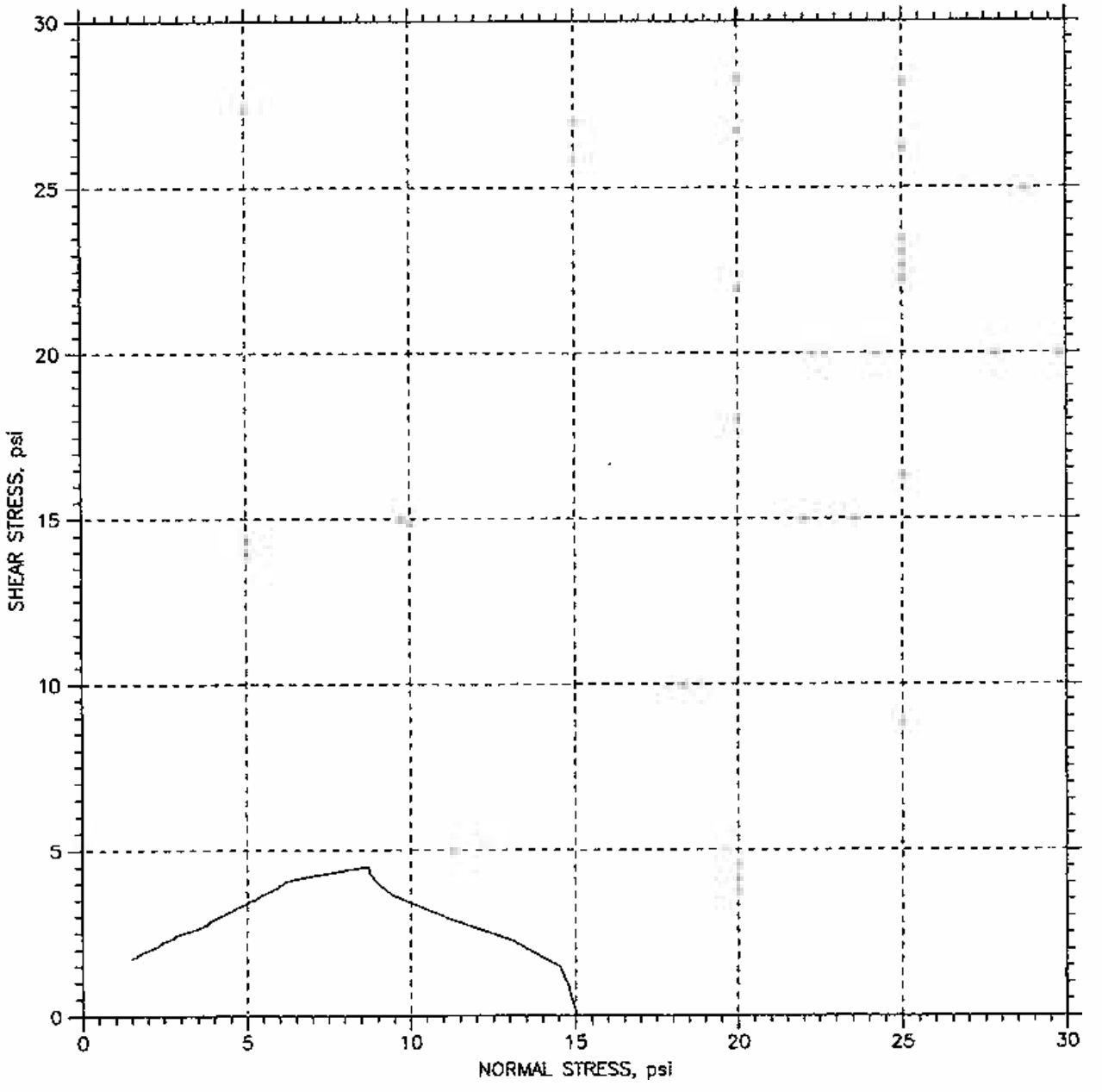
DIRECT SIMPLE SHEAR TEST



Project: Kingston Ash Pond	Location: Roane, TN	Project No.: GTX-9015
Boring No.: ST-15 D	Tested By: md	Checked By: jdt
Sample No.: ST-5	Test Date: 05/15/09	Depth: 34-34.5
Test No.: DSS-4	Sample Type: core	Elevation: ---
Description: Moist, yellowish brown clay with sand		
Remarks: System J - 1.0 membrane		
File: \\Geocompdb1\projects\Gtx9015\dss\9015-DSS-4n.dat		

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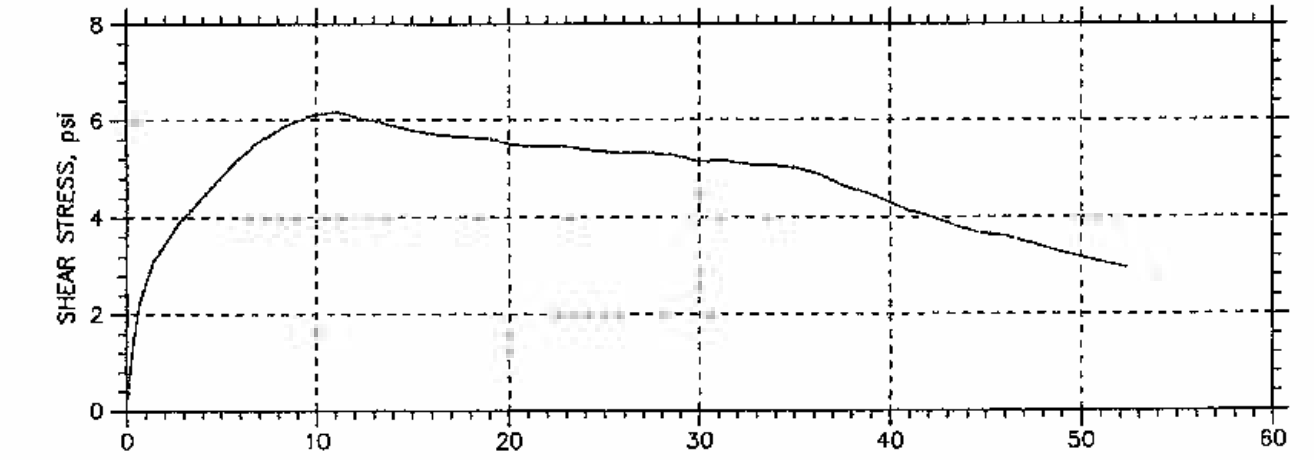

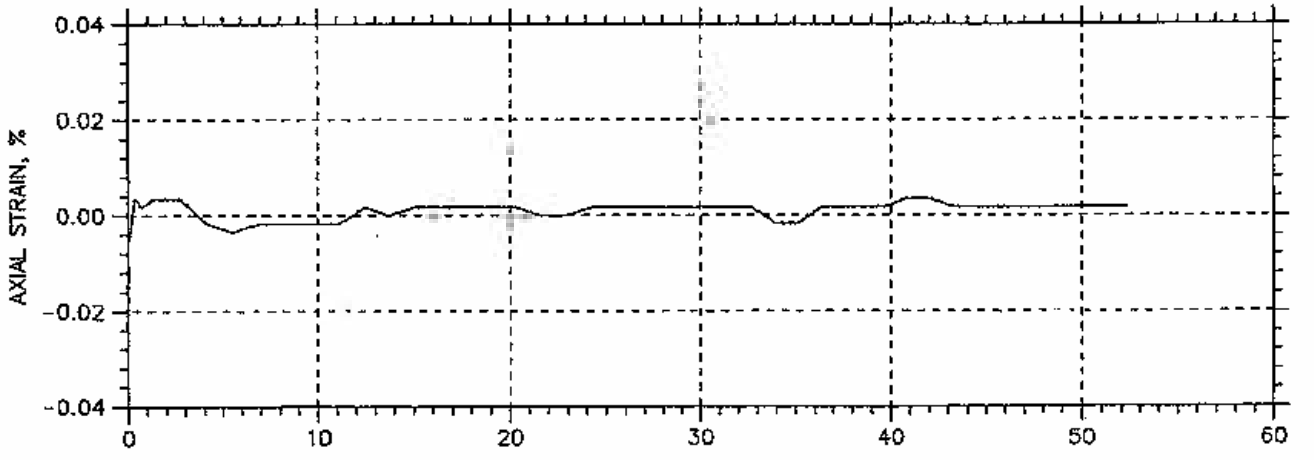

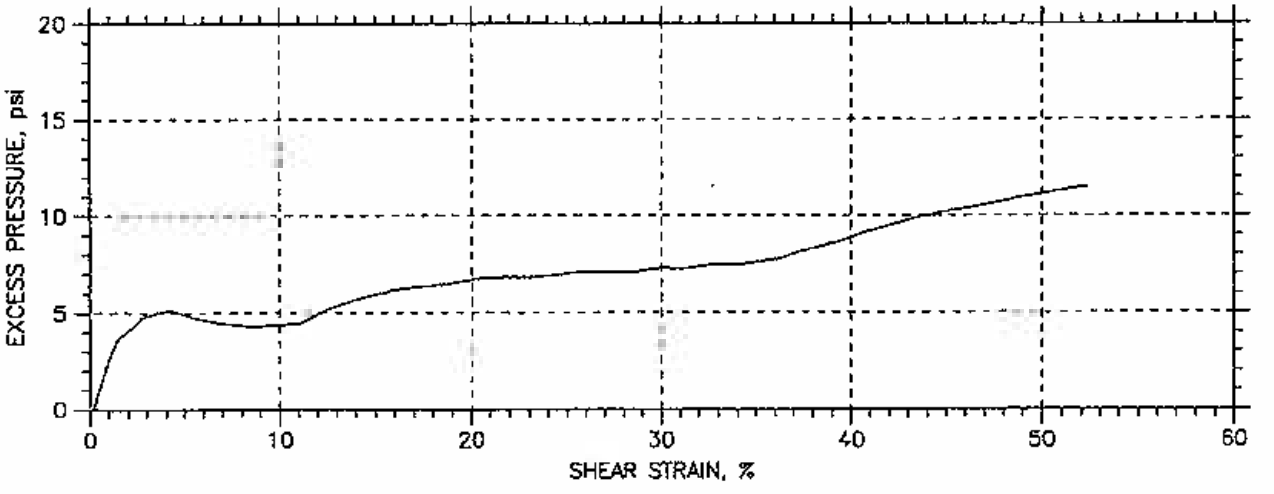

Project: Kingston Ash Pond	Location: Roane, TN	Project No.: GTX-9015
Boring No.: ST-15 D	Tested By: md	Checked By: jdt
Sample No.: ST-5	Test Date: 05/17/09	Depth: 34.5-35 ft
Test No.: DSS-5	Sample Type: tube	Elevation: ---
Description: Moist, yellowish brown clay with sand		
Remarks: System J - 1.0 membrane		
File: \\Geocompdb1\projects\Gtx9015\dss\9015-DSS-5n.dat		

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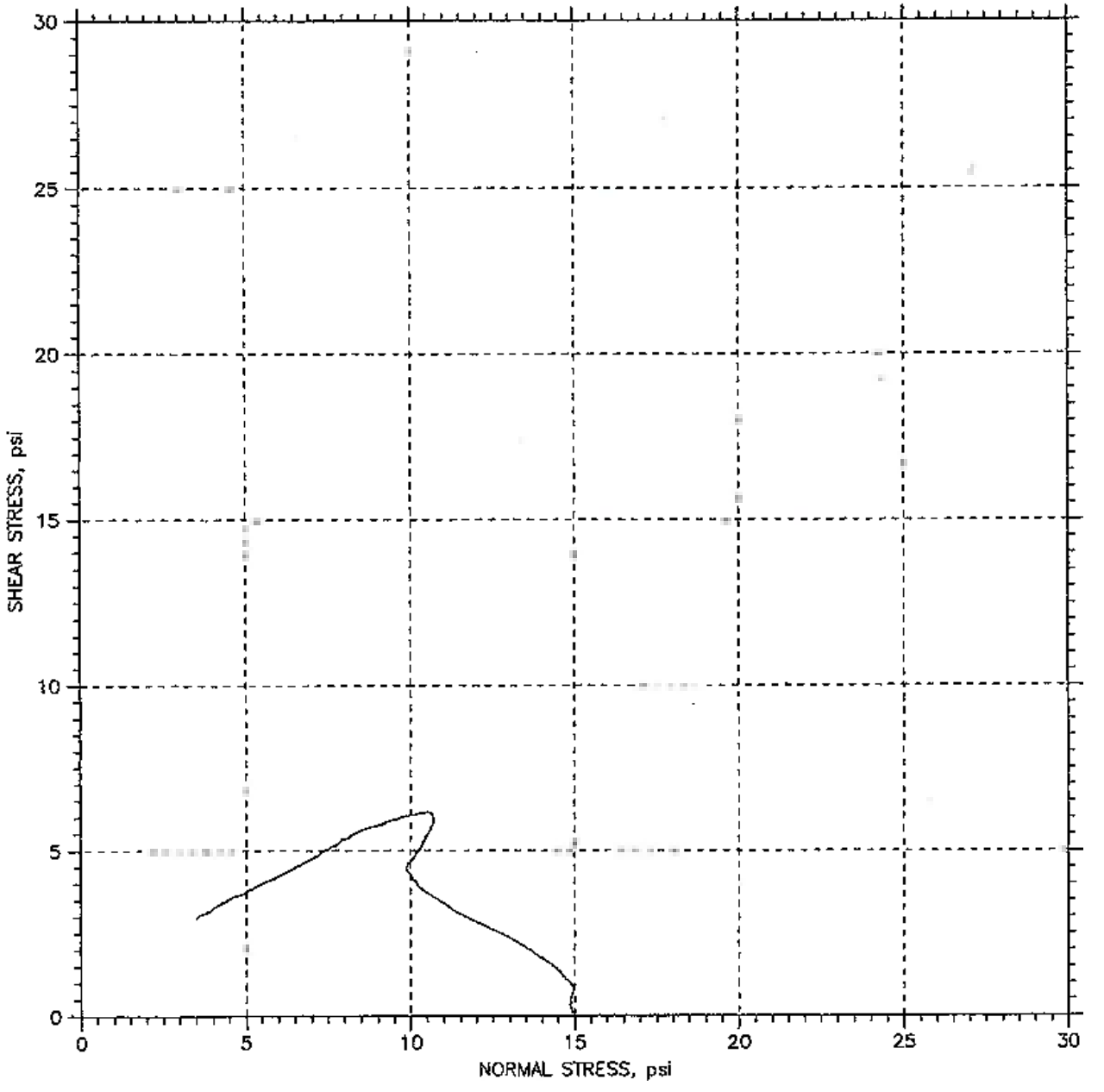
DIRECT SIMPLE SHEAR TEST



Project: Kingston Ash Pond	Location: Roane, TN	Project No.: GTX-9015
Boring No.: ST-15 D	Tested By: md	Checked By: jdt
Sample No.: ST-5	Test Date: 05/17/09	Depth: 34.5-35 ft
Test No.: DSS-5	Sample Type: tube	Elevation: ---
Description: Moist, yellowish brown clay with sand		
Remarks: System J - 1.0 membrane		
File: \\Geocompdb1\projects\Gtx9015\dss\9015-DSS-5n.dat		

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Consolidated Undrained Direct Simple Shear Test of Cohesive Soil by ASTM D 6528

Client:	GeoTesting of Georgia	GTX#:	9015
Project Name:	Kingston Ash Pond	Test Date:	05/12/09
Project Location:	TN		

Boring ID:	STN-27B
Sample ID:	ST-4
Depth, ft:	33.2-33.8 ft

Visual Description: Moist, olive gray sandy clay

Test Equipment: Top and bottom box (circular) = 2.62 in diameter. Load cells and LVDT's connected to data acquisition system for shear force, normal load, horizontal and vertical displacement; surface area = 5.39 in^2, soil height = 1 inch

Test Condition: inundated

Sample Type and Preparation: Extruded from tube, cut, trimmed and placed into apparatus at as-received density and moisture content.

Parameter	Point 1	Point 2	Point 3	Point 4	Point 5
Test No.	DSS-1				
Initial Moisture Content, %	23.8				
Initial Dry Density, pcf	102				
Nominal Rate of Shear Strain, %/min	0.0008				
Vertical Consolidation Stress, psi	15.5				
Final Moisture Content, %	22.8				
Measured Peak Shear Stress, psi	4.085				
Shear Strain at Peak Shear Stress, %	7.19				
Membrane Correction, psi	0.18				
Corrected Peak Shear Stress, psi	3.905				
S / σ'_{vc}	0.25				

Comments: Tested By: njh Checked By: jdt

Notes: These results apply only to the sample tested for the specific test conditions. The test procedures employed follow accepted industry practice and the indicated test method. GeoTesting Express has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

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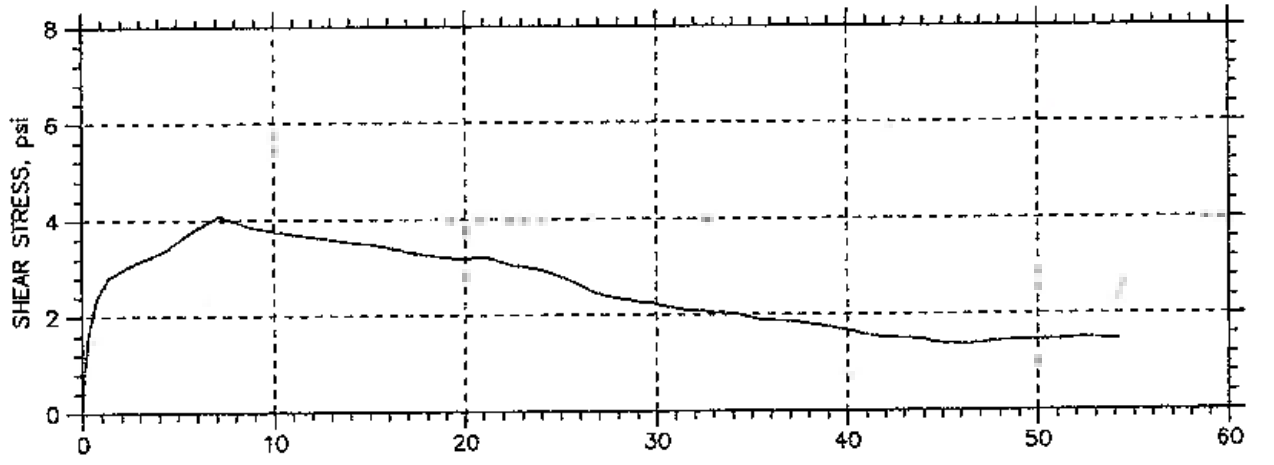
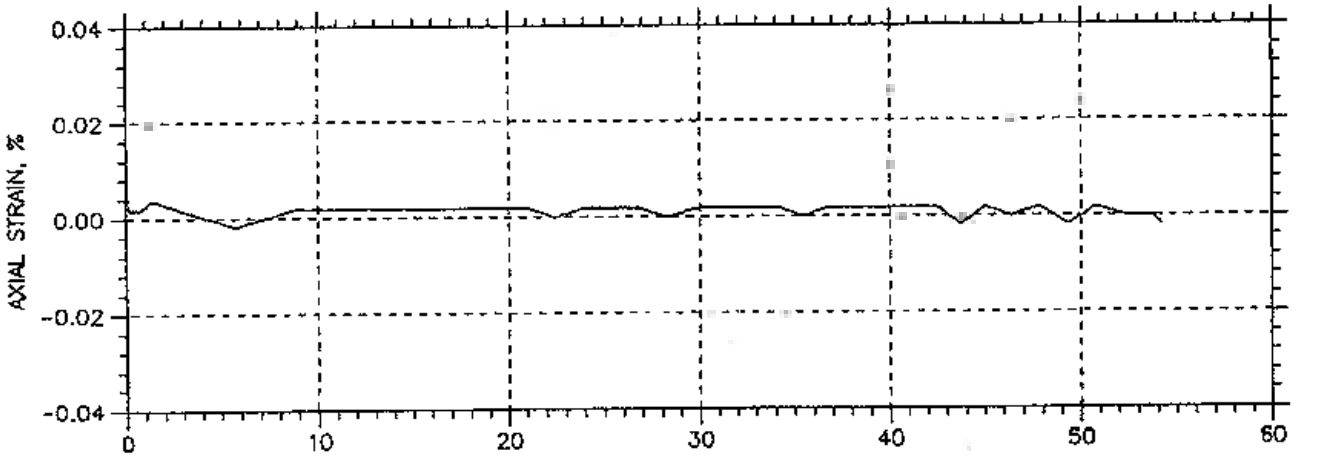
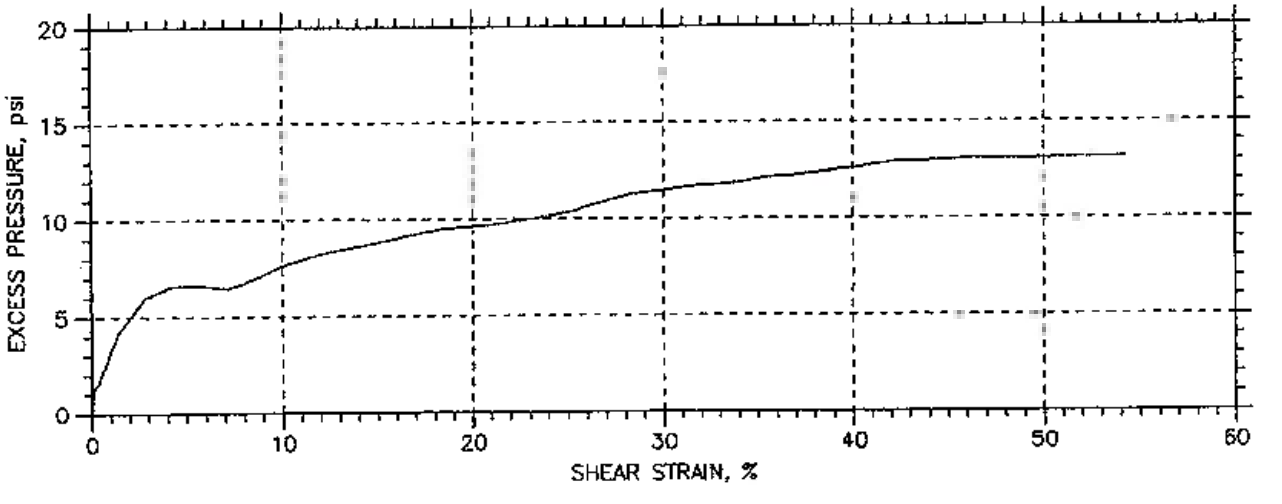
DIRECT SIMPLE SHEAR TEST







Project: Kingston Ash Pond	Location: Roane, TN	Project No.: GTX-9015
Boring No.: STN -27 B	Tested By: md	Checked By: jdt
Sample No.: ST-4	Test Date: 05/12/09	Depth: 33.2-33.8
Test No.: DSS-1	Sample Type: core	Elevation: ---
Description: Moist, olive gray sandy clay		
Remarks: System J - 1.0 membrane		
File: \\Geocompdb1\projects\Gtx9015\dss\9015-DSS-1n.dat		

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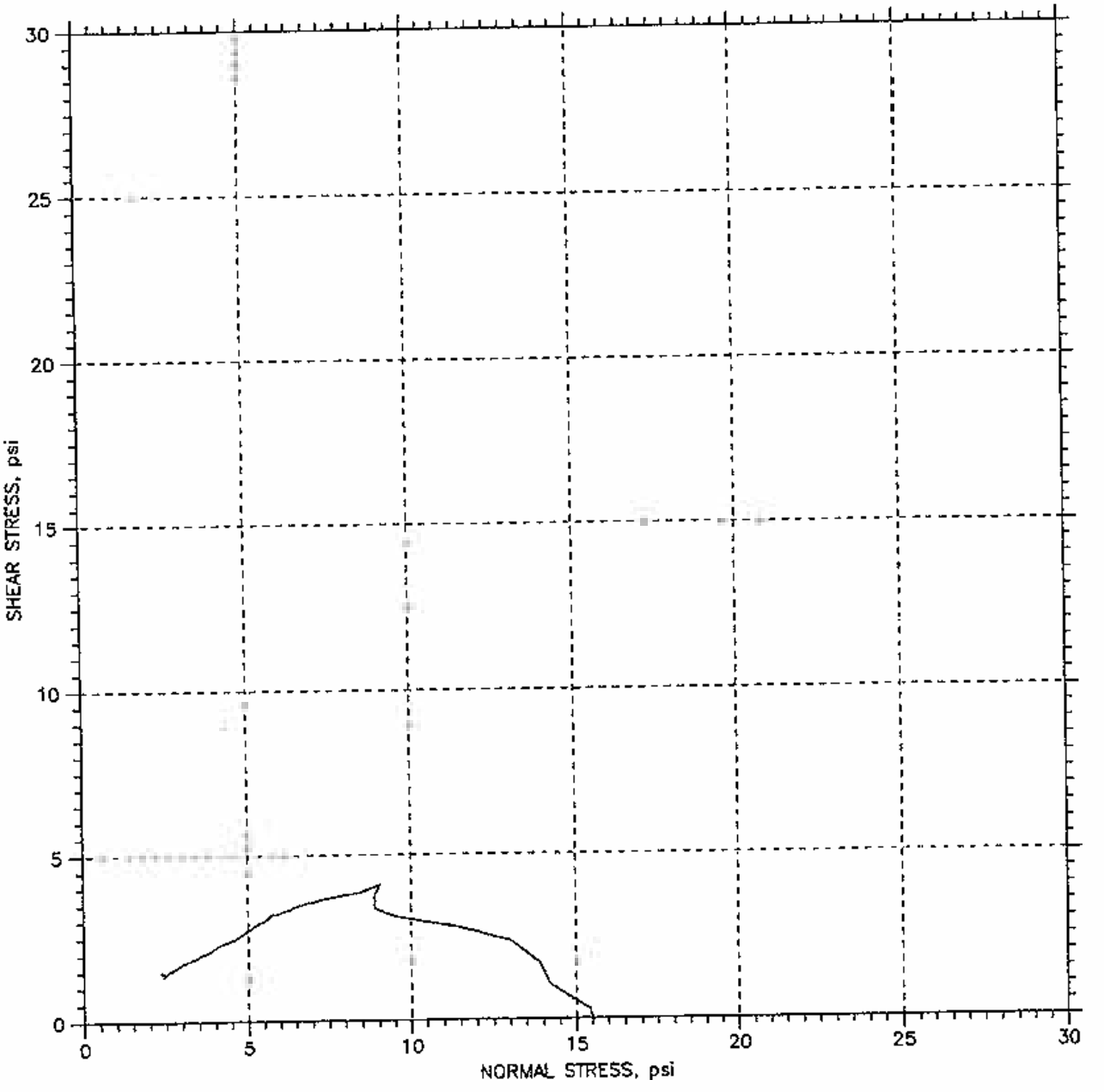
DIRECT SIMPLE SHEAR TEST



Project: Kingston Ash Pond	Location: Roane, TN	Project No.: GTX-9015
Boring No.: STN -27 B	Tested By: rnd	Checked By: jdt
Sample No.: ST-4	Test Date: 05/12/09	Depth: 33.2-33.8
Test No.: DSS-1	Sample Type: core	Elevation: ---
Description: Moist, olive gray sandy clay		
Remarks: System J - 1.0 membrane		
File: \\Geocompdb1\projects\Gtx9015\dss\9015-DSS-1n.dat		

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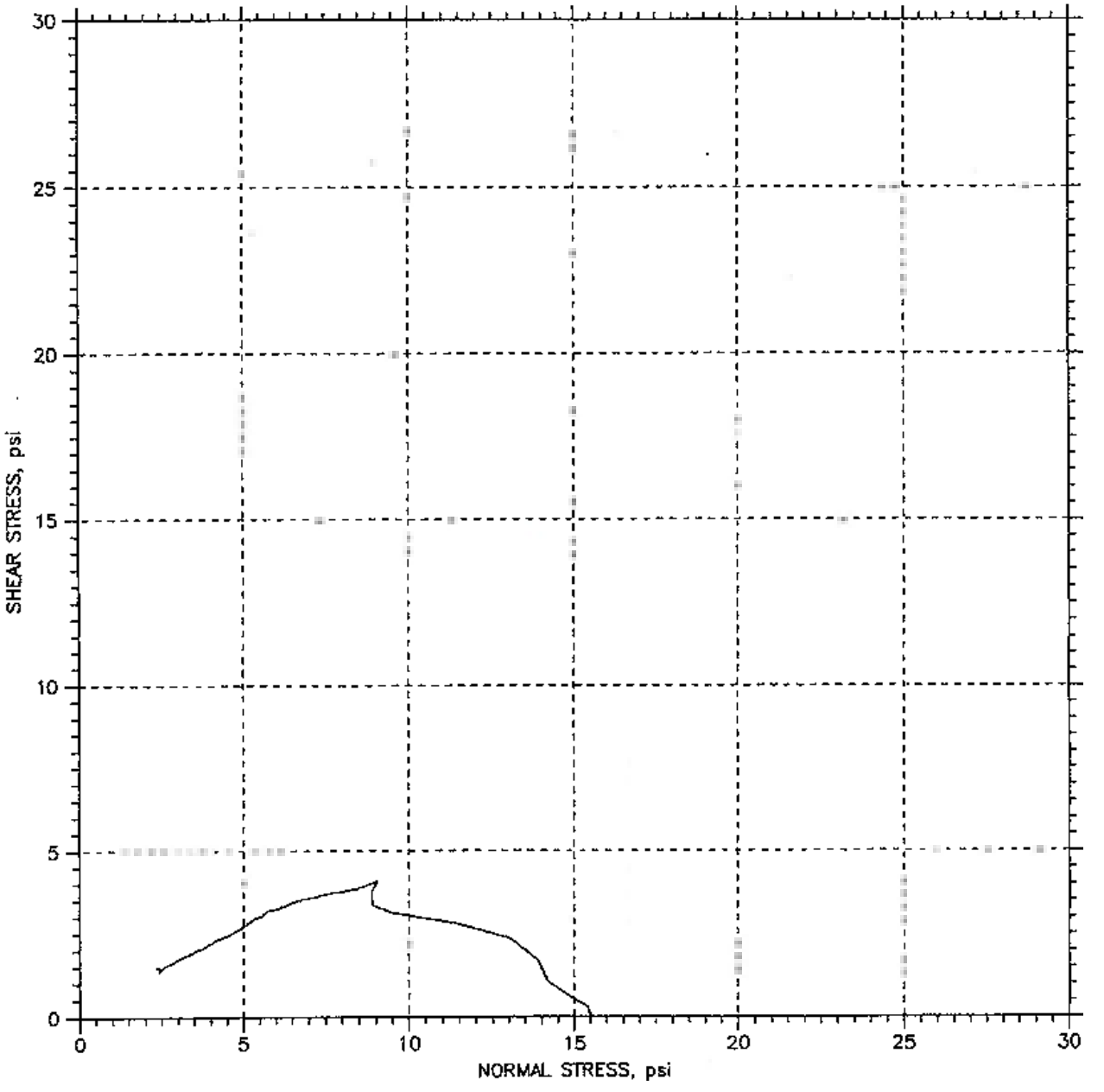
DIRECT SIMPLE SHEAR TEST



Project: Kingston Ash Pond	Location: Roone, TN	Project No.: GTX-9015
Boring No.: STN -27 B	Tested By: md	Checked By: jdt
Sample No.: ST-4	Test Date: 05/12/09	Depth: 33.2-33.8
Test No.: DSS-1	Sample Type: core	Elevation: ---
Description: Moist, olive gray sandy clay		
Remarks: System J - 1.0 membrane		
File: \\Geocompdb1\projects\Gtx9015\dss\9015-DSS-1n.dot		

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Consolidated Undrained Direct Simple Shear Test of Cohesive Soil by ASTM D 6528

Client:	GeoTesting of Georgia	GTX#:	9015
Project Name:	Kingston Ash Pond	Test Date:	05/13/09
Project Location:	TN		

Boring ID: STN-27B
Sample ID: ST-5
Depth, ft: 35.2-35.8 ft

Visual Description: Moist, yellowish brown sandy silty clay

Test Equipment: Top and bottom box (circular) = 2.62 in diameter. Load cells and LVDT's connected to data acquisition system for shear force, normal load, horizontal and vertical displacement; surface area = 5.39 in^2, soil height = 1 inch

Test Condition: inundated

Sample Type and Preparation: Extruded from tube, cut, trimmed and placed into apparatus at as-received density and moisture content.

Parameter	Point 1	Point 2	Point 3	Point 4	Point 5
Test No.	DSS-2	DSS-3			
Initial Moisture Content, %	22.3	23.0			
Initial Dry Density, pcf	102	104			
Nominal Rate of Shear Strain, %/min	0.0008	0.0008			
Vertical Consolidation Stress, psi	15.5	15.5			
Final Moisture Content, %	24.2	23.1			
Measured Peak Shear Stress, psi	5.296	5.273			
Shear Strain at Peak Shear Stress, %	15.78	13.80			
Membrane Correction, psi	0.29	0.28			
Corrected Peak Shear Stress, psi	5.006	4.993			
S / σ'_{vc}	0.32	0.32			

Comments: Tested By: njh Checked By: jdt

Notes: These results apply only to the sample tested for the specific test conditions. The test procedures employed follow accepted industry practice and the indicated test method. GeoTesting Express has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

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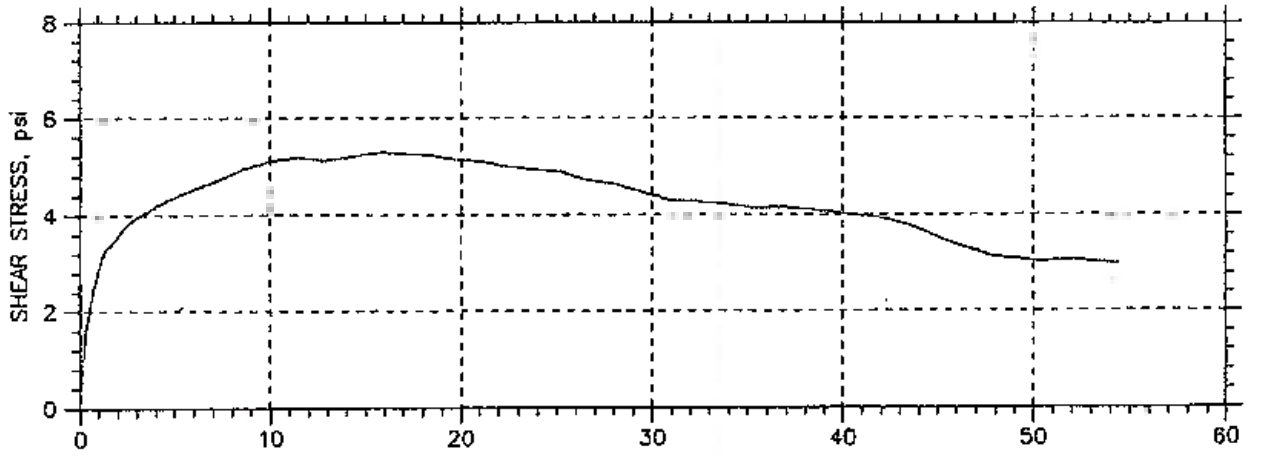
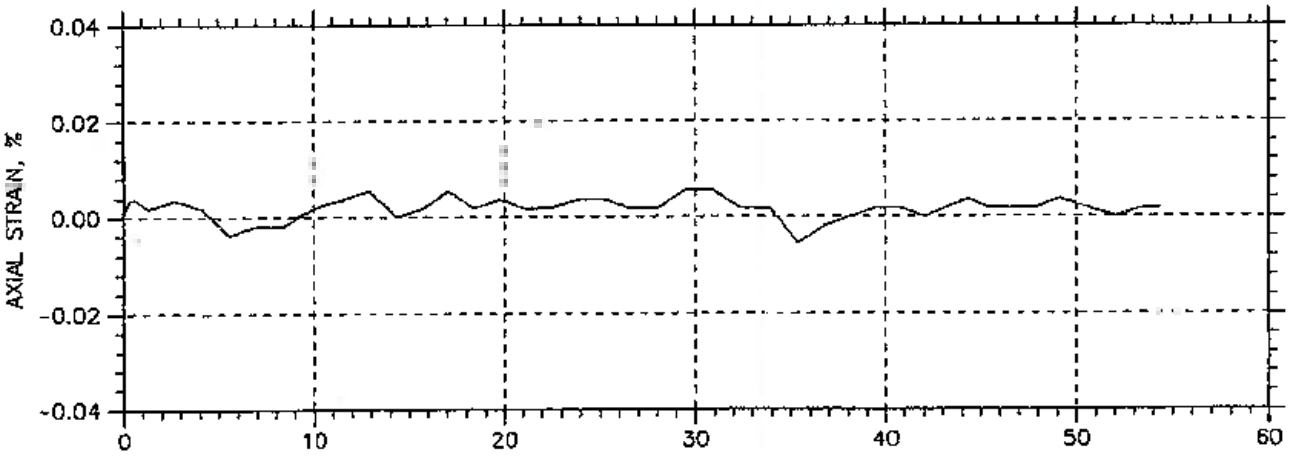
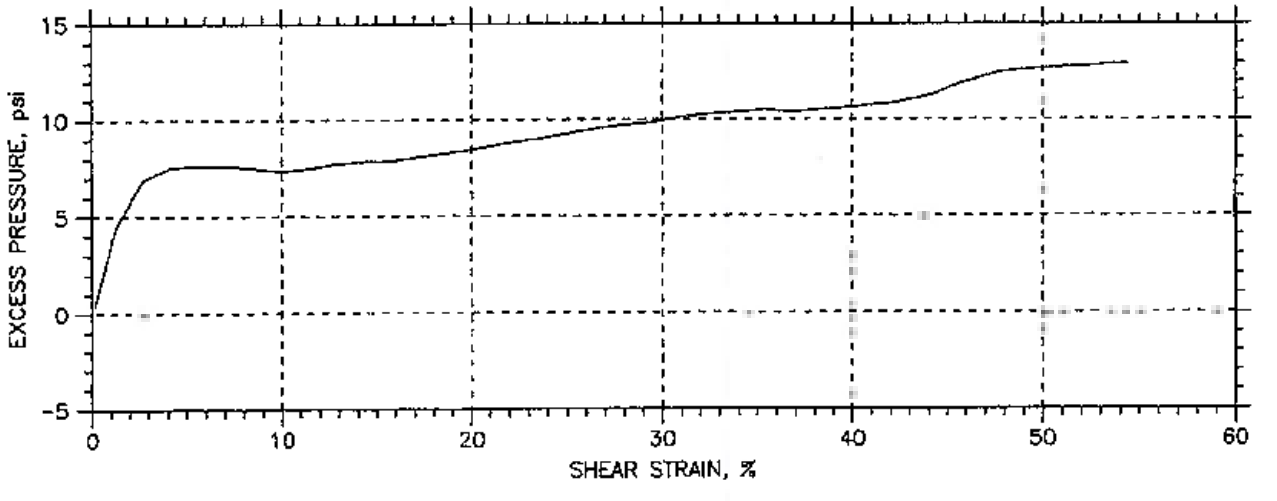
DIRECT SIMPLE SHEAR TEST







Project: Kingston Ash Pond	Location: Roane TN	Project No.: GTX-9015
Boring No.: STN-27 B	Tested By: md	Checked By: jdt
Sample No.: ST-5	Test Date: 05/13/09	Depth: 35.2-35.8
Test No.: DSS-2	Sample Type: Core	Elevation: ---
Description: Moist, yellowish brown sandy silty clay		
Remarks: System J - 1.0 membrane		
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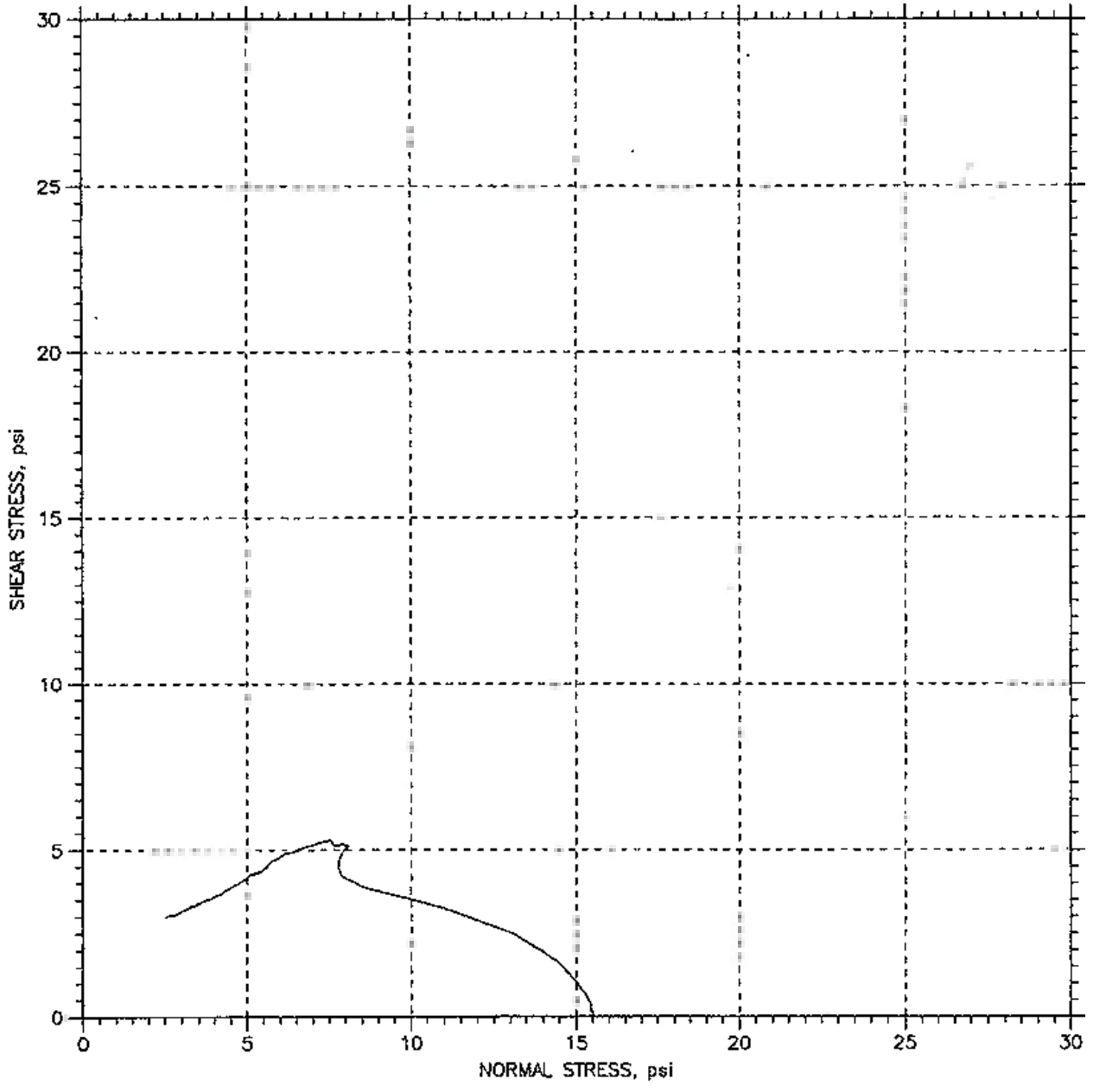
DIRECT SIMPLE SHEAR TEST



Project: Kingston Ash Pond	Location: Roane TN	Project No.: GTX-9015
Boring No.: STN-27 B	Tested By: md	Checked By: jdt
Sample No.: ST-5	Test Date: 05/13/09	Depth: 35.2-35.8
Test No.: DSS-2	Sample Type: Core	Elevation: ---
Description: Moist, yellowish brown sandy silty clay		
Remarks: System J - 1.0 membrane		
File: \\Geocompdb1\projects\Gtx9015\dss\9015-DSS-2n.dat		

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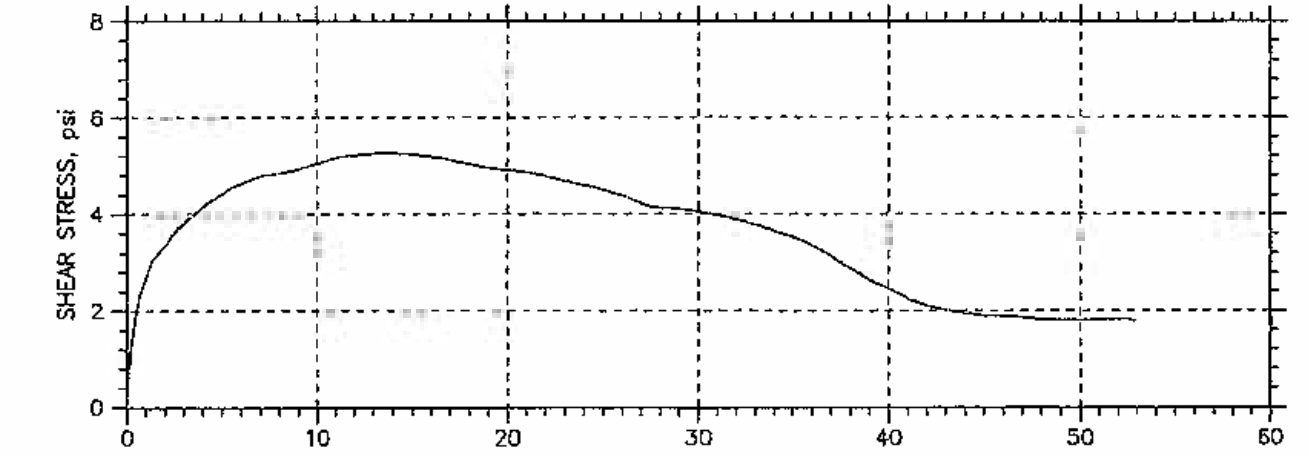
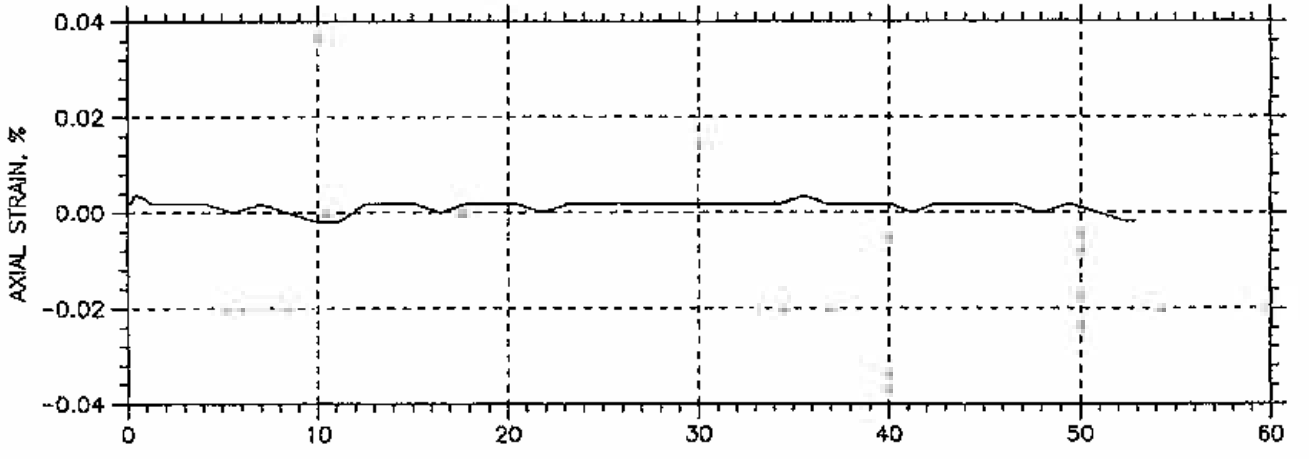
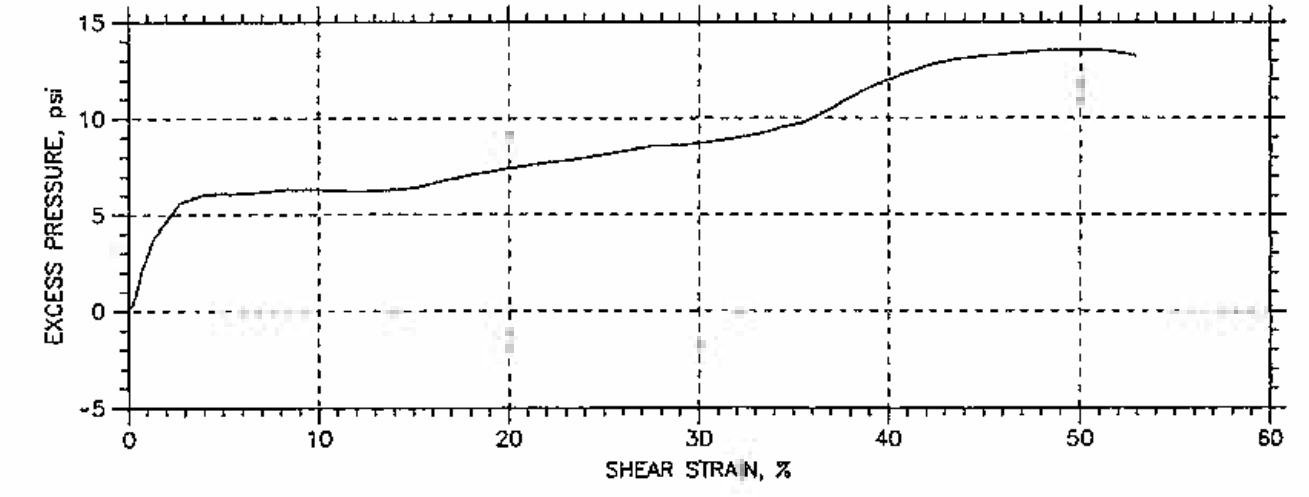
DIRECT SIMPLE SHEAR TEST







Project: Kingston Ash Pond	Location: Roane, TN	Project No.: GTX-9015
Boring No.: STN-27 B	Tested By: md	Checked By: jdt
Sample No.: ST-5	Test Date: 05/14/09	Depth: 35.2-35.8
Test No.: DSS-3	Sample Type: core	Elevation: ---
Description: Moist, yellowish brown sandy silty clay		
Remarks: System J - 1.0 membrane		
File: \\Geocompdb1\projects\Gtx9015\dss\9015-DSS-3n.dat		

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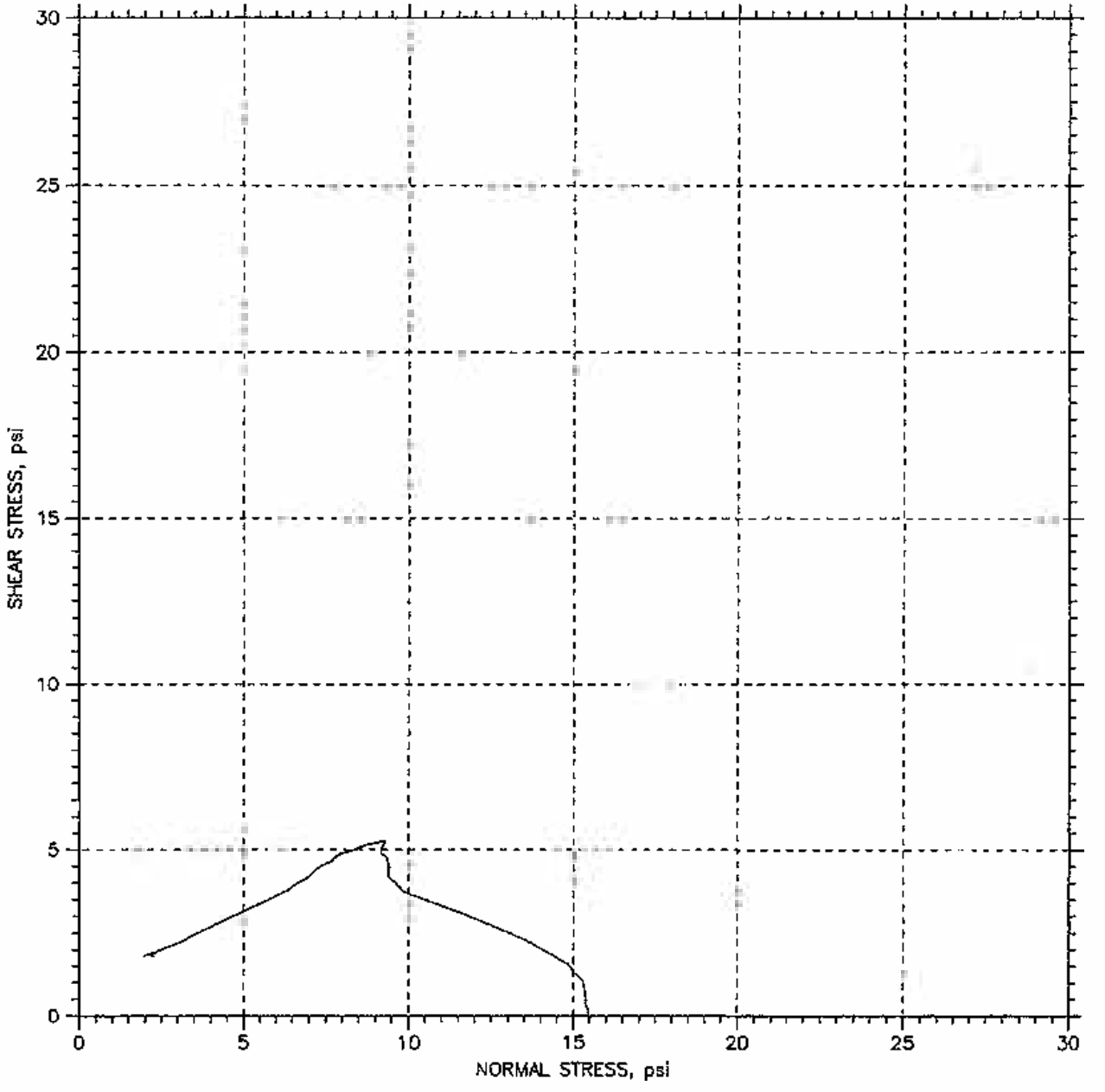
DIRECT SIMPLE SHEAR TEST



Project: Kingston Ash Pond	Location: Roane, TN	Project No.: GTX-9015
Boring No.: STN-27 B	Tested By: md	Checked By: jdt
Sample No.: ST-5	Test Date: 05/14/09	Depth: 35.2-35.8
Test No.: DSS-3	Sample Type: core	Elevation: ---
Description: Moist, yellowish brown sandy silty clay		
Remarks: System J - 1.0 membrane		
File: \\Geocompdb1\projects\Gtx9015\dss\9015-DSS-3n.dat		

One-Dimensional Consolidation Test Results

Reconstructed by C. Barnett 7/9/09

Stantec

One-Dimensional Consolidation of Soils

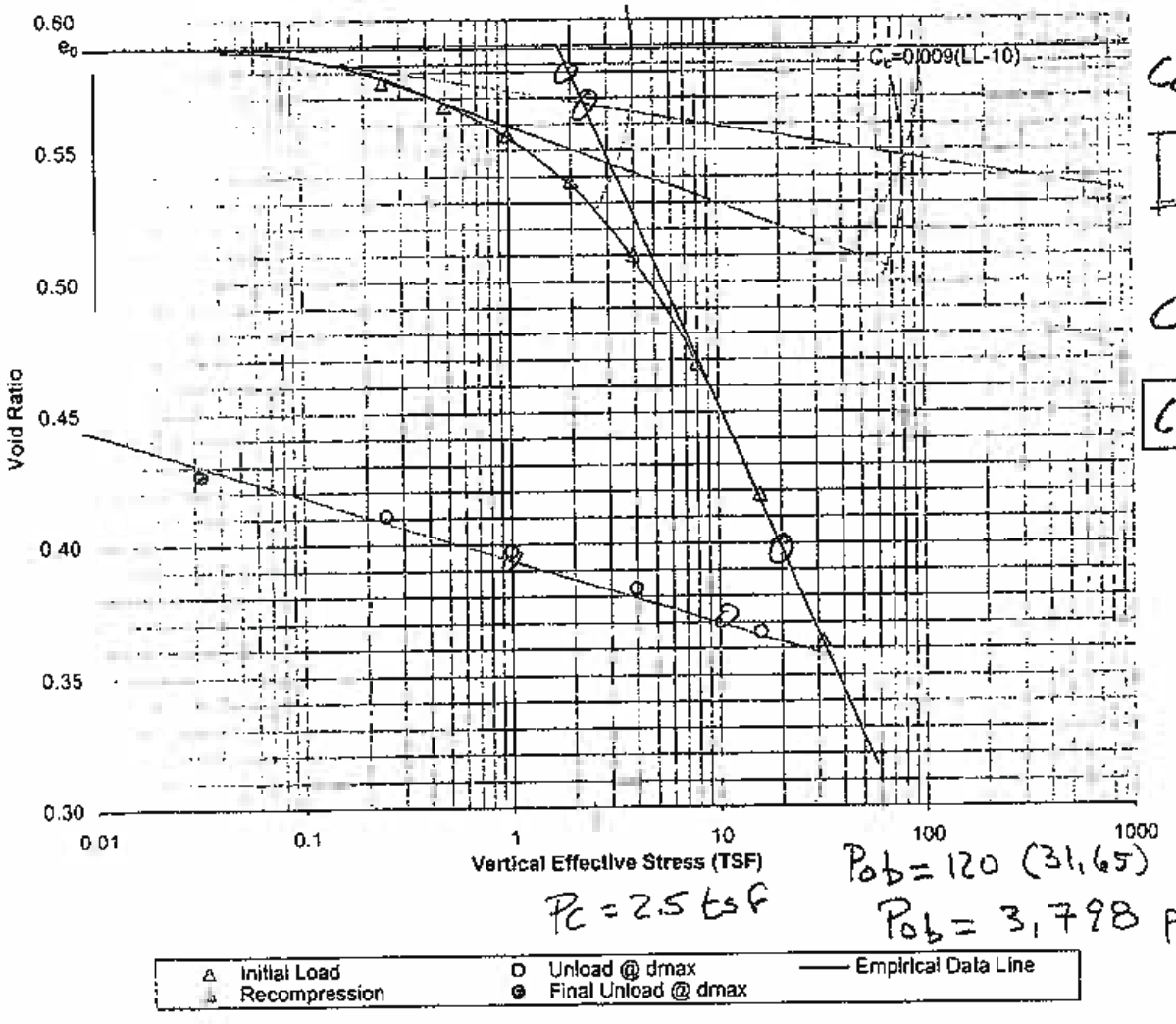
ASTM D 2435

Project Name: Kingston Ash Pond — Project No.: 175569042
Source: STN-2, 31.4'-31.9' — Sample ID: 536
Cv computation Method: Square Root of Time — Initial Void Ratio: 0.589
Swell Pressure (tsf) = 0 — Preconsolidation Pressure (tsf): 2.5

$C_c = 0.182$

$C_r = 0.025$

Void Ratio at d_{100} vs. Stress



$C_c = \frac{0.580 - 0.398}{\log(20/2)}$

$C_c = 0.182$

$C_r = \frac{0.395 - 0.370}{\log(10/1)}$

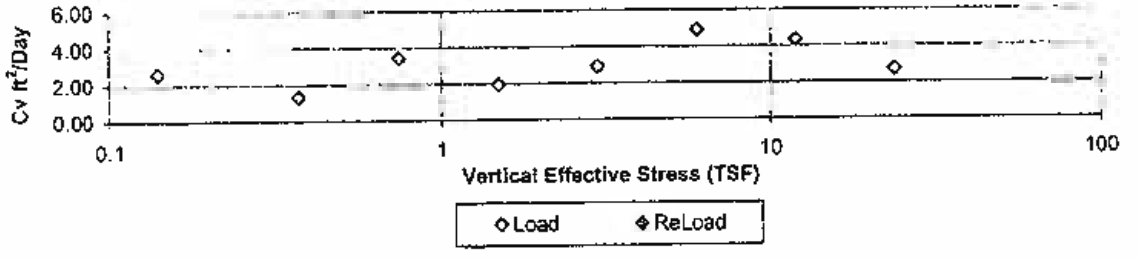
$C_r = 0.025$

$P_c = 2.5$ tsf

$P_{ob} = 120\ (31.65)$

$P_{ob} = 3,798$ psf

Coefficient of Consolidation



Reconstructed by C Barnett 7/9/08

Stantec

One-Dimensional Consolidation of Soils

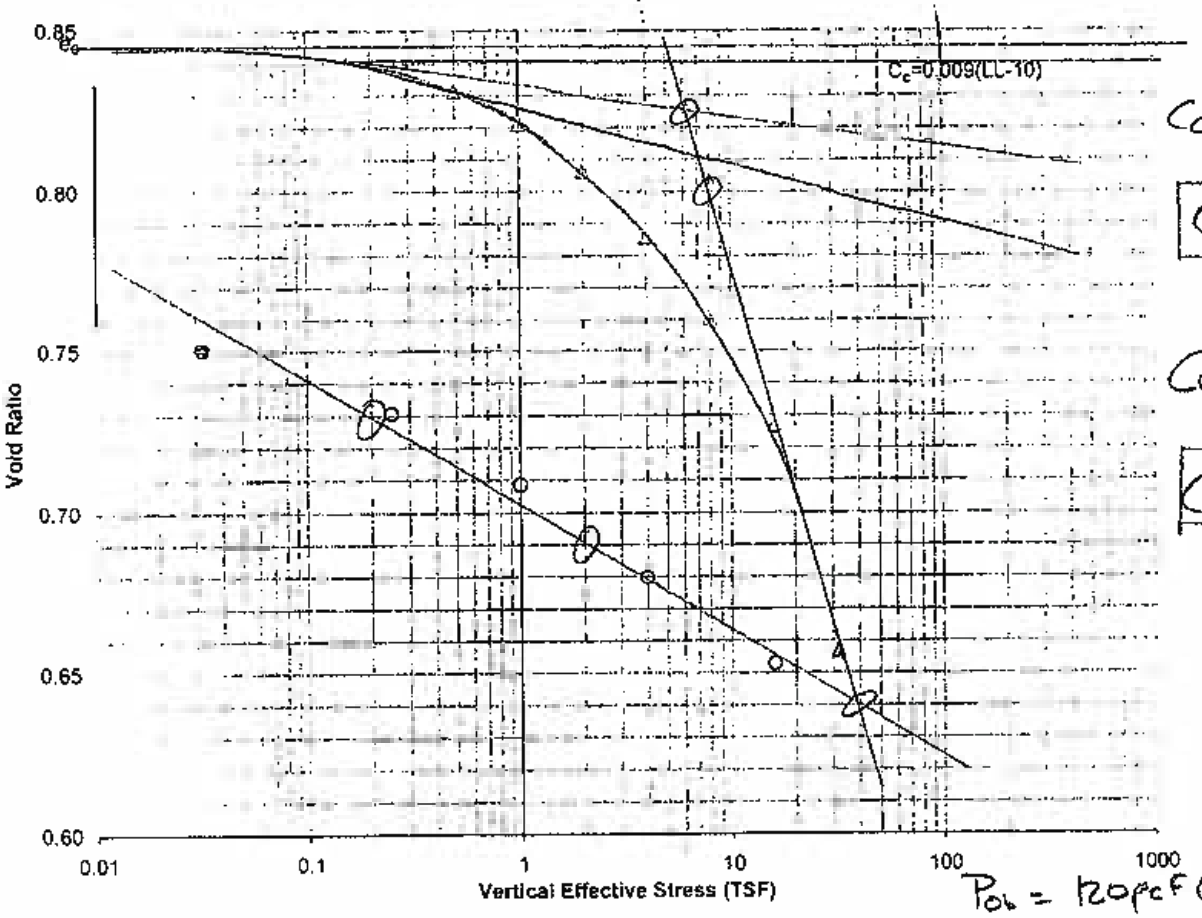
ASTM D 2435

Project Name	Kingston Ash Pond	Project No.	175569042
Source	STN-9, 11.7'-12.2'	Sample ID	559
Cv computation Method: Square Root of Time		Initial Void Ratio	0.844
Swell Pressure (tsf) - 0.279		Preconsolidation Pressure (tsf)	6.0

$C_c = 0.216$

$C_r = 0.04$

Void Ratio at d_{100} vs. Stress



$C_c = \frac{0.800 - 0.649}{\log\left(\frac{H_o}{\delta}\right)}$

$C_c = 0.216$

$C_r = \frac{0.730 - 0.694}{\log\left(\frac{2}{0.2}\right)}$

$C_r = 0.04$

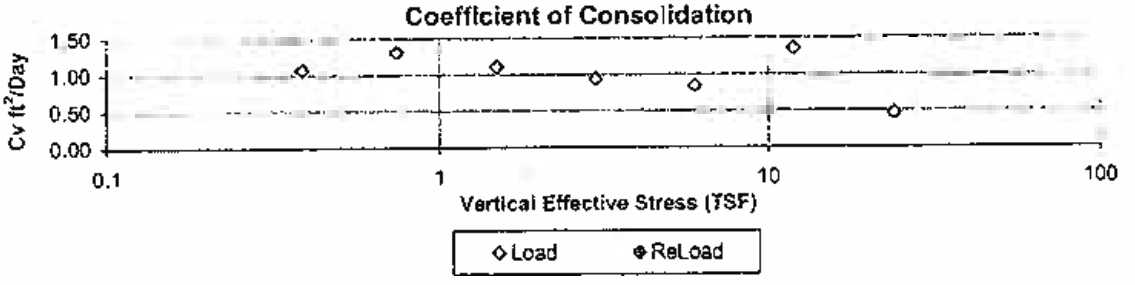
$P_{ob} = 120 pcf (11.95 ft)$

$P_{ob} = 1434 psf$

$P_c = 6$ tsf

Initial Load / Recompression — Unload @ dmax — Final Unload @ dmax — Empirical Data Line

Coefficient of Consolidation



Reconstructed by C Barnett 7/9/09

Stantec

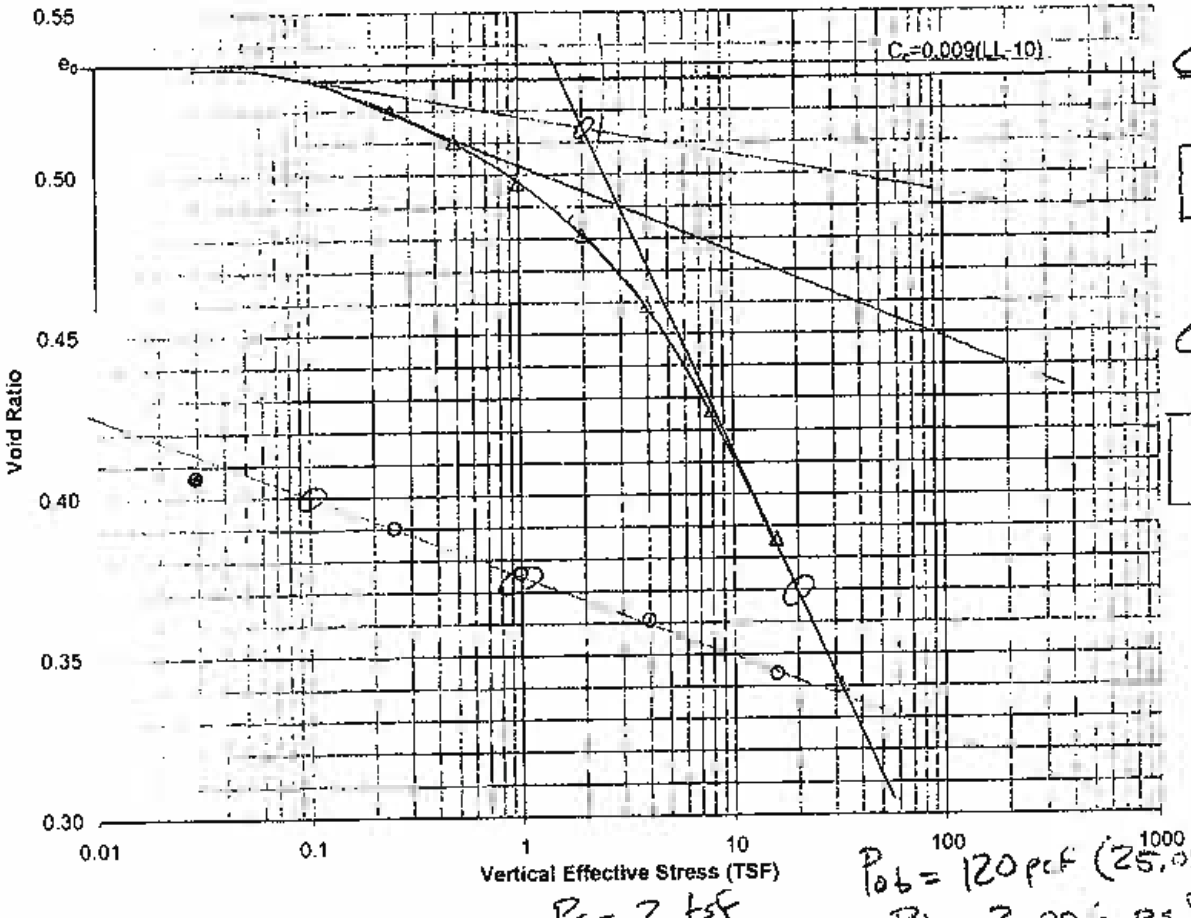
One-Dimensional Consolidation of Soils

ASTM D 2435

Project Name Kingston Ash Pond — Project No. 175569042
Source STN-14, 24.8'-25.3' — Sample ID 514
Cv computation Method: Square Root of Time — Initial Void Ratio 0.534
Swell Pressure (tsf) - 0 — Preconsolidation Pressure (tsf) 2.0

Cc = 0.145
Cr = 0.025

Void Ratio at d_{100} vs. Stress



$C_c = \frac{0.515 - 0.37}{\log(2/1)}$

$C_c = 0.145$

$C_r = \frac{0.404 - 0.3}{\log(1/0.1)}$

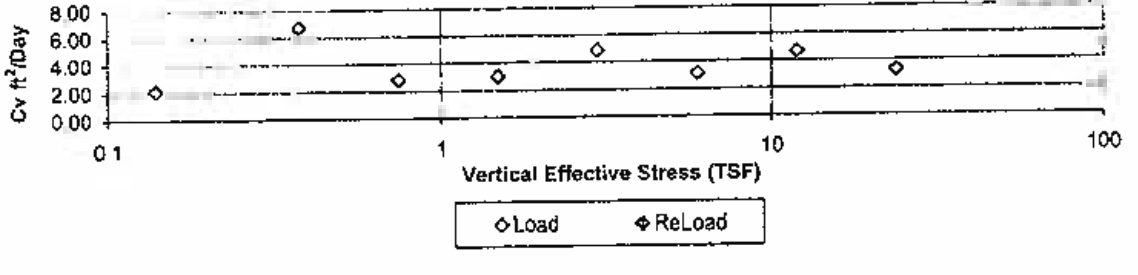
$C_r = 0.025$

$P_c = 2$ tsf

$P_{ob} = 120$ pcf (25.05 ft)

$P_{ob} = 3,006$ psf

Coefficient of Consolidation



KKG KV

Reconstructed by C Bauer 7/9/09

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One-Dimensional Consolidation of Soils

ASTM D 2435

Project Name Kingston Ash Pond
Source STN-19, 14.1'-14.6'
Cv computation Method: Square Root of Time
Swell Pressure (tsf) - 0

Project No. 175569042
Sample ID 516
Initial Void Ratio 0.681
Preconsolidation Pressure (tsf) 3.1

$C_c = 0.125$
$C_r = 0.032$

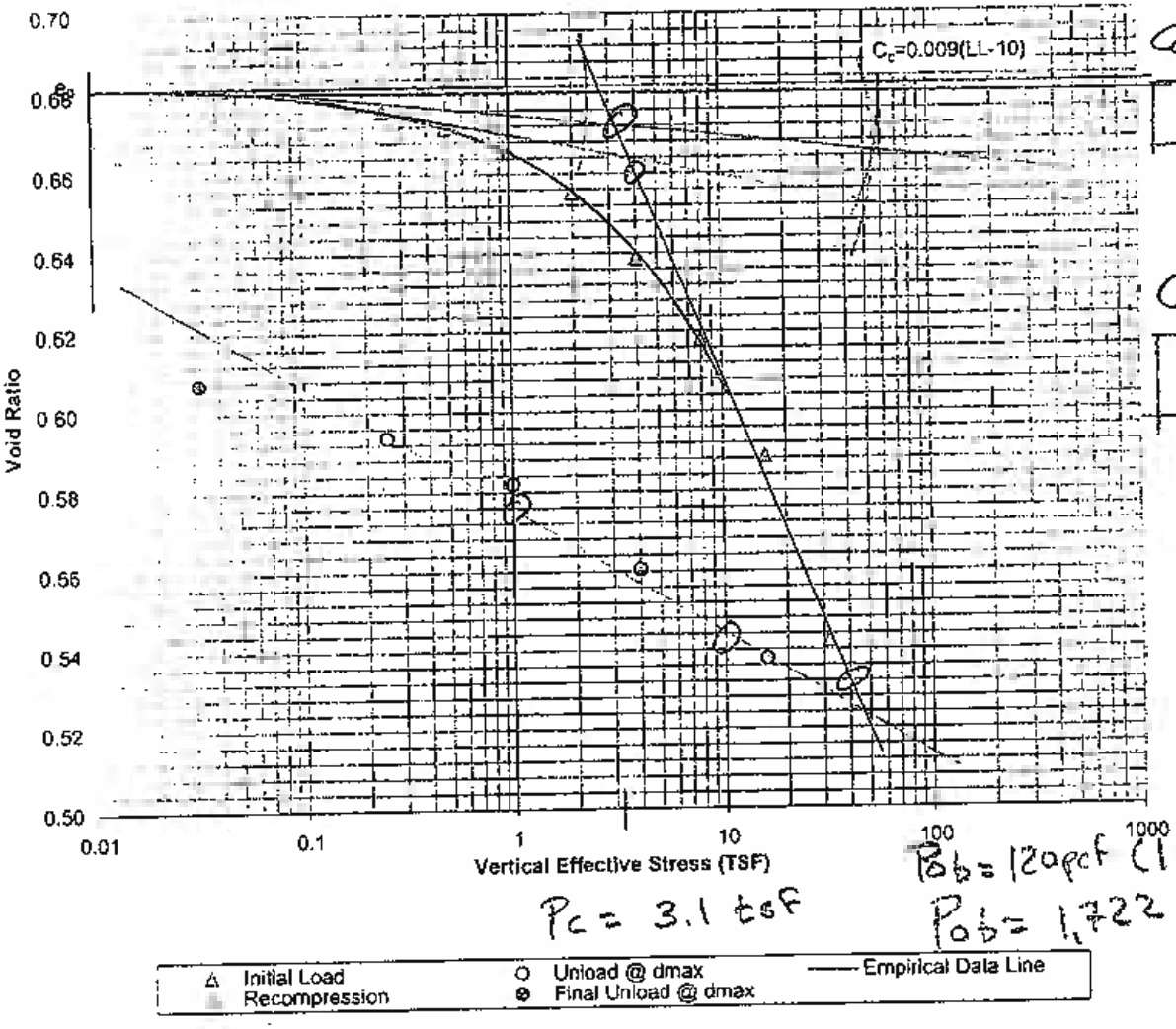
$C_c = \frac{0.660 - 0.53?}{\log(40/4)}$

$C_c = 0.125$

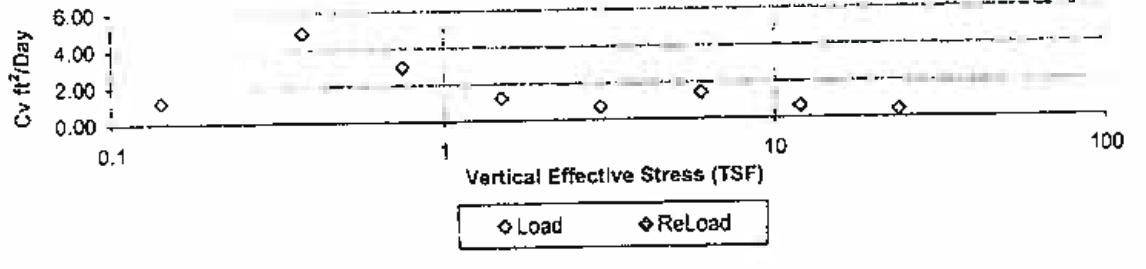
$C_r = \frac{0.576 - .544}{\log(10/1)}$

$C_r = 0.032$

Void Ratio at d_{100} vs. Stress



Coefficient of Consolidation



File: frm_175569042_cons_516 Sheet: e d100
Prepared: 02-1998
Revised: 1-2006

Stantec Consulting Services Inc.

Laboratory Document
3
Prepared By: JW
Approved By: TLK

Reconstructed by C. Barnett 6/22/

Stantec

One-Dimensional Consolidation of Soils

ASTM D 2435

Project Name	Kingston Ash Pond	Project No.	171468117
Source	STN-32, 14.0'-14.5'	Sample ID	359
Cv computation Method: Square Root of Time		Initial Void Ratio	0.700
Swell Pressure (tsf) - 0.24		Preconsolidation Pressure (tsf)	3.0

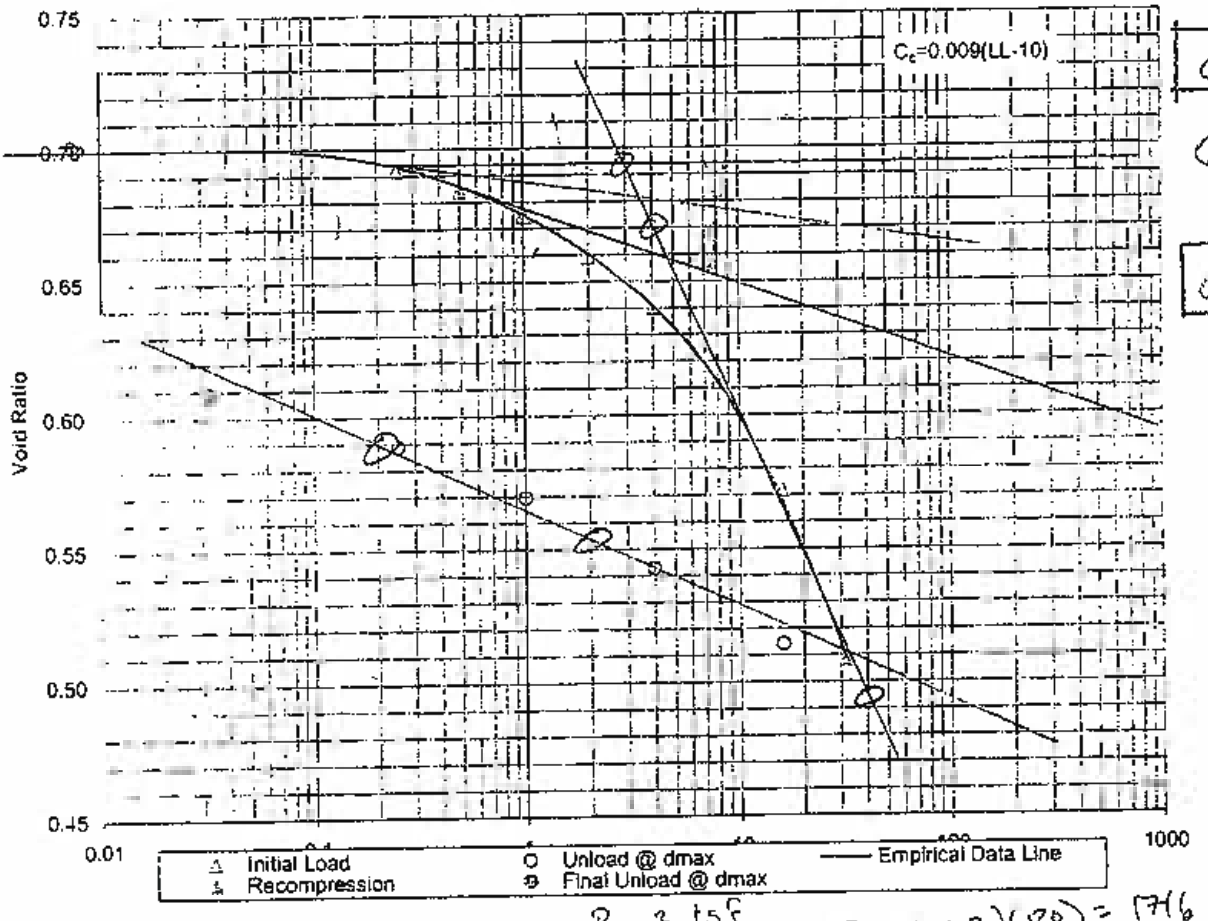
$C_c = \frac{0.670 - 0.495}{\log(4^{\circ}/4)}$

$C_c = 0.175$

$C_r = \frac{0.590 - 0.55}{\log(\quad/0.1}$

$C_r = 0.05$

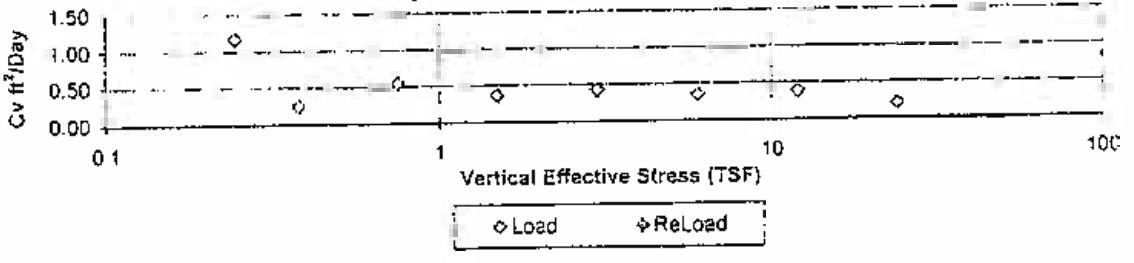
Void Ratio at d_{100} vs. Stress



$P_c = 3$ tsf

$P_{o_1} = (14.3)(120) = 1716$ psf

Coefficient of Consolidation



Reconstructed by C. Tennant 7/9/09

Stantec

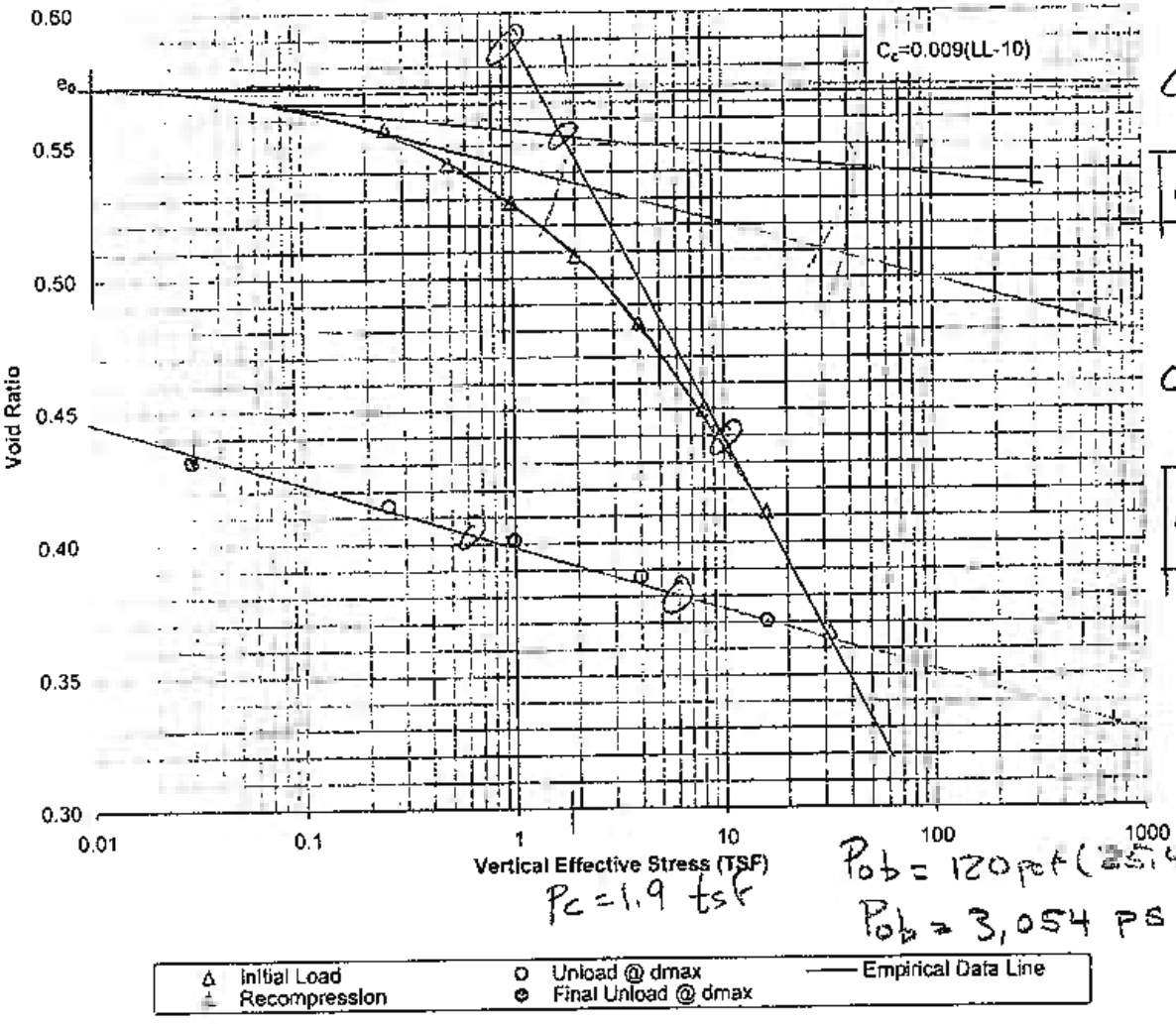
One-Dimensional Consolidation of Soils

ASTM D 2435

Project Name Kingston Ash Pond — Project No. 175569042
Source STN-52, 25.2'-25.7' — Sample ID 552
Cv computation Method: Square Root of Time — Initial Void Ratio 0.573
Swell Pressure (tsf) - 3.35E-02 — Preconsolidation Pressure (tsf) 1.9 tsf

C_c = 0.150
C_r = 0.025

Void Ratio at d_{100} vs. Stress



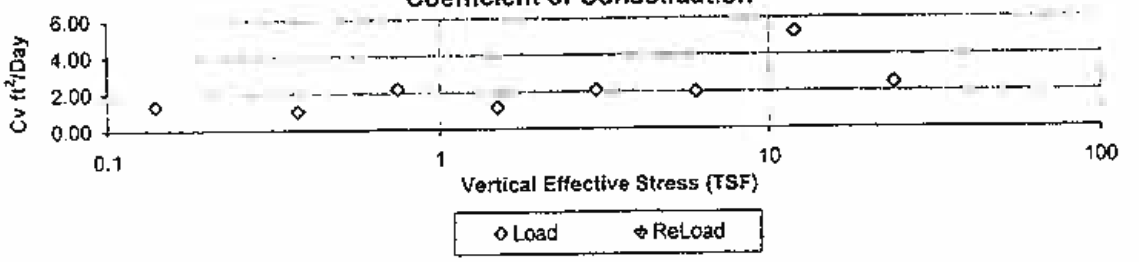
$C_c = \frac{0.590 - 0.446}{\log(10/1)}$

$C_c = 0.150$

$C_r = \frac{0.405 - 0.38}{\log(6/1.6)}$

$C_r = 0.025$

Coefficient of Consolidation



Stantec

One-Dimensional Consolidation of Soils

ASTM D 2435

Project Name Kingston Ash Pond — Project No. 171468117
Source STN-63, 15.2'-15.7' — Sample ID 362
Cv computation Method: Square Root of Time — Initial Void Ratio 0.785
Swell Pressure (tsf) - 0.58 — Preconsolidation Pressure (tsf) 0.8

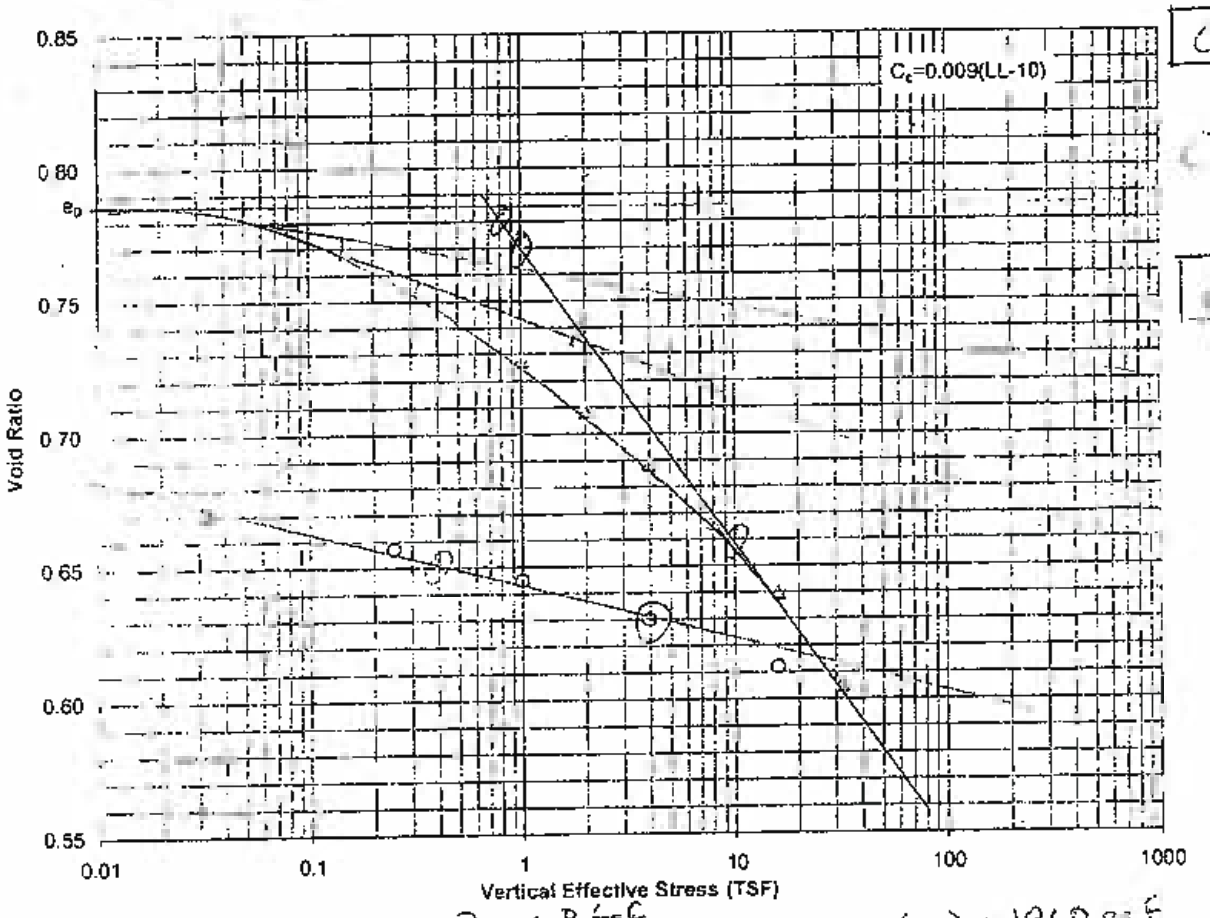
$C_c = \frac{0.770 - 0.660}{\log(\frac{10}{1})}$

$C_c = 0.110$

$C_r = \frac{0.650 - 0.630}{\log(\frac{4}{0.8})}$

$C_r = 0.020$

Void Ratio at d_{100} vs. Stress

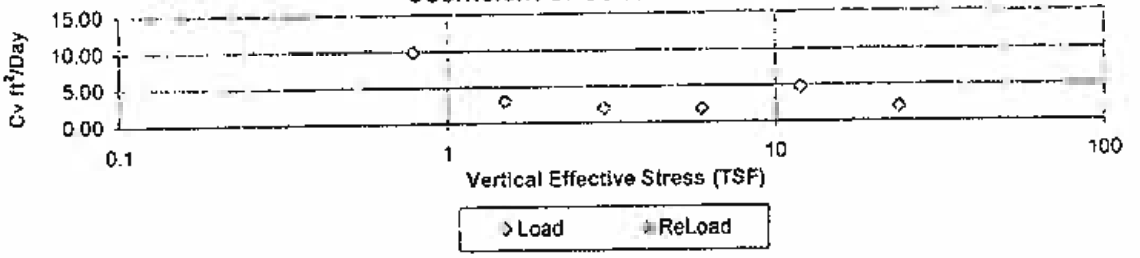


$P_c = 0.8$ tsf

$P_o = (15.5)(120) = 1860$ psf

Initial Load
Recompression
Unload @ dmax
Final Unload @ dmax
Empirical Data Line

Coefficient of Consolidation



Load
ReLoad

Stantec

One-Dimensional Consolidation of Soils

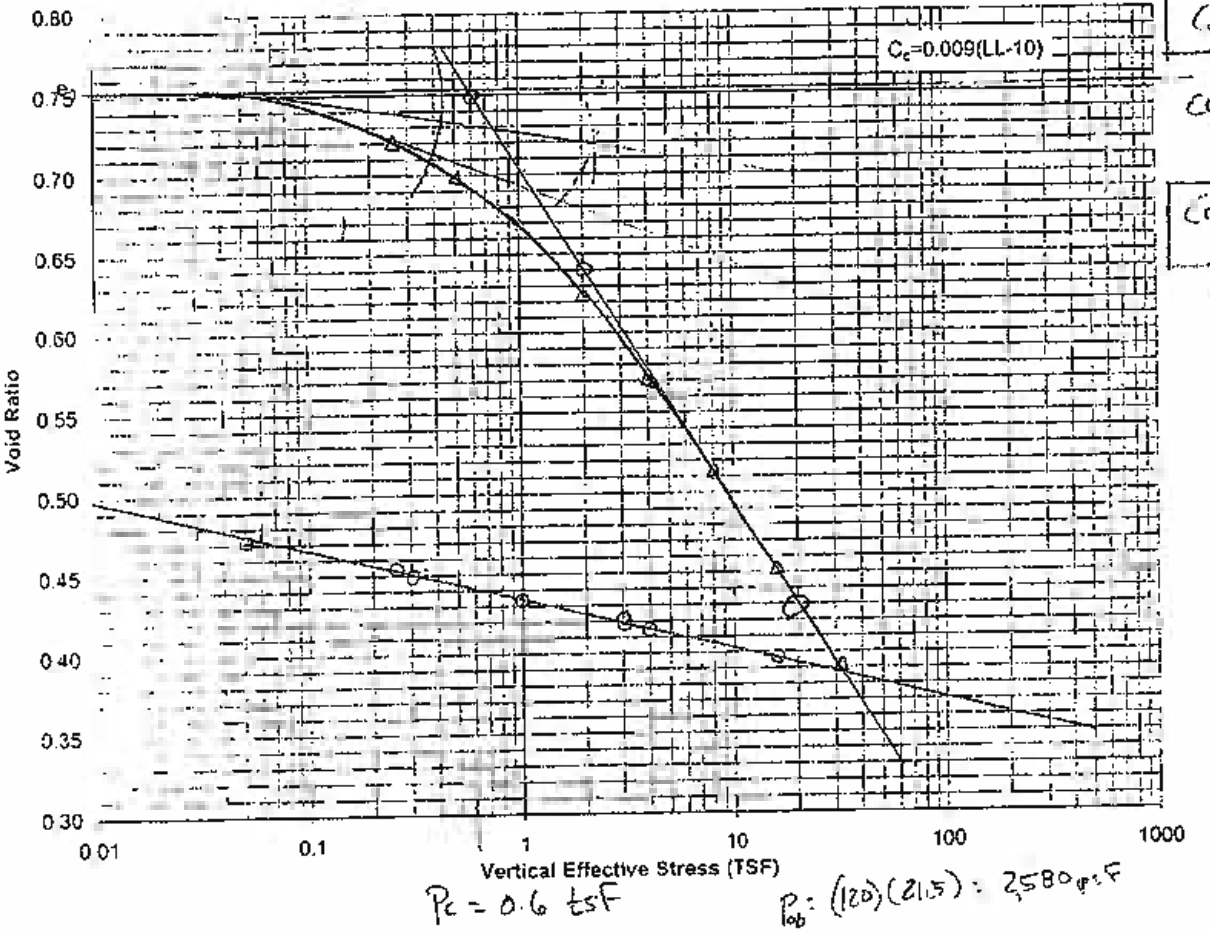
ASTM D 2435

Project Name Kingston Ash Pond
Source STN-64, 21.2'-21.7'
Cv computation Method: Log of Time
Swell Pressure (tsf) - 0.16

Project No. 171468117
Sample ID 608
Initial Void Ratio 0.752
Preconsolidation Pressure (tsf) 0.6

$C_c = \frac{0.450 - 0.430}{\log(2/1)}$

Void Ratio at d_{100} vs. Stress



$C_c = 0.320$

$C_r = \frac{0.450 - 0.420}{\log(2/1)}$

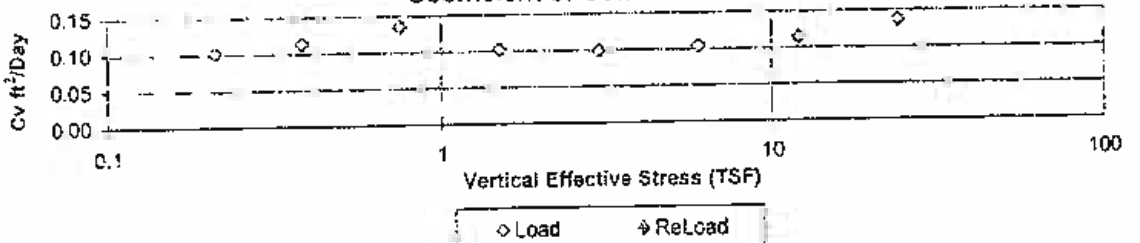
$C_r = 0.020$

$P_c = 0.6$ tsf

$P_{ob} = (120)(21.5) = 2580$ psf

Initial Load
Recompression
Unload @ dmax
Final Unload @ dmax
Empirical Data Line

Coefficient of Consolidation



Load
ReLoad

Laboratory Document
Prepared By: JW
Approved By: TLK

Reconsolidated by C. Rennett 6/22/09

Stantec

One-Dimensional Consolidation of Soils

ASTM D 2435

Project Name Kingston Ash Pond
Source STN-65, 33.8'-34.3'
Cv computation Method: Square Root of Time
Swell Pressure (tsf) - 0.0

Project No. 171468117
Sample ID 614
Initial Void Ratio 0.815
Preconsolidation Pressure (tsf) 1.7

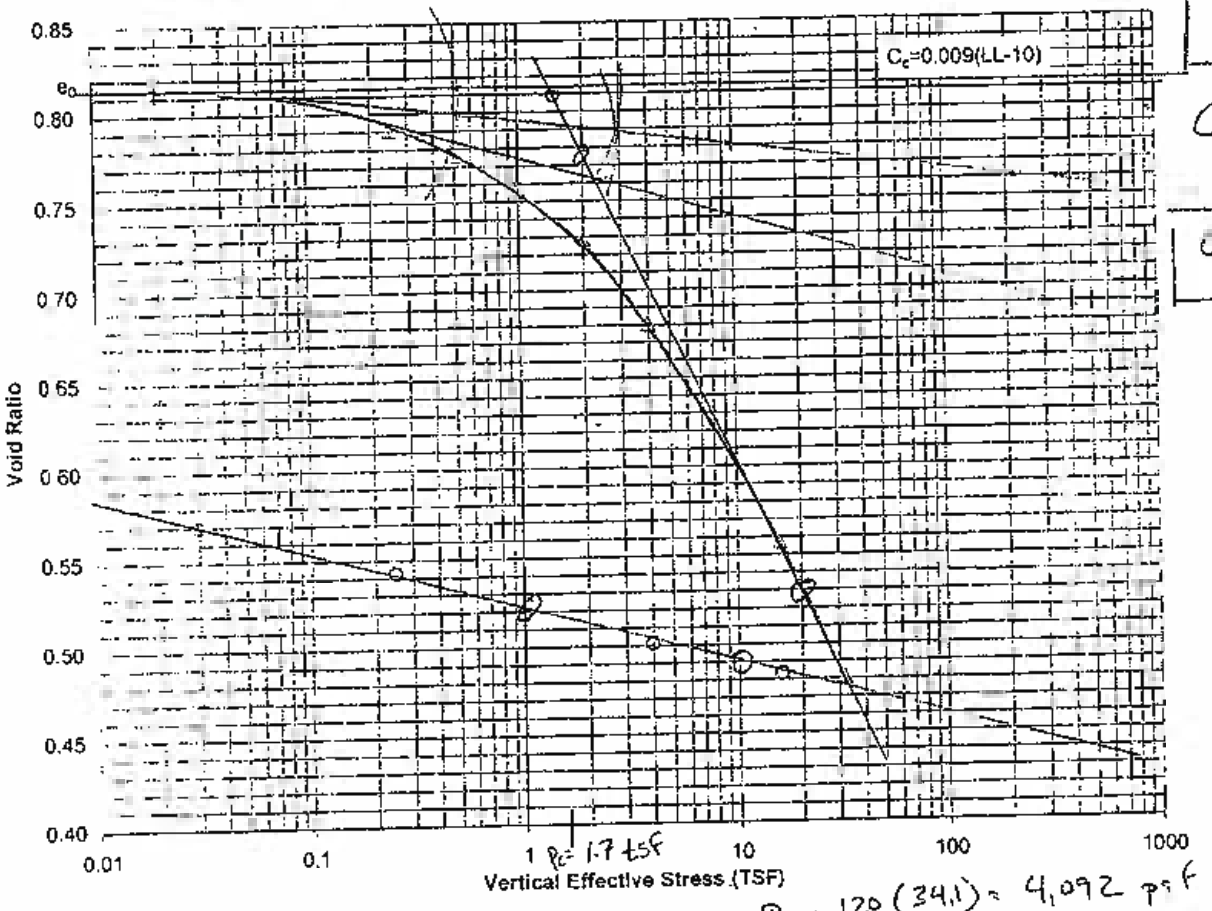
$C_c = \frac{0.755 - 0.5}{\log(10/1)}$

$C_c = 0.225$

$C_r = \frac{0.523 - 0.496}{\log(10/1)}$

$C_r = 0.032$

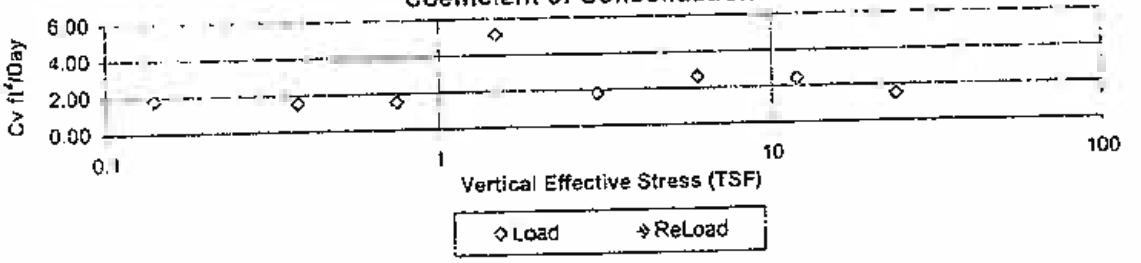
Void Ratio at d_{100} vs. Stress



$P_{06} = 120\,(34.1) = 4{,}092$ psf

Initial Load
Recompression
Unload @ dmax
Final Unload @ dmax
Empirical Data Line

Coefficient of Consolidation



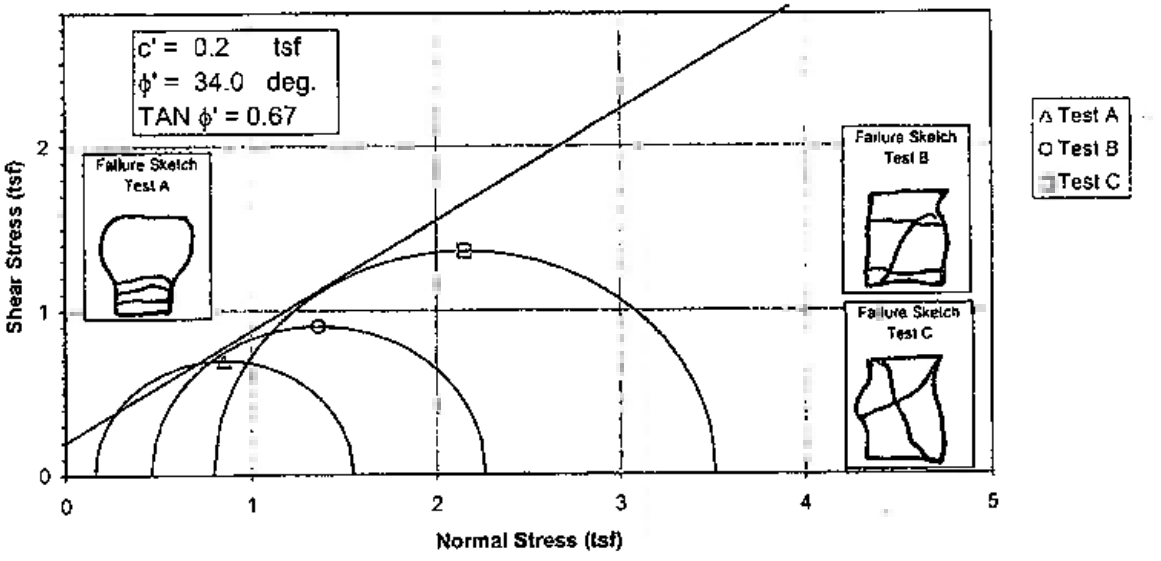
◇ Load ◇ ReLoad

Consolidated Undrained Triaxial Test Results

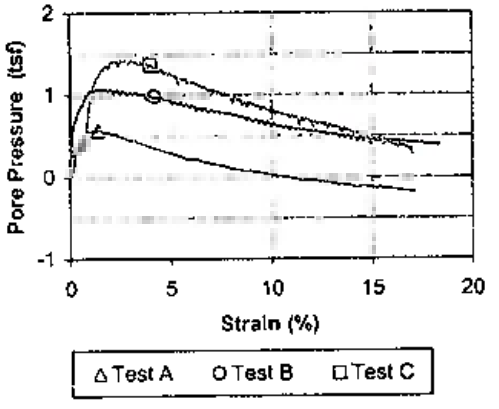
EM 1110-2-1906
Appendix X
30 Nov. 70

Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



Specimen No.			A	B	C	
Initial Data	Water content %	W_o	17.5	17.9	19.4	
	Dry Density PCF	γ_{d_o}	112.9	111.0	108.2	
	Saturation %	S_o	97.4	94.6	95.3	
	Void Ratio	e_o	0.482	0.508	0.546	
After Shear	Water content %	W_f	18.0	15.6	17.7	
	Dry Density PCF	γ_{d_f}	112.9	118.0	113.4	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.482	0.417	0.475	
	Final Back Pressure TSF	u_c	5.76	5.04	4.32	
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.16	0.46	0.80	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	1.39	1.81	2.72	
Time to $(\sigma 1'-\sigma 3')$max min.		t_f	6.0	129.1	145.1	
Ultimate Deviator Stress, t/sq ft		$(\sigma 1'-\sigma 3')_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.884	2.884	2.884	
Initial Height, In.		H_o	5.999	6.006	6.065	

Controlled - Strain Test

Description of Specimens: Sandy Lean Clay (CL), brown, moist, firm, coal fragments

LL	23	PL	15	PI	8	Gs	2.68

Remarks:

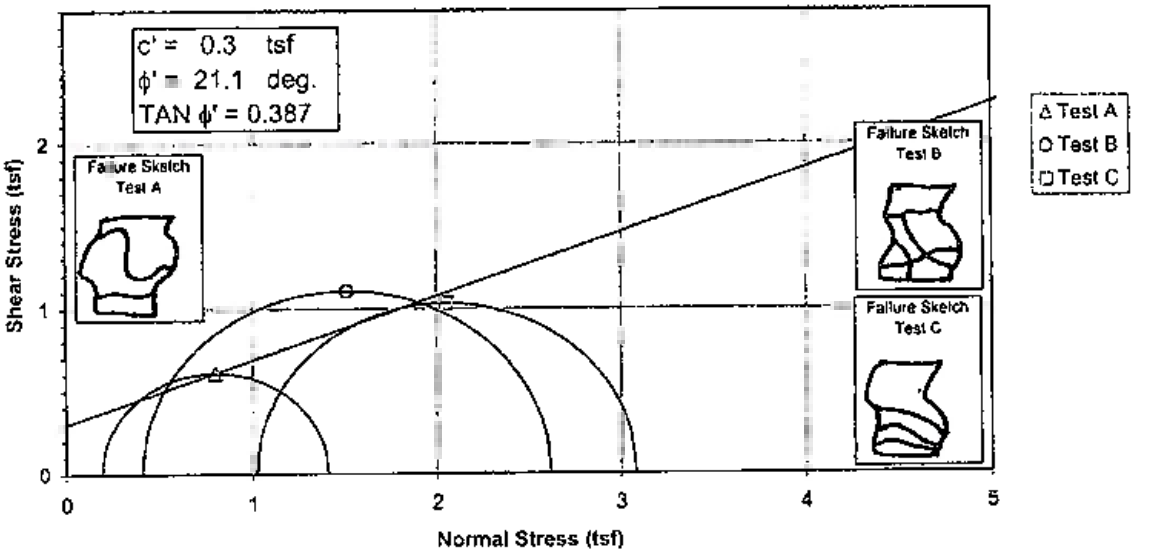
Type of Specimen	Undisturbed	Type of test	R
Project	Kingston Ash Pond		
Boring No.	STN-2	Sample No.	528
Depth Elev.	9.0'-9.5', 14.0'-14.5', 14.6'-15.1'		
Laboratory	Stantec	Date	7-1-09

TRIAXIAL COMPRESSION TEST REPORT

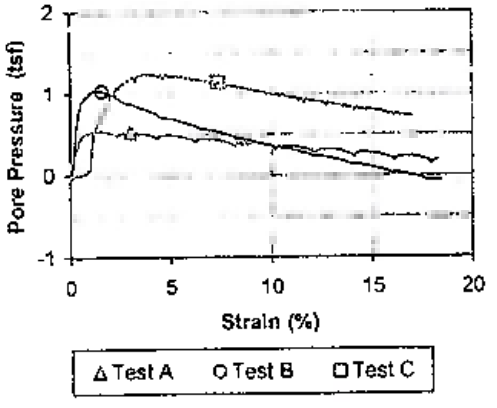
EM 1110-2-1906
Appendix X
30 Nov. 70

Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



Specimen No.			A	B	C
Initial Data	Water content %	W_o	24.8	25.4	27.4
	Dry Density PCF	γ_{d_o}	97.5	97.4	96.5
	Saturation %	S_o	90.1	92.1	97.2
	Void Ratio	e_o	0.755	0.757	0.772
After Shear	Water content %	W_f	25.8	26.2	25.7
	Dry Density PCF	γ_{d_f}	100.2	99.6	100.3
	Saturation %	S_f	100.0	100.0	100.0
	Void Ratio	e_f	0.706	0.718	0.705
	Final Back Pressure TSF	u_c	5.76	5.04	4.32
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.19	0.41	1.02
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	1.22	2.21	2.06
Time to $(\sigma 1'-\sigma 3')$max min.		t_f	14.2	8.1	244.6
Ultimate Deviator Stress, t/sq ft		$(\sigma 1'-\sigma 3')_{ult}$	n/a	n/a	n/a
Initial Diameter, in.		D_o	2.875	2.864	2.856
Initial Height, in.		H_o	6.054	6.137	5.985

Controlled - Strain Test

Description of Specimens: Fat Clay with Sand (CH), red brown, moist, firm

LL 55 | PL 19 | PI 37 | Gs 2.74

Remarks:

Type of Specimen: Undisturbed | Type of test: R

Project: Kingston Ash Pond

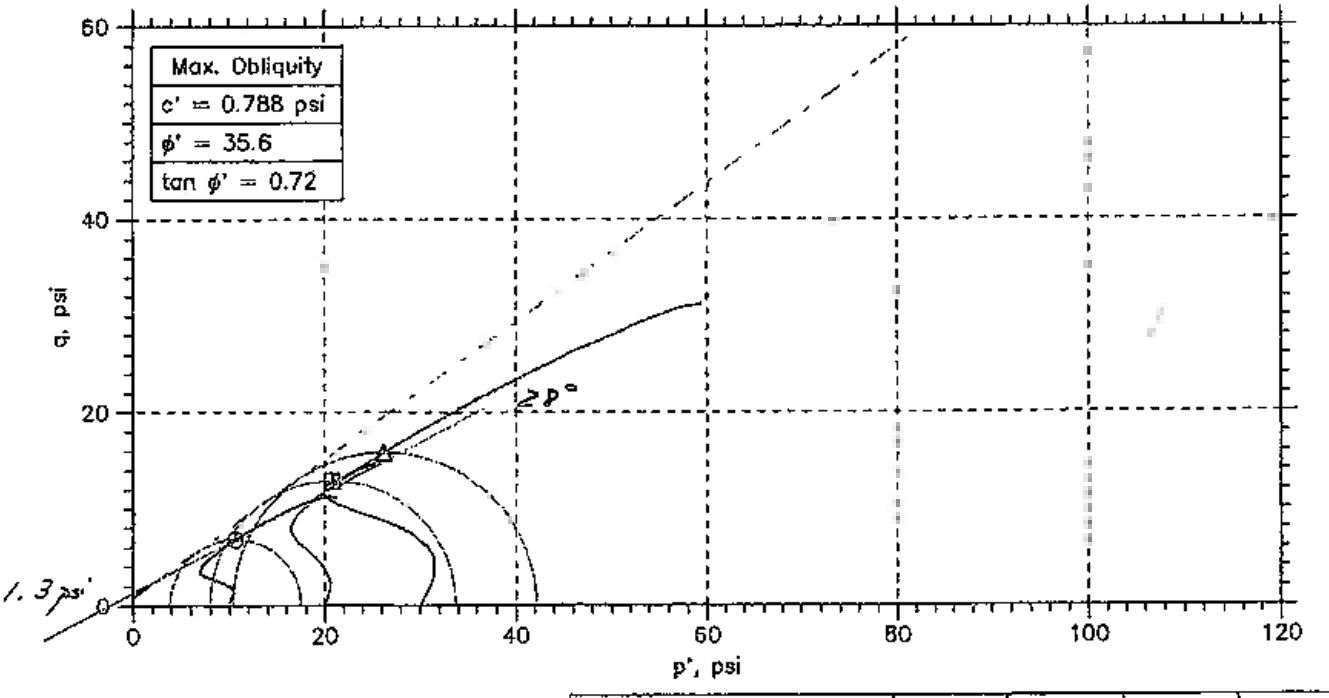
Boring No.: STN-3, STN-5 | Sample No.: 538

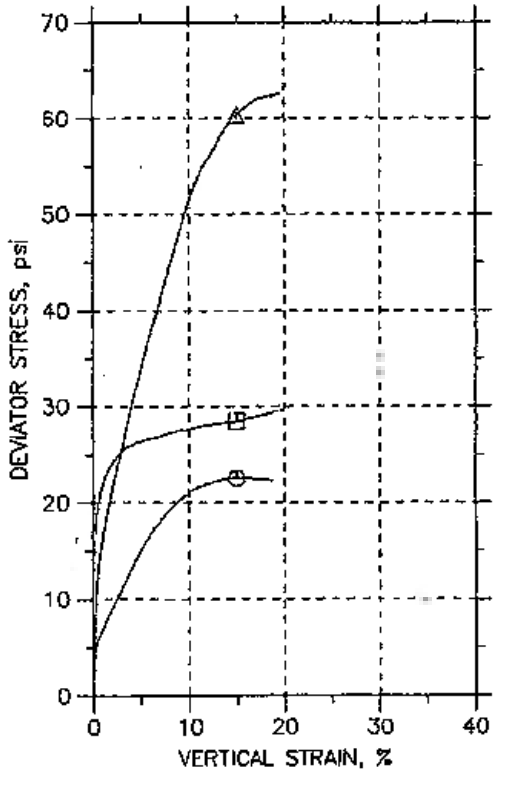
Depth Elev.: 10.5'-11.0', 11.3' - 11.8', 12.5'-13.0'

Laboratory: Stantec | Date: 6-30-09

TRIAXIAL COMPRESSION TEST REPORT

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





Symbol		⊙	△	⊡	
Sample No.		ST-4	ST-4	ST-3	
Test No.		CU-4-1	CU-4-2	CU-4-3	
Depth		31.0-31.6	31.6-32.2	31.6-32.8	
Initial	Diameter, in	2.88	2.87	2.87	
	Height, in	6.1	5.95	6.01	
	Water Content, %	22.1	16.6	18.8	
	Dry Density, pcf	101.2	114.6	111.7	
	Saturation, %	91.1	95.2	100.0	
	Void Ratio	0.647	0.471	0.509	
Before Shear	Water Content, %	20.6	17.3	18.5	
	Dry Density, pcf	107.5	114.9	112.5	
	Saturation, %	100.0	100.0	100.0	
	Void Ratio	0.551	0.467	0.499	
	Back Press., psi	27.99	121.	27.99	
Ver. Eff. Cons. Stress, psi		10.	20.	30.01	
Shear Strength, psi		11.29	30.17	14.25	
Strain at Failure, %		15	15	15	
Strain Rate, %/min		0.032	0.032	0.032	
B-Value		1.25	0.95	0.97	
Measured Specific Gravity		2.67	---	---	
Liquid Limit		22	---	---	
Plastic Limit		16	---	---	

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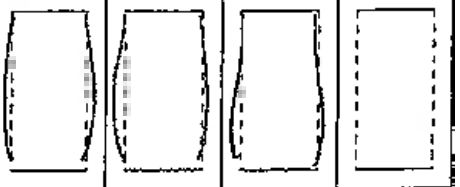
Project: Kingston Ash Pond
Location: Roane, TN
Project No.: GTX-9015
Boring No.: STN-3 D
Sample Type: core

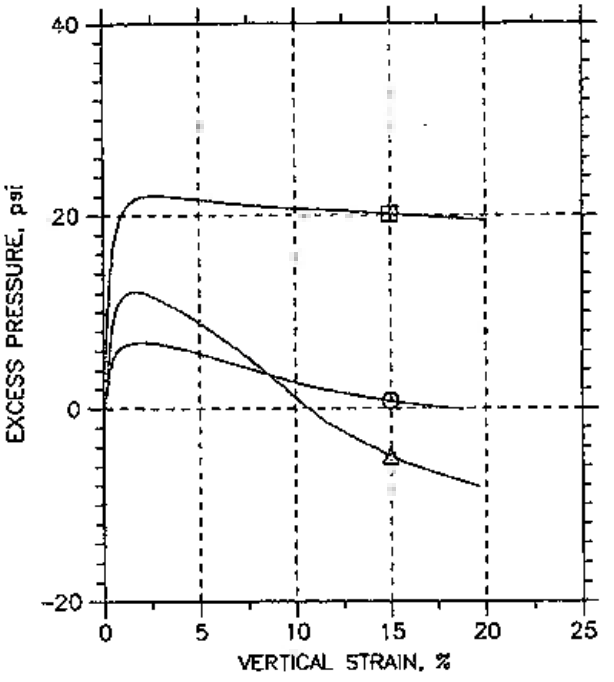


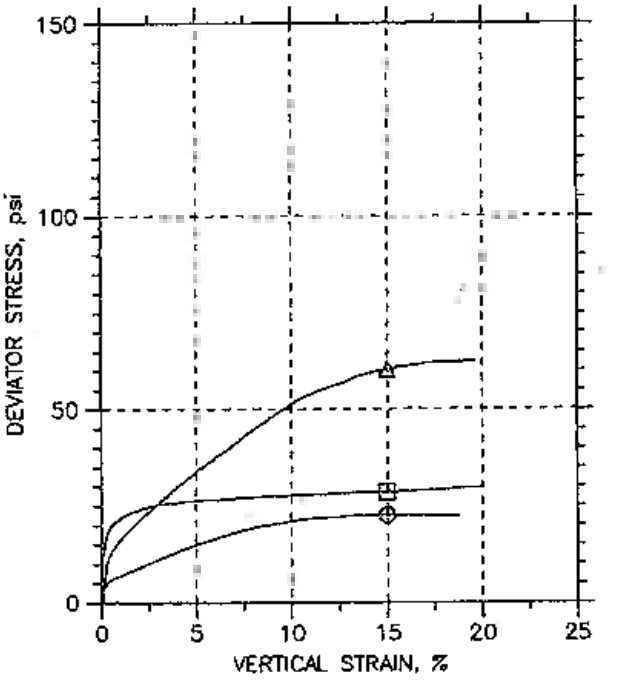
Description: CU-4-1 STN-3D Moist, olive brown sandy silty clay; CU-4-2 STN-3D Moist, green, yellow
Remarks: and brown sandy silt; CU-4-3 STN-37D Moist, brown and yellow sandy silt

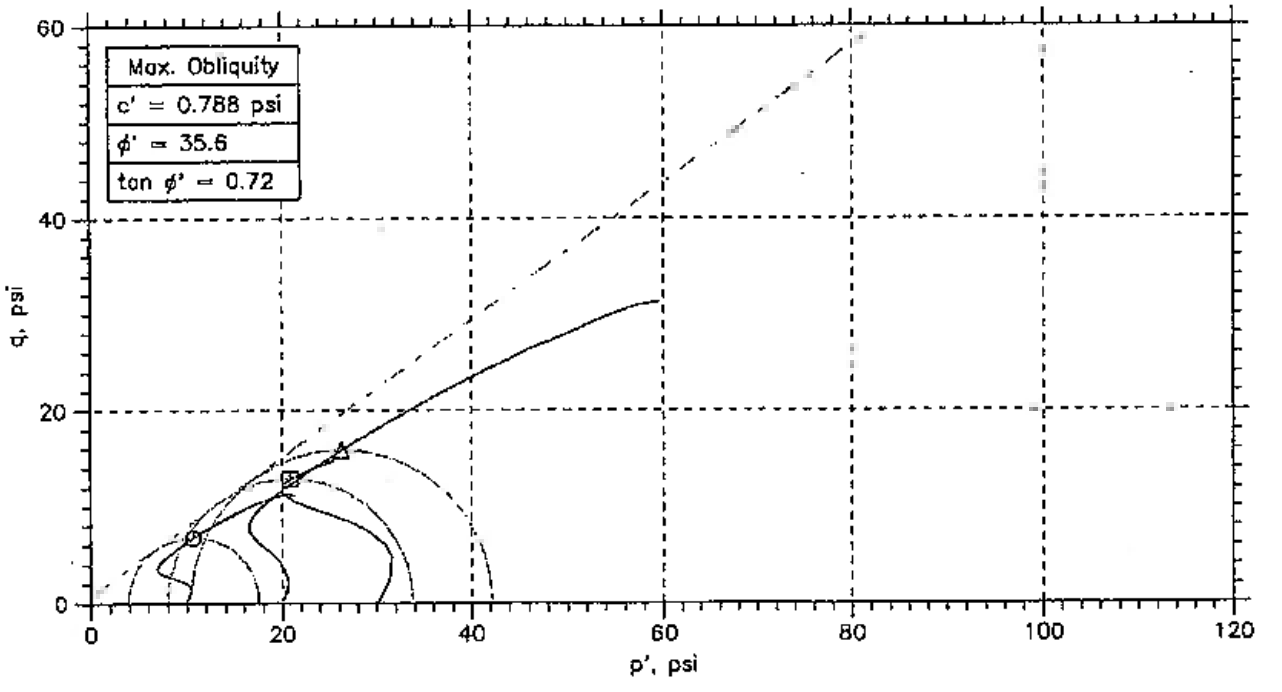
Phase calculations based on start and end of test.

Tue, 19-MAY-2009 13:11:52

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
○	ST-4	CU-4-1	31.0-31.6	md	05/12/09	jdt		9015-CU-4-1n.dat
△	ST-4	CU-4-2	31.6-32.2	md	05/12/09	jdt		9015-CU-4-2n.dat
□	ST-3	CU-4-3	31.6-32.8	md	05/12/09	jdt		9015-CU-4-3n.dat

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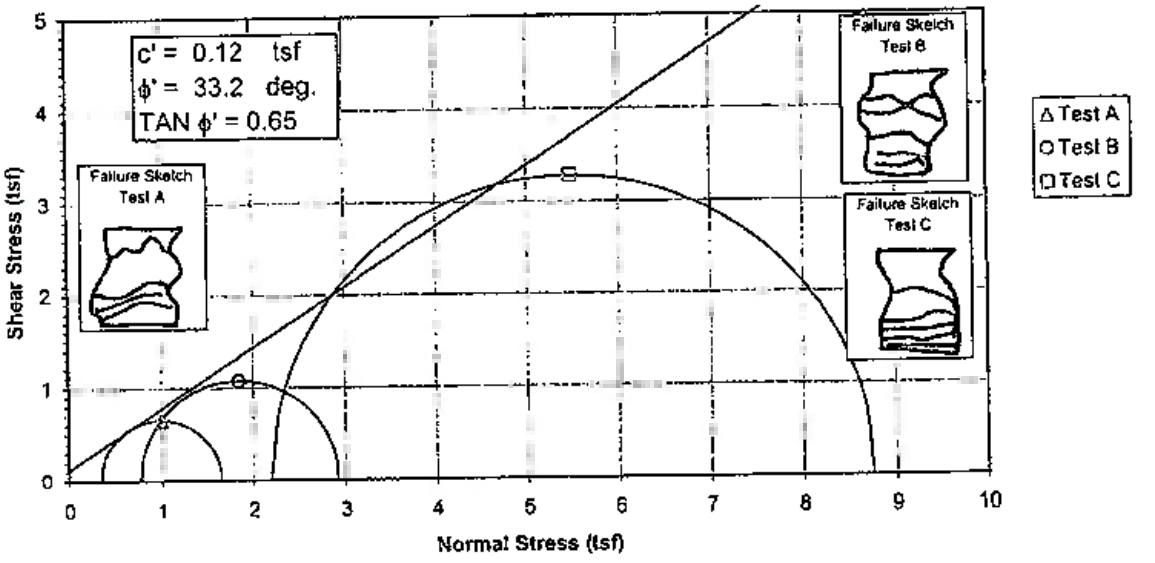
Project: Kingston Ash Pond	Location: Roone, TN	Project No.: GTX-9015
Boring No.: STN-3 D	Sample Type: core	
Description: CU-4-1 STN-3D Moist, olive brown sandy silty clay; CU-4-2 STN-3D Moist, green, yellow		
Remarks: and brown sandy silt; CU-4-3 STN-37D Moist, brown and yellow sandy silt		

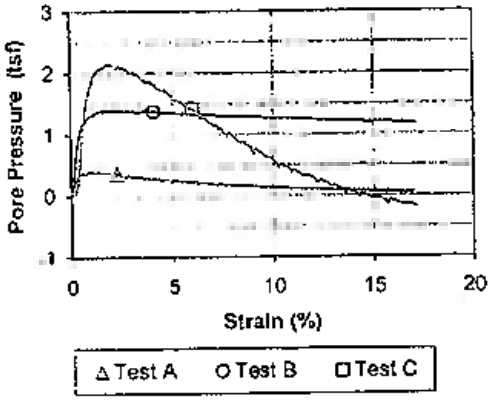
EM 1110-2-1906
Appendix X
30 Nov. 70

Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



Specimen No.			A	B	C
Initial Data	Water content %	W_o	22.2	20.5	20.0
	Dry Density PCF	γ_{d_o}	106.2	107.0	109.7
	Saturation %	S_o	105.6	99.3	104.3
	Void Ratio	e_o	0.558	0.547	0.508
After Shear	Water content %	W_f	19.9	19.4	16.0
	Dry Density PCF	γ_{d_f}	108.2	109.3	116.1
	Saturation %	S_f	100.0	100.0	100.0
	Void Ratio	e_f	0.529	0.513	0.425
	Final Back Pressure TSF	u_c	5.76	4.32	2.88
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.35	0.78	2.20
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	1.29	2.14	6.57
Time to $(\sigma 1'-\sigma 3')$max min.		t_f	72.6	19.8	88.2
Ultimate Deviator Stress, t/sq ft		$(\sigma 1'-\sigma 3')_{ult}$	n/a	n/a	n/a
Initial Diameter, in.		D_o	2.870	2.880	2.859
Initial Height, in.		H_o	6.065	5.997	5.961

Controlled - Strain Test

Description of Specimens: Sandy Silty Clay (CL-ML), brown, moist, soft to firm

LL	PL	PI	Gs 2.65

Remarks:

Type of Specimen: Undisturbed | Type of test: R

Project: Kingston Ash Pond

Boring No.: STN-14, STN-61 | Sample No.: 512

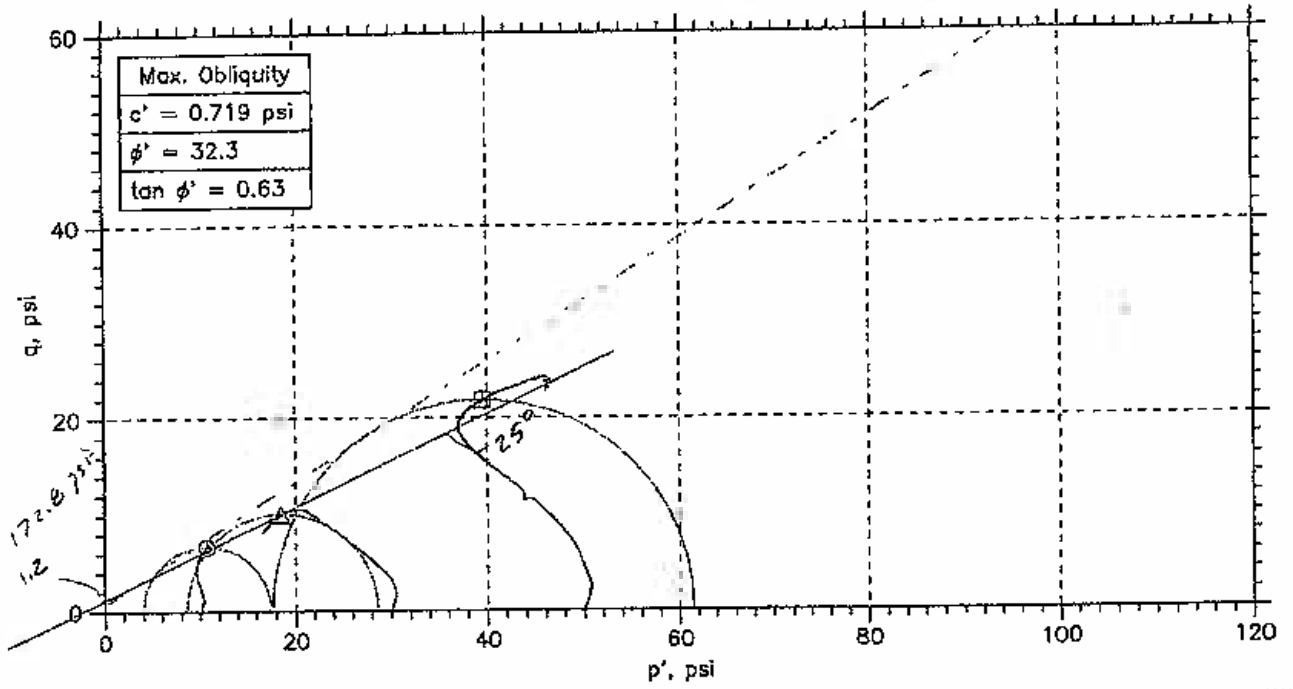
Depth Elev.: STN-14, 23.6'-24.1', 24.2'-24.7', STN-61, 23.0'-23.5'

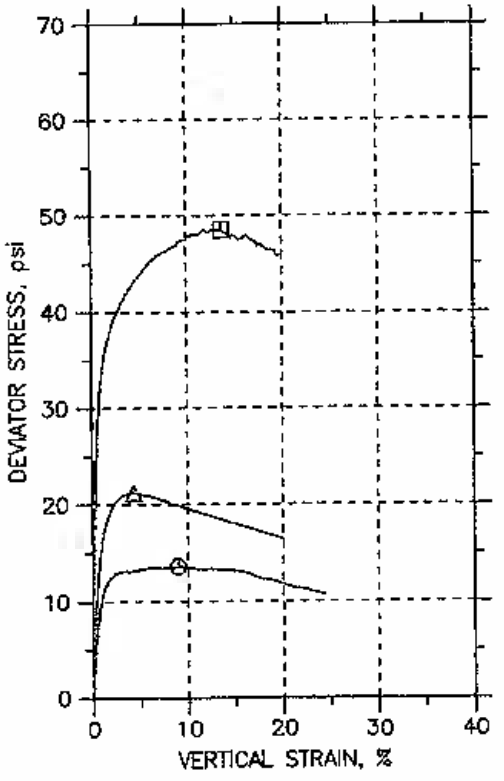
Laboratory: Stantec | Date: 6-25-09

TRIAXIAL COMPRESSION TEST REPORT

KPG

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





Symbol		⊙	△	□	
Sample No.		ST-1	ST-1	ST-2	
Test No.		CU-5-1	CU-5-2	CU-5-3	
Depth		38.3-38.9	38.9-39.5	46.3-46.9	
Initial	Diameter, in	2.87	2.88	2.87	
	Height, in	5.95	5.89	5.91	
	Water Content, %	32.8	27.7	22.8	
	Dry Density, pcf	89.33	90.97	102.5	
	Saturation, %	103.1	88.8	95.4	
	Void Ratio	0.838	0.832	0.644	
Before Shear	Water Content, %	27.3	28.8	22.4	
	Dry Density, pcf	95.58	94.21	105.1	
	Saturation, %	100.0	100.0	100.0	
	Void Ratio	0.718	0.769	0.604	
	Back Press., psi	28.	109.	82.02	
Ver. Eff. Cons. Stress, psi		9.996	30.	50.	
Shear Strength, psi		6.805	10.6	24.28	
Strain at Failure, %		8.95	4.33	13.8	
Strain Rate, %/min		0.016	0.016	0.016	
B-Value		0.95	0.95	0.95	
Measured Specific Gravity		2.63	2.67	---	
Liquid Limit		38	38	---	
Plastic Limit		23	23	---	

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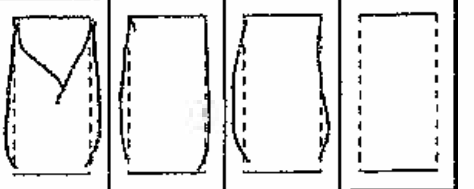
Project: Kingston Ash Pond

Location: Roane, TN

Project No.: GTX-9015

Boring No.: ST-28

Sample Type: core

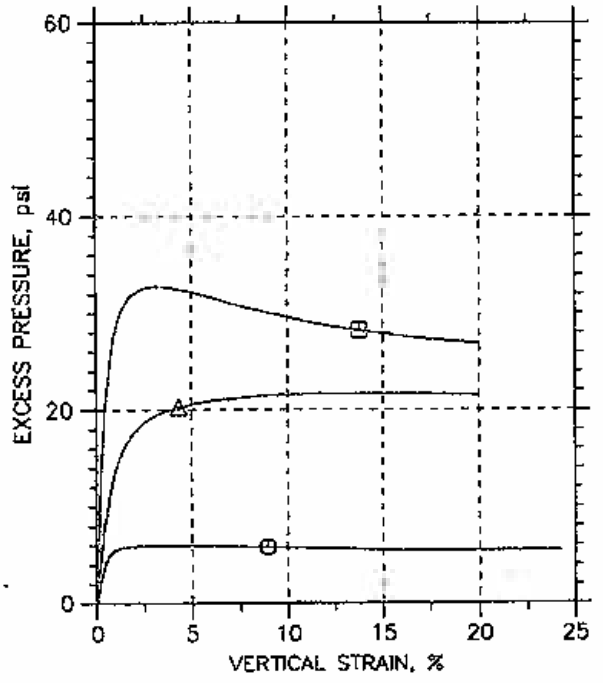


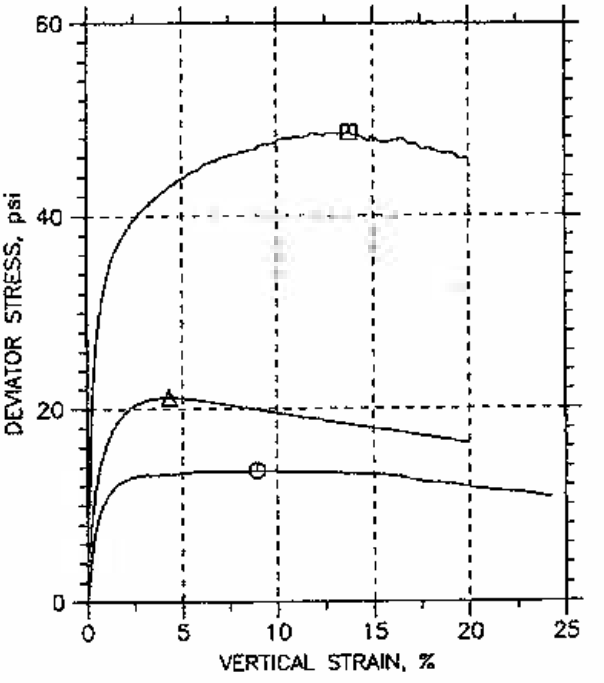
Description: CU-5-1 ST-28 Moist, dark olive gray clay with sand; CU-5-2 ST-28 Moist, dark olive

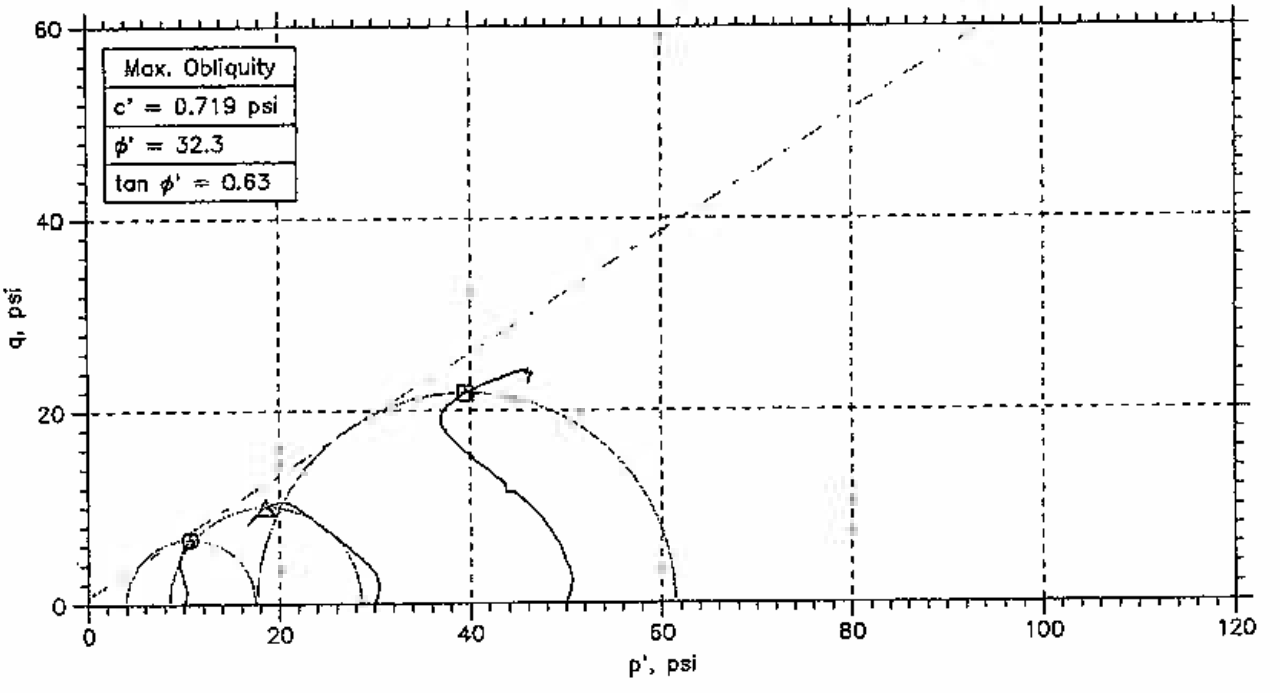
Remarks: gray clay and sand; CU-5-3 ST-28 Moist, yellow and gray silt with clay and sand

Phase calculations based on start and end of test.

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
⊙	ST-1	CU-5-1	38.3-38.9	md	05/14/09	jdt		9015-CU-5-1n.dat
△	ST-1	CU-5-2	38.9-39.5	md	05/14/09	jdt		9015-CU-5-2an.dat
□	ST-2	CU-5-3	46.3-46.9	md	05/14/09	jdt		9015-CU-5-3n.dat

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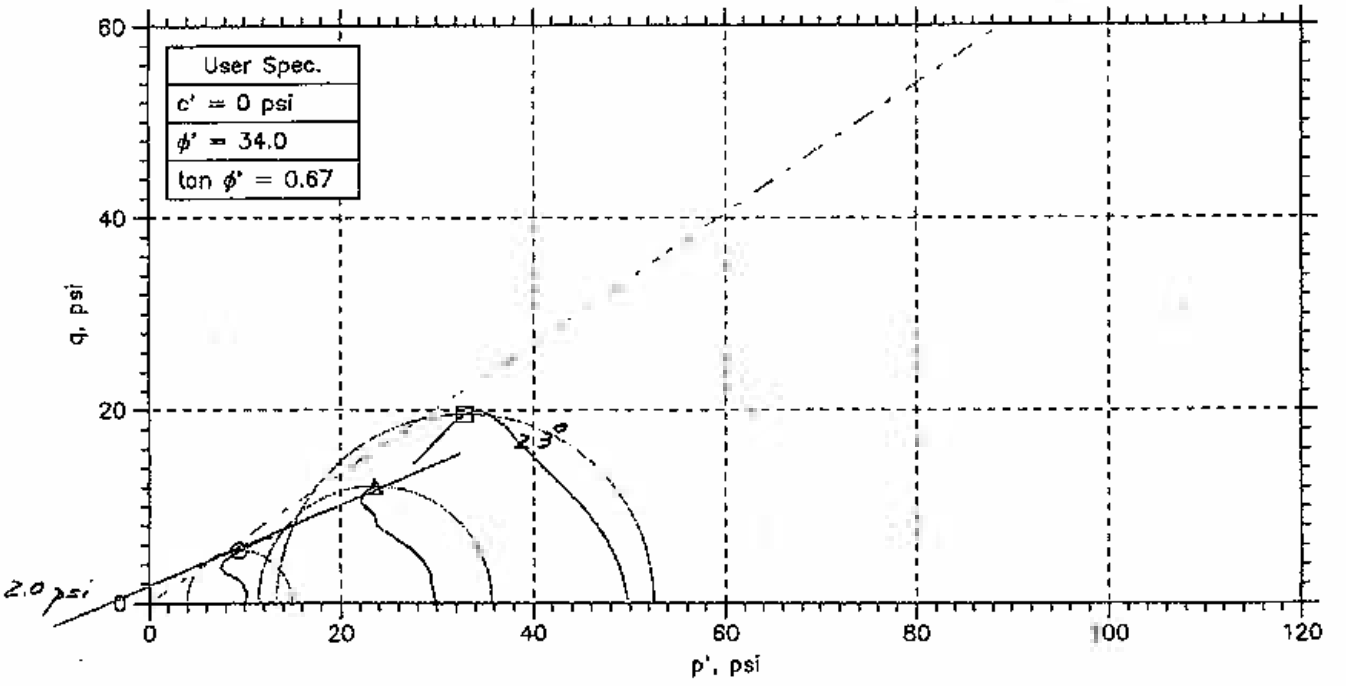
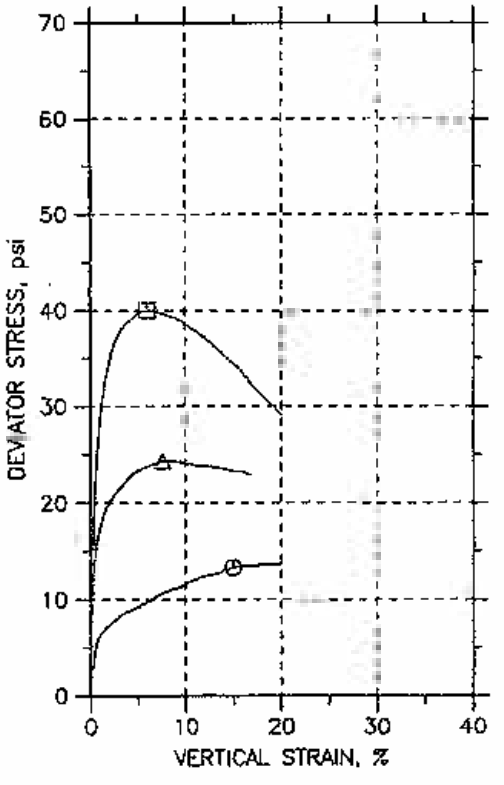
Project: Kingston Ash Pond	Location: Roane, TN	Project No.: GTX-9015
Boring No.: ST-28	Sample Type: core	
Description: CU-5-1 ST-28 Moist, dark olive gray clay with sand; CU-5-2 ST-28 Moist, dark olive		
Remarks: gray clay and sand; CU-5-3 ST-28 Moist, yellow and gray silt with clay and sand		

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





Symbol		⊙	△	⊡	
Sample No.		ST-7	ST-7	ST-7	
Test No.		CU-6-1	CU-6-2	CU-6-3	
Depth		60.2-60.8	60.8-61.4	61.4-62.0	
Initial	Diameter, in	2.88	2.88	2.87	
	Height, in	5.95	5.99	6	
	Water Content, %	21.5	31.4	43.8	
	Dry Density, pcf	103.7	87.45	74.79	
	Saturation, %	100.0	96.2	98.0	
	Void Ratio	0.554	0.842	1.15	
Before Shear	Water Content, %	22.3	26.3	36.5	
	Dry Density, pcf	102.3	95.9	83.	
	Saturation*, %	100.0	100.0	100.0	
	Void Ratio	0.575	0.68	0.941	
	Back Press., psi	28.	72.98	55.01	
Ver. Eff. Cons. Stress, psi		10.	30.01	49.98	
Shear Strength, psi		6.668	12.2	20.01	
Strain at Failure, %		15	7.6	6.03	
Strain Rate, %/min		0.016	0.016	0.016	
B-Value		0.95	0.95	0.96	
Measured Specific Gravity		2.58	2.58	2.58	
Liquid Limit		36	36	36	
Plastic Limit		19	19	19	

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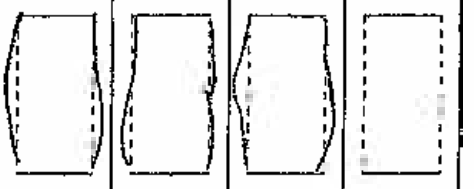
Project: Kingston Ash Pond
Location: Roane, TN
Project No.: GTX-9015
Boring No.: ST-29
Sample Type: core
Description: CU-6-1, 6-2 and 6-3 all: Moist, dark olive gray clay
Remarks:



Phase calculations based on start and end of test.

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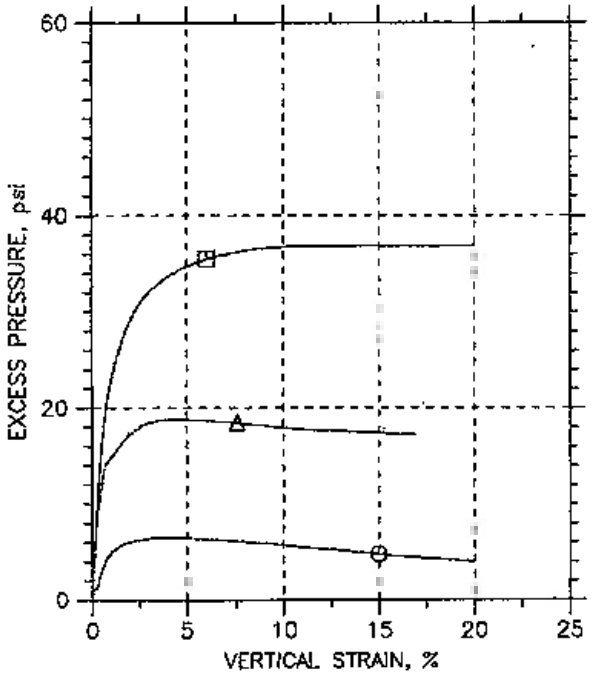
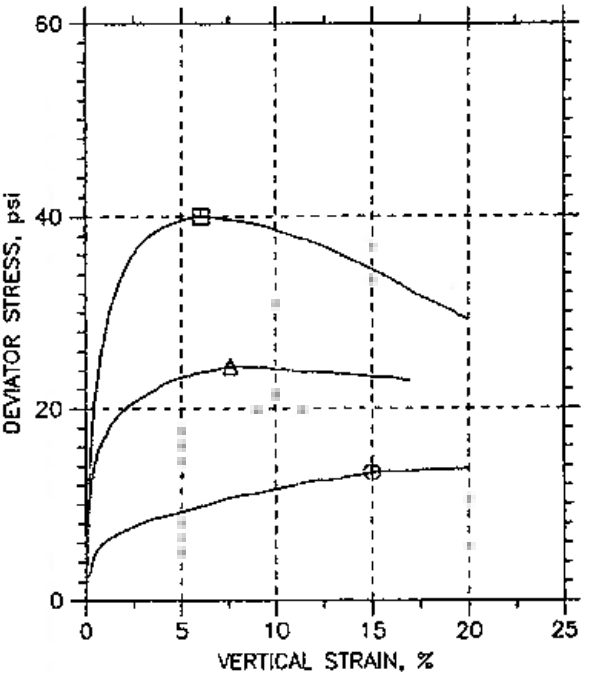
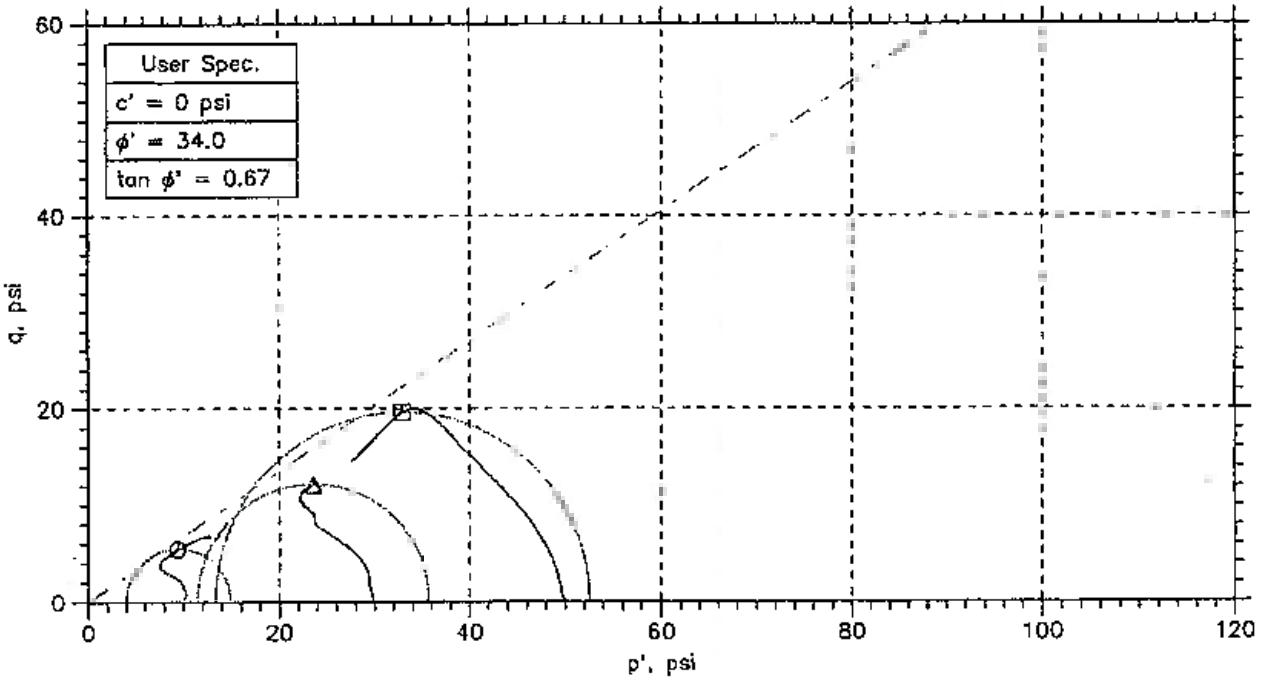
CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
○	ST-7	CU-6-1	60.2-60.8	md	05/14/09	jdt		9015-CU-6-1n.dat
△	ST-7	CU-6-2	60.8-61.4	md	05/14/09	jdt		9015-CU-6-2n.dat
□	ST-7	CU-6-3	61.4-62.0	md	05/14/09	jdt		9015-CU-6-3n.dat

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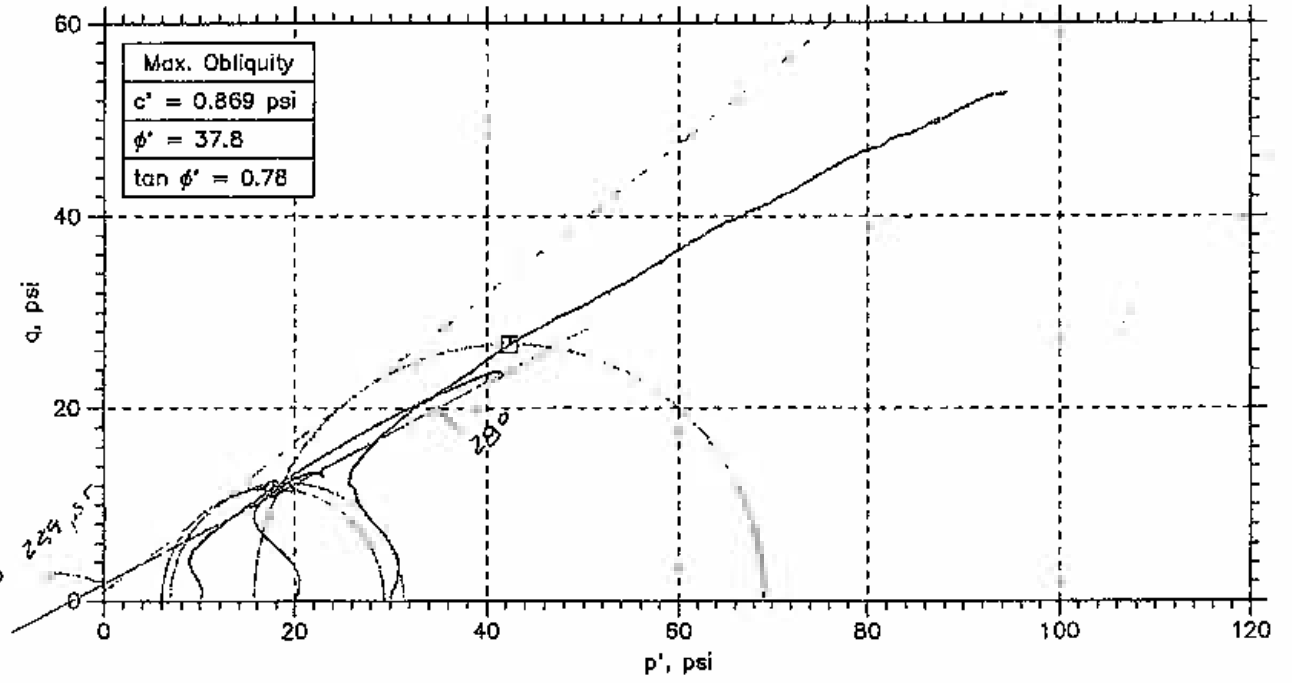
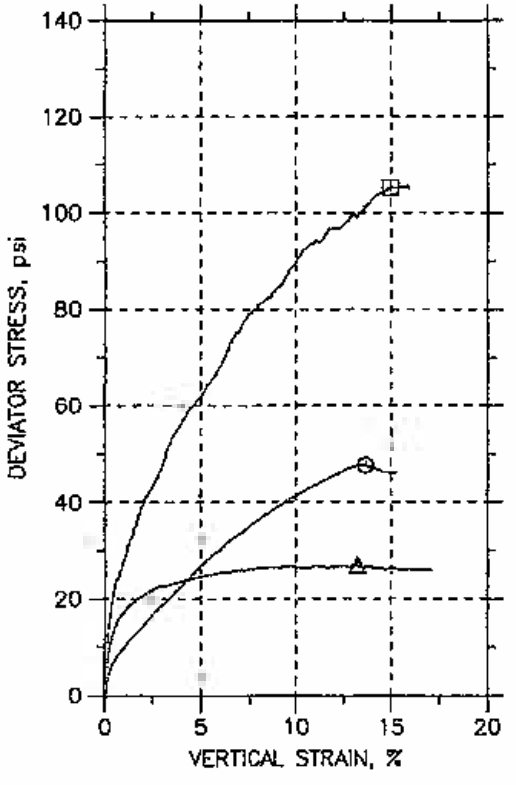
Project: Kingston Ash Pond	Location: Roane, TN	Project No.: GTX-9015
Boring No.: ST-29	Sample Type: core	
Description: CU-6-1, 6-2 and 6-3 all: Moist, dark olive gray clay		
Remarks:		

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





Symbol		⊙	△	⊡	
Sample No.		335 A	608 B	348	
Test No.		CU-2-1	CU-2-2	CU-2-3	
Depth		20-20.5	20.6-21.1	30.3-30.8	
Initial	Diameter, in	2.81	2.85	2.81	
	Height, in	5.71	5.76	5.75	
	Water Content, %	28.7	26.2	22.2	
	Dry Density, pcf	94.97	98.63	104.	
	Saturation, %	100.0	99.9	98.7	
	Void Ratio	0.775	0.709	0.597	
Before Shear	Water Content, %	24.7	24.3	19.2	
	Dry Density, pcf	101.1	101.8	110.	
	Saturation, %	100.0	100.0	100.0	
	Void Ratio	0.667	0.656	0.51	
	Back Press., psi	51.99	82.	54.99	
Ver. Eff. Cons. Stress, psi		10.01	20.	30.01	
Shear Strength, psi		23.83	13.49	52.61	
Strain at Failure, %		13.7	13.2	15	
Strain Rate, %/min		0.032	0.032	0.032	
B-Value		0.95	0.96	0.95	
Measured Specific Gravity		---	2.7	2.66	
Liquid Limit		---	37	22	
Plastic Limit		---	19	16	

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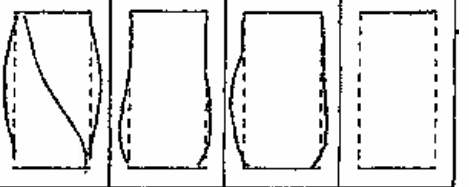
Project: Kingston Ash Pond
Location: Roane, TN
Project No.: GTX-9015
Boring No.: ---
Sample Type: core

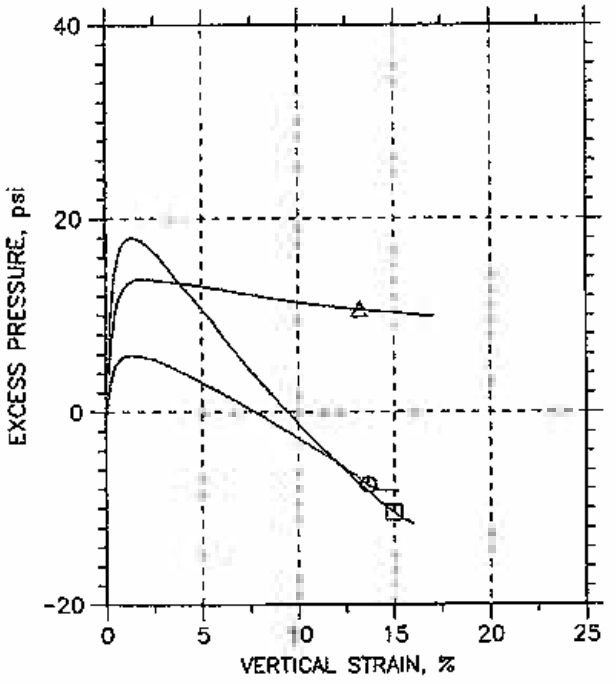


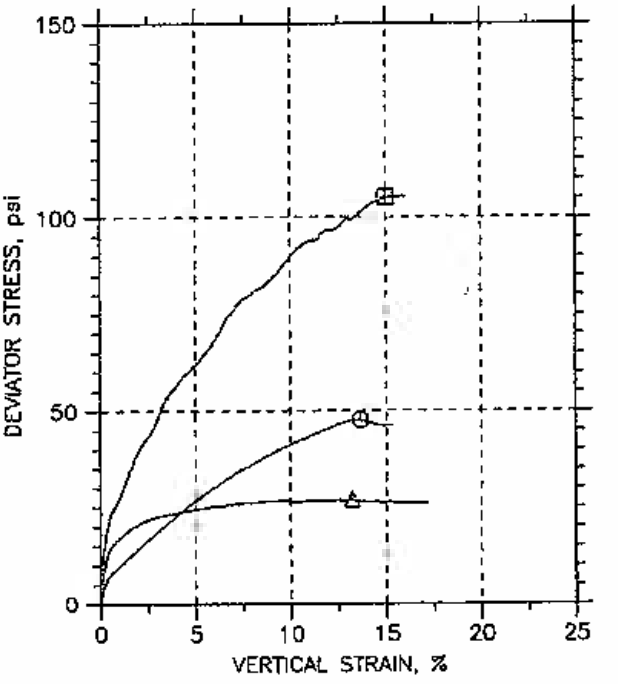
Description: CU-2-1 STN-26 Moist, dark brown sandy silt; CU-2-2 STN-64 Moist, reddish yellow clay

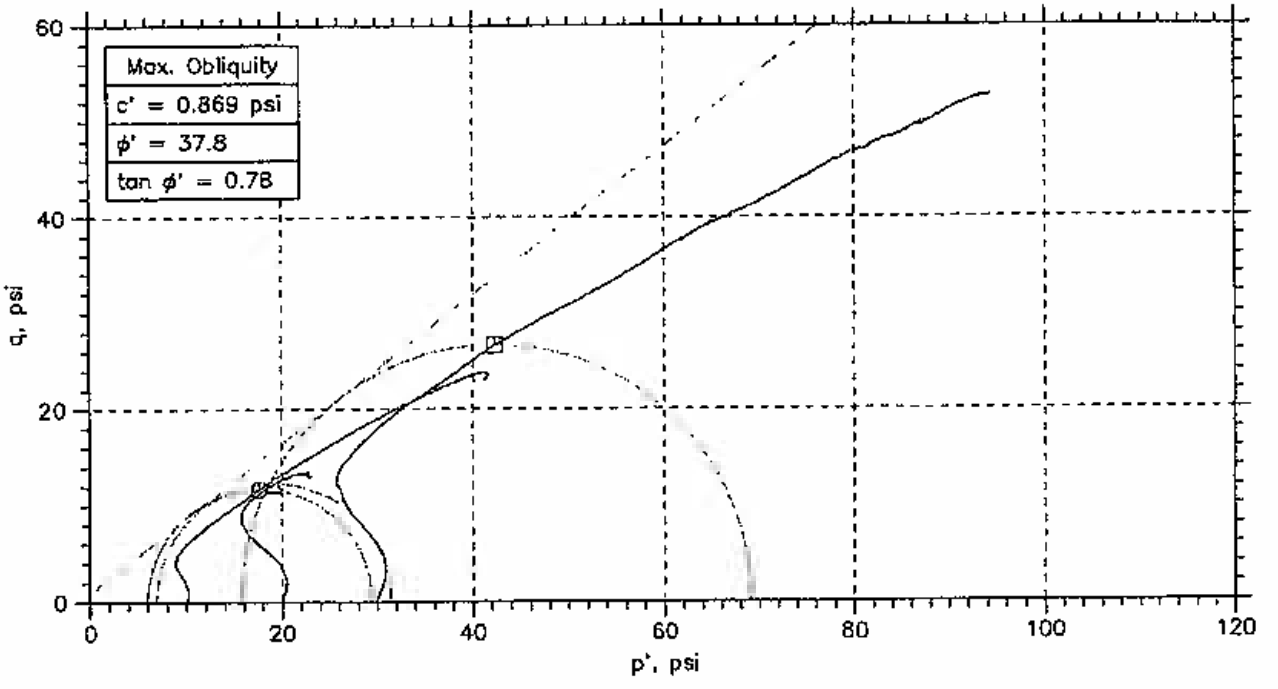
Remarks: CU-2-3 STN-27 Moist, olive brown sandy silty clay

Phase calculations based on start and end of test.

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
○	335 A	CU-2-1	20-20.5	md	05/11/09	jdt		9015-CU-2-1n.dat
△	608 B	CU-2-2	20.6-21.1	md	05/11/09	jdt		9015-CU-2-2n.dat
□	348	CU-2-3	30.3-30.8	md	05/11/09	jdt		9015-CU-2-3n.dat

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Project: Kingston Ash Pond	Location: Roane, TN	Project No.: GTX-9015
Boring No.: ---	Sample Type: core	
Description: CU-2-1 STN-26 Moist, dark brown sandy silt; CU-2-2 STN-64 Moist, reddish yellow clay		
Remarks: CU-2-3 STN-27 Moist, olive brown sandy silty clay		

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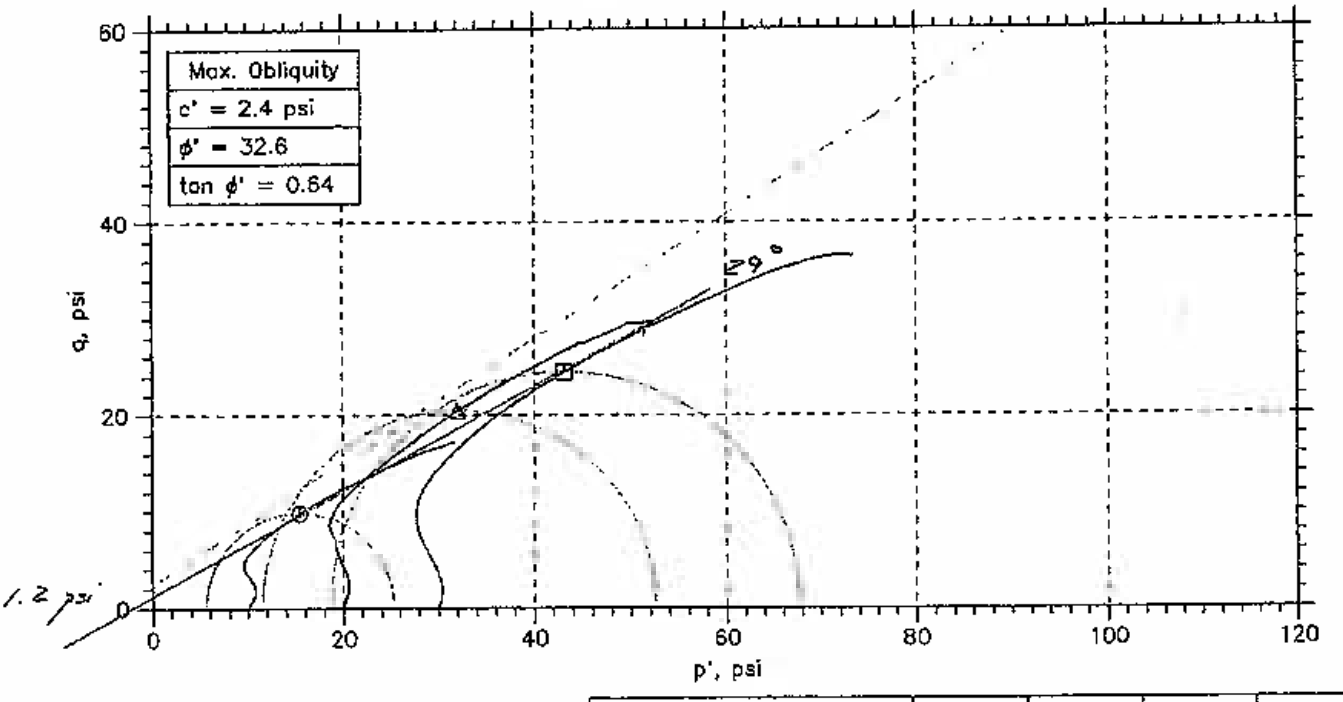
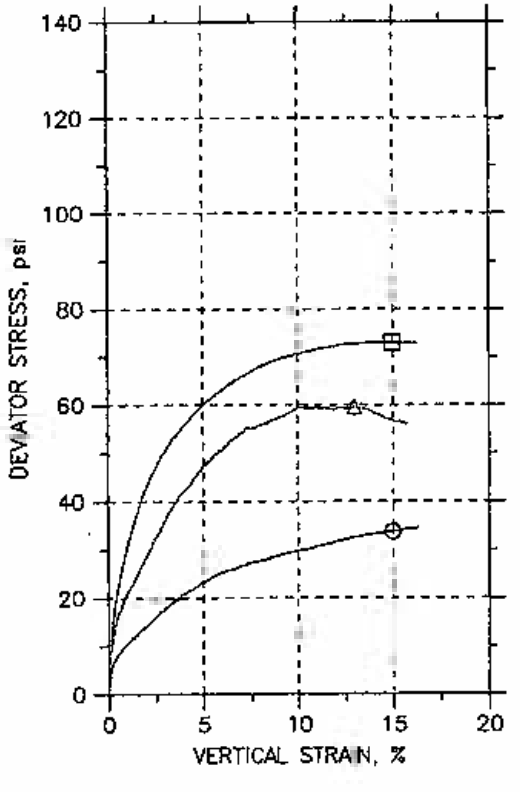
CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





Symbol		○	△	□	
Sample No.		340 B	616 A	360 C	
Test No.		CU-1-1	CU-1-2	CU-1-3	
Depth		33.6-34.1	33.6-34.1	50.0-50.5	
Initial	Diameter, in	2.87	2.83	2.87	
	Height, in	5.8	5.7	5.78	
	Water Content, %	22.9	19.2	20.1	
	Dry Density, pcf	104.2	109.	107.8	
	Saturation, %	100.0	95.0	96.4	
	Void Ratio	0.618	0.547	0.563	
Before Shear	Water Content, %	23.2	18.5	19.2	
	Dry Density, pcf	103.7	112.4	111.	
	Saturation, %	100.0	100.0	100.0	
	Void Ratio	0.625	0.5	0.519	
	Back Press., psi	27.99	73.	85.01	
Ver. Eff. Cons. Stress, psi		10.	19.99	29.98	
Shear Strength, psi		16.88	29.77	36.54	
Strain at Failure, %		15	13	15	
Strain Rate, %/min		0.032	0.032	0.032	
B-Value		0.99	0.95	0.96	
Estimated Specific Gravity		2.7	2.7	2.7	
Liquid Limit		---	---	---	
Plastic Limit		---	---	---	

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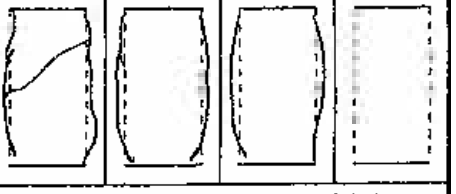
Project: Kingston Ash Pond
Location: Roane, TN
Project No.: GTX-9015
Boring No.: ---
Sample Type: core

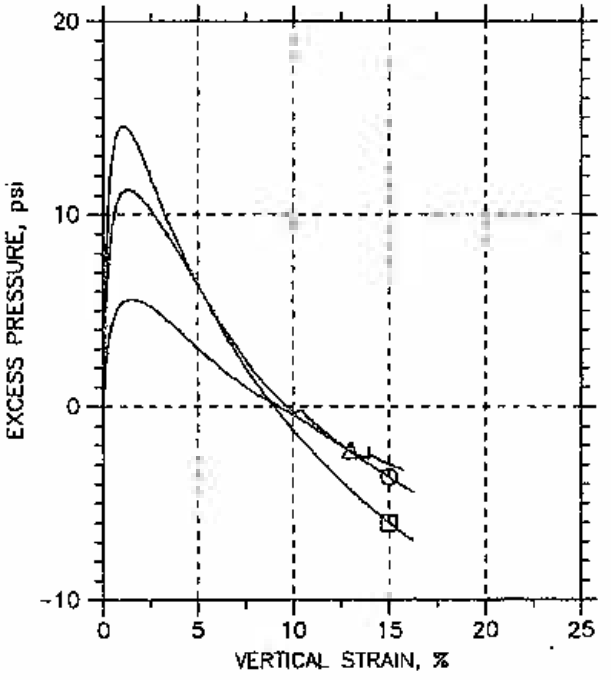


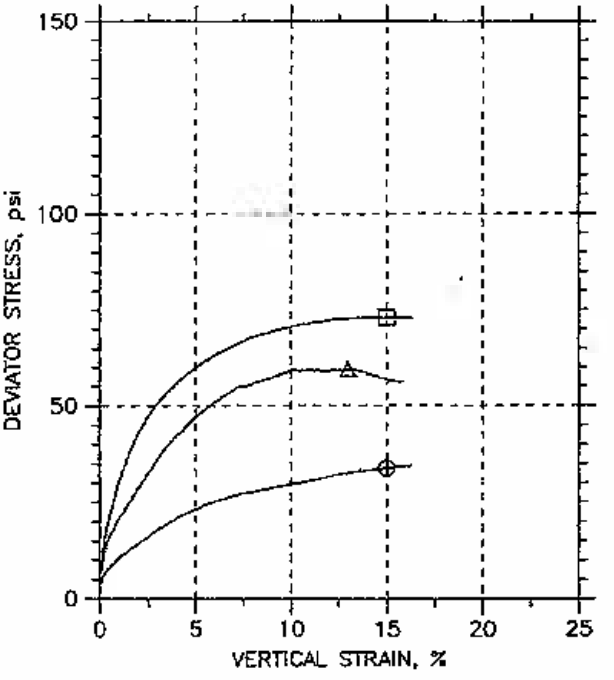
Description: CU-1-1 STN-31 Moist, yellowish brown sandy silt; CU-1-2 STN-66 Moist, yellowish brown

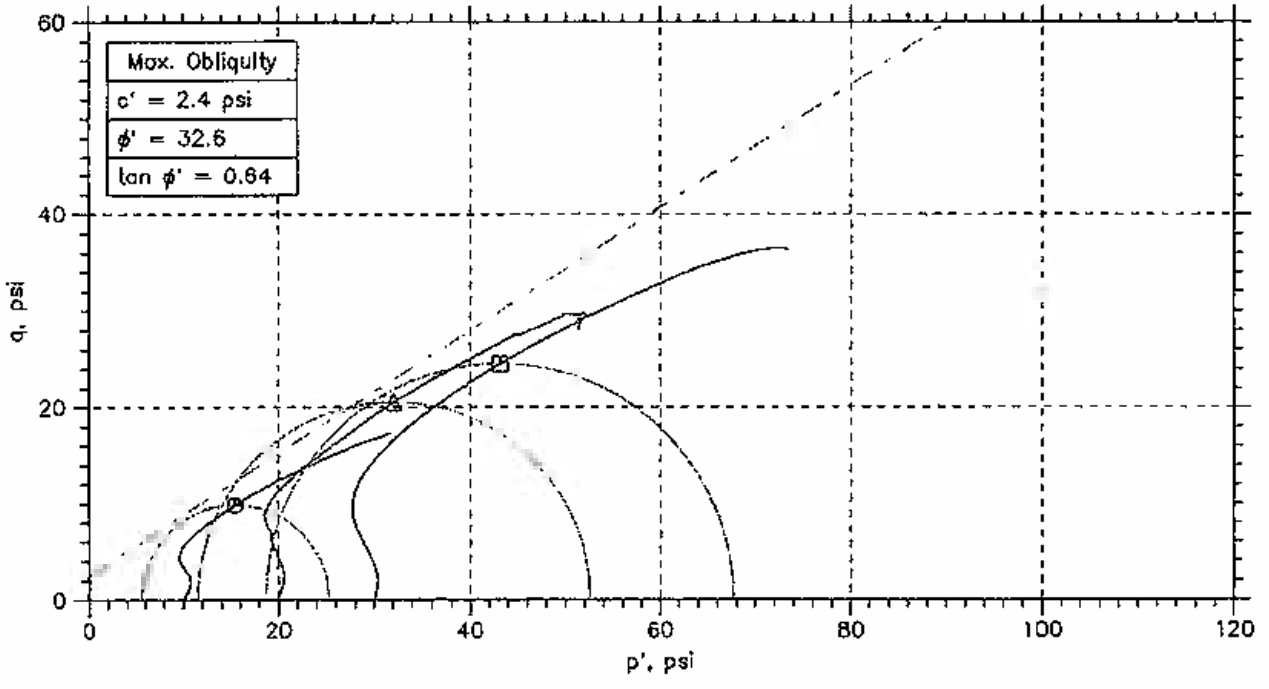
Remarks: sandy silt; CU-1-3 STN-32 Moist, brown and gray silty clay with sand

Phase calculations based on start and end of test.

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
○	340 B	CU-1-1	33.6-34.1	md	05/11/09	jdt		9015-CU-1-1n.dat
△	616 A	CU-1-2	33.6-34.1	md	05/11/09	jdt		9015-CU-1-2n.dat
□	360 C	CU-1-3	50.0-50.5	md	05/11/09	jdt		9015-CU-1-3n.dat

GeoTesting express
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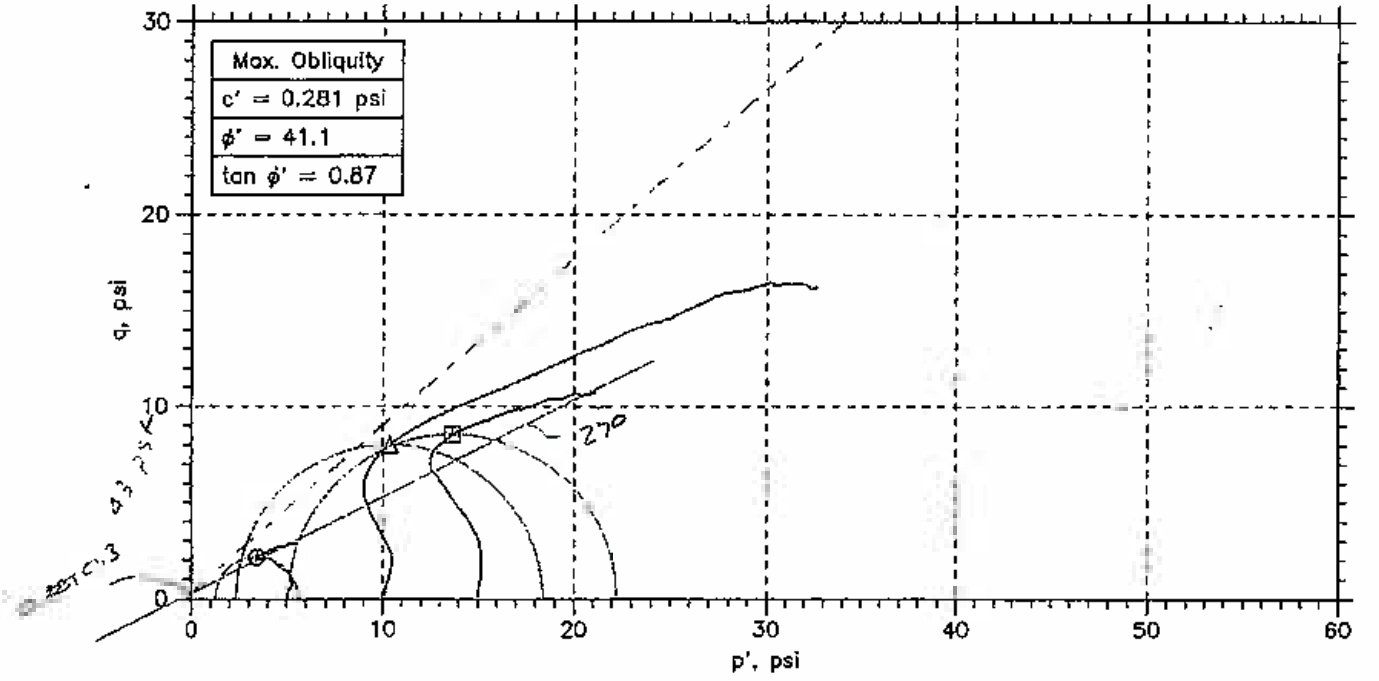
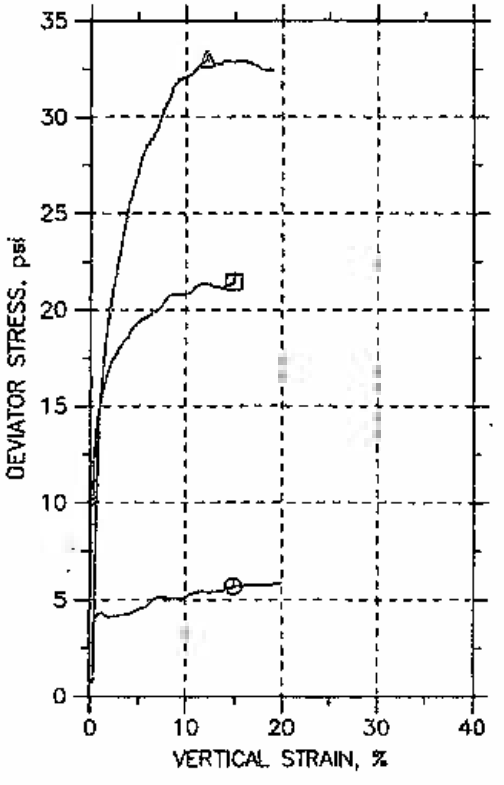
Project: Kingston Ash Pond	Location: Roane, TN	Project No.: GTX-9015
Boring No.: ---	Sample Type: core	
Description: CU-1-1 STN-31 Moist, yellowish brown sandy silt; CU-1-2 STN-66 Moist, yellowish brown		
Remarks: sandy silt; CU-1-3 STN-32 Moist, brown and gray silty clay with sand		

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





Symbol		⊙	△	⊡	
Sample No.		342 A	342 B	343 A	
Test No.		CU-3-1	CU-3-2	CU-3-3	
Depth		13.5-14.0	14.3-14.8	20.0-20.3	
Initial	Diameter, in	2.86	2.87	2.86	
	Height, in	5.95	5.79	5.8	
	Water Content, %	25.3	19.8	21.8	
	Dry Density, pcf	97.83	108.1	105.5	
	Saturation, %	94.5	98.1	98.2	
	Void Ratio	0.723	0.536	0.598	
Before Shear	Water Content, %	25.5	27.9	24.2	
	Dry Density, pcf	99.88	95.26	101.9	
	Saturation*, %	100.0	100.0	100.0	
	Void Ratio	0.688	0.743	0.654	
	Back Press., psi	133.	100.	132.8	
Ver. Eff. Cons. Stress, psi		5.008	9.994	15.	
Shear Strength, psi		2.863	16.53	10.74	
Strain at Failure, %		15	12.2	15	
Strain Rate, %/min		0.016	0.016	0.016	
B-Value		0.93	0.95	0.95	
Measured Specific Gravity		---	2.66	---	
Liquid Limit		---	52	---	
Plastic Limit		---	20	---	

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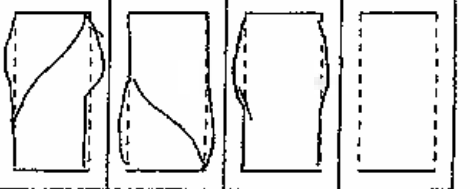
Project: Kingston Ash Pond

Location: Roane, TN

Project No.: GTX-9015

Boring No.: ---

Sample Type: core



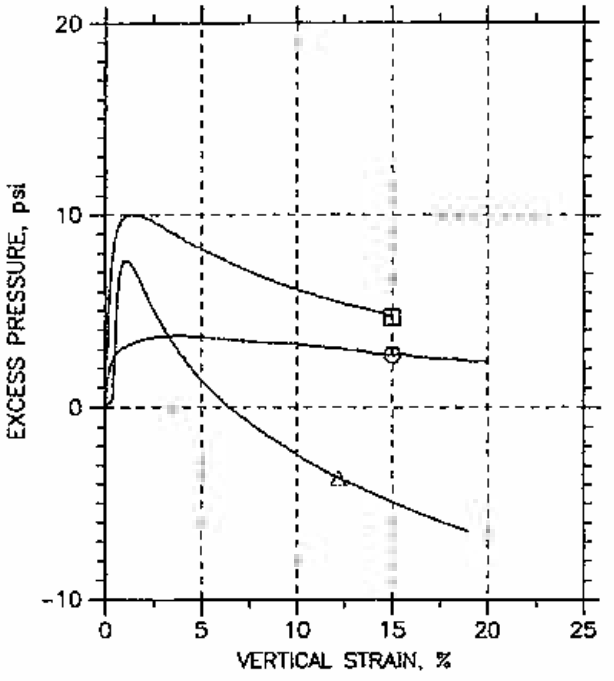
Description: CU-3-1 STN-37 Moist, yellowish brown clay with sand and gravel; CU-3-2 STN-37 Moist,

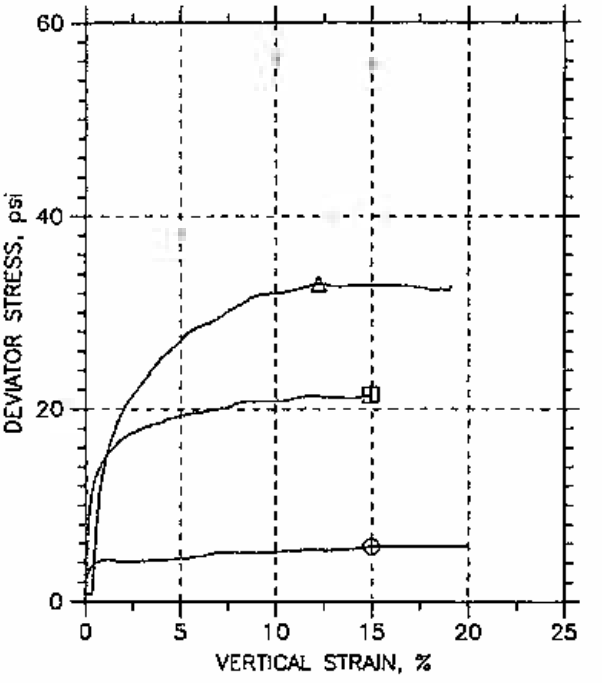
Remarks: reddish brown clay with sand; CU-3-3 STN-37 Moist, reddish brown clay

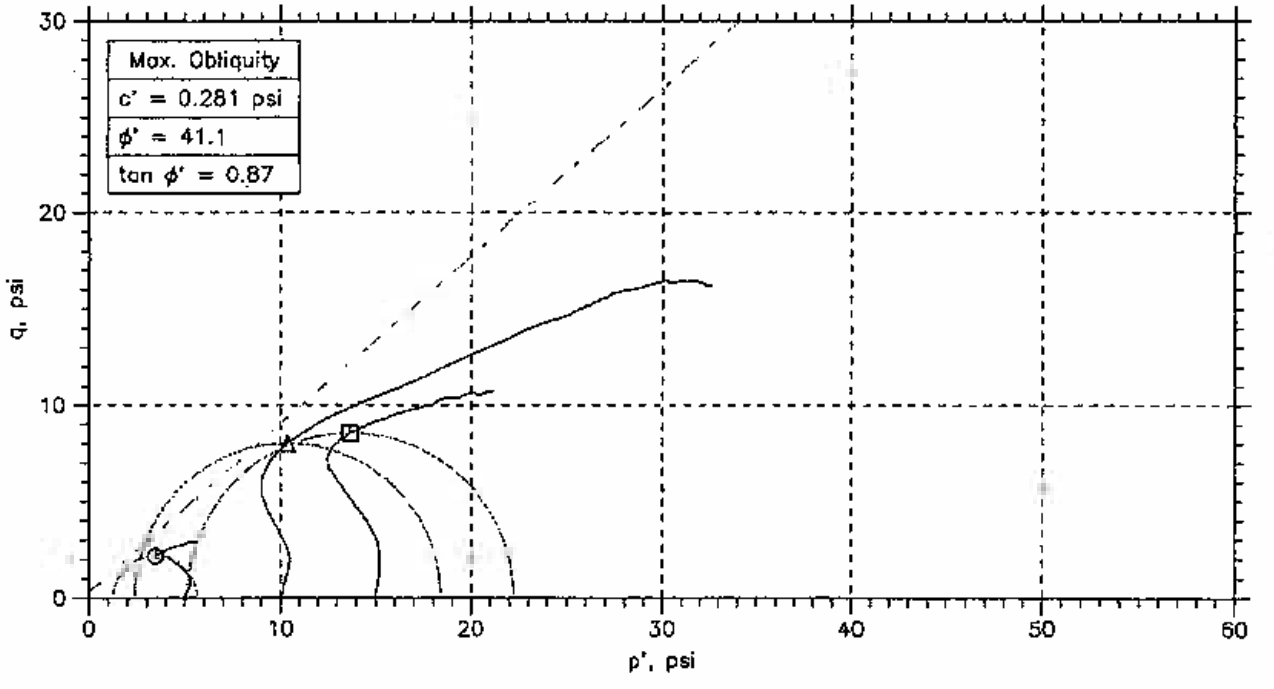
Phase calculations based on start and end of test.

Tue 19-MAY-2009 13:09:27

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
○	342 A	CU-3-1	13.5-14.0	md	05/12/09	jdt		9015-CU-3-1n.dat
△	342 B	CU-3-2	14.3-14.8	md	05/12/09	jdt		9015-CU-3-2n.dat
□	343 A	CU-3-3	20.0-20.3	md	05/11/09	jdt		9015-CU-3-3n.dat

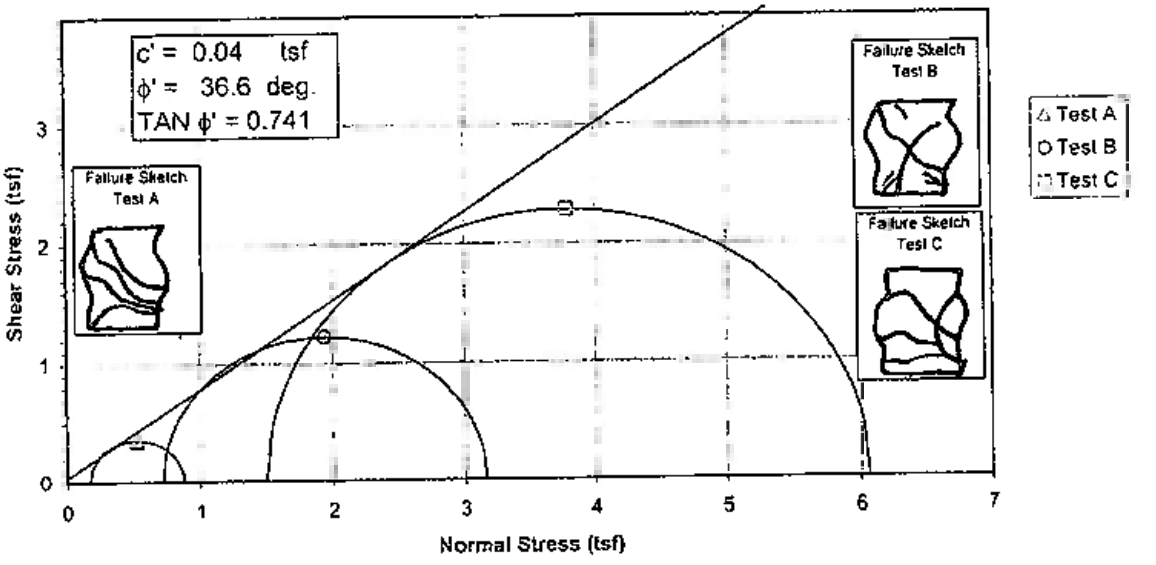
GeoTesting express
A subsidiary of Geocomp Corporation

Project: Kingston Ash Pond	Location: Roane, TN	Project No.: GTX-9015
Boring No.: ---	Sample Type: core	
Description: CU-3-1 STN-37 Moist, yellowish brown clay with sand and gravel; CU-3-2 STN-37 Moist,		
Remarks: reddish brown clay with sand; CU-3-3 STN-37 Moist, reddish brown clay		

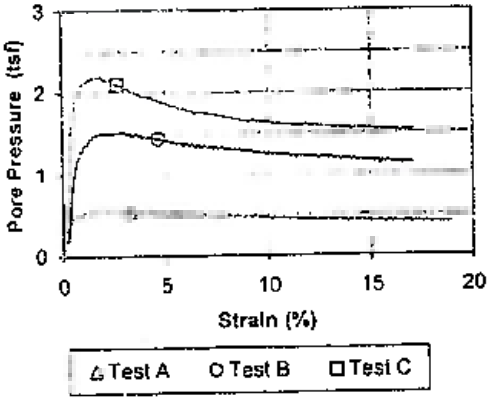
EM 1110-2-1906
Appendix X
30 Nov. 70

Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



Specimen No.			A	B	C
Initial Data	Water content %	W_o	25.4	23.7	23.1
	Dry Density PCF	γ_{d_o}	101.3	102.8	102.2
	Saturation %	S_o	105.4	102.3	98.3
	Void Ratio	e_o	0.642	0.616	0.625
After Shear	Water content %	W_f	19.8	19.5	22.0
	Dry Density PCF	γ_{d_f}	108.7	109.3	104.8
	Saturation %	S_f	100.0	100.0	100.0
	Void Ratio	e_f	0.528	0.519	0.585
	Final Back Pressure TSF	u_c	5.76	4.32	2.88
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.17	0.72	1.50
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	0.71	2.44	4.57
Time to $(\sigma 1'-\sigma 3')$max min.		t_f	95.2	338.5	21.1
Ultimate Deviator Stress, t/sq ft		$(\sigma 1'-\sigma 3')_{ult}$	n/a	n/a	n/a
Initial Diameter, in.		D_o	2.901	2.901	2.891
Initial Height, in.		H_o	5.834	5.980	6.067

Controlled - Strain Test

Description of Specimens: Sandy Lean Clay (CL), brown, moist, soft

LL 26 | PL 17 | PI 9 | Gs 2.66

Remarks:

Type of Specimen: Undisturbed | Type of test: R

Project: Kingston Ash Pond

Boring No.: STN-50, STN-51 | Sample No.: 546

Depth Elev.: 20.0'-20.5', 20.5'-21.0', 23.5'-24.0'

Laboratory: Stantec | Date: 6-30-09

TRIAXIAL COMPRESSION TEST REPORT

Permeability Test Results

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name: Kingston Ash Pond — Project No.: 175569042
Source: STN-2, 21.1'-21.6' — Test ID: 532
Visual Classification: Lean Clay with Sand (CL), brown, moist, firm — Prepared By: CM
Undisturbed: XX — Specific Gravity: 2.7 ASTM D854-A — Date: 6-5-09
Maximum Dry Density (pcf): — 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 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

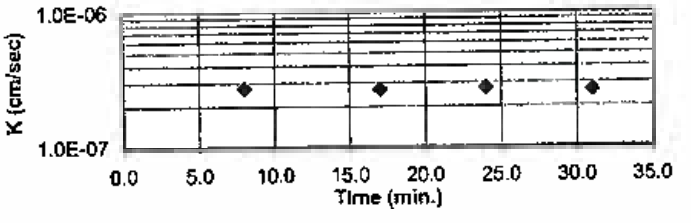
	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4481	2.4151	2.4151
Diameter (in.)	2.8010		2.7894
Moisture Content (%)	21.5		20.2
Dry Unit Weight (pcf)	106.4		108.8
Void Ratio	0.584		0.550
Degree of Saturation (%)	99.2		99.0
Trimmings MC (%)	21.5		

Final Pressures (psi): Chamber 75; Influent 70; Effluent 65

Applied Head Difference (psi): 5
Back Pressure Saturated to (psi): 65
Maximum Effective Consolidation Stress (psi): 10
Minimum Effective Consolidation Stress (psi): 5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
6-10-09	12:49	72.0	22.06	3.39	0	---	---	---	---
6-10-09	12:57	72.0	21.69	3.79	4.80E+02	2.9E-09	2.9E-07	2.7E-09	2.7E-07
6-10-09	13:06	72.0	21.28	4.21	5.40E+02	2.8E-09	2.8E-07	2.7E-09	2.7E-07
6-10-09	13:13	72.0	20.92	4.54	4.20E+02	2.9E-09	2.9E-07	2.7E-09	2.7E-07
6-10-09	13:20	72.0	20.61	4.87	4.20E+02	2.8E-09	2.8E-07	2.6E-09	2.6E-07

Corrected Permeability vs. Time



A gradient of approximately 56.4 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) m/s 2.69E-09 cm/s 2.69E-07
Average Hydraulic Conductivity @ 20°C (last run) m/s 2.69E-09 cm/s 2.69E-07

Reviewed by:

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name: Kingston Ash Pond
Project No.: 175569042
Source: STN-4, 26.0'-26.5'
Test ID: 540
Visual Classification: Sandy Lean Clay (CL), brown, moist, firm
Prepared By: CM
Undisturbed: XX
Specific Gravity: 2.69 ASTM D854-A
Date: 6-5-09
Maximum Dry Density (pcf):
Percent of Maximum:

Permeant: De-aired tap water
Selection and Preparation Comments:

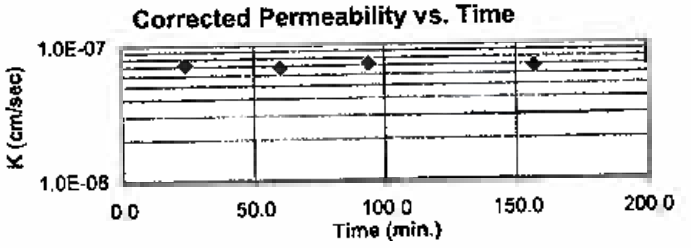
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4336	2.3625	2.3629
Diameter (in.)	2.8013		2.8004
Moisture Content (%)	18.4		16.6
Dry Unit Weight (pcf)	112.6		116.1
Void Ratio	0.491		0.447
Degree of Saturation (%)	101.1		100.1
Trimmings MC (%)	19.7		

Final Pressures (psi)
Chamber: 75
Influent: 70
Effluent: 65

Applied Head Difference (psi): 5
Back Pressure Saturated to (psi): 65
Maximum Effective Consolidation Stress (psi): 10
Minimum Effective Consolidation Stress (psi): 5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
6-11-09	7:44	72.0	22.26	3.20	0	---	---	---	---
6-11-09	8:08	72.0	21.95	3.52	1.44E+03	7.6E-10	7.6E-08	7.2E-10	7.2E-08
6-11-09	8:44	72.0	21.52	3.98	2.16E+03	7.2E-10	7.2E-08	6.8E-10	6.8E-08
6-11-09	9:18	72.0	21.09	4.44	2.04E+03	7.7E-10	7.7E-08	7.3E-10	7.3E-08
6-11-09	10:21	72.0	20.32	5.21	3.78E+03	7.2E-10	7.2E-08	6.8E-10	6.8E-08



A gradient of approximately 56.7 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) m/s 7.02E-10 cm/s 7.02E-08
Average Hydraulic Conductivity @ 20°C (last run) m/s 7.02E-10 cm/s 7.02E-08

Reviewed by:

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name: Kingston Ash Pond — Project No.: 175569042
Source: STN-5, 39.1'-39.6' — Test ID: 544
Visual Classification: Sandy Lean Clay (CL), light brown, wet, soft — Prepared By: CM
Undisturbed: XX — Specific Gravity: 2.67 ASTM D854-A — Date: 6-5-09
Maximum Dry Density (pcf): — Percent of Maximum:

Permeant: De-aired tap water

Selection and Preperation Comments:

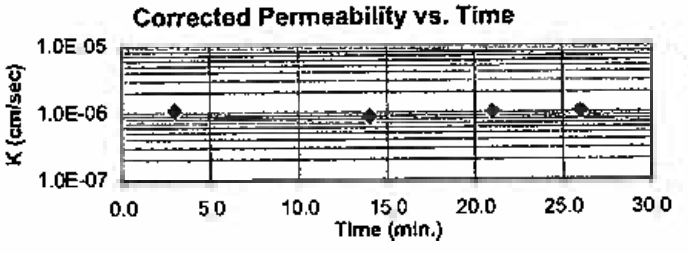
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4178	2.3717	2.3719
Diameter (in.)	2.7913		2.8035
Moisture Content (%)	23.0		20.5
Dry Unit Weight (pcf)	107.4		108.5
Void Ratio	0.552		0.536
Degree of Saturation (%)	111.1		102.0
Trimmings MC (%)	21.9		

Final Pressures (psi): Chamber 75; Influent 70; Effluent 65

Applied Head Difference (psi): 5
Back Pressure Saturated to (psi): 65
Maximum Effective Consolidation Stress (psi): 10
Minimum Effective Consolidation Stress (psi): 5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
6-10-09	12:52	72.0	13.82	11.73	0	—	—	—	—
6-10-09	12:55	72.0	13.65	11.86	1.80E+02	1.2E-08	1.2E-06	1.1E-08	1.1E-06
6-10-09	13:06	72.0	13.23	12.32	6.60E+02	9.2E-09	9.2E-07	8.8E-09	8.8E-07
6-10-09	13:13	72.0	12.93	12.67	4.20E+02	1.1E-08	1.1E-06	1.0E-08	1.0E-06
6-10-09	13:18	72.0	12.65	12.86	3.00E+02	1.1E-08	1.1E-06	1.0E-08	1.0E-06



A gradient of approximately 57.1 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) m/s 1.01E-08 cm/s 1.01E-06
Average Hydraulic Conductivity @ 20°C (last run) m/s 1.01E-08 cm/s 1.01E-06

Reviewed by:

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name: Kingston Ash Pond — Project No.: 175569042
Source: STN-8, 9.0'-9.5' — Test ID: 554
Visual Classification: Lean Clay (CL), brown, moist, firm — Prepared By: CM
Undisturbed: XX — Specific Gravity: 2.69 ASTM D854-A — Date: 6-5-09
Maximum Dry Density (pcf): — 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 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

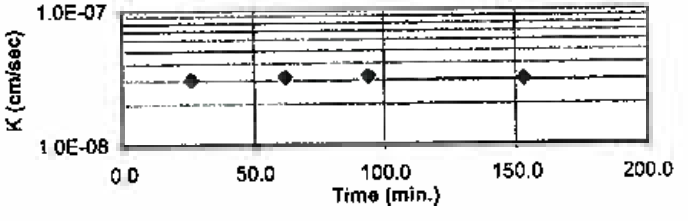
	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4595	2.4449	2.4449
Diameter (in.)	2.8013		2.7987
Moisture Content (%)	22.9		22.9
Dry Unit Weight (pcf)	103.2		104.0
Void Ratio	0.627		0.614
Degree of Saturation (%)	98.3		100.3
Trimmings MC (%)	2[illegible]3		

Final Pressures (psi): Chamber 75; Influent 70; Effluent 65

Applied Head Difference (psi): 5
Back Pressure Saturated to (psi): 65
Maximum Effective Consolidation Stress (psi): 10
Minimum Effective Consolidation Stress (psi): 5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
6-11-09	7:43	72.0	22.05	3.47	0	---	---	---	---
6-11-09	8:09	72.0	21.91	3.61	1.56E+03	3.2E-10	3.2E-08	3.1E-10	3.1E-08
6-11-09	8:45	72.0	21.71	3.81	2.16E+03	3.3E-10	3.3E-08	3.2E-10	3.2E-08
6-11-09	9:17	72.0	21.55	4.01	1.92E+03	3.4E-10	3.4E-08	3.2E-10	3.2E-08
6-11-09	10:16	72.0	21.22	4.31	3.54E+03	3.2E-10	3.2E-08	3.1E-10	3.1E-08

Corrected Permeability vs. Time



A gradient of approximately 56.1 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) m/s 3.12E-10 cm/s 3.12E-08
Average Hydraulic Conductivity @ 20°C (last run) m/s 3.12E-10 cm/s 3.12E-08

Reviewed by:

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name: Kingston Ash Pond — Project No.: 175569042
Source: STN-8, 16.1'-16.6' — Test ID: 556
Visual Classification: Sandy Lean Clay (CL), brown, moist, firm — Prepared By: CM
Undisturbed: XX — Specific Gravity: 2.69 ASTM D854-A — Date: 6-5-09
Maximum Dry Density (pcf): — 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 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

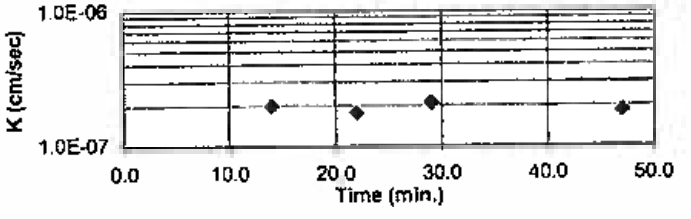
	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4430	2.3759	2.3759
Diameter (in.)	2.8023		2.8074
Moisture Content (%)	18.8		17.2
Dry Unit Weight (pcf)	111.3		114.1
Void Ratio	0.508		0.472
Degree of Saturation (%)	99.3		98.1
Trimmings MC (%)	21.0		

Final Pressures (psi): Chamber 75; Influent 70; Effluent 65

Applied Head Difference (psi): 5
Back Pressure Saturated to (psi): 65
Maximum Effective Consolidation Stress (psi): 10
Minimum Effective Consolidation Stress (psi): 5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
6-10-09	12:53	72.0	22.26	3.16	0	—	—	—	—
6-10-09	13:07	72.0	21.79	3.71	8.40E+02	2.1E-09	2.1E-07	2.0E-09	2.0E-07
6-10-09	13:15	72.0	21.54	3.97	4.80E+02	1.9E-09	1.9E-07	1.8E-09	1.8E-07
6-10-09	13:22	72.0	21.30	4.26	4.20E+02	2.2E-09	2.2E-07	2.1E-09	2.1E-07
6-10-09	13:40	72.0	20.74	4.88	1.08E+03	1.9E-09	1.9E-07	1.8E-09	1.8E-07

Corrected Permeability vs. Time



A gradient of approximately 56.5 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) m/s 1.92E-09 cm/s 1.92E-07
Average Hydraulic Conductivity @ 20°C (last run) m/s 1.92E-09 cm/s 1.92E-07

Reviewed by:

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name: Kingston Ash Pond — Project No.: 175569042
Source: STN-15, 12.0'-12.5' — Test ID: 511
Visual Classification: Gravelly Fat Clay (CH), red brown, moist, firm — Prepared By: CM
Undisturbed: XX — Specific Gravity: 2.71 ASTM D854-A — Date: 6-5-09
Maximum Dry Density (pcf): ____ — Percent of Maximum: ____

Permeant: De-aired tap water

Selection and Preparation Comments: ____

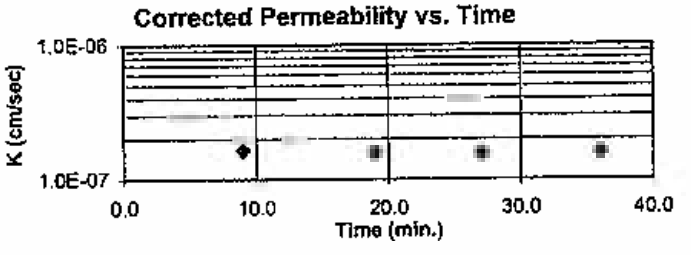
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4819	2.4387	2.4387
Diameter (in.)	2.8047		2.7942
Moisture Content (%)	27.7		29.6
Dry Unit Weight (pcf)	90.8		93.1
Void Ratio	0.864		0.817
Degree of Saturation (%)	87.0		98.3
Trimmings MC (%)	32.2		

Final Pressures (psi): Chamber 75; Influent 70; Effluent 65

Applied Head Difference (psi): 5
Back Pressure Saturated to (psi): 65
Maximum Effective Consolidation Stress (psi): 10
Minimum Effective Consolidation Stress (psi): 5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
6-10-09	12:46	72.0	22.34	3.26	0	---	---	---	---
6-10-09	12:55	72.0	22.10	3.54	5.40E+02	1.7E-09	1.7E-07	1.6E-09	1.6E-07
6-10-09	13:05	72.0	21.83	3.83	6.00E+02	1.7E-09	1.7E-07	1.6E-09	1.6E-07
6-10-09	13:13	72.0	21.61	4.05	4.80E+02	1.7E-09	1.7E-07	1.6E-09	1.6E-07
6-10-09	13:22	72.0	21.38	4.32	5.40E+02	1.7E-09	1.7E-07	1.6E-09	1.6E-07



A gradient of approximately 55.6 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) m/s 1.60E-09 cm/s 1.60E-07
Average Hydraulic Conductivity @ 20°C (last run) m/s 1.60E-09 cm/s 1.60E-07

Reviewed by: ____

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 5084-03

Project Name: Kingston Ash Pond — Project No.: 175569042
Source: STN-18, 26.1'-26.6' — Test ID: 522
Visual Classification: Lean Clay with Sand (CL), brown, moist, firm — Prepared By: CM
Undisturbed: XX — Specific Gravity: 2.69 ASTM D854-A — Date: 6-5-09
Maximum Dry Density (pcf): — 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 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

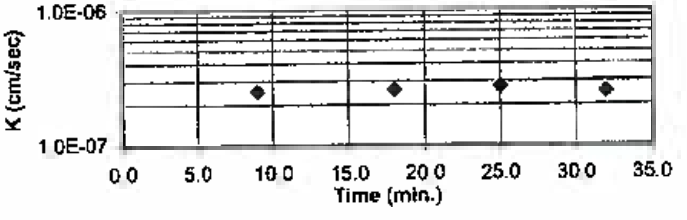
	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4499	2.4130	2.4130
Diameter (in.)	2.8013		2.7908
Moisture Content (%)	20.7		19.6
Dry Unit Weight (pcf)	107.4		109.9
Void Ratio	0.563		0.528
Degree of Saturation (%)	99.0		99.9
Trimmings MC (%)	21.7		

Final Pressures (psi): Chamber 75; Influent 70; Effluent 65

Applied Head Difference (psi): 5
Back Pressure Saturated to (psi): 65
Maximum Effective Consolidation Stress (psi): 10
Minimum Effective Consolidation Stress (psi): 5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
6-10-09	12:47	72.0	22.04	3.42	0	---	---	---	---
6-10-09	12:56	72.0	21.63	3.81	5.40E+02	2.6E-09	2.6E-07	2.5E-09	2.5E-07
6-10-09	13:05	72.0	21.24	4.24	5.40E+02	2.7E-09	2.7E-07	2.6E-09	2.6E-07
6-10-09	13:12	72.0	20.90	4.57	4.20E+02	2.9E-09	2.9E-07	2.7E-09	2.7E-07
6-10-09	13:19	72.0	20.60	4.88	4.20E+02	2.6E-09	2.6E-07	2.5E-09	2.5E-07

Corrected Permeability vs. Time



A gradient of approximately 56.3 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) m/s 2.58E-09 cm/s 2.58E-07
Average Hydraulic Conductivity @ 20°C (last run) m/s 2.58E-09 cm/s 2.58E-07

Reviewed by:

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name: Kingston Ash Pond — Project No.: 171468117
Source: STN-26 / ST-2, 20.0'-20.5' — Test ID: 335A
Visual Classification: Gravelly Lean Clay (CL), brown, wet, soft — Prepared By: KDG
Undisturbed: XX — Specific Gravity: 2.72 ASTM D854-A — Date: 5-11-09
Maximum Dry Density (pcf): — 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 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

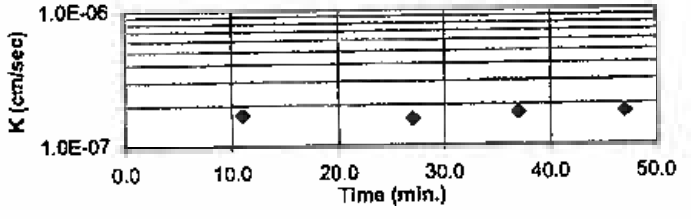
	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4529	2.3547	2.3547
Diameter (in.)	2.8050		2.7790
Moisture Content (%)	24.0		22.1
Dry Unit Weight (pcf)	99.4		105.5
Void Ratio	0.709		0.609
Degree of Saturation (%)	92.0		98.9
Trimmings MC (%)	23.5		

Final Pressures (psi): Chamber 75; Influent 70; Effluent 65

Applied Head Difference (psi): 5
Back Pressure Saturated to (psi): 65
Maximum Effective Consolidation Stress (psi): 10
Minimum Effective Consolidation Stress (psi): 5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
5-14-09	12:49	70.0	22.12	3.06	0	—	—	—	—
5-14-09	13:00	70.0	21.82	3.41	6.60E+02	1.7E-09	1.7E-07	1.7E-09	1.7E-07
5-14-09	13:16	70.0	21.38	3.84	9.60E+02	1.6E-09	1.6E-07	1.6E-09	1.6E-07
5-14-09	13:26	70.0	21.08	4.14	6.00E+02	1.8E-09	1.8E-07	1.7E-09	1.7E-07
5-14-09	13:36	70.0	20.78	4.44	6.00E+02	1.8E-09	1.8E-07	1.7E-09	1.7E-07

Corrected Permeability vs. Time



A gradient of approximately 56.3 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): m/s 1.67E-09; cm/s 1.67E-07
Average Hydraulic Conductivity @ 20°C (last run): m/s 1.67E-09; cm/s 1.67E-07

Reviewed by:

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name: Kingston Ash Pond
Project No.: 171468117
Source: STN-27, 19.0'-19.5'
Test ID: 347
Visual Classification: Fat Clay with Gravel, red brown, moist, firm
Prepared By: RC
Undisturbed: XX
Specific Gravity: 2.73 ASTM D854-A
Date: 5-12-09
Maximum Dry Density (pcf):
Percent of Maximum:
Permeant: De-aired tap water
Selection and Preparation Comments:

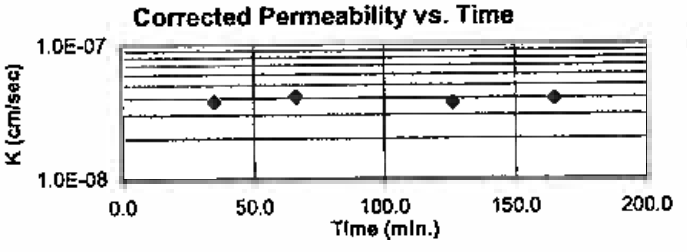
Specimens (If compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4305	2.4040	2.4099
Diameter (in.)	2.7933		2.7741
Moisture Content (%)	29.5		29.9
Dry Unit Weight (pcf)	91.7		93.7
Void Ratio	0.859		0.818
Degree of Saturation (%)	93.7		99.8
Trimmings MC (%)	31.5		

Final Pressures (psi)
Chamber: 75
Influent: 70
Effluent: 65

Applied Head Difference (psi): 5
Back Pressure Saturated to (psi): 65
Maximum Effective Consolidation Stress (psi): 10
Minimum Effective Consolidation Stress (psi): 5

Date	Clock (24H.M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
5-15-09	7:47	70.0	22.04	3.35	0	---	---	---	---
5-15-09	8:22	70.0	21.81	3.57	2.10E+03	3.9E-10	3.9E-08	3.8E-10	3.8E-08
5-15-09	8:53	70.0	21.60	3.79	1.86E+03	4.2E-10	4.2E-08	4.1E-10	4.1E-08
5-15-09	9:53	70.0	21.23	4.17	3.60E+03	3.8E-10	3.8E-08	3.7E-10	3.7E-08
5-15-09	10:32	70.0	20.98	4.44	2.34E+03	4.0E-10	4.0E-08	3.9E-10	3.9E-08



A gradient of approximately 56.8 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 effect test results.

Average Hydraulic Conductivity @ 20°C (last 4 determinations) m/s 3.86E-10 cm/s 3.86E-08
Average Hydraulic Conductivity @ 20°C (last run) m/s 3.86E-10 cm/s 3.86E-08

Reviewed by:

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name: Kingston Ash Pond
Project No.: 171468117
Source: STN-27, 44.1'-44.6'
Test ID: 349A
Visual Classification: Sandy Lean Clay (CL), light brown, moist, firm
Prepared By: RC
Undisturbed: XX
Specific Gravity: 2.7 ASTM D854-A
Date: 5-12-09
Maximum Dry Density (pcf): ____
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 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

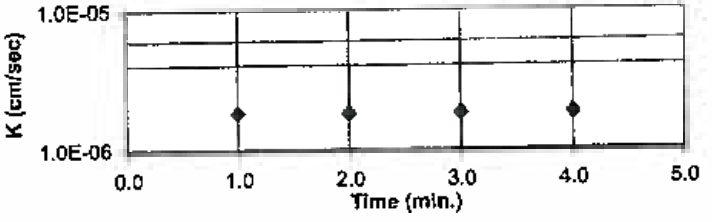
	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4495	2.4416	2.4416
Diameter (in.)	2.7817		2.7532
Moisture Content (%)	20.4		19.1
Dry Unit Weight (pcf)	107.8		110.4
Void Ratio	0.563		0.527
Degree of Saturation (%)	97.9		97.9
Trimmings MC (%)	20.5		

Final Pressures (psi): Chamber 75; Influent 70; Effluent 65

Applied Head Difference (psi): 5
Back Pressure Saturated to (psi): 65
Maximum Effective Consolidation Stress (psi): 10
Minimum Effective Consolidation Stress (psi): 5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
5-14-09	11:03	70.0	22.03	3.61	0	---	---	---	---
5-14-09	11:04	70.0	21.72	3.91	6.00E+01	1.9E-08	1.9E-06	1.8E-08	1.8E-06
5-14-09	11:05	70.0	21.42	4.21	6.00E+01	1.9E-08	1.9E-06	1.8E-08	1.8E-06
5-14-09	11:06	70.0	21.12	4.51	6.00E+01	1.9E-08	1.9E-06	1.8E-08	1.8E-06
5-14-09	11:07	70.0	20.82	4.81	6.00E+01	1.9E-08	1.9E-06	1.8E-08	1.8E-06

Corrected Permeability vs. Time



A gradient of approximately 56.3 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) m/s 1.82E-08 cm/s 1.82E-06
Average Hydraulic Conductivity @ 20°C (last run) m/s 1.82E-08 cm/s 1.82E-06

Reviewed by: ____

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name: Kingston Ash Pond — Project No.: 171468117
Source: STN-31 / ST-4, 38.8'-39.3' — Test ID: 341B
Visual Classification: Lean Clay (CL), brown, moist, firm — Prepared By: RC
Undisturbed: XX — Specific Gravity: 2.71 ASTM D854-A — Date: 5-11-09
Maximum Dry Density (pcf): — 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 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

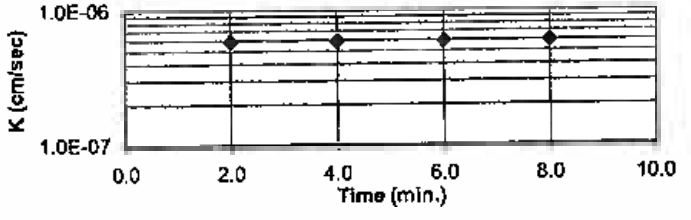
	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4510	2.4217	2.4216
Diameter (in.)	2.7990		2.7788
Moisture Content (%)	24.1		23.9
Dry Unit Weight (pcf)	100.1		102.8
Void Ratio	0.690		0.646
Degree of Saturation (%)	94.5		100.3
Trimmings MC (%)	24.3		

Final Pressures (psi): Chamber 75, Influent 70, Effluent 65

Applied Head Difference (psi): 5
Back Pressure Saturated to (psi): 65
Maximum Effective Consolidation Stress (psi): 10
Minimum Effective Consolidation Stress (psi): 5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
5-14-09	10:41	70.0	21.90	3.73	0	—	—	—	—
5-14-09	10:43	70.0	21.70	3.93	1.20E+02	6.0E-09	6.0E-07	5.8E-09	5.8E-07
5-14-09	10:45	70.0	21.50	4.13	1.20E+02	6.0E-09	6.0E-07	5.9E-09	5.9E-07
5-14-09	10:47	70.0	21.30	4.33	1.20E+02	6.0E-09	6.0E-07	5.9E-09	5.9E-07
5-14-09	10:49	70.0	21.11	4.54	1.20E+02	6.1E-09	6.1E-07	5.9E-09	5.9E-07

Corrected Permeability vs. Time



A gradient of approximately 56.3 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) m/s 5.88E-09 cm/s 5.88E-07
Average Hydraulic Conductivity @ 20°C (last run) m/s 5.88E-09 cm/s 5.88E-07

Reviewed by:

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name: Kingston Ash Pond
Project No.: 171468117
Source: STN-32, 14.0'-14.5'
Test ID: 359
Visual Classification: Fat Clay with Gravel (CH), red brown, moist, firm
Prepared By: RC
Undisturbed: XX
Specific Gravity: 2.75 ASTM D854-A
Date: 5-12-09
Maximum Dry Density (pcf):
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 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

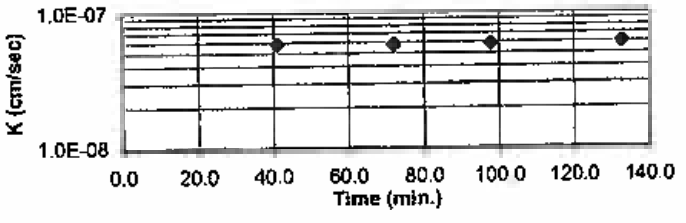
	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4620	2.4466	2.4468
Diameter (in.)	2.7920		2.7829
Moisture Content (%)	27.5		28.4
Dry Unit Weight (pcf)	94.8		96.0
Void Ratio	0.810		0.788
Degree of Saturation (%)	93.2		99.1
Trimmings MC (%)	27.7		

Final Pressures (psi): Chamber 75, Influent 70, Effluent 65

Applied Head Difference (psi): 5
Back Pressure Saturated to (psi): 65
Maximum Effective Consolidation Stress (psi): 10
Minimum Effective Consolidation Stress (psi): 5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
5-15-09	7:40	70.0	22.11	3.52	0	—	—	—	—
5-15-09	8:21	70.0	21.71	3.93	2.46E+03	6.0E-10	6.0E-08	5.8E-10	5.8E-08
5-15-09	8:52	70.0	21.40	4.22	1.86E+03	5.9E-10	5.9E-08	5.7E-10	5.7E-08
5-15-09	9:18	70.0	21.14	4.47	1.56E+03	6.0E-10	6.0E-08	5.8E-10	5.8E-08
5-15-09	9:53	70.0	20.81	4.84	2.10E+03	6.1E-10	6.1E-08	6.0E-10	6.0E-08

Corrected Permeability vs. Time



A gradient of approximately 56.1 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) m/s 5.85E-10 cm/s 5.85E-08
Average Hydraulic Conductivity @ 20°C (last run) m/s 5.85E-10 cm/s 5.85E-08

Reviewed by:

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name: Kingston Ash Pond — Project No.: 171468117
Source: STN-36 / ST-2, 29.6'-30.1' — Test ID: 337B
Visual Classification: Lean Clay with Sand (CL), light brown, moist, soft — Prepared By: KDG
Undisturbed: XX — Specific Gravity: 2.7 ASTM D854-A — Date: 5-11-09
Maximum Dry Density (pcf): — 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 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

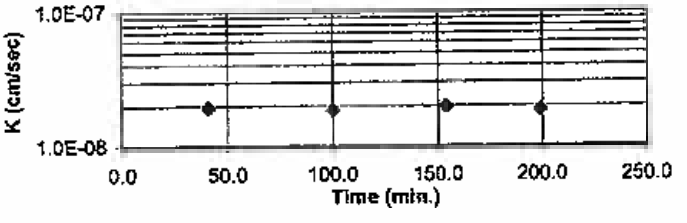
	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4708	2.3994	2.4061
Diameter (in.)	2.7753		2.7576
Moisture Content (%)	24.8		22.4
Dry Unit Weight (pcf)	100.5		104.6
Void Ratio	0.677		0.612
Degree of Saturation (%)	99.0		98.8
Trimmings MC (%)	24.6		

Final Pressures (psi): Chamber 75; Influent 70; Effluent 65

Applied Head Difference (psi): 5
Back Pressure Saturated to (psi): 65
Maximum Effective Consolidation Stress (psi): 10
Minimum Effective Consolidation Stress (psi): 5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
5-15-09	10:05	70.0	22.24	3.43	0	—	—	—	—
5-15-09	10:46	70.0	22.10	3.56	2.46E+03	2.0E-10	2.0E-08	1.9E-10	1.9E-08
5-15-09	11:45	70.0	21.93	3.76	3.54E+03	1.9E-10	1.9E-08	1.9E-10	1.9E-08
5-15-09	12:39	70.0	21.80	3.99	3.24E+03	2.0E-10	2.0E-08	2.0E-10	2.0E-08
5-15-09	13:24	70.0	21.67	4.14	2.70E+03	1.9E-10	1.9E-08	1.8E-10	1.8E-08

Corrected Permeability vs. Time



A gradient of approximately 55.9 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) m/s 1.91E-10 cm/s 1.91E-08
Average Hydraulic Conductivity @ 20°C (last run) m/s 1.91E-10 cm/s 1.91E-08

Reviewed by:

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name: Kingston Ash Pond | Project No.: 171468117
Source: STN-48, 5.1'-5.6 | Test ID: 351B
Visual Classification: Fat Clay with Gravel (CH), red brown, moist, firm | Prepared By: RC
Undisturbed: XX | Specific Gravity: 2.75 ASTM D854-A | Date: 5-12-09
Maximum Dry Density (pcf): | 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 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

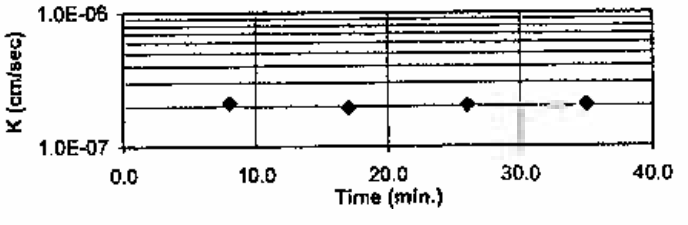
	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4570	2.4570	2.4572
Diameter (in.)	2.8023		2.8009
Moisture Content (%)	27.9		29.4
Dry Unit Weight (pcf)	94.8		94.9
Void Ratio	0.812		0.810
Degree of Saturation (%)	94.5		99.7
Trimmings MC (%)	28.4		

Final Pressures (psi)	
Chamber	75
Influent	70
Effluent	65

Applied Head Difference (psi)	5
Back Pressure Saturated to (psi)	65
Maximum Effective Consolidation Stress (psi)	10
Minimum Effective Consolidation Stress (psi)	5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
5-14-09	13:29	70.0	21.79	2.34	0	—	—	—	—
5-14-09	13:37	70.0	21.51	2.64	4.80E+02	2.2E-09	2.2E-07	2.1E-09	2.1E-07
5-14-09	13:46	70.0	21.21	2.94	5.40E+02	2.0E-09	2.0E-07	2.0E-09	2.0E-07
5-14-09	13:55	70.0	20.90	3.25	5.40E+02	2.1E-09	2.1E-07	2.0E-09	2.0E-07
5-14-09	14:04	70.0	20.59	3.56	5.40E+02	2.1E-09	2.1E-07	2.0E-09	2.0E-07

Corrected Permeability vs. Time



A gradient of approximately 56.2 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) m/s 2.04E-09 cm/s 2.04E-07
Average Hydraulic Conductivity @ 20°C (last run) m/s 2.04E-09 cm/s 2.04E-07

Reviewed by:

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name: Kingston Ash Pond — Project No.: 171468117
Source: STN-48, 34.1'-34.6' — Test ID: 354B
Visual Classification: Sandy Lean Clay (CL), light brown, moist, soft — Prepared By: RC
Undisturbed: XX — Specific Gravity: 2.69 ASTM D854-A — Date: 5-12-09
Maximum Dry Density (pcf): — Percent of Maximum:
Permeant: De-aired tap water
Selection and Preparation Comments:

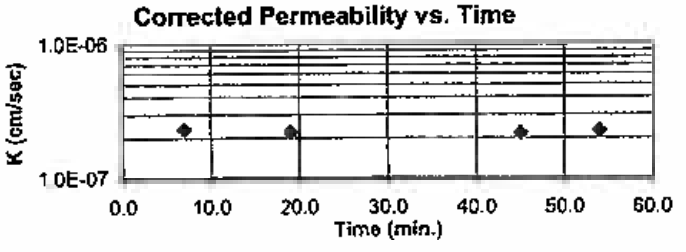
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4510	2.1745	2.1743
Diameter (in.)	2.8010		2.8701
Moisture Content (%)	20.8		16.2
Dry Unit Weight (pcf)	107.8		115.8
Void Ratio	0.568		0.451
Degree of Saturation (%)	100.2		96.9
Trimmings MC (%)	19.9		

Final Pressures (psi)	
Chamber	75
Influent	70
Effluent	65

Applied Head Difference (psi): 5
Back Pressure Saturated to (psi): 65
Maximum Effective Consolidation Stress (psi): 10
Minimum Effective Consolidation Stress (psi): 5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20°C (m/s)	k @ 20°C (cm/s)
5-18-09	10:31	70.0	22.10	3.53	0	---	---	---	---
5-18-09	10:38	70.0	21.80	3.89	4.20E+02	2.4E-09	2.4E-07	2.3E-09	2.3E-07
5-18-09	10:50	70.0	21.30	4.46	7.20E+02	2.3E-09	2.3E-07	2.2E-09	2.2E-07
5-18-09	11:16	70.0	20.25	5.65	1.56E+03	2.2E-09	2.2E-07	2.2E-09	2.2E-07
5-18-09	11:25	70.0	19.81	6.01	5.40E+02	2.3E-09	2.3E-07	2.3E-09	2.3E-07



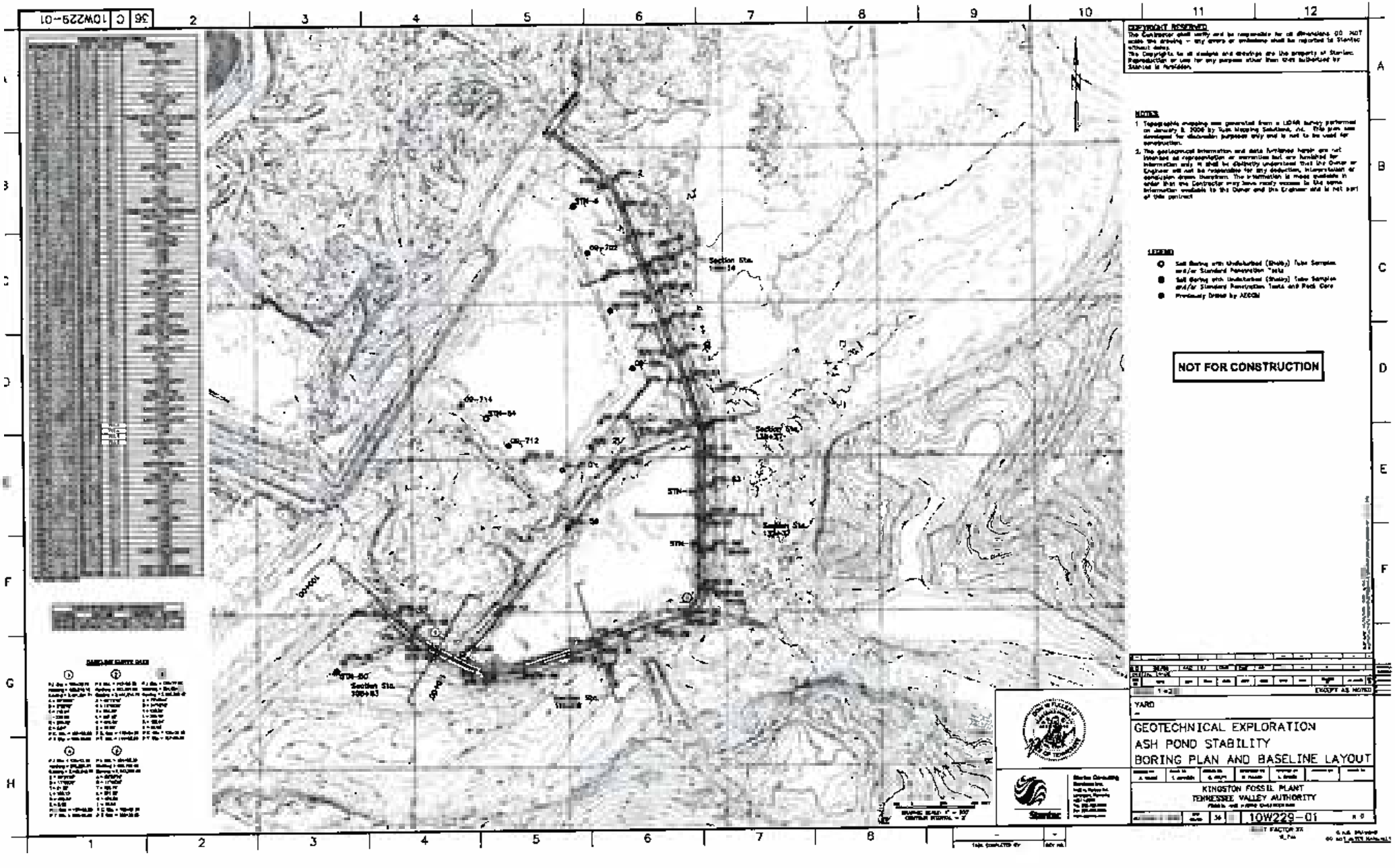
A gradient of approximately 56.3 was used for this test. This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration. Examination of the sample shows no signs of material loss or clogging that may affect test results.

Average Hydraulic Conductivity @ 20°C (last 4 determinations) m/s 2.24E-09 cm/s 2.24E-07
Average Hydraulic Conductivity @ 20°C (last run) m/s 2.24E-09 cm/s 2.24E-07

Reviewed by:

Appendix F

Boring Layout, Stability Sections, Profile Sheets and Logs of Borings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STN-64
STN-80
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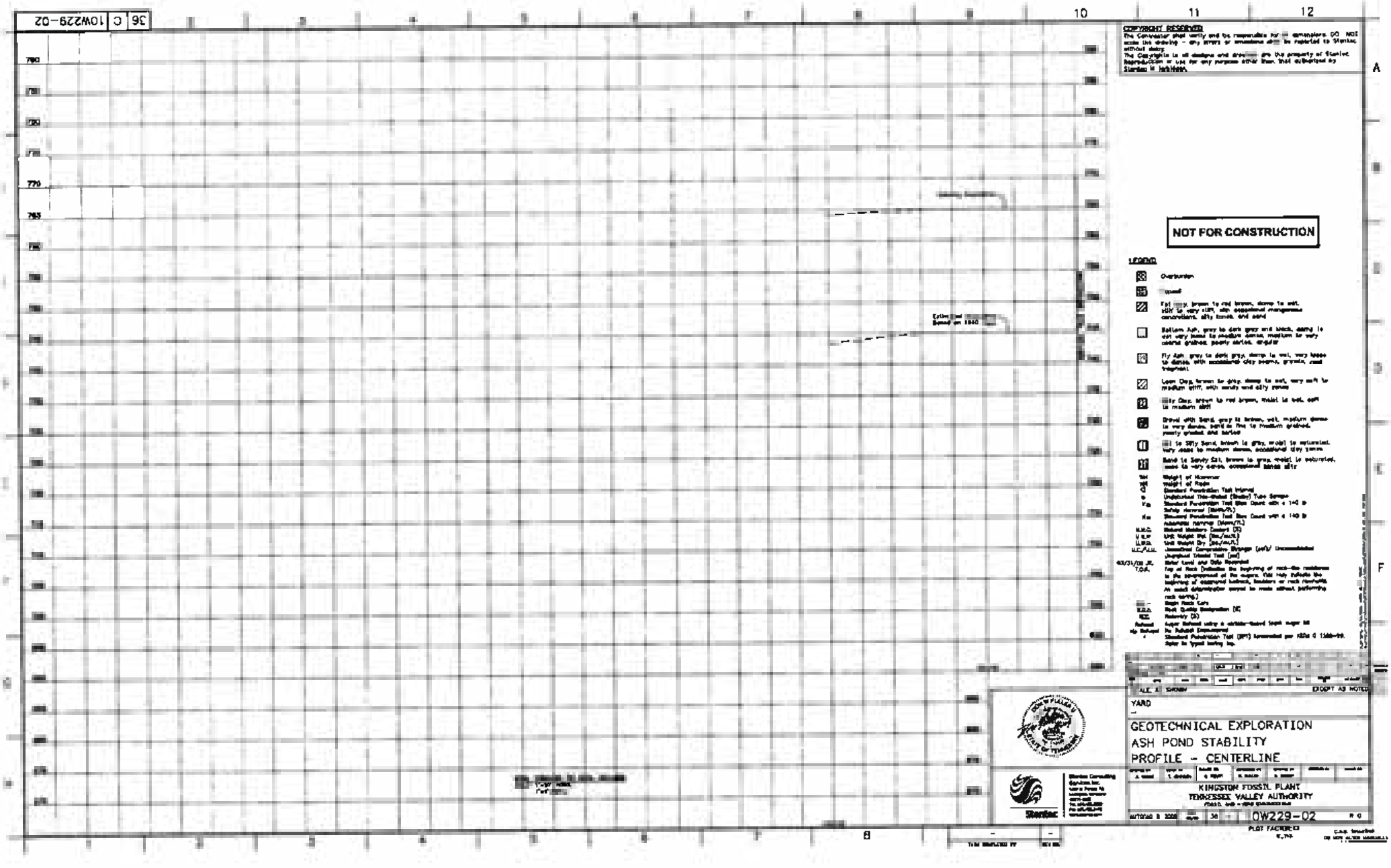
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ASH POND STABILITY
PROFILE - CENTERLINE
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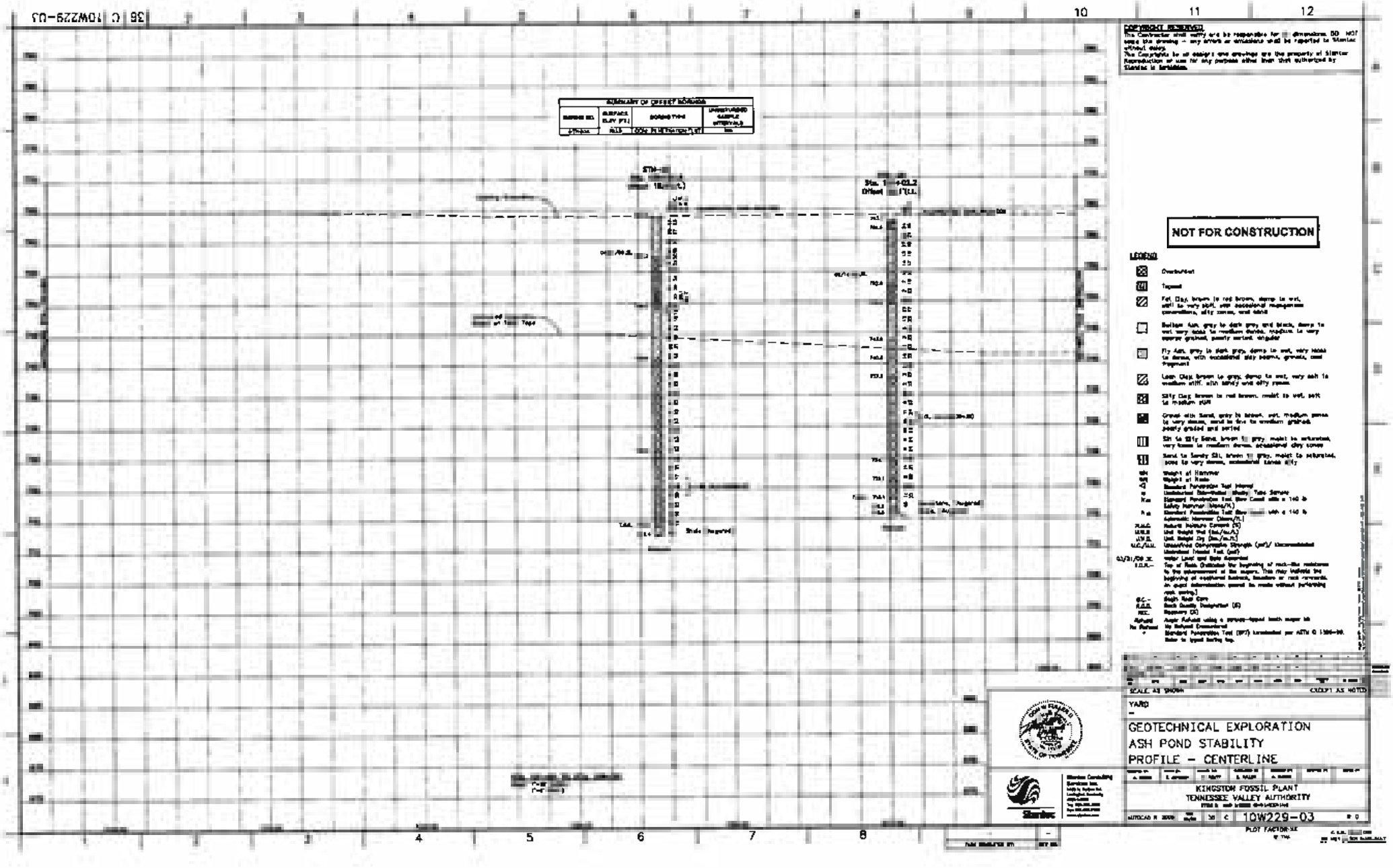
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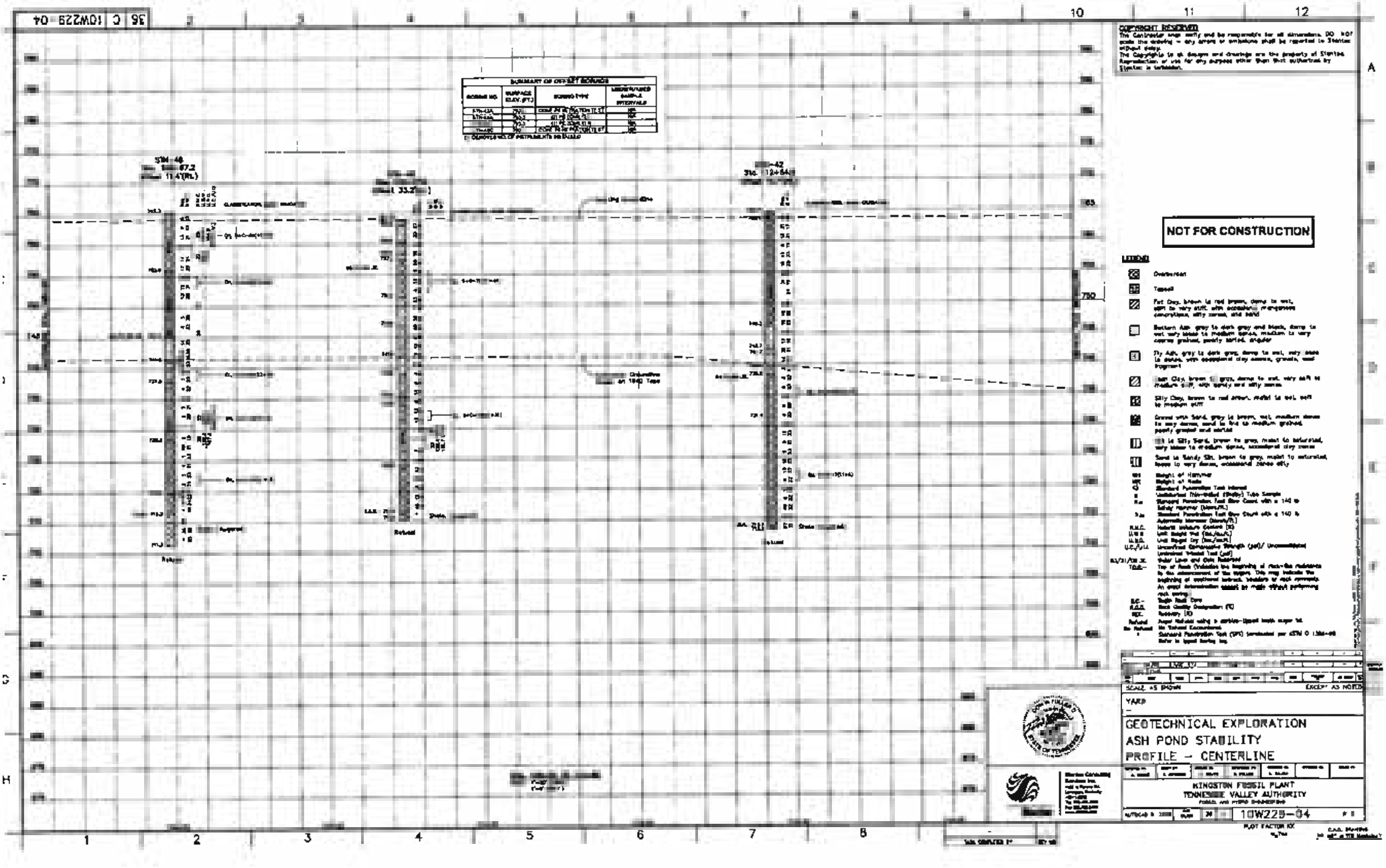
ASH POND STABILITY
PROFILE - CENTERLINE
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W229-03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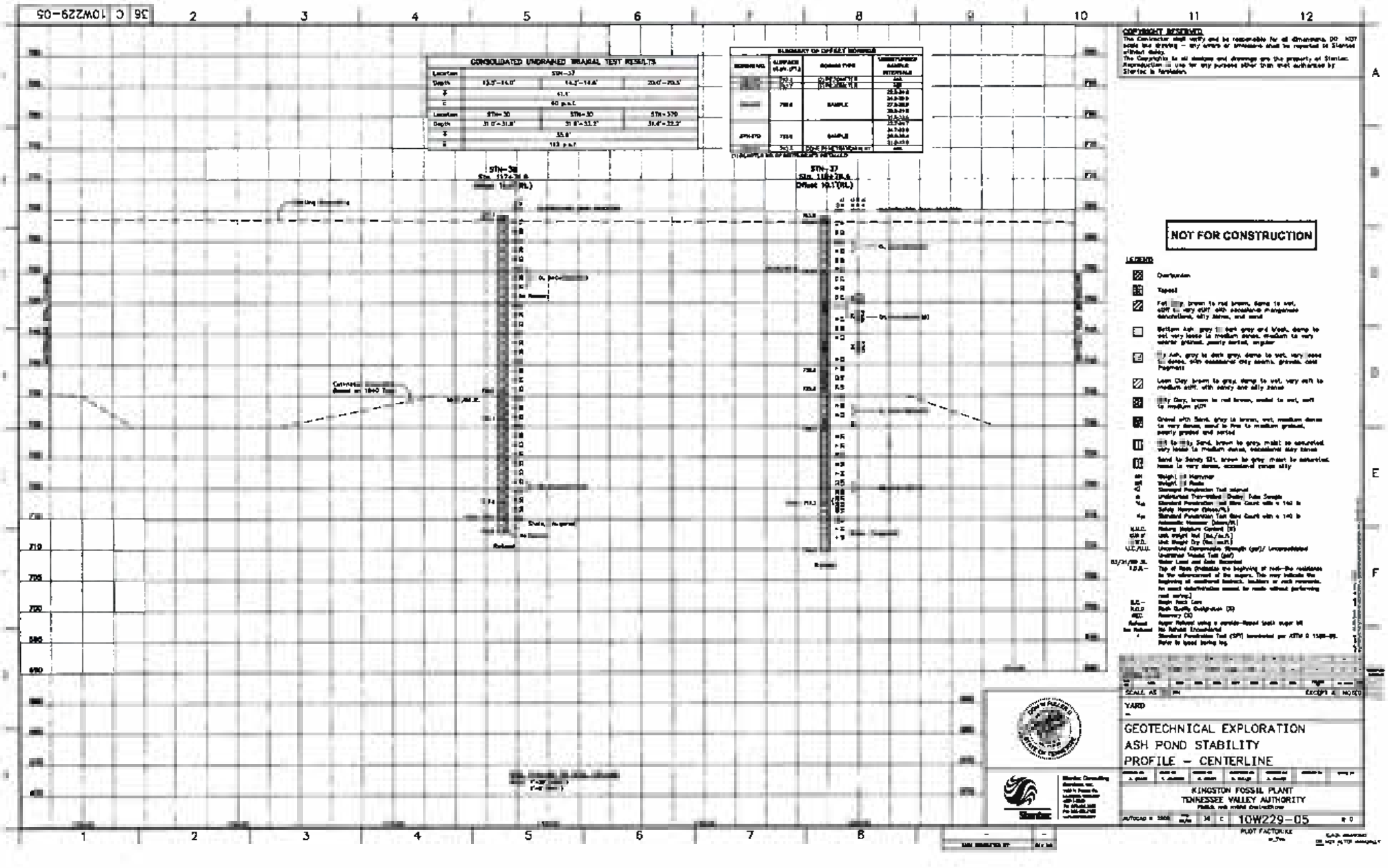
NOT FOR CONSTRUCTION
LEGEND
SCALE: AS SHOWN
EXCEPT AS NOTED
YARD
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE - CENTERLINE
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W229-04


CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS
SUMMARY OF OFFSET BOREHOLE
STN-38
STN-37
NOT FOR CONSTRUCTION
LEGEND
Overburden
Topsoil
Ash
Clay
Sand
Gravel
Rock
Weight (d) Hammer
Standard Penetration Test (blows)
Unconfined Compressive Strength (psf)
Water Level and Date Recorded
Top of Rock (indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock removals. No exact determination cannot be made without performing rock coring.)
Bore Hole Camera
Rock Quality Designation (%)
Recovery (%)
Auger Refusal using a carbide-tipped tooth auger bit
No Refusal Encountered
Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer to boad boring log.
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ASH POND STABILITY
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NOT FOR CONSTRUCTION

SUMMARY OF OFFSET BORINGS

BORING NO.	SURFACE ELEV. (FT.)	BORING TYPE	UNDISTURBED SAMPLE INTERVALS
	ft	CORE PENETRATION TEST	NA

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

Location	STN-31	STN-33	STN-34
Depth	33.8'–34.1'	50.0'–50.8'	33.8'–34.1'
ϕ'	32.6°		
c'	345 p.s.f.		

STN-34
Sta. 1214+66.8
Offset

STN-33
Sta. 1253+71.0
Offset 2.2'(Rt.)

Existing Groundline

Estimated Groundline Based on 1940 Topo

MAINTENANCE ROAD STA 1274+40

Shale, (Weathered)

Shale, (Augered)

Refusal

STA 1214+40 TO STA 1274+40

LEGEND

- Overburden
- Topsoil
- Fat Clay, brown to red brown, damp to wet, stiff to very stiff, with occasional manganese concretions, silty zones, and sand.
- Bottom Ash, gray to dark gray and black, damp to wet very loose to medium dense, medium to very coarse gravel, poorly sorted, angular
- Fly Ash, gray to dark gray, damp to wet, very loose to dense, with occasional silty seams, granule size fragment
- Lean Clay, brown to gray, damp to wet, very soft to medium stiff, with sandy and silty seams
- Silty Clay, brown to red brown, moist to wet, soft to medium stiff
- Gravel with Sand, gray to brown, wet, medium dense to very dense, sand is fine to medium grained, poorly graded and rounded
- Silt to Silty Sand, brown to gray, moist to saturated, very loose to medium dense, occasional clay lenses
- Sand to Sandy Silt, brown to gray, moist to saturated, loose to very dense, occasional lenses silty
- Weight of Hammer
- Weight of Rods
- Standard Penetration Test Interval
- Undisturbed Thin-Walled (Shelby) Tube Sample
- Standard Penetration Test Blow Count with a 140 lb Safety Hammer (Sawyer)
- Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (Sawyer)
- Natural Moisture Content (%)
- Unit Weight Wet (lbs/cu.ft.)
- Unit Weight Dry (lbs/cu.ft.)
- Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
- Water Level and Date Recorded
- Top of Rock (indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock anomalies. For exact determination cannot be made without performing rock coring.)
- Rock Core
- Rock Quality Designation (%)
- Recovery (%)
- Auger Refusal using a conventional hand auger bit
- No Natural Encountered
- Standard Penetration Test (SPT) terminated per ASTM D 1586-08. Refer to typed boring log.

SCALE: AS SHOWN — EXCEPT AS NOTED

YARD

GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE – CENTERLINE

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY

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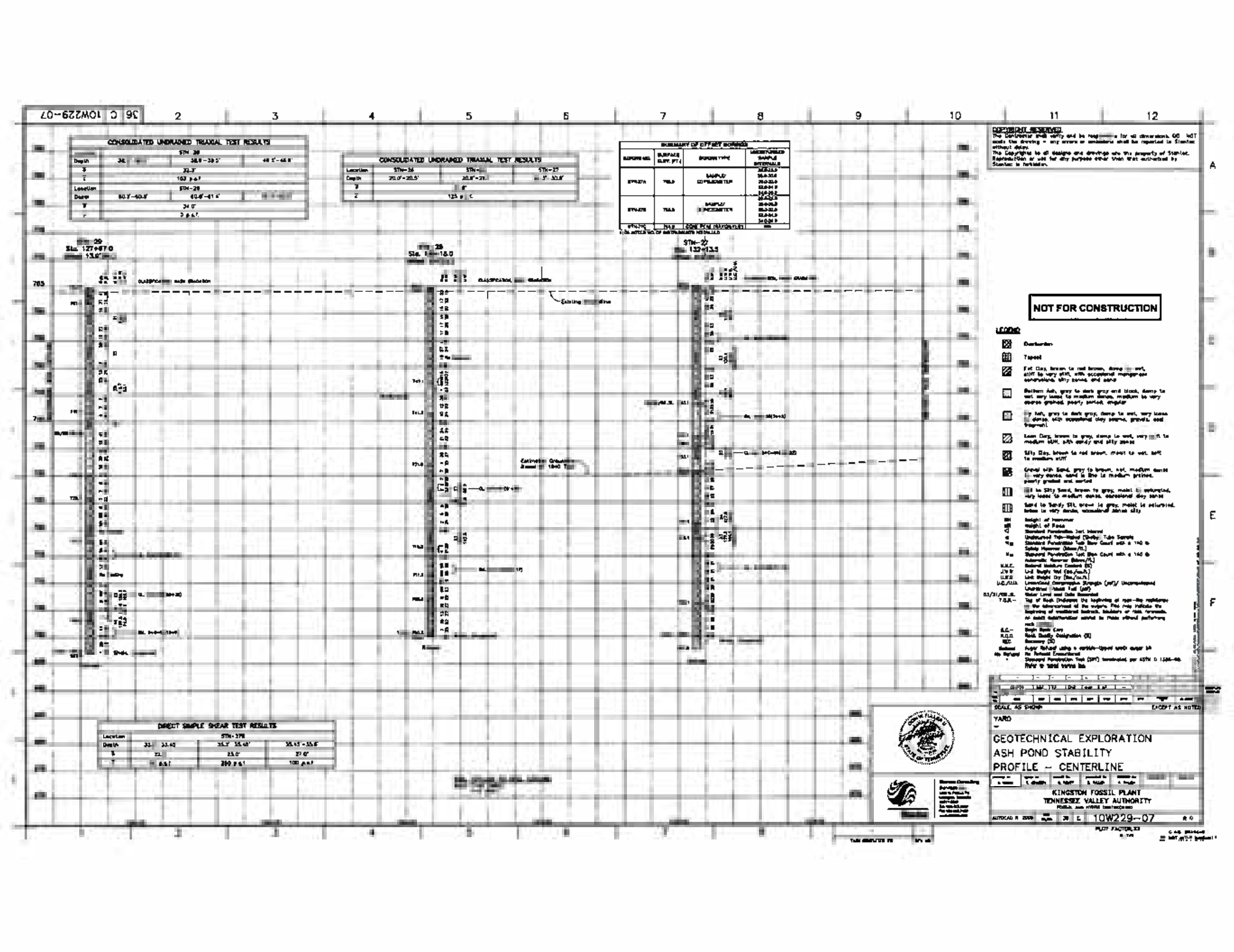
CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS
CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS
SUMMARY OF DRILL BOREHOLES
NOT FOR CONSTRUCTION
LEGEND
DIRECT SIMPLE SHEAR TEST RESULTS
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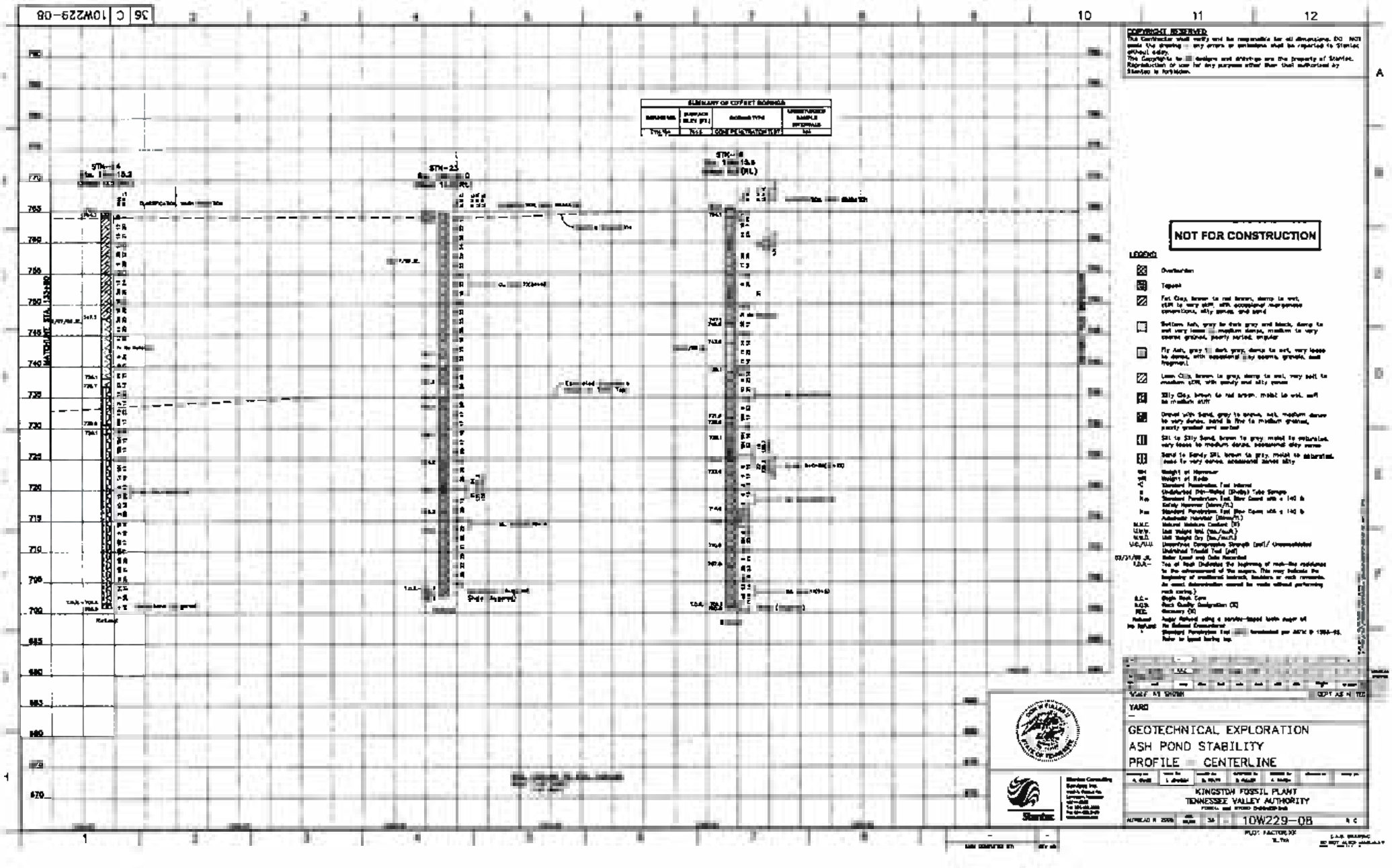
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE – CENTERLINE
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W229-07



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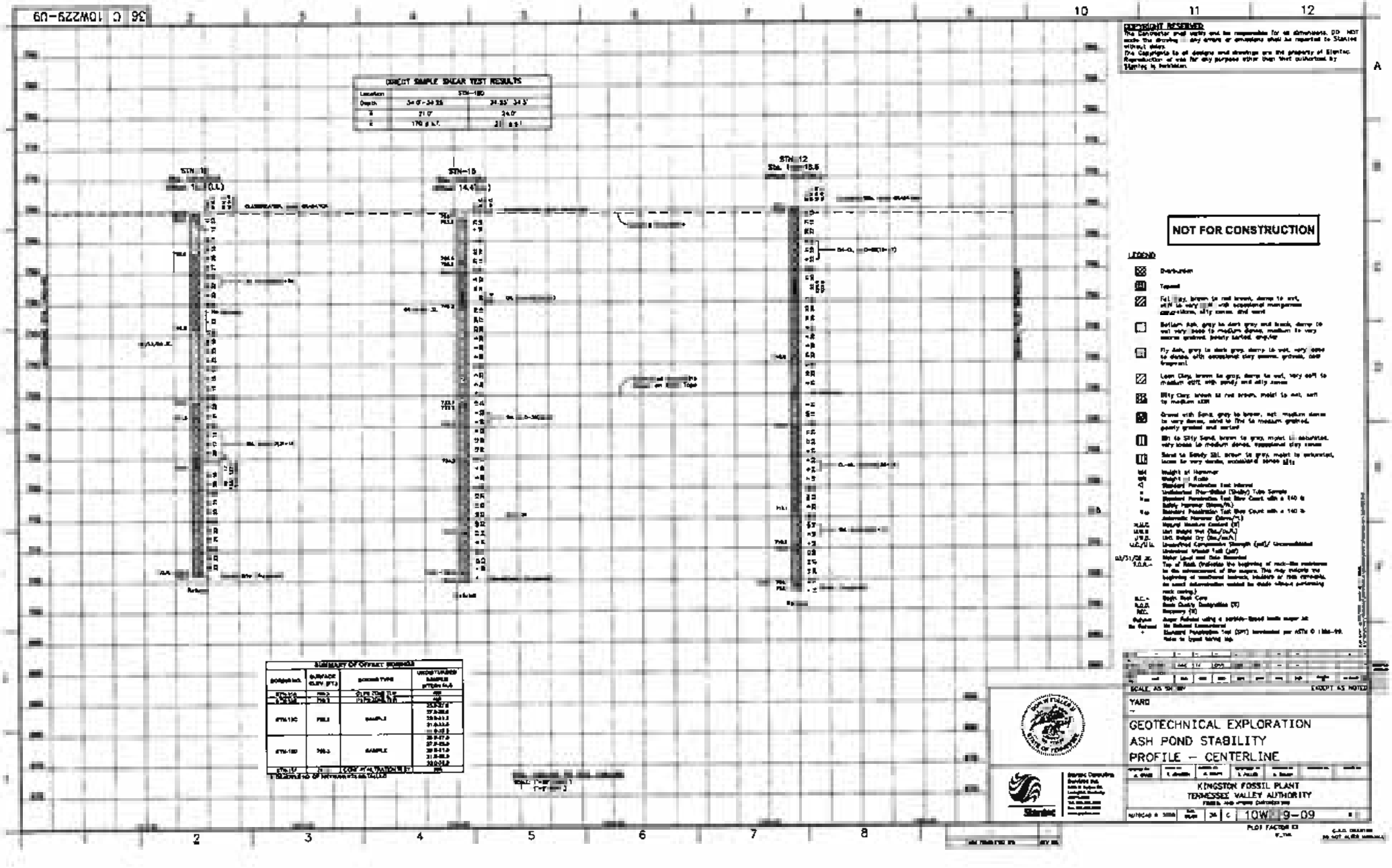
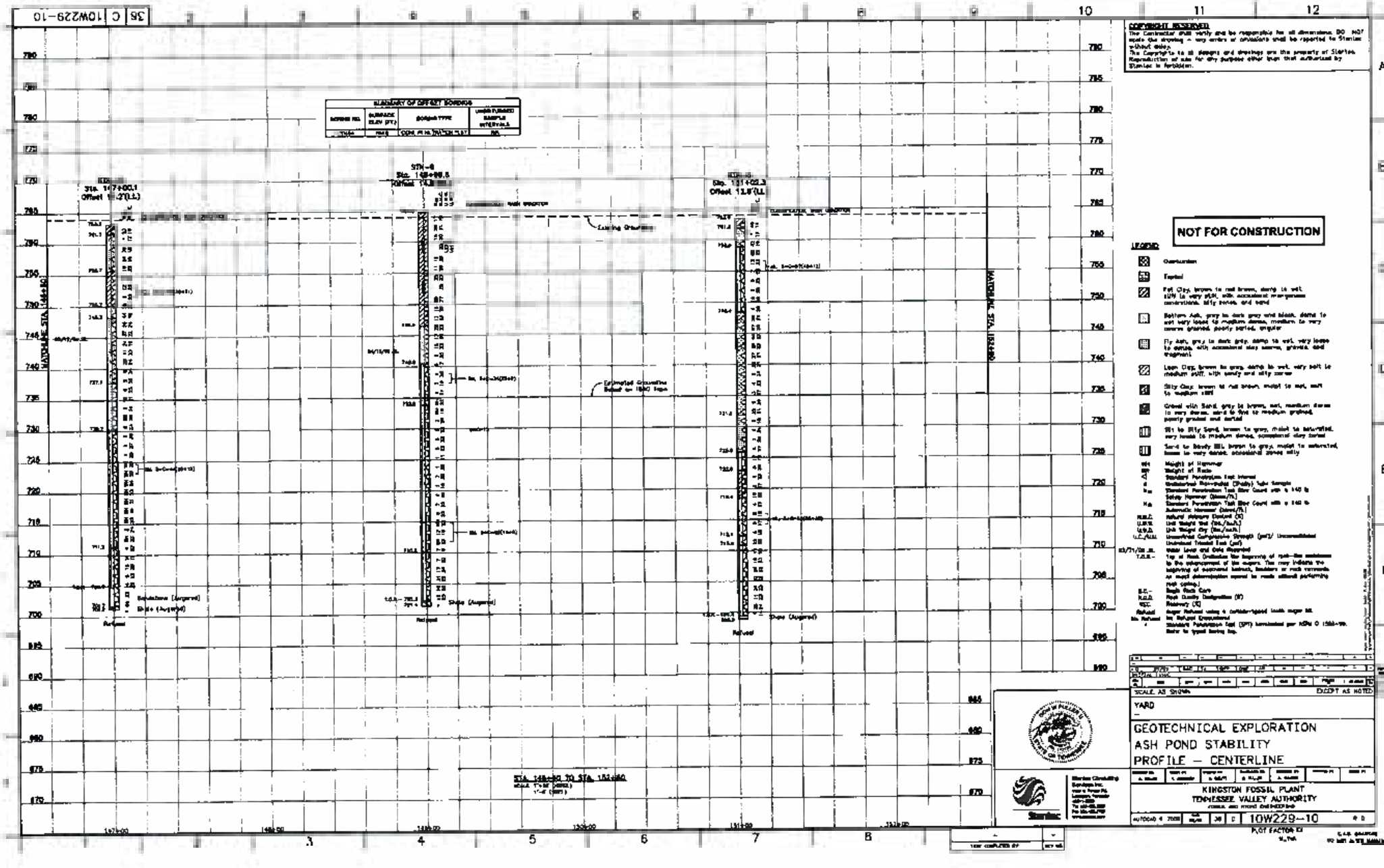
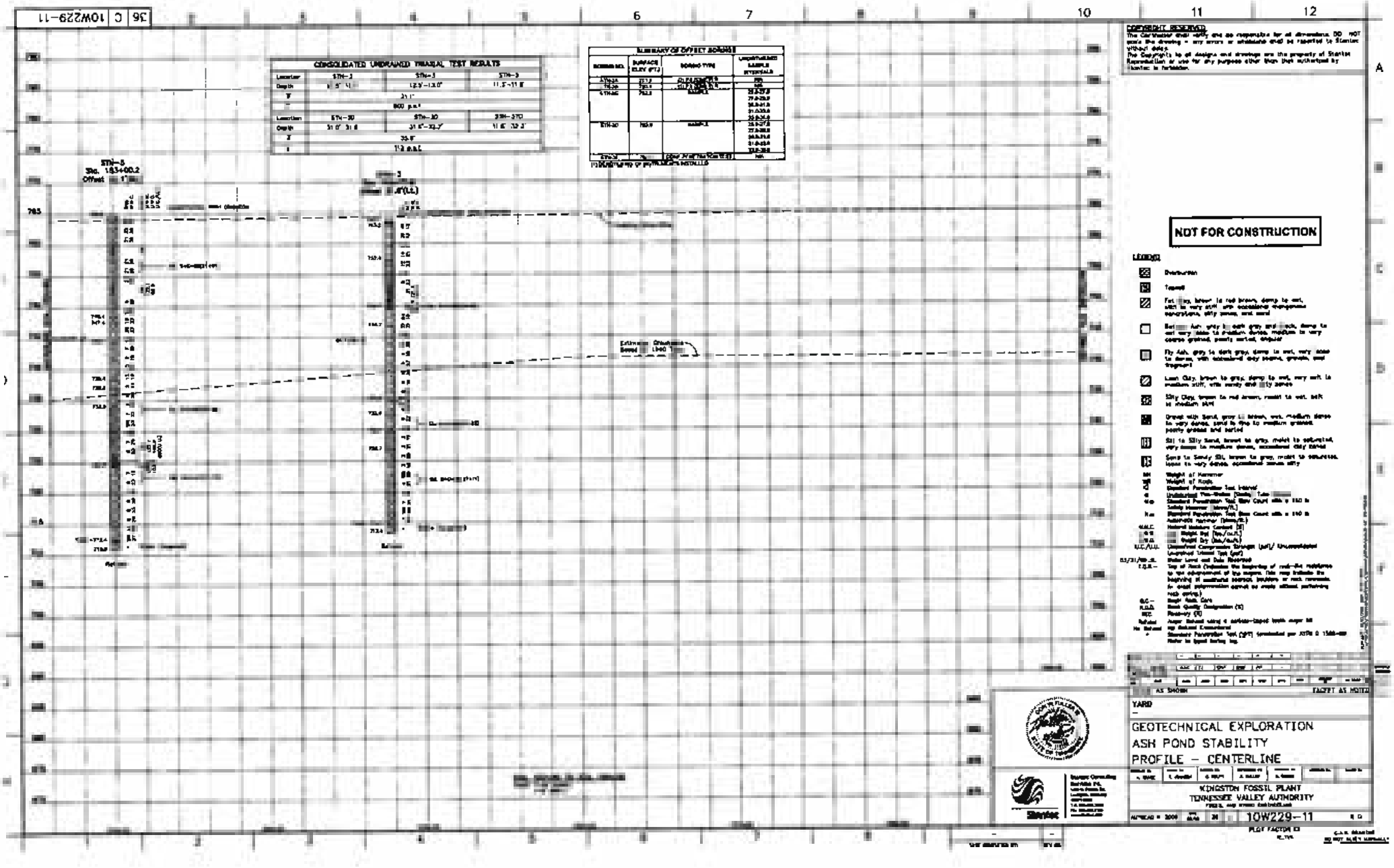
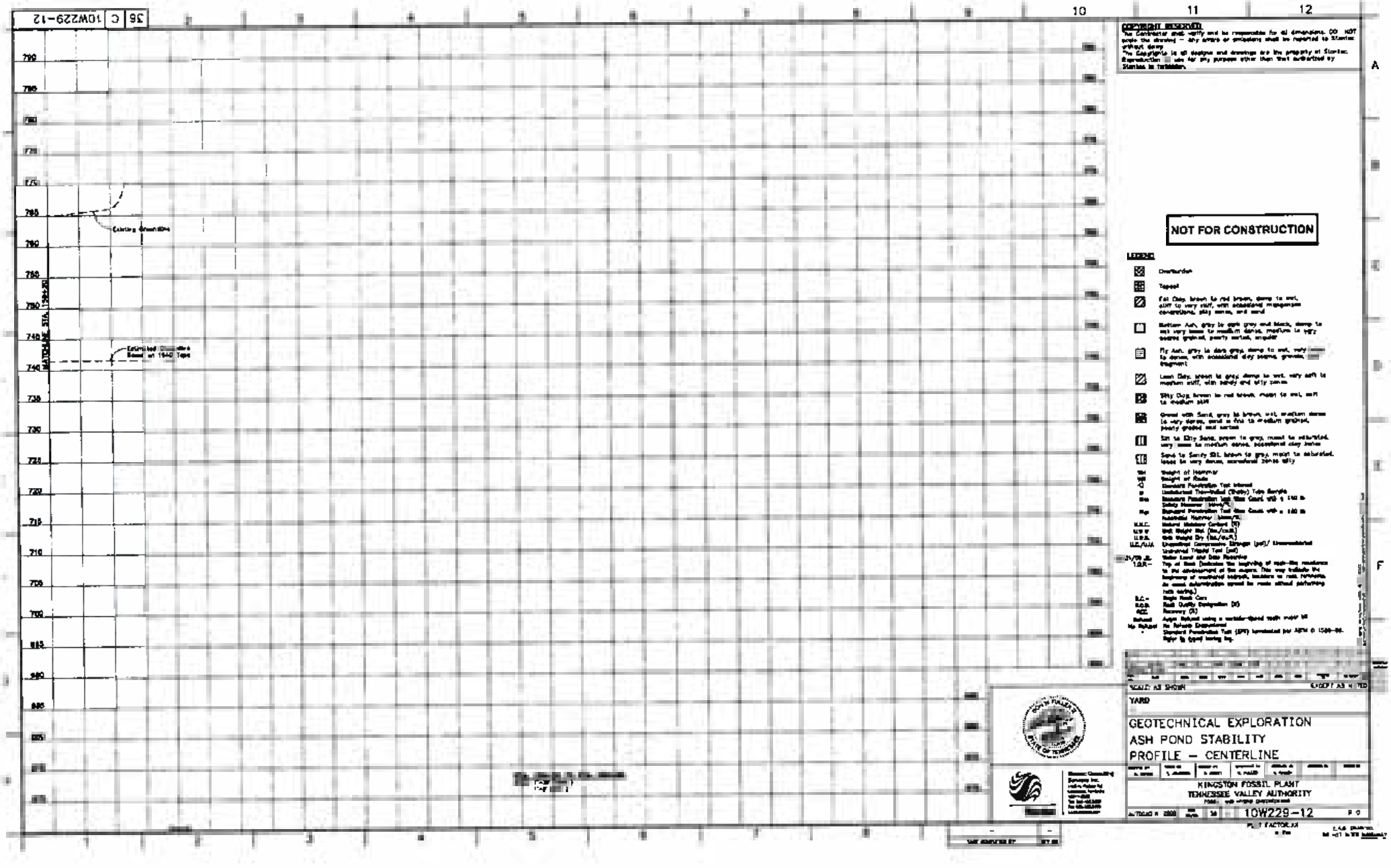

DIRECT SIMPLE SHEAR TEST RESULTS
STN-15D
NOT FOR CONSTRUCTION
LEGEND
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE – CENTERLINE
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W729-09


SUMMARY OF OFFSET BORINGS
NOT FOR CONSTRUCTION
LEGEND:
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE – CENTERLINE
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W229-10
YARD
SCALE: AS SHOWN
EXCEPT AS NOTED


CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS
SUMMARY OF OFFSET BORINGS
NOT FOR CONSTRUCTION
LEGEND
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE - CENTERLINE
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W229-11


10W229-12
C
36
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NOT FOR CONSTRUCTION
LEGEND
Overburden
Topsoil
Fat Clay, brown to red brown, damp to wet, stiff to very stiff, with occasional manganese concretions, silty seams, and sand
Bottom Ash, gray to dark gray and black, damp to wet very loose to medium dense, medium to very coarse grained, poorly sorted, angular
Fly Ash, gray to dark gray, damp to wet, very loose to dense, with occasional clay seams, granular, fragment
Lean Clay, brown to gray, damp to wet, very soft to medium stiff, with sandy and silty zones
Silty Clay, brown to red brown, moist to wet, soft to medium stiff
Gravel with Sand, gray to brown, wet, medium dense to very dense, sand is fine to medium grained, poorly graded and sorted
Silt to Silty Sand, brown to gray, moist to saturated, very loose to medium dense, occasional clay zones
Sand to Sandy Silt, brown to gray, moist to saturated, loose to very dense, occasional zones silty
Weight of Hammer
Weight of Rods
Standard Penetration Test Interval
Undisturbed Thin-Walled (Shelby) Tube Sample
Bulk Sample
Standard Penetration Test Split Spoon Sample with a 140 lb Safety Hammer (SPT)
Standard Penetration Test Split Spoon Sample with a 140 lb Automatic Hammer (SPT)
Natural Moisture Content (%)
Unit Weight Wet (lbs/cu.ft.)
Unit Weight Dry (lbs/cu.ft.)
Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
Water Level and Date Recorded
Top of Bank Indicates the beginning of each dike reference in the advancement of the report. This may indicate the beginning of weathered bedrock, boulders or rock formations. An exact determination cannot be made without performing rock coring.
Rock Core
Rock Quality Designation (%)
Recovery (%)
Auger Refusal using a center-bored rock auger bit
Air Rotary Encountered
Standard Penetration Test (SPT) terminated per ASTM D 1586-84. Refer to report boring log.
SCALE: AS SHOWN
YARD
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE – CENTERLINE
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W229-12
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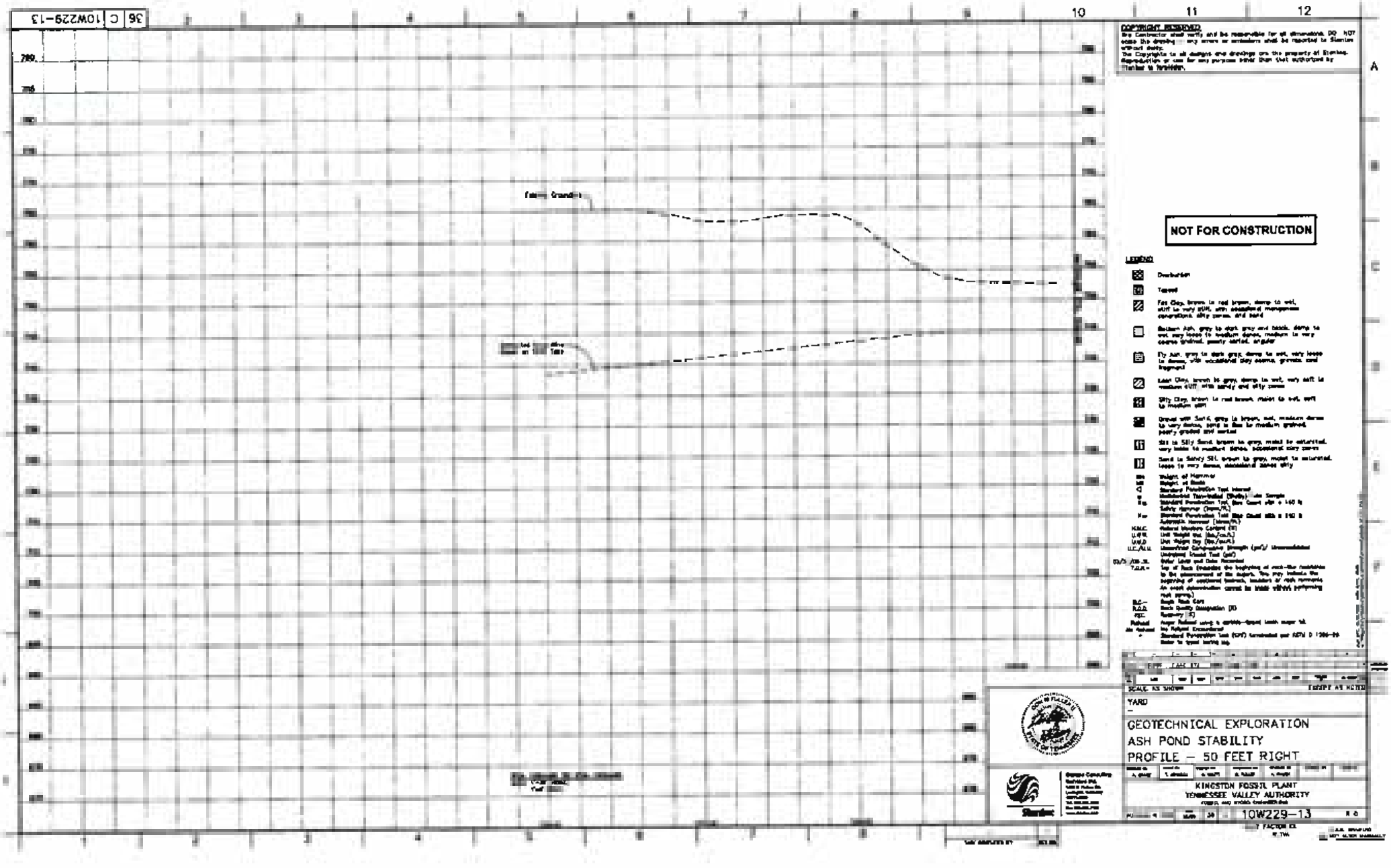
10W229-13
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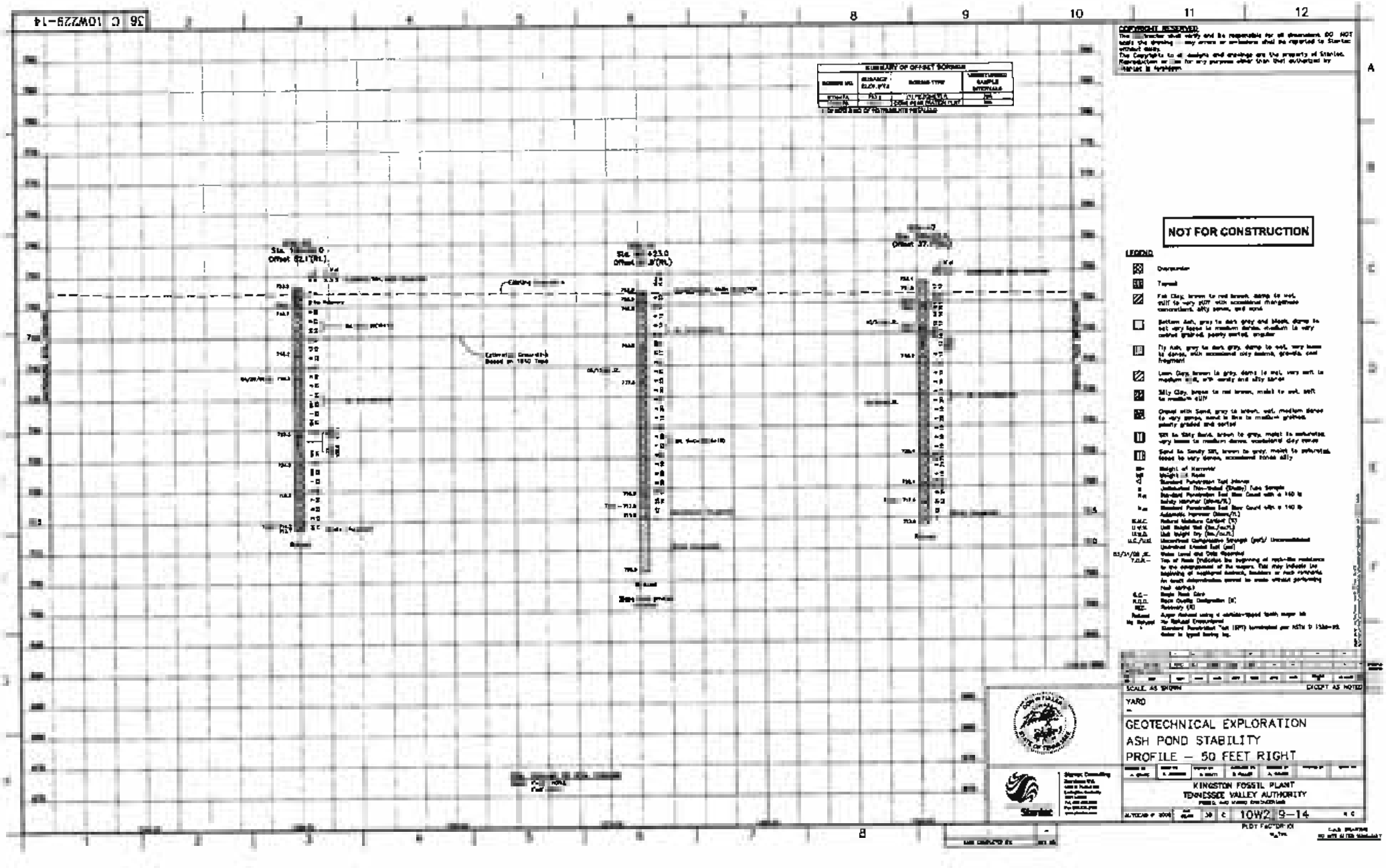
SCALE AS SHOWN
EXCEPT AS NOTED
YARD
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE – 50 FEET RIGHT
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W229-13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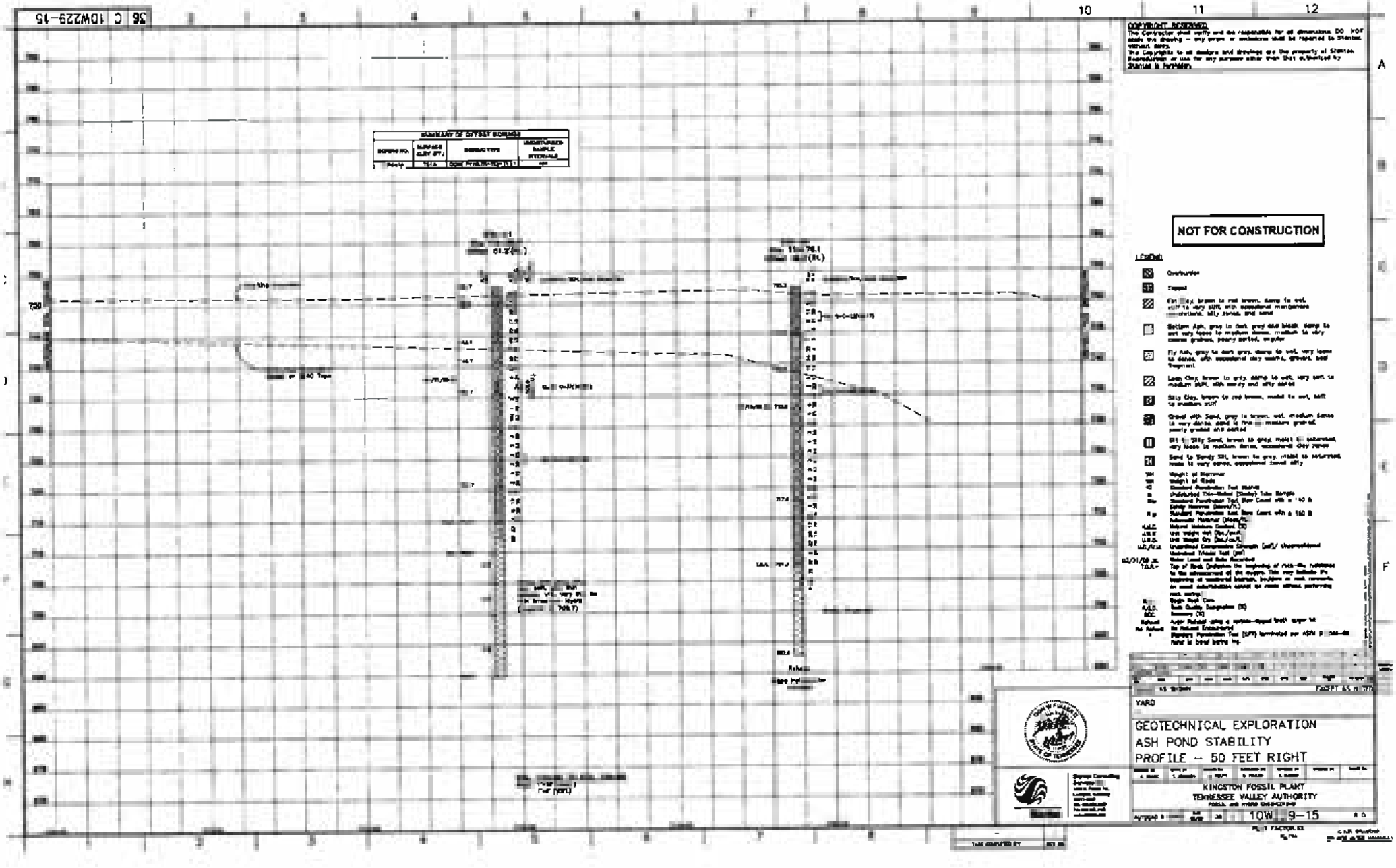
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE – 50 FEET RIGHT
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W2 9-14


SUMMARY OF DRIVEN BOREHOLES
NOT FOR CONSTRUCTION
LEGEND
Overburden
Topsoil
Clay
Bottom Ash
Fly Ash
Loam Clay
Silty Clay
Gravel with Sand
Silt to Silty Sand
Sand to Sandy Silt
Weight of Hammer
Weight of Rods
Standard Penetration Test Started
Undisturbed Thin-Walled Shelby Tube Sample
Standard Penetration Test Core Count with a 140 lb
Sandy Hammer (Core/ft)
Standard Penetration Test Core Count with a 140 lb
Hammer Material (Core/ft)
Natural Moisture Content (%)
Unit Weight Wet (lbs/cu.ft.)
Unit Weight Dry (lbs/cu.ft.)
Unconfined Compressive Strength (psf)/ Unconfined
Undrained Triaxial Test (psf)
Water Level and Date Recorded
Top of Rock Indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock removable by hand excavation tools or rocks without performing rock coring.
Single Rock Core
Rock Coring Completed (R)
Boreholes (B)
Auger Refusal using a carbide-tipped rock auger bit
Not Refusal Encountered
Standard Penetration Test (SPT) terminated per ASTM D 1586-84
Refer to boring below log
YARD
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE – 50 FEET RIGHT
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W 9-15
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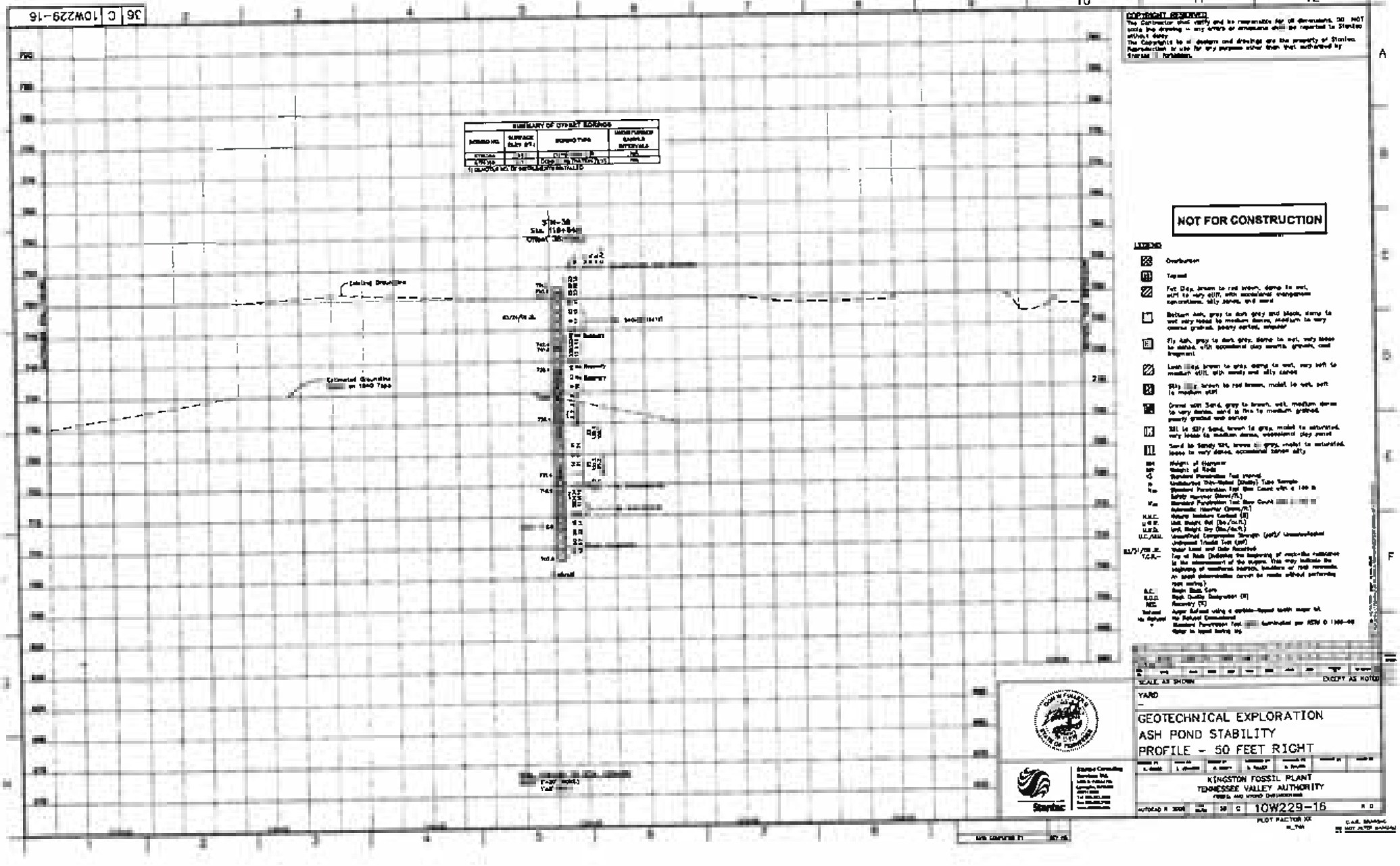
SUMMARY OF STREET BORINGS
STM-38
Existing Groundline
Estimated Groundline
NOT FOR CONSTRUCTION
LEGEND
Overburden
Topsoil
Fat Clay, brown to red brown, damp to wet, soft to very stiff, with occasional manganese concretions, silty zones, and sand
Bottom Ash, gray to dark gray and black, damp to wet very loose to medium dense, medium to very coarse grained, poorly sorted, angular
Fly Ash, gray to dark gray, damp to wet, very loose to medium, with occasional clay seams, gravel fragment
Lean Clay, brown to gray, damp to wet, very soft to medium stiff, with sandy and silty zones
Silt, brown to red brown, moist to wet, soft to medium stiff
Gravel with Sand, gray to brown, wet, medium dense to very dense, sand is fine to medium grained, poorly graded sand zones
Silt to Silty Sand, brown to gray, moist to saturated, very loose to medium dense, occasional clay zones
Sand to Sandy Silt, brown to gray, moist to saturated, loose to very dense, occasional laminar silty
Weight of Hammer
Weight of Rods
Standard Penetration Test Blow Count with a 140 lb Safety Hammer Blows/ft.)
Standard Penetration Test Blow Count
Automatic Hammer Blows/ft)
Moisture Moisture Content (%)
Liquid Limit (%)
Plastic Limit (%)
Unit Weight Wet (lbs/cu.ft.)
Unit Weight Dry (lbs/cu.ft.)
Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
Water Level and Date Recorded
Top of Rock (Indicating the beginning of rock-like resistance to the advancement of the augers, this may indicate the beginning of weathered bedrock, boulders or rock removals. An exact determination cannot be made without performing rock coring.)
Rock Core Run
Rock Quality Designation (RQD)
Recovery (%)
Auger Refusal using a carbide-tipped tooth auger bit.
No Refusal Encountered
Standard Penetration Test Refusal per ASTM D 1586-99
Refusal to Rotary Boring
SCALE: AS SHOWN
EXCEPT AS NOTED
YARD
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE - 50 FEET RIGHT
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W229-16
PLOT FACTOR XX
36 C 10W229-16

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NOT FOR CONSTRUCTION

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

Specimen	STH-37	STH-32	STH-36
Depth	33.5' – 34.1'	50.0' – 50.5'	33.8' – 34.1'
ϕ	33.6°		
c	345 psf		

SUMMARY OF OFFSET BORINGS

BORING NO.	SURFACE ELEV. (FT.)	BORING TYPE	GROUNDWATER SAMPLE INTERVALS
STH-37	748.7	Core & Hollow Stem Auger	N/A

LEGEND

- Embankment
- Topsoil
- Fill: Clay, brown to red brown, damp to wet, stiff to very stiff, with occasional manganese concretions, silty zones, and sand
- Bottom Ash: gray to dark gray and black, damp to wet, very loose to medium dense, medium to very coarse grained, poorly sorted, angular
- Fly Ash: gray to dark gray, damp to wet, very loose to dense, with occasional clay seams, granular and fragment
- Loam: Clay, brown to gray, damp to wet, very soft to medium stiff, with sandy and silty seams
- Silty Clay: brown to red brown, moist to wet, soft to medium stiff
- Gravel with Sand: gray to brown, wet, medium dense to very dense, sand is fine to medium grained, poorly graded and sorted
- Silt to Silty Sand: brown to gray, moist to saturated, very loose to medium dense, occasional clay seams
- Sand to Sandy Silt: brown to gray, moist to saturated, loose to very dense, occasional dense silty
- Weight of Hammer
- Weight of Rods
- Standard Penetration Test Interval
- Undisturbed (Thin-Walled (Shelby) Tube Sample
- Standard Penetration Test Split Spoon Sample with a 140 lb Safety Hammer Dropping 30"
- Standard Penetration Test Split Spoon Sample with a 140 lb Automatic Hammer Dropping 30"
- Natural Moisture Content (%)
- Unit Weight Wet (lbs/cu.ft.)
- Unit Weight Dry (lbs/cu.ft.)
- Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
- Water Level and Date Recorded
- Top of Rock Indicates the beginning of rock-like resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock removable by auger advancement except by auger without performing rock coring.
- Begin Rock Core
- Rock Quality Designation (%)
- Recovery (%)
- Auger Refusal using a carbide-tipped tooth auger bit on Bedrock Encountered
- Standard Penetration Test (SPT) terminated per ASTM D 1586-99 Refer to Typed Boring Log.

SCALE: AS SHOWN — ERROR: AS NOTED

YARD

GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE – 50 FEET RIGHT

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY

AUTOCAD # 2000 — 36 — 10W229-17 — 0

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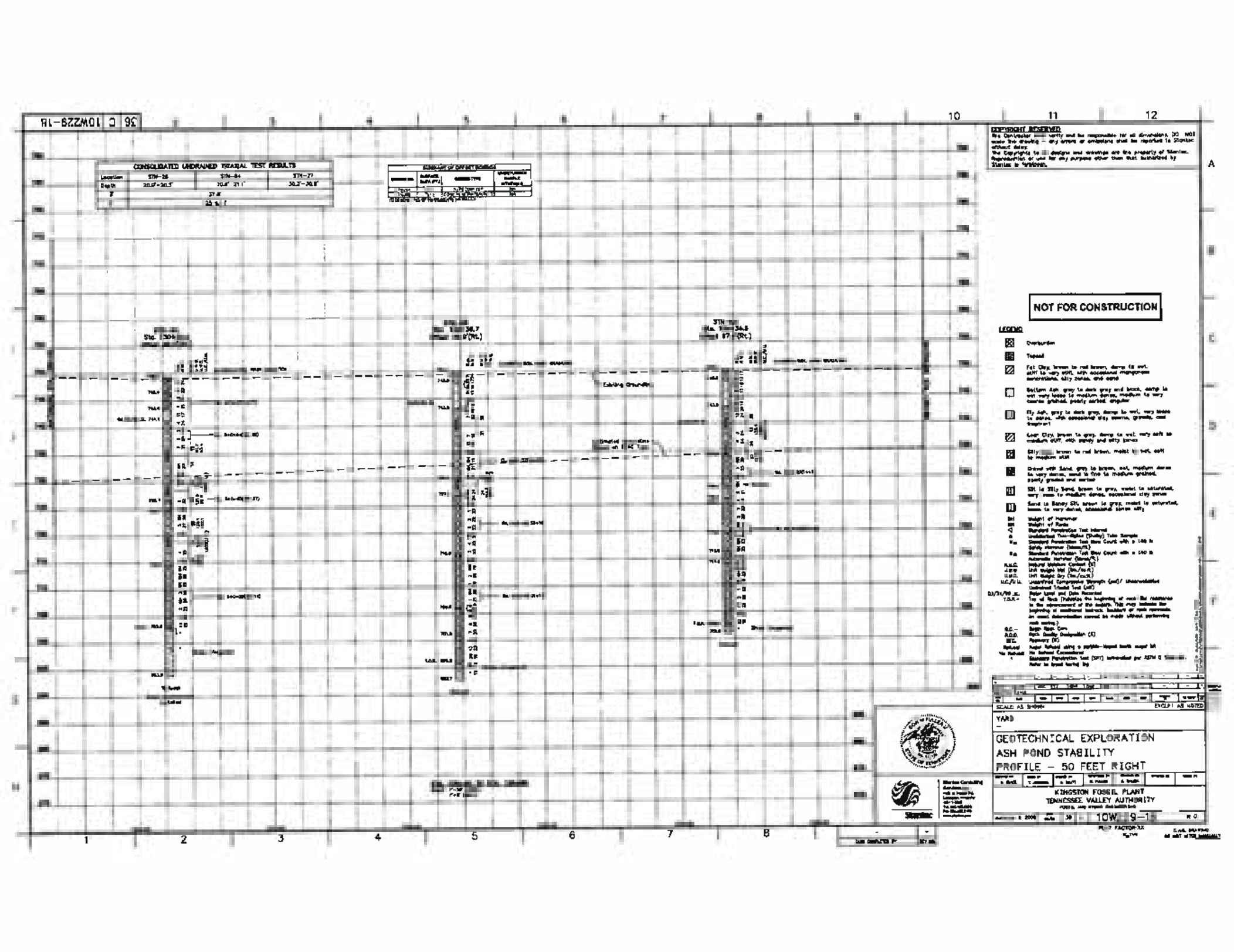
36 C 10W229-17


CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS
Location
STN-26
STN-84
STN-77
Depth
20.5'-30.5'
30.4'-31.1'
30.3'-30.8'
NOT FOR CONSTRUCTION
LEGEND
Overburden
Topsoil
Fat Clay, brown to red brown, damp to wet, stiff to very stiff, with occasional manganese concretions, silty zones, and sand
Bottom Ash gray to dark gray and black, damp to wet, very loose to medium dense, medium to very coarse grained, poorly sorted, angular
Fly Ash, gray to dark gray, damp to wet, very loose to dense, with occasional silt, coarse, gravelly, coal fragment
Lean Clay, brown to gray, damp to wet, very soft to medium stiff, with sandy and silty zones
Silty brown to red brown, moist to wet, soft to medium stiff
Gravel with Sand, gray to brown, wet, medium dense to very dense, sand is fine to medium grained, poorly graded and sorted
Silt, to Silty Sand, brown to gray, moist to saturated, very loose to medium dense, occasional clay zones
Sand to Sandy Silt, brown to gray, moist to saturated, loose to very dense, occasional zones silty
Weight of Hammer
Weight of Rods
Standard Penetration Test Interval
Undisturbed Thin-Walled (Shelby) Tube Sample
Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
Natural Moisture Content (%)
Liquid Limit (%)
Plastic Limit (%)
Unit Weight Wet (lbs/cu.ft.)
Unit Weight Dry (lbs/cu.ft.)
Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
Water Level and Date Recorded
Top of Rock (Indicates the beginning of rock for reference to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock removals. An exact determination cannot be made without performing rock coring.)
Auger Refusal using a 140lb. Hammer Safety Hammer (a) No Refusal Encountered
Standard Penetration Test (SPT) conducted per ASTM D
Refer to Typical Coring Log
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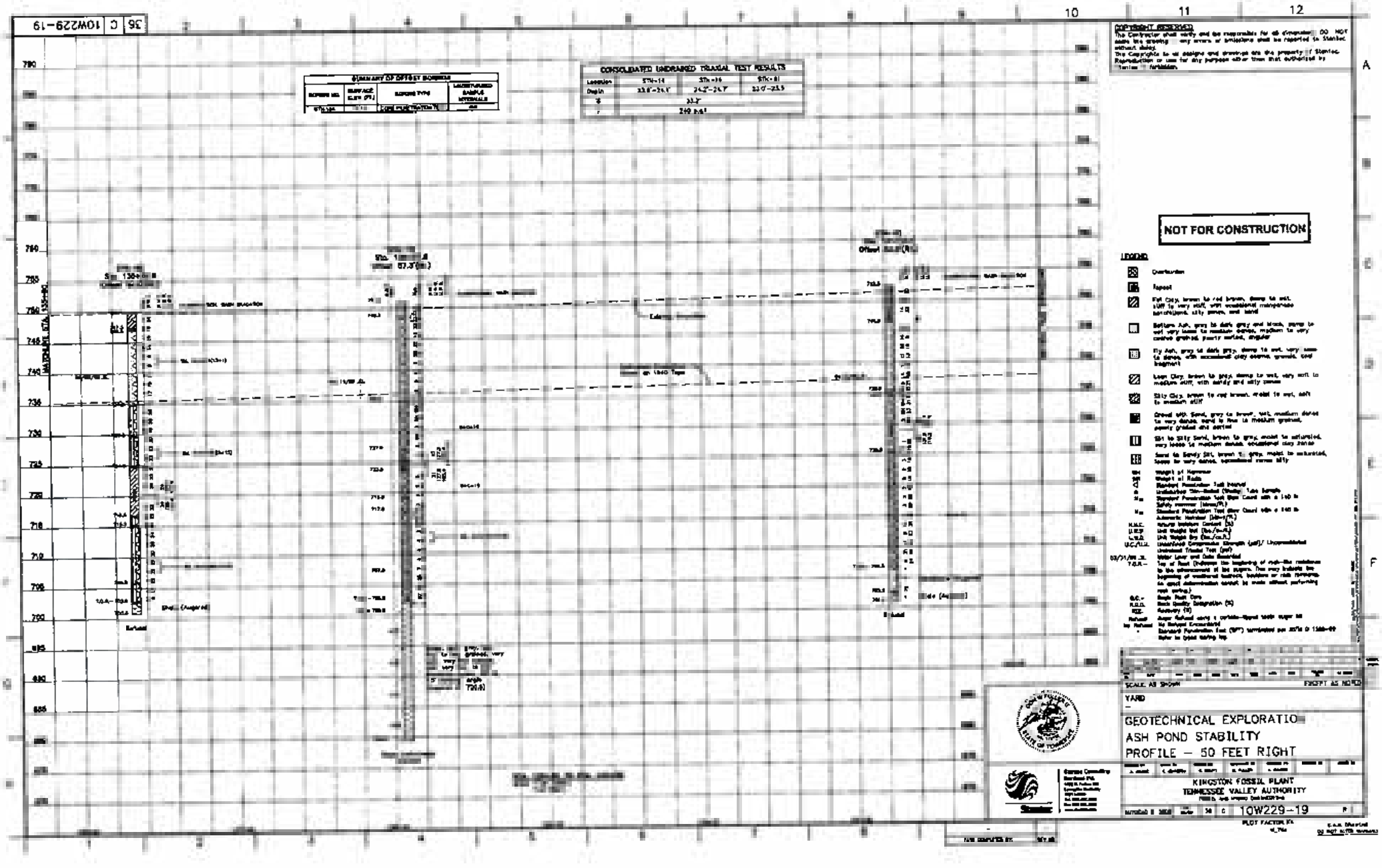
SCALE: AS SHOWN
PLOT FACTOR: N/A
YARD
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE - 50 FEET RIGHT
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W 9-1
Stantec


10W229-19
SUMMARY OF OFFSET BORINGS
CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS
NOT FOR CONSTRUCTION
LEGEND
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE – 50 FEET RIGHT
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W229-19

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NOT FOR CONSTRUCTION

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

Location	STH-14	STH-15	STH-41
Depth	23.8'-24.1'	24.2'-25.9'	23.1'-23.5'
ϕ	33.2°		
c	240 psf		

LEGEND

- Overburden
- Topsoil
- Fat Clay, brown to red brown, damp to wet, stiff to very stiff, with occasional manganese concretions, silty zones, and sand
- Bottom Ash, gray to dark gray and black, damp to wet very loose to medium dense, medium to very coarse grained, poorly sorted, angular
- Fly Ash, gray to dark gray, damp to wet, very loose to dense, with occasional clay seams, gravels, coal fragment
- Lean Clay, brown to gray, damp to wet, very soft to medium stiff, with sandy and silty zones
- Silty Clay, brown to red brown, moist to wet, soft to medium stiff
- Gravel with Sand, gray to brown, wet, medium dense to very dense, sand is fine to medium grained, poorly graded and sorted
- Silt to Silty Sand, brown to gray, moist to saturated, very loose to medium dense, occasional clay zones
- Sand to Sandy Silt, brown to gray, moist to saturated, loose to very dense, occasional zones silty

WOH = Weight of Hammer
WOR = Weight of Rods
SPT = Standard Penetration Test Interval
UTBS = Undisturbed Thin-Walled (Shelby) Tube Sample
SPT N = Standard Penetration Test Blow Count with a 140 lb Hammer
Density Potential (Dmax-%)
SPT N = Standard Penetration Test Blow Count with a 140 lb Hammer
Moisture Content (%)
Modified Moisture Content (%)
Unit Weight Wet (lbs/cu.ft.)
Unit Weight Dry (lbs/cu.ft.)
UCS/UU = Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
Water Level and Date Recorded
Top of Rock Indicates the beginning of rock--the resistance to the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock fragments. In most circumstances augers do cease without performing rock coring.
RC = Rock Core
RQD = Rock Quality Designation (%)
REC = Recovery (%)
Auger Refusal using a carbide-tipped tooth auger bit in the Natural Encountered
Standard Penetration Test (SPT) terminated per ASTM D 1586-84 after 50 blows having no

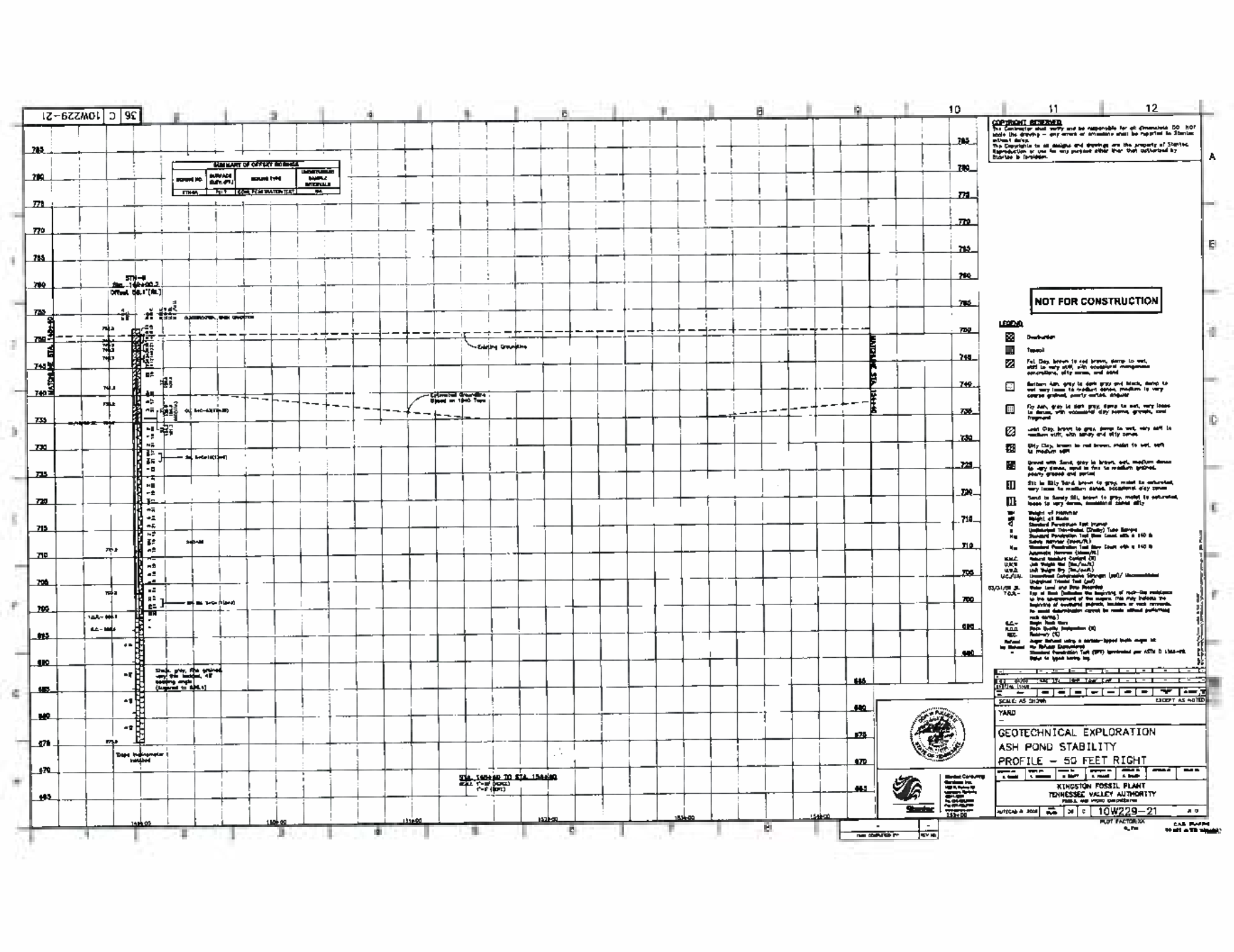
YARD

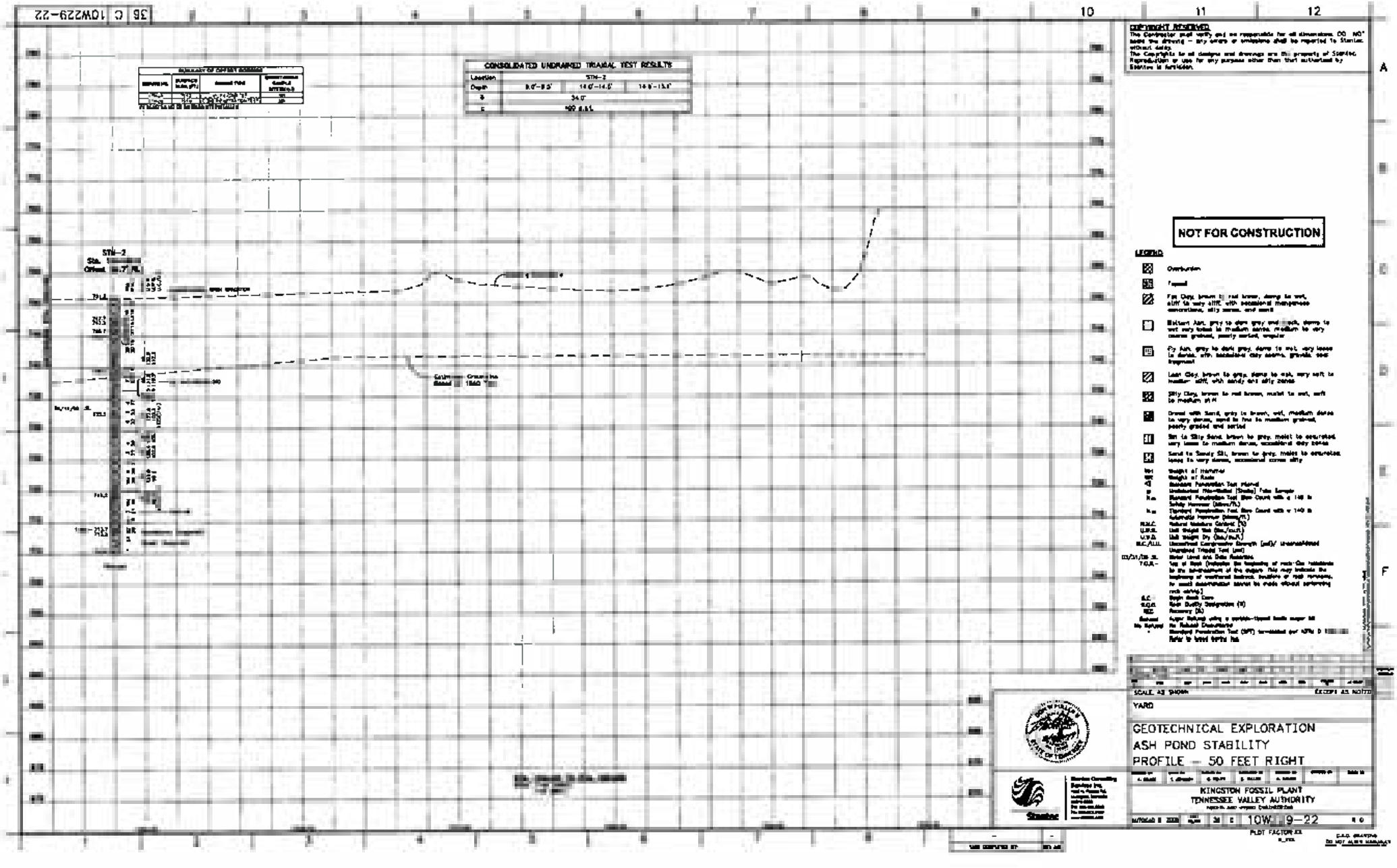
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE - 50 FEET RIGHT

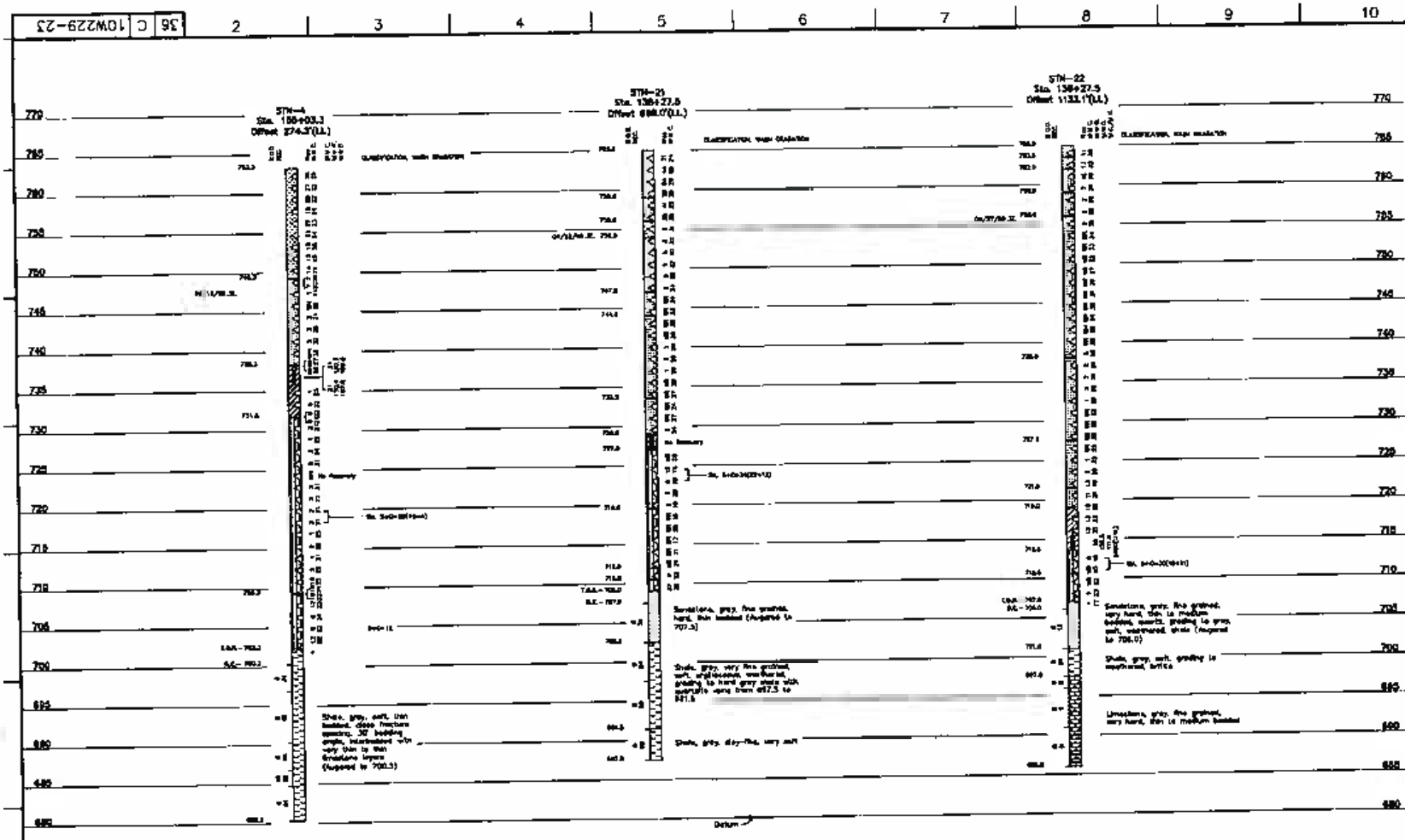
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY

10W229-20

PLOT FACTOR: 33


SUMMARY OF OFFSET BORINGS
NOT FOR CONSTRUCTION
LEGEND
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE – 50 FEET RIGHT
YARD
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W229-21
Existing Groundline
Estimated Groundline Based on 1940 Trend
Sta. 1484+00 TO STA. 1546+00


CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS
STN-2
NOT FOR CONSTRUCTION
LEGEND
Overburden
Topsoil
Fill: Clay, brown to red brown, damp to wet, stiff to very stiff, with occasional manganese concretions, silty zones, and sand
Bottom Ash: gray to dark gray and black, damp to wet, very loose to medium dense, medium to very coarse gravel, poorly sorted, angular
Fly Ash: gray to dark gray, damp to wet, very loose to dense, with occasional clay seams, granular and fragment
Lean Clay: brown to gray, damp to wet, very soft to medium stiff, with sandy and silty zones
Silty Clay: brown to red brown, moist to wet, soft to medium stiff
Gravel with Sand: gray to brown, wet, medium dense to very dense, sand is fine to medium grained, poorly graded and sorted
Silt to Silty Sand: brown to gray, moist to saturated, very loose to medium dense, occasional clay zones
Sand to Sandy Silt: brown to gray, moist to saturated, loose to very dense, occasional coarse silty
SCALE AS SHOWN
EXCEPT AS NOTED
YARD
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
PROFILE – 50 FEET RIGHT
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W 9-22
PILOT FACTOR EX
DO NOT ALTER MARGINS
10W229-22 C 36



LOGS OF BORINGS

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NOT FOR CONSTRUCTION

LEGEND

SCALE: AS SHOWN — CHECK AS NOTED

YARD

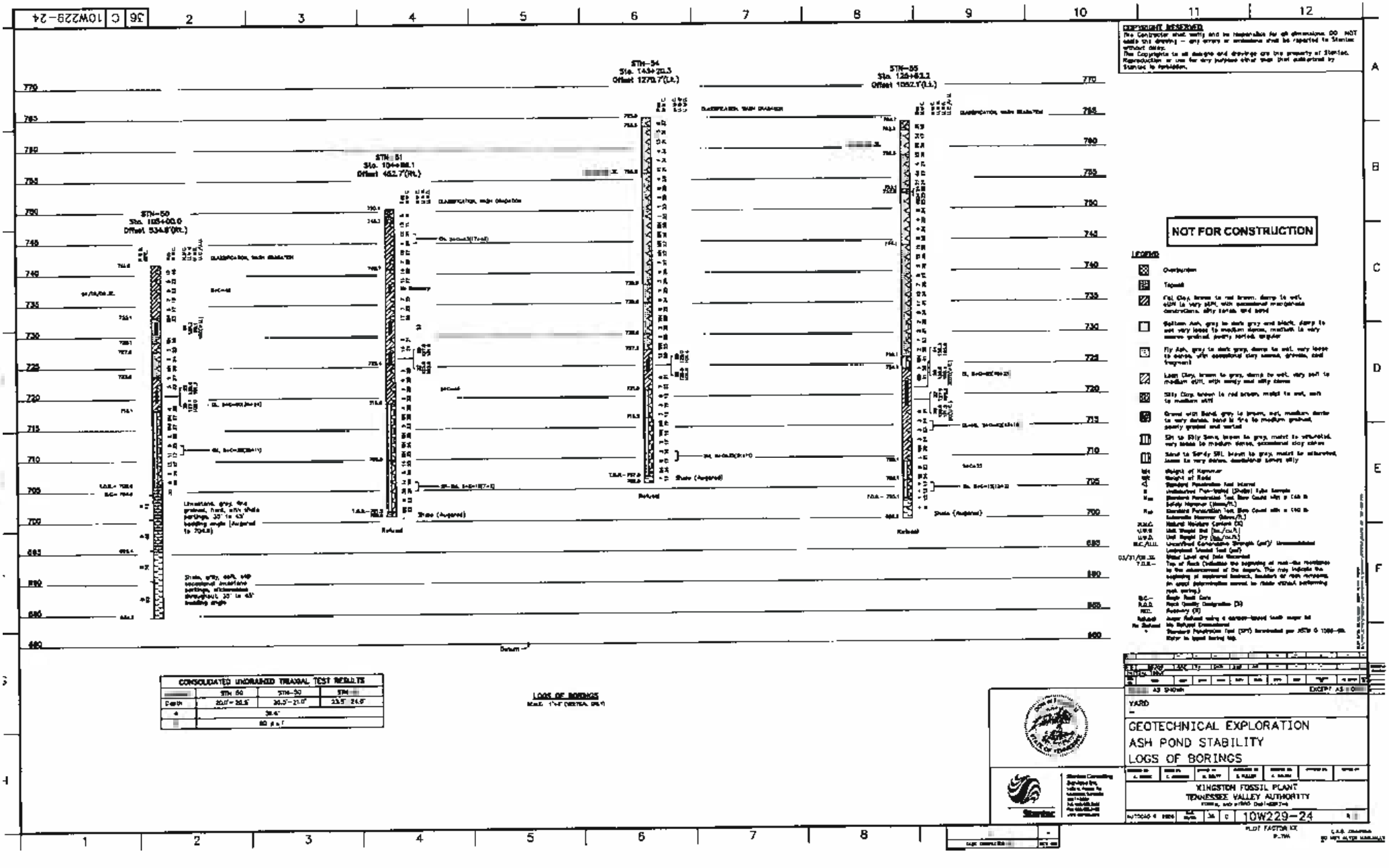
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
LOGS OF BORINGS

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY

10W229-23

PLOT FACTOR: 1.000

DO NOT ALTER WARRANTY



NOT FOR CONSTRUCTION

LEGEND

- Overburden
- Topsoil
- Fat Clay, brown to red brown, damp to wet, CH/MH in very stiff, with occasional manganese concretions, silty seams and pond
- Bottom Ash, gray to dark gray and black, damp to wet, very loose to medium dense, medium to very coarse gradded, poorly sorted, angular
- Fly Ash, gray to dark gray, damp to wet, very loose to dense, with occasional clay seams, gravels, coal fragments
- Lean Clay, brown to gray, damp to wet, very soft to medium stiff, with sandy and silty seams
- Silty Clay, brown to red brown, moist to wet, soft to medium stiff
- Gravel with Sand, gray to brown, wet, medium dense to very dense, sand is fine to medium grained, poorly graded and rounded
- Silt to Silty Sand, brown to gray, moist to saturated, very loose to medium dense, occasional clay seams
- Sand to Sandy Silt, brown to gray, moist to saturated, loose to very dense, occasional lenses silty

Weight of Hammer
Height of Rods
Standard Penetration Test Interval
Undisturbed Thin-Walled (Shelby) Tube Sample
Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
Natural Moisture Content (%)
Unit Weight Wet (lbs./cu.ft.)
Unit Weight Dry (lbs./cu.ft.)
Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
Water Level and Date Recorded
Top of Rock (indicates the beginning of rock--the roundness is the advancement of the augers. This may indicate the beginning of weathered bedrock, boulders or rock formations, or auger penetration refusal in rock(s) without performing rock coring.)
Rock Core
Rock Quality Designation (%)
Recovery (%)
Auger Refusal using a carbide-tipped tooth auger bit
No Refusal Encountered
Standard Penetration Test (SPT) terminated per ASTM D 1586-08. Refer to typed boring log.

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

	STN 50	STN-50	STN
Depth	20.0' - 22.5'	20.5' - 21.0'	23.5' - 24.5'
ϕ	38.4°		
	80 psf		

LOGS OF BORINGS

YARD

GEOTECHNICAL EXPLORATION
ASH POND STABILITY
LOGS OF BORINGS

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY

10W229-24

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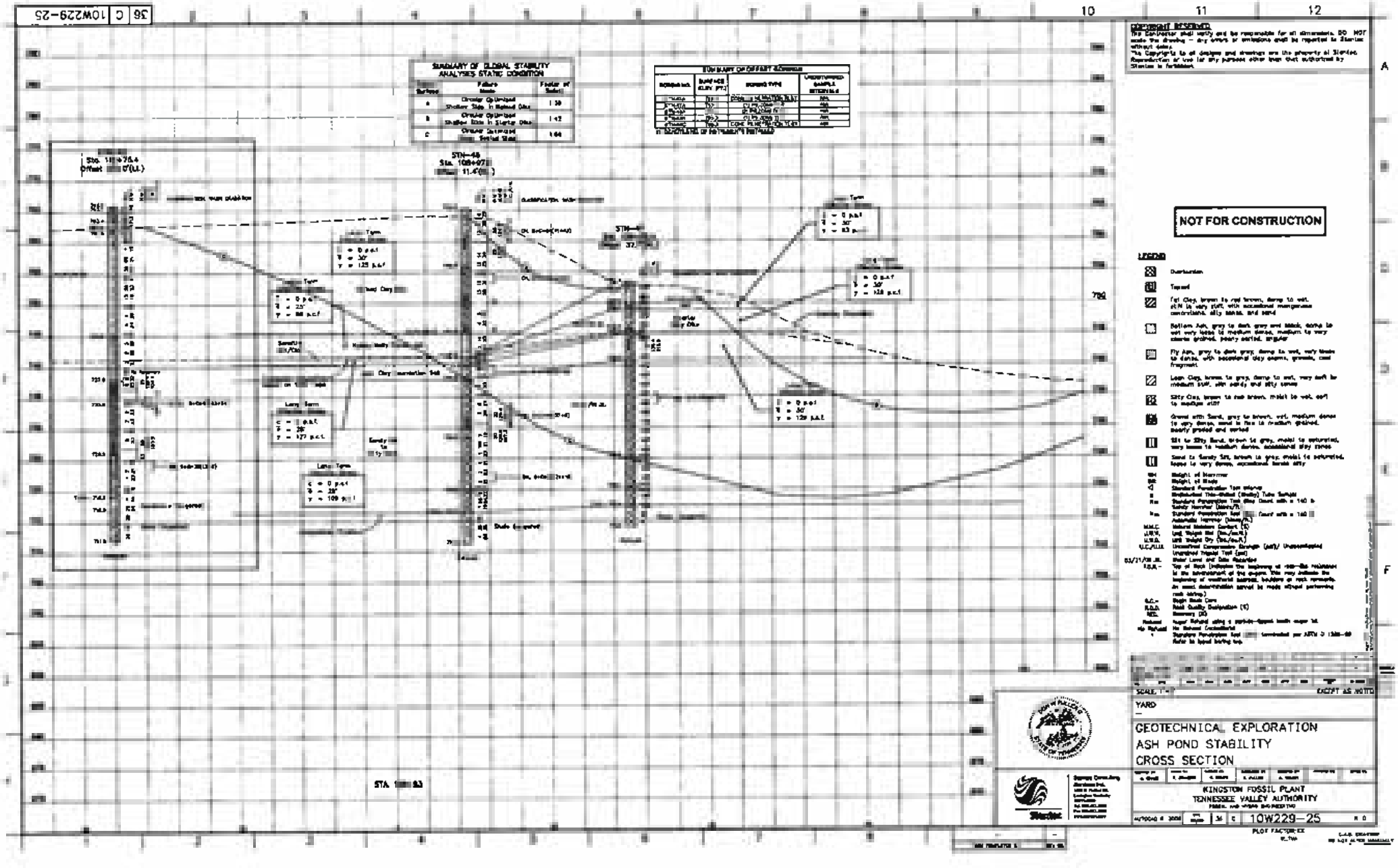
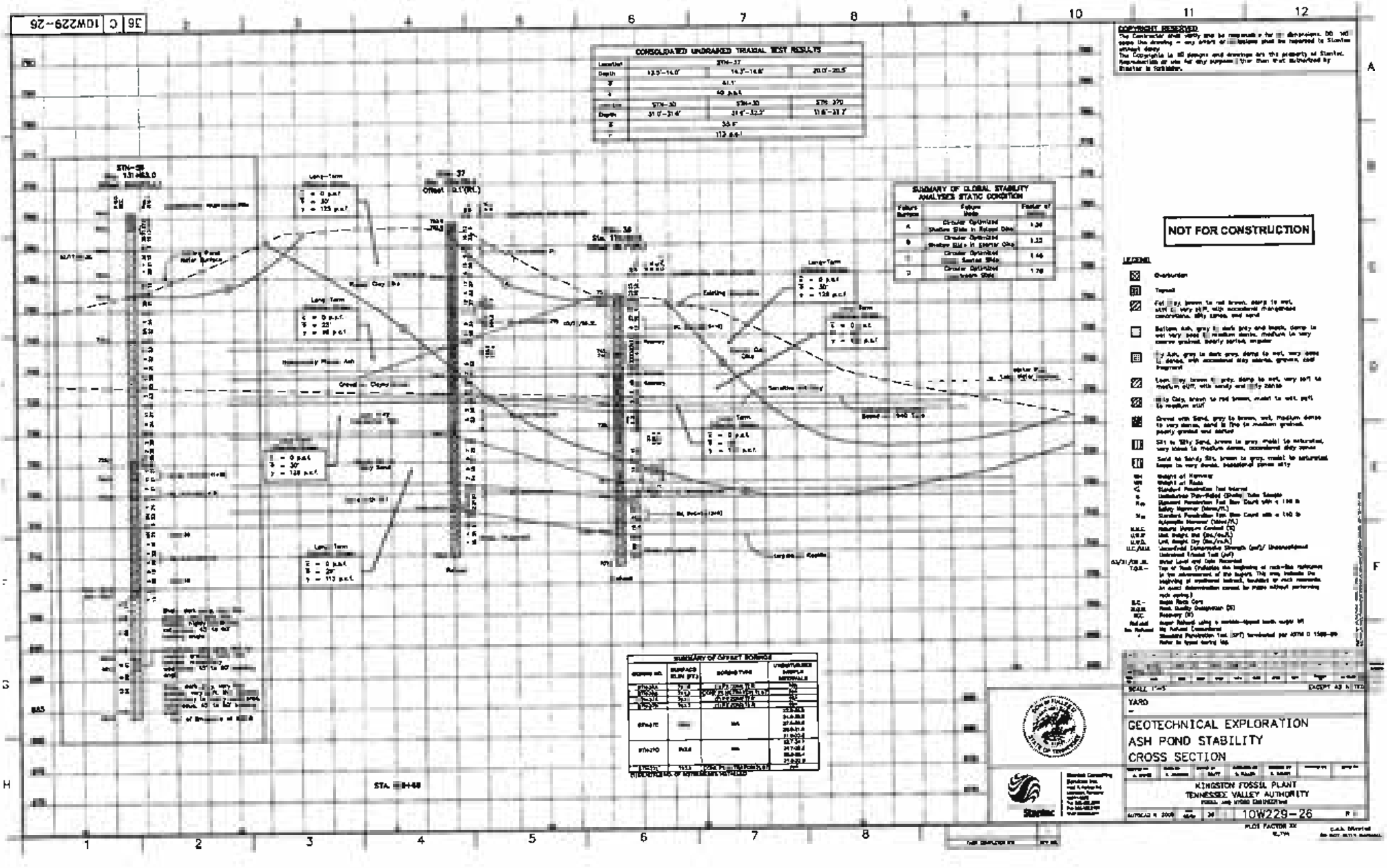

SUMMARY OF GLOBAL STABILITY ANALYSES STATIC CONDITION
NOT FOR CONSTRUCTION
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
CROSS SECTION
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W229-25


CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS
SUMMARY OF GLOBAL STABILITY ANALYSES STATIC CONDITION
NOT FOR CONSTRUCTION
LEGEND
Overburden
Topsoil
Fill
Bottom Ash
Fly Ash
Clay
Gravel with Sand
Silt to Silty Sand
Sand to Sandy Silt
Weight of Hammer
Weight of Rods
Standard Penetration Test Interval
Undisturbed Thin-Walled (Shelby) Tube Sample
Diamond Penetration Test Blow Count with a 140 lb
Safety Hammer (blows/ft.)
Standard Penetration Test Blow Count with a 140 lb
Automatic Hammer (blows/ft.)
Moisture Content (%)
Liquid Limit (%)
Plastic Limit (%)
Unit Weight Wet (lbs./cu.ft.)
Unit Weight Dry (lbs./cu.ft.)
Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
Water Level and Date Recorded
Top of Rock (Indicates the beginning of rock-like refusal in the advancement of the boring. This may include the beginning of weathered bedrock, boulders or rock ledges. An exact determination cannot be made without performing rock coring.)
Rock Core
Rock Quality Designation (%)
Recovery (%)
Auger Refusal using a conical-tipped tools auger bit
No Refusal Encountered
Standard Penetration Test (SPT) terminated per ASTM D 1586-99
Refer to typed boring log
SUMMARY OF CORRECT BORINGS
STA. 31+48
SCALE 1"=5
YARD
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
CROSS SECTION
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W229-26
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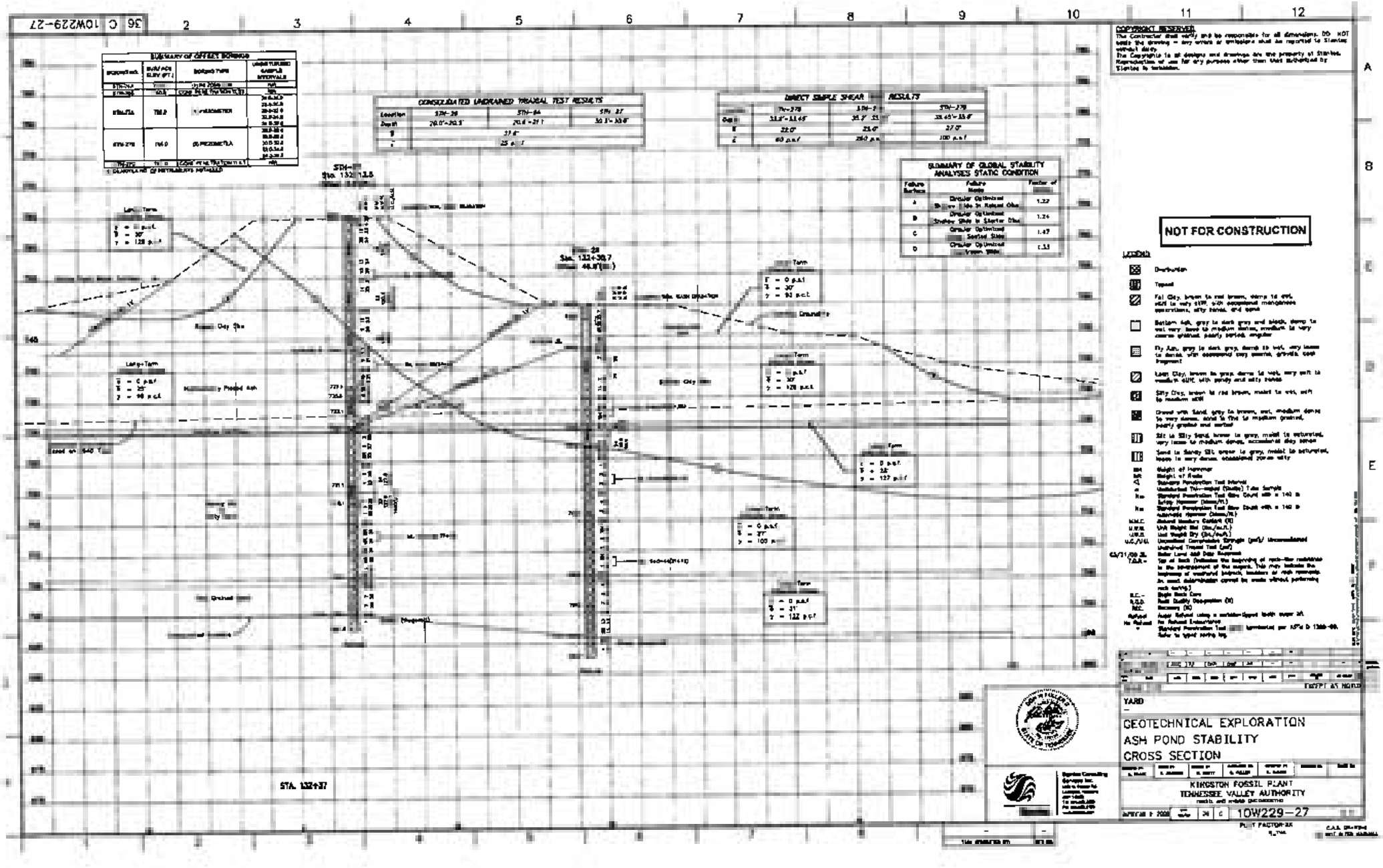
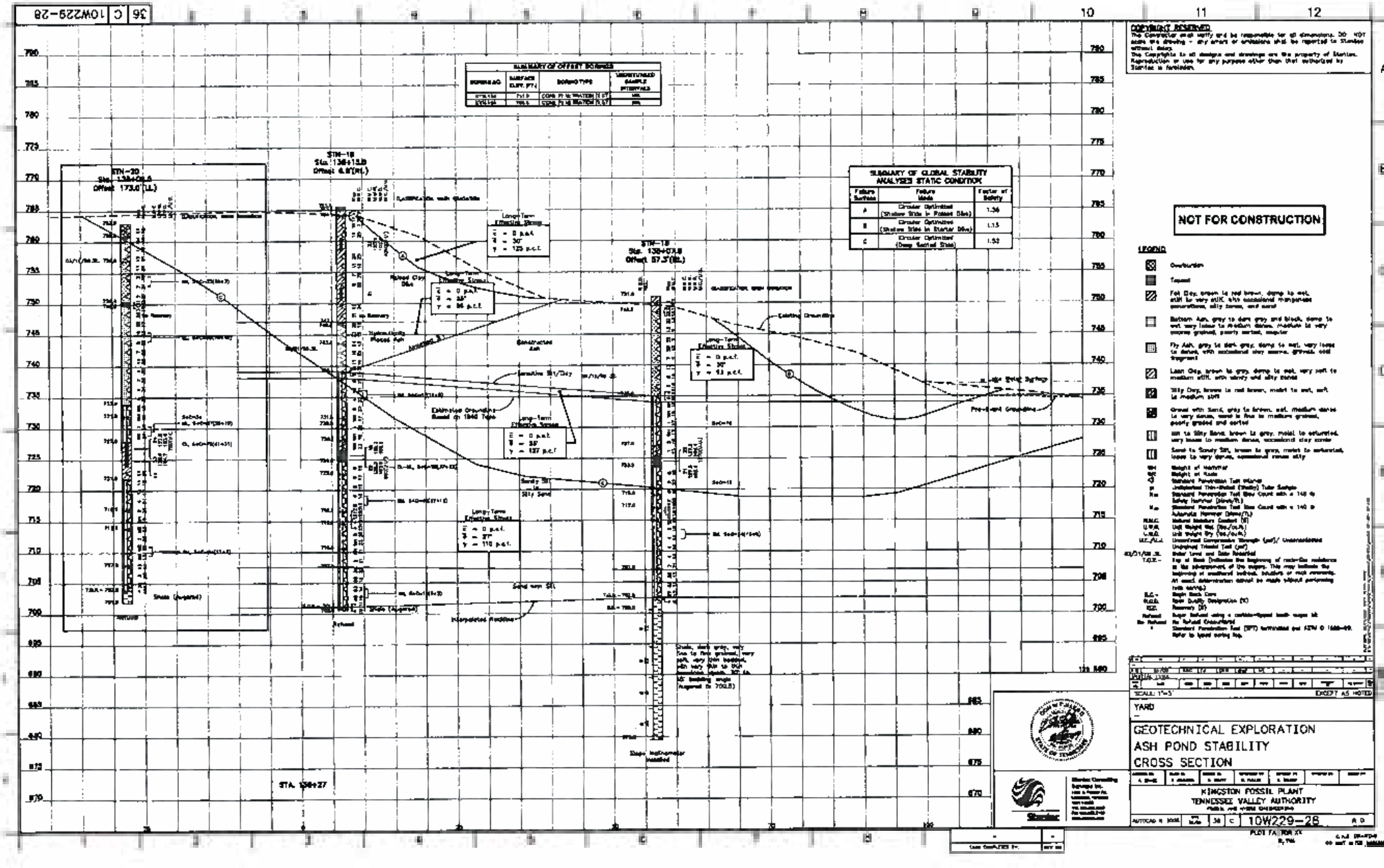
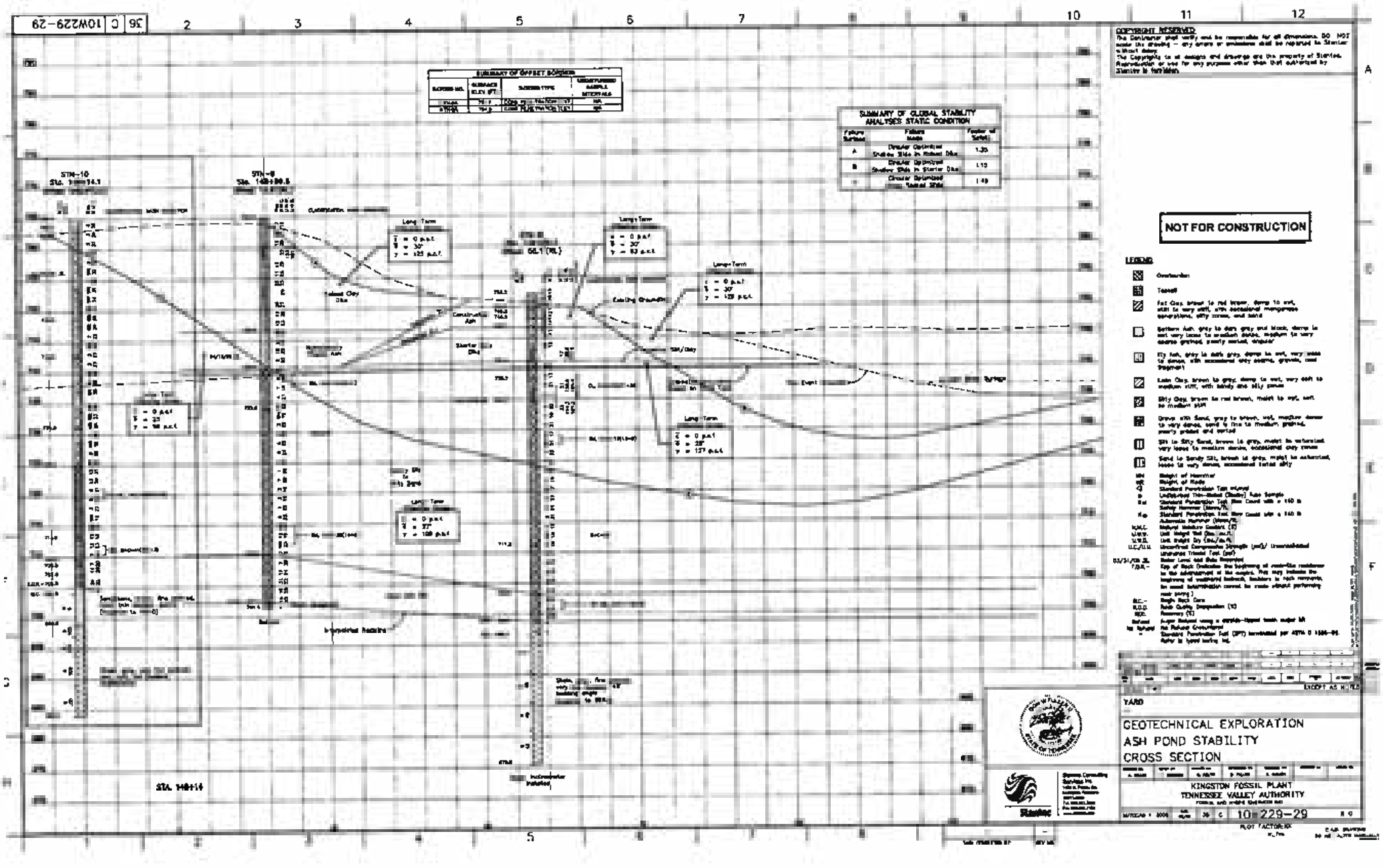

SUMMARY OF OFFSET BORINGS
CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS
DIRECT SIMPLE SHEAR RESULTS
SUMMARY OF GLOBAL STABILITY ANALYSES STATIC CONDITION
NOT FOR CONSTRUCTION
LEGEND
YARD
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
CROSS SECTION
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10W229-27
STA. 132+37


SUMMARY OF OFFSET BORINGS
SUMMARY OF GLOBAL STABILITY ANALYSES STATIC CONDITION
Failure Surface
Failure Mode
Factor of Safety
A
Circular Optimized (Shallow Slide in Raised Dike)
1.36
B
Circular Optimized (Shallow Slide in Starter Dike)
1.13
C
Circular Optimized (Deep Seated Slide)
1.52
STN-20
Sta. 138+08.8
Offset 173.0' (LT.)
STN-18
Sta. 136+13.9
Offset 6.8'(Rt.)
STN-16
Sta. 138+07.8
Offset 57.3'(Rt.)
Existing Grade/Bed
Pre-Event Groundline
Interpolated Position
STA. 136+27
Shale (Augered)
Sandy Silt to Silty Sand
Silty Sand
Existing Ash
Sensitive Silt/Clay
Shale, dark gray, very low to fine grained, very soft, very thin bedded, thin very thin to thick laminations, bent, to...


SUMMARY OF GLOBAL STABILITY ANALYSES STATIC CONDITION
Failure Surface
Failure Mode
Factor of Safety
A
Circular Optimized
Shallow Slide in Retread Dike
1.35
B
Circular Optimized
Shallow Slide in Starter Dike
1.13
C
Circular Optimized
Deep Seated Slide
1.49
STN-10
STN-9
Long Term
Retread Clay Dike
Starter Dike
Existing Ground
Construction Ash
Bottom Ash
Inclinometer Installed
STA. 148+16
NOT FOR CONSTRUCTION
LEGEND
Overburden
Topsoil
Bottom Ash: gray to dark gray and black, damp to wet, very loose to medium dense, medium to very coarse grained, poorly sorted, angular
Lean Clay: brown to gray, damp to wet, very stiff to medium stiff, with sandy and silty zones
Silty Clay: brown to red brown, moist to wet, soft to medium stiff
Gravel with Sand: gray to brown, wet, medium dense to very dense, sand is fine to medium grained, poorly graded and sorted
Silt to Silty Sand: brown to gray, moist to saturated, very loose to medium dense, occasional clay zones
Sand to Sandy Silt: brown to gray, moist to saturated, loose to very dense, occasional trace silty
Weight of Hammer
Weight of Rods
Standard Penetration Test refusal
Undisturbed Thin-Walled (Shelby) Tube Sample
Standard Penetration Test Blow Count with a 140 lb Safety Hammer (Blows/ft.)
Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (Blows/ft.)
Moisture Content (%)
Unit Weight Wet (lbs/cu.ft.)
Unit Weight Dry (lbs/cu.ft.)
Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
Water Level and Date Measured
Top of Rock (Indicates the beginning of moderate resistance in the advancement of the augers, this may indicate the beginning of weathered bedrock, boulders or rock remnants, no exact determination cannot be made without performing rock coring.)
Weight Rock Core
Rock Quality Designation (%)
Recovery (%)
Auger Refusal using a carbide-tipped tooth auger bit
No Refusal Encountered
Standard Penetration Test (SPT) terminated per ASTM D 1586-99.
Refer to typed boring log.
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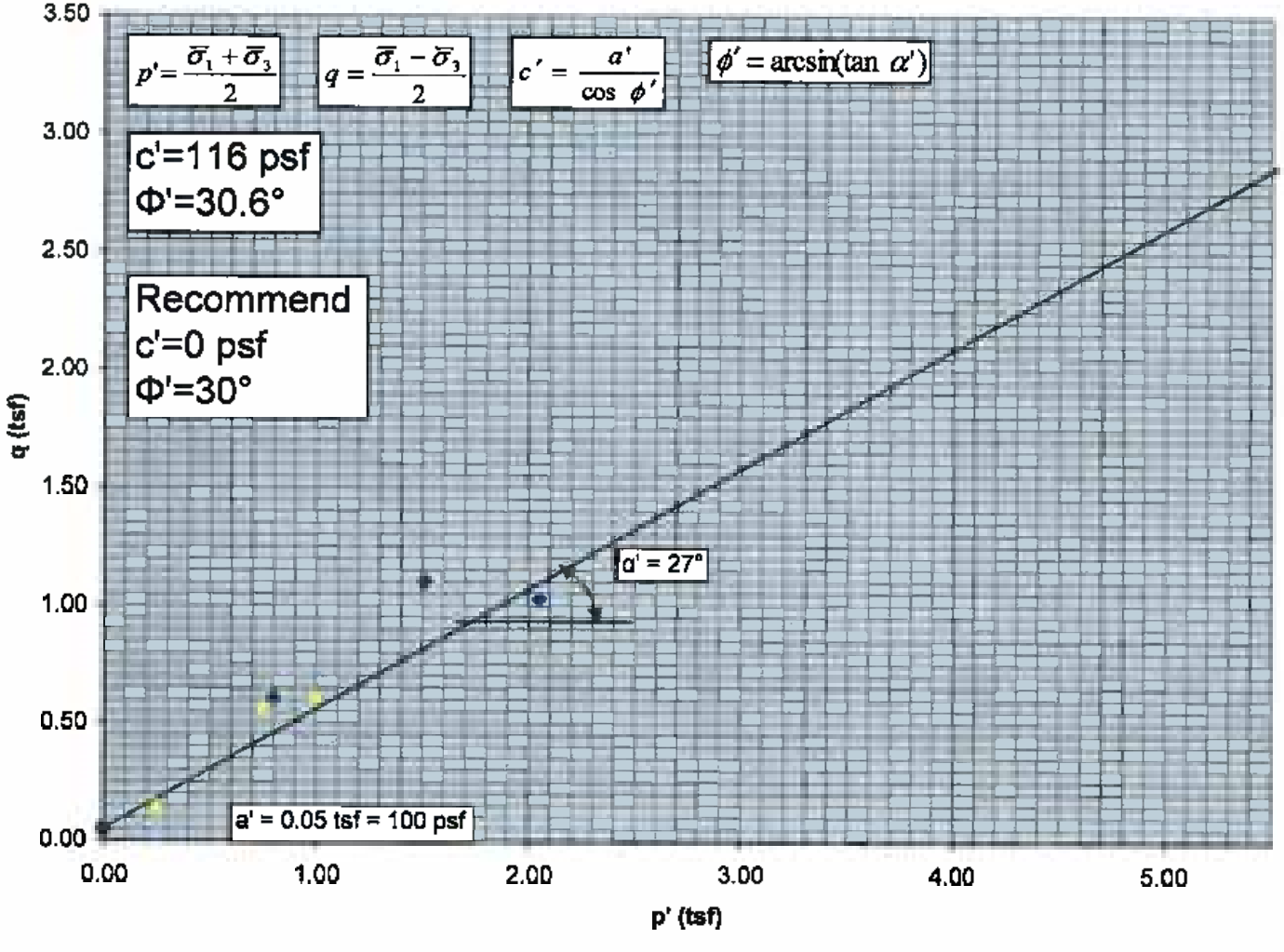
EXCEPT AS NOTED
YARD
GEOTECHNICAL EXPLORATION
ASH POND STABILITY
CROSS SECTION
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
10229-29
Stantec

Appendix G

Strength Parameter Selection Charts

Raised Clay Dike
Effective Stress from CU Triaxial Tests

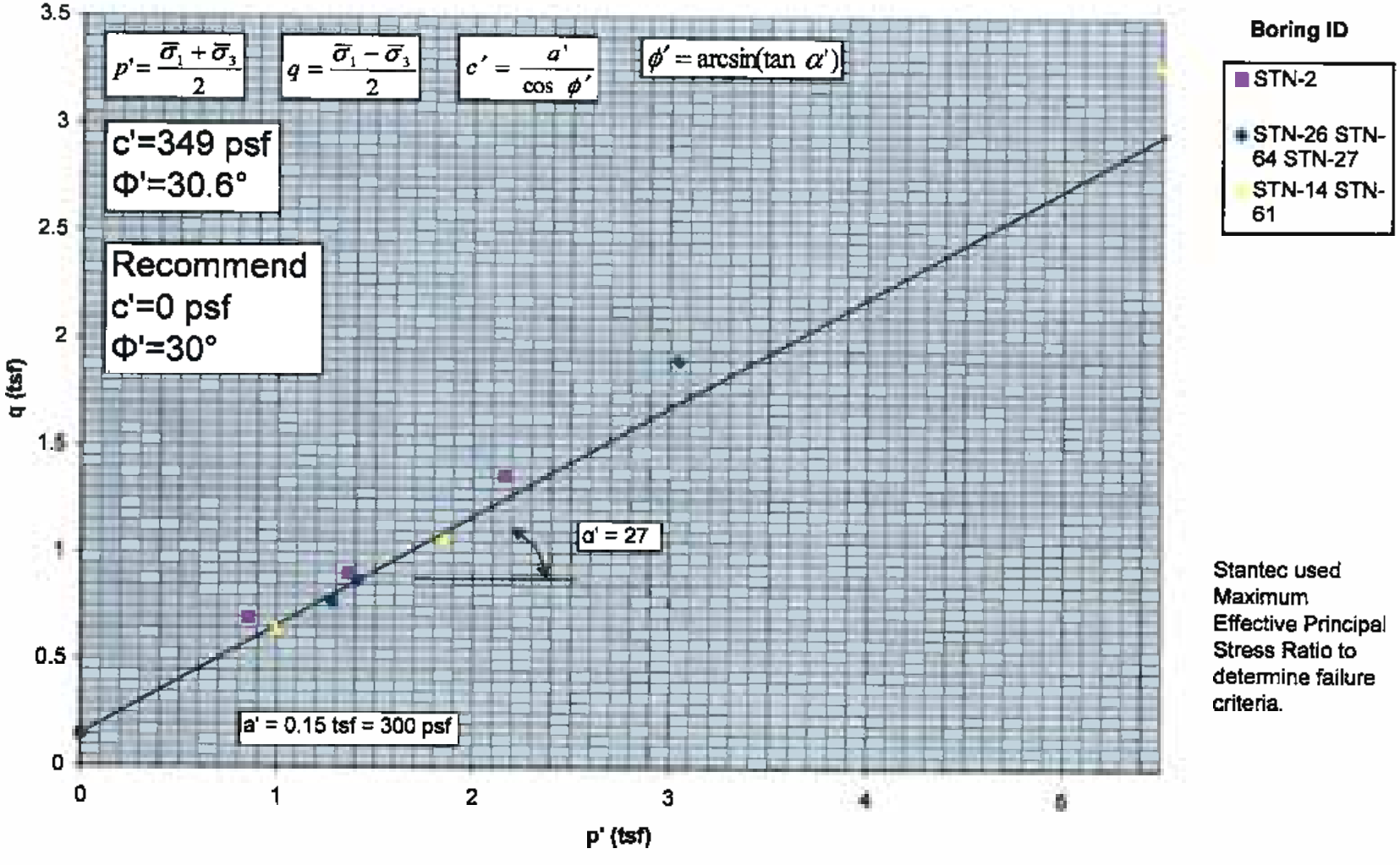


Boring ID

- STN-3 STN-5
- STN-37D

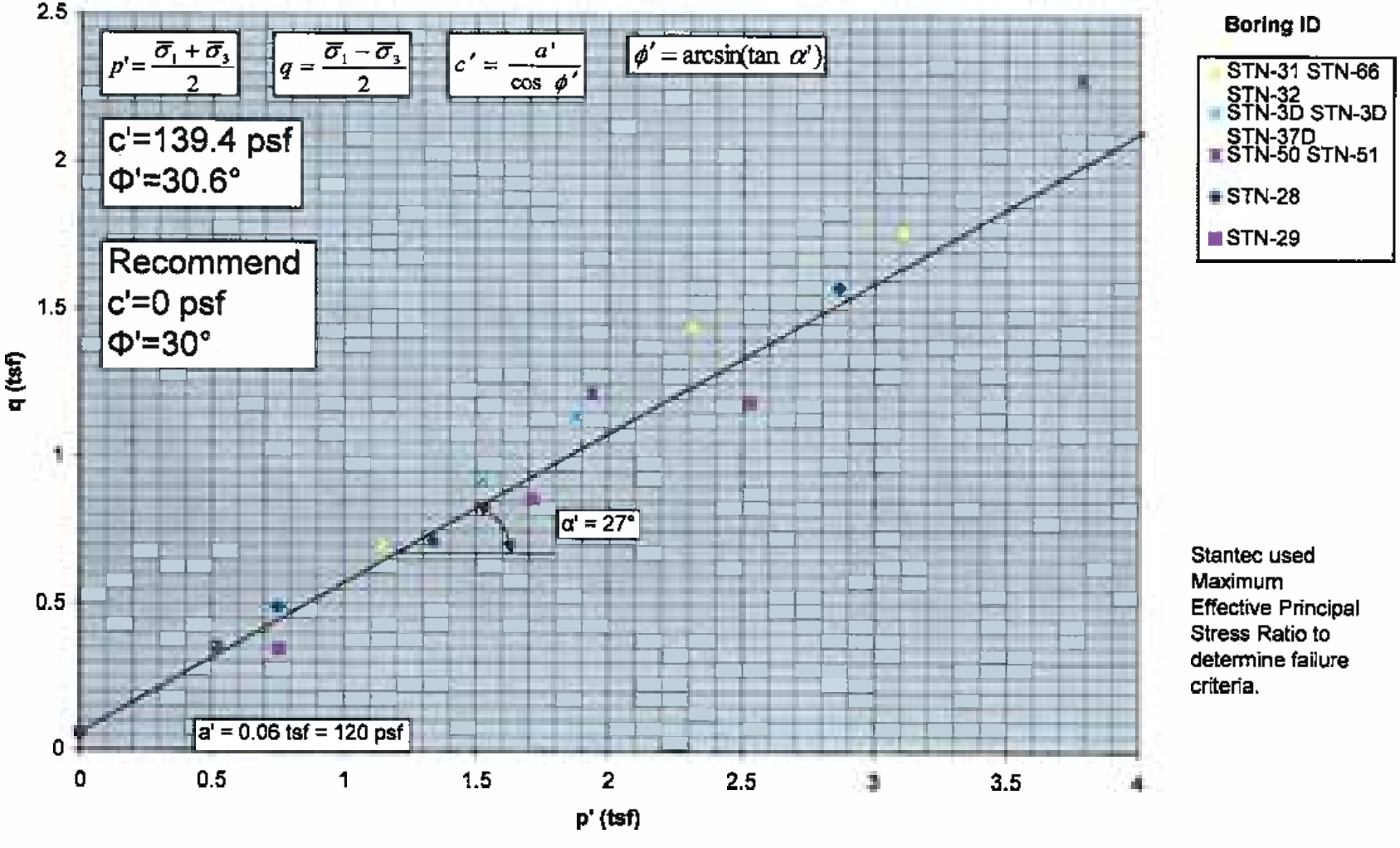
Stantec used Maximum Effective Principal Stress Ratio to determine failure criteria.

Starter Clay Dike
Effective Stress from CU Triaxial Tests



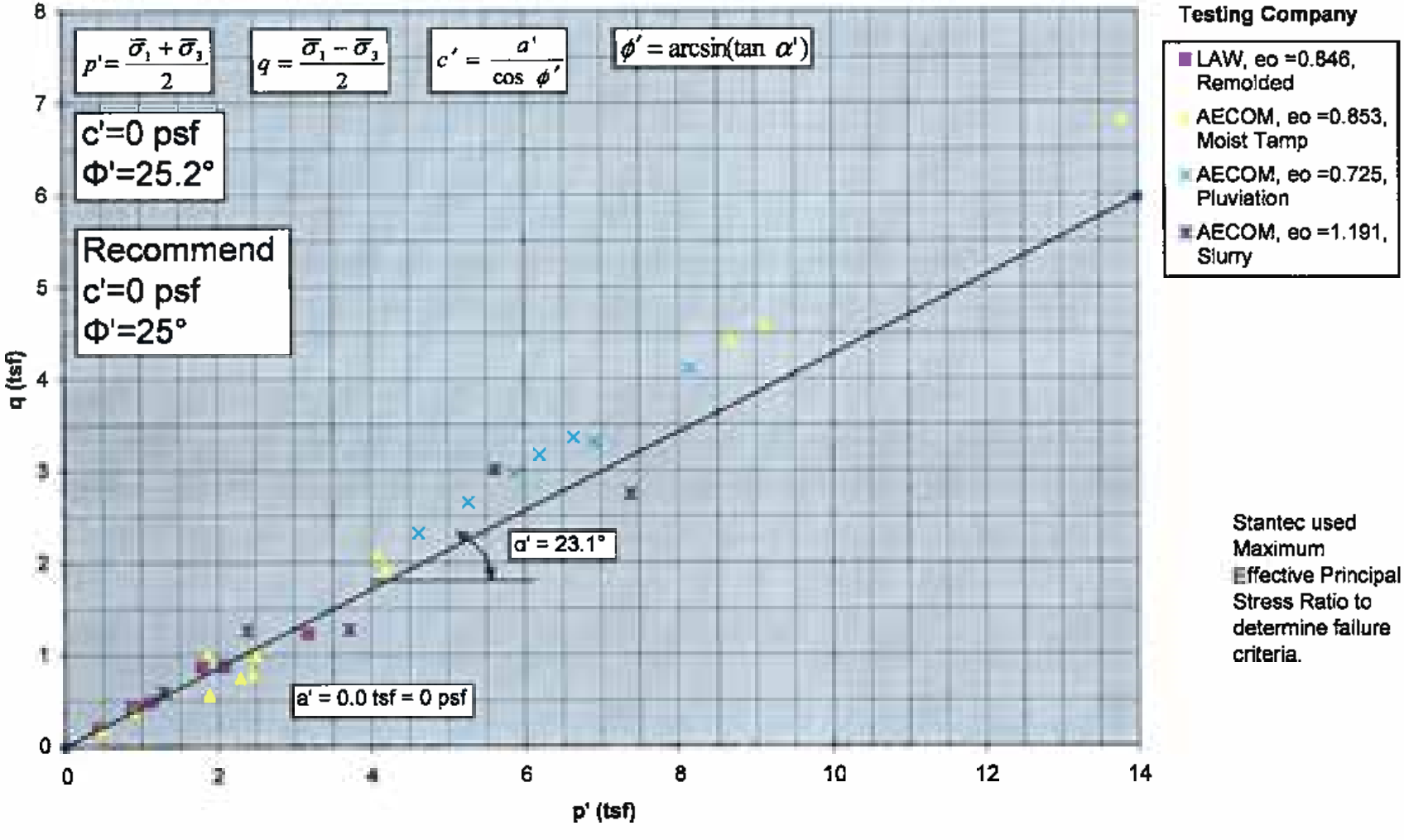
Stantec used Maximum Effective Principal Stress Ratio to determine failure criteria.

Foundation Clay
Effective Stress from CU Triaxial Tests

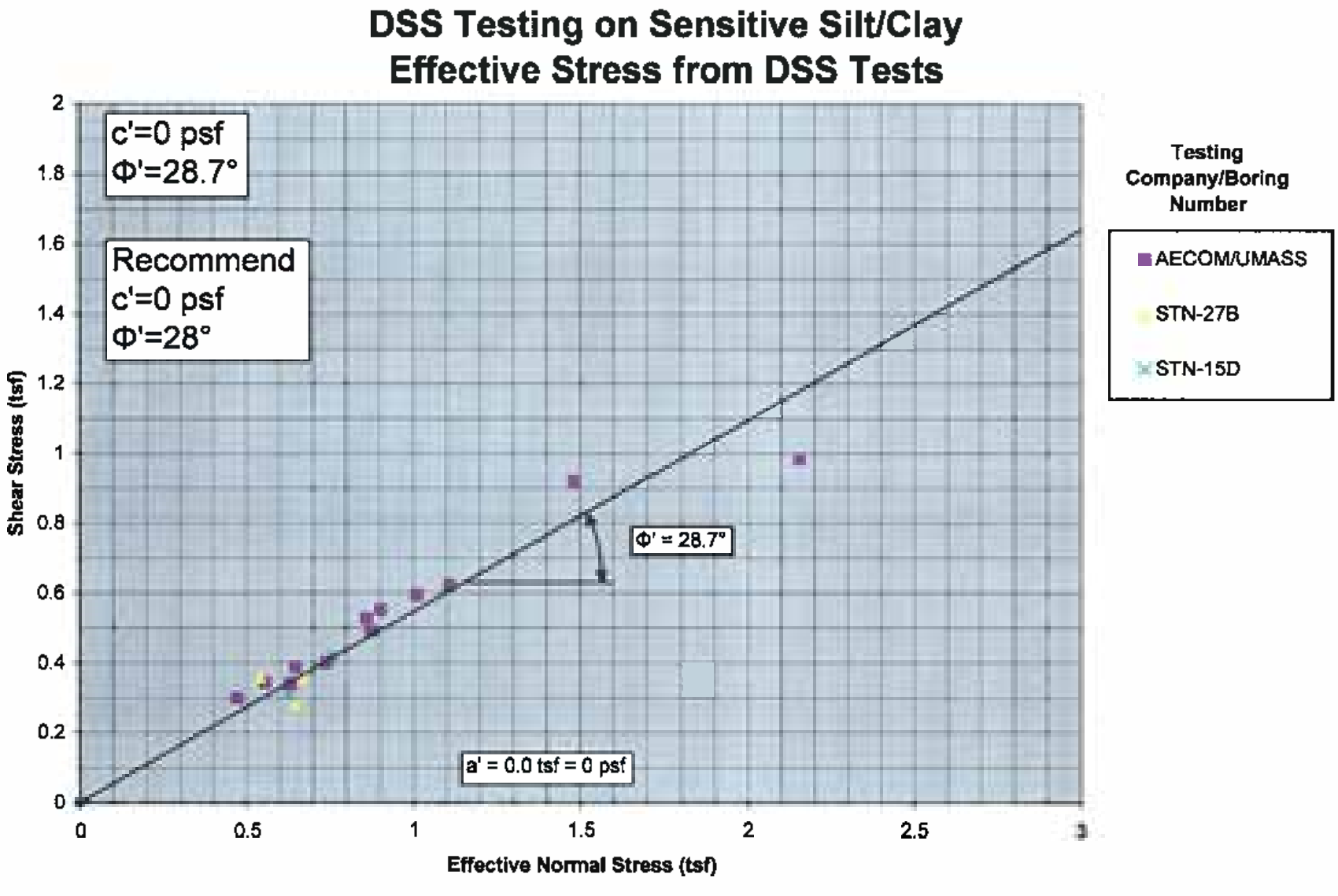


Stantec used Maximum Effective Principal Stress Ratio to determine failure criteria.

Hydraulically Placed Ash
Effective Stress from CU Triaxial Tests



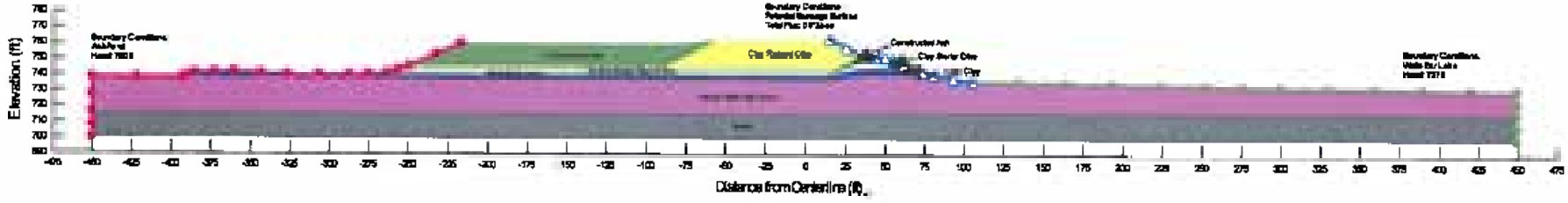
Stantec used Maximum Effective Principal Stress Ratio to determine failure criteria.


DSS Testing on Sensitive Silt/Clay
Effective Stress from DSS Tests
c'=0 psf
Φ'=28.7°
Recommend
c'=0 psf
Φ'=28°
Φ' = 28.7°
a' = 0.0 tsf = 0 psf
Shear Stress (tsf)
Effective Normal Stress (tsf)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
0.5
1
1.5
2
2.5
3
Testing Company/Boring Number
AECOM/UMASS
STN-27B
STN-15D

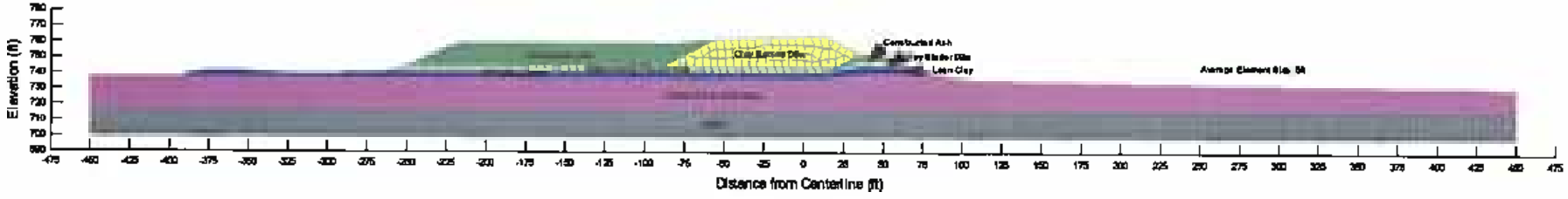
Appendix H

Pore Water Pressure Contours

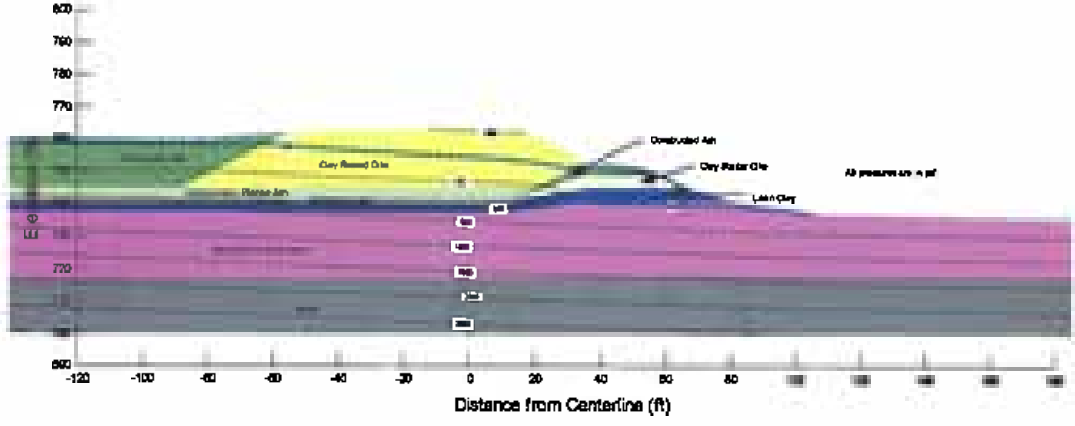
Kingston Fossil Plant
Dike C - Station 108+93
Subsurface Profile and Boundary Conditions



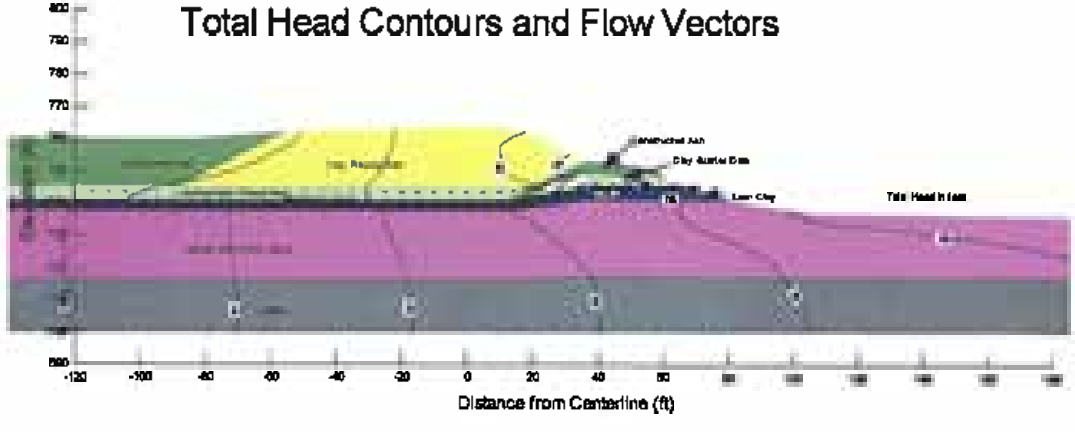
Kingston Fossil Plant
Dike C - Station 108+93
Finite Element Mesh



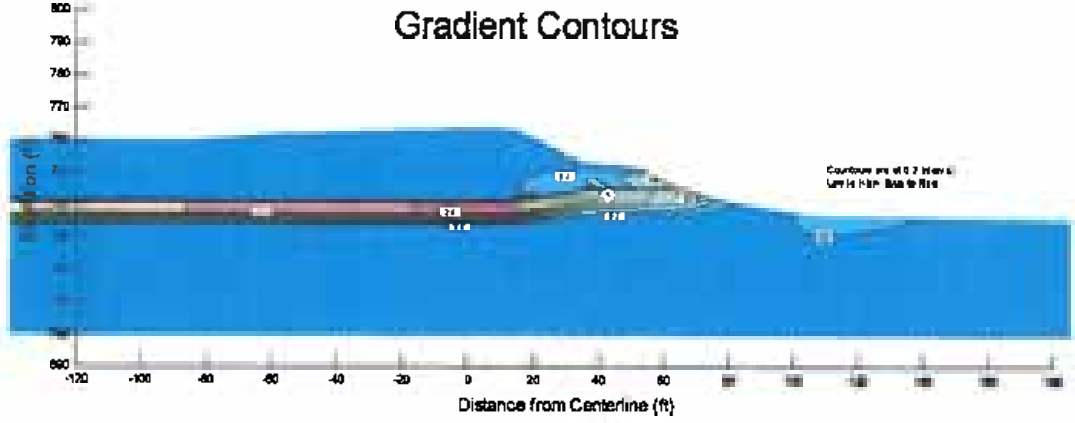
Kingston Fossil Plant
Dike C - Station 108+93
Pore Water Pressure Contours



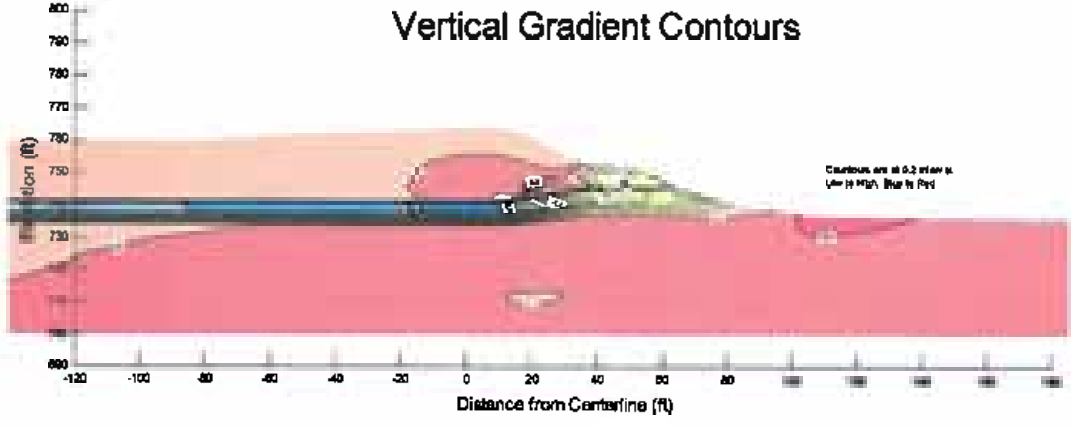
Kingston Fossil Plant
Dike C - Station 108+93
Total Head Contours and Flow Vectors



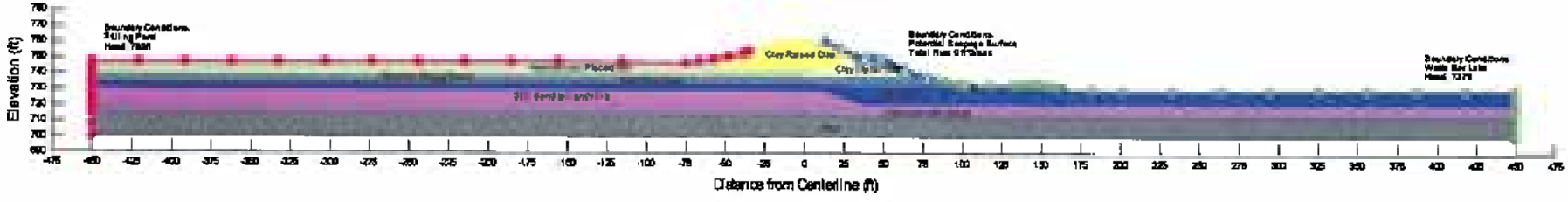
Kingston Fossil Plant
Dike C - Station 108+93
Gradient Contours



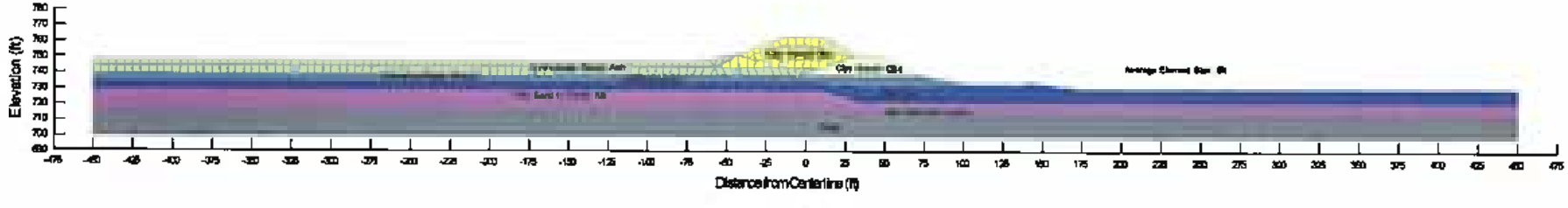
Kingston Fossil Plant
Dike C - Station 108+93
Vertical Gradient Contours



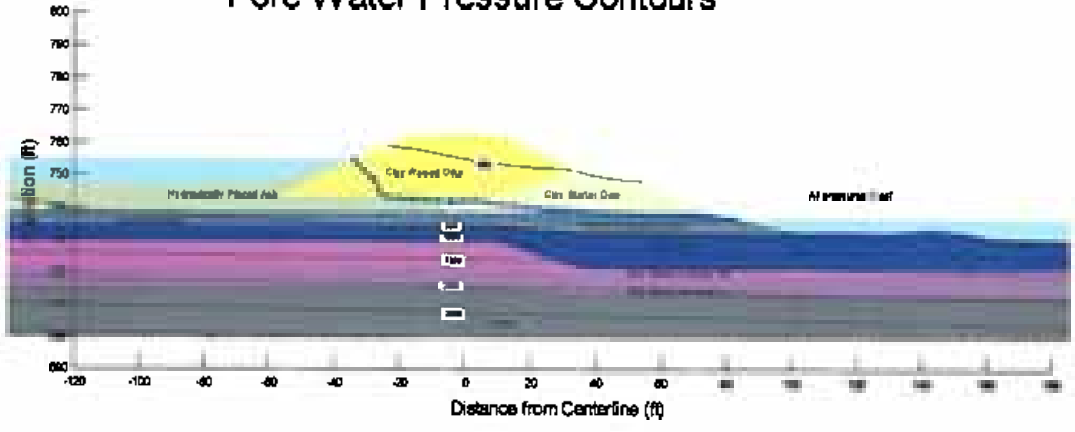
Kingston Fossil Plant
Dike C - Station 119+69
Subsurface Profile and Boundary Conditions



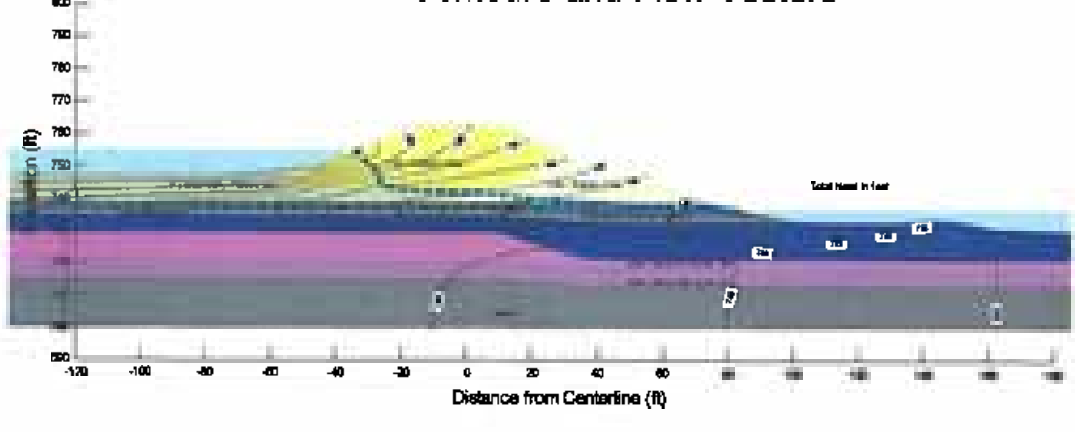
Kingston Fossil Plant
Dike C - Station 119+69
Finite Element Mesh



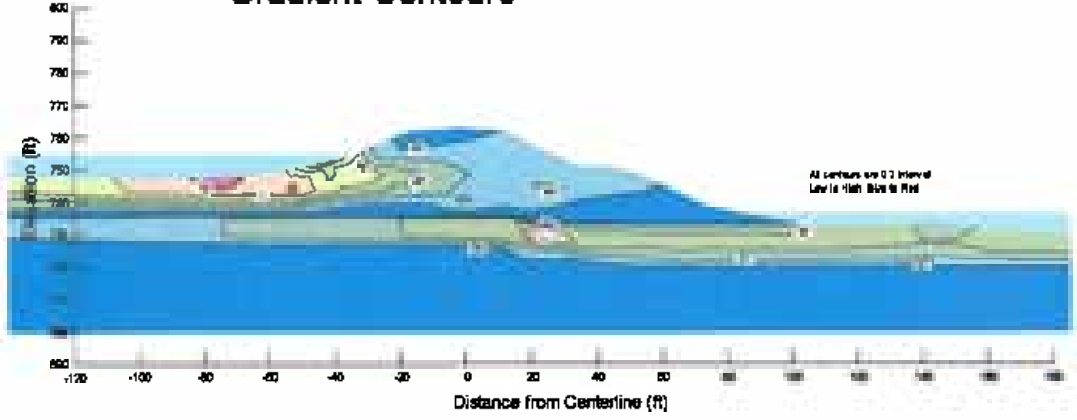
Kingston Fossil Plant
Dike C - Station 119+69
Pore Water Pressure Contours



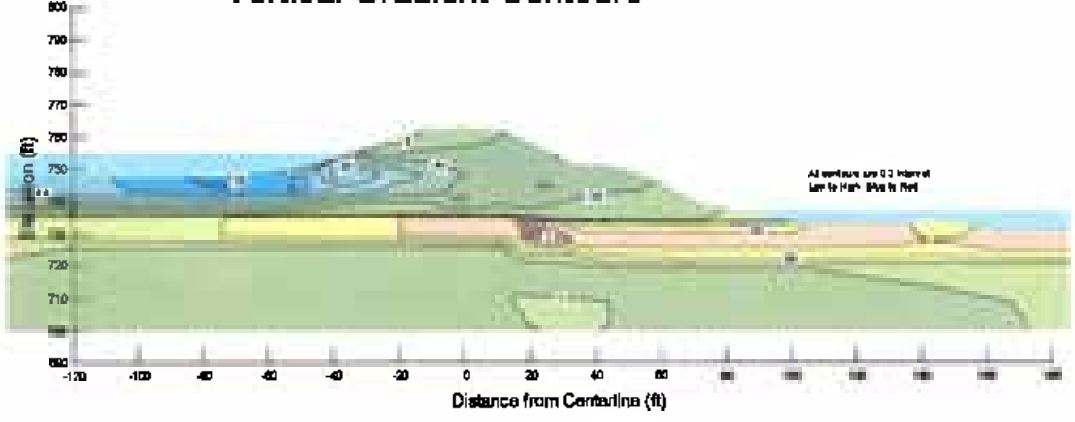
Kingston Fossil Plant
Dike C - Station 119+69
Total Head Contours and Flow Vectors



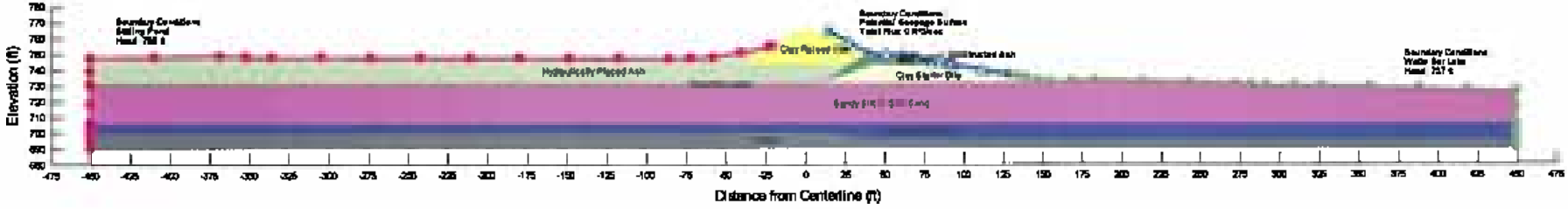
Kingston Fossil Plant
Dike C - Station 119+69
Gradient Contours



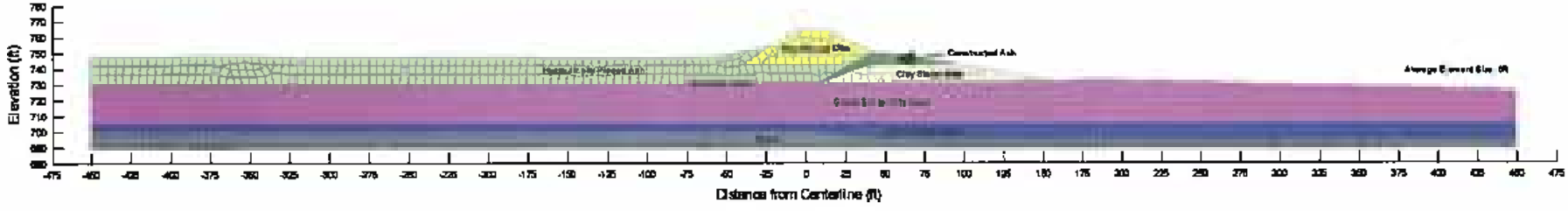
Kingston Fossil Plant
Dike C - Station 119+69
Vertical Gradient Contours



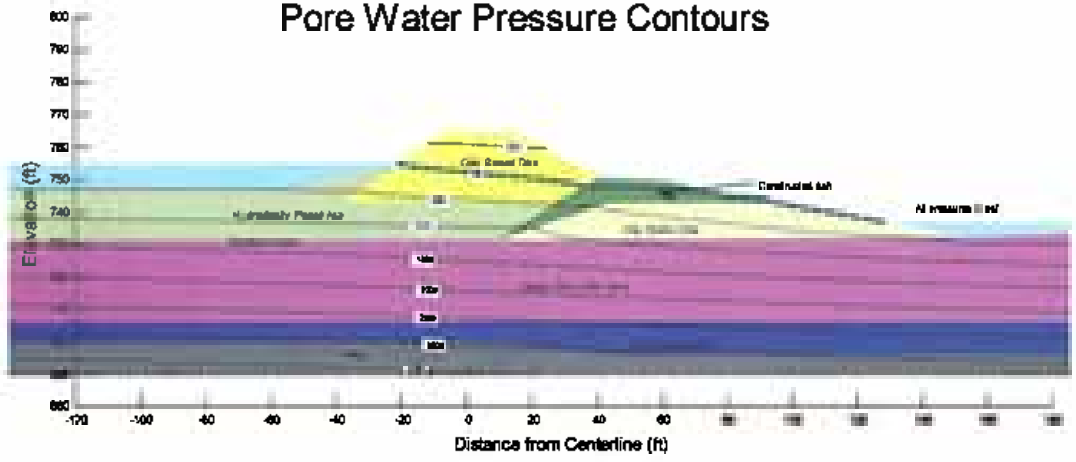
Kingston Fossil Plant
Dike C - Station 132+37
Subsurface Profile and Boundary Conditions



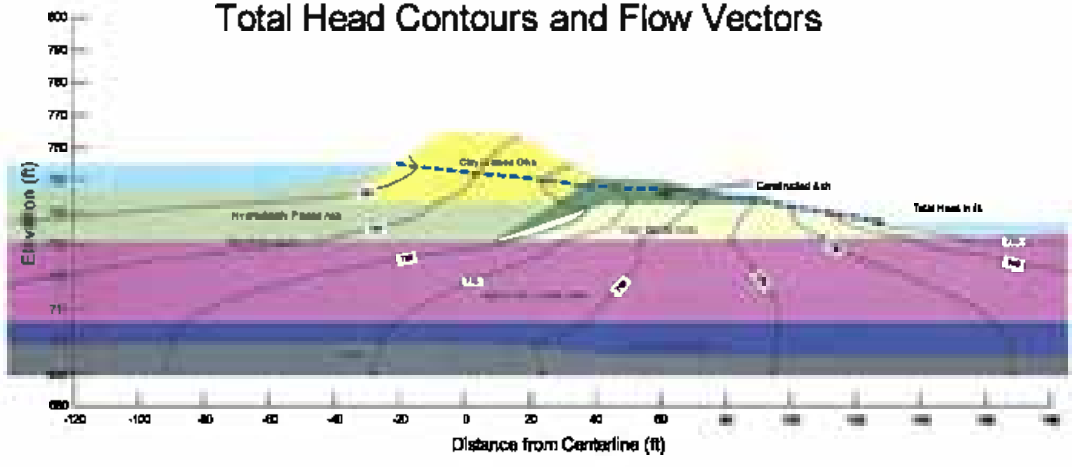
Kingston Fossil Plant
Dike C - Station 132+37
Finite Element Mesh



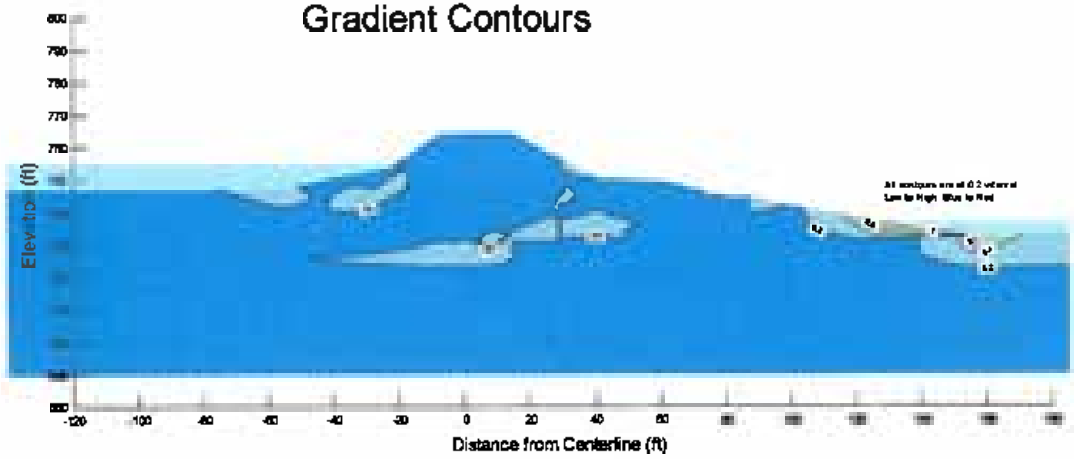
Kingston Fossil Plant
Dike C - Station 132+37
Pore Water Pressure Contours



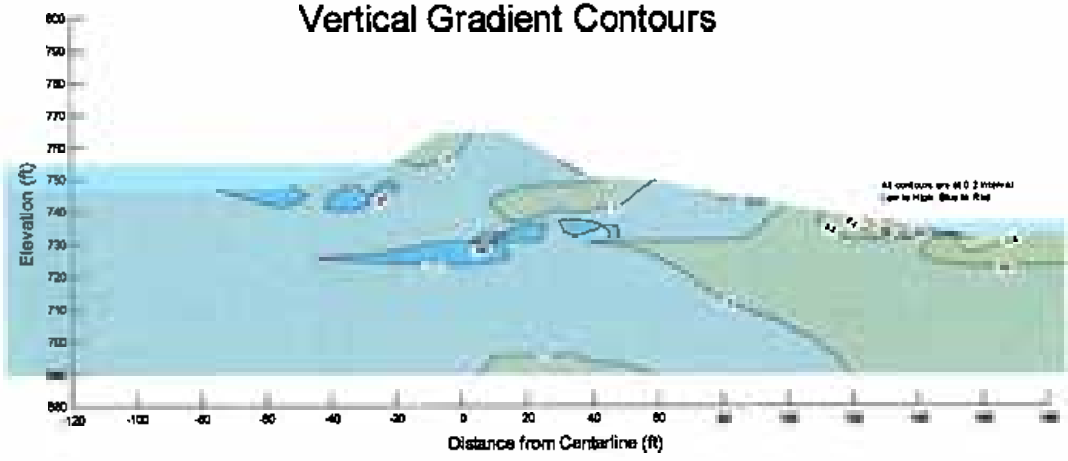
Kingston Fossil Plant
Dike C - Station 132+37
Total Head Contours and Flow Vectors



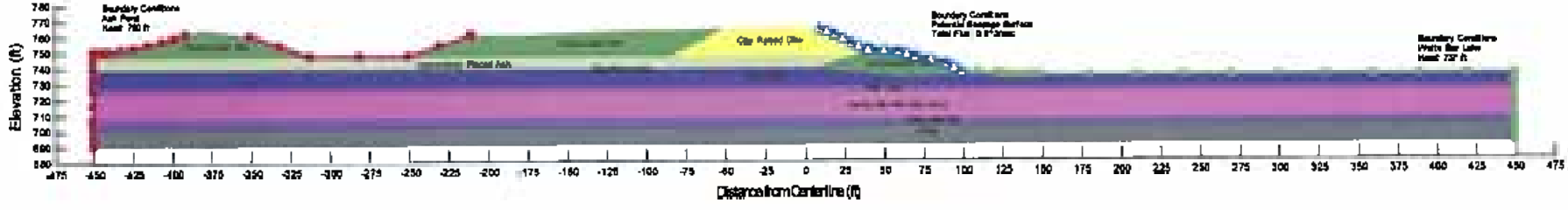
Kingston Fossil Plant
Dike C - Station 132+37
Gradient Contours



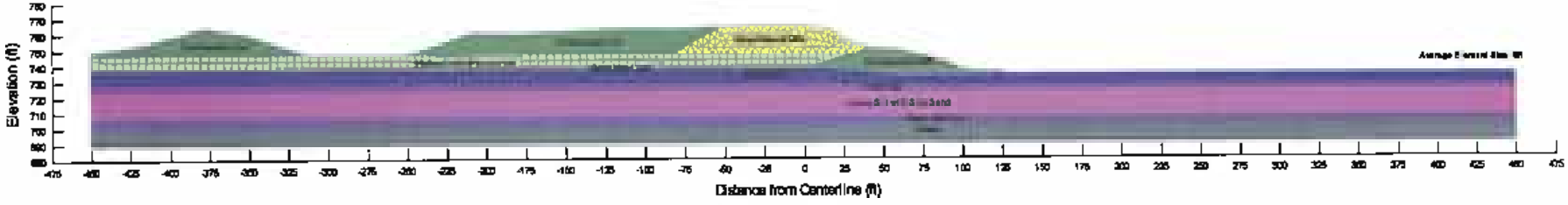
Kingston Fossil Plant
Dike C - Station 132+37
Vertical Gradient Contours



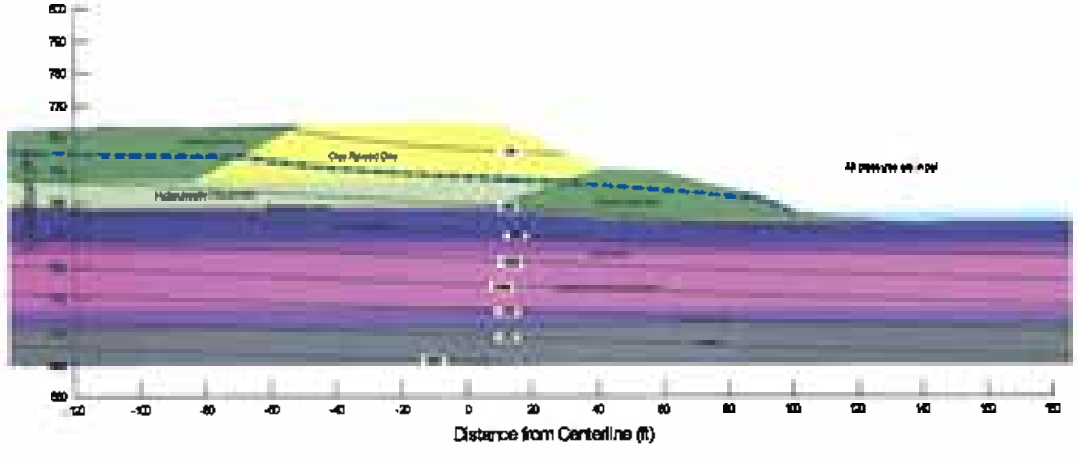
Kingston Fossil Plant
Dike C - Station 138+27
Subsurface Profile and Boundary Conditions



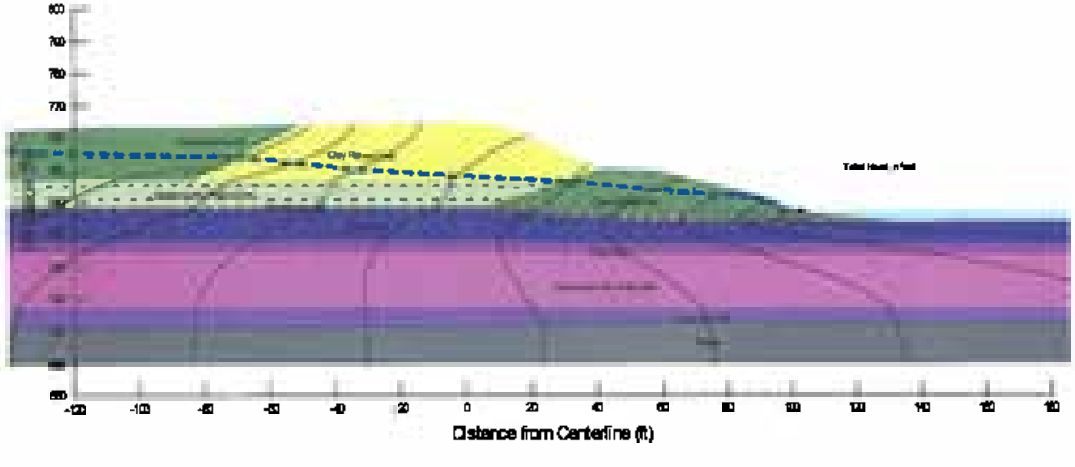
Kingston Fossil Plant
Dike C - Station 138+27
Finite Element Mesh



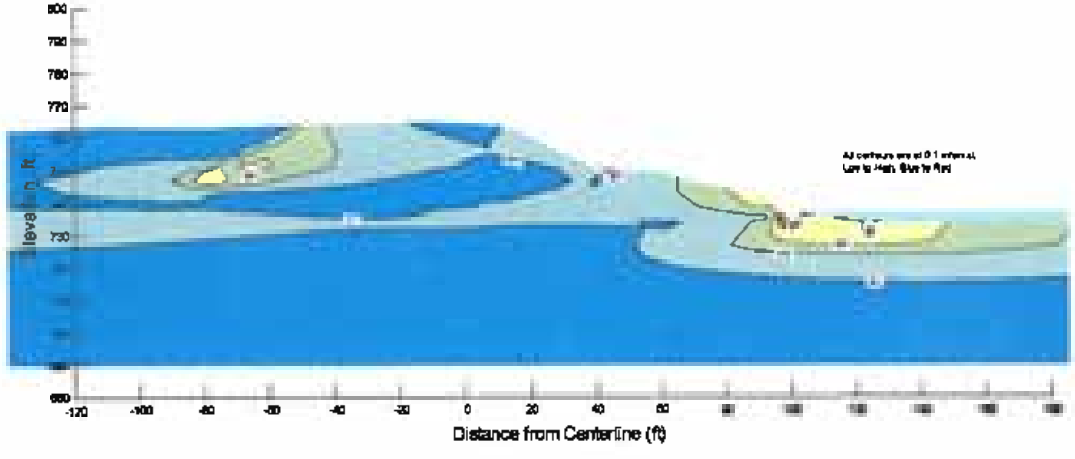
Kingston Fossil Plant
Dike C - Station 138+27
Pore Water Pressure Contours



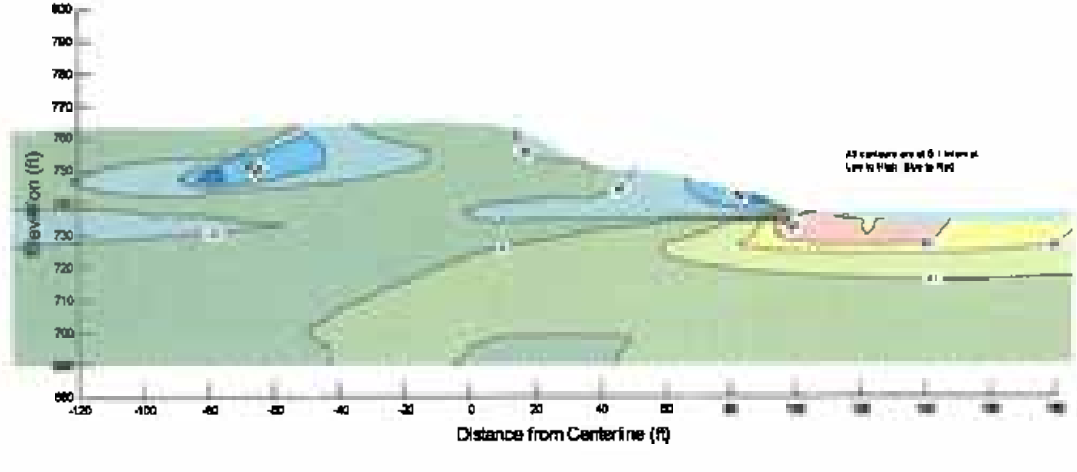
Kingston Fossil Plant
Dike C - Station 138+27
Total Head Contours and Flow Vectors



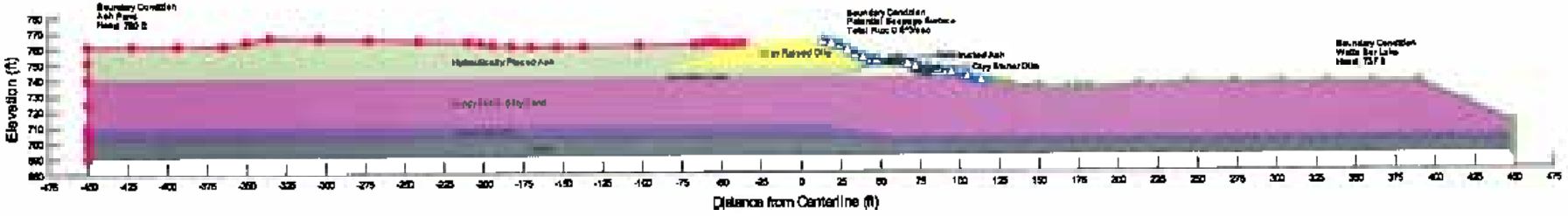
Kingston Fossil Plant
Dike C - Station 138+27
Gradient Contours



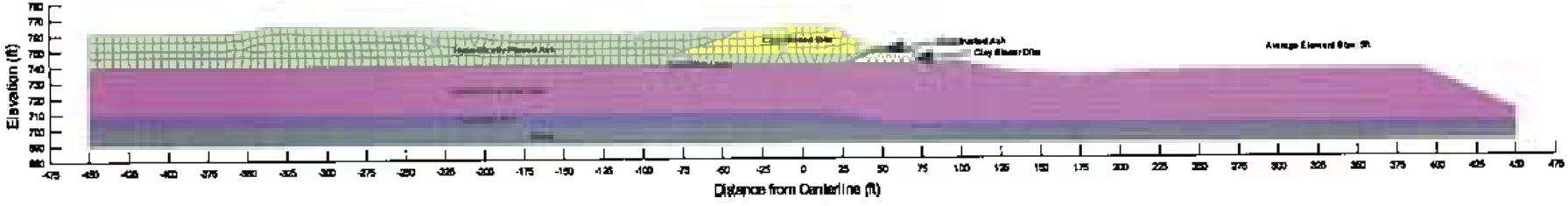
Kingston Fossil Plant
Dike C - Station 138+27
Vertical Gradient Contours



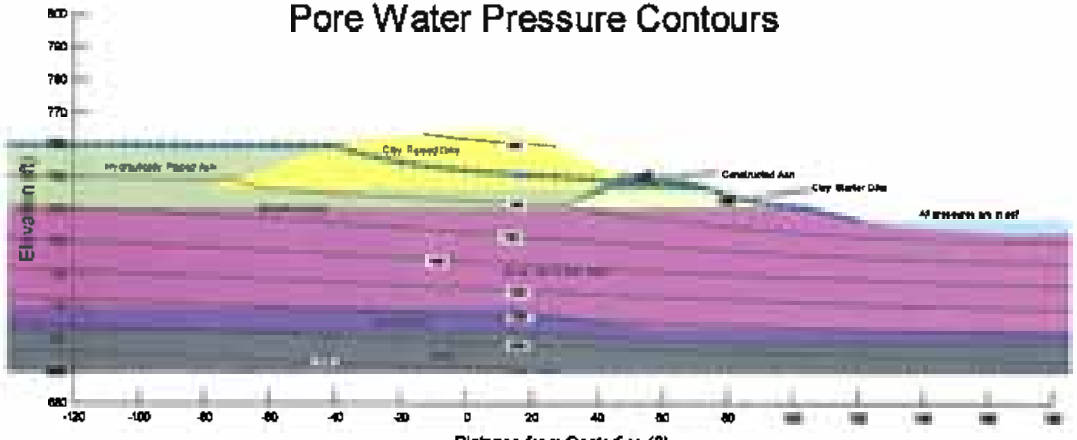
Kingston Fossil Plant
Dike C - Station 149+14
Subsurface Profile and Boundary Conditions



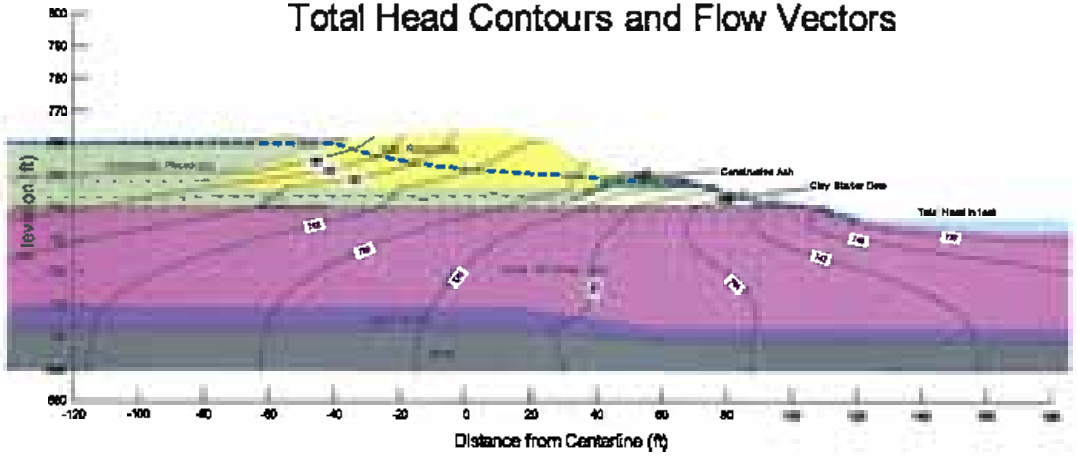
Kingston Fossil Plant
Dike C - Station 149+14
Finite Element Mesh



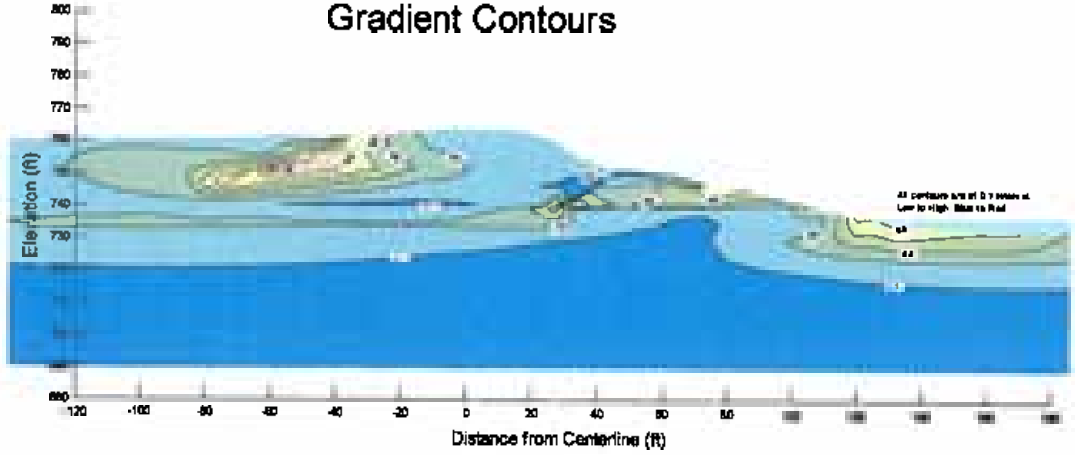
Kingston Fossil Plant
Dike C - Station 149+14
Pore Water Pressure Contours



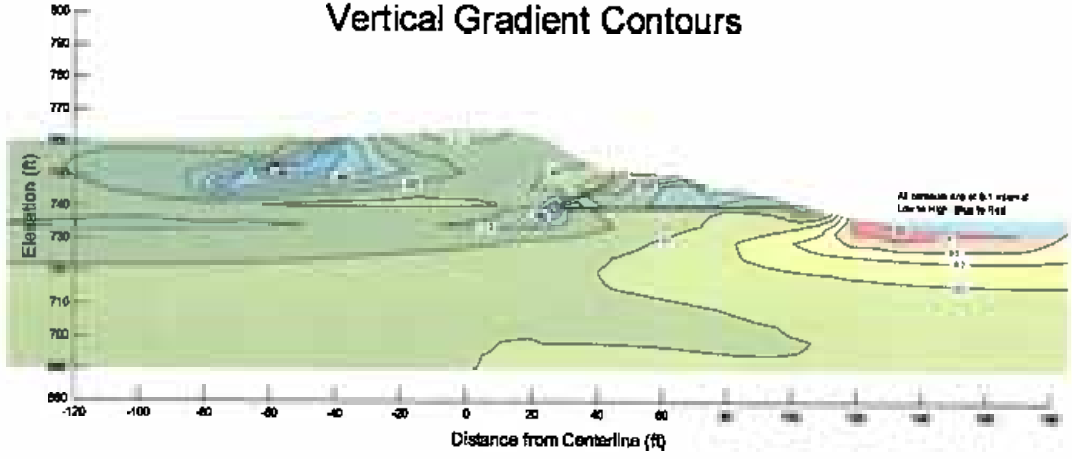
Kingston Fossil Plant
Dike C - Station 149+14
Total Head Contours and Flow Vectors



Kingston Fossil Plant
Dike C - Station 149+14
Gradient Contours



Kingston Fossil Plant
Dike C - Station 149+14
Vertical Gradient Contours



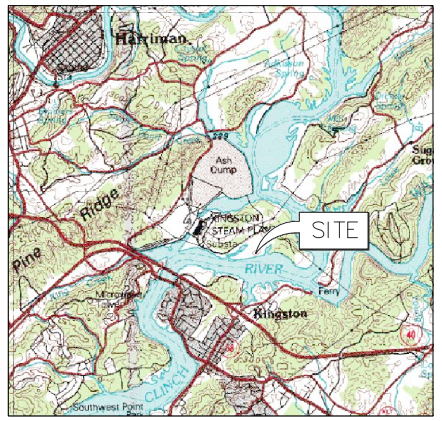
APPENDIX A

Document 2

Construction Drawings, "Coal Combustion By-Products (Gypsum) Disposal Facility, Kingston Fossil Plant – Peninsula Site" TVA Drawing Numbers 10W428-1 through 10W428-22

DRAWING INDEX

10W428–1	COVER SHEET
10W428–2	EXISTING SITE CONDITIONS
10W428–3	SITE DEVELOPMENT PLAN
10W428–4	EROSION CONTROL PLAN
10W428–5	EROSION CONTROL DETAILS SHEET 1 OF 2
10W428–6	EROSION CONTROL DETAILS SHEET 2 OF 2
10W428–7	PHASE I INITIAL GRADING PLAN AND SOIL DIKES
10W428–8	PHASE I TOP OF GEOLOGIC BUFFER
10W428–9	CROSS SECTIONS
10W428–10	EXISTING BORROW AREA
10W428–11	PROPOSED BORROW AREA GRADING PLAN
10W428–12	PERIMETER BERM CROSS SECTIONS SHEET 1 OF 2
10W428–13	PERIMETER BERM CROSS SECTIONS SHEET 2 OF 2
10W428–14	STORM DETENTION POND SECTIONS
10W428–15	PROPOSED ROAD PLAN AND PROFILE
10W428–16	PROPOSED ROAD CROSS SECTIONS SHEET 1 OF 3
10W428–17	PROPOSED ROAD CROSS SECTIONS SHEET 2 OF 3
10W428–18	PROPOSED ROAD CROSS SECTIONS SHEET 3 OF 3
10W428–19	PUMP STATION PLAN, SECTIONS, AND DETAILS
15W703	PUMP STATION ELECTRICAL
10W427–20	STORM DRAINAGE PLAN
10W427–21	DRAINAGE SYSTEM DETAILS SHEET 1 OF 2
10W427–22	DRAINAGE SYSTEM DETAILS SHEET 2 OF 2



LOCATION MAP

VICINITY MAP

COAL-COMBUSTION BY PRODUCT (GYPSUM) DISPOSAL FACILITY
KINGSTON FOSSIL PLANT - PENINSULA SITE

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV NO.
R 0	02/08	JTS	SAH	JTS	HLP	BAK					D

INITIAL ISSUE, FOR W.O.# KIF 08–500095–000 R0

DISCIPLINE INTERFACE

SCALE: NTS EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
COVER SHEET

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

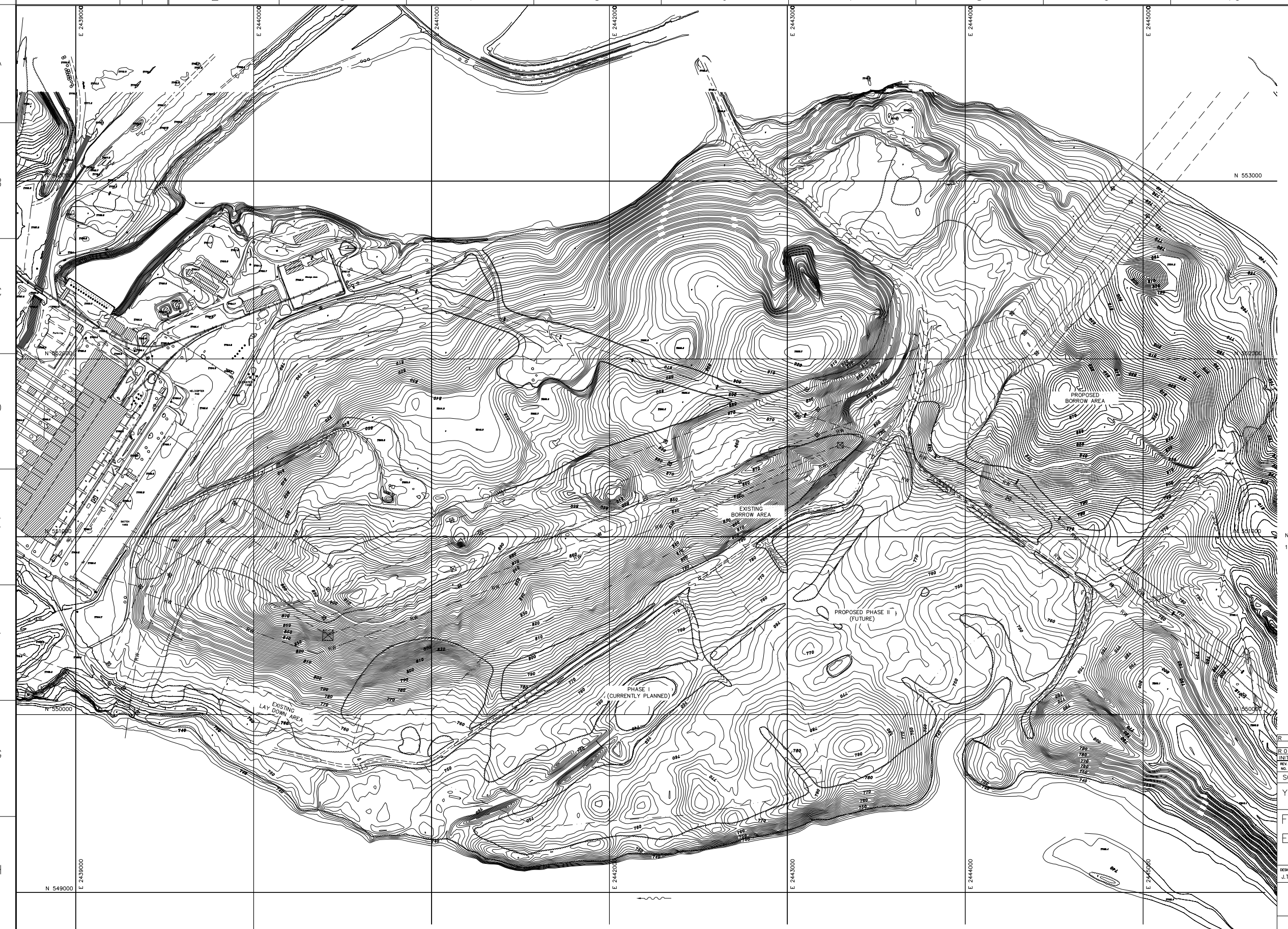
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R00	DATE	36	C	10W428–1	R 0

CONSOLIDATED TECH., INC.
TASK COMPLETED BY: REV NO.

PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ENGR	AS CONST	REV NO.
R											
R 0	02/08	JTS	SAH	JTS	HLP	BAK					0

INITIAL ISSUE. FOR W.O.# KIF 08-500095-000 R0

DISCIPLINE INTERFACE

SCALE: 1"=200' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
EXISTING SITE CONDITIONS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

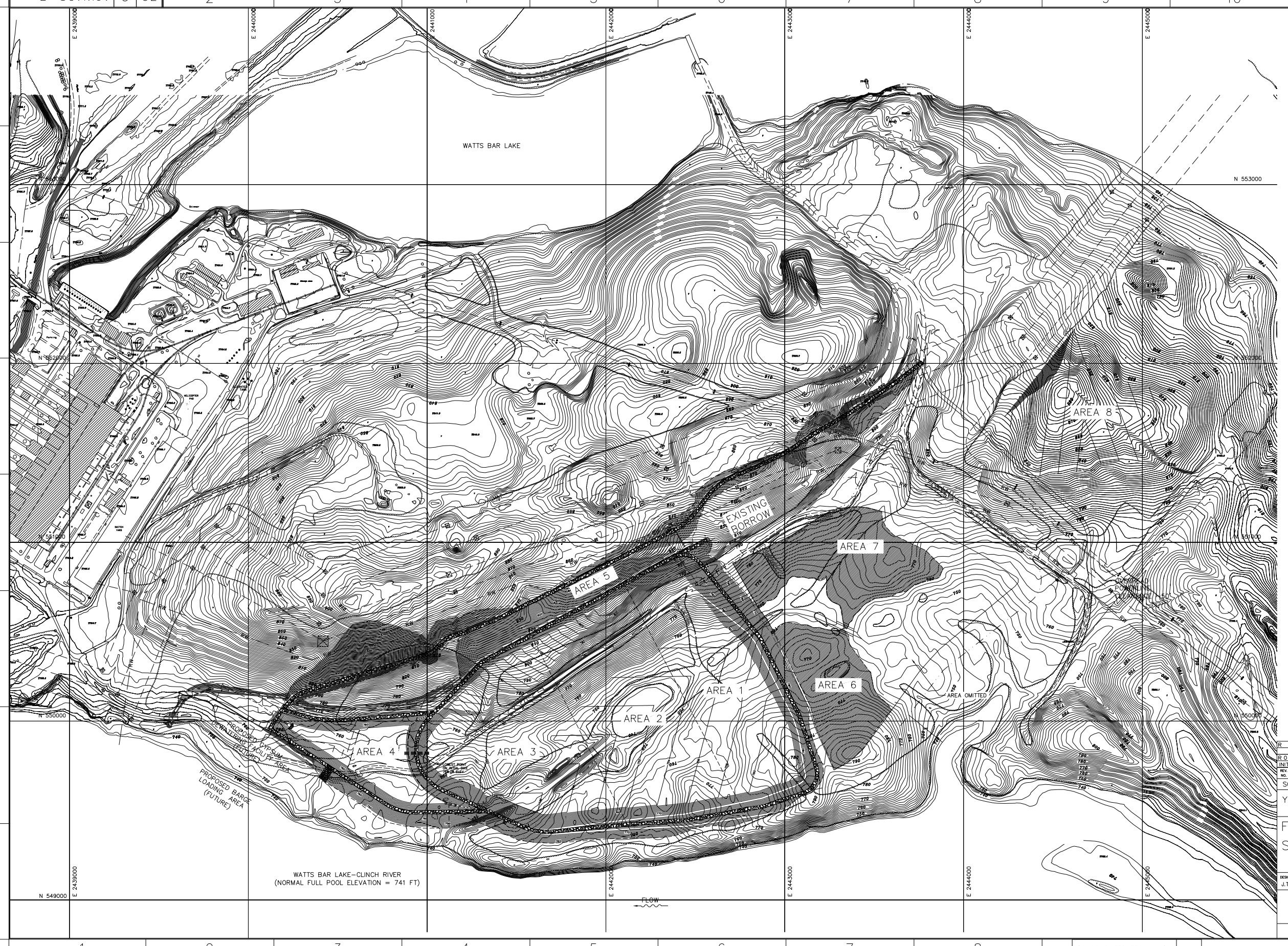
AUTOCAD R00	DATE	36	C	10W428-2	R 0

CONSOLIDATED TECH., INC.	
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

36 C 10W428-2



REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	02/08	JTS	SAH	JTS	HLP	BAK				

INITIAL ISSUE; FOR W.O.# KIF 08-500095-000 R0

DISCIPLINE INTERFACE

SCALE: 1"=200' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
SITE DEVELOPMENT PLAN

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

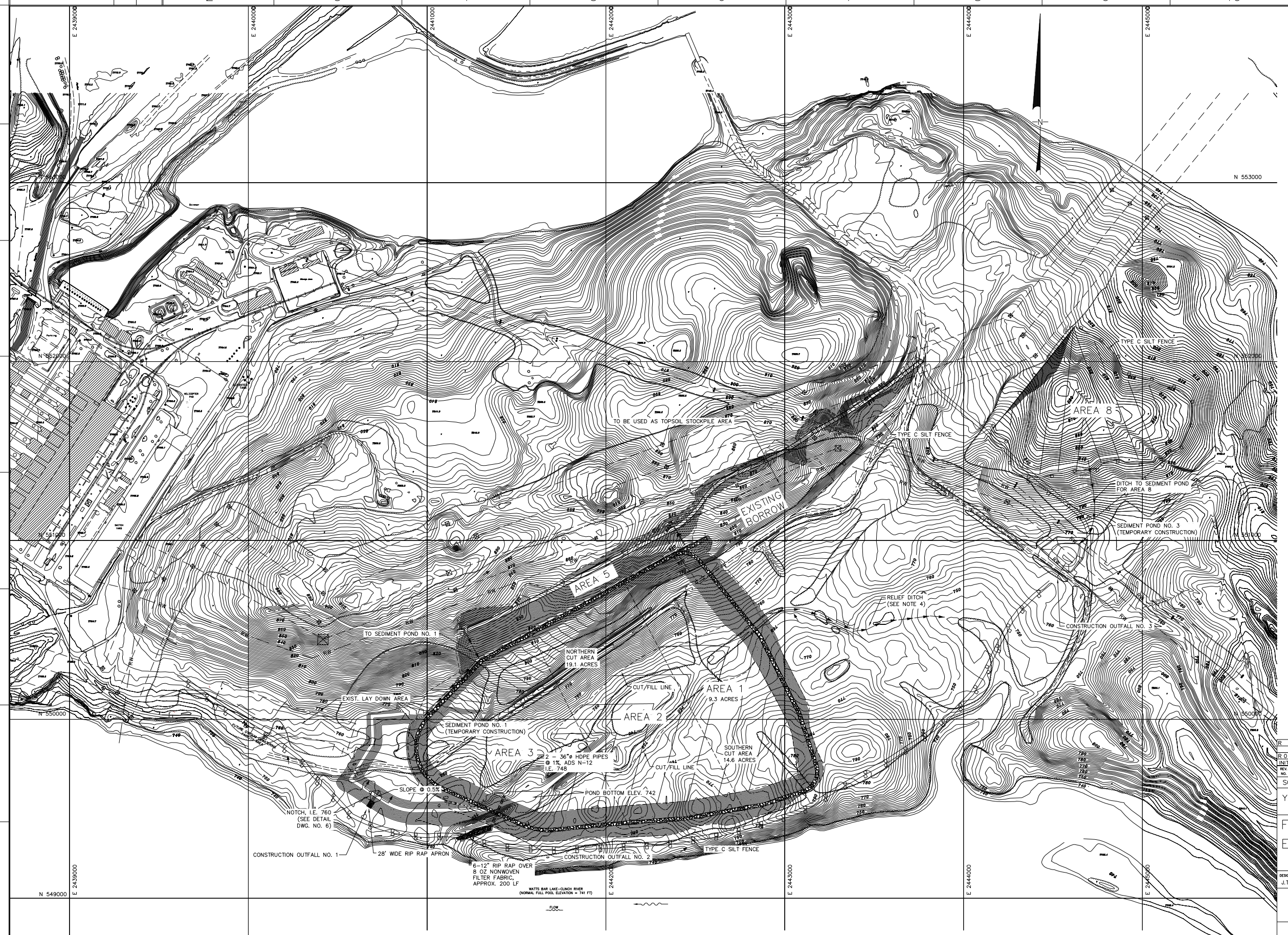
AUTOCAD R00	DATE	36	C	10W428-3	R 0

CONSOLIDATED TECH., INC.

TASK COMPLETED BY: REV NO.

PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



QUANTITY TABLE

AREA	CUT, CY	FILL, CY	NET, CY	ACREAGE	TOPSOIL, CY
1	114,830	165,047	(50,217)	19.70	31,796
2	88,905	115,696	(27,391)	19.40	31,312
3	78,677	164,369	(85,692)	20.35	32,845
4	14,457	88,750	(74,293)	7.78	12,557
5	199,122	61,055	138,067	13.73	22,160
6	44,770	0	44,770	6.32	10,200
7	93,851	0	93,851	8.80	14,203
8	251,463	0	251,463	9.78	15,785

QUANTITY TABLE NOTES:
1. AREAS 6 AND 7 HAVE BEEN OMITTED FOR USE AS BORROW AREAS.
2. TOPSOIL QUANTITY IS BASED ON AN AVERAGE STRIPPING DEPTH OF 12-INCHES.
3. A SHRINKAGE FACTOR OF 20 PERCENT HAS BEEN ADDED TO FILL QUANTITIES.
4. THE QUANTITY OF TOPSOIL FROM STRIPPING ACTIVITIES IS APPROXIMATELY 150,000 CUBIC YARDS. THE DIMENSIONS FOR A SINGLE STOCKPILE OF THIS MATERIAL WOULD HAVE A SQUARE BASE WITH SIDE DIMENSIONS OF 450 FEET , A HEIGHT OF 25 FEET, AND A SQUARE TOP WITH SIDE DIMENSIONS OF 354 FEET ASSUMING SIDE SLOPES OF 2:1.

TEMPORARY SEDIMENT PONDS

POND NO.	TOTAL REQUIRED CAPACITY (CF)	DRAINAGE AREA (ACRES)	CAPACITY PER ACRE (CF)	TOTAL CAPACITY (CF)
1	146,255	46.9	3,118	580,934
2	243,238	78.0	3,118	846,320
3	46,777	16.0	2,924	47,448

1. TOTAL CAPACITY BASED ON RUNOFF FROM THE 2-YEAR, 24-HOUR STORM

NOTE:
REFER TO DOCUMENT ENTITLED KIF GYPSUM POND LINE ITEMS FOR CONSTRUCTION SEQUENCE.

NOTES:
1. ALL SLOPES ASSOCIATED WITH THE ACCESS ROAD CONSTRUCTION AND THE OUTER SLOPE OF THE PHASE I AND STORM WATER POND DIKES WILL RECEIVE SOD.
2. THE TOP OF THE 3-FOOT GEOLOGIC BUFFER AND INSIDE SLOPES OF THE PHASE I AREA WILL RECEIVE POSI-SHELL.
3. THE INSIDE SLOPES AND BOTTOM SURFACE OF THE STORM WATER POND WILL RECEIVE POSI-SHELL.
4. CONSTRUCT RELIEF DITCH PRIOR TO CONSTRUCTION OF SOIL DIKE CONSTRUCTION IN THIS AREA.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV ID
R											
R 0	02/08	JTS	SAH	JTS	HLP	BAK					D

INITIAL ISSUE: FOR W.O.# KIF 08-500095-000 R0

SCALE: 1"=200' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
EROSION CONTROL PLAN

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

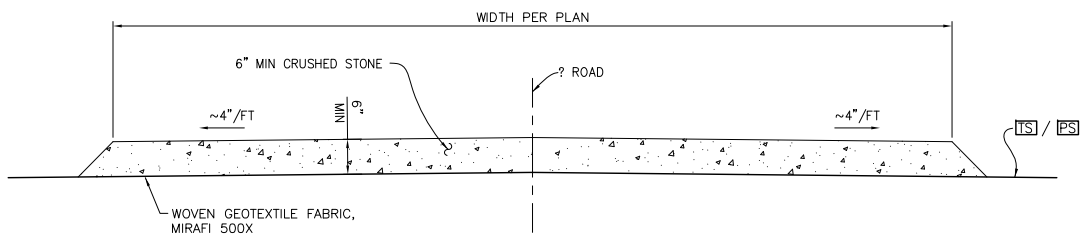
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R00	DATE 02/08	36	C	10W428-4	R 0

CONSOLIDATED TECH., INC.
TASK COMPLETED BY: | REV NO.

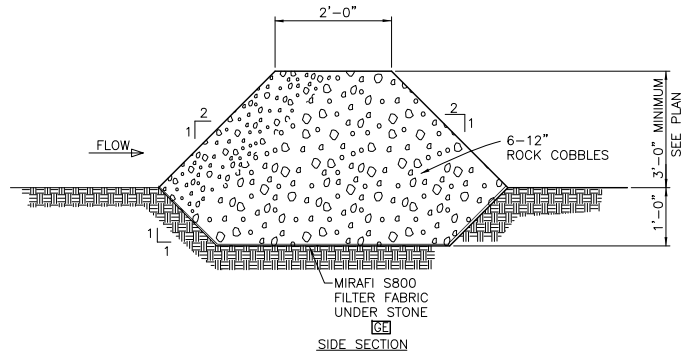
PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

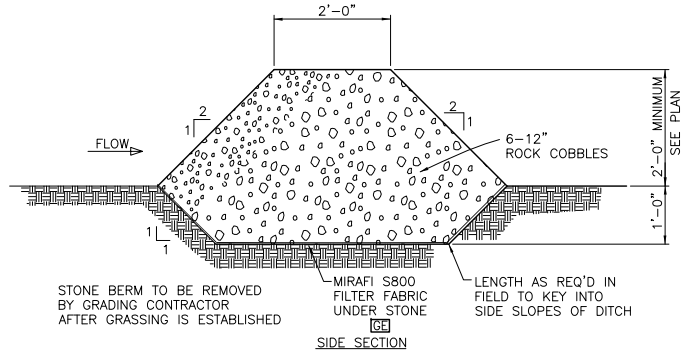


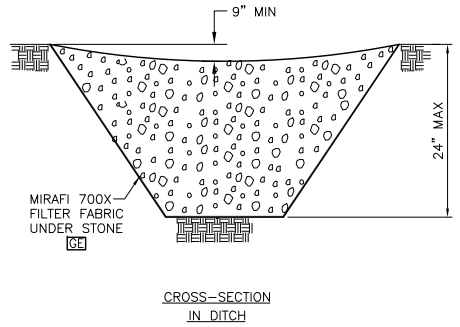
ROADWAY
TYPICAL SECTION
NOT TO SCALE

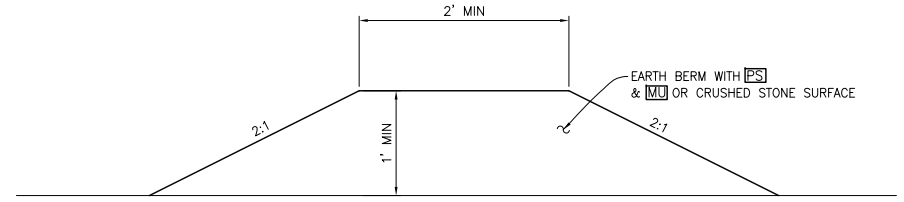
GRAVEL THICKNESS:
1. 6-INCHES PERIMETER ROAD ON STORM WATER AND PHASE 1 DIKES.
2. 12-INCHES ON ACCESS ROAD.
3. GRAVEL SHALL CONFORM TO TYPE "A" GRADING "D" PER T.D.O.T. SPECIFICATIONS SECTION 303.



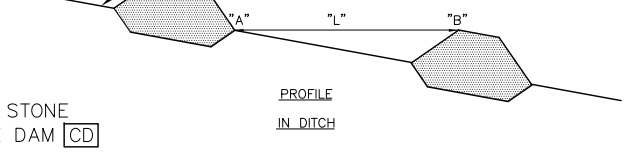
STORM WATER PUMP STATION
INLET FILTER RING DETAIL
NOT TO SCALE



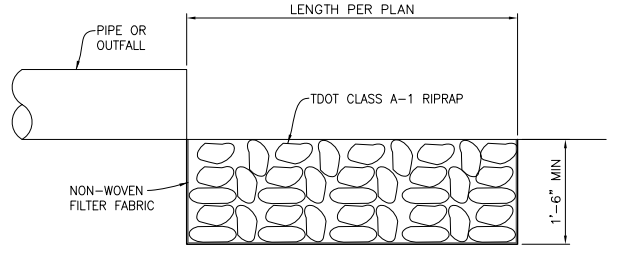




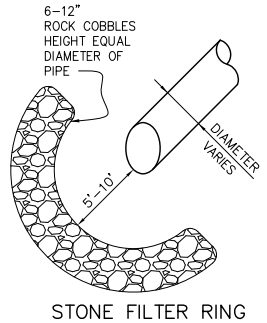
DIVERSION BERM DI
TYPICAL DETAIL 9
NOT TO SCALE



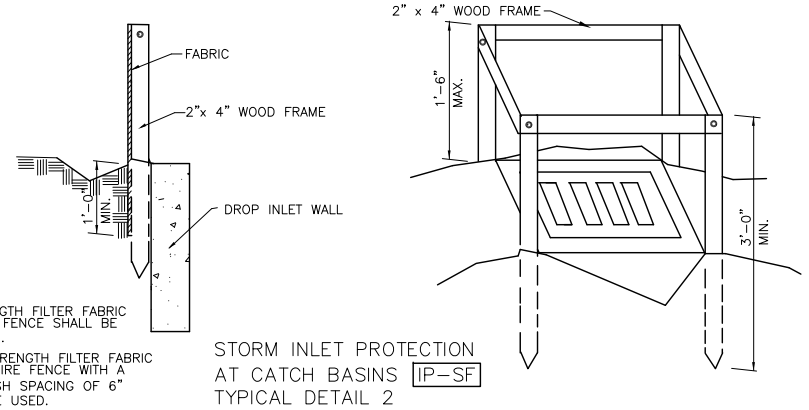
DITCH STONE
CHECK DAM CD
TYPICAL DETAIL 4
NOT TO SCALE



OUTLET PROTECTION OP
TYPICAL DETAIL 8
NOT TO SCALE



STONE FILTER RING
INLET
PROTECTION FR
TYPICAL DETAIL 7
NTS



NOTES
EXTRA STRENGTH FILTER FABRIC
1. NO WIRE FENCE SHALL BE REQUIRED.

STANDARD STRENGTH FILTER FABRIC
1. 14 GA. WIRE FENCE WITH A MAX. MESH SPACING OF 6" SHALL BE USED.
2. EXTEND WIRE FENCE TO BOTTOM OF TRENCH.

STORM INLET PROTECTION
AT CATCH BASINS IP-SF
TYPICAL DETAIL 2
NOT TO SCALE

TS DISTURBED AREA STABILIZATION WITH TEMPORARY VEGETATION
PS DISTURBED AREA STABILIZATION WITH PERMANENT VEGETATION
MU DISTURBED AREA STABILIZATION WITH MULCH
GE GEOTEXTILE

NOTES:
1. CONSTRUCT EROSION PROTECTION SILT FENCE DOWNSTREAM OF ALL DISTURBED AREA PERIMETER.
2. STAKE STRAW BALES AND SILT FENCE AS DESCRIBED IN SWPPP
3. EROSION CONTROL MEASURES SHALL BE INSTALLED AND MAINTAINED AND SHALL INCLUDE, BUT NOT LIMITED TO, SILT FENCES, AND STONE CHECK DAMS. ALL EROSION CONTROL MEASURES SHALL BE ESTABLISHED BEFORE BEGINNING CLEARING, GRUBBING AND CONSTRUCTION OPERATIONS.
4. SEE THE STORMWATER POLLUTION PREVENTION PLAN (SWPPP) FOR ADDITIONAL REQUIREMENTS FOR STORM WATER DISCHARGE AND SEDIMENTATION CONTROL.
5. THE CONTRACTOR SHALL FIELD VERIFY ALL EXISTING UNDERGROUND UTILITIES PRIOR TO BEGINNING THE HAUL ROAD AND FACILITY CONSTRUCTION.
6. STRIP SURFACE OF ALL VEGETATION, DEBRIS, STUMPS, BRUSH AND ORGANIC PERISHABLE MATERIAL PRIOR TO GRADING. DISPOSAL OF MATERIAL SHALL BE IN ACCORDANCE WITH SWPPP.
7. FOR SOIL EROSION PLANS SEE DRAWING NO.10W428-4.
8. REMOVE EXISTING FENCE AS REQUIRED FOR GRADING OPERATIONS.
9. IF WORK IS SUSPENDED AND WILL NOT RESUME WITHIN 15 DAYS, TEMPORARY OR PERMANENT STABILIZATION OF DISTURBED AREAS SHALL BE COMPLETED WITHIN 15 DAYS OF WORK CEASING.
10. TVA CONSTRUCTION MANAGER HAS THE AUTHORITY TO MODIFY DESIGN DOCUMENTS AS NEEDED TO INSURE ADEQUATE MEASURES ARE TAKEN TO CONTROL RUNOFF DURING CONSTRUCTION. ANY MODIFICATIONS SHALL BE INCORPORATED INTO THE SWPPP WITHIN 14 DAYS.
11. PLACE SILT FENCING AROUND STOCKPILE MATERIALS, UNLESS OTHERWISE NOTED ON DRAWINGS.
12. SEDIMENT SHOULD BE REMOVED FROM SEDIMENT TRAPS, SILT FENCES, SEDIMENT PONDS, AND OTHER SEDIMENT CONTROLS AS NECESSARY, AND MUST BE REMOVED WHEN DESIGN CAPACITY HAS BEEN REDUCED BY 50%.
13. THE FIELD MAY UTILIZE DETAIL 6 AS AN ALTERNATIVE FOR STORM INLET PROTECTION, DETAIL 2, IF DESIRED.
14. ALL EROSION CONTROL MATERIALS & DEVICES SHALL COMPLY WITH THE "TENNESSEE EROSION AND SEDIMENT CONTROL HANDBOOK".
15. SILT FENCE AND STRAW BALES MAY BE REMOVED ONCE AREAS ARE STABILIZED.

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE
R											
R 0	02/08	JTS	SAH	JTS	HLP	BAK					D

INITIAL ISSUE; FOR W.O.# KIF 08-500095-000 R0

SCALE: NTS — EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
EROSION CONTROL DETAILS
SHEET 1 OF 2

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

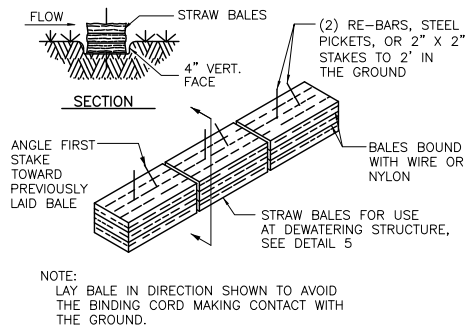
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R00	DATE 02/08	36	C	10W428-5	R 0

CONSOLIDATED TECH., INC.
TASK COMPLETED BY: | REV NO.

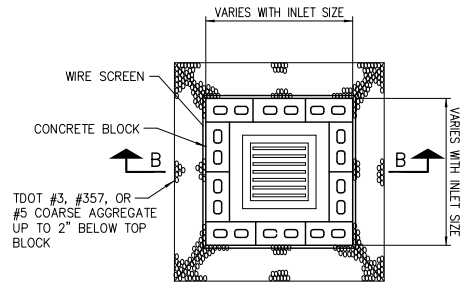
PLOT FACTOR: 1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

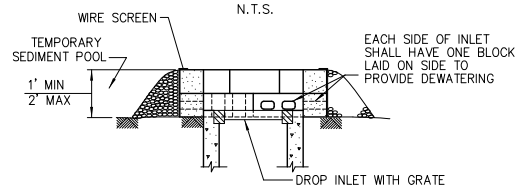


NOTE:
LAY BALE IN DIRECTION SHOWN TO AVOID THE BINDING CORD MAKING CONTACT WITH THE GROUND.

STRAW BALES ANCHORING
TYPICAL DETAIL 3
NOT TO SCALE

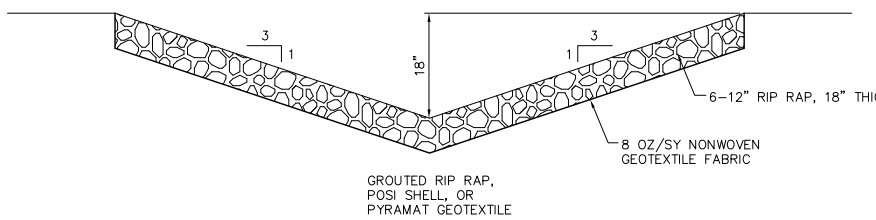


PLAN
N.T.S.

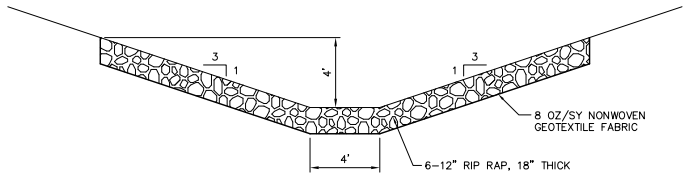


SECTION B–B
NTS

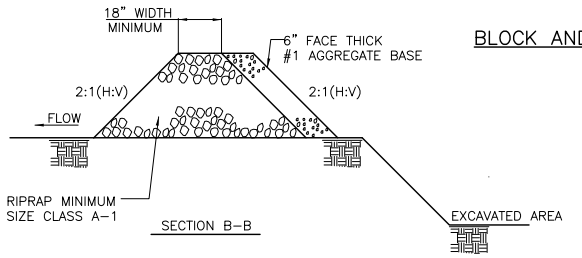
BLOCK AND GRAVEL INLET PROTECTION IP–BG
TYPICAL DETAIL 6
NOT TO SCALE



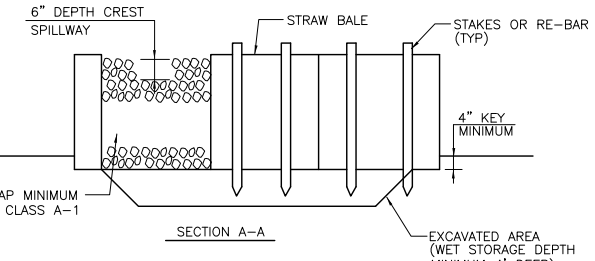
PROPOSED BORROW AREA DITCH TO SEDIMENT POND NO. 3
NOT TO SCALE



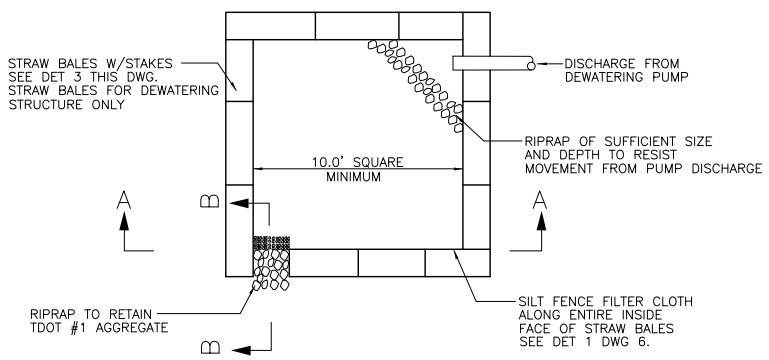
SEDIMENT POND NO. 1 NOTCH SECTION
SCALE: ¼"=1'-0"



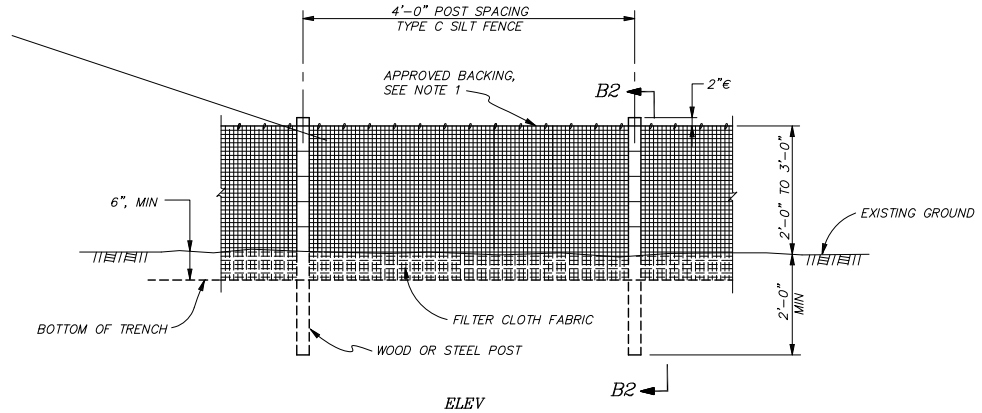
SECTION B–B



SECTION A–A



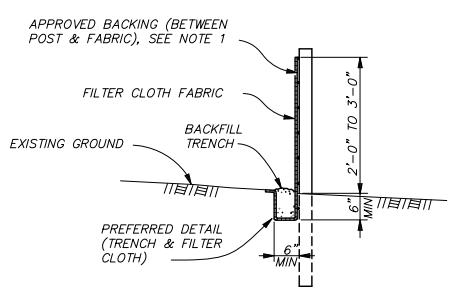
DEWATERING STRUCTURE
STRAW BALE/SILT FENCE DW
TYPICAL DETAIL 5
(AS REQUIRED
AT PUMP LOCATIONS)
NTS



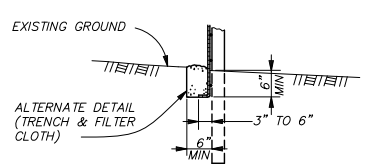
ELEV

SILT FENCE NOTES

1. FILTER CLOTH SHALL HAVE APPROVED BACKING OR A BUILT–IN REINFORCED STRUCTURE, AS RECOMMENDED BY THE MANUFACTURER TO SUPPORT THE FILTER CLOTH.
2. CLASS A FILTER FABRIC SHALL MEET THE REQUIREMENTS OF SECTION 571 OF THE T–1 SPECIFICATIONS.
3. A PREASSEMBLED SILT FENCE MEETING THE REQUIREMENTS OF THIS DRAWING IS ACCEPTABLE IN LIEU OF A FIELD CONSTRUCTED SILT FENCE.



B2–B2
PREFERRED TRENCH



B2–B2
ALTERNATE TRENCH

SILT FENCE TYPE "C"
NOT TO SCALE

R																
R 0	02/08	JTS	SAH	JTS	HLP	BAK										D
INITIAL ISSUE; FOR W.O.# KIF 08–500095–000 R0																
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

DISCIPLINE INTERFACE

SCALE: NTS — EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
EROSION CONTROL DETAILS
SHEET 2 OF 2

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R00	DATE 02/08	36	C	10W428–6	R 0

CONSOLIDATED TECH., INC.	
TASK COMPLETED BY:	REV NO.

PLOT FACTOR: 1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

36 | C | 10W428-7

REV	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV
R 0	02/08	JTS	SAH	JTS	HLP	BAK					0

INITIAL ISSUE. FOR W.O.# KIF 08-500095-000 R0

DISCIPLINE INTERFACE

SCALE: 1"=200' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
PHASE I INITIAL GRADING PLAN AND SOIL DIKES

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

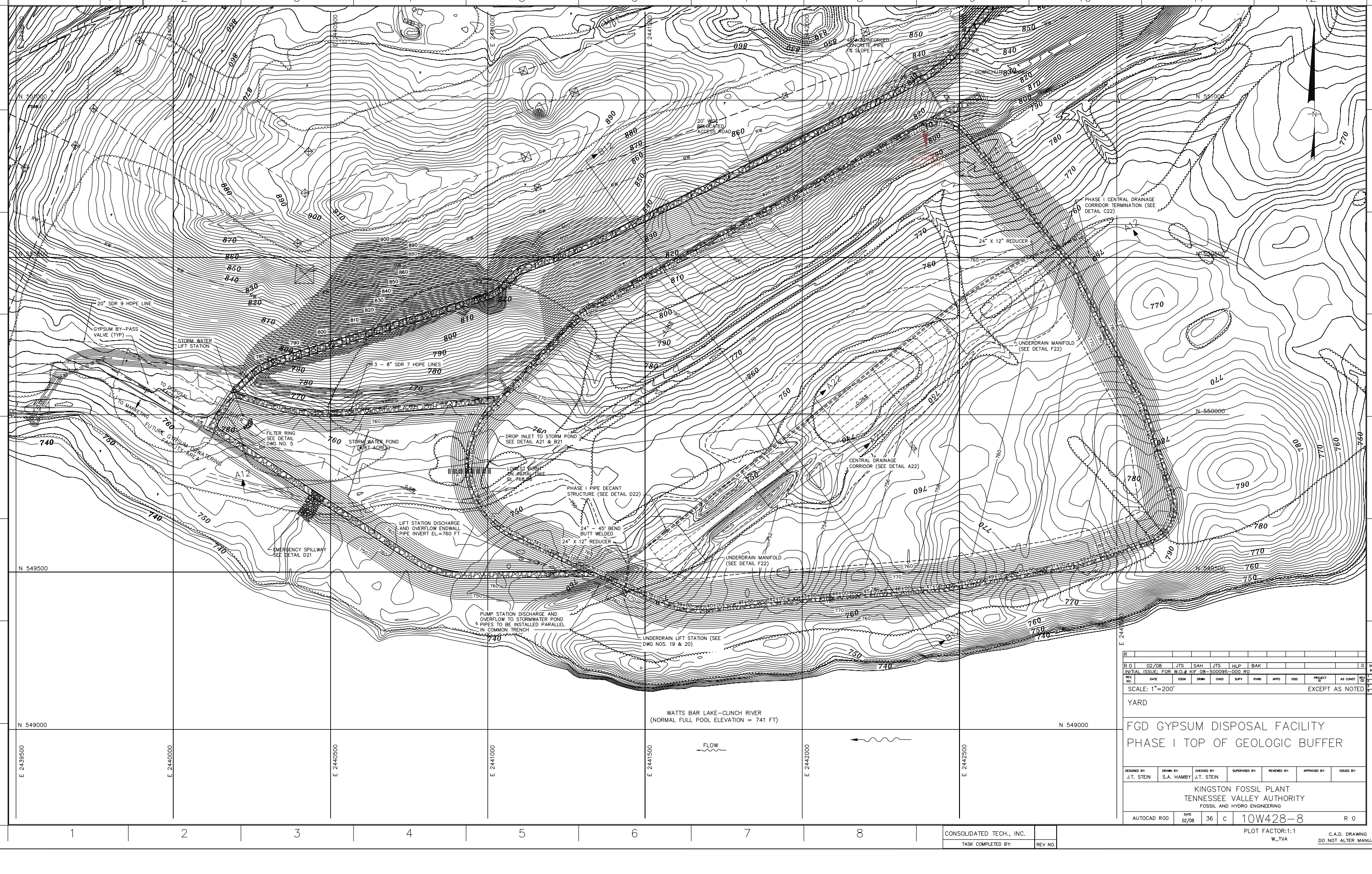
AUTOCAD R00	DATE 02/08	36	C	10W428-7	R 0

CONSOLIDATED TECH., INC.
TASK COMPLETED BY: REV NO.

PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

36 | C | 10W428-8



R															
R 0	02/08	JTS	SAH	JTS	HLP	BAK									D
INITIAL ISSUE; FOR W.O.# KIF 08-500995-000 R0															DISCIPLINE INTERFACE
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. ID				

SCALE: 1"=200' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
PHASE I TOP OF GEOLOGIC BUFFER

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

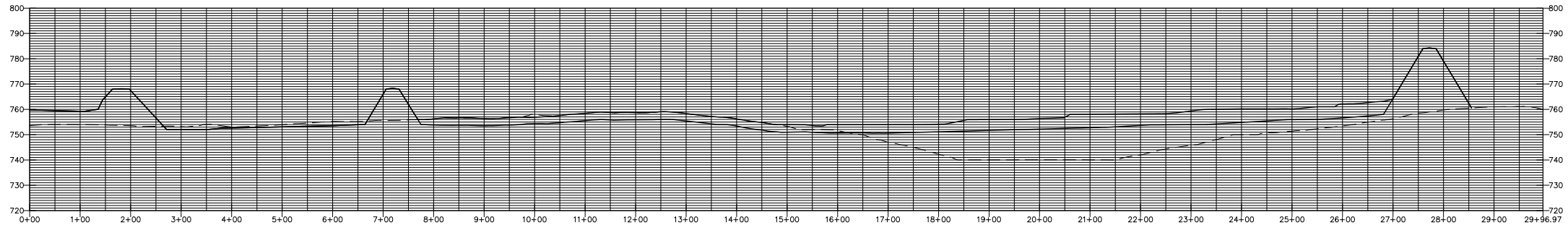
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R00	DATE 02/08	36	C	10W428-8	R 0

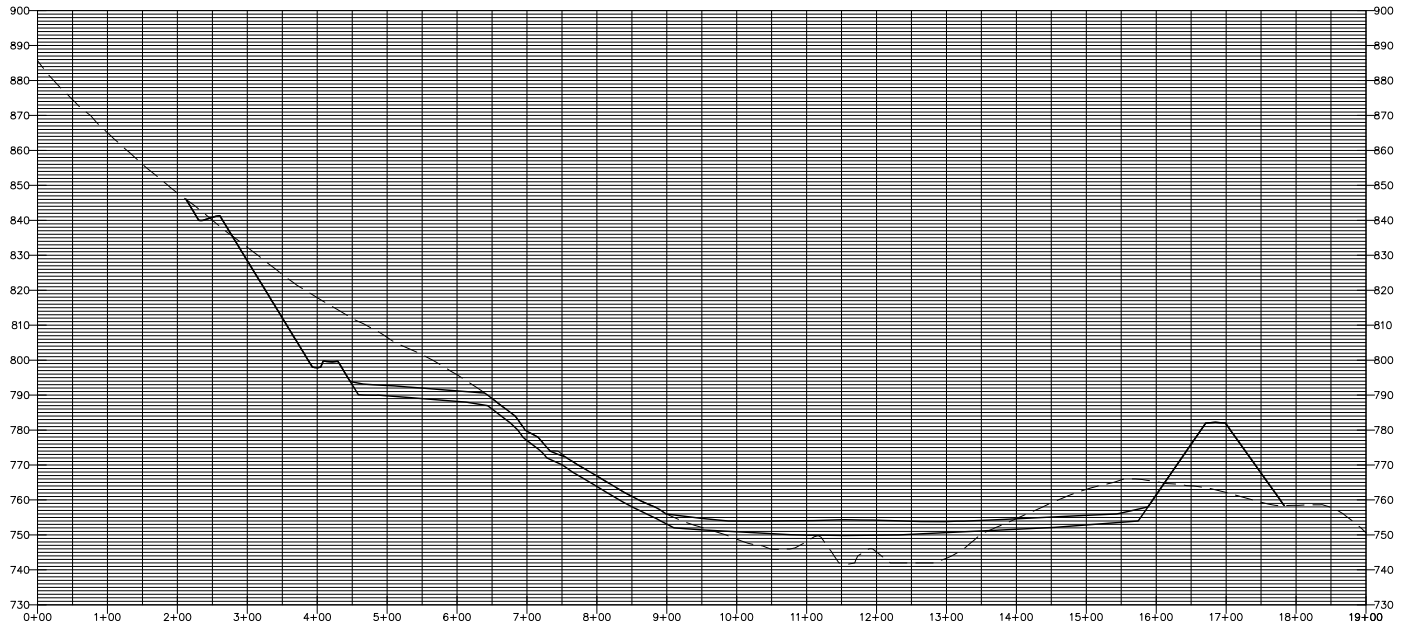
CONSOLIDATED TECH., INC.
TASK COMPLETED BY: REV NO.

PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



SECTION A12
HORIZ: 1"=100'
VERT: 1"=20'



SECTION B12
HORIZ: 1"=100'
VERT: 1"=20'

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE
R											
0	02/08	JTS	SAH	JTS	HLP	BAK					

INITIAL ISSUE; FOR W.O.# KIF 08-500995-000 R0

SCALE: 1"=200' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
CROSS SECTIONS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

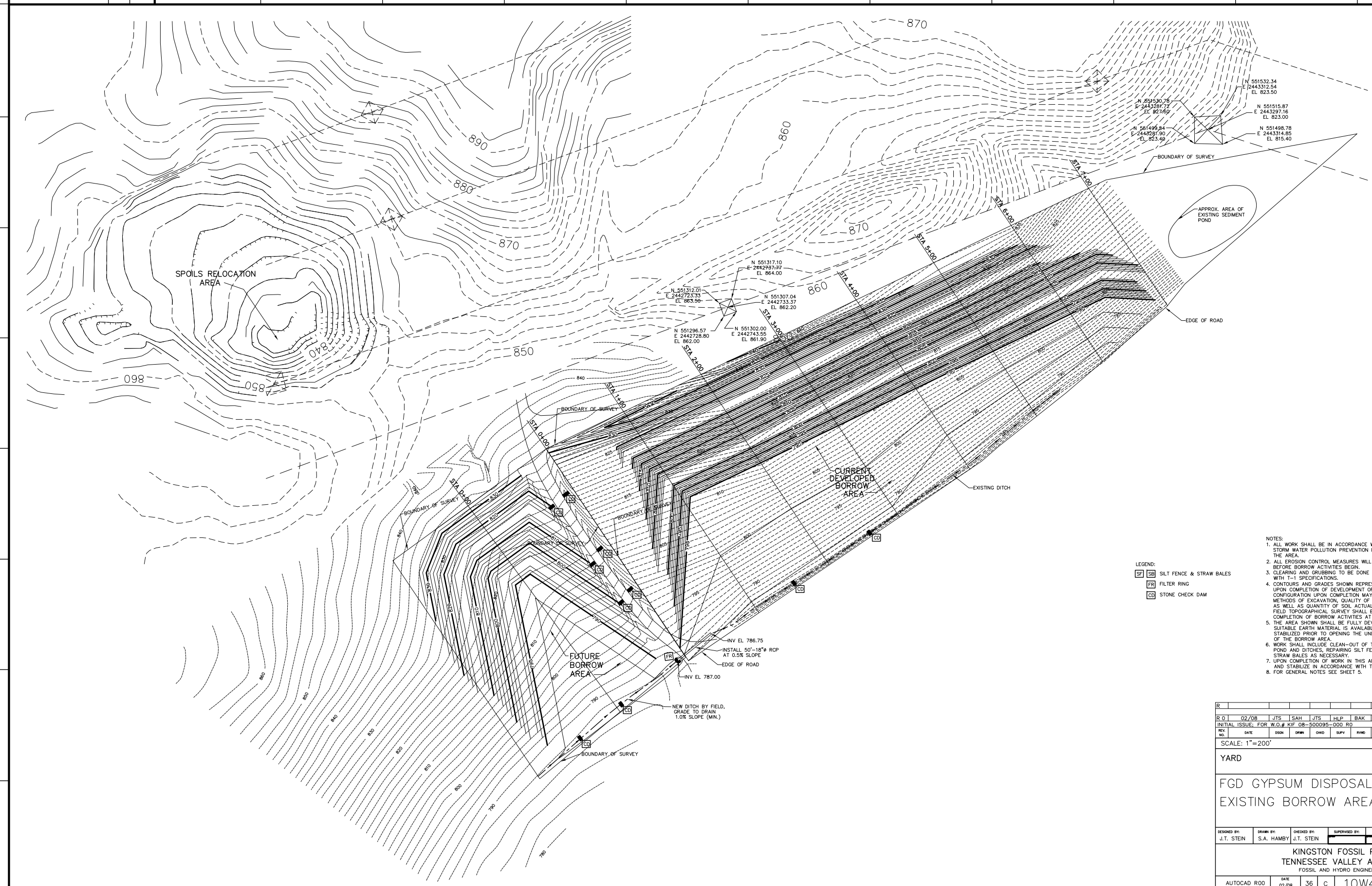
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R00	DATE 02/08	36	C	10W428-9	R 0

CONSOLIDATED TECH., INC.
TASK COMPLETED BY: REV NO.

PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



LEGEND:

SF SB SILT FENCE & STRAW BALES
FR FILTER RING
CD STONE CHECK DAM

NOTES:

1. ALL WORK SHALL BE IN ACCORDANCE WITH THE CONSTRUCTION STORM WATER POLLUTION PREVENTION PLAN DEVELOPED FOR THE AREA.
2. ALL EROSION CONTROL MEASURES WILL BE IN PLACE BEFORE BORROW ACTIVITIES BEGIN.
3. CLEARING AND GRUBBING TO BE DONE IN ACCORDANCE WITH T-1 SPECIFICATIONS.
4. CONTOURS AND GRADES SHOWN REPRESENT EXPECTED CONFIGURATION UPON COMPLETION OF DEVELOPMENT OF THE AREA. ACTUAL CONFIGURATION UPON COMPLETION MAY VARY DEPENDING UPON METHODS OF EXCAVATION, QUALITY OF SOIL IN CERTAIN LOCATIONS, AS WELL AS QUANTITY OF SOIL ACTUALLY REQUIRED. A FINAL FIELD TOPOGRAPHICAL SURVEY SHALL BE COMPLETED UPON COMPLETION OF BORROW ACTIVITIES AT THE SITES.
5. THE AREA SHOWN SHALL BE FULLY DEVELOPED TO THE EXTENT SUITABLE EARTH MATERIAL IS AVAILABLE AND SHALL BE STABILIZED PRIOR TO OPENING THE UNDEVELOPED PORTION OF THE BORROW AREA.
6. WORK SHALL INCLUDE CLEAN-OUT OF THE EXISTING SEDIMENT POND AND DITCHES, REPAIRING SILT FENCE AND REPLACING STRAW BALES AS NECESSARY.
7. UPON COMPLETION OF WORK IN THIS AREA, SEED, MULCH AND STABILIZE IN ACCORDANCE WITH T-1 SPECIFICATIONS.
8. FOR GENERAL NOTES SEE SHEET 5.

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	02/08	JTS	SAH	JTS	HLP	BAK				

INITIAL ISSUE; FOR W.O.# KIF 08-500095-000 R0

DISCIPLINE INTERFACE

SCALE: 1"=200' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
EXISTING BORROW AREA

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

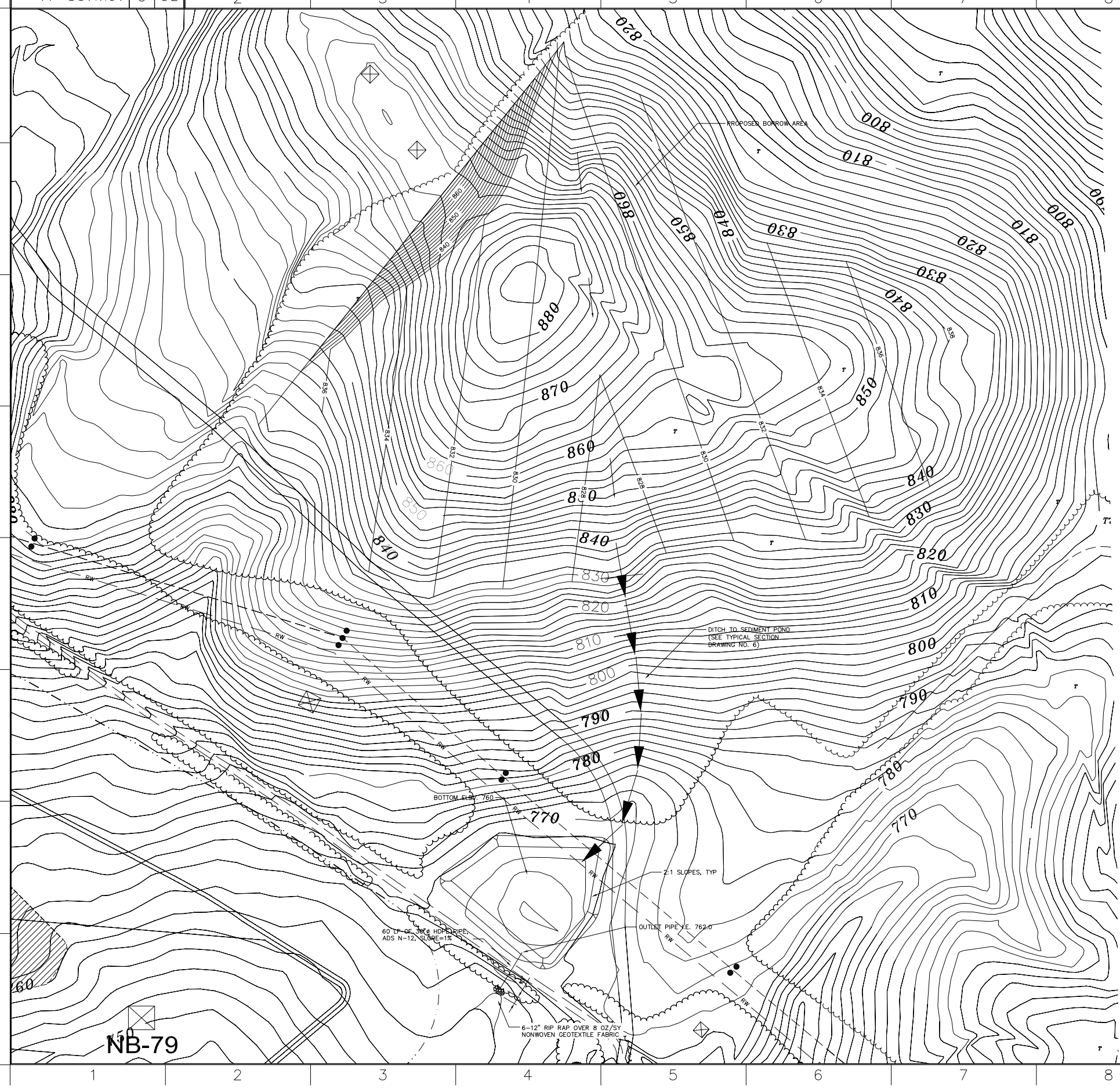
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R00	DATE 02/08	36	C	10W428-10	R 0

CONSOLIDATED TECH., INC.
TASK COMPLETED BY: REV NO.

PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



NOTE:
FINAL CONTOURS MAY VARY BASED ON THE ACTUAL AMOUNT OF BORROW MATERIAL REQUIRED FOR THE PROJECT.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV TO
R 0	02/08	JTS	SAH	JTS	HLP	BAK					D

INITIAL ISSUE; FOR W.O.# KIF 08-500095-000 R0

DISCIPLINE INTERFACE

SCALE: 1"=60' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
PROPOSED BORROW AREA
GRADING PLAN

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

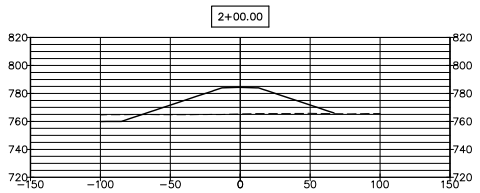
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

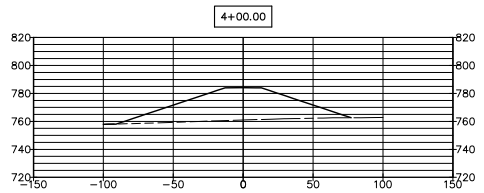
AUTOCAD R00	DATE 02/08	36	C	10W428-11	R 0

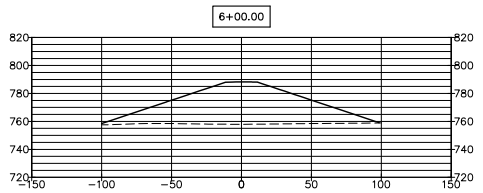
CONSOLIDATED TECH., INC.
TASK COMPLETED BY: REV NO.

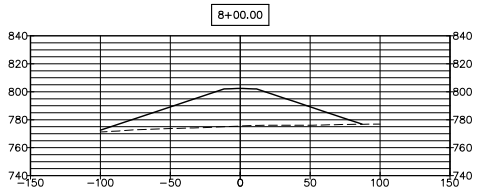
PLOT FACTOR:1:1
W_TVA

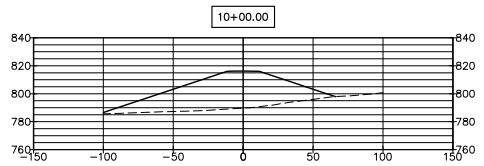
C.A.D. DRAWING
DO NOT ALTER MANUALLY

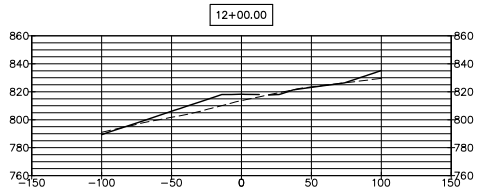


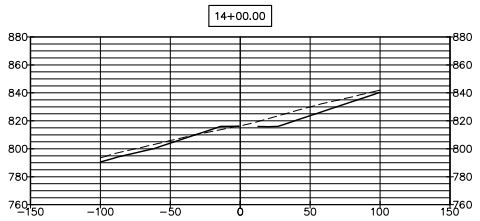


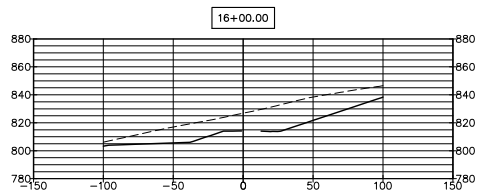


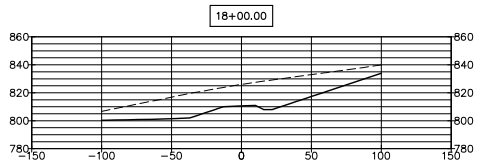


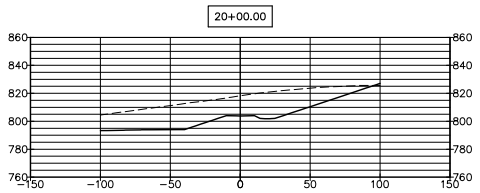


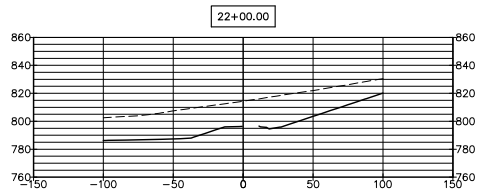


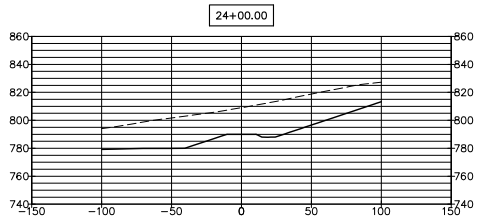


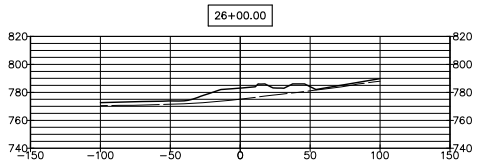


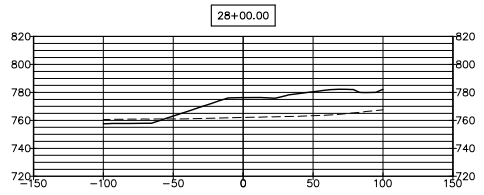


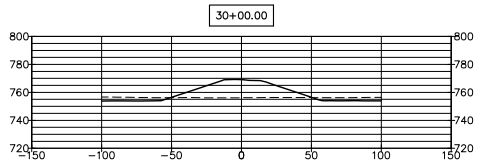












REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE
R											
R 0	02/08	JTS	SAH	JTS	HLP	BAK					D

INITIAL ISSUE; FOR W.O.# KIF 08-500995-000 R0

SCALE: 1"=50' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
PERIMETER BERM CROSS SECTIONS
SHEET 1 OF 2

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

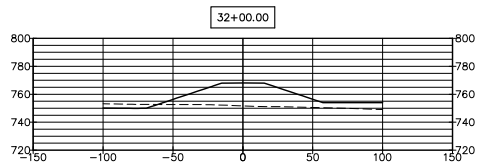
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

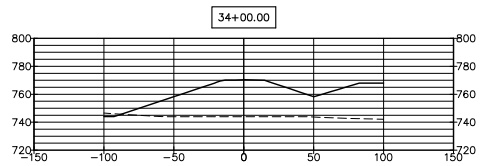
AUTOCAD R00	DATE 02/08	36	C	10W428-12	R 0

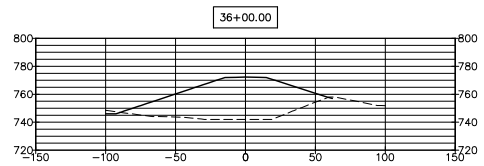
CONSOLIDATED TECH., INC.
TASK COMPLETED BY: REV NO.

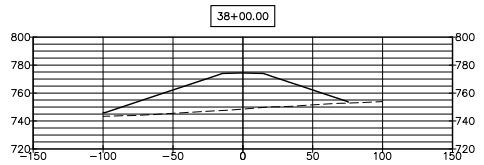
PLOT FACTOR:1:1
W_TVA

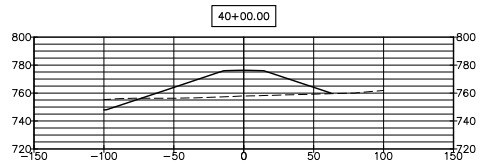
C.A.D. DRAWING
DO NOT ALTER MANUALLY

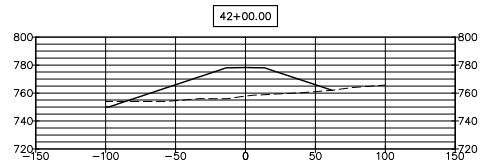


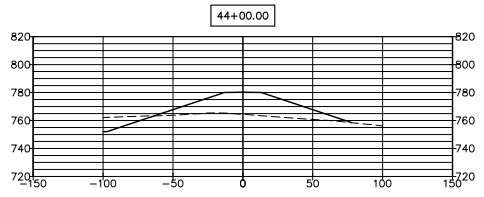


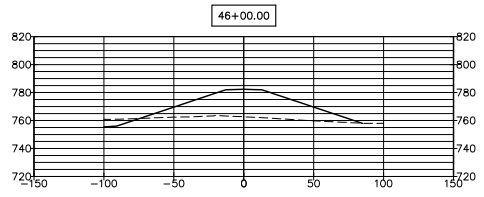


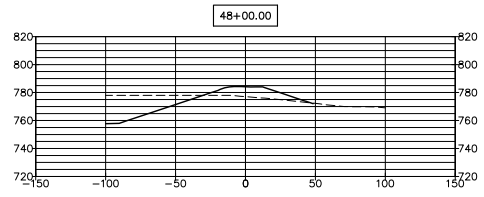


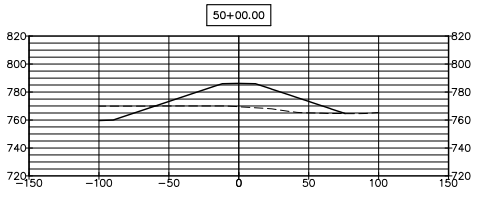


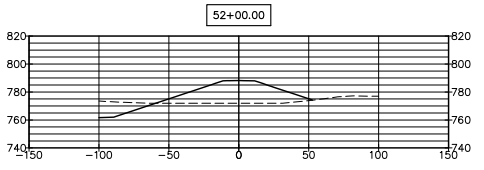


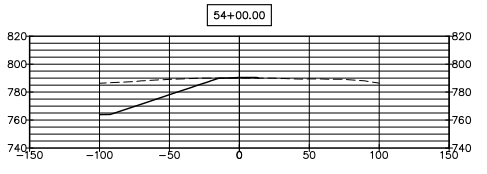


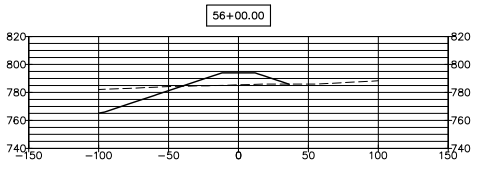


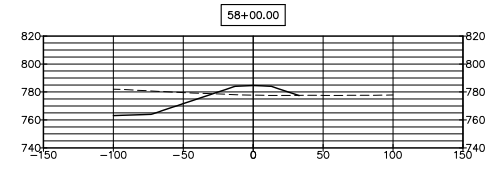












REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ED	AS CONST	DISCIPLINE INTERFACE
R 0	02/08	JTS	SAH	JTS	HLP	BAK					

INITIAL ISSUE; FOR W.O.# KIF 08-500995-000 R0

SCALE: 1"=50' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
PERIMETER BERM CROSS SECTIONS
SHEET 2 OF 2

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

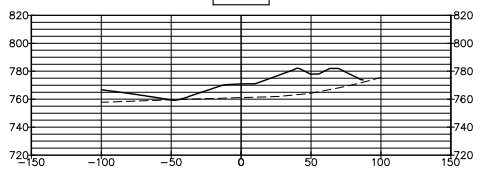
AUTOCAD R00	DATE 02/08	36	C	10W428-13	R 0

CONSOLIDATED TECH., INC.
TASK COMPLETED BY: REV NO.

PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

1+00.00



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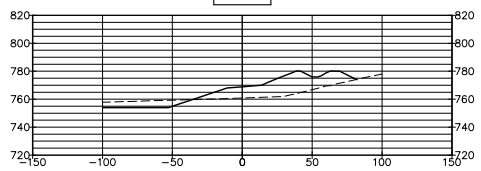

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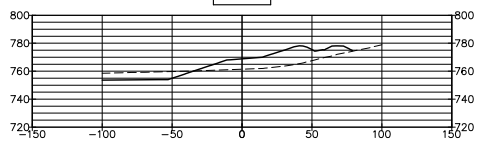

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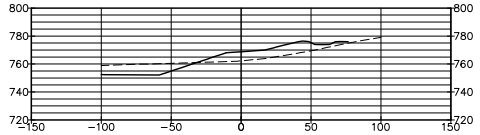

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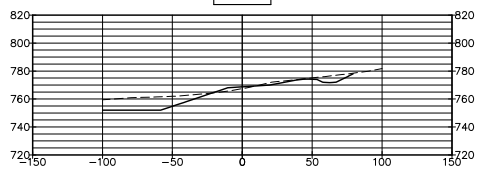

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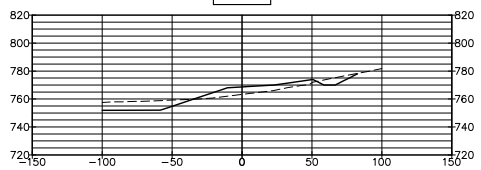

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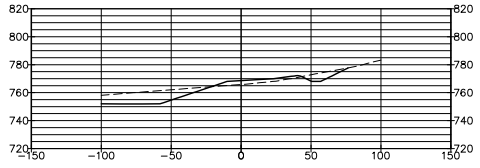

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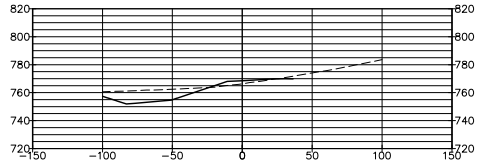

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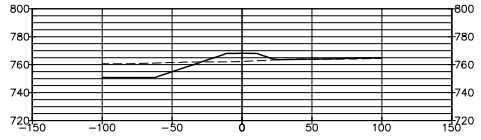

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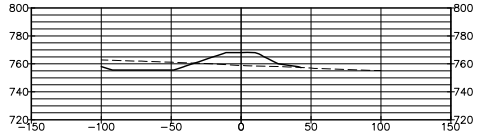

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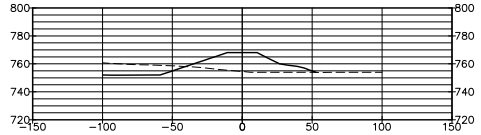

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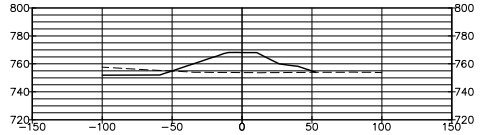

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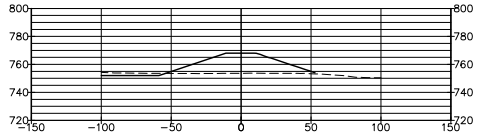

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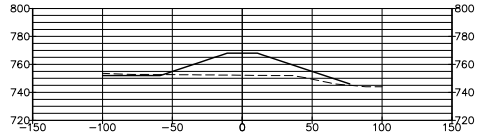

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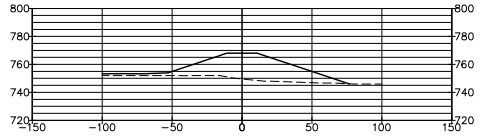

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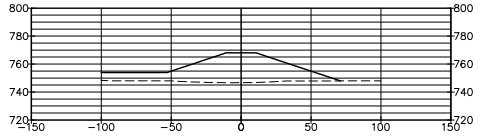

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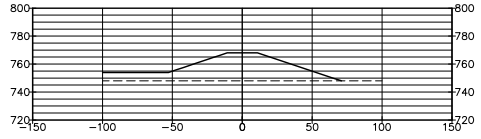

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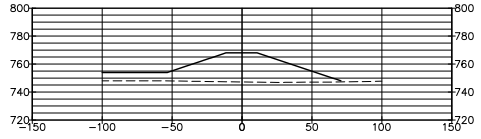

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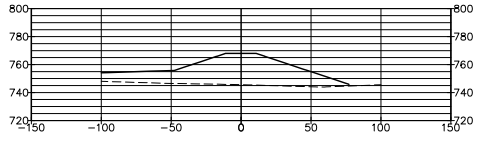

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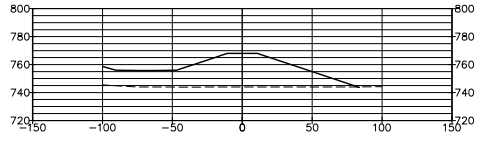

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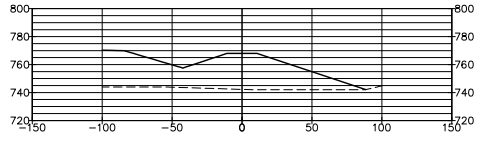

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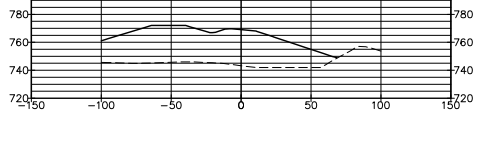


R

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE
R 0	02/08	JTS	SAH	JTS	HLP	BAK					D

INITIAL ISSUE; FOR W.O.# KIF 08-500095-000 R0

SCALE: 1"=50' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
STORM DETENTION POND SECTIONS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

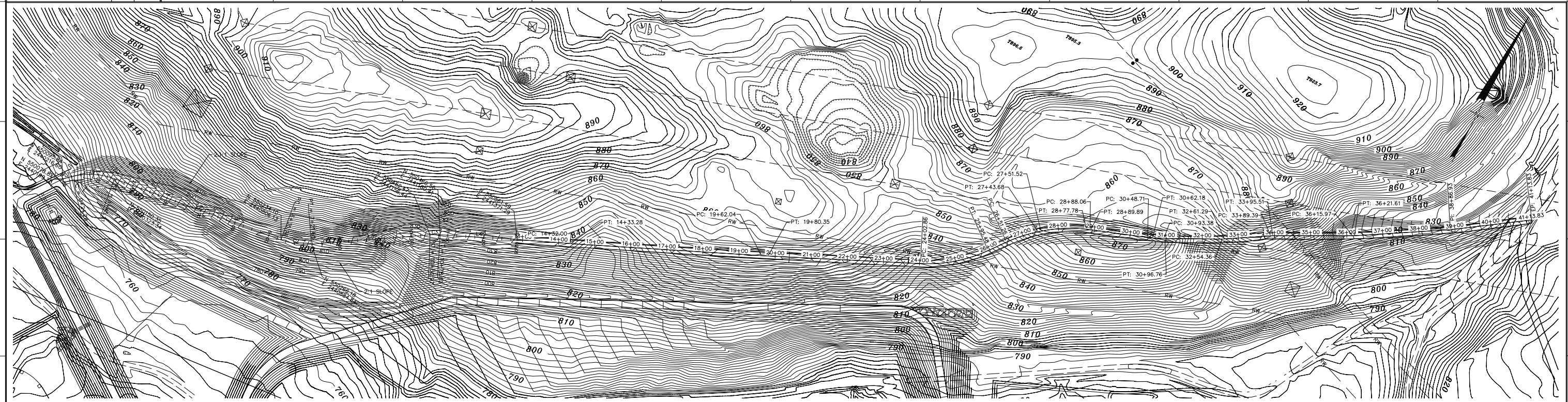
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R00	DATE 02/08	36	C	10W428-14	R 0

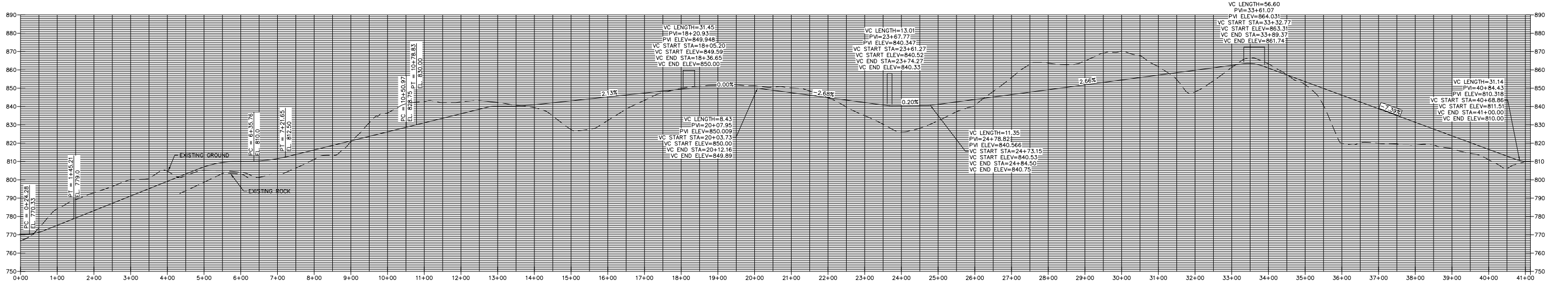
CONSOLIDATED TECH., INC.
TASK COMPLETED BY: REV NO.

PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



ROAD PLAN
SCALE: 1"=100'



ROAD PROFILE
HORIZ: 1"=100'
VERT: 1"=20'

LINE TABLE		
LINE	LENGTH	BEARING
L1	24.28	N45°30'50"E
L2	490.55	N80°09'32"E
L3	329.32	N55°33'14"E
L4	213.23	N63°32'07"E

CURVE TABLE						
CURVE	LENGTH	RADIUS	DELTA ANGLE	TANGENT	CHORD DIRECTION	CHORD
C1	120.93	200.00	34°38'42"	62.38	S62°50'11"W	119.10
C2	85.89	200.00	24°36'18"	43.62	N67°51'23"E	85.23
C3	27.86	200.00	7°58'53"	13.95	S59°32'40"W	27.84

R											
R 0	02/08	JTS	SAH	JTS	HLP	BAK					D
INITIAL ISSUE; FOR W.O.# KIF 08-500095-000 RO											DISCIPLINE INTERFACE
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	

SCALE: 1"=200' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
PROPOSED ROAD PLAN AND PROFILE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

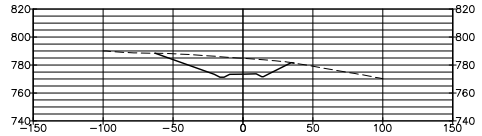
AUTOCAD R00	DATE 02/08	36	C	10W428-15	R 0

CONSOLIDATED TECH., INC.
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

1+00.00



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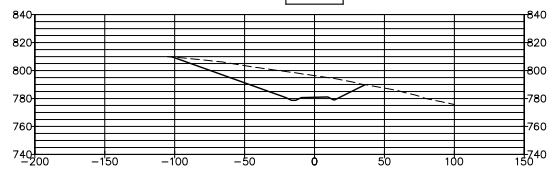

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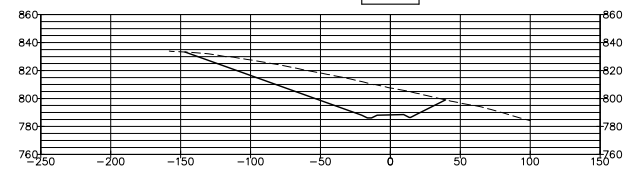

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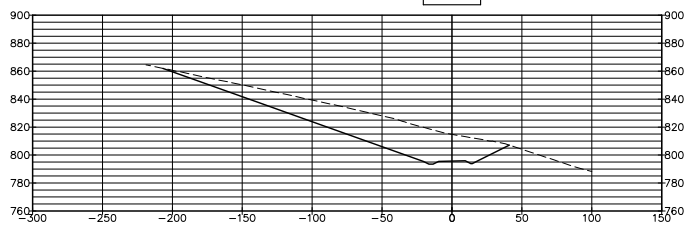

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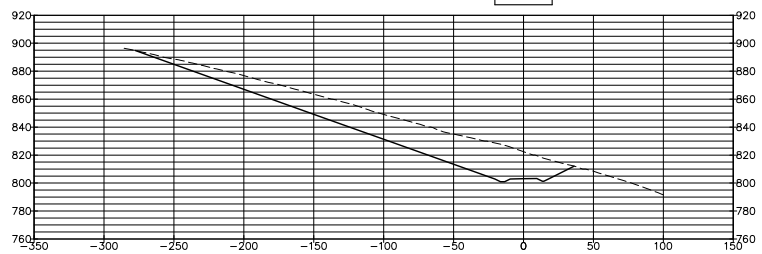

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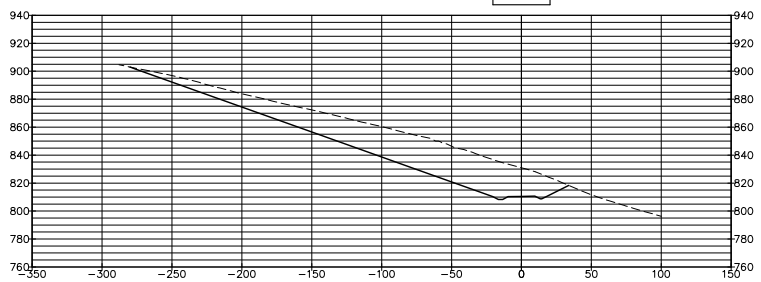

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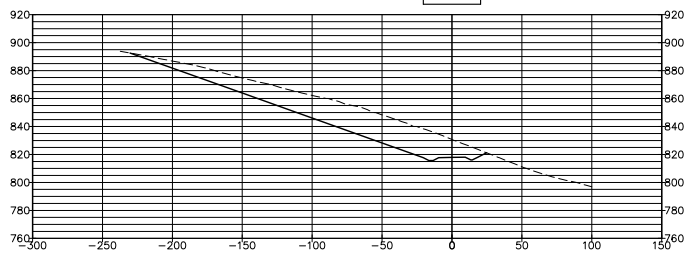

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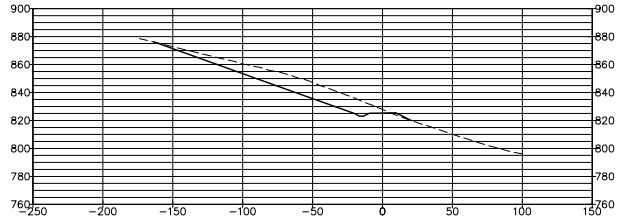

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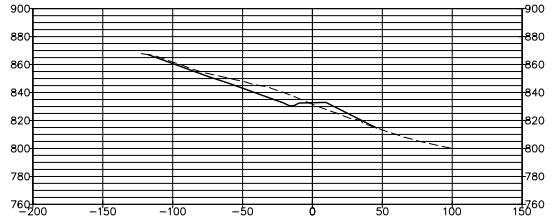

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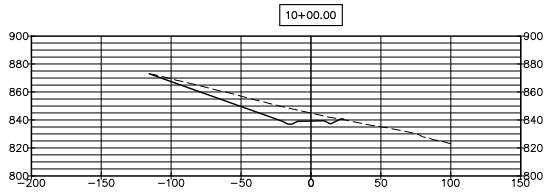

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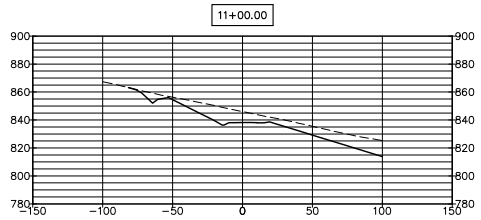

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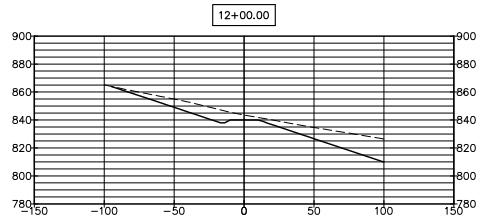

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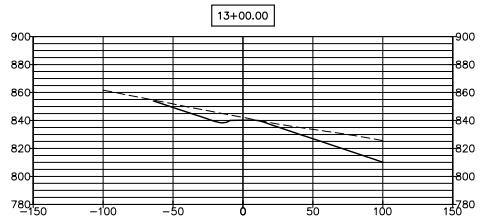

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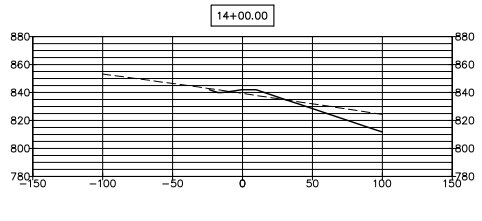

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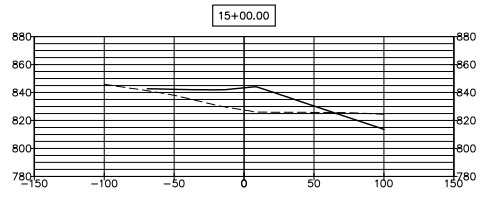


R													
R 0	02/08	JTS	SAH	JTS	HLP	BAK							D
INITIAL ISSUE. FOR W.O.# KIF 08-500095-000 R0													
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. ID		

SCALE: 1"=50' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
PROPOSED ROAD CROSS SECTIONS
SHEET 1 OF 3

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

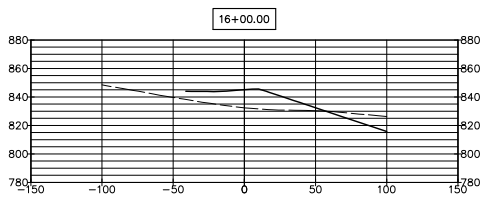
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

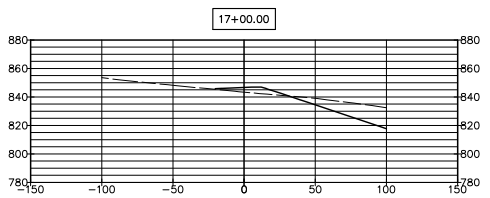
AUTOCAD R00	DATE 02/08	36	C	10W428-16	R 0

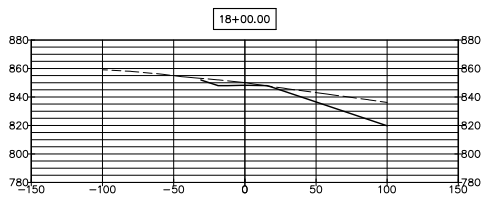
CONSOLIDATED TECH., INC.
TASK COMPLETED BY: REV NO.

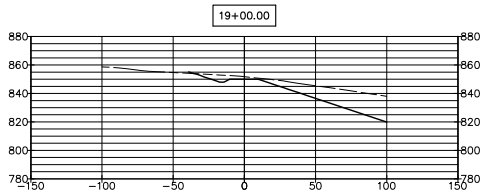
PLOT FACTOR:1:1
W_TVA

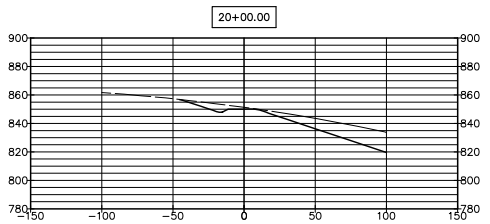
C.A.D. DRAWING
DO NOT ALTER MANUALLY

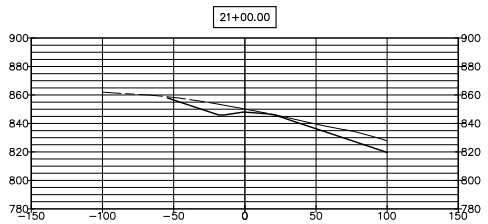


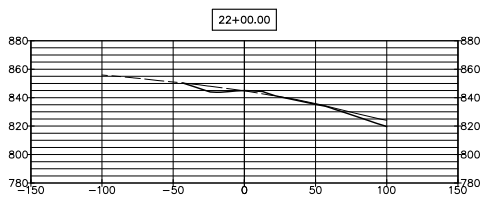


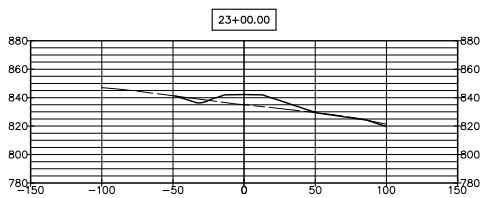


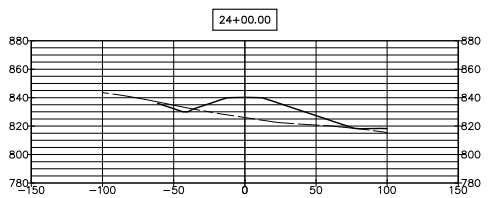


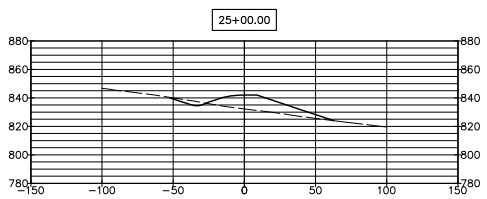


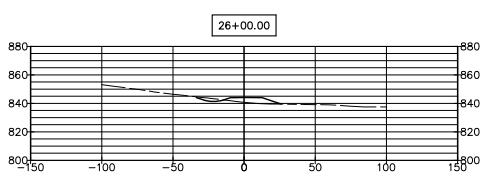


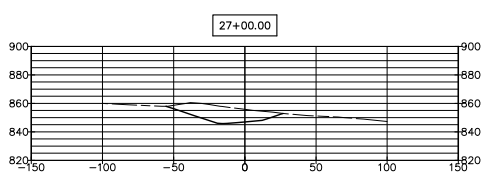


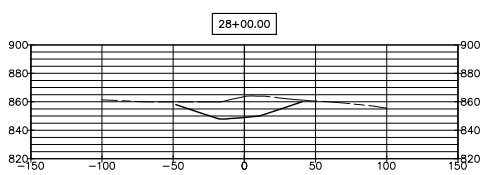


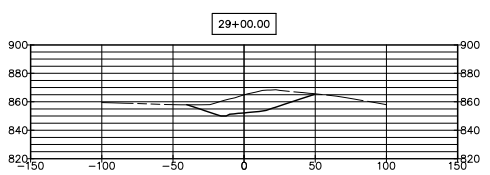


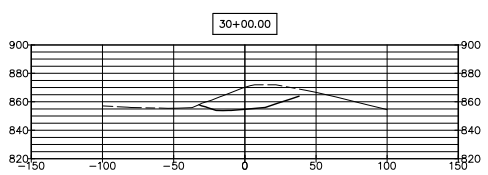












REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV NO.
R 0	02/08	JTS	SAH	JTS	HLP	BAK					D
INITIAL ISSUE; FOR W.O.# KIF 08-500095-000 RO											C

DISCIPLINE INTERFACE

SCALE: 1"=200' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
PROPOSED ROAD CROSS SECTIONS
SHEET 2 OF 3

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

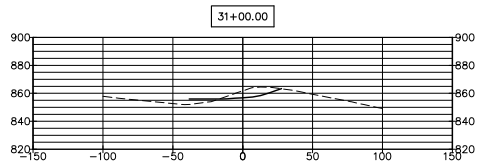
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

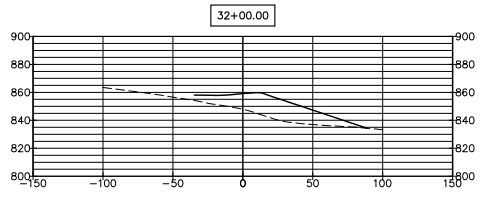
AUTOCAD R00	DATE 02/08	36	C	10W428-17	R 0

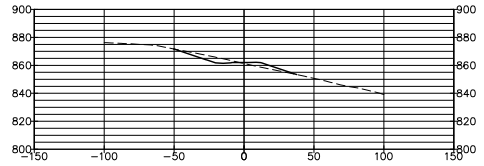
CONSOLIDATED TECH., INC.
TASK COMPLETED BY: | REV NO.

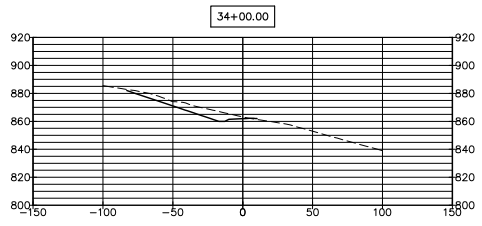
PLOT FACTOR:1:1
W_TVA

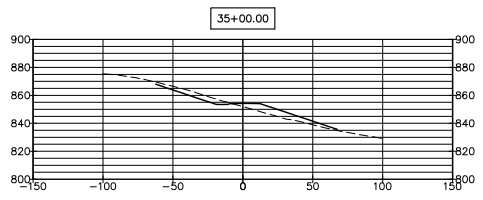
C.A.D. DRAWING
DO NOT ALTER MANUALLY

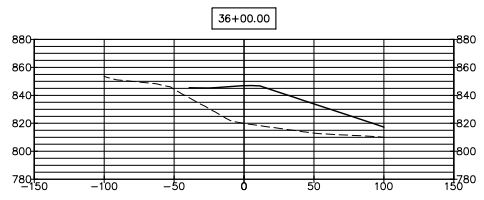


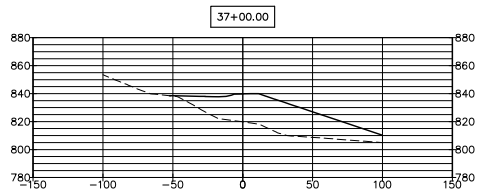


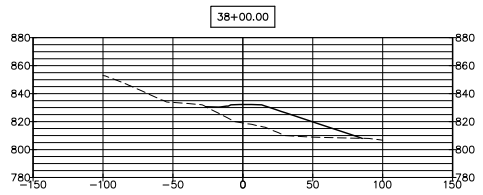


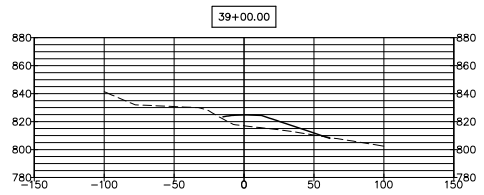


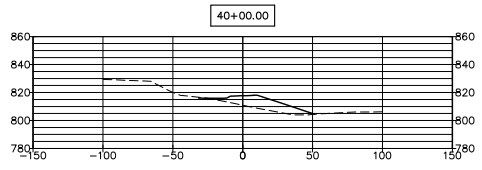


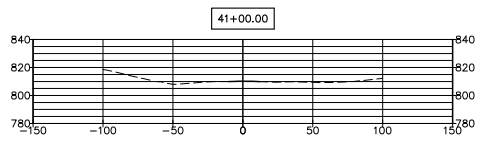












R

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE
R 0	02/08	JTS	SAH	JTS	HLP	BAK					D

INITIAL ISSUE; FOR W.O.# KIF 08-500095-000 R0

SCALE: 1"=50' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
PROPOSED ROAD CROSS SECTIONS
SHEET 3 OF 3

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

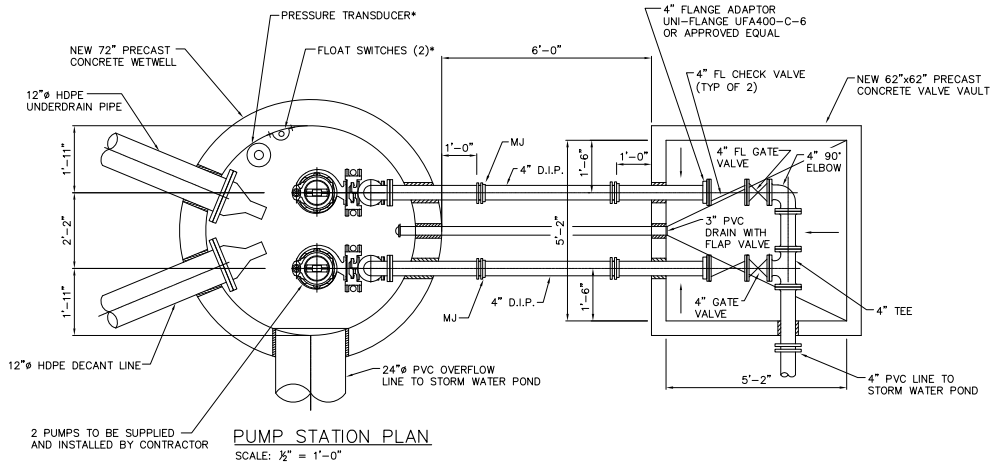
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R00	DATE 02/08	36	C	10W428-18	R 0

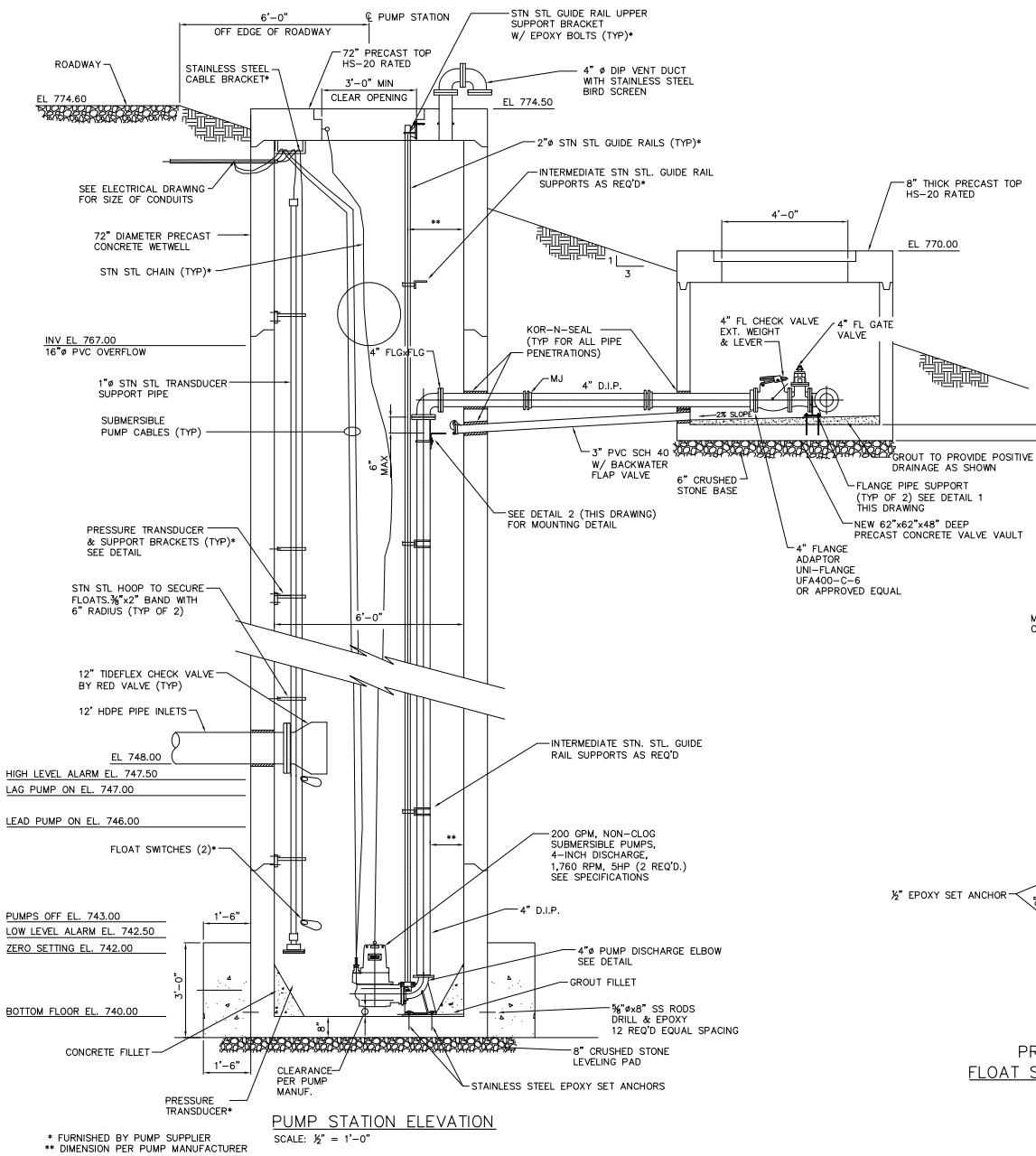
CONSOLIDATED TECH., INC.
TASK COMPLETED BY: REV NO.

PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

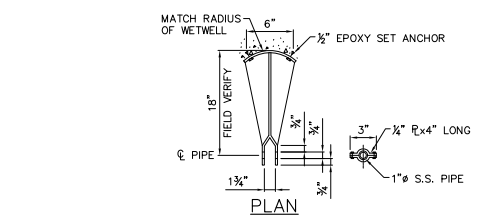


PUMP STATION PLAN
SCALE: ½" = 1'-0"

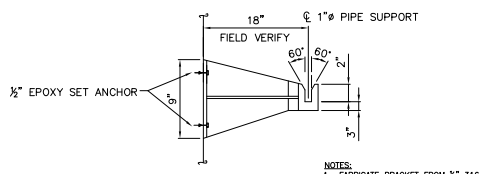


* FURNISHED BY PUMP SUPPLIER
** DIMENSION PER PUMP MANUFACTURER

PUMP STATION ELEVATION
SCALE: ½" = 1'-0"



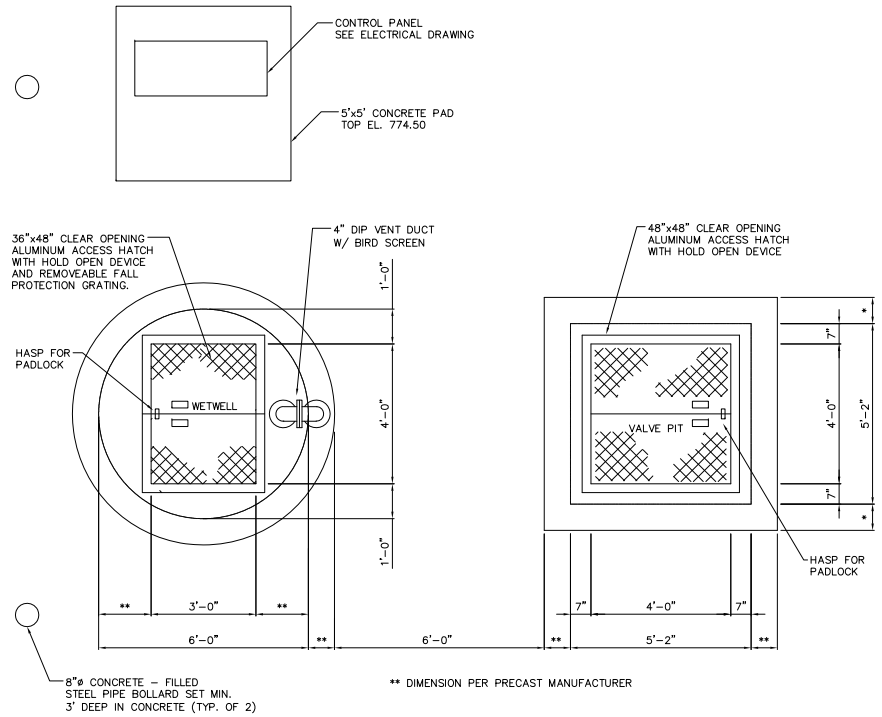
PLAN



NOTES:
1. FABRICATE BRACKET FROM ¾" 316 STAINLESS STEEL.
2. LOCATE BRACKETS SO PIPE CAN BE REMOVED THROUGH HATCH OPENING

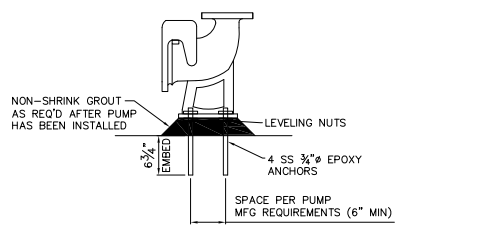
ELEVATION

PRESSURE TRANSDUCER AND FLOAT SUPPORT BRACKET (3 REQUIRED)
N.T.S.

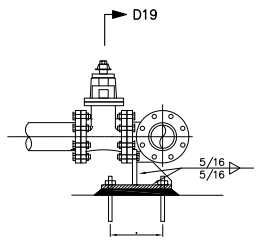


** DIMENSION PER PRECAST MANUFACTURER

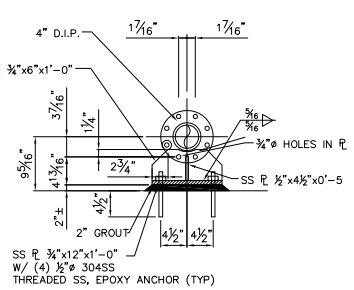
PUMP STATION TOP PLAN
SCALE: ½" = 1'-0"



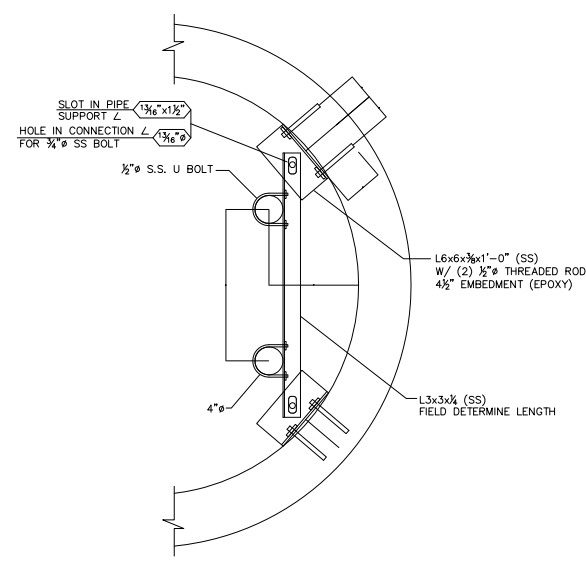
TYPICAL PUMP DISCHARGE
SCALE: 1" = 1'-0"



DETAIL 1
SCALE: 1"=1'-0"



SECTION D19
SCALE: 1"=1'-0"



DETAIL 2
SCALE: 1" = 1'-0"

GENERAL NOTES:
1. PRECAST CONCRETE MANHOLE BASE, RISERS, AND TOP SHALL CONFORM TO ASTM C478. JOINT SEALS SHALL CONSIST OF BUTYL RUBBER ROPE SEAL CONFORMING TO ASTM C990 PLUS EXTERNAL BUTYL RUBBER WRAP CONFORMING TO ASTM C877. COAT INSIDE SURFACES OF WETWELL WITH CEMENT-BASED WATERPROOFING, THOROSEAL, XYPEX, OR EQUAL.
2. PIPE TO MANHOLE CONNECTORS SHALL BE RESILIENT CONNECTORS CONFORMING TO ASTM C923, KOR-N-SEAL, OR EQUAL.
3. DUCTILE IRON PIPE SHALL CONFORM TO AWWA C151, CLASS 350. DUCTILE IRON FITTINGS SHALL CONFORM TO AWWA C110, CLASS 250. FLANGE BOLTS SHALL BE CADMIUM OR ZINC PLATED. PROVIDE STANDARD CEMENT LINING. EXTERIOR SURFACES SHALL BE PRIMED. COAT EXTERIOR SURFACES IN THE FIELD WITH TWO COATS OF COAL TAR EPOXY PAINT.
4. GATE VALVES SHALL BE RESILIENT SEAT GATE VALVES CONFORMING TO AWWA C509. CHECK VALVES SHALL BE OUTSIDE LEVER AND WEIGHT VALVES CONFORMING TO AWWA C508. PROVIDE EPOXY COATING ON INSIDE AND OUTSIDE SURFACES.
5. ALL DRILLED-IN ANCHORS SHALL BE EPOXY-SET, STAINLESS STEEL.
6. EARTH BACKFILL SHALL BE COMPACTED IN 8-INCH LIFTS TO 95 PERCENT OF MAXIMUM DENSITY.

R																
R 0	02/08	JTS	SAH	JTS	HLP	BAK										D
INITIAL ISSUE; FOR W.O.# KIF 08-500095-000 R0																
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. NO.					

DISCIPLINE INTERFACE

SCALE: 1"=200' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
PUMP STATION PLAN
SECTIONS AND DETAILS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R00	DATE 02/08	36	C	10W428-19	R 0

CONSOLIDATED TECH., INC.	
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PLOT FACTOR:1:1
W_TVA

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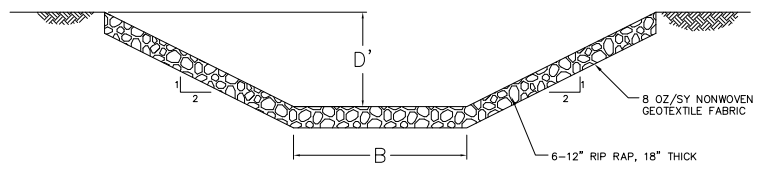
LEGEND

- 780 — EXISTING GROUND CONTOUR
- T791.2 — SPOT GROUND ELEVATION
- EXISTING UNPAVED ROAD
- EXISTING TREELINE
- EXISTING OVERHEAD ELECTRICAL TOWER
- LIMIT OF GYPSUM DISPOSAL AREA
- <830> — FINAL COVER GRADE CONTOUR (FT)
- 790 — FINISHED GRADE CONTOUR (FT)
- BENCH FLOW
- XXX — SILT FENCE
- RIPRAP
- PERIMETER ROAD
- C2 — CULVERT PIPE AND DESIGNATION
- DROP INLET
- HP — HIGH POINT ON DRAINAGE DITCH
- R1 — PERIMETER DRAINAGE CHANNEL
- RN1 — RUN-ON DRAINAGE CHANNEL



DETAIL G20
RUN-ON DRAINAGE CHANNEL
SCALE: N.T.S.
XREF:37314055
(SEE TABLE - RUN-ON DRAINAGE CHANNELS)

SUMMARY TABLE OF RUNOFF DITCH PARAMETERS - RUN-ON DRAINAGE CHANNELS

	REACH NUMBER	SLOPE, S_o (ft/ft)	REACH DIMENSIONS: LENGTH (ft)	BOTTOM WIDTH, B (ft)	DEPTH OF CHANNEL, D (ft)	SIDE SLOPES: LEFT (H:1V)	SIDE SLOPES: RIGHT (H:1V)	LINING TYPE	STARTING ELEVATION (ft)	ENDING ELEVATION (ft)
*	RN1	0.1133	528.7	3.0	2.0	2.0	2.0	RIPRAP	828.00	768.08
*	RN2	0.0231	432.3	3.0	2.0	2.0	2.0	GRASS	828.00	818.00
*	RN3	0.0215	371.4	3.0	2.0	2.0	2.0	RIPRAP	818.00	810.00
	RN4	0.0727	731.1	3.0	2.0	2.0	2.0	RIPRAP	861.90	808.75
	RN5	0.0281	591.7	3.0	3.0	2.0	2.0	RIPRAP	808.12	791.50
	RN6	0.0337	947.6	3.0	2.0	2.0	2.0	RIPRAP	861.90	829.92
	RN7	0.0368	490.9	3.0	2.0	2.0	2.0	RIPRAP	848.00	829.92
	RN8	0.1664	69.0	3.0	2.0	2.0	2.0	RIPRAP	829.12	817.64
	RN9	0.0162	955.7	3.0	2.0	2.0	2.0	GRASS	848.00	834.16
	RN10	0.0730	892.0	3.0	2.0	2.0	2.0	RIPRAP	836.00	770.00
DELETED →	~~RN11~~	~~0.0760~~	~~378.5~~	~~3.0~~	~~2.0~~	~~2.0~~	~~2.0~~	~~RIPRAP~~	~~794.93~~	~~766.18~~
	RN12	0.0229	430.0	4.0	5.0	2.0	2.0	RIPRAP	765.33	755.50
	RN13	0.0179	246.6	4.0	5.0	2.0	2.0	RIPRAP	770.60	766.18
	RN14	0.0155	712.3	4.0	5.0	2.0	2.0	RIPRAP	781.64	770.60
	RN15	0.0282	1158.2	6.0	3.0	2.0	2.0	RIPRAP	814.27	781.64
	RN16	0.0104	311.5	6.0	3.0	2.0	2.0	RIPRAP	817.50	814.27
*	RN17	0.0117	416.6	0.0	3.0	2.0	2.0	GRASS	822.36	817.50
*	RN18	0.0149	392.0	3.0	5.0	2.0	2.0	GRASS	822.36	816.53
*	RN19	0.0639	391.7	3.0	6.0	2.0	2.0	RIPRAP	816.53	791.50
*	RN20	0.0060	229.0	3.0	29.0	2.0	2.0	GRASS	791.50	790.12
*	RN21	0.0231	872.8	3.0	8.0	2.0	2.0	RIPRAP	790.12	770.00
*	RN22	0.0129	465.1	18.0	3.0	2.0	2.0	GRASS	770.00	764.00
*	RN23	0.0289	154.8	1.0	2.0	2.0	2.0	RIPRAP	767.38	764.00
	RN24	0.0224	91.5	4.0	5.0	2.0	2.0	RIPRAP	751.64	749.59

* DITCHES TO BE CONSTRUCTED IN THE FUTURE

	CULVERT ID	CULVERT Type	DIAMETER (in)	LENGTH (ft)	STARTING ELEVATION (ft)	ENDING ELEVATION (ft)	SLOPE (ft/ft)
	C1	Concrete	(3) x 48"	54.2	759.39	758.31	0.020
*	C2	Concrete	(1) x 36"	69.8	768.08	767.38	0.010
*	C3	Concrete	(1) x 36"	69.8	810.00	808.37	0.023
	C4	Concrete	(1) x 36"	63.5	808.75	808.12	0.010
	C5	Concrete	(1) x 48"	80.0	829.92	829.12	0.010
	C6	Concrete	(2) x 48"	80.4	766.18	765.33	0.011
	C7	Concrete	(3) x 48"	160.0	755.50	751.64	0.025
	C8	Concrete	(3) x 48"	60.0	749.59	748.05	0.025

* PIPES TO BE INSTALLED IN THE FUTURE

NOTE:
STORM DRAINAGE PIPE SHALL BE REINFORCED CONCRETE PIPE (RCP) CONFORMING TO ASTM C76, CLASS III, WALL B. JOINTS SHALL BE MADE WITH PORTLAND CEMENT MORTAR SSRBC, SECTION 905, SUBSECTION 905.02 OR RUBBER GASKETS (ASTM C443).

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE
R											
R 0	02/08	JTS	SAH	JTS	HLP	BAK				D	

INITIAL ISSUE; FOR W.O.# KIF 08-500095-000 RO

SCALE: 1"=200' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY
STORM DRAINAGE PLAN

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R00	DATE 02/08	36	C	10W428-20	R 0

CONSOLIDATED TECH., INC.
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
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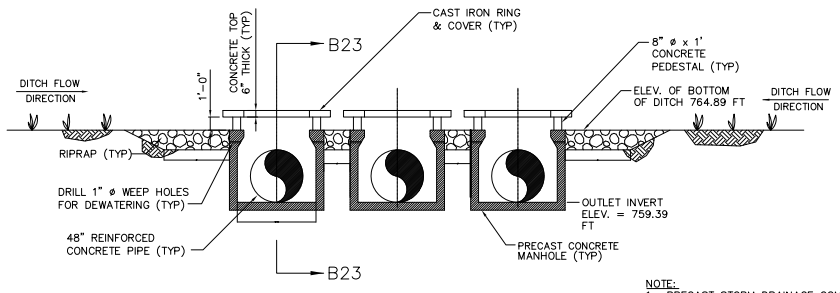
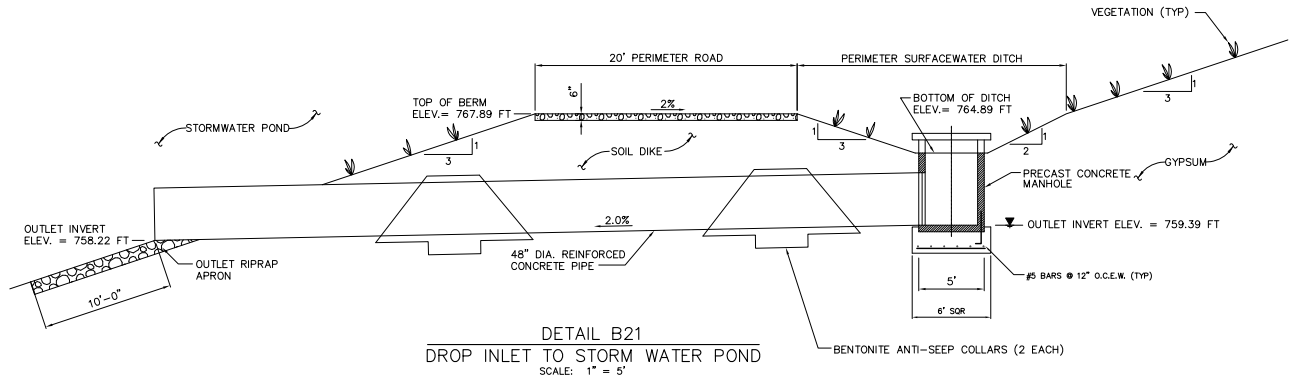
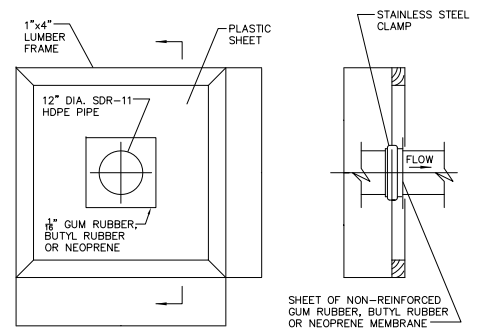


DETAIL A21
STORM WATER POND DROP INLET
SCALE: 1" = 5'

NOTE:
1. PRECAST STORM DRAINAGE COMPONENTS SHALL BE MANUFACTURED IN CONFORMANCE WITH ASTM C478. JOINT SEALS SHALL CONSIST OF BUTYL RUBBER ROPE CONFORMING TO ASTM C990.



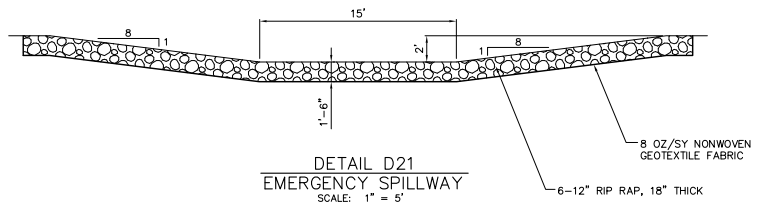
DETAIL B21
DROP INLET TO STORM WATER POND
SCALE: 1" = 5'



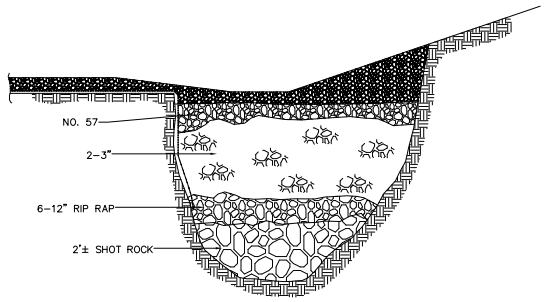
ELEVATION

SECTION

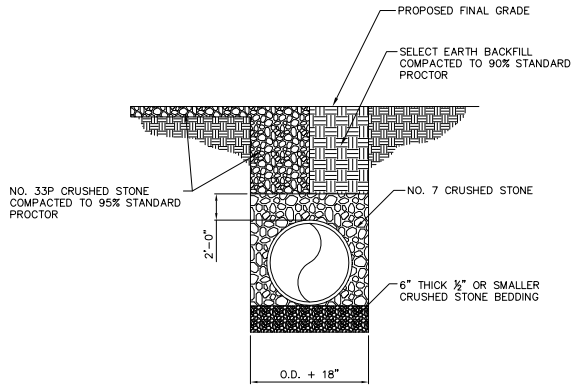
DETAIL C21
FLEXIBLE ANTI-SEEP COLLAR (NOTE 1)



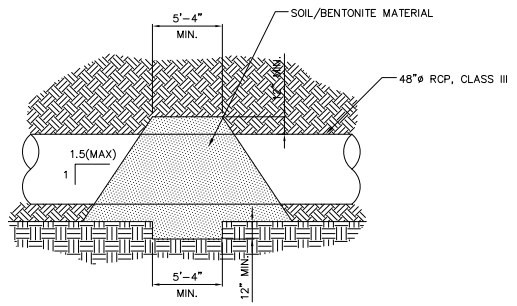
DETAIL D21
EMERGENCY SPILLWAY
SCALE: 1" = 5'



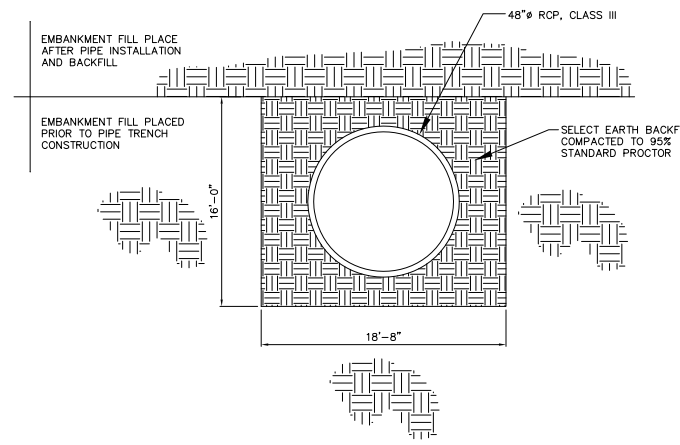
SUBGRADE STABILIZATION(IF REQUIRED)



TYPICAL PIPE INSTALLATION DETAIL FOR RCP AND HDPE
N.T.S.



BENTONITE/EARTH ANTI-SEEP COLLAR
SCALE: ¼"=1'-0"



48" RCP DROP INLET PIPE INSTALLATION DETAIL
N.T.S.

R
R 0 | 02/08 | JTS | SAH | JTS | HLP | BAK | D
INITIAL ISSUE; FOR W.O.# KIF 08-500095-000 RO

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

SCALE: 1"=200' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY DRAINAGE SYSTEM DETAILS SHEET 1 OF 2

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R00	DATE 02/08	36	C	10W428-21	R 0

DISCIPLINE INTERFACE: CIVIL

CONSOLIDATED TECH., INC.
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
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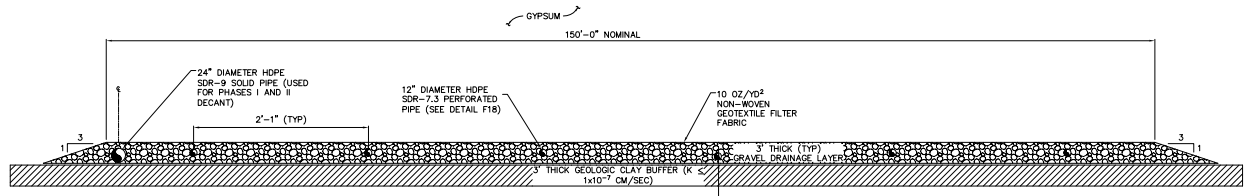
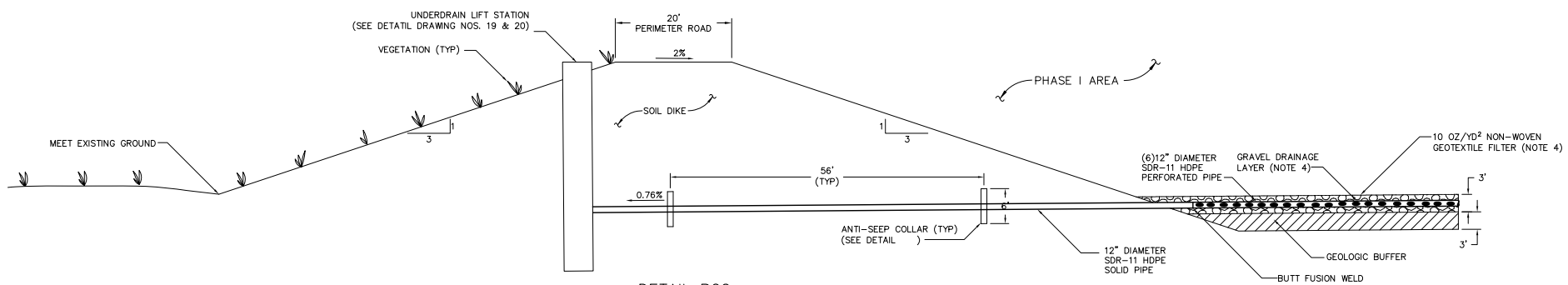
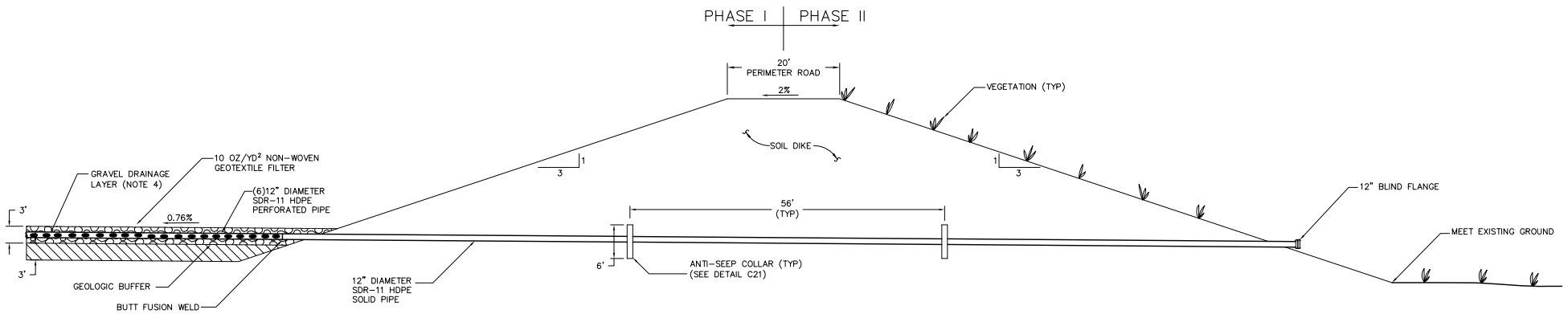


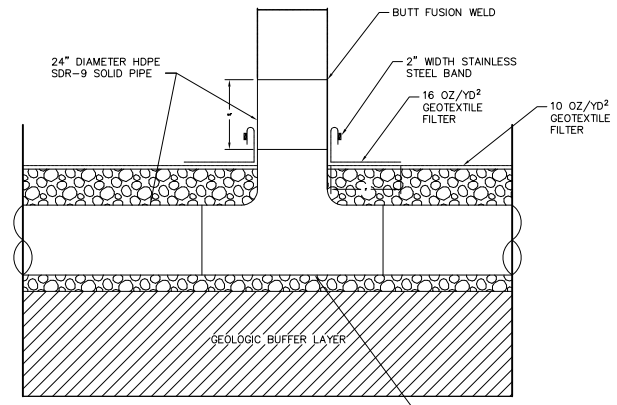
DETAIL A22
GEOLOGIC BUFFER AND CENTRAL DRAINAGE CORRIDOR (NOTE 2)



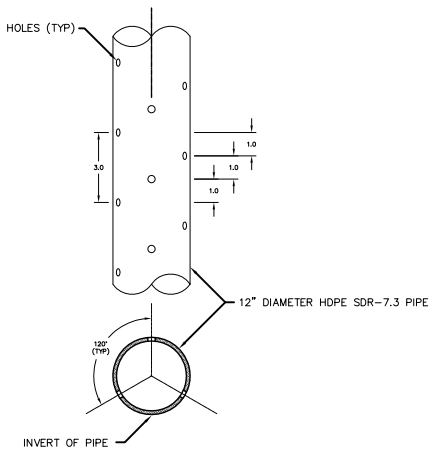
DETAIL B22
DRAINAGE PIPE PENETRATION OF PERIMETER SOIL DIKE
SCALE: 1" = 10'



DETAIL C22
PHASE I CENTRAL DRAINAGE CORRIDOR TERMINATION
SCALE: 1" = 10'



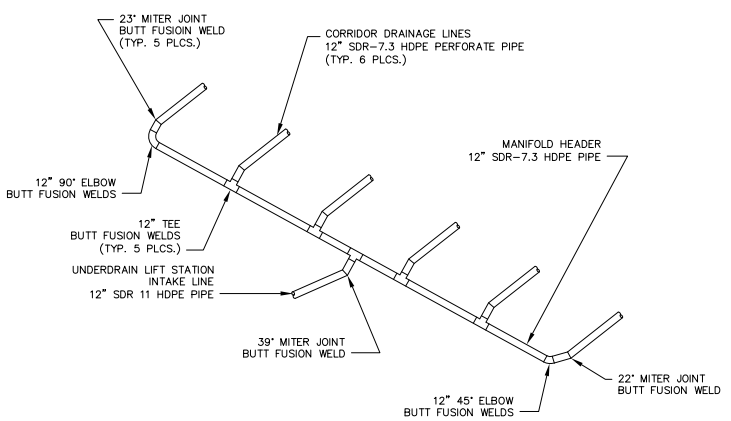
DETAIL D22
PHASE I PIPE DECANT STRUCTURE (NOTE 2)
SCALE: 1" = 2'



DETAIL E22
PERFORATED DRAINAGE PIPE
SCALE: NTS

NOTES:

1. AVOID VEHICLE TRAFFIC ON TOP OF OUTLET PIPE.
2. THE GEOLOGIC CLAY BUFFER AND COMPONENTS OF THE CENTRAL DRAINAGE CORRIDOR ARE CONSTRUCTED IN ACCORDANCE WITH THE MATERIAL SPECIFICATION AND CONSTRUCTION QUALITY ASSURANCE AND QUALITY CONTROL PLAN INCLUDED IN APPENDIX F OF THIS PERMIT APPLICATION.



DETAIL F22
UNDERDRAIN MANIFOLD

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. NO.
R 0	02/08	JTS	SAH	JTS	HLP	BAK					D

INITIAL ISSUE; FOR W.O.# KIF 08-500095-000 R0

SCALE: 1"=200' EXCEPT AS NOTED

YARD

FGD GYPSUM DISPOSAL FACILITY DRAINAGE SYSTEM DETAILS SHEET 2 OF 2

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.T. STEIN	S.A. HAMBY	J.T. STEIN				

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R00	DATE 02/08	36	C	10W428-22	R 0

CONSOLIDATED TECH., INC.
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

APPENDIX A

Document 3

TVA Spreadsheet "CCR Generation and Handling," dated September 27, 2011

Questions:	Kingston
1. Does the utility have drawings showing the CCR generation/handling/storage train for:	
a. Fly Ash	Yes
b. Bottom Ash	Yes
c. Boiler Slag	Yes
d. FGD wastes	Yes
2. What specific equipment is used to collect, handle, and store CCR material? For:	
a. Fly Ash	SCR Hoppers, Economizer Hoppers, Precipitator Hoppers, jet pumps, hydroveyors, air separator tanks, piping, ash pond
b. Bottom Ash	Bottom Ash Hoppers, jet pumps, piping, ash pond
c. Boiler Slag	N/A
d. FGD wastes	Limestone preparation facilities, absorbors, recycle pumps, area sump, piping, FGD pond
3. Is there design information on the handling and transport equipment?	Yes
a. Example:size and length of pipe for sluicing the CCR	Yes
b. Is equipment within a secondary containment or just sitting on the ground?	SCR Hoppers, Economizer Hoppers, Precipitator Hoppers and bottom ash hoppers are inside a building. Jet pumps, hydroveyors, air separator tanks, piping, ash pond
c. Volume of storage silo	5265 Tons
4. What equipment is outside versus enclosed?	SCR Hoppers, Economizer Hoppers, Precipitator Hoppers and bottom ash hoppers are inside a building. Jet pumps, hydroveyors, air separator tanks, piping, ash pond
5. Has there ever been a release of CCR to the environment from the collection/handling/disposal system?	Yes, hydroveyor release to sump, ash lines parted at coupling
6. How much CCR per hour are they handling in each system, actual and design?	

APPENDIX A

Document 4

Tennessee Valley Authority (TVA) Routine Handling Operations and Maintenance (RHO&M) Operations Support Document, Kingston Fossil Plant, July 2011

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Notes: Each section to be updated as required by RHO&M.

(1) **Red indicates annual updates required**

(2) **Blue indicates the contract term is currently 2 years**

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Notes: Each section to be updated as required by RHO&M.

(1) **Red indicates annual updates required**

(2) **Blue indicates the contract term is currently 2 years**

OVERVIEW OF OPERATIONS SUPPORT DOCUMENT

1.0 TABLE OF CONTENTS

The table of contents is presented in **Section 100**.

2.0 OVERVIEW

The overview of the OSD is presented herein as **Section 200**.

2.1 Overview and History

KIF was the fifth steam-electric power plant constructed by TVA. The first of these, the Watts Bar Plant, was built as part of an emergency power program of the World War II period. In 1949, some four years after completion of the Watts Bar plant, construction started on the first of seven large steam-electric projects to be built over a span of eight and a half years. This program included, successively, Johnsonville, Widows Creek, Shawnee, Kingston, Colbert, John Sevier, and Gallatin.

Rapid expansion of power facilities in TVA's service area resulted mainly from increased power demands of the Atomic Energy Commission and other federal defense agencies. Additional electric energy was required also by the expanding program of private industry and the increased needs of commercial and domestic consumers in the service area.

KIF is a fossil-fueled, steam-electric generating plant with total generating capacity of 1,723 megawatts. The active CCP handling facilities at KIF includes the Ballfield, Ash Pond, Dredge Cell, and Gypsum Pond Peninsula, as shown in **Figure 1**. Since the dredge cell failure in December 2008, the active CCP facility is the Ballfield.

Figure 1 – Kinston Fossil Plant Aerial Image (north direction to top)

The production rates for the CCP materials are listed below:

2.2 Fly Ash

Prior to the dredge cell failure, approximately 390,000 dry tons of fly ash was wet sluiced to the main ash pond each year. Fly ash was dredged from the main ash pond and pumped to the upper dredge cell. Since the failure, production ash is currently being dewatered in the Ballfield area in preparation for transportation to an offsite landfill. Operations currently focus on the cleanup of the dredge cell failure with production ash regulatory compliance largely driven by NPDES and Air permit requirements.

2.3 Bottom Ash

Prior to the dredge cell failure, approximately 95,000 dry tons of bottom ash was wet sluiced to the main ash pond each year. Bottom ash was retrieved in the bottom ash sluice channel and used to construct the raised dredge cell dikes which consist of bottom ash, fly ash, and clay.

2.4 Gypsum

As the new scrubbers come online, approximately 545,000 dry tons of scrubber gypsum will be produced each year and will be transported to the new peninsula disposal area.

3.0 ROLES AND RESPONSIBILITIES

Roles and responsibilities, **Section 300**, contains a narrative of the responsibilities for the daily operations for routine handling of CCP material. Two responsibility matrices are provided to better define all responsibilities for the routine handling group and TVA.

4.0 CONTACTS

Contacts, **Section 400**, defines contact information for RHO&M group personnel, the facility engineer, client project contacts, emergency service contacts and local hospital information.

The latest RHO&M contact list, facility engineer and client project contacts should be included in this document. This contact list should be updated as personnel change or positions are added. The contacts list should include any third party engineers.

The emergency contact list is provided as a general overview of emergency services. This emergency contact list is not intended to replace any site specific emergency action plans or emergency procedures such as the IPP Plan, Emergency Action Plan or Seepage Action Plan; it only should serve as supplemental information. Contact the site specific RHO&M or CCP personnel for additional emergency plans and procedures. In addition, phone numbers, a map and directions to the local hospital are included.

5.0 HISTORIC INFORMATION

The historical information, **Section 500**, contains the information pertaining to the history of the facility to assist the operators of the facility during inspections and construction. The following subsections are included: historical timeline, pipe inventory, instrumentation plan with factor of safety against sliding (global conditions), seepage log and FEMA Floodplain Maps.

5.1 Historical Timeline

The historical timeline included in **Section 501** provides an overview of the history of the CCP facilities at Kingston Fossil Plant (KIF). The timeline provides historical aerial photographs and a description of the major construction events. It also notes any major failures that may have occurred.

5.2 Pipe Inventory

The pipe inventory included in **Section 502** was conducted by Stantec Consulting Services, Inc (Stantec) in 2010 and updated in June, 2011. The inventory contains a plan view showing the locations of all major spillways and pipes at the facility. Photos of each spillway (when available) are also included.

5.3 Instrumentation Plan

The instrumentation plan included in **Section 503** is a plan view depicting the locations of piezometers and slope inclinometers installed at the active facility during the geotechnical investigations performed by Stantec since 2009. The instrumentation plan should be updated as new instruments are installed and old instruments are removed. Contact CCP Engineering for the latest instrumentation plan. A factor of safety map showing F.S. against sliding based on global conditions is also included. The factor of

safety map is based on site specific reports of geotechnical exploration and slope stability analysis. As remedial construction projects are completed the factory of safety map should be updated.

5.4 Seepage Log

The seepage log included in **Section 504** contains an executive summary of the Seepage Action Plan, followed by the latest seepage log for KIF to be used as an example. The seepage log is updated as needed by the RHO&M Field Supervisor and is kept electronically on the Maximo System.

The link to the Seepage Action Plan is \\chapgfs\ccp\Seepage_Action_Plans\KIF.

5.5 FEMA Flood Maps

The Federal Emergency Management Agency (FEMA) flood map included in **Section 505** contains flood insurance rate maps (FIS) produced under the National Flood Insurance Program. The maps show areas subject to inundation by the 1% annual chance flood for the KIF plant area.

6.0 CONTRACT

The current scope of work for the handling of coal combustion products at Kingston Fossil Plant is included in **Section 600**. The scope involves the handling of 545,000 dry tons of production gypsum. The current scope of work for the handling of fly ash is under revision.

The current scope of work should be included in the document. The routine handling contracts are typically five years in length. The contract section should be updated with the issuance of a new contract.

7.0 CONSTRUCTION PLANS

The construction plans are presented in **Section 700**. The construction plans section is intended to keep 11x17 copies of the current drawings RHO&M utilizes for active placement of CCP materials as well as other current construction projects at the active CCP facilities. In cases where construction drawings have not been developed, the permit drawings should be included, as this is the only information the contractor has for the handling and placement of CCP materials. The active construction drawings are included in Section 700. Only the current drawings for the placement of CCP materials are included in Section 701. Refer to Section 800 for a list of other drawings for the active facilities.

Kingston is currently working under an interim plan for handling ash at the Ballfield. The interim plan is to provide storage capacity until the permitting and initial construction of Phase II at the Peninsula Site is finished and ready to receive ash for permanent disposal. Phase I of the Peninsula Site is to receive gypsum from the newly installed scrubber system. The construction plans for the Ballfield and Peninsula Site are included under the Construction Plans section of this document.

8.0 DRAWING INVENTORY LIST

The drawing inventory list is presented in **Section 800**. The purpose of the drawing inventory list is to maintain a record of pertinent drawings for the active disposal facility at the plant. These drawings should include the original design drawings for the initial construction of the disposal facility, as well as any additional designs for changes to the disposal area, remedial measures, or additional work plans that do not directly pertain to the placement of CCP materials.

The list of design drawings is included in this section. As new drawings are developed, revised, or construction is completed the list should be updated. The list includes the TVA series number, number of sheets, revision number, date issued, facility, and a description of the drawing set.

9.0 PERMITS

The Operations Requirement Matrix, NDPES flow schematic and applicable NEPA commitment are included in **Section 900.** The Operations Requirement Matrix lists the various requirements that pertain to routine handling of CCP materials for the active sites. The matrix is divided based on the source of the requirement. The requirements include permit requirements, NEPA commitments, and recommended practices.

The permit section also contains a list of the active permits at the facilities. TVA's Environet site or the responsible Environmental Media Specialist should be contacted to obtain a copy of the current active permits. The permit list may or may not be up-to-date, as new permits, modifications or renewals may occur prior to incorporating revisions to the list. This section should be updated as updates to it occur.

10.0 SURVEY DATA

The survey data is presented in **Section 1000**. TVA routinely develops topographic and hydrographic survey information to calculate free water volume for Kingston Fossil Plant. RHO&M maintains a list of when the most current survey was conducted and when the next planned survey is scheduled for each plant. A topographic survey of KIF is presented in this section as well. CCP engineering should be contacted for the latest topographic information. This section should be updated as updates to the survey schedule occur.

11.0 PROCEDURES

The current procedures for the handling of production CCP are included in **Section 1100**. As operations change, the procedures document should be updated.

The procedures section includes subsections for operations manuals, specifications, QA/QC plans, standard repair guidelines, daily field report, weekly material summary, weekly facility observation form, monthly/quarterly/special facility observation form, project start up checklist, additional work/change order form, TVA internal procedures for NEPA evaluations, RHO&M work control and clay dike restrictions. The subsections are described in the procedures document.

12.0 WORK PACKAGES

Work packages, **Section 1200**, contain a list of all work packages at Kingston. The general routine handling work package is included as an example. Work packages are stored electronically \\chapgfs2\ccp\Work_Packages-JSA's.

13.0 MARKETING INFORMATION

Marketing information included in **Section 1300** contains information for the marketing of CCP materials. This section should be updated every three to five years.

14.0 PLANNING

Section 1400 contains information related to the future of the active CCP facilities. Included in the planning section are the following subsections; remaining life calculations, the long range plan, and the master strategy plan. These are described below.

14.1 Remaining Life Calculations

Remaining life calculations are included in **Section 1401.** Remaining life was estimated for the Ballfield Interim Ash Staging Area and Peninsula Site. Since these facilities have yet to receive CCP materials, remaining life was based on design volumes stated in the operations plans for each site using pre-failure production ash estimates and gypsum production estimates from the operations manual.

Remaining life of the facility should be re-calculated if there is a change in the design of the facility, production rates change, or every year. Topographic survey data of the site should be used to calculate the amount of material placed at the active facilities in a specific amount of time to estimate CCP production rates. This should be used to verify the assumptions made in creating the long range plans discussed below.

14.2 Long Range Plan

The long range plan included in **Section 1402** is developed by the TVA program manager. The plan projects future coal burn at the plant and calculates capacity needs for the storage of CCP materials.

14.3 Master Strategy Plan

The master strategy plan included in **Section 1403** provides an overview presentation of CCP Integrated Planning of Closure Options for Wet CCP Disposal Facilities.

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1.0 OVERVIEW

The chief responsibilities of the RHO&M group are to manage and execute activities for safe and efficient transport and storage of CCP. The RHO&M group also provides recommendations that improve the production processes for cost and safety reasons, and provides guidance and advice to others supporting organizational functions including the Maintenance, Engineering, Environmental, and Marketing groups.

A critical responsibility of CCP RHO&M Group is to closely communicate and interface with the Capital Projects and Marketing functions of the CCP organization. These responsibilities include:

1. Managing capacity and predicting needs six years in advance.
2. Providing routine status updates of CCP plant performance, including operating problems, bottlenecks, or other issues inhibiting the primary mission of the group.
3. Providing routine testing (every 3 to 5 years or as required) of the CCP materials, as appropriate, and maintain a database of CCP physical and chemical characteristics.
4. Tracking free water volume and initiating projects accordingly.
5. Developing free water volume reports to the state.
6. Preparing, updating, and maintaining site-specific operation and maintenance manuals.
7. Maintaining roads for ash hauling.
8. Scheduling of CCP management facility maintenance activities.
9. The provision of routine maintenance priorities for timely repairs and providing direction during maintenance projects.
10. Recommending solutions for routine and non-routine maintenance.
11. Recommending new capital improvement projects.
12. Providing cost-reduction ideas to reduce the cost of finished products.
13. Providing safety improvement ideas.
14. Assisting the Marketing functions to promote the sales of CCP.
15. Executing purchase orders to meet contractual commitments of the Marketing group with customers.
16. Providing support on large capital projects (e.g. new landfill ash impoundment).

Additionally, RHO&M will oversee and direct any outside personnel or organizations involved in the transportation and disposal of CCP materials. These responsibilities cover the following areas:

1. Performance of all subcontractors including those involved in transportation and processing.
2. Safe and responsive operation to meet the commitments of marketing, including making and executing transportation arrangements.
3. Implementation of quality control procedures.

The RHO&M group has the responsibility of safely and efficiently handling and managing CCP, providing recommendations that improve the production processes for cost and safety reasons, and providing guidance and advice to others supporting organizational functions including Maintenance, Engineering, Environmental, and Marketing groups. The primary role of CCP Marketing, a sub-group within the RHO&M Group, is to place products into a wide variety of markets at a profit.

2.0 PERSONNEL RESPONSIBILITIES

The following responsibilities are listed for the daily routine handling of production CCP materials. The list does not contain all responsibilities of the parties listed. Reference is made to the responsibilities matrix included in Section 300 which defines the responsibilities of each personnel group.

2.1 CCP Routine Handling Contractor

1. Implement adherence to safety manual.
2. Inspection of facilities immediately following large storms or earthquakes.
3. Provide scope, estimate, and schedule for new / additional RHO&M T&M work.
4. Verify heavy equipment safety checks.
5. Maintain ancillary facilities (roads, dikes, etc.) associated with routine operations and maintenance.
6. Implement corrective maintenance work orders to repair deficiencies.
7. Manage fugitive dust associated with CCP facilities.
8. Manage cenospheres.
9. Provide quantities of materials handled on a weekly basis.
10. Provide safety and environmental statistics on a weekly basis.
11. Perform inspections on on-site fuel tanks.
12. Report on quantities of materials handled daily. Utilize RHO&M Weekly Material Summary included in **Section 1106**.
13. Report on manpower on-site daily.
14. Perform daily facility observations. Utilize RHO&M Daily Field Report included in **Section 1105**.
15. Maintain heavy equipment.
16. Perform safety and environmental observations and interventions.
17. Prepare and issue any white papers required.

2.2 Field Supervisor (aka Site Supervisor)

1. Perform safety and environmental observations and interventions.
2. Initiate and approve all RHO&M T&M contracts.
3. Adhere to the TVA safety manual (JSA's, pre-job briefings, etc.)

4. Approve all RHO&M T&M invoices.
5. Manage and execute maintenance of disposal facilities and structures.
6. Manage on-site borrow pit areas.
7. Oversight of field operations for CCP disposal facilities.
8. Perform weekly inspection (implement weekly PM work orders). Utilize RHO&M Weekly Facility Observation Form in **Section 1107**.
9. QA / QC have been performed on RHO&M work.
10. Prioritize list of job jar work.
11. Supply partner oversight.
12. Supply safety oversight.
13. Plant interface with PAE and / or plant managers.
14. Identify new seeps and monitor existing.
15. Inspection of erosion and sediment controls immediately following significant precipitation events.
16. Notify plant of and any / all potential critical deficiencies.

2.3 Construction Manager

1. Implement programmatic document.
2. Perform monthly dike inspections (implement monthly PM work orders). Utilize RHO&M Monthly/Quarterly Special Facility Observation Form included in **Section 1108**.
3. Ensure all RHO&M policies and standards are being adhered to in the field.
4. Assist and support field supervisors.
5. Perform Safety and environmental observations and interventions.

2.4 Program Manager

1. Review projects for operability (constructability if capital project).
2. Ensure environmental requirements for CCP facilities are maintained.
3. Predict future storage needs.
4. Track and report on free water volumes.
5. Quantify burn rates vs. ash production.
6. Perform quarterly dike inspections (implement quarterly PM work orders). Utilize RHO&M Monthly/Quarterly Special Facility Observation Form included in **Section 1108**.
7. Have surveys of CCP facilities performed.
8. Manage and track CCP production and facility remaining capacities.
9. Calculate monthly CCP material volumes and quantities handled.

10. Provide plant PAEs with required CCP quantities.
11. Conduct new project design reviews for RHO&M.
12. Perform operability reviews and approval.

2.5 Manager Planning and Programs

1. Attend Site Manager strategy meetings.
2. Develop and manage (TCM) contracts for routine handling of CCPs.
3. Conduct routine site visits to identify opportunities for improvements.
4. Implement programmatic document.

2.6 Field Technician (QA/QC)

1. Stand in for field supervisors.
2. Verify operations are within the design footprints.
3. Verify completion of corrective maintenance work orders (repairs complete).
4. Provide locations of deficiencies.
5. Provide work packages and design drawings.
6. Verify survey results.

3.0 ROLES AND RESPONSIBILITIES SPREADSHEET

Two responsibility matrices are provided herein that define, in detail, each members' roles and responsibilities.

CCP Roles and Responsibilities

Activity Description	CCP Projects and Engineering				CCPM		Environmental	River Ops	Plant	Other
	CCP Engineering	CCP Projects	CCP Construction	CCP Projects & Engr. Support	RHOM	FE				
Capital Projects										
a. Project Initiation/Justification	Structural Deficiencies	Executive Decisions (such as dry ash conversion)			RHO&M (Capacity/Marketing needs,Reductions in routine handling costs/need for borrow areas)		Regulatory Changes		Generation Needs	
b. Development of Project Planning Document	Lead	Input	Input - constructability	Input - scheduling	Input - constructability/operability	Input	Input - Regulatory compliance		Input	
c. Development/Management of Project Budget	Manage Engineering Budget	Ownership of Overall Budget	Manage Construction Budget	Support - track spending	Manage Construction Budget (if involved in construction)		Manage Environmental budget			
d. Obtain Project Approval and Supporting Documents	Support	Lead	Support	Support	Support		Support		Support	
e. Project schedule Development (schedulers work for one manager, individual schedulers assigned to each organization	Engineering Schedule	Ownership of Project Schedule	Construction Schedule	Integrated Schedule	Construction Schedule (if involved in construction)	Input	NEPA/Permitting schedule			
f. Project Design, Engineering, Management of Engr. Consultants	Lead	Manage Overall Project	Input to design		Input to design	Input to design; translate design documentation into field implementation package	Input to design	Input to design (if project is a dam)	Input to design	
g. Joint Project Team (including 10/50/90% reviews) - Follow SPP 19.3 and 34; modify signature forms to indicate focus area for JPT member; emphasize that JPT is a TEAM	Participate	Lead	Participate/review for constructability	Participate - schedule	Participate/review for constructability (if involved in construction) & operability	Participate	Review for Regulatory compliance	Participate (if project involves a structured deemed to be a dam)	Participate	
h. Development of borrow areas	Lead for siting and engineering; identify need for borrow area for projects	Manage Overall Project	Lead	Support	Input for locations, lead for construction if requested; identify need for borrow areas for routine handling		NEPA and permitting		Support	
i. Perform NEPA activites in support of projects	Support	Manage Overall Project	Support	Support	Support		Lead	Support (if involved in project)	Support	
j. Obtain new environmental permits or modify existing environmental permits	Lead for engineering for permits	Manage Overall Project	Input	Input	Input (if new disposal/marketing facility)		Lead for permit negotiations	Input (if involved in project)	Support	
k. Project change control	Identify/justify need for change in area of responsibility	Lead for approval/denial of requested change	Identify/justify need for change in area of responsibility		Identify/justify need for change in area of responsibility	Identify/justify need for change in area of responsibility	Identify/justify need for change in area of responsibility	Identify/justify need for change in area of responsibility	Identify/justify need for change in area of responsibility	
l. Project Construction	Support - Technical Guidance (including pre construction check lists, identification of project risks, and identification of contingency plans for critical projects)	Manage Overall Project	Lead	Support	Lead (if requested), otherwise Support	Support	Support	Support (if project involves a structured deemed to be a dam)	Support	
m. Environmental compliance during construction	Support - Technical Guidance	Manage Overall Project	Lead		Lead (if Lead on Construction)		Establish criteria			
n. Project QA/QC; move to 1 QA contractor for fleet w/Engr as TCM	Develop project quality control plan; Lead for performance of project QA; present in field during key project QA milestones	Manage Overall Project	Lead for QC if lead on Construction		Support, Lead for QC (if Lead on Construction)		Support	Support (if involved in project)		
o. Project Testing and Turnover (Project Commissioning)	Support/sign off; Provide operating constraints/design assumptions	Support/sign off	Lead	Support	Lead (if Lead on Construction)/participate otherwise		Support/sign off		Sign off	
p. Project Acceptance for Operation					Lead (if RHO&M operation)				Lead (if plant operation)	
q. Project closure	Support	Lead	Support		Support (if Lead on Construction)		Support	Support (if involved in project)	Support	
r. Exception for small projects (typically less than $250,000)	Design/Constr. Support/QA/QC plan	Keep checkbook	Construction Lead (if requested)		May serve as TCM/Lead for construction and execution of QC plan		Support			
O&M Projects										
a. Project Initiation/Justification	Structural Deficiencies	Executive Decisions (such as dry ash conversion)			Capacity needs/Marketing needs/Reductions in routine handling costs/need for borrow areas/findings from inspections	Findings from Inspections	Regulatory Changes		Generation Needs	
b. Development of Project Planning Document	Lead	Input	Input - constructability (if involved in construction)		Input - constructability/operability	Input	Input - Regulatory compliance		Input	

CCP Roles and Responsibilities

Activity Description	CCP Projects and Engineering				CCPM		Environmental	River Ops	Plant	Other
	CCP Engineering	CCP Projects	CCP Construction	CCP Projects & Engr. Support	RHOM	FE				
c. Development/Management of Project Budget	Manage Engineering Budget	Manage Overall Budget as appropriate based on project	Manage Construction Budget (if requested to participate in project)	Support - track spending	Manage Construction Budget		Manage environmental budget			
d. Obtain Project Approval and Supporting Documents	Support	Lead to obtain funding for special projects	Support (if involved in construction)	Support	Support		Support		Support	
e. Project schedule Development (schedulers work for one manager, individual schedulers assigned to each organization	Engineering Schedule	Project Schedule	Construction Schedule (if involved in project)	Integrated Schedule	Develop Construction Schedule	Input	NEPA/Permitting schedule			
f. Project Design, Engineering, Management of Engr. Consultants	Lead	Manage Overall Project if requested based on "Who does work" Committee decision	Input to design (if involved in proejct)		Input to design	Input to design; translate design documentation into field implication package	Input to design	Input to design (if project is a dam)	Input to design	
g. Joint Project Team (including 10/50/90% reviews) - modify signature forms to indicate focus area for JPT member; emphasize that JPT is a TEAM	Participate	Lead	Participate/review for constructability (if involved)		Participate/review for constructability & operability	Participate	Review for Regulatory compliance	Participate (if project involves a structured deemed to be a dam)	Participate	
h. Development of borrow areas	Lead for siting and engineering; identify need for borrow area for projects	Manage Overall Project	Lead (if requested by RHO&M)	Support	Identify need and input for locations (if for routine handling), lead for construction		NEPA and permitting		Support	
i. Perform NEPA activites in support of projects	Support	Manage Overall Project	Support	Support	Support		Lead	Support (if involved in project)	Support	
j. Obtain new environmental permits or modify existing environmental permits	Support	Manage Overall Project	Support (if involved in construction)	Support	Input/Support		Lead	Support (if involved in project)	Support	
k. Project change control	Identify/justify need for change in area of responsibility	Lead for approval/denial of requested change	Identify/justify need for change in area of responsibility		Identify/justify need for change in area of responsibility	Identify/justify need for change in area of responsibility	Identify/justify need for change in area of responsibility	Identify/justify need for change in area of responsibility	Identify/justify need for change in area of responsibility	
l. Project Construction	Support - Technical Guidance (including pre construction check lists, identification of project risks, and identification of contingency plans for critical projects)	Support as appropriate based on project	Lead (if requested)	Support	Lead (may request help from other FGD&C resources based on project and work load)	Support	Support	Support (if involved in project)	Support	
m. Environmental compliance during construction	Support - Technical Guidance	Support	Lead (if Lead on construction)		Lead		Support			
n. Project QA/QC; move to 1 QA contractor for fleet w/Engr as TCM	Develop project quality control plan; Lead for performance of project QA; present in field during key project QA milestones		Support (if lead on construction)		Support, Lead for QC (if Lead on Construction)		Support	Support (if involved in project)		
o. Project Testing and Turnover (Project Commissioning)	Support/sign off; Provide operating constraints/design assumptions	Support/sign off	Lead (if Lead on Construction)		Lead		Support/sign off		Sign off	
p. Project Acceptance for Operation					Lead (if RHO&M operation)				Lead (if plant operation)	
q. Project closure	Support	Lead	Support (if Lead on Construction)		Support (if Lead on Construction)		Support	Support (if involved in project)	Support	
r. Exception for small projects (typically less than $250,000)	Design/Constr. Support/QA/QC plan	Keep checkbook	Construction Lead (if requested)		TCM/Lead for construction and execution of QA/QC plan		Support			
Routine Operations and Maintenance - CCPs										
a. Ownership of CCP disposal sites	Accountable for assigned areas of responsibility; provide RHO&M with scope/schedule information for a given site as the site owner; communicate directly with plant on details associated with on-site activities as agreed upon in JPT meetings	Accountable for assigned areas of responsibility; provide RHO&M with scope/schedule information for a given site as the site owner; communicate directly with plant on details associated with on-site activities as agreed upon in JPT meetings	Accountable for assigned areas of responsibility; provide RHO&M with scope/schedule information for a given site as the site owner; communicate directly with plant on details associated with on-site activities as agreed upon in JPT meetings	Accountable for assigned areas of responsibility; provide RHO&M with scope/schedule information for a given site as the site owner; communicate directly with plant on details associated with on-site activities as agreed upon in JPT meetings	Owner of disposal site; ongoing general knowledge of objectives, scope, and schedule of all projects/activities at site. Primary point of contact for plant until specific responsibilities are agreed upon in JPT meetings; kept informed on status of site activities or special visitors				Customer for CCP management activities and ultimate owner of site	
b. Manage capacity at disposal sites/predict new capacity needs 6 yrs in advance; track CCP production and facility remaining capacity (currently referred to as long range plans) - all ponds except coal yard run off ponds	Support - identify capacity reductions due to structural deficiencies				Lead	Support	Support		Support (Gen Plan)	

CCP Roles and Responsibilities

Activity Description	CCP Projects and Engineering				CCPM		Environmental	River Ops	Plant	Other
	CCP Engineering	CCP Projects	CCP Construction	CCP Projects & Engr. Support	RHOM	FE				
c. Manage and execute operational and production activities that transport and store CCP at the intended end purpose and in accordance with engineering design drawings and parameters; manage and execute maintenance of disposal faciltiies and structures, including dikes and embankments; maintain pond freeboard per design (all ponds except coal yard run off pond)	Support				Lead	Prepare work instructions for maintenance activities; execute purchase orders for field materials				
d. Develop and manage contracts for routine operations and maintenance of CCPs and associated disposal facilities					Lead					
e. Maintain Environmental Compliance at CCP facilities					Lead for compliance with permit requirements					
1. Communicate Regulatory requirements							Lead			
2. Negotiate CCP related permits with State and Federal Agencies	Support				Support		Lead			
3. Maintain permit records; provide electronic/hard copies of permitting/regulatory documents	Support				Support	Support	Lead			Support
4. Serve as focal point for all regulatory contact							Lead			
5. Develop, manage, and execute groundwater monitoring program	Support	Support (through projects)	Support		Support		Lead			
6. Develop, manage, and execute air monitoring program							Programmatic Lead			
7. Perform routine environmental auditing functions					Support		Lead		Support	
8. Conduct annual Solid Waste Managment Site Environmental review					Support		Lead		Support	
9. Track free water volume, develop annual free water volume reports to state					Lead	Support	Support			
10. Manage stormwater associated with CCP/disposal facilities					Lead		Support			
11. Manage leachate associated with CCP/disposal facilities					Lead		Support			
12. Manage fugitive dust associated with CCP/disposal facilities					Lead					
13. NPDES sampling					Weir maintenance, support of compliance activities		Program lead (negotiate permits, communicate requirements, audits, etc including weir calibration)		Collect and analyze samples on specified frequencies, routine reporting to regulators	Responsibility for weir calibration returns to Environmental Support group in MS
14. Perform required NEPA activites	Support				Support		Lead		Support	
15. Wetland mitigation					Support		Lead			
16. Seepage Action Plan; Form Team to revise Seepage Action Plan	Program owner; participate in quarterly inspections; Lead to classify seeps, determine actions required & prioritize actions				Execute recommended actions based on identified priorities; monitor seeps for changes as part of routine inspections; write work orders for routine maintenance, write PERS for significant issues	Support	Identify & prioritize actions for compliance		Maintain copies in SOS office	
17. Operate facilities in compliance with permit requirements	Support				Lead		Communicate permit requirements to RHOM		Support	
f. Perform routine testing of CCP materials and maintain data base of CCP physical and chemical characteristics	Lead				Support	Support				
g. Prepare, update, and maintain site-specific operation and maintenance manuals	Support				Lead	Support				
h. Develop and deploy safe work plans for routine operations and maintenance					Execute safe work plans; provide input for development of plans	Support				Corporate Governance lead for plan development with input from Safety Staff; lead for training; communicate plan requirements to RHOM
i. Maintain heavy equipment and ancillary facilities (roads, dikes etc) associated with routine operations and maintenance of CCPs and associated disposal facilities					Lead				Support	
j. Develop & manage projects and contracts for marketing/beneficial reuse of CCPs	Support				Lead		Support		Support	
k. Manage budgets for routine operation and maintenance activities					Lead					
l. Develop engineering plan to ensure facilities are operating to the appropriate standards of safety, functionality, and environmental compliance; lead for ensuring structural stability of site	Lead				Support; ensure engineering recommendations are implemented	Assist with field documentation	Support	Support		
m. Audit routine activities for compliance with design and construction documents; perform QA for routine handling	Lead				Support; fund QA for remainder of FY	Support				
n. Provide factors of safety, load ratings, design assumptions, risks etc as needed to support routine O&M activities	Lead				Identify needs					
o. Prepare facility phaseing plans to prevent field engineering (3D drawings)	Lead				Support					

CCP Roles and Responsibilities

Activity Description	CCP Projects and Engineering				CCPM		Environmental	River Ops	Plant	Other
	CCP Engineering	CCP Projects	CCP Construction	CCP Projects & Engr. Support	RHOM	FE				
p. Prepare Emergency Action Plans for CCP facilities	Lead				Support	Support				Support from Safety Staff
q. Develop and deploy CCP facility stability monitoring program	Lead				Support	Support		Support for dams		
r. Operate and Maintain stationary CCP processing equipment (silos, blowers, pumps, piping, dewatering systems, etc)					Provide input				Lead	
s. Annual review of programmatic document	Lead	Support	Support	Support	Support	Support	Support	Support		
t. Provide security for CCP processing and management facilities					Lead				Support	
u. Adherence to the TVA safety manual (JSA's, Pre-job briefings, etc)					Lead					Support from Safety Staff
v. Design changes resulting from Routine Operations	Review/approve changes				Request design changes		Modify permit as required			
w. Strategic Planning for sites	Lead (coordinate with FPG)	Input/support	Input/support	Input/support	Input/support (ensure linkage with marketing plans and remaining facilitiy capacity	Input/support	Input/support	Input/support	Input/support	
x. Technical guidance and advice on major maintenance and process problems	Lead				Input	Support				
y. Organizational indicators for CCBP management	Support	Support	Support		Support	Lead	Support			
Inspections and monitoring										
a. Daily Inspections	Develop scope				Lead - Perform and report; maintain files on site		Input to scope			
b. Weekly inspections	Develop scope				Lead - Perform and report; maintain files on site		Input to scope			
c. Unscheduled inspections	Lead				Support					
d. Quarterly inspections	Participate; prioritize corrective actions				Lead - Perform and report; maintain files on site; correct deficiencies per priorities	Support				
e. Annual inspections	Lead for inspection and reporting; prioritize corrective actions				Participate; maintain files on site; correct deficiencies per priorities	Support			Participate	
f. Annual inspections - landfill overlying an inactive pond	Participate				Participate			Lead and program oversight		
g. Ash Pond Dam Safety inspections	Participate				Participate			Lead and program oversight		
h. Inspection of erosion and sediment controls immediately following signficant precipitation events	Support				Lead			Support		
i. Inspection of facilities immediately following large storms or earthquakes	Support				Lead					
j. Closed ash ponds										
1. Daily "drive by" inspection					Lead					
2. Dam safety inspection	Participate				Participate			Lead		
3. Maintenance of closed ash ponds and stacks	Support				Lead		Support	Support	Support	
k. Ash Pond monitoring										
1. Develop and deploy monitoring program	Lead							Support		
2. Read instruments on established schedule	Lead							Read during Dam Safety Inspections		
3. Establish action ranges	Lead							Support		
4. Review and interpret instrument data	Lead							Support		
5. Identify and prioritize required actions based on data	Lead							Support		
6. Implement corrective actions	Support				Lead	Support		Support		
7. Maintenance of instruments	Support					Lead		Support		
Other										
Properties and Siting Studies a. Buffer Properties, Regional Siting Studies, Landfill Siting Property Issues	Lead for scope, schedule, engineering, communications plan, coordination with Realty/Environmental/GI&E, coordinate demolition	Lead for PJ package, overall project management	Involvement as requested	Integrated schedule	Identify need, input, other involvement as requested		Lead for NEPA, permitting if required		Stay informed via JPT	GI&E - maps, surveying; Realty - parcel data, access permission, land procurement; Communication & Valley Relations - Communications plan
Properties and Siting Studies b. Fossil Property Transfers										Transfer to Fossil Engineering
Procedure development (SPPs) -	Support	Support	Support	Support	Support	Support	Support			Project Governance and Oversight is the lead
Root Cause Analysis (PER's, CAP's, etc.)	Input as needed	Input as needed	Input as needed	Input as needed	Input as needed	Input as needed				Owning organization leads with oversight by Project Governance organization

CCP Roles and Responsibilities

Activity Description	CCP Projects and Engineering				CCPM		Environmental	River Ops	Plant	Other
	CCP Engineering	CCP Projects	CCP Construction	CCP Projects & Engr. Support	RHOM	FE				
DCN's for all projects capital, O&M, and routine to be performed by CCP Engineering	Input as needed	Input as needed	Input as needed	Input as needed	Input as needed	Input as needed				Owning organization leads with oversight by Project Governance organization
Work Packages for Maximo	Lead for project work packages	Support - project work packages	Support - capital project work packages		Lead for routine handling work packages; support for O&M project work packages	Support	Support			
Process deployment and audits	Input as needed	Input as needed	Input as needed	Input as needed	Input as needed	Input as needed				Project Governance and Oversight
Back up plans for off site CCP disposal	Identify need for backup off-site capacity based on remaining capacity and schedule for projects to provide additional capacity	Identify need for backup off-site capacity based on remaining capacity and schedule for projects to provide additional capacity	Identify need for backup off-site capacity based on remaining capacity and schedule for projects to provide additional capacity		Identify need for backup off-site capacity based on remaining capacity and schedule for projects to provide additional capacity; Make decision and establish contracts for backup off-site capacity when required					
Communications										
a. Monthly project review meetings (capital and O&M) at plants	Participate	Lead	Participate	Participate	Participate	Participate	Participate		Participate	

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1	Overall Management and Execution of Operational and Production Activities that Transport and Store CCP	**LEAD**	Support	Support	Support	Support		Support	Support	Support					Support	Support	Support	Support	
2	Attend Site Master Strategy Meetings	Support	**LEAD**	Support	Support	Support										Support			
3	Develop and Manage (TCM) Contracts for Routine Handling of CCPs	Support	**LEAD**	Support	Support	Support		Support	Support	Support					Support				
4	Routine Site Visits to Identify Opportunities for Improvements	**High Support**	**LEAD**	Support	Support	Support													
5	Implement Programmatic Document	Support	**LEAD (for technical)**	Support	**LEAD (for field)**	Support									Support	Support			
6	Review Projects for Operability, (Constructability if Capital Project)	Support	**High Support**	**LEAD**	Support	**High Support**													
7	Ensure Environmental Requirements for CCP Facilities are Maintained	Support	Support	**LEAD**	Support	**High Support**									Support				
8	Predict Future Storage Area Needs	Support	**High Support**	**LEAD**				Support	Support	Support					Support		Support		Support
9	Track and Report on Free Water Volumes	Support	**High Support**	**LEAD**				Support	Support	Support	Support				Support		Support		
10	Quantify Burn Rates Verses Ash Production	Support	**High Support**	**LEAD**	Support	Support		Support	Support	Support					Support		Support		
11	Perform Quarterly Dike Inspections (Implement Quarterly PM WO's)	Support	**High Support**	**LEAD**	Support	Support	Support	Support	Support	Support					Support				
12	Have Surveys of CCP Facilities Performed	Support	Support	**LEAD**				**High Support**	Support	Support									
13	Manage and Track CCP Production and Facility Remaining Capacities	Support	Roll Up To	**LEAD**	Support	Support		Support	Support	Support	Support				Support		Roll Up To		
14	Calculate Monthly CCP Material Volumes and Quantities Handled	Support	Support	**LEAD**				Support		Support					Support		Roll Up To		
15	Provide Plant PAE's with Required CCP Quantities	Support	**High Support**	**LEAD**							Support				Support		Support		
16	New Project Design Reviews for RHO&M	Support	Support	**LEAD**												**LEAD**			
17	PPD Operability Reviews and Approval	Support	Support	**LEAD**		Support										**High Support**			
18	Perform Monthly Dike Inspections (Implement Monthly PM WO's)	Support			**LEAD**					Support	Support							Support	
19	Ensure all RHO&M Policies and Standards are being Adhered to in the Field	**High Support**	Support	Support	**LEAD**	**High Support**		Support	Support	Support					Support			Support	
20	Assist and Support Field Supervisors	Support	Support	Support	**LEAD**	Support		Support		Support									
21	Perform Safety & Environmental Observations & Interventions	Support	Support	Support	**LEAD**	**LEAD**									**LEAD**		Roll Up To		
22	Initiate & approve all RHO&M T&M Contracts	Support	Support	Support		**LEAD**													
23	Adherence to the TVA Safety Manual (JSA's, Pre-job briefings, etc)	Support	Support	Support	**High Support**	**LEAD**		Support	Support	Support					Support				
24	Approve all RHO&M T&M Invoices	Support	Support	**High Support**	Support	**LEAD**													

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25	Manage and Execute Maintenance of Disposal Facilities and Structures	Support				LEAD									High Support				
26	Manage Onsite Borrow Pit Areas	Support				LEAD									High Support				
27	Oversight of Field Operation for CCP Disposal Facilities	Support	Support	Support	Support	LEAD		Support	Support	Support					High Support				
28	Perform Weekly Inspection (Implement Weekly PM WO's)	Support				LEAD												Support	
29	QA / QC has been performed on RHO&M work	Support	High Support	Support		LEAD		Support	Support	Support									
30	Prioritize List of Job Jar Work	Support				LEAD													
31	Supply Partner oversight	Support				LEAD													
32	Supply Safety Oversight	Support				LEAD													
33	Plant Interface w/PAE and or Plant Managers	Support	Support	Support	Support	LEAD													
34	Identify New Seeps and Monitor Existing	Support	Support	Support	Support	LEAD	Support	Support	Support	Support						Support		Support	
35	Inspection of Erosion and Sediment Controls Immediately Following Significant Precipitation Events	Support	Support	Support	Support	LEAD	Support								Support				
36	Notify Plant of Any / All Potential Critical Deficiencies	Support	Support	Support	Support	LEAD									Support				
37	Oversee Vegetation Control Practices	Support	Support	Support	Support	Support	LEAD		Support										
38	Identify Facility Deficiencies on Aerial Maps	Support						LEAD	Support	High Support									
39	Track Facility Deficiencies and Provide Documentation for Resolved Items	Support						LEAD	Support	High Support							Roll Up To	High Support	
40	Produce Updated Facility Maps	Support	Support	Support				LEAD	Support	Support									
41	Prepare and Implement Spill Prevention / Response Plan	Support	Support	Support	Support	Support			LEAD						High Support				
42	Prepare and Issue any White Papers Required	Support	Support	Support	Support	Support			LEAD						LEAD				
43	Ensure all PER's are initiated and tracked for CCP	Support							LEAD										
44	Track for closure all Performance Evaluation Reviews (PER's) for CCP	Support	Support	Support	Support	Support		Support	LEAD	Support	Support								
45	Ensure all Corrective Action Plans are Implemented for CCP	Support							LEAD										
46	Update and Revise Safety Flashes for CCP & CCP RHO&M Lessons Learned	Support				Support			LEAD								Roll Up To		
47	Serve as Environmental Liaison for CCP and Environmental Corporate	Support				Support			LEAD										
48	Support Operations for Safety and Environmental Notifications & Issue Environmental Updates to Field Personnel	Support				Support			LEAD										

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49	Develop and Deploy all RHOM Communication "Huddle Boards" & update with JSA, Safety, Environmental, and Operations Materials	Support		Support		Support			LEAD		Support								
50	Track and Trend Corrective Actions	Support	Support	Support	Support	Support		Support	LEAD		Support	Support	Support	Support	Support		Roll Up To		Support
51	PER Dispositions	Support	Support	Support	Support	Support			LEAD								Support		
52	Stand-in for Field Supervisors									LEAD									
53	Verify Operations are with in the Design Footprints	Support	Support	Support	Support	Support		Support	Support	LEAD					Support				
54	Verify Completion of Corrective Maintenance WO's (Repairs Cpt)	Support						Support	Support	LEAD								Support	
55	Provide Locations of Deficiencies	Support						Support	Support	LEAD								Support	
56	Provide Work Packages & Design Drawings	Support	Support	Support		Support		Support		LEAD									
57	Verify Survey Results	Support	Support	Support		Support		Support	Support	LEAD	Support								
58	Provide Status and Track Completed Dike Observations/Inspections and Environmental Items	Support			Support	Support					LEAD						Roll Up To		Support
59	Maintain weekly spreadsheet of DRF (Daily Field Report) on share drive										LEAD								
60	Maintain updated contact list										LEAD								
61	Provide Meeting Minutes and Action Items for RHO&M Meetings, Including Weekly Call										LEAD								Support
62	Develop & Manage Projects and Contracts for Marketing/Beneficial Reuse of CCPs	Support	Support	Support								LEAD	Support						
63	Develop Integrated Strategy for CCP Management, Manage CCP Marketing and Beneficial Reuse	Support	Support	Support								LEAD	Support	Support					
64	Place Products into a Wide Variety of Markets											LEAD	Support	Support					
65	Prepare annual report to the State of Tennessee on beneficial use of CCPs.											LEAD		Support					
66	Prepare annual report to the State of Kentucky on beneficial use of CCPs.											LEAD		Support					
67	Complete American Coal Ash Association (ACAA) production and use survey annually											LEAD	Support	Support					
68	Establish R&D Priorities for Beneficial Reuse											LEAD	LEAD						
69	Develop Strategic Sales and Production Alliances											LEAD	LEAD						
70	Prepare yearly ash production and utilization report for Toxics Release Inventory (TRI)												LEAD	Support					

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71	Prepare monthly report on slag operations at PAF for Title V compliance												LEAD	Support					
72	Report of all CCP production, utilization, stockpiles, disposal and remaining capacities for DOE Energy Information Administration (EIA) annually.		Support									Support	LEAD						
73	Prepare annual report of gypsum utilization and revenue to United States Geological Survey (USGS).												LEAD	Support					
74	Manage performance and compliance of CCP marketing contracts.											Support	LEAD	Support					
75	Perform biennial physical and chemical characterization of CCPs.											Support	LEAD						
76	Track Costs, Revenues and Indicators for Marketing											Support	Support	LEAD	Support		Roll Up To		
78	Track and Report on RHO&M Routine Handling Budgets	Support	Support											LEAD	Support		Support		
79	Track and Report on RHO&M Project Budgets	Support	Support											LEAD	Support		Support		
77	Track Additional Work List													LEAD					
80	Prepare Monthly CCP Utilization and Revenue Report for FGD&C/CCPM/RHO&M dashboard												Support	LEAD					
81	Prepare report on Greenhouse Gas Emissions Reduction											Roll Up To		LEAD					
82	Prepare Quarterly Report of Utilization for Environment & Technology's Environmental Dashboard													LEAD					
83	Prepare Quarterly Revenue Accruals for Business Services											Support		LEAD					
84	Prepare Recycled CCPs Report for the Stewart-Montgomery-Robertson (SMR) Municipal Solid Waste Planning Region's Annual Solid Waste Progress Report												Support	LEAD					
85	Serve as Liaison for Business Services & Procurement													LEAD					
86	Implement Adherence to Safety Manual	Support		Support	Support	**High Support**									LEAD				
87	Inspection of Facilities Immediately Following Large Storms or Earthquakes	Support	Support	Support	Support	**High Support**		Support		Support	Support				LEAD				
88	Provide Scope, Estimate, Schedule for New / Additional RHO&M T&M Work	Support	Support	Support	Support	**High Support**									LEAD				

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89	Verify Heavy Equipment Safety Checks	Support				**High Support**									LEAD				
90	Maintain Ancillary Facilities (roads, dikes etc) Associated with Routine Operations and Maintenance	Support				**High Support**									LEAD				
91	Implement Corrective Maintenance WO's to Repair Deficiencies	Support				**High Support**									LEAD			LEAD	
92	Manage Fugitive dust Associated with CCP Facilities	Support				**High Support**									LEAD				
93	Manage Cenospheres	Support	Support			**High Support**							Support		LEAD				
94	Provide Quantities of Materials Handled on a Weekly Basis	Support			Support	Support		Support			**High Support**				LEAD		Roll Up To		Support
95	Provide Safety and Environmental Statistics on a Weekly Basis	Support	Support	Support	Support	Support					Support				LEAD		Roll Up To		Support
96	Perform Inspections of Onsite Fuel Tanks	Support				Support									LEAD		Support		
97	Report on Quantities of Materials Handled Daily	Support				Support					Support				LEAD		Support		Support
98	Report on Manpower Onsite Daily	Support									Support				LEAD		Support		
99	Perform Daily Facility Observations	Support									Support				LEAD		Support		
100	Maintain Heavy Equipment	Support				Support									LEAD				
101	Contract Engineering Facilitator for Phase 2 of Operational Support Effort	Support	Support	Support	Support	Support		Support	Support	Support						LEAD			
102	Capital Project Joint Team Member	Support	Support	Support	Support											LEAD			
103	Maintain Operation Support Document (O&M Manuals)	Support	Support	Support	Support	Support		Support	Support	Support					Support	LEAD			
104	Liaison Between CCP Engineering and RHO&M	Support	Support	Support				Support								LEAD			
105	Obtain Factors of Safety, Load Ratings, Design Assumptions, Risks etc as to Support Routine O&M Activities	Support														LEAD			
106	Technical Guidance and Advice on Major Maintenance and Process Problems	Support	Support	Support	Support	Support									Support	LEAD			
107	Coordinate Review of Programmatic Document for RHO&M	Support	Support	Support	Support	Support		Support	Support	Support					Support	LEAD			
108	Produce Weekly RHO&M Highlights for FGDC Report on Weekly Basis	Support	Support	Support	Support	Support					Support				Support		LEAD		Support
109	Provide Breakdown of Types of Deficiencies Found	Support						**High Support**	Support	Support							LEAD	Support	
110	Provide Safety Flashes	Support				Support					Support				Support		LEAD		
111	Provide Weekly Resource Counts (Head Counts)	Support			Support	Support					Support				Support		LEAD		Support
112	Produce Monthly Material Quantity Reports	Support	Support	Support	Support	Support		Support				Support			Support		LEAD		Support
113	Produce Monthly Safety Reports	Support	Support	Support	Support	Support		Support				Support	Support		Support		LEAD		Support

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		Sr. Manager	**Manager Planning & Programs**	**Program Manager**	**Manager Construction / Field Support**	**Field Supervisor**	**Foremen**	**Technician (CAD Design)**	**General Technician**	**Field Technician**	**Business Support Rep**	**Manager Marketing**	**Specialist Marketing**	**Specialist Business Operations**	**Construction Partner**	**Field Engineering**	**Operational Support**	**Work Controls**	**Dam Safety**
114	Produce Overall RHO&M Monthly KPI's	Support	Support	Support	Support	Support		Support			Support	Support		Support	Support		**LEAD**	Support	Support
115	Track Safety Observations, Interventions - Input Hard Copies	Support	Support	Support	Support	Support			Support		Support						**LEAD**		
116	Track all Required Training	Support	Support	Support	Support	Support			Support								**LEAD**		
117	Produce Monthly Work Order Reports	Support	Support	Support	Support	Support		Support							Support		**High Support**	**LEAD**	Support
118	Work Controls Procedure Development (SPPs)	Support	Support	Support	Support	Support										Support		**LEAD**	
119	Plan Preventive Maintenance WO's for Inspections	Support																**LEAD**	
120	Close Completed Preventive Maintenance WO's and Vault	Support															Support	**LEAD**	
121	Create Corrective Maintenance WO's for Deficiencies	Support															Support	**LEAD**	
122	Plan Corrective Maintenance WO's for Deficiencies	Support															Support	**LEAD**	
123	Close Completed Corrective Maintenance WO's and Vault	Support															Support	**LEAD**	
124	Create Corrective Maintenance WO's Requiring Engineering Recommendations	Support															Support	**LEAD**	
125	Track and Report on all Work Orders for RHO&M	Support															Support	**LEAD**	
126	Produce Health Report on Facilities	Support	Support	Support				**High Support**	Support	Support							Support		**LEAD**
127	Prepare Emergency Action Plans for CCP facilities	Support									Support					Support			**LEAD**
128	Implementation of CCP Instrumentation Program	Support															Support		**LEAD**
129	Instrumentation Monitoring Program	Support																	**LEAD**
130	Dam Safety Training	Support									Support						Support		**LEAD**
131	Landfill Inspection Program Training	Support									Support						Support		**LEAD**
132	Maintenance of Instruments	Support									Support								**LEAD**
133	Prepare Inspection Plans for DSO	Support	Support	Support	Support	Support													**LEAD**
134	Prepare All Required Reports Per TVA SPP-27.3																		**LEAD**
135	Prepare All Required Per TVA SPP-27.4		Support					Support			Support								**LEAD**
136	Prepare All Required Per TVA SPP-27.5																		**LEAD**
137	Prepare All Required Per TVA SPP-27.6																		**LEAD**
138	Manage TVA Mineral Property Locations																		**LEAD**

The activity descriptions listed are not intended to reflect an individual's entire scope of duties. This is a living document and is subject to change. Please check the CCP share drive (in folder "Roles Responsibilities") for latest version.

1.0 CONTACTS

2.0 RHO&M GROUP PERSONNEL

Table 1 shows the RHO&M group personnel and contact information for KIF.

Table 1 - Contacts

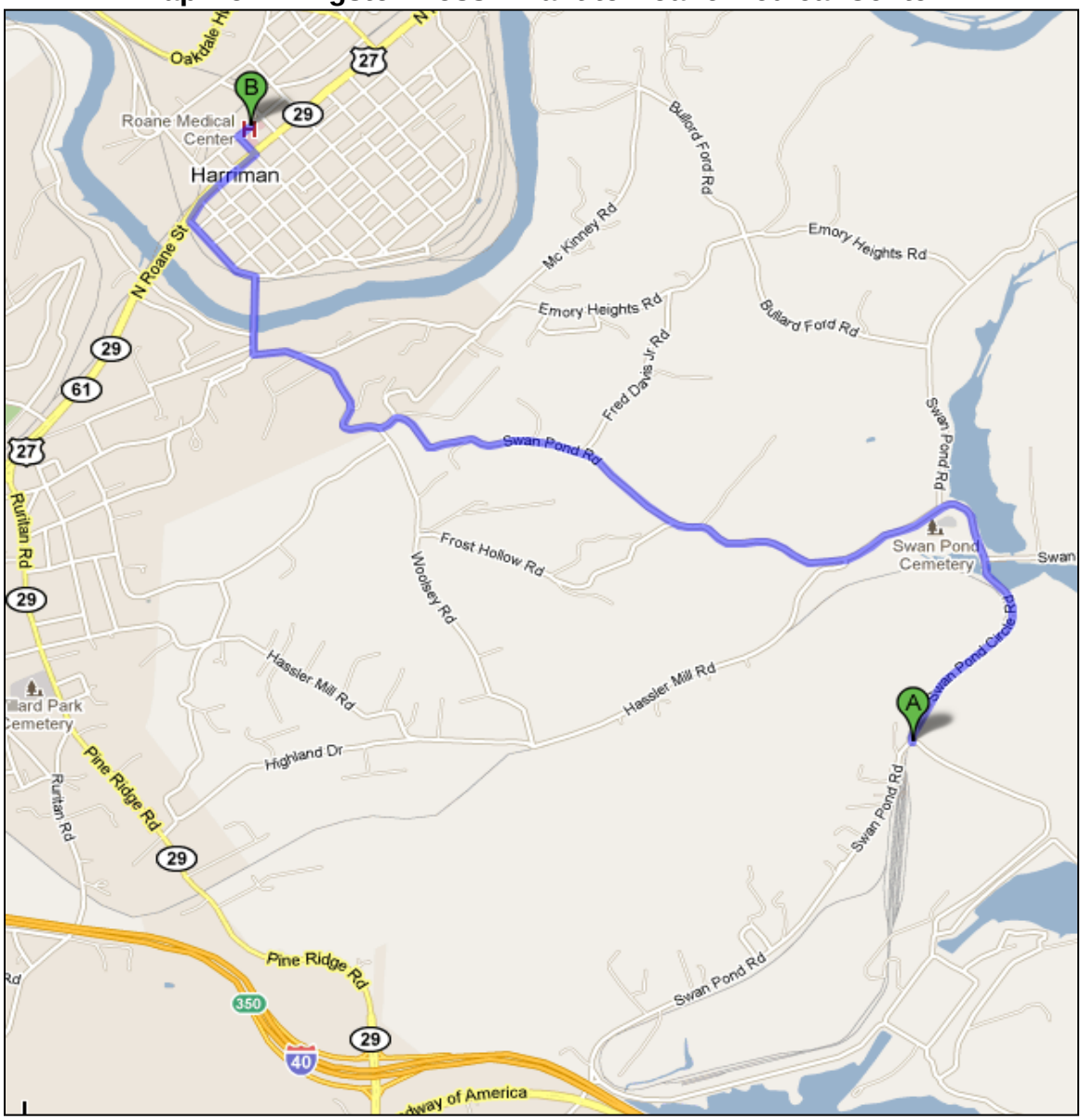
Plant SOS		**865-717-2120**	
Civil Projects FRMN	Dwane Rushing	865-755-8393	fdrushing@tva.gov
Field Supv (FS)	Ben Phillips	423-326-8831	bphillips@tva.gov
Constr Mngr (CM)	Marty Helton	423-637-2680	mrhelton@tva.gov
Program Manager	Steve Shamblin	423-322-3119	sgshamblin@tva.gov
CCP Eng	Jamie Dotson	423-290-7269	vjdotson@tva.gov
Civil Design Tech	Micheal Hulslander	912-398-2876	mhulslander@tva.gov
Env PAE	Adele Dennison	865-755-9280	amdennison@tva.gov
Env PAE	Cynthia McCowan	865-717-2531	cowebb@tva.gov
Stantec Engineer	Don Fuller	859-422-3041	dfuller@stantec.com
Stantec Engineer	Tom Crilly	778 331-0217	tom.crilly@stantec.com

3.0 EMERGENCY CONTACTS

Table 2 shows the RHO&M emergency contact information for KIF.

Table 2 - Emergency Contacts		
Roane Medical Center – Main Switchboard		865-882-1323
Roane Medical Center – Emergency Room		865-882-4155
KIF Plant SOS	Facility Phone	865-717-2120

Map from Kingston Fossil Plant to Roane Medical Center



Directions from Kingston Fossil Plant to Roane Medical Center

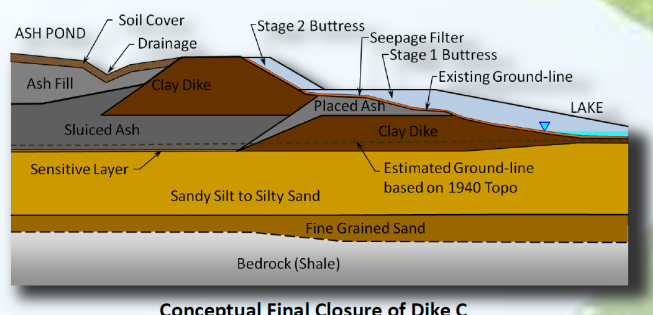
A Swan Pond Circle Rd

1.	Head **north** on **Swan Pond Circle Rd** toward **Swan Pond Rd** About 2 mins	go 0.7 mi total 0.7 mi
2.	Continue straight onto **Swan Pond Rd** About 5 mins	go 2.0 mi total 2.6 mi
3.	Turn left to stay on **Swan Pond Rd** About 2 mins	go 0.6 mi total 3.2 mi
4.	Turn right onto **Pansy Hill Rd** About 1 min	go 0.2 mi total 3.4 mi
5.	Turn left onto **Emory Dr** About 1 min	go 0.3 mi total 3.7 mi
6.	Turn right onto **N Roane St** About 1 min	go 0.3 mi total 4.0 mi
7.	Turn left onto **Walden Ave NW** About 1 min	go 361 ft total 4.0 mi
8.	Turn right onto **Devonia St** Destination will be on the right	go 233 ft total 4.1 mi

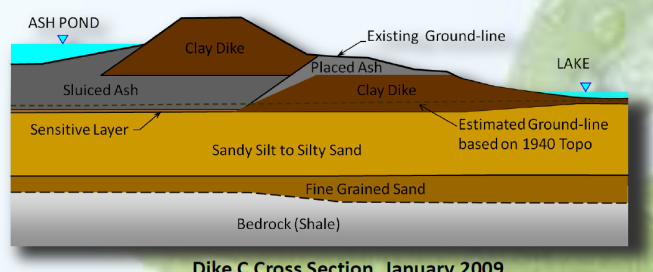
B **Roane Medical Center**
412 Devonia Street, Harriman, TN 37748 - (865) 882-1323

History of Kingston Fossil Plant
Coal Combustion Products Disposal Facilities

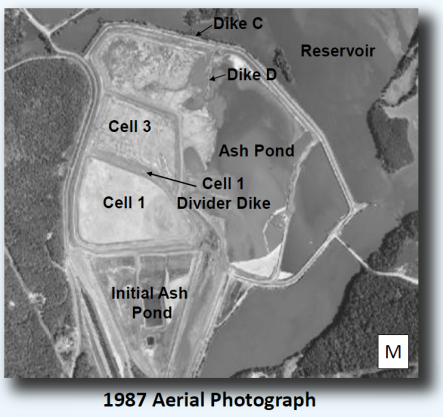
2010 Aerial Photograph



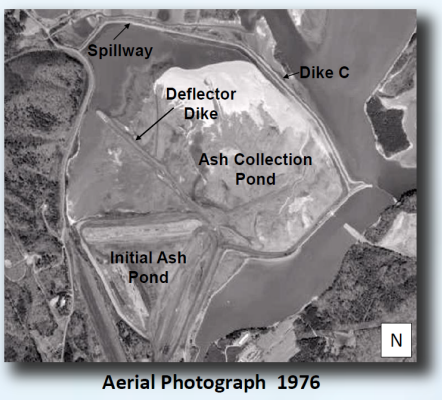
Conceptual Final Closure of Dike C



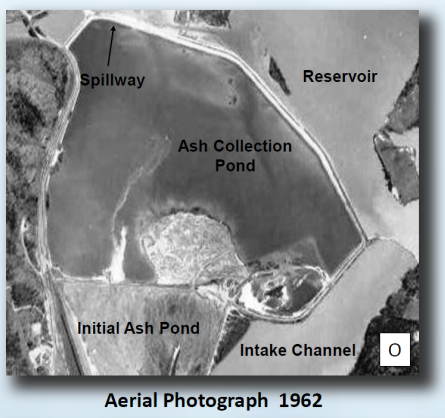
Dike C Cross Section, January 2009



1987 Aerial Photograph



Aerial Photograph 1976



Aerial Photograph 1962

Aerial Photograph 1959

Aerial Photograph 1949

2009
2008
2006
2005
2003
1987
1984
1983
1976
1974
1965
1958
1954
1951

A A dropout occurred at the Phase 1 portion of the Peninsula Site on December 15, 2010. Gypsum production ceased until the cause of the dropout was determined and the dropout was repaired.

B The Coal Yard drainage pond was cleaned out by TVA Civil Projects in the fall of 2009.

C Dike 2 Sediment Pond (Temporary structure) built in 2009 as part of the incident recovery.

D Excavation and construction of the Peninsula Gypsum Pond began in 2008 in order to create a new facility to collect gypsum produced from the new plant scrubbers.

E Available information indicates the December 22, 2008 Dredge Cell incident initiated at the northwest corner of the cell, progressing within the Dredge Cell through Cells 2 and 3. The remaining intact portion of the Dredge Cell, comprised of what was formerly referred to as "Cell 1," is now referred to as the Relic.

F Northern Portion of the Ash Dredge cell failed on Dec. 22, 2008 early morning.

G A leak occurred at the toe of the slope on the east side slope of dredge cells 2/3 on Nov. 6, 2003. In order to repair the leakage, the dredging operation was ceased immediately and Dredge Cell Restoration Project was undertaken. Construction/repair was completed in summer 2005. On Nov. 1, 2006, a localized slope failure occurred very near the 2003 leakage area.

H Sluice water flows from the main Ash Pond to the Stilling Pond through five active spillways constructed in 2005. Water then discharges into the plant Intake Channel via six riser structure spillways equipped with discharge diffusers constructed in November 2003.

I Between 1987 and 1988, Dredge Cells 2 and 3 were created in the northwestern portion of the ash pond. As the Dredge Cells began to fill, an Intermediate Dredge Cell was created to the east of Dredge Cell numbers 1, 2, and 3 and the eastern dike became Dike D.

J The original dike structure (Dike D) which was predominantly west of the current alignment failed in 1984 as a result of foundation undermining associated with dredging and was later reconstructed. The remaining structure alignment which extends to the south side of the ash pond was completed in 2004 to form the intermediate or emergency dredge cell.

K Since 1984 general ash management operations included sluicing fly ash and bottom ash into a channel that drains into the ash pond. The ash was then excavated out of the sluice channels and dredged from the ash pond and then transported to the dredge cells (wet stacks).

L In 1983, an interior ash dike was constructed in a southwest to northeast direction that roughly reduced the size of the ash pond by half and is most likely the first effort in the planned transition to Dredge Cell operations.

M Between 1976 and 1978, major construction and operational changes took place with a major increase in the height of Dike C and the Road Dike and the creation of the stilling pond. Dike C and the Road Dike were both raised, using upstream construction methodology, to an elevation of 765 feet to provide the additional freeboard when the stilling pond was created to allow the finer particles to settle out before the water reentered Watts Bar Lake.

N In 1974, Dike C and the Road Dike underwent an interim raise of approximately 1.5 feet to provide additional freeboard for the ash pond and a deflector dike was created in the southwestern portion of the ash pond (near the current location of Dredge Cell 1).

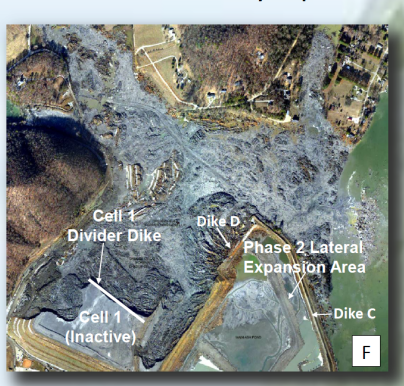
O Initial ash disposal cell bounded by the north and east dikes was filled in 1965. Afterwards, ash was directed into the main ash disposal cell where it deposited and progressively filled from south to north.

P By 1958, the northern 275-acre ash pond containment dike was completed with the construction of Dike C, which was constructed of residual clay and bottom ash to an elevation of 748 feet.

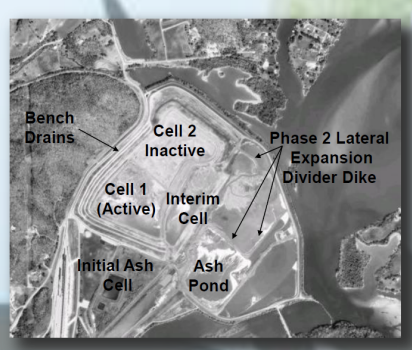
Q From 1954 to 1976, ash sluiced into the pond formed the "Hydraulically Placed Ash" horizon that now lies below the third raising of Dike C.

R Kingston Fossil plant began construction in 1951 and was on-line during February 1954. At that time, ash slurry was discharged directly to slack water area created by Watts Bar Reservoir, which was filled in 1941.

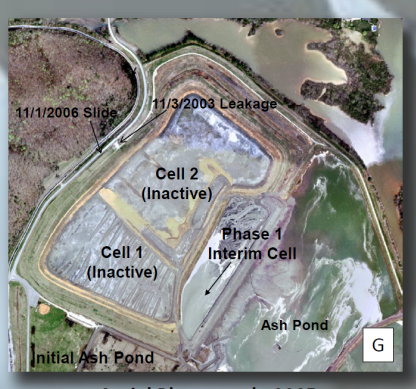
2011 Factor of Safety Map



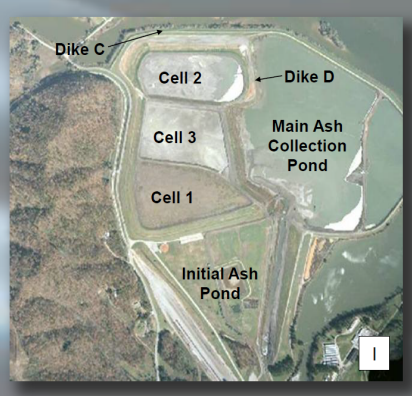
Aerial Photograph 12-30-2008 (Post-failure)



Aerial Photograph 4-5-2008 (Pre-failure)



Aerial Photograph 2005



Aerial Photograph 1996

Rev. 0
July, 2011

Map Directory

Map ID	Pipe ID	Description
001	KIF-AP-MG-001-A	Ash pond primary spillway
002	KIF-AP-MG-002-A	Ash pond primary spillway
003	KIF-AP-MG-003-A	Ash pond primary spillway
004	KIF-AP-MG-004-A	Ash pond primary spillway
005	KIF-AP-MG-005-A	Ash pond primary spillway
006	KIF-SP-MG-006-A	Stilling pond primary spillway
007	KIF-SP-MG-007-A	Stilling pond primary spillway
008	KIF-SP-MG-008-A	Stilling pond primary spillway
009	KIF-SP-MG-009-A	Stilling pond primary spillway
010	KIF-SP-MG-010-A	Stilling pond primary spillway
011	KIF-SP-MG-011-A	Stilling pond primary spillway
012	KIF-SP-PP-012-R	Former stormwater drainage pipe from dike road
013	KIF-AP-PP-013-C	Grouted in Feb. 2009 by Stantec
014	KIF-AP-PP-014-C	Grouted in Feb. 2009 by Stantec
015	KIF-AP-PP-015-A	Discharge outlet to ash pond
016	KIF-AP-PP-016-A	Discharge outlet to ash pond
017	KIF-AP-PP-017-I	Inactive spillway pipe to ash pond
018	KIF-AP-MG-018-A	Spillway to ash pond
019	KIF-AP-MG-019-A	Spillway to ash pond
020	KIF-SP-PP-020-R	Former stormwater drainage pipe from dike road
021	KIF-SP-PP-021-R	Former stormwater drainage pipe from dike road
022	KIF-SP-PP-022-R	Former stormwater drainage pipe from dike road
023	KIF-SP-PP-023-R	Former stormwater drainage pipe from dike road
024	KIF-SP-PP-024-R	Former stormwater drainage pipe from dike road
028	KIF-T2-MG-028-A	Holding pond primary spillway
029	KIF-T2-MG-029-A	Holding pond primary spillway
030	KIF-T2-MG-030-A	Holding pond primary spillway
035	KIF-AP-MG-035-I	Ash pond Kennedy Weir (grouted)
036	KIF-AP-MG-036-I	Ash pond inactive spillway
037	KIF-SP-PP-037-A	Stilling pond pump structure in main ash pond

Note: As an active CCP handling facility, see TVA - CCP Engineering for current inventory updates.

STANTEC CONSULTING SERVICES INC.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000

Stantec

Spillway/Conduit Inventory

Tennessee Valley Authority
Kingston Fossil Plant
Kingston, Roane County, Tennessee

PROJECT NO.	175560044
DATE	JUNE 2011
DRAWN BY	MIA
CHECKED BY	CJJ
CHECKED BY	RDF
SCALE	AS SHOWN
REVISED	
1. Rev. 0 – Initial Issue, 03/2010	
2. Rev. 1 – RHO&M Issue, 06/2011	
3.	
4.	
5.	
6.	
7.	
8.	

SHEET

1 OF 1

V:\175\active\175560044\geotech\calhan\yeat\Phase 2\200.052 Ops Support Doc\KIF\REV 0\0500-Hebcrial Information\502-Spillway and Pipe Inventory\cf_spwy

001 Spillway from main ash pond to stilling pond

002 Spillway from main ash pond to stilling pond

003 Spillway from main ash pond to stilling pond

004 Spillway from main ash pond to stilling pond

005 Spillway from main ash pond to stilling pond

037 Stilling pond pump structure with pipe penetrating dike to aboveground storage tank located along dike to main ash pond

035 Closed and abandoned Kennedy Weir. Spillway removed, access walkway remains.

035 Closed and abandoned outlet from Kennedy Weir.

036 Inactive 48” CMP MG Riser spillway from main ash pond to stilling pond

036 Inactive outlet for spillway from main ash pond to stilling pond

001 Submerged spillway outlet from main ash pond into stilling pond (001-004 outlets are submerged)

001 Submerged spillway outlet from main ash pond into stilling pond (001-004 outlets are submerged)

006 Spillways 006-011 from stilling pond to Watts Bar Lake

006 Spillway from stilling pond to Watts Bar Lake

007 Spillway from stilling pond to Watts Bar Lake

008 Spillway from stilling pond to Watts Bar Lake

009 Spillway from stilling pond to Watts Bar Lake

010 Spillway from stilling pond to Watts Bar Lake

011 Spillway from stilling pond to Watts Bar Lake

006 36” steel outlet pipes from stilling pond to Watts Bar Lake

017 12” Steel Outlet Pipe from Engineered Redwater Wetlands to main ash pond (inactive)

018 12” Plastic Outlet Pipe from Engineered Redwater Wetlands to main ash pond

019 12” Plastic Outlet Pipe from Engineered Redwater Wetlands to main ash pond

017 12” Steel Outlet Pipe from Engineered Redwater Wetlands to main ash pond (inactive)

018 12” Plastic Outlet Pipe from Engineered Redwater Wetlands to main ash pond (steel at outlet)

019 12” Plastic Outlet Pipe from Engineered Redwater Wetlands to main ash pond (steel at outlet)

018 Morning Glory risers in engineered redwater wetlands conveying discharge to main ash pond

018 Morning Glory risers in engineered redwater wetlands conveying discharge to main ash pond

020 12” Steel Outlet pipe from main ash pond into Watts Bar Lake

023 12” Steel Outlet pipe from main ash pond into Watts Bar Lake

024 12” Steel Outlet pipe from main ash pond into Watts Bar Lake

028 Weir inlet from second series of holding ponds to third series of holding ponds (north side of dike T-2)

029 Weir inlet from second series of holding ponds to third series of holding ponds (north side of dike T-2)

029 Discharge point from weir inlets into third series of holding ponds (north end of dike T-2)

030 Discharge inlets from holding ponds through dike T-2 into discharge channel (north end of dike T-2)

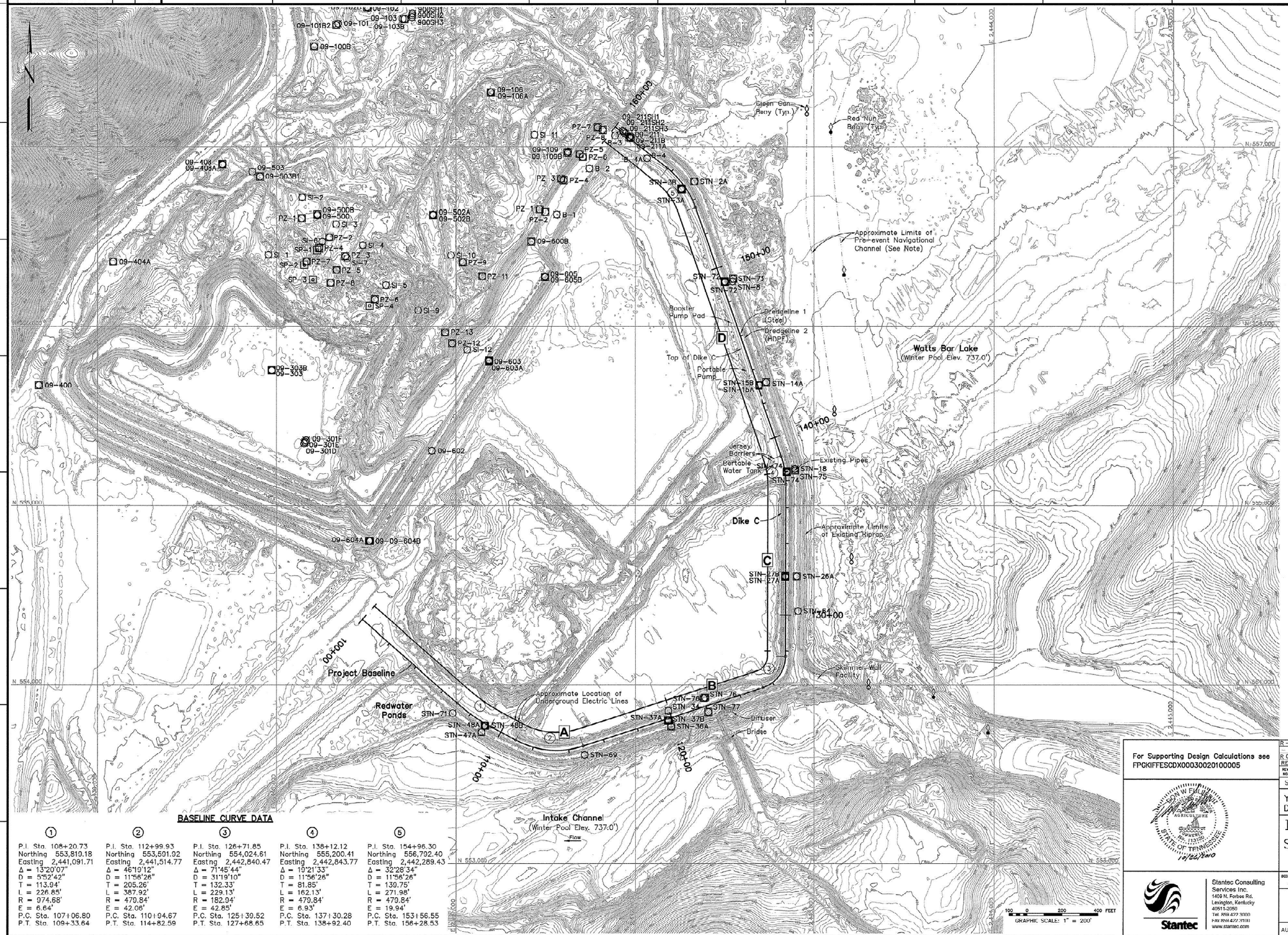
030 Discharge outlets from holding ponds through dike T-2 into discharge channel (north end of dike T-2)

030 Discharge channel from dike T-2 holding ponds into Watts Bar Lake (north end of dike T-2)

Photo Log		
Drawing Mark	**Comments**	
001	Spillway from main ash pond to stilling pond	
002	Spillway from main ash pond to stilling pond	
003	Spillway from main ash pond to stilling pond	
004	Spillway from main ash pond to stilling pond	
005	Spillway from main ash pond to stilling pond	
037	Stilling pond pump structure with pipe penetrating dike to aboveground storage tank located along dike to main ash pond	
035	Closed and abandoned Kennedy Weir. Spillway removed, access walkway remains.	
035	Closed and abandoned outlet from Kennedy Weir.	
036	Inactive 48” CMP MG Riser spillway from main ash pond to stilling pond	
036	Inactive outlet for spillway from main ash pond to stilling pond	
001	Submerged spillway outlet from main ash pond into stilling pond (001-004 outlets are submerged)	
001	Submerged spillway outlet from main ash pond into stilling pond (001-004 outlets are submerged)	
006	Spillways 006-011 from stilling pond to Watts Bar Lake	
006	Spillway from stilling pond to Watts Bar Lake	
007	Spillway from stilling pond to Watts Bar Lake	

008	Spillway from stilling pond to Watts Bar Lake	
009	Spillway from stilling pond to Watts Bar Lake	
010	Spillway from stilling pond to Watts Bar Lake	
011	Spillway from stilling pond to Watts Bar Lake	
006	36” steel outlet pipes from stilling pond to Watts Bar Lake	
017	12” Steel Outlet Pipe from Engineered Redwater Wetlands to main ash pond (inactive)	
018	12” Plastic Outlet Pipe from Engineered Redwater Wetlands to main ash pond	
019	12” Plastic Outlet Pipe from Engineered Redwater Wetlands to main ash pond	
017	12” Steel Outlet Pipe from Engineered Redwater Wetlands to main ash pond (inactive)	
018	12” Plastic Outlet Pipe from Engineered Redwater Wetlands to main ash pond (steel at outlet)	
019	12” Plastic Outlet Pipe from Engineered Redwater Wetlands to main ash pond (steel at outlet)	
018	Morning Glory risers in engineered redwater wetlands conveying discharge to main ash pond	
018	Morning Glory risers in engineered redwater wetlands conveying discharge to main ash pond	
020	Former 12” Steel Outlet pipe from main ash pond into Watts Bar Lake	
023	Former 12” Steel Outlet pipe from main ash pond into Watts Bar Lake	
024	Former 12” Steel Outlet pipe from main ash pond into Watts Bar Lake	

028	Weir inlet from second series of holding ponds to third series of holding ponds (north side of dike T-2)	
029	Weir inlet from second series of holding ponds to third series of holding ponds (north side of dike T-2)	
029	Discharge point from weir inlets into third series of holding ponds (north end of dike T-2)	
030	Discharge inlets from holding ponds through dike T-2 into discharge channel (north end of dike T-2)	
030	Discharge outlets from holding ponds through dike T-2 into discharge channel (north end of dike T-2)	
030	Discharge channel from dike T-2 holding ponds into Watts Bar Lake (north end of dike T-2)	



NOTES

1. Topographic mapping was generated from a LIDAR survey performed on April, 2009 by Tuck Mapping Solutions, Inc.
2. The hydrographic contours shown here were provided by TVA.
3. The navigational channel limits shown were provided by TVA using U.S. Army Corps of Engineers Nashville District data and was reviewed by the U.S. Coast Guard for its approximate location. The location shown is pre-event and is subject to change when clean-up operations are completed.

TABLE OF BASELINE COORDINATES			
Station	Baseline	Northing	Easting
100+00.00	Begin Project Baseline	554,363.86	2,440,477.77
160+00.00	End Project Baseline	557,109.43	2,441,886.36

SEGMENT STATIONS

Segment 'A' – Sta. 100+00.0 to Sta. 120+00.0
Segment 'B' – Sta. 120+00.0 to Sta. 128+00.0
Segment 'C' – Sta. 128+00.0 to Sta. 138+00.0
Segment 'D' – Sta. 138+00.0 to Sta. 160+00.0

INSTRUMENTATION LEGEND

STN-1 ⬡ Slope Inclinometer (SI)
STN-2 ⬡ Piezometer (PZ)
STN-3 ⊡ Settlement Platform (SP)

Note: As an active CCP handling facility, see TVA - CCP Engineering for current inventory updates.

BASELINE CURVE DATA

①	②	③	④	⑤
P.I. Sta. 108+20.73	P.I. Sta. 112+99.93	P.I. Sta. 126+71.85	P.I. Sta. 138+12.12	P.I. Sta. 154+96.30
Northing 553,810.18	Northing 553,501.92	Northing 554,024.61	Northing 555,200.41	Northing 556,792.40
Easting 2,441,091.71	Easting 2,441,514.77	Eastng 2,442,840.47	Easting 2,442,843.77	Easting 2,442,289.43
Δ = 13°20'07"	Δ = 46°19'12"	Δ = 71°45'44"	Δ = 19°21'33"	Δ = 32°28'34"
D = 5°52'42"	D = 11°56'26"	D = 3119'10"	D = 11°56'26"	D = 11°56'26"
T = 113.94'	T = 205.26'	T = 132.33'	T = 81.85'	T = 139.75'
L = 226.85'	L = 387.92'	L = 229.13'	L = 162.13'	L = 271.98'
R = 974.68'	R = 479.84'	R = 182.94'	R = 479.84'	R = 479.84'
E = 6.64'	E = 42.06'	E = 42.85'	E = 6.93'	E = 19.94'
P.C. Sta. 107+06.80	P.C. Sta. 110+94.67	P.C. Sta. 125+30.52	P.C. Sta. 137+30.28	P.C. Sta. 153+56.55
P.T. Sta. 109+33.64	P.T. Sta. 114+82.59	P.T. Sta. 127+68.65	P.T. Sta. 138+92.40	P.T. Sta. 158+28.53

RECORD DRAWING

For Supporting Design Calculations see FPGKIFFESCDX00030020100005

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. BY
R –	–	–	–	–	–	–	–	–	–	–	–
R 0	10/25/10	JDP	TJ	TO	DWF	–	–	–	–	–	–
RECORD DRAWING											

SCALE: 1"=200' EXCEPT AS NOTED

YARD
DIKE C

INSTRUMENTATION PLAN
SEGMENT LAYOUT

JOHN W. FIELDER — 1330 — REGISTERED — AGRICULTURE — ENGINEER — STATE OF TENNESSEE — 10/26/2010

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
Tel: (859) 422-3000
Fax: (859) 422-3181
www.stantec.com

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J. PINEAU	T. JOHNSON	I. CHILLY	D. FULLER	–	–	–

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE: 10/26/10	36	C	10W288-02	R 0

PLOT FACTOR: 200
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	0
TASK COMPLETED BY:	REV NO.

R:\07_DATE: 10/26/2010 USER: JOHNSON, TRACY
L:\DWG\ACTIVE\CP5\ENGR\DWG\ENGRDATA\CIVIL\MISC\INSTRUMENTATION\NEW_RECORD\10W288-02.DWG

LEGEND

A — Global Factor of Safety (F.S.) Against Sliding
F.S. ≥ 1.5

A — Global Factor of Safety (F.S.) Against Sliding
1.3 ≤ F.S. < 1.5

A — Global Factor of Safety (F.S.) Against Sliding
F.S. < 1.3

Note: As an active CCP handling facility, see TVA – CCP Engineering for current factor of safety updates.

0 250 500 1,000
Scale in Feet

Base Map Source:
1. Aerial survey based upon files KIF_20110316_1ft_NAD27.tif -Dated March 16, 2011
2. Information presented in this figure is based on the Facility Risk/Hazard Matrix dated July 15, 2011.

TENNESSEE VALLEY AUTHORITY
KINGSTON FOSSIL PLANT

SUMMARY OF STABILITY RESULTS FROM URS AND STANTEC GEOTECH REPORTS

DATE: JUNE 13, 2011	FIGURE: 1
DRAWN BY: MIA	CHECKED BY: RDF
Stantec	JOB NUMBER: 175560044

The Seepage Action Plan serves three primary functions: educate the inspector about potential seepage areas, assist the inspector in determining the seepage action level based on the seepage characteristics, and inform the inspector of corrective measures to take based on the seepage action level.

Seepage through an impoundment can typically be found on the lower third of the slope and extending downstream beyond the toe approximately fifty feet. Other seepage areas may exist, and the field inspector should be familiar with previous inspection reports and photographed observations. The site plan(s) included in the Seepage Log are intended to document historical locations of seepage.

Three seepage action levels are identified in the plan:

Action Level 1 – Non-Flowing

- Wet areas
- Ponded Water

Action Level 2 – Flowing Seepage – No Erosion

- Non turbid (clear water) flow

Action Level 3 – Flowing Seepage – Active Erosion

- Turbid Flow
- Deposition of Sediment from Dike or Dam
- Boils (Ground Surface/Underwater)
- Upstream Collapse or Sinkhole

Depending on the level of the seepage, various actions need to be taken. For Level 1, the field supervisor should document the seepage area into the seepage log by recording the date, time, size of area, location, and taking photographs.

For Level 2, the field supervisor should carefully inspect the area for outflow quantity, transported material, and take photographs. Team members should be contacted in accordance with Figure 8 of the plan, and photographs should be sent to the RHO&M Construction Manager and Program Manager for distribution. The seepage area should be documented in the log in the same manner as Level 1.

For Level 3, the Field Supervisor should inspect the area for outflow quantity and transported material and determine if piping has occurred. He should take photographs and contact team members in accordance with Figure 9 of the plan. The objective is to determine a plan of action within four hours of notification by the team consisting of the geotechnical consultant, TVA Program Manager, and CCP Engineering Manager. The seepage location and repair should be recorded in the seepage log in the same manner.

In order to be prepared for corrective actions, concrete sand, crushed stone, riprap, sandbags, and pipe for temporary culverts should be purchased and stockpiled onsite for an emergency situation. These readily available materials can be used to construct a reverse graded filter or to place sandbags around a boil to reduce piping of embankment soils. The type and quantity of required materials are defined in Table 1 of the Seepage Action Plan.

KIF Seepage Log

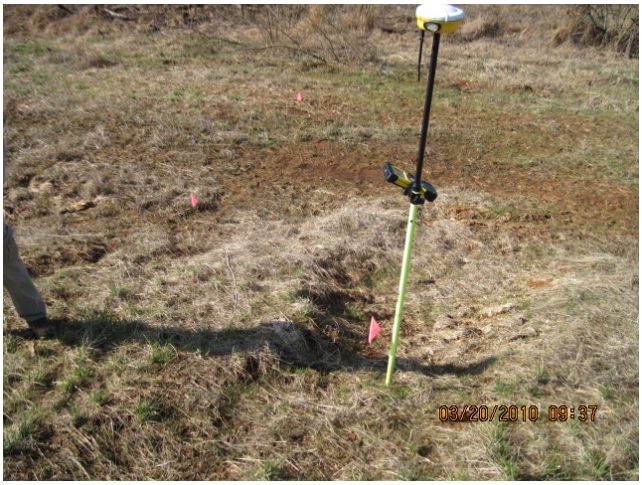
Kingston Fossil Plant
Kingston, Tennessee
Updated 6/22/2010 Rev. 1

Note: As an active CCP handling facility, see RHO&M Field Supervisor and/or the FGD&C sharepoint for the current seepage log.

Area of Concern	Coordinate Location (Northing/Easting)		Date Initially Observed	Time	Approximate Size (Linear Feet)	SAP Level	Description	Mitigation Status/ Future Plans
1	Survey Requested		3/20/2010	N/A	-	1	Wet weather rutting on the access road-initially discovered by Stantec on 3/20/2010. SAP Level 1.	This area should be monitored for change. Once the area is dry the slopes should be graded to allow for proper drainage.
2	Survey Requested		5/4/2010	N/A	-	1	Seepages observed by Stantec on 5/4/2010 at multiple locations near the waterline at the southern portions of the wetland. SAP Level 1	Monitoring of the seeps and ongoing analysis being conducted by Stantec.
3	Survey Requested		3/20/2010	N/A	-	1	Multiple seeps near the toe of the exterior northeast slope of the stilling pond. Initially observed by Stantec on 3/20/2010. SAP Level 1	Monitoring of the seeps and ongoing analysis being conducted by Stantec.
4	554532.07	2442015.24	5/4/2010	N/A	-	1	Possible red water seepage into Stilling Pond through Divider Dike-Initially Observed on 5/4/2010 by Stantec during the 2010 Annual Inspection. SAP Level 1	This area should be monitored for change.

Note: Initial Seepage Log was developed based on Stantec's understanding of known issues from Phase 1 and 2 assessments as well as ongoing construction work and knowledge of the site. No field visit was conducted to verify current seepage areas of concern.

EXAMPLE



Area of Concern 1

3/20/2010
Wet weather rutting on the access road:
Initially discovered by Stantec on 3/20/2010.
SAP Level 1.

Area of Concern 1

3/20/2010
Wet weather rutting on the access road:
Initially discovered by Stantec on 3/20/2010.
SAP Level 1.

Area of Concern 2

5/4/2010
Wet weather rutting on the access road:
Initially discovered by Stantec on 5/4/2010.
SAP Level 1.

EXAMPLE

Area of Concern 3

3/20/2010
Multiple seeps near the toe of the exterior northeast slope of the stilling pond. Initially observed by Stantec on 3/20/2010. SAP Level 1

Area of Concern 3

3/20/2010
Multiple seeps near the toe of the exterior northeast slope of the stilling pond. Initially observed by Stantec on 3/20/2010. SAP Level 1

Area of Concern 4

5/4/2010
Possible seepage into Stilling Pond through Divider Dike. Initially Observed on 5/4/2010 by Stantec. SAP Level 1

EXAMPLE

Notes:
1. The areas identified on this drawing should not be considered as the only areas where seepage might occur. Therefore, a complete inspection of the dike should be performed annually as outlined in Stantec's Dam Safety Training Presentation dated August, 2009.
2. Grid spacing is 500 feet.

LEGEND

N

Areas of Concern

Potential Seepage Zone

0 250 500 Feet

STANTEC CONSULTING SERVICES INC.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000

Stantec

DRAFT

SEEPAGE ACTION PLAN

Tennessee Valley Authority
Kingston Fossil Plant
Kingston, Roane County, Tennessee

PROJECT NO.	175560021
DATE	MARCH 2010
DRAWN BY	AMG
CHECKED BY	
CHECKED BY	
SCALE	1" = 500 '
REVISED	
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

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SHEET

1 OF 2

504-6

K L M N O P Q R S T U V W

12 11 10 9 8 7 6 5 4 3

Peninsula Gypsum Pond

#1

Notes:
1. The areas identified on this drawing should not be considered as the only areas where seepage might occur. Therefore, a complete inspection of the dike should be performed annually as outlined in Stantec's Dam Safety Training Presentation dated August, 2009.
2. Grid spacing is 500 feet.

LEGEND

N

Areas of Concern

Stockpile Location

Potential Seepage Zone

0 250 500 Feet

EXAMPLE

STANTEC CONSULTING SERVICES INC.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000

Stantec

DRAFT

SEEPAGE ACTION PLAN

Tennessee Valley Authority
Kingston Fossil Plant
Kingston, Roane County, Tennessee

PROJECT NO.	175560021
DATE	MAY 2010
DRAWN BY	AMG
CHECKED BY	
CHECKED BY	
SCALE	1" = 500 '
REVISED	
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

SHEET

2 OF 2

504-7

V:\175\active\175560.002\1g\gis\mxd\kingston_2.mxd

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Tennessee State Plane (FIPSZONE 4100). The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC- 3, #9202
1315 East- West Highway
Silver Spring, MD 20910- 3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242,** or visit its website at http://www.ngs.noaa.gov/.

Base map information on this FIRM was provided in digital format by the State of Tennessee.

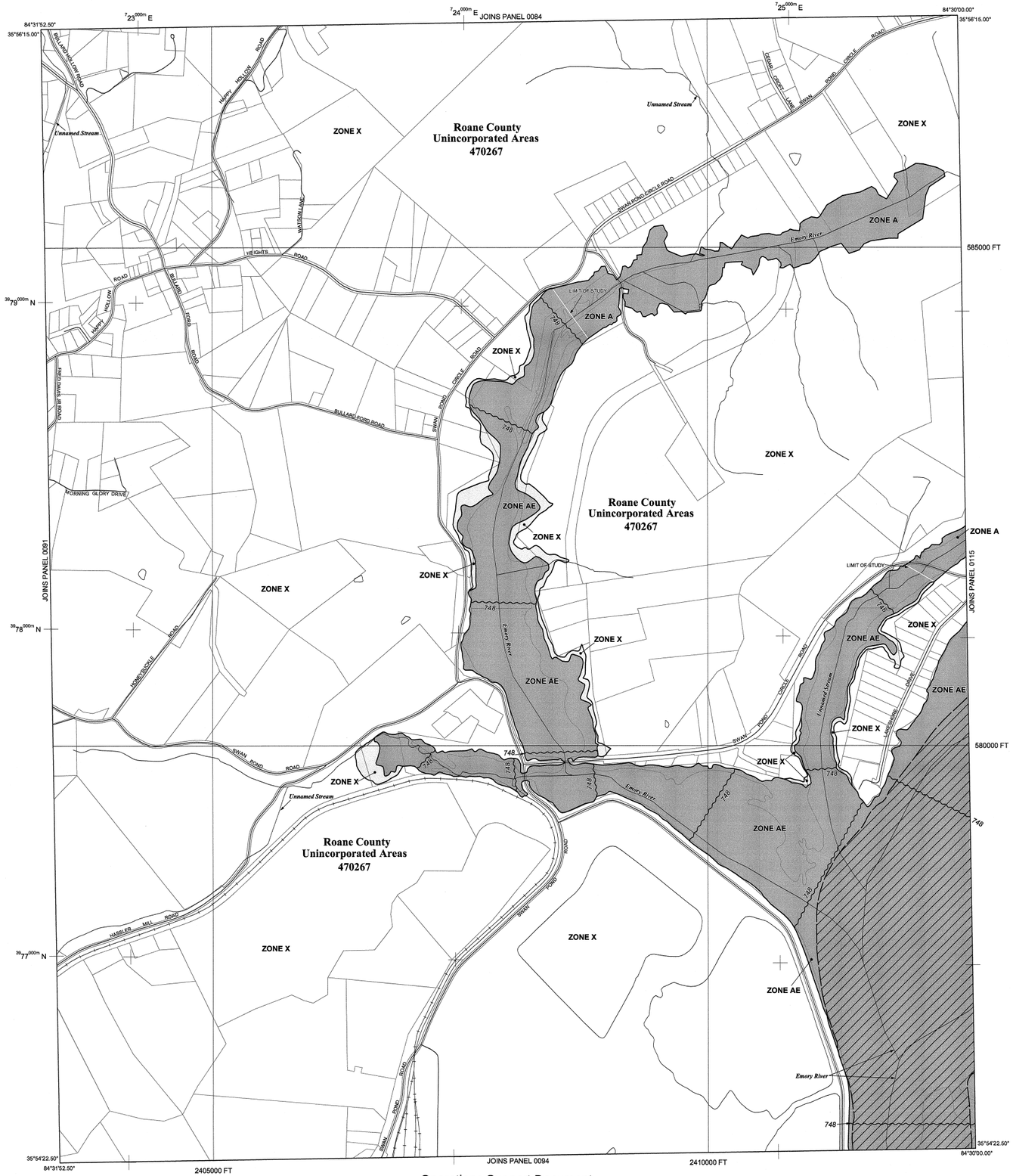
This map reflects more detailed and up- to- date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables *in the Flood Insurance Study report (which contains authoritative hydraulic data)* may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de- annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1- 800- 358- 9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, *a Flood Insurance Study report*, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1- 800- 358- 9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1- 877- FEMA MAP** (1- 877- 336- 2627) or visit the FEMA website at http://www.fema.gov/.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equalled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

- A — A — Cross section line
- 23 — 23 — Transect line
- 97°07'30", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 42 75 000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 16
- 6000000 FT — 5000-foot grid values: Tennessee State Plane coordinate system, (FIPSZONE 4100), Lambert Conformal Conic
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 28, 2007
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1- 800- 638- 6620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0092F

FIRM
FLOOD INSURANCE RATE MAP
ROANE COUNTY, TENNESSEE
AND INCORPORATED AREAS

PANEL 92 OF 335
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ROANE COUNTY	470267	0092	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
47145C0092F

EFFECTIVE DATE
SEPTEMBER 28, 2007

Federal Emergency Management Agency

NOTES TO USERS

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Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was STATE PLANE. The **horizontal datum** was the North American Datum of 1983 (NAD 83), GRS1980 Spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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NGS Information Services
NOAA, NINGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland, 20910-3282
(301) 713-3242

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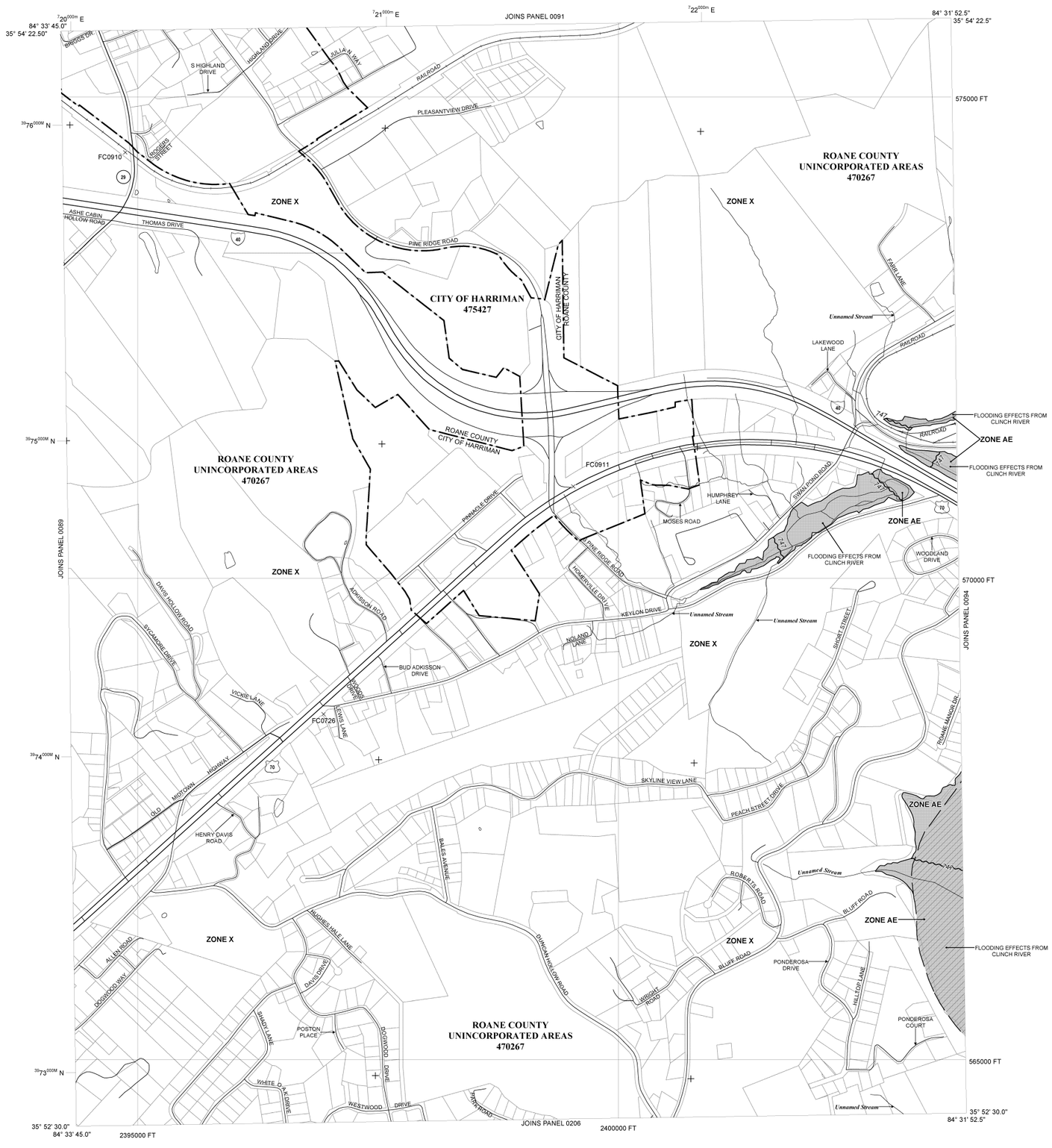

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

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ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

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Floodplain Boundary

Floodway Boundary

Zone D Boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513 Base Flood Elevation line and value; elevation in feet*

(EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A Cross section line

23 — 23 Transect line

45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

4989000 mN 1000-meter Universal Transverse Mercator grid ticks, zone 17

4989000FT 5000-foot grid values: TENNESSEE STATE PLANE 4100

DX5510 Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 28, 2007
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 18, 2009 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0093G

FIRM
FLOOD INSURANCE RATE MAP

ROANE COUNTY, TENNESSEE AND INCORPORATED AREAS

PANEL 93 OF 335
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HARRIMAN, CITY OF	475427	0093	G
ROANE COUNTY	470267	0093	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
47145C0093G
MAP REVISED
NOVEMBER 18, 2009

Federal Emergency Management Agency

NOTES TO USERS

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NGS Information Services
NOAA, N/NGS12
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1315 East-West Highway
Silver Spring, Maryland, 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was provided in digital format by the State of Tennessee.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a *Flood Insurance Study report*, and /or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain Boundary

Floodway Boundary

Zone D Boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A — Cross section line

23 — 23 — Transect line

45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

4989000m N — 1000-meter Universal Transverse Mercator grid ticks, zone 17

4989000FT — 5000-foot grid values: TENNESSEE STATE PLANE 4100

DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)

• M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 28, 2007
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 18, 2009 - to update corporate limits, to change
Base Flood Elevations and Special Flood Hazard Areas

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP — NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0094G

FIRM
FLOOD INSURANCE RATE MAP

ROANE COUNTY, TENNESSEE
AND INCORPORATED AREAS

PANEL 94 OF 335
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
KINGSTON, CITY OF	470274	0094	G
ROANE COUNTY	470267	0094	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
47145C0094G
MAP REVISED
NOVEMBER 18, 2009

Federal Emergency Management Agency

Kingston/Watts Bar Fossil Plant's
Coal Combustion Byproduct Handling
Scope of Work/Contract

I. GYPSUM ASH HANDLING

CONTRACTOR's responsibility will begin at the at the discharge point of the gypsum sluice line from the plant. CONTRACTOR will provide all required material, equipment, and labor to place production gypsum in conformance with design drawings and plant permit requirements. If the CONTRACTOR allows more than 2% of total annual gypsum production to reach the storm water pond, the CONTRACTOR must remove any gypsum over the 2% of annual production from the pond at its own expense within three months of discovery by CCP or on a schedule determined by CCP. CONTRACTOR will inspect the gypsum disposal area on a daily basis to runoff is minimized and the stormwater pond is clear of material. CONTRACTOR will haul, place, and compact gypsum on the gypsum stack in accordance with TVA approved design drawings/specifications & TDEC permit requirements.

The expected volume of gypsum to be handled is 545,000 dry tons per year.

II. DUST CONTROL

CONTRACTOR will maintain a zero visible dust standard 24/7/365 at Kingston regardless of whether the CONTRACTOR is actively performing work.

III. FACILITY INSPECTIONS

CONTRACTOR will perform daily inspections of all ash and/or gypsum storage facilities within their area of responsibility, in accordance with the CCP Programmatic Document. In addition to the daily inspections at KIF, the CONTRACTOR will also perform weekly inspections of the CCP facilities at WBF. CONTRACTOR will complete required forms and maintain records in onsite trailer. Seepage discovered or appearing to change during inspections will be immediately communicated with TVA Field Supervisor. Problems discovered during these routine inspections will be corrected by the contractor under a T&M pricing structure, upon written request.

IV. COMMUNICATIONS

CONTRACTOR will provide daily report summarizing work item status. Each report will include amount of ash moved that day and equipment onsite. In the event an accident occurs it is the CONTRACTOR's responsibility to immediately notify the CCP Field Supervisor. In the event an accident/incident occurs the CONTRACTOR must within 24 hours develop a "White Paper" describing the event and the immediate steps to mitigate future similar events.

V. AGREEMENT PRICE & DURATION

CONTRACTOR agrees that the work specified in this agreement can be performed for a fixed rate price of , to be paid to CONTRACTOR in twelve monthly payments as the work is performed. A onetime mobilization fee will be paid to the contractor in the amount of . The purpose of the fixed monthly payment is to compensate the CONTRACTOR for the estimated manpower, equipment, overhead and profit to perform the work. The fixed monthly payments will be paid only during the months that the CONTRACTOR is actively operating. In the event that

TVA shuts down the work, it will be TVA's sole discretion to utilize the manpower and equipment for other activities; to furlough the manpower and pay a standby charge for the equipment equal to 65% of the regular equipment rate; or to enact a partial termination of the contract, per Section 51 (Termination of Convenience) of the blanket contract.

CONTRACTOR will maintain and distribute a report card to track key measures of CONTRACTOR performance. This agreement is in effect from October 1, 2010 through September 30, 2015.

VI. ADDITIONAL WORK

Additional work shall be defined as activities other than basic routine handling of ash and/or gypsum. Additional work shall be paid for using the T&M pricing structure. Examples of additional work shall include temporary earth cover, density testing, seeding & erosion control, cenosphere management, quarterly inspection repairs, etc. Examples of activities that are not considered additional work are construction surveying, attending meetings, participation in quarterly inspections, housekeeping, etc. Work that can be performed with the existing onsite manpower and equipment, within normal work hours will be completed at no additional charge to TVA. Otherwise, the CONTRACTOR shall provide a scope, schedule and budget to perform the additional work and obtain written approval from the TCM prior to proceeding with the work.

VII. CALCULATION OF OVERAGES

Tonnages over the annual amounts noted in this scope of work will be calculated based upon coal burn data. RHO&M and the Partners will work together in an effort to verify the annual production. The lump sum pricing stated above is good for up to 10% over the annual tonnage quantities detailed in this scope of work. The additional charge per ton to be paid for tonnage quantities greater than 10% is .

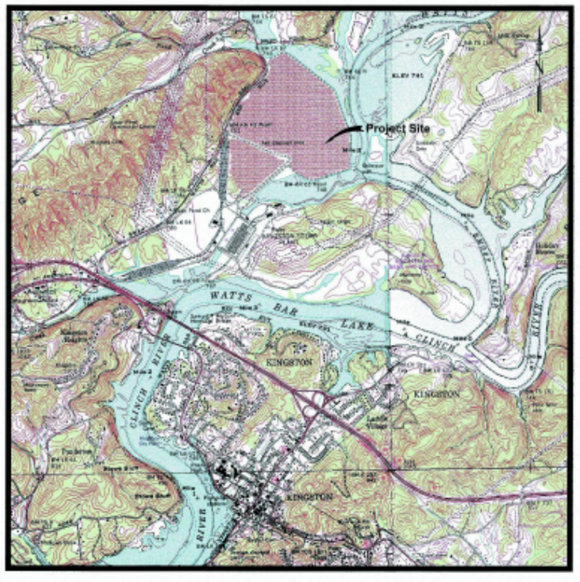
PLANS FOR CONSTRUCTION

LATERAL EXPANSION (CELL 4)
ASH STACKING
KINGSTON FOSSIL PLANT

HARRIMAN, ROANE COUNTY, TENNESSEE

PREPARED FOR

TENNESSEE VALLEY AUTHORITY



VICINITY MAP

GRAPHIC SCALE

PREPARED BY

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
Tel. 859.422.3000
Fax 859.422.3100
www.stantec.com

INDEX OF SHEETS

10W431-01	COVER SHEET
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10W431-04	SUBGRADE PLAN
10W431-05	ASH STACKING PLAN
10W431-06	INSTRUMENTATION PLAN
10W431-07	PROFILE – PROJECT BASELINE
10W431-08	PROFILES – DITCHES
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ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX0003002011D001

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CSWD
0	07/07/11	KDL	PJB	DEH	MJS	VJD	MST	JCK	-	-

ISSUED FOR CONSTRUCTION

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING
COVER SHEET

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
K.D. LINDQUIST	P.J. BOND	D.E. HERRON	W.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 07/07/11 | 36 | C | 10W431-01 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

GENERAL NOTES

1. DEFINITIONS: WHENEVER THE FOLLOWING TERMS ARE USED IN THESE DRAWINGS, IT IS UNDERSTOOD THAT THEY REPRESENT THE FOLLOWING:

   CONTRACTOR: THE ENTITY WITH WHICH THE TENNESSEE VALLEY AUTHORITY (TVA) HAS ENTERED INTO AN AGREEMENT TO CONSTRUCT THIS PROJECT (OR THEIR DESIGNEE).

   EPA: THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY WHICH IS THE REGULATORY AUTHORITY FOR THE SITE.

   TDEC: THE TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION.

   ENGINEER: STANTEC CONSULTING SERVICES INC.

   OWNER: TENNESSEE VALLEY AUTHORITY – KINGSTON FOSSIL PLANT.

   TDOT: THIS MEANS THE TENNESSEE DEPARTMENT OF TRANSPORTATION AND SPECIFICALLY REFERENCES THE "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION", CURRENT EDITION. ANY MATERIAL DESIGNATED AS "TDOT" IS TO CONFORM TO THE MATERIAL STANDARDS NOTED AND PLACEMENT/INSTALLATION METHODOLOGY SPECIFIED IN THE CURRENT EDITION OF THE "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION".

   QUALITY CONTROL (QC) PLAN: REFERS TO A DOCUMENT THAT ESTABLISHES MINIMUM QUALITY CONTROL REQUIREMENTS, TESTING FREQUENCY AND QUALITY OVERSIGHT RESPONSIBILITY.

   QUALITY CONTROL (QC) MANAGER: A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF TENNESSEE THAT IS RESPONSIBLE FOR THE QUALITY OF THE CONSTRUCTED PROJECT AS DEFINED IN THE QC PLAN. THIS INDIVIDUAL IS THE ENGINEER OF RECORD FOR CONSTRUCTION. STANTEC CONSULTING SERVICES, INC. IS THE QC MANAGER FOR THIS PROJECT. THE QC TEAM CONSISTS OF QUALIFIED PERSONNEL THAT WORK UNDER THE DIRECT SUPERVISION OF THE QC MANAGER. THE QC TEAM PERSONNEL ARE INDIVIDUALS THAT ARE FAMILIAR WITH THE MATERIALS UTILIZED.

   RETRIEVED ASH: MATERIAL PLACED ON SITE TO INCLUDE ASH AND INCIDENTAL EARTHEN MATERIALS RECOVERED DURING EXCAVATION ACTIVITIES WITHIN THE EMBAYMENT AREAS.

   CONSTRUCTION MANAGER: RESPONSIBLE FOR CONSTRUCTION ACTIVITY TO INCLUDE BUT NOT BE LIMITED TO THE CHARACTER AND SEQUENCE OF WORK, COORDINATION AND SCHEDULING. JACOBS IS THE CONSTRUCTION MANAGER FOR THIS PROJECT.

   SWMP: STORM WATER MANAGEMENT PLAN.

2. THESE DRAWINGS ARE THE CONSTRUCTION DRAWINGS THAT ARE TO BE REFERENCED ALONG WITH THE TECHNICAL SPECIFICATIONS, THE QC PLAN, THE SITE WIDE SWMP AND APPLICABLE ENVIRONMENTAL AND SAFETY REGULATIONS.

3. TOPOGRAPHIC INFORMATION SHOWN IN THE DRAWINGS IS DATED AND DOES NOT REFLECT CHANGES SINCE THE TIME OF THE LIDAR SURVEY. TEMPORARY STOCKPILING OF MATERIALS AND FILLING HAS OCCURRED SINCE THE DATE OF THE LIDAR SURVEY.

4. JACOBS HAS PERFORMED REQUIRED UTILITY LOCATION SERVICES AND OBTAINED THE PLANT ISSUED EXCAVATION PERMIT FOR THIS PROJECT.

5. JACOBS HAS VERIFIED THAT THERE ARE NO CONFLICTING UTILITY SERVICES WITHIN WORK AREAS.

6. SECURITY ON SITE IS PROVIDED BY TVA.

7. THE CONTRACTOR SHALL PROTECT INSTRUMENTATION FROM DAMAGE. THE CONTRACTOR SHALL INSTALL PROTECTIVE T-POSTS IN ACCORDANCE WITH TVA STANDARDS AROUND SAID INSTRUMENTATION. ORANGE SAFETY FENCE SHALL BE WRAPPED AROUND THE TOP POSTS TO DENOTE LIMITED ACCESS. COMPACTION OF MATERIALS AROUND GEOTECHNICAL INSTRUMENTATION SHALL BE PERFORMED BY MANUALLY OPERATED TAMPING DEVICES. EXISTING INSTRUMENTATION WILL BE EXTENDED UPWARD BY THE QC TEAM DURING THE COURSE OF THE WORK AS DESCRIBED IN THESE CONSTRUCTION DOCUMENTS AND IN ACCORDANCE WITH ESTABLISHED TVA PROCEDURES. PROPOSED GEOTECHNICAL INSTRUMENTATION WILL BE INSTALLED BY THE QC MANAGER.

8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR HEALTH AND SAFETY OF ITS PERSONNEL. THE CONTRACTOR SHALL ADHERE TO TVA REQUIREMENTS FOR SAFETY AND CONSTRUCTION UNLESS OSHA OR OTHER REGULATORY REQUIREMENTS SUPERCEDE THEM.

9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE MAINTENANCE OF ALL ACCESS ROADS, STAGING AREAS AND STORAGE AREAS USED DURING CONSTRUCTION, AND SHALL RESTORE SAID AREAS TO THEIR ORIGINAL CONDITION, OR BETTER ONCE CONSTRUCTION IS COMPLETE UNLESS THE TVA GIVES WRITTEN PERMISSION TO THE CONTRACTOR TO RETAIN THE AREA 'AS IS'.

10. THE CONTRACTOR SHALL CONDUCT ALL OPERATIONS IN ACCORDANCE WITH APPLICABLE ENVIRONMENTAL PERMITS, RULES, LAWS AND REGULATIONS INCLUDED BUT NOT LIMITED TO THOSE SET FORTH IN CEC 19966, 20065 OR OTHER ENVIRONMENTAL REVIEW DOCUMENTS FOR THE PROJECT.

11. THE CONTRACTOR IS RESPONSIBLE FOR SITE DRAINAGE THROUGHOUT CONSTRUCTION AND SHALL INSTALL TEMPORARY DRAINAGE STRUCTURES OR PUMP WATER AS NECESSARY TO PREVENT INTERFERENCE WITH THE WORK. SUCH TEMPORARY DRAINAGE FEATURES SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF ENVIRONMENTAL PERMITS AND THE SITE WIDE SWMP.

12. VEGETATIVE AND ORGANIC MATERIALS SHALL BE REMOVED AS DESCRIBED IN THE TECHNICAL SPECIFICATIONS.

13. DRAINAGE CONDITIONS SURROUNDING EXISTING FACILITIES OUTSIDE THE GRADING LIMITS ARE NOT ADDRESSED BY THE DRAWINGS. GRADING, SHAPING AND INSTALLATION OF DRAINAGE STRUCTURES MAY BE REQUIRED TO PROMOTE POSITIVE DRAINAGE.

14. MATERIALS DELIVERED FOR INCORPORATION INTO THE WORK SHALL BE TEMPORARILY STORED IN AREAS SELECTED BY THE CONTRACTOR AND APPROVED BY TVA. IF SAID MATERIALS ARE STORED WITHIN THE DREDGE CELL, THEN QC MANAGER APPROVAL IS REQUIRED. MATERIALS SHALL BE STORED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS. MATERIALS THAT CAN BE DIRECTLY INCORPORATED INTO THE WORK DO NOT NEED TO BE STOCKPILED.

15. THE EROSION AND SEDIMENT CONTROL PLAN MEASURES SHOWN SHALL BE CONSIDERED THE MINIMUM; SUPPLEMENTAL MEASURES SHALL BE PROVIDED BY THE CONTRACTOR AS FIELD CONDITIONS DICTATE OR AS DIRECTED BY THE CONSTRUCTION MANAGER OR THE REGULATORY AUTHORITY.

16. DURING CONSTRUCTION, THE CONTRACTOR SHALL CLEAN AND MAINTAIN ALL SEDIMENT CONTROL DEVICES AS SHOWN ON THE DRAWINGS. THE CONSTRUCTION MANAGER SHALL PROVIDE REPORTING AS REQUIRED BY THE SWMP, TECHNICAL SPECIFICATIONS AND REGULATIONS ON SAID ITEMS.

17. THE CONTRACTOR SHALL CONTROL FUGITIVE DUST EMISSIONS DURING CONSTRUCTION IN SUCH A MANNER AS TO COMPLY WITH APPLICABLE REGULATIONS. DUST CONTROL MEASURES SHALL BE SUBJECT TO APPROVAL OF THE CONSTRUCTION MANAGER AND THE OWNER.

18. TEMPORARY STOCKPILES WITHIN THE LATERAL EXPANSION SHALL BE PLACED IN UNIFORM 24" LIFTS OVER THE EXTENT OF THE QC MANAGER APPROVED STOCKPILE LIMITS. LOCATIONS AND SIZE OF TEMPORARY STOCKPILES SHALL BE APPROVED BY THE QC MANAGER AND TVA PRIOR TO MATERIAL PLACEMENTS. STOCKPILES SHALL BE GRADED TO MAINTAIN POSITIVE DRAINAGE AT ALL TIMES. THE SIDE SLOPES SHALL HAVE MAXIMUM 6H:1V SLOPE. THE TOP OF THE STOCKPILE SHALL HAVE A MINIMUM TWO PERCENT SLOPE. MATERIALS SHALL BE SEGREGATED AS DIRECTED BY THE QC MANAGER.

19. CERTIFICATIONS OF MATERIAL QUALITY AND CONFORMANCE TO PROJECT REQUIREMENTS SHALL BE SUBMITTED TO THE TVA FOR FORWARDING TO THE QC MANAGER.

20. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONSTRUCTION SURVEYOR SELECTION AND COORDINATION OF ALL CONSTRUCTION RELATED SURVEYING. ALL ESTABLISHED TVA BENCH MARKS OR OTHER MONUMENTS SHALL BE PRESERVED AND PROTECTED. ANY ESTABLISHED MARKER OR BENCHMARK THAT IS DAMAGED BY CONSTRUCTION ACTIVITIES SHALL BE REPLACED BY THE CONTRACTOR AT HIS/HER OWN COST.

21. THE CONSTRUCTION MANAGER SHALL COMMUNICATE CONSTRUCTION ISSUES, PROBLEMS OR DISCREPANCIES IN THE DRAWINGS TO THE QC MANAGER AND TVA IMMEDIATELY UPON BECOMING AWARE OF SUCH PROBLEMS.

22. THE CONTRACTOR SHALL NOTE THAT THIS WORK MAY BE PERFORMED CONCURRENT WITH DREDGE CELL ASH STACKING. THIS WORK MAY ALSO COINCIDE WITH PERIMETER CONTAINMENT CONSTRUCTION.

23. ANY PROPOSED MODIFICATION TO DESIGN FEATURES AS SHOWN (OR DESCRIBED) IN THE APPROVED ISSUED FOR CONSTRUCTION DESIGN DOCUMENTS SHALL BE CONTINGENT UPON ENGINEER OF RECORD APPROVAL. TEMPORARY FEATURES TO FACILITATE CONSTRUCTION TO ACHIEVE THE APPROVED DESIGN FEATURES SHALL BE ADDRESSED BY METHODS DESCRIBED IN APPROVED PROJECT DOCUMENTS AND PRACTICES (E.G. STORM WATER MANAGEMENT PLAN, BEST MANAGEMENT PRACTICES, ETC.).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX00030020110001

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWR	APPD	ISSD	PROJECT ED	AS CONST
R 0	07/07/11	RDL	PJB	DEH	MJS	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: NONE EXCEPT AS NOTED

MICHAEL J. STEELE — REGISTERED ENGINEER — 112171 — STATE OF TENNESSEE

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING
GENERAL NOTES

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	P.J. BOND	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

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Fax 859.422.3100
www.stantec.com

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 07/07/11	36	C	10W431-02	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 07/08/2011 USER: DEHALL DGN: S:\TVA\ACTIVE\TVAMAIN\DRAWINGS\RDP\RDP-0114-A\10W431-02-R0.DGN

BASELINE CURVE DATA

① P.I. STA. = 752+00.00, NORTHING = 556,318.49, EASTING = 2,441,567.36, Δ = 11°51'22", D = 14°19'26", T = 41.53', L = 82.77', R = 400.00', E = 2.15', P.C. STA. = 751+58.46, P.T. STA. = 752+41.23

② P.I. STA. = 758+04.00, NORTHING = 556,865.71, EASTING = 2,441,823.75, Δ = 97°02'40", D = 57°17'45", T = 113.12', L = 169.37', R = 100.00', E = 50.98', P.C. STA. = 756+90.88, P.T. STA. = 758+60.26

③ P.I. STA. = 760+69.64, NORTHING = 556,694.09, EASTING = 2,442,096.80, Δ = 36°47'44", D = 57°17'45", T = 33.26', L = 64.22', R = 100.00', E = 5.39', P.C. STA. = 760+36.38, P.T. STA. = 761+00.60

④ P.I. STA. = 787+08.21, NORTHING = 555,555.30, EASTING = 2,441,076.32, Δ = 45°12'33", D = 57°17'45", T = 41.64', L = 78.90', R = 100.00', E = 8.32', P.C. STA. = 786+66.57, P.T. STA. = 787+45.47

⑤ P.I. STA. = 792+14.21, NORTHING = 556,614.37, EASTING = 2,441,996.47, Δ = 36°47'38", D = 57°17'45", T = 33.26', L = 64.22', R = 100.00', E = 5.39', P.C. STA. = 791+80.95, P.T. STA. = 792+45.17

⑥ P.I. STA. = 803+45.64, NORTHING = 555,546.18, EASTING = 2,442,370.53, Δ = 52°56'19", D = 57°17'45", T = 49.79', L = 92.40', R = 100.00', E = 11.71', P.C. STA. = 802+95.85, P.T. STA. = 803+88.24

⑦ P.I. STA. = 811+08.25, NORTHING = 554,955.54, EASTING = 2,441,878.99, Δ = 82°37'33", D = 57°17'45", T = 87.89', L = 144.21', R = 100.00', E = 33.14', P.C. STA. = 810+20.36, P.T. STA. = 811+64.57

DREDGE CELL

DIKE D

DITCH 6 BASELINE (2/8)

DITCH 5 BASELINE (4/8)

STAGE 1 DIKE C BUTTRESS

FLUME 12 BASELINE (5/9)

N 555,408.93, E 2,441,302.42

FLUME 8 BASELINE (1/9)

N 556,523.36, E 2,442,035.10

PROJECT BASELINE (1/9)

N 555,262.28, E 2,441,505.45

ASH POND (POOL ELEV. ~760.3')

LATERAL EXPANSION

FLUME 11 BASELINE (4/9)

N 555,092.41, E 2,441,689.49

N 556,189.93, E 2,442,135.05

DIKE C

N 555,868.86, E 2,442,274.38

FLUME 9 BASELINE (2/9)

WATTS BAR LAKE (NORMAL SUMMER POOL ELEV. 741.0')

DITCH 7 BASELINE (3/8)

N 555,235.04, E 2,442,141.58

FLUME 10 BASELINE (3/9)

DIVIDER DIKE

STILLING BASIN (POOL ELEV. ~754.6')

SECTION OR DETAIL NO.

SHEET WHERE SHOWN

REFERENCE KEY

GRAPHIC SCALE: 1" =100'
CONTOUR INTERVAL = 1'

NOTES:

1. TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC. AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.
2. EXISTING INSTRUMENTATION LOCATIONS ARE SHOWN ON SHEET 10W431-06.

SURVEY CONTROL NOTE:

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

LEGEND

- EXISTING BORING
- SOIL BORING WITH UNDISTURBED (SHELBY) TUBE SAMPLES AND/OR STANDARD PENETRATION TESTS
- SOIL BORING WITH UNDISTURBED (SHELBY) TUBE SAMPLES AND/OR STANDARD PENETRATION TESTS AND ROCK CORE
- SOIL BORING AND/OR CPTu SOUNDING (AECOM 2009)
- SOIL BORING – PRE-FAILURE
- MONITORING WELL
- CONE PENETROMETER TEST (CPT)
- (MT 2005) (DRILLING COMPANY YEAR)
- NR NO RECORD OF ORIGIN (BORING LOG) AT THIS TIME
- MT MACTEC ENGINEERING AND CONSULTANTS, INC.
- SI SINGLETON LABORATORIES
- ST STANTEC CONSULTING SERVICES
- LAW LAW ENGINEERING
- S&ME SOILS & MATERIALS ENGINEERING
- TVA TENNESSEE VALLEY AUTHORITY

KINGSTON PLANT INDEX
NOT TO SCALE

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX00030020110001

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT MGR	AS BUILT
R 0	07/07/11	KDL	PJB	DEH	MJS	VJD	MST	JDK		
ISSUED FOR CONSTRUCTION										

SCALE: 1"=100' EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING EXISTING CONDITIONS AND BASELINE LAYOUT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDSEY	P.J. BOND	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 07/07/11	36	C	10W431-03	R 0

STANTEC | D
TASK COMPLETED BY: | REV NO.

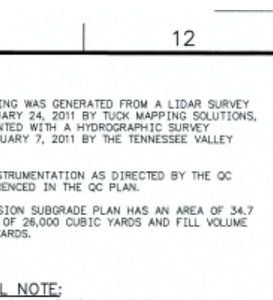
PLOT FACTOR:100
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

NOTES:
1. TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC. AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.
2. INSTALL/EXTEND INSTRUMENTATION AS DIRECTED BY THE QC MANAGER AND REFERENCED IN THE QC PLAN.
3. THE LATERAL EXPANSION SUBGRADE PLAN HAS AN AREA OF 34.7 ACRES, CUT VOLUME OF 26,000 CUBIC YARDS AND FILL VOLUME OF 145,000 CUBIC YARDS.

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

DREDGE CELL
DIKE D
10H:1V
STAGE 1 DIKE C BUTTRESS
ASH POND (POOL ELEV. ~760.3')
PROJECT BASELINE
60+00
65+00
70+00
75+00
80+00
85+00
90+00
LATERAL EXPANSION
DIKE C
WATTS BAR LAKE (NORMAL SUMMER POOL ELEV. 741.0')
DIVIDER DIKE
STILLING BASIN (POOL ELEV. ~754.6')
SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY
GRAPHIC SCALE: 1" =100'
CONTOUR INTERVAL = 1'



KINGSTON PLANT INDEX
NOT TO SCALE

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX0003002011000I

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS ISSUED
R 0	07/07/11	KDL	PJB	DEH	MJS	VJD	MST	JDK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: 1"=100' EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING SUBGRADE PLAN

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	P.J. BOND	D.E. HERRON	M.J. STEELE	V.A. DOTSON	M.S. TURNBOW	J.C. KAMMERER

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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 07/07/11	36	C	10W431-04	R 0

PLOT FACTOR:100
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	0
TASK COMPLETED BY:	REV NO.

NOTES:
1. TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC., MERGED WITH THE SUBGRADE PLAN AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.
2. INSTALL/EXTEND INSTRUMENTATION AS DIRECTED BY THE QC MANAGER AND REFERENCED IN THE QC PLAN.
3. THE LATERAL EXPANSION ASH STACKING PLAN HAS AN AREA OF 44.6 ACRES, CUT VOLUME OF 8,000 CUBIC YARDS AND FILL VOLUME OF 515,000 CUBIC YARDS.
4. THE CONCEPTUAL FOOTPRINT SHOWN IS TAKEN FROM THE 30% DESIGN DRAWINGS DATED APRIL, 2011, RDP-0114-B. THIS FOOTPRINT IS SUBJECT TO CHANGE.

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

DREDGE CELL
CONCEPTUAL LATERAL EXPANSION PERIMETER CONTAINMENT LIMITS (SEE NOTE 4)
DIKE D
DITCH 6 (2/8)
TOP OF ASH FILL COVER (2/22)
DITCH 5 (1/8)
STAGE 1 DIKE C BUTTRESS
FLUME 12 (5/9)
FLUME 8 (1/9)
6H:1V
20 FEET
PROJECT BASELINE (1/7)
ASH POND (POOL ELEV. ~760.3')
60+00
65+00
70+00
75+00
80+00
85+00
90+00
LATERAL EXPANSION
DIKE C
FLUME 11 (4/9)
WATTS BAR LAKE (NORMAL SUMMER POOL ELEV. 741.0')
DITCH 7 (3/8)
FLUME 10 (3/9)
FLUME 9 (2/9)
DIVIDER DIKE
STILLING BASIN (POOL ELEV. ~754.6')
SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY
GRAPHIC SCALE: 1" =100'
CONTOUR INTERVAL = 1'

KINGSTON PLANT INDEX
NOT TO SCALE

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX0003002011000 1

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT MGR	AS CONST
R 0	07/07/11	KDL	PJB	DEH	MJS	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: 1"=100' EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING
ASH STACKING PLAN

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	P.J. BOND	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TURNIPSEED	J.C. KAMMEYER

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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 07/07/11 | 36 | C | 10W431-05 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:100
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

DREDGE CELL

DIKE D

DITCH 6 (2/8)

TOP OF ASH FILL COVER (2/24)

DITCH 5 (1/8)

STAGE 1 DIKE C BUTTRESS

FLUME 12 (3/9)

FLUME 8 (1/9)

PROJECT BASELINE (1/1)

ASH POND (POOL ELEV. ~760.3')

60+00

65+00

70+00

75+00

80+00

85+00

90+00

LATERAL EXPANSION

DIKE C

FLUME 11 (4/9)

FLUME 9 (2/9)

WATTS BAR LAKE (NORMAL SUMMER POOL ELEV. 741.0')

DITCH 7 (3/8)

FLUME 10 (3/9)

DIVIDER DIKE

STILLING BASIN (POOL ELEV. ~754.6')

SECTION OR DETAIL NO.

SHEET WHERE SHOWN

REFERENCE KEY

GRAPHIC SCALE: 1" =100'
CONTOUR INTERVAL = 1'

NOTES:

1. TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC., MERGED WITH THE SUBGRADE PLAN AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.
2. INSTALL/EXTEND INSTRUMENTATION AS DIRECTED BY THE QC MANAGER AND REFERENCED IN THE QC PLAN.

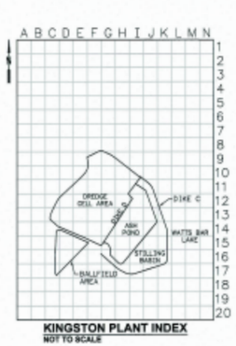
SURVEY CONTROL NOTE:

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

LEGEND

- PIEZOMETER (EXISTING)
- SLOPE INCLINOMETER (EXISTING)
- SETTLEMENT PLATE (EXISTING)
- PIEZOMETER (PROPOSED)
- SLOPE INCLINOMETER (PROPOSED)
- SETTLEMENT PLATE (PROPOSED)

FOR INSTRUMENTATION INSTALLATION DETAILS SEE SHEET 10W431-22.



KINGSTON PLANT INDEX
NOT TO SCALE

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX0003002011000 1

REV NO.	DATE	DESN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ENGR	AS BUILT
0	07/07/11	KDL	PJB	DEH	MJS	VJD	MST	JCK	--	--
ISSUED FOR CONSTRUCTION										

SCALE: 1"=100' EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING INSTRUMENTATION PLAN

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	P.J. BOND	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

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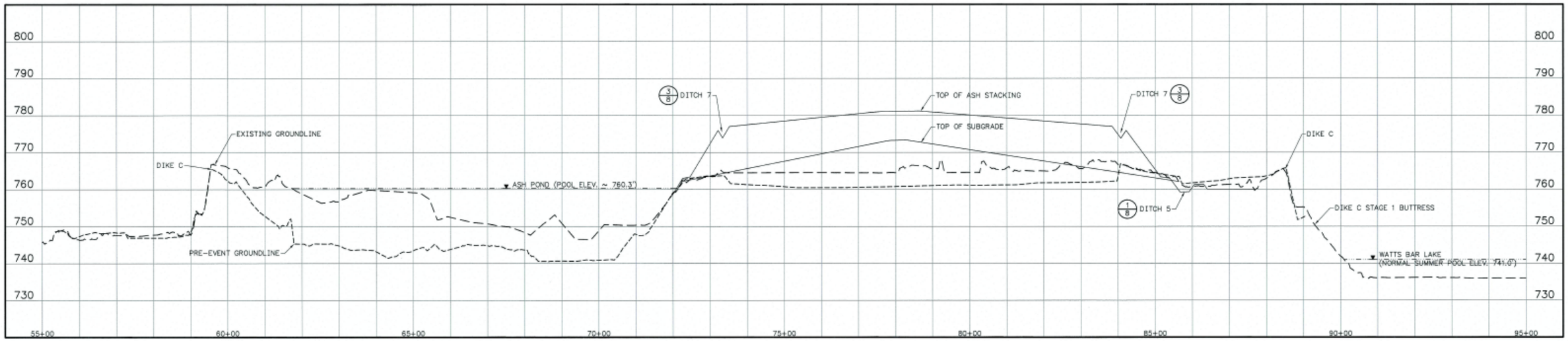
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 07/07/11	36	C	10W431-06	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:100
M_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



1/7 PROFILE – PROJECT BASELINE
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

NOTE:
TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC. AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDXD0030020110001

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	PVMD	APPD	ISSD	PROJECT ID	AS CONST
0	07/07/11	KDL	PJB	DEH	MJS	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING
PROFILE – PROJECT BASELINE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.G. LINDQUIST	P.J. BOND	D.E. HORTON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMERER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE: 07/07/11 | 36 | C | 10W431-07 | R 0

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

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40511-2060
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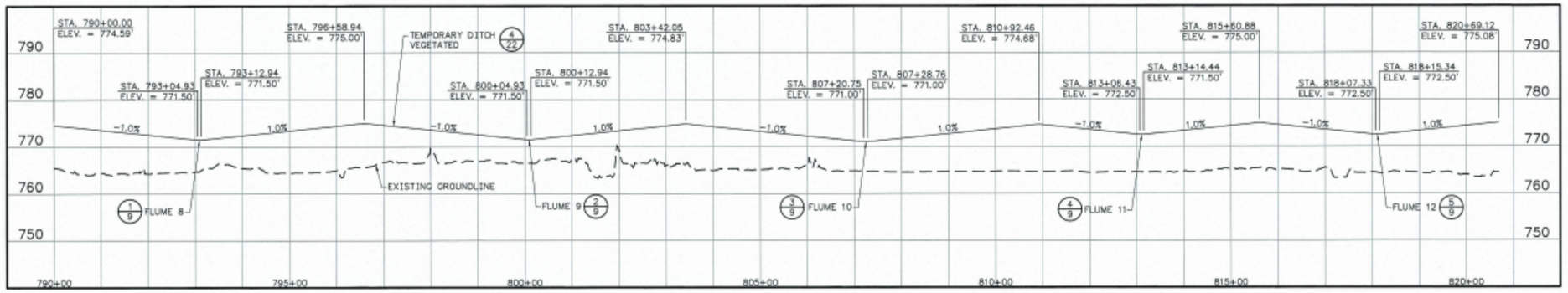
Fax 859.422.3100
www.stantec.com

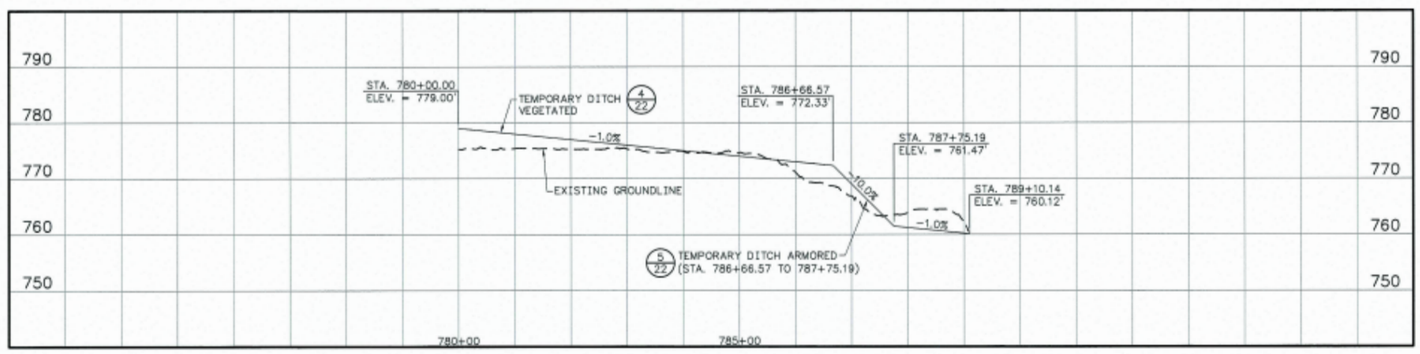
STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

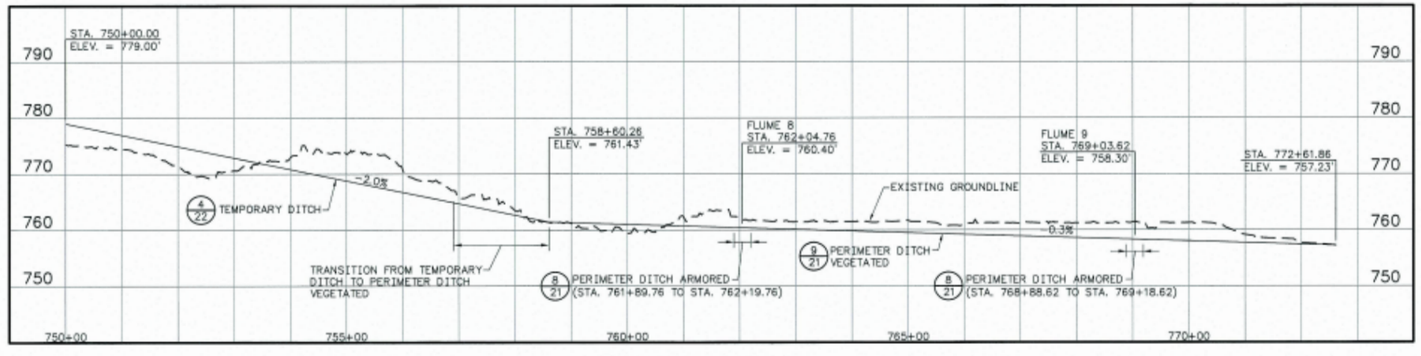
C.A.D. DRAWING
DO NOT ALTER MANUALLY



3/8 PROFILE – DITCH 7
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)



2/8 PROFILE – DITCH 6
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)



1/8 PROFILE – DITCH 5
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

NOTE:
TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC. AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX00030020110001

REV. NO.	DATE	DESN	DRWN	CHKD	SUPV	PCMD	APPD	ISSD	PROJECT ID	AS CONST
R 0	07/07/11	KBL	PJB	DEH	MJS	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING
PROFILES – DITCHES

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	P.J. BONO	D.E. HERRON	M.A. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

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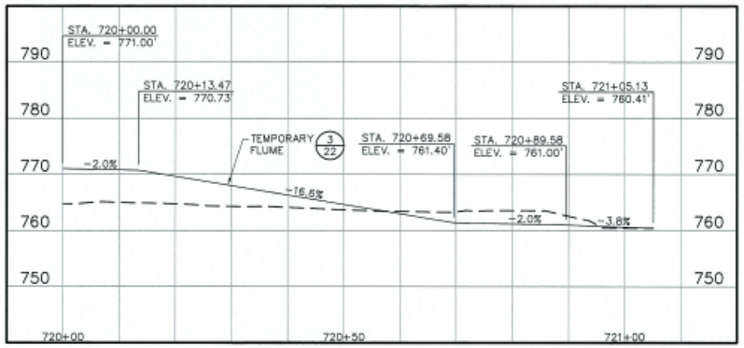
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 07/07/11	36	C	10W431-08	R 0

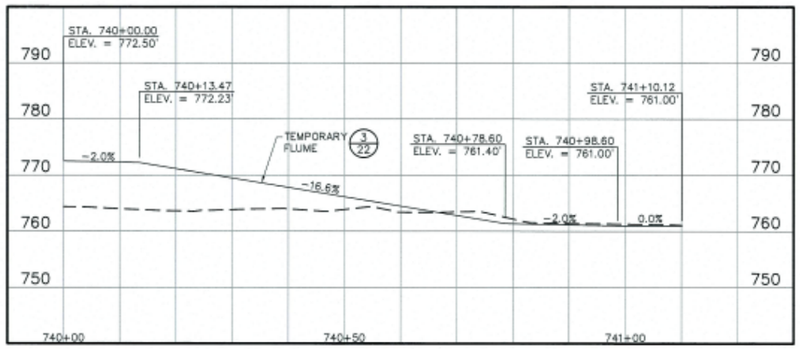
PLOT FACTOR:10
M_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

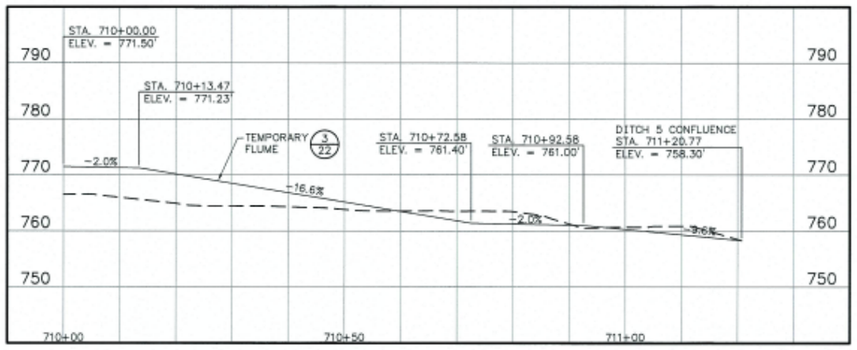
STANTEC	0
TASK COMPLETED BY:	REV NO.



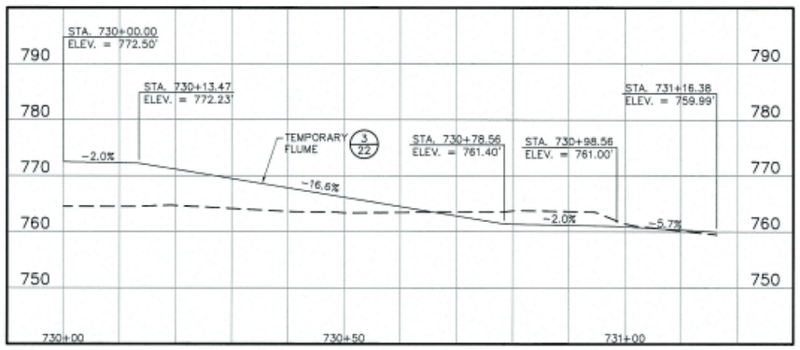
3/9 PROFILE – FLUME 10
SCALE: 1"=10'



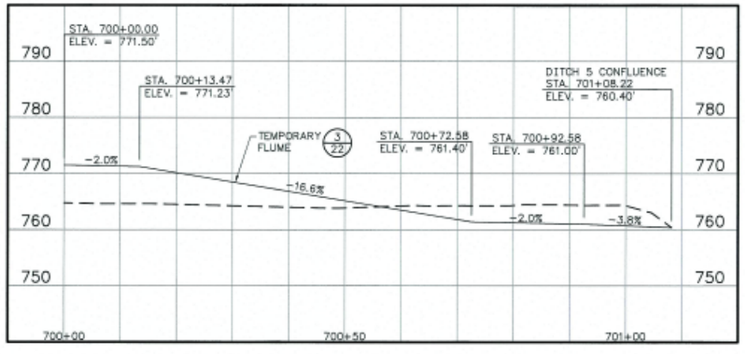
5/9 PROFILE – FLUME 12
SCALE: 1"=10'



2/9 PROFILE – FLUME 9
SCALE: 1"=10'



4/9 PROFILE – FLUME 11
SCALE: 1"=10'



1/9 PROFILE – FLUME 8
SCALE: 1"=10'

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

NOTE:
TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC. AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX0003002011000I

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	PMMD	APPD	ISSD	PROJECT ID	AS CONST
R 0	07/07/11	KDL	PJB	DEH	MJS	VJD	MST	JDK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: 1"=10' EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING
PROFILES – FLUMES

ASSIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	RECORDED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	P.J. BOND	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.D. KAMMEYER

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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

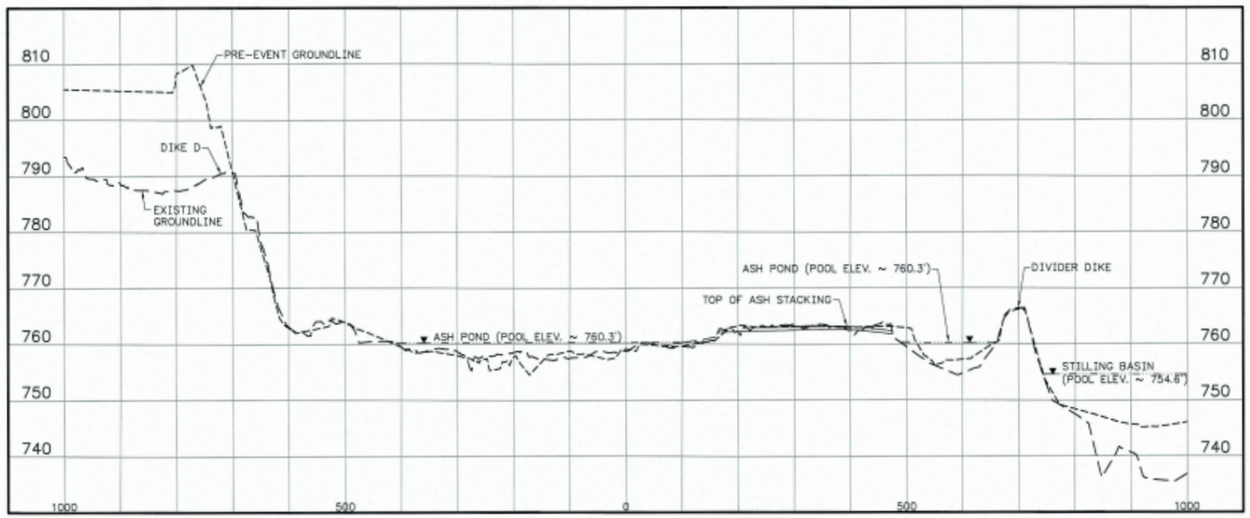
AUTOCAD R 2000 | DATE: 07/07/11 | 36 | C | 10W431-09 | R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

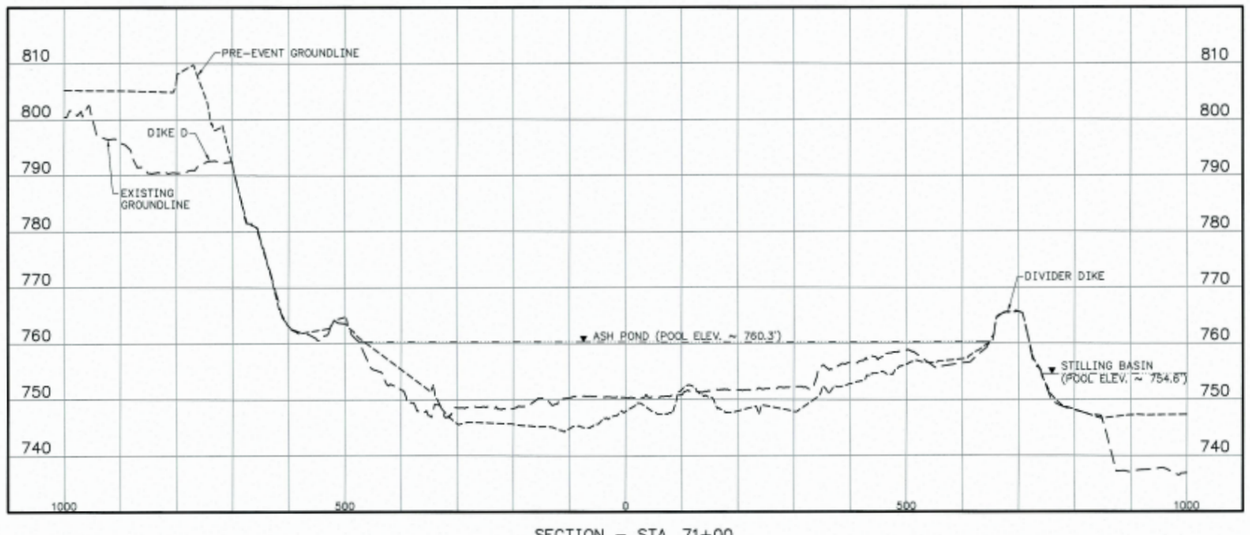
PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 07/06/2011 USER: GRAHAM_KAKE
N:\TVA\LATEST\MASTER\ENGINEERING\Submittals\SHEET_FILES\FLT_STEVENS_STD\10W431_09.DWG



SECTION – STA. 72+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)



SECTION – STA. 71+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

NOTE:
TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC. AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX0003002011O001

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS-BUILT
0	07/07/11	KDL	PJB	DEH	MJS	VJD	MST	JCK	–	–

ISSUED FOR CONSTRUCTION

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING CROSS SECTIONS

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
K.D. LINDQUIST	P.J. BOND	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMICHER

MICHAEL J. STEELE — REGISTERED ENGINEER — No. 113119 — STATE OF TENNESSEE

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Fax 859.422.3100
www.stantec.com

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

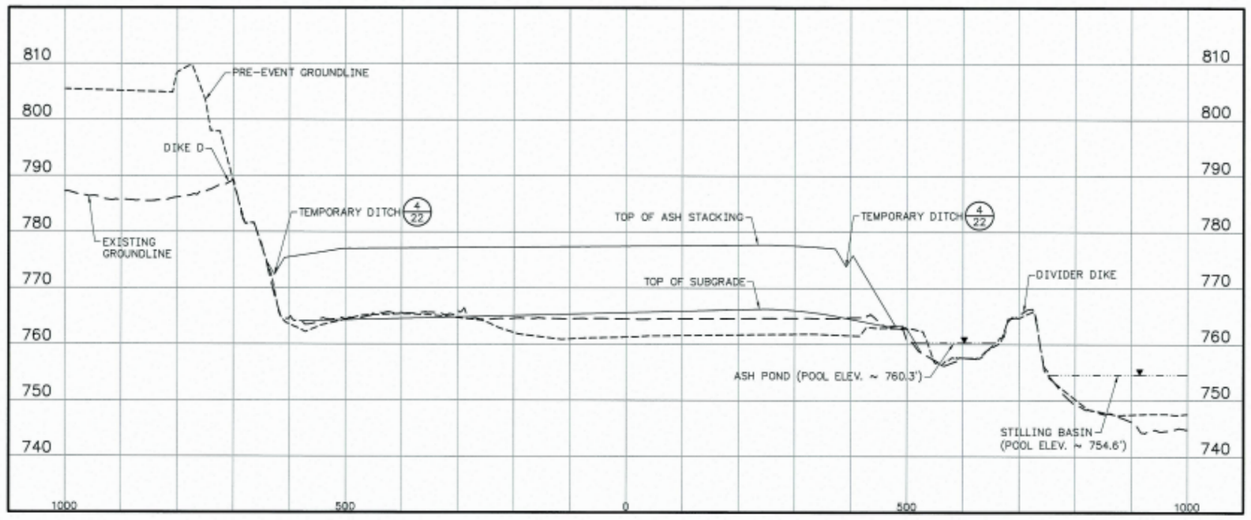
AUTOCAD R 2000 | DATE 07/07/11 | 36 | C | 10W431-10 | R 0

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

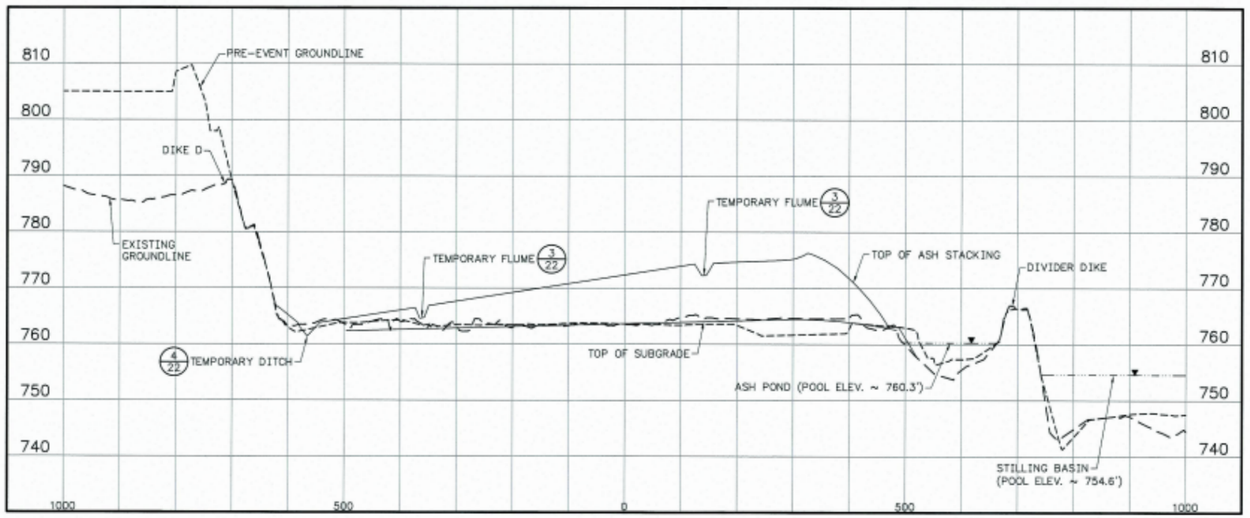
STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
M_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



SECTION – STA. 74+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)



SECTION – STA. 73+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

NOTE:
TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC. AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.

ISSUED FOR CONSTRUCTION

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX00030020110001

REV. NO.	DATE	ORIGN	DRWN	CHKD	SUPV	RVWD	APPR	ISSD	PROJECT ID	AS CONST
R 0	07/07/11	KDL	ACC	DEH	MJS	VJD	MST	JDK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING CROSS SECTIONS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	A.C. CLINK	D.E. HORTON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMERER

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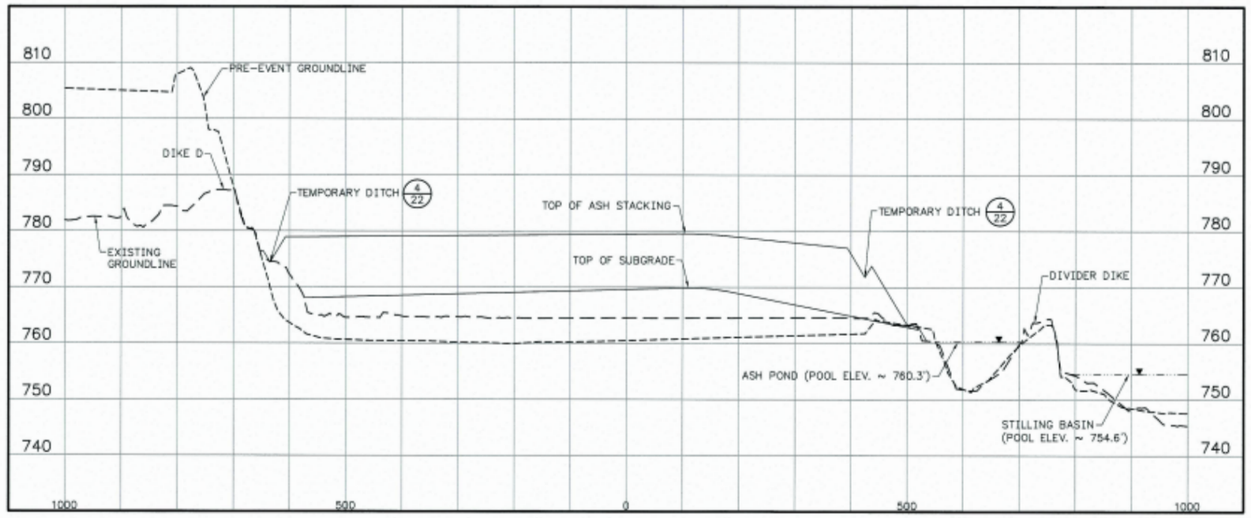
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 07/07/11	36	C	10W431-11	R 0

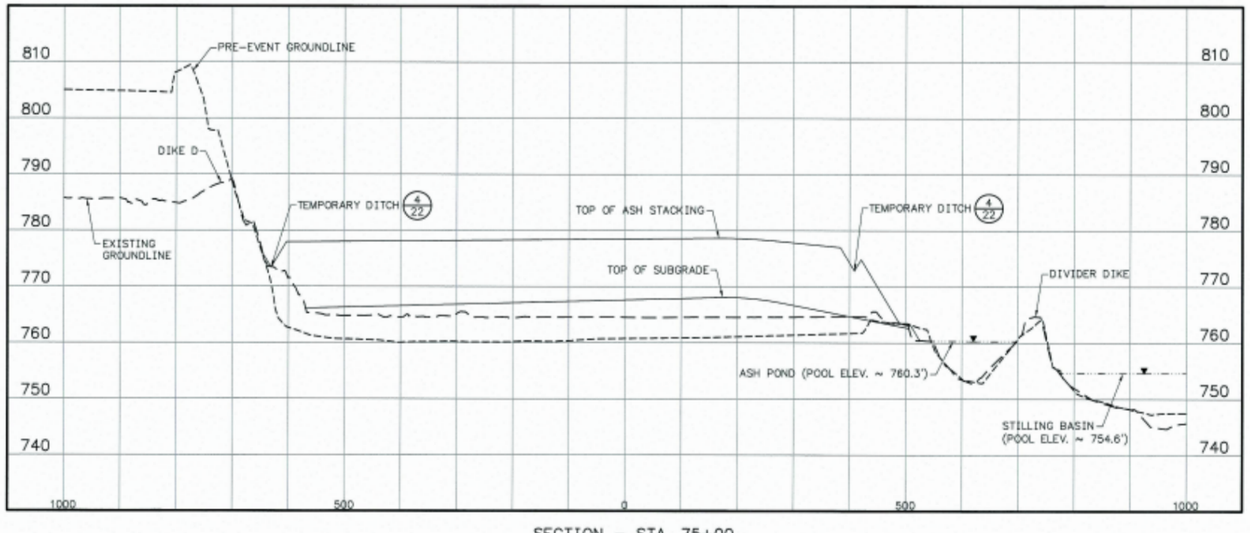
STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



SECTION – STA. 76+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)



SECTION – STA. 75+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

NOTE:
TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC. AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX0D030020110001

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT MGR	AS BUILT
R 0	07/07/11	KDL	ACC	DEH	MJS	VJD	MST	JDK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING
CROSS SECTIONS

ASSIGNED BY:	DRAWN BY:	DESIGNED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	A.C. CLINE	D.E. HERRON	M.J. STEELE	V.J. DOTSON	H.S. TURNBOW	J.C. KAMNEVER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 07/07/11 | 36 | C | 10W431-12 | R 0

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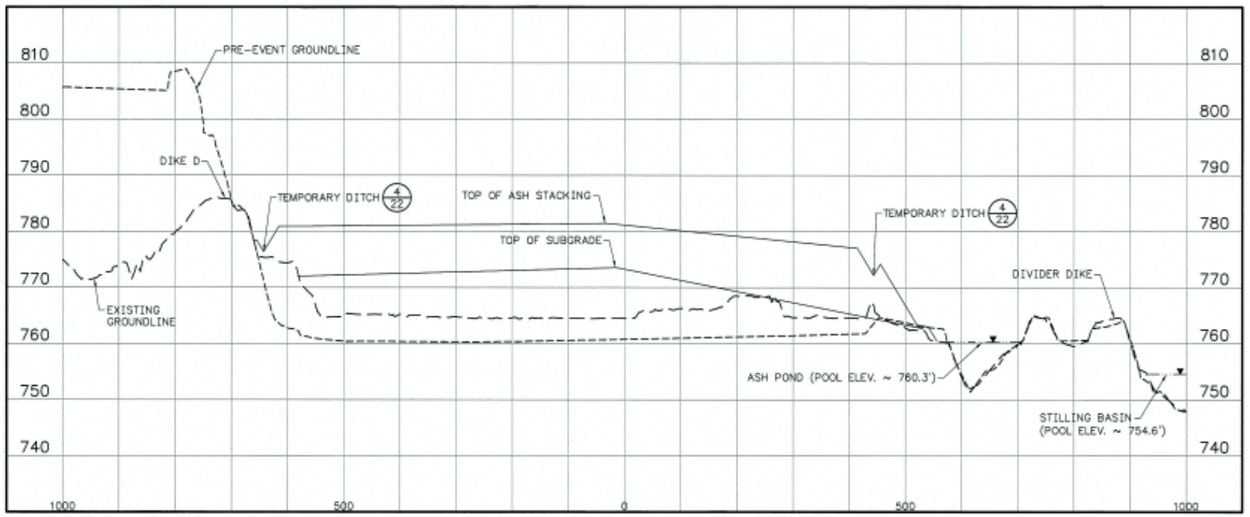
www.stantec.com

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

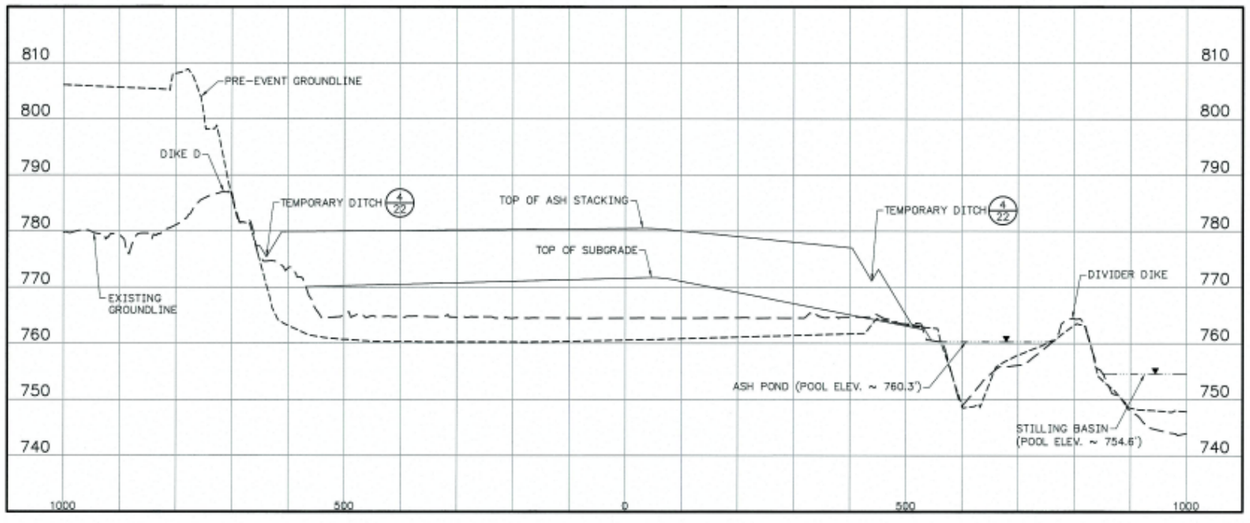
STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



SECTION – STA. 78+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)



SECTION – STA. 77+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

NOTE:
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ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX0003002011000 1

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWR	APPD	ISSD	PROJECT ID	AS CONST
–	–	–	–	–	–	–	–	–	–	–
0	07/07/11	KDL	ACC	DEH	MJS	VJD	MST	JCK	–	–

ISSUED FOR CONSTRUCTION

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING CROSS SECTIONS

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
K.D. LINDQUIST	A.C. CLINK	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. HAMMCYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 07/07/11 | 36 | C | 10W431-13 | R 0

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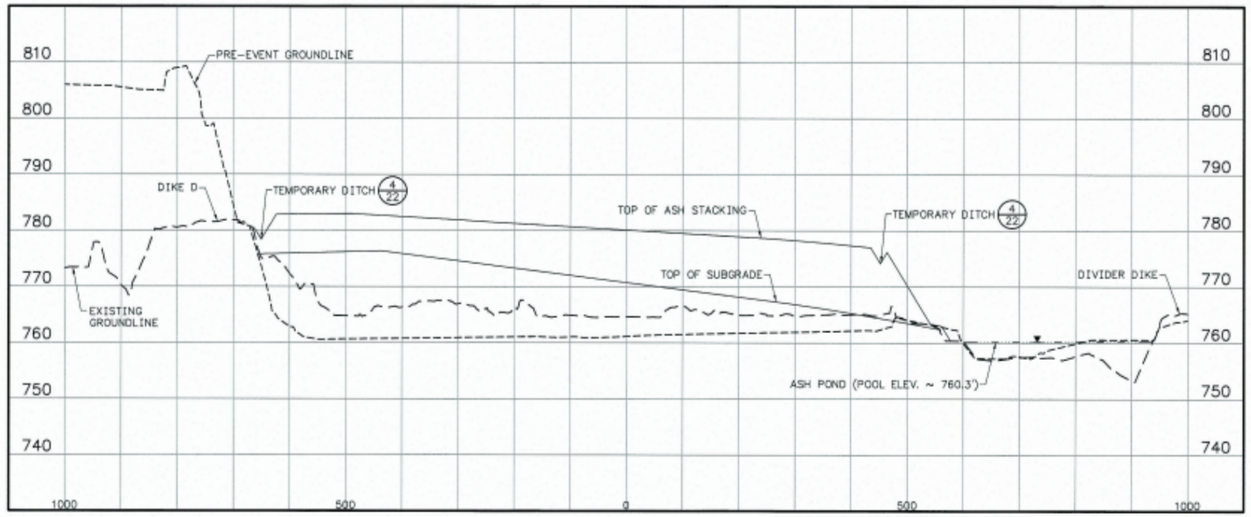
SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

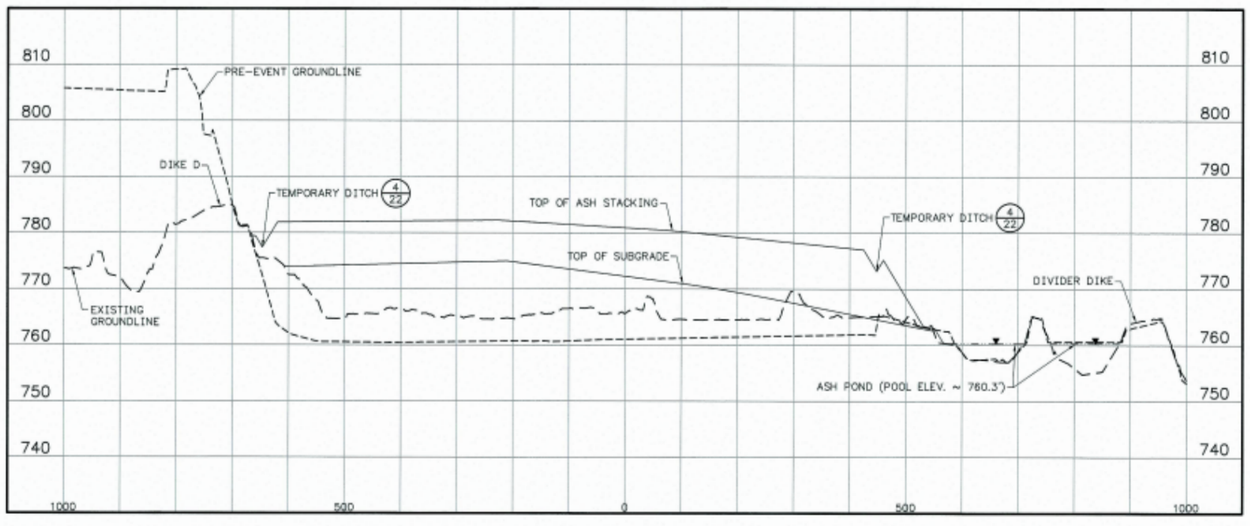
STANTEC	D
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



SECTION – STA. 80+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)



SECTION – STA. 79+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

NOTE:
TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC. AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX0003002011000 1

REV NO.	DATE	ORIGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	07/07/11	KDL	ACC	DEH	MJS	VJD	MST	JCK	–	–
	ISSUED FOR CONSTRUCTION									

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING CROSS SECTIONS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	A.C. CLINK	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TUMMINOW	J.C. KAMMEYER

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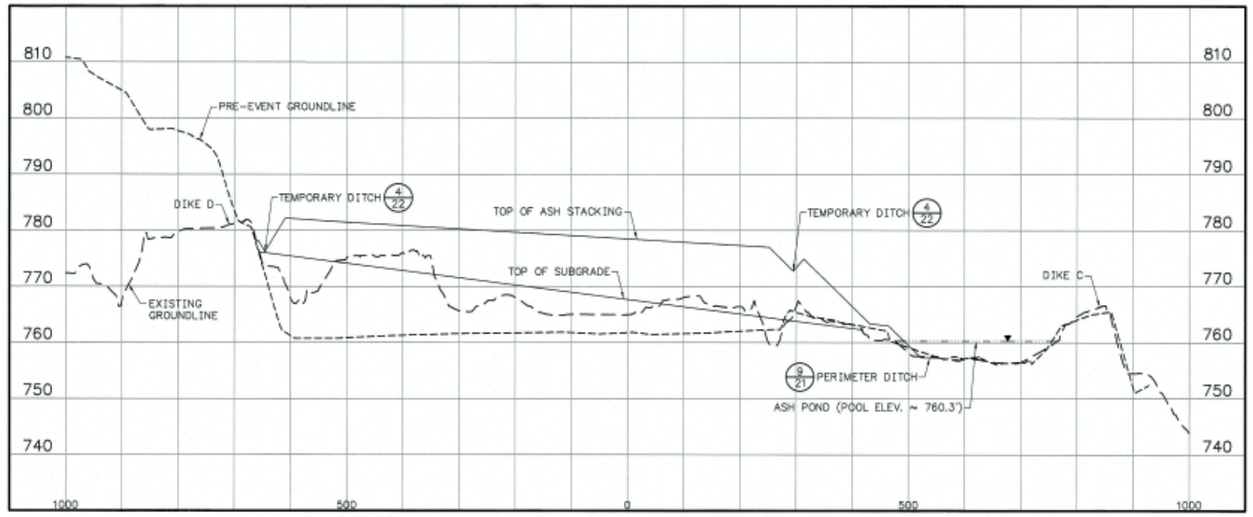
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 07/07/11	36	C	10W431-14	R 0

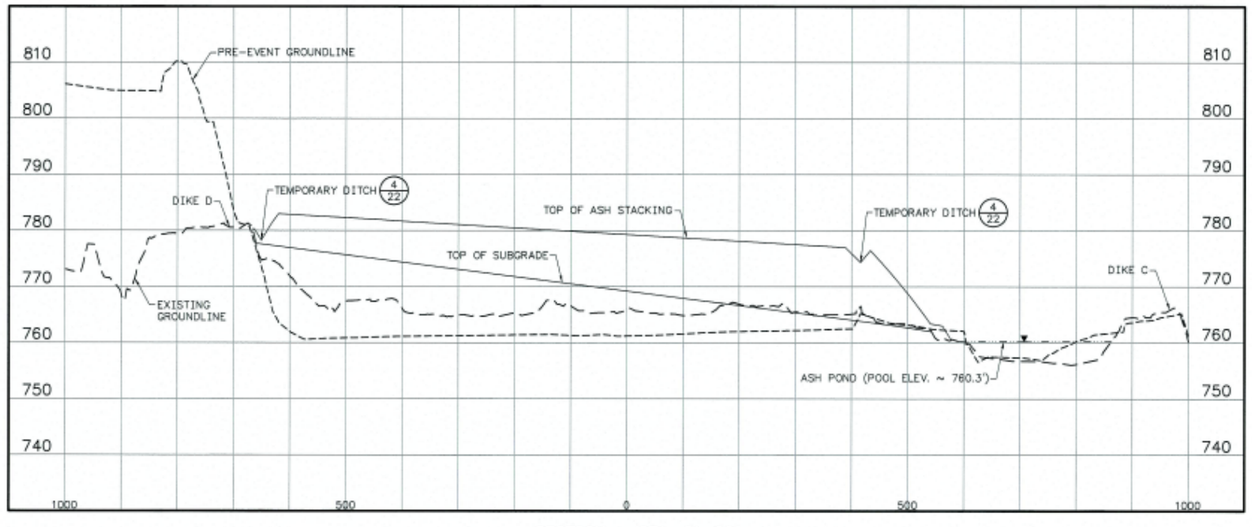
STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



SECTION – STA. 82+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)



SECTION – STA. 81+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

NOTE:
TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC. AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX0003002011O001

REV NO.	DATE	DESN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT MGR	AS CONST
R 0	07/07/11	KDL	ACC	DEH	MJS	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING CROSS SECTIONS

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
K.D. LINDQUIST	A.C. CLINK	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

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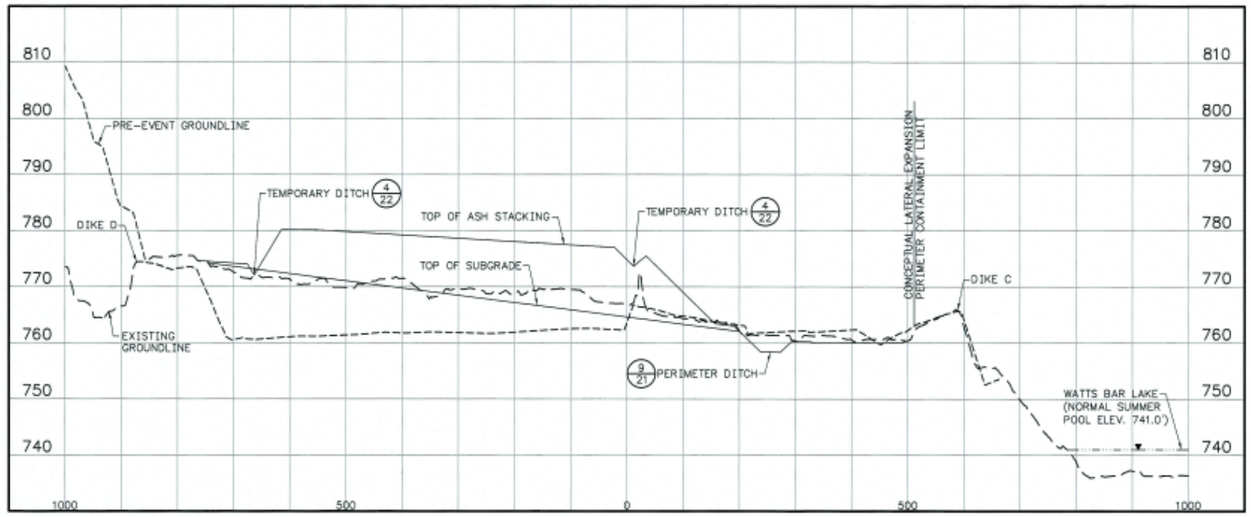
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 07/07/11	36	C	10W431-15	R 0

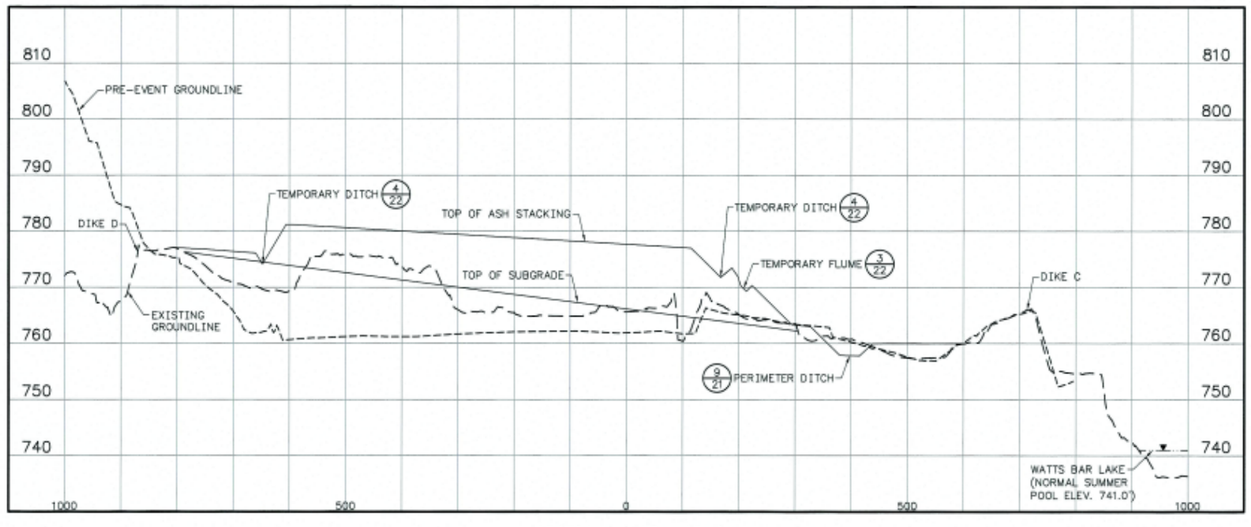
STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



SECTION – STA. 84+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)



SECTION – STA. 83+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

NOTE:
TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC. AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX0003002011000I

REV NO.	DATE	ORIGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	07/07/11	KDL	ACC	DEH	MJS	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING CROSS SECTIONS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	A.C. CLINK	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

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Tel. 859.422.3000
Fax 859.422.3100
www.stantec.com

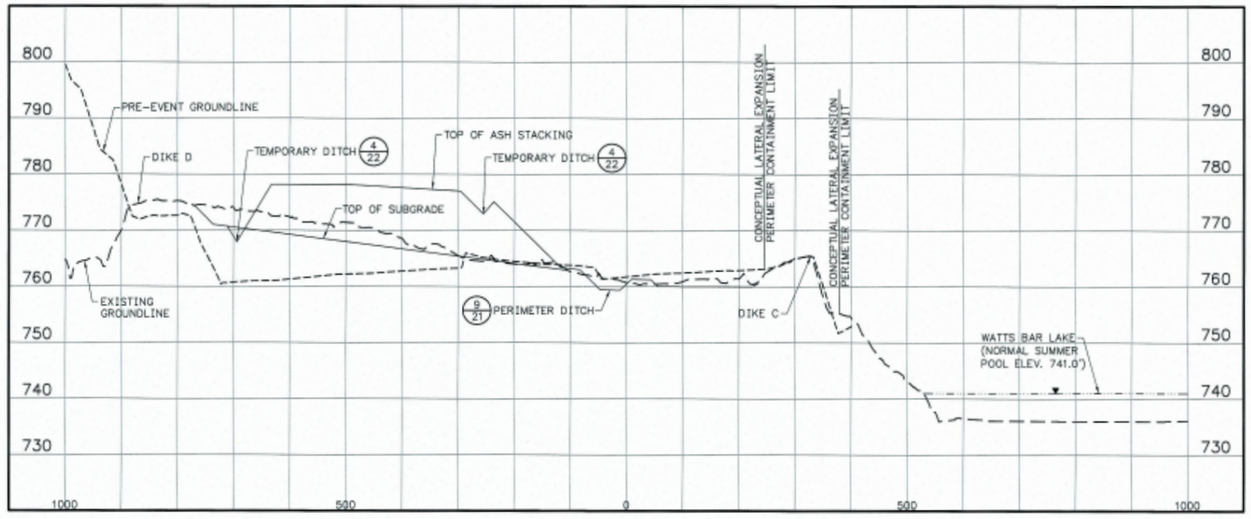
AUTOCAD R 2000 | DATE 07/07/11 | 36 | C | 10W431-16 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

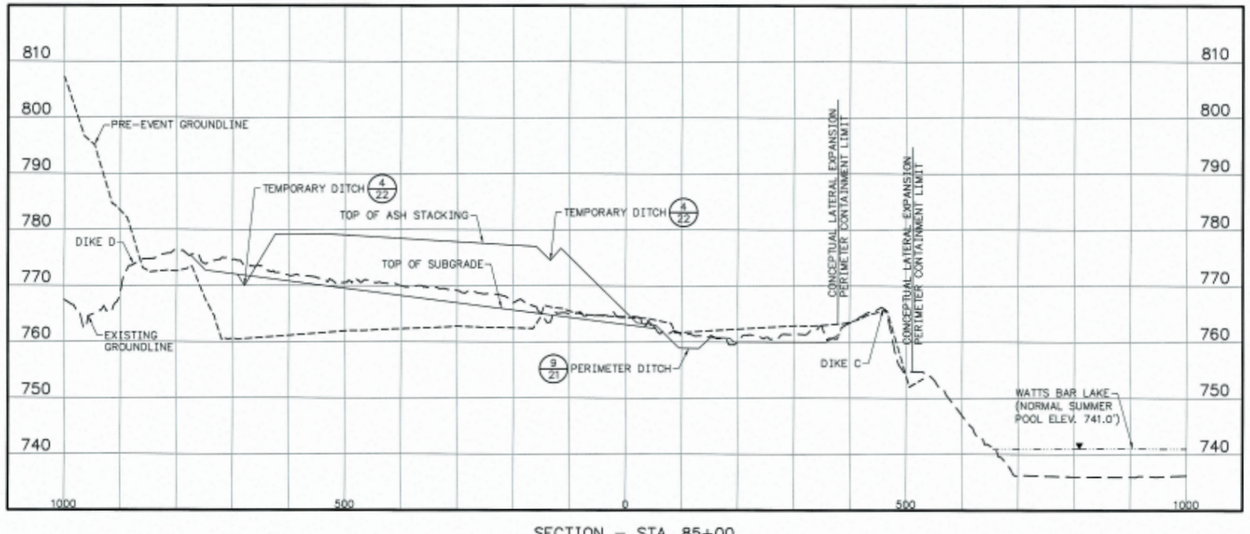
PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 07/08/2011 USER: SRAMAL.SAIC
N:\TVA\ACTIVE\YARD\DRAWINGS\CONSTRUCTION\SHEETS\FPGK1FFESCDX0003002011000I.DGN



SECTION – STA. 86+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)



SECTION – STA. 85+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

NOTE:
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ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX0003002011000I

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ENGR	AS CONST
R 0	07/07/11	KDL	ACC	DEH	MJS	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING CROSS SECTIONS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	A.C. CLINK	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
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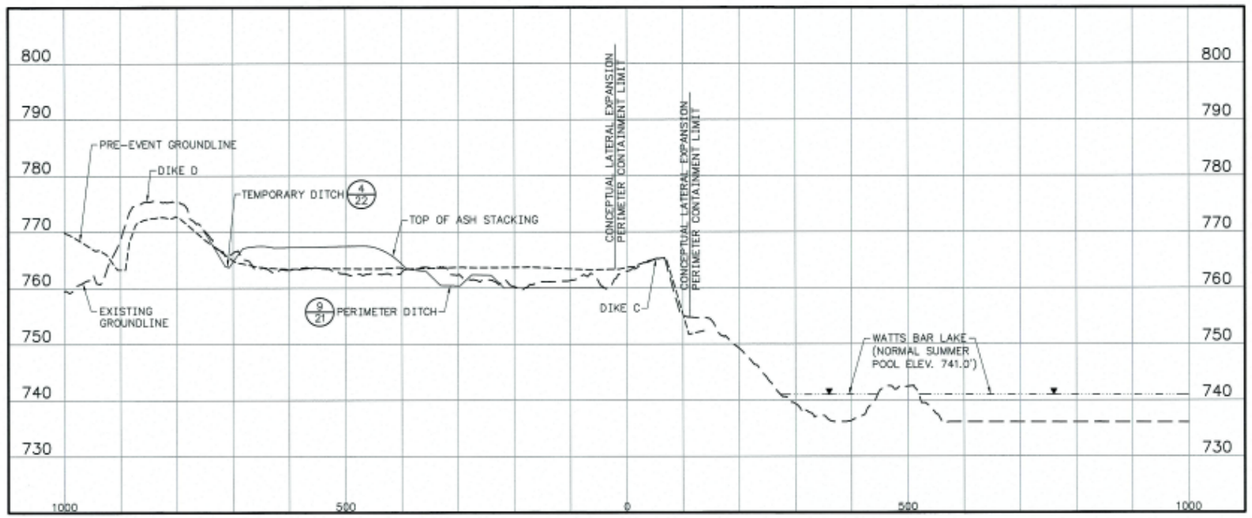
Fax 859.422.3100
www.stantec.com

AUTOCAD R 2000 | DATE 07/07/11 | 36 | C | 10W431-17 | R 0

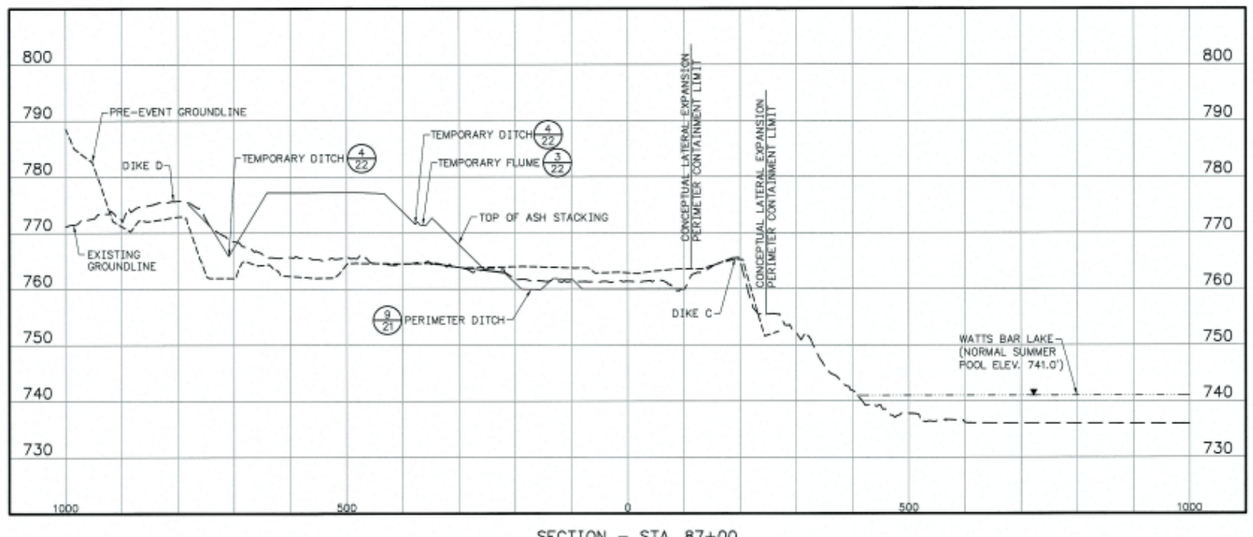
STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



SECTION – STA. 88+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)



SECTION – STA. 87+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

NOTE:
TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC. AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX0003002011000I

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	PMMG	APPD	ISSD	PROJECT MGR	AS SIGNED
R 0	07/07/11	KDL	ACC	DEH	MJS	VJD	MST	JCK	–	–
	ISSUED FOR REVIEW									

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING CROSS SECTIONS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	A.C. CLINK	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

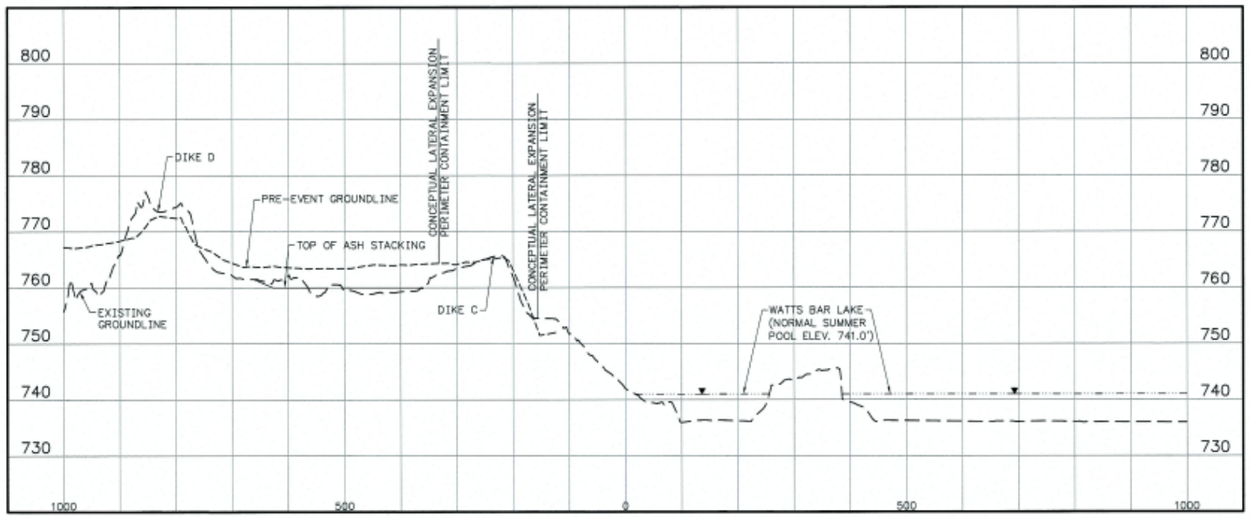
AUTOCAD R 2000 | DATE 07/07/11 | 36 | C | 10W431-18 | R 0

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

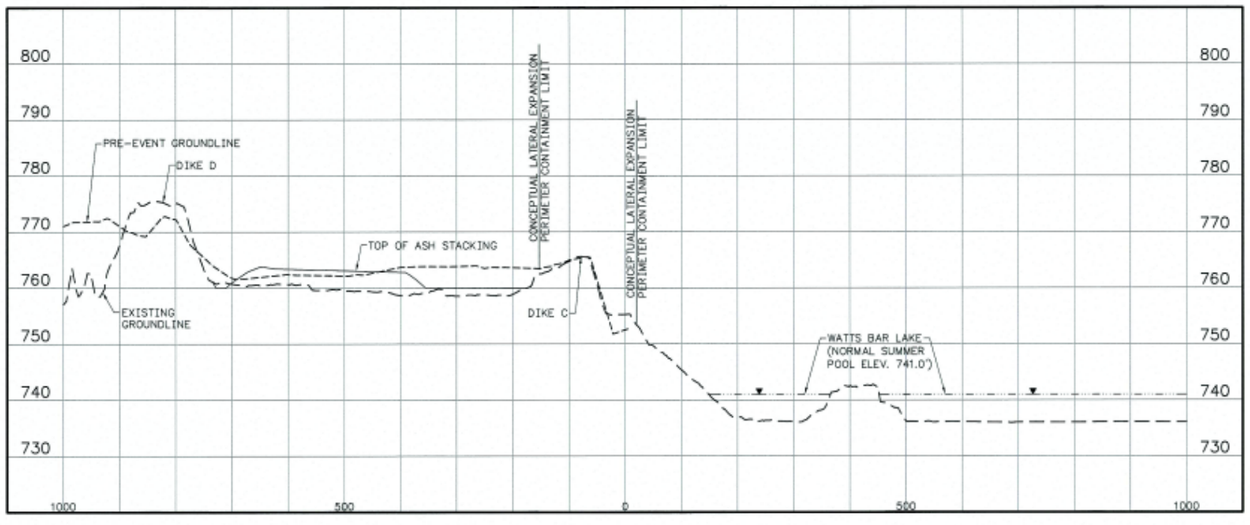
STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



SECTION – STA. 90+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)



SECTION – STA. 89+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

NOTE:
TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC. AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX0003002D110001

REV. NO.	DATE	DESN	DRWN	CHKD	SUPV	RVWR	APPD	ISSD	PROJECT ENGR	AS CONST
R 0	07/07/11	KDL	ACC	DEH	MJS	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING CROSS SECTIONS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	A.C. GLOVA	D.E. HORRIGH	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMERER

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Lexington, Kentucky
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Fax 859.422.3100
www.stantec.com

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

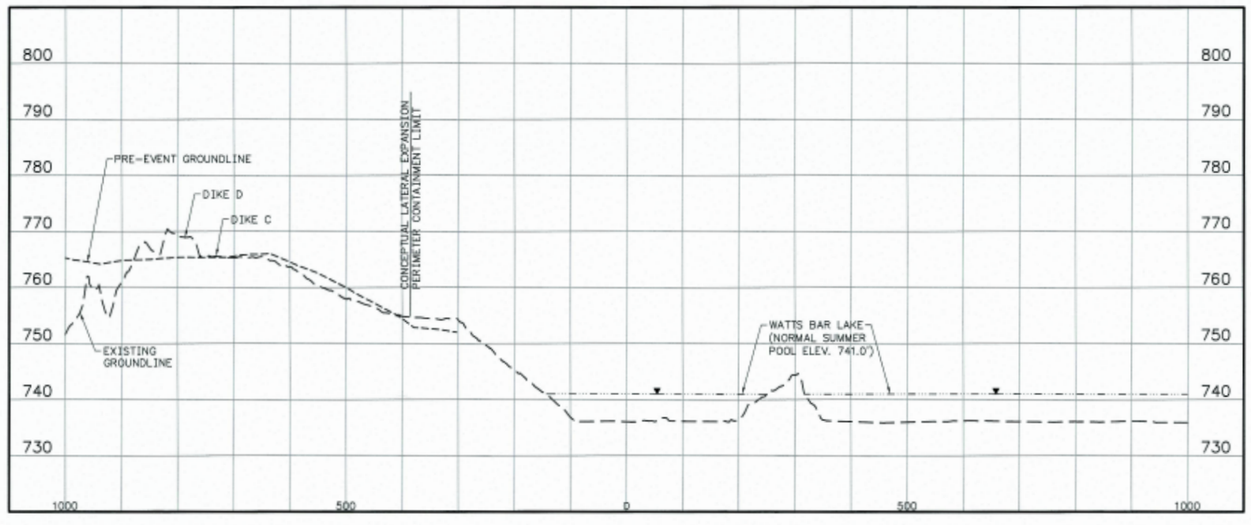
AUTOCAD R 2000 | DATE 07/07/11 | 36 | C | 10W431-19 | R 0

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1D
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



SECTION – STA. 91+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

NOTE:
TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON JANUARY 24, 2011 BY TUCK MAPPING SOLUTIONS, INC. AND SUPPLEMENTED WITH A HYDROGRAPHIC SURVEY PERFORMED ON FEBRUARY 7, 2011 BY THE TENNESSEE VALLEY AUTHORITY.

ISSUED FOR CONSTRUCTION

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX0003002011000 1

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R –	–	–	–	–	–	–	–	–	–	–
R 0	07/07/11	KDL	ACC	DEH	MJS	VJD	MST	JCK	–	–

ISSUED FOR CONSTRUCTION

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING
CROSS SECTIONS

MICHAEL J. STEELE, REGISTERED ENGINEER, NO. 113113, STATE OF TENNESSEE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	A.C. CLINE	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMEYER

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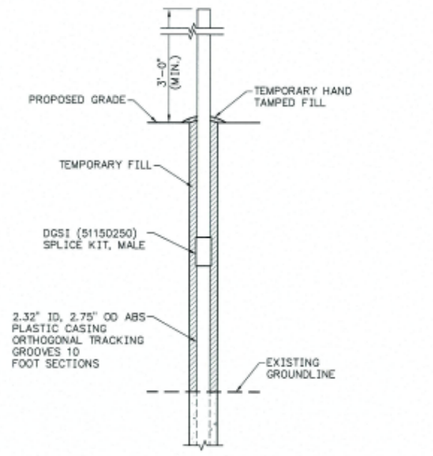
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 07/07/11	36	C	10W431-20	R 0

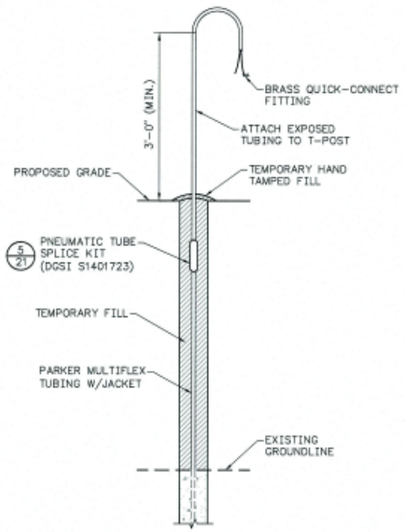
STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

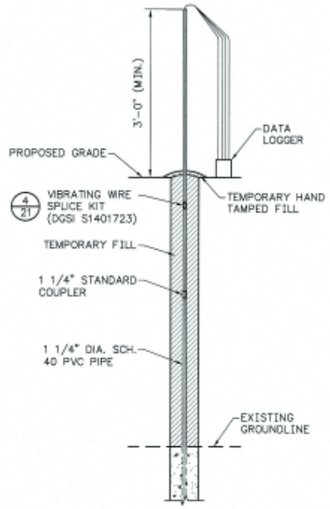
C.A.D. DRAWING
DO NOT ALTER MANUALLY



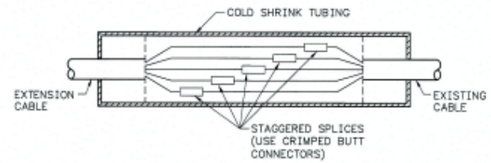
1/21 DETAIL – SLOPE INCLINOMETER EXTENSION
SCALE: 1"=1'-0"



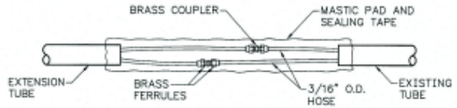
2/21 DETAIL – PNEUMATIC PIEZOMETER EXTENSION
SCALE: 1"=1'-0"



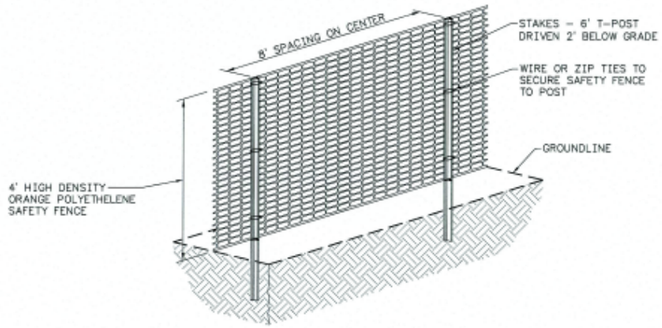
3/21 DETAIL – VIBRATING WIRE PIEZOMETER EXTENSION
SCALE: 1"=1'-0"



4/21 DETAIL – VIBRATING WIRE SPLICE KIT
NOT TO SCALE



5/21 DETAIL – PNEUMATIC TUBE SPLICE KIT
NOT TO SCALE

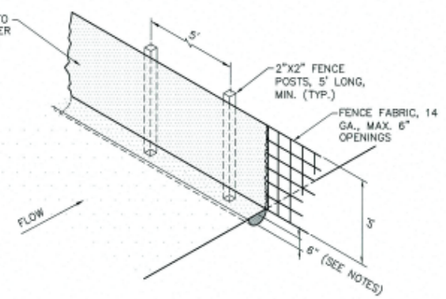


NOTES:
1. PLACE SAFETY FENCE AROUND INSTRUMENTATION TO WARN EQUIPMENT OPERATORS. MOVE FENCE AS INSTRUMENTS ARE EXTENDED.
2. ATTACH SAFETY FENCE TO T-POSTS IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.
3. USE WARNING SIGNS AS APPROPRIATE.
4. REMOVE FENCE AT PROJECT COMPLETION AND DISPOSE OF IN A LEGAL MANNER.

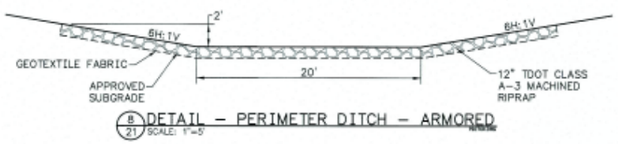
6/21 DETAIL – SAFETY FENCE
NOT TO SCALE

GEOTEXTILE FABRIC SHALL BE ATTACHED TO FENCE USING STAPLES, HOGRINGS OR OTHER METHODS APPROVED BY THE QC MANAGER (SEE NOTES).

NOTES:
1. THE BOTTOM 12 INCHES OF THE FABRIC SHALL BE BURIED IN A 6-INCH TRENCH CUT INTO THE GROUND OR COVERED BY 6 INCHES OF FILL MATERIAL TO PREVENT SEDIMENT FROM ESCAPING UNDER THE FENCE. ALL EARTHWORK SHALL BE ON THE UPSTREAM SIDE OF THE FENCE.
2. GEOTEXTILE FABRIC SHALL MEET THE FOLLOWING SPECIFICATIONS: GRAB STRENGTH (ASTM D 4632) – 90 LBS. MIN., WIDTH – 4' MIN., APPARENT OPENING SIZE (ASTM D4751) NO. 20. ULTRAVIOLET DEGRADATION (ASTM D 4355) 70% STRENGTH RETAINED. ELONGATION AT 45LB (ASTM D 4632).



7/21 DETAIL – SILT FENCE
NOT TO SCALE



8/21 DETAIL – PERIMETER DITCH – ARMORED
SCALE: 1"=5

9/21 DETAIL – PERIMETER DITCH – VEGETATED
SCALE: 1"=5

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX00030020110001

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	07/07/11	KDL	PJB	DEH	MJS	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING DETAILS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LONGO/IST	P.J. BONG	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

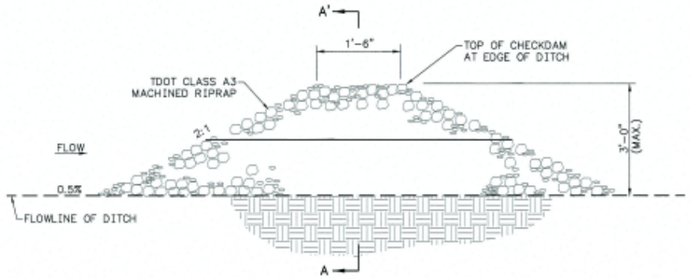
AUTOCAD R 2000	DATE 07/07/11	36	C	10W431-21	R 0

STANTEC	D
TASK COMPLETED BY:	REV NO.

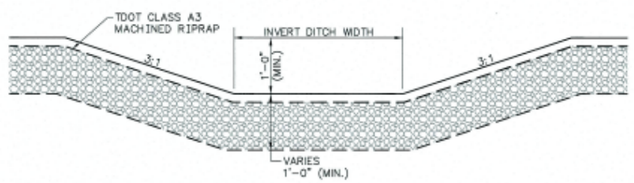
PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 07/08/2011 - 10:06 (ORIGINAL SIZE)
N:\TVA\KINGSTON\CONSULT\PERFORMANCE\ENGINEERING\STATUS\PJB\ENGINEERING_DPC\10W431-21-R0.DWG



ELEVATION

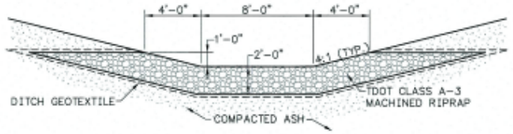


SECTION A-A'

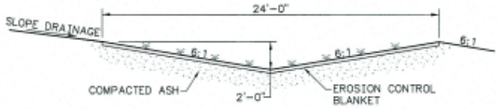
1/22 DETAIL – ROCK SILT CHECK
SCALE: 1"=1'-0"

NOTES:
1. FOR SHORT TERM AND MEDIUM TERM REQUIREMENTS, SEE PROJECT SPECIFICATION SECTION 02936.
2. THE LONG TERM COVER SHALL BE PERFORMED IN ACCORDANCE WITH SPECIFIED REQUIREMENTS IN SECTION 02936 OR APPROVED EQUIVALENT.

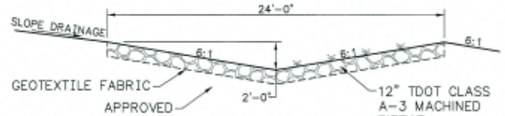
2/22 DETAIL – TOP OF ASH FILL COVER
NOT TO SCALE



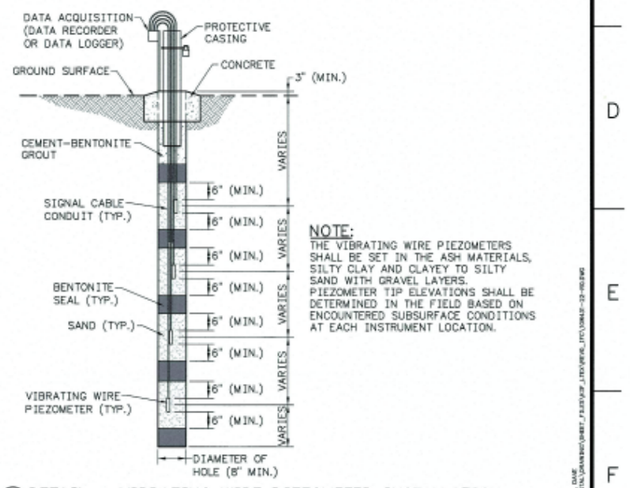
3/22 DETAIL – TEMPORARY FLUME
SCALE: 1/4"=1'-0"



4/22 DETAIL – TEMPORARY DITCH – VEGETATED
SCALE: 1/4"=1'-0"

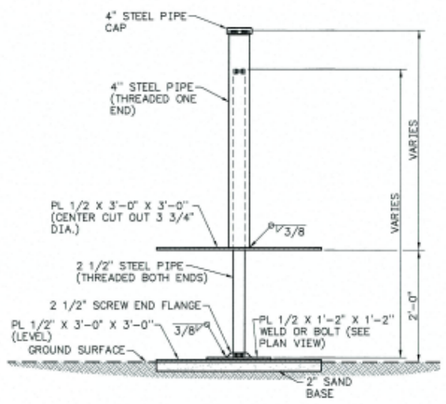


5/22 DETAIL – TEMPORARY DITCH – ARMORED
SCALE: 1/4"=1'-0"



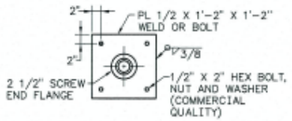
NOTE:
THE VIBRATING WIRE PIEZOMETERS SHALL BE SET IN THE ASH MATERIALS, SILTY CLAY AND CLAYEY TO SILTY SAND WITH GRAVEL LAYERS. PIEZOMETER TIP ELEVATIONS SHALL BE DETERMINED IN THE FIELD BASED ON ENCOUNTERED SUBSURFACE CONDITIONS AT EACH INSTRUMENT LOCATION.

6/22 DETAIL – VIBRATING WIRE PIEZOMETER INSTALLATION
NOT TO SCALE



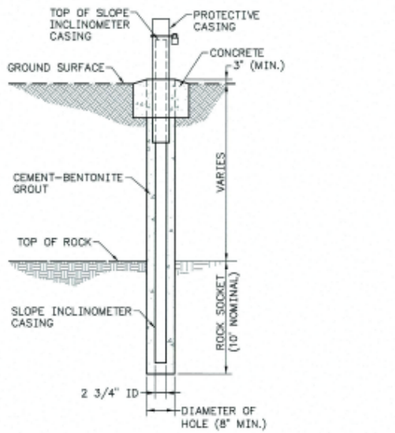
ELEVATION VIEW

NOTES:
1. ADDITIONAL PIPE SHALL BE FURNISHED IN 5'-3" SECTIONS (DUE TO COMMERCIAL PIPE LENGTHS OF 21'-0") THREADED ON BOTH ENDS.
2. PIPE SIZES ARE GIVEN IN NOMINAL DIAMETERS.



PLAN VIEW

7/22 DETAIL – SETTLEMENT PLATFORM INSTALLATION
NOT TO SCALE



8/22 DETAIL – SLOPE INCLINOMETER INSTALLATION
NOT TO SCALE

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX0003002011000 1

REV NO.	DATE	ORIGN	DRWN	CHKD	SUPV	PGMD	APPD	ISSD	PROJECT ID	AS SDMT
R 0	07/07/11	KDL	PJB	DEH	MJS	VJD	MST	JDK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
LATERAL EXPANSION (CELL 4) – RDP-0114-A

ASH STACKING DETAILS

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
K.D. LINDQUIST	P.J. BOND	D.E. HERRON	M.J. STEELE	V.J. DOTSON	M.S. TURNBOW	J.D. KAMMEYER

KINGSTON FOSSIL PLANT
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FOSSIL AND HYDRO ENGINEERING

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AUTOCAD R 2000 | DATE 07/07/11 | 36 | C | 10W431-22 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

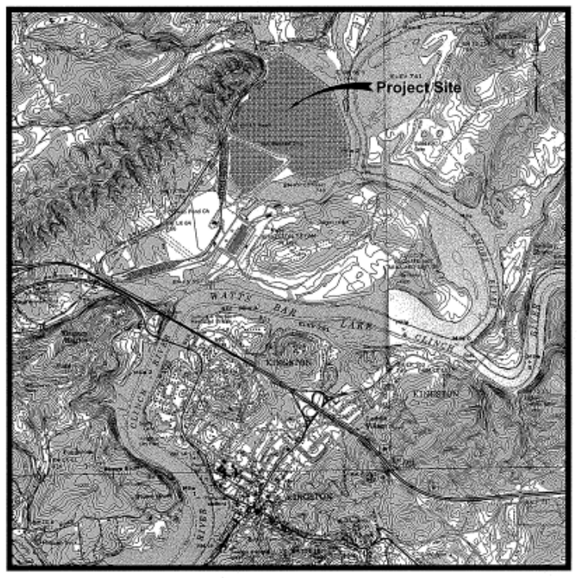
PLANS FOR CONSTRUCTION

NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3) ASH STACKING KINGSTON FOSSIL PLANT

HARRIMAN, ROANE COUNTY, TENNESSEE

PREPARED FOR

TENNESSEE VALLEY AUTHORITY



VICINITY MAP — GRAPHIC SCALE 0 2000 4000 FEET

PREPARED BY

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40511-2050
Tel. 859.422.3000
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INDEX OF SHEETS

10W216-06	COVER SHEET
10W216-07	GENERAL NOTES
10W216-08	EXISTING CONDITIONS (AND BASELINE LAYOUT)
10W216-09	ASH STACKING PLAN
10W216-10	PROFILE - PROJECT BASELINE
10W216-11 THRU 12	PROFILES - DITCHES
10W216-13 THRU 14	PROFILES - FLUMES
10W216-15 THRU 24	CROSS SECTIONS
10W216-25 THRU 26	DETAILS

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX00000020100001

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R0	01/07/11	KDL	DMG	DEH	MJS	–	MST	JCK	–	–
	ISSUED FOR CONSTRUCTION									

SCALE: JCK — EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)
ASH STACKING
COVER SHEET
RDP-0113D-R0

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. KAMMEYER

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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 01/07/11 | 36 | C | 10W216-06 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

GENERAL NOTES

1. Definitions: Whenever the following terms are used in these Drawings, it is understood that they represent the following:

   Contractor: The entity with which the Tennessee Valley Authority (TVA) has entered into an agreement to construct this project (or their designee).

   EPA: The United States Environmental Protection Agency which is the regulatory authority for the site.

   TDEC: The Tennessee Department of Environment and Conservation.

   Engineer: Stantec Consulting Services Inc.

   Owner: Tennessee Valley Authority – Kingston Fossil Plant.

   TDOT: This means the Tennessee Department of Transportation and specifically references the "Standard Specifications for Road and Bridge Construction", current edition. Any material designated as "TDOT" is to conform to the material standards noted and placement/installation methodology specified in the current edition of the "Standard Specifications for Road and Bridge Construction".

   Quality Control (QC) Plan: Refers to a document that establishes minimum quality control requirements, testing frequency and quality oversight responsibility.

   Quality Control (QC) Manager: A professional engineer licensed in the State of Tennessee that is responsible for the Quality of the constructed project as defined in the QC Plan. This individual is the Engineer of Record for Construction. Stantec Consulting Services, Inc. is the QC Manager for this project. The QC Team consists of qualified personnel that work under the direct supervision of the QC Manager. The QC Team personnel are individuals that are familiar with the materials utilized.

   Retrieved Ash: Material placed on site to include ash and incidental earthen materials recovered during excavation activities within the embayment areas.

   Construction Manager: Responsible for construction activity to include but not be limited to the character and sequence of work, coordination and scheduling. Jacobs is the Construction Manager for this project.

   SWMP: Storm Water Management Plan.

2. Construction in the Central and North Dredge Cell will occur under several projects. Embankment construction and installation of instrumentation were addressed in the Interim Dredge Cell Ash Stacking and Instrumentation Plan. This project includes embankment construction above the interim surface to the lines and grades as defined in the drawings.

3. These Drawings are presented as an aid in project construction but should not be construed as the only reference needed. The Contractor shall become familiar with and adhere to the Technical Specifications, the QC Plan, the site wide SWMP and applicable environmental and safety regulations.

4. Topographic information shown in the Drawings is dated and does not reflect changes since the time of the LIDAR Survey. Temporary stockpiling of materials and filling has occurred since the date of the LIDAR Survey.

5. Jacobs has performed required utility location services and obtained the plant issued Excavation Permit for this project.

6. Jacobs has verified that there are no conflicting utility services within work areas.

7. Security on site is provided by TVA.

8. The Contractor shall protect instrumentation from damage. The Contractor shall install protective toposts in accordance with TVA Standards around said instrumentation. Orange safety fence shall be wrapped around the top posts to denote limited access. Compaction of materials around geotechnical instrumentation shall be performed by manually operated tamping devices. Existing instrumentation will be extended upward by the QC Team during the course of the work as described in these construction documents and in accordance with established TVA procedures. Proposed geotechnical instrumentation will be installed by the QC Manager.

9. The Contractor shall be responsible for health and safety of its personnel. The Contractor shall adhere to TVA requirements for safety and construction unless OSHA or other regulatory requirements supercede them.

10. The Contractor shall be responsible for the maintenance of all access roads, staging areas and storage areas used during construction, and shall restore said areas to their original condition, or better once construction is complete unless the TVA gives written permission to the Contractor to retain the area "as is".

11. The Contractor shall conduct all operations in accordance with applicable environmental permits, rules, laws and regulations included but not limited to those set forth in CEC 19966, 20065 or other environmental review documents for the project.

12. The Contractor is responsible for site drainage throughout construction and shall install temporary drainage structures or pump water as necessary to prevent interference with the work. Such temporary drainage features shall be performed in accordance with the requirements of environmental permits and the site wide SWMP.

13. Vegetative and organic materials shall be removed as described in the Technical Specifications.

14. Drainage conditions surrounding existing facilities outside the grading limits are not addressed by the Drawings. Grading, shaping and installation of drainage structures may be required to promote positive drainage.

15. Materials delivered for incorporation into the work shall be temporarily stored in areas selected by the Contractor and approved by TVA. If said materials are stored within the Dredge Cell, then QC Manager approval is required. Materials shall be stored in accordance with the manufacturer's recommendations. Materials that can be directly incorporated into the work do not need to be stockpiled.

16. The erosion and sediment control plan measures shown shall be considered the minimum; supplemental measures shall be provided by the Contractor as field conditions dictate or as directed by the Construction Manager or the regulatory authority.

17. During construction, the Contractor shall clean and maintain all sediment control devices as shown on the Drawings. The Construction Manager shall provide reporting as required by the SWMP, Technical Specifications and regulations on said items.

18. The Contractor shall control fugitive dust emissions during construction in such a manner as to comply with applicable regulations. Dust control measures shall be subject to approval of the Construction Manager and the Owner.

19. Temporary stockpiles within the Dredge Cell shall be placed in uniform 24" lifts over the extent of the QC Manager approved stockpile limits.

20. Locations and size of temporary stockpiles within the Dredge Cell shall be approved by the QC Manager and TVA prior to material placements.

21. Stockpiles shall be graded to maintain positive drainage at all times. The side slopes shall have maximum 6H:1V slope. The top of the stockpile shall have a minimum two percent slope. Materials shall be segregated as directed by the QC Manager.

22. Certifications of material quality and conformance to project requirements shall be submitted to the TVA for forwarding to the QC Manager.

23. The Contractor shall be responsible for construction surveyor selection and coordination of all construction related surveying. All established TVA bench marks or other monuments shall be preserved and protected. Any established marker or benchmark that is damaged by construction activities shall be replaced by the Contractor at his/her own cost.

24. The Construction Manager shall communicate construction issues, problems or discrepancies in the Drawings to the QC Manager and TVA immediately upon becoming aware of such problems.

25. The Contractor shall note that this work may be performed concurrent with Interim Dredge Cell Ash Stacking. This work may also coincide with Perimeter Containment Construction.

26. Any proposed modification to design features as shown (or described) in the approved Issued For Construction design documents shall be contingent upon Engineer of Record approval. Temporary features to facilitate construction to achieve the approved design features shall be addressed by methods described in approved project documents and practices (e.g. Storm Water Management Plan, Best Management Practices, etc.).

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX00000020100001

MICHAEL J. STEELE — REGISTERED ENGINEER — STATE OF TENNESSEE — No. 119118

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT 30	AS CONST	REV. NO.
R 0	01/07/11	KDL	DMG	DEH	MJS	–	MST	JCK	–	–	R 0

ISSUED FOR CONSTRUCTION

SCALE: AS SHOWN — EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING
GENERAL NOTES
RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. KAMNEYER

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Fax 859.422.3100
www.stantec.com

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 01/07/11	36	C	10W216-07	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 31/05/2011 USER: RYAN_FA
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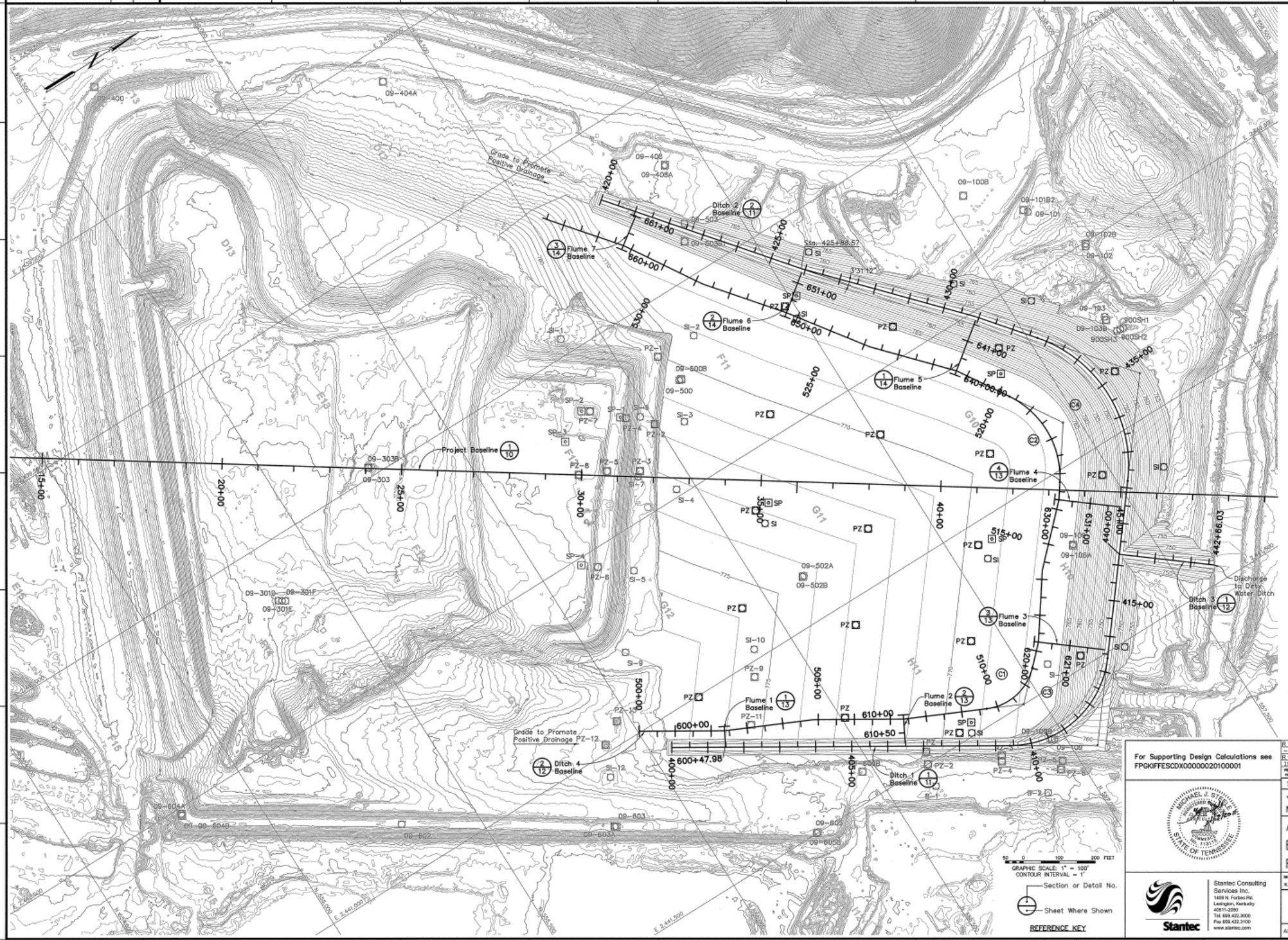
36 | C | 10W216-08



NOTES:

1. Topographic mapping was generated from a LiDAR survey performed on July 23, 2010 by Tuck Mapping Solutions, Inc. and merged with the Interim Ash Stacking Plan.
2. Ditches 1, 2 and 3 were part of the Interim Ash Stacking Plan. The geometry and layout are provided herein as an aid for construction.

BASELINE CURVE DATA

C1

P.I. Sta. = 510+73.72
Northing = 556,950.65
Easting = 2,441,499.29
Δ = 69°31'59"
D = 38°11'50"
T = 104.12'
L = 182.04'
R = 150.00'
E = 32.60'
P.C. Sta. = 509+69.60
P.T. Sta. = 511+51.64

C2

P.I. Sta. = 518+42.51
Northing = 557,459.35
Easting = 2,440,892.51
Δ = 67°09'07"
D = 22°55'6"
T = 165.95'
L = 293.01'
R = 250.00'
E = 50.06'
P.C. Sta. = 516+76.56
P.T. Sta. = 519+69.57

C3

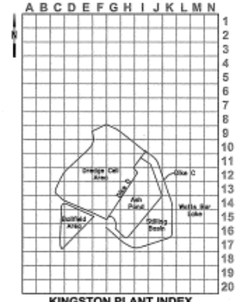
P.I. Sta. = 411+84.04
Northing = 557,713.39
Easting = 2,440,889.45
Δ = 83°12'52"
D = 20°50'05"
T = 244.22'
L = 399.40'
R = 275.00'
E = 92.79'
P.C. Sta. = 409+39.82
P.T. Sta. = 413+39.22

C4

P.I. Sta. = 435+74.05
Northing = 557,064.15
Easting = 2,441,705.42
Δ = 77°33'06"
D = 15°16'44"
T = 301.25'
L = 507.57'
R = 375.00'
E = 106.01'
P.C. Sta. = 432+72.80
P.T. Sta. = 437+80.37

LEGEND

PZ	Proposed Piezometer
SI	Proposed Inclinometer
SP	Proposed Settlement Plate
PZ-1	Existing Piezometer
SI-1	Existing Slope Inclinometer
SP-1	Existing Settlement Plate



ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX00000020100001

MICHAEL J. STEELE — REGISTERED PROFESSIONAL ENGINEER — No. 119115 — STATE OF TENNESSEE

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REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	CSSD	PROJECT MGR	AS CONST	REV NO.
R 0	01/07/11	KDL	DMG	DEH	MJS	–	MST	JCK	–	–	R 0
ISSUED FOR CONSTRUCTION											

SCALE: 1"=100' EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING
EXISTING CONDITIONS
RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. HAMMETER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

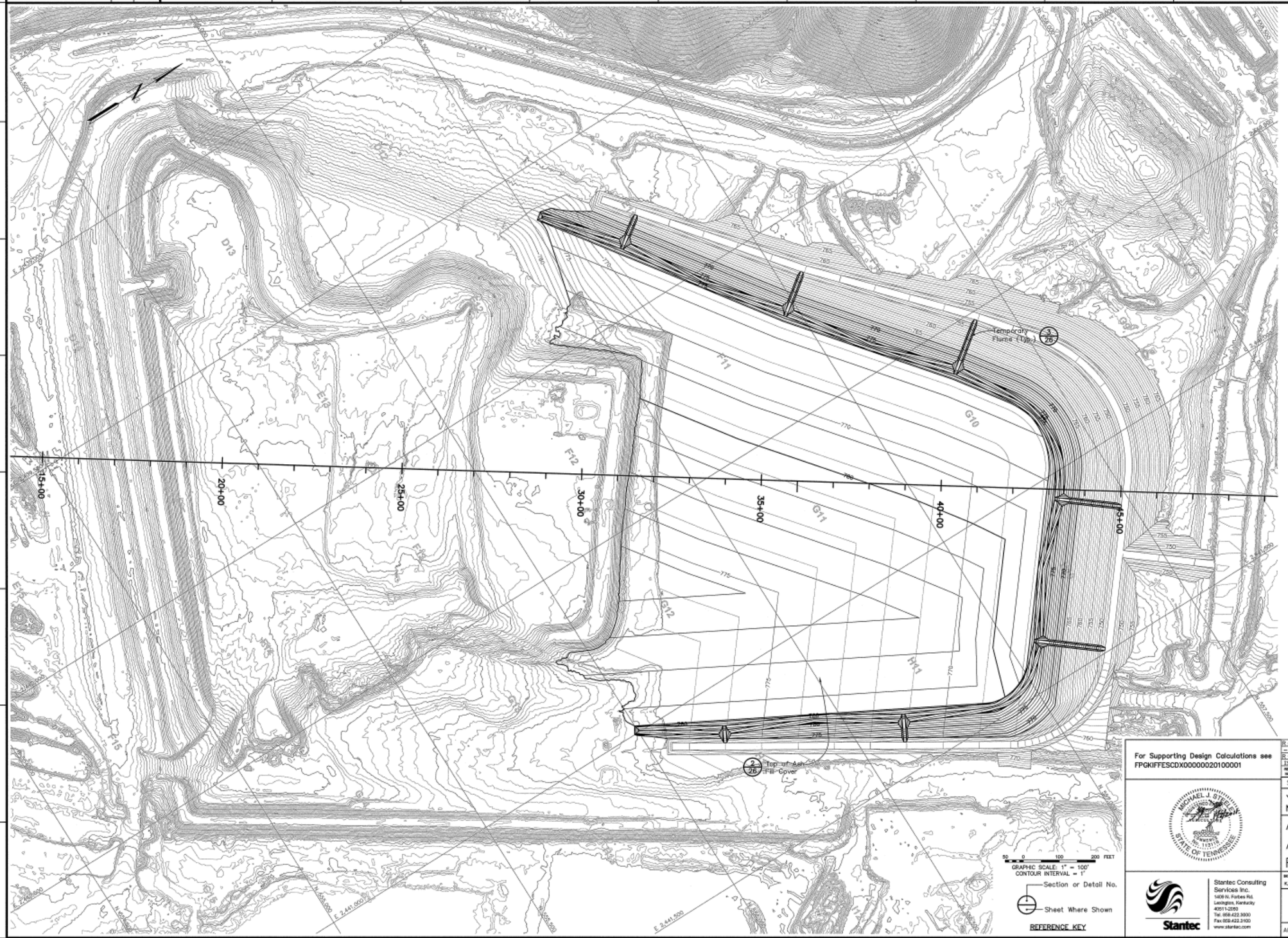
AUTOCAD R 2000	DATE 01/07/11	36	C	10W216-08	R 0

PLOT FACTOR:100
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

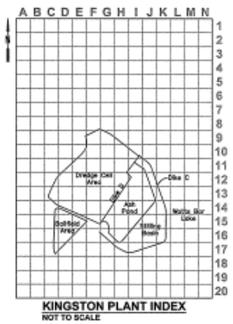
PLOT DATE: 31/05/2011 USER: DMG, PJ
I:\PROJECTS\KINGSTON\ENGINEERING\DRAWINGS\ASH\RDP-0113D-R0.DWG

STANTEC	0
TASK COMPLETED BY:	REV NO.



NOTES:

1. Topographic mapping was generated from a LIDAR survey performed on July 23, 2010 by Tuck Mapping Solutions, Inc. and merged with the Interim Ash Stacking Plan.
2. Extend instrumentation as directed by the QC Manager and referenced in the QC Plan.
3. The Dredge Cell Ash Stacking Plan has an area of 33.5 acres and fill volume of 430,000 cubic yards.



KINGSTON PLANT INDEX
NOT TO SCALE

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX00000020100001

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS ISSUED
R 0	01/07/11	KDL	DMG	DEH	MJS	–	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: 1"=100' EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING

ASH STACKING PLAN

RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
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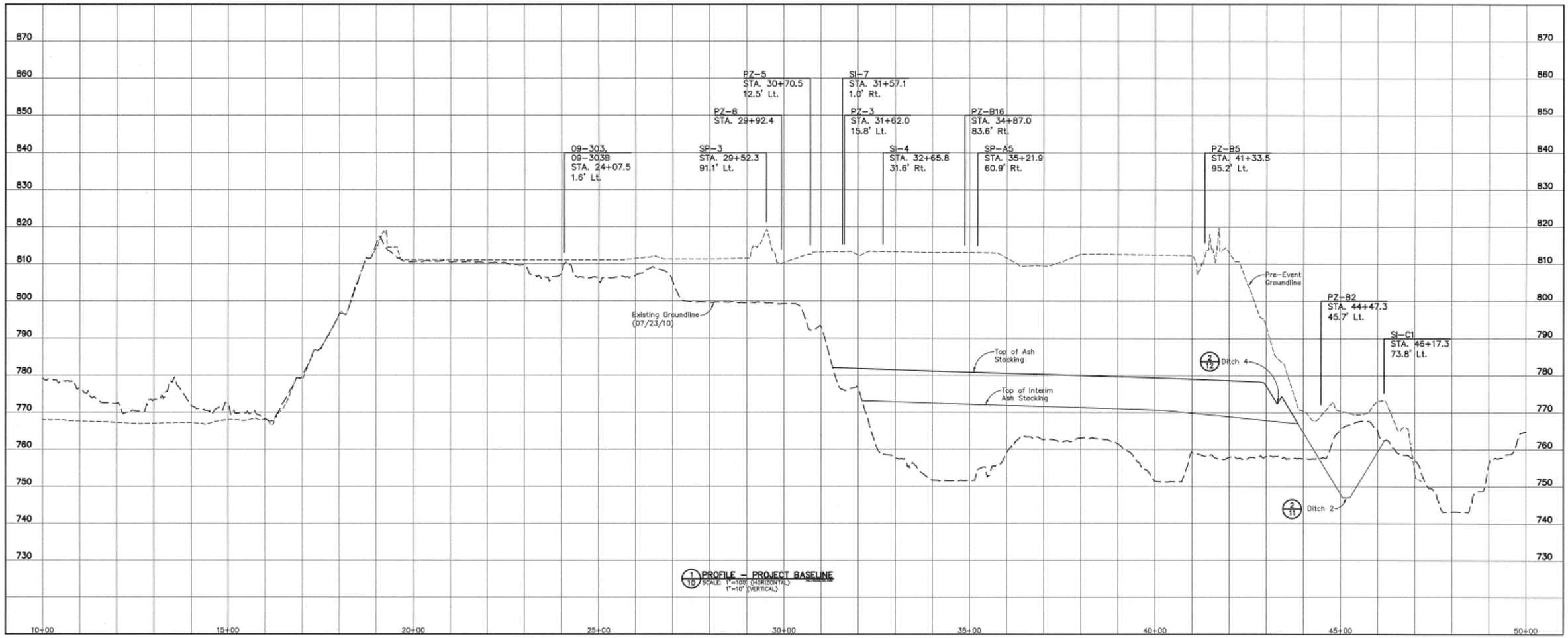
AUTOCAD R 2000	DATE 01/07/11	36	C	10W216-09	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:100
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



1/10 PROFILE – PROJECT BASELINE
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

NOTE:
Illustrated instruments are those which are located within 100 feet (left or right) of the project baseline.

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX000000020100001

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ENGR	AS CONST
R 0	01/07/11	KDL	DMG	DEH	MJS	–	MST	JCK	–	–
	ISSUED FOR CONSTRUCTION									

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING
PROFILE – PROJECT BASELINE
RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. KAMMEYER

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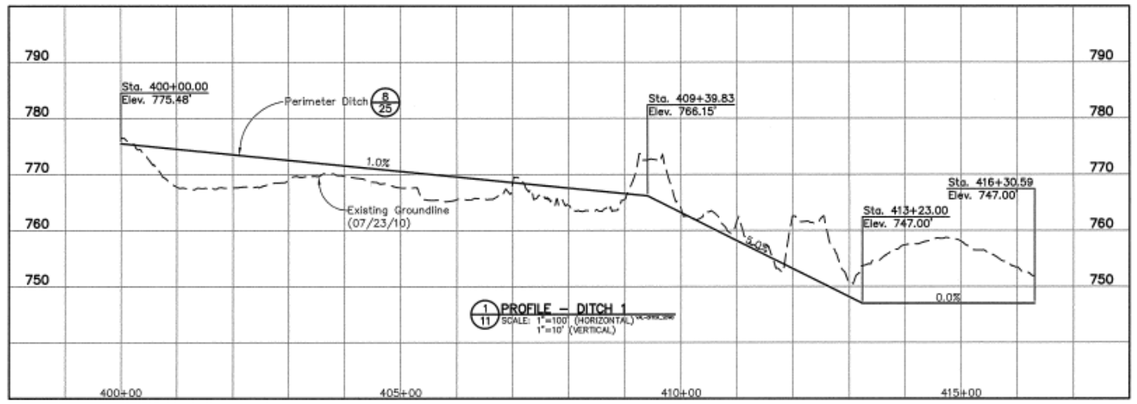
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 01/07/11 | 36 | C | 10W216-10 | R 0

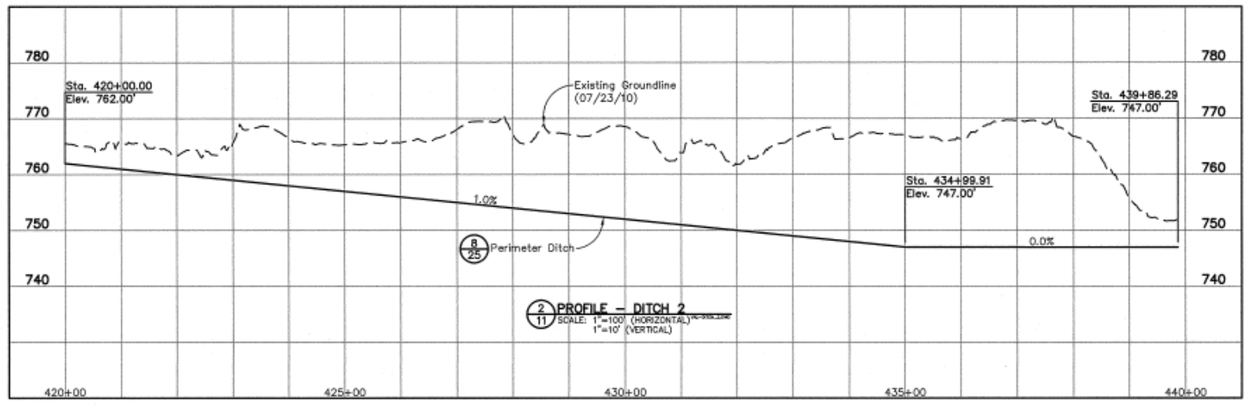
STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



1/11 PROFILE – DITCH 1
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)



2/11 PROFILE – DITCH 2
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

NOTE:
Ditches 1 and 2 were part of the Interim Ash Stacking Plan. The geometry and layout are provided herein as an aid for construction.

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX000000020100001

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS BUILT
R 0	01/07/11	KDL	DMG	DEH	MJS	–	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING
PROFILES – DITCHES
RDP-0113D-R0

MICHAEL J. STEELE – REGISTERED PROFESSIONAL ENGINEER – No. 113114 – STATE OF TENNESSEE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. KAMMEYER

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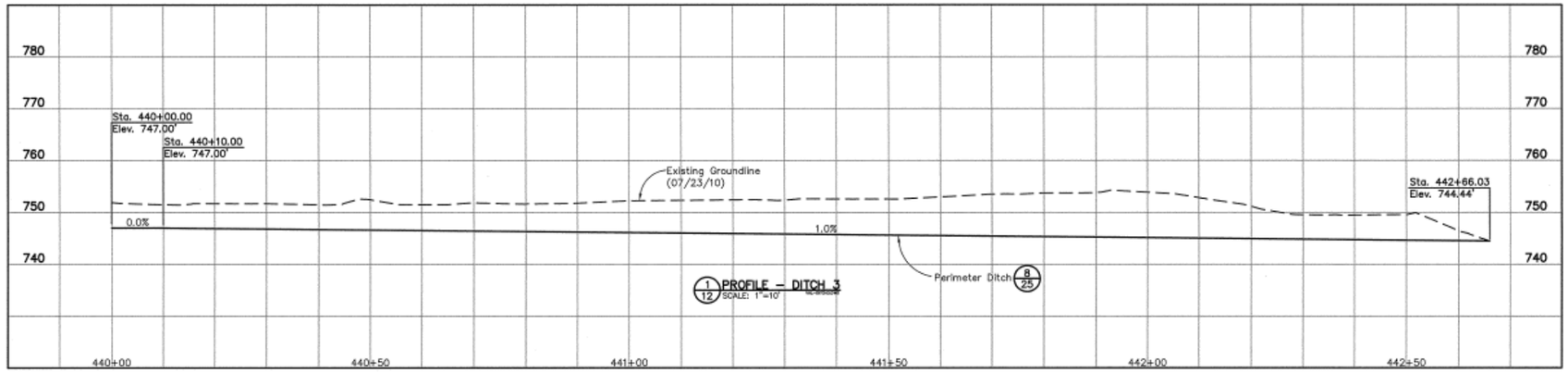
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE: 01/07/11	36	C	10W216-11	R 0

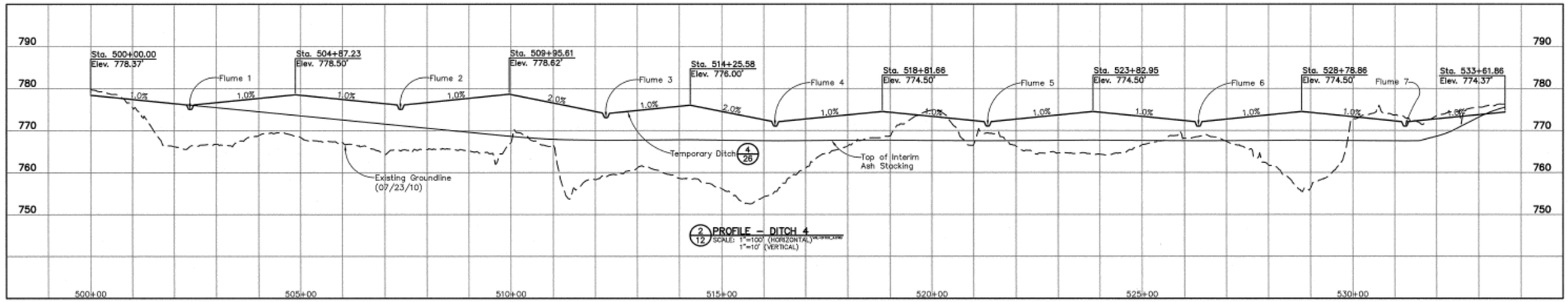
STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



1/12 PROFILE – DITCH 3
SCALE: 1"=10'



2/12 PROFILE – DITCH 4
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

NOTE:
Ditch 3 was part of the Interim Ash Stacking Plan. The geometry and layout are provided herein as an aid for construction.

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX00000020100001

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	PMD	APPD	ISSD	PROJECT ID	AS CONST
R 0	01/07/11	KDL	DMG	DEH	MJS	--	MST	JCK	-	-

ISSUED FOR CONSTRUCTION

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING
PROFILES – DITCHES
RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HORRON	M.J. STEELE	-	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
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www.stantec.com

AUTOCAD R 2000 | DATE 01/07/11 | 36 | C | 10W216-12 | R 0

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT DATE: 01/07/2011 - 10:09:39 PM
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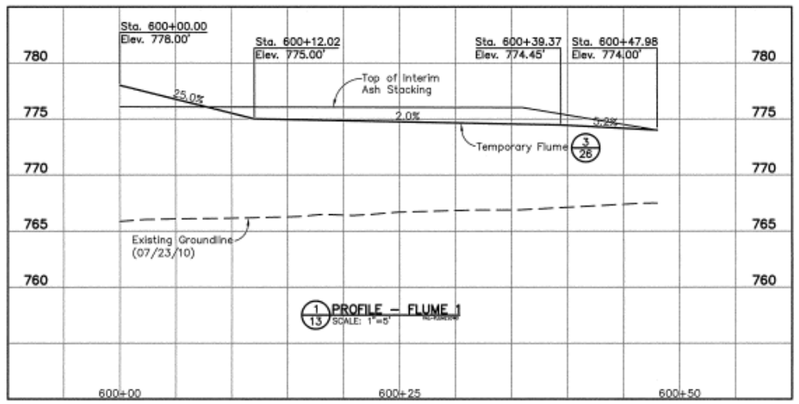
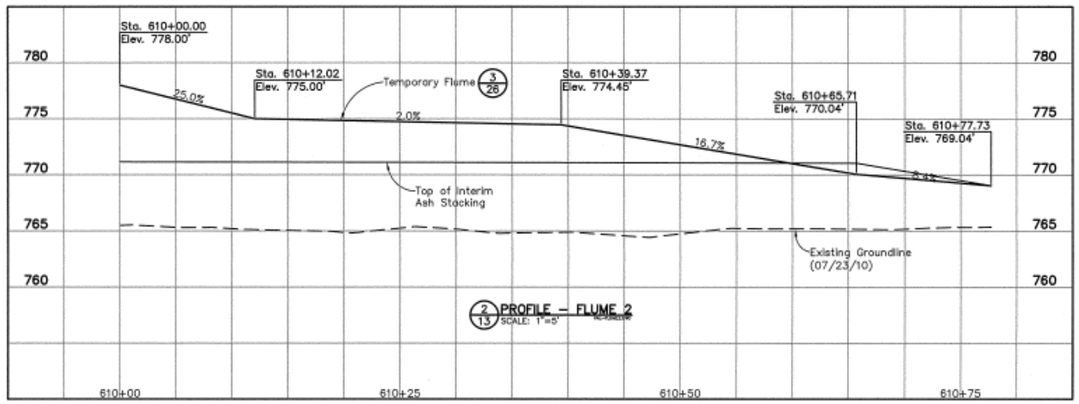
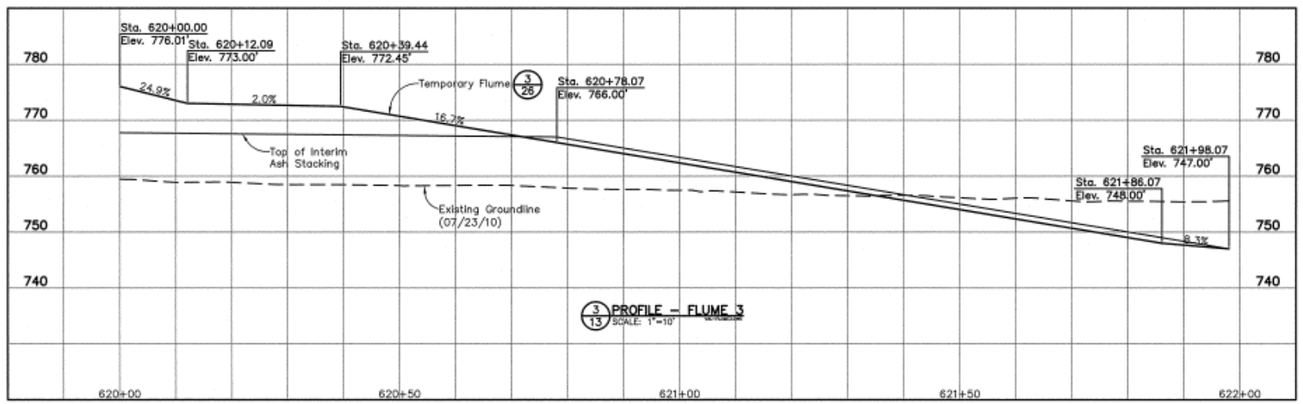


1/13 PROFILE – FLUME 1
SCALE: 1"=5'



2/13 PROFILE – FLUME 2
SCALE: 1"=5'



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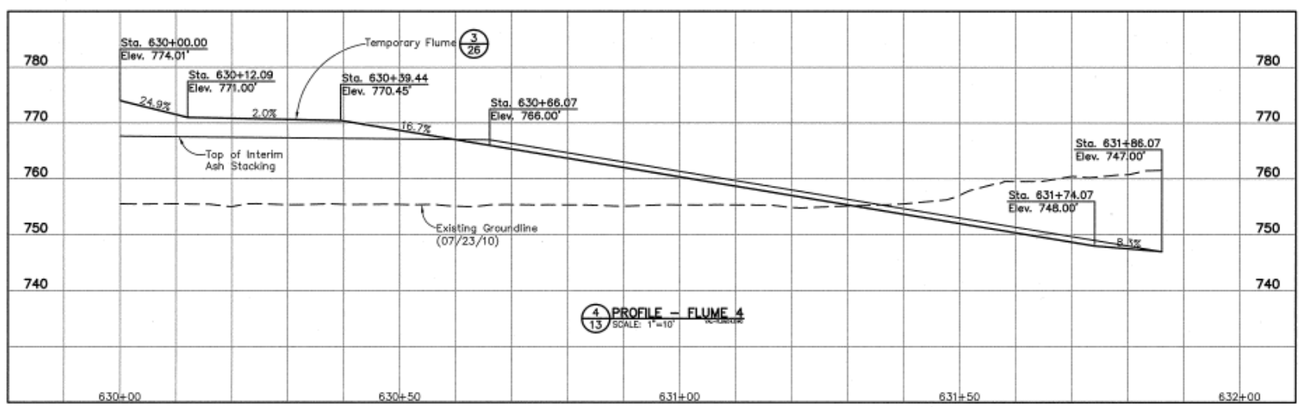
SCALE: 1"=10'



4/13 PROFILE – FLUME 4
SCALE: 1"=10'

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX00000020100001

REV	DATE	DESIGN	DRAWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT MGR	AS CONST	DISCIPLINE INTERFACE
–	–	–	–	–	–	–	–	–	–	–	–
R 0	01/07/11	KDL	DMG	DEH	MJS	–	MST	JCK	–	–	–
ISSUED FOR CONSTRUCTION											

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING
PROFILES – FLUMES 1, 2, 3 & 4
RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 01/07/11 | 36 | C | 10W216-13 | R 0

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
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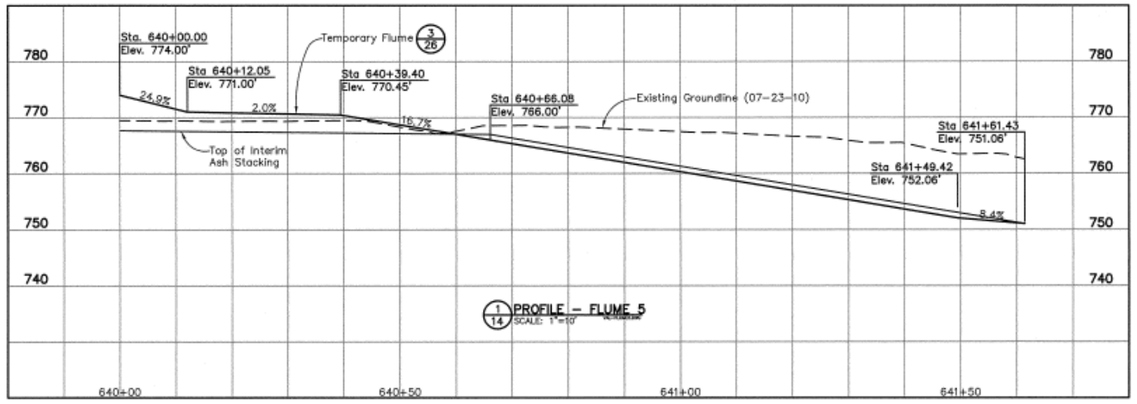
40511-2050
Tel. 859.422.3000
Fax 859.422.3100
www.stantec.com

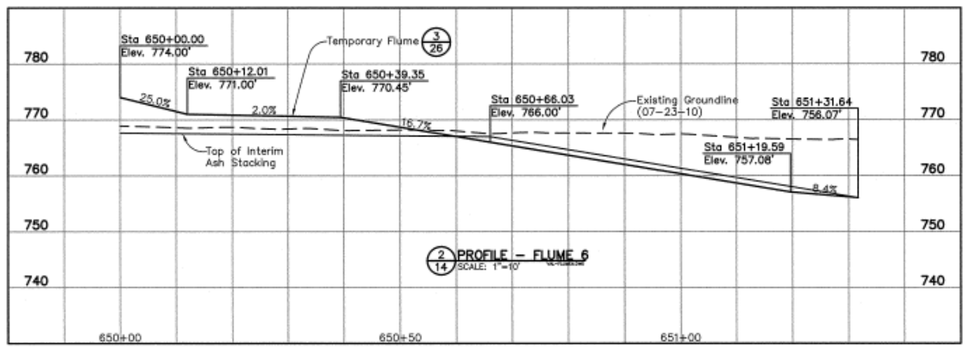
STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

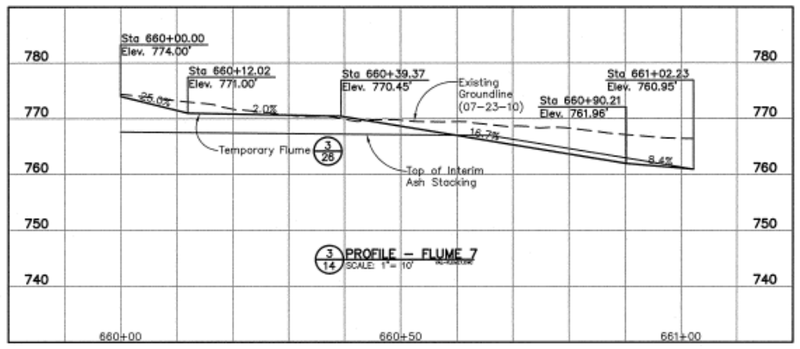
C.A.D. DRAWING
DO NOT ALTER MANUALLY



(1/14) PROFILE – FLUME 5
SCALE: 1"=10'



(2/14) PROFILE – FLUME 6
SCALE: 1"=10'



(3/14) PROFILE – FLUME 7
SCALE: 1"=10'

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX00000020100001

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	ENRG	APPR	ISSD	PROJECT ID	AS CONST	DESCRIPTION/ INITIALS
R 0	01/07/11	KDL	DMG	DEH	MJS	--	MST	JCK	--	--	--
ISSUED FOR CONSTRUCTION											

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING
PROFILES – FLUMES 5, 6 & 7
RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	--	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

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www.stantec.com

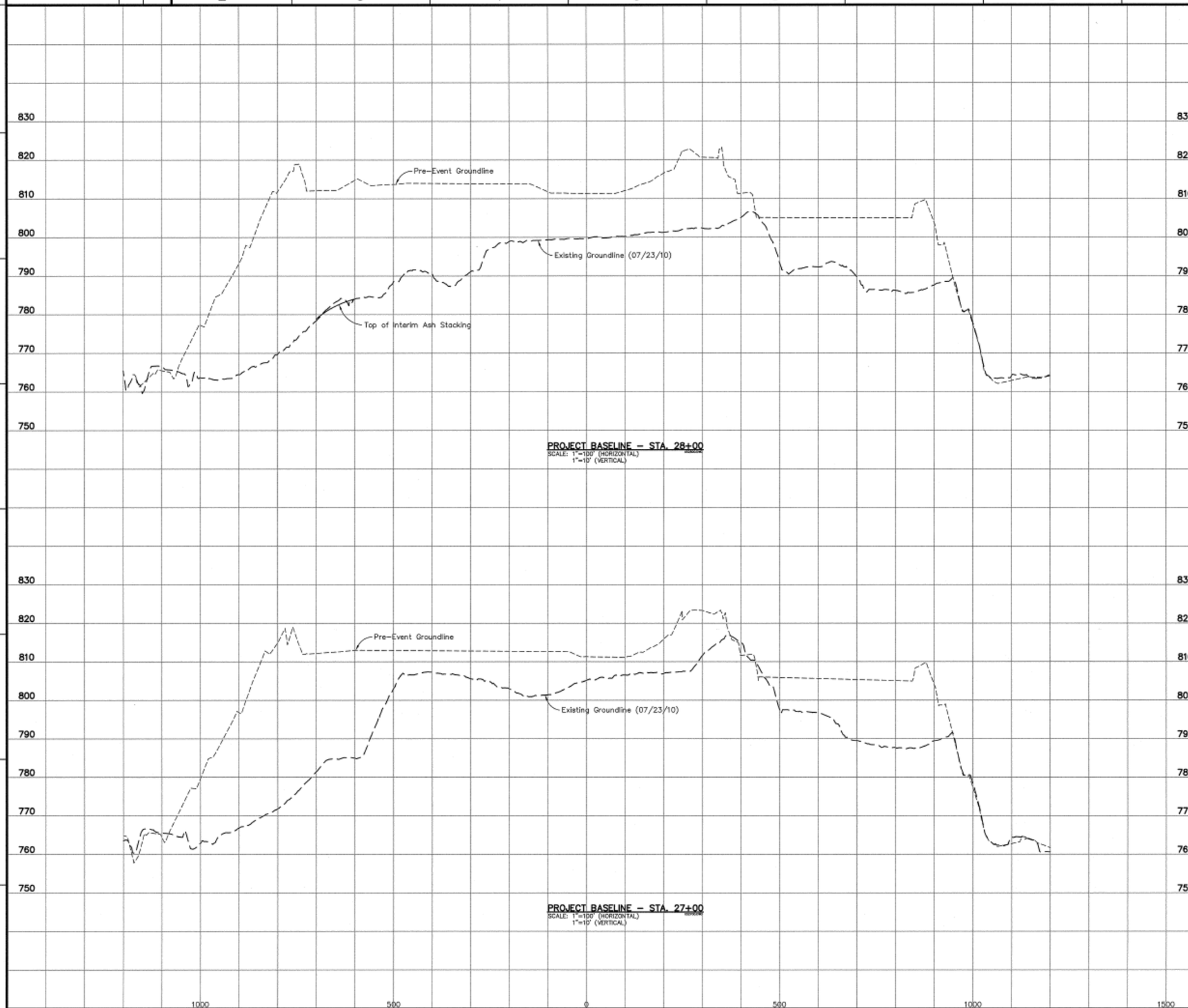
AUTOCAD R 2000 | DATE 01/07/11 | 36 | C | 10W216-14 | R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 07/06/2011 USER: ROBB, PA
V:\CAD\KIF\DGN\ASH\RDP0113D_\DRAWING\MATERIAL\RIDGE_GELLI\RDP0113D0025\10W216-14-R0.DWG



PROJECT BASELINE – STA. 28+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

PROJECT BASELINE – STA. 27+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

Section or Detail No.
Sheet Where Shown

REFERENCE KEY

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX000000020100001

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	01/07/11	KDL	DMG	DEH	MJS	–	MST	JCK	–	–
	ISSUED FOR CONSTRUCTION									

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING
CROSS SECTIONS
RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 01/07/11 | 36 | C | 10W216-15 | R 0

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
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TASK COMPLETED BY: | REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 01/05/2011 - 10:05 (EST)
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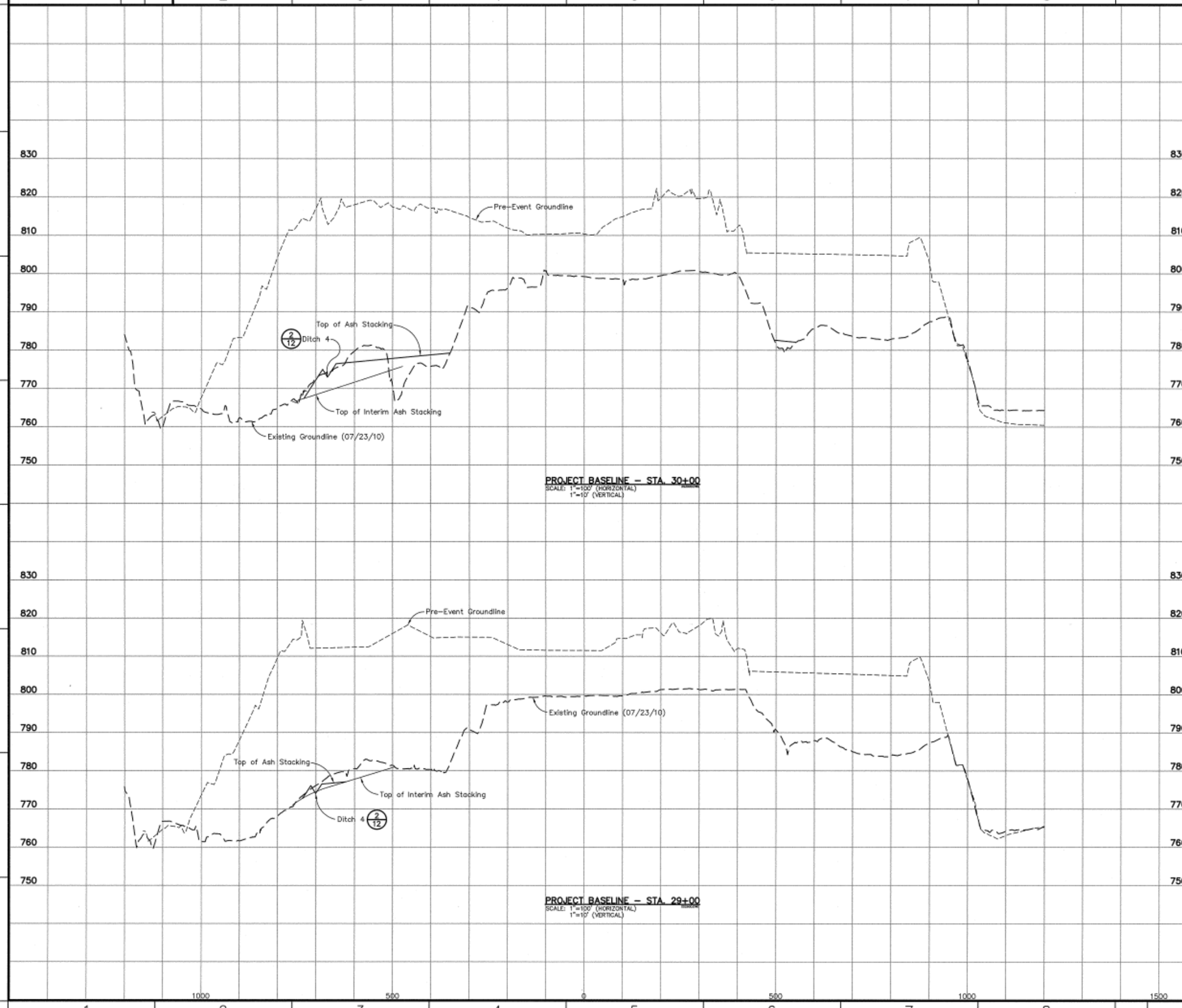

PROJECT BASELINE – STA. 30+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

PROJECT BASELINE – STA. 29+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX000000020100001

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	KWKD	APPD	ESSD	PROJECT ID	AS CONST
R 0	01/07/11	KDL	DMG	DEH	MJS	--	MST	JCK	-	-
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING CROSS SECTIONS RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	--	M.S. TURNBOW	J.C. KAMMEYER

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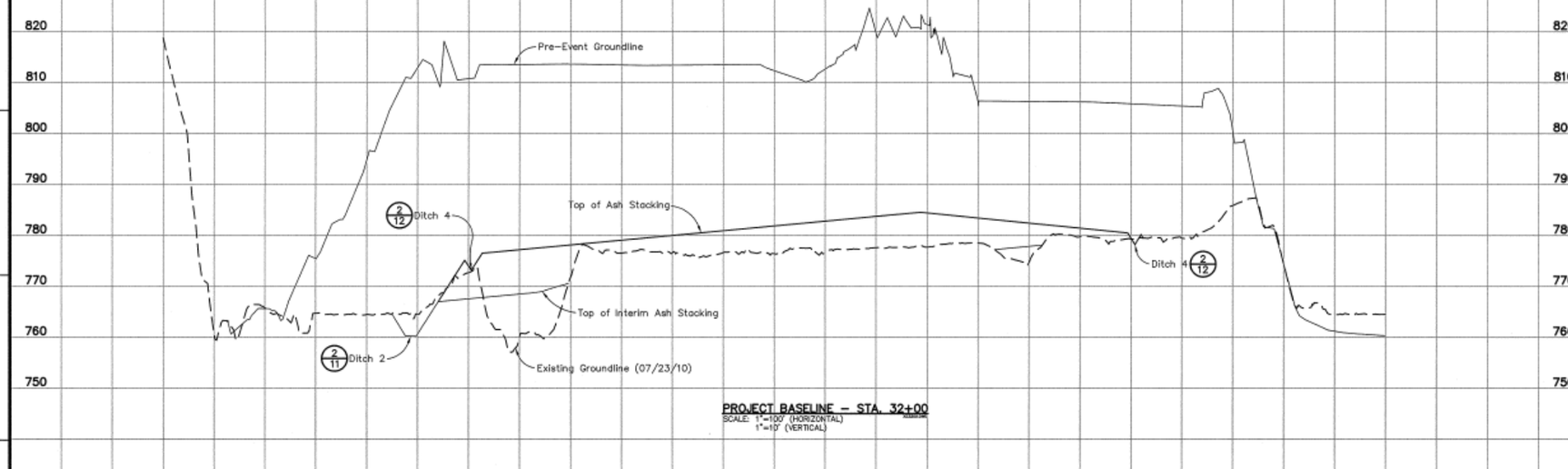
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 01/07/11 | 36 | C | 10W216-16 | R 0

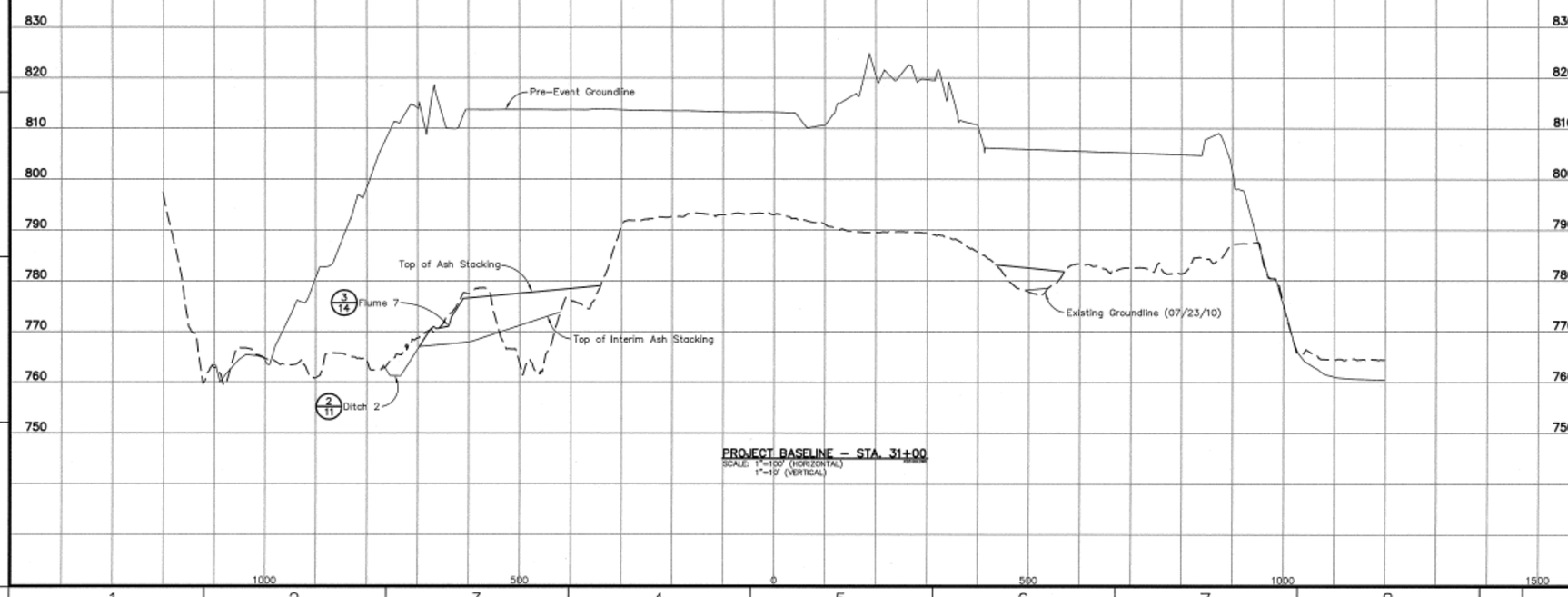
PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	0
TASK COMPLETED BY:	REV NO.



PROJECT BASELINE – STA. 32+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)



PROJECT BASELINE – STA. 31+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX00000020100001

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT LEAD	AS CONST	REV. NO.
R 0	01/07/11	KDL	AOC	DEH	MJS	--	MST	JCK	-	-	-
ISSUED FOR CONSTRUCTION											

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING CROSS SECTIONS RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	--	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
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AUTOCAD R 2000 | DATE 01/07/11 | 36 | C | 10W216-17 | R 0

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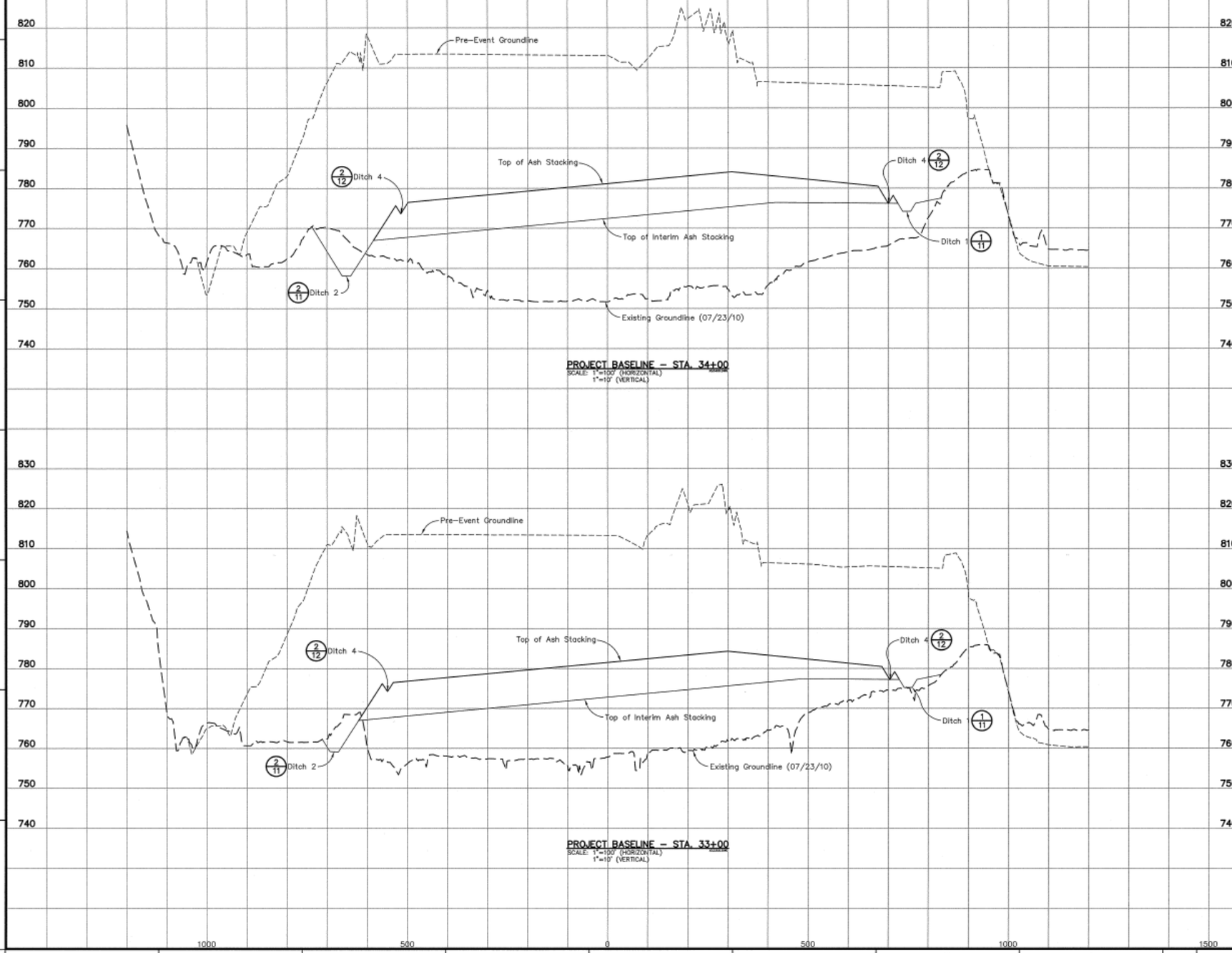
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



PROJECT BASELINE – STA. 34+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

PROJECT BASELINE – STA. 33+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

1000 500 0 500 1000 1500

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

ISSUED FOR CONSTRUCTION

PLOT DATE: 01/07/2011 USER: RDRIS, PA
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For Supporting Design Calculations see FPGKIFFESCDX000000020100001

REV. NO.	DATE	DESN	DRWN	CHKD	SUPV	PMMG	APPD	ESID	PROJECT ENGR	AS CONST BY
R –	–	–	–	–	–	–	–	–	–	–
R 0	01/07/11	KDL	DMG	DEH	MJS	–	MST	JCK	–	–

ISSUED FOR CONSTRUCTION

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING
CROSS SECTIONS
RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. KAMMEYER

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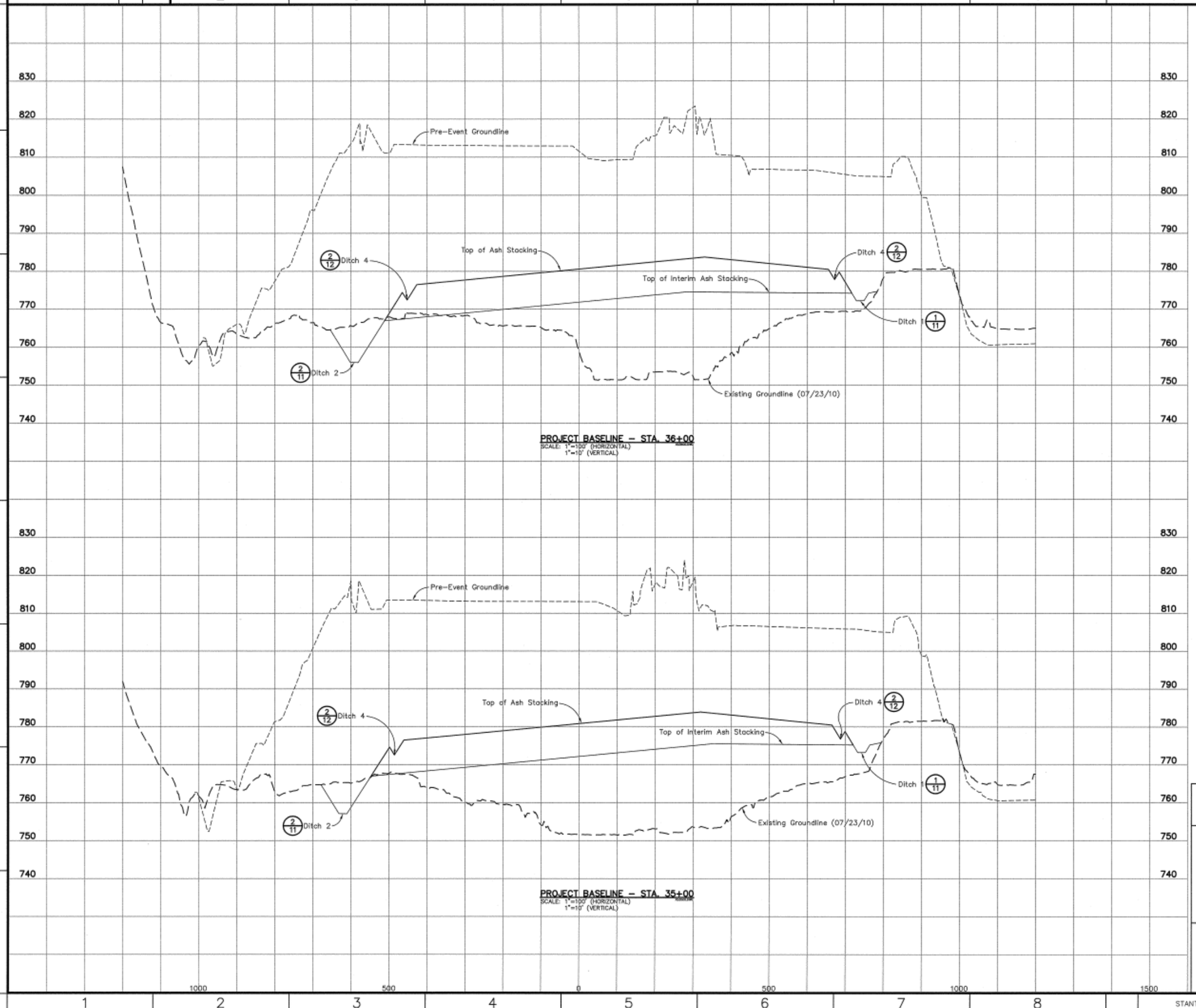
AUTOCAD R 2000	DATE 01/07/11	36	C	10W216-18	R 0

PLOT FACTOR:10
W:_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	0
TASK COMPLETED BY:	REV NO.



PROJECT BASELINE – STA. 36+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

PROJECT BASELINE – STA. 35+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX000000020100001

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R –	–	–	–	–	–	–	–	–	–	–
R 0	01/07/11	KDL	DMG	DEH	MJS	–	MST	JCK	–	–

ISSUED FOR CONSTRUCTION

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING CROSS SECTIONS RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. KAMMEYER

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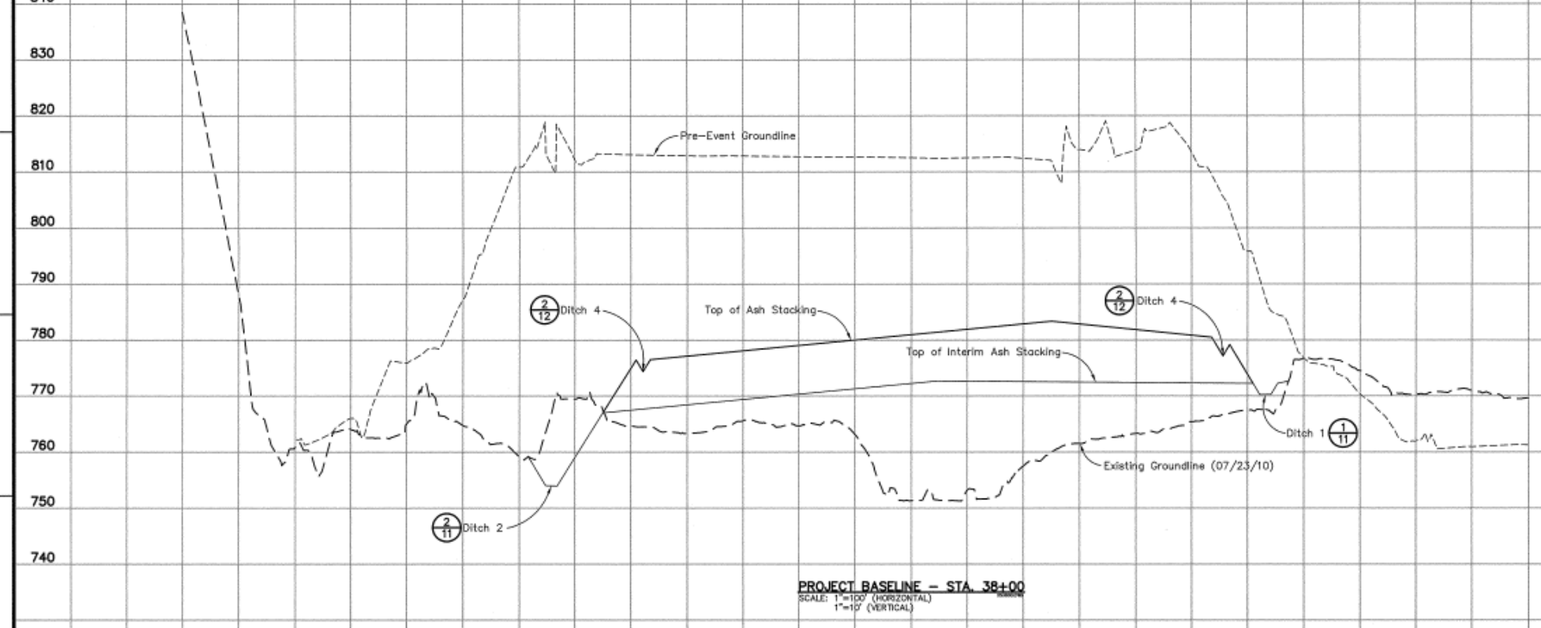
AUTOCAD R 2000 | DATE 01/07/11 | 36 | C | 10W216-19 | R 0

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT DATE: 01/07/2011 USER: BDNS, PJ
FILE: C:\ACAD\DRAWINGS\KINGSTON\ASH_HANDLING\STACKING\10W216-19-36.DWG



PROJECT BASELINE – STA. 38+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

PROJECT BASELINE – STA. 37+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX00000020100001

REV	DATE	DSGN	DRWN	CHKD	SUPV	PANEL	APPD	ISSD	PROJECT ID	AS CONST	REV
R 0	01/07/11	KDL	DMG	DEH	MJS	--	MST	JCK	--	--	--

ISSUED FOR CONSTRUCTION

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING
CROSS SECTIONS
RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	G.E. HERRON	M.J. STEELE	-	M.S. TURNBOW	J.C. KAMMEYER

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FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 01/07/11	36	C	10W216-20	R 0

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

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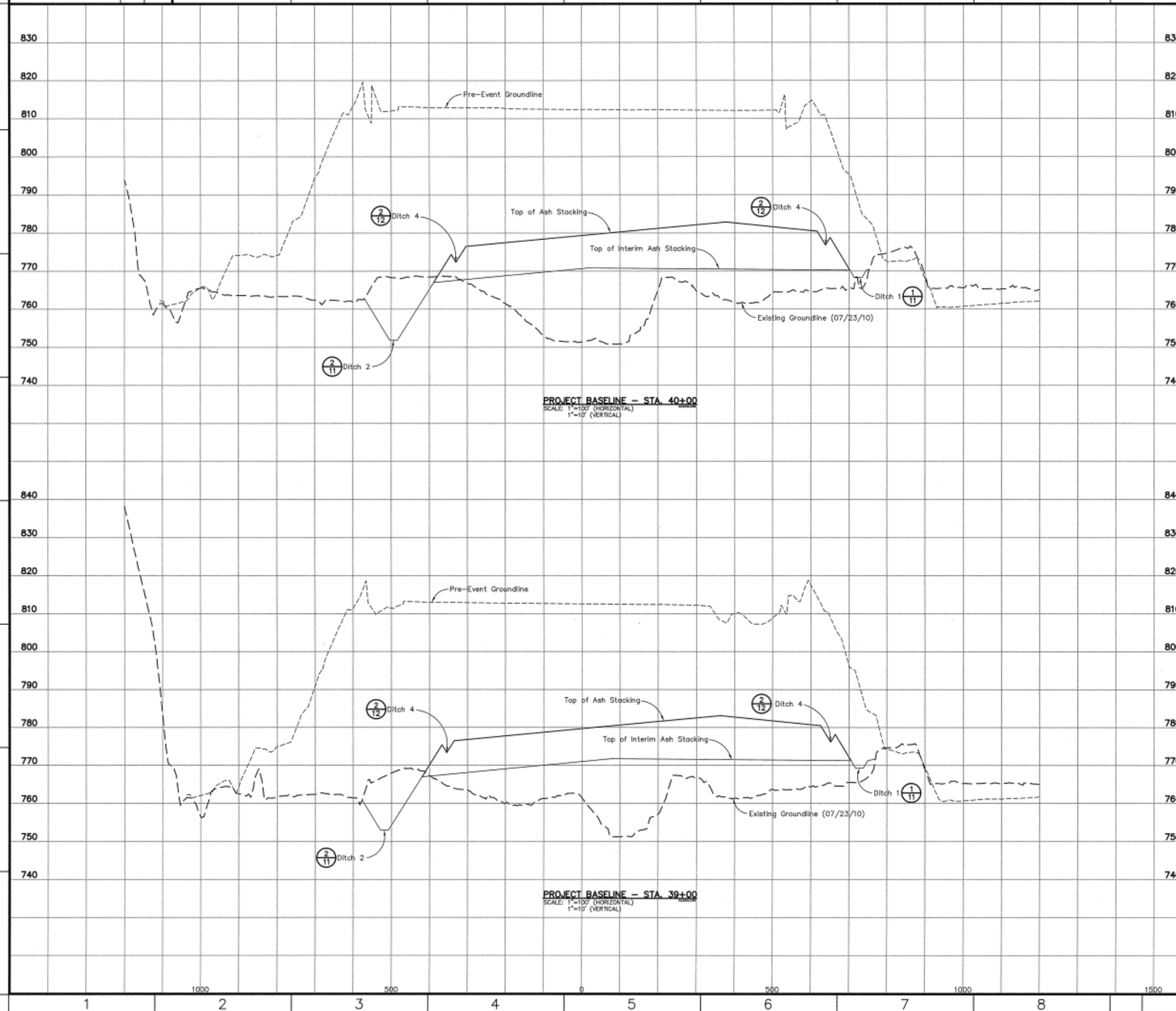
TASK COMPLETED BY:	REV NO.



PROJECT BASELINE – STA. 40+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

PROJECT BASELINE – STA. 39+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX00000020100001

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	PMMD	APPR	ISSD	PROJECT ID	AS CONST
R 0	01/07/11	KDL	DMG	DEH	MJS	--	MST	JCK	-	-

ISSUED FOR CONSTRUCTION

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING
CROSS SECTIONS
RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	-	M.S. TURNSON	J.C. KAMMEYER

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TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 01/07/11 | 36 | C | 10W216-21 | R 0

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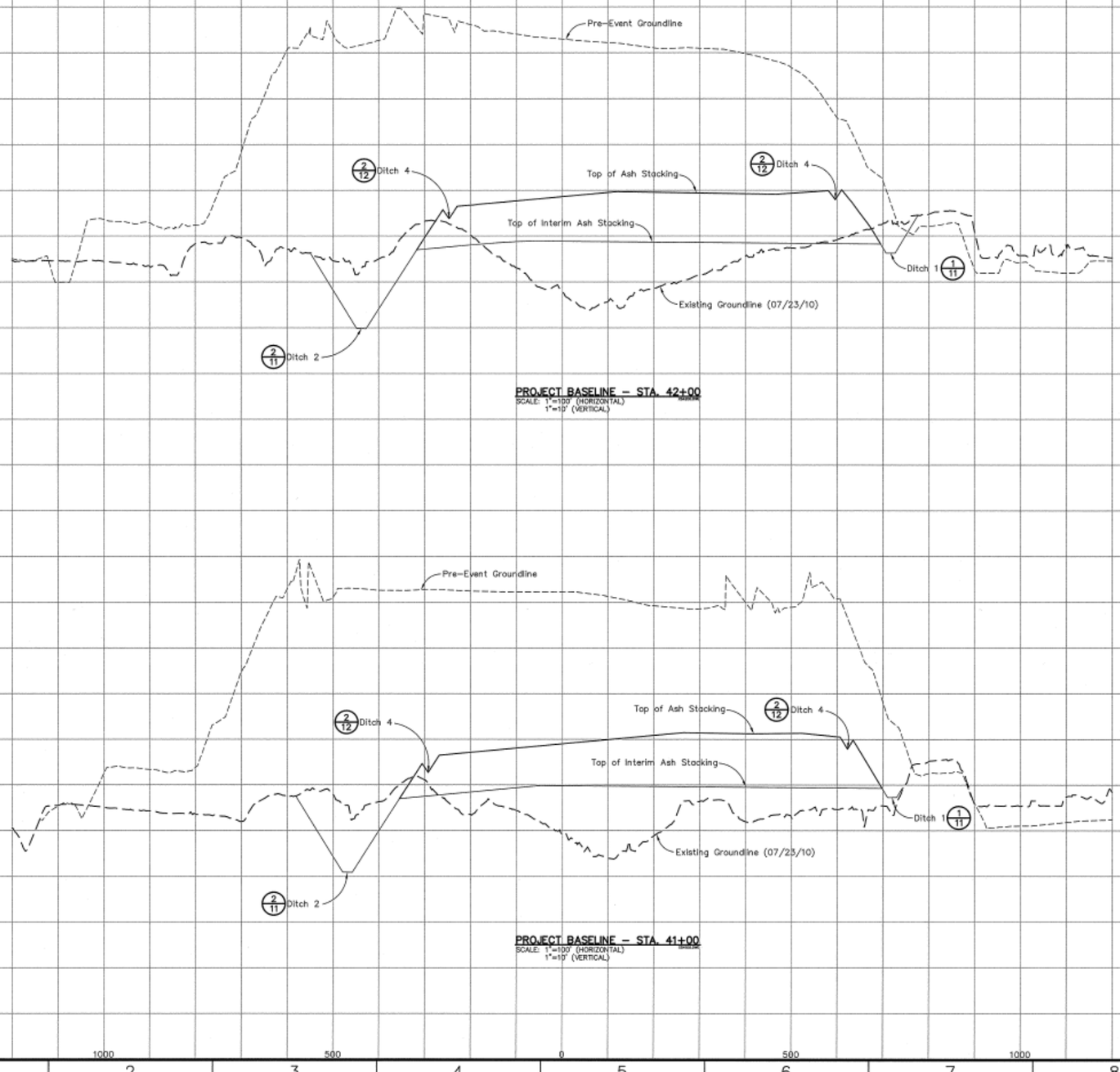
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



PROJECT BASELINE – STA. 42+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

PROJECT BASELINE – STA. 41+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

ISSUED FOR CONSTRUCTION

PLOT DATE: 01/07/2011 - USER: RDMS, PJ
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For Supporting Design Calculations see FPGKIFFESCDX000000020100001

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ENGR	AS CONST
R 0	01/07/11	KDL	ACC	DEH	MJS	–	MST	JCK	–	–
	ISSUED FOR CONSTRUCTION									

DISCIPLINE INTERFACE

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING CROSS SECTIONS RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. KAMMEYER

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TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 01/07/11	36	C	10W216-22	R 0

PLOT FACTOR:10
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C.A.D. DRAWING
DO NOT ALTER MANUALLY

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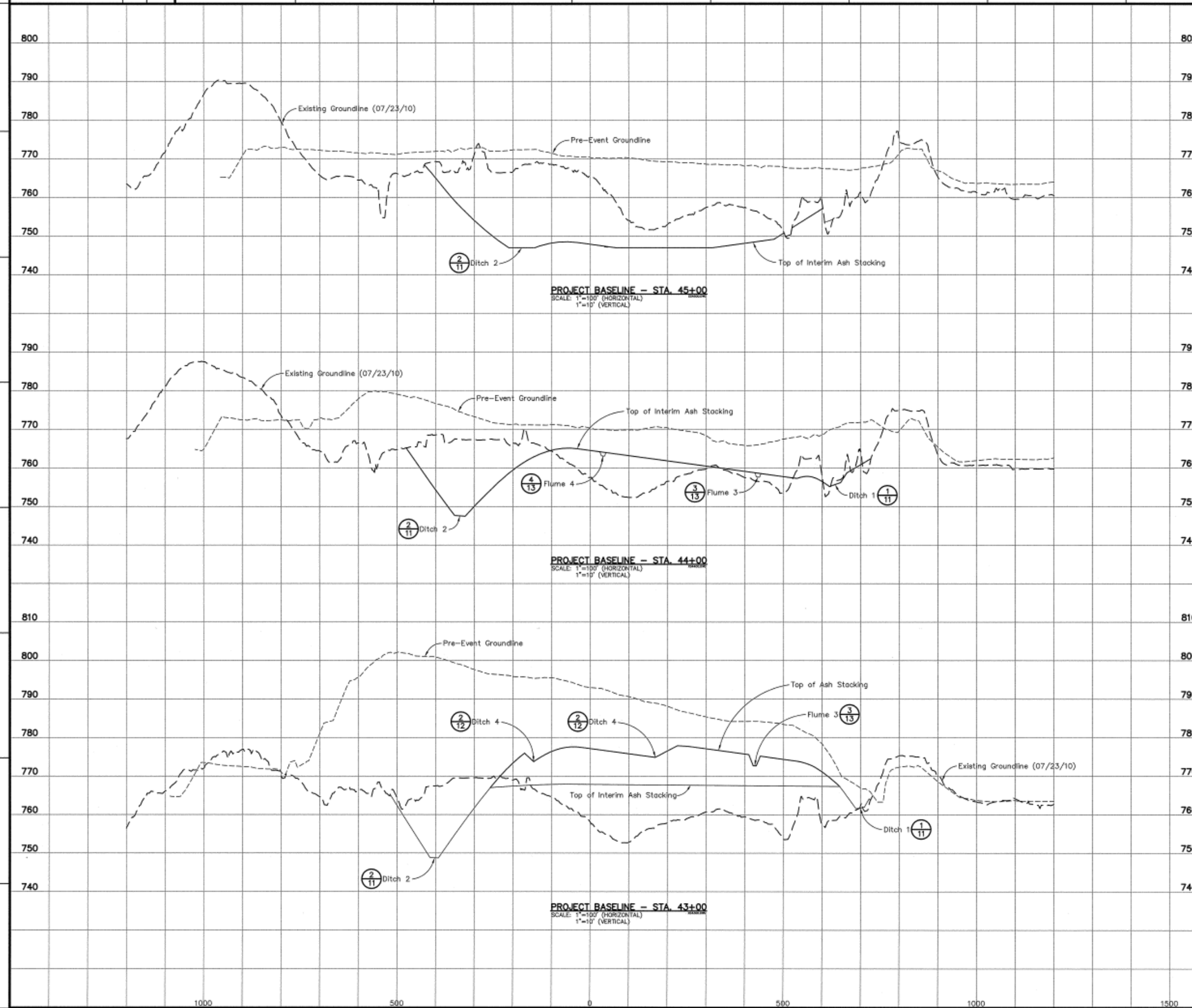
TASK COMPLETED BY:	REV NO.



PROJECT BASELINE – STA. 45+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

PROJECT BASELINE – STA. 44+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

PROJECT BASELINE – STA. 43+00
SCALE: 1"=100' (HORIZONTAL)
1"=10' (VERTICAL)

Section or Detail No.
Sheet Where Shown

REFERENCE KEY

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX00000020100001

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT QC	AS CONST
R 0	01/07/11	KDL	DMG	DEH	MJS	–	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING
CROSS SECTIONS
RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. KAMMEYER

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AUTOCAD R 2000	DATE 01/07/11	36	C	10W216-23	R 0

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT DATE: 01/07/2011 USER: BSNO, PJ
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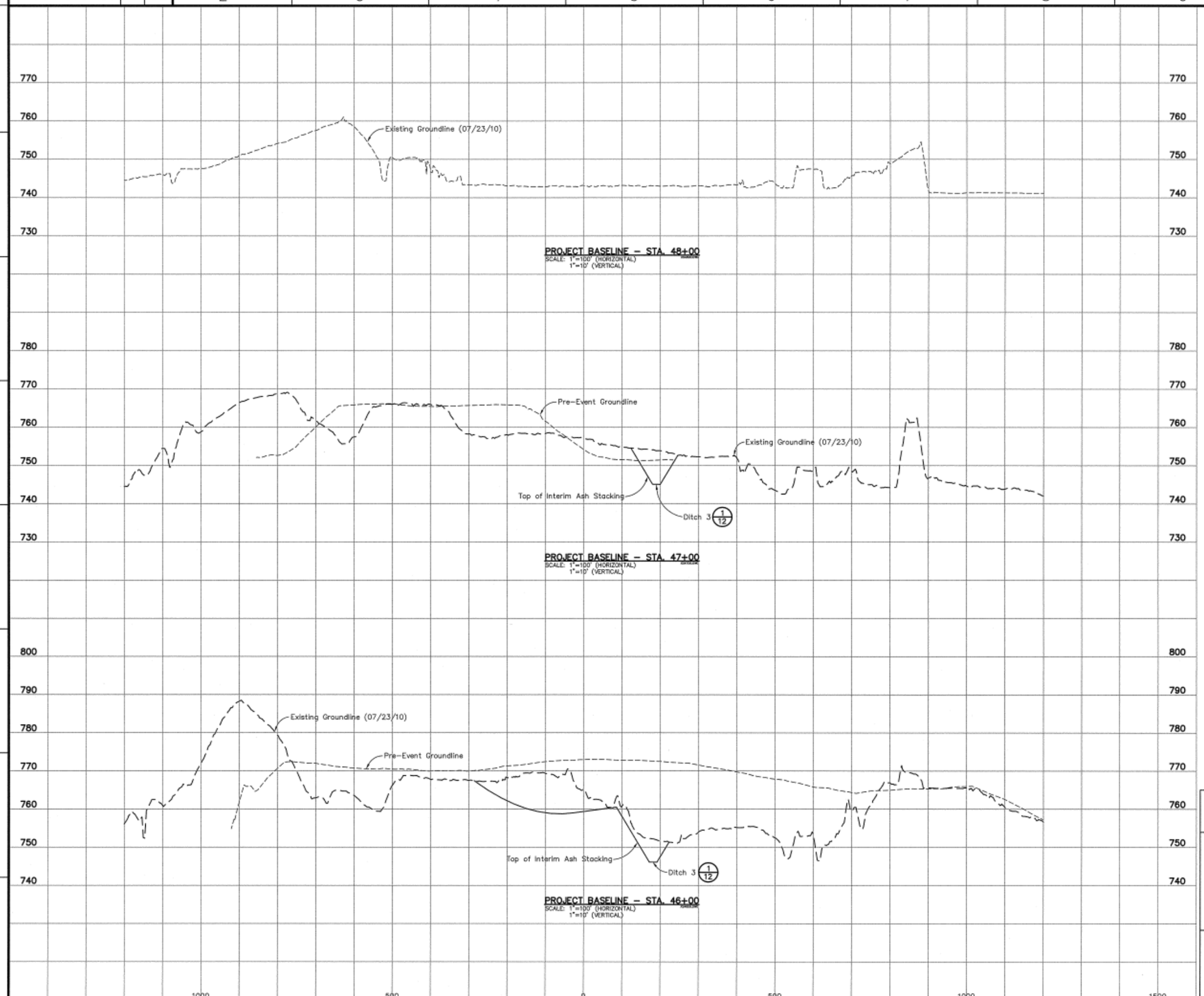

Section or Detail No.

Sheet Where Shown

REFERENCE KEY

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX00000020100001

REV NO.	DATE	DSGN	DWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R –	–	–	–	–	–	–	–	–	–	–
R 0	01/07/11 ISSUED FOR CONSTRUCTION	KDL	DMG	DEH	MJS	–	MST	JCK	–	–

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING CROSS SECTIONS RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. KAMMEYER

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AUTOCAD R 2000	DATE 01/07/11	36	C	10W216-24	R 0

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT DATE: 01/07/2011 - USER: KDL
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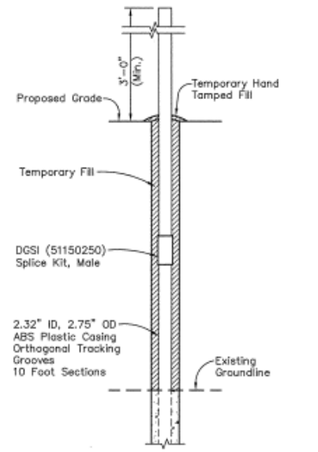
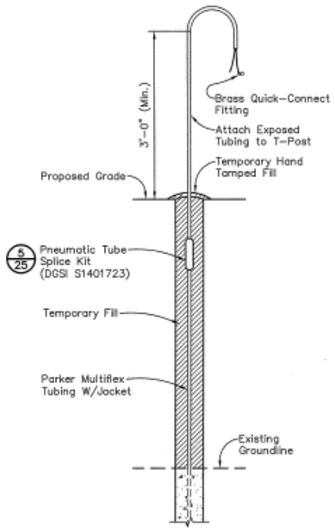
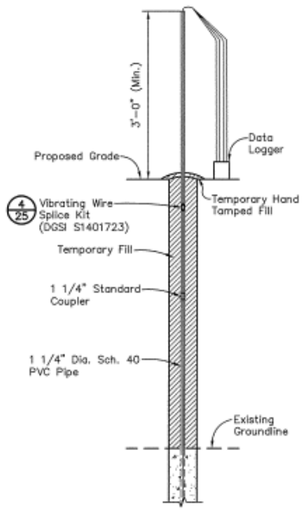


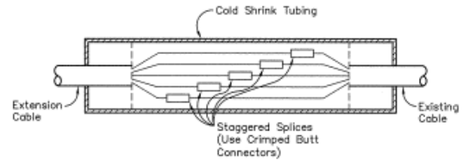
1/25 DETAIL – SLOPE INCLINOMETER EXTENSION
SCALE: 1"=1'-0"



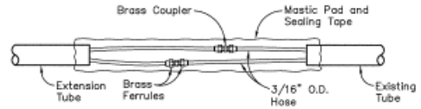
2/25 DETAIL – PNEUMATIC PIEZOMETER EXTENSION
SCALE: 1"=1'-0"



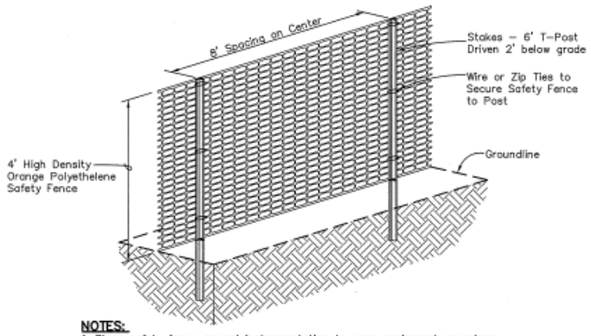
3/25 DETAIL – VIBRATING WIRE PIEZOMETER EXTENSION
SCALE: 1"=1'-0"



4/25 DETAIL – VIBRATING WIRE SPLICE KIT
NOT TO SCALE



5/25 DETAIL – PNEUMATIC TUBE SPLICE KIT
NOT TO SCALE

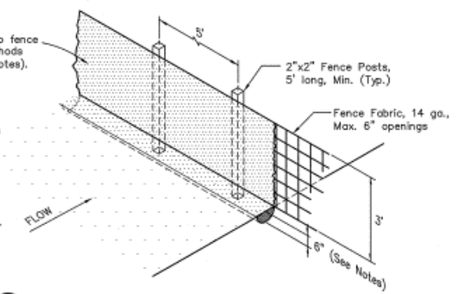


NOTES:
1. Place safety fence around instrumentation to warn equipment operators. Move fence as instruments are extended.
2. Attach safety fence to T-Posts in accordance with the manufacturer's recommendations.
3. Use warning signs as appropriate.
4. Remove fence at project completion and dispose of in a legal manner.

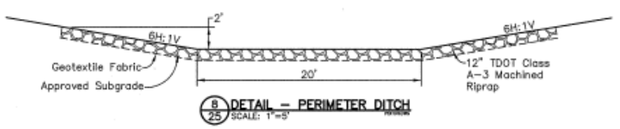
6/25 DETAIL – SAFETY FENCE
NOT TO SCALE

Geotextile Fabric shall be attached to fence using staples, hogrings or other methods approved by the QC Manager (See Notes).

NOTES:
1. The bottom 12 inches of the fabric shall be buried in a 6-inch trench cut into the ground or covered by 6 inches of fill material to prevent sediment from escaping under the fence. All earthwork shall be on the upstream side of the fence.
2. Geotextile fabric shall meet the following specifications: Grab strength (ASTM D 4632) – 90 lbs. Min., Width – 4' Min., Apparent opening size (ASTM D4751) No. 20. Ultraviolet degradation (ASTM D 4355) 70% strength retained. Elongation at 45lb (ASTM D 4632).



7/25 DETAIL – SILT FENCE
NOT TO SCALE



8/25 DETAIL – PERIMETER DITCH
SCALE: 1"=5'

ISSUED FOR CONSTRUCTION

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

For Supporting Design Calculations see FPGKIFFESCDX00000020100001

REV. NO.	DATE	DESIGN	DRAWN	CHKD	SUPV	RVWD	APPD	ISSUED	PROJECT ID	AS CONST
R 0	01/07/11	KDL	DMG	DEH	MJS	–	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING DETAILS RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. KAMMEYER

Stantec Consulting Services Inc.
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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

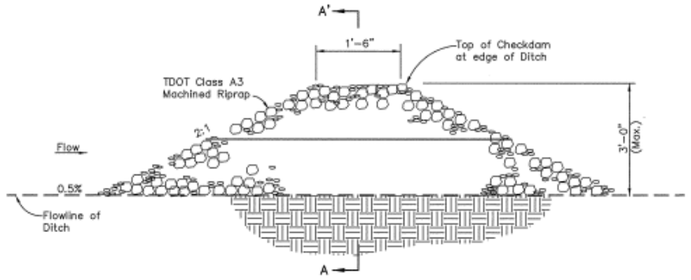
AUTOCAD R 2000 | DATE 01/07/11 | 36 | C | 10W216-25 | R 0

PLOT FACTOR:1
W_TVA

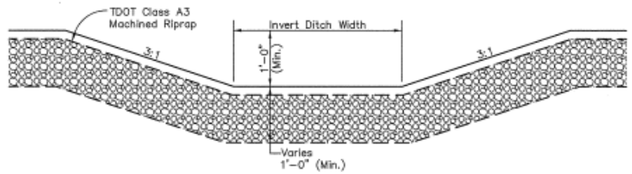
C.A.D. DRAWING DO NOT ALTER MANUALLY

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT DATE: 01/07/2011 - 10:08:16 AM
G:\CAD\CIVIL\KINGSTON\FGD\DRAWINGS\FINAL DESIGN_CELL\W10X216-25-R0.DWG

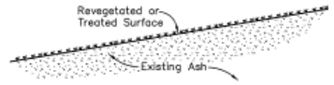


ELEVATION



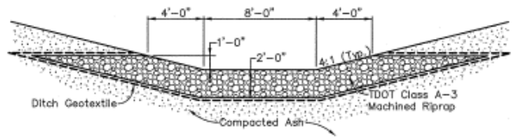
SECTION A-A'

1/26 DETAIL – ROCK SILT CHECK
SCALE: 1"=1'-0"

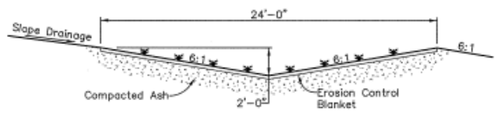


NOTES:
1. For short term and medium term requirements, see Project Specification Section 02936.
2. The long term cover shall be performed in accordance with specified requirements in Section 02936 or approved equivalent.

2/26 DETAIL – TOP OF ASH FILL COVER
NOT TO SCALE



3/26 DETAIL – TEMPORARY FLUME
SCALE: 1/4"=1'-0"



4/26 DETAIL – TEMPORARY DITCH
SCALE: 1/4"=1'-0"

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

ISSUED FOR CONSTRUCTION

For Supporting Design Calculations see FPGKIFFESCDX000000020100001

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	KVMD	APPD	SSSD	PROJECT ED	AS CONST
R 0	01/07/11	KDL	DMG	DEH	MJS	–	MST	JCK	–	–

ISSUED FOR CONSTRUCTION

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
NORTH AND CENTRAL DREDGE CELL (CELLS 2 AND 3)

ASH STACKING DETAILS RDP-0113D-R0

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
K.D. LINDQUIST	D.M. GRAHAM	D.E. HERRON	M.J. STEELE	–	M.S. TURNBOW	J.C. KAMMEYER

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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 01/07/11	36	C	10W216-26	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

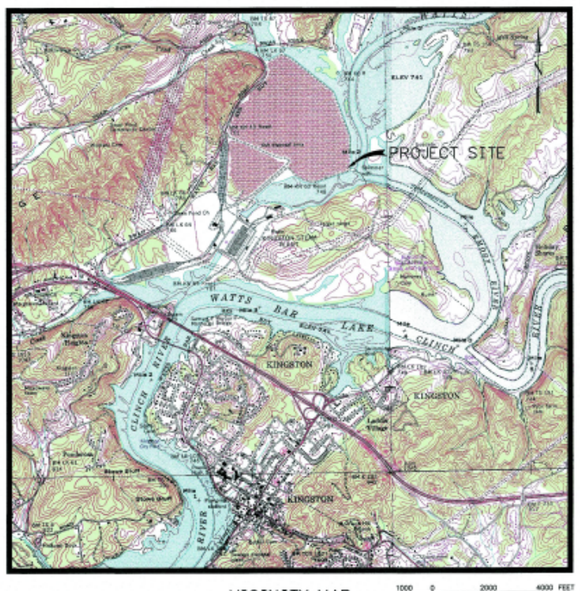
PLANS FOR CONSTRUCTION

DIKE C BUTTRESS
STAGE 1 - SEGMENT 'B'
WORK PLAN 3 (KIF-110316-WP-3)
KINGSTON FOSSIL PLANT

HARRIMAN, ROANE COUNTY, TENNESSEE

PREPARED FOR

TENNESSEE VALLEY AUTHORITY



VICINITY MAP

1000 0 2000 4000 FEET
GRAPHIC SCALE

PREPARED BY

Stantec

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INDEX OF SHEETS

10W229-67	COVER SHEET
10W229-68	GENERAL NOTES (NOT INCLUDED, SUBMITTED REVISION 0, 03/16/11.)
10W229-69	EXISTING CONDITIONS (BASELINE LAYOUT)
10W229-70	PROJECT SETTING
10W229-71	SEGMENT 'B' - GRADING PLAN
10W229-72 - 10W229-77	SEGMENT 'B' - CROSS SECTIONS
10W229-78 - 10W229-79	SEGMENT 'B' - CROSS SECTIONS
10W229-80	TYPICAL SECTIONS AND DETAILS

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX00000020090020

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 1	05/25/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
REVISION NO. 1										
R 0	03/16/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS
STAGE 1 CONSTRUCTION
COVER SHEET
WORK PLAN 3 (KIF-110316-WP-3)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. CRILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE: 03/16/11	36	C	10W229-67	R 1

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STANTEC	1
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

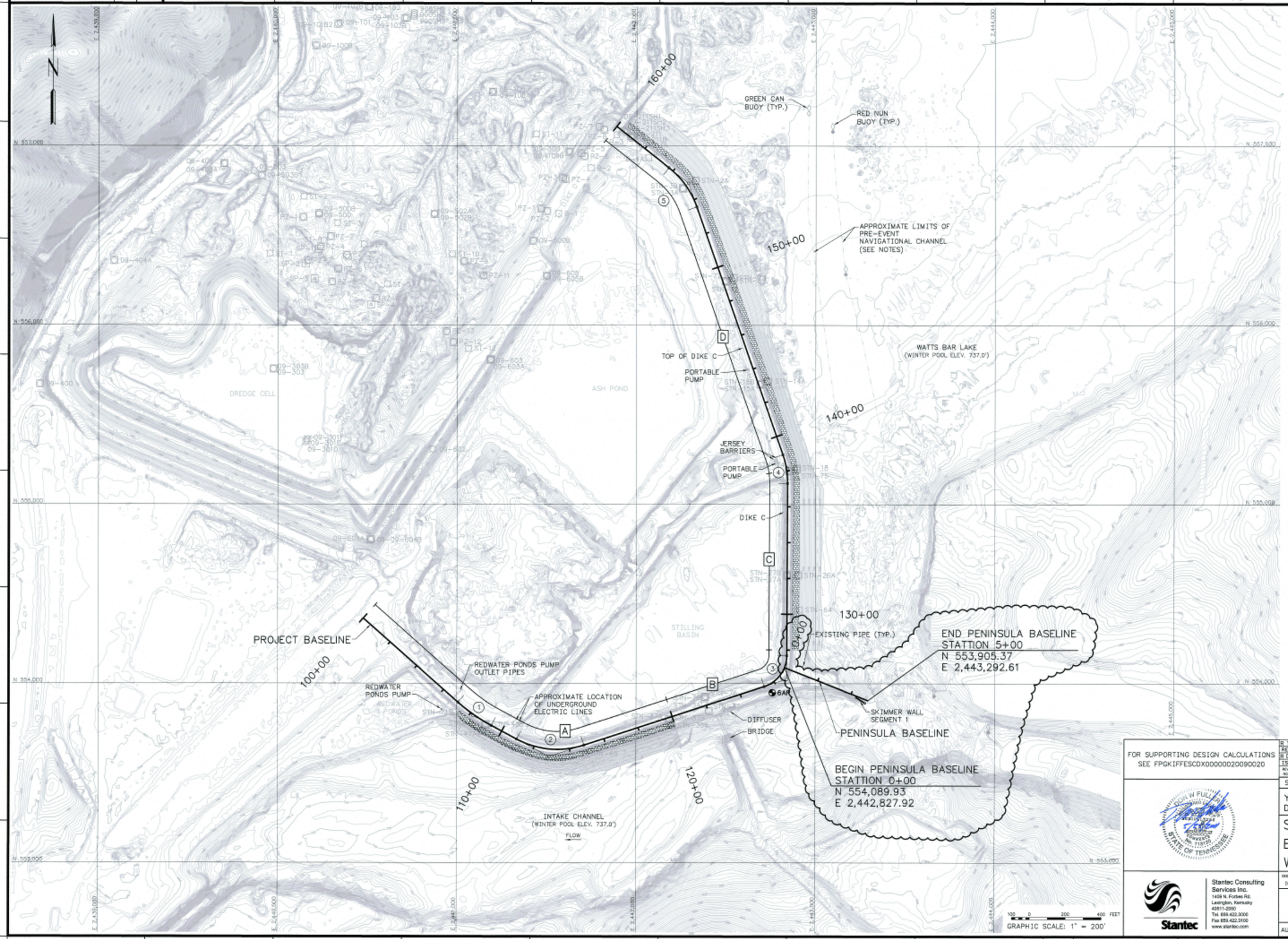

TABLE OF BASELINE COORDINATES

PROJECT BASELINE	STATION	NORTHING	EASTING
BEGIN	100+00.00	554,363.86	2,440,477.77
END	160+00.00	557,109.43	2,441,888.38

BASELINE CURVE DATA

① P.I. STA. = 108+20.74
NORTHING = 553,819.18
EASTING = 2,441,091.71
Δ = 13°20'06"
R = 974.68'
T = 113.94'
L = 226.85'
E = 6.64'
P.C. STA. = 107+06.80
P.T. STA. = 109+33.65

② P.I. STA. = 112+99.93
NORTHING = 553,591.92
EASTING = 2,441,514.77
Δ = 46°19'10"
R = 479.84'
T = 205.26'
L = 387.92'
E = 42.06'
P.C. STA. = 110+94.67
P.T. STA. = 114+82.59

③ P.I. STA. = 126+71.85
NORTHING = 554,024.61
EASTING = 2,442,840.47
Δ = 71°45'50"
R = 182.94'
T = 132.33'
L = 229.13'
E = 42.85'
P.C. STA. = 125+39.52
P.T. STA. = 127+68.65

④ P.I. STA. = 138+12.12
NORTHING = 555,200.41
EASTING = 2,442,843.77
Δ = 19°21'32"
R = 479.84'
T = 81.84'
L = 162.13'
E = 6.93'
P.C. STA. = 137+30.28
P.T. STA. = 138+92.41

⑤ P.I. STA. = 154+96.30
NORTHING = 556,792.40
EASTING = 2,442,289.43
Δ = 32°28'34"
R = 479.84'
T = 139.75'
L = 271.88'
E = 19.94'
P.C. STA. = 153+56.55
P.T. STA. = 156+28.53

SEGMENT STATIONS

SEGMENT 'A' – STA. 100+00.0 TO STA. 120+00.0
SEGMENT 'B' – STA. 120+00.0 TO STA. 128+00.0
SEGMENT 'C' – STA. 128+00.0 TO STA. 138+00.0
SEGMENT 'D' – STA. 138+00.0 TO STA. 160+00.0

LEGEND

STN-1 ○ SLOPE INCLINOMETER
STN-2 □ PIEZOMETER
STN-3 ⊙ SETTLEMENT PLATFORM

SURVEY CONTROL NOTE:

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

NOTES:

1. TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON APRIL, 2009 BY TUCK MAPPING SOLUTIONS, INC.
2. THE HYDROGRAPHIC CONTOURS SHOWN HERE WERE PROVIDED BY TVA.
3. THE NAVIGATIONAL CHANNEL LIMITS SHOWN WERE PROVIDED BY TVA USING U.S. ARMY CORPS OF ENGINEERS NASHVILLE DISTRICT DATA AND WAS REVIEWED BY THE U.S. COAST GUARD FOR ITS APPROXIMATE LOCATION. THE LOCATION SHOWN IS PRE-EVENT AND IS SUBJECT TO CHANGE WHEN CLEAN-UP OPERATIONS ARE COMPLETED.
4. SEGMENTS A,C & D AS DEPICTED REPRESENTS THE PROPOSED DESIGN; NOT AN AS-BUILT CONFIGURATION.
5. 6AR IS AN ENVIRONMENTAL MONITORING WELL INSTALLED AND MAINTAINED BY TVA ENVIRONMENTAL GROUP. SPECIFICATIONS FOR IT'S EXTENSION SHOULD BE OBTAINED BY TVA.

ISSUED FOR CONSTRUCTION

PLOT DATE: 05/24/2011 USER: DJDIXON DGN: V:\FSK\ACTIVE\10W229\DGN\DRAWINGS\10W229WP3FIG1_FC10W229-69-R1.DWG

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX000000020090020

REVISION NO.	DATE	DSGN	DRWN	CHKD	SUPV	PWRD	APVD	ISSD	PROJECT ID	AS CONST
R 1	05/25/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
R 0	03/16/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: 1"=200' EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION EXISTING CONDITIONS WORK PLAN 3 (KIF-110316-WP-3)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. CRILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMERER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 03/16/11	36	C	10W229-69	R 1

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Fax: 859.422.3100
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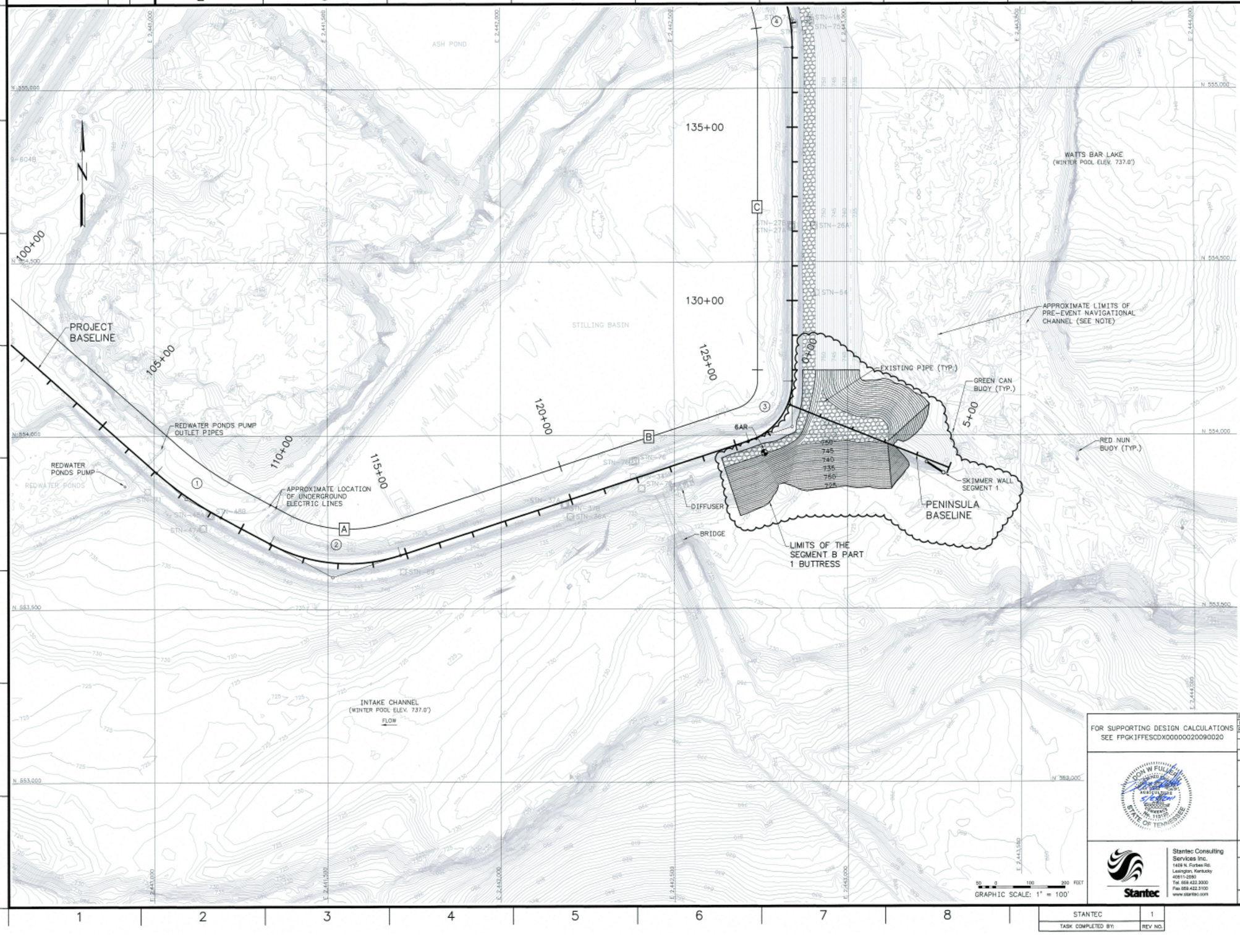
STANTEC | 1
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 200 W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY


ASH POND
STILLING BASIN
WATTS BAR LAKE
(WINTER POOL ELEV. 737.0')
100+00
105+00
110+00
115+00
120+00
125+00
130+00
135+00
PROJECT BASELINE
REDWATER PONDS PUMP OUTLET PIPES
REDWATER PONDS PUMP
REDWATER PONDS
APPROXIMATE LOCATION OF UNDERGROUND ELECTRIC LINES
INTAKE CHANNEL
(WINTER POOL ELEV. 737.0')
FLOW
APPROXIMATE LIMITS OF PRE-EVENT NAVIGATIONAL CHANNEL (SEE NOTE)
EXISTING PIPE (TYP.)
GREEN CAN BUOY (TYP.)
RED NUN BUOY (TYP.)
5+00
6AR
SKIMMER WALL SEGMENT 1
PENINSULA BASELINE
DIFFUSER
BRIDGE
LIMITS OF THE SEGMENT B PART 1 BUTTRESS
STN-1
STN-2
STN-3
STN-4
STN-5
STN-6
STN-7
STN-8
STN-9
STN-10
STN-11
STN-12
STN-13
STN-14
STN-15
STN-16
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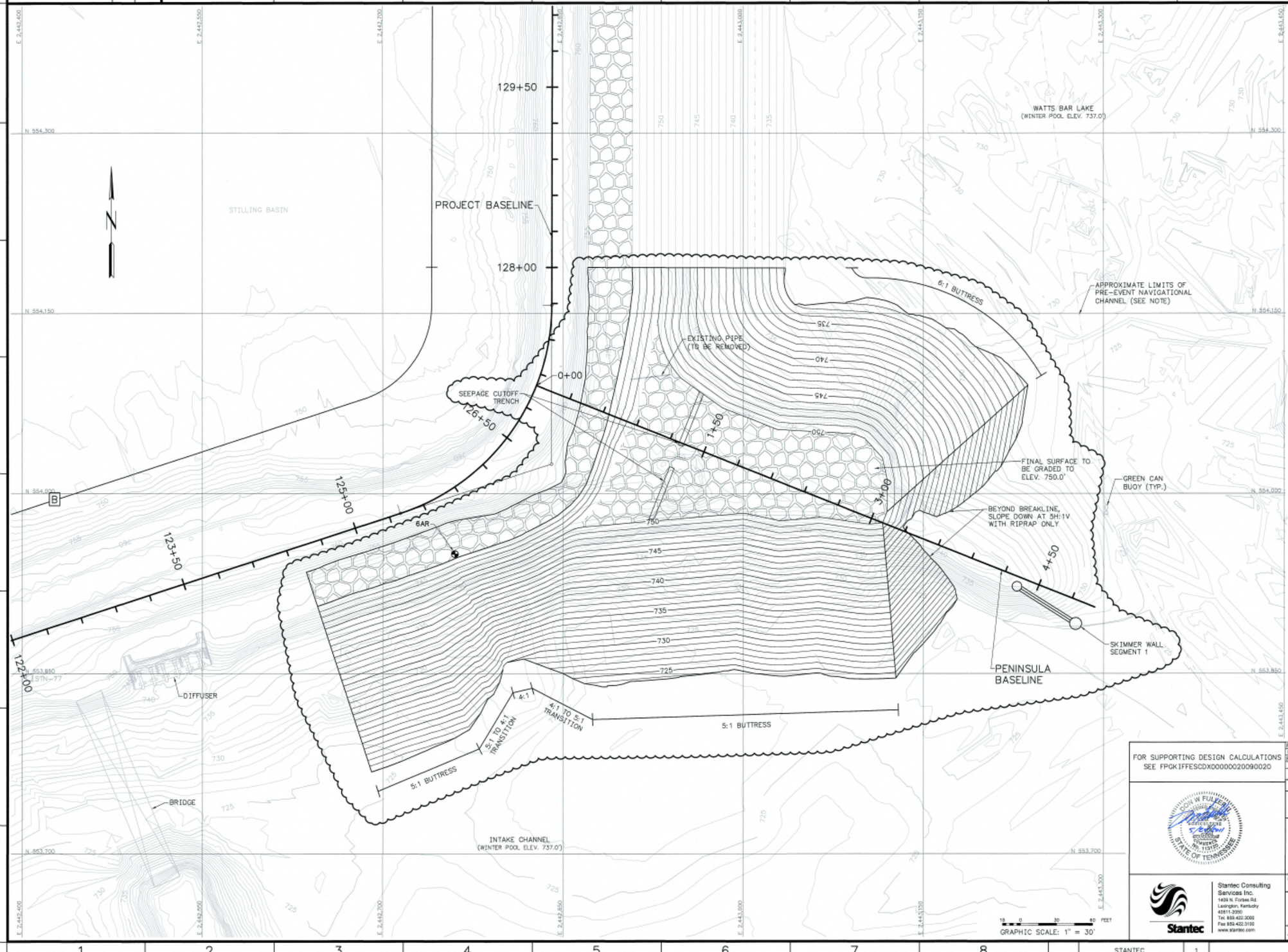
STN-39
STN-40



SEGMENT STATIONS

SEGMENT 'A' – STA. 100+00.0 TO STA. 120+00.0
SEGMENT 'B' – STA. 120+00.0 TO STA. 128+00.0
SEGMENT 'C' – STA. 128+00.0 TO STA. 138+00.0
SEGMENT 'D' – STA. 138+00.0 TO STA. 160+00.0

LEGEND

STN-1 SLOPE INCLINOMETER
STN-2 PIEZOMETER
STN-3 SETTLEMENT PLATFORM

SURVEY CONTROL NOTE:

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

NOTES:

1. TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON APRIL, 2009 BY TUCK MAPPING SOLUTIONS, INC.
2. THE HYDROGRAPHIC CONTOURS SHOWN HERE WERE PROVIDED BY TVA.
3. SEE 10W299-69 FOR PROJECT BASELINE COORDINATES AND CURVE DATA.
4. THE NAVIGATIONAL CHANNEL LIMITS SHOWN WERE PROVIDED BY TVA USING U.S. ARMY CORPS OF ENGINEERS NASHVILLE DISTRICT DATA AND WAS REVIEWED BY THE U.S. COAST GUARD FOR ITS APPROXIMATE LOCATION. THE LOCATION SHOWN IS PRE-EVENT AND IS SUBJECT TO CHANGE WHEN CLEAN-UP OPERATIONS ARE COMPLETED.
5. SEGMENT C AS DEPICTED REPRESENTS THE PROPOSED DESIGN; NOT AN AS-BUILT CONFIGURATION.
6. 6AR IS AN ENVIRONMENTAL MONITORING WELL INSTALLED AND MAINTAINED BY TVA ENVIRONMENTAL GROUP. SPECIFICATIONS FOR IT'S EXTENSION SHOULD BE OBTAINED BY TVA.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX000000020090020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 1	05/25/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
REVISION NO. 1										
R 01	03/16/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: 1"=30' EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
SEGMENT 'B' – GRADING PLAN
WORK PLAN 3 (KIF-110316-WP-3)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. DRILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 03/16/11 | 36 | C | 10W229-71 | R 1

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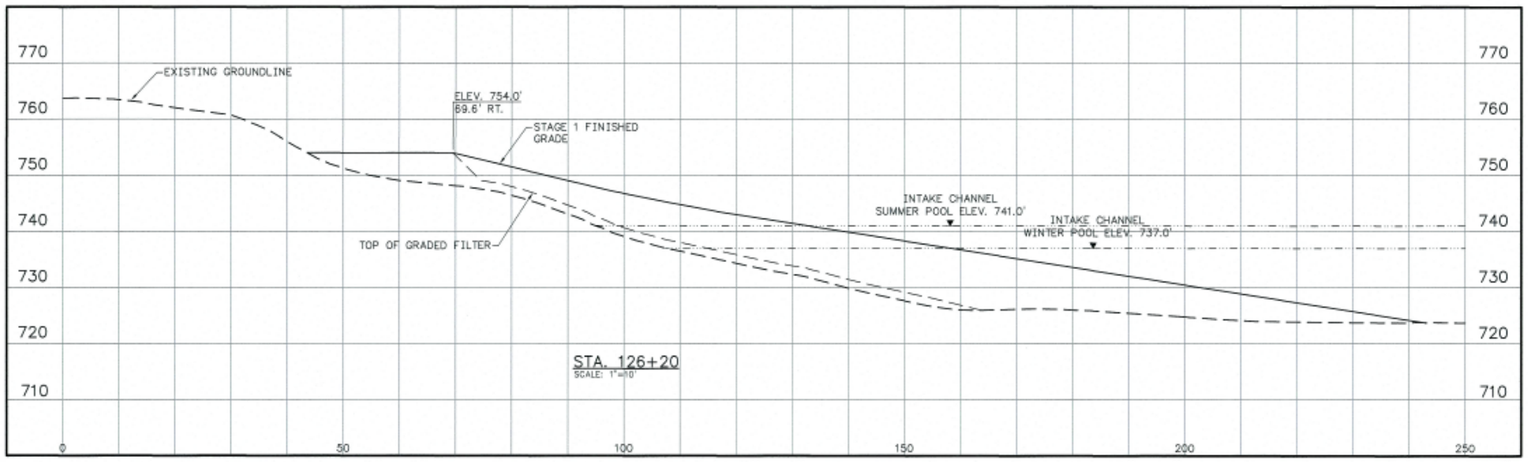
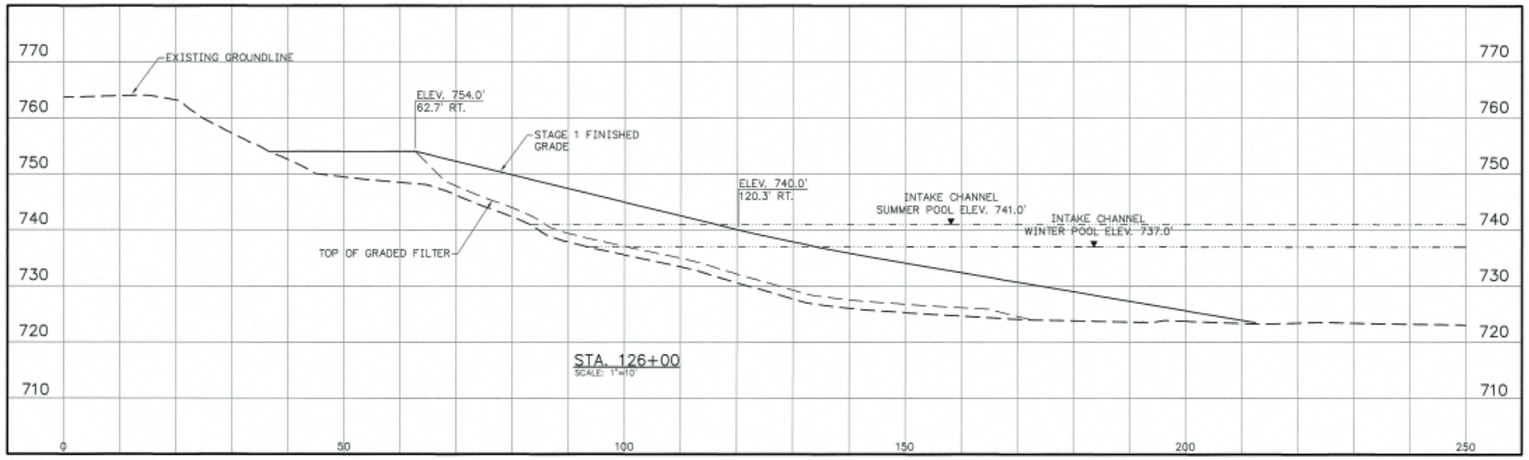
STANTEC | 1
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:30
W_TVA

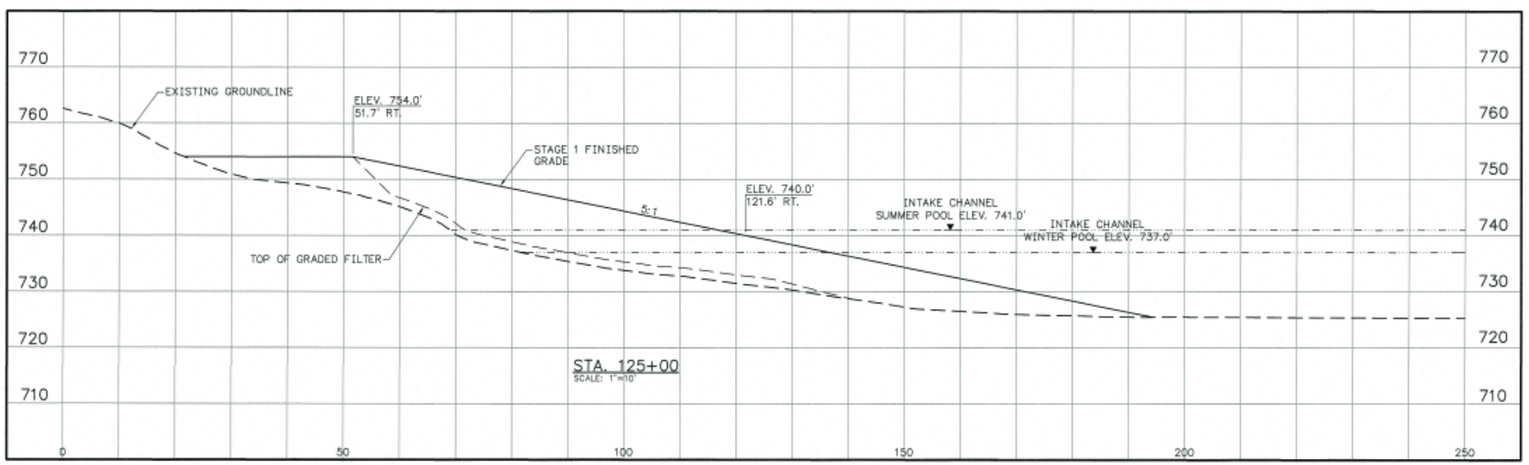
C.A.D. DRAWING
DO NOT ALTER MANUALLY



STA. 126+20
SCALE: 1"=10'



STA. 126+00
SCALE: 1"=10'



STA. 125+00
SCALE: 1"=10'

NOTE:
FOR FILTER CONFIGURATIONS SEE TYPICAL SECTIONS (10W229-80).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX00000020090020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ENGR	AS CONST	DESCRIPTIVE INITIALS
R 1	05/25/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–	–
REVISION NO. 1											
R 0	03/16/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–	–
ISSUED FOR CONSTRUCTION											

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
SEGMENT 'B' – CROSS SECTIONS
WORK PLAN 3 (KIF-110316-WP-3)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. CRILLY	D.N. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KANNEYER

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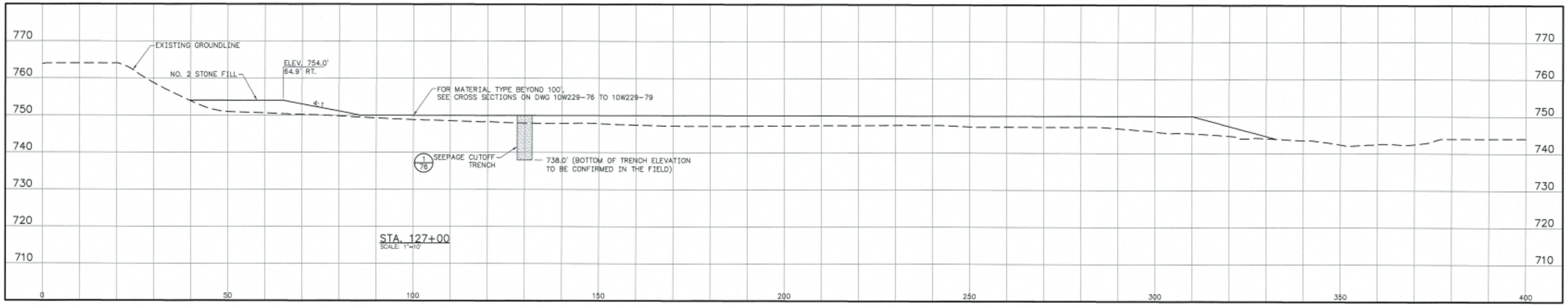
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 03/16/11	36	C	10W229-72	R 1

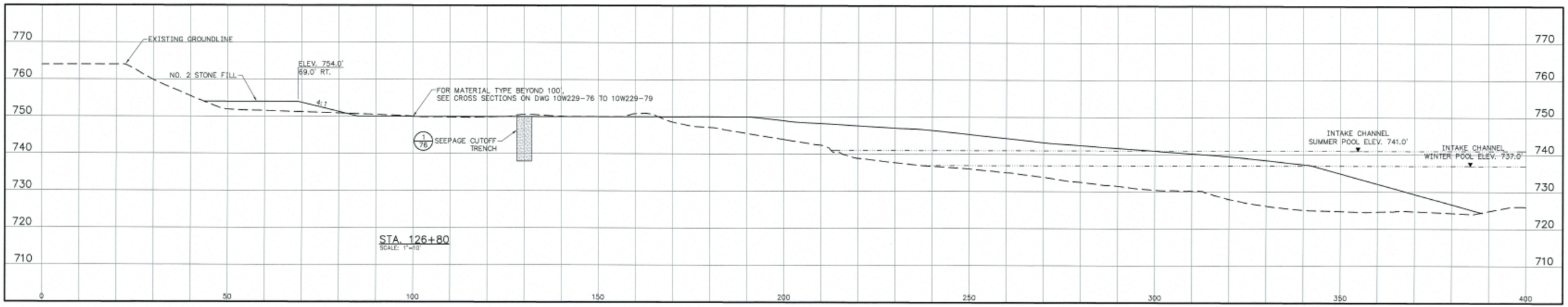
STANTEC	1
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



STA. 127+00
SCALE: 1"=10'



STA. 126+80
SCALE: 1"=10'

NOTE:
FOR FILTER CONFIGURATIONS SEE TYPICAL SECTIONS (10W229-80).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX000000020090020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 1	05/25/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
REVISION NO. 1										
R 0	03/16/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
SEGMENT 'B' – CROSS SECTIONS
WORK PLAN 3 (KIF-110316-WP-3)

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
D.W. FULLER	D.M. GRAHAM	T. O'SILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 03/16/11 | 36 | C | 10W229-73 | R 1

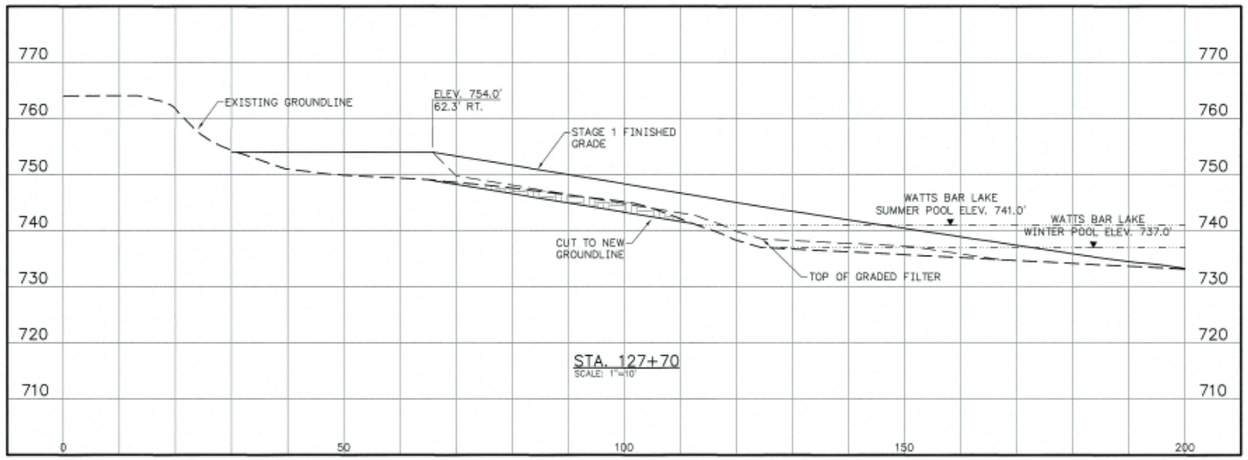
PLOT FACTOR:10
M_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
Tel. 859.422.3000
Fax 859.422.3100
www.stantec.com

STANTEC | 1
TASK COMPLETED BY: | REV NO.

PLOT DATE: 05/25/11 - 08:04 (JCK) | N:\TVA\ACAD\KIF\DRAWINGS\ENVIRONMENTAL\DRAWINGS\WP3\PDF_10W229-73_R1.DWG | XREF: ELLISON, ERIC



STA. 127+70
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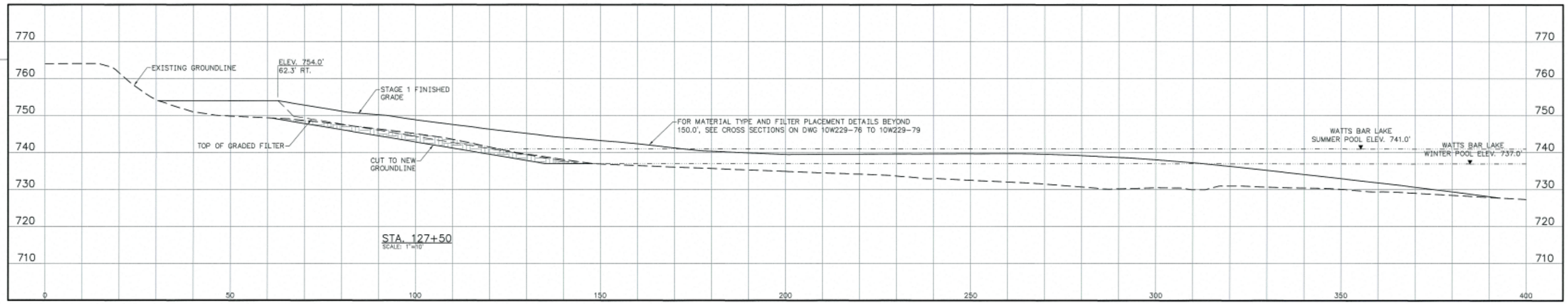

STA. 127+50
SCALE: 1"=10'

NOTE:
FOR FILTER CONFIGURATIONS SEE TYPICAL SECTIONS (10W229-80).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX000000020090020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	PMD	APVD	ISSD	PROJECT ID	AS BUILT	REV. NO.
R 1	05/25/11	DWF	DMG	TC	DWF	VJD	MST	JDK	–	–	–
R 0	03/18/11	DWF	DMG	TC	DWF	VJD	MST	JDK	–	–	–

REVISION NO. 1
ISSUED FOR CONSTRUCTION

SCALE: AS SHOWN EXCEPT AS NOTED

DON W. FULLER — REGISTERED — ENGINEER — No. 119195 — STATE OF TENNESSEE

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
SEGMENT 'B' – CROSS SECTIONS
WORK PLAN 3 (KIF-110316-WP-3)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. CRILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 03/18/11 | 36 | C | 10W229-74 | R 1

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	1
TASK COMPLETED BY:	REV NO.

PLOT DATE: 05/24/2011 10:55:51 AM, DWG
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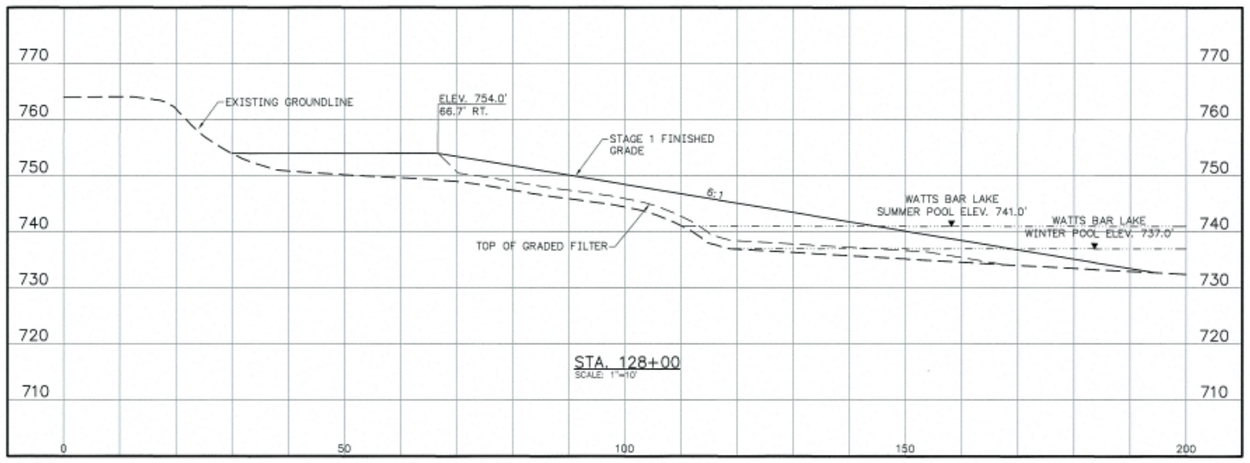

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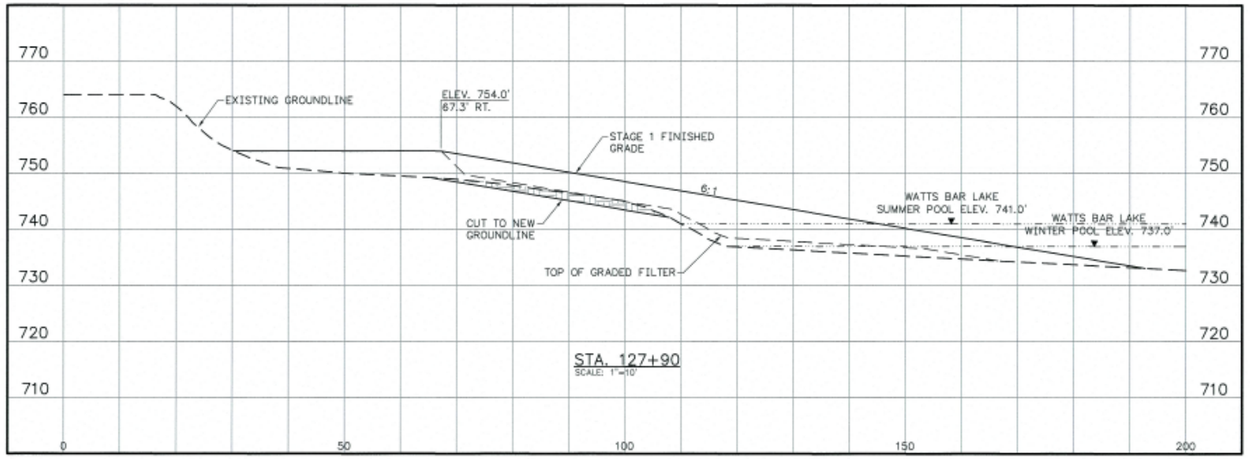

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NOTE:
FOR FILTER CONFIGURATIONS SEE TYPICAL SECTIONS (10W229-80).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX000000200900020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT MGR	AS CONST
R 1	05/25/11	DWF	DMG	TC	DWF	VJD	MST	JCK	--	--
REVISION NO. 1										
R 0	03/16/11	DWF	DMG	TC	DWF	VJD	MST	JCK	--	--
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
SEGMENT 'B' – CROSS SECTIONS
WORK PLAN 3 (KIF-110316-WP-3)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. O'REILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

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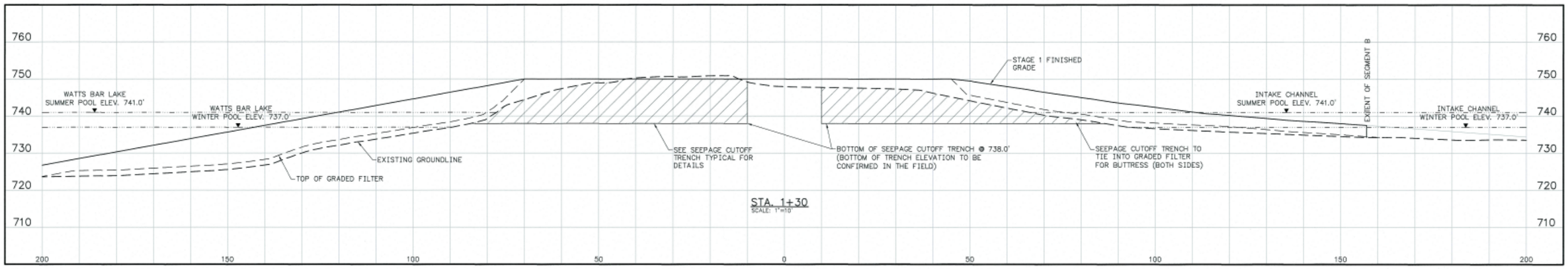
AUTOCAD R 2000	DATE 03/16/11	36	C	10W229-75	R 1

STANTEC	1
TASK COMPLETED BY:	REV. NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



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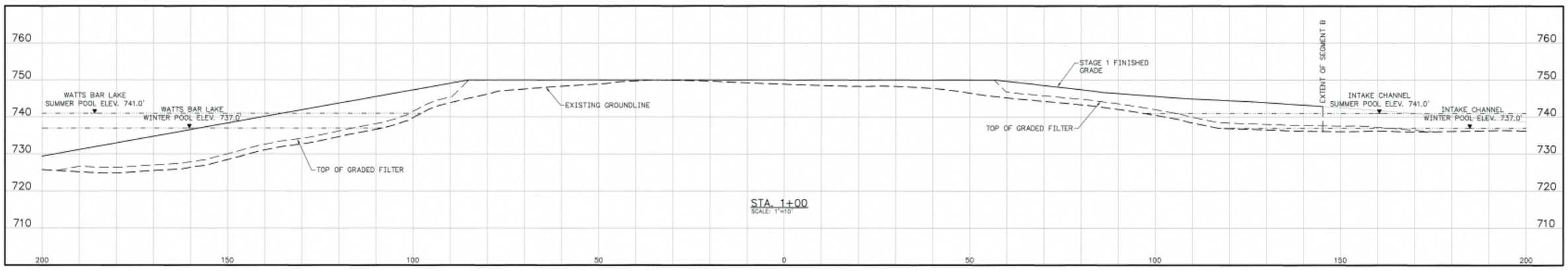

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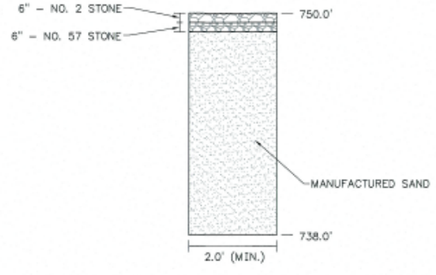

1/76 TYPICAL SEEPAGE CUTOFF TRENCH
SCALE: NOT TO SCALE

NOTE:
FOR FILTER CONFIGURATIONS SEE
TYPICAL SECTIONS (10W229–80).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS
SEE FPGKIFFESCDX000000020090020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ENGR	AS CONST
R 1	05/25/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
REVISION NO. 1										
R 0	03/16/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
PENINSULA – CROSS SECTIONS
WORK PLAN 3 (KIF–110316–WP–3)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. O'REILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

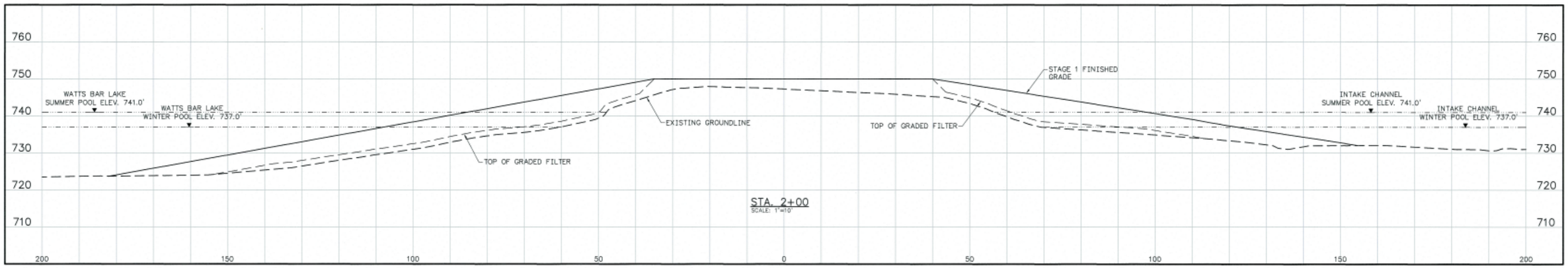
AUTOCAD R 2000	DATE 03/16/11	36	C	10W229–76	R 1

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	1
TASK COMPLETED BY:	REV NO.

PLOT DATE: 05/24/2011 USER: ELLISON, JOEL
V:\2\WORK\KIF\WP3\DRAWINGS\GA\DRAWING\10W229-76-01.DWG



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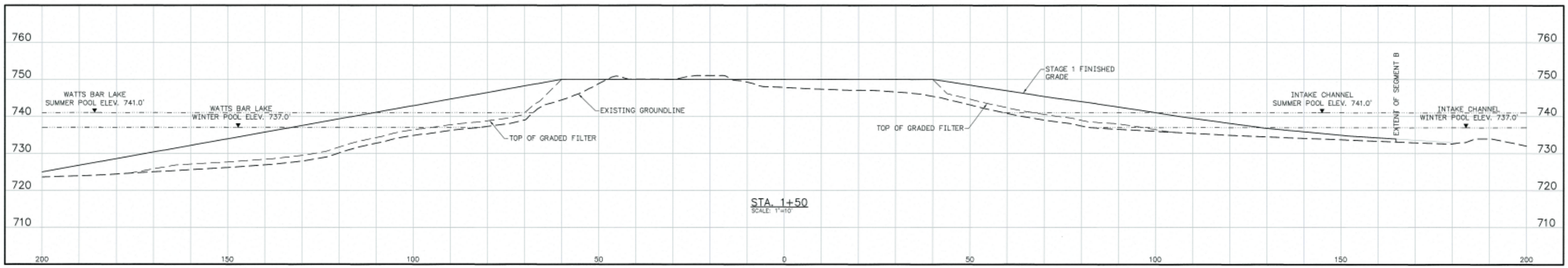

STA. 1+50
SCALE: 1"=10'

NOTE;
FOR FILTER CONFIGURATIONS SEE TYPICAL SECTIONS (10W229-80).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX00000020090020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	DVWR	APPD	ISSD	PROJECT ID	AS CONST	REV. NO.
R 1	05/25/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–	–
REVISION NO. 1											
R 0	03/16/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–	–
ISSUED FOR CONSTRUCTION											

DON W FULLER
REGISTERED ENGINEER
STATE OF TENNESSEE
No. 119135

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
PENINSULA – CROSS SECTIONS
WORK PLAN 3 (KIF-110316-WP-3)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. O'REILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 03/16/11 | 36 | C | 10W229-77 | R 1

STANTEC	1
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 05/24/2011 USER: ELLISPA_000
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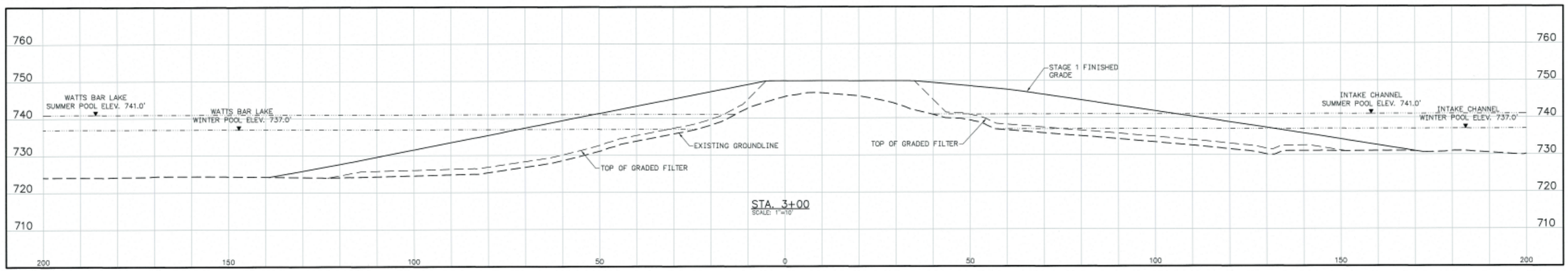

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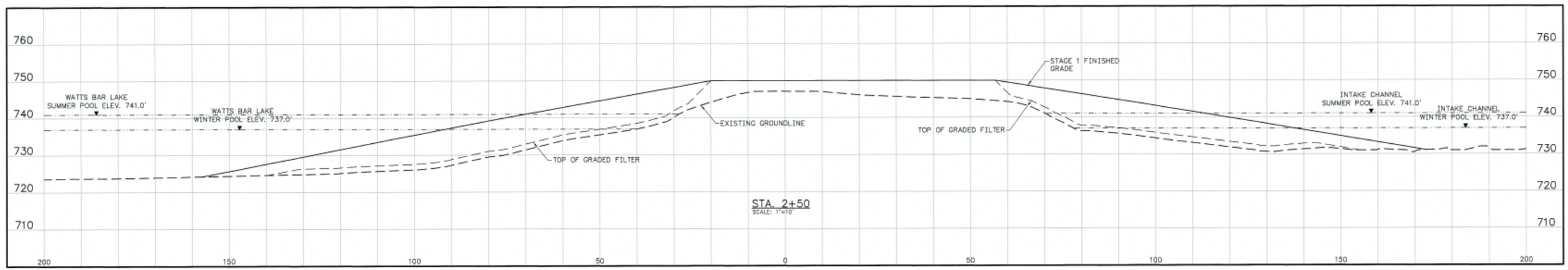
SCALE: 1"=10'



STA. 2+50
SCALE: 1"=10'

NOTE:
FOR FILTER CONFIGURATIONS SEE TYPICAL SECTIONS (10W229-80).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX00000020090020

R	–	–	–	–	–	–	–	–	–	–	–	–
–												
R 0	05/25/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–	–	–
ISSUED FOR CONSTRUCTION												

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	PWR	APPD	ISSD	PROJECT ID	AS CONST

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
PENINSULA – CROSS SECTIONS
WORK PLAN 3 (KIF-110316-WP-3)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. ORILLY	D.R. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 05/25/11 | 36 | C | 10W229-78 | R 0

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1409 N. Forbes Rd.
Lexington, Kentucky
40511-2066
Tel: 859.422.3000
Fax: 859.422.3100
www.stantec.com

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 05/24/2011 - 10:08:15, ELLISDAL, DGC
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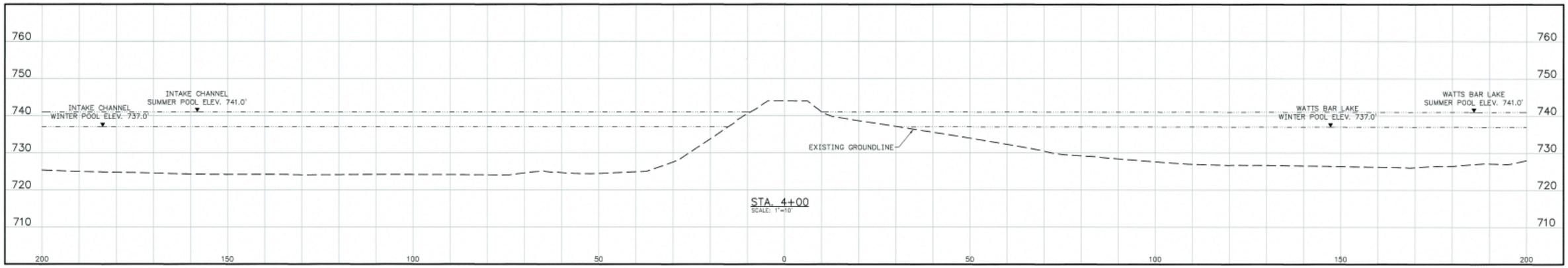

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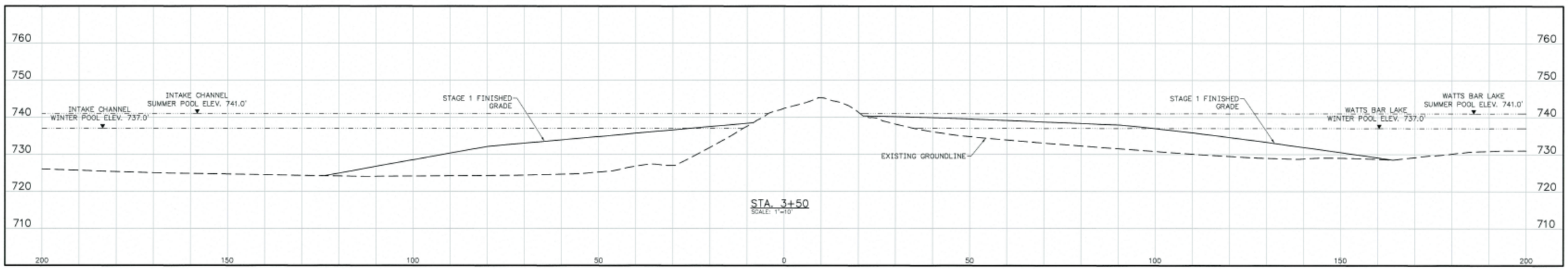

STA. 3+50
SCALE: 1"=10'

NOTE:
FOR FILTER CONFIGURATIONS SEE TYPICAL SECTIONS (10W229-80).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX00000020090020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT IS	AS CONST
R 0	05/25/11	DWF	DMG	TC	DWF	VJD	MST	JCK	--	--
	ISSUED FOR CONSTRUCTION									

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
PENINSULA – CROSS SECTIONS
WORK PLAN 3 (KIF-110316-WP-3)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. O'ELLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KANNEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 05/25/11	36	C	10W229-79	R 0

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Lexington, Kentucky
40511-2080
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Fax 859.422.3100
www.stantec.com

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 05/24/2011 USER: CLUSKA, DOC
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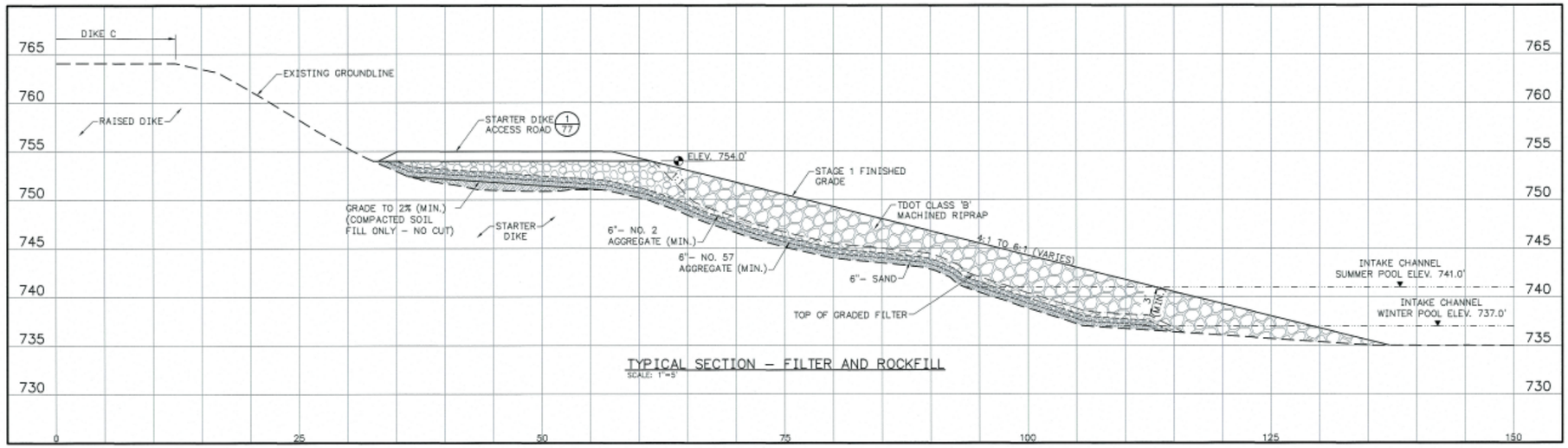
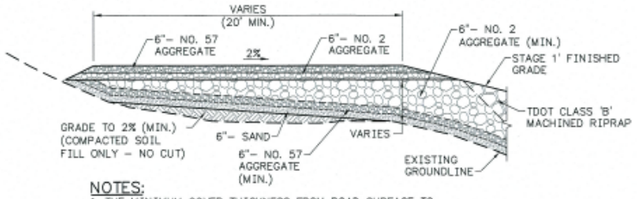


TYPICAL SECTION – FILTER AND ROCKFILL
SCALE: 1"=5'



NOTES:
1. THE MINIMUM COVER THICKNESS FROM ROAD SURFACE TO TOP OF SAND FILTER IS 36–INCHES.
2. PLACE NO. 2 AGGREGATE AND NO. 57 AGGREGATE ON RIPRAP OR NO. 2 AGGREGATE AS APPLICABLE TO FORM A REVERSE FILTER FOR ROAD SURFACE.
3. REMOVE AGGREGATE CONTAMINATED WITH ASH AS DIRECTED BY THE QC MANAGER.

(1/77) DETAIL – STARTER DIKE ACCESS ROAD
SCALE: 1/4"=1'-0"

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX0000002009002O

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	05/25/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
	ISSUED FOR CONSTRUCTION									

DON W. FULLER – REGISTERED PROFESSIONAL ENGINEER – AGRICULTURAL ENGINEER – No. 113131 – STATE OF TENNESSEE

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
TYPICAL SECTIONS AND DETAILS
WORK PLAN 3 (KIF–110316–WP–3)

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
Tel. 859.422.3000
Fax 859.422.3100
www.stantec.com

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.N. FULLER	D.M. GRAHAM	T. CRILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 05/25/11	36	C	10W229–80	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:5
M_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 05/24/2011 10:06:31, ELIZABETH_GLASGOW, DGC
N:\TVA\ACTIVE\TVAKIF00\DRAWINGS\PLANS\WP3\WP3_PCI\10W229-80-R0.DWG

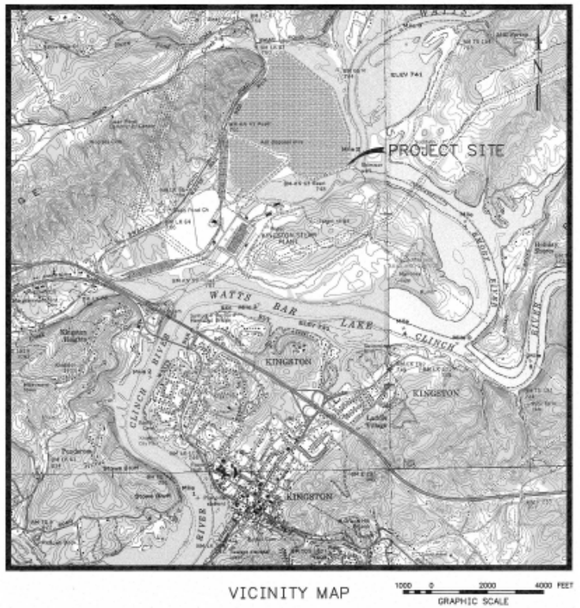
PLANS FOR CONSTRUCTION

DIKE C BUTTRESS
STAGE 1 - SEGMENT 'B'
WORK PLAN 5 (KIF-110028-WP-5)
KINGSTON FOSSIL PLANT

HARRIMAN, ROANE COUNTY, TENNESSEE

PREPARED FOR

TENNESSEE VALLEY AUTHORITY



VICINITY MAP

1000 0 2000 4000 FEET
GRAPHIC SCALE

PREPARED BY

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
Tel. 859.422.3000
Fax 859.422.3100
www.stantec.com

INDEX OF SHEETS

10W229-91	COVER SHEET
10W229-92	GENERAL NOTES
10W229-93	EXISTING CONDITIONS
10W229-94	PROJECT SETTING
10W229-95	SEGMENT 'B' - GRADING PLAN
10W229-96	SEGMENT 'B' - EROSION PROTECTION LIMITS
10W229-97 - 10W229-103	SEGMENT 'B' - CROSS SECTIONS
10W229-104	CAUSEWAY SECTION
10W229-105	TYPICAL SECTIONS AND DETAILS
10W229-106	INSTRUMENTATION EXTENSION DETAIL

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX000000020090020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	05/06/11	DWF	DMG	TC	DWF	VJD	MST	JCK	-	-
	ISSUED FOR CONSTRUCTION									

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
COVER SHEET
WORK PLAN 5 (KIF-110028-WP-5)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. DRILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 05/06/11	36	C	10W229-91	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

GENERAL NOTES

1. DEFINITIONS: WHENEVER THE FOLLOWING TERMS ARE USED IN THESE DRAWINGS, IT IS UNDERSTOOD THAT THEY REPRESENT THE FOLLOWING:

   CP: THE TENNESSEE VALLEY AUTHORITY (TVA) CIVIL PROJECTS WHICH IS RESPONSIBLE FOR CONSTRUCTION FOR THIS PROJECT (OR THEIR DESIGNEE).

   EPA: THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY WHICH IS THE REGULATORY AUTHORITY FOR THE SITE.

   ENGINEER: STANTEC CONSULTING SERVICES INC.

   OWNER: TENNESSEE VALLEY AUTHORITY (TVA) – KINGSTON FOSSIL PLANT

   TDOT: THIS MEANS THE TENNESSEE DEPARTMENT OF TRANSPORTATION AND SPECIFICALLY REFERENCES THE "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION", CURRENT EDITION. ANY MATERIAL DESIGNATED AS "TDOT" IS TO CONFORM TO THE MATERIAL STANDARDS NOTED AND PLACEMENT/INSTALLATION METHODOLOGY SPECIFIED IN THE CURRENT EDITION OF THE "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION".

   QUALITY CONTROL (QC) PLAN: REFERS TO A DOCUMENT THAT ESTABLISHES MINIMUM QUALITY CONTROL REQUIREMENTS, TESTING FREQUENCY AND QUALITY OVERSIGHT RESPONSIBILITY.

   QUALITY CONTROL (QC) MANAGER: A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF TENNESSEE THAT IS RESPONSIBLE FOR THE QUALITY OF THE CONSTRUCTED PROJECT AS DEFINED IN THE QC PLAN. THE QC TEAM CONSISTS OF QUALIFIED PERSONNEL THAT WORK UNDER THE DIRECT SUPERVISION OF THE QC MANAGER. QC TEAM PERSONNEL ARE INDIVIDUALS THAT ARE FAMILIAR WITH THE MATERIALS UTILIZED AND THE BUTTRESS CONSTRUCTION COMPONENTS.

   CONSTRUCTION MANAGER: RESPONSIBLE FOR CONSTRUCTION ACTIVITY TO INCLUDE BUT NOT BE LIMITED TO THE CHARACTER AND SEQUENCE OF WORK, COORDINATION AND SCHEDULING.

2. THE PROJECT WILL BE CONSTRUCTED IN ONE STAGE. THE STAGE SHOWN ON THESE DRAWINGS INVOLVES THE BUTTRESS CONSTRUCTION FOR THE STARTER DIKE. THE WORK IS DIVIDED INTO LINEAR SEGMENTS NOTED AS A, B, C AND D RESPECTIVELY.
3. THESE DRAWINGS ARE PRESENTED AS AN AID IN PROJECT CONSTRUCTION BUT SHOULD NOT BE CONSTRUED AS THE ONLY REFERENCE NEEDED. CP SHALL BECOME FAMILIAR WITH AND ADHERE TO THE TECHNICAL SPECIFICATIONS, THE QC PLAN AND APPLICABLE ENVIRONMENTAL AND SAFETY REGULATIONS. NO MATERIALS SHALL BE PLACED IN THE INTAKE CHANNEL UNTIL APPROVED BY THE REGULATORY AUTHORITY AND THE OWNER.
4. TOPOGRAPHIC INFORMATION SHOWN IN THE DRAWINGS IS DATED AND DOES NOT REFLECT CHANGES SINCE THE TIME OF AERIAL PHOTOGRAPHY. AREAS OF HYDROGRAPHIC SURVEYING MAY NOT REFLECT CURRENT CONDITIONS AS THE UNDERWATER SURFACE CONSTANTLY CHANGES.
5. IT SHALL BE THE CP'S RESPONSIBILITY TO VERIFY THAT ALL UNDERGROUND UTILITIES DISCOVERED DURING THE UNDERGROUND LOCATING SWEEPS ARE RELOCATED OR OTHERWISE PROTECTED IN FULL COMPLIANCE WITH ANY REQUIREMENTS OF THE PLANT–ISSUED EXCAVATION PERMIT TO THE SATISFACTION OF THE OWNER AND IN ACCORDANCE WITH TVA PROCESSES AND PROCEDURES PRIOR TO THE GROUND DISTURBING ACTIVITIES, INCLUDING THE BORROW AREAS. WHERE UTILITIES ARE SHOWN OR INDICATED ON THE DRAWINGS, THE INFORMATION GIVEN IS IN ACCORDANCE WITH THE BEST AVAILABLE INFORMATION IN THE ENGINEER'S POSSESSION, BUT IS APPROXIMATE IN NATURE. THE DATA IS NOT WARRANTED TO BE EITHER COMPLETE OR CORRECT.
6. THE CP SHALL MAKE A CONCERTED EFFORT TO PREVENT ANY DISRUPTION OF UTILITY SERVICES, AND IF ANY UNINTENDED DISRUPTION OCCURS, THE CP SHALL COORDINATE THE SAFE AND IMMEDIATE RESTORATION OF THE SERVICE. IF DISRUPTION OF ANY UTILITY SERVICES IS UNAVOIDABLE, IT SHALL BE THE RESPONSIBILITY OF CP TO NOTIFY AFFECTED UTILITY USERS AND UTILITY OWNERS 48 HOURS IN ADVANCE. THE CP SHALL ALSO MAKE EVERY EFFORT TO RESTORE SAID SERVICES BEFORE QUITTING WORK FOR THE DAY. IN THE EVENT THIS CANNOT BE DONE, THE CP SHALL PROVIDE TEMPORARY SERVICE TO THE PROPERTY OWNERS UNTIL PERMANENT SERVICE CAN BE RESTORED.
7. EXISTING GEOTECHNICAL INSTRUMENTATION IS SHOWN ON THE DRAWINGS. THE CP SHALL PROTECT THIS INSTRUMENTATION FROM DAMAGE. THIS INSTRUMENTATION SHALL BE EXTENDED UPWARD DURING THE COURSE OF THE WORK.
8. ALL ENTITIES SHALL BE RESPONSIBLE FOR HEALTH AND SAFETY OF THEIR PERSONNEL AND SHALL MEET INDUSTRY STANDARD REQUIREMENTS. ALL ENTITIES SHALL ADHERE TO TVA REQUIREMENTS FOR SAFETY AND CONSTRUCTION.
9. THE CP SHALL BE RESPONSIBLE FOR THE MAINTENANCE OF ALL ACCESS ROADS, STAGING AREAS AND STORAGE AREAS USED DURING CONSTRUCTION, AND SHALL RESTORE SAID AREAS TO THEIR ORIGINAL CONDITION, OR BETTER ONCE CONSTRUCTION IS COMPLETE UNLESS DIRECTED BY THE OWNER TO RETAIN THE AREA "AS IS".
10. THE CP SHALL CONDUCT ALL OPERATIONS IN ACCORDANCE WITH APPLICABLE ENVIRONMENTAL PERMITS, RULES, LAWS AND REGULATIONS INCLUDED BUT NOT LIMITED TO THOSE SET FORTH IN CEC 19966, 20065 OR OTHER ENVIRONMENTAL REVIEW DOCUMENTS FOR THIS PROJECT.
11. THE CP IS RESPONSIBLE FOR SITE DRAINAGE THROUGHOUT CONSTRUCTION AND SHALL INSTALL TEMPORARY DRAINAGE STRUCTURES OR PUMP WATER AS NECESSARY TO PREVENT INTERFERENCE WITH THE WORK. SUCH TEMPORARY DRAINAGE FEATURES SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF ENVIRONMENTAL PERMITS AND THE KINGSTON STORM WATER POLLUTION PREVENTION PLAN (SWPPP).
12. THE CP SHALL NOTE SEQUENCING OF OPERATIONS IDENTIFIED IN THE DRAWINGS.
13. VEGETATIVE AND ORGANIC MATERIALS SHALL BE REMOVED AS DESCRIBED IN THE SPECIFICATIONS.
14. DRAINAGE CONDITIONS SURROUNDING EXISTING FACILITIES OUTSIDE THE PROJECT LIMITS ARE NOT ADDRESSED BY THE DRAWINGS. GRADING, SHAPING AND INSTALLATION OF DRAINAGE STRUCTURES MAY BE REQUIRED TO PROMOTE POSITIVE DRAINAGE. SUCH WORK SHALL BE DIRECTED BY OTHERS.
15. MATERIALS DELIVERED FOR INCORPORATION INTO THE WORK SHALL BE TEMPORARILY STORED IN AREAS SELECTED BY THE CP AND APPROVED BY THE OWNER. NO MATERIAL IS TO BE STOCKPILED WITHIN THE FORMER DREDGE CELL FOOTPRINT WITHOUT APPROVAL OF TVA, STANTEC, OR THE QC MANAGER. MATERIALS SHALL BE STORED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.
16. THE EROSION AND SEDIMENT CONTROL MEASURES SHOWN AND AS INCLUDED WITHIN THE SPECIFICATIONS SHALL BE CONSIDERED THE MINIMUM; SUPPLEMENTAL MEASURES SHALL BE PROVIDED BY THE CP AS FIELD CONDITIONS DICTATE OR AS DIRECTED BY THE REGULATORY AUTHORITY.
17. BORROW AREAS SHALL BE GRADED AND VEGETATED IN CONFORMANCE WITH PROJECT REQUIREMENTS, SUBJECT TO ENVIRONMENTAL REGULATIONS FROM OTHER AGENCIES, AND SHALL BE PERMITTED IF REQUIRED BY REGULATION. IT SHOULD BE NOTED THAT THERE MAY BE REGULATORY RESTRICTIONS ASSOCIATED WITH CLEARING A SITE.
18. DURING CONSTRUCTION, THE CP SHALL INSPECT, CLEAN, AND MAINTAIN ALL SEDIMENT CONTROL DEVICES AND PROVIDE REPORTING AS REQUIRED BY THE SPECIFICATIONS AND REGULATIONS ON SAID ITEMS.
19. THE CP SHALL CONTROL FUGITIVE DUST EMISSIONS DURING CONSTRUCTION IN SUCH A MANNER AS TO COMPLY WITH APPLICABLE REGULATIONS. DUST CONTROL MEASURES SHALL BE SUBJECT TO APPROVAL OF THE QC MANAGER AND THE OWNER.
20. BORROW AREAS SHALL BE MAINTAINED IN SUCH A MANNER AS TO PROMOTE POSITIVE DRAINAGE, REDUCE EROSION OF SOILS AND PROVIDE STABLE EXCAVATIONS. FINAL GRADE SLOPES SHALL BE NO STEEPER THAN 3H:1V AND INTERIM SLOPE CONDITIONS SHALL NOT ABRUPTLY TERMINATE OR IMPOUND WATER.
21. DURING BORROW EXCAVATION, SATISFACTORY MATERIALS SHALL BE SEGREGATED FOR USE AS STARTER DIKE BENCH EMBANKMENT. SATISFACTORY MATERIALS ARE SOILS THAT CLASSIFY AS CL OR CH ACCORDING TO THE UNIFIED SOILS CLASSIFICATION SYSTEM. SATISFACTORY MATERIALS WHICH CONTAIN EXCESSIVE MOISTURE SHALL BE STOCKPILED, BLADED, DISKED, OR CHEMICALLY TREATED AS NECESSARY TO PERMIT ADEQUATE DRYING. CLASSIFICATION OF SOIL AS SATISFACTORY OR UNSATISFACTORY SHALL BE DETERMINED BY THE QC MANAGER.
22. UNSATISFACTORY MATERIALS SHALL REMAIN AT THE BORROW SITE. NO SATISFACTORY MATERIAL SHALL BE WASTED WITHOUT AUTHORIZATION BY THE OWNER. MOISTURE CONTENT SHALL NOT BE DEEMED AN APPROPRIATE CAUSE TO HAVE A MATERIAL DEFINED AS UNSATISFACTORY.
23. GRADING OF STOCKPILES SHOULD BE MINIMIZED. HOWEVER, STOCKPILES SHALL BE GRADED TO MAINTAIN POSITIVE DRAINAGE AT ALL TIMES. THE SIDE SLOPES SHALL HAVE 3H:1V SLOPES OR FLATTER. THE TOP OF THE STOCKPILE SHALL HAVE A MINIMUM TWO PERCENT SLOPE. MATERIALS SHALL BE SEGREGATED AS DIRECTED BY THE QC MANAGER.
24. SOIL STOCKPILES THAT WILL NOT BE DISTURBED FOR 21 DAYS OR MORE SHALL BE TEMPORARILY SEEDED WITH WHEAT OR RYE AT A RATE OF 60 LBS/ACRE AND SHALL BE COVERED WITH MULCH.
25. ALL PIPE REMOVAL AND TRENCHING SHALL BE CONDUCTED IN STRICT ACCORDANCE WITH APPLICABLE TVA PROCESS AND PROCEDURE REQUIREMENTS.
26. PIPE REMOVAL AT THE LOCATIONS NOTED ON THE DRAWINGS SHALL REQUIRE BACKFILL. SOIL BACKFILL AND EMBANKMENT SHALL BE PLACED TO A MINIMUM DENSITY OF 95% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY.
27. GEOTEXTILES USED FOR CONSTRUCTION SHALL BE CERTIFIED BY THE MANUFACTURER AS CONFORMING TO THE PROJECT REQUIREMENTS. GEOTEXTILES SHALL NOT BE UTILIZED AS FILTER UNLESS APPROVED BY TVA. IT MAY BE USED AS A TEMPORARY MEASURE AND REMOVED.
28. CERTIFICATIONS OF MATERIAL QUALITY AND CONFORMANCE TO PROJECT REQUIREMENTS SHALL BE SUBMITTED TO THE QC MANAGER FOR APPROVAL PRIOR TO INSTALLATION.
29. ALL SURFACES SHALL BE APPROVED BY THE QC MANAGER PRIOR TO EMBANKMENT OR BUTTRESS CONSTRUCTION.
30. THE CP SHALL DEVELOP A HAUL ROAD PLAN PRIOR TO INITIATION OF CONSTRUCTION AND SUBMIT IT TO THE QC MANAGER FOR APPROVAL.
31. THE CP SHALL BE RESPONSIBLE FOR CONSTRUCTION SURVEYOR SELECTION AND COORDINATION OF ALL CONSTRUCTION RELATED SURVEYING. ALL ESTABLISHED TVA BENCH MARKS OR OTHER MONUMENTS SHALL BE PRESERVED AND PROTECTED, ANY ESTABLISHED MARKER OR BENCHMARK THAT IS DAMAGED BY CONSTRUCTION ACTIVITIES SHALL BE REPLACED BY TVA SURVEYING SERVICES.
32. THE CONSTRUCTION MANAGER SHALL COMMUNICATE CONSTRUCTION ISSUES, PROBLEMS OR DISCREPANCIES IN THE DRAWINGS TO THE QC MANAGER AND OWNER IMMEDIATELY UPON BECOMING AWARE OF SUCH PROBLEMS.
33. ADDITIONAL GEOTECHNICAL INSTRUMENTATION BEYOND THAT CURRENTLY DEPICTED MAY BE INSTALLED DURING CONSTRUCTION.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX000000020090020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS SIGNED
R–	–	–	–	–	–	–	–	–	–	–
R 0	05/06/11 ISSUED FOR CONSTRUCTION	DWF	DMG	TC	DWF	VJO	MST	JCK	–	–

SCALE: NONE EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
GENERAL NOTES
WORK PLAN 5 (KIF–110028–WP–5)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. DRILLY	D.W. FULLER	V.J. DOTSON	M.S. TUMMSON	J.C. KAMMEYER

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Fax 859.422.3100
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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 05/06/11 | 36 | C | 10W229–92 | R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

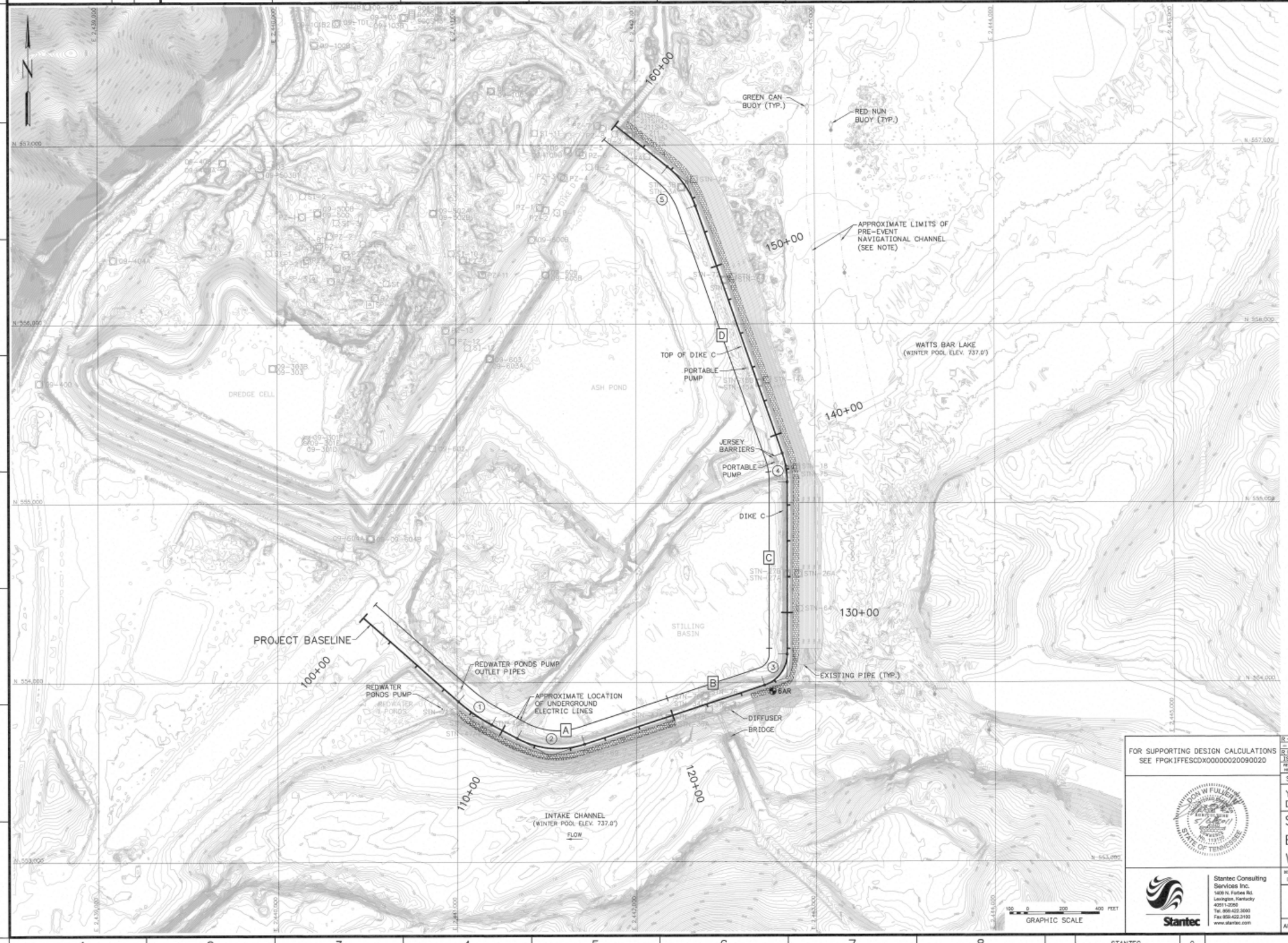

TABLE OF BASELINE COORDINATES			
PROJECT BASELINE	STATION	NORTHING	EASTING
BEGIN	100+00.00	554,363.86	2,440,477.77
END	160+00.00	557,109.43	2,441,888.38

BASELINE CURVE DATA

① P.I. STA. = 108+20.74; NORTHING = 553,819.18; EASTING = 2,441,091.71; Δ = 13°20'06"; R = 974.68'; T = 113.94'; L = 226.85'; E = 6.64'; P.C. STA. = 107+06.80; P.T. STA. = 109+33.65

② P.I. STA. = 112+99.93; NORTHING = 553,591.92; EASTING = 2,441,514.77; Δ = 46°19'10"; R = 479.84'; T = 205.26'; L = 387.92'; E = 42.06'; P.C. STA. = 110+94.67; P.T. STA. = 114+82.59

③ P.I. STA. = 126+71.85; NORTHING = 554,024.61; EASTING = 2,442,840.47; Δ = 71°45'50"; R = 182.94'; T = 132.33'; L = 229.13'; E = 42.85'; P.C. STA. = 125+39.52; P.T. STA. = 127+68.65

④ P.I. STA. = 138+12.12; NORTHING = 555,200.41; EASTING = 2,442,843.77; Δ = 19°21'32"; R = 479.84'; T = 81.84'; L = 162.13'; E = 6.93'; P.C. STA. = 137+30.28; P.T. STA. = 138+92.41

⑤ P.I. STA. = 154+96.30; NORTHING = 556,792.40; EASTING = 2,442,289.43; Δ = 32°28'34"; R = 479.84'; T = 139.75'; L = 271.98'; E = 19.94'; P.C. STA. = 153+56.55; P.T. STA. = 156+28.53

SEGMENT STATIONS

SEGMENT 'A' – STA. 100+00.0 TO STA. 120+00.0
SEGMENT 'B' – STA. 120+00.0 TO STA. 128+00.0
SEGMENT 'C' – STA. 128+00.0 TO STA. 138+00.0
SEGMENT 'D' – STA. 138+00.0 TO STA. 160+00.0

INSTRUMENTATION LEGEND

STN-1 SLOPE INCLINOMETER (SI)
STN-2 PIEZOMETER (PZ)
STN-3 SETTLEMENT PLATFORM (SP)

SURVEY CONTROL NOTE:

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

NOTES

1. TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON APRIL, 2009 BY TUCK MAPPING SOLUTIONS, INC.
2. THE HYDROGRAPHIC CONTOURS SHOWN HERE WERE PROVIDED BY TVA.
3. THE NAVIGATIONAL CHANNEL LIMITS SHOWN WERE PROVIDED BY TVA USING U.S. ARMY CORPS OF ENGINEERS NASHVILLE DISTRICT DATA AND WAS REVIEWED BY THE U.S. COAST GUARD FOR ITS APPROXIMATE LOCATION. THE LOCATION SHOWN IS PRE-EVENT AND IS SUBJECT TO CHANGE WHEN CLEAN-UP OPERATIONS ARE COMPLETED.
4. SEGMENTS D, C, B (WP3), & A AS DEPICTED REPRESENTS THE PROPOSED DESIGN; NOT AN AS-BUILT CONFIGURATION.
5. 6AR IS AN ENVIRONMENTAL MONITORING WELL INSTALLED AND MAINTAINED BY TVA ENVIRONMENTAL GROUP. SPECIFICATIONS FOR IT'S EXTENSION SHOULD BE OBTAINED BY TVA.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX000000020090020

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT MGR	AS CONST
0	05/06/11	DWF	DWG	TC	DWF	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: 1"=200' EXCEPT AS NOTED

DON M. FULLER — 113170 — STATE OF TENNESSEE — REGISTERED ENGINEER

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION EXISTING CONDITIONS WORK PLAN 5 (KIF-110028-WP-5)

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
D.M. FULLER	D.M. GRAHAM	T. CRILLY	D.N. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

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1409 N. Forbes Rd.
Lexington, Kentucky
40511-2056
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www.stantec.com

AUTOCAD R 2000	DATE 05/06/11	36	C	10W229-93	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR: 200
W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

PLOT DATE: 05/06/2011 USER: ELLISON, DOC
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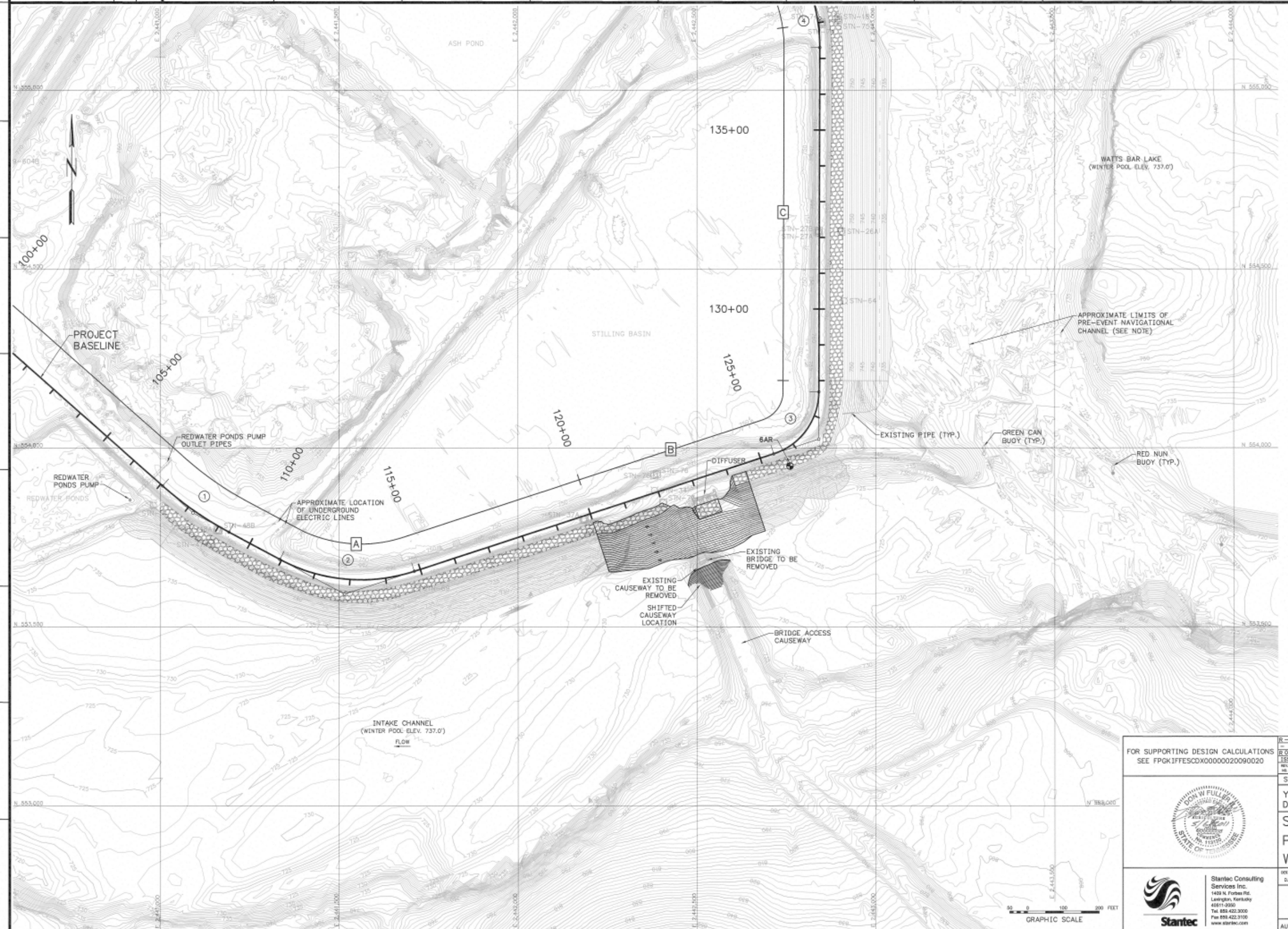
ASH POND
STILLING BASIN
INTAKE CHANNEL
(WINTER POOL ELEV. 737.0')
FLOW
WATTS BAR LAKE
(WINTER POOL ELEV. 737.0')
100+00
105+00
110+00
115+00
120+00
125+00
130+00
135+00
PROJECT BASELINE
REDWATER PONDS PUMP OUTLET PIPES
REDWATER PONDS PUMP
REDWATER PONDS
APPROXIMATE LOCATION OF UNDERGROUND ELECTRIC LINES
EXISTING CAUSEWAY TO BE REMOVED
SHIFTED CAUSEWAY LOCATION
EXISTING BRIDGE TO BE REMOVED
BRIDGE ACCESS CAUSEWAY
DIFFUSER
6AR
EXISTING PIPE (TYP.)
GREEN CAN BUOY (TYP.)
RED NUN BUOY (TYP.)
APPROXIMATE LIMITS OF PRE-EVENT NAVIGATIONAL CHANNEL (SEE NOTE)
STN-1
STN-2
STN-3
STN-4
STN-5
STN-6
STN-7
STN-8
STN-9
STN-10
STN-11
STN-12
STN-13
STN-14
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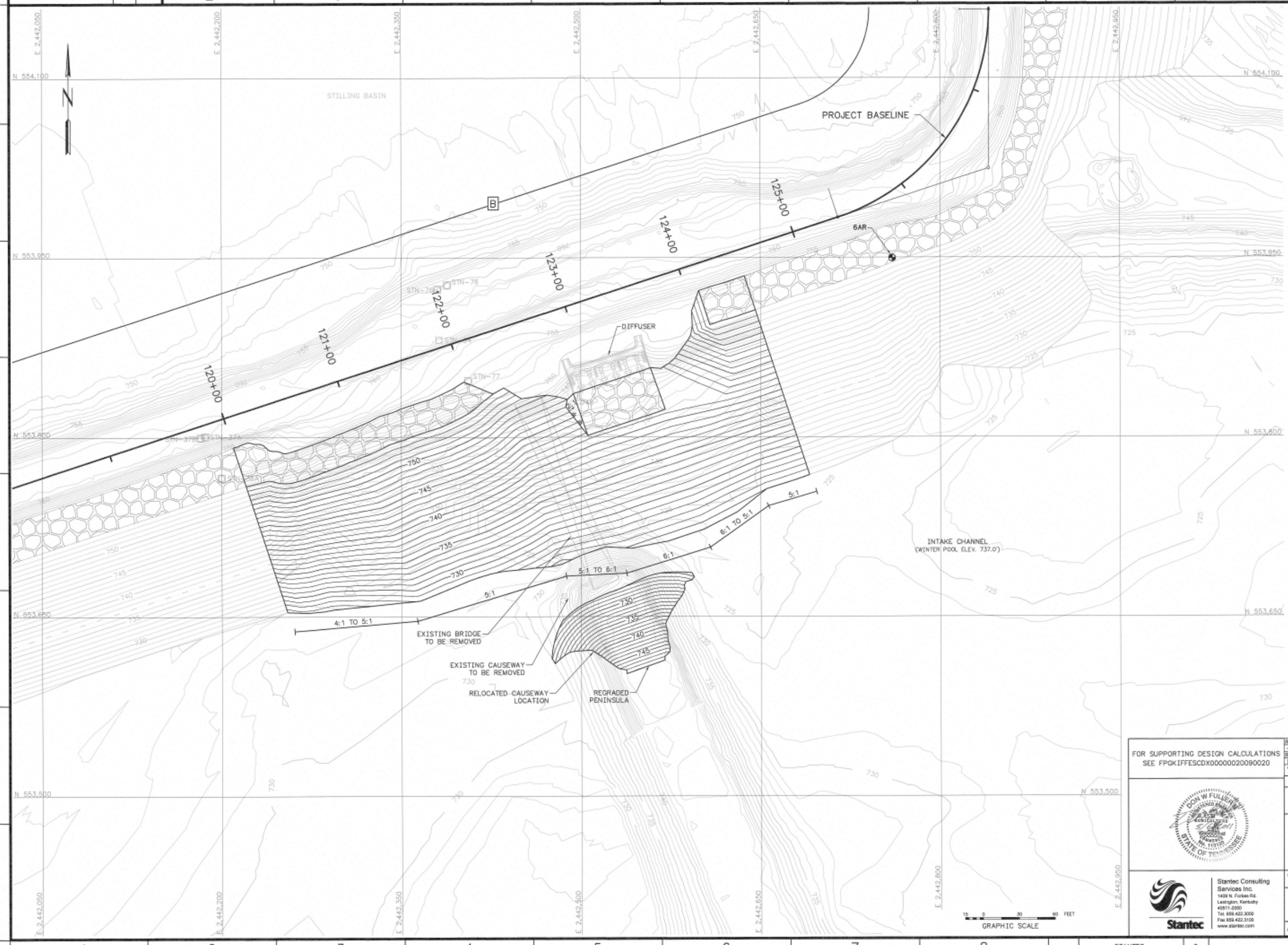

SEGMENT STATIONS

SEGMENT 'A' – STA. 100+00.0 TO STA. 120+00.0
SEGMENT 'B' – STA. 120+00.0 TO STA. 128+00.0
SEGMENT 'C' – STA. 128+00.0 TO STA. 138+00.0
SEGMENT 'D' – STA. 138+00.0 TO STA. 160+00.0

INSTRUMENTATION LEGEND

STN-1 ☐ SLOPE INCLINOMETER (SI)
STN-2 ◯ PIEZOMETER (PZ)
STN-3 ⊙ SETTLEMENT PLATFORM (SP)

SURVEY CONTROL NOTE:

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

NOTES

1. TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON APRIL, 2009 BY TUCK MAPPING SOLUTIONS, INC.
2. THE HYDROGRAPHIC CONTOURS SHOWN HERE WERE PROVIDED BY TVA.
3. SEE 10W299-93 FOR PROJECT BASELINE COORDINATES AND CURVE DATA.
4. THE NAVIGATIONAL CHANNEL LIMITS SHOWN WERE PROVIDED BY TVA USING U.S. ARMY CORPS OF ENGINEERS NASHVILLE DISTRICT DATA AND WAS REVIEWED BY THE U.S. COAST GUARD FOR ITS APPROXIMATE LOCATION. THE LOCATION SHOWN IS PRE-EVENT AND IS SUBJECT TO CHANGE WHEN CLEAN-UP OPERATIONS ARE COMPLETED.
5. SEGMENT B (WP-3) AND SEGMENT A AS DEPICTED REPRESENTS THE PROPOSED DESIGN; NOT AN AS-BUILT CONFIGURATION.
6. 6AR IS AN ENVIRONMENTAL MONITORING WELL INSTALLED AND MAINTAINED BY TVA ENVIRONMENTAL GROUP. SPECIFICATIONS FOR IT'S EXTENSION SHOULD BE OBTAINED BY TVA.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX00000020090020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	05/06/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: 1"=30' EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
SEGMENT 'B' – GRADING PLAN
WORK PLAN 5 (KIF-110028-WP-5)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. O'REILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
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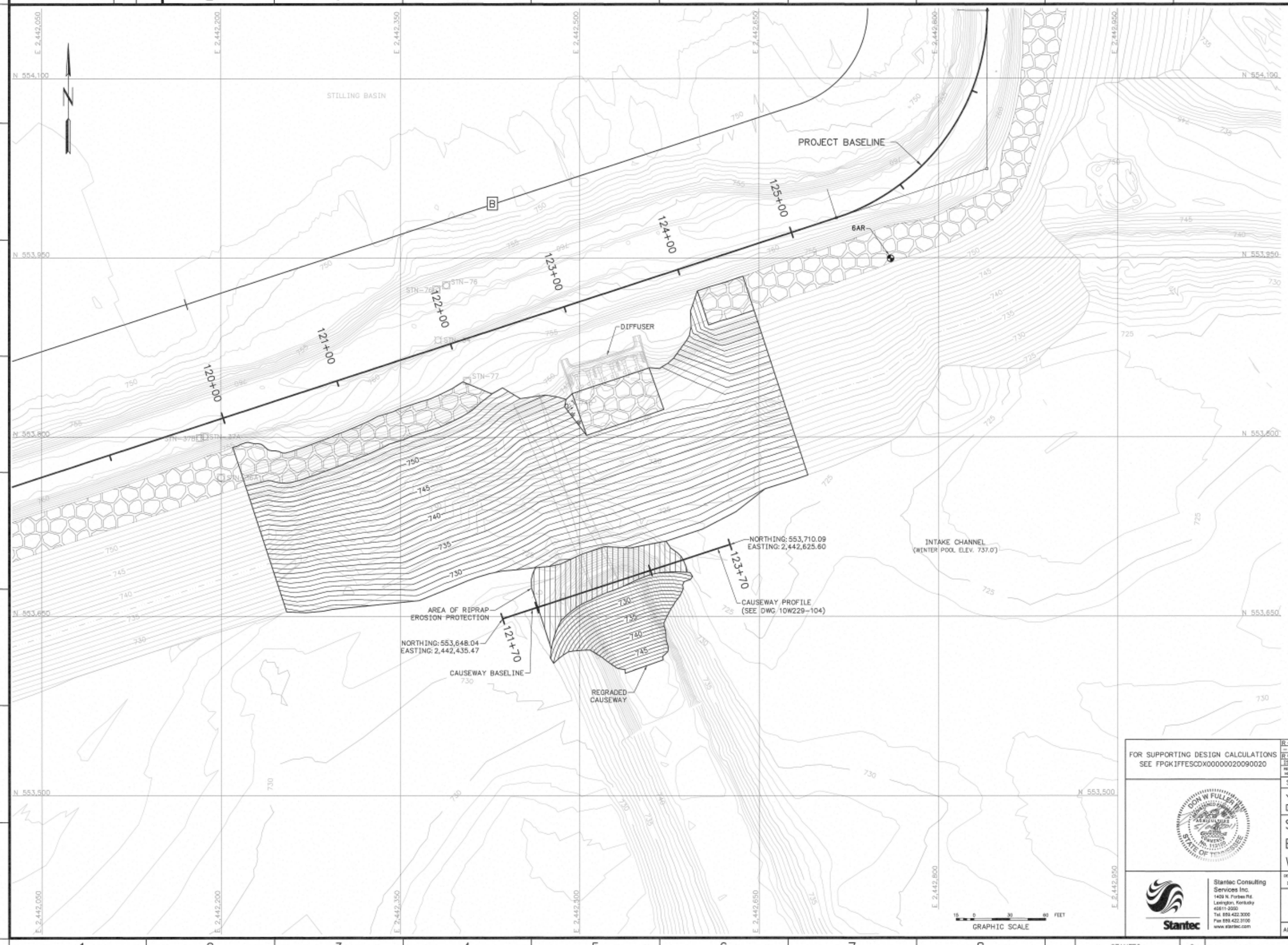
www.stantec.com

AUTOCAD R 2000	DATE 05/06/11	36	C	10W229-95	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:30
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



SEGMENT STATIONS

SEGMENT 'A' – STA. 100+00.0 TO STA. 120+00.0
SEGMENT 'B' – STA. 120+00.0 TO STA. 128+00.0
SEGMENT 'C' – STA. 128+00.0 TO STA. 138+00.0
SEGMENT 'D' – STA. 138+00.0 TO STA. 160+00.0

INSTRUMENTATION LEGEND

STN-1 ☐ SLOPE INCLINOMETER (SI)
STN-2 ▢ PIEZOMETER (PZ)
STN-3 ⊙ SETTLEMENT PLATFORM (SP)

SURVEY CONTROL NOTE:

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

NOTES

1. TOPOGRAPHIC MAPPING WAS GENERATED FROM A LIDAR SURVEY PERFORMED ON APRIL, 2009 BY TUCK MAPPING SOLUTIONS, INC.
2. THE HYDROGRAPHIC CONTOURS SHOWN HERE WERE PROVIDED BY TVA.
3. SEE 10W299-93 FOR PROJECT BASELINE COORDINATES AND CURVE DATA.
4. THE NAVIGATIONAL CHANNEL LIMITS SHOWN WERE PROVIDED BY TVA USING U.S. ARMY CORPS OF ENGINEERS NASHVILLE DISTRICT DATA AND WAS REVIEWED BY THE U.S. COAST GUARD FOR ITS APPROXIMATE LOCATION. THE LOCATION SHOWN IS PRE-EVENT AND IS SUBJECT TO CHANGE WHEN CLEAN-UP OPERATIONS ARE COMPLETED.
5. SEGMENT B (WP-3) AND SEGMENT A AS DEPICTED REPRESENTS THE PROPOSED DESIGN; NOT AN AS-BUILT CONFIGURATION.
6. 6AR IS AN ENVIRONMENTAL MONITORING WELL INSTALLED AND MAINTAINED BY TVA ENVIRONMENTAL GROUP. SPECIFICATIONS FOR IT'S EXTENSION SHOULD BE OBTAINED BY TVA.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX00000020090020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R-0	05/06/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: 1"=30' EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
EROSION PROTECTION LIMITS
WORK PLAN 5 (KIF-110028-WP-5)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.N. FULLER	D.M. GRAHAM	T. O'GILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

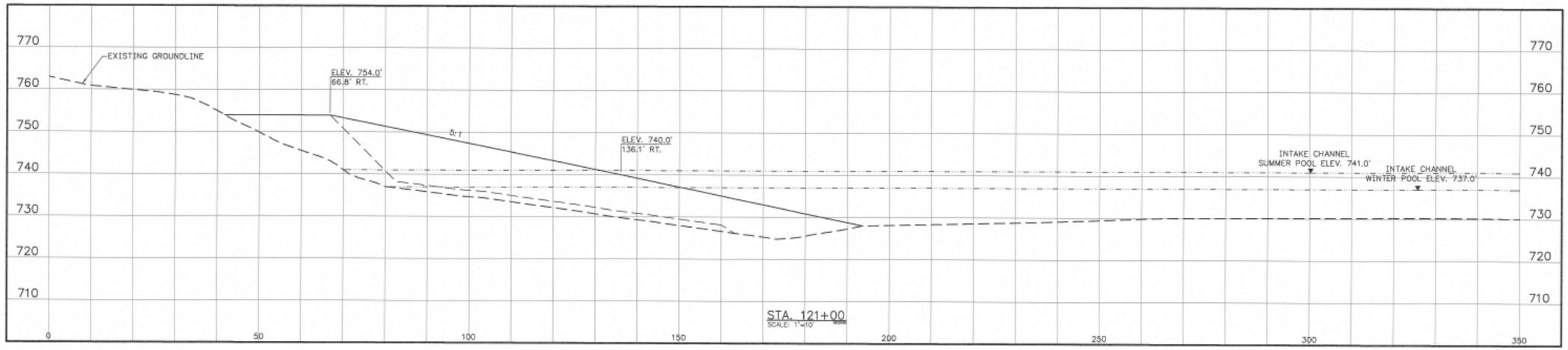
AUTOCAD R 2000 | DATE 05/06/11 | 36 | C | 10W229-96 | R 0

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
Tel. 859.422.3000
Fax 859.422.3100
www.stantec.com

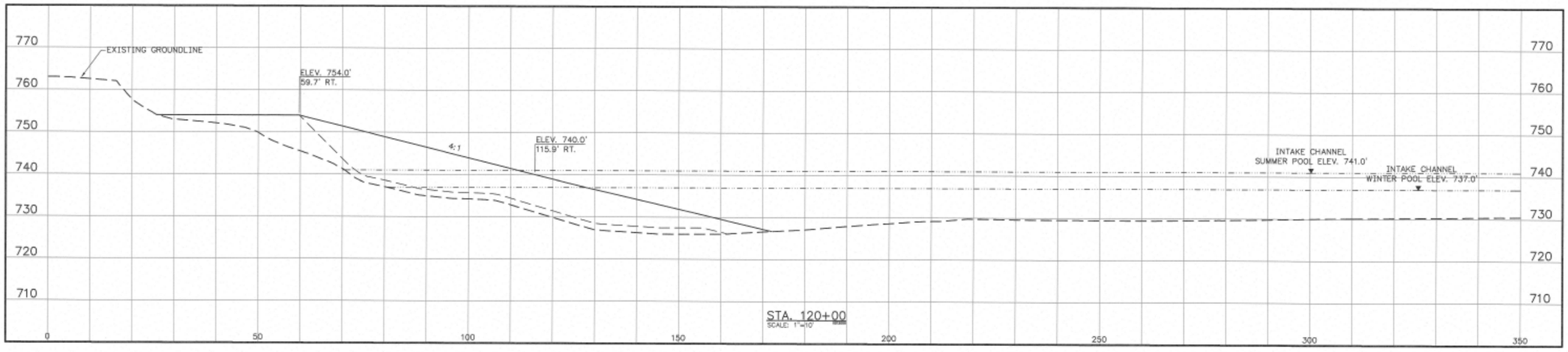
STANTEC | 0
TASK COMPLETED BY: | REV. NO.

PLOT FACTOR:30
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



STA. 121+00
SCALE: 1"=10'



STA. 120+00
SCALE: 1"=10'

NOTE:
FOR FILTER CONFIGURATIONS SEE TYPICAL SECTIONS (10W229-105).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX0000002009002O

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	05/06/11	DMF	DMG	TC	DMF	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
SEGMENT 'B' CROSS SECTIONS
WORK PLAN 5 (KIF-110028-WP-5)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. CRILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

DON W FULLER — REGISTERED PROFESSIONAL ENGINEER — AGRICULTURE — 113121 — STATE OF TENNESSEE

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AUTOCAD R 2000	DATE 05/06/11	36	C	10W229-97	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 05/06/2011 - USER: ELLISON, ERIC
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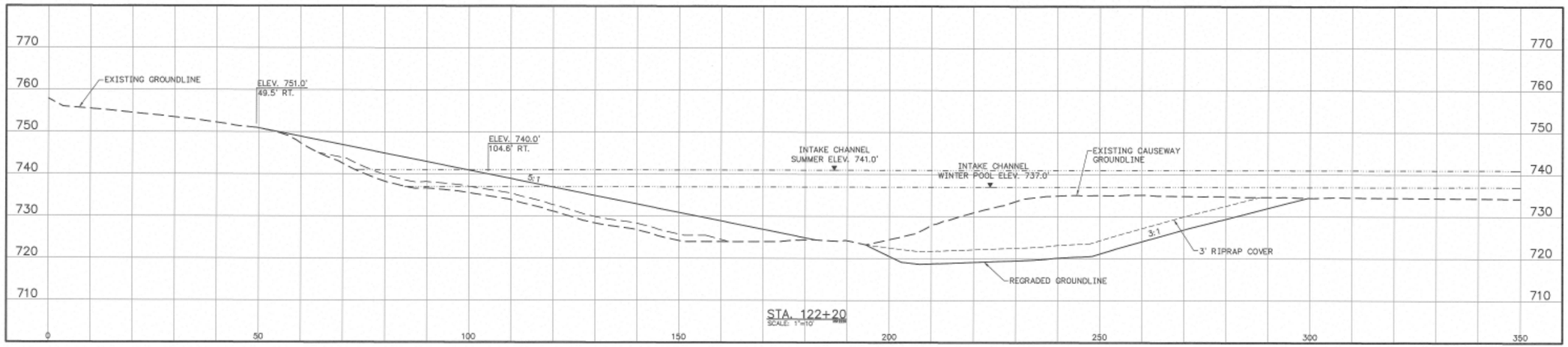

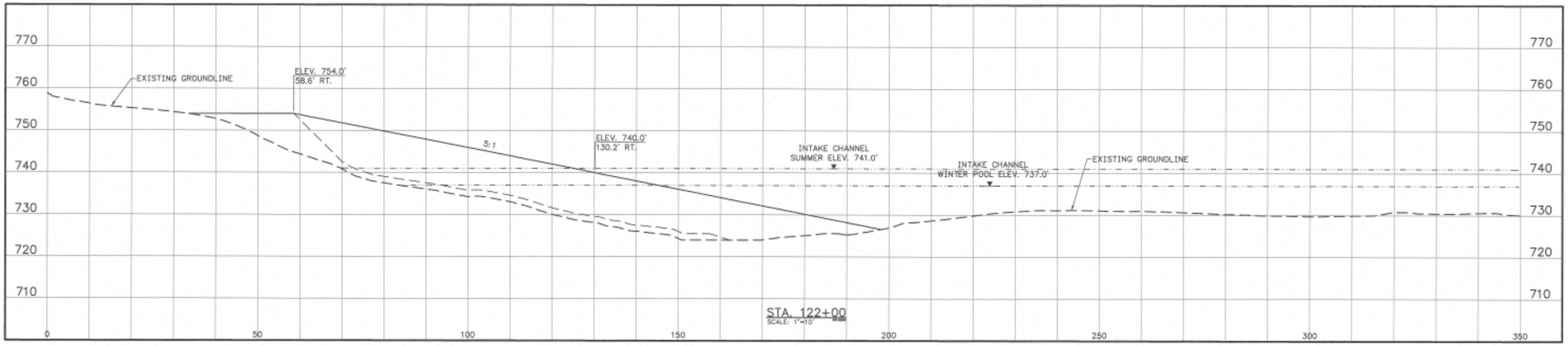

NOTE:
FOR FILTER CONFIGURATIONS SEE TYPICAL SECTIONS (10W229-105).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX000000020090020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT MGR	AS BUILT
R 0	05/06/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
	ISSUED FOR CONSTRUCTION									

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
SEGMENT 'B' CROSS SECTIONS
WORK PLAN 5 (KIF-110028-WP-5)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. CRILLY	D.W. FULLER	V.J. DOTSON	M.S. TUMMSON	J.C. KAMMERER

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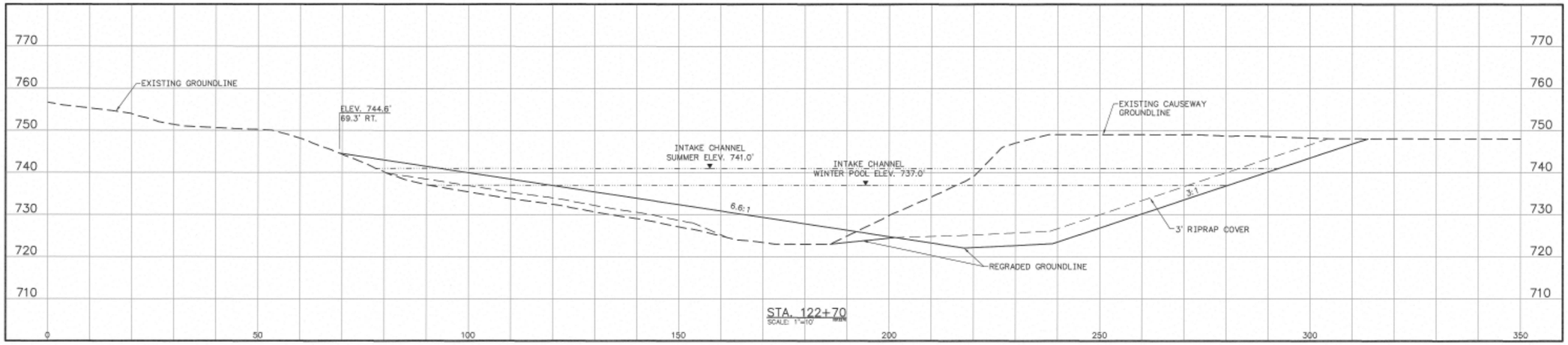
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 05/06/11 | 36 | C | 10W229-98 | R 0

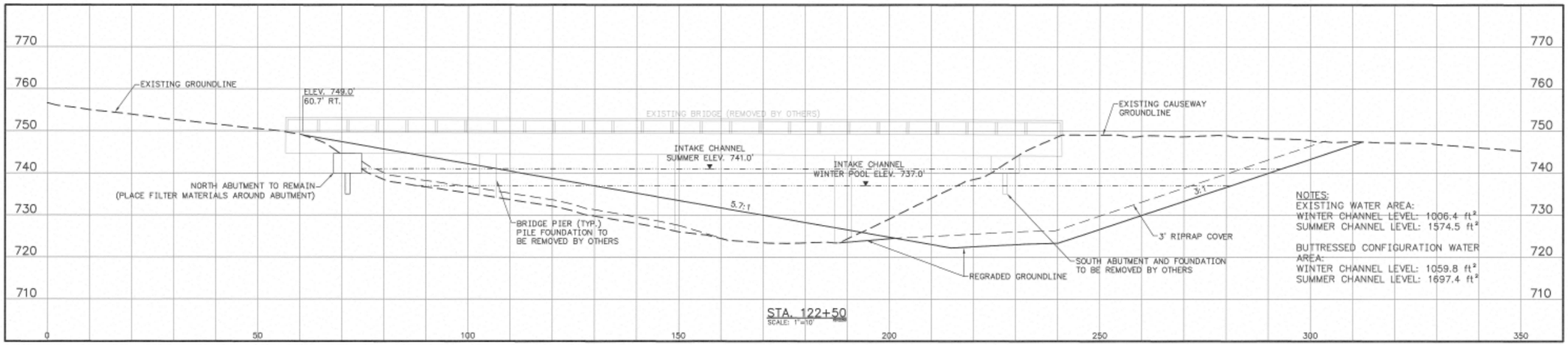
STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



STA. 122+70
SCALE: 1"=10'



STA. 122+50
SCALE: 1"=10'

NOTES:
EXISTING WATER AREA:
WINTER CHANNEL LEVEL: 1006.4 ft²
SUMMER CHANNEL LEVEL: 1574.5 ft²

BUTTRESSED CONFIGURATION WATER AREA:
WINTER CHANNEL LEVEL: 1059.8 ft²
SUMMER CHANNEL LEVEL: 1697.4 ft²

NOTE:
FOR FILTER CONFIGURATIONS SEE TYPICAL SECTIONS (10W229-105).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX000000020090020

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	05/06/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
SEGMENT 'B' CROSS SECTIONS
WORK PLAN 5 (KIF-110028-WP-5)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. CRILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. HAMMETER

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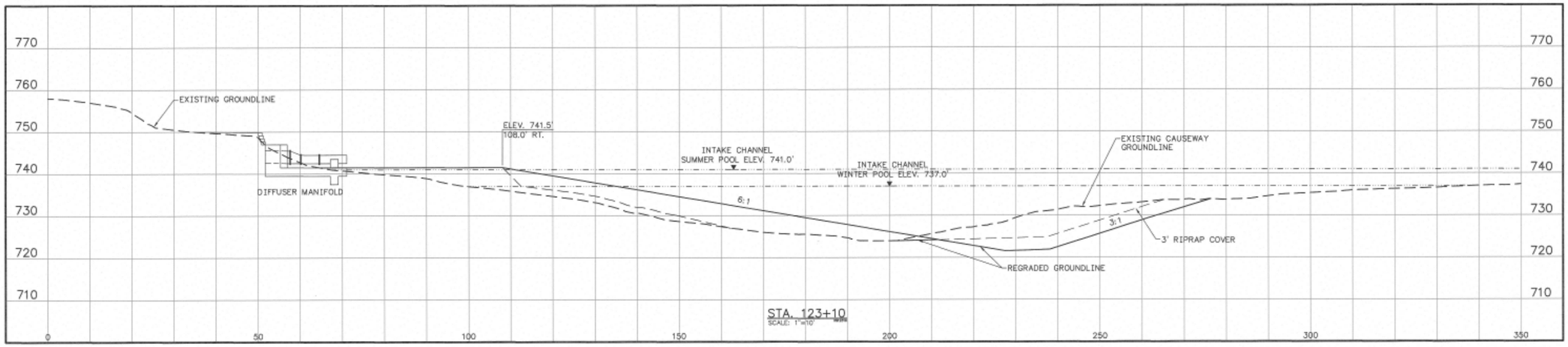
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 05/06/11	36	C	10W229-99	R 0

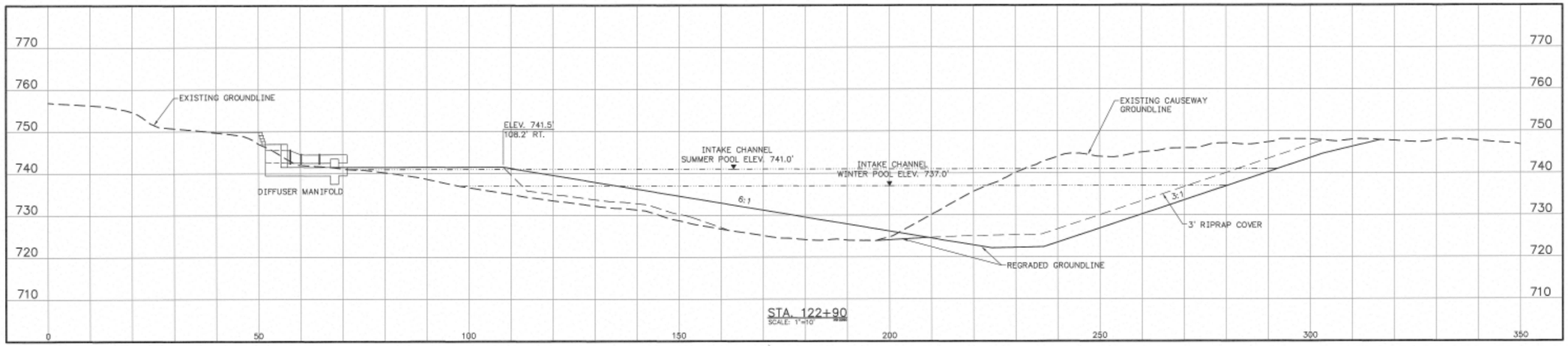
STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



STA. 123+10
SCALE: 1"=10'



STA. 122+90
SCALE: 1"=10'

NOTE:
FOR FILTER CONFIGURATIONS SEE TYPICAL SECTIONS (10W229-105).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX000000020090020

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT IS	AS CONST	REV NO.
R 0	05/06/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–	–
ISSUED FOR CONSTRUCTION											

SCALE: AS SHOWN EXCEPT AS NOTED

DON W FULLER — REGISTERED ENGINEER — AGRICULTURE — 115731 — STATE OF TENNESSEE

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
SEGMENT 'B' CROSS SECTIONS
WORK PLAN 5 (KIF-110028-WP-5)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. CRILLY	D.W. FULLER	V.J. GOTSON	M.S. TURNBOW	J.C. HAMMEYER

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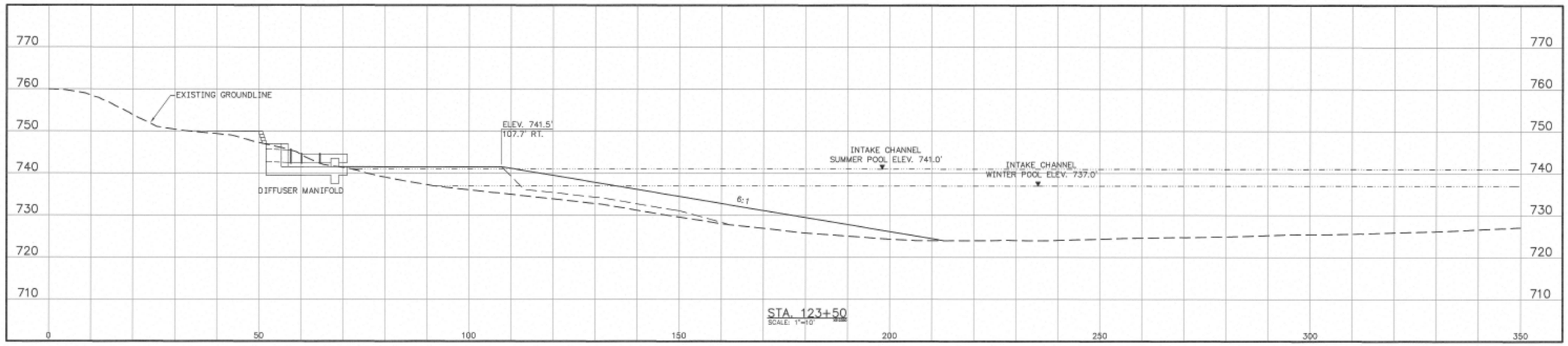
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 05/06/11	36	C	10W229-100	R 0

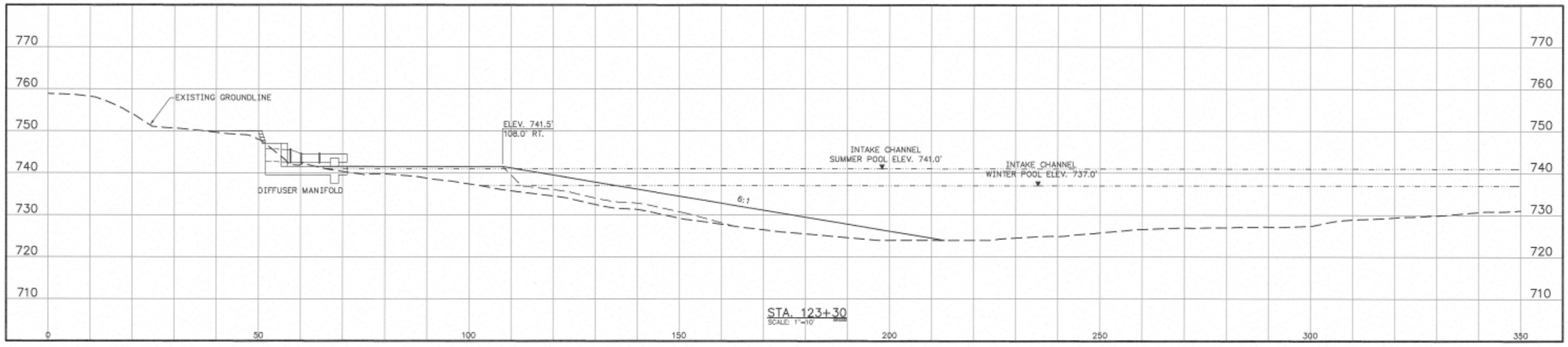
STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



STA. 123+50
SCALE: 1"=10'



STA. 123+30
SCALE: 1"=10'

NOTE:
FOR FILTER CONFIGURATIONS SEE TYPICAL SECTIONS (10W229-104).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX000000200900020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT MGR	AS CONST
R 0	05/06/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
SEGMENT 'B' CROSS SECTIONS
WORK PLAN 5 (KIF-110028-WP-5)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. CRILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

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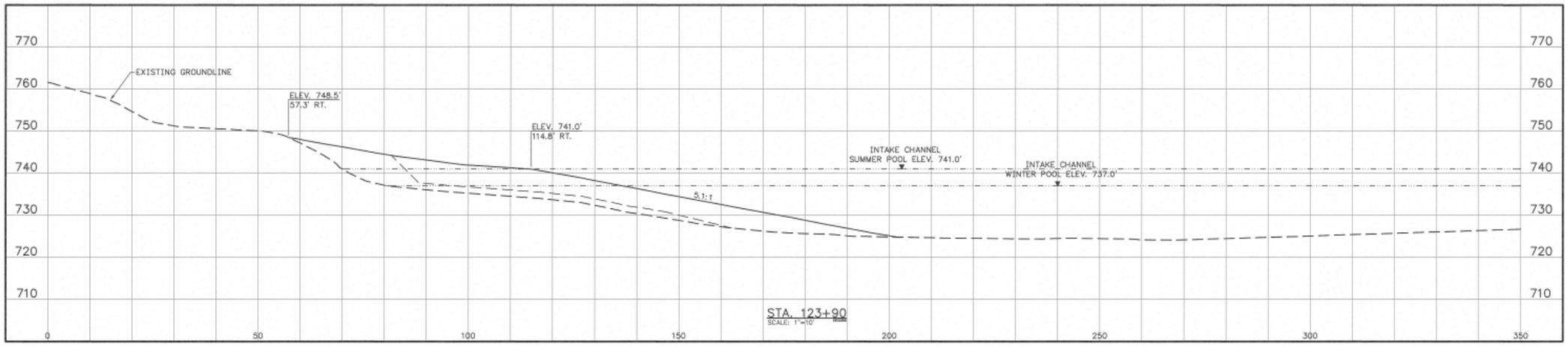
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 05/06/11	36	C	10W229-101	R 0

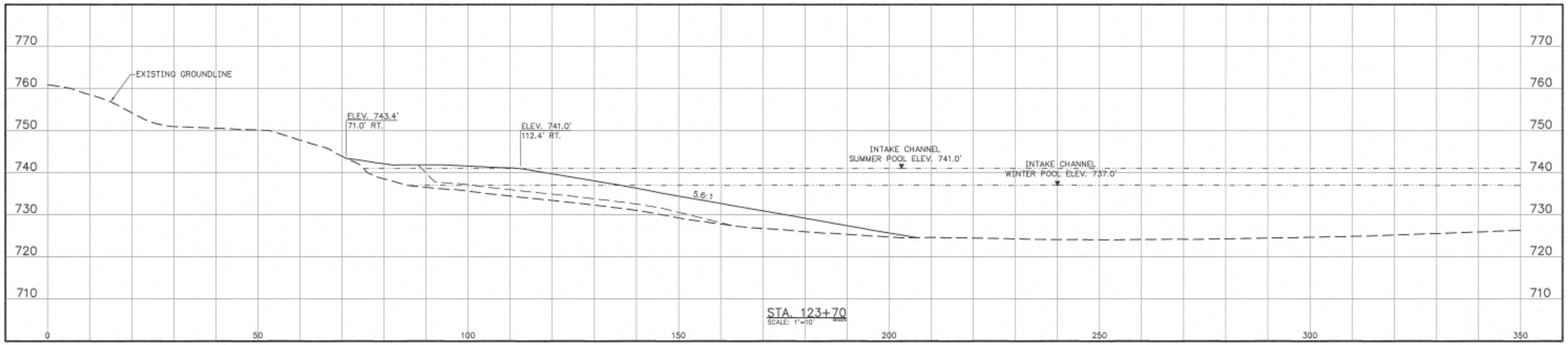
STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



STA. 123+90
SCALE: 1"=10'



STA. 123+70
SCALE: 1"=10'

NOTE:
FOR FILTER CONFIGURATIONS SEE TYPICAL SECTIONS (10W229-105).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX000000020090020

DON W FULLER — ENGINEERING CERTIFICATE — REGISTERED PROFESSIONAL ENGINEER — STATE OF TENNESSEE

R	–	–	–	–	–	–	–	–	–	–	–	–
0	05/06/11	DWF	DNG	TC	DWF	VJD	MST	JCK	–	–	–	–

ISSUED FOR CONSTRUCTION

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	REVD	APPD	ISSD	PROJECT ID	AS CONST

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
SEGMENT 'B' CROSS SECTIONS
WORK PLAN 5 (KIF-110028-WP-5)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. CRILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

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www.stantec.com

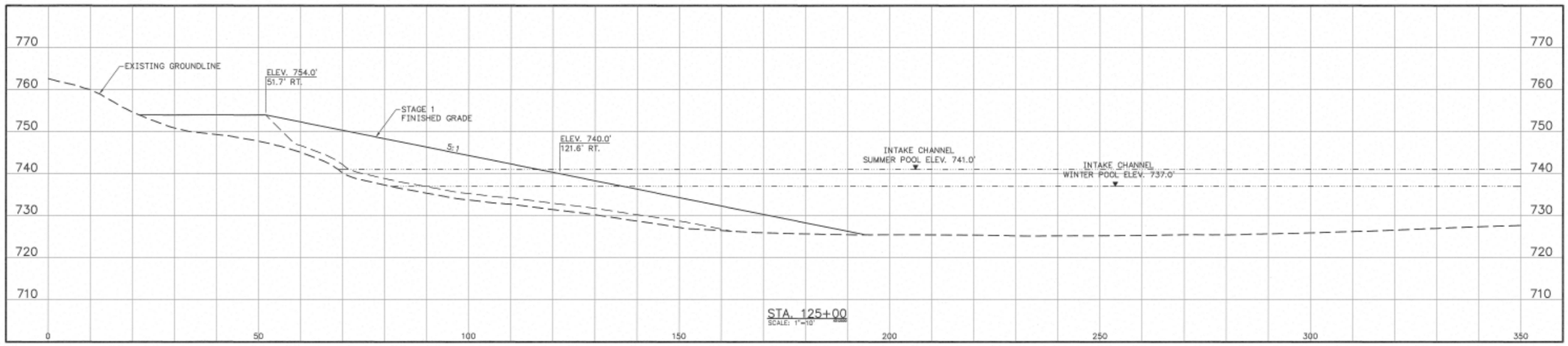
AUTOCAD R 2000	DATE 05/06/11	36	C	10W229-102	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

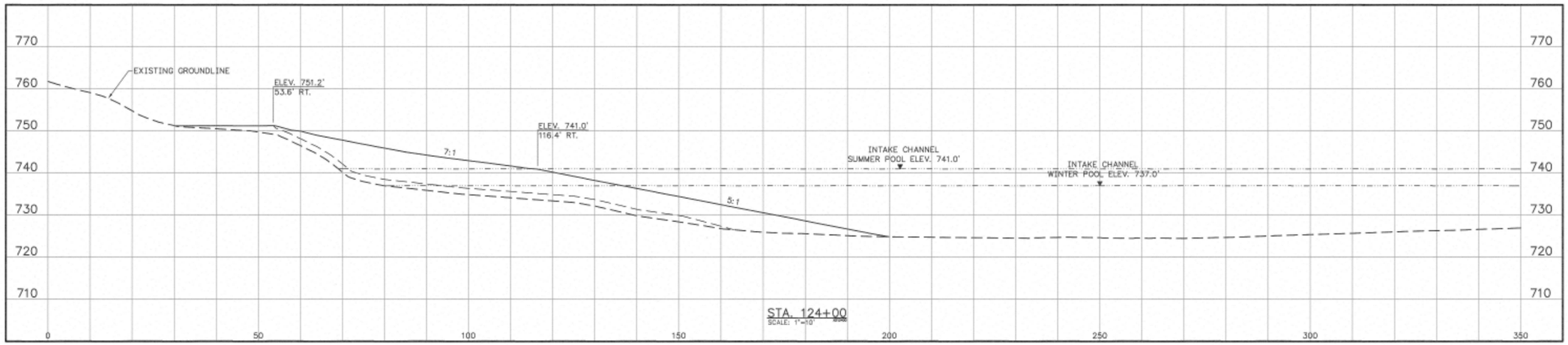
PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 05/06/2011 - USER: CLUSTER_SVC
\\CLUSTER-SVC\Workgroups\KIF\Civil\10W229\10W229-102.DWG



STA. 125+00
SCALE: 1"=10'



STA. 124+00
SCALE: 1"=10'

NOTE:
FOR FILTER CONFIGURATIONS SEE TYPICAL SECTIONS (10W229-105).

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX000000020090020

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CMMT	REV
R 0	05/06/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–	–
ISSUED FOR CONSTRUCTION											

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
SEGMENT 'B' CROSS SECTIONS
WORK PLAN 5 (KIF-110028-WP-5)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. CRILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. HAMMETER

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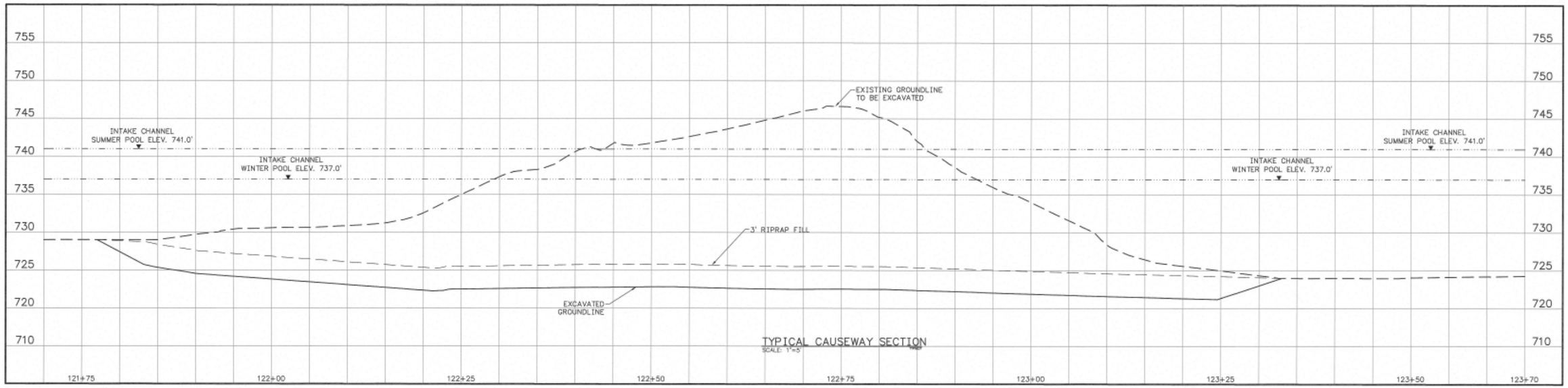
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 05/06/11	36	C	10W229-103	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



TYPICAL CAUSEWAY SECTION
SCALE: 1"=5'

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS
SEE FPGKIFFESCDX00000020090020

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	REVWD	APPD	ISSD	PROJECT SE	AS CONST	REV NO.
R 0	05/06/11	DWF	DMG	TC	DWF	VJD	MST	JCK	--	--	--
ISSUED FOR CONSTRUCTION											

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
TYPICAL CAUSEWAY SECTION
WORK PLAN 5 (KIF-110028-WP-5)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. CRILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 05/06/11 | 36 | C | 10W229-104 | R 0

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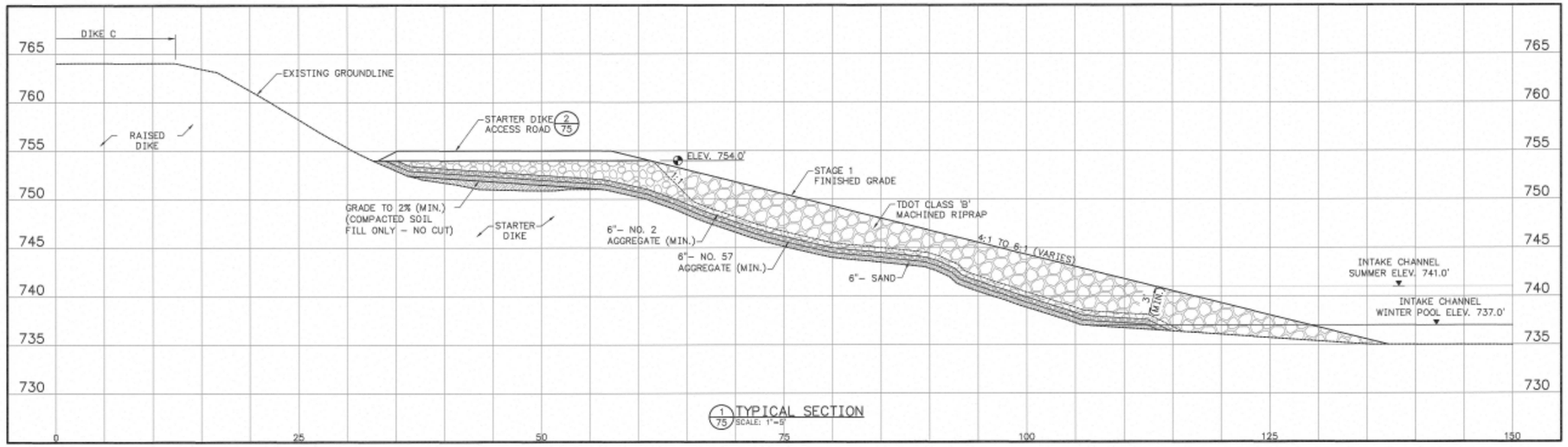
SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

STANTEC | 0
TASK COMPLETED BY: | REV NO.

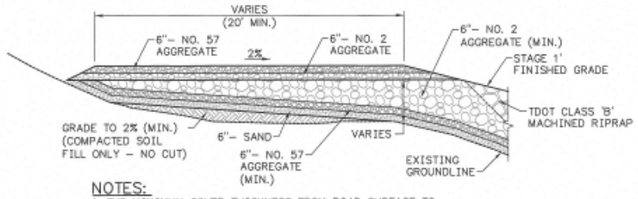
PLOT FACTOR:5
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 05/06/2011 - USER: ELSTON, DEC
\\USER\DAT\FPGKIFFESCDX\DESIGN\DATA\CIVIL\CAD\DRAWINGS\WP5\W10_JFC\W10229-104.DWG



1/75 TYPICAL SECTION
SCALE: 1"=5'



NOTES:
1. THE MINIMUM COVER THICKNESS FROM ROAD SURFACE TO TOP OF SAND FILTER IS 36–INCHES.
2. PLACE NO. 2 AGGREGATE AND NO. 57 AGGREGATE ON RIPRAP OR NO. 2 AGGREGATE AS APPLICABLE TO FORM A REVERSE FILTER FOR ROAD SURFACE.
3. REMOVE AGGREGATE CONTAMINATED WITH ASH AS DIRECTED BY THE QC MANAGER.

2/75 DETAIL – STARTER DIKE ACCESS ROAD
SCALE: 1/4"=1'-0"

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX000000020090020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT QA	AS CONST
R 0	05/06/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION TYPICAL SECTIONS AND DETAILS WORK PLAN 5 (KIF–110028–WP–5)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. CRILLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

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KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

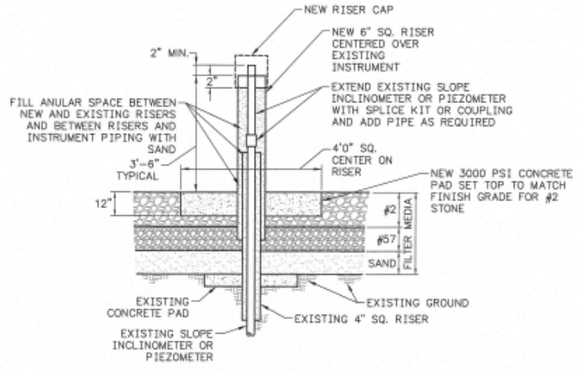
AUTOCAD R 2000	DATE 05/06/11	36	C	10W229–105	R 0

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:5
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



TYPICAL ADJUSTMENT OF INSTRUMENTATION ON DIKE C
NOT TO SCALE

NOTES:
1. MATCH PVC RISER DIAMETER WITH EXTENSION PIPE AND INSTALL STANDARD COUPLING TO EXTEND RISER.
2. EXTEND RISER TO MINIMUM OF 3' ABOVE FINISHED GRADE.
3. INSTALL 6"X6" PROTECTIVE ALUMINUM WELL COVER OVER EXISTING COVER. FILL WITH SAND.
4. FILL WITHIN 3' AROUND CASING SHALL BE COMPACTED USING HAND OPERATED TAMPING EQUIPMENT AND SHALL BE ADVANCED A MINIMUM OF 2' ABOVE EMBANKMENT CONSTRUCTION.
5. 6"X6"X1/8" ALUMINUM CASING AND HAND COMPACTED EMBANKMENT MATERIAL SHALL BE COMPLETED AS EMBANKMENT CONSTRUCTION PROGRESSES.
6. WELL PAD MINIMUM DIMENSION OF 4'X4'X1' THICK.
7. FILL WITHIN 3' AROUND CASING SHALL BE COMPACTED USING HAND OPERATED TAMPING EQUIPMENT AND SHALL BE ADVANCED A MINIMUM OF 2' ABOVE EMBANKMENT CONSTRUCTION.

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX000000020090020

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT MGR	AE CONST	REVISION
R 0	05/06/11	DWF	DMG	TC	DWF	VJD	MST	JCK	–	–	ISSUED FOR CONSTRUCTION

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
DIKE C BUTTRESS

STAGE 1 CONSTRUCTION
TYPICAL SECTIONS AND DETAILS
WORK PLAN 5 (KIF-110028-WP-5)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.W. FULLER	D.M. GRAHAM	T. CRISLY	D.W. FULLER	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

Stantec Consulting Services Inc.
1400 N. Forbes Rd.
Lexington, Kentucky
40511-2080
Tel. 859.422.3000
Fax 859.422.3100
www.stantec.com

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 05/06/11	36	C	10W229-106	R 0

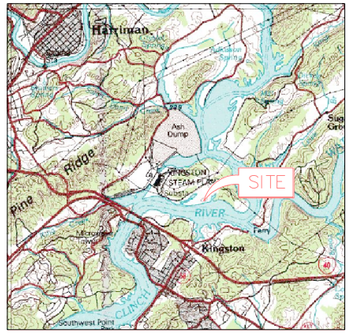
STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:8
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

DRAWING INDEX

10W427-1	COVER SHEET
10W427-2	EXISTING SITE CONDITIONS AND BORING LOCATIONS
10W427-3	SITE DEVELOPMENT PLAN
10W427-4	PHASE I INTIAL GRADING PLAN AND SOIL DIKES
10W427-5	PHASE I TOP OF GEOLOGIC BUFFER
10W427-6	PHASE I STAGE IA
10W427-7	PHASE I STAGE IB
10W427-8	PHASE II INTIAL GRADING PLAN AND SOIL DIKES
10W427-9	PHASE II TOP OF GEOLOGIC BUFFER
10W427-10	PHASE II STAGE IA
10W427-11	PHASE I AND II FINAL COVER GRADING PLAN (WET STACK)
10W427-12	PHASE I AND II FINAL COVER GRADING PLAN (WET AND DRY STACK)
10W427-13	SURFACE WATER MANAGEMENT PLAN
10W427-14	CROSS SECTIONS I
10W427-15	CROSS SECTIONS II
10W427-16	OPERATIONAL AND TYPICAL DETAILS I
10W427-17	OPERATIONAL AND TYPICAL DETAILS II
10W427-18	DRAINAGE SYSTEM DETAILS I
10W427-19	DRAINAGE SYSTEM DETAILS II
10W427-20	FINAL COVER SYSTEM DETAILS
10W427-21	SURFACE WATER MANAGEMENT SYSTEM DETAILS I (DOWNDRAIN CHANNEL OPTION)
10W427-22	SURFACE WATER MANAGEMENT SYSTEM DETAILS II (DOWNDRAIN PIPE OPTION)
10W427-23	SURFACE WATER MANAGEMENT SYSTEM DETAILS III
10W427-24	UNDERDRAIN LIFT STATION
10W427-25	STORMWATER LIFT STATION



LOCATION MAP

VICINITY MAP

COAL-COMBUSTION BY PRODUCT (GYPSUM) DISPOSAL FACILITY
KINGSTON FOSSIL PLANT - PENINSULA SITE

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450	
INITIAL ISSUE										

SCALE: NONE — EXCEPT AS NOTED

COVER SHEET

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

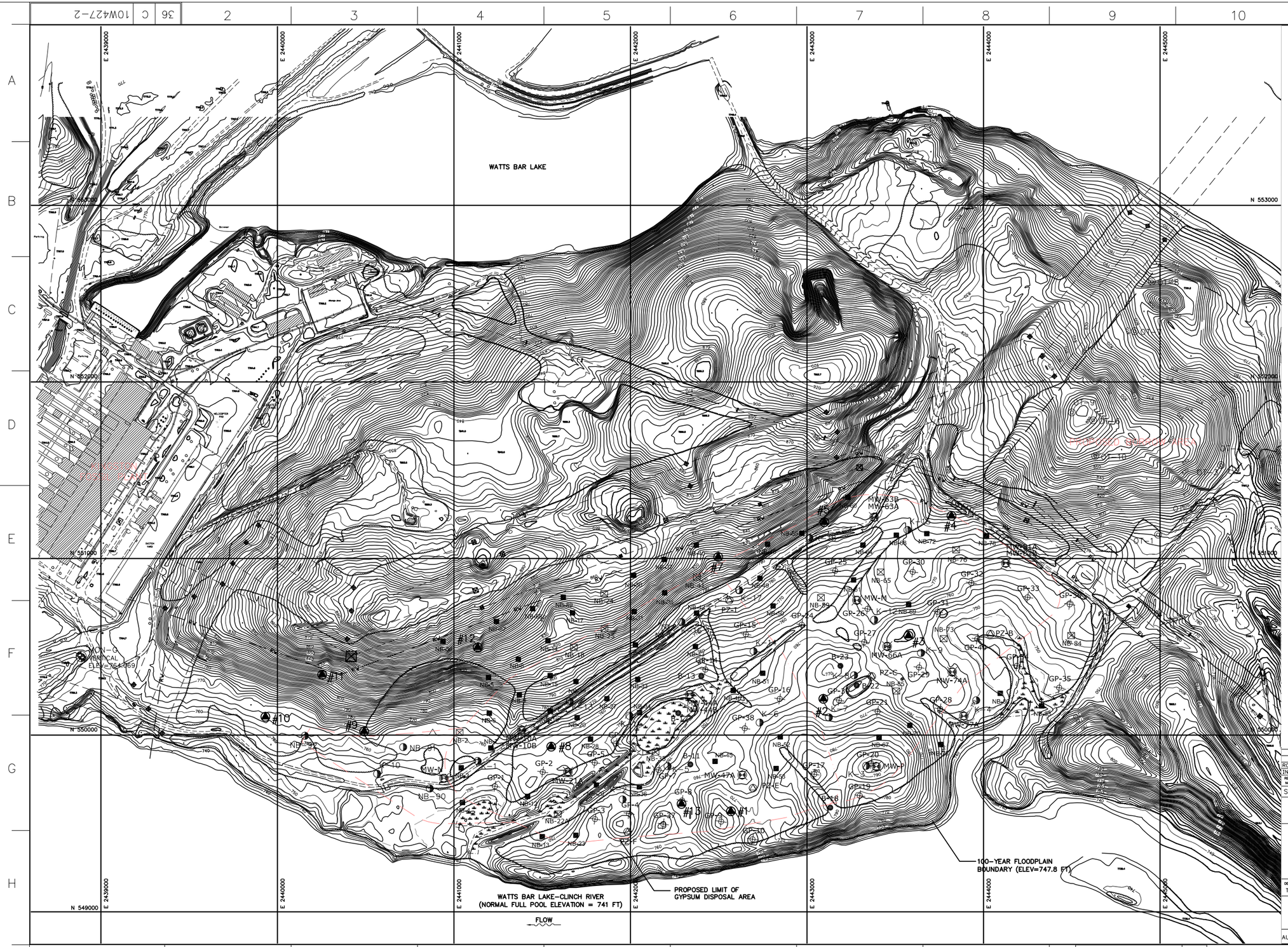
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D | DATE: MAY 06 | 36 | C | 10W427-1 | R 0

GEOSYNTEC CONSULTANTS, INC. | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING DO NOT ALTER MANUALLY



LEGEND

- EXISTING GROUND CONTOUR
- SPOT GROUND ELEVATION
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING TREELINE
- EXISTING OVERHEAD ELECTRICAL TOWER
- LIMIT OF GYPSUM DISPOSAL AREA
- PHASE BOUNDARY
- WETLAND AREAS (NOTE 6)
- APPROXIMATE LIMIT OF BORROW AREA
- #4 — SOIL BORING LOCATION AND IDENTIFICATION FROM SINGELTON MATERIAL ENGINEERING LABORATORY (1988) (NOTE 3)
- B-23 — SOIL BORING LOCATION AND IDENTIFICATION FROM MACTEC SITE INVESTIATION (2003) (NOTE 3)
- GP-20 — GEOPROBE SOIL BORING LOCATION AND IDENTIFICATION FROM MACTEC (2003) (NOTE 3)
- NB-76 — SOIL BORING LOCATION AND IDENTIFICATION FROM MACTEC (2005) (NOTE 3)
- NB-76 — GEOPROBE SOIL BORING LOCATION AND IDENTIFICATION FROM MACTEC (2003) (NOTE 3)
- MW-74 — EXISTING GROUNDWATER MONITORING WELL
- PZ-C — EXISTING PIEZOMETER
- K-6 — SOIL BORING LOCATION AND IDENTIFICATION FROM MACTEC (2006) (NOTE 4)
- MON-G VERTICAL ELEV=764.069 — PERMANENT BENCHMARK
- OT-2 — BORROW AREA TEST PITS (NOTE 5)

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. LOCATION OF SOIL BORING SHOWN ON THIS DRAWING WERE OBTAINED FROM A DRAWING TITLED "FIGURE 2: BORING LOCATION PLAN" INCLUDED IN THE 2005 HYDROGEOLOGIC REPORT DATED OCTOBER 2005.
3. INFORMATION ON GEOTECHNICAL SITE INVESTIGATIONS PERFORMED BETWEEN 1988 AND 2005 ARE PRESENTED IN THE REPORT TITLED "KINGSTON FOSSIL PLANT–PENINSULA SITE, HYDROGEOLOGIC EVALUATION OF COAL COMBUSTION BYPRODUCT DISPOSAL FACILITY" PREPARED BY TENNESSEE VALLEY AUTHORITY DATED OCTOBER 2005. THIS REPORT WAS SUBMITTED TO TDEC ON 29 NOVEMBER, 2005.
4. INFORMATION ON RECENT GEOTECHNICAL EXPLORATIONS (i.e., 2006) WAS OBTAINED FROM THE REPORT TITLED "REPORT OF ADDITIONAL GEOTECHNICAL EXPLORATION, PROPOSED GYPSUM DISPOSAL AREA, KINGSTON FOSSIL PLANT, KINGSTON, TENNESSEE." PREPARED BY MACTEC ENGINEERING AND CONSULTING, INC. AND DATED 24 FEBRUARY 2006. THIS REPORT IS INCLUDED AS APPENDIX A OF THIS PERMIT APPLICATION.
5. LOCATIONS OF TEST PITS PREFORMED IN THE PROPOSED BORROW AREA WERE OBTAINED FROM THE REPORT TITLED "REPORT GEOTECHNICAL INVESTIGATION, 33.5–ACRE BORROW AREA, KINGSTON FOSSIL PLANT, KINGSTON, TENNESSEE" PREPARED BY MACTEC ENGINEERING AND CONSULTING, INC. AND DATED 4 APRIL 2006.
6. LIMIT OF WETLAND AREAS SHOWN ON THIS DRAWING IS BASED ON A SITE WETLAND ASSESSMENT AND GROUND SURVEY PERFORMED BY TENNESSEE VALLEY AUTHORITY ON 13 OCTOBER 2005.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450	

INITIAL ISSUE

DISCIPLINE INTERFACE: REV. 1, 2, 3, 4

SCALE: 1" = 200' EXCEPT AS NOTED

EXISTING SITE CONDITONS AND BORING LOCATIONS

COAL–COMBUSTION BY–PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE	36	C	10W427–2	R 0
	30 MAY 06				

GEOSYNTEC CONSULTANTS, INC. 0
TASK COMPLETED BY: REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

LEGEND

- 780 — EXISTING GROUND CONTOUR
- TW&S — SPOT GROUND ELEVATION
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING TREELINE
- EXISTING OVERHEAD ELECTRICAL TOWER
- LIMIT OF GYPSUM DISPOSAL AREA
- PHASE BOUNDARY
- WETLAND AREAS
- APPROXIMATE LIMIT OF BORROW AREA
- MW-8A/8B — PROPOSED GROUNDWATER MONITORING WELL (NOTE 2)

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. INFORMATION REGARDING WELL DEPTHS AND SCREEN LENGTHS ARE PRESENTED IN THE GROUNDWATER MONITORING PLAN INCLUDED IN APPENDIX D OF THIS PERMIT APPLICATION.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450	
INITIAL ISSUE										

SCALE: 1" = 200' EXCEPT AS NOTED

DISCIPLINE INTERFACE: 1 2 3 4

SITE DEVELOPMENT PLAN

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

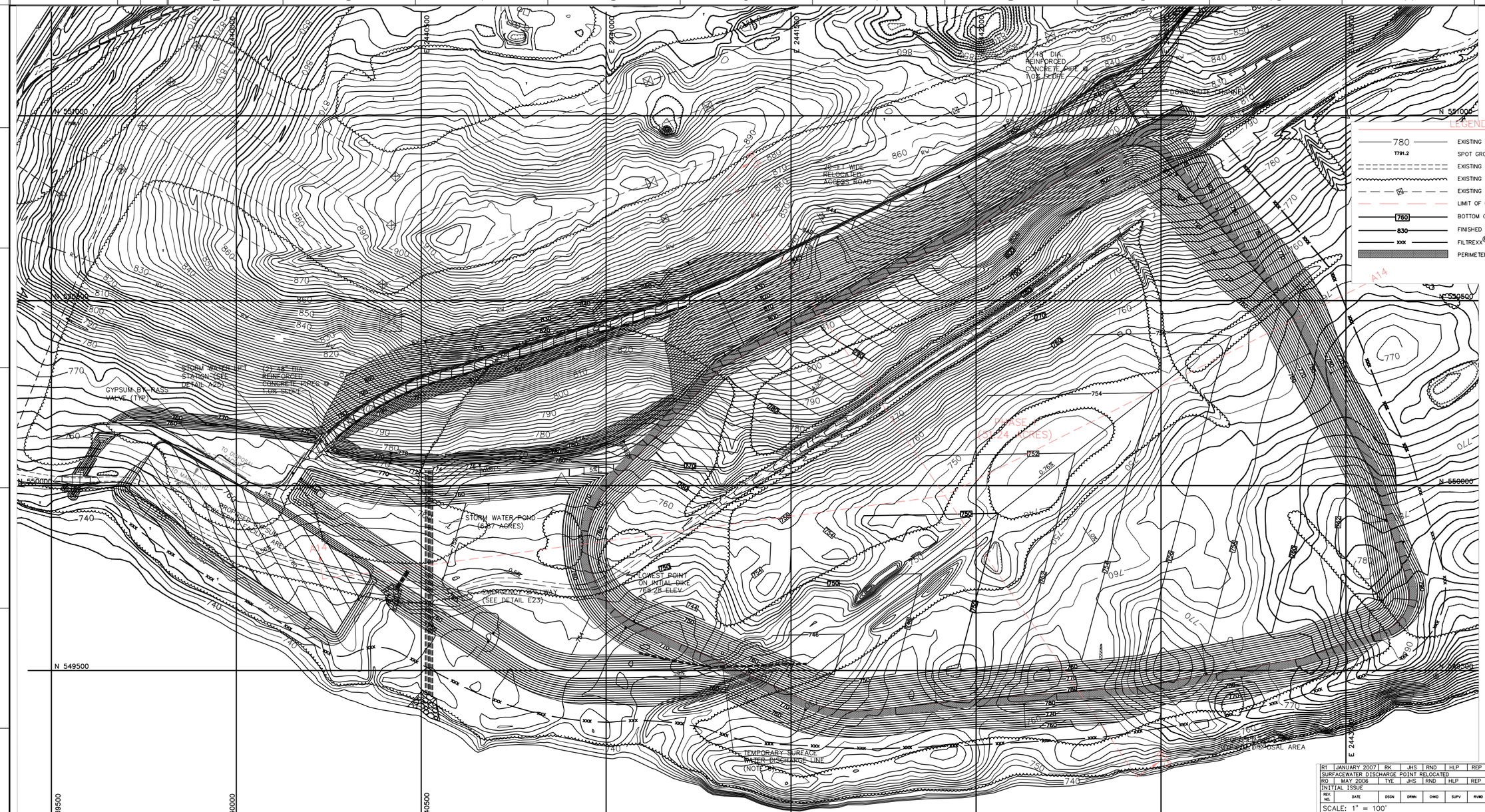
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE	36	C	10W427-3	R 0
	30 MAY 06				

GEOSYNTEC CONSULTANTS, INC. 0
TASK COMPLETED BY: REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING DO NOT ALTER MANUALLY



NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. GRADES SHOWN ON THIS DRAWING REPRESENT INITIAL STARTER DIKES AND BOTTOM OF GEOLOGIC BUFFER.
3. DIKE SIDESLOPES ARE 3H:1V UNLESS OTHERWISE NOTED.
4. PRIOR TO ANY GRUBBING AND LAND DISTURBANCE ACTIVITIES, FILTREXX SILTSOXX, CUT-OFF TRENCHES, AND OTHER EROSION CONTROL MEASURES WILL BE IMPLEMENTED. OTHER EROSION CONTROL MEASURES MAY INCLUDE TEMPORARY SEDIMENTATION PONDS, SURFACE WATER DITCHES, AND ESTABLISHMENT OF TEMPORARY OR PERMANENT VEGETATION ON EXPOSED SOIL SLOPES.
5. AS PART OF PHASE I DEVELOPMENT, THE STORMWATER POND, STORMWATER LIFT STATION, AND THE RELOCATED ACCESS ROAD WILL BE CONSTRUCTED.
6. STORMWATER RUNOFF COLLECTED DURING THE CONSTRUCTION OF PHASE I WILL BE PUMPED TO THE STORMWATER POND USING A TEMPORARY SURFACE WATER DISCHARGE LINE.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R1	JANUARY 2007	RK	JHS	RND	HLP	REP			KIF450	
SURFACEWATER DISCHARGE POINT RELOCATED										
R0	MAY 2006	TYE	JHS	RND	HLP	REP			KIF450	
INITIAL ISSUE										

DISCIPLINE INTERFACE: 1 2 3 4

SCALE: 1" = 100' EXCEPT AS NOTED

PHASE I INTIAL GRADING PLAN AND SOIL DIKES

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

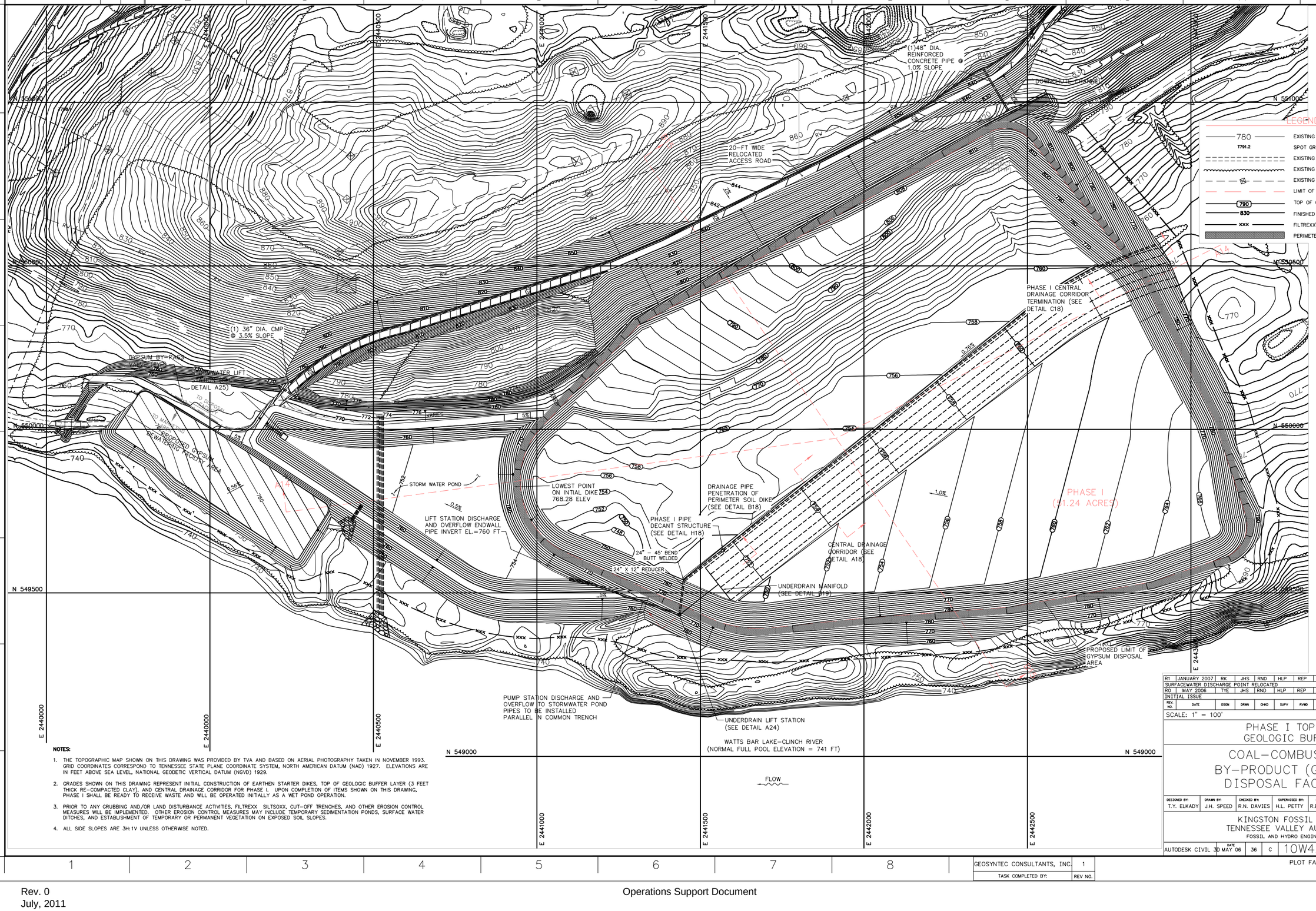
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE MAY 06	36	C	10W427-4	R 1

GEOSYNTEC CONSULTANTS, INC. 1
TASK COMPLETED BY: REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING DO NOT ALTER MANUALLY



NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. GRADES SHOWN ON THIS DRAWING REPRESENT INITIAL CONSTRUCTION OF EARTHEN STARTER DIKES, TOP OF GEOLOGIC BUFFER LAYER (3 FEET THICK RE-COMPACTED CLAY), AND CENTRAL DRAINAGE CORRIDOR FOR PHASE I. UPON COMPLETION OF ITEMS SHOWN ON THIS DRAWING, PHASE I SHALL BE READY TO RECEIVE WASTE AND WILL BE OPERATED INITIALLY AS A WET POND OPERATION.
3. PRIOR TO ANY GRUBBING AND/OR LAND DISTURBANCE ACTIVITIES, FILTREXX SILTSOXX, CUT-OFF TRENCHES, AND OTHER EROSION CONTROL MEASURES WILL BE IMPLEMENTED. OTHER EROSION CONTROL MEASURES MAY INCLUDE TEMPORARY SEDIMENTATION PONDS, SURFACE WATER DITCHES, AND ESTABLISHMENT OF TEMPORARY OR PERMANENT VEGETATION ON EXPOSED SOIL SLOPES.
4. ALL SIDE SLOPES ARE 3H:1V UNLESS OTHERWISE NOTED.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE
R1	JANUARY 2007	RK	JHS	RND	HLP	REP			K1F450		
SURFACEWATER DISCHARGE POINT RELOCATED											
R0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450		
INITIAL ISSUE											

SCALE: 1" = 100' EXCEPT AS NOTED

PHASE I TOP OF GEOLOGIC BUFFER

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

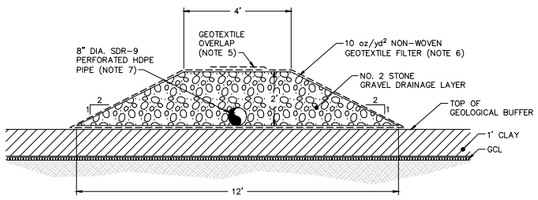
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D | DATE MAY 06 | 36 | C | 10W427-5 | R 1

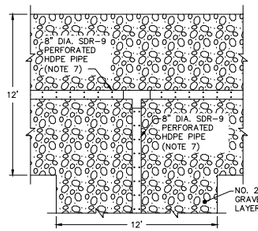
GEOSYNTEC CONSULTANTS, INC. | 1
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING DO NOT ALTER MANUALLY



1 / 5A DETAIL (TYP) FINGER DRAIN
SCALE: 1" = 2'
XREF: 37331031

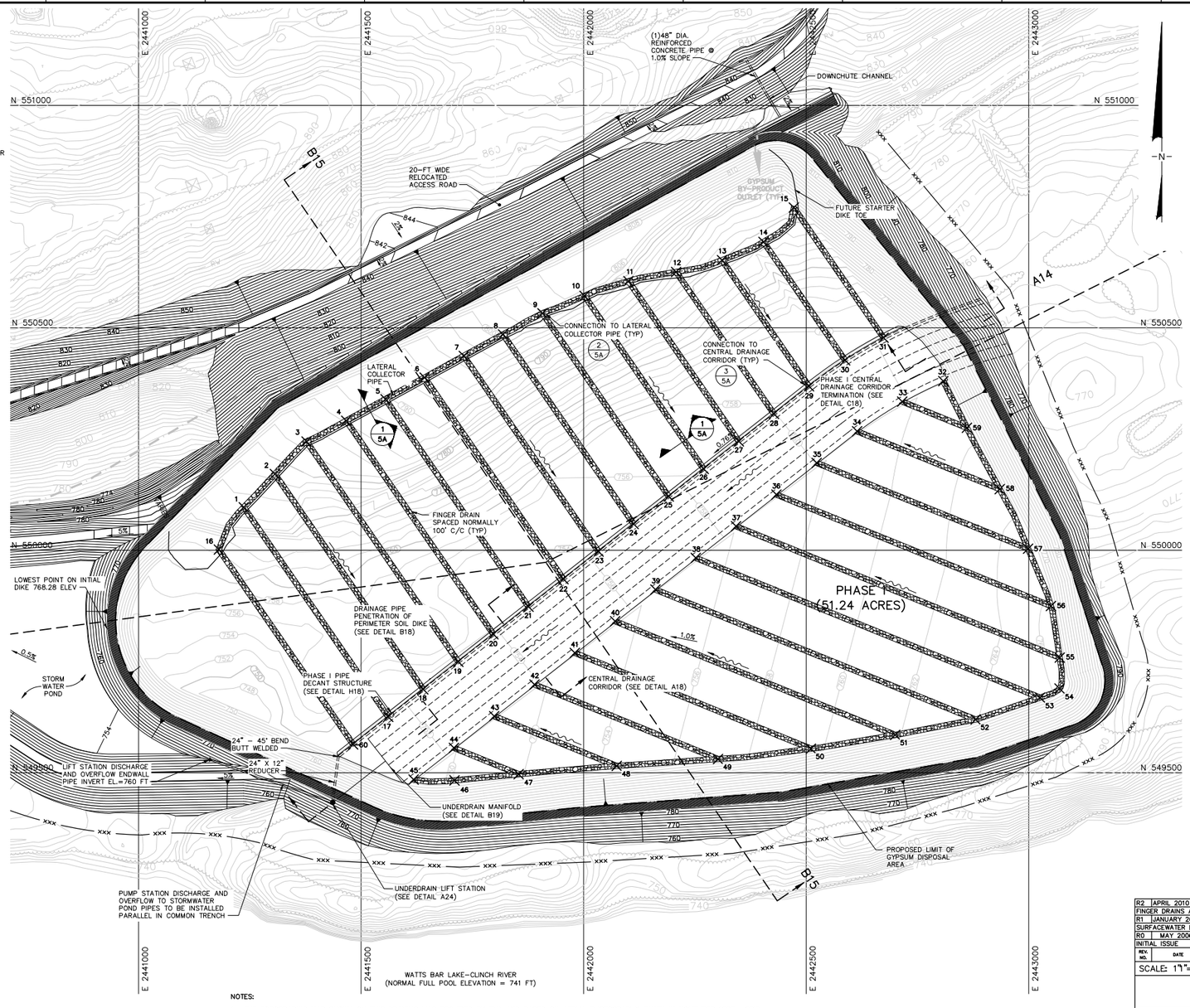


2 / 5A DETAIL (TYP) CONNECTION TO LATERAL COLLECTOR PIPE

HENRY E. JULIAN REGISTERED ENGINEER STATE OF TENNESSEE DEPARTMENT OF AGRICULTURE DEPARTMENT OF COMMERCE No. 021114 — 4/29/2010

10 o
GEO1
(NOT

3 / 5A CONNECTION TO CENTRAL DRAINAGE CORRIDOR
SCALE: 1" = 2'
XREF: 37331033



FINGER DRAIN - SURVEY CONTROL DATA			
POINT NUMBER	NORTHING	EASTING	ELEVATION
1	550096.78	2441236.36	774.83
2	550171.40	2441306.39	778.57
3	550244.38	2441377.54	782.68
4	550291.30	2441466.65	786.17
5	550339.74	2441554.72	789.71
6	550388.21	2441642.76	793.25
7	550436.91	2441730.64	796.79
8	550485.13	2441818.86	800.32
9	550532.60	2441907.59	803.53
10	550571.83	2442002.00	803.74
11	550604.84	2442100.69	797.96
12	550625.60	2442207.82	786.95
13	550652.09	2442311.01	780.02
14	550693.00	2442404.26	777.66
15	550770.39	2442472.38	782.15
16	550001.71	2441180.43	762.64
17	549625.66	2441560.97	751.20
18	549687.57	2441639.76	752.00
19	549749.47	2441718.55	752.01
20	549811.38	2441797.33	752.74
21	549873.28	2441876.12	754.00
22	549935.19	2441954.90	754.11
23	549997.09	2442033.69	756.00
24	550059.00	2442112.47	756.01
25	550120.90	2442191.26	756.24
26	550182.81	2442270.04	758.00
27	550244.71	2442348.83	758.01
28	550306.62	2442427.61	759.15
29	550368.52	2442506.40	759.02
30	550426.97	2442587.56	760.37
31	550477.74	2442674.03	762.01
32	550380.26	2442808.10	762.76
33	550334.25	2442715.89	761.32
34	550267.51	2442614.42	759.40
35	550196.42	2442523.68	759.72
36	550125.26	2442433.12	758.01
37	550054.10	2442342.55	758.00
38	549982.94	2442251.99	756.01
39	549911.78	2442161.42	756.00
40	549840.62	2442070.86	754.23
41	549769.46	2441980.29	754.00
42	549698.30	2441889.73	752.99
43	549627.14	2441799.16	752.01
44	549555.98	2441708.59	752.00
45	549484.84	2441618.06	751.99
46	549482.93	2441709.88	750.78
47	549496.92	2441854.07	751.98
48	549515.40	2442074.42	755.54
49	549530.93	2442302.02	757.79
50	549554.11	2442510.79	761.27
51	549585.19	2442700.07	761.99
52	549619.75	2442880.81	763.99
53	549668.93	2443025.50	765.98
54	549689.50	2443069.29	767.32
55	549758.89	2443069.77	767.57
56	549874.83	2443050.03	767.18
57	550003.59	2442998.71	765.54
58	550137.40	2442934.95	763.81
59	550275.29	2442861.14	761.97
60	549563.76	2441482.19	751.17

LEGEND

780	EXISTING GROUND CONTOUR
T791.2	SPOT GROUND ELEVATION
	EXISTING UNPAVED ROAD
	EXISTING TREELINE
	EXISTING OVERHEAD ELECTRICAL TOWER
	LIMIT OF GYPSUM DISPOSAL AREA
790	TOP OF GEOLOGIC BUFFER CONTOUR (FT)
830	FINISHED GRADE CONTOUR (FT)
xxx	FILTREXX®SILTSOXX OR EQUIVALENT
	PERIMETER ROAD
	FINGER DRAIN
X38	CONTROL POINTS

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. GRADES SHOWN ON THIS DRAWING REPRESENT INITIAL CONSTRUCTION OF EARTHEN STARTER DIKES, TOP OF GEOLOGIC BUFFER LAYER (3 FEET THICK RE-COMPACTED CLAY), AND CENTRAL DRAINAGE CORRIDOR FOR PHASE I. UPON COMPLETION OF ITEMS SHOWN ON THIS DRAWING, PHASE I SHALL BE READY TO RECEIVE WASTE AND WILL BE OPERATED INITIALLY AS A WET POND OPERATION.
3. PRIOR TO ANY GRUBBING AND/OR LAND DISTURBANCE ACTIVITIES, FILTREXX® SILTSOXX, CUT-OFF TRENCHES, AND OTHER EROSION CONTROL MEASURES WILL BE IMPLEMENTED. OTHER EROSION CONTROL MEASURES MAY INCLUDE TEMPORARY SEDIMENTATION PONDS, SURFACE WATER DITCHES, AND ESTABLISHMENT OF TEMPORARY OR PERMANENT VEGETATION ON EXPOSED SOIL SLOPES.
4. ALL SIDE SLOPES ARE 3H:1V UNLESS OTHERWISE NOTED.
5. SEW GEOTEXTILE PANELS CONTINUOUSLY. ALTERNATIVELY, IF HEAT BONDING IS USED FOR BONDING, MAINTAIN A MINIMUM OVERLAP OF 1-FOOT.
6. GEOTEXTILE FILTER SHOULD BE COVERED WITH 4-INCH THICK CRUSHED STONE TO PREVENT UV-EXPOSURE.
7. PERFORATIONS SHOULD BE 0.5-INCH IN DIAMETER.

0 100' 200'
SCALE IN FEET

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R2	APRIL 2010	RND	JFS	MI	VJD	RND			KIF450	
	FINGER DRAINS ADDED									
R1	JANUARY 2007	RK	JHS	RND	HLP	REP			KIF450	
	SURFACEWATER DISCHARGE POINT RELOCATED									
R0	MAY 2006	TYE	JHS	RND	HLP	REP			KIF450	
	INITIAL ISSUE									

DISCIPLINE INTERFACE

SCALE: 1"=100' EXCEPT AS NOTED

PHASE I TOP OF GEOLOGIC BUFFER

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

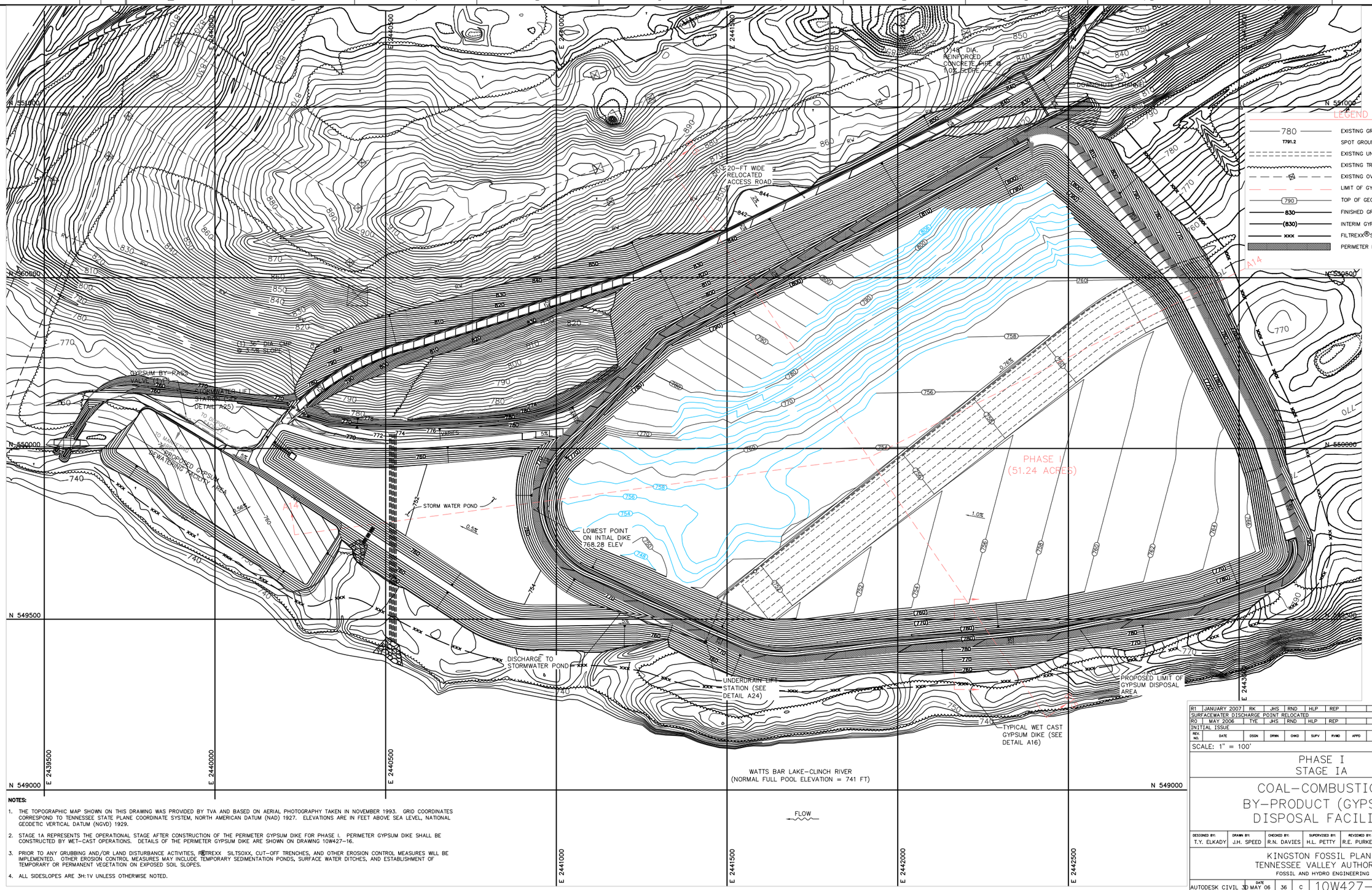
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE MAY 06	36	C	10W427-5A	R 1

GEOSYNTEC CONSULTANTS, INC. | 1
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY



NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. STAGE 1A REPRESENTS THE OPERATIONAL STAGE AFTER CONSTRUCTION OF THE PERIMETER GYPSUM DIKE FOR PHASE I. PERIMETER GYPSUM DIKE SHALL BE CONSTRUCTED BY WET-CAST OPERATIONS. DETAILS OF THE PERIMETER GYPSUM DIKE ARE SHOWN ON DRAWING 10W427-16.
3. PRIOR TO ANY GRUBBING AND/OR LAND DISTURBANCE ACTIVITIES, FILTREXX SILTSOXX, CUT-OFF TRENCHES, AND OTHER EROSION CONTROL MEASURES WILL BE IMPLEMENTED. OTHER EROSION CONTROL MEASURES MAY INCLUDE TEMPORARY SEDIMENTATION PONDS, SURFACE WATER DITCHES, AND ESTABLISHMENT OF TEMPORARY OR PERMANENT VEGETATION ON EXPOSED SOIL SLOPES.
4. ALL SIDESLOPES ARE 3H:1V UNLESS OTHERWISE NOTED.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV
R1	JANUARY 2007	RK	JHS	RND	HLP	REP			K1F450		1
SURFACEWATER DISCHARGE POINT RELOCATED											0
R0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450		
INITIAL ISSUE											

DISCIPLINE INTERFACE: 1 2 3 4

SCALE: 1" = 100' EXCEPT AS NOTED

PHASE I
STAGE IA

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

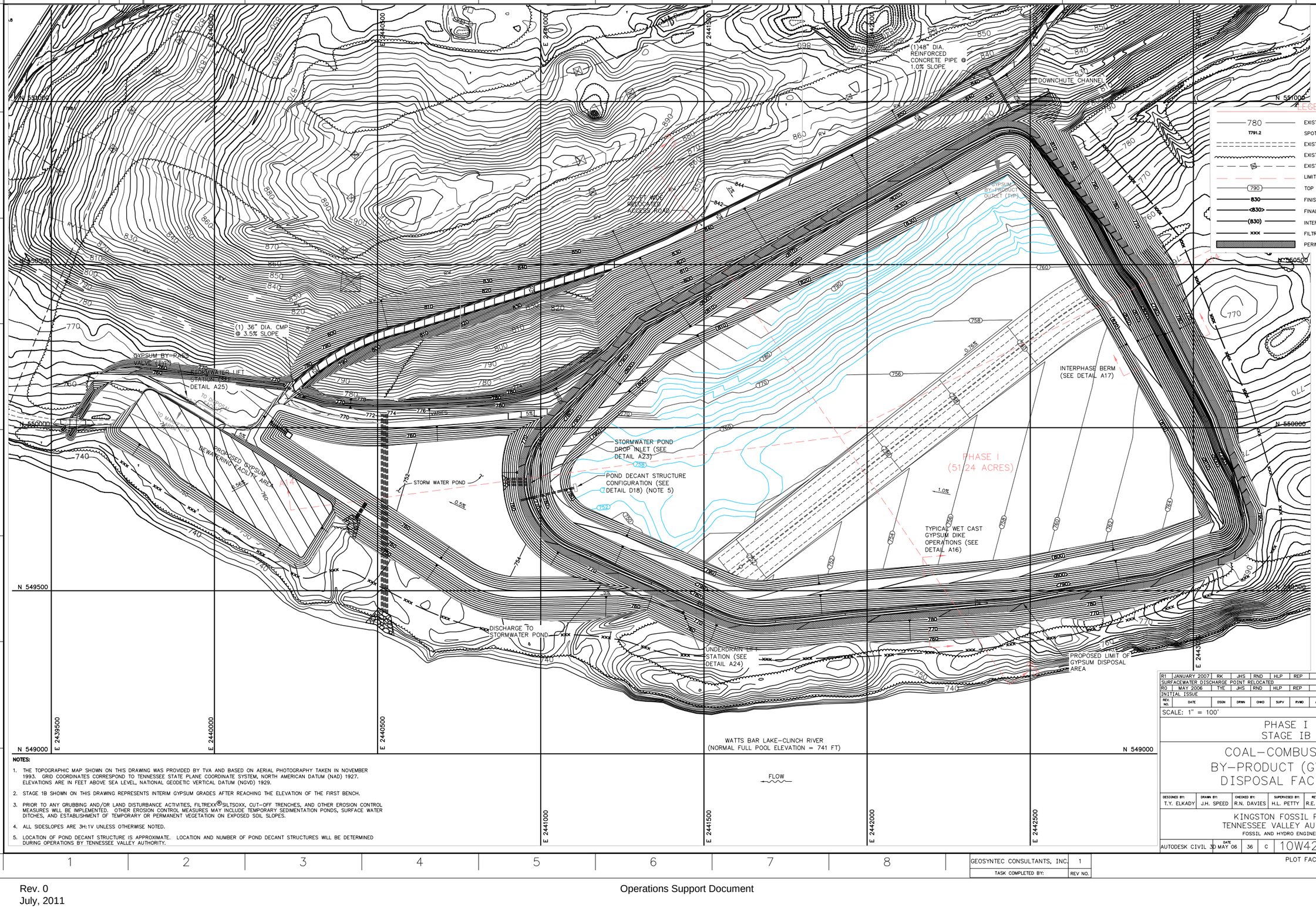
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE	36	C	10W427-6	R 1
	MAY 06				

GEOSYNTEC CONSULTANTS, INC. 1
TASK COMPLETED BY: REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY



NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. STAGE 1B SHOWN ON THIS DRAWING REPRESENTS INTERIM GYPSUM GRADES AFTER REACHING THE ELEVATION OF THE FIRST BENCH.
3. PRIOR TO ANY GRUBBING AND/OR LAND DISTURBANCE ACTIVITIES, FILTREXX®SILTSOXX, CUT-OFF TRENCHES, AND OTHER EROSION CONTROL MEASURES WILL BE IMPLEMENTED. OTHER EROSION CONTROL MEASURES MAY INCLUDE TEMPORARY SEDIMENTATION PONDS, SURFACE WATER DITCHES, AND ESTABLISHMENT OF TEMPORARY OR PERMANENT VEGETATION ON EXPOSED SOIL SLOPES.
4. ALL SIDESLOPES ARE 3H:1V UNLESS OTHERWISE NOTED.
5. LOCATION OF POND DECANT STRUCTURE IS APPROXIMATE. LOCATION AND NUMBER OF POND DECANT STRUCTURES WILL BE DETERMINED DURING OPERATIONS BY TENNESSEE VALLEY AUTHORITY.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R1	JANUARY 2007	RK	JHS	RND	HLP	REP			K1F450		
	SURFACEWATER DISCHARGE POINT RELOCATED										
R0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450		
	INITIAL ISSUE										

DISCIPLINE INTERFACE: 1 2 3 4

SCALE: 1" = 100' EXCEPT AS NOTED

PHASE I STAGE IB

COAL–COMBUSTION BY–PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE			
	MAY 06	36	C	10W427-7 R 1

GEOSYNTEC CONSULTANTS, INC. 1
TASK COMPLETED BY: REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING DO NOT ALTER MANUALLY

LEGEND

- 780 — EXISTING GROUND CONTOUR
- T791.2 — SPOT GROUND ELEVATION
- EXISTING UNPAVED ROAD
- EXISTING TREELINE
- EXISTING OVERHEAD ELECTRICAL TOWER
- LIMIT OF GYPSUM DISPOSAL AREA
- 760 — TOP OF GEOLOGIC BUFFER CONTOUR (FT)
- 830 — FINISHED GRADE CONTOUR (FT)
- <830> — FINAL COVER CONTOUR (FT)
- (830) — INTERIM GYPSUM GRADE CONTOUR (FT)
- XXX — FILTREXX®SILTSOXX OR EQUIVALENT
- PERIMETER ROAD
- HP — HIGH POINT ON DRAINAGE DITCH

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. PHASE II MAY COMMENCE AT ANY TIME DURING DEVELOPMENT OF PHASE I (BASED ON OPERATIONAL EXPERIENCE GAINED BY TVA).
3. GRADES SHOWN IN PHASE II REPRESENT INITIAL SOIL STARTER DIKES AND BOTTOM OF GEOLOGICAL BUFFER.
4. PRIOR TO ANY GRUBBING AND/OR LAND DISTURBANCE ACTIVITIES, FILTREXX SILTSOXX, CUT-OFF TRENCHES, AND OTHER EROSION CONTROL MEASURES WILL BE IMPLEMENTED. OTHER EROSION CONTROL MEASURES MAY INCLUDE TEMPORARY SEDIMENTATION PONDS, SURFACE WATER DITCHES, AND ESTABLISHMENT OF TEMPORARY OR PERMANENT VEGETATION ON EXPOSED SOIL SLOPES.
5. CONSTRUCTION WILL COMMENCE FROM THE LOWEST AREA OF PHASE II. DURING CONSTRUCTION, WATER ACCUMULATED AT THE LOWEST AREA IN PHASE II WILL BE PUMPED INTO PHASE I SURFACE WATER DITCHES.
6. ALL SIDESLOPES ARE 3H:1V UNLESS OTHERWISE NOTED.
7. LOCATION OF POND DECANT STRUCTURE IS APPROXIMATE. LOCATION AND NUMBER OF POND DECANT STRUCTURES WILL BE DETERMINED DURING OPERATIONS BY TENNESSEE VALLEY AUTHORITY.

(1) 48" DIA. REINFORCED CONCRETE PIPE @ 1% SLOPE

20-FT WIDE RELOCATED ACCESS ROAD

PHASE I (51.24 ACRES)

PHASE II (61.46 ACRES)

POND DECANT STRUCTURE CONFIGURATION (SEE DETAIL D18) (NOTE 7)

HAUL ROAD-DRAINAGE BENCH INTERSECTION (SEE DETAIL D20)

LOWEST POINT ON PHASE II SUBGRADE 757.18 ELEV

TEMPORARY SURFACE WATER DISCHARGE LINE

STORMWATER POND DROP INLET (SEE DETAIL A23)

STORM WATER POND

DISCHARGE TO STORMWATER POND

UNDERDRAIN LIFT STATION (SEE DETAIL A24)

PROPOSED LIMIT OF GYPSUM DISPOSAL AREA

FLOW

N 551500 | N 551000 | N 550500 | N 550000 | N 549500

E 2440500 | E 2441000 | E 2441500 | E 2442000 | E 2442500 | E 2443000 | E 2443500 | E 2444000

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV 00
R1	JANUARY 2007	RK	JHS	RND	HLP	REP			K1F450		
SURFACEWATER DISCHARGE POINT RELOCATED											
R0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450		
INITIAL ISSUE											

DISCIPLINE INTERFACE: 1 2 3 4

SCALE: 1" = 100' EXCEPT AS NOTED

PHASE II INTIAL GRADING PLAN AND SOIL DIKES

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

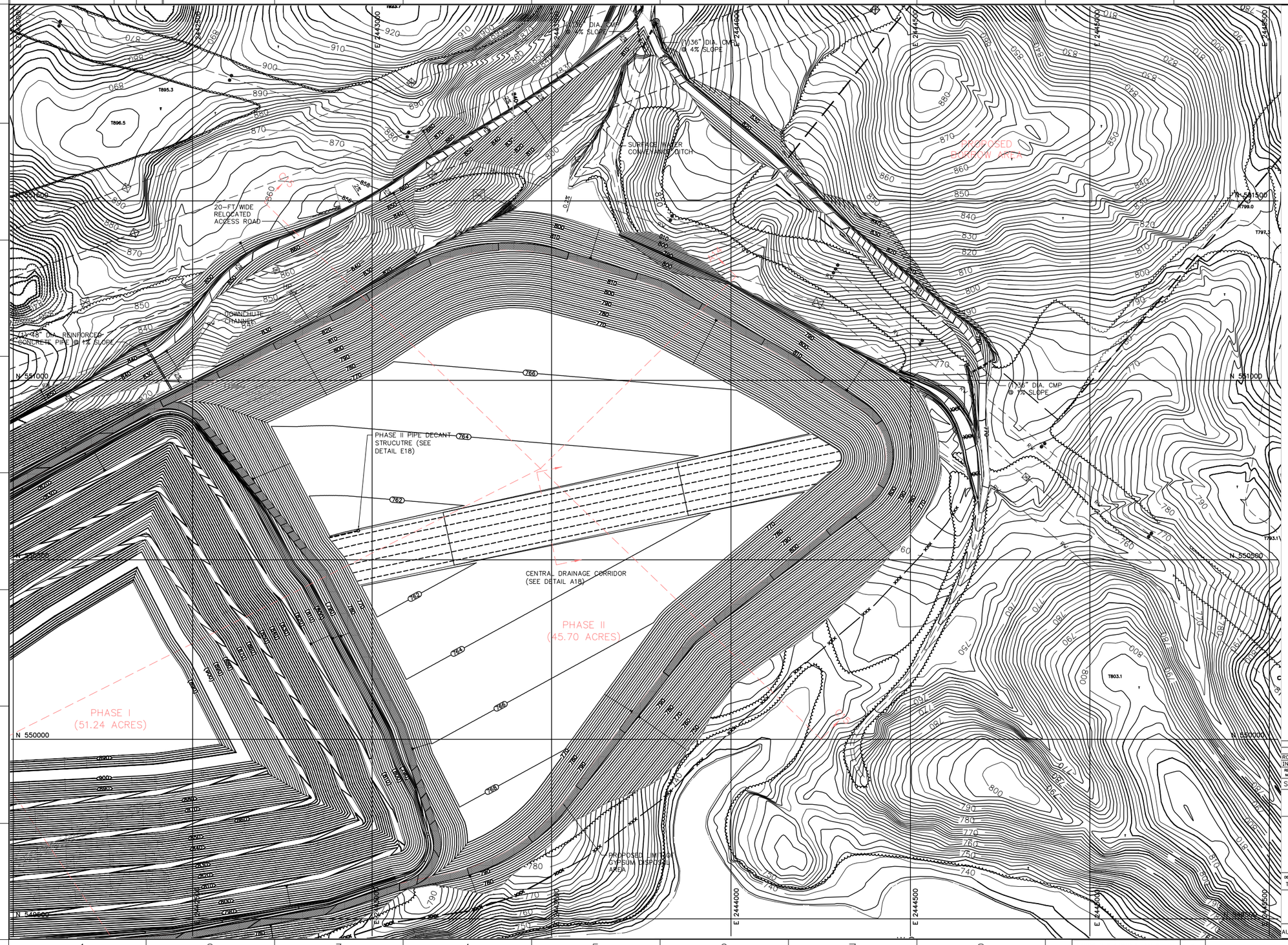
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D | DATE: MAY 06 | 36 | C | 10W427-8 | R 1

GEOSYNTEC CONSULTANTS, INC. | 1
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING DO NOT ALTER MANUALLY



LEGEND

- 780 — EXISTING GROUND CONTOUR
- T791.2 — SPOT GROUND ELEVATION
- EXISTING UNPAVED ROAD
- EXISTING TREELINE
- EXISTING OVERHEAD ELECTRICAL TOWER
- LIMIT OF GYPSUM DISPOSAL AREA
- 790 — TOP OF GEOLOGIC BUFFER CONTOUR (FT)
- 830 — FINISHED GRADE CONTOUR (FT)
- <830> — FINAL COVER CONTOUR (FT)
- (830) — INTERIM GYPSUM GRADE CONTOUR (FT)
- xxx — FILTREXX®SILTSOXX OR EQUIVALENT
- PERIMETER ROAD
- HP — HIGH POINT ON DRAINAGE DITCH

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. GRADES SHOWN ON THIS DRAWING INDICATE INITIAL CONSTRUCTION OF SOIL DIKES AND TOP OF GEOLOGIC BUFFER.
3. PRIOR TO ANY GRUBBING AND/OR LAND DISTURBANCE ACTIVITIES, FILTERXX® SILTSOXX, CUT-OFF TRENCHES, AND OTHER EROSION CONTROL MEASURES WILL BE IMPLEMENTED. OTHER EROSION CONTROL MEASURES MAY INCLUDE TEMPORARY SEDIMENTATION PONDS, SURFACE WATER DITCHES, AND ESTABLISHMENT OF TEMPORARY OR PERMANENT VEGETATION ON EXPOSED SOIL SLOPES.
4. ALL SIDESLOPES ARE 3H:1V UNLESS OTHERWISE NOTED.

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT 35	AS CONST	DISCIPLINE INTERFACE REV 00
R0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450		
INITIAL ISSUE											

SCALE: 1" = 100' EXCEPT AS NOTED

PHASE II TOP OF GEOLOGICAL BUFFER

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

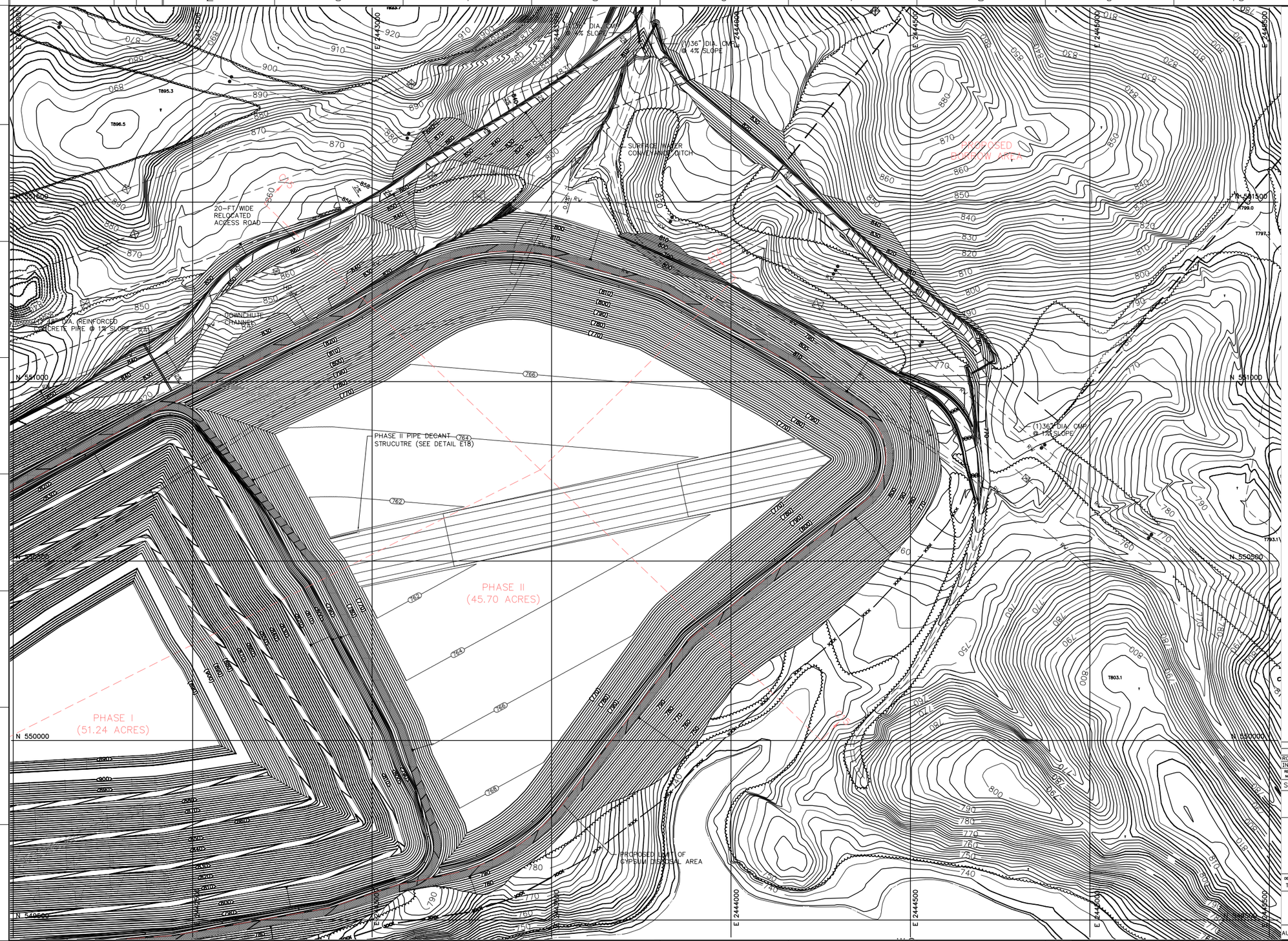
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE MAY 06	36	C	10W427-9	R 0

GEOSYNTEC CONSULTANTS, INC. | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING DO NOT ALTER MANUALLY



LEGEND

- 780 — EXISTING GROUND CONTOUR
- T791.2 — SPOT GROUND ELEVATION
- EXISTING UNPAVED ROAD
- EXISTING TREELINE
- EXISTING OVERHEAD ELECTRICAL TOWER
- LIMIT OF GYPSUM DISPOSAL AREA
- (790) — TOP OF GEOLOGIC BUFFER CONTOUR (FT)
- 830 — FINISHED GRADE CONTOUR (FT)
- <830> — FINAL COVER CONTOUR (FT)
- (830) — INTERIM GYPSUM GRADE CONTOUR (FT)
- xxx — FILTREXX® SILTSOXX OR EQUIVALENT
- PERIMETER ROAD
- HP — HIGH POINT ON DRAINAGE DITCH

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. PHASE II STAGE 1A REPRESENTS THE STAGE AFTER CONSTRUCTION OF THE PERIMETER GYPSUM DIKE FOR PHASE II. PERIMETER GYPSUM DIKE SHALL BE CONSTRUCTED BY WET-CAST OPERATIONS. DETAILS OF THE PERIMETER GYPSUM DIKE ARE SHOWN ON DRAWING 10W427-16.
3. PRIOR TO ANY GRUBBING AND/OR LAND DISTURBANCE ACTIVITIES, FILTERXX® SILTSOXX, CUT-OFF TRENCHES, AND OTHER EROSION CONTROL MEASURES WILL BE IMPLEMENTED. OTHER EROSION CONTROL MEASURES MAY INCLUDE TEMPORARY SEDIMENTATION PONDS, SURFACE WATER DITCHES, AND ESTABLISHMENT OF TEMPORARY OR PERMANENT VEGETATION ON EXPOSED SOIL SLOPES.
4. ALL SIDESLOPES ARE 3H:1V UNLESS OTHERWISE NOTED.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R0	MAY 2006	TYE	JHS	RND	HLP	REP			KIF450	
INITIAL ISSUE										

DISCIPLINE INTERFACE: REV 0 | 1 | 2 | 3 | 4

SCALE: 1" = 100' EXCEPT AS NOTED

PHASE II STAGE 1A

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

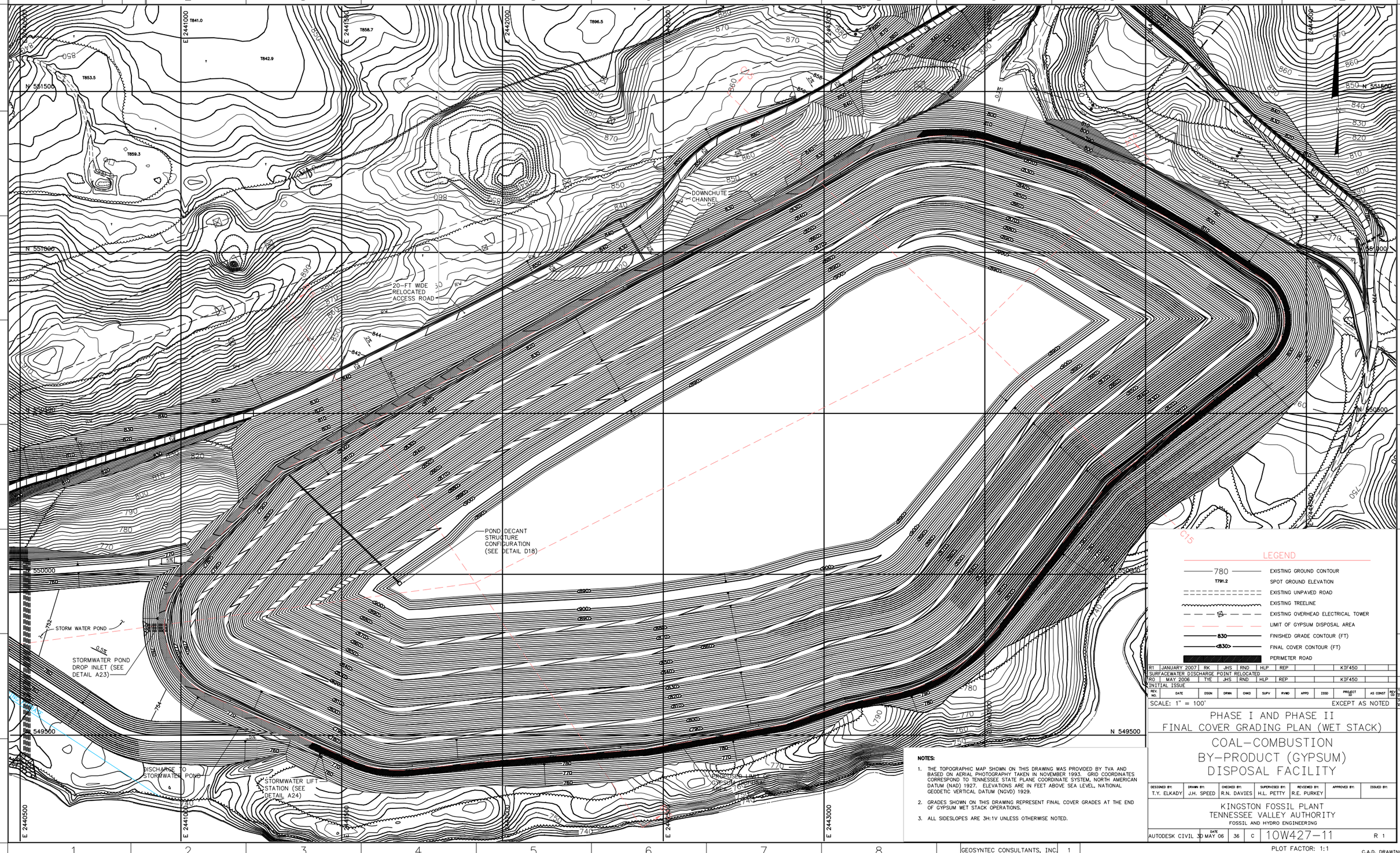
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE	36	C	10W427-10	R 0
	06 MAY 06				

GEOSYNTEC CONSULTANTS, INC.	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY



LEGEND

- 780 — EXISTING GROUND CONTOUR
- T791.2 — SPOT GROUND ELEVATION
- EXISTING UNPAVED ROAD
- EXISTING TREELINE
- EXISTING OVERHEAD ELECTRICAL TOWER
- LIMIT OF GYPSUM DISPOSAL AREA
- 830 — FINISHED GRADE CONTOUR (FT)
- <830> — FINAL COVER CONTOUR (FT)
- PERIMETER ROAD

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. NO.
R1	JANUARY 2007	RK	JHS	RND	HLP	REP			K1F450		
SURFACEWATER DISCHARGE POINT RELOCATED											
R0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450		
INITIAL ISSUE											

DISCIPLINE INTERFACE: 1 2 3 4

SCALE: 1" = 100' EXCEPT AS NOTED

PHASE I AND PHASE II FINAL COVER GRADING PLAN (WET STACK)

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE			
	MAY 06	36	C	10W427-11 R 1

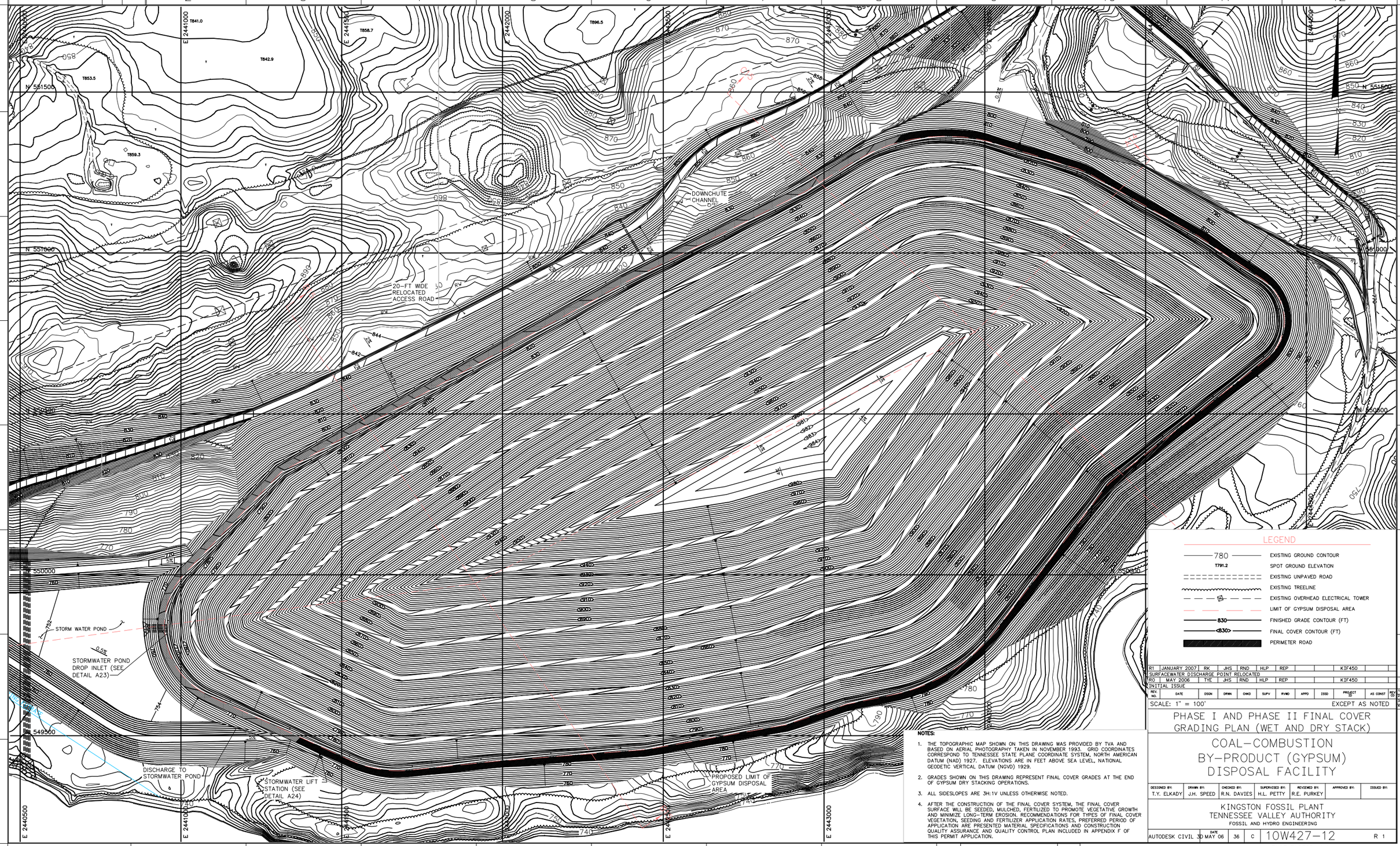
PLOT FACTOR: 1:1

C.A.D. DRAWING DO NOT ALTER MANUALLY

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. GRADES SHOWN ON THIS DRAWING REPRESENT FINAL COVER GRADES AT THE END OF GYPSUM WET STACK OPERATIONS.
3. ALL SIDESLOPES ARE 3H:1V UNLESS OTHERWISE NOTED.

GEOSYNTEC CONSULTANTS, INC.	1
TASK COMPLETED BY:	REV NO.



LEGEND

- 780 — EXISTING GROUND CONTOUR
- T791.2 — SPOT GROUND ELEVATION
- EXISTING UNPAVED ROAD
- EXISTING TREELINE
- EXISTING OVERHEAD ELECTRICAL TOWER
- LIMIT OF GYPSUM DISPOSAL AREA
- 830 — FINISHED GRADE CONTOUR (FT)
- <830> — FINAL COVER CONTOUR (FT)
- PERIMETER ROAD

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R1	JANUARY 2007	RK	JHS	RND	HLP	REP			K1F450		
	SURFACEWATER DISCHARGE POINT RELOCATED										
R0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450		
	INITIAL ISSUE										

DISCIPLINE INTERFACE: 1 2 3 4

SCALE: 1" = 100' EXCEPT AS NOTED

PHASE I AND PHASE II FINAL COVER GRADING PLAN (WET AND DRY STACK)

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE	36	C	10W427-12	R 1
	MAY '06				

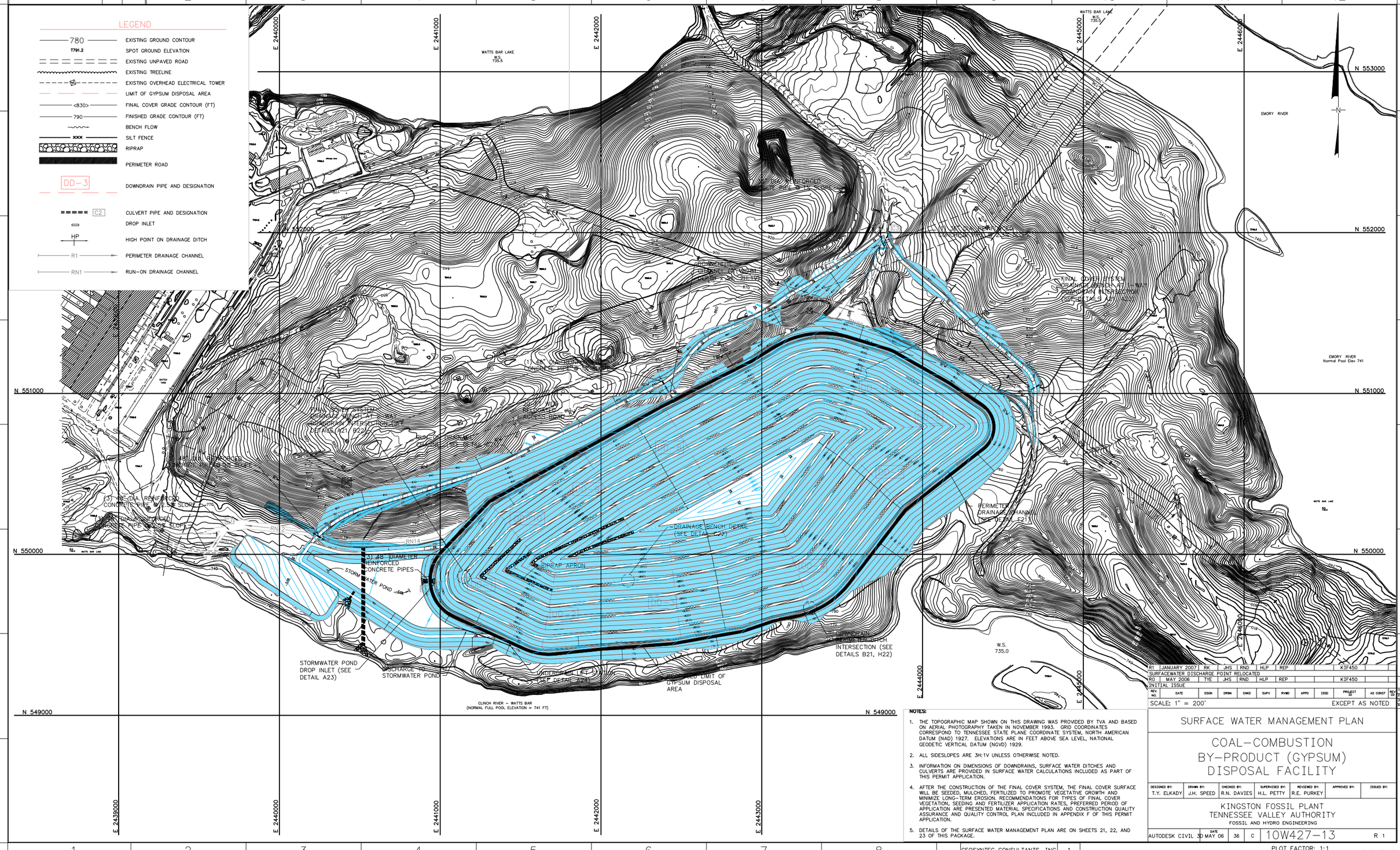
NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. GRADES SHOWN ON THIS DRAWING REPRESENT FINAL COVER GRADES AT THE END OF GYPSUM DRY STACKING OPERATIONS.
3. ALL SIDESLOPES ARE 3H:1V UNLESS OTHERWISE NOTED.
4. AFTER THE CONSTRUCTION OF THE FINAL COVER SYSTEM, THE FINAL COVER SURFACE WILL BE SEEDED, MULCHED, FERTILIZED TO PROMOTE VEGETATIVE GROWTH AND MINIMIZE LONG-TERM EROSION. RECOMMENDATIONS FOR TYPES OF FINAL COVER VEGETATION, SEEDING AND FERTILIZER APPLICATION RATES, PREFERRED PERIOD OF APPLICATION ARE PRESENTED MATERIAL SPECIFICATIONS AND CONSTRUCTION QUALITY ASSURANCE AND QUALITY CONTROL PLAN INCLUDED IN APPENDIX F OF THIS PERMIT APPLICATION.

GEOSYNTEC CONSULTANTS, INC.	1
TASK COMPLETED BY:	REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING DO NOT ALTER MANUALLY



REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. CD
R1	JANUARY 2007	RK	JHS	RND	HLP	REP			K1F450		
	SURFACE WATER DISCHARGE POINT RELOCATED										
R0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450		
	INITIAL ISSUE										

DISCIPLINE INTERFACE: 1 2 3 4

SCALE: 1" = 200' EXCEPT AS NOTED

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. ALL SIDESLOPES ARE 3H:1V UNLESS OTHERWISE NOTED.
3. INFORMATION ON DIMENSIONS OF DOWNDRAINS, SURFACE WATER DITCHES AND CULVERTS ARE PROVIDED IN SURFACE WATER CALCULATIONS INCLUDED AS PART OF THIS PERMIT APPLICATION.
4. AFTER THE CONSTRUCTION OF THE FINAL COVER SYSTEM, THE FINAL COVER SURFACE WILL BE SEEDED, MULCHED, FERTILIZED TO PROMOTE VEGETATIVE GROWTH AND MINIMIZE LONG-TERM EROSION. RECOMMENDATIONS FOR TYPES OF FINAL COVER VEGETATION, SEEDING AND FERTILIZER APPLICATION RATES, PREFERRED PERIOD OF APPLICATION ARE PRESENTED MATERIAL SPECIFICATIONS AND CONSTRUCTION QUALITY ASSURANCE AND QUALITY CONTROL PLAN INCLUDED IN APPENDIX F OF THIS PERMIT APPLICATION.
5. DETAILS OF THE SURFACE WATER MANAGEMENT PLAN ARE ON SHEETS 21, 22, AND 23 OF THIS PACKAGE.

SURFACE WATER MANAGEMENT PLAN

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

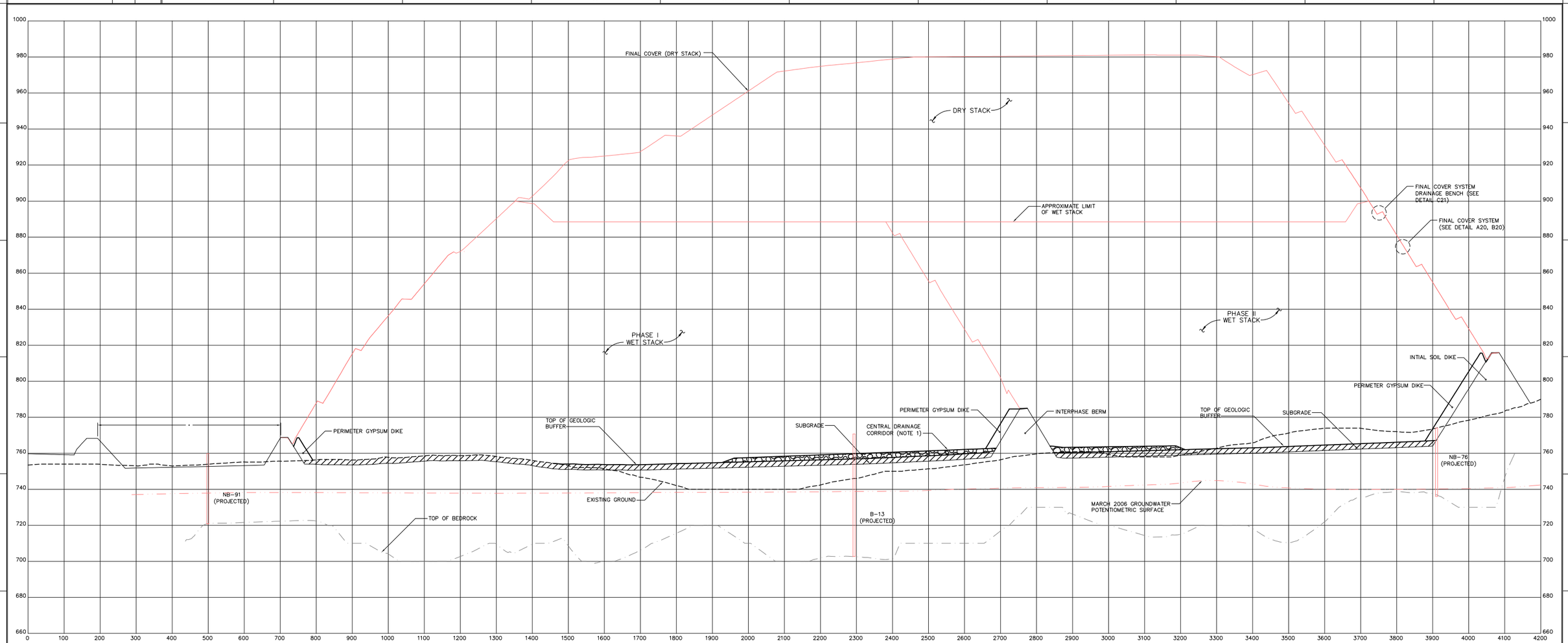
AUTODESK CIVIL 3D	DATE: MAY 06	36	C	10W427-13	R 1

GEOSYNTEC CONSULTANTS, INC. | 1
TASK COMPLETED BY: | REV NO.

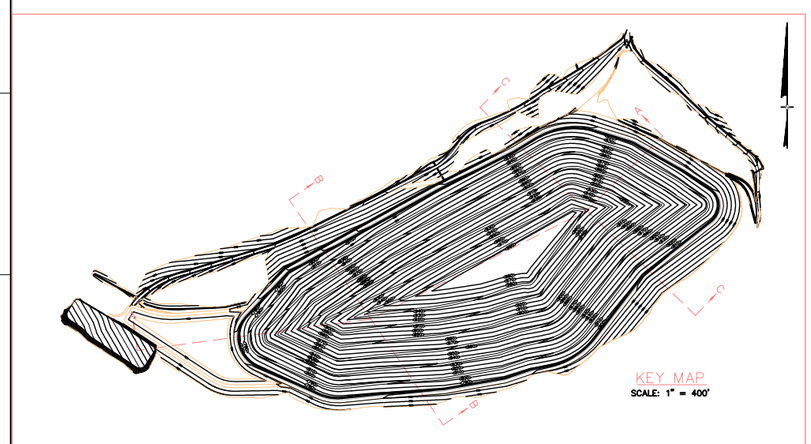
PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

36 C 10W427-13



SECTION A14
SCALE HORIZONTAL: 1" = 100'
SCALE VERTICAL: 1" = 20'



KEY MAP
SCALE: 1" = 400'

NOTES:

1. THE CENTRAL DRAINAGE CORRIDOR ILLUSTRATED ON THIS CROSS SECTIONIS ONLY SHOWN IN AREAS WHERE IT IS COINCIDENT WITH SECTION LINE LOCATION.
2. FOR CLARITY, ONLY FULL DEPTH BORINGS WITHIN 50 FEET OF THE SECTION LINE ARE SHOWN ON THIS CROSS SECTION. FOR ADDITIONAL INFORMATION SEE THE GEOTECHNICAL REPORTS PREPARED BY MACTEC AND DATED OCTOBER 2005 AND FEBRUARY 2006.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R0	MAY 2006	TYE	JHS	RND	HLP	REP			KIF450	
INITIAL ISSUE										

DISCIPLINE INTERFACE

SCALE: AS SHOWN EXCEPT AS NOTED

CROSS SECTIONS I

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE	36	C	10W427-14	R 0
	30 MAY 06				

GEOSYNTEC CONSULTANTS, INC. | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

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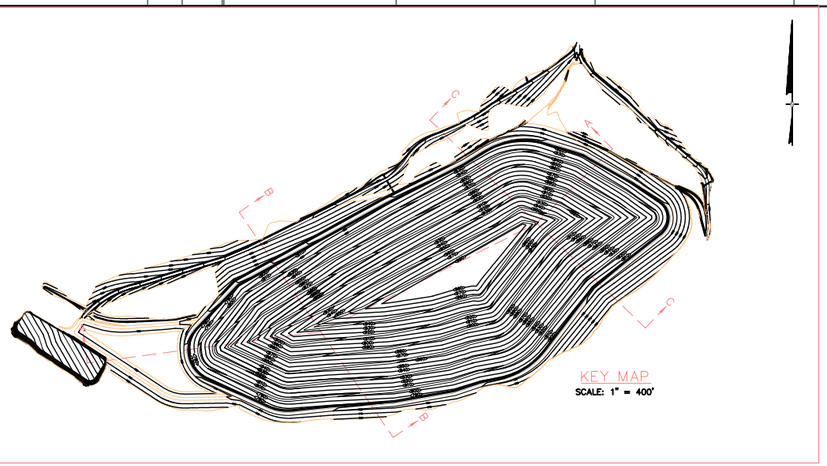
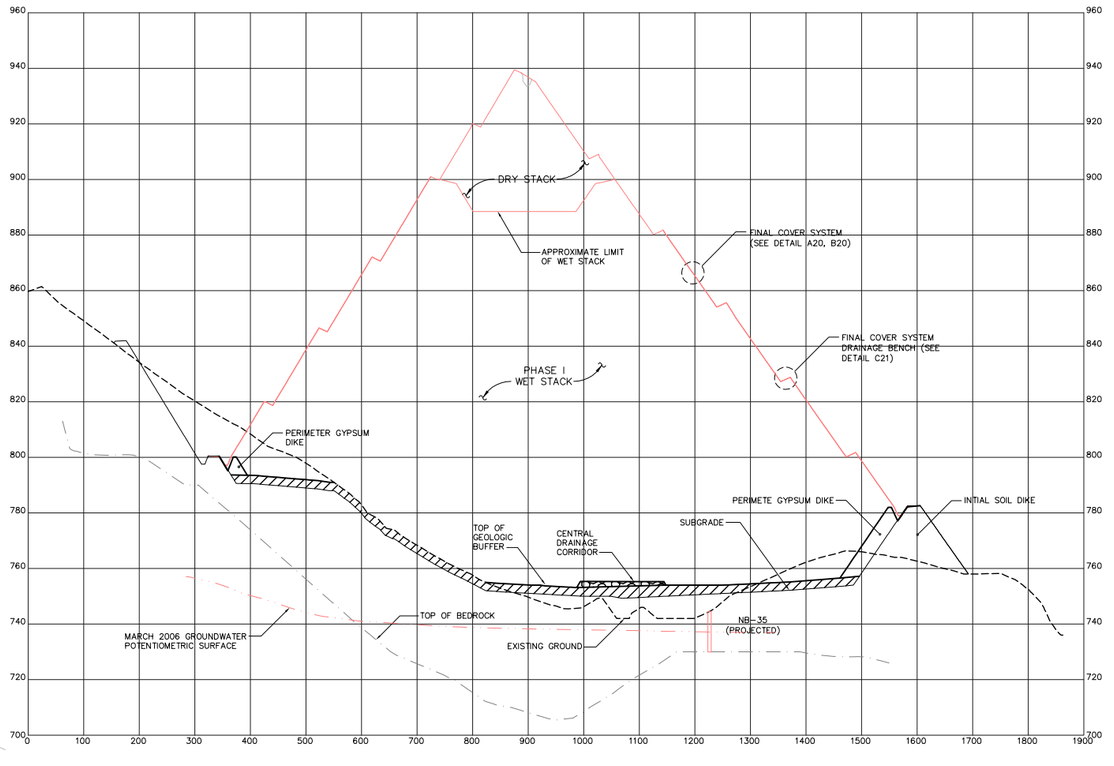
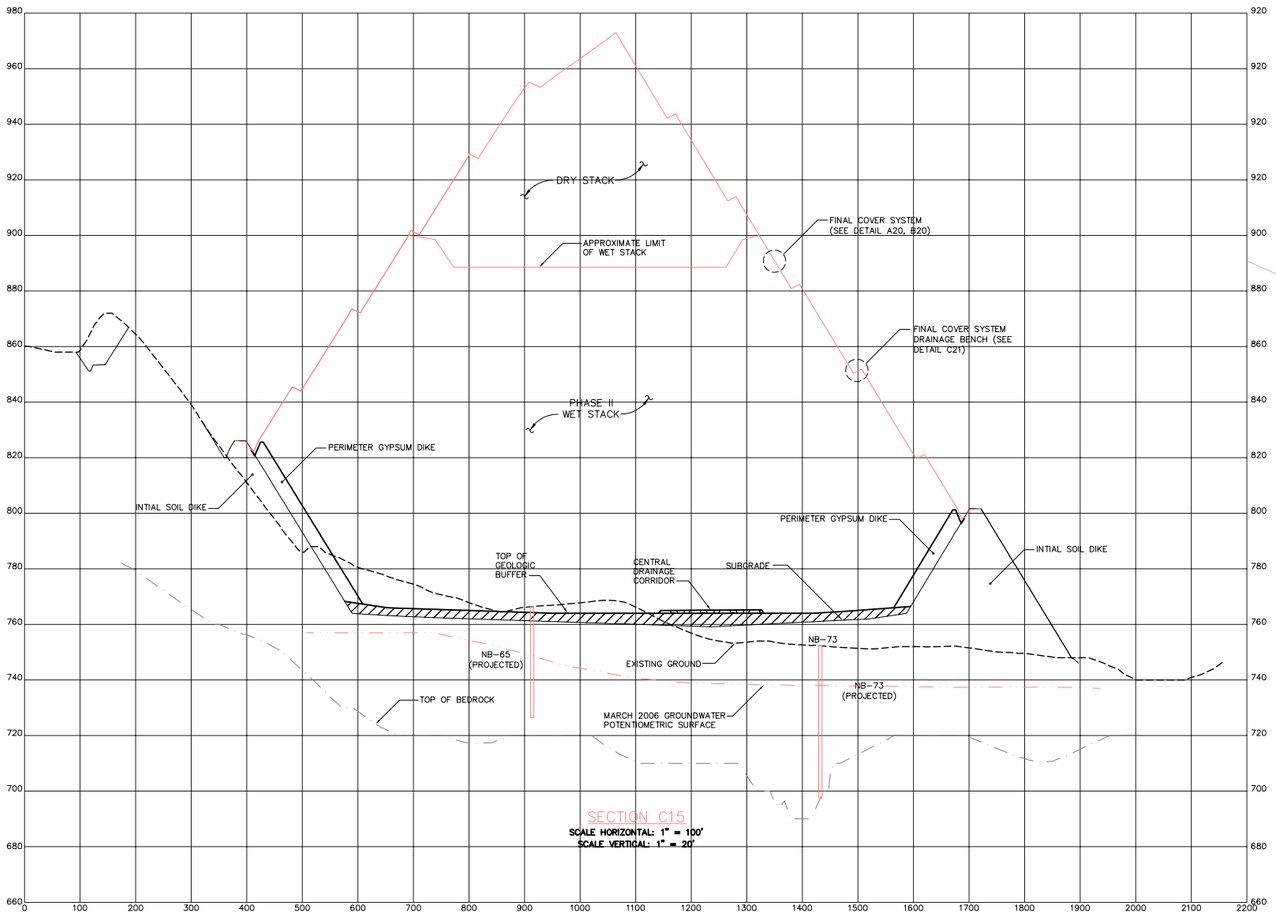




SECTION B15
SCALE HORIZONTAL: 1" = 100'
SCALE VERTICAL: 1" = 20'



SECTION C15
SCALE HORIZONTAL: 1" = 100'
SCALE VERTICAL: 1" = 20'

NOTE:

1. FOR CLARITY, ONLY FULL DEPTH BORINGS WITHIN 50 FEET OF THE SECTION LINE ARE SHOWN ON THIS CROSS SECTION. FOR ADDITIONAL INFORMATION SEE THE GEOTECHNICAL REPORTS PREPARED BY MACTEC AND DATED OCTOBER 2005 AND FEBRUARY 2006.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. ID
R0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450		
INITIAL ISSUE											

DISCIPLINE INTERFACE: 1 2 3 4

SCALE: AS SHOWN EXCEPT AS NOTED

CROSS SECTIONS II

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE			
	MAY 06	36	C	10W427-15 R 0

GEOSYNTEC CONSULTANTS, INC. | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
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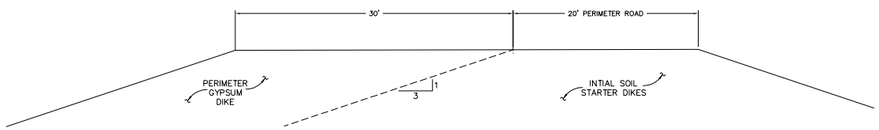
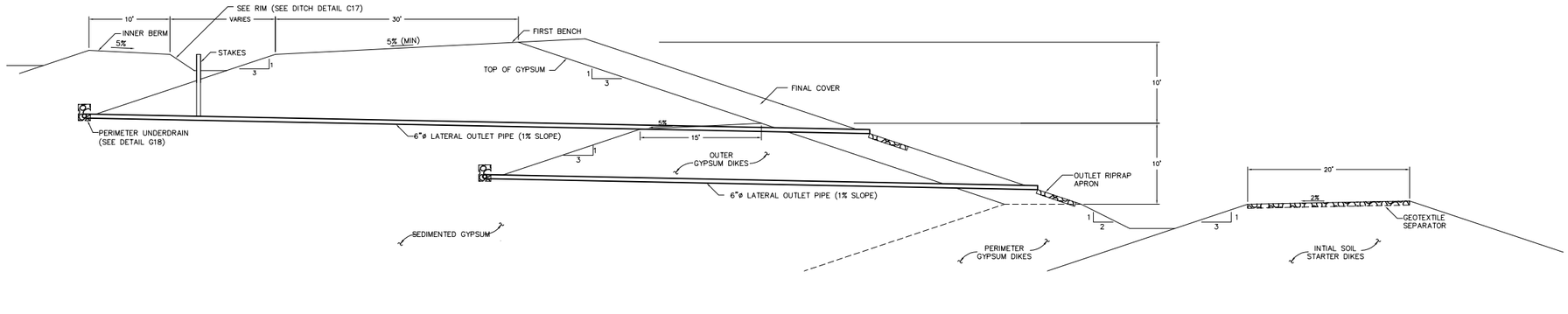


STAGE 1A: CONSTRUCTION OF INITIAL SOIL DIKE AND PERIMETER GYPSUM DITCH

SCALE: 1" = 6'

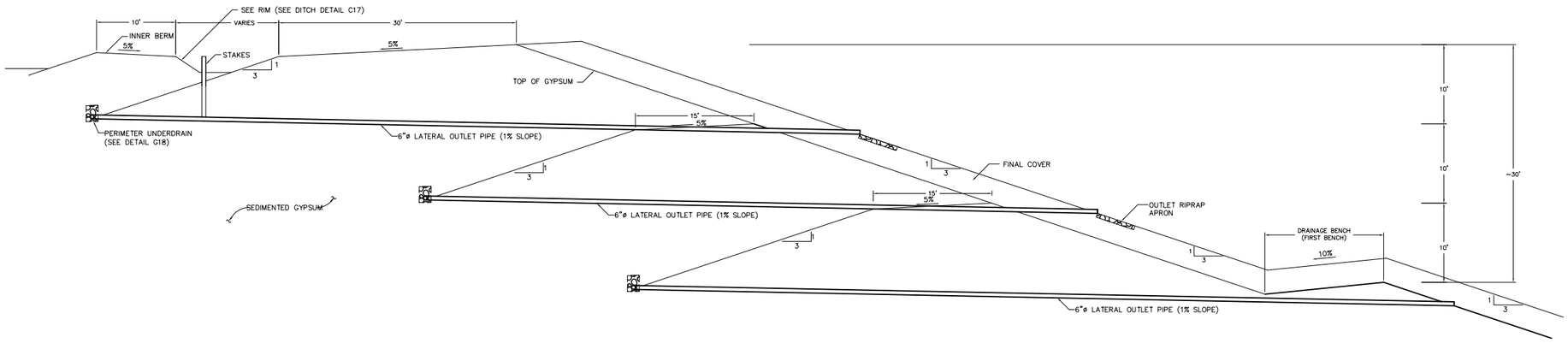
XREF: 3731K041



STAGE 1B: RAISING OF OUTER GYPSUM DIKE TO FIRST BENCH ELEVATION (NOTE 1)

SCALE: 1" = 6'

XREF: 3731K047



RIM DITCH OPERATIONS TO RAISE OUTER GYPSUM DIKE TO SECOND BENCH (NOTE 2)

SCALE: 1" = 6'

XREF: 3731K047

DETAIL A16

TYPICAL WET CAST GYPSUM OPERATIONS

NOTES:

1. INITIAL SOIL DIKES SHALL BE CONSTRUCTED FROM SOIL. TECHNICAL SPECIFICATION OF SOILS USED FOR THE SOIL DIKES ARE PRESENTED IN THE MATERIALS SPECIFICATIONS AND CONSTRUCTION QUALITY ASSURANCE AND QUALITY CONTROL PLAN INCLUDED AS APPENDIX O OF THIS PERMIT APPLICATION.
2. CONSTRUCT PERIMETER GYPSUM DIKE USING WET CAST OPERATIONS.
3. OUTER GYPSUM DIKES WILL BE RAISED PROGRESSIVELY TO THE ELEVATION OF THE FIRST BENCH USING WET CAST GYPSUM.
4. TRANSITION TO RIM DITCH OPERATIONS (IF REQUIRED), DIKES WILL BE RAISED IN 5 FEET (TYP) LIFTS UNTIL NEXT BENCH IS ATTAINED.
5. CONSTRUCT DIKE DRAINS AFTER EACH VERTICAL LIFT OF 10ft. ENSURE A MINIMUM COVER OF 1ft BELOW THE SUBSEQUENT RIM DITCH.
6. PERIMETER UNDERDRAIN SHALL HAVE MINIMUM 1% SLOPE FROM HIGH POINTS TO LOW POINTS. PLACE LATERAL OUTLET PIPES AT LOW POINTS.
7. LATERAL OUTLET PIPES SHALL BE PLACED 250 FEET ON CENTER MAXIMUM.
8. AFTER INSTALLATION OF PERIMETER DRAIN, INSTALL STAKES AT DRAINAGE OUTLET. PROVIDE A MARK ON THE STAKE INDICATING THE DEPTH TO THE DRAIN PIPE VISIBLE TO EQUIPMENT OPERATION TO PREVENT DAMAGE TO DRAIN PIPE.
9. INTERMEDIATE COVER SHALL BE PLACED INCREMENTALLY AND CONCURRENTLY WITH DIKE CONSTRUCTION AND WILL CONSIST OF 9 INCHES OF SOIL SUITABLE FOR THE SUPPORT OF VEGETATION. AFTER PLACEMENT OF COVER, AREA SHALL BE SEEDED IN ACCORDANCE WITH VEGETATION SPECIFICATIONS PROVIDED IN APPENDIX F OF THIS PERMIT APPLICATION.
10. BEFORE FINAL COVER IS COMPLETED, OUTLET PIPES SHALL BE EXTENDED TO INSURE THAT THE END OF THE PIPE PROTRUDES BEYOND THE FINAL COVER GRADE.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. CD
R0	MAY 2006	TYE	JHS	RND	HLP	REP			KIF450		
INITIAL ISSUE											

DISCIPLINE INTERFACE: 1, 2, 3, 4

SCALE: AS SHOWN — EXCEPT AS NOTED

OPERATIONAL AND TYPICAL DETAILS I

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE	36	C	10W427-16	R 0
	MAY 06				

GEOSYNTEC CONSULTANTS, INC. | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

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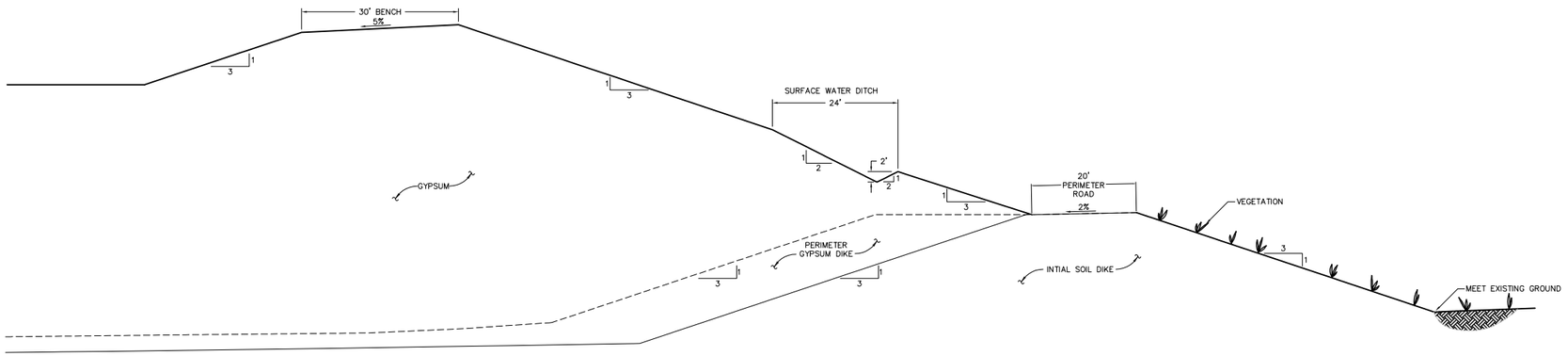
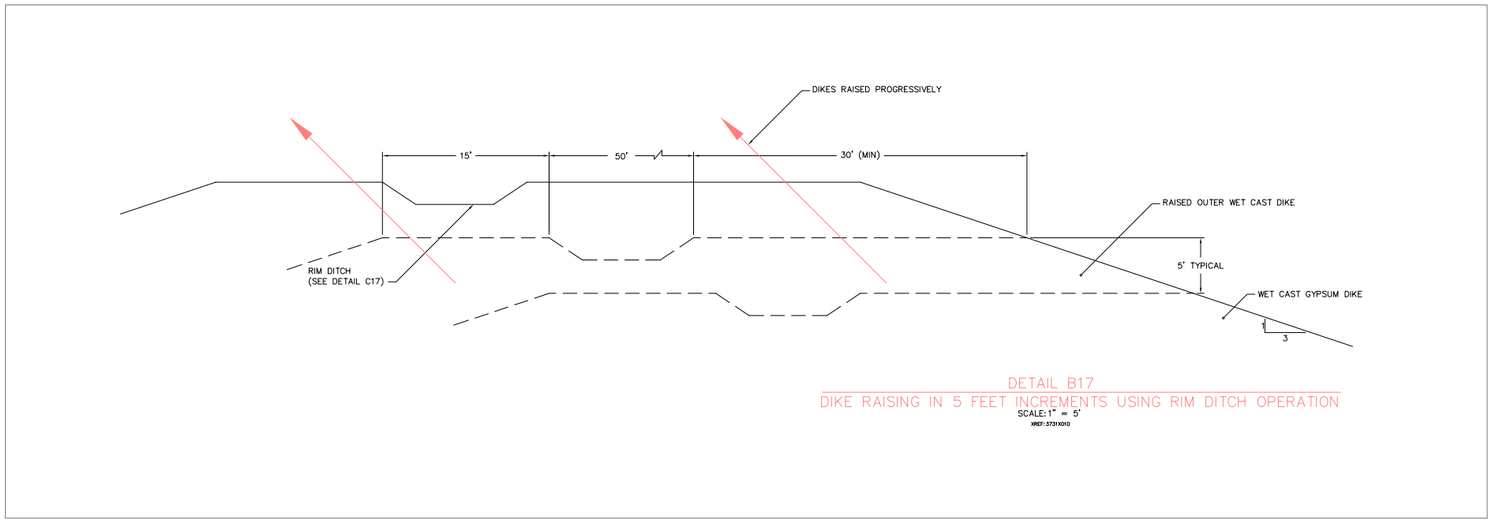
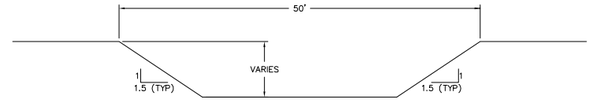


DETAIL A17
INTER PHASE BERM
SCALE: 1" = 10'
XREF: 3371X038



DETAIL B17
DIKE RAISING IN 5 FEET INCREMENTS USING RIM DITCH OPERATION
SCALE: 1" = 5'
XREF: 3731X010



DETAIL C17
RIM DITCH
SCALE: N.T.S.
XREF: 3731X008

R0	MAY 2006	TYE	JHS	RND	HLP	REP				KIF450					
INITIAL ISSUE															
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. CD	DISCIPLINE INTERFACE			
											1				
											2				
											3				
											4				

SCALE: AS SHOWN EXCEPT AS NOTED

OPERATIONAL AND TYPICAL DETAILS II

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE MAY 06	36	C	10W427-17	R 0

GEOSYNTEC CONSULTANTS, INC. | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
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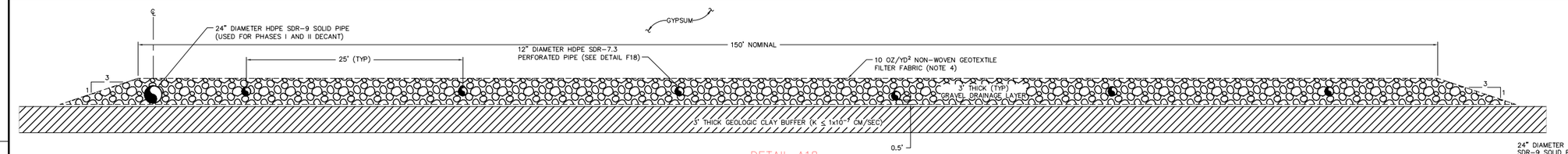
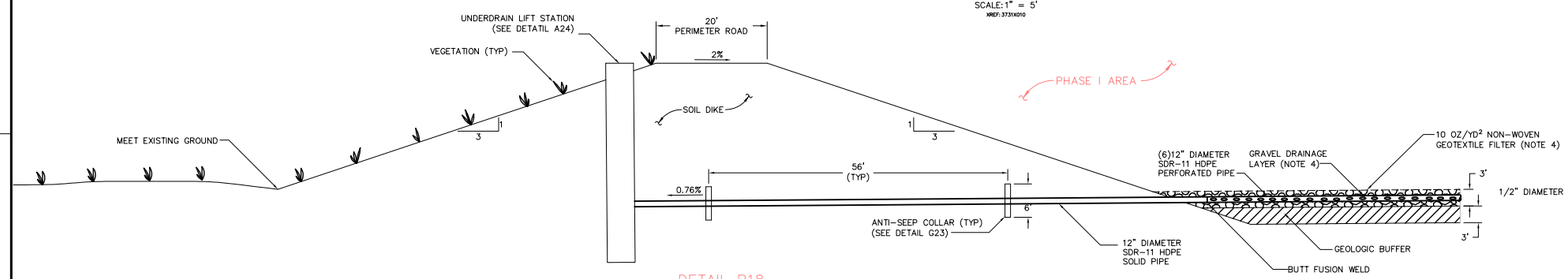
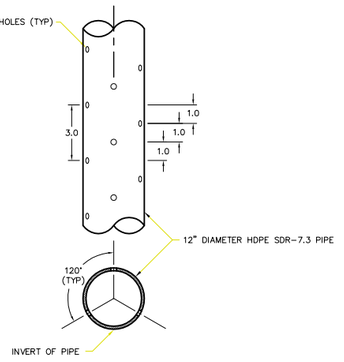


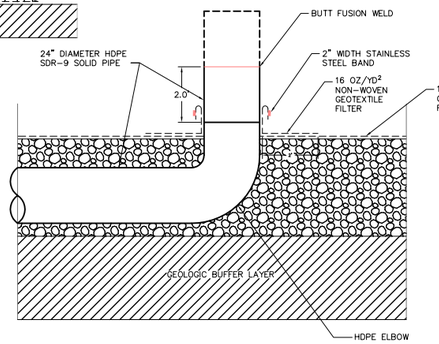
DETAIL A18
GEOLOGIC BUFFER AND CENTRAL DRAINAGE CORRIDOR (NOTE 4)
SCALE: 1" = 5'
XREF: 3731X010



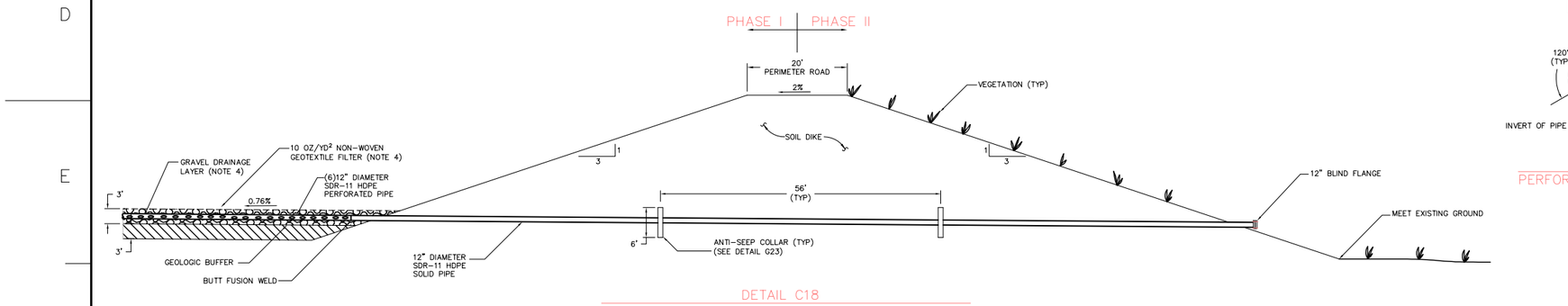
DETAIL B18
DRAINAGE PIPE PENETRATION OF PERIMETER SOIL DIKE
SCALE: 1" = 10'
XREF: 3731X030



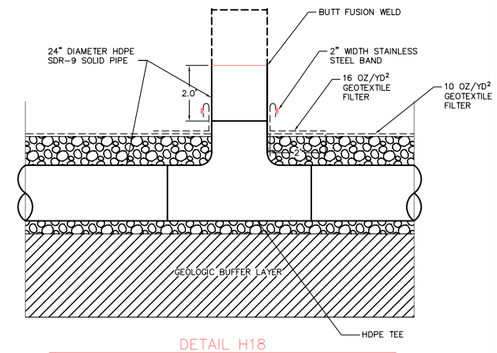
DETAIL F18
PERFORATED DRAINAGE PIPE
SCALE: NTS
XREF: 3731X019



DETAIL E18
PHASE II PIPE DECANT STRUCTURE (NOTE 3)
SCALE: 1" = 2'
XREF: 3731X050



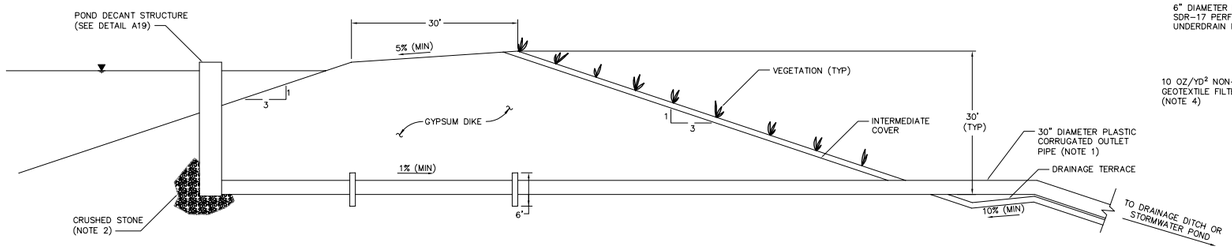
DETAIL C18
PHASE I CENTRAL DRAINAGE CORRIDOR TERMINATION
SCALE: 1" = 10'
XREF: 3731X049



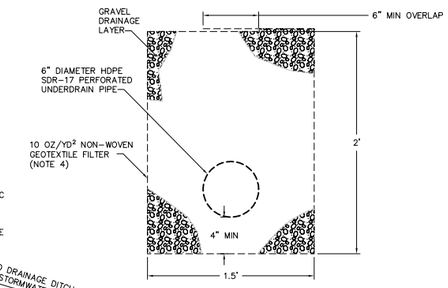
DETAIL H18
PHASE I PIPE DECANT STRUCTURE (NOTE 3)
SCALE: 1" = 2'
XREF: 3731X052

NOTES:

1. AVOID VEHICLE TRAFFIC ON TOP OF OUTLET PIPE.
2. A 5'X5' HOLE SHALL BE EXCAVATED TO A DEPTH OF 2' FOR PLACEMENT OF CRUSHED STONE BENEATH THE PIPE DECANT STRUCTURE. THE HOLE IS TO BE BACKFILLED WITH CRUSHED STONE AND COMPACTED UNTIL A STABLE BASE IS ACHIEVED.
3. DURING THE INITIAL DISPOSAL OF SLUICED GYPSUM IN PHASES I AND II, THE PIPE DECANT STRUCTURE SHALL BE USED. AS THE LEVEL GYPSUM RISES IN PHASES I AND II, THE ELEVATION OF TOP OF PIPE DECANT STRUCTURE WILL BE EXTENDED BY WELDING TWO FOOT PIPE SECTIONS. WHEN THE LEVEL OF SEDIMENTED GYPSUM IN PHASES I AND II REACH THE ELEVATION OF PERIMETER DIKE, THE PIPE DECANT STRUCTURE MAY BE ABANDONED AND POND DECANT STRUCTURES WILL BE USED.
4. THE GEOLOGIC CLAY BUFFER AND COMPONENTS OF THE CENTRAL DRAINAGE CORRIDOR ARE CONSTRUCTED IN ACCORDANCE WITH THE MATERIAL SPECIFICATION AND CONSTRUCTION QUALITY ASSURANCE AND QUALITY CONTROL PLAN INCLUDED IN APPENDIX F OF THIS PERMIT APPLICATION.



DETAIL D18
POND DECANT STRUCTURE CONFIGURATION
SCALE: NTS
XREF: 3731X020



DETAIL G18
PERIMETER UNDERDRAIN
SCALE: 1" = 0.5'
XREF: 3731X009

R0	MAY 2006	TYE	JHS	RND	HLP	REP				K1F450			DISCIPLINE INTERFACE
INITIAL ISSUE													
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. NO.		
											1		
											2		
											3		
											4		

SCALE: AS SHOWN EXCEPT AS NOTED

DRAINAGE SYSTEM DETAILS I

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE 31 MAY 06	36	C	10W427-18 R 0

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TASK COMPLETED BY:	REV NO.

PLOT FACTOR: 1:1

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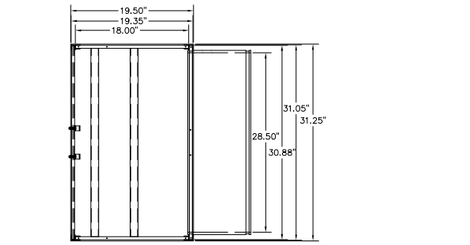

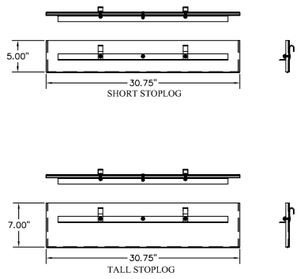

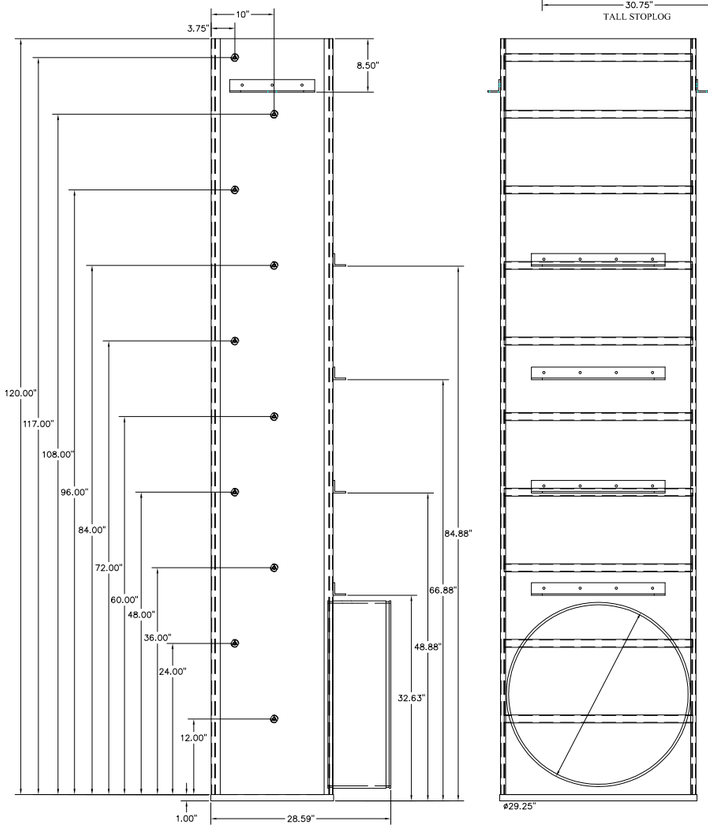

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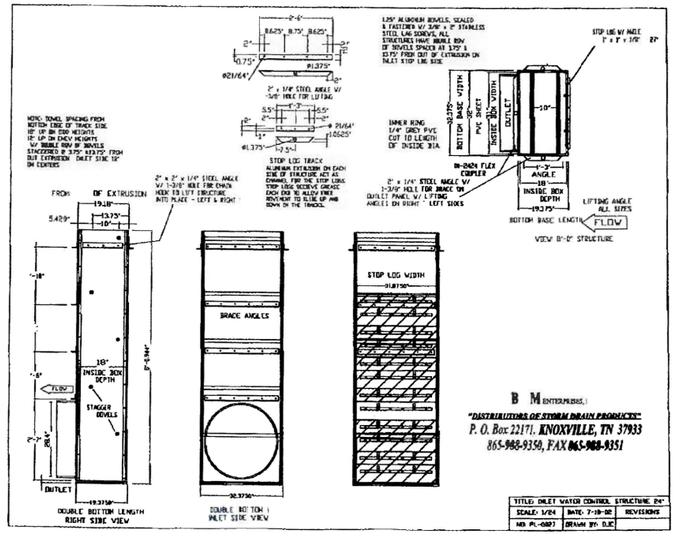

BPM ENTERPRISES, INC.
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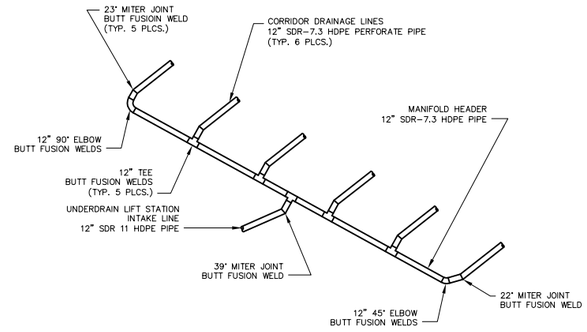
865-988-9350, (F) 865-988-9351

DETAIL A19
POND DECANT STRUCTURE



DETAIL B19
UNDERDRAIN MANIFOLD

ITEM	QTY	ITEM DESCRIPTION	PART NO.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES.
.X ±.06
.XX ±.03
.XXX ±.010
ANGLES ±2°
BREAK ALL SHARP CORNERS.

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TITLE
INLET 24" X 120" WCS

DATE:	DRAWN BY:	PART NO.	REV.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV ID
R0	MAY 2006	TYE	JHS	RND	HLP	REP			KIF450		
INITIAL ISSUE											

SCALE: NONE
EXCEPT AS NOTED

DRAINAGE SYSTEM DETAILS II

COAL-COMBUSTION
BY-PRODUCT (GYPSUM)
DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D | DATE 30 MAY 06 | 36 | C | 10W427-19 | R 0

GEOSYNTEC CONSULTANTS, INC. | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
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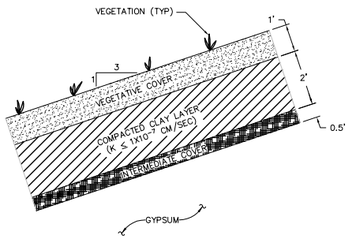
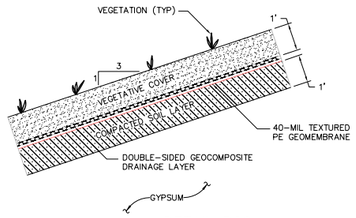
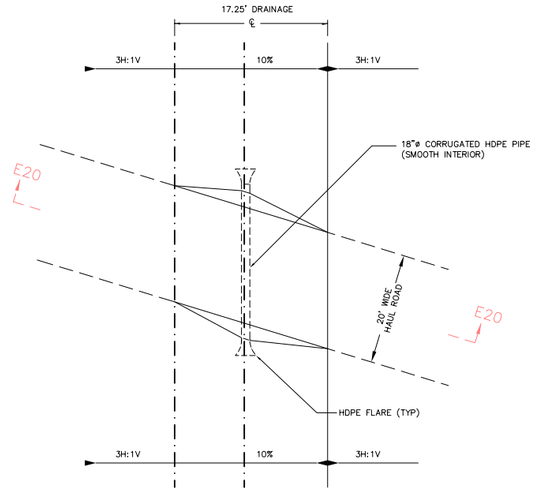


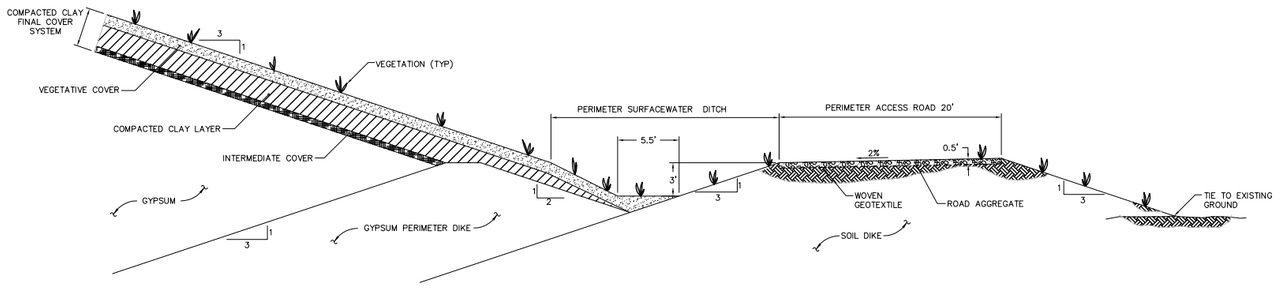
DETAIL A20
COMPACTED CLAY FINAL COVER SYSTEM (NOTE 1)
SCALE: 1" = 2'
XREF: 3731X022



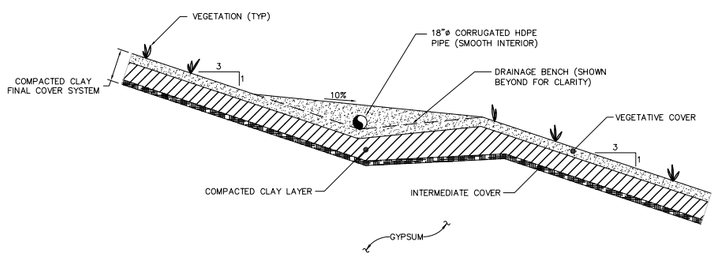
DETAIL B20
ALTERNATIVE FINAL COVER SYSTEM (NOTE 1)
SCALE: 1" = 2'
XREF: 3731X022



DETAIL D20
HAUL ROAD – DRAINAGE TERRACE INTERSECTION
SCALE: 1" = 10'
XREF: 3731X043



DETAIL C20
FINAL COVER TERMINATION AT PERIMETER
SCALE:1" = 5'
XREF: 3731X028



DETAIL E20
HAUL ROAD – DRAINAGE BENCH INTERSECTION
SCALE: 1" = 6'
XREF: 3731X044

NOTE:

1. COMPONENTS OF THE FINAL COVER SYSTEM SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE MATERIAL SPECIFICATIONS AND CONSTRUCTION QUALITY ASSURANCE AND QUALITY CONTROL PLAN INCLUDED IN APPENDIX F OF THIS PERMIT APPLICATION.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. CD
R0	MAY 2006	TYE	JHS	RND	HLP	REP			KIF450		
INITIAL ISSUE											

DISCIPLINE INTERFACE: 1 2 3 4

SCALE: AS SHOWN EXCEPT AS NOTED

FINAL COVER SYSTEM DETAILS

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

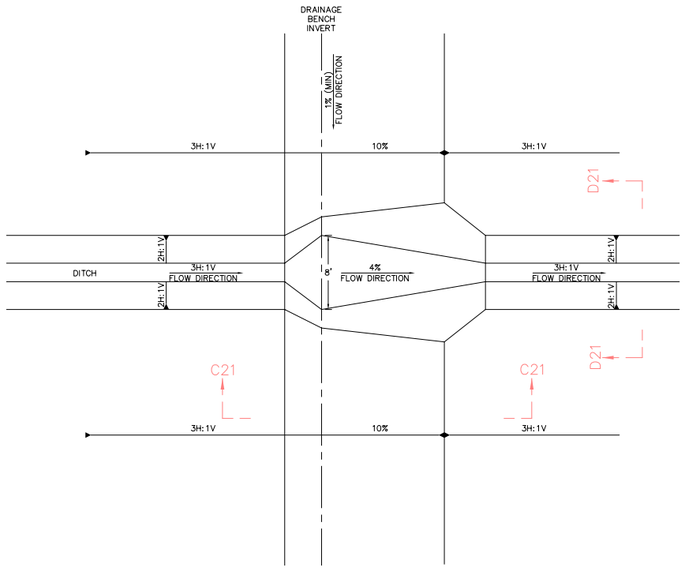
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE MAY 06	36	C	10W427-20	R 0

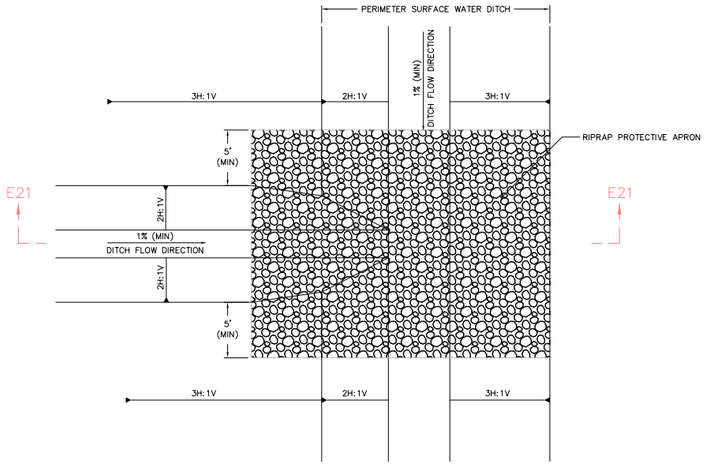
GEOSYNTEC CONSULTANTS, INC. | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

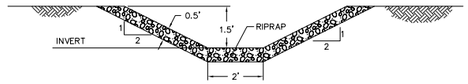
C.A.D. DRAWING
DO NOT ALTER MANUALLY



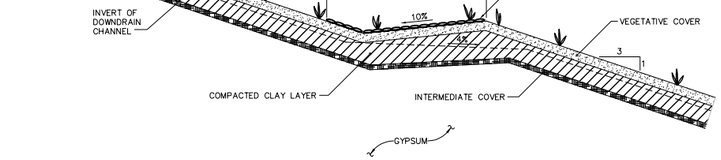
DETAIL A21
FINAL COVER SYSTEM DRAINAGE BENCH – DOWNDRAIN CHANNEL INTERSECTION
SCALE: 1" = 6'
XREF: 3731X021



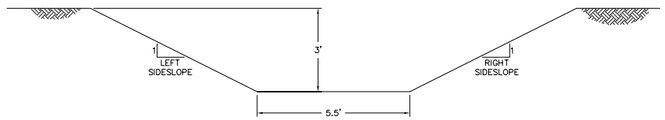
DETAIL B21
DOWNDRAIN CHANNEL – PERIMETER DITCH INTERSECTION
SCALE: N.T.S.
XREF: 3731X024



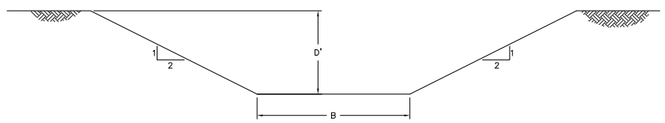
DETAIL D21
FINAL COVER SYSTEM DOWNDRAIN CHANNEL
SCALE: 1" = 2'
XREF: 3731X025



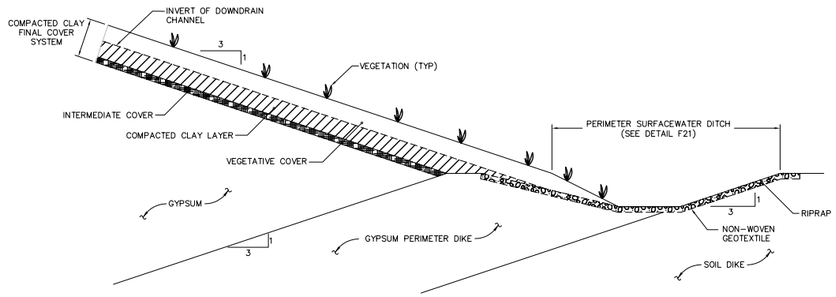
DETAIL C21
FINAL COVER SYSTEM DRAINAGE BENCH
SCALE: 1" = 6'
XREF: 3731X021



DETAIL F21
PERIMETER DRAINAGE CHANNEL
SCALE: N.T.S.
XREF: 3731X026
(SEE TABLE – PERIMETER DRAINAGE CHANNELS)



DETAIL G21
RUN-ON DRAINAGE CHANNEL
SCALE: N.T.S.
XREF: 3731X055
(SEE TABLE – RUN-ON DRAINAGE CHANNELS)



DETAIL E21
DOWNDRAIN CHANNEL – PERIMETER DITCH INTERSECTION
SCALE: 1" = 5'
XREF: 3371X037

SUMMARY TABLE OF RUNOFF DITCH PARAMETERS - PERIMETER DRAINAGE CHANNELS

REACH NUMBER	SLOPE, S_o (ft/ft)	REACH DIMENSIONS					LINING TYPE	STARTING ELEVATION (ft)	ENDING ELEVATION (ft)
		LENGTH (ft)	BOTTOM WIDTH, B (ft)	DEPTH OF CHANNEL, D (ft)	SIDE SLOPES LEFT (H:1V)	SIDE SLOPES RIGHT (H:1V)			
R1	0.044	617.6	5.5	3.0	2.0	3.0	RIPRAP	786.58	759.39
R2	0.0167	822.6	5.5	3.0	3.0	2.0	RIPRAP	773.10	759.39
R3	0.0093	870.4	5.5	3.0	3.0	2.0	GRASS	781.20	773.10
R4	0.0095	828.1	5.5	3.0	3.0	2.0	GRASS	789.05	781.20
R5	0.0126	869.2	5.5	3.0	3.0	2.0	GRASS	800.00	789.05
R6	0.0104	777.2	5.5	3.0	3.0	2.0	GRASS	805.92	797.85
R7	0.0103	908.9	5.5	3.0	3.0	2.0	GRASS	815.32	805.92
R8	0.0103	767.1	5.5	3.0	3.0	2.0	GRASS	823.23	815.32
R9	0.0113	611.2	5.5	3.0	2.0	3.0	GRASS	823.23	816.31
R10	0.012	578.9	5.5	3.0	2.0	3.0	GRASS	816.31	809.39
R11	0.0348	655.3	5.5	3.0	2.0	3.0	RIPRAP	809.39	786.59

SUMMARY TABLE OF RUNOFF DITCH PARAMETERS - RUN-ON DRAINAGE CHANNELS

REACH NUMBER	SLOPE, S_o (ft/ft)	REACH DIMENSIONS					LINING TYPE	STARTING ELEVATION (ft)	ENDING ELEVATION (ft)
		LENGTH (ft)	BOTTOM WIDTH, B (ft)	DEPTH OF CHANNEL, D (ft)	SIDE SLOPES LEFT (H:1V)	SIDE SLOPES RIGHT (H:1V)			
RN1	0.1133	528.7	3.0	2.0	2.0	2.0	RIPRAP	828.00	768.08
RN2	0.0231	432.3	3.0	2.0	2.0	2.0	GRASS	828.00	818.00
RN3	0.0215	371.4	3.0	2.0	2.0	2.0	RIPRAP	818.00	810.00
RN4	0.0727	731.1	3.0	2.0	2.0	2.0	RIPRAP	861.90	808.75
RN5	0.0281	591.7	3.0	2.0	2.0	2.0	RIPRAP	808.12	791.50
RN6	0.0337	947.6	3.0	2.0	2.0	2.0	RIPRAP	861.90	829.92
RN7	0.0368	490.9	3.0	2.0	2.0	2.0	RIPRAP	848.00	829.92
RN8	0.1664	69.0	3.0	2.0	2.0	2.0	RIPRAP	829.12	817.64
RN9	0.0162	855.7	3.0	2.0	2.0	2.0	GRASS	848.00	834.16
RN10	0.0625	627.6	3.0	2.0	2.0	2.0	RIPRAP	834.16	794.93
RN11	0.0760	378.5	3.0	2.0	2.0	2.0	RIPRAP	794.93	766.18
RN12	0.0229	430.0	4.0	5.0	2.0	2.0	RIPRAP	765.33	755.50
RN13	0.0179	246.6	4.0	5.0	2.0	2.0	RIPRAP	770.60	766.18
RN14	0.0155	712.3	4.0	5.0	2.0	2.0	RIPRAP	781.64	770.60
RN15	0.0282	1158.2	6.0	3.0	2.0	2.0	RIPRAP	814.27	781.64
RN16	0.0104	311.5	6.0	3.0	2.0	2.0	RIPRAP	817.50	814.27
RN17	0.0117	416.6	0.0	3.0	2.0	2.0	GRASS	822.36	817.50
RN18	0.0149	392.0	3.0	5.0	2.0	2.0	GRASS	822.36	816.53
RN19	0.0639	391.7	3.0	6.0	2.0	2.0	RIPRAP	816.53	791.50
RN20	0.0060	229.0	3.0	29.0	2.0	2.0	GRASS	791.50	790.12
RN21	0.0231	872.8	3.0	8.0	2.0	2.0	RIPRAP	790.12	770.00
RN22	0.0129	465.1	18.0	3.0	2.0	2.0	GRASS	770.00	764.00
RN23	0.0289	154.8	1.0	2.0	2.0	2.0	RIPRAP	767.38	764.00
RN24	0.0224	91.5	4.0	5.0	2.0	2.0	RIPRAP	751.64	749.59

CULVERT ID	CULVERT Type	DIAMETER (in)	LENGTH (ft)	STARTING ELEVATION (ft)	ENDING ELEVATION (ft)	SLOPE (ft/ft)
C1	Concrete	(3) x 48"	54.2	759.39	758.31	0.020
C2	Concrete	(1) x 36"	69.8	768.08	767.38	0.010
C3	Concrete	(1) x 36"	69.8	810.00	808.37	0.023
C4	Concrete	(1) x 36"	63.5	808.75	808.12	0.010
C5	Concrete	(1) x 48"	80.0	829.92	829.12	0.010
C6	Concrete	(2) x 48"	80.4	766.18	765.33	0.011
C7	Concrete	(3) x 48"	160.0	755.50	751.64	0.025
C8	Concrete	(3) x 48"	60.0	749.59	748.05	0.025

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV ID
R1	JANUARY 2007	RK	JHS	RND	HLP	REP			K1F450		1
DETAIL C21 REMOVED; TABLES ADDED FOR CLARITY											2
R0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450		3
INITIAL ISSUE											4

DISCIPLINE INTERFACE

SCALE: AS SHOWN EXCEPT AS NOTED

SURFACE WATER MANAGEMENT SYSTEM
DETAILS I (DOWNDRAIN CHANNEL OPTION)

COAL–COMBUSTION
BY–PRODUCT (GYPSUM)
DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

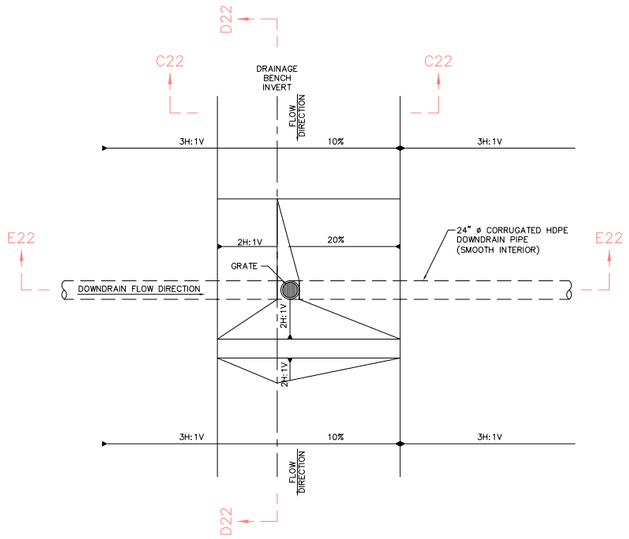
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE MAY 06	36	C	10W427–21	R 1

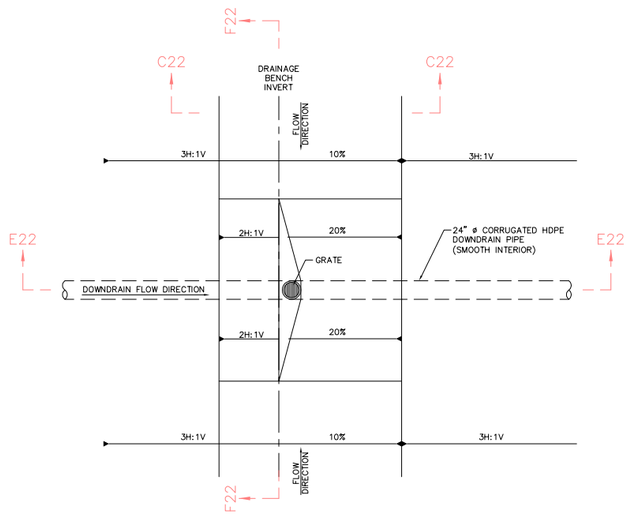
GEOSYNTEC CONSULTANTS, INC. | 1
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

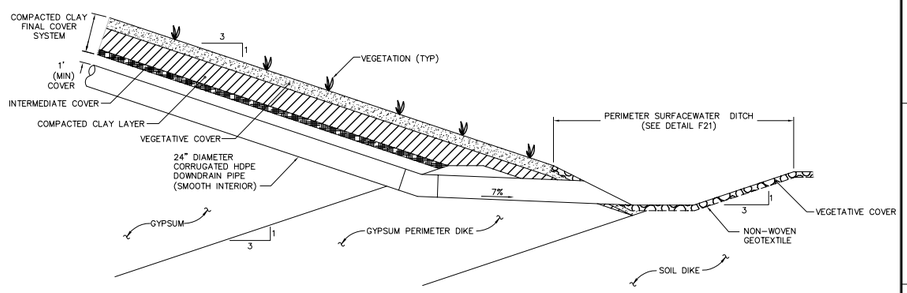
C.A.D. DRAWING
DO NOT ALTER MANUALLY



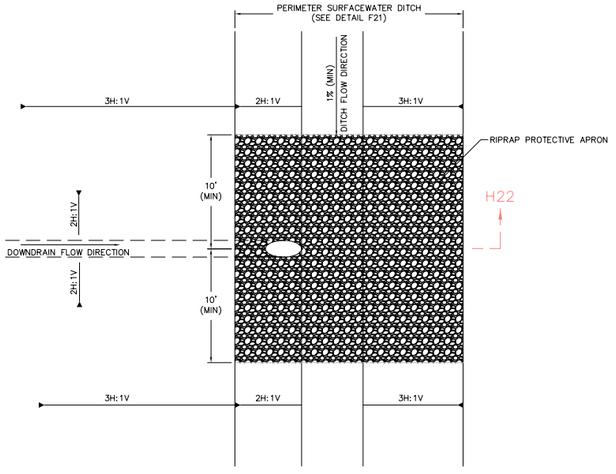
DETAIL A22
FINAL COVER SYSTEM DRAINAGE BENCH – AT 1–WAY DOWNDRAIN INTERSECTION
SCALE: 1" = 6'
XREF: 3731X034



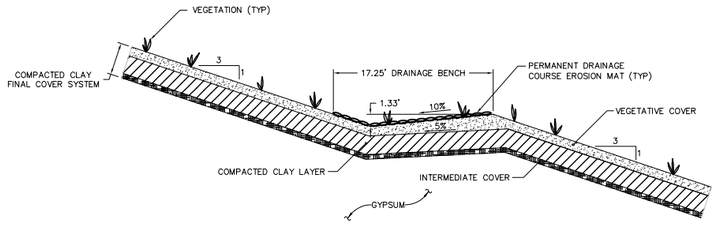
DETAIL B22
FINAL COVER SYSTEM DRAINAGE BENCH – AT 2–WAY DOWNDRAIN INTERSECTION
SCALE: 1" = 6'
XREF: 3731X032



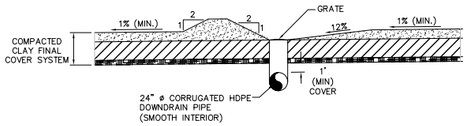
DETAIL H22
DOWNDRAIN PIPE – PERIMETER DITCH INTERSECTION
SCALE: 1" = 5'
XREF: 3731X028



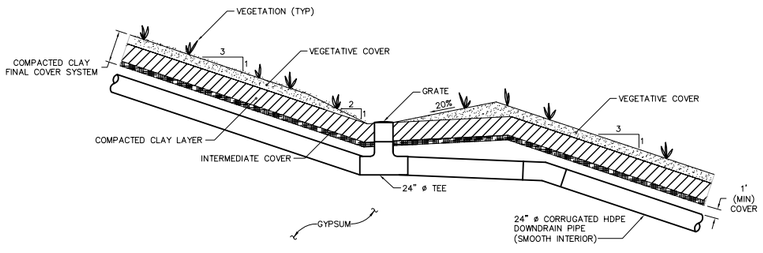
DETAIL G22
DOWNDRAIN PIPE – PERIMETER DITCH INTERSECTION
SCALE: N.T.S.
XREF: 3731X029



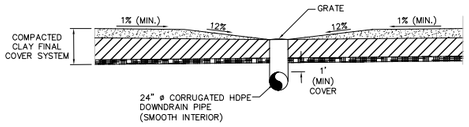
DETAIL C22
FINAL COVER SYSTEM DRAINAGE BENCH
SCALE: 1" = 6'
XREF: 3731X034



DETAIL D22
FINAL COVER SYSTEM DRAINAGE BENCH – AT 1–WAY DOWNDRAIN INTERSECTION
SCALE: 1" = 6'
XREF: 3731X032



DETAIL E22
FINAL COVER SYSTEM AT DOWNDRAIN PIPE DRAINAGE BENCH INTERSECTION
SCALE: 1" = 6'
XREF: 3731X033



DETAIL F22
FINAL COVER SYSTEM DRAINAGE BENCH – AT 2–WAY DOWNDRAIN INTERSECTION
SCALE: 1" = 6'
XREF: 3731X032

NOTE:

1. LOW CHECK DAMS MAY BE PLACED ABOVE THE GRATED INLETS TO PREVENT CLOGGING WITH SEDIMENT.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV ID
0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450		

GRATED INLETS ADDED
INITIAL ISSUE

DISCIPLINE INTERFACE

SCALE: AS SHOWN EXCEPT AS NOTED

SURFACE WATER MANAGEMENT SYSTEM DETAILS II (DOWNDRAIN PIPE OPTION)

COAL–COMBUSTION BY–PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

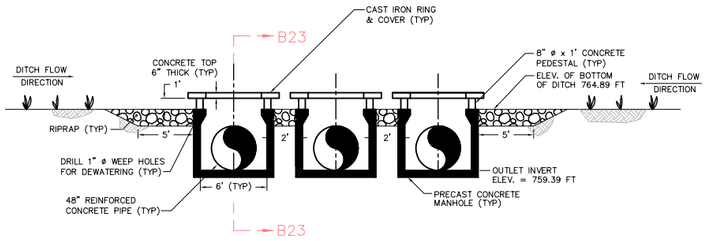
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE	36	C	10W427–22	R 0
	MAY 06				

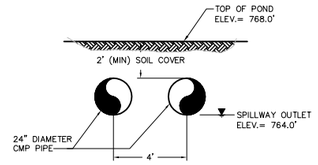
GEOSYNTEC CONSULTANTS, INC. 0
TASK COMPLETED BY: REV NO.

PLOT FACTOR: 1:1

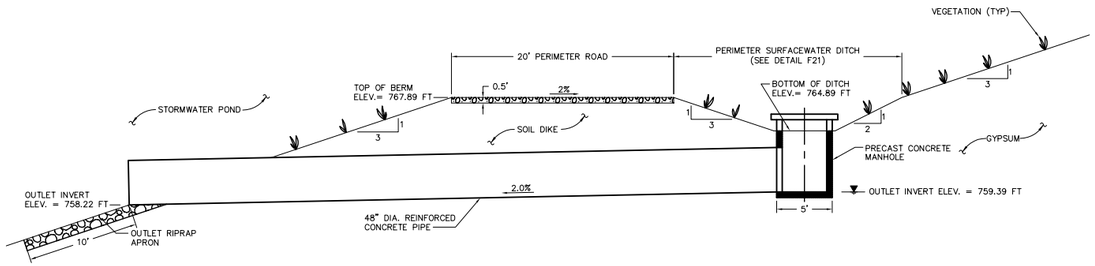
C.A.D. DRAWING DO NOT ALTER MANUALLY



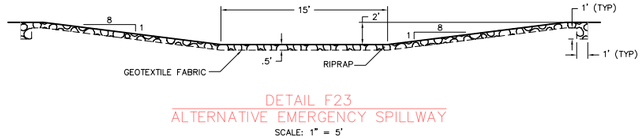
DETAIL A23
STORM WATER POND DROP INLET
SCALE: 1" = 5'
XREF: 3731X039



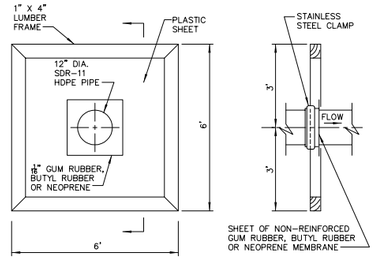
DETAIL E23
EMERGENCY OVERFLOW
SCALE: 1" = 3'
XREF: 3731X042



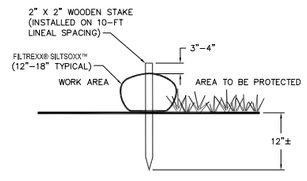
DETAIL B23
DROP INLET TO STORM WATER POND
SCALE: 1" = 5'
XREF: 3731X039



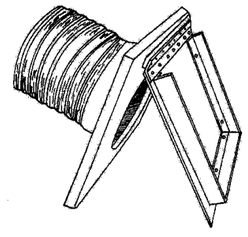
DETAIL F23
ALTERNATIVE EMERGENCY SPILLWAY
SCALE: 1" = 5'
XREF: 3731X054



DETAIL C23
FLEXIBLE ANTI-SEEP COLLAR (NOTE 1)
SCALE: N.T.S.
XREF: 3731X045



DETAIL D23
FILTREXX® SILTSOXX (NOTE 2)
SCALE: N.T.S.
XREF: 3731X051.DWG



DETAIL G23
FLOODWATER FLAP GATE
SCALE:NTS

NOTES:

1. THE FLEXIBLE ANTI-SEEP COLLARS IS INSTALLED BY CUTTING A HOLE 3-INCHES SMALLER THAN THE DIAMETER OF THE PIPE AND FORCING IT OVER THE PIPE. THE ANTI-SEEP MATERIAL SHALL BE FASTENED TO THE PIPE USING STAINLESS STEEL CLAMPS. CARE MUST BE TAKEN TO BACKFILL EQUALLY ON BOTH SIDES OF THE ANTI-SEEP COLLAR.
2. FILTREXX® SILTSOXX SHALL BE INSTALLED AND MAINTAINED IN GENERAL ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND TECHNICAL SPECIFICATIONS.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. CD
R1	JANUARY 2007	RK	JHS	RND	HLP	REP			K1F450		
	STORMWATER CULVERT UNDER POND REMOVED (C23, D23).										
R0	MAY 2006	TYE	JHS	RND	HLP	REP			K1F450		
	INITIAL ISSUE										

DISCIPLINE INTERFACE: 1 2 3 4

SCALE: AS SHOWN EXCEPT AS NOTED

SURFACE WATER MANAGEMENT SYSTEM DETAILS III

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

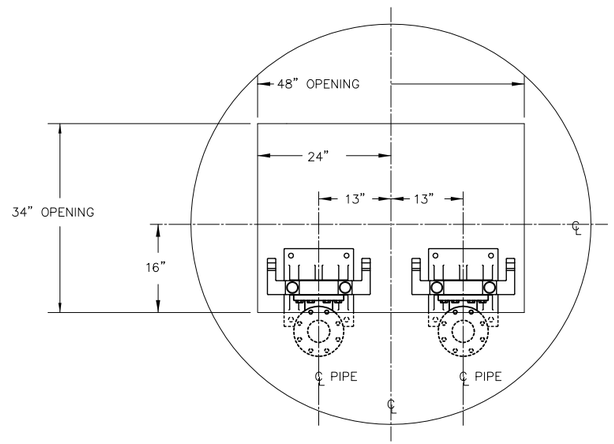
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

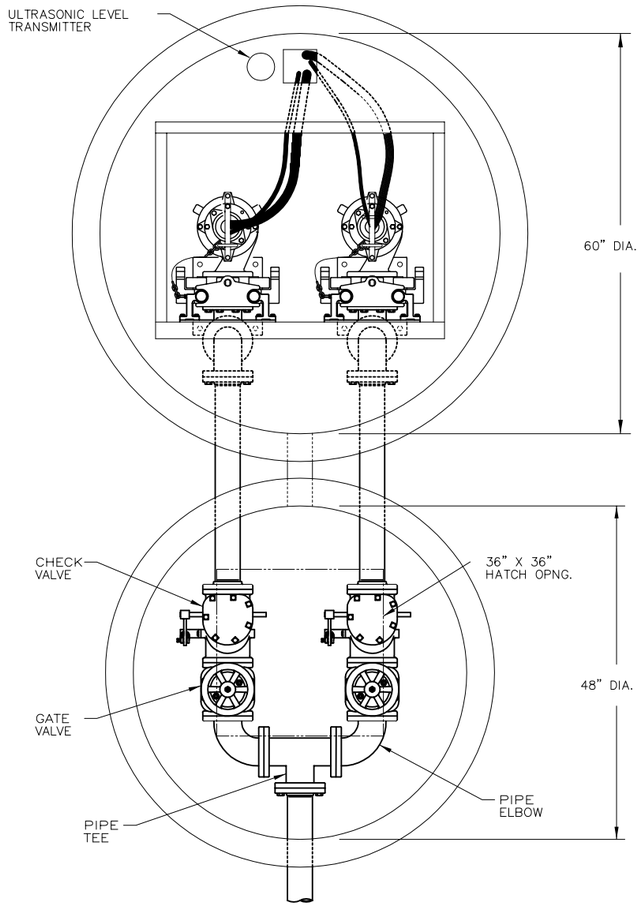
AUTODESK CIVIL 3D	DATE MAY 06	36	C	10W427-23	R 1

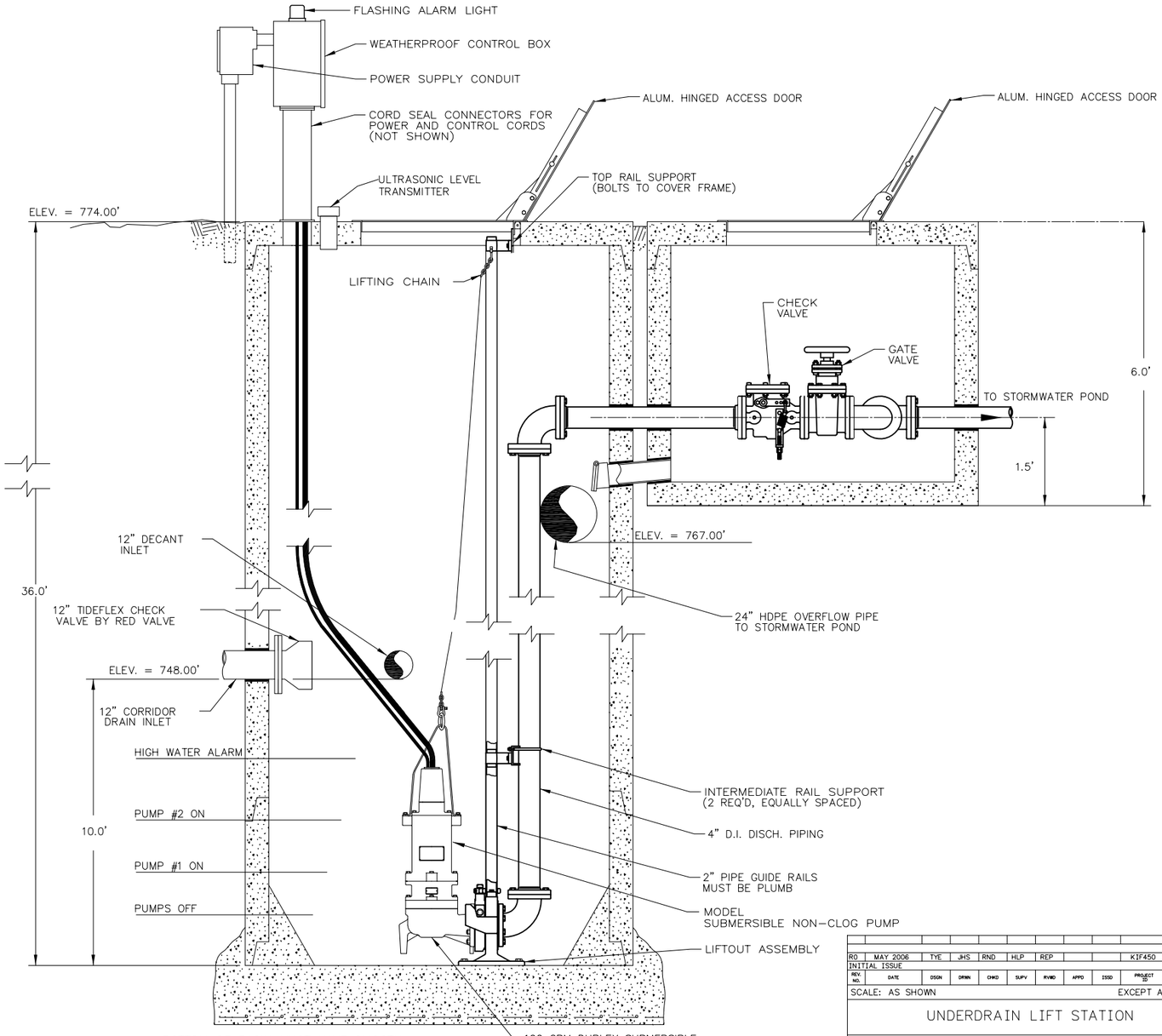
GEOSYNTEC CONSULTANTS, INC. | 1
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING DO NOT ALTER MANUALLY







DETAIL A24
UNDERDRAIN LIFT STATION
SCALE: N.T.S.

R0	MAY 2006	TYE	JHS	RND	HLP	REP				KIF450	
INITIAL ISSUE											DISCIPLINE INTERFACE
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. NO.

SCALE: AS SHOWN EXCEPT AS NOTED

UNDERDRAIN LIFT STATION

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

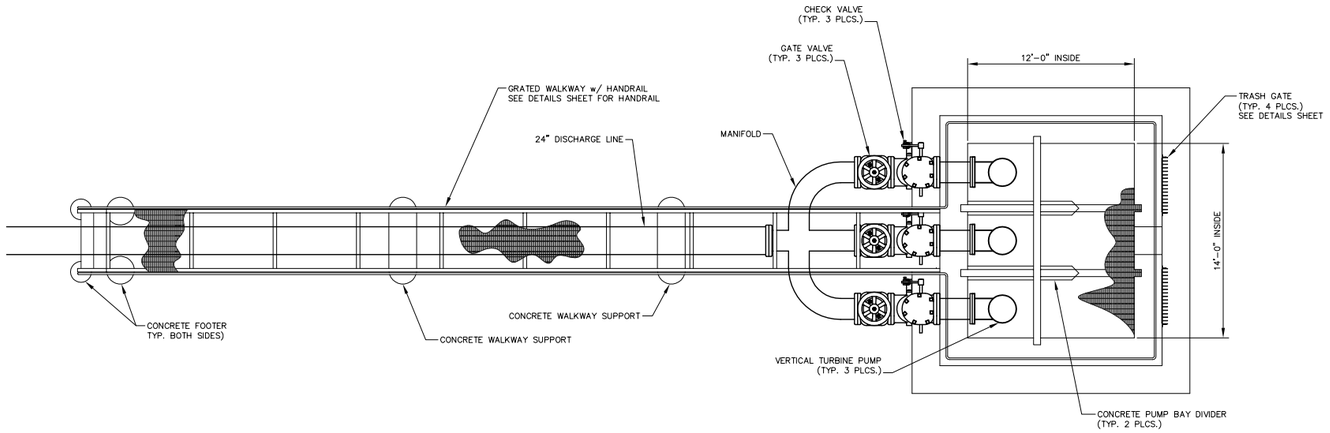
KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

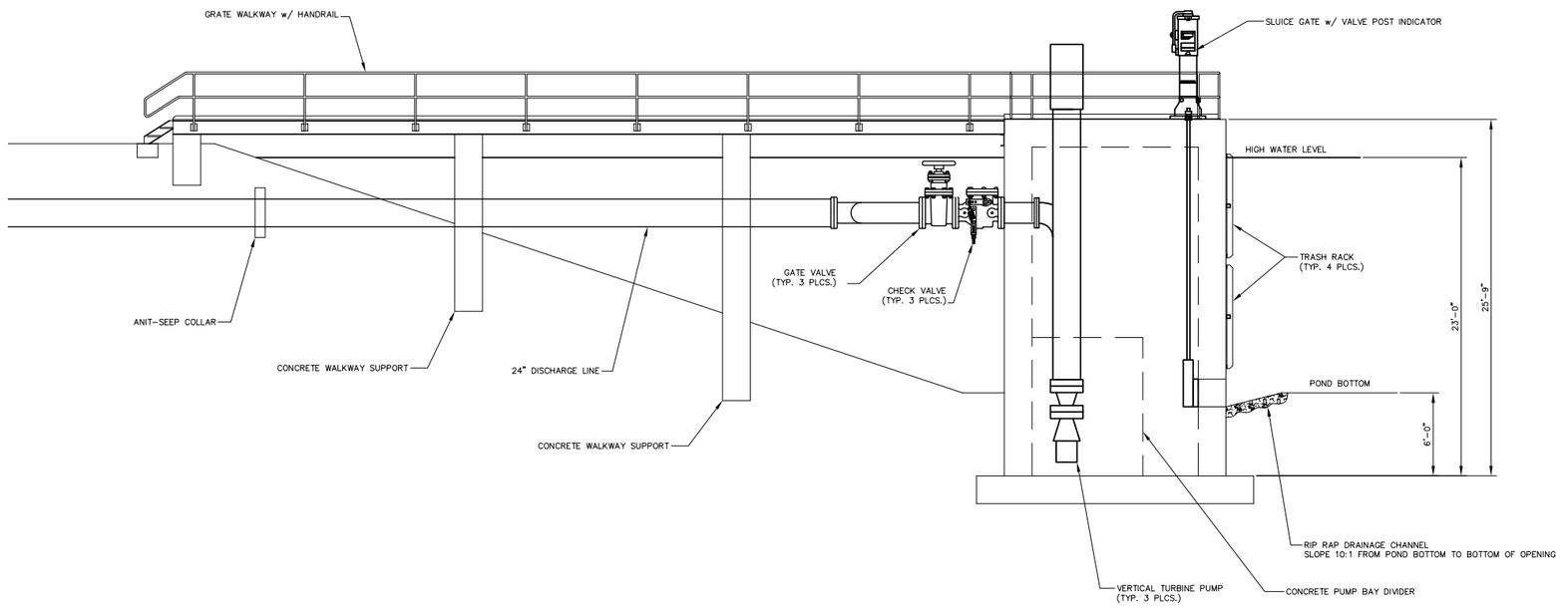
AUTODESK CIVIL 3D	DATE 30 MAY 06	36	C	10W427-24	R 0

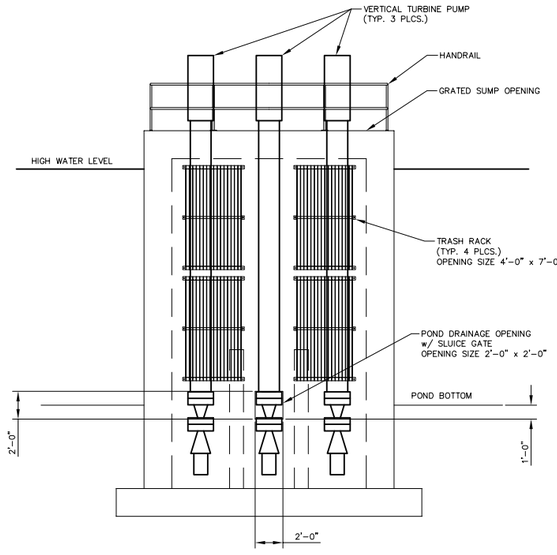
GEOSYNTEC CONSULTANTS, INC.	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY







DETAIL A25
STORMWATER LIFT STATION
SCALE: N.T.S.

R0	MAY 2006	TYE	JHS	RND	HLP	REP				KIF450			DISCIPLINE INTERFACE
INITIAL ISSUE													
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. NO.		

SCALE1" = 10'-0" EXCEPT AS NOTED

STORMWATER LIFT STATION

COAL-COMBUSTION
BY-PRODUCT (GYPSUM)
DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
T.Y. ELKADY	J.H. SPEED	R.N. DAVIES	H.L. PETTY	R.E. PURKEY		

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE: MAY 06	36	C	10W427-25	R 0

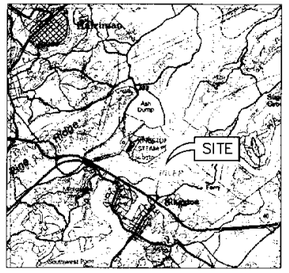
GEOSYNTEC CONSULTANTS, INC.	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR: 1:1

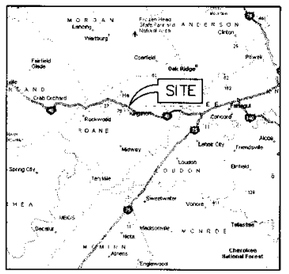
C.A.D. DRAWING
DO NOT ALTER MANUALLY

DRAWING INDEX

10W427-26	COVER SHEET
10W427-27	EXISTING SITE CONDITIONS
10W427-28	GEOMEMBRANE GRADING PLAN
10W427-29	PROTECTIVE COVER LAYER GRADING PLAN
10W427-30	DETAILS



LOCATION MAP



VICINITY MAP

COAL-COMBUSTION BY PRODUCT (GYPSUM) DISPOSAL FACILITY
KINGSTON FOSSIL PLANT - PENINSULA SITE

STORMWATER DETENTION POND LINER DESIGN

RA	DEC. 2009	MI	JAS	RND	MAG	VJD		KIF450	
INITIAL ISSUE									
REV NO.	DATE	ORIG	DFTR	CHKD	SUPV	ENGD	APPD	PROJECT MGR	AS CONST

SCALE: NONE EXCEPT AS NOTED

COVER SHEET

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	APPROVED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. ISCIMEN	J.A. SIMONS	R.N. DAVIES	M.A. OTHMAN	V.J. DOTSON		

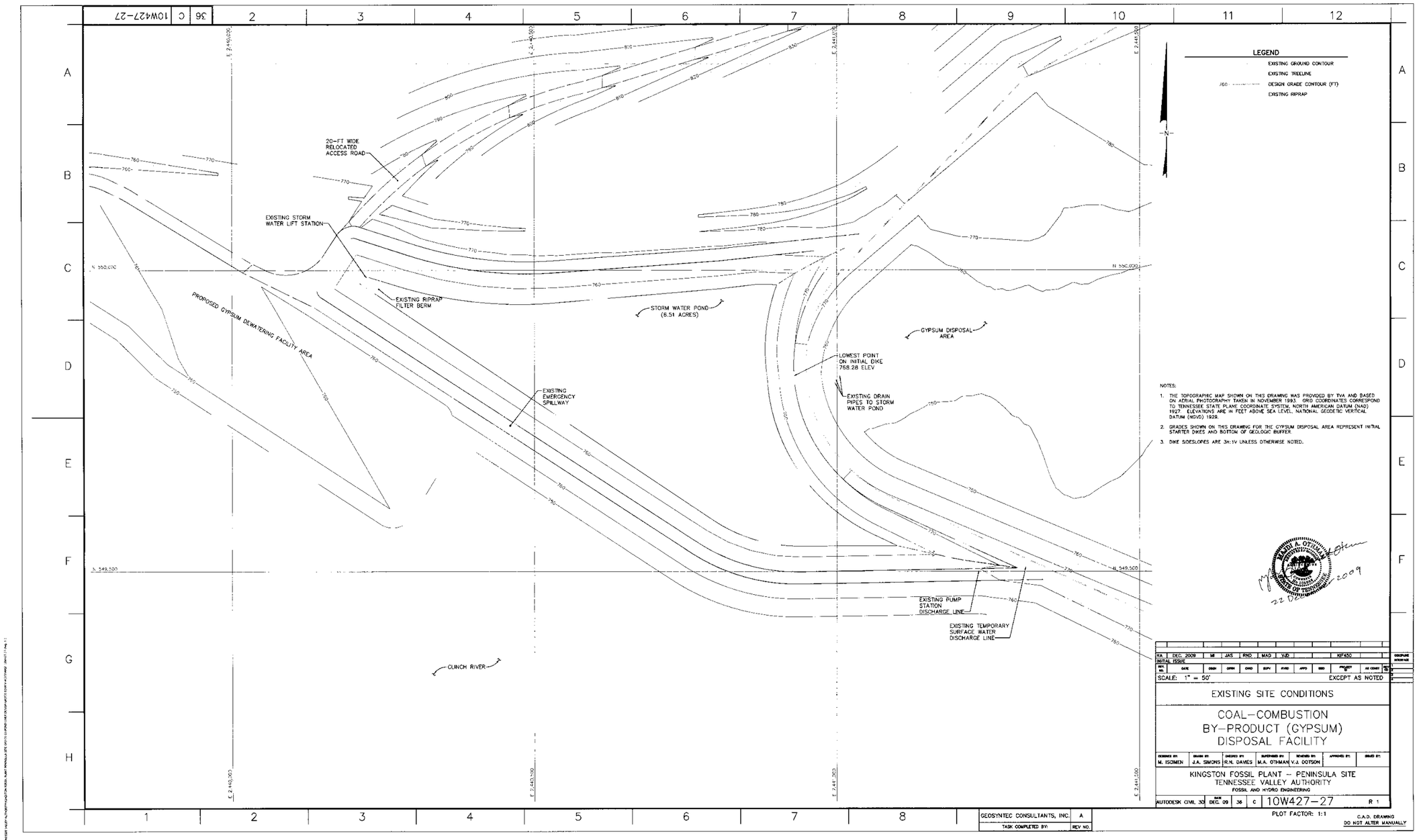
KINGSTON FOSSIL PLANT – PENINSULA SITE
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

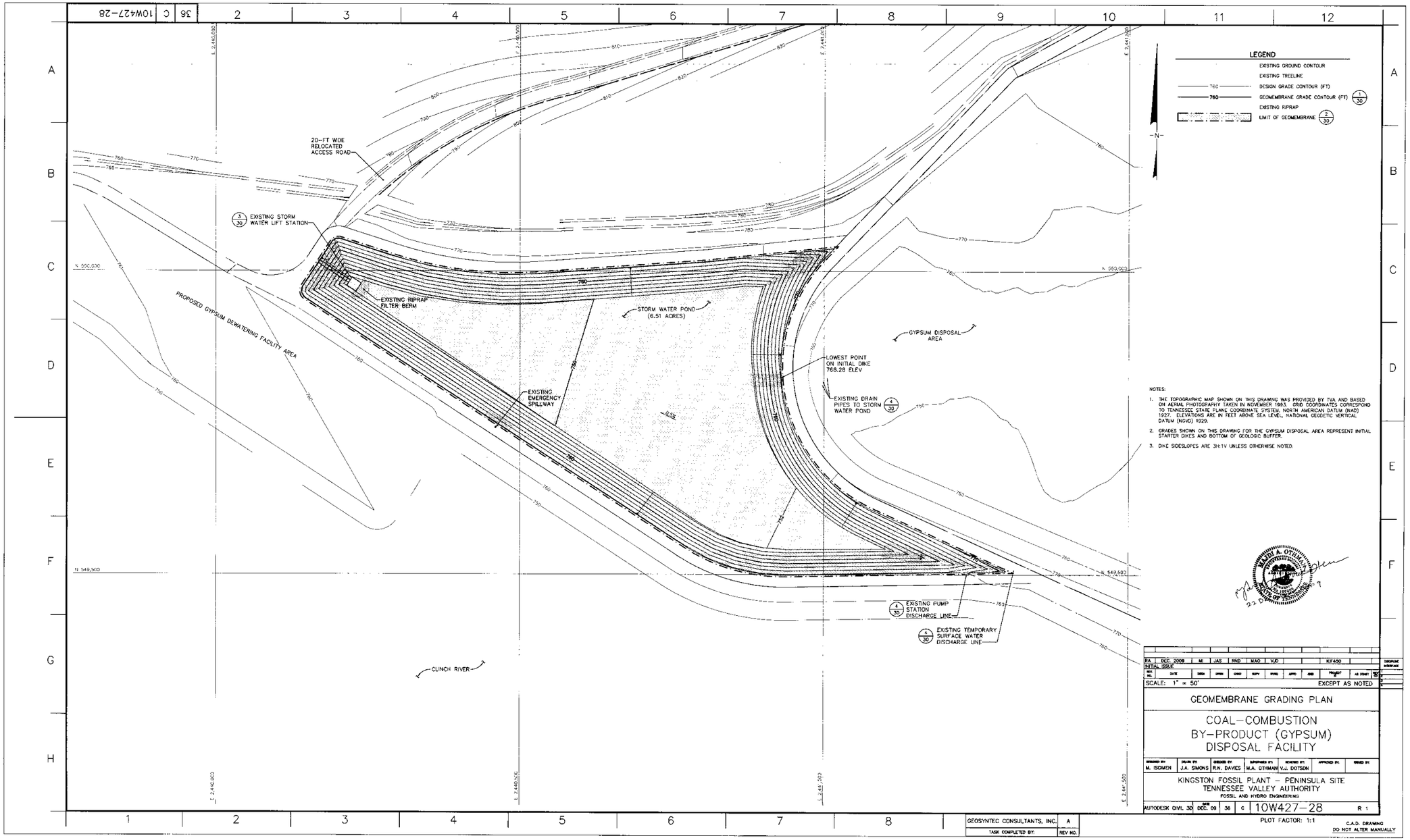
AUTODESK CIVIL 3D	DEC. 09	36	C	10W427-26	R 1

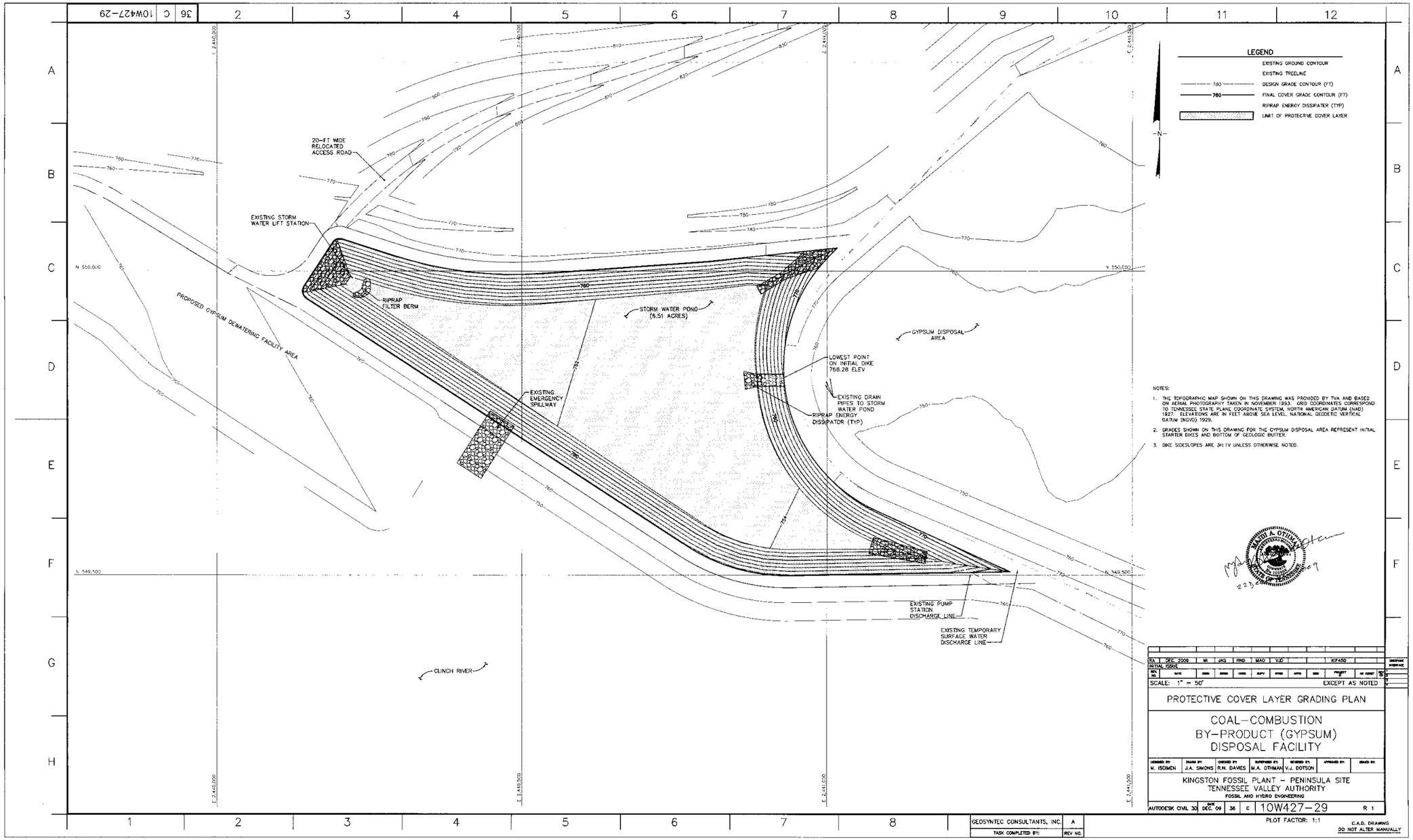
PLOT FACTOR: 1:1

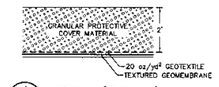
C.A.D. DRAWING DO NOT ALTER MANUALLY

GEOSYNTEC CONSULTANTS, INC. | A
TASK COMPLETED BY: | REV NO.

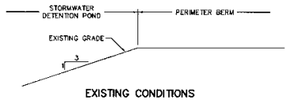

20-FT WIDE RELOCATED ACCESS ROAD
EXISTING STORM WATER LIFT STATION
EXISTING RIPRAP FILTER BERM
PROPOSED GYPSUM DEWATERING FACILITY AREA
STORM WATER POND (6.51 ACRES)
GYPSUM DISPOSAL AREA
LOWEST POINT ON INITIAL DIKE 758.28 ELEV
EXISTING DRAIN PIPES TO STORM WATER POND
EXISTING EMERGENCY SPILLWAY
EXISTING PUMP STATION DISCHARGE LINE
EXISTING TEMPORARY SURFACE WATER DISCHARGE LINE
CLINCH RIVER
N 550,000
N 549,500
E 2,440,000
E 2,440,500
E 2,441,000
E 2,441,500
LEGEND
EXISTING GROUND CONTOUR
EXISTING TREELINE
760 DESIGN GRADE CONTOUR (FT)
EXISTING RIPRAP
N
NOTES:
1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. GRADES SHOWN ON THIS DRAWING FOR THE GYPSUM DISPOSAL AREA REPRESENT INITIAL STARTER DIKES AND BOTTOM OF GEOLOGIC BUFFER.
3. DIKE SIDESLOPES ARE 3H:1V UNLESS OTHERWISE NOTED.
EASTER A. OTMAN
STATE OF TENNESSEE
REGISTERED ENGINEER
22 DEC 2009
RA DEC. 2009 MB JAS RND MAO VJD KEF450
INITIAL ISSUE
SCALE: 1" = 50' EXCEPT AS NOTED
EXISTING SITE CONDITIONS
COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY
M. ISOMEN J.A. SIMONS R.N. DAMES M.A. OTMAN V.J. DOTSON
KINGSTON FOSSIL PLANT - PENINSULA SITE
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING
AUTODESK CIVIL 3D DEC. 09 36 C 10W427-27 R 1
GEOSYNTEC CONSULTANTS, INC. A
TASK COMPLETED BY: REV NO.
PLOT FACTOR: 1:1
C.A.D. DRAWING DO NOT ALTER MANUALLY
36 C 10W427-27


20-FT WIDE RELOCATED ACCESS ROAD
3/30 EXISTING STORM WATER LIFT STATION
EXISTING RIPRAP FILTER BERM
PROPOSED GYPSUM DEWATERING FACILITY AREA
STORM WATER POND (6.51 ACRES)
GYPSUM DISPOSAL AREA
LOWEST POINT ON INITIAL DIKE 768.28 ELEV
EXISTING EMERGENCY SPILLWAY
EXISTING DRAIN PIPES TO STORM WATER POND 4/30
4/30 EXISTING PUMP STATION DISCHARGE LINE
4/30 EXISTING TEMPORARY SURFACE WATER DISCHARGE LINE
CLINCH RIVER
N. 550,000
N. 549,500
N. 549,000
E. 2,440,000
E. 2,440,500
E. 2,441,000
E. 2,441,500
LEGEND
EXISTING GROUND CONTOUR
EXISTING TREELINE
760 DESIGN GRADE CONTOUR (FT)
760 GEOMEMBRANE GRADE CONTOUR (FT) 1/30
EXISTING RIPRAP
LIMIT OF GEOMEMBRANE 2/30
N
NOTES:
1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. GRADES SHOWN ON THIS DRAWING FOR THE GYPSUM DISPOSAL AREA REPRESENT INITIAL STARTER DIKES AND BOTTOM OF GEOLOGIC BUFFER.
3. DIKE SIDESLOPES ARE 3H:1V UNLESS OTHERWISE NOTED.
SCALE: 1" = 50' EXCEPT AS NOTED
GEOMEMBRANE GRADING PLAN
COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY
KINGSTON FOSSIL PLANT - PENINSULA SITE
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING
AUTODESK CIVIL 3D DEC. 09 36 C 10W427-28 R 1
GEOSYNTEC CONSULTANTS, INC. A
TASK COMPLETED BY. REV NO.
PLOT FACTOR: 1:1
C.A.D. DRAWING DO NOT ALTER MANUALLY
36 C 10W427-28

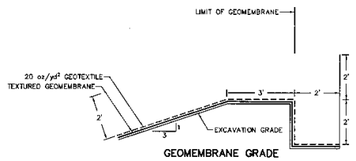

20-FT WIDE RELOCATED ACCESS ROAD
EXISTING STORM WATER LIFT STATION
PROPOSED GYPSUM DEWATERING FACILITY AREA
RIPRAP FILTER BERM
STORM WATER POND (6.51 ACRES)
GYPSUM DISPOSAL AREA
LOWEST POINT ON INITIAL DIKE 768.28 ELEV
EXISTING DRAIN PIPES TO STORM WATER POND
RIPRAP ENERGY DISSIPATOR (TYP)
EXISTING EMERGENCY SPILLWAY
EXISTING PUMP STATION DISCHARGE LINE
EXISTING TEMPORARY SURFACE WATER DISCHARGE LINE
CLINCH RIVER
N 550,000
N 549,500
E 2,440,500
E 2,441,000
E 2,441,500
LEGEND
EXISTING GROUND CONTOUR
EXISTING TREELINE
780 DESIGN GRADE CONTOUR (FT)
760 FINAL COVER GRADE CONTOUR (FT)
RIPRAP ENERGY DISSIPATER (TYP)
LIMIT OF PROTECTIVE COVER LAYER
N
NOTES:
1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN NOVEMBER 1993. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. GRADES SHOWN ON THIS DRAWING FOR THE GYPSUM DISPOSAL AREA REPRESENT INITIAL STARTER DIKES AND BOTTOM OF GEOLOGIC BUFFER.
3. DIKE SIDESLOPES ARE 3H:1V UNLESS OTHERWISE NOTED.
RA DEC. 2009 MI JAS RND MAO VJD KIF450
INITIAL ISSUE
SCALE: 1" = 50' EXCEPT AS NOTED
PROTECTIVE COVER LAYER GRADING PLAN
COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY
DESIGNED BY M. ISOMEN | DRAWN BY J.A. SIMONS | CHECKED BY R.N. DAMES | SUPERVISED BY M.A. OTHMAN | APPROVED BY V.J. DOTSON | APPROVED BY | ISSUED BY
KINGSTON FOSSIL PLANT - PENINSULA SITE
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING
AUTODESK CIVIL 3D | DATE DEC. 09 | 36 | C | 10W427-29 | R 1
GEOSYNTEC CONSULTANTS, INC. | A
TASK COMPLETED BY: | REV NO.
PLOT FACTOR: 1:1
C.A.D. DRAWING DO NOT ALTER MANUALLY
10W427-29 C 36



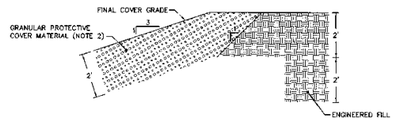
1/28 DETAIL (TYPICAL)
LINER SYSTEM
SCALE: 1" = 2'
REF: 373NX13



EXISTING CONDITIONS

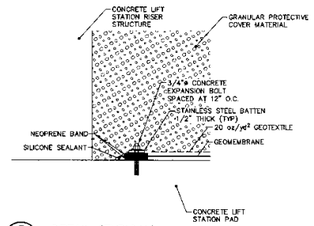


GEOMEMBRANE GRADE

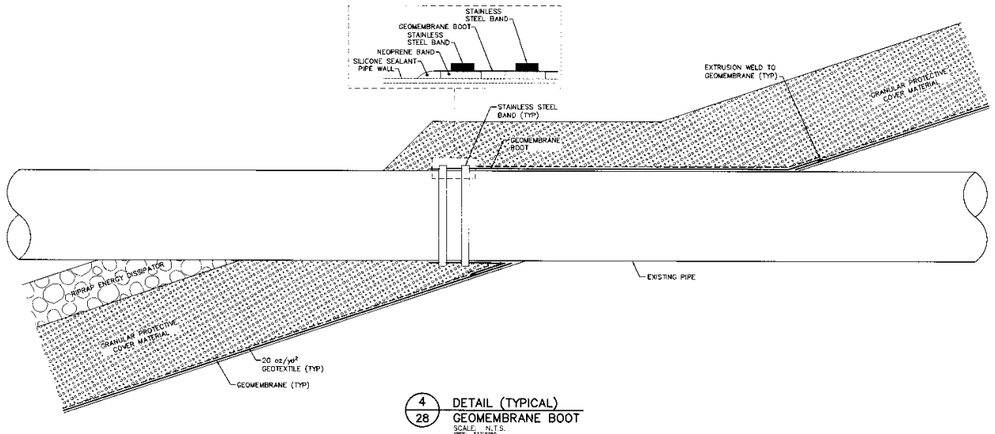


PROTECTIVE COVER LAYER GRADE

2/28 DETAIL (TYPICAL)
PERIMETER ANCHOR TRENCH
SCALE: 1" = 2'
REF: 373NX12



3/28 DETAIL (TYPICAL)
GEOMEMBRANE ATTACHMENT TO LIFT STATION BASE
SCALE: N.T.S.
REF: 373NX01



4/28 DETAIL (TYPICAL)
GEOMEMBRANE BOOT
SCALE: N.T.S.
REF: 373NX00

NOTES:

1. DETAILS ARE SHOWN TO SCALE AS NOTED EXCEPT FOR THE GEOSYNTHETICS WHICH ARE SHOWN AT AN EXAGGERATED SCALE FOR CLARITY.
2. LOWER 12 INCH OF THE PROTECTIVE COVER LAYER THICKNESS, WHICH IS IN CONTACT WITH THE UNDERLYING GEOSYNTHETICS, SHALL HAVE A GRADATION THAT MEETS THE REQUIREMENTS FOR A NO. 4 STONE OR EQUIVALENT, HAVING A MAXIMUM PARTICLE SIZE OF 1 1/2 INCH. GRANULAR MATERIAL WITH PARTICLE SIZES LARGER THAN 1 1/2 INCH CAN BE USED IN THE REMAINING THICKNESS OF THE PROTECTIVE COVER LAYER (I.E., UPPER 12 INCH).

RA	DEC. 2009	MI	JAS	RND	MAO	VJD		KIF450	
INITIAL ISSUE									
NO.	DATE	DRWN	DESN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT MGR

SCALE: AS SHOWN — EXCEPT AS NOTED

DETAILS

COAL-COMBUSTION BY-PRODUCT (GYPSUM) DISPOSAL FACILITY

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. ISCIMEN	J.A. SIMONS	R.N. DAMES	M.A. O'HAIR	V.J. DOTSON		

KINGSTON FOSSIL PLANT - PENINSULA SITE
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE: DEC. 09	36	C	10W427-30	R 1

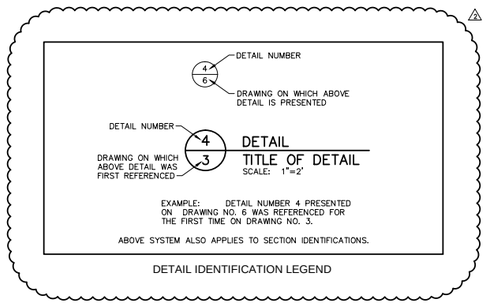
GEOSYNTEC CONSULTANTS, INC. | A
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

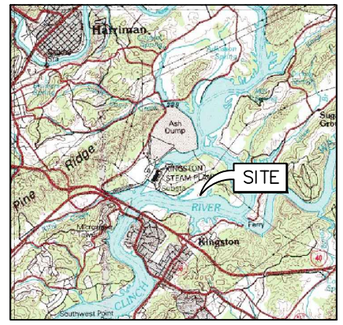
C.A.D. DRAWING
DO NOT ALTER MANUALLY

DRAWING INDEX

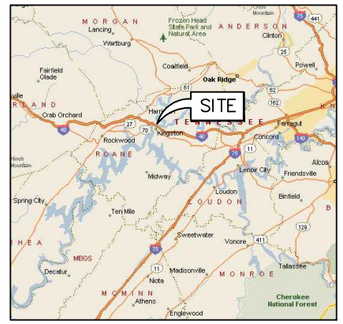
10W429-1	COVER SHEET
10W429-2	EXISTING CONDITIONS AND SITE PLAN
10W429-3	PHASE I STACK GRADING PLAN
10W429-4	PHASE II STACK GRADING PLAN
10W429-5	FINAL STACK GRADING PLAN
10W429-6	CROSS SECTIONS
10W429-7	SURFACE WATER MANAGEMENT DETAILS I
10W429-8	SURFACE WATER MANAGEMENT DETAILS II
10W429-9	RECOMMENDED PROCEDURES FOR RIM DITCH FILLING
10W429-10	SITE RESTORATION PLAN



DETAIL IDENTIFICATION LEGEND



LOCATION MAP



VICINITY MAP

COAL COMBUSTION BYPRODUCT FACILITY
KINGSTON RECOVERY PROJECT
KINGSTON FOSSIL PLANT -
BALLFIELD INTERIM ASH STAGING PLAN
DRAFT DESIGN PLANS FOR TDEC REVIEW

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE
2	FEB 11	MAC	RWL	RND	VJD	RND	MST	SRC			
1	INITIAL ISSUE										

SCALE: NONE — EXCEPT AS NOTED

COVER SHEET

COAL COMBUSTION BYPRODUCT FACILITY
KINGSTON RECOVERY PROJECT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. OTHMAN	R.W. LOWRY	R.N. DAVIES	V.J. DOTSON	R.N. DAVIES	M.S. TURNBOW	S.R. CATHEY

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE: OCT 10	36	C	10W429-1	R 2

GEOSYNTEC CONSULTANTS, INC | 2
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

L:\CAD\TVTENNESSEE VALLEY AUTHORITY\TVA-BALLFIELD AF TEMP STORAGE\CONSTRUCTION\DRAFTS\ STAGING PLAN\REV-2\10W429-1

LEGEND

- EXISTING GROUND CONTOUR (NOTE 1)
- EXISTING RAILROAD
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING FENCELINE
- OE — EXISTING OVERHEAD ELECTRICAL
- EXISTING SANITARY SEWER
- SI-1 — EXISTING SLOPE INCLINOMETER (NOTE 2)
- PC-1 — EXISTING VIBRATING WIRE PIEZOMETER IN CLAY (NOTE 2)
- PA-1 — EXISTING VIBRATING WIRE PIEZOMETER IN ASH (NOTE 2)
- SP-1 — EXISTING SETTLEMENT PLATE (NOTE 2)
- EXISTING 1/2" PVC INSTRUMENTATION PIPELINE (NOTE 2)
- EXISTING PIPE
- PROPOSED PHASE BOUNDARY
- PROPOSED DEEP SOIL MIXING LIMIT
- LOD — PROPOSED LIMIT OF DISTURBANCE

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND IS BASED ON AERIAL PHOTOGRAPHY TAKEN ON 23 JULY 2010. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. THE LOCATIONS OF THE EXISTING INSTRUMENTATION (I.E., VIBRATING WIRE PIEZOMETER IN CLAY/ASH, SLOPE INCLINOMETER, AND SETTLEMENT PLATE) ARE BASED ON THE NORTHING AND EASTING COORDINATES CONTAINED IN A TABLE ON PAGE 9 OF THE JACOBS INSTRUMENTATION WEEKLY SUMMARY REPORT FOR THE WEEK ENDING 10 SEPTEMBER 2010. THE LOCATIONS OF THE EXISTING INSTRUMENTATION WIRING SHOWN ON THIS DRAWING ARE DIGITIZED FROM A FIGURE ON PAGE 9 OF THE SAME SUMMARY REPORT AND SHALL BE CONSIDERED APPROXIMATE.
3. ASH MATERIALS TO BE PLACED IN THE INTERIM ASH STAGING AREA (IASA) SHALL INCLUDE FLY ASH, BOTTOM ASH, AND BOILER SLAG.
4. THE EXISTING CENTRAL AND NORTHERN RAILROAD SPURLINES SHALL BE DECOMMISSIONED PRIOR TO THE BEGINNING OF PHASE I CONSTRUCTION. THE WESTERN RAILROAD SPURINE SHALL BE MAINTAINED OPERATIONAL THROUGHOUT THE IASA PROJECT.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
0	FEB 11	MAD	RWL	RND	VJD	RND	MST	SRC		

INITIAL ISSUE

SCALE: AS SHOWN — EXCEPT AS NOTED

EXISTING CONDITIONS AND SITE PLAN

COAL COMBUSTION BYPRODUCT FACILITY KINGSTON RECOVERY PROJECT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. OTHMAN	R.W. LOWRY	R.N. DAVIES	V.J. DOTSON	R.N. DAVIES	M.S. TURNBOW	S.R. CATHEY

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

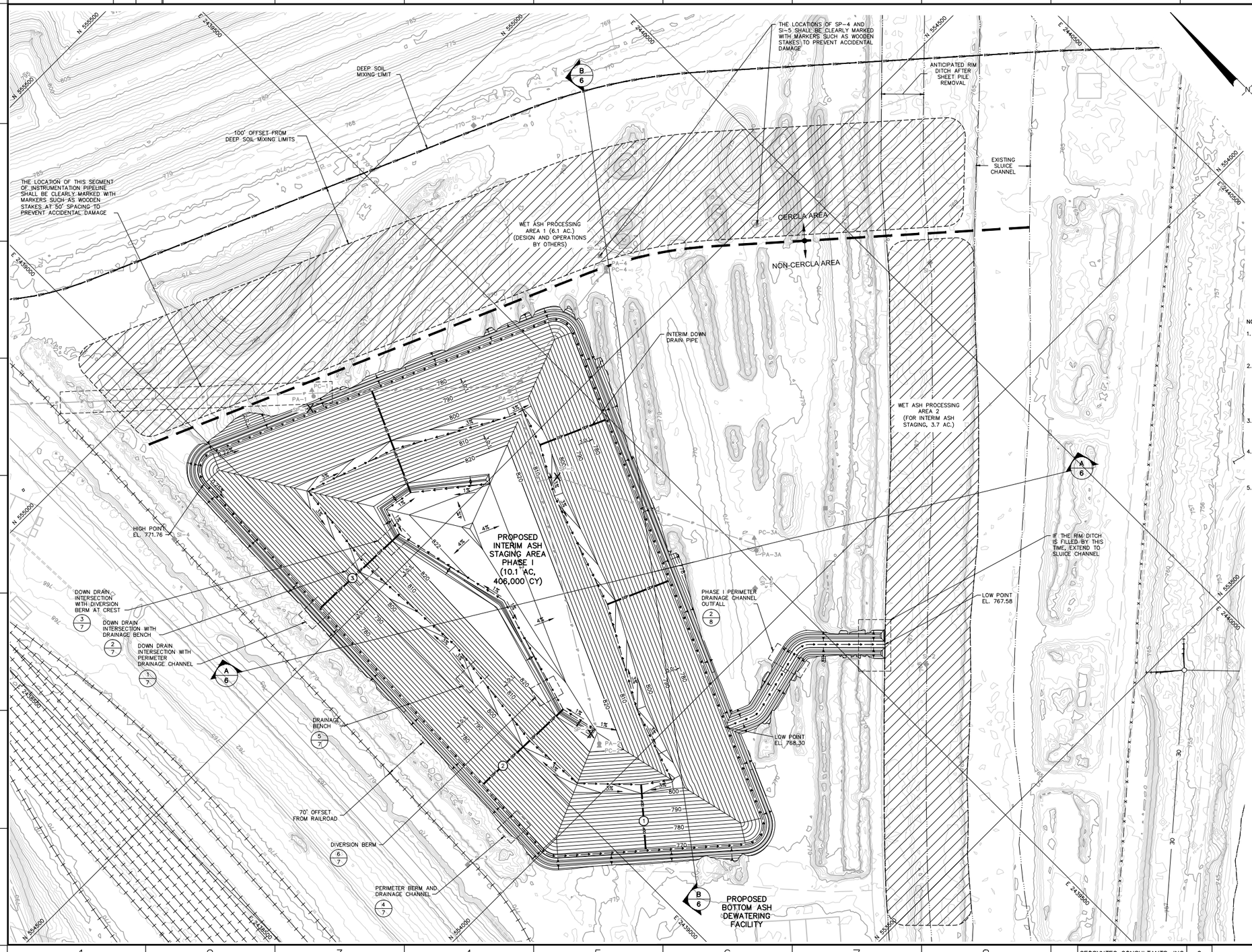
AUTODESK CIVIL 3D	DATE: OCT 10	36	C	10W429-2	R 2

GEOSYNTEC CONSULTANTS, INC. | 2
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

L:\JOBS\TVA\TENNESSEE VALLEY AUTHORITY\TVA-BALLFIELD OF RMP STORAGE\CONSTRUCTION\DRAWS STAGING PLAN\REV-2\10W429-2



LEGEND

- 780 — EXISTING GROUND CONTOUR (NOTE 1)
- EXISTING RAILROAD
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING FENCE LINE
- OE — EXISTING OVERHEAD ELECTRICAL
- EXISTING SANITARY SEWER
- SI-1 — EXISTING SLOPE INCLINOMETER (NOTE 2)
- PC-1 — EXISTING VIBRATING WIRE PIEZOMETER IN CLAY (NOTE 2)
- PA-1 — EXISTING VIBRATING WIRE PIEZOMETER IN ASH (NOTE 2)
- SP-1 — EXISTING SETTLEMENT PLATE (NOTE 2)
- EXISTING 1/2" PVC INSTRUMENTATION PIPELINE (NOTE 2)
- EXISTING PIPE
- 800 — PROPOSED GRADE
- PROPOSED DEEP SOIL MIXING LIMIT
- PROPOSED SURFACE-WATER RUNOFF FLOW LINE
- DDP 1 DDP — PROPOSED DOWN DRAIN PIPE AND DESIGNATION
- PROPOSED INTERIM DOWN DRAIN PIPE
- SP-1 — EXISTING SETTLEMENT PLATE TO BE DECOMMISSIONED (NOTE 2)
- CERCLA AREA BOUNDARY

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND IS BASED ON AERIAL PHOTOGRAPHY TAKEN ON 23 JULY 2010. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
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3. THE LOCATION, WIDTH AND DETAILS OF A FINAL STACK ACCESS ROAD SHALL BE FIELD DETERMINED. WHERE THE FINAL STACK ACCESS ROAD INTERCEPTS A DRAINAGE BENCH, THE DRAINAGE BENCH SHALL TRANSITION INTO A 12" DIAMETER (MIN) HDPE CORRUGATED EXTERIOR, SMOOTH INTERIOR PIPE BENEATH THE ACCESS ROAD WITH A MINIMUM 2-FT THICK COVER.
4. ONLY DEWATERED ASH MATERIALS ARE ALLOWED TO BE PLACED IN THE TEMPORARY ASH STACK. THE ASH LAYER SHALL BE COMPACTED IN HORIZONTAL LIFTS. THE LIFT THICKNESS AND MOISTURE CONTENT OF THE ASH MATERIAL SHALL BE DETERMINED BASED ON A PILOT STUDY PRIOR TO CONSTRUCTION OF THE TEMPORARY ASH STACK SUCH THAT THE REQUIRED DESIGN SHEAR STRENGTH OF THE ASH MATERIAL CAN BE ACHIEVED.
5. DISTURBED AREAS NOT AT FINAL STACK GRADE THAT ARE EXPOSED LONGER THAN 30 DAYS SHALL BE STABILIZED WITH HYDROSEEDING METHOD (I.E., MULCH MIXED WITH SEEDS APPLIED HYDRAULICALLY) USING TEMPORARY SEEDING. DISTURBED AREAS THAT HAVE ACHIEVED FINAL STACK GRADE SHALL BE STABILIZED WITH HYDROSEEDING METHOD USING PERMANENT SEEDING WITHIN 14 DAYS. OTHER EQUIVALENT STABILIZATION METHODS MAY ALSO BE USED UPON TVA'S APPROVAL.

Master Instrumentation Schedule

		To Remain in Place	To Be Decommissioned	To Be Installed
EXISTING	PA-1	X		
	PA-2	X		
	PA-3A	X		
	PA-4	X		
	PA-5	X		
	PC-1	X		
	PC-2	X		
	PC-3A	X		
	PC-4	X		
	PC-5	X		
	SI-1		decommission during Phase II	
	SI-2		decommission during Phase II	
	SI-3	X		
	SI-4	X		
	SI-5		decommission during Phase III	
	SI-6		decommission during Phase II	
	SI-7	X		
	SP-1		decommission during Phase I	
	SP-2		decommission during Phase I	
	SP-3		decommission during Phase II	
	SP-4		decommission during Phase III	
	SP-5		decommission during Phase I	
NEW	SI-1R			install prior to Phase II
	SI-2R			install prior to Phase II
	SI-5R			install prior to Phase III

Notes
1. Existing instrumentation designated to be decommissioned shall be abandonned when the ash fill approaches their vicinity.
2. Existing instrumentation shall be abandonned in accordance with applicable regulations/requirements as directed by TVA.

0 60' 120'
SCALE IN FEET

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
1	FEB 11	MAD	RWL	RND	VJD	RND	MST	SRC		
0	INITIAL ISSUE									

DISCIPLINE INTERFACE

SCALE: AS SHOWN — EXCEPT AS NOTED

PHASE I STACK GRADING PLAN

COAL COMBUSTION BYPRODUCT FACILITY KINGSTON RECOVERY PROJECT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. OTHMAN	R.W. LOWRY	R.N. DAVIES	V.J. DOTSON	R.N. DAVIES	M.S. TURNBOW	S.R. CATHEY

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

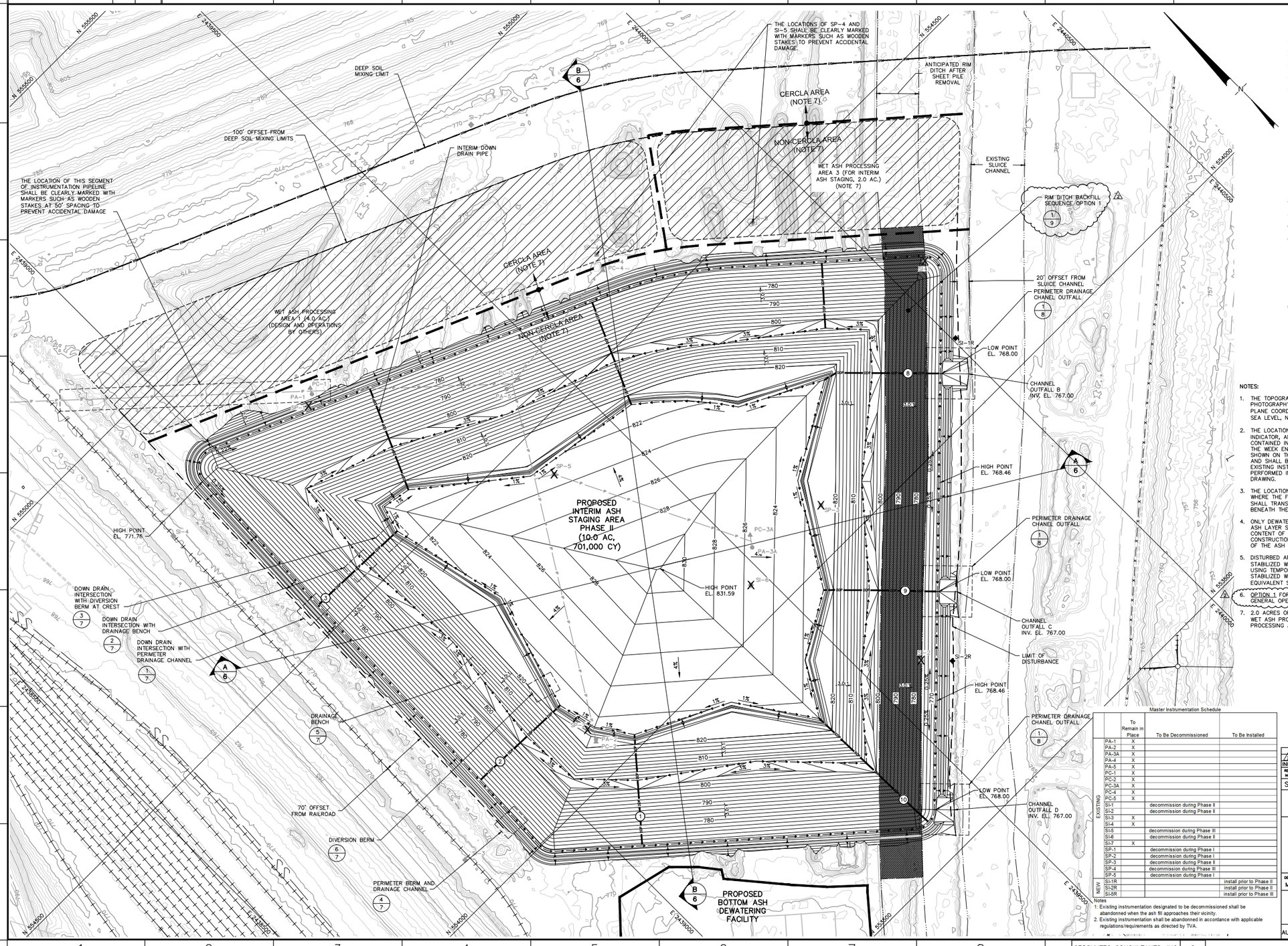
AUTODESK CIVIL 3D | DATE: OCT 10 | 36 | C | 10W429-3 | R 2

GEOSYNTEC CONSULTANTS, INC. | 2
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

L:\CAD\TVA\TENNESSEE VALLEY AUTHORITY\TVA-BALLFIELD AF TEMP STORAGE\CONSTRUCTION\GRATIR STAGING PLAN\RFV-2\10W429-3



LEGEND

- EXISTING GROUND CONTOUR (NOTE 1)
- EXISTING RAILROAD
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING FENCE LINE
- EXISTING OVERHEAD ELECTRICAL
- EXISTING SANITARY SEWER
- SI-1 EXISTING SLOPE INCLINOMETER (NOTE 2)
- PC-1 EXISTING VIBRATING WIRE PIEZOMETER IN CLAY (NOTE 2)
- PA-1 EXISTING VIBRATING WIRE PIEZOMETER IN ASH (NOTE 2)
- SP-1 EXISTING SETTLEMENT PLATE (NOTE 2)
- EXISTING 1/2" PVC INSTRUMENTATION PIPELINE (NOTE 2)
- EXISTING PIPE
- PROPOSED GRADE
- PROPOSED DEEP SOIL MIXING LIMIT
- PROPOSED SURFACE-WATER RUNNOFF FLOW LINE
- PROPOSED DOWN DRAIN PIPE AND DESIGNATION
- PROPOSED INTERIM DOWN DRAIN PIPE
- EXISTING SLOPE INCLINOMETER TO BE DECOMMISSIONED (NOTE 2)
- EXISTING SETTLEMENT PLATE TO BE DECOMMISSIONED (NOTE 2)
- SI-1R PROPOSED SLOPE INCLINOMETER (NOTE 2)
- CERCLA AREA BOUNDARY

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND IS BASED ON AERIAL PHOTOGRAPHY TAKEN ON 23 JULY 2010. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
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3. THE LOCATION, WIDTH AND DETAILS OF A FINAL STACK ACCESS ROAD SHALL BE FIELD DETERMINED. WHERE THE FINAL STACK ACCESS ROAD INTERCEPTS A DRAINAGE BENCH, THE DRAINAGE BENCH SHALL TRANSITION INTO A 12" DIAMETER (MIN) HDPE CORRUGATED EXTERIOR, SMOOTH INTERIOR PIPE BENEATH THE ACCESS ROAD WITH A MINIMUM 2-FT THICK COVER.
4. ONLY DEWATERED ASH MATERIALS ARE ALLOWED TO BE PLACED IN THE TEMPORARY ASH STACK. THE ASH LAYER SHALL BE COMPACTED IN HORIZONTAL LIFTS. THE LIFT THICKNESS AND MOISTURE CONTENT OF THE ASH MATERIAL SHALL BE DETERMINED BASED ON A PILOT STUDY PRIOR TO CONSTRUCTION OF THE TEMPORARY ASH STACK SUCH THAT THE REQUIRED DESIGN SHEAR STRENGTH OF THE ASH MATERIAL CAN BE ACHIEVED.
5. DISTURBED AREAS NOT AT FINAL STACK GRADE THAT ARE EXPOSED LONGER THAN 30 DAYS SHALL BE STABILIZED WITH HYDROSEEDING METHOD (I.E., MULCH MIXED WITH SEEDS APPLIED HYDRAULICALLY) USING TEMPORARY SEEDING. DISTURBED AREAS THAT HAVE ACHIEVED FINAL STACK GRADE SHALL BE STABILIZED WITH HYDROSEEDING METHOD USING PERMANENT SEEDING WITHIN 14 DAYS. OTHER EQUIVALENT STABILIZATION METHODS MAY ALSO BE USED UPON TVA'S APPROVAL.
6. OPTION 1 FOR THE BACKFILL SEQUENCES OF THE RIM DITCH IS ILLUSTRATED ON DRAWING 9 WITH GENERAL OPERATION NOTES.
7. 2.0 ACRES OF WET ASH PROCESSING AREA SHALL BE DESIGNATED AND UTILIZED AS A NON-CERCLA WET ASH PROCESSING AREA (AREA 3) FOR IASA PRIOR TO THE DECOMMISSIONING OF WET ASH PROCESSING AREA 2.

Master Instrumentation Schedule

		To Remain in Place	To Be Decommissioned	To Be Installed
EXISTING	PA-1	X		
	PA-2	X		
	PA-3A	X		
	PA-4	X		
	PA-5	X		
	PC-1	X		
	PC-2	X		
	PC-3A	X		
	PC-4	X		
	PC-5	X		
	SI-1		decommission during Phase II	
	SI-2		decommission during Phase II	
	SI-3	X		
	SI-4	X		
	SI-5		decommission during Phase III	
	SI-6		decommission during Phase II	
	SI-7	X		
	SP-1		decommission during Phase I	
	SP-2		decommission during Phase I	
	SP-3		decommission during Phase II	
	SP-4		decommission during Phase III	
	SP-5		decommission during Phase I	
NEW	SI-1R			install prior to Phase II
	SI-2R			install prior to Phase II
	SI-5R			install prior to Phase III

Notes
1. Existing instrumentation designated to be decommissioned shall be abandonned when the ash fill approaches their vicinity.
2. Existing instrumentation shall be abandonned in accordance with applicable regulations/requirements as directed by TVA.

0 60' 120'
SCALE IN FEET

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
A	FEB 11	MAD	RWL	RND	VJD	RND	MST	SRC		
INITIAL ISSUE										

SCALE: AS SHOWN EXCEPT AS NOTED

DISCIPLINE INTERFACE: 1 2 3 4

PHASE II STACK GRADING PLAN

COAL COMBUSTION BYPRODUCT FACILITY KINGSTON RECOVERY PROJECT

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
M. OTHMAN	R.W. LOWRY	R.N. DAVIES	V.J. DOTSON	R.N. DAVIES	M.S. TURNBOW	S.R. CATHEY

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE	36	C	10W429-4	R 2
	OCT 10				

GEOSYNTEC CONSULTANTS, INC. | 2
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

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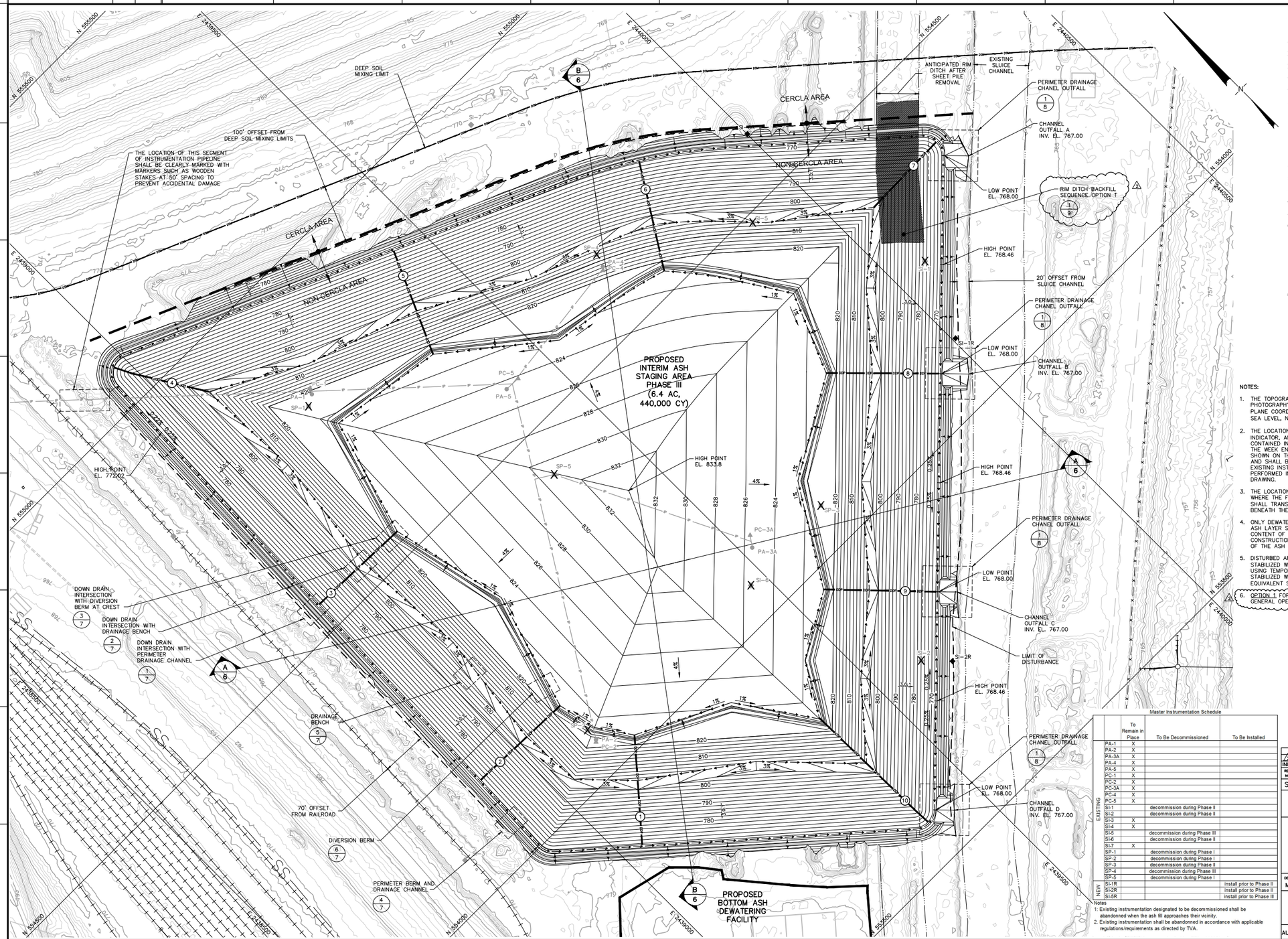

LEGEND

- EXISTING GROUND CONTOUR (NOTE 1)
- EXISTING RAILROAD
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING FENCE LINE
- EXISTING OVERHEAD ELECTRICAL
- EXISTING SANITARY SEWER
- SI-1 EXISTING SLOPE INCLINOMETER (NOTE 2)
- PC-1 EXISTING VIBRATING WIRE PIEZOMETER IN CLAY (NOTE 2)
- PA-1 EXISTING VIBRATING WIRE PIEZOMETER IN ASH (NOTE 2)
- SP-1 EXISTING SETTLEMENT PLATE (NOTE 2)
- EXISTING 1/2" PVC INSTRUMENTATION PIPELINE (NOTE 2)
- EXISTING PIPE
- PROPOSED GRADE
- PROPOSED DEEP SOIL MIXING LIMIT
- PROPOSED SURFACE-WATER RUNOFF FLOW LINE
- PROPOSED DOWN DRAIN PIPE AND DESIGNATION
- SI-1 EXISTING SLOPE INCLINOMETER TO BE DECOMMISSIONED (NOTE 2)
- SP-1 EXISTING SETTLEMENT PLATE TO BE DECOMMISSIONED (NOTE 2)
- SI-1R PROPOSED SLOPE INCLINOMETER (NOTE 2)
- CERCLA AREA BOUNDARY

NOTES:

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6. OPTION 1 FOR THE BACKFILL SEQUENCES OF THE RIM DITCH IS ILLUSTRATED ON DRAWING 9 WITH GENERAL OPERATION NOTES.

Master Instrumentation Schedule

		To Remain in Place	To Be Decommissioned	To Be Installed
EXISTING	PA-1	X		
	PA-2	X		
	PA-3A	X		
	PA-4	X		
	PA-5	X		
	PC-1	X		
	PC-2	X		
	PC-3A	X		
	PC-4	X		
	PC-5	X		
	SI-1		decommission during Phase II	
	SI-2		decommission during Phase II	
	SI-3	X		
	SI-4	X		
	SI-5		decommission during Phase III	
	SI-6		decommission during Phase II	
	SI-7	X		
	SP-1		decommission during Phase I	
	SP-2		decommission during Phase I	
	SP-3		decommission during Phase II	
	SP-4		decommission during Phase III	
	SP-5		decommission during Phase I	
NEW	SI-1R			install prior to Phase II
	SI-2R			install prior to Phase II
	SI-5R			install prior to Phase II

Notes
1: Existing instrumentation designated to be decommissioned shall be abandonned when the ash fill approaches their vicinity.
2. Existing instrumentation shall be abandonned in accordance with applicable regulations/requirements as directed by TVA.

SCALE IN FEET: 0 60' 120'

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV ID
2	FEB 11	MAD	RWL	RND	VJD	RND	MST	SRC			DISCIPLINE INTERFACE
INITIAL ISSUE											

SCALE: AS SHOWN — EXCEPT AS NOTED

FINAL STACK GRADING PLAN

COAL COMBUSTION BYPRODUCT FACILITY KINGSTON RECOVERY PROJECT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. OTHMAN	R.W. LOWRY	R.N. DAVIES	V.J. DOTSON	R.N. DAVIES	M.S. TURNBOW	S.R. CATHEY

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

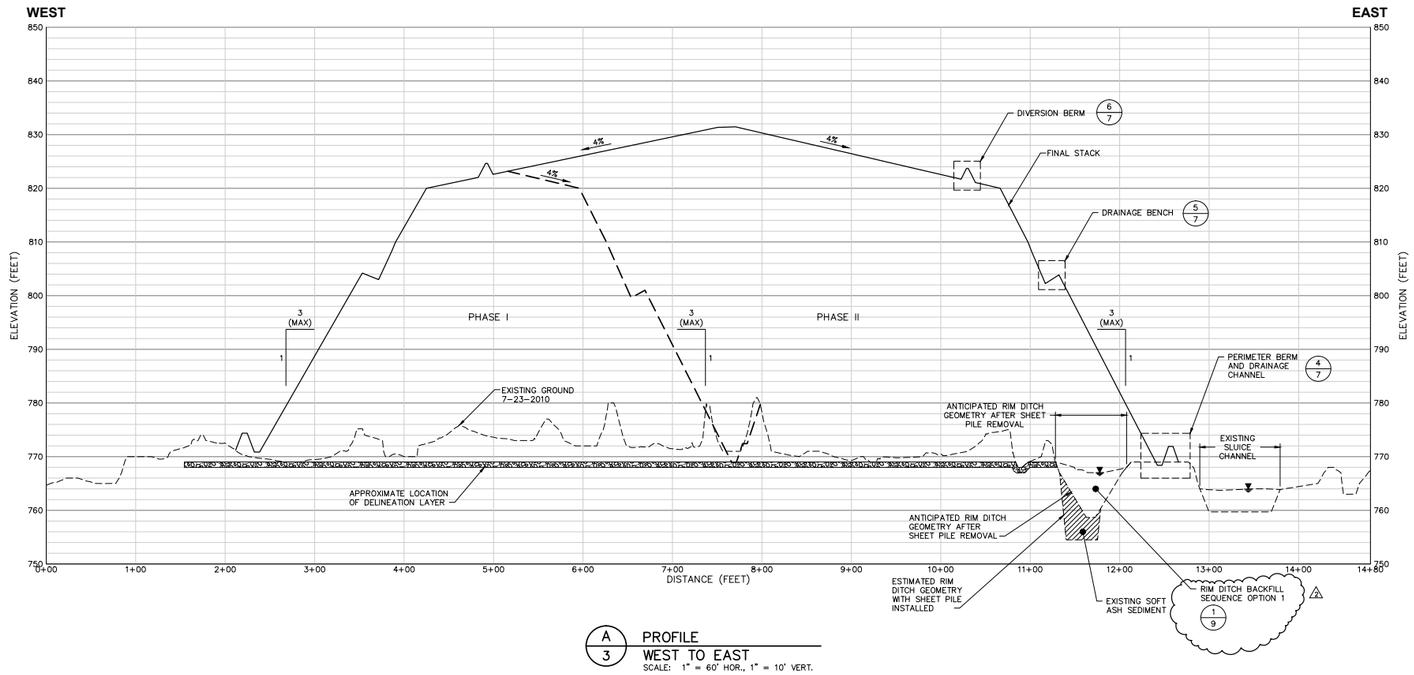
AUTODESK CIVIL 3D | DATE: OCT 10 | 36 | C | 10W429-5 | R 2

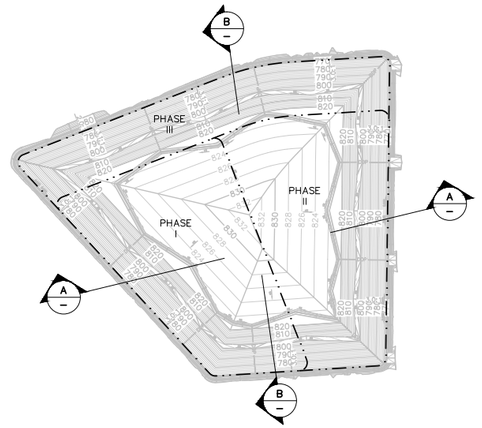
GEOSYNTEC CONSULTANTS, INC. | 2
TASK COMPLETED BY: | REV NO.

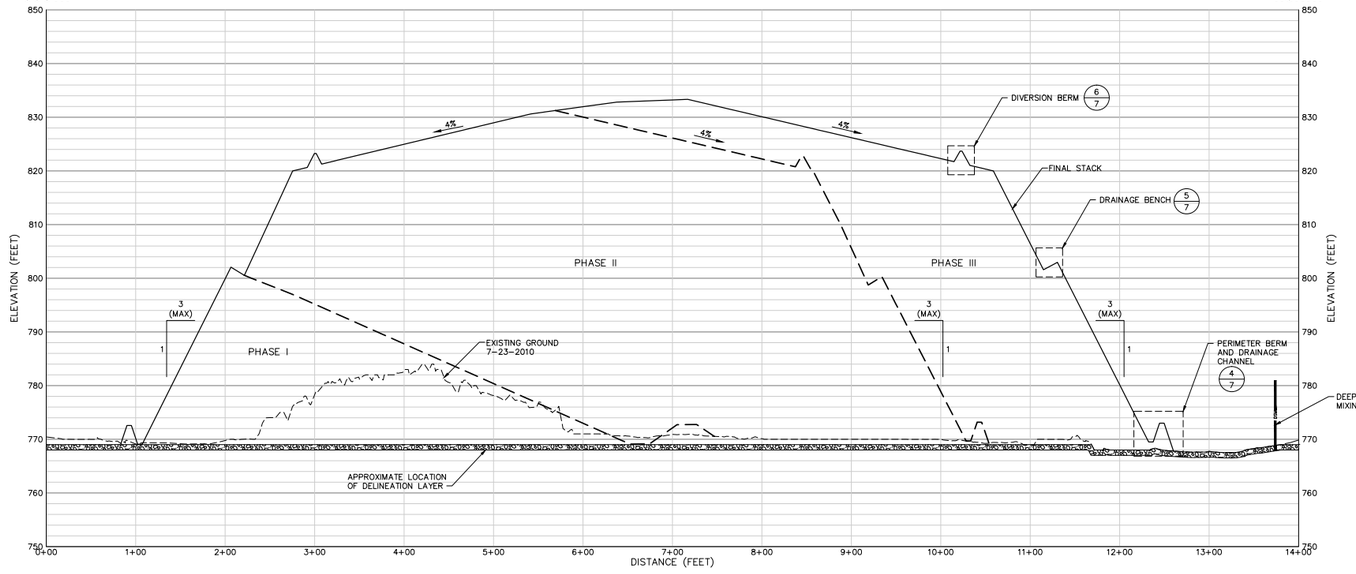
PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

L:\CAD\TVI\TENNESSEE VALLEY AUTHORITY\TVA-RAILFIELD AF ISMP STORAGE\CONSTRUCTION\GRA738 STAGING PLAN\REV-2\10W429-5







NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND IS BASED ON AERIAL PHOTOGRAPHY TAKEN ON 23 JULY 2010. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.

0 60' 120'
HORIZONTAL SCALE IN FEET

0 10' 20'
VERTICAL SCALE IN FEET

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE
2	FEB 11	MAO	RWL	RND	VJD	RND	MST	SRC			
1	INITIAL ISSUE										

SCALE: AS SHOWN EXCEPT AS NOTED

CROSS SECTIONS

COAL COMBUSTION BYPRODUCT FACILITY KINGSTON RECOVERY PROJECT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. OTHMAN	R.W. LOWRY	R.N. DAVIES	V.J. DOTSON	R.N. DAVIES	M.S. TURNBOW	S.R. CATHEY

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

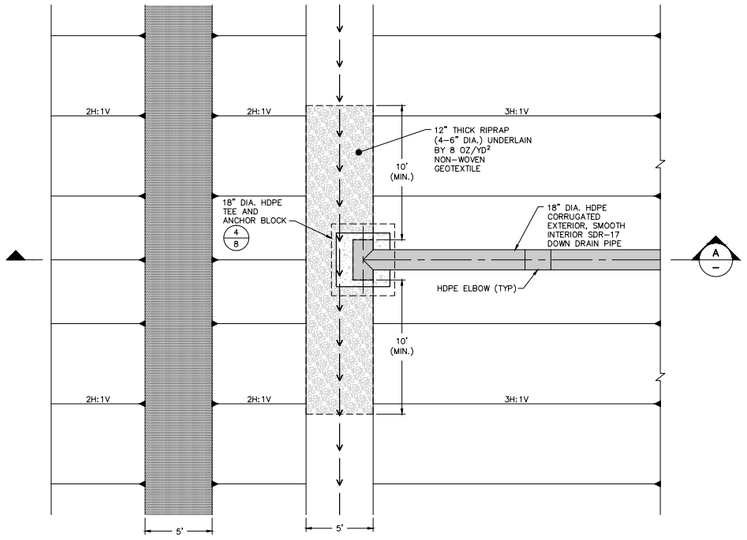
AUTODESK CIVIL 3D	DATE: OCT 10	36	C	10W429-6	R 2

GEOSYNTEC CONSULTANTS, INC. 2
TASK COMPLETED BY: REV NO.

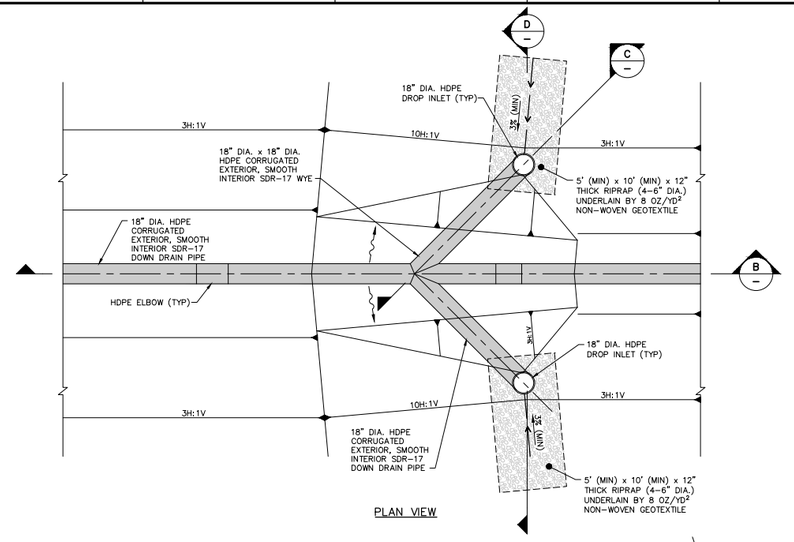
PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

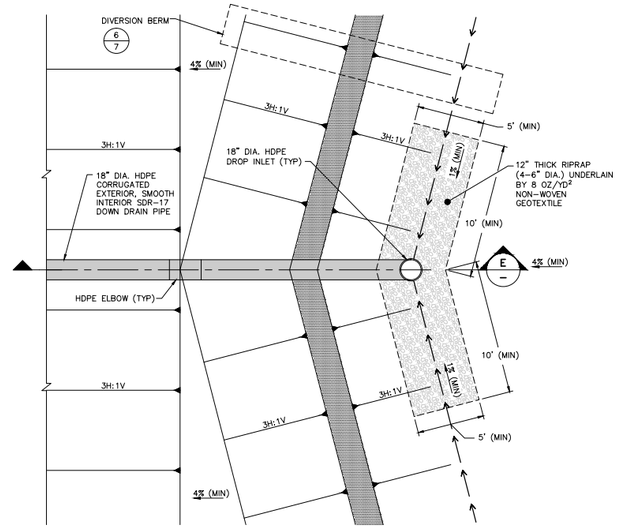
L:\CAD\TVA\TENNESSEE VALLEY AUTHORITY\TVA-BALLFIELD OF TEMP STORAGE\CONSTRUCTION\DR4728 STAGING PLAN\REV-2\10W429-6



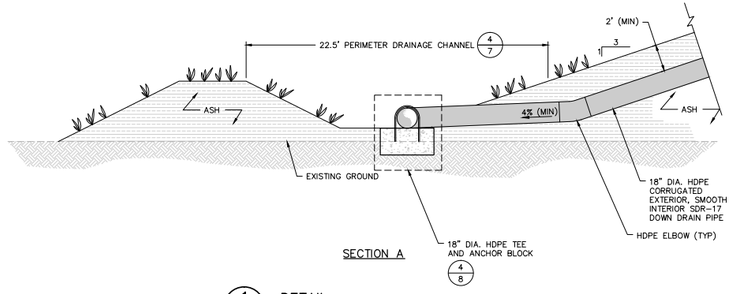
PLAN VIEW



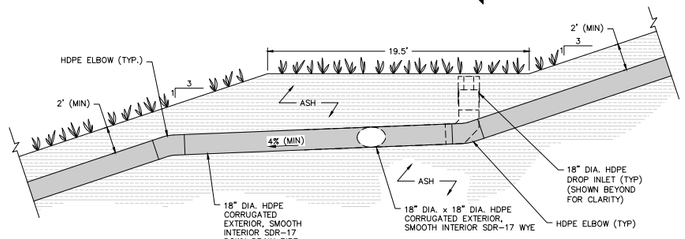
PLAN VIEW



PLAN VIEW



SECTION A



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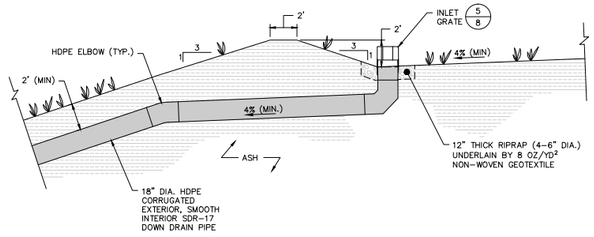
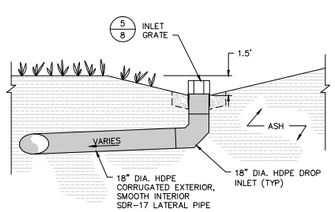
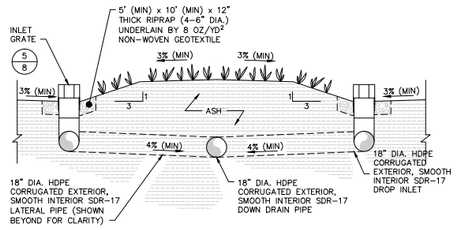


SECTION E



SECTION C

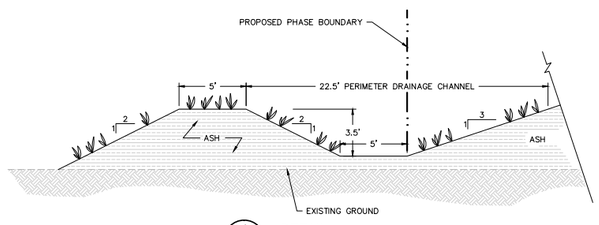


SECTION D

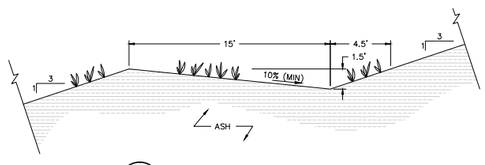
1/3 DETAIL
DOWN DRAIN INTERSECTION WITH PERIMETER DRAINAGE CHANNEL
SCALE: 1" = 4'
XREF: 473BX019.PBERM

2/3 DETAIL
DOWN DRAIN INTERSECTION WITH DRAINAGE BENCH
SCALE: 1" = 4'
XREF: 473BX019.PBERM

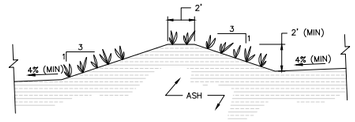
3/3 DETAIL
DOWN DRAIN INTERSECTION WITH DIVERSION BERM AT CREST
SCALE: 1" = 4'
XREF: 473BX019.PBERM



4/3 DETAIL
PERIMETER BERM AND DRAINAGE CHANNEL
SCALE: 1" = 4'
XREF: 473BX019.PBERM



5/3 DETAIL
DRAINAGE BENCH
SCALE: 1" = 4'
XREF: 473BX019.PBERM



6/3 DETAIL
DIVERSION BERM
SCALE: 1" = 4'
XREF: 473BX019.PBERM

NOTES:

1. TOP 6 INCHES OF THE INTERIM ASH STAGING AREA COVER MAY BE SUBSTITUTED WITH 6 INCHES OF VEGETATIVE LAYER.

2	FEB 11	MAO	RWL	RND	VJD	RND	MST	SRC			DISCIPLINE INTERFACE
INITIAL ISSUE											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV'D

SCALE: 1" = 60' EXCEPT AS NOTED

SURFACE WATER MANAGEMENT DETAILS I

COAL COMBUSTION BYPRODUCT FACILITY
KINGSTON RECOVERY PROJECT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. OTHMAN	R.W. LOWRY	R.N. DAVIES	V.J. DOTSON	R.N. DAVIES	M.S. TURNBOW	S.R. CATHEY

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

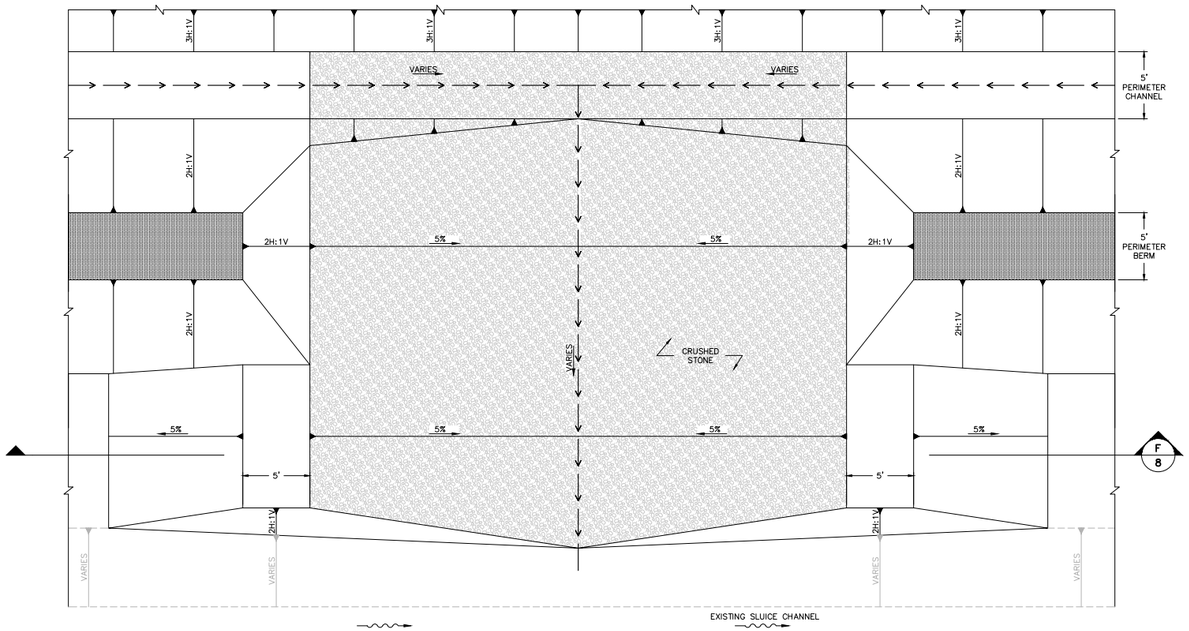
AUTODESK CIVIL 3D	DATE: OCT 10	36	C	10W429-7	R 2

GEOSYNTEC CONSULTANTS, INC. | 2
TASK COMPLETED BY: | REV NO.

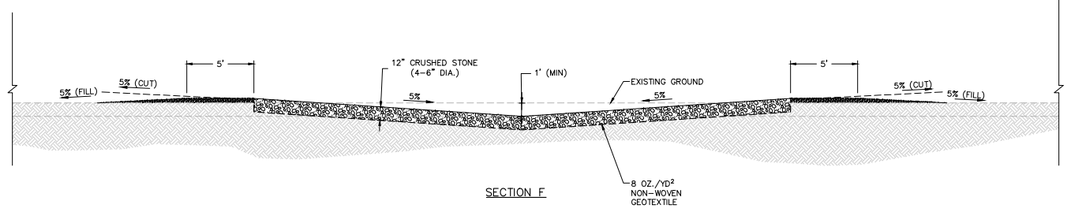
PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

L:\CAD\TVA\TENNESSEE VALLEY AUTHORITY\TVA-BULLFIELD AF TEMP STORAGE\CONSTRUCTION\GRATIS STAGING PLAN\APC-2\10W429-7

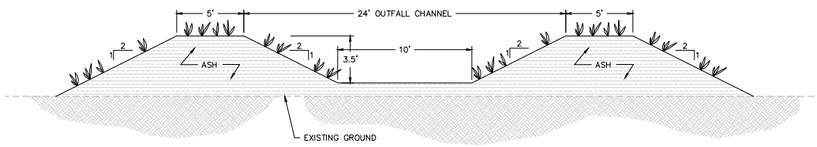


PLAN VIEW

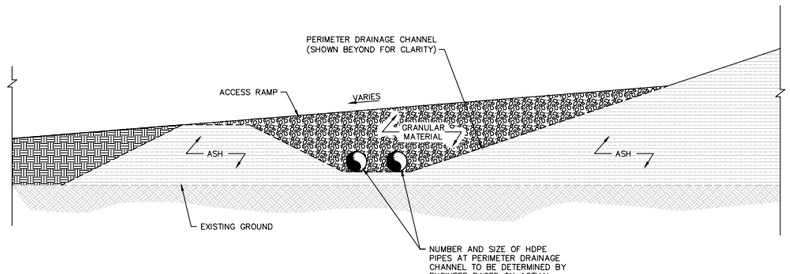


SECTION F

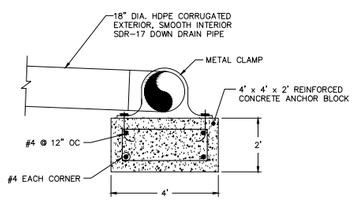
1/4 DETAIL
PERIMETER DRAINAGE CHANNEL OUTFALL
SCALE: 1" = 4'
XREF: 4738X021 OUTFALL



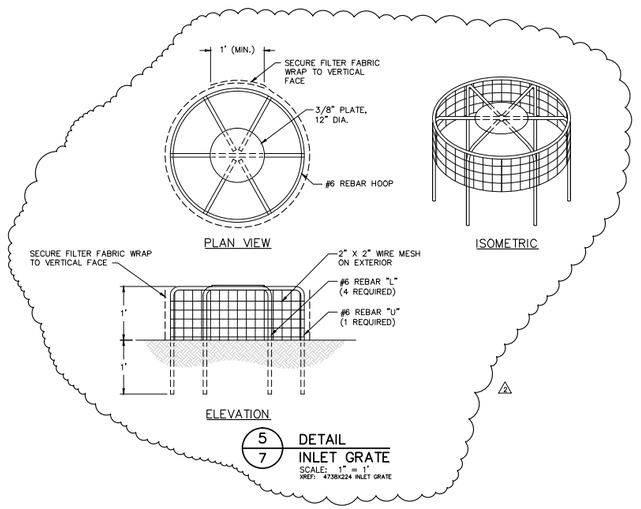
2/3 DETAIL
PHASE I PERIMETER DRAINAGE CHANNEL OUTFALL
SCALE: 1" = 4'
XREF: 4738X021 OUTFALL



3/– DETAIL
ACCESS RAMP OVER PERIMETER DRAINAGE CHANNEL
SCALE: 1" = 4'
XREF: 4738X027 ACCESS RAMP



4/7 DETAIL
18" DIA. HDPE TEE AND ANCHOR BLOCK
SCALE: 1" = 2'
XREF: 4738X025 PIPE DRAIN OUTLET ANCHOR BLOCK



5/7 DETAIL
INLET GRATE
SCALE: 1" = 1'
XREF: 4738X024 INLET GRATE

NOTES:

1. TOP 6 INCHES OF THE INTERIM ASH STAGING AREA COVER MAY BE SUBSTITUTED WITH 6 INCHES OF VEGETATIVE LAYER.

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV NO.
1	FEB 11	MAD	RWL	RND	VJD	RND	MST	SRC			DISCIPLINE INTERFACE
INITIAL ISSUE											

SCALE: 1" = 60' EXCEPT AS NOTED

SURFACE WATER MANAGEMENT DETAILS II

COAL COMBUSTION BYPRODUCT FACILITY
KINGSTON RECOVERY PROJECT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. OTHMAN	R.W. LOWRY	R.N. DAVIES	V.J. DOTSON	R.N. DAVIES	M.S. TURNBOW	S.R. CATHEY

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

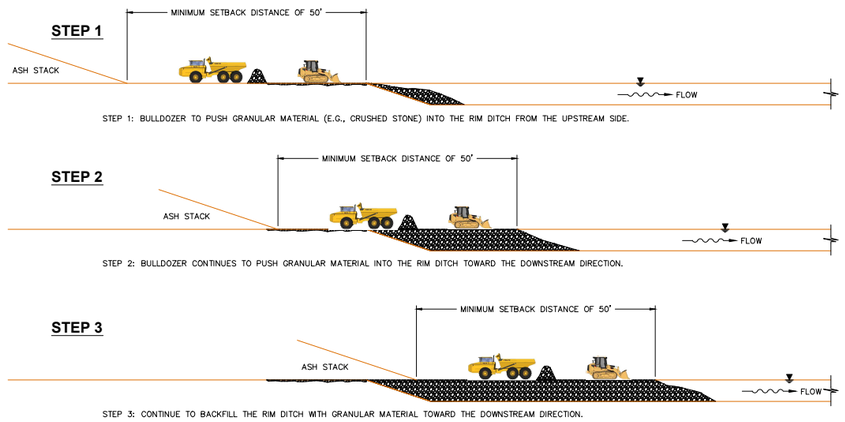
AUTODESK CIVIL 3D	DATE: OCT 10	36	C	10W429-8	R 2

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

GEOSYNTEC CONSULTANTS, INC	2
TASK COMPLETED BY:	REV NO.

L:\CAD\TVA\TENNESSEE VALLEY AUTHORITY\TVA-WALNUT FLD ASH POND STORAGE\CONSTRUCTION\GR4738 STAGING PLAN\REV-2\10W429-8



1/4 DETAIL
RIM DITCH BACKFILL SEQUENCE OPERATION – OPTION 1
SCALE: N.T.S.
XREF: 4738X022 RIM DITCH

GENERAL NOTES:

1. A THOROUGH DREDGING OPERATION MUST BE PERFORMED IN THE INTENDED RIM DITCH WORKING AREA PRIOR TO BACKFILLING TO REMOVE EXISTING ASH SEDIMENT FROM THE RIM DITCH.
2. HEAVY CONSTRUCTION EQUIPMENT SUCH AS BULLDOZERS AND ARTICULATED TRUCKS ARE TO USE CAUTION WHEN OPERATING NEAR THE EDGE OF THE RIM DITCH. IF UNSTABLE CONDITIONS ARE OBSERVED, OPERATING EQUIPMENT MUST PULL BACK TO A SAFE DISTANCE IMMEDIATELY. TYPICAL SIGNS OF UNSTABLE CONDITIONS INCLUDE SOIL SLOUGHING ON THE SIDE SLOPE OF RIM DITCH, FORMATION OF TENSION CRACKS ALONG THE RIM DITCH, EXCESSIVE RUTTING, AND EXCESSIVE GROUND DEPRESSION.
3. THE TOP OF THE GRANULAR MATERIAL MUST BE MAINTAINED TO BE SLIGHTLY HIGHER THAN THE ADJACENT EARTHEN GROUND. RUTTING AND DEPRESSION OF THE GRANULAR MATERIAL MUST BE REPAIRED IN A TIMELY FASHION.
4. BULLDOZERS CAN OPERATE "INSIDE THE RIM DITCH" ON TOP OF THE GRANULAR MATERIAL ONLY WHEN APPROVED BY THE SUPERVISING ENGINEER.
5. HEAVY ARTICULATED TRUCKS MUST AVOID GOING "WITHIN THE RIM DITCH LIMITS" TO THE EXTENT PRACTICAL. THE BACKFILL MATERIAL MAY BE UNLOADED ALONG THE SIDE OF THE RIM DITCH.
6. NO PERSONNEL ARE ALLOWED TO WALK NEAR THE RIM DITCH WHERE ACTIVE BACKFILLING OPERATIONS ARE ONGOING.
7. THE MINIMUM SETBACK DISTANCE BETWEEN THE INTERIM ASH STACK AND THE RIM DITCH MUST BE 50'.

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE
2	FEB 11	MAC	RWL	RND	VJD	RND	MST	SRC			

INITIAL ISSUE

SCALE: 1" = 60' EXCEPT AS NOTED

RECOMMENDED PROCEDURES FOR
RIM DITCH FILLING

COAL COMBUSTION BYPRODUCT
FACILITY
KINGSTON RECOVERY PROJECT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. OTHMAN	R.W. LOWRY	R.N. DAVIES	V.J. DOTSON	R.N. DAVIES	M.S. TURNBOW	S.R. CATHEY

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE OCT 10	36	C	10W429-9	R 2

GEOSYNTEC CONSULTANTS, INC | 2
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

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LEGEND

- EXISTING GROUND CONTOUR (NOTE 1)
- EXISTING RAILROAD
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING FENCELINE
- OE — EXISTING OVERHEAD ELECTRICAL
- EXISTING SANITARY SEWER
- EXISTING PIPE
- DEEP SOIL MIXING LIMIT
- APPROXIMATE LIMIT OF DELINEATION LAYER
- AREA CONTAINING DELINEATION LAYER
- AREA TO BE EXCAVATED TO TOP OF DELINEATION LAYER (NOTE 2)
- AREA TO BE EXCAVATED TO EL. 768.0

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND IS BASED ON AERIAL PHOTOGRAPHY TAKEN ON 23 JULY 2010. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. THE LIMIT OF THE DELINEATION LAYER WAS DIGITIZED FROM A TVA DRAWING TITLED "ASH PROCESSING & TEMPORARY STORAGE AREA GRADING PLAN" DATED 2/16/2009 WITH DCN KIF-09-1230 RO AA2 AND SHALL BE CONSIDERED APPROXIMATE ACCORDING TO THE THIS DRAWING, THE DELINEATION LAYER HAS 6 TO 12 INCHES OF STONE. THE TOP OF THE DELINEATION LAYER IS AT APPROXIMATELY EL. 769 AT TIME OF INSTALLATION. SMALL SETTLEMENT OF THE DELINEATION LAYER MAY OCCUR AS A RESULT OF THE TEMPORARY ASH STACK LOADING. EXCAVATE AND REMOVE THE ASH STACK TO THE TOP OF THE DELINEATION LAYER. FUTURE BENEFICIAL USE OF THE BALLFIELD AREA WILL BE DESIGNED BY OTHERS.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT MGR	AS CONST	REV. NO.
2	FEB 11	MAO	RWL	RND	VJD	RND	MST	SRC			DISCIPLINE INTERFACE
INITIAL ISSUE											

SCALE: 1" = 60' EXCEPT AS NOTED

SITE RESTORATION PLAN

COAL COMBUSTION BYPRODUCT FACILITY KINGSTON RECOVERY PROJECT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. OTHMAN	R.W. LOWRY	R.N. DAVIES	V.J. DOTSON	R.N. DAVIES	M.S. TURNBOW	S.R. CATHEY

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE	36	c	10W429-10	R 2
	OCT 10				

GEOSYNTEC CONSULTANTS, INC. | 2
TASK COMPLETED BY: | REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

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Kingston Drawing Inventory List

Series	Sheets	Revision	Date	Facility	Description
10N200	1	10	01/23/76	All	General Plan - (Drawing Voided)
10W200	1	6	07/15/05	All	General Plan
31N202	1	3	01/17/57	All	Water Supply - Intake Channel Dike - Plan and Section
10W427	11	0	03/01/06	All	Gypsum Disposal Facility - Peninsula Site
10W428	22	0	02/01/08	All	FGD Gypsum Disposal Facility
10E202	1	1	09/30/87	All	Proposed Features
10W472	1	--	--	All	Diked Buttress Cross Sections
10W426	2	0	04/06/98	Ash Pond	Ash Pond Area - Existing Contours (1994)
10W229	30	0	08/01/09	Ash Pond	Geotechnical Exploration - Ash Pond Stability
10W229	15	0	11/18/09	Ash Pond	Dike C Buttress - Stage 1 - Segment D
10W400	10	0	09/01/07	Ash Pond	Ash Pond Dike - Drainage Improvements - Swan Pond Road
10N400	1	6	07/05/56	Ash Pond	Ash Disposal Area
10N420	1	2	05/06/77	Ash Pond	Plan - Raising Ash Disposal Area Dike
10N421	1	1	10/13/77	Ash Pond	Ash Pond Dike - Sections and Details
10N422	1	1	10/08/77	Ash Pond	Ash Disposal Spillway
10N423	1	0	05/20/76	Ash Pond	Weir for Ash Disposal Spillway
10N424	1	0	09/23/77	Ash Pond	Ash Disposal Area Divider Dike & Floating Boom
10B415	1	0	12/04/73	Ash Pond	Ash Disposal Area - Repair of Dike "C"
10W419	3	0	02/15/91	Ash Pond	Concrete Diversion Flume Outline & Reinforcing
10W421	1	5	04/19/04	Ash Pond	Ash Pond Dike - Sections and Details
10W441	2	0	--	Ash Pond	Abandoned Ash Pond - Drainage Diversion - Details and Sections
10W425	18	0	04/06/98	Dredge Cell	Dredge Cells
10W425	74	0	04/28/81	Dredge Cell	Dredge Cell Lateral Expansion
10W440	2	0	07/28/87	Sluice Channel	Redwater Treatment Using Engineered Wetlands
10H431	2	1	01/23/84	Sluice Channel	Acidic Drainage Repair
10N401	1	5	11/14/72	Sluice Channel	Ash Sluice Pipe Trench and Supports
10N402	1	4	07/27/73	Sluice Channel	Ash Sluice Pipe Trench and Supports
10W430	1	2	01/23/84	Sluice Channel	Acidic Drainage Repair - Plan
10W225	3	0	03/12/01	Yard	Coal Yard Runoff Pond Discharge Pipe Upgrade Pipe Route and Grading Plan
10N211	1	6	Unknown	Yard	General Grading Plan - Coal Yard
10W418	9	1	12/19/02	Yard	Yard Plans and Details
10W250	1	--	--	Yard	Yard Drainage Plan
10W254	3	--	--	Yard	Yard Storm Drainage
10W259	1	--	--	Yard	Yard Grading Plan
10W390	5	--	--	Yard	Yard NH3 handling Facility
10N401	1	5	11/11/72	Yard	(Units 1-4) Concrete Ash Sluice Pipe Trench & Supports Outline & Reinf-Sh1
10N402	1	4	07/27/73	Yard	(Units 1-9) Concrete Ash Sluice Pipe Trench & Supports Outline & Reinf-Sh2
17W412	3	1	09/17/07	Yard	(Units 1-9) Chemical Treatment Pond and Coal Pile Drainage
10W408	1	--	--	Yard	(Units 1-9) Concrete Ash Sluice Pipe Trench Addition Outline and Reinforcement
10W407	1	--	--	Yard	(Units 1-9) Concrete Ash Sluice Pipe Trench Addition Outline and Reinforcement

900 PERMITS

The list presented below is of known active permits for the Kingston Fossil Plant. It should be noted that the permit information presented herein may or may not be up-to-date as revisions and modifications to permits can occur. To obtain current permit information the TVA Environet should be referenced or contact the site specific PAE. Environet can be accessed through TVA's intranet at the link provided:

http://insidenet.tva.gov/org/et/environet/toolbox/tva-facility_permit_list.xls

List of Active Permits:

- National Pollutant Discharge Elimination System (NPDES), Permit No.: TN0005452
- National Pollutant Discharge Elimination System (NPDES), Permit No.: TN0080870
- Registration Authorizing Solid Waste Disposal Activities, Registration Number: IDL 73-0211
- Minor Modification to IDL 73-0211, to add a GCL Component to the liner, Peninsula Site
- Tennessee Department of Environment and Conservation (TDEC), Air Quality Permit, Permit No. 548401

900.1 Operations Requirement Matrix

The Operations Requirement Matrix included herein, lists the various requirements that pertain to routine handling of CCP materials for active facilities. The matrix is divided based on the source of the requirement. The requirements include permit requirements, NEPA commitments, and recommended practices. Additionally, presented in the matrix are the designation of the responsible party and a status of each item presented. As responsibilities, requirements, and commitments change, the matrix should be revised.

900.2 NPDES Flow Schematic

The NPDES flow schematic is presented in Section 902.

900.3 NEPA Commitments

If applicable, NEPA commitments are presented in Section 903.

REFERENCE

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Solid Waste Permit (IDL 73-0211)						
1	In the event of noncompliance with the permit, the permittee shall take all reasonable steps to minimize releases to the environment, and shall carry out such measures as are reason to prevent adverse impacts on human health or the environment.	Yes			-	
	The permittee shall allow the Commissioner, or an authorized representative , to:					
2	Enter at any reasonable time the permitee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;	Yes			-	
3	Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;	Yes			-	
4	Inspect at any reasonable time any facilities, equipment (including monitoring and control equipment), practices or operations regulated or required under this permit (Note: If requested by the permittee at the time or sampling, the Commissioner shall split with the permittee any samples taken.);	Yes			-	
5	Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Act any substances or parameters at any location; and	Yes			-	
6	Make photographs for the purpose of documenting items of compliance or noncompliance at waste management units, or where appropriate to protect legitimate proprietary interests, require the permittee to make such photos for the Commissioner.	Yes			-	
7	Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.	Yes			-	
8	The permittee shall retain records of all required monitoring information. The permittee shall maintain records for all ground-water monitoring wells and associated ground-water surface elevations, for the active life of the facility, and for the post-closure care period as well. This period may be extended by request of the Commissioner at any time.	Yes			-	
	Records for monitoring information shall include:					

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Solid Waste Permit (IDL 73-0211)						
9	The date, exact place, and time of sampling or measurements;	Yes			-	
10	The individual(s) who performed the sampling or measurements;	Yes			-	
11	The date(s) analyses were performed;	Yes			-	
12	The individual(s) who performed the analysis;	Yes			-	
13	The analytical techniques or methods used (including equipment used); and	Yes			-	
14	The results of such analyses.	Yes			-	
15	The permittee shall give notice to the Commissioner as soon as possible of any planned physical alterations or additions to the permitted facility.	Yes			-	
16	Monitoring results shall be reported at the intervals specified elsewhere in this permit.	Yes			-	
17	The permittee shall report orally within 24 hours from the time the permittee becomes aware of the circumstances of any release, discharge, fire, or explosion from the permitted solid waste facility which could threaten the environment or human health outside the facility. Such report shall be made to the Tennessee Emergency Management Agency, using 24-hour toll-free number 1-800-262-3300.	Yes			-	
18	Where the permittee becomes aware that it failed to submit any relevant facts in a permit application ,or submitted incorrect information in a permit application or in any report to the Commissioner, it shall promptly submit such facts or information.	Yes			-	
19	Within 60 days of his receipt of the written request of the Commissioner to do so, the permittee shall cause to be conducted a survey of active and/or closed portions of his facility in order to determine if operations (e.g., cut and fill boundaries, grades) are being conducted in accordance with the approved design and operational plans. The permittee must report the results of such survey to the Commissioner within 90 days of his receipt of the Commissioner's request.	Yes			-	
	The Commissioner may request such a survey:					

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Solid Waste Permit (IDL 73-0211)						
20	If he has reason to believe the operations are being conducted in a manner that significantly deviates from the approved plans; and/or	Yes			-	
21	As a periodic verifications (but no more than annually) that operations are being conducted in accordance with the approved plans.	Yes			-	
22	Any survey performed pursuant to this part must be performed by a qualified land surveyor duly authorized under Tennessee law to conduct such activities.	Yes			-	
23	This permit may be transferred, modified, relocated or reissued, or terminated as set forth in 1200-1-7-02(5).	Yes			-	
24	No hazardous waste, as regulated by the Tennessee Hazardous Waste Management Act (TCA Section 68-212-101, et sag.) and the Rules adopted pursuant to that Act, shall be accepted at this facility.	Yes			-	
25	The permittee shall construct and operate the facility in accordance with the approved engineering plans and operations manual which becomes a condition of this permit in Attachment 1.	Yes			-	
26	This facility is specifically prohibited from accepting automobile batteries for disposal	Yes			-	
	The following variances or waivers from standards or requirements in Rule 1200-1-7, Solid Waste Processing and Disposal Amendments, are hereby granted in accordance with Rule 1200-1-7-.01(5):					
27	Rule 1200-1-4-.04(2)(k)2. states that bulk or non-containerized liquids, other than domestic waste or collected leachate or landfill gas condensate, may not be disposed in a landfill. This requirement is being waived to allow disposal of sluiced gypsum slurry, which is a liquid waste. The landfill is designed to manage this waste stream, and this waste is currently being managed at other permitted landfills with similar designs.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Solid Waste Permit (IDL 73-0211)						
28	Rule 1200-1-7-.04 (2)(p) requires that new landfills and lateral expansions shall not be located in wetlands unless that it can be demonstrated that no degradation of wetland and aquatic resources will result from such action. Also Rule 1200-1-7-.04(3)(a)1. states that landfills may not be constructed within 200 feet of the normal boundaries of springs, streams, and lakes. These requirement are being waived to allow filling of a "sinkhole pond" in the "Phase I" area and a channel which connects this pond to Watts Bar Lake; both the pond and the channel normally have water under present conditions as well as areas that are classified as "wetlands". This waiver is subject to the issuance of an ARAP permit to allow such development. The edge of a small stream or wetland is also impacted at the lower corner of the "Phase II" area. This Rule is also waived to allow filling in this area as shown in the construction plans, subject to the issuance of an ARAP permit. This buffer requirement from water bodies is also being waived to allow the "starter berm" along the south side of the site to be constructed less than 200 feet from the normal pool of Watts	Yes			-	
29	Rule 1200-1-7-.04(b) referencing Rule 1200-1-7-.04 (a)7.(i) requires that the leachate collection system must be designed to maintain a maximum leachate head of one foot over the liner. This Rule is waived to allow acceptance of liquid wastes, which will necessitate maintaining a head of greater than one foot over the liner, at least during the active operational phase.	Yes			-	
	The following conditions of this permit are established pursuant to Rule 1200-1-4-.02(4)(b):	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Solid Waste Permit (IDL 73-0211)						
30	No construction or earthmoving activities shall take place in either phase of the landfill within areas that are below the normal pool elevations of Watts Bar Lake and/or include designated streams or wetlands until such time as the Permittee has addressed the stream and wetland related issues to the satisfaction of the Division of Water Pollution Control.	Yes			-	
31	All structural fill for base grade preparation and starter berms shall be constructed under the supervision of a professional engineer. The Division of Solid Waste Management shall be contacted upon completion of each new section of prepared base grade, and a representative of this Division shall inspect the base grade (termed subgrade in the facility permit application) before further construction activities are initiated.	Yes			-	
32	The compact clay liner (termed geologic barrier in the facility permit application), gravel drainage blanket, and underdrain piping system for each phase shall be constructed under the supervision of a professional engineer, and a certification report shall be submitted to the Division of Solid Waste Management and accepted, before waste placement shall begin in this phase. All components of the internal and bench drainage systems shall be installed under the supervision of a professional engineer in a timely manner as the fill increases in height.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site Permit (IDL 73-0211) Operations Manual and Drawings (May, 2006)						
33	Dike side slopes are 3H:1V unless otherwise noted.	Yes			RHO&M	
34	Prior to any grubbing and land disturbance activities, filtrexx siltsoxx, cut-off trenches, and other erosion control measures will be implemented. Other erosion control measures may include temporary sedimentation ponds, surface water ditches, and establishment of temporary or permanent vegetation on exposed soil slopes.	Yes			RHO&M	
35	As part of phase I development, the stormwater pond, stormwater lift station, and the relocated access road will be constructed.	Yes			RHO&M	Yes
36	Stormwater runoff collected during the construction of phase I will be pumped to the stormwater pond using a temporary surface water discharge line.	Yes			RHO&M	
37	Perimeter gypsum dike shall be constructed by wet-cast operations.	Yes			RHO&M	
38	Location and numbers of pond decant structures will be determined during operations by TVA.	Yes			CCP Engineering	
39	Construction will commence from the lowest area of phase II. During construction, water accumulated at the lowest area in phase II will be pumped into phase I surface water ditches.	Yes			RHO&M	
40	After the construction of the final cover system, the final cover surface will be seeded, mulched, fertilized to promote vegetative growth and minimize long-term erosion.	Yes			RHO&M	
41	Initial soil dike shall be constructed from soil.	Yes			RHO&M	Yes
42	Outer gypsum dikes will be raised progressively to the elevation of the first bench using wet cast gypsum.	Yes			RHO&M	
43	Transition to rim ditch operations (if required), dikes will be raised in 5 feet (typ.) lifts until next bench is attained.	Yes			RHO&M	
44	Construct dike drains after each vertical lift of 10 feet. Ensure a minimum cover of 1 feet below the subsequent rim ditch.	Yes			RHO&M	
45	Perimeter under drain shall have minimum 1% slope from high points to low points. Place lateral outlets at low points.	Yes			RHO&M	
46	Lateral outlet pipes shall be placed 250 feet on center maximum.	Yes			RHO&M	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site Permit (IDL 73-0211) Operations Manual and Drawings (May, 2006)						
47	After installation of perimeter drain, install stakes at drainage outlet. Provide a mark on the stake indicating the depth to the drain pipe visible to equipment operation to prevent damage to drain pipe.	Yes			RHO&M	
48	Intermediate cover shall be placed incrementally and concurrently with dike construction and will consist of 9 inches of soil suitable for the support of vegetation. After placement of cover, area shall be seeded.	Yes			RHO&M	
49	Before final cover is completed, outlet pipes shall be extended to insure that the end of the pipe protrudes beyond the final cover grade.	Yes			RHO&M	
50	Avoid vehicle traffic on top of outlet pipe.	Yes			RHO&M	
51	A 5' x 5' hole shall be excavated to a depth of 2' for placement of crushed stone beneath the pipe decant structure. The hole is to be backfilled with crushed stone and compacted until a stable base is achieved.	Yes			RHO&M	
52	During the initial disposal of sluiced gypsum in Phase I and II, the pipe decant structure shall be used. As the level gypsum rises in phases I and II, the elevation of top of pipe decant structure will be extended by welding two foot pipe sections. When the level of sedimented gypsum in phases I and II reach the elevation of perimeter dike. The pipe decant structure may be abandoned and pond decant structures will be used.	Yes			RHO&M	
53	The flexible anti-seep collars is installed by cutting a hole 3-inches smaller than the diameter of the pipe and forcing it over the pipe. The anti-seep material shall be fastened to the pipe using stainless steel clamps. Care must me taken to backfill equally on both sides of the anti-seep collar.	Yes			RHO&M	

Operations Requirement Matrix
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Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Solid Waste Permit Modification (IDL 73-0211), GCL Liner - February 19, 2009						
54	The 1-foot protective layer to be placed of the GCL shall have no required specifications except that there must be no large rocks in it that could damage the GCL.	Yes			CCP Engineering	
55	No more GCL may be placed in a day than can be covered with soil that day.	Yes			CCP Engineering	
56	Dike side slopes are 3H:1V unless otherwise noted	Yes			RHO&M	
57	Lower 12 inch of the protective cover layer thickness, which is in contact with the underlying geosynthetics, shall have a gradation that meets the requirements for a No. 4 stone or equivalent, having a maximum particle size of 1 1/2 inch. Granular material with particle sizes larger than 1 1/2 inch can be used in the remaining thickness of the protective cover layer (i.e., upper 12 inch)	Yes			CCP Engineering	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site Preparation Drawings (10W428)						
58	All slopes associated with the access road construction and the outer slope of the Phase I and storm water pond dikes will receive SOD.	Yes			CCP Engineering	Yes
59	The top of the 3-foot geologic buffer and inside slopes of the Phase I area will receive POSI-Shell.	Yes			CCP Engineering	Yes
60	The inside slopes and bottom surface of the storm water pond will receive POSI-Shell.	Yes			CCP Engineering	Yes
61	Construct relief ditch prior to construction of soil dike construction in this area.	Yes			CCP Engineering	Yes
62	Construct erosion protection silt fence downstream of all disturbed area perimeter.	Yes			CCP Engineering	
63	Stake straw bales and silt fence as described in SWPPP.	Yes			CCP Engineering	
64	Erosion control measures shall be installed and maintained and shall include, but not limited to, silt fences, and stone check dams. All erosion control measures shall be established before beginning clearing, grubbing, and construction operations.	Yes			CCP Engineering	
65	See SWPPP for requirements for storm water discharge and sedimentation control.	Yes			CCP Engineering	
66	The contractor shall field verify all existing underground utilities prior to beginning the haul road and facility construction.	Yes			CCP Engineering	
67	Strip surface of all vegetation, debris, stumps, brush and organic perishable material prior to grading. Disposal of material shall be in accordance with SWPPP.	Yes			CCP Engineering	Yes
68	Remove existing fence as required for grading operations.	Yes			CCP Engineering	Yes
69	If work is suspended and will not resume within 15 days, temporary or permanent stabilization of disturbed areas shall be completed within 15 days of work ceasing.	Yes			CCP Engineering	
70	Any modification in the design document (made by TVA construction manager) shall be incorporated into the SWPPP within 14 days.	Yes			CCP Engineering	
71	Place silt fencing around stockpile materials, unless otherwise noted on drawings.	Yes			CCP Engineering	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site Preparation Drawings (10W428)						
72	Sediment should be removed from sediment traps, silt fences, sediment ponds, and other sediment controls as necessary, and must be removed when design capacity has been reduced by 50%.	Yes			CCP Engineering	
73	Silt fence and straw bales may be removed once areas are stabilized.	Yes			CCP Engineering	
74	All erosion control measures will be in place before borrow activities begin.	Yes			CCP Engineering	
75	Existing sediment pond and ditches shall be cleaned out, silt fences shall be repaired, and the straw bales shall be replaced as necessary.	Yes			CCP Engineering	
76	Existing borrow area for the FGD gypsum disposal facility shall be seeded, mulched, and stabilized after completion of work.	Yes			CCP Engineering	Yes
77	Earth backfill shall be compacted in 8-inch lifts to 95 percent of maximum density.	Yes			CCP Engineering	Yes

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site QA/QC Plan						
Certification Engineer						
	The certification engineer has following duties:					
78	Provide written, certified documentation attesting to conformance with the design requirements and the QA/QC plan with respect to conditions of structural fill, soil dike fill, geologic buffer, gypsum dike construction, and the construction of the soils and geosynthetic components of the final cover system.	Yes			-	
79	Be present at appropriate intervals during construction of the soil components, perform appropriate tests, and obtain samples for laboratory analyses.	Yes			-	
80	Observe material delivery and unloading.	Yes			-	
81	Use the results of tests and laboratory analyses to document conformance with project requirements.	Yes			-	
82	Provide to TVA and the constructor the results of observations and test as the work progresses. Coordinate with constructor when modifications to the plans are necessary.	Yes			-	
83	Schedule and coordinate inspection and testing activities.	Yes			-	
84	Reject defective work and verify that corrective measures have been implemented.	Yes			-	
Project Meetings						
85	A progress meeting will be held daily which will be attended by the construction manager, constructor's on-site superintendent, and the certification engineer.	Yes			-	
86	Deficiency meetings will be held as per requirement to discuss problems or deficiencies. This meeting will be attended by the construction manager, certification engineer, and constructor's on-site superintendent.	Yes			-	
Base Grade Soil Component Construction						
87	Both field and laboratory tests shall be performed prior to construction to evaluate if the characteristics of soil and aggregate from proposed sources meet the material acceptance requirements of the permit and design specifications.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site QA/QC Plan						
88	Prepared subgrade should confirm to the contours shown in the design drawings and verified by the Surveyor. Vegetation and deleterious materials (organics or soft materials) shall be stripped/removed and the surface should be proof rolled.	Yes			-	
89	The subgrade should be accepted by the certification engineer if it does not pump or rut excessively.	Yes			-	
90	Soil dike material, geologic buffer (for base grade) material, and compacted clay/soil layer (for final cover) shall consist of relatively homogeneous, silty, and clayey soils which are substantially free of debris, rock, plant materials, frozen materials, foreign objects, and organics.	Yes			-	
Soil Dikes & Geologic Buffers						
91	The geologic buffer (for base grade) material should have a permeability of less than or equal to 1 x 10^{-7} cm/sec.	Yes			-	
92	Geologic buffer (of base grade) and compacted clay/soil layer (of final cover) materials shall be placed in 8 to 10 inches loose (6 to 8 inches compacted) lifts. Solid clods should be broken down and moisture conditioning should be conducted. Moisture content should be tested during processing, placement, and compaction for geologic buffer and during processing and placement for compacted clay layer.	Yes			-	
93	The finished surface of the geologic buffer and compacted clay/soil layer of final cover should be firm, uniform, and smooth.	Yes			-	
Gravel Drainage Layer						
94	Gravel drainage layer shall be placed around pipes located within central drainage corridor and the perimeter drainage trenches. The gravel drainage aggregate shall be substantially free of organics, frozen material, foreign objects, or other deleterious materials.	Yes			-	
Potential Problems and Deficiencies						
95	If visual observation of construction performance indicate a potential problem, the frequency of testing may be increased by the certification engineer or the construction manager.	Yes[(5)]			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site QA/QC Plan						
96	If a defect is discovered in the earthwork product, the certification engineer shall immediately determine the extent and nature of the defect. He should notify the same to the construction manager and the constructor.	Yes			-	
97	Retests recommended by the certification engineer must verify that the defect has been corrected before any additional work is performed in the area of the deficiency.	Yes			-	
Gypsum Dike Construction and Placement						
98	Outer gypsum dikes will be raised in 5 feet height increments with individual lift thickness being approximately 1 to 2 feet thick. Elevations should be checked during construction and adjustments to avoid damage to the drains.	Yes			-	
99	Surveillance and monitoring of the perimeter gypsum dike will be more frequent in the beginning and will be reduced as successful operation is being demonstrated as determined by the certification engineer.	Yes			-	
100	Samples taken at the four evenly spaced locations along the rim ditch of the outer dike should be tested for grain size to determine the variation in material. Strength tests may also be performed at the beginning and the end point of the rim ditch.	Yes			-	
101	Quarterly inspection will be performed by the certification engineer during dike raising activities. The frequency of the inspection can be increased if necessary. Technician should be present during the construction of drains.	Yes			-	
102	During the progress of the stack construction, certification engineer should ensure that grading is being adequately maintained on the side slopes.	Yes			-	
103	For intermediate cover, vegetation and deleterious materials (organics or soft materials) shall be removed and the surface should be proof rolled prior to placement of subsequent lifts or layers.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site QA/QC Plan						
104	Perforations in the geologic buffer (of the base grade) and compacted clay layer & soil layer (of the final cover) created by nuclear density probes, stakes, or any other methods shall be filled with bentonite, a soil-bentonite mixture, or as approved by certification engineer.	Yes			-	
105	Low ground-pressure equipment shall be used to place the material for the vegetative soil layer (final cover) over the geosynthetics (if geosynthetic option is used). The equipment shall be operated over the full depth of the layer.	Yes			-	
Final Cover System Soil Component Construction						
106	Vegetative soil layer for final cover: In areas traversed by heavy trucks and other non low ground-pressure equipment a minimum material thickness of 3 feet shall be maintained. Material should be placed by pushing upslope only. The finished surface shall be roughened to prevent erosion. Soil thickness verification will be performed by manual methods due to possible settlement of the gypsum layers during final cover construction activities.	Yes			-	
Geomembrane						
107	Certification engineer shall confirm that the geomembrane handling equipment used on-site pose minimal risk of damage to the geomembrane and the geosyntheic installer personnel handle the geomembrane with care.	Yes			-	
108	Rolls without proper identification shall be rejected by construction manager and the certification engineer.	Yes			-	
109	Upon or prior to delivery of the rolls of geomembrane, the certification engineer shall verify that samples are removed and forwarded to the Geosynthetics CQA laboratory for testing.	Yes			-	
110	Geomembrane samples will be taken across the entire width of the roll and will not include the first 3 linear feet of the roll. The certification engineer will mark the machine direction on the geomembrane samples with an arrow.	Yes			-	
111	Storage space of the geomembrane should protect geomembrane from theft, vandalism, water, weather, or damage.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site QA/QC Plan						
112	It is Geosynthetic Installer's responsibility to protect the compacted soil layer after it has been accepted. After the supporting soil has been accepted, it is responsibility of the Geosynthetic Installer and Certification Engineer to indicate to the construction manager any change in the Clay Condition to indicate to the construction manager any change in the clay condition that may require repair work.	Yes			-	
113	The certification engineer shall review the panel layout drawings provided by the Geosynthetics Installer and verify it is consistent with the acceptance state of practice and the QA/QC plan.	Yes			-	
114	The panel layout should be oriented to maximize panel lengths and minimize seams and material waste. In corners and odd-shaped geometric locations, the number of seams should be minimized. Horizontal seams should be greater than 10 feet from the toe of slopes, or areas of potential stress concentration, unless otherwise authorized.	Yes			-	
115	The certification engineer shall document that the installer labels each field panel with an "identification code" consistent with the panel layout plan. Geosynthetics Installer and the certification engineer should verify that each field panel placed can be traced to the original manufacturers roll numbers.	Yes			-	
116	Field panels shall be placed one at a time unless otherwise approved by the certification engineer and the construction manager. Each field panel shall be seamed after its placement to minimize the number of unsealed field panels exposed to weather.	Yes			-	
117	The certification engineer shall record the identification code, location, date of the installation, weather conditions and ambient temperature.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site QA/QC Plan						
118	Geomembrane placement shall not be proceeded when the temperature measured by placing a thermometer on the surface of the sheet, is below 32 deg F (0 deg C) for fusion or extrusion welding. Geomembrane shall also not be performed during precipitation, fog, snow, in an area of ponded water, or in the presence of excessive winds.	Yes			-	
119	Slightly rounded corners will be provided in trenches where the geomembrane adjoins the trench to avoid sharp bends in the geomembrane. Loose soil shall not underlie the geomembrane in the trenches. Seaming should continue through the anchor trench.	Yes			-	
	Responsibility of Geosynthetics Installer and Certification Engineer during the placement of geomembrane are as follows:					
120	Equipment used shall not damage the geomembrane by handling, traffic, excessive heat, leakage of liquids, or other means.	Yes			-	
121	Prepared surface under lying the geomembrane has not deteriorated since previous acceptance, and is still acceptable immediately prior to geomembrane placement.	Yes			-	
122	Personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane.	Yes			-	
123	The method and the equipment used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the underlying layer.	Yes			-	
124	The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels)	Yes			-	
125	Placed geomembrane panels shall extend a minimum of five feet beyond the toe of slope.	Yes			-	
126	Adequate temporary loading and/or anchoring not likely to damage the geomembrane has been placed to prevent uplift by wind.	Yes			-	

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Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site QA/QC Plan						
127	Direct contact with the geomembrane is minimized; i.e., the geomembrane is protected by geotextile, extra geomembrane, or other suitable materials, in areas where excessive traffic may be expected.	Yes			-	
128	The certification engineer shall visually observe each panel, after placement and prior to seaming, for damage.	Yes			-	
129	The panel is placed in such a manner that it is unlikely to be further damaged and any tears, punctures, holes, thin spots, etc. are either marked for repair or the panel is rejected.	Yes			-	
130	Extrusion and Fusion field seams are approved processes, any other process needs Certification Engineer's approval.	Yes			-	
	Responsibility of Geosythetics Installer and Certification Engineer during field seaming:					
131	Geosynthetics Installer maintains on-site the number of spare operable seaming apparatus decided at the Pre-construction meeting.	Yes			-	
132	Equipment used for seaming is not likely to damage the geomembrane.	Yes			-	
133	The extruder is purged prior to beginning a seam and until heat-degraded extrudate has been removed from the barrel.	Yes			-	
134	For cross seams, the edge of the cross seam is ground to a smooth incline prior to seaming.	Yes			-	
135	The electric generator used during geosynthetics installation is placed on a flat smooth base and a rub sheet such that no damage occurs to the geomembrane.	Yes			-	
136	A smooth insulating plate or fabric is placed beneath the hot seaming apparatus after usage.	Yes			-	
137	Extrusion Seaming: The certification engineer shall log apparatus temperature ambient temperatures, extrudate temperatures, and sheet temperatures a minimum of every 5 hours. Apparatus temperatures should be checked randomly during seaming operations to ensure the settings used to complete trials seams are maintained.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site QA/QC Plan						
138	The pressure setting of the fusion seaming shall be verified by the Geosynthetics Installer prior to each seaming period. The certification engineer shall log ambient temperatures, sheet temperatures, and seaming apparatus temperatures, speeds, and pressures of the fusion seaming.	Yes			-	
	Responsibility of Geosynthetics Installer and Certification Engineer during field seam preparation are:					
139	Prior to seaming, the seam area is clean and free of moisture, dust, dirt, oils, greases, debris of any kind, and foreign material; the material to be jointed must be wiped with a clean cloth just prior to seaming.	Yes			-	
140	A rub sheet must be used to protect the underlying layer while cutting any materials.	Yes			-	
141	If seam overlap grinding is required, the process is completed according to the Geomembrane Manufacturer's instructions within 1 hour of the seaming operation in a way that does not damage the geomembrane.	Yes			-	
142	As a general guidance, the panels of geomembrane shall have a finished overlap; of a minimum of 3 in. for extrusion seaming and 4 in for fusion seaming but in any event sufficient overlap will be provided to allow peel tests to be performed on the seam.	Yes			-	
143	No solvent or adhesive is used unless the product is approved in writing by the construction manager.	Yes			-	
144	The procedure used to temporarily bond adjacent panels together does not damage the geomembrane.	Yes			-	
145	No abrading is visible when welding is complete.	Yes			-	
146	Seams are aligned with the fewest possible number of wrinkle and fishmouths.	Yes			-	
147	Trail seams shall be made on fragment pieces of geomembrane to verify that seaming conditions are adequate. Such trail seams shall be made at least once every 5 hours.	Yes			-	
148	A passing trial seam shall be made for each seaming device and technician for each material being welded for each technician.	Yes			-	

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Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site QA/QC Plan						
149	A trial seam shall also be made in the event that the sheet temperature varies more than 18 deg F (10 deg C) since the last passing trial seams.	Yes			-	
150	The Geosynthetics Installer shall provide the tensiometer required for shear and peel testing of trail seams in the field. The Geosynthetics Installer shall also provide the certification Engineer with the calibration certification.	Yes			-	
151	The trial seam sample shall be at least 5 ft long by 1 ft wide with the seam centered lengthwise.	Yes			-	
152	Six specimens, each 1 in. wide shall be cut from the trial seam sample by the Geosynthetics Installer. Three specimens shall be tested in shear and three in peel using a field tensiometer.	Yes			-	
153	See Appendix F for General Seaming procedure, Non-destructive Seaming Continuity Testing, Air Pressure testing, Non-complying Air Pressure testing, Vacuum testing, Non-complying Vacuum testing, Destructive seam testing.	Yes			-	
154	Certification Engineer shall document all continuity testing, record location, date, unit number, name of tester, and outcome of all the testing. He should inform the Geosynthetics Installer and Construction Manager of any required repairs.	Yes			-	
155	When defects are located, Certification Engineer observe the repair and retest the repair, mark on the geomembrane that repair has been made and document the results.	Yes			-	
156	Seams and non-seam areas of the geomembrane shall be examined by the Certification Engineer for identification of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter.	Yes			-	
157	Any portion of the geomembrane exhibiting a flaw, failing a destructive, or failing a non-destructive test, shall be repaired. The final decision to the appropriate repair procedure shall be approved by the construction manager and certification engineer.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site QA/QC Plan						
158	Each repair shall be non-destructively tested and shall be numbered and logged by Certification Engineer and Geosynthetics Installer. The Certification Engineer record the date of the repair and test outcome.	Yes			-	
159	Wrinkles exceeding 6 inches in height shall not be permitted. The Certification Engineer will indicate to the Construction Manager which wrinkle should be cut and resealed by the Geosynthetics Installer.	Yes			-	
160	Anchor trenches will be adequately drained and shall be backfilled and compacted as soon as possible after completion of geosynthetics installation. Care shall be taken during backfilling to prevent any damage to the geosynthetics.	Yes			-	
161	Extreme care shall be exercised so as not to damage the geomembrane during placement of the geocomposite and the materials overlying the geocomposite.	Yes			-	
162	Extreme care shall be taken while seaming around appurtenances since non-destructive nor destructive testing may be feasible in these areas.	Yes			-	
Geocomposite						
163	Geocomposite cleanliness is essential to performance, therefore measures must be taken during shipment and storage to protect the geocomposite from dust and dirt. Wrapping protecting the geocomposite rolls should be removed less than 1 hour prior to unrolling the geocomposite.	Yes			-	
164	Sample should be at a minimum frequency of one sample per 100,000 ft2 of material. Sample will be taken across the entire width of the roll and will not include the first lineal ft. Unless otherwise specified, samples will be 3 ft long by the roll width. The certification engineer will mark the machine direction on the sample with an arrow.	Yes			-	
	The Geosynthetic Installer shall handle the geocomposite in such a manner as to minimize damage and comply with the following:					
165	After the wrapping has been removed, the geocomposite shall not be exposed to sunlight for more than the duration specified by the Geotextile Manufacturer.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site QA/QC Plan						
166	On slopes, the geocomposite shall be secured in the anchor trench and then rolled down the slope in such manner as to continually keep the geocomposite sheet in tension.	Yes			-	
167	The Geocomposite shall extend a minimum of 10 feet beyond the toe of slope.	Yes			-	
168	In the presence of wind, the geocomposite shall be weighted with sandbags or the equivalent.	Yes			-	
169	Unless otherwise specified, the geocomposite shall not be welded to geomembrane.	Yes			-	
170	The geosynthetic Installer shall take necessary precautions to prevent damage to underlying layers during placement of the geocomposite. If any dirt, excessive dust, and/or any stones are entrapped in or below the geocomposite, the geocomposite and underlying liner shall be washed or swept prior to placement of material on it.	Yes			-	
171	During placement of the geocomposite, care shall be taken not to entrap dirt or excessive dust that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane.	Yes			-	
172	Stacked geocomposite shall be placed in the same direction to prevent the stands of one layer from penetrating the channels of the lower layer, thereby significantly reducing the transimissivity.	Yes			-	
173	Geocomposite shall not be laid in direction perpendicular to the underlying geocomposite unless otherwise specified by the design engineer.	Yes			-	
	As a minimum following requirements shall be met:					
	Geonet components:					
174	Adjacent roll shall be overlapped by at least 4 in and shall be secured by tying by nylon cable ties.	Yes			-	
175	Tying devices will be white or yellow and should not be metallic.	Yes			-	
176	Tying devices shall be placed every 5 ft down the slope, every 2 feet across the slope and every 6 feet on horizontal surfaces.	Yes			-	
	Geotextile components:					

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
	Peninsula Site QA/QC Plan					
177	The bottom layers of geotextile shall be overlapped. The top layer shall be continuously sewn. Geotextile panel shall be overlapped a minimum of 4 in prior to sewing.	Yes			-	
178	No horizontal seams shall be allowed on slopes steeper than 10 horizontal to 1 vertical.	Yes			-	
179	Polymeric thread, with chemical resistance properties equal to or exceeding those of the geotextile component, shall be used for all sewing. The seams shall be sewn using Type-401. The seam type shall be Federal Standard Type SSN-1.	Yes			-	
	Geocomposite:					
180	In the corners of the side slopes of rectangular areas of the disposal areas, where overlaps between perpendicular geocomposite shall be unrolled along the slope, on top of the previously installed geocomposite, from top to bottom of the slope.	Yes			-	
181	When more than one layer of geocomposite is installed, joints shall be staggered.	Yes			-	
182	Any hole or tears in the geocomposite shall be repaired by placing a patch extending 2 feet beyond the edges of the hole or tear. The patch shall be secured to the original geocomposite be tying every 6 in. If the hole or tear width of the roll, the damaged area shall be cut out and the two portions of the geocomposite shall be joined.	Yes			-	
	Placement of materials on the geocomposite shall be as soon as possible such that:					
183	The geocomposite and underlying geomembrane are not damaged.	Yes			-	
184	Minimal slippage of the geocomposite on the underlying geomembrane occurs.	Yes			-	
185	No excess tensile stresses occur in the geocomposite.	Yes			-	
186	If portions of the geocomposite are exposed, the certification engineer shall periodically place marks on the geocomposite and the underlying geomembrane and measure the elongation of the geocomposite during the subsequent construction activities.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site QA/QC Plan						
187	Certification engineer should observe the geocomposite and underlying liner to determine if any dirt, excessive dust, or any stones are entrapped in, or below, the liner. If so, the geocomposite and geomembrane must be washed or the geocomposite removed so that the liner can be cleaned.	Yes			-	
Geotextile						
188	During shipping and storage, the geotextile shall be protected from ultraviolet light exposure, precipitation, snow or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions. Any damaged rolls shall be replaced/repaired.	Yes			-	
189	Geotextile shall be kept continually under tension to minimize the presence of wrinkles in the geotextile.	Yes			-	
190	The geotextile shall be cut using an approved geotextile cutter only.	Yes			-	
191	After installation, the entire surface of the geotextile shall be examined, and harmful foreign objects, such as needles, shall be removed.	Yes			-	
192	If white geotextile is used, precautions will be taken against "snow blindness" of personnel.	Yes			-	
193	Geotextile seams shall be continuously sewn using thread, which is at least as chemically resistant and UV resistant as the geotextile. The geotextile shall be overlapped a minimum of 4 in. prior to seaming.	Yes			-	
194	Within the Central Drainage Corridor the geotextile panels may be overlapped a minimum of 2 feet between adjacent panels and the overlap sand bagged, in place of sewing of adjacent panels.	Yes			-	
195	Any holes or tears in the geotextile shall be repaired by the Geosynthetics Installer as a patch made from the same geotextile shall be sewn in place with a minimum of 24 in. overlap in all directions.	Yes			-	
	The Geosynthetic Installer shall place materials on the geotextile taking the following precautions:					
196	Cause no damage to geotextile.	Yes			-	
197	Allow minimal slippage of the geotextile on underlying layers.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site QA/QC Plan						
198	Equipment used for packing the overlying material shall not be driven directly on the geotextile.	Yes			-	
199	A minimum thickness of 1 feet of soil must be maintained between light, low ground-pressure equipment and the geotextile.	Yes			-	
200	A minimum thickness of 1.5 feet of soil must be maintained between rubber-tired vehicles and the geotextile unless approved by the Design Engineer and Construction Manager.	Yes			-	
201	In heavily trafficked areas such as access ramps, soil thickness shall be at least 3 feet.	Yes			-	
202	The minimum thickness of the intermediate cover, compacted clay layer, and vegetative layer in the final cover shall be surveyed to verify that the minimum soil thickness specified in the design drawings are met.	Yes			-	
203	The completed surfaces of subgrade, top of geologic buffer, top of soil dikes and gypsum dikes, completed outer gypsum dikes, top of intermediate cover, and top of vegetative cover will be surveyed. Geomembrane panels shall be surveyed and this survey shall include as-built information of seam intersections, cross seams, repair locations, destructive sample locations, well or pipe penetration locations and location of anchor trenches.	Yes			-	
Surveying and Construction Tolerances						
204	At a minimum, survey points shall be established on a 50 ft x 50 ft grid. Soil layer thickness shall be obtained to the nearest 0.001 feet and reported to the nearest 0.01 feet.	Yes			-	
Reporting and Documentation						
205	When deficiencies are discovered, the Certification Engineer shall immediately determine the nature and extent of the problem, notify the Constructor, and complete required documentation.	Yes			-	
206	Documentation shall consist of daily record keeping, construction problem resolutions, photographic records, design revisions, weekly progress reports, and a certification and summary report.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Peninsula Site QA/QC Plan						
207	A daily meeting report will be prepared each day, summarizing discussions held with a constructor.	Yes			-	
208	Observation and test data sheets shall include date, project name, and location; weather data; reduced-scale site plan showing work area; description of on-going construction; summary of test results identified as passing, failing, or in the event of a failed test, retest; calibration of test equipment; summary of decisions regarding acceptance of the work and/or corrective actions taken; signature of the Certification Engineer.	Yes			-	
209	At completion of each phase of construction, the Certification Engineer shall submit a certification report to the Construction Manager.	Yes			-	
210	For "Minimum Test Frequencies for Soil and Aggregate Materials in Base Grade System Construction" see Table 3 (QC/QA Plan).	Yes			-	
211	For "Minimum Requirement and Test Frequencies for Soil Components of the Final Cover System" see Table 4 (QC/QA Plan).	Yes			-	
212	For "Required 40 MIL Textured PE Geomembrane Properties" see Table 5 (QC/QA Plan).	Yes			-	
213	For "Required 40 MIL Textured PE Geomembrane Properties - Conformance Testing" see Table 6 (QC/QA Plan).	Yes			-	
214	For "Required 40 MIL Textured PE Seam Properties" see Table 7 (QC/QA Plan).	Yes			-	
215	For "Required Geocomposite Properties" see Table 8 (QC/QA Plan).	Yes			-	
216	For "Required Geocomposite Properties - Conformance Testing" see Table 9 (QC/QA Plan).	Yes			-	
217	For "Required Properties for 10 oz/yd2 Geotextiles (Filter)" see Table 10 (QC/QA Plan).	Yes			-	
218	For "Required Properties for 10 oz/yd2 Geotextiles (Filter) - Conformance Testing" see Table 11 (QC/QA Plan).	Yes			-	
219	For "TVA Vegetation Specification" see Attachment-1 of QC/QA Plan.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Ballfield Operations Plan and Drawings (10W429)						
220	Ash materials to be placed in the Interim Ash Staging Area (IASA) shall include fly ash, bottom ash, and boiler slag.			Yes	RHO&M	
221	The existing central and northern railroad spurlines shall be decommissioned prior to the beginning of Phase I construction. The western railroad spurline shall be maintained operational throughout the IASA project.			Yes	RHO&M	
222	The location, width, and details of a final stack access road shall be field determined, where the final stack access road intercepts a drainage bench. The drainage bench shall transition into a 12" diameter (min) HDPE corrugated exterior, smooth interior pipe beneath the access road with a minimum 2 feet thick cover.			Yes	RHO&M	
223	Only dewatered ash materials are allowed to be placed in the temporary ash stack. The ash layer shall be compacted in horizontal lifts. The lift thickness and moisture content of the ash material shall be determined based on a pilot study prior to construction of the temporary ash stack such that the required design shear strength of the ash material can be achieved.			Yes	RHO&M	
224	Disturbed areas not at final stack grade that are exposed longer than 30 days shall be stabilized with hydro seeding method (i.e., mulch mixed with seeds applied hydraulically) using temporary seeding. Disturbed areas that have achieved final stack grade shall be stabilized with hydro seeding method using permanent seeding within 14 days. Other equivalent stabilization methods may also be used upon TVA's approval.			Yes	RHO&M	
225	2 Acres of wet ash processing area shall be designated and utilized as a Non-Cercla Wet Ash Processing Area (Area 3) for IASA prior to the decommissioning of Wet Ash Processing Area 2.			Yes	RHO&M	
226	A thorough dredging operation must be performed in the intended rim ditch working area prior to backfilling to remove existing ash sediment from the rim ditch.			Yes	RHO&M	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Ballfield Operations Plan and Drawings (10W429)						
227	Heavy construction equipment such as bulldozers and articulated trucks are to use caution when operating near the edge of the rim ditch. If unstable conditions are observed, operating equipment must pull back to a safe distance immediately. Typical signs of unstable conditions include soil sloughing on the side slope of rim ditch, formation of tension cracks along the rim ditch, excessive rutting, and excessive ground depression.			Yes	RHO&M	
228	The top of the granular material must be maintained to be slightly higher than the adjacent earthen ground. Rutting and depression of the granular material must be repaired in a timely fashion.			Yes	RHO&M	
229	Bulldozers can operate 'inside the rim ditch' on top of the granular material only when approved by the supervising engineer.			Yes	RHO&M	
230	Heavy articulated trucks must avoid going "within the rim ditch limits" to the extent practical. The backfill material may be unloaded along the side of the rim ditch.			Yes	RHO&M	
231	No personnel are allowed to walk near the rim ditch where active backfilling operations are ongoing.			Yes	RHO&M	
232	The minimum setback distance between the interim ash stack and the rim ditch must be 50 feet.			Yes	RHO&M	
233	Small settlement of the delineation layer may occur as a result of the Temporary Ash Stack loading. Excavate and remove the ash stack to the top of the delineation layer.			Yes	RHO&M	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
RHO&M Scope of Work						
234	If the CONTRACTOR allows more than 2% of total annual gypsum production to reach the storm water pond, the CONTRACTOR must remove any gypsum over the 2% of annual production from the pond at its own expense within three months of discovery by CCP or on a schedule determined by CCP.			Yes	RHO&M Contractor	
235	CONTRACTOR will inspect the gypsum disposal area on a daily basis to runoff is minimized and the stormwater pond is clear of material.			Yes	RHO&M Contractor	
236	CONTRACTOR will maintain a zero visible dust standard 24/7/365 at Kingston regardless of whether the CONTRACTOR is actively performing work.			Yes	RHO&M Contractor	
237	CONTRACTOR will haul, place, and compact gypsum on the gypsum stack in accordance with TVA approved design drawings/specifications & TDEC permit requirements.			Yes	RHO&M Contractor	
238	In addition to the daily inspections at KIF, the CONTRACTOR will also perform weekly inspections of the CCP facilities at WBF.			Yes	RHO&M Contractor	
239	CONTRACTOR will complete required forms and maintain records in onsite trailer.			Yes	RHO&M Contractor	
240	Seepage discovered or appearing to change during inspections will be immediately communicated with TVA Field Supervisor.			Yes	RHO&M Contractor	
241	Problems discovered during these routine inspections will be corrected by the contractor under a T&M pricing structure, upon written request.			Yes	RHO&M Contractor	
242	CONTRACTOR will provide daily report summarizing work item status. Each report will include amount of ash moved that day and equipment onsite.			Yes	RHO&M Contractor	
243	In the event an accident occurs it is the CONTRACTOR's responsibility to immediately notify the CCP Field Supervisor. In the event an accident/incident occurs the CONTRACTOR must within 24 hours develop a "White Paper" describing the event and the immediate steps to mitigate future similar events.			Yes	RHO&M Contractor	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
RHO&M Scope of Work						
244	CONTRACTOR will maintain and distribute a report card to track key measures of CONTRACTOR performance.			Yes	RHO&M Contractor	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
NPDES Permit No.						
NPDES Permit # TN0005452						
245	Internal Monitoring Point 02A discharges stormwater and FGD wet scrubber effluent from the FGD retention pond into the KIF discharge channel with limits: Oil and Grease - 20 mg/L daily maximum, Oil and Grease - 15 mg/L monthly Average, Total Suspended Solids (TSS) - 100 mg/L Daily Maximum, Total Suspended Solids (TSS) - 30 mg/L Monthly Average, pH - 6 SU Minimum, pH - 9 SU Maximum. ***[Report responsibility of the plant and not an RHOM Responsibility. RHOM responsible for operations of the KIF FGD GDA and its associated runoff and needs to be aware of plant's NPDES Permit limits.]***	Yes			-	
246	The Kingston ash pond shall be inspected in accordance with TVA's Reservoir Operations Dam Safety Program criteria and process. This program is directed by TVA's Dam Safety Governance Program and is in accordance with the Federal Guidelines for Dam Safety developed by the Federal Emergency Management Agency (FEMA 93). This document directs TVA to perform inspections scheduled on specific intervals **(daily and annually)** and with qualified personnel. The dikes will also be visually inspected daily during operations by site personnel or designee that are trained in dam safety procedures by TVA's Dam Safety Governance Program. Impoundments shall be inspected annually by a state-registered professional engineer trained and experienced in dam safety inspection procedures. Special inspections by qualified personnel shall be done within 24 hours after intense, large or extended rain events (i.e., 10-year storm or equaling or exceeding the design requirements for managing storm water) or as soon as safely practicable after a significant seismic event approaching or exceeding the design event. The reason for	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
NPDES Permit No.						
NPDES Permit # TN0005452						
247	Daily inspections shall, at a minimum, include observations of dams, dikes and toe areas for erosion, cracks or bulges, subsidence, seepage, wet or soft soil, changes in geometry, the depth and elevation of the impounded water, sediment or slurry, freeboard, changes in vegetation such as overly lush, obstructive vegetation and trees, outlet controls, drains and any other changes which may indicate a potential compromise to impoundment integrity. TVA must prepare a checklist in accordance with proper TVA Dam Safety Governance Program . ***[Daily Dam Safety inspection responsibility of the plant and not an RHOM Responsibility. RHOM responsible for operations of the KIF FGD GDA and Ash Pond need to be aware of NPDES Permit inspection requirements.]***	Yes			-	
248	Imminent impoundment failure conditions should be reported immediately to TDEC and the Roane County Emergency Management Agency, who will report to TEMA. . ***[RHOM shall report any potential condition to Plant.]***	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
NPDES Permit No.						
NPDES Permit # TN0005452						
249	Within 24 hours of discovering a change in the impoundment that indicates a potential compromise to the structural integrity of the dike (e.g., significant changes in seeps, boils, bulges, or cracks), the permittee must make contact with division personnel describing the findings of the inspection, corrective measures taken or proposed (if known), and expected outcomes. TVA must keep current a list of division personnel complete with after-hours contact information and must speak directly to someone on this list within the 24 hour period. Failure to notify the division within 24 hours will be a violation of this permit. In addition, the permittee must submit a follow-up report within 5 days summarizing the incident, corrective actions taken and outcomes. Additional reports pertaining to the event may be required by the Director . ***[Report responsibility of the plant and not an RHOM Responsibility. RHOM shall report any potential condition to Plant.]***	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Air Permit No.						
Dry Fly Ash Handling Air Permit # 964203P						
250	During Phase I (*Fly ash recovered and dewatered from rim ditch),* Wet supression shall be used as needed during tranport of dewatered fly ash and during operations at the temporary storage area.	Yes			-	
251	During Phase 1, No more than 550000 tons of dewatered fly ash shall be handled in any 12 consecutive month period. Monthly records shall be maintained of the amount of dewatered fly ash handled by the facility. All data, including all calculations, must be entered in the the log no later than 30 days from the end of the month for which the data is required. The log must be maintained at thesource location and kept available for inspection. This log must be maintained for a period of not less than five (5) years.	Yes			-	
252	During Phase 2 (*Dry fly ash recovered from precipitator and transported to Temporary Storage Area or off site*), Wet supression shall be used as needed during tranport of conditioned fly ash and during operations at the temporary storage area..	Yes			-	
253	During Phase 2, The haul road between the fly ash collection system and the temporary storage area shall be paved.	Yes			-	
254	During Phase 2, No more than 440000 tons of conditioned fly ash shall be handled in any 12 consecutive month period. Monthly records shall be maintained of the amount of conditioned fly ash handled by the facility. All data, including all calculations, must be entered in the the log no later than 30 days from the end of th emonth for which the data is required. The log must be maintained at thesource location and kept available for inspection. This log must be maintained for a period of not less than five (5) years.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Air Permit No.						
255	During Phase 3 (*Dry fly ash recovered from precipitator and transported to a permanent on-site storage area as well as material recovered and trasported from the temporary storage area),* Wet supression and vacuum sweeping shall be used as needed during tranport of conditioned fly ash from the fly ash collection system to the perminent storage area and during operations at the temporary and the perminent storage area..	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Air Permit No.						
Dry Fly Ash Handling Air Permit # 964203P						
256	The haul road between the fly ash collection system and the permanent storage area shall be paved.	Yes			-	
257	During Phase 3, No more than 1,100,000 tons of dewatered fly ash shall be handled in any 12 consecutive month period. No more than 440000 tons of conditioned fly ash shall be handled in any 12 consecutive month period. Monthly records shall be maintained of the amount of conditioned fly ashthe amount o fdewatered fly ash handled by the facility. All data, including all calculations, must be entered in the the log no later than 30 days from the end of th emonth for which the data is required. The log must be maintained at thesource location and kept available for inspection. This log must be maintained for a period of not less than five (5) years.	Yes			-	
258	During Phase 4 (*Dry fly ash recovered from precipitator and transported to a permanent on-site storage area - Recovery from the temporary storage area complete),* Wet supression shall be used as needed during tranport of conditioned fly ash from the fly ash collection system to the perminent storage area.	Yes			-	
259	During Phase 4, No more than 440000 tons of conditioned fly ash shall be handled in any 12 consecutive month period. Monthly records shall be maintained of the amount of conditioned fly ash handled by the facility. All data, including all calculations, must be entered in the the log no later than 30 days from the end of th emonth for which the data is required. The log must be maintained at thesource location and kept available for inspection. This log must be maintained for a period of not less than five (5) years.	Yes			-	
260	Visible emissions from roads and parking areas shall not exhibit greater than ten percent (10%) opacity as determined by Tennessee Visible Emission Evaluation (TVEE) method 1, as adopted by the Tennessee Air Pollution Control Board on April 29, 1982, as amended o September 15, 1982 and August 24, 1984.	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Air Permit No.						
261	Any change in operation which could affect emmission must be evluated with respect to the permit conditions. **[Corordination with EP&C is required before it the change is implemented]**	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

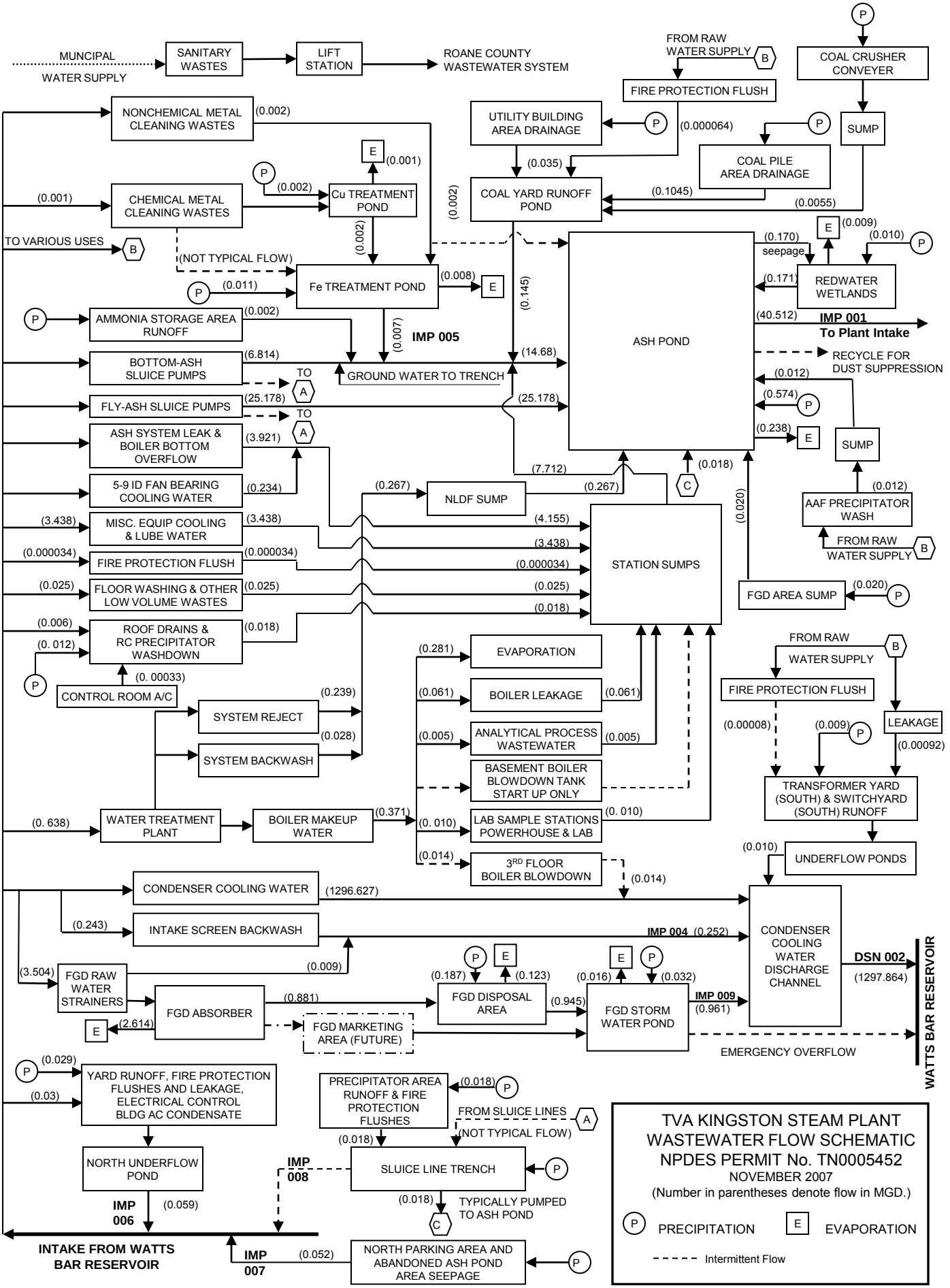
Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Air Permit No.						
Gypsum Dewatering Handling & Storage Air Permit # 963882P						
262	Emmissions from this source shall be limited as follows: (a) Particulate emmissions shall not exceed 22.0 tons in any 12 consecutive month period (b) PM10 emmissions shall not exceed 7.8 tons in any 12 consecutive month period (c) PM2.5 emmissions shall not exceed 2.4 tons in any 12 consecutive month period	Yes			-	
263	The total amount of dewatered gypsum handled by this source shall not exceed 785,000 tons in any 12 consecutive month period and the amount of dewatered gypsum transported off-site by truck shall not exceed 85.000 tons in any 12 month period..	Yes			-	
264	Wet supression shall be used as needed on haul roads.	Yes			-	
265	Monthly records shall be maintained of the amount of dewatered gypsum handled by the facilitythe amunt of dewatered gypsum transported off site. All data, including all required calculations, must be entered in the the log no later than 30 days from the end of the month for which the data is required. The log must be maintained at thesource location and kept available for inspection. This log must be maintained for a period of not less than five (5) years.	Yes			-	
266	Fugitive emmissions from this source shall be controlled as specified in rule 1200-3-8-.01. Specifically no person shall cause, suffer, allow, or permit fugitive dust to be emitted in such a manner to exceed five (5) minutes per hour or twenty (20) minutes per day as to produce a visible emmission beyond the property line of the the property on which the emmision originates, excluding malfunctiobn of equipmnet as provided in Chapter 1200-3-20. Fugitive emmissions from this source shall be determined bt Tennessee Visible Emmissions Evaluation Method 4 as adopted by the Tennessee Air Pollution Control Board on April 16, 1986,	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
Air Permit No.						
267	Visible emissions from roads and parking areas shall not exhibit greater than ten percent (10%) opacity as determined by Tennessee Visible Emission Evaluation (TVEE) method 1, as adopted by the Tennessee Air Pollution Control Board on April 29, 1982, as amended o September 15, 1982 and August 24, 1984.	Yes			-	
268	Any change in operation which could affect emmission must be evluated with respect to the permit conditions. **[Corordination with EP&C is required before it the change is implemented]**	Yes			-	

Operations Requirement Matrix
Kingston Ballfield Interim Ash Staging Area and Peninsula Site

Item No.	Activity	Permit Requirement	NEPA Commitment	Recommended Practice	Responsibility	Complete
NEPA Commitments						
					-	
					-	
					-


MUNCIPAL WATER SUPPLY
SANITARY WASTES
LIFT STATION
ROANE COUNTY WASTEWATER SYSTEM
FROM RAW WATER SUPPLY
B
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FIRE PROTECTION FLUSH
NONCHEMICAL METAL CLEANING WASTES
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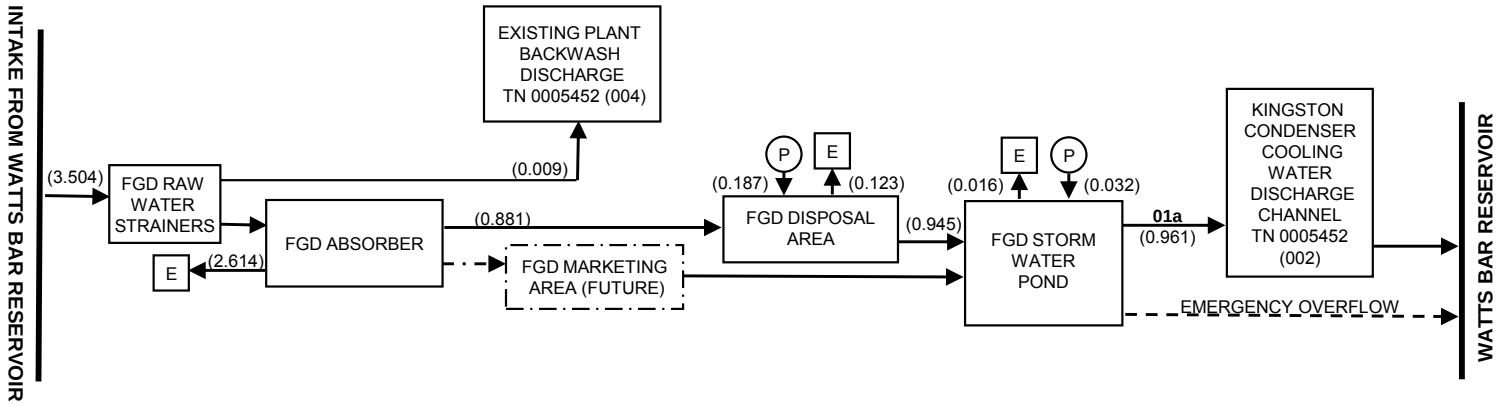
CHEMICAL METAL CLEANING WASTES
COAL YARD RUNOFF POND
(0.002)
(0.009)
(0.010)
(0.170)
seepage
TO VARIOUS USES
(NOT TYPICAL FLOW)
Fe TREATMENT POND
(0.008)
(0.011)
(0.171)
REDWATER WETLANDS
(0.145)
AMMONIA STORAGE AREA RUNOFF
(0.002)
(0.007)
IMP 005
(40.512)
IMP 001
To Plant Intake
BOTTOM-ASH SLUICE PUMPS
(6.814)
GROUND WATER TO TRENCH
(14.68)
ASH POND
RECYCLE FOR DUST SUPPRESSION
(0.012)
FLY-ASH SLUICE PUMPS
(25.178)
(0.574)
ASH SYSTEM LEAK & BOILER BOTTOM OVERFLOW
(3.921)
(0.238)
SUMP
(7.712)
(0.018)
5-9 ID FAN BEARING COOLING WATER
(0.234)
(0.267)
NLDF SUMP
(0.012)
AAF PRECIPITATOR WASH
(3.438)
MISC. EQUIP COOLING & LUBE WATER
(4.155)
(0.020)
FROM RAW WATER SUPPLY
(0.000034)
FIRE PROTECTION FLUSH
STATION SUMPS
(0.025)
FLOOR WASHING & OTHER LOW VOLUME WASTES
FGD AREA SUMP
(0.020)
(0.006)
(0. 012)
ROOF DRAINS & RC PRECIPITATOR WASHDOWN
(0.018)
(0. 00033)
CONTROL ROOM A/C
(0.281)
EVAPORATION
FROM RAW WATER SUPPLY
(0.239)
SYSTEM REJECT
(0.061)
BOILER LEAKAGE
FIRE PROTECTION FLUSH
(0.028)
SYSTEM BACKWASH
(0.005)
ANALYTICAL PROCESS WASTEWATER
(0.00008)
(0.009)
LEAKAGE
(0.00092)
BASEMENT BOILER BLOWDOWN TANK START UP ONLY
TRANSFORMER YARD (SOUTH) & SWITCHYARD (SOUTH) RUNOFF
(0. 638)
WATER TREATMENT PLANT
BOILER MAKEUP WATER
(0.371)
(0. 010)
LAB SAMPLE STATIONS POWERHOUSE & LAB
(0. 010)
(0.010)
UNDERFLOW PONDS
(0.014)
3RD FLOOR BOILER BLOWDOWN
CONDENSER COOLING WATER
(1296.627)
(0.243)
INTAKE SCREEN BACKWASH
IMP 004
(0.252)
CONDENSER COOLING WATER DISCHARGE CHANNEL
DSN 002
(1297.864)
(0.009)
(3.504)
FGD RAW WATER STRAINERS
(0.187)
(0.123)
(0.016)
(0.032)
IMP 009
(0.961)
FGD ABSORBER
(0.881)
FGD DISPOSAL AREA
(0.945)
FGD STORM WATER POND
(2.614)
FGD MARKETING AREA (FUTURE)
EMERGENCY OVERFLOW
WATTS BAR RESERVOIR
(0.029)
(0.03)
YARD RUNOFF, FIRE PROTECTION FLUSHES AND LEAKAGE, ELECTRICAL CONTROL BLDG AC CONDENSATE
PRECIPITATOR AREA RUNOFF & FIRE PROTECTION FLUSHES
(0.018)
FROM SLUICE LINES
(NOT TYPICAL FLOW)
NORTH UNDERFLOW POND
IMP 008
SLUICE LINE TRENCH
(0.018)
TYPICALLY PUMPED TO ASH POND
IMP 006
(0.059)
INTAKE FROM WATTS BAR RESERVOIR
IMP 007
(0.052)
NORTH PARKING AREA AND ABANDONED ASH POND AREA SEEPAGE
TVA KINGSTON STEAM PLANT
WASTEWATER FLOW SCHEMATIC
NPDES PERMIT No. TN0005452
NOVEMBER 2007
(Number in parentheses denote flow in MGD.)
PRECIPITATION
EVAPORATION
Intermittent Flow



TVA KINGSTON STEAM PLANT
FLUE GAS DESULFURIZATION (FGD)
WASTEWATER FLOW SCHEMATIC
NEW PERMIT
February 2009
(Number in parentheses denote flow in MGD.)

P PRECIPITATION E EVAPORATION

----- Intermittent Flow

903 NEPA COMMITMENTS

Currently, there are no NEPA commitments for the handling of CCP materials at Kingston Fossil Plant. As NEPA commitments are added, this section should be updated to include these commitments.

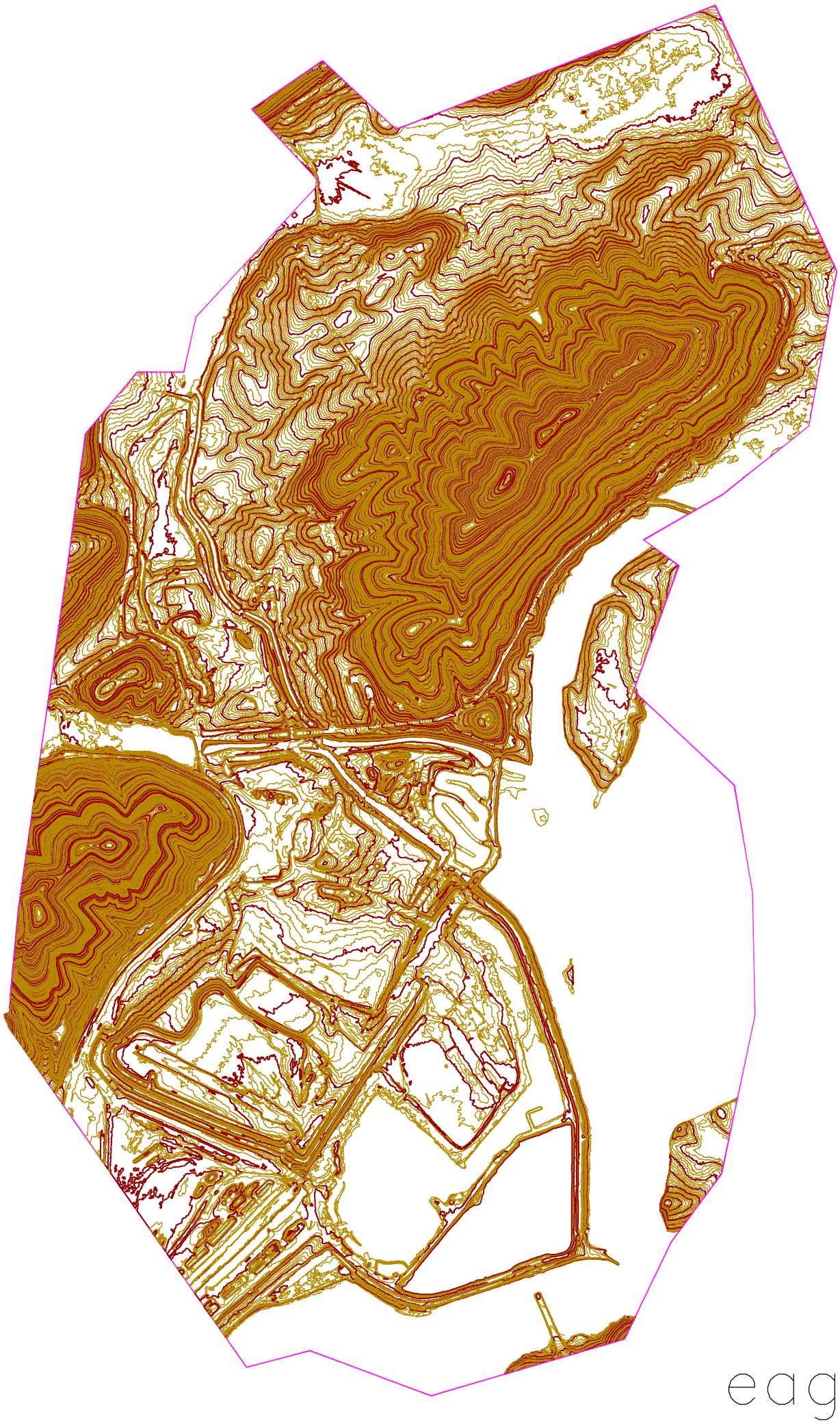
System Wide Fuel By-products Survey Schedule
Schedule For FY11

Plant	Area	FWV Reports	BSL LINK (Document ID)	Last Survey Date	Proposed Next Survey Date	Countdown Clock (Days)	Frequency	Survey Method	**Comments**
Allen									
Allen	East active ash pond	ALF_EASTACTIVE_FWV	38MS461K557(D)	23-Mar-11	22-Jun-11	42	Quarterly	Water	**Pre and Post Dredge Surveys**
Allen	East stilling pond	ALF_EASTSTILLING_FWV	38MS461K552(D)	23-Mar-11	22-Jun-11	42	Quarterly	Water	
Allen	East Dredge Cell	ALF_DREDGECELL_FWV	38MS461K557(D)	6-Oct-10	5-Jan-11	-126	As Requested	Land / Air	**** Survey performed by TA**
Allen	West ash pond			20-May-04	-	-	As Requested	Water / Land	
Allen	Pidgeon Industrial Park		38MS461K556(D)	30-Nov-10	1-Mar-11	-71	Quarterly	Land	
Total									
Bull Run									
Bull Run	Main ash pond w/channel	BRF_MAINASH_FWV	49MS461K553(D)	22-Feb-11	24-May-11	13	Quarterly	Water	**Pre and Post Dredge Surveys**
Bull Run	Main ash stilling pond	BRF_STILLING_FWV	49MS461K553(D)	22-Feb-11	24-May-11	13	Quarterly	Water	
Bull Run	Bottom ash stack (Pond 1)		49MS461K534(D)	8-Sep-10	9-Mar-11	-63	Bi-annually	Land	
Bull Run	Gypsum Storage (Pd 2A)		49MS461K549(D)	26-Jan-09	27-Jul-09	-653	Bi-annually	Land	**Pre and Post Dredge Surveys**
Bull Run	Fly ash stack Phase II		49MS461K533(D)	17-Feb-11	17-Feb-12	282	Bi-annually	Land	
Total									
Colbert									
Colbert	Ash pond 4	COF_MAINASH4_FWV	37MS461G556(D)	3-Mar-11	1-Sep-11	113	Bi-annually	Water	
Colbert	Ash pond 4 stilling	COF_STILLING4_FWV	37MS461G556(D)	3-Mar-11	2-Mar-12	296	Annually	Water	
Colbert	Bottom ash stack		37MS461G551(D)	13-May-09	11-Nov-09	-546	Bi-annually	Land	**SURVEY ON HOLD UNTIL FURTHER NOTICE**
Colbert	Ash pond 5 complex		37MS461K550(D)	1-Nov-10	2-May-11	-9	Bi-annually	Land	
Colbert	Ash pond 5 stilling	COF STILLING5 FWV	37MS461K547(D)	23-Nov-10	23-Nov-11	196	Annually	Water	
Total									
Cumberland									
Cumberland	Retention pond	CUF_RETENTION_FWV	46MS461K542(D)	4-Nov-10	5-May-11	-6	Bi-annually	Water	
Cumberland	Stilling pond	CUF_STILLING_FWV	46MS461K542(D)	4-Nov-10	5-May-11	-6	Bi-annually	Water	
Cumberland	Gypsum stack complex		46MS461K533(D)	6-Mar-10	4-Sep-10	-249	Bi-annually	Land	
Cumberland	Dry flyash stack		CU000046	6-Mar-10	6-Mar-11	-66	Annually	Air	
Cumberland	Ash Stack			1-Jun-04	1-Jun-05	-2170	Bi-annually	Water / Land	
Total									
Gallatin									
Gallatin	Active ash pond A	ACTIVE ASH POND A FWV	39MS461K564(D)	13-Jan-11	14-Jul-11	64	Bi-annually	Water / Land	
Gallatin	Middle pond A		39MS461K564(D)		-	-	As Requested	Water / Land	
Gallatin	Stilling pond (B, C, & D)	GAF_STILLING_FWV	39MS461K567(D)	31-Aug-10	1-Mar-11	-71	Bi-annually	Water	
Gallatin	Ash pond E	GAF_ASHPONDE_FWV	39MS461K567(D)	20-Oct-10	20-Apr-11	-21	Bi-annually	Water / Land	
Gallatin	Bottom ash pond		39MS461K561(D)	16-Sep-08	17-Mar-09	-785	Bi-annually	Water / Land	**Not enough water to complete hydro**
Total									
Johnsonville									
Johnsonville	Main Ash Pond A	JOF_MAIN ASH A_FWV	30MS461K554(D)	14-Feb-11	16-May-11	5	Quarterly	Water	
Johnsonville	Main Ash Pond B	JOF_MAIN ASH B_FWV	30MS461K554(D)	14-Feb-11	16-May-11	5	Quarterly	Water	
Johnsonville	Stilling Pond C	JOF_STILLING C_FWV	30MS461K554(D)	14-Feb-11	16-May-11	5	Quarterly	Water	
Johnsonville	Ash Complex (Island)			4-Apr-06	4-Jul-06	-1772	Quarterly	Land	
Total									
John Sevier									
John Sevier	Dry Fly Ash Stack		41MS461K527(D)	17-Mar-11	16-Mar-12	310	bi-annually	Land	
John Sevier	Dry Fly Ash Stack Stilling Pd		41MS461B538(D)	5-Mar-09	5-Mar-10	-432	Annually	Water / Land	
John Sevier	Dry Fly Ash Stack run off ponds		41MS461K527(D)	5-Mar-09	5-Mar-10	-432	Annually	Water	
John Sevier	Main Ash Pd (Bottom Ash)	JSF_MAIN BOTTOM_FWV	41MS461K548(D)	21-Oct-10	21-Apr-11	-20	Bi-annually	Water	
John Sevier	Stilling Pond	JSF_STILLING_FWV	41MS461K548(D)	28-Oct-10	28-Apr-11	-13	Bi-annually	Water	
Total									
Kingston									
Kingston	Main Ash Pond	KIF_MAIN_FWV	36MS461K623(D)	14-Mar-11	13-Jun-11	33	Quarterly	Water	
Kingston	Stilling Pond	KIF_STILLING_FWV	36MS461K620(D)	11-Nov-10	10-Feb-11	-90	Quarterly	Water	
Kingston	Gypsum Pond			-		-40674	Quarterly	Water	
Total									
Paradise									
Paradise	Daniel run phase II, pond 1			26-Nov-07	25-Nov-08	-897	Annually	Air	**Water too LOW to complete survey (8-9-10)**
Paradise	Daniel run phase II, pond 2		64MS461K557(D)	13-Mar-07	-	-	As Requested	Water	
Paradise	Daniel run phase II, stilling pond		64MS461K557(D)	13-Mar-07	-	-	As Requested	Water	
Paradise	Daniel run phase I, stilling pond		64MS461K557(D)	13-Mar-07	-	-	As Requested	Water	
Paradise	Daniel run phase I, Cell 2		64MS461K557(D)	13-Mar-07	-	-	As Requested	Water	
Paradise	Jacobs creek ash pond			13-Mar-07	-	-	As Requested	Water	
Paradise	Jacobs creek stilling pond		64MS461K558(D)	13-Mar-07		-	As Requested	Water	
Paradise	Peabody ash pond	PAF_PEABODYASH_FWV	64MS461K576(D)	9-Jun-10	8-Dec-10	-154	Bi-annually	Water	
Paradise	Peabody stilling pond	PAF_PEABODYSTILLING_FWV	64MS461K576(D)	9-Jun-10	8-Dec-10	-154	Bi-annually	Water	
Paradise	Slag Mountain			29-Apr-10	-	-	As Requested	Water / Air	
Paradise	Slag pond 2A	PAF_SLAG2A_FWV	64MS461K579(D)	13-Oct-10	13-Apr-11	-28	Bi-annually	Water / Land	
Paradise	Slag pond 2B	PAF_SLAG2B_FWV	64MS461K579(D)	13-Oct-10	13-Apr-11	-28	Bi-annually	Water	
Paradise	Slag stilling pond		64MS461B568(D)	22-Feb-10		-	As Requested	Water	**Only survey if pond is filling up**
Paradise	Scrubber Sludge Complex			6-Mar-10	5-Jun-10	-340	Quarterly	Air	
Paradise	Scrubber sludge stilling pond	PAF_STILLING_FWV		28-Jun-10	27-Sep-10	-226	Quarterly	Water	
Total									
Shawnee									
Shawnee	Consolidated Ash stack		35MS461G551(D)	17-Nov-10	18-May-11	7	Bi-Annually	Land	
Shawnee	Main Ash Pond	SHF_MAINASH_FWV	35MS461K559(D)	2-Nov-10	3-May-11	-8	Bi-Annually	Water	
Shawnee	Ash Stilling Pond	SHF_STILLING_FWV	35MS461K559(D)	2-Nov-10	3-May-11	-8	Bi-Annually	Water	
Total									
Widows Creek									
Widows Creek	Main Ash Pond A	WCF_MAIN_FWV	34MS461K598(D)	4-Jan-11	5-Apr-11	-36	Quarterly	Water / Air	
Widows Creek	Upper Stilling Pond	WCF_STILLING_FWV	34MS461K593(D)	20-Apr-11	20-Jul-11	70	Quarterly	Water	
Widows Creek	Lower Stilling Pond (Pump Pd)				-	-	As Requested	Water	
Widows Creek	Old Scrubber Pond Dredge Cell		34MS461K534(D)	25-Jun-10	25-Jun-11	45	Annually	Water / Air	**Fly before project starts**
Widows Creek	Gypsum Stack			20-Jan-10	20-Jan-11	-111	Bi-annually	Water / Air	
Widows Creek	Gypsum Stilling Pond	WCF_GYP STILLING_FWV	34MS461K534(D)	21-Apr-11	21-Jul-11	71	Quarterly	Water	
Total									
System Total									

Last Updated: April 19, 2011
For latest version, contact Nicole Walker
Phone: (423) 751-6389
E-mail: ndwalker@tva.gov

TVA NAD27 LOCAL

Map Prepared
For
Tennessee Valley Authority



TVA

eagleeye MAPPING SYSTEM

0 1000 2000 3000 4000

Scale 1" = 1000'

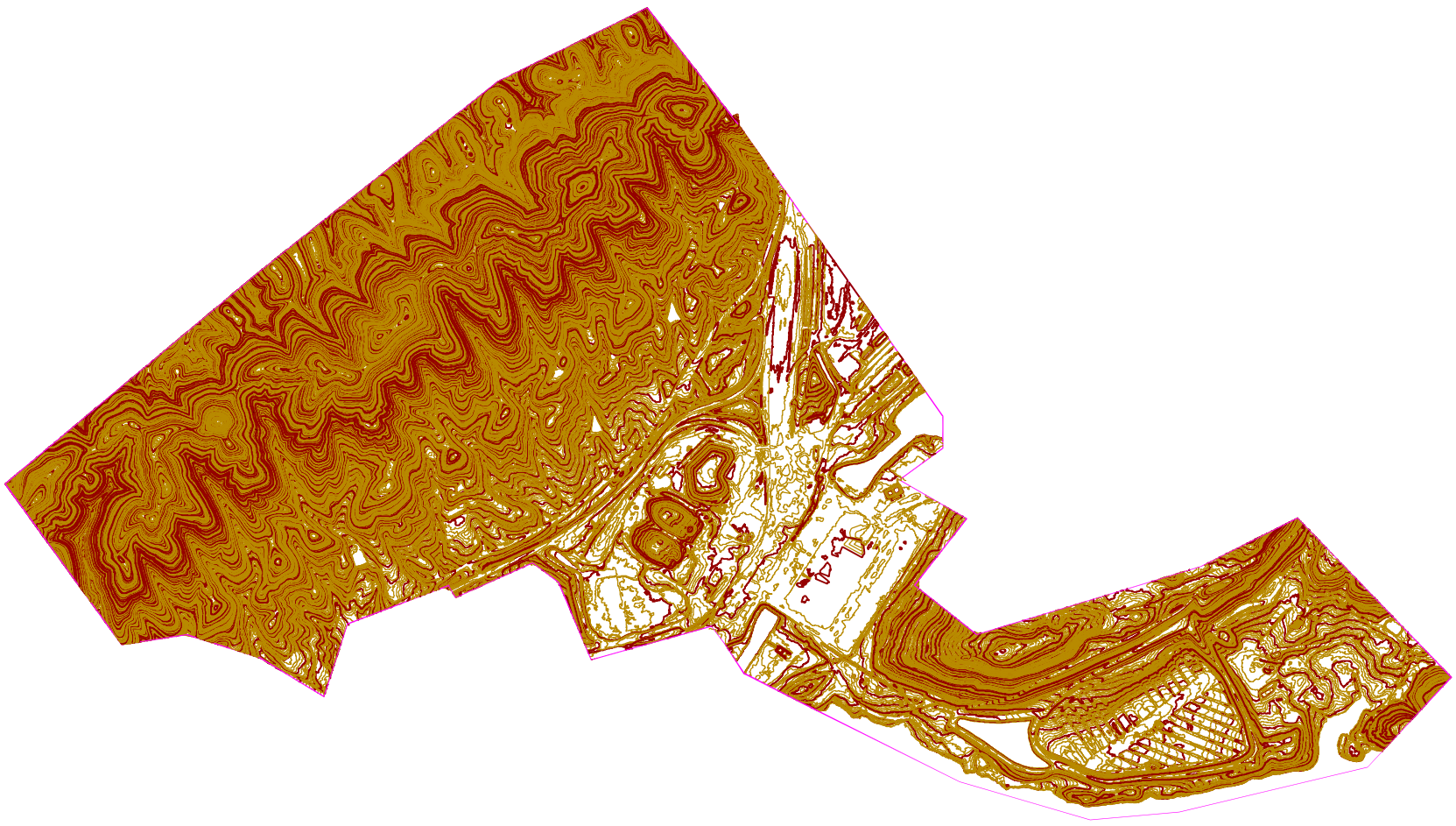
Tuck Mapping Solutions, Inc.
4632 Aerial Way
Big Stone Gap, VA 24219
276-523-4669
www.tuckmapping.com

tuck MAPPING SOLUTIONS, INC.

Client: Tennessee Valley Authority
Plant Site: Kingston Area 1
Job Number: 7592.32
Flight Date: 03.12.2011
Mapped By: Tuck Mapping Solutions, Inc.
Ground Survey By: TVA
Datum: TVA NAD27 LOCAL
Units: Feet
Drawn By: MJD

TVA NAD27 LOCAL

Map Prepared
For
Tennessee Valley Authority



TVA

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Scale 1" = 1500'

Tuck Mapping Solutions, Inc.
4632 Aerial Way
Big Stone Gap, VA 24219
276-523-4669
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tuck MAPPING SOLUTIONS, INC.

Client: Tennessee Valley Authority
Plant Site: Kingston Area 2
Job Number: 7592.32
Flight Date: 03.12.2011
Mapped By: Tuck Mapping Solutions, Inc.
Ground Survey By: TVA
Datum: TVA NAD27 LOCAL
Units: Feet
Drawn By: MJD

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1.0 PURPOSE

The purpose of this document is to define the procedures for handling production ash at Kingston Fossil Plant (KIF). This document defines the roles and responsibilities of all parties, active permits, operational requirements, required documentation, and general procedures for the daily operations of the Ballfield Interim Ash Staging Area and the Peninsula Site at KIF.

2.0 OPERATIONS

Gypsum, Fly Ash, and Bottom Ash will be landfilled at the Peninsula Site at KIF. It Is TVA's plan to make Phase I of the site operational and ready to receive to sluiced gypsum. Following the December, 2008 failure of the dredge cell, production ash was handled at the Ballfield. The Ballfield Interim Ash Staging Area operations plan was developed to stack ash while Phase II of the Peninsula Site was being developed. Once site preparation is completed, fly ash and bottom ash will be landfilled in Phase II of the site.

The operations for the active CCP disposal areas at Kingston Fossil Plant are described in the following two operations manuals: "Operations Manual – Coal Combustion Byproduct Disposal Facility – Peninsula Site" dated May 2006 and "Operations Plan – Ballfield Interim Ash Staging Area – Coal Combustion Byproduct Facility" dated February 2011.

The Peninsula Site Operations Manual (Section 1101) was developed in accordance with Rule 1200-1-7 of the Tennessee Department of Environment and Conservation (TDEC). The manual describes the site location, buffer zone requirements, access control, operations, anticipated volumes, types of waste, covering requirements, operating equipment, storm water run-on/run-off, dust control, quality assurance plans, and other requirements for operating the facilities. The manual included seven appendices. The Material Specifications and Construction Quality Assurance and Quality Control Plan, Appendix F, is included in Section 1103 of this document. The other appendices do not pertain to routine operations and were not included. The requirements outlined in the manual and QA/QC plan shall be followed for routine operations of the disposal of CCP at the Peninsula Site.

The Ballfield Operations Plan (Section 1101) describes ash placement and compaction requirements, interim slopes, access roads, cover requirements, surface water controls, dust control, maintenance, rim ditch filling ,ash removal, instrumentation monitoring, survey control, record keeping, and inclement weather. The QA/QC requirements are included in the narrative of the operations plan. Ash handling and disposal shall be conducted in accordance with the procedures and requirements described in the operations plan at the Ballfield Interim Ash Staging Area.

The associated design drawings for both the Peninsula Site and Ballfield Interim Ash Staging Area are included in Section 700 – Construction Plans.

3.0 GENERAL MAINTENANCE

3.1 Mowing and Vegetation Removal

The slopes shall be mowed to reduce the opportunity for tree growth and allow for visual inspection and observations. The slopes shall be mowed to a height of no less than 3-inches and no more than 12-inches tall with a minimum of three mowings per growing season. If woody growth is detected, it shall be removed.

3.2 Tree Removal

At the location of all trees which are greater than two (2) inches in base diameter, remove the tree and grub to the bottom of the root system at least twelve inches below grade. Backfill the excavations with a similar slope material and compact with a manual tamper. See the *General Guidelines for Tree Removal* in Section 1104.

3.3 Fertilize and Reseed Bare Areas

Bare areas should be reseeded in accordance with permit documents discussed in Section 900 and the specifications included in the operations plans and quality assurance/quality control plans included in Section 1101 and 1103, respectively.

3.4 Erosion Rill and Gully Repair

The cause of erosion shall be identified before beginning repair. Causes of erosion include poor vegetative cover, breach of a hydraulic structure or ditch, long or steep slopes and concentrated flows. Gullies or rills shall be graded, re-seeded and covered with an erosion control blanket. If the problem is ongoing, then consider shaping the gully and forming a ditch lined with riprap. See the *General Guidelines for Rill and Gully Erosion Repair* in Section 1104.

3.5 Animal Burrow Repair

Animal burrows provide a potential location for seepage and piping to occur. In order to repair animal burrows, locate burrows, trap animals, and relocate or dispose of animals as directed. See the *General Guidelines for Animal Burrow Repair* in Section 1104.

3.6 Wave Wash Riprap Protection

Wave erosion shall be controlled on TVA facilities to maintain the integrity of dams and dikes. When present, wave wash erosion typically occurs along interior slopes of dikes near pool level. If left unrepaired, erosion can expand, deepen, and can eventually lead to interior slope sloughing. General guidelines for repair of wave erosion using riprap are provided below. See the *General Guidelines for Wave Wash Erosion Repair & Rip-rap Protection* in Section 1104.

3.7 Rutting Repair

Rutting due to maintenance vehicle traffic can commonly occur along dike crests, slopes, and other areas at TVA fossil plant facilities. It is typically caused by near-surface dike crest materials which have become weak over time because of moisture

infiltration. Repeated passes of maintenance traffic/equipment over weakened materials can lead to rutting. The *General Guidelines for Rutting Repair* is provided in Section 1104. The attached guide is intended to be applicable for minor to moderate cases of rutting, and generally consists of reworking the upper portion of the affected area, followed by re-shaping to provide positive surface drainage. Where widespread or extensively deep rutting has occurred or is recurring, case-specific engineering evaluations may be needed.

4.0 INSPECTIONS AND REPORTING

TVA conducts daily, weekly, quarterly, and annual inspections of the active ash disposal areas at KIF. Following these inspections, reports are completed and filed. Any deficiencies requiring corrective actions/maintenance are reported and tracked using Maximo. A seepage action plan has been developed to track seeps and determine the level of repair necessary. Signs have been placed at all known seeps and pipe penetrations to aid during inspections.

4.1 Daily Field Reports

The daily field reports are used to determine minor deficiencies in operations. These are compiled by the contractor into a weekly report. These two reports are described below.

a. **RHO&M Daily Field Report** - Contractor

The purpose of the **RHO&M Daily Field Report** is to list deficiencies found beyond routine maintenance issues such as seeps or boils, freeboard issues, sloughs, or spillway issues. Also, daily production and activities conducted shall be tracked. The RHO&M Daily Field Repot is included in Section 1105.

b. **RHO&M Weekly Field Report** - Contractor

The **RHO&M Weekly Field Report** summarizes the daily activities for the week based on the daily field report. The Weekly Field Report is included in Section 1106.

4.2 Weekly Inspections

The active ash disposal area shall be inspected weekly by the Field Supervisor. The inspection shall be recorded using the **Weekly Facility Observation Form** included in Section 1107. The dikes shall be inspected for cracks, rutting, settlement, erosion, sloughs, seepage, vegetation, animal burrows, sinkholes, and other deficiencies. Deficiencies noted in previous inspections shall be checked if repairs have not yet been implemented.

4.3 Monthly Inspections

The active ash disposal area shall be inspected monthly by the Construction Manager. The inspection shall be recorded using the **Monthly/Quarterly/Special Facility Inspection Form** included in Section 1108. The dikes shall be inspected for cracks, rutting, settlement, erosion, sloughs, seepage, vegetation, animal burrows, sinkholes, and other deficiencies. Deficiencies noted in previous inspections shall be checked if repairs have not yet been implemented.

4.4 Quarterly Inspections

Quarterly inspections shall be conducted once every three months. The inspection shall be recorded using the **Monthly/Quarterly/Special Facility Inspection Form** included as in Section 1108. The quarterly inspection shall be led by the RHOM Program Manager. The RHOM team including the construction manager and field supervisor shall walk the active ash disposal areas, looking for seeps, sloughs, animal burrows, and any other deficiency which could affect the integrity of the facility. All deficiencies shall be flagged, surveyed, and photographed. A report shall be compiled with all deficiencies, locations, photos, and recommendations for repairs. Areas requiring engineering recommendations shall be sent to CCP Engineering or a geotechnical engineer to provide recommendations for the repair.

4.5 Annual Inspection

Once a year, an annual inspection shall be performed under the ownership of CCP Engineering. This shall be performed by a qualified geotechnical engineer. The purpose of the annual inspection is to inspect both the active and inactive ash disposal areas for structural integrity and make recommendations for any deficiencies noted. Photos shall be taken to describe the existing conditions at the time of the inspection, as well as to show the deficiencies found.

4.6 Inspection Deficiencies

Each potential deficiency encountered as a result of an inspection should be recorded in accordance with the CPP RHO&M Work Control procedure (FGDC-SPP-07.007), Section 3.2 E. Deficiency Monitoring. Recorded deficiencies should be tracked in the Maximo system as “Other” work orders with a work type of “OTH.”

4.7 Seepage Monitoring

The Seepage Action Plan for Kingston dated June 25, 2010 shall be followed as planned to observe, document, and remediate potential seepage areas. The seepage action plan shall be routinely implemented and updated at Kingston. This requires stockpiles of aggregate, sandbags and culvert pipe and updates to the seepage log when evidence of seepage is observed. Signs shall be installed at any new seepage areas.

5.0 PROJECT MANAGEMENT

The following forms are included to assist in project management requirements.

a. Project Startup Checklist

The purpose of the project startup checklist is to define the roles and responsibilities of the various groups within TVA and to insure that the required tasks are completed during the project planning stage. It also includes the required steps to be completed at project completion. The project startup checklist is included in Section 1109.

b. RHO&M Additional Work/ Change Order Form

The additional work/ change order form shall be used when the scope of work changes for the routine handling contractor. The form addresses the reason for the change, who

initiated the change, who needs to be notified, and the financial impacts of the change. The additional work/ change order form is included in Section 1110.

c. Environmental Review (NEPA)

Procedures were developed to provide guidance for compliance with the National Environmental Policy Act (NEPA). These procedures for the environmental review of a project are included in Section 1111.

6.0 Work Control Process

The work control process was developed to provide guidance for implementing a work control process that maximizes safety, facility reliability, work productivity, and risk assessment and management. The procedures describe the process by which maintenance and modification work activities are identified, planned, scheduled, monitored, and completed. It describes the work order process using the Maximo system. The work control process is included in Section 1112.

7.0 Clay Dike Restrictions

The clay dike study report is due September 2, 2011. A summary of the results should be discussed here and included in Section 1113.

8.0 Records

In accordance with the TVA Master Programmatic Documents, the Maximo database shall be used to track all inspection, monitoring, reporting, and maintenance recommendations. Final inspection reports and instrumentation data collection and analysis will be placed in the TVA BSL.

9.0 Subsections

Section 1101 – Operations Manual Coal Combustion Byproduct Disposal Facility Peninsula Site

Section 1101 – Operations Plan – Ballfield Interim Ash Staging Area – Coal Combustion Byproduct Facility

Section 1103 – Material Specifications and Construction Quality Assurance/Quality Control Plan – Coal Combustion Byproduct Disposal Facility – Peninsula Site

Section 1104 – General Maintenance Guidelines

Section 1105 – RHO&M Daily Field Report

Section 1106 – RHO&M Weekly Field Report

Section 1107 – Weekly Facility Observation Form

Section 1108 – Monthly/Quarterly/Special Facility Inspection Form

Section 1109 – Project Startup Checklist

Section 1110 – RHO&M Additional Work/ Change Order Approval Form

Section 1111 – NEPA Process

Section 1112 – CCP RHO&M Work Control Procedures

Section 1113 – Clay Dike Restrictions

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10 February 2011

Mr. Jamey Dotson
CCP Engineering
Tennessee Valley Authority
1101 Market Street LP 5G
Chattanooga, TN 37402

Subject: **Response to TDEC's Comments Regarding**
Design Package of Ballfield Interim Ash Staging Area (IASA)
Ballfield Site, TVA Kingston Fossil Plant
Harriman, TN

Dear Mr. Dotson:

The purpose of this letter is to provide response to comments received from Tennessee Department of Environment and Conservation (TDEC) regarding the Design Package of the Ballfield Interim Ash Staging Area (IASA). TDEC's comments are included in a letter from TDEC to TVA dated 27 January 2011. Each of the TDEC comments is provided below in italics, followed by Geosyntec's response in normal font.

Comment 1: *On page 4 of the 7 page executive summary/cover letter, the bottom line refers to a Figure 1 depicting the proposed truck haul routes. The referenced figure is missing.*

Response: TVA will provide a figure depicting the proposed truck haul routes.

Comment 2: *In Appendix 2, entitled: "Operations Plan Ball Field Interim Ash Staging Area", when specifying acceptable operational metrics, the term "should" (implying non-binding guidance) is used repeatedly as opposed to "shall" (compelling compliance). Numerous metrics were mentioned, but no explicit conformance standards were included. If standards are mission critical, the wording needs to be revised from "should" to "shall" or "must".*

Response: The words "should" and "shall" in the Operation Plan have been revised to "must".

Comment 3: *On page 1 of Appendix 2, there are references to maintaining a 20 foot offset from the existing sluice channel and also by the proposed footprint of the bottom ash dewatering facility. Further, on page 10 of the same Appendix, is the statement that "During the dewatering process, the upper portion of the Rim Ditch side slopes may collapse. Construction equipment must keep a minimum setback distance of 20' from the limit of collapse." The Rim Ditch has already been reinforced with sheet piling. Since the stated offset is 20', has it been determined that the sheet piling is sufficient to prevent any collapse from propagating beyond the piling, and is this 20 foot offset adequate for equipment maneuverability during maintenance/remedial purposes?*

Response: The sheet piles along the northern side of the Rim Ditch were removed in 2010. The crane mats that were placed adjacent to the sheetpiles remain in place. Based on the current dredging equipment, the anticipated current Rim Ditch geometry after sheet pile removal has a trapezoidal shape and is shown in Profile A on Drawing 6.

TVA has made a decision to use Option 1 for the Rim Ditch Backfill Sequence Operation, which involves filling the Rim Ditch completely with gravel. The upper portions of the Rim Ditch side slopes are likely to collapse only during the dewatering process for Option 2. During the Option 1 Rim Ditch backfilling process, the water in the Rim Ditch will be maintained full and thus the collapse of the upper portion of the Rim Ditch side slopes are unlikely to occur.

The 20' corridor between the proposed ash stack to the Sluice Channel is intended only for small vehicles such as a pickup truck or a utility ATV and is considered adequate for assess and maintenance purposes.

Comment 4: *In Appendix B of Appendix 2 (Design Calculations, specifically the "Interim Stability Assessment Analyses for Area of Rim Ditch") are 4 different modeled conditions. Of the 4 options considered, the Department recommends adoption of Case number 2 (Rim Ditch backfilled with gravel) which produces the highest slope stability factor of safety (at 1.62). Has TVA made a decision as to which option will be implemented; and if so, what option was selected?*

Response: TVA has made a decision to use Option 1 for the Rim Ditch Backfill Sequence Operation, which involves filling the Rim Ditch completely with gravel. The Rim Ditch Backfill Sequence Operation Option 2 has been removed from Drawing 9. The general notes on Drawing 9 have been modified to remove Option 2 related languages. Detail callout bubbles on Drawings 4, 5, and 6 for Option 2 have also been removed. Relevant languages for Option 2 have also been removed from the Operations Plan.

Comment 5: *In Appendix A of Appendix 2 (Design Drawings), sheet #8 ("Surface Water Management Details II"), includes detail 5/7 ("Inlet Grate"). This design is commonly seen on roof drains for warehouses, etc., with membrane/graveled surfaces and is not particularly suited to sites with large quantities of highly erodible materials such as ash. At a minimum, it is recommended that this design be revised to include a filter fabric wrap to minimize the amount of fines dropping into the piping.*

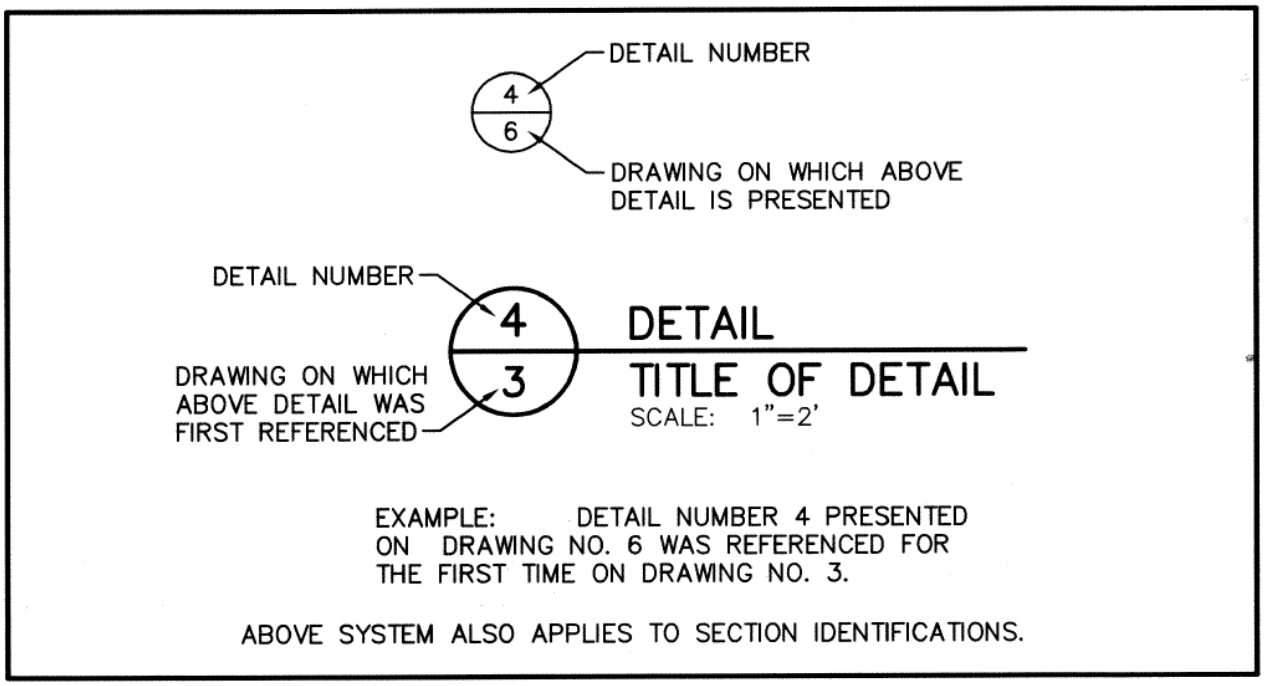
Response: A filter fabric wrap has been added to the vertical face of the inlet grate. The top horizontal opening of the inlet grate is remained uncovered. During small flow condition, ash sediment will be kept outside the down drain pipes. During large flow condition, the water level at the drainage bench will rise above the horizontal opening,

and quickly enter into the down drain pipes. Although the ash loading during large flow condition is high, the water velocity is also high, therefore, ash accumulation inside the down drain pipes is less likely.

A bullet paragraph has been added to Section 8 Maintenance of the Operations Plan regarding the maintenance of the filter fabric wrap. It reads: "The sediments accumulated around the filter fabric wrap of the inlet grate must be cleaned on a regular basis to prevent surface water ponding and overtopping. The filter fabric wrap must be evaluated on a regular basis, and if necessary be replaced. Sediment collected may be disposed back in the IASA."

Comment 6: Numerous detail tags in the plan view drawings do not correlate to the specific details on the detail sheets. This should be corrected to eliminate confusion.

Response: A detail identification legend (shown below) has been added to the cover sheet to help explain the system used for numbering details.



DETAIL IDENTIFICATION LEGEND

CLOSURE

Geosyntec appreciates the opportunity to provide the above responses to the TDEC comments. If you have any questions about the contents of this letter, please do not hesitate to contact any of the undersigned.

RTC LETTER_REVA.DOCX

Sincerely,

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Tennessee Valley Authority
Kingston Recovery Project
Kingston Fossil Plant

OPERATIONS PLAN
BALLFIELD INTERIM ASH STAGING AREA

COAL COMBUSTION BYPRODUCT FACILITY

Prepared By:

Tennessee Valley Authority
1101 Market Street
Chattanooga, TN 37401-2801

February 2011

Title: OPERATIONS PLAN BALFIELD INTERIM ASH STAGING AREA COAL COMBUSTION BYPRODUCT FACILITY				
				Plant/Unit: Kingston Fossil Plant
Vendor	Contract No.		Key Nouns:	
Applicable Design Documents	REV	EDMS NUMBER		DESCRIPTION
	R0			
References	R1			
	R2			

TENNESSEE VALLEY AUTHORITY
KINGSTON RECOVERY PROJECT
KINGSTON FOSSIL PLANT

	Revision 0	R1	R3
Date	December 2010	February 2011	
Prepared	Y. Cao	Y. Cao	
Checked	M. Othman / N. Davies	M. Othman / N. Davies	
Supervised	V. J. Dotson	V. J. Dotson	

OPERATIONS PLAN

BALLFIELD INTERIM ASH STAGING AREA

COAL COMBUSTION BYPRODUCT FACILITY

Prepared By:
Tennessee Valley Authority
1101 Market Street
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Revision 1

February 2011

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APPENDIX A: DESIGN DRAWINGS
APPENDIX B: DESIGN CALCULATIONS

1. Introduction

The purpose of constructing the Interim Ash Staging Area (IASA) at the Ballfield site is to provide interim ash storage capacity until the permitting and initial construction of Phase II of the KIF disposal facility at the TVA Peninsula Site is finished and ready to receive ash for permanent disposal. It is anticipated that the IASA will have a site life of approximately 2 to 4 years.

The design of the proposed IASA at the Ballfield site is presented on the design drawings and calculations included herein as Appendices A and B, respectively. The proposed IASA consists of three phases (Phases I, II, and III) which occupy an approximately 26.5-acre area currently used as a dewatering and processing area for the Rim Ditch dredging operation. The proposed IASA is bounded to the west by a 70-ft offset line from the western railroad line, to the north by a 100-ft offset line from the proposed deep soil mixing limit, to the east by a 20-ft offset line from the western edge of the existing Sluice Channel, and to the south by the proposed footprint of the bottom ash dewatering facility.

The boundaries of Phases I, II and III are shown on Drawing 2 in Appendix A. Phase I occupies the 10.1-acre western area, Phase II occupies the 10-acre eastern area, and Phase III occupies the remaining 6.4-acre northern area. The Phase III area will be used as a wet ash processing area until the construction and ash placement operations in Phases I and II are completed. Table 1 below shows the size, approximate airspace, and maximum elevation for each of the three phases. The total ash storage capacity provided by the IASA is on the order of 1.5 million CY.

Table 1. Summary of Size, Airspace, and Maximum Elevations for IASA Phases.

Phase	Size (AC)	Arispace (CY)	Maximum Elevation (ft)
I	10.1	406,000	824
II	10.0	701,000	830
III	6.4	440,000	832
Total	26.5	1,547,000	

The proposed Phase I, II, and III final grades are shown on Drawings 3, 4, and 5, respectively. As shown in these drawings, the following design features are incorporated into each IASA Phase:

- Each ash stack will have a 4% top deck area and 3 horizontal to 1 vertical (3H:1V) sideslopes. A diversion berm is located around the edge of the top deck area and a 15-ft wide drainage bench is located approximately 30 ft above the perimeter. Each phase will be surrounded by a perimeter drainage channel at the toe of the ash stack.

- The surface water runoff will be intercepted by either the diversion berm or the drainage bench and will flow along their alignments towards drop inlets that connect to downdrain pipes, which in turn convey flow to the perimeter drainage channels, and ultimately to either the Rim Ditch (i.e., during Phase I) or to the Sluice Channel (i.e., during Phases II and III).

As shown on Drawings 4 and 5 the existing Rim Ditch will be decommissioned by completely filling it with granular materials. This option is illustrated on Drawing 9 of Appendix A.

As the ash filling operation progresses through the three phases, the existing geotechnical instrumentation, that was previously installed below ground in the Ballfield site, will either be preserved or will be decommissioned, and new instrumentation will be installed according to the Master Instrumentation Schedule presented on Drawings 3, 4, and 5 of Appendix A.

As shown on Drawing 3, with the beginning of Phase I construction, the northern portion (approximately 6.1 acres) of the IASA footprint will be designated as wet ash processing area 1 (WAPA 1) to process the wet CERCLA-ash. The remaining southern (Non-CERCLA) area will be used for the interim ash staging. A second wet ash processing area (WAPA 2) located on the eastern portion of IASA will be used to process Non-CERCLA ash and will occupy the footprint of a portion of the Rim Ditch and the land adjacent to it.

With the progress of Phase II ash filling, the CERCLA boundary will be adjusted so that the CERCLA WAPA 1 is reduced to 4-acres and renamed as WAPA 1A, and the area yielded from WAPA 1 will be designated as the Non-CERCLA WAPA 3. Depending on the actual operational needs, the sizes of WAPA 1A and WAPA 3, and the corresponding CERCLA boundary in between may need to be adjusted by TVA.

Prior to the beginning of IASA Phase 3, both the CERCLA WAPA 1A and the Non-CERCLA WAPA 3 will no longer be needed and, thus, be decommissioned. As shown on Drawing 5, the CERCLA boundary will be shifted north to run along the northern boundary of IASA Phase 3.

In the remainder of this Operations Plan, guidance is provided for constructing, operating, and decommissioning the IASA. This guidance is not a complete operations manual, but is intended to highlight key procedures and practices that must be incorporated into the daily operations of the IASA.

2. Ash Placement and Compaction

- Only dewatered ash materials are allowed to be placed in the active phase of IASA. No free liquids may be disposed within the active phase of IASA.

- The ash layer must be compacted in approximately horizontal loose lifts.

- The lift thickness, moisture content, suitable operating equipment, and number of equipment passes for the ash material must be determined based on a pilot study that needs to be conducted as part of the initial filling activities for Phase I IASA, such that the required design shear strength and density of the ash material can be achieved. Verification of shear strength must be conducted by obtaining a minimum of three Shelby tube samples from different locations within the pilot study area and performing triaxial shear strength testing on them in the laboratory. As a starting point, the following guidelines are recommended:

- Ash must be placed in loose lifts of approximately 12 inches (maximum) in thickness and graded to a 1% minimum slope.

- Ash placement must not exceed two feet per day in a discrete area unless authorized by the QC Manager based on the response of instrumentation.

- Prior to the compaction, the ash materials being placed must be within four percent below to two percent above optimum moisture content range as determined by ASTM D689.

- At the end of each day's activities, the surface must be sealed to the extent practical with a smooth drum roller.

- Prior to the placement of subsequent lifts, the existing product surface must be lightly scarified to promote lift bonding.

- Compaction of the ash must achieve at least 90 percent of Standard Proctor Density as determined by ASTM D698, at which point the Engineer must collect samples for laboratory strength testing. Field compaction procedures may then be modified accordingly based on the results of testing to provide the optimum procedures that result in attainment of required shear strength of the compacted materials.

- Moisture content and density testing must be performed on the compacted materials during active operations at a frequency of at least one sample per 5,000 cubic yards of placed material, to ensure the material is compacted in accordance with the project specifications.

- The active working area where the ash material is placed and compacted must be kept relatively small to the extent practical. Ideally, the working area must not exceed 5 acres.

3. Interim Slopes

- For slopes with an overall height of up to 10 ft, the interim slopes will be maintained to be no more than 2H:1V.

- For slopes with an overall height of more than 10 ft, the interim slopes will be maintained to be no more than 3H:1V.

4. Access Roads

- All weather access roads may be constructed using either ash material or clayey soil. An optional layer of sand or gravel/crushed stone may be used on top of the roads to promote drainage and to prevent the roads from becoming slippery.

- The location, width, and details of a final stack access road will be determined in the field.

- Where an access road intercepts a drainage bench, the drainage bench must be transitioned into a 12-inch diameter high density polyethylene (HDPE) corrugated exterior, smooth interior pipe beneath the access road with a minimum 2-ft thick cover above the pipe.

- Where an access road intercepts a perimeter drainage channel, it is recommended that the segment of access road over the perimeter drainage channel be constructed of gravel/crushed stone to allow surface water runoff to infiltrate into the perimeter drainage channel. HDPE (or equivalent material) culvert pipes must be installed beneath the access road. The number, diameter, type, and cover thickness of the HDPE culvert pipes must be determined based on actual ramp locations and estimated flow quantities.

5. Cover Vegetation

- When the interim ash stack reaches the final elevations, there are two options to stabilize the ash,

    - Option 1: the ash will be stabilized with hydroseeding method using permanent seeding within 14 days. Other equivalent stabilization methods may be used upon TVA's approval.

  - Option 2: the top 6 inches of ash will be removed, and a 6-inch thick vegetative cover will be placed, and the vegetative cover will be stabilized with hydroseeding method using permanent seeding within 14 days. Other equivalent stabilization methods may be used upon TVA's approval. It is noted that when the Option 2 will be used, the ash can also be placed at 6 inches below the final elevations to avoid the redundant placement and removal of the top 6 inches of ash.

- When Option 2 is used (i.e., the top 6 inch of the ash material is substituted with a 6-inch thick vegetative cover), the following requirements are applicable:

  - The vegetative cover will be constructed using locally available soil from the KIF TVA reservation, or from approved off-reservation material. Regardless of the source, the soil must be capable of sustaining vegetation growth.

  - Prior to placement of vegetative cover, any existing interim/permanent vegetation will be stripped and removed.

  - Upon placement of the vegetative cover, the soil will be prepared and stabilized with hydroseeding method using permanent seeding within 14 days.

- On the 3H:1V sideslope areas of the IASA, it is recommended that Option 2 be the preferred option to establish permanent vegetation due to concern about excessive erosion of the ash materials.

- Permanent vegetation must be established over the following components:

  - The entire exposed surfaces of the perimeter drainage channels (Detail 4 on Drawing 7), the drainage bench (Detail 5 on Drawing 7), the diversion berm (Detail 6 on Drawing 7), and the Phase I perimeter drainage channel outfall (Detail 2 on Drawing 8).

- The entire exposed surfaces of the IASA (where grades have achieved final stack grade) including the 3H:1V sideslopes, the 15-ft wide drainage benches, and the 4% top deck area.

- Any surfaces of the IASA from which surface-water runoff is allowed to enter the IASA surface water management system.

6. Surface Water Controls

- During operations, the surface water runoff from the IASA surfaces will be intercepted by diversion berms and drainage benches, and will flow along their alignments towards HDPE drop inlets and HDPE downdrain pipes, which will convey the flow to perimeter drainage channels and ultimately to either the Rim Ditch or the Sluice Channel during Phase I or the Sluice Channel (during Phases II and III) via four permanent channel outfalls (i.e., outfalls A, B, C and D).

- Only corrugated exterior, smooth interior 18-inch (min.) diameter HDPE pipes are allowed to be used as downdrain pipes.

- The use of corrugated metal pipes (CMP) is not recommended due to potential for corrosion. HDPE/PVC pipes with corrugated interior may be used if they are sized to have the same flow capacity as an 18-inch diameter pipe with a smooth interior.

- A concrete anchor block must be used for each interim or permanent downdrain pipe per Detail 4 on Drawing 8.

- The dimensions and thicknesses for the riprap aprons specified at diversion berm drop inlets, drainage bench drop inlets, and downdrain pipe outlets represent minimum required dimensions.

- The interim down drain pipes and drop inlet that will be filled over during the next IASA phase must be properly decommissioned prior to the beginning of next IASA phase. The interim concrete anchor blocks may be left in place.

- The perimeter drainage channels and the corresponding outfall structures for each IASA phase must be established prior to the ash placement

- Surface water control measures (e.g., separate storm water diversion ditches or common perimeter drainage channels) must be established in the close vicinity of the CERCLA boundary to prevent CERCLA surface water runon from flowing into the Non-CERCLA Ballfield IASA site.

7. Dust Control

- Dust control during dry periods must be achieved by spraying access roads and the active working face with water. Vegetation will be established on roadside backslopes and in completed ash stack areas as quickly as possible to remove the potential for dust production.

- No oil or other chemical substances may be used for dust suppression.

- Interim soil cover may be used as needed for dust control.

8. Maintenance

- The maintenance of the surface water control structures must follow the procedures and guidelines provided in the Storm Water Management Plan developed for the IASA.

- The surface water control structures must be inspected on a regular basis especially after a major rainfall event for signs of damage. Damages identified must be repaired promptly.

- The sediments within the surface water control structures must be cleaned and the structures restored to their original condition on a regular basis to prevent surface water ponding and overtopping. Sediment collected may be disposed back in the IASA.

- The sediments accumulated around the filter fabric wrap of the inlet grate must be cleaned on a regular basis to prevent surface water ponding and overtopping. The filter fabric wrap must be evaluated on a regular basis, and if necessary be replaced. Sediment collected may be disposed back in the IASA.

9. Rim Ditch Filling

- Option 1 for backfilling the Rim Ditch is illustrated on Drawing 9. Option 1 involves backfilling the entire Rim Ditch with gravel.

- A thorough dredging operation must be performed in the intended rim ditch working area prior to backfilling to remove existing ash sediment from the Rim Ditch.

- Heavy construction equipment such as bulldozers and articulated trucks are to use caution when operating near the edge of the Rim Ditch. If unstable conditions are observed, operating equipment must pull back to a safe distance immediately. Typical signs of unstable conditions include soil sloughing on the side slope of Rim Ditch, formation of tension cracks along the Rim Ditch, excessive rutting, and excessive ground depression.

- The top of the granular material must be maintained to be slightly higher than the adjacent earthen ground. Rutting and depression of the granular material must be repaired in a timely fashion.

- Bulldozers can operate "inside the rim ditch" on top of the granular material only when approved by the supervising engineer.

- Heavy articulated trucks must avoid driving within the Rim Ditch limits to the extent practical. The backfill material must be unloaded along the side of the Rim Ditch.

- No personnel are allowed to walk near the Rim Ditch where active backfilling/dewatering operations are ongoing.

- The minimum setback distance between the interim ash stack and the Rim Ditch must be 50 ft.

10. Ash Removal Procedures

- The removal of the IASA over any particular area must start from the top of the stack and proceed downward in relatively horizontal lifts, to the extent practical.

- The perimeter drainage channels and the channel outfalls A through D must not be decommissioned until all ash stack materials have been removed. This is to prevent any uncontrolled surface water from escaping the Ballfield site.

- The ash removal is recommended to be conducted in such a manner that:

    - will not cause an unstable condition such as leaving a interim slope steeper than 2H:1V with slope height greater than 10 ft; and

    - will not cause uncontrolled surface water to escape the Ballfield site.

11. Instrumentation Monitoring

- The preservation and decommissioning of the existing instrumentation, and the installation of any new instrumentation will be performed in accordance with the Master Instrumentation Schedule presented on Drawings 3, 4 and 5.

- It is recommended that TVA adopts the following minimum monitoring frequency for the existing and proposed instrumentation:

    - Vibrating wire piezometers will be read on a daily basis;

    - Slope inclinometers will be read two times per week; and

    - Settlement plates will be surveyed two times per week.

Once a consistent trend and response is established, the frequency of reading may be subsequently adjusted depending on the instrumentation response and actual ash placement rate.

- A Ballfield Site Instrumentation Results & Summary Weekly Report must be prepared and submitted to consultant engineer(s) for review in a timely fashion. The content of this weekly report will be similar to the ones prepared by Jacobs Engineering in 2010.

- The existing instrumentation designated for decommissioning will be abandoned when the ash filling approaches their vicinity and must be performed in accordance with applicable regulations/requirements as directed by TVA.

- There is a segment of the instrumentation wiring pipe between the PA-1/PC-1 and the junction box that will cross the wet ash processing area. This segment of instrumentation wiring pipe will be clearly marked with markers, such as wooden stakes or PVC pipes, at 50-ft spacing to prevent accidental damage.

- Three slope inclinometers (SI-1R, SI-2R and SI-5R) are proposed to be installed during the Ballfield IASA project. It is recommended that the MEMS-based slope inclinometers be used for the proposed slope inclinometers. The proposed slope inclinometers must be anchored below the clayey foundation soil stratum and will be used to monitor lateral spreading and to provide an early warning of potential slope instability.

- Specific recommendations and procedures must be developed regarding Ballfield IASA instrumentation monitoring and will include recommendations, trigger levels and actions to be taken regarding the control of filling within the Ballfield IASA site. Recommendations will specifically indicate that filling in an area must stop when:

    - Excess pore pressure increases to specific limits;

    - Slope inclinometer results show the potential development of a slip surface;

- Settlement rates unexpectedly accelerate; and

- The ratio of lateral to vertical movements in surface monuments exceed specific target levels.

It is suggested that these specific recommendations and procedures with supporting calculations are developed for each Phase prior to the commencement of ash filling operation.

12. Survey Controls

- Survey control must be established and maintained on-site. All perimeter drainage channels, drainage benches, diversion berms, access roads, channel outfalls must be located in accordance with Drawings 3 through 5 to ensure correct location.

- To maintain appropriate control of IASA construction and operation, survey control by a registered land surveyor (RLS) or professional engineer (PE) will be provided at specific stages of operations. These stages are as follows:

  - Pre-construction: Construction staking will be provided to ensure appropriate location of IASA components.

  - Day-to-Day Operations Survey Control: The height of the IASA will be controlled by the use of grade stakes placed at appropriate locations around the active area. These grades stakes will indicate the limit of ash material and will be placed by a surveyor familiar with the site.

  - Operations Survey Control Review: At least annually, a topographic survey of the entire Ballfield site will be conducted to check the progress of filling and to estimate the remaining capacity.

  - Final Stack Geometry: An as-built survey will be prepared after ash disposal has ceased or after the entire IASA has reached final grades and the vegetative cover is placed. This topographic map will serve as a drawing of record of final stack geometry.

- Post-Decommissioning Survey: An as-built survey will be prepared after all of the ash has been removed from the IASA and the Ballfield site is decommissioned.

13. Recordkeeping

- It is recommended that the operator of the IASA maintain a daily log which will include at a minimum the description of the day's weather, employees present, equipment conditions, location of the day's working face as recorded using a handheld GPS unit, ash placement and compaction activities, approximate number of trucks unloading the ash materials, and approximate fill height.

- It is recommended that an Instrumentation Monitoring Record be kept on site to document:

  - weekly instrumentation summary reports;

  - the decommissioning of existing instrumentation devices;

  - the installation of any new instrumentation devices; and

  - any instrumentation repair and maintenance logs.

- Specific recommendations, trigger levels and actions to be taken regarding the control of filling for each Ballfield IASA Phase must be kept at the site.

- The routine maintenance and repair records must be kept at the site.

- The annual topographic map must be kept at the site.

14. Inclement Weather

- During periods of inclement weather conditions such as heavy rainfall or heavy snow, the IASA operations will be shutdown.

- After periods of inclement weather conditions such as heavy rainfall, trucks unloading ash on the working face may occasionally become stuck because of the slick conditions. A dozer and winch must be maintained at the site to remove stuck vehicles if this situation occurs.

- During winter season, freezing is likely especially in the early morning. In the rare situation where icy conditions may develop on top of the access road, making it difficult to drive on, it is recommended that the equipment operator either use an alternative route or wait until the road conditions improve as the day warms up.

APPENDIX A

DESIGN DRAWINGS

APPENDIX B

DESIGN CALCULATIONS

OPERATIONS MANUAL
COAL COMBUSTION BYPRODUCT DISPOSAL FACILITY – PENINSULA SITE

Prepared By:
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1101 Market Street
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Revision 0

May 2006

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Appendix G DSWM Policy Memorandum SW-91-2

Note:

(1) The hydrogeological report was submitted under separate cover to TDEC on November 29, 2005. A Notice of Completeness was received from TDEC on December 16, 2005. Appendix B only includes supplemental data used in the design that was not included in the previous submittal.

1 SITE INFORMATION

1.1 Overview and Introduction

This Operations Manual has been prepared in support of a Part II Permit application for a coal-combustion byproduct (CCB) disposal facility to be located at Tennessee Valley Authority's (TVA's) Kingston Fossil Plant (KIF), located near Harriman, Tennessee. The proposed disposal facility is to be located on lands currently owned by TVA located within the KIF reservation. The CCB disposal facility is an integral part of a project to install a flue gas desulfurization (FGD) system at KIF. When operational, the FGD system will reduce sulfur dioxide emissions through the use of wet limestone forced oxidation technology. Gypsum will be produced as a byproduct of the FGD operations. TVA intends to market the resulting gypsum for beneficial re-use by private companies. However, the proposed CCB disposal facility described herein is needed for the on-site disposal of gypsum materials that cannot be marketed.

This Operations Manual has been developed in accordance with rules published by the Tennessee Department of Environment and Conservation (TDEC), specifically Rule 1200-1-.04. TVA is requesting that TDEC issue a permit for the construction and operation of the CCB disposal facility as a Class II facility. TVA also requests that TDEC issue certain waivers, as specifically identified in this O&M Plan, that are needed to address TVA's operational needs and the inert nature of the materials to be disposed.

Information presented in this document has been organized and presented consistent with the permit application requirements presented in Rule 1200-1-.04 (9). Sections within this application have been titled and enumerated consistent with the regulations to facilitate the review process. Additional information developed in support of this Operations Manual and the permit application has been presented as Appendices or attachments as listed below:

Appendix A	Hydrogeologic Report
Appendix B	Design Calculations
Appendix C	Gypsum Testing and Physical Properties
Appendix D	Groundwater Monitoring Plan

Appendix E	Closure and Post-Closure Plan
Appendix F	Material Specifications and Construction Quality Assurance and Quality Control Plan
Appendix G	DSWM Policy Memorandum dated September 7, 2001

1.2 Hydrogeological Report (ref. 1200-1-7-.04 (9) (a))

The Hydrogeological Report supporting this application is titled *"Kingston Fossil Plant – Peninsula Site, Hydrogeologic Evaluation of Coal-Combustion Byproduct Disposal Facility"* (October 2005) and is presented as Appendix A. This document was submitted to TDEC as a stand alone document on November 29, 2005. Based on TDEC's review, a Notice of Completeness was received by TVA on December 16, 2005. No changes have been made to this document since its submittal to TDEC.

1.3 Engineering Plans (ref. 1200-1-7-.04 (9) (b))

The Engineering Drawings that support this application are presented as Attachment 1 to this Operations Manual. The drawing set is titled, *"Coal-Combustion By-product (Gypsum) Disposal Facility, Kingston Fossil Plant – Peninsula Site"*. The following drawings are included:

Table 1
List of Drawings

Drawing No.	Title
10W427-1	Cover Sheet
10W427-2	Existing Site Conditions and Boring Locations
10W427-3	Site Development Plan
10W427-4	Phase I Initial Grading Plan and Soil Dikes
10W427-5	Phase I Top of Geologic Buffer
10W427-6	Phase I, Stage 1A
10W427-7	Phase I, Stage 1B
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10W427-14	Cross Section I
10W427-15	Cross Section II
10W427-16	Operational and Typical Details I
10W427-17	Operational and Typical Details II
10W427-18	Drainage System Details I
10W427-19	Drainage System Details II
10W427-20	Final Cover System Details
10W427-21	Surface Water Management System Details I (Downdrain Channel Option)
10W427-22	Surface Water Management System Details II (Downdrain Pipe Option)
10W427-23	Surface Water Management System Details III
10W427-24	Underdrain Lift Station
10W427-25	Stormwater Lift Station

2. NARRATIVE DESCRIPTION OF FACILITY OPERATIONS

The following section of this Operations Manual presents a narrative description of the development and operation of the planned CCB disposal facility. To facilitate the review of this document, regulatory requirements are cited in italics at the start of each section followed by a text description indicating how the specific requirement has been addressed. Where appropriate, the text also references engineering drawings or other supporting information that has been developed in support of the Operations Manual and permit application.

2.1 Site Information

2.1.1 Responsible Officials (ref. 1200-1-7-.04 (9) (c) 1)

Regulatory requirement:

1. Identifies the name of the individual responsible for operation and maintenance of the facility;

The following is a list of responsible parties involved in the permitting, design, operation, maintenance, quality control and quality assurance of the CCB disposal facility at TVA's Kingston Fossil Plant.

1. Owner: Tennessee Valley Authority (TVA)
   Contact: Plant Manager
   Tennessee Valley Authority
   Kingston Fossil Plant
   714 Swan Pond Road
   Harriman, Tennessee 37748
   Phone (865) 717-2501

As of the date of this revision, the plant manager is Mr. Michael T. Beckham.

Please direct any correspondence in regards to this document to the designated Solid Waste Specialist. The Solid Waste Specialist for Kingston Fossil Plant is:

Larry C. Bowers
1101 Market Street, LP 5D-C
Chattanooga, Tennessee 37402-2801
Phone:(423)751-4947
Fax:(423)751-7011

2. State: Tennessee Department of Environment and Conservation
Division of Solid Waste Management
Tennessee Department of Environment and Conservation
2700 Middlebrook Pike, Suite 220
Knoxville, Tennessee 37921-5602
Phone:(865) 594-6035
Fax:(865) 594-6115
Contact as of the date of this manual is Mr. Larry Cook, Environmental Field Office Manager.

Tennessee Department of Conservation
Division of Solid Waste Management
Central Office
401 Church Street
5th Floor, L&C Tower
Nashville, TN 37243-1533
Phone:(615) 532-0780
Fax:(615) 532-0886

Contact as of the date of this manual is Mr. Mike Apple, Division Director.

2.1.2 Site Location (ref. 1200-1-7-.04 (9) (c) 2)

Regulatory requirement:

2. *Describes the location of the facility using roads and highways;*

The Site is located on land currently owned by TVA at the Kingston Fossil Plant (KIF). The specific area proposed for the disposal facility is commonly referred to as the "Peninsula Site". KIF is located near the city of Harriman in Roane County, TN. Access to the Site is via the plant main entrance which is located on Swan Pond Road. Swan Pond Road is located off Highway 70 between the cities of Kingston and Harriman. A site location map is provided on Drawing No. 10W427-1 (Cover Sheet).

2.1.3 Site Description (ref. 1200-1-7-.04 (9) (c) 3)

Regulatory requirement:

3. *Describes its compliance with all applicable buffer zone standards listed in paragraph (3) of this Rule. Each buffer zone standard must be specifically addressed referencing the closest property lines, residences, wells, and bodies of water as appropriate, and maps may be attached for easy descriptions and reference or otherwise demonstrate compliance.*

KIF is located at the base of a peninsula formed by the Clinch and Emory River embayments of Watts Bar Lake. Construction of KIF began in 1951 and commercial operation began in 1955. Land acquisition for KIF included approximately 550 acres east of the current plant operational area, commonly referred to as the KIF Peninsula Site. The area was originally devoted to agricultural and residential use. These cultivated fields are currently used by the Tennessee Wildlife Resources Agency (TWRA) to support an onsite wildlife management program (i.e., hunting).

The proposed CCB facility will be located on a peninsula landform at the confluence of the Clinch and Emory Rivers in Roane County, Tennessee. The Emory River enters the Clinch River at Clinch River Mile (CRM) 4.36 along the eastern margin of the peninsula. Existing ground surface across the proposed disposal site

ranges from approximately elevation 735 to 860 ft. msl, and the 100-year flood stage elevation is 747.6 ft. Modern day floods near the mouth of the Clinch River (CRM 0.7) suggest that the highest modern (1903) flood stage was near 746 ft. msl.

The CCB disposal facility proposed at KIF will occur in two separate phases. Both phases would involve disposal of gypsum derived from flue-gas desulfurization (FGD). Phase I would be constructed pending successful marketing of the FGD derived gypsum. The footprint for Phase I includes an area of approximately 51 acres. If efforts to market the gypsum are unsuccessful, the disposal facility will be expanded laterally under Phase II. Phase II includes additional area adjacent to the site and encompasses an additional area of approximately 41 acres (note: areas are measured to limits of waste).

2.1.4 Compliance with Buffer Zones (ref. 1200-1-7-.04 (3) (a)

Regulatory requirement:

Disposal facilities must be located, designed, constructed, operated, and maintained such that the fill areas are, at a minimum:

1. *100 feet from all property lines*

The proposed CCB disposal facility is located on the KIF reservation. No property lines are within 100 ft.

2. *500 feet from all residences, unless the owner of the residential property agrees in writing to a shorter distance*

There are no residences within 500 ft. of the proposed CCB disposal facility.

3. *500 feet from all wells determined to be down gradient and used as a source of drinking water by humans or livestock*

There are no wells downgradient of the site that are used as a source of drinking water by humans or livestock.

4. *200 feet from normal boundaries of springs, streams, lakes (except that this standard shall not apply to any wet weather conveyance nor to bodies of water constructed and designed to be part of the facility)*

The disturbance footprint of the disposal facility is located within 200 ft. of the normal boundary of Watts Bar Lake-Clinch River. However, as indicated on Drawing No. 10W427-3 (Site Development Plan), waste limits shall be maintained beyond the required 200 ft. buffer zone. Only soil starter dikes will be located within the buffer. Prior to construction, TVA will obtain permits required under Section 404 of the Clean Water Act and an Aquatic Resource Alteration Permit (ARAP) to address construction activities within the buffer area.

TVA requests that TDEC issue a waiver of the 200 ft. buffer requirement to allow construction of the soil starter dikes within the buffer zone as indicated on the engineering drawings.

2.1.5 Compliance with Siting Requirements for Fault Areas (ref. 1200-1-7-.04 (9) (c) 4)

Regulatory requirement:

4. Describes its compliance with applicable siting requirements for fault areas.

   Rule 1200-1-7-.04 (u) New Class I and II SWLF units and lateral extensions shall not be located within 200 feet (60 meters) of a fault that has had displacement in Holocene time unless the owner or operator demonstrates in the Narrative Description of the Facility and Operations Manual that an alternative setback distance of less than 200 feet (60 meters) will prevent damage to the structural integrity of the SWLF unit and will be protective to human health and the environment.

As part of the planning and design of the proposed facility, TVA has completed an extensive hydrogeologic evaluation of the site. Based on the investigations performed to date, there is no evidence of Holocene-age faulting within the 200 ft. facility exclusion zone although the Kingston fault (a thrust fault) crosses the southeastern

margin of the site. The Kingston fault is an ancient structure that, along with associated faults, were formed approximately 300 million years ago and further movement along these faults is highly improbable (Julian and Boggs, 2005).

2.1.6 Compliance with Siting Requirements for Seismic Impact Zones (ref. 1200-1-7-.04 (9) (c) 5)

Regulatory requirement:

5. *Describes its compliance with applicable siting requirements for seismic impact zones.*

   Rule 1200-1-7-.04 (v) New Class I and II SWLF units and lateral extensions shall not be located in seismic impact zones unless the owner or operator demonstrates that all containment structures including liners, leachate collection systems and surface water control systems are designed to resist the maximum acceleration in lithified earth material for the site. The owner or operator must place the demonstration in the Narrative Description of the Facility and Operations Manual.

The Site lies within a seismic impact zone, defined by TDEC Rule 1200-1-7-.04 as being an area with a 10 percent or greater probability of being subject to an earthquake ground acceleration of at least 0.10g within 250 years. The Site falls within an area characterized by a maximum horizontal acceleration of 0.25g within 250 years. In accordance with TDEC regulations, "*all containment structures including liners, leachate collection systems, and surface water control systems are to be designed to resist the maximum horizontal acceleration in lithified earth material for the site*".

In accordance with the TDEC regulations, engineering analyses were performed for critical components of the facility considering both static and seismic conditions. Seismic evaluations were performed using a maximum horizontal ground acceleration of 0.25g in 250 years. Calculation packages detailing assumptions and procedures, analyzed cross sections, and material properties for the aforementioned analyses are presented in Appendix B. Results indicate that the proposed facility has adequate factors of safety under both operational and final facility configurations.

2.1.7 Compliance with Siting Requirements for Unstable Areas (ref. 1200-1-7-.04 (9) (c) 6)

Regulatory requirement:

4. *Describes its compliance with applicable siting requirements for unstable areas.*

   Rule 1200-1-7-.04 (2) (w) Owners or operators of new Class I and II SWLF units, existing Class I and lateral expansions located in an unstable area must demonstrate that engineering measures have been incorporated into the SWLF units designed to ensure that the integrity of the structural components of the SWLF unit will not be disrupted. The owner or operator must place the demonstration in the Description of the Facility and Operations Manual operating record. The owner or operator must consider the following factors at a minimum, when determining whether an area is unstable:

1. *On-site local soil conditions that may result in significant differential settlement.*

2. *On-site or local geologic or geomorphologic features; and*

3. *On-site or local human-made features or event (both surface and subsurface).*

Topographic depressions or dolines are exhibited at the site. These features do not possess open throats or avenues for reception of incipient recharge. Rather, the dolines are thickly mantled by soil thicknesses ranging from about 35 to 75 ft. Visual and laboratory classifications of these soils indicate that they are of residual origin except in the area of the site pond where alluvial deposition has occurred. Based on the hydrogeologic evaluation, there were no voids detected immediately above bedrock that would indicate staging of soil into the deeper bedrock system. There are no natural karst features (i.e., sinkholes, sinking streams, and springs) directly integrated into the subsurface. Coring of the bedrock at the site exhibits slight to highly fractured

conditions. Most cavities and joints were also observed to be completely or partially filled with clays and sand. Some topographic depressions coincide with bedrock depressions but no active karst features were observed at these locations.

The only man made feature is the former farm pond located in the center of the site. This feature will be filled in during construction of the facility and therefore will not affect the integrity of the facility. TVA will obtain the necessary permits for this work in advance of proceeding with the work.

A central drainage corridor (150 ft. wide drainage blanket) is included in the design to remove liquids from lower portions of the CCB disposal facility during normal operations and during the post-closure period. As part of the engineering design, differential settlements were estimated along the axis of the corridor to ensure that positive drainage would be maintained under post-settlement conditions. This evaluation is presented in Appendix B and illustrates that positive gravity drainage will be maintained after settlement under the final configuration of the disposal facility.

2.1.8 Access Control (ref. 1200-1-7-.04 (9) (c) 7)

Regulatory requirement:

7. *Describes the barriers, signs, procedures and other measures to be used to control access to and use of the facility;*

Phases I and II of the proposed CCB facility are located within the TVA KIF Reservation. Access to this facility is via the plant entrance and internal plant roads. During normal operations, plant personnel will be at the site performing disposal operations, inspections and maintenance as required. TVA also maintains 24-hour security at the plant.

Temporary signage and barriers will be erected on an as-required basis during construction operations to route construction-related traffic to designated areas.

3 FACILITY OPERATIONS

3.1 Overview

This Section of the Operations Manual provides a description of the normal operations anticipated for the planned CCB facility. Section 3 provides a description of operational procedures and specifically addresses the required elements of Rule 1200-1-7-.04 (9) (c) parts 8 through 18.

3.2 General Sequence of Operations (ref. 1200-1-7-.04 (9) (c) 8)

Regulatory Requirement

8. Describes the methods and sequence of operation;

The proposed CCB disposal facility is intended for the disposal of gypsum derived from flue-gas desulfurization (FGD). While it is TVA's intent to market the resulting gypsum materials for beneficial re-use, the disposal facility is required as a back-up to normal operations. At a minimum, it is anticipated that the facility will be used to dispose of materials resulting from periodic by-passes that will occur during routine maintenance of equipment that will be used as part of the planned marketing activities. In addition, periodic disposal of gypsum materials may be required if market conditions or other external factors result in reduced demand for gypsum materials. Accordingly, the proposed CCB disposal facility has been conservatively sized and designed to handle 100 percent of the anticipated gypsum production once the FGD project is brought on-line.

Figure 1 presents an overall site plan identifying key elements of the proposed CCB disposal facility. Initial activities (prior to waste disposal) will involve construction of the stormwater pond, geologic buffer, central drainage corridor, initial soil dikes, and associated stormwater diversion features associated with development of the Phase I area of the Site.

The disposal footprint of Phase I is approximately 51 acres. The initial soil dikes will be constructed as indicated on Drawing No. 10W427-4 (Phase I Initial Grading

Plan and Soil Dikes). The geologic buffer consisting of a three-foot thickness of re-compacted soil with a specified hydraulic conductivity of no more than 1 x 10^{-7} cm/sec will be constructed and the central drainage corridor will be added as depicted on Drawing No. 10W427-5 (Phase I Top of Geologic Buffer). The soil dikes will form the boundary of an initial wet pond operation and will also provide a means of access for construction equipment around the initial pond perimeter. It is TVA's intent that this layer will meet or exceed the regulatory requirements of a geologic buffer, as defined in the TDEC regulations.

The geologic buffer will be graded towards the center of the disposal area with the central channel graded towards the low point of the Phase I area at the southwest corner of the site. The central drainage corridor consists of a 150 ft. wide drainage blanket constructed of crushed stone wrapped in a geotextile filter fabric with interior perforated pipes. This drainage corridor will be used to collect internal drainage resulting from the consolidation of the disposed gypsum and will convey this water to a sump (underdrain lift station). The contents will be pumped to the stormwater pond and will subsequently be pumped to the plant's discharge channel for discharge in accordance with the plant's NPDES permit.

Phase I will be initially operated as a wet pond, as subsequently described. It is anticipated that operations will transition from a wet pond operation to a Rim Ditch operation if the volume of material being disposed becomes significant. TVA may construct the Phase II area at any time during the operation of Phase I. It is anticipated that TVA will review the timing for the implementation of Phase II once sufficient operational experience has been gathered regarding the efficiency of gypsum byproduct marketing activities. Other external factors such as market demand for gypsum materials may also factor into the need for, and timing of construction of Phase II.

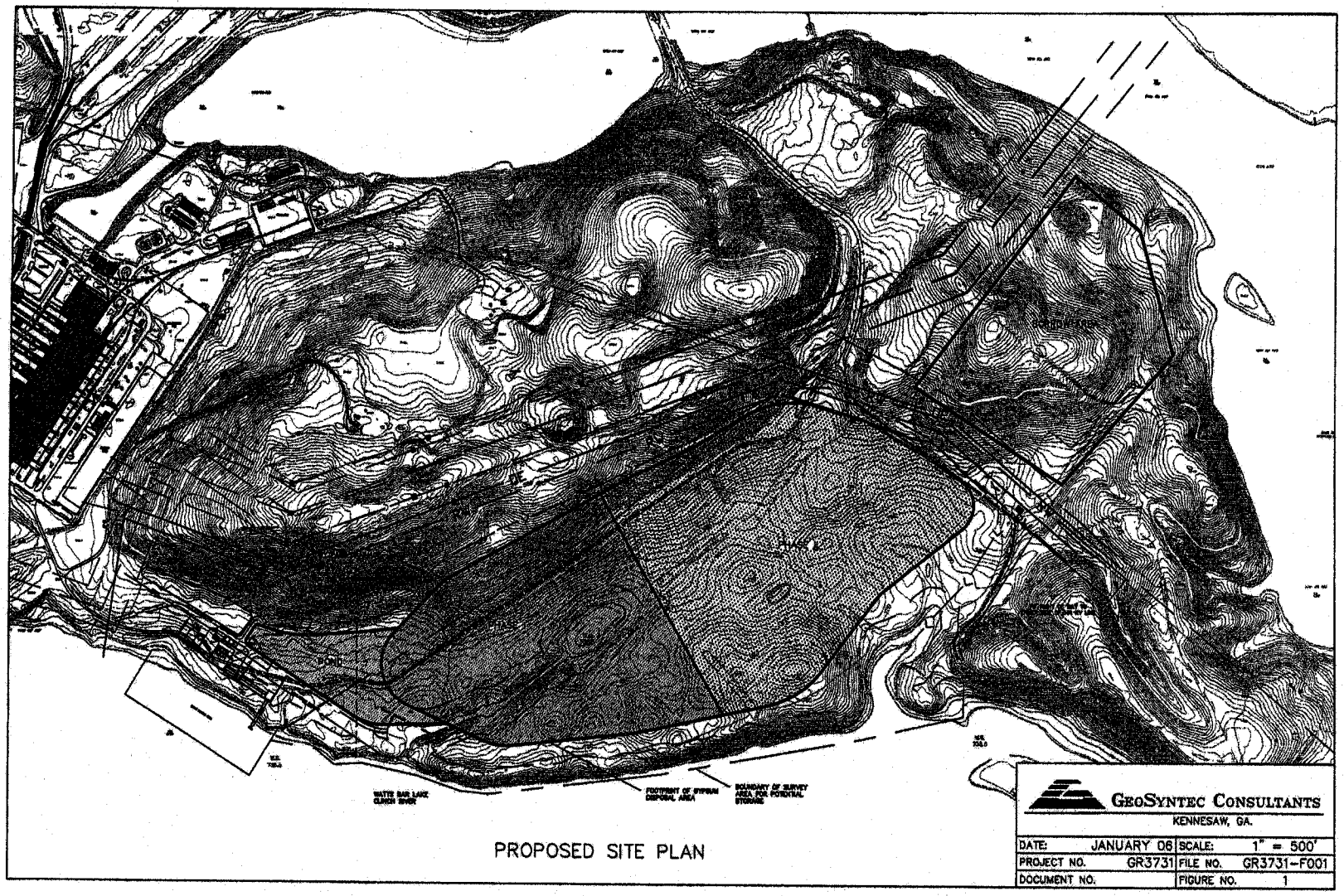

Figure 1 – Site Plan

After completion of initial construction activities to prepare the Phase I area, gypsum will be sluiced to the upper (northern) end of the Phase I wet pond. The wet pond will be decanted at the lower end using a conventional pond decant structure (See Drawing No. 10W427-19, Drainage System Details II) located adjacent to the stormwater pond, with decant water being discharged into the stormwater pond. Temporary diversion berms may be required to promote settling of the coarser gypsum particles. The number and location of these berms (if used) will be field determined based on operational needs. Coarser material will be removed from the pond area and used to progressively raise the elevation of the outer dikes using a conventional wet cast operation.

The outer dikes will be raised progressively during the operation of the wet pond. The dike construction procedure is depicted on Drawing No. 10W427-16 (Operational and Typical Details I). It is estimated that the disposal facility can be operated in this manner for a period of approximately 2 years prior to transitioning to a Rim Ditch operation. However, the actual time period will be highly dependant upon the efficiency of planned marketing operations. Transition to a Rim Ditch operation can occur once sufficient pond capacity is provided to allow for efficient operations.

Once the disposal operation has transitioned to a Rim Ditch operation, gypsum will be sluiced to a Rim Ditch located around the interior of the perimeter dikes rather than directly to the wet pond. The Rim Ditch would discharge to the central pond, with coarser gypsum particles being deposited in the Rim Ditch. The general procedure for raising the elevation of the dikes using a Rim Ditch operation is depicted on Drawing No. 10W427-17 (Operational and Typical Details II). As sufficient materials are deposited, the outer dikes will be raised in elevation using the upstream method of construction. Decant water will continue to be discharged from the central pond to the stormwater pond. Stormwater and decant water collected in the stormwater pond will be pumped to TVA's existing NPDES permitted discharge located at the plant discharge channel.

Once sufficient operational experience has been gained, TVA may elect to expand into the Phase II area. This may be done at any point during the operation of Phase I. The disposal footprint of Phase II is approximately 41 acres. If expansion into Phase II occurs early in the operation of Phase I, it may be possible to operate Phases I and II simultaneously. If expansion into Phase II occurs at a later time, the Phase II area would lean into and "piggyback" the previously constructed sideslope of Phase I that is common to the two areas.

Phase II of the disposal area will be developed in a similar manner to Phase I, i.e., first as a wet pond operation, raising the dikes by a wet casting operation; then as a Rim Ditch operation with a central pond.

The CCB disposal facility design has been developed assuming wet disposal up to an approximate elevation of 900 ft. msl. Dry stack disposal can be performed above this elevation. The estimated airspace available for disposal of gypsum is as follows:

- Phase I – 6,513,000 cubic yards (cy) for wet stack operation (i.e., up to approximate elevation 900 ft. msl);
- Phase I and II – 13,371,000 cy for combined wet stack (i.e., up to elevation 900 ft. msl); and an additional 2,634,000 cy capacity for dry stack operations.

3.3 Type and Volume of Waste (ref. 1200-1-7-.04 (9) (c) 9)

Regulatory requirement:

> 9. *Describes the types and anticipated volumes of solid wastes to be disposed of and the sources which generate the waste, and for special wastes, the physical and chemical characteristics of the wastes and any special handling procedures to be utilized;*

TVA is proposing to construct and operate a wet scrubber system to reduce sulfate (SO_3) emissions from the flue gas emissions at the Kingston Plant. The system is expected to become operational in FY2009. The only wastes that will be disposed of in this facility will be gypsum resulting from the operation of the proposed FGD system. Relatively small quantities of fly ash and/or bottom ash may be used from time to time as construction materials (e.g., road base) during operation of the facility.

Wet gypsum will be pumped from the power generation area to the marketing area, to be located just west of the proposed disposal facility (Figure 1). A by-pass valve will be located at this location. Depending on market conditions, TVA may be able to market up to 90 percent or more of the gypsum generated at KIF to private companies involved in the manufacture of various products. Since there are a variety of uncertainties associated with the actual percentage of gypsum that can be marketed, all life projections included in this Operations Manual have been developed based on worst case (i.e., no marketing) projections.

The design has been developed assuming that gypsum will be wet sluiced or slurried to the CCB disposal facility. Wet disposal operations will continue until approximate elevation 900 feet above mean sea level (msl) has been attained. Above this elevation, it is assumed that any further disposal will be performed as a dry stacking operation since the footprint of the wet pond will be significantly reduced at this point. Drawing No. 10W427-11 illustrates the grades upon completion of wet disposal operations and

Drawing No. 10W427-12 illustrates the final cover grades upon completion of both wet disposal and dry stacking activities.

Gypsum is an inert, non-combustible material and does not decay biologically. It is primarily utilized in the manufacture of gypsum wallboard, but can also be used as a soil amendment and in other products. When slurried, the gypsum slurry will have a pH in the range 6.7 to 7.8 (Law, 1995). Additional data regarding the typical characteristics of gypsum and the typical chemical composition (based on data from TVA's Cumberland Fossil Plant) is included in Appendix C.

Since wet sluicing of gypsum is integral to TVA's gypsum disposal practices, TVA requests a waiver of Rule 1200-1-7-.04 (2), regarding disposal of bulk non-containerized liquids in a landfill.

TVA estimates that approximately 547,500 cy of settled gypsum will be produced each year. Under worst case conditions (i.e., no marketing), TVA has developed the stage-storage capacity estimates presented in Table 2.

Table 2
Stage-Storage Capacity Estimates

Description	Disposal Volume (cy)	Highest Elevation (ft. msl)	Minimum Anticipated Life (1) (years)
Phase 1 – completion of wet stacking	6,513,000	900	12
Phase I and II combined – completion of wet stacking	13,371,000	900	24.5
Phase I and II combined – completion of wet and dry stacking	16,005,000	984	29.25

Notes:
(1) – assumes no marketing

3.4 Areas to be Filled and Permitted (ref. 1200-1-7-.04 (9) (c) 10)

Regulatory requirement:

10. Identifies the number of acres to be filled and the total number of acres to be permitted, including buffer zone acreage (Note: If the site is to be developed in accordance with a phased development plan, each parcel must be separately addressed. If minimum closure areas are to be utilized such proposal must be described here and delineated in the closure plans)

Table 3 provides a summary of the areas to be filled and permitted. The Phases of work and major areas of the site are illustrated on Figure 1 and on Drawing No. 10W427-3 (Site Development Plan).

Table 3
Areas to be Filled and Permitted

Description	Area to Limit of Waste	Area to Limit of Disturbance
Phase I (including Stormwater Pond)	51.24	83.36
Phase I and II (including Stormwater Pond)	92.7	153.74

3.5 Waste Handling and Covering (ref. 1200-1-7-.04 (9) (c) 11)

Regulatory requirement:

11. Describes the waste handling and covering program, to include but not necessarily be limited to, descriptions of:

(i) Unloading, spreading, and compacting operations;
(ii) The frequencies and depths of initial, intermediate, and final cover; and
(iii) The cover material(s) to be utilized, including the estimated volumes to be needed (show initial, intermediate, and final earthwork calculations) and their sources and availability.

3.5.1 Waste Handling Operations

Phase I will be ready to receive waste following completion of the construction activities illustrated on Drawing No. 10W427-4 (Phase I – Initial Grading Plan and Soil Dikes) and Drawing No. 10W427-5 (Phase I – Top of Geologic Buffer). At this point, the disposal area will be bounded around the perimeter with soil dikes; and a geologic buffer consisting of a 3 ft. thick layer of compacted clay having a hydraulic conductivity of not greater than 1×10^{-7} cm/sec. The central internal drainage corridor will also be in place consisting of a 150 ft. wide blanket drain running along the axis of the disposal facility. The central drainage corridor will provide internal drainage to lower portions of the disposal area during operation of the facility and throughout the post-closure period. Drainage collected by the central drainage corridor will be discharged by gravity to the underdrain lift station illustrated on Drawing No. 10W427-24. Further details of the design and operation of the central drainage corridor are provided in Appendix B.

After completion of initial construction activities to prepare the Phase I area, gypsum will be sluiced to the upper (northern) end of the Phase I wet pond. The discharge point may be moved periodically to facilitate distribution of the gypsum materials. The wet pond will be decanted at the lower end using a pond decant structure (see Drawing No. 10W427-19) located adjacent to the stormwater pond, with decant water being discharged into the stormwater pond. Temporary diversion berms may be required to promote settling of the coarser gypsum particles. The number and location of these berms (if used) will be field determined based on operational needs.

The outer dikes will be raised progressively using the upstream method of construction, commencing at the downgradient end (west end) of the Phase I area. The dikes will be raised using settled gypsum that will be excavated from the pond using a long-reach backhoe, drag-line or other conventional earthmoving equipment. The stages of construction are illustrated on Drawing No. 10W427-6 (Phase I Stage 1A) and Drawing No. 10W427-7 (Phase I Stage 1B). Operational details are also illustrated on Drawing No. 10W427-16 and 10W427-17 (Operational Details). Depending on the rate of filling and other operational considerations, TVA may transition to a Rim Ditch operation to facilitate raising of the outer dikes. Operational details for a Rim Ditch operation are illustrated on Drawing No. 10W427-17.

Once the disposal operation has transitioned to a Rim Ditch operation, gypsum will be sluiced to a Rim Ditch located around the interior of the perimeter of the stack rather than directly to the wet pond. The Rim Ditch will discharge to the central pond, with coarser gypsum particles being deposited in the Rim Ditch. As sufficient materials are deposited, the outer dikes will be raised in elevation using the upstream method of construction. Decant water will continue to be discharged from the central pond to the stormwater pond. Stormwater and decant water collected in the stormwater pond will be pumped to TVA's existing NPDES permitted discharge located at the plant discharge channel.

Settled gypsum in the interior of the disposal facility will consolidate as a result of the decanting operations and drainage of free liquids through the perimeter drains and central drainage corridor. Coarse gypsum materials used for the construction of the outer dikes of the disposal facility will be spread in uniform layers and compacted.

Internal drainage features and surface water conveyance ditches will be constructed concurrently as the outer dikes are raised in elevation. Perimeter drains will be installed each time the dike is raised by approximately 10 ft. in elevation. Details are indicated on Drawing Nos. 10W427-18 and -19 (Drainage System Details) and Drawing Nos. 10W427-21 through -23 (Surface Water Management system Details).

An intermediate soil cover will be constructed progressively over the outer dikes as they are raised in elevation. The intermediate soil cover consists of one foot thickness of soil capable of sustaining vegetation. Intermediate cover soils for Phase I will be obtained from either the footprint of Phase II or from the designated borrow area.

Depending on operational needs, TVA may elect to expand the disposal area by implementing Phase II. The decision to implement Phase II will be made based on operational needs and the success of gypsum marketing activities. Prior to placement of waste in Phase II, construction activities illustrated on Drawing Nos. 10W427-8 (Initial Grading Plan and Soil Dikes) and Drawing No. 10W427-9 (Phase II – Top of Geologic Buffer) will be implemented. Waste placement activities in Phase II will be essentially similar to Phase I operations, i.e., the area will initially be operated as a wet pond; outer dikes will be raised in elevation using wet-cast gypsum; and operations may transition to a Rim Ditch operation once sufficient pond capacity has been developed. If TVA elects to expand into Phase II early in the life of the facility, it will be possible to operate Phase I and II as a single cell. However, if Phase II lags Phase I, operations within Phase I may be suspended temporarily until Phase II reaches a similar elevation to Phase I.

3.5.2 Daily and Intermediate Cover

No daily or intermediate cover (other than intermediate cover soil placed on the outer dikes) will be required for this facility. Since gypsum is inert, physically stable, does not biodegrade, and does not attract animals, vector control is not needed. Intermediate soil cover and vegetation will be established progressively on the outer sideslopes as the disposal facility is developed. Water spraying or other dust suppression techniques will be used as needed to control fugitive dust in periods of dry weather.

Due to the physical properties of gypsum and the nature of the proposed operations, TVA requests a waiver to the typical initial and intermediate cover requirements of Rule 1200-1-7-.04 (6) (b) since this requirement typically applies to municipal solid waste facilities where vector control is required.

3.5.3 Final cover

Final closure of the CCB disposal facility will be undertaken as described in the Closure Plan for this facility. Drawing Nos. 10W427-11 and 10W427-12 depict the final closure contours (including the thickness of the final cover). Final cover grades shown on Drawing No. 10W427-12 will be used in the event that TVA elects to use a dry stacking process above elevation 900 ft. msl. If TVA elects to close the facility upon completion of wet stacking operations, the grades shown on Drawing No. 10W427-11 will be the final cover grades.

The final cover will be constructed once disposal activities have been completed. Drawing No. 10W427-20 (Final Cover System Details) depicts details of two alternative cover systems. Soils for the construction of the low permeability soil layer of the final cover system will be obtained from the designated on-site borrow area. Soil balance estimates indicate that sufficient materials will be available from on-site sources. The vegetative soil layer will also be constructed using locally available soils from the KIF reservation, or from off-reservation sources provided the soil meets the requirements contained on the drawings and in the specifications. Following placement of the vegetative soil layer, the soil will be prepared and seeded using appropriate methods outlined in the specifications. Additional provisions for quality assurance and quality control are also contained in the Material Specifications and Quality Assurance and Quality Control (QA/QC) plan for this facility included as Appendix F of this permit application.

The design of the final cover system meets or exceeds the requirements contained in TDEC Policy Memorandum dated September 7, 2001 item 4 for coal ash facilities (see Appendix G).

3.6 Operating Equipment (ref. 1200-1-7-.04 (9) (c) 12)

Regulatory requirement

12. Describes the operating equipment to be utilized (including back-up equipment), and their source and availability

TVA will utilize equipment and resources of its Heavy Equipment Division (HED) for the construction and operation of the CCB disposal facility. It is likely that the following pieces of equipment will be used at this facility:

- Long-reach track-hoes or draglines (hydraulic excavators);
- Bulldozers;
- Compactors;
- Scrapers;
- Water pumps;
- Solids handling pumps;
- Water trucks; and

- Other conventional earthmoving equipment.

TVA can provide additional equipment within 24 hours for construction or disposal operations in the event of a breakdown.

3.7 Control and collection of Litter (ref. 1200-1-7-.04 (9) (c) 13)

Regulatory requirement

13. Describes the structures and procedures to be used in controlling and collecting litter

Litter control is not applicable to this facility. During normal operations, gypsum will be slurried to the disposal facility as previously described.

3.8 Stormwater Run-on and Run-off Control (ref. 1200-1-7-.04 (9) (c) 14)

Regulatory requirement

14. Describes how run-on and run-off collection and holding and erosion control facilities will be managed, including the disposition of collected waters and residues and a comparison of before and after flows in drainageways leaving the site

Also Rule 1200-1-7-.04 (2) (i) Run-on, Run-off, and Erosion Control

1. The operator must design, construct, and maintain a run-on control system capable of plow onto the active portion of the facility for all flow up to and including peak discharge from a 24-hour, 25-year storm.

Soil starter dikes will be used to form the initial footprint of both phases of construction and effectively isolate the waste disposal areas from stormwater run-on. Run-on diversion ditches and associated culverts are provided to intercept and divert stormwater from upgradient slopes along the north side of Phase I and Phase II. The locations of drainage features are shown on Drawing Nos. 10W427-4 (Phase I Initial Grading Plan and Soil Dikes) and 10W427-8 (Phase II Initial Grading Plan and Soil Dikes). Run-on conveyance structures have been designed to handle the peak discharge from a 24-hour, 25-year storm event. Supporting calculations are presented in Appendix B.

2. *The operator must design, construct, and maintain a run-off management system to collect and control at least the peak flow volume resulting from a 24-hour, 25-year storm.*

The run-off management system for the site includes stormwater drainage control structures and features designed to minimize erosion, minimize the conveyance of sediment laden stormwater, and minimize the potential for water pollution. The outer slopes of the CCB disposal facility have been designed with terraces spaced every 90 ft. of slope length (30 ft. vertical spacing) that will be constructed progressively as the elevation of the disposal facility is raised. A network of conveyance channels and downchutes will convey surface water run-off by gravity to a single stormwater pond, located at the west of the facility. The stormwater pond has been designed to collect and control the peak flow volume resulting from a 24-hour, 25-year storm. A stormwater lift station is provided to convey stormwater from the stormwater pond to KIF's plant discharge channel where it will be discharged under the plants existing NPDES permit. The surface water management system is depicted on Drawing No. 10W427-13 (Surface Water Management Plan), and the lift station is depicted on Drawing No. 10W427-25 (Stormwater Lift Station). Calculations supporting the design of the stormwater management systems are presented in Appendix B.

3. *Holding facilities (e.g., sediment basins) associated with run-on and run-off control systems must be designed to detain at least the water volume resulting from a 24-hour, 25-year storm and to divert through emergency spillways at least the peak flow resulting from a 24-hour, 100-year storm.*

The stormwater pond will accommodate a flow volume greater than that resulting from a 24-hour, 25-year storm event. The emergency overflow for the stormwater pond has been sized to convey at least the peak flow from a 24-hour, 100-year storm event without overtopping of the stormwater pond. Two alternative details of the emergency overflow are presented on Drawing No. 10W427-23 (Surface Water Management Details III). Calculations supporting the design of the holding facility and emergency overflow are presented in Appendix B.

4. *Collection and holding facilities associated with run-on and run-off control systems must be emptied or otherwise managed expeditiously after storms to maintain design capacity of the system*

Three vertical turbine pumps will be installed to remove water from the stormwater pond during and after a storm event. The pumps have been sized such that the volume of water resulting from a 24-hour, 10-year storm event can be removed within a 24-hour period. The stormwater lift station is depicted on Drawing No. 10W427-25 (Stormwater Lift Station). Supporting calculations are presented in Appendix B.

5. *Run-on and run-off must be managed separately from leachate unless otherwise approved by the Commissioner.*

As described above, stormwater run-on will be diverted around the footprint of the disposal facility prior to discharge to the river. Leachate from this facility will consist of consolidation water resulting from the self-weight consolidation of the gypsum material. Consolidation water will be collected using the perimeter drains depicted on Drawing No. 10W427-16 (Operational and Typical Details I) and the central drainage corridor depicted on Drawing No. 10W427-18 (Drainage System Details I). Consolidation water will be managed together with stormwater run-off and will be routed through the stormwater pond prior to being pumped (with stormwater) to the plant's discharge channel for discharge under KIF's existing NPDES permit. In addition, decant water from the sluicing operations will also be routed to the stormwater pond.

Both consolidation water and decant water will have been in contact with gypsum due to the nature of the anticipated disposal operations. Contact water is expected to contain trace levels of inorganic constituents and exhibit a pH value in the range 5.5 to 7.5. However, the anticipated levels are not considered problematic and should be within allowable discharge limits.

Due to the nature of the disposal operations, TVA requests that TDEC issue a waiver of the requirement to manage run-off separately from leachate.

6. *The operator must take other erosion control measures (e.g., temporary mulching or seeding, silt barriers) as necessary to control erosion at the site.*

Prior to any grubbing or land disturbance activities, silt fences (Filtrex ® SiltSoxx, or equivalent), cut-off trenches, and other erosion control measures will be implemented. Other erosion control measures may include temporary sedimentation ponds, surface water ditches, and establishment of temporary and permanent vegetation on exposed soil slopes. If the length of exposed area exceeds 150 ft., a series of barriers at no more than 100 ft. spacing may be required. Erosion control measures will meet or exceed those prescribed within the Tennessee Erosion and Sediment Control Handbook.

3.9 Leachate Collection and Management (ref. 1200-1-7-.04 (9) (c) 15)

Regulatory requirement

15. *Describes how leachate collection and holding facilities will be managed, including the disposition of collected leachate*

A mantle of predominantly residual soil of relatively low permeability is present above bedrock at the location of the proposed CCB disposal facility. The soil thickness is variable, but ranges from 8.5 to 120 ft. averaging 40.5 ft. based on available data. The residuum primarily consists of clay and silt with variable chert gravel content. The base of the disposal facility will consist of a geologic buffer constructed of a three-foot thick layer of re-compacted soil having a hydraulic permeability of not more than 1×10^{-7} cm/sec. A central drainage corridor consisting of a 150 ft. wide drainage blanket running along the axis of the facility will be constructed above the geologic buffer to collect and remove free liquids from the base of the facility. The floor of the disposal area will be graded toward the central drainage corridor to promote removal of free liquids. The drainage corridor will operate under gravity flow and will convey collected liquids to an underdrain lift station, depicted on Drawing No. 10W427-24 (Underdrain Lift Station). Calculations were performed to demonstrate that the drainage corridor would maintain gravity flow conditions without grade reversal under anticipated post-settlement conditions. These calculations are presented in Appendix B. Water collected in the underdrain lift station will be pumped to the stormwater management pond and subsequently discharged at the KIF discharge channel under an existing NPDES permit as described in Section 3.8.

TDEC regulations require that the leachate collection system is designed, constructed, operated, and maintained such that the leachate depth over the liner does not exceed one foot as calculated referencing the infiltration volume of the 25-year, 24-hour storm through the intermediate cover. Since this requirement is intended for solid waste facilities and does not contemplate the operation of wet disposal (sluice) operation, TVA requests a waiver of this requirement for this facility.

In support of this request, TVA has performed the following analyses (presented in Appendix B):

- SEEP/W analyses have been performed to illustrate the effectiveness of the central drainage corridor in terms of reducing water levels in the stack during and after of disposal operations. The analyses indicate that the rate at which water levels within the stack will be lowered will be considerably enhanced through the use of the central drainage corridor (when compared to no internal drainage).

- Slope stability analyses have been performed to demonstrate that the stack will attain acceptable factors of safety with regard to slope stability under anticipated short-term and long-term conditions. Stability analyses evaluated both static stability and seismic stability.

TVA representatives met with Mr. Rick Brown of TDEC on March 7, 2006 to discuss this issue. TVA is requesting this waiver consistent with these discussions.

3.10 Dust Control (ref. 1200-1-7-.04 (9) (c) 16)

Regulatory requirement

16. Describes the dust control measures to be taken and when they would be implemented

During wet stacking operations a significant portion of the facility footprint will consist of a wet pond, minimizing the need for dust suppression. Dust control measures will consist of water spraying on access roads and exposed gypsum surfaces and will be implemented on an as needed basis during periods of dry weather. Dust and erosion control for the outer sideslopes will be addressed by the installation of the intermediate cover described in Section 2.5.2.

3.11 Fire Safety (ref. 1200-1-7-.04 (9) (c) 17)

Regulatory requirement

17. Describes the fire safety precautions and procedures to be taken, the types and availability of on-site fire suppression equipment, and/or the arrangements made with the local fire protection agency.

Gypsum material is an inert material derived from limestone, is not combustible, and therefore poses no threat as a potential fire hazard. However, properly maintained fire suppression equipment will be provided for disposal equipment and vehicles. This will consist of fire extinguishers of the appropriate size and type.

3.12 Personnel facilities and Services (ref. 1200-1-7-.04 (9) (c) 18)

Regulatory requirement

18. Describes the facilities and services available to facility personnel, including shelter, drinking water, handwashing and toilet facilities, and communications equipment

Facilities and services that are available and readily accessible to personnel at the KIF plant site, include the following:

- A utility building is on-site for equipment maintenance and yard operations personnel that is accessible by any facility personnel and has adequate screening, heating facilities, and lighting.
- Safe drinking water.
- Sanitary hand-washing facilities.
- Toilet facilities.
- A two-way radio and/or telephone for communications.
- A first aid kit.

3.13 Quality Assurance Plan (ref. 1200-1-7-.04 (9) (c) 19)

Regulatory requirement

19. Describes in a construction quality assurance plan:

(i) How each new "as built" solid waste landfill unit(s) and/or lateral expansion liner(s) and cover system(s) will be inspected and/or tested by a registered engineer as required at rule 1200-1-7-.04(1)(c) during construction or installation for uniformity, damage, and imperfections, and

(ii) How each constructed section of the liner system or final cover system will be certified by a registered engineer.

Procedures for the construction of components of the proposed disposal facility are presented in QA/QC Plan included as Appendix F of this permit application. This QA/QC plan also outlines procedures to verify that proper materials, construction techniques, and installation procedures are used by the constructor and the design intent is met.

3.14 Control of Gas Migration (ref. 1200-1-7-.04 (9) (c) 20)

Regulatory requirement

20. Describes how the migration of explosive gases will be controlled and monitored

Since gypsum is an inert, non-combustible material and does not decay biologically, no gas migration controls are needed. TVA requests a waiver to this requirement consistent with DSWM Policy dated September 7, 2001, item 3 (presented as Appendix G).

3.15 Groundwater Monitoring Program (ref. 1200-1-7-.04 (9) (c) 21)

Regulatory requirement:

> *21. Describes the planned ground water monitoring program, to include but not necessarily be limited to, descriptions of:*
>
> *(i) The number and location of wells or other monitoring points;*
> *(ii) Monitoring well construction;*
> *(iii) The parameters to be monitored for and the frequency they will be checked.*

The Groundwater Monitoring Plan is included as Appendix D of this permit application.

3.16 Location in Floodplains (ref. 1200-1-7-.04 (9) (c) 22)

Regulatory requirement:

> *22. Include an engineering statement of the site flood frequency exposure and describes flood protection measures to be taken.*

Filling operations will be required within the 100-year floodplain. TVA will obtain the appropriate permits required for this work (e.g., Aquatic Resource Alteration Permit (ARAP) under Section 404 of the Clean Water Act) and will provide mitigation measures for impacts to wetland areas. The 100-year flood elevation taken from TVA data is 747.6 ft. msl. Once site preparation activities have been completed, waste limits will be above the 100-year flood elevation. The lower elevations of the soil starter dike in localized areas will be slightly below the 100-year flood elevation. However, these are minor and the impact of a flood event on the facility would be negligible.

3.17 Other Environmental Impacts (ref. 1200-1-7-.04 (9) (c) 23)

Regulatory requirement:

> *23. Describes the impact the facility will have on endangered or threatened species of plants, fish, or wildlife or their habitat.*

As part of the planning process for the FGD project, TVA conducted an Environmental Assessment (TVA, 2006). The EA concluded that the FGD project (which includes the CCB disposal facility) will have no significant impacts on animals, plants, or aquatic life. In addition, no state or federally protected species were identified during the field investigations of the project area. These field investigations were conducted in 2005.

3.18 Random Inspection Program

Regulatory requirement:

24. Describes the random inspection program required under rule 1200-1-7-.04-(2)(s)

A random inspection program for this facility is not required. This disposal facility will only dispose of gypsum from TVA facilities. In addition, minor quantities of bottom ash and fly ash (for use in construction) may be co-disposed. Therefore, a random inspection program for unauthorized wastes is not required. See DSWM Policy, September 7, 2001 Item 5 (Appendix G).

4 CLOSURE/POST-CLOSURE PLAN

A Closure/Post-Closure (C/PC) Plan for this facility is presented as Appendix E. The C/PC plan was prepared to meet the requirements of Rule 1200-1-7-.03 (2).

5. REFERENCES

Julian, Hank E. and Boggs, Mark J 2005, *Kingston Fossil Plant Peninsula Site – Hydrogeologic Evaluation of Coal-Combustion Byproduct Disposal Facility,* October 2005

TVA, 2005, Environmental Assessment – *Installation of Flue Gas Desulfurization System at Kingston Fossil Plant, Roane County, Tennessee,* February 2006

Law, 1995, *Use of Coal Combustion Byproducts as Engineered Fills,* November 10, 1995

1102 Specifications

The current specifications for the handling of production ash are included in Section 1101 – Ballfield Interim Ash Staging Area Operation Plan. As operations change, specifications should be updated in Section 1102.

Tennessee Valley Authority
Kingston Fossil Plant

MATERIAL SPECIFICATIONS AND CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL PLAN

COAL COMBUSTION BYPRODUCT DISPOSAL FACILITY - PENINSULA SITE

KIF450

Prepared By:

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May 2006

Title: MATERIAL SPECIFICATIONS AND CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL PLAN COAL-COMBUSION BYPRODUCT DISPOSAL FACILITY – PENINSULA SITE.			DCN#
			Plant/Unit: Kingston Fossil Plant
Vendor	Contract No.	Key Nouns:	

Applicable Design Documents	REV	EDMS NUMBER	DESCRIPTION
	R0		
References	R1		
	R2		

TENNESSEE VALLEY AUTHORITY
FOSSIL POWER GROUP
FOSSIL ENGINEERING SERVICES
SITE AND ENVIRONMENTAL ENGINEERING

	Revision 0	R1	R2
Date	May 2006		
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1 INTRODUCTION

This Material Specifications and Construction Quality Assurance/Quality Control Plan (QA/QC Plan) is prepared for the proposed Coal Combustion Byproduct (CCB) Disposal Facility located at the Tennessee Valley Authority (TVA) Kingston Fossil Plant – Peninsula Site (hereinafter referenced as CCB disposal facility). The CCB disposal facility will be developed in two phases; namely Phase I and II. The purpose of this QA/QC Plan is to outline procedures for verifying that proper materials, construction techniques, and installation procedures are used by the Constructor, and that the design intent is met. This QA/QC plan has been developed to satisfy the requirements of rule 1200-1-7-.04(9)(c)19. In addition, this QA/QC Plan is intended to define problems that may occur during construction and to provide a mechanism for resolving these problems as they occur.

The elements of construction of the CCB disposal facility requiring field monitoring and documentation under this plan include: subgrade/structural fill, soil dike for Phases I and II, geologic buffer, gypsum dikes, and final cover system construction.

The program described by this Plan is independent of the quality control (QC) program conducted by the Constructor. This QA/QC Plan is intended to provide verification that the Constructor has met his obligation in the supply and installation of the specified materials. This plan does not replace the contract documents (design drawings and documents) regarding the selection and installation of materials.

The construction and operation of this facility involves initial facility construction, as well as on-going construction operations. TVA conducts dike inspections at all fossil plants yearly, and will be performed for the CCB Disposal Facility. Because this facility will be raised during the operational phase, certification activities should be an on-going process during operation, but limited to those periods where dikes are being raised. This can be viewed as an extension of the yearly dike inspections. It is anticipated that during dike raising activities, surveillance by technicians to sample and test material and observe construction techniques would also provide assurance that construction activities are in conformance with the drawings. As construction proceeds, the Certification Engineer can adjust the frequency and type of testing and inspection/surveillance as needed.

2. DEFINITIONS AND USE OF TERMS

This section provides definitions for terms used in the QA/QC Plan.

Owner – Tennessee Valley Authority

Constructor – the individual or firm, responsible for disposal facility-related construction and operational activities. This definition applied to any party performing work defined in the construction documents. TVA may use their own construction organization, Heavy Equipment Division (HED), for initial construction activities, and plant operations personnel (TVA Yard Operations) may perform dike raising activities described herein. TVA may also subcontract construction at it's discretion.

Construction Manager – the official representative of the Owner responsible for overseeing construction of the project. If TVA uses the HED for initial construction, and TVA Yard Operations for operation, the Construction Manager and Constructor are one in the same.

Conformance Testing - includes testing that is performed by the Certification Engineer to conform and qualify material prior to their use.

Certification Engineer – individual appointed by the Owner who is responsible for performing tasks outlined in this QA/QC Plan. The Certification Engineer will be selected by TVA FES and shall be a registered Professional Engineer in the state of Tennessee.

Design Engineer – the individual(s) or firm(s) responsible for the preparation of design documents and significant design changes during construction as determined by the Certification Engineer. The design engineer shall be a registered Professional Engineer in the state of Tennessee. TVA Fossil Engineering Services (FES) is the responsible engineering organization for design and certification of this facility.

Earthwork – an activity involving the use of soil or rock materials. It also includes activities involving the use of byproducts in the construction of waste disposal facilities.

Performance Testing – includes those activities that occur during and following material installation including dike raising activities during facility operation.

Project Design Drawings and Documents – all project related drawings and documents, including design modifications and record drawings.

Project Documents – includes Constructor submittals, construction drawings, record drawings, specifications, shop drawings, field inspection reports, and project schedule.

Quality Control (QC) – functions performed by the Constructor and material supplier to verify that work performed conforms to project design drawings and documents.

Quality Assurance (QA) – provides verification that QC functions have been performed in substantial compliance with the project design drawings and documents, this function will normally be provided by a Certification Engineer chosen by TVA.

Record Drawings – drawings recording the locations, elevations, and details of the facility after construction is completed.

Surveyor – the individual responsible for preparation of as-constructed surveys of the completed subgrade, geologic buffer, soil dike fill, final surface of gypsum fill, final cover compacted clay layer, and completed vegetation layer. The surveyor shall be a registered Surveyor in the state of Tennessee.

Testing Laboratory – one or more laboratories capable of conducting the required conformance and performance laboratory testing of soils and geosynthetics required by this QA/QC Plan.

3 CERTIFICATION ENGINEER

The Certification Engineer (or personnel under his direct supervision) will closely monitor construction of the various components of the CCB disposal facility which includes: structural fill, soil dike fill, geologic buffer, gypsum dike construction; and the construction of the soils and geosynthetic components of the final cover system. The Certification Engineer will be a Professional Engineer licensed to practice in the state of Tennessee, who is knowledgeable in the field of soil mechanics and geosynthetics, and will have a good working knowledge of the equipment and procedures generally used in the construction of landfills.

The Certification Engineer has the following duties:

- provide written, certified documentation attesting to conformance with the design requirements and the QA/QC Plan with respect to conditions of structural fill, soil dike fill, geologic buffer, gypsum dike construction, and the construction of the soils and geosynthetic components of the final cover system;
- be present at appropriate intervals during construction of the soil components, perform appropriate tests, and obtain samples for laboratory analyses;
- observe material delivery and unloading;
- use the results of tests and laboratory analyses to document conformance with project requirements;
- provide to TVA and the Constructor the results of observations and test as the work progresses. Coordinate with Constructor when modifications to the plans are necessary to ensure compliance with the design drawings, specifications, and QA/QC Plan;
- schedule and coordinate inspection and testing activities; and
- reject defective work and verify that corrective measures have been implemented.

The Certification Engineer may utilize qualified field technicians to perform testing described and to provide as necessary additional oversight during construction.

4. PROJECT MEETINGS

4.1 Design Review Meeting (Optional)

Following the completion of the design and after review and approval by the State of Tennessee Department of Environment and Conservation (TDEC), Division of Solid Waste Management (DSWM), a design review meeting will be held. The purpose of this meeting, which the Owner, Construction Manager, and the Certification Engineer shall attend, is to accomplish the following activities:

- identify key personnel;
- provide all parties with relevant documents;
- review the project design drawings, documents, and QA/QC Plan;
- confirm responsibilities of each party;
- review reporting and documenting procedures;
- define lines of communication;
- establish work area procedures; and
- review sampling and testing procedures.

The meeting will be documented by the Certification Engineer or person designated by the Construction Manager. Copies of the minutes and relevant documents will be provided to all parties.

4.2 Pre-construction Meeting

A pre-construction meeting will be held at the site prior to the start of construction. The Owner, Construction Manager, Certification Engineer, Constructor, and others designated by the Owner will attend this meeting. In certain cases, many, if not most of these functions may be performed directly by the Owner. The purpose of the meeting is to accomplish the following activities:

- review the construction drawings and documents, QA/QC Plan, work area procedures, construction procedures, and other related issues;
- define lines of communication and authority;
- review the project schedule;
- review best management practices for erosion and sediment control and construction stormwater management during each phase of construction;
- review testing procedures and procedures for correcting and documenting; construction deficiencies, repairs, and retesting;
- review testing and record drawing documentation procedures; and
- conduct a site inspection to discuss work areas, work plans, stockpiling, equipment and material laydown areas, access roads, and related items.

This meeting will be documented by the Construction Manager or authorized representative, and copies of the documentation will be distributed to all parties.

4.3 Progress Meetings

A progress meeting will be held daily just prior to commencement or just following the completion of work. This meeting will be attended by the Construction Manager, and the Constructor's on-site superintendent and the Certification Engineer. The following activities will be discussed during this meeting:

- review the previous days activities and accomplishments;
- review work locations and scheduled work;
- discuss problems; and
- review test data.

This meeting will be documented by the Certification Engineer, and copies of the documentation will be distributed to the Owner, Construction Manager, and Constructor.

4.4 Deficiency Meetings

As required, meetings will be held to discuss problems or deficiencies. At a minimum, these meetings will be attended by the Construction Manager, Certification Engineer, and the Constructor's on-site superintendent. If the problem requires a design modification, the Design Engineer and Constructor's project manager should also be present. The meeting will be documented by the Certification Engineer.

5. BASE GRADE SOIL COMPONENT CONSTRUCTION

5.1 Introduction

This section addresses material specifications and CQA activities associated with preparation and construction of the soil and aggregate components of the base grade system. Details of the soil components of the base grade system are provided in the Drawings Plans. These components include:

- subgrade/structural fill;
- soil dikes;
- geologic buffer; and
- gravel drainage layer.

The soil and aggregate components of the base grade system shall meet requirements related to material characteristics and construction quality. Both field and laboratory tests shall be performed prior to construction to evaluate if the characteristics of soil and aggregate from proposed sources meet the material acceptance requirements of the permit and design specifications. Throughout construction, additional field and laboratory testing shall be performed to evaluate if the placed material meets the requirements of the permit and construction documents with regard to material acceptance and construction quality.

5.2 Test Methods And Sampling Requirements

Tables 1 and 2 present the laboratory and field test methods which shall be used to determine material characteristics and evaluate construction quality for the soil and aggregate components of the base grade system. The tests shall be conducted in accordance with the current versions of the corresponding standard methods given.

Table 3 provides information regarding the minimum test frequencies. The table also includes the locations at which samples shall be collected, the sample size, and the acceptance criteria.

5.3 Subgrade/Structural Fill

Subgrade refers to a surface which is exposed after stripping topsoil, excavating or filling to design grades. The prepared subgrade should conform to the contours shown on the grading plan, as indicated in the Design Drawings and verified by the Surveyor. Vegetation shall be stripped and the surface proof rolled. Potentially deleterious materials such as organics or soft materials shall be removed and the resulting voids filled with acceptable material, appropriately compacted. As required, structural fill will be used to establish design subgrade elevations.

After proof rolling and/or other suitable techniques, visual examination of the subgrade preparation by the Certification Engineer should be sufficient to evaluate its suitability as a foundation for the geologic buffer.

Conformance and performance testing of the subgrade/structural fill shall be accomplished in accordance with Table 3. The subgrade should be accepted by the Certification Engineer if it does not pump or rut excessively. If excessive pumping or rutting occurs, the area should be reworked or removed by undercutting to more suitable material if possible. The surface of the finished subgrade will be surveyed in accordance with Section 11 of this QA/QC Plan to provide as-built documentation prior to placement of the geologic buffer.

5.4 Soil Dikes

Soil dikes refers to the soil material that will be used to construct the perimeter soil dikes shown on the Design Drawings. Soil dike material shall consist of relatively homogenous, silty, and clayey soils which are substantially free of debris, rock, plant materials, frozen materials, foreign objects, and organics. The soil dike geometry should conform to the contours shown on the grading plan, as indicated in the Design Drawings, and verified by the Surveyor.

Conformance and performance testing of the soil dike material shall be accomplished in accordance with Table 3. The surface of the finished subgrade will be surveyed in accordance with Section 11 of this QA/QC Plan to provide as-built documentation prior to placement of the perimeter gypsum dike.

5.5 Geologic Buffer

Geologic buffer material shall consist of relatively homogenous, silty, and clayey soils which are substantially free of debris, rock, plant materials, frozen materials, foreign objects, and organics. The geologic buffer may be constructed from recompacted soils from within the disposal factory footprint (if suitable) or from the borrow area. The borrow area for the geologic buffer material will be identified in the Design Drawings and the material will be tested to provide an Acceptable Permeability Zone (APZ) to meet the required permeability of less than or equal to 1×10^{-7} cm/s. The Certification Engineer shall obtain samples from within the identified borrow area and subject the soils to conformance testing procedures, frequency, and requirements indicated in Table 3 to verify that the APZ that has been developed is acceptable and that the material does meet the project requirements.

Geologic buffer material shall be placed in 8 to 10 in. loose (6 to 8 in. compacted) lifts. The lift depth shall be verified by a manual method (i.e., use of stakes or cones). Soil clods shall be broken down, and moisture conditioning shall be conducted to preserve the homogeneity of the soil and to obtain a relatively uniform moisture content through the soil mass. The moisture content of the geologic buffer soils shall be field tested during processing, placement, and compaction. The action of heavy equipment on the geologic buffer shall be observed for penetration, pumping, and cracking which would indicate that the material is unsuitable and should be re-conditioned. Performance testing shall be accomplished to verify the requirements listed in Table 3 are met.

The finished surface of the geologic buffer shall be firm, uniform, and relatively smooth. Surveying shall be performed to verify that the finished geologic buffer thickness is equal to or greater than 3 ft and that the minimum drainage grade to the central drainage corridor is met.

Perforations created by nuclear density probe, stakes, or any other methods shall be filled with bentonite, a soil-bentonite mixture, or an Engineer approved equal.

5.6 Gravel Drainage Layer

Gravel drainage layer shall be placed around pipes located within the central drainage corridor and the perimeter drainage trenches. The gravel drainage layer shall be composed of aggregates meeting the Conformance testing requirements provided in

Table 3. The gravel drainage aggregate shall be substantially free of organics, frozen material, foreign objects, or other deleterious materials.

5.7 Potential Problems And Deficiencies

During construction, the frequency of testing may be increased at the discretion of Certification Engineer or the Construction Manager when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- excessive pumping or cracking of material occurs;
- under adverse weather conditions;
- work is conducted in difficult areas; and
- high frequency of failing tests is observed.

If a defect is discovered in the earthwork product, the Certification Engineer shall immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the Certification Engineer shall determine the extent of the deficient area by additional tests, observations, a review of records, or other appropriate means and notify the Constructor and Construction Manager.

The Certification Engineer shall schedule appropriate retests after the work deficiency has been corrected. Retests recommended by the Certification Engineer must verify that the defect has been corrected before any additional work is performed in the area of the deficiency

6. GYPSUM DIKE CONSTRUCTION AND PLACEMENT

6.1 Placement

The sequence for the construction and placement of the perimeter and outer gypsum dikes is illustrated in the Design Drawings and described herein. After the soil dikes are constructed, sluiced gypsum will be placed within the disposal area and the perimeter gypsum dike will be constructed from gypsum sedimented within the disposal area. The perimeter gypsum dike is considered an extension to the soil dikes and will provide a platform for the construction of the outer gypsum dikes. Once the perimeter gypsum dikes are constructed, a rim ditch operation will commence and outer gypsum dikes will be constructed using gypsum. Gypsum will continue to be disposed and the outer dikes will be raised progressively using the upstream method of construction.

Gypsum can also be used to divide the disposal area, as required, into smaller subareas areas. This arrangement allows for the sedimentation of gypsum in one subarea while the other subarea is filled with sluiced gypsum. Once rim ditch construction has been completed, and a subarea has been filled, another subarea will begin to receive sluiced gypsum. During the inactive phase of the first subarea, raising of the outer gypsum dikes may begin. Gypsum is excavated from the rim ditch using long-reach trackhoes and placed along the perimeter of the outer gypsum dikes. Leveling, spreading, and compaction will be accomplished using a small dozer. The outer gypsum dikes will generally be raised in five-foot height increments, with individual lift thicknesses being approximately one to two feet thick. The individual lift thicknesses should be such that material can be placed, spread, shaped and compacted to obtain a uniform consistency and be constructed to the lines and grades on the Design Drawings. Perimeter drainage trenches shall be installed as shown on the Design Drawings. It is important that elevations be checked during construction and adjustments made to avoid damage to the drains. The Design Drawings contain instructions and procedures to prevent this from occurring.

6.2 Monitoring and Testing

Monitoring and testing for gypsum dike construction will include the following activities:

- Monitoring of the perimeter gypsum dike construction is required to verify that material has the desired consistency, and is being placed, shaped, and compacted to the proper shape. It is anticipated that surveillance and monitoring activities will be more frequent in the beginning, and will be reduced as successful operation is being demonstrated. The frequency of monitoring will be determined by the Certification Engineer in concert with TVA FES.

- After the completion of perimeter gypsum dike construction, and the area filled with gypsum, outer gypsum dike raising can begin from the second lift. The technician shall take random samples at four locations along the rim ditch along the outer dike at approximate evenly spaced locations. Samples will be tested for grain size to determine variation in material. This information shall be reviewed by the Certification Engineer. Additionally, if considered necessary by the Certification Engineer, strength testing of material at the beginning and end points of the rim ditch along the outer dike may be performed to determine any variation in strength parameters. Operation of the rim ditch may be adjusted at the discretion of the Certification Engineer. This process can be repeated if determined necessary by the Certification Engineer in concert with TVA FES, but it is expected that as stack progression continues, the need for such testing will diminish over time if satisfactory results are obtained. This process may need to be repeated when Phase II construction begins, or if more frequent testing is deemed necessary by the Certification Engineer in concert with TVA FES.

- It is anticipated that quarterly inspections will be performed by the Certification Engineer during dike raising activities as a minimum, and the frequency increased if necessary. The technician should be present to inspect construction of the drains to ensure that the requirements on the Design Drawings are being met. The frequency of these visits shall be determined by the Certification Engineer in concert with TVA FES.

- As stack construction progresses, TVA will perform surveys to determine the remaining life of the facility. These surveys will be reviewed by the Certification Engineer to ensure that grading is being adequately maintained on the side slopes.

7. FINAL COVER SYSTEM SOIL COMPONENT CONSTRUCTION

7.1 Introduction

This section addresses material specifications and CQA activities associated with the construction of the soil components for the final cover system. Details of the soil components of the final cover system are provided in the Design Drawings. These components include:

- intermediate cover;
- compacted clay layer;
- compacted soil Layer; and
- vegetative soil layer.

The soil components of the final cover system shall meet requirements related to material specification and construction quality provided in this QA/QC Plan. Both field and laboratory tests shall be performed prior to construction to evaluate if the characteristics of soil from proposed sources meet the material acceptance requirements.

7.2 Test Methods and Sampling Requirements

Tables 1 and 2 present the laboratory and field test methods which shall be used to determine material characteristics and evaluate construction quality for the soil components of the final cover system. The tests shall be conducted in accordance with the current versions of the corresponding standard methods given.

Table 4 provides information regarding the minimum test frequencies and values. The table also includes the locations at which samples shall be collected, the sample size, and the acceptance criteria.

7.3 Intermediate Cover

Intermediate cover refers to the layer of soil covering the gypsum by-product in the facility to reach the planned grades for the bottom of compacted clay layer material.

Vegetation and other potentially deleterious materials such as organics or soft materials shall be removed and the resulting voids filled with acceptable material and appropriately compacted. The surface shall be proof rolled prior to the placement of subsequent lifts or layers.

After proof rolling and/or other suitable techniques, visual examination of the intermediate cover preparation by the Certification Engineer should be sufficient to evaluate its suitability as a foundation for the compacted soil layer.

The intermediate cover should be accepted by the Certification Engineer if it does not pump or rut excessively. If excessive pumping or rutting occurs, the area should be reworked or removed by undercutting to more suitable material.

The surface of the finished intermediate cover will be surveyed in accordance with Section 11 of this QA/QC Plan to provide for as-built documentation prior to placement of the compacted clay layer or compacted soil layer.

7.4 Compacted Clay Layer

Soils for the compacted clay layer shall consist of relatively homogenous, silty, and clayey soils which are substantially free of debris, rock, plant materials, frozen materials, foreign objects, and organics. If an approved borrow source is not identified in the permit or permit application, the Construction Manager and Constructor shall identify a borrow area for the compacted clay layer. The Certification Engineer shall obtain samples from within the identified borrow area and subject the soils to the Conformance testing requirements indicated in Table 4 to and develop an APZ for the soil to achieve the required permeability of less than or equal to 1×10^{-7} cm/sec.

Based on the results of these laboratory tests, material which may meet the requirements of compacted clay layer material shall be identified. A range of moisture/density values which results in the required permeability should be determined based on the laboratory testing data. This range will then be used as the acceptable range of moisture/density values for field compaction control.

The compacted clay layer material shall be placed in 8 to 10 in. loose (6 to 8 in. compacted) lifts. The lift depth shall be verified by a manual method (i.e., hand auguring). Soil clods shall be broken down, and moisture conditioning shall be conducted to preserve the homogeneity of the soil and to obtain relatively uniform moisture content through the layer. The moisture content of the compacted clay layer may be field tested during processing and placement when requested by the Constructor for verification purposes. The action of heavy equipment shall be observed for penetration, pumping, and cracking of the compacted soil layer surface. Performance testing shall be accomplished in accordance with Table 4.

The finished surface shall be firm, uniform, and relatively smooth. Perforations in the compacted clay layer created by nuclear density probes, stakes, or any other methods shall be filled with bentonite, a soil-bentonite mixture, or an Engineer approved equal.

The surface of the finished compacted soil layer will be surveyed in accordance with Section 11 of this QA/QC Plan to provide for as-built documentation prior to placement of the geomembrane.

7.5 Compacted Soil Layer

Material for the compacted soil layer shall consist of relatively homogenous, silty, and clayey soils which are substantially free of debris, rock, plant materials, frozen materials, foreign objects, and organics. If an approved borrow source is not identified in the permit or permit application, the Construction Manager and Constructor shall identify a borrow area for the compacted soil layer. The Certification Engineer shall obtain samples from within the identified borrow area and subject the soils to the Conformance testing requirements indicated in Table 4. Based on the results of these laboratory tests, material which may meet the requirements of compacted soil layer shall be identified.

The compacted soil layer material shall be placed in 8 to 10 in. loose (6 to 8 in. compacted) lifts. The lift depth shall be verified by a manual method (i.e., hand auguring). Soil clods shall be broken down, and moisture conditioning shall be conducted to preserve the homogeneity of the soil and to obtain relatively uniform moisture content through the layer. The moisture content of the compacted soil layer may be field tested during processing and placement when requested by the Constructor for verification purposes. The action of heavy equipment shall be observed for

penetration, pumping, and cracking of the compacted soil layer surface. Performance testing shall be accomplished in accordance with Table 4.

The finished surface shall be firm, uniform, and relatively smooth. Perforations in the compacted soil layer created by nuclear density probes, stakes, or any other methods shall be filled with bentonite, a soil-bentonite mixture, or an Certification Engineer approved equal.

The surface of the finished compacted soil layer will be surveyed in accordance with Section 11 of this QA/QC Plan to provide for as-built documentation prior to placement of the vegetative cover.

7.6 Vegetative Soil Layer

The soil to be utilized for establishing the vegetative cover shall be capable of sustaining a healthy stand of vegetation, and shall consist of soil reasonably free from subsoil, noxious weeds, stones larger than two inches in diameter, or other deleterious matter that would prevent the formation of a suitable seed bed.

Low ground-pressure equipment shall be used to place the material for the vegetative soil layer over the geosynthetics (if geosynthetics option is used). The equipment shall be operated over the full depth of the layer. In areas traversed by heavy trucks and other non low ground-pressure equipment a minimum material thickness of three (3) feet shall be maintained. Care should be exercised when material is being placed around pipes and other appurtenances to prevent damage to these components. The material shall be placed by pushing the material upslope only. Vegetative soil layer material should not be placed from the top of the slope. The finished surface of the vegetative soil layer shall be roughened to help prevent erosion from occurring, seeded as described in the Vegetation Specification included in Attachment 1 of this QA/QC Plan. The final surface shall be surveyed in accordance with Section 11 of this QA/QC Plan for as-built documentation. Soil thickness verification will be performed by manual methods (i.e., hand auguring and/or thickness markers) due to possible settlement of the gypsum layers during final cover construction activities.

7.7 Potential Problems And Deficiencies

During construction, the frequency of testing may be increased at the discretion of the Certification Engineer or the Construction Manager when visual observations of

construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- excessive pumping or cracking of material occurs;
- under adverse weather conditions;
- work is conducted in difficult areas; and
- high frequency of failing tests is observed.

If a defect is discovered in the earthwork product, the Certification Engineer shall immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the Certification Engineer shall determine the extent of the deficient area by additional tests, observations, a review of records, or other appropriate means. All deficiencies shall be corrected by the Constructor.

The Certification Engineer shall schedule appropriate retests after the work deficiency has been corrected. Retests recommended by the Certification Engineer must verify that the defect has been corrected before any additional work is performed by the Constructor in the area of the deficiency.

8 GEOMEMBRANE

8.1 Manufacture, Shipment, And Storage

The following addresses the activities associated with the manufacture of the geomembrane; the shipment, handling, and delivery of geomembrane to the site; conformance testing of delivered geomembrane; and the storage of the geomembrane prior to installation.

8.1.1 Manufacture of Polyethylene Geomembrane

The Geomembrane Manufacturer shall provide documentation that the material meets the requirements of this section and that adequate quality control measures have been implemented during the manufacturing process.

8.1.1.1 Resin Quality

The raw material shall be first quality polyethylene resin containing no more than 2 percent clean recycled polymer by weight, and meeting the specification outlined in Table 5.

Prior to the shipment of polyethylene geomembrane material, the Geomembrane Manufacturer shall provide the Construction Manager and the Certification Engineer with the following information:

- the origin (Resin Supplier's name and resin production plant), identification (brand name number), and production date of the resin;
- a copy of the quality control certificates issued by the Resin Supplier;
- reports on the tests conducted by the Manufacturer to verify the quality of the resin used to manufacture the geomembrane rolls and extrudate rods meet the requirements in Table 5; and
- a statement that no reclaimed polymer is added to the resin (however, the use of polymer recycled during the manufacturing process may be permitted if

performed with appropriate cleanliness and if recycled polymer does not exceed 2 percent by weight).

At the Owner's discretion and cost, testing may be carried out on the resin by the Geosynthetics QA Laboratory for purposes of verifying conformance. If the results of the Geomembrane Manufacturer and the Geosynthetics QA Laboratory testing differ, the testing will be repeated by Geosynthetics QA Laboratory, and the Geomembrane Manufacturer will be permitted to monitor this testing. The results of this latter series of tests will prevail, provided that the applicable test methods have been followed.

8.1.1.2 Certification of Property Values

In addition to information regarding the raw material, the Geomembrane Manufacturer shall provide the Construction Manager and the Certification Engineer with the following prior to shipment of the geomembrane:

- a properties sheet certification including, at a minimum, guaranteed values for all specified properties presented in Table 5; and
- a list of quantities and descriptions for materials other than the base polymer which comprise the geomembrane.

The Certification Engineer shall verify that the property values certified by the Geomembrane Manufacturer meet the test methods and values shown on Table 5.

8.1.1.3 Quality Control Certificates

Prior to shipment, the Geomembrane Manufacturer shall provide the Construction Manager and the Certification Engineer with quality control certificates for the geomembrane provided. The quality control certificate will be signed by a responsible party employed by the Geomembrane Manufacturer. The quality control certificate will include:

- roll numbers and identification; and
- sampling procedures and results of quality control testing.

The Manufacturer shall be required to perform, at a minimum, the tests presented in Table 5. The Certification Engineer shall:

- verify that the quality control certificates have been provided at the specified frequency or all rolls; and
- review the quality control certificates and verify that the test methods and values meet the requirements presented in Table 5.

8.1.2 Shipment and Handling

Shipment of the geomembrane to the site is the responsibility of the Geomembrane Manufacturer. Handling on-site is the responsibility of the Geosynthetics Installer.

The Certification Engineer shall confirm that:

- handling equipment used on-site poses minimal risk of damage to the geomembrane; and
- the Geosynthetics Installer's personnel handle the geomembrane with care.

Upon delivery at the site, the Geosynthetics Installer and the Certification Engineer shall confirm that roll identification corresponds to quality control certificates issued by the manufacturer.

Rolls without proper identification shall be rejected by the Construction Manager and Certification Engineer.

8.1.3 Conformance Testing of Geomembrane

Upon, or prior to, delivery of the rolls of geomembrane, the Certification Engineer shall verify that samples are removed and forwarded to the Geosynthetics CQA Laboratory for testing to verify conformance with the test methods and values presented in Table 6.

8.1.3.1 Sample Collection

Using the packing list provided by the manufacturer or a sequential inventory list made by the Certification Engineer, rolls shall be selected for sampling. If the material is shipped in identifiable lots or manufacturing runs, sample selection should be adjusted to assure that the minimum frequency is met and that each different lot or manufacturing run is represented by at least one sample.

Samples will be taken across the entire width of the roll and will not include the first 3 linear ft of the roll. Unless otherwise specified, samples will be 3 ft long by the roll width. The Certification Engineer will mark the machine direction on the samples with an arrow.

8.1.3.2 Test Results

The results of the conformance testing shall be evaluated in accordance to the following procedure:

- If the average test values for the sample meet the requirement presented in Tables 5 and 6, the sample passes.
- If the average test value for the sample does not meet one or more of the required values, additional evaluation procedures will be implemented by the Certification Engineer.
- For the failing parameter(s), perform one additional test on the sample. This test may be performed by another Geosynthetics CQA Laboratory at the discretion of the Certification Engineer and the Construction Manager.
- If the test values for the additional tests meet the required values, the roll and adjacent rolls pass and are acceptable.
- If the test value does not meet requirements, reject the roll, collect samples from the closest numerical roll on both sides of the failed roll and test for the failed parameter(s). If one or both of these tests do not meet requirements, those roll(s) will be rejected and the Certification Engineer and Construction Manager shall determine further testing protocol and criteria for identifying the limits of rejected rolls.

8.1.4 Storage

The Geosynthetics Installer and/or Constructor shall be responsible for the storage of the geomembrane on site. Storage space should protect the geomembrane from theft, vandalism, water, weather, or damage.

8.2 Geomembrane Installation

The installation of the geomembrane and anchoring in place is crucial to the performance of the geomembrane. Geomembrane installation activities shall be monitored by the Certification Engineer.

The Certification Engineer shall document that:

- the Surveyor has verified lines and grades of the compacted soil layer; and
- the requirements of Section 7 of this QA/QC Plan are satisfied.

The Geosynthetics Installer shall certify in writing that the surface on which the geomembrane will be installed is acceptable. This subgrade, acceptance certificates shall be given by the Geosynthetics Installer to the Certification Engineer prior to commencement of geomembrane installation in the area under consideration. The Certification Engineer will document the acceptance certification for the CQA Final Report.

It is the Geosynthetics Installer's responsibility to protect the compacted soil layer after it has been accepted. After the supporting soil has been accepted by the Geosynthetics Installer, it shall be the responsibility of the Geosynthetics Installer and the Certification Engineer to indicate to the Construction Manager any change in the clay condition that may require repair work.

8.2.1 Geomembrane Placement

The placement of field panels of geomembrane is the responsibility of the Geosynthetics Installer and shall be performed in accordance with the previously submitted panel layout and the following subsections.

8.2.1.1 Panel Layout

At the geosynthetics Pre-Construction Meeting, the Geosynthetics Installer shall provide the Construction Manager and the Certification Engineer with a drawing of the facility to be covered showing expected seam location and layout (Panel Layout Drawing). The Certification Engineer shall review the panel layout drawing and verify it is consistent with the acceptance state of practice and the QA/QC Plan.

The panel layout should be oriented to maximize panel lengths and minimize seams and material waste. In corners and odd-shaped geometric locations, the number of seams should be minimized. Horizontal seams should be greater than 10 ft from the toe of slopes, or areas of potential stress concentration, unless otherwise authorized.

8.2.1.2 Field Panel Identification

The Certification Engineer shall document that the Installer labels each field panel with an "identification code" (number and/or letter) consistent with the panel layout plan. This identification code shall be agreed upon by the Construction Manager, Geosynthetics Installer, and Certification Engineer. It is the responsibility of the Geosynthetics Installer and the Certification Engineer to verify that each field panel placed can be traced to the original manufacturers roll number.

The Certification Engineer shall establish a table or chart showing correspondence between roll numbers and field panel identification codes. The field panel identification code will be used for all quality assurance records.

8.2.1.3 Installation Schedule

Field panels shall be placed one at a time unless otherwise approved by the Certification Engineer and the Construction Manager. Each field panel shall be seamed after its placement to minimize the number of unsealed field panels exposed to weather.

It is usually beneficial to "shingle" overlaps in the downward direction to facilitate drainage in the event of precipitation. It is also beneficial to proceed in the direction of prevailing winds. Scheduling decisions must be made during installation, in accordance with varying conditions. In any event, the Geosynthetics Installer shall be fully responsible for the decision made regarding placement procedures.

The Certification Engineer shall record the identification code, location, date of installation, time of installation, weather conditions and ambient temperature.

8.2.1.4 Weather Conditions

Geomembrane placement shall not proceed when sheet temperature, measured by placing a thermometer on the surface of the sheet, is below 32°F (0°C) for fusion or extrusion welding. Deviations from this temperature criterion shall only occur when authorized by the Construction Manager and with the concurrence of the Certification Engineer. Geomembrane placement shall not be performed during precipitation, fog, snow, in an area of ponded water, or in the presence of excessive winds. Limited exceptions may be granted if the Geosynthetics Installer has established satisfactory installation methods under marginal weather conditions and has submitted an Inclement Weather Placement Plan.

The Certification Engineer shall verify that the above conditions are fulfilled and shall inform the Construction Manager if the conditions are not fulfilled.

8.2.1.5 Anchorage System

Anchor trenches shall be excavated by the Constructor (unless otherwise specified) to the lines and widths shown on the Design Drawings prior to geomembrane placement. The Certification Engineer shall verify that anchor trenches have been constructed according to the plans.

Slightly rounded corners will be provided in trenches where the geomembrane adjoins the trench to avoid sharp bends in the geomembrane. Loose soil shall not underlie the geomembrane in the trenches. Seaming shall continue through the anchor trench.

8.2.1.6 Method of Placement

The following is the responsibility of the Geosynthetics Installer; the Certification Engineer shall document that these conditions are satisfied:

- equipment used does not damage the geomembrane by handling, traffic, excessive heat, leakage of liquids, or other means;

- the prepared surface underlying the geomembrane has not deteriorated since previous acceptance, and is still acceptable immediately prior to geomembrane placement;

- personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane;

- the method and equipment used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the underlying layer;

- the method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels);

- placed geomembrane panels shall extend a minimum of five feet (5 ft) beyond the toe of slope.

- adequate temporary loading and/or anchoring (e.g., sand bags, tires), not likely to damage the geomembrane, has been placed to prevent uplift by wind (in case of high winds, continuous loading, e.g., by adjacent sand bags, is recommended along the edges of panels to minimize the risk of wind flow under the panels).; and

- direct contact with the geomembrane is minimized; i.e., the geomembrane is protected by geotextile, extra geomembrane, or other suitable materials, in areas where excessive traffic may be expected.

The Certification Engineer shall inform the Construction Manager if the above conditions are not fulfilled.

8.2.1.7 Damage

The Certification Engineer shall visually observe each panel, after placement and prior to seaming, for damage. The Certification Engineer shall advise the Construction Manager which panels, or portions of panels, should be rejected, repaired, or accepted. Damaged panels or portions of damaged panels which have been rejected shall be marked and their removal from the work area recorded by the Certification Engineer.

As a minimum, the Certification Engineer shall document that:

- the panel is placed in such a manner that it is unlikely to be further damaged; and

- any tears, punctures, holes, thin spots, etc. are either marked for repair or the panel is rejected.

8.2.2 Field Seaming

Field seaming is the responsibility of the Geosynthetics Installer and shall be performed in accordance with approved methods.

Approved processes for field seaming are extrusion seaming and fusion seaming. Proposed alternate processes shall be documented and submitted to the Certification Engineer for approval. Only seaming equipment which has been specifically approved by make and model by the Certification Engineer shall be used. The Geosynthetics Installer shall submit seaming equipment documentation to the Construction Manager and the Certification Engineer for inclusion into the CQA Final report.

The following is the responsibility of the Geosynthetics Installer; the Certification Engineer shall verify that these conditions are met:

- the Geosynthetics Installer maintains on-site the number of spare operable seaming apparati decided at the Pre-Construction Meeting;

- equipment used for seaming is not likely to damage the geomembrane;

- the extruder is purged prior to beginning a seam and until heat-degraded extrudate has been removed from the barrel;

- for cross seams, the edge of the cross seam is ground to a smooth incline (top and bottom) prior to seaming;

- the electric generator used during geosynthetics installation is placed on a flat smooth base and a rub sheet such that no damage occurs to the geomembrane; and

- a smooth insulating plate or fabric is placed beneath the hot seaming apparatus after usage.

8.2.2.1 Extrusion Seaming

The extrusion seaming apparatus shall be equipped with gauges giving the relevant temperatures of the apparatus such as the temperatures of the extrudate, nozzle, and preheat.

The Geosynthetics Installer shall provide documentation on the extrudate to the Construction Manager and the Certification Engineer, and shall certify that the extrudate is compatible with the design specifications, and is comprised of the same resin as the geomembrane sheeting.

The Certification Engineer shall log apparatus temperatures, ambient temperatures, extrudate temperatures, and sheet temperatures a minimum of every five hours. Apparatus temperatures should be checked randomly during seaming operations to ensure the settings used to complete trial seams are maintained.

8.2.2.2 Fusion Seaming

The fusion seaming apparatus must be automated self-propelled devices, equipped with gauges giving the applicable temperatures. The pressure setting shall be verified by the Geosynthetics Installer prior to each seaming period.

The Certification Engineer shall log ambient temperatures, sheet temperatures, and seaming apparatus temperatures, speeds, and pressures.

8.2.2.3 Seam Preparation

The following is the responsibility of the Geosynthetics Installer; the Certification Engineer shall verify that these conditions are met:

- prior to seaming, the seam area is clean and free of moisture, dust, dirt, oils, greases, debris of any kind, and foreign material; the material to be jointed must be wiped with a clean cloth just prior to seaming;

- a rub sheet must be used to protect the underlying layer while cutting any materials;

- if seam overlap grinding is required, the process is completed according to the Geomembrane Manufacturer's instructions within 1 hour of the seaming operation, and in a way that does not damage the geomembrane;

- as a general guidance, the panels of geomembrane shall have a finished overlap; of a minimum of 3 in. for extrusion seaming and 4 in. for fusion seaming, but in any event sufficient overlap will be provided to allow peel tests to be performed on the seam;

- no solvent or adhesive is used unless the product is approved in writing by the Construction Manager (samples will be submitted to the Construction Manager for testing and evaluation);

- the procedure used to temporarily bond adjacent panels together does not damage the geomembrane (in particular, the temperature of hot air at the nozzle of any seaming apparatus is controlled such that the geomembrane is not damaged).

- no abrading is visible when welding is complete; and

- seams are aligned with the fewest possible number of wrinkle and "fishmouths".

The Certification Engineer shall observe all appropriate temperatures and conditions, and shall log and report to the Construction Manager any deviation.

8.2.2.4 Trial Seams

Trial seams shall be made on fragment pieces of geomembrane to verify that seaming conditions are adequate and in accordance with Table 7. Such trial seams shall be made at least once every 5 hours. A passing trial seam shall be made for each seaming device and technician for each material being welded (i.e., smooth to textured, textured to textured) for each technician. A change in technician or machine on a previously passed trial seam warrants the welding of a new passing trial seam. A trial seam shall also be made in the event that the sheet temperature varies more than 18°F (10°C) since the last passing trial seam. Trial seams shall be made under the same conditions as actual seams. If seaming apparatus is turned off for any reason, a new passing trial seam must be completed for that specific seaming apparatus.

The Geosynthetics Installer shall provide the tensiometer required for shear and peel testing of trial seams in the field. The tensiometer shall be automatic and shall have a direct digital readout. The tensiometer shall be calibrated prior to use at the site. The Geosynthetics Installer shall provide the Certification Engineer with the calibration certification.

The trial seam sample shall be at least 5 ft long by 1 ft wide (after seaming) with the seam centered lengthwise.

Six specimens, each 1 in. wide shall be cut from the trial seam sample by the Geosynthetics Installer. Three specimens shall be tested in shear and three in peel using a field tensiometer. For each fusion specimen, both tracks shall be tested. A passing welded seam is achieved in peel and shear when the specimen meets the criteria of Table 7.

If a specimen fails, the entire operation shall be repeated. If the additional specimen fails, the seaming apparatus and seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full trial seams are achieved.

The Certification Engineer shall observe trial seam procedures. The remainder of the successful trial seam sample shall be assigned a number and marked accordingly by the Certification Engineer, who will also log the data, hour, ambient temperature, number of seaming unit, name of seamer, and pass or fail description. This portion of the sample shall be retained for the Construction Manager's archives.

8.2.2.5 General Seaming Procedure

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

- For fusion seaming, a movable protective layer of plastic may be required to be placed directly below each overlap of geomembrane that is to be seamed. This is to help prevent any moisture build-up between the sheets to be seamed. This layer is temporary and shall be removed upon completion of the seam.

- If field conditions necessitate, a firm substrate will be provided by using a flat board or similar hard surface directly under the seam overlap to achieve proper support.

- Wrinkles at the seam overlaps will be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut wrinkles will be seamed and any portion where the overlap is inadequate will then be patched with an oval or round patch of the same geomembrane extending a minimum of 6 in. beyond the cut in all directions.

- Seaming will extend to the outside edge of panels to be placed in the anchor trench.

- No field seaming shall take place without the Geosynthetics Field Superintendent and representatives of the Certification Engineer being present.

The Certification Engineer shall verify that the above seaming procedures are followed, and shall inform the Construction Manager if they are not.

8.2.2.6 Non-Destructive Seam Continuity Testing

The Geosynthetics Installer shall non-destructively test field seams over their full length using a vacuum test unit (for extrusion or single wedge fusion seams only), air pressure test, or other approved method. The testing shall be carried out to the accepted standards of the industry. The purpose of non-destructive tests is to check the continuity of seams. It does not provide any information on seam strength. Continuity testing shall be carried out as the seaming work progresses (maximum of 3,000 lineal ft of seam to be welded prior to beginning nondestructive testing), not at the completion of all field seaming, unless otherwise approved by the Construction Manager. The Geosynthetics Installer shall complete any required repairs in accordance with this QA/QC Plan. Non-destructive testing shall not be permitted before sunrise or after sunset unless the Geosynthetics Installer demonstrates capabilities to do so.

Air Pressure Testing:

Unless otherwise specified, the general air pressure testing procedure used by the Geosynthetics Installer shall be as follows:

- Inflate the test channel to 30 to 35 psi, close valve, and observe initial pressure after approximately 2 minutes.
- Initial pressure settings are read after a 2 minute "relaxing period". Initial pressure setting shall be between 30 and 35 psi. The purpose of the "relaxing period" is to permit the air temperature and pressure to stabilize.
- Observe and record the air pressure 5 minutes after "relaxing period" ends and initial pressure setting is used. If loss of pressure exceeds 3 psi, or if the pressure does not stabilize, locate the faulty area and repair.
- At the conclusion of the pressure test, the end of the seam opposite the pressure gauge is cut. A decrease in a gauge pressure must be observed or the air channel will be considered "blocked" and the test will have to be repeated after the blockage is located and corrected.
- Remove needle or other approved pressure feed device and seal the resulting hole by extrusion welding.
- Test results will be recorded by the Certification Engineer.

Non-complying Air Pressure Test:

In the event of a non-complying air pressure test, the following procedure shall be followed:

- Check the seam and seals and retest the seam.
- If deviation with specified maximum pressure differential reoccurs cut 1 in. samples from each end of the suspect area.
- Perform destructive peel tests on the samples using the field tensiometer.

- If all samples pass destructive testing, the installer may:
  - Cap-strip the suspect area;
  - When sufficient overlap exists (1.5 in.), heat tack the overlap and extrusion weld the entire seam; or
  - Further isolate the air pressure failure as agreed upon by the Certification Engineer and Construction Manager.
- If one or more samples fail the peel tests, additional samples will be taken. When two passing samples are located, the suspect areas will be considered non-complying. In this section the seam shall be cap stripped, or the overlap left by the wedge welder will be heat tacked in place along the entire length of the seam and will be extrusion welded. Test the entire length of the repaired seam by vacuum testing.
- If the seam is in non-compliance due to air channel blockage, the blockage shall be isolated, as agreed upon by the Certification Engineer and the Construction Manager.
- All sections shall be retested and repaired in accordance with this section.

Vacuum Testing:

Unless otherwise specified, the general vacuum testing procedure used by the Geosynthetics Installer shall be as follows.

- Turn on the vacuum pump to reduce the vacuum box to approximately 5 psi.
- Apply a generous amount of a solution of liquid soap and water to the area to be tested.
- Place the vacuum box over the area to be tested and apply sufficient downward pressure to "seat" the seal strip against the liner.
- Close the bleed valve and open the vacuum valve.

- Ensure that a leak tight seal is created.
- For a period of not less than 15 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.
- If no bubbles appear after 15 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 in. overlap, and repeat the process.

Non-Complying Vacuum Test:

In the event of a non-complying vacuum test, the following procedure shall be followed.

- Mark all areas where soap bubbles appear and repair the marked areas, as specified in this section.

CQA Responsibilities:

The Certification Engineer shall:

- document all continuity testing;
- record location, date, unit number, name of tester, and outcome of all testing; and
- inform the Geosynthetics Installer and Construction Manager of any required repairs.

When defects are located, the Certification Engineer shall:

- observe the repair and retesting of the repair;
- mark on the geomembrane that the repair has been made; and
- document the results.

Non-Testable Areas:

The Geosynthetics Installer shall use the following procedures at locations where seams cannot be non-destructively tested:

- Seams shall be cap-stripped with the same geomembrane material.
- If the seam is accessible to testing equipment prior to final installation, the seam shall be non-destructively tested prior to final installation.
- If the seam cannot be tested prior to final installation, the seaming and cap-stripping operations shall be observed by the Certification Engineer and Geosynthetics Installer for uniformity and completeness.

8.2.2.7 Destructive Seam Testing

The Geosynthetics Installer will not be informed in advance of the locations where the seam samples will be taken.

Sampling Procedure:

Samples shall be cut by the Installer as the seaming progresses to have passing laboratory test results before the geomembrane is covered by another material. The Certification Engineer shall:

- observe sample cutting;
- assign a number to each sample, and mark it accordingly;
- record the sample location on the layout drawing; and
- record the reason for taking the sample at this location (e.g., statistical routine, suspicious feature of the geomembrane).

All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired in accordance with repair procedures described in Subsection

8.2.3 of this QA/QC Plan. The continuity of the new seams in the repaired area will be tested.

Size of Samples:

At a given sampling location, two types of samples shall be taken by the Geosynthetics Installer.

First, two specimens for field testing shall be taken. Each of these specimens will be 1 in. wide by 12 in. long, with the seam center parallel to the width. The distance between these two specimens will be 42 in. (or 30 in. see below). If both specimens pass the field tests described under the heading entitled "Field Testing," a sample for laboratory testing shall be taken.

The sample for laboratory testing shall be located between the two specimens for field testing. The destructive sample will be 12 in. wide by 42 in. long if the Geomembrane Installer requests a sample; otherwise the destructive samples will be 30 in. with the seam centered lengthwise. The sample shall be cut into three parts and distributed as follows:

- One portion to the Geosynthetics Installer for laboratory testing, 12 in. × 12 in.;
- One portion to the Construction Manager for archive storage, 12 in. × 12 in.;
- One portion for Geosynthetics CQA Laboratory testing, 12 in. × 18 in.

Final determination of the sample sizes shall be made at the Pre-Construction meeting.

Field Testing:

Two 1 in. wide specimens shall be tested in the field with the tensiometer, for peel and shear respectively, and shall meet the minimum requirements presented in Table 7. If any field test sample fails to pass, then the procedures outlined in this section will be followed.

The Certification Engineer shall review field tests and mark all samples and portions with their number. The Certification Engineer shall also log the date and time, ambient temperature, number of seaming unit, name of technician, seaming apparatus temperatures and speeds, and pass or fail description.

Geosynthetics QA Laboratory Testing:

Destructive test samples shall be packaged and shipped, if necessary, by the Certification Engineer in a manner that will not damage the test sample. The Construction Manager shall be responsible for storing the archive samples. Test samples shall be tested by the Geosynthetics CQA Laboratory.

Testing will include shear and peel as shown in Tables 7. At least five specimens will be tested for each test method. A maximum of one non-film tear bond (FTB) failure is acceptable, for each method, provided that strength requirements are met on that sample.

The Geosynthetics CQA Laboratory shall provide test results, in writing, no more than 24 hours after they receive the samples. The Geosynthetic CQA Laboratory shall document the results of seam testing. The Certification Engineer shall review laboratory test results as soon as they become available, and make appropriate recommendations to the Construction Manager.

Destructive Test Failure:

The following procedures shall apply whenever a sample fails a destructive test, whether that test is conducted by the Geosynthetics CQA Laboratory, the Geosynthetics Installer's Laboratory, or by the field tensiometer.

- The Geosynthetics Installer can reconstruct the seam between any two passed destructive seam test locations; or

- The Geosynthetics Installer can trace the seaming path to an intermediate location (at least 10 ft from the point of the failed test in each direction) and take a small sample for an additional field test at each location. If these additional samples pass field tensiometer testing, then full destructive laboratory samples are taken. If these destructive laboratory samples pass the

tests, then the seam shall be reconstructed between these locations by capping for extrusion or fusion welds, by extrusion welding the flap for fusion welds, or by removing and replacing the seam. If either the field tensiometer or the laboratory test sample fails, then the process is repeated to establish the zone in which the seam should be reconstructed.

If a fusion type seam fails destructive testing and the Geosynthetics Installer chooses to cap the seam, only acceptable capping methods will be allowed.

All acceptable seams must be bounded by two locations from which destructive samples passing laboratory tests have been taken. In cases exceeding 150 ft of reconstructed seam, a sample shall be taken from the zone in which the seam has been reconstructed. This sample must pass destructive testing or the procedure outlined here must be repeated.

The Certification Engineer shall document all actions taken in conjunction with destructive test failures.

8.2.3 Defects and Repairs

Seams and non-seam areas of the geomembrane shall be examined by the Certification Engineer for identification of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane will be clean at the time of examination. The surface shall be swept or washed by the Geosynthetics Installer if the amount of dust or mud inhibits examination.

8.2.3.1 Repair Procedures

Any portion of the geomembrane exhibiting a flaw, failing a destructive, or failing a non-destructive test, shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be approved by the Construction Manager and the Certification Engineer. The procedures available include:

- Patching - Apply a new piece of geomembrane sheet over, and at least 6 in. beyond the limits of a defect. The patch shall be extrusion seamed to the

underlying geomembrane. This method should be used to repair large holes, tears, destructive test locations, undispersed raw materials, and contamination by foreign matter.

- Spot Seaming - Apply a "bead" of extrudate, maximum length of 6 in., over a defect. Spot seaming should be used only to repair dents, pinholes, pressure test air holes, or other minor, localized flaws.

- Capping - Apply a new strip of geomembrane along the length of a delineated faulty seam. The cap strip shall extend at least 6 in., beyond the limit of the seam and the edges will be extrusion seamed to the underlying geomembrane. This method should be used to repair lengths of extrusion or fusion seamed to the underlying geomembrane.

- Welding Flap - Where an adequate flap exists (i.e., 1.5 in. or more), extrusion weld the flap of a fusion seam. At the ends of this repair, the flap shall be cut to allow the extrusion weld to enclose the failed area.

- Replacement - The faulty seam is removed and replaced.

In addition, the following provisions shall be satisfied:

- Surfaces of the geomembrane which are to be repaired will be abraded no more than one hour prior to the repair;

- All surfaces must be clean and dry at the time of the repair;

- All seaming equipment used in repairing procedures must be approved;

- The repair procedures, materials, and techniques will be approved in advance of the specific repair by the Certification Engineer and Geosynthetics Installer;

- Patches or caps will extend at least 6 in. beyond the edge of the defect, and all corners of patches will be rounded;

- Seam repairs over 150 ft long will require a destructive test to be taken from the repair.

8.2.3.2 Verification of Repairs

Each repair shall be numbered and logged by the Certification Engineer and the Geosynthetics Installer. Each repair shall be non-destructively tested using the methods described in this section as appropriate. Repairs which pass the non-destructive test will be taken as an indication of an adequate repair. However, if the Certification Engineer suspects a repair to be questionable, although it passes non-destructive testing, a destructive test can be requested. Failed tests will require the repair to be redone and retested until a passing test results. The Certification Engineer shall observe non-destructive testing of repairs and shall record the date of the repair and test outcome.

8.2.3.3 Large Wrinkles

When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and prior to placing overlying materials, the Certification Engineer shall observe the geomembrane wrinkles. Wrinkles exceeding six inches in height shall not be permitted. The Certification Engineer will indicate to the Construction Manager which wrinkle should be cut and resealed by the Geosynthetics Installer. The seam thus produced will be tested like any other repair.

8.2.4 Backfilling of Anchor Trench

Anchor trenches will be adequately drained, to prevent ponding or otherwise softening of the adjacent soils while the trench is open. Anchor trenches shall be backfilled and compacted as soon as possible after completion of geosynthetics installation. Care shall be taken when backfilling the trenches to prevent any damage to the geosynthetics.

The Certification Engineer shall observe the backfilling operation and advise the Construction Manager of any problems.

8.2.5 Geomembrane Certification/Acceptance

The Geosynthetics Installer and the Geomembrane Manufacturer shall retain ownership and responsibility for the geosynthetics in the facility until acceptance by the Owner.

The geomembrane shall be accepted by TVA when:

- the installation is completed;
- verification of the adequacy of seams and repairs, including associated testing, is complete;
- Geosynthetics Installer's representative furnishes the Construction Manager with certification that the geomembrane was installed in accordance with the Geomembrane Manufacturer's recommendations as well as the Design Drawings and specifications;
- all documentation of installation is completed including the Certification Engineer final report; and
- certification, including record drawings, sealed by a Professional Engineer has been received by the Construction Manager.

The Certification Engineer shall provide certification that installation has proceeded in accordance with this Plan for the project, except as noted to the Construction Manager.

8.2.6 Materials in Contact with the Geomembrane

The quality assurance procedures indicated in this Subsection are only intended to verify that the installation of these materials does not damage the geomembrane. Additional quality assurance procedures provided in other sections of this QA/QC Plan are necessary to verify that the systems built with these materials are constructed to perform as designed.

8.2.6.1 Geocomposite

Extreme care shall be exercised so as not to damage the geomembrane during placement of the geocomposite and the materials overlying the geocomposite. The Certification Engineer shall verify that the geocomposite is installed in accordance with the procedures described in Section 9 "Geocomposite" of this QA/QC Plan.

8.2.6.2 Appurtenances

The Design Engineer shall provide design specifications for appurtenances to the Construction Manager and the Certification Engineer.

The Certification Engineer shall verify that:

- installation of the geomembrane in appurtenance areas, and connection of geomembrane to appurtenances have been made according to the design specifications;
- extreme care is taken while seaming around appurtenances since neither non-destructive nor destructive testing may be feasible in these areas; and
- the geomembrane has not been visibly damaged while making connections to appurtenances.

The Certification Engineer will inform the Construction Manager if the above conditions are not fulfilled.

9 GEOCOMPOSITE

9.1. Manufacturers Documentation

Prior to delivery, the Geocomposite Manufacturer shall provide documentation which demonstrates that the property values of the material meet the requirements as specified in Table 8. Delivered rolls of geocomposite shall be appropriately labeled.

9.1.1 Certification of Property Values

Prior to shipment the Geocomposite Manufacturer shall provide the Construction Manager and Certification Engineer with a list of guaranteed minimum properties (Table 8) for the type of geocomposite to be supplied. The Geocomposite Manufacturer shall also provide the Construction Manager and Certification Engineer with a written certification signed by a responsible party that the geocomposite actually delivered has properties which meet or exceed the guaranteed properties. Geotextile will be thermally bonded to geonet components of geocomposite.

The Certification Engineer shall examine the Manufacturer's certifications to verify that the property values listed on the certifications meet or exceed the project requirements. Deviations from the project requirements shall be reported to the Construction Manager.

9.1.2 Labeling

The Geocomposite Manufacturer shall identify all rolls of geocomposite. Each geocomposite roll shall have a weatherproof label which contains the following:

- manufacturer's name;
- product identification;
- lot number;
- roll number; and
- roll dimensions.

The Certification Engineer shall examine rolls upon delivery and any deviation from the above requirements shall be reported to the Construction Manager.

9.2 Shipment And Storage

Geocomposite cleanliness is essential to performance; therefore, measures must be taken during shipment and storage to protect the geocomposite from dust and dirt. Geocomposite rolls shall be wrapped in plastic sheets or otherwise protected. Wrappings protecting the geocomposite rolls should be removed less than 1 hour prior to unrolling the geocomposite.

The Certification Engineer shall verify that the geocomposite is free of dirt and dust prior to being installed. If the geocomposite is judged dirty or dusty, it shall be washed by the Geosynthetics Installer prior to installation. Washing operations shall be approved by the Certification Engineer.

The Certification Engineer shall examine rolls prior to installation; any deviation from the above requirements shall be reported to the Construction Manager. Damaged rolls shall be rejected and replaced at no cost to TVA.

9.3 Conformance Testing Of Geocomposite

Upon or prior to delivery of the rolls of geocomposite, the Certification Engineer may remove and forward samples to the Geosynthetics CQA Laboratory for testing to verify conformance with the design specifications listed in Table 9.

9.3.1 Sample Collection

Using the packing list provided by the manufacturer or a sequential inventory list made by the Certification Engineer, rolls may be selected for sampling at a minimum frequency of one sample per 100,000 ft^2 of material. If the material is shipped in identifiable lots or manufacturing runs, sample selection should be adjusted to assure that the minimum frequency is met and that each different lot or manufacturing run is represented by at least one sample. If a roll is not identifiable by roll number, the Certification Engineer shall notify the Construction Manager immediately. If the roll cannot be tracked, the Construction Manager shall reject the roll.

Samples will be taken across the entire width of the roll and will not include the first 3 lineal ft. Unless otherwise specified, samples will be 3 ft long by the roll width. The Certification Engineer will mark the machine direction on the samples with an arrow.

9.3.2 Test Results

The results of the conformance testing shall be evaluated in accordance to the following procedure:

- If the test values for the sample meet all of the values given in Table 8 and the Manufacturer's guaranteed minimum values, the sample passes.
- If the test value for the sample does not meet one or more of the required values, additional evaluation procedures will be implemented by the Certification Engineer.
- For the failing parameter(s), perform one additional test on the sample. This test may be performed by another Geosynthetics CQA Laboratory at the discretion of the Certification Engineer and the Construction Manager.
- If the test values for the additional test meet the required values, the roll and adjacent rolls pass and are acceptable.
- If the test value does not met requirements, reject the roll, collect samples from the closest numerical roll on both sides of the failed roll, and test for the failed parameter(s). If one or both of these tests do not meet requirements, those roll(s) will be rejected and the Certification Engineer and Construction Manager shall determine further testing protocol and criteria for identifying the limits of rejected rolls.

9.4. Handling And Placement

The Geosynthetics Installer shall handle the geocomposite in such a manner as to minimize damage and comply with the following:

- After the wrapping has been removed; the geocomposite shall not be exposed to sunlight for more than the duration specified by the Geotextile Manufacturer.

- On slopes, the geocomposite shall be secured in the anchor trench and then rolled down the slope in such manner as to continually keep the geocomposite sheet in tension. If necessary, the geocomposite shall be positioned by hand after being unrolled to minimize wrinkles. Geocomposite can be placed in the horizontal direction (i.e., across the slope) in some special locations (e.g., at the toe of the slope, or, if an extra layer of geocomposite is required, this extra layer can be placed in the horizontal direction). Such locations shall be identified by the Design Engineer in the Design Drawings.

- The geocomposite shall extend a minimum of 10 feet beyond the toe of slope.

- In the presence of wind, the geocomposite shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and remain until replaced with overlying material.

- Unless otherwise specified, the geocomposite shall not be welded to geomembrane.

- The Geosynthetics Installer shall take necessary precautions to prevent damage to underlying layers during placement of the geocomposite. Care should be taken not to leave tools on or in the geocomposite.

- During placement of the geocomposite, care shall be taken not to entrap dirt or excessive dust that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane. If any dirt, excessive dust, and/or any stones are entrapped in or below the geocomposite, the geocomposite and underlying liner shall be washed or swept prior to placement of material on it.

The Certification Engineer shall note any deviation and report it to the Construction Manager.

9.5 Stacking And Joining

Stacked geocomposite shall be placed in the same direction to prevent the stands of one layer from penetrating the channels of the lower layer, thereby significantly reducing the transmissivity. Geocomposite shall not be laid in direction perpendicular to the underlying geocomposite unless otherwise specified by the Design Engineer.

Adjacent geocomposite panels shall be joined according to the plans and CQA Panel. As a minimum, the following requirements shall be met:

Geonet components:

- Adjacent rolls shall be overlapped by at least 4 in.
- These overlaps shall be secured by tying.
- Tying shall be achieved by nylon cable ties. Tying devices will be white or yellow for easy observation. Metallic devices are not allowed.
- Tying devices shall be placed every 5 ft down the slope, every 2 ft across the slope, and every 6 ft on horizontal surfaces.

Geotextile Components:

- The bottom layers of geotextile shall be overlapped. The top layer of geotextile shall be continuously sewn (i.e., spot sewing is not allowed). Geotextile panels shall be overlapped a minimum of 4 in. prior to sewing.
- No horizontal seams shall be allowed on slopes steeper than 10 horizontal to 1 vertical.
- Polymeric thread, with chemical resistance properties equal to or exceeding those of the geotextile component, shall be used for all sewing. The seams shall be sewn using stitch Type 401. The seam type shall be Federal Standard Type SSN-1.

Geocomposite:

- In the corners of the side slopes of rectangular areas of the disposal areas, where overlaps between perpendicular geocomposite strips are required, and extra layer of geocomposite shall be unrolled along the slope, on top of the previously installed geocomposite, from top to bottom of the slope.

- When more than one layer of geocomposite is installed, joints shall be staggered.

The Certification Engineer shall note any deviation and report it to the Construction Manager.

9.6 Repair

Any holes or tears in the geocomposite shall be repaired by placing a patch extending 2 ft beyond the edges of the hole or tear. The patch shall be secured to the original geocomposite by tying every 6 in. If the hole or tear width across the roll is more than one-half the width of the roll, the damaged area shall be cut out and the two portions of the geocomposite shall be joined.

The Certification Engineer shall observe any repair, note any deviation with the above requirements and report them to the Construction Manager.

9.7 Placement of Materials on Geocomposites

The placement of materials on the geocomposite shall be as soon as possible, such that:

- the geocomposite and underlying geomembrane are not damaged;

- minimal slippage of the geocomposite on the underlying geomembrane occurs; and

- no excess tensile stresses occur in the geocomposite.

If portions of the geocomposite are exposed, the Certification Engineer shall periodically place marks on the geocomposite and the underlying geomembrane and measure the elongation of the geocomposite during the subsequent construction activities. Before a subsequent layer of geosynthetic is placed on the geocomposite the Certification Engineer should observe the geocomposite and underlying liner to determine if any dirt, excessive dust, or any stones are entrapped in, or below, the liner. If so, the geocomposite and geomembrane must be washed or the geocomposite removed so that the liner can be cleaned.

Any deviation shall be noted by the Certification Engineer and reported to the Construction Manager.

10 GEOTEXTILE

10.1 Manufacturers Documentation

Prior to delivery, the Geotextile Manufacturer shall provide documentation to demonstrate that the property values of the material meet requirements as specified in Table 10. Delivered rolls of geotextile shall be appropriately labeled.

10.1.1 Certification of Property Values

The Geotextile Manufacturer shall provide the Construction Manager and Certification Engineer with a list of guaranteed "minimum average roll value" properties (as defined by the Design Engineer) for the type of geotextile to be supplied, as defined in Table 10. The Geotextile Manufacturer shall provide the Construction Manager and Certification Engineer with a written certification signed by a responsible party that the geotextile actually delivered have properties which meet or exceed the guaranteed "minimum average roll values" properties.

The Certification Engineer shall examine the Geotextile Manufacturer's certifications to verify that the property values listed on the certifications meet or exceed requirements listed in this QA/QC Plan. Deviations shall be reported to the Construction Manager.

10.1.2 Labeling

The Geotextile Manufacturer shall identify all rolls of geotextile. Each geotextile roll shall have a weatherproof label which contains the following:

- manufacturer's name;
- product identification;
- lot number;
- roll number;
- roll weight; and

- roll dimensions.

In addition, if any special handling of the geotextile is required, it shall be so marked on the top surface of the geotextile, e.g., "This Side Up". Rolls without proper identification shall be rejected by the Construction Manager.

The Certification Engineer shall examine rolls upon delivery and any deviation form the above requirements shall be reported to the Construction Manager.

10.2 Shipment and Storage

During shipment and storage, the geotextile shall be protected from ultraviolet light exposure, precipitation, snow or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions. Geotextile rolls shall be wrapped in plastic sheets or otherwise protected. Wrappings protecting the geotextile rolls should be removed less than one hour prior to unrolling the geotextile.

Geotextile shall not be exposed to precipitation prior to being installed. Wet geotextile is heavy which makes it difficult to deploy. During cold weather, the geotextile must be protected from freezing.

The Certification Engineer shall observe rolls upon delivery and prior to installation, any deviation from the above requirements shall be reported to the Construction Manager. Any damaged rolls shall be rejected and replaced at no cost to TVA.

10.3 Conformance Testing of Geotextile

Prior to the deployment of the rolls of geotextile, the Certification Engineer may remove and forward samples to the Geosynthetics CQA Laboratory for testing to verify conformance with the design specifications. Testing shall be accomplished using the parameters listed in Table 11.

10.3.1 Sample Collection

Using the packing list provided by manufacturer or a sequential inventory list made by the Certification Engineer, rolls may be selected for sampling at a minimum

frequency of one sample per 100,000 ft^2 of material. If the material is shipped in identifiable lots or manufacturing runs, sample selection should be adjusted to assure that the minimum frequency is met and that each different lot or manufacturing run is represented by at least one sample. If a roll is not identifiable by roll number, the Certification Engineer shall inform the Construction Manager immediately. If the roll cannot be tracked, the Construction Manager shall reject the roll.

Samples will be taken across the entire width of the roll and will not include the first 3 lineal ft. Unless otherwise specified, samples will be 3 ft long by the roll width. The Certification Engineer will mark the machine direction on the samples with an arrow.

10.3.2 Test Results

The results of the conformance testing shall be evaluated in accordance to the following procedure:

- If the test values for the sample meet all of the required values, the sample passes.
- If the test value for the sample does not meet one or more of the required values, additional evaluation procedures will be implemented by the Certification Engineer.
- For the failing parameter(s), perform one additional test on the sample. This test may be performed by another Geosynthetics CQA Laboratory at the discretion of the Certification Engineer and the Construction Manager.
- If the test values of the additional test meet the required values, the roll and adjacent rolls pass and are acceptable.
- If the test values do not meet requirements listed in Tables 10 and 11, reject the roll, collect samples from the closest numerical roll on both sides of the failed roll and test for the failed parameter(s). If one or both of these tests do not meet requirements, those roll(s) will be rejected and the Certification Engineer and Construction Manager shall determine further testing protocol and criteria for identifying the limits of rejected rolls.

10.4 Handling and Placement

The Geosynthetics Installer shall handle the geotextile in such a manner as to minimize damage and shall comply with the following:

- After the wrapping has been removed; the geotextile shall not be exposed to sunlight for more than the duration specified by the Geotextile Manufacturer.

- In the presence of wind, the geotextile shall be weighted with sandbags or the equivalent. Sandbags shall be installed during the placement and shall remain until replaced with the appropriate overlying material.

- Geotextile shall be kept continually under tension to minimize the presence of wrinkles in the geotextile.

- The geotextile shall be cut using an approved geotextile cutter only. If in-place, special care must be taken to protect other materials from damage which could be caused by the cutting of the geotextile.

- The Geosynthetics Installer shall take necessary precautions to prevent damage to the underlying layers during placement of the geotextile.

- During placement of geotextile, care shall be taken not to entrap stones, excessive dust, or moisture that could damage the geomembrane, generate clogging of drains or filters, or hamper subsequent seaming.

- After installation, the entire surface of the geotextile shall be examined, and harmful foreign objects, such as needles, shall be removed.

- If white geotextile is used, precautions will be taken against "snow blindness" of personnel.

The Certification Engineer shall note any deviation and report it to the Construction Manager.

10.5 Seams and Overlaps

The Geotextile seams shall be continuously sewn using thread, which is at least as chemically resistant and UV resistant as the geotextile. The thread shall be approved by the Certification Engineer and Construction Manager. Spot sewing is not permitted, except for repairs, and thermal bonding shall not be permitted without the written approval of the Construction Manager. The geotextile shall be overlapped a minimum of 4 in. prior to seaming. The Geosynthetics Installer shall pay particular attention that no material is inadvertently inserted beneath the geotextile. Within the Central Drainage Corridor the geotextile panels may be overlapped a minimum of 2 ft. between adjacent panels and the overlap sand bagged, in place of sewing of adjacent panels.

The Certification Engineer shall note any deviation and report it to the Construction Manager.

10.6 Repair

Any holes or tears in the geotextile shall be repaired by the Geosynthetics Installer as follows:

- A patch made from the same geotextile shall be sewn in place with a minimum of 24 in. overlap in all directions.

Care shall be taken to remove any soil or other material which may have penetrated the torn geotextile.

The Certification Engineer shall observe any repair, note any deviation from the above requirements and report them to the Construction Manager.

10.7 Placement of Materials on Geotextiles

The Geosynthetics Installer shall place materials on the geotextile taking the following precautions:

- cause no damage to geotextile;
- allow minimal slippage of the geotextile on underlying layers;

- equipment used for packing the overlying material shall not be driven directly on the geotextile;
- a minimum thickness of 1 ft of soil must be maintained between light, low ground-pressure equipment (such as a wide pad Caterpillar D-6 or lighter) and the geotextile;
- a minimum thickness of 1.5 ft of soil must be maintained between rubber-tired vehicles and the geotextile unless approved by the Design Engineer and Construction Manager; and
- in heavily trafficked areas such as access ramps, soil thickness shall be at least 3 ft.

Any deviation shall be noted by the Certification Engineer and reported to the Construction Manager.

11. SURVEYING AND CONSTRUCTION TOLERANCES

The minimum thickness of the intermediate cover, compacted clay layer, and vegetative layer in the final cover shall be surveyed to verify that the minimum soil thicknesses specified in the Design Drawings are met. Other construction tolerances are as noted on the drawings.

Surveying will be performed under this section to document as-built conditions, and will be the responsibility of the Constructor. The as-built survey will be performed by a Surveyor registered in the state of Tennessee. Intermediate surveying for construction layout, slope staking, etc., may be performed by the Constructor's personnel.

The completed surfaces of subgrade, top of geologic buffer, top of soil dikes and gypsum dikes, completed outer gypsum dikes, top of intermediate cover, and top of vegetative cover will be surveyed. Geomembrane panels shall be surveyed and this survey shall include as-built information of: seam intersections, cross seams, repair locations, destructive sample locations, well or pipe penetration locations, and location of anchor trenches. In applicable cases, surveys will be performed before placement of the overlying drainage layer, to verify that grades and elevations are in accordance with the approved plans. At a minimum, survey points shall be established on a 50 ft. x 50 ft. grid. Survey grid points shall be located such that the same grid can be reused for subsequent as-built surveys as the completion of each layer progresses. Soil layer thickness shall be obtained to the nearest 0.001 ft. and reported to the nearest .01 ft.

The Certification Engineer may request additional survey information as required for certification.

12 REPORTING AND DOCUMENTATION

12.1 Deficiencies

When deficiencies are discovered, the Certification Engineer shall immediately determine the nature and extent of the problem, notify the Constructor, and complete required documentation. In all cases, the Certification Engineer will notify the Constructor within one-half hour of discovering the deficiency. If the deficiency will cause construction delays of more than four hours or will necessitate substantial rework, the Certification Engineer shall also notify the Construction Manager.

The Constructor shall correct the deficiency to the satisfaction of the Certification Engineer. If the Constructor is unable to correct the problem, the Certification Engineer will prepare a nonconformance report and will develop and present suggested solutions to the Construction Manager for approval.

The corrected deficiency shall be re-tested before additional work is performed. All retests, and the steps taken to correct the problem, will be documented by the Certification Engineer.

12.2 Documentation

The QA/QC Plan depends on through monitoring and documentation of construction activities. Therefore, the Certification Engineer shall document that Quality Assurance requirements have been addressed and satisfied. Documentation shall consist of daily record keeping, construction problem resolutions, photographic records, design revisions, weekly progress reports, and a certification and summary report.

12.2.1 Daily Record Keeping

At a minimum, daily records shall consist of field notes, summaries of the daily meetings with the Constructor, observations and data sheets, and construction problems and resolution reports. This information shall be submitted to the Construction Manager for review and approval.

A Daily Meeting Report will be prepared each day, summarizing discussions held with a Constructor. This report will include the following items:

a. date, project name, and location;

b. names of parties involved in discussions;

c. data on weather conditions;

d. listing and location of construction activities underway during the time frame of the Daily Summary Report;

e. equipment present on-site;

f. descriptions of areas and/or activities being inspected and/or tested, and related documentation;

g. description of off-site materials received;

h. scheduled activities;

i. items discussed;

j. signature of the Certification Engineer.

12.2.2 Observation and Test Sheets

Observation and test data sheets shall include the following information:

a. date, project name, and location;

b. weather data;

c. reduced-scale site plan showing work areas, including sample and test locations;

d. description of ongoing construction;

e. summary of test results identified as passing, failing, or in the event of a failed test, retest;

f. calibration of test equipment;

g. summary of decisions regarding acceptance of the work and/or corrective actions taken;

h. signature of the Certification Engineer.

12.2.3 Construction Problem Reports

This report identifies and documents construction problems and resolutions. It is intended to document problems involving significant rework and is not intended to document items easily corrected unless the problems are recurring. At a minimum, this report shall include the following items:

a. detailed description of the problem;

b. location and cause of the problem;

c. how the problem was identified;

d. resolution of the problem;

e. personnel involved;

f. signature of the Certification Engineer and Construction Manager.

12.2.4 Survey Control

The following procedures will be followed with respect to the as-built survey of the components of the CCB disposal facility.

- The subgrade, geologic buffer, soil dikes, perimeter gypsum dikes, outer gypsum dikes, compacted clay and soil layers, and vegetative soil layer will be surveyed to verify that grades and elevations are in accordance with the

approved Design Drawings. A comparison of the pre- and post-component construction surveys will be conducted to verify construction thickness.

- The Surveyor shall promptly submit results of each survey to the Construction Manager. Survey results shall include: copy of any field notes, electronic and hard copy of the survey point file, and electronic and hard copy of survey drawing.

- The Certification Engineer will certify that the components meet the requirements in the Design Drawings and will submit approval to the Construction Manager.

12.2.5 Design Changes

Design changes may be required during construction. In such cases, the Certification Engineer shall notify the Construction Manager, who will then notify the responsible State Agencies. Design changes shall only be made with written agreement of the Construction Manager.

12.2.6 Weekly Progress Reports

The Certification Engineer will prepare weekly progress reports summarizing construction and quality control activities. At a minimum this report, submitted to the Construction Manager, shall contain the following information:

a. date, project name, and location;

b. summary of work activities;

c. summary of deficiencies and/or defects and resolutions;

d. signature of Certification Engineer.

12.2.7 Certification Reports

The Certification Engineer will be required to submit the following certification reports. The first certification report will cover the construction of the base grade

components for the disposal area including: subgrade/structural fill, geologic buffer, soil dikes, gravel drainage layer and will be required prior to disposal of gypsum. A certification report will also be required for final cover system construction.

The final certification report will be required after the gypsum has reached final permitted grades. This report will cover the capping phase of construction and will be required after closure of the facility. This report will address final gypsum-fill slopes, compacted clay layer, geosynthetics, and vegetative layer.

At completion of each phase of construction, the Certification Engineer shall submit a certification report to the Construction Manager. This report shall certify that the work has been performed in substantial compliance with the approved Design Plans. At a minimum, this repot shall contain the following information:

a. summary of all construction activities;

b. testing laboratory test results;

c. observation and test data sheets;

d. sampling and testing location plan;

e. description of significant construction problems and their resolution;

f. list of changes from the approved plans and the justification for these changes;

g. record drawings; and

h. a certification statement signed and sealed by the Certification Engineer.

TABLES

TABLE 1

LABORATORY TEST METHODS FOR THE EVALUATION OF SOIL AND AGGREGATE

COMMON TEST NAME	PARAMETER DEFINED	STANDARD METHOD
Soil Classification	Unified Soil Classification System	ASTM D 2487
Sieve and Hydrometer Analysis	Particle Size Distribution of Coarse and Fine Grained Soils	ASTM D 422
Sieve Analysis for Aggregates	Particle Size Distribution for Aggregates	ASTM C 136
Atterberg Limits	Liquid and Plastic Limits, Plasticity Index	ASTM D 4318
Standard Proctor Density	Moisture/Density Relationship Using 5.5 lb (2.46 kg) Rammer and 12 in. (305 mm) Drop	ASTM D 698
Moisture Content	Water to Dry Weight Ratio	ASTM D 2216
Permeability: Flex Wall Permeameter	Permeability (Hydraulic Conductivity) on Undisturbed or Remolded Samples of Soil	ASTM D 5084
Permeability: Constant Head	Permeability (Hydraulic Conductivity) of Aggregates	ASTM D 2434
Carbonate Content	Carbonate Content of Aggregate	ASTM D 3042

Notes: 1) Not all tests are required for this site; refer to Tables 3 and 4 in the CQA Plan.

2) Latest version of the applicable ASTM International or USDA testing standards shall be used when conducting tests.

TABLE 2

FIELD TEST METHODS
FOR THE EVALUATION OF SOIL AND AGGREGATE

COMMON TEST NAME	PARAMETER DEFINED	STANDARD METHOD
Visual Classification	Maximum Particle Size, General Material Characteristics	ASTM D 2488
USDA Classification	Classification of Ability to Support Vegetation	USDA Method
Nuclear Densometer	In-Place Density and Moisture Content	ASTM D 2922 and ASTM D 3017
Moisture Content	In-Place Moisture as Check on Nuclear Densometer Measurements	ASTM D 2216
Sand Cone Density	In-Place Density as Check on Nuclear Densometer Measurements	ASTM D 1556
Drive Tube Sample	In-Place Density as Check on Nuclear Densometer Measurements	ASTM D 2937
Lift Depth Check	Thickness of Placed Soils or Aggregates	Visual Confirmation

Notes: (1) Not all tests are required for this site; refer to Tables 3 and 4 in the CQA Plan.

(2) Latest version of applicable ASTM International or USDA testing standards shall be used when conducting tests.

TABLE 3

MINIMUM TEST FREQUENCIES FOR SOIL AND AGGREGATE MATERIALS IN BASE GRADE SYSTEM CONSTRUCTION

LINER COMPONENT	REQUIRED TEST	MINIMUM FREQUENCY	SAMPLE SIZE[a]	ACCEPTANCE CRITERIA
Subgrade/Structural Fill Conformance Testing[c]	Visual Observation	As required	N/A	Substantially free of debris, large rocks, plant materials, or other deleterious material.
	Sieve Analysis	1 per source & 1 per 5,000 yd^3	5-10 lb	Max. 4 in. particle size
	Standard Proctor Density	1 per source & 1 per 10,000 yd^3	50-100 lb	Determination of window of acceptable moisture content given required dry density. Maximum dry unit weight greater than 90 lb/ft^3.
Subgrade/Structural Fill Performance Testing[d]	Visual Observation	As required	N/A	Final surface: firm, smooth, and uniform
	Lift Depth Check	As required		6 to 8 in. compacted lift
	Nuclear Densometer In-place Density and Moisture Content	1 per 100 ft grid per lift	N/A	≥ 95% Standard Proctor maximum dry density, Moisture content -4% +4% of optimum.
	Moisture Content	1 per 10 nuclear densometer tests	Varies	Check nuclear densometer measurements to verify moisture correction.
	Sand Cone Density or Drive Tube Sample	1 per 25 nuclear densometer tests	Varies	Check nuclear densometer measurements to verify moisture correction and density.
Soil Dike Conformance Testing[c]	Visual Observation	As required	N/A	Substantially free of debris, large rocks, plant materials or other deleterious material. Must not pump or rut excessively.
	Sieve Analysis	1 per source & 1 per 5,000 yd^3	5-10 lb	1 inch max. particle size
	Atterberg Limits	1 per source & 1 per 5,000 yd^3	5-10 lb	Plasticity index: 10 or more[b]
	Standard Proctor Density	1 per source & 1 per 5,000 yd^3	50-100 lb	Determination of window of acceptable moisture content given required dry density. Maximum dry unit weight greater than 90 lb/ft^3.
	Moisture Content	1 per 5,000 yd^3	Varies	Determine if adequate moisture is present prior to compaction
	Soil Classification	1 per source & 1 per 5,000 yd^3	5-10 lb	SC, CL, CH, MH, ML, or SM

TABLE 3 (continued)

MINIMUM TEST FREQUENCIES FOR SOIL AND AGGREGATE MATERIALS
IN BASE GRADE SYSTEM CONSTRUCTION

LINER COMPONENT	REQUIRED TEST	MINIMUM FREQUENCY	SAMPLE SIZE[a]	ACCEPTANCE CRITERIA
Soil Dike Performance Testing[d]	Observation			
	Nuclear Densometer In-Place Density and Moisture Content	1 per 100 ft grid per lift	N/A	≥ 95% Standard Proctor maximum dry density. Moisture content -4 to +4% of optimum
	Moisture Content	1 per 5 nuclear densometer tests	Varies	Check nuclear densometer measurements to verify moisture correction.
	Sand Cone Density or Drive Tube Sample	1 per 25 nuclear densometer tests	Varies	Check nuclear densometer measurements to verify moisture correction and density.
	Lift Depth Check	As required	N/A	6 to 8 in. compacted lift
Geologic Buffer Conformance Testing[c]	Visual Observation	As required	N/A	Substantially free of debris, large rocks, plant materials, or other deleterious material.
	Sieve Analysis	1 per source & 1 per 5,000 yd^3	5-10 lb	1 inch max. particle size
	Atterberg Limits	1 per source & 1 per 5,000 yd^3	5-10 lb	Plasticity Index: 10 or more[b]
	Standard Proctor Density	1 per source & 1 per 5,000 yd^3	50-100 lb	Determination of window of acceptable moisture content given required dry density.
	Moisture Content	1 per 5,000 yd^3	Varies	Determine if adequate moisture is present prior to compaction
	Flexible Wall Permeability (remolded)	1 per 10,000 yd^3	50 lb	$\leq 1 \times 10^{-7}$ cm/sec; Certification Engineer to use approved borrow area specification APZ, but shall verify APZ throughout construction.
	Soil Classification	1 per source & 1 per 5,000 yd^3	5-10 lb	SC, CL, CH, MH, or ML
Geologic Buffer Performance Testing[d]	Visual Observation	As required	N/A	Final surface: firm, smooth, and uniform. Perform lift depth check.
	Nuclear Densometer In-place Density and	1 per 100 ft grid per lift	N/A	≥ 95% Standard Proctor maximum dry density and within the approved APZ

MINIMUM TEST FREQUENCIES FOR SOIL AND AGGREGATE MATERIALS IN BASE GRADE SYSTEM CONSTRUCTION

LINER COMPONENT	REQUIRED TEST	MINIMUM FREQUENCY	SAMPLE SIZE[a]	ACCEPTANCE CRITERIA
	Moisture Content			
Geologic Buffer Performance Testing (continued)[d]	Moisture Content	1 per 5 nuclear densometer tests	Varies	Check nuclear densometer measurements to verify moisture correction.
	Sand Cone Density or Drive Tube Sample	1 per 25 nuclear densometer tests	Varies	Check nuclear densometer measurements to verify moisture correction and density.
	Lift Depth Check	As required	N/A	6 to 8 in. compacted lift
Gravel Drainage Layer Conformance Testing[c]	Visual Observation	As required	N/A	Angular and substantially free of debris, large rocks, plant materials, or other deleterious material.
	Sieve Analysis	1 per source & 1 per 5,000 yd^3	5-10 lb	Max. 5% passing #200 sieve.
	Constant Head Permeability	1 per source & 1 per 5,000 yd^3	50 lb	$\geq 1 \times 10^{-1}$ cm/sec
	Carbonate Content	1 per source	50 lb	<10% by weight

[a] In general, where the symbol "N/A" (not applicable) is used, the test is performed on in-place materials.

[b] Minor variations shall be allowed in acceptance criteria for the geologic buffer in order to maintain permeability less than 1×10^{-7} cm/sec. Under no circumstances shall acceptance criteria be enforced which result in permeability greater than 1×10^{-7} cm/sec

[c] Conformance testing is performed on borrow sources and placed material to ensure the minimum required values are met and the material remains consistent.

[d] Performance testing is performed on materials after placement is complete to ensure that the lift or layer meets design requirements.

TABLE 4

MINIMUM REQUIREMENTS AND TEST FREQUENCIES FOR SOIL COMPONENTS OF THE FINAL COVER SYSTEM

LINER COMPONENT	REQUIRED TEST	MINIMUM FREQUENCY	SAMPLE SIZE[a]	ACCEPTANCE CRITERIA
Compacted Clay Layer Conformance Testing[c]	Visual Observation	As required	N/A	Substantially free of debris, large rocks, plant materials, or other deleterious material.
	Sieve Analysis	1 per source & 1 per 5,000 yd^3	5-10 lb	1 inch max. particle size
	Moisture Content	1 per 5,000 yd^3	Varies	Determine if adequate moisture is present prior to compaction
	Atterberg Limits	1 per source & 1 per 5,000 yd^3	5-10 lb	Plasticity Index: 10 or more[b]
	Standard Proctor Density	1 per source & 1 per 5,000 yd^3	50-100 lb	Determination of window of acceptable moisture content given required dry density.
	Soil Classification	1 per source & 1 per 5,000 yd^3	5-10 lb	SC, CL, CH, ML, or MH
	Flexible Wall Permeability (remolded)	As required to determine acceptable results	50 lb	$\leq 1 \times 10^{-7}$ cm/sec
Compacted Clay Layer Performance Testing[d]	Visual Observation	As required	N/A	Final surface: firm, smooth and uniform.
	Moisture Content	1 per 5 nuclear densometer tests	Varies	Check nuclear densometer measurements to verify moisture correction.
	Nuclear Densometer In-place Density and Moisture	1 per 100 ft grid per lift	N/A	$\geq$ 95% Standard Proctor maximum dry density[b]
	Sand Cone Density or Drive Tube Sample	1 per 25 nuclear densometer is used	Varies	Check nuclear densometer measurements to verify moisture correction and density.
	Lift Depth Check	As required	N/A	6 to 8 in. compacted lift
	Flex Wall Permeability	1 per acre per lift	Thin walled tube	$\leq 1 \times 10^{-7}$ cm/sec

TABLE 4 (continued)

MINIMUM TEST FREQUENCIES FOR SOIL COMPONENTS OF THE FINAL COVER SYSTEM CONSTRUCTION

LINER COMPONENT	REQUIRED TEST	MINIMUM FREQUENCY	SAMPLE SIZE[a]	ACCEPTANCE CRITERIA
Compacted Soil Layer Conformance Testing[c]	Visual Observation	As required	N/A	Substantially free of debris, large rocks, plant materials, or other deleterious material. Must not pump or rut excessively.
	Sieve Analysis	1 per source & 1 per 5,000 yd^3	5-10 lb	Max. 1 in. particle size
	Standard Proctor Density	1 per source & 1 per 10,000 yd^3	50-100 lb	Determination of window of acceptable moisture content given required dry density. Maximum dry unit weight greater than 90 lb/ft^3.
Compacted Soil Layer Performance Testing[d]	Visual Observation	As required	N/A	Final surface: firm, smooth, and uniform
	Lift Depth Check	As required		6 to 8 in. compacted lift
	Nuclear Densometer In-place Density and Moisture Content	1 per 100 ft grid per lift	N/A	≥ 95% Standard Proctor maximum dry density, Moisture content -4% +4% of optimum.
	Moisture Content	1 per 10 nuclear densometer tests	Varies	Check nuclear densometer measurements to verify moisture correction.
	Sand Cone Density or Drive Tube Sample	1 per 25 nuclear densometer tests	Varies	Check nuclear densometer measurements to verify moisture correction and density.

[a] In general, where the symbol "N/A" (not applicable) is used, the test is performed on in-place materials.

[b] Minor variations shall be allowed in acceptance criteria for compacted clay layer in order to maintain permeability less than 1×10^{-7} cm/sec. Under no circumstances shall acceptance criteria be enforced which result in permeability greater than 1×10^{-7} cm/sec

[c] Conformance testing is performed on borrow sources and placed material to ensure the minimum required values are met and the material remains consistent.

[d] Performance testing is performed on materials after placement is complete to ensure that the lift or layer meets design requirements.

Table 5

REQUIRED 40 MIL TEXTURED PE GEOMEMBRANE PROPERTIES

Material Property	Value	Units	Test Method
Resin – Melt Flow Index	≤1.0	g/10 min.	ASTM D1238
Thickness[1]	40	mil	ASTM D5994
Asperity Height [2] (min. avg.)	10	mil	GRI GM12
Specific Gravity (max.)	0.939	g/ml	ASTM D792 or ASTM D1505
Tensile Properties (each direction)			ASTM D6693 Type IV
1. Tensile Strength at Break (min. avg.)	60	lb/in.	
2. Elongation at Break (min. avg.)	250	percent	
Tear Resistance (min. avg.)	22	lb	ASTM D1004, Die C
Puncture Resistance (min. avg.)	44	lb	ASTM D4833
Carbon Black Content	2-3	percent	ASTM D1603
Carbon Black Dispersion	Category 1 or 2	Rating	ASTM D5596

Notes:

(1) Minimum of ten readings must average specified thickness or greater. No single reading may fall more than 15% below the specified value. The lowest individual reading for 8 of the 10 readings shall not fall more than 10% below the specified value.

(2) Minimum of ten readings must average specified height. Eight of the readings must be ≥ 7 mils, and the lowest reading must be ≥ 5 mils.

(3) Manufacturer's Quality Control testing shall be performed at a frequency of one test per every 100,000 ft^2 or one test per resin lot, whichever is more frequent. Thickness testing shall be performed on each roll.

(4) Asperity Height measurements shall be performed on every roll, alternating between measurements for top of sheet and bottom of sheet.

Table 6

REQUIRED 40 MIL TEXTURED PE GEOMEMBRANE PROPERTIES – CONFORMANCE TESTING

Material Property	Value	Units	Test Method	Frequency
Thickness[1]	40	mil	ASTM D5994	100,000 SF
Specific Gravity (max)	0.939	g/ml	ASTM D792 or ASTM D1505	100,000 SF
Asperity Height [2] (min. avg.)	10	mil	GRI GM12	100,000 SF Top and Bottom
Tensile Properties (each direction)			ASTM D6693 Type IV	100,000 SF
1. Tensile Strength at Break (min. avg.)	60	lb/in.		
2. Elongation at Break (min. avg.)	250	percent		
3. Tear Resistance (min. avg.)	22	lb	ASTM D1004, Die C	100,000 SF
4. Puncture Resistance (min. avg.)	44	lb.	ASTM D4833	100,000 SF
Carbon Black Content	2-3	percent	ASTM D1603	100,000 SF
Carbon Black Dispersion	Category 1 or 2	None	ASTM D5596	100,000 SF

(1) Minimum of ten readings must average specified thickness or greater. No single reading may fall more than 15% below the specified value. The lowest individual for 8 of the 10 readings shall not fall more than 10% below the specified value.

(2) Minimum of ten readings must average specified height. Eight of the readings must be $\geq$ 7 mils, and the lowest reading must be $\geq$ 5 mils.

(3) Conformance testing shall be performed by the Certification Engineer or TVA at a minimum frequency of one test per 100,000 ft^2 or one test per resin lot, whichever is more frequent.

Table 7

REQUIRED 40 MIL TEXTURED PE SEAM PROPERTIES

Material Property	Value	Units	Test Method
Shear Strength – Fusion and Extrusion[1]	60	lb/in.	ASTM 6392 Strain rate: 2 in./min. 1 in. strip.
Peel Adhesion			ASTM D6392
Fusion[2]	50	lb/in.	Strain rate: 2 in./min. 1 in.
Extrusion[3]	50	lb/in.	strip.

(1) For Shear Testing of both fusion and extrusion welds, the strength of 4 out of 5 specimens should meet or exceed the given value. The 5th must meet or exceed 48 lb/in.

(2) For Peel Testing of fusion welds the strength of 4 out of 5 specimens should meet or exceed the given value. The fifth must meet or exceed 40 lb/in. All specimens shall fail due to film tear bond or with greater than 25% incursion of the weld (peel).

(3) For Peel Testing of extrusion welds, 1 out of 5 specimens may either achieve <50 lb/in. but be ≥40 lb/in. or exhibit greater than 25% incursion of the weld (peel). The remaining four specimens must meet the specified strength and have a maximum of 25% incursion of the weld (peel).

(4) Required laboratory seam testing shall be performed by a geosynthetics testing laboratory at a frequency of one test per 1,000 linear feet of seam constructed for both extrusion and fusion welding equipment.

Table 8

REQUIRED GEOCOMPOSITE PROPERTIES

Material Property	Value	Units	Test Method	Manufacturers Frequency
Geonet Component:				
Thickness (min.)	200	mil	ASTM D 5199	1/50,000 SF
Specific Gravity (min. avg.)	0.94	gm/cm^3	ASTM D 792 or ASTM D 505	1/50,000 SF
Carbon Black Content	2-3	percent	ASTM D1603	1/50,000 SF
Tensile Strength, MD (Machine Direction)	45	lb/ft	ASTM D 5035	1/50,000 SF
Geotextile Component:				
Polymer Composition (min.)	95	% polypropylene or polyester by weight		
Mass per Unit Area (min.)	7.5	oz/yd^2	ASTM D 5261	1/90,000 SF
Grab Tensile Strength	≥170	lbs	ASTM D 4632	1/50,000 SF
Grab Elongation (min. avg.)	50	percent	ASTM D 4632	1/50,000 SF
Puncture Strength (min.)	90	lbs	ASTM D 4833	1/90,000 SF
Apparent Opening Size	70 – 120	sieve size	ASTM D 4751	1/540,000 SF
Water Flow Rate (min.)	110	gpm/ft^2	ASTM D 4491	1/540,000 SF
Ultraviolet Resistance (min. avg.)	70	percent	ASTM D 4355 (after 500 hours)	1/per lot
Geocomposite:				
Transmissivity at 10,000 psf[(1)] (min.)	5×10^{-4}	m^2/sec	ASTM D 4716	1/540,000 SF
Peel Strength (min.)	1	lb/in	GR1 GC-7	1/500,000 SF

Notes:

(1) Transmissivity measured using water at 20°C with a gradient of 0.10 and normal stress of 10,000 psf between two steel plates, after one hour.

Table 9

REQUIRED GEOCOMPOSITE PROPERTIES- CONFORMANCE TESTING

Material Property	Value	Units	Test Method
Thickness (min.)	0.20	inch	ASTM D 5199
Resin Density (min. avg.)	0.935	gm/cm^3	ASTM D1505
Geocomposite:			
Peel Strength (min.)	1	lb/in.	GRI GC-7
Tensile Strength (min.)	45	lb/in.	ASTM D 5035

(1) Conformance testing shall be performed by the Certification Engineer or TVA at a minimum frequency of one test per 100,000 ft^2 or one test per resin lot, whichever is more frequent.

Table 10

REQUIRED PROPERTIES FOR 10 OZ/YD^2 GEOTEXTILES (FILTER)

Material Property	Value	Units	Test Method
Polymer Composition	95 (min.)	% polypropylene or polyester by weight	
Mass per Unit Area (min. avg.)	10	oz/yd^2	ASTM D5261
Grab Tensile Strength(min. avg.)	230	lbs	ASTM D4632
Grab Elongation (min. avg.)	50	percent	ASTM D4632
Puncture Strength (min. avg.)	120	lbs	ASTM D4833
Trapezoidal Tear Strength (min. avg.)	95	lbs	ASTM D4533
Apparent Opening Size[(1)] (max. avg.)	70	sieve size	ASTM D4751
Water Permeability	$\geq 5.0 \times 10^{-3}$	cm/sec	ASTM D4491
Ultraviolet Resistance	70 (typical)	percent	ASTM D4355

Notes:

(1) Required only on material which is to be used in filter applications.

(2) Manufacturer's testing for the above properties shall be performed the Certification Engineer or TVA at a frequency of one test per 100,000 ft^2 and each resin lot must be tested.

Table 11

REQUIRED PROPERTIES FOR 10 OZ/YD^2 GEOTEXTILES (FILTER) - CONFORMANCE TESTING

Material Property	Value	Units	Test Method
Mass per Unit Area (min. avg.)	10	oz/yd^2	ASTM D5261
Grab Tensile Strength (min. avg.)	230	lbs	ASTM D4632
Puncture Strength (min. avg.)	120	lbs	ASTM D4833
Trapezoidal Tear Strength (min. avg.)	95	lbs	ASTM D4533
Apparent Opening Size (max. avg.)	70	sieve size	ASTM D4751

Notes:

(1) Conformance testing shall be performed by the Certification Engineer or TVA at a frequency of one test per 100,000 ft^2 and each resin lot must be tested.

Attachment 1 – TVA Vegetation Specification

VEGETATION SPECIFICATIONS

NATIVE GRASSESS - SEEDING AND MULCHING

(SPECIAL FOR WASTE AREAS)

SECTION 582 - Mulching

Refer to FP-96 Section 625. FP-96 Standard Specification for Construction of Roads and Bridges on Federal Highway Projects (US DOT - FHWA)

SECTION 583 - Native Grasses Seeding

583.1 – Description

This specification consists of furnishing and placing native warm season grass seed on waste disposal areas when specified by the plans or the Engineer. The use of these grasses for landfill cover crops is being encouraged by the Tennessee Department of Environment and Conservation Division of Solid Waste Management.

583.2 – Materials

1. Seeds

Seeds shall meet the requirements of applicable seed laws and shall be tested in accordance with the most current edition of the U.S. Department of Agriculture Handbook No. 30, Testing Agricultural and Vegetable Seed. Seeds shall be from the last preceding crop and comply with the requirements outlined below for purity and germination. Each variety of seed shall be furnished in separate, strong bags with each bag being fully tagged or labeled to show the variety, weight, purity, germination, and test data prescribed by law. All test

results shall be fully certified by the vendor or by a recognized seed testing agency. TVA reserves the right to require that samples be furnished, and to inspect and test the seeds after delivery. Seeds found not to comply with specification requirements shall be subject to rejection.

When mixing or forming seed mixtures, the seeds shall be carefully and uniformly mixed. Seeds shall not be mixed until each variety of seed to be used in the mix has been inspected and/or tested separately and approved.

583.2 – Materials (Continued)

Seed Varieties	Purity, Minimum %	Germination Minimum %
Sideoasts Gramma (*Bouteloua curtipendula*)	95	85
Little Bluestem (Schizachyrium scoparium)	95	85
Sand Lovegrass (*Eragrostis trichodes*)	95	85
Annual Rye (lolium multiflorum)	90	90

Seeding materials shall be free from seeds or bulbets of Wild Onion (Allium vineale), Canada Thistle (Cirsium arvense), and Johnson Grass (Sorghum halepense).

Continued next page.....

Seed species shall not contain more than six seeds per ounce of the seed of any of the following noxious weeds or the seeds of any other weed specifically listed as noxious:

Bindweed (Convolvulus arvensis)
Buckthorn (Plantago lanceolata)
Corncockle (Agrostemmo githago)
Dodder (Cuscuta species)
Oxeyedaisy (Chrysanthemum leucantheumum)
Quackgrass (Agropyron repens)
Sorrel (Rumex acetosella)

Seed species shall not contain an excess of 2 percent by weight of weed seeds, noxious or otherwise.

2. Seed or seed mixtures, rates, and seasons

Seeding mixtures, rates, and seasons shall be those specified herein. The types to be used for each area or project will be specified by the drawing or by memorandum. Mixtures or rates of application other than those specified shall be used only when specified by the plans or the Engineer. Seeding shall be planted during the season and between the dates specified. Note that the pound rates are PLS (pure live seed).

Type 1: Winter seeding ((Plant between November 1 and December 31)

(1) Sideoats Grama	4 pounds per acre
(2) Little Bluestem	5 pounds per acre
(3) Sand Lovegrass	1 pounds per acre
(4) Annual Rye	60 pounds per acre
	70 pounds per acre

Type 2: Spring seeding (Plant between April 15 and July 1).

Mixture:

(1) Sideoats Grama	4 pounds per acre
(2) Little Bluestem	5 pounds per acre
(3) Sand Lovegrass	1 pounds per acre
	10 pounds per acres

Note: All slopes 3:1 or greater shall be seeded with the winter mixture

e. Temporary Cover

Type 3: Temporary winter seeding (Plant between October 15 and March 15).

Annual Ryegrass	80 pounds per acre

583.3– Soil Chemistry Requirements

Soil pH range: 5.0 - 7.8 S.U.

Soil Fertility: Low-Medium for phosphorous and potassium.

583.4 -- Soil Preparation

Areas to be seeded shall have approved cross sections and grades. Objects such as large roots, stones, stumps, coarse vegetation, debris, or any other items that might impede mechanical mowing shall be removed and disposed of satisfactorily.

Seedbeds shall be plowed, disked, harrowed, scarified, or cultivated to the approved depth. In areas where it is practical, this work shall be done with farm-type equipment. On steep slopes, preparation of seedbeds shall be done with the tools and methods specified by the Engineer. It is strongly recommended that scarifying and preparation on cut and fill slopes be accomplished with tools or equipment specially designed for this purpose. Small furrows or grooves formed in the slopes shall be horizontal or as nearly horizontal as practical. The work shall be performed only when the ground is in a workable and tillable condition as determined by good farming practices.

583.5 -- Special Hydroseeding Equipment

Equipment to be used for the hydraulic application of planting materials shall be a Finn Hydro-Seeder, Bowie Hydro Mulcher, Toro Environmental Control Unit, or an approved equal. The equipment shall have mixing tanks with built-in agitators having operating capacities sufficient to agitate, suspend, and homogeneously mix slurries of water and planting materials. The slurry distribution lines shall be large enough to prevent clogging or stoppage. Discharge lines shall be equipped with sets of different sized hydraulic spray nozzles capable of providing for even distribution of varying slurry mixtures on areas to be seeded.

583.6 – Seeding Methods

Seeds shall be sown with approved hydroseeding equipment. Rates specified in Section 583.2 shall be maintained in a manner that will guarantee uniform coverage. Seeding operations shall not be performed when drought, high winds, and excessive moisture or other factors may defer satisfactory results. The carrier mix shall be 0-13-13. The area shall be cultipacked immediately after seeding.

583.7 -- Maintenance

Seeded areas shall be maintained until a satisfactory cover of plant material is secured, unless stipulated otherwise. All areas shall be preserved, repaired, and protected as specified for this purpose. Areas having poor stands of plant material shall be seeded again and fertilized at the proper rates.

Watering shall be accomplished during the maintenance period to the extent necessary.

583.8 -- Method of Measurement

Seeded areas will be measured in square yard units and include the seeded areas along slopes.

TENNESSEE DEPARTMENT OF EVIRONMENT AND CONSERVATION

Division of Solid Waste Management

FOSSIL FUEL FLY ASH AND BOTTOM ASH DISPOSAL WITHIN A CLASS II FACILITY

POLICY

The purpose of this policy is to establish the criteria by which fossil fuel fly and bottom ash may be disposed of in a Class II facility:

1. The geologic buffer required will be 3 feet in total thickness with a maximum hydraulic conductivity of 1×10^{-6} cm/sec. The thickness will be measured from the base of the fill to the seasonal high water table of the uppermost unconfined aquifer, or the top of the formation aquifer;

2. No leachate migration control system will be required;

3. No gas migration control system will be required;

4. The final cover shall be 24 inches of compacted soil with a minimum of 6 inches which shall support vegetative cover; and

5. No random inspection program will be required.

Any variance to the Class II facility permit criteria will require the Commissioner's approval.

(Signature on File) 9-7-01
Mike Apple, Director Date
Division of Solid Waste Management

policy/notebook/pn093
Revision 1: September 2001

1.0 GENERAL MAINTENANCE GUIDELINES

1.1 GENERAL GUIDELINES FOR REPAIR OF ANIMAL BURROWS

1.1.1 IDENTIFICATION

Animal burrows are relatively common along slopes of dams and dikes. If left untreated, these burrows can result in the creation of seepage paths through the embankment. Additionally tunnels may eventually collapse resulting in surface irregularities in the embankment. General guidelines for repair of animal burrows are provided below. However, if the burrow extends more than three (3) feet below the embankment surface or extends across a dam, the repair of these features should be evaluated by a geotechnical engineer on a case-by-case basis so that appropriate recommendations can be made.

1.1.2 GUIDELINES FOR BURROW REPAIR

It is recommended that shallow animal burrows (up to 3 feet) shall be repaired with surface treatment methods as follows:

- Animals shall be captured and removed from the area. It is recommended that a local conservation representative be consulted prior to this action.
- The animal burrow shall be excavated and cleaned of excess soil along its pathway up to a depth of 3 feet. With this type of repair, an isolated excavated area of the embankment is exposed.
- The excavated area shall be backfilled with compacted cohesive material.
- If the burrow extends more than three feet into the embankment, a geotechnical engineer shall further evaluate the burrow depth and recommend a deep burrow treatment method or other exploratory methods.
- One possible method which may be recommended to treat a deep burrow can consist of a special grout (flowable fill) pumping system with a hose inserted into the burrow.

Ultimately, these repairs will not prevent rodents from creating new burrows within dam embankments. Accordingly, continual efforts must be made to discourage rodent activity. Mowing of vegetation on the slopes / crest of the embankment and trimming of water-side vegetation at regular intervals will tend to discourage rodents from re-establishing burrows along the dike and will allow timely observation of new activity if it occurs.

1.2 GENERAL GUIDELINES FOR REPAIR OF RILL AND GULLY EROSION

1.2.1 IDENTIFICATION

Erosion features can commonly occur along dike slopes, dry stack slopes, or other sloped surfaces at TVA fossil plant facilities. Erosion normally appears in the form of rills (shallow channels) and gullies (larger and deeper eroded channels) and is formed by concentrated flow of storm water runoff, especially on bare slopes or where vegetation is sparse. If left

untreated, the rills and gullies can progress in size and could lead to slope instability or other adverse issues. General guidelines for the repair of rills and gullies are provided below. The following guide is intended to be applicable to minor to moderate cases of rill/gully erosion. Where widespread or extensively deep gullies have formed or are recurring, case-specific engineering evaluations may be needed.

1.2.2 GUIDELINES FOR RILL AND GULLY EROSION REPAIR

Shallow Rills and Gullies:

For cases where shallow rills and gullies are present, repair should consist of the following:

- Dump and spread clay soil to fill, re-grade, and shape affected areas to conform to original ground line. Tracking and blading material with a dozer should be performed until the original ground line is reformed and material is reasonably compacted.

- Repaired areas should be seeded to re-establish vegetative cover. Erosion control blankets should be placed over re-graded areas following seeding. Materials and placement of erosion control blankets should comply with the following specifications, depending on the state in which the work is being performed.

Kentucky Plants –	KYTC Standard Specifications, Sections 212.03.03 E and 827.07
Tennessee Plants –	Vegetation Specifications, Landfill Permit
Alabama Plants –	ALDOT Standard Specifications, Section 659

Deep Rills and Gullies:

For deep gullies that cannot be repaired as described above, the following filling procedures apply:

- Clean loose soil/debris from bottom and sides of gullies.

- Place and compact clay in 6 inch lifts using small compaction equipment or hand-held tampers. Vibratory plate compactors are not applicable for clay. Filling should start at the toe (or lowest elevation) and progress upslope.

- In some cases, over-excavation may be required to create benches to facilitate compaction on level surfaces. Benching, if required, will likely have to be performed by hand methods or using small excavation equipment.

- If several side-by-side deeper gullies are present in an area to be repaired, it may be more practical to rework the entire affected area to facilitate use of larger equipment. In this case, slight over-excavation of the slope face will be needed so that foundation benches can be cut to facilitate compaction on level surfaces. Filling should start at the lowest elevation and progress upslope.

- Final filling/shaping to reform the original ground line can be executed by tracking and blading with a dozer.

- Repaired areas should be seeded to re-establish vegetative cover. Erosion control blankets should be placed over re-graded areas following seeding. Materials and placement of erosion control blankets should comply with the following specifications, depending on the state in which the work is being performed.

Kentucky Plants –	KYTC Standard Specifications, Sections 212.03.03 E and 827.07
Tennessee Plants –	Vegetation Specifications, Landfill Permit
Alabama Plants –	ALDOT Standard Specifications, Section 659

1.3 GENERAL GUIDELINES FOR REPAIR OF RUTTING

1.3.1 IDENTIFICATION

Rutting due to maintenance vehicle traffic can commonly occur along dike crests, slopes, and other areas at TVA fossil plant facilities. It is typically caused by near-surface materials which have become weak over time because of moisture infiltration. Repeated passes of equipment over weakened materials can lead to rutting. Maintenance traffic/equipment should avoid wet/rutted areas until repairs can be made. General guidelines for the repair of rutting are provided below. The following guide is intended to be applicable for minor to moderate cases of rutting, and generally consists of reworking the upper portion of the affected area, followed by re-shaping to provide positive surface drainage. Where widespread or extensively deep rutting has occurred or is recurring, case-specific engineering evaluations may be needed.

<u>Guidelines for Rutting and Repair</u>

- Drain any standing water and undercut affected areas to remove rutted and overly wet/soft materials. The undercut depth will be determined by TVA in the field, depending on the severity of the rutting.
- Fill undercut area with clay or bottom ash material and compact in 6 to 8 inch lifts to restore original ground line. Excavated material can be re-used if it is free of organics and can be dried to facilitate re-compaction. Otherwise, borrow material will be needed. For compaction, use hand held jumping jacks or small power equipment.
- Grade and shape repaired areas to provide positive/improved drainage. For dike crests, grade the area to drain inwardly toward the pond or perimeter ditch, as applicable. Re-grade surrounding areas and/or drainage ditches to improve drainage, if possible.
- Repaired surfaces or dike crests that are to be used as access roads should be topped with crushed stone or bottom ash. The thickness should be equal to that which was originally in place prior to the repair, or as judged by TVA to be sufficient for the expected amount of vehicle/equipment traffic.

- For other repaired areas, place seed and cover with erosion control blanket to re-establish vegetation. Materials and placement of erosion control blankets should comply with the following specifications, depending on the state in which the work is being performed.

  Kentucky Plants – KYTC Standard Specifications, Sections 212.03.03 E and 827.07
  Tennessee Plants – TDOT Standard Specifications, Section 805
  Alabama Plants – ALDOT Standard Specifications, Section 659

1.4 GENERAL GUIDELINES FOR TREE REMOVAL ON SLOPES

1.4.1 IDENTIFICATION

Trees and heavy brush growth should be controlled on TVA dams and dikes. If left in place, trees can result in the creation of seepage paths within the embankment. Allowing vegetation to become overgrown restricts the level of inspection that can be performed on the structure. General guidelines for removal of trees and maintenance of vegetation are provided below. Evaluations other than those outlined below shall be made by a geotechnical engineer in consultation with facility representatives on a case-by-case basis.

1.4.2 GUIDELINES FOR TREE REMOVAL AND MAINTENANCE OF VEGETATION

Tree Removal

At locations where it is not reasonable to remove trees by a mowing them with a bush hog or with similar mowing equipment:

- All trees shall be cut using a handsaw or chainsaw and the cut tree and branches discarded.
- Remove the remaining tree trunk, stump, and rootwad.
- Grub any remaining roots of the tree so that only 2 inches or smaller roots are left in place.
- The resulting cavity from removal of the rootwad shall be cleaned of loose soil and debris.
- The cavity shall then be backfilled with cohesive soil and compacted and the area seeded to re-establish vegetation. If the tree has been removed from along the upstream or downstream face of a slope, benches shall be cut into the slope face where the cavity is to be backfilled. This will allow for a proper bond between the existing dike and the backfill being used to reform the slope. If benches are needed, bench heights shall not exceed 4 to 5 feet in height.

Maintenance of Vegetation

- Mowing is recommended at regular intervals to allow for appropriate inspection of embankment slopes.

- If areas lacking vegetation are observed during mowing and clearing operations or subsequent inspections, the areas should be seeded to re-establish vegetation as soon as practicable.

1.5 GENERAL GUIDELINES FOR REPAIR OF WAVE WASH EROSION REPAIR AND CONSTRUCTION OF RIPRAP PROTECTION

1.5.1 IDENTIFICATION

Wave erosion should be controlled on TVA facilities to maintain the integrity of dams and dikes. When present, wave wash erosion typically occurs along interior slopes of dikes near pool level. If left unrepaired, erosion can expand, deepen, and can eventually lead to interior slope sloughing. General guidelines for repair of wave erosion using riprap are provided below.

Guidelines for Wave Wash Erosion Repair and Riprap Protection

The following describes repair of wave wash erosion using riprap protection:

- Vegetation and loose soil should be removed within the affected slope areas to be repaired. This includes undercutting the slope a minimum of 12 inches to remove vegetation and associated roots. The minimum vertical extent of the vegetation removal should extend from one-foot below the pool level upwardly to two feet above pool level.

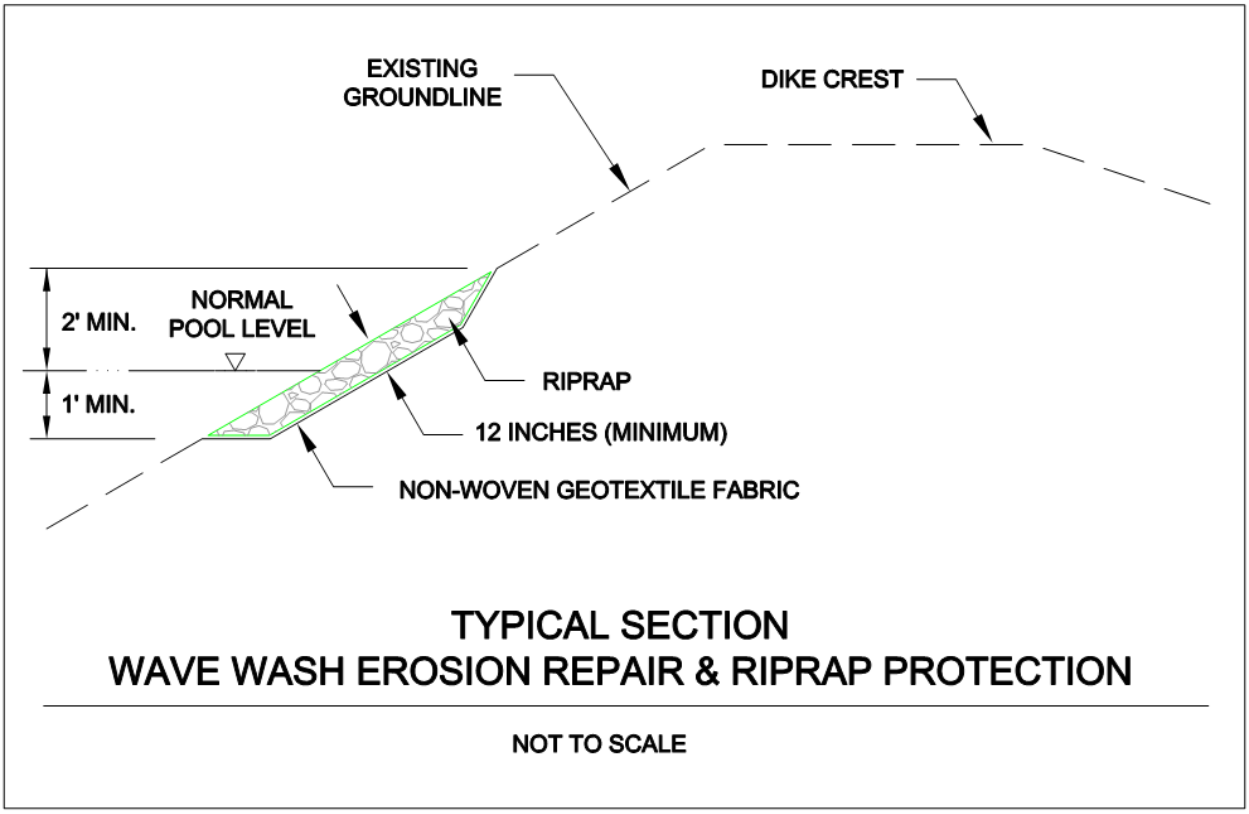
- Place non-woven geotextile fabric along the slope where vegetation and loose soil have been removed. Use fabric meeting or exceeding the following designations, depending on the state in which the work is being performed.

  Kentucky Plants - KYTC Type I Geotextile Fabric
  Tennessee Plants - TDOT Type III Geotextile Fabric
  Alabama Plants - Fabric conforming to Section 608 of ALDOT Standard Specifications

- Place riprap over the geotextile fabric. An excavator should be used to place the riprap in layers (starting from the bottom). Place thickness of riprap to conform to original ground line, or as necessary to create a stable slope face. Use riprap meeting the following designations, depending on the state in which the work is being performed.

  Kentucky Plants - KYTC Class II Channel Lining
  Tennessee Plants - TDOT Class A-1 Machined Riprap
  Alabama Plants - ALDOT Class 2 Riprap

- Field adjustments may be necessary as the work progresses, depending on actual conditions encountered.



1.6 GENERAL GUIDELINES FOR MOWING AND VEGETATION REMOVAL

Slopes shall be mowed to reduce the opportunity for tree growth and allow for visual inspection and observations. The slopes shall be mowed to a height of no less than 3 inches and no more than 12 inches tall with a minimum of three mowings per growing season. If woody growth is detected, it shall be removed.

1.7 GENERAL GUIDELINES FOR BARE AREA FERTILIZING AND RESEEDING

Prepare exposed or bare areas for seeding by discing the surface 3 inches in depth. Apply fertilizer (600 lbs./acre), seed mixture (as directed by facility engineer), mulch (1.5 tons/acre), and netting (0.75” x 1” mesh openings) with pins to the prepared areas. Other application rates may be requested by the facility engineer. The seed mixture utilized depends on the seeding application period and location.

RHO&M Daily Field Report

Date		Plant		Partner

Project No.		Weather Conditions :		High	Low	Rain Gauge Reading:

Daily Facility Observation; List deficiencies found beyond Routine Maint. items (Boils, Freeboard, Seeps [new or changes to existing] , Sloughs Spillways)

Who Was Notified of Deficiency:		Date & Time of Notification:	

Safety Statistics	Current	Year to Date Totals	Environmental Statistics	Current	Year to Date Totals
Near Misses			Near Misses		
First Aides			REE's		
Recordable			NOV's		
Interventions			Interventions		
Observations			Observations		

Safety / Environmental Explanation:

Silo Status

	Starting Level	Ending Level	Load Count	No. Pug Mills in Operation		Constraints / Expectation
Silo "A"						
Silo "B"						
Silo "C"						
Silo "D"						

Daily Production / Materials Handled

	No. of Loads	CY/TNS Hauled	CY/TNS Dipped	Hours		Loc 1	Loc 2	Loc 3	Comments
Bottom Ash									
Fly Ash									
Gypsum Hauled									
Gypsum Dipped									
Boiler Slag									
Coal Fine Haul									
Coal Fine Blend									
Dirt									
Sand									
Rock									
Water/Dust Cont									
Dredging									
Other									
Cenospheres									

NOTE: Loc 1 thru Loc 3 to be used to identify / breakout sub areas such as JOF cells and CUF Gypsum Shed / Pond

Materials / Equipment Delivered

Description:			
Plant / Visitor Interface:		Completed By:	

Routine Handling Activities					
Man Power	Hours	Equipment Description	Equipment # / Rental	Hours	Work ID

Activity Descriptions:

Approved Additional (T&M Work)					
Man Power	Hours	Equipment Description	Equipment # / Rental	Hours	Work ID

Daily Activity Description:

SUMMARY PAGE

Weekly Material Summary for Week Ending : 1/6/00 PLANT: 0

	Bottom Ash				Fly Ash				Gypsum								Boiler Slag				Coal Fine Haul				Coal Fine Blend				Dirt				Sand				Rock				Water/Dust Cont				Dredging				Other				Cenospheres		Silo Load
									Gypsum Hauled				Gypsum Dipped																																												
	Loads	CY/TN Haul	CY/TN Dipped	Hours	Loads	CY/TN Haul	CY/TN Dipped	Hours	Loads	CY/TN Haul	CY/TN Dipped	Hours	Loads	CY/TN Haul	CY/TN Dipped	Hours	Loads	CY/TN Haul	CY/TN Dipped	Hours	Loads	CY/TN Haul	CY/TN Dipped	Hours	Loads	CY/TN Haul	CY/TN Dipped	Hours	Loads	CY/TN Haul	CY/TN Dipped	Hours	Loads	CY/TN Haul	CY/TN Dipped	Hours	Loads	CY/TN Haul	CY/TN Dipped	Hours	Loads	CY/TN Haul	CY/TN Dipped	Hours	Loads	CY/TN Haul	CY/TN Dipped	Hours	Loads	CY/TN	Tons
Monday	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tuesday	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wednesday	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thursday	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Friday	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Saturday	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sunday	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Safety Statics Summary

	Near Misses		First Aides		Recordables		Interventions		Observations	
	WK	YTD	WK	YTD	WK	YTD	WK	YTD	WK	YTD
Monday	0	0	0	0	0	0	0	0	0	0
Tuesday	0	0	0	0	0	0	0	0	0	0
Wednesday	0	0	0	0	0	0	0	0	0	0
Thursday	0	0	0	0	0	0	0	0	0	0
Friday	0	0	0	0	0	0	0	0	0	0
Saturday	0	0	0	0	0	0	0	0	0	0
Sunday	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	0	0	0	0	0	0	0

Environmental Statics Summary

	Near Misses		REE's		NOV''s		Interventions		Observations	
	WK	YTD	WK	YTD	WK	YTD	WK	YTD	WK	YTD
Monday	0	0	0	0	0	0	0	0	0	0
Tuesday	0	0	0	0	0	0	0	0	0	0
Wednesday	0	0	0	0	0	0	0	0	0	0
Thursday	0	0	0	0	0	0	0	0	0	0
Friday	0	0	0	0	0	0	0	0	0	0
Saturday	0	0	0	0	0	0	0	0	0	0
Sunday	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	0	0	0	0	0	0	0	0

Weekly Facility Observation Form

Form Date 06-01-10

1. Site Name: _____ **2. Date & Start Time of Observation** _____

3. Operator Name: _____ **4. Observation Method:** ☐ **Walk** ☐ **Ride** ☐ **Both**

(KNOWN KEY DEFICIENCIES MUST BE INSPECTED)

5. Observer's Name(s): _____

6. Current Weather Conditions _____

7. Prior Weather Conditions, if notable _____

CHECK ALL BOXES WHERE DEFICIENCIES ARE KNOWN AND MAKE APPROPRIATE COMMENTS, OBSERVATIONS, AND/OR ACTIONS TAKEN. NOTE LOCATIONS OF DEFICIENCIES ON AERIAL PHOTO

8. Type(s) of Facilities Observed	Name of Facility	Minimum Freeboard	Current Freeboard
☐X Wet Fly Ash Pond		FT	FT
☐ Wet Gypsum Pond		FT	FT
☐ Wet Bottom Ash Pond		FT	FT
☐ Dry Ash Stack			
☐ Dry Gypsum Stack			
☐ Other			

	YES	NO	COMMENTS
9 .Pre-Job Safety Briefing Performed			
10. Activity / Construction on/ at facility			
11. DIKE CREST	☐ Transverse or Longitudinal Cracks or bulges ☐ Settlement ☐ Displacement ☐ Rutting		
12. DIKE SLOPES	☐ Erosion, ☐ Cracks or Bulges ☐ Slides/Sloughs ☐ Subsidence ☐ Seepage (clear/muddy water, new or flow increasing over time) ☐ Wet or soft spot ☐ Changes in geometry, depth and elevation ☐ Changes in freeboard ☐ Vegetation (excessive/ sparse) ☐ Animal Burrows ☐ Sinkholes ☐ Rutting ☐ Trees		
13. DIKE TOE AREAS	☐ Seepage Areas ☐ Boils ☐ Equipment Rutting ☐ Perimeter Ditches Properly Draining ☐ Sinkholes		
14. SPILLWAY WEIR SYSTEM (Only visibly accessible features checked)	☐ Discharge Channel Erosion ☐ Riser Vertical Alignment ☐ Riser/Outlet Pipe Joint Leakage/Separation ☐ Headwall Condition ☐ Box Weir/Skimmers Operating Properly ☐ Vegetation blocking overflow		
15. SEEPAGE COLLECTION SYSTEM	☐ Check Flow and Water Clarity ☐ Check For Blockages		

16. DEFICIENCIES	YES	NO	COMMENTS
A. Prior Key Deficiencies Checked			
B. New Deficiencies Identified / Flagged			
C. Immediate Actions Taken (Note Below)			
D. Photographs Taken / Attached			

17. **DESCRIPTIONS OF NEWLY IDENTIFIED AND DEGRADING EXISTING KEY DEFICIENCIES/ACTIONS TAKEN/COMMENTS**

18. **Who was Notified of New Key Deficiency:** (Date & Time)

19. **PA(E) Notified of New Key Deficiency:** (Date & Time)

20. **I hereby attest the above is original information (not reproduced) based on actual field observations made during the period indicated, by either myself or an appointed representative and are accurate, complete, and correct to the best of my knowledge.**

Period Covered:

TVA Monthly /Quarterly/Special Facility Inspection Form — Form Date 6-01-10

1. Site Name: _____ 2. Facility Name: _____ 3. Date and Start Time of Inspection: _____

4. Operator Name: _____ 5. Inspection Method: ☐ Walk ☐ Ride ☐ Both
(KNOWN KEY DEFICIENCIES MUST BE INSPECTED)

6. Inspector's Name(s): _____ 7. Hazard Classification: ☐ High ☐ Significant ☐ Low

8. Inspection Frequency: ☐ MONTHLY ☐ QUARTERLY (MUST BE WALKED) ☐ SPECIAL (after significant rain or earthquake event)

9. Current weather conditions_____Prior Conditions, if notable_____

Check the appropriate box below. If not applicable, record "N/A". Provide comments when appropriate. Any other areas that should be brought to the attention of the Program Manager should also be noted in the "Comments" section. Indicate the locations of any areas identified, and photograph and attach to the form. Previous observation forms should be reviewed and any NEW observations or degradation of pervious conditions should be reported on this inspection form.
(NOTE - ONE FORM PER FACILITY)

	Yes	No		Yes	No
10. Pre-Job Safety Briefing Performed			**15. DIKE TOE AREAS**		
11. Activity / Construction on/ at facility			A. Seepage ○ New ○ Existing		
12. DIKE CREST			○ Clear/Cloudy/Red/Muddy		
A. Settlement / Cracking			○Flow Increased / Decreased/Same		gpm
B. Rutting			○ Aquatic Vegetation Growing		
C. Lateral Displacement			○ Ash or Clay Deposits Below Seep Outlet		
D. Erosion			B. Boils ○ New ○ Existing		
13. INTERIOR / EXTERIOR DIKE SLOPES			○ Clear/Cloudy/Red/Muddy		
A. Minimum Freeboard		ft.	○ Flow Increased / Decreased/Same		gpm
B. Current Freeboard		ft.	○ Growing in Size		
C. Instabilities (Sloughs or Slides)			C. Sinkholes/Depressions ○ New ○ Existing		
D. Erosion			**16. SEEPAGE COLLECTION SYSTEM**		
E. Sinkholes/Depressions ○ New ○ Existing			A. Estimated Flow Measurement		gpm
F. Vegetation / Brush / Trees			B. Increased Flow		
○ Heavy/Adequate/Sparse/Bare			C. Emitting Clear or Dirty Water		
G. Animal Burrows ○ New ○ Existing			**17. SPILLWAY WEIRS & OUTLETS**		
H. Seepage ○ New ○ Existing			A. Decant Riser Misaligned		
○ Clear/Cloudy/Red/Muddy			B. Decant Pipe Joints		
○ Flow Increased/Decreased/Same		gpm	○ Leaking		
○ Ash or Clay Deposits Below Seep Outlet			○ Separated		
I. Seep around Drain Pipe(s)			C. Headwall In Good Condition		
○ Clear/Cloudy/Red/Muddy			**18. OPERATIONS & MAINTENANCE**		
14. DEFICIENCIES			A. Major Changes in Operations		
A. Prior Key Deficiencies Checked					
B. New Deficiencies Identified / Flagged					
C. Immediate Actions Taken (Note Below)					
D. Photos of deficiencies attached					

19. Major adverse changes in these items could cause instability and should be reported to the Program Manager as soon as possible for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, etc.) in the space below and on the backside of this sheet if needed.

NOTE: Quarterly Inspection Deficiencies to be documented on spreadsheet with applicable latitude and longitude coordinates referenced. SHOW ALL QUARTERLY INSPECTION DEFICIENCIES ON AERIAL PHOTOS

20. Item #	Comments/New Observations/Action Taken:

21. PA(E) was Notified of New Key Deficiency: (Date / Time)

22. Who else Notified of New Key Deficiency: (Date / Time)

23. I hereby attest the above is original information (not reproduced) based on actual field observations made during the period indicated, by either myself or an appointed representative and are accurate, complete, and correct to the best of my knowledge.

Period Covered:

From: _____ To: _____ Signature: _____ Date: _____

PROJECT START-UP

Partner Performing Work _____ **Attentive Start Date** _____

Design Engineering Firm ☐ Stantec ☐ URS ☐ CDM ☐ Other _____

Task Description	Yes	No	Responsible Group	Verified By	Date
Design Complete			CCP Engineering		
Construction Drawings Issued			CCP Engineering		
Design Coordinates Provided			CCP Engineering		
Risk Analysis Required			Joint Project Team		
(If Yes, Analysis Performed)			CCP Engineering		
(If Yes, Contingency Plan Developed)			CCP Engineering		
Project Transitions			Joint Project Team		
Cost Estimate / Schedule			Field Supervisor		
Procurement Process Followed , Contract PO established			Procurement		
Environmental Requirements Complete			Environmental		
QA / QC Criteria Established			CCP Engineering		
QA / QC Personnel Available			Program Manager		
Maximo Work Package Developed, to include JSA			Work Control Program Manger		
Peer Review Meeting Held			Program Manager		
Project Completion / Closure	**Yes**	**No**	**Responsible Group**	**Verified By**	**Date**
Final Walkdown Completed			Joint Project Team		
Punch List Items Completed			Field Supervisor		
Redline Drawings Completed			CCP Field Engineer		
Ready to Return to Service			CCP Field Engineer		

Completed By _____ **Date** _____

ROUTINE HANDLING OPERATIONS & MAINTENANCE
ADDITIONAL WORK /CHANGE ORDER APPROVAL FORM

Partner / Engineering Company _____

TVA Work Order No. / Work Plan _____

Work Requested By _____

Scope

_____

_____

_____

Emergency Work ☐ Yes ☐ No **Scope Growth** ☐ Yes ☐ No

Project Initiation / Change (Describe Below What Initiated Work or Changed Scope)

_____

_____

_____

Engineering Recommendation Needed? ☐ Yes ☐ No (Explain below if Yes or No)

_____

_____

Environmental Notification Required? ☐ Yes ☐ No (Explain below if Yes or No)

_____

_____

Can Work Be Performed within Monthly Rate? ☐ Yes ☐ No
If **No,** Attach Estimate & Schedule

Is Work in Existing RHO&M Budget? ☐ Yes ☐ No

If **No,** Funding to be Provided By; (capital, O&M, plant, etc.) _____

P.O. / Alias # Work is to be charged _____

Bond Required? ☐ Yes ☐ No If **Yes,** Cost of Bond _____

Approvals	Printed Name & Signature	Date
Business Services Acknowledgement		
Field Supervisor (Up to $50K)		
Program Manager (Up to $50K)		
Construction Manager (Up to $100K)		
RHO&M MP Program Manager (Up to $100K)		
RHO&M Manager (Up to $100K)		
CCP Manager (Over $100K)		

Form Completed By _____ _____
Signature Date

TVA IS NOT OBLIGATED TO PAY FOR ANY / ALL WORK PERFORMED WITHOUT PRIOR WRITTEN APPROVAL

PROCEDURES FOR COMPLIANCE WITH THE NATIONAL ENVIRONMENTAL POLICY ACT

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1.0 Purpose

These procedures provide guidance for compliance by the Tennessee Valley Authority (TVA) with the National Environmental Policy Act (NEPA), 42 U.S.C. 4321, et seq. (1976) and other applicable guidelines, regulations, and Executive orders implementing NEPA. It is intended to incorporate concepts and implement policies in the regulations promulgated by the Council on Environmental Quality at 40 CFR, parts 1500-1508 (1981).

2.0 Policy

TVA, to the fullest extent possible, incorporates environmental considerations into its decision making processes. In carrying out this policy, these procedures ensure that actions are viewed in a manner to encourage productive and enjoyable harmony between man and the environment. Commencing at the earliest possible point and continuing through implementation, appropriate and careful consideration of the environmental aspects of proposed actions is built into the decision making process in order that adverse environmental effects may be avoided or minimized, consistent with the requirements of NEPA.

3.0 Abbreviations

3.1 CEQ - Council on Environmental Quality
3.2 EA - Environmental Assessment
3.3 EIS - Environmental Impact Statement-D-Draft; F-Final
3.4 NEPA - National Environmental Policy Act
3.5 TVA - Tennessee Valley Authority

4.0 Definitions

The following definitions shall apply throughout these procedures. All other applicable terms shall be given the same meaning as set forth in CEQ's currently effective regulations (see 40 CFR regulations, part 1508) unless otherwise inconsistent with the context in which they appear.

4.1 "Floodplain" refers to the lowland and relatively flat areas adjoining flowing inland waters and reservoirs or to those areas inundated by the unusual or rapid accumulation or runoff of surface waters from any source. Floodplain generally refers to the base floodplain, i.e., that area subject to a 1 percent or greater chance of flooding in any given year. A flood having a 1 percent chance of occurring in any given year is usually referred to as a 100-year flood.

4.2 "Natural and beneficial floodplain and wetland values" refer to such attributes as the capability of floodplains and wetlands to provide natural moderation of floodwaters, water quality maintenance, fish and wildlife habitat, plant habitat, open space, natural beauty, scientific and education study areas, and recreation.

4.3 "Practicable" refers to the capability of an action being done within existing constraints. The test of what is practicable depends on the situation involved and should include an evaluation of all pertinent factors, such as environmental impact, economic costs, technological achievability, and public benefit.

4.4 "Wetlands" are those areas inundated by surface or ground water with a frequency sufficient to support, and under normal circumstances do or would support, a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, mud flats, and natural ponds. Wetlands do not include temporary human-made ponds, sloughs, etc., resulting from construction activities.

4.5 "Important farmland" includes prime farmland, unique farmland, and farm land of Statewide importance as defined in 7 CFR, part 657 (1981).

5.0 Procedures

5.1 Action Formulation and NEPA Determination

Each office within TVA is responsible for integrating environmental considerations into its planning and decision making process at the earliest possible time to ensure that potential environmental effects are appropriately considered to avoid potential delays and to minimize potential conflicts. Environmental analyses are to be included in or circulated with and reviewed at the same time as other planning documents. This responsibility is to be carried out in accordance with the environmental review procedures contained herein.

The General Manager and Board of Directors are the major decision points within the agency for TVA's principal programs that are likely to have a significant effect on the quality of the human environment. Alternatives considered by the General Manager and Board of Directors shall be encompassed by the range of alternatives discussed in relevant environmental documents, and the General Manager and Board of Directors shall consider the alternatives described in relevant EISs.

At the earliest possible time, the office proposing to initiate an action will initially determine the level of environmental review required for a specific action. The level of review will be in one of the following categories:

	Procedure
Categorical Exclusions	5.2
Environmental Assessments	5.3
Environmental Impact Statements	5.4

5.2 Categorical Exclusions

Categories of actions listed in this section are those which do not normally have, either individually or cumulatively, a significant impact on the quality of the human environment and require neither the preparation of an EA nor an EIS. The office proposing to initiate an action shall determine, in consultation with the Environmental Quality Staff as appropriate, whether or not the proposed action is categorically excluded. An action which would normally qualify as a categorical exclusion shall not be so classified if: (1) the proposed action could have a potentially significant impact on a threatened or endangered species, wetland or floodplain, cultural or historical resource, important farmland, or other environmentally significant resource; or (2) substantial controversy over the significance of the environmental impacts associated with the proposed action has developed or is likely to develop. Categorical exclusion actions are:

1. Routine operation, maintenance, and minor upgrading of existing TVA facilities.

2. Technical and planning assistance to State and local organizations.

3. Personnel action.

4. Procurement activities.

5. Accounting, auditing, financial reports, and disbursement of funds.

6. Contracts or agreements for the sale, purchase, or interchange of electricity.

7. Activities related to the promotion and maintenance of employee health.

8. Activities of TVA's Equal Employment Opportunity staff.

9. Administrative actions consisting solely of paperwork.

10. Communication, transportation, computer service, and other office services.

11. Property protection, law enforcement, and other legal activities.

12. Emergency preparedness.

13. Preliminary planning, studies, or reviews consisting of only paperwork.

14. Exploration for uranium, including hydrologic investigations.

15. Preliminary onsite engineering and environmental studies for future power generating plants and other energy-related facilities.

16. Establishment of environmental quality monitoring programs and field monitoring stations.

17. Transmission line relocation, tap-ins, or modifications or substation alterations due to conflicts such as new highway projects and projects requiring acquisition of minor amounts of additional substation property or transmission line right-of-way easements.

18. Construction and operation of communication facilities (i.e., powerline carrier, insulated overhead ground wire, VHF radio, and microwave).

19. Backslope agreements involving properties on which TVA holds an interest between operators and other adjacent mining companies.

20. Purchase, exchange, lease or sale, or lease purchase of stepdown facilities, transmission lines, and transmission line rights of way by distributors or customers directly served by TVA.

21. Minor research, development, and joint demonstration projects.

22. Construction of visitor reception centers.

23. Development of minor TVA public use areas and stream access points.
24. Minor non-TVA activities on TVA property authorized under contract or license, permit and covenant agreements, including utility crossings, encroachments, agricultural uses, rental of structures, and sale of miscellaneous structures and materials from TVA land.

25. Purchase, sale, abandonment or exchange of minor tracts of land, mineral rights, or landrights.

26. Approvals under Section 26a of the TVA Act of minor structures, boat docks, and shoreline facilities.

27. Any action which does not have a primary impact on the physical environment.

28. Actions which were the subject of an EA which concluded that the category of such actions should be treated as a categorical exclusion.

5.3 Environmental Assessments

5.3.1 Purpose and Scope

An EA will be prepared for any appropriate action not qualifying as a categorical exclusion to determine whether an EIS is necessary or a Finding of No Significant Impact should be reached. An EA is not necessary if it has been determined that an EIS will be prepared.

5.3.2 Public Participation in EA Preparation

The Environmental Quality Staff or the initiating office, in consultation with the Environmental Quality Staff, Citizen Action Office, and other interested offices, may request public involvement in the preparation of the EA or a revision or supplement thereof. The type of and format for public involvement would be selected as appropriate to best facilitate timely and meaningful public input to the EA process.

5.3.3 EA Preparation

The initiating office is responsible for the preparation of the EA. As soon as practical after the decision to prepare an EA is made, the initiating office in consultation with the Environmental Quality Staff shall determine the need for a coordination meeting to define (1) reasonable alternatives, (2) permit requirements, (3) coordination with other agencies, (4) environmental issues, and (5) a schedule for EA preparation.

The EA will include the identification and, as appropriate, discussion of questions and concerns raised during the public input period, if any. The EA will describe the proposed action and will include brief discussions of the need for the proposed action, reasonable alternatives, the environmental impacts of the proposed action and alternatives, measures (if any) to minimize or mitigate such impacts, and a listing of the agencies and persons consulted. A list of required permits and environmental commitments will be circulated with the EA.

The EA will briefly provide sufficient data and analysis for determining whether to prepare an EIS or a Finding of No Significant Impact. The EA will be reviewed by the Environmental Quality Staff and other interested offices. After completion of the review, the Environmental Quality Staff will, in consultation with the Office of the General Counsel, make one of the following determinations: (1) the action does not require the preparation of an EIS, (2) the action will require the preparation of an EIS, or (3) the EA is incomplete or the decision will be deferred until a later stage in the planning process. Measures (if any) to minimize or mitigate impacts committed to in the EA will be implemented as described in section 5.5 (Mitigation Commitment Identification, Auditing, and Reporting).

5.3.4 Finding of No Significant Impact

If it is concluded, based on an EA, that a proposed action does not require the preparation of an EIS, the Environmental Quality Staff, in consultation with the Office of the General Counsel and the initiating office, will prepare a Finding of No Significant Impact.

Appropriate notice of Finding of No Significant Impact shall be made available to the public by the Environmental Quality Staff.

In the following circumstances, the Environmental Quality Staff, in consultation with the Office of the General Counsel and the initiating office, will make a Finding of No Significant Impact available for public review and comment (including, if appropriate, State and regional A-95

clearinghouses or other designated State/local coordination points) for a period of time (normally 30 days) before a final determination is made as whether or not to prepare an EIS and before the proposed action may begin:

1. The proposed action is, or is closely similar to, an action listed in section 5.4.1

2. TVA has previously announced that the proposed action would be the subject of an EIS.

3. The nature of the proposed action is one without precedent.

5.3.5 Generic EAs

For any category of actions not described in section 5.2 (Categorical Exclusions), the initiating office may prepare a generic EA. The generic EA will be prepared, reviewed, and approved as would any other EA. Upon completion of review, the Environmental Quality Staff, in consultation with the Office of the General Counsel, will determine whether or not the category of actions may normally be treated as if listed in section 5.2 as a categorical exclusion.

5.3.6 Revisions and Supplements

If new information concerning action modifications, alternatives, or probable environmental effects becomes available, the initiating office, in consultation with the Environmental Quality Staff and the Office of the General Counsel, will consider preparing a revision or supplement to the EA based on the significance of the new information.

5.4 Environmental Impact Statements

5.4.1 Purpose and Scope

The following actions normally will require an environmental impact statement:

1. Large water resource development and water control projects.

2. Major power generating facilities.

3. Uranium mining and milling complexes.

4. Any major action, the environmental impact of which is expected to be highly controversial.

5. Any other major action which will have a significant effect on the quality of the human environment.

An EIS should include a description and an analysis of the proposed action; alternatives to the proposed action, including the no-action alternative; probable environmental impacts associated with the proposed action and measures (if any) to minimize impacts; and a list of the major preparers of the EIS. The scope and detail of the EIS should be reasonably related to the scope and the probable environmental impacts of the proposed action and alternative actions (see 40 CFR, parts 1502.10-1502.18).

5.4.2 Lead and Cooperating Agency Determinations

As soon as possible after the decision is made to prepare an EIS, the Environmental Quality Staff, in consultation with the initiating office and the Office of the General Counsel, shall consider requesting other Federal, State, or local agencies to participate in the preparation of the EIS as lead, joint lead (see 40 CFR 1501.5), or cooperating agencies (see 40 CFR 1501.6). If TVA is requested to participate in the preparation of another Federal agency's EIS, the General Manager will determine if TVA will become a cooperating agency.

5.4.3 Scoping Process

As soon as possible after the decision to prepare an EIS is made, the initiating office will organize a scoping committee to tentatively identify action alternatives, probable environmental issues and environmental permits, and a schedule for EIS preparation. The scoping committee will consist of representatives of the Environmental Quality Staff, the initiating office, the Office of the General Counsel, Citizen Action Office, and other interested or affected offices.

The scoping process may include interagency scoping sessions to coordinate an action with and obtain inputs from other interested agencies, and public scoping sessions to obtain input from interested members of the general public. The scoping committee will determine the need, nature, and format for the various scoping sessions. Session type and format will be selected to facilitate timely and meaningful public input into the EIS process.

As soon as practicable in the scoping process, the initiating office will prepare and the Environmental Quality Staff, in consultation with the Office of the General Counsel, will review and make available a Notice of Intent to Prepare an EIS. This notice will briefly describe the action, reasonable alternatives thereto, and potential environmental impacts associated with the action. In addition, those issues which tentatively have been determined to be insignificant and which will not be discussed in detail in the EIS may be identified. The scoping process will be

described and, if a scoping meeting will be held, the notice should state where and when the meeting is to occur. The notice will identify the person in TVA who can supply additional information about the action and to whom comments should be sent. There will normally be a public input period of 30 days from the date of publication of the Notice of Intent in the *Federal Register* to allow other interested agencies and the public an opportunity to review the action alternatives and probable environmental issues identified by the scoping committee. On the basis of input received, the Environmental Quality Staff, in consultation with the scoping committee, may determine what, if any, additions or modifications in the scoping process or schedule are required and establish the scope of the EIS.

At the close of the scoping process, the Environmental Quality Staff, in consultation with the scoping committee, will identify in writing the following EIS components:

1. Key action alternatives.

2. Significant environmental issues to be addressed in detail.

3. Probable nonsignificant environmental issues that should be mentioned but not addressed in detail.

4. Lead and cooperating agency assignments, if any.

5. Related environmental documents.

6. Other environmental review and consultation requirements.

7. Delegation of DEIS work assignments to interested offices.

5.4.4 DEIS Preparation

Based on information obtained and decisions made during the scoping process, the initiating office, in consultation with the Environmental Quality Staff and other interested offices, will prepare the preliminary DEIS using an appropriate format (see 40 CFR 1502.10). In addition, a list of required permits and an environmental commitment list will be prepared and circulated with the DEIS. The preliminary DEIS will be circulated by the initiating office to the Environmental Quality Staff, the Office of the General Counsel, and other interested offices for review and comment. All reviewing offices will, as soon as practical and normally within 30 days, supply comments on the preliminary DEIS to the initiating office, the Environmental Quality Staff, and the Office of the General Counsel. These comments will include lists of agencies, A-95 contacts or other State/local coordination points, and groups and individuals (both proponents and opponents, if any, of the proposed action) who should receive a copy of the DEIS. After the preliminary DEIS is revised, the initiating office will transmit it to other interested offices for their final approval. The Environmental Quality Staff will, in consultation with the Office of the General Counsel, review the document and transmit it and the commitment list to the General Manager for approval.

5.4.5 DEIS Transmittal and Review

Upon notification of approval from the General Manager, TVA will transmit the DEIS and appropriate notices to the Environmental Protection Agency (EPA) and other interested Federal, State, and local agencies (including State and regional A-95 clearinghouses or other State/local coordination points). The Citizen Action Office will coordinate overall DEIS distribution and

will maintain a master list of those to whom the DEIS is sent. The length of the DEIS public comment period, normally no less than 45 days from publication of the notice of availability in the *Federal Register*, will be determined by the scoping committee. Materials to be made available to the public shall be provided to the public without charge to the extent practicable, or at a fee which is not more than the actual costs of reproducing copies required to be sent to other Federal agencies, including CEQ.

At any time in the DEIS process, the initiating office, in consultation with the Environmental Quality Staff, the Citizen Action Office, and other interested offices, may provide for additional public involvement to supplement EIS preparation. The type of and format for public involvement will be selected as appropriate to best facilitate timely and meaningful public input into the EIS process.

5.4.6 FEIS Preparation

At the close of the DEIS public review period, the Environmental Quality Staff will, in consultation with the initiating office and other interested offices, determine what is needed for the preparation of an FEIS. If the requisite changes in the DEIS are limited to making minor factual corrections and explaining why the comments received do not warrant further response, an errata sheet containing only DEIS comments, responses, and factual corrections in the DEIS may be prepared by the initiating office. If other more extensive modifications are required, the initiating office will, in consultation with the Environmental Quality Staff and other interested offices, prepare a preliminary FEIS utilizing an appropriate format (see 40 CFR 1502.10).

The errata sheet or preliminary FEIS will be prepared and circulated by the initiating office to the Environmental Quality Staff, Office of the General Counsel, and other interested offices for review and comment. All reviewing offices will supply written comments concerning the errata sheet or preliminary FEIS to the initiating office with copies to the Environmental Quality Staff and Office of the General Counsel.

The initiating office, with the assistance of the Environmental Quality Staff, will review all comments received and modify, as appropriate, the errata sheet or the preliminary FEIS. After the errata sheet or preliminary FEIS is revised, the initiating office will transmit it to other interested offices for their final approval. The Environmental Quality Staff will, in consultation with the Office of the General Counsel, review the document and transmit it to the General Manager for approval along with a list of environmental commitments made in the EIS.

Measures (if any) to minimize or mitigate impacts committed to in the FEIS will be identified and implemented as described in section 5.5 (Mitigation Commitment Identification, Auditing, and Reporting).

5.4.7 FEIS Transmittal

Upon notification of approval from the General Manager, TVA will transmit the FEIS and appropriate notices to EPA and other Federal, State, and local agencies (including State and regional A-95 clearinghouses or other State/local coordination points) to whom copies of the DEIS were sent. The FEIS will also be sent to every person and organization to whom copies of the DEIS were sent or from whom comments were received.

5.4.8 Commencement of Action

Except in emergency circumstances, an action for which an EIS has been approved will not commence until 30 days after notice of availability of the final statement has been published in

the *Federal Register* or 90 days after a notice of availability of the DEIS has been published in the *Federal Register*, whichever is later.

5.4.9 Record of Decision

After release of the FEIS, a Record of Decision shall be prepared for the General Manager by the Environmental Quality Staff, in consultation with the Office of the General Counsel and the initiating office. The record will normally include the following: (1) what the decision was; (2) what alternatives were considered; (3) which alternative(s) was considered to be environmentally preferable; (4) the alternatives' associated environmental considerations (which may include a discussion of measures to be taken to mitigate or minimize adverse environmental impacts (see 40 CFR 1505.2); and (5) what monitoring, reporting, and administrative arrangements have been made (see 40 CFR 1505.2). Records of decision will be made available to the public.

5.4.10 Revisions and Supplements

If significant new information concerning action modifications, alternatives, or probable environmental effects becomes available, TVA will make such information available to the public. The initiating office shall consider preparing a revision or a supplement to the EIS. The Environmental Quality Staff will, in consultation with the initiating office, Office of the General Counsel, Citizen Action Office, and other interested offices, determine the method of making such information available to the public.

5.4.11 EIS Adoption

TVA may adopt as its final EIS another EIS or any portion thereof whether or not TVA participated in its preparation. The Environmental Quality Staff and the Office of the General Counsel, in consultation with the initiating office, will determine if the EIS proposed for adoption adequately assesses the TVA action and is still generally available to the public.

If it is determined that the EIS proposed for adoption or the relevant portion thereof is adequate and still available, TVA will circulate its written finding of this determination and advise that copies of the EIS will be sent to any person or agency requesting it. If the EIS is not available, TVA will then circulate, along with its written finding, the adopted EIS (or relevant portion) or a summary thereof (see 40 CFR 1502.12; 40 CFR 1502.19 (d)).

If the EIS is generally available and TVA determines that significant supplementary information is needed, TVA will prepare and circulate a supplement to the EIS and advise that copies of the adopted EIS will be sent to any person or agency requesting it. If the EIS is not generally available, TVA will circulate its supplement along with either the adopted EIS or a summary thereof (see 40 CFR 1502.12; 40 CFR 1502.19 (d)). The above findings or documents shall be approved and circulated in accordance with section 5.4.5 or 5.4.7, as appropriate.

5.5 Mitigation Commitment Identification, Auditing and Reporting

All significant measures planned to minimize or mitigate expected environmental impacts shall be identified in the EA or EIS (or, as appropriate, in a memorandum documenting the Environmental Quality Staff's determination or concurrence that a proposed action is a categorical exclusion) and compiled in a commitment list. The commitment list will include, to the extent practicable, the estimated cost of each commitment. The commitment list is prepared for both the draft and final EA or EIS and should be developed in cooperation with the Environmental Quality Staff and all interested offices.

Each such commitment in the commitment list will be tentatively assigned by the initiating office to the appropriate responsible office and such assignments shall be transmitted to the Environmental Quality Staff and affected offices at the time the draft EA or EIS is sent out for review. The initiating office should consult with the assigned offices to resolve assignment conflicts, identify supporting offices, and determine commitment schedules. Prior to finalization of the commitment list, the initiating office shall obtain Environmental Quality Staff concurrence that commitments can be monitored for compliance. At the time of finalizing the EA or EIS, the initiating office shall submit to the Environmental Quality Staff a finalized commitment list.

The initiating office shall report, periodically and upon request to the Environmental Quality Staff, the status of a commitment. The Environmental Quality Staff will ensure that commitments are met and will, as it deems appropriate, audit commitment progress. Circumstances may arise which warrant modifying or deleting previously made commitments. When such circumstances occur, the office desiring the change shall submit to the Environmental Quality Staff and the initiating office a request which shall include the basis for changing or deleting the commitment and an evaluation of the environmental significance of the requested change. The decision to modify or delete the commitment will be made by the Environmental Quality Staff in consultation with the Office of the General Counsel and the initiating office.

5.6 Emergency Action

Because of unforeseen situations or emergencies, or through inadvertence, or for other reasons, some of the steps outlined in these procedures may be consolidated, modified, or omitted. The Environmental Quality Staff and the Office of the General Counsel shall be promptly notified and asked to approve any such consolidation, modification, or omission, and may do so if such change would conform to legal requirements and substantially comply with the intent of these procedures. The Environmental Quality Staff, in consultation with the Office of the General Counsel, will consult with CEQ when appropriate before such changes are approved.

5.7 Floodplains and Wetlands

5.7.1 Purpose and Scope

Consistent with Executive Order Nos. 11988 (Floodplain Management) and 11990 (Protection of Wetlands), and TVA Code under IX FLOODPLAIN MANAGEMENT AND PROTECTION OF WETLANDS, the review of a proposed action undertaken in accordance with sections 5.2, 5.3, or 5.4 of these procedures that potentially may affect floodplains or wetlands shall include a floodplain or wetlands evaluation as required by this section. A wetland evaluation is not required for (1) the issuance of permits, licenses, or allocations to private parties for activities involving wetlands on non-Federal lands; (2) projects or programs under construction or in operation as of May 24, 1977; (3) projects for which all funds were appropriated through June 1977; or (4) projects for which a draft or final EIS was filed before October 1, 1977. Moreover, no reevaluation of floodplain or wetland impacts is required for projects, programs, and policies approved by TVA before July 23, 1979.

5.7.2 Evaluation Process

5.7.2.1 Area of Impact

If a proposed action will potentially occur in or affect wetlands or floodplains, the initiating office, as soon as practicable in the planning process, will request the Office of Natural Resources to determine whether the proposed action will occur in or affect a wetland or floodplain and the level of impact, if any, on the wetland or floodplain. If

the Office of Natural Resources determines that the proposed action (1) is outside the floodplain or wetland, (2) has no identifiable impacts on a floodplain or wetland, and (3) does not directly or indirectly support floodplain development or wetland alteration, further floodplain or wetland evaluation shall be unnecessary.

5.7.2.2 Actions That Will Affect Floodplains or Wetlands

When a proposed action can otherwise be categorically excluded under section 5.2, no additional floodplain or wetland evaluation is required if (1) the initiating office determines that there is no practicable alternative that will avoid affecting floodplains or wetlands and that all practical measures to minimize impacts to floodplains or wetlands are incorporated and (2) the Office of Natural Resources determines that impacts on the floodplain or wetland would be minor.

If the action requires an EA or an EIS, the ensuing evaluation shall consider (1) the effect of the proposed action on natural and beneficial floodplain and wetland values and (2) alternatives that would eliminate or minimize such effects. The initiating office shall determine if there is no practicable alternative to siting in a floodplain or constructing in a wetland. If the Environmental Quality Staff in consultation with the Office of the General Counsel concurs, this determination shall be final. If a determination of no practicable alternative is made, all practical measures to minimize impacts on the floodplain or wetland shall be implemented.

If at any time prior to commencement of the action it is determined that there is a practicable alternative that will avoid affecting floodplains or wetlands, the proposed action shall not proceed.

5.7.2.3 Public Notice

Public notice of actions affecting floodplains or wetlands is not required if the action is categorically excluded under section 5.2. If an EA or EIS is prepared and a determination of no practicable alternative is made in accordance with section 5.7.2.2, the initiating office shall notify the public of a proposed action's potential impact on the floodplain or wetland.

Public notice of actions affecting floodplains or wetlands may be combined with any notice published by TVA or another Federal agency if such a notice generally meets the minimum requirements set forth in this section. Issuance of a draft or final EA or EIS for public review and comment will satisfy this notice requirement.

Public notices shall at a minimum (1) briefly describe the proposed action and the potential impact on the floodplain or wetland; (2) briefly identify alternative actions considered and explain why a determination of no practicable alternative has been proposed; (3) briefly discuss measures that would be taken to minimize or mitigate floodplain or wetland impacts; (4) state when appropriate whether the action conforms to applicable State or local floodplain protection standards; (5) specify a reasonable period of time within which the public can comment on the proposal; and (6) identify the TVA official who can provide additional information on the proposed action and to whom comments should be sent.

Such notices shall be issued in a manner designed to bring the proposed action to the attention of those members of the public likely to be interested in or affected by the action's potential impact on the floodplain or wetland. The initiating office, in

consultation with the Environmental Quality Staff and the Citizen Action Office, shall determine the manner in which the notice will be made available to the public. Typical ways of providing public notice include direct mailing, posting in appropriate places in the vicinity of the proposed action, publication in the *Federal Register,* or publication in newspapers of general circulation in the area of the proposed action. If a floodplain public notice is required, a copy of such notice shall be included in information sent to State and regional clearinghouses for those actions subject to Office of Management and Budget Circular A-95 or other State/local coordination points.

TVA shall consider all relevant comments received in response to a notice and shall reevaluate the action as appropriate to take such comments into consideration. The Environmental Quality Staff, in consultation with the initiating office, shall determine if response is necessary and the initiating office, in coordination with other interested offices, shall prepare comment responses. The Environmental Quality Staff, in consultation with the Office of the General Counsel, shall approve all comment responses before release.

A proposed action may not be implemented before publication of any required public notice and appropriate consideration of any relevant comments received in a timely manner.

5.7.2.4 Disposition of Real Property

When TVA property in a floodplain or wetland is proposed for lease, easement, license, right of way, or disposal to non-Federal public or private parties and the action will not result in disturbance of the floodplain or wetland, floodplain or wetland evaluation is not required. The conveyance document, however, shall specify:

1. Applicable restricted uses under Federal, State or local floodplain and wetland regulations.

2. Other appropriate restrictions to minimize destruction, loss, or degradation of floodplains and wetlands and to preserve and enhance their natural and beneficial values, except when prohibited by law or unenforceable by TVA or, otherwise, the property shall be withheld from conveyance or use.

If the disposition of TVA property rights in a floodplain or wetland potentially will result in disturbance to the floodplain or wetland, the proposed action shall be reviewed in accordance with sections 5.7.2.1 - 5.7.2.3.

5.8 Miscellaneous Procedures

5.8.1 Proposals for Legislation

Proposals for congressional legislation significantly affecting the quality of the human environment will require the preparation of an EIS (see 40 CFR 1506.8).

5.8.2 Private Applicants

In those cases when private applicants or other non-Federal entities propose to undertake an action that will require TVA's approval or involvement and fall within the scope of these procedures, the contacted office will as soon as possible notify the Environmental Quality Staff.

Each office will maintain information to advise potential applicants of studies or other data that may be required in connection with applications and will take reasonable steps to publicize accessibility of such information. The office charged with initiating action, upon the applicant's request, will in consultation with the Environmental Quality Staff when practicable advise the applicant of the information or studies (including the preparation of environmental documents, if necessary) that will be required in order to fulfill its responsibilities hereunder. The applicant must provide TVA sufficient information to allow an accurate determination of the environmental impacts of the proposed action. TVA may require that this information be submitted in the form of a written environmental report. If TVA is required to make investigations or otherwise incur additional expenses, the applicant may be charged for TVA's service. The Environmental Quality Staff, in consultation with the Office of the General Counsel, will also determine the need to consult early with appropriate Federal, State, and local agencies (including State and regional A-95 clearinghouses or their State/local coordination points); Indian tribes; and other interested persons regarding TVA's involvement in or approval of the applicant's proposed action and, where appropriate, should commence such consultation at the earliest practicable time.

5.8.3 Non-TVA EISs

The Environmental Quality Staff, in consultation with other interested offices, will coordinate the review of EISs provided to TVA for review by other Federal agencies. The Environmental Quality Staff, in consultation with the Office of the General Counsel, will prepare comments on such EISs and transmit any TVA comments to the initiating agency (see 40 CFR 1503.2 - 1503.3).

5.8.4 Supplemental Instruction

The Environmental Quality Staff, in consultation with interested offices and with concurrence of the Office of the General Counsel, may issue supplemental or explanatory instructions to these procedures.

5.8.5 Modifications of These Procedures

The assignments to offices in these procedures can be modified by agreement of the offices involved or by instructions from the General Manager.

5.8.6 Tiering

An initiating office may consider tiering the environmental review of a proposed action. Tiering involves coverage of general matters in broader environmental documents, and subsequent narrower analyses need only incorporate by reference the broader analyses (see 40 CFR 1508.28).

5.8.7 Combining Documents

Any environmental document may be combined with any other document to reduce duplication and paperwork.

5.8.8 Applicability to Ongoing Actions

These procedures shall not apply to those actions which have been approved under applicable procedures prior to the effective date of these procedures or for which an EA or a DEIS has already been prepared. No environmental documents need be redone by reason of the adoption of these revised procedures.

5.8.9 Consolidation of Reviews

Review of proposed actions under these procedures may be consolidated with other reviews where such consolidation would reduce duplication or increase efficiency.

5.8.10 Documents

The Environmental Quality Staff shall keep on file all final and approved environmental documents.

5.8.11 Substantial Compliance

Minor deviations from these procedures will be permitted, but in all respects substantial compliance must be achieved. Flexibility is the key to implementing these procedures and reviewing proposed actions.

5.8.12 Reducing Paperwork and Delay

These procedures are to be interpreted and applied with the aim of reducing paperwork and the delay associated with both assessment and implementation of a proposed action. In this regard, data and analyses shall be commensurate with the importance of associated impacts. Less important material should be summarized, consolidated, or referenced.

5.8.13 Office Responsible for NEPA Compliance Efforts

The Director of Environmental Quality is designated as that person responsible for overall NEPA compliance.

5.8.14 Status Reports

Information or status reports on EISs and other related NEPA compliance activities and documents may be obtained by writing to the Director of Environmental Quality, Tennessee Valley Authority, Knoxville, Tennessee 37902.

5.8.15 Public Participation

TVA's policy is to encourage public participation in all of its decision making. This policy is implemented through various mechanisms. TVA has open meetings of the Board of Directors. These Board meetings are widely publicized and include a question and answer session between the public and Board of Directors. TVA has established a Citizen Action Office whose responsibility is to maximize to the extent practicable the interchange of ideas between TVA and the public in the full range of TVA activities. In addition, TVA has set up a "Citizen Action Line" which allows members of the public to call in on toll-free lines to ask questions and make suggestions or comments to TVA. In line with TVA's broad policies, TVA intends to encourage and actively seek public participation in its NEPA review process. The type of and format for public participation will be selected as appropriate to best facilitate timely and meaningful public input into the review process.

FGDC Standard Programs and Processes	**CCP RHO&M Work Control**	**FGDC-SPP-07.007** **Rev. 0000** **Page 1 of 14**
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Approved by:

Electronic signature functionality is currently unavailable for use within the TVA Procedure templates. Replace this message with a TIF image of the applicable signature. General Manager, Coal Combustion Products	

Revision Log

Revision or Change Number	Effective Date	Affected Page Numbers	Description of Revision/Change
0	TBD	All	Initial issue.

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1.0 PURPOSE

This procedure specifies the general requirements and standard programmatic controls for the work controls process. The purpose of this procedure is to provide guidance for implementing a work control process that will maximize personnel safety, facility reliability, work productivity, assess, and manage facility risk. Work management is the process by which maintenance and modification work activities are identified, planned, scheduled, monitored and completed. Work control participants must recognize that work control is a fundamental, cross-functional process with a direct impact on facility condition.

NOTE

For the purpose of this procedure the term facility refers to storage containment facilities such as wet ponds / impoundments and dry stacks / landfills under the governance of the Coal Combustion Products group.

2.0 SCOPE

This procedure applies to all work activities that affect or have the potential to affect a Coal Combustion Products (CCP) asset. This procedure is responsible for ensuring that CCP, as a matter of policy and practice, makes every reasonable effort to maintain and enhance the safety of all facilities that are owned and operated by TVA. Key elements in this procedure include the work flow from identification of new work through recording, document close out and archiving. This procedure applies to all CCP facilities. This procedure designates Maximo as the work management tool for FGD&C. All Maximo tasks discussed herein shall be performed in accordance with the FGD&C Maximo Training Guide.

3.0 PROCESS

3.1 Roles and Responsibilities

RHO&M Foreman (TVA or Partner)

Reports facility deficiencies to the Routine Handling Operations & Maintenance (RHO&M) Field Supervisor when found. Provides peer reviews of planned work, communicates problems or recommendations about the work. Supplies required equipment and personnel to perform the work as planned.

RHO&M Field Supervisors

Responsible for the execution of all work conducted on-site. Ensure work is properly planned and reinforces the integration of employee feedback and continuous improvement. Monitor worker safety performance and continually model and reinforce the practices laid out in the TVA Safety Manual. Interface with the TVA Partners to ensure resources are available to work the schedule. Communicate with Work Control Program Manager when new work orders need to be written and, upon completion of work, ensure that Field Technicians have emailed the Program Manager, Work Control with all information needed to close the work package.

3.1 Roles and Responsibilities (continued)

RHO&M Construction Managers

Review the schedule to determine the impacts and ensure work can be implemented as planned. Perform constructability reviews on work orders prior to issuance to the field for implementation. Control emergent work decisions. The Construction Manager or his designee is responsible for sending weekly schedule updates to the Work Control Program Manager no later than Friday noon, at a minimum. More frequent updates are encouraged.

RHO&M Program Managers

Own the corrective backlog for assigned sites. Obtain scope, schedule and budget requirements for new work from sub contractor. Act as a focal point for work package preparation and problem resolution. Identify and prepare all permits, requests, etc. for any conditions. When requested, provides work plans to Work Control Program Manager for entry into Maximo. Identifies problems with implementation of work, provides updates as work activities complete or fail to complete, and when schedule threats are identified.

Program Manager, Work Control

Responsible for development and maintenance of work control procedures. Chairs weekly work control meetings. Develops and tracks work control indicators, and assigns corrective actions to address gaps. Responsible for training personnel in work control procedures and tools. Creates work orders and enters all documentation needed for document closeout. Archives work orders in the vault. Provides system health information to CCP Engineering. Prepares the schedule and updates the schedule based on input from responsible work groups. Prepares hard copies of the schedule for weekly review and supports the Program Managers and individual work groups with any needed schedule reports or other schedule information.

Field Technicians

Identify and document deficient areas noted during inspections. Perform walk downs of all completed work, verifying work was completed as planned. Upon work completion, notify Program Manager, Work Control of work order number, dates work began and was completed, condition as found, as left and details of work performed, along with any other relevant data such as lessons learned or suggestions for work package improvement. If needed, photographs of repairs may also be sent for entry into Maximo.

CCP Engineering Personnel

Work with program managers to set priorities for new corrective work. Provide technical support needed to troubleshoot and implement required work. Identify and supply technical support with implementation of work orders. Evaluates the overall performance on each facility and recommends any changes needed in the maintenance and repair. Work with Program Manager, Work Control to initiate work orders for all recommendations and designs issued from engineering and third party engineers.

Independent Third Party Engineering Company

3.1 Roles and Responsibilities (continued)

Issue design recommendations and provides technical support needed to troubleshoot and implement work orders. Provide QA/QC requirements and construction monitoring support for field implementation.

3.2 Program Elements

3.2.1 Planning and Scheduling Guidelines

A. Emergency Work

Emergency work may begin immediately, with only a verbal pre-job briefing. Work will continue until the situation has stabilized, at which time a work order will be issued and a work plan developed for the remaining work. Emergency work is defined as work required to mitigate a situation which is causing an immediate safety or environmental hazard.

B. Sponsored Work

Sponsored work is work which, while not an emergency, must be performed during the current work week (T-0). Prior to beginning sponsored work, a work order must be initiated and planned to the minimum requirements per FGDC Work Package Development.

C. Tool Pouch Maintenance

1. No work order or written documentation is needed for deficiencies which meet the following qualifications:

    a. The problem and its correction are self-evident and require no documentation or planning to initiate the work.

    b. Work can be completed within the current shift.

    c. No safety or environmental issues exist with performing the work.

    d. Work will not interrupt or otherwise affect scheduled activities.

    e. Work does not require that equipment to be de-energized or isolated.

    f. Work will not result in the potential for uncontrolled release of hazardous waste.

    g. Only minor or consumable parts are needed.

    h. No records are required for any part of the activity.

2. If, at any point during the performance of tool pouch maintenance, conditions change and the situation no longer meets the qualifications of tool pouch maintenance, work should immediately cease and a work order/work plan should be created.

3.2.1 Planning and Scheduling Guidelines (continued)

D. Minor Maintenance

1. Work which meets the below criteria is considered minor maintenance work and requires a simple one-page Maximo work order. No work package is required.

    a. No safety or environmental issues exist with performing the work.

    b. Work does not require that equipment to be de-energized or isolated.

    c. Work will not result in the potential for uncontrolled release of hazardous waste.

    d. No safety or environmental issues exist with performing the work.

    e. Work will not affect operation of the plant or systems.

    f. The work is limited in scope and within the skill set of the craftsman.

    g. Work does not require coordination between groups.

    h. Generic procedures can be used.

2. If at any point during the performance of minor maintenance conditions change and the situation no longer meets the qualifications of minor maintenance, work should immediately cease and a work plan should be developed. Minor maintenance is treated as job jar work and is not scheduled.

E. Deficiency Monitoring

Some deficiencies discovered during inspections or in the course of routine maintenance will not require immediate repair, but must be monitored on an ongoing basis. Deficiencies of this nature shall be documented in Maximo as “Other” work orders with a work type of “OTH". These work orders will not be included in the corrective work order backlog count, but will be provided to personnel during dike inspections for follow up. If conditions should change, the change should be documented in the log section of the Maximo work order, and photographs should be attached to the Maximo work order through the BSL. If the change is of a nature such that repairs have become necessary, the issue should be elevated to the CCP Construction Supervisor for consideration as emergent work. If the issue is not urgent and can be scheduled for work at a later date, the CCP Construction Supervisor should notify the RHO&M Program Manager to change the work type to corrective maintenance and re-introduce the work order at the weekly work order review meeting for prioritization and placement in the schedule.

F. Complex Corrective Maintenance

Work which does not fall into the above categories is considered a complex corrective maintenance and will require a Maximo work order and a full work package. This work will be scheduled. These jobs may:

1. Require coordination from more than one crew.

3.2.1 Planning and Scheduling Guidelines (continued)

2. Require special permits or clearances.

3. Require special tools or equipment which are not normally kept on site.

4. Have high safety or environmental risks involved in performing the work.

5. Involve a complicated work plan or tasks which are beyond the normal skill range of the worker in the field.

6. Require in-depth planning or coordination with another group's scheduled activities.

3.2.2 Weekly Work Order Review Group

A. A work order review group shall meet once weekly to review new work orders. The meeting will be chaired by Program Manager, Work Control or designee. The group shall review all new work orders and return to the originating organization any that do not contain sufficient detail to adequately define the problem. Additional meetings may be called if needed.

B. The weekly review team will be responsible for performing the following duties:

1. Review and categorize all work orders generated since the last review group meeting (with the exception of auto-generated PM work orders) based upon the expertise and experience of the team members.

2. Cancel duplicate and unnecessary work orders. Determine if work fits criteria for minor maintenance. If not, assign the appropriate sub-priority, job details, and scheduling codes (to include planner and target schedule dates) to new work orders

3. Determine whether service request initiator has correctly checked the "Recommend PER" box and the "Recommend DCN"

4. Determine and set in motion any compensatory actions needed to ensure that CCP equipment / assets could safely operate until repaired if it is to remain available or in service. If compensatory actions are assigned, they will be entered into the log section of the appropriate work order by the Work Control Program Manager.

a. Attendees:

b. RHO&M Construction Manager(s) - Optional

c. RHO&M Program Manager(s) - Optional

d. RHO&M PER Coordinator - Required

e. CCP Engineering Personnel - Required

f. Program Manager, Work Control - Required

3.2.2 Weekly Work Order Review Group (continued)

3.2.3 Work Order Planning

Work Orders shall be planned in accordance with FGDC Work Package Development. If work orders cannot be planned and executed in accordance with the target schedule date assigned in the daily review group meeting, the responsible program manager should notify the Program Manager, Work Control.

3.2.4 Schedule Review and Job Walkdown

A copy of the schedule and hard copies of any required work packages shall be provided to the Field Supervisor and Foreman no later than Monday of T-1. (The week prior to schedule execution.) The Field Supervisor and Foreman should walk down the jobs and review the work packages, and reply to their respective RHO&M Program Manager and Construction Manager with concurrence or identified issues no later than Thursday of T-1. The Program Manager, Work Control, should be copied on the response from the Field Supervisor/Foreman. If issues cannot be resolved by Thursday afternoon of T-1, the work shall be removed from the schedule and rescheduled for a later date. If any work is determined to be generation sensitive, FGD&C personnel will refer to FPG Control of Generation Sensitive Activities and will coordinate with the plant accordingly.

3.2.5 Work Execution

All work shall be performed in accordance with “TVA Plan Work Safely”. The performing organization shall, within one week of work completion, email notes on the work order to describe the condition as found, as left, and all work performed. The performing organization will notify the Work Control Program Manager of any corrective work orders which need to be entered on new deficiencies discovered during the course of the work which cannot be worked under the existing work scope. The Construction Manager or his designee is responsible for sending weekly schedule updates to the Work Control Program Manager no later than Friday noon, at a minimum. More frequent schedule updates are encouraged

4.0 RECORDS

4.1 QA Records

None

4.2 Non-QA Records

Any records generated as a result of this procedure are to be filed and retained in accordance with the Fossil Generation Development & Construction (FGD&C) Comprehensive Records Schedule (CRS)

5.0 DEFINITIONS

Long - Term Maintenance Plan (Rolling Schedule) A twelve week rolling maintenance schedule will be maintained, the backbone of which is the preventive maintenance process. All corrective work shall be documented on a Maximo corrective work order unless the work is specifically exempted as tool pouch in the attached appendix. These work orders shall be scheduled per the weekly review committee determination.

Emergent Work - Any unscheduled activity that must be performed to maintain operations or to sustain the integrated CCP schedule.

Emergency Work - Emergency work that poses an immediate threat to personnel safety, environment, and unit operation.

Maximo - The computerized maintenance management system.

Work Order - A sequentially numbered document generated in the MAXIMO system for the purpose of initiating a work activity.

Work Package - A single work order or a series of work orders linked to a master document for the purpose of packaging or sourcing all the data/instructions/information necessary to perform an item of work.

6.0 REFERENCES

A. FGDC Work Package Development (Under Development)

B. FGD&C Maximo Training Guide (Under Development)

C. TVA Plan Jobs Safely

Appendix A
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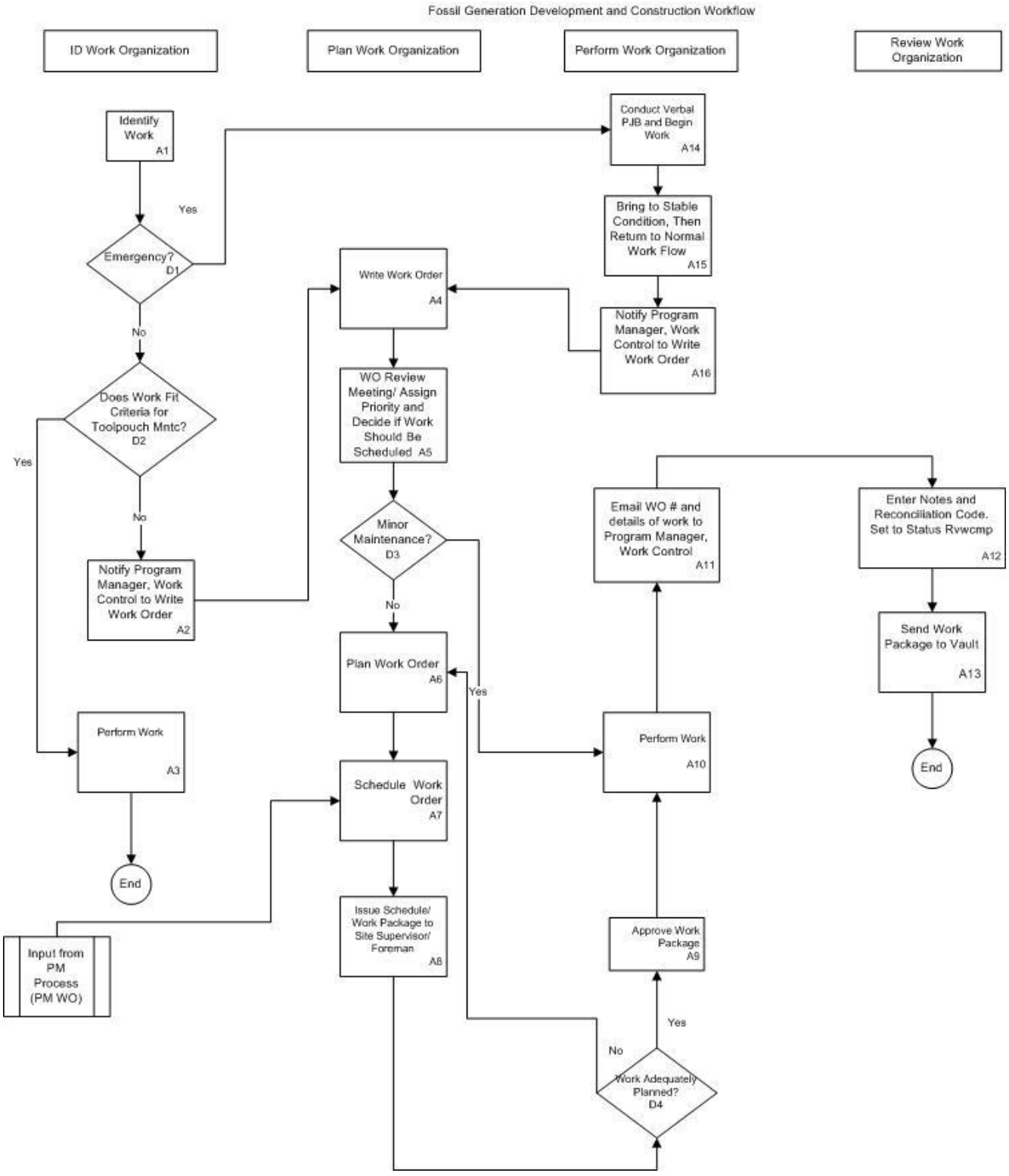
Process Flowchart



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Process Flowchart

A. **Activity Box A1:** Identify Work **-** Personnel typically responsible for authorizing work package initiation are designated by the Department Managers.

B. **Decision Block D1** - Does identified work fit the criteria for emergency work? If yes, continue to Activity Box A14. If no, continue to Decision Block D2.

C. **Activity Box A14:** Conduct verbal pre-job briefing and begin work. This work may only continue to the point that the situation is stable and an immediate safety/environmental hazard no longer exists.

D. **Activity Box A15:** After situation is stable, return to normal workflow.

E. **Activity Box A16:** Notify Program Manager, Work Control to create work order.

F. **Decision Block D2:** Does work qualify as Toolpouch Maintenance? If so, continue to Activity Block A3. If no, continue to Activity Box A2.

G. **Activity Box A2:** Notify Program Manager, Work Control to write a work order.

H. **Activity Box A4**: Write work order to TVA standard.

I. **Activity Box A5:** Present work order in weekly review meeting. Assign priority by consensus and determine if work order should be scheduled.

J. **Activity Box A6:** Plan work order per FGDC Work Package Development.

K. **Activity Box A7:** Populate Maximo Schedule Start Date. Schedule date will pass through interface to correct date on the scheduling tool. This schedule will be provided to CCP scheduler for integrated schedule.

L. **Activity Box A8:** Issue work package/ schedule to for approval.

M. **Decision Block D4:** Determine if job is properly planned. If no, work package is returned to the preparer. (Activity Block A6.) If yes, continue to Activity Block A9.

N. **Activity Box A9:** Communicate approval of schedule/work package to RHO&M Construction Manager and Program Manager, Work Controls.

O. **Activity Box A10:** Perform Work.

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Process Flowchart

P. **Activity Box A11:** Email WO# to Program Manager, Work Control with data regarding condition as found, as left and all work performed, to include methods of post maintenance testing and any data derived from it. Email should additionally include the below items:

1. All Process and Configurations changes must be properly documented and communicated.

2. Problems specific to this work package discovered while performing this work should be captured and analyzed. The problem and analysis may be captured in the feedback tab of the Maximo Work Order before closing the work order and tracked automatically thru the feedback application in Maximo.

3. Deficiencies in the work plan/ work package must be reviewed to identify process improvements, which can be incorporated into future work packages of similar scope throughout TVA. This should be captured thru the Feedback application in Maximo.

4. There may be information developed or discovered during the performance of work, which needs to be captured for the benefit of others who may perform this work at some future time.

Q. **Activity Block A12:** Program Manager, Work Control enters notes on Maximo work order, enters any other needed information, and reviews package for completeness and accuracy of notes/documentation. Place work order in Review Complete (Revwcmp) status.

R. **Activity Block A15**: Program Manager, Work Control sends work package to vault.

Source Notes
(Page 1 of 1)

Requirements Statement	Source Document	Implementing Statement
This document does not contain internal or external commitments or requirements.	N/A	N/A

1113 Clay Dike Restrictions

The Clay Dike Restrictions project is scheduled for completion on September 2, 2011. It should be inserted in this section upon completion.

1200 Work Packages

A list of work packages for Kingston Fossil Plant is not available at this time. However, an example package for Kingston Fossil Plant is included herein.

Fossil By Products
Work Package Cover Sheet

Location: Kingston Fossil Plant **Project Supervisor:**

Work Order No: **Date:**

Work Package Desc: Kingston General Site Support Work Plan

Component / Step

	YES	NO	N/A	
1	X			*STEP TEXT (REQUIRED)*
2	X			*SAFETY ANALYSIS (JSA) (REQUIRED)*
3	X			*PERMIT LIST / HOLD ORDER BOUNDARIES (REQUIRED)*
4	X			*PRE-JOB BRIEFING CHECKLIST (REQUIRED)*
5			X	POTENTIAL PROBLEM ANALYSIS (PPA)
5	X			ENVIRONMENTAL ANALYSIS (CEC)
6	X			MATERIAL LIST
7	X			DRAWINGS / SPECIFICATIONS / MANUALS
8			X	CONFIGURATION MANAGEMENT
9			X	PMT REQUIREMENTS
10			X	GSA
11			X	FME
12	X			TURNOVER CHECKLIST

Purpose / Problem Description:

A general site support work plan for Kingston Fossil Plant is required to provide a basic plan to safely and efficiently address various routine site repairs and for rapid response to requests by KIF plant personnel. This plan shall address the need to perform routine work on site in order to maintain roads, drainage ditches, etc. and to remove undesirable brush, vegetation, etc. as requested or identified as needed. Many requests are small in nature and require rapid response to address the issues at hand.

Scope of Work:

Perform routine required maintenance to site roads, haul roads, drainage ditches, etc. as requested or as needed to repair site travel paths. Remove undesired brush, tall grasses, and other indentified vegetation as needed. Comply with KIF plant personnel's request for the performance of requested tasks that are small in nature and usually short in duration. Requested work that is deemed by the Site Supervisor as extensive in manpower and time required, shall require a work package be developed to address such requests.

Prepared By: Bob Gilchrist **Reviewed By:**
Revised By: Judith "Wanda" Sumerel

Approved By: **Date:**

Meet all Work Package Requirements: **YES** X **NO** **If No, why?**

Optional Supplementary Documentation (References):

	Yes	NO	N/A	Component / Step	File / Location
1	X			Project Funding Approvals	File Server
2	X			Scope Documents	
3	X			Authorizations	
4	X			Estimate Details	
5	X			Schedule	
6	X			Experience Review / Lessons Learned	

17814 [1-2004]

Location: Kingston Fossil Plant

Work Order No: 0 **Date:** 1/0/00

Work Package Desc: Kingston General Site Support Work Plan

Note 1		**Perform daily (minimum) pre-job briefings with crew. Each employee will have a pre-job briefing before each assignment, detailing the scope of the assigned task, the possible hazards, and steps to mitigate the identified hazards. Should the employee's daily assigned task be changed, a subsequent pre-job briefing will be given. Document briefings with signatures, and file in this Work Package.**
Note2		**Anytime the work package is found to have a change in the plan, or a deficient area of instruction, work will be stopped and the document shall be revised and approved by all managers / engineering involved prior to re-start of the work. There will be no exceptions.**
Note3		**This step text is arranged in sequence but is not intended for strict compliance. The site supervisor and foreman may change the sequence in which the work is performed, providing the sequence change has no negative impact on job safety or work quality.**
Note4		**A new "Material Load and Unload Checklist" has been added to this work plan. The checklist is located in the page tab named "Material Load Unload Checklist". Due to previous critical incidents at other sites while unloading materials, ensure that this checklist is used before loading or unloading materials at Kingston Fossil Plant.**
Step No.	**Initial & Date As Steps Are Completed**	**Work Description**
1		Each person assigned a task is to participate in/sign the prejob briefing and use the 2 minute rule in all processes before starting the task. Ask: How do I need to do it? Do I have the proper PPE? What is the procedure? New employees assigned to the job site, including contractors working beneath Supervisor or Forman's oversight, must have new personnel orientation.
2		Mobilize equipment and/or tools required to safely and efficiently perform the assigned task. Use the Material Loading/Unloading checklist before all loading or unloading activities. Due to recent incidents involving overhead power sources and support guide wires, Managers, Supervisors, and/or Foreman shall walk down their worksite to identify any potential Power Line/Guide Wire Hazard. View and discuss the electrical minimum safe working distance charts located in the "Safety Notes" tab of this work plan.
3		Employees must inspect their equipment and/or tools before work begins to ensure all are ready to perform as designed and can be operated safely. Personnel assigned to operate equipment must be qualified and familiar with the equipment they are required to use. Equipment checklists must be completed before equipment operation begins.
4		All personnel assigned to operate ATV's on Kingston Fossil Plant projects must review the operator's manuals and TVA Safety Procedure 601 "All Terrain Vehicles". (TSP 601 is included in the "Safety Notes" tab of this work plan). ATV's shall not exceed safe speeds on all dikes, berms, and dike roadways. No radio or cell phone communications may be used while the vehicle is in operation. Personal cell phone use is absolutely prohibited while operating ATV's on Kingston projects. Review and adhere to additional related information for safe ATV operation contained in the JSA of this work plan.
5		Haul and access roads on site are to be inspected daily by the CCP Site Supervisor/Foreman. All haul roads to and from spoils areas, site ponds, material staging areas, site dike improvement project areas, etc. shall be inspected and repaired as needed. When required, use grader, dozer, etc. to cut the road surfaces to remove washes, pot holes, soft spots, or other rough road imperfections. The graded materials may be spread evenly over the road's surface and compacted to provide a uniform surface for travel. As needed, and when deemed necessary by Site Supervisor, additional crushed stone or similar materials shall be hauled and spread to provide additional cover to provide improved road surfaces.
6		Drainage/run-off ditches will require the use of an excavator or equivalent piece of equipment to remove sediment materials in order for the ditches to perform as designed. Make repairs to eroded areas, wash-outs, etc. as required or when requested. Install or add rip rap stone as needed in eroded areas as needed to deter excessive materials migration. Materials removed during clean-out of ditches, run-offs, sediment ponds, etc. shall be loaded into dump trucks to be carried to the applicable spoils area for disposal.

Location: Kingston Fossil Plant

Work Order No: 0 **Date:** 1/0/00

Work Package Desc: Kingston General Site Support Work Plan

Note 1		**Perform daily (minimum) pre-job briefings with crew. Each employee will have a pre-job briefing before each assignment, detailing the scope of the assigned task, the possible hazards, and steps to mitigate the identified hazards. Should the employee's daily assigned task be changed, a subsequent pre-job briefing will be given. Document briefings with signatures, and file in this Work Package.**
Note2		**Anytime the work package is found to have a change in the plan, or a deficient area of instruction, work will be stopped and the document shall be revised and approved by all managers / engineering involved prior to re-start of the work. There will be no exceptions.**
Note3		**This step text is arranged in sequence but is not intended for strict compliance. The site supervisor and foreman may change the sequence in which the work is performed, providing the sequence change has no negative impact on job safety or work quality.**
Note4		**A new "Material Load and Unload Checklist" has been added to this work plan. The checklist is located in the page tab named "Material Load Unload Checklist". Due to previous critical incidents at other sites while unloading materials, ensure that this checklist is used before loading or unloading materials at Kingston Fossil Plant.**
Step No.	**Initial & Date As Steps Are Completed**	**Work Description**
7		When required and/or directed by the Site Supervisor, make temporary repairs using SWPP BMP's such as silt fence repair, placing of straw bales, straw eels, check dams, and/or addition of riprap in ditches periodically. These potential repairs are required for proper erosion control and to limit material migration. Details for erosion and sediment control features are covered in General Construction Specification T-1. Should new or additional silt fencing be required, ensure plant personnel are contacted in order to inquire for an excavation permit should one be required in the area.
8		Cut undesired vegetation on site as required or requested. Walk down and inspect all areas requiring vegetation removal before any cutting activities begin. Identify and flag areas in the proposed vegetation removal area that are deemed hazardous to the cutting operation, such as holes, scrap materials, stumps, etc. Ensure that personnel assigned to walk down the areas to be cut wear all appropriate required PPE. For larger areas of vegetation cutting, use a tractor with bush hog attachment. Use a side boom cutter to cut vegetation in areas where the machine can be located on flat, stable ground but the slope area is too steep for other equipment travel. Such areas include inside slopes of ponds, roadways, and other areas identified by the Site Supervisor. Utilize a spotter during these cutting operations, ensuring the spotter remains a minimum of 200 feet from the cutting operations. All operations must stop when on coming traffic approaches. Operations may resume after traffic has passed 200 feet from area being cut.
9		In areas that cannot be safely reached by equipment and/or areas deemed too small to involve larger equipment, all vegetation cutting will be performed manually by personnel using power pruners, weed/brush cutters, hedge trimmers, chain saws, etc. Personnel shall walk down the area before cutting begins to identify and flag potential hazard areas, such as holes, soft spots, areas of slick/poor footing, etc. All required PPE shall be worn at all times during vegetation removal, including hard hats, gloves, goggles/face shields, protective leggings, etc. During warm weather operations, snake boots and snake leggings shall be worn. All employees operating chainsaws must have received the training course "Chain Saw Safety", ATIS Number 00059105.
10		All fuel handling safety processes and procedures must be used when providing fuel for general site support projects equipment. Ensure a spill kit is on hand and available during all fueling operations. The foreman's truck with fuel tank located in the truck bed may be used for fueling operations when fueling in the field is required.
11		Perform erosion control tasks as required or requested by promoting vegetative cover growth in identified areas. Restore the area cover by spreading seed and fertilizer and then covering with soil erosion reduction materials, such as hay, straw, curlex, or other suitable products used in erosion stabilization. Attention to details is advantageous when working on all sloped areas in order to avoid slipping, tripping, or falling during the distribution of the materials over the surface.
12		The project area should be picked up daily. Equipment cabs should be free of scrap paper, rags, etc. All debris and job related waste should be disposed of in a manner acceptable to the Kingston Site Environmental Representative.

Location: Kingston Fossil Plant

Work Order No: 0 **Date:** 1/0/00

Work Package Desc: Kingston General Site Support Work Plan

Note 1		**Perform daily (minimum) pre-job briefings with crew. Each employee will have a pre-job briefing before each assignment, detailing the scope of the assigned task, the possible hazards, and steps to mitigate the identified hazards. Should the employee's daily assigned task be changed, a subsequent pre-job briefing will be given. Document briefings with signatures, and file in this Work Package.**
Note2		**Anytime the work package is found to have a change in the plan, or a deficient area of instruction, work will be stopped and the document shall be revised and approved by all managers / engineering involved prior to re-start of the work. There will be no exceptions.**
Note3		**This step text is arranged in sequence but is not intended for strict compliance. The site supervisor and foreman may change the sequence in which the work is performed, providing the sequence change has no negative impact on job safety or work quality.**
Note4		**A new "Material Load and Unload Checklist" has been added to this work plan. The checklist is located in the page tab named "Material Load Unload Checklist". Due to previous critical incidents at other sites while unloading materials, ensure that this checklist is used before loading or unloading materials at Kingston Fossil Plant.**
Step No.	**Initial & Date As Steps Are Completed**	**Work Description**
13		Conduct a post job briefing at the end of each shift, or at the end of the assigned task. Encourage employees to provide input during the briefings to provide added opportunity to improve safety and performance processes and procedures.
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Date:	**1/0/00**	**Project Supervisor/Foreman:**	**0**
Location:	**Kingston Fossil Plant**		
Work Order No:	**0**		
Work Package Desc:	**Kingston General Site Support Work Plan**		
Prepared By:	**Bob Gilchrist**		
Reviewed By:	**0**	**Approved By:**	**0**
Skills Required:	**Qualified Operators and Teamsters, Skilled Laborers**		
Required Personal Protective Equipment:	**Hard Hats, Safety Glasses, Face Shield, Safety Vest, Gloves, Hearing Protection, Adequate Footwear For Foot Protection, Snake Boots/Snake Leggings When Applicable**		
Tools and Equipment Required:	**See Attached Tool and Equipment List**		
Job Preparation:	**Operators must be qualified for the equipment assigned to operate and have current S-5 Medical exam. Osha 10 training required for craft and contract personnel. All chain saw operators must have received the training course "Chain Saw Safety", ATIS Number 00059105.**		
Hazardous Materials:	**None**		

Type In White Cells Only

Step Number	Sequence of Basic Job Steps	Potential Accidents or Hazards	Recommended Safe Job Procedures
Note 1	**Perform daily (minimum) pre-job briefings with crew. Each employee will have a pre-job briefing before each assignment, detailing the scope of the assigned task, the possible hazards, and steps to mitigate the identified hazards. Should the employee's daily assigned task be changed, a subsequent pre-job briefing will be given. Document briefings with signatures, and file in this Work Package.**		
Note 2	**Anytime the work package is found to have a change in the plan, or a deficient area of instruction, work will be stopped and the document shall be revised and approved by all managers / engineering involved prior to re-start of the work. There will be no exceptions.**		
1	**Each person assigned a task is to participate in/sign the prejob briefing and use the 2 minute rule in all processes before starting the task. Ask: How do I need to do it? Do I have the proper PPE? What is the procedure? New employees assigned to the job site, including contractors working beneath Supervisor or Forman's oversight, must have new personnel orientation.**	New employees will not be familiar with assembly points, evacuation routes, accountability procedures, etc, causing increased exposure to new employees. Rule or knowledge based errors could lead to a variety of accidents or injuries.	If performing personnel are new to the job site, conduct new personnel orientation. Discuss emergency alarms, evacuation routes, location of assembly points, personnel accountability procedures, route to local hospital and or Medical Facility. Report all incidents and injuries to Supervisor, no matter how minor they are. View additional safety notes located on the "Notes" page of this work plan that are applicable to this assigned work.

Date:	**1/0/00**	**Project Supervisor/Foreman:**	**0**
Location:	**Kingston Fossil Plant**		
Work Order No:	**0**		
Work Package Desc:	**Kingston General Site Support Work Plan**		
Prepared By:	**Bob Gilchrist**		
Reviewed By:	**0**	**Approved By:**	**0**
Skills Required:	**Qualified Operators and Teamsters, Skilled Laborers**		
Required Personal Protective Equipment:	**Hard Hats, Safety Glasses, Face Shield, Safety Vest, Gloves, Hearing Protection, Adequate Footwear For Foot Protection, Snake Boots/Snake Leggings When Applicable**		
Tools and Equipment Required:	**See Attached Tool and Equipment List**		
Job Preparation:	**Operators must be qualified for the equipment assigned to operate and have current S-5 Medical exam. Osha 10 training required for craft and contract personnel. All chain saw operators must have received the training course "Chain Saw Safety", ATIS Number 00059105.**		
Hazardous Materials:	**None**		

Type In White Cells Only

Step Number	Sequence of Basic Job Steps	Potential Accidents or Hazards	Recommended Safe Job Procedures
2	**Mobilize equipment and/or tools required to safely and efficiently perform the assigned task. Use the Material Loading/Unloading checklist before all loading or unloading activities. Due to recent incidents involving overhead power sources and support guide wires, Managers, Supervisors, and/or Foreman shall walk down their worksite to identify any potential Power Line/Guide Wire Hazard. View and discuss the electrical minimum safe working distance charts located in the "Safety Notes" tab of this work plan.**	Equipment activity and movement could result in strike and contact type accidents. Equipment could overturn while off loading from trucks or trailers. Operators could fall getting into or out of equipment. Personnel in area could be injured if struck or contacted by equipment. Equipment could be damaged and/or personnel could be injured by equipment striking surrounding structures, power poles, etc during unloading and staging of equipment.	Flagman/spotter shall be used as needed while equipment is being unloaded and staged. Workers must wear all appropriate PPE during loading and unloading processes, including high visibility fluorescent vests. Operators must be familiar with and qualified to operate the assigned equipment. All personnel not immediately involved in the equipment unloading and staging must remain clear of this area.
3	**Employees must inspect their equipment and/or tools before work begins to ensure all are ready to perform as designed and can be operated safely. Personnel assigned to operate equipment must be qualified and familiar with the equipment they are required to use. Equipment checklists must be completed before equipment operation begins.**	Contact with pinch points during inspections. Employees contacted by sharp objects, metal burrs, etc. causing puncture wounds. Fingers/hands caught between equipment cabs and doors, etc. Falls to below, Foot level fall.	Read and understand the instructions in the manufacturer's operating manual for each tool or equipment to be used. All equipment/tool protective guards must be in place. Tools or equipment with deficiencies that affect safe operations shall not be operated until corrected. Operators must be qualified for the equipment assigned to operate per TVA Safety Procedure 711, "Heavy Equipment Operations." Employees must wear all appropriate PPE during equipment/tool inspections.

Date:	**1/0/00**	**Project Supervisor/Foreman:**	**0**
Location:	**Kingston Fossil Plant**		
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Prepared By:	**Bob Gilchrist**		
Reviewed By:	**0**	**Approved By:**	**0**
Skills Required:	**Qualified Operators and Teamsters, Skilled Laborers**		
Required Personal Protective Equipment:	**Hard Hats, Safety Glasses, Face Shield, Safety Vest, Gloves, Hearing Protection, Adequate Footwear For Foot Protection, Snake Boots/Snake Leggings When Applicable**		
Tools and Equipment Required:	**See Attached Tool and Equipment List**		
Job Preparation:	**Operators must be qualified for the equipment assigned to operate and have current S-5 Medical exam. Osha 10 training required for craft and contract personnel. All chain saw operators must have received the training course "Chain Saw Safety", ATIS Number 00059105.**		
Hazardous Materials:	**None**		

Type In White Cells Only

Step Number	Sequence of Basic Job Steps	Potential Accidents or Hazards	Recommended Safe Job Procedures
4	**All personnel assigned to operate ATV's on Kingston Fossil Plant projects must review the operator's manuals and TVA Safety Procedure 601 "All Terrain Vehicles". (TSP 601 is included in the "Safety Notes" tab of this work plan). ATV's shall not exceed safe speeds on all dikes, berms, and dike roadways. No radio or cell phone communications may be used while the vehicle is in operation. Personal cell phone use is absolutely prohibited while operating ATV's on Kingston projects. Review and adhere to additional related information for safe ATV operation contained in the JSA of this work plan.**	ATV's being struck by other equipment. Tipping, or lose of control of ATV, causing equipment damage or personnel injury. Running off embankments/Rolling over. Striking against other workers. Striking other equipment. Falling out of ATV.	Seat belts must be fastened at all times when ATV is in transit. All appropriate PPE must be worn and self checking shall be applied. Pre-trip inspections must be completed. Absolutely no communication radio or cell phone use is allowed during ATV movement. All personal cell phone use is prohibited. Review TSP 601 for ATV operations. Operators must be aware of their surroundings at all times and yield to pedestrians and crosswalk requirements to stop. Passengers shall only be permitted when the vehicle is equipped with the manufacturers approved seating for passengers. ATV operators shall not exceed safe operating speeds on all dikes, berms, and dike roadways. Equipment must not be operated under the influence of drugs, alcohol, or impairing medications.

Date:	**1/0/00**	**Project Supervisor/Foreman:**	**0**
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Prepared By:	**Bob Gilchrist**		
Reviewed By:	**0**	**Approved By:**	**0**
Skills Required:	**Qualified Operators and Teamsters, Skilled Laborers**		
Required Personal Protective Equipment:	**Hard Hats, Safety Glasses, Face Shield, Safety Vest, Gloves, Hearing Protection, Adequate Footwear For Foot Protection, Snake Boots/Snake Leggings When Applicable**		
Tools and Equipment Required:	**See Attached Tool and Equipment List**		
Job Preparation:	**Operators must be qualified for the equipment assigned to operate and have current S-5 Medical exam. Osha 10 training required for craft and contract personnel. All chain saw operators must have received the training course "Chain Saw Safety", ATIS Number 00059105.**		
Hazardous Materials:	**None**		

Type In White Cells Only

Step Number	Sequence of Basic Job Steps	Potential Accidents or Hazards	Recommended Safe Job Procedures
5	**Haul and access roads on site are to be inspected daily by the CCP Site Supervisor/Foreman. All haul roads to and from spoils areas, site ponds, material staging areas, site dike improvement project areas, etc. shall be inspected and repaired as needed. When required, use grader, dozer, etc. to cut the road surfaces to remove washes, pot holes, soft spots, or other rough road imperfections. The graded materials may be spread evenly over the road's surface and compacted to provide a uniform surface for travel. As needed, and when deemed necessary by Site Supervisor, additional crushed stone or similar materials shall be hauled and spread to provide additional cover to provide improved road surfaces.**	Personnel in the vicinity could be struck by equipment or materials. Equipment could strike other equipment or other vehicles on road, causing injury to personnel and/or equipment damage. The operator when getting on and off the equipment could be subject to: Fall to below, foot level fall. Operating equipment on uneven ground subject the equipment and operator to tipping, lose of control of equipment, and/or damage to equipment.	Keep equipment steps and rails free of mud, grease, and other slick materials that may contribute to falls when entering or exiting equipment. Always use flagman, warning indicators, barricades, etc. as necessary when making repairs in close proximity to other work and on roads with vehicle and/or equipment traffic. Be aware of all obstructions above ground and any detected below ground. Operators shall use side mirrors while backing and also use flag person if needed for direction. While loading trucks, or other equipment load from driver's side of vehicle or from rear if at all possible. Read and understand operators' manual for each type of equipment to be operated. Equipment with deficiencies that affect safe operations shall not be operated until corrected. Use right machine for job. Operators shall be trained and qualified for the equipment they are to operate. TVA Safety Procedures 711 " Heavy Equipment Operations" is applicable and provides detailed instructions.

Date:	**1/0/00**	**Project Supervisor/Foreman:**	**0**
Location:	**Kingston Fossil Plant**		
Work Order No:	**0**		
Work Package Desc:	**Kingston General Site Support Work Plan**		
Prepared By:	**Bob Gilchrist**		
Reviewed By:	**0**	**Approved By:**	**0**
Skills Required:	**Qualified Operators and Teamsters, Skilled Laborers**		
Required Personal Protective Equipment:	**Hard Hats, Safety Glasses, Face Shield, Safety Vest, Gloves, Hearing Protection, Adequate Footwear For Foot Protection, Snake Boots/Snake Leggings When Applicable**		
Tools and Equipment Required:	**See Attached Tool and Equipment List**		
Job Preparation:	**Operators must be qualified for the equipment assigned to operate and have current S-5 Medical exam. Osha 10 training required for craft and contract personnel. All chain saw operators must have received the training course "Chain Saw Safety", ATIS Number 00059105.**		
Hazardous Materials:	**None**		

Type In White Cells Only

Step Number	Sequence of Basic Job Steps	Potential Accidents or Hazards	Recommended Safe Job Procedures
6	**Drainage/run-off ditches will require the use of an excavator or equivalent piece of equipment to remove sediment materials in order for the ditches to perform as designed. Make repairs to eroded areas, wash-outs, etc. as required or when requested. Install or add rip rap stone as needed in eroded areas as needed to deter excessive materials migration. Materials removed during clean-out of ditches, run-offs, sediment ponds, etc. shall be loaded into dump trucks to be carried to the applicable spoils area for disposal.**	The operator when getting on and off the equipment could be subject to: Fall to below, foot level fall. Operating equipment on uneven ground subject the equipment and operator to tipping, lose of control of equipment, and/or damage to equipment. Personnel in the vicinity could be struck by equipment or materials. Equipment could strike other equipment or other vehicles on road, causing injury to personnel and/or equipment damage.	Always use flagman, warning indicators, barricades, etc. as necessary when making repairs in close proximity to other work and on roads with vehicle and/or equipment traffic. Read and understand operators' manual for each type of equipment to be operated. Equipment with deficiencies that affect safe operations shall not be operated until corrected. Use right machine for job. Operators shall be trained and qualified for the equipment they are to operate. TVA Safety Procedures 711 " Heavy Equipment Operations" is applicable and provides detailed instructions. Be aware of all obstructions above ground and any detected below ground. When using a track hoe, always excavate between the tracks, not over the side. Operators shall use side mirrors while backing and also use flag person if needed for direction. While loading trucks, or other equipment load from driver's side of vehicle or from rear if at all possible.

Date:	**1/0/00**	**Project Supervisor/Foreman:**	**0**
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Skills Required:	**Qualified Operators and Teamsters, Skilled Laborers**		
Required Personal Protective Equipment:	**Hard Hats, Safety Glasses, Face Shield, Safety Vest, Gloves, Hearing Protection, Adequate Footwear For Foot Protection, Snake Boots/Snake Leggings When Applicable**		
Tools and Equipment Required:	**See Attached Tool and Equipment List**		
Job Preparation:	**Operators must be qualified for the equipment assigned to operate and have current S-5 Medical exam. Osha 10 training required for craft and contract personnel. All chain saw operators must have received the training course "Chain Saw Safety", ATIS Number 00059105.**		
Hazardous Materials:	**None**		

Type In White Cells Only

Step Number	Sequence of Basic Job Steps	Potential Accidents or Hazards	Recommended Safe Job Procedures
7	**When required and/or directed by the Site Supervisor, make temporary repairs using SWPP BMP's such as silt fence repair, placing of straw bales, straw eels, check dams, and/or addition of riprap in ditches periodically. These potential repairs are required for proper erosion control and to limit material migration. Details for erosion and sediment control features are covered in General Construction Specification T-1. Should new or additional silt fencing be required, ensure plant personnel are contacted in order to inquire for an excavation permit should one be required in the area.**	Employees being struck by equipment or materials. Equipment striking against other equipment. Strains/Sprains or pinch points while placing straw, eels, silt fencing, etc. Falls to below. Foot level falls. Tipping, lose of control of equipment.	Proper PPE must be worn by all employees at all times when work is in progress. All personnel should be familiar with TVA Safety Procedures that pertain to the assigned task: TVA Safety Procedures 304-Eye & Face, 307-Feet, 308 -Hand, 309-Head, and 310-Hearing Protection all apply. Operators shall be familiar with and qualified to operate the assigned equipment. All equipment checks must be completed to ensure the equipment can be operated as designed and safely. Operators must be aware of all other employees working in the immediate area. Employees working on silt fence, straw eels, straw etc, shall remain aware of pinch points and shall use good ergonomic positioning to deter strains and sprains. All personnel must stay aware of their surroundings and maintain good footing at all times.

Date:	**1/0/00**	**Project Supervisor/Foreman:**	**0**
Location:	**Kingston Fossil Plant**		
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Prepared By:	**Bob Gilchrist**		
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Skills Required:	**Qualified Operators and Teamsters, Skilled Laborers**		
Required Personal Protective Equipment:	**Hard Hats, Safety Glasses, Face Shield, Safety Vest, Gloves, Hearing Protection, Adequate Footwear For Foot Protection, Snake Boots/Snake Leggings When Applicable**		
Tools and Equipment Required:	**See Attached Tool and Equipment List**		
Job Preparation:	**Operators must be qualified for the equipment assigned to operate and have current S-5 Medical exam. Osha 10 training required for craft and contract personnel. All chain saw operators must have received the training course "Chain Saw Safety", ATIS Number 00059105.**		
Hazardous Materials:	**None**		

Type In White Cells Only

Step Number	Sequence of Basic Job Steps	Potential Accidents or Hazards	Recommended Safe Job Procedures
8	**Cut undesired vegetation on site as required or requested. Walk down and inspect all areas requiring vegetation removal before any cutting activities begin. Identify and flag areas in the proposed vegetation removal area that are deemed hazardous to the cutting operation, such as holes, scrap materials, stumps, etc. Ensure that personnel assigned to walk down the areas to be cut wear all appropriate required PPE. For larger areas of vegetation cutting, use a tractor with bush hog attachment. Use a side boom cutter to cut vegetation in areas where the machine can be located on flat, stable ground but the slope area is too steep for other equipment travel. Such areas include inside slopes of ponds, roadways, and other areas identified by the Site Supervisor. Utilize a spotter during these cutting operations, ensuring the spotter remains a minimum of 200 feet from the cutting operations. All operations must stop when on coming traffic approaches. Operations may resume after traffic has passed 200 feet from area being cut.**	Equipment or personnel being struck by other equipment working in or near cutting area, causing personal injury and/or equipment damage. Tipping or loss of control of equipment. Struck by flying debris from the cutting operation. Moving equipment or equipment parts striking against employees. Contact with moving traffic. Snake bites. Slips, trips, same level falls. Falls to below. Inclement weather events. Equipment fires.	TVA Safety Procedures 703 and 715 apply to these operations and shall be reviewed. Safety goggles/glasses, hearing protection, hard hat, and all required PPE must be worn during cutting operations. Pick up any trash or debris that can become airborne before removing vegetation. Before operating the tractor & bush hog, the operator shall be familiar with the operation manual, including speed, braking, and slope & steering capabilities of the equipment. Equipment shall have a fire extinguisher available should equipment fires occur. Walk around and inspect grass cutting equipment before each use. Before beginning operations, and before resuming cutting operations after meal period, inspect equipment for possible loose or missing wheel lug nuts. Should either missing or loose lug nuts be observed, the equipment shall not be operated until corrective repairs have been made. Tractors shall not mow horizontally on slopes greater than 3:1 . Use seat belt and ensure roll bar is in place. Disengage bush hog when traveling . Any embedded encroachments i.e. wells, drains, landmarks will be marked and identified to all operators. Snake boots/leggings shall be worn when needed for protection from possible snake bites. During lightning or other severe weather events, operations must stop and workers shall seek protective shelter.

Date:	**1/0/00**	**Project Supervisor/Foreman:**	**0**
Location:	**Kingston Fossil Plant**		
Work Order No:	**0**		
Work Package Desc:	**Kingston General Site Support Work Plan**		
Prepared By:	**Bob Gilchrist**		
Reviewed By:	**0**	**Approved By:**	**0**
Skills Required:	**Qualified Operators and Teamsters, Skilled Laborers**		
Required Personal Protective Equipment:	**Hard Hats, Safety Glasses, Face Shield, Safety Vest, Gloves, Hearing Protection, Adequate Footwear For Foot Protection, Snake Boots/Snake Leggings When Applicable**		
Tools and Equipment Required:	**See Attached Tool and Equipment List**		
Job Preparation:	**Operators must be qualified for the equipment assigned to operate and have current S-5 Medical exam. Osha 10 training required for craft and contract personnel. All chain saw operators must have received the training course "Chain Saw Safety", ATIS Number 00059105.**		
Hazardous Materials:	**None**		

Type In White Cells Only

Step Number	Sequence of Basic Job Steps	Potential Accidents or Hazards	Recommended Safe Job Procedures
9	**In areas that cannot be safely reached by equipment and/or areas deemed too small to involve larger equipment, all vegetation cutting will be performed manually by personnel using power pruners, weed/brush cutters, hedge trimmers, chain saws, etc. Personnel shall walk down the area before cutting begins to identify and flag potential hazard areas, such as holes, soft spots, areas of slick/poor footing, etc. All required PPE shall be worn at all times during vegetation removal, including hard hats, gloves, goggles/face shields, protective leggings, etc. During warm weather operations, snake boots and snake leggings shall be worn. All employees operating chainsaws must have received the training course "Chain Saw Safety", ATIS Number 00059105.**	Struck by brush, segments of vegetation being cut, or other materials hurled into operator during cutting activities. Coming in contact with cutting chain or cutting areas of tools, such as power pruners, brush cutters, chain saws, etc. Slips, falls to below while working on sloped surfaces. Contact by other equipment when working in close proximity to ongoing projects. Slips, trips, same level falls. Lightning or other inclement weather events. Strains, overexertion. (During warm weather operations, hazards will include: Insect bites. Snake bites. Heat stress.)	All proper PPE must be worn at all times during vegetative cutting operations including gloves, chaps or other approved leg protection, heavy duty footwear with cut-resistant material, hearing protection, eye protection, and hard hat. Stay aware of surroundings at all times and maintain good footing while using cutting tools and equipment. Use good ergonomic positioning to deter strains/sprains. Use a spotter and maintain a minimum of 20 feet distance between cutting operators. Stop all work during periods of lightning or extreme weather activity and take shelter. All chain saw operators must be trained and have received the training course "Chain Saw Safety", ATIS Number 00059105. Operators should read, understand, and follow TVA Safety Procedure 704 "Chain Saw Operations". (During warm season operations, snake leggings and boots shall be worn. Insect repellant shall be provided and worn as needed. During high heat periods, drink plenty of fluids and take breaks in the shade as needed.)

Date:	**1/0/00**	**Project Supervisor/Foreman:**	**0**
Location:	**Kingston Fossil Plant**		
Work Order No:	**0**		
Work Package Desc:	**Kingston General Site Support Work Plan**		
Prepared By:	**Bob Gilchrist**		
Reviewed By:	**0**	**Approved By:**	**0**
Skills Required:	**Qualified Operators and Teamsters, Skilled Laborers**		
Required Personal Protective Equipment:	**Hard Hats, Safety Glasses, Face Shield, Safety Vest, Gloves, Hearing Protection, Adequate Footwear For Foot Protection, Snake Boots/Snake Leggings When Applicable**		
Tools and Equipment Required:	**See Attached Tool and Equipment List**		
Job Preparation:	**Operators must be qualified for the equipment assigned to operate and have current S-5 Medical exam. Osha 10 training required for craft and contract personnel. All chain saw operators must have received the training course "Chain Saw Safety", ATIS Number 00059105.**		
Hazardous Materials:	**None**		

Type In White Cells Only

Step Number	Sequence of Basic Job Steps	Potential Accidents or Hazards	Recommended Safe Job Procedures
10	**Use the plant fuel truck to provide fuel for general site support projects equipment. Should any equipment requiring fueling be positioned where the fuel truck cannot access it safely, then the foreman's truck with fuel tank can be used for this application.**	Spills or leaks of oil, fuel, antifreeze, etc. Static electricity. Foot level falls. Exposure to fuels. Falls to below. Fires and/or explosions	Approved and required PPE to be used during fueling operations. Follow all site specific fueling transfer processes and TVA Safety Procedures. Use drip pans, oil absorbent pads established under leaks as spill prevention. Turn off equipment before refueling starts. Connect bonding cable /grounding cables to receiving equipment at a suitable grounding point during refueling. Ensure that the nozzle is in contact with receiving filler opening before transfer begins. Check all valves for proper settings and leaks. Ensure that all flame or spark producing activities are away from refueling operations. Keep a fire extinguisher available at all times. A spill kit and spill clean-up materials will be on site and in clear location at all times.

Date:	**1/0/00**	**Project Supervisor/Foreman:**	**0**
Location:	**Kingston Fossil Plant**		
Work Order No:	**0**		
Work Package Desc:	**Kingston General Site Support Work Plan**		
Prepared By:	**Bob Gilchrist**		
Reviewed By:	**0**	**Approved By:**	**0**
Skills Required:	**Qualified Operators and Teamsters, Skilled Laborers**		
Required Personal Protective Equipment:	**Hard Hats, Safety Glasses, Face Shield, Safety Vest, Gloves, Hearing Protection, Adequate Footwear For Foot Protection, Snake Boots/Snake Leggings When Applicable**		
Tools and Equipment Required:	**See Attached Tool and Equipment List**		
Job Preparation:	**Operators must be qualified for the equipment assigned to operate and have current S-5 Medical exam. Osha 10 training required for craft and contract personnel. All chain saw operators must have received the training course "Chain Saw Safety", ATIS Number 00059105.**		
Hazardous Materials:	**None**		

Type In White Cells Only

Step Number	Sequence of Basic Job Steps	Potential Accidents or Hazards	Recommended Safe Job Procedures
11	**Perform erosion control tasks as required or requested by promoting vegetative cover growth in identified areas. Restore the area cover by spreading seed and fertilizer and then covering with soil erosion reduction materials, such as hay, straw, curlex, or other suitable products used in erosion stabilization. Attention to details is advantageous when working on all sloped areas in order to avoid slipping, tripping, or falling during the distribution of the materials over the surface.**	Struck by truck delivering erosion control materials. Striking against rip rap material and/or other surface objects while placing ground cover materials around the edges of repaired areas. Contact by or contact with erosion control materials in eyes, nose, etc. Caught in positions to cause sprains and strains while handling and distributing materials. Fall to below and/or foot level falls while working on slopped surfaces, Tipping, lose of control of equipment, causing injury to personnel and/or damage to equipment.	Always use proper PPE and follow all TVA Safety Procedures applicable for the job being done. Be aware of surroundings at all times and use extra caution when working on uneven and/or sloped surfaces. Workers should be familiar with sections 307 (Foot Protection), 308 (Hand Protection), and 609 (Lifting/Handling Materials) from the TVA Safety Manual. Employees should use good ergonomic positioning to deter possible strains and sprains during material handling. Dust masks shall be provided and worn should conditions warrant during spreading of seed, fertilizer, straw, etc.
12	**The project area should be picked up daily. Equipment cabs should be free of scrap paper, rags, etc. All debris and job related waste should be disposed of in a manner acceptable to the Kingston Site Environmental Representative.**	Sprains, strains, etc. while moving materials for disposal. Struck by equipment working in close proximity. Possible pinch points between materials or between materials and equipment. Slips, trips, or falls to below. Same foot level falls.	Employees should be familiar with TVA Safety Procedures 304-Eye & Face, 307-Foot, 308 -Hand, 309-Head, and 310-Hearing Protection for this task. Supportive boots with slip resistant soles should be worn. TSP 609 "Lifting and Handling Materials in applicable to this task. Be observant for possible pinch points and wear protective work gloves to defend against possible puncture wounds during the handling of material for loading and disposal. If the material to be lifted is too heavy, stop and ask for help to avoid strains, sprains, and pulls.

Date:	**1/0/00**	**Project Supervisor/Foreman:**	**0**
Location:	**Kingston Fossil Plant**		
Work Order No:	**0**		
Work Package Desc:	**Kingston General Site Support Work Plan**		
Prepared By:	**Bob Gilchrist**		
Reviewed By:	**0**	**Approved By:**	**0**
Skills Required:	**Qualified Operators and Teamsters, Skilled Laborers**		
Required Personal Protective Equipment:	**Hard Hats, Safety Glasses, Face Shield, Safety Vest, Gloves, Hearing Protection, Adequate Footwear For Foot Protection, Snake Boots/Snake Leggings When Applicable**		
Tools and Equipment Required:	**See Attached Tool and Equipment List**		
Job Preparation:	**Operators must be qualified for the equipment assigned to operate and have current S-5 Medical exam. Osha 10 training required for craft and contract personnel. All chain saw operators must have received the training course "Chain Saw Safety", ATIS Number 00059105.**		
Hazardous Materials:	**None**		

Type In White Cells Only

Step Number	Sequence of Basic Job Steps	Potential Accidents or Hazards	Recommended Safe Job Procedures
13	**Conduct a post job briefing at the end of each shift, or at the end of the assigned task. Encourage employees to provide input during the briefings to provide added opportunity to improve safety and performance processes and procedures.**	**N/A**	**N/A**
14			
15	**0**		
16	**0**		
17	**0**		
18	**0**		
19	**0**		
20	**0**		
21	**0**		
22	**0**		

Location: Kingston Fossil Plant

Work Order No: 0 **Date:** 1/0/00

Work Package Desc: Kingston General Site Support Work Plan

ITEM	Qty	Description
1	1	Tractor/Bush-Hog
2	1	Tractor/Side Boom Cutter
3	1	ATV
4	1	R/T Backhoe
5	1	Dump Trucks
6	1	Track hoe
7	Various	Power Pruners, Weed Trimmers, Hedge Trimmers, Chain Saw
8	1	Grader
9	1	Dozer
10	1	Water Truck

Location:	**Kingston Fossil Plant**
Work Order No:	**0**
Date:	**1/0/00**
Work Package Desc:	**Kingston General Site Support Work Plan**

On File in Primary Project Files

Location: Kingston Fossil Plant

Work Order No: 0 **Date:** 1/0/00

Work Package Desc: Kingston General Site Support Work Plan

PERMIT	REQUIRED YES	REQUIRED NO	PERMIT NUMBER	COMMENTS
Permit				
Hold Order		X		
Operating		X		
Welding		x		
Excavation				Excavation Permit As Required
Temporary Alteration		X		
Scaffold		X		
Confined Space		X		
Caution		X		
Ground Tags		X		

Notes

Location: Kingston Fossil Plant

Work Order No: 0 **Date:** 1/0/00

Work Package Desc: Kingston General Site Support Work Plan

General Safety: Utilize proper PPE for each specific task identified. TVA Safety Procedures 304-Eye & Face, 307-Foot, 308 -Hand, 309-Head, and 310-Hearing Protection are applicable. Utilize florescent green safety vests and hard hats for all personnel in the work area at all times. Maintain adequate Body/Hand Clearances to prevent pinch points. All personnel will participate in Pre-Job and Post-job Briefings. Discuss emergency alarms, evacuation routes, location of assembly points, personnel accountability procedures, route to local hospital/medical facility; discuss applicable lessons learned, if any. Use peer and self checking to identify any hazards that may exist, and consult the site supervisor if doubt arises . Report all incidents and injuries to Supervisor, no matter how minor they are. Work areas shall be barricaded/flagged etc. as necessary.

Weather: Stay alert to changing weather conditions. If electrical storms, heavy rain, icing, high winds, or other hazards exist, stop outside work and notify supervisor. Foremen and Supervisors shall monitor working conditions and require actions to be taken to protect personnel. Areas for employee protection shall be provided for such conditions (rain, snow, warmer or cooler etc.)
Implement heat stress/cold weather prevention methods listed in TVA safety manual. Rotate workers as needed to limit exposure. Use the buddy system to monitor each other, notify supervision if any type of stress is detected. PPE will be evaluated to meet all conditions that arise.
Inspect work areas for infestation of insects, rodents, snakes, etc. and eradicate where possible. Infested areas should be avoided where possible. Provide and instruct in the use of repellants. Insect repellant should be used as needed. Notify supervisor or any known allergies, prior to work activities. Co-workers must be aware of such allergies and be prepared to respond in an emergency situation.

Equipment Operation Safety Precautions: Read and understand operators' manual for each type of equipment to be operated. Always wear seat belt. Use the three points of contact approach while mounting and dismounting equipment. Keep steps and platforms clear of mud and debris. Equipment checklist to be filled out on each piece of equipment at the start of each shift. Equipment with deficiencies that affect safe operations shall not be operated until corrected. Notify supervisor to resolve discrepancies. Be aware of all surroundings and personnel. Do not come between equipment, facilities, or other pinch points. Use flag person/ spotter as needed to safely maneuver equipment in constricted areas. Use right machine for job. Operators shall be trained for the equipment they are to operate. TVA Safety Procedures 805 "Forklift Operations" and TVA SP 711" Heavy Equipment Operations" and 715 "Mowers" are applicable and provide detailed instructions. Operators will always focus their attention to the direction of travel. All ground personnel and persons involved in this activity will make eye contact with the equipment operators when entering work area.

TVA Safety Procedure Number 601 All Terrain Vehicles Revision 0 January 6, 2003

1. Purpose

1.1. The purpose of this procedure is to establish requirements for the use of All-terrain Vehicles (ATVs).

2. Requirements

2.1. ATVs equipped with a single front tire shall not be used on transmission line rights-of-way.

2.2. ATVs shall be equipped with roll over protection, bench seat, and seat belts for each passenger.

2.3. Personal Protective Equipment (PPE) shall include a hard hat and safety eyewear.

2.4. ATVs are for off-road operations and should not be driven on public streets and roads.

2.5. When tools or equipment are transported, they should be properly secured on the vehicle.

2.6. A personal flotation device should be worn when fording streams that could cause the tires to float.

2.7. ATVs are intended to be operated at safe speeds, depending on terrain and conditions. At no time should an ATV be operated in an unsafe manner or used for purposes other than its intended use.

2.8. Passengers shall only be permitted when the vehicle is equipped with the manufacturer approved seating for passengers except in the event of a medical emergency.

3. Definitions

3.1. All-terrain vehicles are vehicles that are operated off the road are not licensed vehicles and include such as Gators, Mules.

4. Training

4.1. Employees who operate ATVs shall receive the safety training course “All Terrain Vehicle (ATV) Safety”, ATIS Number 00059102.

Safe Equipment Working Distances From Electrical Lines. Contact the responsible supervisor for assistance.

TABLE 1

REQUIRED CLEARANCE FOR OPERATIONS NEAR HIGH-VOLTAGE POWER LINES AND FOR OPERATIONS IN TRANSIT WITH NO LOAD AND ROOM FOR MAST LOWERED

Normal Voltage, kV (Phase-to-Phase)	Minimum Required Clearance, ft
Operation Near High-Voltage Power Lines	
0 to 50	10
Over 50 to 200	15
Over 200 to 350	20
Over 350 to 500	25
Over 500 to 750	35
Over 750 to 1000	45
Operation in Transit With No load and Boom or Mast Lowered	
0 to 0.75	4
Over 0.75 to 50	6
Over 50 to 343	10
Over 345 to 750	16
Over 750 to 1000	20

Fossil Generation, Development & Construction
[Civil Projects / Coal Combustion Products]
PRE-JOB BRIEF (PJB)

Turn in to Site Manager or Safety Department at end of day or completion of task.

The PJB shall be completed daily and for each high hazard task. PJBs shall be completed when the scope of work changes or when a new task has been assigned.

Plant/Site: _____

TVA: ☐ Contractor: _____

Foreman: _____

Person conducting the PJB: _____

Date: _____

Location of Task: _____

Task Description: _____

Does this task require special training? Yes ☐ No ☐

If yes, what type? _____

General Information/Considerations/Reminders

1. Is there a work package for this task? Do you have the necessary drawings, procedures or verbal instruction to proceed?
2. Should a safety professional be involved in the planning of this job?
3. Do you have materials staged or available and the proper tools in good working order to complete the work?
4. Does everyone have the training/qualifications to perform the work?
5. Verify safe working standards for all work.
6. Are you conducting routine or non-routine tasks? Non-routine tasks require more planning / awareness. Do you have a contingency plan?
7. Take two extra minutes when arriving at the work area/look for changes/items that impact your work.
8. YOU ARE AUTHORIZED AND RESPONSIBLE FOR STOPPING AT-RISK WORK FOR SAFETY, HEALTH, OR ENVIRONMENTAL REASONS.
9. Has a JSA been completed/reviewed for this task? Yes ☐ No ☐ N/A ☐
10. Observe the Two Minute Rule before starting work.

A check mark below indicates the item applies to this work activity and precautions were discussed during this PJB or was not applicable to the job.

Trucks and Heavy Equipment

11. Equipment inspection check lists on all required equipment. Yes ☐ N/A ☐
12. 3-Points of contact used for climbing on/off equipment. Yes ☐ N/A ☐
13. All personnel wearing bright colored safety vest. Yes ☐ N/A ☐
14. Trucks required to back long distances. Yes ☐ N/A ☐
15. Flag/Signal person required for this job. Yes ☐ No ☐
16. Control of vehicle and pedestrian traffic patterns. Yes ☐ N/A ☐
17. Personnel clear of equipment swing radius; eye contact w/Operator before approaching equipment. Yes ☐ N/A ☐
18. Crane operations near overhead power lines. Yes ☐ N/A ☐

Terrain Stability

19. Dikes/dams/embankments evaluated for stability for heavy equipment and analysis complete. Yes ☐ N/A ☐
20. Personnel prohibited from walking on ash/gypsum ponds. Yes ☐ N/A ☐

Trenching & Excavation Work

21. All personnel entering a trench or excavation trained. Yes ☐ N/A ☐
22. A trained Competent Person is available to inspect and approve entry. Yes ☐ N/A ☐
23. Barricade and safe access maintained. Yes ☐ N/A ☐

Material Handling

24. 50lb manual lifting limit; obtain if needed; use equipment instead of heavy manual lifting; eyes on path when carrying; one hand free for handrails on steps/stairs; load swing path clear; softeners used for sharp edges. Yes ☐ N/A ☐

Personal Protective Equipment (PPE)

25. PPE selected, inspected and available (hand, eye, head, foot, hearing, PFD). Yes ☐ N/A ☐

Rigging

26. Rigging plan developed. Yes ☐ N/A ☐
27. Personnel performing rigging are trained. Yes ☐ N/A ☐

Person-in-Charge of rigging: _____

Housekeeping

28. Housekeeping maintained safe / acceptable in the work area; all flammable/combustible materials properly stored and proper containment around storage area. Yes ☐ N/A ☐

Hazardous Materials

29. The work activity has potential to expose employees to the hazards of lead, arsenic, cadmium or other hazardous substances or materials. Yes ☐ N/A ☐
30. Requirements for training, sampling, monitoring, PPE. Yes ☐ N/A ☐

Emergency Planning

31. List below the location of the nearest fire extinguisher, spill kits, communications source, emergency phone number(s), and assembly area. Yes ☐ N/A ☐

_____

_____

Applicable Permits

32. Hot Work Yes ☐ No ☐
Clearance Yes ☐ No ☐
Excavation Yes ☐ No ☐
Signs/Barricades Yes ☐ No ☐
Confined Space Yes ☐ No ☐
Crane Lift Yes ☐ No ☐
Scaffolds Yes ☐ No ☐
Other: _____ Yes ☐ No ☐

Additional Comment & Precautions Discussed

_____

_____

_____

_____

TVA 20516 [03-08-2011]

Fossil Generation, Development & Construction
[Civil Projects / Coal Combustion Products]
PRE-JOB BRIEF (PJB)

Signature of all Pre-job Briefing Participants

Post-Job Review

For any issues identified during this review, provide comments below the question, including any actions taken already, PER written (document PER#), etc.

Equipment inspection check lists on all required equipment. Yes ☐ No ☐

If a JSA was used in the pre-job briefing, did it adequately cover all of the hazards and control measures? Yes ☐ No ☐

If a JSA was not used in the pre-job briefing, did the checklist cover all of the hazards and control measures? Yes ☐ No ☐

Was there any change in work scope requiring re-briefing of workers? Yes ☐ No ☐

If a JSA was not used in the pre-job briefing should a JSA be developed for this job? Yes ☐ No ☐

Are there recommended changes to the work that could have improved the safety or efficiency of the work, i.e., PPE, work environment, tools, materials, equipment, etc.? Yes ☐ No ☐

Were there any unexpected aspects or occurrences including accidents, injuries or near-miss incidents? Yes ☐ No ☐

Was the task accomplished with expected results? Yes ☐ No ☐

Is any enhancement to plant documentation warranted, i.e., were procedures/step text complete and accurate, any print or schematic discrepancies, etc? Yes ☐ No ☐

Was planning and scheduling optimized to reduce the potential for human error? Yes ☐ No ☐

Was preparation adequate? Yes ☐ No ☐

Were lessons learned that change the way the job should be performed, recorded, passed on to others, and entered into Maximo as appropriate? Yes ☐ No ☐

Were Lessons Learned entered into the FGD&C Lessons Learned website? Yes ☐ No ☐

Did supervision provide the needed support and appropriate guidance when necessary? Yes ☐ No ☐

Did you notice any human factors issues, improper or missing labels, or any significant physical hindrances to the performance of the work? Yes ☐ No ☐

Was training for the job appropriate and effective? Yes ☐ No ☐

Was work area clean/housekeeping adequate? Yes ☐ No ☐

Did all involved with the work understand their individual responsibilities? Yes ☐ No ☐

Is additional follow up required from this Post-job Review? Yes ☐ No ☐

If YES, then the Foreman/Supervisor/Lead Performer is responsible to provide this feedback to the responsible group for action.

Signature of all Pre-job Briefing Participants

Foreman/Supv/Employee: _____

Date of Review: _____

Note: This form must be retained for 30 days or until work order/package is closed.

TVA 20516 [03-08-2011]

PRE-JOB BRIEF SIGNATURE FORM
FOR JOBS CONTINUING ACROSS MULTIPLE SHIFTS

By my signature below I acknowledge instructions regarding this PJB prior to my job task / work shift.

TASK:

DATE: _____ **TIME:**_____

SIGNATURES:

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

DATE: _____ **TIME:**_____

SIGNATURES:

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

DATE: _____ **TIME:**_____

SIGNATURES:

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

TVA – PROJECTS DEVELOPMENT
MATERIAL LOADING/UNLOADING CHECK LIST

Check completed items.
Write N/A where necessary.
If no is checked on any box, STOP
and contact Supervisor

	YES	NO	N/A
TRUCK ON LEVEL SURFACE			
DRIVER HAS PROPER PPE			
PRE-JOB MEETING COMPLETED			
STRAPS SECURED ON LOAD			
LOAD ON DUNNAGE SECURE			
OPERATOR AND DRIVER INSPECTED LOAD			
BLIND SIDE OF LOAD CLEAR			
SPOTTER/FLAGGER IS PRESENT			
OPERATOR CERTIFIED ON EQUIPMENT			
RIGGER CERTIFIED PER TSP #721A			
WEIGHT KNOWN			
DOES JSA ADEQUATELY COVER THIS WORK			

Offloading/Loading Reminders

1) OPERATOR SHALL MAINTAIN VISUAL CONTACT WITH SPOTTER AT ALL TIMES.
2) ALWAYS HAVE FOOT ON BRAKE WHEN SHIFTING MACHINE IN GEAR. (IF NEEDED SET PARKING BRAKE)
3) SPOT LOAD AS WHERE IT IS ON LEVEL GROUND ALWAYS.
4) DRIVER MUST LEAVE STRAPS ON LOAD UNTIL FOREMAN AND CREW ARE SET AND ONLY REMOVE AS DIRECTED. (BY UNLOADING CREW)
5) WHERE NEEDED, STANCHIONS, STANDARDS OR OTHER MEANS PRACTICAL SHALL SECURE LOADS FROM FALLING OFF TRUCK PRIOR TO REMOVING STRAPS.
6) AT NO TIME SHALL ANYONE BE ALLOWED ON THE OPPOSITE SIDE OF LOAD AS IT IS BEING LOADED OR OFFLOADED.
7) SPOTTERS MUST HAVE VISUAL CONTACT W/ HAND SIGNALS OF OPERATOR AT ALL TIMES.
8) SPOTTER ON GROUND SHALL MAKE SURE NO ONE IS ALLOWED TO BE AROUND BASE OF TRUCK. MAINTAIN 10' CLEARENCE OF LOAD PERIMETER.
9) ONCE LOAD CLEARS TRUCK IT MUST BE LOWERED AS CLOSE TO GROUND AS POSSIBLE BEFORE MOVING.
10) KEEP LOAD AS CLOSE TO THE GROUND AS POSSIBLE AT ALL TIMES.
11) MAINTAIN PERIMETER BETWEEN CREW AND LOAD WHEN RELOCATING LOAD.
12) ALWAYS INSPECT AREA FOR SEASONAL WEATHER CONDITIONS (I.E. ICE, FROST, MUD, STANDING WATER.)
13) REFERENCE SAFETY MANUAL PROCEDURE #610 AND #616 FOR ADDITIONAL INFORMATION.

DATE: _____ LOCATION: _____

MATERIAL:_____

FOREMAN SIGNATURE:_____

Routine Handling Operations Document - Marketing
Kingston Fossil Plant

Kingston Fossil Plant (KIF) produces a dry Class F fly ash, bottom ash, FGD gypsum and very small amount of cenospheres.

Fly Ash Marketing

CY 2010 tons produced: 107,863
CY 2010 tons marketed: 0 – none marketed

KIF produces a dry Class F fly ash. KIF burns a blend of eastern and western coals producing a high carbon content fly ash. There are no immediate plans to begin marketing KIF dry fly ash.

Bottom Ash Marketing

CY 2010 tons produced: 26,966
CY 2010 tons marketed: 0 – none marketed

Since the ash spill at Kingston its bottom ash has been used for on-site repairs to dikes, roads and other improvements necessary to bring the plant back into compliance. Generating only 26,966 tons in 2010 all the bottom ash went into on-site projects.

There are no immediate plans to begin marketing KIF bottom ash.

Flue Gas Desulfurization (FGD) Gypsum

CY 2010 tons produced: 17,085
CY 2010 tons utilized: 0 – not marketed

FGD gypsum is currently sluiced to a gypsum pond. There is no current market for this material.

Cenosphere Marketing

CY 2010 tons produced: unknown
CY 2010 tons utilized: 176

There are no immediate plans to market KIF cenosphere since the plant is converting to dry collection and dry disposal.

1401 Remaining Life Calculation

Please see the long range plan and master strategy plan in Sections 1402 and 1403 of the Operations Support Document for information on the remaining life at the active CCP facilities for Kingston Fossil Plant.

KINGSTON FOSSIL PLANT - LONG TERM DISPOSAL PLAN

05/31/2011

	FISCAL YEAR ENDING	PROJECTED COAL BURN (TONS)	FLY ASH PRODUCTION (TONS)	BOTTOM ASH PRODUCTION (TONS)	GYPSUM PRODUCTION (TONS)	LANDFILL CAPACITY (CY)	CAPITAL COSTS ($)	O & M COSTS ($)	TOTAL COSTS ($)	NET PRESENT COSTS ($)
	2010	1287835	98,911	23,439	172,238	11,471,752				
PENINSULA	2011	2,250,539	172,850	40,960	300,992	11,177,165	0	855,241	855,241	855,241
PENINSULA	2012	3,591,624	275,851	65,368	480,352	10,662,362	0	1,398,996	1,398,996	1,295,367
PENINSULA	2013	3,573,325	274,446	65,035	477,904	9,840,792	0	1,217,885	1,217,885	1,044,140
PENINSULA	2014	3,720,140	285,722	67,707	497,540	9,023,408	0	1,267,923	1,267,923	1,006,518
PENINSULA	2015	4,205,813	323,023	76,546	562,495	8,172,440	0	1,433,454	1,433,454	1,053,632
PENINSULA	2016	4,448,214	341,641	80,957	594,914	7,210,376	0	1,516,071	1,516,071	1,031,812
PENINSULA	2017	4,381,201	336,494	79,738	585,951	6,192,864	0	1,493,231	1,493,231	940,989
PENINSULA	2018	3,958,661	304,041	72,048	529,440	5,190,681	0	1,349,218	1,349,218	787,256
PENINSULA	2019	3,866,155	296,936	70,364	517,068	4,285,152	0	1,317,689	1,317,689	711,907
PENINSULA	2020	4,114,290	315,994	74,880	550,254	3,400,784	0	1,402,261	1,402,261	701,479
PENINSULA	2021	3,752,296	288,191	68,292	501,840	2,459,656	19,357,200	1,278,883	20,636,083	9,558,499
NEW LANDFILL	2,022	3,490,246	268,065	63,522	466,793	11,700,000	0	1,189,570	1,189,570	510,186
NEW LANDFILL	2,023	3,809,407	292,578	69,331	509,478	10,901,620	0	1,298,348	1,298,348	515,592
NEW LANDFILL	2,024	3,873,347	297,489	70,495	518,030	10,030,232	0	1,320,140	1,320,140	485,413
NEW LANDFILL	2,025	3,849,327	295,644	70,058	514,817	9,144,219	19,357,200	1,311,954	20,669,154	7,037,042
NEW LANDFILL	2,026	3,924,824	301,442	71,432	524,915	8,263,700	0	1,337,685	1,337,685	421,694
NEW LANDFILL	2,027	4,037,994	310,134	73,491	540,050	7,365,912	0	1,376,257	1,376,257	401,716
NEW LANDFILL	2,028	4,035,330	309,929	73,443	539,694	6,442,236	0	1,375,349	1,375,349	371,714
NEW LANDFILL	2,029	4,107,610	315,481	74,758	549,361	5,519,170	19,357,200	1,399,984	20,757,184	5,194,465
NEW LANDFILL	2,030	4,049,929	311,051	73,709	541,646	4,579,569	0	1,380,324	1,380,324	319,838
NEW LANDFILL	2,031	4,004,030	307,526	72,873	535,508	3,653,164	0	1,364,681	1,364,681	292,790
NEW LANDFILL	2,032	4,010,803	308,046	72,997	536,414	2,737,257	0	1,366,989	1,366,989	271,560
NEW LANDFILL	2,033	4,017,575	308,566	73,120	537,319	1,819,801	19,357,200	1,369,298	20,726,498	3,812,442
NEW LANDFILL	2,034	4,024,348	309,086	73,243	538,225	900,796	0	1,371,606	1,371,606	233,605
NEW LANDFILL	2,035	4,031,121	309,606	73,366	539,131	(19,758)	0	1,373,914	1,373,914	216,665
NEW LANDFILL	2,036	4,037,894	310,126	73,490	540,037	(941,862)	0	1,376,223	1,376,223	200,953
NEW LANDFILL	2,037	4,044,667	310,647	73,613	540,943	(1,865,515)	19,357,200	1,378,531	20,735,731	2,803,507
			114,734,716	**116,616,332**	**24,361,136**		**96,786,000**	**36,121,706**	**132,907,706**	**42,076,024**

Assumptions:
1) Ash production is based on the June 2011, Budget Case Coal Burn Forecast for FY11-15. FY16-30 are based from the March 2011 Forecast.
2) Ash content is 9.1% plus 5.5% unburned carbon, based upon past 3 year average.
3) 80% of the total ash is fly ash, the remaining 20% is bottom ash.
4) 100% of the bottom ash and fly ash is sluiced to the main ash pond, the bottom ash is retrieved and utilized to build dikes.
5) Fly ash density (in pond) = 60 lb/c.f.; bottom ash density (stacked) = 75 lb/c.f.
6) The remaining capacity in the ash pond allows for the free water volume requirement of 102 million gallons (505,050 c.y.).
7) O&M costs are based on the routine ash handling agreement with HED plus any O&M projects.
8) Inflation rate = 2.5%.
9) The net present values are based on a 8% discount rate.

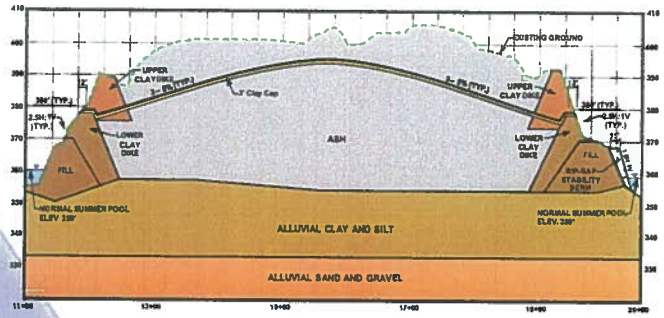
Refer to CCP Engineering for latest version of the Master Strategy Plan.

Coal Combustion Products Master Strategy Review

April 2011

Coal Combustion Products Engineering

Programmatic Pyramid



Typical Dike Section

Dry Storage

Close all Wet Storage Facilities

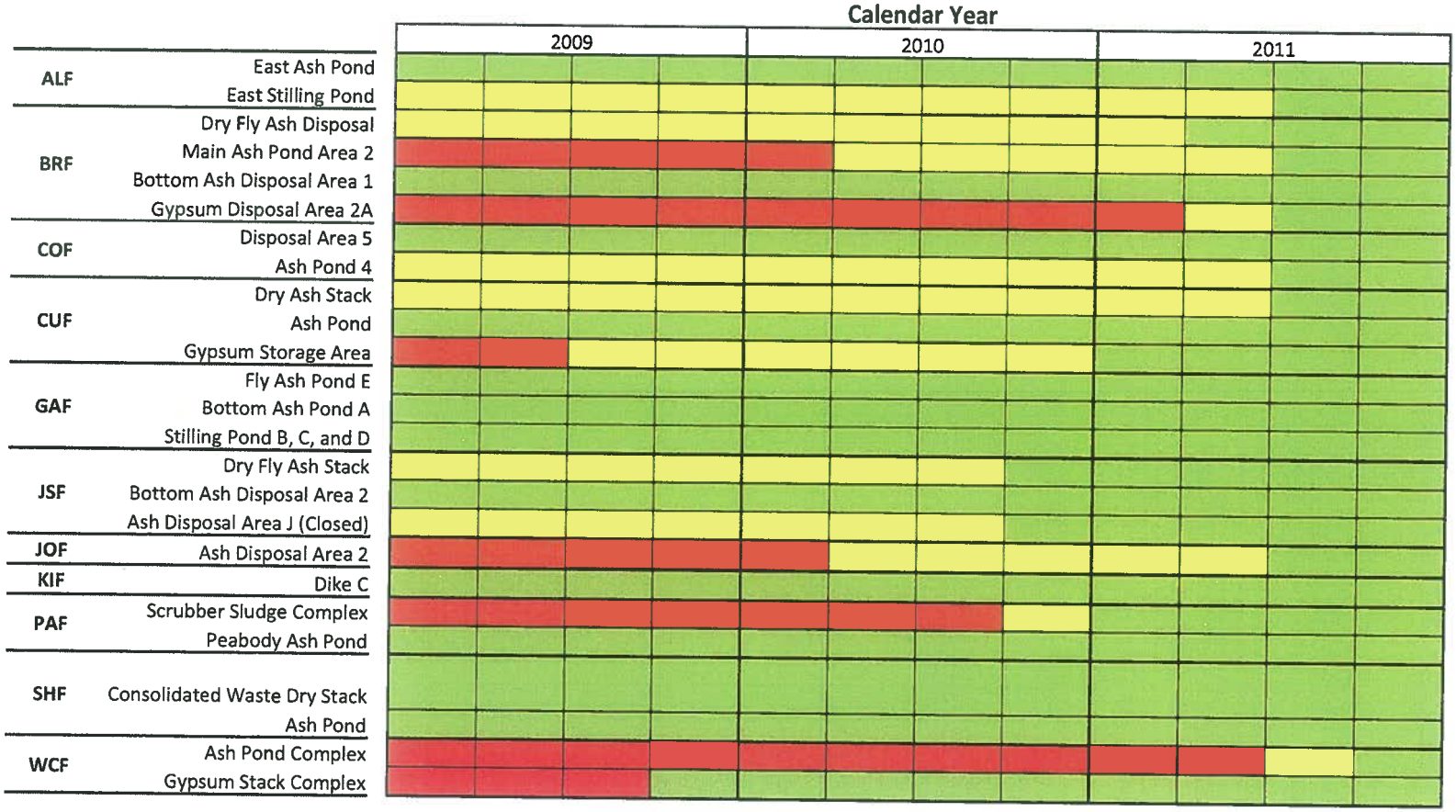
Develop a Water Management Strategy for Plant Process Water

Convert Wet CCP Processes to Dry Operation

(Fly Ash, Bottom Ash, and Gypsum)

Implement Long Term Stability Improvements and Remediation to Existing CCP Facilities

Global Stability



Global Stability	As-Found	Current	Jun-2011
1.5 or Greater	12	17	25
1.3 to 1.5	6	6	0
Less than 1.3	7	2	0

Coal Combustion Products – Projects and Engineering

CCP Score Card

TVA Fossil Plants	Facility	Global Stability	Target to Clear	Non-Global Stability	Target to Clear	Hazard Classification	Target to Clear	Spillways Priority	Schedule
Allen	Ash Disposal		Jun-11		Jun-18		Close		
Bull Run	Ash Pond		Jun-11		Jun-11		Close		
	Gypsum		Jun-11		Dec-11				
Colbert	Dry Stack				May-16	N/A	N/A	N/A	N/A
	Bottom Ash		Jun-11				Close		
Cumberland	Ash Pond						Aug-11	In-Progress	Aug-11
	Dry Stack		Jun-11		Jul-17	N/A	N/A	N/A	N/A
	Gypsum				Jul-17		Close		
Gallatin	Ash Disposal				Sep-17		Close		
John Sevier	Dry Stack				Sep-15	N/A	N/A	N/A	N/A
	Bottom Ash						Close		
Johnsonville	Ash Disposal		Mar-11				Close	In-Progress	Sep-11
Kingston	Dike C				Sep-11		Close		
Paradise	Ash Pond								
	Scrubber Complex				Oct-18				
Shawnee	Dry Stack					N/A	N/A	N/A	N/A
	Ash Pond				Sep-11		Close	In-Progress	May-11
Widows Creek	Ash pond		Sep-11		Sep-12		Close	In-Progress	Jul-12
	Gypsum				Sep-11		Close		

<1.3	Behind Sch	<1.3	Behind Sch	High	Behind Sch	Work Immediately	Behind Sch
1.3 - 1.5	At Risk	1.3 - 1.5	At Risk	Signficant	At Risk	Reduce Risk	At Risk
	On Sch		On Sch	Low	On Sch	Pond Closure	On Sch

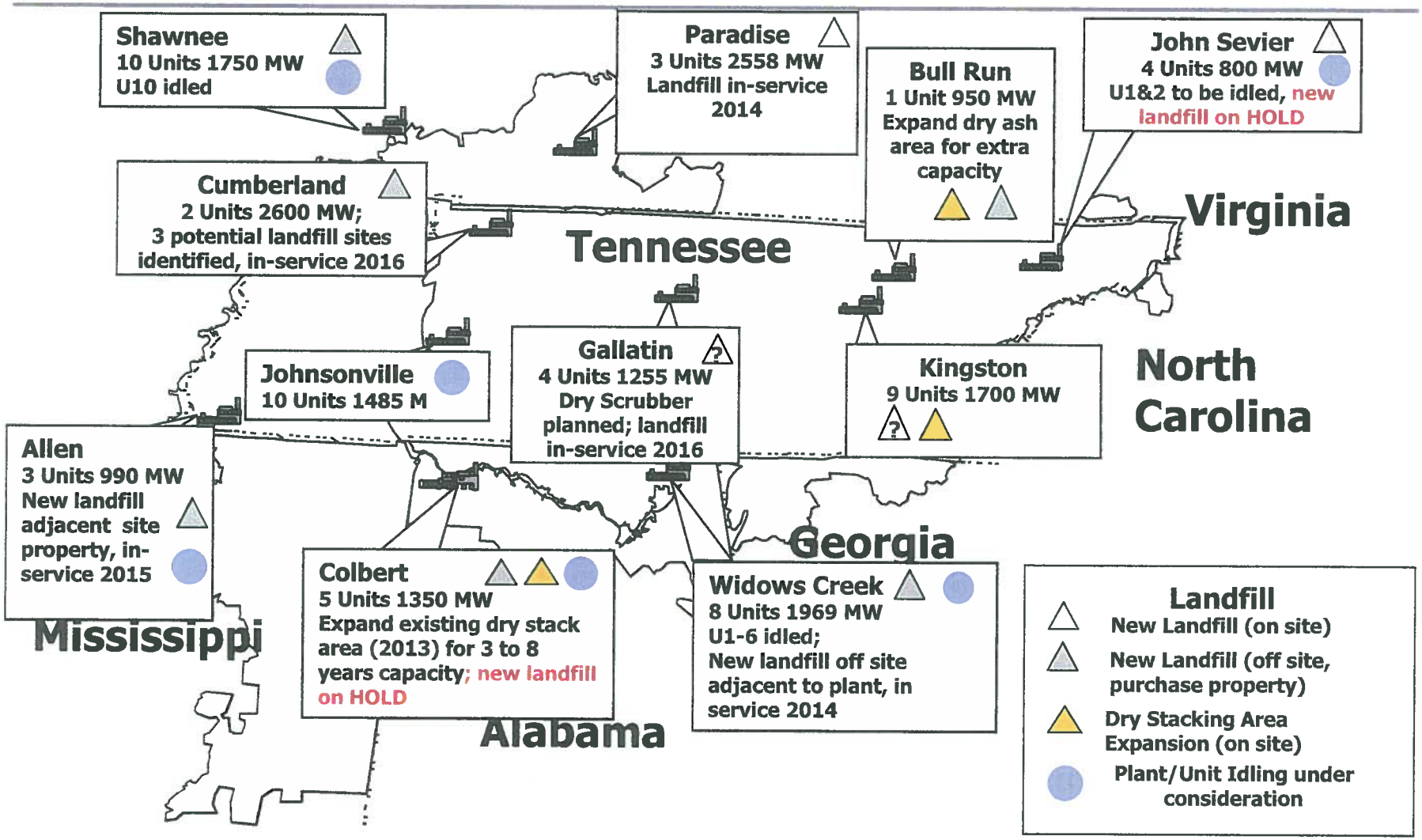
Engineering Overview

Annual Inspection Plan – 5 Year Plan

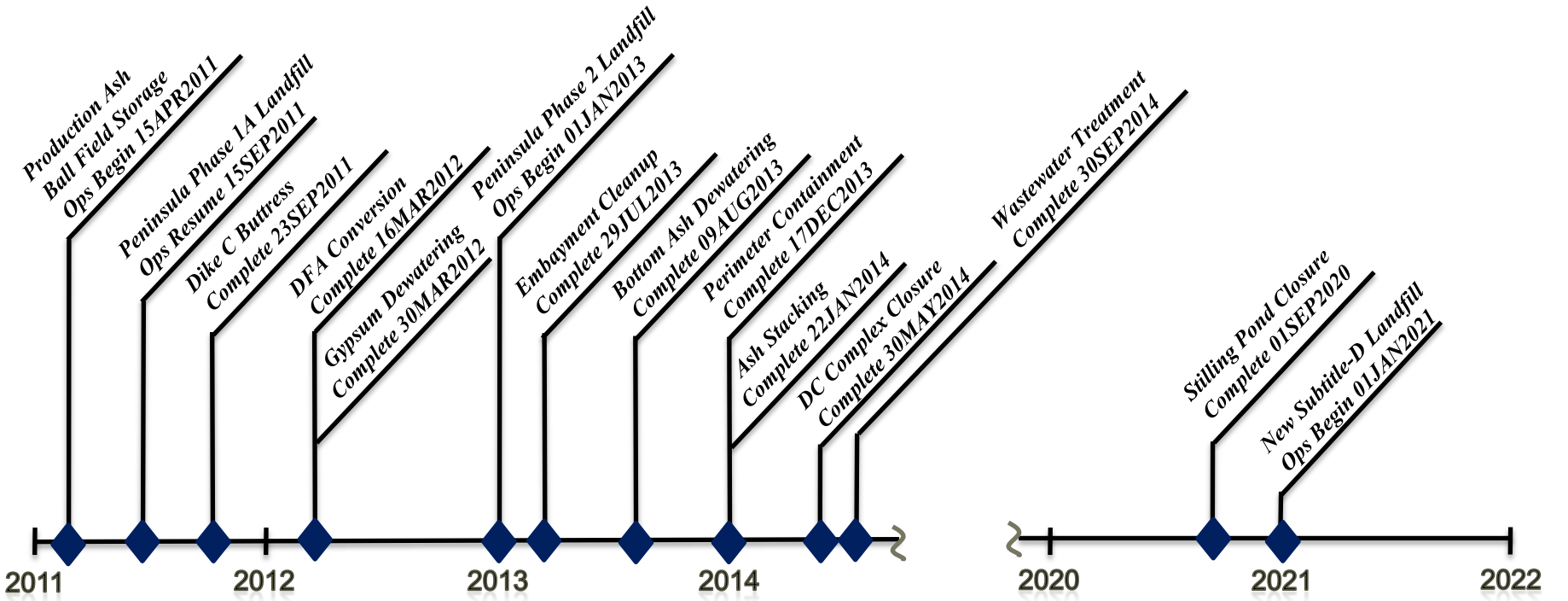
2011 Annual Inspection - 5 Year Plan					
	2011	**2012**	**2013**	**2014**	**2015**
Allen	February	June	September	November	March
Bull Run	August	November	February	May	August
Colbert	July	October	January	April	July
Cumberland	June	September	December	March	June
Gallatin	November	February	May	August	November
Kingston	September	December	March	June	September
John Sevier	November	March	June	September	November
Johnsonville	June	September	December	March	June
Paradise	September	December	March	June	September
Shawnee	September	December	June	February	May
Widows Creek	June	September	December	May	February

Coal Combustion Products – Projects and Engineering

Projects Overview – Landfill Valley Map



Kingston Fossil Plant
Timeline Overview



Coal Combustion Products – Projects and Engineering

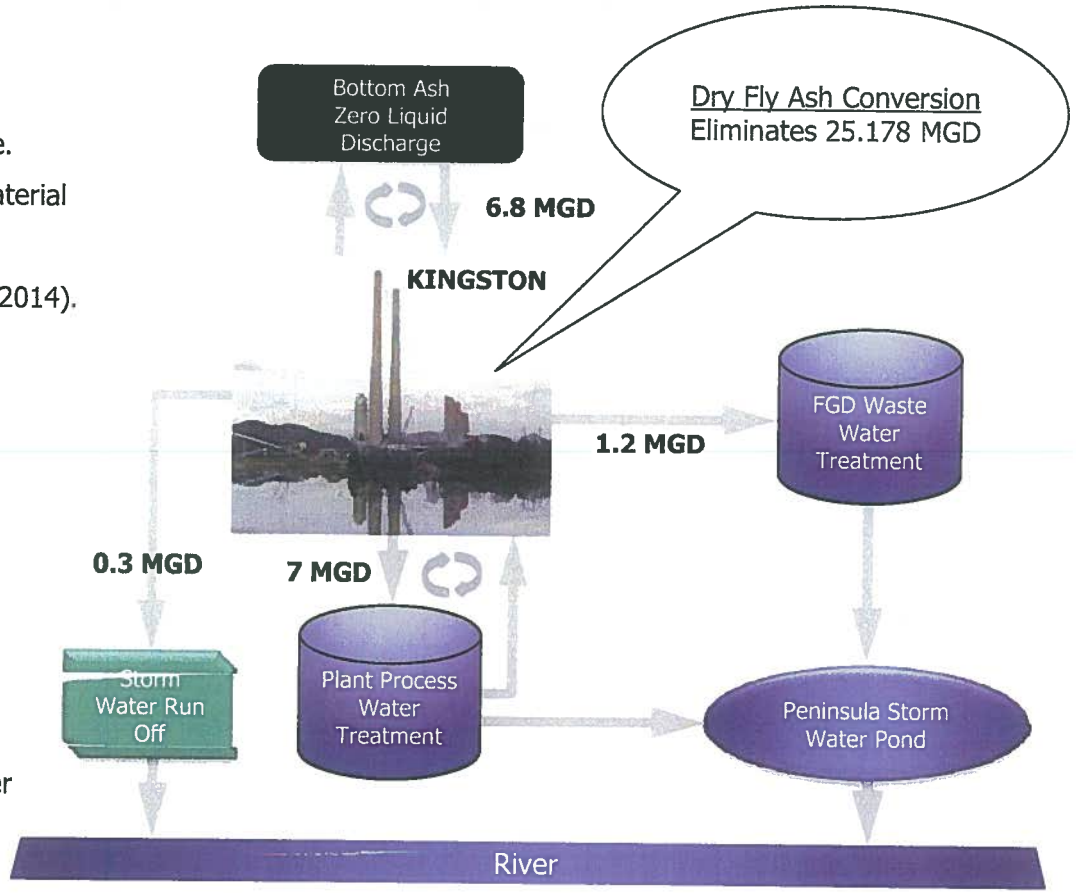
Water Management

Regulatory Drivers

- Closing all CCP Ponds/Impoundments.
- Regulator Changes will force Stilling Ponds to close.
- Dewatering Facilities will be built to handle CCP Material and discharge at current NPDES Discharge Limits.
- NEW Stringent EPA Effluent Limitation Guidelines (2014).
  - Eliminate Fly Ash Transport Water.
  - Selenium, Mercury, and Arsenic.
  - Expect EPA will require Bottom Ash ZLD.
  - Do not expect ZLD requirement on FGD.

TVA Team Approach

- Organized a team of FPG, FGDC (lead), E&T.
- Researched Industry and Manufactures of WWT.
- Performed Water Characterization Study of all water streams at BRF, KIF, and WCF.
- Developed Pilot Strategy for KIF.
- Will be the core JPT for all WWT Projects.
- Current Estimate of $80M-$160M per fossil facility.



APPENDIX A

Document 5

Stantec Consulting Services Correspondence Dated October 4, 2011, "Reference: Dam Safety Hazard Classification Review, Ash Disposal Area 2, Kingston Fossil Plant, Roane County, Tennessee"

Dam Safety Hazard Classification Review

Kingston Main Ash and Stilling Pond
Kingston Fossil Plant
Roane County, Tennessee

Stantec Consulting Services Inc.
One Team. Infinite Solutions
11687 Lebanon Road
Cincinnati, OH 45241-2012
Tel: (513) 842-8200 • Fax: (513) 842-8250
www.stantec.com

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

October, 2011

Stantec Consulting Services Inc.
11687 Lebanon Road
Cincinnati OH 45241-2012
Tel: (513) 842-8200
Fax: (513) 842-8250

October 04, 2011
File: 175630008

Mr. Scott Turnbow
Tennessee Valley Authority
1101 Market Street
LP 5E-C
Chattanooga, Tennessee 37402

Reference: **Dam Safety Hazard Classification Review**
Ash Disposal Area 2
Kingston Fossil Plant
Roane County, Tennessee

Dear Mr. Turnbow:

Stantec has a completed a review of the hazard classification assessments for facilities at the Kingston Fossil Plant. The attached report summarizes the likely impacts of potential failure scenarios and provides conclusions relative to hazard classification.

We appreciate the opportunity to assist you with your dam safety program. If you have any questions or comments, please call.

Sincerely,

STANTEC CONSULTING SERVICES INC.

Dan Hoffman
Project Engineer

John Menninger, PE
Senior Project Engineer

/lfb

Dam Safety Hazard Classification Review

Kingston Main Ash and Stilling Pond
Kingston Fossil Plant
Roane County, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

October, 2011

Dam Safety Hazard Classification Review

Kingston Main Ash and Stilling Pond
Kingston Fossil Plant
Roane County, Tennessee

Table of Contents

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2. Potential Failure Scenarios 1

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2.1.1. Facility Description 1

2.1.2. Failure Scenario 1

3. Hazard Classification 1

4. References 1

Dam Safety Hazard Classification Review

Kingston Main Ash and Stilling Pond
Kingston Fossil Plant
Roane County, Tennessee

1. Study Description

Kingston Fossil Plant is located on the northern shore of Watts Bar Lake, an impoundment of the Clinch River, at the confluence of the Clinch and Emory Rivers. The Clinch River bounds the plant to the south and the Emory River bounds the plant to the east. A natural hill slopes up from the plant to the northwest.

Kingston Fossil Plant has two active ash impoundment facilities: the Main Ash Pond and the Stilling Pond. In July 2009 TVA reviewed the dam safety hazard classification for each of its active coal combustion product (CCP) impoundments and determined these impoundments to be a Significant Hazard[(1)]. The Main Ash Pond and Stilling Pond are both contained by Dike C and act as impoundment areas for settling sluiced ash from the Kingston Fossil Plant.

Stantec has been requested to review the hazard classification assessment and either confirm or recommend a revised classification. This report summarizes the likely impacts of potential failure scenarios and provides conclusions relative to hazard classification. This review is based on available topographic and aerial mapping.

2. Potential Failure Scenarios

2.1. Main Ash Pond and Stilling Pond

2.1.1. Facility Description

The Main Ash Pond and Stilling Pond facilities are located on the northeastern side of Kingston Fossil Plant. The facilities are ringed by Dike C and have a combined surface area of approximately 110 acres. The crest elevation of the impoundment is 765 feet which is 24 feet above the normal pool elevation of Watts Bar Lake (El. 741 ft). The internal dike dividing the Main Ash Pond and Stilling Pond crests at approximate elevation 765 feet. To the northwest, the facility is bounded by the Ash Dredge Cell. The layout is presented as Figure 2.1.

2.1.2. Failure Scenario

One failure scenario for the Main Ash Pond and Stilling Pond facilities was reviewed with regards to the impact to the surrounding structures and infrastructure. The failure is through the dike which separates the facilities from Watts Bar Lake. A breach at this location would discharge directly into Watts Bar Lake or the plant intake channel. The minimum width of the lake at the location of a potential breach is approximately 800 feet. The banks of the river in the vicinity of the plant had multiple private residential structures prior to the failure of the Kingston Dredge Pond in 2008. In response to the failure in 2008, TVA purchased many of the residential structures as shown in Figure 2.1. The three remaining structures in the vicinity of the impoundments, are located an estimated 17 feet or more above normal pool of the lake based on available USGS topographic mapping[(2)] and August 2011 aerial survey data provided

by TVA. Stantec experience with modeling similar impoundment failures into large reservoirs or rivers suggest the likely flood wave will not significantly raise the water surface elevation and thus will not impact the remaining private residential structures on the opposite bank making modeling of the breach unnecessary. Figure 2.1 illustrates the potential breach scenarios.

A breach to the northwest of the Main Ash Pond and Stilling Pond facilities is unlikely because of the presence of the Dredge Cell, and is in the process of being closed.

3. Hazard Classification

No infrastructure, except those owned by TVA, was identified within the direct paths of the identified potential breach scenarios for the Main Ash Pond and Stilling Pond at the Kingston Fossil Plant. Buildings and publicly owned roadways within the vicinity of the Kingston Fossil Plant facilities are either located above the elevation of the impoundment or are separated by distances which would permit the dissipation of a potential breach wave within existing waterways.

A breach of Main Ash Pond and Stilling Pond represents a minor risk to external infrastructure and does not, in Stantec's opinion, represent a probable threat to human life. However, a breach would likely result in the off-site release of CCP's into waters of the United States. Based on the Federal Guidelines for Dam Safety - Hazard Potential Classification System for Dams[3], it is recommended that the dam safety hazard classification of the Main Ash Pond and Stilling Pond remain at Significant Hazard.

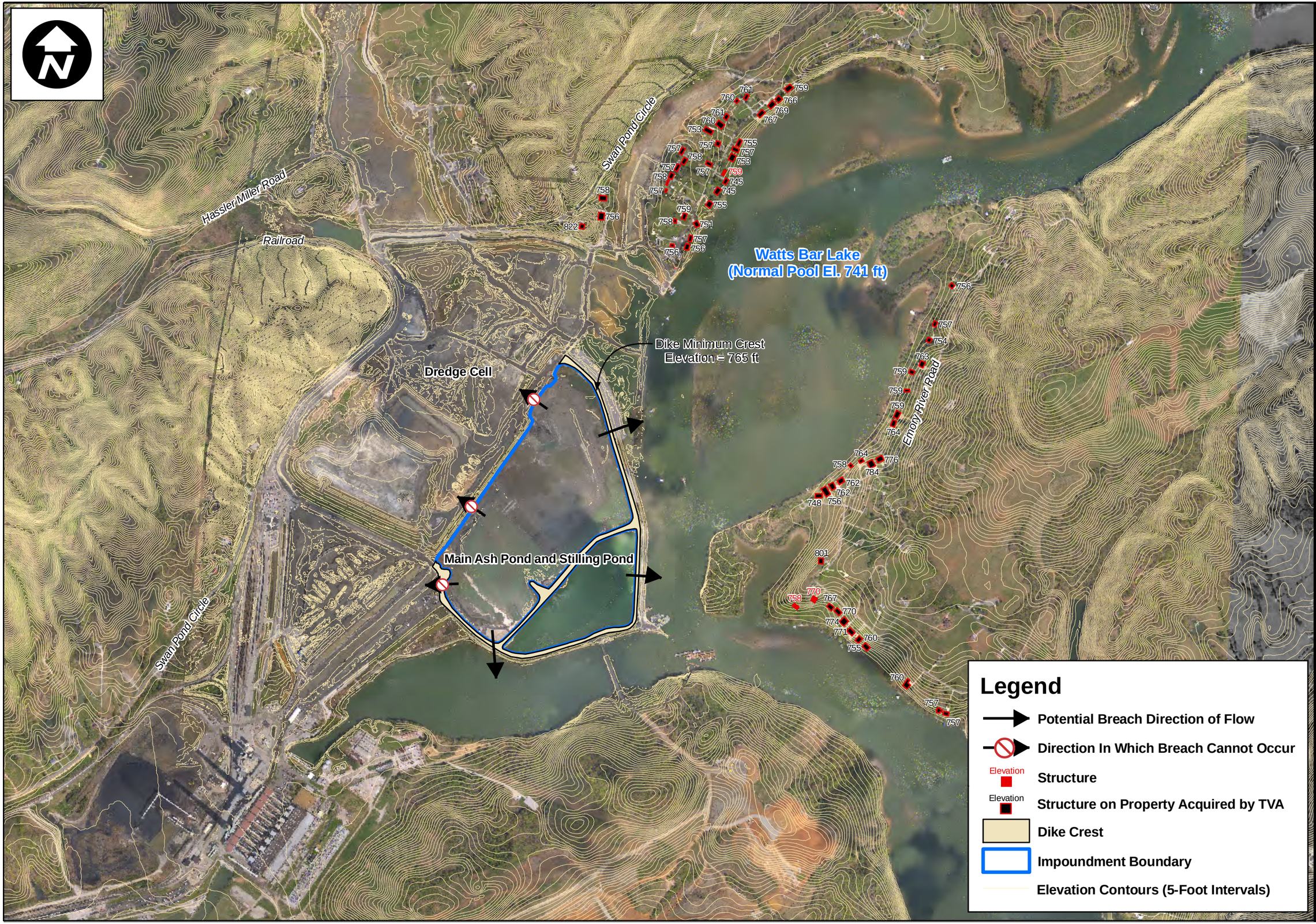
This study addresses the current facility conditions. It is recommended that the hazard classification be revisited once the ash pond is closed in association with the ongoing Dredge Cell closure followed by the planned Stilling Pond closure.

4. References

1. Tennessee Valley Authority (TVA). (2009). *Evaluation of Fossil Coal Combustion Products (CCP) Facilities for Dam Safety Hazard Classification*.

2. United States Geological Survey (USGS). (2009). *1/3-Arc Second National Elevation Dataset*. USGS, Sioux Falls, South Dakota.

3. Federal Emergency Management Association (FEMA). (2004). *Federal Guidelines for Dam Safety: Hazard Potential Classification System for Dams (FEMA 333)*. Interagency Committee on Dam Safety, FEMA.



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45241-2012
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www.stantec.com

Stantec

Main Ash Pond and Stilling Pond Breach Scenarios

TVA Hazard Classification
Kingston Fossil Plant
Tennessee Valley Authority
Roane County, Tennessee

PROJECT NO.	175630008
DATE	September 21, 2011
DRAWN BY	DEH
CHECKED BY	X
CHECKED BY	X
SCALE	1" = 1000'
REVISED	
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

SHEET

Figure 2.1

APPENDIX A

Document 6

"Plans for Construction, Diffuser Replacement Project, Stilling Pond Work Plan 6 (KIF-110503-WP-6) Kingston Fossil Plant" Drawing Numbers 81W403-01 through 81W403-07

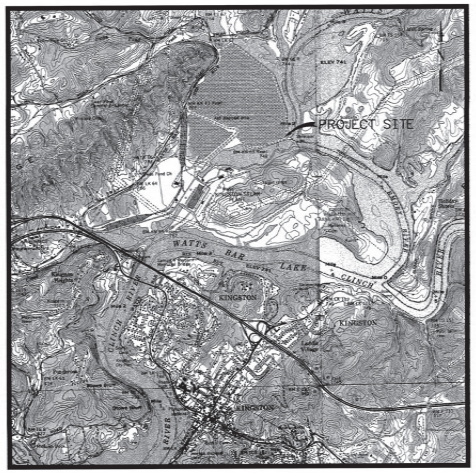
PLANS FOR CONSTRUCTION

DIFFUSER REPLACEMENT PROJECT
STILLING POND
WORK PLAN 6 (KIF-110503-WP-6)
KINGSTON FOSSIL PLANT

HARRIMAN, ROANE COUNTY, TENNESSEE

PREPARED FOR

TENNESSEE VALLEY AUTHORITY



VICINITY MAP

1000 0 2000 4000 FEET
GRAPHIC SCALE

PREPARED BY

Stantec Consulting Services Inc.
1859 Bowles Ave., Ste 250
St. Louis, Missouri
63026-1944
Tel. 636.343.3880
Fax 636.343.3554
www.stantec.com

INDEX OF SHEETS

81W403-01	COVER SHEET
81W403-02	GENERAL NOTES
81W403-03	EXISTING CONDITIONS & BASELINES
81W403-04	PLAN – DIFFUSER REPLACEMENT
81W403-05	DETAILS – SIPHON SPILLWAYS
81W403-06	DETAILS – SIPHON SPILLWAYS
81W403-07	DETAILS – DIFFUSER REPLACEMENT

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX00030020110002

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	PVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	05/03/11	LJP	TMM	MAH	HMW	VJD	MST	JCK	–	–
–	ISSUED FOR CONSTRUCTION									

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
STILLING POND

DIFFUSER REPLACEMENT PROJECT
COVER SHEET
WORK PLAN 6 (KIF–110503–WP–6)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
L.J. PERKINS	T.M. MYERS	M.A. HOY	H.M. WILLIS	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 05/03/11 | 36 | C | 81W403–01 | R 0

Stantec Consulting Services Inc.
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Fax 636.343.3554
www.stantec.com

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

36 | C | 81W403–01

GENERAL NOTES

SUMMARY OF WORK

THE WORK DESCRIBED IN THIS DRAWING SET WILL BE PERFORMED IN THE STILLING POND AND PLANT INTAKE CHANNEL AT THE TENNESSEE VALLEY AUTHORITY (TVA) KINGSTON FOSSIL PLANT (KIF). WORK INCLUDES INSTALLATION OF SIPHON SPILLWAYS TO MAINTAIN THE TYPICAL DAILY PROCESS FLOW FROM THE PLANT WHILE THE EXISTING SPILLWAYS ARE DEACTIVATED TO ALLOW FOR INSTALLATION OF BUTTRESS MATERIAL (BY OTHERS) AND REPLACEMENT OF THE EXISTING SPILLWAY DIFFUSERS.

1.0 GENERAL PROVISIONS

1.1 THE ATTACHED PLANS, TECHNICAL SPECIFICATIONS AND QUALITY CONTROL PLAN WERE PREPARED BY STANTEC CONSULTING SERVICES INC. (STANTEC). FOR THE CONSTRUCTION ASPECTS SHOWN HEREIN THE TENNESSEE VALLEY AUTHORITY (TVA) IS THE OWNER AND STANTEC IS THE ENGINEER. THE CONTRACTOR SHALL BE RETAINED UNDER CONTRACT BY THE OWNER.

1.2 THE CONTRACTOR SHALL SUBMIT DETAILED WORKPLANS OUTLINING ALL PROVISIONS TO OBTAIN REGULATORY APPROVAL PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL SUBMIT SAID WORKPLANS TO THE OWNER FOR APPROVAL AND TO THE ENGINEER.

1.3 THE CONTRACTOR SHALL CONFINE ALL SPECIFIC WORK ACTIVITIES TO THE AREA DEFINED BY THE PLANS OR APPROVED BY THE OWNER. ACCESS INTO THE WORK AREA FOR DELIVERY OF EQUIPMENT, MATERIALS AND WORKFORCE SHALL BE REVIEWED DAILY BY THE CONTRACTOR, AND CONTROLLED AS NEEDED TO PREVENT ANY DAMAGE TO THE CREST AND SLOPES OF THE DIKES SURROUNDING THE ASH POND.

1.4 THE CONTRACTOR SHALL COORDINATE WITH THE OWNER TO DETERMINE THE LOCATION AND AREA FOR EQUIPMENT OR MATERIAL STORAGE AND FOR OTHER CONSTRUCTION LAY DOWN ACTIVITY.

1.5 WHENEVER REFERENCE IS MADE TO TENNESSEE DEPARTMENT OF TRANSPORTATION (TDOT) STANDARD SPECIFICATIONS, AMERICAN CONCRETE INSTITUTE (ACI), AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM) AND OTHER PUBLISHED STANDARDS OR SPECIFICATIONS, IT SHALL MEAN THE LATEST VERSION IN ITS ENTIRETY.

1.6 ACCEPTABLE CONSTRUCTION TOLERANCES FROM PLAN DIMENSIONS, ELEVATIONS, AND GRADES SHALL BE AS FOLLOWS:
–EXCAVATIONS AND FINAL GRADES FOR EARTH SURFACES AND SLOPES: ± 0.25 FEET (FT)
–RIPRAP: FINAL GRADE ±0.5 FT, THICKNESS ZERO TO +0.5 FT
–FINAL GRADE TOP OF DAM: ZERO TO +0.25 FT
–MEASUREMENTS WITHIN 0.5 INCHES OF PLAN DIMENSIONS
–SIPHON PIPES AND APPURTENANCES: ±0.10 FT OF PLAN ELEVATION
–SIPHON AND DIFFUSER PIPES: ±2 FT OF DESIGNATED HORIZONTAL ALIGNMENT

1.7 NO DEVIATIONS FROM THE PLANS OR APPROVED SHOP DRAWINGS SHALL BE MADE WITHOUT PRIOR APPROVAL FROM THE ENGINEER. THE CONTRACTOR SHALL MAINTAIN A RECORD OF ALL DEVIATIONS IN LOCATION OR ELEVATION OF ANY INSTALLATION FROM THAT SHOWN ON THE PLANS, AND ANY DEVIATIONS IN INSTALLATIONS FROM APPROVED SHOP DRAWINGS. AT COMPLETION OF THE PROJECT A SET OF RECORD DRAWINGS WILL BE PREPARED BY THE CONSTRUCTION QUALITY ASSURANCE (CQA) REPRESENTATIVE BASED ON THE AS–BUILT RECORD PROVIDED BY THE CONTRACTOR. THE CONTRACTOR SHALL COOPERATE FULLY AND ASSIST WITH PREPARATION OF THE FINAL RECORD DRAWINGS.

2.0 SITE CONDITIONS

2.1 TOPOGRAPHIC INFORMATION:
UNLESS OTHERWISE INDICATED, THESE DRAWINGS WERE COMPILED USING SURVEY INFORMATION PROVIDED BY TVA. AUTOCAD DRAWING "1–24–11 POINTS.DWG" AND LIDAR DATA FROM A SURVEY PERFORMED IN APRIL OF 2009 BY TUCK MAPPING SOLUTIONS, INC WERE UTILIZED. HORIZONTAL COORDINATES ARE REFERENCED TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NAD 27. ELEVATIONS ARE BASED ON NGVD 29. TOPOGRAPHIC INFORMATION SHOWN IN THE DRAWINGS IS DATED AND DOES NOT REFLECT CHANGES SINCE THE TIME OF AERIAL PHOTOGRAPHY. AREAS OF HYDROGRAPHIC SURVEYING MAY NOT REFLECT CURRENT CONDITIONS AS THE UNDERWATER SURFACE CONSTANTLY CHANGES.

2.2 THE CONTRACTOR SHALL NOTIFY KIF PLANT PERSONNEL 48 HOURS IN ADVANCE OF RAISED DIKE ACCESS ROAD CUTTING TO ALLOW FOR COORDINATION OF ALTERNATIVE TRAFFIC ROUTES.

2.3 VEHICULAR ACCESS TO THE SITE SHALL BE DETERMINED BY TVA. NO CONSTRUCTION ACTIVITIES SHALL BE PERFORMED THAT CAUSE AN INTERFERENCE WITH THROUGH TRAFFIC DURING CONSTRUCTION. CONTRACTOR SHALL PROVIDE APPROVED SIGNAGE, BARRIERS AND TRAFFIC SAFETY PERSONNEL RESPONSIBLE FOR DIRECTING CONSTRUCTION AND PLANT TRAFFIC AT ALL POINTS OF INGRESS AND EGRESS.

2.4 CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING UTILITIES PRIOR TO COMMENCEMENT OF WORK. UTILITIES AND INSTRUMENTATION SHOWN ON THE ATTACHED PLANS SHALL BE CONSIDERED APPROXIMATE AND DO NOT COVER ALL EXISTING UTILITIES IN THE AREA. CONTRACTOR SHALL EXERCISE EXTREME CAUTION DURING EXCAVATION. SHOULD PIPING OR OTHER UTILITIES THAT ARE NOT SHOWN ON THE DRAWINGS BE ENCOUNTERED, CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY, WHO WILL IN TURN NOTIFY TVA PLANT PERSONNEL IMMEDIATELY. WHERE APPLICABLE, THE CONTRACTOR SHALL PROVIDE NECESSARY MEASURES TO PROTECT UTILITIES FROM DAMAGE DUE TO CONTRACTORS WORK.

2.5 CONTRACTOR SHALL BE RESPONSIBLE FOR THE HEALTH AND SAFETY OF ITS PERSONNEL AND SHALL MEET ALL APPLICABLE LOCAL, STATE, AND FEDERAL SAFETY REGULATIONS INCLUDING BUT NOT LIMITED TO OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) STANDARDS AND TVA SAFETY REQUIREMENTS.

2.6 THE CONTRACTOR IS RESPONSIBLE FOR SITE DRAINAGE THROUGHOUT CONSTRUCTION AND SHALL INSTALL TEMPORARY DRAINAGE STRUCTURES OR PUMP WATER AS NECESSARY TO PREVENT INTERFERENCE WITH THE WORK.

3.0 SURVEY

3.1 STAKING:
THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL SURVEYING AND STAKING NECESSARY FOR LAYOUT AND CONSTRUCTION OF THE PROJECT. STAKING SHALL BE PERFORMED BY OR UNDER THE DIRECTION OF A LICENSED LAND SURVEYOR.

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

3.3 CONTRACTOR SHALL EMPLOY A COMPETENT SURVEYOR LICENSED IN THE STATE OF TENNESSEE TO ESTABLISH OR CONFIRM ALL LINES, ELEVATIONS, REFERENCE MARKS, ETC. NEEDED BY THE CONTRACTOR DURING CONSTRUCTION. THE QUANTITIES OF MATERIALS PRESENTED HERE AND IN THE BID SCHEDULE SHALL BE CONSIDERED APPROXIMATE AND ARE SUBJECT TO CHANGE BASED ON FIELD CONDITIONS.

4.0 EROSION PREVENTION AND SEDIMENT CONTROL (EPSC)

4.1 THE CONTRACTOR SHALL EXERCISE EVERY REASONABLE PRECAUTION AT ALL TIMES TO MINIMIZE SOIL EROSION AND PREVENT WATER POLLUTION BY DEPOSITION OF SEDIMENT INTO THE EMORY RIVER. EROSION PREVENTION AND SEDIMENT CONTROL MEASURES SHALL BE IMPLEMENTED AND MAINTAINED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS.

4.2 PRIOR TO BEGINNING CLEARING, GRUBBING, AND TOPSOIL STRIPPING ACTIVITIES, EROSION PREVENTION AND SEDIMENT CONTROL (EPSC) BEST MANAGEMENT PRACTICES (BMP'S) SHALL BE INSTALLED IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS. ANY MODIFICATIONS OF EPSC MEASUREMENTS MUST BE REVIEWED AND APPROVED BY THE ENGINEER. IF DEEMED NECESSARY BY THE ENGINEER, ADDITIONAL EPSC BMP'S SHALL BE INSTALLED.

4.3 EPSC BMP'S SHALL BE MAINTAINED AT ALL TIMES IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS. ANY DEFICIENCIES IDENTIFIED BY THE CQA REPRESENTATIVE DURING INSPECTIONS SHALL BE REMEDIED IMMEDIATELY.

4.4 ACTIONS SHALL BE TAKEN TO MINIMIZE THE TRACKING OF MUD AND SOIL FROM THE PROJECT AREA ONTO THE EXISTING PLANT ACCESS ROAD. SOIL TRACKED ONTO THE ROADWAY SHALL BE REMOVED DAILY.

4.5 WHERE CONSTRUCTION OR LAND–DISTURBING ACTIVITIES HAVE TEMPORARILY CEASED ON ANY PORTION OF THE PROJECT SITE, TEMPORARY SITE STABILIZATION MEASURES SHALL BE IMPLEMENTED AS SOON AS PRACTICABLE, BUT NO LATER THAN 15 CALENDAR DAYS AFTER THE ACTIVITY HAS CEASED.

4.6 SEEDING, MULCHING, AND FERTILIZATION OF DISTURBED AREAS SHALL BE IMPLEMENTED IN ACCORDANCE WITH THE PLANTS EXISTING STORMWATER AND EROSION CONTROL PLAN.

5.0 EARTHWORK

5.1 MATERIAL SPECIFICATIONS FOR STRUCTURAL FILL, AGGREGATE, PIPE AND OTHER CONSTRUCTION MATERIALS ARE DEFINED IN THE TECHNICAL SPECIFICATIONS UNLESS NOTED OTHERWISE.

5.2 TEMPORARY EXCAVATIONS SHALL BE PREPARED IN ACCORDANCE WITH TVA SAFETY STANDARDS (SECTION 804) AND OSHA STANDARDS. STABILITY OF EXCAVATION SLOPES IS THE RESPONSIBILITY OF THE CONTRACTOR.

5.3 NO MATERIAL SHALL BE PLACED IN ANY SECTION OF THE EMBANKMENT UNTIL THE FOUNDATION FOR THAT SECTION HAS BEEN APPROVED BY THE ENGINEER OR CQA REPRESENTATIVE. THE CONTRACTOR SHALL KEEP THE FOUNDATION AND SUBGRADE FREE FROM WATER OR UNACCEPTABLE MATERIALS AFTER FILL OPERATIONS HAVE STARTED.

5.4 MATERIAL THAT IS PLACED ADJACENT TO AND LESS THAN 2 FT ABOVE THE TOP OF SIPHON PIPES SHALL BE COMPACTED USING HAND–DIRECTED COMPACTORS (JUMPING JACK TYPE COMPACTOR/RAMMER) WITH A MAXIMUM LIFT THICKNESS OF 4–INCHES.

6.0 SIPHON SPILLWAY OPERATION

6.1 THE SIPHON SPILLWAYS SHALL BE INSTALLED AND OPERATED TO TEMPORARILY DRAWDOWN THE POOL IN ADDITION TO MAINTAINING THE TYPICAL DAILY PROCESS FLOW DURING EXISTING SPILLWAY DIFFUSER REPLACEMENT.

6.2 THE CONTRACTOR SHALL INSTALL MIRAFI 500X (OR ENGINEER APPROVED EQUIVALENT) GEOTEXTILE FABRIC BENEATH THE TORPEDO STRAINERS TO MINIMIZE MIGRATION OF ASH.

6.3 THE CONTRACTOR SHALL INSTALL A CURTAIN BOOM AROUND THE SIPHON SPILLWAYS TO PREVENT CENOSPHERES AND DEBRIS FROM ENTERING THE TORPEDO STRAINERS.

6.4 THE CONTRACTOR SHALL INSTALL A STAFF GAGE WITH ALTERNATING MARKS AT 0.1 FT INCREMENTS AND WHOLE FOOT CALL–OUTS. THE CONTRACTOR SHALL MONITOR THE GAGE AND REGULATE THE SIPHON FLOWS TO MAINTAIN THE POND ELEVATION DURING DIFFUSER REPLACEMENT.

6.5 THE CONTRACTOR SHALL BE RESPONSIBLE FOR INSTALLING, PERIODICALLY PRIMING (INCLUDING RENTAL OR PURCHASE OF A GODWIN DRI–PRIME PUMP, OR APPROVED EQUAL), MAINTAINING AND REGULATING THE FLOW OF THE SIPHONS IN A MANNER THAT ENSURES SAFETY AND STABILITY OF THE ASH POND DIKES AT ALL TIMES DURING CONSTRUCTION. THE CONTRACTOR SHALL IMMEDIATELY HALT POOL LOWERING IF ANY SIGN OF INTERIOR PERIMETER SLOPE INSTABILITY IS NOTED.

6.6 DRAWDOWN (USING SIPHONS) WILL RESULT IN A DECREASED POND SURFACE AREA DURING CONSTRUCTION. THIS DECREASED SURFACE AREA MAY AFFECT SETTLING TIMES. THE OWNER SHALL BE RESPONSIBLE FOR MITIGATING ANY ADVERSE IMPACTS TO TOTAL SUSPENDED SOLID (TSS) LEVELS.

6.7 THE OUTLETS OF THE EXISTING SPILLWAYS ARE A NPDES PERMITTED DISCHARGE. DURING CONSTRUCTION, WORK IN THE ASH POND MAY CAUSE CHANGES IN PERMITTED EFFLUENT CHARACTERISTICS. THE OWNER SHALL BE RESPONSIBLE FOR MITIGATING EFFECTS OF POOL DRAWDOWN ON PH, TSS, AND DIKE STABILITY.

6.8 THE ROUTINE HANDLING AND OPERATIONS (RHO&M) PROGRAM MANAGER MUST BE NOTIFIED BEFORE CHANGES IN POOL LEVEL OCCUR.

6.9 THE CONTRACTOR SHALL VERIFY NO CENOSPHERES ARE PRESENT NEAR SIPHONS AND THAT CURTAIN BOOM IS IN PLACE PRIOR TO ACTIVATION.

7.0 DIFFUSER REPLACEMENT

7.1 THE CONTRACTOR SHALL PROVIDE A DETAILED WORK PLAN FOR THE REMOVAL AND REPLACEMENT OF THE DIFFUSER PIPES TO THE ENGINEER AT LEAST 15 DAYS PRIOR TO BEGINNING WORK. THE DETAILED WORKPLAN SHALL INCLUDE THE METHOD USED TO REMOVE THE EXISTING DIFFUSER PIPES AND INSTALL THE NEW HDPE DIFFUSER PIPES. THE FLOAT AND SINK METHOD SHALL BE USED TO INSTALL THE DIFFUSER PIPES. BALLAST WEIGHTS SHALL BE SECURED TO PIPE ON LAND. PIPE ENDS SHALL BE PLUGGED AND PIPE SHALL BE FLOATED INTO PLACE ALONG PROPOSED ALIGNMENT. PIPE SHALL BE SLOWLY FILLED WITH WATER SUCH THAT A CONTROLLED SINKING OCCURS.

7.2 ANY HARDWARE USED FOR ATTACHMENT OF BALLAST WEIGHTS TO DIFFUSER PIPE SHALL BE STAINLESS STEEL OR GALVANIZED.

7.3 DIVERS SHALL VERIFY INSTALLED HDPE PIPE IS NOT RESTING ON ANY ROCKS, DEBRIS OR MATERIAL THAT COULD CAUSE DAMAGE TO THE PIPE.

7.4 DURING INSTALLATION, HDPE PIPE BENDS SHALL HAVE A MINIMUM RADIUS OF 30 FT.

8.0 SEQUENCE OF CONSTRUCTION

8.1 PRIOR TO THE COMMENCEMENT OF WORK, CONTRACTOR SHALL VERIFY BUTTRESS CONSTRUCTION HAS BEEN COMPLETED FROM APPROXIMATE STATION 124+00 TO 126+00 (BY OTHERS) TO ALLOW FOR SIPHON INSTALLATION. CONTRACTOR SHALL ALSO VERIFY THAT THE CAUSEWAY HAS BEEN MODIFIED (BY OTHERS) AS SHOWN ON THE PLANS.

8.2 INSTALL SIPHON SPILLWAYS IN ACCORDANCE WITH THE CONSTRUCTION PLANS AND TECHNICAL SPECIFICATIONS.

8.3 ACTIVATE THE SIPHONS. CONTRACTOR SHALL MONITOR AND ADJUST SIPHON VALVES TO TEMPORARILY DRAWDOWN THE POOL TO A MINIMUM ELEVATION OF 754.0 FT AND TO MAINTAIN THE TYPICAL DAILY PROCESS FLOW FROM THE PLANT.

8.4 FOLLOWING TEMPORARY DRAWDOWN TO MINIMUM ELEVATION OF 754.0 FT, CLOSE BUTTERFLY VALVES AT THE EXISTING SPILLWAY OUTLET HEADWALL IN CASE OF LOSS OF PRIME DURING DIFFUSER REMOVAL OR REPLACEMENT.

8.5 REMOVE EXISTING SPILLWAY DIFFUSERS (CONTRACTOR SHALL SUBMIT A DETAILED WORKPLAN AT LEAST 15 DAYS PRIOR TO DIFFUSER REMOVAL FOR ENGINEER APPROVAL).

8.6 REMAINING PORTION OF SEGMENT B OF DIKE C BUTTRESS TO BE CONSTRUCTED BY OTHERS.

8.7 INSTALL NEW 24–INCH HDPE DIFFUSER PIPES AS SHOWN ON THE PLANS AND IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS (CONTRACTOR SHALL SUBMIT A DETAILED WORKPLAN AT LEAST 15 DAYS PRIOR TO DIFFUSER REPLACEMENT FOR ENGINEER APPROVAL).

8.8 FOLLOWING INSTALLATION, CONTRACTOR SHALL VERIFY THE FOLLOWING:
–ALIGNMENT OF INSTALLED DIFFUSER PIPES;
–BALLASTS SECURING THE DIFFUSER PIPE ARE PROPERLY SITTING ON THE CHANNEL BED AND THE PIPE IS NOT FORCED TO BRIDGE ANY CHANGES IN ELEVATION;
–PIPE IS NOT RESTING ON ANY ROCKS, DEBRIS OR MATERIAL THAT COULD CAUSE DAMAGE; AND
–ALL TEMPORARY MATERIALS AND EQUIPMENT USED DURING INSTALLATION HAVE BEEN REMOVED.

8.9 OPEN BUTTERFLY VALVES AND PARTIALLY CLOSE SIPHON VALVES TO RAISE THE POOL LEVEL AND ALLOW FLOW THROUGH THE NEW DIFFUSER PIPES. VERIFY THAT THE EXISTING SPILLWAYS ARE OPERATING CORRECTLY AND THERE ARE NO LEAKS IN THE NEW DIFFUSER PIPES.

8.10 UPON APPROVAL FROM THE OWNER, CLOSE SIPHON SPILLWAY VALVES.

8.11 CLEANUP SITE.

9.0 CONSTRUCTION DOCUMENTATION

9.1 CONSTRUCTION OBSERVATION AND TESTING:
THE OWNER OR DESIGNATED CQA REPRESENTATIVE SHALL PROVIDE QUALITY ASSURANCE CONTROL TESTING AND SHALL OBSERVE AND DOCUMENT CONSTRUCTION ACTIVITIES.

9.2 DAILY REPORT:
THE CONTRACTOR SITE FOREMAN OR CQA REPRESENTATIVE SHALL COMPLETE A DAILY ACTIVITIES REPORT FOR EACH DAY IN WHICH ANY CONSTRUCTION ACTIVITY OCCURS. THIS REPORT SHALL DOCUMENT THE EQUIPMENT AND PERSONNEL ACTIVE ON SITE (WITH RELEVANT TIMES NOTED) AND IT SHALL PROVIDE A GENERAL DESCRIPTION OF THE CONSTRUCTION ACTIVITIES PERFORMED DURING THE DAY. IT SHALL ALSO INCLUDE A DESCRIPTION OF ONGOING CONSTRUCTION PROGRESS. DISCUSSIONS OF INCLEMENT WEATHER, EQUIPMENT BREAKDOWNS AND ANY DAMAGE, SAFETY, ENVIRONMENTAL, ETC. INCIDENTS WHICH OCCUR SHALL BE PROVIDED. THE CONTRACTOR SHALL PROVIDE HIS OWN FORMAT FOR THIS REPORT, SUBJECT TO ENGINEER APPROVAL. IT IS EXPECTED THAT THIS REPORT SHALL BE SUBMITTED BY THE CONTRACTOR TO THE ENGINEER OR CQA REPRESENTATIVE BY NOON ON THE NEXT BUSINESS DAY FOLLOWING THE DAY WITHIN WHICH THE REPORT COVERS.

9.3 RECORD DRAWINGS
THE CONTRACTOR SHALL MAINTAIN A CLEAN SET OF CONSTRUCTION PLANS AT THE PROJECT SITE. THIS SET OF PLANS SHALL BE USED ONLY FOR RECORDING CONSTRUCTION ACTIVITY AS IT OCCURS. ALL ITEMS INSTALLED INTO THE WORK SHALL BE NOTED FOR ANY VARIATION IN MATERIAL SPECIFICATIONS, DETAILS, ELEVATIONS, OR HORIZONTAL LOCATIONS SHALL BE NOTED ON THE PLAN SET WITH RED MARKINGS. TO THE EXTENT NECESSARY, THE CONTRACTOR SHALL ENGAGE A QUALIFIED SURVEYOR TO ESTABLISH THE "AS–BUILT" LOCATION OF ALL PIPES, DRAINS, STRUCTURES, EMBANKMENT ZONE LIMITS, ETC. EACH ITEM'S POSITION SHALL BE DULY NOTED ON THIS "RED–LINE" PLAN SET. THE INFORMATION SHALL BE RECORDED WITH SUFFICIENT ACCURACY AND CLARITY TO BE UNDERSTOOD AND RELIED UPON. AT THE COMPLETION OF THE CONSTRUCTION PROCESS, THIS "RED–LINE" PLAN SET SHALL BE PROVIDED TO THE ENGINEER FOR USE IN DEVELOPING THE RECORD DRAWINGS FOR THE PROJECT. THE INFORMATION ON THE "RED–LINE" DRAWING SET SHALL BE KEPT CURRENT AT ALL TIMES AND SHALL BE AVAILABLE BY THE OWNER OR ENGINEER AT ANY TIME. THE CONTRACTOR SHALL SUBMIT THE "RED–LINE" AS–BUILT SET OF DRAWINGS TO THE CQA REPRESENTATIVE WITHIN FIVE WORKING DAYS OF COMPLETION AND ACCEPTANCE OF THE WORK DESCRIBED IN THIS WORK PACKAGE.

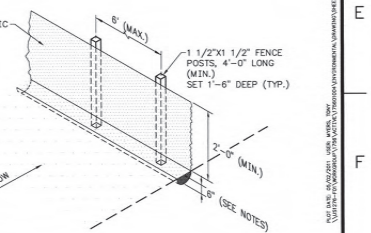
9.4 CONSTRUCTION CERTIFICATION REPORT:
THE CQA REPRESENTATIVE SHALL PREPARE AND SUBMIT A CONSTRUCTION CERTIFICATION REPORT IN ACCORDANCE WITH TVA'S MASTER PROGRAMMATIC DOCUMENTS WITHIN TWO WEEKS FOLLOWING COMPLETION OF CONSTRUCTION.

ISSUED FOR CONSTRUCTION

CONSTRUCTION QUALITY CONTROL PRODUCT SUBMITTALS

MATERIAL	SPECIFICATION	REQUIREMENTS	(FIO)/(EA)[1]	MINIMUM FREQUENCY	SUBMITTAL DATE	APPROVAL DATE
GENERAL		DETAILED WORKPLANS OUTLINING ALL PROJECT PROVISIONS TO BE SUBMITTED FOR APPROVAL BY THE OWNER.	FIO	15 DAYS PRIOR TO BEGINNING WORK		
CONCRETE						
BALLAST WEIGHTS	03 40 00	SHOP DRAWINGS OF THE PROPOSED PRE–CAST BALLAST WEIGHTS	EA	15 DAYS PRIOR TO FABRICATION		
		CERTIFIED TEST RESULTS FROM MANUFACTURER SHOWING THAT CONCRETE MEETS OR EXCEEDS ALL SPECIFICATIONS	FIO	1/SUPPLIER		
NON–SHRINK (EXPANSIVE) GROUT	03 60 00	DESIGN MIX SUBMITTAL AND SUPPLIER CERTIFICATION VERIFYING MIX MEETS SPECIFICATIONS (IF NON–COMMERCIAL GROUT MIX IS USED)	EA	15 DAYS PRIOR TO BEGINNING WORK		
		PASSING RESULTS OF STRENGTH AND EXPANSION TESTS SUBMITTED BY CQA REPRESENTATIVE (IF NON–COMMERCIAL GROUT MIX IS USED)	FIO	1/BATCH		
		DELIVERY SLIPS CERTIFYING CONTENTS OF EACH BATCH NOTING TIME OF DELIVERY	FIO	1/BATCH		
METALS						
WELDING	05 50 00	CERTIFICATION SHOWING THAT WELDERS HAVE SATISFACTORILY PASSED AWS QUALIFICATION TEST WITHIN THE PREVIOUS 12 MONTHS	FIO	PRIOR TO BEGINNING WORK		
EARTHWORK						
SITE PREPARATION	31 10 00	SITE SAFETY PLAN FOR APPROVAL BY TVA SAFETY PROFESSIONAL	FIO	PRIOR TO BEGINNING WORK		
BACKFILL AND EMBANKMENT	31 23 00	MATERIAL CLASSIFICATION OR SAMPLES FOR TESTING FROM EACH REPRESENTATIVE BORROW SOURCE	EA	1/SUPPLIER/SOURCE		
		PASSING RESULTS OF DENSITY AND MOISTURE TESTING DURING PLACEMENT AND COMPACTION.	FIO	1/4–INCH OR 8–INCH LIFT		
GEOTEXTILE FABRIC	31 23 13	CERTIFICATION STATING THAT THE PRODUCT MEETS OR EXCEEDS ALL REQUIREMENTS OF THE TECHNICAL SPECIFICATION	FIO	1/SUPPLIER/SOURCE		
STONE AND RIPRAP	31 37 00	CERTIFICATION INDICATING THE SOURCE OF STONE SURFACING IS AN "APPROVED SOURCE" (APL) PER TDOT SECTION 709.	FIO	1/SUPPLIER/SOURCE		
		GRADATION CURVE FOR THE MATERIAL AND CERTIFICATION THAT THE MATERIAL MEETS THE SPECIFICATIONS IN THE TECHNICAL SPECIFICATIONS.	FIO	1/SUPPLIER/SOURCE		
UTILITIES						
SIPHON SPILLWAYS	33 10 00	SUPPLIER SPECIFICATIONS FOR THE VALVES AND FLOAT BALLS.	FIO	1/SUPPLIER		
		RESULTS OF PASSING PRESSURE TEST FOR EACH PIPE RUN	FIO	1/PIPE RUN		
DIFFUSER REPLACEMENT	33 20 00	DETAILED WORKPLAN FOR THE REMOVAL OF THE EXISTING SPILLWAY DIFFUSERS AND INSTALLATION OF NEW SPILLWAY DIFFUSERS.	EA	15 DAYS PRIOR TO BEGINNING WORK		
		RESULTS OF PASSING PRESSURE TEST FOR EACH PIPE RUN	FIO	1/PIPE RUN		
HDPE PIPE	33 40 00	MANUFACTURER CERTIFICATION THAT THE PIPE AND EACH FITTING COMPLIES WITH THE TECHNICAL SPECIFICATIONS	FIO	1/SUPPLIER		

(1) FIO = FOR INFORMATION ONLY; EA = ENGINEER APPROVAL



NOTES:
1. INSTALL SILT FENCE IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS.
2. THE BOTTOM 12 INCHES OF THE FABRIC SHALL BE BURIED IN A 6–INCH TRENCH CUT INTO THE GROUND TO PREVENT SEDIMENT FROM ESCAPING UNDER THE FENCE. ALL EARTHWORK SHALL BE ON THE UPSTREAM SIDE OF THE FENCE.
3. GEOTEXTILE FABRIC SHALL MEET THE FOLLOWING SPECIFICATIONS: TENSILE STRENGTH (ASTM D 4632) – 100 LBS. MIN., WIDTH – 36" MIN., APPARENT OPENING SIZE (ASTM D4751) NO. 30. ULTRAVIOLET DEGRADATION (ASTM D 4355) 80% STRENGTH RETAINED. ELONGATION OF 40% MAX. (ASTM D 4632).

1/2 DETAIL – SILT FENCE
NOT TO SCALE

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX0003020110002

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE
R 0	05/03/11	LJP	TMM	MAH	HMW	VJD	MST	JCK	–	–	–
ISSUED FOR CONSTRUCTION											

SCALE: NONE EXCEPT AS NOTED

YARD
STILLING POND

DIFFUSER REPLACEMENT PROJECT
GENERAL NOTES
WORK PLAN 6 (KIF–110503–WP–6)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
L.J. PERKINS	T.M. MYERS	M.A. HOY	H.M. WILLIS	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE: 05/03/11 | 36 | C | 81W403–02 | R 0

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

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STANTEC	0
TASK COMPLETED BY:	REV NO.

LAST DATE: 05/03/2011 - USER: MYERS, TMM
L:\STNTEC\FOSSIL\PROJECTS\KINGSTON\DIVISION\DRAWINGS\81W403-02-R0.DWG

36 C 81W403–02

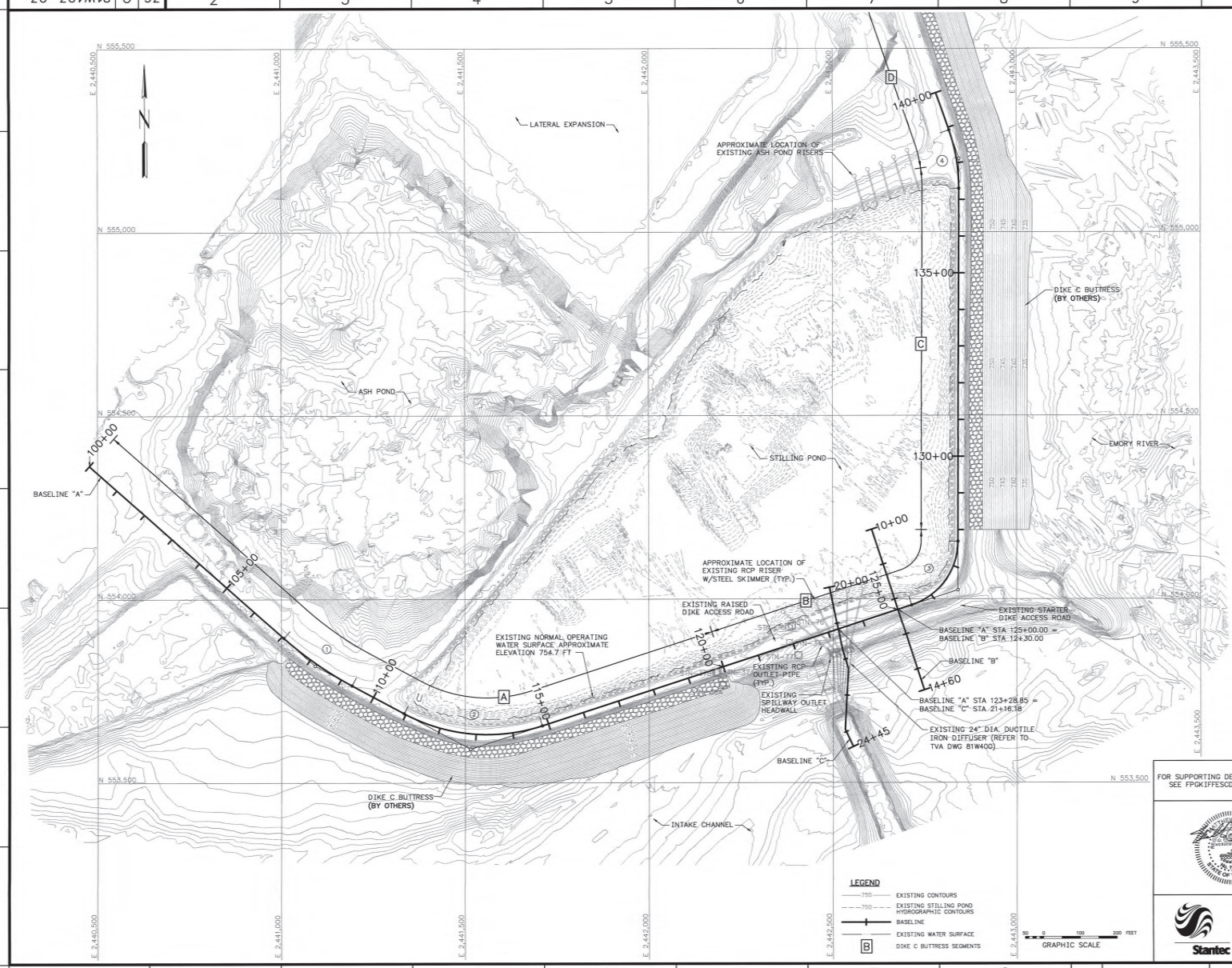


TABLE OF BASELINE COORDINATES			
STATION	BASELINE	NORTHING	EASTING
100+00	A	554,363.86	2,440,447.77
140+00	A	555,379.31	2,442,781.47
10+00	B	554,094.87	2,442,636.76
14+60	B	553,752.64	2,442,748.46
20+00	C	554,031.98	2,442,490.98
21+72.07	C	553,863.44	2,442,525.66
22+28.24	C	553,809.73	2,442,542.12
23+93.08	C	553,645.15	2,442,533.00
24+50	C	553,598.18	2,442,555.13

BASELINE CURVE DATA

①
P.I. STA. = 108+20.74
NORTHING = 553,819.18
EASTING = 2,441,091.71
Δ = 13°20'06"
R = 974.68'
T = 113.94'
L = 226.85'
E = 6.64'
P.C. STA. = 107+06.80
P.T. STA. = 109+33.65

②
P.I. STA. = 112+99.93
NORTHING = 553,591.92
EASTING = 2,441,514.77
Δ = 46°19'10"
R = 479.84'
T = 205.26'
L = 387.92'
E = 42.06'
P.C. STA. = 110+94.67
P.T. STA. = 114+82.59

③
P.I. STA. = 126+71.85
NORTHING = 554,024.61
EASTING = 2,442,840.47
Δ = 71°45'50"
R = 182.94'
T = 132.33'
L = 229.13'
E = 42.85'
P.C. STA. = 125+39.52
P.T. STA. = 127+68.65

④
P.I. STA. = 138+12.12
NORTHING = 555,200.41
EASTING = 2,442,843.77
Δ = 19°21'32"
R = 479.84'
T = 81.84'
L = 162.13'
E = 6.93'
P.C. STA. = 137+30.28
P.T. STA. = 138+92.41

INSTRUMENTATION LEGEND

STN-1 ⬡ SLOPE INCLINOMETER (SI)
STN-2 ⬡ PIEZOMETER (PZ)
STN-3 ⬡ SETTLEMENT PLATFORM (SP)

MAPPING NOTE:

1. THESE DRAWINGS WERE COMPILED USING SURVEY INFORMATION PROVIDED BY TVA.
2. AN AUTOCAD DRAWING INCLUDING TOPOGRAPHIC AND HYDROGRAPHIC SURVEY POINTS ENTITLED '1-24-11 POINTS.DWG' WAS USED FOR ELEVATIONS BELOW AND INCLUDING ELEVATION 760 FT. TOPOGRAPHIC DATA FROM A LIDAR SURVEY PERFORMED IN APRIL 2009 BY TUCK MAPPING SOLUTIONS, INC WAS USED IN AREAS OUTSIDE OF THE STILLING POND ABOVE ELEVATION 760 FT.
3. DIKE C BUTTRESS AS DEPICTED REPRESENTS THE PROPOSED DESIGN (BY OTHERS), NOT AN AS-BUILT CONFIGURATION.
4. HORIZONTAL COORDINATES ARE REFERENCED TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NAD 27. ELEVATIONS ARE BASED ON NGVD 29.

SURVEY CONTROL NOTE:

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

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX00030020110002

REV NO.	DATE	ORIGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD
R 0	05/03/11	LJP	TMM	MAH	HMW	VJD	MST	JCK
ISSUED FOR CONSTRUCTION								

SCALE: 1"=100' EXCEPT AS NOTED

YARD
STILLING POND

DIFFUSER REPLACEMENT PROJECT
EXISTING CONDITIONS & BASELINES
WORK PLAN 6 (KIF-110503-WP-6)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
L.J. PERKINS	T.M. MYERS	M.A. HOY	H.M. WILLIS	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

Stantec Consulting Services Inc.
1859 Bowles Ave., Ste 250
St. Louis, Missouri
63026-1944
Tel. 636.343.3880
Fax 636.343.3554
www.stantec.com

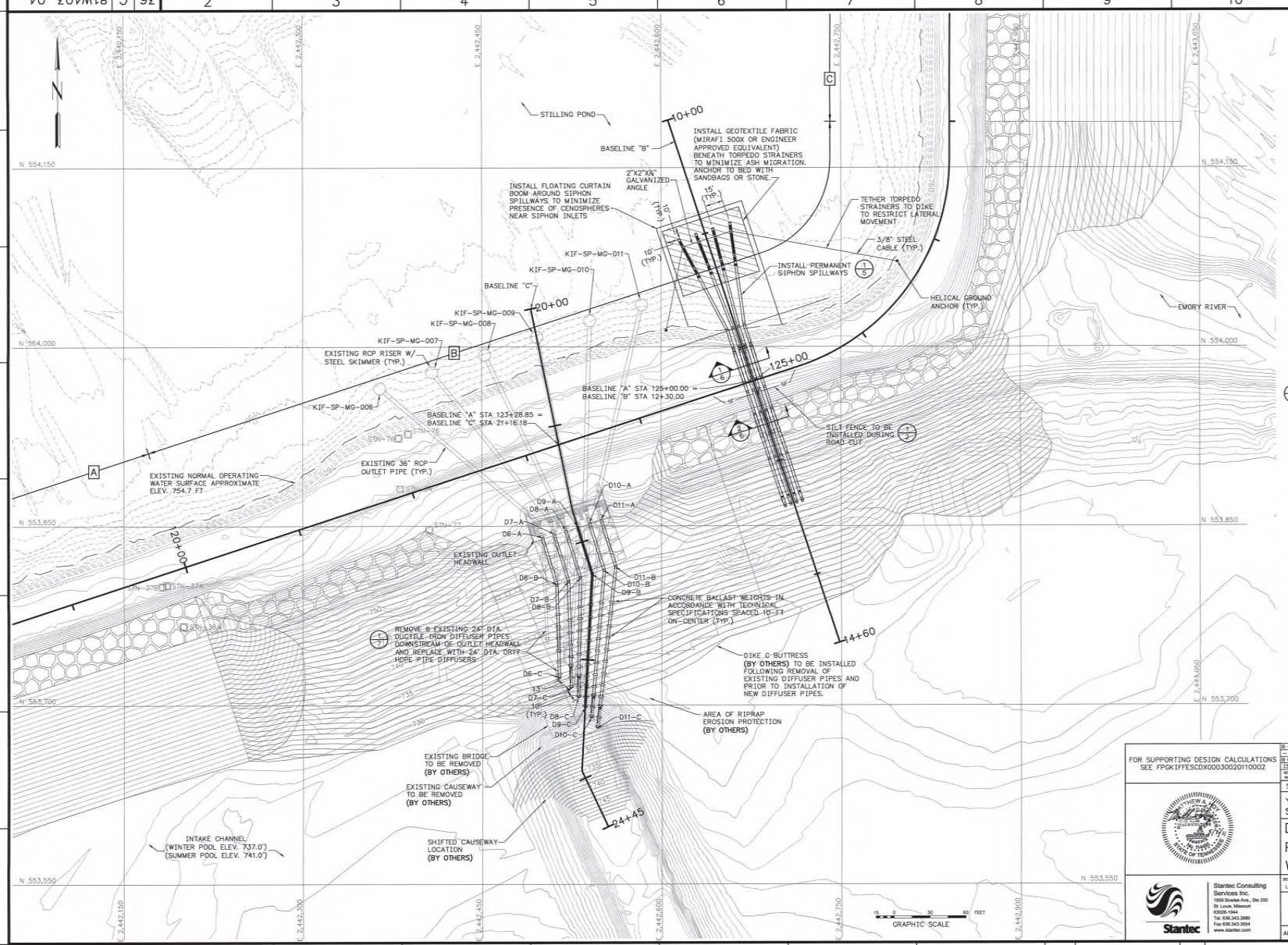
AUTOCAD R 2000 | DATE 05/03/11 | 36 | C | 81W403-03 | R 0

PLOT FACTOR:100 W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

STANTEC 0
TASK COMPLETED BY: REV NO.

36 C 81W403-03



DIFFUSER & SIPHON STRUCTURE SCHEDULE			
STRUCTURE REFERENCE	BASELINE	STATION	OFFSET (FT)
D6-A	C	21+87	30.8'-R
D6-B	C	22+39	28.9'-R
D6-C	C	23+16	22.8'-R
D7-A	C	21+87	20.6'-R
D7-B	C	22+35	19.3'-R
D7-C	C	23+24	12.3'-R
D8-A	C	21+87	10.3'-R
D8-B	C	22+32	9.7'-R
D8-C	C	23+32	6.0'-R
D9-A	C	21+87	0'
D9-B	C	22+28	0'
D9-C	C	23+40	0'
D10-A	C	21+86	10.5'-L
D10-B	C	22+28	10.5'-L
D10-C	C	23+48	5.7'-L
D11-A	C	21+86	20.6'-L
D11-B	C	22+28	20.6'-L
D11-C	C	23+57	11.2'-L

INSTRUMENTATION LEGEND

STN-1 SLOPE INCLINOMETER (SI)
STN-2 PIEZOMETER (PZ)
STN-3 SETTLEMENT PLATFORM (SP)

LEGEND
750 EXISTING CONTOURS
750 EXISTING STILLING POND HYDROGRAPHIC CONTOURS
750 PROPOSED CONTOURS
EXISTING WATER SURFACE
SF SILT FENCE
LIMITS OF DISTURBANCE
BASELINE
A DIKE C BUTTRESS SEGMENT

Section or Detail No.
Sheet Where Shown
REFERENCE KEY

MAPPING NOTE:

1. THESE DRAWINGS WERE COMPILED USING SURVEY INFORMATION PROVIDED BY TVA.
2. AN AUTOCAD DRAWING INCLUDING TOPOGRAPHIC AND HYDROGRAPHIC SURVEY POINTS ENTITLED '1-24-11 POINTS.DWG' WAS USED FOR ELEVATIONS BELOW AND INCLUDING ELEVATION 760 FT. TOPOGRAPHIC DATA FROM A LIDAR SURVEY PERFORMED IN APRIL 2009 BY TUCK MAPPING SOLUTIONS, INC WAS USED IN AREAS OUTSIDE OF THE STILLING POND ABOVE ELEVATION 760 FT.
3. DIKE C BUTTRESS AS DEPICTED REPRESENTS THE PROPOSED DESIGN (BY OTHERS), NOT AN AS-BUILT CONFIGURATION.
4. HORIZONTAL COORDINATES ARE REFERENCED TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NAD 27. ELEVATIONS ARE BASED ON NGVD 29.

SURVEY CONTROL NOTE:

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

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGK1FFESCDX0003002O110002

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	05/03/11	LJP	TMM	MAH	HMW	VJD	MST	JCK	–	–
ISSUED FOR CONSTRUCTION										

SCALE: 1"=30' EXCEPT AS NOTED

YARD
STILLING POND

DIFFUSER REPLACEMENT PROJECT
PLAN – DIFFUSER REPLACEMENT WORK PLAN 6 (KIF-110503-WP-6)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
L.J. PERKINS	T.M. MYERS	M.A. HOY	H.M. WILLIS	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMERER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 05/03/11 | 36 | C | 81W403-04 | R 0

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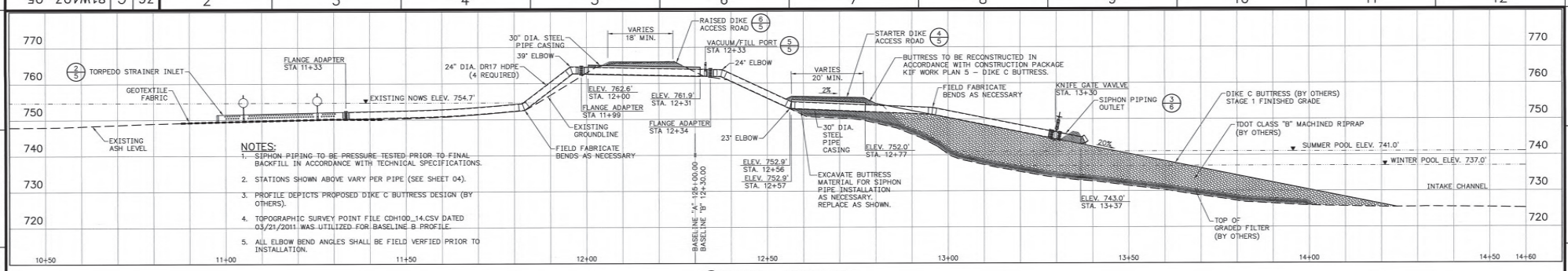
STANTEC | 0
TASK COMPLETED BY: | REV NO.

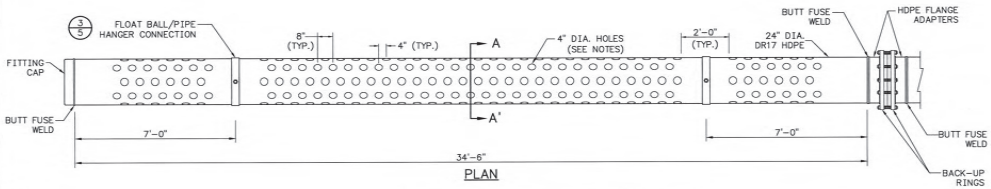
PLOT FACTOR:30
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



NOTES:
1. SIPHON PIPING TO BE PRESSURE TESTED PRIOR TO FINAL BACKFILL IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS.
2. STATIONS SHOWN ABOVE VARY PER PIPE (SEE SHEET 04).
3. PROFILE DEPICTS PROPOSED DIKE C BUTTRESS DESIGN (BY OTHERS).
4. TOPOGRAPHIC SURVEY POINT FILE CDH100_14.CSV DATED 03/21/2011 WAS UTILIZED FOR BASELINE B PROFILE.
5. ALL ELBOW BEND ANGLES SHALL BE FIELD VERFIED PRIOR TO INSTALLATION.

(1/5) PROFILE – BASELINE B
SCALE: 1"=10'

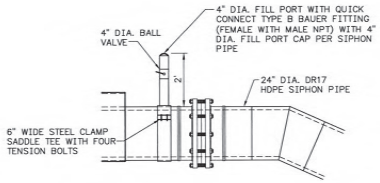


PLAN

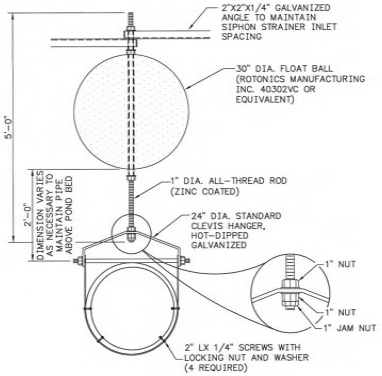
(2/5) DETAIL – TORPEDO STRAINER INLET
SCALE: 1/2"=1'-0"

SECTION A–A'
NOT TO SCALE

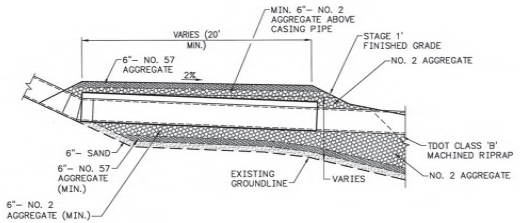
NOTES:
1. HOLES WILL BE ON TOP HALF OF PIPE ONLY.
2. 4" DIA. HOLES AT 8" CENTER TO CENTER.
3. 200 HOLES PER STRAINER (5 ROWS WITH 40 HOLES EACH).
4. ROWS ARE TO BE 8" APART CENTER TO CENTER, AND THE HOLES WILL BE OFFSET BY 4".
5. PROVIDE 2 FOOT LENGTH WITHOUT HOLES AT 7 FEET FROM EACH END FOR FLOAT BALL HANGERS.



(5/5) DETAIL – VACUUM/FILL PORT
NOT TO SCALE

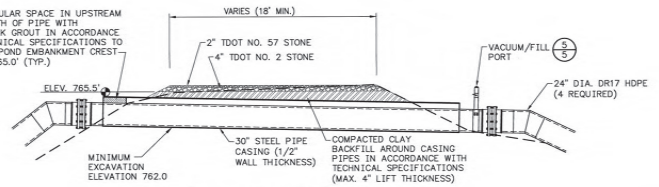


(3/5) DETAIL – FLOAT BALL/PIPE HANGER CONNECTION
SCALE: 1"=1'-0"



NOTES:
1. BUTTRESS MATERIAL AND ACCESS ROAD TO BE CONSTRUCTED BY OTHERS
2. THE MINIMUM COVER THICKNESS FROM ROAD SURFACE TO TOP OF SAND FILTER IS 36–INCHES.
3. PLACE NO. 2 AGGREGATE AND NO. 57 AGGREGATE ON RIPRAP OR NO. 2 AGGREGATE AS APPLICABLE TO FORM A REVERSE FILTER FOR ROAD SURFACE.
4. REMOVE AGGREGATE CONTAMINATED WITH ASH AS DIRECTED BY THE QC MANAGER.

(4/5) DETAIL – STARTER DIKE ACCESS ROAD
SCALE: 1/4"=1'-0"



(6/5) DETAIL – RAISED DIKE ACCESS ROAD
SCALE: 1/4"=1'-0"

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX0003002110002

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

LEGEND
NOWS = NORMAL OPERATING WATER SURFACE

R –	–	–	–	–	–	–	–	–	–	–	–	–	–	–
R 0	05/03/11	LJP	TMM	MAH	HMW	VJD	MST	JCK	–	–	–	–	–	–
ISSUED FOR CONSTRUCTION														
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST				

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
STILLING POND

DIFFUSER REPLACEMENT PROJECT
DETAILS – SIPHON SPILLWAYS
WORK PLAN 6 (KIF–110503–WP–6)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
L.J. PERKINS	T.M. MYERS	M.A. HOY	H.M. WILLIS	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE: 05/03/11 | 36 | C | 81W403–05 | R 0

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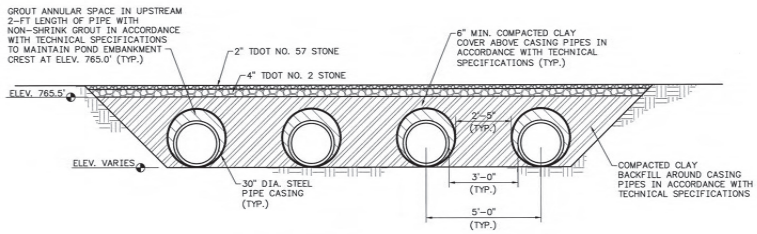
STANTEC	0
TASK COMPLETED BY:	REV NO.

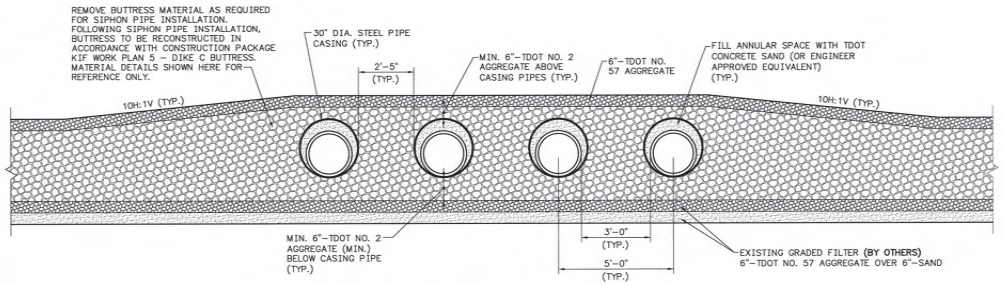
PLOT FACTOR:10
W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

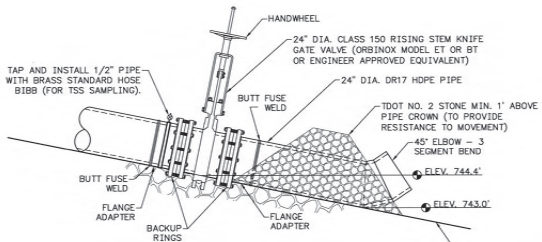
PLOT DATE: 05/03/2011 - 10:09, MYERS, TMM
L:\ENGINEERING\CIVIL\DWG\KIF\FPGKIFFESCDX0003002110002.DWG



1/6 SECTION – RAISED DIKE ACCESS ROAD
SCALE: 1/2"=1'



2/6 SECTION – STARTER DIKE ACCESS ROAD
SCALE: 1/2"=1'



3/6 DETAIL – SIPHON PIPING OUTLET
SCALE: 1/2"=1'

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX0003002011000 2

REV	DATE	DESN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD
R 0	05/03/11	LJP	TNM	MAH	HMW	VJD	MST	JCK
	ISSUED FOR CONSTRUCTION							

SCALE: AS SHOWN — EXCEPT AS NOTED

YARD
STILLING POND

DIFFUSER REPLACEMENT PROJECT
DETAILS – SIPHON SPILLWAYS
WORK PLAN 6 (KIF-110503-WP-6)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
L.J. PERKINS	T.M. MYERS	M.A. HOY	H.M. WILLIS	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
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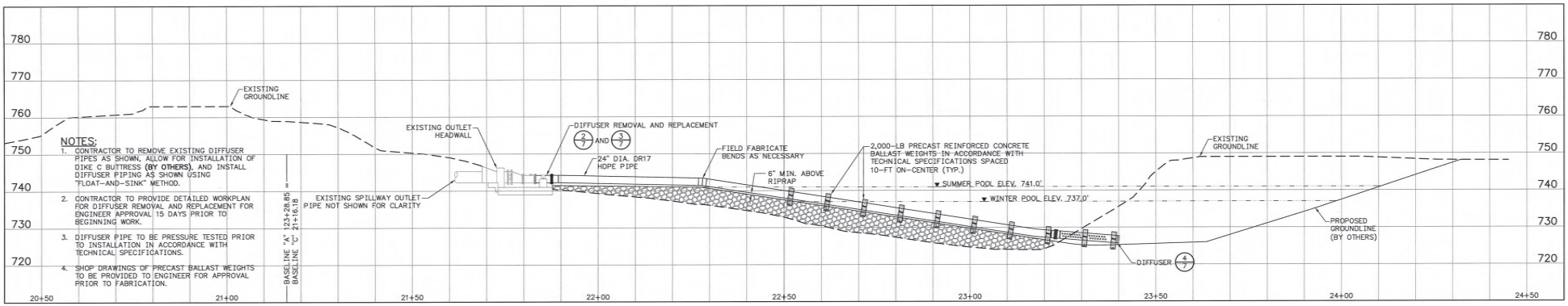
AUTOCAD R 2000 | DATE 05/03/11 | 36 | C | 81W403-06 | R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:1
W_TVA

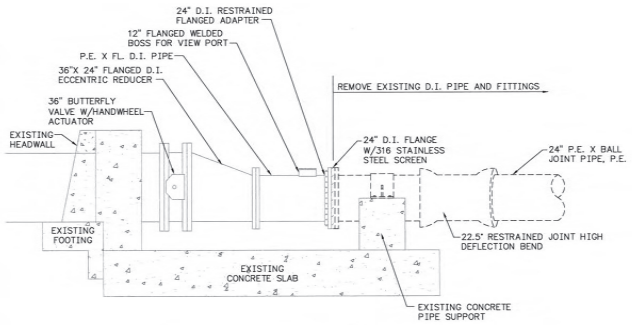
C.A.D. DRAWING
DO NOT ALTER MANUALLY

PLOT DATE: 05/03/2011 - USER: MYERS, TNM
I:\GIS\TVA\KIF\DRAWINGS\FESCD\FESCDX0003002011000.DGN

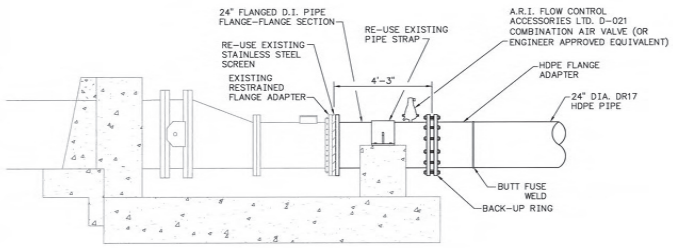


NOTES:
1. CONTRACTOR TO REMOVE EXISTING DIFFUSER PIPES AS SHOWN, ALLOW FOR INSTALLATION OF DIKE C BUTTRESS **(BY OTHERS)**, AND INSTALL DIFFUSER PIPING AS SHOWN USING "FLOAT-AND-SINK" METHOD.
2. CONTRACTOR TO PROVIDE DETAILED WORKPLAN FOR DIFFUSER REMOVAL AND REPLACEMENT FOR ENGINEER APPROVAL 15 DAYS PRIOR TO BEGINNING WORK.
3. DIFFUSER PIPE TO BE PRESSURE TESTED PRIOR TO INSTALLATION IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS.
4. SHOP DRAWINGS OF PRECAST BALLAST WEIGHTS TO BE PROVIDED TO ENGINEER FOR APPROVAL PRIOR TO FABRICATION.

1/7 PROFILE – BASELINE C
SCALE: 1"=10'

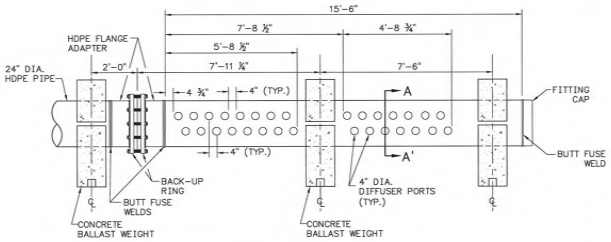


2/7 DETAIL – EXISTING DIFFUSER PIPE REMOVAL
SCALE: 1/2"=1'



3/7 DETAIL – DIFFUSER REPLACEMENT
SCALE: 1/2"=1'

SECTION A–A' – DIFFUSER HOLE ORIENTATION



ELEVATION VIEW

4/7 DETAIL – DIFFUSER
SCALE: 1/2"=1'

NOTE:
1. CONTRACTOR SHALL ASSESS CONDITION OF EXISTING DIFFUSER UPON REMOVAL. IF EXISTING DIFFUSER IS IN ADEQUATE CONDITION, IT MAY BE RE-USED UPON APPROVAL FROM THE ENGINEER.
2. 24" HDPE BLIND FLANGE REQUIRED FOR INSTALLATION OF DIFFUSER PIPING.

SECTION OR DETAIL NO.
SHEET WHERE SHOWN
REFERENCE KEY

ISSUED FOR CONSTRUCTION

FOR SUPPORTING DESIGN CALCULATIONS SEE FPGKIFFESCDX0003002010002

R-	–	–	–	–	–	–	–	–	–	–	–	–
R 0	05/03/11	LJP	TNM	MAH	HMW	VJD	MST	JCK	–	–	CONSTRUCTION ENTRANCE
ISSUED FOR CONSTRUCTION											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
STILLING POND

DIFFUSER REPLACEMENT PROJECT
DETAILS – DIFFUSER REPLACEMENT
WORK PLAN 6 (KIF-110503-WP-6)

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
L.J. PERKINS	T.M. MYERS	M.A. HOY	H.M. WILLIS	V.J. DOTSON	M.S. TURNBOW	J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE: 05/03/11 | 36 | C | 81W403-07 | R 0

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TASK COMPLETED BY:	REV NO.

PLOT FACTOR:10
W_TVA

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PLOT DATE: 05/03/2011 - 10:09, M:\TVA\KIF\ESC\DWG\DIFFUSER\DIFFUSER REPLACEMENT\DRAWINGS\SHEET_FILES\DIFFUSER_DETAILS-07-R0.DWG

APPENDIX A

Document 7

Doc 2010 Annual Inspection of CCP Facilities and Ponds, Kingston Fossil Plant, Harriman, Tennessee, Stantec Consulting Services, June 1, 2010

2010 Annual Inspection of CCP Facilities and Ponds

Kingston Fossil Plant
Harriman, Tennessee

Stantec Consulting Services Inc.
One Team. Infinite Solutions.
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Louisville KY 40223-2177
Tel: (502) 212-5000 • Fax: 502) 212-5055
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Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

June 1, 2010

Stantec Consulting Services, Inc.
1901 Nelson Miller Parkway
Louisville, KY 40223-2177
Tel: (502) 212-5000
Fax: (502) 212-5055

June 1, 2010 175550002

Mr. Michael S. Turnbow
Tennessee Valley Authority
1101 Market Street
LP 2G-C
Chattanooga, Tennessee 37402

Re: 2010 Annual Inspection of CCP Facilities and Ponds
Kingston Fossil Plant
Harriman, Tennessee

Dear Mr. Turnbow:

Stantec Consulting Services Inc. (Stantec) has completed the 2010 annual inspections for CCP facilities and ponds at the Kingston Fossil Plant. Facilities reviewed included:

- Ash Pond
- Coal Yard Drainage Pond
- Dike 2 Sediment Pond
- Dredge Cell
- Engineered Redwater Wetlands
- Peninsula Gypsum Pond
- Sluice Trench
- Stilling Pond

The field work was performed from April 21 through 30, 2010. The results of the work along with facility-specific recommendations for maintenance or other activities are included on the enclosed documents. In addition, the following general plant-wide recommendations and comments are offered:

- It is recommended that vegetation maintenance continue, including mowing and clearing tall grass/cattail growth at regular intervals. If lack of vegetation is observed during these operations, re-seeding should be performed as soon as possible. If continued difficulties establishing new vegetation persist, then TVA should consider refining existing procedures or developing site specific specifications which address topsoil, fertilizing, seed mixtures, etc.

- It is recommended that TVA catalog, assign a responsible party and due date, and track the completion of the facility-specific recommendations provided herein.

- Please note that this scope did not include a review of the current Operations and Maintenance Manual (O&M) or Emergency Action Plan for KIF. Stantec understands that TVA plans to update the current O&M manual to include dam safety-related items in association with the transition from the initial December 2008 Dredge Cell incident recovery to re-initiation of plant operations. Current recovery operations include a site-wide Emergency Action Plan. In addition, Stantec is in the process of reviewing plant operations and developing an O&M Manual for Kingston ash operations.

- It is recommended that TVA personnel continue dike inspections/monitoring to look for changes or conditions that might affect dike integrity. The frequency and procedures for inspections should be consistent with TVA's newly implemented inspection program. Particular emphasis should be placed on reviewing and monitoring the seepage areas for changed or worsened conditions, and identifying and repairing other maintenance items such as animal burrows, erosion, and lack of vegetation.

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

Sincerely,

STANTEC CONSULTING SERVICES INC.

Mark L. Jones, EIT
Project Engineer

Thomas W. Ward, EIT
Project Engineer

Don W. Fuller II, PE
Principal

/cdm

Enclosure A

Ash Pond

TVA 2010 Annual Inspection Program
Kingston Fossil Plant (KIF)
Ash Pond

1. General Facility Information

Facility Status:	Active	NID Identification:	TN14504
Surface Area (inside dikes):	79.92 Acres	TVA Hazard Classification:	Dike C: Significant
Maximum Height (toe to top of dike):	28 ft	Dike Length:	Dike D: 2,641 ft Dike C: 2,813 ft Divider Dike: 2,163 ft
Plant Discharge to Facility:	Unknown	Current Pool Elevation:	Approx. 761 ft

2. Site Visit Information

Stantec Inspection Team:	Thomas Ward EIT, Mark Jones EIT, and Leo Booth
TVA Staff Present:	None present.
Field Inspection Date:	04/30/2010
Weather/Site Conditions:	Sunny, 70s

3. History/Current and Future Operations

History:	This structure is used as the main Ash Pond and receives discharge from the fossil plant, Dredge Cell, Engineered Redwater Wetlands, and river dredging operations through the Sluice Trench. Construction of the Lateral Expansion in the northern extent of the Ash Pond is ongoing.
Current Operations:	Fly ash and bottom ash is sluiced into the Ash Pond. Sluice water flows from the active Ash Pond into the Stilling Pond through the five spillways constructed in 2005.
Future Planned Operational Changes:	The ash pond will be closed as part of the overall Dredge Cell closure.

4. Stantec Field Observations

See attached Photos and Site Plan Drawing.

4.1. Interior Slopes

Vegetation:	Grass-covered dike slopes with generally good coverage. Occasional sparse areas of vegetation and/or settled ash with sparse cattails.
Trees:	Occasional small trees were observed along the toe of the Divider Dike and Dike C.
Wave Wash Protection:	Riprap was observed along north slope in from of riser weirs. Area of concrete observed at the Dike C/Divider Dike junction.
Erosion:	None observed.
Instabilities:	None observed.
Animal Burrows:	None observed, although several rabbits were noted during inspection.
Freeboard:	Approximately 5 feet.
Encroachments:	None observed.
Slope:	Varies from approximately 3.66H:1V to 3.12H:1V along the Ash Pond side of the Divider Dike. The interior slopes of Dike C along the Ash Pond are approximately 1.85H:1V and flatten out to 4.85H:1V near the current pool elevation.

4.2. Crest

Crest Cover and Slope:	Gravel (crushed stone) access road, adequate coverage. Relatively flat.
Erosion:	Some rutting on access road.
Alignment:	No issues observed.
Settlement/Cracking:	None observed.
Bare Spots/Rutting:	Some rutting on access road.
Width:	Approximately 15 to 25 feet.

4.3. Exterior Slopes

Vegetation:	Grass-covered dike slopes with generally good coverage.

Trees:	Numerous trees were observed along the shoreline of Dike C with the Intake Channel (Photo 5).
Erosion:	Some minor erosion on lower bench observed.
Instabilities:	None observed.
Uniform Appearance:	Yes.
Seepage:	Potential seepage was observed along the portion of Dike C where the Intake Channel is directly downstream of the Ash Pond (Photo 3).
Benches:	One bench with a width of approximately 15 feet.
Foundation Drains, and Seepage Collection Systems:	Five 12-inch pipes installed at various locations below lower bench to intersect seeps from Ash Pond and Stilling Pond.
Instrumentation:	Eight piezometers and seven slope inclinometers have been installed along the sections of Dike C that dam the Ash Pond.
Animal Burrows:	None Observed.
Slope:	Varies from approximately 1.57H:1V to 2.89H:1V on the Stilling Pond side of the Divider Dike. Dike C varies from approximately 1.85H:1V near the crest to 3.02H:1V near the river waterline. Buttressing for Dike C being constructed at 6H:1V.
Height:	Approximately 23 ft.

4.4. Spillway Weirs/Riser Inlets

Number:	5
Size, Type and Material:	48-inch diameter RCP push-together risers with standard TVA steel skimmers.
Height of Riser Inlets:	Estimated at 8.5 feet.
Access:	Spillways -001 and -003 accessible via fixed metal catwalks from Dike C.
Joints:	No joints were observable. Reportedly sealed annually by divers.

Mis-Alignment:	None reported or observed.
Closed/Abandoned Conduits:	There is reportedly one abandoned riser (-035) and one inactive riser (-036) in the Ash Pond.

4.5. Outlet Pipes

Number:	5
Size, Type and Material:	36-inch diameter steel pipes.
Headwall:	N/A.
Joint Separations:	Unknown, unable to observe (outlet pipes submerged).
Mis-Alignment:	None reported or observed (outlet pipes submerged).
Closed/Abandoned Conduits:	Kennedy Weir reportedly abandoned and removed.

5. Repairs/Mitigation/New Construction Activities Since Last Annual Inspection

The following activities and/or improvements have been performed within the Ash Pond since the last annual inspection:

- Ongoing construction of the Lateral Expansion.

6. Recommendations

The following maintenance recommendations are offered for the Ash Pond. Priority codes are included in parentheses and are described in Enclosure K:

- Trees and brush are located on the interior and exterior slopes. It is recommended that trees and brush be removed from these slopes in accordance with the general guidelines shown in Enclosure I. (Priority 4)
- It is recommended that TVA continue to monitor the potential seepage area (Photo 3). The frequency of monitoring should be in accordance with TVA's current inspection program.
- It is recommended that dike rutting (Photo 6) and Dike C toe undercutting (Photo 1) be repaired by placing and compacting material to restore the areas. (Priority 4)

Photo 1

Typical view of lower bench on downstream side of Dike C looking east. Some undercutting at toe of riser dike observed.

Photo 2

Outlet pipes from Engineered Redwater Wetlands to Ash Pond through Dike C with overgrown vegetation.

Photo 3

Possible Seepage observed on exterior side of Dike C toward Intake Channel amidst vegetation looking southeast.

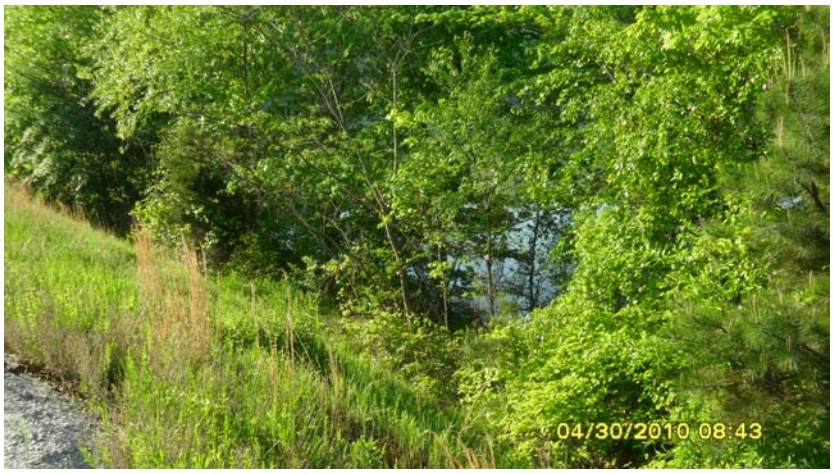

Photo 4

Trees and vegetation on Dike C alongside Intake Channel looking southeast.

Photo 5

Spillways in Ash Pond looking west.

Photo 6

Typical rutting on crest of Dike C looking northeast.

Photo 7

Ongoing buttressing of Dike C looking northeast.

Photo 8

Cenospheres and ash deposits in south end of Ash Pond looking west from Divider Dike.

Photo 9

View looking south of settled ash with sparse vegetation in foreground near intersection with Dike D. Ongoing work for Lateral Expansion in background.

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PROJECT NO. 175550002
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Plan View - KIF 2010 Annual Inspection
Ash Pond

Tennessee Valley Authority
Kingston Fossil Plant
Kingston, Roane County, Tennessee

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Enclosure B

Coal Yard Drainage Pond

TVA 2010 Annual Inspection Program
Kingston Fossil Plant (KIF)
Coal Yard Drainage Pond

1. General Facility Information

Facility Status:	Active	NID Identification:	Unknown
Surface Area (inside dikes):	0.408 acres	TVA Hazard Classification:	Not Classified
Maximum Height (toe to top of dike):	8 feet deep	Dike Length:	N/A
Plant Discharge to Facility:	None	Current Pool Elevation:	750 feet

2. Site Visit Information

Stantec Inspection Team:	Thomas Ward EIT, Mark Jones EIT, and Don Fuller PE
TVA Staff Present:	N/A
Field Inspection Date:	April 21, 2010
Weather/Site Conditions:	Sunny, 67 degrees Fahrenheit

3. History/Current and Future Operations

History:	Basin excavated below grade to capture local stormwater runoff from the coal yard and areas immediately south.
Current Operations:	Local stormwater and drainage basin for runoff from the coal yard and areas immediately south. Water is discharged from the pond by being pumped into the fly ash discharge ditch and flows to the active ash disposal area.
Future Planned Operational Changes:	None reported.

4. Stantec Field Observations

See attached Photos and Site Plan Drawing.

4.1. Interior Slopes

Vegetation:	Mixture of grasses and shrubs, generally good coverage.
Trees:	Numerous small trees observed on south and west

	slopes (Photos 10 and 11).
Wave Wash Protection:	N/A
Erosion:	Severe localized erosion at inlet pipe on north embankment of pond. Soil eroded and undercut area approximately 10 feet by 3 feet (Photo 14).
Instabilities:	Slough several feet across observed immediately west of inlet erosion on pond embankment (Photo 15).
Animal Burrows:	None observed.
Freeboard:	Approximately 6 feet (estimated).
Encroachments:	None observed.
Slope:	Estimated at approximately 2H:1V.

4.2. Crest

Crest Cover and Slope:	N/A
Erosion:	N/A
Alignment:	N/A
Settlement/Cracking:	N/A
Bare Spots/Rutting:	N/A
Width:	N/A

4.3. Exterior Slopes

Vegetation:	N/A
Trees:	N/A
Erosion:	N/A
Instabilities:	N/A
Uniform Appearance:	N/A
Seepage:	N/A
Benches:	N/A
Foundation Drains, and	N/A

Seepage Collection Systems:	
Instrumentation:	N/A
Animal Burrows:	N/A
Slope:	N/A
Height:	N/A

4.4. Spillway Weirs/Riser Inlets

Number:	N/A
Size, Type and Material:	N/A
Height of Riser Inlets:	N/A
Access:	N/A
Joints:	N/A
Mis-Alignment:	N/A
Closed/Abandoned Conduits:	N/A

4.5. Outlet Pipes

Number:	3
Size, Type and Material:	Two 14-inch corrugated steel stormwater pipes. One 12-inch steel drainage pipe.
Headwall:	N/A
Joint Separations:	Unable to observe.
Mis-Alignment:	Unable to observe.
Closed/Abandoned Conduits:	Unknown.

5. Repairs/Mitigation/New Construction Activities Since Last Annual Inspection

The following activities and/or improvements have been performed within the Coal Yard Drainage Pond since the last annual inspection:

- The pond was cleaned out by TVA Civil Projects in the fall of 2009.

6. Recommendations

The following maintenance recommendations are offered for the Coal Yard Drainage Pond. Priority codes are included in parentheses and are described in Enclosure K:

- It is recommended that the large undermined area with adjacent slough be repaired (Photos 14 and 15). These and other eroded areas should be cleaned of loose/sloughed material, re-filled, and re-seeded. Filling procedures should include cutting foundation benches (as necessary), placing clay in maximum 6-inch lifts, and compacting with small compaction equipment such as a jumping jack or a hand-held mechanical tamper. An erosion control blanket should be placed after seeding. (Priority 4)
- It is recommended that the 2 rock check dams located in the drainage basin be cleaned and repaired as needed.
- It is recommended that TVA personnel monitor the storage capacity and pool level of the basin and perform dredging and pumping as needed to maintain sufficient capacity. (Priority 5)
- Trees and brush are located on the interior and exterior slopes. It is recommended that trees and brush be removed from these slopes in accordance with the general guidelines shown in Enclosure I. (Priority 4)

Photo 10

View of rock check dams from floating pump structure looking east. Trees and storm water outlet visible on south slope in upper right of photo.

Photo 11

Pump structure with attached walkway, looking west. South slope visible on left of photo showing overgrown vegetation.

Photo 12

Settled material immediately east/northeast of coal yard drainage basin, looking southeast.

Photo 13

Settled material immediately east of coal yard drainage basin, looking southwest.

Photo 14

Erosion undercutting inlet pipe northward from drainage pond.

Photo 15

Sloughing on the north slope near eroded inlet as shown in Photo 5.

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Plan View - KIF 2010 Annual Inspection
Coal Yard Drainage Pond

Tennessee Valley Authority
Kingston Fossil Plant
Kingston, Roane County, Tennessee

Sheet 1 of 1

PROJECT NO.	175550002
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Enclosure C

Dike 2 Settlement Pond

TVA 2010 Annual Inspection Program
Kingston Fossil Plant (KIF)
Dike 2 Sediment Pond

1. General Facility Information

Facility Status:	Active	NID Identification:	Unknown
Surface Area (inside dikes):	3.86 acres	TVA Hazard Classification:	Not Classified
Maximum Height (toe to top of dike):	12 feet	Dike Length:	2,090 feet
Plant Discharge to Facility:	Unknown	Current Pool Elevation:	742 feet

2. Site Visit Information

Stantec Inspection Team:	Thomas Ward EIT, Mark Jones EIT, and Leo Booth
TVA Staff Present:	N/A
Field Inspection Date:	April 30, 2010
Weather/Site Conditions:	Partly cloudy with a high of 84 degrees Fahrenheit

3. History/Current and Future Operations

History:	Temporary structure built in 2009 as part of the incident recovery.
Current Operations:	Final series of sediment control ponds for water discharging from the Dredge Cell and embayment areas to the Emory River. Structure capacity maintained as part of recovery operations.
Future Planned Operational Changes:	Dike 2 structure will be removed in association with embayment restoration following completion of the incident ash removal operations.

4. Stantec Field Observations

See attached Photos and Site Plan Drawing.

4.1. Interior Slopes

Vegetation:	None observed.

Trees:	None observed.
Wave Wash Protection:	Shot rock observed on outslopes of temporary dike.
Erosion:	Some minor erosion features of co-mingled ash on exterior side of dike.
Instabilities:	None observed.
Animal Burrows:	None observed.
Freeboard:	Approximately 4 feet on the west interior slope and 8 feet on the east interior slope.
Encroachments:	None Observed.
Slope:	Varies from approximately 2.24H:1V to 2.96H:1V.

4.2. Crest

Crest Cover and Slope:	Crushed stone co-mingled with ash, sloped towards pond.
Erosion:	None observed.
Alignment:	No issues observed.
Settlement/Cracking:	No issues observed.
Bare Spots/Rutting:	Some minimal rutting observed on roadway surface.
Width:	Approximately 30 feet.

4.3. Exterior Slopes

Vegetation:	None observed.
Trees:	None observed.
Erosion:	Minor surficial erosion features in exposed ash.
Instabilities:	None observed.
Uniform Appearance:	Yes.
Seepage:	None observed.
Benches:	N/A
Foundation Drains, and	None reported or observed.

Seepage Collection Systems:	
Instrumentation:	N/A
Animal Burrows:	None observed.
Slope:	Approximately 2:1 on the river side.
Height:	5 to 12 feet

4.4. Spillway Weirs/Riser Inlets

Number:	5 between three holding ponds.
Size, Type and Material:	First to second pond: Two 36-inch corrugated metal pipe (CMP) inlets. Second to third pond: Two 48-inch CMP inlets with 36-inch CMP pipes. One additional 12-inch corrugated plastic pipe convey discharge from pump station.
Height of Riser Inlets:	Unknown.
Access:	Access by boat or amphibious craft only.
Joints:	None observable.
Mis-Alignment:	None observable.
Closed/Abandoned Conduits:	None reported or observed.

4.5. Outlet Pipes

Number:	5
Size, Type and Material:	36-inch diameter reinforced concrete pipes from third pond to river.
Headwall:	N/A
Joint Separations:	None observable.
Mis-Alignment:	None observable.
Closed/Abandoned Conduits:	None reported or observed.

5. Repairs/Mitigation/New Construction Activities Since Last Annual Inspection

Dike 2 is a temporary structure that was not in place during previous inspections.

6. Recommendations

The following maintenance recommendations are offered for the Dike 2 Sediment Pond. Priority codes are included in parentheses and are described in Enclosure K:

- It is recommended that TVA continue to periodically clean out holding ponds by mechanical dredging. Perform as needed.
- It is recommended that TVA monitor crests and slopes of the temporary basin and regrade rutting and erosion as may be needed. Stantec observed some minor rutting/erosion (Photo 19) beginning to form. (Priority 3)

Photo 16

View looking north/northeast at Dike 2 sediment basin.

Photo 17

View of south end of sediment basin looking west, with floating pump attached to guy wire located in pond.

Photo 18

Shot rock on downstream (river side) slope. Emory River in background.

Photo 19

Minor surficial erosion located on river side of Dike 2 in exposed ash.

Photo 20

View looking north at extent of exterior Dike 2 slope.

Photo 21

View looking south across sediment basin with 2 spillway inlets visible in center of photo.

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Plan View - KIF 2010 Annual Inspection
Dike 2 Sediment Pond

Tennessee Valley Authority
Kingston Fossil Plant
Kingston, Roane County, Tennessee

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Enclosure D

Dredge Cell

TVA 2010 Annual Inspection Program
Kingston Fossil Plant (KIF)
Dredge Cell

1. General Facility Information

Facility Status:	Inactive		
Surface Area:	17.93 acres	Maximum Height (toe to top of stack):	51 feet

2. Site Visit Information

Stantec Inspection Team:	Thomas Ward EIT, Mark Jones EIT, and Mike Crouch
TVA Staff Present:	N/A
Field Inspection Date:	April 28, 2010
Weather/Site Conditions:	Cloudy with a high of 67 degrees Fahrenheit and wet ground conditions

3. History/Current and Future Operations

History:	Available information indicates the December 22, 2008 Dredge Cell incident initiated at the northwest corner of the cell, progressing within the Dredge Cell through Cells 2 and 3. The remaining intact portion of the Dredge Cell, comprised of what was formerly referred to as "Cell 1," is now referred to as the Relic.
Current Operations:	Production ash stacking operations have been suspended.
Future Planned Operational Changes:	The current plan indicates the Relic will be reduced in height. The maximum elevation will be EL 790 feet at the time of closure as per the current closure option.

4. Stantec Field Observations

See attached Photos and Site Plan Drawing.

4.1. Exterior Slopes and Benches

Vegetation:	Grass-covered, adequate coverage in most cases. Sparse coverage exists in several areas (Photos 29, 32, and 34).
Trees:	Few small trees observed at base of Dike D to the east of the southeast corner of the Dredge Cell just north of the Rim Ditch and Sluice Trench (Photo 38).
Erosion:	Erosion features on the dikes were observed, typically limited

	to minor washouts (Photo 27). Some minor erosion of ash from the test trench was also observed extending east and west on the middle bench (Photos 34 and 35). A clogged drain pipe will was observed (Photo 26). A localized erosion feature in an exposed area of ash was observed on the southwest corner (Photo 28).
Instabilities:	None observed.
Uniform Appearance	Yes.
Benches:	A total of five benches on the south side of the Relic varied on approximate height intervals between 6 to 15 feet and were approximately 20 feet wide, sloped toward the stack. Two benches were present on the southern half Dike D, with the top bench tapering off to the north.
Slope:	Dike C on the south side of the Relic (Cell 1) exhibited slopes ranging between approximately 3.25H:1V and 4.79H:1V. Dike D on the east side of the former Dredge Cell exhibited slopes between approximately 2.77H:11 and 3.08V:1V.
Height:	Approximately 51 feet.
Other:	None.

4.2. Perimeter Drainage Ditches and Down-Drains

Vegetation:	Grass-covered with occasional areas of cattails.
Rip-Rap Channel Lining:	None observed.
Erosion:	None observed.
Sedimentation in Ditches:	Some minor sedimentation observed.
Standing Water in Ditches or on Benches:	Observed at multiple locations on south side of Dredge Cell along Dike C (Photo 30) and on the east side of the Dredge Cell along Dike D (Photo 37).
Silted/Impeded Drainage Pipes:	Occasionally observed (Photo 26).
Other:	None.

5. Repairs/Mitigation/New Construction Activities Since Last Annual Inspection

The following maintenance activities and improvements have been performed for the

Dredge Cell since the last annual inspection:

- Construction of the Test Embankment on the north side of the Relic was completed.
- Filling operations for ash storage in the Valley area on the east side of the Relic have been conducted.

6. Recommendations

The following maintenance recommendations are offered for the Dredge Cell. Priority codes are included in parentheses and are described in Enclosure K:

- Numerous areas of erosion and/or rutting with standing water were observed during the inspection include areas along both Dike C and Dike D (Photos 27, 29, 30, 37, and 38). It is recommended that these areas be drained and/or subsequently filled/graded and in accordance with current site protocols for erosion repair and temporary vegetative cover. Filling should consist of placing select ash or clay and compacting with small compaction equipment, such as a jumping jack, or hand-held tampers. Some excavation may be required to create foundation benches to allow compaction to occur on level ground. Erosion control blankets should be used for the areas on sloping ground. (Priority 4)
- A few areas lacking adequate vegetation coverage were noted in this inspection along Dikes C and D (Photos 25, 27, 29, and 32). Re-seeding of these areas should be performed to re-establish vegetation growth. Erosion control blankets should be used since the areas are on sloping ground. (Priority 4)
- Some small trees and brush are located on the exterior slopes. It is recommended that trees and brush be removed from these slopes in accordance with the general guidelines shown in Enclosure I. (Priority 4)
- It is recommended that the erosion feature encountered in exposed ash (Photo 28) be excavated and re-filled with suitable ash materials in accordance with general site erosion control protocols. (Priority 4)
- It is recommended that the clogged drainage pipe (Photo 26) outlet be cleared and the pipe be evaluated to determine its current working condition and promote positive drainage. (Priority 4)

Photo 22

Shot rock haul road constructed on southwest corner of Dike C. Ponding water observed.

Photo 23

Shot rock built- up section of haul road at southwest corner of Dredge Cell, looking south.

Photo 24

View of vegetation on initial (lowest) dike of southern edge of Dredge Cell, looking east.

Photo 25

Typical Dike C bench, looking east.

Photo 26

Clogged drainage pipe on south side of Dredge Cell Dike C.

Photo 27

Erosion washout on south face of Dredge Cell, second bench, with areas of sparse vegetation on lower benches visible in background.

Photo 28

Ash erosion feature encountered at southwest corner of Dike C.

Photo 29

Minor erosion with sparse vegetation on south side of Dredge Cell.

Photo 30

Typical ponding and rutting for Dike C on south side of Dredge Cell, looking east.

Photo 31

Typical view of Dike D, looking north from southeast corner of Dredge Cell.

Photo 32

Minor erosion with additional vegetative cover required along Dike D.

Photo 33

East face of Dike D looking east into Ash Pond. Rock-lined drainage feature observed midway down slope.

Photo 34

View looking west on second bench of ash deposits on Dike C from erosion of test trench (see Photo 15).

Photo 35

View looking east on second bench of ash deposits on Dike C from erosion of test trench (see Photo 36).

Photo 36

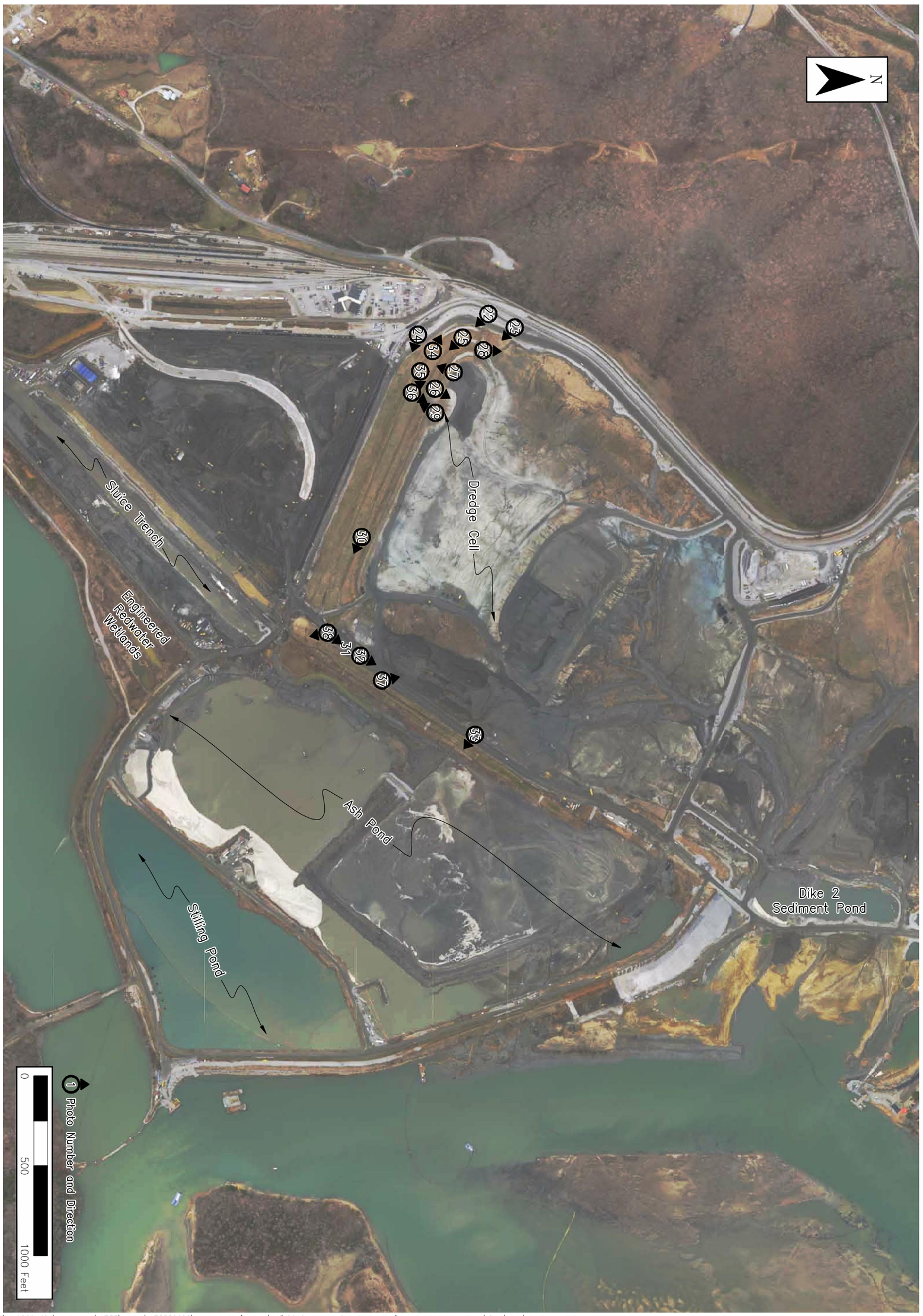
Ash erosion at top of Dike C in the test trench.

Photo 37

Dredge lines, rutting, and ponding on middle bench of Dike D, looking northwest.

Photo 38

Southeast corner of Dredge Cell just north of Sluice Trench/Rim Ditch.



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Plan View - KIF 2010
Annual Inspection - Dredge Cell

Tennessee Valley Authority
Kingston Fossil Plant
Kingston, Roane County, Tennessee

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Enclosure E

Engineered Redwater Wetlands

TVA 2010 Annual Inspection Program
Kingston Fossil Plant (KIF)
Engineered Redwater Wetlands

1. General Facility Information

Facility Status:	Active	NID Identification:	Unknown
Surface Area (inside dikes):	3.31 acres	TVA Hazard Classification:	Not Classified
Maximum Height (toe to top of dike):	12 feet	Dike Length:	Approx. 900 feet
Plant Discharge to Facility:	Unknown	Current Pool Elevation:	749 feet

2. Site Visit Information

Stantec Inspection Team:	Thomas Ward EIT and Mark Jones EIT
TVA Staff Present:	Robert Snow (Jacobs)
Field Inspection Date:	April 21, 2010
Weather/Site Conditions:	Sunny with a high of 67 degrees Fahrenheit

3. History/Current and Future Operations

History:	The Engineered Wetlands between Dike C and the Intake Channel collect seepage from the limestone drain below the bottom ash trench (currently designated as the Sluice Trench). The wetlands aid in naturally removing iron and raising the pH of the water before it is pumped to the Ash Pond via two pumps.
Current Operations:	Numerous seeps of redwater through the east dike toward the Intake Channel were observed in March of 2010 in an area south of the Redwater Wetlands. Borings were drilled by Mactec with piezometers installed to monitor the situation. Ongoing stability and seepage analyses are being conducted by Geosyntec. Preliminary results suggest the dike is in no imminent danger of a significant breach or failure.
Future Planned Operational Changes:	Pending continued monitoring and analyses of observed seepage.

4. Stantec Field Observations

See attached Photos and Site Plan Drawing.

4.1. Interior Slopes

Vegetation:	Heavy brush, grass, and cattails within wetlands.
Trees:	Few relatively large trees observed on southwest end of interior slope of dike.
Wave Wash Protection:	N/A
Erosion:	Not observed.
Instabilities:	Not observed.
Animal Burrows:	Not observed.
Freeboard:	Approximately 1 to 2 feet for majority of actual Wetlands and 3 to 4 feet at collection pond.
Encroachments:	N/A
Slope:	Approximately 2H:1V (estimated).

4.2. Crest

Crest Cover and Slope:	The crest of the slope is overlain with crushed stone and is relatively flat.
Erosion:	Not observed.
Alignment:	No issues observed.
Settlement/Cracking:	Not observed.
Bare Spots/Rutting:	Some minor rutting and ponding is present.
Width:	Approximately 12 to 14 feet.

4.3. Exterior Slopes

Vegetation:	Heavy brush, grass, and tree-covered exterior dike slopes (Photo 41). Some areas lack coverage.
Trees:	Numerous trees were observed along the Intake

	Channel.
Erosion:	No significant erosion features were observed.
Instabilities:	None observed.
Uniform Appearance:	Yes.
Seepage:	Seepage observed at multiple locations near the waterline at the southern portions of the wetland. Monitoring of the seeps and ongoing analysis being conducted (Photo 45).
Benches:	None observed.
Foundation Drains, and Seepage Collection Systems:	None reported or observed.
Instrumentation:	Six piezometers were installed by Mactec in April of 2010 along two cross sections of the east dike to monitor the current seepage conditions.
Animal Burrows:	None observed; however, rabbits were observed, indicating burrows could be likely obscured within thick vegetation.
Slope:	Approximately 2.2H:1V to 1.5H:1V.
Height:	Approximately 15 feet (estimated).

4.4. Spillway Weirs/Riser Inlets

Number:	2
Size, Type and Material:	24-inch steel pipe morning glory spillways (-018 and -019).
Height of Riser Inlets:	Unknown.
Access:	Catwalks from edge of pond.
Joints:	Unable to observe.
Mis-Alignment:	Unable to observe.
Closed/Abandoned Conduits:	One 12-inch steel pipe (-017) northwest of the spillways is reportedly inactive.

4.5. Outlet Pipes

Number:	2
Size, Type and Material:	12-inch plastic pipes with steel outlets in Ash Pond.
Headwall:	N/A
Joint Separations:	Unknown, unable to observe.
Mis-Alignment:	None observed.
Closed/Abandoned Conduits:	One 12-inch steel pipe (-017) northwest of the spillways is reportedly inactive.

5. Repairs/Mitigation/New Construction Activities Since Last Annual Inspection

The following activities and/or improvements have been performed within the Engineered Redwater Wetlands since the last annual inspection:

- None reported.

6. Recommendations

The following maintenance recommendations are offered for the Engineered Redwater Wetlands:

- Trees and brush are located on the interior and exterior slopes. It is recommended that trees and brush be removed from these slopes in accordance with the general guidelines shown in Enclosure I. (Priority 4)
- It is recommended that floating debris/vegetation observed within the discharge pump structures be removed so the pumps do not become clogged or damaged. (Priority 3)
- It is recommended that the seepage observed along the Intake Channel waterline continue to be monitored in the interim until mitigation designs are implemented in association with Ash Pond closure and plant conversion from wet to dry ash handling.

Photo 39

Redwater drainage ditch along west side of access roadway immediately west of Intake Channel, looking north.

Photo 40

View of typical access road corridor along east side Engineered Redwater Wetlands, looking north.

Photo 41

Thick vegetation and trees between access road and Intake Channel.

Photo 42

Discharge pump alongside shoreline of Intake Channel.

Photo 43

Construction debris located on west side of access road with thick vegetation in the Redwater Wetlands.

Photo 44

Thick vegetation and trees on the slopes of the Intake Channel with sparse cover near waterline, looking north/northeast from the access road.

Photo 45

Typical seepage observed along Intake Channel.

Photo 46

Various debris floating near and within the two active morning glory spillways for the discharge pumps in collection pond.

N

Sluice Trench

Engineered Redwater Wetlands

Stilling Pond

39 40 41 42 43 44 45 46

1 Photo Number and Direction

0 200 400 Feet

Plan View - KIF 2010 Annual Inspection
Engineered Redwater Wetlands

Tennessee Valley Authority
Kingston Fossil Plant
Kingston, Roane County, Tennessee

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Enclosure F

Peninsula Gypsum Pond

TVA 2010 Annual Inspection Program
Kingston Fossil Plant (KIF)
Peninsula Gypsum Pond

1. General Facility Information

Facility Status:	Inactive	NID Identification:	Unknown
Surface Area (inside dikes):	51.2 acres (TVA Drawing 10W427-3)	TVA Hazard Classification:	Not Classified
Maximum Height (toe to top of dike):	28 feet	Dike Length:	5,904 feet
Plant Discharge to Facility:	Unknown	Current Pool Elevation:	Unknown

2. Site Visit Information

Stantec Inspection Team:	Thomas Ward EIT, Mark Jones EIT, and Leo Booth
TVA Staff Present:	N/A
Field Inspection Date:	April 30, 2010
Weather/Site Conditions:	Partly cloudy with a high of 84 degrees Fahrenheit

3. History/Current and Future Operations

History:	Excavation and construction began in 2008 in order to create a new facility to collect gypsum produced from the new plant scrubbers.
Current Operations:	Unknown.
Future Planned Operational Changes:	Unknown.

4. Stantec Field Observations

See attached Photos and Site Plan Drawing.

4.1. Interior Slopes

Vegetation:	Sparse grasses to no vegetative cover (bare soil).
Trees:	None observed.
Wave Wash Protection:	None observed.

Erosion:	Some minor erosion features observed, most notably a washout on the south slope (Photo 47).
Instabilities:	None observed.
Animal Burrows:	None observed.
Freeboard:	N/A.
Encroachments:	None observed.
Slope:	Interior slopes varied from approximately 2.73:1 to 3.92:1

4.2. Crest

Crest Cover and Slope:	Crushed stone.
Erosion:	None observed.
Alignment:	No issues observed.
Settlement/Cracking:	None observed.
Bare Spots/Rutting:	None observed.
Width:	Varied from approximately 21 to 33 feet.

4.3. Exterior Slopes

Vegetation:	Grass-covered, ranging from well covered to bare soil.
Trees:	Trees were not present on any of the slopes. However, numerous large trees lined the edge of the peninsula beyond the toe of the exterior slopes along the south (Photo 48).
Erosion:	None observed.
Instabilities:	None observed.
Uniform Appearance:	Yes.
Seepage:	None observed.
Benches:	None observed.
Foundation Drains, and Seepage Collection Systems:	None reported or observed.

Instrumentation:	None observed.
Animal Burrows:	None observed.
Slope:	Exterior constructed fill slopes varied from 2.91H:1V to 2.88H:1V. The cut slope to the north side of the pond was approximately 3.01H:1V.
Height:	Based on Lidar data, the pond appears to have a maximum pool elevation of approximately 768 feet, corresponding to an approximate maximum pool depth of 18 feet. The constructed dike on the south side is approximately 25 feet in height.

4.4. Spillway Weirs/Riser Inlets

Number:	3
Size, Type and Material:	5-foot diameter drop inlets, precast concrete.
Height of Riser Inlets:	5.5 feet.
Access:	N/A
Joints:	None observed.
Mis-Alignment:	None observed.
Closed/Abandoned Conduits:	None observed.

4.5. Outlet Pipes

Number:	5
Size, Type and Material:	Three 48-inch reinforced concrete pipes (RCPs) located at the western Gypsum Pond dike discharge into the storm water pond. Additionally, two 12-inch HDPE underdrain pipes drain into a pump station at the southwestern portion of the Gypsum Pond dike. Two pumps are included in the pump station and pump to the adjacent storm water pond via two 4-inch ductile iron pipes (D.I.P.), combining into one 4-inch D.I.P. Additionally, a 24-inch PVC overflow line to the storm water pond is located within the pump station.
Headwall:	N/A

Joint Separations:	None observed.
Mis-Alignment:	None observed.
Closed/Abandoned Conduits:	None reported or observed.

5. Repairs/Mitigation/New Construction Activities Since Last Annual Inspection

Ongoing construction since previous inspection.

6. Recommendations

The following maintenance recommendations are offered for the Peninsula Gypsum Pond. Priority codes are included in parentheses and are described in Enclosure K:

- Areas of erosion observed during the inspection include areas along the interior of the Gypsum Pond dike (Photo 47). It is recommended that these be filled/graded and seeded to re-establish vegetation. Filling should consist of placing clay and compacting with small compaction equipment, such as a jumping jack, or hand-held tampers. Some excavation may be required to create foundation benches to allow compaction to occur on level ground. Erosion control blankets should be used for the areas on sloping ground. (Priority 4)
- Many areas lacking adequate vegetation coverage were noted in this inspection along the perimeter of the Gypsum Pond (Photo 50). Re-seeding of these areas should be performed to re-establish vegetation growth. Erosion control blankets should be used since the areas are on sloping ground. (Priority 4)
- It is recommended that the pump outlet system be checked periodically for proper operation. Maintenance should be performed as needed.

Photo 47

View of erosion feature on south slope looking to the south from north side. Vegetation not present in some areas.

Photo 48

Exterior slope on south side of gypsum pond with crushed stone access road at crest, looking southeast.

Photo 49

Drainage layer under construction on east side of Gypsum pond.

Photo 50

Typical view of lack of vegetative cover. Several feet of water present in much of pond at time of inspection.

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Plan View - KIF 2010 Annual Inspection
Peninsula Gypsum Pond

Tennessee Valley Authority
Kingston Fossil Plant
Kingston, Roane County, Tennessee

Stantec

STANTEC CONSULTING SERVICES INC.
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St. Louis, Missouri
63026-1944
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www.stantec.com

Enclosure G

Sluice Trench

TVA 2010 Annual Inspection Program
Kingston Fossil Plant (KIF)
Sluice Trench

1. General Facility Information

Facility Status:	Active	NID Identification:	Unknown
Surface Area (inside dikes):	2.31 acres western, 3.87 acres eastern	TVA Hazard Classification:	Not Classified
Maximum Height (toe to top of dike):	19 feet	Dike Length:	N/A
Plant Discharge to Facility:	Unknown	Current Pool Elevation:	764 feet

2. Site Visit Information

Stantec Inspection Team:	Thomas Ward EIT and Mark Jones EIT
TVA Staff Present:	Robert Snow (Jacobs)
Field Inspection Date:	April 30, 2010
Weather/Site Conditions:	Sunny with a high of 67 degrees Fahrenheit

3. History/Current and Future Operations

History:	Previously used as the bottom ash trench with discharge directly from the plant, it has been converted into the current Sluice Trench to accommodate river dredging operations.
Current Operations:	Used as discharge point for dredge lines and initial retrieval point for ash being dredged out of the Emory River. Access near the trench is restricted due to safety concerns associated with the current mechanical dredging operations from the Sluice Trench and presence of large volumes of saturated ash near the Trench.
Future Planned Operational Changes:	Sluice Trench to remain active during dredging.

4. Stantec Field Observations

See attached Photos and Site Plan Drawing.

4.1. Interior Slopes

Vegetation:	None observed.
Trees:	None observed.
Wave Wash Protection:	None observed.
Erosion:	None observed.
Instabilities:	None observed.
Animal Burrows:	None observed.
Freeboard:	None observed.
Encroachments:	Wet ash being mechanically dredged from Sluice Trench.
Slope:	Not observable; obscured by wet ash being removed from Sluice Trench.

4.2. Crest

Crest Cover and Slope:	Obscured by wet ash being removed from Sluice Trench. Access road constructed immediately east of the Sluice Trench of crushed stone.
Erosion:	None observed.
Alignment:	No issues.
Settlement/Cracking:	None observed.
Bare Spots/Rutting:	None observed.
Width:	Not observable.

4.3. Exterior Slopes

Vegetation:	Grass-covered, generally good coverage. Areas approaching the shoreline were sparsely covered at time of inspection due to recent lowering of the existing pool elevation of the reservoir.
Trees:	Numerous trees with some areas of thick underbrush along shoreline on eastern edge of original dike.
Erosion:	Occasional minor erosion features observed near the

	shoreline along the east dike.
Instabilities:	None observed.
Uniform Appearance:	Yes.
Seepage:	Seepage observed at multiple locations between the Sluice Trench and the Engineered Redwater Wetlands (Photos 53 and 54). Monitoring of the seeps and ongoing analysis being conducted by Geosyntec.
Benches:	N/A
Foundation Drains, and Seepage Collection Systems:	None reported or observed.
Instrumentation:	Six piezometers were installed by Mactec in April of 2010 along two cross sections of the east dike to monitor the current seepage conditions.
Animal Burrows:	None observed.
Slope:	Varies from approximately 4.25H:1V to 4.61H:1V. Slopes on the east dike varied from approximately 1.96H:1V to 3.36H:1V, flattening out to 5.23H:1V along the southern portion of the east dike.
Height:	19 feet

4.4. Spillway Weirs/Riser Inlets

Number:	N/A
Size, Type and Material:	N/A
Height of Riser Inlets:	N/A
Access:	Unable to access.
Joints:	N/A
Mis-Alignment:	N/A
Closed/Abandoned Conduits:	N/A

4.5. Outlet Pipes

Number:	N/A
Size, Type and Material:	N/A
Headwall:	N/A
Joint Separations:	N/A
Mis-Alignment:	N/A
Closed/Abandoned Conduits:	N/A

5. Repairs/Mitigation/New Construction Activities Since Last Annual Inspection

The following activities and/or improvements have been performed within the Sluice Trench since the last annual inspection:

- Increase in river dredging operations in conjunction with Ballfield operations to facilitate removal of ash from site have resulted in the Sluice Trench being the initial point of mechanical dredging of incoming slurry. A sheet pile wall was also installed on the west side of the trench to aid in this effort.

6. Recommendations

The following maintenance recommendations are offered for the Sluice Trench:

- Trees and brush are located on the interior and exterior slopes. It is recommended that trees and brush be removed from these slopes in accordance with the general guidelines shown in Enclosure I. (Priority 4)
- It is recommended that the seepage observed along the Intake Channel waterline continue to be monitored. Stantec understands that Geosyntec has been tasked with this effort initiate a mitigation plan.
- Although no animal burrows were visible at the time of inspection, several rabbits were observed in the area, indicating burrows were likely obscured by thick vegetation. TVA should periodically monitor the area for animal burrows. If encountered, it is recommended that these burrows be repaired by collapsing the tunnels, cleaning loose soil, and refilling the resulting cavities/depressions with compacted clay. If the burrows are found to be severe and extensive, then filling with flowable fill may be more appropriate. (Priority 4)

Photo 51

Road constructed in corridor between Sluice Trench to the west and Intake Channel to the east. Typical minor surface rutting on east dike visible in foreground.

Photo 52

Typical view of thick vegetation and trees located along the Intake Channel, looking east.

Photo 53

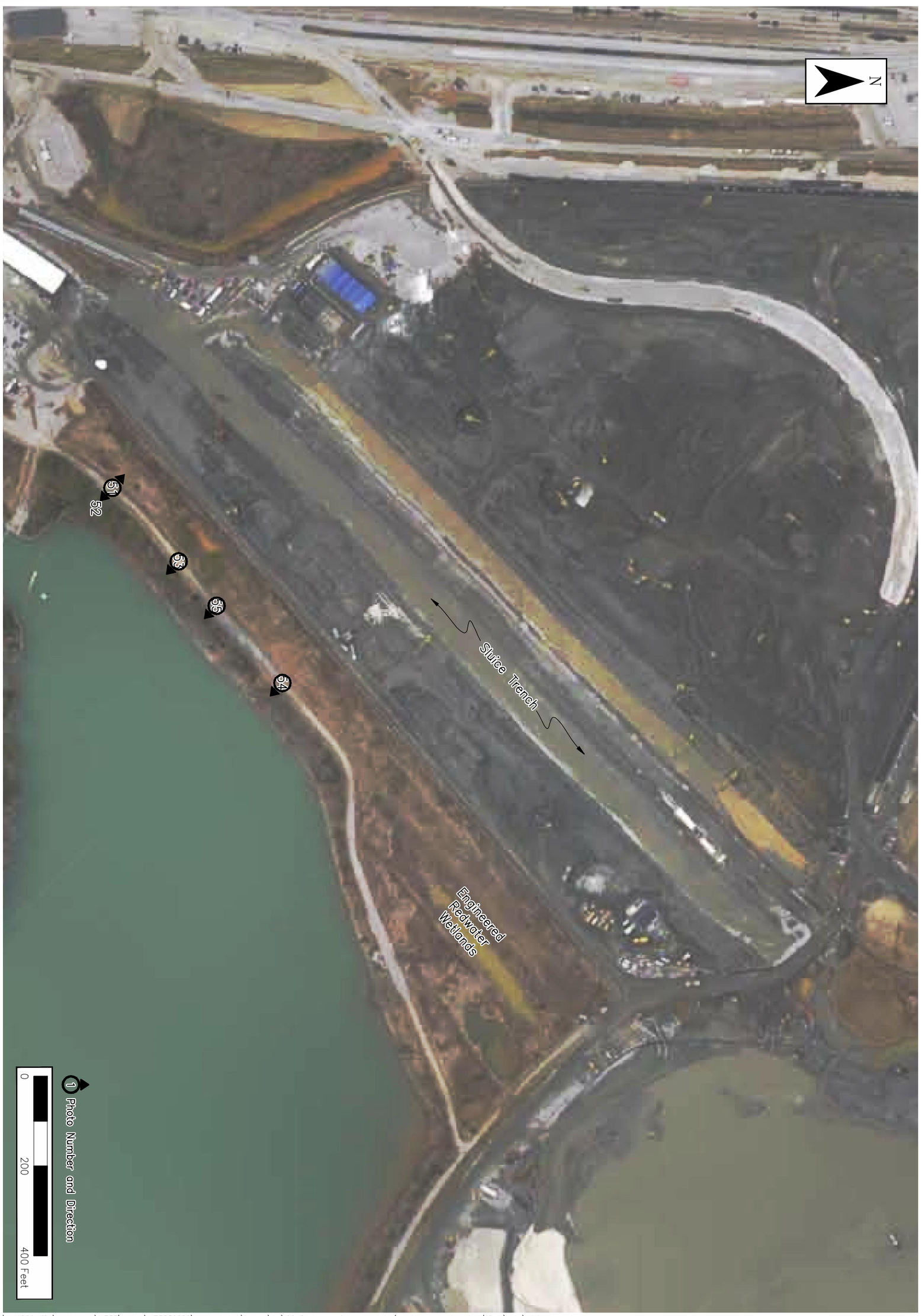
Seepage located along the Intake Channel.

Photo 54

Typical view of redwater seepage observed, looking east into Intake Trench. Note: crushed stone in foreground placed as working platform for drilling operations that had recently been conducted to monitor seepage.

Photo 55

Debris located on the exterior slope, looking east.



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Plan View - KIF 2010
Annual Inspection - Sluice Trench

Tennessee Valley Authority
Kingston Fossil Plant
Kingston, Roane County, Tennessee

Stantec

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Enclosure H

Stilling Pond

TVA 2010 Annual Inspection Program
Kingston Fossil Plant (KIF)
Stilling Pond

1. General Facility Information

Facility Status:	Active	NID Identification:	TN14504
Surface Area (inside dikes):	24.28 acres	TVA Hazard Classification:	Dike C: Significant
Maximum Height (toe to top of dike):	28 feet	Dike Length:	2,716 ft of Dike C and 2,163 ft of the Divider Dike.
Plant Discharge to Facility:	Unknown	Current Pool Elevation:	755 feet

2. Site Visit Information

Stantec Inspection Team:	Thomas Ward EIT, Mark Jones EIT, and Leo Booth
TVA Staff Present:	N/A
Field Inspection Date:	April 30, 2010
Weather/Site Conditions:	Partly cloudy with a high of 84 degrees Fahrenheit

3. History/Current and Future Operations

History:	Sluice water flows from the main Ash Pond to the Stilling Pond through five active spillways constructed in 2005. Water then discharges into the plant Intake Channel via six riser structure spillways equipped with discharge diffusers constructed in November 2003.
Current Operations:	Continuing normally as mentioned above.
Future Planned Operational Changes:	No changes are planned.

4. Stantec Field Observations

See attached Photos and Site Plan Drawing.

4.1. Interior Slopes

Vegetation:	Grass-covered, generally thick with good coverage.

	Some areas exhibited sparse vegetation near the waterline.
Trees:	Occasional small trees were observed near the water line.
Wave Wash Protection:	None observed.
Erosion:	No significant signs of erosion on interior slopes. However, possible seepage at one location through the Divider Dike into the Stilling Pond (Photo 66) was observed.
Instabilities:	None observed.
Animal Burrows:	None observed.
Freeboard:	Approximately 10 to 11 feet.
Encroachments:	None observed.
Slope:	Varies from approximately 2.8H:1V to 1.59H:1V.

4.2. Crest

Crest Cover and Slope:	Crushed stone access road.
Erosion:	None observed.
Alignment:	No issues observed.
Settlement/Cracking:	None observed.
Bare Spots/Rutting:	Occasional minor rutting observed with potential for erosion at observed steep cut (Photo 62).
Width:	Approximately 12 to 15 feet.

4.3. Exterior Slopes

Vegetation:	Grass-covered, generally good coverage with some sparse areas observed (Photos 56 and 57).
Trees:	Numerous medium to large trees and brush were observed at the toe of Dike C running alongside the Intake Channel. None observed along remainder of perimeter.
Erosion:	Some significant rutting with standing water and adjacent

	erosion washouts were observed on the exterior bench of Dike C (Photos 59 and 60).
Instabilities:	None Observed.
Uniform Appearance:	Slope on Divider Dike not uniform - generally steeper towards the southwest portion of the dike.
Seepage:	None observed.
Benches:	One bench, approximately 15 to 20 feet wide.
Foundation Drains, and Seepage Collection Systems:	None reported or observed.
Instrumentation:	Four slope inclinometers and four piezometers are present along the segment of Dike C adjacent to the Stilling Pond.
Animal Burrows:	None observed.
Slope:	Varies from approximately 1.77H:1V to 3.56H:1V.
Height:	28 feet.

4.4. Spillway Weirs/Riser Inlets

Number:	6
Size, Type and Material:	48-inch RCP push-together riser pipes with standard TVA steel skimmers.
Height of Riser Inlets:	Approximately 8.5 feet.
Access:	Catwalk from Dike C (Photo 63).
Joints:	Not observable.
Mis-Alignment:	Not observable.
Closed/Abandoned Conduits:	There is reportedly an unidentified 12-inch diameter pipe connected to weir -010 that penetrates the dike with no evidence of an outlet.

4.5. Outlet Pipes

Number:	6

Size, Type and Material:	36-inch steel pipes.
Headwall:	No issues observed.
Joint Separations:	Unknown, unable to observe.
Mis-Alignment:	Unknown, unable to observe.
Closed/Abandoned Conduits:	Six 12-inch steel outlet pipes are reportedly in service to drain stormwater from the Stilling Pond to Watts Bar Lake, although only 3 could be located in the January 2010 pipe inventory inspection performed by Stantec. Historical drawings did not indicate any removal.

5. Repairs/Mitigation/New Construction Activities Since Last Annual Inspection

The following maintenance activities and improvements have been performed for the Stilling Pond since the last annual inspection:

- Buttressing of Dike C is ongoing and will continue south along the exterior slopes toward the Stilling Pond.

6. Recommendations

The following maintenance recommendations are offered for the Stilling Pond:

- During the inspection, Stantec observed an area of potential seepage on the Stilling Pond side of the Divider Dike (Photo 66). It is therefore recommended that TVA continue to monitor this area to observe changes in appearance in accordance with TVA's current inspection program.
- Trees and brush are located on the interior and exterior slopes. It is recommended that trees and brush be removed from these slopes in accordance with the general guidelines shown in Enclosure I. (Priority 4)
- Areas of extensive rutting and/or erosion on the middle bench of Dike C need to be repaired (Photos 59 and 60). It is recommended that these areas be drained, filled, graded, and subsequently seeded to re-establish vegetation. Filling should consist of placing clay in 6-inch lifts and compacting with small compaction equipment, such as a jumping jack or hand-held tampers. Some excavation may be required to establish benches to facilitate proper compaction on level surfaces. Erosion control blankets should be used on sloping areas. (Priority 4)
- Areas lacking adequate vegetation coverage should be re-seeded to establish proper vegetative cover (Photos 56 and 57). Erosion control blankets should be

used on sloping areas. (Priority 4)

- Re-grading should be considered at the areas along the crest of Dike C near the catwalk to the spillways exhibiting very steep slopes (Photo 62) to reduce future potential for localized sloughing. (Priority 5)

Photo 56

Typical view of access roadway on lower bench of Dike C with some minor rutting and exposed soil.

Photo 57

Sparse vegetation on exterior slopes of Dike C.

Photo 58

Boulder observed alongside dredge pipes on exterior slopes of Dike C adjacent to Intake Channel.

Photo 59

Typical view of more significant rutting and standing water on bench of exterior slope; looking east adjacent to the Intake Channel with numerous trees present at toe of Dike C.

Photo 60

Typical erosion washout on exterior bench of Dike C.

Photo 61

Overflow pipe to discharge into Intake Channel.

Photo 62

Steep cut approximately 5 feet high on crest of Dike C with exposed clay and minor rutting.

Photo 63

Catwalk access to spillways.

Photo 64

View of spillways looking northeast from Dike C.

Photo 65

Slope protection at intersection of Dike C and Divider Dike in north corner of Stilling Pond; typical small trees present near waterline.

Photo 66

Possible seepage into Stilling Pond through Divider Dike, looking east.

Photo 67

Ash deposit with sparse vegetation along Divider Dike in Stilling Pond. Dike C in background.

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Plan View - KIF 2010
Annual Inspection - Stilling Pond

Tennessee Valley Authority
Kingston Fossil Plant
Kingston, Roane County, Tennessee

Stantec

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Enclosure I

General Guidelines for Tree Removal and Maintenance of Vegetation

General Guidelines for Tree Removal on Slopes at TVA Fossil Plants

Identification

Trees and heavy brush growth should be controlled on TVA dams and dikes. If left in place, trees can result in the creation of seepage paths within the embankment. Allowing vegetation to become overgrown restricts the level of inspection that can be performed on the structure. General guidelines for removal of trees and maintenance of vegetation are provided below. Evaluations other than those outlined below shall be made by a geotechnical engineer in consultation with facility representatives on a case-by-case basis.

Guidelines for Tree Removal and Maintenance of Vegetation

Tree Removal

At locations where it is not reasonable to remove trees by a mowing them with a bush hog or with similar mowing equipment:

- All trees shall be cut using a handsaw or chainsaw and the cut tree and branches discarded.
- Remove the remaining tree trunk, stump, and rootwad.
- Grub any remaining roots of the tree so that only 2 inches or smaller roots are left in place.
- The resulting cavity from removal of the rootwad shall be cleaned of loose soil and debris.
- The cavity shall then be backfilled with cohesive soil and compacted and the area seeded to re-establish vegetation. If the tree has been removed from along the upstream or downstream face of a slope, benches shall be cut into the slope face where the cavity is to be backfilled. This will allow for a proper bond between the existing dike and the backfill being used to reform the slope. If benches are needed, bench heights shall not exceed 4 to 5 feet in height.

Maintenance of Vegetation

- Mowing is recommended at regular intervals to allow for appropriate inspection of embankment slopes.
- If areas lacking vegetation are observed during mowing and clearing operations or subsequent inspections, the areas should be seeded to re-establish vegetation as soon as practicable.

Enclosure J

General Guidelines for Repair of Animal Burrows

General Guidelines for Repair of Animal Burrows at TVA Fossil Plants

Identification

Animal burrows are relatively common along slopes of dams and dikes. If left untreated, these burrows can result in the creation of seepage paths through the embankment. Additionally tunnels may eventually collapse resulting in surface irregularities in the embankment. General guidelines for repair of animal burrows are provided below. However, if the burrow extends more than three (3) feet below the embankment surface or extends across a dam, the repair of these features should be evaluated by a geotechnical engineer on a case-by-case basis so that appropriate recommendations can be made.

Guidelines for Burrow Repair

It is recommended that shallow animal burrows (up to 3 feet) shall be repaired with surface treatment methods as follows:

- Animals shall be captured and removed from the area. It is recommended that a local conservation representative be consulted prior to this action.
- The animal burrow shall be excavated and cleaned of excess soil along its pathway up to a depth of 3 feet. With this type of repair, an isolated excavated area of the embankment is exposed.
- The excavated area shall be backfilled with compacted cohesive material.
- If the burrow extends more than three feet into the embankment, a geotechnical engineer shall further evaluate the burrow depth and recommend a deep burrow treatment method or other exploratory methods.
- One possible method which may be recommended to treat a deep burrow can consist of a special grout (flowable fill) pumping system with a hose inserted into the burrow.

Ultimately, these repairs will not prevent rodents from creating new burrows within dam embankments. Accordingly, continual efforts must be made to discourage rodent activity. Mowing of vegetation on the slopes / crest of the embankment and trimming of water-side vegetation at regular intervals will tend to discourage rodents from re-establishing burrows along the dike and will allow timely observation of new activity if it occurs.

Enclosure K

Dam Safety Priorities

Dam Safety Priorities

	Description
1	Urgent - Correct Immediately
2	Complete Within 1 Week of inspection
3	Complete Within 1 Month (30 days) of Inspection
4	Complete Within 6 Months of Original Entry Date
5	Complete Within 1 Year of Original Entry Date
6	Complete Within 3 Years of Original Entry Date
7	Complete Within 5 Years of Original Entry Date
8	Work During Scheduled Outage - Blank Until Outage is Scheduled

APPENDIX A

Document 8

NPDES Permit No. TN0005452, TVA – Kingston Fossil Plant, Harriman, Roane County, Tennessee

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
401 CHURCH STREET
L & C ANNEX 6TH FLOOR
NASHVILLE TN 37243-1534

August 29, 2003

Ms. Lindy Johnson
TVA - Kingston Fossil Plant
1101 Market Street, LP 5D-C
Chattanooga, TN 37402-2801

Subject: NPDES Permit No. TN0005452
TVA - Kingston Fossil Plant
Harriman, Roane County, Tennessee

Dear Ms. Johnson:

In accordance with the provisions of the Tennessee Water Quality Control Act, Tennessee Code Annotated, Sections 69-3-101 through 69-3-120, the enclosed NPDES Permit is hereby issued by the Division of Water Pollution Control. The continuance and/or reissuance of this NPDES Permit is contingent upon your meeting the conditions and requirements as stated therein.

Please be advised that you have the right to appeal any of the provisions established in this NPDES Permit, in accordance with Tennessee Code Annotated, Section 69-3-110, and the General Regulations of the Tennessee Water Quality Control Board. If you elect to appeal, you should file a petition within thirty (30) days of the receipt of this permit.

If you have questions, please contact the Division of Water Pollution Control at your local Environmental Assistance Center at 1-888-891-TDEC; or, at this office, please contact Mr. Vojin Janjic at (615) 532-0670 or by E-mail at *Vojin.Janjic@state.tn.us*.

Sincerely,

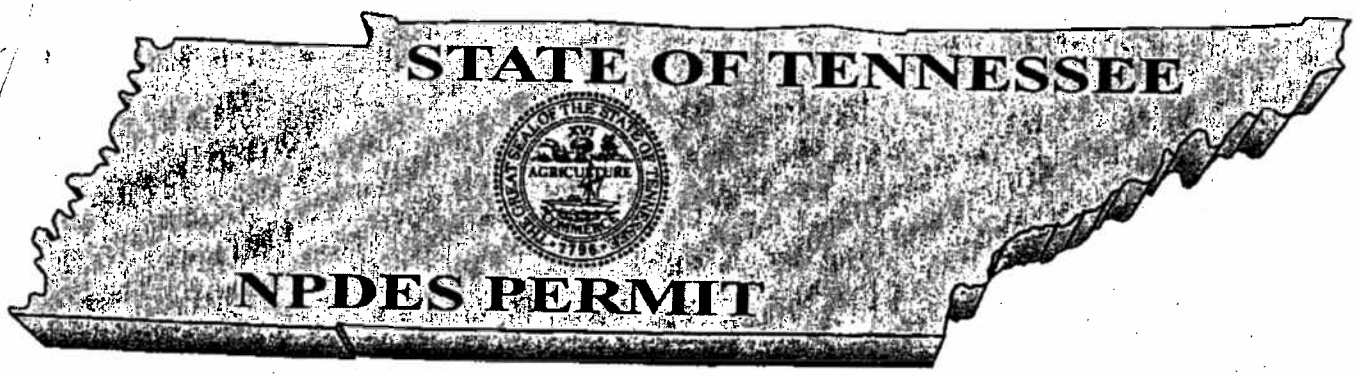
Robert L. Haley for

Saya Ann Qualls, P.E.
Manager, Permit Section
Division of Water Pollution Control

SAQ/VMJ

Enclosure

cc: Division of Water Pollution Control, Permit Section
Division of Water Pollution Control, Environmental Assistance Center - Knoxville
Ms. Connie A. Kagey, Sam Nunn Atlanta Federal Center, 61 Forsyth Street, SW, Atlanta, GA 30303-3104



No. TN0005452

Authorization to discharge under the
National Pollutant Discharge Elimination System (NPDES)

Issued By
Tennessee Department of Environment and Conservation
Division of Water Pollution Control
401 Church Street
6th Floor, L & C Annex
Nashville, Tennessee 37243-1534

Under authority of the Tennessee Water Quality Control Act of 1977 (T.C.A. 69-3-101 et seq.) and the delegation of authority from the United States Environmental Protection Agency under the Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977 (33 U.S.C. 1251, et seq.)

Discharger: **TVA - Kingston Fossil Plant**

is authorized to discharge: **fly ash and bottom ash sluice water, storm water runoff, fire protection flushes and groundwater, coal yard runoff pond discharges including utility building drainage, coal pile and coal conveyor drainage, red water wetlands discharges, precipitator area washdown and roof drains, station sump discharges including boiler leakage, laboratory and analytical process water, boiler blowdown, miscellaneous equipment cooling and lubricating water, floor washing wastes, air conditioning cooling water, ID fan cooling water, ash system leakage and boiler bottom overflow, water treatment plant wastes, ammonia storage runoff, treated chemical and nonchemical metal cleaning wastes from Internal Monitoring Point 005 and nonchemical metal cleaning wastes from Outfall 001; once through condenser cooling water, storm water runoff, groundwater, raw water leakage and fire protection flushes, intake screen backwash, and boiler blowdown, from Outfall 002; storm water runoff, fire protection flushes, raw water leakage and noncontact cooling water from Outfall 006; storm water runoff and abandoned ash pond seepage from Outfall 007; drainage from sluice line trench from Outfall 008**

from a facility located: **In Harriman, Roane County, Tennessee**

to receiving waters named: **Clinch River at mile 2.9**

in accordance with effluent limitations, monitoring requirements and other conditions set forth herein.

This permit shall become effective on: **October 1, 2003**

This permit shall expire on: **August 31, 2008**

Issuance date: **September 1, 2003**

Robert L. Haley for SHQ

Paul E. Davis, Director
Division of Water Pollution Control

CN-0759

RDAs 2352 and 2366

APPENDIX A

Document 9

NPDES Permit No. TN0080870, TVA – Kingston Fossil Plant – Flue Gas Desulfurization System Discharges, Harriman, Roane County, Tennessee

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION

DIVISION OF WATER POLLUTION CONTROL
401 CHURCH STREET
L & C ANNEX 6TH FLOOR
NASHVILLE TN 37243-1534

October 16, 2009

Mr. Leslie Nale
Plant Manager
Tennessee Valley Authority
714 Swan Pond Road KFP 1A-KST
Harriman, TN 37748

Subject: **NPDES Permit No. TN0080870**
TVA - Kingston Fossil Plant (KIF)
Harriman, Roane County, Tennessee

Dear Mr. Nale:

In accordance with the provisions of the Tennessee Water Quality Control Act, Tennessee Code Annotated, Sections 69-3-101 through 69-3-120, the Division of Water Pollution Control hereby issues the enclosed NPDES Permit. The continuance and/or reissuance of this NPDES Permit is contingent upon your meeting the conditions and requirements as stated therein.

Please note the attached permit includes corrections to typographic errors for sampling frequency for TSS and Oil and Grease, and for dike inspections under the TVA Dam Safety Program. Please be advised that you have the right to appeal any of the provisions established in this NPDES Permit, in accordance with Tennessee Code Annotated, Section 69-3-105(i), and the General Regulations of the Tennessee Water Quality Control Board. If you elect to appeal, you should file a petition within thirty (30) days of the receipt of this permit.

If you have questions, please contact the Division of Water Pollution Control at your local Field Office at 1-888-891-TDEC; or, at this office, please contact Mr. Bob Alexander at (615) 532-0659 or by E-mail at *Robert.Alexander@tn.gov*.

Sincerely,

Mr. Vojin Janjić
Manager, Permit Section
Division of Water Pollution Control

Enclosure
cc: DWPC, Permit Section & Knoxville Environmental Field Office
Ms. Karrie-Jo Robinson Shell, Environmental Engineer, EPA Region 4, Sam Nunn Atlanta Federal Center, NPDES Permit Section, 61 Forsyth Street SW, Atlanta, GA 30303
Ms. Lindy Johnson, TVA Environmental Compliance, 1101 Market Street, LP 5D, Chattanooga, TN 37402

STATE OF TENNESSEE

NPDES PERMIT

No. TN0080870

Authorization to discharge under the
National Pollutant Discharge Elimination System (NPDES)

Issued By

Tennessee Department of Environment and Conservation
Division of Water Pollution Control
401 Church Street
6th Floor, L & C Annex
Nashville, Tennessee 37243-1534

Under authority of the Tennessee Water Quality Control Act of 1977 (T.C.A. 69-3-101 et seq.) and the delegation of authority from the United States Environmental Protection Agency under the Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977 (33 U.S.C. 1251, et seq.)

Discharger:	**TVA - Kingston Fossil Plant - Flue Gas Desulfurization System Discharges**
is authorized to discharge:	**Discharges from FGD detention pond into the Kingston Fossil Plant discharge channel via Outfall 01A**
from a facility located:	**in Harriman, Roane County, Tennessee**
to receiving waters named:	**Clinch River mile 2.5**

in accordance with effluent limitations, monitoring requirements and other conditions set forth herein.

This permit shall become effective on: **October 1, 2009**

This permit shall expire on: **September 30, 2013**

Issuance date: **September 22, 2009**

B Tabor FOR
Paul E. Davis, Director
Division of Water Pollution Control

CN-0759

RDAs 2352 and 2366

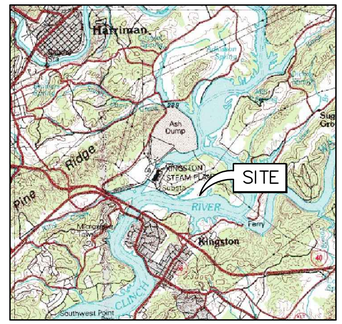
APPENDIX A

Document 10

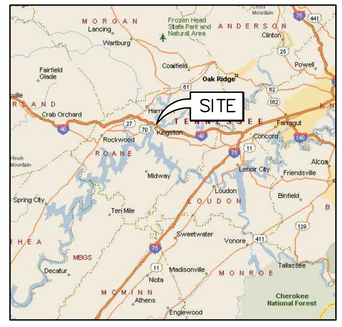
"Construction Drawings, Phase 1A Area, Gypsum Disposal Facility, Kingston Fossil Plant – Peninsula Site," Drawing Nos. 10WXXX-1 through 10WXXX-16, Dated July, 2011, Prepared by Geosyntec Consultants

DRAWING INDEX

10WXXX–1	COVER SHEET
10WXXX–2	SITE CONDITIONS PRIOR TO THE DECEMBER 2010 DROP–OUT
10WXXX–3	OVER–EXCAVATION AND TEMPORARY STORMWATER DIVERSION BERM PLAN
10WXXX–4	BOTTOM OF SUBGRADE
10WXXX–5	BOTTOM OF SUBGRADE CONSTRUCTION CONTROL POINTS
10WXXX–6	TOP OF SUBGRADE
10WXXX–7	TOP OF SUBGRADE CONSTRUCTION CONTROL POINTS
10WXXX–8	BOTTOM OF 1 FOOT SCREENED CLAY
10WXXX–9	BOTTOM OF 1 FOOT SCREENED CLAY CONSTRUCTION CONTROL POINTS
10WXXX–10	TOP OF 1 FOOT SCREENED CLAY
10WXXX–11	TOP OF 1 FOOT SCREENED CLAY CONSTRUCTION CONTROL POINTS
10WXXX–12	DRAINAGE SYSTEM, DIVIDER DIKE, AND SETTLING POND LAYOUT
10WXXX–13	INTERIM LAYOUT OF THE PHASE 1A CELL
10WXXX–14	FINAL LAYOUT OF THE PHASE 1A CELL
10WXXX–15	DETAILS I
10WXXX–16	DETAILS II



LOCATION MAP



VICINITY MAP

CONSTRUCTION DRAWINGS
PHASE 1A AREA
GYPSUM DISPOSAL FACILITY
KINGSTON FOSSIL PLANT - PENINSULA SITE

DRAFT CONSTRUCTION DRAWINGS FOR REVIEW

Geosyntec consultants
1255 ROBERTS BOULEVARD, N.W., SUITE 200
KENNESAW, GEORGIA 30144 USA
PHONE: 678.202.9500

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

CONSTRUCTION DRAWINGS

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
0	JULY 2011	M	RML							

DISCIPLINE INTERFACE

SCALE: NONE EXCEPT AS NOTED

COVER SHEET

GYPSUM DISPOSAL FACILITY,
PHASE IA AREA

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. ISOMEN	R.M. LOWRY					

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

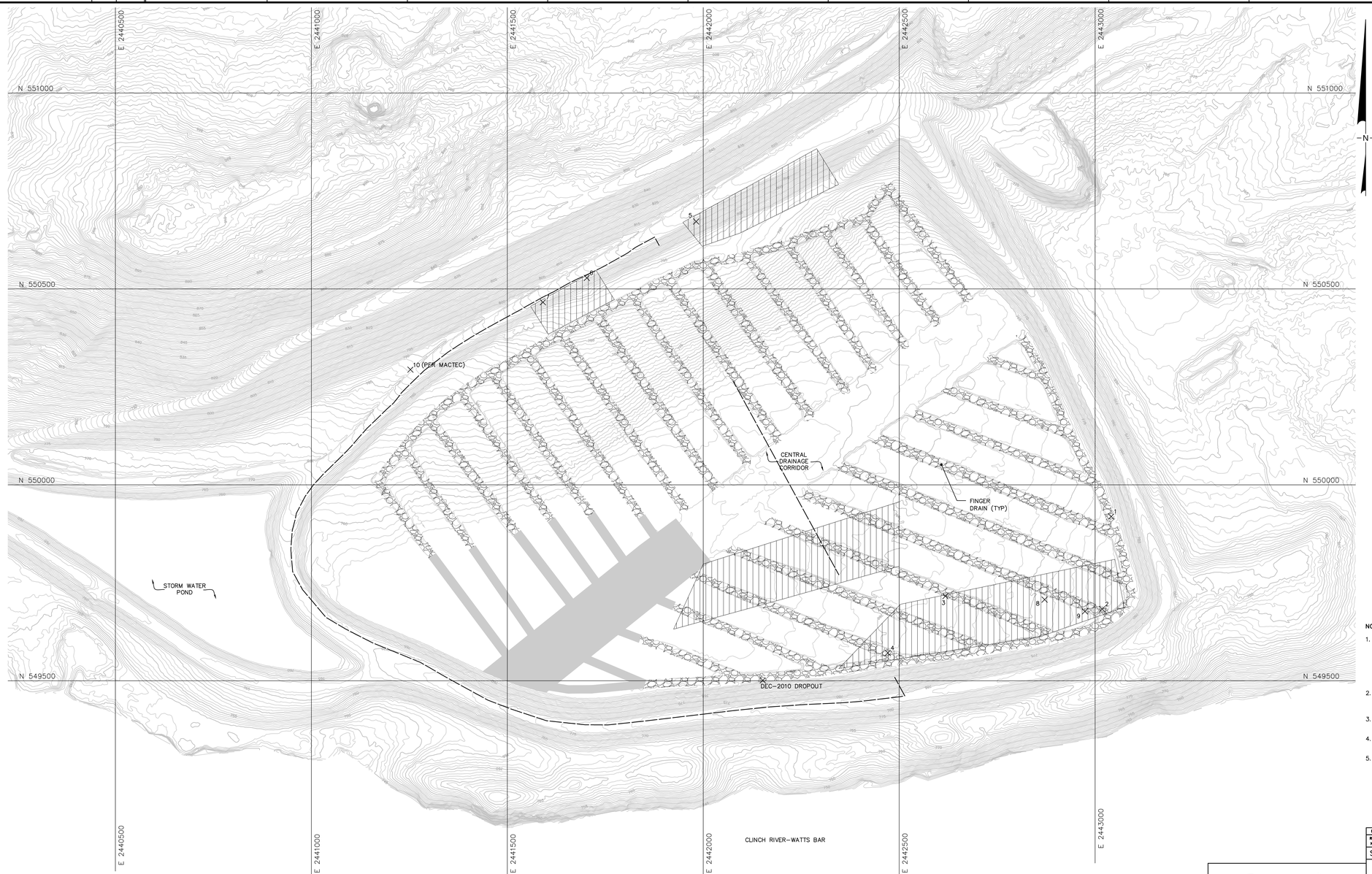
AUTODESK CIVIL 3D	DATE JULY 11	36	C	10WXXX–1	R 0

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

GEOSYNTEC CONSULTANTS, INC.	0
TASK COMPLETED BY:	REV NO.

L:\CAD\TVKINGSTON FOSSIL PLANT- CONSTRUCTION FOR GYPSUM DISPOSAL FACILITY, PHASE 1A AREA (SHEETS)\DRAWINGS\10WXXX01.DWG



LEGEND

- 770 — EXISTING GROUND CONTOUR (NOTE 1)
- FINGER DRAINS (NOTE 3)
- APPROXIMATE FINGER DRAIN LAYOUTS (NOTES 1 AND 4)
- PREVIOUSLY OVER-EXCAVATED AREAS (NOTE 5)
- ×8 DROPOUT LOCATION (NOTE 5)

–N–

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN AUGUST 2010. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929. CONTOUR LINES NEAR THE SOUTHWEST CORNER OF PHASE I AREA WERE NOT CAPTURED BY THE AERIAL SURVEY DUE TO PRESENCE OF WATER GENERATED FROM THE GYPSUM SCRUBBING OPERATIONS.
2. PHASE IA CONSTRUCTION DRAWINGS 10W236-1 THROUGH 10W236-16 DATED JULY 2011 ARE ISSUED TO SUPPLEMENT THE PERMIT MODIFICATION DRAWINGS 10W236-1 THROUGH 10W236-6 DATED APRIL 2011.
3. THE AS-BUILT CONFIGURATION OF THE FINGER DRAINS WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN AUGUST 2010.
4. FINGER DRAINS THAT WERE COVERED WITH WATER COULD NOT BE SURVEYED. FOR THOSE AREAS, APPROXIMATE LAYOUTS WERE PRESENTED IN THIS DRAWING.
5. DROPOUT LOCATIONS AND PREVIOUSLY OVER-EXCAVATED AREAS SHOWN ON THIS DRAWING ARE OBTAINED FROM THE "SUMMARY OF CONSTRUCTION DROP-OUT MITIGATION MEASURES" REPORT PREPARED BY GEOSYNTEC CONSULTANTS, DATED JANUARY 2010.

0 100' 200'
SCALE IN FEET

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. NO.
R0	JULY 2011	MI	RWL								DISCIPLINE INTERFACE

SCALE: 1" = 100' EXCEPT AS NOTED

SITE CONDITIONS PRIOR TO THE DECEMBER 2010 DROP-OUT

GYPSUM DISPOSAL FACILITY, PHASE IA AREA

Geosyntec consultants
1255 ROBERTS BOULEVARD, N.W., SUITE 200
KENNESAW, GEORGIA 30144 USA
PHONE: 678.202.9500

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. ISOMEN	R.W. LOWRY					

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

CONSTRUCTION DRAWINGS | AUTODESK CIVIL 3D | DATE JULY 11 | 36 | C | 10WXXX-2 | R 0

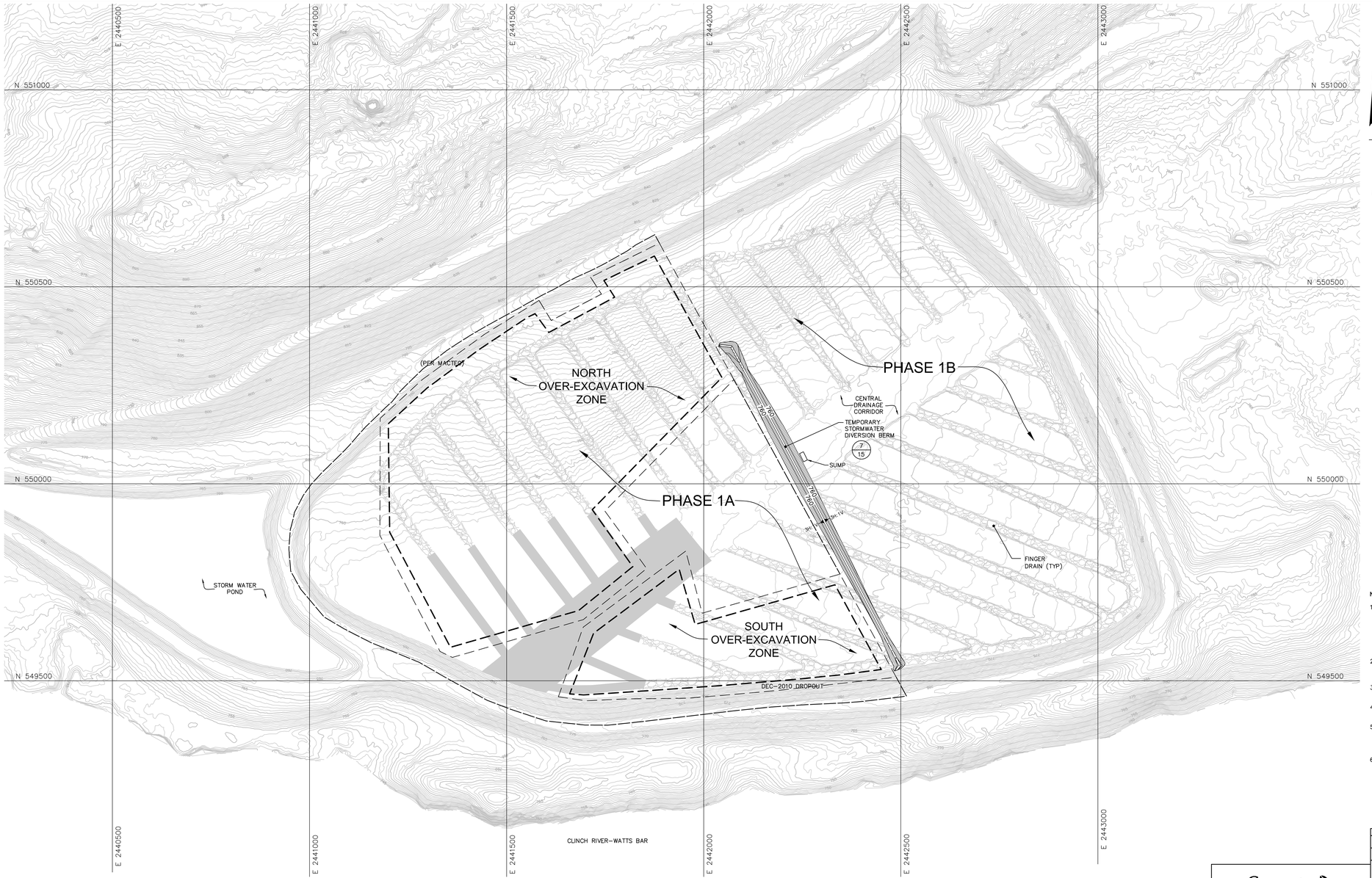
PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

DRAFT CONSTRUCTION DRAWINGS FOR REVIEW

GEOSYNTEC CONSULTANTS, INC.	0
TASK COMPLETED BY:	REV NO.

L:\CAD\TVI\TENNESSEE VALLEY AUTHORITY\KINGSTON FOSSIL PLANT - CONSTRUCTION FOR GYPSUM DISPOSAL FACILITY, PHASE IA AREA (DAN)\DRAWINGS\ABU1000.DWG



NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN AUGUST 2010. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929. CONTOUR LINES NEAR THE SOUTHWEST CORNER OF PHASE I AREA WERE NOT CAPTURED BY THE AERIAL SURVEY DUE TO PRESENCE OF WATER GENERATED FROM THE GYPSUM SCRUBBING OPERATIONS.
2. PHASE IA CONSTRUCTION DRAWINGS 10W236-1 THROUGH 10W236-16 DATED JULY 2011 ARE ISSUED TO SUPPLEMENT THE PERMIT MODIFICATION DRAWINGS 10W236-1 THROUGH 10W236-6 DATED APRIL 20, 2011.
3. THE AS-BUILT CONFIGURATION OF THE FINGER DRAINS WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN AUGUST 2010.
4. FINGER DRAINS THAT WERE COVERED WITH WATER COULD NOT BE SURVEYED. FOR THOSE AREAS, APPROXIMATE LAYOUTS WERE PRESENTED IN THIS DRAWING.
5. LIMIT OF EXCAVATION ASSUMES A 7 FOOT VERTICAL CUT AT THE BASE OF THE EXCAVATION AND 3H:1V SIDE SLOPES TO THE TOP OF THE EXCAVATION EXCEPT WHERE ADJACENT TO A PERIMETER BERM AND A 1.5H:1V SIDE SLOPE SHALL BE USED.
6. TEMPORARY DIVERSION BERM SHALL BE REMOVED ONCE THE DIVIDER DIKE IS CONSTRUCTED AND DEWATERING MEASURES ARE IN PLACE.

0 100' 200'
SCALE IN FEET

RO	JULY 2011	MI	RWL						PROJECT ID		AS CONST	REV. CD
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD				

SCALE: 1" = 100' EXCEPT AS NOTED

DISCIPLINE INTERFACE
1
2
3
4

OVER-EXCAVATION AND TEMPORARY STORMWATER DIVERSION BERM PLAN

GYPSUM DISPOSAL FACILITY, PHASE IA AREA

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. ISOMOV	R.W. LOWRY					

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE JULY 11	36	C	10WXXX-3	R 0

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Geosyntec consultants
1255 ROBERTS BOULEVARD, N.W., SUITE 200
KENNESAW, GEORGIA 30144 USA
PHONE: 678.202.9500

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

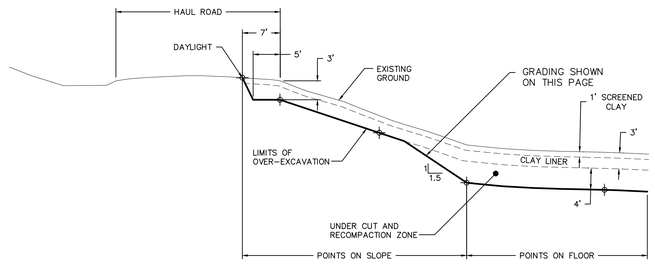
CONSTRUCTION DRAWINGS

DRAFT CONSTRUCTION DRAWINGS FOR REVIEW

GEOSYNTEC CONSULTANTS, INC.	0
TASK COMPLETED BY:	REV NO.

L:\CAD\TVA\TENNESSEE VALLEY AUTHORITY\KINGSTON FOSSIL PLANT - CONSTRUCTION FOR GYPSUM DISPOSAL FACILITY, PHASE IA AREA GRADING\DRAWINGS\10WXXX-3.DWG

1 — PLAN
BOTTOM OF SUBGRADE
SCALE: 1" = 60'



GRADING KEY MAP
N.T.S.

LEGEND

- 770 — EXISTING GROUND CONTOUR (FEET) (NOTE 2)
- <760> — PROPOSED BOTTOM OF SUBGRADE CONTOUR (FEET)
- BASE OF THE PHASE IA AREA TO BE OVER-EXCAVATED, PROOF-ROLLED, AND BACKFILLED
- LIMIT OF EXCAVATION (NOTE 3)
- LIMIT OF POTENTIAL EXCAVATION
- 3000 — CONSTRUCTION CONTROL POINT

NOTES:

1. CONTROL POINTS ARE PROVIDED OUTSIDE THE PLANNED NORTH AND SOUTH OVER EXCAVATION ZONES IN THE EVENT THAT EXCAVATION ACTIVITIES EXTEND BEYOND THE PLANNED AREAS INTO THE "POTENTIAL EXCAVATION ZONE".
2. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN AUGUST 2010. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
3. LIMIT OF EXCAVATION ASSUMES A 7 FOOT VERTICAL CUT AT THE BASE OF THE EXCAVATION AND 3H:1V SIDE SLOPES TO THE TOP OF THE EXCAVATION EXCEPT WHERE ADJACENT TO A PERIMETER BERM AND A 1.5H:1V SIDE SLOPE SHALL BE USED.

0 60' 120'
SCALE IN FEET

RO REV. NO.	JULY 2011 DATE	MI DSGN	RML DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV NO.	DISCIPLINE INTERFACE
											1	
											2	
											3	
											4	

SCALE: 1" = 60' EXCEPT AS NOTED

Geosyntec consultants
1255 ROBERTS BOULEVARD, N.W., SUITE 200
KENNESAW, GEORGIA 30144 USA
PHONE: 678.202.9500

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.
SIGNATURE
DATE

BOTTOM OF SUBGRADE

GYPSUM DISPOSAL FACILITY, PHASE IA AREA

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. ISOMEN	R.W. LOWRY					

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

CONSTRUCTION DRAWINGS | AUTODESK CIVIL 3D | DATE JULY 11 | 36 | C | 10WXXX-4 | R 0

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

GEOSYNTEC CONSULTANTS, INC. | 0
TASK COMPLETED BY: | REV NO.

DRAFT CONSTRUCTION DRAWINGS FOR REVIEW

L:\CAD\TVA\TENNESSEE VALLEY AUTHORITY\KINGSTON FOSSIL PLANT - CONSTRUCTION FOR GYPSUM DISPOSAL FACILITY, PHASE IA AREA (SHMI)\DRAWINGS\36X10W.DWG

BOTTOM OF SUBGRADE NORTH OVER-EXCAVATION ZONE CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
301	550152.49	2441199.84	765.69
302	550084.33	2441200.71	760.00
303	549989.71	2441201.93	755.00
304	549876.99	2441203.38	749.72
305	549783.72	2441252.60	745.00
306	549584.89	2441357.53	744.00
307	550336.61	2441424.49	775.05
308	550278.27	2441411.79	770.00
309	550176.09	2441396.47	765.00
310	550091.11	2441388.73	760.00
311	550019.15	2441387.50	755.00
312	549945.92	2441399.76	750.00
313	549815.23	2441421.27	745.00
314	549619.46	2441477.87	744.00
315	550384.05	2441607.11	780.26
316	550337.88	2441595.26	775.00
317	550275.05	2441592.89	770.00
318	550199.00	2441593.00	765.00
319	550121.34	2441591.05	760.00
320	550055.15	2441585.01	755.00
321	549990.66	2441588.28	750.00
322	549827.78	2441597.75	745.00
323	549678.25	2441682.60	744.37
324	550473.69	2441774.01	784.59
325	550412.43	2441775.21	780.00
326	550365.56	2441775.38	775.00
327	550310.73	2441779.69	770.00
328	550252.43	2441785.44	765.00
329	550199.03	2441793.56	760.00
330	550161.75	2441810.42	755.00
331	550112.10	2441833.20	750.00
332	550076.99	2441857.11	748.56
333	550577.92	2441874.94	790.34
334	550529.70	2441901.73	785.00
335	550463.70	2441938.40	780.00
336	550420.90	2441962.17	775.00
337	550393.56	2441977.36	770.00
338	550362.07	2441994.86	765.00
339	550323.75	2442016.14	759.00
340	550293.16	2442033.14	755.00
341	550269.80	2442046.11	752.44
342	549934.31	2441717.25	745.87
343	549789.73	2441820.14	745.21
344	550241.72	2441296.68	769.10
345	550370.56	2441474.95	778.42
346	550431.77	2441572.20	785.11
347	550515.97	2441746.82	789.92
2548	549809.19	2441239.16	746.00
2549	549824.24	2441286.84	746.00
2550	549839.10	2441334.58	746.00
2551	549853.88	2441382.35	746.00
2552	549868.49	2441430.16	746.00
2553	549882.66	2441478.11	746.00
2554	549896.84	2441526.06	746.00
2555	549911.01	2441574.01	746.00
2556	549925.26	2441621.93	746.00
2557	549941.07	2441669.37	746.00
2558	549956.87	2441716.81	746.00
2560	549905.15	2441272.80	750.00
2561	549876.21	2441312.66	748.00
2562	549927.36	2441333.71	750.00
2564	549959.82	2441458.85	750.00
2565	549933.89	2441501.74	748.00
2566	549975.19	2441524.27	750.00
2568	550016.69	2441652.03	750.00
2569	549970.65	2441624.86	748.00
2570	550049.73	2441713.24	750.00
2571	550075.75	2441768.46	750.00
2572	550090.44	2441818.22	749.00
2573	550009.50	2441734.72	748.00
2574	550143.64	2441901.96	750.00
2576	549999.24	2441250.97	755.00
2577	549971.83	2441299.77	753.00
2578	550010.00	2441329.01	755.00
2580	550031.62	2441458.96	755.00
2581	550013.95	2441495.38	753.00
2582	550039.09	2441532.97	755.00
2584	550077.01	2441640.04	755.00
2585	550068.21	2441694.54	752.00

BOTTOM OF SUBGRADE NORTH OVER-EXCAVATION ZONE CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
2586	550100.13	2441706.36	755.00
2587	550129.57	2441759.83	755.00
2589	550204.70	2441878.22	755.00
2590	550164.06	2441864.62	752.00
2591	550253.47	2441956.45	755.00
2592	550222.26	2441961.65	752.00
2595	550089.08	2441266.62	760.00
2596	550043.89	2441301.50	757.00
2597	550090.76	2441332.41	760.00
2599	550098.42	2441461.09	760.00
2600	550070.25	2441504.88	758.00
2601	550106.40	2441531.55	760.00
2603	550138.83	2441661.64	760.00
2604	550127.79	2441701.32	758.00
2605	550164.72	2441733.52	760.00
2607	550231.53	2441843.83	760.00
2608	550239.89	2441884.37	758.00
2609	550267.95	2441898.54	760.00
2610	550299.33	2441951.07	760.00
2611	550323.62	2441994.73	760.00
2613	550177.10	2441264.21	765.00
2614	550139.48	2441289.62	763.00
2615	550176.58	2441331.56	765.00
2617	550180.27	2441455.23	765.00
2618	550150.10	2441494.59	763.00
2619	550187.88	2441520.74	765.00
2621	550208.80	2441655.60	765.00
2622	550184.46	2441692.07	763.00
2623	550225.08	2441727.84	765.00
2625	550274.11	2441823.41	765.00
2626	550297.66	2441867.29	765.00
2627	550318.36	2441912.77	765.00
2628	550342.29	2441956.66	765.00
2629	550264.92	2441327.93	770.00
2630	550278.58	2441374.21	770.00
2631	550274.19	2441460.10	770.00
2632	550235.06	2441403.29	768.00
2633	550273.27	2441523.42	770.00
2635	550276.52	2441654.42	770.00
2636	550252.70	2441678.66	768.00
2637	550291.74	2441720.99	770.00
2639	550325.18	2441814.86	770.00
2640	550343.68	2441861.28	770.00
2641	550361.18	2441908.10	770.00
2642	550383.50	2441952.81	770.00
2644	550342.09	2441491.53	775.00
2645	550318.15	2441516.22	773.00
2646	550339.69	2441544.14	775.00
2647	550337.26	2441652.41	775.00
2648	550319.41	2441675.41	773.00
2649	550350.64	2441720.30	775.00
2651	550379.77	2441815.80	775.00
2652	550396.10	2441863.05	775.00
2653	550408.52	2441911.46	775.00
2655	550389.54	2441503.48	780.00
2656	550386.16	2441553.34	780.00
2658	550382.07	2441653.12	780.00
2659	550376.60	2441705.48	778.00
2660	550404.00	2441750.34	780.00
2661	550430.49	2441822.90	780.00
2662	550425.56	2441863.23	778.00
2663	550450.45	2441884.09	780.00
2665	550512.89	2441854.64	785.00
2666	550495.13	2441897.98	785.00
2667	549783.72	2441252.60	745.00
2668	549793.23	2441301.69	745.00
2669	549802.74	2441350.78	745.00
2670	549811.72	2441399.96	745.00
2671	549819.84	2441449.29	745.00
2672	549827.96	2441498.63	745.00
2673	549834.93	2441547.98	745.00
2674	549827.82	2441597.47	745.00
2675	549814.13	2441645.47	745.00
2676	549798.25	2441692.88	745.00
2677	549782.66	2441740.39	745.00
2678	549753.30	2441268.65	744.00
2679	549763.66	2441317.43	744.00
2680	549767.53	2441367.28	744.00
2681	549770.70	2441417.18	744.00

BOTTOM OF SUBGRADE NORTH OVER-EXCAVATION ZONE CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
2682	549773.03	2441467.05	744.00
2683	549761.89	2441515.26	744.00
2684	549735.54	2441557.05	744.00
2685	549694.12	2441582.07	744.00

BOTTOM OF SUBGRADE SOUTH OVER-EXCAVATION ZONE CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
401	549466.59	2441659.90	745.03
402	549620.50	2441720.57	744.15
403	549525.88	2441716.79	744.00
404	549465.61	2441718.84	745.42
405	549705.07	2441833.68	745.00
406	549474.16	2441849.11	746.90
407	549584.10	2441837.53	745.00
408	549782.92	2441937.82	745.55
409	549642.97	2441978.21	745.99
410	549574.46	2442007.43	747.00
411	549484.26	2441993.34	749.18
412	549696.49	2442167.01	748.00
413	549498.93	2442175.55	752.88
414	549743.57	2442333.07	749.95
415	549635.58	2442392.03	751.18
416	549528.66	2442450.41	754.90
417	549596.09	2442211.44	749.00
418	549614.22	2442287.94	750.00
419	549702.22	2441909.70	745.41
420	549507.80	2441790.26	745.00
421	549564.14	2441928.16	746.00
422	549583.38	2442107.40	748.00
423	549671.25	2442312.00	750.00
424	549550.84	2442245.76	750.00
425	549572.53	2442355.66	751.00
426	549514.62	2441747.24	744.00
427	549594.91	2441757.19	744.00
428	549531.06	2441811.95	745.00
429	549650.77	2441850.32	745.00
430	549485.65	2441845.48	746.00
431	549531.31	2441899.77	746.00
432	549488.80	2441919.44	747.00
433	549547.98	2441985.60	747.00
434	549624.29	2442048.52	747.00
435	549669.46	2442071.68	747.00
436	549521.29	2442040.38	748.00
437	549646.40	2442148.23	748.00
438	549499.96	2442103.03	749.00
439	549559.00	2442191.03	749.00
440	549648.03	2442240.01	749.00
441	549723.16	2442261.06	749.00
442	549514.07	2442293.05	751.00
443	549537.54	2442333.75	751.00
444	549529.83	2442412.56	752.00
445	549573.66	2442425.84	752.00

BOTTOM OF SUBGRADE POTENTIAL EXCAVATION ZONE-FLOOR CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
3172	550119.00	2441178.00	763.00
3173	550113.19	2441200.34	761.56
3174	550112.57	2441162.41	762.50
3175	550081.02	2441150.75	760.00
3176	550078.70	2441137.68	760.00
3177	550049.72	2441201.16	758.09
3178	550051.99	2441151.13	758.50
3179	550043.88	2441105.28	758.50
3180	550028.88	2441201.43	756.86
3181	550032.63	2441151.38	757.50
3182	550023.55	2441100.00	757.50
3183	550020.90	2441085.04	757.50
3184	549997.57	2441200.00	755.45
3185	549996.45	2441150.00	756.00
3186	549995.46	2441107.87	756.00
3187	549985.56	2441049.95	756.00
3188	549978.17	2441202.08	754.48
3189	549975.98	2441150.00	755.00
3190	549974.56	2441101.56	755.00
3191	549966.69	2441055.52	755.00
3192	549966.04	2441032.63	755.00
3193	549949.18	2441202.45	753.17
3194	549944.67	2441150.89	753.50
3195	549943.40	2441100.00	753.50
3196	549942.59	2441050.00	753.50
3197	549935.96	2441012.81	753.50
3198	549930.07	2441202.70	752.30
3199	549923.42	2441152.78	752.50
3200	549920.59	2441100.00	752.50
3201	549920.90	2441050.00	752.49
3202	549914.98	2441005.50	752.50
3203	549901.41	2441203.07	750.89
3204	549889.56	2441153.21	751.00
3205	549888.07	2441093.27	751.00
3206	549889.56	2441050.32	751.50
3207	549873.59	2441013.93	751.43
3208	549847.53	2440996.07	751.50
3209	549865.67	2441150.00	750.00
3210	549864.28	2441103.90	750.00
3211	549834.41	2441050.00	750.00
3212	549828.03	2441037.48	750.00
3213	549809.38	2441026.62	750.00
3214	549800.00	2441024.49	750.00
3215	549791.28	2440998.02	751.00
3216	549757.80	2441014.92	750.00
3217	549850.58	2441217.32	748.34
3218	549843.46	2441200.00	748.50
3219	549823.87	2441149.89	748.51
3220	549816.30	2441123.61	748.50
3221	549791.03	2441079.47	748.50
3222	549750.00	2441063.74	748.50
3223	549840.49	2441114.54	749.00
3224	549809.90	2441061.59	749.00
3225	549783.96	2441052.39	749.00
3226	549721.62	2441048.57	749.00
3227	549693.88	2441077.61	748.00
3228	549828.97	2441228.72	747.36
3229	549813.81	2441200.00	747.50
3230	549800.00	2441173.83	747.50
3231	549787.42	2441150.00	747.50
3232	549769.73	2441116.46	747.53
3233	549740.04	2441089.24	747.50
3234	549710.13	2441086.02	747.50
3235	549688.47	2441089.27	747.50
3236	549759.98	2441200.00	746.00
3237	549733.59	2441150.00	746.00
3238	549716.12	2441116.90	746.00
3239	549700.00	2441113.73	746.00
3240	549677.21	2441117.34	746.00
3241	549730.18	2441200.00	745.50
3242	549707.65	2441160.94	745.50
3243	549675.54	2441156.16	745.49
3244	549655.59	2441171.48	745.50
3245	549740.26	2441275.54	744.00
3246	549726.78	2441250.00	745.00
3247	549700.00	2441199.25	745.00
3248	549678.39	2441185.44	745.00
3249	549694.64	2441189.09	745.00
3250	549662.29	2441200.00	745.00

BOTTOM OF SUBGRADE POTENTIAL EXCAVATION ZONE-FLOOR CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
3251	549633.96	2441225.63	745.00
3252	549711.17	2441290.89	744.00
3253	549689.60	2441250.00	744.50
3254	549672.51	2441217.62	744.50
3255	549664.38	2441215.80	744.50
3256	549633.73	2441237.36	744.39
3257	549620.54	2441258.60	744.50
3258	549682.09	2441306.24	744.00
3259	549652.41	2441250.00	744.00
3260	549633.73	2441244.58	744.00
3261	549607.13	2441291.58	744.00
3262	549579.03	2441350.00	744.00
3263	549603.55	2441300.00	744.00
3264	549555.60	2441400.00	744.00
3265	549531.36	2441450.00	744.00
3266	549550.00	2441450.00	744.00
3267	549550.00	2441500.00	744.00
3268	549600.00	2441450.00	744.00
3269	549600.00	2441500.00	744.00
3270	549600.00	2441550.00	744.00
3271	549600.00	2441600.00	744.03
3272	549600.00	2441650.00	744.03
3273	549650.00	2441600.00	744.03
3274	549650.00	2441650.00	744.10
3275	549650.00	2441700.00	744.26
3276	549600.00	2441700.00	744.02
3277	549550.00	2441550.00	744.00
3278	549550.00	2441600.00	744.01
3279	549550.00	2441650.00	744.00
3280	549513.90	2441500.00	744.00
3281	549498.20	2441550.00	744.00
3282	549483.00	2441598.92	744.00
3283	549472.13	2441650.00	744.00
3284	549500.00	2441600.00	744.00
3285	549500.00	2441650.00	744.00
3286	549650.00	2441750.00	744.29
3287	549700.00	2441750.00	744.56
3288	549750.00	2441800.00	745.02
3289	549700.00	2441800.00	744.76
3290	549750.00	2441850.00	745.15
3291	549800.00	2441850.00	745.31
3292	549800.00	2441900.00	745.43
3293	549850.00	2441800.00	745.40
3294	549900.00	2441750.00	745.64
3295	549950.00	2441750.00	745.92
3296	549950.00	2441800.00	745.92
3297	549950.00	2441850.00	745.94
3298	549900.00	2441800.00	745.66
3299	549900.00	2441850.00	745.70
3300	549900.00	2441900.00	745.77
3301	549900.00	2441950.00	745.88
3302	549850.00	2441850.00	745.49
3303	549850.00	2441900.00	745.59
3304	549850.00	2441950.00	745.72
3305	549800.00	2441950.00	745.58
3306	549750.00	2441950.00	745.58
3307	549850.00	2442000.00	745.87
3308	549800.00	2442000.00	745.77
3309	549750.00	2442000.00	745.81
3310	549700.00	2442000.00	745.92
3311	549962.94	2441750.00	746.00
3312	549965.39	2441800.00	746.00
3313	549962.99	2441850.00	746.00
3314	549956.51	2441900.00	746.00
3315	549950.00	2441900.00	745.97
3316	549950.00	2441950.00	746.22
3317	549937.69	2441950.00	746.00
3318	549905.53	2441991.27	746.00
3319	549852.00	2442044.55	746.00
3320	549838.69	2442052.66	746.00
3321	549811.49	2442055.26	746.00
3322	549772.43	2442048.02	746.00
3323	549741.27	2442036.18	746.00
3324	549719.36	2442025.46	746.00
3325	549676.49	2442000.00	746.00
3326	550000.00	2441800.00	747.07
3327	550000.00	2441850.00	746.97
3328	550000.00	2441900.00	746.97
3329	550000.00	2441950.00	747.07

BOTTOM OF SUBGRADE POTENTIAL EXCAVATION ZONE-FLOOR CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
3330	550023.02	2441850.00	747.51
3331	550027.60	2441900.00	747.50
3332	550027.89	2441950.00	747.50
3333	550005.62	2442000.00	747.50
3334	549950.00	2442000.00	746.69
3335	549950.00	2442050.00	747.12
3336	549900.00	2442050.00	746.57
3337	549979.90	2442050.00	747.50
3338	549950.00	2442087.90	747.50
3339	549900.00	2442135.05	747.50
3340	549900.00	2442100.00	747.09
3341	549850.00	2442100.00	746.72
3342	549850.00	2442155.04	747.49
3343	549830.08	2442157.82	747.50
3344	549800.00	2442100.00	746.73
3345	549800.00	2442154.12	747.50
3346	549750.00	2442050.00	746.15
3347	549750.00	2442100.00	746.87
3348	549750.00	2442144.50	747.50
3349	549700.00	2442050.00	746.48
3350	549700.00	2442100.00	747.14
3351	549700.00	2442129.54	747.49
3352	550014.67	2441800.00	747.50
3353	550050.00	2441850.00	748.09
3354	550050.00	2441900.00	747.92
3355	550050.00	2441950.00	747.89
3356	550050.00	2442000.00	748.09
3357	550050.00	2442050.00	748.22
3358	550050.00	2442100.00	748.35
3359	550000.00	2442050.00	747.78
3360	550000.00	2442100.00	748.08
3361	550000.00	2442150.00	748.27
3362	549950.00	2442150.00	748.07
3363	549950.00	2442200.00	748.34
3364	549900.00	2442200.00	748.22
3365	549900.00	2442150.00	747.67
3366	549850.00	2442200.00	748.07
3367	549800.00	2442200.00	748.11
3368	549750.00	2442200.00	748.22
3369	549750.00	2442250.00	748.79
3370	549800.00	2442250.00	748.70
3371	549850.00	2442250.00	748.66
3372	549800.00	2442302.30	749.35
3373	549750.00	2442329.56	749.87
3374	549750.00	2442300.00	749.45
3375	549850.00	2442275.03	748.96
3376	549900.00	2442247.77	748.67
3377	549950.00	2442220.50	748.46
3378	550000.00	2442193.24	748.50
3379	550050.00	2442150.00	748.43
3380	550050.00	2442165.97	748.52
3381	550100.00	2441900.00	748.79
3382	550100.00	2441950.00	748.64
3383	550100.00	2442000.00	748.59
3384	550100.00	2442050.00	748.58
3385	550100.00	2442100.00	748.67
3386	550100.00	2442138.71	748.76
3387	550150.00	2441950.00	749.61
3388	550150.00	2442000.00	749.22
3389	550150.00	2442050.00	748.97
3390	550150.00	2442100.00	749.08
3391	550150.00	2442111.44	749.12
3392	550083.21	2441900.00	748.50
3393	550090.33	2441950.00	748.50
3394	550091.55	2442000.00	748.50
3395	550089.53	2442050.00	748.50
3396	550074.47	2442100.00	748.50
3397	550062.37	2442150.00	748.50
3398	550165.68	2441950.00	750.00
3399	550188.62	2442000.00	750.00
3400	550200.22	2442025.30	750.00
3401	550202.23	2442050.00	750.00
3402	550204.42	2442081.77	750.00
3403	550214.48	2442000.00	751.00
3404	550240.27	2442050.00	751.00
3405	550242.80	2442060.84	751.00
3406	550400.00	2441600.00	782.18
3407	550450.00	2441650.00	786.07
3408	550431.67	2441600.00	785.00

BOTTOM OF SUBGRADE POTENTIAL EXCAVATION ZONE-FLOOR CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
3409	550436.93	2441650.00	785.00
3410	550450.00	2441700.00	785.25
3411	550500.00	2441750.00	787.18
3412	550493.75	2441700.00	789.42
3413	550470.03	2441650.00	787.94
3414	550446.30	2441600.00	786.57

DRAFT CONSTRUCTION DRAWINGS FOR REVIEW

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE REV ID
0	JULY 2011	M	RWL								1
											2
											3
											4

SCALE: 1" = 60' EXCEPT AS NOTED

BOTTOM OF SUBGRADE CONSTRUCTION CONTROL POINTS

GYPSUM DISPOSAL FACILITY, PHASE IA AREA

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. ISOMEN	R.W. LOWRY					

Geosyntec consultants
1255 ROBERTS BOULEVARD, N.W., SUITE 200
KENNESAW, GEORGIA 30144 USA
PHONE: 678.202.9500

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

CONSTRUCTION DRAWINGS

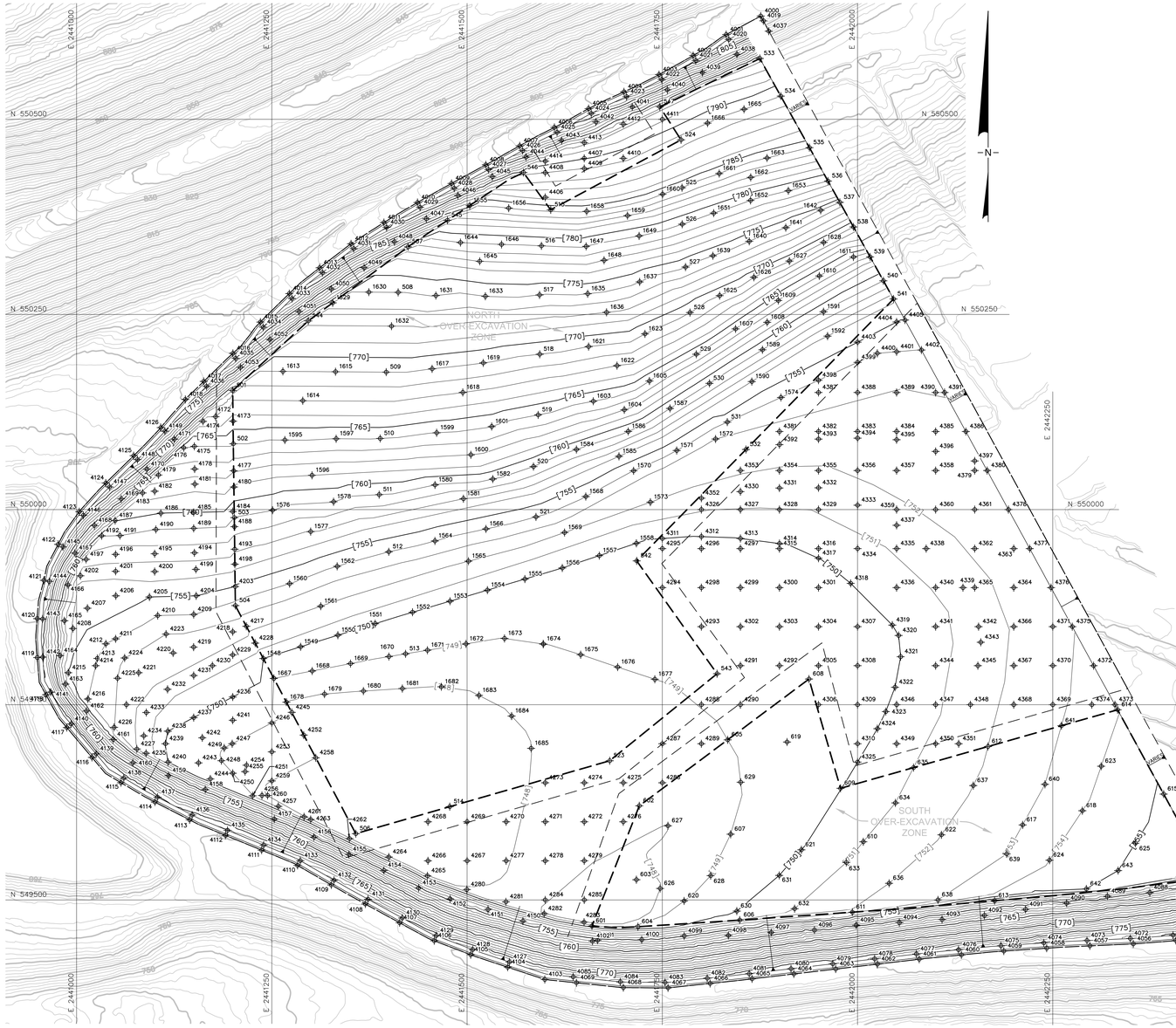
AUTODESK CIVIL 3D	DATE JULY 11	36	C	10WXXX-5	R 0

PLOT FACTOR: 1:1

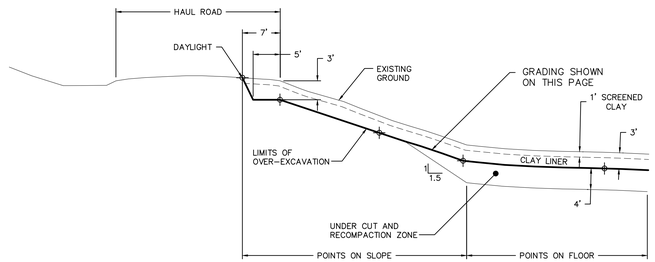
C.A.D. DRAWING
DO NOT ALTER MANUALLY

GEOSYNTEC CONSULTANTS, INC.	0
TASK COMPLETED BY:	REV NO.

L:\CAD\TVENNESSEE VALLEY AUTHORITY\KINGSTON FOSSIL PLANT- CONSTRUCTION FOR GYPSUM DISPOSAL FACILITY, PHASE IA AREA (SAME)\DRAWINGS\10WXXX-5.DWG



2 PLAN
TOP OF SUBGRADE
SCALE: 1" = 60'



GRADING KEY MAP
N.T.S.

LEGEND

- 770 — EXISTING GROUND CONTOUR (FEET) (NOTE 2)
- [760] — PROPOSED TOP OF SUBGRADE CONTOUR (FEET)
- BASE OF THE PHASE IA AREA TO BE OVER-EXCAVATED, PROOF-ROLLED, AND BACKFILLED
- LIMIT OF EXCAVATION (NOTE 3)
- LIMIT OF POTENTIAL EXCAVATION
- 8000 — CONSTRUCTION CONTROL POINT

NOTES:

1. CONTROL POINTS ARE PROVIDED OUTSIDE THE PLANNED NORTH AND SOUTH OVER EXCAVATION AREAS IN THE EVENT THAT EXCAVATION ACTIVITIES EXTEND BEYOND THE PLANNED AREAS INTO THE "POTENTIAL EXCAVATION ZONE".
2. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN AUGUST 2010. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
3. LIMIT OF EXCAVATION ASSUMES A 7 FOOT VERTICAL CUT AT THE BASE OF THE EXCAVATION AND 3H:1V SIDE SLOPES TO THE TOP OF THE EXCAVATION EXCEPT WHERE ADJACENT TO A PERIMETER BERM AND A 1.5H:1V SIDE SLOPE SHALL BE USED.

0 60' 120'
SCALE IN FEET

RO	JULY 2011	M	FML								DISCIPLINE INTERFACE
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV 1 2 3 4

SCALE: 1" = 60' EXCEPT AS NOTED

TOP OF SUBGRADE

GYPSUM DISPOSAL FACILITY,
PHASE IA AREA

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. ISOMOV	R.W. LOWRY					

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE JULY 11	36	C	10WXXX-6	R 0

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Geosyntec consultants
1255 ROBERTS BOULEVARD, N.W., SUITE 200
KENNESAW, GEORGIA 30144 USA
PHONE: 678.202.9500

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

CONSTRUCTION DRAWINGS

GEOSYNTEC CONSULTANTS, INC.	0
TASK COMPLETED BY:	REV NO.

DRAFT CONSTRUCTION DRAWINGS FOR REVIEW

L:\CAD\TVA\TENNESSEE VALLEY AUTHORITY\KINGSTON FOSSIL PLANT- CONSTRUCTION FOR GYPSUM DISPOSAL FACILITY, PHASE IA AREA (DWG\DRAWINGS\MASTER.DWG

TOP OF SUBGRADE NORTH OVER-EXCAVATION ZONE CONTROL DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
501	550152.49	2441199.84	769.69
502	550084.33	2441200.71	764.00
503	549989.71	2441201.93	759.00
504	549876.99	2441203.38	753.72
505	549783.72	2441252.60	749.00
506	549584.89	2441357.53	748.00
507	550336.61	2441424.49	779.11
508	550278.27	2441411.79	774.00
509	550176.09	2441396.47	769.00
510	550091.11	2441388.73	764.00
511	550019.15	2441387.50	759.00
512	549945.92	2441399.76	754.00
513	549815.23	2441421.27	749.00
514	549619.46	2441477.87	748.00
515	550384.05	2441607.11	784.26
516	550337.88	2441595.26	779.00
517	550275.05	2441592.89	774.00
518	550199.00	2441593.00	769.00
519	550121.34	2441591.05	764.00
520	550055.15	2441585.01	759.00
521	549990.66	2441588.28	754.00
522	549827.78	2441597.75	749.00
523	549678.25	2441682.60	748.37
524	550473.69	2441774.01	788.59
525	550412.43	2441775.21	784.00
526	550365.56	2441775.38	779.00
527	550310.73	2441779.69	774.00
528	550252.43	2441785.44	769.00
529	550199.03	2441793.56	764.00
530	550161.75	2441810.42	759.00
531	550112.10	2441833.20	754.00
532	550076.99	2441857.11	752.56
533	550577.92	2441874.94	794.34
534	550529.70	2441901.73	789.00
535	550463.70	2441938.40	784.00
536	550420.90	2441962.17	779.00
537	550393.56	2441977.36	774.00
538	550362.07	2441994.86	769.00
539	550323.75	2442016.14	763.00
540	550293.16	2442033.14	759.00
541	550269.80	2442046.11	756.44
542	549934.31	2441717.25	749.87
543	549789.73	2441820.14	749.21
544	550241.72	2441296.68	773.10
545	550370.56	2441474.95	782.42
546	550431.77	2441572.20	789.11
547	550515.97	2441746.82	793.92
1548	549809.19	2441239.16	750.00
1549	549824.24	2441286.84	750.00
1550	549839.10	2441334.58	750.00
1551	549853.88	2441382.35	750.00
1552	549868.49	2441430.16	750.00
1553	549882.66	2441478.11	750.00
1554	549896.84	2441526.06	750.00
1555	549911.01	2441574.01	750.00
1556	549925.26	2441621.93	750.00
1557	549941.07	2441669.37	750.00
1558	549956.87	2441716.81	750.00
1560	549905.15	2441272.80	754.00
1561	549876.21	2441312.66	752.00
1562	549927.36	2441333.71	754.00
1564	549959.82	2441458.85	754.00
1565	549933.89	2441501.74	752.00
1566	549975.19	2441524.27	754.00
1568	550016.69	2441652.03	754.00
1569	549970.65	2441624.86	752.00
1570	550049.73	2441713.24	754.00
1571	550075.75	2441768.46	754.00
1572	550090.44	2441818.22	753.00
1573	550009.50	2441734.72	752.00
1574	550143.64	2441901.96	754.00
1576	549999.24	2441250.97	759.00
1577	549971.83	2441299.77	757.00
1578	550010.00	2441329.01	759.00
1580	550031.62	2441458.96	759.00
1581	550013.95	2441495.38	757.00
1582	550039.09	2441532.97	759.00
1584	550077.01	2441640.04	759.00
1585	550068.21	2441694.54	756.00

TOP OF SUBGRADE NORTH OVER-EXCAVATION ZONE CONTROL DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
1586	550100.13	2441706.36	759.00
1587	550129.57	2441759.83	759.00
1589	550204.70	2441878.22	759.00
1590	550164.06	2441864.62	756.00
1591	550253.47	2441956.45	759.00
1592	550222.26	2441961.65	756.00
1595	550089.08	2441266.62	764.00
1596	550043.89	2441301.50	761.00
1597	550090.76	2441332.41	764.00
1599	550098.42	2441461.09	764.00
1600	550070.25	2441504.88	762.00
1601	550106.40	2441531.55	764.00
1603	550138.83	2441661.64	764.00
1604	550127.79	2441701.32	762.00
1605	550164.72	2441733.52	764.00
1607	550231.53	2441843.83	764.00
1608	550239.59	2441884.37	762.00
1609	550267.95	2441898.54	764.00
1610	550299.33	2441951.07	764.00
1611	550323.62	2441994.73	764.00
1613	550177.10	2441264.21	769.00
1614	550139.48	2441289.62	767.00
1615	550176.58	2441331.56	769.00
1617	550180.27	2441455.23	769.00
1618	550150.10	2441494.59	767.00
1619	550187.88	2441520.74	769.00
1621	550208.80	2441655.60	769.00
1622	550184.46	2441692.07	767.00
1623	550225.08	2441727.84	769.00
1625	550274.11	2441823.41	769.00
1626	550297.66	2441867.29	769.00
1627	550318.36	2441912.77	769.00
1628	550342.29	2441956.66	769.00
1629	550264.92	2441327.93	774.00
1630	550278.58	2441374.21	774.00
1631	550274.19	2441460.10	774.00
1632	550235.06	2441403.29	772.00
1633	550273.27	2441523.42	774.00
1635	550276.52	2441654.42	774.00
1636	550252.70	2441678.66	772.00
1637	550291.74	2441720.99	774.00
1639	550325.18	2441814.86	774.00
1640	550343.68	2441861.28	774.00
1641	550361.18	2441908.10	774.00
1642	550383.50	2441952.81	774.00
1644	550342.09	2441491.53	779.00
1645	550318.15	2441516.22	777.00
1646	550339.69	2441544.14	779.00
1647	550337.26	2441652.41	779.00
1648	550319.41	2441675.41	777.00
1649	550350.64	2441720.30	779.00
1651	550379.77	2441815.80	779.00
1653	550408.52	2441911.46	779.00
1655	550389.54	2441503.48	784.00
1656	550386.16	2441553.34	784.00
1658	550382.07	2441653.12	784.00
1659	550376.60	2441705.48	782.00
1660	550404.00	2441750.34	784.00
1661	550430.49	2441822.90	784.00
1662	550425.56	2441863.23	782.00
1663	550450.45	2441884.09	784.00
1665	550512.89	2441854.64	789.00
1666	550495.13	2441807.98	789.00
1667	549783.72	2441252.60	749.00
1668	549793.23	2441301.69	749.00
1669	549802.74	2441350.78	749.00
1670	549811.72	2441399.96	749.00
1671	549819.84	2441449.29	749.00
1672	549827.96	2441498.63	749.00
1673	549834.93	2441547.98	749.00
1674	549827.82	2441597.47	749.00
1675	549814.13	2441645.47	749.00
1676	549798.25	2441692.88	749.00
1677	549782.66	2441740.39	749.00
1678	549753.30	2441268.65	748.00
1679	549763.66	2441317.43	748.00
1680	549767.53	2441367.28	748.00
1681	549770.70	2441417.18	748.00

TOP OF SUBGRADE NORTH OVER-EXCAVATION ZONE CONTROL DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
1682	549773.03	2441467.05	748.00
1683	549761.89	2441515.26	748.00
1684	549735.54	2441557.05	748.00
1685	549694.12	2441582.07	748.00

TOP OF SUBGRADE SOUTH OVER-EXCAVATION ZONE CONTROL DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
601	549466.59	2441659.90	749.03
602	549620.50	2441720.57	748.15
603	549525.88	2441716.79	748.00
604	549465.61	2441718.84	749.42
605	549705.07	2441833.68	749.00
606	549474.16	2441849.11	750.90
607	549584.10	2441837.53	749.00
608	549782.92	2441937.82	749.55
609	549642.97	2441978.21	749.99
610	549574.46	2442007.43	751.00
611	549484.26	2441993.34	753.18
612	549696.49	2442167.01	752.00
613	549498.93	2442175.55	756.88
614	549743.57	2442333.07	753.95
615	549635.58	2442392.03	755.18
616	549528.66	2442450.41	758.90
617	549596.09	2442211.44	753.00
618	549614.22	2442287.94	754.00
619	549702.22	2441909.70	749.41
620	549498.66	2441777.95	749.00
621	549564.14	2441928.16	750.00
622	549583.38	2442107.40	752.00
623	549671.25	2442312.00	754.00
624	549550.64	2442245.76	754.00
625	549572.53	2442355.66	755.00
626	549514.62	2441747.24	748.00
627	549594.91	2441757.19	748.00
628	549531.06	2441811.95	749.00
629	549650.77	2441850.32	749.00
630	549485.65	2441845.48	750.00
631	549531.31	2441899.77	750.00
632	549488.80	2441919.44	751.00
633	549547.98	2441985.60	751.00
634	549624.29	2442048.52	751.00
635	549669.46	2442071.68	751.00
636	549521.29	2442040.38	752.00
637	549646.40	2442148.23	752.00
638	549499.96	2442103.03	753.00
639	549559.00	2442191.03	753.00
640	549648.03	2442240.01	753.00
641	549723.16	2442261.06	753.00
642	549514.07	2442293.05	755.00
643	549537.54	2442333.75	755.00
644	549529.83	2442412.56	756.00
645	549573.66	2442425.84	756.00

TOP OF SUBGRADE POTENTIAL EXCAVATION ZONE-SLOPE CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
4019	550626.16	2441879.43	808.55
4020	550602.32	2441835.16	807.85
4021	550575.41	2441792.88	805.84
4022	550551.05	2441749.21	803.88
4023	550529.01	2441704.28	802.25
4024	550507.53	2441659.04	800.93
4025	550483.40	2441615.25	799.39
4026	550460.03	2441571.04	797.84
4027	550435.58	2441527.42	795.05
4028	550411.67	2441483.51	793.85
4029	550387.28	2441439.86	791.85
4030	550361.53	2441396.95	790.13
4031	550334.27	2441354.86	788.85
4032	550303.65	2441314.78	786.88
4033	550270.36	2441275.81	784.86
4034	550233.75	2441238.82	781.97
4035	550193.83	2441203.64	778.94
4036	550157.81	2441166.33	777.19
4037	550612.96	2441886.10	803.86
4038	550583.23	2441845.57	800.55
4039	550559.91	2441801.33	799.50
4040	550537.72	2441756.44	798.40
4041	550515.75	2441711.51	797.54
4042	550496.56	2441665.02	797.81
4043	550472.85	2441621.00	795.55
4044	550451.68	2441575.59	794.96
4045	550426.46	2441532.40	791.95
4046	550402.38	2441488.31	790.77
4047	550372.63	2441447.85	786.94
4048	550343.14	2441406.98	783.25
4049	550309.91	2441368.13	779.17
4050	550282.69	2441326.04	778.95
4051	550253.74	2441284.88	778.72
4052	550217.88	2441247.48	776.45
4053	550182.18	2441209.99	774.69
4070	549461.03	2442457.50	780.85
4071	549454.71	2442404.00	780.52
4072	549450.51	2442349.34	779.63
4073	549447.94	2442293.79	778.85
4074	549444.91	2442238.49	778.11
4075	549441.18	2442183.57	777.85
4076	549436.19	2442129.34	777.15
4077	549430.64	2442075.42	776.84
4078	549424.36	2442021.89	776.23
4079	549418.07	2441968.37	775.84
4080	549411.79	2441914.85	775.84
4081	549405.50	2441861.32	775.81
4082	549399.65	2441807.56	774.96
4083	549394.28	2441753.54	774.61
4084	549394.96	2441696.22	773.70
4085	549401.32	2441635.80	772.85
4086	549511.90	2442451.64	764.42
4087	549510.31	2442430.63	763.62
4088	549509.25	2442374.26	760.02
4089	549504.51	2442319.89	759.01
4090	549495.77	2442267.72	760.83
4091	549487.79	2442215.11	761.97
4092	549480.01	2442162.40	762.86
4093	549475.00	2442108.19	762.16
4094	549470.84	2442053.50	761.16
4095	549467.56	2441998.33	759.21
4096	549461.29	2441944.80	759.99
4097	549458.27	2441889.50	758.49
4098	549454.46	2441834.63	757.40
4099	549453.71	2441778.08	754.97
4100	549449.10	2441723.65	754.90
4101	549448.21	2441667.18	755.62
4102	549447.20	2441660.61	756.22
4127	549420.45	2441554.23	771.84
4128	549436.29	2441507.15	771.51
4129	549454.19	2441460.47	770.69
4130	549476.86	2441417.02	769.99
4131	549500.86	2441373.18	769.06
4132	549525.25	2441329.70	768.11
4133	549550.29	2441286.43	766.97
4134	549570.24	2441239.59	766.39
4135	549589.18	2441193.31	766.12
4136	549608.78	2441148.01	765.32
4137	549631.63	2441103.53	765.10

TOP OF SUBGRADE POTENTIAL EXCAVATION ZONE-SLOPE CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
4138	549656.16	2441060.48	765.52
4139	549687.03	2441020.37	765.84
4140	549725.25	2440992.84	765.84
4141	549766.18	2440966.97	765.07
4142	549811.06	2440956.58	765.10
4143	549859.80	2440956.46	766.10
4144	549908.06	2440965.00	767.80
4145	549952.25	2440982.57	769.41
4146	549992.60	2441008.63	770.62
4147	550029.02	2441042.27	771.97
4148	550064.02	2441078.00	773.34
4149	550100.50	2441113.07	775.03
4150	549472.86	2441571.56	753.80
4151	549487.73	2441526.88	753.39
4152	549501.31	2441481.38	754.54
4153	549515.24	2441437.98	755.44
4154	549537.78	2441393.51	754.87
4155	549558.26	2441348.81	755.39
4156	549580.45	2441303.88	755.16
4157	549603.48	2441253.19	754.57
4158	549641.44	2441164.79	754.23
4159	549659.21	2441117.70	755.60
4160	549675.69	2441072.08	758.88
4161	549705.40	2441046.85	755.62
4162	549741.96	2441012.65	756.27
4163	549776.45	2440985.64	756.94
4164	549812.89	2440978.84	758.37
4165	549857.64	2440984.42	757.24
4166	549903.44	2440988.94	758.69
4167	549944.29	2440997.95	763.29
4168	549979.65	2441022.79	764.23
4169	550013.76	2441057.18	765.67
4170	550051.53	2441090.12	767.79
4171	550090.18	2441125.20	769.87

TOP OF SUBGRADE POTENTIAL EXCAVATION ZONE-FLOOR CONTROL-DATA

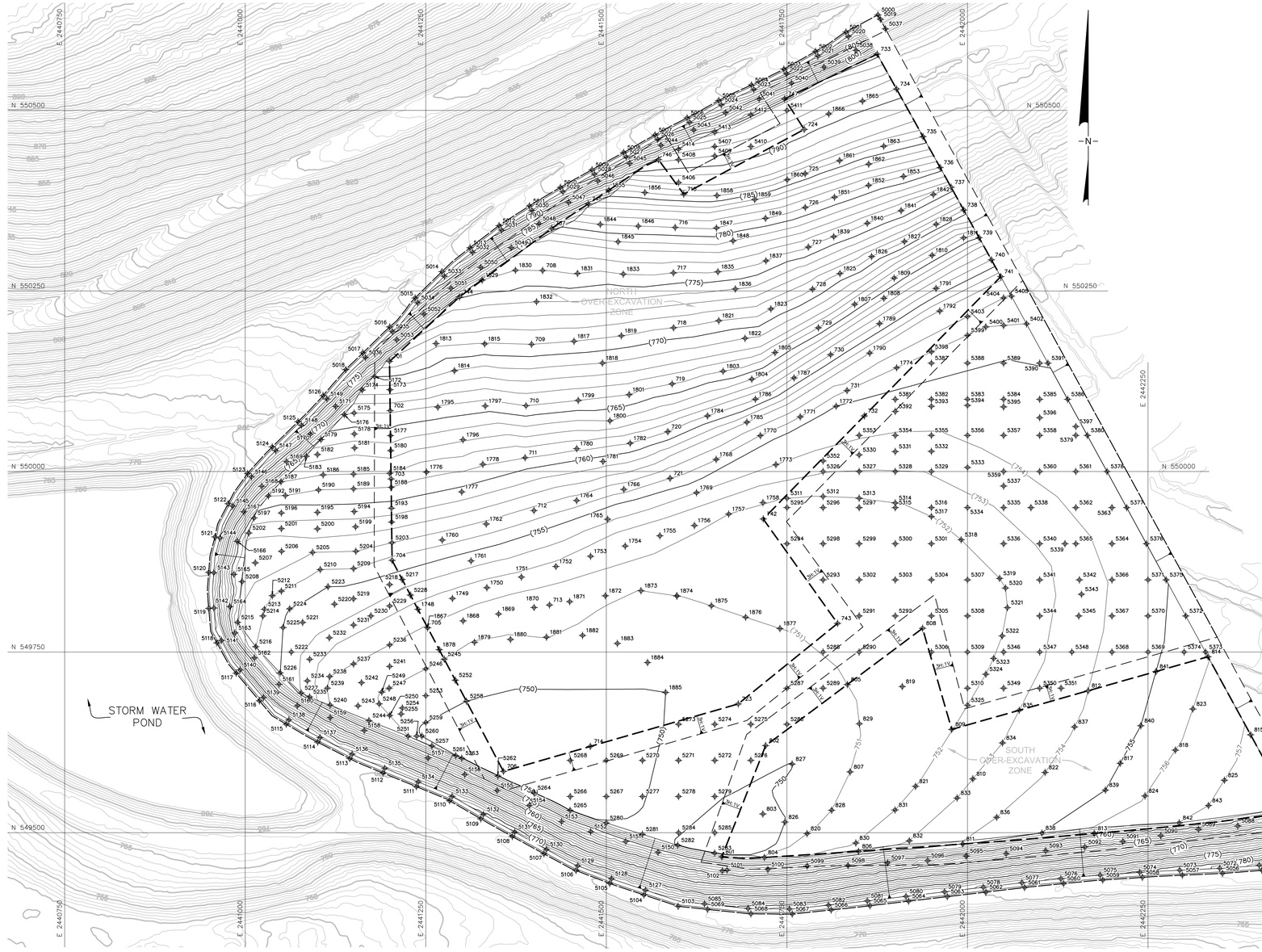
POINT NUMBER	NORTHING	EASTING	ELEVATION
4172	550119.00	2441178.00	767.00
4173	550113.19	2441290.89	766.50
4174	550113.02	2441161.87	766.78
4175	550081.02	2441150.75	764.00
4176	550079.17	2441137.16	764.08
4177	550049.72	2441201.16	762.50
4178	550051.99	2441151.13	762.50
4179	550044.36	2441104.77	762.82
4180	550028.88	2441201.43	761.50
4181	550032.63	2441151.38	761.50
4182	550023.55	2441100.00	761.50
4183	550021.34	2441084.49	761.68
4184	549997.57	2441200.00	760.00
4185	549996.45	2441150.00	760.00
4186	549995.46	2441107.87	760.00
4187	549986.01	2441049.42	760.36
4188	549978.17	2441202.08	758.84
4189	549975.98	2441150.00	759.00
4190	549974.56	2441101.56	759.00
4191	549966.69	2441055.52	759.00
4192	549966.50	2441032.10	759.16
4193	549949.18	2441202.45	757.50
4194	549944.67	2441150.89	757.50
4195	549943.40	2441100.00	757.50
4196	549942.59	2441050.00	757.50
4197	549936.22	2441012.16	757.68
4198	549930.07	2441202.70	756.50
4199	549923.42	2441152.78	756.50
4200	549920.59	2441100.00	756.50
4201	549920.90	2441050.00	756.49
4202	549915.22	2441004.85	756.60
4203	549900.41	2441203.07	755.00
4204	549889.56	2441153.22	755.00
4205	549888.07	2441093.27	755.00
4206	549889.56	2441050.32	755.50
4207	549873.59	2441013.93	755.60
4208	549847.60	2440995.37	755.84
4209	549865.67	2441150.00	754.00
4210	549864.28	2441103.90	754.00
4211	549834.41	2441050.00	754.00
4212	549828.03	2441037.48	754.00
4213	549809.38	2441026.62	754.00
4214	549800.00	2441024.49	754.00
4215	549791.08	2440989.29	755.05
4216	549757.30	2441014.43	753.94
4217	549850.58	2441217.32	752.50
4218	549843.46	2441200.00	752.50
4219	549823.87	2441149.89	752.51
4220	549816.30	2441123.61	752.50
4221	549791.03	2441079.47	752.50
4222	549750.00	2441063.74	752.50
4223	549840.49	2441114.54	753.00
4224	549809.90	2441061.59	753.00
4225	549783.96	2441052.39	753.00
4226	549721.08	2441048.12	753.05
4227	549693.29	2441077.21	752.12
4228	549828.97	2441228.72	751.50
4229	549813.81	2441200.00	751.50
4230	549800.00	2441173.83	751.50
4231	549787.42	2441150.00	751.50
4232	549769.73	2441116.46	751.53
4233	549740.04	2441089.24	751.50
4234	549710.13	2441086.02	751.50
4235	549687.83	2441088.98	751.77
4236	549759.98	2441200.00	750.00
4237	549733.59	2441150.00	750.00
4238	549716.12	2441116.90	750.00
4239	549700.00	2441113.73	750.00
4240	549676.56	2441117.09	750.12
4241	549730.18	2441200.00	749.50
4242	549707.65	2441160.94	749.50
4243	549675.54	2441156.16	749.59
4244	549654.94	2441171.23	749.74
4245	549740.26	2441275.54	749.00
4246	549726.78	2441250.00	749.00
4247	549700.00	2441199.25	749.00
4248	549678.39	2441185.44	749.00
4249	549694.64	2441189.09	749.00
4250	549662.29	2441200.00	749.00

TOP OF SUBGRADE POTENTIAL EXCAVATION ZONE-FLOOR CONTROL-DATA

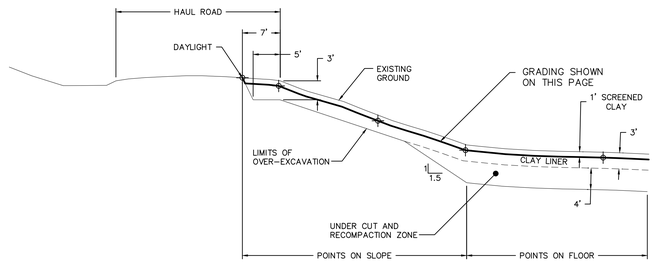
POINT NUMBER	NORTHING	EASTING	ELEVATION
4251	549633.31	2441225.36	749.01
4252	549711.17	2441290.89	748.50
4253	549689.60	2441250.00	748.50
4254	549672.51	2441217.62	748.50
4255	549664.38	2441215.80	748.50
4256	549633.73	2441237.36	748.56
4257	549619.90	2441258.34	748.73
4258	549682.09	2441306.24	748.00
4259	549652.41	2441250.00	748.00
4260	549633.73	2441244.58	748.00
4261	549606.48	2441291.30	748.12
4262	549578.59	2441349.32	748.13
4263	549602.91	2441299.73	748.12
4264	549554.96	2441399.71	748.06
4265	549530.80	2441449.26	748.12
4266	549550.00	2441450.00	748.00
4267	549550.00	2441500.00	748.00
4268	549600.00	2441550.00	748.00
4269	549600.00	2441500.00	748.00
4270	549600.00	2441550.00	748.00
4271	549600.00	2441600.00	748.27
4272	549600.00	2441650.00	748.33
4273	549650.00	2441600.00	748.18
4274	549650.00	2441650.00	748.52
4275	549650.00	2441700.00	748.40
4276	549600.00	2441700.00	748.15
4277	549550.00	2441550.00	748.00
4278	549550.00	2441600.00	748.18
4279	549550.00	2441650.00	748.06
4280	549513.24	2441499.77	748.48
4281	549497.54	2441550.79	748.72
4282	549482.33	2441598.73	748.16
4283	549471.44	2441649.87	748.12
4284	549500.00	2441600.00	748.01
4285	549500.00	2441650.00	748.00
4286	549650.00	2441750.00	748.29
4287	549700.00	2441750.00	748.56
4288	549750.00	2441800.00	749.02
4289	549700.00	2441800.00	748.76
4290	549750.00	2441850.00	749.15
4291	549800.00	2441850.00	749.31
4292	549800.00	2441900.00	749.43
4293	549850.00	2441850.00	749.40
4294	549900.00	2441750.00	749.64
4295	549950.00	2441750.00	749.93
4296	549950.00	2441800.00	749.92
4297	549950.00	2441850.00	749.94
4298	549900.00	2441800.00	749.66
4299	549900.00	2441850.00	749.71
4300	549900.00	2441900.00	749.77
4301	549900.00	2441950.00	749.88
4302	549850.00	2441850.00	749.49
4303	549850.00	2441900.00	749.59
4304	549850.00	2441950.00	749.72
4305	549800.00	2441950.00	749.58
4306	549750.00	2441950.00	749.58
4307	549850.00	2442000.00	749.87
4308	549800.00	2442000.00	749.77
4309	549750.00	2442000.00	749.81
4310	549700.00	2442000.00	749.92
4311	549962.94	2441750.00	750.00
4312	549965.39	2441800.00	750.00
4313	549962.99	2441850.00	750.00
4314	549956.51	2441900.00	750.00
4315	549950.00	2441900.00	749.97
4316	549950.00	2441950.00	750.22
4317	549937.69	2441950.00	750.00
4318	549905.53	2441991.27	750.00
4319	549852.00	2442044.55	750.00
4320	549838.69	2442052.66	750.00
4321	549811.49	2442055.26	750.00
4322	549772.43	2442048.02	750.00
4323	549741.27	2442036.18	750.00
4324	549719.36	2442025.46	750.00
4325	549676.49	2442000.00	750.00
4326	550000.00	2441800.00	751.07
4327	550000.00	2441850.00	750.97
4328	550000.00	2441900.00	750.97
4329	550000.00	2441950.00	751.07

TOP OF SUBGRADE POTENTIAL EXCAVATION ZONE-FLOOR CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
4330	550023.02	2441850.00	751.51
4331	550027.60	2441900.00	751.50
4332	550027.89	2441950.00	751.50
4333	550005.62	2442000.00	751.50
4334	549950.00	2442000.00	750.69
4335	549950.00	2442050.00	751.12
4336	549900.00	2442050.00	750.57
4337	549979.90	2442050.00	751.50
4338	549950.00	2442087.90	751.50
4339	549900.00	2442135.05	751.50
4340	549900.00	2442100.00	751.09
4341	549850.00	2442100.00	750.72
4342	549850.00	2442155.04	751.49
4343	549830.08	2442157.82	751.50
4344	549800.00	2442100.00	750.73
4345	549800.00	2442154.12	751.50
4346	549750.00	2442050.00	750.15
4347	549750.00	2442100.00	750.87
4348	549750.00	2442144.50	751.50
4349	549700.00	2442050.00	750.48
4350	549700.00	2442100.00	751.15
4351	549700.00	2442129.54	751.51
4352	550014.67	2441800.00	751.50
4353	550050.00	2441850.00	752.09
4354	550050.00	2441900.00	751.92
4355	550050.00	2441950.00	751.89
4356	550050.00	2442000.00	752.09
4357	550050.00	2442050.00	752.23
4358	550050.00	2442100.00	752.37
4359	550000.00	2442050.00	751.78
4360	550000.00	2442100.00	752.05
4361	550000.00	2442150.00	752.27
4362	549950.00	2442150.00	752.07
4363	549950.00	2442200.00	752.34
4364	549900.00	2442200.00	752.23
4365	549900.00	2442150.00	751.67
4366	549850.00	2442200.00	752.08
4367	549800.00	2442200.00	752.11
4368	549750.00	2442200.00	752.22
4369	549750.00	2442250.00	752.79
4370	549800.00	2442250.00	752.70
4371	549850.00	2442250.00	752.66
4372	549800.00	2442302.30	753.35
4373	549750.00	2442329.56	753.87
4374	549750.00	2442300.00	753.45
4375	549850.00	2442275.04	752.96
4376	549900.00	2442247.77	752.67
4377	549950.00	2442220.50	752.46
4378	550000.00	2442193.24	752.50
4379	550050.00	2442150.00	752.43
4380	550050.00	2442165.98	752.52
4381	550100.00	2441900.00	752.79
4382	550100.00	2441950.00	752.64
4383	550100.00	2442000.00	752.59
4384	550100.00	2442050.00	752.58
4385	550100.00	2442100.00	752.69
4386	550100.00	2442138.71	752.76
4387	550150.00	2441950.00	753.61
4388	550150.00	2442000.00	753.22
4389	550150.00	2442050.00	752.97
4390	550150.00	2442100.00	753.08
4391	550150.00	2442111.44	753.12
4392	550083.21	2441900.00	752.50
4393	550090.33	2441950.00	752.50
4394	550091.55	2442000.00	752.50
4395	550089.53	2442050.00	752.50
4396	550074.47	2442100.00	752.51
4397	550062.37	2442150.00	752.52
4398	550165.68	2441950.00	754.00
4399	550188.62	2442



3 — PLAN
BOTTOM OF 1 FOOT SCREENED CLAY
SCALE: 1" = 60'



GRADING KEY MAP
N.T.S.

LEGEND

- 770 — EXISTING GROUND CONTOUR (FEET) (NOTE 2)
- (760) — PROPOSED BOTTOM OF 1 FOOT SCREENED CLAY CONTOUR (FEET)
- BASE OF THE PHASE IA AREA TO BE OVER-EXCAVATED, PROOF-ROLLED, AND BACKFILLED
- LIMIT OF EXCAVATION (NOTE 3)
- LIMIT OF POTENTIAL EXCAVATION
- 8000 — CONSTRUCTION CONTROL POINT

NOTES:

1. CONTROL POINTS ARE PROVIDED OUTSIDE THE PLANNED NORTH AND SOUTH OVER EXCAVATION ZONES IN THE EVENT THAT EXCAVATION ACTIVITIES EXTEND BEYOND THE PLANNED AREAS INTO THE "POTENTIAL EXCAVATION ZONE".
2. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN AUGUST 2010. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
3. LIMIT OF EXCAVATION ASSUMES A 7 FOOT VERTICAL CUT AT THE BASE OF THE EXCAVATION AND 3H:1V SIDE SLOPES TO THE TOP OF THE EXCAVATION EXCEPT WHERE ADJACENT TO A PERIMETER BERM AND A 1.5H:1V SIDE SLOPE SHALL BE USED.

0 60' 120'
SCALE IN FEET

RO	JULY 2011	M	FML								DISCIPLINE INTERFACE
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST (X)	REV 1 2 3 4

SCALE: 1" = 60' EXCEPT AS NOTED

BOTTOM OF 1 FOOT SCREENED CLAY

GYPSUM DISPOSAL FACILITY,
PHASE IA AREA

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. ISOMOV	R.W. LOWRY					

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTODESK CIVIL 3D	DATE JULY 11	36	C	10WXXX-8	R 0

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Geosyntec consultants
1255 ROBERTS BOULEVARD, N.W., SUITE 200
KENNESAW, GEORGIA 30144 USA
PHONE: 678.202.9500

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

CONSTRUCTION DRAWINGS

GEOSYNTEC CONSULTANTS, INC. 0
TASK COMPLETED BY: REV NO.

DRAFT CONSTRUCTION DRAWINGS FOR REVIEW

L:\CAD\TVA\TENNESSEE VALLEY AUTHORITY\KINGSTON FOSSIL PLANT- CONSTRUCTION FOR GYPSUM DISPOSAL FACILITY, PHASE IA AREA (DWRS)\DWRS\10WXXX-8.DWG

BOTTOM OF 1 FOOT SCREENED CLAY NORTH OVER-EXCAVATION ZONE CONTROL DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
701	550152.49	2441199.84	771.69
702	550084.33	2441200.71	766.24
703	549989.71	2441201.93	761.62
704	549876.99	2441203.38	755.72
705	549783.72	2441252.60	751.93
706	549584.89	2441357.53	750.00
707	550336.61	2441424.49	781.11
708	550278.27	2441411.79	776.00
709	550176.09	2441396.47	771.00
710	550091.11	2441388.73	766.00
711	550019.15	2441387.50	761.03
712	549945.92	2441399.76	756.70
713	549815.23	2441421.27	751.62
714	549619.46	2441477.87	750.00
715	550384.05	2441607.11	786.26
716	550337.88	2441595.26	781.00
717	550275.05	2441592.89	776.00
718	550199.00	2441593.00	771.00
719	550121.34	2441591.05	766.00
720	550055.15	2441585.01	761.00
721	549990.66	2441588.28	756.00
722	549827.78	2441597.75	751.00
723	549678.25	2441682.60	750.37
724	550473.69	2441774.01	790.59
725	550412.43	2441775.21	786.00
726	550365.56	2441775.38	781.00
727	550310.73	2441779.69	776.00
728	550252.43	2441785.44	771.00
729	550199.03	2441793.56	766.00
730	550161.75	2441810.42	761.00
731	550112.10	2441833.20	756.00
732	550076.99	2441857.11	754.56
733	550577.92	2441874.94	796.34
734	550529.70	2441901.73	791.00
735	550463.70	2441938.40	786.00
736	550420.90	2441962.17	781.00
737	550393.56	2441977.36	776.00
738	550362.07	2441994.86	771.00
739	550323.75	2442016.14	765.00
740	550293.16	2442033.14	761.00
741	550269.80	2442046.11	758.44
742	549934.31	2441717.25	751.86
743	549789.73	2441820.14	751.67
744	550241.72	2441298.68	775.10
745	550370.56	2441474.95	784.41
746	550431.77	2441572.20	791.10
747	550515.97	2441746.82	795.92
748	549809.19	2441239.16	752.71
749	549824.24	2441286.84	752.64
750	549839.10	2441334.58	752.60
751	549853.88	2441382.35	752.72
752	549868.49	2441430.16	752.76
753	549882.66	2441478.11	752.61
754	549896.84	2441526.06	752.51
755	549911.01	2441574.01	752.50
756	549925.26	2441621.93	752.31
757	549941.07	2441669.37	752.00
758	549956.87	2441716.81	752.41
760	549905.15	2441272.80	756.38
761	549876.21	2441312.66	754.40
762	549927.36	2441333.71	756.76
764	549959.82	2441458.85	756.56
765	549933.89	2441501.74	754.22
766	549975.19	2441524.27	756.33
768	550016.69	2441652.03	756.00
769	549970.65	2441624.86	754.00
770	550049.73	2441713.24	756.00
771	550075.75	2441768.46	756.00
772	550090.44	2441818.22	755.00
773	550009.50	2441734.72	754.00
774	550143.64	2441901.96	756.00
776	549999.24	2441250.97	761.33
777	549971.83	2441299.77	759.66
778	550010.00	2441329.01	761.10
780	550031.62	2441458.96	761.18
781	550013.95	2441495.38	759.50
782	550039.09	2441532.97	761.00
784	550077.01	2441640.04	761.00
785	550068.21	2441694.54	758.00

BOTTOM OF 1 FOOT SCREENED CLAY NORTH OVER-EXCAVATION ZONE CONTROL DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
1786	550100.13	2441706.36	761.00
1787	550129.57	2441759.83	761.00
1789	550204.70	2441878.22	761.00
1790	550164.06	2441864.62	758.00
1791	550253.47	2441956.45	761.00
1792	550222.26	2441961.65	758.00
1795	550089.08	2442266.62	765.90
1796	550043.89	2441301.50	763.10
1797	550090.76	2441332.41	765.51
1799	550098.42	2441461.09	766.00
1800	550070.25	2441504.88	764.00
1801	550106.40	2441531.55	766.00
1803	550138.83	2441661.64	766.00
1804	550127.79	2441701.32	764.00
1805	550164.72	2441733.52	766.00
1807	550231.53	2441843.83	766.00
1808	550239.89	2441884.37	764.00
1809	550267.95	2441898.54	766.00
1810	550293.33	2441951.07	766.00
1811	550323.62	2441994.73	766.00
1813	550177.10	2441264.21	771.33
1814	550139.48	2441289.62	768.97
1815	550176.58	2441331.56	770.93
1817	550180.27	2441455.23	771.00
1818	550150.10	2441494.59	769.00
1819	550187.88	2441520.74	771.00
1821	550208.80	2441655.60	771.00
1822	550184.46	2441692.07	769.00
1823	550225.08	2441727.84	771.00
1825	550274.11	2441823.41	771.00
1826	550297.66	2441867.29	771.00
1827	550318.36	2441912.77	771.00
1828	550342.29	2441956.66	771.00
1829	550264.92	2441327.93	776.00
1830	550278.58	2441374.21	776.00
1831	550274.19	2441460.10	776.00
1832	550235.06	2441403.29	774.00
1833	550273.27	2441523.42	776.00
1835	550276.52	2441654.42	776.00
1836	550252.70	2441678.66	774.00
1837	550291.74	2441720.99	776.00
1839	550325.18	2441814.86	776.00
1840	550343.68	2441861.28	776.00
1841	550361.18	2441908.10	776.00
1842	550383.50	2441952.81	776.00
1844	550342.09	2441491.53	781.00
1845	550318.15	2441516.22	779.00
1846	550339.69	2441544.14	781.00
1847	550337.26	2441652.41	781.00
1848	550319.41	2441675.41	779.00
1849	550350.64	2441720.30	781.00
1851	550379.77	2441815.80	781.00
1852	550396.10	2441863.05	781.00
1853	550408.52	2441911.46	781.00
1855	550389.54	2441503.48	786.00
1856	550386.16	2441553.34	786.00
1858	550382.07	2441653.12	786.00
1859	550376.60	2441705.48	784.00
1860	550404.00	2441750.34	786.00
1861	550430.49	2441822.90	786.00
1862	550425.56	2441863.23	784.00
1863	550450.45	2441884.09	786.00
1865	550512.89	2441854.64	791.00
1866	550495.13	2441807.98	791.00
1867	549783.72	2441252.60	751.93
1868	549793.23	2441301.69	751.69
1869	549802.74	2441350.78	751.59
1870	549811.72	2441399.96	751.63
1871	549819.84	2441449.29	751.53
1872	549827.96	2441498.63	751.28
1873	549834.93	2441547.98	751.00
1874	549827.82	2441597.47	751.00
1875	549814.13	2441645.47	751.00
1876	549798.25	2441692.88	751.00
1877	549782.66	2441740.39	751.00
1878	549753.30	2441268.65	751.28
1879	549763.66	2441317.43	750.98
1880	549767.53	2441367.28	750.91
1881	549770.70	2441417.18	751.00

BOTTOM OF 1 FOOT SCREENED CLAY NORTH OVER-EXCAVATION ZONE CONTROL DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
1882	549773.03	2441467.05	750.82
1883	549761.89	2441515.26	750.54
1884	549735.54	2441557.05	750.67
1885	549694.12	2441582.07	750.00

BOTTOM OF 1 FOOT SCREENED CLAY SOUTH OVER-EXCAVATION ZONE CONTROL DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
801	549466.59	2441659.90	751.03
802	549620.50	2441720.57	750.15
803	549525.88	2441716.79	750.20
804	549465.61	2441718.84	751.42
805	549705.07	2441833.68	751.00
806	549474.16	2441849.11	752.90
807	549584.10	2441837.53	751.00
808	549782.92	2441937.82	751.56
809	549642.97	2441978.21	751.99
810	549574.46	2442007.43	753.00
811	549484.26	2441993.34	755.31
812	549696.49	2442167.01	754.00
813	549498.63	2442175.55	758.88
814	549743.57	2442333.07	755.95
815	549635.58	2442392.03	757.19
816	549528.66	2442450.41	760.90
817	549596.09	2442211.44	755.00
818	549614.22	2442287.94	756.00
819	549702.22	2441909.70	751.43
820	549498.66	2441777.95	751.00
821	549564.14	2441928.16	752.00
822	549583.38	2442107.40	754.00
823	549671.25	2442312.00	756.00
824	549550.84	2442245.76	756.00
825	549572.53	2442355.66	757.00
826	549514.62	2441747.24	750.00
827	549594.91	2441757.19	750.00
828	549531.06	2441811.95	751.00
829	549650.77	2441850.32	751.00
830	549485.65	2441845.48	752.00
831	549531.31	2441899.77	752.00
832	549488.80	2441919.44	753.00
833	549547.98	2441985.60	753.00
834	549624.29	2442048.52	753.00
835	549669.46	2442071.68	753.00
836	549521.29	2442040.38	754.00
837	549646.40	2442148.23	754.00
838	549499.46	2442103.09	755.09
839	549559.00	2442191.03	755.00
840	549648.03	2442240.01	755.00
841	549723.16	2442261.06	755.00
842	549513.57	2442293.07	757.09
843	549537.54	2442333.75	757.14
844	549529.33	2442412.63	758.09
845	549573.66	2442425.84	758.00

BOTTOM OF 1 FOOT SCREENED CLAY POTENTIAL EXCAVATION ZONE-SLOPE CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
5019	550626.16	2441879.43	810.66
5020	550602.32	2441835.16	809.96
5021	550575.41	2441792.88	807.95
5022	550551.05	2441749.21	805.99
5023	550529.01	2441704.28	804.36
5024	550507.53	2441659.04	803.04
5025	550483.40	2441615.25	801.50
5026	550460.03	2441571.04	799.95
5027	550435.58	2441527.42	797.16
5028	550411.67	2441483.51	795.96
5029	550387.28	2441439.86	793.96
5030	550361.53	2441396.95	792.24
5031	550334.27	2441354.86	790.96
5032	550303.65	2441314.78	788.99
5033	550270.36	2441275.81	786.97
5034	550233.75	2441238.82	784.08
5035	550193.83	2441203.64	781.05
5036	550157.81	2441166.33	779.30
5037	550612.85	2441886.36	805.97
5038	550583.23	2441845.57	802.66
5039	550559.91	2441801.33	801.61
5040	550537.72	2441756.44	800.51
5041	550515.75	2441711.51	799.65
5042	550496.56	2441665.02	799.92
5043	550472.85	2441621.00	797.66
5044	550451.68	2441575.59	797.07
5045	550426.46	2441532.40	794.06
5046	550402.38	2441488.31	792.88
5047	550372.63	2441447.85	789.05
5048	550343.14	2441406.98	785.35
5049	550309.95	2441368.13	781.20
5050	550282.69	2441328.04	781.06
5051	550253.74	2441284.88	780.83
5052	550217.88	2441247.48	778.56
5053	550182.18	2441209.99	776.76
5070	549461.03	2442457.50	782.96
5071	549454.71	2442404.00	782.63
5072	549450.51	2442349.34	781.74
5073	549447.94	2442293.79	780.96
5074	549444.91	2442238.49	780.22
5075	549441.18	2442183.57	779.96
5076	549436.19	2442129.34	779.26
5077	549430.64	2442075.42	778.95
5078	549424.36	2442021.89	778.34
5079	549418.07	2441968.37	777.95
5080	549411.79	2441914.85	777.95
5081	549405.50	2441861.32	777.92
5082	549399.65	2441807.56	777.07
5083	549394.28	2441753.54	776.72
5084	549394.96	2441696.22	775.81
5085	549401.32	2441635.80	774.96
5086	549511.90	2442451.64	766.53
5087	549510.31	2442430.63	765.73
5088	549509.25	2442374.26	762.13
5089	549504.51	2442319.89	761.12
5090	549495.77	2442267.72	762.94
5091	549487.79	2442215.11	764.08
5092	549480.01	2442162.40	764.97
5093	549475.00	2442108.19	764.27
5094	549470.84	2442053.50	763.27
5095	549467.56	2441998.33	761.32
5096	549461.29	2441944.80	762.10
5097	549458.27	2441889.50	760.60
5098	549454.46	2441834.63	759.50
5099	549453.71	2441778.08	757.08
5100	549449.10	2441723.65	757.01
5101	549448.21	2441667.18	757.73
5102	549447.20	2441660.61	758.29
5127	549420.45	2441554.23	773.95
5128	549436.29	2441507.15	773.62
5129	549454.19	2441460.47	772.80
5130	549476.86	2441417.02	772.10
5131	549500.86	2441373.18	771.17
5132	549525.25	2441329.70	770.22
5133	549550.29	2441286.43	769.08
5134	549570.24	2441239.59	768.50
5135	549589.18	2441193.31	768.23
5136	549608.78	2441148.01	767.43
5137	549631.63	2441103.53	767.21

BOTTOM OF 1 FOOT SCREENED CLAY POTENTIAL EXCAVATION ZONE-SLOPE CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
5138	549656.16	2441060.48	767.63
5139	549687.03	2441025.07	767.95
5140	549725.25	2440992.84	767.95
5141	549766.18	2440966.97	767.18
5142	549811.06	2440956.58	767.21
5143	549859.80	2440956.46	768.21
5144	549908.06	2440965.00	769.91
5145	549952.25	2440982.57	771.52
5146	549992.60	2441008.63	772.73
5147	550029.02	2441042.27	774.08
5148	550064.02	2441078.00	775.45
5149	550100.50	2441113.07	777.14
5150	549472.86	2441551.76	755.89
5151	549487.73	2441526.88	755.55
5152	549501.31	2441498.41	756.65
5153	549515.24	2441437.98	757.55
5154	549537.78	2441393.51	756.98
5155	549558.26	2441348.81	757.50
5156	549580.45	2441303.88	757.27
5157	549603.48	2441253.19	756.70
5158	549641.44	2441164.79	756.34
5159	549659.21	2441117.70	757.71
5160	549675.69	2441072.08	760.99
5161	549705.40	2441046.85	757.74
5162	549741.96	2441012.65	758.38
5163	549776.45	2440985.64	759.05
5164	549812.89	2440978.84	760.48
5165	549857.64	2440984.42	759.35
5166	549903.44	2440988.94	760.80
5167	549944.29	2440997.95	765.40
5168	549979.65	2441022.79	766.34
5169	550013.76	2441057.18	767.78
5170	550051.73	2441090.12	769.90
5171	550090.18	2441125.20	771.98

BOTTOM OF 1 FOOT SCREENED CLAY POTENTIAL EXCAVATION ZONE-FLOOR CONTROL-DATA

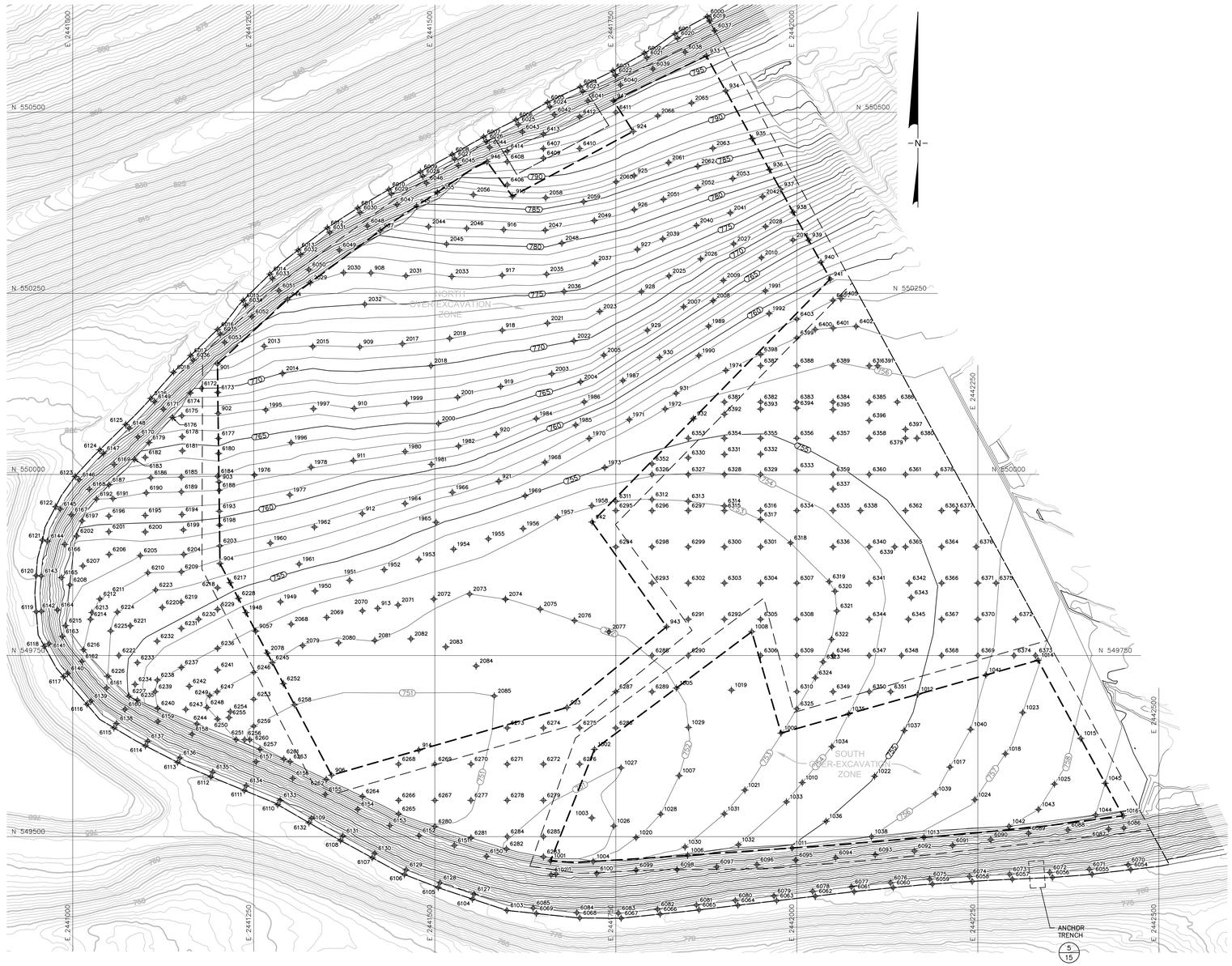
POINT NUMBER	NORTHING	EASTING	ELEVATION
5172	5501.31.36	2441179.20	768.95
5173	550113.19	2441200.34	768.50
5174	550112.83	2441161.98	768.87
5175	550081.02	2441150.75	766.00
5176	550078.76	2441137.06	766.10
5177	550049.72	2441201.16	764.50
5178	550051.99	2441151.13	764.45
5179	550044.20	2441104.90	764.91
5180	550028.88	2441201.43	763.45
5181	550032.63	2441151.38	763.50
5182	550023.55	2441100.00	763.45
5183	550021.14	2441084.59	763.76
5184	549997.57	2441200.00	762.00
5185	549996.45	2441150.00	762.00
5186	549995.46	2441107.87	761.95
5187	549985.84	2441049.52	762.21
5188	549978.17	2441202.08	761.00
5189	549975.98	2441150.00	761.00
5190	549974.56	2441101.56	761.00
5191	549966.69	2441055.52	760.95
5192	549966.20	2441032.10	761.17
5193	549949.18	2441202.45	759.50
5194	549944.67	2441150.89	759.50
5195	549943.40	2441100.00	759.50
5196	549942.59	2441050.00	759.45
5197	549935.70	2441012.17	759.75
5198	549930.07	2441202.70	758.50
5199	549923.42	2441152.78	758.50
5200	549920.59	2441100.00	758.50
5201	549920.90	2441050.00	758.44
5202	549914.96	2441004.98	758.68
5203	549901.41	2441203.07	757.00
5204	549889.56	2441153.22	757.00
5205	549888.07	2441093.27	757.00
5206	549889.56	2441050.32	757.45
5207	549873.59	2441013.93	757.55
5208	549847.57	2440995.57	757.94
5209	549865.67	2441150.00	756.00
5210	549864.28	2441103.90	756.00
5211	549834.41	2441050.00	756.00
5212	549828.03	2441037.48	756.00
5213	549809.38	2441026.62	756.00
5214	549800.00	2441024.49	755.95
5215	549791.14	2440989.50	757.10
5216	549757.44	2441014.57	756.02
5217	549850.58	2441217.32	754.45
5218	549843.46	2441200.00	754.50
5219	549823.87	2441149.89	754.51
5220	549816.30	2441123.61	754.50
5221	549791.03	2441079.47	754.50
5222	549750.00	2441063.74	754.50
5223	549840.49	2441114.54	755.00
5224	549809.90	2441061.59	755.00
5225	549783.96	2441052.39	755.00
5226	549721.23	2441048.25	755.10
5227	549693.43	2441077.35	754.16
5228	549828.97	2441228.72	753.50
5229	549813.81	2441200.00	753.50
5230	549800.00	2441173.83	753.50
5231	549787.42	2441150.00	753.50
5232	549769.73	2441116.46	753.48
5233	549740.04	2441089.24	753.50
5234	549710.13	2441086.02	753.50
5235	549687.99	2441089.11	753.86
5236	549759.98	2441200.00	752.00
5237	549733.59	2441150.00	752.00
5238	549716.12	2441116.90	752.00
5239	549700.00	2441113.73	752.00
5240	549676.63	2441117.51	752.13
5241	549730.18	2441200.00	751.50
5242	549707.65	2441160.94	751.45
5243	549675.54	2441156.16	751.54
5244	549655.12	2441171.30	751.84
5245	549740.26	2441275.54	751.00
5246	549726.78	2441250.00	751.00
5247	549700.00	2441199.25	751.00
5248	549678.39	2441185.44	751.00
5249	549694.64	2441189.09	751.00
5250	549662.29	2441200.00	751.00

BOTTOM OF 1 FOOT SCREENED CLAY POTENTIAL EXCAVATION ZONE-FLOOR CONTROL-DATA

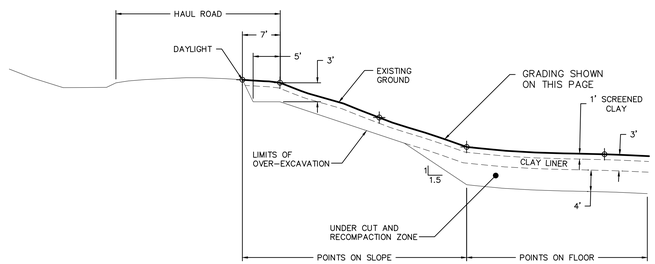
POINT NUMBER	NORTHING	EASTING	ELEVATION
5251	549633.50	2441225.43	751.07
5252	549711.17	2441290.89	750.50
5253	549689.60	2441250.00	750.50
5254	549672.51	2441217.62	750.50
5255	549664.38	2441215.80	750.45
5256	549633.73	2441237.36	750.51
5257	549620.07	2441258.45	750.80
5258	549682.09	2441306.24	750.00
5259	549652.41	2441250.00	750.00
5260	549633.73	2441244.58	750.00
5261	549606.67	2441291.38	750.20
5262	549578.58	2441349.79	750.16
5263	549603.09	2441299.80	750.15
5264	549555.13	2441399.81	750.09
5265	549530.82	2441449.80	750.15
5266	549550.00	2441450.00	750.00
5267	549550.00	2441500.00	750.00
5268	549600.00	2441450.00	750.00
5269	549600.00	2441500.00	750.00
5270	549600.00	2441550.00	750.48
5271	549600.00	2441600.00	750.27
5272	549600.00	2441650.00	750.33
5273	549650.00	2441600.00	750.18
5274	549650.00	2441650.00	750.52
5275	549650.00	2441700.00	750.40
5276	549600.00	2441700.00	750.15
5277	549550.00	2441550.00	750.00
5278	549550.00	2441600.00	750.18
5279	549550.00	2441650.00	750.06
5280	549513.41	2441499.89	750.56
5281	549497.73	2441549.85	750.82
5282	549482.54	2441598.73	750.19
5283	549471.63	2441649.91	750.15
5284	549500.00	2441600.00	750.01
5285	549500.00	2441650.00	750.00
5286	549650.00	2441750.00	750.29
5287	549700.00	2441750.00	750.56
5288	549750.00	2441800.00	751.02
5289	549700.00	2441800.00	750.76
5290	549750.00	2441850.00	751.15
5291	549800.00	2441850.00	751.31
5292	549800.00	2441900.00	751.43
5293	549850.00	2441800.00	751.40
5294	549900.00	2441750.00	751.64
5295	549950.00	2441750.00	751.93
5296	549950.00	2441800.00	751.92
5297	549950.00	2441850.00	751.94
5298	549900.00	2441800.00	751.66
5299	549900.00	2441850.00	751.71
5300	549900.00	2441900.00	751.77
5301	549900.00	2441950.00	751.88
5302	549850.00	2441850.00	751.49
5303	549850.00	2441900.00	751.59
5304	549850.00	2441950.00	751.72
5305	549800.00	2441950.00	751.58
5306	549750.00	2441950.00	751.58
5307	549850.00	2442000.00	751.87
5308	549800.00	2442000.00	751.77
5309	549750.00	2442000.00	751.81
5310	549700.00	2442000.00	751.92
5311	549962.94	2441750.00	752.00
5312	549965.39	2441800.00	752.00
5313	549962.99	2441850.00	752.00
5314	549956.51	2441900.00	752.00
5315	549950.00	2441900.00	751.97
5316	549950.00	2441950.00	752.22
5317	549937.69	2441950.00	752.00
5318	549905.53	2441991.27	752.00
5319	549852.00	2442044.55	752.00
5320	549838.69	2442052.66	752.00
5321	549811.49	2442055.26	752.00
5322	549772.43	2442048.02	752.00
5323	549741.27	2442036.18	752.00
5324	549719.36	2442025.46	752.00
5325	549676.49	2442000.00	752.00
5326	550000.00	2441800.00	753.07
5327	550000.00	2441850.00	752.97
5328	550000.00	2441900.00	752.97
5329	550000.00	2441950.00	753.07

BOTTOM OF 1 FOOT SCREENED CLAY POTENTIAL EXCAVATION ZONE-FLOOR CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
5330	550023.02	2441850.00	753.51
5331	550027.60	2441900.00	753.50
5332	550027.89	2441950.00	753.50
5333	550005.62	2442000.00	753.50
5334	549950.00	2442000.00	752.69
5335	549950.00	2442050.00	753.12
5336	549900.00	2442050.00	752.57
5337	549979.90	2442050.00	753.50
5338	549950.00	2442087.90	753.50
5339	549900.00	2442135.05	753.50
5340	549900.00	2442100.00	753.09
5341	549850.00	2442100.00	752.72
5342	549850.00	2442155.04	753.49
5343	549830.08	2442157.82	753.50
5344	549800.00	2442100.00	752.73
5345	549800.00	2442154.12	753.50
5346	549750.00	2442050.00	752.15
5347	549750.00	2442100.00	752.87
5348	549750.00	2442144.50	753.50
5349	549700.00	2442050.00	752.48
5350	549700.00	2442100.00	753.15
5351	549700.00	2442129.54	753.51
5352	550014.67	2441800.00	753.50
5353	550050.00	2441850.00	754.09
5354	550050.00	2441900.00	753.92
5355	550050.00	2441950.00	753.89
5356	550050.00	2442000.00	754.09
5357	550050.00	2442050.00	754.23
5358	550050.00	2442100.00	754.37
5359	550000.00	2442050.00	753.78
5360	550000.00	2442100.00	754.09
5361	550000.00	2442150.00	754.27
5362	549950.00	2442150.00	754.07
5363	549950.00	2442200.00	754.34
5364	549900.00	2442200.00	754.23
5365	549900.00	2442150.00	753.67
5366	549850.00	2442200.00	754.08
5367	549800.00	2442200.00	754.11
5368	549750.00	2442200.00	754.22
5369	549750.00	2442250.00	754.79
5370	549800.00	2442250.00	754.70
5371	549850.00	2442250.00	754.66
5372	549800.00	2442302.30	755.35
5373	549750.00	2442329.56	755.87
5374	549750.00	2442300.00	755.45
5375	549850.00	2442275.04	754.96
5376	549900.00	2442247.77	754.67
5377	549950.00	2442220.50	754.46
5378	550000.00	2442193.24	754.50
5379	550050.00	2442165.98	754.52
5380	550050.00	2442165.98	754.52
5381	550100.00	2441900.00	754.79
5382	550100.00	2441950.00	754.64
5383	550100.00	2442000.00	754.59
5384	550100.00	2442050.00	754.58
5385	550100.00	2442100.00	754.69
5386	550100.00	2442138.71	754.76
5387	550150.00	2441950.00	755.61
5388	550150.00	2442000.00	755.22
5389	550150.00	2442050.00	754.97
5390	550150.00	2442100.00	755.08
5391	550150.00	2442111.44	755.12
5392	550083.21	2441900.00	754.50
5393	550090.33	2441950.00	754.50
5394	550091.55	2442000.00	754.50
5395	550089.53	2442050.00	754.



4 — PLAN
TOP OF 1 FOOT SCREENED CLAY
SCALE: 1" = 60'



GRADING KEY MAP
N.T.S.

LEGEND

- 770 — EXISTING GROUND CONTOUR (FEET) (NOTE 2)
- (760) — PROPOSED TOP OF 1 FOOT SCREENED CLAY CONTOUR (FEET)
- BASE OF THE PHASE IA AREA TO BE OVER-EXCAVATED, PROOF-ROLLED, AND BACKFILLED
- LIMIT OF EXCAVATION (NOTE 3)

NOTES:

1. CONTROL POINTS ARE PROVIDED OUTSIDE THE PLANNED NORTH AND SOUTH OVER EXCAVATION AREAS IN THE EVENT THAT EXCAVATION ACTIVITIES EXTEND BEYOND THE PLANNED AREAS INTO THE "POTENTIAL EXCAVATION ZONE".
2. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN AUGUST 2010. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
3. LIMIT OF EXCAVATION ASSUMES A 7 FOOT VERTICAL CUT AT THE BASE OF THE EXCAVATION AND 3H:1V SIDE SLOPES TO THE TOP OF THE EXCAVATION EXCEPT WHERE ADJACENT TO A PERIMETER BERM AND A 1.5H:1V SIDE SLOPE SHALL BE USED.

0 60' 120'
SCALE IN FEET

RO	JULY 2011	M	FWL								DISCIPLINE INTERFACE
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV 1 2 3 4

SCALE: 1" = 60' EXCEPT AS NOTED

Geosyntec consultants
1255 ROBERTS BOULEVARD, N.W., SUITE 200
KENNESAW, GEORGIA 30144 USA
PHONE: 678.202.9500

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

TOP OF 1 FOOT SCREENED CLAY

GYPSUM DISPOSAL FACILITY, PHASE IA AREA

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. ISOMEN	R.W. LOWRY					

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

CONSTRUCTION DRAWINGS

AUTODESK CIVIL 3D	DATE JULY 11	36	C	10WXXX-10	R 0

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

DRAFT CONSTRUCTION DRAWINGS FOR REVIEW

GEOSYNTEC CONSULTANTS, INC.	0
TASK COMPLETED BY:	REV NO.

L:\CAD\TVA\TENNESSEE VALLEY AUTHORITY\KINGSTON FOSSIL PLANT- CONSTRUCTION FOR GYPSUM DISPOSAL FACILITY, PHASE IA AREA (DWRS)\DWRS\10WXXX-10.DWG

TOP OF 1 FOOT SCREEN CLAY NORTH OVER-EXCAVATION ZONE CONTROL DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
901	550152.49	2441199.84	772.69
902	550084.33	2441200.71	767.24
903	549989.71	2441201.93	762.62
904	549876.99	2441203.38	756.72
905	549783.72	2441252.60	752.93
906	549584.89	2441357.53	751.00
907	550336.61	2441424.49	782.11
908	550278.27	2441411.79	777.00
909	550176.09	2441396.47	772.00
910	550091.11	2441388.73	767.00
911	550019.15	2441387.50	762.03
912	549945.92	2441399.76	757.70
913	549815.23	2441421.27	752.62
914	549619.46	2441477.87	751.00
915	550384.05	2441607.11	787.26
916	550337.88	2441595.26	782.00
917	550275.05	2441592.89	777.00
918	550199.00	2441593.00	772.00
919	550121.34	2441591.05	767.00
920	550055.15	2441585.01	762.00
921	549990.66	2441588.28	757.00
922	549827.78	2441597.75	752.00
923	549678.25	2441682.60	751.37
924	550473.69	2441774.01	791.59
925	550412.43	2441775.21	787.00
926	550365.56	2441775.38	782.00
927	550310.73	2441779.69	777.00
928	550252.43	2441785.44	772.00
929	550199.03	2441793.56	767.00
930	550161.75	2441810.42	762.00
931	550112.10	2441833.20	757.00
932	549857.11	2441855.56	752.00
933	550577.92	2441874.94	797.34
934	550529.70	2441901.73	792.00
935	550463.70	2441938.40	787.00
936	550420.90	2441962.17	782.00
937	550393.56	2441977.36	777.00
938	550362.07	2441994.86	772.00
939	550323.75	2442016.14	766.00
940	550293.16	2442033.14	762.00
941	550269.80	2442046.11	759.44
942	549934.31	2441717.25	752.86
943	549789.73	2441820.14	752.67
944	550241.72	2441296.68	776.10
945	550370.56	2441474.95	785.41
946	550431.77	2441572.20	792.10
947	550515.97	2441746.82	796.92
948	549809.19	2441239.16	753.71
949	549824.24	2441286.84	753.64
950	549839.10	2441334.58	753.60
951	549853.88	2441382.35	753.72
952	549868.49	2441430.16	753.76
953	549882.66	2441478.11	753.61
954	549896.84	2441526.06	753.51
955	549911.01	2441574.01	753.50
956	549925.26	2441621.93	753.31
957	549941.07	2441669.37	753.00
958	549956.87	2441716.81	753.41
960	549905.15	2441272.80	757.38
961	549876.21	2441312.66	755.40
962	549927.36	2441333.71	757.76
964	549959.82	2441458.85	757.56
965	549933.89	2441501.74	755.22
966	549975.19	2441524.27	757.33
968	550016.69	2441652.03	757.00
969	549970.65	2441624.86	755.00
970	550049.73	2441713.24	757.00
971	550075.75	2441768.46	757.00
972	550090.44	2441818.22	756.00
973	550009.50	2441734.72	755.00
974	550143.64	2441901.96	757.00
976	549999.24	2441250.97	762.33
977	549971.83	2441299.77	760.66
978	550010.00	2441329.01	762.10
980	550031.62	2441458.96	762.18
981	550013.95	2441495.38	760.50
982	550039.09	2441532.97	762.00
984	550077.01	2441640.04	762.00
985	550068.21	2441694.54	759.00

TOP OF 1 FOOT SCREEN CLAY NORTH OVER-EXCAVATION ZONE CONTROL DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
1986	550100.13	2441706.36	762.00
1987	550129.57	2441759.83	762.00
1989	550204.70	2441878.22	762.00
1990	550164.06	2441864.62	759.00
1991	550253.47	2441956.45	762.00
1992	550222.26	2441961.65	759.00
1995	550089.08	2441266.62	766.90
1996	550043.89	2441301.50	764.10
1997	550090.76	2441332.41	766.51
1999	550098.42	2441461.09	767.00
2000	550070.25	2441504.88	765.00
2001	550106.40	2441531.55	767.00
2003	550138.83	2441661.64	767.00
2004	550127.79	2441701.32	765.00
2005	550164.72	2441733.52	767.00
2007	550231.53	2441843.83	767.00
2008	550239.89	2441884.37	765.00
2009	550267.95	2441898.54	767.00
2010	550299.33	2441951.07	767.00
2011	550323.62	2441994.73	767.00
2013	550177.10	2441264.21	772.33
2014	550139.48	2441289.62	769.97
2015	550176.58	2441331.56	771.93
2017	550180.27	2441455.23	772.00
2018	550150.10	2441494.59	770.00
2019	550187.88	2441520.74	772.00
2021	550208.80	2441655.60	772.00
2022	550184.46	2441692.07	770.00
2023	550225.08	2441727.84	772.00
2025	550274.11	2441823.41	772.00
2026	550297.66	2441867.29	772.00
2027	550339.36	2441914.77	772.00
2028	550342.29	2441956.66	772.00
2029	550264.92	2441327.93	777.00
2030	550278.58	2441374.21	777.00
2031	550274.19	2441460.10	777.00
2032	550235.06	2441403.29	775.00
2033	550273.27	2441523.42	777.00
2035	550276.52	2441654.42	777.00
2036	550252.70	2441678.66	775.00
2037	550291.74	2441720.99	777.00
2039	550325.18	2441814.86	777.00
2040	550343.68	2441861.28	777.00
2041	550361.18	2441908.10	777.00
2042	550383.50	2441952.81	777.00
2044	550342.09	2441491.53	782.00
2045	550318.15	2441516.22	780.00
2046	550339.69	2441544.14	782.00
2047	550337.26	2441652.41	782.00
2048	550319.41	2441675.41	780.00
2049	550350.64	2441720.30	782.00
2051	550379.77	2441815.80	782.00
2052	550396.10	2441863.05	782.00
2053	550408.52	2441911.46	782.00
2055	550389.54	2441503.48	787.00
2056	550386.16	2441553.34	787.00
2058	550382.07	2441653.12	787.00
2059	550376.60	2441705.48	785.00
2060	550404.00	2441750.34	787.00
2061	550430.49	2441822.90	787.00
2062	550425.56	2441863.23	785.00
2063	550450.45	2441884.09	787.00
2065	550512.89	2441854.64	792.00
2066	550495.13	2441807.98	792.00
2067	549783.72	2441252.60	752.93
2068	549793.23	2441301.69	752.69
2069	549802.74	2441350.78	752.59
2070	549811.72	2441399.96	752.63
2071	549819.84	2441449.29	752.53
2072	549827.96	2441498.63	752.28
2073	549834.93	2441547.98	752.00
2074	549827.82	2441597.47	752.00
2075	549814.13	2441645.47	752.00
2076	549798.25	2441692.88	752.00
2077	549782.66	2441740.39	752.00
2078	549753.30	2441268.65	752.28
2079	549763.66	2441317.43	751.98
2080	549767.53	2441367.28	751.91
2081	549770.70	2441417.18	752.00

TOP OF 1 FOOT SCREEN CLAY NORTH OVER-EXCAVATION ZONE CONTROL DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
2082	549773.03	2441467.05	751.82
2083	549761.89	2441515.26	751.54
2084	549735.54	2441557.05	751.67
2085	549694.12	2441582.07	751.00

TOP 1 FOOT SCREEN CLAY SOUTH OVER-EXCAVATION ZONE CONTROL DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
1001	549466.59	2441659.90	752.03
1002	549620.50	2441720.57	751.15
1003	549525.88	2441716.79	751.20
1004	549465.61	2441718.84	752.42
1005	549705.07	2441833.68	752.00
1006	549474.16	2441849.11	753.90
1007	549584.10	2441837.53	752.00
1008	549782.92	2441937.82	752.56
1009	549642.97	2441978.21	752.99
1010	549574.46	2442007.43	754.00
1011	549484.26	2441993.34	756.31
1012	549696.49	2442167.01	755.00
1013	549498.93	2442175.55	759.88
1014	549743.57	2442333.07	756.95
1015	549635.58	2442392.03	758.19
1016	549528.66	2442450.41	761.90
1017	549596.09	2442211.44	756.00
1018	549614.22	2442287.94	757.00
1019	549702.22	2441909.70	752.43
1020	549498.66	2441777.95	752.00
1021	549564.14	2441928.16	753.00
1022	549583.38	2442107.40	755.00
1023	549671.25	2442312.00	757.00
1024	549550.84	2442245.76	757.00
1025	549572.53	2442355.66	758.00
1026	549514.62	2441747.24	751.00
1027	549594.91	2441757.19	751.00
1028	549531.06	2441811.95	752.00
1029	549650.77	2441850.32	752.00
1030	549485.65	2441845.48	753.00
1031	549531.31	2441899.77	753.00
1032	549488.80	2441919.44	754.00
1033	549547.98	2441985.60	754.00
1034	549624.29	2442048.52	754.00
1035	549669.46	2442071.68	754.00
1036	549521.29	2442040.38	755.00
1037	549646.40	2442148.23	755.00
1038	549499.96	2442103.03	756.00
1039	549559.00	2442191.03	756.00
1040	549648.03	2442240.01	756.00
1041	549723.16	2442261.06	756.00
1042	549514.07	2442293.05	758.00
1043	549537.54	2442333.75	758.14
1044	549529.83	2442412.56	759.00
1045	549573.66	2442425.84	759.00

TOP OF 1 FOOT SCREEN CLAY POTENTIAL EXCAVATION ZONE-FLOOR CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
6172	550119.00	2441178.00	770.00
6173	550113.19	2441200.34	769.50
6174	550112.57	2441162.41	769.86
6175	550084.02	2441150.75	767.00
6176	550078.70	2441137.68	767.00
6177	550049.72	2441201.16	765.50
6178	550051.99	2441151.13	765.50
6179	550043.88	2441105.28	765.92
6180	550028.88	2441201.43	764.50
6181	550032.63	2441151.38	764.50
6182	550023.55	2441100.00	764.50
6183	550020.90	2441085.04	764.76
6184	549997.57	2441200.00	763.00
6185	549996.45	2441150.00	763.00
6186	549995.46	2441107.87	763.00
6187	549985.56	2441049.95	763.00
6188	549978.17	2441202.08	762.00
6189	549975.98	2441150.00	762.00
6190	549974.56	2441101.56	762.00
6191	549966.69	2441055.52	762.00
6192	549966.04	2441032.63	762.00
6193	549949.18	2441202.45	760.50
6194	549944.67	2441150.89	760.50
6195	549943.40	2441100.00	760.50
6196	549942.59	2441050.00	760.50
6197	549935.96	2441012.81	760.81
6198	549930.07	2441202.70	759.50
6199	549923.42	2441152.78	759.50
6200	549920.59	2441100.00	759.50
6201	549920.90	2441050.00	759.49
6202	549914.98	2441005.50	759.71
6203	549901.61	2441203.07	758.00
6204	549889.56	2441153.22	758.00
6205	549888.07	2441093.27	758.00
6206	549889.56	2441050.32	758.50
6207	549873.59	2441013.93	758.60
6208	549847.53	2440996.07	758.96
6209	549865.67	2441150.00	757.00
6210	549864.28	2441103.90	757.00
6211	549834.41	2441050.00	757.00
6212	549828.03	2441037.48	757.00
6213	549809.38	2441026.62	757.00
6214	549800.00	2441024.49	757.00
6215	549791.28	2440990.02	758.00
6216	549757.80	2441014.92	757.00
6217	549850.58	2441217.32	755.50
6218	549843.46	2441200.00	755.50
6219	549823.87	2441149.89	755.51
6220	549816.30	2441123.61	755.50
6221	549791.03	2441079.47	755.50
6222	549750.00	2441063.74	755.50
6223	549840.49	2441114.54	756.00
6224	549809.90	2441061.59	756.00
6225	549783.96	2441052.39	756.00
6226	549721.62	2441048.57	756.00
6227	549693.88	2441077.61	755.00
6228	549828.97	2441228.72	754.50
6229	549813.81	2441200.00	754.50
6230	549800.00	2441173.83	754.50
6231	549787.42	2441150.00	754.50
6232	549769.73	2441116.46	754.53
6233	549740.04	2441089.24	754.50
6234	549710.13	2441086.02	754.50
6235	549688.47	2441089.27	754.86
6236	549759.98	2441200.00	753.00
6237	549733.59	2441150.00	753.00
6238	549716.12	2441116.90	753.00
6239	549700.00	2441113.73	753.00
6240	549677.21	2441117.34	753.00
6241	549730.18	2441200.00	752.50
6242	549707.65	2441160.94	752.50
6243	549675.54	2441156.16	752.59
6244	549655.59	2441171.48	752.88
6245	549740.26	2441275.54	752.00
6246	549726.78	2441250.00	752.00
6247	549700.00	2441199.25	752.00
6248	549678.39	2441185.44	752.00
6249	549694.64	2441189.09	752.00
6250	549662.29	2441200.00	752.00

TOP OF 1 FOOT SCREEN CLAY POTENTIAL EXCAVATION ZONE-FLOOR CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
6251	549633.96	2441225.62	752.00
6252	549711.17	2441290.89	751.50
6253	549689.60	2441250.00	751.50
6254	549672.51	2441217.62	751.50
6255	549664.38	2441215.80	751.50
6256	549633.73	2441237.36	751.56
6257	549620.54	2441258.60	751.77
6258	549682.09	2441306.24	751.00
6259	549652.41	2441250.00	751.00
6260	549633.73	2441244.58	751.00
6261	549607.13	2441291.58	751.00
6262	549579.03	2441350.00	751.01
6263	549603.55	2441300.00	751.00
6264	549555.60	2441400.00	751.00
6265	549531.36	2441450.00	751.00
6266	549550.00	2441450.00	751.00
6267	549550.00	2441500.00	751.00
6268	549600.00	2441450.00	751.00
6269	549600.00	2441500.00	751.00
6270	549600.00	2441550.00	751.00
6271	549600.00	2441600.00	751.27
6272	549600.00	2441650.00	751.33
6273	549650.00	2441600.00	751.18
6274	549650.00	2441650.00	751.52
6275	549650.00	2441700.00	751.40
6276	549600.00	2441700.00	751.15
6277	549550.00	2441550.00	751.00
6278	549550.00	2441600.00	751.18
6279	549550.00	2441650.00	751.06
6280	549513.90	2441500.00	751.54
6281	549498.20	2441550.00	751.85
6282	549483.50	2441600.00	752.04
6283	549472.13	2441650.00	751.00
6284	549500.00	2441600.00	751.01
6285	549500.00	2441650.00	751.00
6286	549650.00	2441750.00	751.29
6287	549700.00	2441750.00	751.56
6288	549750.00	2441800.00	752.02
6289	549700.00	2441800.00	751.76
6290	549750.00	2441850.00	752.15
6291	549800.00	2441850.00	752.31
6292	549800.00	2441900.00	752.43
6293	549850.00	2441800.00	752.40
6294	549900.00	2441750.00	752.64
6295	549950.00	2441750.00	752.93
6296	549950.00	2441800.00	752.92
6297	549950.00	2441850.00	752.94
6298	549900.00	2441800.00	752.66
6299	549900.00	2441850.00	752.71
6300	549900.00	2441900.00	752.77
6301	549900.00	2441950.00	752.88
6302	549850.00	2441850.00	752.49
6303	549850.00	2441900.00	752.59
6304	549850.00	2441950.00	752.72
6305	549800.00	2441950.00	752.58
6306	549750.00	2441950.00	752.58
6307	549850.00	2442000.00	752.87
6308	549800.00	2442000.00	752.77
6309	549750.00	2442000.00	752.81
6310	549700.00	2442000.00	752.92
6311	549962.94	2441750.00	753.00
6312	549965.39	2441800.00	753.00
6313	549962.99	2441850.00	753.00
6314	549956.51	2441900.00	753.00
6315	549950.00	2441900.00	752.97
6316	549950.00	2441950.00	753.22
6317	549937.69	2441950.00	753.00
6318	549905.53	2441991.27	753.00
6319	549852.00	2442044.55	753.00
6320	549838.69	2442052.66	753.00
6321	549811.49	2442055.26	753.00
6322	549772.43	2442048.02	753.00
6323	549741.27	2442036.18	753.00
6324	549719.36	2442025.46	753.00
6325	549676.49	2442000.00	753.00
6326	550000.00	2441800.00	754.07
6327	550000.00	2441850.00	753.97
6328	550000.00	2441900.00	753.97
6329	550000.00	2441950.00	754.07

TOP OF 1 FOOT SCREEN CLAY POTENTIAL EXCAVATION ZONE-FLOOR CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
6330	550023.02	2441850.00	754.51
6331	550027.60	2441900.00	754.50
6332	550027.89	2441950.00	754.50
6333	550005.62	2442000.00	754.50
6334	549950.00	2442000.00	753.69
6335	549950.00	2442050.00	754.12
6336	549900.00	2442050.00	753.57
6337	549979.90	2442050.00	754.50
6338	549950.00	2442087.90	754.50
6339	549900.00	2442135.05	754.50
6340	549900.00	2442100.00	754.09
6341	549850.00	2442100.00	753.72
6342	549850.00	2442155.04	754.49
6343	549830.08	2442157.82	754.50
6344	549800.00	2442100.00	753.73
6345	549800.00	2442154.12	754.50
6346	549750.00	2442050.00	753.15
6347	549750.00	2442100.00	753.87
6348	549750.00	2442144.50	754.50
6349	549750.00	2442050.00	753.48
6350	549700.00	2442100.00	754.15
6351	549700.00	2442129.54	754.51
6352	550014.67	2441800.00	754.50
6353	550050.00	2441850.00	755.09
6354	550050.00	2441900.00	754.92
6355	550050.00	2441950.00	754.89
6356	550050.00	2442000.00	755.09
6357	550050.00	2442050.00	755.23
6358	550050.00	2442100.00	755.37
6359	550000.00	2442050.00	754.78
6360	550000.00	2442100.00	755.09
6361	550000.00	2442150.00	755.27
6362	549950.00	2442150.00	755.07
6363	549950.00	2442200.00	755.34
6364	549900.00	2442200.00	755.23
6365	549900.00	2442150.00	754.67
6366	549850.00	2442200.00	755.08
6367	549800.00	2442200.00	755.11
6368	549750.00	2442200.00	755.22
6369	549750.00	2442250.00	755.79
6370	549800.00	2442250.00	755.70
6371	549850.00	2442250.00	755.66
6372	549800.00	2442302.30	756.35
6373	549750.00	2442329.56	756.87
6374	549750.00	2442300.00	756.43
6375	549850.00	2442275.04	755.96
6376	549900.00	2442247.77	755.67
6377	549950.00	2442220.50	755.46
6378	550000.00	2442193.24	755.50
6379	550050.00	2442150.00	755.43
6380	550050.00	2442165.98	755.52
6381	550100.00	2441950.00	755.79
6382	550100.00	2441900.00	755.64
6383	550100.00	2442000.00	755.59
6384	550100.00	2442050.00	755.58
6385	550100.00	2442100.00	755.69
6386	550100.00	2442138.71	755.76
6387	550150.00	2441950.00	756.61
6388	550150.00	2442000.00	756.22
6389	550150.00	2442050.00	755.97
6390	550150.00	2442100.00	756.08
6391	550150.00	2442111.44	756.12
6392	550083.21	2441900.00	755.50
6393	550090.33	2441950.00	755.50
6394	550091.55	2442000.00	755.50
6395	550089.53	2442050.00	755.50
6396	550074.47	2442100.00	755.51
6397	550062.37	2442150.00	755.52
6398	550165.68	2441950.00	757.00
6399	550188.62	2442000.00	757.00
6400	550200.22	2442025.30	757.00
6401	550202.23	2442050.00	757.00
6402	550204.42	2442081.77	757.00
6403	550214.48	2442000.00	758.00
6404	550240.27	2442050.00	758.00
6405	550242.80	2442060.84	758.00
6406	550400.00	2441600.00	789.18
6407	550450.00	2441650.00	793.07
6408	550431.67	2441600.00	792.00

TOP OF 1 FOOT SCREEN CLAY POTENTIAL EXCAVATION ZONE-SLOPE CONTROL-DATA

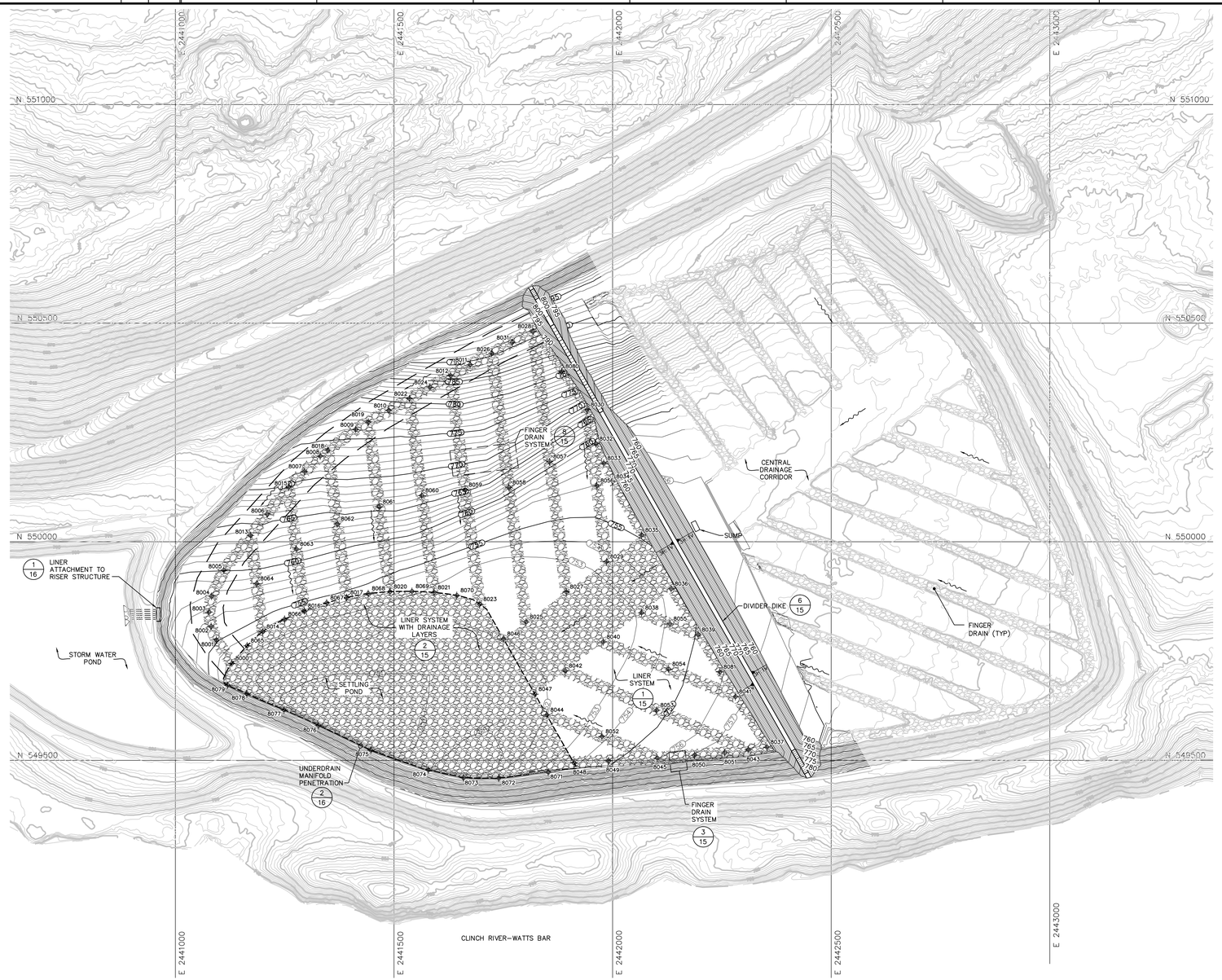
POINT NUMBER	NORTHING	EASTING	ELEVATION
6409	550436.93	2441650.00	792.00
6410	550450.00	2441700.00	792.25
6411	550500.00	2441750.00	794.18
6412	550493.75	2441700.00	796.58
6413	550470.03	2441650.00	795.55
6414	550446.30	2441600.00	793.91

TOP OF 1 FOOT SCREEN CLAY POTENTIAL EXCAVATION ZONE-SLOPE CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
6019	550626.16	2441879.43	811.71
6020	550602.32	2441835.16	811.01
6021	550575.41	2441792.88	809.00
6022	550551.05	2441749.21	807.04
6023	550529.01	2441704.28	805.41
6024	550507.53	2441659.04	804.09
6025	550483.40	2441615.25	802.55
6026	550460.03	2441571.04	801.00
6027	550435.58	2441527.42	798.21
6028	550411.67	2441483.51	797.01
6029	550387.28	2441439.86	795.01
6030	550361.53	2441396.95	793.29
6031	550334.27	2441354.86	792.01
6032	550303.65	2441314.78	790.04
6033	550270.36	2441275.81	788.02
6034	550233.75	2441238.82	785.13
6035	550193.83	2441203.64	782.10
6036	550157.81	2441166.33	780.35
6037	550612.85	2441886.36	807.02
6038	550583.23	2441845.57	803.71
6039	550559.91	2441801.33	802.66
6040	550537.72	2441756.44	801.56
6041	550515.75	2441711.51	800.70
6042	550496.56	2441665.02	800.97
6043	550472.85	2441621.00	798.71
6044	550451.68	2441575.59	798.12
6045	550426.46	2441532.40	795.11
6046	550402.38	2441488.31	793.93
6047	550372.63	2441447.85	790.10
6048	550343.14	2441406.98	786.40
6049	550309.95	2441368.13	782.25
6050	550282.69	2441326.04	782.11
6051	550253.74	2441284.88	781.88
6052	550217.88	2441247.48	779.61
6053	550182.18	2441209.99	777.81
6070	549461.03	2442457.50	784.01
6071	549454.71	2442404.00	783.68
6072	549450.51	2442349.34	782.79
6073	549447.94	2442293.79	782.01
6074	549444.91	2442238.49	781.27
6075	549441.18	2442183.57	781.01
6076	549436.19	2442129.34	780.31
6077	549430.64	2442075.42	780.00
6078	549424.36	2442021.89	779.39
6079	549418.07	2441968.37	779.00
6080	549411.79	2441914.85	779.00
6081	549405.50	2441861.32	778.97
6082	549399.65	2441807.56	778.12
6083	549394.28	2441753.54	777.77
6084	549394.96	2441696.22	776.86
6085	549401.32	2441635.80	776.01
6086	549511.90	2442451.64	767.58
6087	549510.31	2442430.63	766.78
6088	549509.25	2442374.26	763.18
6089	549504.51	2442319.89	762.17
6090	549495.77	2442267.72	763.99
6091	549487.79	2442215.11	765.13
6092	549480.01	2442162.40	766.02
6093	549475.00	2442108.19	765.32
6094	549470.84	2442053.50	764.32
6095	549467.56	2441998.33	762.37
6096	549461.29	2441944.80	763.15
6097	549458.27	2441889.50	761.65
6098	549454.46	2441834.63	760.55
6099	549453.71	2441778.08	758.13
6100	549449.10	2441723.65	758.08
6101	549448.21	2441667.18	758.78
6102	549447.20	2441660.61	759.34
6127	549420.45	2441554.23	775.00
6128	549436.29	2441507.15	774.67
6129	549454.19	2441460.47	773.85
6130	549476.86	2441417.02	773.15
6131	549500.86	2441373.18	772.22
6132	549525.25	2441329.70	771.27
6133	549550.29	2441286.43	770.13
6134	549570.24	2441239.59	769.55
6135	549589.18	2441193.31	769.28
6136	549608.78	2441148.01	768.48
6137	549631.63	2441103.53	768.26

TOP OF 1 FOOT SCREEN CLAY POTENTIAL EXCAVATION ZONE-SLOPE CONTROL-DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
6138	549656.16	2441060.48	768.68
6139	549687.03	2441025.07	769.00
6140	549725.25	2440992.84	769.00
6141	549766.18	2440966.97	768.23
6142	549811.06	2440956.58	768.26
6143	549859.80	2440956.46	769.26
6144	549908.06	2440965.00	770.96
6145	549952.25	2440982.57	772.57
6146	549992.60	2441008.63	773.78
6147	550029.02	2441042.27	775.13
6148	550064.02	2441078.00	776.50



LEGEND

- 770 — EXISTING GROUND CONTOUR (FEET) (NOTE 1)
- 770 — PROPOSED GROUND CONTOUR (FEET)
- APPROXIMATE FOOTPRINT OF RIM DITCH
- EXISTING FINGER DRAINS (NOTE 3)
- PROPOSED FINGER DRAINS
- 8000 CONSTRUCTION CONTROL POINT

FINGER DRAIN CONTROL-DATA

POINT NUMBER	NORTHING	EASTING
8000	549721.83	2441129.15
8001	549775.52	2441093.78
8002	549806.40	2441081.77
8003	549839.14	2441077.25
8004	549875.28	2441082.90
8005	549934.91	2441110.66
8006	550063.34	2441209.62
8007	550160.72	2441295.13
8008	550195.94	2441331.16
8009	550257.16	2441412.35
8010	550300.68	2441488.16
8011	550404.88	2441674.00
8012	550379.95	2441629.24
8013	550014.20	2441171.96
8014	549794.03	2441200.13
8015	550124.62	2441258.64
8016	549841.80	2441294.83
8017	549872.43	2441391.72
8018	550209.12	2441348.65
8019	550273.83	2441441.18
8020	549885.54	2441490.86
8021	549883.82	2441591.90
8022	550327.53	2441535.13
8023	549856.95	2441696.15
8024	550353.74	2441582.18
8025	549816.37	2441802.16
8026	550431.10	2441723.51
8027	549885.23	2441894.16
8028	550481.11	2441817.92
8029	549854.36	2441986.13
8030	550301.83	2441941.68
8031	550456.10	2441770.71
8032	550223.83	2441961.51
8033	550179.41	2441979.68
8034	550137.51	2441999.97
8035	550014.88	2442066.27
8036	549892.20	2442133.86
8037	549530.14	2442352.78
8038	549837.26	2442066.18
8039	549786.92	2442195.69
8040	549770.62	2441978.10
8041	549645.44	2442280.85
8042	549704.56	2441891.68
8043	549524.32	2442309.98
8044	549603.59	2441849.31
8045	549505.26	2442101.98
8046	549777.68	2441750.49
8047	549651.21	2441822.28
8048	549494.16	2441911.50
8049	549499.18	2441990.60

FINGER DRAIN CONTROL-DATA

POINT NUMBER	NORTHING	EASTING
8050	549511.58	2442187.16
8051	549517.26	2442256.56
8052	549554.43	2441975.65
8053	549614.44	2442100.83
8054	549708.60	2442128.11
8055	549812.09	2442130.94
8056	550128.09	2441963.90
8057	550183.17	2441856.04
8058	550123.74	2441762.83
8059	550118.45	2441662.69
8060	550105.68	2441563.51
8061	550079.68	2441466.02
8062	550040.78	2441370.19
8063	549983.21	2441276.74
8064	549904.11	2441186.04
8065	549762.03	2441164.14
8066	549822.79	2441249.72
8067	549860.11	2441346.01
8068	549881.42	2441440.97
8069	549886.45	2441541.27
8070	549877.14	2441643.76
8071	549473.16	2441852.64
8072	549459.29	2441739.70
8073	549460.12	2441658.96
8074	549477.79	2441578.76
8075	549523.20	2441447.25
8076	549579.70	2441327.34
8077	549615.19	2441248.53
8078	549652.31	2441163.64
8079	549671.75	2441119.32
8080	550389.50	2441883.87
8081	549702.08	2442245.51

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN AUGUST 2010. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. THE AS–BUILT CONFIGURATION OF THE FINGER DRAINS WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN AUGUST 2010.

DRAFT CONSTRUCTION DRAWINGS FOR REVIEW

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	DSD	PROJECT ID	AS CONST	REV ID
R0	JULY 2011	MI	RWL								

SCALE: 1" = 100' EXCEPT AS NOTED

DISCIPLINE INTERFACE

Geosyntec consultants
1255 ROBERTS BOULEVARD, N.W., SUITE 200
KENNESAW, GEORGIA 30144 USA
PHONE: 678.202.9500

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

DRAINAGE SYSTEM, DIVIDER DIKE, AND SETTLING POND LAYOUT

GYPSUM DISPOSAL FACILITY, PHASE IA AREA

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. ISOMEN	R.W. LOWRY					

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

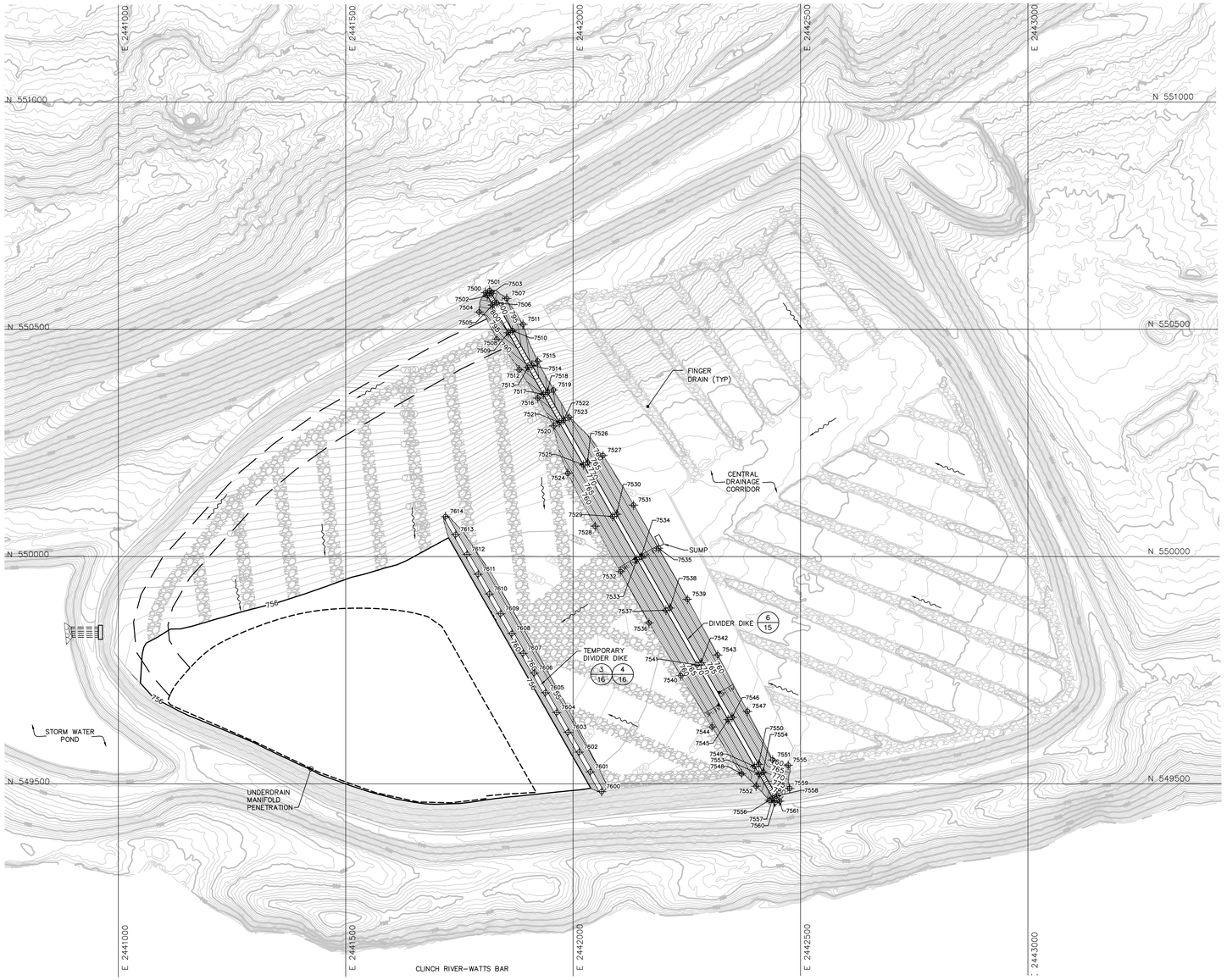
CONSTRUCTION DRAWINGS | AUTODESK CIVIL 3D | DATE JULY 11 | 36 | C | 10WXXX–12 | R 0

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

GEOSYNTEC CONSULTANTS, INC. | 0
TASK COMPLETED BY: | REV NO.

L:\CAD\TVTENNESSEE VALLEY AUTHORITY\KINGSTON FOSSIL PLANT- CONSTRUCTION FOR GYPSUM DISPOSAL FACILITY, PHASE IA AREA (GA-MEA)\DRAWINGS\MEA7000.DWG



LEGEND

- 770 — EXISTING GROUND CONTOUR (FEET) (NOTE 1)
- 770 — PROPOSED GROUND CONTOUR (FEET)
- APPROXIMATE FOOTPRINT OF RIM DITCH
- EXISTING FINGER DRAINS (NOTE 3)
- PROPOSED FINGER DRAINS
- 8000 CONSTRUCTION CONTROL POINT

DIVIDER DIKE CONTROL DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
7500	550581.10	2441807.28	809.00
7501	550585.29	2441816.40	809.00
7502	550574.06	2441811.28	809.00
7503	550579.00	2441819.97	809.00
7504	550537.96	2441793.13	796.00
7505	550553.34	2441823.04	803.00
7506	550558.28	2441831.75	803.00
7507	550567.76	2441854.15	797.00
7508	550478.20	2441832.39	790.35
7509	550492.50	2441857.57	800.00
7510	550497.44	2441866.27	800.00
7511	550510.78	2441889.78	790.99
7512	550410.63	2441881.38	783.00
7513	550416.41	2441900.77	789.00
7514	550421.35	2441909.46	789.00
7515	550430.07	2441922.30	784.00
7516	550348.74	2441922.28	775.00
7517	550356.63	2441934.67	779.99
7518	550361.56	2441943.40	780.00
7519	550366.60	2441956.73	775.00
7520	550287.49	2441957.59	765.26
7521	550294.51	2441969.96	770.00
7522	550299.45	2441978.66	770.00
7523	550306.49	2441991.06	765.25
7524	550183.24	2441988.28	757.00
7525	550201.44	2442022.79	770.00
7526	550206.38	2442031.49	770.00
7527	550222.43	2442065.61	757.47
7528	550067.08	2442048.41	755.31
7529	550088.23	2442087.06	770.00
7530	550093.17	2442095.76	770.00
7531	55011 3.15	2442132.71	756.00
7532	549966.95	2442104.16	755.00
7533	549993.88	2442140.62	770.00
7534	549998.81	2442149.32	770.00
7535	550018.33	2442187.91	755.60
7536	549854.07	2442167.02	754.65
7537	549881.95	2442204.16	770.00
7538	549886.89	2442212.85	770.00
7539	549906.00	2442251.33	755.70
7540	549737.98	2442236.55	755.70
7541	549761.62	2442272.46	770.00
7542	549766.38	2442281.26	770.00
7543	549783.49	2442317.96	756.54
7544	549625.24	2442305.40	757.11
7545	549641.29	2442340.77	770.00
7546	549646.23	2442349.46	770.00
7547	549659.49	2442383.33	758.00
7548	549522.08	2442370.49	759.00
7549	549538.15	2442399.31	770.00
7550	549543.09	2442408.01	770.00
7551	549552.45	2442438.83	759.53
7552	549494.82	2442402.34	770.00
7553	549520.96	2442409.07	770.00
7554	549525.90	2442417.77	770.00
7555	549540.93	2442472.92	760.00
7556	549464.23	2442431.46	781.95
7557	549468.44	2442438.88	784.00
7558	549473.38	2442447.58	784.00
7559	549489.97	2442476.17	776.00
7560	549459.14	2442444.16	784.00
7561	549461.81	2442454.15	784.00

STORM FLAP BERM CONTROL DATA

POINT NUMBER	NORTHING	EASTING	ELEVATION
7600	549482.89	2442062.72	760.00
7601	549526.37	2442038.04	760.00
7602	549569.85	2442013.36	760.00
7603	549613.34	2441988.67	760.00
7604	549656.82	2441963.99	760.00
7605	549700.30	2441939.31	760.00
7606	549743.78	2441914.62	760.00
7607	549787.27	2441889.94	760.00
7608	549830.75	2441865.26	760.00
7609	549874.23	2441840.57	760.00
7610	549917.71	2441815.89	760.00
7611	549961.20	2441791.21	760.00
7612	550004.68	2441766.52	760.00
7613	550048.16	2441741.84	760.00
7614	550087.96	2441719.25	760.00

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN AUGUST 2010. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. THE AS–BUILT CONFIGURATION OF THE FINGER DRAINS WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN AUGUST 2010.

RO	JULY 2011	MI	RWL								
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV ID

DISCIPLINE INTERFACE

SCALE: 1" = 100' EXCEPT AS NOTED

Geosyntec consultants
1255 ROBERTS BOULEVARD, N.W., SUITE 200
KENNESAW, GEORGIA 30144 USA
PHONE: 678.202.9500

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

INTERIM LAYOUT OF PHASE 1A CELL

GYPSUM DISPOSAL FACILITY, PHASE IA AREA

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. ISOMEN	R.W. LOWRY					

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

DRAFT CONSTRUCTION DRAWINGS FOR REVIEW

CONSTRUCTION DRAWINGS

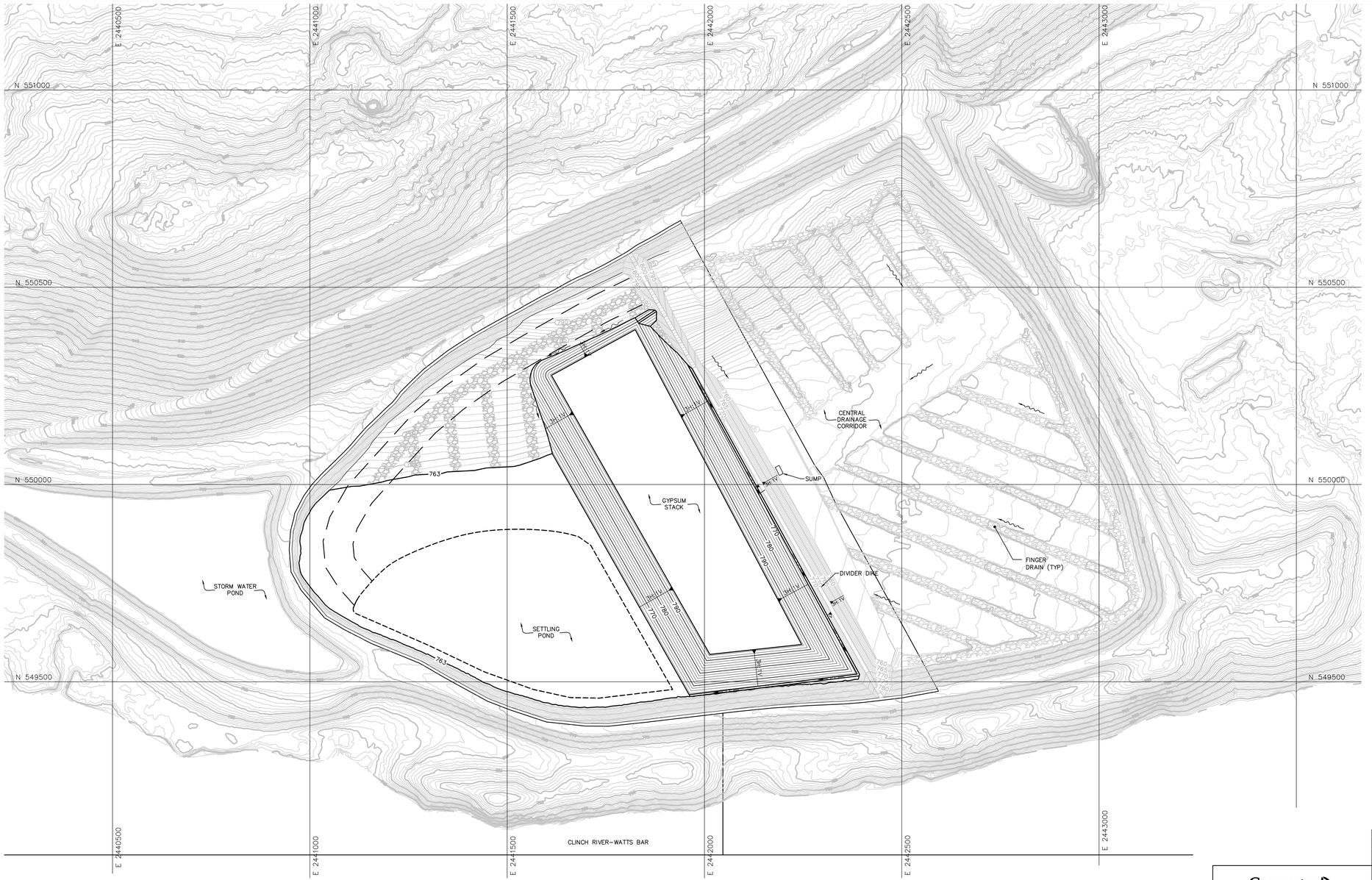
AUTODESK CIVIL 3D	DATE JULY 11	36	C	10W236–13	R 0

GEOSYNTEC CONSULTANTS, INC. 0
TASK COMPLETED BY: REV NO.

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

L:\CAD\TVJ\TENNESSEE VALLEY AUTHORITY-KINGSTON FOSSIL PLANT- CONSTRUCTION FOR GYPSUM DISPOSAL FACILITY, PHASE IA AREA (DAVIS)\DRAWINGS\MM3700.DWG



LEGEND

- 770 — EXISTING GROUND CONTOUR (FEET) (NOTE 1)
- 770 — PROPOSED GROUND CONTOUR (FEET)
- APPROXIMATE FOOTPRINT OF RIM DITCH
- FINGER DRAINS

NOTES:

1. THE TOPOGRAPHIC MAP SHOWN ON THIS DRAWING WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN AUGUST 2010. GRID COORDINATES CORRESPOND TO TENNESSEE STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM (NAD) 1927. ELEVATIONS ARE IN FEET ABOVE SEA LEVEL, NATIONAL GEODETIC VERTICAL DATUM (NGVD) 1929.
2. THE AS-BUILT CONFIGURATION OF THE FINGER DRAINS WAS PROVIDED BY TVA AND BASED ON AERIAL PHOTOGRAPHY TAKEN IN AUGUST 2010.

0 100' 200'
SCALE IN FEET

RO REV. NO.	JULY 2011 DATE	MI DSGN	RWL DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. NO.	DISCIPLINE INTERFACE
											1	
											2	
											3	
											4	

SCALE: 1" = 100' EXCEPT AS NOTED

Geosyntec consultants
1255 ROBERTS BOULEVARD, N.W., SUITE 200
KENNESAW, GEORGIA 30144 USA
PHONE: 678.202.9500

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.
SIGNATURE
DATE

FINAL LAYOUT OF THE PHASE 1A CELL

GYPSUM DISPOSAL FACILITY, PHASE IA AREA

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. ISOMEN	R.W. LOWRY					

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

CONSTRUCTION DRAWINGS | AUTODESK CIVIL 3D | DATE JULY 11 | 36 | C | 10WXXX-14 | R 0

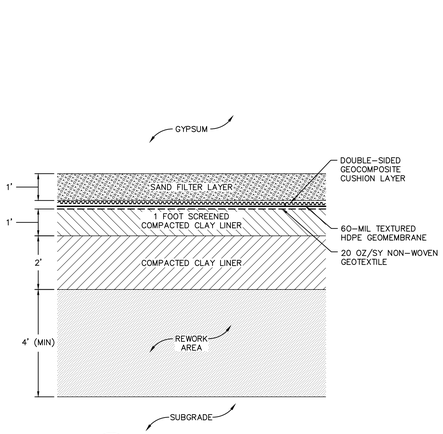
PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

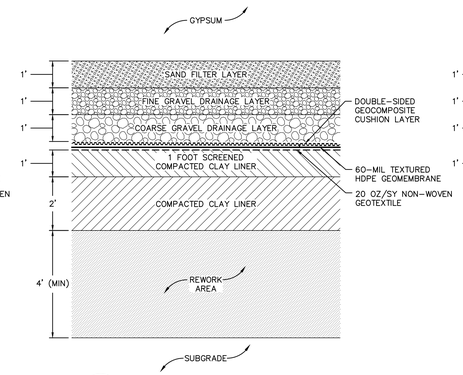
DRAFT CONSTRUCTION DRAWINGS FOR REVIEW

GEOSYNTEC CONSULTANTS, INC. | 0
TASK COMPLETED BY: | REV NO.

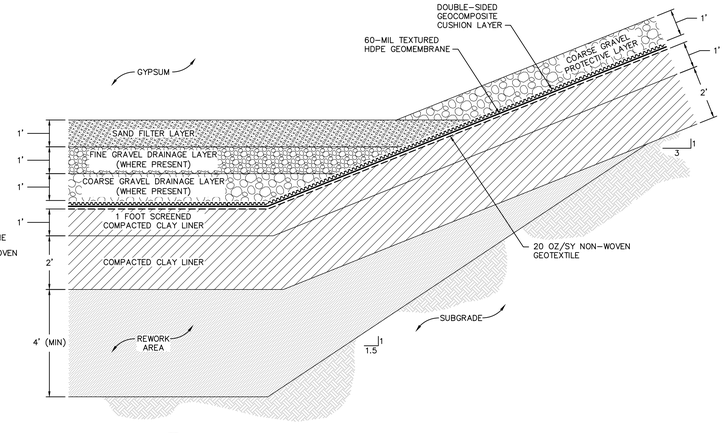
L:\CAD\TVA\TENNESSEE VALLEY AUTHORITY\KINGSTON FOSSIL PLANT- CONSTRUCTION FOR GYPSUM DISPOSAL FACILITY, PHASE IA AREA CHANGE\DRAWINGS\MASTER.DWG



1/12 DETAIL
LINER SYSTEM
SCALE: N.T.S.
XREF: 4863X011 LINER SYSTEM



2/12 DETAIL
LINER SYSTEM WITH DRAINAGE LAYERS
SCALE: N.T.S.
XREF: 4863X021 LINER SYSTEM WITH DRAIN



3/12 DETAIL
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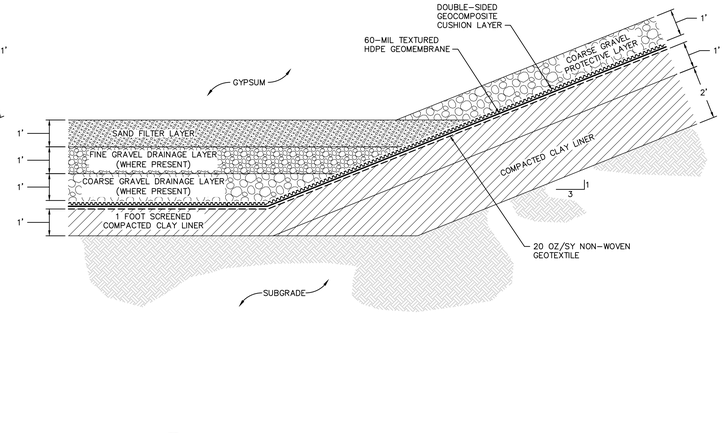
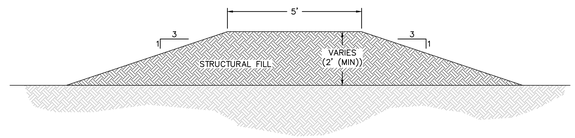
SCALE: N.T.S.
XREF: 4863X017 LINER SYSTEM ON SIDESLOPE I



4/12 DETAIL
LINER SYSTEM BEYOND LIMITS OF OVER-EXCAVATION AREA
SCALE: N.T.S.
XREF: 4863X018 LINER SYSTEM ON SIDESLOPE II

5/10 DETAIL
ANCHOR TRENCH
SCALE: N.T.S.
XREF: 4863X019 ANCHOR TRENCH

6/12 DETAIL
DIVIDER DIKE
SCALE: 1" = 2'
XREF: 4863X012 DIVIDER DIKE



7/3 DETAIL
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8/12 DETAIL
FINGER DRAIN SYSTEM
SCALE: N.T.S.
XREF: 4863X020

NOTE:

1. PHASE IA PERMIT MODIFICATION DRAWINGS 10W236-1 THROUGH 10W236-6 ARE ISSUED TO SUPPLEMENT THE PERMIT DRAWINGS 10W427-1 THROUGH 10W427-25 DATED MAY 2006 AND THE PERMIT MODIFICATION DRAWINGS 10W427-42 THROUGH 10W427-58 DATED DECEMBER 2010.

DRAFT CONSTRUCTION DRAWINGS FOR REVIEW

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE
0	JULY 2011	M	RWL								1

SCALE: EXCEPT AS NOTED

Geosyntec consultants
1255 ROBERTS BOULEVARD, N.W., SUITE 200
KENNESAW, GEORGIA 30144 USA
PHONE: 678.202.9500

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

DETAILS I

GYPSUM DISPOSAL FACILITY, PHASE IA AREA

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
M. ISOMEN	R.W. LOWRY					

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

CONSTRUCTION DRAWINGS

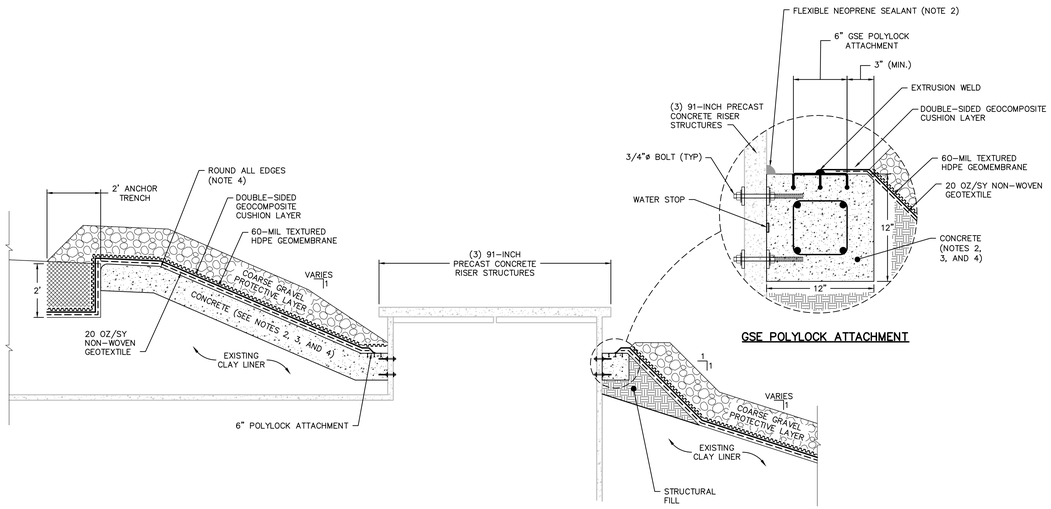
AUTODESK CIVIL 3D	DATE	36	C	10WXXX-15	R 0
	JULY 11				

PLOT FACTOR: 1:1

C.A.D. DRAWING
DO NOT ALTER MANUALLY

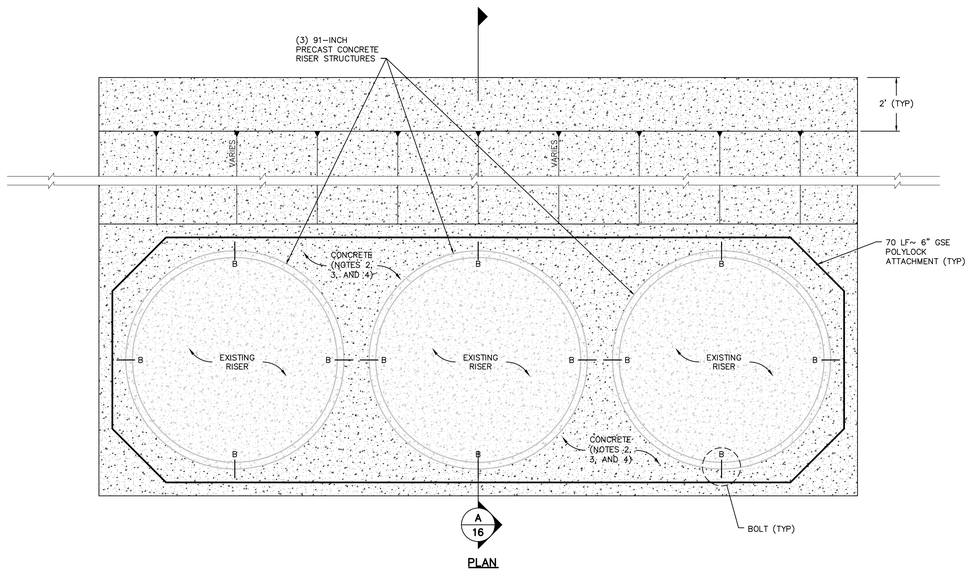
GEOSYNTEC CONSULTANTS, INC.	0
TASK COMPLETED BY:	REV NO.

L:\CADD\TENNESSEE VALLEY AUTHORITY\KINGSTON FOSSIL PLANT - CONSTRUCTION FOR GYPSUM DISPOSAL FACILITY, PHASE IA AREA (GAMBLE)\DRAWINGS\4863T006.DWG



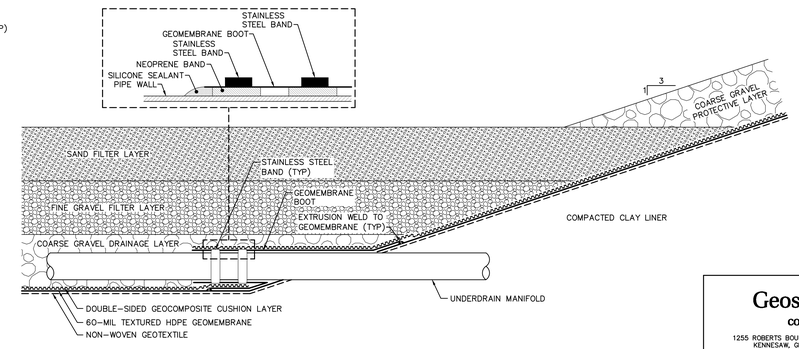
GSE POLYLOCK ATTACHMENT

SECTION A



PLAN

1 / 12 DETAIL
GEOMEMBRANE ATTACHMENT TO RISER STRUCTURES
SCALE: N.T.S.
XREF: 4863X016 GM TO RISER PLAN



2 / 12 DETAIL
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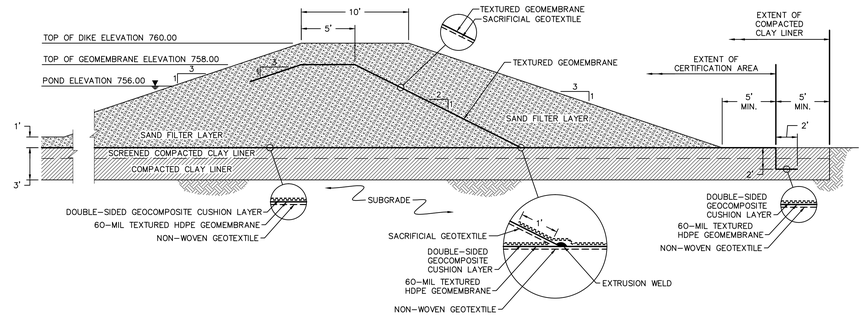
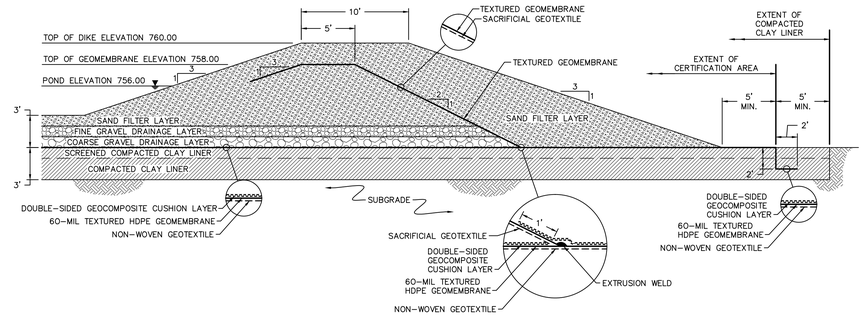
XREF: 4863X020



3 / 13 DETAIL
TEMPORARY DIVIDER DIKE LINER SYSTEM
SCALE: 1" = 5'
XREF: 4863X029 BERM DETAIL



4 / 13 DETAIL
TEMPORARY DIVIDER DIKE LINER SYSTEM WITH DRAINAGE LAYERS
SCALE: 1" = 5'
XREF: 4863X029 BERM DETAIL

NOTE:

1. PHASE IA CONSTRUCTION DRAWINGS 10W236-1 THROUGH 10W236-16 DATED JULY 2011 ARE ISSUED TO SUPPLEMENT THE PERMIT MODIFICATION DRAWINGS 10W236-1 THROUGH 10W236-6 DATED APRIL 2011.
2. UPON FINAL CURING OF THE CONCRETE A FLEXIBLE NEOPRENE SEALANT SHALL BE INSTALLED AT THE RISER TO NEW CONCRETE INTERFACE.
3. ALL CONCRETE SHALL BE 3,000 PSI AIR ENTRAINED CONCRETE REINFORCED WITH NO. 4 REBAR SPACED 12-IN ON CENTER EACH DIRECTION. MINIMUM 3-IN EMBEDMENT OF REBAR INTO CONCRETE.
4. EARTH ADJACENT TO CONCRETE COLLAR TO BE WELL COMPACTED TO PREVENT FUTURE DIFFERENTIAL SETTLEMENT. ALL CONCRETE COLLARS TO BE CHAMFERED A MINIMUM OF 1" (TYP.) @ ALL CORNERS IN CONTACT WITH LINER INCLUDING CONCRETE ON WESTERN SLOPE.

DRAFT CONSTRUCTION DRAWINGS FOR REVIEW

Geosyntec consultants
1255 ROBERTS BOULEVARD, N.W., SUITE 200
KENNESAW, GEORGIA 30144 USA
PHONE: 678.202.9500

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

RO	JULY 2011	MI	RML								DISCIPLINE INTERFACE
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV ON 1 2 3 4

SCALE: EXCEPT AS NOTED

DETAILS II

GYPSUM DISPOSAL FACILITY, PHASE IA AREA

DESIGNED BY: M. ISOMEN	DRAWN BY: R.M. LOWRY	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

CONSTRUCTION DRAWINGS | AUTODESK CIVIL 3D | DATE JULY 11 | 36 | C | 10WXXX-16 | R 0

PLOT FACTOR: 1:1

C.A.D. DRAWING DO NOT ALTER MANUALLY

GEOSYNTEC CONSULTANTS, INC.	0
TASK COMPLETED BY:	REV NO.

L:\CAD\TVA\TENNESSEE VALLEY AUTHORITY\KINGSTON FOSSIL PLANT- CONSTRUCTION FOR GYPSUM DISPOSAL FACILITY, PHASE IA AREA (SAME)\SAME\SAME\10W236-16.DWG

APPENDIX A

Document 11

Report of Hydrologic and Hydraulic Analysis, Ash Pond and Stilling Pond, TVA Kingston Fossil Plant, Roans County, Tennessee, Stantec Consulting Services, September 30, 2010

Report of Hydrologic and Hydraulic Analysis

Ash Pond and Stilling Pond
TVA Kingston Fossil Plant
Roane County, Tennessee

Stantec Consulting Services Inc.
One Team. Infinite Solutions
1409 North Forbes Road
Lexington, KY 40511-2050
Tel: (859) 422-3000 • Fax: (859) 422-3100
www.stantec.com

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

September 30, 2010

Stantec Consulting Services Inc.
1409 North Forbes Road
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Tel: (859) 422-3000
Fax: (859) 422-3100

September 30, 2010 rpt_003_175660008

Ms. Shannon Bennett
Tennessee Valley Authority
1101 Market Street, LP 5E-C
Chattanooga, Tennessee 37402

Re: Report of Hydrologic and Hydraulic Analysis
Ash Pond and Stilling Pond
TVA Kingston Fossil Plant
Roane County, Tennessee

Dear Ms. Bennett:

Stantec Consulting Services Inc. (Stantec) has been assisting TVA with risk assessment and mitigation for a number of facilities associated with its coal combustion processes at various fossil plants. The Ash Pond and Stilling Pond at the Kingston Fossil Plant were identified for Hydrologic and Hydraulic Freeboard Analysis as a part of our Phase 1 Assessment. The goal of this analysis was to develop a conceptual-level hydrologic and hydraulic runoff model of the area to help assess capacity, freeboard, and hydraulic operation of the Ash Pond and Stilling Pond during various hydrologic events. Results of this modeling effort and recommendations are included in the attached report.

The normal freeboard conditions were assessed and found to be adequate (>5 feet) according to TVA guidelines. Storm surge conditions were also assessed. In general, the capacity of the Ash Pond and Stilling Pond along with their spillways was found to be adequate for most storm events up to and including the 100-year return period. However, during the Probable Maximum Precipitation (PMP) event, there is a chance that the ponds could overtop. Stantec recommends that TVA assess the risk associated with a PMP event in comparison with the amount of time this pond system will remain in operation, and then consider options to reduce the flooding potential for this pond system if performance during the PMP event is required.

Potential options for improving operation during that period could include constructing a defined overflow pathway from the Ash Pond to the Stilling Pond and adding an emergency overflow spillway for the Stilling Pond in the event that overtopping occurs. Additional information from the modeling efforts and an explanation of potential improvements is included herein.

We appreciate the opportunity to assist TVA with these assessment efforts and look forward to continuing work on other TVA facilities. Please do not hesitate to contact Stantec with any questions, concerns, or clarifications.

Sincerely,

STANTEC CONSULTING SERVICES INC.

C.W. Gaskill, PE
Water Resource Engineer

Erman Caudill, PE, CFM
Project Manager

/cmw

Report of Hydrologic and Hydraulic Analysis

Ash Pond and Stilling Pond
TVA Kingston Fossil Plant
Roane County, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

September 30, 2010

Report of Hydrologic and Hydraulic Analysis
Ash Pond and Stilling Pond
TVA Kingston Fossil Plant
Roane County, Tennessee

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Executive Summary

A hydrologic and hydraulic study was conducted for the Ash Pond and Stilling Pond at the Kingston Fossil Plant in Roane County, Tennessee. The purpose of the study was to help assess freeboard requirements, capacity, and hydraulic operation of spillway systems in relation to the structural hazard classifications that would be appropriate in Tennessee using the effective size of the facilities. In order to perform the study, site visits were conducted, TVA personnel were interviewed, historical drawings and documents were reviewed, survey data was obtained, and hydrologic/hydraulic (H&H) modeling was performed.

An H&H model was developed to simulate storm water drainage and runoff from overland areas, process discharges, and pond interconnectivity by spillways based on our understanding of the geometry and design of the drainage and conveyance network. A map showing the hydraulic connectivity is attached as Appendix A. The model was used to assess the performance of the ponds during the 1-, 10-, 25-, 50- and 100-year 24-hour SCS Type II storms as well as a 6-hour Probable Maximum Precipitation (PMP) event.

Based on the data gathering efforts, collective review of the data available, and the modeling efforts, Stantec noted the following observations:

- Aside from the principal spillway systems, there are no defined emergency spillways or overflow paths. Ponds similar in size and capacity to these typically have emergency spillway systems to prevent overflows.
    - If the principal spillways were to become clogged, or if a heavy rainfall event were to cause any of the ponds to overtop, there are no defined and protected overflow paths to help prevent erosion of the dikes.
- Based on the modeling of the current conditions, the Ash Pond appears unable to pass the PMP event through the existing principal spillway system without overtopping the embankment. It does appear to be able to pass the 100-year storm event.
    - In the event of a PMP storm, the Ash Pond would overtop the dike between the Ash Pond and the Stilling Pond as well as the embankment between the Ash Pond and the Emory River.
- A potential closure scenario was modeled assuming the Stilling Pond would function as it currently does, but act as a settling basin for the to-be closed Ash Pond prior to discharge to the Emory River. As presently configured and under this operational scenario, the Stilling Pond appears unable to pass the PMP event through the spillway system without overtopping the embankment. It does appear to be able to pass the 100-year storm event.
    - In the event of a PMP storm during the above described closure scenario, the Stilling Pond would overtop the dike between the Stilling Pond and the Emory River.

- As we understand, the principal spillway risers in the Stilling Pond are targeted for potential replacement. Upgrading the principal spillways so that the Stilling Pond would pass the PMP event would result in upgrading the six (6) existing risers to approximately 7' diameter risers with 6' diameter barrels. A complete design would need to be performed to determine the exact up-sizing necessary, but this would not appear to be as effective as a formal emergency spillway system for controlling large storm events such as the PMP.

Based on the results of the analysis, Stantec recommends TVA consider the following:

- Assess the risk of a PMP event occurring during the remaining life of the pond system.

- If necessary, consider installing an emergency spillway & overflow connector between the Ash Pond and Stilling Pond.

- Consider installing an emergency spillway between the Stilling Pond and the Emory River if the principal spillway system is replaced or during the closure of the Ash Pond.

Stantec recommends that these potential improvements be further evaluated by TVA to determine if they are warranted and can be incorporated into future construction projects at the plant.

Report of Hydrologic and Hydraulic Analysis
Ash Pond and Stilling Pond
TVA Kingston Fossil Plant
Roane County, Tennessee

1. Introduction

This study was conducted to help assess capacity and hydraulic operation of spillway systems and freeboard requirements in relation to the structural hazard classifications of the facilities at the Kingston Fossil Plant in Roane County, Tennessee. The ponds evaluated include the Ash Pond and Stilling Pond.

This analysis included field visits, review of historical TVA drawings and discussions with TVA personnel. This report details the assumptions, methodology, and results of the H&H analyses for the ponds analyzed.

2. Modeling Assumptions

a. Pipes are assumed to be flowing freely and are not clogged or leaking. Some of the pipes may, in actuality, be clogged and some of the older pipes may be leaking (especially older corrugated metal pipes). Elevations and flows determined for this analysis may not be applicable in those situations. This assumption is inherent in this type of analysis and is acceptable.

b. Wave action is not considered in this analysis. Overtopping is assumed to occur only when the elevation of the pond rises above the minimum surveyed crest elevation. In actuality, wave action would likely play a role in the overtopping of the ponds. The modeling performed for this work is conceptual in nature. Compensating for wave action is beyond this scope of work and would not change the outcome of the study.

c. The model takes into account a tailwater effect of the downstream water surface elevation (WSEL) of the Stilling Pond on the upstream outfall structures in the Ash Pond. A rating curve was developed for each storm event for the Ash Pond utilizing an expected downstream WSEL for the Stilling Pond. The expected WSEL of the Stilling Pond was generated using the HEC-HMS model as if the outfall structures of the Ash Pond were free flowing. This generated a maximum WSEL for the Stilling Pond. This WSEL was then used to generate a new rating curve for the Ash Pond. This gives a conservative value for the Ash Pond rating curves because only the maximum WSEL of the downstream Stilling Pond was used. All rating curves can be reviewed in Appendix C.

d. During the initial run for the 6-HR PMP event, the model ends when the WSEL rises to the top of the pond at an elevation of 765.00 ft. This elevation is the actual elevation of the top of the embankment. This action showed that the water in the Ash Pond would overtop the existing dike during the 6-HR PMP event. To estimate the amount of flow overtopping the dike and entering the downstream Stilling Pond, weir flow going over the top of the dike had to be modeled. In reality, not all of the overtopping flow would enter the Stilling Pond

as some of the flow would leave the Ash Pond and flow directly into the river. For the purposes of this model it was proposed that all the overtopping flow would enter the Stilling Pond.

e. For modeling purposes the spillway was conservatively estimated to be the length of the dike separating the two ponds at 2070 LF. In reality, a localized low area would serve as the primary flow path. To facilitate modeling, a new pond top elevation was used at 766.00 ft. The surface area of the pond at both the 766.00 ft and 765.00 ft elevations was estimated to be 83.58 acres. With these two values, a new stage-discharge rating curve and a stage-volume curve could be generated for the 6-HR PMP event. The 6-HR PMP Ash Pond rating curve can be reviewed in Appendix C.

f. NRCS/SCS TR-55 methodology was used for drainage area calculations. Wherever ash existed in the drainage area, it was treated as a Hydrologic Group C soil. The water surface of the ponds was considered to be impervious, to model 100% of the rainfall being captured in the pond.

g. A time of concentration was assumed to be 5 minutes (lag time of 3 minutes) for the existing conditions. This value was selected as a conservative assumption based on the varied flow path of the watershed subbasins.

h. For the closure scenario (described below), the existing process discharges and a drainage area of 320 acres was assumed to flow to the Stilling Pond. A time of concentration of 50 minutes (lag time of 30 minutes) and a curve number of 80 were also assumed. These assumptions were based on estimates of the anticipated closure conditions for the Ash Pond.

i. It should be noted, that this was an uncalibrated model and sufficient data from actual storms was not available to calibrate it. Stantec tested the sensitivity of the model to input parameters and found the overall general results of the model consistent throughout. This model is suitable for planning purposes, but it should not be used for simulation of actual storm events without further calibration efforts involving actual storm discharge and stage measurements. This model is suitable as a screening and planning tool, however Stantec would discourage its use beyond the current scope of work and the context described in this report.

3. Methodology

Rainfall-runoff relationships were determined using methods described by the NRCS in “Part 630-Hydrology” of the National Engineering Handbook (NEH4). SCS Curve Number Unit Hydrograph methods were used to generate runoff hydrographs for routing through the ponds in lieu of the more complex methods described in Chapter 21 of NEH4 and commonly implemented in NRCS TR-60 based methods.

A HEC-HMS model was developed and used to simulate runoff from the probable maximum precipitation (PMP) event in accordance with TVA design guidance. SCS Type II rainfall depth for the 1-, 10-, 25-, 50-, and 100-year storm events were taken from NOAA Atlas 14 for Kingston, TN. Rainfall depth for the 6-HR PMP event was taken from NOAA HMR-56. From

Figure 23 *"6 hr 1-mi^2 PMP (in.) – eastern half of Tennessee River Watershed"* of HMR-56, the 6-HR PMP rainfall depth for the Kingston site was estimated to be 36.3 in.

The PMP event was formatted using the distribution chart included in NRCS TR-60, Figure 2-4 "*Dimensionless design storm distribution, auxiliary spillway and freeboard.*" A formatted 6-HR PMP chart can be found in Appendix C.

Pump flows are given for normal and full operation. The "Wastewater Flow Schematic" provided by TVA to Stantec states that the plant flows are 48.46 MGD (75 cfs). This value is used as a constant input in the model. The "Wastewater Flow Schematic" is included in Appendix E.

4. Input Data

4.1. Watershed Parameters

It is our understanding that process water enters the Ash Pond. The Ash Pond discharges to the Stilling Pond through an adjustable weir structure. Drawings utilized to develop the connectivity which was used in the creation of the hydrologic model are included in Appendix A. The following table lists the main hydrologic parameters of the watersheds draining to the ponds. The impervious area is a separate entry into the model and the curve numbers listed below are for the pervious sections of the drainage areas only.

Table 1. Watershed Parameters

Name	Drainage Area (acres)	Receiving Pond	Curve Number	*Percent Impervious	Estimated Lag Time (min)
Ash Pond Area	90	Ash Pond	71	*34	3
Ash Storage and Processing Area	40	Ash Pond	87	*0	3
Sluice Channel Area	22	Ash Pond	87	*23	3
Dredge Cell Dike Slope Area	23	Ash Pond	80	*0	3
Stilling Pond Area	29	Stilling Pond	87	*83	3
Stilling Pond Area (Closure)	320	Stilling Pond	80	0	30

*The amount of impervious area is not reflected in the Curve Number.

A potential closure scenario for the Ash Pond was also modeled assuming the Stilling Pond would act as a settling basin prior to discharge to the Emory River. The Ash Pond and Dredge Cell Areas were assumed to be filled and regraded to drain positively to the stilling pond and all the process water was routed through the Stilling Pond. Although the exact configuration may change during design, this assumption appears to be sufficient for this concept level model.

4.2. Rainfall Data

Rainfall depths were taken from NOAA Atlas 14 for the storm events evaluated. The PMP event was formatted using the distribution chart included in NRCS TR-60, Figure 2-4 "*Dimensionless design storm distribution, auxiliary spillway and freeboard.*" Rainfall depths used in the HMS model are summarized below in Table 2.

Table 2. Rainfall Depths

Storm Event	Rainfall Depth (inches)
1-year 24-hour	2.84
10-year 24-hour	4.72
25-year 24-hour	5.52
50-year 24-hour	6.15
100-year 24-hour	6.80
6-hour PMP	36.3

4.3. Spillway Data

TVA drawings 10W421, 10N422, 10N423 depict the six risers in the Stilling Pond. The six riser structures were located and appeared to be consistent with current conditions during the field visit. Data was used from these drawings in the H&H analysis. Drawings can be found in Appendix B.

TVA drawings 10W425-24, 10W425-70, 10W425-77, 10W425-78, 10W425-79, 10W425-80 depict the five risers in the Ash Pond. The five riser structures were located and appeared to be consistent with current conditions during the field visit. Data was used from these drawings in the H&H analysis.

An Excel file provided by TVA titled "TVA Spillway Concrete Top Survey"; dated January 23, 2009 lists multiple plants with surveyed riser elevations and approximate riser invert elevations. The approximate riser invert elevations match the data given in TVA drawing 10W421. Data was used from these files in the H&H analysis. This was a conservative assumption used in the model. Stantec tested the sensitivity of this assumption and it did not overrule any of the findings discussed herein. A summary of the spillway data is listed below in Table 3.

The data gathered from these files were compiled to create the rating curves. The Ash Pond rating curves estimate the tailwater effects from the water surface elevation of the downstream Stilling Pond. The tailwater elevation changed with each storm event. Tailwater effects on the Stilling Pond were assumed to be equal to the 100-YR water surface elevation of the receiving river for all storm events. This was a conservative assumption used in the model. Stantec tested the sensitivity of this assumption and it did not overrule any of the findings discussed herein. A summary of the tailwater data is listed below in Table 4.

Table 3. Existing Principal Spillway and Emergency Spillway Data

Pond	Weir/Orifice Structure	Weir Length (ft)	Weir Elevation (ft)	Orifice Opening (ft^2)	Orifice Invert (ft)	Data Source
Ash Pond	1	48	760.00	36	752.00	TVA drawings 10W425-70, 10W425-79, 10N425-80
Ash Pond	2	48	760.00	36	752.00	TVA drawings 10W425-70, 10W425-79, 10N425-80
Ash Pond	3	48	760.00	36	752.00	TVA drawings 10W425-70, 10W425-79, 10N425-80
Ash Pond	4	48	760.00	36	752.00	TVA drawings 10W425-70, 10W425-79, 10N425-80
Ash Pond	5	48	760.00	36	752.00	TVA drawings 10W425-70, 10W425-79, 10N425-80
Stilling Pond	A	48	756.54	36	746.00	"TVA Spillway Concrete Top Survey", 1-23-09
Stilling Pond	B	48	754.48	36	746.00	"TVA Spillway Concrete Top Survey", 1-23-09
Stilling Pond	C	48	754.44	36	746.00	"TVA Spillway Concrete Top Survey", 1-23-09
Stilling Pond	D	48	754.43	36	746.00	"TVA Spillway Concrete Top Survey", 1-23-09
Stilling Pond	E	48	754.45	36	746.00	"TVA Spillway Concrete Top Survey", 1-23-09
Stilling Pond	F	48	754.42	36	746.00	"TVA Spillway Concrete Top Survey", 1-23-09

Table 4. Pond Tailwater Elevations

Pond	Riser Structure	Storm Event	Tailwater Elevation (ft)
Ash Pond	1-5	1-YR	755.2
Ash Pond	1-5	10-YR	755.5
Ash Pond	1-5	25-YR	755.6
Ash Pond	1-5	50-YR	755.6
Ash Pond	1-5	100-YR	755.7
Ash Pond	1-5	6-hr PMP	761.4
Stilling Pond	A-F	100-YR	748.4

4.4. Pond Overflow and Normal Pool

Table 5 shows the embankment elevation and the assumed normal pool elevations at each pond. The normal pool elevations were assumed to be equal to the principal riser elevation in the pond.

Table 5. Pond Overflow Elevation

Pond Name	Embankment Elevation (feet)	Normal Pool Elevation (feet)
Ash Pond	765.00	760.0
Stilling Pond	765.00	754.4

4.5. Stage Storage Data

Stage storage curves were developed for each pond based on data provided by TVA. For the Ash Pond and Stilling Pond, the stage-storage data came from AutoCAD files *Topo 02-27-10.dwg* and *MainAshPond 8-20-09.dwg*. Stage-storage curves are included in Appendix C for each pond. Survey data utilized can be found in Appendix D.

4.6. Spillway Rating Curves

Rating curves for the spillway systems were developed based on the geometric data available and weir, orifice, and culvert discharge relationships. Weir equations and coefficients were based on guidance provided in "Open Channel Hydraulics," V.T. Chow, 1959. Orifice equations and coefficients were based on guidance provided in "Handbook of Hydraulics," E. F. Brater and H.W. King, 1976. Culvert discharge ratings were developed using procedures outlined in "Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5 (HDS-5)," U.S. Department of Transportation Federal Highway Administration (FHWA) 1985.

The model takes into account a tailwater effect of the downstream WSEL of the Stilling Pond on the upstream outfall structures in the Ash Pond. A rating curve was developed for each storm event for the Ash Pond utilizing an expected downstream WSEL for the Stilling Pond. Tailwater elevation for the Stilling Pond was assumed to be the 100-YR WSEL of the receiving waterway (Emory River). Rating curves for each pond are attached in Appendix C.

4.7. Plant Process Flow

Pump discharge values used in the modeling match those provided on the wastewater flow schematic. As we understand, these discharge values are indicative of typical conditions during a normal full operation condition. According to the wastewater flow schematic, provided by TVA to Stantec the plant flows are 48.46 MGD (75 cfs). This value is used as a constant input in the model.

5. Results

Results are summarized in the following sections for the capacity/freeboard analysis. The results shown are based on the assumptions described herein and should be considered approximate.

5.1. Capacity and Freeboard Results

Estimated peak pool elevations for the storms analyzed are shown in Table 6. Numbers in bold indicate that the pond is likely overtopping the embankment for the associated storm event. Table 7 shows the estimated peak pond inflows associated with each event and Table 8 shows estimated peak pond outflows associated with each event.

Table 6. Estimated Peak Pool Elevations

Pond Name	1-year 24-hour storm (ft)	10-year 24-hour storm (ft)	25-year 24-hour storm (ft)	50-year 24-hour storm (ft)	100-year 24-hour storm (ft)	6-hr PMP storm (ft)
Ash Pond	760.8	761.1	761.2	761.3	761.4	***765.4**
Stilling Pond	755.2	755.4	755.5	755.5	755.6	761.0

*Vertical sides assumed above top of dike elevation at 765 ft to model overtopping event.

Table 7. Estimated Peak Pond Outflows

Pond Name	1-year 24-hour storm (ft)	10-year 24-hour storm (ft)	25-year 24-hour storm (ft)	50-year 24-hour storm (ft)	100-year 24-hour storm (ft)	6-hr PMP storm (ft)
Ash Pond	138	221	262	295	334	2154
Stilling Pond	128	191	221	247	273	718

Table 8. Estimated Peak Pond Outflows

Pond Name	1-year 24-hour storm (ft)	10-year 24-hour storm (ft)	25-year 24-hour storm (ft)	50-year 24-hour storm (ft)	100-year 24-hour storm (ft)	6-hr PMP storm (ft)
Ash Pond	138	221	262	295	334	2154
Stilling Pond	128	191	221	247	273	718

5.2. Ash Pond Closure Scenario Conditions Results

A separate H&H basin model for the closure scenario was created. For the closure scenario, the Ash Pond Stilling Pond was found to be sufficient to pass the 100-year storm, but not the PMP. See Tables 9, 10 and 11 for a summary of the results.

Table 9. Estimated Peak Pool Elevations – Ash Pond Closure Scenario

Pond Name	1-year 24-hour storm (ft)	10-year 24-hour storm (ft)	25-year 24-hour storm (ft)	50-year 24-hour storm (ft)	100-year 24-hour storm (ft)	6-hr PMP storm (ft)
Stilling Pond	754.9	755.5	755.7	755.9	756.2	***766.0**

*Vertical sides assumed above top of dike elevation at 765 ft to model overtopping event.

Table 10. Estimated Peak Pond Inflows – Ash Pond Closure Scenario

Pond Name	1-year 24-hour storm (cfs)	10-year 24-hour storm (cfs)	25-year 24-hour storm (cfs)	50-year 24-hour storm (cfs)	100-year 24-hour storm (cfs)	6-hr PMP storm (cfs)
Stilling Pond	227	553	700	819	942	5960

Table 11. Estimated Peak Pond Outflows – Ash Pond Closure Scenario

Pond Name	1-year 24-hour storm (cfs)	10-year 24-hour storm (cfs)	25-year 24-hour storm (cfs)	50-year 24-hour storm (cfs)	100-year 24-hour storm (cfs)	6-hr PMP storm (cfs)
Stilling Pond	69	230	315	371	400	4962

6. Conclusions and Recommendations

Based on the data gathering efforts, collective review of the data available, and the modeling efforts, Stantec noted the following observations:

- Aside from the principal spillway systems, there are no defined emergency spillways or overflow paths. Ponds similar in size and capacity to these typically have emergency spillway systems to prevent overflows.
    - If the principal spillways were to become clogged, or if a heavy rainfall event were to cause any of the ponds to overtop, there are no defined and protected overflow paths to help prevent erosion of the dikes.
- Based on the modeling of the current conditions, the Ash Pond appears unable to pass the PMP event through the existing principal spillway system without overtopping the embankment. It does appear to be able to pass the 100-year storm event.
    - In the event of a PMP storm, the Ash Pond would overtop the dike between the Ash Pond and the Stilling Pond as well as the embankment between the Ash Pond and the Emory River.
- A potential closure scenario was modeled assuming the Stilling Pond would function as it currently does, but act as a settling basin for the to-be closed Ash Pond prior to discharge to the Emory River. As presently configured and under this operational scenario, the Stilling Pond appears unable to pass the PMP

event through the spillway system without overtopping the embankment. It does appear to be able to pass the 100-year storm event.

- In the event of a PMP storm during the above described closure scenario, the Stilling Pond would overtop the dike between the Stilling Pond and the Emory River.

- As we understand, the principal spillway risers in the Stilling Pond are targeted for potential replacement. Upgrading the principal spillways so that the Stilling Pond would pass the PMP event would result in upgrading the six (6) existing risers to approximately 7' diameter risers with 6' diameter barrels. A complete design would need to be performed to determine the exact up-sizing necessary, but this would not appear to be as effective as a formal emergency spillway system for controlling large storm events such as the PMP.

Based on the results of the analysis, Stantec recommends TVA consider the following:

- Assess the risk of a PMP event occurring during the remaining life of the pond system.

- If necessary, consider installing an emergency spillway & overflow connector between the Ash Pond and Stilling Pond.

- Consider installing an emergency spillway between the Stilling Pond and the Emory River if the principal spillway system is replaced or during the closure of the Ash Pond.

Stantec recommends that these potential improvements be further evaluated by TVA to determine if they are warranted and can be incorporated into future construction projects at the plant.

7. References

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"Kingston Fossil Plant Flow Schematic Diagram." NPDES Permit No. TN0005452FP August, 2003.

Schreiner, Louis C. and Riedel, John T. (National Weather Service), "Hydrometeorological Report No. 51, Probable Maximum Precipitation Estimates, United States East of the 105th Meridian."

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US Department of Agriculture (USDA) National Engineering Handbook Part 630 – Hydrology. May, 2007.

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US Department of Transportation Federal Highway Administration (FHWA) "Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5 (HDS-5)." 1985.

Appendix A

Connectivity Map

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Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
Tel. 859.422.3000
Fax. 859.422.3100
www.stantec.com

Legend

Notes

Client/Project
TVA
KINGSTON H&H

Figure No.

Title
EXISITING CONDITIONS

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Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
Tel. 859.422.3000
Fax. 859.422.3100
www.stantec.com

Legend

Notes

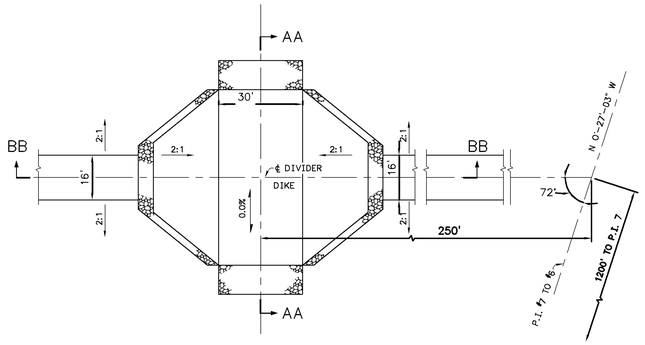
Client/Project
TVA
KINGSTON H&H

Figure No.

Title
CLOSEOUT CONDITIONS

Appendix B

TVA Historical Drawings



DETAIL B

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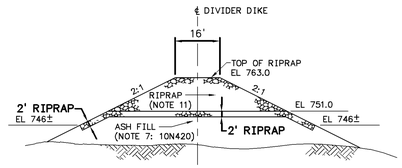
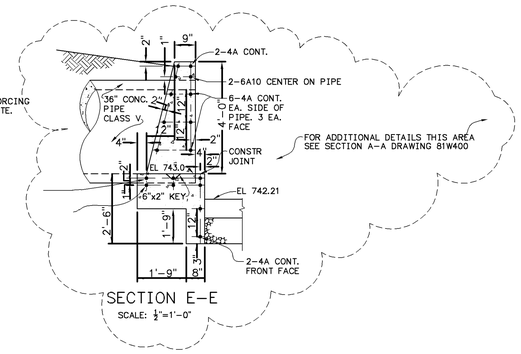


SECTION AA–AA

SCALE: 1"=20'

NOTE:
SPACER BARS BY FIELD

NOTE:
USE VERTICAL CONSTRUCTION JOINTS AT THIRD POINTS OF THE LENGTH WITH 6"x2" KEY. CHAMFER EXPOSED EDGES ¾". LAP REINFORCING BARS A MINIMUM DISTANCE OF 36" DIAMETERS. DIMENSIONS TO REINFORCING ARE CLEAR DISTANCES TO FACE OF CONCRETE.



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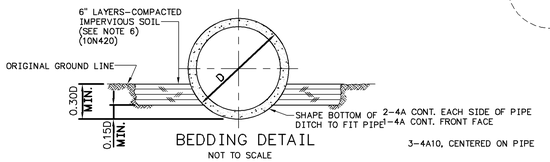

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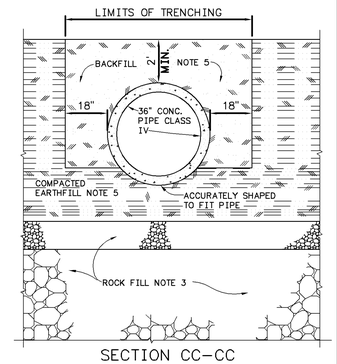
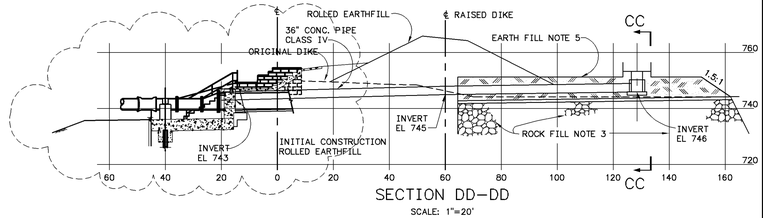


SECTION CC–CC

NTS



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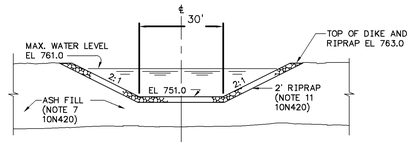
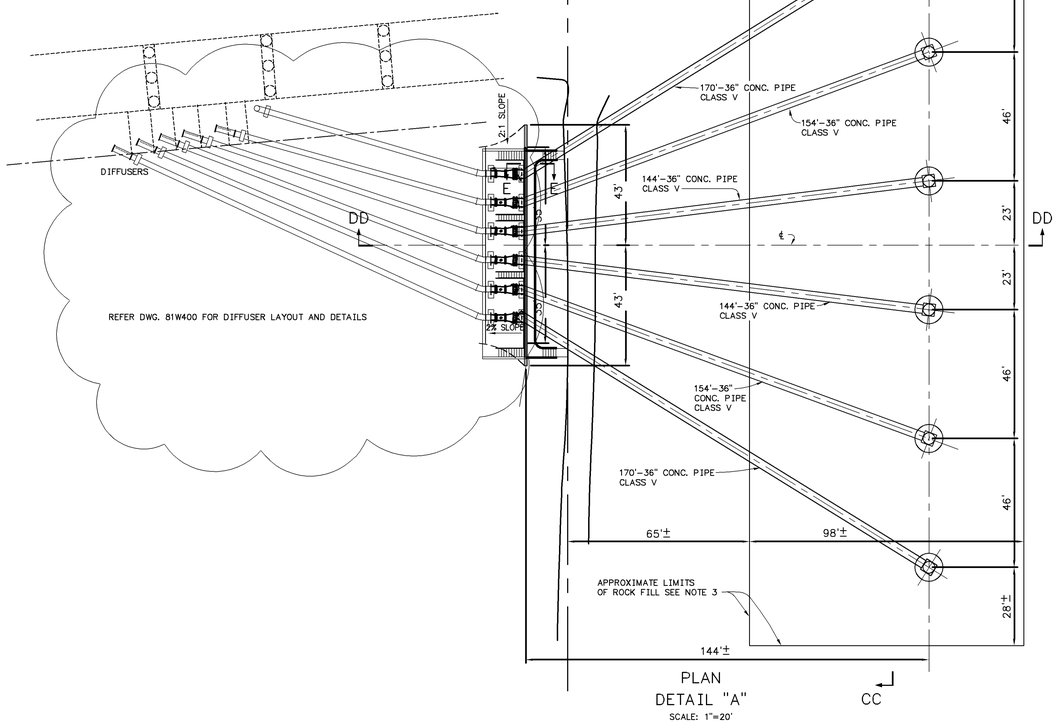


SECTION BB–BB

SCALE: 1"=20'

NOTES:
1. FOR ADDITIONAL NOTES SEE DWG. 10N420. NOTES BELOW ARE FOR REVISION R1.
2. SPILLWAYS, OUTLET PIPES, AND HEADWALL WERE INSTALLED IN 1976. OUTLET PIPES ARE CRACKED AND JOINTS OPEN GENERALLY OVER HALF THE PIPE LENGTH TOWARD THE SPILLWAYS. ALL PIPES ARE TO BE REMOVED AND REPLACED. THE SPILLWAY BOXES AND HEADWALL ARE TO BE RAISED 2 FEET AND THE PIPES LAID TO NEW GRADE AS SHOWN ON SECTION DD–DD.
3. THE ROCKFILL SHOWN ON PLAN–DETAIL "A" AND SECTIONS DD–DD AND CC–CC IS THE ROCKFILL PLACED IN ACCORDANCE WITH THE REPORT FROM J.P. HILLIER STIVERS TO CIVIL ENGINEERING AND DESIGN BRANCH FILES, DATED AUGUST 27, 1976, COPIES TO DIVISION OF CONSTRUCTION (H.H. MULL AND GENE FARMER) AMONG OTHERS. THE SPILLWAY BOXES AND PART OF THE OUTLET PIPE LENGTHS WERE INSTALLED ON THE ROCKFILL.
4. COMPACTED EARTH FILL IS TO BE PLACED ON THE ROCKFILL TO PROVIDE NEW FOUNDATION FOR THE SPILLWAY BOXES AND OUTLET PIPES. BEFORE THE EARTHFILL IS PLACED, THE ROCKFILL SHALL BE TESTED FOR SOUNDNESS. SEVERAL PASSES OF HEAVY EARTH MOVING EQUIPMENT SHALL BE MADE ON THE ROCKFILL TO ENSURE THAT THE ROCKFILL IS STABLE AND NON–SETTLING. IT MUST BE ASSURED THAT THERE IS A MINIMUM OF 6" OF COMPACTED CRUSHED STONE ON THE ROCKFILL TO PREVENT MIGRATION OF COMPACTED EARTHFILL INTO ROCKFILL.
5. COMPACTED EARTHFILL SHALL BE PLACED TO 2 FEET ABOVE TOP OF PIPE IN ACCORDANCE WITH NOTE 4 ON DWG. 10N420, TRENCHED AS SHOWN ON SECTION CC–CC, THE OUTLET PIPES LAID, AND THE PIPES BACKFILLED IN ACCORDANCE WITH NOTE 6 ON DWG. 10N420. THE SPILLWAY BOXES SHALL BE RESET ON THE COMPACTED EARTHFILL AND A NEW HEADWALL CONSTRUCTED. THE EARTHFILL AROUND THE SPILLWAY BOXES SHALL BE REMOVED TO EL 749 OR LOWER WHEN THE INSTALLATION OF THE SPILLWAYS, PIPES, AND HEADWALL IS COMPLETE. THE EARTHFILL SHALL BE REMOVED FROM A STRIP 10' EACH SIDE OF THE CENTERLINE OF THE SPILLWAY BOXES AND EXTENDING COMPLETELY BETWEEN ALL SPILLWAYS.

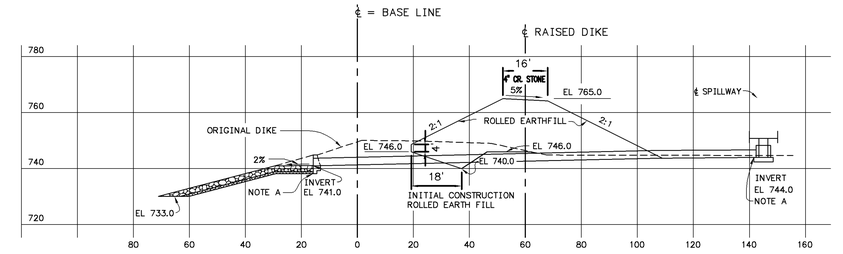


PLAN
DETAIL "A"

SCALE: 1"=20'

CC

DD

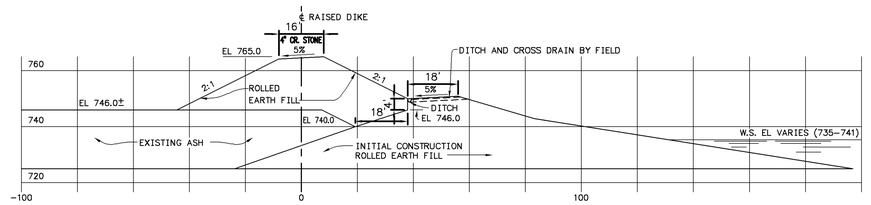


SECTION B–B

SCALE: 1"=20'
(10N420)

(PIPE DETAILS SUPERSEDED SEE SECT. DD–DD)

NOTE A:
STRUCTURES TO BE ON FIRM FOUNDATION. IF NATURAL GROUND IS NOT FIRM, REMOVE TO DEPTH OF 4' AND REPLACE WITH COMPACTED FILL.



NOTE:
AS DIKES ARE RAISED, THE FIELD SHALL PROVIDE DRAINAGE FROM THE TOP AND OUTSIDE SLOPES OF THE DIKES THAT WILL CONTROL EROSION OF THE DIKES.

SECTION A–A

SCALE: 1"=20'
(10N420)

COMPANION DRAWING: 10N420, N422, N423
HWY. PROJECT 2102

ACCESS SYSTEMS CERTIFIED INC.

ACCESS SYSTEMS INC CERTIFIES THIS CONVERSION AS CORRECT WITH ANY INCONSISTENCIES NOTED BY THIS STAMP. "F"

PROJECT REVISION HISTORY

R 4	06–05–03	CRN	SAK	PSN	ETK	REP/TJI	JGA/DGB		KIF451		D
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R 5	04–19–04	WWP	WHL	PSN	ETK	REP/TJI	JGA/DGB		KIF 451		D
ISSUED FOR DCN KIF–02–61 R0, APPROVALS PER EDMS B65 020912 251											
R 3	03–10–03	CRN	SAK	PSN	ETK	REP/TJI	JGA/DGB		KIF 451		D
ISSUED FOR DCN KIF 02–61/R0 APP PER EDMS B65 020912 251											

DISCIPLINE INTERFACE

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

SCALE: 1"=20' EXCEPT AS NOTED

ASH POND DIKE

SECTION & DETAILS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
D.R. GALLOWAY	J.R. LOY	D.R. GALLOWAY	J.P.H. STIVERS			

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R14	DATE 5–20–76	36	C	10W421	R 5

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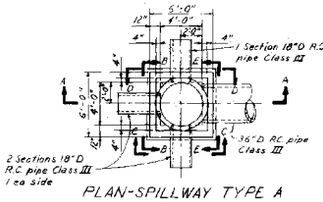
TASK COMPLETED BY:	REV NO.	

PLOT FACTOR:240
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

10N422



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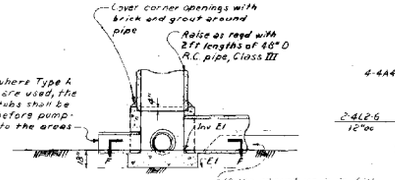

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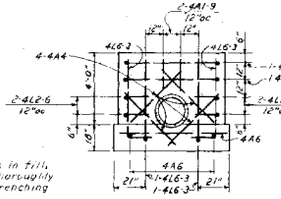

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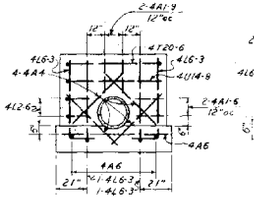

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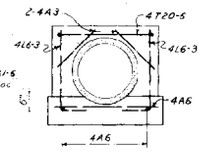

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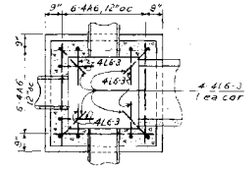

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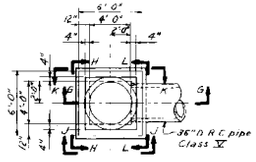

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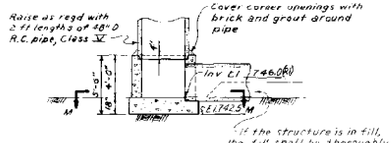

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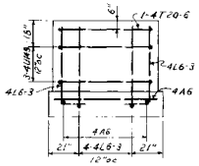

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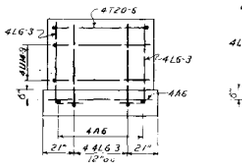

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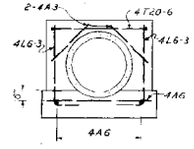

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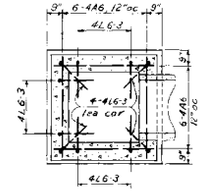

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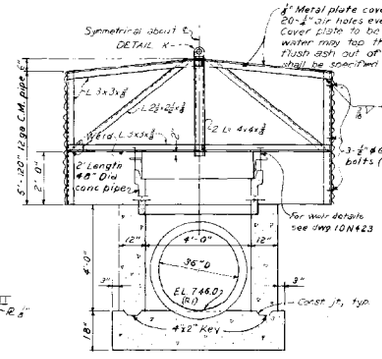

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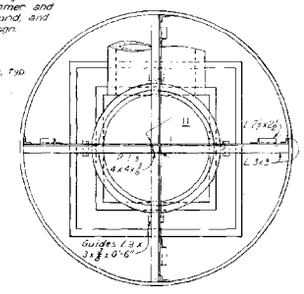

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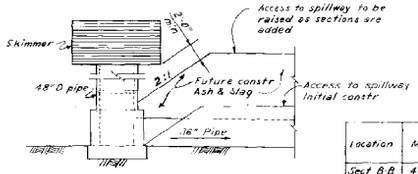
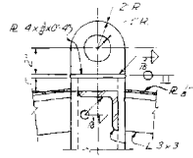


DETAIL A
Not to Scale



DETAIL X
Scale 3"=1'-0"

SKIMMER DETAILS
Scale ½"=1'-0"

(12) PLANT PERSONNEL SHALL DETERMINE THE NEED FOR ADDITIONAL DETENTION TIME IN THE DISPOSAL AREA AND SHALL PROVIDE THE ADDITIONAL DETENTION TIME BY ADDING A TWO FOOT SECTION OF 48" CONCRETE PIPE TO THE SPILLWAYS.

NOTES:
(1) SPECIFICATIONS: All work shall be done in accordance with the T-V Specifications.
(2) All concrete shall be Class A in accordance with Section 400.
~~(3) Where borrow can be obtained economically, example from disposal area if they be used to raise dikes.~~
~~(4) Vegetation shall be established on all earth slopes. Initial and future construction. Seeding specifications to be furnished with drawings for each project in general, type 3 Section 180 of T-V Specifications is recommended.~~
~~Elevation and elevation of the spillways shall be selected so as to maintain the depth of water in the ash pond at an absolute minimum.~~
~~(5) Use Type A spillways for ash areas not scheduled for immediate use.~~
~~(7) A section of 180° corrugated metal pipe, fully coated, shall be used for the skimmer device. All seams and joints shall be riveted. Fabrication of the pipe shall be complete prior to coating.~~
(8) One 2' section of 48" Dia pipe shall be installed during initial construction.
(9) As additional sections of 48" pipe are added, grout the joint to form a stable and water tight connection.
(10) Top of dike must be maintained a minimum of 4' above the elevation of water in the Ash Disposal Area.
(11) As dikes are raised the Field Shall provide drainage from the top and outside slopes of the dikes that will control erosion of dikes.
(12) SEE ABOVE NOTE.

REFERENCE DRAWINGS:
30B519 REINFORCEMENT BENDING DIAGRAMS

Scale ½"=1'-0"
Except as noted

Location	Mark	No. of Units per Unit	Unit Weight	Bend Dim. a	b	c
Sect B-B	4T20-6	1	1	5'-0	5'-0	
	4U14-9	1	1	5'-0	5'-0	Ex
	4L6-3	1	2	2'-0	Ex	
	4L2-6	1	4	1'-3	Ex	
	4A4	1	4			
	4A1-9	1	2			
Sect C-C&D-D	4L6-3	2	2	4	2'-0	Ex
	4A6	2	4	8		
	4A1-9	2	2	4		
	4A1-6	2	2	4		
Sect E-E	4A3	1	2			
Sect F-F	4L6-3	1	4	7'-9	Ex	
	4A6	1	12			

TYPE A SPILLWAY

Location	Mark	No. of Units per Unit	Unit Weight	Bend Dim. a	b	c
Sect H-H	4T20-6	1	1	5'-0	5'-0	
	4U14-9	1	3	5'-0	5'-0	Ex
	4L6-3	1	6	2'-0	Ex	
Sect J-J&K-K	4L6-3	2	4	8	2'-0	Ex
Sect L-L	4A3	1	2			
Sect M-M	4L6-3	1	4	2'-0	Ex	
	4A6	1	12			

TYPE B SPILLWAY

REINFORCEMENT SCHEDULE

BILL OF MATERIAL

ITEM	DESCRIPTION	NO. of Spwys	PER SPLWY	TOTAL RQMT
401	Class A Concrete	6	5 cu yd	30CUYD
416	Reinforcing Steel	6	170 lb	1020LB
~~603~~	~~18"D Reinforced Concrete Pipe-Class V~~ ~~Type A Only~~			
604	36"D Reinforced Concrete Pipe-Class V "O" RING	6	VARIES	936FT
* 604	48"D Reinforced Concrete Pipe-Class V (Bell & Spigot)	6	12	72FT
660	120°-12 Gage Corrugated Metal Pipe	6	5 ft	30FT
	¾" ϕ Galvanized Bolt	6	12	72
	~~Metal cover ——— (By Field see Skimmer Details)~~	~~6~~	~~1~~	~~6~~
	L 3x3x⅜ Angle	6	23 ft	138FT
	3x3x⅜ Angle	6	67 ft	402FT
	4x4x⅜ Angle	6	8 ft	48FT

* 48" CONCRETE PIPE TO BE IN 2' LENGTHS.

INSPECTED AND APPROVED FOR ISSUE
DESIGN PROJECT MANAGER

COMPANION DRAWING: 10N420, N421, N423
HWY PROJECT C10Z

STANDARD DRAWING

ASH DISPOSAL SPILLWAY

KINGSTON STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
Robert J. Bowman	R. B. Scott	G. L. Buchanan
KNOXVILLE	5-20-76	35 C 10N422 R1

RECORD DRAWING AS CONSTRUCTED

PRINTS REQD-9
AMT OF PROJ
DWG SIZE
F H
WE
TE
GE
AD
CD
ED
MD
BF
SW
BL
FA

MARK	DATE	NAME	CHKD	SUPV	INSP	SUBM	RECM	TYPE
ORIGINAL								
DESIGN				SUPV.				
DRAWN				INSP.				
CHKD				SUBM.				
TRCD				RECM.				
COMP.				APPROVED				

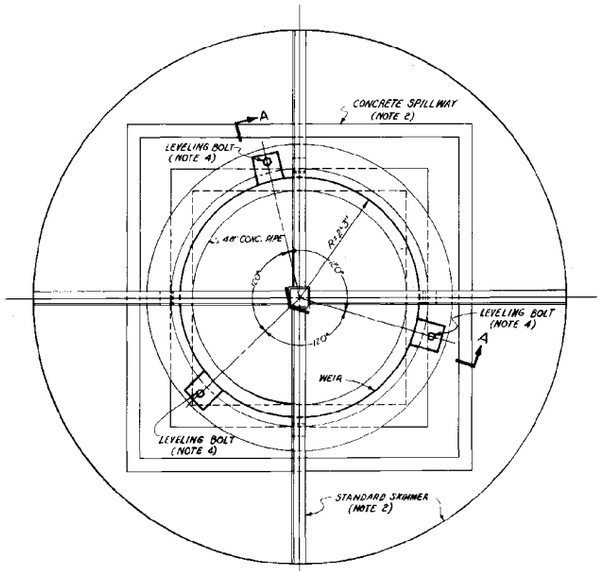
DO NOT USE ORIGINAL

Conc Type C 4.9 cu yd
" D 4.7 cu yd

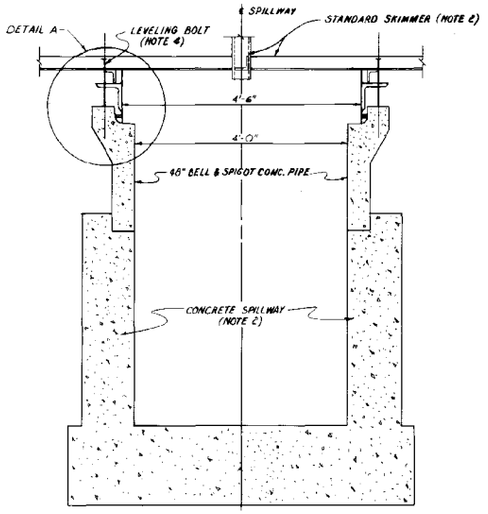
DO NOT USE ORIGINAL

TVA-00000568

10N423



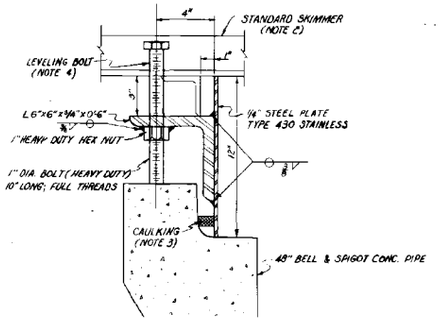
PLAN
SCALE: 1"=1'



SECTION A-A
SCALE: 1"=1'

WEIR DISCHARGE
IN CUBIC FEET PER SECOND

HEAD IN FEET	0.0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.	.04	.11	.21	.35	.52	.72	.95	1.20	1.54
0.1	1.54	1.75	1.97	2.20	2.44	2.70	2.96	3.24	3.52	3.81
0.2	4.11	4.41	4.72	5.04	5.36	5.69	6.04	6.38	6.73	7.10
0.3	7.47	7.85	7.23	8.62	9.00	9.41	9.82	10.2	10.6	11.1
0.4	11.5	11.9	12.4	12.8	13.3	13.7	14.2	14.7	15.1	15.6
0.5	16.1	16.6	17.1	17.6	18.1	18.6	19.1	19.6	20.1	20.7
0.6	21.2	21.7	22.3	22.8	23.4	23.9	24.5	25.0	25.6	26.2
0.7	26.7	27.3	27.9	28.5	29.1	29.7	30.3	30.9	31.5	32.1
0.8	32.7	33.4	34.0	34.6	35.2	35.9	36.5	37.2	37.8	38.5
0.9	39.1	39.8	40.4	41.1	41.8	42.5	43.1	43.8	44.5	45.2
1.0	45.9									



DETAIL A
3 REQUIRED
SCALE: 3"-1'-0"

NOTES:
1. ALL CONNECTIONS TO BE WELDED.
2. FOR SKIMMER AND SPILLWAY DETAILS SEE STD. DWG. 10N422.
3. CAULKING SHALL EXTEND COMPLETELY AROUND THE WEIR AND FORM A WATER TIGHT SEAL.
4. WHEN THE WEIR IS INSTALLED THE TOP SHALL BE LEVELED WITH THE USE OF LEVELING BOLTS.

REFERENCE DRAWING: 10N422 ASH DISPOSAL SPILLWAY

BILL OF MATERIAL

ITEM	DESCRIPTION	NO. SHEETS	PER SHEET	TOTAL REQ'D.
ANGLES	5"x6"x 3/4"x 0'-6"	6	3	18
BOLTS	1"x 10" HEAVY DUTY (FULL THREADS) W/NUT	6	3	18
STEEL PLATE	12"x 14" 2" TYPE 430 STAINLESS	6	1	6
CAULKING	BY FIELD			

SCALE AS NOTED

STANDARD DRAWING

WEIR FOR ASH DISPOSAL SPILLWAY

KINGSTON STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
Robert J. Bowman		G. L. Buchanan

KNOXVILLE | 5-20-76 | 36 | HR | 5 | 10N423 | R0

RECORD DRAWING AS CONSTRUCTED

INSPECTED AND APPROVED FOR ISSUE
DESIGN PROJECT MANAGER

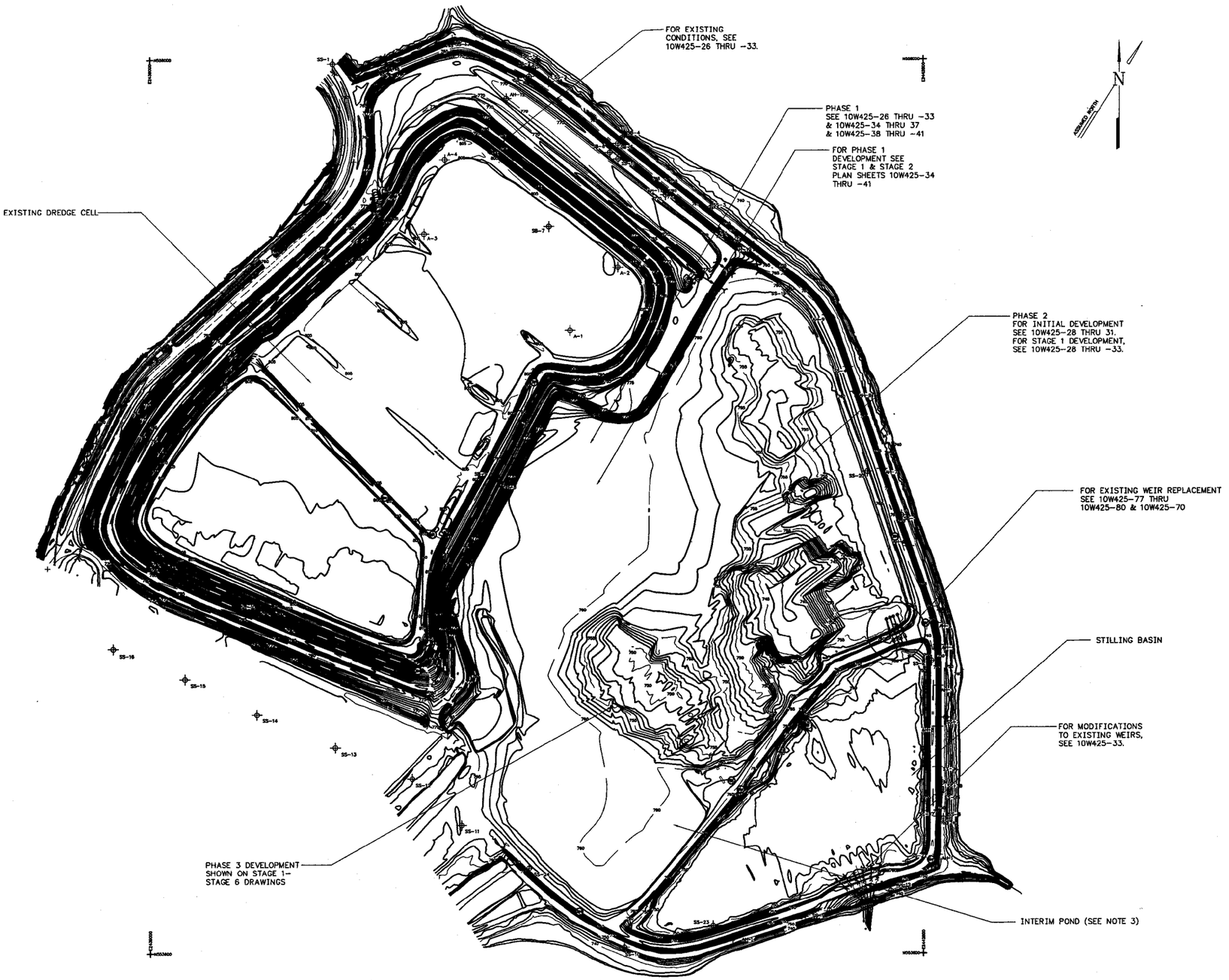
COMPANION DRAWING: 10N420, N421, N422
HMT. PROJECT 2102

REV NO	DATE	MADE	CHKD	SUPV	WEB	SUBM	RECM
DSGN							
DRWN							
TRCD							
CONF							

SUPV. H.N. Stafford
WSP J.E. Fox
APPD D.R. Gallyon
ENGINEER E.B. Jones

ORIGINAL - DO NOT USE

TVA-00000569



NOTES:

1. FOR DRAWING INDEX AND LEGEND, SEE DRAWING 10W425-20.
2. DRAWINGS 10W425-24 AND -25 DEPICT PHASED CONSTRUCTION INFORMATION. INITIAL CONSTRUCTION DRAWINGS BEGIN WITH 10W425-26.
3. FOR INTERIM POND DEVELOPMENT, SEE NOTE 3 ON 10W425-28.

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE
R 0		HLP	DRD	REP	SRC	LJP	DLL		KIF531		
INITIAL ISSUE PER DCA KIF-05-1074-001-R0											

SCALE: 1" = 200' EXCEPT AS NOTED

YARD

PHASE 1 DREDGE CELL LATERAL EXPANSION DEVELOPMENT PLAN SHEET 1

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
H.L. PETTY	D.R. DODSON	R.E. PURKEY	S.R. CATHEY	L.J. PETERSON	D.L. LUNDY	

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

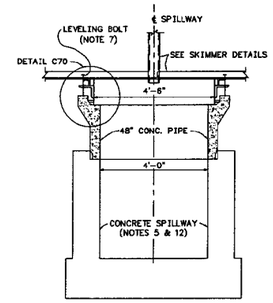
AUTOCAD R 14	DATE	36	C	10W425-24	R 0

TASK COMPLETED BY: | REV NO.

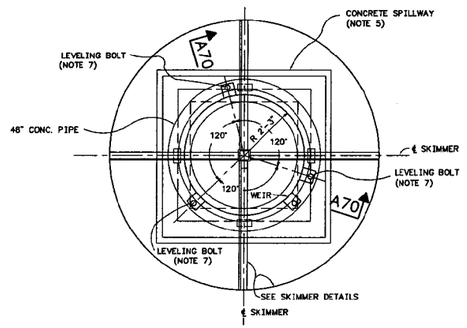
PLOT FACTOR: 200
W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

TVA-00000346

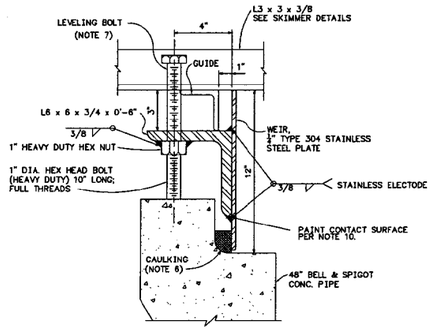


SECTION A70



PLAN

DETAIL B70
WEIR DETAILS



DETAIL C70
3 REQUIRED
3"=1'-0"

WEIR DISCHARGE * IN CUBIC FEET PER SECOND										
HEAD IN FEET	0.0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	.0	.04	.11	.21	.35	.52	.72	.95	1.20	1.34
0.1	1.54	1.75	1.97	2.20	2.44	2.70	2.96	3.24	3.52	3.81
0.2	4.11	4.41	4.72	5.04	5.36	5.69	6.04	6.38	6.73	7.10
0.3	7.47	7.85	8.23	8.62	9.00	9.41	9.82	10.20	10.60	11.10
0.4	11.50	11.90	12.40	12.80	13.30	13.70	14.20	14.70	15.10	15.60
0.5	16.10	16.60	17.10	17.60	18.10	18.60	19.10	19.60	20.10	20.70
0.6	21.20	21.70	22.30	22.80	23.40	23.90	24.50	25.00	25.60	26.20
0.7	26.70	27.30	27.90	28.50	29.10	29.70	30.30	30.90	31.50	32.10
0.8	32.70	33.40	34.00	34.60	35.20	35.90	36.50	37.20	37.80	38.50
0.9	39.10	39.80	40.40	41.10	41.80	42.50	43.10	43.80	44.50	45.20
1.0	45.90									

* 4'-6" DIAMETER

BILL OF MATERIAL				
ITEM	DESCRIPTION	NO. SPLWYS.	PER SPLWY.	TOTAL REQ'D.
	WEIR			
ANGLE	6 x 6 x 3/4 x 0'-6"		3	
BOLT	1"ø x 0'-10" HEAVY DUTY (FULL THREADS) WITH NUT		3	
PL CAULKING	1/4 x 12 x 14'-2" TYPE 304 STAINLESS BY FIELD		1	
	SKIMMER			
660	120" x 12 GAGE CORRUGATED METAL PIPE (NOTE 4)		5 FT.	
BOLT	1/2" ø x 0'-1 1/2 GALVANIZED		12	
PL	1/8" METAL COVER (BY FIELD SEE DETAILS)		1	
ANGLE	2 1/2 x 2 1/2 x 3/8		23 FT.	
ANGLE	3 x 3 x 3/8		64 FT.	
ANGLE	4 x 4 x 3/8		8 FT.	

BENT BAR LIST						
BAR MARK	NO REQD	BENDING DIMENSIONS				
		a	b	c	e	
4L6-3	10	4-4	EX			
4T20-6	1	5-0	5-0			
4U14-9	1	5-0	5-0	EX		
4L2-6	4	1-3	EX			

TYPE A SPILLWAYS

BENT BAR LIST						
BAR MARK	NO REQD	BENDING DIMENSIONS				
		a	b	c	e	
4L6-3	15	4-4	EX			
4T20-6	1	5-0	5-0			
4U14-9	3	5-0	5-0	EX		

TYPE B SPILLWAYS

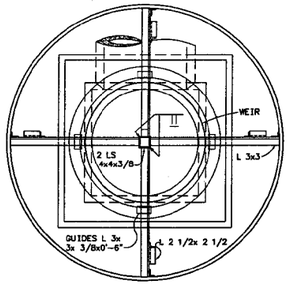
BILL OF MATERIAL				
ITEM	DESCRIPTION	NO. OF SPLWYS	PER SPLWY	TOTAL REQD
402	CLASS X CONCRETE		5 CU. YD.	
418	REINFORCING STEEL		170 LB.	
	18" D REINFORCED CONCRETE PIPE-CLASS II			
	36" D REINFORCED CONCRETE PIPE-CLASS III			
603	48" D REINFORCED CONCRETE PIPE-CLASS IV			

NOTES:

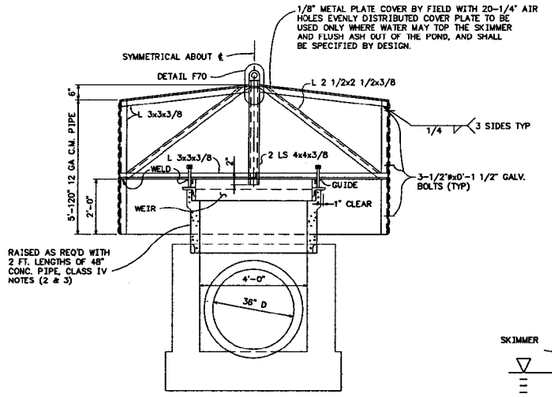
1. A SECTION OF 120" DIA. CORRUGATED METAL PIPE, FULLY COATED, SHALL BE USED FOR THE SKIMMER DEVICE. FABRICATION OF THE PIPE SHALL BE COMPLETE PRIOR TO COATING.
2. ONE SECTION OF 48" PIPE SHALL BE INSTALLED DURING INITIAL CONSTRUCTION.
3. AS ADDITIONAL SECTIONS OF 48" PIPE ARE ADDED, GROUT THE JOINT TO FORM A STABLE AND WATER TIGHT CONNECTION.
4. ALL CONNECTIONS TO BE WELDED.
5. FOR SPILLWAY DETAILS SEE STD. DWG. SD-C11.1.
6. CAULKING SHALL EXTEND COMPLETELY AROUND THE WEIR AND FORM A WATER TIGHT SEAL.
7. WHEN THE WEIR IS INSTALLED THE TOP SHALL BE LEVELED WITH THE USE OF LEVELING BOLTS.
8. ALL WELDS BY TVA FIELD SHALL BE MADE AND INSPECTED IN ACCORDANCE WITH TVA CONSTRUCTION SPECIFICATION G29C.
9. ALL WELDS BY TVA TO HAVE VISUAL INSPECTION.
10. ALL SURFACES OF FABRICATED STEEL ITEMS SHALL BE PAINTED IN ACCORDANCE WITH CONSTRUCTION SPECIFICATION G14, PART XIX.
11. DEWATER AREA WHERE WEIRS ARE TO BE INSTALLED BY CONSTRUCTING ASH DIKES OR INSTALLING SHEET PILE, AND REMOVING WATER FROM THE INSTALLATION AREA. DESIGN OF ASH DIKES AND/OR SHEET PILE BY TVA FES.
12. PROVIDE ADEQUATE FIRM BASE FOR INSTALLATION OF CONCRETE SPILLWAY BY INSTALLING ROCK BASE OR TENSAR GEOGRID. SELECTION OF TENSAR GEOGRID. SELECTION OF TENSAR GEOGRID BY TVA FES.

NOTES:

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE T-1 SPECIFICATIONS, UNLESS OTHERWISE NOTED.
2. ALL CONCRETE SHALL BE CLASS "X" IN ACCORDANCE WITH SECTION 400.
3. ALL REINFORCEMENT SHALL CONFORM TO ASTM SPECIFICATION A615 GRADE 60, DEFORMED.
4. DIMENSIONS SHOWN ARE TO THE CENTERLINE OF REINFORCING BARS, UNLESS OTHERWISE NOTED.
5. CONCRETE CLEAR COVER DIMENSIONS ARE AS FOLLOWS:
   3 INCHES FOR FACES CAST AGAINST EARTH OR ROCK;
   2 INCHES FOR ALL OTHER FACES.

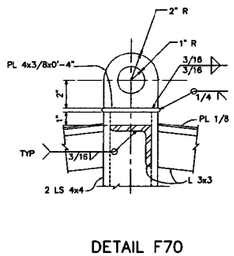


SECTIONAL PLAN

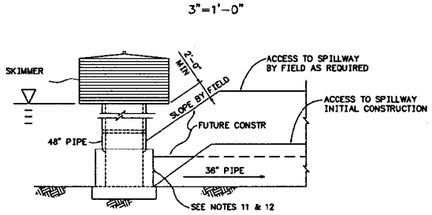


SECTIONAL ELEVATION

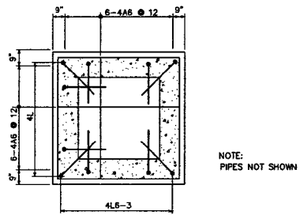
DETAIL D70
SKIMMER DETAILS



DETAIL F70
3"=1'-0"

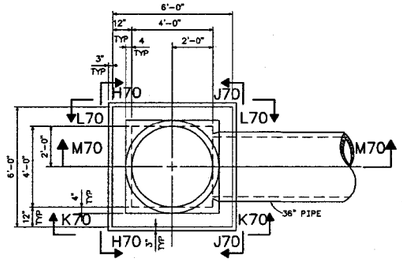


DETAIL E70
TYPICAL SECTION FOR
ACCESS TO SPILLWAY
3/16"= 1'-0"

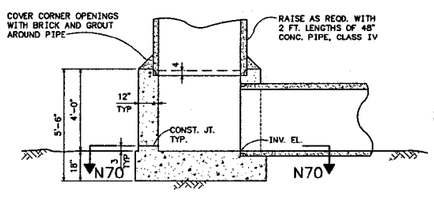


NOTE:
PIPES NOT SHOWN

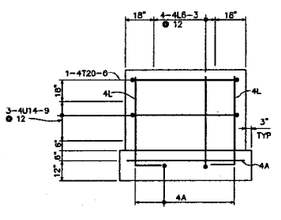
SECTION N70
(TYPE A & B)



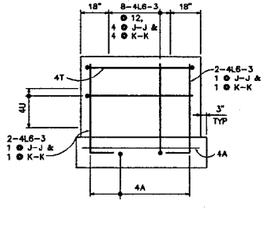
DETAIL G70
PLAN-SPILLWAY TYPE B



SECTION M70



SECTION H70
SECTION J70
(OPPOSITE HAND)



SECTION K70
SECTION L70
(OPPOSITE HAND)

R											
R 0		HLP	DRD	REP	SRC	LJP	DLL		KIF531		J
INITIAL ISSUE PER DCA KIF-05-1074-002-R0											DISCIPLINE INTERFACE
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	SEAL

SCALE: NONE EXCEPT AS NOTED

YARD

ASH DISPOSAL AREA
LATERAL EXPANSION
WEIR & SKIMMER DETAILS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
H.L. PETTY	D.R. DODSON	R.E. PURKEY	S.R. CATHEY	L.J. PETERSON	D.L. LUNDY	

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R14 | DATE | 36 | C | 10W425-70 | R 0

TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

TVA-0000347

EXISTING
ASH POND

WATTS BAR LAKE NORMAL
POOL = 741.0

EXISTING WEIR
(SEE NOTE 3)

EXISTING WEIR
(SEE NOTE 3)

EXISTING DISCHARGE PIPES
(SEE NOTE 3)

EXISTING WALKWAY
(SEE NOTE 6)

EXISTING
LIME
DISCHARGE

NEW DIKE
(SEE NOTE 5)

TURBIDITY
CURTAIN
(BY OTHERS)

NEW DIKE
(SEE NOTE 5)

WEIR
(TYP)

DIVIDER DIKE

NEW LIME
DISCHARGE

STILLING BASIN

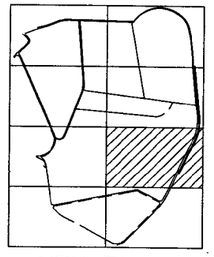
APPROXIMATE FUTURE
TOE OF GYPSUM/ASH
DISPOSAL FACILITY

DETAIL B70
(SEE 10W425-70)

ASSUMED NORTH

WEIR REPLACEMENT GENERAL NOTES:

1. FOR DRAWING INDEX & LEGEND SEE 10W425-20
2. FOR GENERAL NOTES SEE 10W425-26.
3. AFTER INSTALLATION OF NEW WEIRS, DISCONNECT STORM DRAIN FROM WEIR AT LOCATION NEAR DIVIDE DIKE, TREMIE GROUT STORM DRAINS CONNECTED TO EXISTING WEIRS. GROUT SHALL CONSIST OF VOLCLAY GROUT OR VOLCLAY GRANULAR GROUT, AS MANUFACTURED BY CETCO. MIX AND PLACE GROUT AS RECOMMENDED BY THE MANUFACTURER. VOLCLAY GRANULAR GROUT MAY BE MIXED WITH FLYASH IN LIEU OF SILICA SAND. MIXTURE SHALL BE PUMPABLE, YET STIFF ENOUGH TO INSTALL UNDERWATER. INSTALL TREMIE PIPE & VERIFY FULL PENETRATION TO OUTLET END OF STORM DRAIN. SEAL WELD 1/4" THICK A36 STEEL PLATE TO END OF STORMDRAIN TO PREVENT FLOWING WATER. PUMP GROUT MIXTURE INTO PIPE AND GRADUALLY WITHDRAW TREMIE PIPE DURING FILLING. MAINTAIN TREMIE PIPE WITHIN GROUT TO PREVENT THE FORMATION OF AIR POCKETS OR HONEYCOMB AREAS.
4. OTHER METHODS MAY BE USED BY THE CONTRACTOR TO GROUT WEIR DISCHARGE PIPING, IF APPROVED BY ENGINEERING.
5. NEW DIKE SHOWN IN FINAL CONFIGURATION. SEE DRAWING 10W425-78 FOR DIKE CONSTRUCTION
6. REMOVE TWO SECTIONS (APPROXIMATELY 20 FT) OF THE EXISTING WALKWAY AT THE DIVIDER DIKE SIDE TO PREVENT PERSONNEL FROM ACCESSING THE EXISTING WEIR. THE REMAINING SECTION OF THE WALKWAY SHALL REMAIN IN PLACE. EXISTING WOODEN POLES SHALL BE LEFT IN PLACE AND NOT REMOVED.



KEY PLAN

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	XYRD	APPD	ISSD	PROJECT ID	AS CONST	DISCIPLINE INTERFACE
R 0		HLP	DRD	REP	SRC	LJP	DLL		KIF531		J
INITIAL ISSUE PER DCA KIF-05-1074-003-R0											

SCALE: 1" = 50' EXCEPT AS NOTED

YARD

DREDGE CELL
WEIR REPLACEMENT
OVERALL PLAN

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
H.L. PETTY	D.R. DODSON	R.E. PURKEY	S.R. CATHEY	L.J. PETERSON	D.L. LUNDY	

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

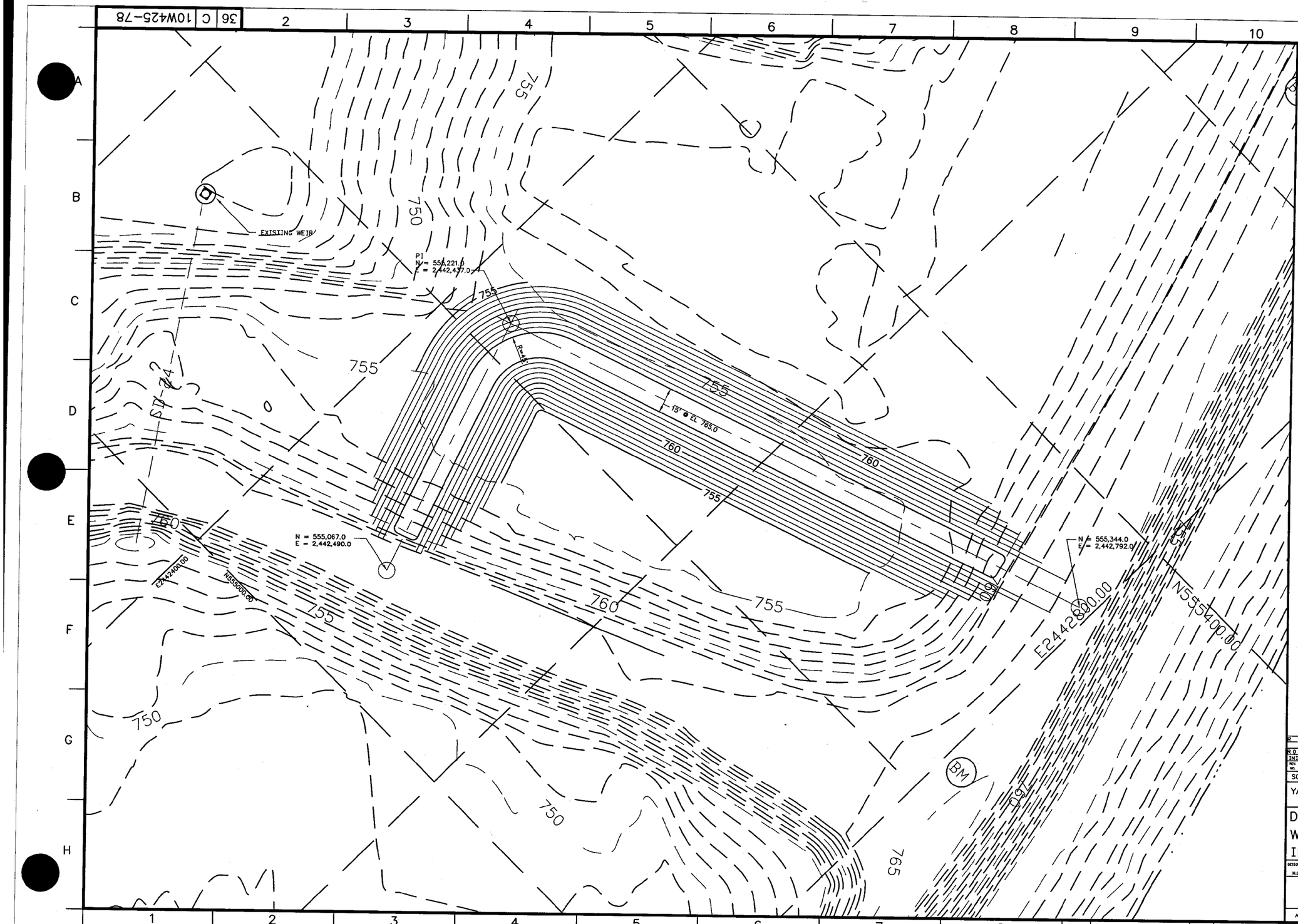
AUTOCAD R14 | DATE | 36 | C | 10W425-77 | R 0

TASK COMPLETED BY: | REV NO.

PLOT FACTOR:50
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

TVA-00000348



NOTES:

1. FOR WEIR REPLACEMENT GENERAL NOTES, SEE 10W425-77
2. NEW DIKE SHALL BE CONSTRUCTED AS SHOWN TO ALLOW FOR DEWATERING OF THE CONSTRUCTION AREA. CONSTRUCT THE NEW DIKE IN CONFORMANCE WITH DETAILS SHOWN ON 10W425-6 AND 10W425-72, EXCEPT THAT UNDERDRAINS ARE NOT REQUIRED. ASH SHALL BE BOTTOM ASH OR A MIXTURE OF FLYASH AND BOTTOM ASH OBTAINED FROM THE DREDGE CELL. PLACE BOTTOM ASH AND COMPACT TO ESTABLISH AN INITIAL WORKING BASE SUITABLE TO SUSTAIN EQUIPMENT LOADS. THEN PLACE ASH IN THIN LIFTS AND COMPACT.
3. TESTING FOR COMPACTED DIKES AS PRESCRIBED IN THE QA/QC PLAN IS NOT REQUIRED FOR THIS DIKE, BECAUSE IT IS NOT A LOAD-BEARING DIKE FOR ASH DISPOSAL. AFTER A FIRM BASE IS ESTABLISHED, PERFORM COMPACTION TESTING AT FOUR TESTS PER LIFT.

R													
R 0	HLP	DRD	REP	SRC	LJP	DLL		KIF53I					J
INITIAL ISSUE PER DCA KIF-05-1074-004-R0													
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV. ID	DISCIPLINE INTERFACE	

SCALE: 1" = 20' EXCEPT AS NOTED

YARD

DREDGE CELL
WEIR REPLACEMENT
INITIAL DIKE LAYOUT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
H.L. PETTY	D.R. DODSON	R.E. PURKEY	S.R. CATHEY	L.J. PETERSON	D.L. LUNDY	

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

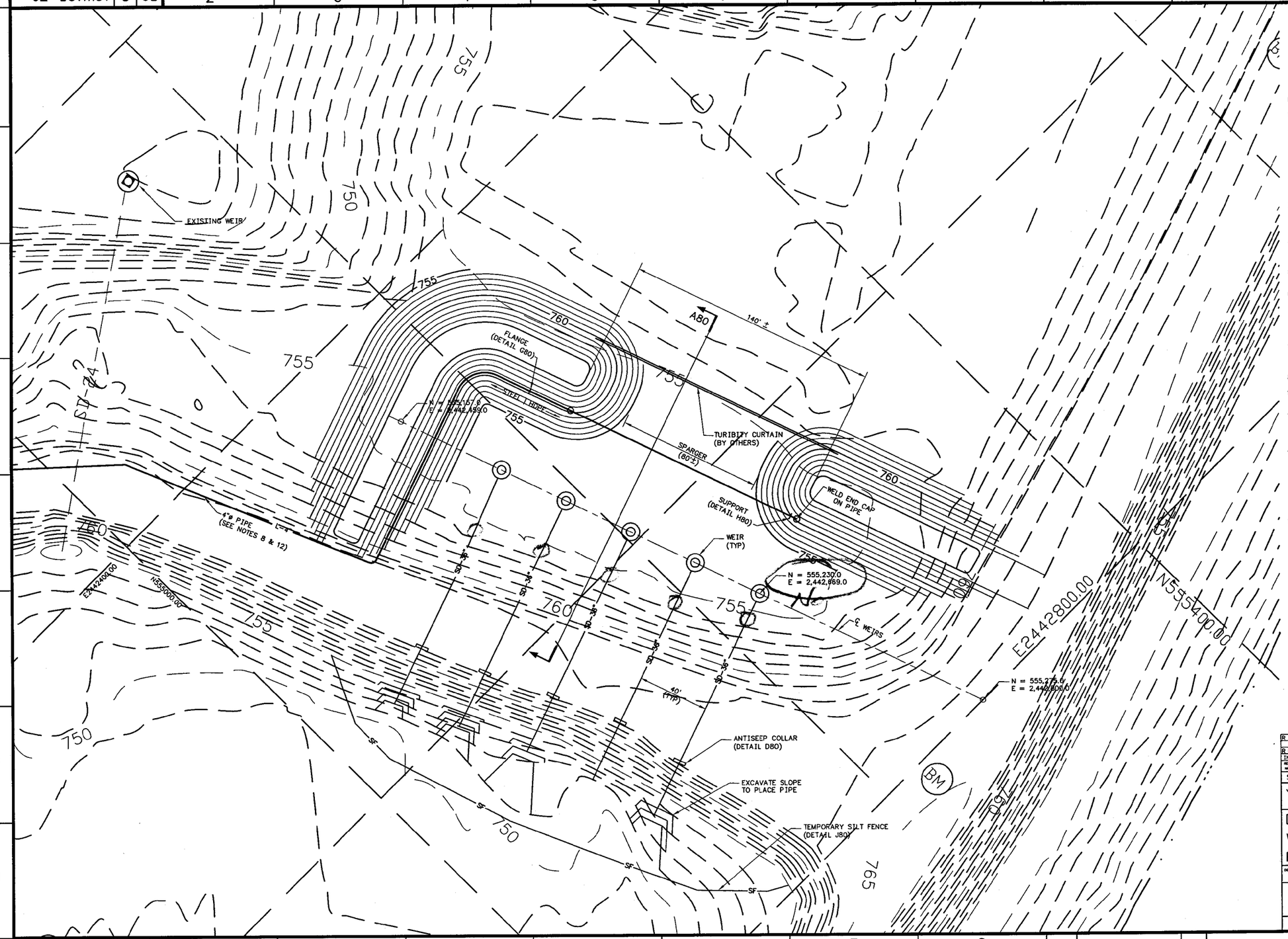
AUTOCAD R14	DATE	36	C	10W425-78	R 0

TASK COMPLETED BY: | REV NO.

PLOT FACTOR:20
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

TVA-00000349



NOTES:

1. FOR WEIR REPLACEMENT GENERAL NOTES, SEE 10W425-77.
2. REMOVE EXISTING LIME SLUDGE DISCHARGE LINE WHERE IT IS ROUTED FROM THE BANK TO THE EXISTING WEIR. PIPE MAY BE REUSED AT CONSTRUCTOR'S OPTION, OR A NEW PIPE USED TO REROUTE THE LIME SLUDGE DISCHARGE LINE TO THE NEW WEIRS. NEW PIPE SHALL BE STEEL PIPE TO MATCH DIAMETER AND WALL THICKNESS OF EXISTING. BUTT WELD OR USE FLANGE CONNECTION TO SPLICE THE PIPE TOGETHER WHERE IT IS REROUTED TO THE NEW WEIR. INSTALL LIME SLUDGE DISCHARGE LINE TO THE NEW WEIRS AS SHOWN.
3. WHERE DISCHARGE PIPE IS TO BE SUBMERGED, PIPING SHALL BE HDPE, SDR 11. WELD A STEEL FLANGE ADAPTOR TO THE FABRICATED AS A SPARGER. SEE DETAILS ON 10W425-80.
4. AFTER COMPLETION OF WEIR INSTALLATION, EXCAVATE THE CENTER SECTION FROM THE DIKE AS SHOWN, TO ALLOW THE ASH POND TO DISCHARGE TO THE STILLING BASIN.
5. REMOVE SECTIONS OF DISCHARGE FROM EXISTING WEIRS, AND TREMIE GROUT AS DISCUSSED IN NOTE 3 ON 10W425-77.
6. PIPE AND FITTING USED TO CONSTRUCT HDPE LIME SLUDGE DISCHARGE PIPING SHALL BE HIGH-DENSITY POLYTHYLENE (HDPE) PE 3408 PIPE. CELL CLASSIFICATIONS 345444C IN ACCORDANCE WITH ASTM D 3350. ALL PIPING AND FITTINGS SHALL BE NEW MATERIAL AND BE INSTALLED IN ACCORDANCE WITH TH MANUFACTURER'S INSTRUCTIONS.
7. ALL HDPE PIPING AND FITTINGS SHALL BE JOINED BY BUTT FUSION WELDING, IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
8. PROVIDE MINIMUM 0.5% SLOPE ON LIME SLURRY PIPE.
9. INSTALL WEIR AT EL 760 AS SHOWN. WEIR WILL BE LOWERED TO EL 758 PRIOR TO GYPSUM/ASH DISPOSAL FACILITY CONSTRUCTION.
10. PROTECT EXCAVATIONS BY SHORING, BRACING, SHEET PILING, OR OTHER METHODS AS REQUIRED TO PREVENT CAVE-IN OF LOOSE SOIL INTO EXCAVATION IN ACCORDANCE WITH OSHA 29 CFR 1926, SUBPART P - EXCAVATION.
11. PRIOR TO REMOVING INSULATION FROM EXISTING LIME SLURRY DISCHARGE PIPE, DETERMINE WHETHER INSULATION CONTAINS ASBESTOS. CONTACT KIF ENVIORNMENTAL PROGRAM ADMINISTRATOR PA(E) (LINDA CAMBPELL) PRIOR TO REMOVING INSULATION. REMOVE INSULATION IN ACCORDANCE WITH OSHA REQUIREMENTS. IF IT CONTAINS ASBESTOS. DISPOSE OF ASBESTOS-CONTAINING MATERIALS IN ACCORDANCE WITH STATE OF TENNESSEE SOLID WASTE REQUIREMENTS.
12. SPACE SUPPORTS FOR 4" ø LIME SLURRY PIPING ON 10' CENTER TO CENTER. SEE PIPE SUPPORT DETAIL H80 ON 10W425-80.

DCA 1074
PIC 05-1077
Ant - 1

R														
R 0		HLP	DRD	REP	SRC	LJP	DLL		KIF531					J
INITIAL ISSUE PER DCA KIF-05-1074-005-RO														
REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPV	ISSD	PROJECT ID	AS CONST				DISCIPLINE INTERFACE

SCALE: 1" = 20' EXCEPT AS NOTED

YARD

DREDGE CELL
WEIR REPLACEMENT
FINAL DIKE & WEIR LAYOUT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
H.L. PETTY	D.R. DODSON	R.E. PURKEY	S.R. CATHEY	L.A. PETERSON	D.L. LUNDY	

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

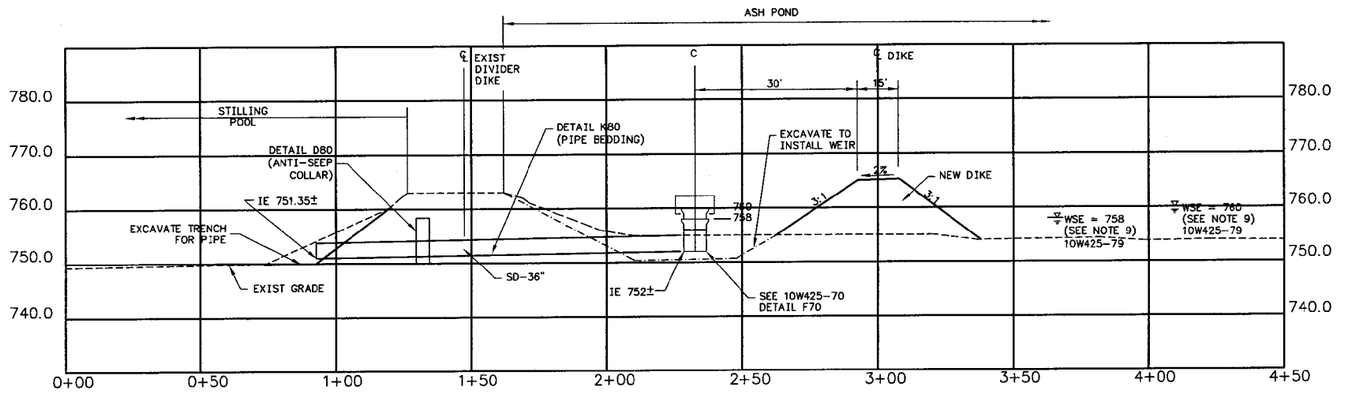
AUTOCAD R14	DATE	36	C	10W425-79	R 0

PLOT FACTOR:20
W_TVA

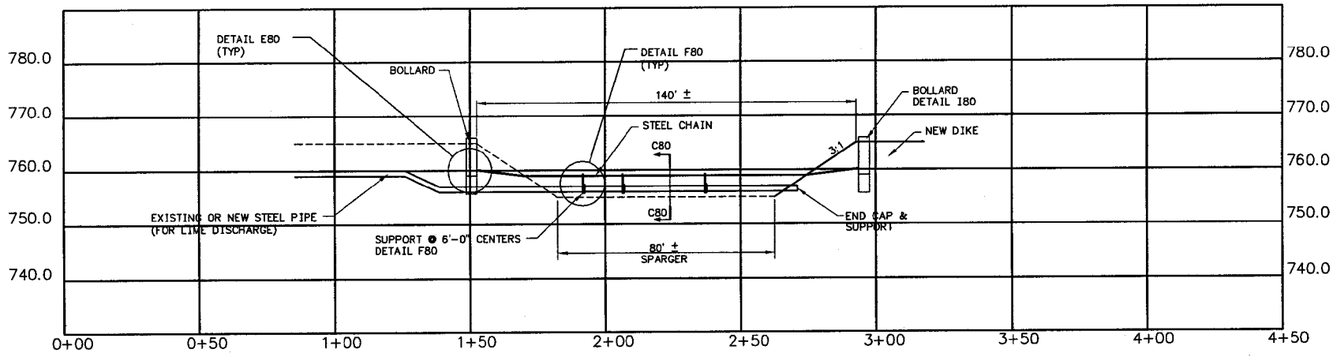
C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY:	REV NO.

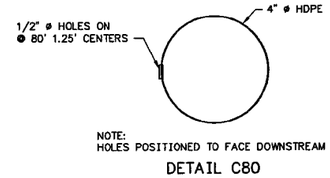
TVA-00000350



SECTION A80-A80
SCALE: HORIZONTAL: 1"=20'
VERTICAL: 1"=10'

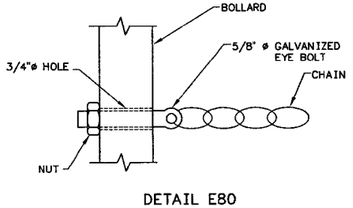


SECTION B80-B80
SCALE: HORIZONTAL: 1"=20'
VERTICAL: 1"=10'

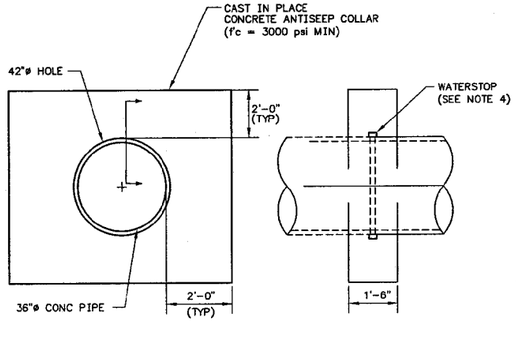


NOTE:
HOLES POSITIONED TO FACE DOWNSTREAM

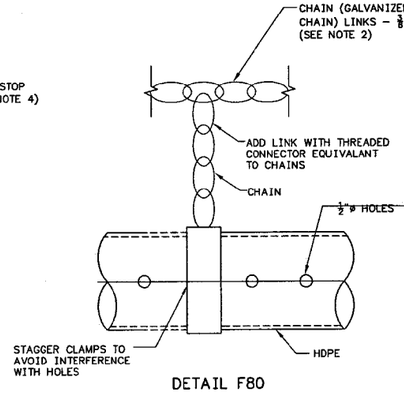
DETAIL C80
N.T.S.



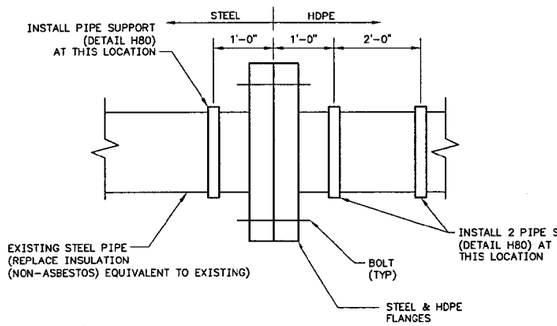
DETAIL E80
N.T.S.



DETAIL D80
(ANTI SEEP COLLAR)
N.T.S.



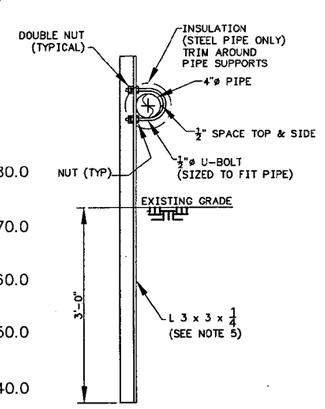
DETAIL F80
N.T.S.



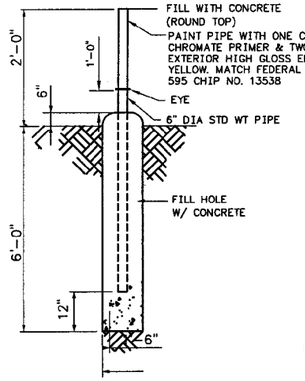
DETAIL G80
N.T.S.

NOTES:

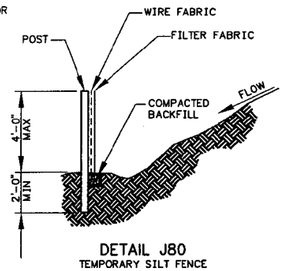
1. FOR ADDITIONAL NOTES SEE 10W425-79.
2. CHAIN SHALL BE HIGH STRENGTH GRADE 80 ALLOY STEEL CHAIN TRADE SIZE 9/32", .28"ø, 3500 LB WLL, McMASTER-CARR, PART #3457T31.
3. FOR WEIR REPLACEMENT NOTES, SEE 10W425-77.
4. WATER STOP SHALL BE AKWASTOP GASKET WATERSTOP AS MANUFACTURED BY CETCO. INSTALL IN ACCORDANCE WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS.
5. L SECTION SHALL BE GALVANIZED FINISH, TOUCH UP AREAS WHERE GALAVANIZED FINISH IS REMOVED DURING CONSTRUCTION WITH ZINC RICH PAINT.



DETAIL H80
PIPE SUPPORT
N.T.S.



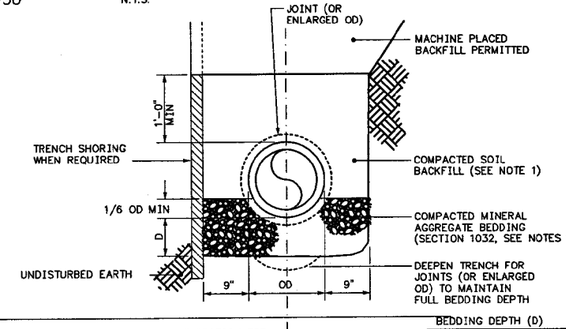
DETAIL I80
PIPE BOLLARD
N.T.S.



DETAIL J80
TEMPORARY SILT FENCE
N.T.S.

NOTES:

1. FILTER FABRIC FENCE TO BE PLACED PRIOR TO THE START OF ROUGH GRADING.
2. STEEL POSTS SHALL BE METAL "T" POSTS - 6'-0" LONG.
3. POSTS SHALL BE PLACED AT 4' INTERVALS MAX.
4. WIRE FABRIC AND FILTER FABRIC SHALL BE SECURELY BOUND TO POSTS WITH EITHER STAPLES OR WIRE TIES.
5. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING CONDITION OF FILTER FABRIC FENCE IN A CONDITION THAT IS SATISFACTORY TO TVA UNTIL FINAL ACCEPTANCE OF WORK. REMOVE SEDIMENT WHEN SEDIMENT HEIGHT IS ONE-THIRD THE HEIGHT OF THE FENCE.
6. FILTER FABRIC SHALL BE A CLASS A FABRIC IN ACCORDANCE WITH TVA SPECIFICATION T-1, SECTION 571.



DETAIL K80
N.T.S.

BEDDING DEPTH (D)

DIAMETER	D MIN
27" & SMALLER	3"
30" TO 60"	4"
66" & LARGER	6"

NOTES:

1. PLACE COMPACTED MINERAL AGGREGATE BEDDING SOIL BACKFILL IN LOOSE LIFTS NOT EXCEEDING 8" IN THICKNESS & COMPACT TO 95% STANDARD PROCTOR DENSITY IN ACCORDANCE WITH ASTM D 698. MOISTURE & DENSITY TESTING SHALL BE IN ACCORDANCE WITH ASTM D 2922, AT A FREQUENCY OF NOT LESS THAN 6 TESTS PER LIFT. SCARIFY EXISTING SOIL TO A DEPTH OF 3" PRIOR TO PLACEMENT OF THE FIRST LIFT. COMPACTION TESTING FOR COMPACTED FILL AROUND STORM DRAIN PIPING AND DITCH ONLY REQUIRES 2 TESTS PER LIFT.
2. STORM DRAIN PIPING FOR WEIR INSTALLATION IS PLACED ON THE STILLING POND SIDE OF THE DIVIDER DIKE, BEDDING MAY BE DUMPED INTO THE TRENCHES. DO NOT PLACE DUMPED MATERIAL BENEATH ANY ROADWAYS.

REV NO.	DATE	DRAWN	CHKD	SUPV	SYMB	APPD	NEED	PROJECT #	AS CONST	
R 0		HLP	DRD	REP	SBC	LJP	DLL	KIF331		
INITIAL ISSUE PER DCA KIF-05-1074-D06-R0										

SCALE: NONE EXCEPT AS NOTED

YARD

DREDGE CELL WEIR REPLACEMENT CROSS SECTION & DETAILS

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
H.L. PETTY	D.R. DODSON	R.E. PURKEY	S.E. CATHEY	L.J. PETERSON	D.L. LUNDY	

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R14 | DATE | 36 | C | 10W425-80 | R D

PLOT FACTOR: 20
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY: | REV NO.

TVA-00000351

Appendix C

Rating Curves

Figure 2-4 Dimensionless design storm distribution, auxiliary spillway and freeboard

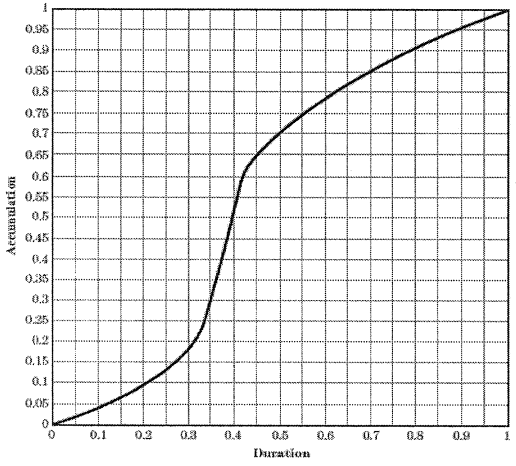
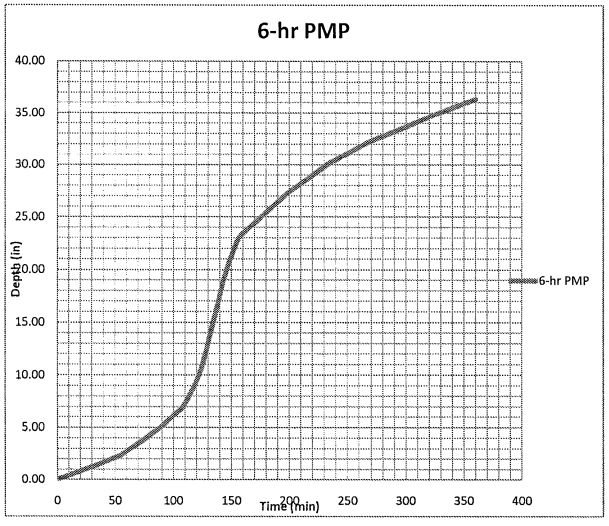


Fig 2-4 NRCS TR-60 - Eath Dams and Reseviors, July 2005



6-hr PMP Event

Duration(hr)=	6
Depth (in)=	36.3

% Duration	% Accumulation
0.00	0.000
0.05	0.020
0.10	0.040
0.15	0.063
0.20	0.100
0.25	0.140
0.30	0.190
0.35	0.310
0.40	0.530
0.45	0.650
0.50	0.700
0.55	0.750
0.60	0.790
0.65	0.830
0.70	0.860
0.75	0.890
0.80	0.912
0.85	0.935
0.90	0.960
0.95	0.980
1.00	1.000

Time (hr)	Accum Depth (in)
0.00	0.00
0.30	0.73
0.60	1.45
0.90	2.29
1.20	3.63
1.50	5.08
1.80	6.90
2.10	11.25
2.40	19.24
2.70	23.60
3.00	25.41
3.30	27.23
3.60	28.68
3.90	30.13
4.20	31.22
4.50	32.31
4.80	33.11
5.10	33.94
5.40	34.85
5.70	35.57
6.00	36.30

Time (min)	Accum. Depth (in)
0	0.00
6	0.24
12	0.48
18	0.73
24	0.97
30	1.21
36	1.45
42	1.73
48	2.01
54	2.29
60	2.73
66	3.18
72	3.63
78	4.11
84	4.60
90	5.08
96	5.69
102	6.29
108	6.90
114	8.04
120	9.40
126	11.25
132	13.92
138	16.58
144	19.24
150	21.22
156	22.89
162	23.60
168	24.20
174	24.81
180	25.41
186	26.02
192	26.62
198	27.23
204	27.71
210	28.19
216	28.68
222	29.16
228	29.65
234	30.13
240	30.49
246	30.86
252	31.22
258	31.58
264	31.94
270	32.31
276	32.57
282	32.84
288	33.11
294	33.38
300	33.66
306	33.94
312	34.24
318	34.55
324	34.85
330	35.09
336	35.33
342	35.57
348	35.82
354	36.06
360	36.30

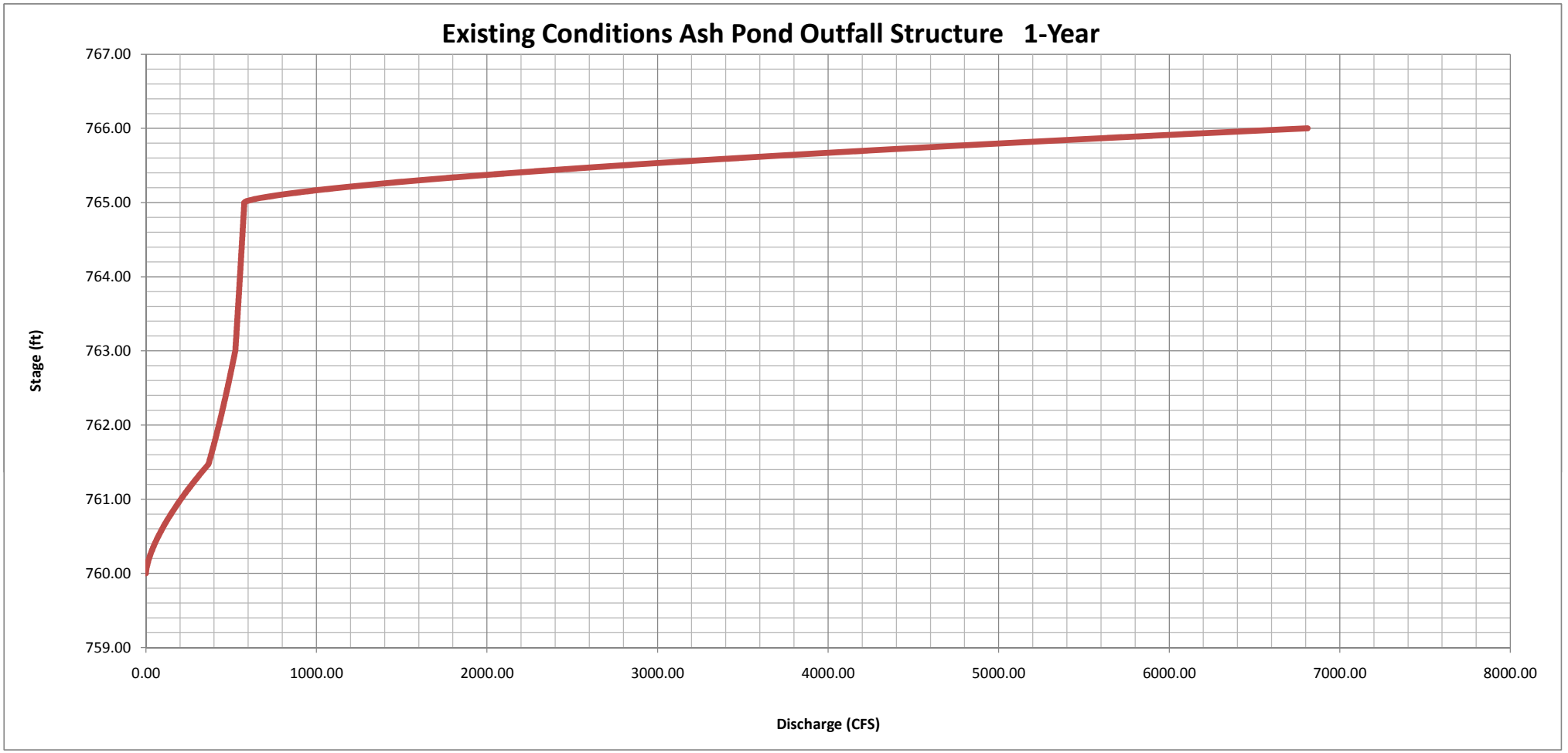
ASH POND

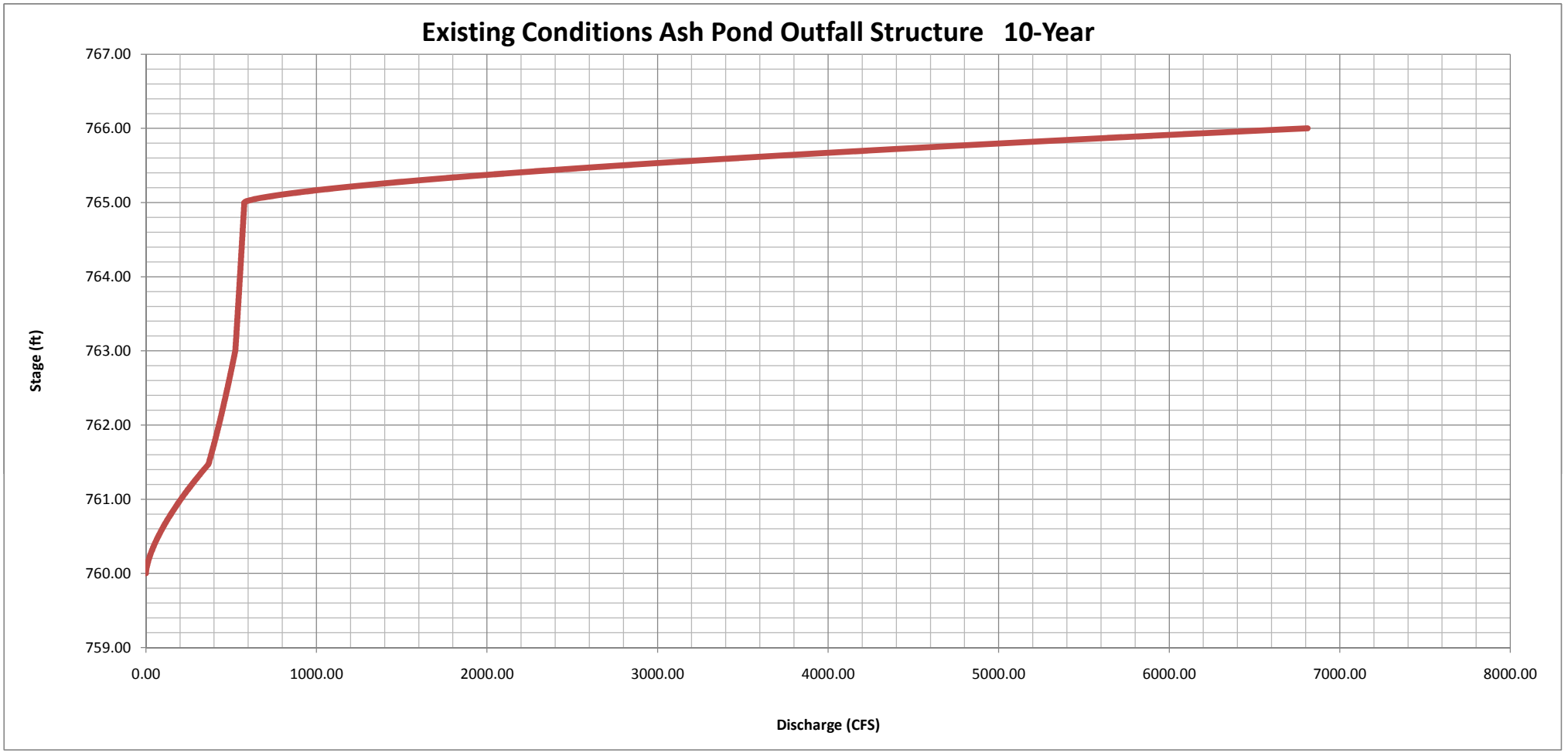
	Pond Elev. (ft)	Pond Area (ac)	Incremental Volume (ft^3)	Cummulative Volume (ft^3)	Cummulative Volume (gal)	
	742	0.21	0	0	0	
	743	3.74	70,152	70,152	524,772	
	744	5.13	192,201	262,352	1,962,532	
	745	9.39	311,295	573,647	4,291,181	
	746	10.91	441,279	1,014,926	7,592,174	
	747	11.89	495,935	1,510,861	11,302,023	
	748	12.98	540,954	2,051,814	15,348,637	
	749	13.97	586,252	2,638,066	19,734,108	
	750	14.96	629,342	3,267,409	24,441,916	
	751	15.91	671,570	3,938,979	29,465,610	
	752	17.43	725,168	4,664,147	34,890,241	
	753	18.27	776,697	5,440,843	40,700,337	
	754	19.13	813,686	6,254,529	46,787,129	
	755	20.03	851,977	7,106,506	53,160,359	
	756	21.01	892,872	7,999,378	59,839,510	
	757	22.58	948,236	8,947,614	66,932,806	
	758	24.76	1,029,670	9,977,284	74,635,272	
	759	26.18	1,108,220	11,085,504	82,925,335	
	760	30.79	1,238,211	12,323,715	92,187,796	Water Surface
5 Feet of Freeboard	761	34.86	1,427,511	13,751,226	102,866,322	
	762	39.77	1,622,643	15,373,869	115,004,537	
	763	43.8	1,817,629	17,191,499	128,601,350	
	764	57.14	2,189,853	19,381,352	144,982,591	
	765	83.58	3,043,640	22,424,992	167,750,598	Lowest Elevation at Top of Dike

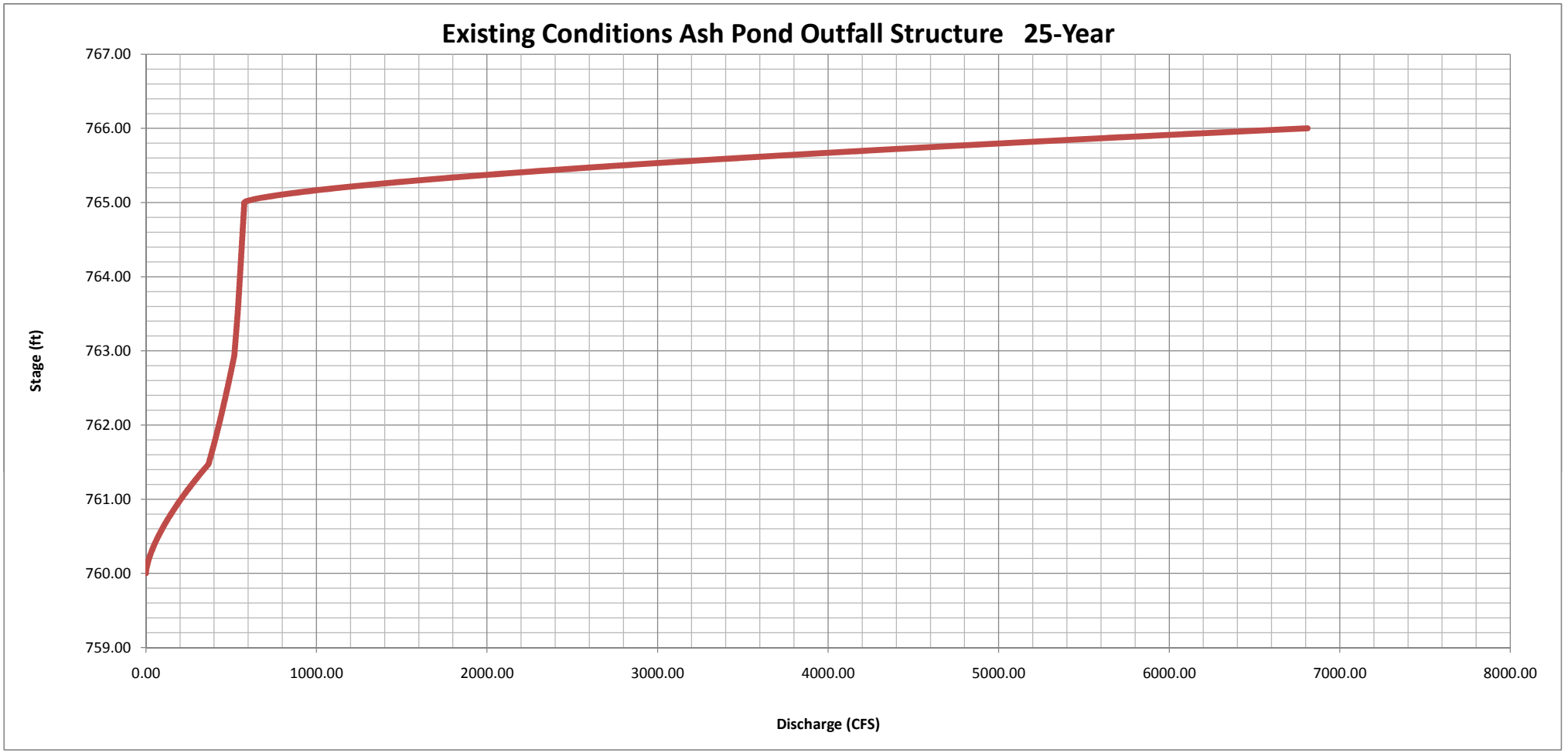
STILLING POND

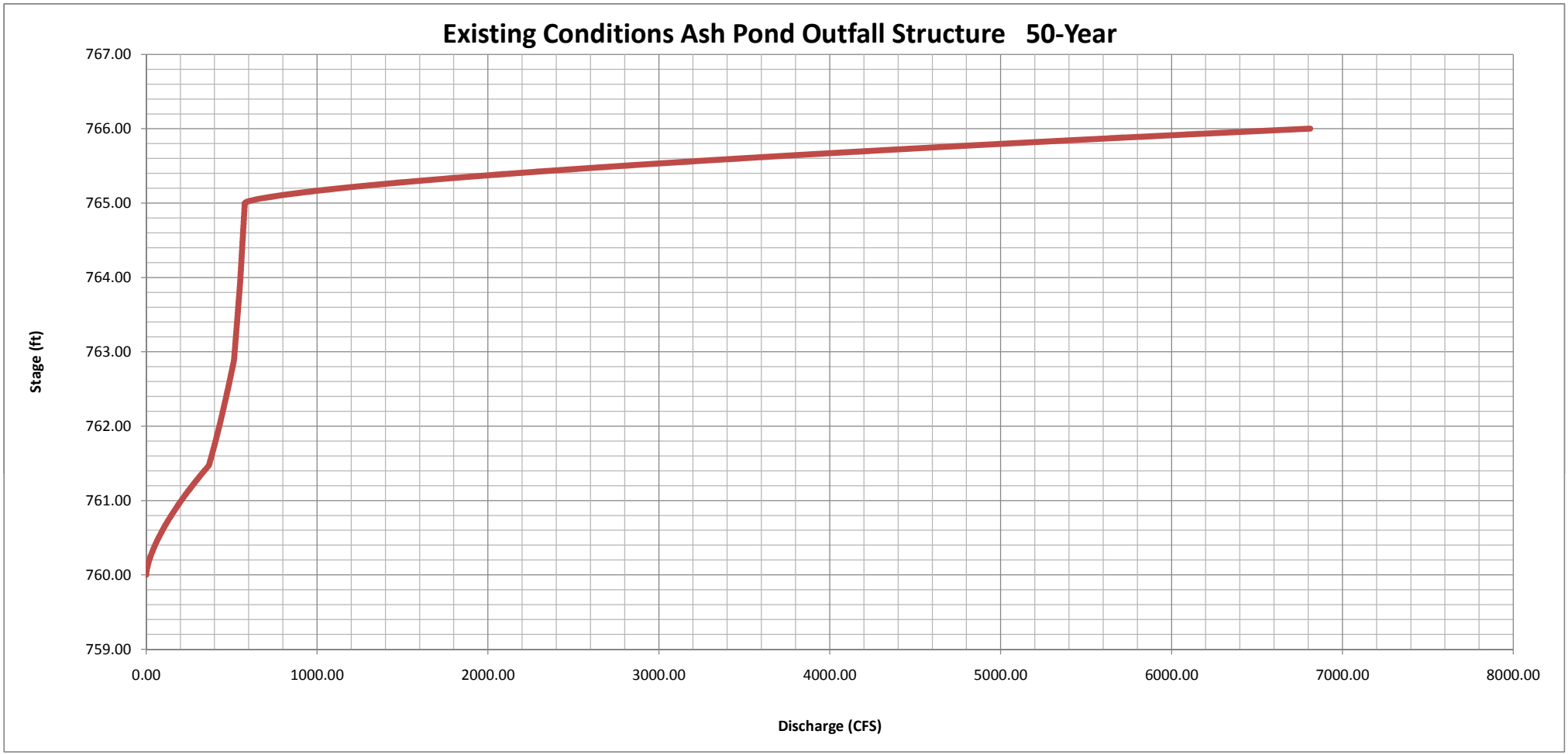
	Pond Elev(ft)	Pond Area(ac)	Incremental Volume (ft^3)	Cummulative Volume (ft^3)	Cummulative Volume (gal)	
	740	0.05	0	0	0	
	741	0.33	7,375	7,375	55,171	
	742	0.53	18,541	25,916	193,868	
	743	0.91	30,962	56,878	425,477	
	744	1.55	52,911	109,789	821,278	
	745	2.7	91,323	201,111	1,504,418	
	746	3.18	127,796	328,907	2,460,399	
	747	3.83	152,306	481,214	3,599,727	
	748	12.34	334,275	815,489	6,100,279	
	749	19.42	685,245	1,500,733	11,226,266	
	750	20.98	878,814	2,379,547	17,800,248	
	751	22.01	935,296	3,314,843	24,796,752	
	752	22.67	972,122	4,286,965	32,068,729	
	753	23.23	998,678	5,285,643	39,539,356	
	754	23.79	1,023,047	6,308,690	47,192,282	
	754.42	23.99	436,634	6,745,324	50,458,531	Water Surface
	755	24.27	1,045,683	7,791,007	58,280,781	
	756	24.69	1,065,269	8,856,276	66,249,550	
	757	25	1,081,159	9,937,435	74,337,181	
	758	25.27	1,093,780	11,031,215	82,519,228	
10.6 Feet of Freeboard	759	25.5	1,104,661	12,135,877	90,782,667	
	760	25.72	1,114,453	13,250,329	99,119,352	
	761	25.95	1,124,244	14,374,573	107,529,278	
	762	26.21	1,134,904	15,509,477	116,018,951	
	763	26.45	1,145,784	16,655,261	124,590,010	
	764	26.76	1,157,748	17,813,009	133,250,570	
	765	27.48	1,180,131	18,993,140	142,078,565	Lowest Elevation at Top of Dike

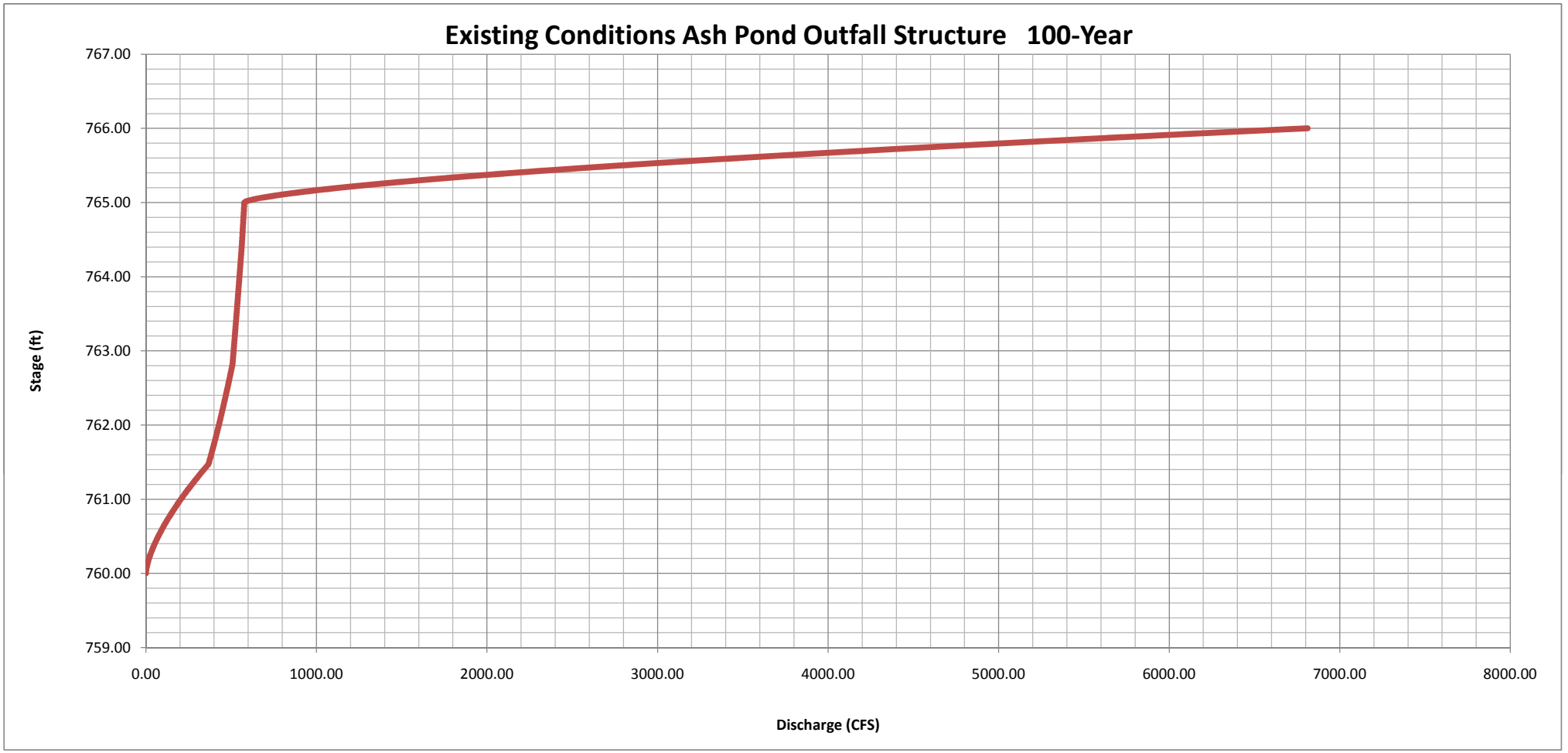
	Total Free Water Volume	Storage Capacity	Total Capacity
Ash Pond (gal)	92,187,796	75,562,803	167,750,598
Stilling Pond (gal)	50,458,531	91,620,033	142,078,565
Total (gal)	142,646,327	167,182,836	309,829,163
Permit Requirement (gal)	102,000,000		

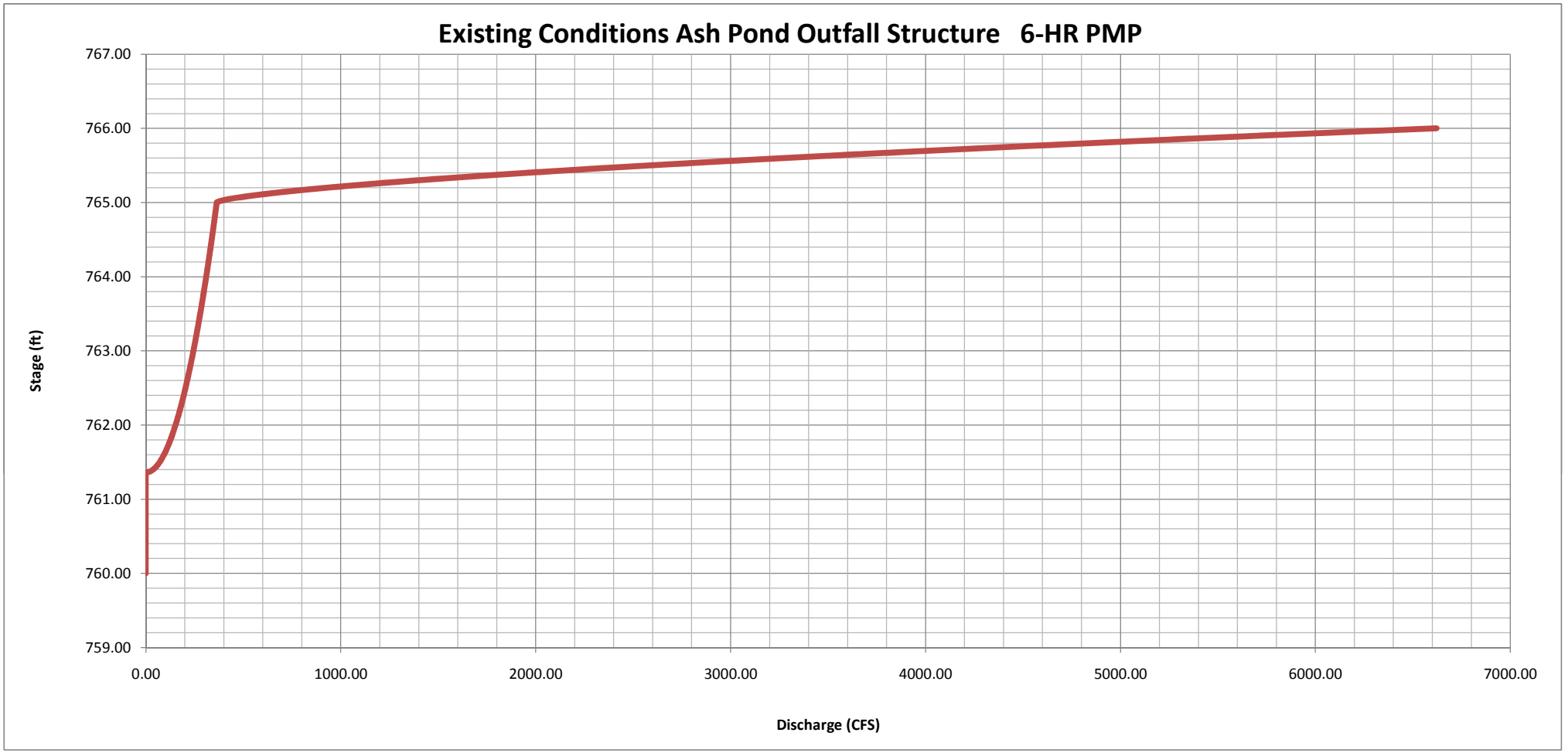

Existing Conditions Ash Pond Outfall Structure 1-Year
767.00
766.00
765.00
764.00
763.00
762.00
761.00
760.00
759.00
Stage (ft)
0.00
1000.00
2000.00
3000.00
4000.00
5000.00
6000.00
7000.00
8000.00
Discharge (CFS)

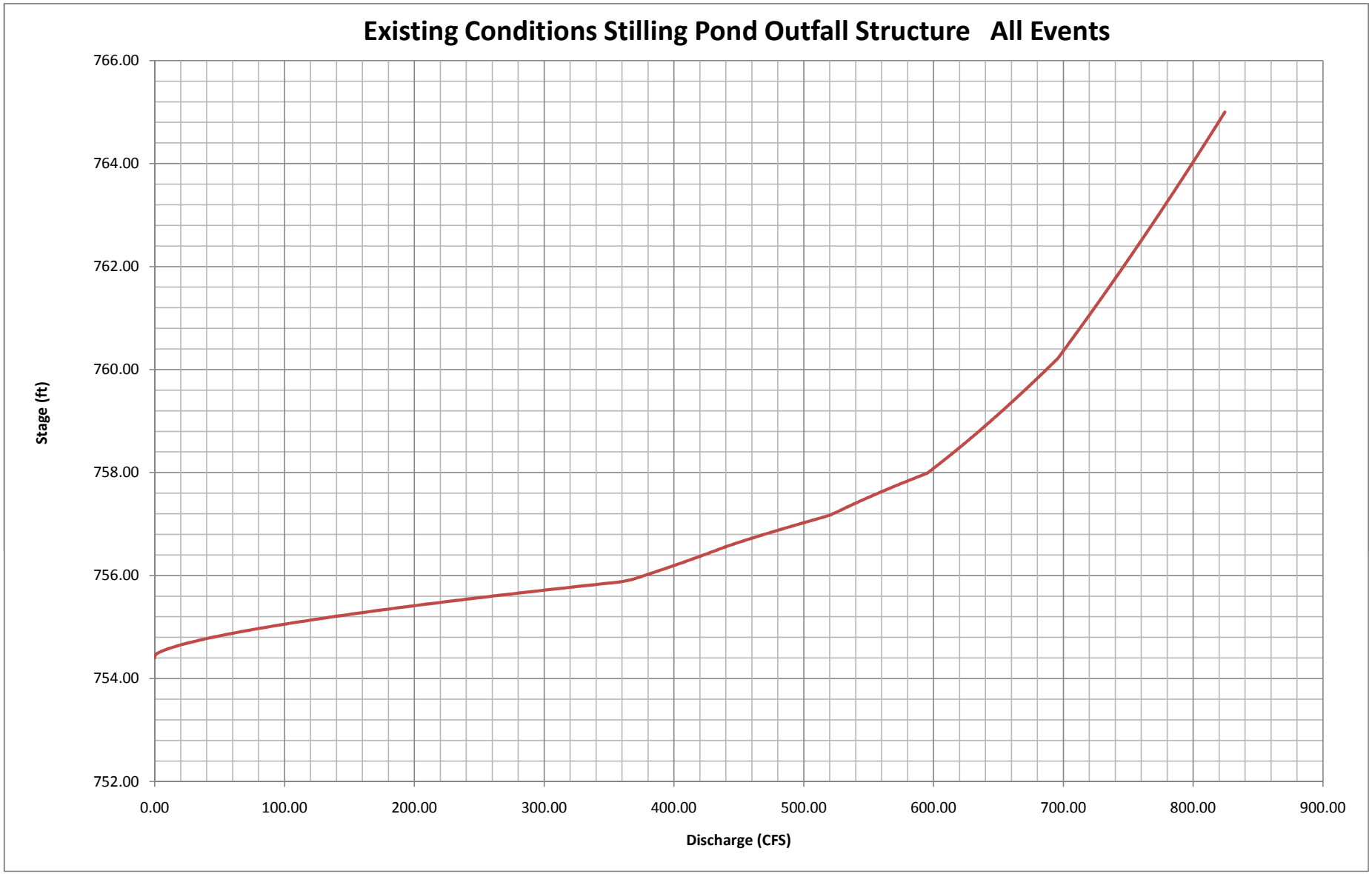

Existing Conditions Ash Pond Outfall Structure 10-Year
767.00
766.00
765.00
764.00
763.00
762.00
761.00
760.00
759.00
Stage (ft)
0.00
1000.00
2000.00
3000.00
4000.00
5000.00
6000.00
7000.00
8000.00
Discharge (CFS)

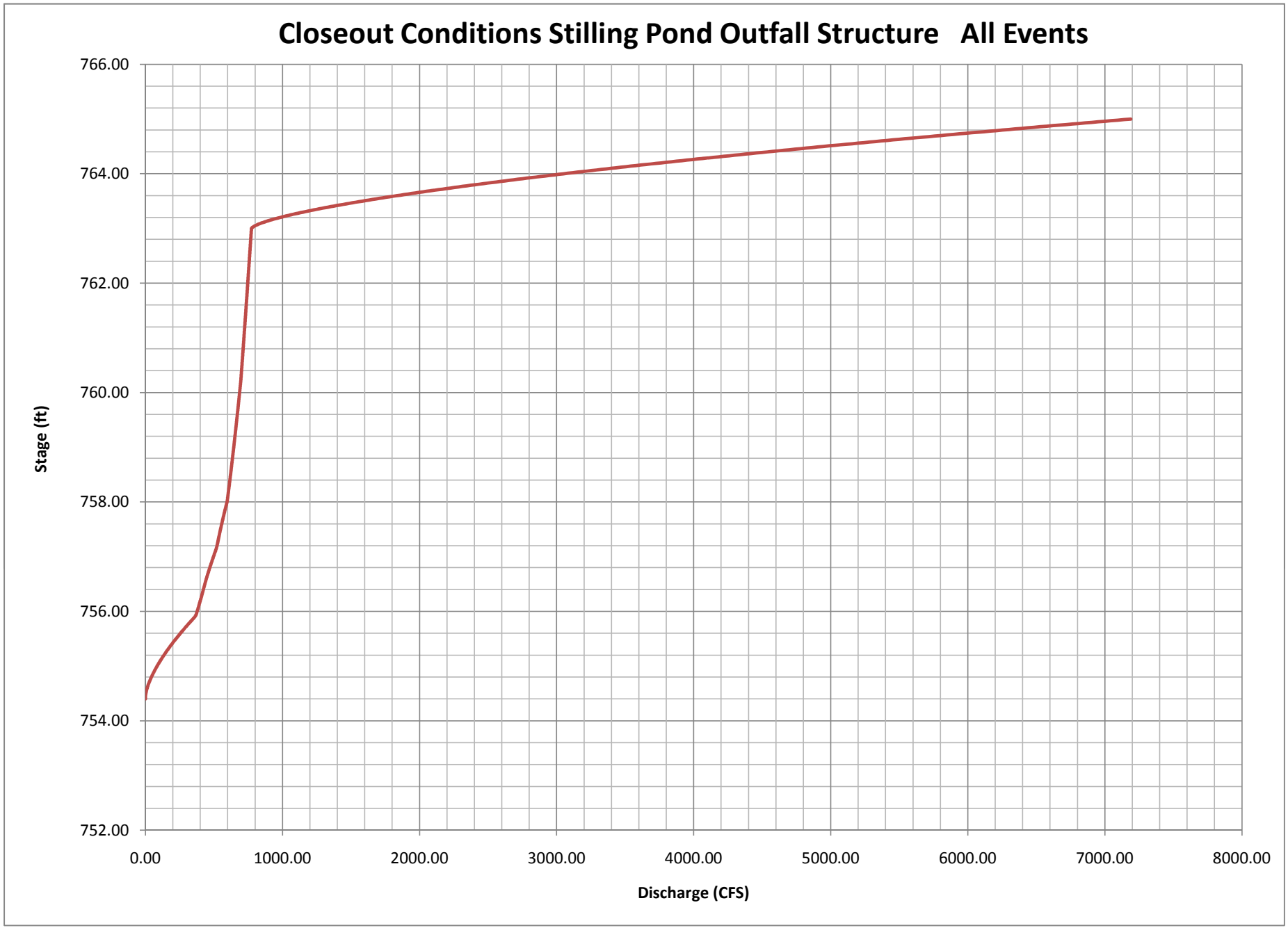

Existing Conditions Ash Pond Outfall Structure 25-Year
767.00
766.00
765.00
764.00
763.00
762.00
761.00
760.00
759.00
Stage (ft)
0.00
1000.00
2000.00
3000.00
4000.00
5000.00
6000.00
7000.00
8000.00
Discharge (CFS)


Existing Conditions Ash Pond Outfall Structure 50-Year
767.00
766.00
765.00
764.00
763.00
762.00
761.00
760.00
759.00
Stage (ft)
0.00
1000.00
2000.00
3000.00
4000.00
5000.00
6000.00
7000.00
8000.00
Discharge (CFS)


Existing Conditions Ash Pond Outfall Structure 100-Year
767.00
766.00
765.00
764.00
763.00
762.00
761.00
760.00
759.00
Stage (ft)
0.00
1000.00
2000.00
3000.00
4000.00
5000.00
6000.00
7000.00
8000.00
Discharge (CFS)


Existing Conditions Ash Pond Outfall Structure 6-HR PMP
767.00
766.00
765.00
764.00
763.00
762.00
761.00
760.00
759.00
Stage (ft)
0.00
1000.00
2000.00
3000.00
4000.00
5000.00
6000.00
7000.00
Discharge (CFS)


Existing Conditions Stilling Pond Outfall Structure All Events
766.00
764.00
762.00
760.00
758.00
756.00
754.00
752.00
Stage (ft)
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
Discharge (CFS)


Closeout Conditions Stilling Pond Outfall Structure All Events
766.00
764.00
762.00
760.00
758.00
756.00
754.00
752.00
Stage (ft)
0.00
1000.00
2000.00
3000.00
4000.00
5000.00
6000.00
7000.00
8000.00
Discharge (CFS)

Appendix D

TVA Survey Data

TVA SPILLWAY DATA
CONCRETE TOP SURVEY

NOTE: SURVEY IS OF THE TOP OF THE CONCRETE OF THE SPILLWAY

	Spillway #	Delta	Approx. EL	Invert EL.	Approx. Height	Comment
ALF	EAST	NO DATA	229.47	216.00	13.47	
ALF	WEST	NO DATA	229.47	216.00	13.47	
ALF	OVERFLOW #1	NO DATA	230.43	216.00	14.43	
ALF	OVERFLOW #2	NO DATA	230.30	216.00	14.30	
SHF	1	0.13	345.41	314.10	31.31	
SHF	2	0.03	345.41	314.10	31.31	
SHF	3	0.12	345.43	314.10	31.33	
SHF	4	0.09	345.49	314.10	31.39	
SHF	5	0.07	345.39	314.10	31.29	
COF	A	0.06	452.42	430.00	22.42	
COF	B	0.09	452.38	430.00	22.38	
COF	C	0.16	452.39	430.00	22.39	
COF	D	0.09	452.32	430.00	22.32	
PAF - FLY	A	0.16	403.65	397.00	6.65	
PAF - FLY	B	0.03	403.66	397.00	6.66	
PAF - FLY	C	0.08	403.59	397.00	6.59	
PAF - BOT	A	NO DATA	405.63	---		Invert elevation not listed on dwg 10W3214.
PAF - BOT	B	NO DATA	405.62	---		Invert elevation not listed on dwg 10W3214.
PAF - BOT	C	NO DATA	405.62	---		Invert elevation not listed on dwg 10W3214.
GAF	A	0.07	456.08	449.60	6.48	See dwg 10N274 about change in pipe and elevation (451.5)?
GAF	B	0.08	456.05	449.60	6.45	See dwg 10N274 about change in pipe and elevation (451.5)?
GAF	C	0.03	456.05	449.60	6.45	See dwg 10N274 about change in pipe and elevation (451.5)?
GAF	D	0.02	456.03	449.60	6.43	See dwg 10N274 about change in pipe and elevation (451.5)?
JOF	NORTH	NO DATA	386.49	351.00	35.49	
JOF	MIDDLE	NO DATA	387.60	351.00	36.60	
JOF	SOUTH	NO DATA	386.49	351.00	35.49	
JSF	WEST	0.03	1133.09	1120.00	13.09	
JSF	EAST	0.07	1133.04	1120.00	13.04	
CUF	A	NO DATA	383.87	361.00	22.87	
CUF	B	NO DATA	383.97	361.00	22.97	
CUF	C	NO DATA	383.86	361.00	22.86	
CUF	D	NO DATA	384.00	361.00	23.00	

TVA SPILLWAY DATA
CONCRETE TOP SURVEY

BRF	NORTH	0.03	805.53	793.00	12.53	This outfall pipe was repaired a couple of years ago due to joint separation
BRF	MIDDLE	0.05	805.58	793.00	12.58	
BRF	SOUTH	0.09	805.55	793.00	12.55	Tree has roots growing in South Outfall pipe
KIF	A - Overflow	0.07	756.54	746.00	10.54	
KIF	B	0.06	754.48	746.00	8.48	
KIF	C	0.07	754.44	746.00	8.44	
KIF	D	0.03	754.43	746.00	8.43	
KIF	E	0.05	754.45	746.00	8.45	
KIF	F	0.06	754.42	746.00	8.42	
WCF - Upper Ash	A	NO DATA	631.75	595.00	36.75	Spillways were noted in 2004 as having an 1.5" gap in the joints 12 feet down
WCF - Upper Ash	B	NO DATA	631.72	595.00	36.72	Spillways were noted in 2004 as having an 1.5" gap in the joints 12 feet down
WCF - Upper Ash	C	NO DATA	631.57	595.00	36.57	Spillways were noted in 2004 as having an 1.5" gap in the joints 12 feet down
WCF - Upper Ash	D	NO DATA	631.68	595.00	36.68	Spillways were noted in 2004 as having an 1.5" gap in the joints 12 feet down
WCF - Upper Ash	E	NO DATA	631.74	595.00	36.74	Spillways were noted in 2004 as having an 1.5" gap in the joints 12 feet down
WCF - Stilling	1	NO DATA	610.47	591.00	19.47	Dwgs 10N8223 (597.0) and 10N7424 (591.0) disagree about the invert elevation.
WCF - Stilling	2	NO DATA	610.43	591.00	19.43	Dwgs 10N8223 (597.0) and 10N7424 (591.0) disagree about the invert elevation.
WCF - Stilling	3	NO DATA	610.11	591.00	19.11	Dwgs 10N8223 (597.0) and 10N7424 (591.0) disagree about the invert elevation.
WCF - Stilling	4	NO DATA	610.44	591.00	19.44	Dwgs 10N8223 (597.0) and 10N7424 (591.0) disagree about the invert elevation.
WCF - Stilling	5	NO DATA	610.42	591.00	19.42	Dwgs 10N8223 (597.0) and 10N7424 (591.0) disagree about the invert elevation.

Appendix E

Wastewater Flow Schematic

From: Weaver, Jason T
Sent: Thursday, August 20, 2009 7:27 PM
To: Russ, Timothy A
Subject: Pumps in service and discharge to trench and ash pond

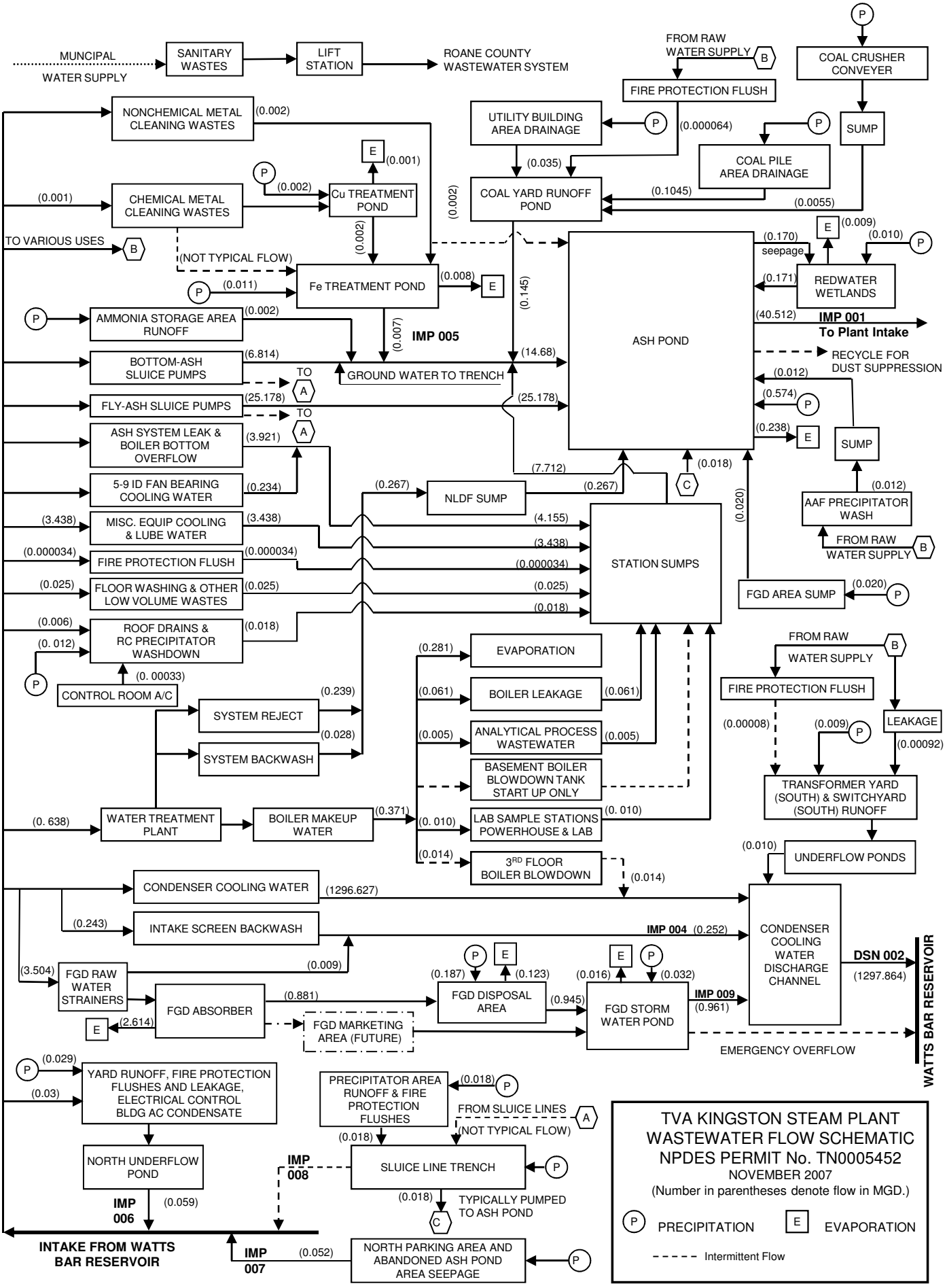
KIF Plant Water Flows to Ash Pond Area

Station sump pump flow increases approx 50% with units online if lined up correctly(Approx. 6k gpm now, and 10k gpm with all units online). We have 9 Fly Ash pumps(4@1925gpm and 5@4800gpm) and 4 Bottom Ash Pumps(2600gpm each). The bottom ash pumps are turned on when sluicing the bottoms of the boilers which occurs once per shift at 1 hour per unit. At least 3 fly ash pumps are on all the time to support the fire protection and hydrovactors at the precipitators. As the units are started, more fly ash pumps are required to run to support the hydrovactor operation at the precipitators.

With all nine units running, we normally have 6 fly ash pumps on @ 18,250 gpm, 2 bottom ash pumps running @ 5,200 gpm, 5 station sumps running at 10,000 gpm, and smaller auxiliary pumps running that may total 200 gpm....Total: 33,650 gpm

With 2-3 units running, we normally have 3 fly ash pumps on @ 8,650 gpm, 2 bottom ash pumps on intermittently @ 5,200 gpm, 3 station sumps running at 6,000 gpm, and the smaller auxiliary pumps running at 200 gpm.....Total: 20,050 gpm.

These are all rough numbers, but it gives you an idea of the flow that you are seeing. Please remember that the station sump pump discharge(and auxiliary pumps) is currently being pumped directly into the ash pond. The fly ash and bottom ash pumps are being pumped to the trench.


MUNCIPAL WATER SUPPLY
SANITARY WASTES
LIFT STATION
ROANE COUNTY WASTEWATER SYSTEM
FROM RAW WATER SUPPLY
B
COAL CRUSHER CONVEYER
FIRE PROTECTION FLUSH
NONCHEMICAL METAL CLEANING WASTES
(0.002)
UTILITY BUILDING AREA DRAINAGE
(0.000064)
SUMP
(0.001)
E
(0.035)
COAL PILE AREA DRAINAGE
(0.001)
CHEMICAL METAL CLEANING WASTES
(0.002)
Cu TREATMENT POND
(0.002)
COAL YARD RUNOFF POND
(0.1045)
(0.0055)
TO VARIOUS USES
(NOT TYPICAL FLOW)
(0.009)
(0.170)
seepage
(0.010)
(0.011)
Fe TREATMENT POND
(0.008)
(0.145)
(0.171)
REDWATER WETLANDS
AMMONIA STORAGE AREA RUNOFF
(0.002)
(0.007)
IMP 005
ASH POND
(40.512)
IMP 001
To Plant Intake
BOTTOM-ASH SLUICE PUMPS
(6.814)
TO
(14.68)
GROUND WATER TO TRENCH
RECYCLE FOR DUST SUPPRESSION
(0.012)
FLY-ASH SLUICE PUMPS
(25.178)
(0.574)
ASH SYSTEM LEAK & BOILER BOTTOM OVERFLOW
(3.921)
(0.238)
SUMP
(7.712)
(0.018)
5-9 ID FAN BEARING COOLING WATER
(0.234)
(0.267)
NLDF SUMP
(0.012)
AAF PRECIPITATOR WASH
(3.438)
MISC. EQUIP COOLING & LUBE WATER
(4.155)
(0.020)
(0.000034)
FIRE PROTECTION FLUSH
STATION SUMPS
FROM RAW WATER SUPPLY
(0.025)
FLOOR WASHING & OTHER LOW VOLUME WASTES
FGD AREA SUMP
(0.020)
(0.006)
(0. 012)
ROOF DRAINS & RC PRECIPITATOR WASHDOWN
(0.018)
(0.281)
EVAPORATION
FROM RAW WATER SUPPLY
(0. 00033)
CONTROL ROOM A/C
(0.239)
SYSTEM REJECT
(0.061)
BOILER LEAKAGE
(0.061)
FIRE PROTECTION FLUSH
(0.028)
SYSTEM BACKWASH
(0.005)
ANALYTICAL PROCESS WASTEWATER
(0.005)
(0.00008)
(0.009)
LEAKAGE
(0.00092)
BASEMENT BOILER BLOWDOWN TANK START UP ONLY
(0. 638)
WATER TREATMENT PLANT
BOILER MAKEUP WATER
(0.371)
(0. 010)
LAB SAMPLE STATIONS POWERHOUSE & LAB
(0. 010)
TRANSFORMER YARD (SOUTH) & SWITCHYARD (SOUTH) RUNOFF
(0.014)
3RD FLOOR BOILER BLOWDOWN
(0.014)
(0.010)
UNDERFLOW PONDS
CONDENSER COOLING WATER
(1296.627)
(0.243)
INTAKE SCREEN BACKWASH
IMP 004
(0.252)
CONDENSER COOLING WATER DISCHARGE CHANNEL
DSN 002
(1297.864)
WATTS BAR RESERVOIR
(3.504)
FGD RAW WATER STRAINERS
(0.009)
(0.187)
(0.123)
(0.016)
(0.032)
FGD ABSORBER
(0.881)
FGD DISPOSAL AREA
(0.945)
FGD STORM WATER POND
IMP 009
(0.961)
(2.614)
FGD MARKETING AREA (FUTURE)
EMERGENCY OVERFLOW
(0.029)
(0.03)
YARD RUNOFF, FIRE PROTECTION FLUSHES AND LEAKAGE, ELECTRICAL CONTROL BLDG AC CONDENSATE
PRECIPITATOR AREA RUNOFF & FIRE PROTECTION FLUSHES
(0.018)
FROM SLUICE LINES
(NOT TYPICAL FLOW)
NORTH UNDERFLOW POND
IMP 008
SLUICE LINE TRENCH
(0.018)
TYPICALLY PUMPED TO ASH POND
IMP 006
(0.059)
INTAKE FROM WATTS BAR RESERVOIR
IMP 007
(0.052)
NORTH PARKING AREA AND ABANDONED ASH POND AREA SEEPAGE
TVA KINGSTON STEAM PLANT
WASTEWATER FLOW SCHEMATIC
NPDES PERMIT No. TN0005452
NOVEMBER 2007
(Number in parentheses denote flow in MGD.)
PRECIPITATION
EVAPORATION
Intermittent Flow

APPENDIX A

Document 12

Stantec Consulting Services Correspondence Dated October 11, 2011, "Re: Addendum, September 30, 2010 H&H Report – KIF Ash Pond/Stilling Basin, Dam Safety Regulation – Spillway Capacity Evaluation"

Stantec Consulting Services Inc.
1409 North Forbes Road
Lexington KY 40511-2050
Tel: (859) 422-3000
Fax: (859) 422-3100

October 11, 2011 let_001_175601004

Mr. Scott Turnbow, PE
Tennessee Valley Authority
1101 Market Street, LP 5E
Chattanooga, Tennessee 37402-2801

Re: Addendum
September 30, 2010 H&H Report – KIF Ash Pond/Stilling Basin
Dam Safety Regulation-Spillway Capacity Evaluation

Dear Mr. Turnbow:

This addendum letter presents Stantec's supplemental Hydrologic and Hydraulic (H&H) analysis on the Ash Pond at Kingston. The initial H&H model and analysis was developed to determine freeboard and capacity in the Ash Pond with results summarized in a report dated September 30, 2010. The initial analysis was performed consistent with TVA's overall objective of evaluating storm freeboard and capacity on all major Fossil Power impoundments. That analysis included evaluation of the full Probable Maximum Precipitation (PMP) event consistent with the design criteria established in TVA's Programmatic Document. The use of the PMP in the initial analysis was intended to provide uniform performance benchmarking of all facilities as part of the overall engineering assessment program.

Consistent with TVA's directive that the design criteria presented in the Programmatic Document was not intended to be retro-active to existing facilities, this supplemental analysis adopts design criteria established within the Tennessee Dam Safety regulations which are viewed as the governing minimum design standards.

Spillway capacity and freeboard analysis design criteria are established in the dam safety regulations based on the structure hazard classification and size of the impoundment. The Ash Pond hazard classification is designated as significant based on the assessment that a failure is not expected to cause a loss of life. The structure falls into the regulatory intermediate category for size based on an estimated storage volume of approximately 1,900 acre-feet. Based on the metrics as outlined in the dam safety regulations, the Ash Pond spillway is required have the capacity to pass a design storm corresponding to one-half (½) the PMP event without overtopping the perimeter dikes.

Engineering methodology for this analysis is documented in the initial report. This supplemental analysis included revising the rating curve for the Ash Pond to reflect the anticipated tailwater condition in the Stilling Pond during the design storm event. The maximum tailwater elevation for the Stilling Pond was determined to be approximately 756.8'. The resulting rating curve and HEC-HMS Input and Output are provided as attachments to this letter.

The results of this analysis indicate that the Ash Pond reaches a peak elevation of 764.4' during the designated design storm which is below the crest of the dike (765.0'). Therefore, the Ash Pond is able to pass the ½-PMP rainfall event through the existing Ash Pond outlet structures without the pond overtopping and meets the pertinent requirements designated in Tennessee's Dam Safety regulations.

Stantec appreciates the opportunity to provide these TVA engineering support services. If you have any questions or need additional information, please contact Don Fuller at 859-619-8960.

Sincerely,

STANTEC CONSULTING SERVICES INC.

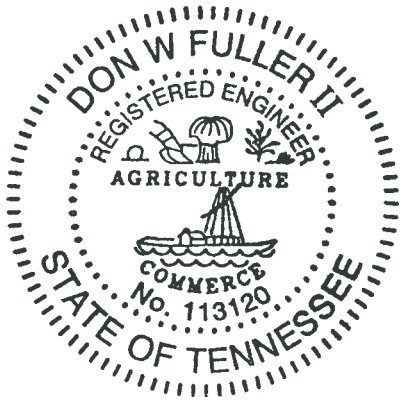
Michelle Meehan, PE
Project Engineer

Don Fuller II, PE
Principal

/mmm/rdr

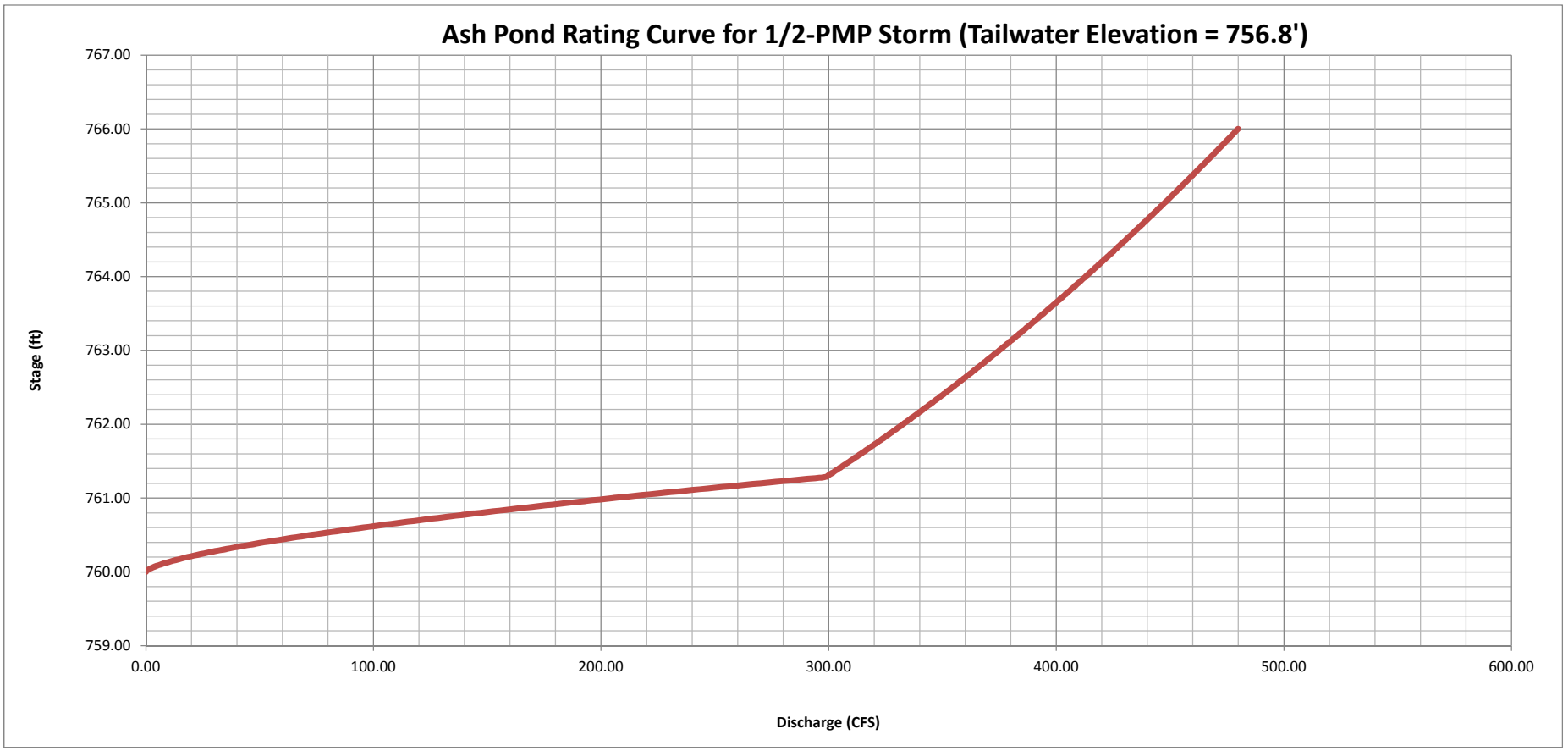
2 Enclosures: Rating Curve and HEC-HMS Input-Output

c. Jamey Dotson, Michelle Cagley, John Dizer



Attachment 1

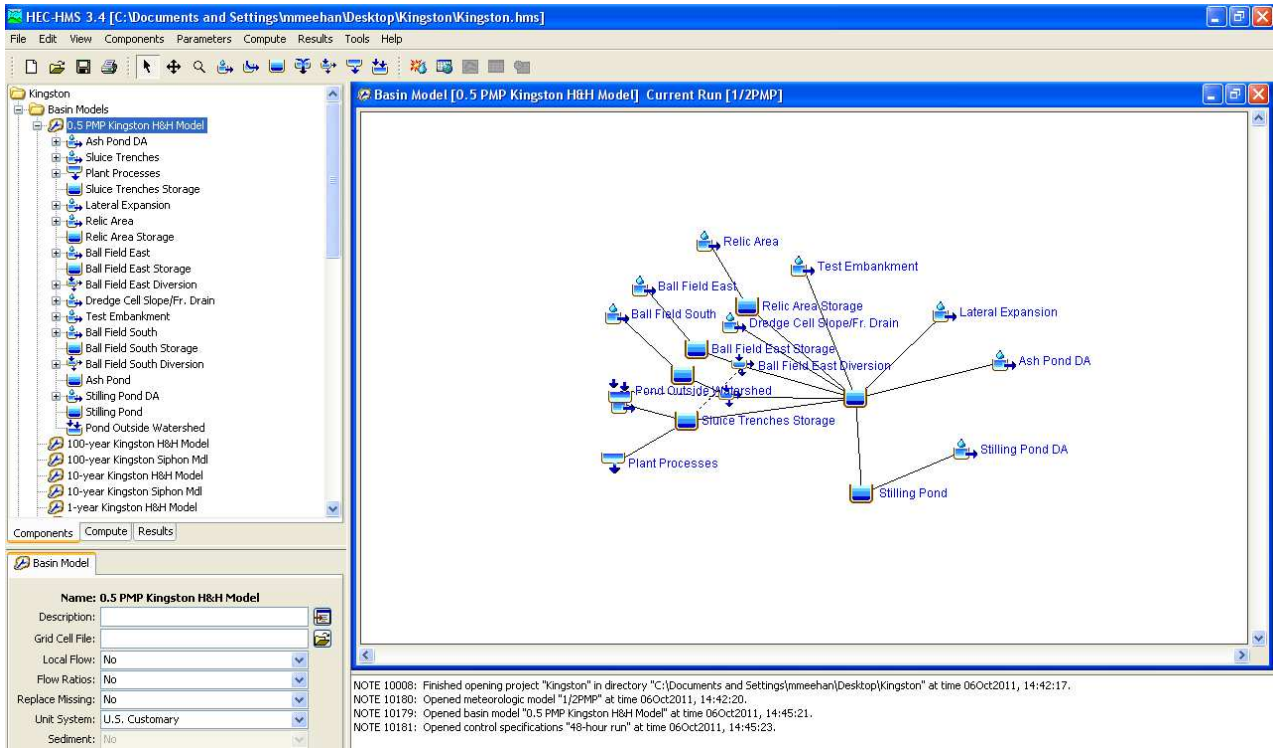
Rating Curve


Ash Pond Rating Curve for 1/2-PMP Storm (Tailwater Elevation = 756.8')
Stage (ft)
767.00
766.00
765.00
764.00
763.00
762.00
761.00
760.00
759.00
0.00
100.00
200.00
300.00
400.00
500.00
600.00
Discharge (CFS)

Attachment 2

Model Input and Output

HEC-HMS Input Files



Basin Model

1/2 PMP Existing Conditions

Basin: 0.5 PMP Kingston H&H Model
- Last Modified Date: 6 October 2011
- Last Modified Time: 14:56:37
- Version: 3.4
- Unit System: English
- Missing Flow To Zero: No
- Enable Flow Ratio: No
- Allow Blending: No
- Compute Local Flow At Junctions: No

- Enable Sediment Routing: No

- Enable Quality Routing: No

End:

Subbasin: Ash Pond DA
- Description: Drainage area surrounding Ash Pond
- Canvas X: 4630.681818181818
- Canvas Y: 738.636363636364
- Area: 0.102
- Downstream: Ash Pond

- Canopy: None

- Surface: None

- LossRate: SCS
- Percent Impervious Area: 45.9
- Curve Number: 87

Transform: SCS
Lag: 5
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Sluice Trenches
Description: Sluice Channel Area
Canvas X: -7193.0479032751755
Canvas Y: -572.2323051182293
Area: 0.047
Downstream: Sluice Trenches Storage

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 11.7
Curve Number: 87

Transform: SCS
Lag: 6
Unitgraph Type: STANDARD

Baseflow: None
End:

Source: Plant Processes
Description: Flows from Plant Processes
Canvas X: -7490.530303030303
Canvas Y: -2443.181818181818
Area: 0.0
Downstream: Sluice Trenches Storage

Flow Method: CONSTANT_FLOW
Constant Flow: 75
End Flow Method:
End:

Reservoir: Sluice Trenches Storage
Description: Storage behind 3 30" Corrugated HDPE Pipes
Canvas X: -5222.426283032342
Canvas Y: -1103.321819793603
Downstream: Ash Pond

Route: Modified Puls
Routing Curve: Elevation-Area-Outflow
Initial Elevation: 763
Elevation-Area Table: Sluice Trenches
Elevation-Outflow Table: Sluice Trenches
Primary Table: Elevation-Outflow
End:

Subbasin: Lateral Expansion
Canvas X: 2784.09090909091
Canvas Y: 2234.848484848485
Area: 0.046
Downstream: Ash Pond

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 3.9
Curve Number: 87

Transform: SCS

Lag: 13
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Relic Area
Canvas X: -4551.576369758188
Canvas Y: 4431.189964718182
Area: 0.039
Downstream: Relic Area Storage

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 87

Transform: SCS
Lag: 7
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: Relic Area Storage
Description: Storage area behind 2 24" Corrugated HDPE Pipes
Canvas X: -3349.636941808658
Canvas Y: 2446.592304615471
Downstream: Ash Pond

Route: Modified Puls
Routing Curve: Elevation-Area-Outflow
Initial Elevation: 790.6
Elevation-Area Table: Relic Area
Elevation-Outflow Table: Relic Area
Primary Table: Elevation-Outflow
End:

Subbasin: Ball Field East
Canvas X: -6550.150069720776
Canvas Y: 3061.5380584501136
From Canvas X: 153.7364384586608
From Canvas Y: 852.5384314525727
Label X: -1.0
Label Y: 0.0
Area: 0.034
Downstream: Ball Field East Storage

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 87

Transform: SCS
Lag: 9
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: Ball Field East Storage
Description: Storage behind 3 18" Corrugated HDPE Pipes
Canvas X: -4914.953406115022
Canvas Y: 1104.8924780671596

From Canvas X: 377.3530762167129
From Canvas Y: 796.6342720130597
Downstream: Ball Field East Diversion

Route: Modified Puls
Routing Curve: Elevation-Area-Outflow
Initial Elevation: 766
Elevation-Area Table: Ball Field East
Elevation-Outflow Table: Ball Field East
Primary Table: Elevation-Outflow
End:

Diversion: Ball Field East Diversion
Description: When water overtops the ball field east storage area it flows to the sluice trences storage area
Canvas X: -3475.421300547562
Canvas Y: 580.7909833217254
Downstream: Ash Pond
Divert To: Sluice Trenches Storage

Diverter: Inflow-Diversion Table
Inflow Diversion Table Name: Ball Field East Diversion
End Diverter:
End:

Subbasin: Dredge Cell Slope/Fr. Drain
Description: French Drain
Canvas X: -3736.382078964274
Canvas Y: 1894.893509293437
Area: 0.020
Downstream: Ash Pond

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 81

Transform: SCS
Lag: 5
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Test Embankment
Canvas X: -1637.572058973572
Canvas Y: 3655.519752494939
Area: 0.017
Downstream: Ash Pond

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 87

Transform: SCS
Lag: 8
Unitgraph Type: STANDARD

Baseflow: None
End:

Subbasin: Ball Field South
Canvas X: -7374.736421453592
Canvas Y: 2181.0475472777844

Label X: -1.0
Label Y: 0.0
Area: 0.014
Downstream: Ball Field South Storage

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 87

Transform: SCS
Lag: 7
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: Ball Field South Storage
Description: Storage behind 3 18" Corrugated HDPE Pipes
Canvas X: -5348.2106417712475
Canvas Y: 315.2462259840386
Downstream: Ball Field South Diversion

Route: Modified Puls
Routing Curve: Elevation-Area-Outflow
Initial Elevation: 765
Elevation-Area Table: Ball Field South
Elevation-Outflow Table: Ball Field South
Primary Table: Elevation-Outflow
End:

Diversion: Ball Field South Diversion
Description: When the storage area for the south ball field overtops it flows to a small pond outside of the watershed area
Canvas X: -3880.7264564840316
Canvas Y: -355.6036872901177
Downstream: Ash Pond
Divert To: Pond Outside Watershed

Diverter: Inflow-Diversion Table
Inflow Diversion Table Name: Ball Field South Diversion
End Diverter:
End:

Reservoir: Ash Pond
Description: Ash Pond
Canvas X: -2.7207711442788423
Canvas Y: -399.6230556702658
Label X: -1.0
Label Y: 0.0
Downstream: Stilling Pond

Route: Modified Puls
Routing Curve: Elevation-Area-Outflow
Initial Elevation: 760.5
Elevation-Area Table: Ash Pond EL-AREA
Elevation-Outflow Table: 6-HR 0.5 PMP Ash Pond El-Q
Primary Table: Elevation-Outflow
End:

Subbasin: Stilling Pond DA
Description: DA to Stilling Pond
Canvas X: 3416.815742397138
Canvas Y: -2012.5223613595708
Area: 0.044
Downstream: Stilling Pond

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 85.9
Curve Number: 87

Transform: SCS
Lag: 5
Unitgraph Type: STANDARD

Baseflow: None
End:

Reservoir: Stilling Pond
Description: Stilling Pond
Canvas X: 181.96597300060967
Canvas Y: -3339.220399976404
Label X: 3.0
Label Y: 0.0

Route: Modified Puls
Routing Curve: Elevation-Area-Outflow
Initial Elevation: 754.9
Elevation-Area Table: Stilling Pond EL-AREA
Elevation-Outflow Table: Stilling Pond El-Q
Primary Table: Elevation-Outflow
End:

Sink: Pond Outside Watershed
Canvas X: -7304.8562221542015
Canvas Y: -173.91516911170038
End:

Basin Schematic Properties:
Last View N: 4356.060606060606
Last View S: -3893.280632411068
Last View W: -7821.969696969696
Last View E: 4630.681818181818
Maximum View N: 4356.060606060606
Maximum View S: -3893.280632411068
Maximum View W: -7821.969696969696
Maximum View E: 4630.681818181818
Extent Method: Elements
Buffer: 0
Draw Icons: Yes
Draw Icon Labels: Yes
Draw Map Objects: No
Draw Gridlines: No
Draw Flow Direction: Yes
Fix Element Locations: No
Fix Hydrologic Order: No
End:

Meteorologic Models

Meteorology: 1/2PMP
Last Modified Date: 6 October 2011
Last Modified Time: 14:52:47
Version: 3.4
Unit System: English
Precipitation Method: Specified Average
Radiation Method: None
Snowmelt Method: None
Evapotranspiration Method: No Evapotranspiration
Use Basin Model: PMP Kingston H&H Model
Use Basin Model: 0.5 PMP Kingston H&H Model
End:

Precip Method Parameters: Specified Average
    Allow Depth Override: No
    Set Missing Data to Zero: Yes
End:

Subbasin: Ash Pond DA
    Gage: 6-HR 1/2 PMP
End:

Subbasin: Sluice Trenches
    Gage: 6-HR 1/2 PMP
End:

Subbasin: Lateral Expansion
    Gage: 6-HR 1/2 PMP
End:

Subbasin: Relic Area
    Gage: 6-HR 1/2 PMP
End:

Subbasin: Ball Field East
    Gage: 6-HR 1/2 PMP
End:

Subbasin: Dredge Cell Slope/Fr. Drain
    Gage: 6-HR 1/2 PMP
End:

Subbasin: Test Embankment
    Gage: 6-HR 1/2 PMP
End:

Subbasin: Ball Field South
    Gage: 6-HR 1/2 PMP
End:

Subbasin: Stilling Pond DA
    Gage: 6-HR 1/2 PMP
End:

Control Specifications

Control: 48-hour run
    Description: 24-hour run
    Last Modified Date: 9 August 2010
    Last Modified Time: 16:35:08
    Start Date: 31 December 2009
    Start Time: 24:00
    End Date: 2 January 2010
    End Time: 24:00
    Time Interval: 1
End:

Paired Data

Existing Conditions

Storage-Discharge

(see Appendix B for stage-storage and storage-discharge data)

Time-Series Data

Precipitation Gages: 6-Hour ½ PMP

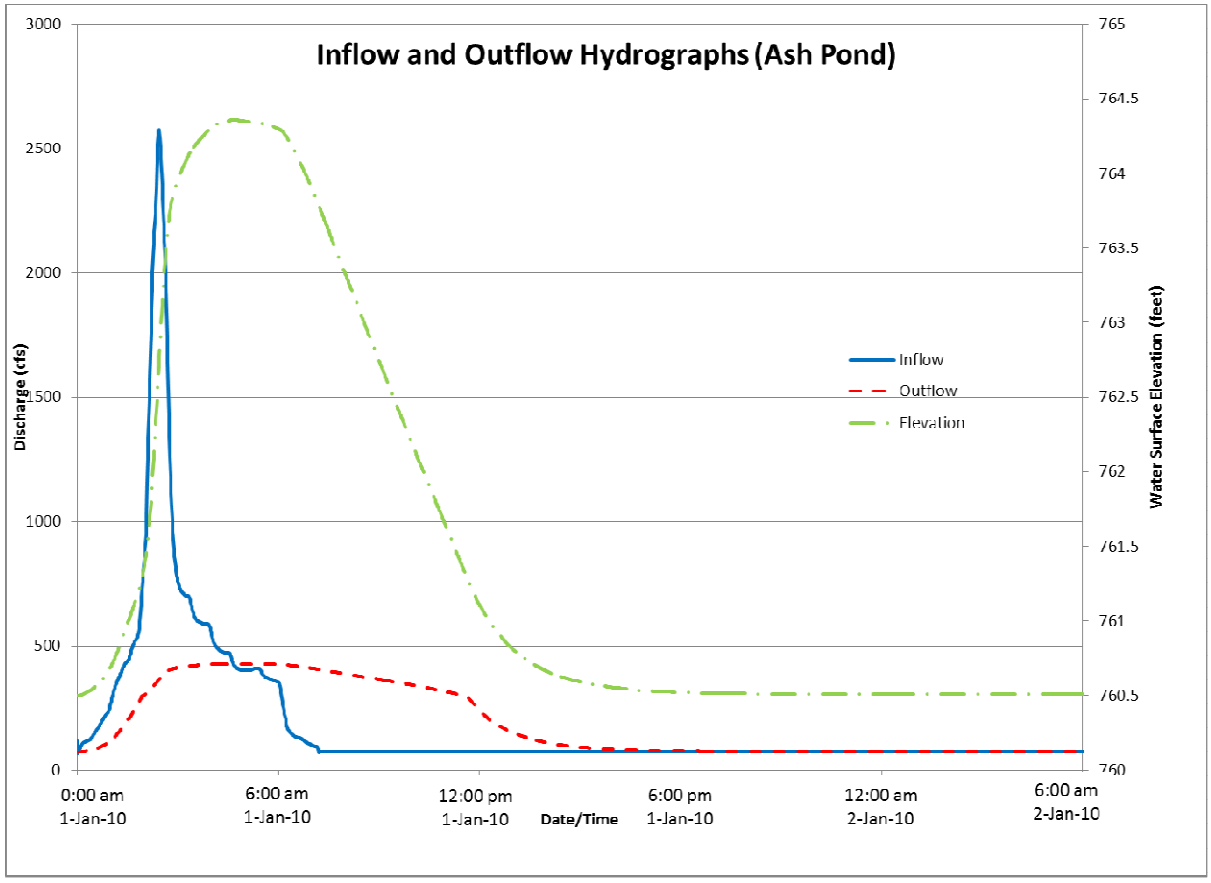
Time	Cumulative Precipitation (inches)
01Jan2010, 00:00	0
01Jan2010, 00:06	0.12
01Jan2010, 00:12	0.24
01Jan2010, 00:18	0.365
01Jan2010, 00:24	0.485
01Jan2010, 00:30	0.605
01Jan2010, 00:36	0.725
01Jan2010, 00:42	0.865
01Jan2010, 00:48	1.005
01Jan2010, 00:54	1.145
01Jan2010, 01:00	1.365
01Jan2010, 01:06	1.59
01Jan2010, 01:12	1.815
01Jan2010, 01:18	2.055
01Jan2010, 01:24	2.3
01Jan2010, 01:30	2.54
01Jan2010, 01:36	2.845
01Jan2010, 01:42	3.145
01Jan2010, 01:48	3.45
01Jan2010, 01:54	4.02
01Jan2010, 02:00	4.7
01Jan2010, 02:06	5.625
01Jan2010, 02:12	6.96
01Jan2010, 02:18	8.29
01Jan2010, 02:24	9.62
01Jan2010, 02:30	10.61
01Jan2010, 02:36	11.445
01Jan2010, 02:42	11.8
01Jan2010, 02:48	12.1
01Jan2010, 02:54	12.405
01Jan2010, 03:00	12.705
01Jan2010, 03:06	13.01
01Jan2010, 03:12	13.31
01Jan2010, 03:18	13.615
01Jan2010, 03:24	13.855
01Jan2010, 03:30	14.095

01Jan2010, 03:36	14.34
01Jan2010, 03:42	14.58
01Jan2010, 03:48	14.825
01Jan2010, 03:54	15.065
01Jan2010, 04:00	15.245
01Jan2010, 04:06	15.43
01Jan2010, 04:12	15.61
01Jan2010, 04:18	15.79
01Jan2010, 04:24	15.97
01Jan2010, 04:30	16.155
01Jan2010, 04:36	16.285
01Jan2010, 04:42	16.42
01Jan2010, 04:48	16.555
01Jan2010, 04:54	16.69
01Jan2010, 05:00	16.83
01Jan2010, 05:06	16.97
01Jan2010, 05:12	17.12
01Jan2010, 05:18	17.275
01Jan2010, 05:24	17.425
01Jan2010, 05:30	17.545
01Jan2010, 05:36	17.665
01Jan2010, 05:42	17.785
01Jan2010, 05:48	17.91
01Jan2010, 05:54	18.03
01Jan2010, 06:00	18.15

HEC-HMS Output Files

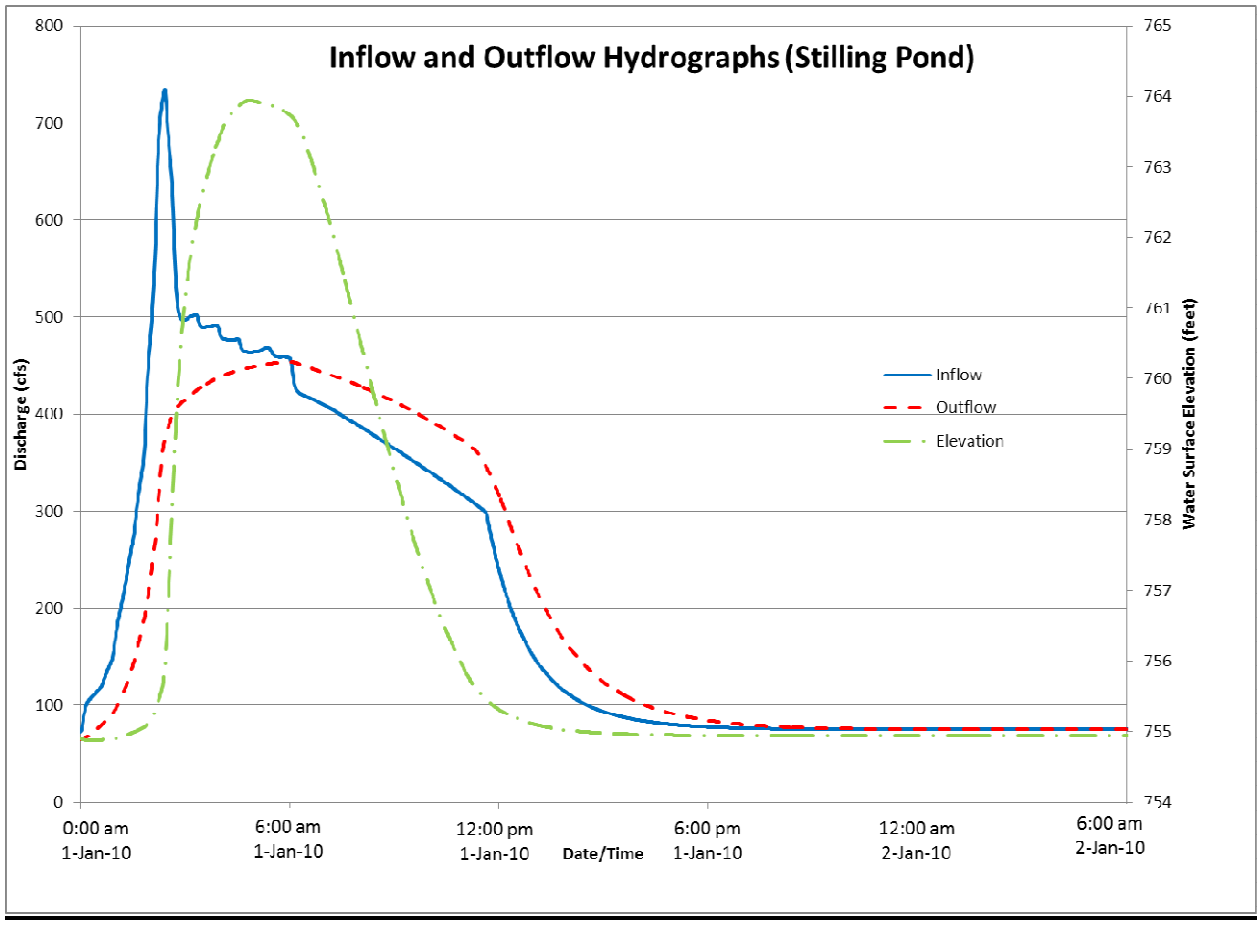
Existing Conditions - Ash Pond Routing

6-hr ½ PMP



Existing Conditions - Stilling Pond Routing

6-hr ½ PMP



APPENDIX A

Document 13

Geosyntec Consultants Technical Memorandum, October 14, 2011, "Subject: Evaluating Stormwater Runoff in the Gypsum Disposal Area for the One-Third Probable Maximum Precipitation Event

Geosyntec consultants

1255 Roberts Blvd. NW, Suite 200
Kennesaw, GA 30144
PH 678.202.9500
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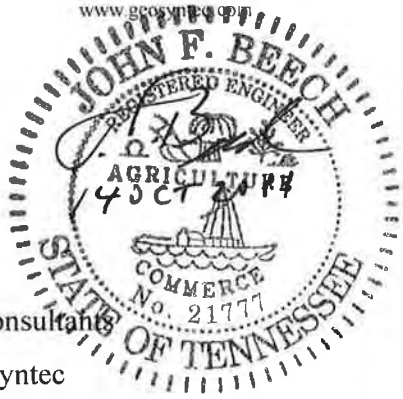

TECHNICAL MEMORANDUM

Date:	10/14/2011
To:	Jamey Dotson, Tennessee Valley Authority
Copies to:	Neil Davies, Mehmet Iscimen, Cuneyt Gokmen, Geosyntec Consultants
From:	Jay Beech, Jesus Sanchez, Mark Schillinger, Eban Bean, Geosyntec Consultants
Subject:	Evaluating Stormwater Runoff in the Gypsum Disposal Area for the One-Third Probable Maximum Precipitation Event

PURPOSE

The purpose of this technical memorandum is to evaluate the stormwater runoff in the Gypsum Disposal Area (GDA) located at the Kingston Fossil Plant (KIF) Peninsula Site for the One-Third (1/3) Probable Maximum Precipitation (PMP) event, as requested by Tennessee Valley Authority (TVA). The operational conditions of the GDA is analyzed in this memorandum is depicted in Figure 1. For this analysis the stormwater runoff conveyance for the GDA consists of: (i) the Phase IA area with the composite liner system and drainage layers in place; and (ii) construction spoils stockpiles in the unlined Phase IB area. The Phase IA and IB areas are separated by a divider dike. Stormwater runoff in the Phase IB area is pumped to the stormwater pond. The inflows in Phase IA from stormwater runoff and the slurrying of gypsum is conveyed to the settling pond and then pumped to the stormwater pond. Phase IA and IB areas can be conveyed to the stormwater pond by pumps that are situated near the low-spot of each area.

If stormwater runoff flows exceed the capacity of the pumps in the Phase I area then a portion of the excess can be conveyed by three 44-inch culverts that connect the stormwater pond to the Phase IA area (stormwater in Phase IB will overtop the divider dike and flow into Phase IA). The stormwater pond has an emergency spillway to prevent ponded water from overtopping the berm forming the pond.

If the stormwater runoff in the Phase IA area exceed the flow capacity through the three 44-inch culverts then the ponded water will overtop the GDA berm. Similarly, if total flows into the stormwater pond exceed the design capacity of the spillway then the ponded water in the stormwater pond will overtop the dike.

The hydrologic and hydraulic analyses of the Phase IA and Phase IB areas along with drainage from the surrounding landfill and direct rainfall into the adjacent stormwater pond were modeled using HydroCAD™ (HydroCAD, 2009). The modeling results were used to evaluate whether the

1/3 PMP Event would result in exceedance of flow capacity through: (1) the three 44-inch culverts from the Phase IA area to the stormwater pond and/or (2) the emergency spillway in the stormwater pond.

PROBABLE MAXIMUM PRECIPITATION

The PMP is defined in the National Oceanic and Atmospheric Administration's (NOAA) Hydrometeorological Report (HMR) No. 56 as "Theoretically the greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographical location at a certain time of the year."

The 6-hour, 1-mi^2 PMP for the Site location is estimated to be 36.3 inches from HMR 56 (NOAA, 1986); by comparison, the 1,000-yr, 6-hr event for this location is 7.01 in. (NWS, 2011). The storm considered here is a 1/3 PMP, which is equivalent to 12.1 in.

Following guidance provided in HMR 56, the depth of the 1/3 PMP was then used to calculate the hourly cumulative rainfall depths within the event. Cumulative 1/3 PMP depths were then converted to 1-hr incremental depths.

Hourly rainfall depths were then arranged following guidance provided in HMR 56 with the intention to produce the greater runoff rates at the Site. The six 1-hour rainfall depths were arranged in the following order: 5, 4, 3, 2, 1, and 6, with 1 being the most intense hour and 6 being the least intense. The time series was then transformed into a 15 minute incremental time series which accounted for changing intensities over the hourly time steps. This produced a peak intensity of 8.8 in/hr for the most intense 15 minute period (2.2-in.). The rainfall time series was then converted to a mass fraction time series for incorporation into HydroCAD^{TM}.

HYDROLOGIC AND HYDRAULIC MODELING

A hydrologic and hydraulic model was developed for the 1/3 PMP rainfall event at the GDA for the Phase I area. The drainage areas from to both phases are conservatively assumed to be impervious and could be conceptualized as sheet flow that would drain to the low elevation for each respective area. The depth of water in the settling pond in Phase IA is assumed to be 5-ft (an elevation of 756 ft-MSL) prior to the start of the 1/3 PMP event. The stormwater pond water surface elevation (WSEL) was assumed to be at the elevation of the lowest pump (759.5 ft-MSL) prior to the rainfall event. It was assumed the pumps would malfunction during the extreme event. In addition, it was assumed that slurrying of gypsum would be discontinued during the 1/3 PMP event.

RESULTS AND CONCULSIONS

The HydroCAD model results indicate that the peak WSELs from the 1/3 PMP event in the stormwater pond, Phase IA area, and Phase IB area were 761 ft-MSL, 759 ft-MSL, and 762 ft-MSL, respectively. These peak WSELs indicate that the stormwater pond would not be hydraulically connected to the Phase IA area as the inlet invert of the riser structure, which is connected to the three 48-inch culverts, has an elevation of 765 ft-MSL. The Phase I Divider Dike's low elevation of 770 ft-MSL was higher than the peak WSELs in both the Phase IA and IB areas, indicating that the Phase IB Area would not be hydraulically connected via overtopping during this event. These results indicate the dikes would not be overtopped during a 1/3 PMP event and the runoff and direct rainfall into the stormwater pond would not be sufficient enough to reach the invert of the emergency spillway.

REFERNCES

HydroCAD Software Solutions (HydroCAD), 2009. *HydroCAD* v. 9.10.

National Oceanic and Atmospheric Administration (NOAA). 1986. *Hydrometeorological Report Number 56: Probable Maximum and TVA Precipitation Estimates with Areal Distribution for Tenneseee River Drainages Less than 3000 mi^2 in Area.* Silver Springs, Md. October, 1986.

National Weather Service. 2011. *Precipitation Frequency Data Server.* Kingston, TN. <http://hdsc.nws.noaa.gov/hdsc/pfds/> accessed: October 3, 2011.

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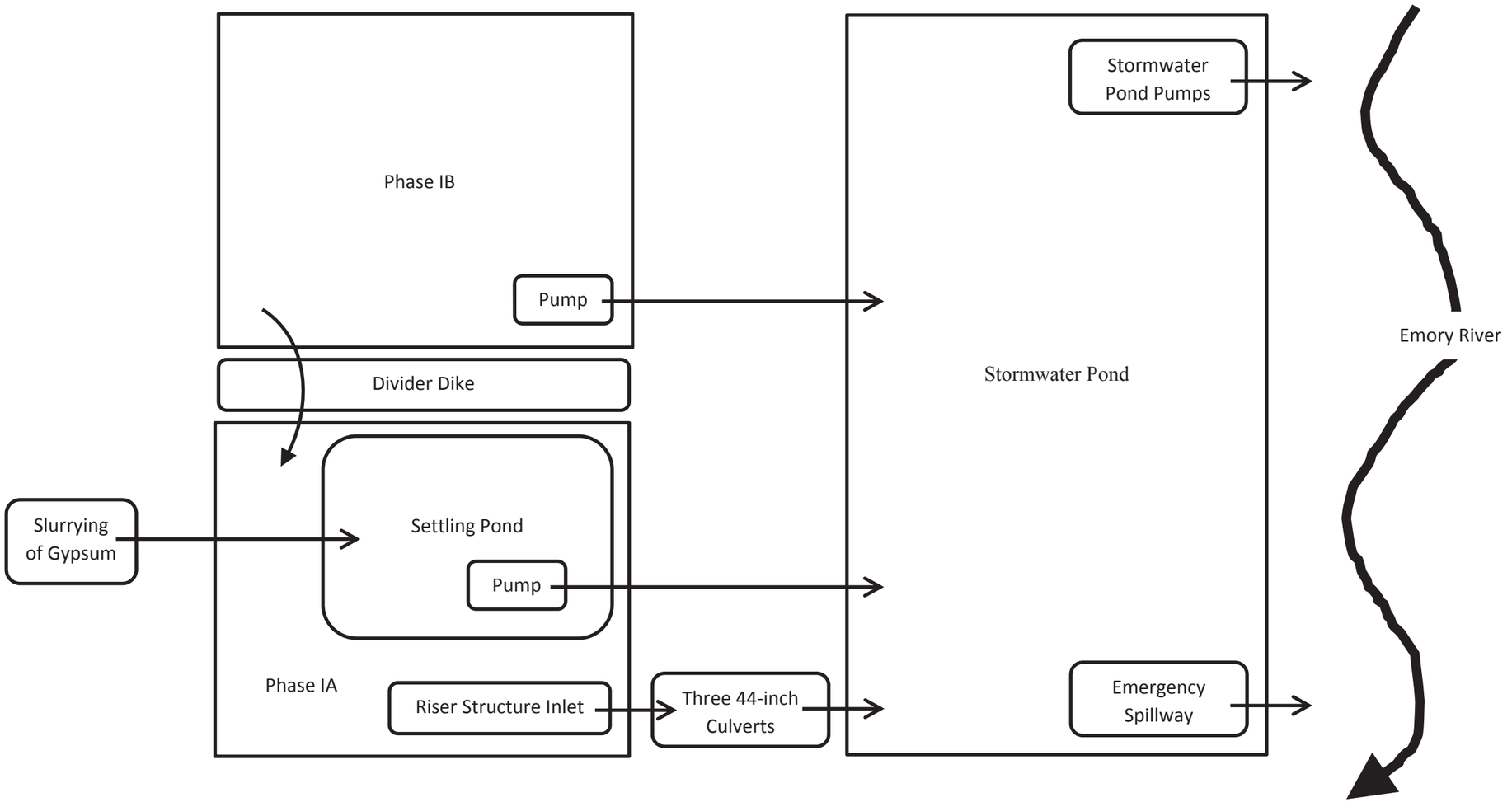

APPENDIX A

Document 14

Stantec Consulting Service correspondence Dated October 5, 2011 "Re: Results of Seismic Slope Stability Analysis, Main Ash Pond, Stilling Pond, Dike C, Kingston Fossil Plant"

Stantec Consulting Services Inc.
10509 Timberwood Circle Suite 100
Louisville, KY 40223-5301
Tel: (502) 212-5000
Fax: (502) 212-5055

October 5, 2011 ltr_009_175551015

Mr. Michael S. Turnbow
Tennessee Valley Authority
1101 Market Street, LP 2G-C
Chattanooga, Tennessee 37402-2801

Re: Results of Seismic Slope Stability Analysis
Main Ash Pond, Stilling Pond, Dike C
Kingston Fossil Plant

Dear Mr. Turnbow:

As requested, Stantec Consulting Services Inc. (Stantec) has conducted seismic slope stability analyses to support the U.S. Environmental Protection Agency's assessment of TVA's CCP disposal facilities. The results for Kingston Fossil Plant (KIF) are presented in this letter.

1. Introduction

The U.S. Environmental Protection Agency is undertaking a nationwide effort to assess coal combustion product (CCP) disposal facilities. These assessments are now underway for facilities at TVA's fossil plants. To support TVA, Stantec has conducted seismic stability analysis for Dike C of KIF's Ash Pond Stilling Basin.

The seismic slope stability analysis results presented in this letter employ a pseudostatic approach and are representative of current conditions. For seismic assessment in upcoming closure design, TVA will undertake a comprehensive risk/consequences-based approach, with design and mitigation decisions being based on the likelihood and consequences of failure. This approach is described in the document presented in Enclosure A. For KIF, closure of the Ash Pond Stilling Basin is currently planned for approximately 2020.

2. Seismic Stability Analysis Approach

Seismic slope stability has been performed for current conditions using pseudostatic stability methods, where the added inertial load from an earthquake is represented by a simple horizontal pseudostatic coefficient which provides an approximate representation of the dynamic loads imposed by an earthquake. Specifics related to the analyses/approach are as follows:

- Subsurface data was obtained from Stantec's geotechnical report entitled Report of Geotechnical Exploration and Slope Stability for Dike C; Kingston Fossil Plant, Harriman, Tennessee; August 3, 2009.

- SLOPE/W software (from GEO-SLOPE International, Inc.) was used to perform the calculations.

- One existing SLOPE/W cross-section model was selected for analysis of Dike C. The selected section is representative of Dike C's lowest current static (long-term) factor of safety, with consideration given to proper representation of a release/breach.

- Undrained shear strength parameters were used.

- Ground motion level corresponding to a return period of 500 years (or approximate exceedance probability of 10% in 50 years) was used for selection of horizontal seismic coefficients. This return period is consistent with seismic stability analysis guidance provided by Tennessee's dam safety regulations Chapter 1200-5-7, "Rules and Regulations Applied to the Safe Dams Act of 1973". The peak ground acceleration (or seismic coefficient) for a 500 year return period was selected from Table 20 of TVA's March 28, 2011 region-specific seismic hazard study performed by AMEC Geomatrix, Inc.

- A target factor of safety (FS) of 1.0 was considered for comparing results.

3. Results

The results of the pseudostatic stability analysis indicate a factor of safety of 1.4 for the section representing Dike C of the Ash Pond Stilling Basin. This exceeds the target of 1.0. Enclosure B contains a summary spreadsheet, SLOPE/W cross-section, and plan view showing the cross-section location.

Stantec appreciates the opportunity to provide these services. If you have questions, or if we can provide additional information, please let us know.

Sincerely,

STANTEC CONSULTING SERVICES INC.

Randy L. Roberts, PE
Principal

Enclosures

/cdm

Enclosure A

White Paper - Seismic Risk Assessment Closed CCP Storage Facilities

Seismic Risk Assessment
Closed CCP Storage Facilities
Tennessee Valley Authority Fossil Plants

Prepared by:

Alan F. Rauch, PhD, P.E.
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Stantec Consulting Services, Inc.

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Senior Associate
Stantec Consulting Services, Inc.

Jeffrey S. Dingrando, P.G., P.E.
Associate
Stantec Consulting Services, Inc.

Reviewed and Approved by:

Barry S. Snider, P.E.
TVA-CCP Interim Engineering Manager
Tennessee Valley Authority

William H. Walton, P.E.
Vice President, Senior Principal Engineer
AECOM

Thomas L. Cooling, P.E.
Vice President, Geotechnical Services
URS Corporation

Gonzalo Castro
Independent Consultant

Seismic Risk Assessment
Closed CCP Storage Facilities
Tennessee Valley Authority Fossil Plants

This document outlines proposed engineering analyses to estimate seismic failure risks at wet storage facilities for coal combustion products, following closure, at various TVA fossil power plants. The specific details outlined in this document are subject to future discussion and modification by the project team.

OVERVIEW

Tennessee Valley Authority (TVA) operates storage facilities for coal combustion products (CCPs) at eleven fossil power generating stations. As TVA transitions to dry systems for handling these materials, 18 to 25 wet storage facilities (CCP ponds, impoundments, dredge cells, etc.) will be closed (drained and capped). The CCP storage facilities are currently operated in accordance with state and federal regulations, but previously issued permits have not required evaluations for seismic performance. Moreover, the existing permits do not require seismic qualification for the storage facilities in their closed configurations.

TVA recognizes there is a potential for strong earthquakes to occur within the region, and there is a tangible risk for seismic failure at each closed CCP facility. These risks, including both the likelihood of failure and the consequences, must be understood to effectively manage TVA's portfolio of byproduct storage sites. This white paper summarizes the methodology that will be used to estimate these risks at the CCP storage facilities following closure.

Seismicity in the TVA service area is attributed to the New Madrid fault and smaller, less concentrated crustal faults. These two earthquake scenarios generate significantly different seismic hazards at each locality and will be considered independently within the risk assessment. At each closed byproduct facility, potential seismic failure modes will be evaluated in sequence. Instability due to soil liquefaction, slope instability due to inertial loading, and other potential failure mechanisms will be addressed. Seismic performance will be evaluated for differing earthquake return periods until a limiting (lowest return period) event that would cause failure is obtained. The probability of seismic failure will then correspond to the probability of this limiting earthquake event. The assessment of risk will also include estimates of potential consequences, as well as costs to mitigate the risks, that reflects the unique setting of the individual storage facilities after closure.

Following the same general methodology, seismic risks will be estimated in two phases. The near-term "Portfolio Seismic Assessment" will provide a rough estimate of seismic risks. The likely performance of each facility will be evaluated using simplified analyses, empirical methods, and the judgment of experienced engineers. The results will establish a ranking of the relative risks across the closure portfolio and also provide a preliminary picture of overall seismic risk. For the subsequent "Facility Seismic Assessments", seismic performance will be judged on the basis of site-specific data and detailed engineering analyses, which will be completed during the closure design process for individual facilities.

SEISMIC RISKS

This white paper provides an overview of the engineering methods proposed by Stantec for estimating seismic risks at TVA's closed byproduct storage sites. For each facility, four specific questions must be answered quantitatively:

(1) What is the approximate probability that a strong earthquake will occur?

Several seismic source zones could produce earthquakes large enough to impact these TVA sites. Very large magnitude earthquakes have occurred within the New Madrid seismic zone, which is located along the western boundaries of Tennessee and Kentucky. Because of their observed large magnitude and frequency of occurrence, New Madrid events contribute substantially to the seismic risks at all TVA sites. Ground motions from a New Madrid earthquake would attenuate with distance toward the east, such that local area sources also contribute significantly to site-specific seismic hazards.

Seismicity across the Tennessee Valley was previously characterized by AMEC/Geomatrix (2004), in a probabilistic study that focused on TVA dam sites. The same seismogenic model can be applied in evaluating earthquakes that would impact other TVA sites. Accordingly, probabilistic seismic hazards obtained from the 2004 AMEC/Geomatrix model will be used in the seismic risk assessment of the closed CCP storage facilities.

(2) Will a given earthquake cause failure in the closed facility?

Many of the TVA byproduct storage facilities are underlain by a substantial thickness of loose, saturated, alluvial soils (silts and sands). Some facilities will have layers of ash or other uncemented CCPs that remain saturated following closure. These materials, especially sluiced fly ash, are prone to liquefaction in a strong earthquake, as cyclic motions cause a build up of pore water pressure and a consequent loss of effective stress and shearing resistance. Extensive liquefaction in a foundation or CCP deposit under a storage facility would be expected, in most cases, to result in lateral spreading and massive slope movements (failure). Even without liquefaction, large slope deformations or failures may be triggered by lateral inertial loads during an earthquake. Liquefaction and dynamic loading of slopes are the most likely failure mechanisms, but other seismic failure modes, which may be unique to a particular closed storage facility, must also be evaluated.

(3) What are the potential consequences of a failure?

In addition to understanding the probability of failure, a risk assessment should consider the potential consequences. A failure is likely to have economic costs associated with clean-up and restoration of the site. Depending on the local site conditions, failure of a closed CCP facility may or may not cause significant impacts on the environment, waterways, transportation routes, buried or overhead utilities, or other infrastructure. Substantial economic costs would result if power generation is interrupted. Failure consequences may also include the potential loss of human life at some sites.

In this proposed seismic risk assessment, the definition of "failure" will be constrained to

mean the displacement of stored materials to a distance beyond the permitted boundary of the facility. While smaller deformations in a closed storage facility could cause economic damages, the resulting consequences for TVA should be manageable. Hence, this risk assessment will focus on potential "failures" where stored materials could move past the permitted boundary.

(4) What are the approximate costs to mitigate the risks of a seismic failure?

With an understanding of the probability and consequences of failure, the potential risks can be quantified and understood, possibly leading to decisions to mitigate seismic risks in the closure of certain facilities. Mitigation measures might include ground improvement to reduce liquefaction potential (stone columns, deep soil mixing, jet grouting, or other appropriate technology), stabilization of slopes by flattening or buttressing, enhanced drainage features, or some other engineered solution. The potential cost of these risk mitigation strategies are needed to make appropriate management decisions.

PORTFOLIO AND FACILITY ASSESSMENTS

Seismic evaluations will be completed for each of the CCP storage facilities that TVA has slated for closure; a tentative list is given in Table 1. The assessment of seismic risks will be accomplished in two phases:

A. Portfolio Seismic Assessment

In this first phase, the seismic risk assessment will be carried out using general site information, simplified analyses, empirical methods, and the judgment of experienced engineers. A team of four to five engineers will complete this evaluation for the entire portfolio, with assistance from the engineering teams currently working on each facility. After the probabilistic seismic hazards are defined, this phase of the work can be completed in a relatively short timeframe.

Given the level of effort and the simplified engineering analyses to be employed, the seismic risk estimates from the Phase A assessment will be approximate. Rather than attempting to compute precise risk numbers, Phase A will focus on capturing the relative risks between the different closed facilities. The key to successfully meeting this objective will be the consistent application of the assessment process across the portfolio.

This effort will result in a ranked list of sites that can be used to illustrate where seismic risks are greatest within the portfolio. The results will also provide some insight for understanding and communicating the magnitude of potential risks associated with seismic loading of the closed CCP facilities.

As a secondary objective, the Phase A assessment team will also consider the potential for failure of the active storage facilities, due to an earthquake occurring prior to closure. The seismic risks associated with the operating facility will not be estimated, but the Phase A assessment process provides an opportunity to identify potential failure mechanisms that should be addressed in the short term. This information may suggest the need to re-prioritize the closure schedule. Prior to closure, many of the wet CCP storage facilities retain large pools of water and are thus more susceptible to uncontrolled

releases in an earthquake. TVA has already made the decision to close these wet storage facilities to manage these risks, so the effort in Phase A will focus on identifying sites that may have unusually high seismic risks and deserve more study or higher priority in the closure program.

B. Facility Seismic Assessment

In this subsequent phase of work, more detailed engineering analyses will be carried out using site-specific geometry, subsurface conditions, material parameters, and results from static slope stability analyses. Simplified, state-of-the-practice methods of engineering analysis will be used; more complex analytical methods will be generally impractical for this risk assessment.

This phase of the work will be accomplished for individual facilities as part of the closure design, after the completion of other engineering analyses. The risks will be quantified by the design team, with assistance from the portfolio seismic assessment team. Significant, detailed effort will be required to assess each closed facility.

Compared to Phase A, the risk estimates obtained at this stage will be more reliable and better represent the actual risks for seismic failure. While it will be impossible to know how accurately the risks have been characterized at the completion of Phase B, the objective is to obtain results that are within perhaps ± 30% of the "actual" risk numbers. TVA expects to use the Phase B results to decide if the risks are acceptable, or if the closure design should be modified to mitigate risks for a seismic failure.

The engineering methodology (described below) to be followed in the Phase A and B evaluations will not characterize all of the uncertainties with respect to seismic performance. The uncertainties in the soil parameters and in the liquefaction, stability, and deformation analyses will not be quantified and carried through the risk assessment. Consequently, the estimated risk numbers will be approximate, but the results will be sufficiently accurate to support TVA decisions regarding prioritization for closure or the need for seismic mitigation. At most sites, the risks are expected to be high enough or low enough that further refinement in the risk numbers would not change these decisions. More detailed analysis beyond Phase B would be unjustified in these cases.

This assessment plan does not preclude the possibility that more detailed risk evaluations could be undertaken in subsequent phases of work. The Phase B results might reveal a subset of closed facilities with marginal risks, where a more rigorous and complete calculation of the risks would be needed to support a management decision. Hence, at the conclusion of the Phase B assessments, a "Phase C" evaluation may be needed for select sites and facilities, wherein uncertainties in the soil parameters and performance analyses would be quantified and carried through the risk assessment.

RESULTS AND APPLICATION

The results from the Phase A Portfolio Assessment will be presented in a table, like Table 1. For each facility evaluated, the estimated annual probability of failure due to a seismic event, the expected consequences (economic costs and potential loss of life), and the mitigation costs (design features to reduce risks) will be tabulated. The same parameters, but more

accurate numbers, will be reported from the more in-depth Phase B assessments. A qualitative description of the data quality (based on the number of borings, test data on key soil properties, etc.) will also be included, to indicate how well the site conditions were characterized at the time of the Phase A or B assessment.

In both Phase A and B, the evaluation teams will prepare a discussion of significant issues driving the seismic risks at each site. This summary will include knowledge gaps, likely failure mechanisms, unique consequences, suggested approaches for risk mitigation, and other key information. The Phase A evaluation of a facility may point out the need for additional data to support later seismic analyses in Phase B; needed field or laboratory testing could then be accomplished and documented as part of the facility closure design effort.

In the short term, TVA will utilize the Phase A results to better plan budgets and schedules for managing the closure process over the next several years. The Phase A assessment will also be used as an opportunity to identify operating facilities with especially high seismic risks. While these risks will not be quantified for conditions prior to closure, the consideration of potential seismic failure modes may prompt additional study and reconsideration of priorities. Where justified, the priorities for closure may be changed to more quickly address sites with higher seismic risks.

More accurate risk estimates will be obtained from the Phase B assessments, which will be completed as part of the closure design process. Those results will be used, within TVA's existing decision making framework, to judge if seismic mitigation is needed. For context, the criteria in Tables 2 and 3 represent the risk-based framework TVA uses to guide enterprise-level decisions. This framework relies upon broad, qualitative scoring of consequences and risks for the organization. For managing the seismic risks at the closed CCP facilities, complete probabilistic calculations of risk are not needed; approximate estimates of seismic risk will be sufficient to support TVA decisions.

The risks computed in Phase A and B will not be compared to a prescribed threshold or design risk level. Criteria for tolerable seismic risk in these closed CCP storage facilities has not been defined in the existing permits, in TVA policy, or in TVA design guidance.

METHODOLOGY

The same general methodology, outlined in ten steps below and in Figures 1 through 4, will be used to evaluate seismic risk in both the Phase A Portfolio Assessments and the Phase B Facility Assessments. While advanced engineering analyses may be required to demonstrate acceptable seismic performance in a design situation, simplified analyses will be used here, consistent with the goal of estimating the probability of failure.

In Step 1, seismic hazard parameters will be defined for each site; the results will be used as inputs for both the Phase A and Phase B assessments. Then, the evaluation of a particular facility will begin with a review of existing site information (Step 2), followed by engineering analyses for seismic performance. As described in Steps 3 through 7 below, the engineering analyses in Phase B will be more detailed than the simplified estimates in Phase A. The analyses will commence with an initial selection of an earthquake return period and evaluation for seismic performance. Steps 3 through 7 will be repeated until the limiting (lowest) earthquake return period expected to cause failure is obtained. Flowcharts

summarizing Steps 1 through 7 in the Phase A and B seismic performance assessments are given in Figures 3 and 4, respectively. The earthquake event with the lowest return period that causes failure will then be used to compute the probability of failure in Step 8. The potential consequences and mitigation costs will be estimated in Steps 9 and 10.

Step 1 – Define Seismic Input Parameters

Seismic hazards at TVA dam sites were quantified in a 2004 study by AMEC/Geomatrix. The New Madrid fault zone and several area source zones contribute to the seismicity of the region, as represented schematically in Figure 1. The New Madrid seismic zone is characterized by a large linear, combined reverse/strike-slip fault. Earthquakes in the area source zones are more diffuse (less concentrated in clusters) and tend to occur in zones of weakness of large crustal extent rather than along narrow, well-defined faults. Earthquakes occurring within the New Madrid Seismic Zone and in area sources outside of it will be considered in developing seismic input parameters for each CCP facility. However, only seismic source zones that contribute significantly to the ground motion hazard at a particular site will be used to develop seismic input parameters.

The national USGS seismic hazard model will not be used in these seismic risk assessments; instead, TVA will ask AMEC/Geomatrix to compute the site-specific seismic hazards for each closed CCP facility. The needed information can be obtained from the existing seismogenic model, but will need to separately consider the hazards associated with the New Madrid events and all other seismic sources (Figure 2), hereafter referred to in this white paper as the “earthquake scenarios”. The following parameters are needed for each earthquake scenario:

- Uniform hazard spectra for frequencies from 0.25 to 100 Hz (100 Hz value is equivalent to peak ground acceleration, PGA) at the top of rock for a range of return periods from 100 to 2,500 years.
- De-aggregation for relevant ground motion frequencies (one or more of the following: 0.5, 1.0, 2.5, 5.0, and 100 Hz) at each return period. The de-aggregation results will be used to select appropriate, representative earthquake parameters (magnitude and distance from the site), from which inputs needed for liquefaction analyses can be developed.

In the Phase A effort, the project team (including seismologists designated by TVA) will meet to consider the earthquake hazard data produced by the AMEC/Geomatrix model for each site. The team will reach consensus on the appropriate parameters (return period, earthquake magnitude, and peak ground acceleration) to be used in evaluating each facility, before proceeding with work on subsequent steps of the analysis. The seismic parameters to be tabulated (Table 4) will then be used in both the Phase A and Phase B assessments.

Ground motion time histories will be needed for the detailed Phase B calculations, and TVA will need to ask AMEC/Geomatrix to provide:

- Representative acceleration time histories (two orthogonal components), representing ground motions at the top of the rock profile for the specified earthquake return periods.

Given the results of the Phase A assessment, the Phase B analyses will focus on a narrower range of possible earthquakes. Hence, acceleration time histories will not be needed for every seismic event listed in Table 4.

Step 2 – Review Site and Facility Information

To meet the requirements for closure of TVA ash storage facilities, the closed condition may involve placement of compacted ash behind a strengthened dike, drainage of pond water to the levels of the surrounding groundwater table, and capping of the area with native soils. The collection of available site information for each facility will be reviewed from a seismic performance perspective. For the Phase B assessment, this information will be augmented with new data that becomes available during the closure design process.

The project information needed for each storage facility includes:

- Planned geometry of the closed storage facility, as needed to meet current design criteria and regulatory requirements.
- Geologic mapping and related information about the site geology.
- Historical records and other information related to site development.
- Boring logs, SPT data, CPT data, shear wave velocities, etc. from field explorations.
- Laboratory data from testing of site materials, including classification, Atterberg limits, moisture content, particle size, specific gravity, unit weight, compaction tests, and other relevant test data.
- Laboratory data on measured strength properties, for both drained and undrained conditions.
- Previously completed slope stability analyses, where available, will be modified for calculations in the risk assessments.

Step 3 - Evaluate Potential for Soil Liquefaction

The potential for soil liquefaction may be the greatest contributor to failure risk at many of the TVA storage sites. Liquefaction will thus be considered first in the assessment of seismic performance at each closed facility (Figures 3 and 4).

The Phase A assessment will utilize empirical charts and back-of-the-envelope calculations to judge if liquefaction would be likely for a given earthquake scenario. For example, Ambraseys (1988) compiled magnitude, epicentral distance, and whether or not liquefaction was observed in past earthquakes, and then suggested a threshold boundary (in terms of magnitude and epicentral distance) where liquefaction might occur in natural soil deposits. Selected, parametric calculations with the simplified procedure outlined by Youd et al (2001) will also be useful in judging what earthquakes would cause liquefaction in the Phase A Portfolio Assessments. These empirical methods may be unconservative for evaluating saturated CCPs, which are often more prone to liquefaction than a sandy soil, but the results will still provide useful guidance in the Phase A assessment.

For the Phase B liquefaction evaluations, detailed engineering analyses will be undertaken to obtain estimates of cyclic loading, soil resistance, and factor of safety as described below. Potentially liquefiable soils include saturated alluvial soils, loose granular fills, and sluiced ash. The detailed analyses will focus on critical cross sections of the closed facilities; liquefaction safety factors will not be computed for all boring locations at a site.

(a) Soil Loading from Earthquake Motions

The magnitude of the cyclic shear stresses induced by an earthquake are represented by the cyclic stress ratio (CSR). The simplified method proposed by Seed and Idriss (1971) will be used to estimate CSR in the Phase A parametric analyses (ground response analyses will not be completed in Phase A).

In Phase B, the CSR at specific locations (borings and depths where in situ penetration resistance are measured) will be computed using one-dimensional, equivalent-linear elastic methods as implemented in the ProSHAKE software. Using an acceleration time history at the top of rock (obtained from the seismic hazards study in Step 1), the computer program will model the upward propagation of the ground motions through a one-dimensional soil profile. For cases where the one-dimensional assumption is inadequate, the calculations can be accomplished using QUAKE, a two-dimensional finite element program that implements the same dynamic modulus reduction curves and damping relationships as used in ProSHAKE.

The cyclic stresses imparted to the soil will be estimated from the earthquake parameters described in Step 1, representing earthquakes on the New Madrid fault and local crustal events.

(b) Soil Resistance from Correlations with Penetration Resistance

The resistance to soil liquefaction, expressed in terms of the cyclic resistance ratio (CRR), will be assessed using the NCEER empirical methodology (Youd et al. 2001). Updates to the procedure from recently published research will be used where warranted. The analyses will be based on the blowcount value (N) measured in the Standard Penetration Test (SPT) or the tip resistance (q_c) measured in the Cone Penetration Test (CPT). In Phase A, typical or representative values will be used in parametric hand calculations; detailed data from site-specific explorations will be analyzed in Phase B.

The NCEER procedure involves a large number of correction factors. Based on the site-specific conditions and soil characteristics, engineering judgment will be used to select appropriate correction factors consistent with the consensus recommendations of the NCEER panel (Youd et al. 2001). To avoid inappropriately inflating the CRR, the NCEER fines content adjustment will not be applied where zero blowcounts (“weight of hammer” or “weight of rod”) are recorded. The magnitude scaling factor (MSF) is used in the empirical liquefaction procedure to normalize the representative earthquake magnitude to a baseline 7.5M earthquake. The earthquake magnitude (M) considered to be most representative of the liquefaction risk will be determined by applying the MSF to the de-aggregation data (from Step 1) for each selected earthquake return period.

Saturated fly ash, where it remains following closure, is likely to be more susceptible to liquefaction than indicated by these empirical methods. Values of CRR determined via the NCEER procedure are related to the observation of liquefaction in natural soils, mostly silty sands. Given the spherical particle shape and uniform, small grain size of fly ash, the NCEER procedure may give CRR values that are too high for saturated fly ash.

Lacking better methods of analysis, the lower-bound, "clean sand" base curve (Youd et al. 2001) will be assumed to apply for fly ash in the Phase A assessment. Within the liquefaction calculations, this will be accomplished for these materials by neglecting the fines content adjustment to the normalized penetration resistance. For Phase B, published and unpublished data from cyclic laboratory testing on similar materials will be sought to augment the indications of liquefaction resistance obtained from in situ penetration tests.

(c) Factor of Safety Against Liquefaction

The factor of safety against liquefaction (FS_{liq}) is defined as the ratio of the liquefaction resistance (CRR) over the earthquake load (CSR). Following TVA design guidance and the precedent set by Seed and Harder (1990), FS_{liq} is interpreted as follows:

- Soil will liquefy where $FS_{liq} \leq 1.1$.
- Expect substantial soil softening where $1.1 < FS_{liq} \leq 1.4$.
- Soil does not liquefy where $FS_{liq} > 1.4$.

Using this criteria for guidance, values of FS_{liq} computed throughout a soil deposit or cross section (at specific CPT-q_c and SPT-N locations) will be reviewed in aggregate. Occasional pockets of liquefied material in isolated locations are unlikely to induce a larger failure, and are typically considered tolerable. Instead, problems associated with soil liquefaction are indicated where continuous zones of significant lateral extent exhibit low values of FS_{liq}. Engineering judgment, including consideration for the likely performance in critical areas, will be used for the overall assessment of each facility. A determination of "extensive" or "insignificant" liquefaction will then lead to the appropriate stability analyses in the next stage of the evaluation, as indicated in Figures 3 and 4.

Step 4 – Characterize Post-Earthquake Soil Strengths

The post-earthquake shearing resistance of each soil and CCP will be estimated, with consideration for the specific characteristics of that material. The full, static shear strength will be assigned to unsaturated soils. Excess pore pressures will not develop in an unsaturated soil during seismic loading, so drained strength parameters can be used. The undrained strengths of saturated soils will be decreased to account for the softening effects of pore pressure buildup during the earthquake. Specifically:

- In saturated clays and soils with $FS_{liq} > 1.4$, 80% of the static undrained strength will be assumed.
- In saturated, low-plasticity, granular soils with $1.1 < FS_{liq} \leq 1.4$, a reduced strength will be assigned, based on the excess pore pressure ratio, r_u (Seed and Harder 1990).

Typical relationships between FS_{liq} and r_u have been published by Marcuson and Hynes (1989).

- In saturated, low-plasticity, granular soils with $FS_{liq} \leq 1.1$, a residual (steady state) strength (S_{us}) will be estimated for the liquefied soil. Values of S_{us} can be obtained from the empirical correlations published by Seed and Harder (1990), Castro (1995), Olson and Stark (2002), Seed et al. (2003), and Idriss and Boulanger (2008).

Subsequent stability and deformation analyses will be accomplished using these reduced strength parameters. No attempt will be made to model the cyclic reduction in soil shear strength during an earthquake. In the deformation analyses, the fully reduced strengths will be assumed at the start of cyclic loading, which will yield conservative estimates of slope displacements.

Step 5 – Analyze Slope Stability

The next step in the performance evaluation (Figures 3 and 4) will consider slope stability, for conditions with or without significant liquefaction. Slope stability will be evaluated using two-dimensional, limit equilibrium, slope stability methods. Reduced soil strengths (from Step 4), conservatively representing the loss of shearing resistance due to cyclic pore pressure generation during the earthquake, will be used in the stability calculations. The analyses will be accomplished using Spencer's method of analysis, as implemented in the SLOPE/W software, considering both circular and translational slip mechanisms.

Input files for static stability calculations, where previously completed for a particular facility, will be updated to represent seismic conditions. These stability analyses may be not available, or the closure geometry may be undefined, for the Phase A assessment of some sites. In those cases, simplified or approximate geometries will be developed for approximate analysis in Phase A. Engineering experience will also be useful in judging likely seismic stability. For example, a complete failure is likely if liquefaction undermines the foundation of the outslope. In the absence of liquefaction, a slope that exhibits adequate safety factors under static conditions is unlikely to fail in an earthquake. Back-of-the-envelope hand calculations can be useful in assessing stability where extensive liquefaction occurs in the saturated materials within or below CCPs retained by a stable perimeter dike. Detailed slope stability calculations, which accurately represent the planned closure geometry, will be used in the Phase B facility assessments.

(a) Slope Stability if Extensive Liquefaction

If extensive liquefaction is indicated, stability will be evaluated for the static conditions immediately following the cessation of the earthquake motions. Residual or steady state strengths will be assigned in zones of liquefied soil, with reduced strengths that account for cyclic softening and pore pressure build up assumed in non-liquefied soil. In both Phase A and B, complete failure (large, unacceptable displacements) will be assumed if the safety factor (FS_{slope}) computed in this step is less than one (Figures 3 and 4).

For slopes where the post-earthquake $FS_{slope} \geq 1$, deformations will be estimated in the Phase B assessment (Step 6 and Figure 4). Slope deformations will not be estimated in the Phase A portfolio assessment, where ground motion time histories will not be available. In Phase A, slopes exhibiting $FS_{slope} \geq 1$ with liquefaction will be assumed

stable with tolerable deformations; this condition may exist, for example, where liquefied ash at the base of a closed storage facility is contained within a stable perimeter dike.

Note that pseudostatic stability analyses are not useful for evaluating a factor of safety where extensive liquefaction is expected, because appropriate pseudostatic coefficients can not be defined.

(b) Slope Stability if No Significant Liquefaction

If no significant liquefaction is expected, seismic stability will be analyzed in Phase A using approximate, pseudostatic stability methods (Figure 3). The added inertial loads from the earthquake will be represented with a simple, horizontal pseudostatic coefficient (k_h), which provides an approximate representation of the dynamic loads imposed by an earthquake. The horizontal pseudostatic coefficient will be set to one-tenth of the peak ground acceleration in rock ($k_h = 0.1 \cdot PGA_{rock}$). In Phase A, tolerable deformations (less than about 5 meters) will be assumed if the pseudostatic $FS_{slope} \geq 1$, and failure will be assumed if the pseudostatic $FS_{slope} < 1$.

This approach and criteria are based on the work of Hynes-Griffin and Franklin (1984). They performed Newmark deformation analyses, integrated over 350 ground motion time histories, used an amplification factor of three to represent peak accelerations at the base of an earth embankment, and assumed a displacement of 1 meter would be tolerable for an embankment dam. For a typical CCP facility, assuming no pool is retained following closure, “failure” would imply displacements significantly greater than 1 meter. A tolerable displacement of about 5 meters will be assumed here, for the Phase A risk assessments. From the upper bound curve plotted by Hynes-Griffin and Franklin (1984), a displacement of 5 meters would correspond to a yield acceleration of about 0.03 times the peak acceleration along the slip surface. Then, assuming an amplification factor of 3 for the ground motions at the base of the embankment, this suggests $k_h = 0.1 \cdot PGA_{rock}$ can be used conservatively in the pseudostatic analysis to judge failure, as described above.

Pseudostatic factors of safety will not be computed in the Phase B assessment. Instead, where a liquefaction failure is not predicted, potential slope displacements will be computed as described in Step 6.

Step 6 – Predict Deformations

In the Phase A Portfolio Assessment, closed facilities that are expected to remain stable (pseudostatic $FS_{slope} \geq 1$ with no liquefaction, or post-earthquake $FS_{slope} \geq 1$ with liquefaction) will be assumed to have tolerable displacements. Dynamic slope deformations are difficult to estimate without detailed analysis; the available empirical or approximate methods do not represent the conditions of interest, or the level of effort is not consistent with the goals of the first phase of risk assessments. In addition, earthquake ground motion time histories will not be available for the Phase A analyses.

In the Phase B Facility Assessments, the potential deformation of stable slopes will be evaluated as indicated in Figure 4. Conventional methods of analysis will be implemented to estimate potential slope displacements that accumulate during earthquake shaking; movements are assumed to stop when the earthquake ends, consistent with a post-

earthquake safety factor greater than one. The acceleration time histories obtained from the ground response analyses in Step 3a will be used as inputs for computing deformations with one of the following simplified methods:

- Newmark's (1965) method involves double integration of accelerations greater than the yield acceleration (k_y), which will be determined from a succession of pseudostatic slope stability analyses in which k_h is varied. The value of k_h where the pseudostatic FS_{slope} = 1.0 corresponds to the yield acceleration.
- The Makdisi-Seed (1978, 1979) procedure, which better accounts for the dynamic response of embankments. This procedure was developed based on parametric numerical simulations for earthen dams. The procedure is iterative, considers the fundamental periods of the embankment response, and can be completed in steps using published charts. Results from QUAKE can also be used as input in this procedure.

The slope deformations predicted in Phase B will be conservative, because the yield acceleration will be computed based on reduced, post-earthquake soil strengths. In reality, the yield acceleration declines in successive cycles of seismic loading, as pore pressures accumulate and saturated soils become weaker. The analysis outlined in Figure 4 assumes reduced strengths and, where liquefaction is predicted, residual strengths at the start of the earthquake. Detailed numerical simulations can be used to track the progressive softening and liquefaction of soil within an embankment during an earthquake; such analyses are expensive and time consuming. Rigorous analyses of this type will not be justified except in a "Phase C" analysis, or where performance in a given seismic design event must be demonstrated. Note that the logic in Figure 4 might appear to assume a slope will be stable if there is no significant liquefaction; however, the deformation analysis will indicate unlimited deformations and certain failure if $FS_{slope} < 1$ for static, post-earthquake conditions.

Step 7 – Consider Other Potential Failure Modes

For most of the closed facilities, soil liquefaction, slope instability, and slope deformations will be the most likely seismic failure modes. However, depending on the unique configuration of each CCP facility, other potential failure modes may contribute significantly to the seismic risks. For example, the loss of critical drainage structures or retaining walls could lead to a failure condition. Other potential failure modes will be identified and evaluated quantitatively in this step.

As a secondary objective of the Phase A effort, the assessment team will consider the potential for failure of the active storage facilities, due to an earthquake occurring prior to closure. Many of the wet CCP storage facilities retain large pools of water, so this assessment will need to consider additional failure modes such as seepage and embankment cracking. The objective here will be to identify operating facilities that may have unusually high seismic risks, and might deserve more study or higher priority in the closure program.

Step 8 – Estimate Annual Probability of Seismic Failure

As indicated in the flowcharts in Figures 3 and 4, the assessments of seismic performance (in both the Phase A and Phase B efforts) will consider a range of potential earthquakes with differing return periods. The analyses will be repeated until the limiting (lowest) earthquake return period (from the candidate events defined in Step 1) that predicts failure of a particular CCP storage facility is obtained. Interpolation may be used, as appropriate, to narrow the definition of the limiting earthquake.

The return period for each earthquake scenario (Table 4) represents the annual probability of exceedance for the associated ground motion parameter. Hence, for each earthquake scenario, the event with the smallest return period that causes failure represents a limiting case, where all events having longer return periods would also cause failure. The inverse of the limiting return period thus represents the annual probability of seismic failure due to that earthquake scenario.

Step 9 – Estimate Potential Consequences of Failure

The potential consequences of a failure at each closed facility will be estimated in this step. The potential consequences will be unique to each site, but may include any of the following:

- restoration of the site and storage facility,
- clean-up to address environmental impacts,
- off-site disposal of released materials,
- damages and loss of use for transportation routes, including buried or overhead utilities,
- damages to buildings and other infrastructure,
- economic losses from the possible shutdown of power generation, and
- loss of human life (expected to be unlikely at most sites following closure).

Except for the potential loss of life, the failure consequences will be expressed in terms of present day costs. Detailed cost estimates of the potential consequences of failure will not be attempted in the Phase A assessments; instead, the potential magnitude of total consequence costs will be estimated using broad categories (< $100K, < $500K, < $1M, < $5M, < $10M, < $50M, < $100M). Cost estimates that better reflect the local site conditions will be produced by the closure design teams during the Phase B assessments.

Step 10 – Estimate Possible Mitigation Costs

The final step in the process will involve estimating the costs to mitigate seismic risks, perhaps by altering the closure design to withstand stronger earthquakes. Examples of possible mitigation measures include:

- ground improvements to reduce liquefaction potential (stone columns, deep soil mixing, jet grouting, or other appropriate technology),
- altering the geometry of outslopes (setbacks, benches, or flatter slopes) to improve

stability,

- adding buttresses or other supporting structures at the toe of slopes,
- enhanced drainage features, and
- relocation of infrastructure or people away from potential impact zones.

These mitigation approaches generally involve higher construction costs, which can be quantified in terms of present dollars. As with the consequence costs, detailed estimates of mitigation costs will not be attempted in the Phase A assessments. The potential magnitude of mitigation will be estimated in categories (< $100K, < $500K, < $1M, < $5M, < $10M, < $50M, < $100M). Mitigation cost estimates that better reflect the local conditions and facility layout will be developed by the closure design teams during the Phase B assessments.

Table 1. Expected Results from the Phase A and B Seismic Risk Assessments

TVA Facility	Prob. Failure	Econ. Costs	Loss of Life	Mitigat. Costs	Data Quality
ALF East Ash Disposal					
ALF East Stilling Pond					
BRF Dry Fly Ash Disposal					
BRF Fly Ash Pond And Stilling Basin Area 2					
BRF Bottom Ash Disposal Area 1					
BRF Gypsum Disposal Area 2a					
COF Disposal Area 5					
COF Ash Pond 4					
CUF Dry Ash Stack					
CUF Ash Pond					
CUF Gypsum Storage Area					
GAF Fly Ash Pond E					
GAF Bottom Ash Pond A					
GAF Stilling Pond B, C & D					
JSF Dry Fly Ash Stack					
JSF Bottom Ash Disposal Area 2					
JOF Ash Disposal Area 2					
KIF Dike C					
PAF Scrubber Sludge Complex					
PAF Peabody Ash Pond					
PAF Slag Areas 2a & 2b					
SHF Consolidated Waste Dry Stack					
SHF Ash Pond					
WCF Ash Pond Complex					
WCF Gypsum Stack					

Prob Failure = Annual probability of failure due to earthquakes
Econ. Costs = Economic costs resulting from a failure
Loss of Life = Potential loss of life resulting from a failure
Mitigat. Costs = Costs to mitigate seismic risks in closure design
Data Quality = Qualitative indication of how well conditions in the facility are characterized

Table 2. Risk Severity Scoring (Draft) used by TVA

as of 4/22/2009

TVA Risk Event Consequence Rating Scale (Work-In-Progress)						
Strategic Objective	Success Factor	5 Worst Case	4 Severe	3 Major	2 Moderate	1 Minor
Customer	Public Image	International media attention; nearly unanimous public criticism	National media attention; federal, state officials, and customers publicly critical	Regional / local media attention; customers voice concern	Minimal media attention; letters / emails to executive leadership voicing concern	No media attention; sparse criticism
	Rate Impact	Average total retail rate increases by 15%, relative to peers	Average total retail rate increases by 10%-15%, relative to peers	Average total retail rate increases by 5%-10%, relative to peers	Average total retail rate increases by 2%-5%, relative to peers	Average total retail rate increases by 0-2%, relative to peers
People	Safety	Fatalities	Wide spread injuries	Major injuries	Significant injuries	Minor injuries
	Employee Confidence	Widespread departures of key staff with scarce skills or knowledge	Sharp, sustained drop in CHI results; departures of key staff with scarce skills or knowledge	Sharp decline in CHI results	Modest decline in CHI results	No effect on CHI results
Financial	Cash Flow Impact	>$500M	$100M - $500M	$25M - $100M	$5M - $25M	<$5M
	Credit Worthiness	Credit rating downgrade to below investment grade	Credit Rating Downgrade	TVA put on credit watch	TVA put on negative outlook	Credit rating agencies and bondholders express concern
Assets and Operations	LNS (Load not served)*	10% of System Daily Sales (48,000 MWhrs)	1% of System Daily Sales (4,800 MWhrs)	0.1% of System Daily Sales (480 MWhrs)	0.05% of System Daily Sales (240 MWhrs)	140 MWhrs
	CPI (Connection Point Interruptions)	10% of CPs are down simultaneously	5% of CPs are down simultaneously	CPI totaling 10% of current CP count (124 for FY09)	CPI totaling 7.5% of current CP count (93 for FY09)	CPI totaling 5% of current CP count (62 for FY09)
	Duration (in Hours) of Service Interruption	3,000 cumulative hours for CPs	1,000 cumulative hours for CPs	500 cumulative hours for CPs	150 cumulative hours for CPs	50 cumulative hours for CPs
	Delivered Cost of Power	Sustained increase in delivered cost of power >1 year	Increase in delivered cost of power <1 year	Increase in delivered cost of power <1 month	Increase in delivered cost of power <1 week	Delivered cost of power not effected
	Damage to environment; type and magnitude of contamination / discharge	Major coal, nuclear plant accident or dam failure	Significant hazardous waste discharged; nuclear plant accident; dam integrity failure resulting in drawdown of pool elevation	Hazardous materials / waste discharge; clean up / remediation time takes approximately two weeks	Localized environmental damage, no impact to wildlife, clean up / remediation time less than two weeks	Minimal environmental damage, no hazardous discharge; clean up time takes a few days

Table 3. Risk Likelihood Scoring used by TVA

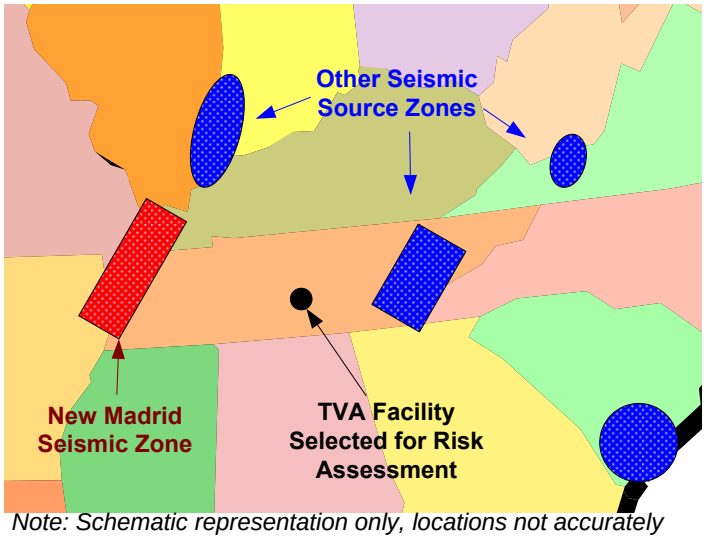
TVA Risk Event Probability Rating Scale		
Score	Rating	Description
5	Virtually Certain	95% probability that the event will occur in the next 3 years /10 years
4	Very Likely	75% probability that the event will occur in the next 3 years/10 years
3	Even Odds	50% probability that the event will occur in the next 3 years/10 years
2	Unlikely	25% probability that the event will occur in the next 3 years/10 years
1	Remote	5% probability that the event will occur in the next 3 years/10 years

- *The 3-year timeframe will be the primary focus for the business unit risk maps*
- *The 10-year risks will be collected by the ERM organization and charted separately for the enterprise*

Table 4. Seismic Hazard Input Data for Probabilistic Assessment of TVA Facilities

Seismic Sources	Return Period (years)	Annual Probability of Exceedance	Peak Ground Acceleration (g)	Earthquake Magnitude
New Madrid Seismic Zone	2,500 1,000 500 250 100	0.0004 0.001 0.002 0.004 0.01	*Values to be determined from the seismic hazard curves*	*Values to be determined from the hazard de-aggregation data**
All Other Seismic Sources	2,500 1,000 500 250 100	0.0004 0.001 0.002 0.004 0.01		

** Representative magnitude corresponding to the maximum contribution to the seismic hazard for liquefaction, as determined from the de-aggregation data weighted by the magnitude scaling factor (maximum PGA / MSF)*



Note: Schematic representation only, locations not accurately depicted, some sources omitted.

Figure 1. Schematic Representation of Seismic Source Model for TVA Facilities

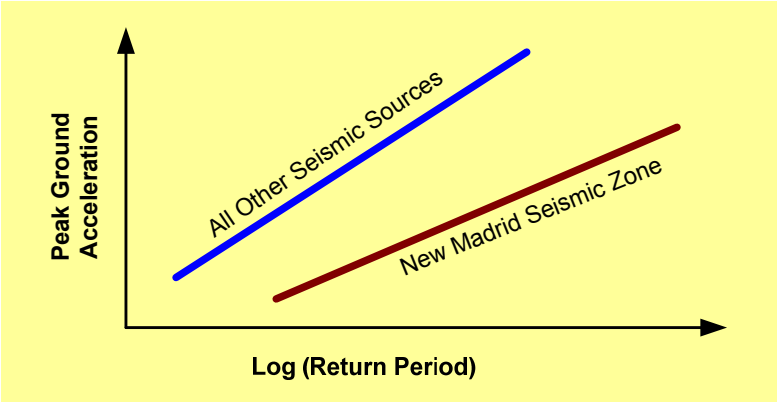


Figure 2. Typical Seismic Hazard Curves for Proposed Probabilistic Assessment of TVA Facilities

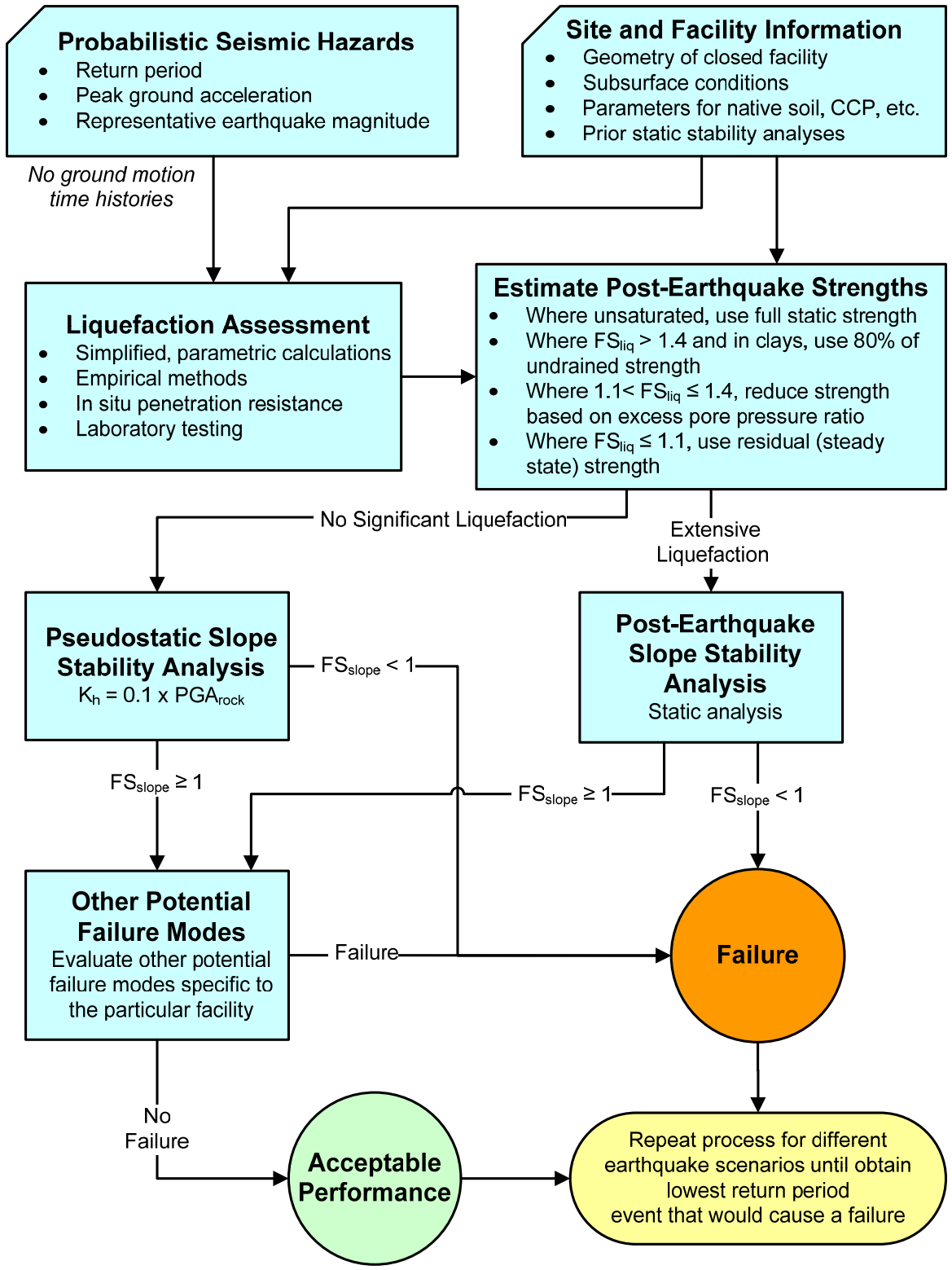


Figure 3. Simplified Flowchart for Assessing Facility Performance During a Probabilistic Seismic Event in Phase A

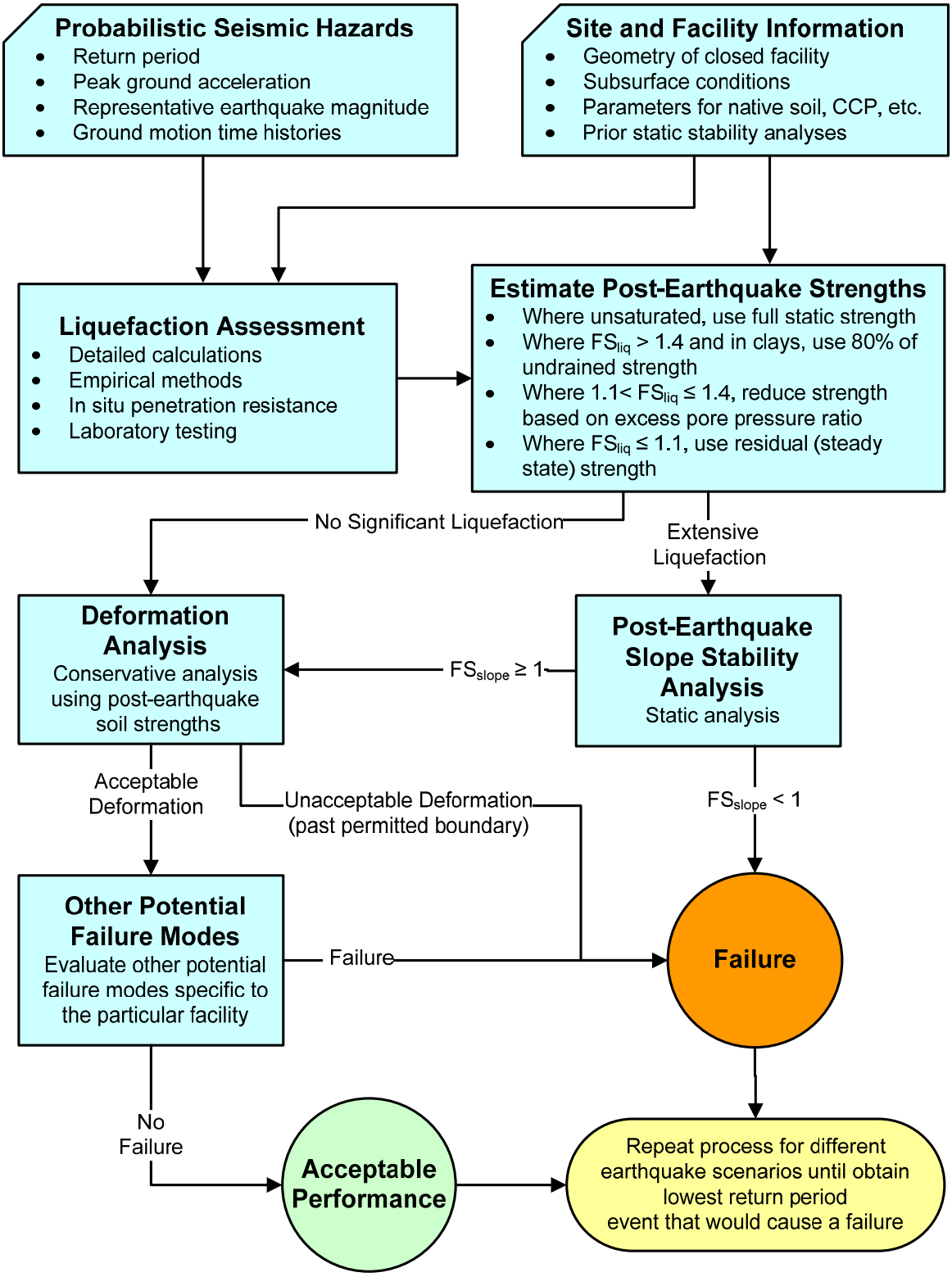


Figure 4. Simplified Flowchart for Assessing Facility Performance During a Probabilistic Seismic Event in Phase B

Enclosure B

Pseudostatic Analysis Results

Kingston Fossil Plant - Pseudostatic Stability Analysis Summary

CCP Disposal Facility		Cross-Section Information		500 yr Return		Mitigation and Improvement Activities Since January 2009 As-Found Conditions
Name	Type	Section Analyzed	Section Location	PGA (g)	Factor of Safety	
Ash Pond Stilling Basin, Dike C	Impoundment	132+37	East Side	0.041	1.4	Construction activities have recently been completed to improve static stability and seepage conditions for the entire length of Dike C. This included a graded sand and gravel seepage filtering system and 4H:1V to 6H:1V rockfill buttress along the outslope of the dike. Section 132+37 represents these mitigations.

Notes:

1) Acceleration is from March 28, 2011 TVA region-specific seismic hazard study performed by AMEC Geomatrix, Inc. (total hazard).
2) Refer to layout plan for location of cross-section.
3) Stability models reflect current ground lines and conditions.
4) Liquefaction was not considered in this analysis.

Pseudostatic Slope Stability Analysis
CCP Storage Facilities - Existing Conditions
Tennessee Valley Authority Fossil Plants

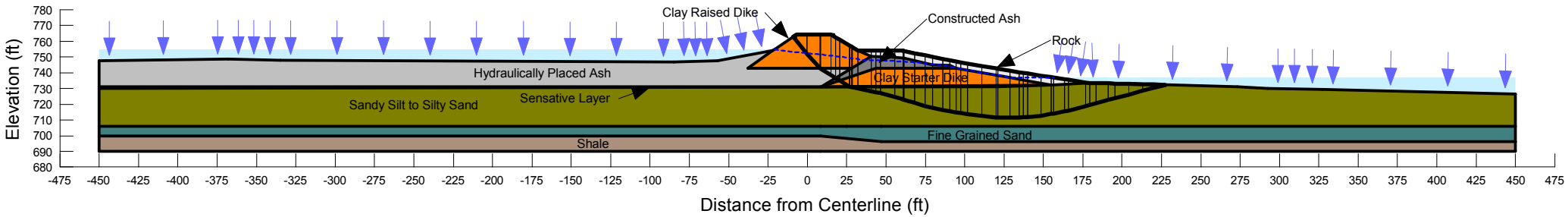
Section STA. 132+37
Kingston Fossil Plant
Harriman, Tennessee

Note:
The results of the analysis shown here are based on available subsurface information, laboratory test results, and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Material Type	Unit Weight	Cohesion	Friction Angle
Clay Raised Dike	125 pcf	65 psf	23 °
Constructed Ash	93 pcf	0 psf	30 °
Hydraulically Placed Ash	96 pcf	0 psf	10 °
Sandy Silt to Silty Sand	105 pcf	0 psf	27 °
Fine Grained Sand	122 pcf	0 psf	31 °
Clay Starter Dike	129 pcf	300 psf	26 °
Sensative Layer	127 pcf	c/p = 0.32	N/A
Rock	110 pcf	0 psf	38 °
Shale	N/A	N/A	N/A

Factor of Safety: 1.36

Horizontal Seismic Coefficient Kh = 0.041 g
500-year Return Period Event



Date of Assessment - 09/09/2011

Project No 175551015

BORING LOCATION TABLE			
Boring No.	Northing	Easting	Elevation (Feet)
STN-2	556804.57	2442329.32	751.20
STN-2B	556801.29	2442323.04	751.00
STN-3	556756.78	2442263.59	763.70
STN-3C	556763.50	2442257.42	763.80
STN-3D	556762.50	2442258.42	763.80
STN-3E	556764.10	2442559.45	763.80
STN-4	556625.56	2442047.01	763.30
STN-5	556611.15	2442365.31	764.90
STN-6	556416.17	2442407.10	763.40
STN-8	556248.52	2442540.30	752.20
STN-8A	556254.96	2442535.17	751.70
STN-9	556233.82	2442499.72	764.80
STN-9A	556234.82	2442499.81	764.80
STN-10	556162.76	2442251.63	765.00
STN-11	556034.83	2442535.05	763.20
STN-12	555873.09	2442622.48	765.10
STN-14	555685.58	2442733.21	753.10
STN-14B	555690.29	2442730.41	753.00
STN-15	555662.69	2442667.52	763.70
STN-15C	555671.50	2442690.88	765.30
STN-15D	555665.72	2442690.78	765.30
STN-15E	555694.24	2442681.34	765.00
STN-16	555501.40	2442725.94	764.50
STN-18	555204.87	2442894.11	751.00
STN-18A	555204.57	2442886.00	751.80
STN-19	555204.68	2442842.94	765.60
STN-19A	555204.68	2442843.94	765.60
STN-20	555168.84	2442666.59	762.90
STN-21	555076.61	2442149.85	765.00
STN-22	554990.27	2441723.40	765.00
STN-23	555020.22	2442857.46	764.70
STN-24	554803.45	2442843.16	765.10
STN-26	554624.86	2442889.00	750.00
STN-26B	554604.57	2442896.12	751.00
STN-27	554601.77	2442850.67	765.10
STN-27A	554600.64	2442840.21	765.00
STN-27B	554606.18	2442840.52	765.00
STN-27C	554607.18	2442840.92	765.00
STN-28	554406.25	2442841.10	764.80
STN-29	554155.15	2442854.72	764.70
STN-31	553954.94	2442758.22	749.50
STN-31A	553980.30	2442764.66	749.70
STN-32	553994.90	2442746.44	764.80
STN-32A	553996.72	2442757.13	764.80
STN-34	553882.51	2442381.24	764.70

BORING LOCATION TABLE			
Boring No.	Northing	Easting	Elevation (Feet)
STN-36	553776.74	2442198.78	751.90
STN-36B	553753.47	2442155.66	751.50
STN-37	553799.90	2442184.40	763.80
STN-37C	553798.81	2442171.01	763.60
STN-37D	553798.26	2442168.95	763.60
STN-37E	553799.26	2442183.40	763.80
STN-38	553730.83	2441988.70	764.10
STN-41	553583.10	2441510.71	752.70
STN-41A	553584.59	2441512.86	751.80
STN-42	553623.48	2441513.69	764.70
STN-42A	553624.48	2441512.69	764.70
STN-43	554004.68	2441548.50	765.90
STN-43A	554005.71	2441549.61	765.90
STN-45	553740.50	2441308.40	763.90
STN-47	553747.39	2441146.83	753.40
STN-47B	553742.43	2441143.28	753.80
STN-48	553773.29	2441154.53	765.30
STN-48C	553770.51	2441164.28	765.30
STN-49	553921.85	2441024.39	763.10
STN-50	553631.96	2440496.85	741.60
STN-50A	553632.98	2440497.85	741.60
STN-51	553696.02	2440548.48	750.40
STN-52	553992.98	2440817.40	753.20
STN-53	554011.12	2440902.46	763.90
STN-53A	554012.14	2440904.05	763.90
STN-54	555263.94	2441476.12	765.00
STN-55	554943.73	2442287.49	764.10
STN-56	554555.61	2441998.50	765.80
STN-59	556075.53	2442603.06	752.20
STN-60	555886.92	2442663.31	752.50
STN-61	555513.59	2442792.80	752.50
STN-62	555020.69	2442907.23	749.80
STN-63	554822.75	2442910.57	750.00
STN-64	554411.29	2442911.08	749.40
STN-65	554147.51	2442915.09	748.60
STN-66	553888.83	2442584.24	750.90
STN-69	553607.58	2441718.01	752.30
STN-71	553840.20	2440981.04	752.00
STN-72	556243.56	2442498.40	765.70
STN-73	556264.59	2442544.34	763.90
STN-74	555189.21	2442848.63	766.20
STN-74	555184.59	2442849.41	766.20
STN-75	555194.95	2442895.83	753.40
STN-76	553923.59	2442380.21	762.00
STN-77	553847.01	2442405.85	754.90

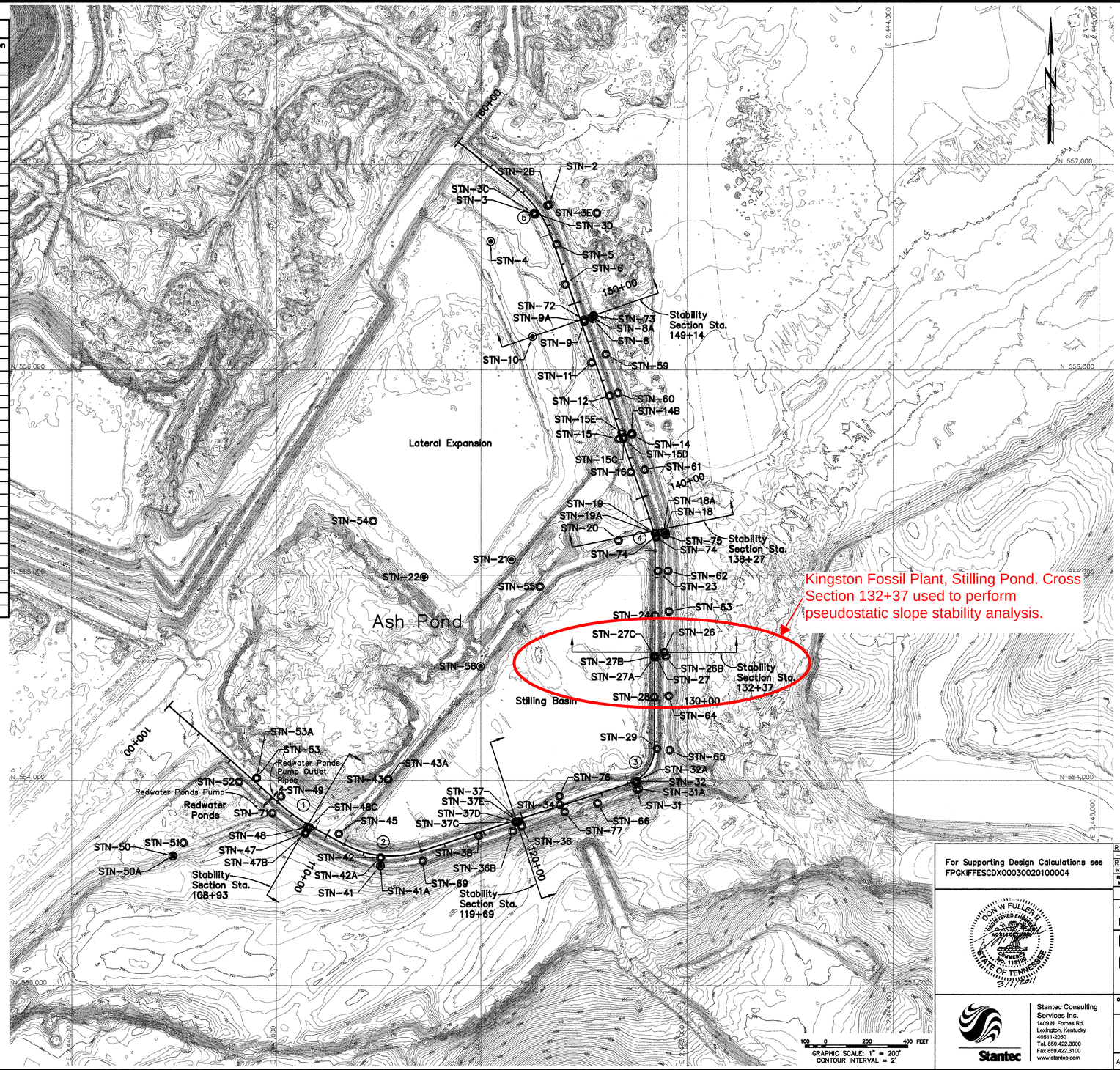


TABLE OF BASELINE COORDINATES			
Station	Baseline	Northing	Easting
100+00.00	Begin Project Baseline	554,363.86	2,440,477.77
160+00.00	End Project Baseline	557,109.43	2,441,888.38

BASELINE CURVE DATA

① P.I. Sta. = 108+20.74; Northing = 553,819.18; Easting = 2,441,091.71; Δ = 13°20'06"; R = 974.68'; T = 113.94'; L = 226.85'; E = 6.64'; P.C. Sta. = 107+06.80; P.T. Sta. = 109+33.65

② P.I. Sta. = 112+99.93; Northing = 553,591.92; Easting = 2,441,514.77; Δ = 46°19'10"; R = 479.84'; T = 205.26'; L = 387.92'; E = 42.06'; P.C. Sta. = 110+94.67; P.T. Sta. = 114+82.59

③ P.I. Sta. = 126+71.85; Northing = 554,024.61; Easting = 2,442,840.47; Δ = 71°45'50"; R = 182.94'; T = 132.33'; L = 229.13'; E = 42.85'; P.C. Sta. = 125+39.52; P.T. Sta. = 127+68.65

④ P.I. Sta. = 138+12.12; Northing = 555,200.41; Easting = 2,442,843.77; Δ = 19°21'32"; R = 479.84'; T = 81.84'; L = 162.13'; E = 6.93'; P.C. Sta. = 137+30.28; P.T. Sta. = 138+92.41

⑤ P.I. Sta. = 154+96.30; Northing = 556,792.40; Easting = 2,442,289.43; Δ = 32°28'34"; R = 479.84'; T = 139.75'; L = 271.98'; E = 19.94'; P.C. Sta. = 153+56.55; P.T. Sta. = 156+28.53

LEGEND

- Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests
- Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests and Rock Core
- Previously Drilled by AECOM
- Cone Penetration Test

NOTES

1. Topographic mapping was generated from a LIDAR survey performed on January 8, 2009 by Tuck Mapping Solutions, Inc. This plan was developed for discussion purposes only and is not to be used for construction.
2. The geotechnical information and data furnished herein are not intended as representation or warranties but are furnished for information only. It shall be distinctly understood that the Owner or Engineer will not be responsible for any deduction, interpretation or conclusion drawn therefrom. The information is made available in order that the Contractor may have ready access to the same information available to the Owner and the Engineer and is not part of this contract.

FOR INFORMATION ONLY
This Record Drawing which has been previously submitted to TVA is provided for Information Only.

RECORD DRAWING

For Supporting Design Calculations see FPGKIFFESCDX00030020100004

DON W. FULLER II REGISTERED ENGINEER 119150 STATE OF TENNESSEE 5/17/2011

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
Tel. 859.422.3000
Fax 859.422.3100
www.stantec.com

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT MGR	AS CONST
R 0	03/01/11	JDP	TJ	TC	DWF	–	MST	JCK	–	–
RECORD DRAWING										

SCALE: 1"=200' EXCEPT AS NOTED

YARD
DIKE C

BUTTRESS DESIGN
BORING PLAN AND BASELINE LAYOUT

DESIGNED BY: J.D. PINEAU	DRAWN BY: T. JOHNSON	CHECKED BY: T. CRILLY	SUPERVISED BY: D.W. FULLER	REVIEWED BY: –	APPROVED BY: M.S. TURNBOW	ISSUED BY: J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 03/01/11	36	C	10W287-01	R 0

PLOT FACTOR:200
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT DATE: 05/04/2011 USER: HOWL GORDON
S:\CIVIL\STANTEC\172589\03_ENGINEERING\FOSSIL PLANT - DIRECT\CAD\ESTE\CIVIL\10W287-BUTTRESSDESIGN\DWG\NEW_LAYOUT\10W287-01.DWG

APPENDIX A

Document 15

Geosyntec Consultants "Site Response and Seismic Deformation Analyses, Kingston Peninsula Permit Modification," November 10, 2010

Written by:	Neven Matasovic	Date:	11/24/2010	Reviewed by:	M. Othman	Date:	11/24/2010
Client:	TVA	Project:	Kingston Peninsula Permit Modification	Project/ Proposal No.:	GR4694	Task No.:	05

SITE RESPONSE AND SEISMIC DEFORMATION ANALYSES

PURPOSE

This calculation package presents the results of the site-specific seismic site response and seismic deformation analysis performed by Geosyntec Consultants (Geosyntec) for the coal-combustion residue (CCR) disposal facility (Landfill) at the Kingston Fossil Plant (KIF) near Harriman, Tennessee. The analyses are based upon the probabilistic seismic hazard evaluation performed by Geosyntec [2010], design ground motions developed for KIF by AMEC Geomatrix [2009], site-specific geotechnical investigations by MACTEC [2005; 2006], and pseudostatic slope stability evaluation of the Landfill performed by Geosyntec [2010].

BACKGROUND

The Kingston Fossil Plant (KIF) is near Harriman, Tennessee, approximately 30 miles west of Knoxville. The approximate location of KIF is shown in Figure 1. The approximate coordinates of the geometric center of the KIF are 35.8947 degrees North Latitude and 84.5035 degrees West Longitude. The proposed footprint for Landfill will occupy an area of approximately 92 acres. A plan view of the Landfill is shown in Figure 2. The landfill will be lined and capped with a composite landfill liner and cover. CCRs will be disposed off in the Landfill.

Geotechnical investigation of the Landfill area was performed by MACTEC [2005; 2006]. The results of this investigation served as a basis for Landfill design by Geosyntec [2010]. As a part of design considerations, Geosyntec developed a series of representative cross sections and performed static and pseudostatic slope stability evaluations. Representative cross sections analyzed by Geosyntec are shown in Figure 2. The results of pseudostatic stability evaluations indicated that, from the seismic stability standpoint, cross section 4 is the most critical. The lowest yield acceleration of sliding mass (k_y) of 0.28 g was calculated by Geosyntec [2010] for this cross section.

SEISMIC HAZARD EVALUATION

The seismic hazard for the KIF has been evaluated by AMEC Geomatrix [2009]. This evaluation was performed for an event with 2 percent probability of exceedance (PE) in 50 years (2,475 years return period). The results of AMEC Geomatrix evaluation indicate that seismic hazard at KIF is governed by a Moment Magnitude (M_w) 6 earthquake at an approximate distance of 22.4 miles (36 km) from the geometric center of the site. This design seismic event, referred to herein as the near-field event, is characterized with bedrock Peak Horizontal Ground Acceleration (PHGA) of PHGA = 0.11 g and relatively short duration of shaking (less than 5 seconds). The impact of a M_w 7.6 event on the New Madrid Seismic Zone (NMSZ) at an approximate distance of 270 miles (435 km) was found by AMEC Geomatrix to be of far lesser

significance. The estimated bedrock PHGA from this M_w 7.6 event is on the order of 0.03 g. Therefore, by inspection, Geosyntec eliminated the M_w 7.6 on the NMSZ from further considerations.

The 2008 edition of the 2 percent PE in 50 years United States Geological Survey (USGS) seismic hazard map is reproduced in Figure 3. This seismic hazard map indicates that bedrock PHGA at the site is on the order of 0.2 g, i.e., almost double the value evaluated for KIF by AMEC Geomatrix [2009].

To provide a conservative basis for seismic design of the Landfill, consistent with the USGS map, Geosyntec selected bedrock PHGA of 0.2 g for seismic site response and seismic deformation analysis of the Landfill.

DESIGN GROUND MOTIONS

Design ground motions are required for seismic site response and seismic deformation analysis. AMEC Geomatrix [2009] developed a suite of three synthetic design ground motions (synthetic time histories) for the KIF site. These design ground motions conform to the spectral ordinates (i.e., frequency content) and duration of shaking of the design near-field event, i.e., they are representative of strong ground shaking in hypothetical bedrock outcrop at the approximate location of the Landfill that were induced by a M_w 6 earthquake at an approximate distance of 22.4 miles (36 km) from the Landfill.

Geosyntec adopted synthetic time histories developed by AMEC Geomatrix [2009] for the design near-field event. The acceleration response spectra of these time histories are shown in Figure 4. Also shown in Figure 4, for quality control purpose, are the target bedrock acceleration spectra and "seed ground motions", that served as a basis for spectral matching and development of design ground motions.

SITE RESPONSE ANALYSIS

General

Geosyntec conducted a site-specific seismic site response analysis for the Landfill. This analysis was conducted to account for the influence of both local soil conditions and Landfill waste fill on the design ground motions. Given the relatively flat site topography, relatively flat slopes of the Landfill, and horizontally layered ground conditions, a one-dimensional (1-D) site response analysis was deemed appropriate.

Representative Site Response Model

A representative two-dimensional geotechnical model of the Landfill was developed on the basis of a site-specific geotechnical investigations by MACTEC [2005; 2006]. This 2-D model was developed at a location of the most critical cross section identified in a pseudostatic slope stability analysis by Geosyntec [2010] (pseudostatic analysis cross section 4).

The representative site response model is one-dimensional (1-D). This 1-D model was developed in the center of the critical pseudostatic failure surface. The 1-D site response model is schematically shown in Figure 5 as a system of lumped masses, springs, and viscous damping dashpots. It includes the following materials, top to bottom: (i) 130-ft thick pile of fly ash, with composite landfill liner and cover systems at its base and top, respectively; (ii) 35-ft thick deposit of medium stiff to stiff silty clay; and (iv) 15-ft thick deposit of soft silty clay. The site response model also includes crystalline bedrock at its base.

Material Parameters

Material parameters assigned by Geosyntec to the above listed materials are summarized in Table 1. Unit weights listed in Table 1 are from Geosyntec [2010]. Since majority of the waste material will consist of fly ash, the waste layer is modeled as a fly ash layer. Shear wave velocities assigned to the on-site materials were either directly measured (fly ash; AECOM, 2009] or indirectly estimated using the Imai and Tonouchi [1982] correlation between Standard Penetration Test (SPT) blow count and shear wave velocity. Modulus reduction and damping curves assigned to the materials listed in Table 1 were selected based upon material classification and/or Plasticity Indices (PI-s) reported in Geosyntec [2010] and engineering judgment. For example, the fly ash material was modeled as low plasticity silt [Ishihara et al., 1987 set of material parameters] while, based upon material description and recorded low SPT blow count, the stiff and soft clay materials were modeled as clay of high plasticity using the Vucetic and Dobry [1991] set of material parameters. The clay liner was modeled as clay (PI 50) using the Vucetic and Dobry [1991] set of material properties.

Numerical Model

One-dimensional non-linear site response analysis of the representative landfill/soil profile was conducted using the computer program D-MOD2000 [Matasovic, 1993; Matasovic, 2006; www.GeoMotions.com]. D-MOD2000 is a fully nonlinear code that solves the dynamic equation of motion in the time domain. The behavior of soil and soil-like materials is modeled in D-MOD2000 using the non-linear hysteretic constitutive model proposed by Matasovic and Vucetic [1993]. A small amount of viscous damping (typically on the order of 0.5 percent) was assigned across the profile to ensure the numerical stability of the solution.

Parameters for the Matasovic and Vucetic [1993] stress-strain constitutive model were developed by curve-fitting the modulus reduction and damping curves specified in Table 1.

The representative accelerograms, scaled to the design bedrock PHGA of 0.2 g, were applied to the transmitting base of the model in the D-MOD2000 analysis.

Results of Site Response Analysis

The results of site response analyses were monitored at the top of the Landfill and at the base of the site response model, i.e., just above crystalline bedrock. The results at the top of the Landfill were monitored in a form of Peak Ground Acceleration (PGA). The results at the base of the model were monitored in a form of peak average acceleration of sliding mass (k_{max}). The corresponding time history of k_{max} was saved and used as an input for seismic deformation potential evaluation of the Landfill.

The results of site response analyses indicate that design soil profile (site response model) does not amplify the design ground motions. Calculated PGA values at the Landfill surfaces are in the range of 0.19 to 0.21, i.e., almost identical to the input bedrock PHGA of 0.2 g. Calculated average acceleration of critical pseudostatic sliding mass is on the order of 0.08 g.

SEISMIC DEFORMATION ANALYSIS

Maximum seismically induced permanent displacements of the waste-fill-landfill subgrade system can be evaluated using Newmark-type [Newmark, 1965] seismic deformation analysis as coded in program SLIP2000 [Matasovic, 1996; 2007; www.GeoMotions.com]. However, as the calculated yield acceleration of the sliding mass (k_y = 0.28g) is significantly higher than the calculated peak average acceleration of sliding mass (k_{max} = 0.08 g), calculated permanent seismic displacements of waste fill and its subgrade, for deep-seated failure surfaces, are zero.

SUMMARY AND RECOMMENDATIONS

This letter report presents the results of the site-specific seismic site response and seismic deformation analyses performed by Geosyntec Consultants (Geosyntec) for a CCR landfill at the Kingston Fossil Plant (KIF) near Harriman, Tennessee. The analyses are based upon the probabilistic seismic hazard parameters evaluated based upon the 2008 edition of the USGS seismic hazard maps (2% PE in 50 years), design ground motions developed by AMEC Geomatrix [2009] for KIF, results of the site-specific geotechnical investigation by MACTEC [2005; 2006], and pseudostatic slope stability evaluation performed by Geosyntec [2010].

To evaluate the influence of local soil conditions and the Landfill on input (bedrock) ground motions, Geosyntec preformed a site-specific, seismic site response analysis. The results of this analysis indicate that the influence of local soil conditions and the Landfill in input ground motions is small.

The results of site response analysis were further used to evaluate seismic deformation potential for deep-seated surfaces of Landfill presented in Figure 6 (cross section 4). The results of the seismic deformation analyses indicate that, as long as calculated yield acceleration of sliding mass is higher than 0.08 g, the maximum calculated permanent seismic displacements of sliding mass (i.e., Landfill Liner) will be zero. The lowest calculated yield acceleration by Geosyntec is 0.28 g.

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TABLES

Table 1 – Material Parameters for Site Response Analysis

MATERIAL	UNIT WEIGHT	SHEAR WAVE VELOCITY	MODULUS REDUCTION AND DAMPING(1)
Landfill Cover	120 pcf	771 ft/s	Vucetic and Dobry [1991] (PI = 30)
Fly Ash	100 pcf	600 ft/s	Low Plasticity Silt (Ishihara et al, 1987)
Landfill Liner	125 pcf	984 ft/s	Vucetic and Dobry [1991] (PI = 50)
Medium Stiff to Stiff Silty Clay	120 pcf	712 ft/s	Vucetic and Dobry [1991] (PI = 100)
Soft Silty Clay	105 pcf	394 ft/s	Vucetic and Dobry [1991] (PI = 100)
Crystalline Bedrock	155 pcf	2,500 ft/s	Transmitting Base Assumed

Notes:
(1) Modulus reduction and damping curves listed here were curve-fitted to evaluate the parameters of the Matasovic and Vucetic [1993] constitutive model which is embedded in program D-MOD2000.

FIGURES

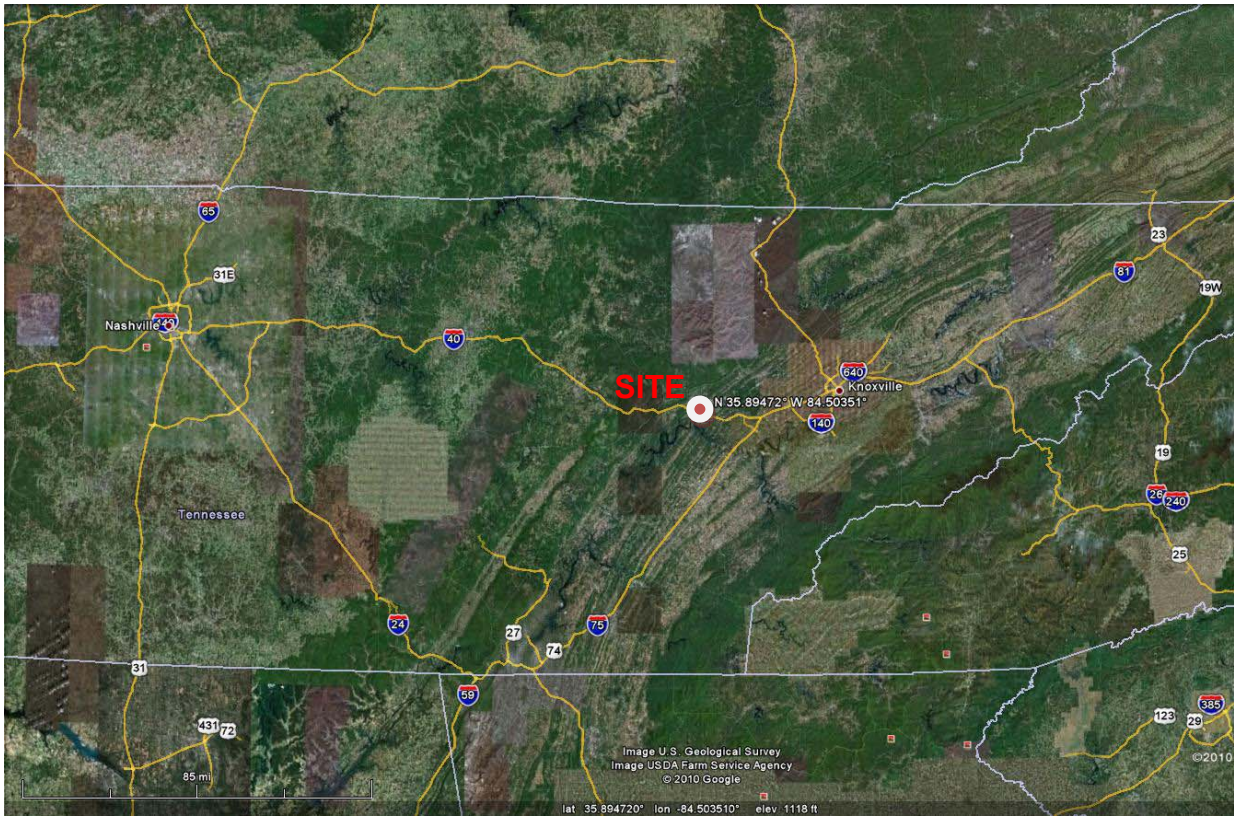

Figure 1. Site Location Map.

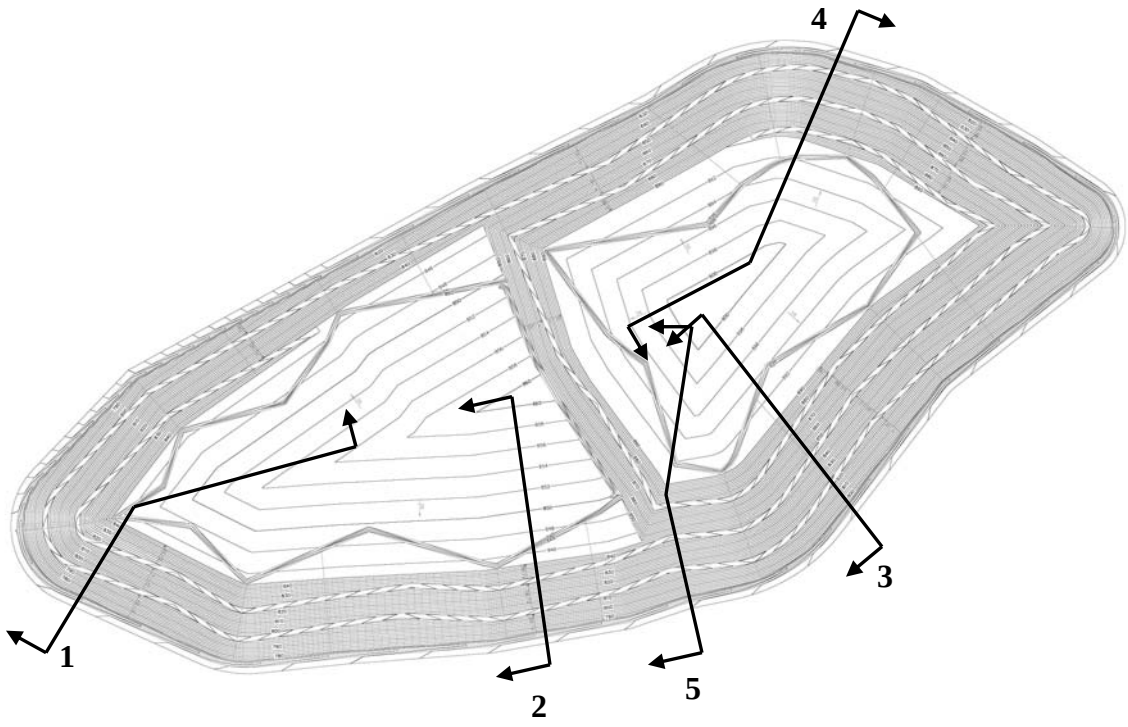

Figure 2. Plan View of the Landfill with indicated Cross Sections evaluated Pseudostatically by Geosyntec [2010].

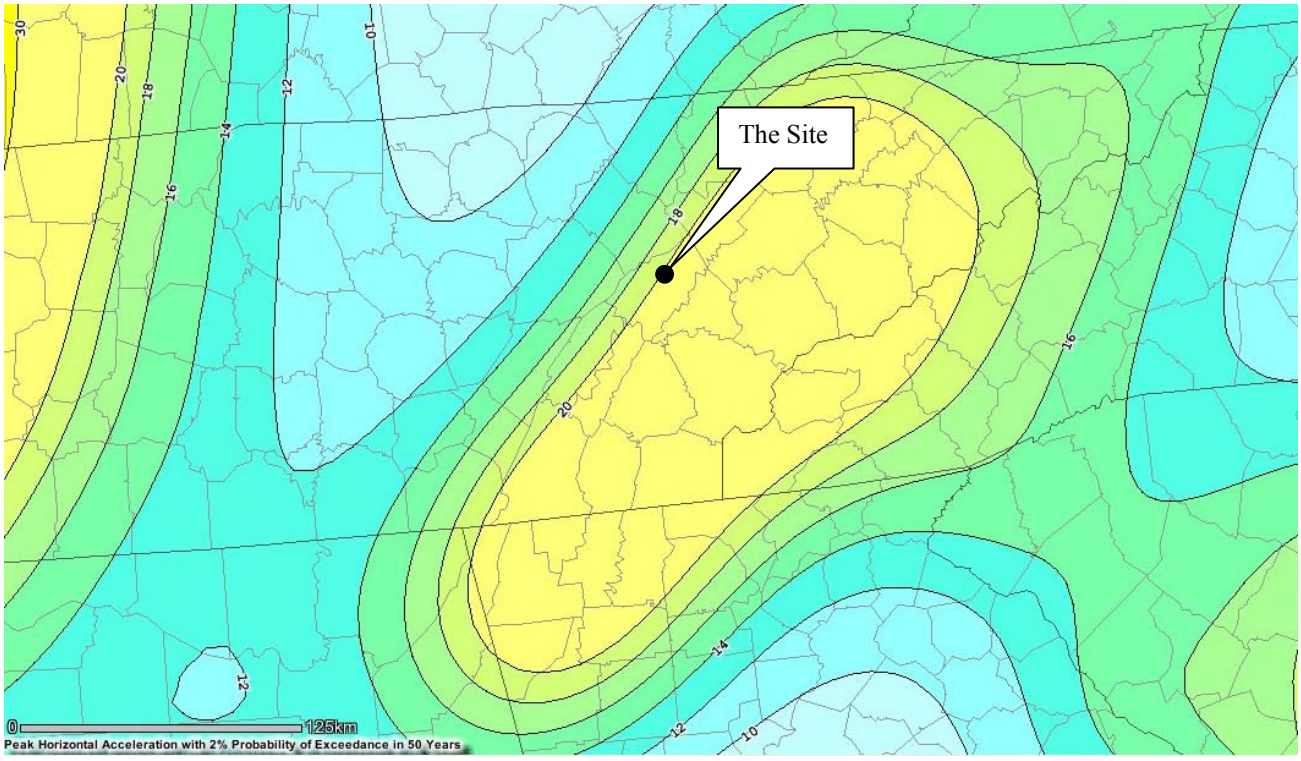

Figure 3. Contours of bedrock Peak Ground Acceleration (PGA) with a 2 Percent Probability of Exceedance in 50 Years. Adopted from USGS web site; USGS [2008].

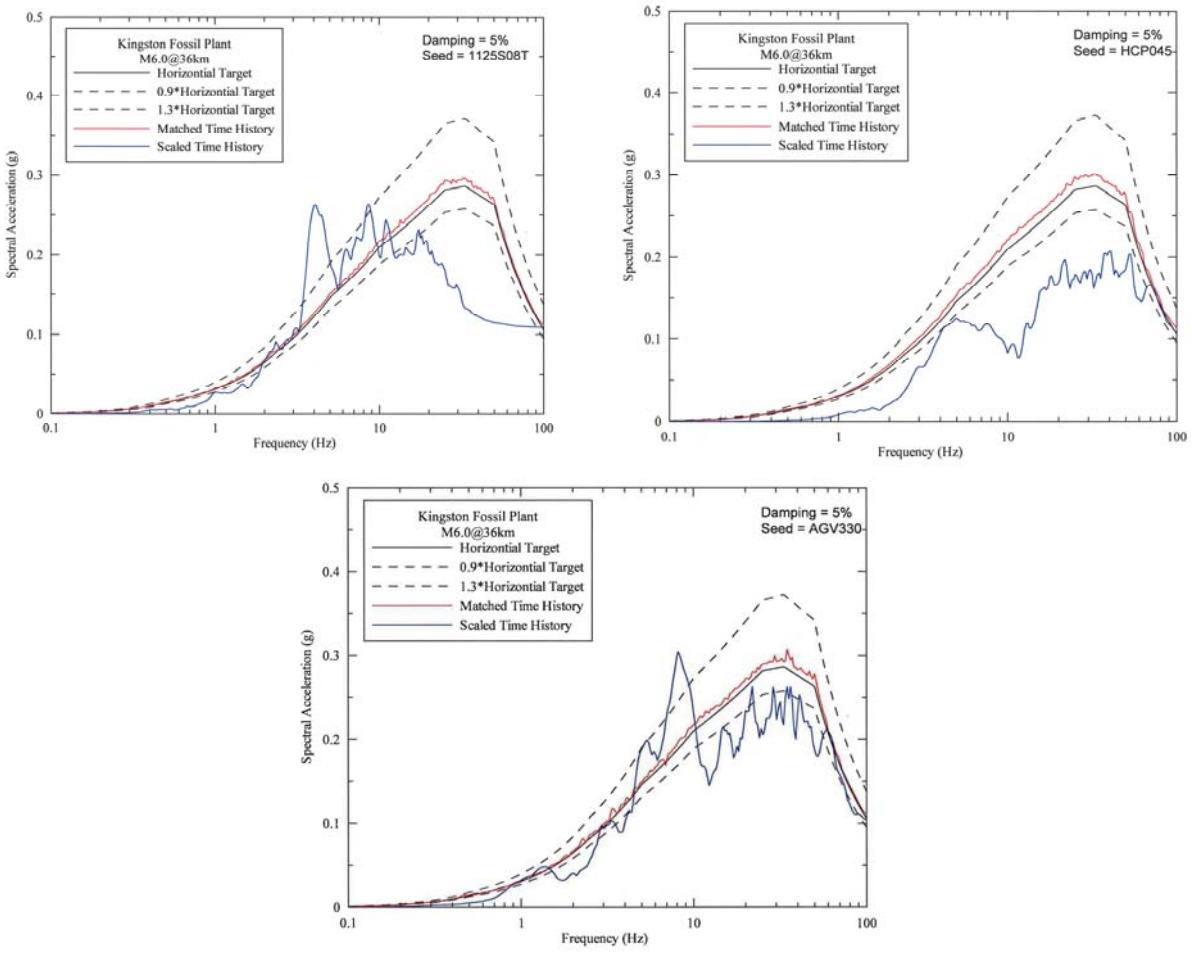

Figure 4. Acceleration Response Spectra of Design Ground Motions. Adopted from AMEC Geomatrix [2009].

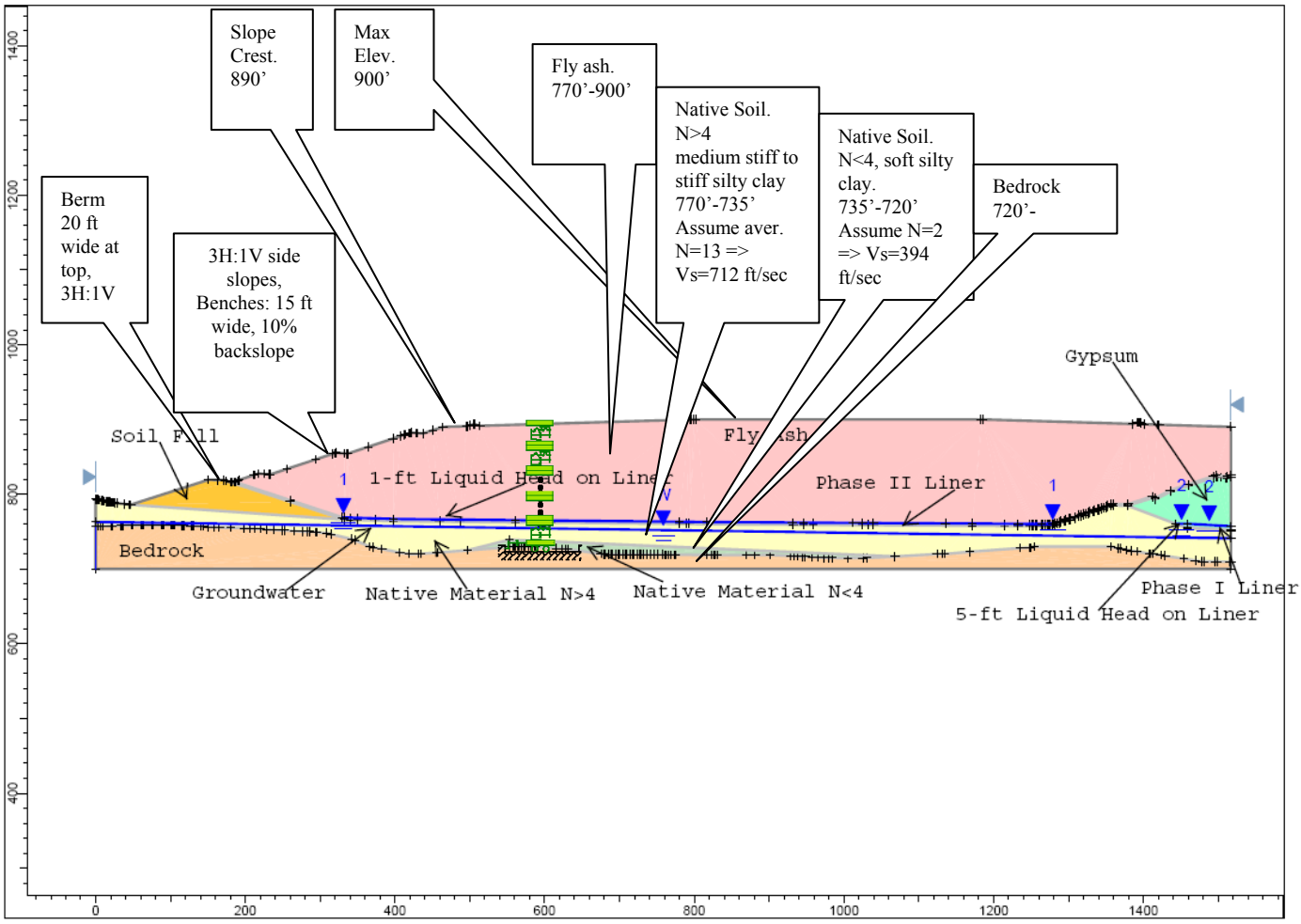

Figure 5. Annotated Cross Section 4 with Material Parameters used in Site Response Analysis. The Dynamic Site Response Model is also shown in this Figure. Adopted from Geosyntec [2010].

Notes:

1-Undrained shear strengths were derived from the CPT soundings based on the method developed by Schmertmann [1978]. An N_k factor of 19 was chosen to calibrate the CPT data to the triaxial data.

2-Undrained shear strengths based on CPT soundings in the soft native material (N<4) are indicated. An average undrained shear strength of 800 psf was chosen based on these data.

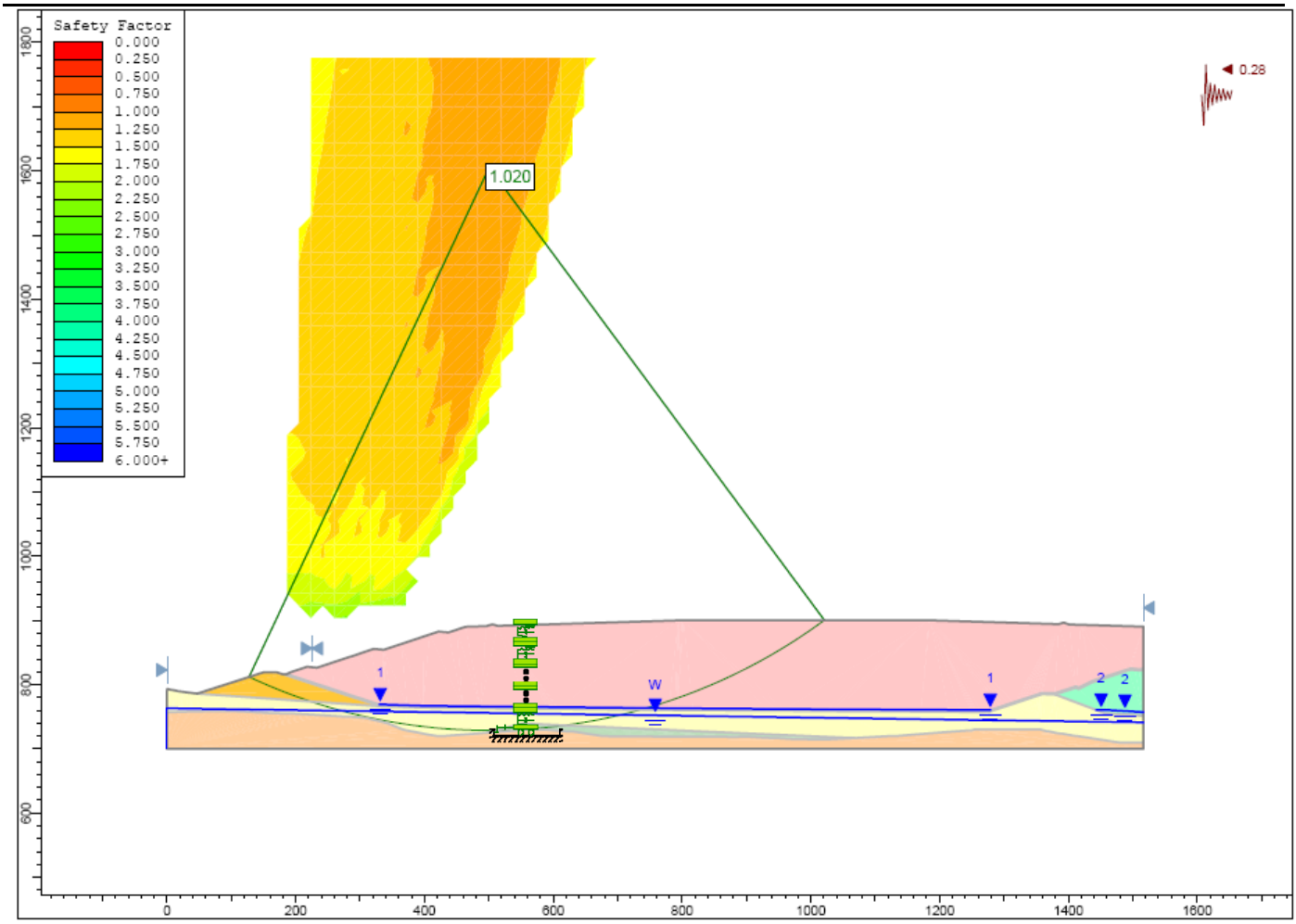

Figure 6. Calculation of Yield Acceleration for Section 4. The Dynamic Site Response Model is also shown in this Figure. Adopted from Geosyntec [2010].

APPENDIX A

Document 16

Design Report for Dike C Buttress, Kingston Fossil Plant, Harriman, TN, Stantec Consulting Services, Inc., March 1, 2011

VOLUME 2 OF 3:
FACILITIES DESIGN AND CONSTRUCTION REQUIREMENTS

TVA COAL COMBUSTION PRODUCTS MANAGEMENT PROGRAM

MASTER PROGRAMMATIC DOCUMENT

(REVISION 1.0)

Prepared for:

Tennessee Valley Authority (TVA)
1101 Market Street
Chattanooga, TN 37402-2801

December 7, 2009

1375 Euclid Avenue
Cleveland, Ohio 44115
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Master List of Acronyms

ACAA	American Coal Ash Association
ADEM	Alabama Department of Environmental Management
ALF	Allen Fossil Plant
AOS	Apparent Opening Size
ARAP	Aquatic Resources Alteration Permit
ARPA	Archaeological Resources Preservation Act
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
BMP	Best Management Practice
BOD	Basis of Design
BRF	Bull Run Fossil Plant
BSL	Business Support Library
C&DD	Construction and Demolition Debris
C2P2	Coal Combustion Products Partnership
CBMPP	Construction Best Management Practices Plan
CBR	California Bearing Ration
CCP	Coal Combustion By Product
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CGP	Construction General Permit
COF	Colbert Fossil Plant
CPT	Cone Penetration Testing
CQA	Construction Quality Assurance
CS&PD	Clean Strategies & Project Development
CUF	Cumberland Fossil Plant
DEP	Department of Environmental Protection
DOT	Department of Transportation
DSWM	Division of Solid Waste Management
E&S	Erosion and Sediment
EA	Environmental Assessment
EAP	Emergency Action Plan
ECM	Erosion Control Matting

EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FERC	Federal Regulatory Energy Commission
FGD	Flue Gas Desulfurization
FHWA	Federal Highway Administration
FML	Flexible Membrane Liner
FOIA	Freedom of Information
FOTG	Field Office Technical Guide
GAF	Gallatin Fossil Plant
GAI-LAP	Geosynthetic Accreditation Institute Laboratory Accreditation Program
GVW	Gross Vehicle Weight
HASP	Health and Safety Plan
HDPE	High Density Polyethylene
HELP	Hydrologic Evaluation of Landfill Performance
HRIM	Haul Road Inspection Manual
IDW	Investigative derived wastes
IW	Industrial Waste
JOF	Johnsonville Fossil Plant
JSA	Job safety analysis
JSF	John Sevier Fossil Plant
KAR	Kentucky Administrative Regulations
KDEP	Kentucky Department of Environmental Protection
KIF	Kingston Fossil Plant
KPDES	Kentucky Pollutant Discharge Elimination System
KRS	Kentucky Revised Statutes
LLDPE	linear low density polyethylene
MS4	Municipal Separate Storm Sewer Systems
MSHA	Mine Safety and Health Administration
MSW	Municipal Solid Waste
MSWL	Municipal Solid Waste Landfill
NAVFAC	Naval Facilities Engineering Command

NDSP	National Dam Safety Program
NEHRP	National Earthquake Hazards Reduction Program
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
O&M	Operation and Maintenance
O.C.	On Center
OEPA	Ohio Environmental Protection Agency
ONRW	Outstanding National Resource Water
OSHA	Occupational Safety and Health Administration
PAE	Program Administrator of Environmental
PAF	Paradise Fossil Plant
P.E.	Professional Engineer
PGA	Peak Ground Acceleration
PMP	Probable Maximum Precipitation
PPE	Personal Protective Equipment
PRB	Powder River Basin
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QCP	Qualified Credentialed Professional
RCRA	Resource Conservation and Recovery Act
RFP	Request for Proposal
RHO&M	Routine Handling, Operations, and Maintenance
RLS	Registered Land Surveyor
RO-DS	Reservoir Operations, Dam Safety
RSL	Recompacted Soil Liner
RUSLE	Revised Universal Soil Loss Equation
SAF	Shawnee Fossil Plant
SCD	Soil Conservation District

SCS	Soil Conservation Service
SEM	Scanning Electron Microscope
SPT	Standard Penetration Test
SSD	Stopping sight distance
SWCC	Soil and Water Conservation Committee
SWPPP	Stormwater Pollution Prevention Plan
T&O	Technology and Operations
TADS	Training Aids for Dam Safety
TCA	Tennessee Code Annotated
TCLP	Toxicity Characteristic Leaching Procedure
TDEC	Tennessee Department of Environment and Conservation
TDH	Total Dynamic Head
TPE	Third Party Engineering
TR	Technical Release
TRM	Turf Reinforced Matrix
TSS	Total Suspended Solids
TVA	Tennessee Valley Authority
UIP	Underground Injection Permit
USEPA	United States Environmental Protection Agency
USACE	United States Army Corps of Engineers
USCS	United Soil Classification System
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USET	United Southeastern Tribes
USGS	U.S. Geological Survey
USWAG	Utility Solid Waste Activities Group
VOC	Volatile Organic Compound
WCF	Widows Creek Fossil Plant

The Programmatic Document was designed as a management tool to provide guidance for the effective management and planning of Coal Combustion By Product (CCP) streams generated by Tennessee Valley Authority (TVA). The Document addresses engineering design, environmental compliance, safety, training, data management, procedural requirements for construction, inspection, monitoring, and operation of CCP facilities, and applies to all CCP materials generated by TVA. Existing facilities where these materials are managed includes ash ponds (or impoundments), wet stacks, dry landfills, surface water ponds, and chemical ponds. New facilities will include ash ponds, dry landfills, surface water ponds, leachate ponds, and chemical ponds. The Programmatic Document only applies to chemical ponds with respect to structural integrity.

Volume 2 of the Programmatic Document establishes design criteria for all elements of CCP facilities, and includes a Master and Abbreviated version. This volume of the Programmatic Document, **Master Volume 2**, is generally organized to:

1. Define CCP facility types;

2. Define key design elements of CCP facilities;

3. Present minimum state and federal standards and identify industry standards associated with each design element ; and,

4. Provide a selected design standard for each design element.

Similarly, the Abbreviated Volume 2 contains the same information as the Master Version with the omission of the minimum state and federal standards, thereby providing the selected standard for each topic. The Programmatic Document shall be periodically reviewed to reflect the most current CCP streams, design references, regulations and management protocols. The Document should be considered current as of the revision date and number provided on the Document cover.

1.1 FACILITY TYPES

This section describes the facility types discussed in Volume 2 including landfills, ash impoundments, surface water ponds, and leachate storage facilities.

1.1.1 Landfills

Definition

Landfills are defined for the purpose of this Document as an area of land or an excavation in which wastes are placed for disposal or temporary storage and that is not a land application unit, surface impoundment, injection well, or waste pile (any non-containerized accumulation of solid, non-flowing waste that is used for treatment or storage). For TVA purposes, landfills will be used for deposition of CCPs in solid form. Landfills for CCP can be used for permanent disposal or temporary deposition. When landfills are used for temporary deposition, it is to enable beneficial reuse of the CCP upon its removal.

There are several design and construction components to landfills considered standard across the solid waste management industry. These generally include a bottom liner system, leachate collection system, leachate conveyance system, leachate storage or treatment system, waste disposal area, final closure cap system, surface water management system, haul and service roads, groundwater management system, and operational and service infrastructure. The design requirements for each of these components are described in more detail in Volume 2 Section 1 of this Document. A generalized schematic of a landfill, which illustrates these key components, is presented in Figure 1.1.1-1.

Landfill Regulations

Following the Ruling on the Bevil Amendment in 1980, large volume wastes generated from the combustion of coal were determined to be exempt from federal hazardous waste regulations under Subtitle C of RCRA section 3001(b)(3)(C). CCPs are not currently regulated at the federal level and therefore, regulations for disposal of CCPs are administered at the State level.

As of the date of this Document, USEPA is in the process of establishing/negotiating an appropriate classification and regulatory designation for CCP including Federal regulations for management. It is anticipated that the regulations for management of CCPs at the Federal level will be put in-place and will require more stringent regulation of CCPs at the State level. This Document is limited to the current status of the regulations, and does not speculate on the content of the future Federal and state-specific regulations.

Alabama: In Alabama, CCPs are specifically exempted from the definitions of "solid waste" and "industrial waste". Bottom ash and fly ash are defined as a "Special Waste" per Alabama Department of Environmental Management (ADEM) 335-13-1-.03(134). However, ashes from combustion of fossil fuels at electric or steam generating facilities are excluded per ADEM 335-

13-1-.03(13). Therefore, there is no landfill permitting requirements for CCP materials in Alabama.

Kentucky: CCPs are defined as a "Special Waste" per KRS Chapter 224.50-760(1)(a) and are therefore treated separately than solid wastes. The requirements for management and disposal of special wastes are presented in 401 KAR Chapter 45 and the technical and operating requirements for special waste landfills are specified in 401 KAR 45:110. There are very limited requirements specified in 401 KAR 45:110 with respect to specific design, construction and/or operational requirements for Special Waste landfills. Specifics regarding new facility permitting are provided in 401 KAR 45:30.

Tennessee: Disposal of CCPs is permitted in Class II (non-hazardous industrial wastes, commercial wastes and fill) Disposal Facilities, as defined in TDEC 1200-1-7-.01(3). Management of CCP is specifically regulated in Tennessee as presented in TDEC 1200-1-7-.04, which has specific design, permitting, construction and operation requirements for Class II Disposal Facilities.

1.1.2 Ash Impoundments

Definition

Ash impoundment can be defined as a collection of water, wastewater, or liquid-borne materials that is contained by an artificial structure (dam), into which CCPs are placed for disposal or temporary storage. All ash impoundments shall be managed by the TVA Dam Safety Program.

For reference, Table 1.1.2-1 compares the state and federal definitions of dams. Table1.1.2-2 compares the state and federal hazard classifications.

Table 1.1.2-1
Comparison of State and Federal Regulations: Definition of "Dam"

Criteria	Alabama	Kentucky	Tennessee	Federal[2]
Any artificial barrier that impounds water	Yes	Yes	Yes	Yes
Impounds wastewater or liquid-borne materials	Yes	No	No	See tailings dams, below
Height[3]	≥25 feet	≥25 feet	≥20 feet	≥25 feet
Storage Volume[4]	≥50 acre-feet	≥50 acre-feet	≥30 acre-feet	≥50 acre-feet
Other criteria that trigger classification as a dam:	Probable **loss of human life** due to failure or improper operation regardless of height or storage volume	N/A	N/A	This lower size limitation should be waived if there is potentially significant downstream hazard. In addition to conventional structures, this definition specifically includes "tailings dams", embankments built by waste products disposal and retaining a disposal pond.
	Probable **loss of critical infrastructure** due to failure or improper operation regardless of height or storage volume [1]	N/A	N/A	

Note 1: If the dam and/or the appurtenant utility and ash handling facilities are considered to be critical infrastructure, then any artificial barrier that impounds water, wastewater or liquid-borne materials meets the definition of a dam.
Note 2: Federal criteria referenced from the Federal Guidelines for Dam Safety, prepared by the Interagency Committee on Dam Safety, U.S. Department of Homeland Security, Federal Emergency Management Agency, June 1979, Reprinted April 2004.
Note 3: Federal and state guidelines measure height of dam from the top of the dam crest to the lowest point where the original streambed intersects the downstream toe, or the lowest point along the toe.
Note 4: Federal and state guidelines measure storage capacity at the top of the dam crest, i.e., the maximum possible impounded capacity, irrespective of the elevation of spillways or outlet works.

Table 1.1.2-2
Comparison of State and Federal Regulations: Dam Hazard Classifications

Category	Alabama[1]	Kentucky[1]	Tennessee[1]	Federal
High Hazard	High Hazard Potential Dam: Failure or improper operation will cause probable loss of human life.	Class C: Failure would cause loss of life or serious damage to homes, commercial buildings, utilities, highways or railroads.	Category 1 : Failure would probably result in: loss of human life; excessive economic loss due to damage to downstream properties; excessive economic loss, public hazard, or public inconvenience due to loss of impoundment and/or damage to roads or any public or private utilities.	High Hazard Potential Dam**:** Failure or misoperation will probably cause loss of human life.
Moderate Hazard	Moderate Hazard Potential Dam: Failure or improper operation results in no probable loss of human life but will cause probable loss of critical infrastructure.	Class B: Failure would cause significant damage to property and project operation, but loss of life is not envisioned.	Category 2 : Failure may damage downstream private or public property, but such damage would be relatively minor and within the general financial capabilities of the dam owner. Public hazard or inconvenience due to loss of roads or any public or private utilities would be minor and of short duration. Chances of loss of life would be possible but remote.	Significant Hazard Potential Dam: Failure or improper operation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns.
Low Hazard	Low Hazard Potential Dam: A dam not assigned the moderate or high hazard potential classification.	Class A: Failure results in loss of structure itself but little or no additional damage to other property.	Category 3: Failure may damage uninhabitable structures or land but such damage would probably be confined to the dam owner's property. No loss of human life would be expected.	Low Hazard Potential: Failure or improper operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

1. According to the TVA Dam Safety Program, state dam safety regulations do not apply. Rather, the TVA Dam Safety Program follows Federal programs in these regards. The following sections for each state are therefore provided for reference only.

TVA operates coal-fired power plants in Alabama, Kentucky and Tennessee. Dam safety regulations define a "dam" similarly in all three states and federal programs. Once an ash impoundment is closed (in accordance with the provisions herein), it is no longer considered a possible dam structure.

TVA Ash Impoundment Inventory

CCP Engineering will use the TVA Ash Impoundment Inventory Sheet (Appendix 1) to collect information on all wet CCP disposal impoundments, such as location, power plant served, the name of stream impounded (if applicable), USGS quadrangle sheet that shows the site location, original designer, construction contractor, year constructed, height, length, impoundment capacity and related information. Completed inventory sheets will be forwarded to the TVA Reservoir Operations, Dam Safety Group, who will use the information to determine:

- Does the impoundment meet the definition of a dam?
- What is its probable hazard category?
- Should the structure be managed in accordance with the TVA Dam Safety Program?

As appropriate, TVA Reservoir Operations, Dam Safety will accept the facility into its ongoing dam safety program, and will decide what if any investigations or analyses such as dam break inundation mapping are needed to definitively establish the hazard category of the dam.

TVA Reservoir Operations, Dam Safety will assume responsibility for dam safety activities for the ash impoundment classified as a dam, including scheduling of an initial dam inspection, scheduling and frequency of future dam inspections, and the nature and extent of additional investigations that may be required. This may include items such as spillway capacity evaluations, slope stability analyses, seismic evaluations, seepage analyses or other technical activities that are found to be necessary. TVA Reservoir Operations, Dam Safety will also assume responsibility for making repairs, improvements or modifications to the dam as required to promote continued safe operation of the impoundment.

Ash Impoundment Regulations

According to the TVA Dam Safety Program, state dam safety regulations do not apply. Rather, the TVA Dam Safety Program follows Federal programs in these regards. The following sections for each state are therefore provided for reference only,

Alabama: Alabama currently has no dam safety regulations. However, a bill entitled "Alabama Dam Inventory and Classification Act" is under consideration of the state legislature as of February 2008.

Kentucky: Dam safety regulations are in KAR Chapter 4, Title 401, Water Resources, last amended in 1990.

Tennessee: Regulations for dam safety are found in the TDEC, Division of Water Supply, Chapter 1200-5-7, effective February 2001.

Federal: Guidelines for dam safety are found in Federal Guidelines for Dam Safety, prepared by the Interagency Committee on Dam Safety, U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA), June 1979. Water quality from ash impoundment

discharges is regulated under the NPDES regulations, under the terms of the facility's NPDES permit.

1.1.3 Surface Water Ponds

Definition

Surface water ponds related to management of stormwater discharges from landfills can be defined as earthen structures used to temporarily retain and/or detain surface water (non-contact water) away from the limits of the landfill or other disturbed area (clean earth disturbances) within the landfill facility. This non-contact water is surface water that has not come into contact with the waste materials and therefore is not considered leachate. Surface water ponds are used for temporarily retaining and/or detaining flows from active construction areas to allow for sediment to settle out of the surface water prior to discharge. In this case, surface water ponds are also referred to as sediment basins. Surface water ponds are also used as permanent stormwater management control structures for stormwater conveyed from a final closure or post-construction area.

Surface water ponds generally consist of an excavated area surrounded by a containment berm that may be formed by either excavated soils (cut) or embankment soils (fill). Inlets and outlets for surface water ponds can be via inlet ditches or piped structures, both typically operating by gravity flow. Riser structures may be used to control the rate and quantity of discharge from the ponds. Typically, surface water ponds are not constructed with bottom liner systems, since the surface water is not contaminated and should not pose a risk to groundwater. Design requirements for surface water ponds are discussed in Volume 2, Section 1 of this Document

Surface Water Pond Facility Regulations

State/Federal: The requirements for the design, use, and monitoring of surface water ponds will be based on the requirements included in the approved site-specific NPDES permit administered by the state regulatory agency (ADEM, KDEP or TDEC). The specified state regulatory agency is responsible for administering the state NPDES and stormwater management program, which may closely follow the federal NPDES requirements. The state NPDES programs regulate the surface water discharge limits from contact water (leachate) and non-contact water (stormwater), or a combined flow of leachate and stormwater.

The design guidance provided in either state specific guidance manuals (available in Alabama and Tennessee, but not in Kentucky), or in the federal Natural Resources Conservation Service (NRCS) standards of the *Field Office Technical Guide* (FOTG) – *Section IV – Practice Standards and Specifications*, are used as the basis for developing surface water pond practices, as well as other best management practices (BMP), for inclusion in the site-specific stormwater pollution prevention plan (SWPPP). The development and submittal of the SWPPP is a regulatory requirement of the general construction permit under state NPDES programs.

Sediment control basins, along with other erosion and sediment (E&S) controls are also regulated at the state level via the state's NPDES program. However, many counties have their

own Soil Conservation Districts (SCDs), which are overseen by the NRCS of the United States Department of Agriculture (USDA). The County SCDs also typically offer technical guidance in the development of stormwater and E&S control design and associated planning. Unless granted regulatory or enforcement authority by the State or County, the SCDs and their technical guidance documents do not have the force of law, rather provide guidance for preventing or minimizing the related problems of stormwater management and E&S control.

While regulations for stormwater management are administered at the state level, certain counties or municipalities – typically ones that are closest to or more directly affect significant or sensitive water bodies or locations defined within Municipal Separate Storm Sewer Systems (MS4) regions – may have additional stormwater or E&S requirements. Some of these additional requirements may include detailed design submittals, increased requirements for use of various BMPs, different design storm events, etc. For this reason, it is necessary that the design engineer/consultant preparing the permitting and design documents check with the applicable county or municipality where the facility is sited to determine if there are additional regulatory requirements specific to the facility location.

1.1.4 Leachate Storage Facilities

Definition

Leachate storage facilities are those facilities that temporarily store leachate produced in the landfill or ash impoundment prior to final treatment or disposal. Leachate is liquid that is generated when the materials (CCPs) are compressed. The liquid originates from the material itself, or when surface water infiltrates through the landfill cover materials and/or CCPs. In addition, any surface water that comes in contact with the CCPs is also considered leachate and shall be treated as such. Of the three states, only Kentucky has defined leachate. Kentucky defines leachate as any liquid, including any suspended components in the liquid that has percolated through or drained from waste materials.

Leachate storage facilities typically consist of either an above or below ground leachate storage tank or a leachate storage pond. Leachate can be conveyed to the storage facility by gravity or by forcemains from the operational cells of the landfill.

Key Components of Leachate Storage Facilities

Leachate storage tanks are typically constructed of specialized plastics, fiberglass or metallic with specially treated internal coatings or glass lining to limit corrosion and be compatible (nonreactive) with the chemicals in the leachate. The storage tanks can be single-walled or double-walled. If the tank is single-walled, it is required that a system for secondary containment is included (vault for below grade tanks or perimeter containment for above ground tanks) to reduce the potential for groundwater contamination. The storage tank typically consists of an inlet conveying leachate from a collection manhole with control valving, and an outlet. Leachate is typically pumped from the leachate storage tank to a loadout facility (for truck hauling), treatment system, or connection to a sanitary sewer.

Leachate storage ponds are excavated ponds constructed with a bottom liner system and groundwater monitoring wells to enable monitoring of any potential leaks through from the liner system. The storage pond typically consists of an inlet conveying leachate from a collection manhole with control valving. Leachate is typically pumped or otherwise conveyed from the leachate storage pond to a loadout facility (for truck hauling), treatment system, connection to a sanitary sewer, or a receiving surface water body under an NPDES permit.

Leachate Storage Facility Regulations

As discussed in the Landfill Regulations section (Section 1.1.1), Federal regulations do not govern the design and construction of leachate storage facilities. The State regulations for leachate storage facilities are the same as specified in Section 1.1.1.

1.2 REFERENCES AND SOURCES

References are provided in Appendix 3.

1.3 GENERAL DESIGN CRITERIA

1.3.1 Siting Criteria

Definition

Siting criteria are the exclusionary requirements/guidance to regulate the permitting and ultimate construction of a facility. Siting criteria often include items such as prohibited areas and buffer zones/distances that are to be maintained with respect to the location of a landfill.

Minimum Design Standards

Alabama: In Alabama, CCPs are specifically exempted from the definition of solid waste and industrial waste. Bottom ash and fly ash are defined as a "Special Waste" per Alabama Department of Environmental Management (ADEM) 335-13-1-.03(134). However, ashes from combustion of fossil fuels at electric or steam generating facilities are excluded per ADEM 335-13-1-.03(13). As such, there are no has no specific siting criteria requirements associated with CCP materials

Kentucky: In Kentucky, CCP wastes are considered special wastes, regulated under 401 KAR 45. 401 KAR 45:130 provides siting requirements for new special waste landfills and horizontal expansions to permitted waste boundaries. Requirements include maintaining buffer zones, restricting disposal in floodplain areas, and conforming to site suitability criteria. Site suitability criteria includes satisfying upper aquifer monitoring and corrective action requirements.

Tennessee: Siting criteria requirements for Class I and II facility are provided in TDEC Rule 1200-1-7-.04(2). Siting criteria to be considered includes impact to endangered species, floodplain location, wetland restrictions, karst terrain, seismic impact zones, unstable areas, and maintaining buffer zones.

Selected Design Standards

For a new landfill, all applicable state regulatory siting criteria shall apply. However, in states where specific siting criteria is not defined, landfills shall be located in compliance with the following items:

- Facilities shall not be located in a manner that contributes loss of endangered species, or adverse modification of their habitat.
- Facilities must not be located in a 100-year floodplain unless it can be proven that the location will not restrict the flow of the 100-year flood nor reduce temporary floodplain storage capacity, and the facility is designed, constructed, operated, and maintained to prevent washout of any waste.
- Facilities shall not be located in wetlands, unless the applicant can demonstrate under USEPA Clean Water Act, Section 404, that a practical alternative does not exist. Additionally, the applicant shall demonstrate that construction of the landfill will not cause or contribute to violations of any applicable state water quality standard; or, violate any applicable toxic effluent standard or prohibition under Section 307 of the Clean Water Act. The applicant shall also demonstrate that the facility will not cause or contribute to significant degradation of wetlands by establishing the integrity of the landfill and the ability to protect ecological resources. Lastly, as required under Section 404 of the Clean Water Act the applicant shall show that steps have been taken to attempt to achieve no net loss of wetlands.
- For a facility proposed in an area of highly developed karst terrain, the applicant must demonstrate that there is no significant potential for surface collapse, and the location will not cause any significant degradation to the local ground water resources.
- Facilities shall not be located within 200 feet of a fault that has had displacement in Holocene time, unless the applicant demonstrates that an alternative setback distance of less than 200 feet will prevent damage to the structural integrity of the landfill unit and will be protective of human health and the environment.
- Facilities shall not be located in seismic impact zones, unless the applicant demonstrates that all containment structures, including liners, leachate collection systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth materials.
- Facilities proposed for locations in an unstable area must demonstrate that engineering measures have been incorporated to ensure integrity of landfill components. The demonstration shall consider the following factors: soil conditions that may result in significant differential settling; geologic or geomorphologic features; and man-made features or events (both surface and subsurface).
- Additionally, the following buffer distances/zones shall be maintained when siting a landfill:
    - 100 feet from all property lines;
    - 500 feet from all residences, unless the owner of the residential property agrees in writing to a shorter distance;

- 500 feet from all wells determined to be downgradient and used as a source of drinking water by humans or livestock;
- 200 feet from the normal boundaries of springs, streams and lakes; and
- 50 feet from the property line for all constructed appurtenances.

1.3.2 Site Investigations

Site investigations for landfill and impoundment systems shall include geotechnical and hydrogeological explorations. These investigations include exploratory drilling and sampling, field testing, and laboratory testing, and are necessary to establish the subsurface soil, rock, and groundwater conditions to support the facility design. Often, similar drilling and sampling tasks are required for both types of investigations. Costs and schedule can usually be optimized if both investigations are coordinated in conjunction with one another, so that duplication of tasks is eliminated or minimized. The Engineer should be cognizant of this during planning of these investigations.

1.3.2.1 Geotechnical Investigations

Definition

The objective of the geotechnical investigation is to collect sufficient information to define the subsurface conditions at a site as it relates to facility design and construction, and use this information to provide recommendations and perform geotechnical analyses to support the facility design. Important aspects of the geotechnical investigation include defining the stratigraphy, extent and engineering properties of subsurface soils and rock influenced by the facility, groundwater conditions on the site, and the nature and extent of any geologic hazards (such as karst formations and mining activity) that exist on the site as they may influence facility construction and operation.

Minimum Design Standards

Minimum design standards for landfills and ash impoundments on a state-by-state and federal level are described below.

Alabama: Alabama has no specific requirements for geotechnical investigations associated with landfills.

Alabama provides no specific requirements for geotechnical investigations related to impoundment systems.

Kentucky: In Kentucky, CCPs are generally considered special wastes, which are regulated under 401 KAR 45. There are no specific requirements for geotechnical investigations supporting special waste facilities, other than a general statement in 401 KAR 45:110, Section 1 (5) which states that the engineering design for a special waste landfill shall consider the properties of the soil underlying the facility. Requirements for geotechnical investigations for new municipal solid waste facilities (contained wastes) are given in 401 KAR 47:170, Section 3. The requirements for geotechnical investigations for contained waste facilities include a

minimum of nine soil borings per 1000 ft x 1000 ft area of the facility (roughly one boring per 2.5 acres), and a minimum of four rock core borings per facility, with the requirement of an additional rock core boring for each 25 acre increment for facilities whose area is greater than 50 acres. Requirements for reporting information obtained from geotechnical investigations are given in 401 KAR 47:180, Section 6.

Kentucky provides no specific requirements for geotechnical investigations related to impoundment systems.

Tennessee: Tennessee has no specific requirements for geotechnical investigations associated with landfills. Requirements for hydrogeologic investigations are given in 1200-1-7-.04(9)(a).

Tennessee provides guidance for hydrogeologic investigations in its Technical Guidance Document 001, "Hydrogeologic Investigation Guidance Document", January 1, 1993. This document does not make specific reference to geotechnical investigations. Major requirements listed in the document include:

- Borings shall be drilled on an equivalent triangular grid pattern having 200 foot spacing between holes. Holes are to be drilled to a depth of 20 feet below the bottom of the clay liner or to the top of rock, whichever is shallower.
- At least one boring per site or per ten acres of the site shall be drilled to a depth of at least 70 feet below the top of the proposed clay liner or at least 20 feet into bedrock, whichever is shallower. Continuous bedrock cores are required in these borings.
- A complete grain size analysis, natural moisture content, and Atterberg limit tests, shall be performed on a representative sample from each significant stratum encountered.
- For each three acres proposed for landfilling a minimum of one hydraulic conductivity test (ASTMD D5084) shall be conducted on a Shelby tube sample at a random sampling interval approved by the Division. The samples shall be taken from within the proposed geologic buffer.

Tennessee provides no specific requirements for geotechnical investigations related to impoundment systems.

Selected Design Standard

The geotechnical investigation shall be performed prior to detailed design and construction of the landfill or impoundment site and shall be planned and conducted by or under the supervision of a professional engineer specializing in geotechnical engineering. In general, the investigation shall include the following tasks and considerations:

- A study of the general geologic setting of the site area shall be made during planning of the investigation. Publicly available information such as bedrock geology and topographic maps, karst maps, groundwater resource maps and reports, mine maps and soil surveys should be consulted. This study should be used to gain an understanding of the local geology and to identify potential geologic hazards that may be present in the area of the site. Additionally, a thorough search of existing documents, records, plan drawings, etc related to the site should be performed, including research into the past history and use of the site.

- For all sites, a site reconnaissance shall be performed prior to beginning the geotechnical investigation. Areas with karst formations or mining activity should be evaluated by qualified geologists knowledgeable in the identification of karstic/mine subsidence features. Subsidence features (such as caves, sinkholes, losing streams, etc) on site should be thoroughly described and mapped as part of the reconnaissance. Consideration should be given to performing special investigations to delineate the location, extent, and most appropriate mitigation techniques for subsidence features as deemed appropriate by the Geotechnical Engineer. Such investigations may include the use of geophysical and/or electromagnetic surveys, dye tracing, etc.
- Consideration should be given to performing a preliminary investigation prior to implementing the full geotechnical investigation. The preliminary investigation may consist of several borings performed across the site, to establish the basic characteristics of the subsurface. Information gained from this investigation can be used in planning for the main geotechnical investigation that is to follow – such as boring locations and depth, location and characteristics of geologic strata of interest, etc.
- The scope of the geotechnical investigation should include, at a minimum: soil sampling using the Standard Penetration Test (SPT) method, per ASTM D 1586; collection of undisturbed samples when soft, cohesive soils are encountered per ASTM D 1587; and, where bedrock is encountered within a depth corresponding to 50 ft below the base of the facility, rock coring should be performed per ASTM D 2113. In areas with karst or mining activity, rock coring may be required to depths exceeding 50 ft. If the site conditions warrant and if deemed appropriate by the Geotechnical Engineer, other sampling and field testing methods, such as Cone Penetration Testing (CPT), dilatometer or pressuremeter testing, and shear vane testing, may also be considered in addition to the above testing methods. Appropriate observation of groundwater levels during and after drilling should be performed. Monitoring wells or piezometers should be installed and monitored as necessary to establish the position of the water table, as necessary to support the geotechnical design of the facility.
- Soil borings should be drilled at the following minimum frequency:

  Landfills: Minimum of one boring per four acres, unless a greater frequency is specifically required by the state or if subsurface conditions such as karst or mining activity dictate otherwise. To the extent practicable, borings should be located on a uniform grid pattern across the area of the site within the limits of proposed CCP placement. Additional borings should be drilled at locations of proposed structure foundations, haul roads, or other site features, at the discretion of the Geotechnical Engineer.

  Impoundment Systems: Borings should be drilled at a minimum spacing of 200 ft on center (O.C.) along the centerline of the alignment of the impoundment structure (i.e., earth dam, dike, etc.). For impoundment structures with a total base width exceeding 100 ft, sets of two borings shall be drilled at each 200 ft interval along the centerline. One boring shall be located normal to the centerline on the downstream side and one boring shall be located normal to the centerline on the upstream side. The two borings should be roughly equidistant from the centerline. Borings sufficient to characterize the soil

deposits underlying the area within the impoundment should also be performed, at the discretion of the Geotechnical Engineer.

- Soil borings should be drilled to sufficient depth to identify and characterize critical subsurface materials that will be influenced by the facility or may affect the stability of the facility. The final depth of borings will depend on site-specific conditions, and should be determined by the Geotechnical Engineer. Minimal guidelines for soil boring depths are as follows:

  Landfills: Borings should extend to the top of competent bedrock or other competent material that will resist substantial settlement and has enough strength to preclude shear failure through it.. The investigation should further include an appropriate amount of bedrock coring to characterize the strength and other engineering properties of the competent bedrock and assess karst/mining activity.

  Impoundments: Borings should extend to the top of competent bedrock or other competent material that will resist substantial settlement and has enough strength to preclude shear failure through it. Borings shall also extend to a stratum that is considered to be impervious or minimally pervious with respect to seepage beneath the impoundment. Where bedrock is encountered, the investigation should further include an appropriate amount of rock coring to characterize the strength and other engineering properties of the competent bedrock and assess karst/mining activity.

- For projects where high seismicity is a controlling aspect of design, additional field testing to determine dynamic properties of the foundation soils may be warranted. This may include downhole seismic testing per ASTM D 7400, crosshole testing per ASTM D 4428, or seismic CPT. Such testing should be performed under the guidance and supervision of an experienced geotechnical engineer or geophysicist.

- For impoundment projects, where the seepage characteristics of the foundation soils are required, field tests to determine permeability in-situ such as pump tests, slug tests, or piezocone testing may be warranted. Such testing should be performed under the guidance and supervision of an experienced hydrogeologist or geotechnical engineer.

- Laboratory Testing Program: The geotechnical investigation should include a laboratory testing program performed on soil and rock samples collected from the borings, as well as on materials scheduled for use in constructing the facility. The laboratory testing program should be designed to define the index and engineering properties (including at a minimum, soil unit weights, shear strength parameters, compressibility parameters, and permeability) of all distinct soil and rock units encountered within the borings. This data will be essential in supporting assumptions made in the geotechnical analyses performed for the facility. A sufficient number of tests should be specified to define the range of material characteristics that may be anticipated within each critical soil and rock unit. A list of test procedures for soil and rock materials that should be considered for use is provided in Table 1.3.1-1 as follows:

Table 1.3.1-1
Laboratory Soil and Rock Test Procedures

Test Procedures	Test Standard
Index Properties	
Water Content	ASTM D 2216
Atterberg Limits	ASTM D 4318
Particle Size Analysis	ASTM D 422
Specific Gravity of Soils	ASTM D 854
Determination of Shear Strength	
Direct Shear Test of Soils	ASTM D 3080
Triaxial Test (U-U)	ASTM D 2850
Triaxial Test (C-U)	ASTM D 4767
Unconfined Compression	ASTM D 2166
Moisture-Density Relationships (Compaction Testing)	
Standard Proctor Test	ASTM D 698
Modified Proctor Test	ASTM D 1557
Compressibility Testing:	
1-D Consolidation Test	ASTM D 2435
Hydraulic Conductivity:	
Permeability Test	ASTM D 2434

Characterization of Strength of Geosynthetic Interfaces: A laboratory testing program establishing the shear strengths of the various interfaces to be used in the design of the cap and liner systems of the facility (soil and geosynthetics) should be performed as part of the construction sequencing, but when determined to be appropriate by the Geotechnical Engineer due to site conditions or design constraints, laboratory testing can be incorporated into the scope of the geotechnical investigation, if the specific materials to be used are known during the design phase. Testing should consist of, at a minimum, 3-point direct shear tests performed per ASTM D 5321 and with a recommended maximum strain rate of 0.04 in/min for all interfacing involving a clay or GCL. Strain rates of up to 0.2 in/min may be used for geosynthetic to geosynthetic interfaces that are not expected to build up pore water pressure during the laboratory test such as a geomembrane to geotextile interface. The tests should determine both peak and residual shear strength parameters (friction angle and adhesion) for each interface being examined. Care should be taken when a non-linear shear strength envelope is apparent, such is common with many geosynthetic interfaces, especially

those involving a GCL or some clay materials. The Engineer may consider additional testing points in the range of anticipated normal stresses to further characterize the interface shear strength.

Characterization of Earthen Materials to Be Used In Embankment Systems: For projects including embankment systems, appropriate laboratory testing should be performed to characterize the index, strength, consolidation and compaction characteristics of the earthen materials used to construct the embankments and associated features. The list of testing presented above is generally applicable for these systems. Other tests may also be performed based on project-specific requirements and as determined to be appropriate by the Engineer.

Characterization of CCP Materials: Physical and chemical properties of the CCP materials to be disposed of at the facility should be determined, as described in the Ash Characterization Section (Section 1.3.2), and as appropriate for the project. The results of this characterization will be used to establish input parameters related to the CCP materials for use in the stability analyses and other engineering analyses that support the landfill or ash pond design.

1.3.2.2 Hydrogeologic Studies

Definition

Hydrogeologic studies are required by regulatory guidance to evaluate the suitability of proposed landfill sites with respect to the subsurface environment. A suitable subsurface environment is typically one in which the near-surface materials (soils) can be used or otherwise managed to help create the landfill containment (liner and/or capping materials), and in which the uppermost saturated zone (aquifer) can be readily monitored to detect the presence or absence of a potential release from the landfill. Other factors in the evaluation include the character of the aquifer and its use or potential for use as a water supply.

Minimum Design Standards

Each state stipulates the minimum content and order for the hydrogeological report. The most current version of this form should be obtained from the appropriate state at the initiation of the project.

The hydrogeologic report summarizing the investigation methods and results may be required for regulatory review and comment prior to the engineering design.

Specific requirements for the specific state should be reviewed prior to initiating an investigation since there are unique requirements for each state. An overview of requirements for the subject states is provided below.

Alabama: Hydrogeologic investigation requirements for siting coal ash facilities are not explicitly identified in Alabama environmental regulations. Rather, they defer to the intent of the administrative code as determined by ADEM. As a conservative guide, ADEM Form 439, Solid Waste Disposal Permit Application, page 11, provides a detailed list of data that ADEM requires

to be submitted with a permit application. These requirements should be incorporated into the investigation at the onset. The following are unique requirements to the state of Alabama:

- The applicant may be required to pay ADEM to conduct an independent site investigation.
- A minimum of three borings converted to piezometers will be required for site characterization.
- ADEM must approve boring locations prior to installation.

Kentucky: Unique requirements for Special Waste Landfills in Kentucky stipulate the following:

- Baseline groundwater characterization requires monitoring for a CCP specific list of constituents provided 401KAR45:160 Section 71.
- Cannot be located within 250 feet of a sinkhole or other karst feature suggesting rapid transmission of water to the water table.
- Cannot be located within the 100-year floodplain.
- Operations must be capable of monitoring the uppermost aquifer in a manner that will detect the targeted constituents. Furthermore, the operator must be able to demonstrate that corrective action of the uppermost aquifer is capable of being performed in accordance with 401 KAR 45:160, or propose an equivalent statistical procedure that provides reasonable confidence that the migration of leachate from the site is capable of being detected.

Tennessee: The hydrogeologic report requirements are provided in 1200-1-7-.04(9)(a) of the TDEC Rules. The hydrogeological investigation and report must include the following:

- If the facility will be placed in a karst terrain, the investigation must demonstrate that:
  - There is no significant potential for collapse.
  - That the groundwater flow mechanism is not conduit flow.
  - The facility will not degrade local groundwater resources.
  - Piezometers, geophysical survey, or dye trace studies will be installed/performed as required by TDEC.
- If a fault is located within 200 ft of the proposed location that underwent displacement in Holocene time, it will be necessary to prove the facility will be safe from seismic issues.
- Bottom clay must be 1x10-5 cm/s and 10 ft, or 1x10-6 cm/s and 5 ft, above seasonal high water level (unconfined) or the top of a confined aquifer.
- The quantity of all sample sets must be consistent with the appropriate statistical procedures.

Selected Design Standard

Investigation

Hydrogeologic studies for landfill siting shall be conducted in two phases. The first phase involves desktop studies, a minimal site investigation to support a fatal flaw analysis. The second phase involves site-specific field studies to generate data in support of the evaluation and potentially an extended fatal flaw analysis.

The elements of the investigation process are as follows:

1. Literature review (typically Phase 1 only)
2. Work Plan Development
3. Site Investigation
4. Data Analysis and Reporting

The investigation process is iterative until sufficient data is collected to determine if the site is suitable for a landfill.

Literature Review

The objective of the literature review is to gather and evaluate the available site specific, local, and regional hydrogeologic data including:

- Existing site information from previous studies. For developed properties this may include geotechnical and groundwater investigations.
- Published material regarding
    - Geology. Geologic reports from the U.S. Geological Survey (USGS) or the applicable state geological survey.
    - Hydrogeology. USGS water resource investigations, state-generated groundwater resource maps, and other special reports.
    - Topography. USGS topographic maps and any local or site-specific maps.
    - Flood insurance maps. Obtained from the FEMA National Flood Insurance Program.
    - Aerial photographs. Obtained from state transportation and agricultural departments (National Agricultural Imagery Program), public-domain internet services, and private services.
    - Soil maps. Obtained from the U.S. Department of Agriculture local Soil Conservation Service extension.
    - Applicable regulations
    - Permits for nearby facilities. Obtained through www.epa.gov/enviro/ or a Freedom of Information (FOIA) request.

- A well inventory to identify all private, commercial and agricultural wells within at least one mile of the site. This information is available on-line for some states and can only be obtained through direct contact in others.

Following completion of the literature review, there may be sufficient information to conduct an initial fatal flaw analysis. Elimination as a result of a fatal flaw analysis at this stage should be based on readily apparent criteria such as regulatory prohibitions or grossly unsuitable physical characteristics.

Work Plan Development

The findings of the literature review or the summary report from the previous investigation shall be used to develop a work plan for onsite investigations. The following provides an overview of the items included in a work plan:

- Soil borings to inspect subsurface conditions.
- Conversion of site borings to monitoring wells or piezometers with which to test the uppermost aquifer conditions.
- Groundwater monitoring for a sufficient period of time to provide a statistically defensible background data set, which is often four to eight monitoring events.
- Groundwater elevation measurements to establish the seasonal high water table and/or the range of groundwater flow conditions.
- Aquifer testing to characterize the aquifer transmissivity, permeability, and other elements required to characterize the direction, rate and mechanism of flow within the aquifer.
- Laboratory testing may be required to document soil permeability and other characteristics.

The work plan document should clearly identify the data to be collected, how it will be collected, and where it will be collected. The components of the work plan include:

- Identification of data gaps
- Identification of investigative methods to be implemented.
- Identification of investigation locations

Data gaps shall be identified prior to selecting the investigative methods to be used. The appropriate investigative methods to provide the targeted data should be included in the work plan. Potentially applicable investigative methods are listed on Table 1.3.1-2.

Table 1.3.1-2
Investigation Methods and Implementation Considerations

Investigative Method	Implementation Considerations
Photogrammetric Study	Aerial photos- preferably from multiple years, stereo pairs, taken in winter and prior to development are preferred
Test Pits	Utility clearance
Geophysical Survey	Survey lines must be cleared to allow vehicle access
Borehole Geophysics	Methods will be limited based on the type of casing used to hold open the formation, if required
Soil borings & Monitoring Well Installation	▪ Investigative derived waste (IDW) plan ▪ Backfill as stipulated by State ▪ Use appropriately licensed contractor ▪ Register borings/monitoring wells with state if required ▪ Utility clearance
Soil sampling	▪ QA/QC samples should be collected according to the work plan or QAPP ▪ Sample protocol should be provided in workplan ▪ Contracted lab should provide appropriate sample jars
Groundwater Elevation Survey	Measure depth of water from top of casing (TOC) to the 1/10th of foot
Groundwater Sampling	▪ QA/QC samples should be collected according to the work plan or QAPP ▪ Sample protocol should be provided in workplan ▪ Contracted lab should provide appropriate sample jars
Slug Test	
Pumping Test	
Packer Test	
Dye Trace Study	UIC permit required
In-Situ Flow Direction	Method is time-intensive if well recover slowly
Surface Water Elevation Survey	All wells and piezometers must be surveyed to the nearest 0.01 ft.
Surface Water Sampling	▪ QA/QC samples should be collected according to the work plan or QAPP ▪ Sample protocol should be provided in workplan ▪ Contracted lab should provide appropriate sample jars

After the investigative methods have been selected, the final step is selection of the investigative locations. In Phase 1 investigations locations may be biased to identify potential fatal flaws such as sinkholes. Phase 2 investigation locations shall be spatially unbiased to document the homogeneity or heterogeneity of the site.

The work plan, particularly a Phase 2 work plan, may require review by the regulatory agency prior to implementation. Proceeding without regulatory buy-in may result in an additional mobilization to collect specific data required by the agency.

Hydrogeologic investigations must be tailored to the specifics of the site, disposal unit, permit requirements, geology, and regulatory agency. Hydrogeologic investigations are typically required to be conducted directly by or under the supervision of a registered or licensed geologist, or otherwise qualified professional.

A boring plan must be included in the work plan. The boring plan shall identify proposed boring locations, drilling methods, sampling frequency and sampling method. A justification for the location and depth of each boring shall be provided. General guidelines on boring frequency and depth are described below.

The frequency of borings is dependent upon the phase of the investigation, the site size, and hydrogeologic complexity. Five soil borings are typically sufficient for a Phase 1 investigation to confirm the regional and local hydrogeological setting. Phase 2 investigations require a greater spatial density of borings (up to one boring per 10 acres) to ensure the homogeneity of the strata and aquifer beneath the site.

All borings must be advanced a minimum of 25 feet below ground surface. Increasing the boring depth for one or all borings may be necessary if groundwater or bedrock has not been encountered. If groundwater is reached prior to bedrock and bedrock is not expected within 25 feet of the groundwater elevation, then the boring can be halted otherwise it should be advanced to the bedrock interface.

Two downgradient and one upgradient monitoring well installations are typically sufficient for a Phase 1 investigation. As with soil borings, a greater spatial density of wells will be required to ensure the homogeneity or define the heterogeneity of the site in Phase 2. The following information must be considered before installing a monitoring well:

- Data to be obtained.
- Well must be located in an area or of a construction type that will not be damaged during site operations.
- Well construction methods must prevent downward migration of surface water.
- If a confining unit is present, surface casing must be installed into the confining unit and the well drilled through the casing to termination.
- Wells that are not necessary to the investigation should be abandoned according to state-specific procedures as soon as possible to reduce the risk of possible contamination to the aquifer. Abandonment may require state regulatory approval.

Aquifer characterization is typically performed only in Phase 2 investigations. Characterization includes testing by slug tests, pumping tests or packer tests to obtain information on transmissivity, storativity, and permeability. In areas of high secondary porosity such as karst or fractured rock, a dye trace study may be required.

Modifications to the work plan should be expected if site conditions deviate from those anticipated.

Site Work/Data Collection

Work plan implementation begins with the non-invasive methods first, then investigation of overburden, followed by (or simultaneously with) investigations of the uppermost aquifer. The following outlines the typical progression of site work for Phase 2 of a project:

1. Perform surface geophysical survey.
2. Confirm boring and monitoring well locations based on geophysical survey.
3. Install soil borings.
4. Convert soil borings to monitoring wells or piezometers. All borings that will not be converted to monitoring wells or piezometers should be abandoned upon completion.
5. Survey monitoring wells and piezometers to ± 0.01 ft.
6. Collect water level measurements at least twice ten days apart.
7. Perform pumping tests or other appropriate aquifer characterization methods.

All site work shall be thoroughly documented in serialized, bound logbooks or equivalent. Errors should be lined through once, dated and initialed. Lines should not be skipped. Once a page, is complete it shall be signed and dated. Boring logs and monitoring well diagrams are frequently recorded on forms specifically designed for this purpose. Critical information from these forms shall also be included in the bound logbook:

- boring or monitoring well name
- location relative to fixed landmarks or coordinates using a handheld GPS unit
- total depth drilled
- drilling and sampling method
- reason for ending the boring
- well construction information, including:
  - total depth of monitoring well
  - length of screened interval, specifically the distance from highest and lowest slots to the bottom of the well
  - well material type and diameter
  - filter pack type and amount
  - annular seal type and amount
  - grout seal and amount type
  - type of surface completion

Investigative derived wastes (IDW) will be generated during most intrusive investigations. The IDW should be handled/disposed of appropriately. For greenfield sites, this may simply be spreading drill cuttings and discharging groundwater on ground surface. For other sites, wastes shall be handled in a manner consistent with local, state and federal regulations, as dictated by a waste characterization analysis. The TVA Environmental group should be contacted regarding IDW prior to initiation of field activities.

Data Analysis and Reporting

It is critical to evaluate data as it is collected for the following reasons:

- To ensure that the data has been collected in an appropriate manner such that the data is representative and reproducible.
- To verify that the data collected will increase the accuracy of the developing conceptual site model. If the data is not required by regulation and it does not increase the accuracy of the developing conceptual site model (CSM) then it may be appropriate to cease that data collection method in lieu of a more appropriate method.
- To continuously evaluate of the CSM, allowing for modifications to the field program when unexpected data is encountered.
- To collect additional data while personnel and equipment are still mobilized, if the data set is determined to be inadequate

Conceptual Site Model (CSM)

The hydrogeologic study results are used to develop a CSM. The CSM synthesizes the data into a graphical representation of the geology, geologic structure, and groundwater flow at the site. The CSM is a dynamic model that starts on a broad basis and evolves as more information is generated.

The CSM should characterize groundwater conditions on site as they may apply to the design and operation of the proposed facility such as:

- The character of the unsaturated zone (soil, rock or other) between the facility and the underlying saturated zone.
- The character and identity of the geologic materials in which the uppermost saturated zone (aquifer) and potentially interconnected aquifers occur on site.
- The ability of the aquifer to transmit groundwater and the character of that flow (whether diffuse or discrete).
- The path of groundwater flow from upgradient (recharge) to downgradient (discharge) areas.
- The gradient and rate of groundwater flow through the uppermost aquifer.
- The local use of groundwater for water supply.

The amount of information needed to develop a sufficient CSM to the support site selection will depend on the complexity of the site. Table 1.3.1-3 provides a generalized representation of how the site complexity increases the amount of data required to develop the CSM. All sites must be evaluated at the regional (~100 mile radius), local (facility) and the site specific scale.

Table 1.3.1-3
Generalized Representation of Relationship Between Site Complexity and Data Required

Investigative and Data Analysis Methods	Least Complex	Moderately Complex	Highly Complex
	Shallow, unconfined overburden aquifer	Confined overburden aquifer above bedrock	Bedrock aquifer with fractures, jointing and high secondary porosity
	homogenous → isotropic		heterogeneous → anisotropic
Cross Sections	2	2	2
Piezometers	3	3 per geologic unit	3 per geologic unit
Soil Borings	3	8	15
Monitoring Wells	1	5	15
Hydraulic Conductivity	slug tests	pumping test	pumping tests
Potentiometric Surface Maps	2 at least 2 wks apart	quarterly for 1/2 year	quarterly for 1 yr
Stratigraphic Maps	yes	yes	yes
Flow Nets		1	multiple
Borehole Geophysics		yes	yes
Geological Mapping of Bedrock and Structure		yes	yes
Surface Geophysics		yes	yes
3-D Geology/Lab Testing			yes
Conceptual Models			yes
Core Drilling			yes
Geochemical Groundwater Comparisons			yes
In-Situ Flow Direction			yes
Dye Trace Studies			yes
Groundwater Modeling			yes
Fracture Trace Analysis			yes
Fault Mapping			yes

1.3.3 Ash Characterization

1.3.3.1 Chemical Characterization

Definition

Chemical characterization of CCP materials can be conducted to evaluate regulatory classification, leachate treatment requirements, chemical compatibility with landfill components, etc. The chemical characteristics of CCP materials will vary based on factors including coal source, coal processing mechanism, scrubbing technology, boiler type, other emissions control technologies, and conveyance type (especially wet sluice versus dry conveyance). Chemical characterization can include more conventional leach testing such as synthetic precipitation leaching procedure (SPLP), and toxicity leaching characteristic procedure (TCLP), column leaching) and totals analysis (digestion), but could include other analyses such as x-ray diffraction, x-ray fluorescence, scanning electron microscope (SEM), etc. depending on the purpose of the characterization.

The TCLP procedure is commonly used and utilizes an extraction fluid designed to mimic the environment of a typical municipal solid waste landfill. The TCLP method may yield higher concentrations of heavy metals compared with other methods that may more represent a CCP disposal facility such as the SPLP method (SW-846 Method 1312) or a deionized (DI) water leach (e.g. ASTM D3987). If chemical compatibility or prediction of heavy metal concentrations for treatment evaluation and/or fate and transport modeling are of critical importance methods using a more representative extraction fluid may be warranted.

All TCLP extracts should be analyzed for the 8 RCRA Metals listed in 40 CFR §261.24 (Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver). In addition, TCLP samples should be analyzed for other constituents commonly found in CCP materials, including Chloride, Sulfate, Aluminum, Antimony, Beryllium, Boron, Calcium, Cobalt, Copper, Iron, Magnesium, Manganese, Nickel, Thallium, Titanium, Vanadium, and Zinc. Organic compounds are not typically found in CCP materials, but should be evaluated if there is reason to believe they may be present.

Minimum Design Standards

Alabama: In Alabama, "ashes" are defined as the solid residue from the burning of wood, coal, coke or combustible material used for heating or burning or incineration of solid waste. The terms "solid waste", garbage", and "ash", as defined in ADEM solid waste rules, do not include ash resulting from the combustion of coal at electric or steam generating plants. Therefore, no specific testing requirements or frequency of testing is specified in the state of Alabama.

Kentucky: In Kentucky, CCPs are generally considered special wastes, which are regulated under 401 KAR 45. There are few specific requirements for chemical characterization of special wastes. 401 KAR 45:110, Section 1 (1) states that the engineering design of a special waste facility should consider the physical and chemical characteristics of the waste, including compatibility with the liner system, cap system, and water that comes into contact with the waste. In addition, 401 KAR 45:210 Section 3 (2) states that the special waste material must not be a hazardous waste material as defined in 401 KAR Chapter 31. Determination of the special

waste material as hazardous/non-hazardous is done through the TCLP procedure and comparison with the hazardous levels in 40 CFR §261.24. No frequency of testing is specified.

Tennessee: The existing TVA CCP facilities in Tennessee are permitted as Class II Industrial Waste Landfills. It is assumed that future solid waste landfills will also be constructed as Class II facilities. The definition of Industrial Wastes states that the material cannot be deemed hazardous as regulated under Subtitle C of RCRA. This implies that TCLP analysis of the material cannot yield constituent levels greater than those listed in 40 CFR §261.24. Rule 1200-1-7-04 (a)(4) requires that a potential alternative liner system must be chemically compatible with the leachate generated by the waste. Similarly, Rule 1200-1-7-04 (a)(5) states that the leachate collection system must be chemically resistant to the leachate produced by the waste material. No specific testing requirements or frequency of testing is specified.

Federal: No specific chemical characterization of the material is required.

Selected Design Standard

With respect to chemical characterization, the characteristic that is of most importance to the design and maintenance of a containment facility is the leachable constituents of the ash, and in particular leachable heavy metals and salts. The chemical characteristics for each CCP material should be evaluated as follows:

- The primary goals for chemical analysis of the CCP material is to evaluate if the material leaches constituents in concentrations that exceed state or federal regulations (in particular levels greater than those listed in 40 CFR §261.24) and to evaluate chemical compatibility with containment facility components. In order to allow comparison with 40 CFR §261.24 limits for hazardous waste, a TCLP procedure (EPA SW-846 Method 1311) should be performed.
- If no historic data exists for the CCP material, samples should be collected and analyzed using TCLP on enough individual samples to allow for statistical significance (typically eight samples). Thereafter, samples should be collected and analyzed at least annually or when any significant fuel source change (i.e. change from eastern coal to PRB coal), after a significant process modification including, but not limited to, the addition/modification of pollution control equipment, boiler modification, coal processing modification, etc. State regulations and/or permit conditions may require more frequent sampling events.
- An annual analysis of an undiluted leachate sample may be performed in lieu of a TCLP analysis on the CCP material if there have been no other significant process changes to the generating facility, coal source, etc.
- Other types of testing can be performed as required for various projects. For example, column tests, sequential batch tests, batch testing with various solid to liquid ratios, etc. may be more useful for groundwater modeling projects than a TCLP or SPLP test.

1.3.3.2 Physical Characterization

Definition

Determination of the physical characteristics of the CCP material may include material strength, grain size distribution, Atterberg Limits, material compaction characteristics, material density, moisture content requirements for handling and compaction, compressibility, dynamic property evaluation, and hydraulic conductivity. The importance of these parameters will vary depending on the parameter's importance to the design of the facility.

Minimum Design Standards

Alabama: No specific physical characterization of the material is required.

Kentucky: No specific physical characterization of the material is required.

Tennessee: No specific physical characterization of the material is required.

Federal: No specific physical characterization of the material is required.

Selected Design Standard

Required testing of CCP materials for physical properties is to be determined by the design Engineer. It is the design Engineer's responsibility to determine what physical characteristics are important for a specific facility.

Frequency of testing shall also be determined by the Engineer. It is recommended that all tests for critical parameters be completed in duplicate on distinct samples. It is also recommended that critical physical properties of CCPs, as determined by the Engineer, be repeated upon significant change in fuel source or after a significant process modification including, but not limited to, the addition/modification of pollution control equipment, boiler modification, coal processing modification, etc.

TVA has a database of physical properties of its CCP materials in a report by Law Engineering entitled "Fly Ash, Bottom Ash, and Scrubber Gypsum Study" (Contract No. TV-92657V, Phase 1) completed in 1995 (referred to herein as "TVA CCP Database"). This source may provide an adequate basis for material properties. It is the Designer's responsibility to evaluate whether system changes since 1995 may have altered properties of the CCP material or whether the data is adequate and representative. It is of particular importance to ensure that strength testing data performed as part of this study were performed over the range of normal stresses that represent the design of a new facility for critical applications.

If the results from the TVA CCP Database are to be used for design, it is recommended that index testing such as grain size distribution and standard compaction testing be performed to establish whether the materials are similar enough in basic physical characteristics to use other physical characteristics shown in the database such as shear strength.

The following tests are recommended for CCP materials if the material properties are deemed important to the design:

Grain Size Distribution

- All CCP materials should be tested in accordance with ASTM D422. For more coarse grained CCPs, sieve alone may provide adequate data for the design. For other design applications, the designer may want to perform sieve with hydrometer to better classify the fine material.

Hydraulic Conductivity

- Materials should be evaluated for hydraulic conductivity under the conditions (density, moisture content, gradient, etc.) that the material will be placed during construction of the intended design.
- Gypsum, and fly ash (ponded and dry) should be tested for hydraulic conductivity using ASTM D5084.
- Bottom ash should be tested for hydraulic conductivity using ASTM D2434
- Other non-gypsum scrubber byproducts should be tested for hydraulic conductivity using ASTM D5084 if they are generally fine-grained and are anticipated to have a permeability of less than 1×10^{-5} cm/s. If the non-gypsum scrubber material is granular in nature, samples should be tested using ASTM D2434.
- Materials that are pozzolonic (self-cementing) in nature should be prepared and allowed to cure prior to testing (typically 7 to 30+ days). Depending on the nature of the material, curing time may or may not affect the hydraulic conductivity of the material, but allowance for curing time will be more representative of the long-term properties of the material.

Shear Strength

- Shear strength for all CCPs should be determined at the lowest density and highest moisture content that are anticipated for the project.
- In general, effective stress shear strengths for all CCP materials should be determined by the direct shear method (ASTM D3080), or by triaxial testing with pore pressure measurements (ASTM D 4767). Other test methods, such as the direct simple shear test (ASTM D 6528) may also be used, at the discretion of the Geotechnical Engineer and as appropriate. Total stress shear strengths should be determined using triaxial testing (ASTM D 4767).
- Materials that are pozzolonic (self-cementing) in nature should be prepared and allowed to cure prior to testing (typically 7 to 30+ days). Depending on the nature of the material, curing time may or may not affect the shear strength of the material, but allowance for curing time will be more representative of the long-term properties of the material.

Atterberg Limits

CCP materials are generally non-plastic. If Atterberg Limits are desired by the design engineer, they should be performed as per ASTM D4318

Compaction and Density Testing

In general, compaction testing for all CCP materials should be conducted using standard effort (ASTM D698) unless the project warrants the material to be compacted at higher densities with greater effort during construction.

- The compaction characteristics of coarse grained material such as bottom ash and boiler slag may be determined using a one-point proctor test using standard effort at the discretion of the design engineer. Compaction curves for bottom ash and boiler slag with low fines content are typically "flat". Bottom ash should be compacted moist, at its typical as-received moisture content (e.g. bottom ash from pond, freely drained) or at a value established by historical data.
- Care must be taken when oven drying CCP materials containing hydrated water, such as gypsum and non-gypsum FGD material. ASTM 2216 recommends that materials that contain hydrated water be dried at 60 degrees Celsius or using a desiccator at room temperature. Regardless if low temperature or room temperature drying techniques are used, care must be taken to ensure that free water content is being determined in relation to compaction testing and not total water content (which would include hydrated water).

Consolidation Testing

- Most CCP materials exhibit low consolidation coefficients (<0.1) for moderate to well compacted CCP materials and is generally not a critical concern for most applications. If the designer desires consolidation data for CCP materials, it should be performed per ASTM 2435. The sample should be prepared in a manner that represents the moisture content and density of the condition being evaluated. This is of particular consequence when evaluating the compressive behavior of ponded fly ash material.

Other Testing

Other material testing for design purposes should be determined by the design engineer.

1.3.4 Liner and Cap System

1.3.4.1 Liner System

Definition

A liner refers to a continuous layer of natural or man-made materials, beneath and/or on the sides of a surface impoundment, landfill, or landfill cell, which restricts the downward or lateral escape of wastes, waste constituents, or leachate. Liners for disposal facilities are typically composite systems constructed of one or more layers of a low permeability synthetic material such as high density polyethylene (HDPE), linear low density polyethylene (LLDPE), or polyvinyl chloride (PVC) and a low permeability compacted clayey soil.

Minimum Design Standards

Alabama: There are no known minimum design standards for liners for CCP facilities in Alabama. Design requirements for liners of Municipal Solid Waste (MSW) facilities are given in 335-13-4-.18. MSW facilities are to be equipped with a composite liner system consisting of

two components; the upper component must consist of a minimum 40 mil (60 mil if using HDPE) flexible membrane liner (FML), and the lower component must consist of at least a two-foot layer of compacted soil with a hydraulic conductivity of no more than 1 x 10^{-7} cm/sec. The FML component must be installed in direct and uniform contact with the compacted soil component.

Alabama has an additional requirement of a leachate collection system. A leachate collection system shall be required that is designed and constructed to maintain less than a 12-inch depth of leachate over the liner. Refer to Section 1.5 for leachate management system design standards.

Kentucky: There are no known minimum design standards for liners used for special waste facilities in Kentucky. Minimum design standards for liners of contained facilities for other types of waste are given in 401 KAR 48:080. For contained facilities a primary and secondary composite liner system is required. The primary liner system shall consist, at a minimum, (from bottom to top): a 36 inch clay layer with a permeability of 1 x 10^{-7} cm/sec; a primary synthetic liner with a demonstrated hydraulic conductivity less than 1 x 10^{-12} cm/sec and a thickness of at least 60 mils; a 12 inch drainage layer with permeability of 1 x 10^{-2} cm/sec or a layer of equivalent performance; and a filter fabric. The secondary liner system shall consist of (from bottom to top): a 12 inch soil layer with a permeability of 1 x 10^{-7} cm/ sec; a secondary synthetic liner as specified above for the primary liner; a 12 inch drainage layer with a permeability of 1 x 10^{-2} cm/ sec; and a filter fabric. The secondary soil and synthetic components may be replaced with an existing naturally occurring soil material meeting the requirements given in 401 KAR 48:080, Section 1(2).

Additional requirements in Kentucky:

- Liner subgrade shall be sufficiently dry, compacted and structurally sound to ensure that the first lift and all succeeding lifts of soil placed over the landfill subgrade can be adequately compacted to the design requirements. Proofrolling of the subgrade is required, with a minimum 100,000 pound loaded four tire scraper (20 cubic yard size) or equivalent procedure and equipment approved by the cabinet.
- Strains in all geosynthetic components are required to be maintained at less than 10%;
- The slope of liner components shall be no less than 3% percent toward the main leachate collection line, 1% along the main leachate collection line, and no greater than 50% at any point.

Tennessee: Liners for Class II facilities in Tennessee are required to meet minimum design requirements for liners of Class I facilities, which are given in 1200-1-7-.04(4)(a)(1), unless otherwise approved by the State. In summary, a composite liner system is required, consisting of two components: the upper component must consist of a minimum 30-mil (60-mil for HDPE) geosynthetic FML, and the lower component must consist of at least a two-foot layer of compacted soil with a hydraulic conductivity of no more than 1.0 x 10^{-7} cm/sec. The FML component must be installed in direct and uniform contact with the compacted soil component. Liners shall be sloped such that, excluding excavation side slopes, the slope of the liner shall not exceed 25%.

Additional requirements in Tennessee:

- Geologic Buffer: The liner system shall be placed on top of a geologic buffer which has a maximum hydraulic conductivity of 1.0×10^{-5} cm/sec and measures at least ten feet from the bottom of the liner (or have a maximum hydraulic conductivity of 1×10^{-6} cm/sec and measures at least 5 ft from the bottom of the liner) to the seasonal high water table of the uppermost unconfined aquifer or the top of the formation of a confined aquifer.
- Leachate Collection System: A leachate collection and removal system is required immediately above the liner that is designed, constructed, maintained, and operated to collect and remove leachate from the facility. Refer to Section 1.5 for leachate management system design standards.

Federal: No liner system is specified for CCP facilities.

Selected Design Standard

The design of liner systems shall based on the following standards, which have been determined based on the state requirements given above. Alternate and equivalent systems may also be applicable, if acceptable to the regulators:

Thickness and Materials: Where specific State requirements are given for CCP facilities (such as in Tennessee), the liner system should be designed to meet those specific requirements. Where no specific requirements are given, the basic liner system design should consist of (from top to bottom) a drainage layer; an FML; and a recompacted soil liner (RSL). These layers should meet the following minimum guidelines:

Drainage Layer: Should consist of a minimum 12-inch thick layer of granular soil, a geocomposite material with an equivalent transmissivity, or a combination of geocomposite and granular soil materials designed to maintain less than a 30 centimeter (12 inch) depth of leachate above the liner system. A geotextile separator, or graded granular filter, should be included between the top of the drainage layer and the emplaced CCP. Refer to Section 1.5 for leachate management system design standards.

FML: FMLs should have a minimum thickness of 30 mils (60-mils if HDPE). As an industry standard, typically HDPE or PVC materials are used in liner system FML applications. The FML should be physically and chemically resistant to chemical attack by the waste, leachate, or other materials to which it may come into contact. The FML should be placed in direct contact with the RSL layer. The FML should be protected from the drainage layer by an appropriate cushion, such as a geotextile fabric.

RSL: RSL should consist of at least 24-inches of material meeting classifications of CL, CH, or CL-ML per the United Soil Classification System (USCS). It should be demonstrated by appropriate laboratory testing that the material has a maximum permeability of 1×10^{-7} cm/sec under moisture and density conditions consistent with those under which it will be placed in the field. RSL should be free from organic and other deleterious materials, and sharp materials which may pose puncture hazards to the FML.

A generalized schematic of this basic liner system, which illustrates the key components, is presented in Figure 1.3.3-1.

Additional design considerations include:

Geologic Buffer: If specifically required by the state, the landfill design shall include a geologic buffer between the liner system and groundwater. Buffer materials may consist of or include the existing soil materials below the facility, if these materials meet the state requirements. If the existing materials do not meet the requirements, compacted fill materials meeting the requirements shall be included in the design to act as the geologic buffer.

Liner Slope: Unless specific state requirements are more stringent, the facility should be designed such that the liner system has a minimum slope of at least 2% toward leachate collection piping and a minimum of 0.5% along leachate collection piping, after including the effects of estimated facility settlements. Where state requirements are more stringent, those requirements should be incorporated into the design.

Anchor Trenches: In general, anchor trenches for geosynthetic components of the liner system should be provided around the entire perimeter of the landfill facility. Anchor trenches should be designed to provide resistance against pullout of the materials. Anchor trenches should be designed per Section 1.4.5.

Shear Strength: The liner design should include the determination of combinations of peak and residual shear strength properties (friction angle and cohesion) which satisfy requirements for global slope stability of the facility, as described in Section 1.4.

Working Strain: The facility should be designed such that the maximum predicted strain induced in any FML components is less than 5%, under all or part of the weight of the facility, and considering the predicted settlements under the facility, unless specific data from the synthetic manufacturer allows for a higher strain.

1.3.4.2 Cap System

Definition

The cap system, also referred to as the final cover system, is the cover material and components that are spread and compacted on the top and side slopes of a facility which will be permanently exposed to the environment. The cap system is placed at the end of the life of the facility and is designed to inhibit and control the movement of CCP, dust, water, and gases both into and out of the emplaced CCP. Caps are typically composite systems constructed of one or more layers of: a vegetative cover, protective soil material, a drainage layer, and a low permeability layer of recompacted soil or a geosynthetic material (such as HDPE).

Minimum Design Standards

Alabama: There are no known minimum design standards for caps of CCP waste facilities in Alabama. Design requirements for caps of MSW facilities are given in 335-13-4-.20. In summary, the MSW requirements state: The final cover system must be comprised of an erosion layer(s) underlain by an infiltration layer(s). The infiltration layer must be comprised of a

minimum of 18 inches of earthen material and/or a synthetic layer that has a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1 x 10^{-5} cm/sec, whichever is less. The erosion layer must consist of a minimum 6 inches of earthen material that is capable of sustaining native plant growth.

Kentucky: There are no minimum design standards for caps used for special waste facilities. Minimum design standards for caps of contained facilities are given in 401 KAR 48:080, Section 8. In summary, the contained facilities requirements state: At a minimum the final cap shall consist of a layered system. Each layer shall have the same slope of between five and twenty-five (25) percent. The components, listed from bottom to top, are: a filter fabric or other material approved by the cabinet; a 12 inch sand gas venting system with a minimum hydraulic permeability of 1 x 10^{-3} (a layer that is not needed in a CCP landfill as it does not generate gases); a filter fabric or other material approved by the cabinet; an 18 inch clay layer with a maximum permeability of 1 x 10^{-7} cm/sec; for areas of the final cap with a slope of less than 15 percent, a 12 inch drainage layer with a minimum permeability of 1 x 10^{-3} cm/sec; and a 36 inch vegetative soil layer.

Tennessee: Unless otherwise approved by the State, caps for Class II facilities in Tennessee are required to meet minimum design requirements for caps of Class I facilities, which are given in 1200-1-7-.04(4)(a)(6) and 1200-1-7-.04(8)(a)(1). Section 1200-1-7-.04(8)(a)(1) states: "The depth of final cover system shall be at least 36 inches of soil of which a minimum of 12 inches shall be for the support of vegetative cover. The design of the final cover system shall be such that the infiltration volume of water will be equal to or less than the percolation volume through the bottom liner system or a design which includes a compacted soil layer of at least 24 inches which has a permeability no greater than 1 x 10^{-7} cm/sec, whichever is less. This design shall be supported by the use of the Hydrologic Evaluation of Landfill Performance (HELP) model or other equivalent method approved by the Commissioner".

Federal: No cap system is specified for CCP facilities.

Selected Design Standard

The design of cap systems should be based on the following standards, which have been determined based on the state requirements given above. Alternate and equivalent systems may also be applicable, if acceptable to the regulators:

Thickness and Materials: Where specific state requirements are given for CCP facilities (such as in Tennessee), cap design should follow those requirements. Otherwise, the basic cap system should consist of the following layers, at a minimum (from top to bottom): A layer of cover soil material, with a total thickness that is equal to or greater than the local frost penetration depth and of which the upper 6-inches is capable of supporting vegetation (topsoil); A minimum 24-inch thick layer of recompacted soil with a permeability of less than 1 x 10^{-7} cm/sec and meeting USCS soil classifications of CL, CL-ML, or CH should be placed below the cover soil. Additionally, dense vegetative (non-woody) growth at the surface of the cap shall be specifically included in the design.

An alternate cap system may be considered, if clay materials are unavailable or difficult to obtain. The alternate system should consist of the following layers, from top to bottom: Minimum 24-inches of cover soil, of which the upper 6-inches is capable of supporting vegetation (topsoil); a nonwoven geotextile separator, or graded granular filter,; a drainage layer consisting of either 12-inches of granular soil materials or a geocomposite material; a nonwoven geotextile separator (if a geocomposite drainage layer is selected, the geotextile separator may be omitted); and a FML with a minimum thickness of 30-mils (40 mils if LLDPE or HDPE). As an industry standard, typically LLDPE or PVC materials are used in cap system FML applications. The FML should be physically and chemically resistant to chemical attack by the CCP, leachate, or other materials to which it may come into contact. The FML should be placed directly on top of a prepared, compacted subgrade that is free from sharp materials that pose a puncture hazard to the FML. Additionally, dense vegetative (non-woody) growth at the surface of the cap shall be specifically included in the design. A generalized schematic of this alternate cap system, which illustrates the key components, is presented in Figure 1.3.3-2.

Infiltration Analysis: The cap system should be designed to restrict infiltration of surface water into the facility such that all requirements for operating head on the leachate collection system at the base of the facility are met. This design should be evaluated by use of the HELP model. HELP Model analysis is described in Section 1.5.1.

Cap Slope: Where specific requirements on maximum slope are given by a state (such for facilities in Alabama), the design should follow those requirements. If there are no specific requirements, the slope of all cap system layers should not exceed 3 Horizontal to 1 Vertical (3H:1V), unless it is explicitly demonstrated by analysis that all cap system components and the underlying CCP subgrade will be stable at a steeper slope.

Stability: If geosynthetics are to be used in the cap, the cap design should include the determination of combinations of peak and residual shear strength properties (friction angle and cohesion) which satisfy minimum guidelines for shallow translational slope stability, as described in Section 1.4.4. Additionally, anchor trenches should be provided for geosynthetic components as required to provide resistance against pullout of the materials. Anchor trenches should be designed per Section 1.4.5.

Surface Water Management and Soil and Erosion Control: In general, benches/terraces should be provided in the design of the cap system, to limit surface erosion and convey stormwater off of the landfill cap system. The spacing of benches shall be designed in accordance with soil and erosion control requirements described in Section 1.6.1. The design requirements for surface water management structures, including benches/terraces, are described in Section 1.6.2. The design requirements for sediment basins are described in Section 1.6.3.

1.3.5 Volume and Life Calculations

Definition

Volume and life calculations are performed to determine the disposal volume, operational lifetime, and soil balance for the overall facility, as well as for interim phases within the facility. These calculations are based on estimates of CCP generation rates, in-place CCP density, and the

geometry and areal limits of phases within the facility design. The calculations provide a basis to measure disposal rates and to schedule construction to provide for additional disposal capacity.

Minimum Design Standards

Alabama: There are no minimum design standards for volume and life calculations for special waste facilities or MSW facilities in Alabama.

Kentucky: There are no minimum design standards for volume and life calculations for special waste facilities in Kentucky. However, 401 KAR 47:190 Section 2 requires submission of phasing plans within the application for the proposed facility. Development of these plans will inherently require an analysis of volume and life.

Tennessee: For Class I, II, and III facilities that require a permit, 1200-1-7-.04(9)(c)(9) and (10) require narrative descriptions to be provided of the volume and type of waste to be disposed of in the facility, as well as the total acreage to be filled in each phase.

Federal: There are no minimum design standards for volume and life calculations for CCP facilities.

Selected Design Standard

The landfill design shall include specific volume and life calculations and a technical memo summarizing these calculations.

Volume and life calculation standards for new facilities should be based on the following considerations:

- The desired working life of the facility. Regarding facility life, TVA has the following internal goals:
    - Facilities are to be designed for a minimum 20 year working life, if possible.
    - Facility planning should be such that design of new facilities should begin a minimum of six years prior to the end of the working life of the previous facility.
- Estimates of annual CCP generation rates, as well as potential for future increases/decreases in these rates during the lifetime of the facility.
- Estimates of the in-place volume of the CCP within the facility. These should be based on prior experience as well as results of the ash characterization program.
- In general, separate volume and life calculations should be performed for each construction phase of the facility.
- The volume of any required cover, soil liners and caps, berms, etc. should be accounted for in the available volume and life calculations of any phase within the facility.

To obtain accurate results, it is recommended that available phase and facility volumes be computed using computer-aided design and drafting techniques and software packages, rather than via hand calculations.

1.4 STABILITY ANALYSIS

The following criteria have been developed to define performance standards and an overview of methods of engineering evaluation for the construction of new dry ash landfills. Analyses and evaluations are currently being performed by others for wet ash landfills and will be incorporated at a later date.

1.4.1 Hydrostatic Uplift Analysis

Definition

Soils, geosynthetics, or CCP materials that are placed underneath a temporary or permanent phreatic surface may be subject to hydrostatic forces, especially when the phreatic surface lies above materials or components with low permeability, such as the base liner system. If the driving force of the hydrostatic pressure at the base of a facility component exceeds the resisting force, primarily provided by the weight of the component and any soils placed over it, the component may be physically uplifted or deformed. Other effects such as heave or instability of the subgrade or excessive groundwater infiltration at the facility base may also occur. The hydrostatic uplift analysis evaluates the driving and resisting forces and determines a factor of safety against uplift, defined as the ratio of the resisting to the driving forces.

Minimum Design Standards

Alabama: There are no minimum design standards for hydrostatic uplift analysis in Alabama.

Kentucky: There are no minimum design standards for hydrostatic uplift analysis in Kentucky.

Tennessee: There are no minimum design standards for hydrostatic uplift analysis in Tennessee.

Federal: There are no federal minimum design standards for hydrostatic uplift analysis.

Selected Design Standard

The selected design standard includes the following components:

- Contours defining the highest temporal phreatic and potentiometric (confined or pressurized water table) surfaces on site shall be established based on the results of the hydrogeological and geotechnical investigations.

- Using the design base grades of the facility and the contours of the phreatic and potentiometric surfaces, an elementary hydrostatic uplift analyses should be performed. Methods of elementary analysis are presented in the Ohio EPA's "Geotechnical and Stability Analyses for Ohio Waste Containment Facilities", Chapter 7. In summary, this analysis involves computing the hydrostatic uplift at the base of a facility component or

at the base of a confining subsurface layer (based on the elevation of the phreatic or potentiometric surface relative to the elevation of the base of the component or confining layer), and comparing it with the total vertical stress acting at the base of the component or layer. The factor of safety, defined as the ratio of the total vertical stress and the hydrostatic uplift pressure, should be greater than 1.4. The elementary analysis should include cases which consider all interim or permanent configurations of the facility and subsurface soils that may be prone to hydrostatic uplift (such as a point in time during landfill construction at which the liner has been placed and minimal or no cover is present over the liner) and should delineate areas of the facility footprint exhibiting factors of safety less than the design criteria presented above. If such areas are identified through the elementary analysis, an effort should be made to adjust the design of the facility's base grades to yield a safety factor satisfying the above recommended design criteria.

- If redesign to satisfy the design criteria established by the elementary analysis is not feasible, then more rigorous analyses may be performed to demonstrate that the factors of safety are higher than predicted by the elementary analysis. Such analyses may include steady state or transient seepage analyses that predict the magnitude of hydrostatic uplift forces on the liner system, or other analyses deemed appropriate by the Geotechnical Engineer.
- In the case that the factor of safety requirement for uplift cannot be met with more rigorous analyses or by redesign of the facility's base grades, then specific engineering modifications to lower the phreatic or potentiometric surfaces, such as underdrain systems, pumping wells, etc., may be incorporated into the design, to raise the factor of safety against hydrostatic uplift. If required, these systems should remain active until such time as the weight of materials placed over the component or layer of concern is sufficient to counteract the hydrostatic uplift forces with a factor of safety of 1.4.

1.4.2 Slope Stability Analysis

1.4.2.1 Deep-Seated Failure Analysis (Static)

Definition

Deep seated failure analyses evaluate the potential for mass slope instabilities. Qualitatively, failure geometries with a maximum thickness greater than 10 ft may be considered to be deep-seated. Deep-seated failures may involve the CCP alone, or pass through the CCPs and into the underlying foundation materials, and are generally analyzed as being rotational (having a circular geometry) or translational (having a block-like geometry). The potential for deep-seated instability is dependent on factors such as slope geometry, shear strength of the CCPs, foundation materials, liner materials, and groundwater conditions. The analysis of deep-seated instabilities is performed using computer slope stability analysis software, which generally use limit equilibrium analysis and the method of slices.

Analyses under static conditions evaluate the potential for deep-seated instabilities under normal, service conditions of the facility, either during its construction or post closure.

Minimum Design Standards

Alabama: There are no known minimum design standards for deep-seated stability analyses in Alabama.

Kentucky: There are no specific minimum design standards for deep-seated stability analyses for special waste facilities or for contained waste facilities in Kentucky. However, for contained waste facilities, 401 KAR 48:080 Section 3 (1) makes the following generalized requirement pertaining to the subgrade soils below a proposed landfill: The landfill subgrade material shall be free of organic material and consist of bedrock, on-site soils, or any select fill with the structural ability to support the landfill maximum load with a factor of safety of two (2.0).

Tennessee: There are no known specific minimum design standards for deep-seated stability analyses for Class II or Class I facilities in Tennessee.

Federal: There are no federal minimum design standards for deep-seated stability analyses for CCP facilities.

Selected Design Standard

Static, deep-seated stability analyses shall be performed based on the following recommendations. Guidance for these types of analyses is provided in [NAVFAC, 1986] and [OEPA, 2004]. The recommendations presented herein are based in part on these documents. A deep-seated stability analysis should include the following:

- Critical slope geometries under interim and long term configurations. Interim conditions are defined as any configuration of the facility that is of a temporary nature (such as a temporary internal slope that exists at close of one cell and prior to start of construction of the adjacent cell) that will be present for a period of less than one year. A long term configuration refers to any configuration that is not classified as interim (for example, post-closure geometries, or semi-temporary conditions that may exist for longer than one year during construction).
- Cross-sections of the facility which represent critical (worst-case) geometries or configurations. Prior to beginning the stability calculations, a screening analysis should be performed in order to identify these critical cross-sections considering both long term and interim facility configurations (such as height of fill over existing grade, sideslope geometry, etc.), properties of the foundation materials (including strength and consistency of the foundation materials, depths to competent material, etc.), and groundwater conditions. It will likely be necessary to analyze more than one section in a given project if a single critical section cannot be identified by inspection.
- Both circular and block-type failure surface geometries, as well as geometries involving failures along internal slopes and along liners featuring geosynthetic interfaces. Failure surface geometries of a wide range of sizes should be considered in the analyses, in order to identify the critical failure surface geometry.

- The results of the geotechnical investigation and laboratory testing should be utilized to establish shear strength and unit weight parameters for the foundation soils and to establish groundwater elevations for input into the stability analyses.
- All static slope stability analyses should be based on effective stress strength parameters. Peak shear strength parameters should be assigned to earthen materials. For analyses of block failure surfaces which pass through a multilayer base liner system, shear strengths representing the liner should correspond to the weakest interface within the liner system. The Geotechnical Engineer should consider the amount of displacement that is anticipated along the liner system during service when selecting shear strengths for use in the analyses. Low anticipated deformations warrant the use of peak shear strength parameters, while high anticipated deformations would warrant the use of residual shear strength parameters. If the specific materials that are to comprise the liner system are known at the time of the stability modeling, the strengths assigned should be based on the results of laboratory direct shear testing that are representative of the materials and interfaces to be used in the design. If the specific materials that are to comprise the liner system are unknown at the time of the stability modeling, the modeling should be used to establish an envelope of friction angle and adhesion combinations, which together satisfy the design criteria minimum safety factors (see below) for all design cases. This envelope should be made part of a performance specification for the liner materials in conjunction with similar requirements determined from the seismic deep-seated stability analyses (Section 1.4.2.2) and the shallow translational stability analyses (Section 1.4.4).
- Landfill construction involves incremental placement of fill materials over a relatively long period of time. Thus increases in porewater pressures induced by each increment of loading will generally have time to come to equilibrium with the applied loads, prior to application of the next increment – i.e., effective strength conditions will prevail in the foundation. However, soft, cohesive materials with low permeability that underlie the facility may not adequately drain in response to one load increment before the next increment is applied. Such layers may be prone to stability failures under undrained conditions. In such situations, stability analyses should include a check of slope stability utilizing total strength parameters for the soft, cohesive layers.

  The Geotechnical Engineer should determine if a facility is prone to failure in a total strength mode, on a case-by-case basis. The following guidance is provided for total strength stability analyses:

  - Total strength stability analyses should be considered if soil materials with undrained shear strength of less than 1,000 pounds per square foot (psf) and permeability of $1x10^{-7}$ cm/sec are present within or underneath the facility.
  - Implementation of total strength analyses must consider the estimated rate of fill placement within the facility, and the value of the undrained shear strength that is available in each soft, cohesive layer at any time during the landfilling process. The undrained shear strength of these materials will change over time, depending on the amount of consolidation that has occurred under the load that has already been applied. Analyses representing a number of points in time during the landfilling process will usually be required.

- The rate of consolidation and the undrained shear strength available after a particular amount of consolidation has occurred under a given load should be determined based on laboratory consolidation and triaxial testing.

- A minimum factor of safety of 1.5 shall be used for static analysis of deep-seated stability for post-closure slopes or slopes that are not classified as interim slopes. Interim slopes shall be designed for a factor of safety of 1.3. These factors of safety pertain to both effective strength and total strength analyses. Facilities that do not meet these criteria will need to be redesigned. If the facility meets the criteria under effective strength analyses but not under total strength analyses, consideration should be given to incorporating controlled loading rates (staged construction), vertical subdrainage (wick drains) or other methods of ground improvement. These techniques should be clearly incorporated into the plans and specifications for the facility.
- At a minimum, all slope stability analyses should be performed using 2-dimensional limit equilibrium analysis based on the method of slices and capable of determining minimum (critical) factors of safety based on a search of a wide range of potential circular and block failure geometries. An analysis methodology satisfying both force and moment equilibrium and incorporating the effects of interslice forces should be utilized – such as Spencer's Method or the Morgenstern-Price Method. Hand calculations and computer analyses are acceptable for this purpose. In certain situations, finite element or finite difference methods may also be used in conjunction with the limit equilibrium procedures, at the discretion of the Geotechnical Engineer.

1.4.2.2 Deep Seated Failure Analysis (Seismic)

1.4.2.2.1 Design Seismic Event

Definition

The design seismic event is defined as the event producing the maximum horizontal acceleration at the base of the facility for which the facility and its components must be designed to remain stable. This maximum horizontal acceleration is used as input in evaluating the liquefaction potential and seismically influenced global stability analyses.

Minimum Design Standards

Alabama: There are no minimum design standards for the design seismic event for special waste facilities. For municipal solid waste facilities 335-13-4-.01 (1) (d) gives requirements that are essentially identical to those in Tennessee (see below).

Kentucky: There are no specific minimum design standards for special waste facilities. For contained waste facilities, 401 KAR 48:070 Section 3 states: At a new contained solid waste landfill unit located in a seismic impact zone, all containment structures, including liners, leachate collection systems, and surface water control systems shall be designed to resist the maximum anticipated horizontal acceleration in lithified material for the site.

Tennessee: 1200-1-7-.04(2)(v) states that Class I and II disposal facilities shall not be located in seismic impact zones, unless the owner or operator demonstrates that all containment structures, including liners, leachate collection systems, and surface water control systems, are designed to

resist the maximum horizontal acceleration in lithified earth material for the site. The owner or operator must place the demonstration in the Narrative Description of the Facility and Operations Manual. The state provides the following definitions with regard to this regulation:

> "Seismic impact zone" means an area with a ten percent or greater probability that the maximum horizontal acceleration in lithified earth materials, expressed as a fraction of the earth's gravitational pull will exceed 0.10g in 250 years.
>
> "Maximum horizontal acceleration in lithified earth material" means the maximum expected horizontal acceleration depicted on a seismic hazard map, with a 90 percent or greater probability that the acceleration will not be exceeded in 250 years, or the maximum expected horizontal acceleration based on a site-specific seismic risk assessment.

Selected Design Standard

Seismic design of facilities shall be performed based on an event which produces a maximum horizontal acceleration in lithified earth materials with a probability of exceedance of 2% in 50 years (the design event). This corresponds to an event with a return period of approximately 2,500 years, and is approximately equivalent to the requirements for Class I and II facilities in Tennessee and MSW facilities in Alabama.

The following information should be obtained/established, prior to performing seismic stability analyses:

- The seismic site class should be determined using the NEHRP site class definitions and based on the results of the geotechnical investigation. Sites that include ponded or sluiced fly ash materials or fly ash materials below the water table should be given Site Class F designation, by inspection.
- The peak ground acceleration in lithified earth at the site and corresponding to the design event should be selected based on data from the United States Geological Survey's (USGS) Seismic Hazard maps (currently available online at http://gldims.cr.usgs.gov/nshmp2008/viewer.htm and/or from the data in TVA's region-specific study performed by AMEC GeoMatrix.

  The peak acceleration obtained as above is referred to herein as PGA_{rock}.

- Most sites will include overburden soils and geomaterials lying above bedrock. In these cases, the parameter PGA_{rock} should be corrected to account for the characteristics of the overburden (i.e., potential for amplification of the rock motions through the overburden materials), to obtain the peak horizontal acceleration at the ground surface at the site (i.e., at the base of the facility), referred to herein as PGA_{design}.. The parameter PGA_{design} will be used as input in several of the seismic stability analyses described in the subsequent sections.

The following minimum level of effort should be implemented to determine PGA_{design}:

For sites classified as Class A or B (rock sites), PGA_{rock} can be used as PGA_{design}. A site-specific response analysis (as described below) may also be used to determine PGA_{design}

Sites for which PGA_{rock} is less than 0.20g and the seismic site classification is C through E, PGA_{design} may be determined by multiplying PGA_{rock} by published amplification ratios to account for amplification of rock motions through the soil profile at the site. References containing amplification ratios include [Idriss, 1991]. A site-specific response analysis (as described below) may also be used to determine PGA_{design}.

Sites that have PGA_{rock} greater than 0.20g and are designated Site Classes C through E, or Class F sites with any value of PGA_{rock} warrant further study to obtain PGA_{design}. A site-specific response analysis is recommended for such sites. The site response analysis should include a seismological evaluation to establish the design moment magnitude, M_{design} (as described below) and to develop time histories at bedrock that are representative of the design event. The response analysis should also include a 1-D nonlinear or equivalent-linear ground response analyses which accounts for propagation of the rock motions through the soil column and to the ground surface. This analysis should be used to establish PGA_{design}.

- The mean moment magnitude for the event at the location of the site should be selected using USGS deaggregation data (currently available online at http://eqint.cr.usgs.gov/deaggint/2008/) and/or from the data in TVA's region-specific study performed by AMEC GeoMatrix (most current study at the time of writing of this document is dated 2004).

  The moment magnitude obtained in this fashion is referred to herein as M_{design}. This moment magnitude should be used as input to the seismic stability analyses described in subsequent sections.

1.4.2.2.2 Liquefaction Analysis

Definition

Liquefaction is a phenomenon in which the strength and stiffness of a soil is reduced by earthquake shaking or other rapid loading. Liquefaction generally occurs in saturated fine to medium sands, silts, or similar cohesionless soils, in response to increases in pore pressures and associated loss of shear strength created by seismically induced ground motion. Liquefaction analyses are performed with the objectives of evaluating the potential for liquefaction of each subsurface deposit underlying a facility, and if liquefaction potential exists, predicting the extent of deformation that may occur due to liquefaction. This section describes minimum design guidelines for liquefaction analyses.

Minimum Design Standards

Alabama: There are no minimum design standards for liquefaction analyses for CCP facilities. For municipal solid waste facilities, regulations which are indirectly related to liquefaction include: 335-13-4-.01 (1) (d) which presents requirements for facilities located in seismic impact zones. The requirements are essentially identical to those in Tennessee (see above).

Kentucky: There are no minimum design standards for liquefaction analysis for special waste facilities and contained waste facilities.

Regulations which are indirectly related to liquefaction include:

> 401 KAR 48:070 Section 3 states: At a new contained solid waste landfill unit located in a seismic impact zone, all containment structures, including liners, leachate collection systems, and surface water control systems shall be designed to resist the maximum anticipated horizontal acceleration in lithified material for the site.
>
> 401 KAR 48:070 Section 4 for contained facilities which require that the facility design address stability of the facility components if constructing in unstable areas.

Tennessee: Tennessee addresses liquefaction analyses in a document published by the Division of Solid Waste Management and entitled "Earthquake Evaluation Guidance Document". This guidance references a procedure for evaluating liquefaction potential of foundation soils presented in [Seed and Idriss, 1971] (see references below).

Regulations which are indirectly related to liquefaction include:

> 1200-1-7-.04(2)(v) Class I and II disposal facilities shall not be located in seismic impact zones, unless the owner or operator demonstrates that all containment structures, including liners, leachate collection systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site. The owner or operator must place the demonstration in the Narrative Description of the Facility and Operations Manual. The state provides the following definition with regard to this regulation:
>
> "Seismic impact zone" means an area with a ten percent or greater probability that the maximum horizontal acceleration in lithified earth materials, expressed as a fraction of the earth's gravitational pull will exceed 0.10g in 250 years.
>
> "Maximum horizontal acceleration in lithified earth material" means the maximum expected horizontal acceleration depicted on a seismic hazard map, with a 90 percent or greater probability that the acceleration will not be exceeded in 250 years, or the maximum expected horizontal acceleration based on a site-specific seismic risk assessment.

Selected Design Standard

- Soil units defined by the geotechnical investigation should be separated into materials that may subject to classical liquefaction and those that may be subject to softening and substantial reduction in strength during and after earthquake shaking. Separate evaluations will be required for each type of material.

Soil layers susceptible to classical liquefaction should be identified as follows: Layers classified as sands or gravels, per USCS (all S- and G- classes); Layers classified as silts or clays (M- and C- classes) that have plasticity index less than 7. These soil layers are defined as Category 1 materials herein.

Natural silt, clay, or organic soils (M- and C- and O- classes) that have plasticity index greater than or equal to 7 though not susceptible to classic liquefaction, may be prone to softening under cyclic loads. These soil layers are defined as Category 2 materials herein.

Soils not fitting within the definitions of Categories 1 and 2 as defined above are considered special soils and are defined as Category 3 materials. Category 3 materials include fly ash and other CCPs, or other unnatural soil materials. Category 3 soils may be prone to classic liquefaction or cyclic softening, but their liquefaction (or softening) behavior is not well established in the literature and needs to be specifically addressed by the Geotechnical Engineer.

Evaluation of Soils With Potential For Classical Liquefaction (Category 1)

- All soil layers that fall under Category 1 as described above should be evaluated for the potential for liquefaction.
- Analysis of liquefaction potential should be performed in general accordance with the methods given in [You'd et al., 2001]. This methodology is an update to the methodology presented in the Tennessee guidance document referred above. This is a semi-empirical procedure which relates the soil's resistance to liquefaction based on typical field data that is obtained during the geotechnical investigation (SPT N values, CPT resistances, etc). The liquefaction analysis shall have the design seismic event (defined in Section 1.4.2.2.1) as its basis. Material properties for each layer used as input to the analyses should be established based on the results of the geotechnical investigation and site-specific laboratory testing.
- The result of the liquefaction analyses will be a factor of safety against liquefaction, where the factor of safety is defined as follows:

$$FS_{liq} = \frac{CRR}{CSR}$$

Where CRR = Cyclic Resistance Ratio, corresponding to the design event

CSR = Cyclic Stress Ratio, corresponding to the design event.

The factor of safety against liquefaction of each subsurface layer within Category 1 should be determined.

- Interpretation of the computed factors of safety is performed as part of the seismic slope stability analyses and seismic deformation analyses, as defined in Sections 1.4.2.2.3 and 1.4.2.2.4 below.
- If appropriate and at the discretion of the Geotechnical Engineer, the cyclic resistance of soils may be determined through the use of project-specific laboratory testing. Project-specific laboratory testing is recommended to establish cyclic resistance of highly

sensitive clay soils falling within Category 2 (sensitivity greater than 6) or soils which reach peak undrained strength at low strains (less than 5% strain).

Evaluation of Soils With Potential For Cyclic Softening (Category 2)

- All soil layers that fall under Category 2 as described above should be evaluated for the potential for softening under cyclic loading.
- Analysis of the potential for cyclic softening should be evaluated according to [Idriss and Boulanger, 2008]. This is a semi-empirical procedure which relates the soil's resistance to cyclic softening based on data that is obtained during the geotechnical investigation (undrained shear strength and overconsolidation ratio). The analysis should have the design seismic event (defined in Section 1.4.2.2.1) as its basis. Material properties for each layer used as input to the analyses should be established based on the results of the geotechnical investigation and site-specific laboratory testing.
- The result of the liquefaction analyses will be a factor of safety against cyclic softening for each layer within Category 2. The factor of safety is defined as follows:

$$FS_{cs} = \frac{CRR}{CSR}$$

Where CRR = Cyclic Resistance Ratio, corresponding to the design event

CSR = Cyclic Stress Ratio, corresponding to the design event.

- Interpretation of the computed factors of safety is performed as part of the seismic slope stability analyses and seismic deformation analyses, as defined in Sections 1.4.2.2.3 and 1.4.2.2.4 below.
- If appropriate and at the discretion of the Geotechnical Engineer, the cyclic resistance of soils may be determined through the use of project-specific laboratory testing.

Evaluation of Special Soils (Category 3)

- Since the seismic response of Category 3 materials may differ from that of natural or typical soils, the methods for determining the potential for liquefaction or cyclic softening recommended for Category 1 and 2 soils above may or may not be applicable. Analysis of liquefaction or softening potential of Category 3 materials should be at the discretion of the Geotechnical Engineer and should be based on material and site-specific laboratory testing data, and on the design event. The Geotechnical Engineer should provide detailed description, assumptions, and supporting data to substantiate the methods that are selected to analyze Category 3 materials.

1.4.2.2.3 Seismic Slope Stability Analysis

Definition

Deep seated stability analyses evaluate the potential for mass slope instabilities, as defined above in Section 1.4.2.1.

Analyses under seismic conditions evaluate the potential for deep-seated instabilities under the action of the design seismic event and after the end of this event. This analysis also seeks to

estimate the amount of permanent deformation that may occur within the facility due to the seismic action, so that facility components can be appropriately designed.

Minimum Design Standards

Alabama: Regulations and guidance pertaining to seismic stability analyses are as given for the liquefaction analyses, see Section 1.4.2.2.2.

Kentucky: Regulations and guidance pertaining to seismic stability analyses are as given for the liquefaction analyses, see Section 1.4.2.2.2.

Tennessee: Regulations and guidance pertaining to seismic stability analyses are as given for the liquefaction analyses, see Section 1.4.2.2.2.

Selected Design Standard

Seismic slope stability evaluations should, at a minimum, include the following:

1. Determination of critical cross-sections and failure geometries for analysis.
2. An interpretation of the results of the liquefaction analyses (described in Section 1.4.2.2.2).
3. Evaluation of post-earthquake shear strengths.
4. Post-earthquake residual conditions slope stability analyses.

Recommendations and guidelines for each of these components are as follows:

Determination of Critical Cross-Sections and Failure Geometries For Analysis

- The recommendations related to selection of critical cross-sections, failure surface geometries to be considered and slope stability analysis methods given in Section 1.4.2.1 for static stability analyses may also be applied to the seismic stability analyses. At a minimum, cross-sections and failure geometries considered in the seismic stability analyses should include all post-closure configurations and all configurations not classified as interim conditions, as defined for the static stability analyses (Section 1.4.2.1).

Interpretation of Liquefaction Analysis

- Prior to performing slope stability and deformation analyses, the liquefaction analyses presented in Section 1.4.2.2.2 should be performed, to identify those deposits within and underneath the facility that are prone to liquefaction or significant strength loss during the design seismic event. As described previously, the results of the analyses of 1.4.2.2.2 are the factors of safety against liquefaction (FS_{liq})or against cyclic softening (FS_{cs}) for each major soil layer. The potential for liquefaction of each layer should be interpreted based on the computed factors of safety, as follows:

  For soils susceptible to classical liquefaction (Category 1 as defined in Section 1.4.2.2.2):

  $FS_{liq} <= 1.10$ Assume layer liquefies under design event

  $1.1 < FS_{liq} <= 1.4$ Assume partial liquefaction and strength loss in layer

  $FS_{liq} > 1.4$ Assume no liquefaction

For soils susceptible to cyclic softening (Category 2 as defined in Section 1.4.2.2.2):

FS_{cs} <= 1.4 Assume cyclic softening occurs as a result of design event.

FS_{cs} > 1.4 Assume no cyclic softening occurs.

Evaluation of Post-Earthquake Shear Strengths

The shear strength of soils that have liquefied or softened and liner and cap components that have displaced substantially in response to the design earthquake may be substantially smaller than the static shear strength of these materials.

The first estimate of post-earthquake shear strengths should be evaluated as follows. It may be appropriate in some cases to establish post-earthquake shear strengths in a manner other than that presented below. In such a case, the Geotechnical Engineer shall provide thorough written documentation of the procedures and methodology used to establish the post-earthquake shear strengths assigned.

- For soils susceptible to classical liquefaction (Category 1 as defined in Section 1.4.2.2.2), shear strengths should be taken no higher than as follows:

  If FS_{liq}<=1.10 Assume layer is liquefied following the design event and assign post-liquefaction residual strength to the layer.

  If 1.1<FS_{liq}<=1.4 Determine the strength for the layer by interpolation based on the computed safety factor against liquefaction. Interpolate between the post-liquefaction residual strength at FS = 1.10, and the full peak strength of the material at FS = 1.40.

  If FS_{liq}> 1.4 Assign the full static drained strength of the layer for soils classified as sands or gravels (G- or S- classes); Assign the full static undrained strength for soils classified as silts or clays (M- and C- classes).

  The post-liquefaction residual strengths may be determined using published empirical methods, such as given in Seed, et. al, (2003) and Idriss and Boulanger, (2008) or using project-specific laboratory testing performed under the supervision of the Geotechnical Engineer.

- For soils susceptible to softening under cyclic loads (Category 2 as defined in Section 1.4.2.2.2), shear strengths should be taken as follows:

  FS_{cs} <= 1.4 Assign shear strength equal to 80% of the peak undrained shear strength under static conditions.

  FS_{cs} > 1.4 Assign shear strength equal to 100% of the peak undrained shear strength under static conditions.

  Special Cases For highly sensitive clay soils falling within Category 2 (sensitivity of 6 or greater) or soils which reach peak undrained strength at low strains, FS_{cs} may be interpreted as given above, but it is recommended that the post-

earthquake shear strength be established using project-specific laboratory testing.

- For special soils (Category 3), post-earthquake shear strengths should be established by material and site-specific laboratory testing, and at the discretion of the Geotechnical Engineer.
- For liner interfaces containing geosynthetics, assign residual shear strengths. Residual strength properties used in the analyses should correspond to the weakest interface within the liner system. If the specific materials that are to comprise the liner system are known at the time of the stability modeling, the strengths assigned should be based on the results of laboratory direct shear testing on the materials and interfaces to be used in the design. If the specific materials that are to comprise the liner system are unknown at the time of the analysis, the analysis should be used to establish an envelope of friction angle and adhesion combinations, which together satisfy the design criteria minimum safety factors (see below) for all design cases. This envelope should be made part of a performance specification for the liner materials, in conjunction with similar requirements determined from the static deep-seated stability analyses (Section 1.4.2.1) and the shallow translational stability analyses (Section 1.4.4).

Post-Earthquake Residual Conditions Slope Stability Analysis

- This analysis consists of limit-equilibrium slope stability evaluations under post-earthquake conditions. It analyzes the susceptibility of the facility to slope failures occurring after the end of the design seismic event. The analysis should be performed using the post-earthquake shear strengths established as recommended above. Separate analyses should be performed for each critical cross-section and failure surface geometry. Acceptable limit equilibrium analysis procedures for this analysis are the same as those presented for the static stability analyses (Section 1.4.2.1).

  If the factor of safety at any cross-section under this analysis is less than 1.0, the facility is prone to large scale failure after the end of the seismic event, and redesign of the facility is warranted.

1.4.2.2.4 Seismic Deformation Analyses

Definition

Seismic deformation analyses are used to estimate the amount of permanent deformations (horizontal and vertical) that may occur within the facility in response to the design seismic event, as defined above in Section 1.4.2.2.1. The results of this analysis are used to evaluate the potential for damage of facility components due to seismically induced deformations.

Minimum Design Standards

Alabama: Regulations and guidance pertaining to seismic stability analyses are as given for the liquefaction analyses, see Section 1.4.2.2.2.

Kentucky: Regulations and guidance pertaining to seismic stability analyses are as given for the liquefaction analyses, see Section 1.4.2.2.2.

Tennessee: Regulations and guidance pertaining to seismic stability analyses are as given for the liquefaction analyses, see Section 1.4.2.2.2.

Selected Design Standard

At a minimum, seismic deformation analyses shall include the following:

1. Newmark-type Sliding Block Analysis to determine accumulated displacements that occur during earthquake shaking.
2. For sites at which liquefaction is predicted in Category 1 soils (as defined in Section 1.4.2.2.2) and that also include incised by stream channels or other open face channels, or that are sites constructed on sloping ground, an evaluation of lateral spreading-type displacements should be performed.
3. An analysis of vertical deformations (settlements) induced by earthquake shaking.

Displacements Occurring During Earthquake (Newmark-Type Sliding Block Analyses)

Displacements accumulating during earthquake shaking should be performed using Newmark-type Sliding Block Analyses that explicitly accounts for propagation and amplification of the acceleration at the ground surface at the base of the facility (PGA_{design}), through the CCP mass above. The analysis should include the following:

- A separate Newmark Sliding Block analysis should be performed for each individual critical cross-section and failure geometry considered in the Post-Earthquake Residual Conditions Slope Stability Analysis (see Section 1.4.2.2.3 above).
- The analysis should be implemented such that an estimated magnitude of displacement within the CCP mass, along liner and cap systems, and at the location of any major facility components (underdrainage, leachate collection piping, etc) are obtained.
- Newmark Sliding Block analyses of each cross-section and failure geometry should begin by performing a pseudostatic limit equilibrium slope stability analysis, to establish the yield acceleration, k_y – defined as the magnitude of the pseudostatic seismic coefficient required to obtain a factor of safety of 1.0. Limit equilibrium analyses should be performed using the same methods and assumptions on shear strength as were used for the Post-Earthquake Residual Conditions Slope Stability Analyses (see Section 1.4.2.2.3).
- Using k_y determined as above, and using the geometric and stratigraphic configuration of the cross-section, perform a Newmark-type analysis to obtain seismically induced displacements.

  For Sites classified as Seismic Site Class A and B, or for sites classified as Site Classes C through E that have maximum horizontal acceleration (MHA) < 0.20g (as determined in Section 1.4.2.2.1), the sliding block analysis may be implemented using a simplified procedure such as given in Makdisi and Seed (1978) or Bray, (2007).

  Per the requirements of Section 1.4.2.2.1, a site response analysis will have been performed for sites classified as Site Class F, or for sites classified as C through E that have MHA>0.20g. The site response analysis would include development of site-specific earthquake time histories. For such sites, the Newmark-type sliding block calculations should be performed based on these time histories.

- More rigorous methods such as finite element or finite difference methods may be utilized to estimate accumulated displacements during earthquake shaking, if warranted and at the discretion of the Geotechnical Engineer.

Deformations Occurring Due to Liquefaction-Induced Lateral Spreads

If the results of the liquefaction analysis of Section 1.4.2.2.2 indicate a factor of safety against classical liquefaction (FS_{liq}) less than 1.10 for any Category 1 soil layers, an evaluation of liquefaction-induced lateral spread displacements should be performed. Lateral spread displacements should be evaluated for each pertinent critical cross-section.

Lateral spread displacements may be computed using semi-empirical procedures, such as given in Bartlett and Youd (1995), and updated in Youd, et. al (2002), or by finite element or finite difference methods, at the discretion of the Geotechnical Engineer.

Earthquake-Induced Vertical Deformations (Settlement)

The buildup and subsequent dissipation of pore pressures induced by earthquake shaking may result in volumetric strains and corresponding settlements of unsaturated and saturated sand soils. The potential and magnitude for such settlements should be evaluated as part of the seismic deformation analyses. Earthquake-induced settlement analyses should be based on published and widely accepted empirical procedures, such as Tokimatsu and Seed, (1987).

Evaluation of earthquake-induced settlements should be performed for each individual critical section considered in the seismic deformation analyses. Additional analyses should also be performed to estimate settlements underneath subdrainage infrastructure, such as leachate collection piping and other facility components that may be sensitive to settlement. .

Deformation Performance Criteria

- *Displacement Criteria:* If applicable, displacement estimates from the Newmark-type Sliding Block analysis should be added to the estimates of lateral spread displacements. The resulting total displacement should then be compared to the following allowable displacements given in Table 1.4.2-1 from Kavazanjian (1999):

Table 1.4.2-1
Allowable Displacement

Component	Allowable Calculated Displacement	Comment
Liner System	150 to 300 mm	Actual expected deformation is very small.
Cover System	300 mm to 1 m	Damage is repairable.
Waste Mass	1 m	For displacement not impacting cover or liner.
Roadways, Embankments	1 m	Conventional geotechnical criteria.
Surface Water Controls	1 m	Conventional geotechnical criteria.
Gas Collection System	No Limit	Breakage common under normal operating conditions.

If the predicted displacements exceed the allowable values, redesign of the facility is warranted.

The values given in Table 1.4.2-1 correspond to allowable displacements within the CCP mass and for materials and systems typically included in the design of landfill systems. For sites that include other structures or systems not covered by the above table, the Geotechnical Engineer should select appropriate displacement tolerances for these structures or systems.

- *Settlement Criteria:* Differential settlements under the liner and leachate collection systems will tend to reduce the constructed slope of these systems, and can affect their capacity to drain and manage leachate. The facility should be designed such that the minimum post-settlement slopes of the liner between leachate collection pipes is 2% and that the minimum post-settlement slope of leachate collection piping is 0.5 to 1 %. Differential settlements of piping should be limited to allowable values as established by the pipe manufacturer.

  Differential settlement of the liner system may induce strains in the geosynthetic components. The results of the settlement analysis should be used to estimate the maximum strain in the liner geosynthetic components. The facility should be designed to limit the strain to 5%. The strain across two points on the liner system that settle differentially with respect to each other may be computed using the following equation:

  $$E_T(\%) = \frac{L_f - L_0}{L_0} * 100$$ where,

  E_T = Tensile strain

  L_f = Original distance separating two location points

  L_0 = Final distance separating the same two points after settlement is complete

1.4.3 Settlement Analysis and Liner Strain Evaluation

Definition

Settlement analyses predict total and differential subsurface deformations underneath critical elements of the facility, such as the liner system, leachate collection system, and cap system. Settlements are induced by the loads imposed by the facility, the self weight of facility components and the CCP materials, acting on the foundation soils below the facility. Settlement analyses are used to evaluate the effects of the subsurface deformations on the integrity and operation of the facility components and to design appropriate strategies to mitigate these effects in order to maintain serviceability and stability of the facility.

Minimum Design Standards

Alabama: There are no minimum design standards for settlement analyses for CCP facilities in Alabama. For municipal solid waste facilities, settlement concerns are generally addressed in 335-13-4-.01 (1) (5) (i), which requires that the design of the facility address on-site or local soil conditions that may result in significant differential settling.

Kentucky: There are no minimum design standards for settlement analysis for special waste facilities in Kentucky. There are also no specific standards for settlement analyses for contained waste facilities. However, 401 KAR 48:070 Section 4 (1) for contained facilities generally addresses settlement concerns by requiring that the facility design address on-site or local soil conditions that may result in significant differential settling.

Tennessee: For Class II facilities, 1200-1-7-.04(2)(w)(1) generally addresses settlement concerns by requiring that the facility design demonstrate that measures have been incorporated to ensure the integrity of the facility under the effects of on-site or local soil conditions that may result in significant differential settling. This demonstration is to be made in the design narrative for the facility which is submitted as part of the facility permit application. For Class II facilities, 1200-1-7-.04(4)(a)(1)(iii) states that the liner system be "Placed upon a foundation or base capable of providing support to the liner and resistance to pressure gradients above and below the liner to prevent failure of the liner due to settlement, compression, or uplift". 1200-1-7-.04(4)(a)(4)(iv) makes an equivalent statement for the cap system.

Federal: There are no federal minimum design standards for settlement analyses for CCP facilities.

Selected Design Standard

Settlement analyses shall be performed as part of the facility design and shall be documented for inclusion with the design narrative for the facility. The settlement analyses should include the following components:

- The geotechnical investigation should include laboratory testing that establishes the compressibility characteristics of all critical subsurface layers that are expected to undergo settlements under the facility. At a minimum, the laboratory testing plan should include one-dimensional consolidation tests per ASTM D 2435. A minimum of two tests per critical layer should be specified, to establish a range of values for the compressibility parameters in each layer.
- Settlement analyses should be focused on critical cross-sections of the facility, such as those sections featuring the highest fill, largest variations in the heights of fill, and underneath subdrainage infrastructure, such as leachate collection piping. The settlement analyses should generally be based on the maximum proposed grades for the facility.
- Settlement Analysis Methods: Settlement analyses for normally or over-consolidated fine-grained soils may be based on classical methods as presented in McCarthy, (1998). Settlement analyses for coarse-grained materials may be performed using the Hough Method, see FHWA, (2002). In lieu of, or complementary to, the classical analyses presented above, more rigorous analyses of settlement, such as by finite element or finite difference techniques, may also be performed, if warranted. Constitutive models and corresponding input parameters should be selected based on the characteristics of the materials being analyzed for settlement, and should be based on appropriate laboratory testing.

  Settlement analyses should also include an evaluation of secondary compression and creep of critical layers, as determined appropriate by the Geotechnical Engineer.

- Because typical facilities will feature large area fills, the load of the facility will generally be transmitted to significant depths below the landfill base. The settlement analysis should account for compression of all soil layers within the subsurface profile to the top of competent bedrock. Settlement of competent bedrock materials can generally be neglected, unless determined otherwise by the Geotechnical Engineer.
- *Seismically Induced Settlements:* Settlement occurs when liquefaction and attendant pore pressure dissipation causes densification of the liquefied layer. The magnitude of settlement (volumetric strain) can be estimated from charts developed in Tokimatsu and Seed (1987) based on the average cyclic shear stress ratio induced by the earthquake and the density of the soil in question. Settlement may result in damage to the liner and/or internal drainage systems. The effects of seismically induced settlements should be considered in the design, at the discretion of the Geotechnical Engineer.
- *Areas of Karstic Terrain and Former Mining Activity:* Where a facility is to be constructed on karstic terrain or former mined areas, appropriate field investigations should be made to identify any underground voids that may exist (geophysical surveys, etc). Near-surface voids or open sinkholes, should be appropriately treated and filled to prevent subsidence underneath the constructed facility. If deep voids are present, further study of the overlying materials should be performed to evaluate the potential for subsidence and its effects on the facility.
- Results of the settlement analyses should be used to estimate differential settlements underneath the liner system collection piping and other components prone to settlement-related distress. The facility should be designed to limit total and differential settlements under these components to allowable values as established by the manufacturer.
- Settlements under the facility will occur after construction of the base liner and leachate collection systems, and during/after filling operations. Differential settlements under the liner and leachate collection systems will tend to reduce the constructed slope of these systems, and can affect their capacity to drain and manage leachate. The facility should be designed such that the minimum post-settlement slopes of the liner between leachate collection pipes is 2% and that the minimum post-settlement slope of leachate collection piping is 0.5 to 1 %. Differential settlements of piping should be limited to allowable values as established by the pipe manufacturer.
- Differential settlement of the liner system may induce strains in the geosynthetic components. The results of the settlement analysis should be used to estimate the maximum strain in the liner geosynthetic components. The facility should be designed to limit the strain to 5%. The strain across two points on the liner system that settle differentially with respect to each other may be computed using the following equation:

  $$E_T(\%) = \frac{L_f - L_0}{L_0} * 100$$ where,

  E_T = Tensile strain

  L_f = Original distance separating two location points

  L_0 = Final distance separating the same two points after settlement is complete

1.4.4 Shallow Translational Failure Analysis

Definition

Shallow translational failures are failures involving sloped interfaces within the cap or liner systems constructed near the surface of a proposed facility. Generally, failures involving interfaces that are within 10 ft of the surface of a permanent or interim slope may be considered shallow translational failures. Critical interfaces for shallow translational failures typically include interfaces involving geosynthetic to soil contact or geosynthetic to geosynthetic contact. Forces driving shallow translational failures include the gravity load (weight) of the cap or liner system (i.e., the component of the weight aligned parallel to the interface slope), seismic forces, and hydrostatic forces due to subsurface water collecting within the interfaces. Forces resisting shallow translational failures include friction and adhesion between the materials at the critical interfaces, and passive earth forces at the base of a run of the cap or liner system. Shallow translational stability analyses quantify the driving and resisting forces along each critical interface, and establish the factor of safety against failure, defined as the ratio of the resisting forces to the driving forces.

Minimum Design Standards

Alabama: There are no specific minimum design standards for shallow translational stability analyses for CCP or MSW facilities. Regulations which are indirectly related to shallow translational stability include: 335-13-4-.20(2)(c)(2), which requires that final slopes for MSW landfill covers not exceed 25%.

Kentucky: There are no specific minimum design standards for shallow translational stability analyses for special waste facilities. For contained waste facilities, general requirements for structural stability of cap and liner systems are given in 401 KAR 48:080 Section 10, which states the following: "The design engineer shall analyze the structural integrity of the site, the subbase, each component of the composite liner, each component of the final cover, the composite liner system and the final cap as a system. Modifications to the design shall be provided where necessary, to achieve a minimum factor of safety of two (2) for the subbase, one and one-fourth (1.25) for the structural design of the facility liner components, and one and one-half (1.5) for the final cover system. Synthetic liner material and structural synthetic materials shall be designed for a maximum elongation of ten (10) percent."

The requirement does not present any specific analysis methodologies or assumptions to be used in evaluating the factors of safety.

Tennessee: There are no specific minimum design standards for shallow translational stability analyses for Class I or II landfills. Regulations which are indirectly related to shallow translational stability include: 1200-1-7-.04(4)(a)(1) which requires that slopes for landfill liners not exceed 25%.

Tennessee provides guidance for seismic stability design of landfill covers in a document published by the Division of Solid Waste Management and entitled "Earthquake Evaluation Guidance Document". This guidance presents a procedure for evaluating seismic displacements of landfill caps, based on that given in [Makidisi and Seed, 1978].

Federal: There are no specific federal minimum design standards for shallow translational stability analyses for CCP facilities.

Selected Design Standard

Final design of cap and liner materials shall conform to state standards on maximum slopes. Shallow translational stability analyses shall be performed for each critical interface within the final cap system, and should be considered for interim configurations of the liner system (i.e., prior to CCP placement or during the early stages of CCP placement) where liner slopes exceed 10%. The analyses should be performed for the most steeply sloped sections of the proposed cap or liner.

If the specific materials to be used for the cap and liner system components are known during the design phase, a program of direct shear testing should be implemented on all critical interfaces of the design. The resulting shear strength parameters should be used as input within the shallow translational stability analyses.

If the specific materials to be used in construction of the liner and cap system are not known during the design phase, the shallow translational stability analyses should be utilized to develop an envelope of friction angle and adhesion combinations, which together satisfy the minimum factors of safety presented below, for all design cases. This envelope should be made part of a performance specification for the liner and cap materials.

As a minimum design standard, the following conditions should be considered in the shallow translational stability analyses:

1) Static, Drained Conditions: This condition consists of the typical, service conditions to be experienced at the facility. This analysis does not account for the effects of seepage or groundwater, nor those of seismic events.
2) Static, Saturated Conditions: This condition adds the effects of seepage forces on the critical interfaces to the assumptions for the static drained conditions described above. Seepage forces may build within the cap system if the drainage layer becomes clogged or its capacity is exceeded during a high intensity storm event.
3) Seismic Conditions: This condition should consist of the basic conditions assumed for the static, drained analysis, with the addition of a seismic factor corresponding to the design seismic event, as described in Section 1.4.2.2.1. The seismic factor used as input into the analysis should correspond to the ground acceleration at the level of the system being analyzed (cap or liner), after accounting for amplification of ground motions through the materials underlying the system.
4) Static, Residual Strength Conditions: This condition analyzes the susceptibility of the facility to a large scale shallow translational failure, occurring after an unanticipated, short duration event that produces large displacements within the cap system (such as an earthquake). Though the critical interface may survive the initial event, the displacements that are experienced may exceed the peak

strength of the interface and create a lower strength, residual strength condition afterward. If the residual strength is too low, large scale failure may result after the end of the initial event.

5) Other Conditions: Other project-specific conditions should be considered at the discretion of the Geotechnical Engineer. These may include conditions incorporating surcharges such as construction equipment, temporary slopes or configurations that may exist at some point in the construction or service of the facility, or special conditions such as gas pressures acting on the cap or liner systems.

The analyses should be based on limit equilibrium methodologies, using a slope stability analysis computer program or using suitable closed form solutions such as those presented in the Ohio EPA's "Geotechnical and Stability Analyses for Ohio Waste Containment Facilities" (2004), or in Soong, and Koerner (1996).

In general, peak shear strength parameters may be utilized as input into the shallow translational stability analyses with exception of the following: the static, residual strength condition, and liquefaction at the toe of slope, for which residual strength parameters should be utilized. In addition, the tensile capacity of geosynthetics should be neglected in analyses of shallow translational stability.

The buildup of head at interfaces involving the drainage layer component of cap or liner systems should be limited to the thickness of the drainage layer or less, in order to minimize the effects of hydrostatic uplift forces at this interface for the static, saturated analysis condition. It is recommended that the design be based on procedures given in OEPA (2004).

Recommended minimum factors of safety for each condition are as follows:

1) Static, Drained Conditions: 1.5
2) Static, Saturated Conditions: 1.1
3) Seismic Conditions: >1.0
4) Static, Residual Strength Condition: 1.1
5) Other Conditions: Project-specific and determined by the Geotechnical Engineer.

- These minimum factors of safety assume that strength parameters for the critical interfaces have been established using rigorous, project-specific laboratory testing, and that the analysis is for a typical CCP facility. Uncertainties in strength characteristics of the critical interfaces or in the use or configuration of the facility, or other special project considerations may dictate the use of higher factors of safety in design.
- If the factor of safety under seismic conditions (computed using the limit equilibrium methods described above) is less than 1.0 for the permanent cap system, an analysis of permanent, seismically induced deformations of the cap should be made. As a minimum design standard, a Newmark-type Sliding Block analysis, as described in Section 1.4.2.2.3 should be utilized to estimate deformations. The facility should be designed such that the predicted deformation under the design seismic event is no greater than

listed in Table .1.4.2.1, and/or not in excess of allowable deformations as established by the manufacturer.

1.4.5 Anchor Trench Analysis

Definition

The terminus of geosynthetic components of liner and cap systems consists of a horizontal runout length and vertical embedment into an excavated anchor trench. The dimensions and configuration of this anchor trench is based on the tensile forces applied to the geosynthetic materials during temporary loading conditions in conjunction with the allowable tensile stresses for these materials.

Minimum Design Standards

Alabama: There are no known minimum design standards for the design of anchor trenches in Alabama.

Kentucky: There are no known minimum design standards for the design of anchor trenches for special waste facilities or contained waste facilities in Kentucky.

Tennessee: There are no known minimum design standards for the design of anchor trenches for Class I or Class II facilities in Tennessee.

Federal: There are no minimum federal design standards for the design of anchor trenches for CCP facilities.

Selected Design Standard

Anchorage shall be designed for a worst-case temporary scenario occurring during construction, such as a condition that may exist while earthmoving equipment is placing cover soil over geosynthetic components of the facility. The loading applied to the geosynthetic components should consider the weight of the soil present over these components, as well as the surcharge loads applied by the construction equipment.

Anchor trench design should be in general accordance with the methodology given in Qian, Koerner, and Gray (2002).

The resistance provided by runout length and anchor trench combinations should not be so great as to induce yield or tensile failure of the geosynthetic material prior to pullout. It is recommended that the resistance provided not exceed 2/3 of the geosynthetic material's yield strength (if the material has a definable yield strength) or ½ of the material's tensile strength.

Regardless of the results of analysis, a minimal anchor trench or combination runout section and anchor trench should be specified in the facility design, to provide resistance against unforeseen loadings such as wind. The minimal design should develop a stress in the geoynthetics that is no greater than ½ of the material's tensile strength.

1.5 LEACHATE MANAGEMENT SYSTEM

This section presents engineering design and performance standards associated with the effective management of leachate. The leachate management system includes components for collection and extraction of leachate from the landfill, as well as conveyance, storage, and treatment of the leachate. Design standards are provided in this section to estimate leachate generation, design leachate collection system piping and drainage layers, properly size leachate extraction and conveyance systems, and provide adequate leachate storage facilities.

1.5.1 Leachate Generation Calculations

Definition

Leachate generation calculations are conducted to estimate the volume of leachate that will be produced during various phases of the landfill life. The calculations are used for design of the leachate management system, including leachate collection pipe sizing, pipe spacing, leachate collection layer design, leachate extraction system design (pump sizing or gravity outlets), and leachate storage facility volumes.

Minimum Design Standards

Alabama: There are no minimum design standards for leachate generation calculations for CCP waste facilities. There are also no minimum design standards for leachate generation calculations for municipal solid waste (MSW), industrial waste (IW), and construction and demolition debris (C&DD) landfills.

Kentucky: There are no minimum design standards for leachate generation calculations for special waste facilities. There are also no minimum design standards for leachate generation calculations for contained landfills (i.e., MSW).

Tennessee: The minimum design standard for Class II disposal facilities are specified in TDEC 1200-1-7-.04(7). These standards specify that the leachate generation calculations are to be based on the infiltration volume of the 25-year 24-hour storm through the intermediate cover.

Selected Design Standard

The standard to be used for calculating leachate generation shall be based on the Tennessee regulation (TDEC 1200-1-7-.04(7)). More specifically, the Hydrologic Evaluation of Landfill Performance (HELP) model shall be used to calculate leachate generation. The HELP model was developed by the U.S. Army Engineer Waterways Experiment Station under a cooperative agreement with the U.S. Environmental Protection Agency (EPA) and is recommended by the USEPA, widely accepted in industry, and required by many States for evaluating waste management facilities. The HELP model is a computer program that computes estimates of water balances for land disposal systems. As of the date of this Document, the most recent model version is Version 3.07, which can be downloaded free on the Internet at the following website: http://el.erdc.usace.army.mil/products.cfm?Topic=model&Type=landfill.

At a minimum, the following scenarios should be analyzed by the HELP model to determine leachate generation rates:

- Scenario 1 – Initial Conditions: This scenario should assume one 10-ft lift of CCP material has been placed in the landfill, with 12-inches of intermediate cover soils placed over the CCP material. This scenario provides the peak expected leachate generation rate for the facility, which is typically utilized for sizing leachate extraction and conveyance systems (Section 1.5.4) and leachate storage facilities (Section 1.5.3). In addition, leachate collection pipe spacing and minimum required leachate collection layer permeability should be designed using this HELP model analysis (Section 1.5.2). Site specific design for the minimum liner system grades and maximum leachate flow length to the leachate collection piping should be utilized in the HELP model.

- Scenario 2 - Intermediate Conditions: This scenario assumes half of the permitted CCP height has been placed in the landfill. The CCP material is assumed to be covered with 12-inches of intermediate cover soils. This scenario provides the average leachate generation rates over the active life of the landfill.

- Scenario 3 - Closed Conditions: This scenario assumes the full height of CCP has been placed in the landfill and the final closure cap system has been constructed. This scenario estimates leachate generation rates during the post-closure period and provides cap system infiltration estimates for use in the design of cap system drainage layers.

Each scenario should be simulated by the HELP model for a minimum thirty (30) year time period to verify that all scenarios are modeled for all reasonably expected climactic conditions. Synthetic weather and solar radiation data may be generated using the HELP model for the specific project location. However, the designer must verify that synthetically generated rainfall data provides a peak daily rainfall amount greater than or equal to the 25-year, 24-hour storm event. Current weather data, such as the National Oceanic and Atmospheric Administration (NOAA) shall be referenced to determine the 25-year, 24-hour storm event. If the 25-year, 24-hour storm event is not provided, the designer should manually input this storm event into the HELP model simulation.

As the operation of the first phase of the landfill progresses, actual site-specific leachate generation data may be available based on volumes collected in the leachate management system. If this data is available, the design of the future leachate management system should be evaluated and compared to the HELP model results. Using site specific data as opposed to data obtained from the HELP model will likely require regulatory approval prior to acceptance of any design modifications.

1.5.2 Pipe Sizing and Spacing and Leachate Drainage Layer

Definition

Calculations for establishing the design requirements of the leachate collection drainage layer and the sizing and spacing of leachate collection piping are required to evaluate whether the leachate collection system is adequately designed to maintain leachate depth (head) above the

liner system below the regulatory-required depth. The maximum depth of leachate head above the liner system is limited to 12-inches per federal regulations 40CFR258 Subtitle D. The leachate collection system, which includes the collection piping and drainage layer, is used to collect the leachate produced in the landfill to prevent the buildup of leachate head on the liner, and to drain leachate to a leachate extraction system. Leachate collection piping is typically constructed of a system of perforated PVC or HDPE pipe. The leachate drainage layer can be constructed of natural material (sand or gravel), geosynthetic materials (geonet or geocomposite synthetic drainage layers), or a combination of natural and geosynthetic materials. Geocomposite drainage layers can accommodate significantly larger flow rates compared with natural drainage layers.

Minimum Design Standards

Alabama: There are no minimum design standards for size and spacing of leachate collection piping and the leachate drainage layer calculations for CCP facilities. There are, however, minimum design standards for MSW, IW, and C&DD landfills as specified in ADEM 335-13-4-.18, which states that the leachate collection system shall be designed and constructed to maintain less than 1-foot of leachate head over the liner.

Kentucky: There are no minimum design standards for size and spacing of leachate collection piping or the leachate drainage layer calculations for special waste facilities. There are, however, minimum component requirements for contained landfills (MSW) as specified in 401 KAR 48:080(6)(4a), which states that a 12 inch drainage layer with a minimum permeability of 1×10^{-2} cm/sec or a layer of equivalent performance shall be designed and constructed to maintain less than one foot of leachate head over the liner. A filter fabric is required above the drainage layer. The slope of leachate collection piping shall be no less than 1% along the main leachate collection line, and no greater than 50% at any point. All leachate collection pipes shall be designed and constructed to a minimum slope of 1%, and no greater than 50% at any point. Main leachate collection lines shall have a minimum diameter of eight (8) inches, and lateral leachate collection pipes shall have a minimum diameter of four (4) inches.

Tennessee: The minimum design standards for size and spacing of leachate collection piping and the leachate drainage layer calculations for Class II disposal facilities are specified in TDEC 1200-1-7-.04(7)(i) and (ii). This regulation states that the leachate collection system must be designed, constructed, operated, and maintained such that the leachate depth over the liner does not exceed 1-foot of leachate head over the liner as calculated referencing the infiltration volume of the 25-year 24-hour storm through the intermediate cover. The regulation further states that leachate interception surfaces and associated piping must be designed, constructed, operated, and maintained to function without clogging throughout the scheduled post-closure care period.

Selected Design Standard

In all cases, the leachate collection system shall be designed to maintain less than 1-foot of leachate head over the liner. The decision on which type of leachate drainage layer to use, either natural materials, geosynthetic materials, or a combination of natural and geosynthetic materials is largely based on material availability and their comparative cost and shall be evaluated on a case-by-case basis.

Natural Drainage Layer Design: For natural (sand or gravel) leachate collection layers, the minimum spacing of leachate collection piping and minimum required permeability for the leachate collection drainage layer should be evaluated using the HELP model (Scenario 1 as described in Section 1.5.1). The maximum pipe spacing (leachate flow length along the liner system to the leachate collection piping) and minimum required permeability of the granular drainage layer should be designed such that the peak head on the liner system provided in the HELP model output is less than 12 inches. Site specific design for the minimum liner system grades and maximum leachate flow length to the leachate collection piping should be utilized in the HELP model. All natural drainage layers shall include a non-woven geotextile, or graded granular filter, above the leachate drainage layer.

Geosynthetic Drainage Layer Design: The HELP model does not accurately calculate the head on the liner system when modeling geosynthetic drainage layers. The standard method for designing geosynthetic drainage layers, commonly known as the Giroud equation, is provided in Giroud et al. (2000). The Giroud equation calculates the ultimate transmissivity of drainage layers taking into account reduction factors for intrusion, creep, chemical clogging, and biological clogging. Geosynthetic drainage layers should generally be designed to carry the peak leachate inflow rate from the HELP model (Scenario 1 as described in Section 1.5.1) entirely within the geocomposite drainage layer (leachate head should not exceed the thickness of the geocomposite drainage layer). Site specific design for the minimum liner system grades and maximum leachate flow length to the leachate collection piping should be utilized when evaluating geocomposite drainage layers using the Giroud equation.

Natural and Geosynthetic Drainage Layer Design: If the proposed leachate collection system consists of a geosynthetic drainage layer with an overlying natural drainage material, it is recommended that the Giroud equation be used to verify that the peak leachate inflow rate from the HELP model (Scenario 1 as described in Section 1.5.1) can be carried entirely within the geocomposite drainage layer. If leachate cannot be maintained within the thickness of the specified geocomposite, another, larger geocomposite should be specified or additional calculations should be performed to show that the geocomposite combined with the overlying natural drainage layer is adequate to manage the leachate under the peak conditions while maintaining less than 1-foot of head over the liner system using conservative, but reasonable assumptions. The methodology for designing a leachate collection system consisting of a geosynthetic drainage layer and a natural drainage layer is described in Giroud et al. (2004).

Pipe Sizing: The Mannings equation shall be used to verify the size of leachate collection piping using the minimum leachate collection pipe grades and peak daily leachate generation rate from the HELP model (Scenario 1 as described in Section 1.5.1). The Mannings equation is an empirical equation that applies to uniform flow in open channels and pipes and is a function of the velocity, flow area and slope of these systems. This methodology is supported by Quain, Koerner and Gray (2002), and Chevron Phillips Chemical Company (1985).

Pipe Slope: Unless specific state requirements are more stringent, the facility should be designed such that the leachate collection piping has a minimum grade of at least 0.5%, after including the effects of estimated facility settlements. Where state requirements are more stringent, those requirements should be incorporated into the design.

Additional design considerations for the leachate collection system include the following:

- Designed to function without clogging throughout the scheduled post-closure care period. Clogging shall be considered for both collection pipe perforations as well as clogging (also referred to as "blinding") of the geotextile component of a geosynthetic drainage layer. To minimize clogging of pipe perforations, the size of the perforation needs to be considered when selecting a granular material to surround the collection piping. To minimize clogging of the geotextile component of a geosynthetic drainage layer, the particle size/gradation of the overlying buffer material or CCP must be determined to be compatible with the apparent opening size (AOS) of the geotextile. Design methodology for this is provided in Quain, Koerner and Gray (2002). Alternatively, a graded granular filter (sand, aggregate, etc.) can be used in place of the geotextile to minimize clogging.

- Configure the leachate collection piping system to allow internal inspection, cleaning and maintenance.

1.5.3 Leachate Storage Facility Sizing

Definition

Leachate storage facilities, whether a leachate storage tank, or a leachate storage pond, must be sized to accommodate storage of the anticipated leachate generated at the landfill for an established time period. Sizing of leachate storage facilities is typically conducted using leachate generation calculations to estimate the volume of leachate that will be produced during various phases of the landfill life (as previously discussed in Section 1.5.1). The capacity of the leachate storage facility typically varies from site-to-site, since it is dependent on the type of treatment facilities that are available and the maximum allowable discharge rate to the treatment facility. This is further discussed in the Leachate Loadout, Treatment and Disposal section (Section 1.5.7) of this Document.

Minimum Design Standards

Alabama: There are no minimum design standards for leachate storage facility sizing for CCP facilities. There are also no minimum design standards for leachate storage facility sizing for MSW, IW, and C&DD landfills.

Kentucky: There are no minimum design standards for leachate storage facility sizing for special waste facilities. There are, however, minimum design standards for contained landfills (MSW) as specified in 401 KAR 48:080(6)(4f), which states the leachate collection tanks shall be a minimum of 1,000 gallons and that additional capacity shall be provided to store leachate for a minimum of 15 days production at peak production rates during operation and closure.

Tennessee: The minimum design standard for leachate storage facility sizing for Class II disposal facilities are specified in TDEC 1200-1-7-.04(7)(iii). This regulation states that leachate collection reservoirs must have sufficient capacity to store the volume of leachate expected to be generated in 30 days, or other adequate provisions approved by the Commissioner.

Selected Design Standard

As previously stated, the capacity of the holding tank will depend on the type of treatment facilities that are available and the maximum allowable discharge rate to the treatment facility. If leachate is to be recirculated onto the landfill, a smaller storage volume may be adequate since storage will be retained within the CCP material. For the purposes of this Document, leachate recirculation refers to the reintroduction of collected leachate into the CCP mass (within the lined areas of the landfill) for purposes of dust control and to aid in material compaction. To a limited extent in CCP landfills, leachate recirculation also allows for temporary storage of leachate within the landfill, thereby delaying overall leachate generation rate into the leachate collection system at the bottom of the landfill. If leachate will be hauled by tanker truck from the storage facility, sufficient volume should be provided to allow for tanker truck down-time, long weekends or allowable discharge rates at the treatment plant. If leachate is to be treated on-site prior to disposal, the volume of the storage facility will be dependent on the flow limitations of the treatment system. If leachate will be conveyed to a connection to a sanitary sewer line, the storage facility size will be governed by the allowable discharge rate to the treatment plant. Note that discharge to a local sewer would need to be coordinated with the appropriate agencies for their specific requirements. Pretreatment and flow control may be necessary prior to its discharge.

Regardless of the multiple scenarios that are typically site-specific, the design standard shall include first calculating leachate generation rates using the HELP model as discussed previously in the Leachate Generation Calculations section (Section 1.5.1). Based on the leachate generation rates, the minimum storage volume for the leachate storage facility shall be one (1) to three (3) days of leachate production during the peak daily leachate production period as specified by the design engineer and recommended in the following reference: "Integrated Solid Waste Management, Engineering Principles and Management Issues", G. Tchobanolglous, H. Theisen, S. Vigil, 1993, pp. 439-440. As stated previously, site specific means of leachate treatment and disposal shall be considered when determining the leachate storage requirements of a facility. If leachate for the facility is being hauled by truck for disposal, three days of peak leachate production is recommended to allow for leachate build-up during such events as long weekends, temporary reductions in hauling capacity due to mechanic problems, weather, etc., and to allow for adequate storage in the event that a significant rainfall event comes while the leachate tanks or ponds have not been fully emptied.

If the facility drains to a gravity sewer or gravity drains to the plant's treatment system, then reduced storage requirements (one day of peak leachate production) may be reasonable for the site.

Additional considerations for the leachate storage facility include the following:

- If the leachate storage facility is a pond, it shall be constructed with a bottom composite (compacted clay and geosynthetic membrane) liner system and groundwater monitoring wells to enable monitoring of any potential leaks through the liner system.
- If the leachate storage facility is a storage tank, whether above ground or below ground, the tank shall be constructed of materials compatible (nonreactive) with the chemicals in the leachate. Storage tanks are typically constructed of specialized plastics, fiberglass, or metal

with specially treated internal coatings or glass lining. Leachate storage tanks can be single- or double-walled, however double-walled tanks are preferred because of the added safety.

- The leachate storage facility should have a reliable and convenient means of detecting the volume of collected leachate in the facility and of sampling such leachate.
- It is standard industry practice and therefore a design standard requirement of this document that a secondary containment system be constructed around the leachate storage facility in the event of leakage or catastrophic failure of the system. In accordance with the federal secondary containment requirements for oil storage (40 CFR 112.8(c)(2) - Spill Prevention, Control, and Countermeasure Plan Requirements), the secondary containment system shall be constructed to provide containment for the entire capacity of the largest single container and sufficient freeboard to contain precipitation. For leachate storage tanks, the typical industry standard volume provided by the secondary containment system is 110% of the total volume contained in the largest storage tank within the leachate storage facility. It is therefore required that the volume of the secondary containment system be designed to provide the larger of either the entire capacity of the largest single container and sufficient freeboard to contain precipitation or 110% of the total volume contained in the largest storage tank within the leachate storage facility.
- The leachate storage facility shall include an early warning high-level alarm (audible and visual) and automatic shut-down of the supply forcemain or pumps to prevent leachate overflows.

1.5.4 Leachate Extraction System Sizing

Definition

The leachate extraction system includes the means to withdraw or convey leachate collected within the limits of the landfill/CCP boundary to the external leachate conveyance system, which ultimately conveys the leachate to the storage system typically located outside the limits of the landfill/CCP boundary. Leachate extraction systems, in general, consist of either gravity flow extraction systems or pumped extraction systems. In either system, the leachate is collected via the leachate collection system (collection piping and drainage layer) and conveyed to the leachate collection sump(s), which are located in low points within the landfill cell liner system. Gravity extraction systems convey the leachate by gravity from the leachate collection sump, through the liner system of the sideslope berm or bottom sump of the landfill, to the external leachate conveyance system and storage system. Pumped extraction systems similarly collect the leachate in a collection sump. However, pumped extraction systems use a pumping system (typically a side-slope riser pumping system) to lift the leachate from the collection sump into the external leachate conveyance system and storage system. Appropriate sizing of the leachate extraction system is important to avoid leachate backups in the landfill cell and to maintain less than one foot of leachate head over the liner system.

Minimum Design Standards

Alabama: There are no minimum design standards for leachate extraction system sizing for CCP facilities. There are also no minimum design standards for leachate extraction system sizing for MSW, IW, and C&DD landfills.

Kentucky: There are no minimum design standards for leachate extraction system sizing for special waste facilities. There are also no minimum design standards for leachate extraction system sizing for contained landfills (MSW).

Tennessee: There are no minimum design standards for leachate extraction system sizing for Class II disposal facilities. There are also no minimum design standards for leachate extraction system sizing for Class I disposal facilities (i.e., MSW).

Selected Design Standard

The leachate extraction system shall be sized based on the peak daily leachate generation rates calculated using the HELP Model (Scenario 1 as described in Section 1.5.1). The peak leachate generation rate shall be calculated based on the landfill area draining to each leachate collection sump. Based on the leachate generation rates anticipated in each collection sump, the extraction system sizing shall be calculated.

For a gravity flow extraction system, the size of the leachate extraction pipe shall be determined using the daily maximum rate of leachate generation to the collection sump from the HELP model in conjunction with the Manning's equation. As a separate note, for gravity flow extraction systems where the pipe penetrates the liner system of the sideslope berm or bottom sump of the landfill, great care must be taken to ensure that the seal where the pipe penetrates the landfill liner is sound.

For a pumped extraction system, the leachate extraction pumps shall be sized to ensure removal of leachate at the daily maximum rate of leachate generation from the collection sump according to the HELP model. The pumps shall have sufficient operating head to lift the leachate from the base of the leachate collection sump to the access port. Typically, submersible pumps are utilized in pumped extraction systems. The pump "off" level switches shall be set at an appropriate elevation to maintain a sufficient leachate level covering the submersible pump to prevent the pump from burning out. The pump "on" switch shall be set at an appropriate elevation to activate the lead pump to allow for efficient pumping cycles (typically 10 to 12 minutes between cycles). The pump cycle is dependent on the flow capacity of the pump, the peak leachate flow rate into the sump, and the leachate storage volume of the depressed sump area where the pumps are located. This methodology is supported Quain, Koerner and Gray (2002).

It is recommended that a two pump system, operating in a lead-lag configuration be utilized for each side slope riser pumping system. A two pump system provides the ability for intermittent pumping during varied low and medium flow conditions, while also providing for a back-up during pump maintenance and dividing the wear between the two pumps. In addition, in situations where high rates of leachate are being produced, both pumps can operate simultaneously to extract leachate. It is further recommended that a pumped extraction system

be provided with a visual alarm system at the pump panel to alert operators when the pumping system is not operational or leachate levels are higher than the pump set points. It is recommended that an auto dialer function be utilized to alert operations personnel, a site supervisor at the landfill, or appropriate personnel in a control room at the power plant. The pumps should also be controlled automatically by an automatic shut-off relay from the leachate storage facility prior to the storage facility experiencing overflow levels.

1.5.5 Pipe Strength Calculations

Definition

Leachate collection piping internal to the landfill cells and conveyance piping external to the landfill cells are subject to both dynamic and static loadings capable of damaging (crushing) the piping systems. Significant static and/or dynamic loading may also cause pipe deflection resulting in changes in the underlying pipe slope, as well as its alignment and elevation, and therefore affect the function of the piping system. Static loadings on the piping system are produced from deposited CCP material and/or soil overburden above the piping system. Dynamic loadings on the piping system are produced from equipment or vehicles traversing the area above the piping system. Pipe strength and deflection calculations should verify that the pipe material type, burial depth, and bedding material are adequate to prevent pipe crushing and/or significant deflection.

Minimum Design Standards

Alabama: There are no minimum design standards to withstand for pipe strength to withstand crushing and deflection for CCP facilities. There are also no minimum design standards for pipe strength to withstand crushing and deflection for MSW, IW, and C&DD landfills.

Kentucky: There are no minimum design standards for pipe strength to withstand crushing and deflection for special waste facilities. There are, however, minimum design requirements for contained landfills (MSW) as specified in 401 KAR 48:080(6)(4a), which states that piping shall be designed to withstand static and dynamic loads that may be encountered.

Tennessee: The minimum design standard for pipe strength to withstand crushing and deflection for Class II disposal facilities are specified in TDEC 1200-1-7-.04(5)(i)(II). This regulation states that the leachate collection and removal system be constructed of materials that are of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying CCPs, cover materials and by any equipment used at the facility.

Selected Design Standard

Pipe strength and deflection calculations shall be conducted for both static and dynamic conditions. Pipe strength calculations shall include resistance to pipe deflection and critical buckling pressure.

It is recommended that pipe deflection for the static case be calculated using the Modified Iowa Formula. It is further recommended that the static pipe strength analysis be conducted based on the external soil/CCP pressure and that the piping system's critical buckling pressure is taken

into account. Deflection less than five percent (5%) is considered acceptable, as recommended by the Plastic Pipe Institute. Consideration must be given to perforated versus solid wall piping. A factor of safety greater than 2.0 shall be acceptable for pipe strength. The calculation methodology for both static pipe deflection and static pipe strength is supported by Quain, Koerner and Gray (2002).

It is recommended that pipe deflection and pipe strength for the dynamic case be calculated using the Boussinesq Point Load Equation and that the PLEXCALC II computer program be used (developed by Performance Pipe, a division of Chevron Phillips Chemical Company LP). The PLEXCALC II program is utilized to calculate factors of safety against wall crushing, wall buckling, and short-term and long-term deflection. This methodology is presented in the Performance Pipe Engineering Manual, Book 2, Chevron Phillips Chemical Company LP (2003). Consideration must be given to perforated versus solid wall piping. Deflection less than five percent (5%) is considered acceptable, as recommended by the Plastic Pipe Institute. A factor of safety greater than 2.0 shall be acceptable for pipe strength.

In addition to the requirements stated above, the soil frost depth shall be considered such that the top of the piping is at least as deep as the local frost depth. Frost depths can be found by consulting the local (typically County) building codes.

1.5.6 Leachate Conveyance

Definition

Leachate conveyance piping, also sometimes referred to as transmission piping, includes piping that transfers the leachate collected within the limits of the landfill/CCP boundary from the leachate extraction system to the leachate storage system located outside the limits of the landfill/CCP boundary. Leachate conveyance piping can function as a gravity flow pipe or as a force main (under pressure). Leachate conveyance piping is typically constructed of PVC or HDPE materials. This section will discuss the design standards to be used for these conveyance piping systems.

Minimum Design Standards

Alabama: There are no minimum design standards for leachate conveyance piping for CCP facilities. There are also no minimum design standards for leachate conveyance piping for MSW, IW, and C&DD landfills.

Kentucky: There are no minimum design standards for leachate conveyance piping for special waste facilities. There are also no minimum design standards for leachate conveyance piping for contained landfills (MSW).

Tennessee: There are no minimum design standards for leachate conveyance piping for Class II disposal facilities, other than requiring that the system be chemically resistant to the leachate expected to be generated, per TDEC 1200-1-7-.04(5)(i)(I). There are no further design standards for leachate conveyance piping for Class I disposal facilities (MSW).

Selected Design Standard

The decision whether the leachate conveyance piping will be a gravity flow system or a force main is largely dictated by the topography of the site perimeter, the location of the leachate storage or treatment system, as well as owner preference.

The design standard for gravity flow leachate conveyance piping is that it shall be sized to carry the anticipated peak daily flows from upgradient landfill cells based on the leachate generation calculations (HELP model Scenario 1, as described in Section 1.5.1). The size of gravity piping can be designed using the Manning's equation. It is recommended that manholes be included at approximately 500-foot intervals or other intervals as specified by local code, as well as in locations where significant changes in direction, both horizontal and vertical, to enable the gravity line segments to be isolated for repair and maintenance. If necessary, gravity flow leachate conveyance piping shall be equipped with air release valves and vacuum break valves or a combination air release/vacuum break valve in the appropriate locations to avoid air blockage and/or to provide a vacuum break. These typically will not be necessary if the conveyance piping is operating at a continuous downward slope with manholes, as referenced above, such that the manholes will also act to release air and provide a vacuum break. In addition, for gravity flow systems, consideration must be given to provide a means to stop the flow of leachate through the conveyance piping to the leachate storage facility in the event that the leachate storage facility is full or needs to be shut down for maintenance or other reasons. Flow is typically regulated through the use of manual or automatic valves located near the limits of the landfill/CCP boundary, where the conveyance piping connects to the leachate extraction system.

The design standard for a leachate conveyance force main shall be based on calculations conducted whereby the total system head loss is balanced with the operating range(s) of the pump(s). This methodology, which is outlined below, is supported by US Army Corps of Engineers Guidance Manual TM 5-814-2 (1985). The following methodology shall be used:

- Based on the leachate generation calculations (Section 1.5.1) and leachate extraction system sizing calculations conducted (Section 1.5.4), the anticipated leachate flow shall be established.
- An iterative approach using the Hazen-Williams formula with a variety of internal pipe diameters (4-inch, 6-inch, 8-inch, etc.) should be used to calculate the friction losses for each scenario. The Hazen-Williams formula utilizes roughness coefficients (C-values) which correspond to the force main piping material to be utilized. Alternately, head losses due to friction can be calculated using the Darcy formula. Friction factors used in the Darcy formula can be determined using the Moody friction factor curves.
- Minor losses through bends, fittings, and valves should be accounted for in the overall friction loss. This can be done using the equivalent length method or by calculating the head loss coefficient (K) for each bend or fitting. Typical values for each method are tabulated in the Cameron Hydraulics handbook for various pipe materials and pipe diameters. For the equivalent length method, the tabulated equivalent length for each fitting is added to the actual pipe length and substituted back into the Hazen-Williams or Darcy equations to calculate the overall friction loss. When using the head loss coefficient method, the K value is multiplied by the velocity head yielding the head loss

through that fitting in feet. Those losses are then added to the friction loss through the pipe.

- The velocity of the leachate through the leachate conveyance force main is affected by the friction factor and pipe diameter; therefore these variables must be balanced during the design of the leachate conveyance force main. Flow rate velocity shall be maintained at a minimum of two (2) feet/second to avoid settling of particulates and a maximum of ten (10) feet/second to avoid pipe scouring, as referenced in USACE TM 5-814-2 (1985).
- Static head, the difference in elevation between the pump suction level and the highest proposed point in the leachate conveyance force main, should be calculated. The total dynamic head (TDH), the summation of the friction loss and the static head, should be calculated. The Hazen-Williams calculation provides results for different friction head losses at varying flow rates, while the static head loss is independent of the flow rate.
- Using the design flow rate and the total dynamic head, a pump size should be selected based on manufacturer-specified pump curves. This process is an iterative approach to select the leachate conveyance force main size to balance overall friction loss through the pipe while maintaining operations within design range.
- If multiple pumps are included in the design, as is typical with a multi-cell landfill configuration, each different pumping scenario shall be considered in sizing the pumps and the leachate conveyance force main.
- The velocity of the leachate through the leachate conveyance force main is affected by the friction factor and pipe diameter; therefore these variables must be balanced during the design of the leachate conveyance force main.
- It is recommended that cleanouts be included in the leachate conveyance force main in areas of significant low spots in elevation along the force main profile. Shut-off valves (gate valves or plug valves) should be included at approximately 1000-foot intervals, or other interval as specified by local code, to enable leachate conveyance force main segments to be isolated for repair and maintenance.
- Leachate conveyance force mains should be equipped with air release valves and vacuum break valves or a combination air release/vacuum break valves in the appropriate locations to avoid air blockage and/or to provide a vacuum break.
- It is recommended that a double-walled conveyance pipe should be used whenever leachate is transported outside the limits of the lined landfill area. This applies to gravity flow and force main systems. Use of double-walled leachate conveyance piping is an industry standard, is required in various states, as well as recommended in Bolton, (1995). Although it is recommended that double-contained piping be utilized, the designer may wish to further discuss the alternate use of single-wall piping with the appropriate regulatory authority.

1.5.7 Leachate Loadout, Treatment, and Disposal

Definition

The landfill leachate loadout, treatment, and disposal system includes the means by which the leachate is loaded or extracted from the leachate storage system into a final treatment and disposal system. Leachate loadout areas may consist of a tanker-truck loading area if discharging leachate at an off-site treatment plant or using trucks for leachate recirculation. Leachate recirculation is defined in Section 1.5.3. The loadout area may also consist of a monitored connection or pump station to convey the leachate into an on-site treatment system, for direct discharge to a sanitary sewer, or for direct discharge to a receiving surface water body under an NPDES permit.

Leachate treatment and disposal system options depend on site-specific conditions and may include the following: on-site treatment and discharge to surface water in compliance with a site-specific NPDES permit, direct discharge to a sanitary sewer, truck hauling to a wastewater treatment plant, leachate recirculation into the landfill, or a combination of these approaches. An additional approach that is commonly used by CCP landfills is to return the leachate to the powerplant for use as plant process water.

Minimum Design Standards

Alabama: There are no minimum design standards for leachate loadout, treatment and disposal for CCP facilities. There are also no minimum design standards for leachate loadout, treatment and disposal for MSW, IW, and C&DD landfills.

Kentucky: There are no minimum design standards for leachate loadout, treatment and disposal for special waste facilities. There are, however, minimum component requirements for leachate loadout, treatment, and disposal for contained landfills (MSW) as specified in 401 KAR 48:080(6)(4g). This regulation generally states that when leachate is discharged to a sediment basin structure, or leachate is treated using an on-site wastewater treatment plant, or other method of discharge is proposed, a KPDES permit shall reflect this provision. When an off-site wastewater treatment plant is used, written documentation shall be provided showing the acceptance of the leachate, including the criteria for disposal at the wastewater treatment plant. The regulation also states that the system shall have a method to measure the quantity of leachate managed at the site.

Tennessee: The minimum design standard for leachate loadout, treatment, and disposal for Class II disposal facilities are specified in TDEC 1200-1-7-.04(4)(a).8. This regulation generally states that collected leachate must be managed in accordance with any other applicable state and local regulations, that the leachate must be sampled and analyzed, and that leachate recirculation into the emplaced waste is acceptable.

Selected Design Standard

The selection of the leachate loadout, treatment, and disposal system is based on site-specific conditions. All potential loadout, treatment, and disposal options should be considered and evaluated on a site-specific basis. The evaluation shall include, but not be limited to, the

system's technical feasibility, permitting requirements, and relative costs. TVA should make a decision regarding the treatment and disposal methodology best suited for the specific site based on this evaluation.

If discharging to a sanitary sewer or wastewater treatment plant, plant capacity and the potential chemical overload of the treatment plant must be considered. Coordination with the wastewater treatment plant is imperative, including anticipated flows and chemical constituents, which will need to be agreed upon prior to allowing this discharge. Additional discharge permits will most likely be required, governed by state and possibly county-specific regulations. Prior to discharge of the leachate to the sewer or treatment plant, flow control or pretreatment may be required. Other concerns that the sewer or treatment plants may have include pH, corrosivity, odor, retention time, and potential for chemical reaction with sewer system components, among others.

In all cases, the leachate loadout, treatment, and disposal system shall have a method to measure the quantity of leachate managed at the site and the leachate must be sampled and analyzed in accordance with the requirements of the site-specific discharge permits. In addition, the leachate loadout area shall be contained within a secondary containment area to avoid releases while transferring leachate from the conveyance system to the loadout system. Design of the leachate loadout system shall also take into account any applicable Occupational Safety and Health Administration (OSHA) regulations, as well as methods to enable the system to be user-friendly for operators, leachate truck haulers, etc.

1.6 SURFACE WATER RUN-OFF AND EROSION CONTROL

This section discusses the engineering design and performance standards associated with the management of surface water and sediment and erosion control measures. Factors considered with respect to surface water run-off include the design of surface water management structures and sediment basins to convey and manage expected stormwater flows from the landfill.

Factors considered with respect to erosion control measures include minimizing the volume of anticipated soil loss and providing sediment basins and BMPs to manage erosion during construction and development of the landfill.

1.6.1 Soil Erosion Calculations

Definition

Soil erosion calculations for landfill design and for pond closures (in above-grade facilities where the CCPs are emplaced above the perimeter berm, i.e., wet-stacking necessitating a sloped closure system) are performed for three essential reasons. The first reason is to estimate the amount of soil loss from the upper soil component of a landfill closure cap system. A second reason is to understand the quantity of sediment that may accumulate in a sediment basin to estimate maintenance and sediment removal activities. The third reason is to provide erosion and sediment controls construction periods at the landfill and to manage sediment and erosion from soil stockpiles used in the operation of the landfill.

Soil erosion can become a significant problem on landfill embankments and closure cap systems. If significant soil erosion occurs, the structural integrity of an embankment may become compromised. In addition, soil erosion in the upper soil component of a closure cap system may cause the underlying closure cap layers (clay or geosynthetics) to become uncovered or exposed which may result in slope instabilities and potential releases of CCPs to the environment. In areas where only soil cover is placed above the CCP material, erosion may cause the CCP to become uncovered in areas, resulting in exposed material, additional leachate production, and significant maintenance issues.

Minimum Design Standards

Alabama: There are no minimum design standards for soil erosion calculations for CCP facilities. There are, however, minimum design standards for MSW, IW, and C&DD landfills as specified in ADEM 335-13-4-.20, which states that slopes longer than 25 feet shall require horizontal terraces, of sufficient width for equipment operation, for every 20 feet rise in elevation or utilize other approved erosion control measures.

The Alabama Soil and Water Conservation Committee (SWCC) published a guidance manual, *The Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas* (2003). This guidance manual, while not having the force of law, provides guidance for preventing or minimized the related problems of erosion, sediment and stormwater. It provides a basis for developing sound plans and implementing appropriate measures (BMPs). This handbook is available via the internet at: http://swcc.alabama.gov/pdf/Handbooks&Guides/ASWCC_June_2003_Alabama_Handbook_Construction_E&S_Control.pdf

In addition, the National Resource Conservation Service (NRCS) has state-specific and county-specific technical guides, referred to as Field Office Technical Guides (FOTGs). The FOTGs contain technical information provided by the Alabama NRCS about the conservation of soil, water, air, and related plant and animal resources. The FOTGs are localized so that they apply specifically to the geographic area for which they are prepared. The FOTGs specific to Alabama are available via the Internet at: http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=AL. Referring to Section IV - Practice Standards and Specifications, provides specific details, specifications, detailed requirements and practices for erosion and sediment control, as well as other practices specific to the state. The design guidance provided in these documents are used as the basis for developing sound erosion and sediment control practices for inclusion in the site-specific SWPPP, which is a regulatory requirement of the general construction permit under the state's NPDES program administered by ADEM.

Kentucky: There are no minimum design standards for soil erosion calculations for special waste facilities. There are, however, minimum design standards for surface water calculations for contained landfills (MSW) as specified in 401 KAR 48:080. This regulation generally requires berms of at least one foot in height or two feet in width be placed at various specified intervals for varying slopes to prevent erosion.

Currently there are no state or county-specific technical guidance manuals published for Kentucky. However, the NRCS has state-specific and county-specific technical guides, referred

to as Field Office Technical Guides (FOTGs). The FOTGs contain technical information provided by the Kentucky NRCS about the conservation of soil, water, air, and related plant and animal resources. The FOTGs are localized so that they apply specifically to the geographic area for which they are prepared. The FOTGs specific to Kentucky are available via the Internet at: http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=KY. Referring to Section IV - Practice Standards and Specifications, provides specific details, specifications, detailed requirements and practices for erosion and sediment control, as well as other practices specific to the state. The design guidance provided in this document can be used as the basis for developing sound erosion and sediment control practices for inclusion in the site-specific stormwater pollution prevention plan (SWPPP), which is a regulatory requirement of the general construction permit under the state's KPDES program.

Tennessee: The minimum design standard for soil erosion calculations for Class II disposal facilities are specified in TDEC 1200-1-7-.04(8)(c).4. This regulation does not provide a specific design standard for these calculations, rather provides general requirements that the final surface of the disposal facility or disposal facility parcel shall be graded and/or provided with drainage facilities in a manner that:

- Minimizes erosion of cover material (e.g., no steep slopes);

- In order to minimize soil erosion, as soon as practicable after final grading, the operator shall take steps as necessary to establish a protective vegetative cover of acceptable grasses over disturbed areas of the site. These steps shall include seeding, mulching, and any necessary fertilization at a minimum, and may include additional activities such as sodding of steeper slopes and drainage ways if such are necessary.

- In addition to the drainage and grading requirements and vegetative cover requirements, the operator shall take other measures as may be necessary to minimize and control erosion and sedimentation (e.g., soil stabilization, sediment ponds) at the site.

TDEC has published the *Tennessee Erosion and Sediment Control Handbook*, (2002), which is designed to provide information to planners, developers, engineers, and contractors on the proper selection, installation, and maintenance of BMPs. The handbook is intended for use during the design and construction of projects that require erosion and sediment controls to protect waters of the state. This handbook is available via the internet at:

http://www.state.tn.us/environment/wpc/sed_ero_controlhandbook/eschandbook.pdf

In addition, the NRCS has state-specific and county-specific technical guides, referred to as Field Office Technical Guides (FOTGs). The FOTGs contain technical information provided by the Tennessee NRCS about the conservation of soil, water, air, and related plant and animal resources. The FOTGs are localized so that they apply specifically to the geographic area for which they are prepared. The FOTGs specific to Tennessee are available via the Internet at: http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=TN. Referring to Section IV - Practice Standards and Specifications, provides specific details, specifications, detailed requirements and practices for erosion and sediment control, as well as other practices specific to the state. The design guidance provided in these documents are used as the basis for developing sound erosion

and sediment control practices for inclusion in the site-specific SWPPP, which is a regulatory requirement of the general construction permit under the state's NPDES program administered by TDEC.

Selected Design Standard

Cap System Erosion Control: The Revised Universal Soil Loss Equation (RUSLE) shall be used to predict maximum soil loss from the final cap system. The RUSLE was developed by the USDA Agricultural Research Service and takes into account all the factors known to affect rainfall erosion, including climate, soil, topography and vegetation. The allowable soil loss from the cap system, based on calculations with the RUSLE, shall be 2 tons per acre per year. It is recommended that benches or terraces be designed on the cap system to limit erosion such that it is below the maximum soil loss requirement of 2 tons per acre per year. Factors that will affect the erosion rate from the cap system include the slope of the cap system, the drainage length between benches or terraces, and the properties of the cap system cover soil and vegetation. In states that provide specific guidance on the spacing and design of cap system erosion control benches or berms, the specific state design standards shall be followed, and RUSLE shall be used to confirm adequate erosion control is provided. The surface water design criteria for benches on the cap system are discussed in the Surface Water Calculations Section (Section 1.6.2). The 2 ton/acre/year allowable erosion value is provided by the USDA and many state regulations. This is also referenced in Section 11.4 of Qian, Koerner, and Gray (2002).

Erosion Control During Construction: Sediment and erosion control BMPs shall be provided during all construction activities, and to manage sediment from the landfill area and stockpiles during operations. The methodology or BMPs used to provide erosion control shall be based on the details and specifications provided on a state and county basis as presented in the NRCS FOTGs as well as any state or county technical guidance manuals or handbooks specified for the specific states as referenced in the Minimum Design Standards paragraphs of this section.

1.6.2 Surface Water Calculations

Definition

Surface water runoff (non-contact water) that has not come in contact with the CCP materials must be planned for by developing surface water management controls within the site. Sloped areas within the landfill will cause large volumes and higher peak runoff flows from the site than would occur naturally. The surface water runoff should be directed into channels that are capable of carrying most storm loads without overflowing or flooding adjacent areas. Generally, surface water drainage structures are designed based on calculations that take into account a specific design storm event for the particular region. Diversion channels consisting of benches, berms or swales on the side slopes of the landfill are used to intercept runoff before it has a chance to accumulate, flood areas and/or cut erosion gullies. Structures such as riprap letdowns or pipe slope drains are also used to convey runoff (surface water) from the diversion channels to the toe of slope of the landfill where a perimeter surface water collection channel is typically located. The perimeter surface water collection channels convey the surface water to the sedimentation basins to retain any collected sediment prior to discharge of the flow, as controlled by the site-specific NPDES permit.

Minimum Design Standards

Alabama: There are no minimum design standards for surface water calculations for CCP facilities. There are, however, minimum design standards for surface water calculations for MSW, ILF, C&DD landfills as specified in 335-13-4-.17 - Drainage. This regulation generally requires a run-on and run-off control system for the active and/or closed portions of the landfill during a 24-hour, 25-year storm event. Additionally, on-site drainage structures are required to carry incident precipitation from the disposal site so as to minimize the generation of leachate, erosion and sedimentation.

In addition, as discussed in more detail in the Minimum Design Standards section for design of erosion and sediment controls, the *Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas* (2003), provides guidance for preventing or minimizing the related problems of erosion, sediment and stormwater. Also, the NRCS FOTGs for Alabama provide BMPs for surface water management.

Kentucky: There are no minimum design standards for surface water calculations for special waste facilities. There are, however, minimum design standards for surface water calculations for contained landfills (MSW) as specified in 401 KAR 48:080. This regulation states that surface run-on and run-off ditches pass the 100-year, 24-hour, 100-year storm event, and that all designs shall be verified by the unit hydrograph method of calculation unless another method is approved. Also, the NRCS FOTGs for Kentucky provide BMPs for surface water management.

Tennessee: The minimum design standard for surface water calculations for Class II disposal facilities are specified in TDEC 1200-1-7-.04(2)(i). This regulation generally requires that the run-on and run-off control system be designed, constructed, operated, and maintained such that it is capable of preventing flow onto the active portion of the facility for all flow up to and including peak discharge from a 24-hour, 25-year storm.

In addition, as discussed in more detail in the Soil Erosion Calculations Section (Section 1.6.1), the *Tennessee Erosion and Sediment Control Handbook* (2002), provides information on the proper selection, installation, and maintenance of BMPs. Also, the NRCS FOTGs for Tennessee provide BMPs for surface water management.

Selected Design Standard

Surface water calculations shall be prepared using the Soil Conservation Service (SCS) method (previously by the USDA Soil Conservation Service, now by the Natural Resources Conservation Service (NRCS)). This includes using rainfall frequency curves provided by the NRCS and precipitation data provided by National Oceanic and Atmospheric Administration (NOAA) for the specific region where designing. The calculated surface water runoff will be based on peak flow SCS method, which entails conducting hydraulic modeling using Technical Release 55 (TR-55) method. The TR-55 method was developed by the USDA NRCS Conservation Engineering Division. TR-55 presents procedures to calculate storm runoff volume, peak rate of discharge, hydrographs, and storage volumes required for stormwater reservoirs. TR-55 can be used in conjunction with the Mannings equation to determine the design dimensions, maximum water elevations and flow velocities of the conveyance structure;

including open channels, culverts, letdowns, etc. Numerous computer software applications are available that assist in surface water calculations using these methods.

All surface water drainage structures, including channels, culverts, and benches on the landfill cap system shall be designed to carry expected flows based on the 24-hour, 25-year storm event for the particular region. This is supported by the Tennessee Class II disposal facility regulations (TDEC 1200-1-7-.04(2)(i)), as well as Federal regulations 40CFR258 Subtitle D. If specific state requirements provide more stringent design standards, the state design requirements shall be followed.

In addition, it shall be required (and is in accordance with Federal regulations 40CFR258 Subtitle D), that run-on controls be utilized to control drainage into and out of the landfill working face (area where CCP is currently being placed). Run-off from the active and/or closed portions of the landfill unit must also be controlled and shall be conveyed to a settling basin or other sedimentation control structure in accordance with the state's NPDES program

The following additional design elements shall be considered during the design of the surface water system:

- Velocity of the surface water flow through the surface water drainage structures must be calculated as referenced above. The velocity must be coordinated with the lining material used for the structure. For example, grass-lined channels are sufficient for low velocity flows, erosion control matting (ECM) or turf reinforced matrix (TRM) is used for medium to high velocity flows, while riprap and hard-liner materials (i.e., concrete, grouted riprap, and fabriform) are used for very high velocities. Specific velocity limits for each of these materials can be obtained in the NRCS FOTGs, state-specific design guidance manuals and/or from the material vendors.

- The dimensions and slope of the surface water drainage structure, as well as the maximum design water level in the structure, must be calculated as referenced above. The dimension of the conveyance structure must also allow for a free-board distance above the maximum design water level. A minimum of 6-inches of freeboard is recommended, or as otherwise specified in the NRCS FOTGs. A minimum grade of 2% shall be used for benches or berms conveying surface water off of the landfill cap system. A 0.5% minimum grade is required for perimeter surface water structures outside of the landfill cap system. However, shallow slopes shall be implemented at the discretion of the design engineer. Slopes of 1% or greater are desirable to achieve maintained positive drainage and provide surface water structures that are constructible.

- Energy dissipation devices, such as riprap protection placed at inlets and outlets to culverts, channels or letdowns; check-dams within channels; gabion baskets or other structural reinforcement at sharp channel bends; etc. must be considered to avoid excessive erosion and scouring.

- The use of non-mechanical gravity-flow surface water conveyance structures is most desirable and recommended. Mechanical conveyance (pumping) of surface water is not

typically desired, and in some cases not permitted by the regulatory authorities. This is because since the control and conveyance of surface water that is generated by storm events at quantities, durations and times that cannot be well predicted, a system reliant on a mechanical means (pumps) that are susceptible to malfunction and power outages would not be reliable.

Lastly, the methodology or BMPs used to meet the referenced surface water management requirements shall be based on the details and specifications provided on a state and county basis as presented in the NRCS FOTGs as well as the technical guidance manuals or handbooks specified for the specific states as referenced in the Minimum Design Standards paragraphs of this section.

1.6.3 Sedimentation Basin Design

Definition

A sediment basin is a temporary holding pond created by construction of a barrier across a drainageway or by excavating a basin or by a combination of both. The purpose of the sediment basin is to detain sediment-laden runoff from disturbed areas in storage long enough for most of the sediment to settle out of the runoff and be deposited in the basin. This practice applies where erosion control measures are insufficient to prevent excessive off-site sedimentation. The design of the sediment basin is largely based on the storage volume and detention time required to settle out the sediment from the runoff. Also taken into consideration is the amount of sedimentation anticipated during the construction activities.

Minimum Design Standards

Alabama: There are no minimum design standards for sedimentation basin analysis for CCP facilities. There are, however, general requirements for sedimentation basins for MSW, ILF, C&DD landfills as specified in 335-13-4-.17(3). This regulation generally requires that run-off from the active and/or closed portions of the landfill unit must be handled in accordance with NPDES and shall be routed to a settling basin or other sedimentation control structure.

In addition, as discussed in more detail in the Soil Erosion Calculations Section (Section 1.6.1), the *Alabama Handbook for Erosion Control, Sediment Control and Stormwater Management on Construction Sites and Urban Areas* (2003) provides guidance for preventing or minimizing the related problems of erosion, sediment and stormwater. Specifically, the design of sediment basins is presented on page 295 in the Handbook. Also, the NRCS FOTGs for Alabama provide details on the design of sediment basins.

Kentucky: There are no minimum design standards for sedimentation basin analysis for special waste facilities. There are, however, minimum design standards for sedimentation basin analysis for contained landfills (MSW) as specified in 401 KAR 48:070(2)(4). This regulation generally requires that sediment basins be designed such that the storage volume and principal spillway do not cause the emergency spillway to discharge during the 25-year, 24-hour storm event. Additional requirements include that the emergency spillway is capable of passing a 100 year, 24

hour storm even with no flow overtopping the structure and that the minimum sediment storage volume be provided for 1-year prior to requiring maintenance to restore the design volume.

Also, the NRCS FOTGs for Kentucky provide details on the design of sediment basins.

Tennessee: The minimum design standard for sedimentation basin analysis for Class II disposal facilities is specified in TDEC 1200-1-7-.04(2)(i). This regulation generally requires the following:

- Sediment basins associated with run-on and run-off control systems must be designed to detain at least the water volume resulting from a 24-hour, 25-year storm and to divert through emergency spillways at least the peak flow resulting from a 24-hour, 100-year storm.

- Sedimentation basins must be emptied or otherwise managed expeditiously after storms to maintain design capacity of the system.

- Run-on and run-off must be managed separately from leachate unless otherwise approved by the Commissioner.

In addition, as discussed in more detail in the Soil Erosion Calculations Section (Section 1.6.1), the *Tennessee Erosion and Sediment Control Handbook* (2002) provides information on the proper selection, installation, and maintenance of BMPs, including sedimentation basins. Specifically, the design of sediment basins is presented on page SB-1 in the Handbook.

Also, the NRCS FOTGs for Tennessee provide details on the design of sediment basins.

Selected Design Standard

The design standard, which is also the Industry standard, is to calculate the surface water runoff based on the peak flow SCS method. For conducting a sediment basin design, this entails conducting hydraulic modeling using TR-55 and Technical Release 20 (TR-20) methods. TR-55 has already been discussed in the Surface Water Calculations section. TR-20 was developed by the USDA NRCS Hydrology Branch and is now available as a WinTR20 version. TR-20 provides a hydrologic analysis of a watershed under present conditions. Output consists of peaks and/or storm hydrographs. Subarea surface runoff hydrographs are developed from storm rainfall using the hydrograph, drainage areas, times of concentration, and SCS runoff curve numbers. Instructions to develop, route, add, store, divert, or divide hydrographs are established to convey floodwater from the headwaters to the watershed outlet or in this case a sedimentation basin. Other computer programs, for example HydroCAD, can be used to incorporate TR-55 and TR-20 modeling.

The hydraulic modeling shall be conducted to design the sediment basin to detain at least the surface water volume resulting from a 24-hour, 25-year storm and to divert through the emergency spillways at least the peak flow resulting from a 24-hour, 100-year storm.

Additional and specific design features for sediment basins, including inlet and outlet structures, shall be based on the state-specific and county-specific requirements (if applicable). Relevant details provided in the NRCS FOTGs may also be used for design guidance.

1.7 IMPOUNDMENT SYSTEMS

As stated in the Ash Impoundments Section (Section 1.1.2), ash impoundment can be defined as a collection of water, wastewater, or liquid-borne materials that is contained by an artificial structure (dam), into which CCPs are placed for disposal or temporary storage. This section discusses seepage analysis design standards for impoundments.

1.7.1 Seepage Analysis

Definition

The movement of water through and underneath impoundments for water or saturated earthen materials is referred to as seepage. All such structures are subject to seepage through and underneath the impoundment and foundation. Seepage can impact the operation and stability of impoundment systems, and seepage control is generally necessary in these systems to prevent excessive uplift pressures, instability of slopes, piping through the impoundment and foundation, and erosion of material by loss into open joints or pore spaces in the foundation.

Minimum Design Standards

Alabama: There are currently no specific minimum design standards for seepage analyses of impoundment systems at waste facilities. However, dam safety regulations are in the process of being developed.

Kentucky: There are no specific minimum design standards for seepage analyses of impoundment systems at waste facilities.

Kentucky regulates dams and dam safety in the state via 401 KAR 4:030, and provides design requirements in Division of Water Engineering Memorandum No. 5 (2-1-75). There are no specific requirements for seepage analyses in these documents.

Tennessee: There are no specific minimum design standards for seepage analyses of impoundment systems at waste facilities.

However, Tennessee provides general requirements for seepage in its dam safety regulations, Chapter 1200-5-7, "Rules and Regulations Applied to the Safe Dams Act of 1973". Requirements related to seepage in this document include:

> 1200-5-7-.07 (5) (d) states: "All dams shall be designed and constructed to prevent the development of instability due to excessive seepage forces, uplift forces, or loss of materials in the impoundment, abutments, spillway areas, or foundation. Seepage analysis for design and inspection during construction shall be in sufficient detail to prevent the occurrence of critical seepage gradients. All dams permanently impounding water shall be constructed with an impoundment toe drain with drain pipes installed to discharge the seepage."

1200-5-7-.08 (5) (f) requires that seepage control features be presented in the plans for dams projects.

Selected Design Standard

Appropriate seepage analyses shall be performed to estimate the quantity of seepage both through and underneath the impoundment, and to estimate the distribution of pore pressures and seepage velocities within and beneath the impoundment

Seepage analyses should be implemented using appropriate 2-D or 3-D finite element or finite difference computer programs or by manual techniques such as drawing flow nets. It is recommended that seepage analyses be performed by computer analysis. The analyses should be performed by a qualified Geotechnical Engineer or Hydrogeologist with substantial experience in seepage modeling.

Input parameters to the seepage analysis, such as hydraulic conductivity of impoundment and foundation materials, should be based on the judgment of an experienced Geotechnical Engineer or Hydrogeologist and on the results of field and laboratory testing performed as part of the geotechnical investigation and judged to be sufficient by the qualified and experienced Geotechnical Engineer responsible for the analysis.

The following points shall be considered for seepage underneath and through impoundments and associated embankments:

- Impoundments and associated embankments shall be configured to mitigate all detrimental effects of seepage underneath and through the structure, such as excessive uplift pressures, piping (internal erosion), instability, sloughing, or removal of material by dissolution or erosion.
- All potential modes of piping and/or uplift for a given embankment should be considered in the evaluation on a case by case basis. These modes include , but are not necessarily limited to the following:

  (1) Upward seepage emerging at the downstream or exterior toe.

  (2) Heave where a low-permeability layer overlies a more pervious stratum.

  (3) Seepage emerging along the downstream or exterior slope or along some other sloping downstream surface.

- The evaluation of piping potential for the assessment or design of an impoundment or associated embankment should be conducted by an experienced engineer and consider several factors including, but not limited to: subsurface conditions and soil types/characteristics, embankment geometry and materials zoning, and exit gradients. There is not a universally accepted criteria for assessing the factor of safety against piping, and piping should be considered on a case by case basis.
- For piping mode (1), upward seepage emerging at the downstream or exterior toe, the critical gradient factor of safety method is commonly used whereby the factor of safety is computed as follows:

$$FS_{eg} = \frac{i_{cr}}{i_e}$$ where,

FS_{eg} = factor of safety for vertical exit gradient

i_e = maximum exit gradient computed from seepage modeling

i_c = critical gradient causing flotation of the impoundment foundation material.

$$i_c = \frac{G_s - 1}{1 + e}$$

G_s = specific gravity of foundation soils

e = void ratio of foundation soils

USACE Engineering Manual EM 1110-2-1901 (1993, p. 4-24 states: "Investigators have recommended ranges for factor of safety for escape gradient, FSg = i_{cr}/i_e from 1.5 and [sic] 15, depending on knowledge of soil and possible seepage conditions. Generally, factors of safety in the range of 4-5 (Harr 1962 and 1977) or 2.3-3 (Cedergren 1977) have been proposed." The U.S. Bureau of Reclamation (USBR) Design Standard No. 13, Chapter 8, page 8.8 provides more specific guidance as follows: "The heterogeneity of soils in nature, the progressive and hidden deterioration that can occur from seepage flow, and the sparse data base from appropriate testing justify a conservative safety factor (SF=4) for design of exit gradient protective features."

Selection of an acceptable minimum FSeg against piping should be on a case by case basis at the discretion of an experienced engineer. Based on the literature, a FS_{eg} greater than or equal to 4 should provide reasonable guidance as an acceptable minimum factor of safety for this piping mode, providing it is used in conjunction with other factors and sound engineering judgment. Subsurface conditions and piping susceptibility of soils must be taken into account when assessing the adequate factor of safety. Highly piping susceptible soils such as nonplastic cohesionless silts and fine sands, poorly graded, or gap-graded soils, and dispersive clays may justify a higher minimum factor of safety. Conversely if the engineer has adequate and reliable information that the soils and site conditions have a low susceptibility to piping, the engineer may decide to accept a lower FSeg value

- For piping mode (2), heave where a low-permeability layer overlies a more pervious stratum, the Natural Resources Conservation Service (NRCS) Soil Mechanics Note No. 7 (1979) states: :"To be safe against uplift or blowout a suitable factor of safety is needed. A value of 1.5 to 2 is suggested with the higher values to be used on the

more piping prone materials. Using an effective stress analysis the FS_h value should be computed as:

$$FS_h = \frac{Z\gamma b}{(ho - htw)\gamma w}$$ where,

FS_h = factor of safety against heave

Z = thickness of upper low-permeability layer

γb = buoyant unit weight of soil

ho = piezometric head in lower pervious layer at toe

htw = tailwater head at toe

- For piping mode (3), seepage emerging along the downstream or exterior slope or along some other sloping downstream surface, there is no generally accepted guidance for evaluating the minimum factor of safety against piping and each case must be evaluated individually by an experienced engineer..
- Where the above factor of safety cannot be met, engineering features (e.g. filters) meant specifically to control exit gradients and their detrimental effects shall be incorporated into the impoundment design. The state of the practice for design of new water retention embankments includes such engineering features in any embankment which woulf jeopardize human life it if was to fail.

The following points shall be considered for seepage underneath and through impoundments and associated embankments:

- The impoundment/embankment cross-section shall not be configured such that the predicted phreatic surface exits at a point along the downstream slope of the impoundment in an uncontrolled manner. The design of all impoundments should include pervious drainage features (such as toe drains, inclined or chimney drains, rockfill toes, etc.) meant specifically to collect and manage seepage flows passing through the impoundment structure's cross-section and discharge these flows safely away from the structure. Appropriate filtering media or features shall be provided between the embankment fill materials and/or foundation materials, and the pervious drainage features to preclude piping or migration (internal erosion) of soil particles.
- Design of seepage control features and filter media should be in general accordance with recommendations given USACE EM 1110-2-2300 General Design and Construction Considerations for Earth and Rock-fill Dams, Appendix B, (2004) or other similar references. Filter media shall be designed such that all interfaces between embankment soils, foundation materials, filter material, and drain material across which water can flow are filter-compatible. Discharge capacities of seepage control features should be established based on the maximum steady-state seepage rates estimated in the analysis

multiplied times a factor of safety, tyoically between 3 and 1o, depending on the confidence in the analysis..

- In addition to pervious seepage control features, planning and design of all impoundments/embankments should also formally consider the applicability of using impervious structures meant to control, limit, or direct seepage – such as cores, cut-off walls, grout curtains, etc. The results of these considerations should be reported in the design documentation.

1.7.2 Impoundment Stability Analysis

1.7.2.1 Deep-Seated Stability Analyses (Static)

Definition

The definition of deep-seated stability analyses as it applies to impoundment systems is generally the same as for landfill systems, as described in the Slope Stability Analysis Section (Section 1.4.2).

Minimum Design Standards

There are no specific minimum design standards for static stability analyses of impoundment systems at waste facilities in any of the three states. Related guidance and regulations for landfill facilities were described in the Slope Stability Analysis Section (Section 1.4.2), and could generally also apply to impoundment systems.

Some states have dam safety regulations, which may also apply to impoundment systems. Requirements are summarized below:

Alabama: Alabama currently does not have any dam safety regulations. However, regulations are in the process of being developed.

Kentucky: Kentucky regulates dams and dam safety in the state via 401 KAR 4:030, and provides design requirements in Division of Water Engineering Memorandum No. 5 (2-1-75). There are no specific requirements for stability analyses in these documents.

Tennessee: Tennessee provides its dam safety regulations in Chapter 1200-5-7, "Rules and Regulations Applied to the Safe Dams Act of 1973". There are no specific requirements for stability analyses for new dams in this document. For existing dams 1200-5-7-.06 (1) states: "All dams shall be stable. There shall not be excessive cracks, sloughing, seepage or other signs of instability or deterioration. In cases where the stability of the dam is questionable, it shall be the responsibility of the owner to either demonstrate to the Commissioner that the dam is stable or drain the reservoir and remedy the unstable condition prior to refilling the reservoir."

Selected Design Standard

Due to the nature of their construction and use, the stability of impoundment systems should be evaluated using analysis cases and criteria that are accepted for the design of dams. For static stability evaluations of impoundment systems, methodologies, guidance on use of total or effective strength parameters, and minimum factors of safety for design given in the USACE EM-1110-2-1902 (2003) should be utilized.

The stability analysis cases to be considered should include, at a minimum:

1. Construction and End of Construction Conditions: This analysis considers the newly completed impoundment and/or one or more critical configurations of the impoundment during construction. The analysis assumes that the impoundment has been constructed such that pore pressures in low permeability materials both within and underneath the impoundment have not had sufficient time to come to equilibrium. Thus, drained (effective) strengths are input into this analysis for free-draining materials (typically those with permeability of $1x10^{-4}$ cm/sec or higher) and undrained (total) strengths are input into this analysis for materials that drain slowly (typically those with permeability less than $1x10^{-7}$ cm/sec). For materials with permeability intermediate to these values, analysis should be implemented using both undrained and drained strengths, and the more conservative assumption should be used for design. The effects of staged impoundment construction or any other special drainage enhancing features (such as wick drains) should be included in this analysis, as and if appropriate.

2. Long-Term Stability Conditions: This analysis considers the impoundment under normal operating conditions that will exist a sufficient length of time after construction. It is assumed that pore pressures have had sufficient time to reach equilibrium both within and underneath the impoundment and steady-state seepage and/or hydrostatic conditions corresponding to the normal operating pool have developed. The steady state seepage and pore water pressure distributions determined in the Seepage Analysis Section (Section 1.7.1) should be used in this analysis. Drained (effective) shear strengths should be used for all materials.

3. Sudden Drawdown Conditions: This analysis considers a condition in which the impoundment has been under a long term stability condition for some time and then is subjected to a sudden lowering of the pool elevation. This condition represents a critical scenario for the upstream slope of the impoundment, due to loss of stabilizing hydrostatic pressure from the reservoir that has been drawn down. It should be assumed that drawdown is very fast, and no drainage occurs in materials with low permeability. Materials with values of permeability greater than $1x10^{-4}$ cm/s can be assumed to drain during drawdown, and drained strengths are used for these materials. The three-stage methods and procedures given in Appendix G of USACE EM-110-2-1902 should be used for implementing stability analyses for this condition.

   If the impoundment structure being designed is to be situated adjacent to or in close proximity to another impoundment, consideration shall also be given to the effects of sudden drawdown of the adjacent impoundment on the structure being designed.

Table 1.7.2-1 (reproduced from EM-1110-2-1902, 2003) provides additional summary information for the static stability analysis conditions described above.

Table 1.7.2-1
Cases to be analyzed for static stability of impoundment systems
(Taken from USACE EM-1110-2-1902 "Slope Stability", Table 2-1, 2003)

Shear Strengths and Pore Pressures for Static Design Conditions

Design Condition	Shear Strength	Pore Water Pressure
During Construction and End-of-Construction	Free draining soils – use drained shear strengths related to effective stresses[1]	Free draining soils – Pore water pressures can be estimated using analytical techniques such as hydrostatic pressure computations if there is no flow, or using steady seepage analysis techniques (flow nets or finite element analyses).
	Low-permeability soils – use undrained strengths related to total stresses[2]	Low-permeability soils – Total stresses are used; pore water pressures are set to zero in the slope stability computations.
Steady-State Seepage Conditions	Use drained shear strengths related to effective stresses.	Pore water pressures from field measurements, hydrostatic pressure computations for no-flow conditions, or steady seepage analysis techniques (flow nets, finite element analyses, or finite difference analyses).
Sudden Drawdown Conditions	Free draining soils – use drained shear strengths related to effective stresses.	Free draining soils – First-stage computations (before drawdown) – steady seepage pore pressures as for steady seepage condition. Second- and third-stage computations (after drawdown) – pore water pressures estimated using same techniques as for steady seepage, except with lowered water level.
	Low-permeability soils – Three-stage computations: First stage--use drained shear strength related to effective stresses; second stage--use undrained shear strengths related to consolidation pressures from the first stage; third stage--use drained strengths related to effective stresses, or undrained strengths related to consolidation pressures from the first stage, depending on which strength is lower – this will vary along the assumed shear surface.	Low-permeability soils – First-stage computations--steady-state seepage pore pressures as described for steady seepage condition. Second-stage computations – total stresses are used; pore water pressures are set to zero. Third-stage computations -- same pore pressures as free draining soils if drained strengths are used; pore water pressures are set to zero where undrained strengths are used.

Minimum Factors of Safety: Impoundment systems should be designed to meet the factors of safety given in Table 1.7.2-2 below.

Table 1.7.2-2

Minimum Factors of Safety for Static Stability Analyses of Cases for Impoundment Systems.

(Taken from USACE EM-1110-2-1902 "Slope Stability", Table 3-1, 2003)

Minimum Required Factors of Safety: New Earth and Rock-Fill Dams

Analysis Condition[1]	Required Minimum Factor of Safety	Slope
End-of-Construction (including staged construction)[2]	1.3	Upstream and Downstream
Long-term (Steady seepage, maximum storage pool, spillway crest or top of gates)	1.5	Downstream
Maximum surcharge pool[3]	1.4	Downstream
Rapid drawdown	1.1-1.3[4,5]	Upstream

[1] For earthquake loading, see ER 1110-2-1806 for guidance. An Engineer Circular, "Dynamic Analysis of Embankment Dams," is still in preparation.

[2] For embankments over 50 feet high on soft foundations and for embankments that will be subjected to pool loading during construction, a higher minimum end-of-construction factor of safety may be appropriate.

[3] Pool thrust from maximum surcharge level. Pore pressures are usually taken as those developed under steady-state seepage at maximum storage pool. However, for pervious foundations with no positive cutoff steady-state seepage may develop under maximum surcharge pool.

[4] Factor of safety (FS) to be used with improved method of analysis described in Appendix G.

[5] FS = 1.1 applies to drawdown from maximum surcharge pool; FS = 1.3 applies to drawdown from maximum storage pool.

For dams used in pump storage schemes or similar applications where rapid drawdown is a routine operating condition, higher factors of safety, e.g., 1.4-1.5, are appropriate. If consequences of an upstream failure are great, such as blockage of the outlet works resulting in a potential catastrophic failure, higher factors of safety should be considered.

The standards related to selection of material parameters, critical cross-sections, and slope stability analysis methods given in Section 1.4.2 for static stability analyses of landfill systems also apply to static stability analysis for impoundment systems. Additional considerations for impoundment systems are listed below

- Failure surface geometries considered in the analysis should include toe, basal geometries passing through the impoundment foundation and block failure geometries. Consideration should be given to preferential sliding planes such as along drainage layers or along interfaces anticipated to have weaker shear strength than the general impoundment fill.
- Earthen structural components of impoundment systems (such as perimeter dikes) are generally expected to be of lower height and extent than earthen components of landfills. Therefore, the properties of the foundation materials underneath impoundments may have greater influence on stability analyses. Careful consideration of variations of the foundation materials along the alignment of impoundments should be included when selecting critical cross-sections for stability analysis.
- Total and effective stress shear strength properties for stability analyses of impoundment systems should be established based on site specific field and laboratory testing, as described in the Site Investigation Section (Section 1.3.1).

1.7.2.2 Seismic Stability Analyses

Definition

Seismic stability analysis for impoundment systems includes evaluation of liquefaction potential and seismic deep-seated stability. These terms were defined previously for landfill systems in Sections 1.4.2.2, and these definitions also generally carry over to impoundment systems.

Minimum Design Standards

There are no specific minimum design standards for seismic stability analyses of impoundment systems at waste facilities in any of the three states. Related guidance and regulations for landfill facilities were described in Section 1.4.2.2, and could generally apply to impoundment systems.

Some states have dam safety regulations, which may also apply to impoundment systems. Requirements are summarized below:

Alabama: Alabama currently does not have any dam safety regulations. However, regulations are in the process of being developed.

Kentucky: Kentucky regulates dams and dam safety in the state via 401 KAR 4:030, and provides design requirements in Division of Water Engineering Memorandum No. 5 (2-1-75). There are no specific requirements for seismic stability analyses in these documents.

Tennessee: Tennessee provides its dam safety regulations in Chapter 1200-5-7, "Rules and Regulations Applied to the Safe Dams Act of 1973". There are no specific requirements for seismic stability analyses for new dams in this document.

Regarding seismic design of dams, 1200-5-7-.07 (1) (b) states: "All structures other than Category 3 dams constructed before 2008 shall be designed to withstand seismic accelerations of the following intensities: Zone 1 = 0.025g, Zone 2 = 0.05g, Zone 3 = 0.15g. Zones refer to *Geologic Hazards Map of Tennessee* (Miller, 1978). All dams constructed during or after 2008 shall be designed to withstand the peak ground acceleration for an earthquake with a 10% probability of exceedance in 50 years as determined by the United States Geological Survey at the time the construction permit is issued. A different peak ground acceleration may be used if site specific studies using accepted engineering practices determine that a different value is appropriate.

The above magnitude of peak ground acceleration corresponds to an event with an approximate 475-year return period. This is a substantially smaller event than the 2,400-yr return period event that the state requires for design of new landfill facilities, and much lower than the 3,000 to 10,000 year return periods typically used for dams (,more specifically, high hazard dams).

Selected Design Standard

The design seismic event for impoundment systems shall be the same as that described in Section 1.4.2.2.1 for landfill systems and consistent with the design structure.

Liquefaction analyses as described in Section 1.4.2.2.2 for landfill systems should also be performed for impoundment systems.

The seismic slope stability analyses and seismic deformation analyses presented in Section 1.4.2.2.3 for landfill systems are also applicable to impoundment systems. The seismic analyses should be performed assuming that the fluid level existing within the impoundment at the time of the design seismic event corresponds to the coincident pool elevation, defined as the elevation at which the impounded fluid is expected to be at or below for half of the time during each year.

1.7.3 Settlement Evaluations

Definition

Settlement analysis consists of predicting of total and differential subsurface deformations underneath impoundments and critical structures associated with impoundments (such as drainage features, seepage collection features, etc). Settlements are induced primarily by the self weight of the impoundment and the materials retained by the impoundment.

Minimum Design Standards

There are no specific minimum design standards for settlement analyses of impoundment systems at CCP facilities in any of the three states. Related guidance and regulations described in Section 1.4.3, under landfill systems may generally apply to impoundment systems as well.

Similarly, there are no minimum design standards for settlement analysis in any of the three states within their dam safety regulations.

Selected Design Standard

The recommended methodologies for settlement analyses given in Section 1.4.3 for landfill systems shall also apply to impoundment systems. For impoundment systems, the following additional guidelines are applicable:

- Impoundments shall be designed such that all freeboard requirements are met assuming the maximum computed static settlements. The design should be implemented such that freeboard of at least 2 ft is predicted after including seismic deformations corresponding to the design seismic event.
- Analyses focused specifically on determining settlement profiles underneath drainage structures, piping, spillways and outlet works, and other structures should be performed, and these components should be designed to accommodate the estimated settlements.

1.8 SPILLWAY / DRAINAGE SYSTEMS

Definition

A spillway is an open or closed channel, or both, used to convey water from a reservoir. It may contain gates, either manually or automatically controlled, to regulate the discharge of water. A principal spillway is the first discharge system designed to begin operation after the normal design storage capacity is exceeded. An emergency spillway is a discharge system designed to operate at an elevation above the principal spillway to safely convey discharges that exceed the principal spillway's capacity without jeopardizing the safety of the dam.

Minimum Design Standards

State and federal regulations for minimum spillway design flow requirements are given in Table 1.9-1.

Table 1.9-1
Comparison of State and Federal Regulations: Spillway Design Flow Requirements

Hazard Category of Dam	Alabama	Kentucky	Tennessee[2]	Federal
High Hazard	N/A	Class C Dams: $P_C = PMP$[1]	Small Dams: 1/2 PMP Intermediate Size Dams: PMP Large Dams: PMP	High Hazard Potential[3]
Moderate Hazard	N/A	Class B Dams: $P_B = P_{100} + 0.40 \times (PMP - P_{100})$[1]	Small Dams: 1/3 PMP Intermediate Size Dams: 1/2 PMP Large Dams: PMP	Significant Hazard Potential[3]
Low Hazard	N/A	Class A Dams: $P_A = P_{100} + 0.12 \times (PMP - P_{100})$ [1]	Small Dams: 100-Year Flood Intermediate Size Dams: 1/3 PMP Large Dams: 1/2 PMP	Low Hazard Potential[3]

Note 1: Criteria are for Freeboard Hydrograph. P denotes 6-hour design precipitation, P_{100} refers to 6-hour, 100-year precipitation, and PMP represents 6-hour Probable Maximum Precipitation.
Note 2: Tennessee dam size classifications:

Category	Storage (acre-feet)	Height (ft.)
Small	30 – 999	20 - 40
Intermediate	1000 – 50,000	41 - 100
Large	50,000+	100+

Note 3: For Federal inflow criteria refer to Federal Guidelines for Dam Safety: Selecting and Accommodating Inflow Design Floods for Dams, U.S. Department of Homeland Security, Federal Emergency Management Agency, October 1998, Reprinted April 2004

Selected Design Standard

Flood and freeboard spillway criteria are provided in Table 1.9-2. The remainder of the section presents additional spillway design standards.

Table 1.9-2
TVA Spillway Criteria for Wet Ash Disposal Impoundments

Federal Hazard Category	Spillway Design Flood[1,2]	Minimum Freeboard During Normal Operating Conditions	
		Dam[2]	Upground Reservoir
High	100% Probable maximum flood (PMF) unless a flood inflow condition is identified such that a failure at that flow or larger flows (up to the PMF) will no longer result in unacceptable additional consequences.	Sufficient freeboard shall be provided to prevent overtopping of the top of the dam the design flood and factors such as wind, wave action, ice, ..etc. reservoir.	5 feet
Significant			5 feet
Low			3feet

Note 1: Hydrologic and hydraulic calculations must prove that the combined spillway capacity is sufficient to safely pass the inflow design flood without overtopping the dam. The inflow hydrograph shall be calculated as the flow resulting from the design flood storm event falling on the watershed upstream of the impoundment and the impoundment itself during a 6-hour period.
Note 2: For inflow design flood and freeboard requirements use procedures outlined in Federal Guidelines for Dam Safety: Selecting and Accommodating Inflow Design Floods for Dams, U.S. Department of Homeland Security, Federal Emergency Management Agency, October 1998, Reprinted April 2004**.**

Spillway structures shall consist of reinforced concrete or steel construction with proper foundations, engineered to withstand with a minimum Factor of Safety of 2.0 for all wind, water, ice, debris and other loads that can reasonably be expected to impinge on the structure during its service life.

Spillways should consist of a single outlet structure serving as both principal spillway and emergency spillway, a principal spillway and a dedicated emergency spillway, or two or more spillways having combined flow capacity sufficient to safely pass the design flood. Spillways consisting of a poorly founded vertical or near vertical outlet pipe with an open end at the desired pool level should be avoided unless they can satisfy all required design criteria.

Outlet works design should adhere to currently accepted engineering practice, and should consider design issues including but not limited to:

- Settlement along conduit profile
- Pipe joint requirements (pipe joint separation)
- Seepage control associated with conduits
- Proper application of spillway materials deemed appropriate with respect to embankment depth, foundation conditions, etc.
- Pipe bedding, cradling and/or encasement
- Energy dissipation and erosion control
- Corrosion protection for ductile iron or other metal pipe

All spillway structures shall be equipped with a means to shut off flow, such as by emplacing stop-logs, or by actuating a gate or valve. Such control features should be located at or near the upstream end of the discharge pipe, near the spillway structure, so that pressurizing the outlet pipe is avoided when valve is closed.

Principal spillways shall be equipped with trash racks designed and built to provide positive protection from clogging of the spillway at any point. The average velocity of flow through a clean trash rack shall not exceed 2 ft/sec with the water elevation in the reservoir 5 feet above the top of the trash rack or at the crest of the emergency spillway, whichever is lower. Velocity will be computed on the basis of net area of opening through the rack.

All spillway structures shall be equipped with personnel access devices meeting pertinent OSHA safety requirements. These may consist of fixed or floating walkways and platforms capable of safely holding a minimum of 1,000 pounds of personnel and equipment without sinking or otherwise becoming unstable. Walkway loadings shall be incorporated into the design of the structure. Guardrails shall be provided to prevent falls into the ash impoundment or the spillway structure.

Whenever possible, discharge conduits should be founded in natural foundation soil at the base of the impoundment dam/dike or at an abutment, and not through the embankment itself. If the conduit must be placed through the dam/dike embankment the design shall include seepage control features such as cutoffs, collars and filter drains. Discharge conduits may not be made of corrugated metal pipe.

Chutes or channels conveying water from the outlet end of discharge conduits should be located in natural ground to the extent possible. Chutes and outlet channels located on the dam embankment should include robust erosion control features such as filters and riprap between them and the surface of the dam to prevent or minimize erosion due to water leakage or spillover.

Pipe conduits shall be of such design as to safely support the total external loads and shall convey flow without rupture or leakage. All pipes shall have the ability to resist corrosion from surrounding soils and impounded materials based on current acceptable testing standards. All pipe conduits shall convey flow at the maximum design velocity without damage to the interior surface.

Up-ground or off stream reservoirs shall be equipped with a passive overflow prevention device that limits the maximum water level by discharging excess water. It shall have sufficient flow capacity to exceed by a minimum of 10% the sum of all pumped inflows plus precipitation runoff to the reservoir. Upground or off stream reservoirs shall be equipped with water level monitoring instruments. If practical, instruments that can be read from a remote location, such as a control panel at the power plant, are recommended. At a minimum, upground reservoirs should be equipped with a staff gage that can be read conveniently from locations readily accessible to power plant personnel.

1.9 ASH STORAGE POND AND LINER DESIGN CRITERIA

This section describes ash storage ponds and liner materials. Selected design standards are presented for dike construction, vertical separation distance, liner systems, protective drainage cover, liner penetrations, discharge structures, splitter dikes, pond sizing and future dam raising, as they relate to the of design ash storage ponds and liners.

When designing new dams, dikes and appurtenances for wet ash disposal facilities, the designer should refer to published design manuals such as the US Army Corps of Engineers EM-series manuals including EM-1110-2-2300, *Engineering and Design - General Design and Construction Considerations for Earth and Rock-Fill Dams* (2004), and related manuals.

Definition

An ash storage pond is defined as an impoundment formed by earthen dams/dikes built above the pre-existing ground surface, excavation into the existing ground surface, or a combination thereof that is used for temporary or permanent storage of wet-sluiced coal combustion products.

The liner is defined as an impervious or low-permeability layer of soil or man-made geomembrane that separates the saturated wet-sluiced coal combustion products and transport water from the soils and groundwater below and outside of the ash storage pond.

1.9.1 Recommendations for Dike Construction

Construction of the dikes should proceed as zoned earthen embankments, with a low permeability (clay) layer comprising the upstream or shoreline side. Material behind and below the impervious material should be selected to meet filter criteria with respect to the low permeability liner material. On the downstream toe of the dike, a graded filter and toe drain to control seepage is recommended. Filter criteria and filter drain design should adhere to USACE EM 1110-2-2300, Appendix B, Filter Design (2004). The slopes should be no steeper than 3H:1V, providing a factor of safety consistent with the parameters presented in this Document.

The crest of the dike should be wide enough to accommodate a two-way road, corresponding to a 25 to 30 ft wide crest. The road should include geotextile in its base and at least 6 to 9 inches of aggregate (“road stone”) so that medium weight service trucks can use the road without damage.

The impervious core of the dikes, built on the upstream slope, should be thicker at the bottom and thinner at the top, with a minimum of 3-foot thickness at the top. Thickness at the bottom should be determined by geotechnical engineering analysis, but in general the clay thickness should not be less than 1/3 the depth of the water to be stored above.

1.9.2 Vertical Separation Distance above Groundwater

A geologic buffer should be present between the base of the ash pond and the underlying groundwater system. In lieu of geologic buffers to maintain a groundwater separation distance, artificial groundwater controls via gravity draining underdrain systems, capable of lowering the groundwater to create separation between the liner and the seasonal high ground water table may

be proposed. Such an underdrain system would need to be monitored, sampled, and tested as part of the facility monitoring program, similar to groundwater or surface water monitoring.

1.9.3 Liner System

A composite liner system should be present along the base of the sideslopes of the ash pond. The composite system should be comprised of a synthetic geomembrane in direct contact with a low permeability soil. More specifically, an impervious clay layer (permeability less than 1 X 10^{-7} cm/sec) should be constructed at the bottom of the pond such that the thickness is a minimum of 3 feet, or 1/6 the depth of the water to be stored above it. This ratio can be adjusted/refined using geotechnical engineering analysis. Overlying the clay liner, an HDPE, 60 mil geomembrane (or approved equivalent is recommended based on adequate design and testing for stability during construction and operation.

In general, the bottom of the pond should promote positive drainage to the outlet structure. Pond bottom slopes should be 2% minimum in the direction of liquid flow, with minimum 0.5% slopes in the direction of drainage pipes placed at regular intervals within the protective cover layer above the liner (discussed below).

1.9.4 Protective Drainage Cover

Overlying the composite liner, a protective cover system should be installed to protect the liner during construction and operation as well as facilitate a drainage path below the deposited ash. A drainage blanket of fine to medium sand (or possibly bottom ash/boiler slag) meeting filter criteria with respect to the fly ash, can be constructed at the bottom of the pond, just above the impervious blanket. Slotted or perforated drainage pipe can be embedded in it to drain transport water from the fly ash. The following are generally criteria to achieve this component:

- Protective cover at the pond bottom should be at least 24 inches in thickness, and comprised of a two-layered system.

- The bottom layer should be at least 12 inches thick. The bottom layer of the protective cover should be overlain by a continuously sewn geotextile having an AOS compatible with the upper component of the protective cover.

- The upper layer of the protective cover should be at least 12 inches in thickness. The upper layer of the protective cover should be capable of resisting the erosion force of sluice water as the pond is initially filled. Bottom ash may be used for either component of the protective cover layer, and may be placed at a greater thickness if desired to provide adequate erosion resistance to sluice water anticipated at initial pond filling.

- Protective cover on the pond slopes should satisfy the requirements listed for the pond bottom with the following exceptions:
  - The shoreline of the pond should have erosion protection such as crushed stone or riprap. Size requirements can be determined using wave-fetch design methods.

The erosion protection material should be bedded on granular filter material or a geotextile fabric.

- In areas where future bottom ash removal can be reasonably anticipated the minimum 24-inch thick protective cover should be overlain with riprap to serve as a physical barrier to excavating equipment. A geotextile separation layer may be needed beneath the rip rap layer.
- Beneath any permanent inlet pipe, having its discharge end lying above any portion of the pond slope, a minimum rip rap thickness of 24 inches of suitably sized rock extending the entire slope length, and a minimum distance of 50 feet out onto the pond bottom is recommended. A geotextile separation layer may be needed beneath the rip rap layer. Alternatively, a concrete slab, consisting of at least a 4-inch thick mesh reinforce concrete slab, having the same surface dimensions recommended for the riprap armoring layer, may be substituted for the riprap.
- All pond slopes should satisfy the shallow translational stability analysis (veneer stability calculation) for the selected liner and protective systems as described elsewhere in this document.

1.9.5 Liner Penetrations

Concrete outfall structures with stop log adjustable outlets should be used in regulating water levels in the pond. Geosynthetic liner materials should be mechanically fastened to the concrete surface using stainless steel flat bars with anchor bolts spaced at 12 inch centers. Alternatively, specially designed HDPE embedment strips may be cast in the concrete surface onto which the HDPE liner component may be continuously welded. No pipe penetrations of the liner are anticipated.

1.9.6 Pond Discharge Structure

The pond discharge should be comprised of a long shallow trough that drains to a central discharge structure. The trough should be designed to reduce flow velocities within the pond and reduce the occurrence of concentrated flow ("short-circuiting"). The main discharge structure should be equipped with water level control facilities such as stop-logs so that the pond water level can be raised as it fills with ash over time. While no specific recommendation is provided for the configuration and/or material selection as this is an element of design, due to problems with corrosion and design life, corrugated metal pipe is not recommended.

1.9.7 Splitter Dikes

If desired, splitter dikes can be constructed within the pond using bottom ash, boiler slag or earth materials to partition the pond into two or more sections. Each section should have sufficient surface area to satisfy settling requirements for the coal combustion product to be disposed of in the pond.

In the event that different water elevations are to be considered for either side of the splitter dike, the dike should be designed prior to construction.

1.9.8 Pond Size/Configuration

The surface area of the pond should be large in comparison to its depth. Settling equations should be used for pond sizing, using particle size and specific gravity values that are representative of the coal combustion product to be disposed of.

1.9.9 Future Dam Raisings

The potential impacts of future embankment raisings should be considered when planning the geotechnical aspects of ash pond design, such as predicted foundation settlement, slope stability, embankment zoning and geometry, and pipe material selection. When the possibility of future raisings cannot be ruled out, the design of new ash disposal ponds should be sufficiently conservative to support future raising(s).

1.10 VISIBILITY

While there are no specific State or Federal regulations regarding visibility, the following discussion is provided as a recommendation, especially when facilities are sited in locations where they will operate within clear view of residential areas.

It is standard procedure to locate landfills in areas where they are less visible to the surrounding public. Landfills must be designed and situated in accordance with the applicable siting regulations, which typically require a specified buffer distance between the limits of CCP and the property line, as well as from surrounding domiciles. The following is recommended to minimize visibility to the surrounding public:

- Visibility from outside the landfill property in the direction of all sides of the landfill should be obstructed using either constructed berm, landscaping or tall vegetation, to the extent possible;
- Haul roads, stockpiles, operational areas and staging areas should be screened either using a constructed berm, landscaping or tall vegetation, to the extent possible;
- Evaluations such as a line-of-sight study or balloon test should be conducted in the earliest stages of site planning.

Note that it may not be possible to completely obstruct the view of the landfill, especially as the landfill increases in height. The surrounding topography and existing vegetation can sometimes be used to the designer's advantage. Three-dimensional line-of-sight evaluations can be conducted to determine at what point or phase in the landfill life it will become visible to the surrounding community. Other methods, such as balloon testing, may be conducted to determine at what elevation the landfill will be visible to the surrounding community. In some cases, the ultimate height of the landfill will need to be negotiated with the surrounding community, depending on the level of community opposition to the project.

1.11 ACCESS, PERIMETER, HAUL, & SERVICE ROADS

General Definitions

There are four primary types of roadways that are used in CCP Facilities

The following text defines the design requirements for Access, Perimeter, Haul, and Service Roads as they pertain to CCP facilities.

1.11.1 Access Roads

Definition

Access roads are roads that are used to enter the facility, generally from a public road.

Minimum Design Standards

State/Local: There is no specific state standards in Alabama, Kentucky or Tennessee associated with private roads. Contact the local authorities for specific requirements that may need to be incorporated to the design.

The design standards listed below are based upon the Mine Safety and Health Administration (MSHA) Haul Road Inspection Manual (HRIM) 1999, United States Department of Labor, Mine Safety and Health Administration and Design of Surface Mine Haulage Roads. References to the respective State's Department of Transportation (DOT) design guidance for pavements are included as well.

Selected Design Standard

Road design is based upon factors that must be determined for the specifics of each individual facility. These factors include the following items:

- Vehicle Types-Vehicles that may be utilizing the road should be determined prior to the commencement of design.
- Gross Vehicle Weight (GVW)-GVW shall be established prior to design.
- Traffic Volumes-Projected traffic volumes should be established prior to design commencement.
- Design Speed –Typical Access Road design speeds range from 10 mph to 30 mph. A design speed should be selected and used for design iterations, and adjusted as necessary.
- Road Surface-The desired road surface (pavement, aggregate, etc.) should be established so that a friction factor can be selected for design.
- Road Widths – Haul roads widths should be 3.5 x widest vehicle width for a 2-lane road. See MSHA (HRIM), for recommended road widths based upon the number of traffic lanes and vehicle widths. Additional pavement widening may required around sharp curves. See MSHA (HRIM), Table 15 for widening based upon the curve radius dimension and the GVW.

Once these criteria are established, the following criteria shall be observed:

- Stopping Sight Distance (SSD) – The SSD may vary between 50 ft to 1700 ft based upon design speed, GVW, road surface friction factor and gradient.
- Vertical Alignment - Maximum grade is restricted to 10% with grades to 15% permitted only for short distances. There are no minimum grade restrictions.
- Horizontal Alignment- The following guidelines pertain to horizontal alignments:
    - Minimum horizontal curve is 130 ft (20mph design speed)
    - Minimum horizontal curve is 300 ft (30mph design speed)
    - Super-elevation is required for curves with a radius less than or equal to 1000 ft.
    - Intersection Sight Distance varies between 225' to 375' depending upon design speeds ranging from 15 mph to 30mph.
- Pavement Design – There are no minimum pavement design standards. State specific DOT design guidelines should be utilized. Soil types should be evaluated and considered for pavement design.
- Cross Section – Pavement cross slope to range between 2% and 4%.
- Drainage Design Criteria
    - Roadside Drainage Ditches – 10-year storm for flow capacity of V-ditch.
    - Roadway Culverts – No minimum requirements are listed for culvert design. Use local DOT guidelines or 10-year storm design, whichever is greater.
    - Culvert Outlet Protection – recommended with no standard listed. Use State specific DOT guidelines.
- Runaway Vehicle Provision – No Minimum Requirements
- Guardrail or Earthen Berms-Required for 2:1 foreslope on adjacent ditches or a fill height of 10 feet or greater.
- Storm Water Pollution Prevention Plan (SWP3) – Specific State and Local requirements for construction and post- construction storm water management should be incorporated into the design.
- Right-of-Way Permits-A permit for constructing an entrance within the public right-of-way may be required. Coordinate with the State specific DOT or locality for more information and for more information regarding this permit.
- Signage-Signs indicating speed, direction of movement (right-of-way), use of headlights, railroad crossings, and hazardous conditions must be readily visible and legible.
- Clearance from overhead power lines- Overhead high-voltage power lines are required to be installed no less than 15 feet above grade. Booms and masts of equipment shall not be operated within 10 feet of an energized overhead power line. For more information see chapter 12 of the HRIM.

1.11.2 Perimeter Roads

Definition

Perimeter roads are roads to facilitate the operation of the facility, located around and outside of the limits of CCP placement.

Minimum Design Standards

State/Local: There is no specific state standards in Alabama, Kentucky or Tennessee associated with perimeter roads.

Selected Design Standard

Perimeter Road design is based upon factors that must be determined for the specifics of each individual facility. To some degree, the perimeter road design will be governed by the landfill design standards. See Section 1.10.1 "Recommendations for Dike Construction" for further detail. Additionally the following guidelines are recommended for good engineering practice.

- Vehicle Types-Generally these facilities are designed for medium-weight service trucks however be sure to confirm this with the operations personnel.
- Traffic Volumes-Projected traffic volumes should be established prior to design commencement. These roads are generally very low volume.
- Road Surface and Composition- These roads are generally aggregate, varying in thickness from 6 to 12 inches. A 6 inch base material should underlay the aggregate, with a non-woven geotextile placed in between the two layers (10 oz. is typical). All materials should be well compacted according to specification. Soil types should be evaluated and considered for pavement design.
- Road Widths – Perimeter roads typically allow for 2-way traffic, however, one-way traffic may be permitted if frequently spaced turn-arounds are provided and space is of concern. Each lane should be no less than 12 feet wide.
- Cross Section – Pavement cross slope to range between 2% and 4%.
- Drainage Design Criteria-Drainage criteria should match that for the landfill surface drainage requirements.
- Guardrail or Earthen Berms-Required for 2:1 foreslope on adjacent ditches or a fill height of 10 feet or greater.
- Clearance from overhead power lines- Overhead high-voltage power lines are required to be installed no less than 15 feet above grade. Booms and masts of equipment shall not be operated within 10 feet of an energized overhead power line. For more information see chapter 12 of the HRIM.

1.11.3 Haul Roads

Definition

Haul Roads are roads that are designed to accommodate large trucks with a payload at a design speed with consistent daily (hourly) traffic. Haul roads are used within the footprint of a landfill, used for delivery of material to the working face. These roads are not for public use.

Minimum Design Standards

State/Local: There is no specific state standards in Alabama, Kentucky or Tennessee associated with private haul roads. They are generally the responsibility of the landfill operator to design, build, and maintain.

Selected Design Standard

The Haul Roads used within the footprint of the landfill are the responsibility of the Operator to design, build, and maintain. The design may be based upon the minimum design standards in accordance with MSHA. The Operator may be required to submit the typical Haul Road section to TVA for evaluation, however, ultimately, it is their responsibility to ensure its integrity and functionality. The Haul Road design should be based on the following criteria at a minimum:

- Vehicle Types
- Gross Vehicle Weight (GVW)
- Traffic Projections
- Desired Design Speed
- Road surface-Soil types should be evaluated and considered for pavement design.

Vehicle types, GVW including payloads and traffic projections should be selected to optimize hauling efficiency. Road surface design should consider costs, dust control, vehicle tires and friction factors.

1.11.4 Service Roads

Definition

Service Roads are roads that allow maintenance vehicles to access certain facilities on a periodic basis. Service Roads are not intended to carry payloads within the facility.

Minimum Design Standards

State/Local: There are no specific minimum design standards for private service road designs in any of the three states.

Selected Design Standards

Road design is based upon factors that must be determined for the specifics of each individual facility. These factors include the following items:

- Vehicle Types-Service Roads shall be designed for maintenance vehicles (pickup trucks, gators, etc.)
- GVW-Gross Vehicle Weight shall be established prior to design.
- Traffic Volumes-Projected traffic volumes should be established prior to design commencement. Volumes on Service Roads are assumed to be extremely low.
- Design Speed –Typical Service Road design speeds range from 10 mph to 30 mph. A design speed should be selected and used for design iterations, and adjusted as necessary.
- Road Surface-The desired road surface (pavement, aggregate, etc.) should be established so that a friction factor can be selected for design. Generally, Service Roads are aggregate, dirt, or reinforced grass.
- Service Road Widths – One lane service roads shall be 9 feet wide (min), or equal to the maximum vehicle width. Two lane service roads shall be 18 feet wide (min).

Once these criteria are established, the following criteria shall be observed:

- Stopping Sight Distance (SSD) – The SSD may vary between 50 ft to 1700 ft based upon design speed, GVW, road surface friction factor and gradient.
- Vertical Alignment - Maximum grade should be restricted to 10% with grades up to 15% only for short distances. There are no minimum grade restrictions.
- Horizontal Alignment- The following guidelines pertain to horizontal alignments:
    - Minimum horizontal curve is 50 feet.
    - Super-elevation is not required.
    - Minimum Intersection Sight Distance varies between 225' to 375' depending upon design speeds ranging from 15 mph to 30mph. These values should be compared to the State DOT standards and designed based upon the most stringent requirements.
- Pavement Design – There are no minimum requirements for pavement design. A geotechnical evaluation of the pavement subgrade is recommended to determine the bearing capacity referred to as the CBR. The pavement section should be a minimum section based on soil conditions (CBR value), groundwater, and level of maintenance desired by TVA.
- Cross Section and Drainage Design – Allow for positive drainage.
- Guardrail or Earthen Berms-Required for 2:1 foreslope on adjacent ditches or a fill height of 10 feet or greater.
- Storm Water Pollution Prevention Plan (SWP3) – Specific State and Local requirements for construction and post- construction storm water management should be incorporated into the design. If the road is hard-surfaced, it will be considered
- Signage-Signs indicating speed, direction of movement (right-of-way), use of headlights, railroad crossings, and hazardous conditions must be readily visible and legible.
- Clearance from overhead power lines- Overhead high-voltage power lines are required to be installed no less than 15 feet above grade. Booms and masts of equipment shall not be

operated within 10 feet of an energized overhead power line. For more information see chapter 12 of the HRIM.

1.12 SURVEYING

Definition

Land surveying is the detailed study or inspection, as by gathering information through observations, measurements in the field, verbal or written inquiry, or research of legal instruments, and data analysis in the support of planning, designing, and establishing of property boundaries. It involves the re-establishment of cadastral surveys and land boundaries based on documents of record and historical evidence, as well as certifying surveys (as required by statute or local ordinance) of subdivision plats/maps, registered land surveys, judicial surveys, and space delineation. Land surveying can include associated services such as mapping and related data accumulation, construction layout surveys, precision measurements of length, angle, elevation, area, and volume, as well as horizontal and vertical control surveys, and the analysis and utilization of land survey data. Expectations prior to commencement of surveying are established in regards to accuracy, datum, field equipment, hardware and software and other related requirements. These expectations can vary from project to project, state to state or within surveying sub disciplines.

Surveying and Mapping for Design and Plan Development

Field survey data shall be used to create mapping or supplement existing mapping. When applicable, determinations regarding level of supplemental survey shall be established prior to project start. Criteria shall be determined prior to map creation regarding the level of detail required. Detail shall meet or exceed minimum criteria requirements. Supervisory control of all survey and map efforts shall be by a registered professional surveyor in the State in which surveys are performed and maps created. Quality assurance / quality control measures shall be in place to ensure proper map development procedures are in use.

Key Components of Surveying Control

Key components of surveying are the establishment of control in which all future survey data will be based. Control points shall be durable in the environment they are set and uniquely and easily identified. Control points shall have specific northing, easting and elevation information attributes. From these control points, data is gathered and a data base is created. Supervisory control of all survey efforts shall be by a registered professional surveyor in the State in which surveys are performed. Quality assurance / quality control measures shall be in place to ensure proper field and office procedures.

Minimum Surveying Standards

Alabama: As indicated by statute, or as established prior to project start.

Kentucky: As indicated by statute or as established prior to project start.

Tennessee: As indicated by statute or as established prior to project start.

Accuracy Requirements & Measurement Specifications

Every determination of distance shall be made either directly or indirectly in such a manner that the linear error in the distance between any two points (not necessarily adjacent points) shall not exceed the reported distance divided by ten thousand (allowable linear error = reported distance divided by ten thousand) and every angular measurement shall be made in such a manner that the allowable (directional) error, in radians, shall not exceed the allowable linear error divided by the reported distance (allowable (directional) error = allowable linear error divided by reported distance). When the reported distance is less than two hundred feet, the linear error shall not exceed 0.02 feet. The reported distance is the distance established by the survey. The lengths and directions of the lines shall be specified so that the mathematical error in closure of the property boundary does not exceed 0.02 feet in latitudes and 0.02 feet in departure. Surveys performed using metric measurements shall utilize the metric equivalents based upon the U.S. survey foot conversion factor.

2.1 BASIS OF DESIGN REPORT

2.1.1 Definition

The Basis of Design (BOD) Report shall be developed for each specific design related project and is intended to supplement the Construction Documents. The BOD report is intended to document the design criteria and minimum standards utilized for each specific project. This guidance document shall be utilized as the initial basis for the BOD but contains only the specific standards and assumptions related to each specific project. The BOD report shall also provide relevant calculations utilized in the design.

The BOD report shall at a minimum include the following:

1. Project Description – defining the scope of work, the location and types of the facilities, purpose or intentions of the proposed improvements and the general design criteria established (i.e. TVA Guidance Document, Federal Guidelines, State or Local Guidelines)

2. Existing Site Conditions – description of the existing site and facility(s) conditions involved in the project and the associated problems necessitating the required improvements.

3. Proposed Improvements – description of the proposed improvements to each facility within the project.

4. Design Criteria – listing of the established design criteria and assumptions utilized in the design of the proposed improvements. The list should be separated into facility types or design components (i.e. Stability Analysis, Surface Water Run-off and Erosion Control, etc.) and identify the sources of each criteria listed.

5. Design Exceptions or deviations from the recommended minimum standards. This should also include an explanation or justification of the deviations from the minimum standards. Note: These should be identified as early as possible or red flagged and discussed with TVA prior to design development.

6. Design Narratives – a description or brief narrative of each design related component including the following as they pertain to the proposed improvements:

    a. Stability Analysis

    b. Leachate Management System

    c. Surface Water Run-off and Erosion Control

    d. Embankment systems

    e. Spillway / Drainage Systems

f. Haul and Service Roads

g. Special Factors

Note: Spcific calculations should be referenced and included in Appendices.

7. Construction Cost Estimate and Schedule

8. Permits – A listing of the required design and construction permits necessary for the project completion.

9. Construction or Implementation Plan - a brief description of the major construction components and a brief implementation plan identifying services or facilities that are required to be maintained during construction. Also include a list of long lead time procurement items.

10. Operational features - a brief of the operating and maintenance requirements of the proposed facilities.

11. Appendix – Supplemental Reports (i.e. Geotechnical Report**),** Detailed Calculations or modeling output, Catalogue Cuts of proposed equipment or materials specified in the design and pertinent correspondence with TVA or regulatory agencies.

2.2 CALCULATION DOCUMENTATION

The following section describes the preparation and documentation of calculations. All calculations shall be prepared and submitted to TVA using the following guidelines:

- General Information - Be neat and legible. Use a standard computation pad if performing hand-calculations and include a calculation cover sheet and table of contents. A heading should be included on all pages to reflect project, consultant name, name of person performing calculation, reviewer's name, and date. All calculations should be grouped together for various portions of a project and submitted electronically to TVA.

- Objectives - Briefly state the description and purpose of the calculation and where the result is used (e.g., drawings, specifications, equipment structure). Use sketches for clarity.

- References – List the references (reports, technical papers, codes, textbooks, etc.) on which the calculation(s) is based.

- Inputs - Define all parameters used in the calculation. This includes items such as geometry, material properties, and symbols not commonly used. Give references for values, properties and coefficients used.

- Assumptions - List all pertinent engineering assumptions made, and the basis for these assumptions.

- Methodology – Provide a narrative explaining the methodology used to implement the calculation. Show sources or derivations of equations not commonly used. Give references for methods applied. Include the name, source and revision of any technical software used to assist in performing the calculation. State the criteria for judging results, including regulatory approaches.

- Results – Provide all results pertinent to the calculation. Explain the results in a clear manner. Compare results to minimum acceptable standards, codes or commonly applied design practice.

- Conclusions – Provide a narrative interpreting the results with respect to their end-use. All recommendations concluded from the calculations should be stated in a separate report.

2.3 TRIGGER POINT MEMORANDUM

Definition

Trigger Points are design elements considered critical to a facility's integrity. Any element or specific design criteria of an engineering project considered critical to the stability or function of the facility shall be identified as a trigger point. The following section outlines a TVA strategy to identify and provide the extra attention required to manage trigger points at all TVA CCP facilities.

Selected Standard

For all major capital projects at CCP facilities, including all major permitting and construction projects, the design engineer shall develop and submit a trigger point evaluation document to TVA in the form of a brief technical memorandum. At a minimum, the trigger point memorandum shall include:

1. An introduction of the project;
2. The definition and identification of trigger points specific to the project; and,
3. Recommendations for each identified trigger point. Recommendations shall include:
    - Additional measures that may be taken to verify construction in accordance with the design specifications;
    - Recommendations to be incorporated into the inspection or maintenance programs of each identified trigger point;
    - Identification of potential problems for each trigger point; and,
    - Development of an action plan to mitigate the trigger point if potential problems are identified.

When necessary, figures or specific references to the design documents (drawings or specifications) shall be provided to aid in the identification and discussion of each trigger point. The trigger point memorandum shall be provided to TVA at the conclusion of the engineering design process and be revisited at the close of permitting and construction activities. A meeting should be held between TVA and the design engineer to discuss and clarify the findings of the trigger point memorandum as needed.

Typical trigger points for CCP facilities include, but are not limited to:

- **Material strength or construction requirements**, such as compaction or minimum material interface shear values required for the stability of the facility.
- **Critical design assumptions** that should be confirmed during construction or revisited in future design projects.
- **Systems designed to stabilize the facility**, including wick drains or underdrain systems which must function properly over the life of the facility.
- **Design elements that may be impacted by potential settlement**, such as liner and leachate collection systems, final cap systems, and structural foundations.
- **Specific areas of concern**, such as spillways or critical embankment areas.
- **Design elements requiring critical maintenance or inspection**, such as piping systems, pumping systems, embankments, or spillways critical for the facility to function as designed.

2.4 PERMIT REGULATORY REQUIREMENTS SUMMARY

A Permit Regulatory Requirements Summary shall be provided on a permit-by-permit basis by the Engineer preparing the specific permit. The Permit Regulatory Requirements Summary shall consist of the following at a minimum:

- a compilation table or summary of the key regulatory requirements by the permit,
- a description of inspections/monitoring requirements,
- a description of documentation and reporting requirements, and
- a reporting schedule.

This Permit Regulatory Requirements Summary shall be prepared by the design engineer upon receipt of the final permit. The Permit Regulatory Requirements Summary is provided for internal use by TVA and shall be regularly reviewed and updated.

2.5 OTHER RELATED DOCUMENTATION

In the preparation of design and permit documents, additional requirements are necessary. As such, the following additional plans, calculations, and reports shall be required:

1. For all permits, the following plans shall be prepared and submitted to TVA as required by regulations or in addition to:
    a. QA/QC Plan: A plan documenting the quality control items and acceptable values.

b. Waste Characterization Plan: A plan documenting the chemical characteristics of the CCP materials included in the permit as well as testing procedures and frequency.

c. Operations Plan: A plan documenting the key aspects of the operation of the facility such that the operation remains in compliance with the permit.

d. Groundwater Monitoring Plan: A plan documenting the method, frequency, data collection and processing, reporting, etc. related to groundwater quality assessment. This plan shall be prepared with the Environmental Support Group.

2. For all construction documents, the following documents shall be prepared and submitted to TVA as required by regulations, contract, or in addition to:

a. CQA requirements: Within the technical specifications for the project, construction quality assurance testing requirements shall be provided with the understanding that these items will be monitored and recorded during the construction.

This section lists the requirements of the regulations. In general, the specific requirements are not identified; and a reference to the full text of the regulation is presented instead

3.1 ENGINEERING CERTIFICATION

This section defines the certification requirements for dry ash landfills and wet ash ponds for each of the three states where TVA facilities are located. During the design, permitting, construction and operation of both permitted ash landfills and ash impoundments there are specific instances whereby a state licensed engineer is required to provide written certifications. This section provides information relative to what certifications are required in each of the states.

3.1.1 Dry Ash Landfills

Minimum Design Standards

Alabama: General design standards for solid waste disposal facilities are contained in the ADEM administrative code §335-13-4-.11 that references §§335-13-4-.12 through 335-13-4-.20 as well as §335-13-5-.02(1). These regulations require that all plans, specifications, operational procedures, letters of final construction certification and other technical data for the construction and operation of a permitted facility be prepared by a professional engineer registered in the State of Alabama. The seal or signature and registration number of the design engineer shall be affixed to the plans, specifications and reports. All legal property descriptions and survey plats shall be by a registered land surveyor (RLS) with the seal or signature and registration number of the land surveyor affixed. Landfill closure must be certified by a registered professional engineer or registered land surveyor. Alabama currently does not require CCP to be disposed on in permitted landfills. Therefore, there are no specific disposal requirements other than what is deemed necessary by the agency on a case-by-case basis. Therefore, the above certifications apply if CCP is disposed of in a permitted landfill.

Kentucky: The landfill permitting law is found in the Kentucky Revised Statutes (KRS) Chapter 224 and the regulations are in 401 Kentucky Administrative Regulations (KAR) Chapters 30, 40, 45, 47, 48, and 49. Generally the landfill application for contained landfills, construction/demolition debris landfills, and residual landfills is in three phases: the Notice of Intent, the Administrative Application, and the Technical Application; however, in Kentucky, CCP is considered a special waste. The special waste landfill application is a single phase with its own public notice requirements. The special waste requirements are found in 401 KAR Chapter 45. This regulation requires that all plans, reports, phasing, closure and post-closure plans be prepared by a professional engineer registered in the State of Kentucky.

Tennessee: Under the TDEC rules, Chapter 1200-1-7-.04 provides specific requirements for Class I, II, III and IV disposal facilities. A professional engineer registered in the State of Tennessee must plan, design, and inspect the construction of any of these facilities; also a registered professional engineer must assist in the start-up and outlining of correct operating procedures for any new or altered facility. In Tennessee, CCP's must be disposed of in either a

Class I or Class II landfill. A landfill in Tennessee for which only CCP waste is disposed would be subject to the Class II standards.

Federal: 40 CFR 258 establishes the design criteria for new nonhazardous waste disposal facilities and lateral expansions of existing facilities. However, a plan approved by the division director of an approved state will meet the specifications of this rule. Since each of the three states is an approved state, there are no additional federal requirements.

Selected Standard

For all projects governed by regulations that require engineering certification, these activities shall be completed and submitted to the Agency accordingly.

For projects not governed by regulations that require engineering certification, these activities shall be completed and submitted to TVA for project documentation. In this way, the information shall be available for these projects upon request.

3.1.2 Wet Ash Ponds (Impoundments and Dams)

None of the states or the federal regulations specifically address engineering certification of non-hazardous waste impoundments. However, if the structure provides treatment prior to discharge through a permitted outfall, a professional engineer certification may be required. Additionally, if the structure has a dam, as defined by the applicable regulations (1200-5-7), certification would be required in each state. However, according to the TVA Dam Safety Program, state dam safety regulations do not apply. Rather, the TVA Dam Safety Program follows Federal programs in these regards. The following sections for each state are therefore provided for reference only,

Alabama: The ADEM Water Division – Industrial Section provides Construction Guidelines for Industrial Wastewater Impoundments (Rev. 03/00). These guidelines state that a professional engineer should supervise construction and verify that engineering requirements and best engineering construction practices are met during construction. The guidelines further state that after construction is complete, a professional engineer should submit a letter of certification stating that the impoundment was built in conformity with the engineering requirements listed above or alternate requirements determined acceptable by the Department, any stipulations specified by the Department, and the initial submittal. If the impoundment differs from the initial submittal, 'as built' drawings should be submitted.

Kentucky: Certification of KPDES permit applications and reports are defined in 401 KAR 5.060 Section 9. However, this certification is not required to be stamped by a professional engineer. Additionally, there are no specific engineering certification requirements for impoundments other than those required for dam safety. All plans and specifications submitted for consideration of a dam must bear the seal and signature of the responsible engineer as defined in KRS 322.010(2), except officers and employees of the United States government while engaged in engineering for the government. Each sheet of the drawings shall bear the seal and signature of the engineer or engineers responsible for its preparation (Title 401 Chapter 4, Section 030).

Tennessee: Whenever any new construction or change in existing construction in a wastewater treatment facility is performed, a registered engineer must plan, design, and inspect the construction of such works (TN Rule 1200-4-2-.01). The certified plans must be submitted to TDEC as part of the application for a NPDES permit. Additionally, should the structure require a dam, as defined in TN Rule 1200-5-7-.02(10), a qualified professional engineer must prepare design and specification and supervise the construction. An application for an operating certificate must be submitted to TDEC.

Federal: Since all three of the states in which TVA has facilities are approved states under the NPDES program (40CFR123), no additional certification to the USEPA is required. The federal government does not have governing dam safety certifications.

3.2 BORROW SOURCE REQUIREMENTS

This section will present the applicable regulatory requirements for investigation and testing of soil borrow material sources and provide recommendations on the related procedures. The purpose of borrow material testing is to prequalify the proposed soils intended for use as natural liner or closure materials for landfill or pond constructions. Prequalification is conducted so that the engineer and/or construction contractor have advance knowledge of whether the planned borrow source materials will most likely meet the required design specifications for use as natural liner or closure materials. Potential borrow source materials should be inspected, sampled, and tested prior to their use under the direction of a qualified, geotechnical or landfill engineer. The following subsections discuss sampling, testing and stockpile management in relation to soil borrow source materials.

3.2.1 Sampling

Several methods exist for sampling proposed soil borrow sources. Samples can be obtained by drilling soil borings and recovering samples of the soil from the borings or excavating test pits into the borrow source and collecting bulk samples from the exposed cuts. Excavating test pits in the borrow source provides greater information about the variability of the soils and potential stratigraphic changes than viewing small soil samples recovered from soil borings and is therefore the preferred method.

Qualified field personnel, typically a representative of the design engineer firm or third party QA/QC firm, should be present during sampling to ensure the collection of high quality samples, and to provide an accurate representation of the soil conditions. Samples of approximately 50 pounds should be collected from specified depth intervals at each test pit location and stored in a clean 5-gallon sample bucket. Samples should be collected at specified depth intervals as appropriate to ensure complete coverage of the borrow source and to satisfy the sampling frequency. Small samples of the soil should be placed in a sealed plastic bag to determine the in-situ moisture content of the soil. The sealed plastic bag should be placed inside of the 5-gallon bucket for shipping. Samples should be shipped at the end of the sampling process to a qualified geotechnical laboratory for analysis.

3.2.2 Testing

Samples taken from the borrow source should be tested to ensure conformance with specifications for parameters defined in the design documents such as percent fines and plasticity index. The soil samples will undergo preliminary testing referred to as index testing. Index or characterization testing will determine if the borrow source samples meet the minimum criteria to be considered as natural liner or closure materials for landfills or ponds. Index testing includes Moisture Content, Atterberg Limits, Particle Size Analysis, and Standard or Modified Proctor Tests. Hydraulic Conductivity testing is performed on borrow source materials that are determined to meet the minimum specifications through index testing. Hydraulic conductivity tests are performed on soils to verify that the potential soil liner or cap material can be compacted to achieve the required low hydraulic conductivity determined by the design engineer.

Minimum Design Standard

Alabama: There are no state regulatory requirements governing the frequency of testing of soil borrow sources for the state of Alabama.

Kentucky: There are no state regulatory requirements governing the frequency of testing of soil borrow sources for Special Waste Landfills. There are, however, minimum requirements for contained landfills (MSW) as specified in 401 KAR 48:80 Section 4, which provides the following testing frequencies for proposed natural liner and cap soils. Table 2.2.2-1 provides American Society for Testing and Materials (ASTM) specifications and recommended frequencies for soil borrow source material investigations in Kentucky.

Table 3.2.2-1

ASTM Specifications and Recommended Frequencies for Soil Borrow Source Material Investigations in Kentucky

Test	Frequency	ASTM Standard
Moisture Content	1 / 2,000 cubic yards	ASTM D 2216
Particle Size Analysis / Soil Classification	1 / 2,000 cubic yards	ASTM D 422
Atterberg Limits	1 / 2,000 cubic yards	ASTM D 4318
Standard or Modified Proctor Test	1 / 20,000 cubic yards	ASTM D 698 ASTM D 1557
Hydraulic Conductivity	1 / 20,000 cubic yards	ASTM D 5084

Tennessee: There are no state regulatory requirements governing the testing of soil borrow sources for the state of Tennessee.

Selected Design Standard

Table 2.2.2-2 provides ASTM specifications and recommended frequencies for soil borrow source material investigations.

Table 3.2.2-2

ASTM Specifications and Recommended Frequencies for Soil Borrow Source Material Investigations

Test	Frequency	ASTM Standard
Moisture Content	1 / 2,000 cubic yards	ASTM D 2216
Particle Size Analysis / Soil Classification	1 / 2,000 cubic yards	ASTM D 422
Atterberg Limit Determination	1 / 2,000 cubic yards	ASTM D 4318
Standard Proctor Test or Modified Proctor Test	1 / 10,000 cubic yards	ASTM D 698 ASTM D 1557
Hydraulic Conductivity	1 / 10,000 cubic yards	ASTM D 5084

3.2.3 Stockpile Management

Soil borrow materials that have been pre-qualified via the testing and analysis program (and are thus determined to meet the criteria for soil liner or cap material) shall be excavated and stockpiled on-site. Stockpiles should be constructed in accordance with these recommended guidelines:

- Locate stockpiles in a strategic location to minimize haul distance and double handling;
- Do not stockpile soils in a location which will interfere with the natural drainage tendencies of the surrounding areas;
- Stockpile soils a minimum of 50-feet away from concentrated flows of stormwater, drainage courses, and inlets;
- Slope stockpile to promote drainage;
- Protect soil stockpiles from stormwater run-on with temporary perimeter barriers such as berms, dikes, silt fencing, or hay bales; and

- Provide temporary seeding in accordance with erosion and sediment control regulations as discussed in the Soil Erosion Section (Section 1.6.1) of this Volume.

3.3 AGENCY NOTIFICATIONS AND RESTRICTIONS

Definition

Agency notifications by way of applications, correspondence, etc are required for permitted facilities in accordance with several state and federal regulations. This section summarizes general notification requirements for the states and government and then provides a reference to the notification requirements. Additionally, in order to do significant work affecting federally controlled properties (i.e. work in which federal funds are used, work requiring federally issued permits such as USA COE Section 10 and Section 404 permits or TVA Section 26a permits) a number of federal agencies must be notified. These agencies, notified as part of the NEPA process, are listed in the sections which follow.

3.3.1 Dry Ash Landfill

Alabama**:** The notification process for a permitted landfill in Alabama requires notification to ADEM through the application process (ADEM Rule 333-13-5). However, prior to ADEM's beginning review of a new permit application the local government with jurisdiction over the proposed landfill site must approve the location, after involving the public in the siting process (Code of Alabama 1975, §22-27-48). A pre-application conference with the technical staff of the Land Division and the applicant's representatives to discuss specific requirements for the application is recommended. Specific processing steps and time periods are provided so that the applicant can include these tasks in the overall planning of the project development. In some instances, all necessary media-specific permit applications can be processed on parallel tracks. Applications for construction or modification of an existing landfill should be made at least 180 days in advance of start of construction.

Since construction of a landfill by TVA would involve federally owned property or federal funding, an environmental assessment (EA) of the project would be reviewed through the NEPA process. Numerous state and federal agencies are included in the scoping and coordination of the NEPA process. In Alabama these include: Alabama Historical Commission, ADEM Division of Water Quality, Division of Solid Waste, Division of Air, Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries, Alabama National Floodplain Insurance Program, as well as numerous other state, local, and federal agencies.

Kentucky: Prior to submitting an application for a special waste landfill permit, as required by 401 KAR 45:030, a meeting should be scheduled with the Division of Waste Management concerning the location of the site and to review the potential need of additional permits that might be necessary for the project, such as KPDES discharge permits, floodplain permit, transportation permit, etc. The division has a list of agencies and points of contacts for these other permits. Division staff is also available to discuss the permitting and public notification

process. Once an application is deemed complete, the state's timeline for issuing a preliminary decision to deny the permit is 180 calendar days. If the decision is made to issue the permit, a draft permit is prepared and 30-day public notice is published. Depending on the comments received, the construction permit may be issued soon after the comment periods, or if more concerns are identified, it may take several months.

As with Alabama, construction of a landfill in Kentucky would involve federally owned property or federal funding, and an EA of the project would be reviewed through the NEPA process. Coordination would be required with the State Historic Preservation Officer, Kentucky Department of Environmental Protection (Air, Water and Solid Waste), State Fish and Game agencies, Forest Service, Economic and Community Development, Agriculture Transportation and others. Federal agency coordination is described below.

Tennessee**:** The notification process for a landfill in Tennessee requires notification to the Division of Solid Waste Management through the local field office. In accordance with TDEC Rule 1200-1-7-.02(2), a Part I and Part II application, along with the application fee, must be submitted before the application is deemed complete. The Part I application (Form CN-1036) which includes the name, address and phone numbers of the owner(s); proposed activities to be conducted at the facility; a statement regarding whether the facility is subject to local approval (TCA § 68-211-701) and county approval if necessary, a topographic map and disclosure statement. The Part II includes: a hydrogeologic assessment of the potential site; facility design plans and operations manual; financial assurance demonstrating the financial responsibility for closure and post-closure care; and other specific requirements for Class I, II, III, and IV disposal facilities.

After the Part I application is received and reviewed for completeness, a preliminary public notice is issued. The state archeologist reviews the site for the existence of burial grounds. The Part II items are then submitted to the Division and are reviewed by a committee. When all documents and approvals have been met, a second public notice of intent to issue a permit is issued. Public response to this second notice may generate another public notice to hold a public hearing. If requested, the Division may give notice of a public hearing concurrently with the second public notice of intent to issue a permit. After review of the public comments, a final public notice with the permit decision is issued. The entire permit process may take from 12 months or longer, depending on the type of facility, public interest, public hearings, revisions, appeals, and site preparation.

Since construction of the landfill would involve federally owned property or federal funding, an EA of the project would be reviewed through the NEPA process. Within the state of Tennessee there are a total of six departments that must be notified prior to construction if any of the following issue categories are pertinent to the NEPA review. These departments and their divisions that should be included in the review process if there are issues pertinent to that division include:

- TN Department of Environment and Conservation (TDEC) Divisions: Threatened and Endangered Species and Wild/Scenic Rivers; State Parks; Public Recreation; Water; Air;

Surface/subsurface Drinking Water Sources; Septic Systems; Superfund; Underground Storage Tanks; Solid/Hazardous Waste; and Radiological Health.

- TDEC Tennessee Historical Commission
- Tennessee Department of Agriculture
- Tennessee Department of Transportation
- Tennessee Wildlife Resources Agency
- Tennessee Department of Economic and Community Development.

Federal**:** Construction of a landfill in any of the three states would involve federally owned property or federal funding; therefore an EA of the project would be reviewed through the NEPA process. Federal agencies that are included in the NEPA process include:

- US Fish and Wildlife Service
- US Forest Service
- Natural Resources Conservation Service
- Native American Tribes (United Southeastern Tribes – USET)
- US Army Corps of Engineers
- US Environmental Protection Agency
- Tennessee Valley Authority

3.3.2 Wet Ash Ponds (Impoundments and Dams)

According to the TVA Dam Safety Program, state dam safety regulations do not apply. Rather, the TVA Dam Safety Program follows Federal programs in these regards. The following sections for each state are therefore provided for reference only.

Alabama: ADEM regulations do not specifically address wet ash impoundments or dams. Prior to any construction of a new wet ash impoundment or modification to an existing impoundment whereby water may be discharged, an application to ADEM's Water Division must be made in accordance with rules provided in Chapters 335-6-6. The application must include technical components of the control structures, BMPs, etc.

Kentucky: The Kentucky DEP regulations do not specifically address wet ash impoundments. Prior to any construction of a new wet ash impoundment or modification to an existing impoundment whereby water may be discharged, an application to KDEP in accordance with 401 KAR 5:060 must be submitted and a permit issued. The technical and administrative

requirements are similar to other states, such as Alabama (above) that have permit programs approved by the EPA, with the exception that the Dam Safety Section and Floodplain Compliance Section requirements for dam construction would be part of the submittal package. Regulations relating to dam safety are in Kentucky Administrative Regulations Chapter 4, Title 401, Water Resources.

Tennessee: TDEC regulations do not specifically address wet ash impoundments. However, prior to any construction of a new wet ash impoundment or modification to an existing impoundment whereby water may be discharged, an application to TDEC Division of Water Pollution Control must be made in accordance with TDEC Rule 1200-4-5-.05. The technical and administrative requirements are similar to other states, such as Alabama (above) that have permit programs approved by EPA.

Federal: Since all three of the states in which TVA has facilities are approved states under the NPDES program (40 CFR 122), no additional notification to USEPA are required. In the case of new land disturbances or federal properties, the NEPA notification for wet ash ponds is the same as for dry ash landfills (Section 3.3.1).

3.4 GENERAL CONSTRUCTION PERMITS (LOCAL, STATE, AND FEDERAL)

Definition

If a facility plans to clear, grade, or excavate an area of one or more acres, a stormwater construction permit is required by all states in the TVA region. This section outlines the general requirement necessary for obtaining such permits

3.4.1 Dry Ash Landfills

Alabama: The rules for storm water construction permits require an operator/owner to register construction activities and associated areas one acre or greater in size. Construction activities less than one acre in size that are part of or associated with a larger plan of development or sale that might eventually exceed one acre, must register. In addition, construction activities less than one acre in size that are determined by ADEM to have significant potential to cause or contribute to water quality impairment, may be required to register.

These rules require that a Construction Best Management Practices Plan (CBMPP), prepared by a qualified credentialed professional (QCP), and designed to minimize pollutant discharges in stormwater runoff to the maximum extent practicable during land disturbance activities, be fully implemented and effectively maintained. A CBMPP is required to be submitted with the request for registration for proposed discharges to a Tier 1 waterbody(s), proposed discharges to an Outstanding National Resource Water (ONRW) designated waterbody, and for projects involving waterbody relocation or significant alteration. NPDES registration coverage must be retained until all disturbed areas have been reclaimed and/or effective storm water quality remediation has been achieved.

Kentucky: The storm water construction permit requires any agency, company or individual planning construction activity in Kentucky disturbing one acre or more to:

- Develop and implement a "Storm Water Best Management Practices Plan." Among the requirements of this plan is that there be provisions for inspections every seven days and after each rain of one-half inch or more.

- Submit a signed Notice of Intent (NOI) form to Kentucky Division of Water at least 7 day before construction begins (if filed electronically and 30 days if paper filled.

- Submit a copy of the NOI to the municipal operator of any municipal separate storm sewer system (MS4) the site discharges into. Note that a NOI is now not required on activities at a facility that is covered under an NPDES permit.

- Submit a signed Notice of Termination (NOT) form to the Kentucky Division of Water after construction activity has ceased and the site has been finally stabilized.

Tennessee: Applicants must submit the following information for a Storm Water Construction Permit:

- A completed and signed NOI for Construction Activity - Storm Water Discharges. The NOI must include a map on 8 ½ inch by 11 inch paper with boundaries 1-2 miles outside the site property with the site and construction area outlined and the receiving water or receiving storm sewer highlighted and identified. It is preferable for this map to be the appropriate portion of a USGS 7.5-minute quadrangle map.

- A site-specific SWPPP must be developed and submitted with the NOI. The SWPPP must be developed, implemented, and updated according to Part 3 of the Construction General Permit (CGP).

Federal: Construction permits follow state regulations in all states of the TVA Region. The NEPA process must be followed for any construction that involves significant work affecting federally controlled properties. Certain project activities can trigger the need for an EA under NEPA. Pursuant to the Council on Environmental Quality (CEQ) regulations (40 CFR 1500-1508) for implementing the procedural provisions of the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 et seq.), an EA of potential environmental effects associated with federally funded projects is required. Other federal permits include Section 404 (for activities that impact waters of the United States) and/or Section 10 (for activities that impact navigation) with Joint Section 26a TVA permits. Where there are results of an EA warrant, an environmental impact statement (EIS) may be required. In industrial development type projects, an EA and possibly an EIS may be triggered by:

- Significant work affecting federally controlled properties. In Tennessee this is most often work on properties controlled by the Corps of Engineers or TVA;

- Work requiring federally issued permits such as Corps Section 10 and 404 permits or TVA Section 26a permits;

- Project work for which federal funds are used.

See Section 3.3 for agencies which require notification. The lead agency is identified by the category of impact. If a 404 permit is required, the USACE is the lead reviewing agency. Following notification to the agencies, an EA will be prepared by, or on behalf of the applicant.

3.4.2 Wet Ash Ponds (Impoundments and Dams)

The storm water general construction permitting requirements for dry ash landfills would be applicable to wet ash impoundments as well. The rule is based on the one acre disturbance and requirement of a storm water construction permit. In addition, to the storm water construction permit, and subsequent NEPA process, impoundments are subject to Dam Safety Compliance. According to the TVA Dam Safety Program, state dam safety regulations do not apply. Rather, the TVA Dam Safety Program follows Federal programs in these regards. The following sections for each state are therefore provided for reference only.

Alabama**:** see Section 3.3.2

Kentucky: see Section 3.3.2

Tennessee: see Section 3.3.2

Federal: see Section 3.3.2

This section addresses the various elements of managing construction projects within TVA. There are no references to specific regulations as these do not apply, but rather, the information presented herein is consistent with TVA's procedural and organizational approaches to management of construction project with either TVA or a Consultant in the roles defined.

4.1 OVERVIEW OF BID, EVALUATION, AND CONTRACT AWARD PROCESS

Bidding is the procurement of goods or services through a process of open and free competition. There are generally two types of bid processes, Request for Proposal and Competitive Bidding using Sealed Bids. Bids are evaluated and awarded based on a system of assessment criteria.

Prior to the bid process, the first step to successfully bidding a project for construction is to have a clearly defined project. An engineering firm or TVA depending on size/type of project should develop a complete set of design documents including drawings and specifications. This construction package should be reviewed and approved by the Owner prior to being issued for bid. It is from this construction package that a RFP will be developed.

The bid process begins through the development of the scope of work (SOW) statement (description of services) or specifications (description of goods), proposal evaluation criteria, and a recommended sources list. These are submitted to the Purchasing Department, which takes this SOW or specifications and develops a complete RFP including standard contract clauses, special clauses, instructions to prospective bidders, and any requisite technical exhibits or attachments. The RFP states a specific date and time deadline for proposal receipt and often has mandatory pre-bid meetings for bidders to attend. This meeting offers the opportunity to ask questions and gives the Owner a chance to determine whether any changes (addenda) need to be issued to the RFP. This is also an excellent time to conduct any requisite site visits to familiarize bidders with the project site(s).

After proposals are received, they are evaluated against the criteria stipulated in the RFP. After evaluating the proposals, the Owner chooses the awarded firm. Once approved, a purchase order and/or contract are processed. The following sections provide a general discussion of the bidding, evaluation, and contract award process.

4.1.1 Developing the Scope of Work

A well-written scope of work is critical to the success of a contract. A good scope of work is clear, complete, and logical enough to be understood by the bidder and Owner. Because it describes the details of performance, it is the yardstick against which the bidder's performance is measured. The structure of the document is meant to organize a bidder's response. It may be helpful to organize the RFP document in numbered sections, and require the bidders to use this same numbering/sectioning format in their responses. This ensures clarity and consistency in the RFP and in the bidders' responses, and will make the evaluation and selection process easier.

- Suggested Content - Introduction and general information, task description, constraints on the contractor, contractor personnel requirements, Owner responsibilities, special conditions, and evaluation criteria.

4.1.2 Developing a List of Bidders

A list of bidders should be developed in order to solicit bids from qualified contractors. The number of bidders can vary depending upon the size of the scope, corporate requirements, and availability of qualified bidders. The bidders listed will receive a construction document package including the RFP, construction documents, and drawings. The list of bidders should be limited to contractors that meet a series of defined criteria. Contractors should be "pre-qualified" prior to being included on the bidders list. The development of bidder's qualifications will limit the list of bidders to contractors that possess the ability, manpower, equipment, performance reputation, and experience to perform the work defined in the RFP. A list of qualifications should be developed and demonstrated by potential bidders.

- Suggested list of bidder qualifications (experience, minority requirements, safety record (OSHA), and union requirements)

4.1.3 Bidding

A pre-bid meeting is typically held to issue the RFP and a set of Contract Documents to the qualified bidders. The pre-bid meeting provides the Owner an opportunity to describe the project scope, introduce the engineer and key project personnel, define roles and responsibilities, and answer questions. Bidders are typically given the opportunity to request additional information or clarifications in writing prior to the bid submittal date. In addition, the Owner will notify the bidders of the specific date and time for bids to be submitted as well as the expected award date. Bidders may also be given the opportunity to visit the project site(s).

4.1.4 Developing Proposal Evaluation Criteria

A prerequisite for award is that the bidder must be responsible and must submit a responsive offer. To be responsible means the bidder has the requisite business integrity, as well as financial and organizational capacities, to ensure good-faith performance. To be responsive, an offer must conform in all material respects to the RFP or at least offer valid alternatives such that all aspects of the RFP are addressed. Nonresponsive offers, those bids that do not address all aspects of the RFP nor detail valid alternatives, will not be considered. Beyond these two basic criteria, the proposal evaluation criteria, which are published in the RFP aid in the selection of the bidder.

A comparative analyses of different bidder's proposals must be defensible and objective. This makes the drafting of reasonable and definitive evaluation criteria very important to the RFP and source selection process.

Some evaluation criteria to consider for inclusion in the RFP are as follows: (1) performance record of the contractor, (2) safety record, (3) relevant experience in providing comparable services on projects of similar size and scope, (4) overall quality of proposal, and (5) pricing.

The RFP should contain a cost proposal format that allows the bidders to explicitly identify their charges for the deliverables identified in the project. Deliverables must be well defined so that all bidders can respond to the same deliverables thus allowing the Owner to make comparative analyses of the bidder's costs.

4.1.5 Evaluating the Proposal

After the Purchasing Department has reviewed each bidder's proposal to determine that they are complete, the proposals are then forwarded to the department and/or committee members for evaluation. During the period of evaluation and prior to award, possession of proposals and accompanying information is limited to personnel responsible for participating in the evaluation. Any communications with bidders must be approved in advance through the purchasing agent handling the bid process.

Recommendation for award must be in written form and must address how each bidder has met or failed to meet the evaluation criteria stated in the RFP. All areas of non-conformity with any terms, conditions, or listed specifications shall be clearly stated in the evaluation.

To assist those individuals responsible for evaluating proposals, the Purchasing Department creates an evaluation matrix, based upon evaluation factors listed in the RFP. This matrix is a tool to assist those evaluating the proposals.

4.1.6 Awarding the Contract

Based on the evaluation process, a clear choice should present itself. The contract is awarded to the bidder that best meets the evaluation criteria. The Owner will issue a Letter of Intent to the apparent winning bidder and contract negotiations will follow. The Owner and winning bidder will enter into a contract and a Notice to Proceed will be issued.

4.2 CONSTRUCTION MANAGEMENT

Construction Managers are often contracted by the owner to oversee a project's completion. The American Society of Civil Engineers (ASCE) Committee on Construction Management accepts the concept of construction management being performed by the firm responsible for the design. However, construction management is typically conducted by a third party firm not involved in the design or construction of the project.

4.2.1 Construction Manager – TVA Employee

The role of the construction manager is solely dependent on the needs and preferences of the owner. Comprehensive construction managers provide a wide range of services and can be

involved in both the design and construction phases of a project. In general, a construction manager provides leadership to the construction team, and coordinates between the owner, engineer, and contractor to plan and oversee the completion of a project. Responsibilities of the construction manager may include:

- Performing constructability analysis and reviews of design submittals and contract documents during the design phase of the project.
- Bid opening and evaluation, and assistance in contractor selection.
- Managing the project budget for the owner.
- Monitoring construction progress and maintaining the project schedule.
- Advising on and coordinating the procurement of materials and equipment.
- Coordinating between the owner, engineer, and contractor to resolve design and construction issues.
- Providing general construction oversight to monitor conformity with construction requirements.
- Contract administration.
- Senior site representative leading progress meetings.
- Acting as a day to day liaison between the Owner, Construction Quality Assurance (CQA) Consultant, and the Contractor
- Interpreting construction plans, specifications, and contracts.
- Overseeing day to day activities and generating progress reports.
- Maintaining the logs, data, files, and correspondence for the field records.

4.2.2 Resident Engineer – TVA Employee / Third Party

The CQA Resident Engineer acts as the engineering site representative for the inspection of contractor construction activities. The CQA Resident Engineer is generally responsible for:

- Planning, organizing, and executing resident engineering activities.
- Review submittals for compliance with engineering design.
- Coordinating between the Owner, Engineer, and Contractor to resolve design issues.
- Coordinating responses to RFI's and other technical issues with design engineers.
- Providing engineering oversight and assuring compliance with the engineered design.

4.3 CQA CONSULTANT – THIRD PARTY

The CQA Consultant is responsible for making observations and performing field tests to ensure that a facility is constructed in accordance with the applicable plans, and specifications and QA/QC Plan. The following section provides a description of the typical CQA Consultant team, including each member's roles and responsibilities.

4.3.1 Certifying Engineer

The CQA Certifying Engineer is responsible for certifying to the Owner and the permitting agency that the facility has been constructed in accordance with the plans, drawings, and the approved CQA Plan. The certifying engineer serves as the Professional Engineer for the project and properly certifies the as-built construction certification report.

4.3.2 Project Engineer

The CQA Project Engineer is responsible for providing engineering and technical support to the field CQA team throughout the construction process. The Project Engineer works closely with the Construction Manager to assist with calculations and complete take-offs in support of as-built quantities for payment. The Project Engineer also responds to contractor RFIs, reviews and maintains QA/QC data and coordinates all supplementary laboratory testing of geosynthetics and soils.

4.3.3 Field Technicians

Field Technicians provide general inspection of materials, equipment, and workmanship under the direction of the CQA Resident Engineer. Specific duties include conducting in-situ nuclear density testing and in-place geosynthetic testing, field testing and verifying compliance with standards. Field technicians are also responsible for maintaining testing data logs and daily reports.

4.3.4 Scheduler / Administrative Personnel

The scheduler / administrator is responsible for file management, invoicing and billing, and maintaining the schedule. The scheduler assembles documentation from the project team and maintains the files. The scheduler is responsible for reviewing and incorporating monthly invoices into tracking forms, and issuing payments for services and materials.

4.3.5 Soils / Geosynthetics Laboratory

Soils and Geosynthetic Laboratories are responsible for performing specific tests on materials submitted for testing. The laboratories are responsible for ensuring that tests are performed in accordance with applicable standards, following internal QC procedures, maintaining chain-of-custody records, and accurately reporting data. The testing lab should be accredited. For

geosynthetic material testing, such an accreditation is available through the Geosynthetic Accreditation Institute Laboratory Accreditation Program (GAI-LAP).

4.4 CONSTRUCTION DOCUMENTATION PREPARATION

Definition

A Construction Certification Report (Certification Report) is a report that documents construction activities and provides record of a project's completion in accordance with applicable design drawings, specifications, and CQA Plan.

Minimum Standards

The minimum regulatory requirements for providing construction certification reports are outlined below:

Alabama: There are no specific requirements related to the preparation or submittal of construction certification documents in Alabama.

Kentucky: As stated in 401 KAR 45:030 Section 9(11), prior to receiving a construction/operation permit from the Kentucky DEP, a certification must be submitted by a registered engineer that the liner system, if required, and other features have been constructed in accordance with the approved plans a specifications.

Tennessee: Rule 1200-1-7-.04(1)(c) requires that a registered engineer must inspect the construction of any Class I, II, III, or IV disposal facility, but does not appear to require the submittal of construction inspection documentation. However, the requirement to submit construction QA/QC documentation may be a specific condition of the TDEC permit.

Depending on the nature and scope of the project, the Construction Certification Report may need to be submitted to the governing regulatory agency for review. The governing regulatory agency should be notified during the design phase of all construction projects to determine what, if any, construction documentation is required to be submitted for approval.

Selected Standard

It is recommended that a Construction Certification Report be prepared by the CQA Consultant for all major construction activities. At a minimum, the Certification Report shall include the following elements:

- Introduction: An introduction and description of the construction project, including tasks to be completed, a timeline of construction activities, and any applicable permits authorizing the construction activity.

- Personnel: A listing of all personnel associated with the construction, including TVA Construction Managers, Resident Engineers, CQA Consultant, and all Contractors associated with the construction.

- Alterations to the Design: Should the design be modified during construction activities, a description of each specific design alteration shall be discussed.

- Impacts to Construction: A general discussion of impacts to the construction project, such as any weather delays or mechanical failure of construction equipment shall be included.

- Construction Narrative: The construction narrative provides the main body of the Certification Report. A narrative description of each construction activity shall be included to describe the construction activities performed such that an outside party could review and adequately understand the construction. The narrative shall include, at a minimum, the duration and dates of completion for each construction activity and should reference all CQA testing and documentation procedures performed as part of each construction activity.

- Daily Reports: The CQA Consultant shall complete daily reports of construction activities to document the construction and aid in the completion of the Certification Report.

- Photo Logs: In addition to daily reports, a log of photographs shall be maintained by the CQA Consultant and included in the Certification Report.

- CQA Test Results: The results of all CQA testing required in the CQA Plan shall be included in the Certification Report.

- Other CQA Documentation: Each construction activity may require the completion of specific CQA documentation. Examples of such documentation include subgrade acceptance forms and geosynthetic seam and repair logs. Required CQA documentation shall be described in the CQA Plan and completed documentation shall be included in the Certification Report to verify that the construction has been completed in accordance with the CQA Plan.

- Record (As-Built) Drawings: A package of Record Drawings shall be completed for each construction project. Typically, the record drawings include as-built surveys for each construction milestone. The CQA Plan shall provide specific instruction related to the record surveys required, and the specific elements to be included in each record drawing.

  Record surveys are to be completed by the Contractor and provided to TVA and the CQA Consultant to verify that the construction milestone has been completed in accordance with the applicable Design Drawings and Specifications. For example, in the construction of a new facility, a record survey of the excavation or subgrade may be required prior to the construction of the facility liner system. Once the record survey has been completed and submitted to the CQA Consultant, the Certifying Engineer will review the survey and either accept the record survey, or reject the record survey and provide guidance on the remedies or alterations required. The construction milestone

should be considered complete only after the CQA Consultant provides approval of the record survey. Record Survey data will be submitted to TVA and documented in the TVA surveying system. TVA reserves the right to perform the Record Survey in lieu of the contractor.

In addition to record surveys, the Resident Engineer shall maintain a set of the Design Drawings and make note of any changes to the design. These as-built notations shall be combined with the record surveys by the CQA Consultant into a final package of Record Drawings.

- Notarized Statement of Accuracy: The Certification Report shall include a statement that the documentation provided in the Certification Report is true and accurate. The statement shall be notarized and signed and by the Certifying Engineer and TVA management personnel.

5.1 CLOSURE REQUIREMENTS

This section identifies regulatory requirements for closure of dry ash landfills and wet ash impoundments in each of the three states in which TVA has facilities.

Definitions

Alabama: In Alabama, closure is the process by which a landfill unit permanently ceases to accept waste, to include those actions taken by the permittee or owner of the facility to prepare the site for post-closure monitoring and maintenance or to make it suitable for other uses.

Kentucky: In Kentucky, closure means the time at which a waste treatment, storage, or disposal facility permanently ceases to accept wastes, and includes those actions taken by the owner or operator of the facility to prepare the site for post-closure monitoring and maintenance or to make it suitable for other uses (KRS 224.01-010(4).

Tennessee: In Tennessee, closure means taking the actions at the termination of a disposal operation that are necessary to finally close the disposal facility or disposal facility parcel.

5.1.1 Dry Ash Landfills

Alabama: The closure requirements for a permitted landfill facility are contained in the ADEM administrative code §335-13-4-.20. The closure plan must be submitted as part of the permit application to the Department. This plan must address specific elements of the cover system, which for municipal and industrial waste landfills includes an infiltration layer equal to the permeability of the bottom liner system or 1 X 10^{-5} cm/sec, whichever is less, and an erosion layer on minimum of 6 inches of earthen material capable of sustaining native plant growth. For permitted special waste landfills, the cover system must be constructed in a manner deemed necessary by the Department on a case by case basis. The length of time necessary for post-closure care is established by the Department.

Kentucky: The closure requirements for a special waste landfill are contained in 401 KAR 45:110 Section 5. As part of the initial permit application, the applicant must submit a closure plan for approval that specifies the design of the final cover including functionality, erodibility, stability, etc. The closure plan design shall comply with 401 KAR 30:031 performance standards including, but not limited to, no discharge of pollutants into the waters of the state no release to underground drinking water source beyond the point of compliance in excess of maximum contaminant levels (MCL's).

Tennessee: The closure requirements for a permitted landfill facility are contained in Tennessee Division of Solid Waste Management Rule 1200-1-7-.04. The closure plan must be submitted as part of the permit application to the Department. This plan must address specific elements of the cover system, which for Class II landfills includes a 24 inch compacted soil layer with a permeability equal to that of the bottom liner system or 1 X 10^{-7} cm/sec, whichever is less, and a vegetative layer of a minimum thickness of 12 inches. By regulation the agency can approve an alternate cover if it can be demonstrated to provide equivalent or superior performance. The

length of time necessary for post-closure care is 30 years unless alternate period is established by the Department.

Federal: Tennessee, Alabama and Kentucky have developed and implemented a Subtitle D permit program and therefore, provided USEPA does not determine in the future that their programs are inadequate; there will be no additional federal requirements.

5.1.2 Wet Ash Ponds (Impoundments)

According to the TVA Dam Safety Program, state dam safety regulations do not apply. Rather, the TVA Dam Safety Program follows Federal programs in these regards. The following sections for each state are therefore provided for reference only.

Alabama: Although there are no regulations that specifically address the closure of wastewater impoundments, ADEM has promulgated guidance. This document, titled The ADEM Water Division – Industrial Section provides Closure Guidelines for Industrial Wastewater Impoundments (Rev. 03/00), requires the submittal of a site specific closure plan. This plan must be certified by a professional engineer if it involves the practice of engineering and certified by a professional geologist if it involves the public practice of geology. The only regulatory citation in the guidelines has to do with the cap design meeting the requirements of ADEM Solid Waste Rule 335-13-4-.20(2). Alabama currently has no dam safety legislation or formal dam safety program. Currently the Alabama Dam Security and Safety Initiative has been created to establish dam safety laws and regulations in Alabama.

Kentucky: Kentucky does not have any specific regulations relative to closure of nonhazardous wastewater impoundments nor does it provide formal closure and post-closure guidelines for impoundments. The Kentucky Water Quality Control Act prohibits the discharge of any substance into the waters of the state that could cause damages or pollution to such waters. Therefore, each impoundment must be properly closed to eliminate discharge of pollutant to both the surface water and ground water. Although not specifically addressed in the Groundwater Protection Plan required by 401 KAR 5:037, it is recommended that this plan address proper closure of all wastewater impoundments to ensure protection of all current and future uses of groundwater and to prevent groundwater pollution. Both the Kentucky Division of Waste Management and Division of Water should be notified of intent to close an impoundment in order to get approval of proposed procedure.

Tennessee: Tennessee does not have any specific regulations relative to closure of nonhazardous wastewater impoundments nor does it provide formal closure and post-closure guidelines for impoundments. The Tennessee Water Quality Control Act prohibits the discharge of any substance into the waters of the state that could cause damages or pollution to such waters. Therefore, each impoundment must be properly closed to eliminate discharge of pollutant to both the surface water and ground water. Both the Tennessee Division of Solid Waste and Division of Water Pollution Control should be notified of intent to close an impoundment to obtain approval of proposed procedure.

Federal**:** There are no specific federal requirements for wastewater impoundment enclosures.

6.1 POST-CLOSURE REQUIREMENTS

This section identifies state and federal regulatory requirements for post-closure for each type of facility.

Definition

Post-closure requirements are requirements that must be met following the closure of a landfill or an impoundment.

6.1.1 Dry Ash Landfills

Minimum Standards

Alabama: Code Section 335-13-4-.20(3) – For municipal and industrial landfills, the operator must maintain post-closure care for a minimum 30 years; however, length may be decreased by the Department if owner/operator can demonstrate that a shorter post-closure period can be justified [335-13-4-.20(3) (b)]. For CCP, which is a nonregulated waste, this period, would be set by the department at the time of a permit application, depending on the type of permit applied for.

Kentucky: Per 401 KAR 45:110 Section 5(3), the landfill operator must maintain post-closure for a minimum 5 years.

Tennessee**:** Rule 1200-1-7-.04(8) post-closure care requirements 8(d) & (e) is for 30 years for Class I and II landfills, 2 years for Class III and IV landfills. CCP landfills are Class II landfills and therefore require 30 years of post-closure care.

Federal**:** Tennessee, Alabama and Kentucky have developed and implemented a Subtitle D permit program and therefore, provided EPA does not determine in the future that their programs are inadequate; there will be no additional federal requirements.

6.1.2 Wet Ash Impoundments

According to the TVA Dam Safety Program, state dam safety regulations do not apply. Rather, the TVA Dam Safety Program follows Federal programs in these regards. The following sections for each state are therefore provided for reference only.

Minimum Standards

Alabama: The ADEM Water Division – Industrial Section provides Closure Guidelines for Industrial Wastewater Impoundments (Rev. 03/00). There are no post-closure guidelines.

Kentucky: No Post Closure Care rules are provided in Kentucky. Closure and Post Closure Care Rules may be adapted from 401 KAR 45:110 Section 5(3) – See 2.4.1.2.

Tennessee: No Post Closure Care rules are provided in Tennessee. Closure and Post Closure Care Rules may be adapted from Division of Solid Waste Rule for Landfills or NRCS Rules for waste impoundments, See 2.4.1.3

Federal**:** Tennessee, Alabama and Kentucky have developed and implemented a Subtitle D permit program and therefore, there will be no additional federal requirements.

Industrial and commercial facilities that store waste materials should prepare a response or contingency plan to respond to emergencies involving the accidental release of these substances into the environment. Response plans should identify potential hazards, develop systems for preventing accidents, provide appropriate mechanisms for minimizing risk, loss and damage resulting from such incidents and provide an incident management structure to guide response activities.

In this section, the Document details the steps necessary to identify potential emergency situations and verify that a system of emergency procedures and directions, and general standard responses for possible emergency situations, are in place prior to facility operation, and that those procedures are sufficient to meet applicable regulatory standards.

7.1 EMERGENCY OPERATIONS AND CONTIGENCIES

Definitions

In the context of this industry involving both CCP dry disposal facilities (landfills) and wet impoundments (ponds, wet stacks), an emergency is any unexpected or accidental, serious occurrence or situation involving the release or imminent release of CCPs that could result in adverse effects on human health or the environment that requires immediate action. Items to be considered will include natural disasters (hurricanes, tornadoes, floods, earthquakes, etc.); operational failures (power outages, equipment breakdown, etc.); and, accidents (fire, vehicular or machinery accidents, etc.). It may also be necessary to consider terrorist attacks.

For the purpose of this Document, risk assessment means identifying those components of CCP landfills and impoundments that could lead to operational conditions or emergencies that may need immediate attention. Operational risk can be managed by development of administrative and operational programs designed to reduce the risk of these emergencies. Such programs include design standards discussed previously in this document. However, in this section, the applicable information is intended for the operational life of the facilities and can include standard operating procedures, equipment and facility preventive maintenance, and employee training, all in the context of emergency planning.

A contingency is an uncertainty, such as when things are left to chance, which can lead to accidents and otherwise preventable emergency situations. In order to reduce the risks associated with CCP landfills and impoundments and to avoid emergencies to the extent possible, facilities are designed, constructed and operated in accordance with strict guidelines that are imposed as a result of regulation, an engineer's recommendations, or the owner's preferences, typically whichever is most protective. Because emergencies do occur and require immediate attention when they happen, an Emergency Operations and Contingency Planning document, also know as an Emergency Action Plan (EAP) is recommended to adequately plan for emergency situations and to train employees to address them before they occur.

Minimum Standards

Alabama: In Alabama, CCPs are specifically exempted from the definition of "solid waste" and "industrial waste." Therefore, no specific requirements for CCPs are presented in this section.

Alabama currently does not have any dam safety regulations. However, regulations are in the process of being developed.

Kentucky: In Kentucky, CCPs are managed as special wastes with limited requirements with respect to specific design, construction and/or operational requirements. Minimum standards for solid waste facilities are given in 401 KAR Chapter 48, which defines contingency plan. "Contingency plan means a document setting out an organized, planned and coordinated course of action to be followed in the event of a fire, explosion, or release of waste or waste constituents into the environment which has the potential for endangering human health and the environment. Financial planning to identify resources for initiation of such action is a part of contingency plan development. Kentucky 401 KAR 48.070, design requirements for contained landfills includes a Safety and Communication Plan – The landfill safety and communication plan shall contain:

- Safe operating and maintenance procedures for heavy equipment;
- Procedures to protect employees in a manner complying with the Kentucky Labor Cabinet OSHA requirements;
- A description of equipment to achieve emergency communication. At a minimum, the applicant shall specify an on-site telephone or a two-way radio connection to an off-site telephone. The radio base station shall be monitored during landfill operations.
- A fire fighting contingency plan containing a topographic map denoting the location of the landfill, a site map and an emergency contact. The operator shall mail a copy of the safety and communications plan to the local fire chief. The plan shall include the location of fire fighting water sources, roads, and major site features. Note: the potential for fire at a contained landfill, which can include municipal solid waste (with large percentages of flammable wastes such as paper and plastic) or flammable industrial wastes is greater than for a special waste CCP facility and, as such, the requirement for a fire fighting contingency plan is made.

Kentucky regulates dams and dam safety in the state via 401 KAR 4:030, and provides design requirements in Division of Water Engineering Memorandum No. 5 (2-1-75). There are no specifics provided regarding contingency planning.

Tennessee: In Tennessee, management of CCPs is specifically regulated as presented in TDEC 1200-1-7-.04. Section two refers to General Facility Standards, which include:

- Overall Performance Standard - The facility must be located, designed, constructed, operated, maintained, closed, and cared for after closure in such a manner as to minimize to the extent practicable:
  - The potential for explosions or uncontrolled fires.
  - The potential for releases of solid wastes, solid waste constituents, or other potentially harmful materials to the environment except in a manner authorized by state and local

air pollution control, water pollution control, and/or waste management control agencies.

- The exposure of the public to potential health and safety hazards through uncontrolled or unauthorized public access.

- Fire Safety:
  - The facility must have, on-site and continuously available, properly maintained fire suppression equipment in sufficient quantities to control accidental surface fires that may occur, or arrangements must be made with the local fire protection agency to provide immediate fire fighting services when needed.
- Communications - The facility must have operating and effective communications devices (e.g., telephone, 2-way radio) capable of summoning emergency assistance on-site and available to facility personnel at all times the facility is in operation.

Tennessee provides its dam safety regulations in Chapter 1200-5-7, "Rules and Regulations Applied to the Safe Dams Act of 1973". They include:

- Inspection Process
  - State - The public safety and welfare requiring it, the commissioner shall conduct a program of regular inspections of dams, reservoirs, and downstream floodplains within the state. The frequency of such inspections shall be as determined by the commissioner, who may establish different inspection intervals for dams based on their hazard categories. An inspection frequency table is not in the laws or regulations, but a permit cannot be issued for more than five years.
  - Owner - Owner inspections are not specified in the rules and laws. Also, it is not mentioned if owner inspections are required to be conducted by an engineer.

- Emergencies

  The owner is responsible for taking emergency action when necessary but, when the owner fails to take satisfactory action where, in the judgment of the commissioner, the danger to life or property will not permit delay, the commissioner shall request that a state of emergency be declared by the governor, and upon such declaration, shall take such action as he deems necessary to render the dam or reservoir safe.

  The regulations require that new dams with a high-hazard potential rating submit EAPs to the commissioner. The regulations list what should be included in the EAP (1200-5-7-.10).

Selected Design Standard

Because all CCP identified dams in the TVA operations can be addressed by the comprehensive Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners (FEMA 64) guidelines, which encourages strict safety standards in the practices and procedures employed by federal agencies or required of dam owners regulated by the federal agencies, this guide shall be used for EAP planning purposes for both types of TVA CCP disposal and impoundment

facilities. The Guidelines address management practices and procedures, but do not attempt to establish technical standards. They provide the most complete and authoritative statement available of the desired management practices for promoting dam safety and the welfare of the public. The individual facility EAPs must also address any specific requirements of state guidance, such as those set forth in Tennessee as discussed above.

TVA facilities will also prepare and have readily available contingency plans for operational issues. Contingency plans should include protocol to temporarily replace necessary equipment, such as pumps, generators, loaders, etc. to ensure operations can continue without disruption in the event of unexpected events that could affect plant operations. Alternate disposal management planning shall also be included to effectively redirect the CCP materials to an alternate site/location in the event the current disposal plan can no longer operate (e.g., alternate landfill locations, etc.). Planning should include a written plan summarizing possible events that may warrant a shift to a contingency plan, a list and description of alternate disposal options, potential costs and driving factors in the decision process, and any general contact information and/or contract agreements.

FEMA 64 contains guidelines for preparing or revising EAPs for all high and significant hazard potential dams. These guidelines shall also be applied to landfills. Ownership and development of the floodplain downstream from dams and downslope of landfills varies; therefore, the potential for damage to the environment or loss of life as a result of failure or operation of a dam or landfill will also vary. Every EAP must be tailored to site-specific conditions**.**

EAPs generally contain six basic elements described in the next section, including:

- Notification Flowchart (Information provided by TVA appears to list many of the emergency contacts for each facility.)
- Emergency Detection, Evaluation, and Classification
- Responsibilities
- Preparedness
- Inundation Maps
- Appendices

All of these elements should be included in a complete EAP. TVA shall be responsible for the development of the EAP, specific to each facility. However, the development or revision of an EAP shall be done in coordination with those having emergency management responsibilities at the state and local levels as well as familiarity with the facility. Therefore, for new facilities, comprehensive EAPs shall be prepared as part of the permitting process so that they are complete and available at the time of operation. Emergency management agencies will use the information in a dam owner's EAP to facilitate the implementation of their responsibilities. State and local emergency management authorities will generally have some type of plan in place, either a Local Emergency Operations Plan or a Warning and Evacuation Plan.

The Six Basic Elements of an EAP

The requirements of these elements are discussed in detail in Chapter II of FEMA 64, which presents a recommended format for uniformity among EAPs. Although intended for use with dams, this document adapts the FEMA EAP format for use at landfills.

1. Notification Flowchart. A notification flowchart shows who is to be notified, by whom, and in what priority. The information on the notification flowchart is necessary for the timely notification of persons responsible for taking emergency actions.

2. Emergency Detection, Evaluation, and Classification. Early detection and evaluation of the situation(s) or triggering event(s) that initiate or require an emergency action are crucial. The establishment of procedures for reliable and **timely** classification of an emergency situation is imperative to ensure that the appropriate course of action is taken based on the urgency of the situation. It is better to activate the EAP while confirming the extent of the emergency than to wait for the emergency to occur.

3. Responsibilities. A determination of responsibility for EAP-related tasks must be made during the development of the plan. Owners (such as TVA) are responsible for developing, maintaining, and implementing the EAP. State and local emergency management officials having statutory obligation are responsible for warning and evacuation within affected areas of dams. The EAP must clearly specify the Owner's responsibilities to ensure effective, timely action is taken should an emergency occur at the dam. The EAP must be site-specific because conditions at the dam and downstream of all dams are different.

Landfills: With landfills, state and local emergency management officials have little or no obligation to address most occurrences associated with landfills. The most prevalent emergency is fire; however, landfill fires are most commonly associated with municipal solid wastes or industrial waste facilities and the need for involvement by local fire officials at a TVA facility is unlikely.

4. Preparedness. Preparedness actions are taken to moderate or alleviate the effects of a failure or operational release and to facilitate response to emergencies. This section identifies actions to be taken before any emergency.

5. Inundation Maps. An inundation map should delineate the areas that would be flooded as a result of a dam failure. Inundation maps are used both by the dam owner and emergency management officials to facilitate timely notification and evacuation of areas affected by a dam failure or flood condition. These maps greatly facilitate notification by graphically displaying flooded areas and showing travel times for wave front and flood peaks at critical locations. Mapping of adjacent properties and knowledge of neighbors may be appropriate for some of the TVA dry disposal facilities as well. Similarly, the possible impact to adjacent areas from a landfill emergency shall be defined in the EAP.

Landfills: Mapping of adjacent properties and knowledge of neighbors may be appropriate for some of the TVA dry disposal facilities as well. Similarly, the

possible impact to adjacent areas from a landfill emergency shall be defined in the EAP.

6. Appendices. The contain information that supports and supplements the material used in the development and maintenance of the EAP.

General Procedures to Address Potential Emergencies

In the event a potential emergency is identified (boil, slough, seep, fire, slope failure, etc.), the following general procedures shall be followed:

- Notify the designated shift/ unit supervisor.
- Make an initial assessment as to the severity of the potential emergency and address immediately if possible (i.e. use fire extinguisher to extinguish small, contained fire). For all other situations that cannot be addressed immediately by plant personnel, make appropriate contacts to those on the EAP contact list
    - 911/ Police/ Fire for immediate danger situations;
    - Qualified geotechnical engineer for identified earthen or otherwise man-made impoundments and fills (slope failure, seeps, etc.); and,
    - Appropriate plant personnel for plant and personnel related conditions (e.g. a broken weld on a catwalk should be cordoned off until fixed and approved by plant maintenance).
- Those specialists contacted in certain situations, such as the geotechnical engineer brought in to evaluate a slope failure, may also raise the level of awareness/ severity as necessary, and thereby contact local officials to evacuate in extreme cases, or to otherwise address situations as may be necessary.
- In the vast majority of these cases, the more likely scenario after visit by the engineer will include
    - Fully describe and document the conditions observed (size, shape, severity, volume, color, date, time, time elapsed since first noticed, condition stable/ worsening, etc.)
    - Interview appropriate plant personnel
    - Obtain relevant data (water levels in ponds, adjacent wells/ piezometers, survey data)
    - Make recommendations and implement additional data gathering needs (borings, wells, document review, calculations, drawings, engineering analyses, etc.)
    - Develop a remedial work plan to address the situation
    - Implement the approved remedial plan

The following sections address specific triggering events or emergencies that should be addressed in Section 2 of the EAP: Emergency Detection, Evaluation, and Classification. If local conditions warrant, other potential triggering events should be identified.

7.1.1 Fire

Fires are common at some landfill sites from a variety of sources. Although not anticipated to be common at TVA facilities due to the type of waste products being disposed, fires are still a possibility, especially when considering heavy equipment use and probable fuel storage. Whatever the cause, it is important that those involved stay calm and have an accessible plan for managing the fire, personnel and neighbors.

Identifying an appropriate fire suppression source (i.e. water, fire extinguishers, etc.) is one of the most critical components of an EAP to address fires. TVA shall identify and coordinate with the respective local fire departments to develop a plan for managing fires, establish evacuation protocols, and to train all pertinent personnel.

7.1.2 Power Outage

A power outage at a facility may result from inclement weather, lightning strikes, capacity or grid problems, or other reasons. Without power, any facility that uses conveyance systems to transport waste may be required to employ alternative power sources or transport wastes for a specified period of time by truck.

At all facilities with non-gravity drained leachate or stormwater systems, the transfer of leachate and stormwater to the appropriate storage or treatment and disposal facilities cannot occur in the event of a power outage unless alternative power sources are available. Depending on the period of power outage, alternative means of power or of liquid transfer may be required. Such contingency plans shall be specified in the EAP.

7.1.3 Leachate Outbreaks

Leachate outbreaks may occur from exterior landfill slopes during operations and even after closure. When an outbreak occurs, the proper steps should be taken to mitigate the situation. This includes the following steps:

- Contain and properly mange the leachate outbreak
- Minimize, control, or eliminate the conditions that are contributing to additional leachate production
- Collect and transport leachate to the appropriate containment or disposal facility

In some instances, the state or local regulatory official will also need to be notified. The appropriate steps for managing a leachate outbreak shall be outlined in the EAP.

7.1.4 Inclement Weather

Inclement weather can occur throughout the calendar year. It may impede operations at TVA facilities and create unsafe conditions. CCP landfills and disposal impoundments are designed to be in continuous operation. Provisions should be in place to address in the EAP for inclement weather conditions including methods to allow for the receipt and compaction of incoming CCPs and/or temporary storage, as appropriate. Access roads and facilities that are part of the operations should be maintained during inclement weather. If weather creates a situation in which compliance is compromised, the operator may need to contact regulatory officials.

7.1.5 Spills and Releases

This section of the EAP should outline operational methods to manage an accidental spill or release, and the location, capability, and limitations of equipment to be used to contain or remediate the spill. The Response Plan should not provide detailed descriptions, but refer to separate standard operating procedures or detailed technical documents need to specify which plans the reader should be accessing that apply to spill response operations.

The plan should list available on-site and off-site equipment, how it is to be accessed and who has the responsibility for it. The plan should also describe how people and equipment will get to the site, how they will be supported during the crisis, how security and safety will be maintained and how crews will be supplied for the duration of the incident.

7.1.6 Local Transportation Issues

For any site that will require over-the-road transport of CCP materials or leachate for disposal, a plan shall be developed for secondary carriers in the case of equipment breakdown, contractor failure to perform, work stoppages, etc. Also, the plan shall address alternate routes for transport in case of route closures due to reduced load limits on roadways, storm/ washouts of roadways, regular highway maintenance, etc.

On-site transportation issues shall be addressed by the Operator and will include provisions to rent more equipment from outside vendors as the need may arise. All onsite access roads and issues associated with them are the responsibility of TVA or their designated operator, so route issues will be addressed on an as-needed basis.

7.1.7 Other Emergencies

Whether classified as other emergencies or rare operational issues that need to be addressed quickly, there are several other potential problems that may need to be addressed in the individual plant EAPs.

In landfills, waste settlement and/or slope failure of the waste and/ or interior sideslopes, or final existing cover soils, can occur during construction, during operation, or after closure. Waste settlement or slope failure may expose waste and require timely, if not emergency, repairs. In

rare instances, large displacement failures may also jeopardize operations or human health and the environment. Settlement in a CCP landfill should be minimal if waste is properly placed and compacted due to the uniformity of CCPs, but may be caused by consolidation of waste or foundation materials under the weight of waste material and cap. Possible consequences of settlement include instability in the waste or cover soil, which can damage the cap, and disruption of storm water drainage.

The weight of the new cap can be significant enough to cause additional waste settlement and compaction. The effect of this additional weight may initiate differential settlement across the cap, thus compromising the integrity of the cap, or create stability problems such as slippage failures in the waste and/or existing cover system. Differential settlement occurs when one area of waste settles more readily than another because of differences in moisture content, waste compaction, or waste composition. Settlement, and especially differential settlement, may create cracks in the cap and allow rainwater to reach the waste. Changes in the topography of the landfill because of settlement may also create areas on the cap surface where rainwater can pond. These conditions, if left unchecked, can lead to bigger issues of slope instability and failure, and leachate generation.

The following list provides other typical types of landfill facility emergencies requiring emergency actions be taken:

- Slope Failures and Settlement

  Slope failures, cracks or sloughing in constructed earthen slopes should be fixed immediately as part of construction. The facility design, construction specifications, construction procedures, construction oversight, or all of these possible reasons should be investigated to determine the cause of the failure and to prevent re-occurrence of slope failures during construction. The observance and notation of these types of failures resides with the construction contractor and CQA oversight firm.

  During operation, slope failures or ponding water should be addressed immediately as part of operations by regrading waste to eliminate ponding and to repair any failed waste slopes. Operational procedures, grade control, compaction control, moisture control, and record-keeping should all be investigated to determine the cause of internal waste slope failures or settlement and to prevent any recurrence.

  Although settlement and moreover differential settlement should be minimal in these types of residual waste landfills, any obvious settlement of the CCPs should be addressed as part of operation the landfill to maintain positive surface water drainage. Differential settlement is typically addressed by the addition of more waste (if feasible in an active waste placement area of the landfill) or the by the addition of intermediate or final cover soil, depending on where the settlement occurs. Additional fill should be added to return the grades to the necessary design grades to promote proper drainage.

In above-grade ponds, impoundments or wet stacks, emergency issues may involve the movement of water through the dike (seeps), beneath the dike (boils) or over the dike (overflows) which may lead to significant erosion leading to dike failure. The movement of

water, when left unchecked, leads to erosion of the earthen structure until failure occurs. TVA dam safety will be reviewing all the ash disposal impoundments and will decide which will be considered to be dams. Those that are will be brought under the TVA Reservoir Operations, Dam Safety Inspection and Maintenance program. Emergency responses for dams are covered by EAPs administered by that program. For all of these earthen structures, regular inspections will be made to look for specific indications of pending problems. If encountered, the EAPs will identify the contacts to be made and the procedures to be enacted, such as follow.

- Once noted on an inspection form, notation of seeps and boils should require the inspection by a qualified engineer. Depending on the advice of the engineer, measures may be taken to stop or slow the water flow by placement of sandbags or additional earthen material, followed by a period of planned investigation into the cause of the outbreak. Once the cause is determined, an engineered fix can be designed an implemented to stop the flow and reduce the hydrostatic head pressure.

- Overtopping of any impoundment should be prevented through regular inspection procedures however can occur for several reasons (significant storm events, plugged pipes or drains, etc.) The EAP for all impoundments shall provided measures for quickly lowering water levels or redirecting overflows should they occur.

7.2 COMMUNICATION PROCEDURES

During an emergency, effective and reliable electronic communications equipment and procedures are vital. This section of the plan should detail the types of communication equipment to be used by personnel during an emergency response. Since normal means of communication can break down in an emergency, alternative means must be considered. Cellular telephones, public address systems, two-way radios and messengers should be used.

Training and arrangements may be necessary to ensure that telephone services are available for official calls during an emergency and that unauthorized calls will not be placed. Within an Incident Command Post, telephone circuits may quickly become jammed with calls. Direct hot lines that are not available to outside lines may be considered for critical communications. Use of 1-800 numbers for public inquires is another option to manage external calls.

FIGURES

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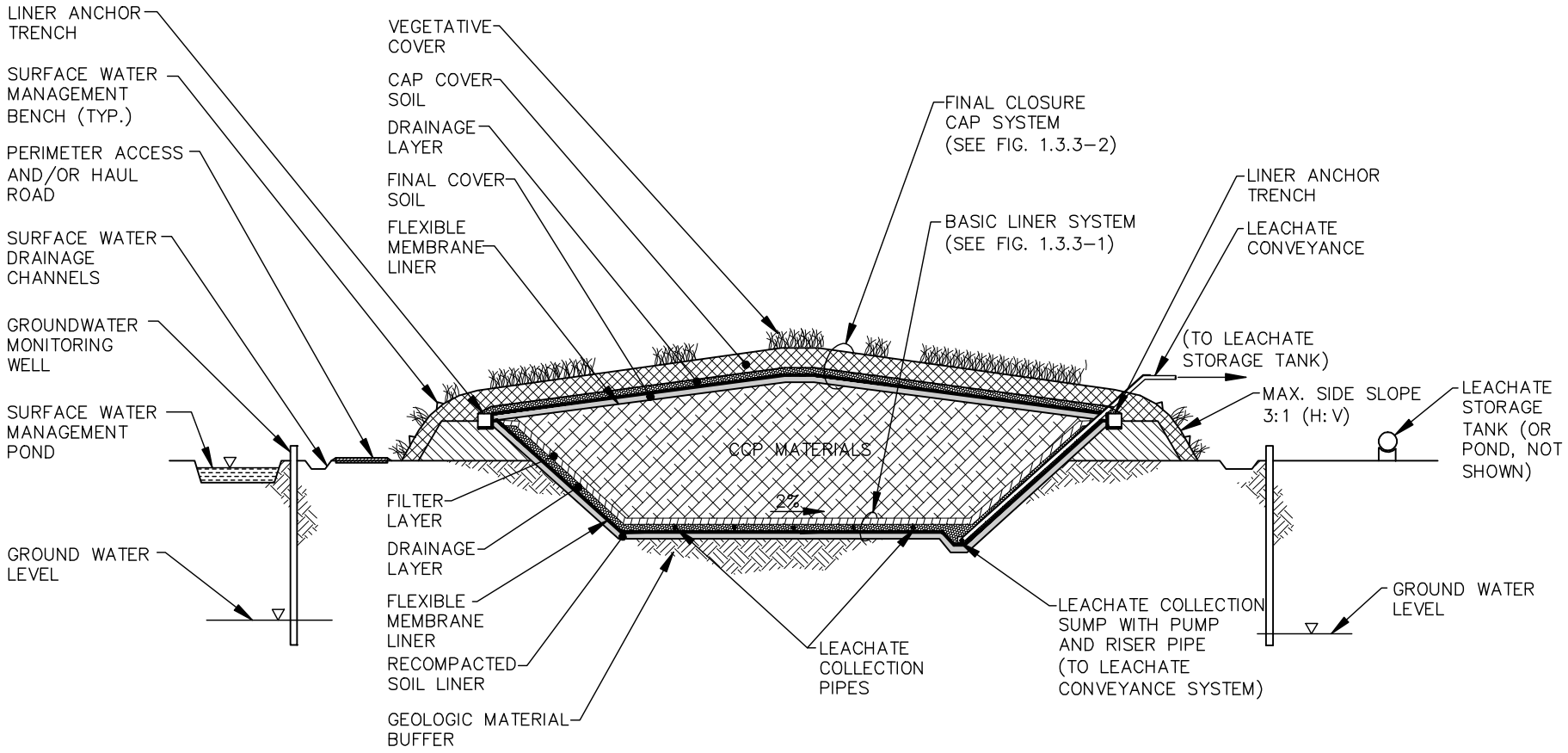

NOTE:
THIS FIGURE ILLUSTRATES A PUMPED LEACHATE EXTRACTION SYSTEM AS OPPOSED TO A GRAVITY FLOW EXTRACTION SYSTEM.

COAL COMBUSTION PRODUCT LANDFILL

URS

TVA COAL COMBUSTION PRODUCTS MANAGEMENT PROGRAM
PROGRAMMATIC DOCUMENT - VOL. 2

COAL COMBUSTION PRODUCT LANDFILL TYPICAL CROSS-SECTION

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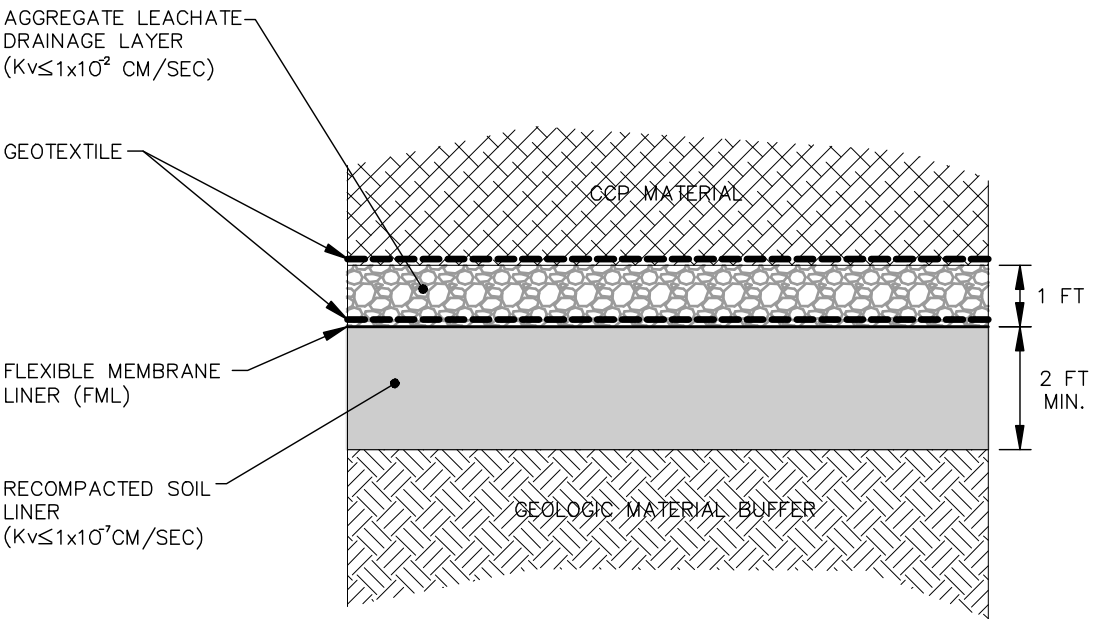

NOTE:
A GEOCOMPOSITE LEACHATE DRAINAGE LAYER MAY BE CONSIDERED AS AN ALTERNATE TO THE AGGREGATE LEACHATE DRAINAGE LAYER.

LINER SYSTEM

NOT TO SCALE

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TVA COAL COMBUSTION PRODUCTS MANAGEMENT PROGRAM

PROGRAMMATIC DOCUMENT - VOL. 2

LINER SYSTEM TYPICAL CROSS-SECTION

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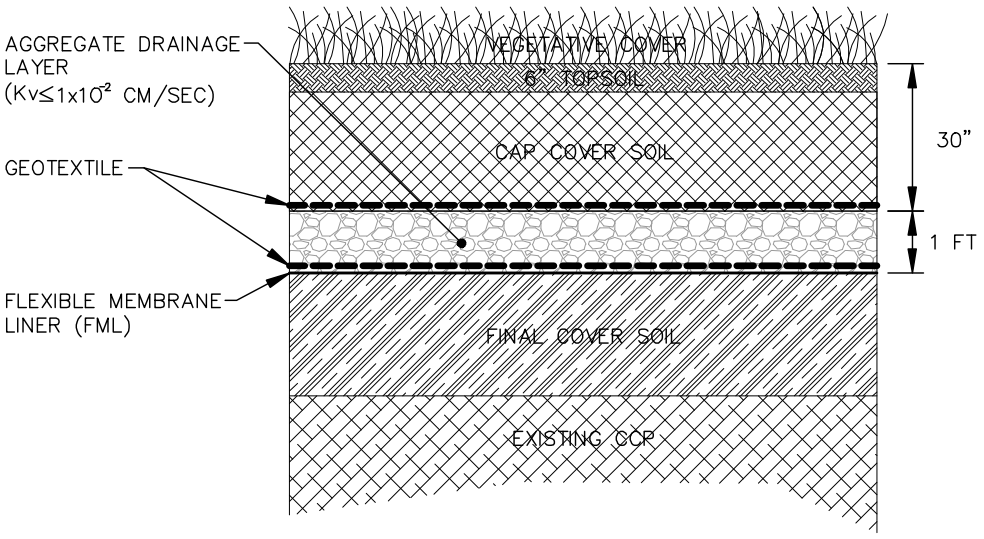

NOTE:
A GEOCOMPOSITE LEACHATE DRAINAGE LAYER MAY BE CONSIDERED AS AN ALTERNATE TO THE AGGREGATE DRAINAGE LAYER.

ALTERNATE CLOSURE CAP SYSTEM

NOT TO SCALE

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TVA COAL COMBUSTION PRODUCTS MANAGEMENT PROGRAM

PROGRAMMATIC DOCUMENT - VOL. 2

ALTERNATE CLOSURE CAP SYSTEM TYPICAL CROSS-SECTION

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APPENDIX 1

TVA Ash Impoundment Inventory Sheet

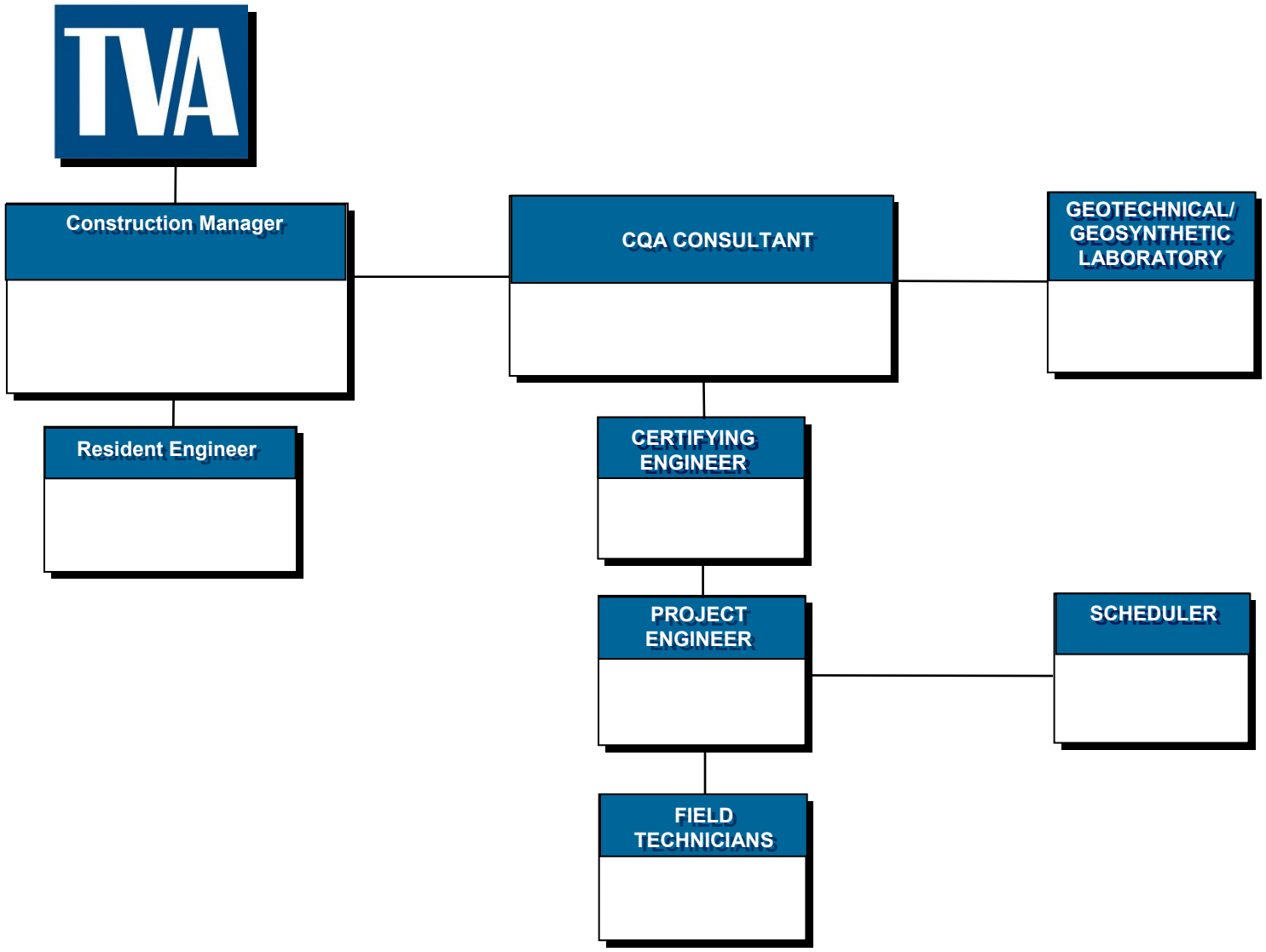
General Information											
Name of Dam:											
Reservoir Name:											
Power Plant Name:											
Street Address:											
City:				State:			Zip:				
Contact Person:				Phone No:							
Location Information											
County:		Latitude Deg.:		Min.:		Sec.:					
Township:		Longitude Deg.:		Min.:		Sec.:					
Stream:											
Nearest Affected Community:											
Community's Distance from Dam (miles):											
USGS Quad:				USGS Basin No.:							
Design/Construction Information											
Designed By:											
Constructed By:											
Year Completed:		Plans Available? Y N		At:							
Failure/Incident/Breach:											
Structure Information											
Purpose:											
Type of Structure:											
Drainage Area (Sq. Miles):				Or (Acres):							
Length of Dam (Ft.)				Upstream Slope (H:V):							
Height of Dam (Ft.)				Downstream Slope (H:V):							
Top Width (Ft.):				Volume of Fill (Cubic Yds.):							

Principal Spillway:			
Emergency Spillway:			
Maximum Spillway Discharge (combined), cfs		Design Flood:	
Dam Reservoir Data:	**Elevation (Ft., MSL)**	**Area, (Acres):**	**Storage, (Acre-Ft.)**
Top of Dam:			
Emergency Spillway:			
Principal Spillway:			
Streambed at D/S Toe			

Notes & Comments

APPENDIX 2

Construction Site Organization Chart



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APPENDIX 3

Note: All regulations/standards are current as of the date of the Document, unless otherwise noted.

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Kentucky Legislative Research Commission 401 KAR Chapter 45. Special Waste. 401 KAR 45

Kentucky Legislative Research Commission 401 KAR Chapter 47. Solid Waste Facilities. 401 KAR 47

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APPENDIX A

Document 17

Seepage Action Plan (SAP), Kingston Fossil Plant, Harriman, Roans County, Tennessee, Stantec Consulting Services, June 10, 2010

Seepage Action Plan (SAP)

Kingston Fossil Plant
Harriman, Roane County,
Tennessee

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One Team. Infinite Solutions
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Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

June 25, 2010

Seepage Action Plan (SAP)

Kingston Fossil Plant
Harriman, Roane County,
Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

June 25, 2010

Seepage Action Plan (SAP)

Kingston Fossil Plant
Harriman, Roane County, Tennessee

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Seepage Action Plan (SAP)

Kingston Fossil Plant
Harriman, Roane County, Tennessee

1. Potential Seepage Areas

For readers not familiar with seepage through dams, refer to Appendix B, "Possible Seepage Problems and Recommendations" for more illustrative details. Seepage through an impoundment dam can typically be found on the lower third of the slope and extending beyond the toe approximately fifty feet. Figure 1 below displays the typical area on a cross section that should be reviewed during the seepage inspection for the Peninsula Gypsum Pond, Dredge Cell, Main Ash Pond and Stilling Pond. However, other seepage areas may exist, and the field inspector should be familiar with previous inspection reports and observations. Based on geotechnical analysis, plan views illustrating low factors of safety in terms of seepage have been prepared and are included in Appendix A. The areas identified, along with any other area previously identified during inspections, should be reviewed on a regular basis as identified in this document.

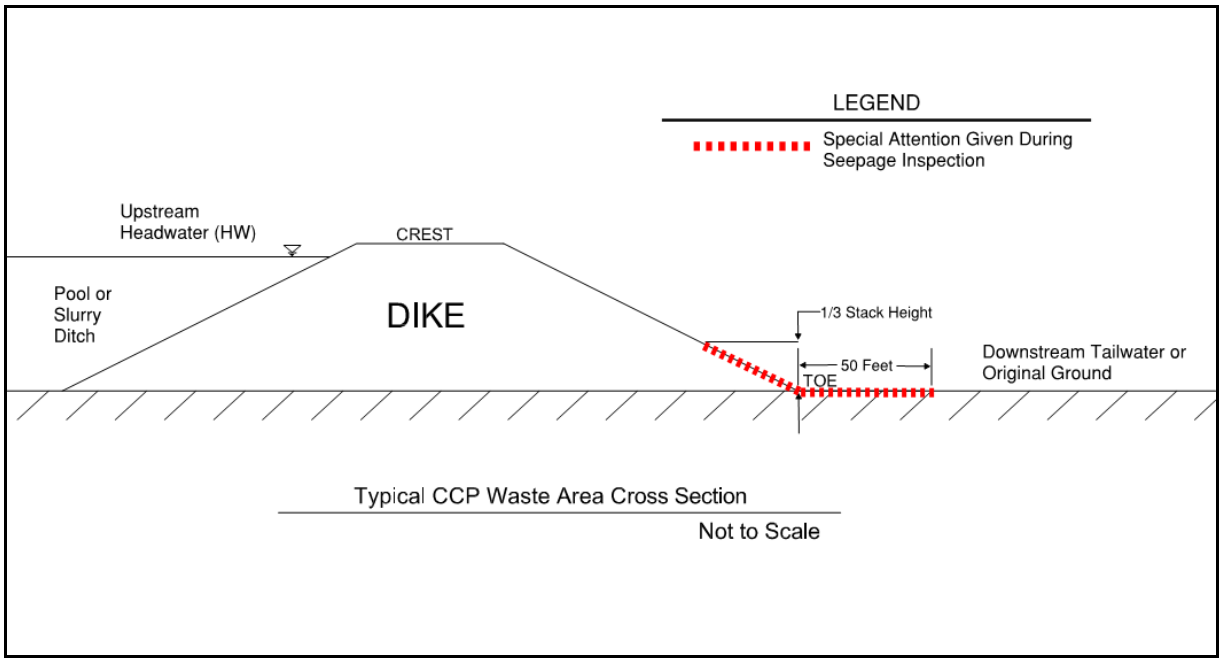

Figure 1. Seepage Inspection Location

2. Basic SAP Data

2.1. Purpose

The purpose of this SAP is to describe potential seepage action levels, and provide seepage short term management measures and actions in the event these action levels are observed.

2.2. Potential Impacted Area

Seepage related issues impact the integrity of earthen embankments. Seepage can lead to internal erosion of the embankment, known as piping, which has been the cause of many catastrophic failures in the past. Piping is a process where soil particles slowly carried out from inside the dam, eventually creating a tunnel or pipe. If the pipe forms all the way to the reservoir, the embankment will fail rapidly. Since the embankments at Kingston Fossil Plant serve as an impoundment for ash and gypsum slurry, it is imperative to maintain the embankments and prevent any possible failure from occurring. If a failure were to occur, the ash and gypsum slurry mixture could potentially contaminate Kingston Fossil Plant and the Tennessee River.

2.3. Primary Responsibility and Frequency of Dike Safety Inspections

1. TVA RHO&M Field Supervisor for Kingston Fossil Plant (**Field Supervisor**)
2. TVA RHO&M East Region Construction Manager
3. TVA RHO&M Program Manager for Kingston Fossil Plant

Documented inspections should occur at a minimum of once per month. Additionally, there are two criteria which warrant an inspection. A documented inspection should occur following a significant precipitation event (0.5 inches of rain, 4 inches of snow), as well as following a change in the operation of the wet stack, pond, or other CCP wet waste area (switching between east/west ditch, switching ponds, raising pool elevations, etc.). A documented inspection involves inspecting the potential seepage areas noted on the plan views in Appendix A, paying particular attention to areas of concern previously identified. The **Seepage Log** should be updated to include new descriptions and photographs of any new areas of concern or changes to previously identified areas. Random inspections can occur on a more frequent basis if deemed necessary by the **Field Supervisor**.

3. Seepage Action Level Determination

For the purpose of this plan, three seepage action levels have been identified. The levels are based on potential risk associated with progressive erosion due to seepage and resulting breach of the embankment or impoundment.

Action Level 1 – Non-Flowing

- Wet areas
- Ponded Water

Action Level 2 – Flowing Seepage – No Erosion

- Non turbid (clear water) flow

Action Level 3 – Flowing Seepage – Active Erosion

- Turbid Flow
- Deposition of Sediment from Dike or Dam
- Boils (Ground Surface/ Underwater)
- Upstream Collapse or Sinkhole

3.1. Action Level 1 – Non Flowing

Seepage occurs in all earthen dams and dikes. The key is to properly collect and control seepage in a manner that does not cause damage to the embankment. Seepage that is not flowing but is evident by damp areas or ponded water does not generally represent an imminent threat to the embankment in terms of erosion (see Figure 2). However, if left unattended this seepage can lead to slope instabilities. Therefore, this should be noted so that it can be observed for changing conditions both at the downstream observation point and immediately upstream along the interior slopes.

Figure 2. Example of Action Level 1 – Non-Flowing – Wet Area

3.2. Action Level 2 – Flowing Seepage – No Erosion

Action Level 2 involves observations of flowing seepage, but evidence of erosion is not noted. Evidence of erosion can be in the form of turbid (muddy water) flow, sediment deposition, obvious hole or soil "pipe". Evidence of erosion can be subtle and as a result, any flowing seepage should be carefully reviewed and monitored at least monthly. A picture

of flowing seepage water showing no evidence of erosion is depicted in Figure 3. Note that a seep does not need to be continuously turbid for a piping situation to be forming.

Figure 3. Example of Action Level 2 – Clear Flowing – Seepage Boil

3.3. Action Level 3 – Flowing Seepage – Active Erosion

Left unmitigated seepage demonstrating active erosion can lead to progressive failure of the embankment and catastrophic loss of the impoundment. Evidence of erosion can be in the form of turbid flow, sediment deposition, boil, obvious hole or soil "pipe". Evidence of erosion can be subtle and as a result, any flowing seepage should be carefully reviewed and monitored frequently. Careful attention should be given to seepage below water such as a stilling pond, creek or river (see Figure 6). This type of seepage is difficult to observe and determine if soil erosion is occurring. In moving water, evidence of seepage boils conveying embankment soil/ash materials will likely be (partially) washed away. Examples of active erosion are shown in Figures 4 thru 5.

Figure 4. Example of Action Level 3 – Turbid Flowing – Seepage Boil

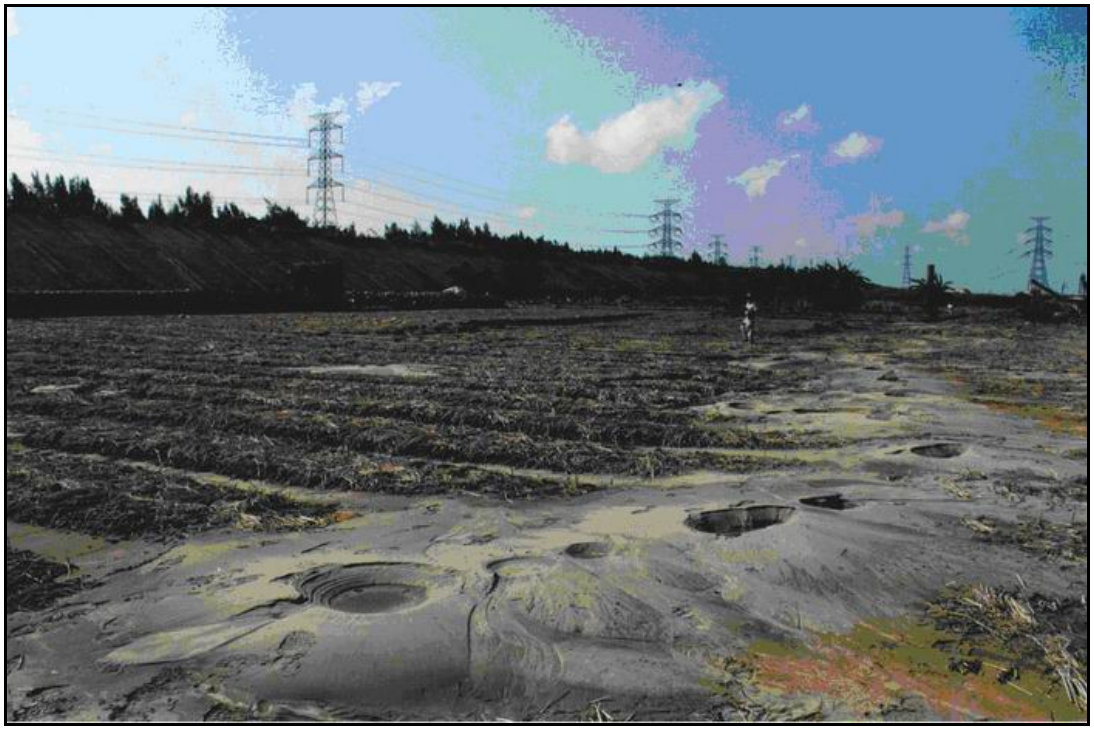

Figure 5. Example of Action Level 3 – Deposition of Sediment from Dike

Figure 6. Example of Action Level 3 – Underwater Turbid Flowing – Seepage Boil

4. Intermediate Corrective Measures

For each action level a typical corrective measure is listed below.

4.1. Action Level 1 – Non Flowing

- **Field Supervisor** should document the seepage area into the **Seepage Log** (see below).
- All observers should pay particular attention to conduits through the embankments.
- **Field Supervisor** should record the date, time, size of area, location, and photographs in the **Seepage Log**.

The **Seepage Log** should be kept at the Shift Operation Supervisor's (SOS) office such that inspectors (TVA, geotechnical consultant, or others) can document event triggers (date, time, location, pool level, etc.) and the site conditions observed for each seepage event. The **Seepage Log** shall function as a "living document" and be part of an ongoing monitoring program (to be controlled by TVA). As the monitoring program progresses, the **Seepage Log** will allow inspectors to summarize the historical conditions observed and provide a baseline of events to compare with future readings.

4.2. Action Level 2 – Flowing Seepage – No Erosion

- **Field Supervisor** should carefully inspect the area for outflow quantity, any transported material, and take photographs.
- If the seepage involves a conduit penetration associated with a spillway pipeline, storm culvert, or underdrain pipeline, the observer(s) should carefully inspect the

area by probing and /or carefully shoveling to see if the cause can be determined, determine if embankment materials are being transported, evident by turbid or cloudy water, and determine quantity of flow.

- Contact team members in accordance with Figure 8.
- Send photographs to the RHO&M Regional Construction Manager and CCP Program Manager for distribution.
- Geotechnical consultant, with concurrence of the TVA Program Manager and CCP Engineering Manager, should determine a plan of action within four hours of notification
- **Field Supervisor** should record the date, time, size of area, location, and photographs in the **Seepage Log**.

4.3. Action Level 3 – Flowing Seepage – Active Erosion

- **Field Supervisor** should carefully inspect the area for outflow quantity and transported material.
- **Field Supervisor** should determine if piping has occurred and extent by observing locations of seepage exits, take photographs, and contact team members in accordance with Figure 9.
- Geotechnical consultant, TVA Program Manager, and CCP Engineering Manager should determine a plan of action within four hours of notification such as lowering the pool, constructing a reverse graded filter, or sand bagging
- A typical reverse graded filter will consist of the following:
  - One foot of Concrete Sand (TDOT Concrete Sand)
  - One foot of TDOT No. 89 Stone
  - Twp feet of TDOT Machine Rip Rap Class A-3
  - Silt Fence as required by guidance provided in the Best Management Practices for Erosion Prevention and Sediment Control
- An example of sandbagging is provided in Figure 7.
- **Field Supervisor** should record the date, time, size of area, location, and photographs in the **Seepage Log**.

Figure 7. Sand Bag Treatment (Temporary)

5. Materials On-Site

In case an emergency situation is observed during the inspection of the potential seepage areas, it is necessary to have materials readily available on-site to correct the situation. Table 1 below lists the materials to be stockpiled on-site and the quantity of each material.

Table 1. Stockpile Material Quantities

Material	Tons	Cubic Yards
Concrete Sand	90	60
TDOT No. 89 Stone	90	60
TDOT Machine Rip Rap Class A-3	180	120
Sandbags (filled)	300 (total)	NA
30” Diameter HDPE Pipe	100 feet	NA

The amount of materials to be stockpiled is based on a production rate of 60 cubic yards per hour for a 2.5 CY long reach excavator assuming a material unit weight of 110 PCF.

The materials should be stockpiled at the location determined by the **Field Supervisor.** The following earthwork equipment and qualified operator(s) should be located to place the material in case of an emergency:

- Long Reach Excavator
- Dump Truck
- Compactor, Bulldozer, Bobcat, any other nearby equipment which aids in the emergency

6. The SAP Process

6.1. Step 1 – Dike Observation or Event Detection

This step describes the detection of an unusual observation or emergency event and provides information to assist the Kingston RHO&M **Field Supervisor** or appropriate personnel in determining the appropriate emergency level for the observation or event. These observations could be made by inspectors during routine inspections of the embankments, or by everyday personnel.

6.2. Step 2 – Emergency Level Determination

Following an unusual observation or emergency event detection, the **Field Supervisor** is responsible for classifying the event into one of the following three emergency levels:

6.2.1. Action Level 1 – Non Flowing

Observation is routine to other observations and a similar established plan of action for minor repair or continued observation will be required. If a Level 1 Emergency is identified, the following steps should be taken:

- Update maps and **Seepage Log**
- Inform KIF personnel if repairs are needed
- Determine if other work activities need to be made aware of observation.

6.2.2. Action Level 2 – Flowing – No Erosion

A change in condition or a condition that has not been previously identified and discussed with the geotechnical engineers. If a Level 2 Emergency is identified, the following steps should be taken:

- Inform individuals in accordance with the flowchart in Figure 8.
- Update map and **Seepage Log**
- Inform KIF personnel if repairs are needed
- Determine if other work activities need to be made aware of new conditions.

6.2.3. Action Level 3 – Flowing – Active Erosion

A change in condition that is drastic and could rapidly lead to failure of the embankment if not corrected. If a Level 3 Emergency is identified, the following steps should be taken:

- Inform plant SOS, who will initiate TVA plant-specific Emergency Action Plan (see Figure 9).
- Inform geotechnical consultant
- Develop safe plan of action for repair with geotechnical consultants
- Initiate repairs once plan has been approved by site safety and geotechnical consultant
- Update map and **Seepage Log**.

6.3. Step 3 – Notification and Communication

6.3.1. Notification

Following the determination of a possible seepage situation, it is necessary to notify the appropriate personnel discussed below for the required action to occur.

6.3.2. Communication

In case of an Action Level 2 emergency, the flowchart presented in Figure 8 should be followed to ensure the proper personnel are contacted. In an Action Level 3 emergency, the flowchart presented in Figure 9 should be followed.

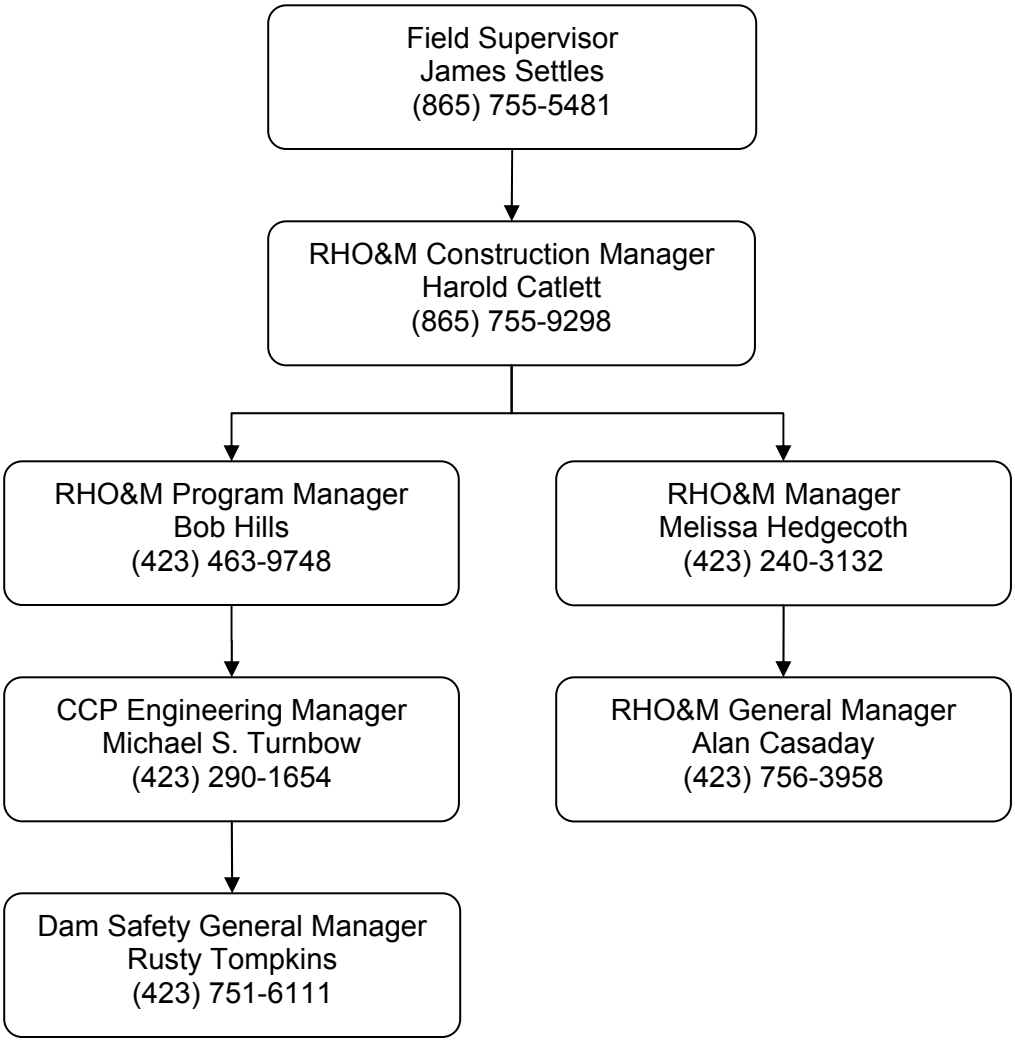

Figure 8. Level 2 Emergency Contact Flowchart

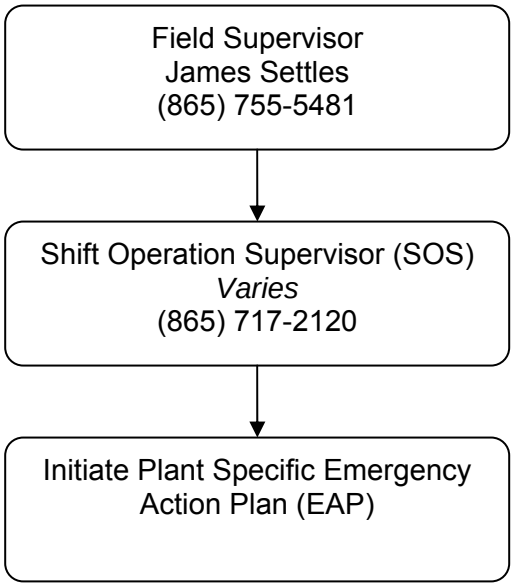

Figure 9. Level 3 Emergency Contact Flowchart

Appendix A

Peninsula Gypsum Pond, Dredge Cell, Main Ash Pond, and Stilling Pond Site Plans

Notes:
1. The areas identified on this drawing should not be considered as the only areas where seepage might occur. Therefore, a complete inspection of the dike should be performed annually as outlined in Stantec's Dam Safety Training Presentation dated August, 2009.
2. Grid spacing is 500 feet.

LEGEND

N

Areas of Concern

Potential Seepage Zone

0 250 500 Feet

STANTEC CONSULTING SERVICES INC.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000

Stantec

DRAFT

SEEPAGE ACTION PLAN

Tennessee Valley Authority
Kingston Fossil Plant
Kingston, Roane County, Tennessee

PROJECT NO.	175560021
DATE	MARCH 2010
DRAWN BY	AMG
CHECKED BY	
CHECKED BY	
SCALE	1" = 500 '
REVISED	
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

SHEET

1 OF 2

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Notes:
1. The areas identified on this drawing should not be considered as the only areas where seepage might occur. Therefore, a complete inspection of the dike should be performed annually as outlined in Stantec's Dam Safety Training Presentation dated August, 2009.
2. Grid spacing is 500 feet.

LEGEND

N

Areas of Concern

Stockpile Location

Potential Seepage Zone

Feet
0 250 500

STANTEC CONSULTING SERVICES INC.
1409 N. Forbes Rd.
Lexington, Kentucky
40511-2050
859-422-3000

Stantec

DRAFT

SEEPAGE ACTION PLAN

Tennessee Valley Authority
Kingston Fossil Plant
Kingston, Roane County, Tennessee

PROJECT NO.	175560021
DATE	MAY 2010
DRAWN BY	AMG
CHECKED BY	
CHECKED BY	
SCALE	1" = 500 '
REVISED	
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SHEET

2 OF 2

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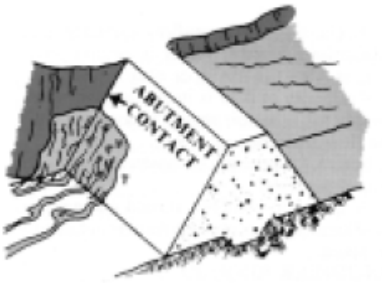
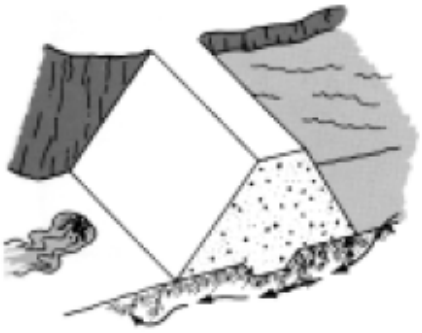
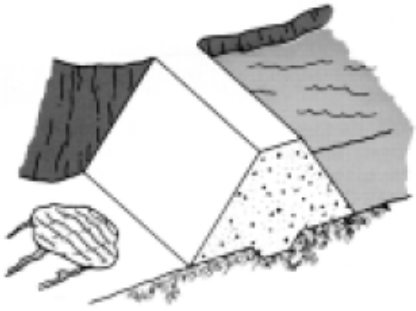
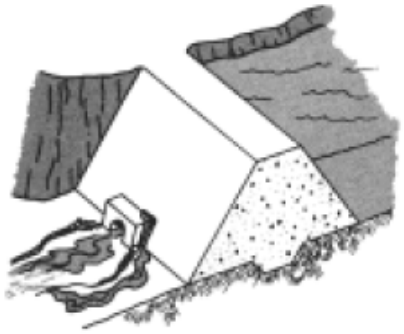
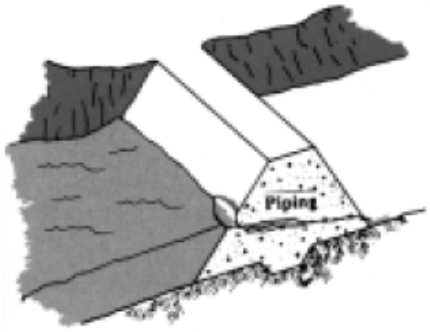
Appendix B

Possible Seepage Problems and Recommendations

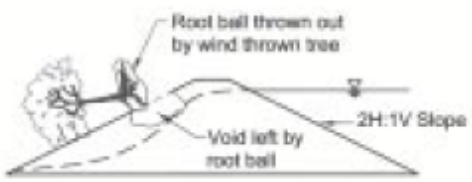
Appendix B – Possible Problems and Recommendations

Seepage Problem	Recommendations
Seepage Water Exiting at Abutment Contact 	Study leakage area to determine quantity of flow and extent of saturation. Stake out the saturated area and monitor for growth or shrinkage. Inspect frequently for slides. Water level in the impoundment may be lowered to increase embankment safety. A QUALIFIED ENGINEER should inspect the conditions and recommend further actions to be taken.
Seepage Water Exiting as a Boil in the Foundation 	Examine boil for transportation of foundation materials, evidenced by discoloration. If soil particles are moving downstream, create a sand bag or earth dike around the boil. This is a temporary control measure. The pressure created by the water level within the dike may control flow velocities and prevent further erosion. If erosion continues, lower the reservoir level. A QUALIFIED ENGINEER should inspect the condition and recommend further actions to be taken.
Spongy Condition at Toe of Dam 	Carefully inspect the area for outflow quantity and any transported material. A QUALIFIED ENGINEER should inspect the condition and recommend further actions to be taken.

Appendix B – Possible Problems and Recommendations

Seepage Problem	Recommendations
Rodent Activity	Control rodents to prevent more damage. Determine exact location of digging and extent of tunneling. Remove rodents and backfill existing holes.
Seepage Water Exiting from a Point Adjacent to the Outlet 	Investigate the area by probing and/or carefully shoveling to see if the cause can be determined. Determine if leakage water is carrying soil particles evidenced by discoloration. Determine quantity of flow. If flow increases, or is carrying embankment materials, reservoir level should be lowered until leakage stops. A QUALIFIED ENGINEER should inspect the condition and recommend further actions to be taken.
Sinkhole 	Inspect other parts of the dam for seepage or more sinkholes. Identify exact cause of sinkholes. Check seepage and leakage outflows for dirty water. A QUALIFIED ENGINEER should inspect the conditions and recommend further actions to be taken.

Appendix B – Possible Problems and Recommendations

Seepage Problem	Recommendations
Trees and Brush 	Remove all trees and shrubs on and within 25 feet of the embankment. Properly backfill void with compacted material. A QUALIFIED ENGINEER may be required.

Source: Connecticut Department of Environmental Protection, Guidelines for Inspection and Maintenance of Dams, September 2001.

Appendix C

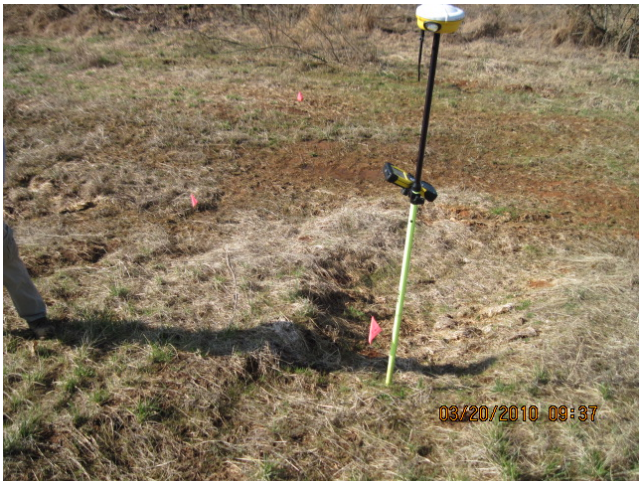
Seepage Log

KIF Seepage Log

Kingston Fossil Plant
Kingston, Tennessee
Updated 6/22/2010 Rev. 1

Area of Concern	Coordinate Location (Northing/Easting)		Date Initially Observed	Time	Approximate Size (Linear Feet)	SAP Level	Description	Mitigation Status/ Future Plans
1	Survey Requested		3/20/2010	N/A	-	1	Wet weather rutting on the access road-initially discovered by Stantec on 3/20/2010. SAP Level 1.	This area should be monitored for change. Once the area is dry the slopes should be graded to allow for proper drainage.
2	Survey Requested		5/4/2010	N/A	-	1	Seepages observed by Stantec on 5/4/2010 at multiple locations near the waterline at the southern portions of the wetland. SAP Level 1	Monitoring of the seeps and ongoing analysis being conducted by Stantec.
3	Survey Requested		3/20/2010	N/A	-	1	Multiple seeps near the toe of the exterior northeast slope of the stilling pond. Initially observed by Stantec on 3/20/2010. SAP Level 1	Monitoring of the seeps and ongoing analysis being conducted by Stantec.
4	554532.07	2442015.24	5/4/2010	N/A	-	1	Possible red water seepage into Stilling Pond through Divider Dike-Initially Observed on 5/4/2010 by Stantec during the 2010 Annual Inspection. SAP Level 1	This area should be monitored for change.

Note: Initial Seepage Log was developed based on Stantec's understanding of known issues from Phase 1 and 2 assessments as well as ongoing construction work and knowledge of the site. No field visit was conducted to verify current seepage areas of concern.



Area of Concern 1

3/20/2010
Wet weather rutting on the access road:
Initially discovered by Stantec on 3/20/2010.
SAP Level 1.

Area of Concern 1

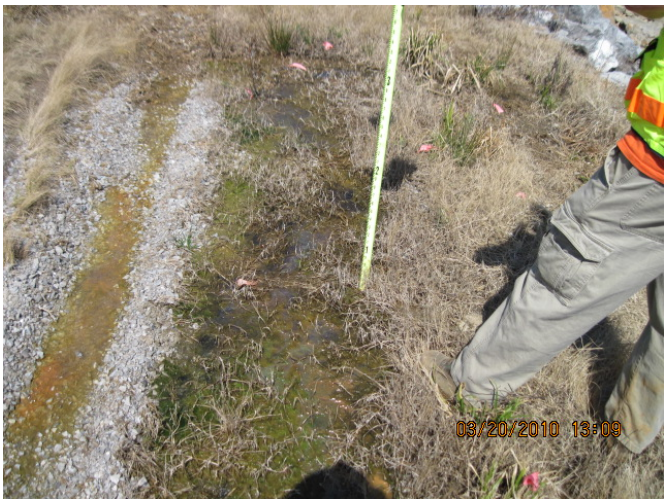
3/20/2010
Wet weather rutting on the access road:
Initially discovered by Stantec on 3/20/2010.
SAP Level 1.

Area of Concern 2

5/4/2010
Wet weather rutting on the access road:
Initially discovered by Stantec on 5/4/2010.
SAP Level 1.

Area of Concern 3

3/20/2010
Multiple seeps near the toe of the exterior northeast slope of the stilling pond. Initially observed by Stantec on 3/20/2010. SAP Level 1



Area of Concern 3

3/20/2010
Multiple seeps near the toe of the exterior northeast slope of the stilling pond. Initially observed by Stantec on 3/20/2010. SAP Level 1

Area of Concern 4

5/4/2010
Possible seepage into Stilling Pond through Divider Dike. Initially Observed on 5/4/2010 by Stantec. SAP Level 1

Appendix D

KIF CCP Emergency Action Plan

APPENDIX A

Document 18

Stantec Consulting Services Memo Dated August 8, 2011 "Reference: Dike C Slope Inclinometer Data Weekly Review"

Memo

Stantec Consulting Ltd.
4370 Dominion Street, 5th Floor
Burnaby, BC V5G 4L7
Tel: (604) 436-3014
Fax: (604) 436-3752

To: Tod Woodson **From:** Tom Crilly

Project: Kingston Fossil Plant Date: August 8, 2011

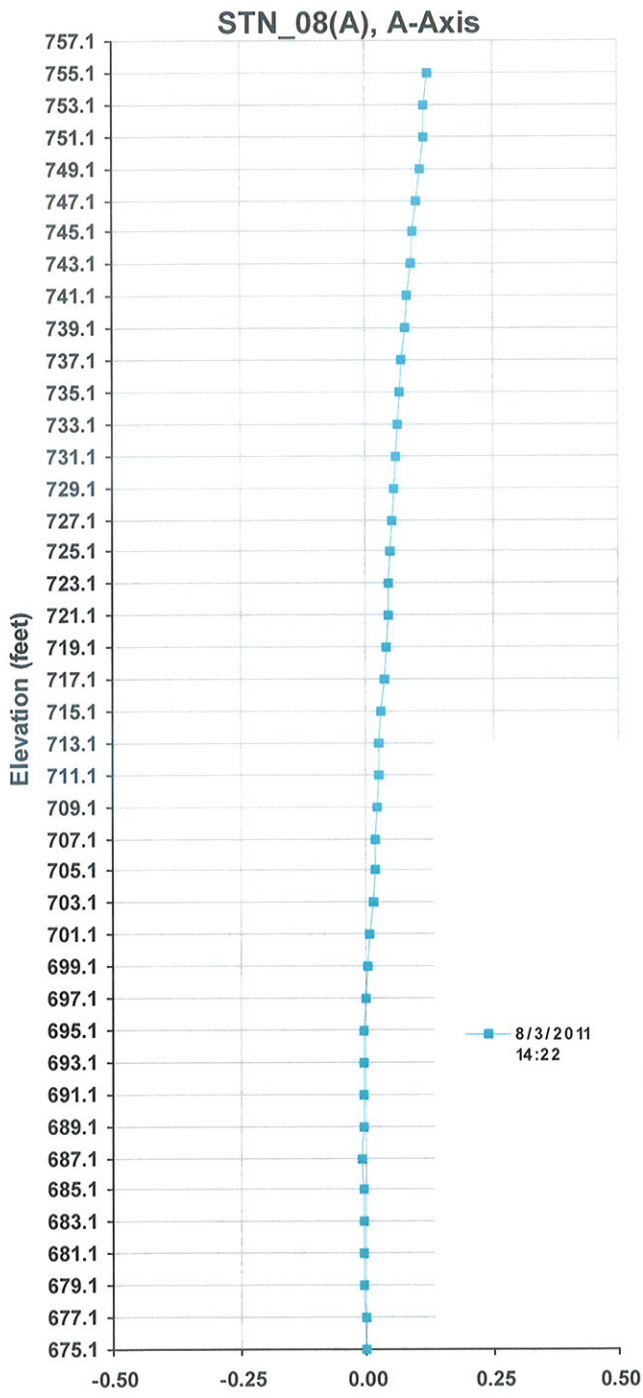
Reference: **Dike C Slope Inclinometer Data Weekly Review**

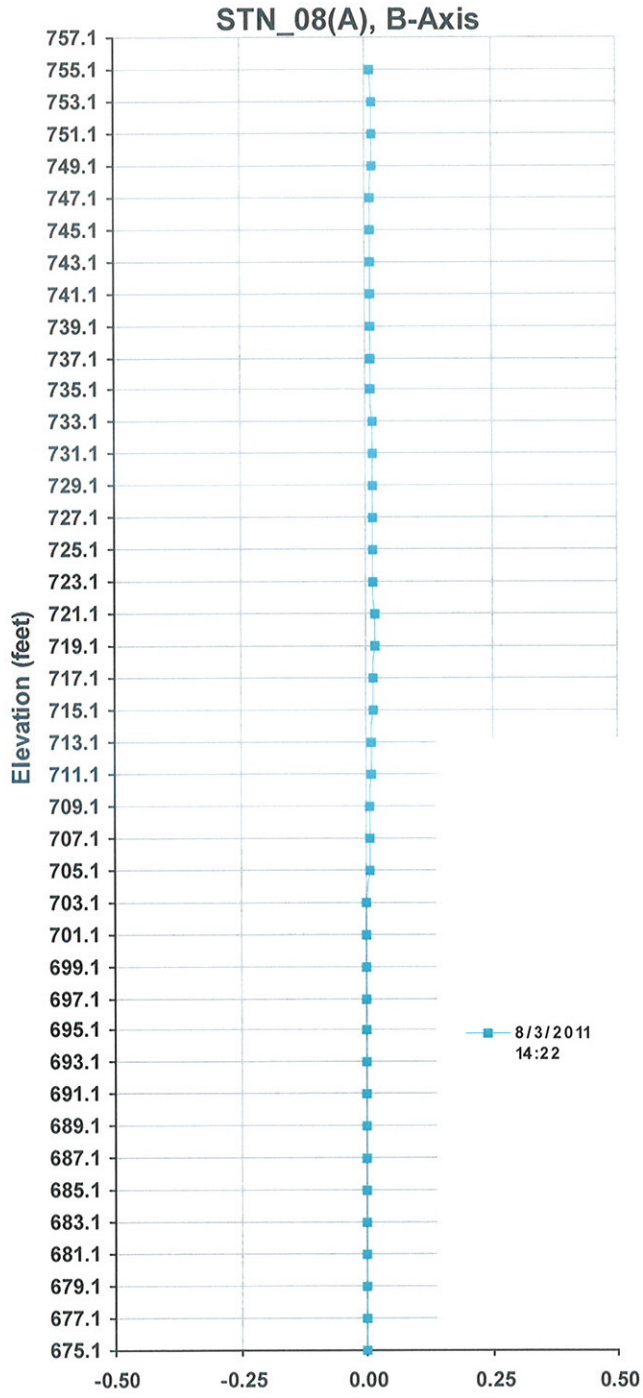
Because of annual calibration of the SI probe used on site, all slope inclinometers have been re-baselined on July 29, 2011 using a new (rental) SI probe. The limited monitoring of the SI's using the new probe are attached on Figures 1 – 7.

The limited data using the new probe is generally consistent with the movements monitored using the original probe.

Attachment: SI Data

Figure 1



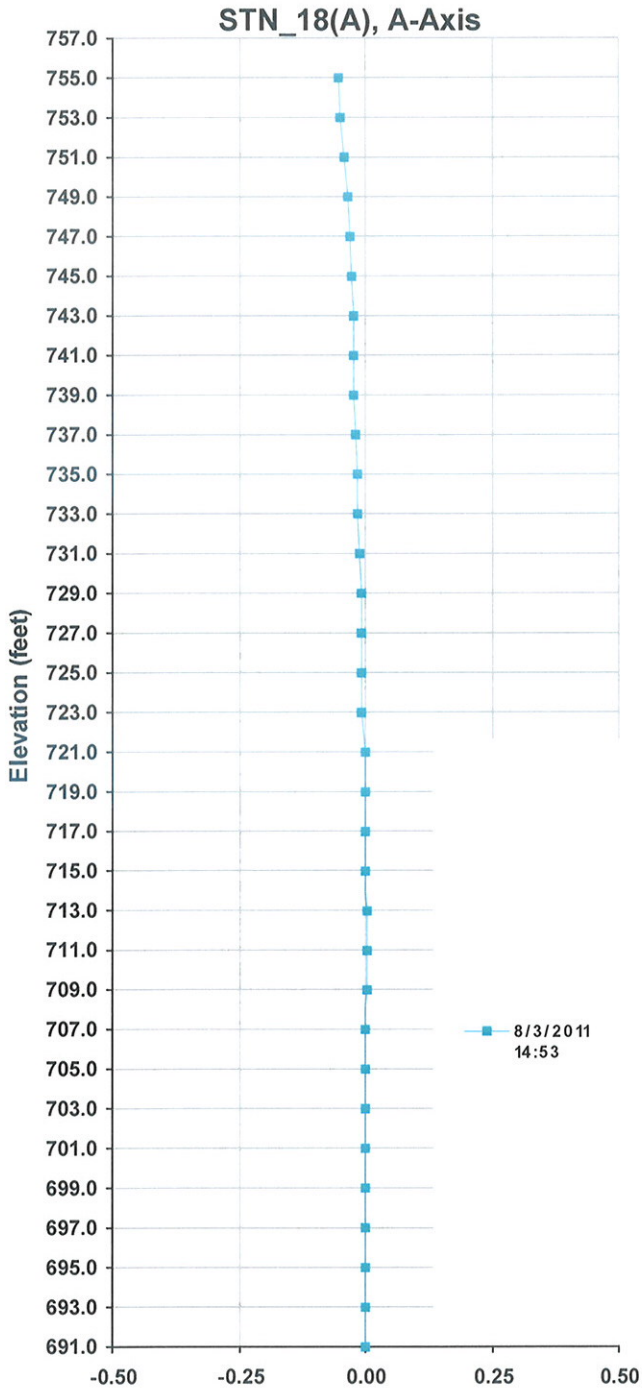


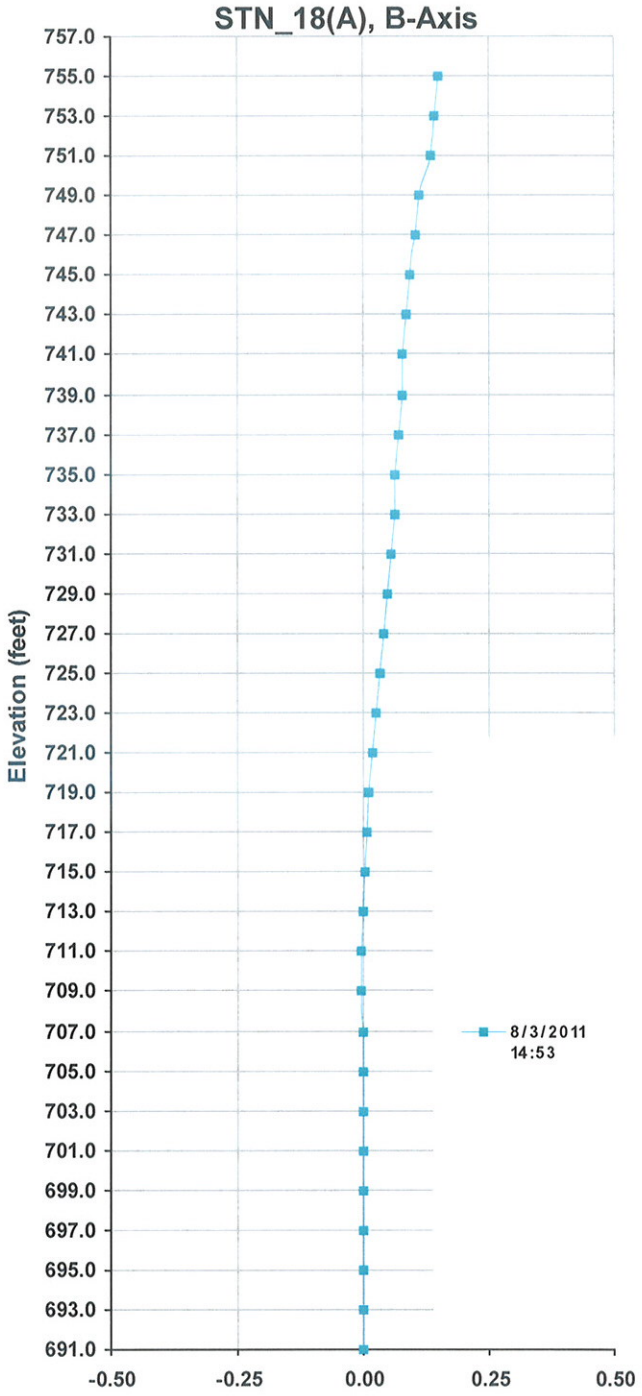
Stantec

BC - Both A and B Axis

Kingston Fossil Plant
Dike C
Kingston, TN
175569042
8/5/2011

Figure 2



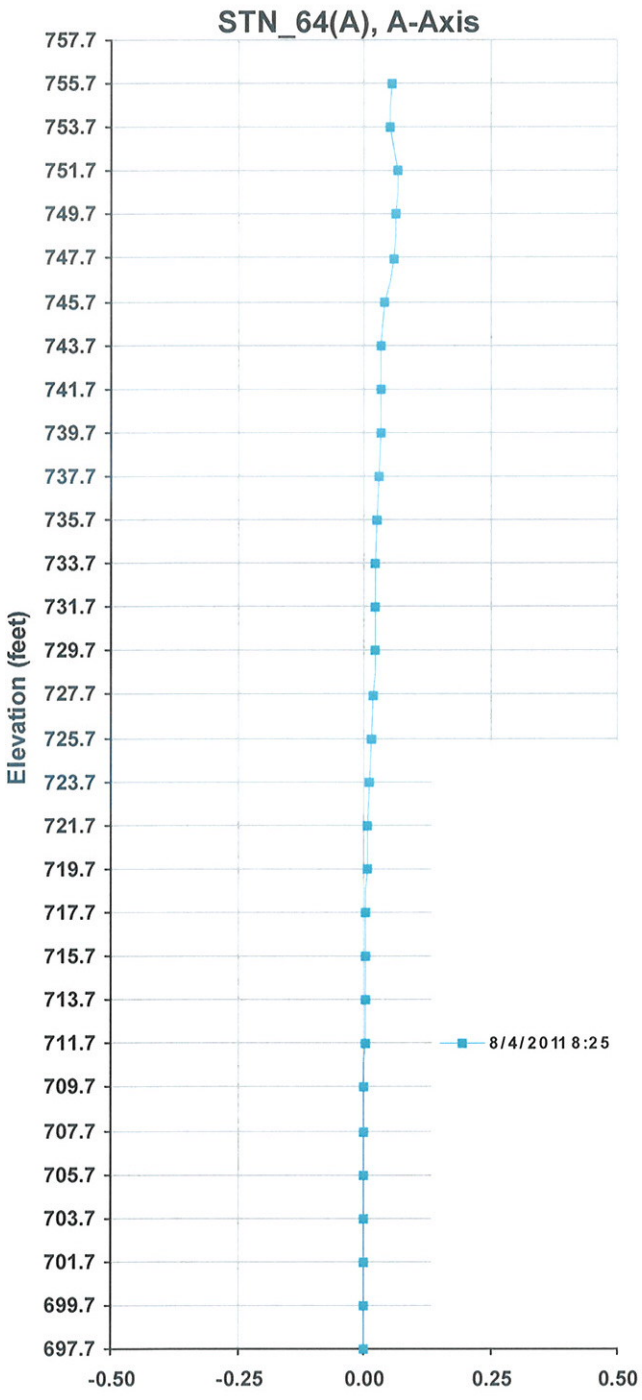


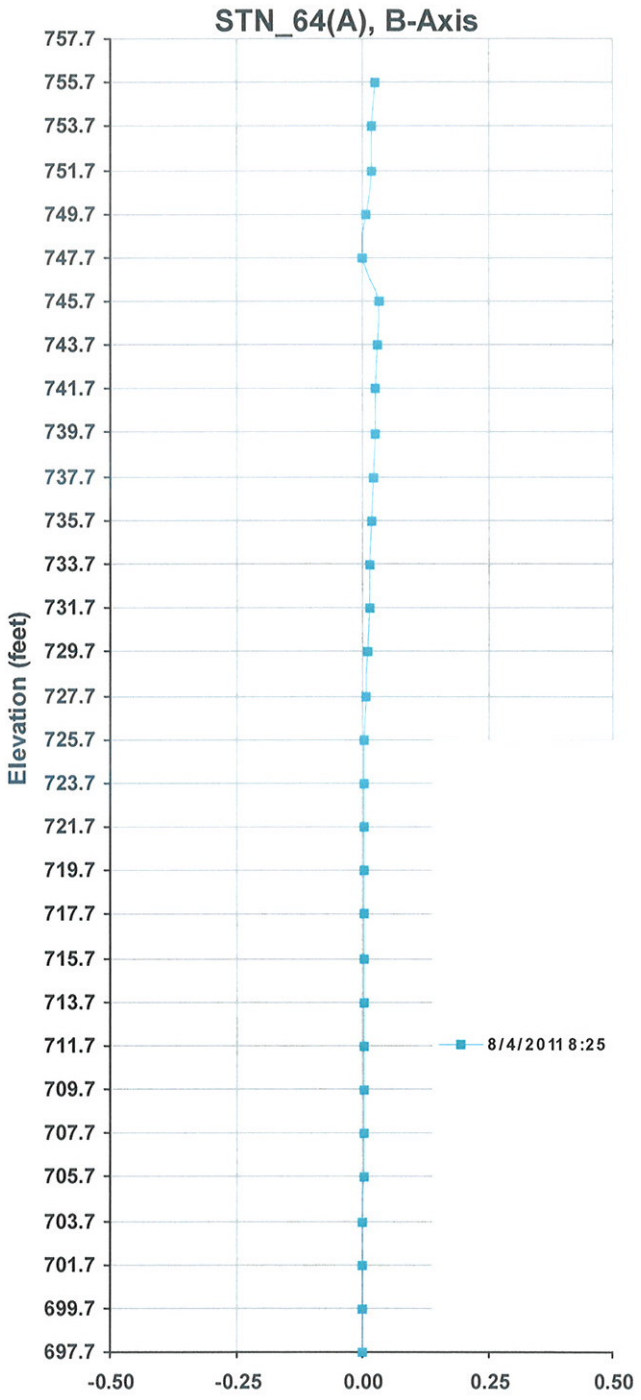
Stantec

BC - Both A and B Axis

Kingston Fossil Plant
Dike C
Kingston, TN
175569042
8/5/2011

Figure 3



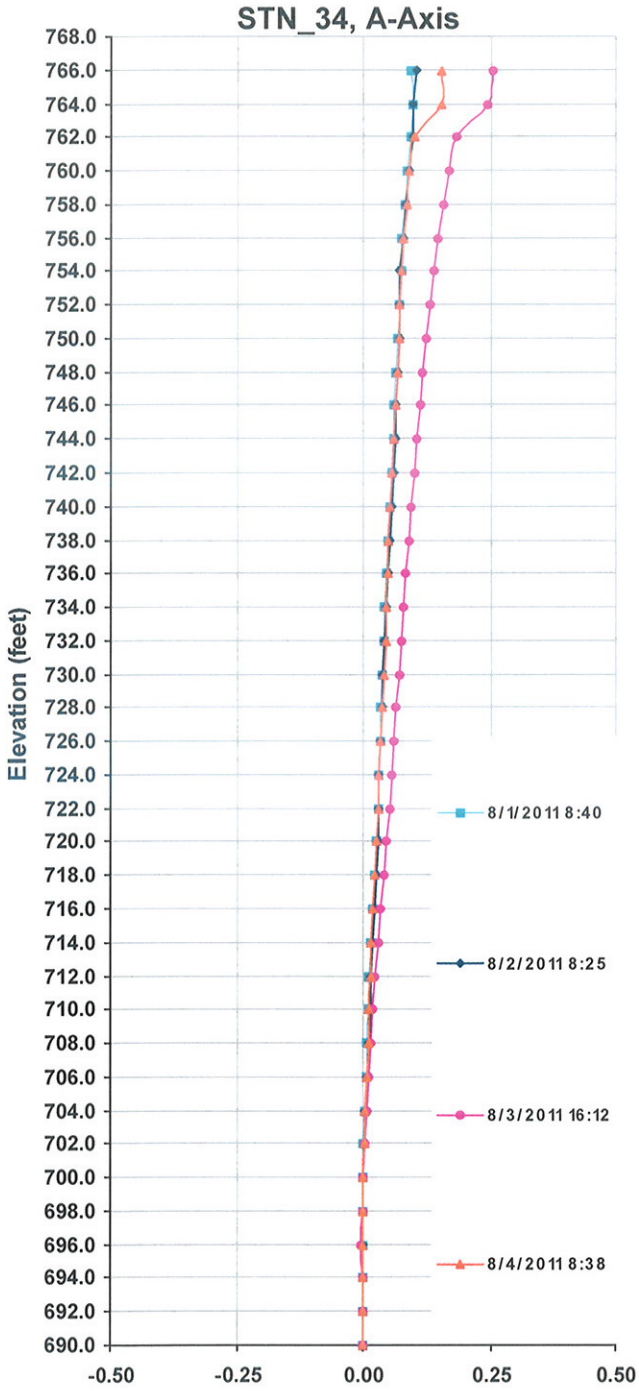


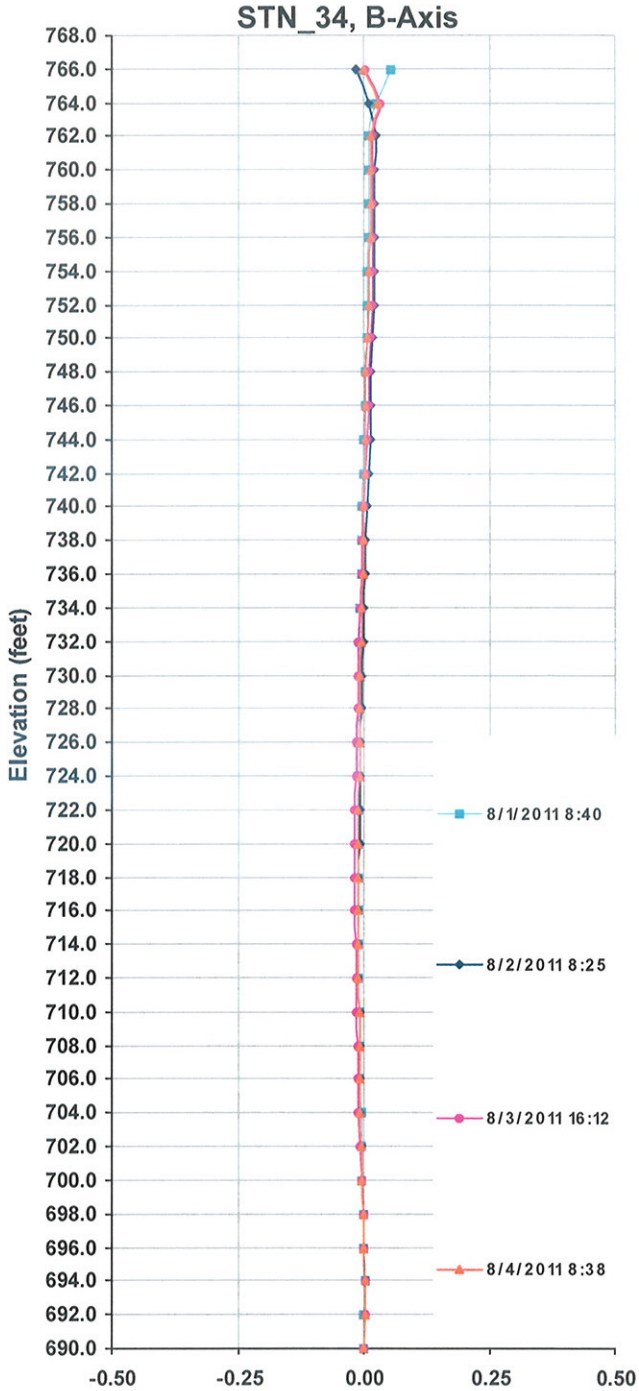
Stantec

BC - Both A and B Axis

Kingston Fossil Plant
Dike C
Kingston, TN
175569042
8/5/2011

Figure 4





Stantec

BC - Both A and B Axis

Kingston Fossil Plant
Dike C
Kingston, TN
175569042
8/5/2011

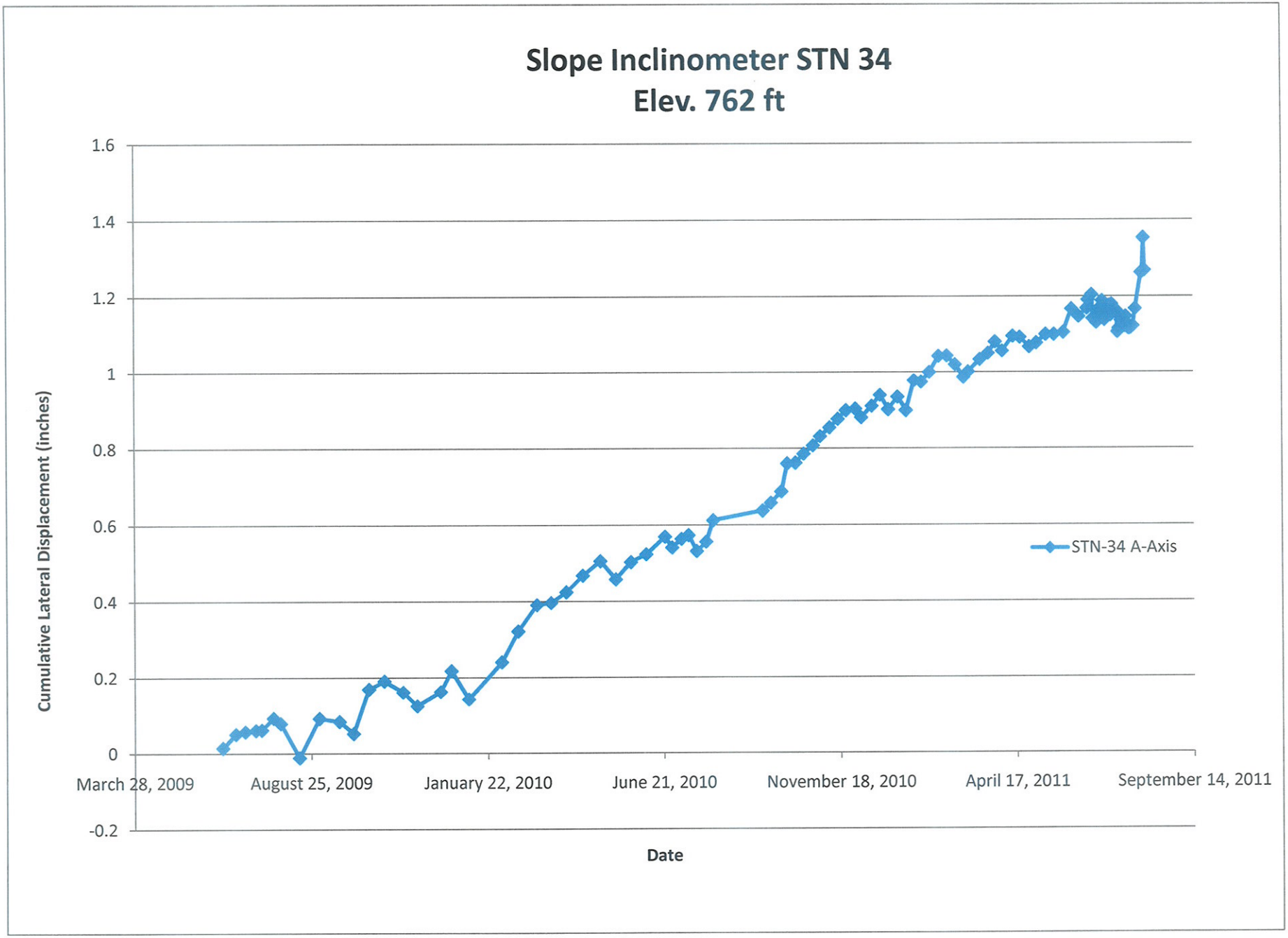
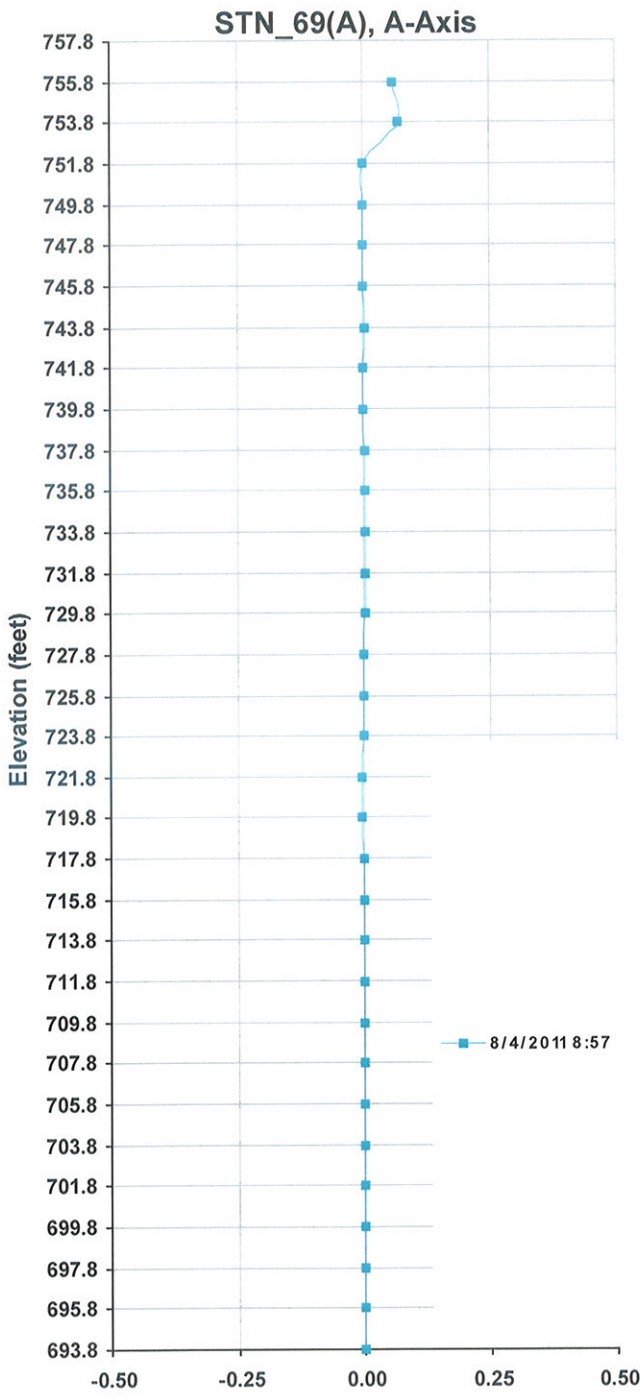
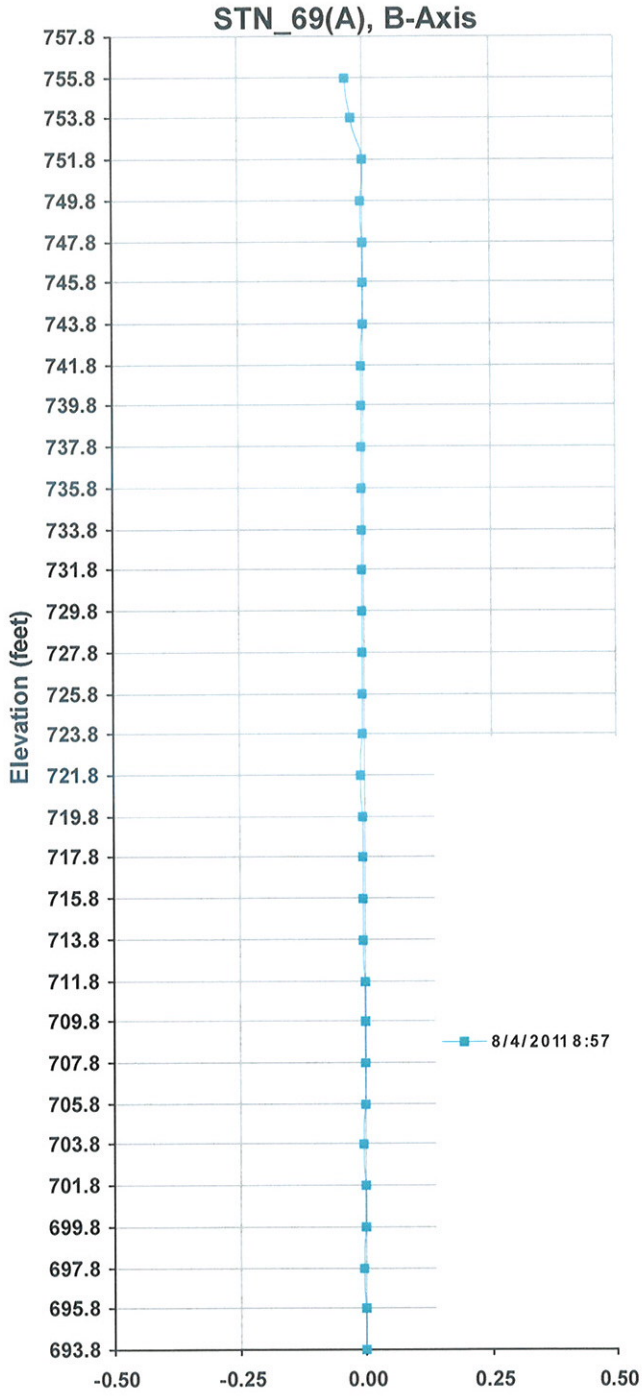

Slope Inclinometer STN 34
Elev. 762 ft
Cumulative Lateral Displacement (inches)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
March 28, 2009
August 25, 2009
January 22, 2010
June 21, 2010
November 18, 2010
April 17, 2011
September 14, 2011
Date
STN-34 A-Axis

Figure 5

Figure 6



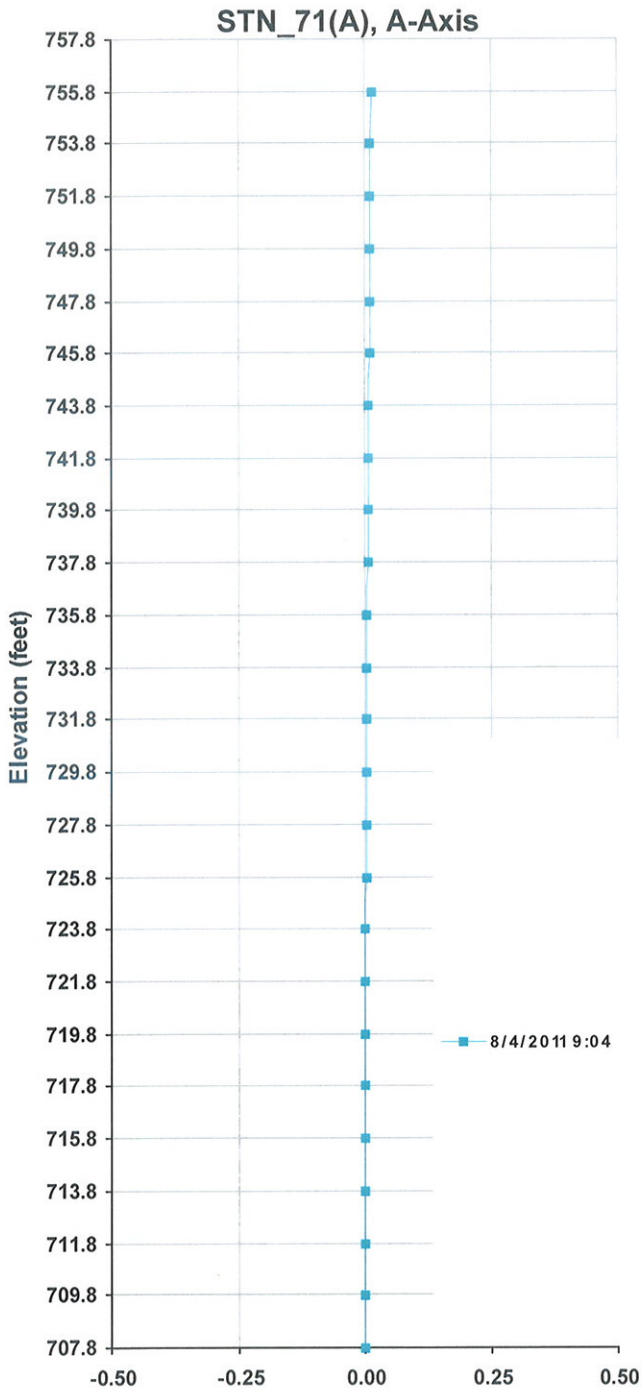


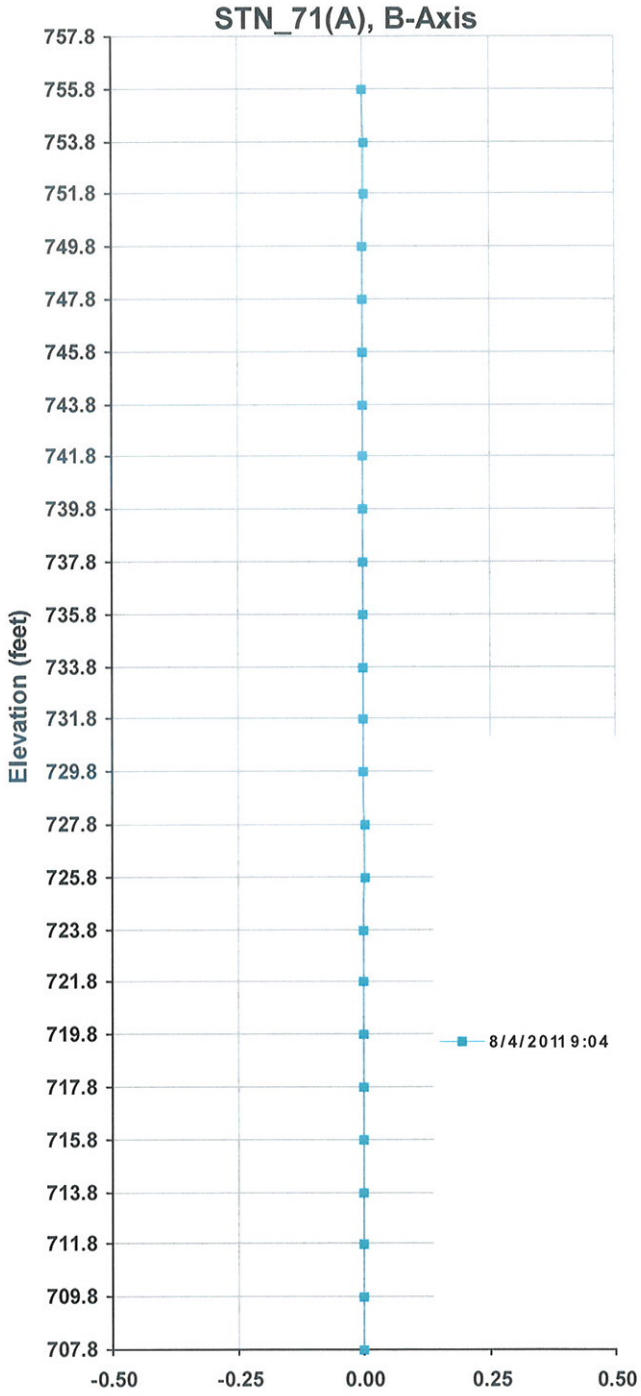
Stantec

BC - Both A and B Axis

Kingston Fossil Plant
Dike C
Kingston, TN
175569042
8/5/2011

Figure 7





Stantec

BC - Both A and B Axis

Kingston Fossil Plant
Dike C
Kingston, TN
175569042
8/5/2011

APPENDIX A

Document 19

Stantec Consulting Services Memo Dated August 8, 2011, "Reference" Dike C Weekly Piezometer Data Review (Data from July 22, 2011, to August 5, 2011)"

Memo

Stantec Consulting Ltd.
4370 Dominion Street, 5th Floor
Burnaby, BC V5G 4L7
Tel: (604) 436-3014
Fax: (604) 436-3752

Stantec

To: Tod Woodson **From:** Tom Crilly

Project: Kingston Fossil Plant Date: August 8, 2011

Reference: **Dike C Weekly Piezometer Data Review (Data from July 22, 2011 to August 5, 2011)**

The weekly monitoring results for the piezometers at Dike C are included on the attached Figures B-22 to B-29. The attached piezometer results include monitoring up to August 5, 2011. Outlined below is a summary of the monitoring results from July 22, 2011 to August 5, 2011. The water level of Watts Bar Lake has remained approximately the same during the period at 740.3 ft (August 6). Trigger levels will be referenced to summer lake levels.

Sta. 108+93 (PZ-17 to PZ-20) – Figure B-22

- All PZ's decreased by 0 to 0.6 ft.
- The identified critical piezometer for this group (PZ-19(L)) decreased by 0.6 ft to Elev. 749.9 ft. This remains below the established trigger level of 760.0 ft.

Sta. 119+69 (PZ-13 to PZ-16) – Figure B-23

- All piezometers decreased by 0 to 1.1 ft.
- The identified critical piezometer for this group (PZ-13) decreased by 1.1 ft to Elev. 740.0 ft, below the established trigger level of 742.5 ft.
- PZ-129 located within the starter dike at Sta. 122+00 **(Figure B-27)** has decreased from 741.3 ft on July 19 to 740.4 ft on August 4. The piezometers at Sta. 122+00 have been monitored on a daily basis since June 22. All piezometers within this group have generally decreased during the monitoring period July 19 to August 4.

Sta. 132+37 (PZ-9 to PZ-12) – Figure B-24

- All PZ's decreased by 0 to 0.5 ft.
- The identified critical piezometer for this group (PZ-9) decreased by 0.5 ft to Elev. 741.2 ft. This remains below the established trigger level of 754.0 ft.

Reference: Dike C Weekly Piezometer Data Review (Data from July 22, 2011 to August 5, 2011)

Sta. 143+05 (PZ-5 to PZ-8) – Figure B-25

- All PZ's decreased by 0 to 0.8 ft.
- The identified critical piezometer for this group (PZ-5) was unchanged at Elev. 742.9 ft. This remains below the established trigger level of 754 ft.
- The piezometers installed within the starter dike at Sta. 138+27 have shown a similar trend of following the level of the lake, and are 1.6 ft lower than PZ-5. For the piezometers installed within the raised dike; PZ-124A (shallow screen tip) is reading 4.2 ft lower than PZ-6(U); PZ-124B (intermediate screen tip) is approximately 3.9 ft lower than PZ-7(L); and PZ-125 (deep screen tip) is reading approximately 2 ft higher than PZ-8. All piezometers within this group have generally decreased by 0.3 to 1.4 ft over the monitoring interval. The piezometer readings for Sta. 138+27 are shown on **Figure B-28.** From the monitoring to date, there is no indication that the stability analysis at Sta. 138+27 using piezometers at Sta. 143+05 (to be representative of the dike from Sta. 138+00 to 146+50) should be revised to include the piezometer results at Sta. 138+27.

Sta. 154+82 (PZ-1 to PZ-4) - Figure B-26

- All PZ's decreased by 0.1 to 2.4 ft.
- The identified critical piezometer for this group (PZ-3(L)) decreased by 2.4 ft to Elev. 750.6 ft. This is below the established trigger level of 762 ft.
- The piezometers installed within the starter dike at Sta. 149+14 have shown a similar trend of following the level of the lake, and are being monitored 1.3 to 3.9 ft higher than the starter dike piezometer at Sta. 154+82. For the piezometers installed within the raised dike; PZ-121A (shallow screen tip) is reading 0.5 ft higher than PZ-2(U); PZ-121B (intermediate screen tip) is approximately 3.4 ft lower than PZ-3(L); and PZ-122 (deep screen tip) is reading approximately 1.4 ft lower than PZ-4. The piezometer readings for Sta. 149+14 are shown on **Figure B-29.** From the monitoring to date, there is no indication that the stability analysis at Sta. 149+14 using piezometers at Sta. 154+82 (to be representative of the dike from Sta. 146+50 to 160+00) should be revised to include the piezometer results at Sta. 149+14.

Summary

None of the established critical piezometers reached their established trigger levels for the weekly piezometer monitoring to August 5, 2011. The PZ's monitored daily at Sta. 122+00 adjacent to the buttress construction decreased slightly during the monitoring period.

Attachment: PZ Data

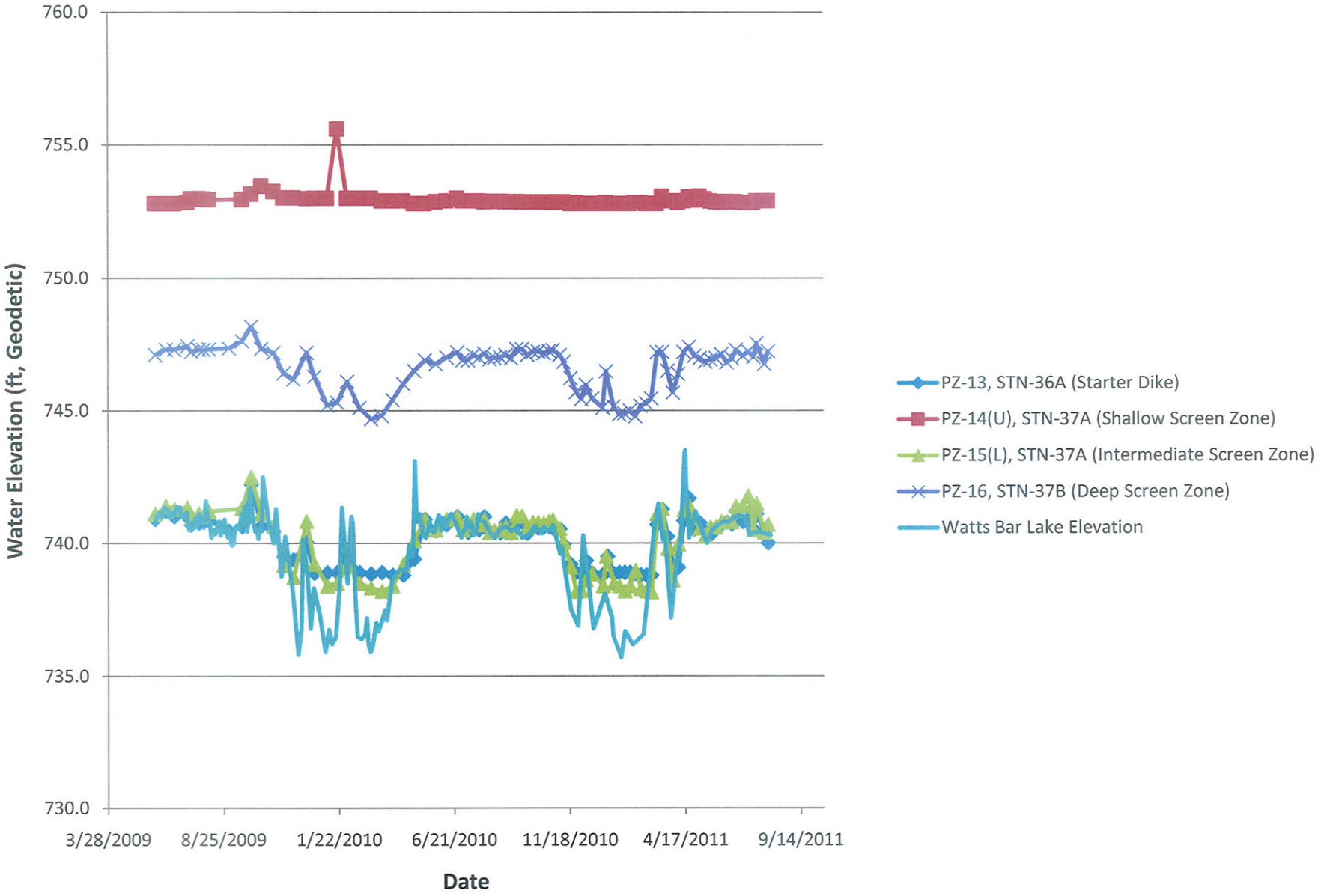
C:\Users\tcrilly\Desktop\TVA Invoicing and files working in wpg\monitoring to August 5 2011\August_5_2011_PZ_review.docx

Sta. 108+93 Piezometer Readings

Figure B-22

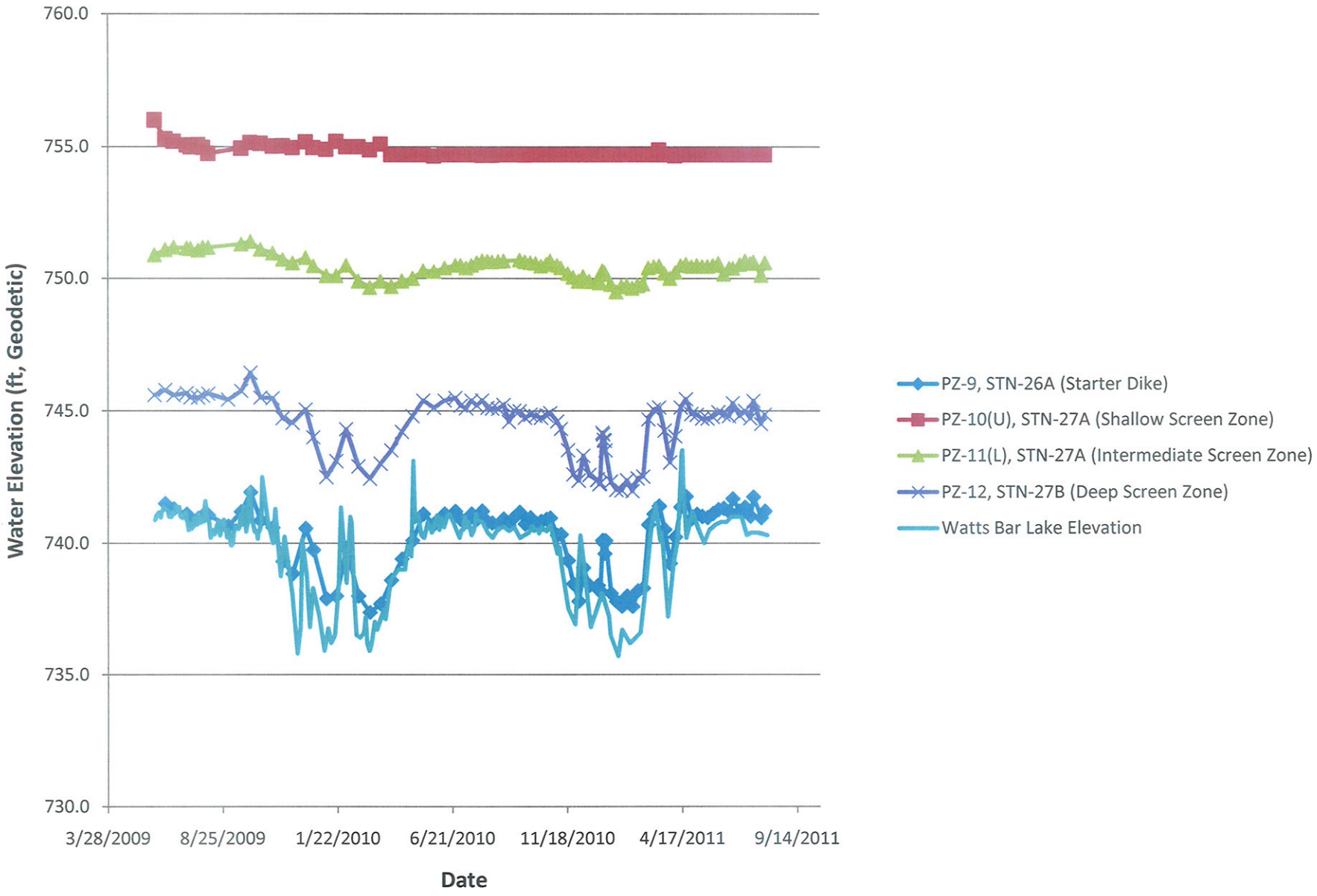
Sta. 119+69 Piezometer Readings

Figure B-23



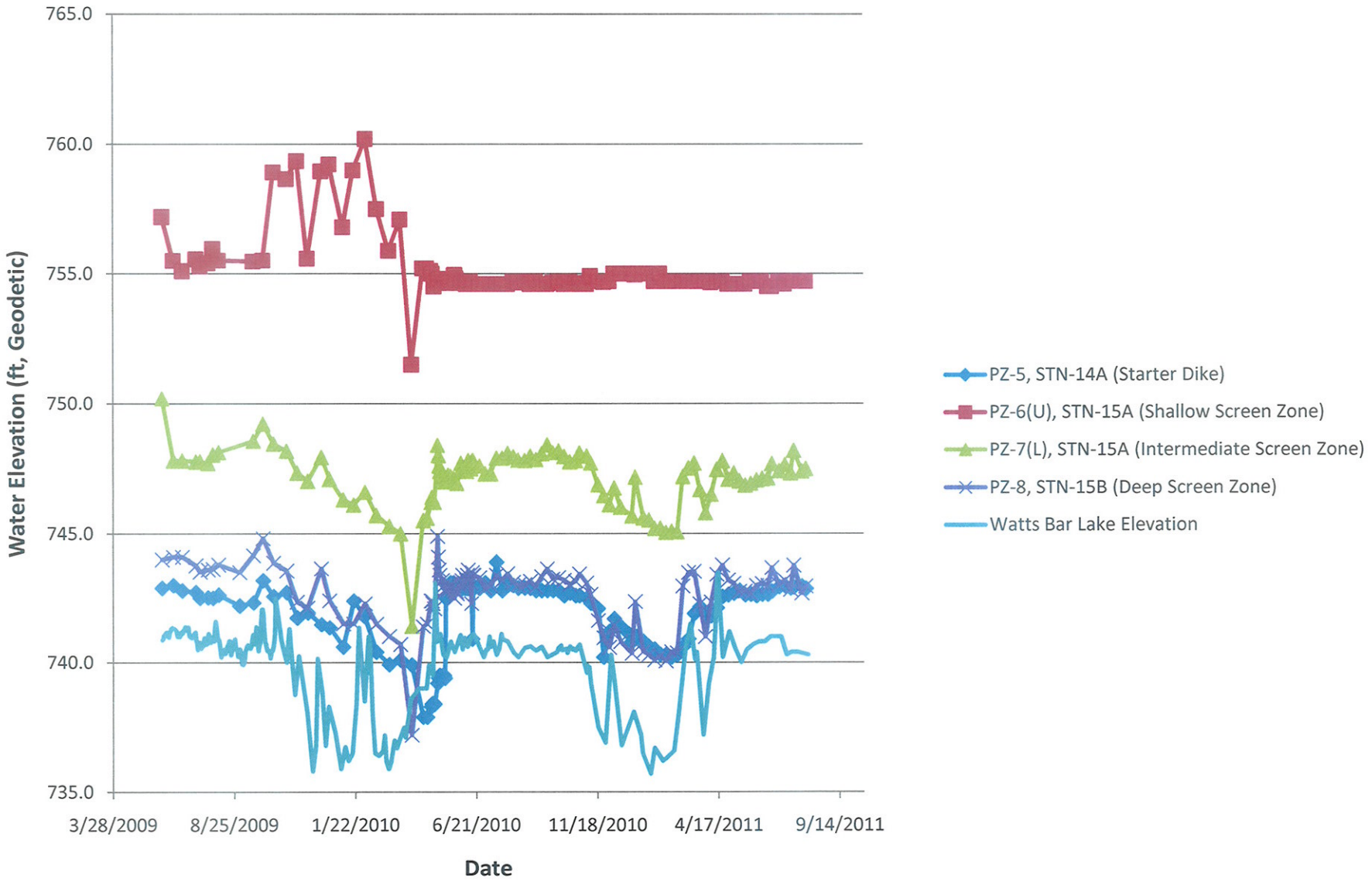
Sta. 132+37 Piezometer Readings

Figure B-24



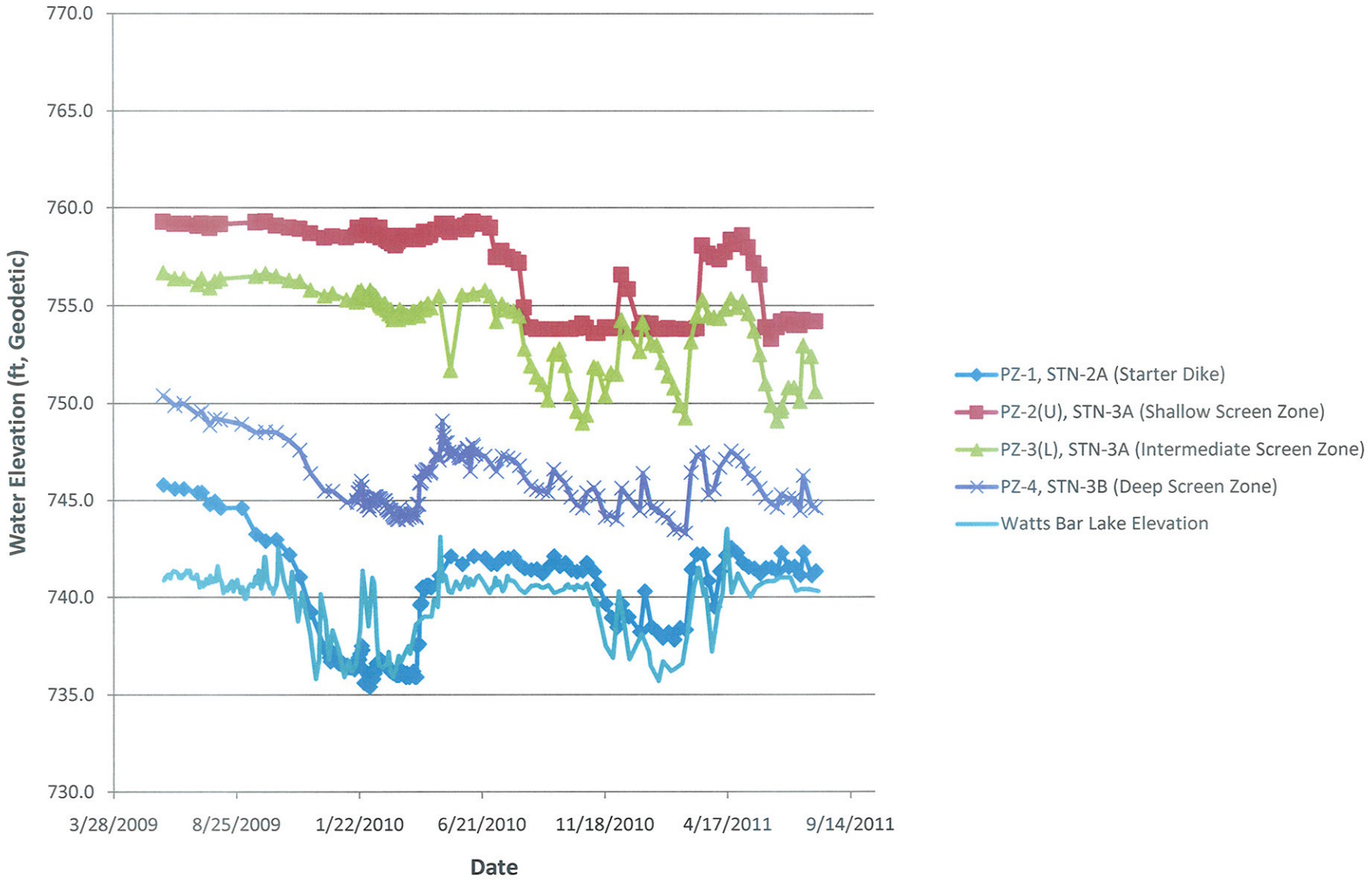
Sta. 143+05 Piezometer Readings
(Stability Cross-Section at STA 138+27)

Figure B-25



Sta. 154+82 Piezometer Readings
(Stability Cross-Section at STA 149+14)

Figure B-26



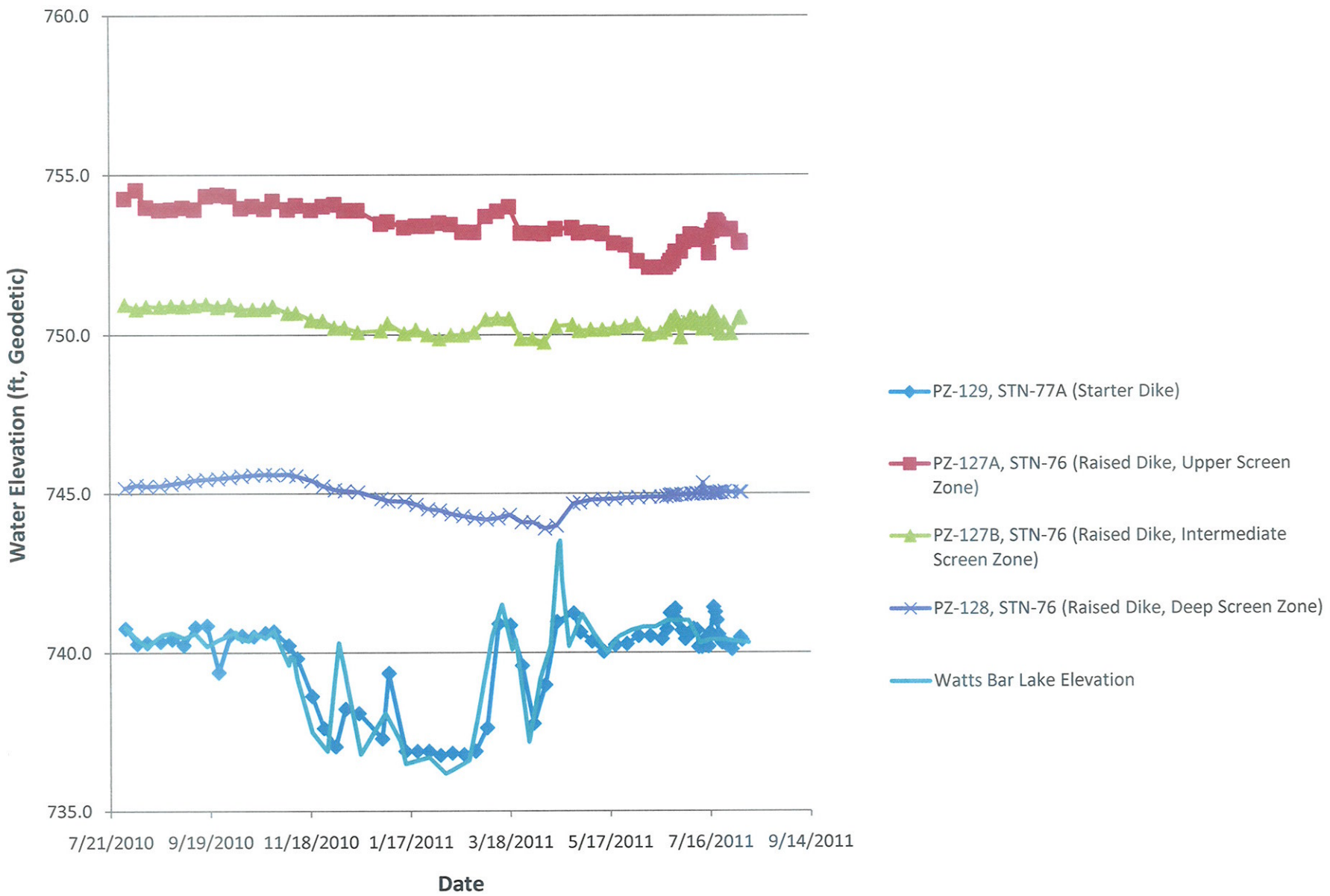
Stantec

Kingston Fossil Plant
Kingston, TN
175669093

8/8/2011

Sta. 122+00 Piezometer Readings

Figure B-27



Sta. 138+27 Piezometer Readings

Figure B-28

Stantec

Kingston Fossil Plant
Kingston, TN
175669093

8/8/2011

Sta. 149+14 Piezometer Readings

Figure B-29

APPENDIX A

Document 20

Stantec Consulting Services Inc. Correspondence Dated February 15, 2012, Re: Results of Pseudostatic Slope Stability Analysis, Active CCP Disposal Facilities, BRF, COF, GAF, JSF, KIF, PAF, and WCF

Stantec Consulting Services Inc.
10509 Timberwood Circle Suite 100
Louisville, KY 40223-5301
Tel: (502) 212-5000
Fax: (502) 212-5055

February 15, 2012 ltr_002_175551015

Mr. Michael S. Turnbow
Tennessee Valley Authority
1101 Market Street, LP 2G-C
Chattanooga, Tennessee 37402-2801

Re: Results of Pseudostatic Slope Stability Analysis
Active CCP Disposal Facilities
BRF, COF, GAF, JSF, JOF, KIF, PAF, and WCF

Dear Mr. Turnbow:

As requested, Stantec Consulting Services Inc. (Stantec) has conducted pseudostatic slope stability analyses for ground motion levels corresponding to a return period of 2,500 years to support the U.S. Environmental Protection Agency's assessment of TVA's CCP disposal facilities. The results for Bull Run (BFR), Colbert (COF), Gallatin (GAF), John Sevier (JSF), Johnsonville (JOF), Kingston (KIF), Paradise (PAF), and Widows Creek (WCF) are provided in this letter.

Approach

The analyses were performed for current conditions using pseudostatic stability methods, where the added inertial load from an earthquake is assumed to be represented by a simple horizontal pseudostatic coefficient. Specifics related to the analyses/approach are as follows:

- Subsurface data was obtained from the Stantec's recent geotechnical studies performed in 2009 and 2010 time frame.
- SLOPE/W software (from GEO-SLOPE International, Inc.) was used to perform the calculations.
- One existing SLOPE/W cross-section model per disposal facility was selected from the previous studies for analysis. For simplicity and conservatism, the selected sections represent the facility's lowest current static (long-term) factor of safety. The SLOPE/W models were updated to reflect any significant mitigations or operational changes that have occurred since completion of Stantec's geotechnical studies.
- Undrained shear strength parameters were used.
- Ground motion levels corresponding to a return period of 2,500 years (or approximate exceedance probability of 2% in 50 years) was used for selection of a horizontal seismic coefficient. For simplicity, the horizontal seismic coefficient was selected to equal the total hazard peak ground acceleration (rock) for 2,500 year return periods as shown in plant-

specific tables (Tables 13 through 23) of TVA's March 28, 2011 region-specific seismic hazard study performed by AMEC Geomatrix, Inc.

- A target factor of safety (FS) of 1.0 was considered for comparing results.

Results

The results of the pseudostatic stability analyses are enclosed (summary spreadsheet, SLOPE/W cross-sections, and plan views showing cross-section locations). The results indicate factors of safety greater than or equal to the target of 1.0.

Stantec appreciates the opportunity to provide these services. If you have questions, or if we can provide additional information, please let us know.

Sincerely,

STANTEC CONSULTING SERVICES INC.

Randy L. Roberts, PE
Principal

Enclosures

/cdm

Pseudostatic Stability Analysis Summary - TVA Active CCP Disposal Facilities

BRF, COF, GAF, JSF, JOF, KIF, PAF, WCF

Plant	CCP Disposal Facility		Cross-Section	2,500 yr Return	
	Name	Type		PGA (g)	Factor of Safety
BRF	Gypsum Disposal Area 2A	Wet Stack	I	0.131	1.0
	Fly Ash Disposal Area 2	Impoundment	S		1.4
	Bottom Ash Disposal Area 1	Stack	D		1.1
COF	Disposal Area 5 Stack	Stack	I	0.138	1.0
	Disposal Area 5 Stilling Basin	Impoundment	J		1.2
	Ash Pond 4	Impoundment	D		1.0
GAF	Ash Pond A	Impoundment	K	0.108	1.0
	Ash Pond E	Impoundment	B		1.3
JSF	Bottom Ash Pond	Impoundment	I	0.115	2.2
JOF	Ash Disposal Area 2	Impoundment	K	0.254	1.0
KIF	Stilling Pond	Impoundment	132+37	0.115	1.0
PAF	Slag Ponds 2A and 2B	Impoundment	Typical	0.157	1.1
	Scrubber Sludge Complex	Impoundment	G		1.0
	Peabody Ash Pond	Impoundment	A		1.0
WCF	Gypsum Stack	Wet Stack	F	0.1	1.5
	Dredge Cell (Old Scrubber Sludge Pond)	Impoundment	D		1.1
	Main Ash Pond	Impoundment	J		1.4

Kingston Fossil Plant
(KIF)

Pseudostatic Slope Stability Analysis
CCP Storage Facilities - Existing Conditions
Tennessee Valley Authority Fossil Plants

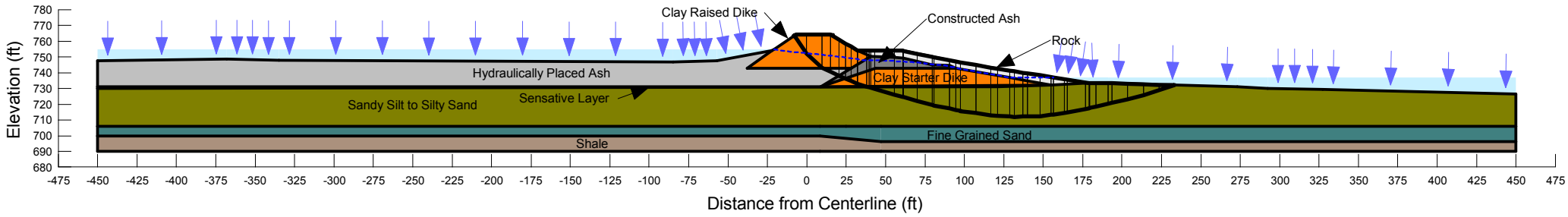
Section STA. 132+37
Kingston Fossil Plant
Harriman, Tennessee

Note:
The results of the analysis shown here are based on available subsurface information, laboratory test results, and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Material Type	Unit Weight	Cohesion	Friction Angle
Clay Raised Dike	125 pcf	65 psf	23 °
Constructed Ash	93 pcf	0 psf	30 °
Hydraulically Placed Ash	96 pcf	0 psf	10 °
Sandy Silt to Silty Sand	105 pcf	0 psf	27 °
Fine Grained Sand	122 pcf	0 psf	31 °
Clay Starter Dike	129 pcf	300 psf	26 °
Sensative Layer	127 pcf	c/p = 0.32	N/A
Rock	110 pcf	0 psf	38 °
Shale	N/A	N/A	N/A

Factor of Safety: 1.0

Horizontal Seismic Coefficient Kh = 0.115 g
2500-year Return Period Event



Date of Assessment - 11/4/2011

Project No 175551015

BORING LOCATION TABLE			
Boring No.	Northing	Easting	Elevation (Feet)
STN-2	556804.57	2442329.32	751.20
STN-2B	556801.29	2442323.04	751.00
STN-3	556756.78	2442263.59	763.70
STN-3C	556763.50	2442257.42	763.80
STN-3D	556762.50	2442258.42	763.80
STN-3E	556764.10	2442559.45	763.80
STN-4	556625.56	2442047.01	763.30
STN-5	556611.15	2442365.31	764.90
STN-6	556416.17	2442407.10	763.40
STN-8	556248.52	2442540.30	752.20
STN-8A	556254.96	2442535.17	751.70
STN-9	556233.82	2442499.72	764.80
STN-9A	556234.82	2442499.81	764.80
STN-10	556162.76	2442251.63	765.00
STN-11	556034.83	2442535.05	763.20
STN-12	555873.09	2442622.48	765.10
STN-14	555685.58	2442733.21	753.10
STN-14B	555690.29	2442730.41	753.00
STN-15	555662.69	2442667.52	763.70
STN-15C	555671.50	2442690.88	765.30
STN-15D	555665.72	2442690.78	765.30
STN-15E	555694.24	2442681.34	765.00
STN-16	555501.40	2442725.94	764.50
STN-18	555204.87	2442894.11	751.00
STN-18A	555204.57	2442886.00	751.80
STN-19	555204.68	2442842.94	765.60
STN-19A	555204.68	2442843.94	765.60
STN-20	555168.84	2442666.59	762.90
STN-21	555076.61	2442149.85	765.00
STN-22	554990.27	2441723.40	765.00
STN-23	555020.22	2442857.46	764.70
STN-24	554803.45	2442843.16	765.10
STN-26	554624.86	2442889.00	750.00
STN-26B	554604.57	2442896.12	751.00
STN-27	554601.77	2442850.67	765.10
STN-27A	554600.64	2442840.21	765.00
STN-27B	554606.18	2442840.52	765.00
STN-27C	554607.18	2442840.92	765.00
STN-28	554406.25	2442841.10	764.80
STN-29	554155.15	2442854.72	764.70
STN-31	553954.94	2442758.22	749.50
STN-31A	553980.30	2442764.66	749.70
STN-32	553994.90	2442746.44	764.80
STN-32A	553996.72	2442757.13	764.80
STN-34	553882.51	2442381.24	764.70

BORING LOCATION TABLE			
Boring No.	Northing	Easting	Elevation (Feet)
STN-36	553776.74	2442198.78	751.90
STN-36B	553753.47	2442155.66	751.50
STN-37	553799.90	2442184.40	763.80
STN-37C	553798.81	2442171.01	763.60
STN-37D	553798.26	2442168.95	763.60
STN-37E	553799.26	2442183.40	763.80
STN-38	553730.83	2441988.70	764.10
STN-41	553583.10	2441510.71	752.70
STN-41A	553584.59	2441512.86	751.80
STN-42	553623.48	2441513.69	764.70
STN-42A	553624.48	2441512.69	764.70
STN-43	554004.68	2441548.50	765.90
STN-43A	554005.71	2441549.61	765.90
STN-45	553740.50	2441308.40	763.90
STN-47	553747.39	2441146.83	753.40
STN-47B	553742.43	2441143.28	753.80
STN-48	553773.29	2441154.53	765.30
STN-48C	553770.51	2441164.28	765.30
STN-49	553921.85	2441024.39	763.10
STN-50	553631.96	2440496.85	741.60
STN-50A	553632.98	2440497.85	741.60
STN-51	553696.02	2440548.48	750.40
STN-52	553992.98	2440817.40	753.20
STN-53	554011.12	2440902.46	763.90
STN-53A	554012.14	2440904.05	763.90
STN-54	555263.94	2441476.12	765.00
STN-55	554943.73	2442287.49	764.10
STN-56	554555.61	2441998.50	765.80
STN-59	556075.53	2442603.06	752.20
STN-60	555886.92	2442663.31	752.50
STN-61	555513.59	2442792.80	752.50
STN-62	555020.69	2442907.23	749.80
STN-63	554822.75	2442910.57	750.00
STN-64	554411.29	2442911.08	749.40
STN-65	554147.51	2442915.09	748.60
STN-66	553888.83	2442584.24	750.90
STN-69	553607.58	2441718.01	752.30
STN-71	553840.20	2440981.04	752.00
STN-72	556243.56	2442498.40	765.70
STN-73	556264.59	2442544.34	763.90
STN-74	555189.21	2442848.63	766.20
STN-74	555184.59	2442849.41	766.20
STN-75	555194.95	2442895.83	753.40
STN-76	553923.59	2442380.21	762.00
STN-77	553847.01	2442405.85	754.90

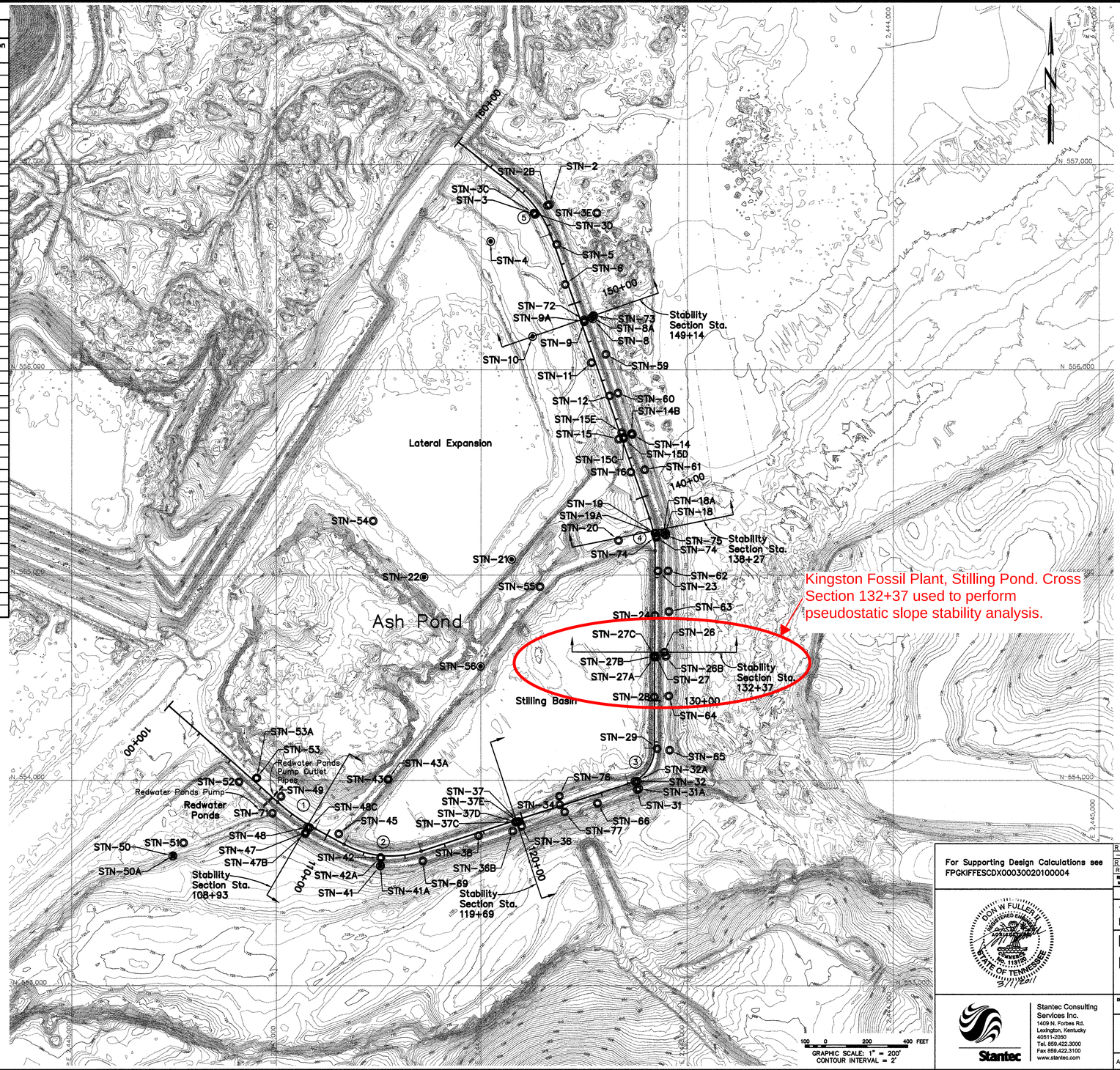


TABLE OF BASELINE COORDINATES			
Station	Baseline	Northing	Easting
100+00.00	Begin Project Baseline	554,363.86	2,440,477.77
160+00.00	End Project Baseline	557,109.43	2,441,888.38

BASELINE CURVE DATA

① P.I. Sta. = 108+20.74; Northing = 553,819.18; Easting = 2,441,091.71; Δ = 13°20'06"; R = 974.68'; T = 113.94'; L = 226.85'; E = 6.64'; P.C. Sta. = 107+06.80; P.T. Sta. = 109+33.65

② P.I. Sta. = 112+99.93; Northing = 553,591.92; Easting = 2,441,514.77; Δ = 46°19'10"; R = 479.84'; T = 205.26'; L = 387.92'; E = 42.06'; P.C. Sta. = 110+94.67; P.T. Sta. = 114+82.59

③ P.I. Sta. = 126+71.85; Northing = 554,024.61; Easting = 2,442,840.47; Δ = 71°45'50"; R = 182.94'; T = 132.33'; L = 229.13'; E = 42.85'; P.C. Sta. = 125+39.52; P.T. Sta. = 127+68.65

④ P.I. Sta. = 138+12.12; Northing = 555,200.41; Easting = 2,442,843.77; Δ = 19°21'32"; R = 479.84'; T = 81.84'; L = 162.13'; E = 6.93'; P.C. Sta. = 137+30.28; P.T. Sta. = 138+92.41

⑤ P.I. Sta. = 154+96.30; Northing = 556,792.40; Easting = 2,442,289.43; Δ = 32°28'34"; R = 479.84'; T = 139.75'; L = 271.98'; E = 19.94'; P.C. Sta. = 153+56.55; P.T. Sta. = 156+28.53

LEGEND

- Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests
- Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests and Rock Core
- Previously Drilled by AECOM
- Cone Penetration Test

NOTES

1. Topographic mapping was generated from a LIDAR survey performed on January 8, 2009 by Tuck Mapping Solutions, Inc. This plan was developed for discussion purposes only and is not to be used for construction.
2. The geotechnical information and data furnished herein are not intended as representation or warranties but are furnished for information only. It shall be distinctly understood that the Owner or Engineer will not be responsible for any deduction, interpretation or conclusion drawn therefrom. The information is made available in order that the Contractor may have ready access to the same information available to the Owner and the Engineer and is not part of this contract.

FOR INFORMATION ONLY
This Record Drawing which has been previously submitted to TVA is provided for Information Only.

RECORD DRAWING

For Supporting Design Calculations see FPGKIFFESCDX00030020100004

DON W. FULLER II REGISTERED ENGINEER 119150 STATE OF TENNESSEE 5/17/2011

Stantec Consulting Services Inc.
1409 N. Forbes Rd.
Lexington, Kentucky
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Tel. 859.422.3000
Fax 859.422.3100
www.stantec.com

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT MGR	AS CONST
R 0	03/01/11	JDP	TJ	TC	DWF	–	MST	JCK	–	–
RECORD DRAWING										

SCALE: 1"=200' EXCEPT AS NOTED

YARD
DIKE C

BUTTRESS DESIGN
BORING PLAN AND BASELINE LAYOUT

DESIGNED BY: J.D. PINEAU	DRAWN BY: T. JOHNSON	CHECKED BY: T. CRILLY	SUPERVISED BY: D.W. FULLER	REVIEWED BY: –	APPROVED BY: M.S. TURNBOW	ISSUED BY: J.C. KAMMEYER

KINGSTON FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 03/01/11	36	C	10W287-01	R 0

PLOT FACTOR:200
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT DATE: 05/04/2011 USER: HOWL GORDON
S:\CIVIL\STANTEC\172589\03_ENGINEERING\FOSSIL PLANT - DIRECT\CAD\ESTE\CIVIL\10W287-BUTTRESSDESIGN\DWG\NEW_LAYOUT\10W287-01.DWG

APPENDIX A

Document 21

Geosyntec Consultants "Foundation Stability Analyses," Kingston Peninsula Permit Modification, October 29, 2010

GEOSYNTEC CONSULTANTS

COMPUTATION COVER SHEET

Client: TVA **Project:** Kingston Peninsula Permit Modification **Project/Proposal #:** GR4694 **Task #:** 05

TITLE OF COMPUTATIONS **FOUNDATION STABILITY ANALYSES**

COMPUTATIONS BY:
Signature Kushwant Chohan/Fan Zhu DATE 10/29/2010
Printed Name and Title Kush Chohan/Fan Zhu, Senior Staff Engineer/ Senior Staff Engineer

ASSUMPTIONS AND PROCEDURES CHECKED BY: (Peer Reviewer)
Signature R. Kulasingam DATE 11/01/2010
Printed Name and Title R. Kulasingam, Senior Engineer

COMPUTATIONS CHECKED BY:
Signature Fan Zhu DATE 10/29/2010
Printed Name and Title Fan Zhu, Senior Staff Engineer

COMPUTATIONS BACKCHECKED BY: (Originator)
Signature Kushwant Chohan/Fan Zhu DATE 10/29/2010
Printed Name and Title Kush Chohan/Fan Zhu, Senior Staff Engineer/ Senior Staff Engineer

APPROVED BY: (PM or Designate)
Signature Majdi Othman DATE 11/2/10
Printed Name and Title Majdi Othman, Principal

APPROVAL NOTES:

REVISIONS (Number and initial all revisions)

NO.	SHEET	DATE	BY	CHECKED BY	APPROVAL

Written by: **Kush Chohan/Fan Zhu** Date: **9/28/2010** Reviewed by: **R. Kulasingam/M. Othman** Date: **10/1/2010**

Client: **TVA** Project: **Kingston Peninsula Permit Modification** Project/ Proposal No.: **GR4694** Task No.: **05**

FOUNDATION STABILITY ANALYSES

PURPOSE

The purpose of this calculation package is to evaluate the static and seismic slope stability of the proposed disposal facility at the Kingston Fossil Plant (KIF). For these analyses, potential slip surfaces passing through the waste material and underlying native foundation soils are considered. It is noted that the analysis presented herein is based on the dry disposal of the waste materials with the exception of the wet disposal of the gypsum in the Phase I area for the first year of operation.

METHOD OF ANALYSIS

Static Stability Analysis:

Slope stability analyses were performed using the Spencer method [Spencer, 1967] with the circular search method for potential slip surfaces as implemented in the computer program SLIDE [2009]. The computer program was used to generate potential slip surfaces and calculate the factor of safety for each of these surfaces. SLIDE identifies the slip surface with the lowest factor of safety. Information required for the analyses include:

- the geometry of the gypsum (Phase I) and fly ash (Phase II) disposal facility at the cross section location;
- the subsurface soil stratigraphy at the cross section location;
- the material properties for gypsum, fly ash, subgrade fill, and subsurface materials;
- the water level within the gypsum and fly ash stacks; and
- the groundwater table elevation along the cross section location.

Analyses were performed for the final build out of Phase I and II. Both drained and undrained analyses were performed.

Seismic Stability Analysis:

Seismic slope stability analyses were performed using a procedure consistent with a guidance document prepared by the U.S. Environmental Protection Agency [USEPA, 1995]. The procedure is as follows:

1. Estimate the peak ground acceleration (PGA) at the site. Estimate the peak horizontal acceleration (a_{max}) of the potential critical slip surface based on PGA.

2. Perform pseudo-static slope stability analyses for the potential critical section to evaluate the yield acceleration. The yield acceleration is the horizontal acceleration at which a marginally stable condition is produced (i.e., factor of safety of 1.0) for the potential slip surface. A trial-and-error process was applied to evaluate the yield acceleration.

3. The yield acceleration (k_y) was compared to the peak horizontal acceleration (a_{max}) of the slide mass due to the design earthquake. If k_y is greater than a_{max}, the analysis is concluded, as the landfill will not likely undergo permanent displacement. If k_y is less than a_{max}, then the landfill will likely undergo permanent displacement and a displacement analysis is performed to evaluate the magnitude of the permanent displacement.

4. The seismic displacement, corresponding to the computed k_y/a_{max} ratio, is estimated using the results presented by Hynes and Franklin [1984] and the "modified mean + one standard deviation curve" developed by Geosyntec, as presented in Figure 1. The "modified mean + one standard deviation curve" considers data associated with only large earthquakes, and therefore, is more conservative to use. This procedure is consistent with those given in the USEPA guidance document [USEPA, 1995].

According to United States Geological Survey (USGS) seismic hazard map [2008], the PGA with a 2 percent probability of exceedence in 50 years (or 10 percent probability of exceedence in 250 years) is 0.20 g for the KIF site as presented in Figure 2. The peak horizontal acceleration (a_{max}) was assumed the same as the PGA because subsurface soil conditions were considered not to have the potential for amplification of the ground motion.

Target Factors of Safety:

The target calculated factor of safety for static stability analyses is 1.5.

The criterion for seismic stability is based on calculated permanent deformation. Based on the limiting seismic slope stability design criteria of the Tennessee Division of Solid Waste Management, a division of the Tennessee Department of Environment and Conservation (TDEC) [TDEC, 1993], "*No landfill shall be acceptable if the predicted seismic induced deformations within the waste fill exceed one-half the thickness of the clay liner component of the liner system*." Also, based on the recommendations of Seed and Bonaparte [1992] and Anderson and Kavazanjian [1995] for seismic

analysis, maximum permanent seismic deformations of 6 to 12 inches are typically acceptable for the design of geosynthetic liner systems.

CROSS SECTIONS ANALYZED

Five cross sections were analyzed. The locations of the cross sections with respect to the final cover system of the KIF Phase I and Phase II facility features are shown in Figure 3. The cross section geometries at each location (including gypsum/fly ash, soil stratigraphy, water table, and piezometric surface within the material) are shown in Figures 4 through 8. Each cross section is considered potentially critical since the maximum waste height and slope are located at these sections.

SITE STRATIGRAPHY

Information on the site stratigraphy used in these analyses is summarized in MACTEC [2005], MACTEC [2006], and TVA [2005]. The top of bedrock elevations were obtained from a contour map developed from a series of site investigations that included soil borings, CPT soundings, and GeoProbe soundings performed at the site as presented in TVA [2005]. Current ground elevations were obtained from the KIF topographic map provided by TVA. Nearby borings were projected to the cross section to develop the thicknesses of the compressible native material along the cross section. This native material was subdivided into two groups based on the Standard Penetration Test (SPT) blow count and water content of the material. A description of the subsurface stratigraphy and the corresponding material properties are presented in the following section.

MATERIAL PARAMETERS

Information on the material parameters used in these analyses is obtained from MACTEC [2004], MACTEC [2005], and MACTEC [1995]. Material parameters used for the stability analyses are summarized in Table 1.

Gypsum (Phase I)

Samples of gypsum are not yet available from the KIF. Material from the Cumberland Fossil Plant is considered representative of the material that will be produced at the KIF once the scrubber is brought online.

Two types of gypsum (i.e., coarse and fine grained) were reported from Cumberland Fossil Plant by MACTEC [2004]. For design purposes, strength properties of the fine gypsum are used herein as they were lower and, thus, more conservative. Shear strength parameters were estimated based on a three-point CU triaxial test assuming failure occurs where the shear induced excess pore pressures are

zero. Based on these results, the effective stress shear strength parameters used in the analyses presented herein are an effective stress friction angle of 30 degrees and a zero cohesion intercept. An undrained shear strength ratio (S_u/σ_{vo}') of 1.5 was also selected. The unit weight of the gypsum was selected as 100 pcf.

Dry Fly Ash (Phase II)

The effective stress shear strength parameters used in the analyses presented herein are an effective stress friction angle of 30 degrees and a zero cohesion intercept, based on information presented in MACTEC [1995] and Geosyntec [2010]. An undrained shear strength ratio (S_u/σ_{vo}') of 0.8 was selected. A unit weight of 100 pcf was selected. It is noted that Phase II area will be receiving other coal combustion by-products including bottom ash and boiler slag; however, their generation quantities will be relatively low compared to the quantities of fly ash.

Soil Fill/Subgrade

On site material will be used to construct the initial soil berm around the gypsum pond and the subgrade fill. Standard Proctor tests were run on 17 samples of native material from depths ranging from 6 to 12.5 ft. The unit weight of the soil fill material was selected as 117 pcf, which is 95 percent of the average of the maximum dry unit weights resulting from the Standard Proctor tests. Effective stress properties for the soil berm and subgrade material are average values from three, three-point CU triaxial tests performed on remolded samples taken from depths ranging from 6 to 10 ft. Based on these results, the effective stress shear strength parameters used in the analyses presented herein are an effective stress friction angle of 30 degrees and a zero cohesion intercept.

Native Soil

The onsite native material is primarily classified as a medium stiff to stiff silty clay. The average blow count of the material onsite ranges from 6 to 20 blows per foot (bpf). Approximately one-half of the borings encountered a "soft" material, classified by Standard Penetration Test (SPT) N values less than or equal to 4 bpf. This soft material ranged in thickness from 0 to 20 ft along the cross sections selected for the stability analyses and occurred just above the bedrock material. For the analyses performed herein, drained and undrained shear strength parameters were selected for two layers of foundation material (i.e., N>4 and N≤4). Triaxial tests summarized in MACTEC [2006] and CPT soundings summarized in TVA [2005] were used to develop the short and long term shear strength of the native material.

- N>4: CU and unconsolidated undrained (UU) triaxial tests were performed on eight samples obtained from depths ranging from 13 to 41 ft below ground surface. This triaxial data in combination with data from ten Cone Penetration Test (CPT) soundings performed across the site to depths of 42 ft were used to estimate native soil undrained shear strength. The undrained shear strength can be estimated from the measured tip resistance according to the following equation developed by Schmertmann [1978]:

$$S_u = \frac{q_c - \sigma_{vo}}{N_k}$$

where N_k is a normalizing factor that ranges from 12 to 19 and is related to the plasticity index of the in situ material. For the native soil at the KIF gypsum disposal facility, an N_k factor of 19 was chosen to calibrate the calculated CPT undrained shear strength data to the undrained shear strength developed from the triaxial test data.

The undrained shear strength data were plotted versus effective confining pressure to develop an undrained shear strength profile for the native material (i.e., a best fit linear trend line through the data as shown in Figure 9) resulting in the following equation:

S_u = 1,792 psf + 0.27*Confining Pressure (psf)

Conservatively assuming that the native soil is saturated, and a unit weight of 120 pcf, an undrained strength profile with depth can be estimated using the following equation:

S_u = 1,792 psf + 15.6*depth

where depth is measured in feet below the pre-construction ground surface (i.e. at the elevation of the top of the native material).

For the drained analyses, an average effective stress friction angle of 34 degrees was used based on triaxial testing results.

- N≤4: No triaxial tests were performed on native material with SPT blow counts of less than or equal to 4 bpf. Four of the ten CPT soundings performed at the site encountered the soft native material. The average undrained shear strength of this material was developed from these CPT soundings and is 800 psf for the analyses performed herein. The improved undrained shear strength of the "soft" native material was not developed.

  For the drained analyses, an effective stress friction angle for the soft native material was estimated based on the plasticity index (PI) using the following relationship [Mitchell, 1976]:

$$\sin\phi'_{cv} \approx 0.8 - 0.094\ln(PI)$$

  Considering an average PI of the soft native material to be 43, an effective stress friction angle of 26.5 degrees was calculated. A friction angle of 25 degrees was used for the analyses described herein.

Bedrock

Due to the anticipated high shear strength of the bedrock, the top of bedrock elevation is considered the lower limit for the potential critical slip surface; reasonable cohesion, friction angle, and unit weight values were selected as required by the computer simulation.

RESULTS

Table 2 summarizes the results of the static slope stability analyses for Cross Sections 1-5 under both drained and undrained conditions. Table 3 summarizes the results of the seismic slope stability analyses performed for the KIF gypsum disposal facility. Seismic slope stability analyses were performed for the final closure condition for Phase I and Phase II. Strength gain of the foundation soils due to waste loading was conservatively not considered. The calculated yield accelerations were larger than the peak ground acceleration at the site, thus, permanent displacements are not anticipated. The associated output files and figures from SLIDE are presented in Attachments A and B, for static and seismic analyses, respectively.

SUMMARY AND CONCLUSIONS

The stability of the KIF disposal facility (Phase I and Phase II) was evaluated with respect to static and seismic foundation stability. The most critical cross sections with respect to foundation stability were analyzed. Results indicate that the minimum static stability factor of safety for a potential slip surface through the gypsum/fly ash and foundation soils is 1.73, which is greater than the target factor of safety of 1.5.

Results indicate that the minimum yield acceleration for slip surfaces through the waste and the foundation soils is 0.30 g, which is greater than the site peak ground horizontal acceleration. Based on this analysis, no permanent displacements are anticipated during the design earthquake event.

REFERENCES

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TABLES

Table 1. Summary of Material Properties.

Material	Unit Weight (pcf)	Effective Stress		Undrained Strength, S_u (psf)
		Cohesion (psf)	Friction Angle (degrees)	
Gypsum (Phase I)	100	0	30	S_u/σ_{vo}'=1.5
Dry Fly Ash (Phase II)	100	0	30	S_u/σ_{vo}'=0.8
Soil Fill	117	0	30	-
Phase I GCL	1	φ_{peak} = 10°, φ_{res} = 6°		
Phase II Geosynthetic	1	back calculated		
Native Soil (N>4)	120	0	34	1792+15.6 * depth
Native Soil (N<4)	105	0	25	800
Bedrock	155	10,000	30	0

Note:

The influence of the liner shear strengths on the calculated FSs for the foundation stability analyses is insignificant. Failure through the liner system is evaluated in the calculation package titled "*Liner Waste Block Slope Stability Analyses*".

Table 2. Summary of Static Foundation Stability Analyses.

Cross Section	Drained/ Undrained	Factor of Safety	Target Factor of Safety	Is FS OK?
1	Undrained	3.39	1.5	Yes
1	Drained	1.75	1.5	Yes
2	Undrained	4.08	1.5	Yes
2	Drained	1.73	1.5	Yes
3	Undrained	3.01	1.5	Yes
3	Drained	1.78	1.5	Yes
4	Undrained	3.03	1.5	Yes
4	Drained	1.74	1.5	Yes
5	Undrained	3.19	1.5	Yes
5	Drained	1.73	1.5	Yes

Table 3. Summary of Seismic Foundation Stability Analyses.

Cross Section	Drained/ Undrained	Yield Acceleration (g)	Seismic Deformation Analysis Needed?
1	Undrained	0.34	No
2	Undrained	0.43	No
3	Undrained	0.41	No
4	Undrained	0.28	No
5	Undrained	0.21	No

FIGURES

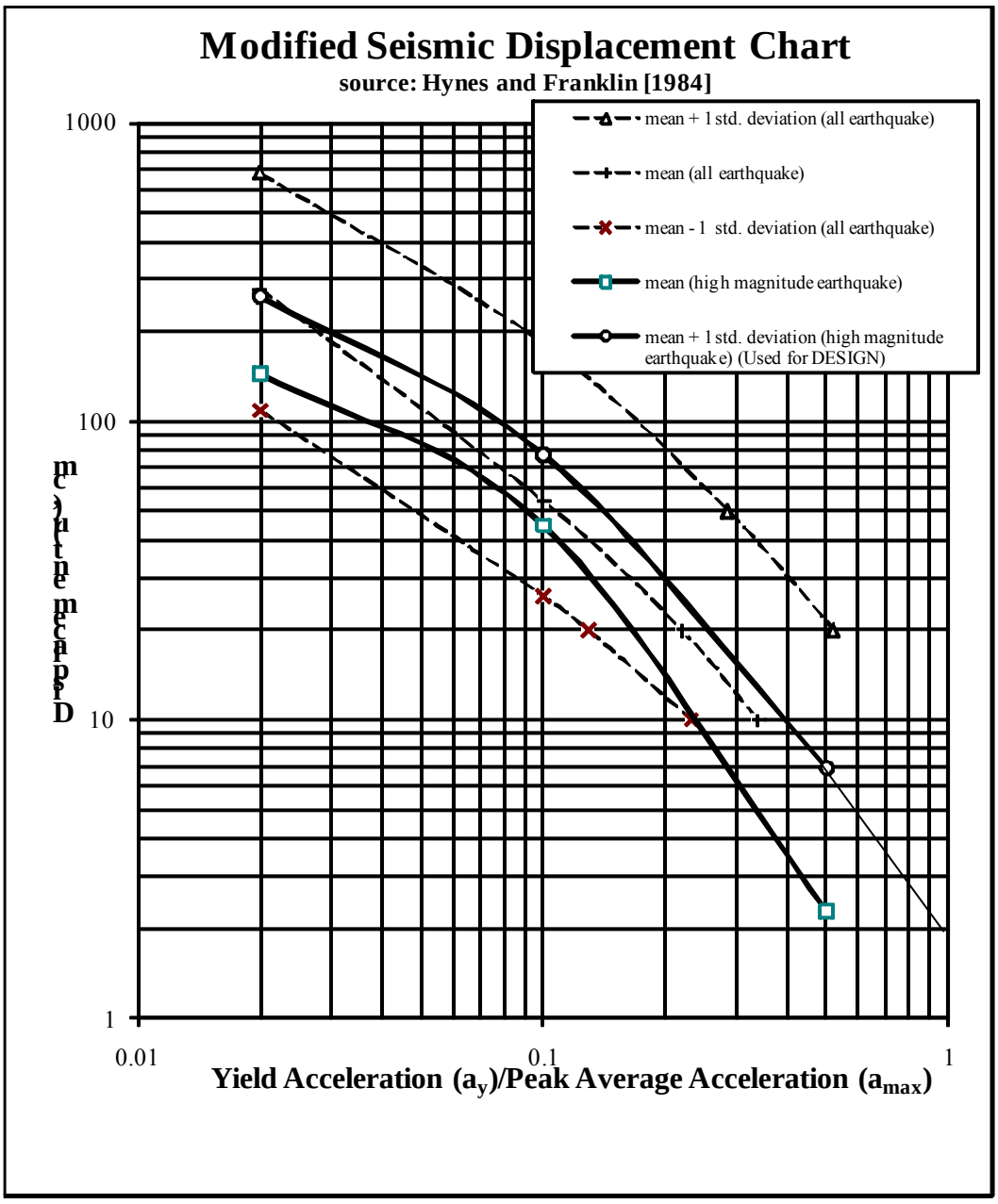
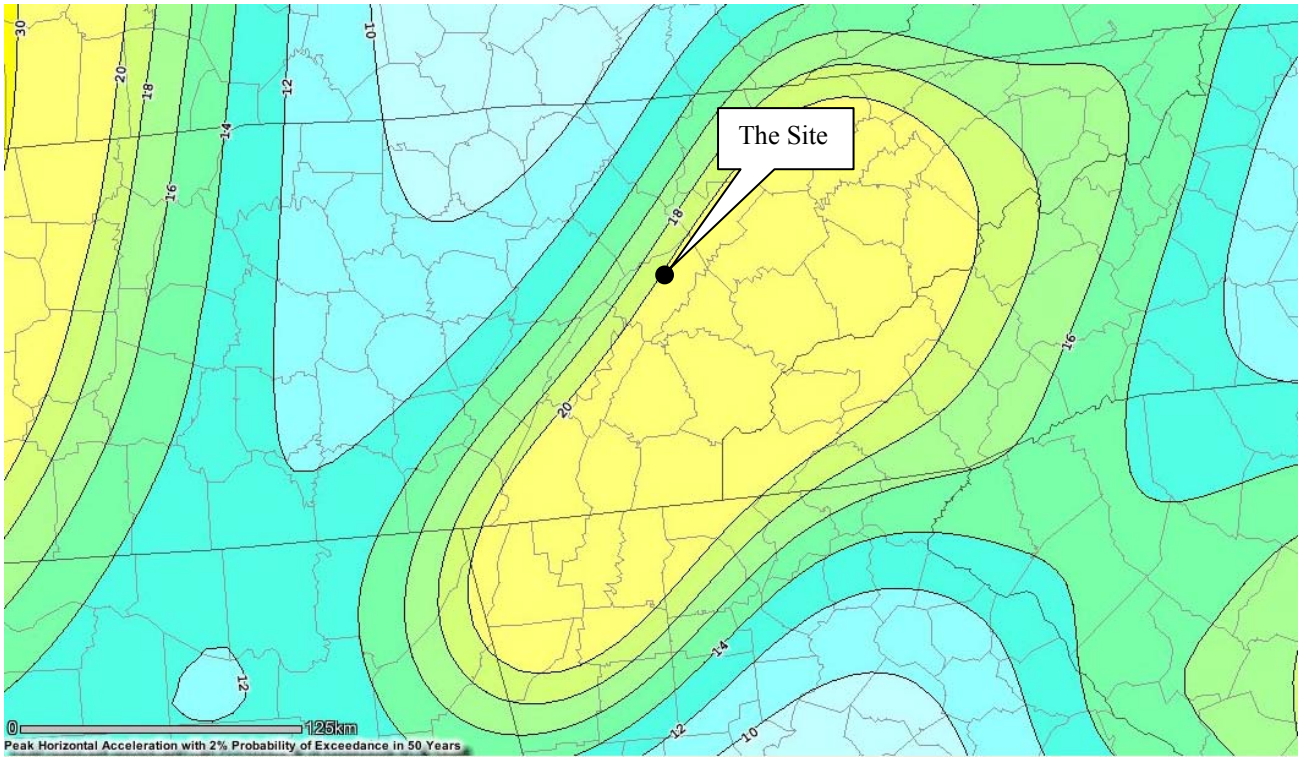


Figure 1. Selection of Calculated Displacement



N 35.89472°
W 84.50351°

Figure 2. The Peak Ground Acceleration (PGA) with a 2 Percent Probability of Exceedence in 50 Years (or 10 Percent Probability of Exceedence in 250 Years) [USGS, 2008]

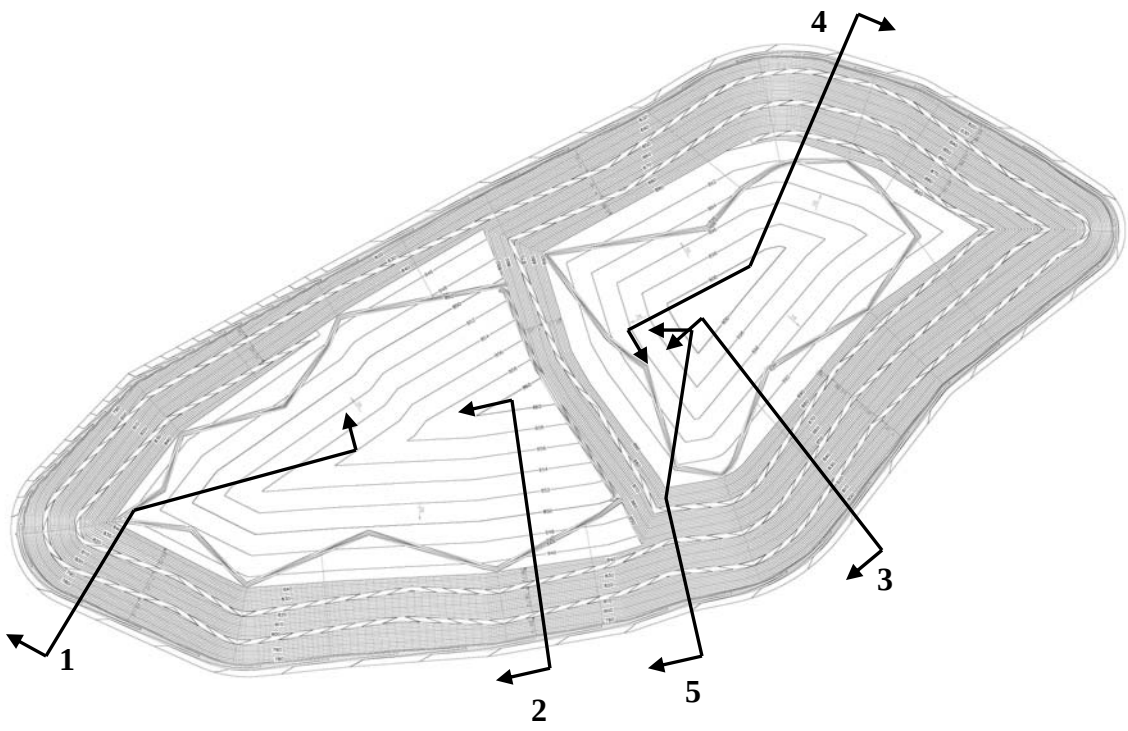


Figure 3. Location of the Analyzed Cross Sections on Final Cover Grading Plan

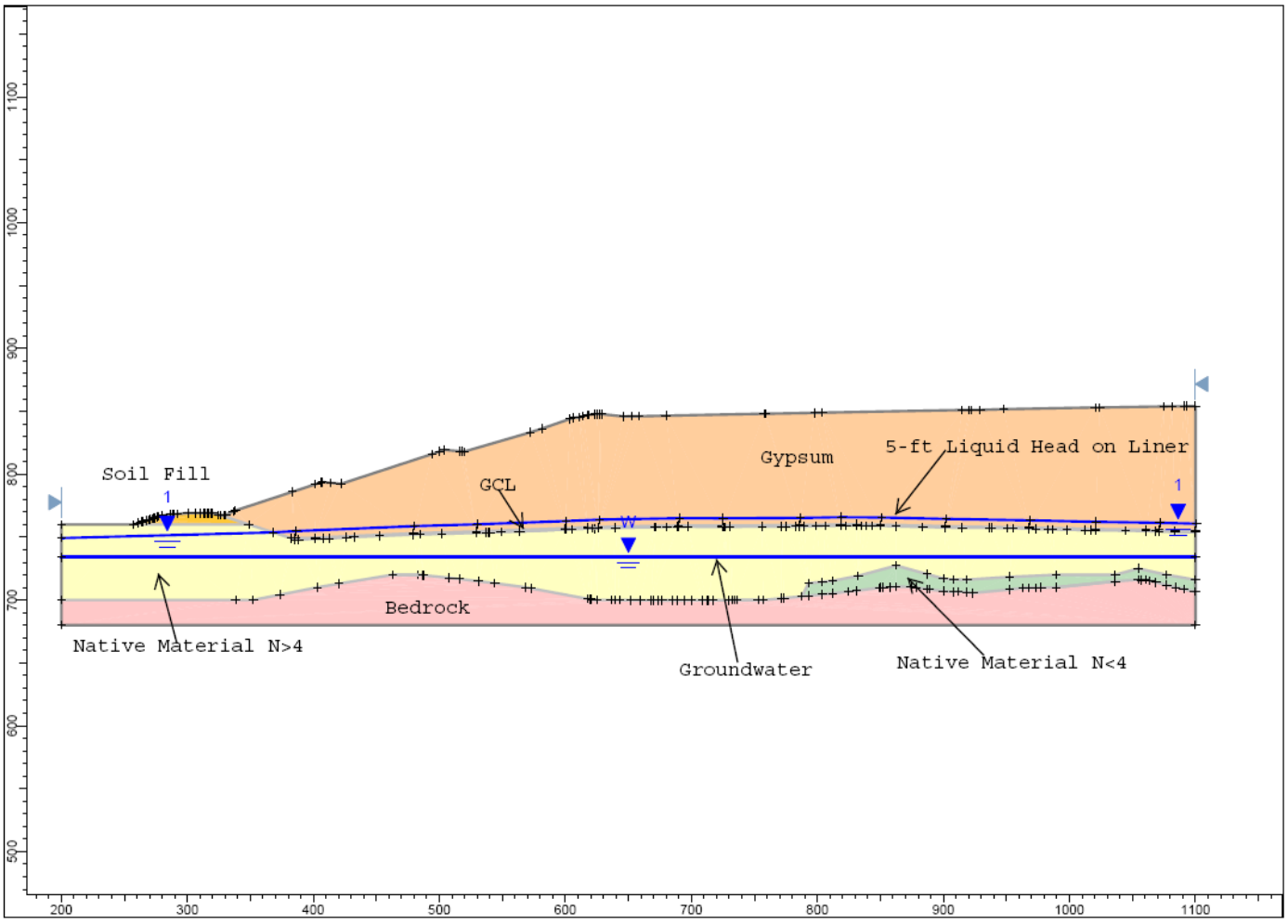


Figure 4. Geometry of Cross Section 1

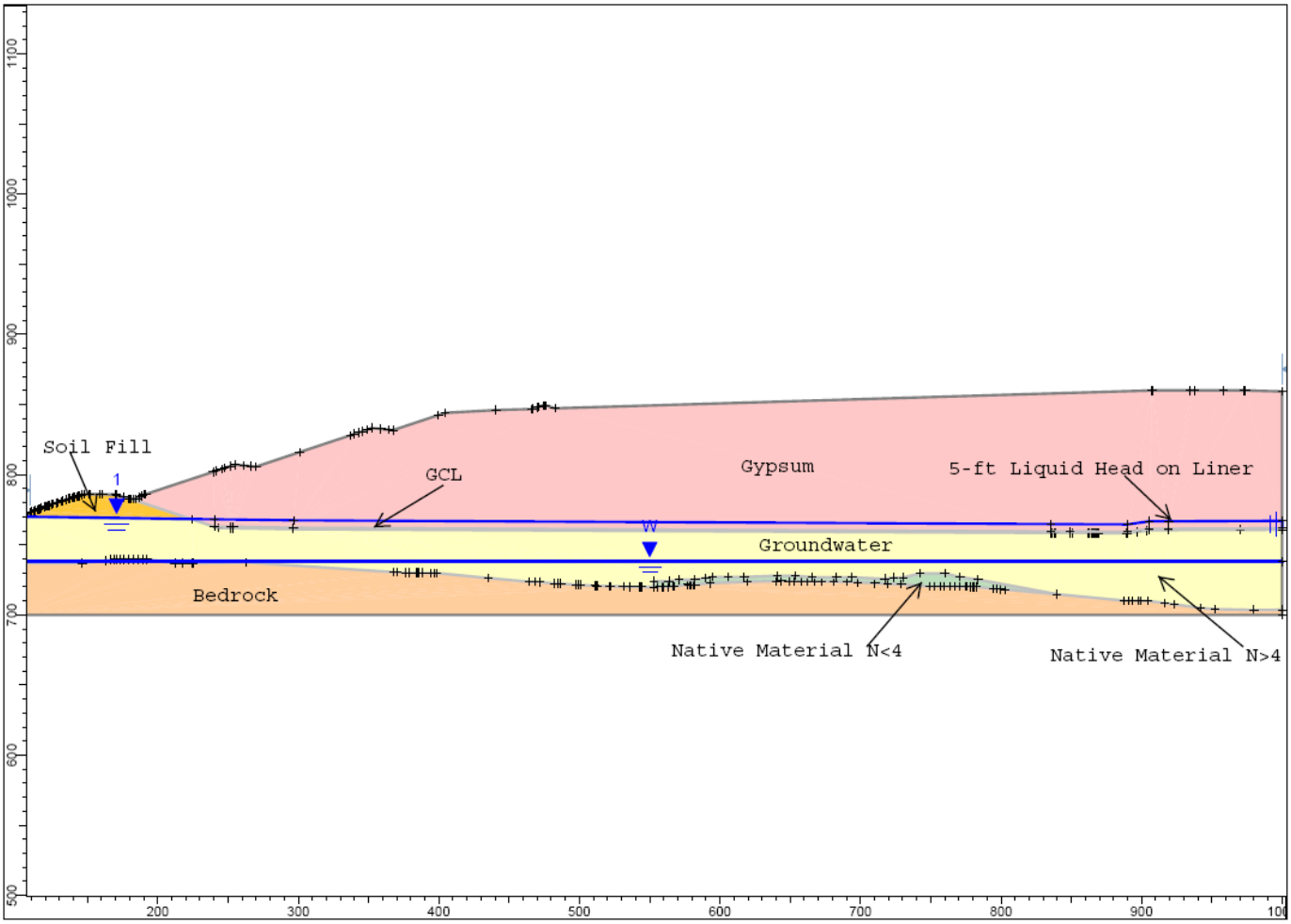


Figure 5. Geometry of Cross Section 2

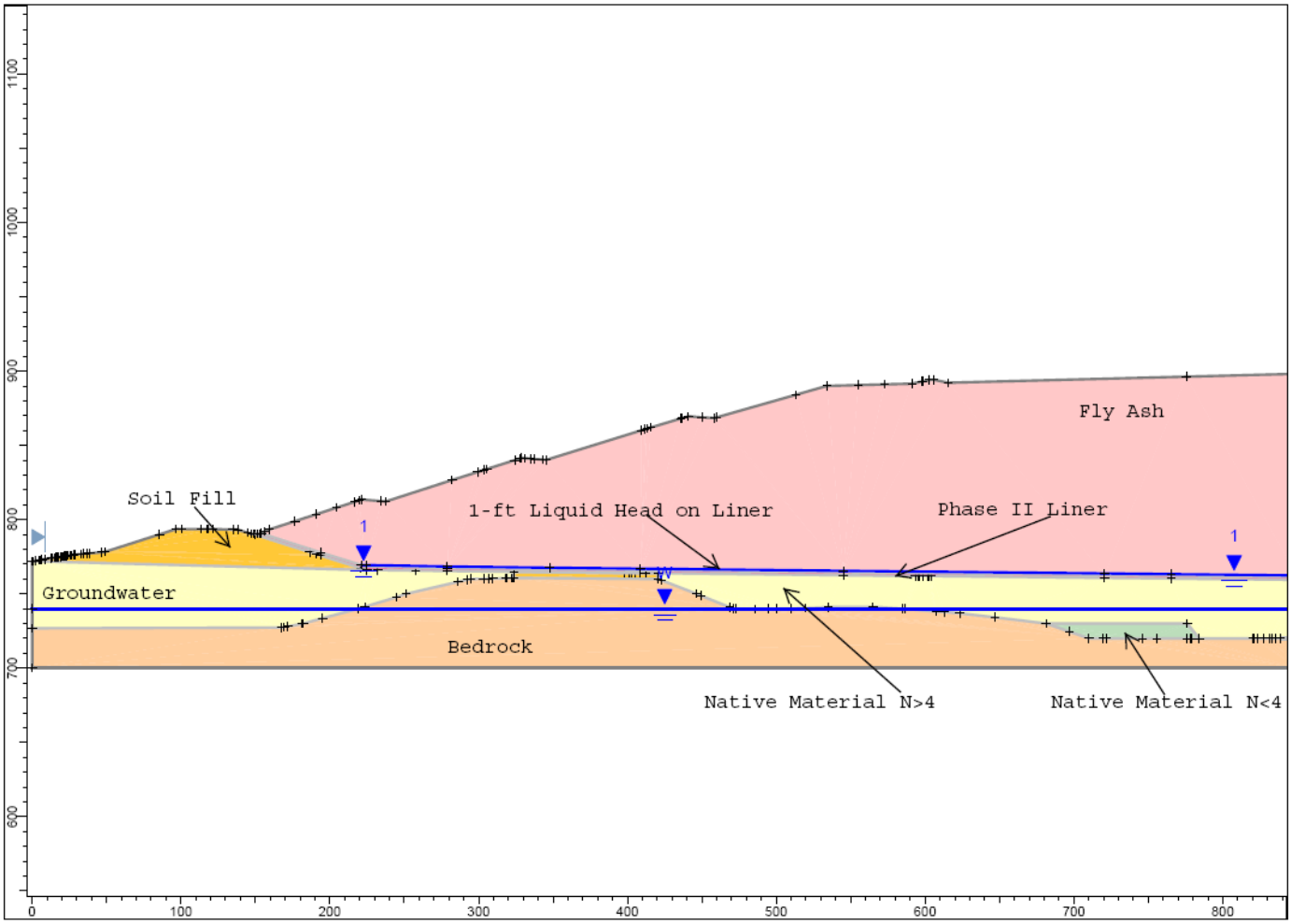


Figure 6. Geometry of Cross Section 3

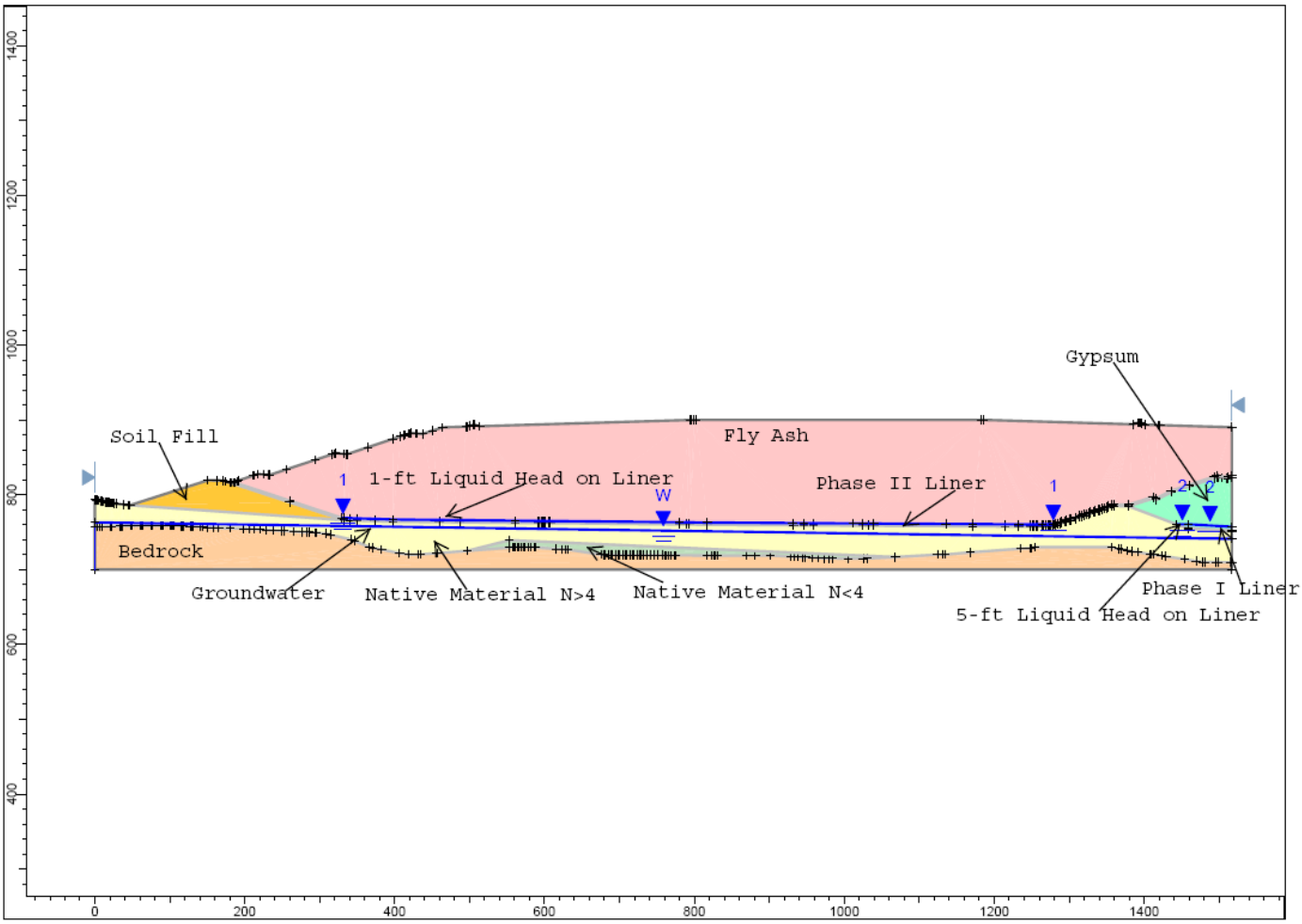


Figure 7. Geometry of Cross Section 4

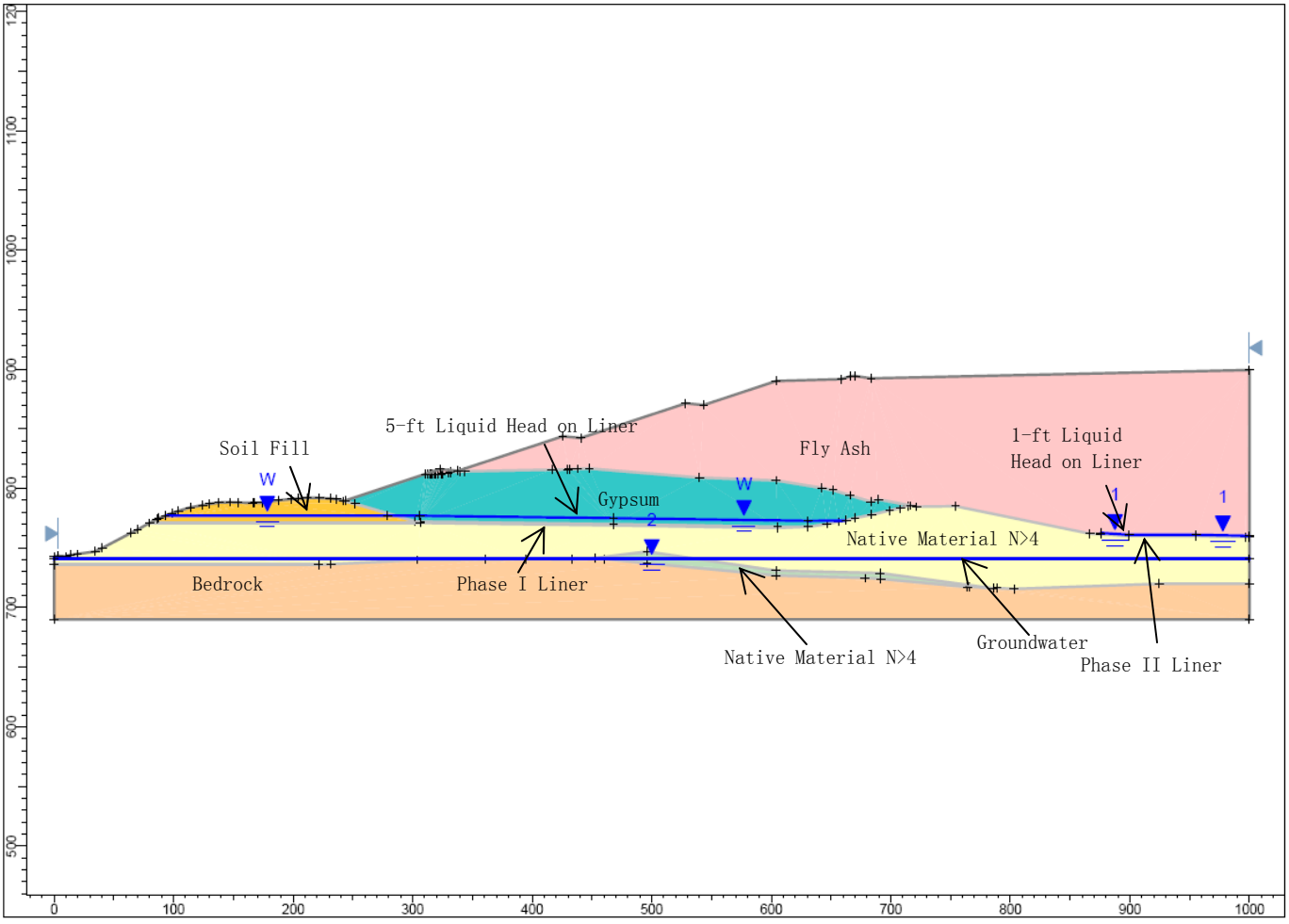
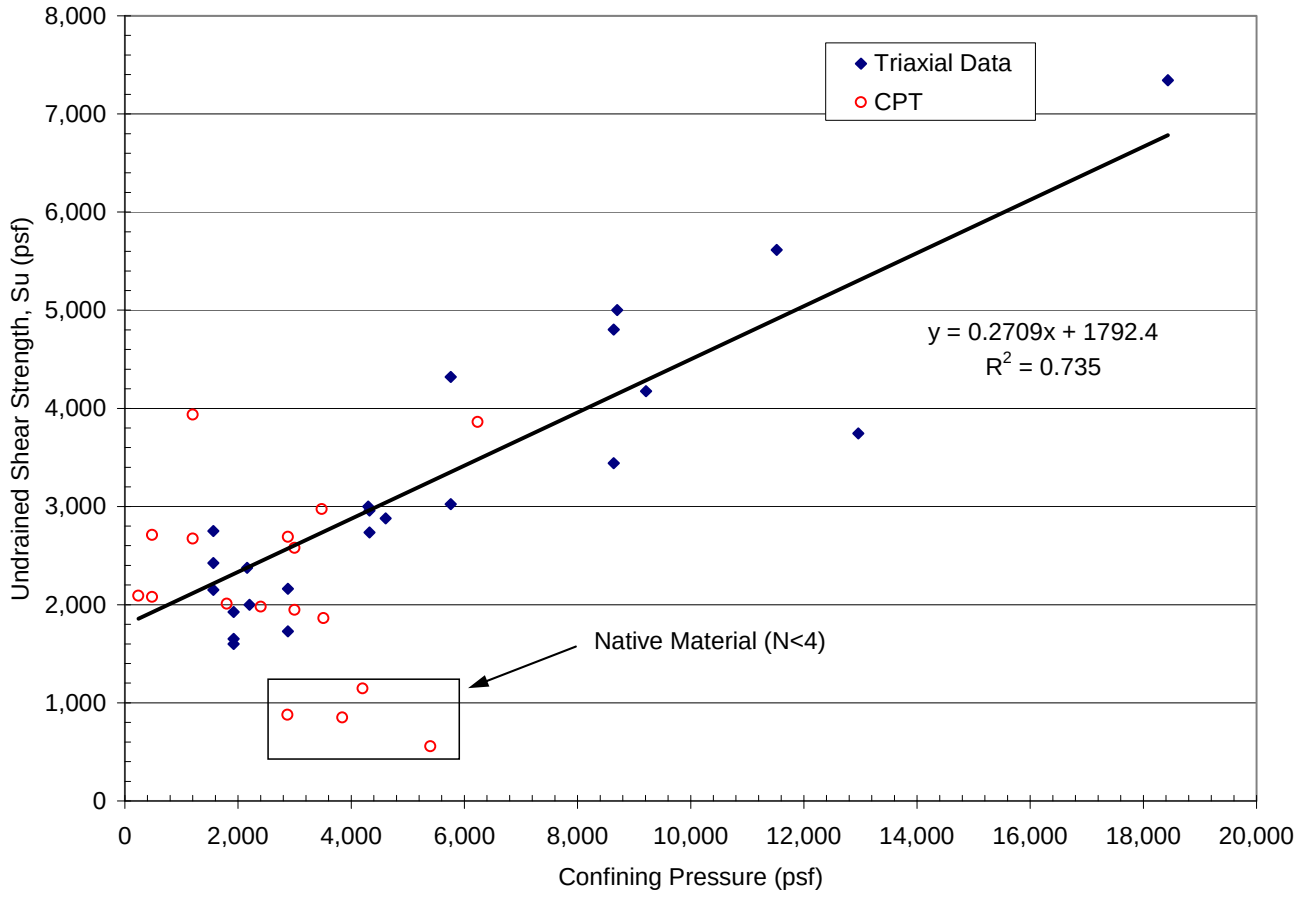


Figure 8. Geometry of Cross Section 5



Notes:

1-Undrained shear strengths were derived from the CPT soundings based on the method developed by Schmertmann [1978]. An N_k factor of 19 was chosen to calibrate the CPT data to the triaxial data.

2-Undrained shear strengths based on CPT soundings in the soft native material (N<4) are indicated. An average undrained shear strength of 800 psf was chosen based on these data.

Figure 9. Determination of Undrained Shear Strength Profile for Foundation Material.

ATTACHMENT A

SLIDE OUTPUT
CROSS SECTIONS 1-5 – STATIC

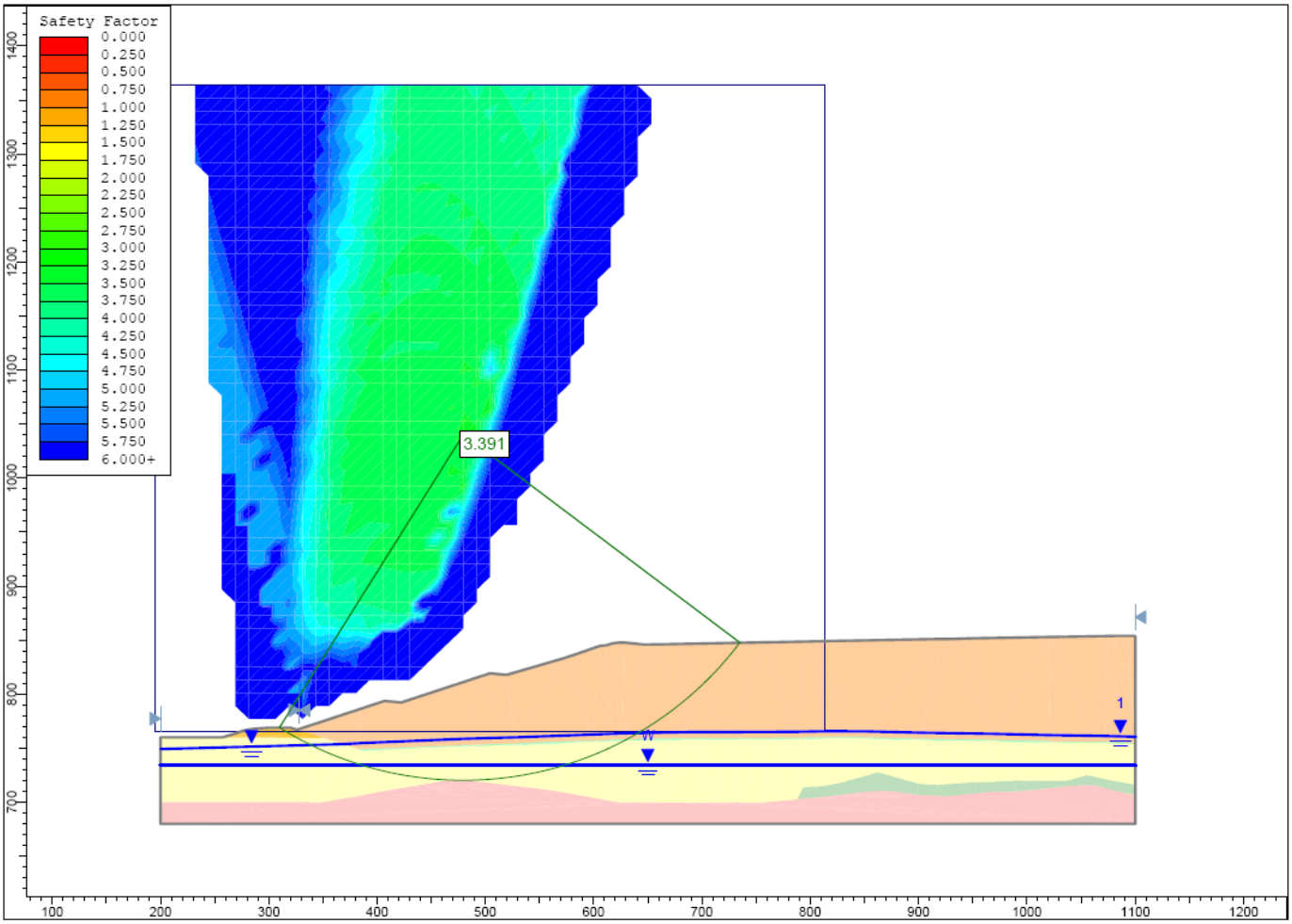


Figure A-1. Static Slope Stability Analysis Result for Section 1
(undrained condition)

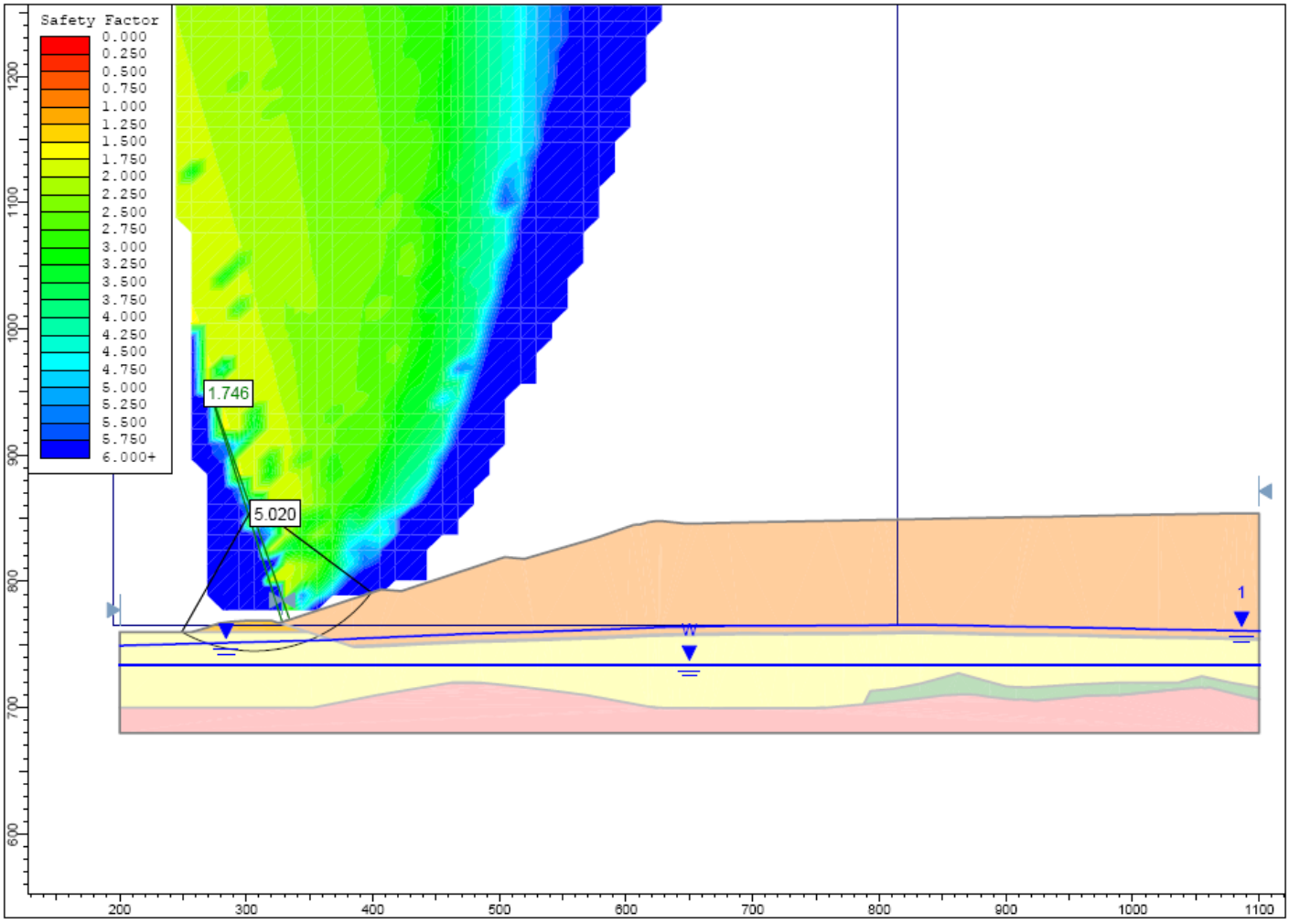


Figure A-2. Static Slope Stability Analysis Result for Section 1
(drained condition)

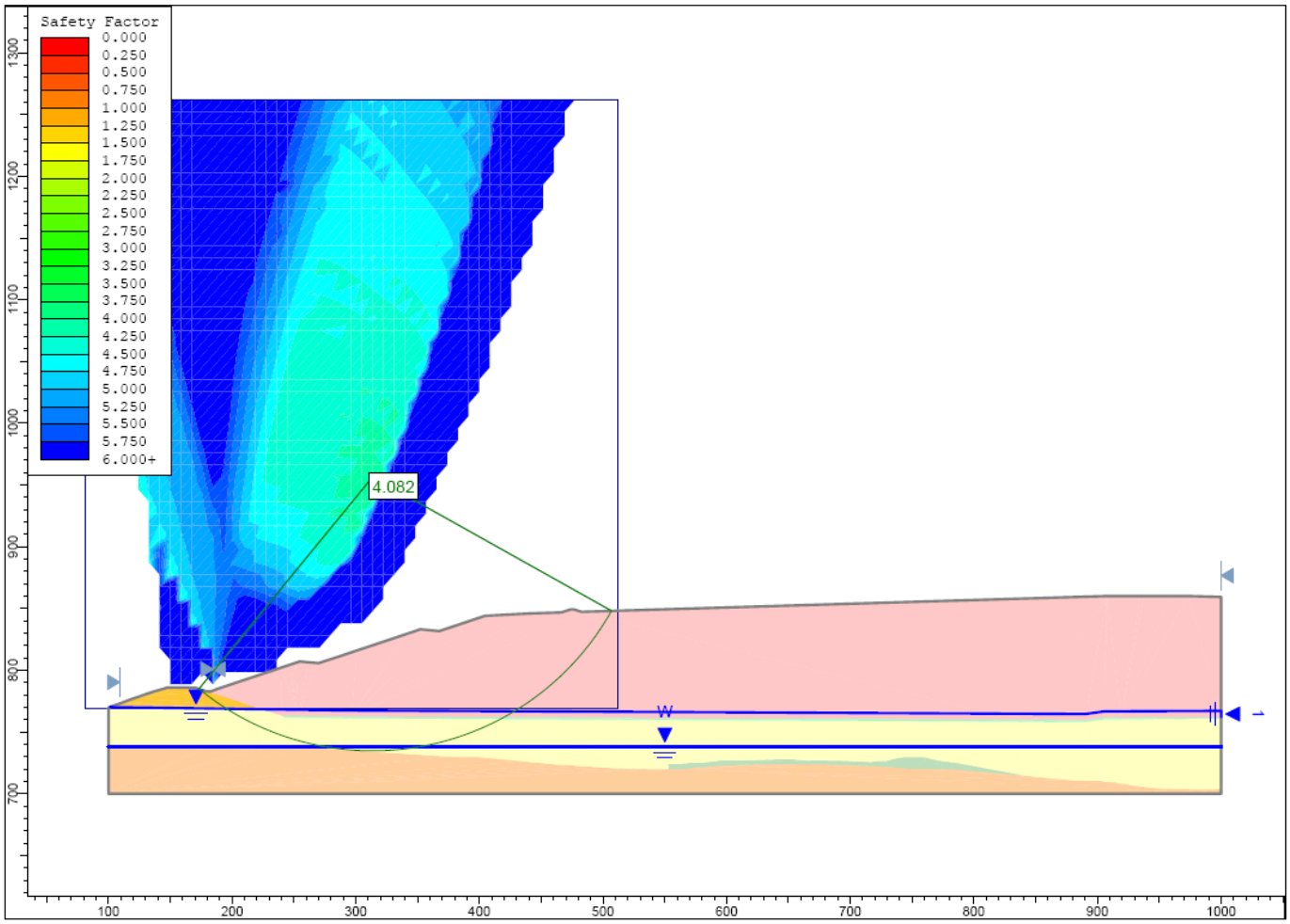


Figure A-3. Static Slope Stability Analysis Result for Section 2
(undrained condition)

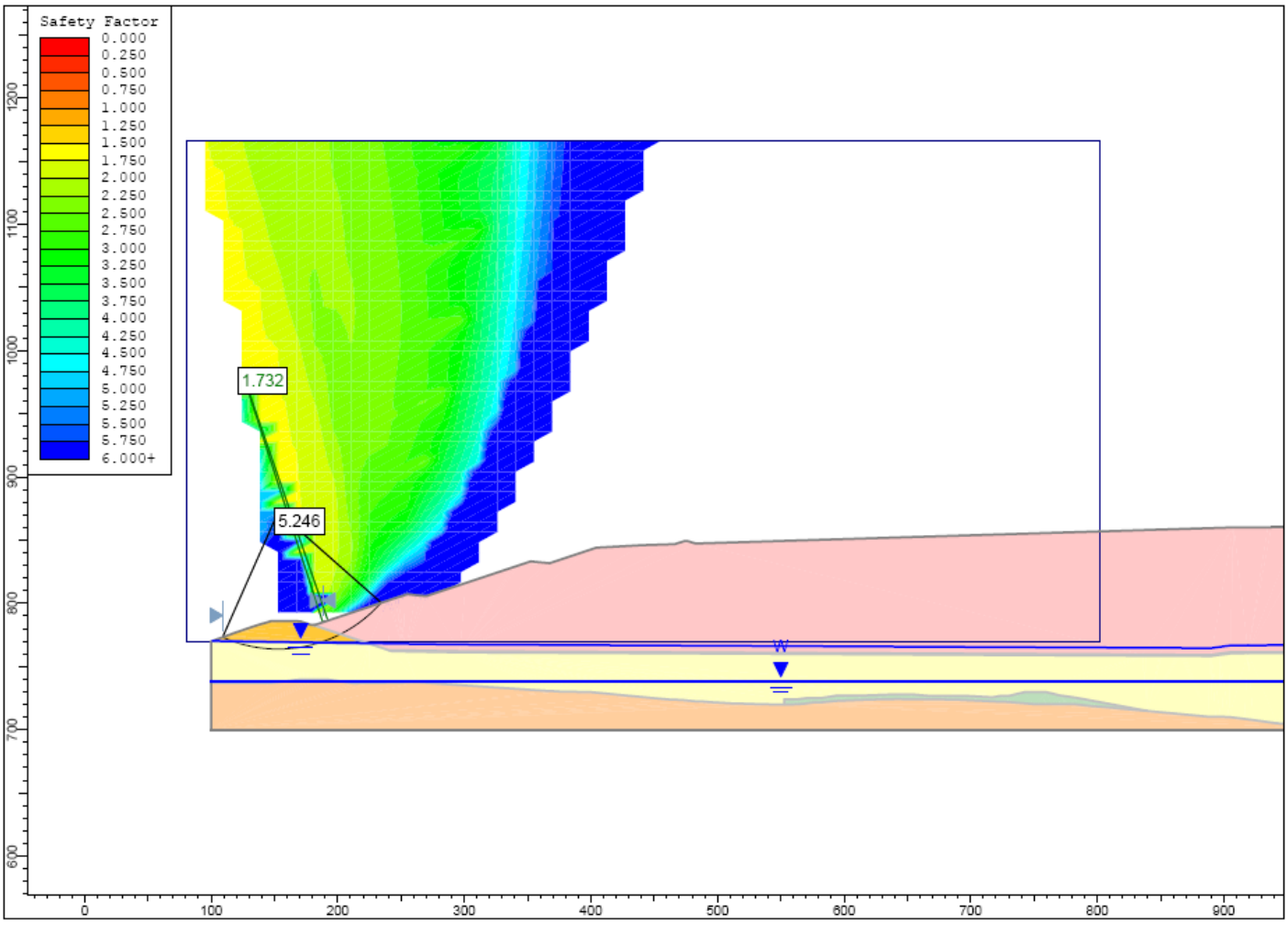


Figure A-4. Static Slope Stability Analysis Result for Section 2
(drained condition)

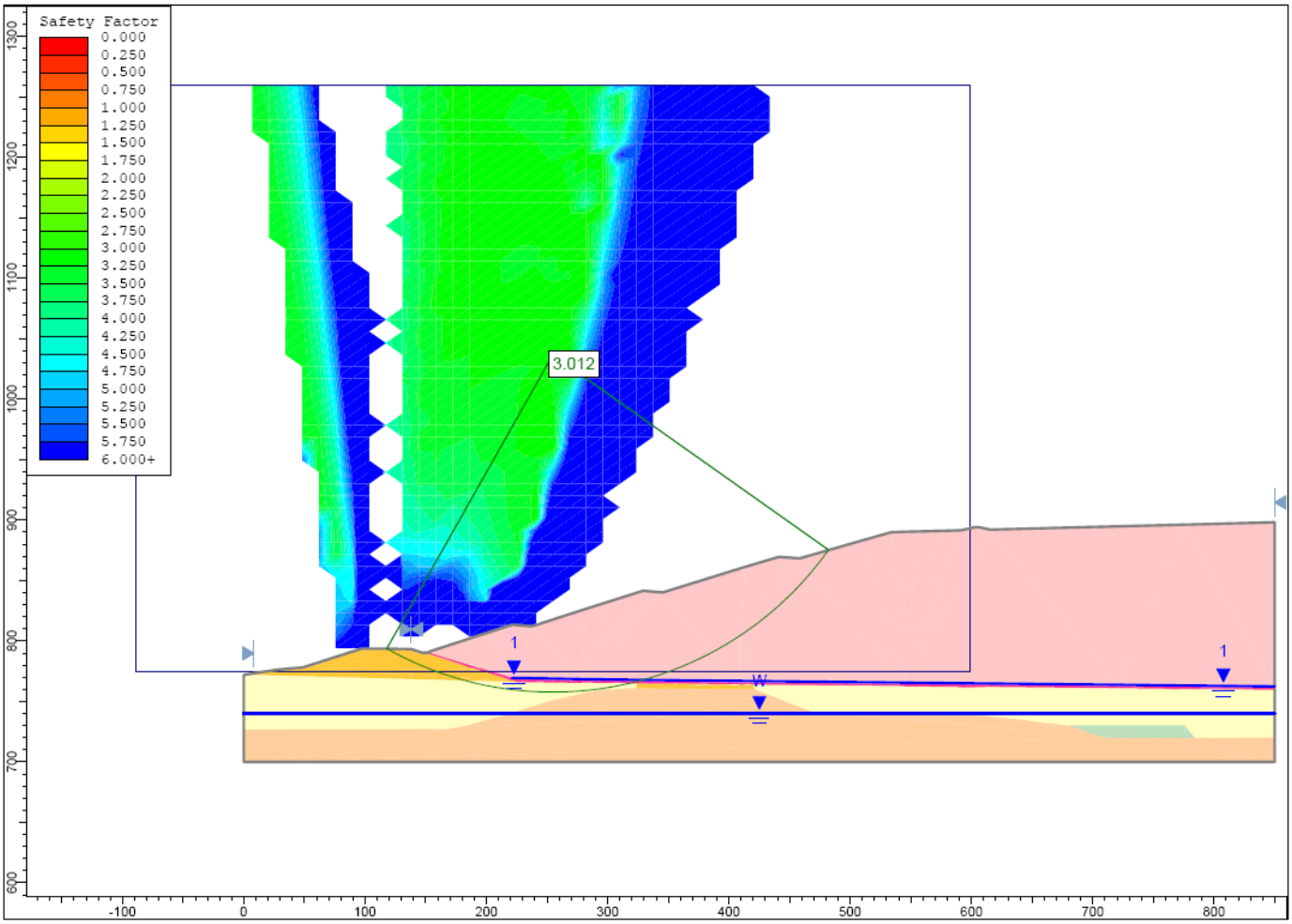


Figure A-5. Static Slope Stability Analysis Result for Section 3
(undrained condition)

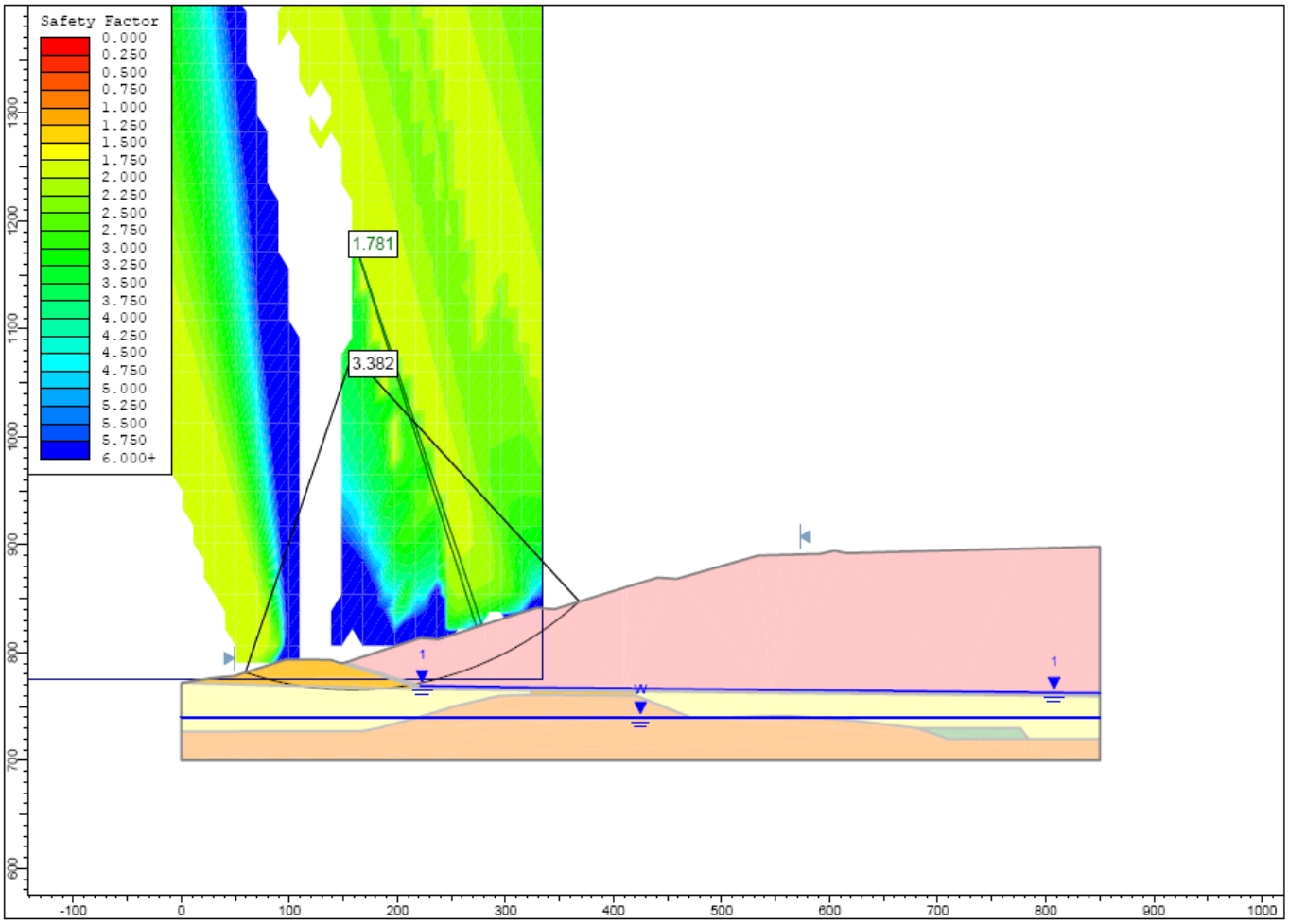


Figure A-6. Static Slope Stability Analysis Result for Section 3
(drained condition)

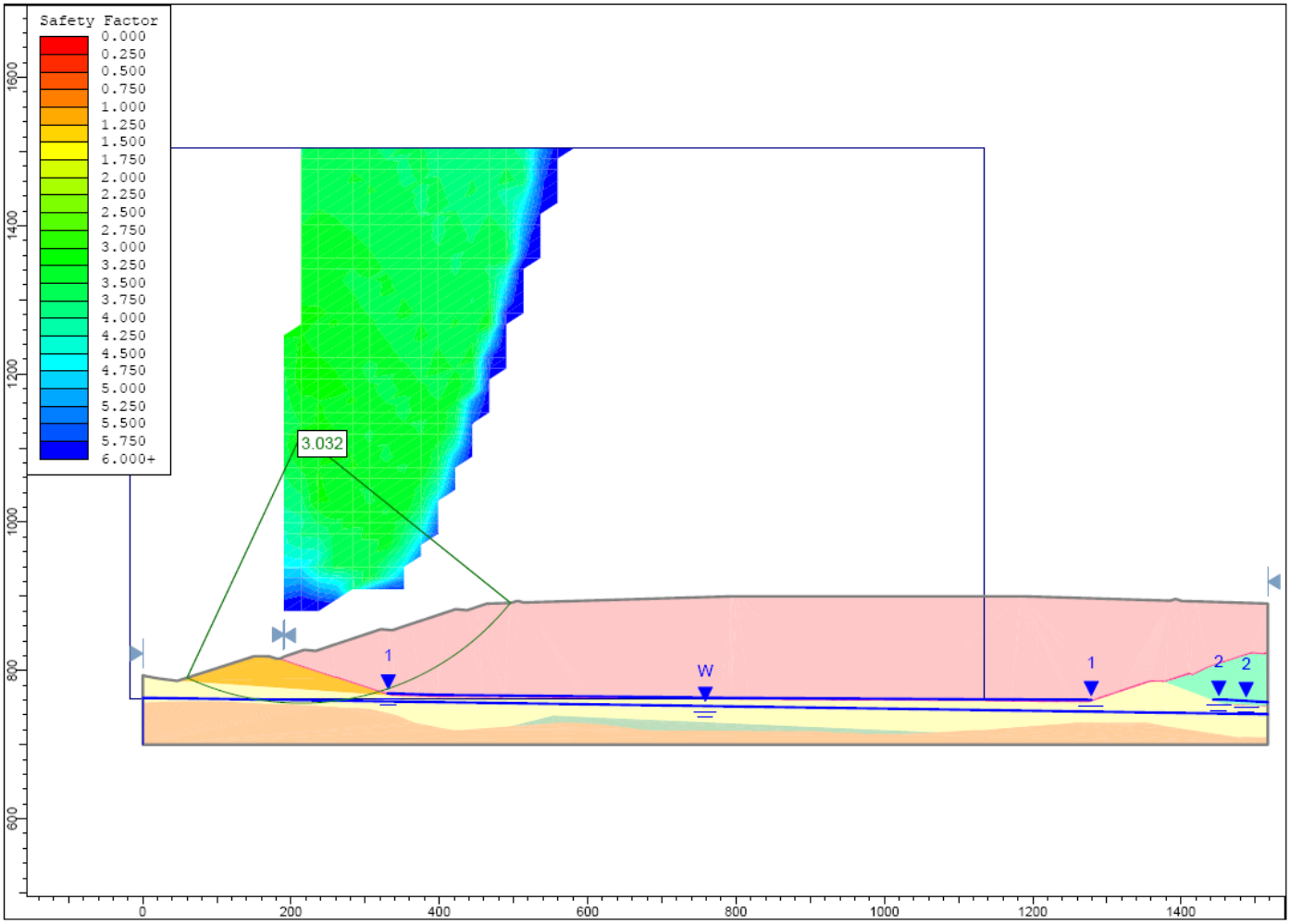


Figure A-7. Static Slope Stability Analysis Result for Section 4
(undrained condition)

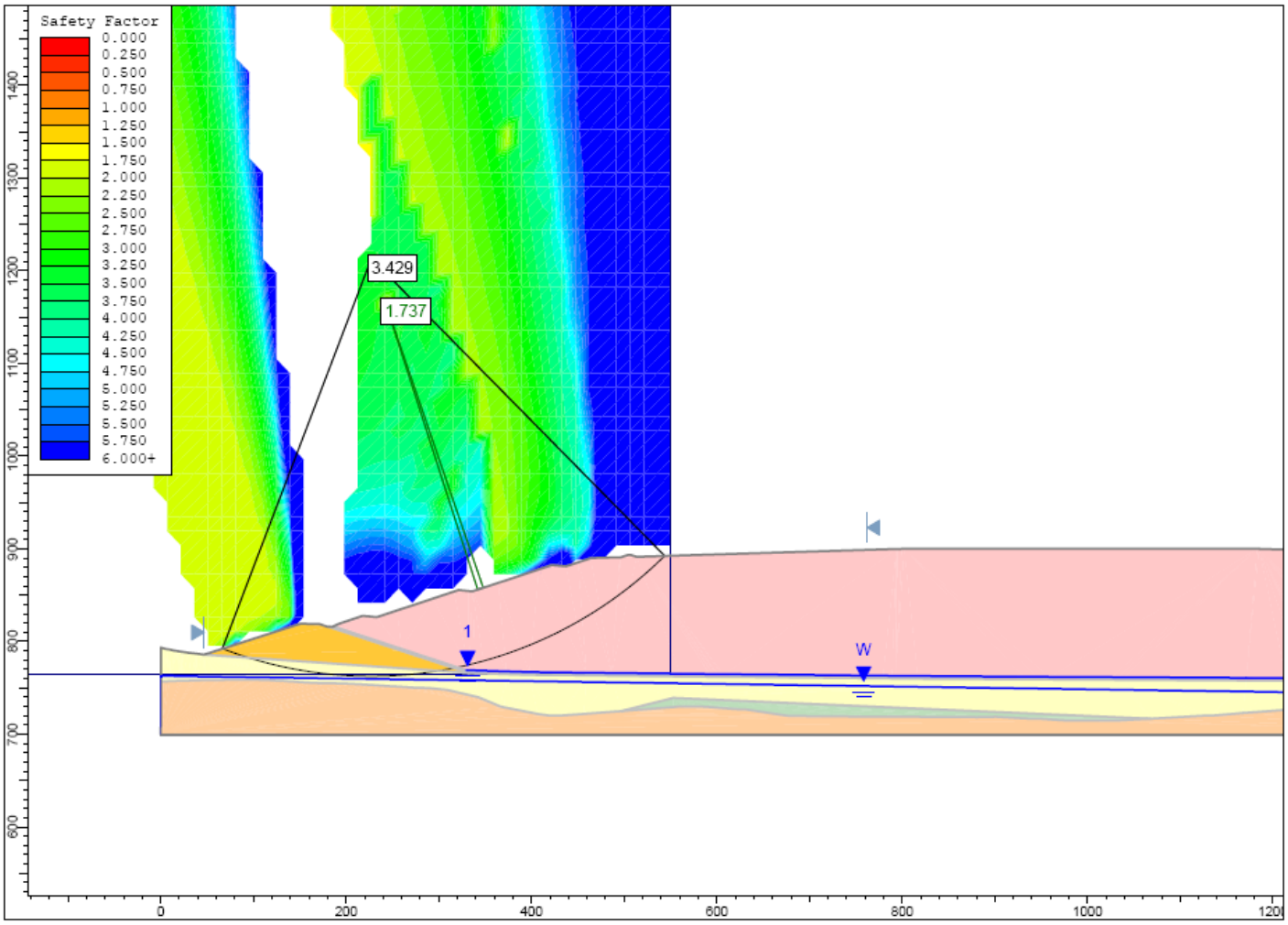


Figure A-8. Static Slope Stability Analysis Result for Section 4
(drained condition)

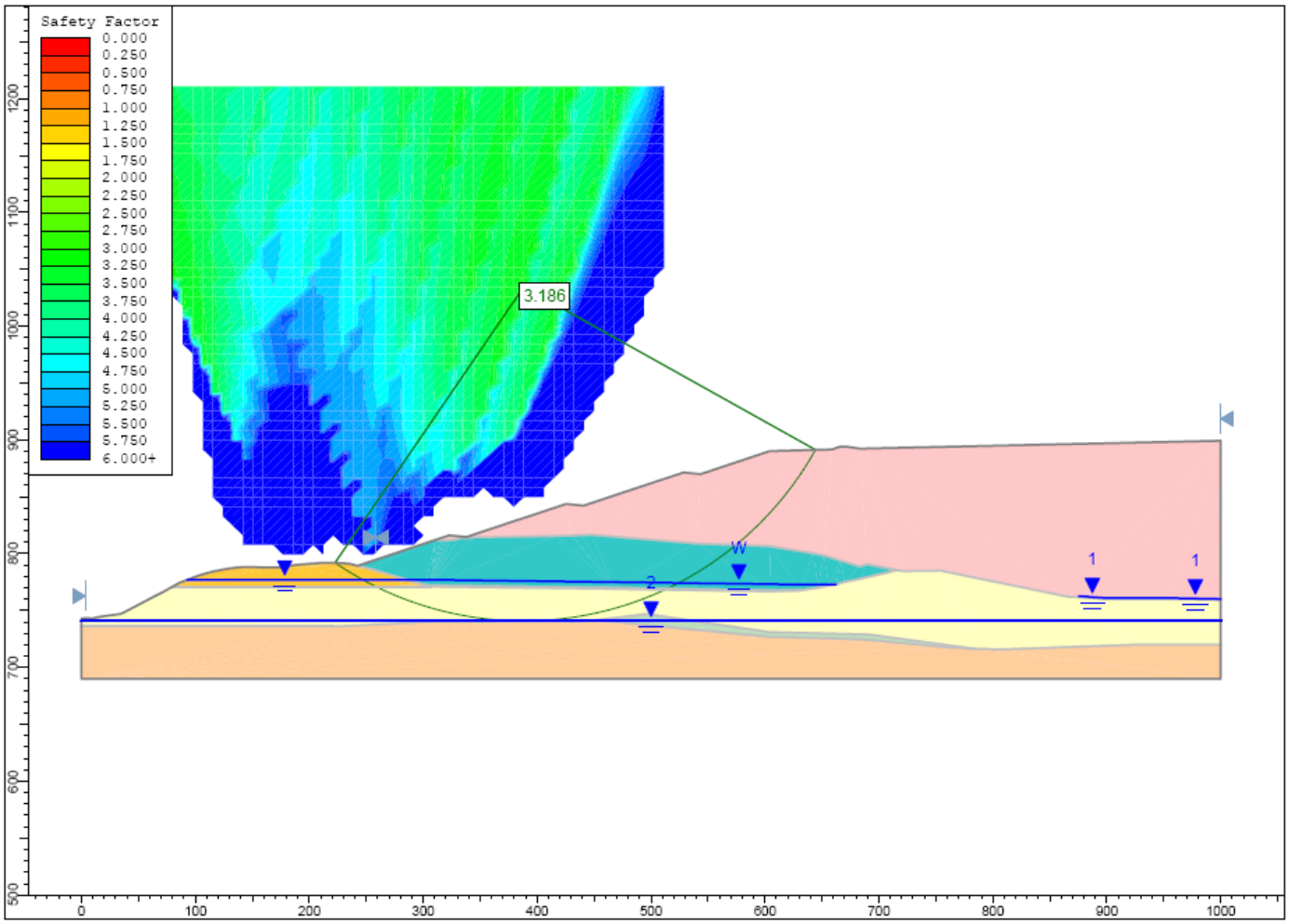


Figure A-9. Static Slope Stability Analysis Result for Section 5
(undrained condition)

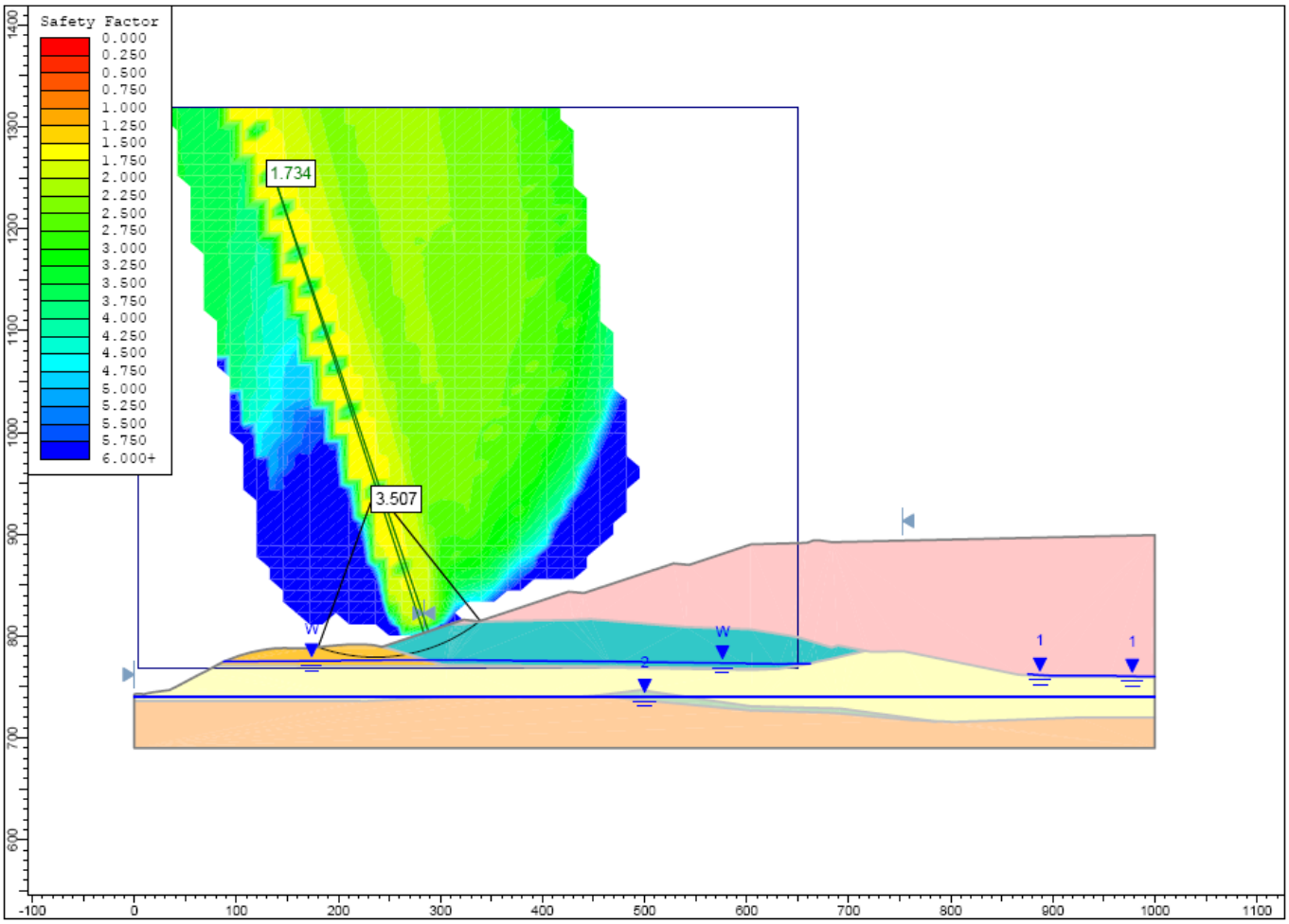


Figure A-10. Static Slope Stability Analysis Result for Section 5 (drained condition)

ATTACHMENT B

SLIDE OUTPUT
CROSS SECTIONS 1-5 – SEISMIC

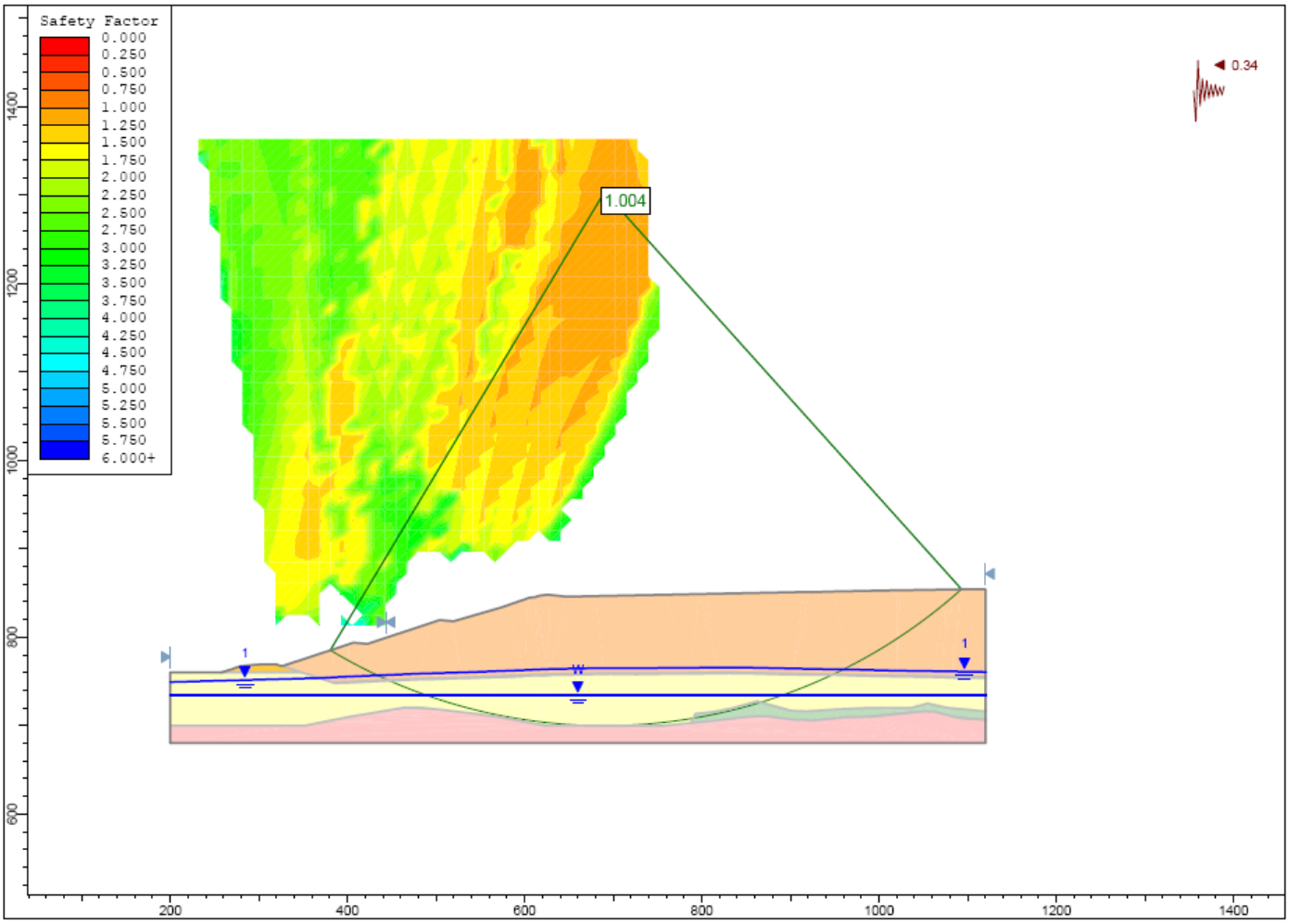


Figure B-1. Calculation of Yield Acceleration for Section 1

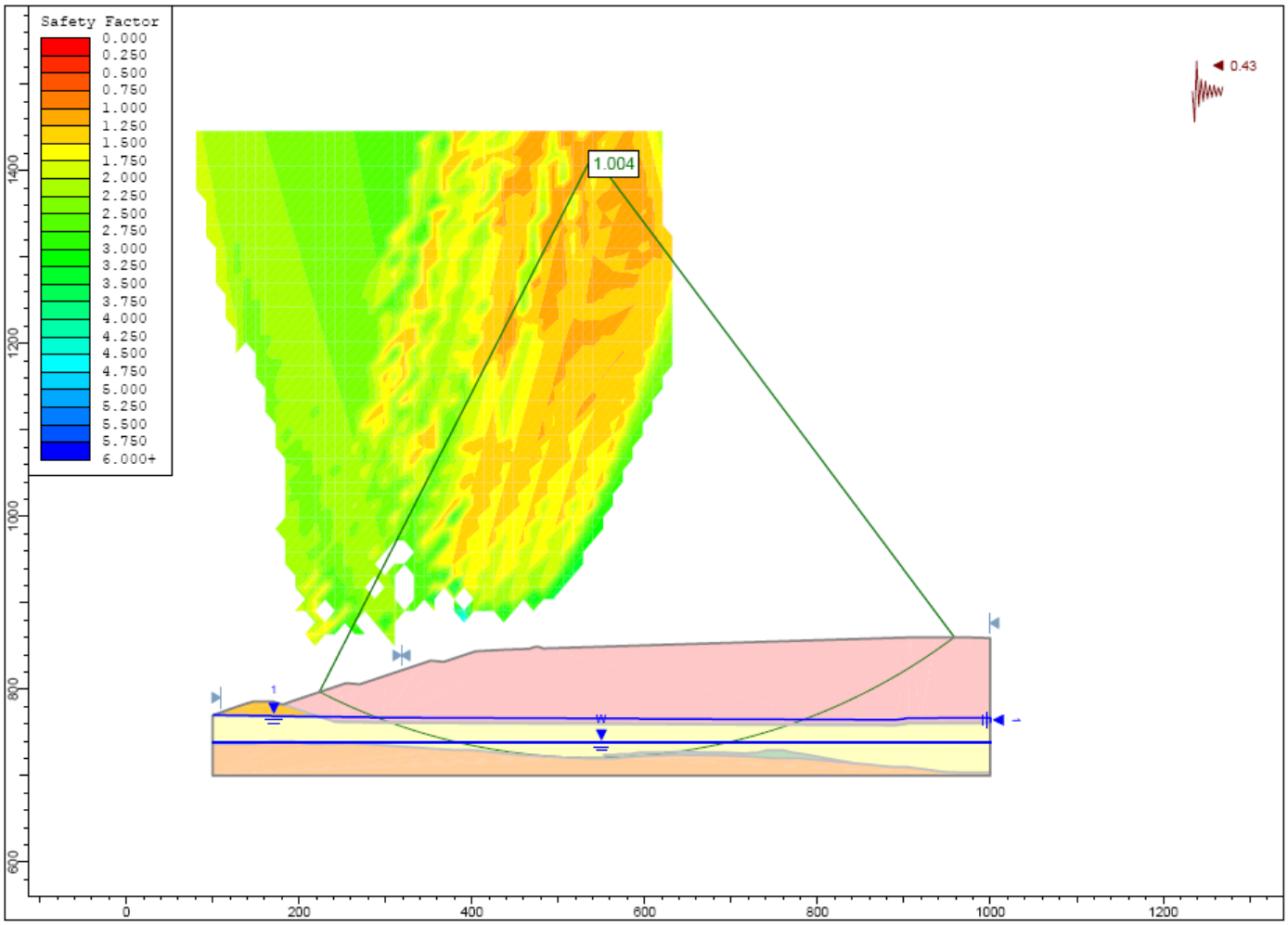


Figure B-2. Calculation of Yield Acceleration for Section 2

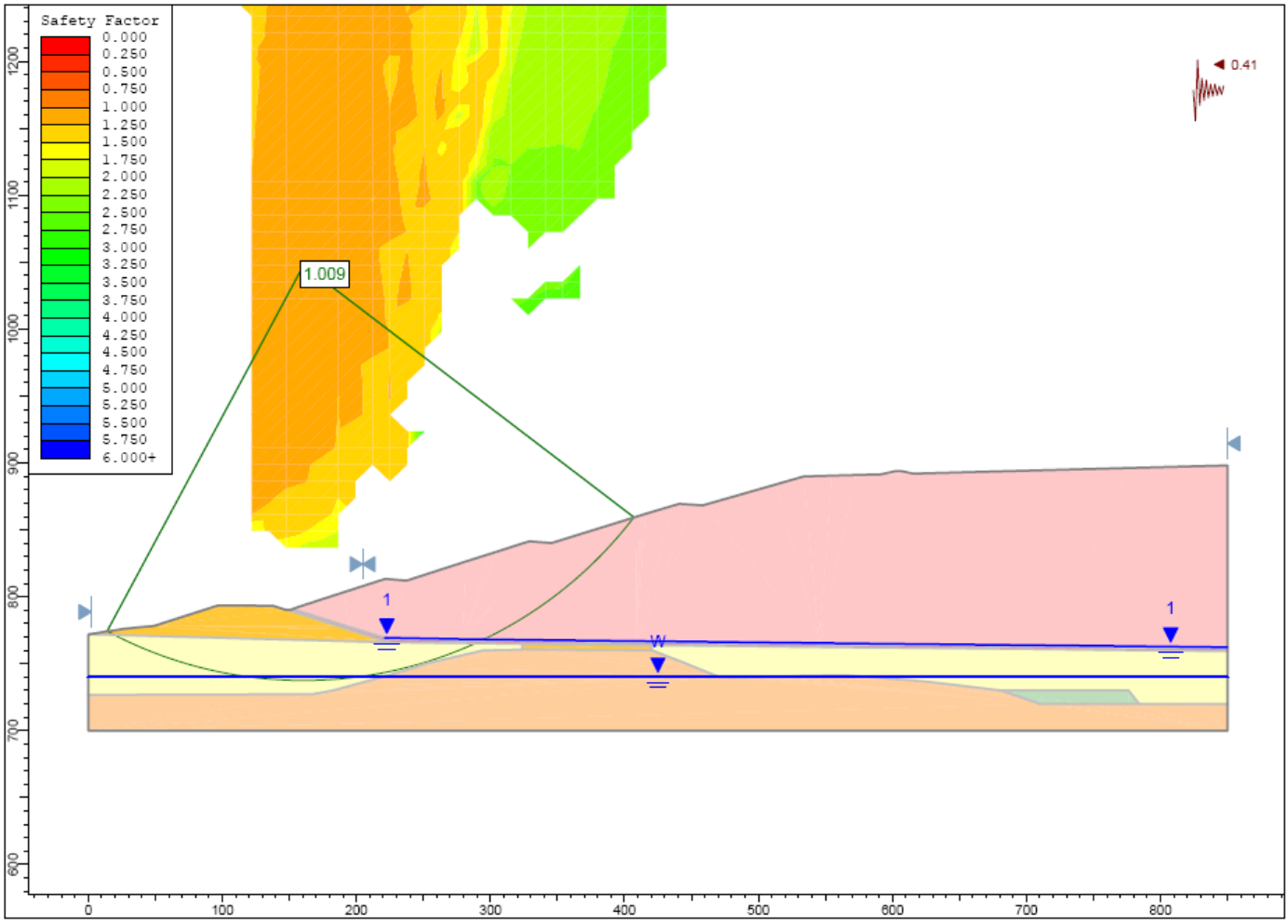


Figure B-3. Calculation of Yield Acceleration for Section 3

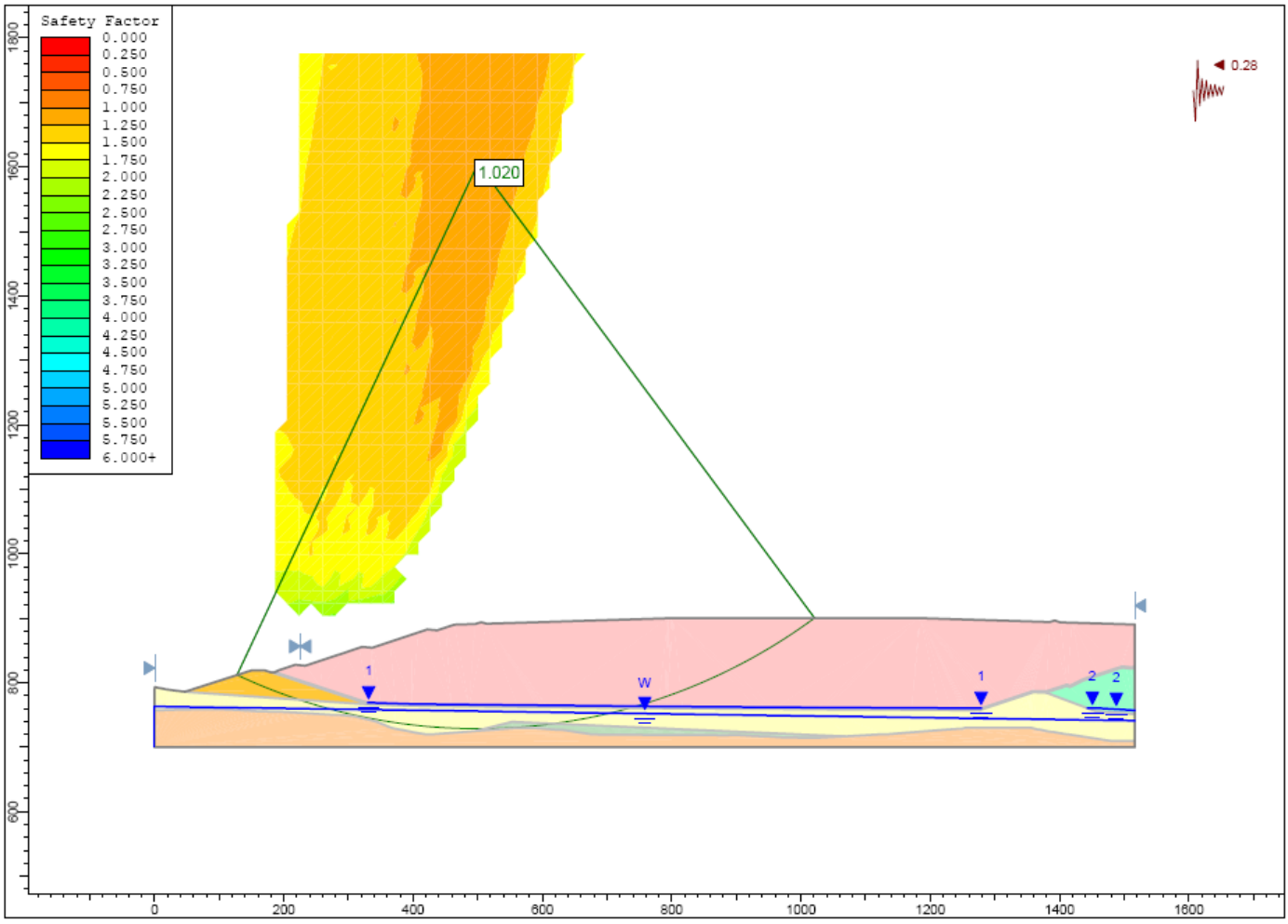


Figure B-4. Calculation of Yield Acceleration for Section 4

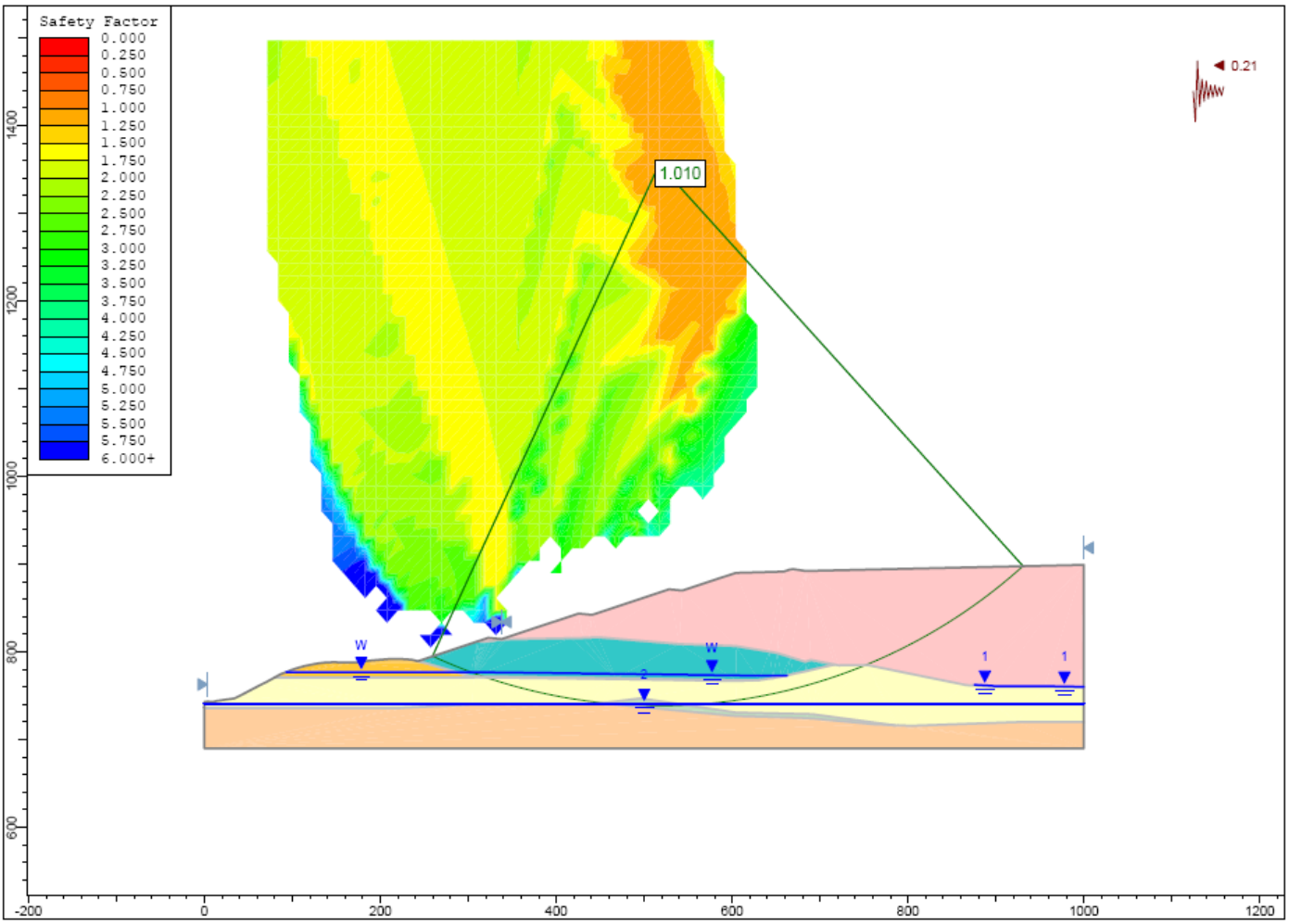


Figure B-5. Calculation of Yield Acceleration for Section 5

APPENDIX A

Document 22

Dewberry Memorandum, "Qualitative Assessment. Liquefaction Potential, TVA Fossil Plant CCR Impoundments, Dewberry Project No. 50047151," May 25, 2012

Memorandum

To: Stephen Hoffman, USEPA
Through: Jerry Strauss

From: Joe Klein

Date: May 25, 2012

Re: Qualitative Assessment
Liquefaction Potential
TVA Fossil Plant CCR Impoundments
Dewberry Project No, 50047151

This memorandum provides the results of a qualitative assessment of CCR impoundment embankment susceptibility to liquefaction at eight of the TVA fossil fuel plants assessed by Dewberry. The plants are: Bull Run; Colbert; Cumberland; Gallatin; John Sevier; Johnsonville; Kingston, and Widows Creek. We have not included Watts Bar (small pond, inactive for 30 years, minimal potential ash release), and Allen (TVA continuing deformation analyses, awaiting data and report)

TVA has indicated that a formal assessment of liquefaction susceptibility is underway; a completion date has not been provided. In prior rounds of the EPA CCR program, Dewberry has provided a preliminary indication of the presence of soils susceptible to liquefaction based on the geotechnical data provided with the slope stability analysis. The purpose of this assessment is to include similar information as a component of our reports to EPA, and to provide a uniform approach to the remaining plant sites.

Generally the geotechnical review looks at the soil stratification beneath both the embankments and impoundments to identify soil types considered susceptible to liquefaction; i.e., fine to medium grain sands, and some silts with Standard Penetration Resistance, or N-Values of less than 15 blows per foot[1]. That criterion, is an accepted industry standard for first level reviews.

Because several of the embankments had been constructed to their current configuration in stages, and because the raised sections were typically constructed by extending embankments in the *upstream* direction, most of TVA raised dikes are supported in part on stored bottom ash and/or fly ash. As bottom ash and fly ash are both known to be somewhat susceptible to liquefaction, an assessment of the potential impact on loss of subgrade support to the raised dike sections is a key consideration in the assessments.

For most of the other management units I have visited, the impoundments were expanded by *building out* on the downstream side of the dikes, eliminating the situation of building on the existing ash layer. The one site that did expand inward conducted a liquefaction analysis which indicated a potential for liquefaction in the ash at certain groundwater elevations. In that case the utility combined a groundwater monitoring system and construction schedule in an effort to prevent groundwater elevation

[1]Winterkorn, H.F., and Fang, H., *Foundation Engineering Handbook, Van Nostrand Reinhold, Ltd., New York, NY, 1975, pg. 268*

increases. If the approach proved to be unsuccessful, the utility had a drainage system design ready to be installed to stabilize the embankment against a potential liquefaction failure.

Because the assessments are qualitative rather than quantitative, I elected not to consider the results as indicative of either SATISFACTORY or UNSATISFACTORY. The assessed liquefaction condition at each impoundment is presented as either NO CONCERN or CONCERN. Each impoundment is assessed based on the natural foundation soils at the site, and the supporting material of raised dike sections. A composite rating is provided as described below.

The evaluations are based on the embankment cross-sections used in the recent (February 2012 and April 2012) pseudo static slope stability analyses conducted by Stantec Consulting Services for TVA.

Foundation Rating

Foundation soils are rated not only on the presence of liquefaction susceptible soils, but also the depth and thickness of the stratum, the slope of the base of the stratum, and whether the stratum extends beneath the base dike, or is restricted to the impoundment area. A CONCERN rating indicates the presence of soils susceptible to liquefaction at a relatively shallow depth below the embankment, and sufficiently thick to result in substantial deformations to the embankment in the event liquefaction occurs.

Dike Rating

Dikes were rated based on the presence of bottom ash, fly ash or other CCR material underlying raised dike sections. If the CCR material supported 50 percent or more of the raised dike, the dike received a CONCERN rating.

Composite Ratings

Composite ratings are based on a judgment of deformations that may occur to the embankments in the event of liquefaction of materials supporting the initial and/or raised dikes, The rating reflects the potential volume of material released in the event of an embankment failure, and the nature of the adjoining area expected to receive the outflow. In most cases, the controlling parameter for each perimeter dike is the potential failure of raised dikes supported in part by CCR material. Conversely, the controlling factor for interior dikes is the foundation rating.

Results

Table 1 presents a summary of the results of this assessment.

Plant	Impoundment	Liquefaction Stability Rating		
		Foundation	Dikes	Composite
Bull Run	Disposal Area 2A	NO CONCERN	CONCERN	**CONCERN**
	Disposal Area 2	NO CONCERN	NO CONCERN	NO CONCERN
	Bottom Ash Disposal Area 1	NO CONCERN	CONCERN	**CONCERN**
Colbert	Ash Pond 4	CONCERN	CONCERN	**CONCERN**
	Ash Pond 5	NO CONCERN	NO CONCERN	NO CONCERN
Cumberland	Ash Pond	NO CONCERN	NO CONCERN	NO CONCERN
Gallatin	Ash Pond A	NO CONCERN	CONCERN	NO CONCERN
	Ash Pond E	NO CONCERN	CONCERN	NO CONCERN
John Sevier	Bottom Ash Pond	NO CONCERN	NO CONCERN	NO CONCERN
	Ash Disposal Area J	NO CONCERN	NO CONCERN	NO CONCERN
Johnsonville	Ash Disposal Area 2	NO CONCERN	CONCERN	**CONCERN**
Kingston	Ash Pond Dike C	CONCERN	CONCERN	**CONCERN**
	Gypsum Stack	NO CONCERN	NO CONCERN	NO CONCERN
Widows Creek	Main Ash Pond Complex	NO CONCERN	CONCERN	**CONCERN**
	Gypsum Stack	NO CONCERN	NO CONCERN	NO CONCERN

The embankment composite ratings at Gallatin Fossil Plant are the exception to the general case of the dike rating being the controlling factor. Gallatin Ash Pond A embankment is an interior dike separating Ash Pond A and Stilling Pond B. Failure of the embankment due to liquefaction of the supporting ash would result in an intermingling of ash and decant water within the impoundment, a release from the impoundment would not be expected to occur.

Gallatin Ash Pond E is supported on an underlying layer of ash that extends beyond the toe of the embankment to a natural slope, expected to be the excavation limits for the original impoundment area. Failure of the Ash Pond E due to liquefaction of the underlying material is not expected to result in a significant release beyond the boundaries of the current impoundment,

Conclusions

Based on the results of this review, the stability of six impoundments is rated as CONCERN relative to potential liquefaction during a seismic event.

As previously discussed, the embankment stability ratings are based on a qualitative review of the current geotechnical data. More rigorous analytical assessments may arrive at different results. Such analyses should evaluate both the likelihood of liquefaction occurring from susceptible soils in the event of the design earthquake, and the effects of liquefaction on the embankments. The second phase of analyses is important to assess the risk posed by potential liquefaction of (or beneath) the CCR impoundment embankments.

Limitations

Our assessment of the stability of CCR impoundment embankments includes evaluation of many variables, including liquefaction potential. Most of the other variables have data developed with significantly more technical rigor than this qualitative assessment. *Therefore, I caution against using the results of this assessment as a primary determinant on the overall rating of a CCR impoundment.* Although reasonable judgment was used throughout the evaluation, uncertainties were evaluated using the most conservation assumptions.

Further, it is likely that the geotechnical data provided by TVA is "inconsistent" with the data (i.e., procedure) used in the Foundation Engineering Handbook (Footnote 1) to develop correlations with liquefaction susceptibility and N-values. That is, information in the TVA geotechnical reports indicate that the Standard Penetration Tests were conducted using an automatic hammer to drive the sampler. Research has shown that automatic hammers impart a significantly higher percentage of the theoretical maximum hammer to the drive anvil energy than achieved by traditional manual methods using a rope and cathead to raise and release the hammer. The result is that TVA's recorded N-values can be expected to be lower than those achieved by manual hammers in use at the time the industry-practice (i.e., Handbook) liquefaction correlations were developed.

Further, the sand strata encountered at TVA sites were below the ground water level. The boring logs indicated borings were advanced using a hollow stem auger. Hollow stem augers are a standard method for advancing soil borings, and comply with ASTM requirements. However, it is difficult to maintain the required hydrostatic head inside the augers while inserting and removing the sampler. If the hydrostatic head is not maintained, an upward gradient can develop at the tip of the auger which also reduces the N-value below the theoretical value.

It is for these reasons that the results of this assessment should not be used as the primary determinate of the overall rating for an embankment.

APPENDIX B

Document 23

Dam Inspection Check List Form: Ash Pond C

Site Name:	**Kingston Steam Plant**	**Date:**	**21 September 2011**
Unit Name:	**Ash Pond and Stilling Pond**	**Operator's Name:**	**Tennessee Valley Authority (TVA)**
Unit I.D.:	**Ash Pond and Stilling Pond**	**Hazard Potential Classification:**	**High** ☐ **Significant** ☒ **Low** ☐
	Inspector's Name:	Stanley W., Notestine, P.E. and Joseph P. Klein, III, P.E.	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	X		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	754.7		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	750		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	765		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?	X		Is water exiting outlet flowing clear?	X	
7. Is the embankment currently under construction?	X		21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	N/A		From underdrain?		X
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?	N/A	
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?	X		From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?		X	23. Water against downstream toe?	X	
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments
2.	Pool elevation based on "Diffuser Replacement Project Details – Siphon Spillways Work Plan 6" dated May 3, 2010
3.	Decant elevation is siphon inlet design elevation shown on Drawing referenced in Issue #2. Siphon system in use at time of site visit. Original Stilling Pond spillway system of six 48-inch diameter reinforced concrete pipes remains in place but is currently out of service.
7.	The Ash Pond is adjacent to the Dredge Cell that experienced a significant embankment failure is December 2008. Reconstruction of the Dredge Cell designed for use as a dry ash storage facility includes construction along Dike D between the Dredge Cell and the Ash Pond and interior grading of the Ash Pond.

8.	Documentation of original dike foundation preparation not available. Borings conducted as part of 2009 Geotechnical Exploration and Slope Stability for Dike C do not indicate the presence of vegetation or other organic matter in the uppermost foundation materials.
19.	Minor slope toe damage near outlet structure. Expected to be result of mowing tractors or other equipment traffic along toe.

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit	**TN0005452**	**INSPECTOR**	Stanley W., Notestine, P.E. and Joseph P. Klein, III, P.E.
Date	Permit Effective Date October 1, 2003		
Impoundment Name	TVA Fossil Plant Ash Pond Outfall 001		
Impoundment Company	Tennessee Valley Authority		
EPA Region	4		
State Agency (Field Office) Address	Tennessee Department of Environment and Conservation 401 Church Street L&C Annex 6th Floor Nashville, TN 37243		
Name of Impoundment	Ash Pond Outfall 001		

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☐ **Update** ☒

	Yes	**No**
Is impoundment currently under construction?	☒	☐
Is water or ccw currently being pumped into the impoundment?	☒	☐

IMPOUNDMENT FUNCTION: Storage and settling of sluiced ash and other plant process waters.

Nearest Downstream Town Name: Kingston, TN

Distance from the impoundment: Approx. 6 miles

Location:

Latitude	35	Degrees	54	Minutes	16.59	Seconds	**N**
Longitude	84	Degrees	30	Minutes	20.84	Seconds	**W**

State Tennessee **County** Roane

	Yes	No
Does a state agency regulate this impoundment?	☒	☐

If So Which State Agency? Tennessee Department of Environment and Conservation

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☐ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

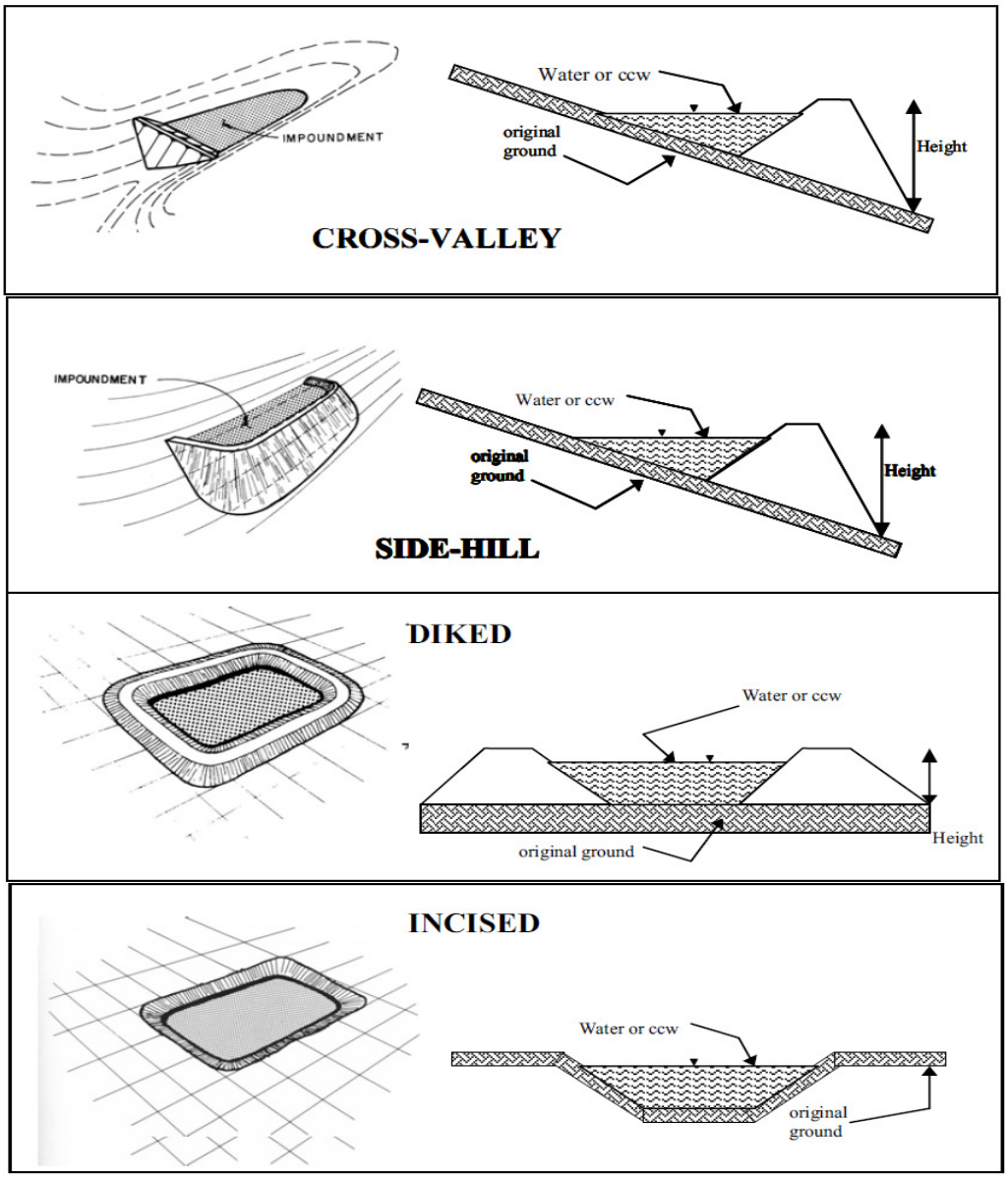
☒ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

Based on the size and location of the impoundment, a release due to embankment failure or misoperation there is not a probable loss of human life. As the impoundment is adjacent to the Emory River such a release is expected to cause economic loss and environmental damage.

CONFIGURATION:



☐ Cross-Valley ☐ Side-Hill ☒ Diked

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft)	25	**Embankment Material**	Starter Dike: Clay Starter Dike Cap: Constructed ash Raised Dike: Clay
Pool Area (ac)	120	**Liner**	No
Current Freeboard (ft)	10.3	**Liner Permeability**	N/A

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

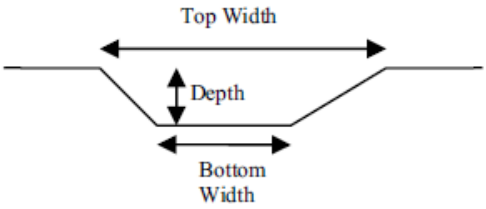
- ☐ Trapezoidal
- ☐ Triangular
- ☐ Rectangular
- ☐ Irregular

depth (ft)

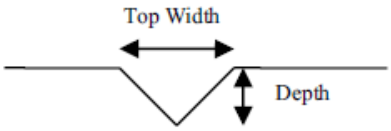
average bottom width (ft)

top width (ft)

TRAPEZOIDAL



TRIANGULAR



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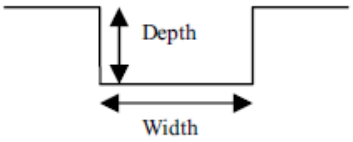

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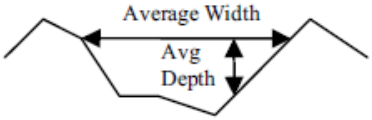
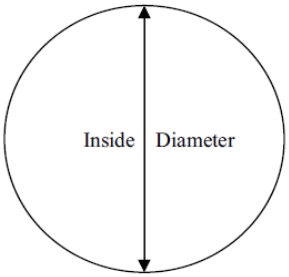


☒ **Outlet -** Four pipe siphon system

24 " inside diameter



Material

- ☐ corrugated metal
- ☐ welded steel
- ☐ concrete
- ☒ plastic (hdpe, pvc, etc.)
- ☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☒	☐

☐ **No Outlet**

☐ **Other Type of Outlet** (specify):

The Impoundment was Designed By Data not available at the time of the site visit.

	Yes	No
Has there ever been a failure at this site?	☒	☐

If So When? Dec. 2008

If So Please Describe: A dike failure in the adjacent Dredge Cell is reported to have damaged an area at the north end of Dike D, the western boundary of the Ash Pond. The damage was repaired and no release from the Ash Pond was reported.

The Stantec geotechnical report also indicates prior shallow sliding of the downstream face of Dike C in an area along the perimeter of the dredge call has been reported. The slides were reported to have been repaired as part of the TVA routine maintenance program.

	Yes	No	
Has there ever been significant seepages at this site?	☐	☐	See Below

If So When?

If So Please Describe: The August 2009 Geotechnical Exploration report prepared by Stantec Consulting Services did not cite past seepages. However a seepage analysis was conducted and concluded that conditions favorable to seepage occurrence existed within the embankment.

Rain shortly before and during the site visit limited observation of potential seepage areas.

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☒	☐

If so, which method (e.g., piezometers, gw pumping,...)? Network of piezometers

If So Please Describe: Stantec installed a total of 20 piezometers in the starter dike and raised dike as part of the 2009 geotechnical exploration.

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

The Stantec geotechnical report does not indicate the presence of wet ash, slag, or other unsuitable materials beneath the starter dike.

The report indicates that the dike was raised using inward construction such that the raised clay dike is founded on previously deposited sluiced ash.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

No.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

No.

APPENDIX B

Document 24

Dam Inspection Check List Form: Gypsum Disposal Facility

Site Name:	**Kingston Steam Plant**	**Date:**	**21 September 2011**
Unit Name:	**Gypsum Impoundment**	**Operator's Name:**	**Tennessee Valley Authority**
Unit I.D.:	**Gypsum Impoundment**	**Hazard Potential Classification:**	**High ☐ Significant ☒ Low ☐**
	Inspector's Name:	Stanley W. Notestine, P.E. and Joseph P. Klein, III, P.E.	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	X		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	759		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?			20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	X		Is water entering inlet, but not exiting outlet?		
5. Lowest dam crest elevation (operator records)?	767.9		Is water exiting outlet, but not entering inlet?		
6. If instrumentation is present, are readings recorded (operator records)?	X		Is water exiting outlet flowing clear?		
7. Is the embankment currently under construction?	X		21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?			From underdrain?		
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?			From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?	X		"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?			23. Water against downstream toe?	X	
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments
7.	The embankment impounding the stormwater pond and cell 1 of the gypsum impoundment is essentially completed and the stormwater pond is in service. Gypsum cell 1A lining is currently being installed as is the subgrade drainage system. A temporary interior dike that will separate cells 1A and 1B has been started, but no activity is underway in cell 1B. It is being used as a lay-down area for materials and equipment working in cell 1A. No CCR is currently present in the impoundment.
13.	Small karst features were encountered during excavation and grading for the gypsum impoundment. Design changes were made to stabilize the karst features and reduce the risk of adverse impacts of potential future karst development.
23.	The Clinch River is adjacent to the toe of the gypsum impoundment south dike embankment.

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit	TN 0080870	**INSPECTOR**	Stanley W. Notestine, P.E. and Joseph P. Klein, III, P.E.

Date Permit Effective Date: October 1, 2009

Impoundment Name Kingston Plant Flue Gas Desulfurization Detention Pond

Impoundment Company Tennessee Valley Authority

EPA Region 4

State Agency (Field Office) Address Tennessee Department of Environment and Conservation
401 Church Street
L&C Annex 6th Floor
Nashville, TN 37243

Name of Impoundment Kingston Plant Flue Gas Desulfurization Detention Pond

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☒ **Update** ☐

	Yes	No
Is impoundment currently under construction?	☒	☐
Is water or ccw currently being pumped into the impoundment?	☐	☒

IMPOUNDMENT FUNCTION:

Nearest Downstream Town Name:

Distance from the impoundment:

Location:

Latitude	35	Degrees	53	Minutes	37.91	Seconds	**N**
Longitude	84	Degrees	30	Minutes	49.70	Seconds	**W**

State Tennessee **County** Roane

	Yes	No
Does a state agency regulate this impoundment?	☒	☐

If So Which State Agency? Tennessee Department of Environment and Conservation

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☐ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

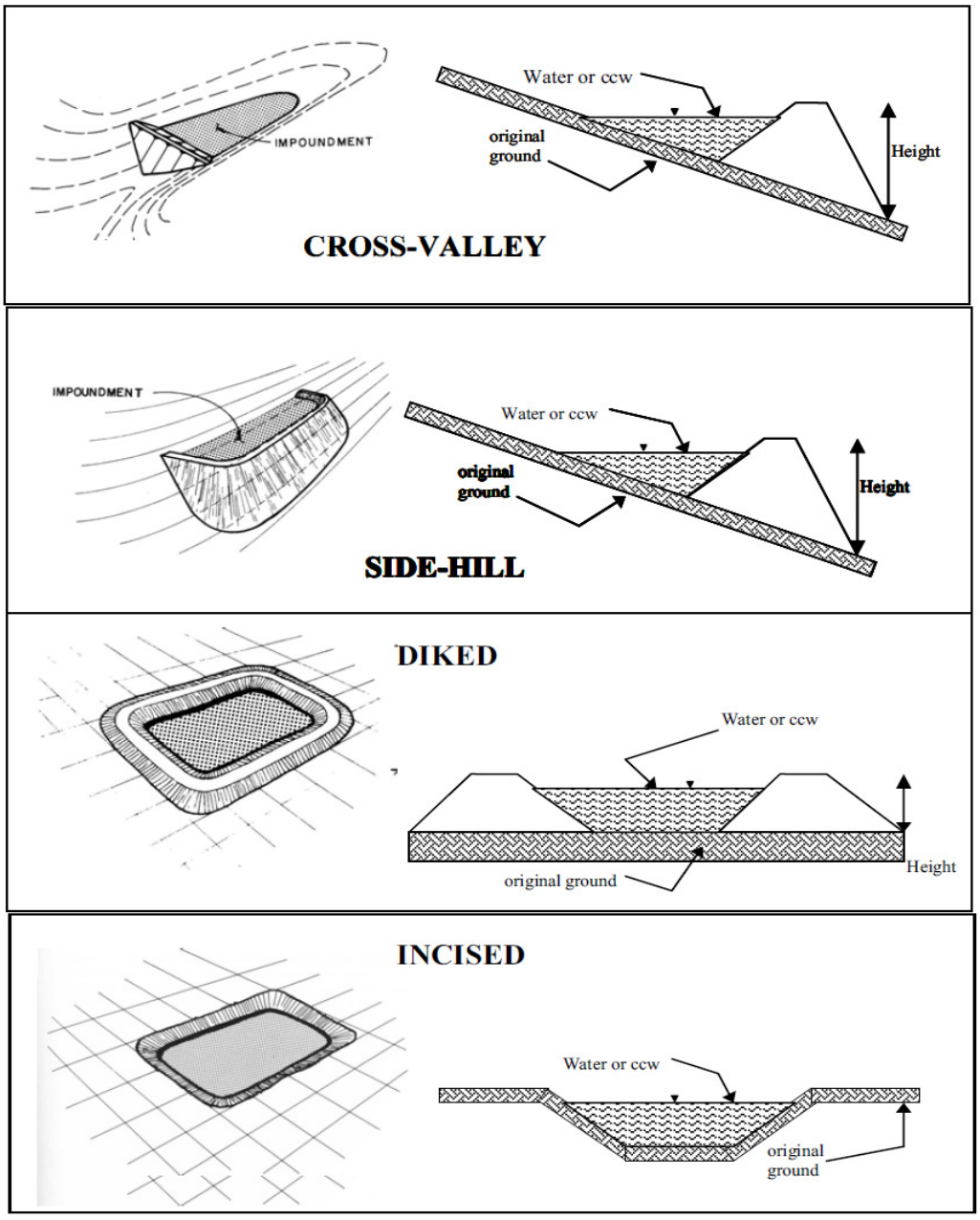
☒ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

Based on the size and location of the impoundment, a release due to embankment failure or misoperation there is not a probable loss of human life. As the impoundment is adjacent to the Clinch River such a release is expected to cause economic loss and environmental damage.

CONFIGURATION:



☐ Cross-Valley ☒ Side-Hill ☐ Diked

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft)

Pool Area (ac)

Current Freeboard (ft)

Embankment Material

Liner HDPE

Liner Permeability

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

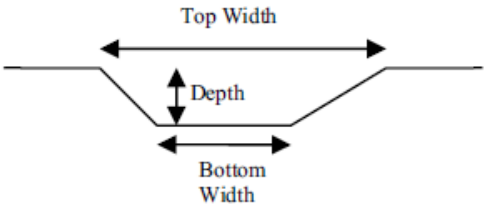
- ☐ Trapezoidal
- ☐ Triangular
- ☐ Rectangular
- ☐ Irregular

depth (ft)

average bottom width (ft)

top width (ft)

TRAPEZOIDAL



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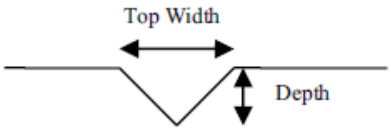

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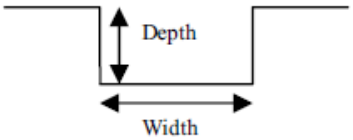

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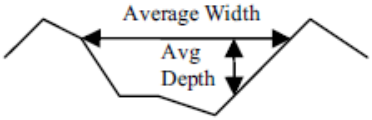
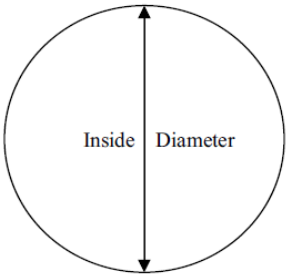


☐ **Outlet**

18" inside diameter
(SDR 17 – smooth lined – 19.5" OD)



Material

- ☐ corrugated metal
- ☐ welded steel
- ☐ concrete
- ☐ plastic (hdpe, pvc, etc.)
- ☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☐	☐

☐ **No Outlet**

☐ **Other Type of Outlet**
(specify):

The Impoundment was Designed By

	Yes	No
Has there ever been a failure at this site?	☐	☐
If So When?		

If So Please Describe :

	Yes	No
Has there ever been significant seepages at this site?	☐	☐
If So When?		

If So Please Describe :

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☐	☐
If so, which method (e.g., piezometers, gw pumping,...)?		

If So Please Describe :

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

No. Observations during the site visit the embankment was substantially complete and the stormwater pond was in service. However, the gypsum cells were uncompleted and no CCR was present in the impoundment. The embankment appeared to be supported on natural ground at the site.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

No.

Site Name:	**Kingston Steam Plant**	**Date:**	**21 September 2011**
Unit Name:	**Gypsum Impoundment**	**Operator's Name:**	**Tennessee Valley Authority**
Unit I.D.:	**Gypsum Impoundment**	**Hazard Potential Classification:**	**High ☐ Significant ☒ Low ☐**
	Inspector's Name:	Stanley W. Notestine, P.E. and Joseph P. Klein, III, P.E.	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	X		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	759		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?			20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	X		Is water entering inlet, but not exiting outlet?		
5. Lowest dam crest elevation (operator records)?	767.9		Is water exiting outlet, but not entering inlet?		
6. If instrumentation is present, are readings recorded (operator records)?	X		Is water exiting outlet flowing clear?		
7. Is the embankment currently under construction?	X		21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?			From underdrain?		
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?			From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?	X		"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?			23. Water against downstream toe?	X	
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments
7.	The embankment impounding the stormwater pond and cell 1 of the gypsum impoundment is essentially completed and the stormwater pond is in service. Gypsum cell 1A lining is currently being installed as is the subgrade drainage system. A temporary interior dike that will separate cells 1A and 1B has been started, but no activity is underway in cell 1B. It is being used as a lay-down area for materials and equipment working in cell 1A. No CCR is currently present in the impoundment.
13.	Small karst features were encountered during excavation and grading for the gypsum impoundment. Design changes were made to stabilize the karst features and reduce the risk of adverse impacts of potential future karst development.
23.	The Clinch River is adjacent to the toe of the gypsum impoundment south dike embankment.

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit	TN 0080870	**INSPECTOR**	Stanley W. Notestine, P.E. and Joseph P. Klein, III, P.E.

Date Permit Effective Date: October 1, 2009

Impoundment Name Kingston Plant Flue Gas Desulfurization Detention Pond

Impoundment Company Tennessee Valley Authority

EPA Region 4

State Agency (Field Office) Address Tennessee Department of Environment and Conservation
401 Church Street
L&C Annex 6th Floor
Nashville, TN 37243

Name of Impoundment Kingston Plant Flue Gas Desulfurization Detention Pond

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☒ **Update** ☐

	Yes	No
Is impoundment currently under construction?	☒	☐
Is water or ccw currently being pumped into the impoundment?	☐	☒

IMPOUNDMENT FUNCTION:

Nearest Downstream Town Name:

Distance from the impoundment:

Location:

Latitude	35	Degrees	53	Minutes	37.91	Seconds	**N**
Longitude	84	Degrees	30	Minutes	49.70	Seconds	**W**

State Tennessee **County** Roane

	Yes	No
Does a state agency regulate this impoundment?	☒	☐

If So Which State Agency? Tennessee Department of Environment and Conservation

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☐ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

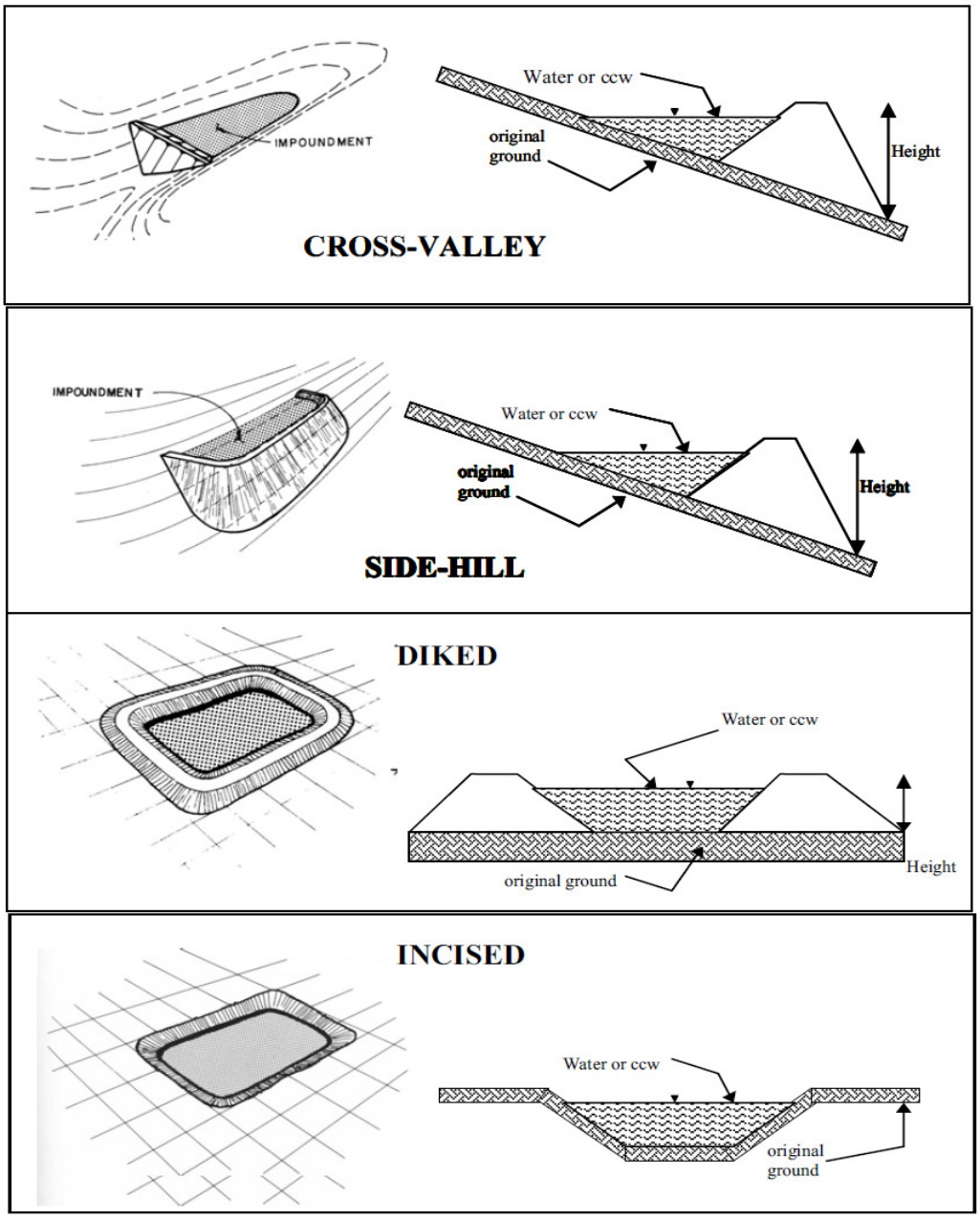
☒ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

Based on the size and location of the impoundment, a release due to embankment failure or misoperation there is not a probable loss of human life. As the impoundment is adjacent to the Clinch River such a release is expected to cause economic loss and environmental damage.

CONFIGURATION:



☐ Cross-Valley ☒ Side-Hill ☐ Diked

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft)

Pool Area (ac)

Current Freeboard (ft)

Embankment Material

Liner HDPE

Liner Permeability

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

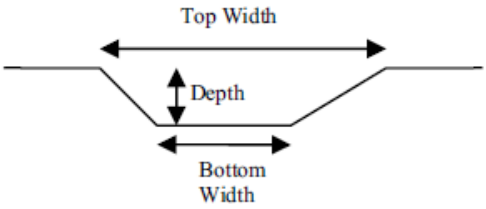
- ☐ Trapezoidal
- ☐ Triangular
- ☐ Rectangular
- ☐ Irregular

depth (ft)

average bottom width (ft)

top width (ft)

TRAPEZOIDAL



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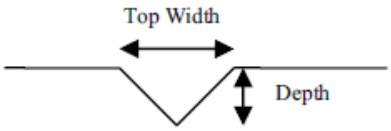

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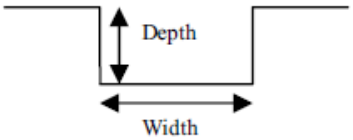
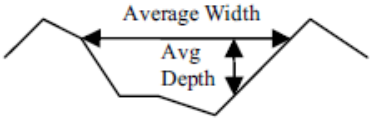
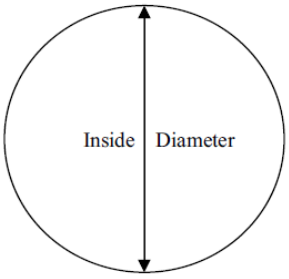


IRREGULAR



☐ **Outlet**

91" inside diameter
(SDR 17 – smooth lined – 19.5" OD)



Material

- ☐ corrugated metal
- ☐ welded steel
- ☒ concrete
- ☐ plastic (hdpe, pvc, etc.)
- ☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☐	☒

☐ **No Outlet**

☐ **Other Type of Outlet**
(specify):

The Impoundment was Designed By

	Yes	No
Has there ever been a failure at this site?	☐	☒
If So When?		

If So Please Describe :

	Yes	No
Has there ever been significant seepages at this site?	☒	☐
If So When?	2010	

If So Please Describe : Sinkholes in Gypsum Stack foundation. Facility redesigned and reconstructed with liner.

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☐	☒
If so, which method (e.g., piezometers, gw pumping,...)?		

If So Please Describe :

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

No. Observations during the site visit the embankment was substantially complete and the stormwater pond was in service. However, the gypsum cells were uncompleted and no CCR was present in the impoundment. The embankment appeared to be supported on natural ground at the site.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

No.

APPENDIX C

DREDGE POND
Remediated/Closed
Dike C
Dike D
ASH POND C
Ash Pond
Stilling
Pond
Dike C
TO GYPSUM DISPOSAL
FACILITY
Swan Pond Rd
Swan Pond Rd
Image © 2013 DigitalGlobe
© 2013 Google
Google earth

GYPSUM DISPOSAL FACILITY
Storm Water Pond
Dry Gypsum Stack Impoundment Phase 2
Dry Gypsum Stack Impoundment Phase 1
Image © 2013 DigitalGlobe
© 2013 Google
Google earth