Coal Combustion Waste Impoundment

Round 5 - Dam Assessment Report

Wateree Station (Site #01)

Ash Pond 1 & 2

South Carolina Electric & Gas Company
Eastover, South Carolina

Prepared for:

United States Environmental Protection Agency
Office of Resource Conservation and Recovery

Prepared by:

Dewberry & Davis, LLC
Fairfax, Virginia

Under Contract Number: EP-09W001727
July 2010

INTRODUCTION, SUMMARY, CONCLUSION AND RECOMMENDATIONS

The release of over five million cubic yards of coal ash 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 waste disposal units. . A first step to prevent such catastrophic failure and damage is to assess the stability and functionality of ash impoundments and other units, then quickly take any needed corrective measures.

This assessment of the stability and functionality of the Wateree Station fly ash management unit is based on a review of available documents and on the site assessment conducted by Dewberry personnel on June 28, 2010. We found the supporting technical information adequate (Section 1.1.3). As detailed in Section 1.2.6 there are recommendations that may help to maintain a safe and trouble-free operation,

In summary, the Wateree Station ash ponds are SATISFACTORY for continued safe and reliable operation, with no apparent existing or potential management unit safety deficiencies.

PURPOSE AND SCOPE

The U. S. Environmental Protection Agency (EPA) is embarking on an initiative to investigate 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 impoundment 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 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 December 2009, the EPA sent 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 if coal combustion waste. 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 asked utility companies to identify all management units: surface impoundments or similar diked or bermed structures; and; landfills receiving liquid-borne materials that store or dispose of coal-combustion residuals or by-products, including, but not limited to, fly ash, bottom ash, boiler slag, and flue gas emission control residuals. Utility companies responded with information on the size, design, age, and the amount of material placed in the units so that EPA could gauge which management units had or potential could rank as having High Hazard Potential. The USEPA and its contractors used the following definitions for this study:

> “Surface Impoundment or impoundment means a facility or part of a facility which is a natural topographic depression, man-made excavation, or diked area formed primarily of earthen materials (although it may be lined with man-made materials), which is designed to hold an accumulation of liquid wastes or wastes containing free liquids, and which is not an injection well. Examples of surface impoundments are holding, storage, settling and aeration pits, ponds, and lagoons.”
>
> For this study, the earthen materials could include coal combustion residuals. EPA did not provide an exclusion for small units based on whether the placement was temporary or permanent. Furthermore, the study covers not only waste units designated as surface impoundments, but also other units designated as landfills which receive free liquids.
>
> EPA is addressing any land-based units that receive fly ash, bottom ash, boiler slag, or flue gas emission control waster along with free liquids. If the landfill is receiving coal combustion wastes with liquids limited to that for proper compaction, then there should not be free liquids present and the EPA did not seek information on such units which are appropriately designated a landfill.
>
> In some cases coal combustion wastes are separated from the water, and the water containing de minimum levels of fly ash, bottom ash, boiler slag, or flue gas emission control wastes are sent to an impoundment. EPA is including such impoundments in this study, because chemicals of concern may have leached from the solid coal combustion wastes into the waster waters, and the suspended solids from the coal combustion wastes remain.

The purpose of this report is to **evaluate the condition and potential of waste release from management units that have not been rated for hazard potential classification**. A two-person team reviewed the information submitted to EPA, reviewed any relevant publicly available information from state or federal agencies regarding the unit potential hazard classification (if any) and accepted information provided via telephone communication with a management unit representative.

This evaluation included a site visit. EPA sent two engineers, one licensed in the State of South Carolina, for a one-day visit. The two-person team met with the owner of the management unit as well as technical and several technical representative and management unit supervisors to discuss the engineering characteristics of the unit as part of the site visit. During the site visit the team collected additional information about the management unit to be used in determining the hazard potential classifications of the management unit(s). Subsequent to the site visit the management unit owner provided additional engineering data pertaining to the management unit(s).

Factors considered in determining the hazard potential classification of the management unit(s) included the age and size of the impoundment, that quantity of coal combustion residuals or by-products that were stored or disposed in the 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 units(s). The team considered criteria in evaluating the dams under the National Inventory of Dams in making these determinations.

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 waste 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.

TABLE OF CONTENTS

APPENDICES

APPENDIX A – REFERENCE DOCUMENTS

Doc 1: Plan View (Spatial Data).pdf
Doc 2: Hydraulic Analysis.pdf
Doc 3: NPDES Permit.pdf
Doc 4: Hydrogeologic Report.pdf
Doc 5: Structural Report and Analysis.pdf
Doc 6: Riverbank Stabilization Project.pdf
Doc 7: Ash Pond 1.pdf
Doc 8: Ash Pond 2.pdf
Doc 9: Embankment Cross Sections.pdf
Doc 10: 5 Mile Radius Downstream Map.pdf

APPENDIX B – SITE ASSESSMENT DOCUMENTATION

Doc 1: 2010.06.28 – Ash Pond No. 1.pdf
Doc 2: 2010.06.28 – Ash Pond No. 2.pdf
Doc 3: Separation Dike Photo Log
Doc 4: Photographs

APPENDIX C – CORRESPONDENCE & ADDITIONAL REFERENCE DOCUMENTATION

RESERVED

1.0 CONCLUSIONS AND RECOMMENDATIONS

1.1 CONCLUSIONS

Conclusions are based on visual observations from the one-day site visit, review of technical documentation provided by South Carolina Electric & Gas Company (SCE&G), and review of state inspection reports.

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

Ash Pond 1 - The structural stability of the Ash Pond embankments appears to be in satisfactory condition.

Ash Pond 2 - The structural stability of the Ash Pond embankments appears to be in satisfactory condition.

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

Ash Pond 1 - Adequate capacity and freeboard exist to safely pass the design storm.

Ash Pond 2 - Adequate capacity and freeboard exist to safely pass the design storm.

1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

Ash Pond 1 and Ash Pond 2 - Supporting technical documentation is adequate.

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

Descriptions provided are appropriate.

1.1.5 Conclusions Regarding the Field Observations

Ash Pond 1 and Ash Pond 2 - Small diameter pines trees were beginning to establish and need to be routinely removed. Pot holes along the crest had formed and were holding water that needs to be repaired. Erosion is occurring along the upstream slope that needs to be addressed. Past and present seepage areas need to be monitored. There were no safety issues that were found, just maintenance items that need to be monitored.

1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

Ash Pond 1 and Ash Pond 2 – It was stated during the field visit that the Wateree Station would begin monthly and annual inspections effective of July 2010.

1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

Ash Pond 1 and Ash Pond 2 - Existing surveillance and monitoring programs are adequate.

1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

Facility is SATISFACTORY for continued safe and reliable operation. A classification of "satisfactory" is appropriate when no existing or potential management unit safety deficiencies are recognized. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) in accordance with the applicable criteria. Minor maintenance items may be required.

1.2 RECOMMENDATIONS

1.2.1 Recommendations Regarding the Structural Stability

Continue with the newly implemented maintenance and inspection programs.

1.2.2 Recommendations Regarding the Hydrologic/Hydraulic Safety

None appear warranted at this time.

1.2.3 Recommendations Regarding the Supporting Technical Documentation

None appear warranted at this time.

1.2.4 Recommendations Regarding the Description of the Management Unit(s)

None appear warranted at this time.

1.2.5 Recommendations Regarding the Field Observations

Ash Pond 1 and Ash Pond 2 - Vegetation should be cut or mowed on an as-needed basis to prevent the establishment of large woody-stemmed vegetation. Pot-holes in the crest need repair and remediation to prevent water from ponding.

1.2.6 Recommendations Regarding the Maintenance and Methods of Operation

Ash Pond 1 and Ash Pond 2 – Items in 1.2.5 need to be addressed. The implementation of monthly and annual inspections should help with discovering maintenances problems before they become a safety hazard.

1.2.7 Recommendations Regarding the Surveillance and Monitoring Program

Ash Pond 1 and Ash Pond 2 – The newly implemented monthly and annual inspections need to address monitoring any past or present seepage areas. One inactive and two active seepage areas were identified by SCE&G during the site visit.

1.2.8 Recommendations Regarding Continued Safe and Reliable Operation

None appear warranted at this time.

1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

Tom Effinger – SCANA
Jean-Claude Younan – SCANA
Tim Miller – South Carolina Electric & Gas Company (SCE&G)
Mike Summer – South Carolina Electric & Gas Company (SCE&G)
April Kelly – South Carolina Electric & Gas Company (SCE&G)
Petar Milenkov – South Carolina Department of Health & Environment Control (SCDHEC)
Justin Story – Dewberry & Davis, Inc.
Frederic Shmurak – Dewberry & Davis, Inc

1.3.2 Acknowledgement and Signature

We acknowledge that the management unit referenced herein was assessed on June 28, 2010.

________________________________ ________________________________
Frederic M. Shmurak, PE, Civil Engineer Justin R. Story, EI, Civil Designer

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

2.1 LOCATION

The Wateree Station and ash ponds are located near the town of Eastover, SC and adjacent to the Wateree River. Figure 2.1 depicts a vicinity map around the Wateree Station, while Figure 2.1 b depicts an aerial view of the Wateree Station.

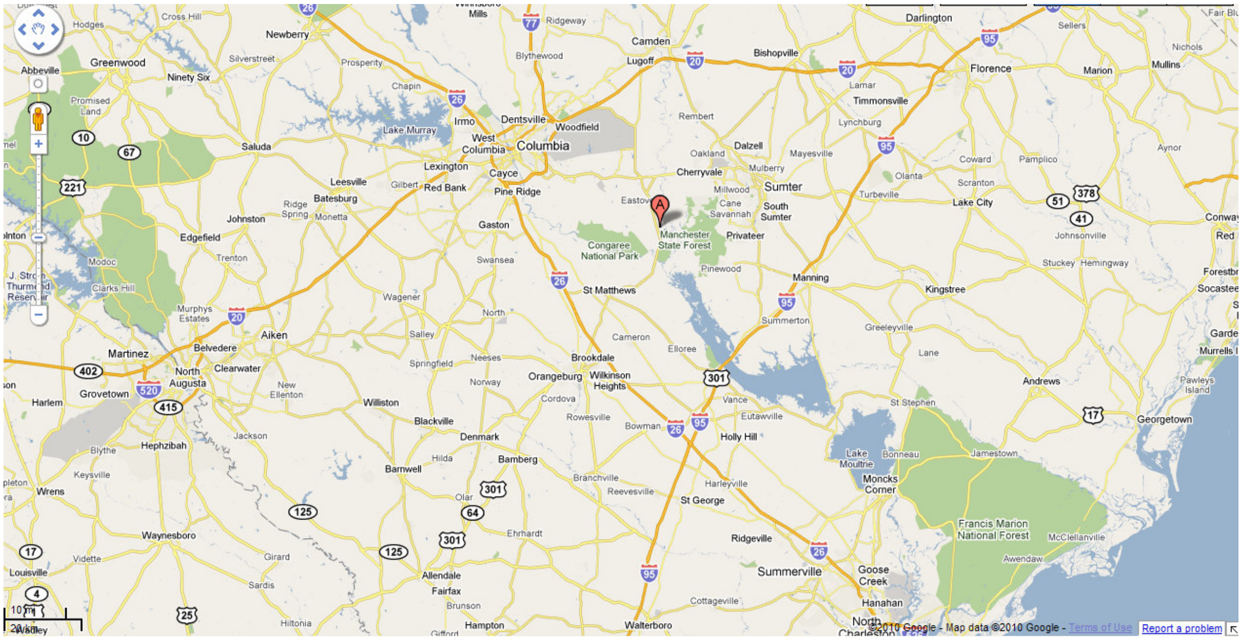


Figure 2.1 a: Wateree Station Vicinity Map

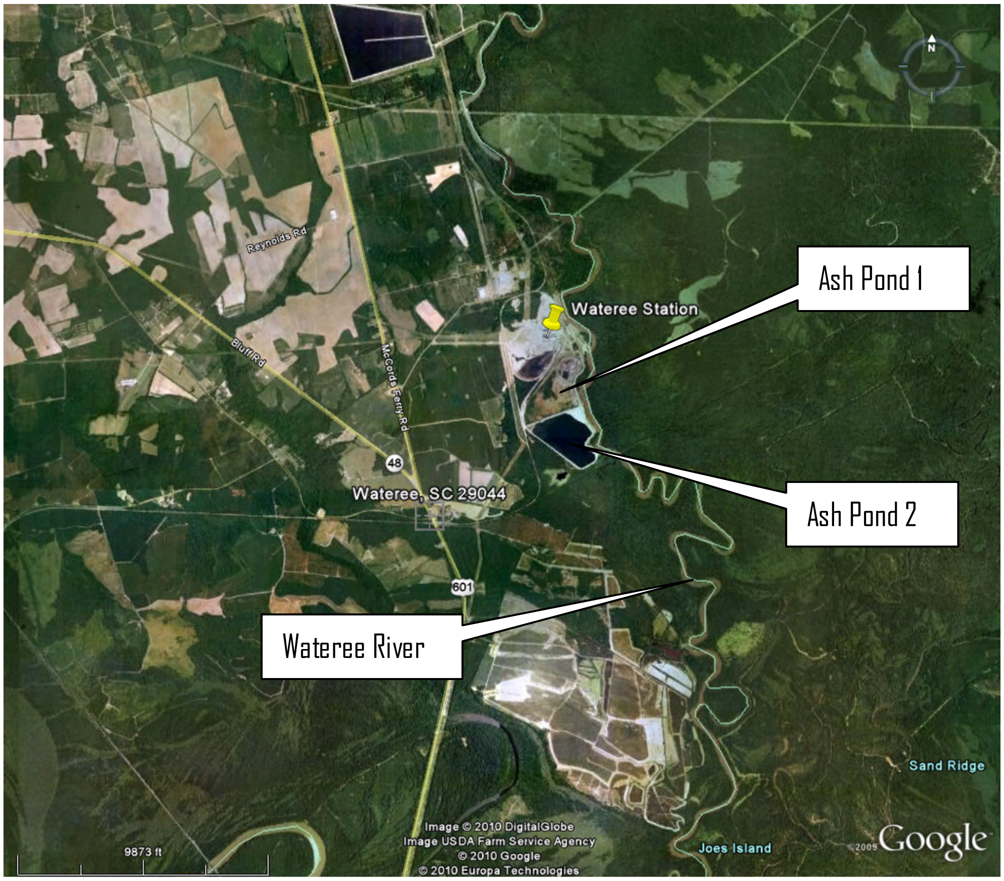


Figure 2.1 b: Wateree Station Aerial View

2.2 SIZE AND HAZARD CLASSIFICATION

Ash Pond 1 - The ash pond is impounded by an earthen embankment system consisting of a combination of an incised and diked configuration. The majority of Ash Pond 1 is incised with the exception of the internal dike. The internal dike separates Ash Pond 1 from Ash Pond 2 (See Figure 2.2 or Appendix A, Doc 01: Plan View (Spatial Data).pdf). Based on data provided by South Carolina Electric & Gas Company (SCE&G), the ash pond embankment system was originally constructed in 1970 to a maximum height of 21 feet, with upstream and downstream slopes of 2(H):1(V) and a minimum crest width of approximately 20 feet. Ash Pond 1 is assumed to be completely full of ash according to a hydrologic and hydraulic study provided by SCE&G dated October 2006 (see Appendix A Doc: 02 Hydraulic Analysis.pdf). At normal pool (104.7'), the impoundment capacity is 2,000,000 cubic yards (1,240 acre-feet) and at the maximum pool (106.0'), the impoundment capacity is 2,260,000 cubic yards (1,401 acre-feet). The classification for size, based on the height of the dam and storage capacity, is Intermediate in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria (see Table 2.2a for size classification criteria).

Ash Pond 2 - The ash pond is impounded by an earthen embankment system consisting of a combination of an incised and diked configuration. There is one internal dike that separates Ash Pond 1 from Ash Pond 2 (See Figure 2.2 or Appendix A, Doc 01: Plan View (Spatial Data).pdf). Ash Pond 2 is downstream of Ash Pond 1, which is full, therefore Ash Pond 2 receives a majority if not all of the wastewater flow into Ash Pond 1. Based on data provided by South Carolina Electric & Gas Company (SCE&G), the ash pond embankment system was originally constructed in 1970 to a maximum height of 21 feet, with upstream and downstream slopes of 2(H):1(V) and a minimum crest width of approximately 20 feet. Ash Pond 2 has an estimated remaining volume of 306 million gallons (940 acre-feet) as discussed in a report provided by SCE&G dated October 2006 (see Appendix A Doc: 02 Hydraulic Analysis.pdf). At normal pool (103.7'), the impoundment capacity is 1,871,000 cubic yards (1,160 acre-feet) and at the maximum pool (107.0'), the impoundment capacity is 2,279,000 cubic yards (1,413 acre-feet). The classification for size, based on the height of the dam and storage capacity, is Intermediate in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria (see Table 2.2a for size classification criteria).

During the initial site visit, the flue-gas desulfurization (FGD) ponds and the landfill ponds were observed. No documentation was provided on these units. These newly constructed ponds were assumed to meet local codes and standards. There were no indications of any safety concerns for these units.

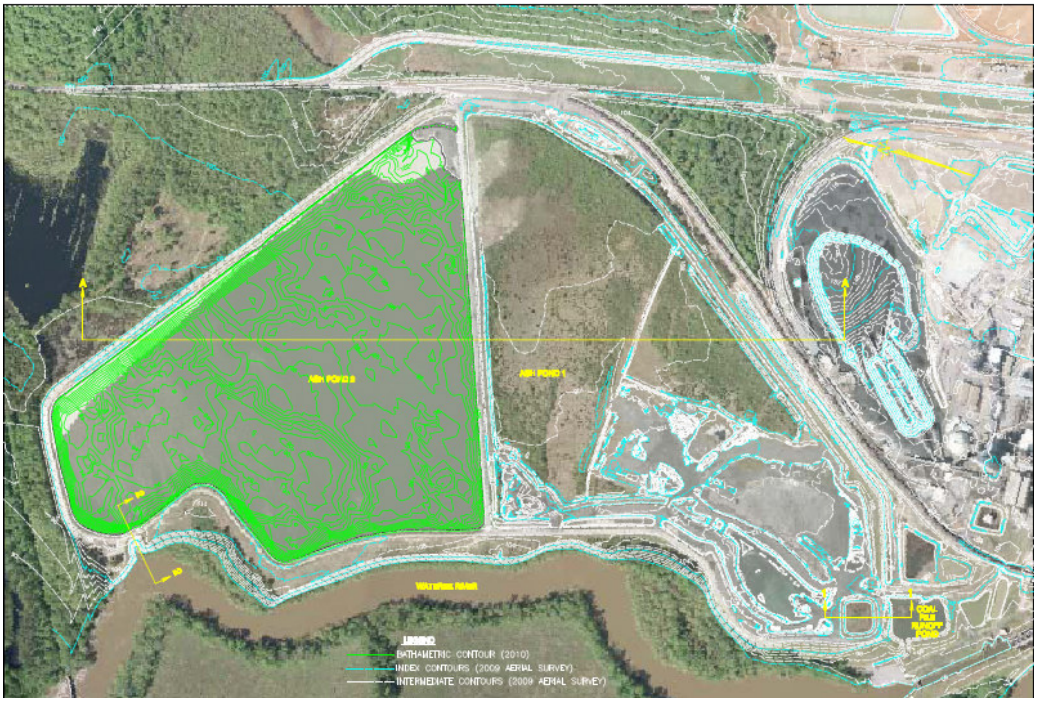


Figure 2.2: Ash Pond 1 & 2 Plan View

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

Table 2.2b: Summary of Dam Dimensions and Size		
	Ash Pond 1	**Ash Pond 2**
Dam Height (ft)	21	20
Crest Width (ft)	20 (Min)	20 (min)
Length (ft)	Not Listed	Not Listed
Side Slopes (upstream) H:V	2(H):1(V)	2(H):1(V)
Side Slopes (downstream) H:V	2(H):1(V)	2(H):1(V)
Hazard Classification	Low	Low

Ash Pond 1 & 2 - A Hazard Classification has not been assigned by a regulatory agency, but based on observations, a classification of **Low** appears to be appropriate. Per the Federal Guidelines for Dam Safety dated April 2004, a Low Hazard Potential classification applies to those dams where failure or mis-operation results in no probable loss of human life and/or environmental losses. Losses are principally limited to the owner's property. Considering the low probability of loss of life and/or environmental losses, should the fly ash dam system fail, a Federal Hazard Classification of **Low** appears to be appropriate for this facility (see Table 2.2c for Hazard classification criteria).

Table 2.2c FEMA Federal Guidelines for Dam Safety Hazard Classification		
Hazard Potential 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 this classification)

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

Ash Pond 1 - Per the South Carolina Department of Health & Environmental Control (SCDHEC) Permit issued August 29, 2008 (See Appendix A, Doc 03: NPDES Permit.pef), the ash ponds may receive the following wastewaters: cooling tower blowdown, low volume wastes, ash transport wastewaters, landfill runoff/leachate, coal pile runoff, miscellaneous power plant wastewaters, and storm water. Documentation was provided stating Ash Pond 1 occupies 80.65 acres. The drainage area is assumed to be the surface area of the pond. The maximum design storage capacity for Ash Pond 1 is approximately 2,260,000 cubic yards (1,401 acre-feet).

Ash Pond 2 - Per the SCDHEC Permit issued August 29, 2008 (See Appendix A, Doc 03: NPDES Permit.pef) Ash Pond 2 occupies 76.6 acres. The drainage area is assumed to be the surface area of the pond. The maximum design storage capacity is approximately 2,279,000 cubic yards (1,413 acre-feet).

Table 2.3: Amount of Residuals and Maximum Capacity of Unit*

	Ash Pond 1*	Ash Pond 2
Surface Area (acre)	80.65	76.6
Current Storage Volume (acre-feet)	1,240	1,160
Max. Design Storage Capacity (acre-feet)	1,401	1,413

* Ash Pond 1 is assumed to be full

2.4 PRINCIPAL PROJECT STRUCTURES

2.4.1 Earth Embankment Dam

Ash Pond 1 - The original materials used for construction of the ash pond were not provided. Ash Pond 1 is mostly incised and therefore any failure in the structure would not result in a release. (See Appendix A, Doc 05: Structural Report and Analysis).

Ash Pond 2 - The original materials used for construction of the ash pond were not provided. Geotechnical results show that the constructed embankment around Ash Pond 2 consists of mostly densely compacted clayey soils. (See Appendix A, Doc 05: Structural Report and Analysis).

2.4.2 Outlet Structures

Ash Pond 1 – The outlet conduit is a 24-inch diameter corrugated metal pipe which discharges into Ash Pond 2. At the time of the inspection the outlet structure was not accessible.

Ash Pond 2 – The outlet conduit is a 36-inch diameter reinforced concrete pipe. The pipe discharges into a Parshall Flume which then flows into the Wateree River.

2.5 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

All critical infrastructures were located using aerial photography and might not accurately represent what currently exists down-gradient of the site. No critical infrastructures are within 5 miles downstream of the Wateree Station were located according the aerial map below. Figure 2.5 shows aerial photography of the Wateree Station. A map showing a 5 mile radius provided by SCE&G can be found in Appendix A, Doc 10: 5 Mile Radius Downstream Map.pdf.

Figure 2.5: Wateree Station Critical Infrastructure Map

3.0 SUMMARY OF RELEVANT REPORTS, PERMITS AND INCIDENTS

3.1 SUMMARY OF REPORTS ON THE SAFETY OF THE MANAGEMENT UNIT(S)

SCE&G is implementing monthly and annual inspections as of July 2010. No reports or inspection reports were provided.

3.2 SUMMARY OF LOCAL, STATE AND FEDERAL ENVIRONMENTAL PERMITS

The Ash Pond facility is under regulation by the South Carolina Department of Health & Environmental Control. The discharges of the Ash Pond are permitted under the Federal National Pollutant Discharge Elimination System Permit (Permit # SC0002038).

3.3 SUMMARY OF SPILL/RELEASE INCIDENTS (IF ANY)

No spills or releases from the Ash Pond facilities have been noted by SCE&G for this site.

4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

4.1 SUMMARY OF CONSTRUCTION HISTORY

4.1.1 Original Construction

Ash Pond 1 - Original construction information was not provided for this facility. To the best of SCE&G's knowledge, the facility was constructed in 1970.

Ash Pond 2 - Original construction information was not provided for this facility. To the best of SCE&G's knowledge, the facility was constructed in 1970.

4.1.2 Significant Changes/Modifications in Design since Original Construction

Ash Pond 1 – No significant changes/modifications were noted for Ash Pond 1.

Ash Pond 2 – No significant changes/modifications were noted for Ash Pond 2.

4.1.3 Significant Repairs/Rehabilitation since Original Construction

No significant repairs/rehabilitation information was provided on Ash Pond 1 or Ash Pond 2 other than the riverbank stabilization described below.

A riverbank stabilization occurred onsite to protect the ash pond facility (which includes Ash Ponds 1 & 2). Approximately 2,000 LF of riverbank was stabilized which also included adding fill along the embankment at Ash Pond 1. See Figure 4.1.3 below and Appendix A, Doc 06: Riverbank Stabilization Project.pdf for the complete documents.

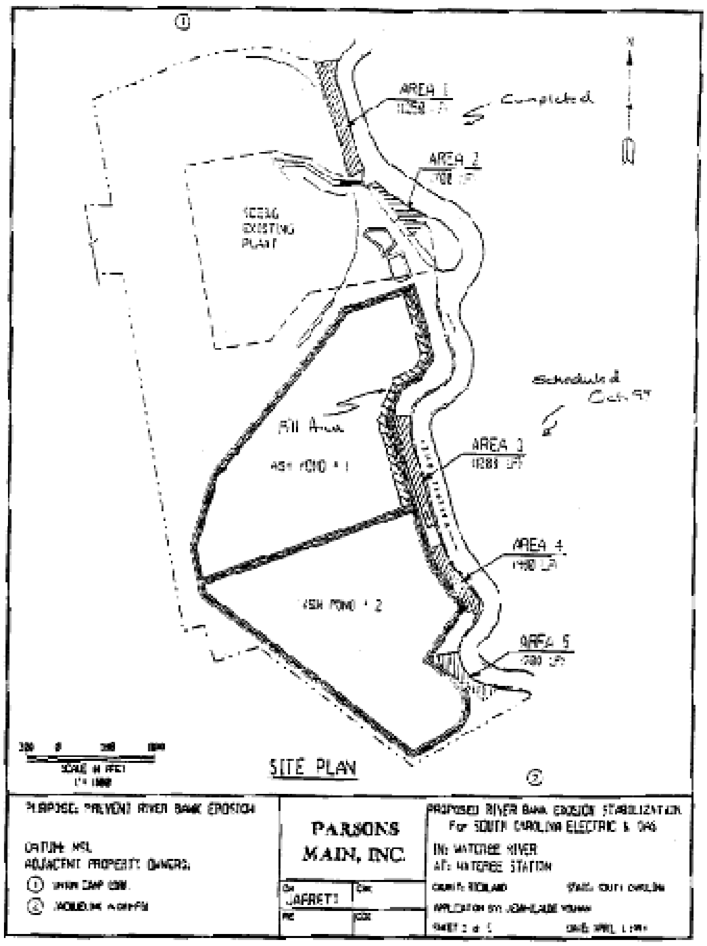


Figure 4.1.3: Riverbank Stabilization

4.2 SUMMARY OF OPERATIONAL HISTORY

4.2.1 Original Operational Procedures

Ash Pond 1 and Ash Pond 2 – Based upon information provided and discussions with plant personnel, operational procedures have not changed and the original operation procedures are the same as the current ones (See 4.2.3).

4.2.2 Significant Changes in Operational Procedures since Original Startup

Ash Pond 1 and Ash Pond 2 - No documentation was provided describing any significant changes in Operating Procedures.

4.2.3 Current Operational Procedures

Ash Pond 1 - The ash pond collects and stores cooling tower blowdown, low volume wastes, ash transport wastewaters, landfill runoff/leachate, coal pile runoff, miscellaneous power plant wastewaters and storm water and discharges through a 24” outlet into Ash Pond 2.

Ash Pond 2 - The ash pond collects and stores effluent from Ash Pond 1 and discharges through a 36” outlet into the Wateree River.

4.2.4 Other Notable Events since Original Startup

Ash Pond 1 - No additional information was provided.

Ash Pond 2 - No additional information was provided.

5.0 FIELD OBSERVATIONS

5.1 PROJECT OVERVIEW AND ASSESSMENT

Dewberry personnel Frederic Shmurak, PE and Justin Story, EIT performed a site visit on Monday, June 28, 2010. The site visit began at 10:00 AM. Weather was clear, hot and humid. The overall visual assessment of the ash pond embankments were that they are in satisfactory condition, but some minor maintenance items need to be addressed. Coal Combustion Dam Inspection Checklists created on June 28, 2010, by the two assessment engineers for the Wateree Station ash ponds are provided in Appendix B, Documents 1 and 2. Photographs from the site visit are provided in Appendix B, Document 4.

5.2 EARTH EMBANKMENT DAM

5.2.1 Crest

Ash Pond 1 - The crest was covered by a graded aggregate base material. The crest had no significant signs of any rutting, depressions, tension cracks or other indications of settlement or shear failure, and appeared to be in satisfactory condition.

Ash Pond 2 - The crest was covered by a graded aggregate base material. The crest had no significant signs of any rutting, depressions, tension cracks or other indications of settlement or shear failure, and appeared to be in satisfactory condition. There were pot-holes holding water which required routine maintenance, but was not a current safety hazard.

Figure 5.2.1: Ash Pond 2 Crest – Water Ponding

5.2.2 Upstream Slope

Ash Pond 1 – The upstream slopes are mostly vegetated with tall grasses and other wetland vegetation. No scarps, sloughs, depressions, bulging or other indications of slope instability or signs of erosion were observed. Ash Pond 1 is at full capacity and therefore most up the upstream slopes were not observed.

Ash Pond 2 – The upstream slopes are mostly vegetated with tall grasses and other wetland vegetation. No scarps, sloughs, depressions, bulging or other indications of slope instability were observed. Erosion was observed along the upstream slope at the southern embankment which requires maintenance.

Figure 5.2.2: Ash Pond 2 Upstream Slope Erosion

5.2.3 Downstream Slope and Toe

Ash Pond 1 – The downstream slopes are mostly vegetated with tall grasses and other wetland vegetation. No scarps, sloughs, depressions, bulging or other indications of slope instability were observed. Seepage was observed at two areas downstream of Ash Pond 1. From visual observance, flow appeared clear and consistent, but requires further monitoring.

Figure 5.2.3a: Ash Pond 1 Downstream Seepage

Ash Pond 2 - The downstream slopes are mostly vegetated with tall grasses and other wetland vegetation. No scarps, sloughs, depressions, bulging or other indications of slope instability were observed. Pine trees (less than 2" in diameter) were observed along the downstream slope and toe. This is not a safety hazard, but vegetation needs to be routinely mowed. Reseeding needs to occur in areas where vegetation is bare (see Figure 5.2.3b).

Figure 5.2.3b: Ash Pond 2 Downstream Slope

5.2.4 Abutments and Groin Areas

The ash pond embankment consists of a combination of a dike and incised system; therefore the earthen embankment does not abut existing hillsides, rock outcrops or other raised topographic features.

5.3 OUTLET STRUCTURES

5.3.1 Overflow Structure

Ash Pond 1 – No overflow structure is present.

Ash Pond 2 - The outlet structure was properly discharging flow from the pond and visually appeared to be in good condition.

5.3.2 Outlet Conduit

Ash Pond 1 - The outlet structure was not accessible and therefore not observed.

Ash Pond 2 - The visual portion of the outlet conduit was functioning properly with no apparent deterioration.

Figure 5.3.2: Ash Pond 2 Discharge into Wateree River

5.3.3 Emergency Spillway (If Present)

Ash Pond 1 - No emergency spillway is present. Overflow would overtop the interior dike and flow into Ash Pond 2.

Ash Pond 2 – The impoundment's spillway consists of two 42-inch diameter corrugated metal pipes and no problems were observed.

5.3.4 Low Level Outlet

Ash Pond 1 - No low level outlet is present.

Ash Pond 2 - No low level outlet is present.

6.0 HYDROLOGIC/HYDRAULIC SAFETY

6.1 SUPPORTING TECHNICAL DOCUMENTATION

6.1.1 Floods of Record

Ash Pond 1 - No information was provided. The ash pond is a diked embankment facility having a contributing drainage area equal to the surface area of the impoundment; therefore the impounded pool would not be anticipated to experience significant flood stages.

Ash Pond 2 - No information was provided. The ash pond is a diked embankment facility having a contributing drainage area equal to the surface area of the impoundment; therefore the impounded pool would not be anticipated to experience significant flood stages.

6.1.2 Inflow Design Flood

According to FEMA Federal Guidelines for Dam Safety, the current practice in the design of dams is to use the Inflow Design Flood (IDF) that is deemed appropriate for the hazard potential of the dam and reservoir, and to design spillways and outlet works that are capable of safely accommodating the floodflow without risking the loss of the dam or endangering areas downstream from the dam to flows greater than the inflow. The recommended IDF or spillway design flood for a low hazard, intermediate sized structure (See section 2.2), in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria is the 100-yr to ½ PMF (See Table 6.1.2).

Table 6.1.2: USACE Hydrologic Evaluation Guidelines
Recommended Spillway Design floods

Hazard	Size	Spillway Design Flood
Low	Small	50 to 100-yr frequency
	Intermediate	100-yr to ½ PMF
	Large	½ PMF to PMF
Significant	Small	100-yr to ½ PMF
	Intermediate	½ PMF to PMF
	Large	PMF
High	Small	½ PMF to PMF
	Intermediate	PMF
	Large	PMF

The Probable Maximum Precipitation (PMP) is defined by American Meteorological Society as the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year. The National Weather Service (NWS) further states that in consideration of our limited knowledge of the complicated processes and interrelationships in storms, PMP values are identified as estimates. The NWS has published application procedures that can be used with PMP estimates to develop spatial and temporal characteristics of a Probable Maximum Storm (PMS). A PMS thus developed can be used with a precipitation-runoff simulation model to calculate a probable maximum flood (PMF) hydrograph.

In a hydrologic and hydraulic analysis report dated October 2006, it was stated the existing ash ponds will handle the 10-year, 24-hour rainfall event. The detention time for the ponds under this event is approximately 8 days and as the report states, the pond volume “significantly exceeds” the daily flow rate for a 10 year, 24-hour rainfall event. The 10-year, 24-hour rainfall event at the Wateree Station was deemed to be 6.25 inches. (See Appendix A, Doc 02: Hydraulic Analysis).

Ash Pond 1 - During this event Ash Pond 1 would rise approximately 10 inches above Ash Pond 2, and the freeboard available from the maximum pool (elevation 106.0’) to the dam crest (elevation 108.0’) is 2.0’. The typically freeboard from the normal pool (elevation 104.0’) to the dam crest is 4.0’ (See Appendix A, Doc 07: Ash Pond 1.pdf). The PMP 6-hour, 10 square mile rainfall depth is 30.5 inches. Adequate freeboard exists to store the PMP event.

Ash Pond 2 – There is approximately 1.0’ feet of freeboard available from the maximum pool (elevation 107.0’) and the dam crest (elevation 108.0’). The typically freeboard from the normal pool (elevation 103.7’) to the dam crest is 4.3’ (See Appendix A, Doc 08: Ash Pond.pdf). The PMP 6-hour, 10 square mile rainfall depth is 30.5 inches. Adequate freeboard exists to store the PMP event.

6.1.3 Spillway Rating

Ash Pond 1 - No spillway rating was provided. The Fly Ash Pond is a diked embankment facility having a contributing drainage area equal to the surface area of the impoundment; therefore the impounded pool would not be anticipated to experience significant changes in elevation. The outlet structure type is unregulated and, given little change in the normal pool elevation, the resulting discharge rate is expected to be relatively constant.

Ash Pond 2 - No spillway rating was provided. The Fly Ash Pond is a diked embankment facility having a contributing drainage area equal to the surface area of the impoundment; therefore the impounded pool would not be anticipated to experience significant changes in elevation. The outlet structure type is unregulated and, given little change in the normal pool elevation, the resulting discharge rate is expected to be relatively constant.

6.1.4 Downstream Flood Analysis

Ash Pond 1 and Ash Pond 2 - No downstream flood analyses were provided.

6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Ash Pond 1 and Ash pond 2 - Supporting technical documentation is sufficient.

6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

Ash Pond 1 - Adequate capacity and freeboard exists to safely pass the design storm.

Ash Pond 2 - Adequate capacity and freeboard exists to safely pass the design storm.

7.0 STRUCTURAL STABILITY

7.1 SUPPORTING TECHNICAL DOCUMENTATION

7.1.1 Stability Analyses and Load Cases Analyzed

A stability analysis report for the ash pond dated June 22, 2010, by F&ME Consultants for SCE&G, provides information on the stability analysis results and is presented in Section 7.1.4 Factors of Safety and Base Stresses. Both steady state (normal) loading and earthquake loading conditions were analyzed. See Appendix A (Doc 05: Structural Report and Analysis.pdf) for the complete report.

7.1.2 Design Properties and Parameters of Materials

A report for the Wateree Station ash ponds was prepared by F&ME Consultants in 2010. The 2010 Engineering Report includes documentation of the shear strength design properties for the ash pond embankments. The documentation is included within the drawings (an example is presented in the following section); see Appendix A (Doc 09: Embankment Cross Sections.pdf) for the full size drawings.

The strength parameters of the embankments are presented below. The results present generally acceptable values for these types of materials.

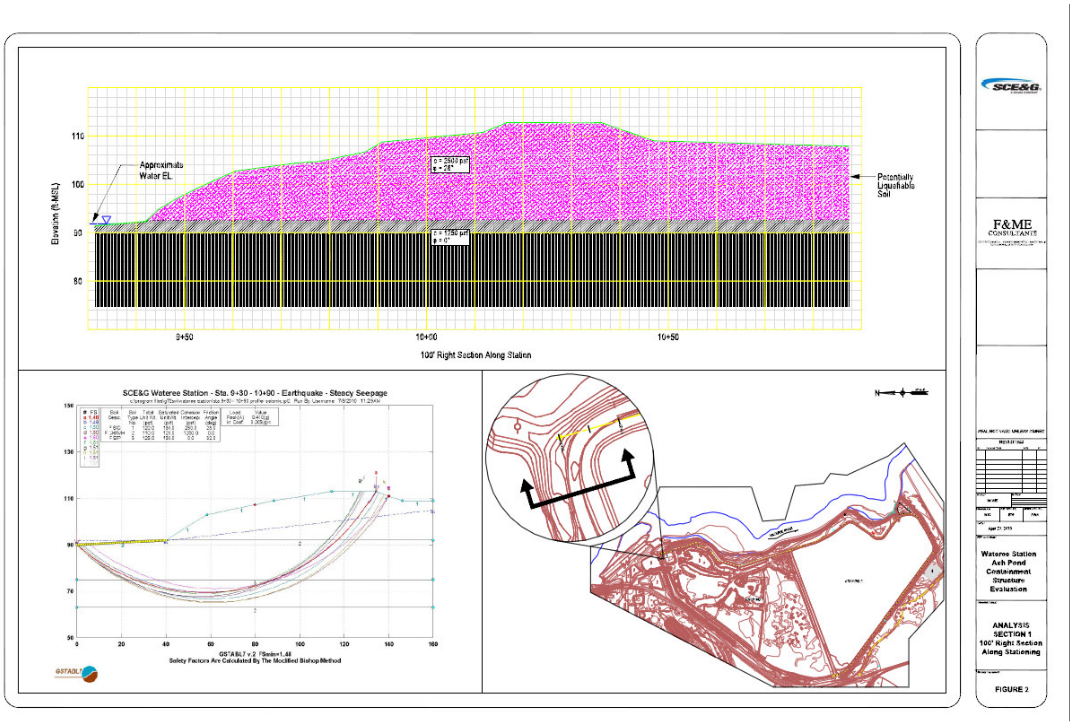


Figure 7.1.2: Embankment Cross Section

7.1.3 Uplift and/or Phreatic Surface Assumptions

Monitoring instrumentation devices have not been installed to verify water levels within the embankment. The assumed phreatic surfaces are shown on the figure in section 7.1.2 above and the depiction seems appropriate for these types of structures. No additional information was provided.

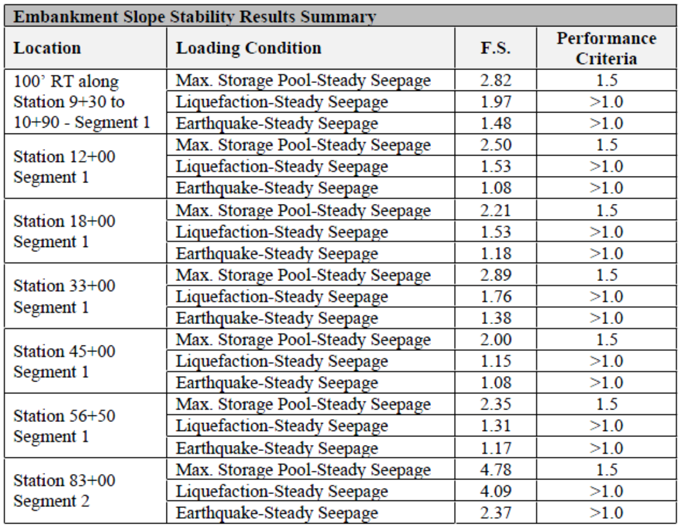
Ash Pond 1 - The normal water level of the pond was stated to be 104.0’. This elevation was not verified.

Ash Pond 2 - The normal water level of the pond was stated to be 103.7’. This elevation was not verified.

7.1.4 Factors of Safety and Base Stresses

A stability analysis report for the ash pond dated June 22, 2010, by F&ME Consultants, provides information on the factors of safety and comments on that information as presented below. See Appendix A (Doc 5: Structural Analysis and Report.pdf) for the complete report.

Table 7.1.4: Factors of Safety



Embankment Slope Stability Results Summary

Location	Loading Condition	F.S.	Performance Criteria
100’ RT along Station 9+30 to 10+90 - Segment 1	Max. Storage Pool-Steady Seepage	2.82	1.5
	Liquefaction-Steady Seepage	1.97	>1.0
	Earthquake-Steady Seepage	1.48	>1.0
Station 12+00 Segment 1	Max. Storage Pool-Steady Seepage	2.50	1.5
	Liquefaction-Steady Seepage	1.53	>1.0
	Earthquake-Steady Seepage	1.08	>1.0
Station 18+00 Segment 1	Max. Storage Pool-Steady Seepage	2.21	1.5
	Liquefaction-Steady Seepage	1.53	>1.0
	Earthquake-Steady Seepage	1.18	>1.0
Station 33+00 Segment 1	Max. Storage Pool-Steady Seepage	2.89	1.5
	Liquefaction-Steady Seepage	1.76	>1.0
	Earthquake-Steady Seepage	1.38	>1.0
Station 45+00 Segment 1	Max. Storage Pool-Steady Seepage	2.00	1.5
	Liquefaction-Steady Seepage	1.15	>1.0
	Earthquake-Steady Seepage	1.08	>1.0
Station 56+50 Segment 1	Max. Storage Pool-Steady Seepage	2.35	1.5
	Liquefaction-Steady Seepage	1.31	>1.0
	Earthquake-Steady Seepage	1.17	>1.0
Station 83+00 Segment 2	Max. Storage Pool-Steady Seepage	4.78	1.5
	Liquefaction-Steady Seepage	4.09	>1.0
	Earthquake-Steady Seepage	2.37	>1.0

7.1.5 Liquefaction Potential

Liquefaction studies were included the report for the ash pond dated June 22, 2010, by F&ME Consultants, See Appendix A (Doc 5: Structural Analysis and Report.pdf) for the complete report.

The report concluded that the foundation soil conditions do not appear susceptible to support liquefaction.

The following is directly from the F&ME report with the results of the liquefaction analysis:

> *"We have analyzed the liquefaction potential for the soil mass composing the ash pond containment structure embankments and foundation materials. The general conditions of the soil profile and our findings are as follows:*
>
> - *The solid composing the ash pond containment structure is predominantly low to moderate dense sandy clay underlain by sandy soils. During the seismic design event, these sandy soils have the potential to liquefy.*
> - *Our analysis indicates liquefaction-induced permanent vertical settlements ranging from 0.1 to 3.0 inches, with the average being 1.35 inches.*
> - *For a Magnitude 7.0 (Richter) earthquake event, the farthest documented liquefaction event to the epicenter is about 110 kilometers (approximately 69 miles). The Wateree Station facility is located beyond this distance from the epicenter of the 1886 Charleston earthquake.*
> - *When exposed to the expected seismic event, ground surface ruptures are not likely. Typically, the resulting phenomena will be in the form of small, localized surface depressions.*
>
> *In summary, our data and analysis indicates that detrimental liquefaction will not occur."*

7.1.6 Critical Geological Conditions and Seismicity

Ash Pond 1 & 2: No critical geologic conditions or seismic conditions are present at the site.

A hydrogeologic report by General Engineering dated May 15, 1998 (See Appendix A, Doc: 04 Hydrogeologic Report.pdf) states the following:

Regional Geology and Hydrogeology
Previous regional studies indicate that this area is underlain by Precambrian crystalline basement complex, the Cretaceous age Middendorf and Black Creek formations, and the Paleocene age Black Mingo group, which consists of the Sawdust Landing and Lang Syne Formations. The uppermost soils underlying the site are unconsolidated sediments deposited in the flood plain of the Wateree River.

The regional topography of the area gently slopes toward the Wateree River. The western side of the river is mostly highland in the vicinity of the subject site with numerous tributaries which drain eastward, toward the river. The eastern side of the river is flanked by wetlands with some highland.

Site Geology and Hydrogeology

The uppermost sediments at the site are composed of relatively sandy clay overlain by clay at varying depths across the site. The confining bottom clay is within the Black Mingo Group, and is suspected to be the Sawdust landing Formation. Some isolated occurrences of clean sand are present. These sands are potential preferential pathways for groundwater flow. Groundwater is present from approximately 8 to 23 feet below land surfaces (bls), and the overall groundwater flow is toward the Wateree River.

Based on USGS ground motion map web site, dated 2005, the facility is located in an area anticipated to experience a 0.361g acceleration with a 2-percent probability of exceedance in 50-years.

7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Ash Pond 1 - Original constructions drawings are not available, but the structural stability documentation provided is adequate.

Ash Pond 2 - Original constructions drawings are not available, but the structural stability documentation provided is adequate.

7.3 ASSESSMENT OF STRUCTURAL STABILITY

Ash Pond 1 - The structural stability of the ash pond appears to be satisfactory.

Ash Pond 2 - The structural stability of the ash pond appears to be satisfactory.

Based on the previous assessment reports/inspections provided by SCE&G, this assessment of the ash ponds is consistent with historical observations.

8.0 MAINTENANCE AND METHODS OF OPERATION

8.1 OPERATIONAL PROCEDURES

Ash Pond 1 and Ash Pond 2 - Operational procedures are adequate

8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

Ash Pond 1 and Ash Pond 2 – Maintenance of the dam and project facilities is adequate, although a few maintenance items need to be addressed.

8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATION

8.3.1 Adequacy of Operational Procedures

Operational procedures are adequate.

8.3.2 Adequacy of Maintenance

The current maintenance procedures are inadequate to maintain the ponds and dike system so that dike material is not released to the environment. A better program needs to be set in place.

9.0 SURVEILLANCE AND MONITORING PROGRAM

9.1 SURVEILLANCE PROCEDURES

Ash Pond 1 & 2 – Monthly and Annual inspections will begin in July of 2010. The program is newly implemented, therefore no previous reports have been provided.

9.2 INSTRUMENTATION MONITORING

9.2.1 Instrumentation Plan

Ash Pond 1 and Ash Pond 2 - This facility does not have an instrumentation program.

9.2.2 Instrumentation Monitoring Results

Not applicable

9.2.3 Evaluation

Not applicable

9.3 ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM

9.3.1 Adequacy of Inspection Program

Ash Pond 1 and Ash pond 2 - Newly Implemented Inspection program is adequate.

.

9.3.2 Adequacy of Instrumentation Monitoring Program

Not applicable

ATTACHMENT 1

1.1) FIGURE 1, SPATIAL DATA, ASH POND 1 AND ASH POND 2

ASH PONDS 1 AND ASH POND 2

1"= 200' HOR

GENERAL NOTES

1) AERIAL IMAGE AND EXISTING GROUND TOPOGRAPHIC INFORMATION FROM AERIAL TOPOGRAPHIC SURVEY PERFOMED APRIL 19, 2009
HORIZONTAL DATUM: NAD 83 SC STATE PLANE ZONE 3900 (IFT)
VERTICAL DATUM: NAVD '88

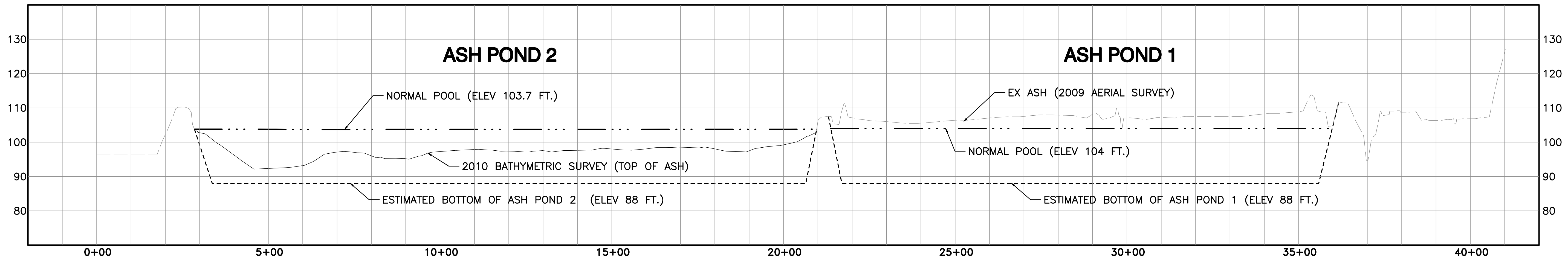
2) BATHYMETRIC SURVEY PERFORMED BY WHITWORTH & ASSOCIATES, INC. MARCH 24, 2010

ASH POND 1 NOTES

1) NORMAL POOL ELEVATION = ELEV 104 FT. IMPOUNDMENT CAPACITY BETWEEN NORMAL POOL (ELEV 104 FT) AND ESTIMATED BOTTOM (ELEV 88 FT) IS 2,000,000 CYDS
2) MAXIMUM POOL ELEVATION = ELEV 106 FT. IMPOUNDMENT CAPACITY BETWEEN MAXIMUM POOL (ELEV 106 FT) AND ESTIMATED BOTTOM (ELEV 88 FT) IS 2,265,000 CYDS
3) THE IMPOUNDMENT SUFACE AREA AT NORMAL POOL (ELEV 104 FT) IS 80.65 ACRES.
4) ASH POND 1 HAS NOT BEEN ASSIGNED A HAZARD CLASSIFICATION BY A REGULATORY AGENCY.
5) FREEBOARD BETWEEN NORMAL POOL (ELEV 104 FT) AND MAXIMUM POOL (ELEV 106) IS 2 FT.
6) THE MAXIMUM DAM HEIGHT IS APPROXIMATELY 21 FT. SEE SECTION 1–1 .
7) THE DAM CREST ELEVATION IS ELEV 108 FT. SEE SECTION 1–1.
8) THE MINIMUM DAM CREST WIDTH IS APPROXIMATELY 20 FT. SEE SECTION 1–1.
9) THE UPSTREAM SLOPE INCLINATION IS APPROXIMATELY 2:1. SEE SECTION 1–1.
10) THE DOWNSTREAM SLOPE INCLINATION IS APPROXIMATLEY 2:1. SEE SECTION 1–1.

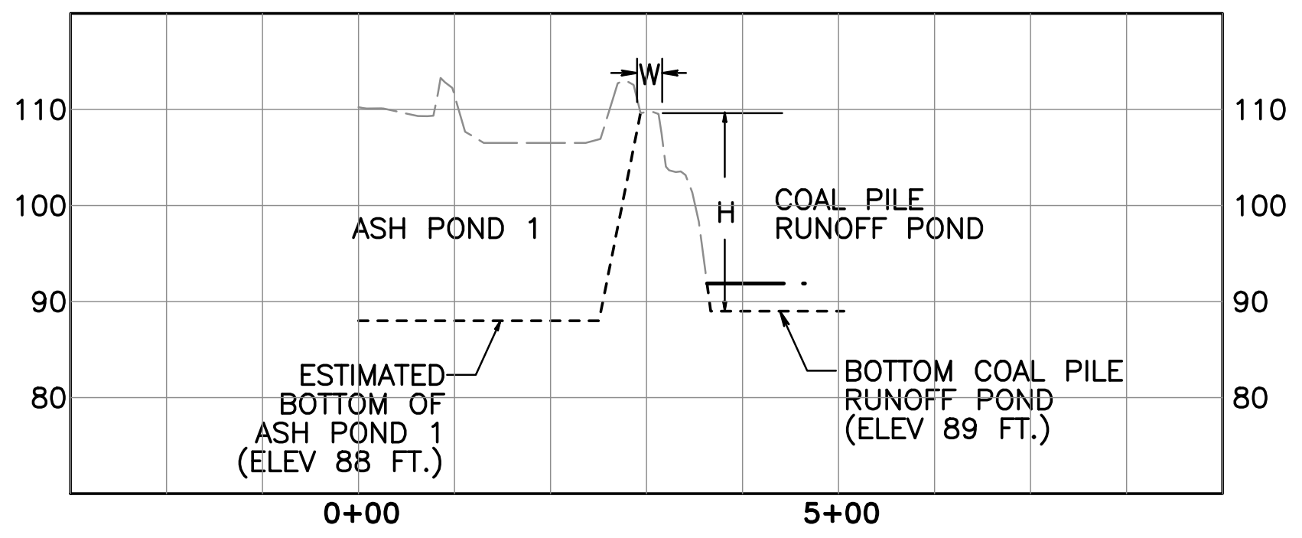
ASH POND 2 NOTES

1) NORMAL POOL ELEVATION = ELEV 103.7 FT. IMPOUNDMENT CAPACITY BETWEEN NORMAL POOL (ELEV 103.7 FT) AND ESTIMATED BOTTOM (ELEV 88 FT) IS 1,871,000 CYDS
2) MAXIMUM POOL ELEVATION = ELEV 107 FT. IMPOUNDMENT CAPACITY BETWEEN MAXIMUM POOL (ELEV 107 FT) AND ESTIMATED BOTTOM (ELEV 88 FT) IS 2,279,000 CYDS
3) THE IMPOUNDMENT SUFACE AREA AT NORMAL POOL (ELEV 103.7 FT) IS 76.6 ACRES.
4) ASH POND 2 HAS NOT BEEN ASSIGNED A HAZARD CLASSIFICATION BY A REGULATORY AGENCY.
5) FREEBOARD BETWEEN NORMAL POOL (ELEV 103.7 FT) AND MAXIMUM POOL (ELEV 107) IS 3.3 FT.
6) THE MAXIMUM DAM HEIGHT AS SEEN ON SECTION 2–2 IS 20 FT.
7) THE DAM CREST ELEVATION IS ELEV 108 FT. SEE SECTION 2–2.
8) THE MINIMUM DAM CREST WIDTH IS APPROXIMATELY 20 FT. SEE SECTION 2–2.
9) THE UPSTREAM SLOPE INCLINATION IS APPROXIMATELY 2:1. SEE SECTION 2–2.
10) THE DOWNSTREAM SLOPE INCLINATION IS APPROXIMATLEY 2:1. SEE SECTION 2–2.



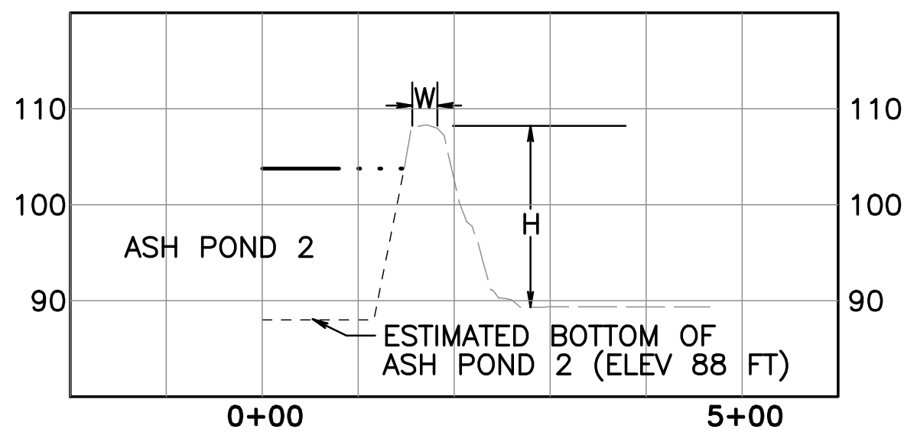
SECTION A-A

1"= 200' HOR
1" = 20' VERT



SECTION 1-1

1"= 200' HOR
1" = 20' VERT



SECTION 2-2

1"= 200' HOR
1" = 20' VERT

SOUTH CAROLINA ELECTRIC & GAS **WATEREE STATION**	**SPATIAL DATA**	**ASH POND 1 AND ASH POND 2**	**FIG #** **1**

ATTACHMENT 5

5.1) POND DETENTION STUDY AND HYDAULIC ANALYSIS, ERM,OCTOBER 2006

South Carolina Electric & Gas Company

Pond Detention Study and Hydraulic Analysis

Wateree Station

Richland County, South Carolina

October 2006

www.erm.com

Delivering sustainable solutions in a more competitive world

South Carolina Electric and Gas Company

Pond Detention Study and Hydraulic Analysis

Wateree Station

Richland County, South Carolina

October 2006

Environmental Resources Management

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1.0 BACKGROUND

The South Carolina Electric & Gas Company's (SCE&G's) Wateree Station, is a two-unit, coal-fired, steam-electric generating facility located on the Wateree River near Eastover, South Carolina in Richland County (see Figure 1). Wastewater discharges from this facility are permitted under NPDES Permit No. SC0002038. SCE&G is also constructing two multi-cell, recirculated cooling towers to replace the once-through cooling system. This project will result in the elimination of NPDES Outfalls 001 and 002, the addition of Outfall 01A (an internal outfall), and an increased discharge flow rate at Outfall 03A.

During the NPDES permit limit modification/renewal for Outfall 03A, the Steam Electric Effluent Guidelines limitations for the coal pile runoff can be developed in several different ways. One way would be to apply flow weighted limits for the wet weather conditions, which could potentially result in two sets of limitations and prove tedious for compliance purposes. Monthly compliance data would have to be separated into two groups for compliance.

Alternatively, a limit for coal pile runoff may not be imposed if it can be shown that adequate treatment is being provided. This is typically demonstrated by showing that there is sufficient detention based on the volume in the treatment pond(s) under worst case conditions (i.e., during a 10-year, 24-hour rain event). If the pond volume exceeds the inflows, then the pond is expected to be adequate to assure compliance with the guideline limitations and preclude washout during wet weather conditions.

Environmental Resources Management (ERM) surveyed the Wateree wastewater ponds, generated a site wastewater plan, evaluated the entire wastewater collection and treatment system, and compiled this report for two purposes.

1. The first purpose of this report is to perform a hydraulic analysis to ensure that all downstream facilities are adequately sized to accommodate the additional flow resulting from the cooling tower (CT) blowdown. (This report may be revised at a later date to consider the future ash landfill runoff.) Based on the proposed location of the cooling tower blowdown line (into the Yard Sump discharge line for transfer to the Ash Ponds), this analysis only includes the overflow structure between Ash Ponds 1 and 2 and the discharge outlet structure at Outfall 03A. It is assumed that the scope of work for the engineering firm that performed the cooling tower

design (Parsons E&C) included ensuring the Yard Sump and associated discharge line could accommodate this additional flow. ERM recommends that SCE&G confirm that the design of the line leading to Ash Pond #1 is sufficiently sized and will not result in an overflow at the Yard Sump due to increased head pressure from the new cooling tower discharge pumps.

2. The second purpose of this report is to serve as a supplement to the SCE&G NPDES permit renewal application previously submitted to the South Carolina Department of Health and Environmental Control (SCDHEC). The supplemental information will be submitted to SCDHEC to document that the combined, required detention volume of the Coal Pile Runoff Pond and the Ash Ponds is available to allow the method for permit limit development to remain as used in previous permits and assure compliance with the federal effluent guideline limitations.

2.0 CURRENT OUTFALL 03A FLOWS (INCLUDING SITE STORM WATER)

As shown in Figure 2, the Ash Ponds, which discharge through Outfall 03A, currently receive wastewater/storm water from the following sources, except those labeled as "future:"

- Coal Pile Runoff Pond
- Unit #1 & #2 Ash Sluice Lines
- Unit #1 & #2 Boiler Sumps (includes the Water Treatment Sump)
- Yard Sump
- Cooling Tower Area Sump (Future)
- Ash Landfill Runoff (Future - not shown)

Though the most recent Form 2C submittal (August 2004) indicated a daily maximum flow of 6.0 million gallons per day (mgd) for Outfall 03A for the combined discharge of these sources, to be conservative, 9.0 mgd was used for the detention time calculations. 9.0 mgd was the daily maximum flow from the 1998 Form 2C and was used for the 1998 pond detention evaluation. Due to the fact that Outfall 03A includes site storm water as well as direct rainfall on the ponds, the 9.0 mgd discharge, which is considerably greater than the monthly average flow rate, possibly occurred during a significant storm event which may have exceeded a 10-year, 24-hour storm. Therefore, the hydraulic analysis conducted by ERM is based upon the addition of the CT Area Sump flow to the 9.0 mgd "process water" flow.

In addition, as shown in the "Wastewater/Storm Water Piping Plan" included as Appendix A, all of the remaining plant site areas drain to sumps or ponds that are pumped to Ash Pond #1. Therefore, the storm water from these areas is included within the pumping capacities of the Cooling Tower Area Sump, Yard Sump, and Coal Pile Runoff Pond, and there was no need to route/model the site storm water runoff and conveyance system to consider peak storm flows as they are "equalized" by these lift stations.

3.0 HYDRAULIC ANALYSIS FOR ADDITIONAL COOLING TOWER (CT) FLOW

As stated previously, due to the addition of wastewater flow from the cooling tower area sump, the maximum flow rate capacity of the overflow structure between Ash Ponds #1 and #2 as well as the Outfall 03A discharge flume were evaluated to insure that their capacities will not be exceeded.

Determination of Additional CT Area Flow

Parsons E&C designed the entire recirculated CT system, and within their calculations, they determined the 10-yr, 24-hr rain event appropriate for the Wateree Station to be 6.25 inches. While the previous detention time certification submitted to SCDHEC in 1998 specified that the 10-yr, 24-hr rainfall for Richland County as 5.7 inches, to be conservative, the 6.25-inch value was used. This storm event resulted in a peak flow velocity of 11.2 cfs (5,100 gpm) which was used to design the CT Area Sump and pumps. Parsons also determined the total volume collected during this storm to be 40,320 cubic feet over a 12-hour period. Refer to Parsons Apron Drainage Plan calculation (WATE-0-DC-048-CE-002) and Process Water Flow Balance (WATE-0-DB-043-001) included in Appendix B. This information was also included in the Final Engineering Report submitted to SCDHEC for approval.

In order to evaluate the additional CT area flow, the total volume of 40,320 cubic feet was doubled to cover a 24-hour period and converted to mgd. This is conservative because the majority of the total flow volume from the 10-yr, 24-hr storm event was determined to occur during a 12-hour period.

40,320 CF per 12 hours X 2 = 80,640 CF per 24 hours
80,640 CF per day = 603,000 gpd

Therefore, the calculations for the total daily flow rate used to perform the hydraulic analysis are as follows:

Plant process and storm water (Unit #1 & #2 Ash Sluice, Unit #1 & #2 Boiler Sumps, Yard Sump and CPR Pond)	9.0 mgd
Cooling Tower Area Sump (Process Wastewater and Storm Water)	0.6 mgd
Total	**9.6 mgd**

Evaluation of Overflow Structure Between Ash Ponds #1 & #2

As shown on Figure 3, the top of the 24-inch (assumed) transfer pipe inside the riser structure within Pond # 1 is submerged. This condition is due to the level within Pond #2 being high enough to back up the equilibrium level in Pond #1. During the site visit, the elevation in Pond #1 was 0.2 feet, or approximately 2.5 inches, higher than in Pond #2. Based on visual observation, we can reasonably assume that the rate of flow between the ponds was 4.4 mgd at that time, which is the average daily flow rate at Outfall 03A. Therefore, the difference in elevation between the ponds can be assumed to represent the head loss for the water flowing from one pond to the next. Based on the estimated maximum flow rate of 9.6 mgd (6,670 gpm), the height of Pond #1 would rise approximately 10 inches (0.83 feet) above the level in Pond #2. This would result in a Pond #1 elevation of approximately 102.83 feet (102.00 feet + 0.83 feet). These estimated elevations presume a linear relationship between the rate of flow and the increase in head, which is reasonable in these circumstances. Therefore, the capability of the 24” pipe to convey the additional flow being transferred from the cooling tower area sump from Pond #1 to Pond #2 is well within the capacity of the pipeline. In addition, the available freeboard within Pond #1 will allow the operating level in Pond #1 to increase and provide the necessary head to transfer the flow into Pond #2.

Evaluation of Outfall 03A Discharge Flume

SCE&G supplied several drawings of the pH adjustment system and discharge at Outfall 03A, and based on those drawings, ERM determined that hydraulically, the Parshall flume, rather than the pH system discharge or the 36-inch pipe beneath the dike, would be the most restrictive component. Based on the drawings supplied by SCE&G (refer to Figure 4), the throat width of the Parshall flume at Outfall 03A was determined to be 18 inches. Based on this size flume, the maximum flow capacity is 15.9 mgd (refer to flume discharge tables within Appendix C). When compared to the maximum calculated flow rate of 9.6 mgd, the flume should have more than enough capacity to effectively measure the discharge flow.

4.0 POND VOLUMES

Ash Pond #1 is assumed to be completely full of ash; therefore, detention for the coal pile runoff at NPDES Outfall 03A is provided primarily by Ash Pond #2, though a much smaller detention volume is also provided by the Coal Pile Runoff (CPR) Pond. As shown in Appendix A, all of the runoff from the coal pile area enters the CPR Pond at two locations. The level within the CPR Pond is maintained by a pump station automatically started/stopped by level controls.

In order to determine the detention volume available within the CPR Pond and the Ash Ponds, ERM performed bathymetric surveys of all the wastewater and storm water ponds to obtain the water volumes between water surface and top of sediment. The data was collected using a level, a boat, a depth finder, and a hand-held Global Positioning Station (GPS). The water surface was used as the benchmark elevation for each pond. All of the resulting data was transferred to a three-dimensional mapping/volume calculation program (Surfer$^{(R)}$ Version 7 - Sep 6, 2001). Figures 5 and 6 include graphical representations of the bathymetric surveys as well as the associated volume calculations generated by Surfer for the CPR Pond and Ash Pond #2. Note that while the acreage for Ash Pond #2 was calculated to be 78.5 acres, the previous 80-acre value from the 1998 report was used. Also, though not included within this report, the detention volumes of several smaller ponds which discharge to the CPR Pond, but do not contain coal pile runoff, were also surveyed. Table 4-1 below summarizes the data.

Table 4- 1 Pond Volumes
SCE&G – Wateree Station
Richland County, SC

Pond	**Area (ac)**	**Average Depth (ft)**	**Modeled Volume (million-cf)**	**Modeled Volume (mg)**
CPR Pond	1.5	3	0.19	1.4
Ash Pond 1	80	0*	-	-
Ash Pond 2	80	12	40.9	306
Total				**307**

* *Though some detention volume is available, it is assumed to be zero.*

5.0 *COAL PILE RUNOFF DETENTION TIME*

Direct Storm Water Flows

As stated above, the 9.0 mgd maximum measured discharge value at Outfall 03A likely included a significant storm water contribution from the plant site and from rainfall directly on the ponds. Regardless, for determining the coal pile runoff detention time, the flow resulting from the rain falling directly on the wastewater ponds (refer to Table 5-1) was considered separate from and added to the 9.0 mgd maximum discharge flow rate. This approach is additionally conservative because it does not consider equalization of the storm surge within the ash ponds and assumes all of the storm water falling on Ash Pond #1, which is almost completely full of ash, runs off the ash and reaches the outfall. This methodology was utilized to parallel the approach used within the previous certification submitted to SCDHEC December 1998.

Table 5-1 ***Direct Rainfall Volume Calculations***
SCE&G – Wateree Station
Richland County, SC

Pond	**Area (ac)**	**Direct Rainfall[*] (ft)**	**Flow (ac-ft/day)**	**Flow (mgd)**
CPR Pond	1.5	0.52	0.78	0.25
Ash Pond 1	80	0.52	41.7	13.6
Ash Pond 2	80	0.52	41.7	13.6
Total				**27.5**

[*] *Based on a 10-year, 24-hour storm event of 6.25 inches*

Therefore, the calculations for the total daily flow rate used to determine the detention time are as follows:

Plant process and storm water (Unit #1 & #2 Ash Sluice, Unit #1 & #2 Boiler Sumps, Yard Sump and CPR Pond)	9.0 mgd
Cooling Tower Area Sump (Process Wastewater and Storm Water)	0.6 mgd
Direct Rainfall on Ponds (CPR Pond and Ash Ponds #1 & #2)	27.5 mgd
Total	**37.1 mgd**

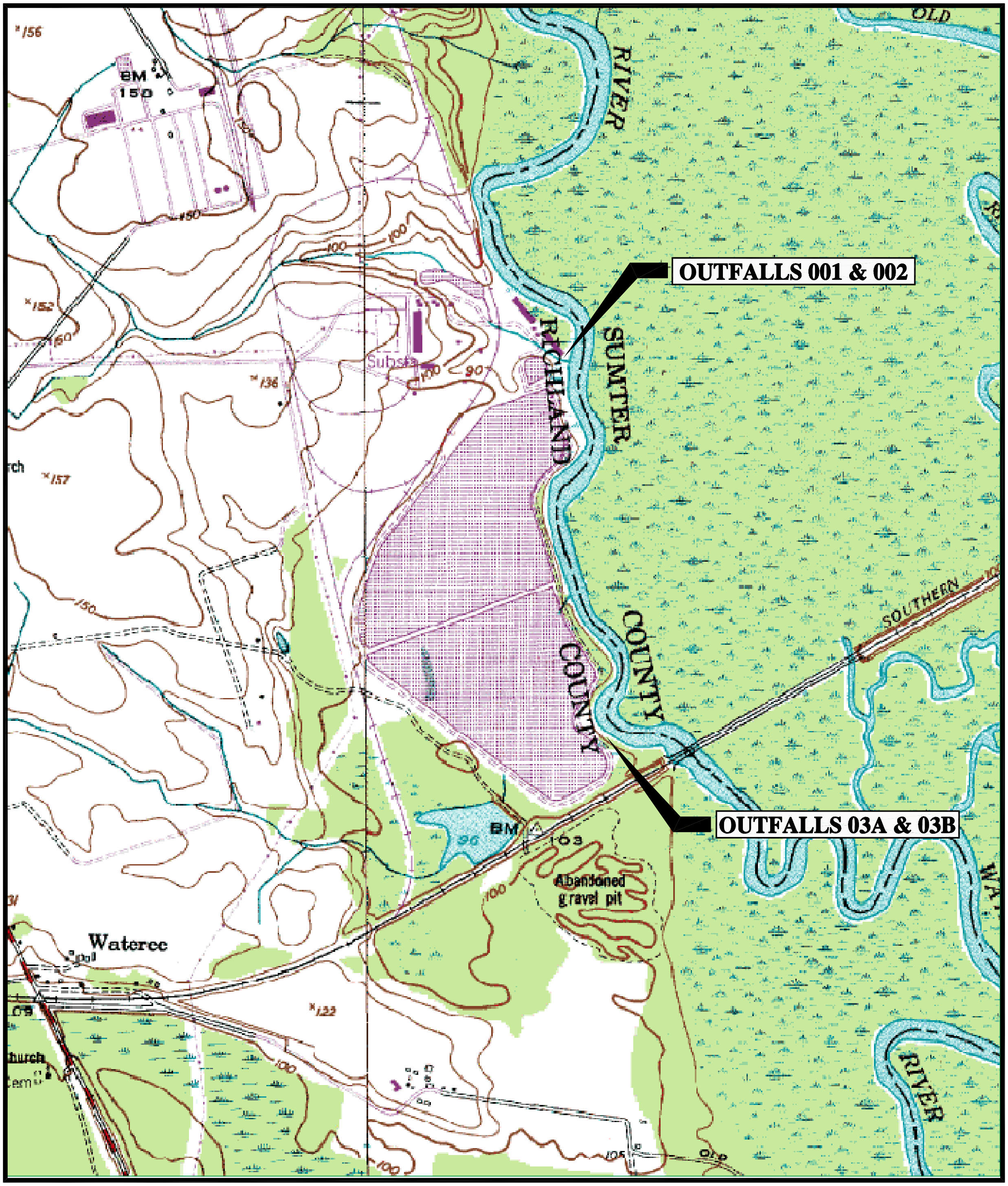
Therefore, the total available detention time for the coal pile runoff is:

$T_d = V_{ponds}/Q_{in}$ = (307 mg)/(37.1 mgd) = 8.3 days.

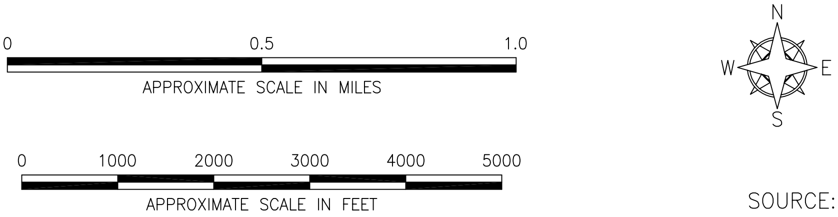
Based on the (very conservative) calculated detention time of approximately eight days under worst-case conditions (i.e., during a 10-year, 24-hour storm event), the pond volume significantly exceeds the daily flow rate. Therefore, the coal pile runoff detention time will be more than adequate to assure compliance with the guideline limitations and preclude washout of the coal pile runoff during wet weather conditions. Therefore, an internal outfall and discharge limitations for coal pile runoff are not required for the coal pile runoff.

(For reference, the previous permit rationale and an SCE&G letter dated September 26, 1998, indicated that the available treatment volume of the ponds was 363 million gallons (mg), while the coal pile runoff was estimated at 7.2 mg and the direct rainfall was estimated to be 27.1 mg).

Figures



APPROXIMATE
QUADRANGLE LOCATION



SOURCE:
U.S. Geological Survey
Poinsett State Park, SC (1983)
7.5 Minute Series (Topographic)

PREPARED FOR:

A SCANA COMPANY

SITE LOCATION MAP

WATEREE STATION

WATEREE, SOUTH CAROLINA

PREPARED BY:

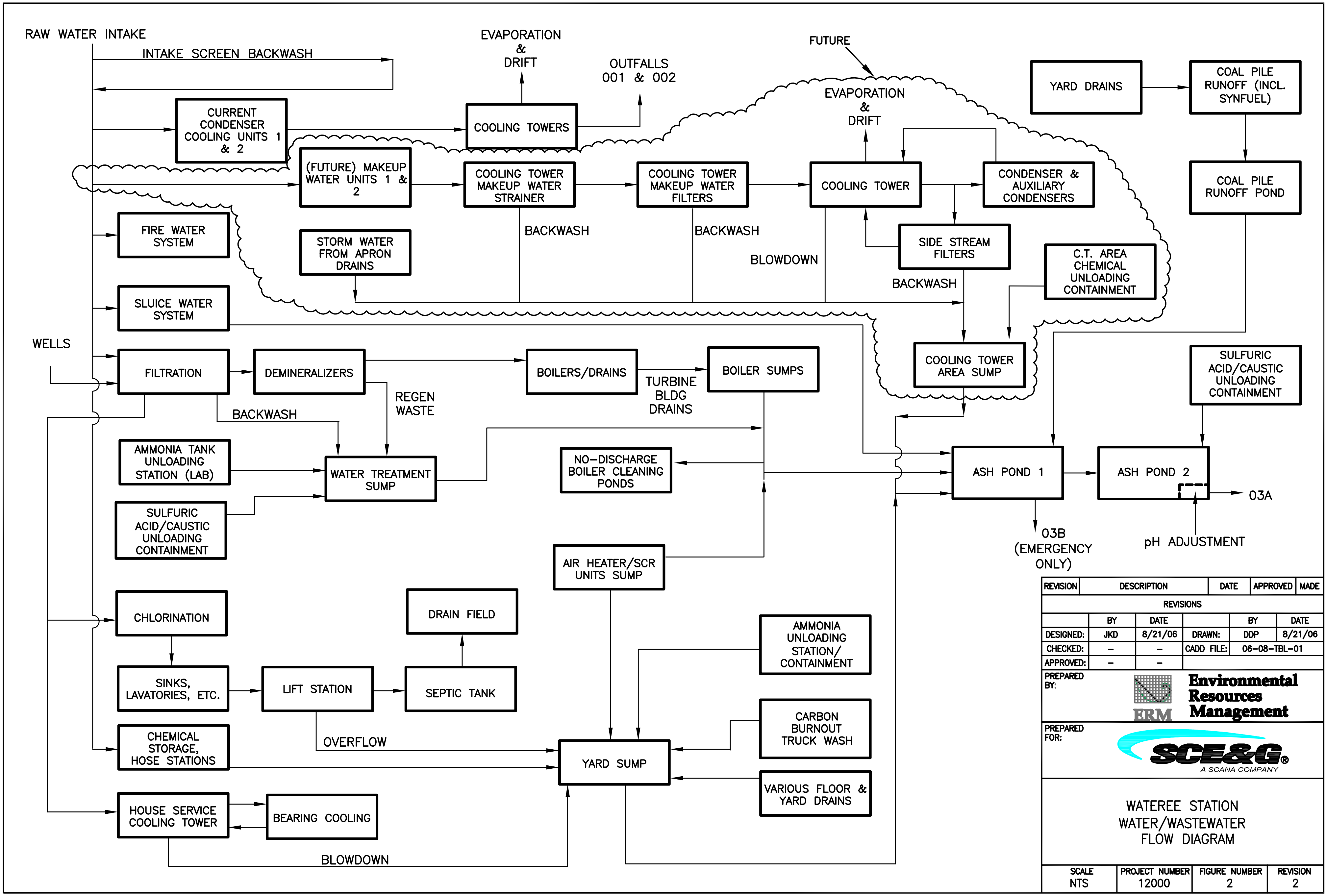
ERM

Environmental Resources Management

PROJECT:
16707

FIGURE:
1

Q:\2004 Acad\SCE&G-16707\FIGONE.dwg, 4600



REVISION	DESCRIPTION	DATE	APPROVED	MADE

REVISIONS

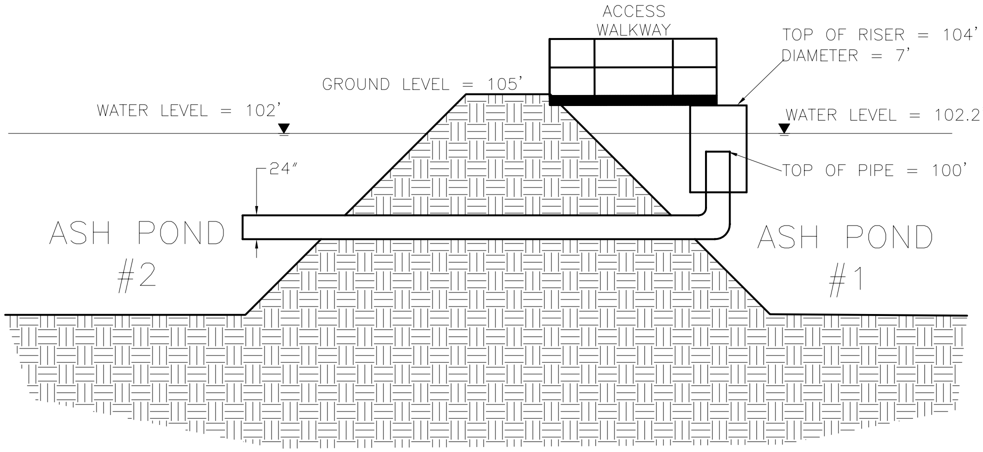
	BY	DATE		BY	DATE
DESIGNED:	JKD	8/21/06	DRAWN:	DDP	8/21/06
CHECKED:	–	–	CADD FILE:	06-08-TBL-01	
APPROVED:	–	–			

PREPARED BY: ERM **Environmental Resources Management**

PREPARED FOR: SCE&G® A SCANA COMPANY

WATEREE STATION
WATER/WASTEWATER
FLOW DIAGRAM

SCALE	PROJECT NUMBER	FIGURE NUMBER	REVISION
NTS	12000	2	2



NOTE: ALL DIMENSIONS AND ELEVATIONS ARE APPROXIMATE/ ESTIMATED.

NOTE: THOUGH DIFFICULT TO DISCERN IN THIS PHOTO, THE VEGETATION SURROUNDING STRUCTURE IS FLOATING ON THE WATER SURFACE.

ERM
Environmental Resources Management

WATEREE ASH POND #1 OUTLET STRUCTURE

POND DETENTION STUDY AND HYDRAULIC ANALYSIS

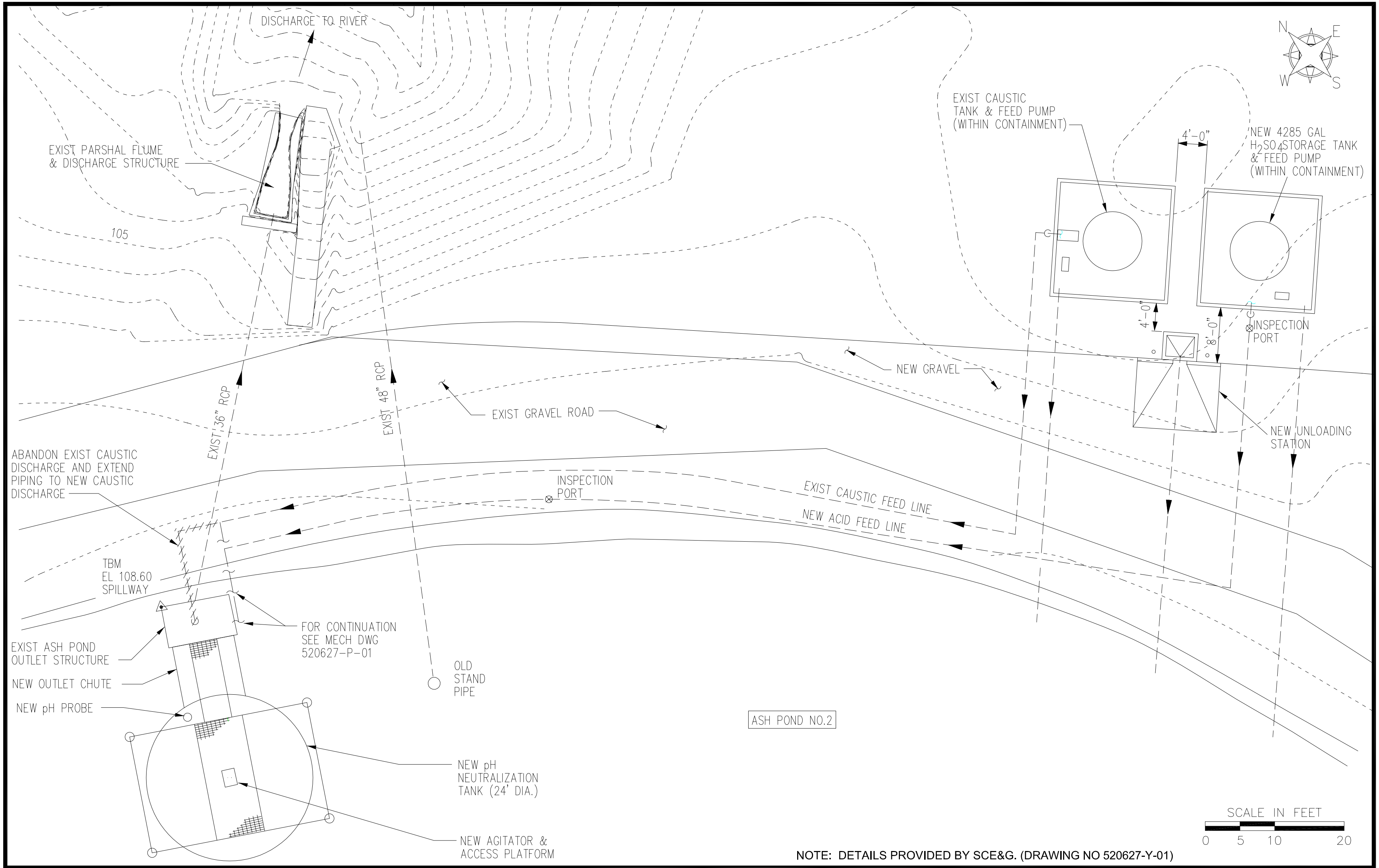
SCE&G

WATEREE, SOUTH CAROLINA

FIGURE

3

06-08-DCH-01.DWG 08-21-06 1"=20' DDP REV



NOTE: DETAILS PROVIDED BY SCE&G. (DRAWING NO 520627-Y-01)

Environmental Resources Management

OUTFALL 03A DISCHARGE DETAILS

POND DETENTION STUDY AND HYDRAULIC ANALYSIS

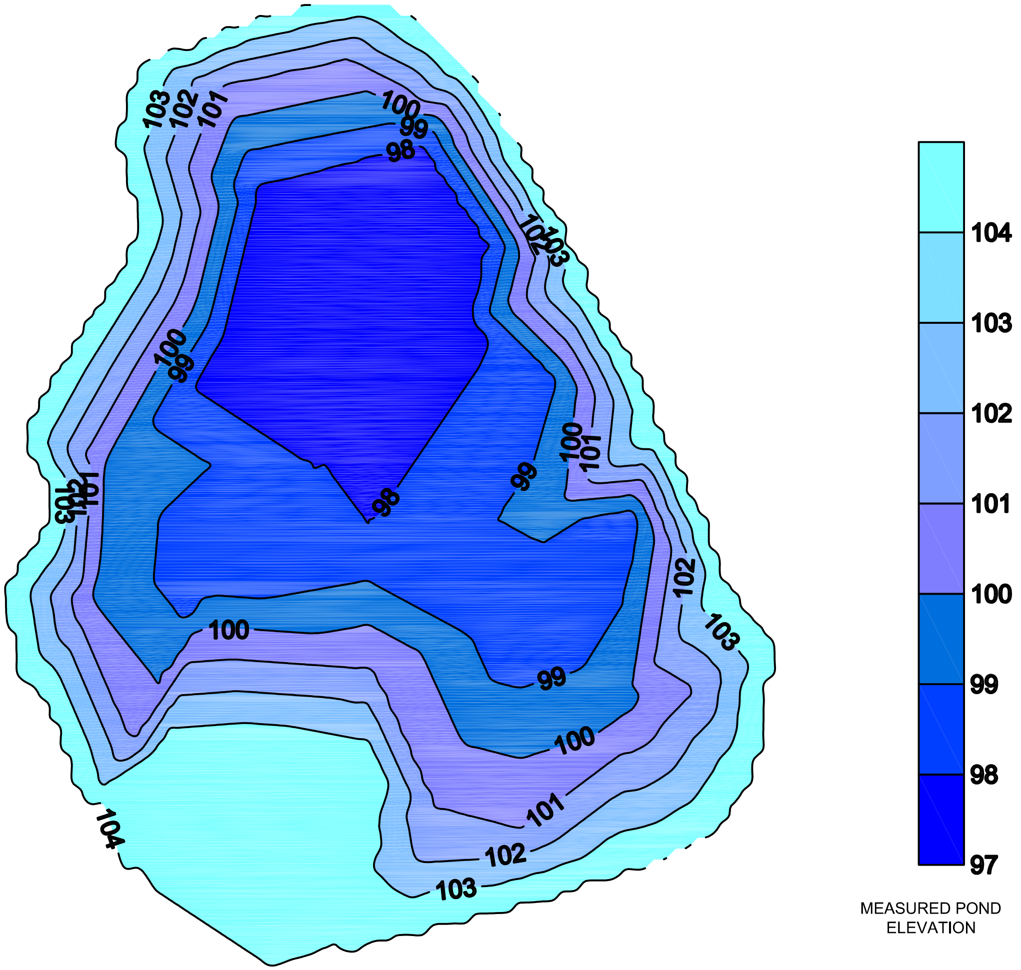
SCE&G

WATEREE, SOUTH CAROLINA

FIGURE

4

06-08-CP-01.DWG 08-21-06 NTS DDP REV



```
SURFER® VERSION 7 MODEL OUPUT

UPPER SURFACE
     Level Surface defined by Z = 104.2

LOWER SURFACE
     Grid size as read:          84 cols by 100 rows
     Delta X:                    3.4911686747
     Delta Y:                    3.4767979798
     X-Range:                    2115630.428 to 2115920.195
     Y-Range:                    724652.496 to 724996.699
     Z-Range:                    97.0625744075 to 104.02

VOLUMES
     Approximated Volume by
     Trapezoidal Rule:           187128.110617
     Simpson's Rule:             187140.461274
     Simpson's 3/8 Rule:         187130.886291

CUT & FILL VOLUMES
     Positive Volume [Cut]:      187128.110617
     Negative Volume [Fill]:     0
     Cut minus Fill:             187128.110617

AREAS
     Positive Planar Area
     (Upper above Lower):        64277.2460383
     Negative Planar Area
     (Lower above Upper):        0
     Blanked Planar Area:        35461.4246626
     Total Planar Area:          99738.670701

     Positive Surface Area
     (Upper above Lower):        64611.1712604
     Negative Surface Area
     (Lower above Upper):        0
```

NOTE: THE MEASURED ELEVATIONS WERE ESTIMATED USING A KNOWN SITE BENCHMARK.

ERM

**Environmental
Resources
Management**

COAL PILE RUNOFF POND SURVEY

POND DETENTION STUDY AND HYDRAULIC ANALYSIS

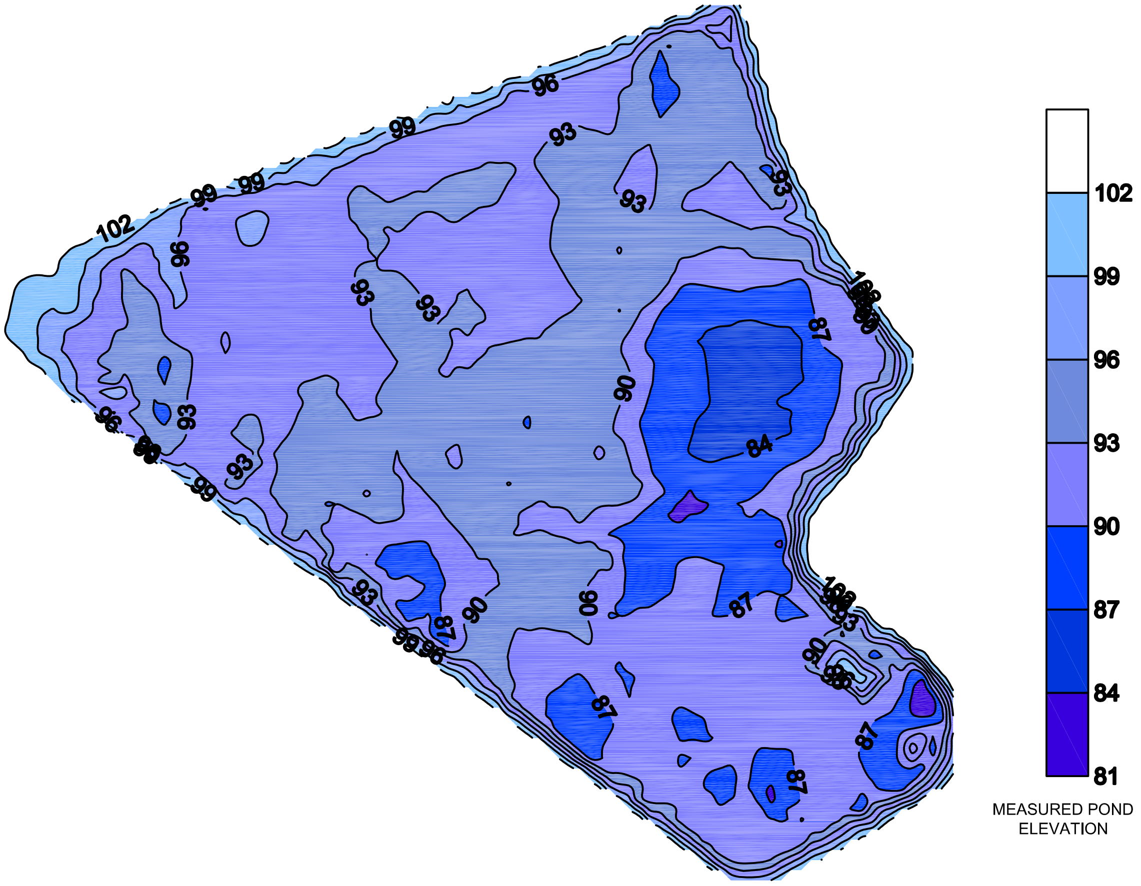
SCE&G

WATEREE, SOUTH CAROLINA

FIGURE

5

06-08-AP-01.DWG 08-21-06 NTS DDP REV



MEASURED POND ELEVATION

SURFER® VERSION 7 MODEL OUPUT

```
UPPER SURFACE
    Level Surface defined by Z = 103.68

LOWER SURFACE
    Grid size as read:          100 cols by 89 rows
    Delta X:                    27.1474343434
    Delta Y:                    27.3280795455
    X-Range:                    2113885.344 to 2116572.94
    Y-Range:                    720051.172 to 722456.043
    Z-Range:                    81.6988602054 to 103.68

VOLUMES
    Approximated Volume by
    Trapezoidal Rule:           40936380.6893
    Simpson's Rule:             40959282.518
    Simpson's 3/8 Rule:         40953012.4582

CUT & FILL VOLUMES
    Positive Volume [Cut]:      40936380.6893
    Negative Volume [Fill]:     1.30006445585E-008
    Cut minus Fill:             40936380.6893

AREAS
    Positive Planar Area
    (Upper above Lower):        3407573.14694
    Negative Planar Area
    (Lower above Upper):        104521.071796
    Blanked Planar Area:        2951227.46138
    Total Planar Area:          6463321.68012

    Positive Surface Area
    (Upper above Lower):        3417708.93951
    Negative Surface Area
    (Lower above Upper):        104521.071796
```

NOTE: THE MEASURED ELEVATIONS WERE ESTIMATED USING A KNOWN SITE BENCHMARK.

ERM
Environmental Resources Management

ASH POND #2 SURVEY
POND DETENTION STUDY AND HYDRAULIC ANALYSIS
SCE&G
WATEREE, SOUTH CAROLINA

FIGURE
6

Appendix A
Wastewater/Storm Water Piping Plan

LEGEND

┼┼┼┼┼┼┼┼	RAILROAD
—·—·—	16" PIPE – UNIT SUMPS
—·—·—	10" PIPE – ASH SLUICE
▬▬▬	COAL PILE RUNOFF POND LINE
— — — —	CT BLOWDOWN YARD SUMP LINE
---ST---ST---ST-	STORM WATER LINE
→	STORM WATER RUNOFF DIRECTION
➞	STORM WATER DRAINAGE DITCH
■	STORM WATER CATCH BASIN

SCALE IN FEET
200 100 50 0 200

PRELIMINARY

12000 06-07-SLM-02.DWG 7/17/06 1=200 DDP REV

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION
1	7/18/06	JKD	FOR SCE&G REVIEW				

SCE&G
A SCANA COMPANY
SCE&G
WATEREE, SC

DRAWN BY DDP
PROJECT ENGINEER JKD
DESIGN ENGINEER JKD
PROJECT MANAGER JKD

ERM

NOT FOR CONST-RUCTION

WASTEWATER/ STORM WATER PIPING PLAN

SCALE 1"=200'
DATE JULY 18, 2006
PROJECT NO. 12000
AutoCAD 2002 06-07-SLM-02
DRAWING NO. 1
REV. NO.
SHEET 1 OF 1

Appendix B
Parsons E&C Storm Water Calculations

PARSONS

CALCULATION COVER SHEET

CLIENT	SCE&G Wateree Station
PROJECT	Cooling Tower Installation
SUBJECT	Apron Drainage Plan
JOB NUMBER	53758401
WBS NUMBER	N/A
CALCULATION NO.:	WATE-0-DC-048-CE-002

DESCRIPTION/PURPOSE

These calculations are for the Apron Drainage Plan for the construction of cooling towers. Design system to control the post development runoff.

METHOD OF ANALYSIS

Utilize the codes and standards noted below along with calculations for the Apron Drainage for the construction cooling towers.

CODES AND STANDARDS

1. "StormCAD" Version 4.1.1, Haestad Methods Inc., Waterbury, CT.
2. United States Department of Agriculture, Natural Resources Conservation Service, Conservation Engineering Division, Technical Release 55 (TR-55) (June 1986), Urban Hydrology for Small Watersheds.

INFORMATION SOURCES

1. Urban Drainage Design Manual, Haestad Methods Inc., Waterbury, CT.

ASSUMPTIONS

Assumptions will be included with the calculations.

CONCLUSIONS OR RESULTS

Apron Drainage and Storm Water Management are designed to meet necessary requirements.

REV	DATE	DESCRIPTION	PAGES REVISED	PAGES ADDED	PAGES DELETED	BY/DATE	REV/DATE	LDE/DATE
4								
3								
2								
1								
0	9/15/04	ORIGINAL	BY: GDM	REV'D	------	GDM / GDM 9/15/2004	DRS 9/15/2004	9/15/04

STORMWATER DRAINAGE DESIGN CRITERIA

These calculations are prepared for Apron Drainage for the construction of cooling towers. The site area includes the area between cooling towers, cooling towers, dense stone area, catch basins, expansion sumps, and other site areas as shown on the drawings. Specific design criteria is as follows:

1. Runoff calculations to be based on Rational Method 24 hour storm duration.
2. Rational coefficients are based on Intensity-Duration-Frequency methodology.
3. Use reinforced concrete pipe (RCP).
4. Use concrete catch basins.

SITE CONDITIONS

Site topographic conditions are flat with no vertical relief. Grades of apron drain system and storm water drain system are typically less than 0.5 percent. The aprons are composed of dense graded aggregate. The catch basins drain is located in the on the perimeter of cooling towers 1 and 2. The current groundwater table (prior to site grading modifications) is 111 to 114 feet mean sea level. Wetland areas exist on the western portion of the site. The railroad is along the northern perimeter of the site.

THIS IS A DESIGN RECORD

PARSONS	**CLIENT NAME:** SCE&G Wateree Station **PROJECT NAME:** Cooling Tower Installation	**JOB NO.:** **53758401**
STANDARD CALCULATION SHEET	**SUBJECT:** Apron Drainage Plan	**CALC NO.:** WATE -0-DC-048-CE-002

REVISION	**0**	**1**	**2**	3	**PAGE 3 OF 5**
ORIGINATOR	**GDM**				
REVIEWER	**DRS**				
DATE:	**0915/04**				

STORM MANAGEMENT CALCULATIONS

1. General approach:

   A. A future apron drainage plan is to be constructed on the perimeter of the cooling towers during the beginning phases of the construction. The proposed apron drainage will contain the surface runoff from the cooling tower drainage and will discharge to sump as shown on the drawings. Apron Drainage system will consist of area stormwater collector catch basins on the perimeter of cooling tower 1 and cooling tower 2. The RCP between catch basins will slope so the storm water will flow to the outlet sump. The outlet structure to be located at between cool tower 1 and cooling tower 2 on the south end. The RCP is designed for the 2 and 10 year storm event and will discharge to the sump located between the cooling towers.

   B. A storm water drainage system for the yard area will be constructed but is not included in this calculation.

   C. <u>Rational Coefficients:</u> Utilize rational coefficients from table B.8.2 in Urban Drainage Design Manual for rational method. Primarily a densely compacted stone is noted in the Apron Drainage Area. The Surface Water Drainage Area is railroads and gravel roads.

   D. <u>Time of Concentration Calculations:</u> Use rational methods available in StormCAD. For flows in apron drain network and drain network, time of concentration in pipe network estimated based on flows and velocities.

   E. <u>Rainfall:</u> Use published rainfall values obtained from Codes and Standards Reference 1 as design storm inputs for 2, 10, 25, and 50 year, 24 hour storm events. Utilize storm in accordance with TR-55 method for each storm event. Rainfall events are synthetically generated using StormCAD.

   F. <u>Drainage Area:</u> Measure drainage area tributary for the post development apron area drainage and surface water drainage. The catch basins located on the perimeter the cooling towers. The drainage areas are shown on the sketches provided in Attachment A.

   G. The purpose of the apron drainage system is to capture any process cooling water that escapes the boundary of the cooling towers. No flow has been assigned to this event, and it is assumed that precipitation from storm events will be the controlling design event. Two cases were evaluated: 1) Spare cooling tower cell areas (4 cells) that will initially drain into the sump, and 2) Cooling towers fully built out and no basin drainage to sump.

   H. The transformer secondary containment will drain to the sump. System is conservatively analyzed for peak flow storm event. The secondary containment will have a closed valve with manual option to open after effluent is determined to be ok for release. Flow for the fire protection deluge system is not considered in the apron drainage system. Peak fire flow coinciding with peak storm flow is not likely to occur simultaneously.

PARSONS	**CLIENT NAME:** SCE&G Wateree Station **PROJECT NAME:** Cooling Tower Installation					**JOB NO.:** 53758401
	SUBJECT: Apron Drainage Plan					**CALC NO.:** WATE -0-DC-048-CE-002
STANDARD CALCULATION SHEET	**REVISION**	0	1	2	3	**PAGE 4** **OF 5**
	ORIGINATOR	GDM				
	REVIEWER	DRS				
	DATE:	09/15/04				

2. Drainage Summary:

See attached StormCAD output for and post-construction areas, Rational Coefficients, flow rates, time of concentration, and pipe profiles. The design has two flow conditions: one involving fourteen cells on each cooling tower (no drainage to sump) and the other is only ten cells for each cooling tower (4 cells draining to sump) with the option to build the remain four in the future.

Table 1:

WATEREE STORM FLOWS TO SUMP

	Flow (CFS)		Volume (CF)	
Storm Event	w/4 cells to sump	w/o 4 cells to sump	w/4 cells to sump	w/o 4 cells to sump
10 yr	11.2	7.65	40320	27540
25 yr	12.53	8.59	45108	30924
50 yr	13.18	9.66	47448	34776

Note: If the sump is not covered add .14 cfs to the flow during a 10 yr storm event, .16 cfs to the flow during a 25 yr storm event, and .18 cfs to the flow during a 50 yr storm event.

3. Conclusion:

The design will accommodate flow including spare cooling tower area and flow not including spare cooling tower area during a 50 year storm event.

B. COOLING TOWER BLOWDOWN

1. Design Conditions

Blowdown= Evaporation - (Cycles of concentration -1) X Drift / (Cycles of concentration - 1)

Evaporation at:

Design Conditions:	Evaporation	1.7	% of Cooling Tower Flow	
	Cycles of concentration	6		
	Design Flow	170,000	gpm	
	Drift	8.5	gpm	
	Evaporation	2890	Use	2900
	Blowdown	569.5	Use	580

2. Maximum Conditions

Evaporation at:

Maximum Conditions:	Evaporation =	2.2	% of Cooling Tower Flow	
	Cycles of concentration	5		
	Design Flow	170,000	gpm	
	Drift	8.5	gpm	
	Evaporation	3740	Use	3750
	Blowdown	926.5	Use	950

C. SURFACE WATER

1. Rain Analysis

Process water that is splashed out of the cooling towers or droplets that are blown out of the cooling towers by wind are collected in an area around each cooling tower basin to catch and drain this water separate from the storm drain system. This ‘apron’ is 20 feet wide on three sides and 30 feet wide on the riser side of the cooling towers. Water collected on the apron is drained into an underground drains system which channels the water to the cooling tower area sump for discharge with the rest of the process waste water. Also, water that is collected on the foundations of the makeup filters, side stream filters, chemical building sump, and transformer sumps in the electrical building are drained into the Area Sump; this includes rainwater.

Water from the side stream filter foundations is transported to the Area Sump by way of the Cooling Tower Apron Drains system. The other drains are discharged directly into the Area Sump.

Because rain will also be collected by the apron area, the apron drains system is sized to handle rain water generated by the ten year storm. This system is analyzed in calculation WATE-0-DC-048-CE-002.The calculation uses the rational basis for determining the piping size by utilizing

Q=CiA, where:

Q= flow in CFS

C= coefficient of run-off

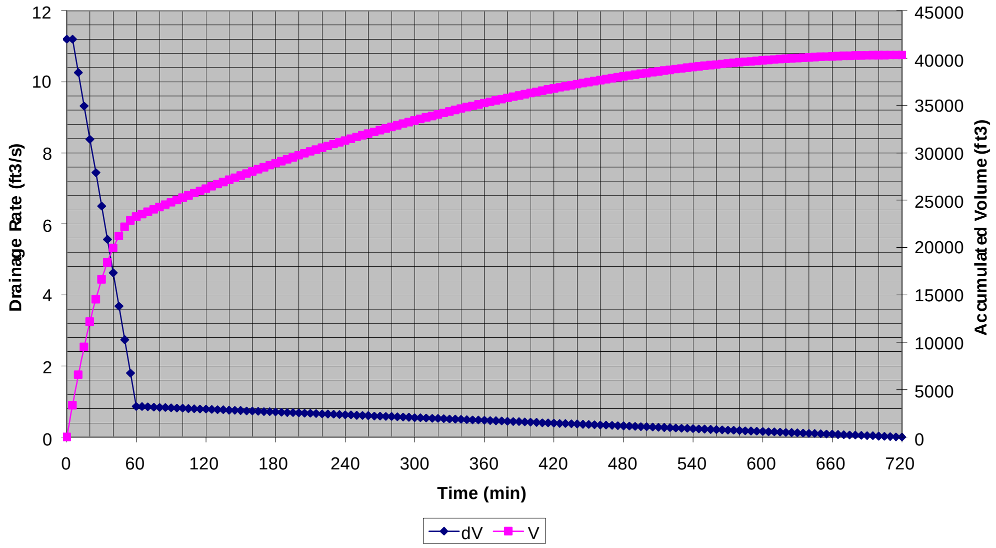
i= intensity (5 min basis)

A=area in acres

The results of this calculation are presented here:

a.	Total Volume collected during storm	40,320 Cubic Feet (302,400 gallons)
b.	Peak flow to sump (first 5 minutes)	11.2 CFS (5100 GPM)

Rainfall Drainage Into Area Sump
12 Hour Basis



2. Sump In-Flow calculations are based upon the following assumptions:

The runoff produced by the storm is analyzed in calculation WATE-0-DC-043-ME-001. This was modeled in the sump as follows:

a. Storm occurs in 12 hour period.

b. Peak flow to sump occurs in first 5-minute period of storm, and greater than 50% of storm volume occurs in the first hour, and then tapers off over the next 11 hours to give the total volume generated during the storm.

c. Total volume from storm enters sump in 12 hours.

3. Sump Level analysis for this event is given in Attachment 7.

D. PIPE SYSTEM PRESSURE LOSSES / FLOWS

The piping systems used in the handling of process water and waste water are evaluated for flows, pressure losses, and fluid velocities for the various operating scenarios that a system or equipment component could operate in. These scenarios are depicted in Attachments 10 through 38. The bases for these are discussed in this section.

1. Circulating Water - (Attachment 10)

The circulating water systems are shown on P&ID WATE-1-DW-461-302-001, -002, -003 for Unit 1, and WATE-2-DW-461-302-001, -002, -003 for Unit 2.

The circulating water system is designed to provide 170,000 gpm of 90°F water from the cooling tower basin through the steam turbine condensers. The pumps also provide flow for the blowdown of the cooling tower and for the operation of the side stream filters. The pumps are specified to supply one-half of the required flow of 174,000 gpm with a margin of 5% on flow and discharge head, thereby giving a specified flow of 91,500 gpm per pump.

2. Makeup Water - (Attachments 11, 12, 13, & 14)

The makeup water system is shown on P&ID WATE-0-DW-511-302-001.

The makeup water system provides water to the cooling tower to makeup for the evaporation and drift losses from the tower, blowdown from the towers to control the concentration of chemicals within the circulating water, water for backwash of the makeup strainers, makeup filters and replacement of the water used from the basin for backwash of the side stream filters for both Units 1 & 2. There are two 100% makeup water pumps.

Daily Average makeup provides for normal filter backwashes of once per day for the makeup filters and once per day for the side stream filters for each unit with single pump operation. Only one filter of any one filter set is backwashed at any one time. See Attachment 11 for the flow without backwash and Attachment 12 for the flow with filter backwash. Attachment 13 shows the capability of a single pump to provide water to the towers during periods of high evaporation or maximum flow conditions.

During periods of high TSS in the makeup water, it is possible to operate both makeup pumps to provide filtered makeup to the towers and water to blow down two makeup filters at a time, one from each unit set of filters. See Attachment 14.

3. Process Waste Water to Existing Plant Drains –(Attachment 15)

The waste water to existing plant drains is shown on P&IDs WATE-1-DW-526-302-002 for Unit 1 and WATE-2-DW-526-302-003 for Unit 2.

Existing Amertap ball strainers in the circulating water discharge from each plant will be relocated in new pits constructed external to the existing plant building. The new circulating

Appendix C
Parshall Flume Discharge Tables

Table 13-6:
1 ft. Parshall Flume Discharge Table with Head in Feet *(continued)*

Formulas: $CFS = 4.000\ H^{1.522}$ $MGD = 2.585\ H^{1.522}$
$GPM = 1795\ H^{1.522}$
Where: H = head in feet

Head (feet)	CFS	GPM	MGD
2.01	11.58	5194	7.480
2.02	11.66	5234	7.537
2.03	11.75	5273	7.594
2.04	11.84	5313	7.651
2.05	11.93	5352	7.708
2.06	12.02	5392	7.765
2.07	12.11	5432	7.823
2.08	12.19	5472	7.880
2.09	12.28	5512	7.938
2.10	12.37	5552	7.996
2.11	12.46	5593	8.054
2.12	12.55	5633	8.112
2.13	12.64	5674	8.171
2.14	12.73	5714	8.229
2.15	12.82	5755	8.288
2.16	12.92	5796	8.346
2.17	13.01	5837	8.405
2.18	13.10	5878	8.464
2.19	13.19	5919	8.523
2.20	13.28	5960	8.583
2.21	13.37	6001	8.642
2.22	13.47	6042	8.702
2.23	13.56	6084	8.762
2.24	13.65	6126	8.821
2.25	13.74	6167	8.881
2.26	13.84	6209	8.942
2.27	13.93	6251	9.002
2.28	14.02	6293	9.062
2.29	14.12	6335	9.123
2.30	14.21	6377	9.184
2.31	14.30	6419	9.244
2.32	14.40	6462	9.305
2.33	14.49	6504	9.366
2.34	14.59	6547	9.428
2.35	14.68	6589	9.489
2.36	14.78	6632	9.551
2.37	14.87	6675	9.612
2.38	14.97	6718	9.674
2.39	15.07	6761	9.736
2.40	15.16	6804	9.798
2.41	15.26	6847	9.860
2.42	15.35	6890	9.923
2.43	15.45	6934	9.985
2.44	15.55	6977	10.05
2.45	15.64	7021	10.11
2.46	15.74	7064	10.17
2.47	15.84	7108	10.24
2.48	15.94	7152	10.30
2.49	16.04	7196	10.36
2.50	16.13	7240	10.43

Table 13-7:
1½ ft. Parshall Flume Discharge Table with Head in Feet

Formulas: $CFS = 6.000\ H^{1.538}$ $MGD = 3.878\ H^{1.538}$
$GPM = 2693\ H^{1.538}$
Where: H = head in feet

Head (feet)	CFS	GPM	MGD
0.01			
0.02			
0.03			
0.04			
0.05			
0.06			
0.07			
0.08			
0.09			
0.10	0.1738	78.03	0.1124
0.11	0.2013	90.34	0.1301
0.12	0.2301	103.3	0.1487
0.13	0.2603	116.8	0.1682
0.14	0.2917	130.9	0.1885
0.15	0.3243	145.6	0.2096
0.16	0.3582	160.8	0.2315
0.17	0.3932	176.5	0.2541
0.18	0.4293	192.7	0.2775
0.19	0.4665	209.4	0.3015
0.20	0.5048	226.6	0.3263
0.21	0.5442	244.2	0.3517
0.22	0.5845	262.4	0.3778
0.23	0.6259	280.9	0.4045
0.24	0.6682	299.9	0.4319
0.25	0.7115	319.4	0.4599
0.26	0.7558	339.2	0.4885
0.27	0.8009	359.5	0.5177
0.28	0.8470	380.2	0.5474
0.29	0.8940	401.2	0.5778
0.30	0.9418	422.7	0.6087
0.31	0.9905	444.6	0.6402
0.32	1.040	466.8	0.6722
0.33	1.091	489.5	0.7048
0.34	1.142	512.4	0.7379
0.35	1.194	535.8	0.7716
0.36	1.247	559.5	0.8058
0.37	1.300	583.6	0.8404
0.38	1.355	608.1	0.8756
0.39	1.410	632.8	0.9113
0.40	1.466	658.0	0.9475
0.41	1.523	683.4	0.9842
0.42	1.580	709.2	1.021
0.43	1.638	735.4	1.059
0.44	1.697	761.8	1.097
0.45	1.757	788.6	1.136
0.46	1.817	815.8	1.175
0.47	1.879	843.2	1.214
0.48	1.940	870.9	1.254
0.49	2.003	899.0	1.295
0.50	2.066	927.4	1.335
0.51	2.130	956.0	1.377
0.52	2.195	985.0	1.418
0.53	2.260	1014	1.461
0.54	2.326	1044	1.503
0.55	2.392	1074	1.546
0.56	2.460	1104	1.590
0.57	2.527	1134	1.634
0.58	2.596	1165	1.678
0.59	2.665	1196	1.723
0.60	2.735	1228	1.768
0.61	2.805	1259	1.813
0.62	2.876	1291	1.859
0.63	2.948	1323	1.905
0.64	3.020	1356	1.952
0.65	3.093	1388	1.999
0.66	3.167	1421	2.047
0.67	3.241	1455	2.095
0.68	3.316	1488	2.143
0.69	3.391	1522	2.192
0.70	3.467	1556	2.241
0.71	3.543	1590	2.290
0.72	3.620	1625	2.340
0.73	3.698	1660	2.390
0.74	3.776	1695	2.441
0.75	3.855	1730	2.491
0.76	3.934	1766	2.543
0.77	4.014	1802	2.594
0.78	4.094	1838	2.646
0.79	4.175	1874	2.699
0.80	4.257	1911	2.751
0.81	4.339	1948	2.805
0.82	4.422	1985	2.858
0.83	4.505	2022	2.912
0.84	4.589	2060	2.966
0.85	4.673	2097	3.020
0.86	4.758	2135	3.075
0.87	4.843	2174	3.130
0.88	4.929	2212	3.186
0.89	5.015	2251	3.242
0.90	5.102	2290	3.298
0.91	5.190	2329	3.354
0.92	5.278	2369	3.411
0.93	5.366	2409	3.468
0.94	5.455	2449	3.526
0.95	5.545	2489	3.584
0.96	5.635	2529	3.642
0.97	5.725	2570	3.701
0.98	5.816	2611	3.759
0.99	5.908	2652	3.819
1.00	6.000	2693	3.878

Table 13-7:
1½ ft. Parshall Flume Discharge Table with Head in Feet *(continued)*

Formulas: $CFS = 6.000\ H^{1.538}$ $MGD = 3.878\ H^{1.538}$
$GPM = 2693\ H^{1.538}$
Where: H = head in feet

Head (feet)	CFS	GPM	MGD	Head (feet)	CFS	GPM	MGD
1.01	6.093	2735	3.938	1.51	11.31	5076	7.309
1.02	6.186	2776	3.998	1.52	11.42	5128	7.384
1.03	6.279	2818	4.058	1.53	11.54	5180	7.459
1.04	6.373	2860	4.119	1.54	11.66	5232	7.534
1.05	6.468	2903	4.180	1.55	11.77	5284	7.609
1.06	6.563	2945	4.242	1.56	11.89	5337	7.685
1.07	6.658	2988	4.303	1.57	12.01	5389	7.761
1.08	6.754	3031	4.365	1.58	12.13	5442	7.837
1.09	6.850	3075	4.428	1.59	12.24	5495	7.913
1.10	6.947	3118	4.490	1.60	12.36	5548	7.990
1.11	7.045	3162	4.553	1.61	12.48	5602	8.067
1.12	7.142	3206	4.616	1.62	12.60	5655	8.144
1.13	7.241	3250	4.680	1.63	12.72	5709	8.222
1.14	7.340	3294	4.744	1.64	12.84	5763	8.299
1.15	7.439	3339	4.808	1.65	12.96	5817	8.377
1.16	7.539	3384	4.872	1.66	13.08	5872	8.455
1.17	7.639	3429	4.937	1.67	13.20	5926	8.534
1.18	7.739	3474	5.002	1.68	13.33	5981	8.613
1.19	7.840	3519	5.068	1.69	13.45	6036	8.692
1.20	7.942	3565	5.133	1.70	13.57	6091	8.771
1.21	8.044	3610	5.199	1.71	13.69	6146	8.850
1.22	8.147	3656	5.265	1.72	13.82	6201	8.930
1.23	8.249	3703	5.332	1.73	13.94	6257	9.010
1.24	8.353	3749	5.399	1.74	14.06	6312	9.090
1.25	8.457	3796	5.466	1.75	14.19	6368	9.171
1.26	8.561	3842	5.533	1.76	14.31	6424	9.251
1.27	8.666	3889	5.601	1.77	14.44	6481	9.332
1.28	8.771	3937	5.669	1.78	14.56	6537	9.414
1.29	8.876	3984	5.737	1.79	14.69	6594	9.495
1.30	8.982	4032	5.806	1.80	14.82	6650	9.577
1.31	9.089	4079	5.875	1.81	14.94	6707	9.659
1.32	9.196	4127	5.944	1.82	15.07	6764	9.741
1.33	9.303	4176	6.013	1.83	15.20	6822	9.823
1.34	9.411	4224	6.083	1.84	15.33	6879	9.906
1.35	9.519	4273	6.153	1.85	15.45	6937	9.989
1.36	9.628	4321	6.223	1.86	15.58	6994	10.07
1.37	9.737	4370	6.293	1.87	15.71	7052	10.16
1.38	9.847	4419	6.364	1.88	15.84	7110	10.24
1.39	9.957	4469	6.435	1.89	15.97	7169	10.32
1.40	10.07	4518	6.507	1.90	16.10	7227	10.41
1.41	10.18	4568	6.578	1.91	16.23	7286	10.49
1.42	10.29	4618	6.650	1.92	16.36	7344	10.58
1.43	10.40	4668	6.722	1.93	16.49	7403	10.66
1.44	10.51	4718	6.795	1.94	16.63	7462	10.75
1.45	10.63	4769	6.867	1.95	16.76	7522	10.83
1.46	10.74	4820	6.940	1.96	16.89	7581	10.92
1.47	10.85	4870	7.014	1.97	17.02	7641	11.00
1.48	10.97	4922	7.087	1.98	17.16	7700	11.09
1.49	11.08	4973	7.161	1.99	17.29	7760	11.17
1.50	11.19	5024	7.235	2.00	17.42	7820	11.26

Table 13-7:
1½ ft. Parshall Flume Discharge Table with Head in Feet *(continued)*

Formulas: $CFS = 6.000\ H^{1.538}$ $MGD = 3.878\ H^{1.538}$
$GPM = 2693\ H^{1.538}$
Where: H = head in feet

Head (feet)	CFS	GPM	MGD	Head (feet)	CFS	GPM	MGD
2.01	17.56	7880	11.35	2.26	21.03	9437	13.59
2.02	17.69	7941	11.44	2.27	21.17	9502	13.68
2.03	17.83	8001	11.52	2.28	21.31	9566	13.78
2.04	17.96	8062	11.61	2.29	21.46	9631	13.87
2.05	18.10	8123	11.70	2.30	21.60	9696	13.96
2.06	18.23	8184	11.79	2.31	21.75	9760	14.06
2.07	18.37	8245	11.87	2.32	21.89	9826	14.15
2.08	18.51	8306	11.96	2.33	22.04	9891	14.24
2.09	18.64	8368	12.05	2.34	22.18	9956	14.34
2.10	18.78	8430	12.14	2.35	22.33	10,020	14.43
2.11	18.92	8491	12.23	2.36	22.47	10,090	14.53
2.12	19.06	8553	12.32	2.37	22.62	10,150	14.62
2.13	19.20	8616	12.41	2.38	22.77	10,220	14.72
2.14	19.33	8678	12.50	2.39	22.92	10,290	14.81
2.15	19.47	8740	12.59	2.40	23.06	10,350	14.91
2.16	19.61	8803	12.68	2.41	23.21	10,420	15.00
2.17	19.75	8866	12.77	2.42	23.36	10,480	15.10
2.18	19.89	8929	12.86	2.43	23.51	10,550	15.19
2.19	20.03	8992	12.95	2.44	23.66	10,620	15.29
2.20	20.17	9055	13.04	2.45	23.81	10,680	15.39
2.21	20.32	9118	13.13	2.46	23.96	10,750	15.48
2.22	20.46	9182	13.22	2.47	24.11	10,820	15.58
2.23	20.60	9245	13.31	2.48	24.26	10,890	15.68
2.24	20.74	9309	13.41	2.49	24.41	10,950	15.77
2.25	20.88	9373	13.50	2.50	24.56	11,020	15.87

ATTACHMENT 3

3.1) SCE&G WATEREE STEAM STATION NPDES PERMIT, ISSUED AUGUST 29, 2008

DHEC
PROMOTE PROTECT PROSPER
South Carolina Department of Health
and Environmental Control

National Pollutant Discharge Elimination System Permit

for Discharge to Surface Waters

This Permit Certifies That

South Carolina Electric & Gas Company
Wateree Steam Station

has been granted permission to discharge from a facility located at

142 Wateree Station Road
Eastover, South Carolina
Richland County

to receiving waters named

Wateree River

in accordance with limitations, monitoring requirements and other conditions set forth herein. This permit is issued in accordance with the provisions of the Pollution Control Act of South Carolina (S.C. Code Sections 48-1-10 *et seq*., 1976), Regulation 61-9 and with the provisions of the Federal Clean Water Act (PL 92-500), as amended, 33 U.S.C. 1251 *et seq*., the "Act."

Jeffrey P. deBessonet, P.E., Director
Water Facilities Permitting Division

Issue Date: **August 29, 2008** ***Expiration Date:*** **December 31, 2012**

Effective Date: **October 1, 2008** ***Permit No.:*** **SC0002038**

D H E C

PROMOTE PROTECT PROSPER

South Carolina Department of Health
and Environmental Control

National Pollutant Discharge Elimination System Permit

for Discharge to Surface Waters

This Permit Certifies That

South Carolina Electric & Gas Company
Wateree Steam Station

has been granted permission to discharge from a facility located at

142 Wateree Station Road
Eastover, South Carolina
Richland County

to receiving waters named

Wateree River

in accordance with limitations, monitoring requirements and other conditions set forth herein. This permit is issued in accordance with the provisions of the Pollution Control Act of South Carolina (S.C. Code Sections 48-1-10 *et seq*., 1976), Regulation 61-9 and with the provisions of the Federal Clean Water Act (PL 92-500), as amended, 33 U.S.C. 1251 *et seq*., the "Act."

Jeffrey P. deBessonet, P.E., Director
Water Facilities Permitting Division

Issue Date: **August 29, 2008** ***Expiration Date:*** **December 31, 2012**

Effective Date: **October 1, 2008** ***Permit No.:*** **SC0002038**

Table of Contents

PART I. Definitions

Any term not defined in this Part has the definition stated in the Pollution Control Act or in "Water Pollution Control Permits", R.61-9 or its normal meaning.

A. The "Act", or CWA, shall refer to the Clean Water Act (Formerly referred to as the Federal Water Pollution Control Act) Public Law 92-500, as amended.

B. The "average" or "arithmetic mean" of any set of values is the summation of the individual values divided by the number of individual values.

C. "Basin" (or "pond") means any in-ground or earthen structure designed to receive, treat, store, temporarily retain and/or allow for the infiltration/evaporation of wastewater.

D. "Blowdown" means the minimum discharge of recirculating water for the purpose of discharging materials contained in the water, the further buildup of which would cause concentration in amounts exceeding limits established by best engineering practices.

E. "Bottom ash" means the ash that drops out of the furnace gas stream in the furnace and in the economizer sections. Economizer ash is included when it is collected with bottom ash (40 CFR 423.11(f)).

F. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

G. "Chemical metal cleaning waste" means any wastewater resulting from the cleaning of any metal process equipment with chemical compounds, including, but not limited to, boiler tube cleaning (40 CFR 423.11(c)).

H. "Coal pile runoff" means the rainfall runoff from or through any coal storage pile (40 CFR 423.11(m)).

I. A "composite sample" shall be defined as one of the following four types:

   1. An influent or effluent portion collected continuously over a specified period of time at a rate proportional to the flow.

   2. A combination of not less than 8 influent or effluent grab samples collected at regular (equal) intervals over a specified period of time and composited by increasing the volume of each aliquot in proportion to flow. If continuous flow measurement is not used to composite in proportion to flow, the following method will be used: An instantaneous flow measurement should be taken each time a grab sample is collected. At the end of the sampling period, the instantaneous flow measurements should be summed to obtain a total flow. The instantaneous flow measurement can then be divided by the total flow to determine the percentage of each grab sample to be combined. These combined samples form the composite sample.

   3. A combination of not less than 8 influent or effluent grab samples of equal volume but at variable time intervals that are inversely proportional to the volume of the flow. In other words, the time interval between aliquots is reduced as the volume of flow increases.

   4. If the effluent flow varies by less than 15 percent, a combination of not less than 8 influent or effluent grab samples of constant (equal) volume collected at regular (equal) time intervals over a specified period of time.

All samples shall be properly preserved in accordance with Part II.J.4. Continuous flow or the sum of instantaneous flows measured and averaged for the specified compositing time period shall be used with composite results to calculate mass.

J. "Daily discharge" means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the daily discharge is calculated as the average measurement of the pollutant over the day.

K. "Daily maximum" is the highest average value recorded of samples collected on any single day during the calendar month.

L. "Daily minimum" is the lowest average value recorded of samples collected on any single day during the calendar month.

M. The "Department" or "DHEC" shall refer to the South Carolina Department of Health and Environmental Control.

N. "Fly ash" means the ash that is carried out of the furnace by the gas stream and collected by mechanical precipitators, electrostatic precipitators, and/or fabric filters. Economizer ash is included when it is collected with fly ash (40 CFR 423.11(e)).

O. "Free available chlorine" shall mean the value obtained using the amperometric titration method for free available chlorine described in *Standard Methods for the Examination of Water and Wastewater* (40 CFR 423.11(l)).

P. The "geometric mean" of any set of values is the Nth root of the product of the individual values where N is equal to the number of individual values. The geometric mean is equivalent to the antilog of the arithmetic mean of the logarithms of the individual values. For purposes of calculating the geometric mean, values of zero (0) shall be considered to be one (1).

Q. A "grab sample" is an individual, discrete or single influent or effluent portion of at least 100 milliliters collected at a time representative of the discharge and over a period not exceeding 15 minutes and retained separately for analysis.

R. "Groundwater" means the water below the land surface found in fractured rock or various soil strata.

S. "Low volume waste sources" include, but are not limited to: wastewaters from wet scrubber air pollution control systems, ion exchange water treatment systems, water treatment evaporator blowdown, laboratory and sampling streams, boiler blowdown, floor drains, cooling tower basin cleaning wastes, and recirculating house service water systems. Sanitary and air conditioning wastes are not included (40 CFR 423.11(b)).

T. The "maximum or minimum" is the highest or lowest value, respectively, recorded of all samples collected during the calendar month. These terms may also be known as the instantaneous maximum or minimum.

U. "Metal cleaning waste" means any wastewater resulting from cleaning [with or without chemical cleaning compounds] any metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning, and air preheater cleaning (40 CFR 423.11(d)).

V. "Monitoring well" means any well used to sample groundwater for water quality analysis or to measure groundwater levels.

W. The "monthly average", other than for fecal coliform and enterococci, is the arithmetic mean of all samples collected in a calendar month period. The monthly average for fecal coliform and enterococci bacteria is the geometric mean of all samples collected in a calendar month period. The monthly average loading is the arithmetic average of all daily discharges made during the month.

X. "Once through cooling water" means water passed through the main cooling condensers in one or two passes for the purpose of removing waste heat (40 CFR 423.11(g)).

Y. The "PCA" shall refer to the Pollution Control Act (Chapter 1, Title 48, Code of Laws of South Carolina).

Z. The "practical quantitation limit" (PQL) is the concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point. It is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all the method-specific sample weights, volumes, and processing steps have been followed. It is also referred to as the reporting limit.

AA. "Quarter" is defined as the first three calendar months beginning with January and each group of three calendar months thereafter (also known as calendar quarters).

BB. "Quarterly average" is the arithmetic mean of all samples collected in a quarter.

CC. "Recirculated cooling water" means water which is passed through the main condensers for the purpose of removing waste heat, passed through a cooling device for the purpose of removing such heat from the water then passed again, except for blowdown, through the main condenser (40 CFR 423.11(h)).

DD. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

EE. "Sludge" means industrial sludge. Industrial sludge is a solid, semi-solid, or liquid residue generated during the treatment of industrial wastewater in a treatment works. Industrial sludge includes, but is not limited to, industrial septage; scum or solids removed in primary, secondary, or advanced wastewater treatment processes; and a material derived from industrial sludge. Industrial sludge does not include ash generated during the firing of industrial sludge in an industrial sludge incinerator or grit and screenings generated during preliminary treatment of industrial wastewater in a treatment works. Industrial sludge by definition does not include sludge covered under 40 CFR Part 503 or R.61-9.503.

FF. "Total residual chlorine" (or total residual oxidants for intake water with bromides) means the value obtained using the amperometric method for total residual chlorine described in 40 CFR Part 136. The term "average concentration" as it relates to chlorine discharge means the average of analyses made over a single period of chlorine release which does not exceed two hours (40 CFR 423.11(a) and (k)).

GG. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

HH. "Wastewater" means industrial wastewater. Industrial wastewater is wastewater generated from a federal facility, commercial or industrial process, including waste and wastewater from humans when generated at an industrial facility.

PART II. Standard Conditions

A. Duty to comply

The permittee must comply with all conditions of the permit. Any permit noncompliance constitutes a violation of the Clean Water Act and the Pollution Control Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. The Department's approval of wastewater facility plans and specifications does not relieve the permittee of responsibility to meet permit limits.

1. The permittee shall comply with effluent standards or prohibitions established under section 307(a) of the Clean Water Act for toxic pollutants and with standards for sewage sludge use or disposal established under section 405(d) of the CWA within the time provided in the regulations that establish these standards or prohibitions or standards for sewage sludge use or disposal, even if the permit has not yet been modified to incorporate the requirement.

2. Failure to comply with permit conditions or the provisions of this permit may subject the permittee to civil penalties under S.C. Code Section 48-1-330 or criminal sanctions under S.C. Code Section 48-1-320. Sanctions for violations of the Federal Clean Water Act may be imposed in accordance with the provisions of 40 CFR Part 122.41(a)(2) and (3).

3. A person who violates any provision of this permit, a term, condition or schedule of compliance contained within this NPDES permit, or the State law is subject to the actions defined in the State law.

B. Duty to reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. A permittee with a currently effective permit shall submit a new application 180 days before the existing permit expires, unless permission for a later date has been granted by the Department. The Department shall not grant permission for applications to be submitted later than the expiration date of the existing permit.

C. Need to halt or reduce activity not a defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper operation and maintenance

1. The permittee shall at all times properly operate and maintain in good working order and operate as efficiently as possible all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance includes effective performance based on design facility removals, adequate funding, adequate operator staffing and training and also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

2. Power Failures. In order to maintain compliance with effluent limitations and prohibitions of this permit, the permittee shall either:

   a. provide an alternative power source sufficient to operate the wastewater control facilities;

   b. or have a plan of operation which will halt, reduce, or otherwise control production and/or all discharges upon the reduction, loss, or failure of the primary source of power to the wastewater control facilities.

3. The permittee shall develop and maintain at the facility a complete Operations and Maintenance Manual for the waste treatment facilities. The manual shall be made available for on-site review during normal working hours. The manual shall contain operation and maintenance instructions for all equipment and appurtenances associated with the waste treatment facilities and land application system, if applicable. The manual shall contain a general description of the treatment process(es), the operational procedures to meet the requirements of E.1 above, and the corrective action to be taken should operating difficulties be encountered.

4. The permittee shall provide for the performance of daily treatment facility inspections by a certified operator of the appropriate grade as defined in Part V.E of this permit. The Department may make exceptions to the daily operator requirement in accordance with R.61-9.122.41(e)(3)(ii). The inspections shall include, but should not necessarily be limited to, areas which require visual observation to determine efficient operation and for which immediate corrective measures can be taken using the O & M manual as a guide. All inspections shall be recorded and shall include the date, time, and name of the person making the inspection, corrective measures taken, and routine equipment maintenance, repair, or replacement performed. The permittee shall maintain all records of inspections at the permitted facility as required by the permit, and the records shall be made available for on-site review during normal working hours.

5. The name and grade of the operator of record shall be submitted to DHEC/Bureau of Water/Water Pollution Control Division prior to placing the facility into operation. A roster of operators associated with the facility's operation and their certification grades shall also be submitted with the name of the "operator-in-charge." Any changes in operator or operators shall be submitted to the Department as they occur.

F. Permit actions

This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

G. Property rights

This permit does not convey any property rights of any sort, or any exclusive privilege nor does it authorize any injury to persons or property or invasion of other private rights, or any infringement of State or local law or regulations.

H. Duty to provide information

The permittee shall furnish to the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The permittee shall also furnish to the Department upon request, copies of records required to be kept by this permit.

I. Inspection and entry

The permittee shall allow the Department, or an authorized representative (including an authorized contractor acting as a representative of the Department), upon presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

4. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act and Pollution Control Act, any substances or parameters at any location.

J. Monitoring and records

1. a. (1) Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

   (2) Samples shall be reasonably distributed in time, while maintaining representative sampling.

   (3) No analysis, which is otherwise valid, shall be terminated for the purpose of preventing the analysis from showing a permit or water quality violation.

   b. Flow Measurements.

   (1) Where primary flow meters are required, appropriate flow measurement devices and methods consistent with accepted scientific practices shall be present and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to ensure that the accuracy of the measurements are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than 10% from the true discharge rates throughout the range of

expected discharge volumes. The primary flow device, where required, must be accessible to the use of a continuous flow recorder.

(2) Where permits require an estimate of flow, the permittee shall maintain at the permitted facility a record of the method(s) used in estimating the discharge flow (e.g., pump curves, production charts, water use records) for the outfall(s) designated on limits pages to monitor flow by an estimate.

(3) Records of any necessary calibrations must be kept.

2. Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by R.61-9.503 or R.61-9.504), the permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time.

3. Records of monitoring information shall include:

   a. The date, exact place, and time of sampling or measurements;

   b. The individual(s) who performed the sampling or measurements;

   c. The date(s) analyses were performed;

   d. The individual(s) who performed the analyses;

   e. The analytical techniques or methods used; and

   f. The results of such analyses.

4. a. Analyses for required monitoring must be conducted according to test procedures approved under 40 CFR Part 136, equivalent test procedures approved by the Department or other test procedures that have been specified in the permit.

   In the case of sludge use or disposal, analysis for required monitoring must be conducted according to test procedures approved under 40 CFR Part 136, test procedures specified in R.61-9.503 or R.61-9.504, equivalent test procedures approved by the Department or other test procedures that have been specified in the permit.

   b. Unless addressed elsewhere in this permit, the permittee shall use a sufficiently sensitive analytical method that achieves a value below the derived permit limit stated in Part III. If more than one method of analysis is approved for use, the Department recommends for reasonable potential determinations that the permittee use the method having the lowest practical quantitation limit (PQL) unless otherwise specified in Part V of the permit. For the purposes of reporting analytical data on the Discharge Monitoring Report (DMR):

(1) Analytical results below the PQL conducted using a method in accordance with Part II.J.4.a above shall be reported as zero (0). Zero (0) shall also be used to average results which are below the PQL. When zero (0) is reported or used to average results, the permittee shall report, in the "Comment Section" or in an attachment to the DMR, the analytical method used, the PQL achieved, and the number of times results below the PQL were reported as zero (0).

(2) Analytical results above the PQL conducted using a method in accordance with Part II.J.4.a shall be reported as the value achieved. When averaging results using a value containing a "less than," the average shall be calculated using the value and reported as "less than" the average of all results collected.

(3)(a) The mass value for a pollutant collected using a grab sample shall be calculated using the 24-hour totalized flow for the day the sample was collected (if available) or the instantaneous flow at the time of the sample and either the concentration value actually achieved or the value as determined from the procedures in (1) or (2) above, as appropriate. Grab samples should be collected at a time representative of the discharge.

(b) The mass value for a pollutant collected using a composite sample shall be calculated using the 24-hour totalized flow measured for the day the sample was collected and either the concentration value actually achieved or the value as determined from the procedures in (1) or (2) above, as appropriate.

5. The PCA provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $25,000 or by imprisonment for not more than 2 years, or both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment provided by the Clean Water Act is also by imprisonment of not more than 4 years.

K. Signatory requirement.

1. All applications, reports, or information submitted to the Department shall be signed and certified.

a. Applications. All permit applications shall be signed as follows:

(1) For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

(a) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or

(b) The manager of one or more manufacturing, production, or operating facilities, provided the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

(3) For a municipality, State, Federal, or other public agency or public facility: By either a principal executive officer, mayor, or other duly authorized employee or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:

(a) The chief executive officer of the agency, or

(b) A senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrator, Region IV, EPA).

b. All reports required by permits, and other information requested by the Department, shall be signed by a person described in Part II.K.1.a of this section, or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described in Part II.K.1.a of this section;

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.) and,

(3) The written authorization is submitted to the Department.

c. Changes to authorization. If an authorization under Part II.K.1.b of this section is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part II.K.1.b of this section must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.

d. Certification. Any person signing a document under Part II.K.1.a or b of this section shall make the following certification: "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

2. The PCA provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including

monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a fine of not more than $25,000 per violation, or by imprisonment for not more than two years per violation, or by both.

L. Reporting requirements

1. Planned changes.

The permittee shall give written notice to DHEC/Bureau of Water/Water Facilities Permitting Division as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in R 61-9.122.29(b); or

b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under Part II.L.8 of this section.

c. The alteration or addition results in a significant change in the permittee's sewage sludge or industrial sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan (included in the NPDES permit directly or by reference);

2. Anticipated noncompliance.

The permittee shall give advance notice to the DHEC/Bureau of Water/Water Pollution Control Division of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

3. Transfers.

This permit is not transferable to any person except after written notice to the DHEC/Bureau of Water/NPDES Administration. The Department may require modification or revocation and reissuance of the permit to change the name of permittee and incorporate such other requirements as may be necessary under the Pollution Control Act and the Clean Water Act.

a. Transfers by modification. Except as provided in paragraph b of this section, a permit may be transferred by the permittee to a new owner or operator only if the permit has been modified or revoked and reissued (under R.61-9.122.62(e)(2)), or a minor modification made (under R.61-9.122.63(d)), to identify the new permittee and incorporate such other requirements as may be necessary under CWA.

b. Other transfers. As an alternative to transfers under paragraph a of this section, any NPDES permit may be transferred to a new permittee if:

(1) The current permittee notifies the Department at least 30 days in advance of the proposed transfer date in Part II.L.3.b(2) of this section;

(2) The notice includes U.S. EPA NPDES Application Form 1 and a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them; and

(3) Permits are non-transferable except with prior consent of the Department. A modification under this section is a minor modification which does not require public notice.

4. Monitoring reports. Monitoring results shall be reported at the intervals specified elsewhere in this permit.

a. Monitoring results must be reported on a Discharge Monitoring Report (DMR) or forms provided or specified by the Department for reporting results of monitoring of sludge use or disposal practices including the following:

(1) Effluent Monitoring: Effluent monitoring results obtained at the required frequency shall be reported on a Discharge Monitoring Report Form (EPA Form 3320-1). The DMR is due postmarked no later than the 28th day of the month following the end of the monitoring period. One original and one copy of the Discharge Monitoring Reports (DMRs) shall be submitted to:

S.C. Department of Health and Environmental Control
Bureau of Water/Water Pollution Control Division
Data Management Section
2600 Bull Street
Columbia, South Carolina 29201

(2) Groundwater Monitoring: Groundwater monitoring results obtained at the required frequency shall be reported on a Groundwater Monitoring Report Form (DHEC 2110) postmarked no later than the 28th day of the month following the end of the monitoring period. One original and one copy of the Groundwater Monitoring Report Form (DHEC 2110) shall be submitted to:

S.C. Department of Health and Environmental Control
Bureau of Water/Water Monitoring, Assessment and Protection Division
Groundwater Quality Section
2600 Bull Street
Columbia, South Carolina 29201

(3) Sludge, Biosolids and/or Soil Monitoring: Sludge, biosolids and/or soil monitoring results obtained at the required frequency shall be reported in a laboratory format as stated in Part V of the permit. Two copies of these results shall be submitted to:

S.C. Department of Health and Environmental Control
Bureau of Water/Water Pollution Control Division
Water Pollution Enforcement Section
2600 Bull Street
Columbia, South Carolina 29201

(4) All other reports required by this permit shall be submitted at the frequency specified elsewhere in the permit to:
S.C. Department of Health and Environmental Control
Bureau of Water/Water Pollution Control Division
Water Pollution Enforcement Section
2600 Bull Street
Columbia, South Carolina 29201

b. If the permittee monitors any pollutant more frequently than required by the permit using test procedures approved under 40 CFR Part 136 or, in the case of sludge use or disposal, approved under 40 CFR Part 136 unless otherwise specified in R.61-9.503 or R.61-9.504, or as specified in the permit, all valid results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR or sludge reporting form specified by the Department. The permittee has sole responsibility for scheduling analyses, other than for the sample date specified in Part V, so as to ensure there is sufficient opportunity to complete and report the required number of valid results for each monitoring period.

c. Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Department in the permit.

5. Twenty-four hour reporting

a. The permittee shall report any non-compliance, which may endanger health or the environment. Any information shall be provided orally to local DHEC office within 24 hours from the time the permittee becomes aware of the circumstances. During normal working hours call:

County	**EQC Region**	**Phone No.**
Fairfield, Lexington, Newberry, Richland	Region 3 –Columbia EQC Office	803-896-0620

*After-hour reporting should be made to the 24-Hour Emergency Response telephone number 803-253-6488 or 1-888-481-0125 outside of the Columbia area.

A written submission shall also be provided to the address in Part II.L.4.a(4) within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

b. The following shall be included as information which must be reported within 24 hours under this paragraph.

(1) Any unanticipated bypass which exceeds any effluent limitation in the permit. (See R.61-9.122.44(g)).

(2) Any upset which exceeds any effluent limitation in the permit.

(3) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Department in the permit to be reported within 24 hours (See R 61-9.122.44(g)). If the permit contains maximum limitations for any of the pollutants listed below, a violation of the maximum limitations shall be reported orally to the DHEC/Bureau of Water/Water Pollution Control Division within 24 hours or the next business day.

(a) Whole Effluent Toxicity (WET),
(b) tributyl tin (TBT), and
(c) any of the following bioaccumulative pollutants:

α BHC
β BHC
δ BHC (Lindane)
BHC
Chlordane
DDD
DDE
DDT
Dieldrin
Hexachlorobenzene
Hexachlorobutadiene
Mercury
Mirex
Octachlorostyrene
PCBs
Pentachlorobenzene
Photomirex
1,2,3,4-Tetrachlorobenzene
1,2,4,5-Tetrachlorobenzene
2,3,7,8-TCDD
Toxaphene

c. The Department may waive the written report on a case-by-case basis for reports under Part II.L.5.b of this section if the oral report has been received within 24 hours.

6. Other noncompliance.

The permittee shall report all instances of noncompliance not reported under Part II.L.4 and 5 of this section and Part IV at the time monitoring reports are submitted. The reports shall contain the information listed in Part II.L.5 of this section.

7. Other information.

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 Department, it shall promptly submit such facts or information to the Water Facilities Permitting Division. This information may result in permit modification, revocation and reissuance, or termination in accordance with Regulation 61-9.

8. Existing manufacturing, commercial, mining, and silvicultural dischargers.

In addition to the reporting requirements under Part II.L.1-7 of this section, all existing manufacturing, commercial, mining, and silvicultural dischargers must notify the DHEC/Bureau of Water/Water Pollution Control Division of the Department as soon as they know or have reason to believe:

a. That any activity has occurred or will occur which would result in the discharge on a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

(1) One hundred micrograms per liter (100 μg/l);

(2) Two hundred micrograms per liter (200 μg/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 μg/l) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/l) for antimony;

(3) Five (5) times the maximum concentration value reported for that pollutant in the permit application; or

(4) The level established by the Department in accordance with section R.61-9.122.44(f).

b. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed in the highest of the following "notification levels":

(1) Five hundred micrograms per liter (500 μg/l);

(2) One milligram per liter (1 mg/l) for antimony;

(3) Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with R.61-9.122.21(g)(7).

(4) The level established by the Department in accordance with section R.61-9.122.44(f).

M. Bypass

1. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Part II.M.2 and 3 of this section.

2. Notice.

a. Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible, at least ten days before the date of the bypass to the DHEC/Bureau of Water/ Water Facilities Permitting Division.

b. Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in Part II.L.5 of this section.

3. Prohibition of bypass

a. Bypass is prohibited, and the Department may take enforcement action against a permittee for bypass, unless:

(1) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

(3) The permittee submitted notices as required under Part II.M.2 of this section.

b. The Department may approve an anticipated bypass, after considering its adverse effects, if the Department determines that it will meet the three conditions listed above in Part II.M.3.a of this section.

N. Upset

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of Part II.N.2 of this section are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

2. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

   a. An upset occurred and that the permittee can identify the cause(s) of the upset;

   b. The permitted facility was at the time being properly operated; and

   c. The permittee submitted notice of the upset as required in Part II.L.5.b(2) of this section.

   d. The permittee complied with any remedial measures required under Part II.D of this section.

3. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

O. Misrepresentation of Information

1. Any person making application for a NPDES discharge permit or filing any record, report, or other document pursuant to a regulation of the Department, shall certify that all information contained in such document is true. All application facts certified to by the applicant shall be considered valid conditions of the permit issued pursuant to the application.

2. Any person who knowingly makes any false statement, representation, or certification in any application, record, report, or other documents filed with the Department pursuant to the State law, and the rules and regulations pursuant to that law, shall be deemed to have violated a permit condition and shall be subject to the penalties provided for pursuant to 48-1-320 or 48-1-330.

Part III. Limitations and Monitoring Requirements

A. Effluent Limitations and Monitoring Requirements

1. During the period beginning on the effective date of this permit and lasting through the expiration date, the permittee is authorized to discharge from outfall serial number 01A: Recirculated cooling tower blowdown (internal outfall to Outfall 03A(and 03B))

Such discharge shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	**DISCHARGE LIMITATIONS**				**MONITORING REQUIREMENTS**	
	Mass		**Concentration**			
	Monthly Average	**Daily Maximum**	**Monthly Average**	**Daily Maximum**	**Sampling Frequency**	**Sample Type**
Flow	MR[1], MGD	MR[1], MGD			1/week	Estimate[2]
Free Available Chlorine (FAC)[3]			0.2 mg/l	0.5 mg/l	1/week	Multiple Grabs[4]
Chromium, total[5]			0.2 mg/l	0.2 mg/l	1/month	Grab
Zinc, total[5]			1.0 mg/l	1.0 mg/l	1/month	Grab

[1] MR: Monitor and Report

[2] See Part II.J.1.b

[3] See Part I.O and V.A.4.

[4] Multiple grabs shall consist of grab samples collected at the approximate beginning of the period of Total Residual Chlorine (TRC) and/or Free Available Chlorine (FAC) discharge and once every twenty (20) minutes until TRC or FAC is no longer present.

[5] These parameters are only required to be monitored when chromium and zinc-containing cooling tower maintenance chemicals are used.

a. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): at or near the cooling tower discharge but prior to mixing with the receiving stream or any other waste stream.

b. The discharge of one hundred twenty-six (126) toxic pollutants, except chromium and zinc, is prohibited in detectable amounts in chemicals added for cooling tower maintenance. The permittee may demonstrate compliance with such limitations by either routinely sampling and analyzing for the pollutants in the discharge or providing engineering calculations which demonstrate that the regulated pollutants are not detectable in the discharge. Results of sampling or calculations to meet this requirement shall be submitted as an attachment to the DMRs on an annual basis. See Attachment 4 of the Fact Sheet for this permit for a list of PQLs and methods for these pollutants to be used to determine detectable amounts.

2. During the period beginning on the effective date of this permit and lasting through the expiration date, the permittee is authorized to discharge from outfall serial numbers 03A and 03B: cooling tower blowdown from 01A, low volume wastes, ash transport wastewaters, coal pile runoff, miscellaneous power plant wastewaters, and storm water

Such discharge shall be limited and monitored by the permittee as specified below:

Effluent Characteristics	**Discharge Limitations**					**Monitoring Requirements**	
	Mass		**Concentration**				
	Monthly Average	**Daily Maximum**	**Monthly Average**	**Daily Maximum**	**Instantaneous Maximum[1]**	**Sampling Frequency**	**Sample Type**
Flow	MR[2], MGD	MR[2], MGD				1/month	Instantaneous[3]
pH			Min[1] 6.0 su		Max 8.5 su	1/month	Grab
Total Suspended Solids (TSS)			30 mg/l		100 mg/l	1/month	Grab
Oil & Grease			15 mg/l	20 mg/l		1/month	Grab
Temperature				MR[2] °F		1/quarter	Grab
Ammonia, total			MR[2] mg/l[4,5]	MR[2] mg/l[4,5]		1/quarter	Grab
Mercury, total			MR[2] µg/l[4,5]	MR[2] µg/l[4,5]		1/quarter	Grab
Phosphorous, total	MR[2] lb/d		MR[2] mg/l[4,5]	MR[2] mg/l[4,5]		1/quarter	Grab
Iron				MR[2] mg/l[4,5]		1/quarter	Grab
Manganese				MR[2] mg/l[4,5]		1/quarter	Grab
Iron in intake water				MR[2] mg/l		1/quarter	Grab
Manganese in intake water				MR[2] mg/l		1/quarter	Grab

[1] See Part I.T
[2] MR: Monitor and Report
[3] See Part II.J.1.b
[4] See Part V.A.8
[5] See Part V.A.9

a. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): after treatment and prior to mixing with the receiving stream or any other waste stream.

b. Use of Outfall No. 03B shall be limited to emergency conditions necessary to assure dike stability and shall not be used for routine discharge. Notification of each emergency use and the reason for the emergency shall be made per Part II.L.5.

3. **Interim Limits:** During the period beginning on the effective date of this permit and lasting through the date of notification by the Department to the Permittee based on issuance of the Approval to Place into Operation for either the FGD scrubber blowdown system or landfill sedimentation basin or April 1, 2011, whichever comes first, the permittee is authorized to discharge from outfall serial numbers 03A and 03B: cooling tower blowdown from 01A, low volume wastes, ash transport wastewaters, coal pile runoff, miscellaneous power plant wastewaters, and storm water

Such discharge shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	**DISCHARGE LIMITATIONS**				**MONITORING REQUIREMENTS**	
	Mass		**Concentration**			
	Monthly Average	**Daily Maximum**	**Monthly Average**	**Daily Maximum**	**Sampling Frequency**	**Sample Type**
Arsenic, total			MR[1,2] mg/l	MR [1,2] mg/l	1/month	Grab

[1] MR: Monitor and Report
[2] See Part V.A.9

Final Limits: During the period beginning on the date of notification by the Department to the Permittee based on issuance of the Approval to Place into Operation for either the FGD scrubber blowdown system or landfill sedimentation basin, or April 1, 2011, whichever comes first and lasting until the expiration date of the permit, the permittee is authorized to discharge from outfall serial numbers 03A and 03B: cooling tower blowdown from 01A, low volume wastes, ash transport wastewaters, landfill runoff/leachate, coal pile runoff, miscellaneous power plant wastewaters, and storm water

Such discharge shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	**DISCHARGE LIMITATIONS**				**MONITORING REQUIREMENTS**	
	Mass		**Concentration**			
	Monthly Average	**Daily Maximum**	**Monthly Average**	**Daily Maximum**	**Sampling Frequency**	**Sample Type**
Arsenic, total			0.027 mg/l	0.040 mg/l	1/month	Grab

a. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): after treatment and prior to mixing with the receiving stream or any other waste stream.

b. Use of Outfall No. 03B shall be limited to emergency conditions necessary to assure dike stability and shall not be used for routine discharge. Notification of each emergency use and the reason for the emergency shall be made per Part II.L.5.

B. Whole Effluent Toxicity and Other Biological Limitations and Monitoring Requirements

1. During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the permittee is authorized to discharge from serial numbers 03A and 03B: cooling tower blowdown from 01A, low volume wastes, ash transport wastewaters, landfill runoff/leachate, coal pile runoff, miscellaneous power plant wastewaters, and storm water

   Such discharge shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	**DISCHARGE LIMITATIONS**		**MONITORING REQUIREMENTS**	
	Monthly Average	Daily Maximum	Measurement Frequency	Sample Type
Ceriodaphnia dubia Acute Whole Effluent Toxicity @ ATC= 15%	-	0*	1/quarter	Grab

* Report "0" if test passes or "1" if test fails in accordance with Part V.B.1

a. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations: at or near the discharge, but prior to mixing with the receiving waters.

2. During the period beginning on the effective date and lasting through the expiration date, the permittee is authorized to discharge from outfall serial numbers 03A and 03B: cooling tower blowdown from 01A, low volume wastes, ash transport wastewaters, landfill runoff/leachate, coal pile runoff, miscellaneous power plant wastewaters, and storm water

Such discharge shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS	
	Monthly Average	Maximum[1]	Measurement Frequency	Sample Type
Ceriodaphnia dubia Chronic Whole Effluent Toxicity @ CTC= 2.3%	MR %[2]	MR %[2]	1/month[3]	Grab
Ceriodaphnia dubia Chronic Whole Effluent Toxicity-Reproduction @ CTC=2.3%	MR %[2]	MR %[2]	1/month[3]	Grab
Ceriodaphnia dubia Chronic Whole Effluent Toxicity- 7-day Survival @ CTC=2.3%	MR %[2]	MR %[2]	1/month[3]	Grab

[1] Maximum is defined as the highest percent effect of all valid tests performed during the monitoring period following the procedures in Part V.B.2.d.

[2] See Part V.B.2 for additional toxicity reporting requirements. MR = Monitor and Report.

[3] Valid tests must be separated by at least 7 days (from the time the first sample is taken to start one test until the time the first sample is taken to start a different test). There is no restriction on when a new test may begin following a failed or invalid test.

a. Samples used to demonstrate compliance with the discharge limitations and monitoring requirements specified above shall be taken at or near the final point-of-discharge but prior to mixing with the receiving waters or other waste streams.

b. Valid test results from split samples shall be reported on the DMR. For reporting an average on the DMR, individual valid results for each test from a split sample are averaged first to determine a sample value. That value is averaged with other sample results obtained in the reporting period and the average of all sample results reported. For reporting the maximum on the DMR, individual valid results for each test from a split sample are averaged first to determine a sample value. That value is compared to other sample results obtained in the reporting period and the maximum of all sample results reported. For the purposes of reporting, split samples are reported as a single sample regardless of the number of times it is split. All laboratories used shall be identified on the DMR attachment.

C. Groundwater Monitoring Requirements

See Part V.C.

D. Sludge Monitoring Requirements

See Part V.D

E. Soil Monitoring Requirements

none

Part IV. Schedule of Compliance

A. Schedule(s)

1. For arsenic limits on Outfalls 03A and 03B:

Date Due	Action Required
February 1, 2009	Submit an interim report of progress describing measures to comply with the Final Limits for arsenic on page 21 of this permit. The report should describe the progress towards construction of the FGD scrubber system and landfill runoff/leachate basin.
October 1, 2009	If the Approvals to Place into Operation for both the FGD scrubber blowdown system and landfill runoff/leachate basin have not been granted by this date, the permittee shall submit three copies of a Preliminary Engineering Report (PER), in accordance with South Carolina Regulation 61-67, which clearly describes how the facility will attain compliance with the arsenic final limitations set forth on page 21. If there are no plans to construct any wastewater treatment facilities, an alternative method of compliance must be identified by this date and a revised schedule for its compliance shall be proposed, as necessary, to meet the final limits due date. If this alternative method does not include plans to perform additional work to meet the limitations, the permittee shall request that the final limits become effective immediately.
July 1, 2010	If construction of any wastewater treatment and/or collection facilities is necessary to meet the final limitations, the permittee shall submit three copies of an administratively and technically complete Construction Permit Application (DHEC Form 1970). If no construction is necessary, provide a progress report with the justification for no construction included per the alternative method indicated in the submittal above.
Upon notification to the permittee by the Department based on receipt of Approval to Place into Operation of either the FGD scrubber system blowdown or the landfill runoff/leachate basin or April 1, 2011, whichever comes first	The discharge shall be in compliance with arsenic final limitations on page 21.

B. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each scheduled date.

Part V. Other Requirements

A. Effluent Requirements

1. There shall be no discharge of floating solids or visible foam in other than trace amounts, nor shall the effluent cause a visible sheen on the receiving waters.

2. There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

3. The Permittee shall route metal cleaning wastes to a separate holding basin, which shall have no discharge to surface waters or other plant streams.

4. Neither free available chlorine or total residual chlorine may be discharged from any single generating unit for more than two (2) hours in any one day, and not more than one unit in any plant may discharge Free Available Chlorine or Total Residual Chlorine at any one time unless the permittee can demonstrate to the Department that the units in a particular location cannot operate at or below this level of chlorination.

5. Unless authorized elsewhere in this Permit, the permittee must meet the following requirements concerning maintenance chemicals for the following waste streams: once-through noncontact cooling water, recirculated cooling water, boiler blowdown water, and air washer water. Maintenance chemicals shall be defined as any man-induced additives to the above-referenced waste streams.

   a. Detectable amounts of any of the one hundred and twenty-six priority pollutants is prohibited in the discharge, if the pollutants are present due to the use of maintenance chemicals.

   b. Slimicides, algicides and biocides are to be used in accordance with registration requirements of the Federal Insecticides, Fungicide and Rodenticide Act.

   c. The use of maintenance chemicals containing bis(tributyltin) oxide is prohibited.

   d. Any maintenance chemicals added to the above-referenced waste streams must degrade rapidly, either due to hydrolytic decomposition or biodegradation.

   e. Discharges of maintenance chemicals added to waste streams must be limited to concentrations which protect indigenous aquatic populations in the receiving stream.

   f. The permittee must keep sufficient documentation on-site that would show that the above requirements are being met. The information shall be made available for on-site review by Department personnel during normal working hours.

   g. The occurrence of instream problems may necessitate the submittal of chemical additive data and permit modification to include additional monitoring and limitations.

6. The company shall notify the South Carolina Department of Health and Environmental Control in writing no later than sixty (60) days prior to instituting use of any additional maintenance chemicals in the cooling water system. Such notification shall include:

a. Name and general composition of the maintenance chemical
b. Quantities to be used
c. Frequency of use
d. Proposed discharge concentration
e. EPA registration number, if applicable
f. Aquatic toxicity information

7. The permittee is required to submit a completed Form 2C for the discharge from Outfall 03A within 21 months of the start of operations discharging from both the landfill runoff/leachate basin and the FGD scrubber blowdown system. The permittee shall provide at least four (4) samples for all parameters in Section V Part A, Part B, and Part C.1M-15M, 1V-31V, and 1A-11A. These four samples shall be separated such that one sample is collected during each season (i.e., spring, summer, fall and winter) after operations at these facilities begin discharging. Sampling should begin after three months of operation of the scrubbers and landfill runoff/leachate basin.

8. This permit may be reopened to include additional monitoring and/or limitations for ammonia, mercury, phosphorus, iron and manganese based on monitoring results obtained.

9. Where the permit limitation in Part III is below the practical quantitation limit (PQL), the PQL and analytical method stated below shall be considered as being in compliance with the permit limit. Additionally, where the permit requires only monitoring and reporting (MR) in Part III, the PQL and analytical method stated below shall be used for reporting results.

Parameter	Analytical Method	PQL
Ammonia	SM4500NH3 C, F, G or H, or EPA 350.1 (Rev. 2.0 1993)	0.10 mg/l
Arsenic	200.8, 200.9, SM3113B	0.0050 mg/l
Mercury	1669(sampling)/1631E (analysis)	0.0005 µg/l
Phosphorus	365.1(Rev. 2.0 1993), 365.3, 365.4, or SM 4500 P, E, or F	0.050 mg/l
Iron	200.7, 200.8, 200.9	0.020 mg/l
Manganese	200.7, 200.8, 200.9	0.010 mg/l

B. Whole Effluent Toxicity and Other Biological Requirements

1. Acute Toxicity -For the requirements identified in Part III.B.1:

a. A 48-hour static acute toxicity test shall be conducted at the frequency stated in Part III.B Effluent Toxicity Limitations and Monitoring Requirements using a control and the acute test concentration (ATC) of 15%. The test shall be conducted using *Ceriodaphnia dubia* as the test organism using EPA Method 2002.0 in accordance with "Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms," EPA 821/R-02/012 (October 2002). The test shall be conducted at 25°C ±1°C.

b. If the test group *Ceriodaphnia dubia* survival is less than the control group survival at the 0.05α level of a left-tailed Fisher's exact test, the test shall be deemed a failure.

c. The permittee must report on the discharge monitoring report (DMR) form whether the test passes or fails at the specified ATC. If the test fails, the number "1" shall be placed on the form. If the test passes, the number "0" shall be placed on the form. If more than one test is performed during a monitoring period (including tests from split samples), the worst case result shall be reported on the DMR. The DMR Attachment for Toxicity Test Results, DHEC Form 3420, shall also be completed and submitted with the DMR.

d. A test shall be invalidated if any part of Method 2002.0 is not followed or if the laboratory is not certified at the time the test is conducted.

e. All valid toxicity test results shall be submitted on the DHEC Form 3710 entitled "DMR Attachment for Toxicity Test Results" in accordance with Part II.L.4. In addition, results from all invalid tests must be appended to DMRs, including lab control data. The permittee has sole responsibility for scheduling toxicity tests so as to ensure there is sufficient opportunity to complete and report the required number of valid test results for each monitoring period.

f. The permittee is responsible for reporting a valid test during each monitoring period. However, the Department acknowledges that invalid tests may occur. All of the following conditions must be satisfied for the permittee to be in compliance with Whole Effluent Toxicity (WET) testing requirements for a particular monitoring period when a valid test was not obtained.

   (1) A minimum of five (5) tests have been conducted which were invalid in accordance with Part V.B.1.d above;
   (2) The data and results of all invalid tests are attached to the DMR;
   (3) At least one additional State-certified laboratory is used after two (2) consecutive invalid tests were determined by the first laboratory. The name(s) and lab certification number(s) of the additional lab(s) shall be reported in the comment section of the DMR; and
   (4) A valid test was reported during each of the previous three reporting periods.

   If these conditions are satisfied, the permittee may enter "H" in the appropriate boxes on the toxicity DMR and add the statement to the Comment Section of the DMR that "H indicates invalid tests."

g. This permit may be modified based on new information that supports a modification in accordance with Regulation 61-9.122.62 and Regulation 61-68.D.

2. Chronic Toxicity - For the requirements identified in Part III.B.2:

a. A *Ceriodaphnia dubia* three brood chronic toxicity test shall be conducted at the frequency stated in Part III.B, Effluent Toxicity Limitations and Monitoring Requirements, using the chronic test concentration (CTC) of 2.3% and the following test concentrations: 0% (control), 1.0%, 10%, 32% and 100% effluent. The permittee may add additional test concentrations without prior authorization from the Department provided that the test begins with at least 10 replicates in each concentration and all data is used to determine permit compliance.

b. The test shall be conducted using EPA Method 1002.0 in accordance with "Short-Term Methods for Estimating Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms," EPA/821/R-02/013 (October 2002).

c. The permittee shall use the linear interpolation method described in "Short-Term Methods for Estimating Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms," EPA/821/R-02/013 (October 2002), Appendix M to estimate the percent effect on survival and reproduction at the CTC according to the equations in d below.

d. The linear interpolation estimate of percent effect is $\left(1-\frac{M_{CTC}}{M_1}\right)*100$ if the CTC is a tested concentration. Otherwise, it is

$$\left(1-\frac{M_J-\frac{M_{J+1}-M_J}{C_{J+1}-C_J}*C_J+\frac{M_{J+1}-M_J}{C_{J+1}-C_J}*CTC}{M_1}\right)*100.$$

e. The permittee shall report the percent effect on both *Ceriodaphnia dubia* survival and reproduction at the CTC. Overall percent effect is the greater of the percent effect on survival and reproduction. On the DMR Attachment, the permittee shall also report the IC25 and, using the same test data, the 48-hour chronic LC50.

f. A test shall be invalidated if any part of Method 1002.0 is not followed or if the laboratory is not certified at the time the test is conducted.

g. All valid toxicity test results shall be submitted on the DHEC Form 3710 entitled "DMR Attachment for Toxicity Test Results" in accordance with Part II.L.4. In addition, results from all invalid tests must be appended to DMRs, including lab control data. The permittee has sole responsibility for scheduling toxicity tests so as to ensure there is sufficient opportunity to complete and report the required number of valid test results for each monitoring period.

h. The permittee is responsible for reporting a valid test during each monitoring period. However, the Department acknowledges that invalid tests may occur. All of the following conditions must be satisfied for the permittee to be in compliance with Whole Effluent Toxicity (WET) testing requirements for a particular monitoring period when a valid test was not obtained.

   (1) A minimum of five (5) tests have been conducted which were invalid in accordance with Part V.B.1.e above;

   (2) The data and results of all invalid tests are attached to the DMR;

   (3) At least one additional State-certified laboratory is used after two (2) consecutive invalid tests were determined by the first laboratory. The name(s) and lab certification number(s) of the additional lab(s) shall be reported in the comment section of the DMR; and

   (4) A valid test was reported during each of the previous three reporting periods.

If these conditions are satisfied, the permittee may enter "H" in the appropriate boxes on the toxicity DMR and add the statement to the Comment Section of the DMR that "H indicates invalid tests."

i. This permit may be modified based on new information that supports a modification in accordance with Regulation 61-9.122.62 and Regulation 61-68.D.

C. Groundwater Requirements

A groundwater monitoring plan should be submitted to the Ground Water Quality Section (see address in Part II.L.4.a(2)) for approval within six months of completing construction of the landfill runoff/leachate basin. The plan should include a minimum of three monitoring wells, with at least two located downgradient and within 50 feet of the basin. Analytical parameters should be similar to those specified in Mixing Zone Agreement #01-053-W, with the addition of total mercury, established for the SCE&G/Wateree Facility in February 2001.

D. Sludge Requirements

1. All waste oil and solid and hazardous waste shall be properly disposed of in accordance with the rules and regulations of the Bureau of Land and Waste Management of SCDHEC.
2. The on-site landfill will primarily receive the gypsum solids from the FGD scrubber, though it is approved to accept fly ash and bottom ash as well. Fly/bottom ash, including ash recovered from the ash basins and gypsum may also be sent off-site for recycling or beneficial reuse. The permittee shall obtain written approval from the Industrial Wastewater Permitting Section prior to sending any ash material off-site for disposal.
3. Written approval from the Department must be obtained prior to disposal of other sludges or use of other sludge disposal methods.

E. Other Conditions

1. The wastewater treatment plants are each assigned a classification of Group I-P/C. The Environmental Certification Board Rules require that a Grade D-P/C operator be assigned to operate these facilities.
2. The permittee shall maintain an all weather access road to the wastewater treatment plant and appurtenances at all times.
3. The permittee shall monitor all parameters consistent with conditions established by this permit on the 1st Thursday of every calendar month in which sampling is required, unless otherwise approved by this Department. If this day falls on a holiday, sampling shall be conducted on the next business day. If no discharge occurs on this day, the permittee shall collect an effluent sample during the reporting period on a day when there is a discharge or report "no discharge" for the reporting period for all parameters. Additional monitoring as necessary to meet the frequency requirements of this permit shall be performed by the permittee.
4. The permittee shall continue to maintain a Best Management Practices (BMP) plan to identify and control the

discharge of significant amounts of oils and the hazardous and toxic substances listed in 40 CFR Part 117 and Tables II and III of Appendix D to 40 CFR Part 122. The plan shall include a listing of all potential sources of spills or leaks of these materials, a method for containment, a description of training, inspection and security procedures, and emergency response measures to be taken in the event of a discharge to surface waters or plans and/or procedures which constitute an equivalent BMP. Sources of such discharges may include materials storage areas; in-plant transfer, process and material handling areas; loading and unloading operations; plant site runoff; and sludge and waste disposal areas. The BMP plan shall be developed in accordance with good engineering practices, shall be documented in narrative form, and shall include any necessary plot plans, drawings, or maps. The BMP plan shall be maintained at the plant site and shall be available for inspection by EPA and Department personnel.

5. The permittee shall not store coal, soil nor other similar erodible materials in a manner in which runoff is uncontrolled, nor conduct construction activities in a manner which produces uncontrolled runoff unless such uncontrolled runoff has been specifically approved by SCDHEC. "Uncontrolled" shall mean without sedimentation basin or other controls approved by SCDHEC.

6. The permittee shall periodically survey all ash basin dikes and toe areas and to determine that seepage is not occurring. In the event that seepage does occur and has the potential to reach waters of the State, the permittee shall notify SCDHEC within five (5) days of becoming aware of the situation and provide a proposed course of corrective action and implementation schedule.

7. Intake screen backwash may be discharged from this facility.

8. This permit no longer covers the discharge of storm water associated with industrial activity. The permittee shall obtain coverage for storm water associated with industrial activity after the issuance of this permit and prior to the effective date of this permit to remain covered for those discharges.

9. This permit may be reopened to address compliance with 316(b) requirements for cooling water intake structures upon resolution of the EPA regulations in 40 CFR Part 125 Subpart J.

6.1

HYDROGEOLOGIC ASSESSMENT REPORT, GENERAL ENGINEERING, MAY 1998

Hydrogeologic Assessment Report

South Carolina Electric & Gas Company
Wateree Station
Eastover, South Carolina

Submitted to:

South Carolina Electric & Gas Company
6248 Bush River Road
Columbia, South Carolina 29212

Submitted by:

General Engineering
A Division of General Engineering Laboratories, Inc.
Post Office Box 30712/2040 Savage Road
Charleston, South Carolina 29417

Submittal Date: May 15, 1998

Hydrogeologic Assessment Report

South Carolina Electric & Gas Company
Wateree Station
Eastover, South Carolina

TABLE OF CONTENTS

Signature Page

This report, entitled "Hydrogeologic Assessment Report," has been prepared for the South Carolina Electric and Gas Company, Wateree Station facility located on Highway 601 in Eastover, South Carolina. It has been prepared by Tracy J. Barnhart, P.G. at the request of South Carolina Electric and Gas Company. It has been prepared in accordance with accepted quality control practices and has been reviewed by the undersigned.

GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

Tracy Barnhart
Tracy J. Barnhart, P.G.
Project Hydrogeologist I

for Tracy Barnhart
Scott D. Carney, P.E.
Senior Staff Engineer

Tom Hutto
Thomas D.W. Hutto, P.G.
Senior Staff Hydrogeologist

May 15, 1998
Date

Hydrogeologic Assessment Report

South Carolina Electric & Gas Company
Wateree Station
Eastover, South Carolina

Executive Summary

The South Carolina Electric & Gas Company (SCE&G) Wateree Station facility is located along Highway 601 near Eastover, South Carolina. SCE&G operates two adjacent approximately 80-acre ash ponds at Wateree Station, an electrical power generating facility. Pond 1 was constructed in a re-worked borrow pit, and Pond 2 was constructed adjacent to Pond 1 but outside of the historic borrow pit area. Pond 1 contains bottom ash and fly ash generated by the burning of coal for power generation, while Pond 2 receives only wastewater overflow from Pond 1.

Routine groundwater monitoring required by the South Carolina Department of Health and Environmental Control as a permit condition of SCE&G's National Pollution Discharge Elimination System Permit indicated that elevated arsenic concentrations are present in groundwater near the ponds. This hydrogeologic assessment was performed to obtain data concerning the site stratigraphy and aquifer characteristics so that potential horizontal and vertical migration pathways for arsenic impacted groundwater could be better defined. In addition, groundwater quality in the surficial aquifer near the river was also evaluated. Furthermore, a determination of the volume of ash remaining in Pond 1 was made.

Results of the assessment indicate that approximately 1,683,000 cubic yards of ash are currently present in Pond 1. Stratigraphic boreholes installed in the vicinity of the ash ponds indicate that isolated lenses of conductive sands are present between Pond 1 and the river, and in localized areas on the western side of Pond 1. These sands appear to be a preferential flow paths for the arsenic-impacted groundwater.

The groundwater quality assessment consisted of the installation and sampling of two groundwater monitoring wells near the Wateree River. Results of the groundwater analyses indicate that the arsenic is predominantly traveling through the lower portions of the aquifer and is likely discharging to the river as base flow. However, based on the presence of the Sawdust Landing Formation, a confining unit, at approximately 24 feet below land surface (bls) east of the pond and 55 feet bls west of the pond, the arsenic impact will be limited to the surficial aquifer. Furthermore, shallow clays likely limit arsenic to shallower depths even within the surficial aquifer. Based on the results of this assessment, the applicability of a mixing zone to Wateree Station will be evaluated.

Hydrogeologic Assessment Report

South Carolina Electric & Gas Company
Wateree Station
Eastover, South Carolina

1.0 Introduction

The South Carolina Electric & Gas Company (SCE&G) Wateree Station facility is located along Highway 601 near Eastover in lower Richland County, South Carolina. The location of this site is shown on Figure 1, an excerpt from the United States Geologic Survey (USGS) 7.5-minute quadrangle maps of Wateree and Poinsett State Park, South Carolina.

Wateree Station is an electrical power generating station located on the Wateree River. SCE&G operates two adjacent approximately 80-acre ash ponds at Wateree Station. The locations of the ponds are shown on Figures 1 and 2. Pond 1 was constructed in a re-worked borrow pit, and Pond 2 was constructed adjacent to Pond 1 but outside of the historic borrow pit area. The ponds were designed to receive waste water, bottom ash and fly ash generated by the burning of coal for power generation. Pond 1 currently receives ash, whereas Pond 2 receives only wastewater overflow from Pond 1 and functions as a polishing pond. The ash in Pond 1 is separated from the Wateree River by a dike which is approximately 150 feet wide at its narrowest location.

Over the last 15 years, SCE&G has intensified efforts to market both fly ash and ponded ash from Wateree Station. By their estimate, sales of ash have effectively reduced inventory in Pond 1 by approximately 100,000 yd3. Wateree Station has recently invested significant capital funds and is in the final construction phase of a new ash handling system, which will process dry fly-ash. The technology to be employed will re-burn dry fly ash to remove residual carbon, and thereby significantly improve the quality and marketablility of the ash. When the Carbon Burn Out processing plant is started in late 1998, fly ash may be virtually eliminated as a waste stream managed in the ponds. SCE&G believes this investment to improve ash quality along with ongoing efforts to market and reclaim ponded ash will continue to mitigate any long term impact from the remaining pond ash inventory.

Ash will contain varying concentrations of trace metals which are natural constituents of coal. As the ash comes in contact with water, some of the metal constituents within the ash tend to leach or dissolve into the water and cause trace concentrations of metals. As a result, arsenic has been detected in two groundwater monitoring wells and some surface water seeps at the site.

This investigation was conducted in response to the South Carolina Department of Health and Environmental Control's (DHEC's) request for further evaluation. General Engineering performed this hydrogeologic assessment to obtain additional data concerning the site stratigraphy and aquifer characteristics so that potential horizontal and vertical migration pathways for arsenic impacted groundwater could be better defined. Also included in the assessment was a determination of the approximate volume of ash remaining in Pond 1. Details of these activities and a summary of previous site activities are discussed in the following sections.

2.0 Previous Site Activities and Current Operations

In 1994, SCE&G installed groundwater monitoring wells MW-1 through MW-9 around the periphery of the ponds at the locations shown on Figure 3. Installation of the wells was required by DHEC as a permit condition of SCE&G's National Pollution Discharge Elimination System (NPDES) Permit Number SC0002038. Quarterly groundwater monitoring was initiated as requested by DHEC. Elevated arsenic concentrations have been detected in groundwater samples collected from well MW-7 and, to a lesser extent, in samples collected from well MW-3. Elevated arsenic concentrations have not been detected in the remaining seven wells.

Based on the arsenic detections, DHEC requested that additional evaluation be conducted. In June 1997, two samples of surface water seeps were collected from the toe of the dike next to the Wateree River near well MW-7, and one sample was collected from a seep near well MW-3. The sample locations are shown on Figure 3. The most elevated arsenic concentrations were detected in the seep samples collected near well MW-7, downgradient of Pond 1. The concentrations detected near well MW-3 was below regulatory standards.

Since construction of the ponds in 1970, the width of the dike separating the two ponds from the Wateree River has diminished as a result of erosion. Figure 4 shows an overlay of historical aerial photographs over a site base map which illustrates the natural migration of the river over time relative to the ponds and the former borrow pit. The figure shows a trace of the river location at various years and the approximate former location of the borrow pit. The borrow pit was originally mined in linear trenches which were oriented at a slight angle to the river.

Figure 4 shows that the Wateree River in the immediate vicinity of the site has migrated westward over time, toward the ash ponds. The river appears to have migrated approximately 120 to 200 feet to the west between 1938 and 1970. Consequently, SCE&G has initiated a river bank stabilization plan for the areas that have suffered the most erosion. To stabilize the river bank, slopes are being cut and stabilized with a variety of hard materials designed to withstand erosion. Ash is also being excavated from the interior side of the dike of Pond 1 and moved approximately 50 to 100 feet from its existing position along the dike margin. One of the areas planned for stabilization is near well MW-7; therefore, this well was relocated during this hydrogeologic assessment, as discussed in the following sections.

3.0 Geology and Hydrogeology of the Area

The Wateree Station is located in lower Richland County and is underlain by sediments of the Upper Coastal Plain Physiographic Province. This area of the Coastal Plain is composed of mostly unconsolidated sedimentary strata overlying a shallow basement of igneous and metamorphic rocks.

3.1 Regional Geology and Hydrogeology

Previous regional studies indicate that this area is underlain by a Precambrian crystalline basement complex, the Cretaceous age Middendorf and Black Creek formations, and the Paleocene age Black Mingo group, which consists of the Sawdust Landing and Lang Syne Formations. The uppermost soils underlying the site are unconsolidated sediments deposited in the flood plain of the Wateree River.

The regional topography of the area gently slopes toward the Wateree River. The western side of the river is mostly highland in the vicinity of the subject site with numerous tributaries which drain eastward, toward the river. The eastern side of the river is flanked by wetlands with some highland.

3.2 Site Geology and Hydrogeology

The uppermost sediments at the site are composed of relatively sandy clay overlain and underlain by clay at varying depths across the site. The confining bottom clay is within the Black Mingo Group, and is suspected to be the Sawdust Landing Formation. Some isolated occurrences of clean sand are present. These sands are potential preferential pathways for groundwater flow. Groundwater is present from approximately 8 to 23 feet below land surface (bls), and the overall groundwater flow is toward the Wateree River.

4.0 Hydrogeologic Assessment

To evaluate the arsenic occurrences in the groundwater, General Engineering conducted a hydrogeologic assessment of the Wateree Station property surrounding Pond 1. The assessment was designed to: 1) better define the overall stratigraphy of the area, 2) further evaluate groundwater quality, 3) identify preferential groundwater flow paths, and 4) evaluate aquifer characteristics in the immediate vicinity of the ponds and river.

4.1 Define Overall Site Stratigraphy

During previous well installations on the site, sediments of the surficial aquifer were characterized; however, the stratigraphy was not well defined. To define the site stratigraphy in the vicinity of the ponds, eight boreholes were installed at the locations shown on Figure 3. These borings are designated B-1 through B-6, P-1, and MW-10. P-1 and MW-10 are also locations of a piezometer and groundwater monitoring well, respectively. The stratigraphic boreholes were installed within 2 feet of the piezometer and well location; due to the scale of the map, they could not be differentiated on Figure 3.

All borings were installed using a drill rig equipped with 3.5-inch inside diameter hollow-stem augers. During boring activities, a 2-foot split-spoon soil sample was collected from every 5 feet drilled. The lithology was classified by an on-site hydrogeologist. The boring logs are included in Appendix I. Based on the river locations shown on Figure 4, it appears that the locations of the wells and borings installed previously and during this assessment are outside the former borrow pit, which indicates that these sediments are likely native.

To better define the base of the uppermost aquifer and provide data on the potential for vertical migration of impacted groundwater, three deep borings (B-1, B-2, and P-1) were installed around the perimeter of the ponds to depths ranging from approximately 45 to 65 feet bls. The locations of these borings are shown on Figure 3.

Borings B-1 and B-2 are located on the western side of the ash ponds along with existing well MW-3. P-1 is located on the eastern side of the pond, along the dike. As shown on the logs from borings B-2 and P-1, a dense clay was encountered from the land surface to approximately 29 and 13 feet bls, respectively. Sands and sandy clays were encountered beneath the dense clay in each of these boreholes. The log of B-1 indicates that interbedded clay and sandy clays dominate the lithology of this borehole. A dense clay was noted at a depth of approximately 55 feet bls in B-1 and B-2 and at 24 feet bls in P-1. Characteristics of this clay indicate that it is likely the Sawdust Landing Formation of the Black Mingo Group and is the aquitard that forms the base of the uppermost aquifer.

Based on the construction of boreholes within Pond 1, discussed in Section 5.0 below, the approximate depth of the base of Pond 1 is 18 to 20 feet below the top of the dike. Therefore, the western side of the base of the pond appears to be within the sands of the surficial aquifer. This explains why elevated concentrations of arsenic were detected in MW-3 since the sand would act as a primary transport conduit for water from the.

On the eastern side of Pond 1, clay underlain by sand was identified to depths ranging from 23 to 34.5 feet bls in all previously installed wells except well MW-7 in which the clay terminated at 14 feet bls. The occurrence of sand in MW-7 at depths that correspond to the lower portion of the pond is likely a primary reason for the higher arsenic concentrations detected at this location compared to other locations.

To further document the variability and distribution of sediments along the dike wall between Pond 1 and the Wateree River and to determine if additional preferential flow pathways exist, six stratigraphic boreholes were installed along the dike and near the river bank. The six boring locations, B-3, B-4, B-5, B-6, P-1, and MW-10 are shown on Figure 3. Borings B-3, B-5, and MW-10 were installed to depths of 30 feet each. Boring B-4 was installed to a depth of 37 feet bls, and B-6 and P-1 were installed to depths of 45 feet bls.

Figure 5 shows a layout of the boring locations and the lines of two cross-sections (A-A' and B-B') which have been drawn through the study area between Pond 1 and the river. As shown on Figure 6, a cross-section across the length of the dike downgradient of Pond 1, clay and sandy clay underlain by a dense, hard, clay dominate the lithology. However, isolated sand lenses occur in borings B-4, P-1, and B-6 as was noted during the installation of MW-7. These sand pockets may also act as preferential flow pathways for arsenic impacted groundwater.

The logs of borings B-3, B-4, B-5, and B-6 indicate that the top of the underlying white and gray dense, hard clay was encountered in these boring at depths of 24.5 feet, 29.5 feet, 28.5 feet, and 45 feet bls, respectively. This clay is likely the Sawdust Landing formation and the basal confining layer of the surficial aquifer. Other isolated clays are also present above a 45 foot depth in boring B-6. These clays, although dense in areas, are not thought to be a part of the Sawdust Landing Formation; however, they could act as local aquitards. Similarly to the situation with MW-3, the base of the ash pond abuts the clean sands of the surficial aquifer on the eastern side indicating that these sands, where present, serve as a primary flow conduit. Since the Sawdust Landing formation was encountered at depths below the pond base on both sides of the pond, arsenic containing groundwater is not expected to migrate downward, through the confining unit.

The boring log from MW-10 indicates that coarse grained sands dominate the lithology to a depth of 19 feet bls where the dense clay of the suspected Sawdust Landing formation is encountered. Cross-section B-B' presented as Figure 7 is a section from P-1 to MW-10. The depths of the sands and clays in the other piezometers are inferred on the cross-section because stratigraphic boreholes were not installed at each location since P-1 and MW-10 bracket the line of piezometers. Both P-1 and MW-10 contain medium to coarse grained sands above the confining clay which is likely a preferential flow pathway for the arsenic impacted groundwater.

4.2 Install Piezometers to Define Groundwater Flow

To evaluate the groundwater flow regime between Pond 1 and the Wateree River, four piezometers P-1 through P-4 were installed across the dike, as shown on Figure 3. These piezometers were installed using a drill rig equipped with 4 1/4-inch inside diameter hollow-stem augers. The piezometers were constructed of 2-inch diameter, flush-threaded, PVC well casings and No. 10 slot screens. After placement of the PVC well casing and screen in each borehole, a well sorted, medium-grained, silica sand was used for the sand pack. Piezometer construction details are included in Appendix II. The sand pack extended approximately 1 foot above the top of the screen and a hydrated bentonite plug was placed in the borehole above the sand to seal the wells. The bentonite was extended to a depth above the top of the water table. The piezometers were installed as temporary points; therefore, no cement or protective casing was set around the piezometers. A locking cap was placed on each piezometer to prohibit rain water from entering the well casing.

Each piezometer was installed so that the screened section was positioned in approximately the same geologic interval. The piezometers were installed with 5-foot screens. Since well MW-10, which is located directly east of piezometer P-4 and discussed in detail below, was installed with a 5-foot screen at the base of the aquifer, it is used in conjunction with the piezometers to determine the flow paths through the aquifer.

Figure 7 is a cross-section across the dike which shows the water level in each piezometer and in well MW-10. The water level in the piezometers, which are each screened in approximately the center of the sand, slightly decrease toward the river. The potentiometric head elevation in MW-10, which is screened deeper in the aquifer, is also deeper than the head elevation in the piezometers. These water levels indicate that relatively laminar flow is present within these sands and that no obstructions to flow are present in this area. Figure 8 is a generalized cross-section which shows the same area as Figure 7; however, it has been expanded to show Pond 1 and the river. Figure 8 conceptually shows that the base of Pond 1 is above the top of the Sawdust Landing Formation and among the sands and sandy clays of the surficial aquifer. Therefore, the Sawdust Landing should confine the arsenic to the surficial aquifer.

4.3 Measure Groundwater Quality in the Uppermost Aquifer

To further evaluate the groundwater quality in the uppermost aquifer, two groundwater monitoring wells were installed on the property. These wells, MW-10 and MW-11, are shown on Figure 3. The wells were installed close to the river to obtain information about the extent of arsenic migration through the subsurface. Since the stratigraphic borehole for MW-10 was installed within approximately 3 feet of well MW-11, a separate stratigraphic borehole was not installed for this well.

Wells MW-10 and MW-11 were installed in accordance with R. 61-71 by South Carolina Certified Well Driller Geoff Bostic. The wells were installed using a drill rig equipped with 4 1/4-inch inside diameter hollow-stem augers. Equipment used to install these wells was steam cleaned prior to use at the site and between the installation of each monitoring well.

Each well was installed to a total depth of 19 feet bls, which was determined to be the top of the confining clay layer. Well MW-10 was installed with a 5-foot screen to bracket the lower portion of the aquifer so that the vertical extent of impact could be determined. Well MW-11 was installed with a 15 foot screen in order to determine the total arsenic concentrations across the saturated thickness of the aquifer. This well, MW-11, serves as a replacement well for existing well MW-7, which will be abandoned during the bank stabilization activities.

The monitoring wells were constructed of 2-inch diameter, flush-threaded, PVC well casings and No. 10 slot screens. After placement of the PVC well casing and screen in each borehole, a well sorted, medium-grained, silica sand was used for the sand pack. Monitoring well construction details are included in Appendix II. The sand pack extended approximately 1 foot above the top of the screen. Approximately 2.5 feet of hydrated bentonite plug was placed in the borehole of MW-11 above the sand to seal the well. The remainder of the annulus of monitoring well MW-11 was filled with cement grout and an upright protective steel casing and concrete pad were set around the well to make the well permanent. Well MW-10 was left as a temporary well; therefore, a 9-foot bentonite plug was placed above the sand pack to seal the well. No cement or protective casing was set around MW-10. A locking cap was placed on each well to prohibit rain water from entering the well casing.

The wells were developed on December 19, 1997, using a 2-inch diameter submersible pump and surge block until the groundwater was relatively sediment-free, and pH, specific conductivity, and turbidity readings stabilized. Groundwater samples were collected from MW-10 and MW-11 by General Engineering personnel on December 23, 1997. All procedures used during sample collection were performed in accordance with accepted United States Environmental Protection Agency protocols. Techniques used for well evacuation, sample collection, and measurement of the water table depth were designed to ensure that representative groundwater samples were collected and accurate field measurements were made.

Sampling personnel wore new, laboratory quality PVC gloves during all well evacuation and sample collection activities, and changed gloves, at a minimum, between each well. Depth to groundwater data was collected from each well using a water level probe. The volume of water in each monitoring well was calculated, and a minimum of three casing volumes were evacuated from each well using a peristaltic pump. The peristaltic pump was used because the wells could be purged at a low flow rate, thus minimizing turbidity in the wells. Evacuation of the wells continued until pH, temperature, and specific conductivity measurements stabilized, thereby ensuring that representative groundwater samples were collected.

Groundwater samples were slowly pumped directly into the sample containers to minimize the potential for aeration of the sample and to ensure that the samples were not altered during withdrawal from the well and introduction to the sample container. Samples for total and dissolved arsenic were collected from each well. All sample containers were sealed, placed immediately into a clean sample cooler, and covered with ice. The Chain of Custody Record was completed for each well immediately following the completion of the sample collection.

The samples remained in the custody of General Engineering personnel throughout the collection process and transportation to the laboratory. Upon arrival at the laboratory, sampling personnel relinquished the samples to log-in personnel. The chain of custody was maintained for all samples from the time of collection through the completion of the analyses.

4.4 Groundwater Investigation Results

Groundwater samples collected from wells MW-10 and MW-11 were analyzed for total arsenic. Table 1 summarizes the results of the laboratory analyses of the groundwater samples. The Certificates of Analysis and the Chain of Custody Records for all samples are included in Appendix III.

Table 1
Summary of Groundwater Analyses Results

Well Number	Total Arsenic
MW-10	1,040
MW-11	579
MCL	**50**

Note: MCL = South Carolina Class GB Groundwater Maximum Contaminant Level.
All concentrations in micrograms per liter, which is equivalent to parts per billion.

As presented in Table 1, the total arsenic in both exceed the South Carolina Class GB Groundwater Maximum Contaminant Level (MCL) for arsenic. These results also indicate that the arsenic occurs at higher concentrations near the base of the surficial aquifer.

4.5 Determine Aquifer Characteristics

To determine the hydraulic characteristics of the uppermost aquifer, rising head slug tests were performed in monitoring wells MW-3, MW-7, and MW-11. Potentiometric information determined during this assessment is used to determine groundwater flow velocity.

Slug tests were performed according to the methods described in Bouwer and Rice (1976) for unconfined aquifers. Prior to performing each slug test, the static water level was determined by measuring the depth to groundwater using an electronic pressure transducer connected to a Hermit 2000™ data logger.

A solid slug was then introduced into the well casing and the water level was allowed to equilibrate to a static level. After equilibrium, the slug was rapidly withdrawn from the well, thereby decreasing the water level in the well instantaneously. During the recovery of the well, the water level was measured and recorded electronically using the data logger and pressure transducer. The water level was measured in each well and recorded at specified time intervals until the water level in the well approximated the static water level measured prior to the beginning of each slug test.

The data obtained during the slug tests were reduced and analyzed using AQTESOLV™ (AQuifer TEst SOLVer) software to determine the hydraulic conductivity of the soil in the vicinity of monitoring wells MW-3, MW-7, and MW-11. The average hydraulic conductivity determined in wells MW-3, MW-7, and MW-11 is 2.608E-04 feet per second (ft/s). The slug test summary sheets and AQTESOLV™ Time vs. Drawdown plots and model input parameters are included in Appendix IV. Table 2 below summarizes the hydraulic conductivities in each well.

Table 2
Hydraulic Conductivity Values

Well Number	Test Number	Hydraulic Conductivity
MW-3	1	1.096E-04 ft/sec
MW-3	2	1.012E-04 ft/sec
MW-7	1	2.561E-04 ft/sec
MW-7	2	2.569E-04 ft/sec
MW-11	1	5.846E-04 ft/sec
MW-11	2	2.563E-04 ft/sec
Average	-----	**2.608E-04 ft/sec**

The hydraulic gradient at the subject site was determined from water level measurements in the piezometers obtained during the slug test activities. The hydraulic gradient between Pond 1 and the Wateree River is approximately 0.011 ft/ft. An effective porosity of 0.25 was assumed based on the sands and sandy clays which comprise the uppermost aquifer underlying the site. The groundwater flow velocity for the uppermost aquifer was calculated from these parameters using the following equation.

Groundwater Velocity Equation:
(derived from Darcy's Law and the velocity equation of hydraulics)

$$v = \frac{Kdh}{n_e dl}$$

Where,

v = average linear groundwater velocity (seepage velocity)
K = hydraulic conductivity
dh/dl = hydraulic gradient
n_e = effective porosity

Using the available information from wells MW-3, MW-7 and MW-11, the groundwater flow velocity calculated in the vicinity of these monitoring wells is approximately 362 ft/yr. This hydraulic information is based on the sands of the uppermost aquifer only. The hydraulic conductivities in the clay units would likely be significantly lower.

5.0 Seep Mapping and Sampling

In summer/fall 1997, three seep samples were collected and analyzed from the area surrounding the ponds. The locations of the seep samples (Seep 1, Seep 2, and Seep 3) are shown on Figure 3. Seep 1 and Seep 3 were collected on the eastern side of Pond 1, along the river bank, and Seep 2 was collected on the western side of Pond 2, near monitoring well MW-3. Details of the seep sampling are provided in the August 1997, "Field and Laboratory Studies to Develop Effective Waste Management Strategies for the Wateree Station" report, by Battelle Northwest Division. Additional seep sampling, which was proposed for this project, could not be performed because the river level sustained an elevated height (above the seeps) during the duration of the project.

Seeps were noted during the previous work (summer/fall 1997) along the river bank extending from the southern end of Pond 1, northward to Seep 3. The arsenic concentrations detected in each sample are summarized below.

Table 3
Analytical Results - Seep Samples
Summer/Fall 1997

Sample Number	Arsenic (ug/L)
Seep 1	348
Seep 2	35.4
Seep 3	604

As shown in the table, arsenic was detected in each seep sample. However, the concentrations on the eastern side of ponds (Seep 1 and Seep 3) were significantly higher than the concentration on the western side of the pond (Seep 2). The concentration at Seep 2 is below the Maximum Contaminant Level for arsenic.

6.0 Existing Ash Volume in Pond 1

Ash Pond 1 is essentially full of ash that is saturated with water, except for localized areas near its northeastern corner where it has been excavated. One goal of this project was to estimate the total volume of ash in Pond 1. The thickness of ash was measured in three borings, AB-1 through AB-3, constructed on roads built over the ash. The locations of these borings are shown on Figure 3. The depth to native soil in these locations is 19.5 ft, 24 ft, and 20 ft in borings AB-1, AB-2, and AB-3, respectively. Assuming that the road is approximately 8 ft above the upper surface of the ash, the actual thickness of ash is 11.5 ft, 16 ft, and 14 ft, respectively, in the borings. Averaging these thicknesses yields an average thickness of 13.1 ft or 4.37 yards (yd).

The perimeter length of the approximately 80-acre (equal to 193,600 yd^2) pond is approximately 7,650 ft or 2,550 yd. According to SCE&G contractors familiar with the pond, it was constructed with an approximately 2.5:1 side slope. Using these dimensions, the volume of the ash is calculated as:

$$\text{surface area } (yd^2) * \text{depth } (yd) - \text{area lost to side slope } (yd^3)$$

$$387{,}200\ yd^2 * 4.37\ yd = 1{,}692{,}064\ yd^3 - 9{,}716\ yd^3 =\sim 1{,}683{,}000\ yd^3$$

This calculation is intended to provide a general estimate of the volume of ash and could be altered by changes in any of the variables, particularly the depth of ash and actual surface area of the pond. Because of the relatively large size of the pond, the estimate of volume is less sensitive to variations in the side slope.

7.0 Conclusions and Recommendations

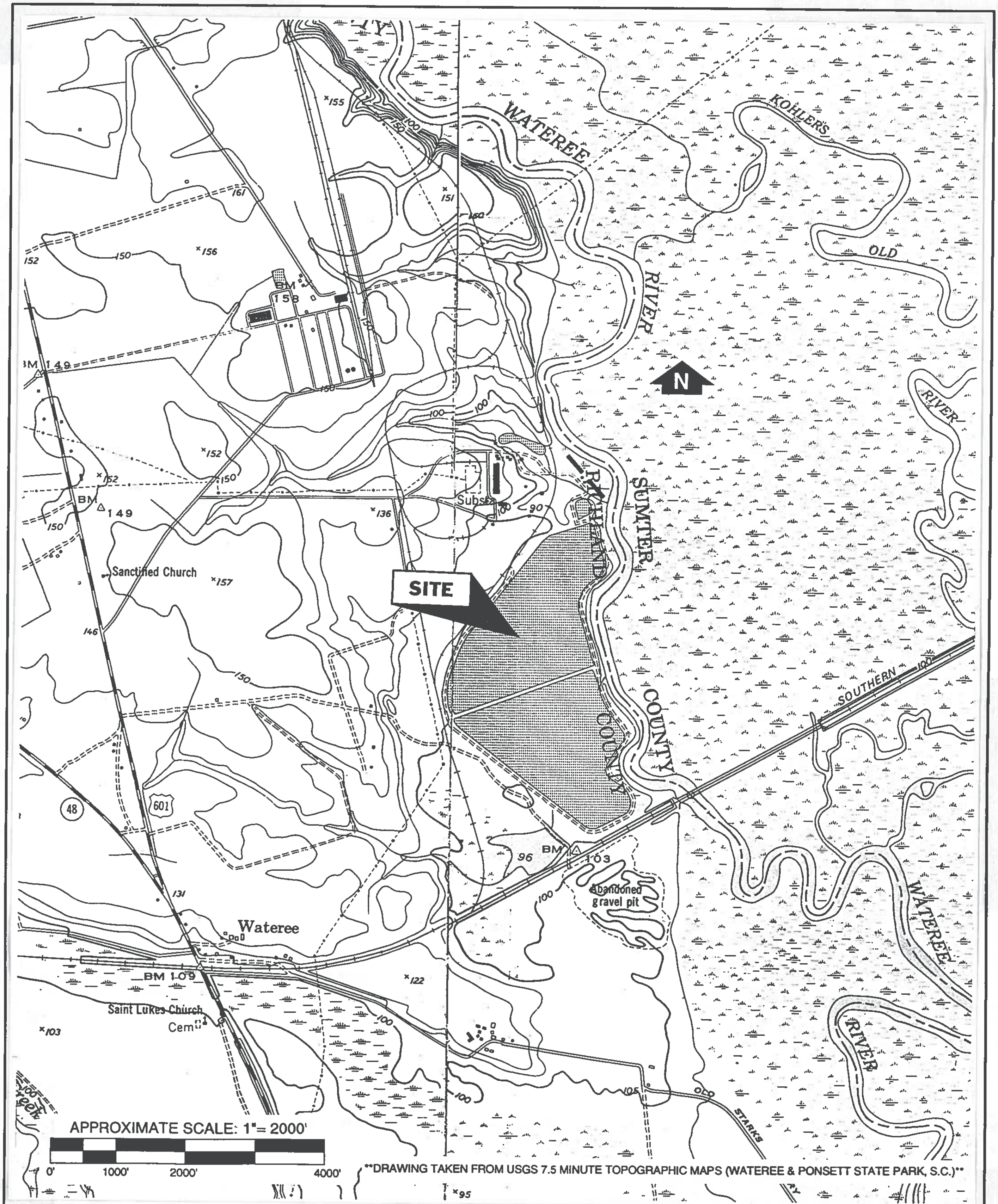
Previous assessments at the Wateree Station facility indicated that the deposition of ash in Pond 1 has impacted groundwater underlying the ponds with arsenic. This assessment was designed to estimate the volume of ash in the ponds and to (by defining site stratigraphy) determine if preferential flow pathways (vertical and horizontal) exist for the arsenic.

Results of the assessment indicate that approximately 1,683,000 yd^3 of ash are currently present in Pond 1. Stratigraphic boreholes installed in the vicinity of the ash ponds indicate that isolated lenses of highly conductive sands are present between Pond 1 and the river, and in localized areas on the western side of the pond. These sands appear to be preferential flow paths for the arsenic-impacted groundwater. The top of the basal confining unit (Sawdust Landing Formation) was determined to be approximately 24 feet bls east of the pond and 55 feet bls west of the pond.

The groundwater quality assessment consisted of the installation and sampling of two groundwater monitoring wells. One well, MW-11, was used to replace the existing well MW-7 which will be removed during dike stabilization activities. Well MW-10, which is screened in the lower portion of the surficial aquifer, contained higher arsenic concentrations than did MW-11, which was screened across the entire saturated thickness of the aquifer. These results indicate that the arsenic is predominantly traveling through the lower portions of the aquifer and is likely discharging to the river as base flow. However, based on the presence of the Sawdust Landing Formation, a confining unit, at approximately 24 feet bls east of the pond and 55 feet bls west of the pond, the arsenic impact will be limited to the surficial aquifer. Furthermore, shallow clays (particularly west of the pond) likely limit arsenic to shallower depths even within the surficial aquifer.

Based on the results of this assessment, the applicability of a mixing zone to Wateree Station will be evaluated. SCE&G will submit a workplan to DHEC for river surface water, river sediment, and fish sampling to determine the effects of the operation of the pond on the Wateree River.

FIGURES



DRAWING TAKEN FROM USGS 7.5 MINUTE TOPOGRAPHIC MAPS (WATEREE & PONSETT STATE PARK, S.C.)

GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC AND GAS COMPANY
EASTOVER, SOUTH CAROLINA

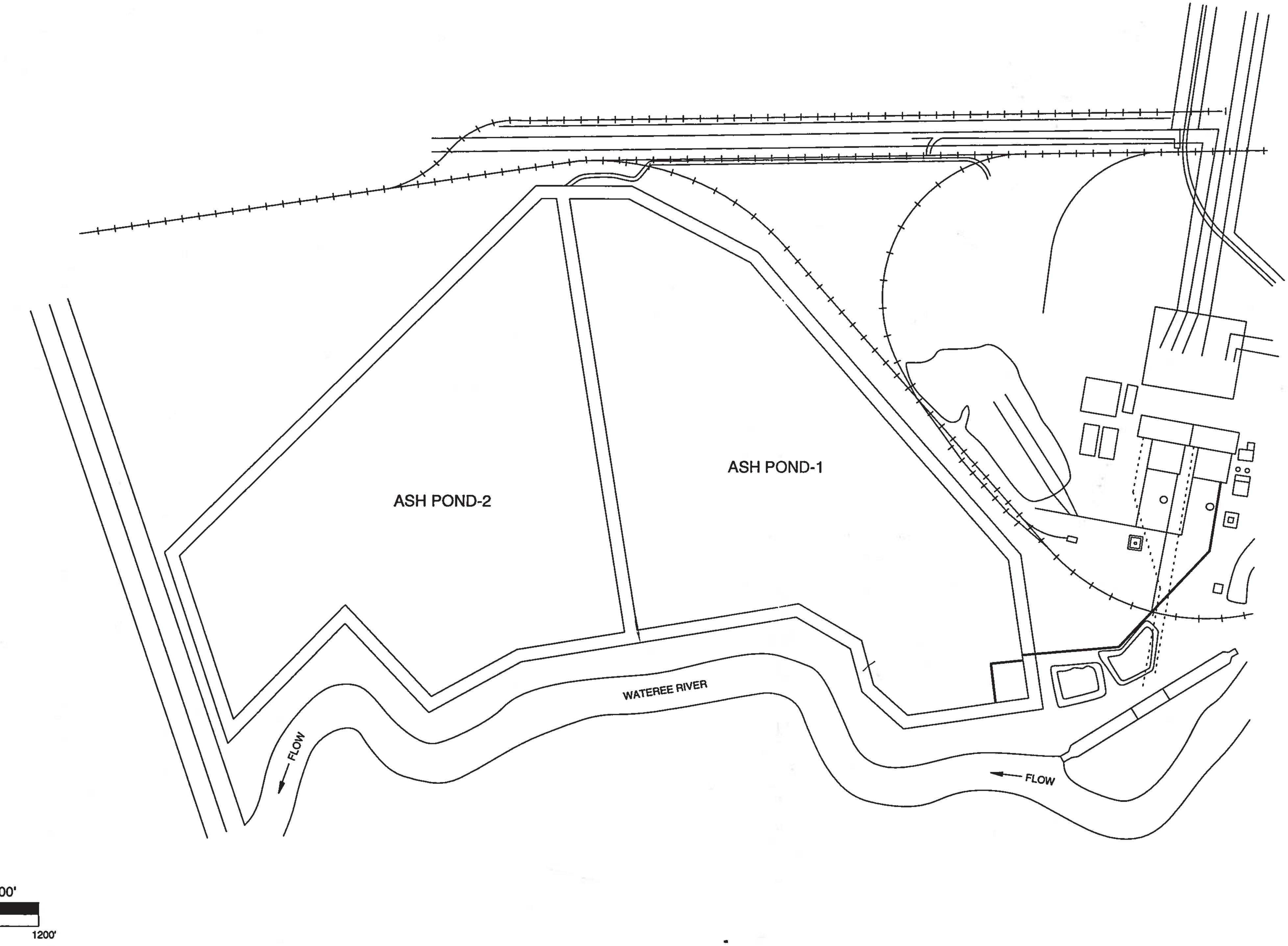
SITE LOCATION MAP

FIGURE
1

DATE: March 3, 1998

DRAWN BY: SMY

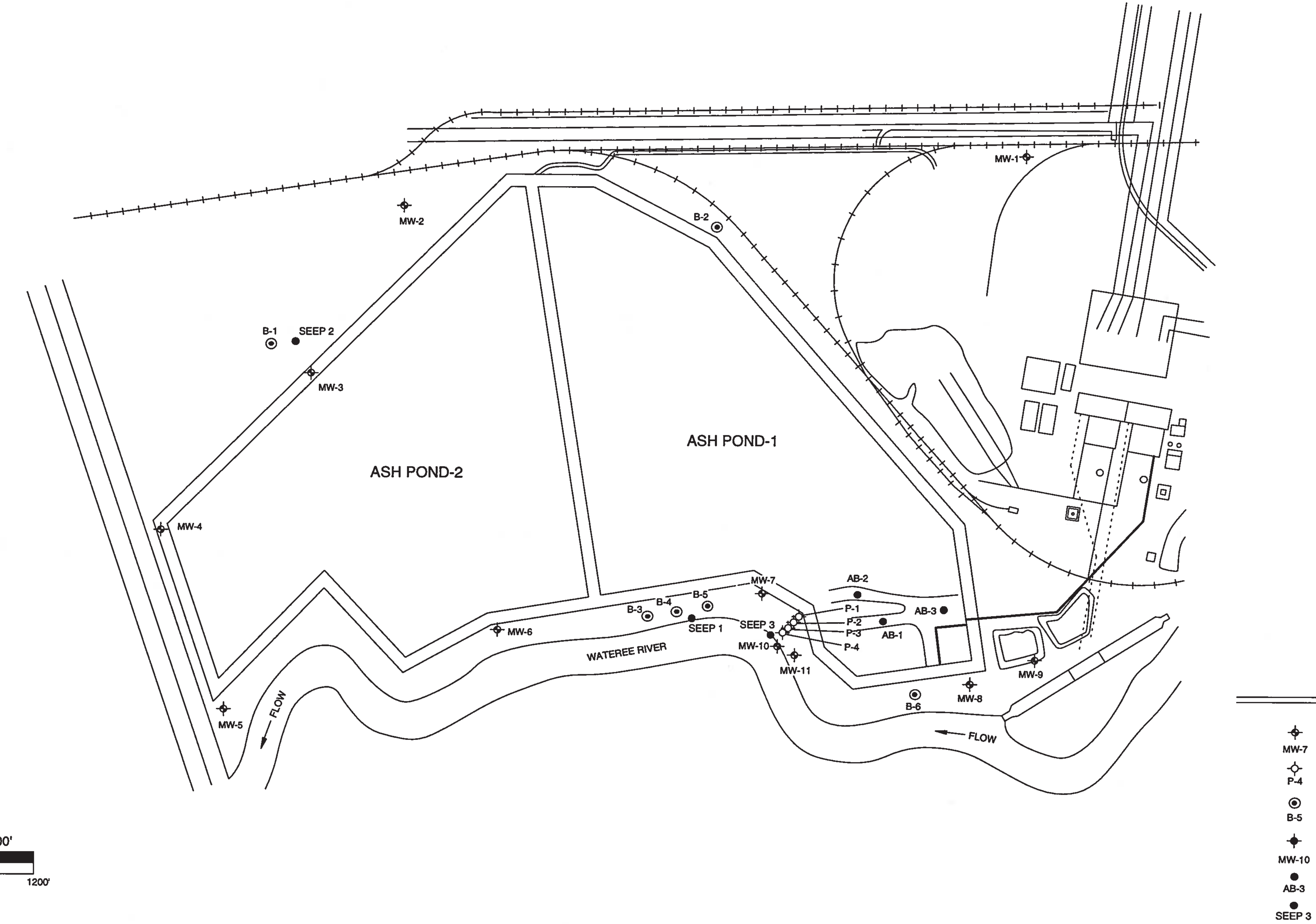
APPRV. BY: TJB



ERING
atories, Inc.

PROJECT: sceg01897

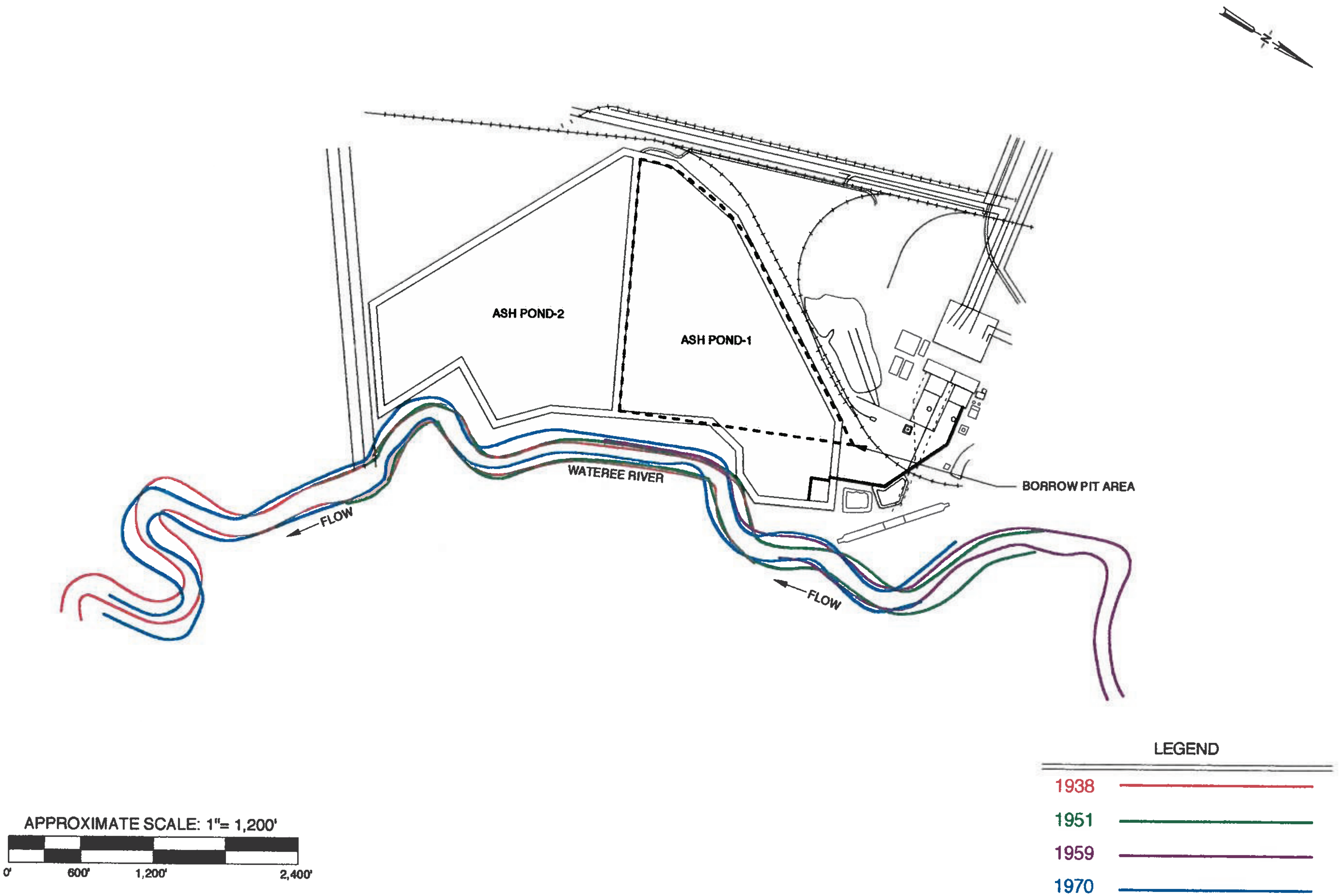
HYDROGEOLOGIC ASSESSMENT REPORT



RING
tories, Inc.

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT



GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC AND GAS COMPANY
EASTOVER, SOUTH CAROLINA

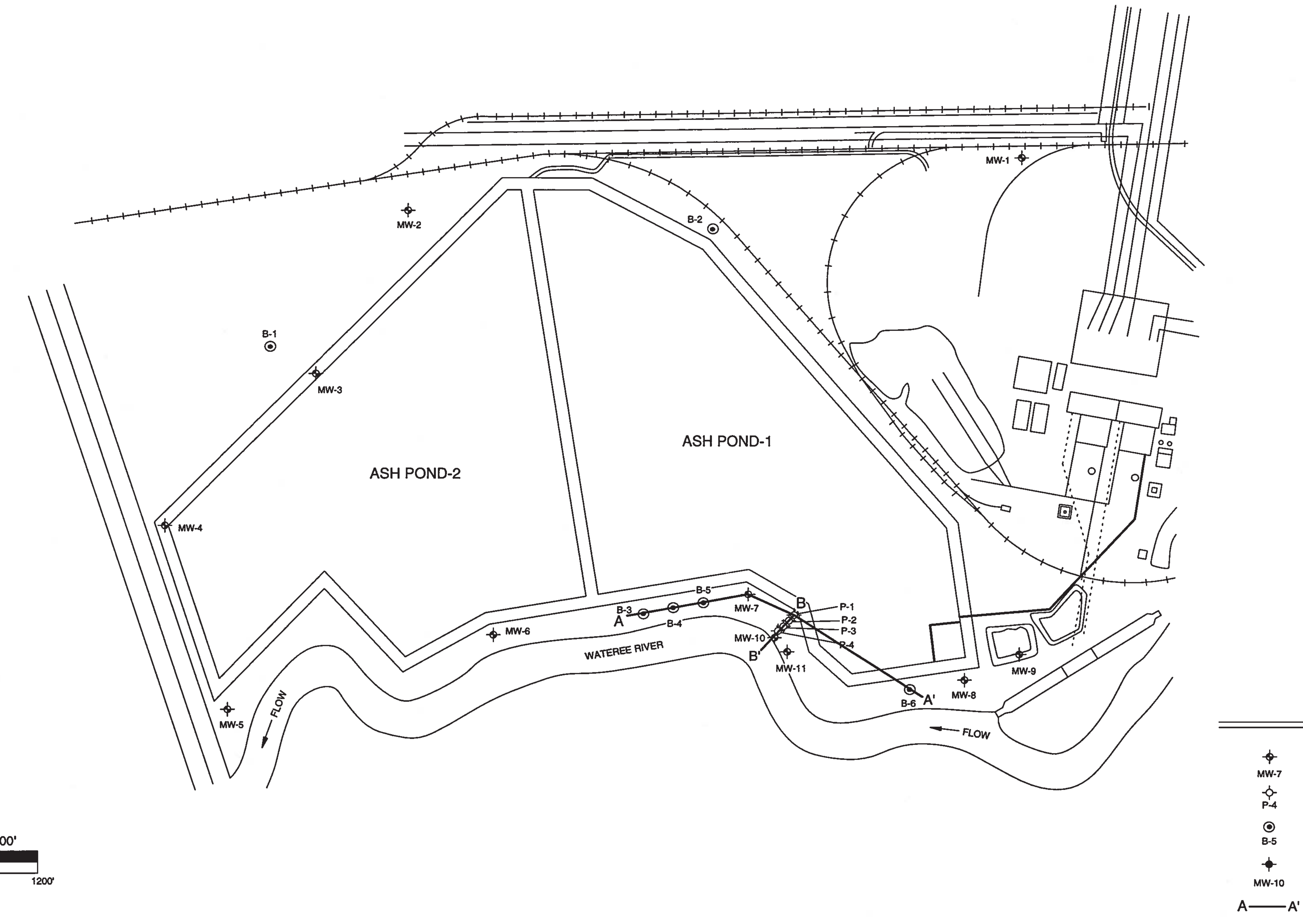
DATE: April 23, 1998

AERIAL PHOTOGRAPH OVERLAY

DRAWN BY: WFH

APPRV. BY: TJB

FIGURE
4

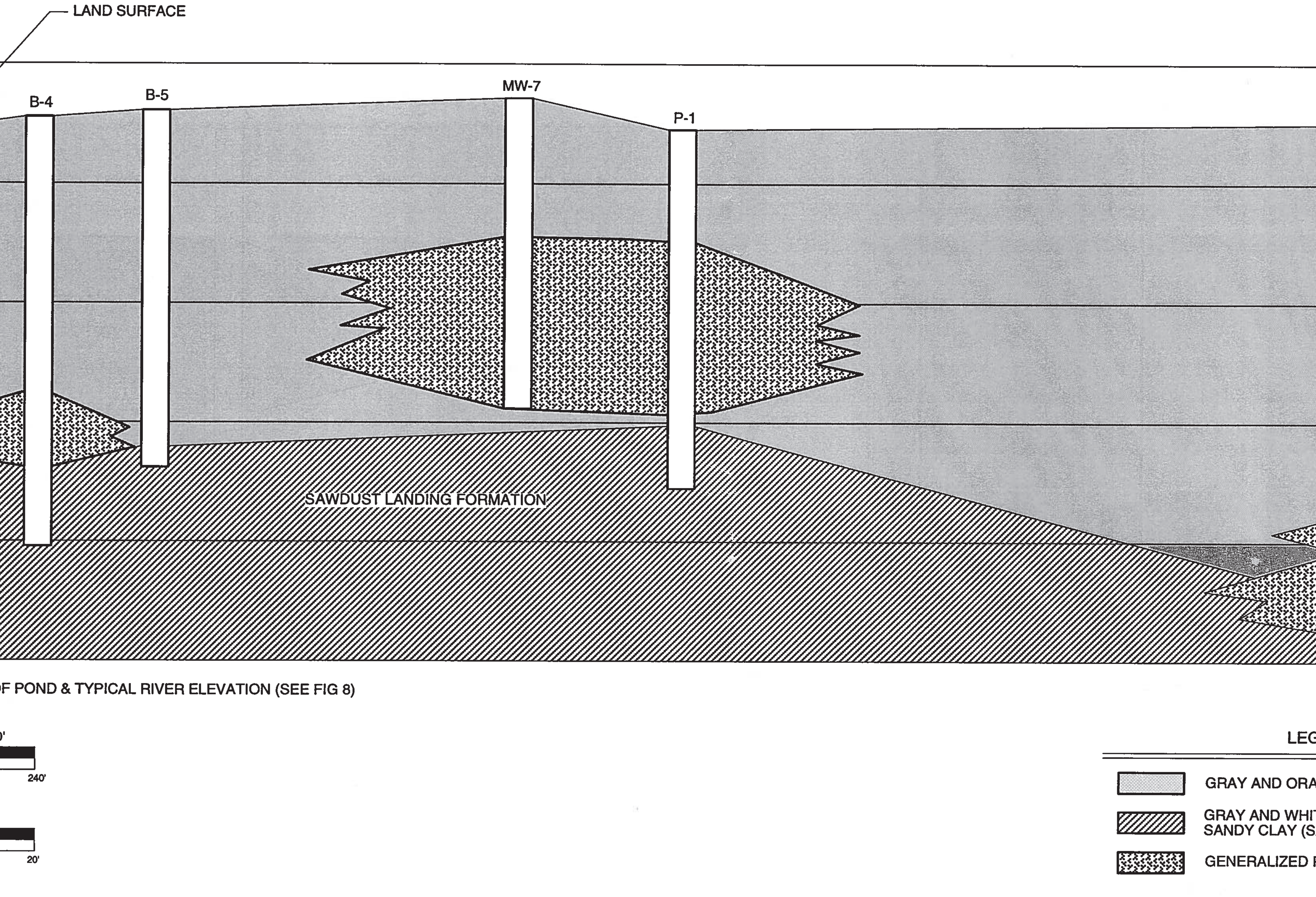


ERING
atories, Inc.

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION

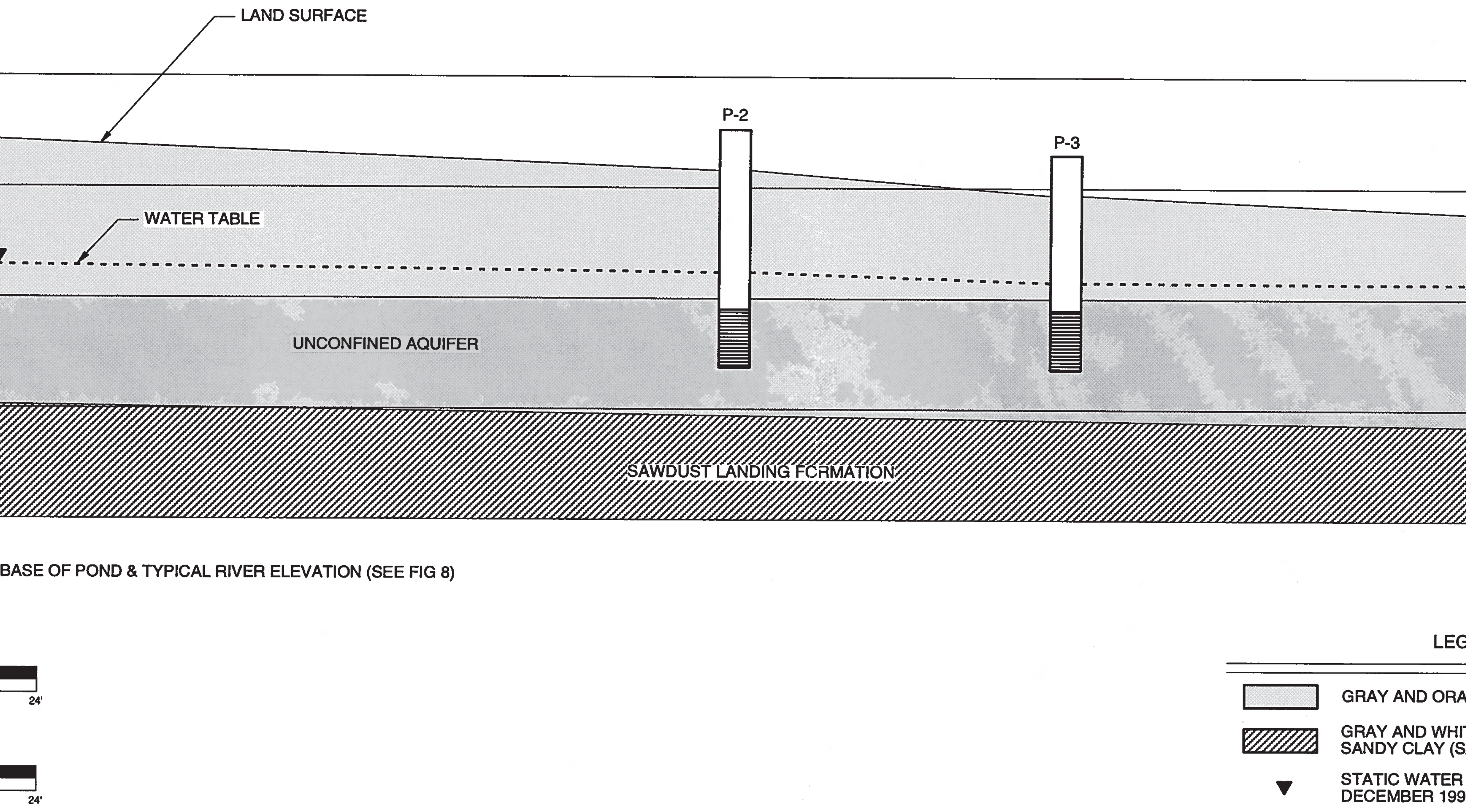
SITE MAP SHOWING



RING
tories, Inc.

PROJECT: sceg01897

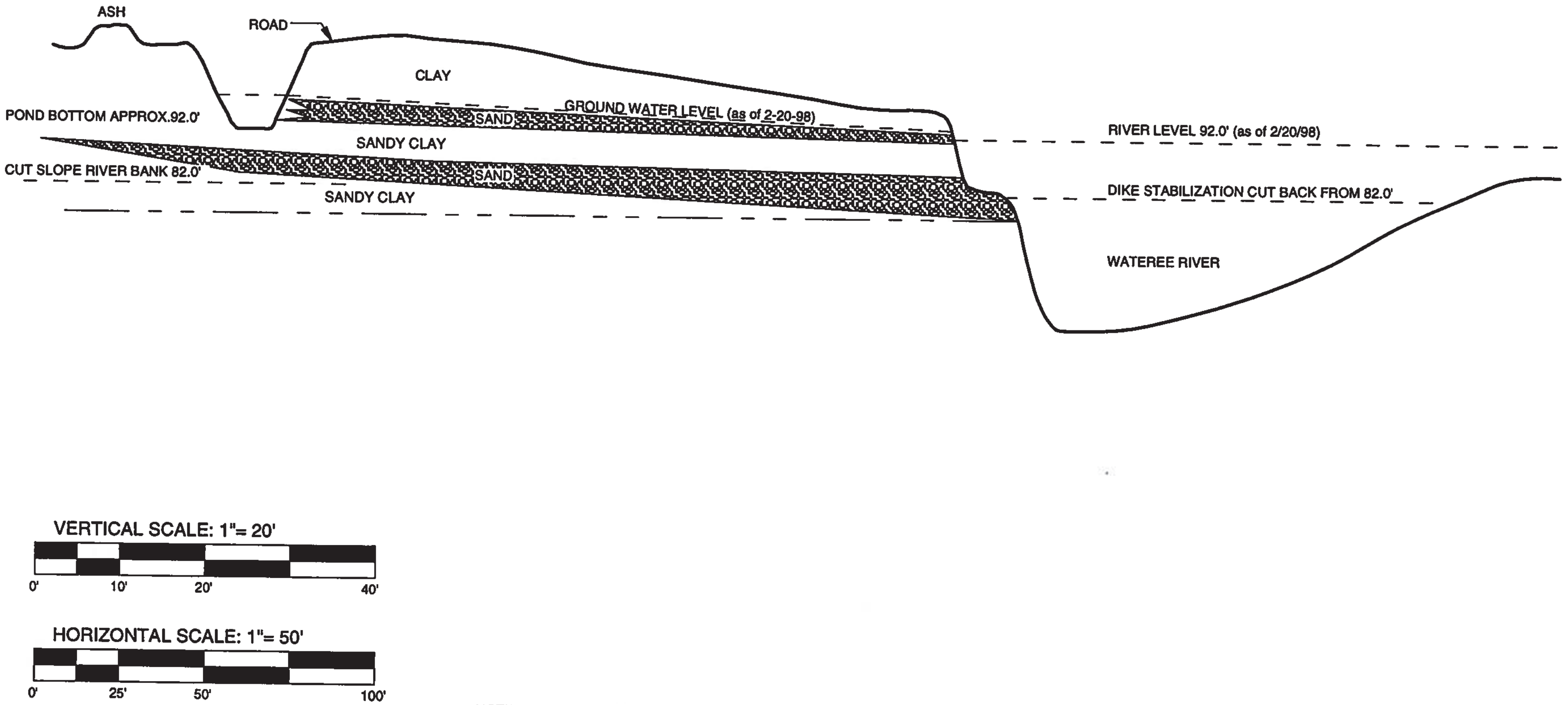
HYDROGEOLOGIC ASSESSMENT REPORT



RING
tories, Inc.

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT



NOTE: DIAGRAM GENERATED FROM LITHOLOGIC LOGS FROM MW-7, P-1, MW-10, AMD MW-1.

GENERAL ENGINEERING

A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC AND GAS COMPANY
EASTOVER, SOUTH CAROLINA

CONCEPTUAL CROSS SECTION
ACROSS DIKE

FIGURE
8

DATE: May 8, 1998

DRAWN BY: WFH

APPRV. BY: TJB

APPENDIX I

Soil Boring Logs

LOG OF SOIL BORING: B-1

PROJECT: SOUTH CAROLINA ELECTRIC & GAS

PROJECT NUMBER: sceg01897

DATE/TIME STARTED: DECEMBER 4, 1997 / 13:15

DATE FINISHED: DECEMBER 4, 1997

DRILLING METHOD: HSA

DRILLED BY: G. BOSTIC

LOGGED BY: T. BARNHART

LOCATION: WATEREE STATION

Elev.(ft)	Depth(ft)	Graphic	Geologic Description	USCS Class	OVA (ppm)	Blows\ft	Remarks
97	1						
96	2						
95	3	▨	BROWN AND ORANGE SANDY CLAY	SC	--	--	SAND (20%), SUBANGULAR, COHESIVE, ROUNDED PEBBLES, FINE TO MEDIUM GRAINED
93	4	▨	GRAY,ORANGE,RED CLAY	CL	--	--	DENSE, MOTTLED, COHESIVE
94	5						
92	6						
91	7						
90	8	▨	(75% RECOVERY) 9"- GRAY, ORANGE, RED CLAY	CL	--	--	PEBBLES (.5-1" DIAMETER), ANGULAR, DENSE, COHESIVE
89	9	▨	(75% RECOVERY) 9"- GRAY CLAY	CL	--	--	
88	10						
87	11						
86	12						
85	13						
84	14	▒	(75% RECOVERY) GRAY AND WHITE SAND	SP	--	--	BLACK MICA, SUBANGULAR, FINE TO MEDIUM GRAINED
82	15						
83	16						
81	17						
80	18						
79	19	▨	(6" RECOVERY) ORANGE AND GRAY SANDY CLAY	SC	--	--	SAND (50%), SUBANGULAR, BLACK MICA; CLAY, COHESIVE, HARD
78	20						
77	21						
76	22						
75	23						
74	24	▨	(6" RECOVERY) ORANGE AND GRAY SANDY CLAY	SC	--	--	SAND (50%), SUBANGULAR,BLACK MICA; CLAY, COHESIVE, HARD
73	25						
72	26						
71	27						
70	28	▨	5" ORANGE AND GRAY SANDY CLAY	SC	--	--	SAND (50%), SUBANGULAR, BLACK MICA; CLAY, COHESIVE, HARD
69	29	▨	4" BROWN SAND GRADING TO YELLOWISH WHITE SANDY CLAY	SC	--	--	
68	30						
67	31						
66	32						

GENERAL ENGINEERING

A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897		
HYDROGEOLOGIC ASSESSMENT REPORT WATEREE STATION SOUTH CAROLINA ELECTRIC & GAS EASTOVER, SOUTH CAROLINA	SOIL BORING LOG	B-1
DATE: May 8, 1998	DRAWN BY: WFH APPRV. BY: TJB	Pg 1 of 2

LOG OF SOIL BORING: B-1

PROJECT: SOUTH CAROLINA ELECTRIC & GAS
PROJECT NUMBER: sceg01897
DATE/TIME STARTED: DECEMBER 4, 1997 / 13:15
DATE FINISHED: DECEMBER 4, 1997

DRILLING METHOD: HSA
DRILLED BY: G. BOSTIC
LOGGED BY: T. BARNHART
LOCATION: WATEREE STATION

Elev.(ft)	Depth(ft)	Graphic	Geologic Description	USCS Class	OVA (ppm)	Blows\ft	Remarks
65	33	▨	PURPLE AND GRAY SANDY CLAY	SC	–	–	MOSTLY FINE TO MEDIUM GRAINED SAND, SUBANGULAR, BLACK MICA, CLAY ; COHESIVE
64	34	▨	GRAY SANDY CLAY	SC	–	–	FINE TO MOSTLY MEDIUM GRAINED SAND, SUBANGULAR, BLACK MICA, CLAY ; COHESIVE
63	35						
62	36						
61	37						
60	38	▨	6" GRAY SANDY CLAY	SC	–	–	SAND (50%), FINE TO MEDIUM GRAINED, SUBANGULAR WHITE; BLACK ACCESSORY MINERALS, SUGARY TEXTURE, CLAY, MODERATELY COHESIVE
59	39	▨	GRAY SANDY CLAY	SC			SAND (30-40%), SUBANGULAR, FINE TO MEDIUM GRAINED, DARK GRAY CLAY LENSES AT 40' CLAY, MODERATELY COHESIVE
58	40						
57	41						
56	42						
55	43						
54	44	▒	(50% RECOVERY) WHITE SAND, SOME CLAY	SP	–	–	BLACK MICA, SLIGHTLY COHESIVE, MEDIUM GRAINED, SUBANGULAR TO MODERATELY ROUNDED
53	45						
52	46						
51	47						
49	48	▒	(50% RECOVERY) WHITE SAND, LITTLE CLAY	SP	–	–	BLACK MICA, SLIGHTLY COHESIVE, MEDIUM GRAINED,SUBANGULAR
50	49	▨	2" MEDIUM TO DARK GRAY SANDY CLAY	SC	–	–	SAND COHESIVE, FINE TO MEDIUM GRAINED,SUBANGULAR
48	50	▒	3" WHITE AND GRAY CLAYEY SAND	SP	–	–	BLACK MICA, SLIGHTLY COHESIVE, MEDIUM GRAINED, ROUNDED
47	51						
46	52						
45	53	▒	4" WHITE & GRAY CLAYEY SAND	SP	–	–	BLACK MICA, SLIGHTLY COHESIVE, MEDIUM GRAINED, ROUNDED
44	54	▨	8" DARK GRAY CLAY	CL	–	–	DENSE, COHESIVE
43	55						
42	56						
41	57						
40	58						
39	59	▒	GRAY GRADING TO ORANGE SAND	SP	–	–	BLACK MICA, MEDIUM TO COARSE GRAINED, MODERATELY ROUNDED, NOT COHESIVE
38	60						
37	61						
36	62						
35	63	▒	ORANGE SAND	SP	–	–	BLACK MICA, MEDIUM TO COARSE GRAINED, MODERATELY ROUNDED, NOT COHESIVE
34	64	▨	ORANGE AND GRAY SANDY CLAY	SC	–	–	SAND, FINE TO MEDIUM GRAINED, SUBANGULAR TO MODERATELY ROUNDED; CLAY, COHESIVE, MOTTLED
33	65						

GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC & GAS
EASTOVER, SOUTH CAROLINA

SOIL BORING LOG

B-1

DATE: May 8, 1998

DRAWN BY: WFH

APPRV. BY: TJB

LOG OF SOIL BORING: B-2

PROJECT: SOUTH CAROLINA ELECTRIC & GAS
PROJECT NUMBER: sceg01897
DATE/TIME STARTED: DECEMBER 2, 1997 / 12:20
DATE FINISHED: DECEMBER 2, 1997

DRILLING METHOD: HSA
DRILLED BY: G. BOSTIC
LOGGED BY: T. HUTTO
LOCATION: WATEREE STATION

Elev.(ft)	Depth(ft)	Graphic	Geologic Description	USCS Class	OVA (ppm)	Blows\ft	Remarks
109	1						
108	2						
107	3	≈	ASH		--	--	
106	4	▨	WHITE, ORANGE, RED CLAY	CL	--	--	DENSE, MOTTLED, COHESIVE, MALLEABLE
105	5						
104	6						
103	7						
102	8						
101	9	▨	WHITE, ORANGE, RED CLAY	CL	--	--	DENSE, MOTTLED, COHESIVE, MALLEABLE
100	10						
99	11						
98	12						
97	13						
96	14	▨	WHITE, ORANGE, RED CLAY	CL	--	--	DENSE, MOTTLED, COHESIVE, MALLEABLE
95	15						
94	16						
93	17						
92	18	▨	WHITE, ORANGE, RED CLAY	CL	--	--	DENSE, MOTTLED, COHESIVE, MALLEABLE
91	19	▩	ORANGE-RED TO LIGHT GRAY CLAYEY SAND	SC	--	--	SAND (60%), SUBANGULAR TO SUBGROUNDED MEDIUM TO COARSE GRAINED, LOCALIZED QUARTZ, INTERSTITIAL LIGHT GRAY DENSE, COHESIVE
90	20	▨	WHITE, ORANGE, RED CLAY	CL	--	--	DENSE, MOTTLED, COHESIVE, MALLEABLE
89	21						
88	22						
87	23	▩	ORANGE-RED TO LIGHT GRAY CLAYEY SAND (2")	SC	--	--	SAND (60%), SUBANG., MED. GRN., QUARTZ, INTERSTITIAL GRAY DENSE, COHESIVE
86	24	▩	LIGHT GRAY, CLAYEY SAND	SC	--	--	SAND (70%) FINE GRAINED; CLAY INTERSTITIAL TO SAND, MODERATELY COHESIVE
85	25						
84	26						
83	27						
82	28	▩	LIGHT GRAY, CLAYEY SAND	SC	--	--	SAND (70%) FINE GRAINED; CLAY INTERSTITIAL TO SAND, MODERATELY COHESIVE
81	29	▨	LIGHT GRAY CLAY	CL	--	--	DENSE, COHESIVE
80	30	▒	ORANGE SAND	SW	--	--	SAND (>95%), SUBANGULAR TO SUBROUNDED, COARSE GRAINED, WELL SORTED, LOCALLY CONTAINING ROUNDED QUARTZ PEBBLES (< 1" DIAMETER)

GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC & GAS
EASTOVER, SOUTH CAROLINA

DATE: May 8, 1998

SOIL BORING LOG

B-2

DRAWN BY: WFH **APPRV. BY:** TJB

Pg 1 of 2

LOG OF SOIL BORING: B-2

PROJECT: SOUTH CAROLINA ELECTRIC & GAS

PROJECT NUMBER: sceg01897

DATE/TIME STARTED: DECEMBER 2, 1997 / 12:20

DATE FINISHED: DECEMBER 2, 1997

DRILLING METHOD: HSA

DRILLED BY: G. BOSTIC

LOGGED BY: T. HUTTO

LOCATION: WATEREE STATION

Elev.(ft)	Depth(ft)	Graphic	Geologic Description	USCS Class	OVA (ppm)	Blows\ft	Remarks
79	31						
78	32						
77	33	▨	ORANGE SAND	CL	—	—	SAND (>95%), SUBANGULAR TO SUBROUNDED, COARSE GRAINED, WELL SORTED, LOCALLY CONTAINING ROUNDED QUARTZ PEBBLES (< 1" DIAMETER)
76	34	▨					
75	35						
74	36						
73	37						
72	38						
71	39						
70	40						
69	41						
68	42						
67	43						
66	44						
65	45						
64	46						
63	47						
62	48						
61	49						
60	50						
69	51						
68	52						
67	53						
66	54	▨	CLAY	CL	—	—	DENSE, MALLEABLE
65	55	▨					
64	56	▨					
63	57	▨					
62	58						

GENERAL ENGINEERING

A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897		
HYDROGEOLOGIC ASSESSMENT REPORT WATEREE STATION SOUTH CAROLINA ELECTRIC & GAS EASTOVER, SOUTH CAROLINA	SOIL BORING LOG	B-2
DATE: May 8, 1998	DRAWN BY: WFH APPRV. BY: TJB	Pg 2 of 2

LOG OF SOIL BORING: B-3

PROJECT: SOUTH CAROLINA ELECTRIC & GAS
PROJECT NUMBER: sceg01897
DATE/TIME STARTED: DECEMBER 3, 1997 / 14:30
DATE FINISHED: DECEMBER 3, 1997

DRILLING METHOD: HSA
DRILLED BY: G. BOSTIC
LOGGED BY: T. HUTTO
LOCATION: WATEREE STATION

Elev.(ft)	Depth(ft)	Graphic	Geologic Description	USCS Class	OVA (ppm)	Blows\ft	Remarks
103	1						
102	2						
101	3						
100	4	▨	GRAY, ORANGE, RED CLAY	CL	---	---	DENSE, MOTTLED, COHESIVE
99	5						
98	6						
97	7						
96	8						
95	9	▨	GRAY, ORANGE, RED CLAY	CL	---	---	DENSE, MOTTLED, COHESIVE
94	10						
93	11						
92	12						
91	13	▨	(40% RECOVERY) / 6" GRAY, ORANGE, RED CLAY	CL	---	---	DENSE, MOTTLED,COHESIVE
90	14	▨	3" CLAYED SAND 1" GRAY, ORANGE, RED CLAY	CL CL	--- ---	--- ---	LOCALIZED, DENSE, MOTTLED, COHESIVE, WOOD FRAGMENTS, PEBBLES DENSE, MOTTLED,COHESIVE
89	15						
88	16						
87	17						
86	18	▨	2" GRAY, ORANGE, RED CLAY	CL	---	---	DENSE, MOTTLED,COHESIVE
85	19	▩	BROWN CLAYED SAND	SC	---	---	SAND (50-60%),FINE TO MEDIUM GRAINED, QUARTZ; SUBANGULAR, CLAY, INTERSTITIAL TO QUARTZ, MODERATELY COHESIVE
84	20	▩	WHITE CLAYED SAND	SC	---	---	SAND (90%), PEBBLY, MEDIUM TO COARSE GRAINED,SUBANGULAR, QUARTZ; CLAY,INCOHESIVE, LOCALLY CONTAINS WELL ROUNDED PEBBLES
83	21						
82	22						
81	23						
80	24	▩	WHITE CLAYED SAND	SC	---	---	SAND (90%), PEBBLY, MEDIUM TO COARSE GRAINED, SUBANGULAR, QUARTZ; CLAY, INCOHESIVE, LOCALLY CONTAINS WELL ROUNDED PEBBLES
79	25	▨	LIGHT GRAY TO ORANGE CLAY	CL	---	---	DENSE, COHESIVE
78	26						
77	27						
76	28						
75	29	▨	LIGHT GRAY TO ORANGE CLAY	CL	---	---	DENSE, COHESIVE
74	30						

GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC & GAS
EASTOVER, SOUTH CAROLINA

SOIL BORING LOG

B-3

DATE: May 8, 1998

DRAWN BY: WFH

APPRV. BY: TJB

LOG OF SOIL BORING: B-4

PROJECT: SOUTH CAROLINA ELECTRIC & GAS
PROJECT NUMBER: sceg01897
DATE/TIME STARTED: DECEMBER 3, 1997 / 12:20
DATE FINISHED: DECEMBER 3, 1997

DRILLING METHOD: HSA
DRILLED BY: G. BOSTIC
LOGGED BY: T. HUTTO
LOCATION: WATEREE STATION

Elev.(ft)	Depth(ft)	Graphic	Geologic Description	USCS Class	OVA (ppm)	Blows\ft	Remarks
104	1						
103	2						
102	3	▨	RED, GRAY-ORANGE SANDY CLAY	SC	---	---	MOTTLED, DENSE, MALLEABLE, COHESIVE, SPARSE PEBBLES (< - 1" DIAMETER)
101	4	▨					
100	5						
99	6						
98	7						
97	8	▨	RED, GRAY, ORANGE SANDY CLAY	SC	---	---	MOTTLED, DENSE, MALLEABLE, COHESIVE, SPARSE PEBBLES (< - 1" DIAMETER)
96	9	▨					
95	10						
94	11						
93	12						
92	13	▨	RED, GRAY, ORANGE SANDY CLAY	SC	---	---	MOTTLED, DENSE, MALLEABLE, COHESIVE, SPARSE PEBBLES (< - 1" DIAMETER)
91	14	▨					
90	15						
89	16						
88	17						
87	18	▨	CLAY TO SILTY CLAY	CL	---	---	SPARSE PEBBLES AND WOOD FRAGMENTS, INCREASING SILT/ SAND TOWARD 20'
86	19	▨					
85	20						
84	21						
83	22						
82	23	▨	CLAY TO SILTY CLAY	CL	---	---	SPARSE PEBBLES AND WOOD FRAGMENTS
81	24	▒	BROWN SAND	SW	---	---	SAND (95%), COARSE GRAINED, PEBBLES
80	25						
79	26						
78	27						
77	28	▒	BROWN SAND	SW	---	---	SAND (95%), COARSE GRAINED, PEBBLES
76	29	▒					
75	30	▨	LIGHT GRAY CLAY	CL	---	---	MOTTLED, DENSE, COHESIVE
74	31						
73	32						
72	33	▨	LIGHT GRAY CLAY	CL	---	---	MOTTLED, DENSE, COHESIVE
71	34	▨					
70	35	▨					
69	36	▨					
68	37	▨					

GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC & GAS
EASTOVER, SOUTH CAROLINA

SOIL BORING LOG

B-4

DATE: April 23, 1998

DRAWN BY: WFH

APPRV. BY: TJB

LOG OF SOIL BORING: B-5

PROJECT: SOUTH CAROLINA ELECTRIC & GAS

PROJECT NUMBER: sceg01897

DATE/TIME STARTED: DECEMBER 4, 1997 / 9:20

DATE FINISHED: DECEMBER 4, 1997

DRILLING METHOD: HSA

DRILLED BY: G. BOSTIC

LOGGED BY: T. BARNHART

LOCATION: WATEREE STATION

Elev.(ft)	Depth(ft)	Graphic	Geologic Description	USCS Class	OVA (ppm)	Blows\ft	Remarks
105	1						
104	2						
103	3	▨	BROWN SANDY CLAY	SC	—	—	PEBBLY
102	4	▨	GRAY, ORANGE, RED CLAY	CL	—	—	DENSE, MOTTLED, COHESIVE
101	5						
100	6						
99	7						
98	8	▨	GRAY, ORANGE, RED CLAY	CL	—	—	MOTTLED, QUARTZ (.5-1" DIAMETER), WELL ROUNDED
97	9	▨	GRAY AND BROWN SANDY CLAY	SC	—	—	SAND (20%), BROWN, FINE TO MEDIUM GRAINED, CLAY, VERY COHESIVE
96	10						
95	11						
94	12						
93	13	▨	GRAY AND RED CLAY	CL	—	—	SAND LENSES IN TOP 5", FINE TO MEDIUM GRAINED SAND; CLAY, MOTTLED, COHESIVE, MALLEABLE
92	14						
91	15						
90	16						
89	17						
88	18	▨	BROWN AND GRAY SANDY CLAY	SC	—	—	SAND (30-40%), WOOD FRAGMENTS, .5" DIAMETER, WELL ROUNDED QUARTZ PEBBLES
87	19	▨	GRAY CLAY, SOME BLACK AND ORANGE	CL	—	—	DENSE, MOTTLED, COHESIVE
86	20						
85	21						
84	22						
83	23	▨	BROWN CLAY	CL	—	—	
82	24	▨	SANDY CLAY	SC	—	—	SAND (40-50%), FINE TO MEDIUM GRAINED, SUBANGULAR, MODERATELY COHESIVE
81	25						
80	26						
79	27						
78	28	▨	SANDY CLAY	SC	—	—	SAND (40-50%), FINE TO MEDIUM GRAINED, SUBANGULAR, COHESIV
77	29	▨	WHITE AND ORANGE CLAY	CL	—	—	VERY DENSE, COHESIVE
76	30						

GENERAL ENGINEERING

A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897		
HYDROGEOLOGIC ASSESSMENT REPORT WATEREE STATION SOUTH CAROLINA ELECTRIC & GAS EASTOVER, SOUTH CAROLINA	SOIL BORING LOG	B-5
DATE: May 8, 1998	DRAWN BY: WFH	APPRV. BY: TJB

LOG OF SOIL BORING: B-6

PROJECT: SOUTH CAROLINA ELECTRIC & GAS
PROJECT NUMBER: sceg01897
DATE/TIME STARTED: DECEMBER 4, 1997 / 10:45
DATE FINISHED: DECEMBER 4, 1997

DRILLING METHOD: HSA
DRILLED BY: G. BOSTIC
LOGGED BY: T. BARNHART
LOCATION: WATEREE STATION

Elev.(ft)	Depth(ft)	Graphic	Geologic Description	USCS Class	OVA (ppm)	Blows\ft	Remarks
104	1						
103	2						
102	3	▨	ORANGE AND GRAY SANDY CLAY	SC	—	—	SAND (30%), COHESIVE
101	4	▨	GRAY, ORANGE, RED CLAY	CL	—	—	DENSE, MOTTLED, COHESIVE
100	5						
99	6						
98	7						
97	8	▨	4" GRAY SANDY CLAY	SC	—	—	SAND (30-40%), STIFF, COHESIVE, FINE TO MEDIUM GRAINED, SUBANGULAR.
96	9	▨	GRAY WHITE RED CLAY	CL	—	—	VERY DENSE, COHESIVE, MOTTLED
95	10						
94	11						
93	12						
92	13	▨	GRAY AND ORANGE CLAY	CL	—	—	MOTTLED, WELL ROUNDED PEBBLES (<.5" DIAMETER)
91	14	▨	ORANGE, GRAY, RED CLAY, GRADING TO GRAY SANDY	CL	—	—	SAND (30-40%), FINE TO MEDIUM GRAINED, SUBANGULAR; CLAY, MOTTLED, WOOD FRAGMENTS
90	15						
89	16						
88	17						
87	18	▨	ORANGE AND GRAY SANDY CLAY	SC	—	—	SAND (30-40%), MEDIUM GRAINED, SUBANGULAR;CLAY, MOTTLED
86	19	▨	WHITE-ORANGE RED CLAY	CL	—	—	MOTTLED, WOOD FRAGMENS FROM 19'-19.5', DENSE, COHESIVE
85	20						
84	21						
83	22						
82	23	▨					
81	24	▨	GRAY AND ORANGE CLAY	CL	—	—	1 CM. WOOD LAYER, MOTTLED, AT 23.5'
80	25	▨					
79	26						
78	27						
77	28	▨	GRAY CLAY	CL	—	—	DENSE, COHESIVE
76	29	▨					
75	30	▨	GRAY SANDY CLAY	SC	—	—	SAND (30-50%), SUBANGULAR; CLAY, MODERATELY COHESIVE, 1" DIAMETER PEBBLES NEAR 30'
74	31						
73	32						
72	33	▒					
71	34	▒	ORANGE, GRAY, WHITE SAND	SP	—	—	MOTTLED, BLACK MICA, NO COHESION, FINE TO MEDIUM GRAINED, SUBANGULAR
70	35	▒					
69	36						
68	37						
67	38	▒					
66	39	▒	ORANGE, GRAY, WHITE SAND	SP	—	—	MOTTLED, BLACK MICA, NO COHESION, FINE TO MEDIUM GRAINED, SUBANGULAR
65	40	▒					
64	41						
63	42						
62	43	▒					
61	44	▒	ORANGE SAND	SP	—	—	MOTTLED, BLACK MICA, NO COHESION, FINE TO MEDIUM GRAINED, SUBANGULAR
60	45	▨	GRAY AND ORANGE CLAY	CL	—	—	DENSE, COHESIVE

GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC & GAS
EASTOVER, SOUTH CAROLINA

SOIL BORING LOG

B-6

DATE: April 23, 1998

DRAWN BY: WFH

APPRV. BY: TJB

LOG OF SOIL BORING: P-1

PROJECT: SOUTH CAROLINA ELECTRIC & GAS
PROJECT NUMBER: sceg01897
DATE/TIME STARTED: DECEMBER 11, 1997 / 9:30
DATE FINISHED: DECEMBER 11, 1997

DRILLING METHOD: HSA
DRILLED BY: G. BOSTIC
LOGGED BY: T. BARNHART
LOCATION: WATEREE STATION

Elev.(ft)	Depth(ft)	Graphic	Geologic Description	USCS Class	OVA (ppm)	Blows\ft	Remarks
103	1						
102	2						
101	3	▨	GRAY, ORANGE, RED CLAY	CL	—	—	DENSE, COHESIVE, SOME FINE TO MEDIUM GRAINED SAND LENSES
100	4						
99	5						
98	6						
97	7						
96	8	▨	GRAY, ORANGE, RED CLAY	CL	—	—	DENSE, COHESIVE, SOME FINE TO MEDIUM GRAINED SAND LENSES
95	9						
94	10						
93	11						
92	12						
91	13	▓	GRAY SAND	SW	—	—	MEDIUM TO COARSE GRAINED, SUBANGULAR TO ROUND, ACCESSORY MINERALS
90	14	▒	ORANGE SAND	SW	—	—	MEDIUM TO COARSE GRAINED, ACCESSORY MINERALS, SUBANGULAR TO ROUND, SOME CLAY LENSES
89	15						
88	16						
87	17						
86	18	▩	(25%RECOVERY) - ORANGE SANDY CLAY	SC	—	—	SAND; MEDIUM GRAINED
85	19						
84	20						
83	21						
82	22						
81	23	▓	9" GRAY SAND	SP	—	—	ACCESSORY MINERALS, MEDIUM TO COARSE GRAINED, ROUNDED
80	24	▨	9" GRAY ORANGE CLAY	CL	—	—	DENSE, HARD
79	25						
78	26						
77	27						
76	28						
75	29	▨	GRAY AND ORANGE SANDY CLAY	SC	—	—	SAND (30%), FINE GRAINED; CLAY, HARD, DENSE
74	30						
73	31						
72	32						
71	33	▩	GRAY SANDY CLAY	SC	—	—	SAND (30%), FINE GRAINED; CLAY, HARD, DENSE
70	34						
69	35						
68	36						
67	37						
66	38	▩	GRAY AND ORANGE SANDY CLAY	SC	—	—	SAND (30%), FINE GRAINED; CLAY, DENSE, MODERATELY HARD
65	39						
64	40						
63	41						
62	42						
61	43	▩	GRAY TO ORANGE SANDY CLAY	SC	—	—	SAND (40-50%), MEDIUM GRAINED, SUBANGULAR TO ROUNDED; CLAY, MODERATELY STIFF
60	44						
59	45						

GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC & GAS
EASTOVER, SOUTH CAROLINA

SOIL BORING LOG

P-1

DATE: April 23, 1998

DRAWN BY: WFH

APPRV. BY: TJB

LOG OF SOIL BORING: MW-10

PROJECT: SOUTH CAROLINA ELECTRIC & GAS
PROJECT NUMBER: sceg01897
DATE/TIME STARTED: DECEMBER 5, 1997 / 10:00
DATE FINISHED: DECEMBER 5, 1997

DRILLING METHOD: HSA
DRILLED BY: G. BOSTIC
LOGGED BY: T. BARNHART
LOCATION: WATEREE STATION

Elev.(ft)	Depth(ft)	Graphic	Geologic Description	USCS Class	OVA (ppm)	Blows\ft	Remarks
96	1						
95	2						
94	3	▨	GRAY-ORANGE SANDY CLAY	SC	—	—	SAND (30%), FINE TO MEDIUM GRAINED;CLAY, MOTTLED
93	4	▒	ORANGE SAND	SP	—	—	MEDIUM TO COARSE GRAINED,SUBANGULAR
92	5						
91	6						
90	7						
89	8	▨	GRAY SANDY CLAY	SC	—	—	SAND (20-30%), FINE TO MEDIUM GRAINED, SUBANGULAR TO ROUNDED; CLAY, STICKY, MALLEABLE, PLASTICY
88	9						
87	10						
86	11						
85	12						
84	13	▒	BROWN SAND	SW	—	—	COARSE GRAINED, SOME ACCESSORY MINERALS, ROUNDED
83	14						
82	15						
81	16						
80	17						
79	18	▒	BROWN SAND	SW	—	—	COARSE GRAINED, SOME ACCESSORY MINERALS, ROUNDED
78	19	▨	WHITE AND ORANGE CLAY	CL	—	—	DENSE, COHESIVE
77	20						
76	21						
75	22						
74	23	▨	GRAY AND ORANGE CLAY	CL	—	—	DENSE, COHESIVE, FEW FINE TO MEDIUM GRAINED SAND LENSES
73	24						
72	25						
71	26						
70	27						
69	28	▨	(10% RECOVERY) - GRAY SANDYCLAY	SC	—	—	SAND(10%), FINE GRAINED; CLAY, DENSE, COHESIVE
68	29						
67	30						

GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC & GAS
EASTOVER, SOUTH CAROLINA

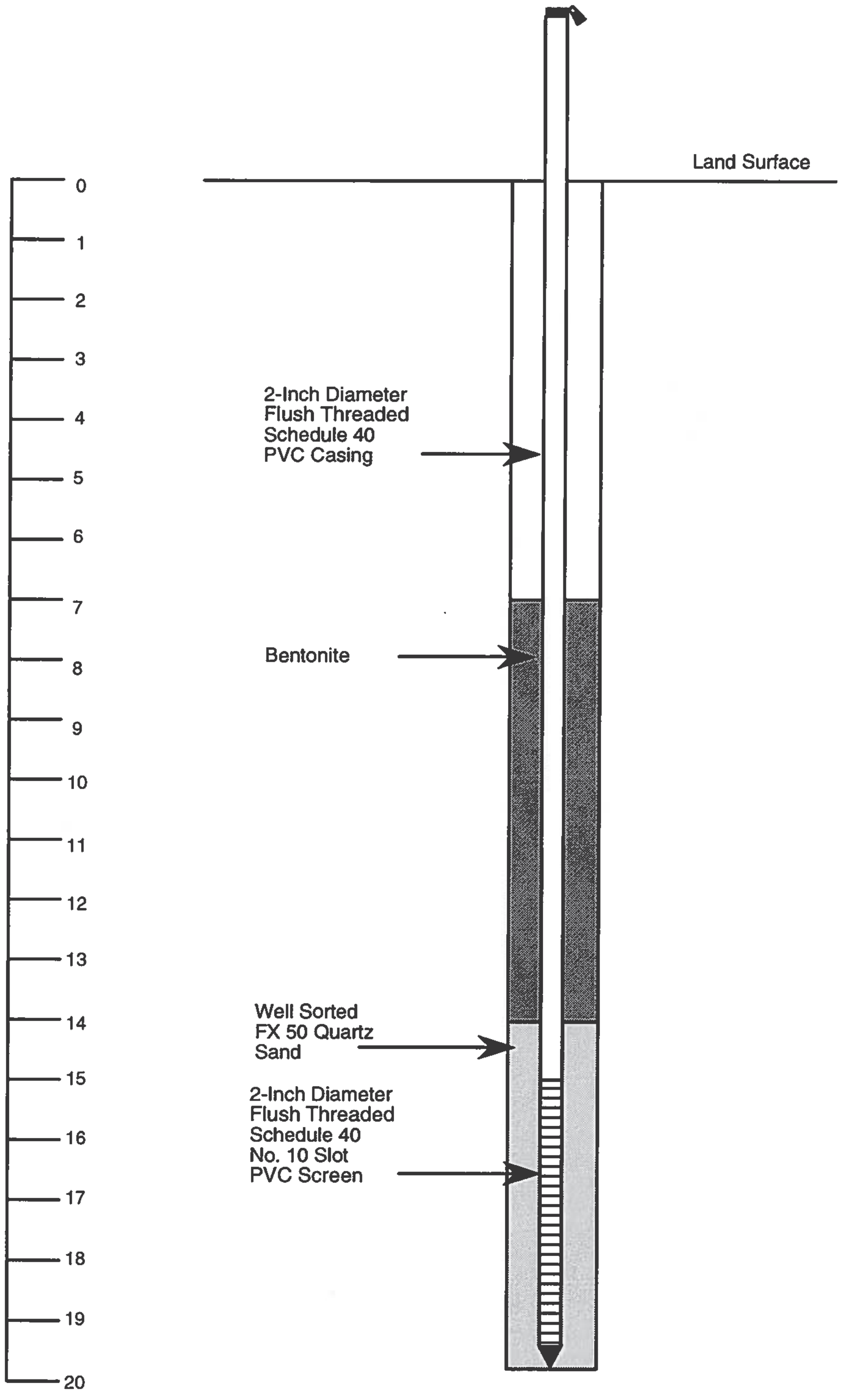
SOIL BORING LOG

MW-10

DATE: April 23, 1998
DRAWN BY: WFH
APPRV. BY: TJB

APPENDIX II

Well Construction Logs



GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC AND GAS COMPANY
EASTOVER, SOUTH CAROLINA

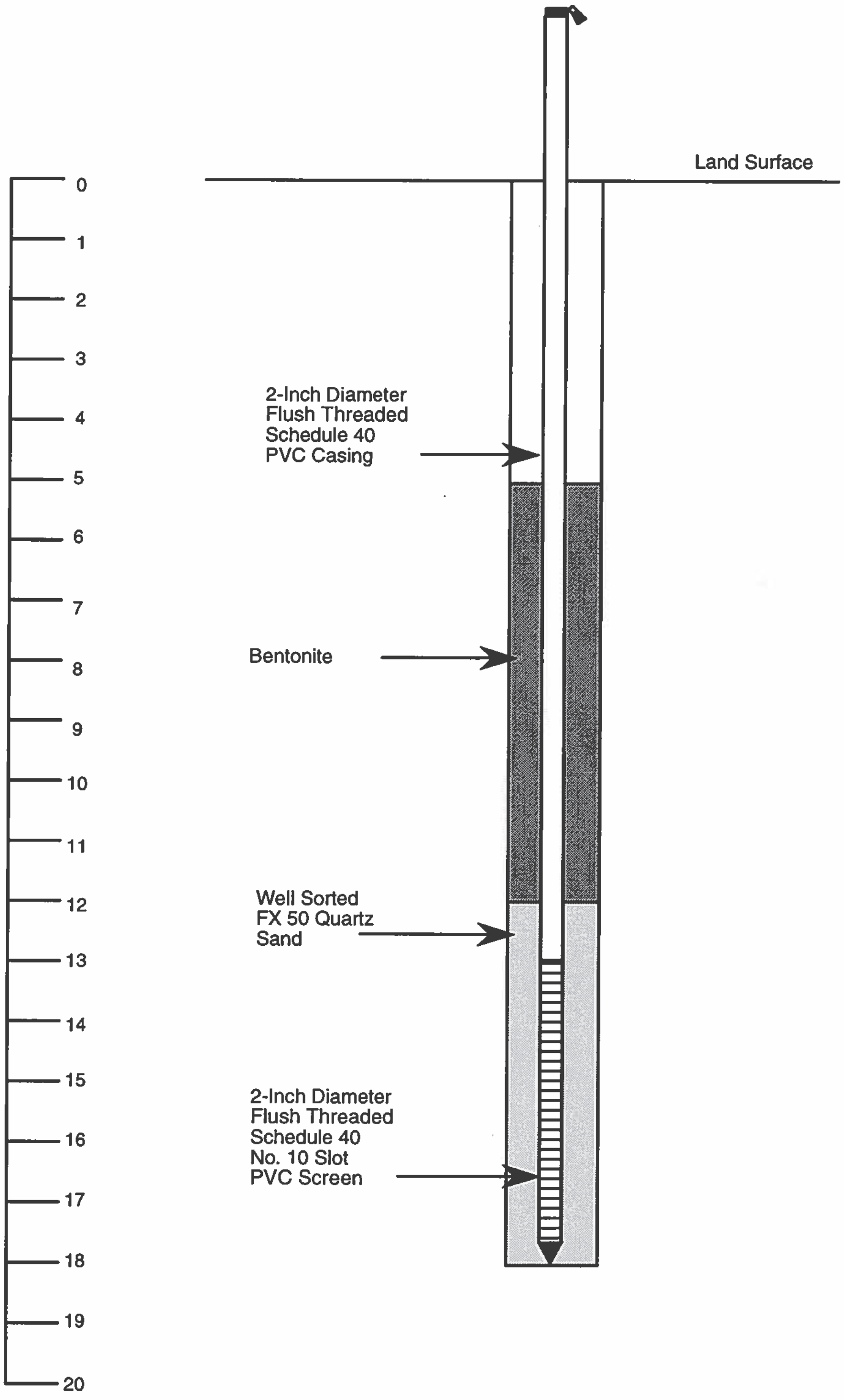
TEMPORARY PIEZOMETER

P-1

DATE: February 10, 1998

DRAWN BY: SAR

APPRV. BY: TJB



GENERAL ENGINEERING

A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC AND GAS COMPANY
EASTOVER, SOUTH CAROLINA

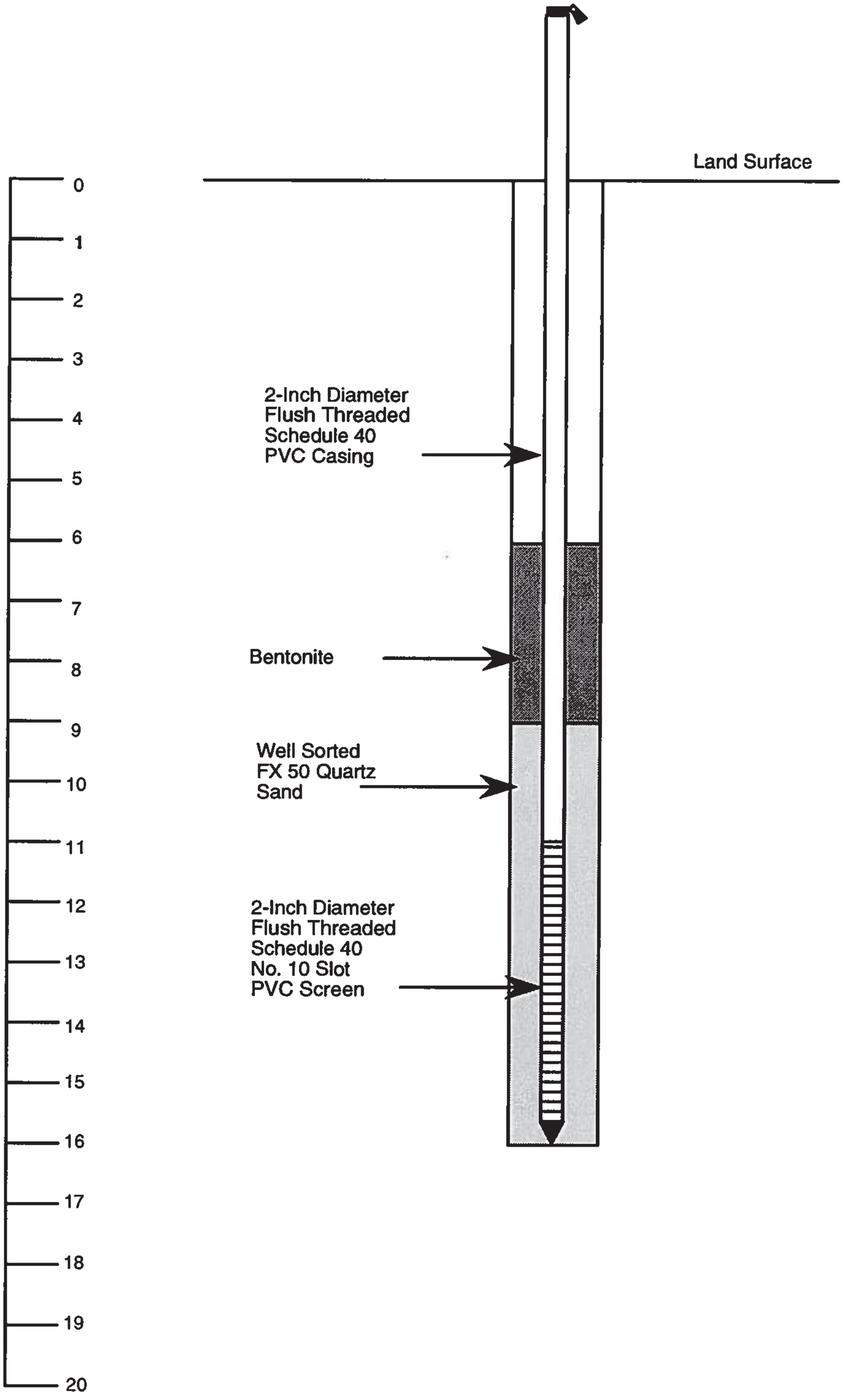
TEMPORARY PIEZOMETER

P-2

DATE: February 10, 1998

DRAWN BY: SAR

APPRV. BY: TJB



GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC AND GAS COMPANY
EASTOVER, SOUTH CAROLINA

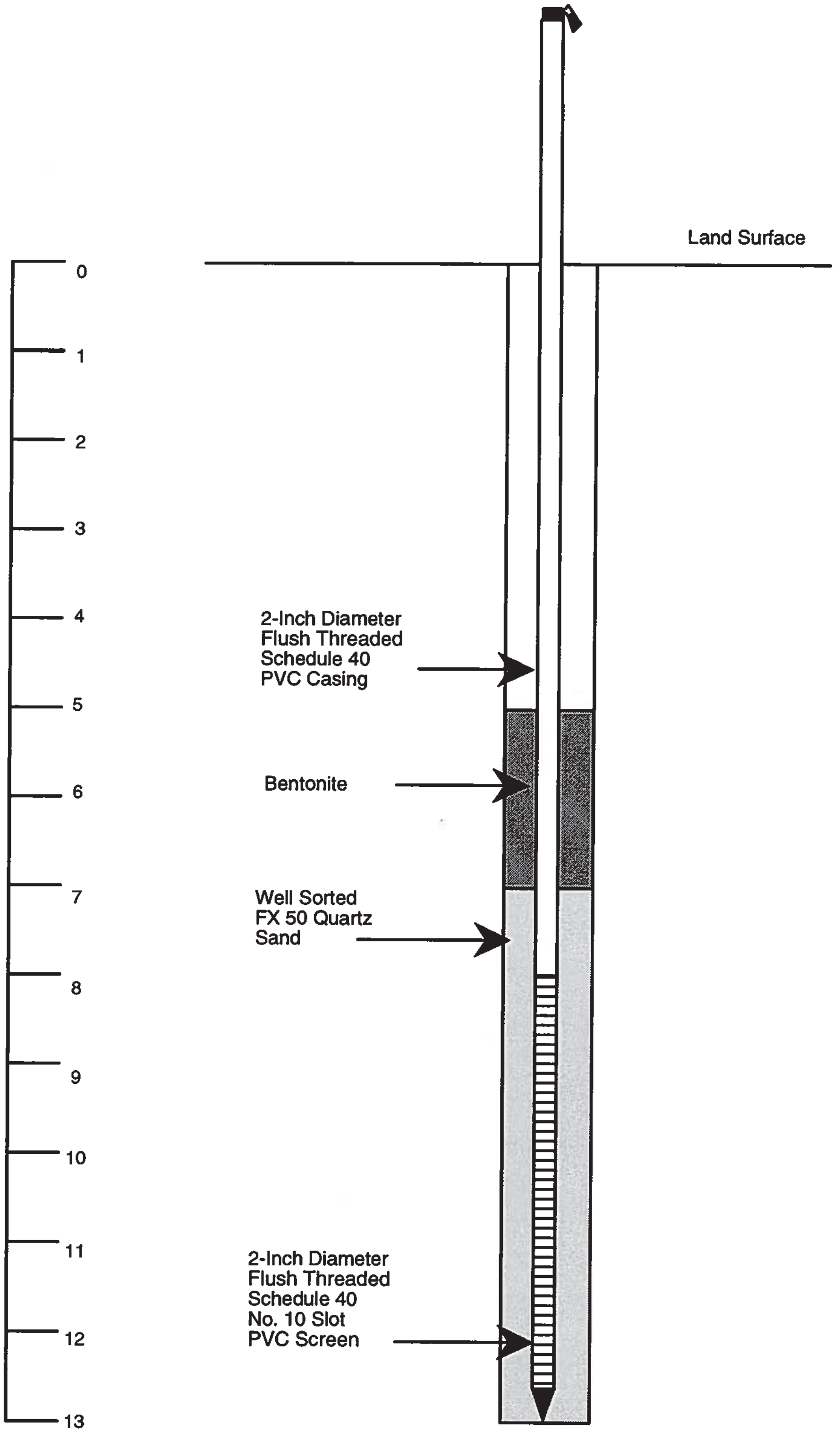
TEMPORARY PIEZOMETER

P-3

DATE: February 10, 1998

DRAWN BY: SAR

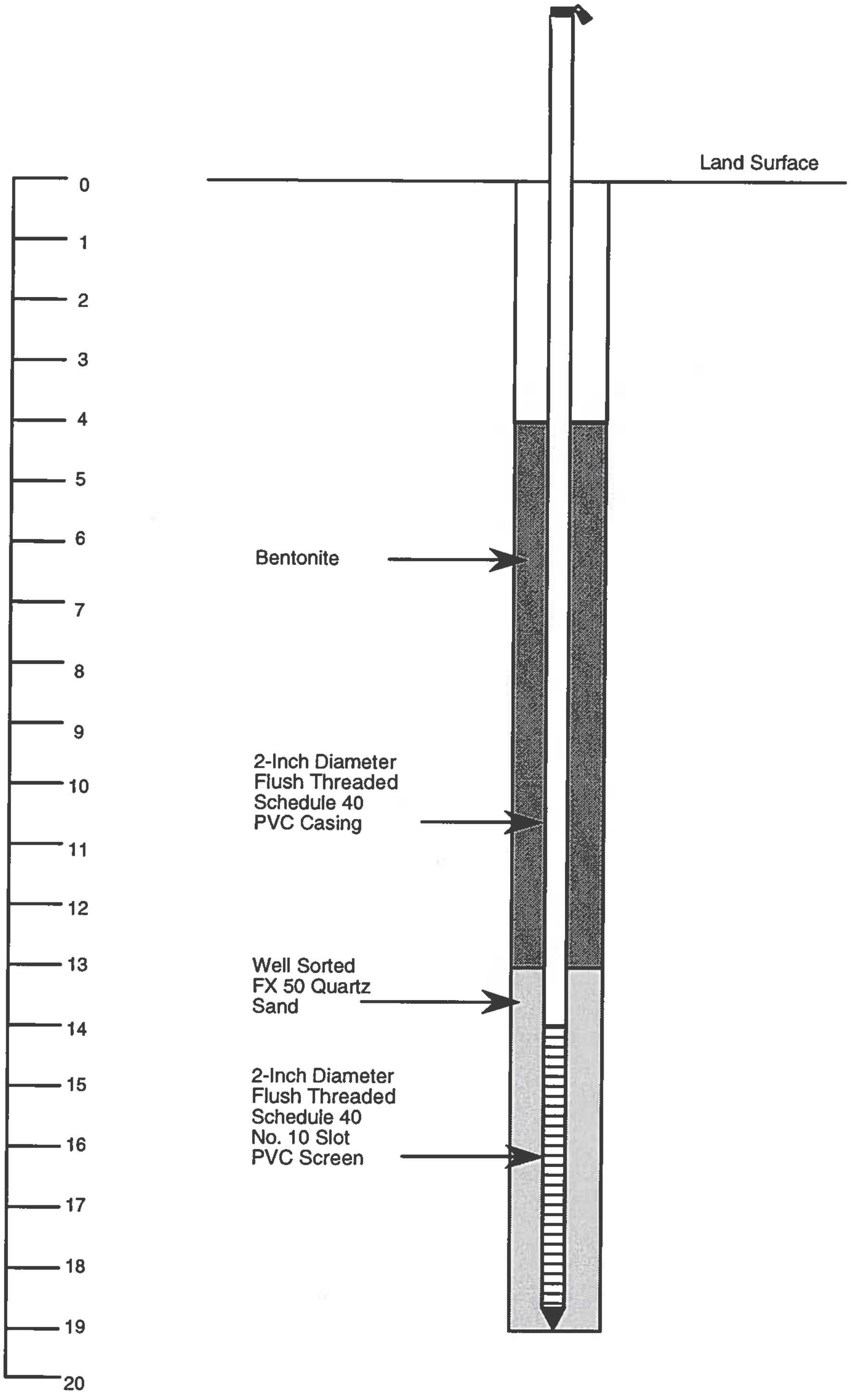
APPRV. BY: TJB



GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897		
HYDROGEOLOGIC ASSESSMENT REPORT WATEREE STATION SOUTH CAROLINA ELECTRIC AND GAS COMPANY EASTOVER, SOUTH CAROLINA	TEMPORARY PIEZOMETER	P-4
DATE: February 10, 1998	DRAWN BY: SAR	APPRV. BY: TJB



GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC AND GAS COMPANY
EASTOVER, SOUTH CAROLINA

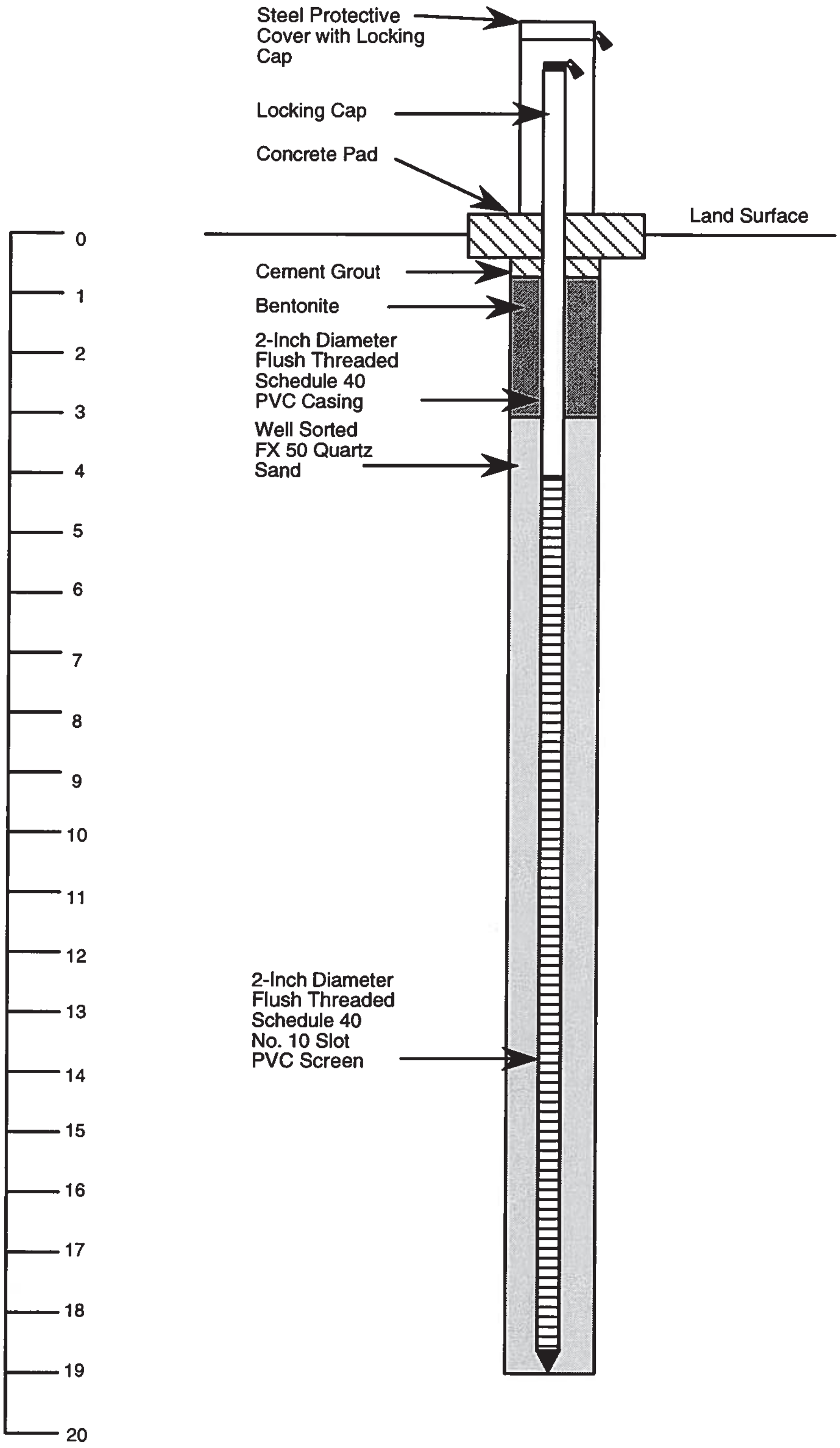
TEMPORARY
MONITORING WELL SCHEMATIC

MW-10

DATE: February 10, 1998

DRAWN BY: SAR

APPRV. BY: TJB



GENERAL ENGINEERING
A Division of General Engineering Laboratories, Inc.

P.O. BOX 30712
CHARLESTON, SC 29417
(803) 769-7378

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION
SOUTH CAROLINA ELECTRIC AND GAS COMPANY
EASTOVER, SOUTH CAROLINA

PERMANENT
MONITORING WELL SCHEMATIC

MW-11

DATE: February 10, 1998

DRAWN BY: SAR

APPRV. BY: TJB

APPENDIX III

Certificates of Analysis & Chain of Custody Record

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

Laboratory Certifications

STATE	GEL	EPI
FL	E87156/87294	E87472/87458
NC	233	
SC	10120	10582
TN	02934	02934

Client: South Carolina Electric & Gas
Mail Code 175
1426 Main Street
Columbia, South Carolina 29218

Contact: Mr. Jean Claude Younan

Project Description: Hydrogeologic Investigation - Wateree Sration

cc: SCEG01897

Report Date: January 07, 1998

Page 1 of 1

Sample ID : MW-10
Lab ID : 9712590-02
Matrix : GroundH2O
Date Collected : 12/22/97
Date Received : 12/23/97
Priority : Routine
Collector : GEL

Parameter	Qualifier	Result	Units	Method	Analyst	Date	Time	Batch
Metals Analysis								
Arsenic		1040	ug/l	EPA 6010A	AME	12/30/97	0307	113527
The following prep procedures were performed:								
TRACE				EPA 3005	FGD	12/29/97	1200	113527

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Tom Hutto at (803) 556-8171.

Thomas M. Seabrook

Reviewed By

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

Laboratory Certifications

STATE	GEL	EPI
FL	E87156/87294	E87472/87458
NC	233	
SC	10120	10582
TN	02934	02934

Client: South Carolina Electric & Gas
Mail Code 175
1426 Main Street
Columbia, South Carolina 29218
Contact: Mr. Jean Claude Younan
Project Description: Hydrogeologic Investigation - Wateree Sration

cc: SCEG01897

Report Date: January 07, 1998

Page 1 of 1

Sample ID : MW-11
Lab ID : 9712590-04
Matrix : GroundH2O
Date Collected : 12/22/97
Date Received : 12/23/97
Priority : Routine
Collector : GEL

Parameter	Qualifier	Result	Units	Method	Analyst	Date	Time	Batch
Metals Analysis								
Arsenic		579	ug/l	EPA 6010A	AME	12/30/97	0318	113527

The following prep procedures were performed:

TRACE	EPA 3005	FGD	12/29/97	1200	113527

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Tom Hutto at (803) 556-8171.

Thomas M. Seabrook

Reviewed By

9712590-04

TS

CHAIN OF CUSTODY RECORD

9712590

Page 1 of 1

General Engineering Laboratories, Inc.
2040 Savage Road
Charleston, South Carolina 29407
P.O. Box 30712
Charleston, South Carolina 29417
(803) 556-8171

Client Name/Facility Name: SCE&G/Wateree Station

Collected by/Company: Barnhart/Horton/GEL

SAMPLE ANALYSIS REQUIRED (x) - use remarks area to specify specific compounds or methods

⬅ Use F or P in the boxes to indicate whether sample was filtered and/or preserved

30640

SAMPLE ID	DATE	TIME	WELL	SOIL	COMP	GRAB	# OF CONTAINERS	pH, conductivity	TOC/DOC	TOX	Chloride, Fluoride, Sulfide	Nitrite/Nitrate	VOC - Specify Method required	Arsenic METALS - specify	Arsenic- Diss Pesticide	Herbicide	Total Phenol	Acid Extractables	B/N Extractables	PCB's	Cyanide	Coliform - specify type			Remarks
-01 -02 MW-10	12/22/97	16:16	X			X	3							✓	✓										Lab filter dissolved
-03 -01 MW-11	12/22/97	16:45	X			X	3							✓	✓										metals.

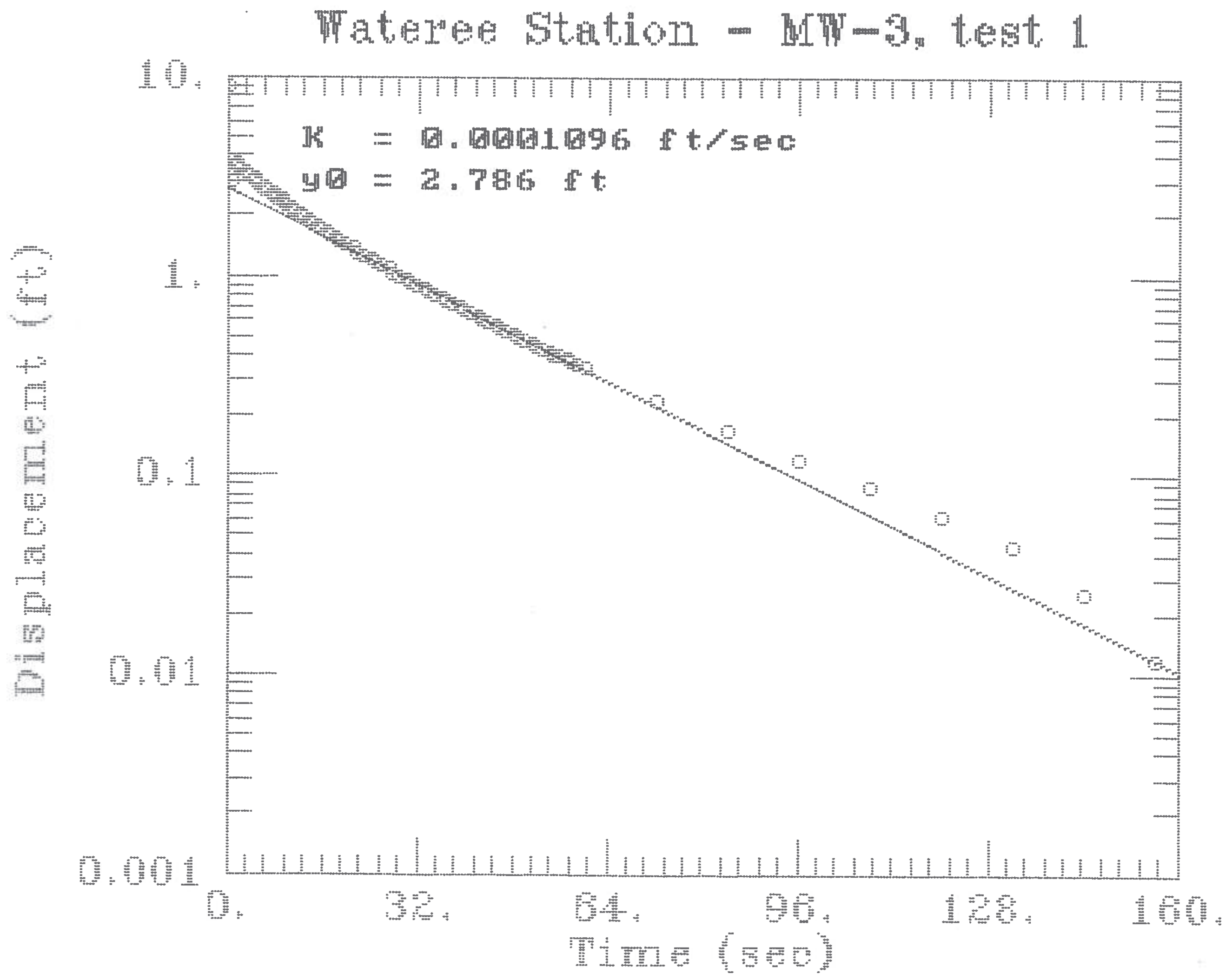
Relinquished by: Tracy W Barnhart	**Date:** 12/22/97	**Time:** 19:15	**Received by:**	**Relinquished by:**	**Date:**	**Time:**
Relinquished by:	**Date:**	**Time:**	**Received by lab by:** Michael Patrick	**Date:** [illegible]	**Time:** [illegible]	**Remarks:**

Received by:

White = sample collector **Yellow = file** **Pink = with report**

APPENDIX IV

Slug Test Data

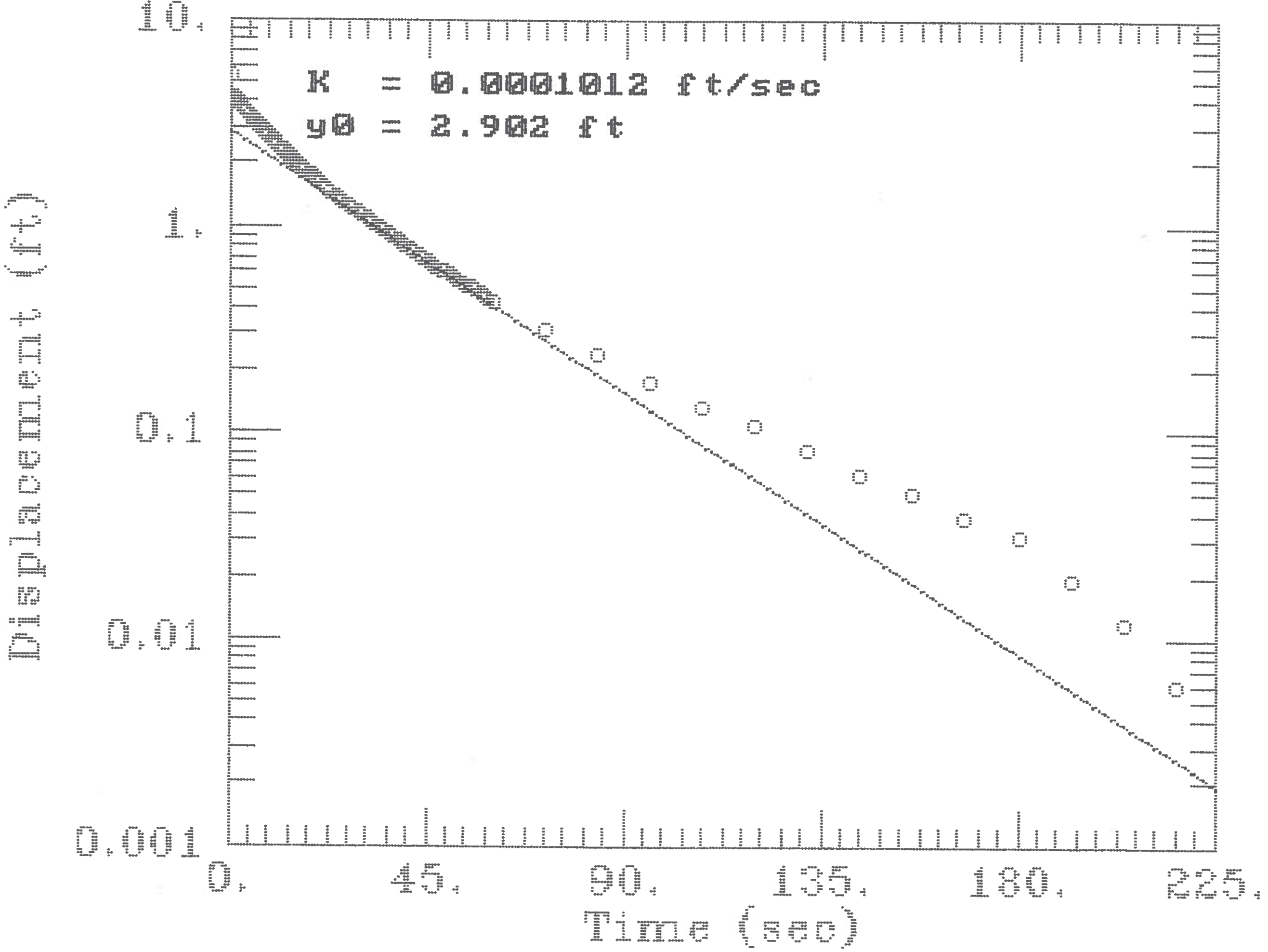

Wateree Station - MW-3, test 1
K = 0.0001096 ft/sec
y0 = 2.786 ft
10.
1.
0.1
0.01
0.001
Displacement (ft)
0.
32.
64.
96.
128.
160.
Time (sec)

```
        SE2000
  Environmental Logger
      12/29 12:59

 Unit# 2K-447    Test 0

Setups:        INPUT  1
------------   ---------
Type           Level (F)
Mode            TOC
I.D.           MW3

Reference        0.000
PSI at Ref.      6.487
SG              1.000
Linearity        0.112
Scale factor     20.096
Offset          0.029
Delay mSEC        50.000

Step 1   12/22 09:23:58

Elapsed Time  INPUT  1
------------  ---------
   0.0000      5.233
   0.0083      8.983      ↓
   0.0166      2.960     Start Test
   0.0250      3.684
   0.0333      3.570
   0.0416      3.462
   0.0500      3.322
   0.0583      3.240
   0.0666      3.138
   0.0750      3.062
   0.0833      2.973
   0.0916      2.884
   0.1000      2.763
   0.1083      2.706
   0.1166      2.636
   0.1250      2.566
   0.1333      2.503
   0.1416      2.439
   0.1500      2.376
   0.1583      2.319
   0.1666      2.262
   0.1750      2.204
   0.1833      2.154
   0.1916      2.103
   0.2000      2.052
   0.2083      2.001
   0.2166      1.957
   0.2250      1.912
   0.2333      1.868
```

0.2416	1.823
0.2500	1.785
0.2583	1.747
0.2666	1.709
0.2750	1.664
0.2833	1.626
0.2916	1.595
0.3000	1.563
0.3083	1.525
0.3166	1.493
0.3250	1.461
0.3333	1.436
0.3500	1.372
0.3666	1.315
0.3833	1.264
0.4000	1.213
0.4166	1.169
0.4333	1.118
0.4500	1.080
0.4666	1.035
0.4833	0.997
0.5000	0.959
0.5166	0.921
0.5333	0.889
0.5500	0.857
0.5666	0.826
0.5833	0.794
0.6000	0.768
0.6166	0.743
0.6333	0.718
0.6500	0.692
0.6666	0.667
0.6833	0.648
0.7000	0.622
0.7166	0.603
0.7333	0.578
0.7500	0.565
0.7666	0.546
0.7833	0.533
0.8000	0.508
0.8166	0.495
0.8333	0.476
0.8500	0.463
0.8666	0.451
0.8833	0.432
0.9000	0.419
0.9166	0.406
0.9333	0.394
0.9500	0.381
0.9666	0.368
0.9833	0.362
1.0000	0.349
1.2000	0.241
1.4000	0.171

1.6000	0.120
1.8000	0.088
2.0000	0.063
2.2000	0.044
2.4000	0.025
2.6000	0.012
2.8000	0.006
3.0000	0.000
3.2000	-0.006
3.4000	-0.012
3.6000	-0.019
3.8000	-0.025
4.0000	-0.025
4.2000	-0.031
4.4000	-0.031
4.6000	-0.038
4.8000	-0.038
5.0000	-0.044
5.2000	-0.044
5.4000	-0.044
5.6000	-0.044
5.8000	-0.050
6.0000	-0.050
6.2000	-0.044
6.4000	-0.050
6.6000	-0.050
6.8000	-0.050
7.0000	-0.057
7.2000	-0.050
7.4000	-0.057
7.6000	-0.057
7.8000	-0.057
8.0000	-0.057
8.2000	-0.057
8.4000	-0.057
8.6000	-0.057
8.8000	-0.057
9.0000	-0.057
9.2000	-0.057
9.4000	-0.057
9.6000	-0.057
9.8000	-0.057
10.0000	-0.057
12.0000	-0.063
14.0000	-0.063
16.0000	-0.069
18.0000	-0.076
20.0000	-0.082
22.0000	-0.082
24.0000	-0.082
26.0000	-0.088
28.0000	-0.088

Wateree Station - MW-3, test 2



SE2000
Environmental Logger
12/29 13:00

Unit# 2K-447 Test 1

Setups:	INPUT 1
Type	Level (F)
Mode	TOC
I.D.	MW3

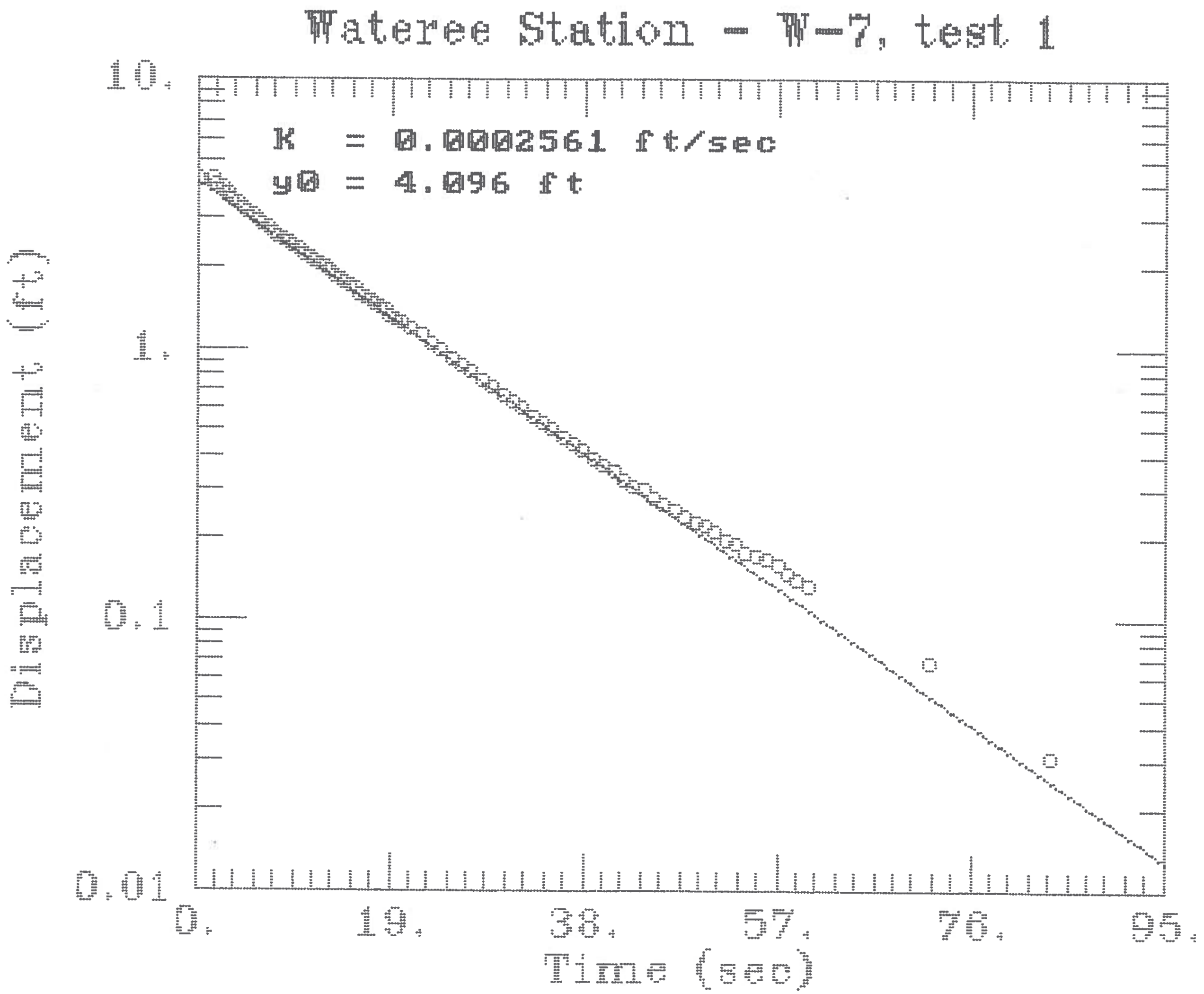
Reference	0.000
PSI at Ref.	6.526
SG	1.000
Linearity	0.112
Scale factor	20.096
Offset	0.029
Delay mSEC	50.000

Step 0 12/22 10:08:21

Elapsed Time	INPUT 1
0.0000	5.424
~~0.0083~~	~~3.507~~
0.0166	4.142
0.0250	4.103
0.0333	3.970
0.0416	3.818
0.0500	3.691
0.0583	3.602
0.0666	3.475
0.0750	3.399
0.0833	3.297
0.0916	3.208
0.1000	3.125
0.1083	3.037
0.1166	2.954
0.1250	2.897
0.1333	2.821
0.1416	2.751
0.1500	2.687
0.1583	2.605
0.1666	2.541
0.1750	2.484
0.1833	2.420
0.1916	2.370
0.2000	2.312
0.2083	2.262
0.2166	2.211
0.2250	2.160
0.2333	2.115

0.2416	2.065
0.2500	2.020
0.2583	1.976
0.2666	1.938
0.2750	1.893
0.2833	1.855
0.2916	1.817
0.3000	1.779
0.3083	1.741
0.3166	1.709
0.3250	1.671
0.3333	1.639
0.3500	1.575
0.3666	1.512
0.3833	1.455
0.4000	1.398
0.4166	1.347
0.4333	1.296
0.4500	1.245
0.4666	1.201
0.4833	1.156
0.5000	1.118
0.5166	1.080
0.5333	1.042
0.5500	1.004
0.5666	0.972
0.5833	0.934
0.6000	0.908
0.6166	0.877
0.6333	0.845
0.6500	0.819
0.6666	0.794
0.6833	0.768
0.7000	0.743
0.7166	0.718
0.7333	0.699
0.7500	0.673
0.7666	0.654
0.7833	0.635
0.8000	0.616
0.8166	0.597
0.8333	0.578
0.8500	0.559
0.8666	0.546
0.8833	0.527
0.9000	0.514
0.9166	0.502
0.9333	0.489
0.9500	0.470
0.9666	0.457
0.9833	0.451
1.0000	0.432
1.2000	0.317
1.4000	0.235

1.6000	0.177
1.8000	0.133
2.0000	0.108
2.2000	0.082
2.4000	0.063
2.6000	0.050
2.8000	0.038
3.0000	0.031
3.2000	0.019
3.4000	0.012
3.6000	0.006
3.8000	0.006
4.0000	0.000
4.2000	-0.006
4.4000	-0.006
4.6000	-0.006
4.8000	-0.012
5.0000	-0.012
5.2000	-0.019
5.4000	-0.019
5.6000	-0.019
5.8000	-0.019
6.0000	-0.025
6.2000	-0.025
6.4000	-0.025
6.6000	-0.025
6.8000	-0.025
7.0000	-0.025
7.2000	-0.025
7.4000	-0.025
7.6000	-0.031
7.8000	-0.031
8.0000	-0.031
8.2000	-0.031
8.4000	-0.031
8.6000	-0.031
8.8000	-0.031
9.0000	-0.031
9.2000	-0.031
9.4000	-0.031
9.6000	-0.031
9.8000	-0.031
10.0000	-0.031
12.0000	-0.038
14.0000	-0.038
16.0000	-0.044
18.0000	-0.044
20.0000	-0.050
22.0000	-0.050
24.0000	-0.057
26.0000	-0.057
28.0000	-0.057
30.0000	-0.057
32.0000	-0.063

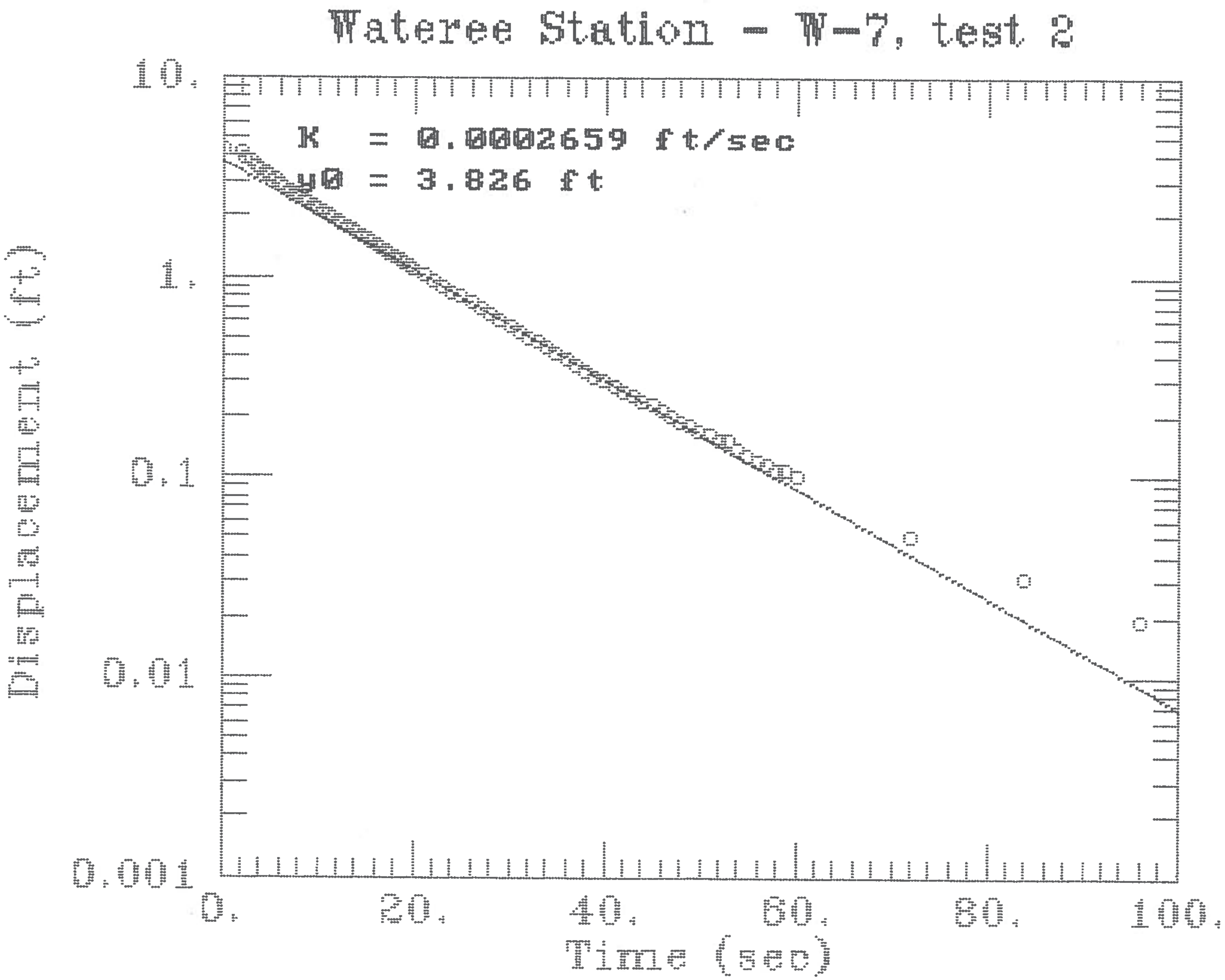

Wateree Station - W-7, test 1
K = 0.0002561 ft/sec
y0 = 4.096 ft
Displacement (ft)
10.
1.
0.1
0.01
0.
19.
38.
57.
76.
95.
Time (sec)

```
        SE2000
  Environmental Logger
      12/29 13:02

 Unit# 2K-447    Test 2

Setups:       INPUT  1
------------  ---------
Type          Level (F)
Mode           TOC
I.D.          MW7

Reference        0.000
PSI at Ref.      4.037
SG             1.000
Linearity       0.112
Scale factor    20.096
Offset         0.029
Delay mSEC       50.000

Step 0  12/22 11:53:16

Elapsed Time  INPUT  1
------------  ---------
   0.0000        3.787
   0.0083        4.072
   0.0166        4.085
   0.0250        4.244     ↓
   0.0333        4.066    Start Test
   0.0416        3.869
   0.0500        3.711
   0.0583        3.540
   0.0666        3.438
   0.0750        3.299
   0.0833        3.185
   0.0916        3.064
   0.1000        2.975
   0.1083        2.893
   0.1166        2.791
   0.1250        2.683
   0.1333        2.607
   0.1416        2.550
   0.1500        2.474
   0.1583        2.379
   0.1666        2.309
   0.1750        2.239
   0.1833        2.170
   0.1916        2.106
   0.2000        2.043
   0.2083        1.979
   0.2166        1.922
   0.2250        1.859
   0.2333        1.808
```

0.2416	1.757
0.2500	1.707
0.2583	1.656
0.2666	1.599
0.2750	1.554
0.2833	1.510
0.2916	1.465
0.3000	1.415
0.3083	1.377
0.3166	1.332
0.3250	1.300
0.3333	1.256
0.3500	1.186
0.3666	1.116
0.3833	1.047
0.4000	0.983
0.4166	0.926
0.4333	0.875
0.4500	0.818
0.4666	0.767
0.4833	0.723
0.5000	0.679
0.5166	0.641
0.5333	0.602
0.5500	0.564
0.5666	0.533
0.5833	0.501
0.6000	0.469
0.6166	0.444
0.6333	0.418
0.6500	0.393
0.6666	0.374
0.6833	0.349
0.7000	0.330
0.7166	0.310
0.7333	0.298
0.7500	0.279
0.7666	0.266
0.7833	0.253
0.8000	0.241
0.8166	0.228
0.8333	0.222
0.8500	0.209
0.8666	0.196
0.8833	0.190
0.9000	0.177
0.9166	0.171
0.9333	0.165
0.9500	0.158
0.9666	0.145
0.9833	0.139
1.0000	0.133
1.2000	0.069
1.4000	0.031

1.6000	0.019
1.8000	0.000
2.0000	-0.006
2.2000	-0.012
2.4000	-0.019
2.6000	-0.019
2.8000	-0.025
3.0000	-0.025
3.2000	-0.025
3.4000	-0.025
3.6000	-0.025
3.8000	-0.025
4.0000	-0.031
4.2000	-0.031
4.4000	-0.031
4.6000	-0.031
4.8000	-0.031
5.0000	-0.031
5.2000	-0.031
5.4000	-0.031
5.6000	-0.038
5.8000	-0.038
6.0000	-0.038
6.2000	-0.038
6.4000	-0.038
6.6000	-0.038
6.8000	-0.038
7.0000	-0.038
7.2000	-0.038
7.4000	-0.038
7.6000	-0.038
7.8000	-0.038
8.0000	-0.038
8.2000	-0.038
8.4000	-0.038
8.6000	-0.038
8.8000	-0.038
9.0000	-0.038
9.2000	-0.038
9.4000	-0.038
9.6000	-0.044
9.8000	-0.038
10.0000	-0.038
12.0000	-0.038
14.0000	-0.038
16.0000	-0.044
18.0000	-0.044
20.0000	-0.044
22.0000	-0.044
24.0000	-0.038
26.0000	-0.044
28.0000	-0.044
30.0000	-0.050
32.0000	-0.050

34.0000	-0.050
36.0000	-0.050
38.0000	-0.050

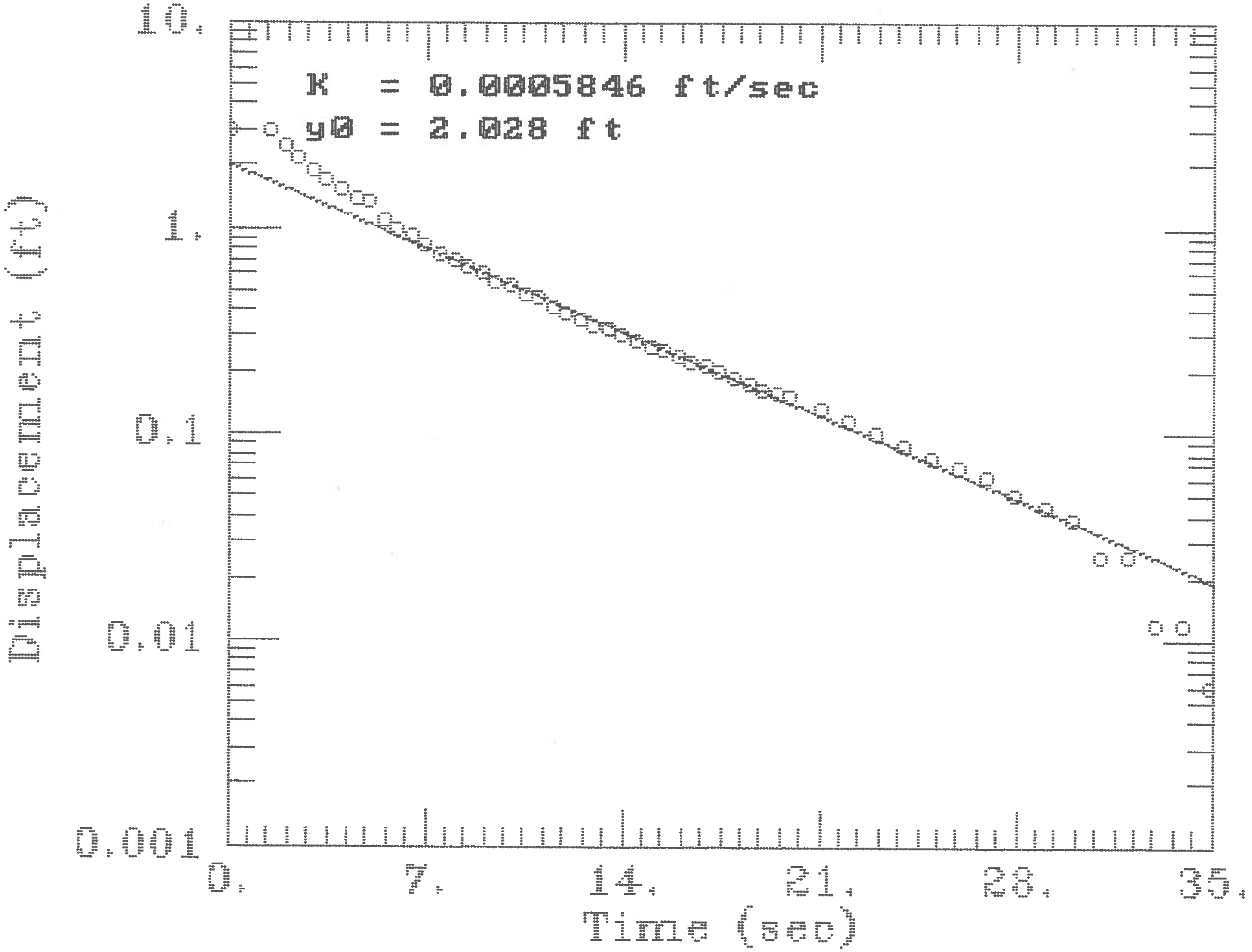

Wateree Station - W-7, test 2
K = 0.0002659 ft/sec
y0 = 3.826 ft
Displacement (ft)
10.
1.
0.1
0.01
0.001
0.
20.
40.
60.
80.
100.
Time (sec)

```
        SE2000
  Environmental Logger
     12/29 13:04

 Unit# 2K-447    Test 3

Setups:        INPUT  1
------------  ---------
Type           Level (F)
Mode            TOC
I.D.          MW7

Reference        0.000
PSI at Ref.      4.149
SG             1.000
Linearity        0.112
Scale factor     20.096
Offset         0.029
Delay mSEC        50.000

Step 0  12/22 12:44:06

Elapsed Time  INPUT  1
------------  ---------
   0.0000        4.301
~~  0.0083        2.436~~
~~  0.0166        3.337~~
~~  0.0250        4.104~~
   0.0333        4.168
   0.0416        3.933
   0.0500        3.743
   0.0583        3.578
   0.0666        3.438
   0.0750        3.274
   0.0833        3.153
   0.0916        3.033
   0.1000        2.906
   0.1083        2.804
   0.1166        2.715
   0.1250        2.620
   0.1333        2.544
   0.1416        2.443
   0.1500        2.360
   0.1583        2.278
   0.1666        2.195
   0.1750        2.106
   0.1833        2.030
   0.1916        1.960
   0.2000        1.891
   0.2083        1.821
   0.2166        1.757
   0.2250        1.700
   0.2333        1.650
```

0.2416	1.592
0.2500	1.535
0.2583	1.485
0.2666	1.427
0.2750	1.383
0.2833	1.339
0.2916	1.294
0.3000	1.256
0.3083	1.212
0.3166	1.174
0.3250	1.136
0.3333	1.097
0.3500	1.028
0.3666	0.958
0.3833	0.901
0.4000	0.837
0.4166	0.787
0.4333	0.736
0.4500	0.691
0.4666	0.647
0.4833	0.609
0.5000	0.564
0.5166	0.533
0.5333	0.495
0.5500	0.469
0.5666	0.437
0.5833	0.412
0.6000	0.387
0.6166	0.361
0.6333	0.342
0.6500	0.317
0.6666	0.304
0.6833	0.285
0.7000	0.266
0.7166	0.253
0.7333	0.241
0.7500	0.228
0.7666	0.215
0.7833	0.203
0.8000	0.190
0.8166	0.184
0.8333	0.171
0.8500	0.165
0.8666	0.152
0.8833	0.152
0.9000	0.139
0.9166	0.126
0.9333	0.120
0.9500	0.114
0.9666	0.107
0.9833	0.107
1.0000	0.101
1.2000	0.050
1.4000	0.031

1.6000	0.019
1.8000	0.006
2.0000	0.000
2.2000	-0.006
2.4000	-0.006
2.6000	-0.006
2.8000	-0.012
3.0000	-0.012
3.2000	-0.012
3.4000	-0.012
3.6000	-0.019
3.8000	-0.019
4.0000	-0.019
4.2000	-0.019
4.4000	-0.019
4.6000	-0.025
4.8000	-0.019
5.0000	-0.025
5.2000	-0.025
5.4000	-0.025
5.6000	-0.025
5.8000	-0.025
6.0000	-0.025
6.2000	-0.025
6.4000	-0.025
6.6000	-0.025
6.8000	-0.025
7.0000	-0.025
7.2000	-0.025
7.4000	-0.025
7.6000	-0.031
7.8000	-0.025
8.0000	-0.031
8.2000	-0.025
8.4000	-0.025
8.6000	-0.031
8.8000	-0.025
9.0000	-0.025
9.2000	-0.031
9.4000	-0.031
9.6000	-0.031
9.8000	-0.025
10.0000	-0.031
12.0000	-0.031
14.0000	-0.031
16.0000	-0.031
18.0000	-0.031
20.0000	-0.038
22.0000	-0.038
24.0000	-0.038
26.0000	-0.044

Wateree Station - W-11, test 1

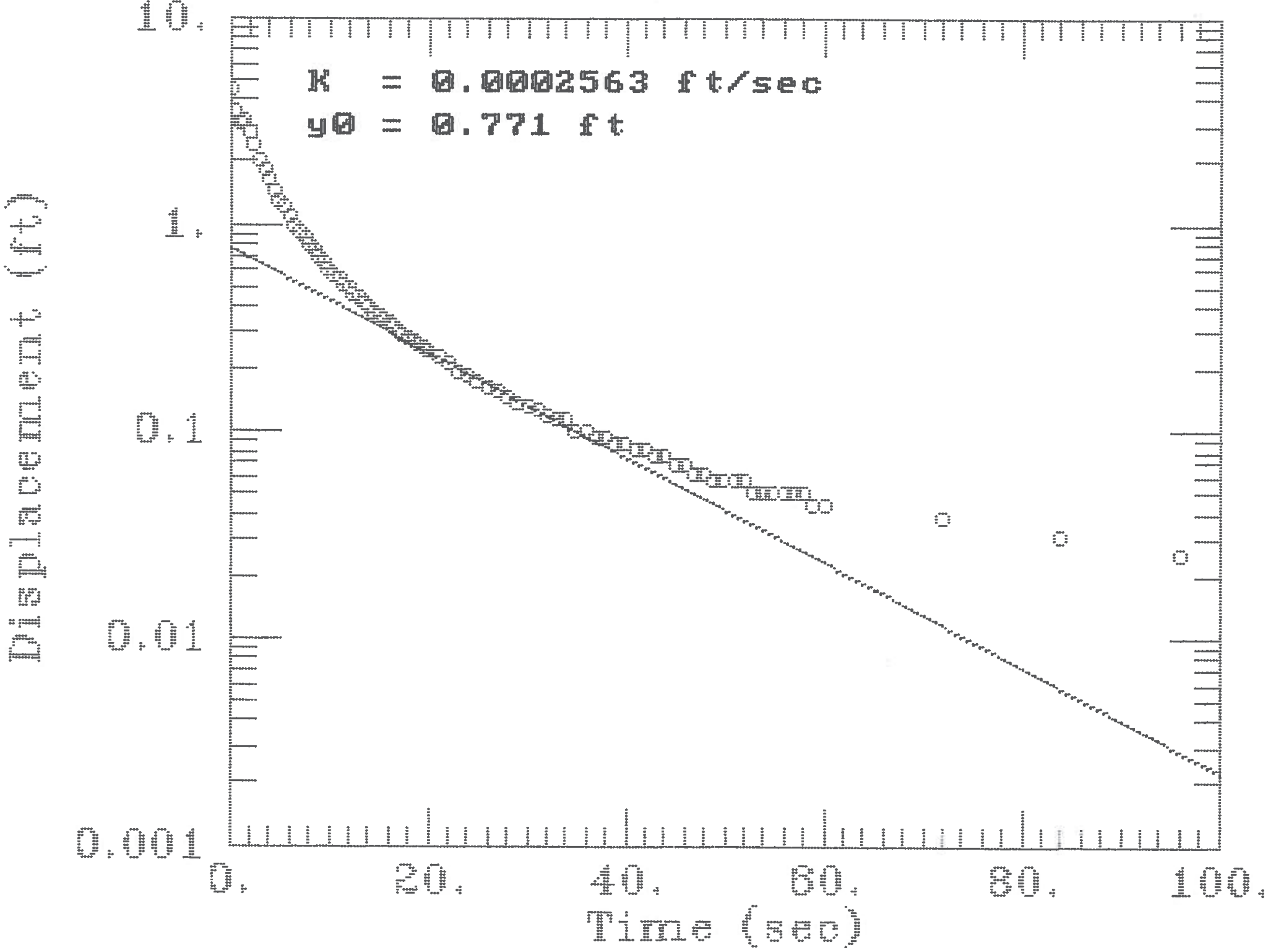


```
       SE2000
  Environmental Logger
      12/29 13:05

 Unit# 2K-447     Test 4

Setups:       INPUT  1
------------  ---------
Type          Level (F)
Mode           TOC
I.D.          MW11

Reference        0.000
PSI at Ref.      3.866
SG             1.000
Linearity        0.112
Scale factor    20.096
Offset         0.029
Delay mSEC       50.000

Step 0  12/22 13:43:31

Elapsed Time  INPUT  1
------------  ---------
   0.0000       2.575
   0.0083       2.360
   0.0166       2.601
   0.0250       2.937   ↓ Start Test
   0.0333       2.506
   0.0416       2.182
   0.0500       1.890
   0.0583       1.687
   0.0666       1.516
   0.0750       1.383
   0.0833       1.319
   0.0916       1.078
   0.1000       0.989
   0.1083       0.907
   0.1166       0.831
   0.1250       0.755
   0.1333       0.691
   0.1416       0.647
   0.1500       0.602
   0.1583       0.552
   0.1666       0.520
   0.1750       0.475
   0.1833       0.456
   0.1916       0.412
   0.2000       0.387
   0.2083       0.361
   0.2166       0.342
   0.2250       0.323
   0.2333       0.304
```

0.2416	0.285
0.2500	0.266
0.2583	0.253
0.2666	0.241
0.2750	0.222
0.2833	0.215
0.2916	0.203
0.3000	0.190
0.3083	0.177
0.3166	0.165
0.3250	0.158
0.3333	0.152
0.3500	0.133
0.3666	0.114
0.3833	0.101
0.4000	0.088
0.4166	0.076
0.4333	0.069
0.4500	0.063
0.4666	0.050
0.4833	0.044
0.5000	0.038
0.5166	0.025
0.5333	0.025
0.5500	0.012
0.5666	0.012
0.5833	0.006
0.6000	0.000
0.6166	-0.006
0.6333	-0.006
0.6500	-0.012
0.6666	-0.012
0.6833	-0.019
0.7000	-0.019
0.7166	-0.025
0.7333	-0.025
0.7500	-0.031
0.7666	-0.031
0.7833	-0.031
0.8000	-0.038
0.8166	-0.038
0.8333	-0.038
0.8500	-0.044
0.8666	-0.044
0.8833	-0.044
0.9000	-0.044
0.9166	-0.050
0.9333	-0.050
0.9500	-0.050
0.9666	-0.050
0.9833	-0.050
1.0000	-0.057
1.2000	-0.063
1.4000	-0.069

1.6000	-0.076
1.8000	-0.076
2.0000	-0.082
2.2000	-0.082
2.4000	-0.088
2.6000	-0.088
2.8000	-0.088
3.0000	-0.088
3.2000	-0.095

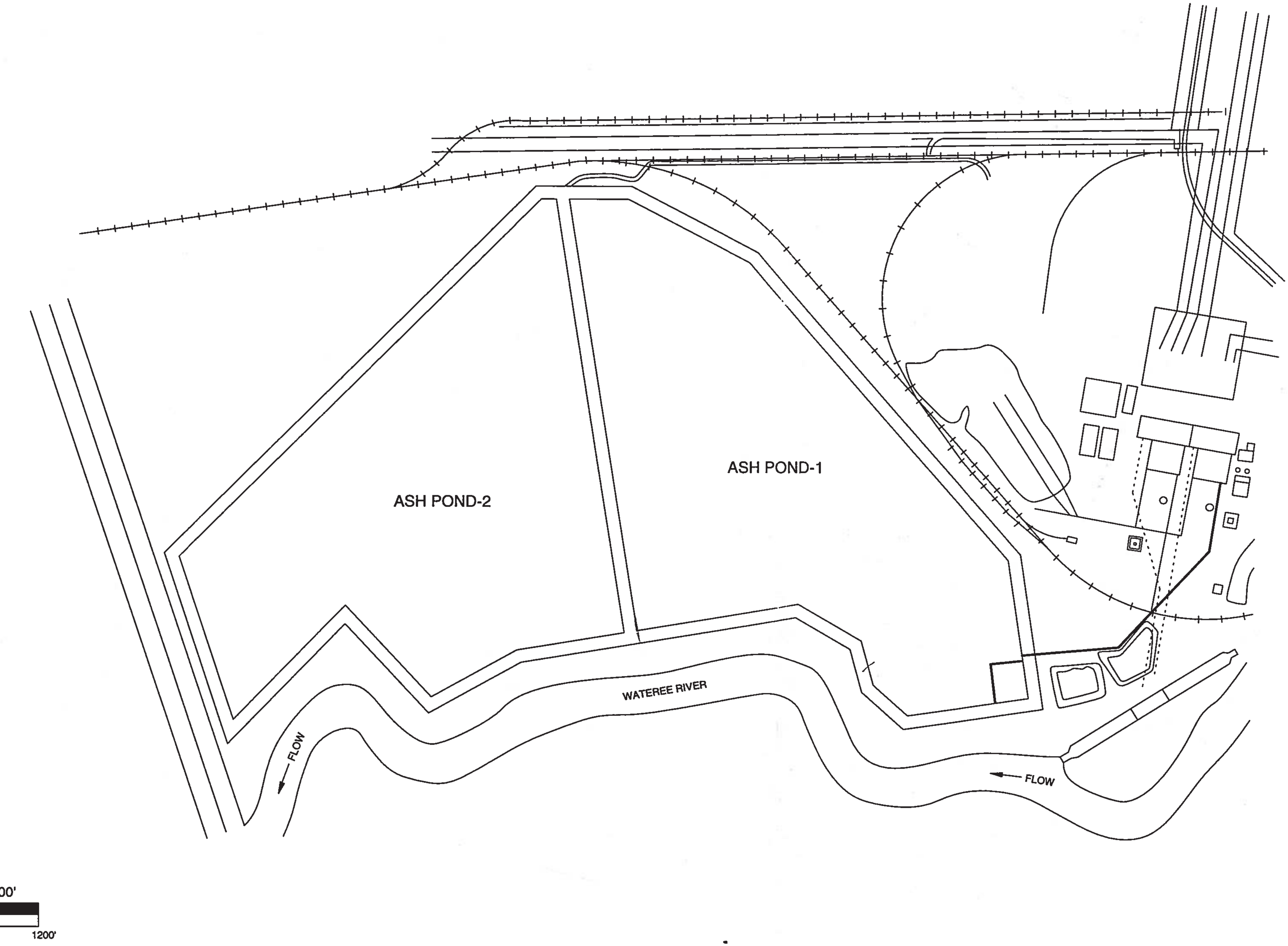
Wateree Station - MW-11, test 2



```
      SE2000
  Environmental Logger
     12/29 13:07

 Unit# 2K-447    Test 5

Setups:      INPUT  1
------------  ---------
Type         Level (F)
Mode          TOC
I.D.         MW11

Reference      0.000
PSI at Ref.    3.866
SG            1.000
Linearity      0.112
Scale factor   20.096
Offset        0.029
Delay mSEC       50.000

Step 0  12/22 14:19:31

Elapsed Time  INPUT  1
------------  ---------
   0.0000      4.446
   0.0083      3.470
   0.0166      3.051
   0.0250      3.203
   0.0333      2.740
   0.0416      2.372
   0.0500      2.055
   0.0583      1.846
   0.0666      1.624
   0.0750      1.446
   0.0833      1.294
   0.0916      1.199
   0.1000      1.091
   0.1083      0.996
   0.1166      0.920
   0.1250      0.850
   0.1333      0.786
   0.1416      0.736
   0.1500      0.685
   0.1583      0.640
   0.1666      0.602
   0.1750      0.571
   0.1833      0.539
   0.1916      0.507
   0.2000      0.488
   0.2083      0.463
   0.2166      0.437
   0.2250      0.418
   0.2333      0.399
```

0.2416	0.380
0.2500	0.361
0.2583	0.349
0.2666	0.336
0.2750	0.323
0.2833	0.304
0.2916	0.298
0.3000	0.285
0.3083	0.272
0.3166	0.266
0.3250	0.253
0.3333	0.247
0.3500	0.228
0.3666	0.215
0.3833	0.196
0.4000	0.190
0.4166	0.177
0.4333	0.165
0.4500	0.158
0.4666	0.145
0.4833	0.139
0.5000	0.133
0.5166	0.126
0.5333	0.120
0.5500	0.114
0.5666	0.114
0.5833	0.101
0.6000	0.101
0.6166	0.095
0.6333	0.095
0.6500	0.088
0.6666	0.088
0.6833	0.082
0.7000	0.082
0.7166	0.076
0.7333	0.076
0.7500	0.069
0.7666	0.069
0.7833	0.063
0.8000	0.063
0.8166	0.057
0.8333	0.057
0.8500	0.057
0.8666	0.057
0.8833	0.050
0.9000	0.050
0.9166	0.050
0.9333	0.050
0.9500	0.050
0.9666	0.050
0.9833	0.044
1.0000	0.044
1.2000	0.038
1.4000	0.031

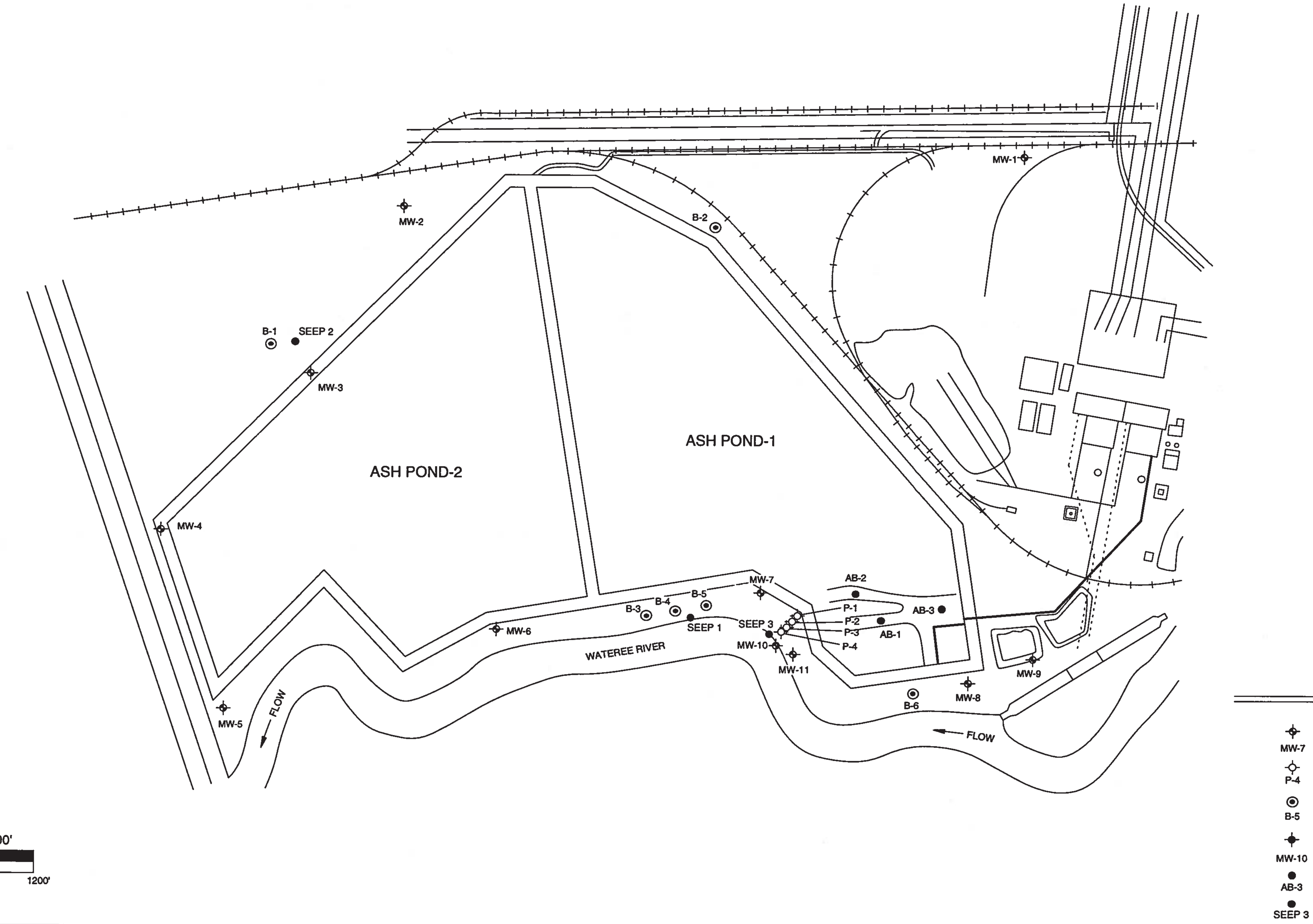
1.6000	0.025
1.8000	0.019
2.0000	0.019
2.2000	0.019
2.4000	0.012
2.6000	0.012
2.8000	0.012
3.0000	0.012
3.2000	0.012
3.4000	0.012
3.6000	0.012
3.8000	0.012
4.0000	0.006
4.2000	0.006
4.4000	0.012
4.6000	0.006
4.8000	0.012
5.0000	0.012
5.2000	0.012
5.4000	0.012
5.6000	0.012
5.8000	0.012
6.0000	0.012
6.2000	0.012
6.4000	0.012
6.6000	0.012
6.8000	0.006
7.0000	0.012
7.2000	0.012
7.4000	0.012
7.6000	0.012
7.8000	0.012
8.0000	0.012
8.2000	0.012
8.4000	0.012
8.6000	0.012
8.8000	0.012
9.0000	0.012
9.2000	0.012
9.4000	0.012
9.6000	0.019
9.8000	0.019
10.0000	0.012
12.0000	0.025
14.0000	0.025
16.0000	0.031
18.0000	0.038



ERING
atories, Inc.

PROJECT: sceg01897

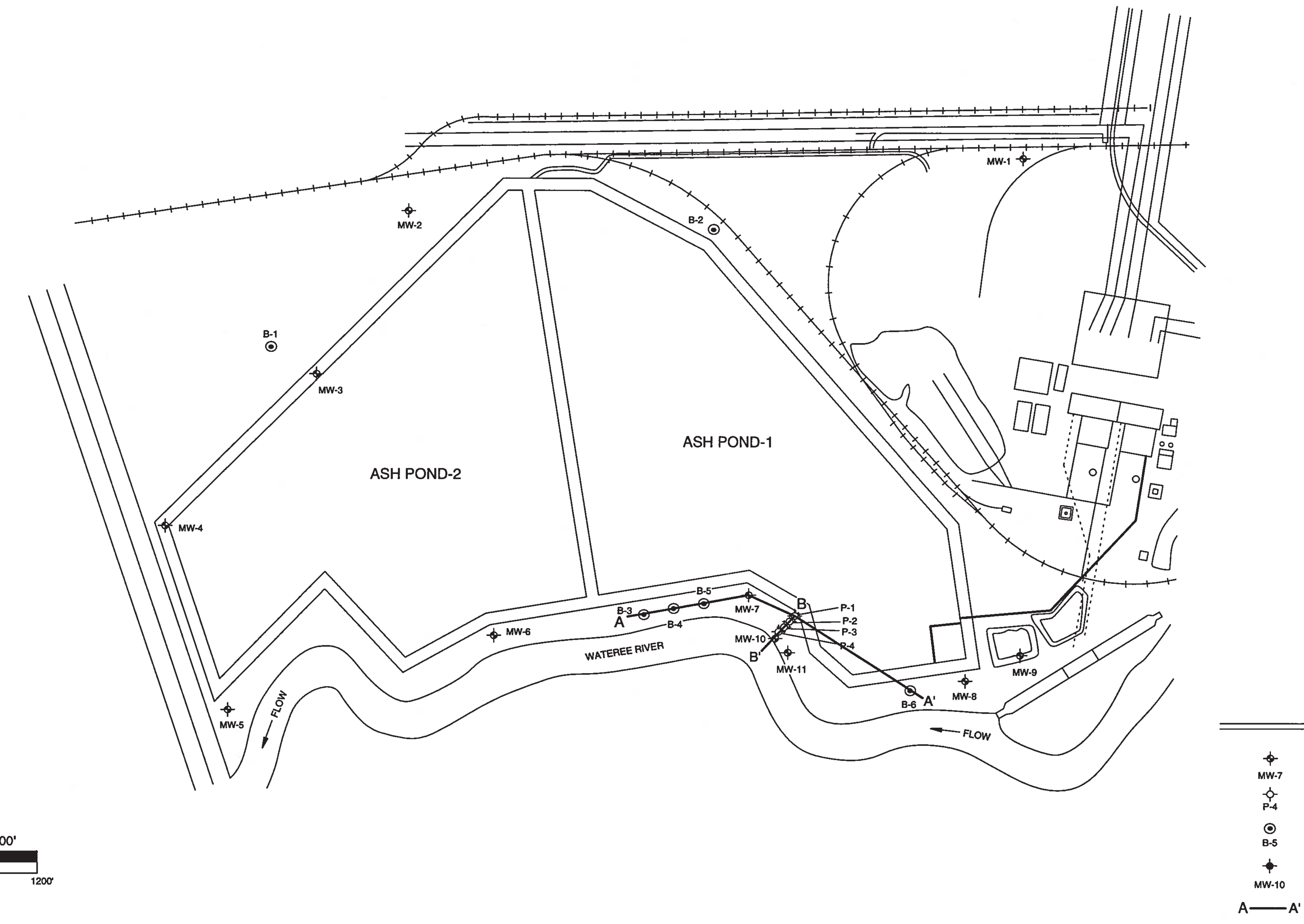
HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION



RING
tories, Inc.

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT

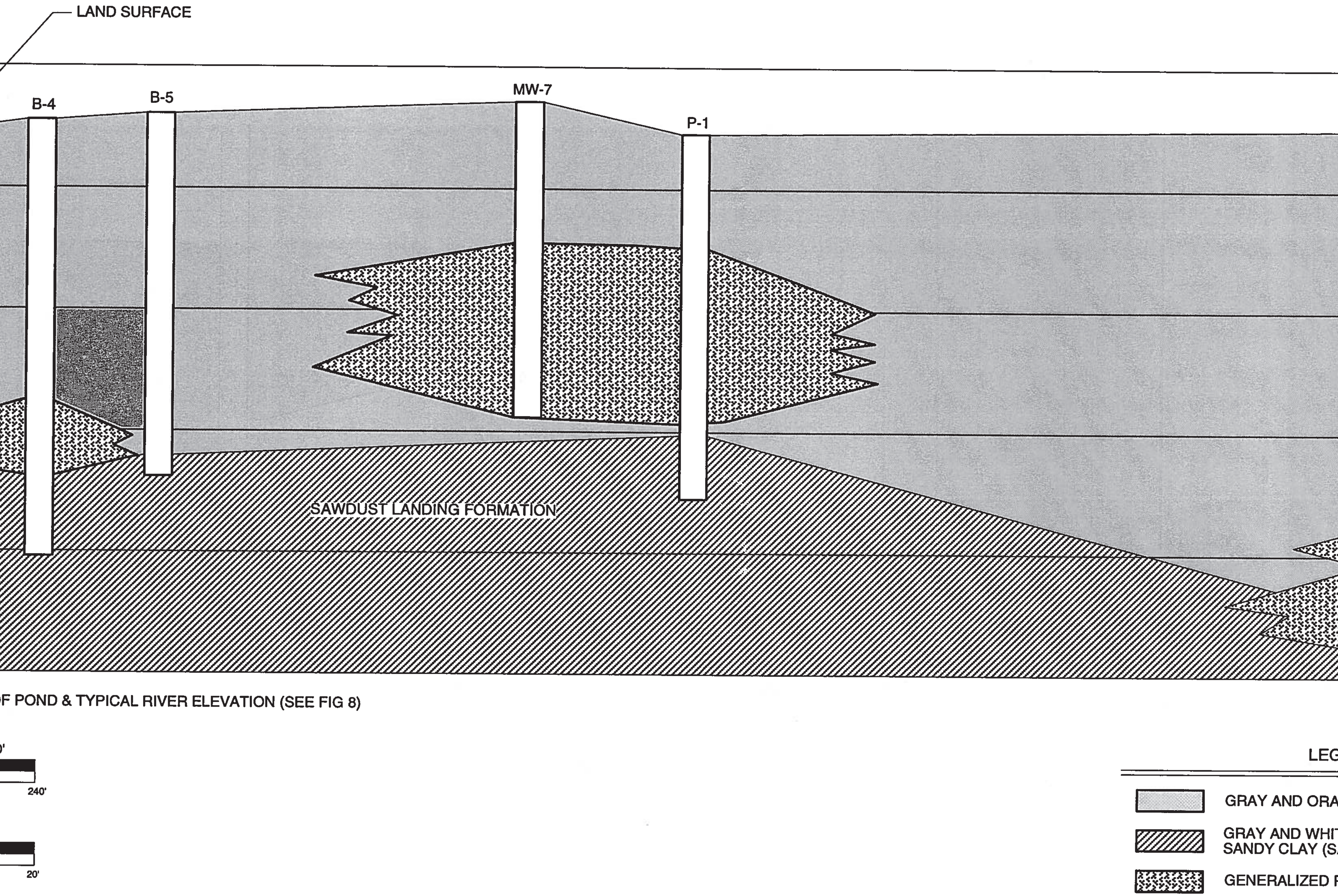


ERING
atories, Inc.

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT
WATEREE STATION

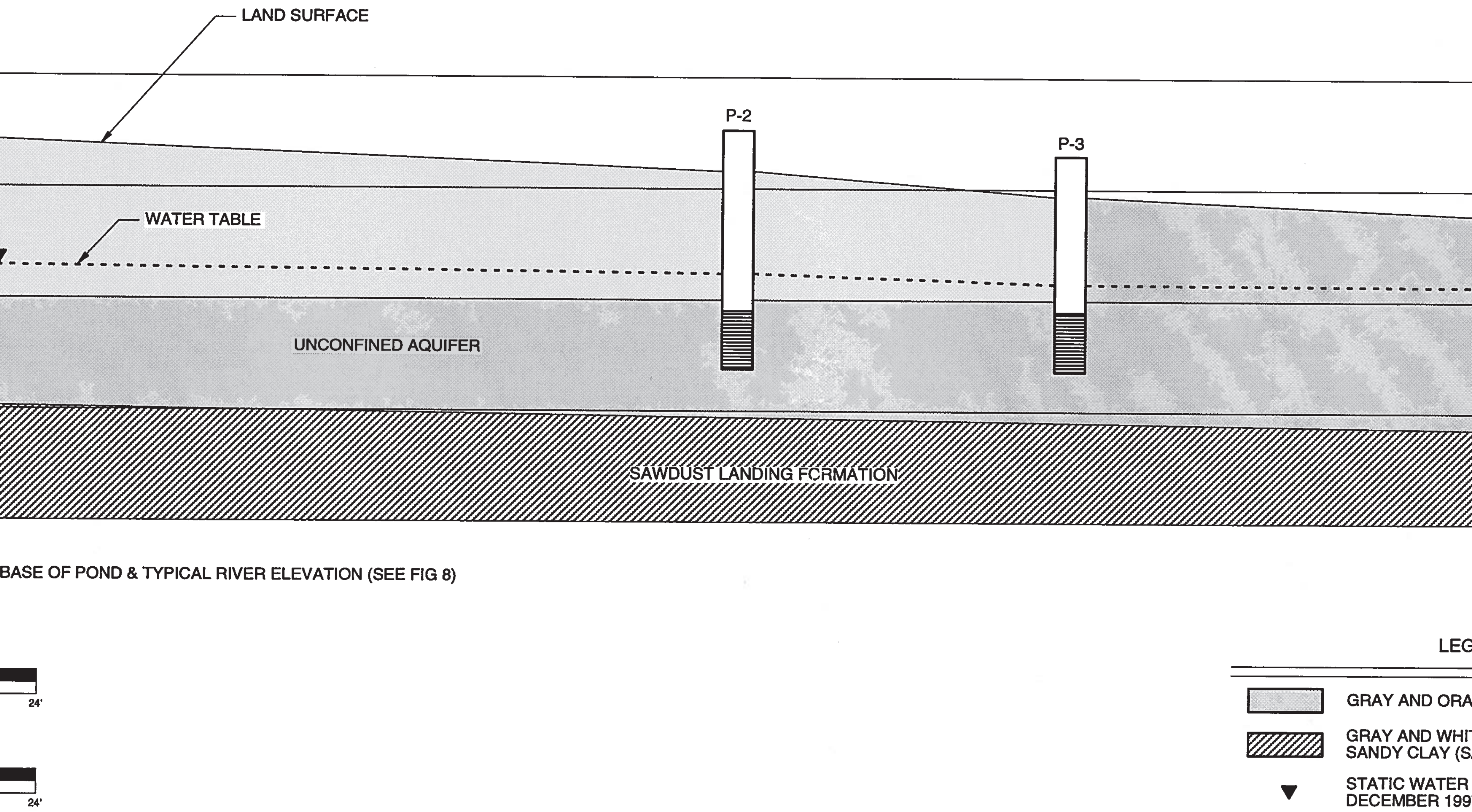
SITE MAP SHOWING



RING
tories, Inc.

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT

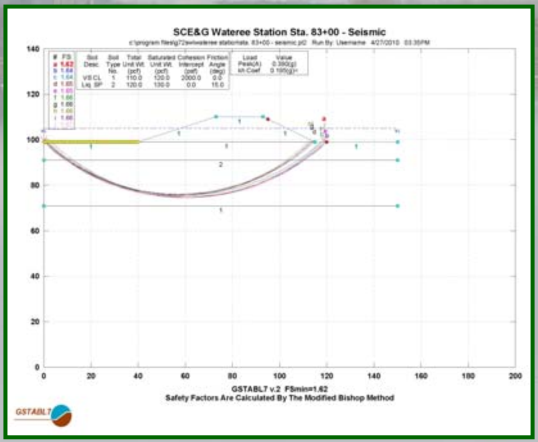


RING
ories, Inc.

PROJECT: sceg01897

HYDROGEOLOGIC ASSESSMENT REPORT

WATEREE STATION
ASH POND CONTAINMENT STRUCTURE
SUBSURFACE INVESTIGATION AND STRUCTURAL STABILITY REPORT



PREPARED FOR:

SCE&G

PREPARED BY:

F&ME CONSULTANTS

JUNE 22, 2010

F&ME CONSULTANTS

GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

COLUMBIA OFFICE
3112 Devine Street
Columbia, SC 29205
ph (803) 254-4540
fx (803) 254-4542

MYRTLE BEACH OFFICE
1903 Legion Street
Myrtle Beach, SC 29577
ph (843) 626-9253
fx (843) 448-0681

AASHTO R18

AASHTO ACCREDITED LABORATORY

www.fmecol.com

June 22, 2010

Mr. Jim Devereaux
South Carolina Electrical & Gas Company
220 Operations Way
MC A221
Cayce, South Carolina 29033

Re: Wateree Station
Ash Pond Containment Structure
Subsurface Investigation and Structural Stability Report

Dear Mr. Devereaux:

Enclosed herein is a report of our Subsurface Investigation and Structural Stability Analysis. If you have any questions concerning any aspect of our investigation or report, please do not hesitate to contact me or Mr. Adam Shannon, our Senior Project Engineer for this investigation.

Respectfully submitted,

Zane W. Abernethy, P.E.
President

EXECUTIVE SUMMARY

A Structural Stability Analysis has been completed for the perimeter containment system of Ash Ponds 1 and 2 at the Wateree Station. The following is a summary of the findings and conclusions of our Site Subsurface Investigation and Structural Stability Analysis.

1. The perimeter containment system for Ponds 1 and 2 has been characterized into three unique segments:

   A. Segment 1: River bluff along the eastern sides of Ponds 1 and 2 paralleling the Wateree River.

   B. Segment 2: Constructed embankment, which forms the south side of Pond 2.

   C. Segment 3: The remaining perimeter of the ponds, western perimeter of Ponds 1 and 2 and the northern perimeter of Pond 1, where the ponds are constructed below original grade (incised).

   NOTE: See Figure CSCS-1

2. Based upon our integration of all the data gathered during our investigations, slope stability analyses were performed in "worst case" areas of Segment 1, River Bluff, and Segment 2, Constructed Embankment, of the containment system.

3. Segment 3 was not analyzed for slope stability since it is an incised section and any structural instability would be contained within the pond and would not result in the release of ash. We do point out that based on our analysis of the other segments, Segment 3 is statically and seismically stable.

4. Federal Energy Regulatory Commission Dam Guidelines were utilized to establish design factors of safety.

5. United States Geologic Survey Seismic Criteria were utilized to determine maximum ground acceleration for our seismic analysis.

6. There have been no historical slope stability issues within the perimeter containment system.

7. The perimeter containment system exceeds all minimum factors of safety for design static loading.

8. The perimeter containment system exceeds minimum factors of safety for the assumed seismic event loading condition.

9. During the assumed seismic event, liquefaction of the foundation soils could occur. Maximum liquefaction induced settlement will be about three inches. The settlement is expected to occur over a broad area extending beyond the pond perimeter and to be uniform in nature. The magnitude of anticipated differential settlement would not create instability of the perimeter containment system.

This report has been prepared by F&ME Consultants for use by South Carolina Electric and Gas and/or their parent company, SCANA. The following F&ME professionals assisted in the performance of fieldwork and the preparation of this report.

Signatures:

Seals:

Zane W. Abernethy, P.E.
Senior Project Engineer/Author

SOUTH CAROLINA
REGISTERED PROFESSIONAL ENGINEER
No. 6485
ZANE W. ABERNETHY

Adam J. Shannon, P.E.
Senior Project Engineer

SOUTH CAROLINA
REGISTERED PROFESSIONAL ENGINEER
No. 21272
ADAM JOHNSON SHANNON

Michael S. Miller, P.E.
Project Engineer

SOUTH CAROLINA
REGISTERED PROFESSIONAL ENGINEER
No. 20955
MICHAEL S. MILLER

TABLE OF CONTENTS

1.0 Introduction

F&ME Consultants has performed a subsurface investigation and structural stability analysis for the perimeter containment system of the ash pond system at the Wateree Power Generating Station. Wateree Station is located adjacent to the Wateree River in southeastern Richland County, South Carolina. The ash pond system contains two ponds identified as Pond 1 and Pond 2.

The scope of our investigation and analysis included:

Field Investigation

- Geophysical Surveys: Electrical Resistivity Imaging, Ground Penetrating Radar, and Seismic Refraction Survey
- Stratigraphic Boreholes (Without Groundwater Sampling): Continuously Sampled Borings Using Rotosonic Drilling, Piezocone Soundings, and Shallow Hand Augers
- Topographic Survey: Detailed On-The-Ground Survey to Locate All Data Points, Develop Typical Cross-Sections, and Tie in With Existing Aerial Topographic Survey

Analysis

- Characterization of Ponds 1 and 2 Perimeter Containment System
- Analyze Field Investigation Data and Integrate Into Analytical Models
- Analyze the Perimeter Containment System for Static and Seismic Stability

This scope of work was accomplished by performing a detailed geophysical investigation to identify areas for further geotechnical exploration. Submitted herein is the report of the detailed geophysical investigation, the geotechnical exploration, detailed topographic survey data with stationing, a summary of our findings, and the results of our analysis of the structural stability of the ash pond containment system.

With respect to static and seismic stability evaluations, our field investigations and analyses were performed in general accordance with Federal Energy Regulatory Commission (FERC) publication guidelines for embankment dams (Embankment Dams of the Federal Energy Regulatory Commission, Chapter IV, April 1991) and the United States Society on Dams (USSD) publication (Strength of Materials for Embankment Dams, February 2007). Submitted herein is the report of our investigations, analyses, and findings.

1.1 General Description of Area

Wateree Station is a 700-megawatt coal-fired power station owned by SCE&G. The station is located on the Wateree River near the town of Eastover, South Carolina. The plant began operation in 1970 and is located in Richland County, South Carolina. It burns approximately 250 tons of coal per hour when running at full capacity. Coal waste from the plant operations is stored and processed in a series of two ponds. The ponds are designated as Ash Pond 1 (Pond 1) and Ash Pond 2 (Pond 2), with Pond 1 being used for coal ash sluicing activities and Pond 2 being used as a polishing pond. Water is discharged into the Wateree River in accordance with the facilities wastewater permit (NPDES Permit Number SC0002038). The ponds are approximately eighty acres each.

The land where Wateree Station is located was previously owned by the Lawrence Stone & Gravel Company, Inc. Indications are that river gravel and sand were quarried using open pit mining. SCE&G acquired a 181-acre tract from the Lawrence Stone & Gravel Company, Inc., which included at least one open pit. The open pit was modified for use as ash storage.

1.2 Initial Pond Containment Structure Characterization

Based upon location and composition, the ash pond containment system exists in three distinct segments. 1) The existing River Bluff that makes up the north and east sides of Ponds 1 and 2. This segment has well-maintained grass and moderate tree growth along the river and the existing river bluff. 2) The constructed embankment on the south and west sides of Pond 2. This segment has a simple earthen embankment covered by well-maintained grass. The embankment does not exceed 24 feet in height at any location. There are a minimal number of very small trees and no heavy woody growth on the constructed embankment. 3) The remaining perimeter of the ponds where the containment is below original grade (incised).

There is a road surfaced with gravel and ash that traverses the perimeter of the ponds with the exception of the west side of Pond 1.

2.0 Site Geology

The project site is geographically located in Richland County, South Carolina and is situated near the boundary between the Middle and Upper Coastal Plain Physiographic Provinces. The Coastal Plain consists of a wedge of sedimentary deposits, which starts at the Fall Line and becomes progressively thicker moving toward the Coast. The deposits in this area generally consist of sands, silts, and clays, which have eroded from the Piedmont Province. Some of these sedimentary materials have been consolidated/indurated and are expressed as siltstone and mudstone. This wedge of sedimentary materials overlying the crystalline rocks of the Piedmont is approximately 650 feet thick in the project area. The site is also situated north of the confluence of the Wateree and Congaree Rivers. Both rivers have influenced the local geology of the site, and repeated meanderings of the river systems over time have deposited various sedimentary sequences including channel deposits (clean sands and gravels) and flood plain deposits (silt and clay materials).

The site is overlain by the shallow surface Congaree River Valley Terrace Complex (layered fluvial deposits) and underlain by the Sawdust Landing Formation. The Sawdust Landing Formation is generally consolidated sandy clay/clayey sand and functions as an aquitard below the surficial aquifer, preventing/limiting downward flow. The depth to this formation varies across the site, from approximately 25 feet below ground surface along the Wateree River to approximately 50 feet to the southwest of Pond 2. This southwest dip of the Sawdust Landing Formation was probably cut down due to the past meandering of the Congaree River.

The prevailing regional flow of shallow ground water, above the Sawdust Landing Formation will be generally south to southeast toward the Wateree and Congaree Rivers. The occurrence and flow of the shallow ground water will fluctuate substantially depending upon climatic conditions.

3.0 Site Seismicity

The records for seismic activity in the southeastern United States cover a span of about 300 years and consist mostly of non-instrumented data. The seismic activity in the southeast is also infrequent. Because of the infrequency of southeastern earthquakes and the lack of statistical data, little basis exists for development of typical seismic design response spectrums. Unlike earthquakes of California, southeastern earthquakes have not caused ground surface ruptures, which make it difficult for geologists to predict active fault locations.

The earthquake that occurred in 1886 in the Coastal Plain Physiographic Province near Charleston, South Carolina dominates the seismic history of the southeastern United States. It is the largest historic earthquake in the southeastern United States with an estimated moment magnitude, M_W, of 7.3 (Richter scale). The resulting earthquake damage area with a Modified Mercalli Intensity Scale of X (X being the highest degree of ground shaking and damage to structures on the Mercalli Scale) is an elliptical shape approximately 20 by 30 miles trending northeast between Charleston and Jedburg, South Carolina, including Summerville and roughly centered at Middleton Place. The intraplate (i.e. areas of the earth's crustal tectonic plates not associated with plate-to-plate tectonic boundaries) epicenter of the 1886 Charleston earthquake and its magnitude is not unique in the central and eastern United States. Other intraplate earthquakes include those at Cape Ann, Massachusetts (1755) with a M_W of 5.9, and Madrid, Missouri (1811-1812) with M_W of at least 7.7.

US Geological Survey methodology and mapping were utilized to establish ground accelerations for our analysis. The data utilized in our analysis is discussed further in this report. A copy of the USGS methodology and mapping is included in Appendix F.

4.0 Historical Records Review

During our investigation, F&ME reviewed aerial photography of the area that includes Wateree Station. We used black and white aerial photographs that were taken from 1938 to 1981, as well as a color satellite image taken in 2006. The available aerial photography shown in Appendix E was acquired from the University of South Carolina's Thomas Cooper Library. These aerial photographs are dated 1938, 1943, 1951, 1963, 1970, and 1981. The satellite image was obtained from Google Earth.

The 1970, 1981, and 2006 photographs show the power plant, Pond 1, and Pond 2 in relationship to the Wateree River. The remaining photographs show the overgrown previous areas of strip mining operations and the adjacent river. Once the aerial photographs were reviewed, it was determined that the Wateree River has not meandered far from its present course in the span of the 68 years for which we have aerial photography; however, the land development has changed.

5.0 Field Investigation

Our investigation work plan consisted of four principal elements: a detailed topographic survey, a geophysical investigation, a geotechnical exploration, and a subsurface characterization.

A detailed topographic survey of the containment system was performed by a registered South Carolina Land Surveyor to develop a system of stationing that allows for accurate location of both the geophysical investigation and geotechnical exploration data.

In addition to the stationing set up along the perimeter, a 100-foot grid was established such that a contour map was produced. Cross sections of Segments 1 and 2 of the containment structure were created on 100-foot intervals. Once the topographical survey was completed, an existing aerial topographical survey provided by SCE&G was combined with the detailed survey described above. By recording all fieldwork and critical work elements on a topographical survey, we have created a baseline of information such that future investigations, if necessary, can be performed with a high degree of repeatability at the same locations. The geophysical investigation consisted of two-dimensional electrical resistivity imaging, three-dimensional electrical resistivity imaging, and ground penetrating radar scans. After analyzing the field data from our geophysical investigation, our geotechnical exploration was performed. This exploration consisted of stratigraphic borings with continuous vertical sampling drilled using rotosonic drilling techniques, cone penetrometer soundings, and shallow hand auger borings. Standard soil index tests, plasticity index (Atterberg Limits), and grain size distribution were performed on samples collected during boring operations. Utilizing all of the field data, a subsurface characterization was developed.

5.1 Geophysical Investigation

For the initial field investigation, F&ME selected four geophysical investigation techniques as our primary investigation methods. These were two-dimensional electrical resistivity imaging, three-dimensional electrical resistivity imaging, ground penetrating radar, and seismic refraction. The main objective of our geophysical investigation was to provide a continuous indication of subsurface conditions beyond that which can be inferred from widely spaced test borings. The results from the geophysical investigation were used to select locations for borings and soundings as a part of the geotechnical exploration. Borings and soundings from the geotechnical exploration were used to proof the geophysical data allowing additional refinement and interpretation.

5.1.1 Two-Dimensional Electrical Resistivity Imaging

F&ME utilizes the SuperSting Earth Resistivity System manufactured by Advanced Geosciences, Inc. (AGI). The system consists of the SuperSting eight-channel resistivity meter and a multi-electrode cable with 42 electrodes at nine feet spacing and an automatic switching unit. The eight channels allow eight resistivity measurements to be taken simultaneously. The electrodes are "grounded" at the desired design electrode spacing utilizing steel spring clips and stakes pushed into the ground subgrade.

The basic principle of electrical resistivity imaging (ER) is that all materials have physical characteristics, which determine how well, or poorly, the material can conduct an electrical current. The current is injected at two points and then measured at other pre-determined points depending upon the array arrangement for the selected in-situ measurement methodology. Analysis of the potential electrical current drops between electrodes using a finite difference algorithm allows a determination of the resistance of the subsurface material (expressed as ohms per meter).

Resistivity values of soil and rock are affected by mineral composition, porosity, moisture, dissolved electrolytes, and temperature. See Appendix D for a table of expected resistivity values. Soils generally have low resistivity values, whereas rock has a relativity high resistivity value. A soil or rock resistivity can vary greatly depending on whether it is wet or dry. Because of overlap in the range of resistivity for various materials, this method is used in conjunction with other geotechnical methods to verify data interpretation.

The "resolution" that the ER equipment can detect is a function of the electrode probe spacing. In general, objects and specific soil strata that are smaller or thinner than one-half the individual electrode probe spacing may not be easily discernable. The depth of investigation that ER data acquisition is capable of is a function of the total survey line length. The depth that can be interpreted with a reasonable resolution is approximately one-fourth to one-fifth of the total survey line length.

Points to remember when reviewing the data collected from resistivity surveys are as follows:

- The resistivity imaging technique is "side-looking." This results in the fact that while the ER profiles depict a vertical slice, roughly perpendicular to ground surface, the indicated anomalies may be located to either side of the survey line.

- The resistivity image may be distorted by unknown formations.

- Constructed objects at ground surface (e.g., metallic fencing, power lines, grounding systems, etc.) and below ground (e.g., metallic pipelines, bridge steel piling, foundation reinforcing steel, etc.) will provide "artificial" high conductivity values.

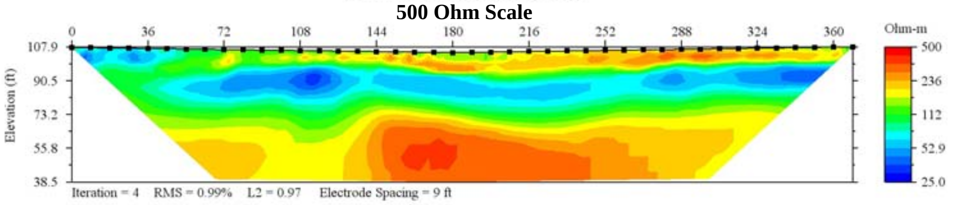
- Clay layers at ground surface or below grade with relatively high electro-chemical, conductivities can "mask" deeper soil and rock strata.

- The resistivity image is a picture in terms of electrical resistivity and not a true picture of subsurface strata as we are accustomed to visualizing (i.e., pseudo-section).

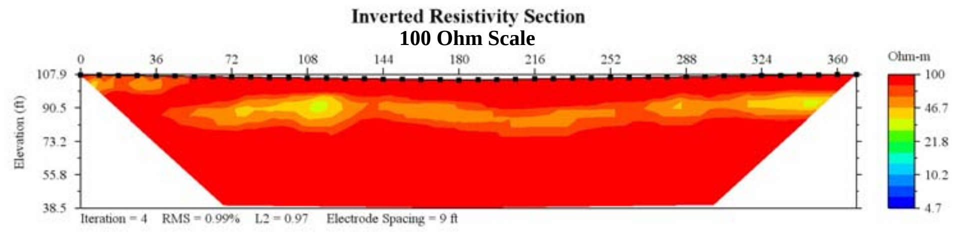
- The electrical resistivity of the strata will slightly change depending on the electrode signal configuration.

For this project, two-dimensional resistivity was used to develop an initial indication of the stratigraphy of the containment structures. The ER imaging will indicate areas of low resistivity, which could represent areas of high hydraulic conductivity. Although electrical resistivity cannot definitively determine soil type and strength, it can show the stratigraphy of the soil. F&ME conducted two-dimensional resistivity testing around the entire Segment 1 and Segment 2 containment perimeter. The two-dimensional resistivity lines were overlapped by seven electrodes in order to generate a continuous two-dimensional image of the subsurface at a continuous depth. The layout of the two-dimensional survey runs continuous around the perimeter and runs parallel to the centerline of the containment structure as much as possible. The only gap in the electrical resistivity lines was near the outfall structure. This was due to a chain link fence, which runs parallel to the containment structure at that location. The highly conductive fence will distort the ER image. The earthen embankment that separates the two ponds was not scanned.

Shown below are examples of the two-dimensional resistivity images taken from this survey. ER Line 5 is located along the containment structure in the area of Seeps A and B. The vertical axis indicates the elevation and the horizontal axis indicates the horizontal distance along the scan. Each block on the horizontal axis at the top of the image represents the location of an electrode. The color scale on the right shows the resistance values for each color shown on the image. Resistivity images can have their color scales changed to better enhance certain features or to highlight a certain layer. The following images illustrate a 500-ohm scale and a 100-ohm scale. Note that when the scale is changed from the 500-ohm scale to the 100-ohm scale, it highlights the areas of lowest resistivity.



ER Figure 1
(ER Line 5)



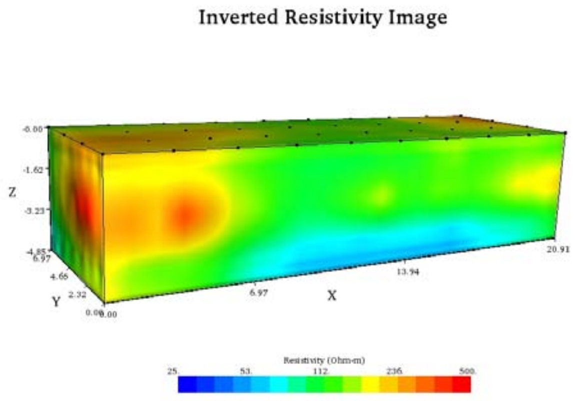
ER Figure 2
(ER Line 5)

When analyzing the two-dimensional electrical resistivity data, we specifically focused on the areas of lowest resistivity within that electrical resistivity section. In the image above (ER Figure 2), the area of lowest resistivity occurs between 72 feet and 126 feet measured horizontally from left to right. A boring located in this area verified that clean sand existed here and that the low resistivity coincided with high hydraulic conductivity. Such correlations were utilized when reviewing the other electrical resistivity images.

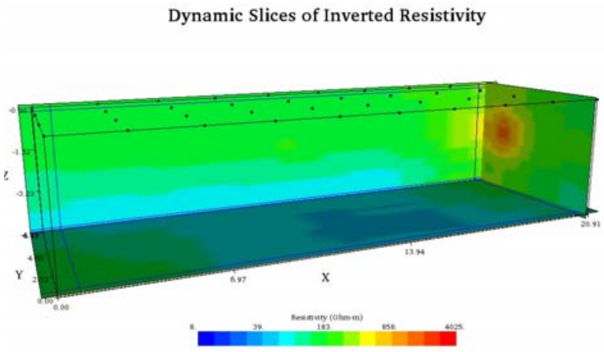
When interpreting ER Data, the colors in the various line scan images do not universally coincide with a particular soil type. The image portrays apparent resistivity, which, as noted, will be affected by such factors as soil composition, moisture, and electrolytes in the moisture and must be proofed with a test boring. Once a soil type is correlated with an apparent resistivity, interpretations of changes in that soil can be predicted with the ER scans.

5.1.2 Three-Dimensional Electrical Resistivity Imaging

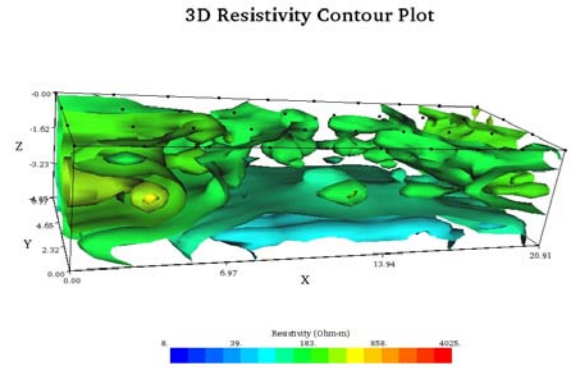
In addition to conducting two-dimensional electrical resistivity surveys, F&ME also conducted three-dimensional electrical surveys. The SuperSting Earth Resistivity System as described above was utilized. Instead of placing the electrodes in a straight line, the electrodes are placed in rectangular grid. For this project, we selected a two electrode by 21-electrode grid, a three electrode by 14-electrode grid, and a four electrode by 10-electrode grid. The spacing between the electrodes for the three-dimensional scans was set at five feet in order to increase the resolution of the image. Three-dimensional ER scans have the same limits as two-dimensional scans, but instead of the image showing a slice of the area, the image represents a certain volume of soil. Another important point to keep in mind is that the resistivity of an area will be different between the two-dimensional and the three-dimensional images. This is due to the electrode configuration as well as the signal configuration. Comparison of two three-dimensional resistivity profiles is viable provided they use the same scale, the same electrode configuration, and the same signal configuration.



In viewing the data gathered in a three-dimensional resistivity scan, there are multiple viewing options. The first presentation option shown on the right is to depict the scan as a solid box. This is a good presentation form if the layers are consistent. Before choosing this form, the entire image will be viewed scan line by scan line searching for anomalies or other disturbances in the middle layers. If there are appreciable amounts of anomalies in the interior of the box or if there is a specific feature of interest in an interior scan, this style of image presentation would not be used.



The second option for viewing the three-dimensional electrical resistivity data, as shown on the left, is called dynamic slice image. This format is an excellent way to pinpoint a localized anomaly that is not persistent through the entire scan. In this scan for instance, the area of high resistivity shown in red would not have been visible using the solid box image. The dynamic slice model allows us to show the layer where the anomaly occurs and remove the front and side layers that would block the area of interest from being seen. In a similar manner to the solid box image, the depth at which the resistivity changes and the approximate size of the layers of each resistivity layer can be estimated.



The third viewing option, shown on the right, is the contour plot image. This style of presentation is useful in showing where the layers of resistivity change. This allows a view of the entire grid while still achieving some transparency through the image. In addition, this style of image is useful for isolating vertical changes in resistivity such as a post in the ground. This is also a useful format when there is a large number of changes in resistivity in the given grid volume. The primary drawback to this type of grid is that it can appear quite convoluted and there is no blending of the layers.

During our investigation, we gathered three-dimensional electrical resistivity data at six selected locations. All of these locations were centered on borings in order to develop a correlation between the electrical resistivity and the boring data. Due to the limited open area of the containment structure, we were not able to use the larger six electrodes by seven-electrode array. Not having the space for this array limited the depth of our data.

5.1.3 Ground Penetrating Radar

Another investigation tool used on this project was Ground Penetrating Radar (GPR). The GPR works by sending a pulse of electromagnetic energy at a controlled frequency into a material and recording the strength and the time required for the return of the reflected signal. A group of these pulses together forms a profile. The antenna receives the electrical pulse produced by the control unit, amplifies it, and transmits it into the area being surveyed at a particular frequency. Antenna frequency is a major factor in depth penetration. The higher the frequency of the antenna, the shallower into the ground (or the surface to be scanned) the electrical pulse will penetrate. The depth penetration of the GPR is limited in wet weather or wet surface conditions, in clayey and silty soil strata, and in areas of shallow groundwater depths. F&ME uses the GPR with a combination of 400 MHz and 200 MHz antennas depending upon the materials anticipated as well as the depth desired to be scanned. F&ME uses Geophysical Survey Systems, Inc. equipment and the associated RADAN GPR software to process and further evaluate the field GPR data.

F&ME performed GPR scans on the River Bluff segment of the perimeter containment system. A five to seven foot layer of clay on the surface masked the reflection of the electromagnetic energy and therefore limited the ability to gather meaningful data from the GPR scans. F&ME scanned with both 400 MHz and 200 MHz antennas without success. Multiple scans were performed before this determination was reached.

5.1.4 Seismic Refraction Survey

Spectral Analysis of Surface Waves (SASW) is a geophysical technique that measures the velocity of shear waves as they travel through the earth’s surface. This method is based on the physical characteristics of different materials refracting energy at different velocities. The shear waves can be active, purposely generated by an impact (such as striking a plate with a sledgehammer), which is a known distance from a geophone array or can be passive, using ambient cultural noises such as vehicular traffic, heavy equipment operations, or industrial activities.

Shear wave measurements allow the user to define site-specific conditions such as ground spectral earthquake response. Building codes often require shear wave velocity measurements for use in foundation designs. Shear wave velocities are dependent on the shear strengths of the subsurface materials and allow one to calculate elastic properties, including Young’s Modulus, Shear Modulus, Bulk Modulus, and Poisson’s ratio. SASW surveys, when combined with other geotechnical methods allow for a greater understanding of the subsurface.

Four SASW surveys were conducted along the containment structure on March 31, April 1, and 2, 2010. The arrays utilized 15-foot spacing between geophones and used 16 geophones for a total array length of 225 feet. Data was collected in the active and passive modes. Arrays 1 and 4 were performed parallel to the river, starting at Stations 24+00 and 38+00 respectively. Arrays 2 and 3 were performed along the top of the manmade section of the containment structure, starting at Stations 62+00 and 69+00 respectively.

Array 1 had an average shear wave velocity in the upper 100 feet of the soil profile (Vs100ft) of 1,176 feet per second. There was a drop in velocity at approximately 10 feet that corresponded to the existing groundwater elevation. There was a prominent increase in velocity at approximately 20 feet, which corresponded with data from CPT-1, indicating dense materials at this depth.

Array 2 had a Vs100ft of 1,103 feet per second. There was a drop in velocity at approximately 15 feet corresponding to the existing groundwater elevation. There was a velocity increase at approximately 23 feet corresponding with data from CPT-2, indicating a density increase at this depth.

Array 3 had a Vs100ft of 1,020 feet per second. There was a drop in velocity at approximately 20 feet corresponding somewhat to the existing groundwater elevation. There was a velocity increase beginning at approximately 37 feet corresponding with data from CPT-5, indicating a density increase at approximately 39 feet.

Array 4 had a Vs100ft of 966 feet per second. There was a drop in velocity at approximately 20 feet. This does not correspond well to the existing groundwater elevation. There was a velocity increase beginning at approximately 30 feet. This does not correspond well with data from CPT-8, which indicates a density increase beginning at approximately 16 feet.

It is important to note that these shear wave velocities are the average over the entire length of the array and are not the velocities at a point. See Appendix E for the SASW Array Location Plan for exact locations.

5.2 Geotechnical Investigation

For the geotechnical field exploration, F&ME used three different investigation, sampling, and testing techniques as our primary exploration methods. These were rotosonic drilling, cone penetrometer soundings, and shallow hand auger borings.

5.2.1 Rotosonic Drilling

F&ME determined that rotosonic drilling would provide the best subsurface method of exploration of the containment system. The rotosonic drilling was accomplished with an ATV-mounted Prosonic SR-116 rig. The adjoining photo shows the rig in operation at Wateree Station. The primary benefit of rotosonic drilling is that it provides continuous sampling of the subsurface materials. Additional benefits of this technology are very rapid drilling rates and reduced volumes of drilling waste. A sonic rig uses an oscillator or head with eccentric weights driven by hydraulic motors to generate high sinusoidal force in a rotating pipe drill. The frequency of vibration (generally between 50 and 120 cycles per second) of the drill bit or core barrel can be varied to allow optimum penetration of subsurface materials. A dual string assembly allows advancement of casing with the pipe drill used to collect samples. Four inch diameter continuous sampling of the subsurface soils was accomplished.

A total of 700 feet of rotosonic drilling was performed at 15 individual boring locations. The boring locations are noted as B-1 to B-15 on Figure 4 in Appendix C. We have also included a fence diagram, which graphically depicts each individual boring stratification, stationing, and elevation. The borings were located along the containment structure perimeter to provide an even distribution of data points while assuring that borings were placed near areas of interest indicated in the geophysical investigation. After boring was complete, the samples were assembled at our warehouse to allow a visual identification and classification of the subsurface stratigraphy. Boring samples were positioned in order from lowest to highest stationing as well as in relative positioning based upon elevations of the top of boreholes. Since the samples were continuous, we were able to document a more accurate log of soil layer composition and thicknesses. The adjoining photo shows the layout of the continuous samples.

The two borings not performed on the perimeter containment structure, B-8 and B-15, served slightly different purposes. B-8 was performed in Pond 1 to provide an indication of the ash thickness as well as the type of soil underlying the ash. B-15 was performed on the embankment between Ponds 1 and 2 to provide data on the embankment composition if required for future analysis.

No rotosonic borings were performed on the south leg of the Constructed Embankment Segment, Station 59+50 to Station 64+60 due to the presence of overhead power lines. Following drilling, all holes were backfilled with high-density bentonite.

5.2.2 Cone Penetrometer Testing

Following the rotosonic drilling, F&ME analyzed the continuous samples and determined locations for additional field investigation to provide strength/relative density data. For this part of the field exploration, we chose to perform cone penetrometer test (CPT) soundings. This subsurface exploration method provides strength and relative density of the soils as well as the pore water pressure. The cone penetrometer soundings were performed with a 20-ton track mounted rig. The adjoining photo shows the interior of the rig as one of the soundings is being performed. A cone penetrometer sounding is conducted by hydraulically pushing a cone penetrometer into the ground. While being pushed, the cone measures the resistance on the tip of the penetrometer (Tip resistance), the resistance on the outside of the penetrometer (sleeve friction), and the pore water pressure (dynamic pore pressure). These measurements are taken every five centimeters, which provides near continuous data. In-situ soil parameters were determined in accordance with the Contec© Interpretation Methods, Revision SZW-Rev 02 (March 12, 2008). These methods along with the correlated soil strength parameters for each CPT sounding are provided in Appendix C. In total, eight cone penetrometer soundings were conducted at selected locations along Containment Segments 1 and 2. When possible, the soundings were performed in proximity of borings to compare and calibrate the data from the two different investigative technologies. Being able to compare continuous sampled borings with in-situ data allowed development of a more detailed understanding of the soil stratification and its physical properties. After each CPT sounding, the hole was backfilled with high-density bentonite.

5.2.3 Hand Auger Investigation

The final component of our geotechnical field exploration was the advancement of shallow hand augers. Eight hand augers were advanced. The hand augers were performed in groups of two on the outside face of the containment system in order to provide data regarding the composition of the slope face as well as the location of the phreatic surface within the berm itself, in lieu of installing temporary piezometers. Three of the four groups were located on the Constructed Embankment Segment, including on the south leg of the constructed embankment where rotosonic drilling was restricted by overhead power lines. The fourth set was performed in the area of previously identified Seeps. After the completion of testing, all boreholes were filled with high-density bentonite.

5.3 Integration of Data

The data gathered during our investigation included:

- Historical mapping
- Visual inspection
- Discussions with SCE&G personnel familiar with pond construction and operation
- Wateree River level data
- Topographical survey
- Local geology
- Local seismicity
- Electrical resistivity scans
- Ground penetrating radar scans
- Seismic refractory scans
- Continuous sampling rotosonic borings
- Cone penetration soundings
- Shallow auger borings

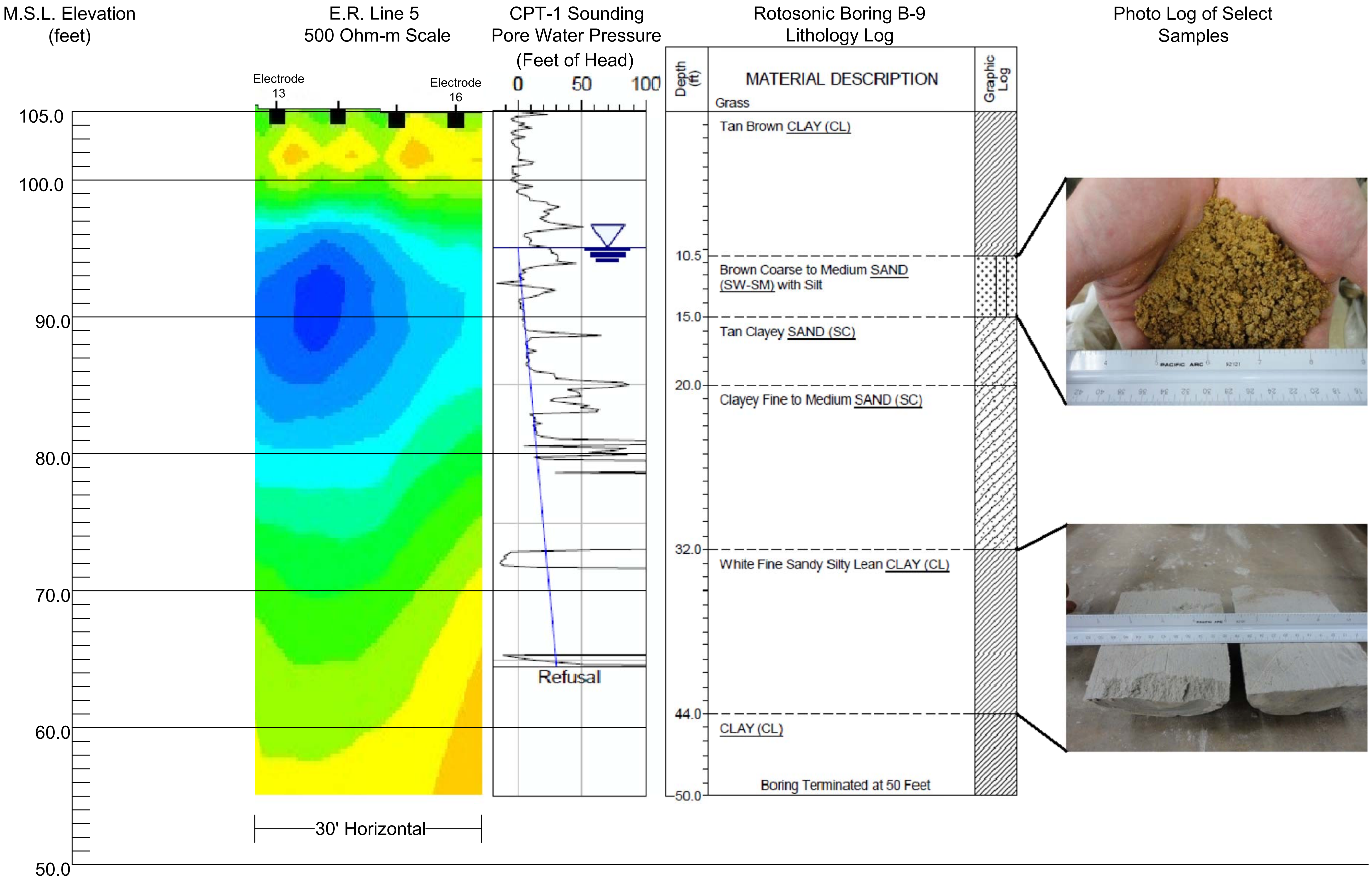
This data was integrated and correlated to provide a characterization of the pond perimeter containment system with respect to:

- Geometry
- Composition
- Physical properties
- Foundation properties
- Continuity/homogeneity

Based upon this characterization, "typical" cross sections and subsurface stratigraphy were identified for analysis. The following figures, SS-1 through SS-4, illustrate a typical integration of topographic, geophysical, geotechnical, and visual identification data.

Typical schematic cross sections were developed for each of the three characteristic segments of the perimeter containment structure.

Based upon our integration of all the data gathered during our investigations, slope stability analyses were performed in "worst case" areas of Segment 1, River Bluff, and Segment 2, Constructed Embankment, of the containment system. Segment 3 was not analyzed for slope stability since it is an incised section and any structural instability would be contained within the pond and would not result in the release of ash. We do point out that based on our analysis of other segments, Segment 3 is stoically and seismically stable.



SCE&G
A SCANA COMPANY

F&ME
CONSULTANTS
GEOTECHNICAL · ENVIRONMENTAL · MATERIALS
COLUMBIA, SOUTH CAROLINA

SEAL NOT VALID UNLESS SIGNED

REVISIONS

NO.	DESCRIPTION	DATE	BY

SCALE: NONE
NOTES:

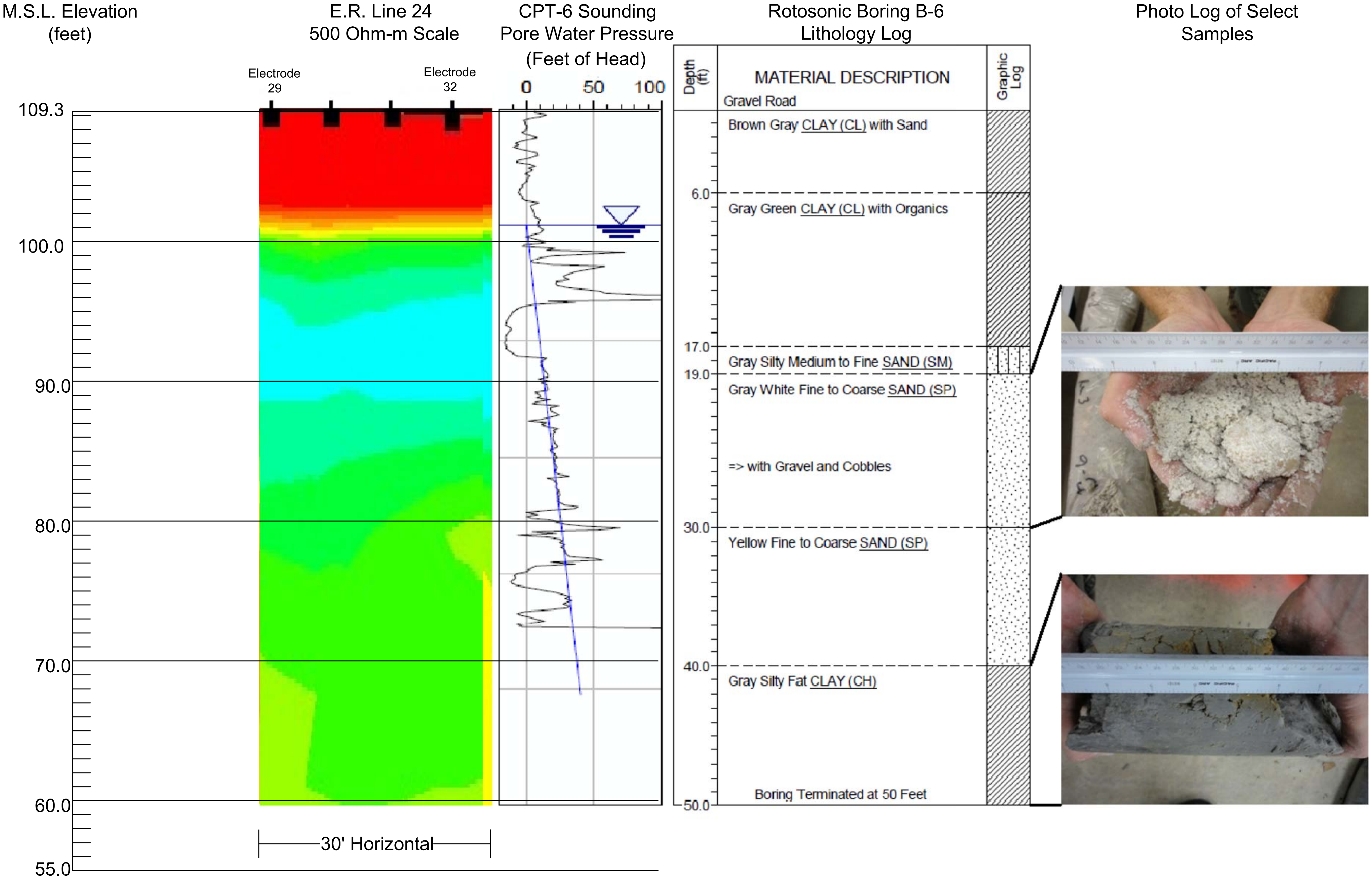
DRAWN BY: WJG
CHECKED BY: JRW
APPROVED BY: ZWA

DATE: April, 15 2010

PROJECT NAME:
Wateree Station Ash Pond Containment Structure Investigation

DRAWING NAME:
Study Section 1

DRAWING NUMBER:
Figure SS-1



SCE&G
A SCANA COMPANY

F&ME
CONSULTANTS
GEOTECHNICAL · ENVIRONMENTAL · MATERIALS
COLUMBIA, SOUTH CAROLINA

SEAL NOT VALID UNLESS SIGNED

REVISIONS

NO.	DESCRIPTION	DATE	BY

SCALE: NONE
NOTES:

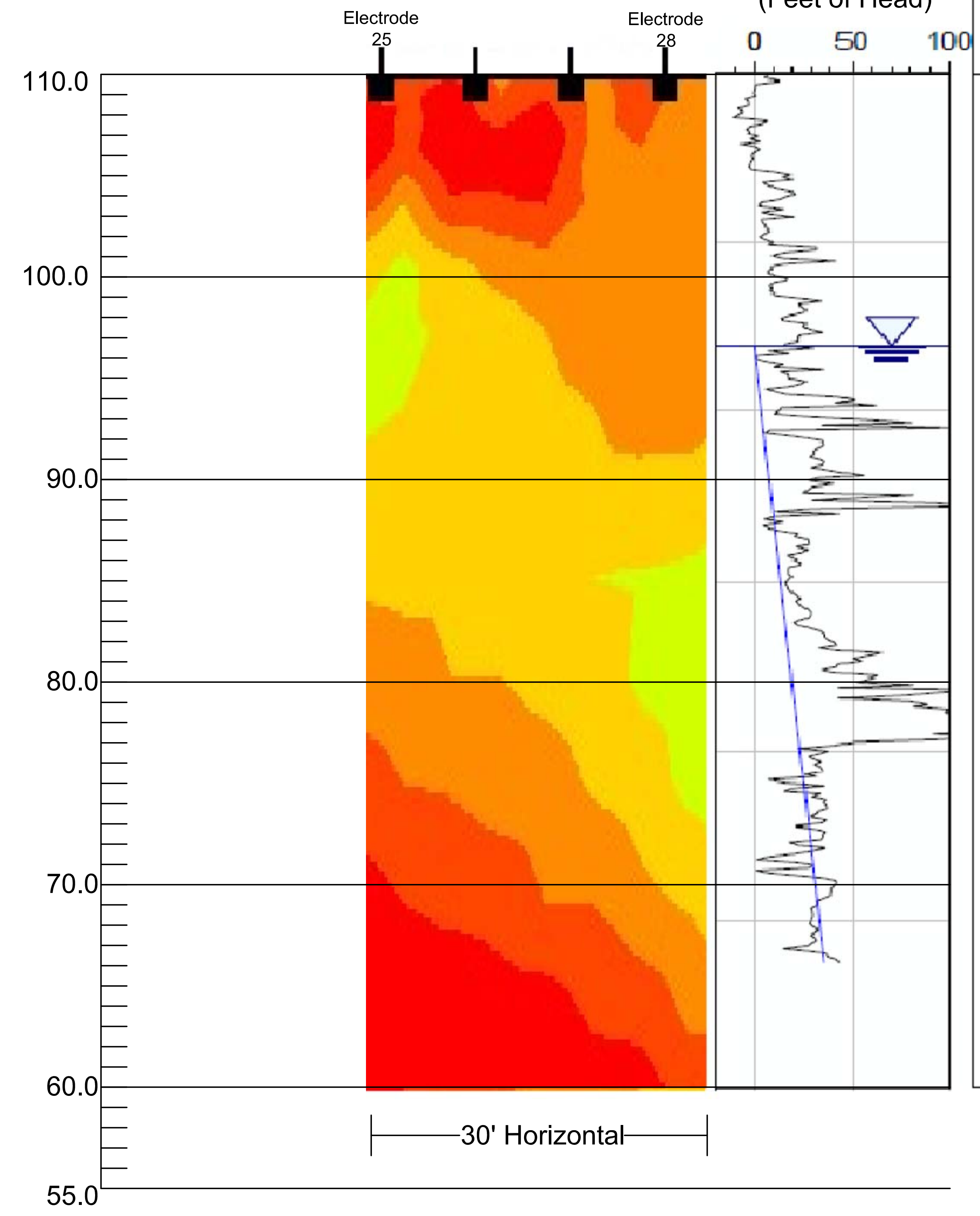
DRAWN BY:	CHECKED BY:	APPROVED BY:
WJG	JRW	ZWA

DATE: April, 15 2010

PROJECT NAME:
Wateree Station Ash Pond Containment Structure Investigation

DRAWING NAME:
Study Section 2

DRAWING NUMBER:
Figure SS-2


M.S.L. Elevation (feet)

E.R. Line 20 100 Ohm-m Scale

CPT-5 Sounding Pore Water Pressure (Feet of Head)

Rotosonic Boring B-5 Lithology Log

Depth (ft)	MATERIAL DESCRIPTION	Graphic Log
	Gravel Road	
	Tan Gray CLAY (CL)	
3.0	Tan Fine to Medium Sandy SILT (ML)	
5.0	Brown Clayey Fine to Coarse SAND (SC) with Organics	
13.0	Gray Red CLAY (CL)	
19.0	Gray Tan CLAY (CL) with Sand	
26.0	Brown Gray CLAY (CL)	
41.0	White Fine SAND (SP) with Silt	
50.0	Boring Terminated at 50 Feet	

Photo Log of Select Samples

SCE&G A SCANA COMPANY

F&ME CONSULTANTS
GEOTECHNICAL · ENVIRONMENTAL · MATERIALS
COLUMBIA, SOUTH CAROLINA

SEAL NOT VALID UNLESS SIGNED

REVISIONS

NO.	DESCRIPTION	DATE	BY

SCALE: NONE

NOTES:

DRAWN BY: WJG

CHECKED BY: JRW

APPROVED BY: ZWA

DATE: April, 15 2010

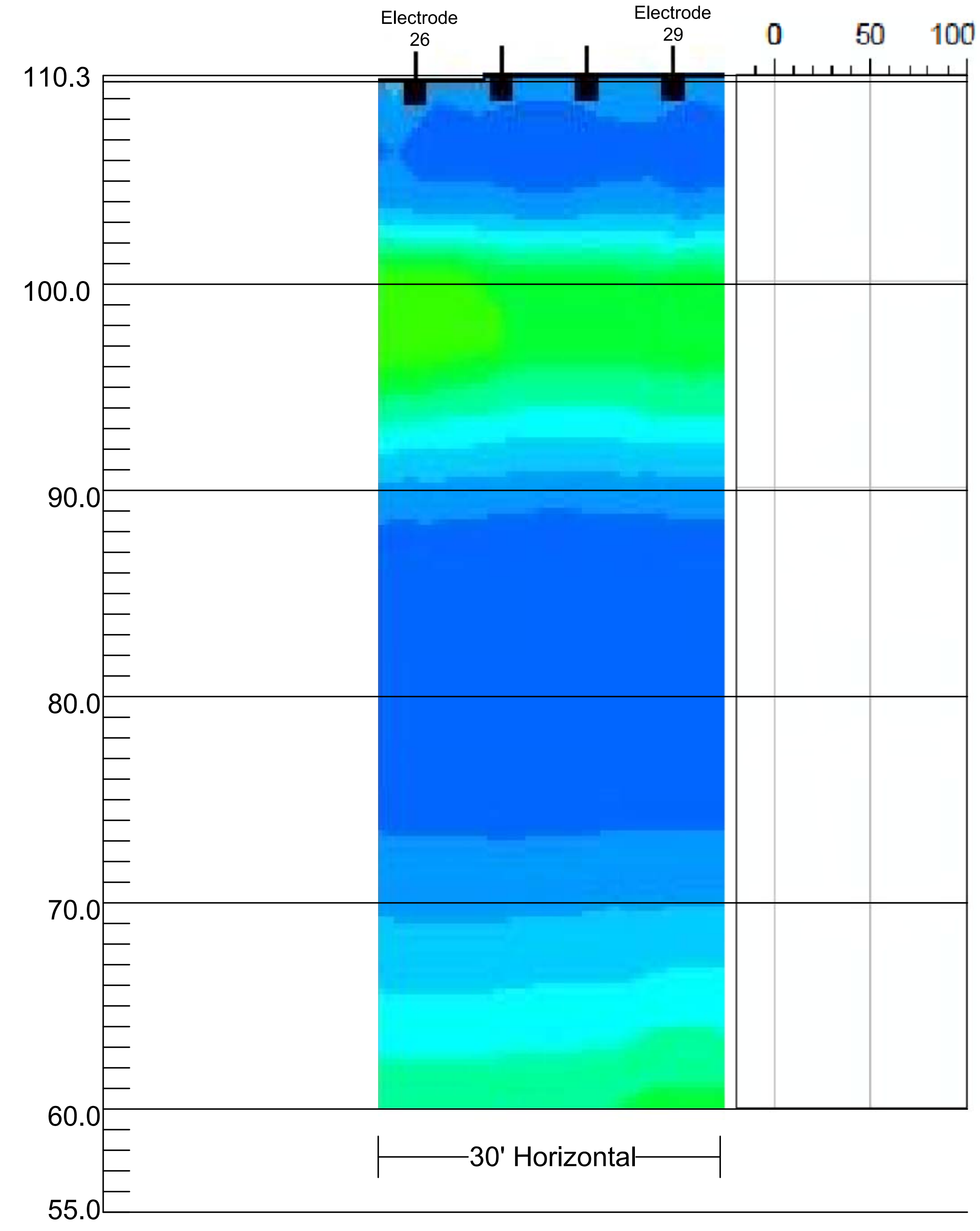
PROJECT NAME:
Wateree Station Ash Pond Containment Structure Investigation

DRAWING NAME:
Study Section 3

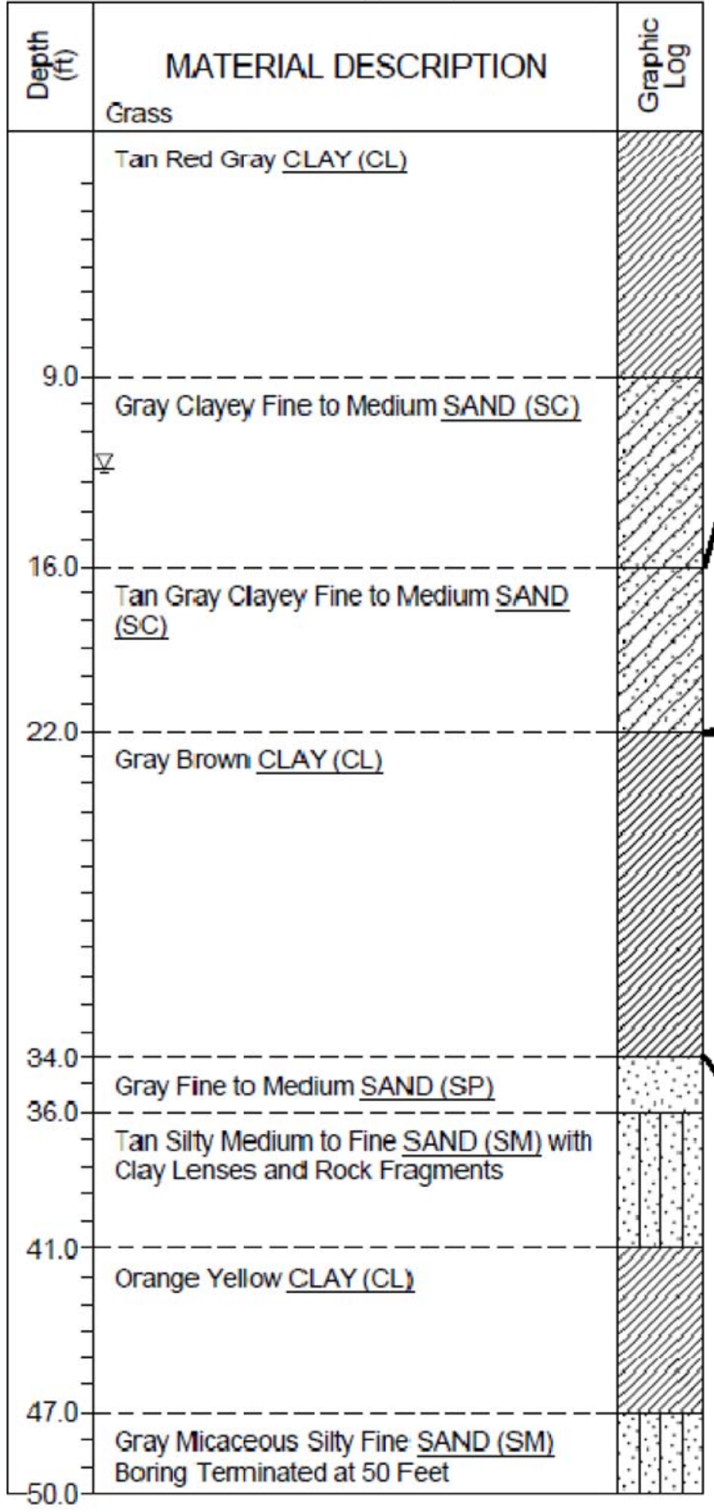
DRAWING NUMBER:
Figure SS-3

M.S.L. Elevation (feet)

E.R. Line 10
500 Ohm-m Scale

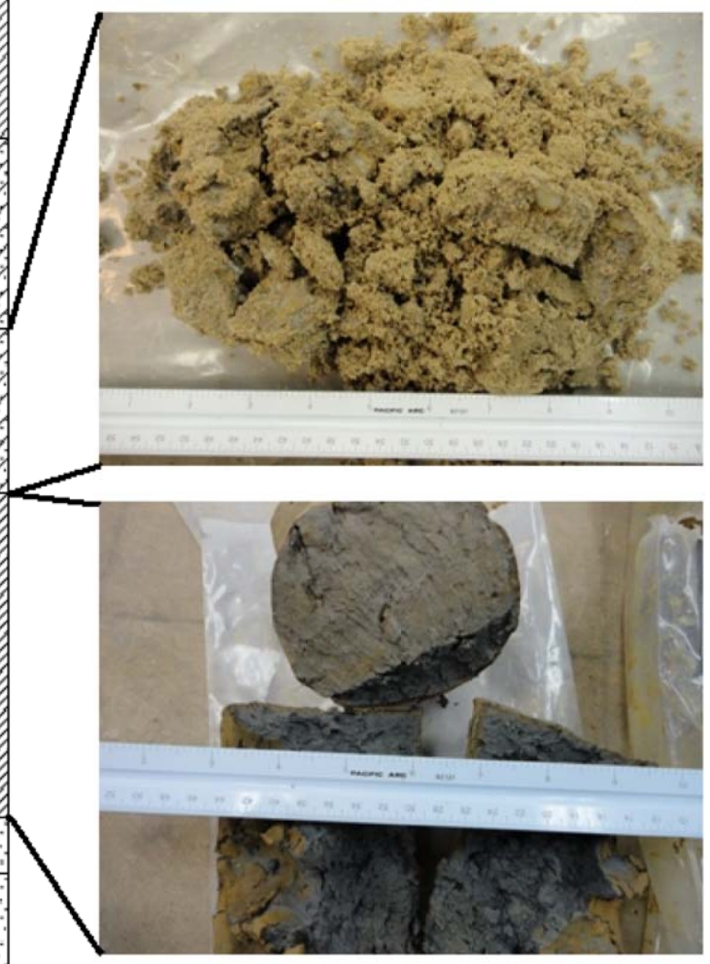


Rotosonic Boring B-3
Lithology Log



Depth (ft)	MATERIAL DESCRIPTION	Graphic Log
	Grass	
	Tan Red Gray CLAY (CL)	
9.0	Gray Clayey Fine to Medium SAND (SC)	
16.0	Tan Gray Clayey Fine to Medium SAND (SC)	
22.0	Gray Brown CLAY (CL)	
34.0	Gray Fine to Medium SAND (SP)	
36.0	Tan Silty Medium to Fine SAND (SM) with Clay Lenses and Rock Fragments	
41.0	Orange Yellow CLAY (CL)	
47.0	Gray Micaceous Silty Fine SAND (SM) Boring Terminated at 50 Feet	
50.0		

Photo Log of Select Samples



SCE&G
A SCANA COMPANY

F&ME
CONSULTANTS
GEOTECHNICAL · ENVIRONMENTAL · MATERIALS
COLUMBIA, SOUTH CAROLINA

SEAL NOT VALID UNLESS SIGNED

REVISIONS

NO.	DESCRIPTION	DATE	BY

SCALE: NONE
NOTES:

DRAWN BY: WJG
CHECKED BY: JRW
APPROVED BY: ZWA

DATE: April, 15 2010

PROJECT NAME:
Wateree Station Ash Pond Containment Structure Investigation

DRAWING NAME:
Study Section 4

DRAWING NUMBER:
Figure SS-4

6.0 Containment System Subsurface Characterization

6.1. General Subsurface Stratigraphy

With the Wateree Station being situated near the confluence of the Wateree and Congaree Rivers as well as at the boundary of the Upper and Middle Coastal Plain Physiographic Subprovinces, a complex subsurface stratigraphy exists. The Congaree River Valley Terrace Complex, which predominates the site, consists of interbedded and depositional layers of coarse sand and gravel to over-consolidated clays. In sandy soil, deposits such as those encountered in and below the impoundment containment system, a moderate increase in fines content (silt and clay size soil particles) will substantially reduce the hydraulic conductivity.

6.2 Embankment Characterization

As previously noted, the current ponds are located in the area of a prior open pit mining operation. Based upon historic records, the current ponds encompass all of the open pit mine operation.

The old mine was also utilized as a source for fill soils during plant construction. This would have caused the mine to be enlarged to approximately the current pond size. It appears that the historic mining operation consisted of removing soils from the bluff adjoining the Wateree River. Mining would have started at the lower natural elevations to the south of the current ponds and proceeded in a northerly direction paralleling the river. A portion of the natural bluff was left in place adjoining the river along the eastern side of the current ponds to control water intrusion from the river. The depth or vertical extent of the mining was most probably controlled by two factors: One being the presence of heavy clay soils, which at the time would have had a low economic value; and two being the ability to control water (run-off, groundwater, and river) through gravity flow. Extensive or continuous pumping would have hindered the economics of the mining operations.

Based upon this historic information and data from our current investigation, we have identified three unique segments of the perimeter containment system of the current ponds as shown in Figure CSCS-1. These are:

6.3.1 Segment 1

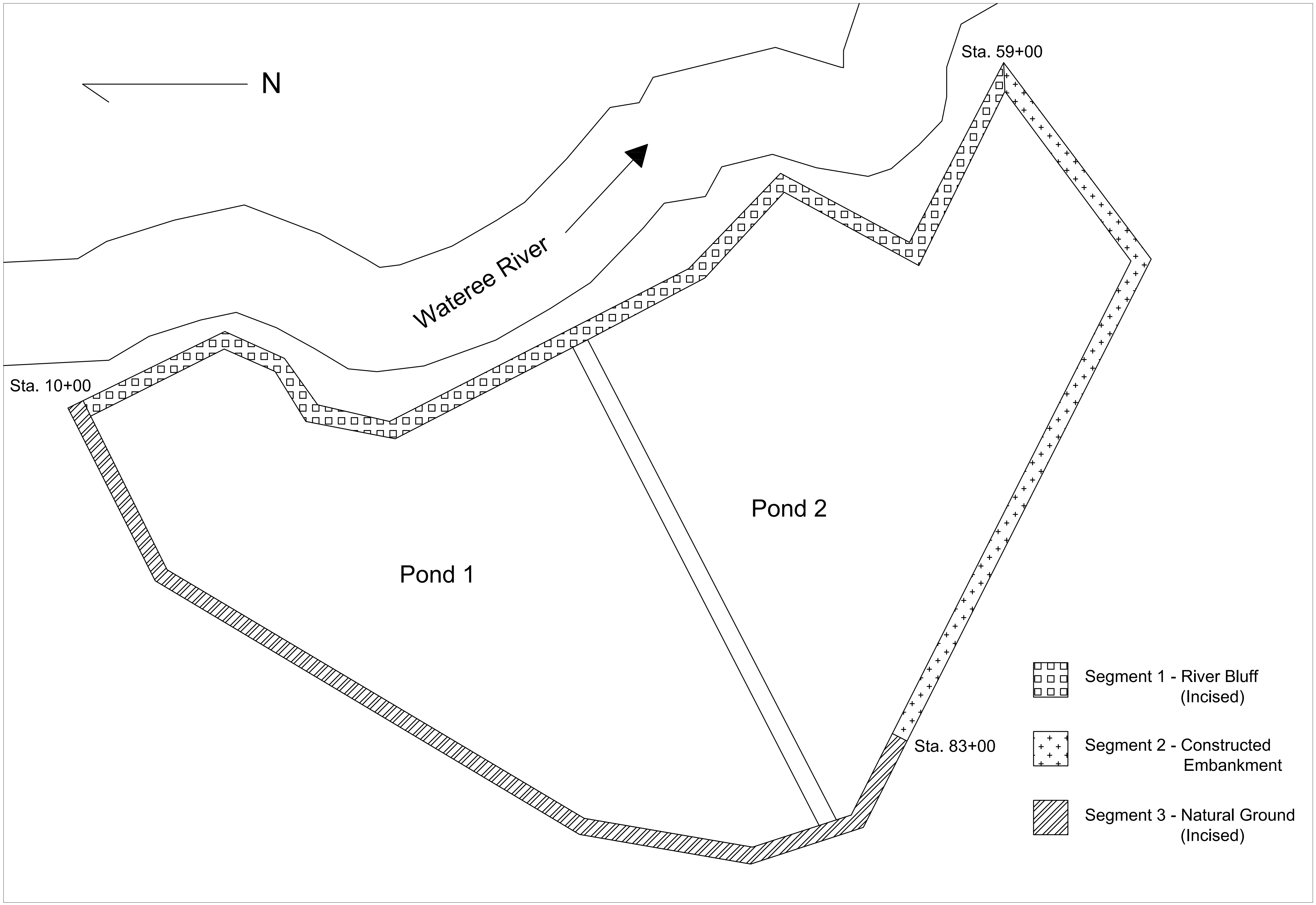
The River Bluff adjoining the Wateree River on the eastern side of both Ponds 1 and 2. This segment of the Pond Containment System starts near the beginning of our survey control stationing, Station 10+00, and continues South to approximately Station 59+00. Some surface fill has been placed along this segment, primarily to provide/improve the perimeter road. This segment of the containment system is characterized as naturally occurring geologic deposits and its physical properties, including structural and hydraulic conductivity, are consistent with adjoining "undisturbed" soils.

6.3.2 Segment 2

The Constructed Embankment along the South side of Pond 2. This segment of the Pond Containment System runs from approximately Station 59+00 to Station 83+00. As noted, this segment traverses the naturally lower lying area of the original river bluff prior to mining operations. This is a constructed embankment formed with soil materials taken from the open pit mine. Soils were placed and compacted beginning at the natural river bluff at the South corner of Pond 2, approximate Station 59+00, and ending on higher natural ground, approximate elevation 110.0 MSL at approximate Station 83+00. This segment is a Constructed Embankment composed of densely compacted clayey soils. Due to its constructed nature, the physical properties of this portion of the embankment are more uniform than those in the River Bluff segment. Both structural properties and hydraulic conductivity are much more homogeneous both horizontally and vertically than the naturally occurring soil deposits.

6.3.3 Segment 3

Natural ground along the western perimeter of Pond 2 and the western and northern perimeter of Pond 1. This segment of the Pond Containment System begins at approximately Station 83+00 and forms the western perimeter of Pond 2, while continuing around Pond 1 to the area of the beginning stationing of our survey, Station 10+00. In this segment of the containment system, the Pond is below natural grade, incised, in the pit formed by the prior mining operations. Like the River Bluff segment of the containment system, this segment is also characterized as naturally occurring geologic deposits and its physical properties, both structural and hydraulic conductivity are consistent with adjoining "undisturbed" soils.



SCE&G
A SCANA COMPANY

F&ME
CONSULTANTS
GEOTECHNICAL · ENVIRONMENTAL · MATERIALS
COLUMBIA, SOUTH CAROLINA

SEAL NOT VALID UNLESS SIGNED

REVISIONS

NO.	DESCRIPTION	DATE	BY

SCALE: NONE

NOTES:

DRAWN BY:	CHECKED BY:	APPROVED BY:
WJG	JRW	ZWA

DATE: April, 15 2010

PROJECT NAME:

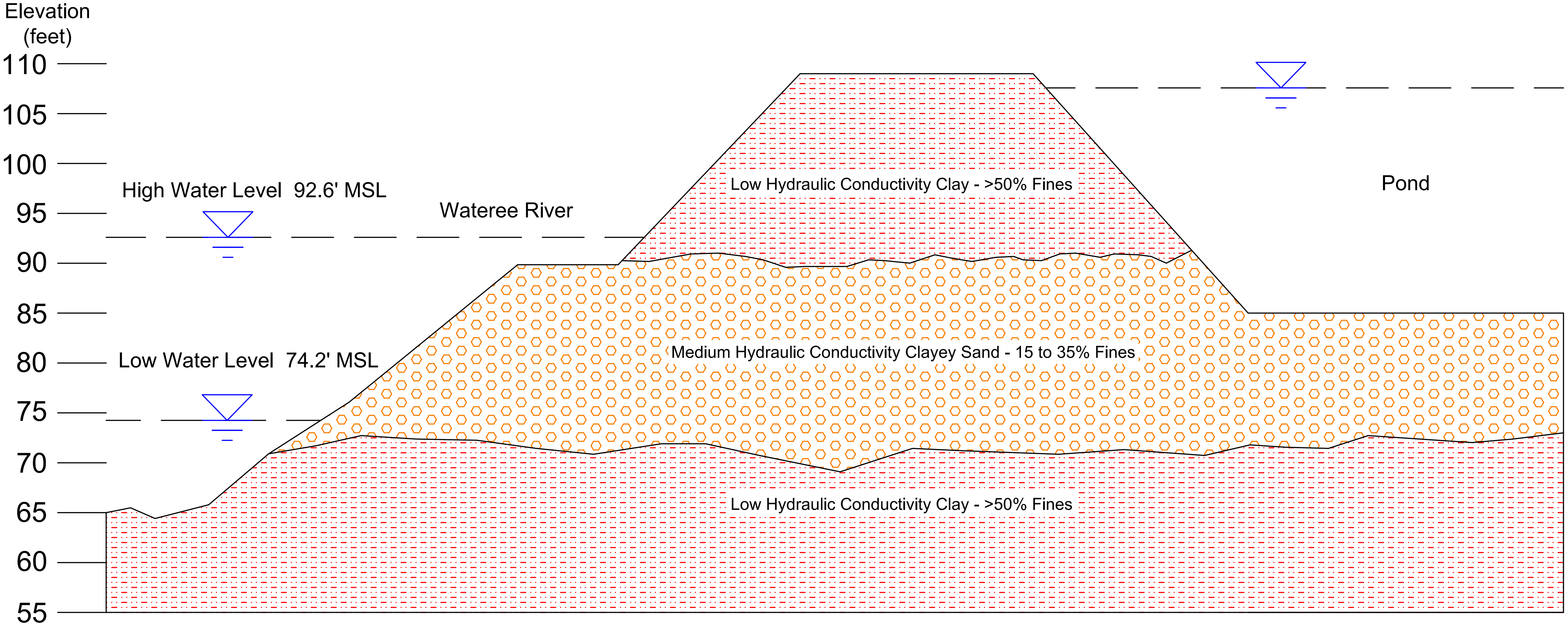
Wateree Station Ash Pond Containment Structure Investigation

DRAWING NAME:

Containment Structure Characterization Schematic

DRAWING NUMBER:

Figure CSCS-1



Containment Structure Segment 1 - River Bluff (Incised) Schematic Cross Section

SCE&G
A SCANA COMPANY

F&ME
CONSULTANTS
GEOTECHNICAL - ENVIRONMENTAL - MATERIALS
COLUMBIA, SOUTH CAROLINA

SEAL NOT VALID UNLESS SIGNED

REVISIONS

NO.	DESCRIPTION	DATE	BY

SCALE: NONE

NOTES:

DRAWN BY:	CHECKED BY:	APPROVED BY:
WJG	JRW	ZWA

DATE: April, 15 2010

PROJECT NAME:

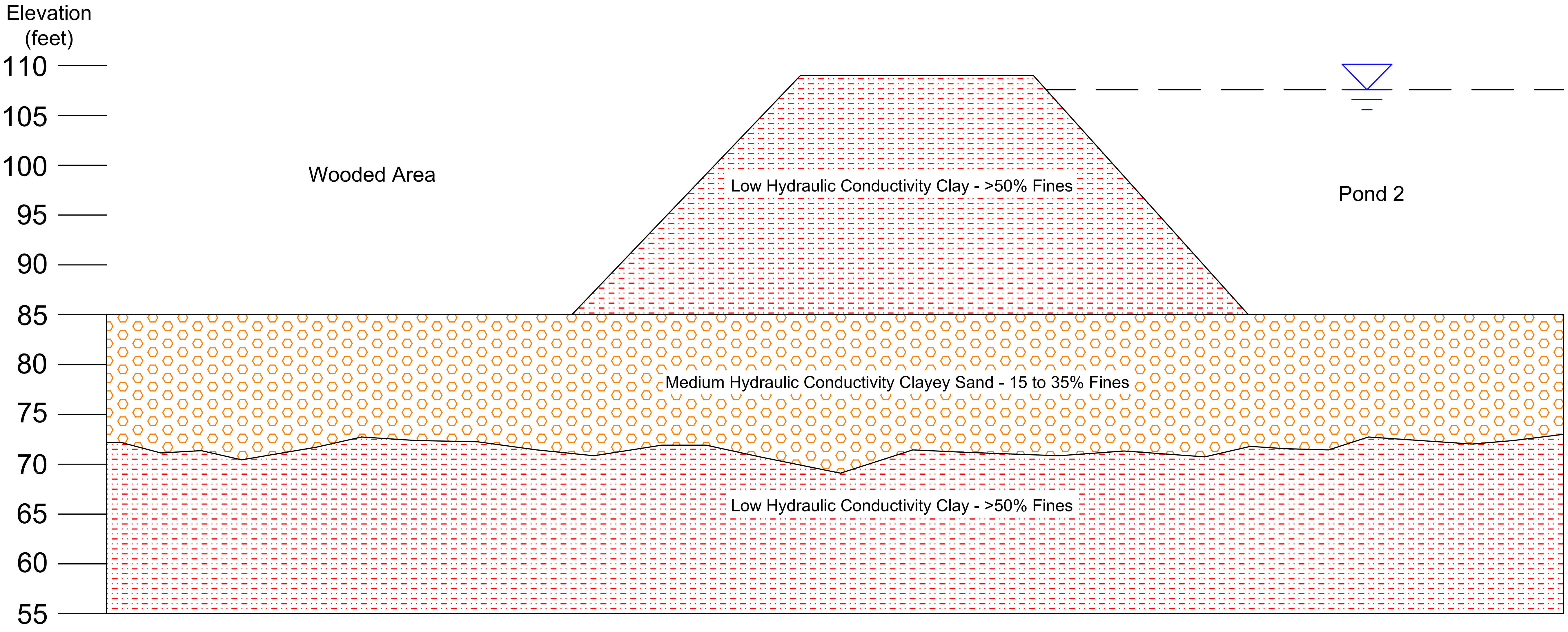
Wateree Station Ash Pond Containment Structure Investigation

DRAWING NAME:

Schematic Cross-Section Typical River Bluff

DRAWING NUMBER:

Figure SCS-1



Containment Structure Segment 2 - Constructed Embankment Schematic Cross Section

SCE&G
A SCANA COMPANY

F&ME
CONSULTANTS
GEOTECHNICAL - ENVIRONMENTAL - MATERIALS
COLUMBIA, SOUTH CAROLINA

SEAL NOT VALID UNLESS SIGNED

REVISIONS

NO.	DESCRIPTION	DATE	BY

SCALE: NONE

NOTES:

DRAWN BY:	CHECKED BY:	APPROVED BY:
WJG	JRW	ZWA

DATE: April, 15 2010

PROJECT NAME:

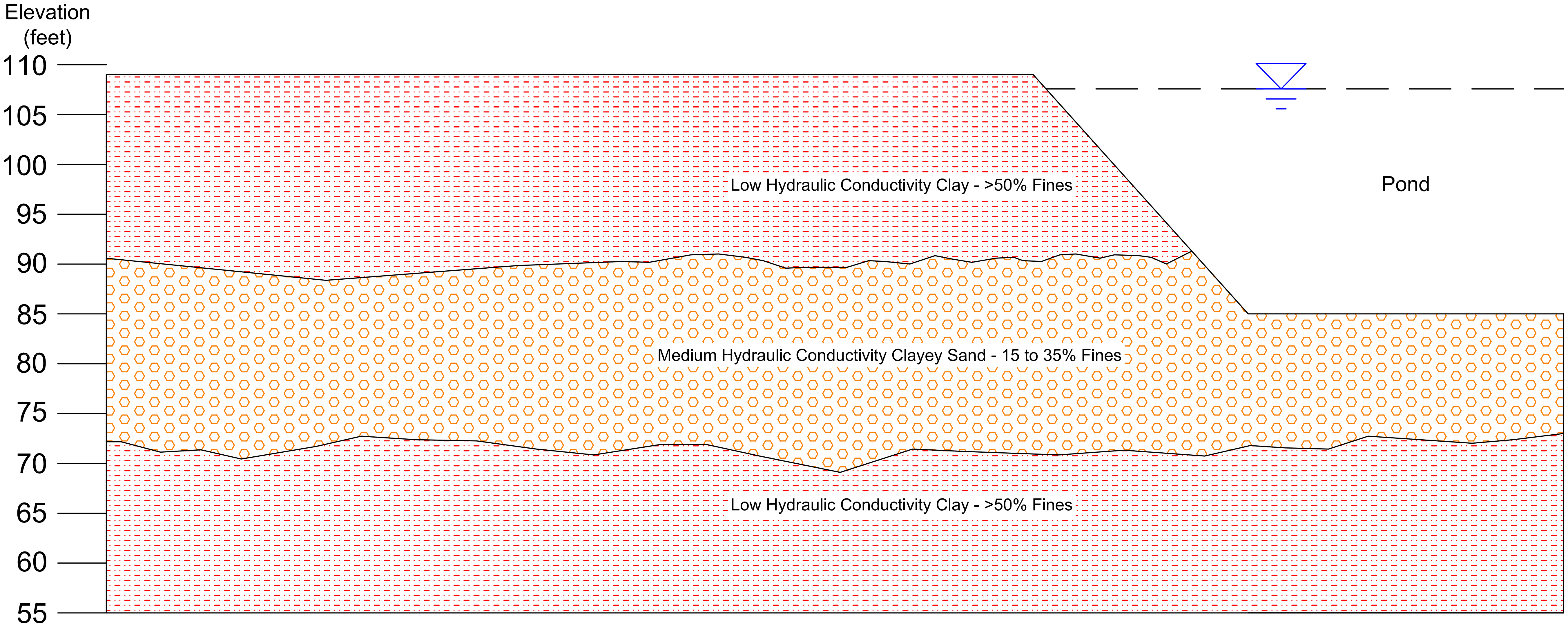
Wateree Station Ash Pond Containment Structure Investigation

DRAWING NAME:

Schematic Cross-Section Typical Constructed Dike

DRAWING NUMBER:

Figure SCS-2



Containment Structure Segment 3 - Natural Ground (Incised) Schematic Cross Section

F&ME
CONSULTANTS
GEOTECHNICAL - ENVIRONMENTAL - MATERIALS
COLUMBIA, SOUTH CAROLINA

SEAL NOT VALID UNLESS SIGNED

REVISIONS

NO.	DESCRIPTION	DATE	BY

SCALE: NONE

NOTES:

DRAWN BY: WJG
CHECKED BY: JRW
APPROVED BY: ZWA

DATE: April, 15 2010

PROJECT NAME:

**Wateree Station
Ash Pond
Containment
Structure
Investigation**

DRAWING NAME:

**Schematic
Cross-Section
Typical
Natural Ground**

DRAWING NUMBER:

Figure SCS-3

7.0 Embankment Structural Analysis

The three distinct segments of the perimeter containment system have been characterized for this analysis. They are:

- Segment 1 – River Bluff
- Segment 2 – Constructed Embankment
- Segment 3 – Below Grade (Incised)

Segment 3 was not included in our detailed analysis. Being below grade (incised), any embankment instability would be internal to the ponds and would not impact the integrity of the perimeter containment system. Based upon our analyses of Segments 1 and 2, Segment 3 is in a very stable condition. In addition, three additional cross-sections, two in the northern portion of Pond 1 and one at the outfall structure, were selected for analysis due to their geometry.

Our initial stability screening included a stability analysis at the location of each of the CPT soundings in Segments 1 and 2. Four analyses were performed in Segment 1 and three analyses were performed in Segment 2. The four "worst case" conditions based upon calculated factors of safety were selected for a more detailed analysis and reporting. The four selected locations included three along Segment 1, the River Bluff, and one in Segment 2, the Constructed Embankment.

Conditions for the modeled design cross sections were based on the following.

1) Bottom of ash pond is at elevation 85.0 ft-MSL.

2) Bottom of river elevation is at 65.0 ft-MSL.

3) Low water elevation in river is at elevation 74.24 ft-MSL (based on measurements performed by SCE&G in Sept. 2003).

4) 'Normal' low water in river is at 82.9 ft-MSL based on USGS data.

5) When modeling embankment geometries outside of surveyed areas, a 2:1 (H:V) slope was assumed to bottom of pond or bottom of river elevation.

Data for developing design soil parameters were based upon our integrated data with heavy reliance on the CPT sounding data. We have included the CPT data reduction tables for each CPT sounding listing the derived soil strength parameters at each depth that a sounding was performed and the ConeTech Interpretation Methods manual in Appendix C. Assumed stratification and soil strength parameter inputs are included on the individual slope stability computer outputs contained in Appendix A. Three distinct loading conditions have been analyzed. These include:

1) Maximum storage pool with steady state seepage. This is a static loading condition with the anticipated maximum static loads.

2) Earthquake loads with steady state seepage. This is a dynamic loading condition with forces applied based upon the design ground accelerations.

3) Liquefaction with steady state seepage. This is a static loading condition, which occurs a short time following the assumed seismic event. There is a time delay between the ground motions of the earthquake and the on-set of liquefaction. During liquefaction, the static soil strength parameters are reduced. This loading condition considers static loads with reduced soil strength parameters in any liquefied soils.

NOTE: This is an industry standard practice for analyzing a water-impounding earthen structure and does not necessarily infer or imply that seepage is in fact occurring through the embankment.

7.1 Seismic Ground Motion Parameters

We have utilized the United States Geological Survey (USGS) ground motion uniform hazard spectrum maps for determination of the peak ground acceleration (PGA) motion value for the seismic design analyses event. The assumed seismic event PGA value used in these analyses was based on a two percent probability of exceedance in 50 years (2%/50 year). The 2%/50 year event is considered as a Safety Evaluation Event (SEE) earthquake which represents a large ground motion and has a relatively low probability of occurrence within the design life of the structure. The 2%/50 year seismic motion event approximates the ground motions associated with the 1886 Charleston earthquake.

The latitude and longitude coordinates of the ash ponds entered on the USGS ground motion map web site were 33.817739 and -80.620331 degrees, respectively. The USGS web site generated $PGA_{B\text{-}C}$ value at the B-C boundary is 0.361g. The B-C boundary is considered as the predicted earthquake motion value at depth where bedrock is encountered and does not reflect any amplification or damping of the $PGA_{B\text{-}C}$ value attributed to the overlying soils above bedrock.

To account for amplification or damping of the soils overlying bedrock, a site class seismic category was determined based on performing on-site Spectral Analysis of Surface Waves (SASW) testing. The SASW test determines the average soil shear wave velocity in the upper one hundred (100) feet of the subsurface soil profile. Four SASW tests were performed with the results indicating that the average shear wave velocities in the upper 100 feet of the soil's profile range from 966 feet per second (fps) to 1,176 fps, averaging 1,066 fps. We have included the four graphs of the SASW curves in the upper 100 feet of the site in Appendix E.

The South Carolina Department of Transportation (SCDOT) has established local industry standards for seismic analysis in South Carolina. Based upon the August 2008 SCDOT Geotechnical Design Manual (GDM), Chapter 12, and based on the SASW derived average shear wave velocity of 1,066 fps, a site class seismic category of D is applicable to this project site. A site class seismic category of D corresponds to a soil profile considered as a stiff soil site. Per Table 12-26, as listed in the SCDOT GDM (previously referenced), the site coefficient, F_{PGA}, for a site class D, and with a $PGA_{B\text{-}C}$ value of 0.361g is 1.15. Multiplication of the F_{PGA} and the $PGA_{B\text{-}C}$ value to account for local site subsurface soil effects yields a design PGA value at the ground surface of 0.41g for use in seismic performance analyses.

7.2 Liquefaction Analyses

F&ME Consultants has completed a liquefaction analysis for the existing ash pond containment structure embankments at the SCE&G Wateree Station facility. The following data has been used in our analysis:

- CPT Soundings (Appendix C).

- Borings and laboratory classification tests performed by F&ME. Fifteen borings were performed within the existing ash pond embankment structure for the collection of soil samples for laboratory analysis. Soil classification testing was performed to evaluate liquefaction potential of the subgrade soils (Appendix C).

- FHWA-HI-99-012; *Geotechnical Earthquake Engineering*, December 1998, and as modified in the Journal of Geotechnical and Geoenvironmental Engineering; *Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils*, October 2001.

At the heart of any discussion of liquefaction potential are three factors:

- The magnitude of the design PGA (Peak Ground Acceleration)
- The composition of the soil mass
- The density of the soil mass

The design PGA was addressed in the Seismic Ground Motion Parameters section of this report, and we have utilized the seismic soil motion PGA value of 0.41g in our liquefaction analyses.

With respect to potentially liquefiable soils, expressed in simplified terms, clean, saturated sands can be highly susceptible to liquefaction while fine-grained soils, particularly those with cohesion, are not.

Furthermore, for a soil composed of liquefiable materials, the lower the density, the higher potential for liquefaction. Determination of the in-situ soil density was extrapolated from CPT soundings as total stress, effective stress, tip resistance, and sleeve resistance.

We have analyzed the liquefaction potential for the soil mass composing the ash pond containment structure embankments and foundation materials. The general conditions of the soil profile and our findings are as follows:

- The soil composing the ash pond containment structure is predominantly low to moderately dense sandy clay underlain by sandy soils. During the seismic design event, these sandy soils have the potential to liquefy.

- Our analysis indicates liquefaction-induced permanent vertical settlements ranging from 0.1 to 3.0 inches, with the average being 1.35 inches.

- For a Magnitude 7.0 (Richter) earthquake event, the farthest documented liquefaction event relative to the epicenter is about 110 kilometers (approximately 69 miles). The Wateree Station facility is located beyond this distance from the epicenter of the 1886 Charleston earthquake.

- When exposed to the expected seismic event, ground surface ruptures are not likely. Typically, the resulting phenomena will be in the form of small, localized surface depressions.

In summary, our data and analyses indicates that detrimental liquefaction will not occur.

7.3 Embankment Stability Analyses

F&ME has performed an ‘over-all’ static and seismic global slope stability analyses of select areas of the embankment creating the ash pond containment structure. The first condition evaluated for static loadings is described as long-term storage of pond water, with water percolating through the embankment to an established steady-state condition of seepage. The ash pond water level elevation was assumed to be at the overflow spillway intake elevation (approximate elevation 108 ft-MSL) as a worst-case condition. The normal ash pond water level is approximately 103 ft-MSL. This condition is referred to as steady seepage with maximum storage pool. A uniform distributed live loading (LL) of 250 pounds per square foot (psf) was applied within roadway areas during our static embankment stability analyses.

For seismic loading conditions, per FHWA-HI-99-012, *Geotechnical Earthquake Engineering*, December 1998, the ground motion horizontal coefficient, K_H, used in seismic global slope stability analyses should be some fraction of the design PGA value. The K_H value used in our seismic slope stability analyses was one-half of the design event PGA value of 0.41g, and this procedure is considered to be industry standard. Roadway surcharge load was neglected during seismic design event analyses.

We also analyzed embankment stability during the indicated liquefiable subgrade soils event. Where a liquefaction condition is expected to occur following the design seismic event, the soil strength parameters were reduced to a residual strength value with the intention of analyzing the stability of the embankment under liquefied soil conditions. The residual liquefied soil strength parameter is about one-half of the soils effective strength as determined by CPT test data.

F&ME utilized the computer software program GSTABL7 w/STEDwin Version 2 for the static, earthquake, and liquefaction embankment slope stability analyses. The computational methodology used in the computer program is the Modified Bishop method of analyses. The subsurface soil stratigraphy, ground water conditions, and soil strength parameters utilized in these analyses were based on generalized conditions as indicated by the CPT soundings. In general, soil parameters for both static and seismic analyses were estimated based on the data from the CPT soundings performed in general proximity to one another.

The following table presents the calculated minimum factor of safety (F.S.) results of these analyses. The listed performance criteria are referenced from Chapter IV of *Embankment Dams of the Federal Energy Regulatory Commission, 1991*.

Embankment Slope Stability Results Summary			
Location	**Loading Condition**	**F.S.**	**Performance Criteria**
100' RT along Station 9+30 to 10+90 - Segment 1	Max. Storage Pool-Steady Seepage	2.82	1.5
	Liquefaction-Steady Seepage	1.97	>1.0
	Earthquake-Steady Seepage	1.48	>1.0
Station 12+00 Segment 1	Max. Storage Pool-Steady Seepage	2.50	1.5
	Liquefaction-Steady Seepage	1.53	>1.0
	Earthquake-Steady Seepage	1.08	>1.0
Station 18+00 Segment 1	Max. Storage Pool-Steady Seepage	2.21	1.5
	Liquefaction-Steady Seepage	1.53	>1.0
	Earthquake-Steady Seepage	1.18	>1.0
Station 33+00 Segment 1	Max. Storage Pool-Steady Seepage	2.89	1.5
	Liquefaction-Steady Seepage	1.76	>1.0
	Earthquake-Steady Seepage	1.38	>1.0
Station 45+00 Segment 1	Max. Storage Pool-Steady Seepage	2.00	1.5
	Liquefaction-Steady Seepage	1.15	>1.0
	Earthquake-Steady Seepage	1.08	>1.0
Station 56+50 Segment 1	Max. Storage Pool-Steady Seepage	2.35	1.5
	Liquefaction-Steady Seepage	1.31	>1.0
	Earthquake-Steady Seepage	1.17	>1.0
Station 83+00 Segment 2	Max. Storage Pool-Steady Seepage	4.78	1.5
	Liquefaction-Steady Seepage	4.09	>1.0
	Earthquake-Steady Seepage	2.37	>1.0

The GSTABL7 output graphs depicting the slope geometry, soil strength parameters, soil profiles and the computer generated critical failure circles of each of the above listed slope stability analyses are presented in Appendix A.

7.4 Summary of Findings

The Wateree Ash Pond Perimeter Containment System is stable under the design loading conditions. The most critical condition is during (earthquake – steady seepage) and immediately following (liquefaction – steady seepage) the assumed seismic event. As noted, the "worst case" conditions were identified for analysis. All computed factors of safety are substantially above the minimum performance criterion.

ATTACHMENT 8

8.1) *WATEREE STATION RIVERBANK EROSION STABILIZATION PROJECT ENGINEERING STUDY REPORT*, **JANUARY 1994**

8.2) **LETTER TO MR TIM ELAEZER, REFERENCE SCE&G WATEREE STATION PLCAEMENT OF FILL ALONG ASH POND DIKE, OCTOBER 2, 1997.**

8.1

WATEREE STATION RIVERBANK EROSION STABILIZATION PROJECT ENGINEERING STUDY REPORT, JANUARY 1994

JACK

SOUTH CAROLINA ELECTRIC & GAS COMPANY

WATEREE STATION

RIVERBANK EROSION STABILIZATION PROJECT

ENGINEERING STUDY REPORT

January 18, 1994

Executive Summary

The purpose of this study is to examine riverbank erosion at the Wateree Station and evaluate several slope stabilization systems for technical merit and cost effectiveness. A system of erosion monitoring monuments has been installed to enable station personnel to measure the encroachment of the riverbank on vital plant equipment and structures. Soil explorations, testing and slope stability analysis were performed to determine the degree of slope that can safely resist landslide. Topographical surveys were made to determine how close the riverbank is to plant structures and to enable detailed estimates of earthwork.

Background

At Wateree Station, South Carolina Electric & Gas Company (SCE&G) has approximately 8000 feet of river frontage on the west bank of the Wateree River. SCE&G has identified 4 areas where the riverbank is in need of stabilization to halt erosion. The 4 areas were estimated to include approximately 2000 feet of riverbank. The areas are identified as follows:

Area 1 - Upstream of plant adjacent to railway at 90 degree bend in river.

Area 2 - Adjacent to the cooling towers.

Area 3 - Adjacent to ash ponds 1 & 2.

Area 4 - Adjacent to ash pond number 2 at effluent discharge point.

SCE&G wishes to apply for a construction permit by April 1, 1994 and start construction on the stabilization project by mid 1995.

Methodology

A reconnaissance survey of the riverbank by Parsons Main revealed that the erosion along the plant boundary is more extensive than previously estimated. Approximately 5000 feet of the riverbank can be classified as a shallow active landslide. The cohesive strength of the soil enables the bank to maintain an almost vertical slope. Small changes in stability conditions such as river scour at the toe of the slope or draw down conditions after high river level may bring on a fall or topple failure of the slope.

Topographic surveys were made only at areas 1, 2 and 4 covering approximately 2900 feet of river frontage. These areas were selected because they appear to be in the most urgent need of stabilization. Area 3 was not surveyed because South Carolina Electric & Gas plans to do a photogrammetic survey of all plant property early in 1994. The results of this survey should be available in time to develop detailed construction drawings and cost estimates for area 3.

A total of 3 soil borings were made to a depth of 40 feet to obtain data for slope stability analysis. Undisturbed shelby tube samples were obtained for cohesive soils and triaxial test were run to determine the cohesive strength properties. The data obtained in these borings should be representative of the conditions along the riverbank.

A slope stability analysis was performed using the Bishop method of slices to determine a safe final slope for the riverbank. A 32' high cross section with a 2:1 slope face was assumed for analysis. A 2' thick rip rap face extending from the river edge to elevation 94' MSL was incorporated into the model. The most conservative soil strength properties obtained from the 3 borings was used in the analysis. Two stability conditions were evaluated, normal flow and rapid drawdown. The analysis yielded a minimum factor of safety of 1.21 and 1.09 respectively. Based on these results a maximum slope of 2:1 should be used in final design. However, during final design a steeper slope may be verified for use at the cooling towers where the riverbank is only approximately 13' high. A 2:1 slope was used for earth work calculations in this study.

Historical data on riverflow was obtained from the United States Geological Survey. The highest flow measurement of record between July 1968 to November 3, 1993 occurred on December 16, 1983. The gage reading was 15.28' with an average velocity of 2.78 feet per second. The gage datum is 77.43 feet which gives a true river elevation of 92.71 feet MSL. Based on this data an elevation of 94.00 feet was used for the top of slope protection in all construction cost estimates. A design velocity of 3 feet per second shall be used in final design for slope protection.

Erosion Monitoring

There is no data available to estimate the past or present rate of riverbank erosion. However, visual evidence at the riverbank can indicate which areas are active and progressing most rapidly. For example, in area 1 trees can be seen leaning towards the river or lying over the side with little vegetation growing down the slope. This would indicate that the slope is in an active state of failure. In area 3 and 4 similar conditions exist except more vegetation appears to be growing down the slope indicating a slower rate of erosion.

A series of 10 erosion monitoring monuments have been set which will allow the erosion rate to be estimated over time. The monuments consist of two reinforcing bars with plastic caps driven into the ground near the edge of the slope as shown in Figure 1. The location coordinates and original dimensions taken on November 22, 1993 are shown in Table 1. The location of the monuments is shown on the enclosed site plan. The two reinforcing bars establish a straight line along which measurements may be taken to the top edge of the river bank. A red witness post has been driven near each monument to assist in location. Plant personnel should take readings with a 50 foot tape every two months until an erosion rate can be estimated. There should be enough time before the anticipated construction date of mid 1995 to detect erosion and evaluate the urgency of the project.

The erosion monitoring monuments were only placed in locations where the riverbank exhibits a steep slope and distinctive top edge. Within area 3 there are locations where the edge of the bank is well rounded without a perceptible edge which renders the monument system useless. These areas appear to have more stable slopes. However, significant surface rutting from storm water runoff was observed inland from the riverbank but confined within the wooded area where it can not be seen by anyone passing by the ash ponds. The condition of the rutting could deteriorate rapidly during the wet seasons and should be inspected periodically to avoid the development of a serious problem. As part of the stabilization project, the ruts may be filled with excess excavated material and re-vegetated. Additionally, surface water runoff control measures will be implemented.

Evaluation of Options

Five slope stabilization schemes were evaluated for potential use on this project. Figures 2, 3 and 4 show different slope surface coverings which require clearing of vegetation from the riverbank and grading to a stable uniform slope. Figures 5 and 6 show earth retaining structures which might be used where space is limited. For example, the area adjacent to the north end of the cooling tower might be too small to allow grading the slope back to 2:1. Another example is adjacent to the USGS monitoring facility. Grading to a 2:1 slope here will require relocation of the facility.

Figure 2 shows a conventional rip rap covering. After grading the slope, a geotextile filter fabric is placed on the slope and anchored in a trench above the high water line. Next a layer of ballast stone is spread over the slope to insure that the geotextile is in complete contact with the earth slope and also protect the geotextile from damage. The rip rap is then carefully placed on top. A thickened edge is required at the edge of the river to protect slope from scour. The advantage of rip rap is the initial installed cost. A disadvantage is less quality control over finished product.

Figure 3 shows a reno mattress slope covering. A reno mattress is a form of gabion. It consists of a double twist hexagonal mesh steel wire mattress filled with stones. The wire mesh is . galvanized and PVC coated to provide a long service life. The stone fill is of smaller size than rip rap and is packed tightly together to obtain smaller void space. The advantage of the reno mattress is that it uses approximately 3 times less stone and generally can resist higher flow velocity than conventional rip rap protection. The quality control of the finished product is high. The disadvantage is the added cost of the wire mesh and extra labor required to fill the mattress. As with the rip rap slope cover, a geotextile filter fabric is required between the mattress and the soil. Several feet of the mattress would be draped over the edge at the toe of the slope to prevent scour.

Figure 4 shows an articulated concrete block system (Armorflex). Armorflex is a patented system of the Nicolan Corporation consisting of open and closed cell concrete blocks factory assembled into mats with high strength cables. The mats are fabricated in 8' widths up to 40' long. Using a spreader bar the mats are placed in units over the prepared slope. The mat is placed over a geotextile filter fabric and anchored at the top in a trench or with an earth anchor. As with the reno mattress, several feet would be draped into the river to protect against scour. An advantage of Armorflex for this project is the ability to cover large areas of slope rapidly. The Armorflex mat does not need to be field assembled as with the reno mattress. Thus, the grading crew will not be able to get very far ahead of the mat placement. The mat may be finished by filling the voids with soil and seeding to establish a natural appearance. The disadvantage of the system is the cost of material is higher than conventional rip rap.

Figure 5 shows a typical cross section of a gabion wall. Gabions are boxes fabricated from hexagonal twisted steel wire mesh filed with stones. The gabions are stacked to form a mass gravity retaining wall. The installed cost of the system is high, but it might be useful where real estate is a premium. A combination of gabion and rip rap might prove beneficial to reduce potential soil loss into the river during grading of slopes. For example, a single tier gabion might be installed at the toe of the slope before grading to act as a massive silt fence. After grading rip rap could be installed up the slope.

Figure 6 shows a terramesh wall. The terramesh wall is a wire mesh system which utilizes the principal of reinforced earth. The face of the wall is filled with gabion sized stones to provide erosion protection. The mesh is placed between layers of backfill material. The backfill is placed in thicknesses of 1' to 3' and compacted. The system uses much less stone than the gabion wall but requires more complicated backfill and compaction technique. The system is less cost effective if excavation is required. The system is generally more cost effective than gabions for walls greater than 12 feet high.

All five of the systems evaluated are sufficient to stabilize the slope and prevent surface erosion. An additional system of grout filled mats was evaluated and rejected on technical grounds. The grout filled mats are rigid and do not tolerate settlement. Obtaining a 2:1 slope will require some cut and fill due to the irregularity of the riverbank. The fill areas would likely settle and cause the rigid mats to crack and lead to premature failure. All of the five systems considered can tolerate ground settlement.

Cost Estimate

A detailed cost estimate was prepared for all five of the systems considered in this study. A 1000 foot section in area 1 was selected for the basis of the cost estimate. Cross sections were plotted at 100 foot intervals to calculate cut and fill for each configuration. The cost of developing an on site borrow pit was considered where extra fill material was required. The terramesh system estimate is based on using some backfill from an onsite borrow pit. The gabion estimate is based on backfilling with material available in the existing slope and grading to a 2:1 slope or flatter; excess material will be hauled to a stockpile area. All the cost estimates are based on 1994 dollars and should be escalated to the year of construction.

The estimated initial installed cost per linear foot of riverbank for each system including a 25% contingency is as follows:

Rip Rap	$298
Reno Mattress	$355
Armorflex	$318
Gabion Wall	$597
Terramesh	$475

From the topographic surveys of areas 1, 2 & 4 it is estimated that a total of 2400' of riverbank should be stabilized. This would consist of 1100' in area 1 extending 100' upstream of the bend in the river, 800' adjacent to the cooling towers and 500' adjacent to the discharge from ash pond Number 2. The estimated cost for 2400' of riverbank stabilization for each system is as follows:

Rip Rap	$ 715,200
Reno Mattress	$ 852,000
Armorflex	$ 763,200
Gabionwall	$1,432,800
Terramesh	$1,140,000

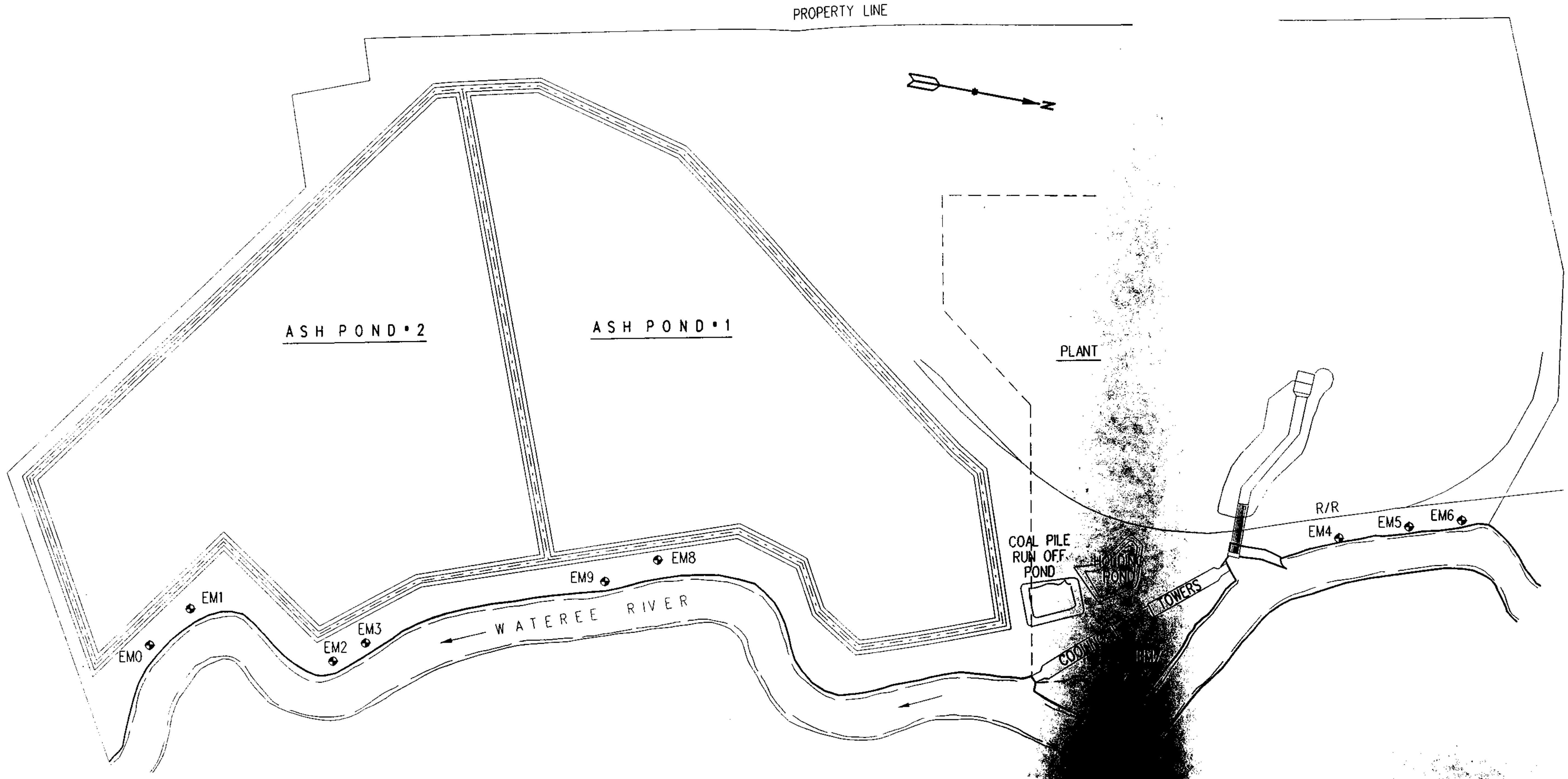
The upper bound estimated cost to stabilize all eroding areas of the entire site boundary based on 5000' of riverbank is as follows:

Rip Rap	$1,490,000
Reno Mattress	$1,775,000
Armorflex	$1,590,000
Gabionwall	$2,985,000
Terramesh	$2,375,000

A line item estimate for each system is included in the Appendix.

Conclusions and Recommendations

The most cost effective approach to riverbank stabilization is grading the bank to a stable slope and covering with a surface protection such as rip rap, Armorflex or Reno mattress. If rip rap is selected, good construction technique and inspection will be necessary to assure equal quality to the other systems. All systems should have a design life sufficient to match the life of the station and be maintenance free. The estimated cost of rip rap is only 6.3% less than Armorflex. We consider rip rap and Armorflex as equal in ability to stabilize the slope. However, the installation advantages of Armorflex may offset the incremental cost differences.



SITE PLAN

PROJECT LOGIN SC528628
NAME/DATE GAZDA 1-14-94
FILE NAME [illegible]

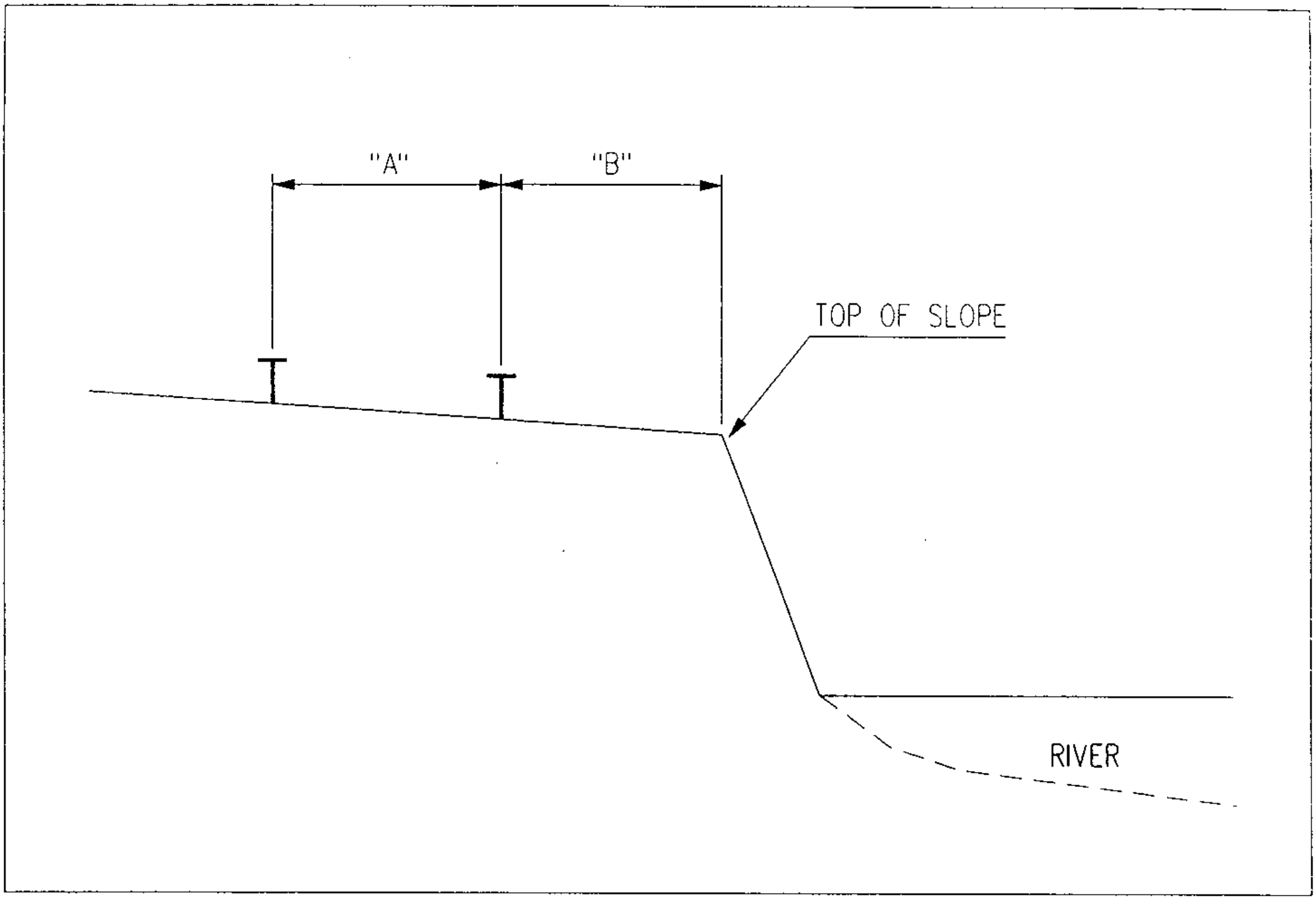


FIGURE 1

MONUMENT NO.	LOCATION COORDINATES		"A"	"B"
	NORTH	EAST		
EM0	4015.84	9891.10	20.00′	17.25′
EM1	4173.71	9689.36	25.00′	26.00′
EM2	4884.33	9825.25	20.00′	20.00′
EM3	5023.04	9715.99	20.05′	18.20′
EM4	9560.89	8475.29	12.20′	12.00′
EM5	9877.15	8363.81	15.85′	20.85′
EM6	10116.18	8288.41	19.80′	22.65′
EM7	8724.45	9289.25	19.95′	22.00′
EM8	6320.53	9108.25	19.95′	25.00′
EM9	6089.45	9249.00	15.95′	21.70′

TABLE 1

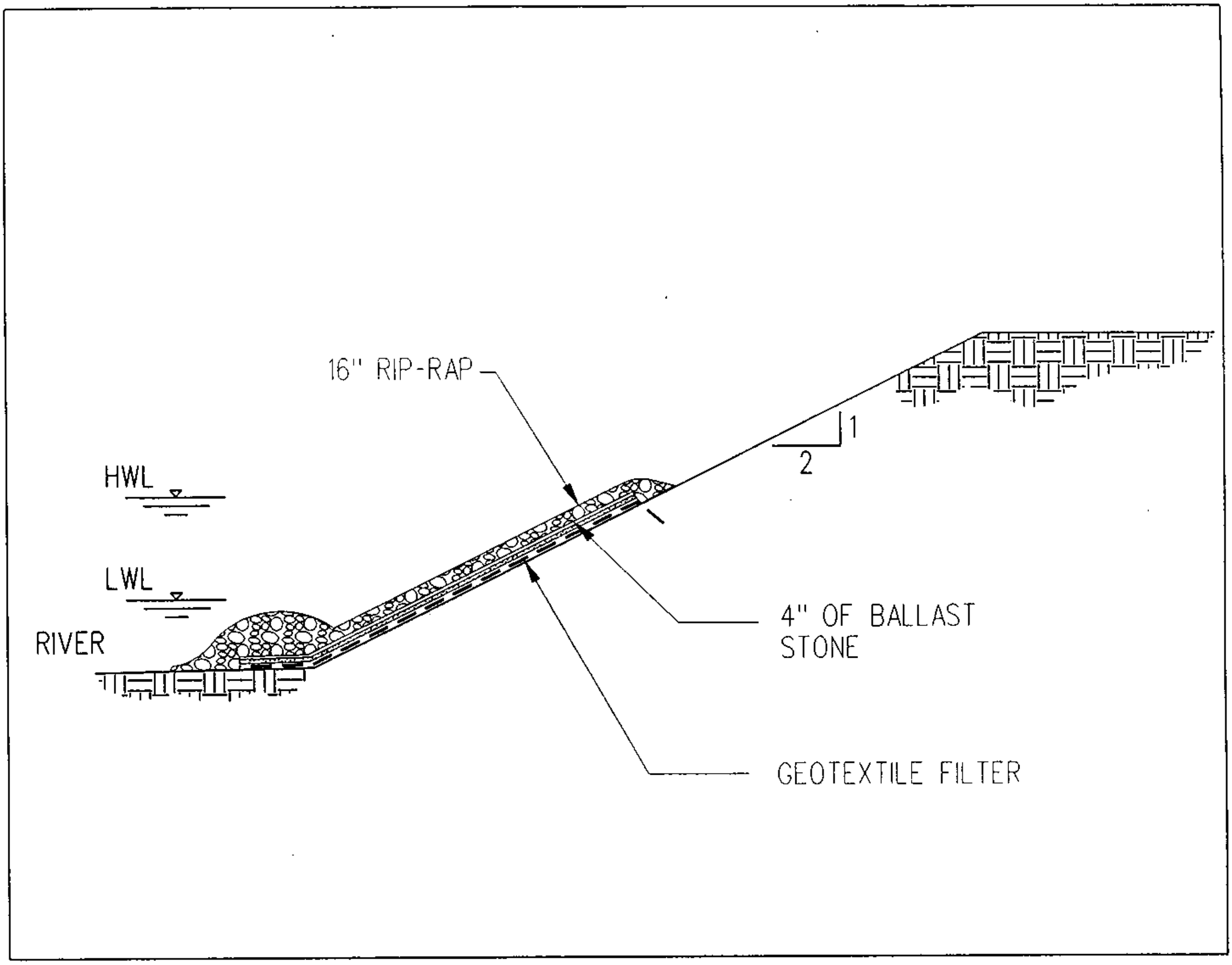


FIGURE 2 RIP-RAP SLOPE PROTECTION

file: sc28y003.dgn
cso gozda
520623-01000

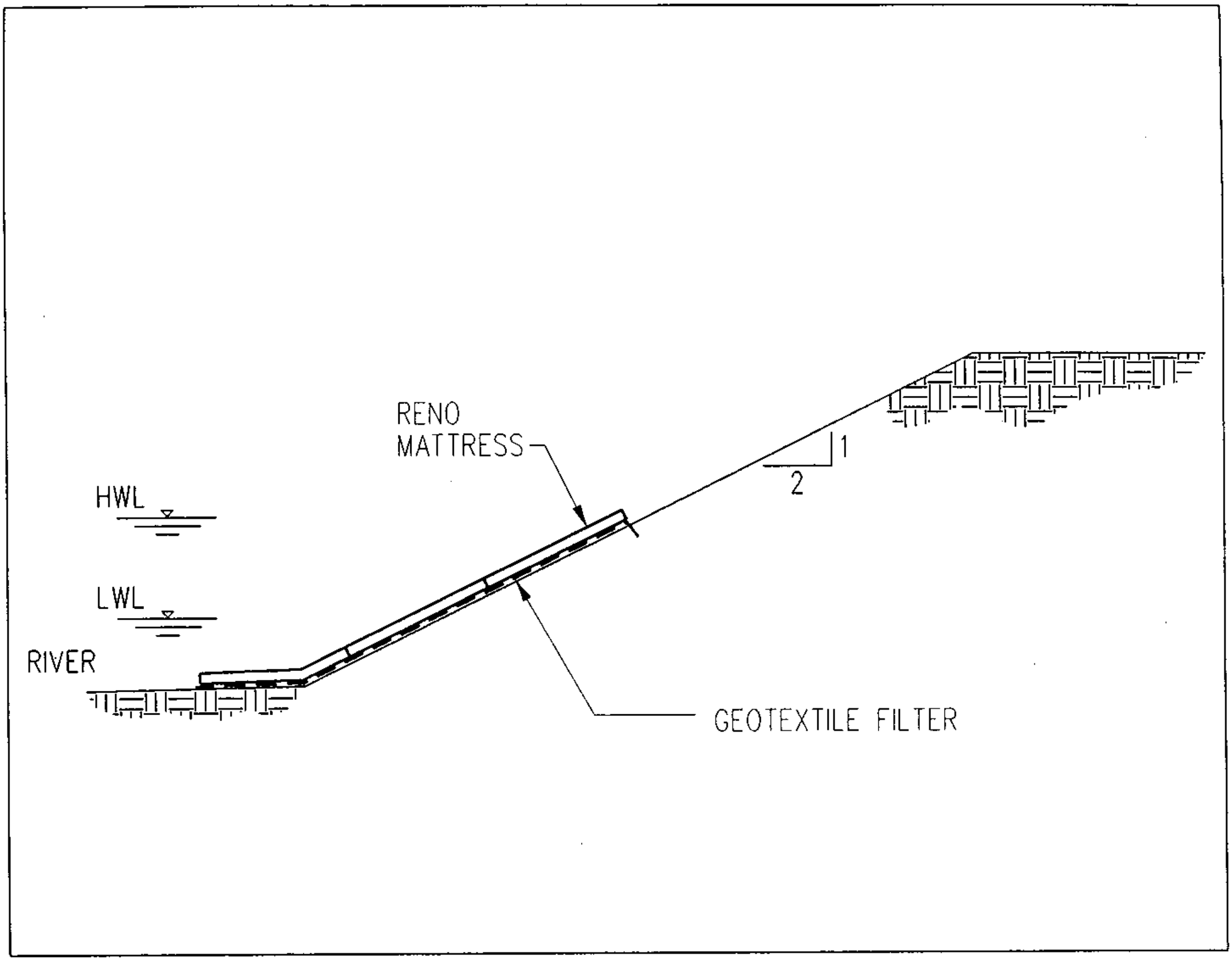


FIGURE 3 RENO MATTRESS SLOPE PROTECTION

file: sc28y005.dgn
cso gazda
520628-01000

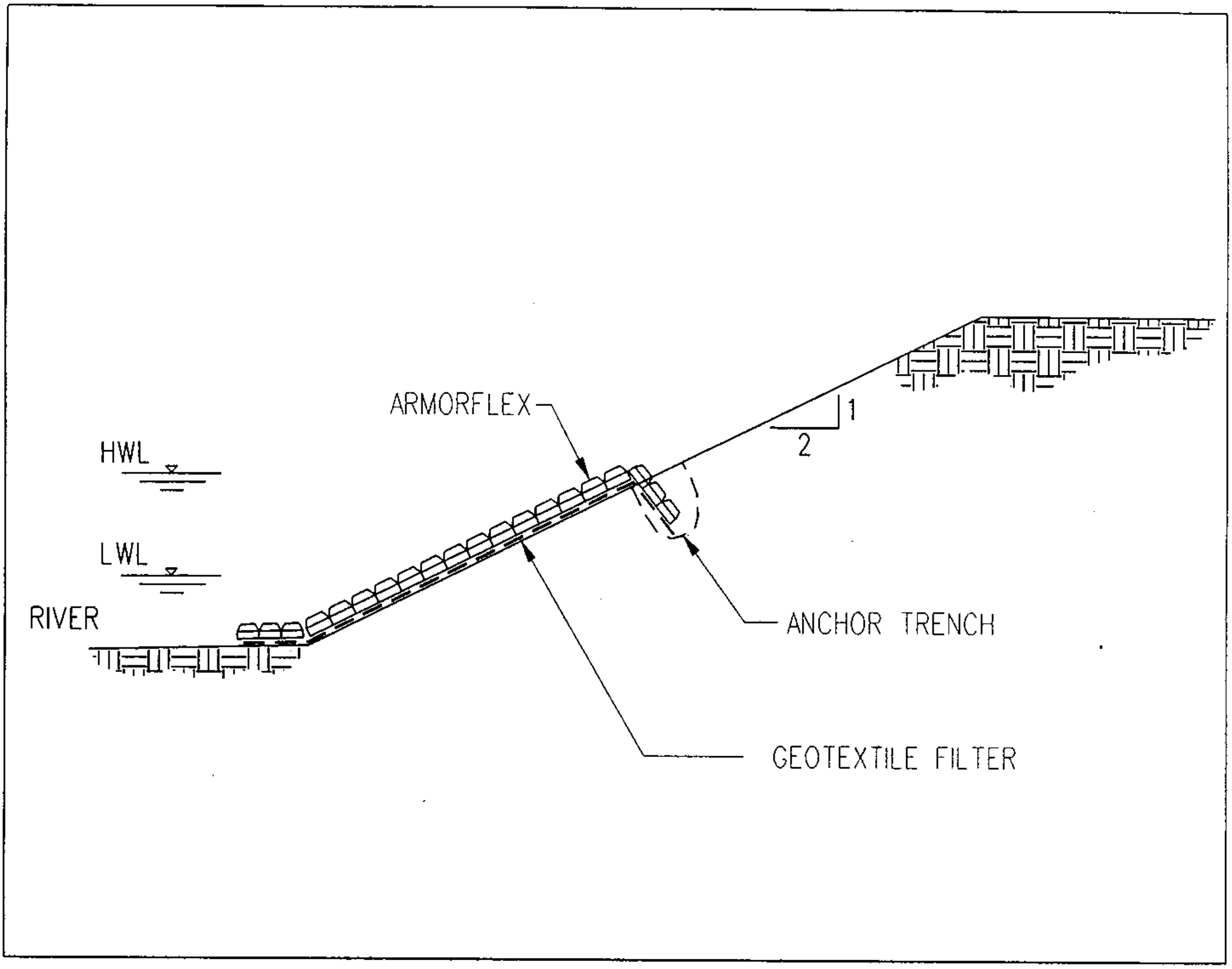


FIGURE 4 ARMORFLEX SLOPE PROTECTION

file: sc23y0C4 dgn
csa gozde
520628-01000

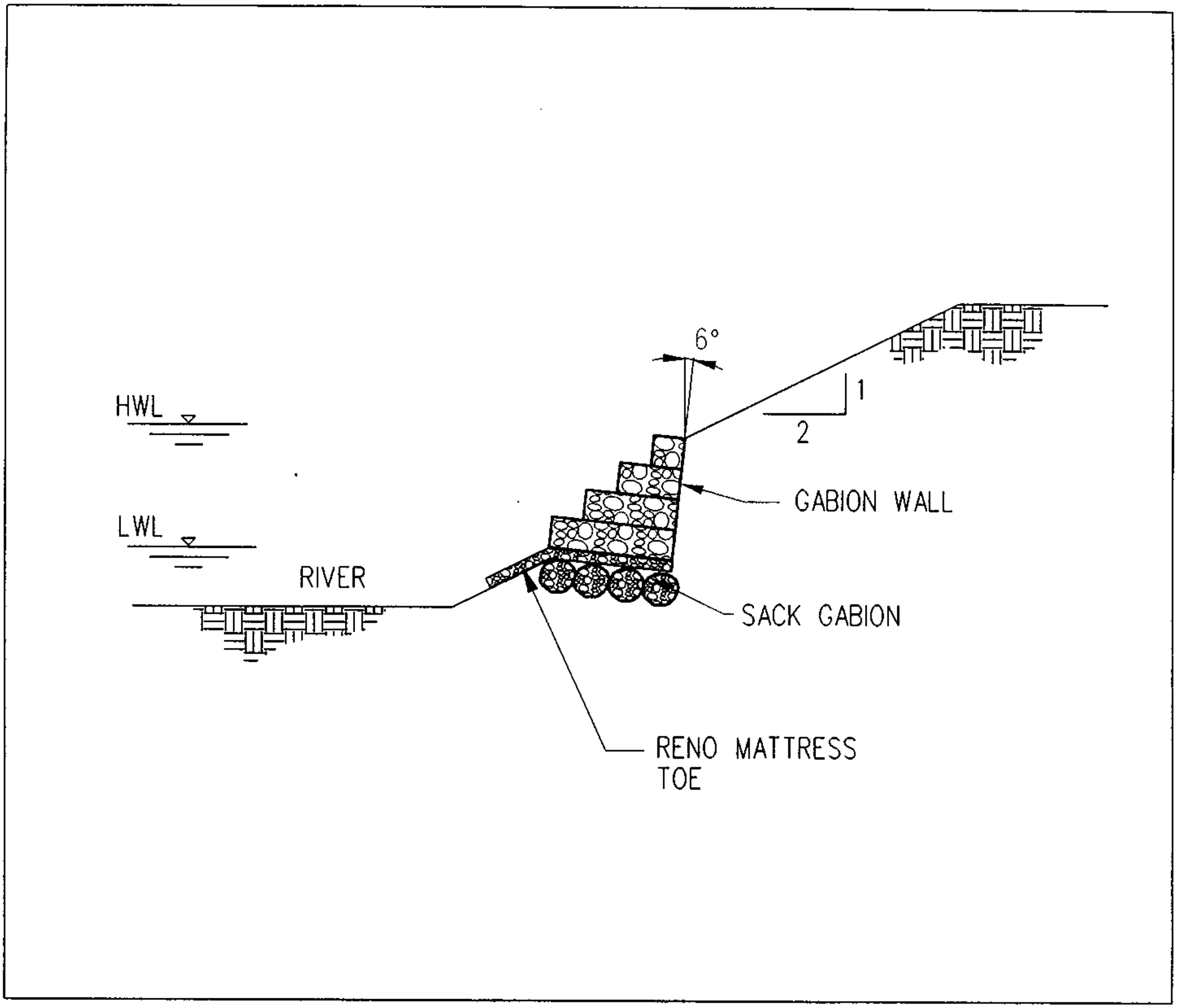


FIGURE 5 GABION WALL

file: sc28y007.dgn
csa gazdo
520628-01000

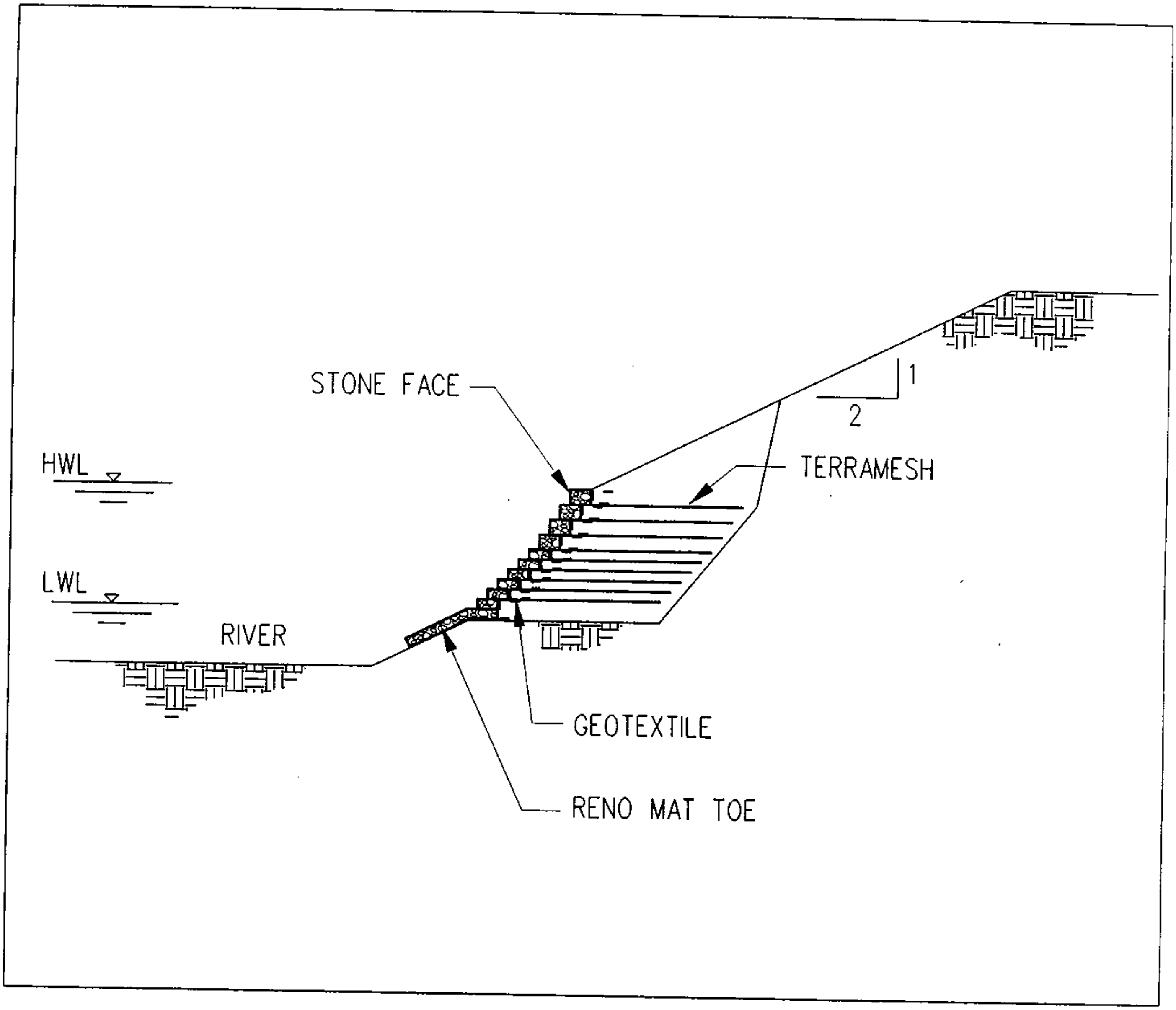


FIGURE 6 TERRAMESH WALL

file: sc28y006.dgn
csa gazda
520628-0100C

SCE & G WATEREE STATION
EROSION CONTROL PROJECT

2 : 1 GRADED SLOPE
RIP RAP SURFACE

Average Cost $298 Per Linear Foot

RIVERBANK WORK:	QTY	UOM	UNIT MANHRS	TOTAL MANHRS	UNIT LABOR	TOTAL LABOR	UNIT EQUIP	TOTAL EQUIP	UNIT MATL	TOTAL MATL	TOTAL
Clear Trees	2.30	AC	70	161	$19.00	$3,059	$663.00	$1,525		$0	$4,584
Grub Stumps	2.30	AC	24	55	$22.00	$1,210	$765.00	$1,759		$0	$2,969
Bank Excavation	16,191	CY	0.050	810	$22.00	$17,820	$0.60	$9,715		$0	$27,535
Excavation Disposal	16,191	CY	0.042	680	$20.75	$14,110	$0.61	$9,877		$0	$23,987
Fine Grade	7,780	SY	0.016	124	$21.00	$2,604	$0.27	$2,101		$0	$4,705
Rip Rap Hand Placed	5,000	SY	0.346	1730	$19.50	$33,735	$3.50	$17,500	$10.23	$51,150	$102,385
Ballast Stone Bedding	5,000	SY	0.069	345	$17.00	$5,865	$0.71	$3,550	$1.96	$9,800	$19,215
Geotextile Filter Mirafi 700X	5,500	SY	0.010	55	$20.00	$1,100		$0	$0.95	$5,225	$6,325
Anchor Trench	340	CY	0.110	37	$22.00	$814	$1.50	$510		$0	$1,324
Seeding & Fertilizer	23,460	SY	0.003	70	$20.00	$1,400	$0.07	$1,642	$0.08	$1,877	$4,919
Erosion Control Blanket	8,940	SY	0.01	89	$20.00	$1,780		$0	$1.75	$15,645	$17,425
Silt Boom in river	1100	LF	0.04	44	$18.00	$792			$12.00	$13,200	$13,992
Mobilization & Demobil.	1	LS					$1,650	$1,650			$1,650
700 Ft. HAUL ROAD:											$7,266
						$84,289		$49,829		$96,897	$238,281

Contingency 25%	$59,570
Grand Total	$297,851

SCE & G WATEREE STATION
EROSION CONTROL PROJECT

2 : 1 GRADED SLOPE
RENO MAT SURFACE Average Cost $355 Per Linear Foot

RIVERBANK WORK:	QTY	UOM	UNIT MANHRS	TOTAL MANHRS	UNIT LABOR	TOTAL LABOR	UNIT EQUIP	TOTAL EQUIP	UNIT MATL	TOTAL MATL	TOTAL
Clear Trees	2.30	AC	70	161	$19.00	$3,059	$663.00	$1,525		$0	$4,584
Grub Stumps	2.30	AC	24	55	$22.00	$1,210	$765.00	$1,759		$0	$2,969
Bank Excavation	16,191	CY	0.05	810	$22.00	$17,820	$0.60	$9,715		$0	$27,535
Excavation Disposal	16,191	CY	0.042	680	$20.75	$14,110	$0.61	$9,877		$0	$23,987
Fine Grade	7,780	SY	0.016	124	$21.00	$2,604	$0.27	$2,101		$0	$4,705
Reno Mat	4,000	SY	0.875	3500	$19.50	$68,250	$8.87	$35,480	$16.38	$65,520	$169,250
Geotextile Filter Mirafi 700X	4,330	SY	0.010	43	$20.00	$860		$0	$0.95	$4,114	$4,974
Anchor Trench	166	CY	0.11	18	$22.00	$396	$1.50	$249		$0	$645
Seeding & Fertilizer	23,460	SY	0.003	70	$20.00	$1,400	$0.07	$1,642	$0.08	$1,877	$4,919
Erosion Control Blanket	8,940	SY	0.01	89	$20.00	$1,780		$0	$1.75	$15,645	$17,425
Silt Boom in river	1100	LF	0.04	44	$18.00	$792			$12.00	$13,200	$13,992
Mobilization & Demobil	1	LS				$0	$1,650.00	$1,650		$0	$1,650
700 Ft. Haul Road											$7,266
						$112,281		$63,998		$100,355	$283,900

Contingency 25%	$70,975
Grand Total	$354,875

SCE & G WATEREE STATION
EROSION CONTROL PROJECT

2 : 1 GRADED SLOPE
ARMORFLEX SURFACE   Average Cost $318 Per Linear Foot

RIVERBANK WORK:	QTY	UOM	UNIT MANHRS	TOTAL MANHRS	UNIT LABOR	TOTAL LABOR	UNIT EQUIP	TOTAL EQUIP	UNIT MATL	TOTAL MATL	TOTAL
Clear Trees	2.30	AC	70	161	$19.00	$3,059	$663.00	$1,525		$0	$4,584
Grub Stumps	2.30	AC	24	55	$22.00	$1,210	$765.00	$1,759		$0	$2,969
Bank Excavation	16,191	CY	0.050	810	$22.00	$17,820	$0.60	$9,715		$0	$27,535
Excavation Disposal	16,191	CY	0.042	680	$20.75	$14,110	$0.61	$9,877		$0	$23,987
Fine Grade	7,780	SY	0.016	124	$21.00	$2,604	$0.27	$2,101		$0	$4,705
Armorflex Mat	40,000	SF	0.005	200	$19.00	$3,800	$0.04	$1,600	$3.30	$132,000	$137,400
Geotextile Filter	4,450	SY	0.010	45	$20.00	$900		$0	$1.35	$6,008	$6,908
Anchor Trench	340	CY	0.110	37	$22.00	$814	$1.50	$510		$0	$1,324
Seeding & Fertilizer	23,460	SY	0.003	70	$20.00	$1,400	$0.07	$1,642	$0.08	$1,877	$4,919
Erosion Control Blanket	8,940	SY	0.01	89	$20.00	$1,780		$0	$1.75	$15,645	$17,425
Silt Boom in river	1100	LF	0.04	44	$18.00	$792			$12.00	$13,200	$13,992
Mobilization & Demobil.	1	LS					$1,650	$1,650			$1,650
700 Ft. Haul Road											$7,266
						$48,289		$30,379		$168,729	$254,663

Contingency 25%	$63,666
Grand Total	$318,329

SCE & G WATEREE STATION
EROSION CONTROL PROJECT

GABION WALL Average Cost $597 Per Linear Foot

RIVERBANK WORK:	QTY	UOM	UNIT MANHRS	TOTAL MANHRS	UNIT LABOR	TOTAL LABOR	UNIT EQUIP	TOTAL EQUIP	UNIT MATL	TOTAL MATL	TOTAL
Clear Trees	2.3	AC	70	161	$19.00	$3,059	$663.00	$1,525		$0	$4,584
Grub Stumps	2.3	AC	24	55	$22.00	$1,210	$765.00	$1,759		$0	$2,969
Excavation	13207	CY	0.024	317	$21.25	$6,736	$0.69	$9,113		$0	$15,849
Backfill & Compact	2383	CY	0.058	138	$21.00	$2,898	$0.67	$1,597		$0	$4,495
Fine Grade	4628	SY	0.016	74	$21.00	$1,554	$0.27	$1,250		$0	$2,804
Excavation Disposal	10824	CY	0.042	455	$20.75	$9,441	$0.61	$6,603		$0	$16,044
Geotextile Filter Mirafi 700X	3780	SY	0.010	38	$20.00	$760		$0	$0.95	$3,591	$4,351
Seeding & Fertilizer	7981	SY	0.003	24	$20.00	$480	$0.07	$559	$0.08	$638	$1,677
Erosion Control Blanket	4628	SY	0.01	46	$20.00	$920		$0	$1.75	$8,099	$9,019
Reno Mat	1000	SY	0.875	875	$19.50	$17,063	$8.87	$8,870	$16.38	$16,380	
Gabion Wire Box	4580	CY	1.3	5954	$18.50	$110,149	$7.10	$32,518	$28.75	$131,675	$274,342
Gabion Stone	5100	CY		0		$0		$0	$23.25	$118,575	$118,575
Silt Boom in river	1100	LF	0.04	44	$18.00	$792		$0	$12.00	$13,200	$13,992
Mobilization & Demobil.	1	LS					$1,500.00	$1,500			$1,500
700 Ft. Haul Road											$7,266
						$155,062		$65,294		$292,158	$477,468

Contingency 25%	$119,367
Grand Total	$596,835

SCE & G WATEREE STATION
EROSION CONTROL PROJECT

GABION WALL Average Cost $597 Per Linear Foot

RIVERBANK WORK:	QTY	UOM	UNIT MANHRS	TOTAL MANHRS	UNIT LABOR	TOTAL LABOR	UNIT EQUIP	TOTAL EQUIP	UNIT MATL	TOTAL MATL	TOTAL
Clear Trees	2.3	AC	70	161	$19.00	$3,059	$663.00	$1,525		$0	$4,584
Grub Stumps	2.3	AC	24	55	$22.00	$1,210	$765.00	$1,759		$0	$2,969
Excavation	13207	CY	0.024	317	$21.25	$6,736	$0.69	$9,113		$0	$15,849
Backfill & Compact	2383	CY	0.058	138	$21.00	$2,898	$0.67	$1,597		$0	$4,495
Fine Grade	4628	SY	0.016	74	$21.00	$1,554	$0.27	$1,250		$0	$2,804
Excavation Disposal	10824	CY	0.042	455	$20.75	$9,441	$0.61	$6,603		$0	$16,044
Geotextile Filter Mirafi 700X	3780	SY	0.010	38	$20.00	$760		$0	$0.95	$3,591	$4,351
Seeding & Fertilizer	7981	SY	0.003	24	$20.00	$480	$0.07	$559	$0.08	$638	$1,677
Erosion Control Blanket	4628	SY	0.01	46	$20.00	$920		$0	$1.75	$8,099	$9,019
Reno Mat	1000	SY	0.875	875	$19.50	$17,063	$8.87	$8,870	$16.38	$16,380	
Gabion Wire Box	4580	CY	1.3	5954	$18.50	$110,149	$7.10	$32,518	$28.75	$131,675	$274,342
Gabion Stone	5100	CY		0		$0		$0	$23.25	$118,575	$118,575
Silt Boom in river	1100	LF	0.04	44	$18.00	$792		$0	$12.00	$13,200	$13,992
Mobilization & Demobil.	1	LS					$1,500.00	$1,500			$1,500
700 Ft. Haul Road											$7,266
						$155,062		$65,294		$292,158	$477,468

Contingency 25% $119,367

Grand Total $596,835

SCE & G WATEREE STATION
EROSION CONTROL PROJECT

TERRAMESH WALL Average Cost $475 Per Linear Foot

RIVERBANK WORK:	QTY	UOM	UNIT MANHRS	TOTAL MANHRS	UNIT LABOR	TOTAL LABOR	UNIT EQUIP	TOTAL EQUIP	UNIT MATL	TOTAL MATL	TOTAL
Clear Trees	2.30	AC	70	161	$19.00	$3,059	$663.00	$1,525		$0	$4,584
Grub Stumps	2.30	AC	24	55	$22.00	$1,210	$765.00	$1,759		$0	$2,969
Reno Mat Foundation	1,333	SY	0.875	1166	$19.50	$22,737	$8.87	$11,824	$16.38	$21,835	$56,396
Excavation	10,634	CY	0.024	255	$21.25	$5,419	$0.69	$7,337		$0	$12,756
Backfill & Compact	10,634	CY	0.05	532	$20.50	$10,906	$0.67	$7,125		$0	$18,031
Backfill & Compact Borrow	3,809	CY		0		$0		$0	$12.83	$48,869	$48,869
Fine Grade	2,817	SY	0.016	45	$21.00	$945	$0.27	$761		$0	$1,706
Geotextile Filter Mirafi 700X	7,700	SY	0.010	77	$20.00	$1,540		$0	$0.95	$7,315	$8,855
Seeding & Fertilizer	6,150	SY	0.003	18	$20.00	$360	$0.07	$431	$0.08	$492	$1,283
Erosion Control Blanket	2,817	SY	0.01	28	$20.00	$560		$0	$1.75	$4,930	$5,490
Terromesh Assembly	1,313	CY	0.733	962	$18.50	$17,797	$4.73	$6,210	$117.29	$154,002	$178,009
Gabion Size Stone	1,313	CY		0		$0		$0	$23.25	$30,527	$30,527
Silt Fence in river	1100	LF	0.04	44	$18.00	$792		$0	$0.75	$825	$1,617
Mobilization & Demobil.	1	LS					$1,500.00	$1,500			$1,500
700 Ft. Haul Road	1										$7,266
						$65,325		$38,472		$268,795	$379,858

Contingency 25%	$94,964
Grand Total	$474,822

SCE & G WATEREE STATION
EROSION CONTROL PROJECT

Estimated Cost Of Access Road To Area 1

700 Ft. HAUL ROAD:	QTY	UOM	UNIT MANHRS	TOTAL MANHRS	UNIT LABOR	TOTAL LABOR	UNIT EQUIP	TOTAL EQUIP	UNIT MATL	TOTAL MATL	TOTAL
Clear Trees	0.32	AC	70	22	$19.00	$418	$663.00	$212		$0	$630
Grub Stumps	0.32	AC	24	8	$22.00	$176	$765.00	$245		$0	$421
Excavation Road	500	CY	0.026	13	$22.00	$286	$0.25	$125		$0	$411
Excavation Ditch	260	CY	0.040	10	$22.00	$220	$0.40	$104		$0	$324
Stone	310	CY	0.026	8	$22.00	$176	$0.69	$214	$15.00	$4,650	$5,040
CMP	20	LF	0.147	3	$22.00	$66	$0.69	$14	$18.00	$360	$440
						$1,342		$914		$5,010	$7,266
										Total	$7,266

SCE & G WATEREE STATION
EROSION CONTROL PROJECT
BORROW PIT COST

Cost include excavation, haul, backfill and compact behind Terramesh or Gabion wall and seeding pit area after completion of project.

PIT VOLUME	20,000 CUBIC YARDS
AVERAGE DEPTH	4 FEET

HAUL ROAD:	QTY	UOM	UNIT MANHRS	TOTAL MANHRS	UNIT LABOR	TOTAL LABOR	UNIT EQUIP	TOTAL EQUIP	UNIT MATL	TOTAL MATL	TOTAL
CLEAR & GRUB	0.23	AC	60.000	14	$22.00	$308	$1,500.00	$345			$653
EXCAVATION ROAD	296	CY	0.026	8	$22.00	$176	$0.25	$74			$250
EXCAVATION DITCH	185	CY	0.040	7	$22.00	$154	$0.40	$74			$228
STONE	296	CY	0.026	8	$22.00	$176	$0.69	$204	$15	$4,440	$4,820
CMP	20	LF	0.147	3	$22.00	$66	$0.69	$14	$18	$360	$440
						$880		$711		$4,800	$6,391

$12.78 PER LF

BORROW/HAUL/COMPACT:	QTY	UOM	UNIT MANHRS	TOTAL MANHRS	UNIT LABOR	TOTAL LABOR	UNIT EQUIP	TOTAL EQUIP	UNIT MATL	TOTAL MATL	TOTAL
CLEAR & GRUB	3.1	AC	60.000	186	22	$4,092	$1,500.00	$4,650			$8,742
SILT FENCE	1469.6	LF	0.020	29	18	$522		$0	$0.75	$1,102	$1,624
SETTLING POND	1	LS	40.000	40	22	$880	$3,000.00	$3,000			$3,880
STOCK PILE TOP SOIL	2500	CY	0.015	38	22	$836	$1.05	$2,625			$3,461
EXCAVATION	20000	CY	0.010	200	22	$4,400	$0.42	$8,400			$12,800
HAUL 2 MILES	20000	CY	0.038	760	20	$15,200	$1.80	$36,000			$51,200
SPREAD	20000	CY	0.035	700	22	$15,400	$6.00	$120,000			$135,400
COMPACT	20000	CY	0.038	760	17	$12,920	$0.25	$5,000			$17,920
SPREAD TOP SOIL	2500	CY	0.060	150	22	$3,300	$1.60	$4,000			$7,300
FINE GRADE BORROW PIT	15004	SY	0.002	30	22	$660	$0.06	$900			$1,560
SEEDING & FERT.	135	MSF	0.300	41	20	$820	$6.60	$891	$23.00	$3,105	$4,816
MOBILIZATION & DEMOB.	1	LS					$1,500.00	$1,500			$1,500
				2934		$59,030		$186,966		$4,207	$250,203
											$6,391
											$12.83 PER CY

8.2

LETTER TO MR TIM ELAEZER, REFERENCE SCE&G WATEREE STATION PLCAEMENT OF FILL ALONG ASH POND DIKE, OCTOBER 2, 1997.

SCE&G
A SCANA Company

South Carolina Electric & Gas Company
Columbia, SC 29218
(803) 748-3000

October 2, 1997

Mr. Tim Eleazer
SCDHEC
Bureau of Water Pollution Control
2600 Bull Street
Columbia, S.C. 29201

RE: SCE&G Wateree Station (SC0002038)
Placement of soil fill along ash pond dike

Dear Mr. Eleazer:

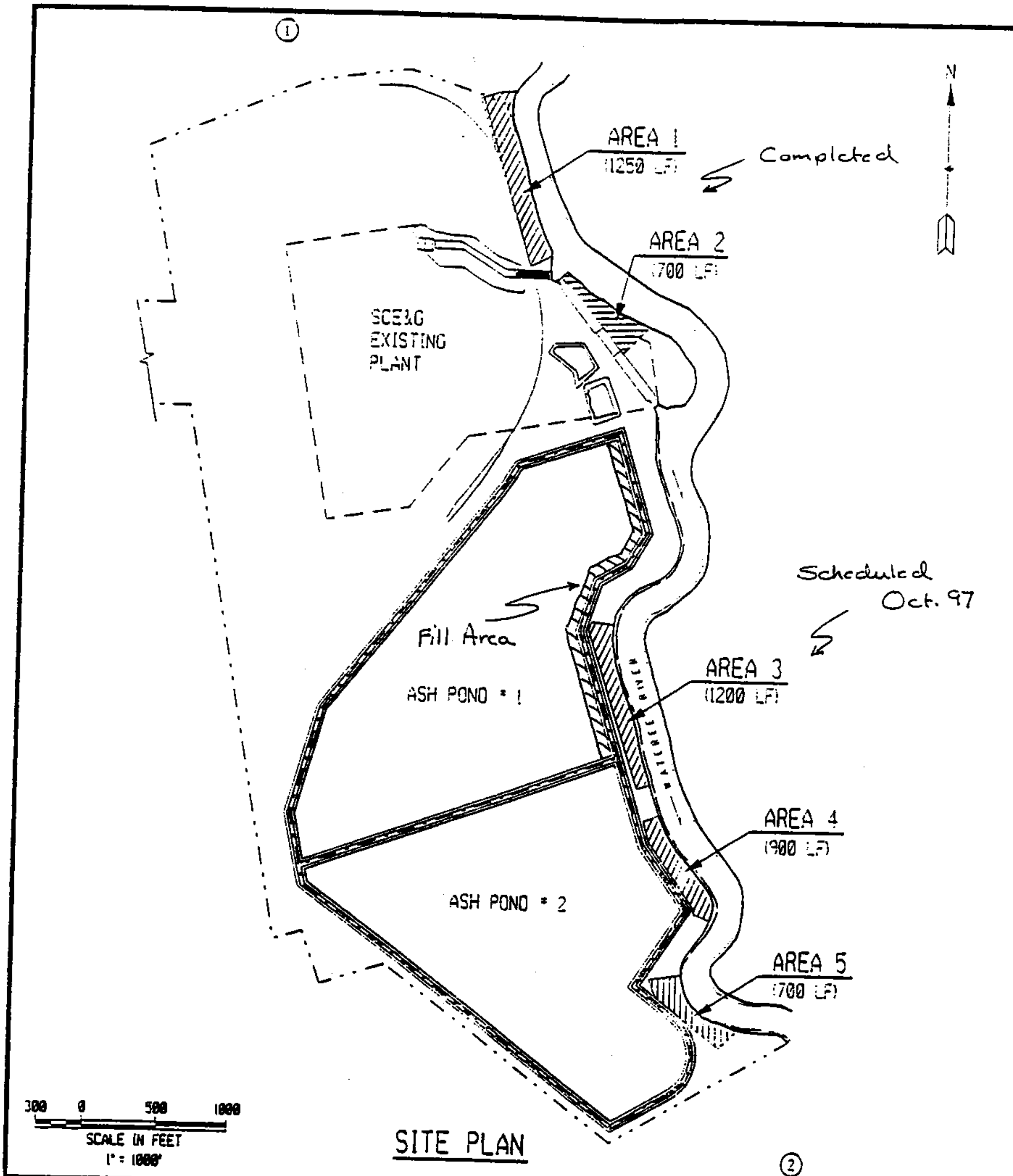
SCE&G requests your approval to begin placement of approximately 20,000 yd^3 of soil fill along the inner slope of our number one ash pond dike, adjacent to the Wateree River. This fill activity will be performed in conjunction with a scheduled project to begin this October, which will stabilize river bank erosion along selected areas of the river. The attached drawing shows the river bank stabilization areas, and the location of proposed fill work. This activity will provide additional buffer distance between the river and the ash pond, and improve the stability of the dike. Fill will be placed at the toe of the dike and worked up the slope to existing grade (fill height approx. 15'). Additionally, fill width will be approximately 10' to accommodate equipment access.

Thanks again for your prompt consideration in this matter. If you have any questions please call Jean-Claude Younan at 748-3617.

Sincerely,

Jean-Claude Younan
Environmental Services

cc: Jim Ellis, SCDHEC.
Bruce Crawford, SCDHEC
J.P. Hudson / J.W. Preston / J.C. Younan / C. Pearson / M.E. Moore / File
M.D. Quinton / M. Ferguson / D. Blanks
H. Moxley / R. A. Ammarrell
T. Frady / A. Shaffer
A. Oden



Completed

Scheduled Oct. 97

Fill Area

SITE PLAN

PURPOSE: PREVENT RIVER BANK EROSION

DATUM: MSL
ADJACENT PROPERTY OWNERS:
① UNION CAMP CORP.
② JACQUELINE A. GRIFFIN

PARSONS
MAIN, INC.

DN JARRETT	CHK
RE	COE

PROPOSED RIVER BANK EROSION STABILIZATION
For SOUTH CAROLINA ELECTRIC & GAS
IN: WATEREE RIVER
AT: WATEREE STATION
COUNTY: RICHLAND STATE: SOUTH CAROLINA
APPLICATION BY: JEAN-CLAUDE YOUNAN
SHEET 2 of 5 DATE: APRIL 1, 1994

ASH POND #1

Available Information Checklist

Coal Combustion Waste Impoundment (CCWI) Dam

1. **Descriptive Information**
    a. **Impoundment Capacity (Normal & Max)**
    At normal pool (104.0 ft), the impoundment capacity is 2,000,000 cubic yards. At maximum pool (106.0 ft), the impoundment capacity is 2,260,000 cubic yards. Supporting information is presented on Figure 1 in Attachment 1.

    b. **Impoundment Surface Area:**
    The impoundment surface area at normal pool is approximately 80.65 acres. Supporting information is presented on Figure 1 in Attachment 1.

    c. **Hazard Classification:**
    The facility has not been assigned a hazard classification by a regulatory agency.

    d. **Freeboard (Normal & Minimum)**
    The freeboard between normal pool (elevation 104.0) and the maximum pool (106.0) is 2.0 feet. The freeboard between normal pool (104.0 ft) and the dam crest (108.0 ft) is 4.0 feet. The freeboard between the maximum pool (106.0 ft) and the dam crest (108.0 ft) is 2.0 feet. Supporting information is presented on Figure 1 in Attachment 1.

    e. **Maximum Dam Height**
    The maximum constructed embankment dam height is approximately 21 feet. Supporting information is presented on Figure 1 in Attachment 1.

    f. **Dam Crest Elevation**
    The dam crest elevation is approximately 108 feet. Supporting information is presented on Figure 1 in Attachment 1.

    g. **Crest Width**
    The minimum dam crest width is approximately 20 feet. Supporting information is presented on Figure 1 in Attachment 1.

h. **Upstream Slope Inclination**

The upstream slope inclination above the normal pool is generally an approximate 2H:1V gradient. Supporting information is presented on Figure 1 in Attachment 1.

i. **Downstream Slope Inclination**

The downstream slope inclination of the constructed embankment is generally an approximate 2H:1V gradient. Supporting information is presented on Figure 1 in Attachment 1.

j. **Spillway Type, Size, & Crest Elevation**

The impoundment does not have a primary overflow spillway. Overflow from Ash Pond 1 would overtop the interior dike between Ash Pond 1 and Ash Pond 2 and flow into Ash Pond 2.

An emergency spillway, comprised of a riser/barrel outlet structure, is located in the southeast corner of the pond. No information is available regarding the emergency spillway's size and elevations.

k. **Outlet Conduit Type, Size, and & Max Flow Capacity**

The impoundment's outlet conduit is a 24-inch diameter corrugated metal pipe which discharges to Pond 2. The maximum flow capacity of the conduit pipe is estimated at 4.8 mgd, as presented in the calculations contained in Attachment 2.

l. **Historical Maximum Pond Elevation**

The pond level is maintained by the existing pond outlet structure. To the best of our knowledge, the historical maximum pond elevation is equivalent to the current pond elevation of 104.0 feet, as shown on Figure 1 in Attachment 1.

m. **Year Built**

To the best of our knowledge, the ash pond impoundment was constructed in 1970.

n. **Design Life**

Documentation regarding the original planned design life of the impoundment is not available. Current management practices include recycling to include excavation of ponded CCB material from within Pond 1. Given current pond management and recycling practices, the design life of Pond 1 is potentially indefinite.

o. **Specific Wastes Permitted in Impoundment**

A copy of the impoundment's current applicable permit (NPDES) is presented in Attachment 3. As identified on page 23 of the permit, the ash pond impoundment is permitted to receive the following wastewaters: "cooling tower blowdown, low volume wastes, ash transport wastewaters, landfill runoff/leachate, coal pile runoff, miscellaneous power plant wastewaters, and storm water".

p. **Other (describe)** - none

2. **Regional Map** showing CCWI & schools, hospitals, etc. within 5 miles downgradient. A regional map is presented in Attachment 4.

3. **Management Unit Drawings**

a. **Plans**

Original plan drawings for the management unit are not available.

b. **Sections**

Original section drawings for the management unit are not available.

c. **Elevations**

Original elevation drawings for the management unit are not available.

d. **Other (describe)** - none

4. **Design Information**

a. **Design Assumptions**

Documentation regarding assumptions used in the impoundment's design is not available.

b. **Design Analysis**

Documentation regarding analysis used in the impoundment's design is not available. A hydraulic analysis has been performed. A report detailing the findings of the hydraulic analysis ("Pond Detention Study and Hydraulic Analysis" dated October 2006 and prepared by ERM) can be found in Attachment 5.

c. **Spillway Design Flood or Design Basis**

Documentation regarding the design flood or basis used in spillways's design is not available. A hydraulic analysis has been performed. A report detailing the findings of the hydraulic analysis ("Pond Detention Study and Hydraulic Analysis" dated October 2006 and prepared by ERM) can be found in Attachment 5.

d. **Slope Stability Factors of Safety**

Documentation regarding the slope stability factors of safety used in the impoundment's design is not available. A slope stability analysis has been performed. The report detailing the findings of the slope stability analysis ("Wateree Station Ash Pond Containment Structure Stability Report", dated July 2010 and prepared by F&ME Consultants) can be found in Attachment 6.

e. **Design Soil Properties and Parameters**

Documentation regarding soil properties and parameters used in the impoundment's design is not available. A subsurface investigation has been performed to identify soil properties and parameters for the purpose of further evaluating impoundment structural stability. The report detailing the findings of the subsurface investigation ("Wateree Station Ash Pond Containment Structure Stability Report", dated July 2010 and prepared by F&ME Consultants) can be found in Attachment 6.

f. **Other (describe)** - none

5. Subsurface Information

Several subsurface investigations have been performed on Ash Pond 1. Reports detailing the findings of these subsurface investigations can be found in Attachment 6 to include the following reports:

- "Hydrogeologic Assessment Report", dated May 15, 1998 and prepared by General Engineering.
- "Mixing Zone Application", dated June 21, 2000 and prepared by General Engineering.
- "Wateree Station Ash Pond Containment Structure Subsurface Investigation Report", dated May, 2010 and prepared by F&ME Consultants.
- "Wateree Station Ash Pond Containment Structure Stability Report", dated July, 2010 and prepared by F&ME Consultants.

The above identified reports present discussions of site geology, geotechnical reporting, test boring logs, and subsurface profiles.

a. **Geology** – see above
b. **Geotechnical Report** – see above
c. **Test Boring Logs** – see above
d. **Subsurface Profiles** – see above
e. **Other (describe)** - none

6. **Monitoring Information**
   a. **Observation Wells/Piezometer Readings**
   Groundwater level readings are collected as part of the facility's groundwater monitoring program. A summary of the historical groundwater level readings as well as a map showing the well locations can be found in Attachment 7.

   b. **Seepage Readings**
   Seepage monitoring has been performed. A summary of the seepage monitoring information can be found in Attachment 7.

   c. **Settlement Readings**
   Settlement monitoring has not been performed.

   d. **Alignment Readings**
   Alignment monitoring has not been performed.

   e. **Inclinometer Readings**
   Inclinometer monitoring has not been performed.

   f. **Time vs Reading Graphs**
   Time vs Reading monitoring has not been performed.

   g. **Other (describe)** - none

7. **Instrumentation Drawings**
   a. **Location Plan**
   The pond/dam does not have an instrumentation program.

b. Section Views
The pond/dam does not have an instrumentation program.

c. Other (describe) - none

8. Miscellaneous

a. Permits
The pond/dam is currently regulated under a NPDES permit. A copy of the current permit can be found in Appendix 3.

b. Construction Documentation / Foundation Prep
Documentation regarding construction and foundation preparations is not available.

c. Spills or Releases
To the best of our knowledge, there have been no spills or releases.

d. Repairs
Soil fill was placed along a portion of the interior slope in 1997 to improve the stability of the dike. Documentation regarding the repairs can be found in Appendix 8. No other impoundment repair documentation is available.

e. Emergency Action Plan
An Emergency Action Plan is not available.

f. Operation & Maintenance Plans / Documents
An O&M Plan is not available.

g. Other (describe) - none

ASH POND #2

Available Information Checklist

Coal Combustion Waste Impoundment (CCWI) Dam

1. **Descriptive Information**
   a. **Impoundment Capacity (Normal & Max)**
   At normal pool (103.7 ft), the impoundment capacity is 1,871,000 cubic yards. At maximum pool (107.0 ft), the impoundment capacity is 2,279,000 cubic yards. Supporting information is presented on Figure 1 in Attachment 1.

   b. **Impoundment Surface Area:**
   The impoundment surface area is approximately 76.6 acres. Supporting information is presented on Figure 1 in Attachment 1.

   c. **Hazard Classification:**
   The facility has not been assigned a hazard classification by a regulatory agency.

   d. **Freeboard (Normal & Minimum)**
   The freeboard between normal pool (elevation 103.7) and the maximum pool (107.0) is 3.3 feet. The freeboard between normal pool (103.7 ft) and the dam crest (108.0 ft) is 4.3 feet. The freeboard between the maximum pool (107.0 ft) and the dam crest (108.0 ft) is 1.0 feet. Supporting information is presented on Figure 1 in Attachment 1.

   e. **Maximum Dam Height**
   The maximum constructed embankment dam height is approximately 20 feet. Supporting information is presented on Figure 1 in Attachment 1.

   f. **Dam Crest Elevation**
   The dam crest elevation is approximately 108 feet. Supporting information is presented on Figure 1 in Attachment 1.

   g. **Crest Width**
   The minimum dam crest width is approximately 20 feet. Supporting information is presented on Figure 1 in Attachment 1.

h. Upstream Slope Inclination

The upstream slope inclination above the normal pool is generally an approximate 2H:1V gradient. Results of a recent bathymetric survey indicate the upstream slope inclination below the normal pool is an approximate 2H:1V gradient. Supporting information is presented on Figure 1 in Attachment 1.

i. Downstream Slope Inclination

The downstream slope inclination of the constructed embankment is generally an approximate 2H:1V gradient. Supporting information is presented on Figure 1 in Attachment 1.

j. Spillway Type, Size, & Crest Elevation

The impoundment's spillway consists of two 42-inch diameter corrugated metal pipes. The invert (crest) elevation of the two 42-inch corrugated metal spillway pipes is 106.7 ft.

k. Outlet Conduit Type, Size, and & Max Flow Capacity

The impoundment's outlet conduit is a 36-inch diameter reinforced concrete pipe. Elevation information for the outlet conduit is not available, and therefore a maximum flow capacity is not able to be estimated.

l. Historical Maximum Pond Elevation

The pond level is maintained by the existing pond outlet structure. To the best of our knowledge, the historical maximum pond elevation is equivalent to the current pond elevation of 103.7 feet, as shown on Figure 1 in Attachment 1.

m. Year Built

To the best of our knowledge, the ash pond impoundment was constructed in 1970.

n. Design Life

Documentation regarding the original planned design life of the impoundment is not available. The impoundment currently has approximately 790,000 cubic yards of available capacity. Current management practices include recycling to include excavation of ponded CCB material from the upstream and connected Pond 1. Given current pond management and recycling practices, the design life of Pond 2 is potentially indefinite.

o. Specific Wastes Permitted in Impoundment

A copy of the impoundment's current applicable permit (NPDES) is presented in Attachment 3. As identified on page 23 of the permit, the ash pond impoundment is permitted to receive the following wastewaters: "cooling tower blowdown, low volume wastes, ash transport wastewaters, landfill runoff/leachate, coal pile runoff, miscellaneous power plant wastewaters, and storm water".

p. **Other (describe)** - none

2. **Regional Map** showing CCWI & schools, hospitals, etc. within 5 miles downgradient. A regional map is presented in Attachment 4.

3. **Management Unit Drawings**

   a. **Plans**

   Original plan drawings for the management unit are not available.

   b. **Sections**

   Original section drawings for the management unit are not available.

   c. **Elevations**

   Original elevation drawings for the management unit are not available.

   d. **Other (describe)** - none

4. **Design Information**

   a. **Design Assumptions**

   Documentation regarding assumptions used in the impoundment's design is not available.

   b. **Design Analysis**

   Documentation regarding analysis used in the impoundment's design is not available. A hydraulic analysis has been performed. A report detailing the findings of the hydraulic analysis ("Pond Detention Study and Hydraulic Analysis" dated October 2006 and prepared by ERM) can be found in Attachment 5.

   c. **Spillway Design Flood or Design Basis**

   Documentation regarding the design flood or basis used in spillways's design is not available. A hydraulic analysis has been performed. A report detailing the findings of the hydraulic analysis ("Pond Detention Study and Hydraulic Analysis" dated October 2006 and prepared by ERM) can be found in Attachment 5.

d. Slope Stability Factors of Safety

Documentation regarding the slope stability factors of safety used in the impoundment's design is not available. A slope stability analysis has been performed. The report detailing the findings of the slope stability analysis ("Wateree Station Ash Pond Containment Structure Stability Report", dated July 2010 and prepared by F&ME Consultants) can be found in Attachment 6.

e. Design Soil Properties and Parameters

Documentation regarding soil properties and parameters used in the impoundment's design is not available. A subsurface investigation has been performed to identify soil properties and parameters for the purpose of evaluating impoundment structural stability. The report detailing the findings of the subsurface investigation ("Wateree Station Ash Pond Containment Structure Stability Report", dated July 2010 and prepared by F&ME Consultants) can be found in Attachment 6.

f. Other (describe)

5. Subsurface Information

Several subsurface investigations have been performed on Ash Pond 2. Reports detailing the findings of these subsurface investigations can be found in Attachment 6 to include the following reports:

- "Hydrogeologic Assessment Report", dated May 15, 1998 and prepared by General Engineering.
- "Mixing Zone Application", dated June 21, 2000 and prepared by General Engineering.
- "Wateree Station Ash Pond Containment Structure Subsurface Investigation Report", dated May, 2010 and prepared by F&ME Consultants.
- "Wateree Station Ash Pond Containment Structure Stability Report", dated July, 2010 and prepared by F&ME Consultants.

The above identified reports present discussions of site geology, geotechnical reporting, test boring logs, and subsurface profiles.

- a. **Geology** – see above
- b. **Geotechnical Report** – see above
- c. **Test Boring Logs** – see above
- d. **Subsurface Profiles** – see above
- e. **Other (describe)** - none

6. **Monitoring Information**

    a. **Observation Wells/Piezometer Readings**

    Groundwater level readings are collected as part of the facility’s groundwater monitoring program. A summary of the historical groundwater level readings as well as a map showing the well locations can be found in Attachment 7.

    b. **Seepage Readings**

    Seepage monitoring has been performed. A summary of the seepage monitoring information can be found in Attachment 7.

    c. **Settlement Readings**

    Settlement monitoring has not been performed.

    d. **Alignment Readings**

    Alignment monitoring has not been performed.

    e. **Inclinometer Readings**

    Inclinometer monitoring has not been performed.

    f. **Time vs Reading Graphs**

    Time vs Reading monitoring has not been performed.

    g. **Other (describe)** - none

7. **Instrumentation Drawings**

    a. **Location Plan**

    The pond/dam does not have an instrumentation program.

    b. **Section Views**

    The pond/dam does not have an instrumentation program.

    c. **Other (describe)** - none

8. Miscellaneous

a. Permits

The pond/dam is currently regulated under a NPDES permit. A copy of the current permit can be found in Appendix 3.

b. Construction Documentation / Foundation Prep

Documentation regarding construction and foundation preparations is not available.

c. Spills or Releases

To the best of our knowledge, there have been no spills or releases.

d. Repairs

Work to improve stability of the riverbank was performed in 1997 for the west bank of the Wateree River and near the southeast corner of the impoundment where the river is near or abuts the exterior toe of the impoundment slope. Documentation regarding the work can be found in Appendix 8. No other impoundment repair documentation is available.

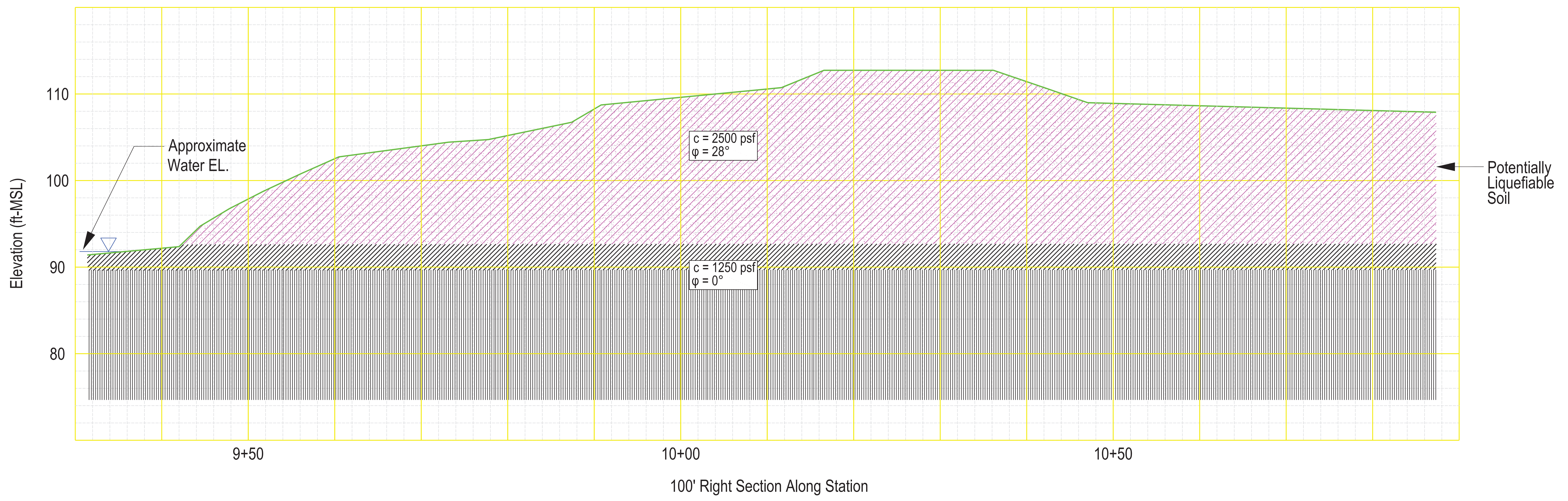
e. Emergency Action Plan

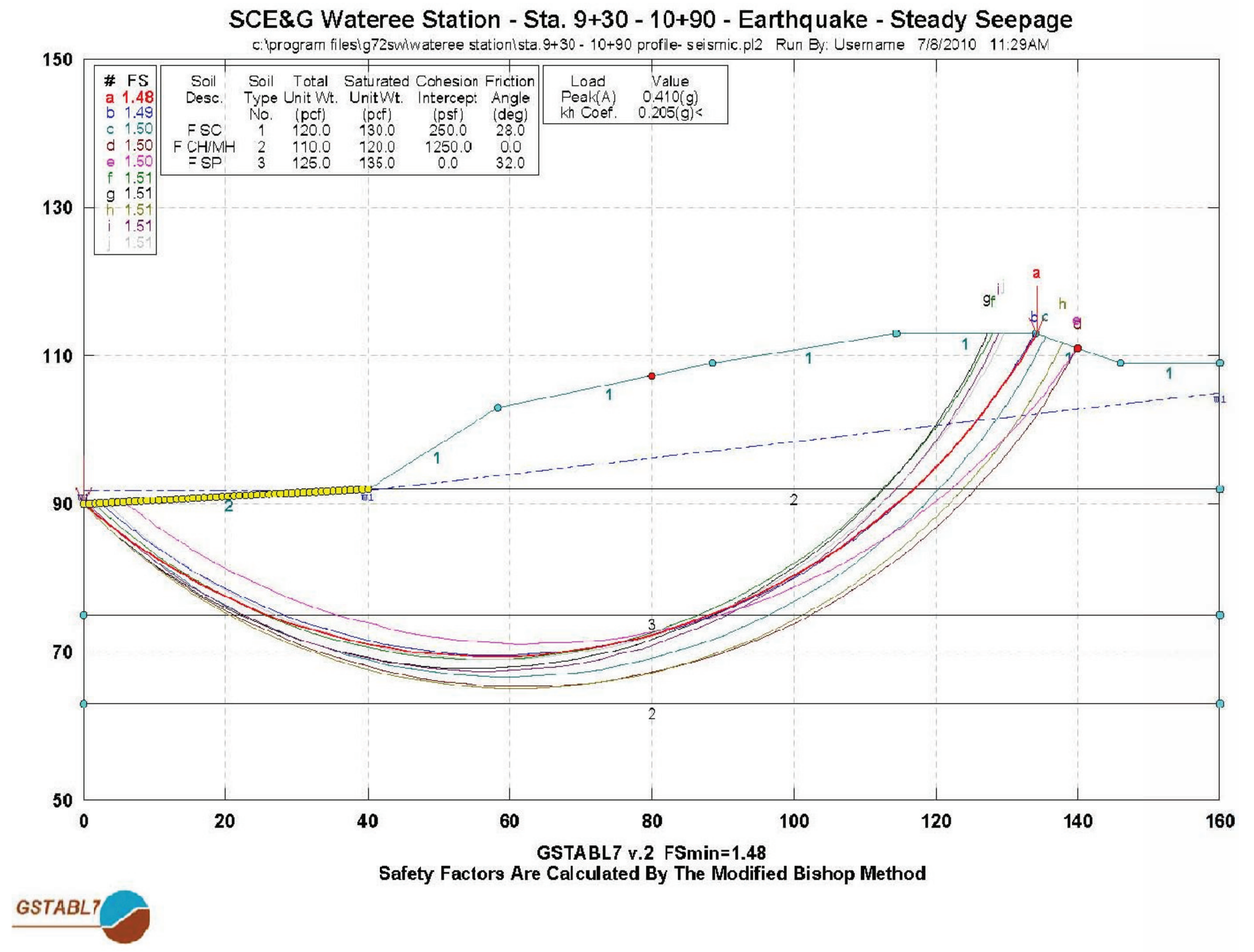
An Emergency Action Plan is not available.

f. Operation & Maintenance Plans / Documents

An O&M Plan is not available.

g. Other (describe) - none





SCE&G Wateree Station - Sta. 9+30 - 10+90 - Earthquake - Steady Seepage

c:\program files\g72sw\wateree station\sta.9+30 - 10+90 profile- seismic.pl2 Run By: Username 7/8/2010 11:29AM

#	FS
a	1.48
b	1.49
c	1.50
d	1.50
e	1.50
f	1.51
g	1.51
h	1.51
i	1.51
j	1.51

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
F SC	1	120.0	130.0	250.0	28.0
F CH/MH	2	110.0	120.0	1250.0	0.0
F SP	3	125.0	135.0	0.0	32.0

Load	Value
Peak(A)	0.410(g)
kh Coef.	0.205(g)<

GSTABL7 v.2 FSmin=1.48
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

SCE&G
A SCANA COMPANY

F&ME
CONSULTANTS
GEOTECHNICAL · ENVIRONMENTAL · MATERIALS
COLUMBIA, SOUTH CAROLINA

SEAL NOT VALID UNLESS SIGNED

REVISIONS

NO.	DESCRIPTION	DATE	BY

SCALE: NONE
NOTES:

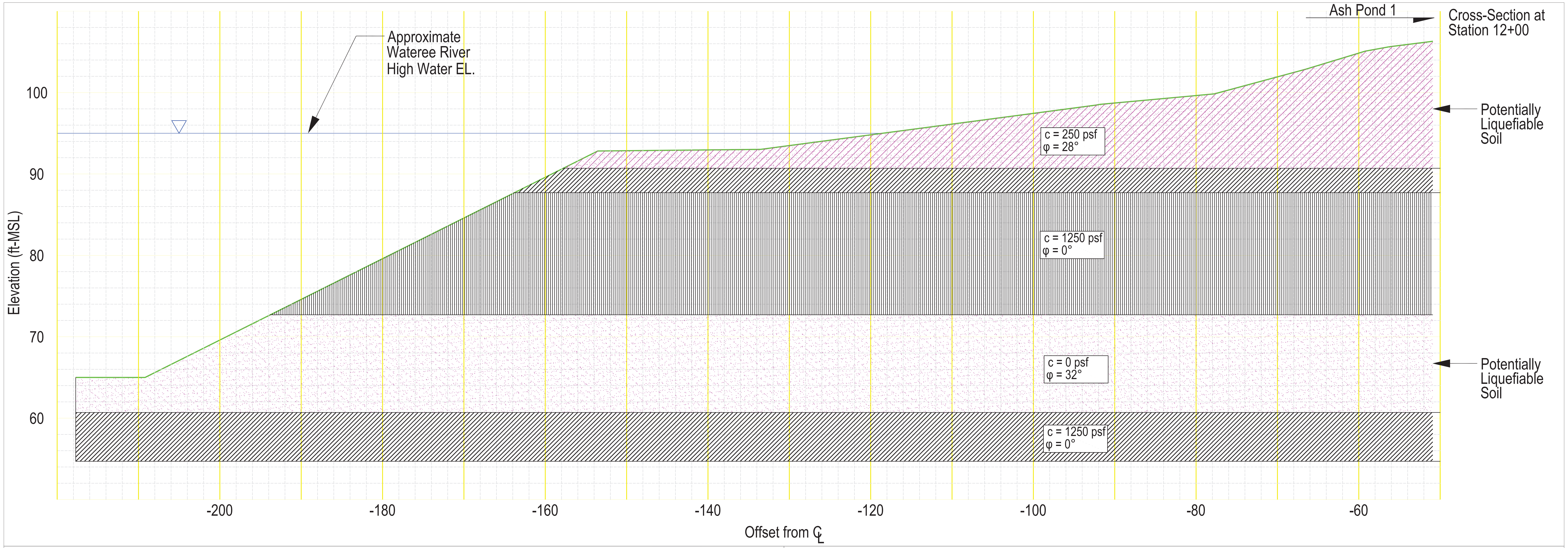
DRAWN BY: WJG
CHECKED BY: JRW
APPROVED BY: ZWA

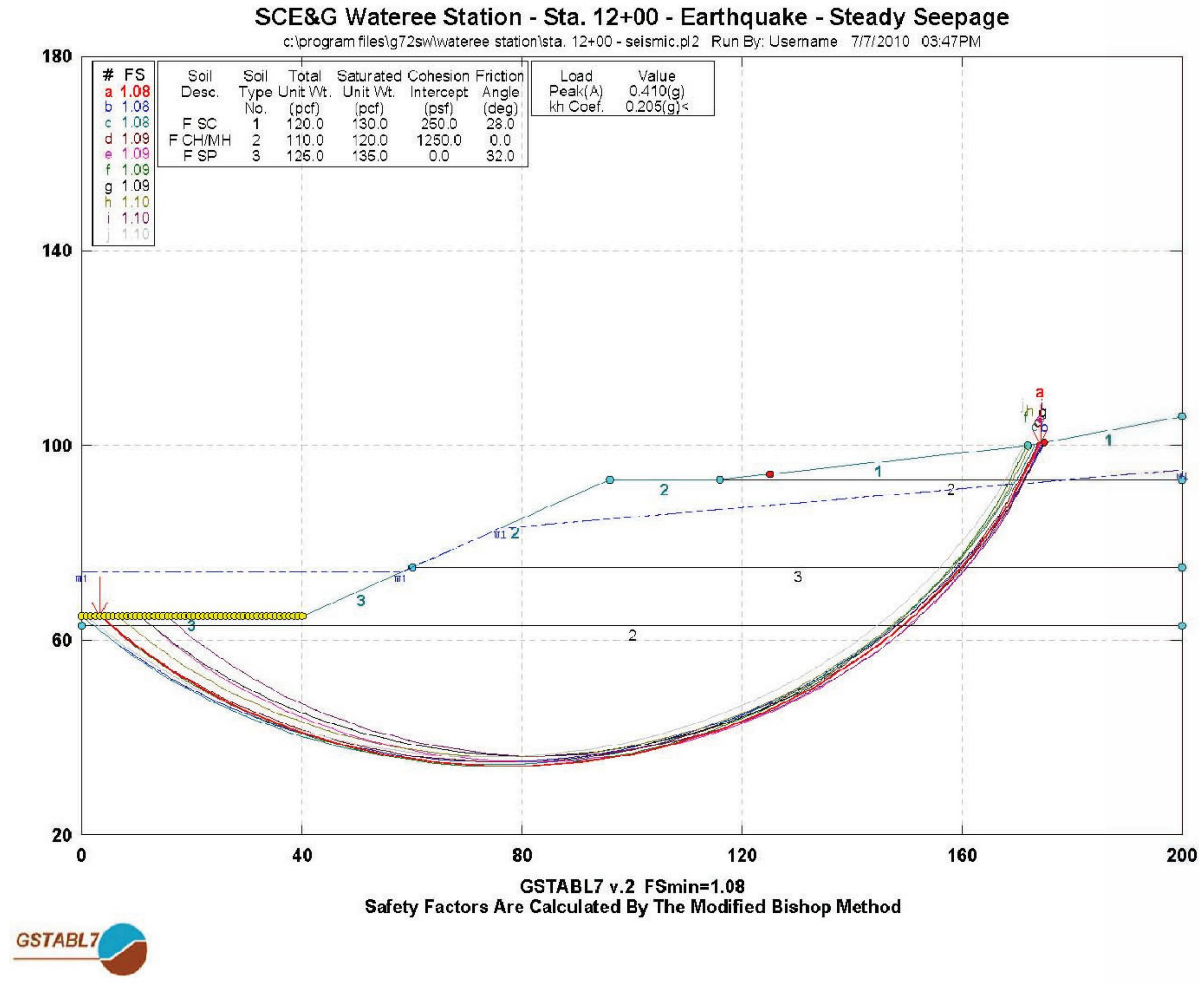
DATE: April 27, 2010

PROJECT NAME:
Wateree Station
Ash Pond
Containment
Structure
Evaluation

DRAWING NAME:
ANALYSIS
SECTION 1
100' Right Section
Along Stationing

DRAWING NUMBER:
FIGURE 2





c:\program files\g72sw\wateree station\sta. 12+00 - seismic.pl2 Run By: Username 7/7/2010 03:47PM

#	FS
a	1.08
b	1.08
c	1.08
d	1.09
e	1.09
f	1.09
g	1.09
h	1.10
i	1.10
j	1.10

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
F SC	1	120.0	130.0	250.0	28.0
F CH/MH	2	110.0	120.0	1250.0	0.0
F SP	3	125.0	135.0	0.0	32.0

Load	Value
Peak(A)	0.410(g)
kh Coef.	0.205(g)<

GSTABL7 v.2 FSmin=1.08
Safety Factors Are Calculated By The Modified Bishop Method

SCE&G A SCANA COMPANY

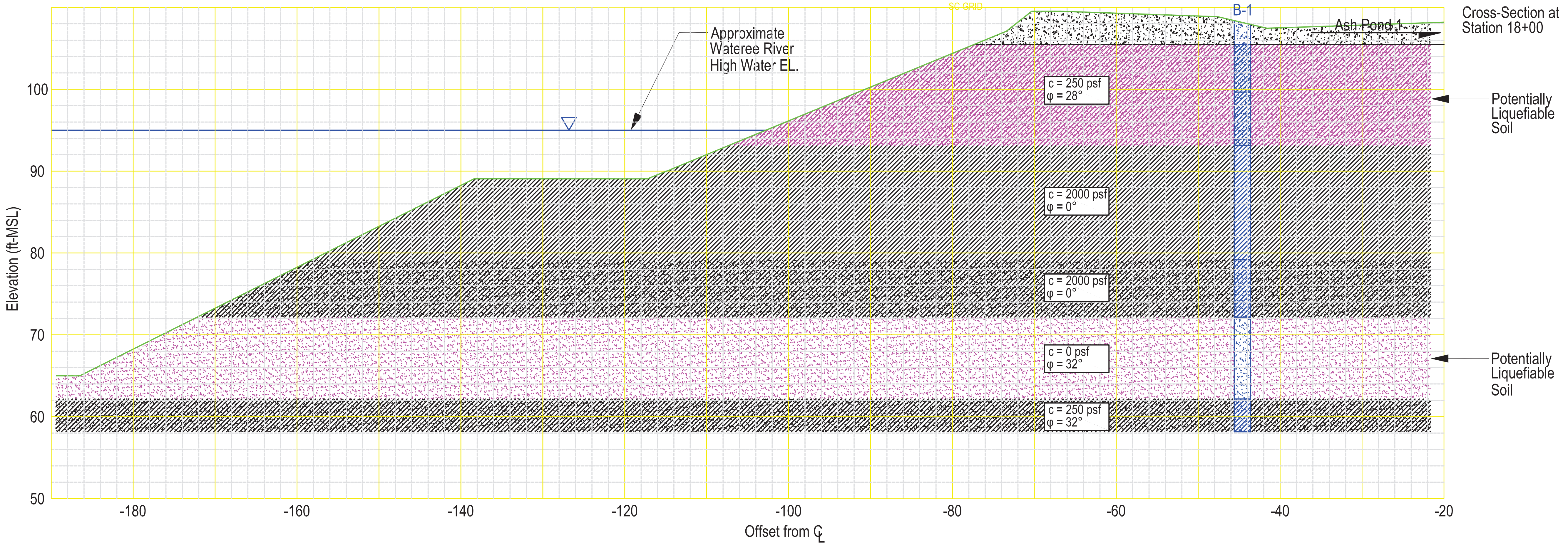
F&ME
CONSULTANTS
GEOTECHNICAL · ENVIRONMENTAL · MATERIALS
COLUMBIA, SOUTH CAROLINA

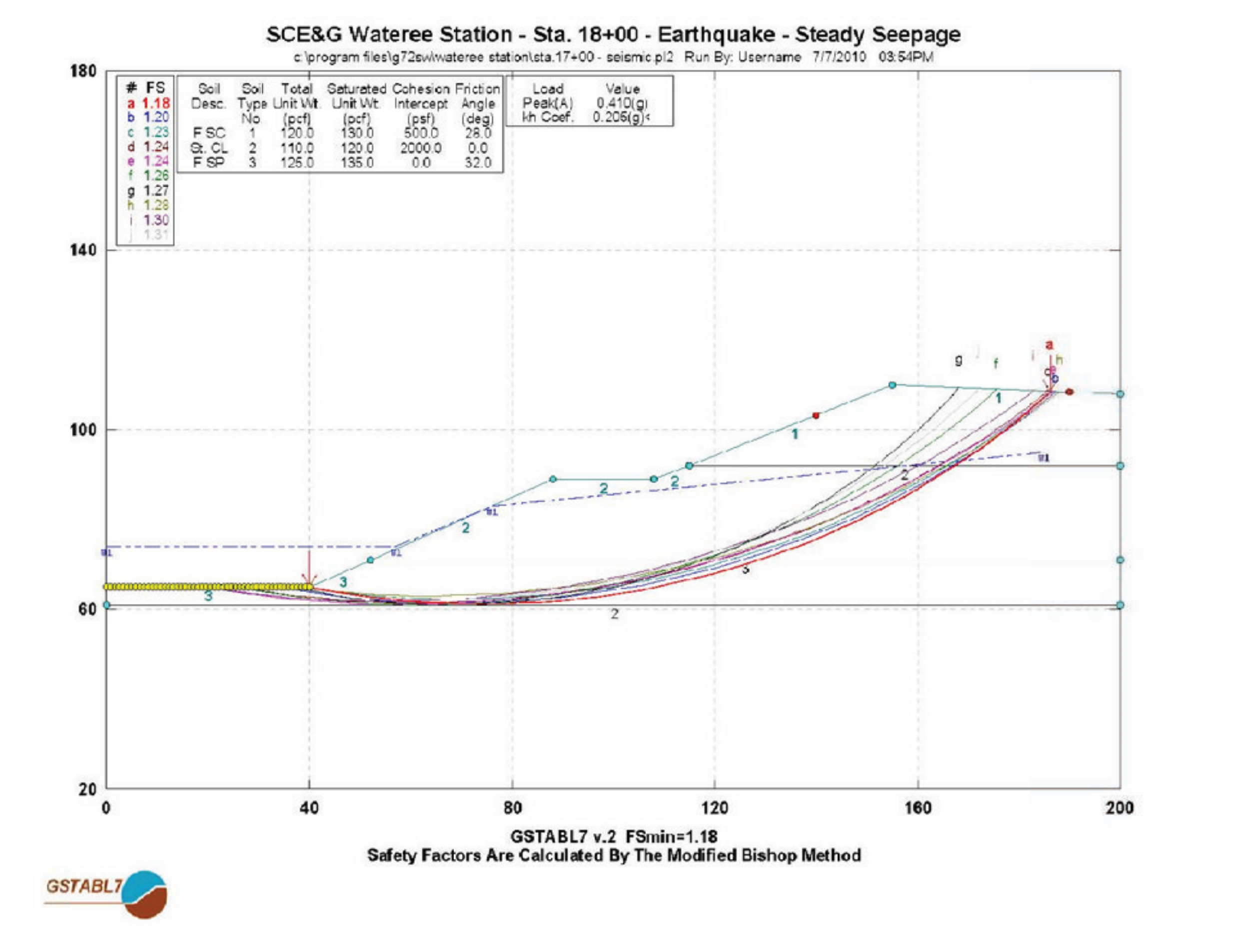
SEAL NOT VALID UNLESS SIGNED

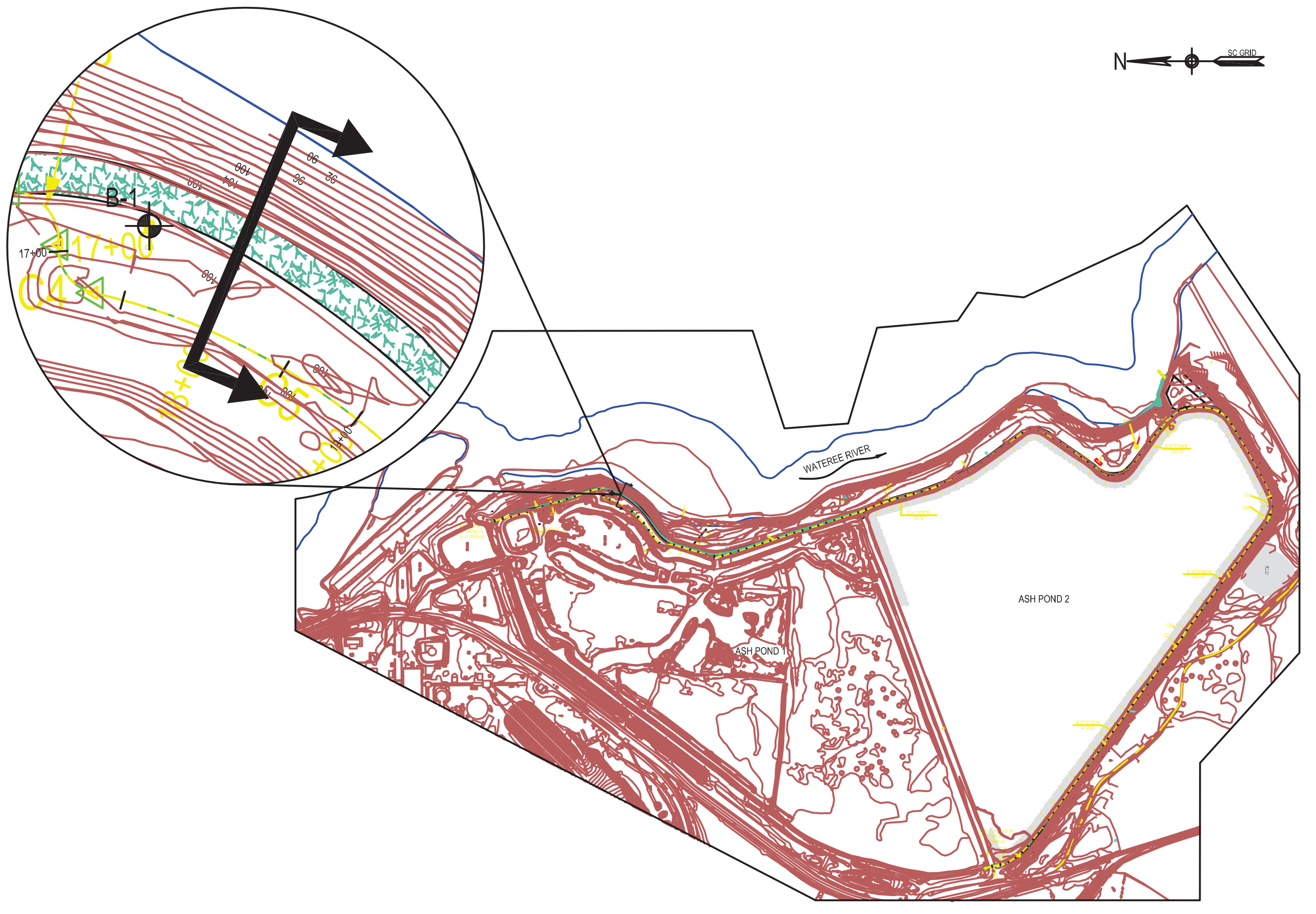
REVISIONS

NO.	DESCRIPTION	DATE	BY

SCALE: NONE
NOTES:
DRAWN BY: WJG
CHECKED BY: JRW
APPROVED BY: ZWA
DATE: April 27, 2010
PROJECT NAME:
Wateree Station Ash Pond Containment Structure Evaluation
DRAWING NAME:
ANALYSIS SECTION 2 STATION 12+00
DRAWING NUMBER:
FIGURE 3







SEAL NOT VALID UNLESS SIGNED

REVISIONS

NO.	DESCRIPTION	DATE	BY

SCALE: NONE

NOTES:

DRAWN BY: WJG

CHECKED BY: JRW

APPROVED BY: ZWA

DATE: April 27, 2010

PROJECT NAME:

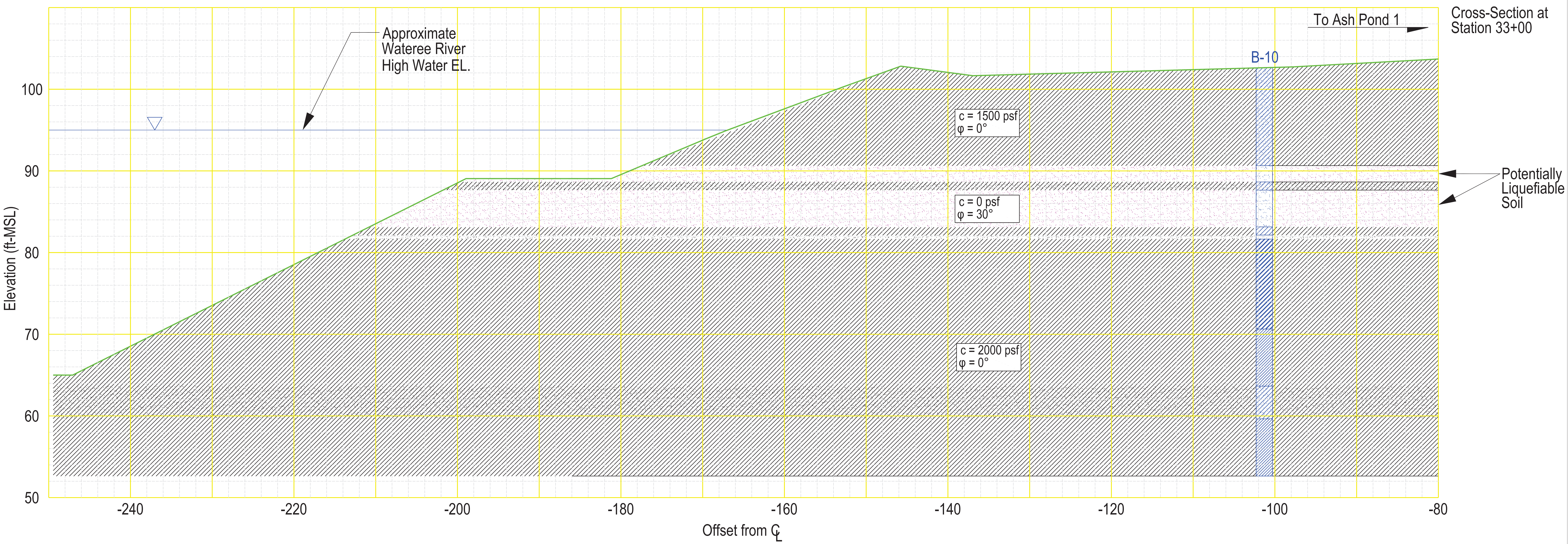
Wateree Station Ash Pond Containment Structure Evaluation

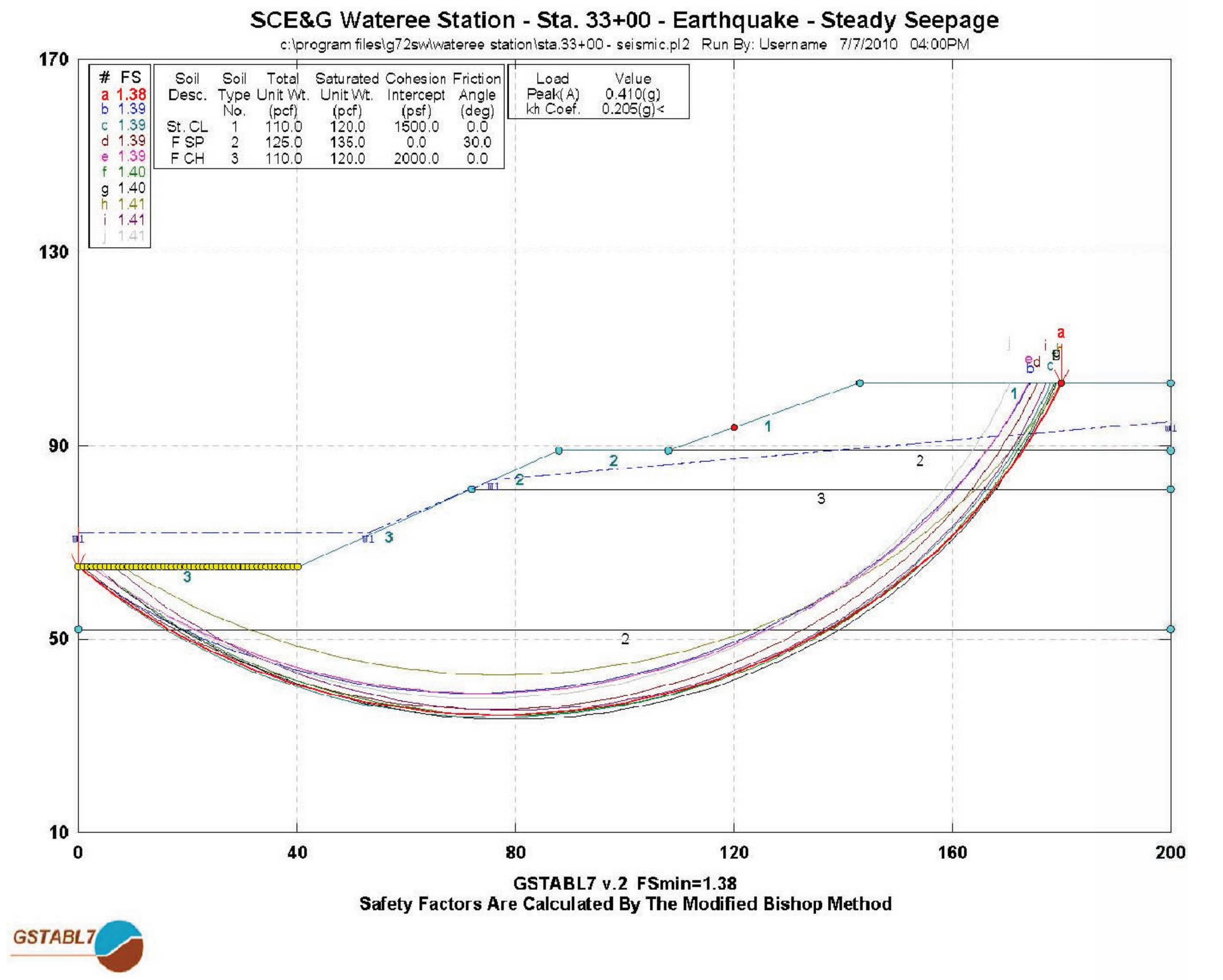
DRAWING NAME:

ANALYSIS SECTION 3 STATION 18+00

DRAWING NUMBER:

FIGURE 4





Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
St. CL	1	110.0	120.0	1500.0	0.0
F SP	2	125.0	135.0	0.0	30.0
F CH	3	110.0	120.0	2000.0	0.0

SCE&G
A SCANA COMPANY

F&ME
CONSULTANTS
GEOTECHNICAL · ENVIRONMENTAL · MATERIALS
COLUMBIA, SOUTH CAROLINA

SEAL NOT VALID UNLESS SIGNED

REVISIONS

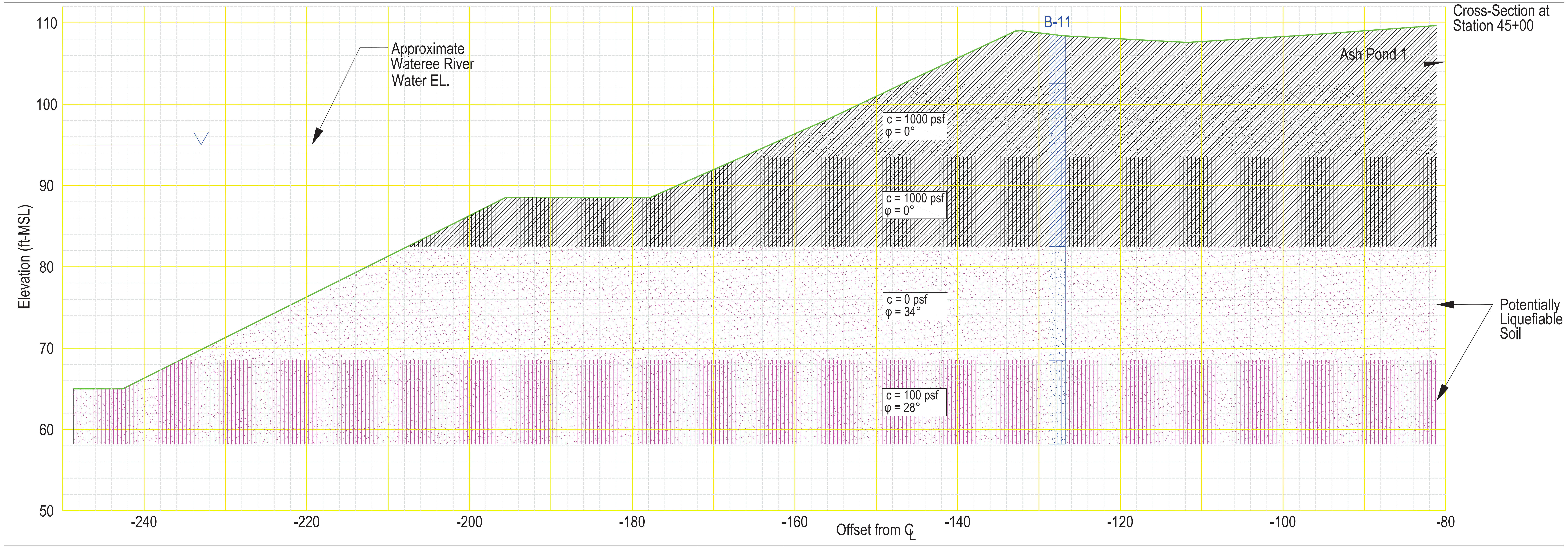
NO.	DESCRIPTION	DATE	BY

SCALE: NONE
NOTES:
DRAWN BY: WJG
CHECKED BY: JRW
APPROVED BY: ZWA
DATE: April 27, 2010

PROJECT NAME:
**Wateree Station
Ash Pond
Containment
Structure
Evaluation**

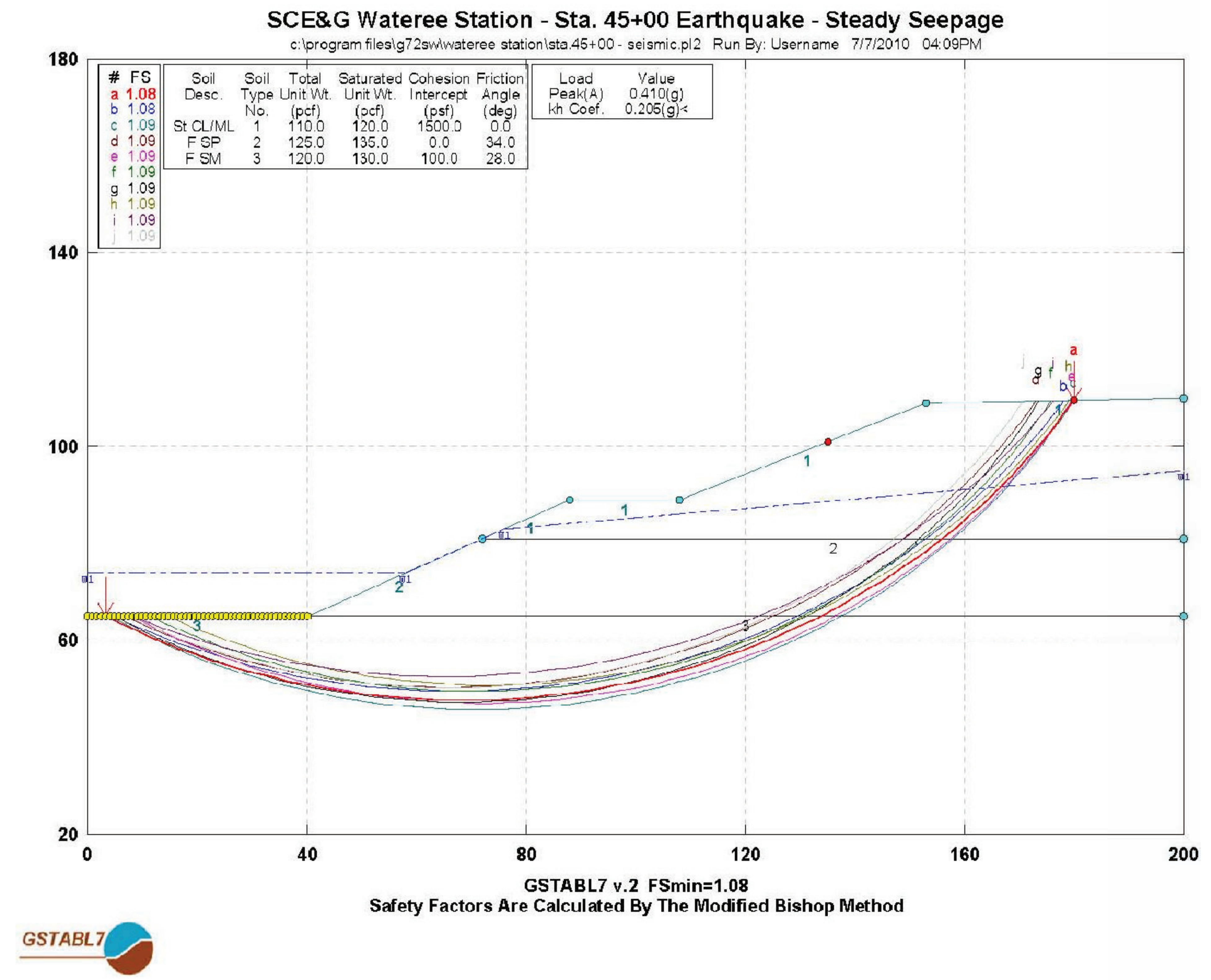
DRAWING NAME:
**ANALYSIS
SECTION 4
STATION 33+00**

DRAWING NUMBER:
FIGURE 5



SCE&G Wateree Station - Sta. 45+00 Earthquake - Steady Seepage

c:\program files\g72sw\wateree station\sta.45+00 - seismic.pl2 Run By: Username 7/7/2010 04:09PM



#	FS
a	1.08
b	1.08
c	1.09
d	1.09
e	1.09
f	1.09
g	1.09
h	1.09
i	1.09
j	1.09

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
St CL/ML	1	110.0	120.0	1500.0	0.0
F SP	2	125.0	135.0	0.0	34.0
F SM	3	120.0	130.0	100.0	28.0

Load	Value
Peak(A)	0.410(g)
kh Coef.	0.205(g)<

GSTABL7 v.2 FSmin=1.08
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

SCE&G
A SCANA COMPANY

F&ME
CONSULTANTS
GEOTECHNICAL · ENVIRONMENTAL · MATERIALS
COLUMBIA, SOUTH CAROLINA

SEAL NOT VALID UNLESS SIGNED

REVISIONS

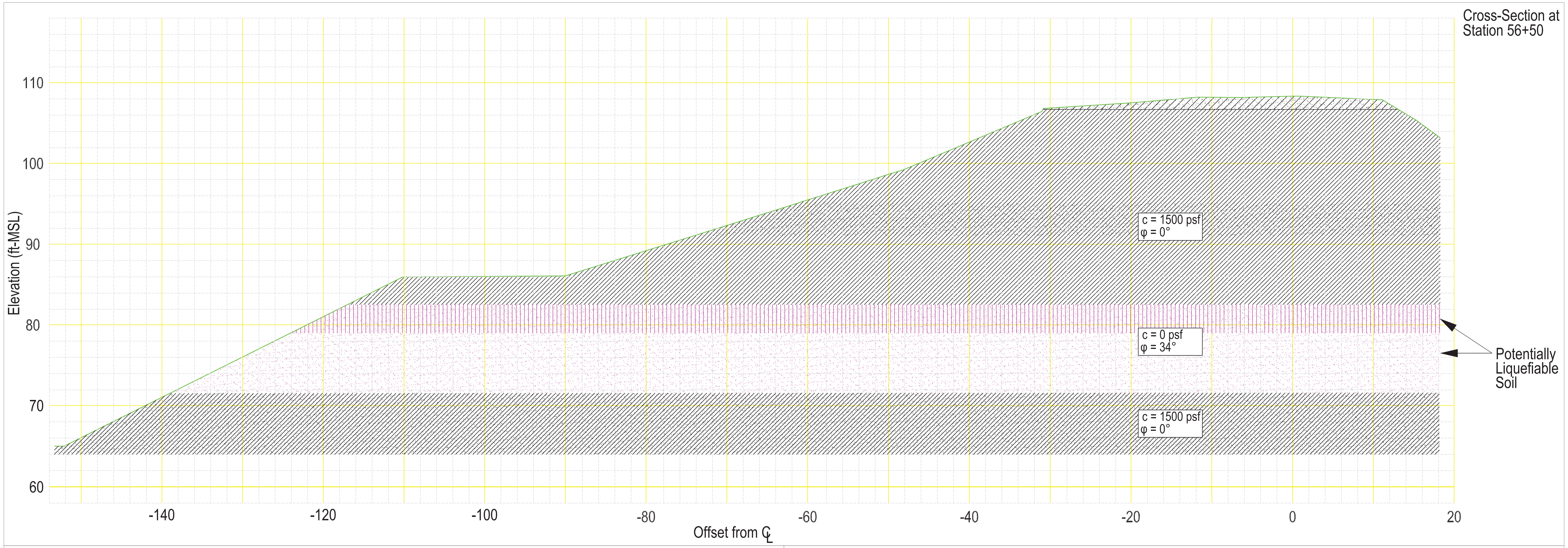
NO.	DESCRIPTION	DATE	BY

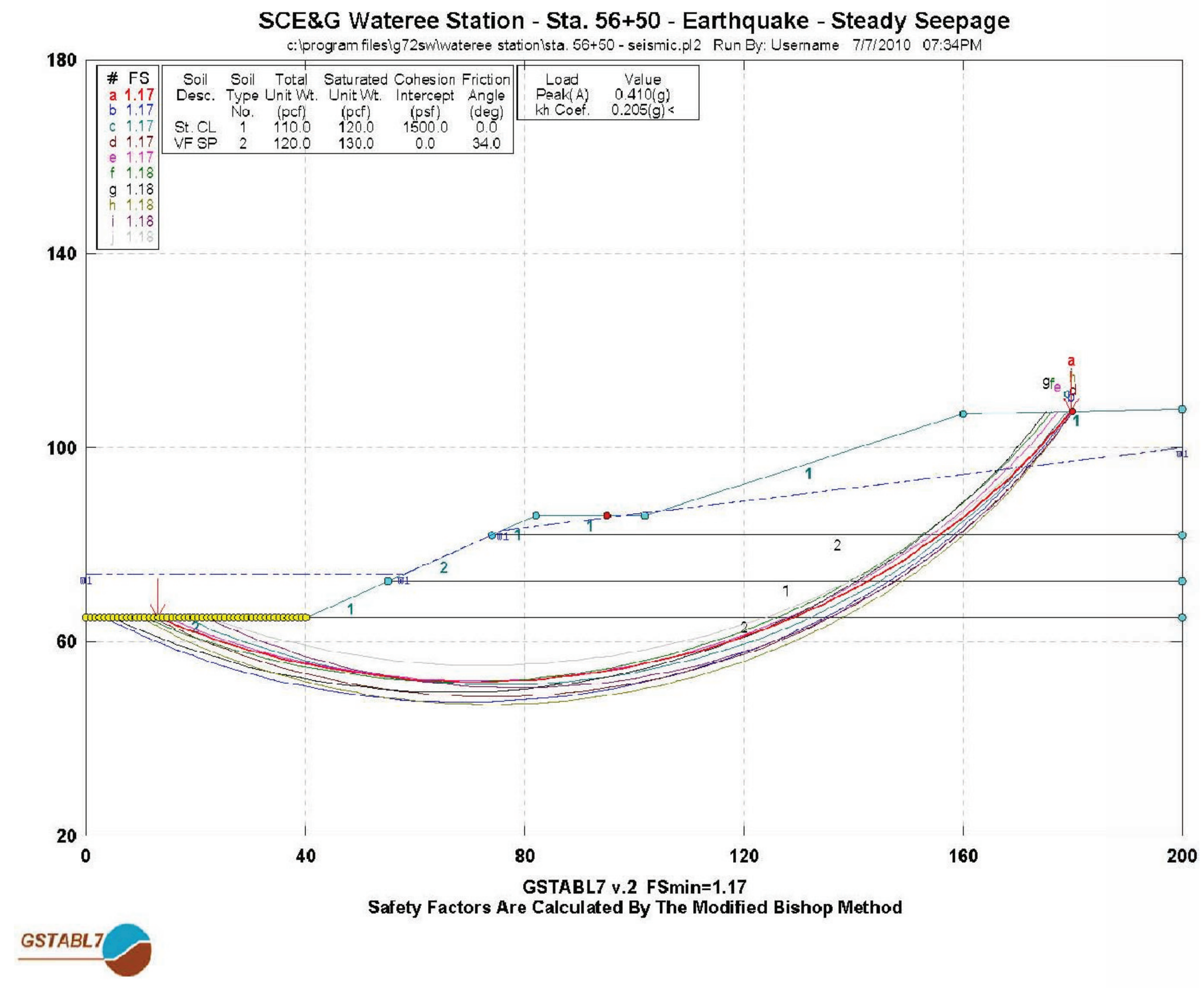
SCALE: NONE
NOTES:
DRAWN BY: WJG
CHECKED BY: JRW
APPROVED BY: ZWA
DATE: April 27, 2010

PROJECT NAME:
Wateree Station
Ash Pond
Containment
Structure
Evaluation

DRAWING NAME:
ANALYSIS
SECTION 5
STATION 45+00

DRAWING NUMBER:
FIGURE 6




SCE&G Wateree Station - Sta. 56+50 - Earthquake - Steady Seepage

c:\program files\g72sw\wateree station\sta. 56+50 - seismic.pl2 Run By: Username 7/7/2010 07:34PM

#	FS
a	1.17
b	1.17
c	1.17
d	1.17
e	1.17
f	1.18
g	1.18
h	1.18
i	1.18
j	1.18

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
St. CL	1	110.0	120.0	1500.0	0.0
VF SP	2	120.0	130.0	0.0	34.0

Load	Value
Peak(A)	0.410(g)
kh Coef.	0.205(g) <

GSTABL7 v.2 FSmin=1.17
Safety Factors Are Calculated By The Modified Bishop Method

SCE&G
A SCANA COMPANY

F&ME
CONSULTANTS
GEOTECHNICAL · ENVIRONMENTAL · MATERIALS
COLUMBIA, SOUTH CAROLINA

SEAL NOT VALID UNLESS SIGNED

REVISIONS

NO.	DESCRIPTION	DATE	BY

SCALE:
NONE

NOTES:

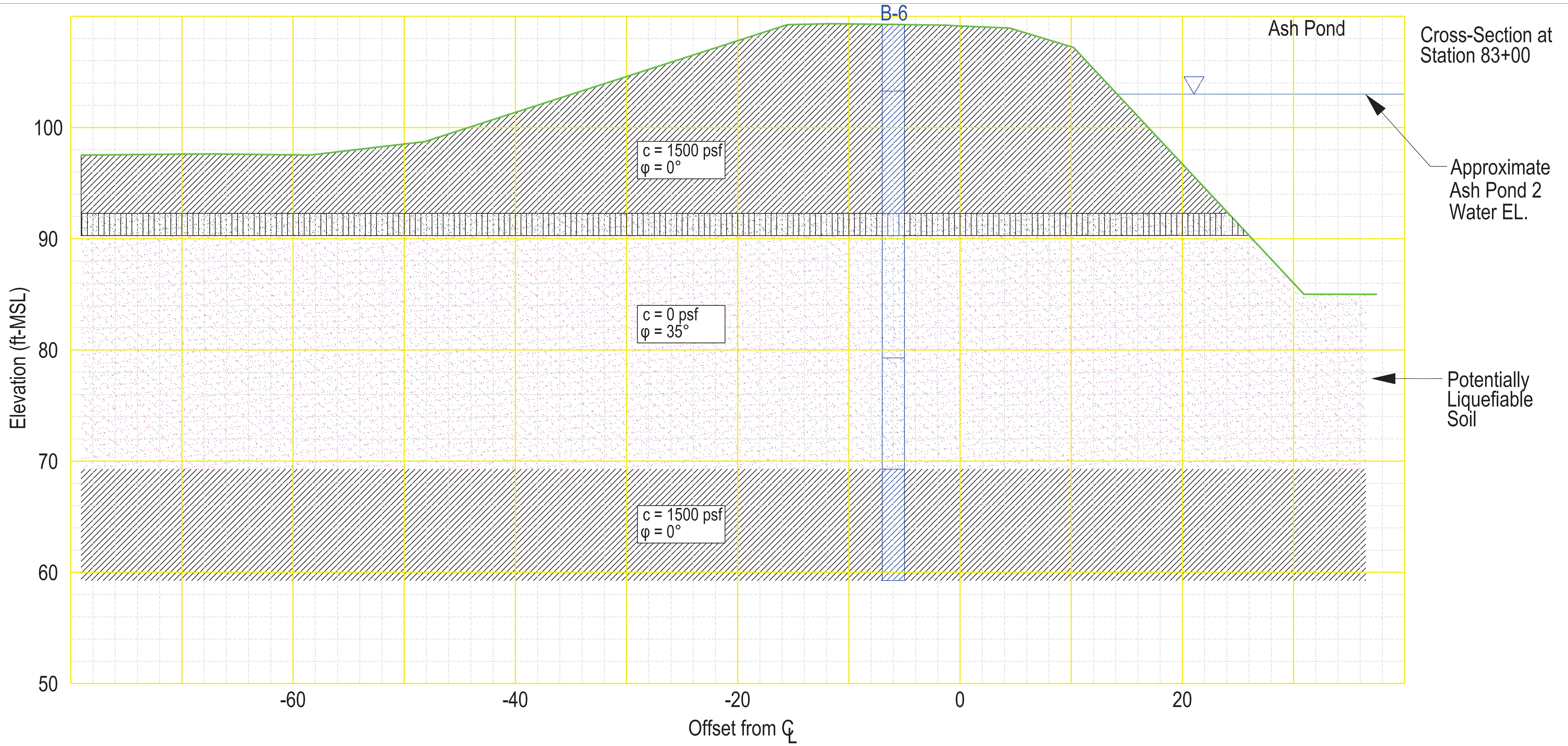
DRAWN BY: WJG
CHECKED BY: JRW
APPROVED BY: ZWA

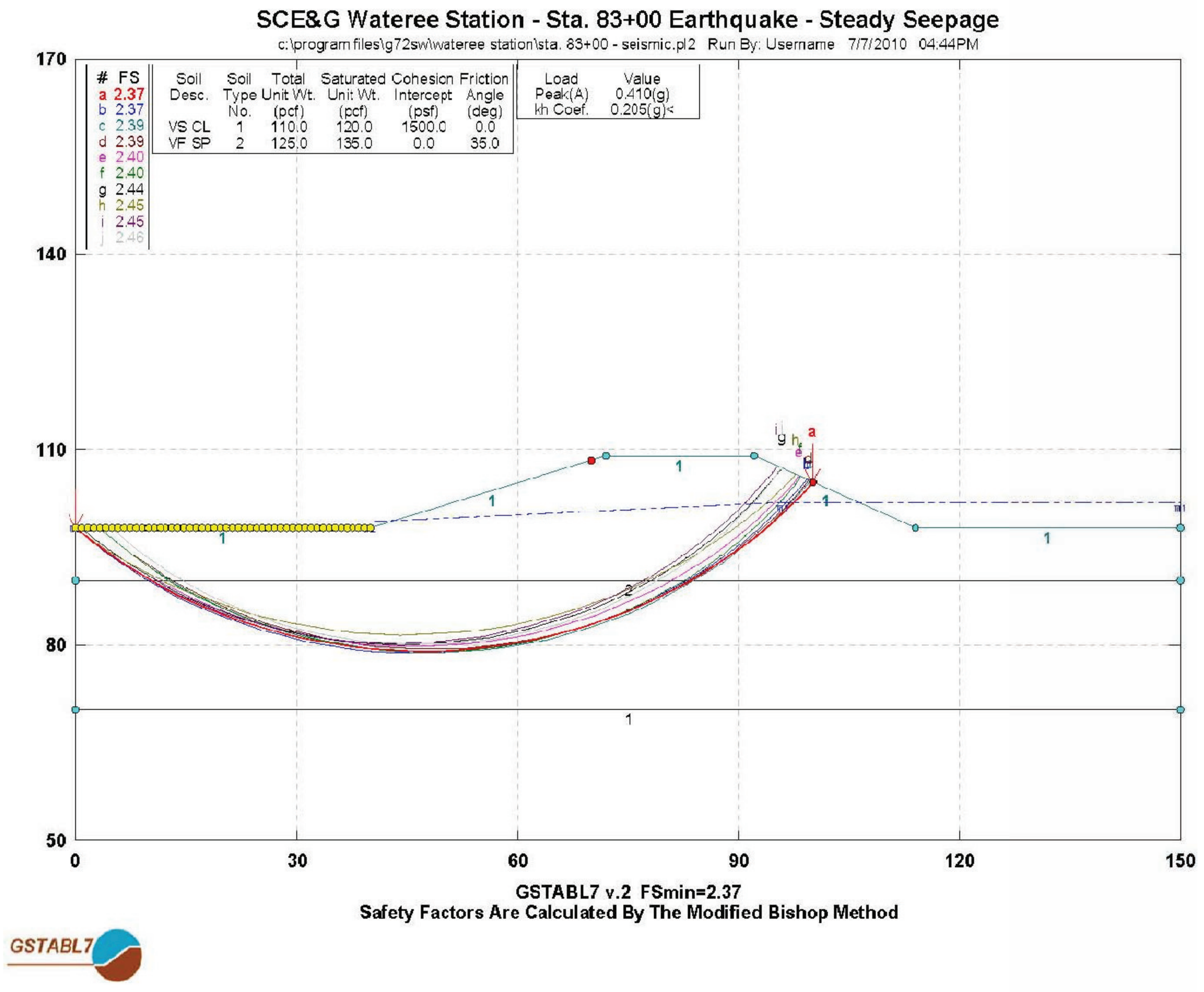
DATE:
April 27, 2010

PROJECT NAME:
**Wateree Station
Ash Pond
Containment
Structure
Evaluation**

DRAWING NAME:
**ANALYSIS
SECTION 6
STATION 56+50**

DRAWING NUMBER:
FIGURE 7





SCE&G
A SCANA COMPANY

F&ME
CONSULTANTS
GEOTECHNICAL · ENVIRONMENTAL · MATERIALS
COLUMBIA, SOUTH CAROLINA

SEAL NOT VALID UNLESS SIGNED

REVISIONS

NO.	DESCRIPTION	DATE	BY

SCALE: NONE
NOTES:

DRAWN BY: WJG
CHECKED BY: JRW
APPROVED BY: ZWA

DATE: April 27, 2010

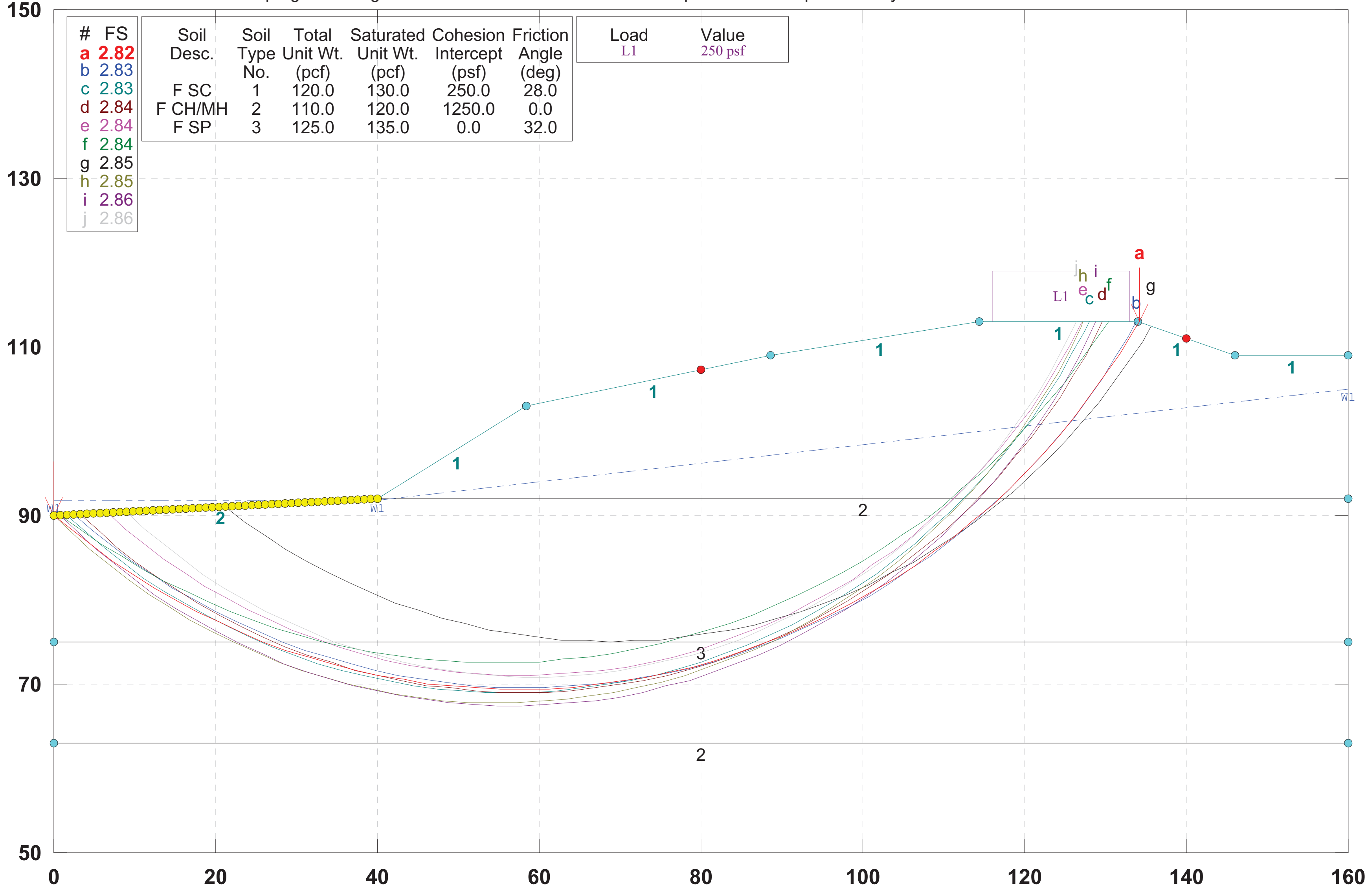
PROJECT NAME:
**Wateree Station
Ash Pond
Containment
Structure
Evaluation**

DRAWING NAME:
**ANALYSIS
SECTION 7
STATION 83+00**

DRAWING NUMBER:
FIGURE 8

SCE&G Wateree Station - Sta. 9+30 - 10+90-Max. Storage Pool - Steady Seepage

c:\program files\g72sw\wateree station\sta.9+30 - 10+90 profile- seismic.pl2 Run By: Username 7/8/2010 11:30AM



#	FS
a	2.82
b	2.83
c	2.83
d	2.84
e	2.84
f	2.84
g	2.85
h	2.85
i	2.86
j	2.86

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
F SC	1	120.0	130.0	250.0	28.0
F CH/MH	2	110.0	120.0	1250.0	0.0
F SP	3	125.0	135.0	0.0	32.0

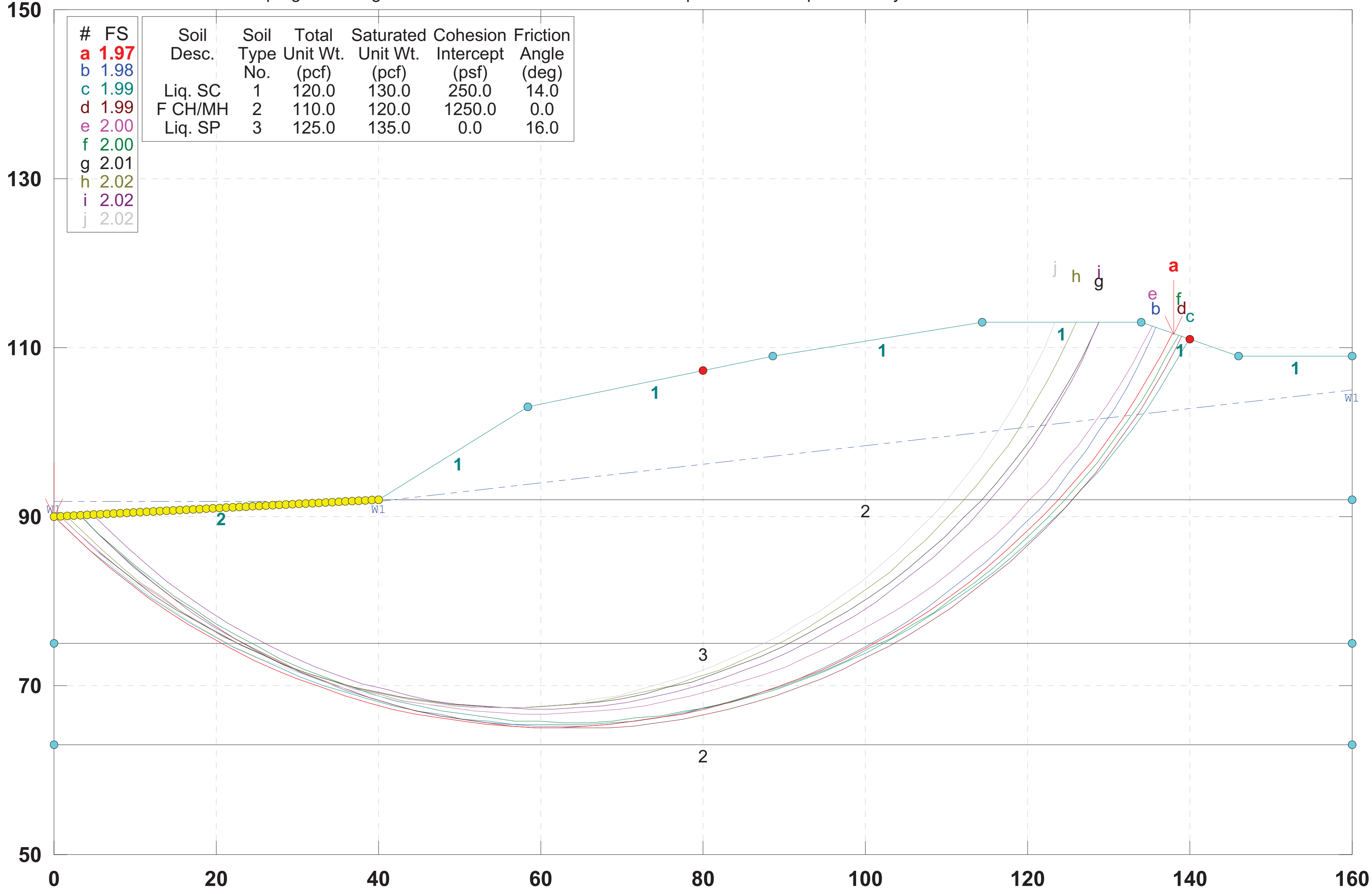
Load	Value
L1	250 psf

GSTABL7 v.2 FSmin=2.82

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 9+30 - 10+90 - Liquefaction - Steady Seepage

c:\program files\g72sw\wateree station\sta.9+30 - 10+90 profile- seismic.pl2   Run By: Username   7/8/2010   11:30AM



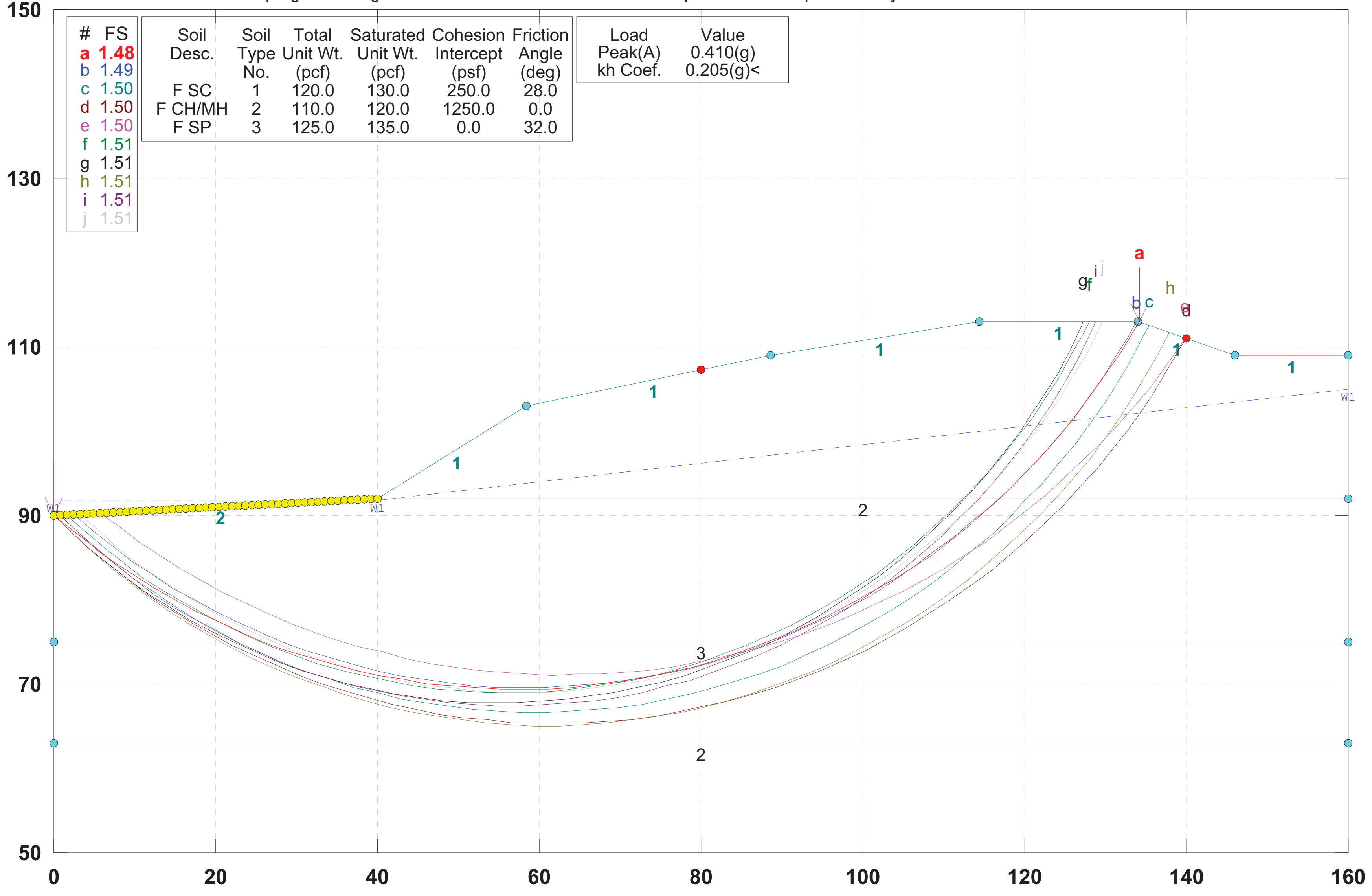
#	FS
a	1.97
b	1.98
c	1.99
d	1.99
e	2.00
f	2.00
g	2.01
h	2.02
i	2.02
j	2.02

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
Liq. SC	1	120.0	130.0	250.0	14.0
F CH/MH	2	110.0	120.0	1250.0	0.0
Liq. SP	3	125.0	135.0	0.0	16.0

GSTABL7 v.2 FSmin=1.97
Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 9+30 - 10+90 - Earthquake - Steady Seepage

c:\program files\g72sw\wateree station\sta.9+30 - 10+90 profile- seismic.pl2   Run By: Username   7/8/2010   11:29AM



#	FS
a	1.48
b	1.49
c	1.50
d	1.50
e	1.50
f	1.51
g	1.51
h	1.51
i	1.51
j	1.51

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
F SC	1	120.0	130.0	250.0	28.0
F CH/MH	2	110.0	120.0	1250.0	0.0
F SP	3	125.0	135.0	0.0	32.0

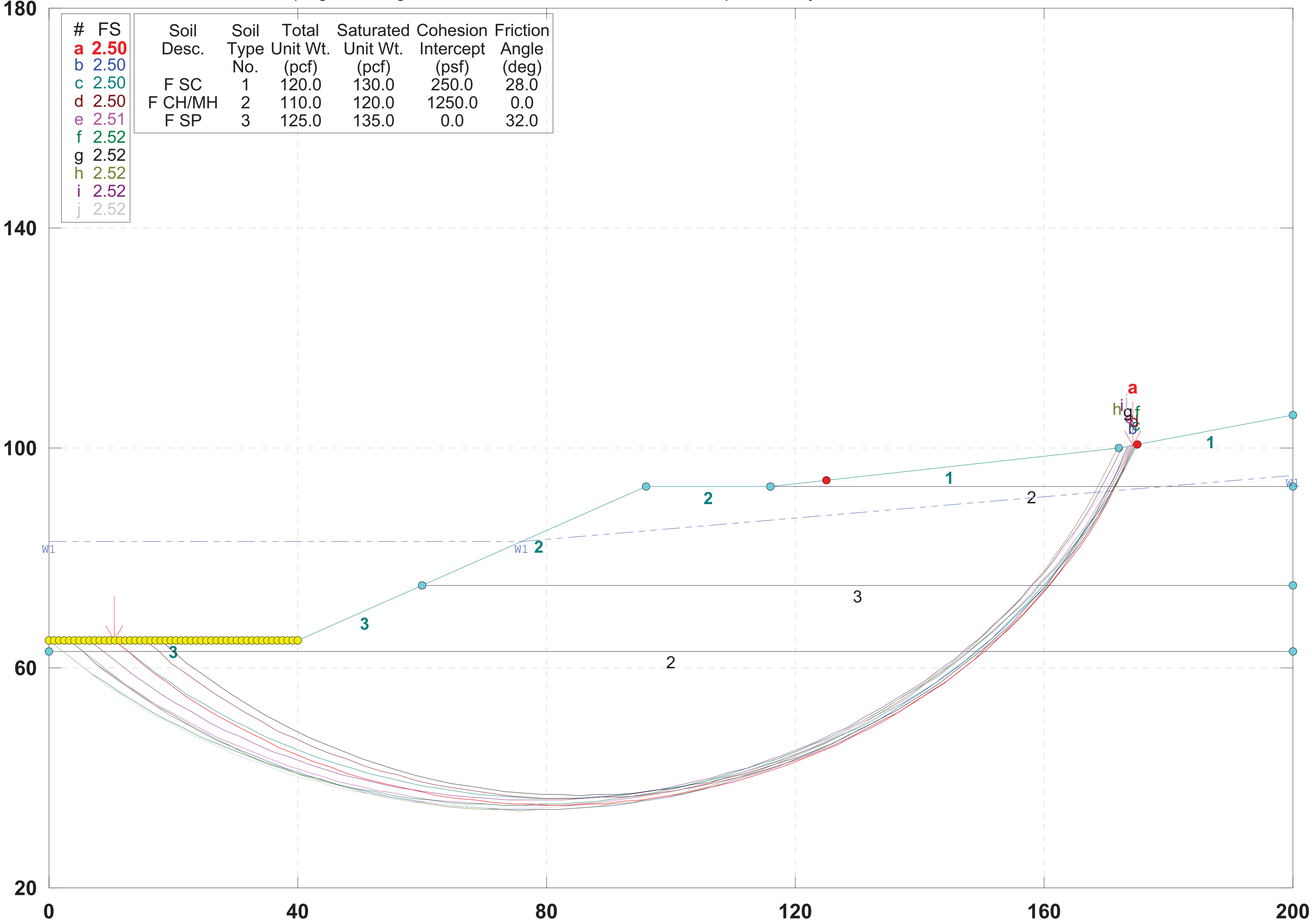
Load	Value
Peak(A)	0.410(g)
kh Coef.	0.205(g)<

GSTABL7 v.2 FSmin=1.48

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 12+00 - Max. Storage Pool - Steady Seepage

c:\program files\g72sw\wateree station\sta. 12+00 - seismic.pl2 Run By: Username 7/7/2010 06:45PM



#	FS
a	2.50
b	2.50
c	2.50
d	2.50
e	2.51
f	2.52
g	2.52
h	2.52
i	2.52
j	2.52

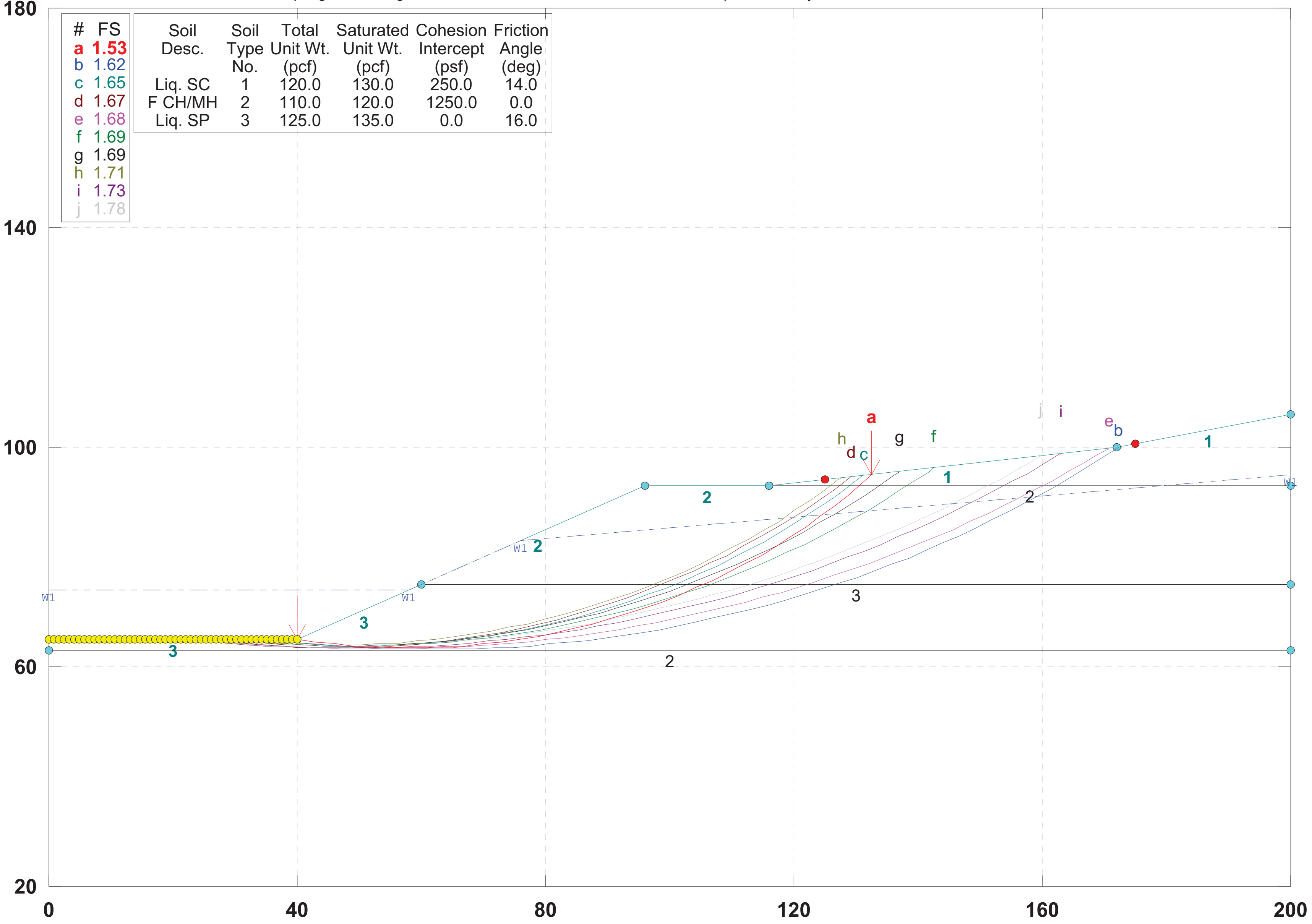
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
F SC	1	120.0	130.0	250.0	28.0
F CH/MH	2	110.0	120.0	1250.0	0.0
F SP	3	125.0	135.0	0.0	32.0

GSTABL7 v.2 FSmin=2.50

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 12+00 - Liquefaction - Steady Seepage

c:\program files\g72sw\wateree station\sta. 12+00 - seismic.pl2   Run By: Username   7/7/2010   06:43PM



#	FS
a	1.53
b	1.62
c	1.65
d	1.67
e	1.68
f	1.69
g	1.69
h	1.71
i	1.73
j	1.78

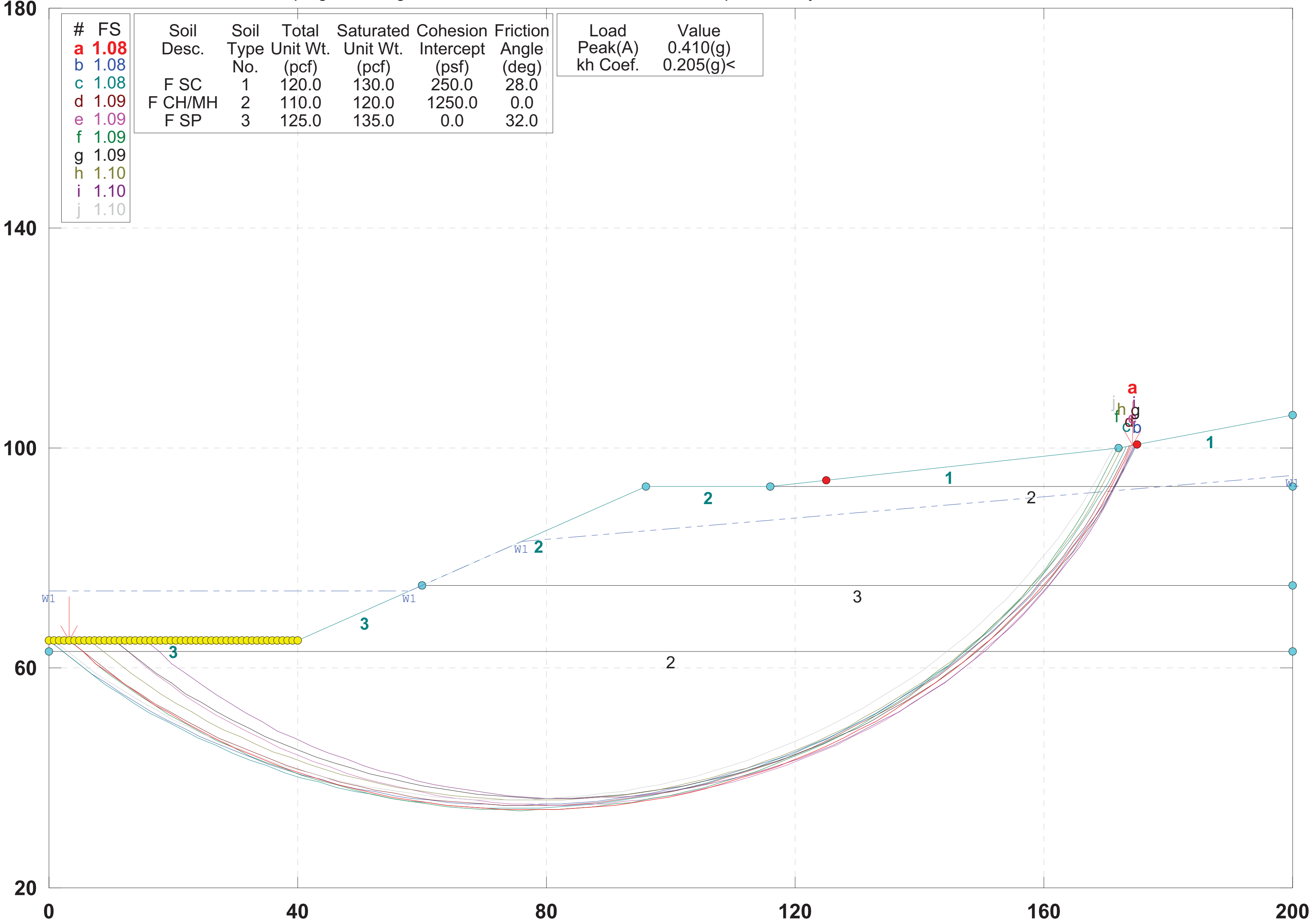
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
Liq. SC	1	120.0	130.0	250.0	14.0
F CH/MH	2	110.0	120.0	1250.0	0.0
Liq. SP	3	125.0	135.0	0.0	16.0

GSTABL7 v.2 FSmin=1.53

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 12+00 - Earthquake - Steady Seepage

c:\program files\g72sw\wateree station\sta. 12+00 - seismic.pl2   Run By: Username   7/7/2010   03:47PM



#	FS
a	1.08
b	1.08
c	1.08
d	1.09
e	1.09
f	1.09
g	1.09
h	1.10
i	1.10
j	1.10

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
F SC	1	120.0	130.0	250.0	28.0
F CH/MH	2	110.0	120.0	1250.0	0.0
F SP	3	125.0	135.0	0.0	32.0

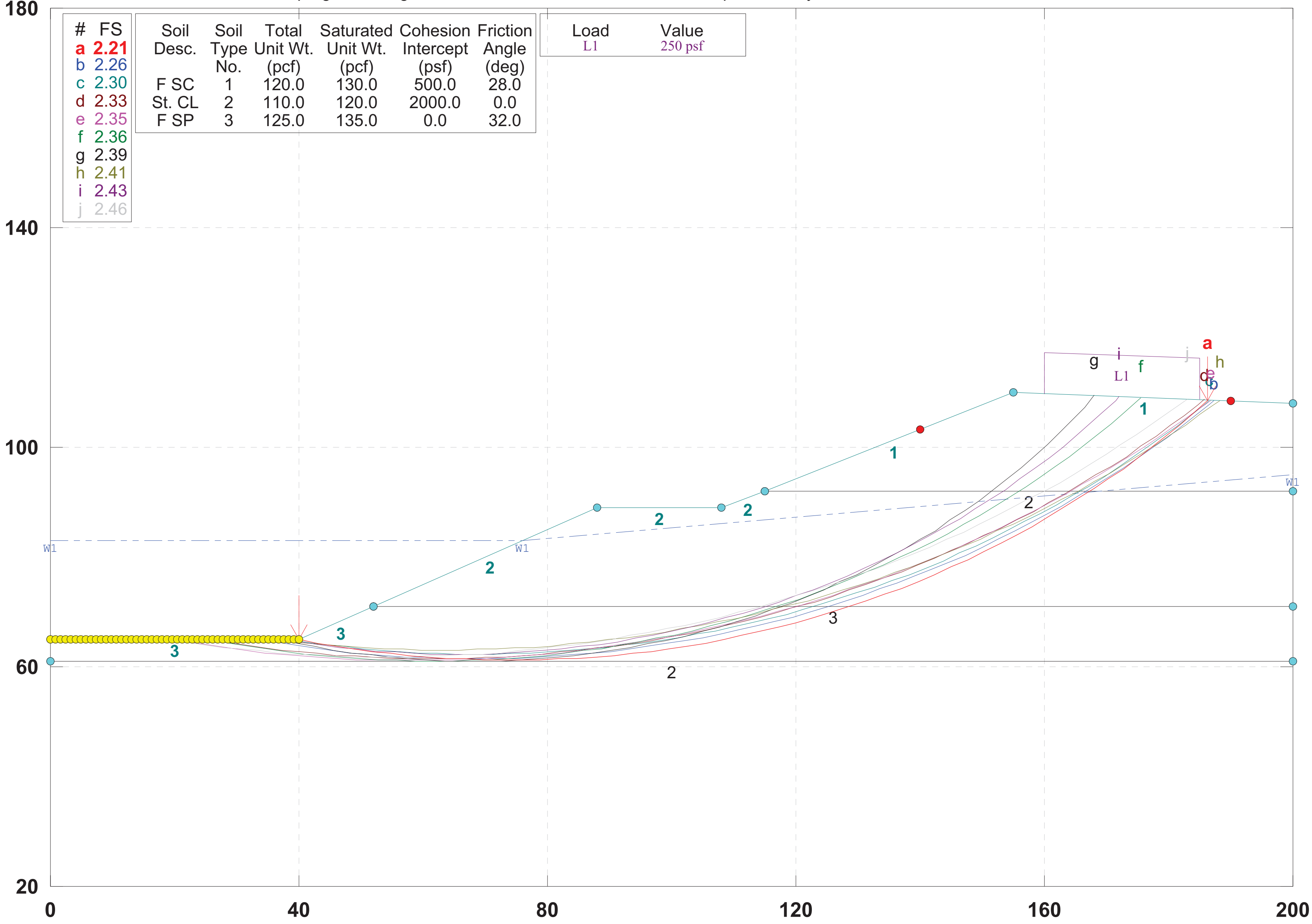
Load	Value
Peak(A)	0.410(g)
kh Coef.	0.205(g)<

GSTABL7 v.2 FSmin=1.08

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 18+00 - Max. Storage Pool - Steady Seepage

c:\program files\g72sw\wateree station\sta.17+00 - seismic.pl2 Run By: Username 7/7/2010 03:57PM



#	FS
a	2.21
b	2.26
c	2.30
d	2.33
e	2.35
f	2.36
g	2.39
h	2.41
i	2.43
j	2.46

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
F SC	1	120.0	130.0	500.0	28.0
St. CL	2	110.0	120.0	2000.0	0.0
F SP	3	125.0	135.0	0.0	32.0

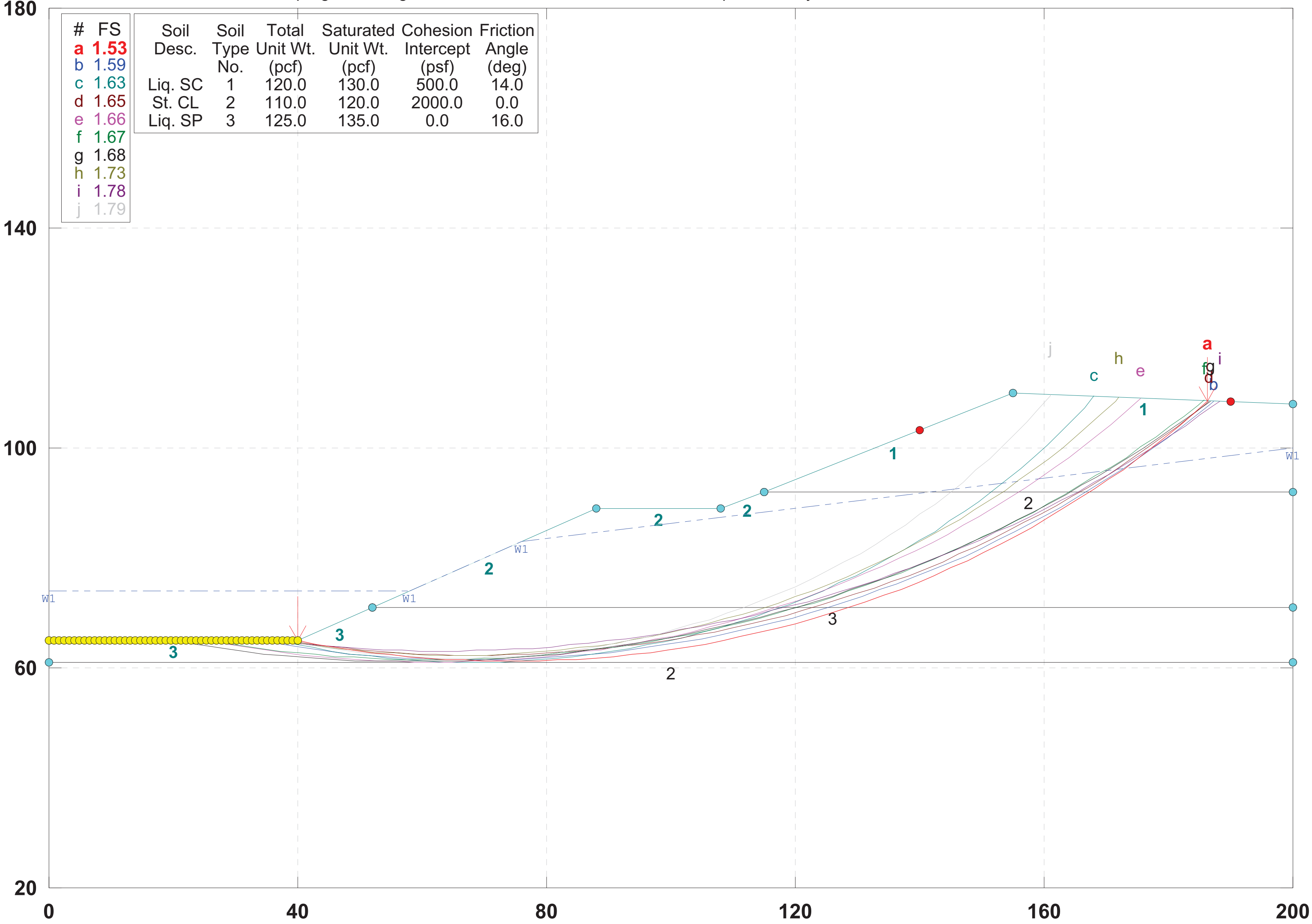
Load	Value
L1	250 psf

GSTABL7 v.2 FSmin=2.21

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 18+00 - Liquefaction - Steady Seepage

c:\program files\g72sw\wateree station\sta.17+00 - seismic.pl2 Run By: Username 7/7/2010 06:47PM



#	FS
a	1.53
b	1.59
c	1.63
d	1.65
e	1.66
f	1.67
g	1.68
h	1.73
i	1.78
j	1.79

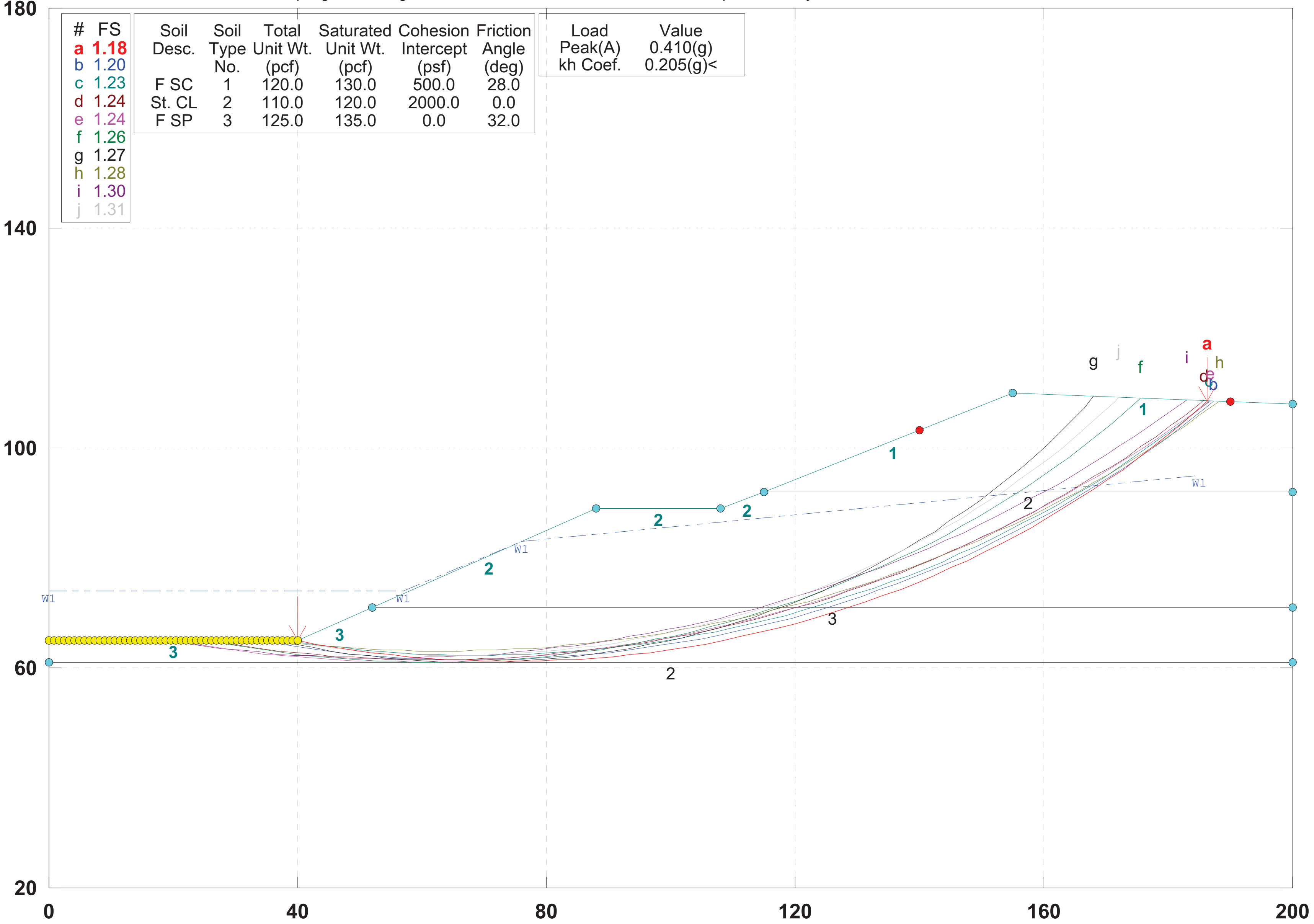
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
Liq. SC	1	120.0	130.0	500.0	14.0
St. CL	2	110.0	120.0	2000.0	0.0
Liq. SP	3	125.0	135.0	0.0	16.0

GSTABL7 v.2 FSmin=1.53

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 18+00 - Earthquake - Steady Seepage

c:\program files\g72sw\wateree station\sta.17+00 - seismic.pl2   Run By: Username   7/7/2010   03:54PM



#	FS
a	1.18
b	1.20
c	1.23
d	1.24
e	1.24
f	1.26
g	1.27
h	1.28
i	1.30
j	1.31

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
F SC	1	120.0	130.0	500.0	28.0
St. CL	2	110.0	120.0	2000.0	0.0
F SP	3	125.0	135.0	0.0	32.0

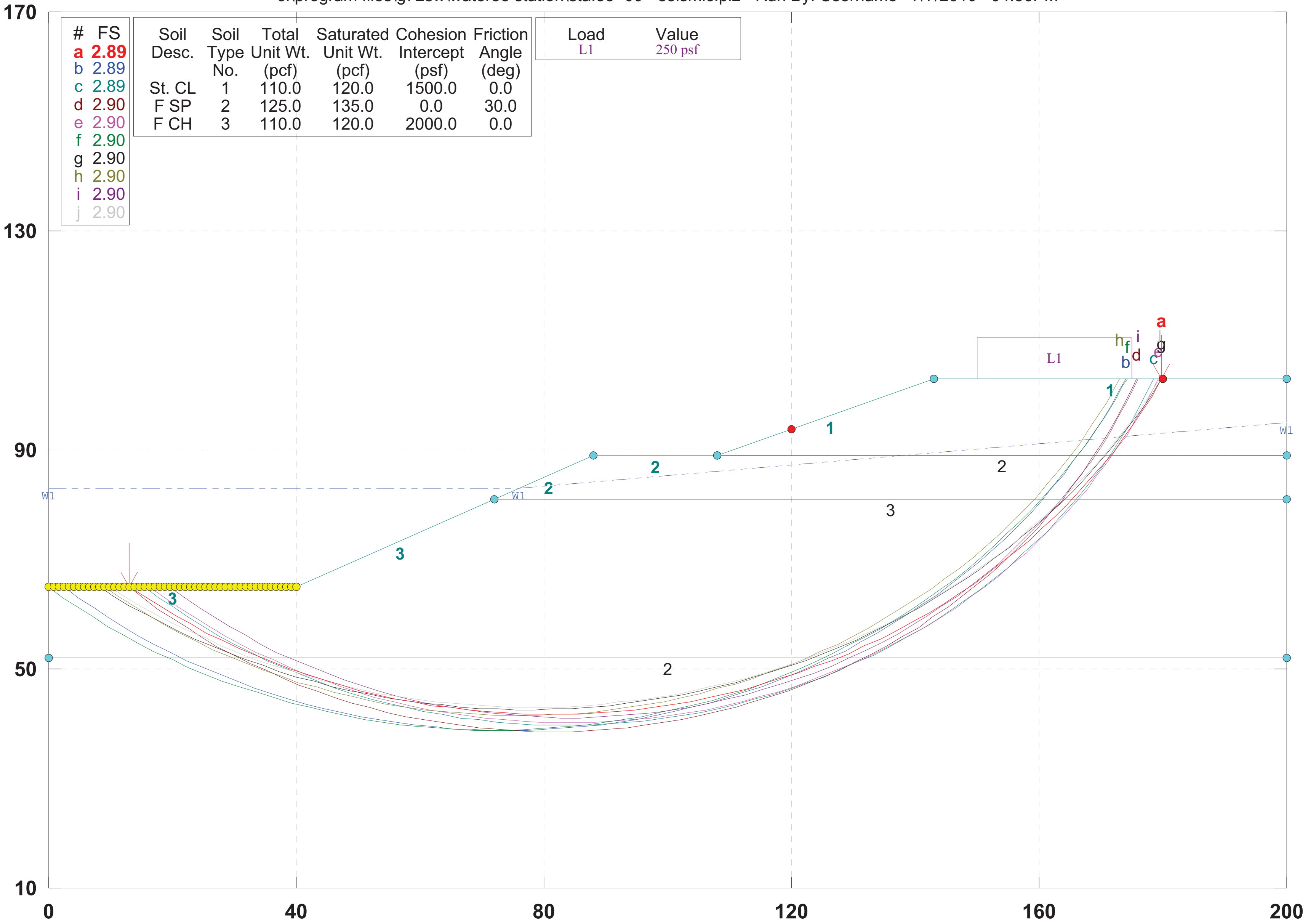
Load	Value
Peak(A)	0.410(g)
kh Coef.	0.205(g)<

GSTABL7 v.2 FSmin=1.18

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 33+00 - Max. Storage Pool - Steady Seepage

c:\program files\g72sw\wateree station\sta.33+00 - seismic.pl2   Run By: Username   7/7/2010   04:36PM



#	FS
a	2.89
b	2.89
c	2.89
d	2.90
e	2.90
f	2.90
g	2.90
h	2.90
i	2.90
j	2.90

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
St. CL	1	110.0	120.0	1500.0	0.0
F SP	2	125.0	135.0	0.0	30.0
F CH	3	110.0	120.0	2000.0	0.0

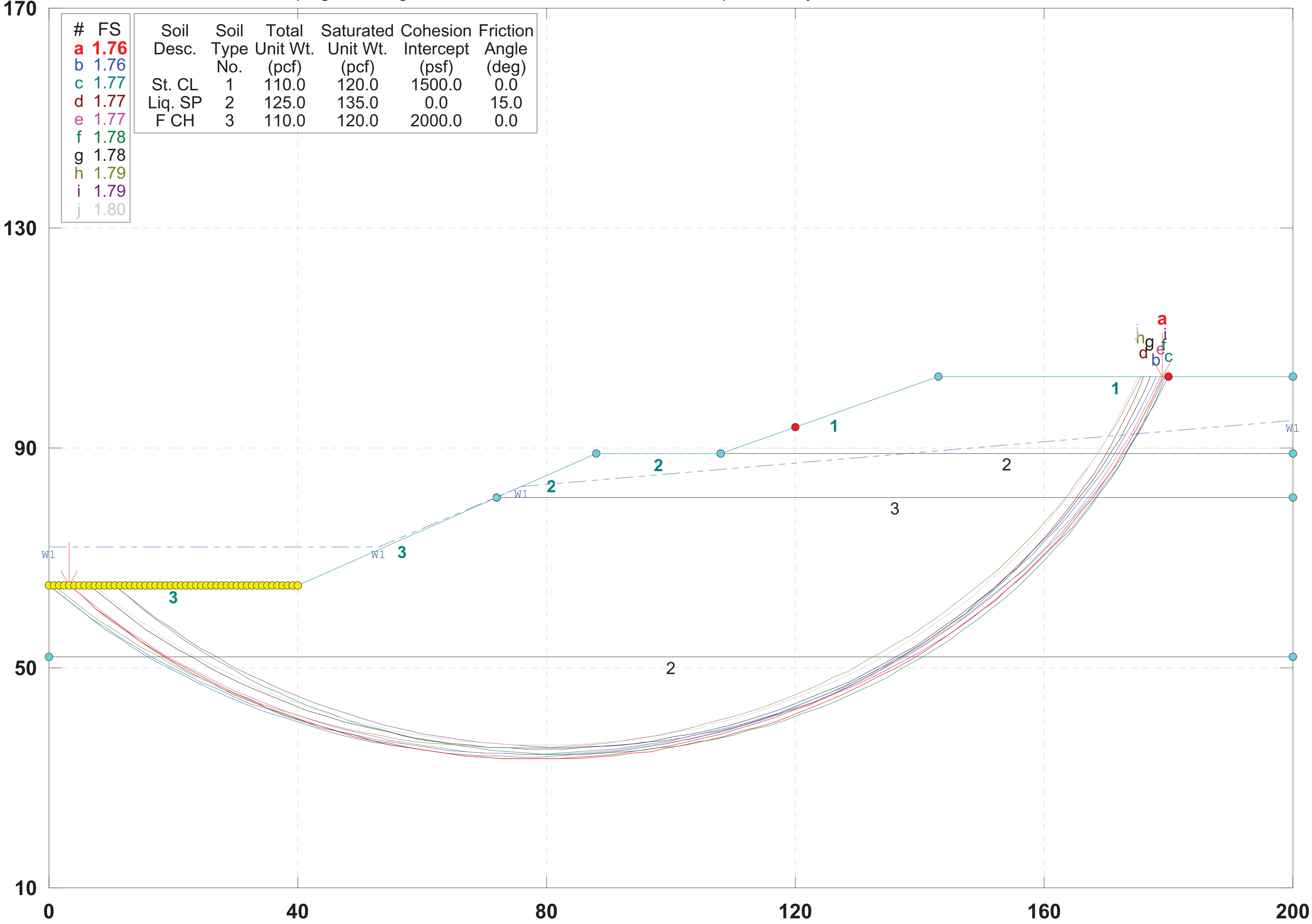
Load	Value
L1	250 psf

GSTABL7 v.2 FSmin=2.89

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 33+00 - Liquefaction - Steady Seepage

c:\program files\g72sw\wateree station\sta.33+00 - seismic.pl2   Run By: Username   7/7/2010   04:01PM



#	FS
a	1.76
b	1.76
c	1.77
d	1.77
e	1.77
f	1.78
g	1.78
h	1.79
i	1.79
j	1.80

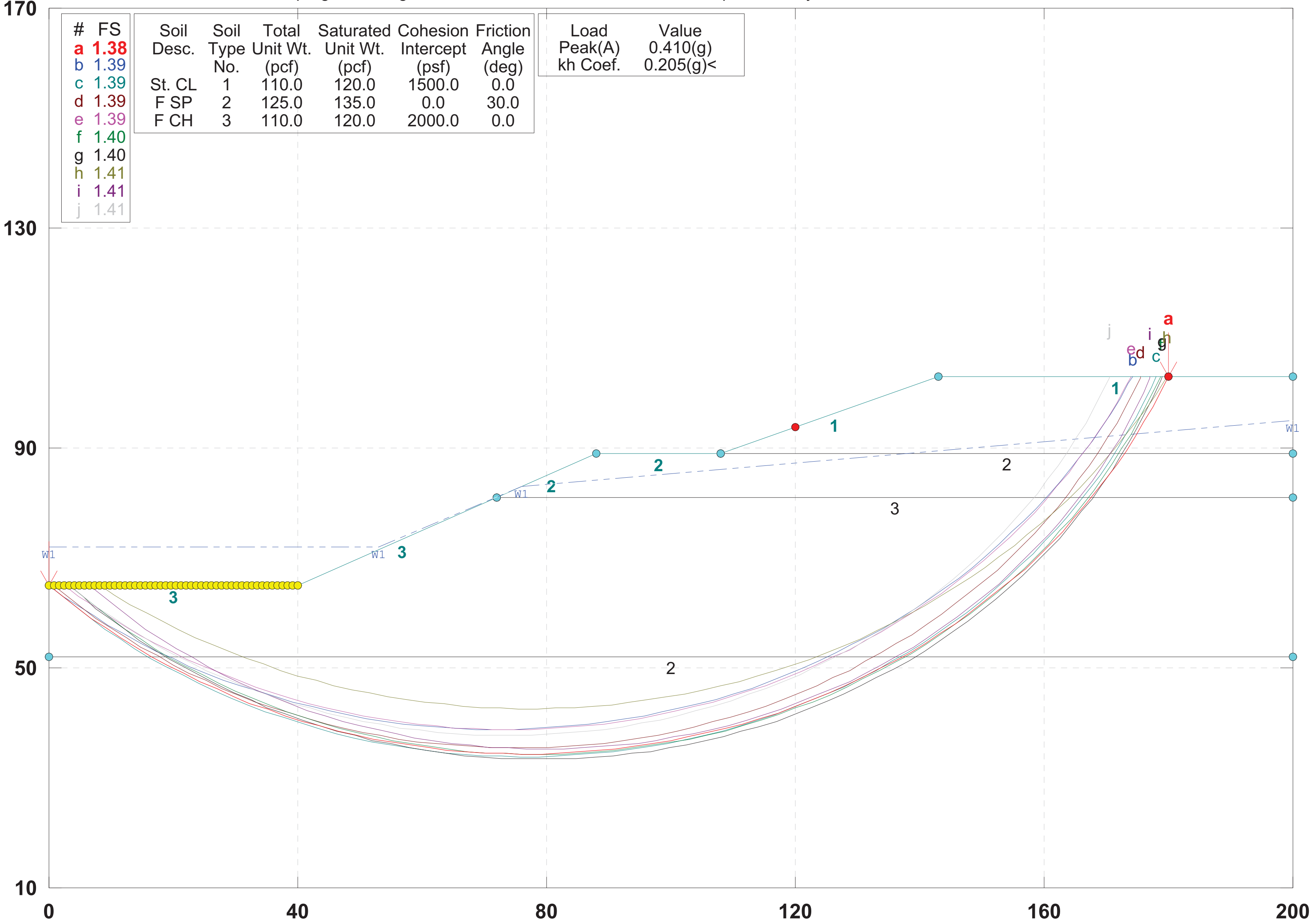
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
St. CL	1	110.0	120.0	1500.0	0.0
Liq. SP	2	125.0	135.0	0.0	15.0
F CH	3	110.0	120.0	2000.0	0.0

GSTABL7 v.2 FSmin=1.76
Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

SCE&G Wateree Station - Sta. 33+00 - Earthquake - Steady Seepage

c:\program files\g72sw\wateree station\sta.33+00 - seismic.pl2   Run By: Username   7/7/2010   04:00PM



#	FS
a	1.38
b	1.39
c	1.39
d	1.39
e	1.39
f	1.40
g	1.40
h	1.41
i	1.41
j	1.41

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
St. CL	1	110.0	120.0	1500.0	0.0
F SP	2	125.0	135.0	0.0	30.0
F CH	3	110.0	120.0	2000.0	0.0

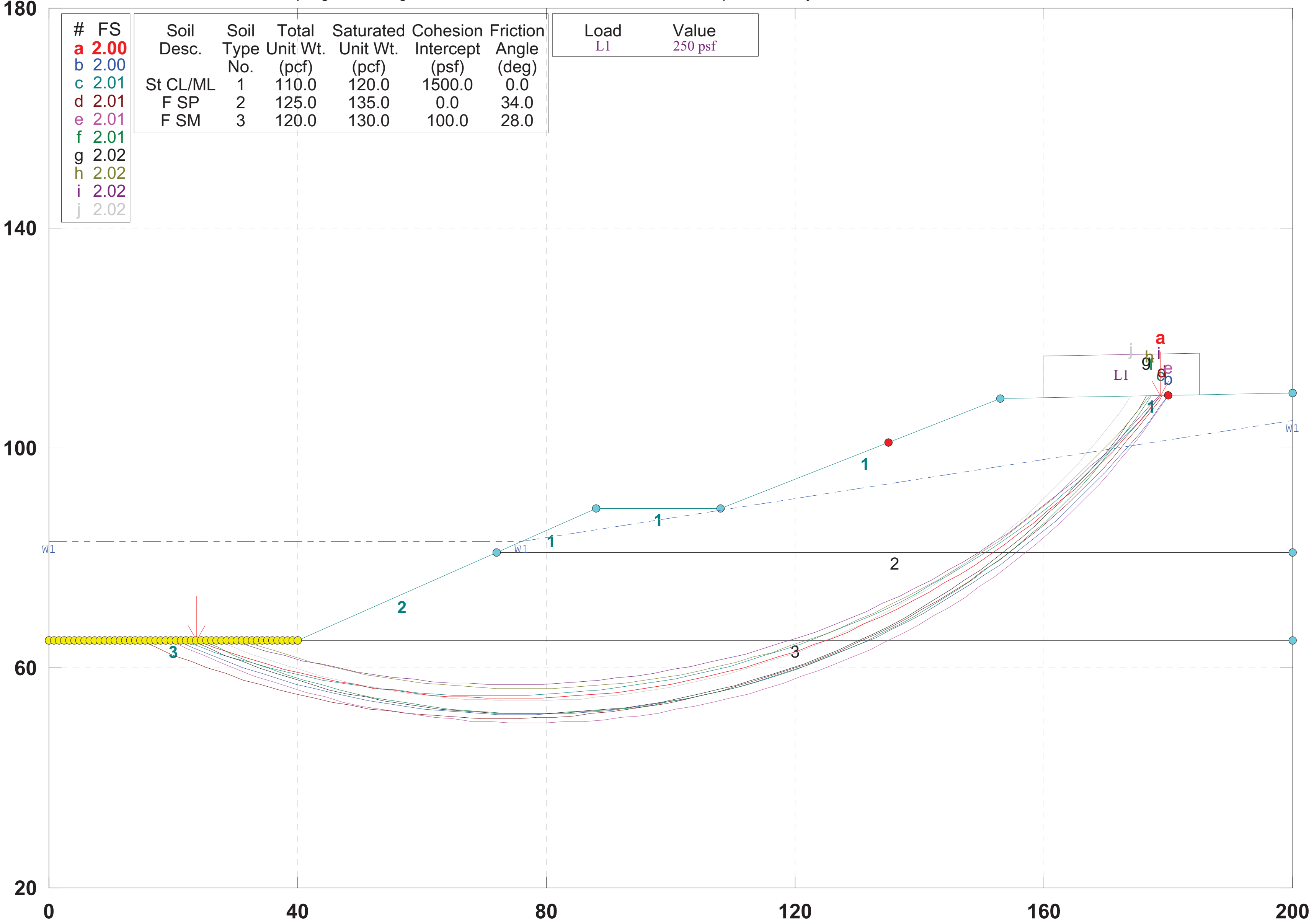
Load	Value
Peak(A)	0.410(g)
kh Coef.	0.205(g)<

GSTABL7 v.2 FSmin=1.38

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 45+00 Max. Storage Pool - Steady Seepage

c:\program files\g72sw\wateree station\sta.45+00 - seismic.pl2   Run By: Username   7/7/2010   04:32PM



#	FS
a	2.00
b	2.00
c	2.01
d	2.01
e	2.01
f	2.01
g	2.02
h	2.02
i	2.02
j	2.02

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
St CL/ML	1	110.0	120.0	1500.0	0.0
F SP	2	125.0	135.0	0.0	34.0
F SM	3	120.0	130.0	100.0	28.0

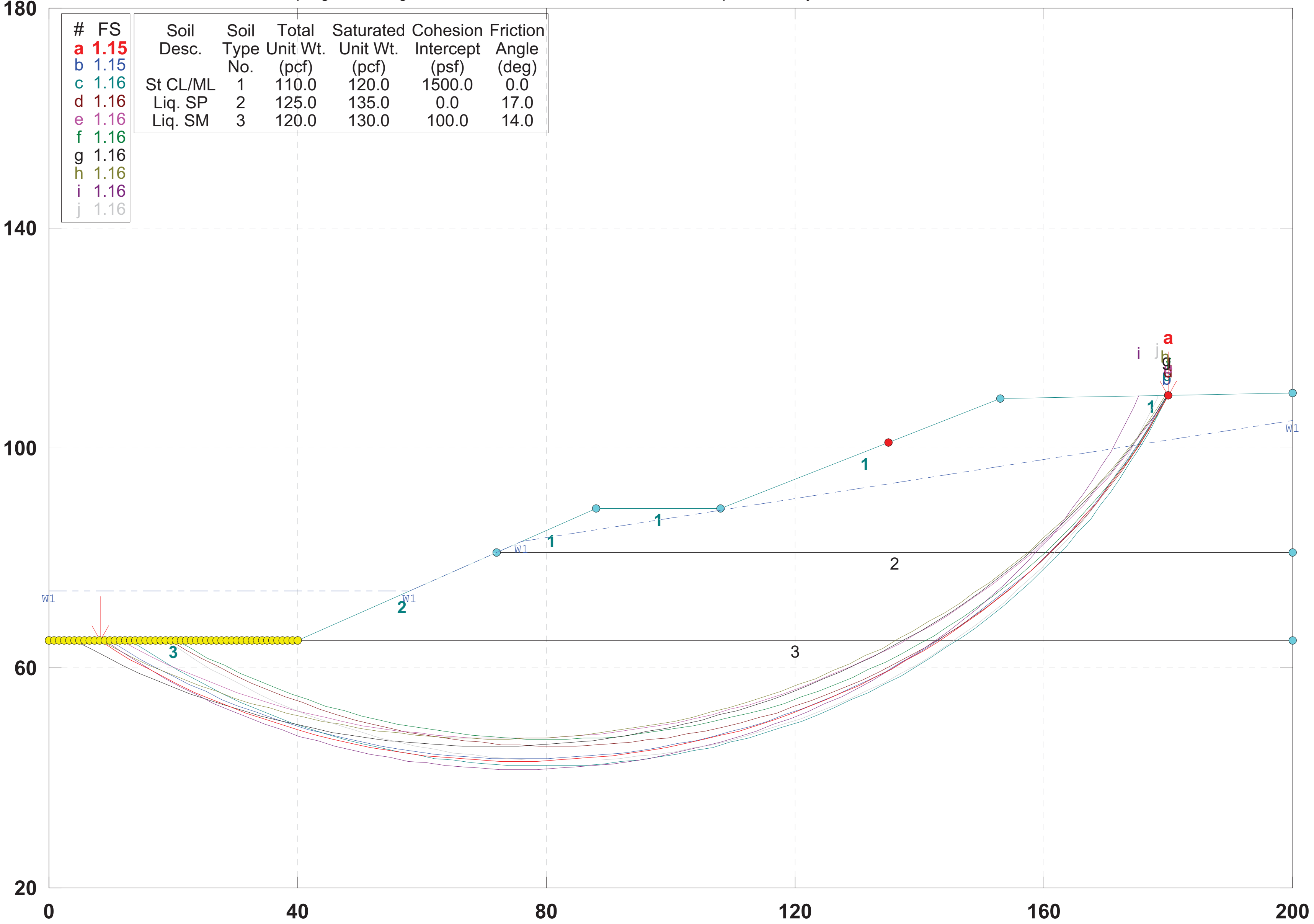
Load	Value
L1	250 psf

GSTABL7 v.2 FSmin=2.00

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 45+00 Liquefaction - Steady Seepage

c:\program files\g72sw\wateree station\sta.45+00 - seismic.pl2   Run By: Username   7/7/2010   06:49PM



#	FS
a	1.15
b	1.15
c	1.16
d	1.16
e	1.16
f	1.16
g	1.16
h	1.16
i	1.16
j	1.16

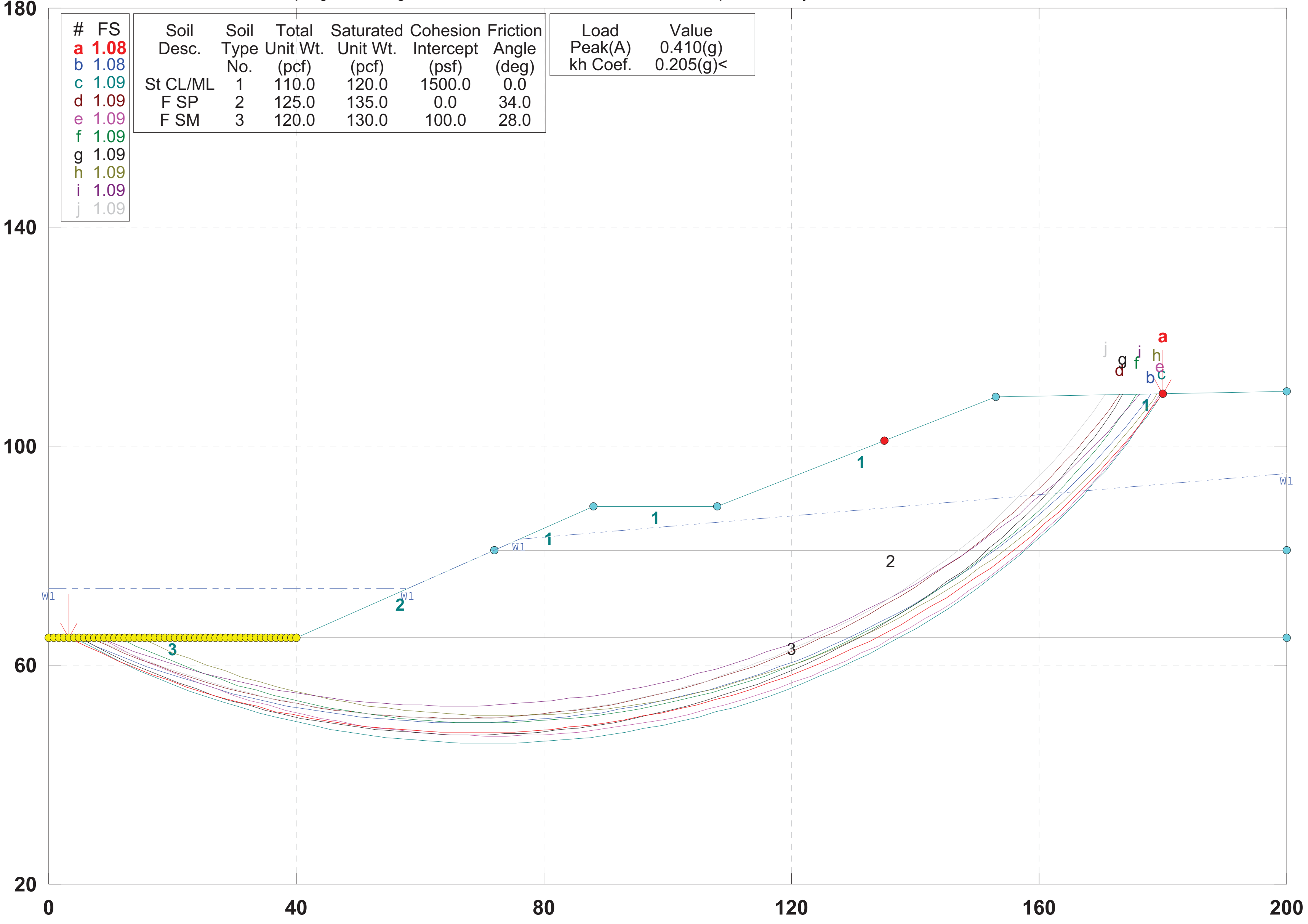
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
St CL/ML	1	110.0	120.0	1500.0	0.0
Liq. SP	2	125.0	135.0	0.0	17.0
Liq. SM	3	120.0	130.0	100.0	14.0

GSTABL7 v.2 FSmin=1.15

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 45+00 Earthquake - Steady Seepage

c:\program files\g72sw\wateree station\sta.45+00 - seismic.pl2   Run By: Username   7/7/2010   04:09PM



#	FS
a	1.08
b	1.08
c	1.09
d	1.09
e	1.09
f	1.09
g	1.09
h	1.09
i	1.09
j	1.09

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
St CL/ML	1	110.0	120.0	1500.0	0.0
F SP	2	125.0	135.0	0.0	34.0
F SM	3	120.0	130.0	100.0	28.0

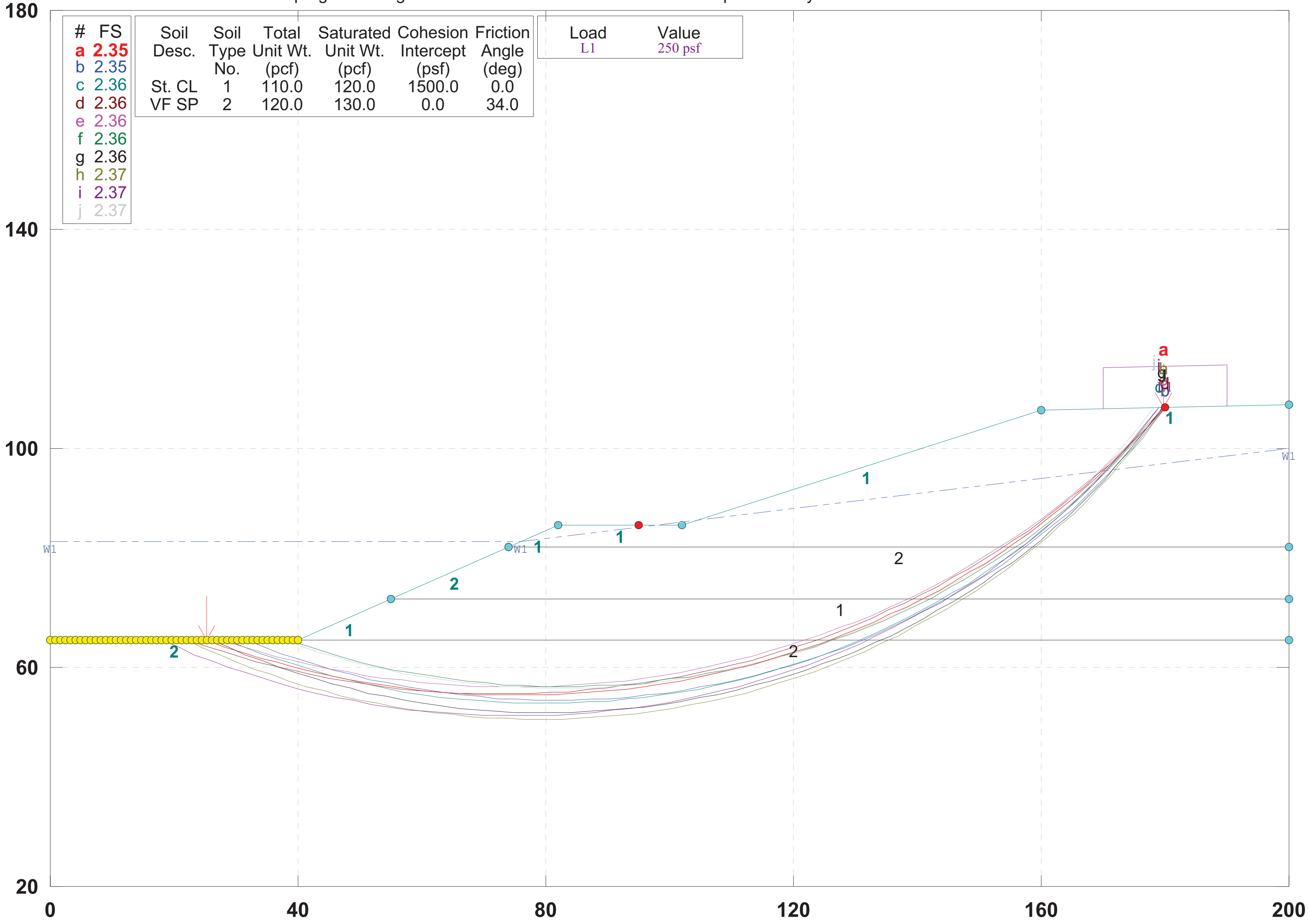
Load	Value
Peak(A)	0.410(g)
kh Coef.	0.205(g)<

GSTABL7 v.2 FSmin=1.08

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 56+50 - Max. Storage Pool - Steady Seepage

c:\program files\g72sw\wateree station\sta. 56+50 - seismic.pl2   Run By: Username   7/7/2010   07:36PM



#	FS
a	2.35
b	2.35
c	2.36
d	2.36
e	2.36
f	2.36
g	2.36
h	2.37
i	2.37
j	2.37

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
St. CL	1	110.0	120.0	1500.0	0.0
VF SP	2	120.0	130.0	0.0	34.0

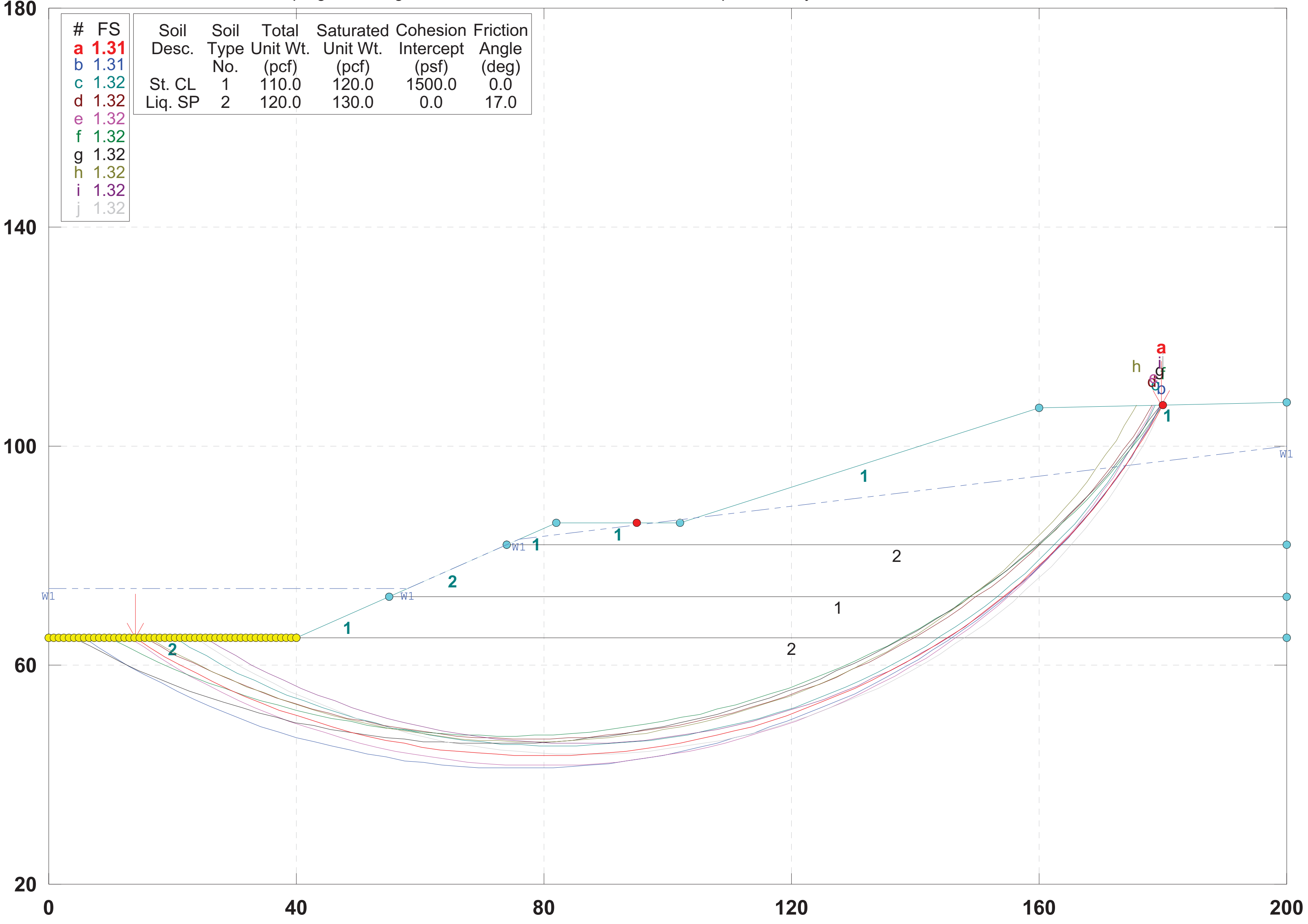
Load	Value
L1	250 psf

GSTABL7 v.2 FSmin=2.35

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 56+50 - Liquefaction - Steady Seepage

c:\program files\g72sw\wateree station\sta. 56+50 - seismic.pl2   Run By: Username   7/7/2010   07:33PM



#	FS
a	1.31
b	1.31
c	1.32
d	1.32
e	1.32
f	1.32
g	1.32
h	1.32
i	1.32
j	1.32

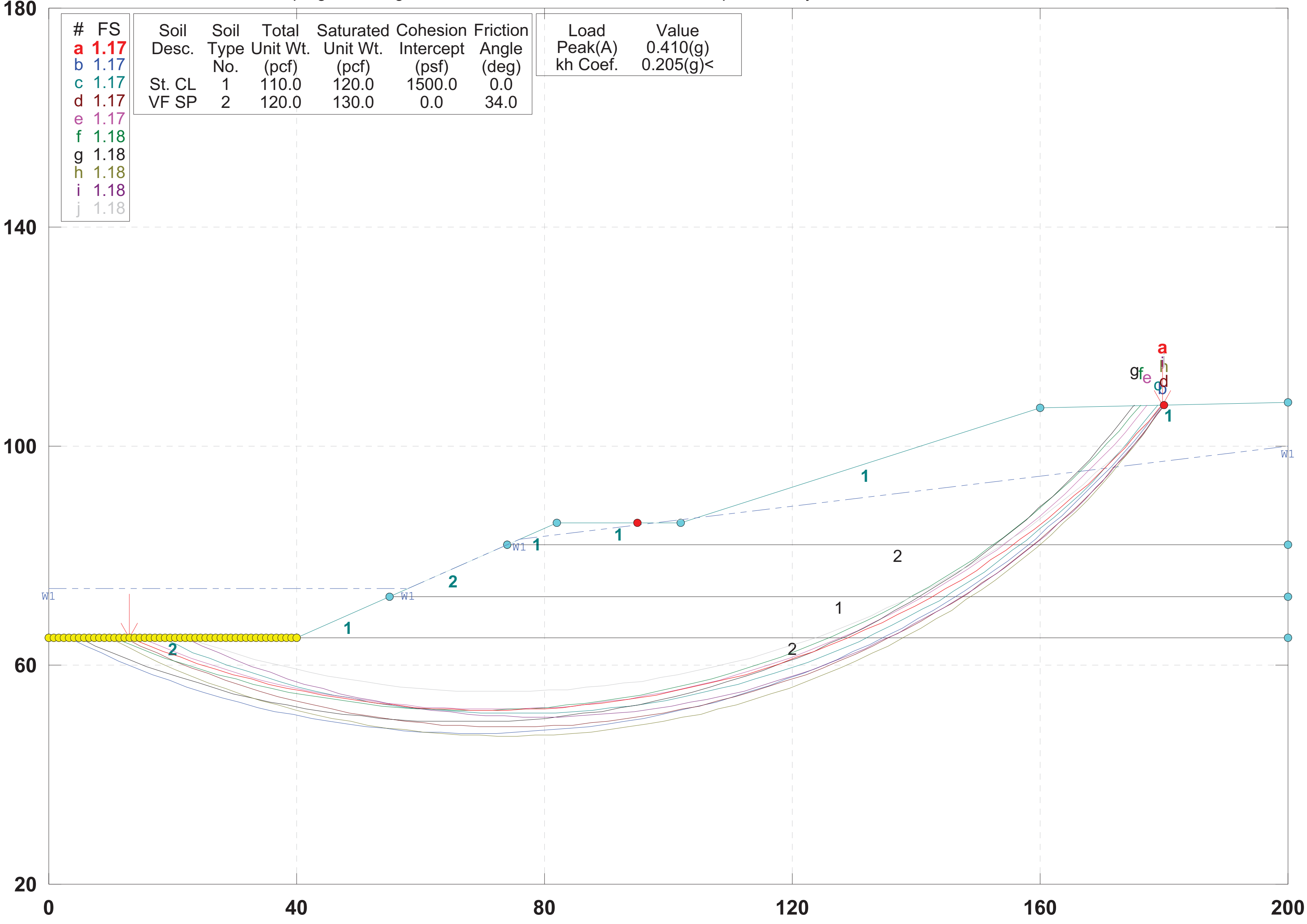
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
St. CL	1	110.0	120.0	1500.0	0.0
Liq. SP	2	120.0	130.0	0.0	17.0

GSTABL7 v.2 FSmin=1.31

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 56+50 - Earthquake - Steady Seepage

c:\program files\g72sw\wateree station\sta. 56+50 - seismic.pl2 Run By: Username 7/7/2010 07:34PM



#	FS
a	1.17
b	1.17
c	1.17
d	1.17
e	1.17
f	1.18
g	1.18
h	1.18
i	1.18
j	1.18

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
St. CL	1	110.0	120.0	1500.0	0.0
VF SP	2	120.0	130.0	0.0	34.0

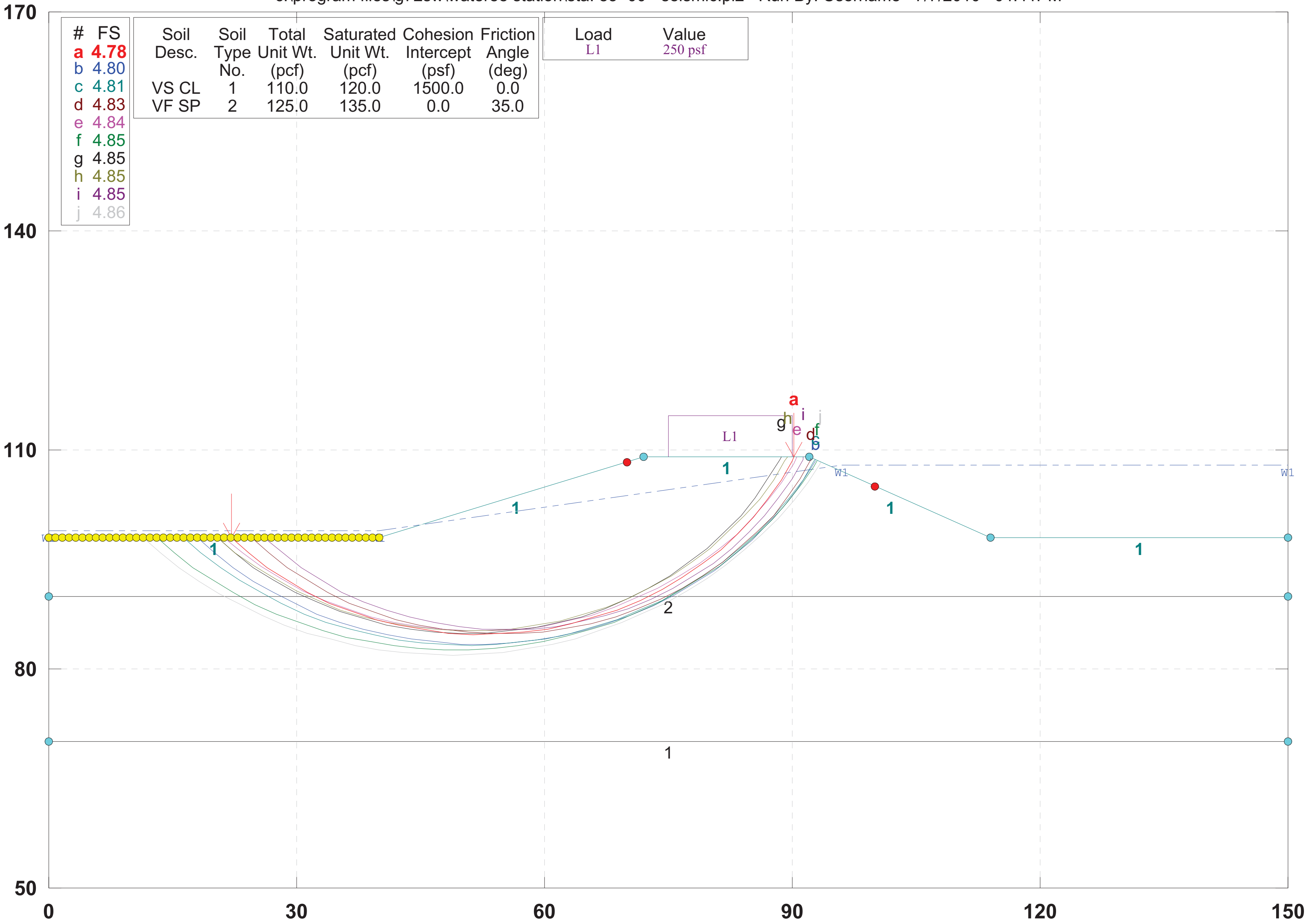
Load	Value
Peak(A)	0.410(g)
kh Coef.	0.205(g)<

GSTABL7 v.2 FSmin=1.17

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 83+00 Max. Storage Pool - Steady Seepage

c:\program files\g72sw\wateree station\sta. 83+00 - seismic.pl2   Run By: Username   7/7/2010   04:41PM



#	FS
a	4.78
b	4.80
c	4.81
d	4.83
e	4.84
f	4.85
g	4.85
h	4.85
i	4.85
j	4.86

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
VS CL	1	110.0	120.0	1500.0	0.0
VF SP	2	125.0	135.0	0.0	35.0

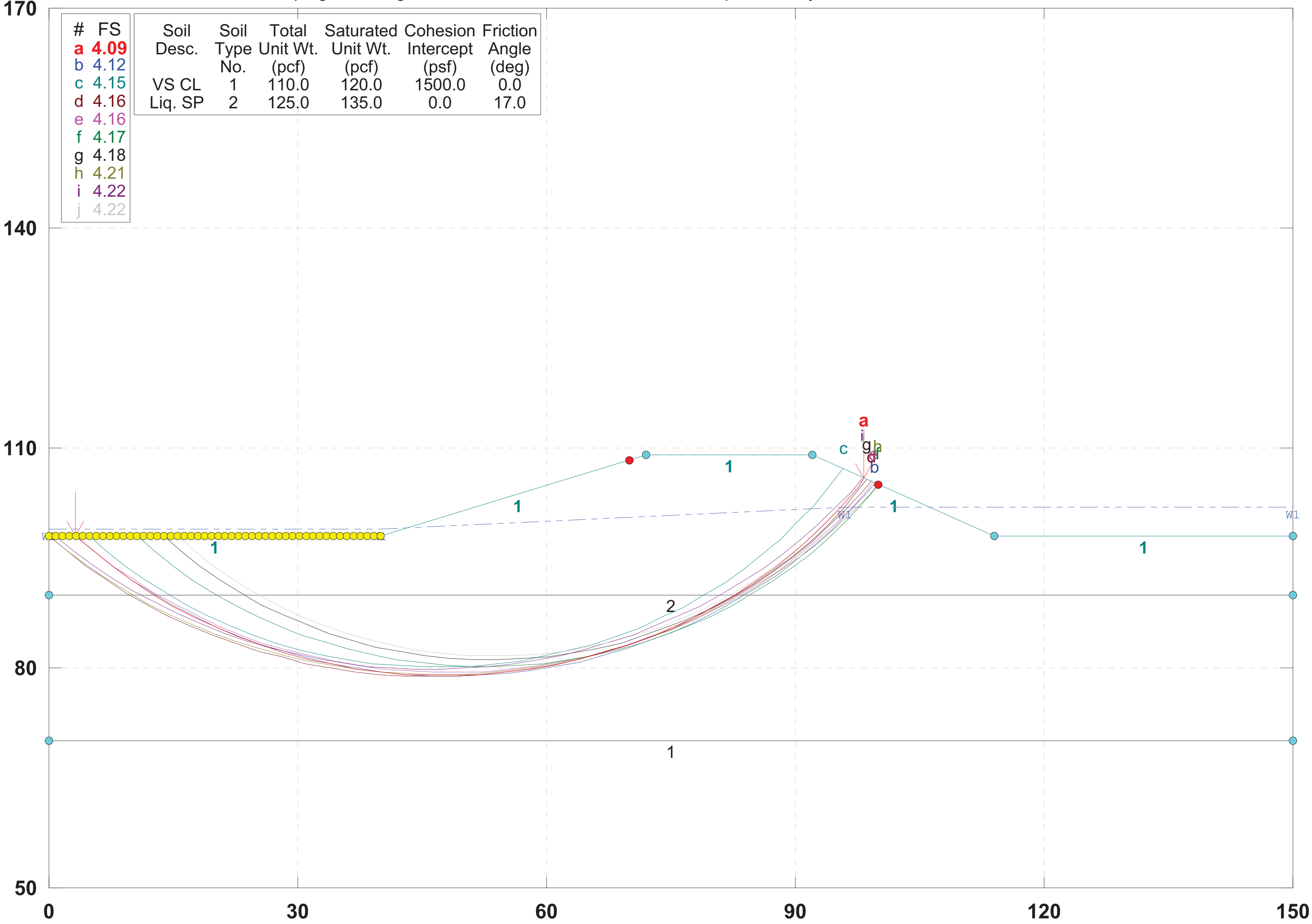
Load	Value
L1	250 psf

GSTABL7 v.2 FSmin=4.78

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 83+00 Liquefaction - Steady Seepage

c:\program files\g72sw\wateree station\sta. 83+00 - seismic.pl2 Run By: Username 7/7/2010 04:44PM



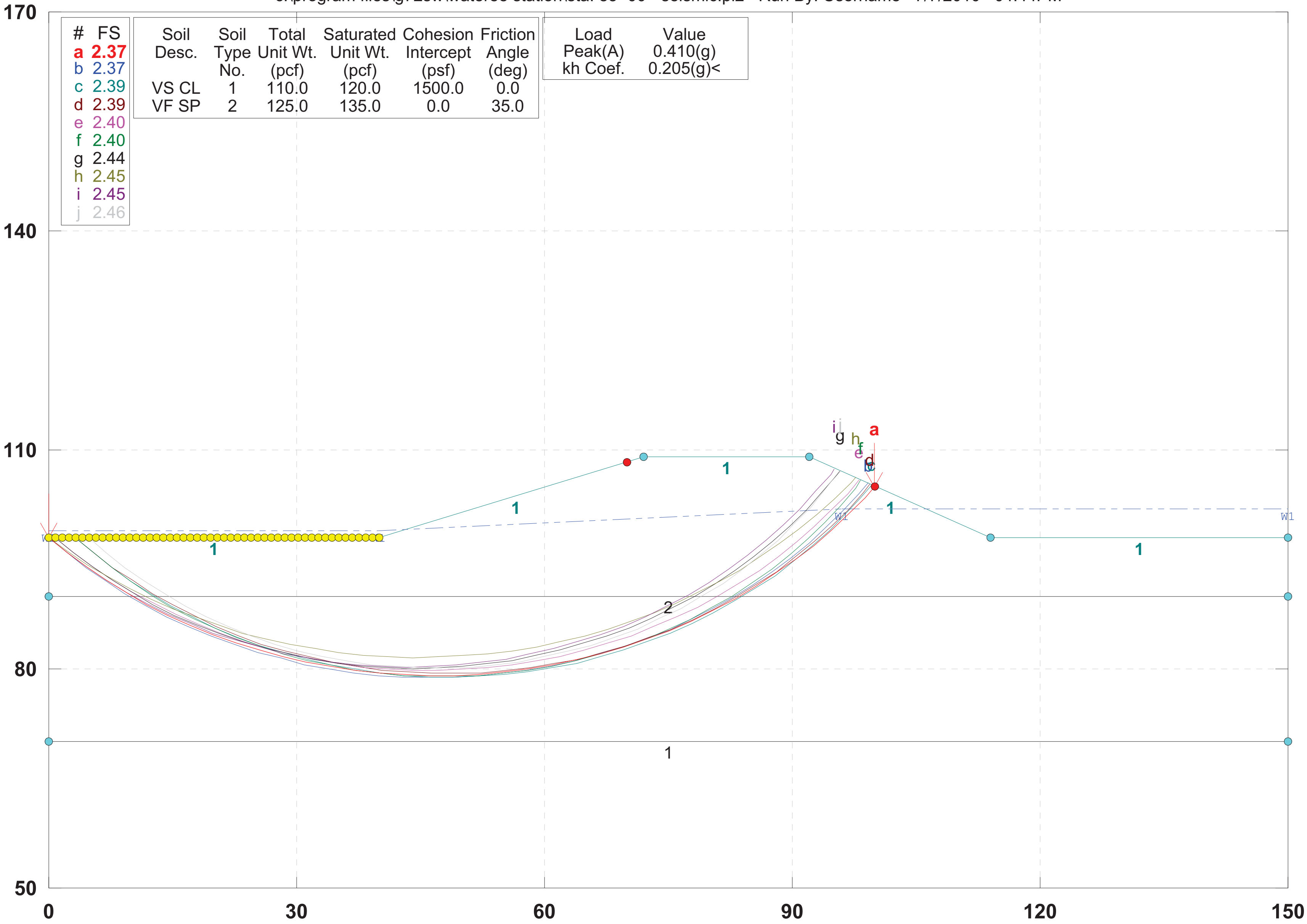
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
VS CL	1	110.0	120.0	1500.0	0.0
Liq. SP	2	125.0	135.0	0.0	17.0

GSTABL7 v.2 FSmin=4.09

Safety Factors Are Calculated By The Modified Bishop Method

SCE&G Wateree Station - Sta. 83+00 Earthquake - Steady Seepage

c:\program files\g72sw\wateree station\sta. 83+00 - seismic.pl2   Run By: Username   7/7/2010   04:44PM



#	FS
a	2.37
b	2.37
c	2.39
d	2.39
e	2.40
f	2.40
g	2.44
h	2.45
i	2.45
j	2.46

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)
VS CL	1	110.0	120.0	1500.0	0.0
VF SP	2	125.0	135.0	0.0	35.0

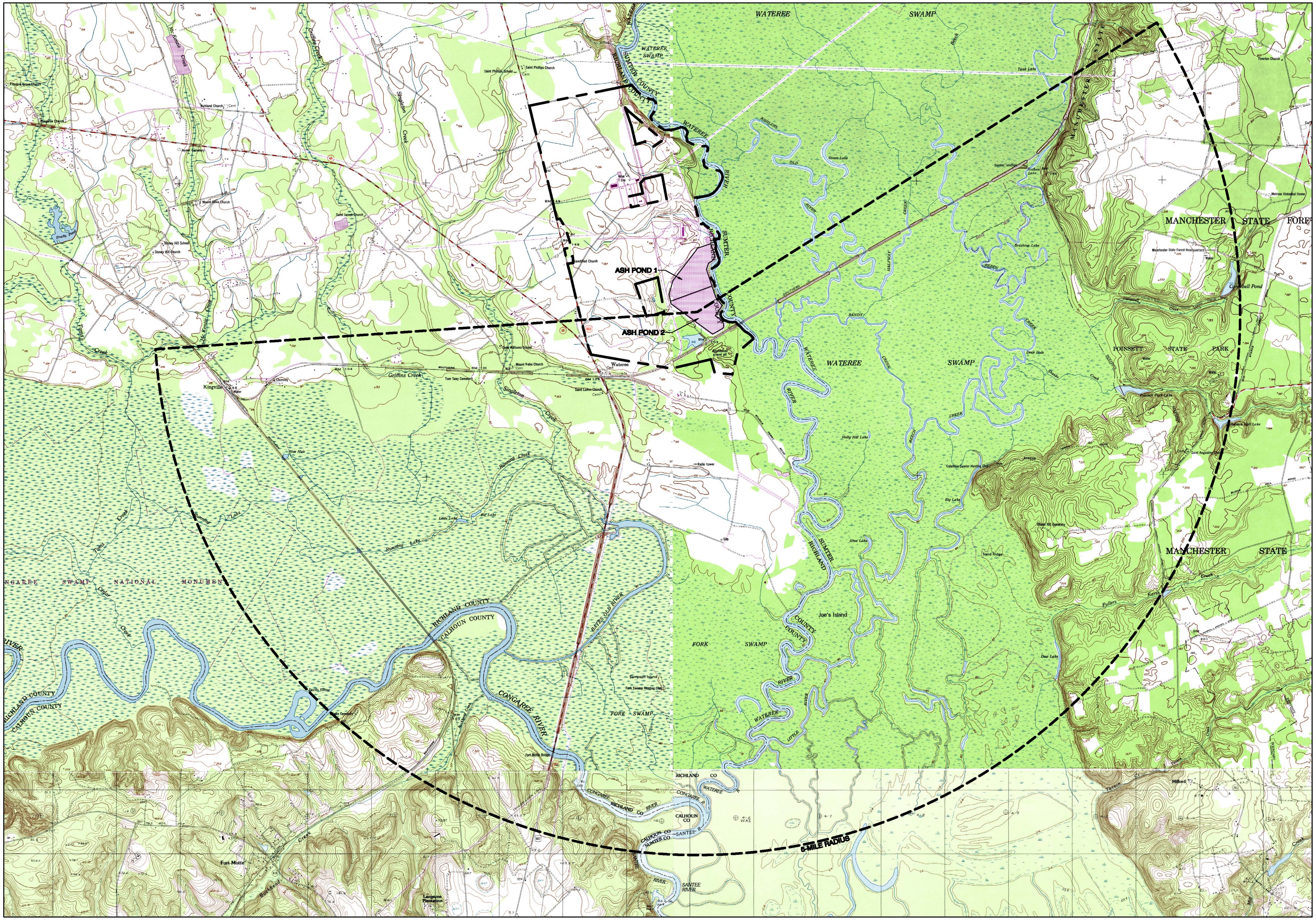
Load	Value
Peak(A)	0.410(g)
kh Coef.	0.205(g)<

GSTABL7 v.2 FSmin=2.37

Safety Factors Are Calculated By The Modified Bishop Method

ATTACHMENT 4

4.1) FIGURE, 2 REGIONAL MAP, 5-MILE RADIUS DOWNSTREAM



NOTES:

1. BACKGROUND USGS TOPOGRAPHIC MAP COMPISED OF THE FOLLOWING 7.5 MINUTES QUADRANGLES MAPS:

   WATEREE
   POINSETT STATE PARK
   FORT MOTTE
   LONE STAR

2. THERE ARE NO HOSPITALS OR SCHOOLS WITHIN A 5-MILE RADIUS DOWNSTREAM OF CCWI.

N

GRAPHIC SCALE 1"=2000'

0 2000

SOUTH CAROLINA ELECTRIC AND GAS WATEREE STATION	REGIONAL MAP	5-MILE RADIUS DOWNSTREAM OF ASH PONDS 1 AND ASH PONDS 2	FIG 2

Coal Combustion Dam Inspection Checklist Form

US Environmental
Protection Agency

Site Name: SCE&G Wateree
Date: 28 June 2010
Unit Name: Ash Pond No. 1
Operator's Name:
Unit I.D.:
Hazard Potential Classification: High Significant [✓ Low]
Inspector's Name: Frederic Shmurak / Justin Story - Dewberry

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?		✓	18. Sloughing or bulging on slopes?	✓	
2. Pool elevation (operator records)?	TBD		19. Major erosion or slope deterioration?	✓	
3. Decant inlet elevation (operator records)?	TBD		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	TBD		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	TBD		Is water exiting outlet, but not entering inlet?		✓
6. If instrumentation is present, are readings recorded (operator records)?		N/A	Is water exiting outlet flowing clear?	✓	
7. Is the embankment currently under construction?		✓	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?		N/A
9. Trees growing on embankment? (If so, indicate largest diameter below)	✓		At isolated points on embankment slopes?		✓
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		✓
11. Is there significant settlement along the crest?		✓	Over widespread areas?		✓
12. Are decant trashracks clear and in place?	✓		From downstream foundation area?	✓	
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		✓
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		N/A	23. Water against downstream toe?	✓	
17. Cracks or scarps on slopes?	✓		24. Were Photos taken during the dam inspection?	✓	

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.

Inspection Issue #	Comments
1.	Annual & Monthly Dam Inspections to begin effective July 2010
9.	Pine Trees < 2" Ø Along D/S slope (Recommended Removal)
11.	Pot-holes holding water (Recommended Repairing)
17; 18; 19	u/s slope (Not a safety issue at this time)
21.	North & south seep active along East D/S toe; West seep along West D/S toe inactive since ~1998 (Recommended Monitoring)
23.	Wetlands, channels & River along sections of D/S toe

EPA FORM -XXXX

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # SC 0002038 INSPECTOR Dewberry
Date 28 JUN 2010

Impoundment Name ASH POND No. 1
Impoundment Company SCE&G
EPA Region IV
State Agency (Field Office) Addresss

Name of Impoundment ASH POND No. 1
(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: CCW Settling & Storage

Nearest Downstream Town : Name Wateree
Distance from the impoundment 1.1 miles SW (NOT DIRECTLY D/S)
Impoundment
Location: Longitude N 80 Degrees 37 Minutes 04 Seconds
Latitude W 33 Degrees 49 Minutes 18 Seconds
State SC County Richland

Does a state agency regulate this impoundment? YES ____ NO ✓

If So Which State Agency? ____

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.

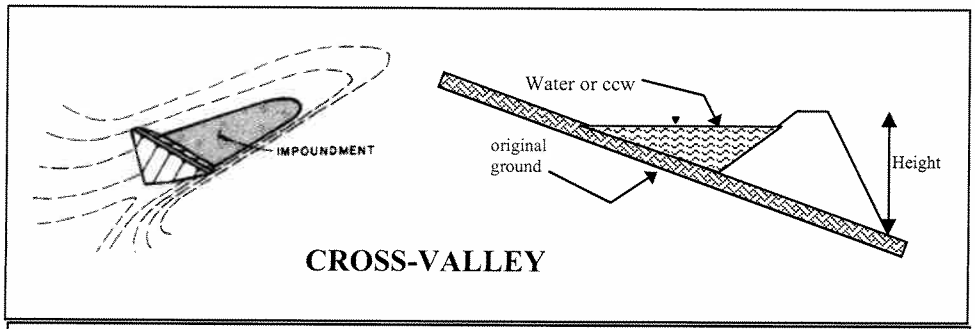
______ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. 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.

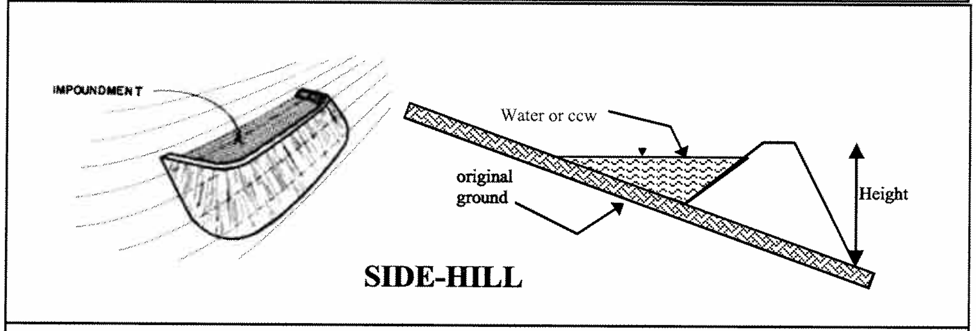
______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

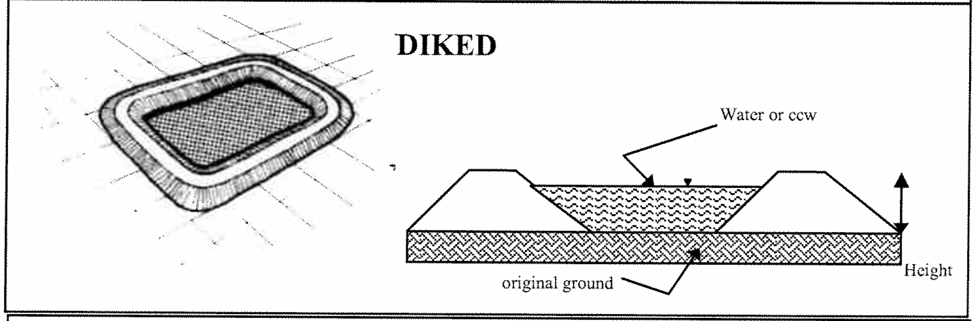
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

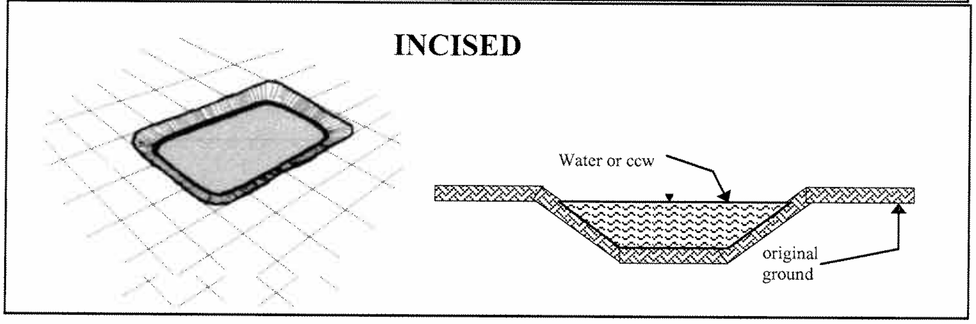
SIZE of Embankment NOT classified as a dam
by SC DHEC Dam Safety, Failure or misoperation
will not likely result in loss of life or
significant environmental/economic losses.

CONFIGURATION:









______ Cross-Valley
______ Side-Hill
______ Diked
______ Incised (form completion optional)
[✓ Combination Incised/Diked]

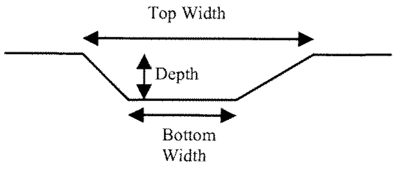
Embankment Height ~~24~~ 20 feet
Embankment Material Soil
Pool Area 80 acres
Liner NONE
Current Freeboard 5+ feet
Liner Permeability N/A

TYPE OF OUTLET (Mark all that apply)

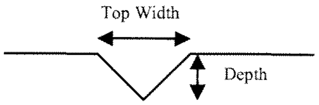
______ **Open Channel Spillway**
______ Trapezoidal
______ Triangular
______ Rectangular
______ Irregular

______ depth
______ bottom (or average) width
______ top width

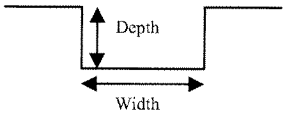
TRAPEZOIDAL



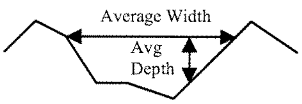
TRIANGULAR



RECTANGULAR



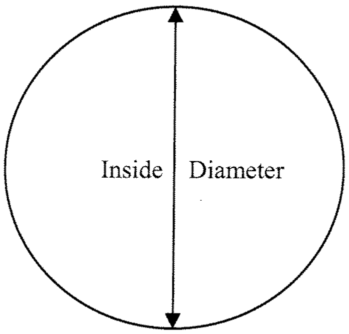
IRREGULAR



______ **Outlet**

?___ inside diameter
NOT ACCESSIBLE AT TIME of observation - Discharges TO ASH POND NO. 2

Material
______ corrugated metal
✓ welded steel
______ concrete
______ plastic (hdpe, pvc, etc.)
______ other (specify) ______________________



Is water flowing through the outlet? YES ✓ NO ______

______ **No Outlet**

______ **Other Type of Outlet** (specify) ______________________

The Impoundment was Designed By UNKNOWN AT TIME of observation

Has there ever been a failure at this site? YES ____________ NO ✓

If So When? ____________________________

If So Please Describe : ____________________________

Has there ever been significant seepages at this site? YES ________ NO ✓

If So When? ____________________

IF So Please Describe:

Three seeps: North & South seep at East D/S TOE and West seep at West D/S TOE (West seep inactive since ~1998; North & South seep currently minor)

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES ________ NO ✓

If so, which method (e.g., piezometers, gw pumping,...)? ________

If so Please Describe : ________

Coal Combustion Dam Inspection Checklist Form

US Environmental
Protection Agency

Site Name: SCE&G Wateree

Date: 28 JUNE 2010

Unit Name: Ash Pond No. 2

Operator's Name:

Unit I.D.:

Hazard Potential Classification: High Significant [✓ Low]

Inspector's Name: Frederic Shmurak / JUSTIN STORY - Dewberry

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?		✓	18. Sloughing or bulging on slopes?	✓	
2. Pool elevation (operator records)?	TBD		19. Major erosion or slope deterioration?	✓	
3. Decant inlet elevation (operator records)?	TBD		20. Decant Pipes:	■	■
4. Open channel spillway elevation (operator records)?	TBD		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	TBD		Is water exiting outlet, but not entering inlet?		✓
6. If instrumentation is present, are readings recorded (operator records)?		N/A	Is water exiting outlet flowing clear?	✓	
7. Is the embankment currently under construction?		✓	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?		N/A
9. Trees growing on embankment? (If so, indicate largest diameter below)	✓		At isolated points on embankment slopes?		✓
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		✓
11. Is there significant settlement along the crest?		✓	Over widespread areas?		✓
12. Are decant trashracks clear and in place?	✓		From downstream foundation area?		✓
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		✓
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		N/A	23. Water against downstream toe?	✓	
17. Cracks or scarps on slopes?	✓		24. Were Photos taken during the dam inspection?		✓

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.

Inspection Issue # Comments

1. Annual & Monthly Dam inspections to begin effective July 2010

9. Pine trees < 2" ∅ along D/S slope (Recommended Removal)

11. Pot-holes holding water (Recommended Repairing)

17; 18; 19 U/S slope (Not a safety issue at this time)

23. Wetlands, channels & river along sections of D/S toe

EPA FORM -XXXX

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # SC 0002038 INSPECTOR Dewberry
Date 28 JUN 2010

Impoundment Name ASH POND No. 2
Impoundment Company SCE&G
EPA Region IV
State Agency (Field Office) Addresss

Name of Impoundment ASH POND No 2
(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: CCW Settling & Storage

Nearest Downstream Town : Name Wateree
Distance from the impoundment 1.1 miles SW (NOT DIRECTLY D/S)
Impoundment
Location: Longitude N 80 Degrees 36 Minutes 57 Seconds
Latitude W 33 Degrees 48 Minutes 58 Seconds
State SC County Richland

Does a state agency regulate this impoundment? YES ____ NO ✓

If So Which State Agency?

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.

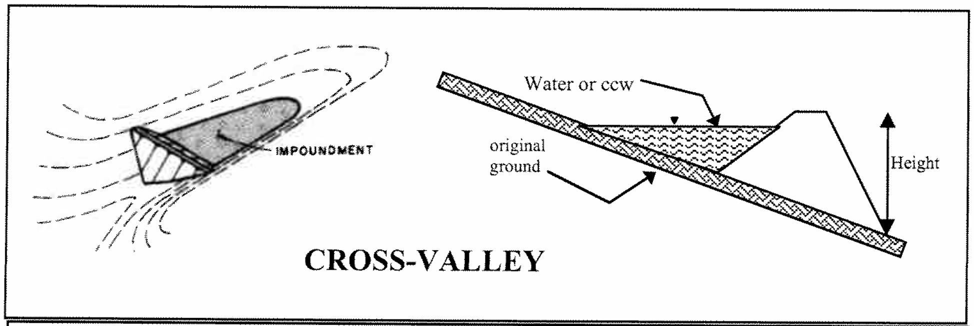
______ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. 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.

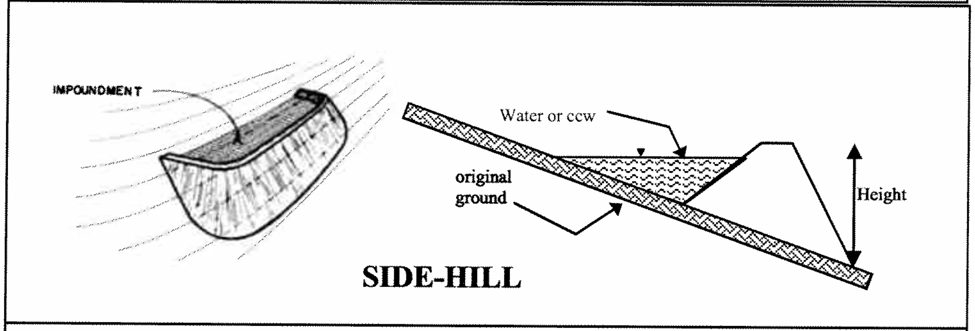
______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

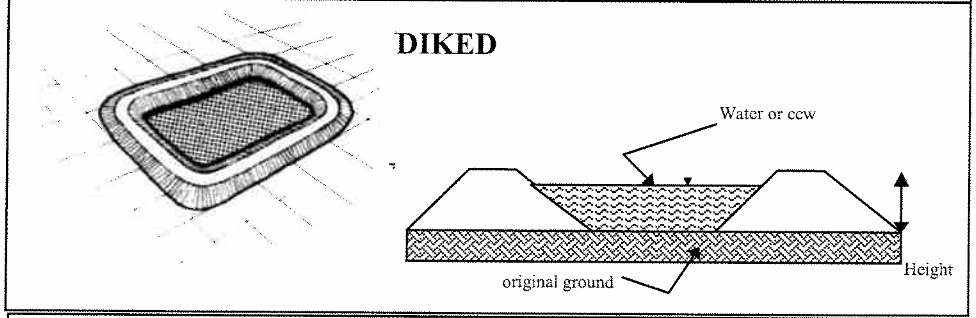
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

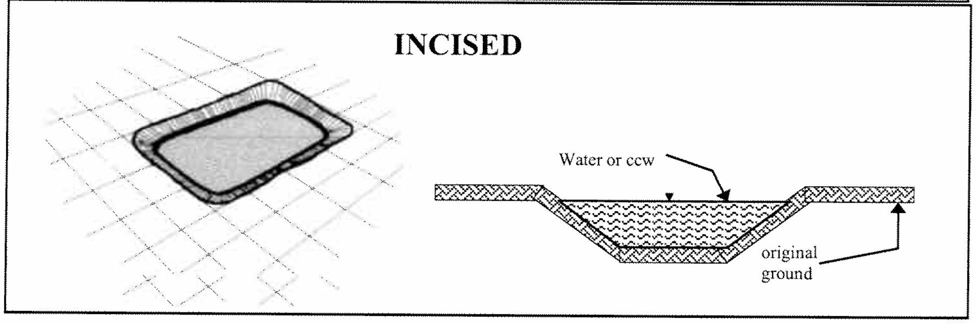
SIZE of Embankment NOT classified AS a
Dam by SC DHEC Dam Safety; Failure or
misoperation will not Likely Result in Loss of
Life or significant environmental/economic
losses.

CONFIGURATION:









_____ Cross-Valley
_____ Side-Hill
✓ Diked
_____ Incised (form completion optional)
_____ Combination Incised/Diked

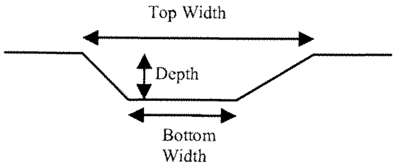
Embankment Height 24 feet Embankment Material SOIL
Pool Area 80 acres Liner NONE
Current Freeboard 5+ feet Liner Permeability N/A

TYPE OF OUTLET (Mark all that apply)

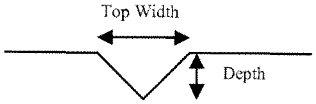
_____ **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

_____ depth
_____ bottom (or average) width
_____ top width

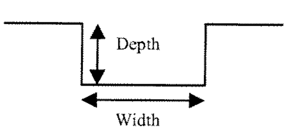
TRAPEZOIDAL



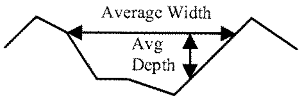
TRIANGULAR



RECTANGULAR

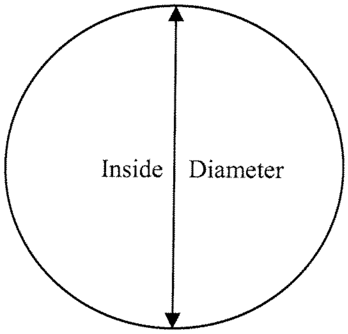


IRREGULAR



_____ **Outlet**

_____ inside diameter



Material
_____ corrugated metal
_____ welded steel
_____ concrete
_____ plastic (hdpe, pvc, etc.)
_____ other (specify) _______________

Is water flowing through the outlet? YES _____ NO _____

_____ **No Outlet**

✓ **Other Type of Outlet** (specify) Parshall Flume (24" THROAT)

The Impoundment was Designed By UNKNOWN AT TIME of observation

Has there ever been a failure at this site? YES ________ NO ✓

If So When? ________________

If So Please Describe : ________________

Has there ever been significant seepages at this site? YES ________ NO ✓

If So When? ______________________________

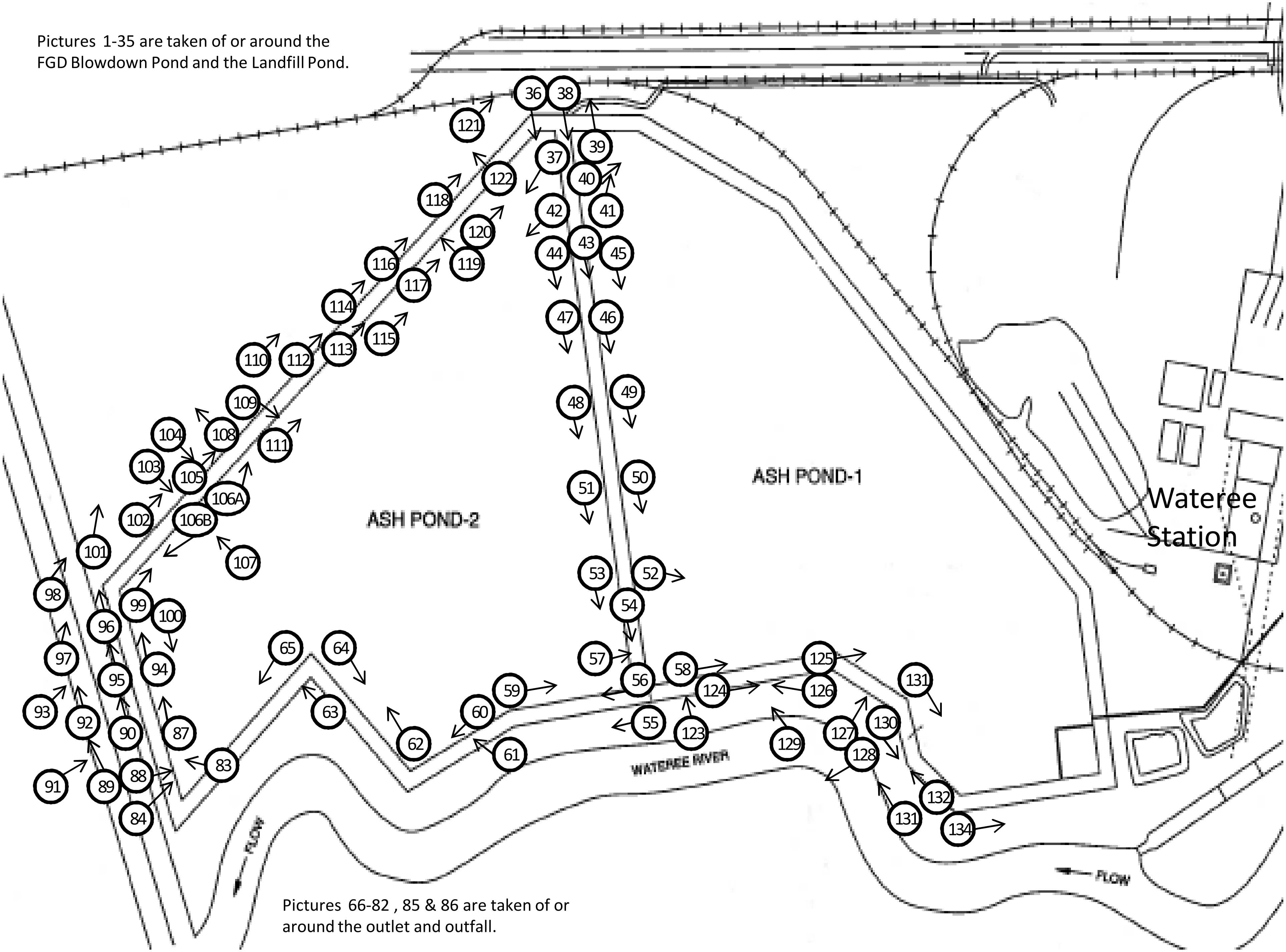
IF So Please Describe: ______________________________

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES ________ NO ✓

If so, which method (e.g., piezometers, gw pumping,...)? ____________________

If so Please Describe : ____________________

Pictures 1-35 are taken of or around the FGD Blowdown Pond and the Landfill Pond.



Pictures 66-82 , 85 & 86 are taken of or around the outlet and outfall.

Photo 036: Internal Dike

Photo 037: Pond 1 Discharge into Pond 2

Photo 038: Internal Dike Upstream Slope

Photo 039: Discharge into Pond 1

Photo 040: Pond 1 Outlet

Photo 041: Pond 1 Outlet

Photo 042: Pond 2

Photo 043: Internal Dike Crest

Photo 044: Internal Dike Slope

Photo 045: Internal Dike Upstream Slope

Photo 046: Internal Dike Upstream Slope

Photo 047: Internal Dike Downstream Slope

Photo 048: Internal Dike Downstream Slope

Photo 049: Internal Dike Upstream Slope

Photo 050: Internal Dike Upstream Slope

Photo 051: Internal Dike Downstream Slope

Photo 052: Pond 1 Upstream Slope

Photo 053: Internal Dike Downstream Slope

Photo 054: Pond 1

Photo 055: Pond 2 Crest

Photo 056: Pond 2 Upstream Slope

Photo 057: Pond 2 at Internal Dike

Photo 058: Pond 1 Upstream Slope (Incised)

Photo 059: Pond 2 Upstream Slope

Photo 060: Pond 2 Upstream Slope (Erosion)

Photo 061: Pond 2 Slope Erosion

Photo 062: Pond 2 Upstream Slope

Photo 063: Pond 2 Crest Looking Towards Outfall

Photo 064: Pond 2 Upstream Slope

Photo 065: Pond 2 Crest Looking Towards Outfall

Photo 066: Outfall to Wateree River

Photo 067: Parshall Flume at Outfall

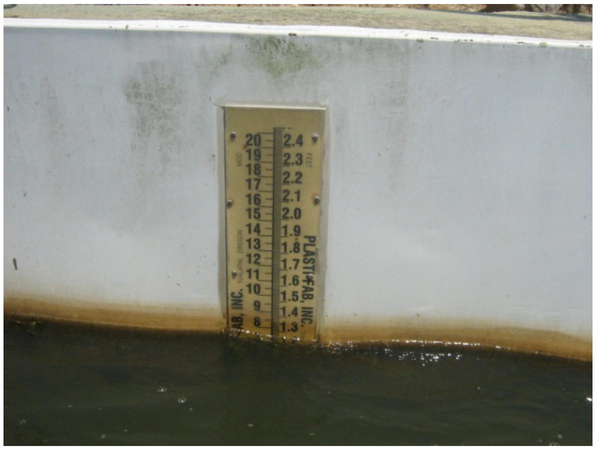


Photo 068: Water Level in Parshall Flume

Photo 069: Discharge Pipe

Photo 070: Outfall to Wateree River

Photo 071: Outfall to Wateree River

Photo 072: Storm Drainage Pipe at Outfall

Photo 073: Pond 2 Outlet

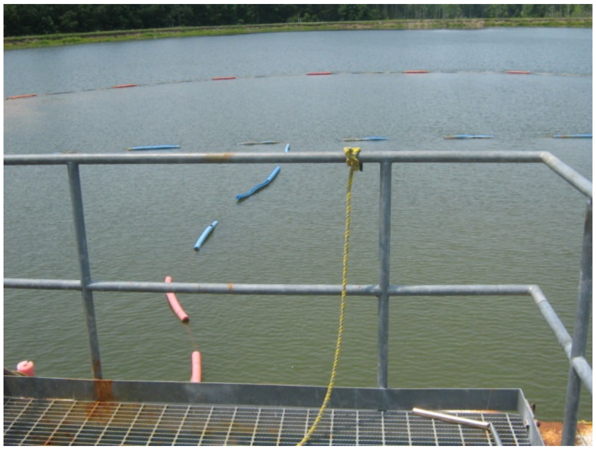


Photo 074: Pond 2

Photo 075: Pond 2 Upstream Slope

Photo 076: Pond 2 Outlet

Photo 077: Pond 2 Outlet

Photo 078: Pond 2 Outlet

Photo 079: Pond 2 Outlet

Photo 080: Pond 2 Upstream Slope

Photo 081: Pond 2

Photo 082: Fenced Area near Pond 2 Outlet

Photo 083: Pond 2 Upstream Slope

Photo 084: Pond 2

Photo 085: Outfall to Wateree River

Photo 086: Outfall to Wateree River

Photo 087: Pond 2 Upstream Slope

Photo 088: Pond 2 Upstream Slope Stabilization

Photo 089: Pond 2 Downstream Slope

Photo 090: Pond 2 Downstream Slope

Photo 091: Pond 2 Downstream Close-up

Photo 092: Pond 2 Downstream Slope

Photo 093: Pond 2 Downstream Slope Bore Hole

Photo 094: Pond 2 Upstream Slope Erosion

Photo 095: Pond 2 Downstream Slope

Photo 096: Pond 2 Downstream Slope

Photo 097: Pond 2 Downstream Slope

Photo 098: Pond 2 Downstream Slope

Photo 099: Pond 2 Upstream Slope

Photo 100: Pond 2 Upstream Slope Erosion

Photo 101: Pond 2 Downstream Slope

Photo 102: Pond 2 Downstream Slope

Photo 103: Vegetation Establishing on D/S Slope

Photo 104: Pond 2 Downstream Slope Erosion

Photo 105: Pond 2 Downstream Slope

Photo 106A: Pond 2 Upstream Slope Erosion

Photo 106B: Pond 2 Upstream Slope Erosion

Photo 107: Pond 2 Upstream Slope Erosion

Photo 108: Pond 2 Downstream Toe (Wetlands)

Photo 109: Pond 2 Downstream Slope Erosion

Photo 110: Pond 2 Downstream Slope

Photo 111: Pond 2 Upstream Slope Erosion

Photo 112: Pond 2 Downstream Slope Erosion

Photo 113: Pond 2 Crest (Water Ponding)

Photo 114: Pond 2 Downstream Slope Erosion

Photo 115: Pond 2 Upstream Slope Erosion

Photo 116: Pond 2 Downstream Slope Erosion

Photo 117: Pond 2 Upstream Slope

Photo 118: Pond 2 Crest (Water Ponding)

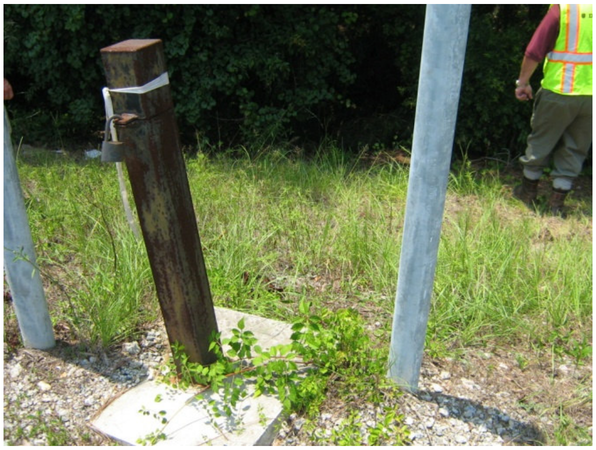


Photo 119: Past seepage monitoring area

Photo 120: Pond 2 Downstream Slope

Photo 121: Pond 2 Upstream Slope

Photo 122: Downstream Seepage Area

Photo 123: Pond 1

Photo 124: Pond 1 Upstream Slope

Photo 125: Pond 1 Upstream Slope

Photo 126: Pond 1 Upstream Slope

Photo 127: Seepage along Pond 1

Photo 128: Seepage along Pond 1

Photo 129: Seepage Area

Photo 130: Pond 1 Downstream Slope

Photo 131: Pond 1 Upstream Slope

Photo 132: Pond 1 Upstream Slope

Photo 133: Pond 1 Downstream

Photo 134: Pond 1 Downstream