ASSESSMENT OF DAM SAFETY OF COAL COMBUSTION SURFACE IMPOUNDMENTS – FINAL REPORT

Gulf Power
Plant Crist
Pensacola, Florida

Prepared for

U.S. Environmental Protection Agency
Washington, D.C.

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CDM Smith Project No.:93083.1801.044.SIT.CRIST

CDM Smith

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Section 1

Introduction, Summary Conclusions and Recommendations

1.1 Introduction

On December 22, 2008 the dike of a coal combustion waste (CCW) ash pond dredging cell failed at a facility owned by the Tennessee Valley Authority in Kingston, Tennessee. The failure resulted in a spill of over one billion gallons of coal ash slurry, which covered more than 300 acres, damaging infrastructure and homes. In light of the dike failure, the United States Environmental Protection Agency (USEPA) is assessing the stability and functionality of existing CCW impoundments at coal-fired electric utilities to ensure that lives and property are protected from the consequences of a failure.

This assessment of the stability and functionality of Gulf Power Company – Plant Crist's CCW impoundments is based on a review of available documents, site assessments conducted by CDM Smith on August 20 and 21, 2012, and technical information provided subsequent to the site visit. In summary, the Gulf Power Company – Plant Crist CCW impoundment embankments are rated SATISFACTORY for continued safe and reliable operation.

It is critical to note that the condition of the embankment(s) depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the embankment(s) will continue to represent the condition of the embankment(s) at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

1.2 Purpose and Scope

CDM Smith was contracted by the USEPA to perform site assessments of selected surface impoundments. As part of this contract, CDM Smith conducted site assessments of the Ash Pond, Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond at the Plant Crist site owned by Gulf Power Company, a division of Southern Company (Gulf Power). The Ash Pond includes five (5) Ash Decant/Settling Ponds that have been formed within the northwest portion of the Ash Pond through construction of divider embankments. The divider embankments appear to be constructed of a mixture of soil and ash. The purposes of this report are to provide the results of the assessments and evaluations of the conditions and potential for waste release from the CCW impoundments.

Site visits were conducted by CDM Smith representatives on August 20 and 21, 2012, to collect relevant information, inventory the impoundments, and perform visual assessments of the impoundments.

Florida Department of Environmental Protection (FDEP) recognized in their letter of March 28, 2014 to Gulf Power, Gulf Power's cessation of coal ash storage and treatment in the Ash Pond. As a result, the Ash Pond falls outside the scope of this assessment program. All condition and hazard ratings for the Ash Pond have been removed from this report.

1.3 Conclusions and Recommendations

1.3.1 Conclusions

Conclusions are based on visual observations during the site assessment on August 20 and 21, 2012 and review of technical documentation provided by Gulf Power (Appendix A). Plant Crist's CCW impoundments appear to be structurally sound based on the visual observations of the structural element components (i.e. inlet structures, earth embankments, and outlet structures).

1.3.1.1 Conclusions Regarding Structural Soundness of the CCW Impoundments

- Gypsum Storage Pond - Stability analyses for the Gypsum Storage Pond performed by Southern Company Services, Inc. (SCS), dated January 28, 2014 were provided to CDM Smith. Liquefaction potential analyses performed by SCS, dated January 27, 2014 were also provided to CDM Smith.

  Liquefaction potential analyses for the Gypsum Storage Pond, performed by SCS evaluated the liquefaction potential of the ponds when subjected to loading associated with a seismic event having a 2-percent exceedance over a 50-year period, considering seismic hazards derived from both the Central and Eastern U.S. random faulting source (CEUS) and the New Madrid Source Zone (NMSZ) scenario earthquakes. Analyses of the Gypsum Storage Pond embankments indicate liquefaction of the foundation soils is not a threat during either of the scenario earthquakes.

  Slope stability analyses were based on available as-built drawings and soil properties from Plant Crist Gypsum Storage Area Hydrogeological and Geotechnical Investigation Report prepared by Earth Science and Environmental Engineering group of Southern Companies Generation, dated June 2007. Calculated factors of safety for the steady-state and seismic loading conditions with the pond at maximum surcharge level conditions were adequate. Slope stability analyses for rapid drawdown conditions were not provided due to the presence of a low-permeability textured high-density polyethylene (HDPE) liner system preventing saturation of underlying soils. CDM Smith agrees that analysis of rapid drawdown is not necessary, based on the presence of the HDPE liner system.

- Process Sedimentation Pond and the Process Return Water Pond - Stability analyses for the Process Sedimentation Pond and Process Return Water Pond, dated January 28, 2014, were provided to CDM Smith. Conditions analyzed included steady-state and seismic loading with the pond at maximum surcharge level and liquefaction potential analyses. Slope stability analyses for rapid drawdown conditions were not provided. Calculated factors of safety for the conditions analyzed were adequate. Rapid drawdown was not considered due to the interior HDPE liner preventing saturation of underlying soil. CDM Smith agrees that analyses of rapid drawdown is not necessary, based on the presence of the HDPE liner.

- Ash Pond – As stated in Section 1.2, the Ash Pond falls outside the scope of this assessment program. Stability analyses provided by Gulf Power and presented in this report are for informational purposes only.

  Stability calculations, provided by Gulf Power for the Ash Pond, at normal pool, determined inadequate factors of safety for steady-state and rapid drawdown loading conditions, and for liquefaction potential. Analyses of liquefaction potential were performed with water surface levels 3 feet and 10 feet below the embankment crest.

For steady-state loading, the calculated factor of safety was 1.2 for the east embankment (river side) exterior slope. The calculated factor of safety was 1.4 for the west embankment (canal side) exterior slope. The minimum required factor of safety established by the United States Army Corps of Engineers for steady-state conditions (USACE) is 1.5.

For the rapid drawdown loading condition, the calculated factor of safety was 1.2 for the east embankment (river side) exterior slope. The minimum required factor of safety established by the USACE for rapid drawdown conditions is 1.3. According to the Gulf Power, the Ash Pond is not operated in a manner that would result in a rapid drawdown condition. If the pond level had to be lowered for maintenance purposes, the discharge rate would be controlled to avoid a rapid drawdown condition.

Liquefaction potential analyses evaluated the Ash Pond embankments when subjected to loading associated with a seismic event having a 2-percent exceedance over a 50-year period, considering seismic hazards derived from both the CEUSNMSZ. Liquefaction analyses of the Ash Pond embankments, dated January 27, 2014, indicate soft natural soils encountered immediately below the embankment fill exhibit factors of safety of 0.9 (NMSZ scenario earthquake) and 1.1 (CEUS scenario earthquake). For the purpose of the January 2014 analyses, water was assumed to be 3 feet below the top of crest for the Ash Pond. Liquefaction analyses of the Ash Pond embankments, dated September 7, 2012, yielded factors of safety ranging from 1.0 to 1.2 during the CEUS and NMSZ scenario earthquakes. For the purpose of the September 7, 2012 liquefaction potential analyses, water was assumed to be 10 feet below the top of crest for the Ash Pond.

The minimum required factor of safety established by the USACE for liquefaction is 1.3. CDM Smith notes there was approximately 3 feet of freeboard in the Ash Pond during our August 20, 2012 site assessment.

1.3.1.2 Conclusions Regarding the Hydrologic/Hydraulic Safety of CCW Impoundments

Gulf Power provided supporting technical documentation regarding the hydrologic/hydraulic safety for Plant Crist's CCW impoundments. The hydrologic/hydraulic safety of Plant Crist's Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond is adequate.

Based on the USEPA classification system, presented on Page 2 of the USEPA checklist and CDM Smith's review of the site and downstream areas, a recommended hazard rating of SIGNIFICANT has been assigned to Plant Crist's Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond, as summarized in Table 2-3, Section 2.3. FEMA guidelines recommend impoundments to have the capacity to pass and/or store some percentage of the Probable Maximum Precipitation (PMP) for a 6-hour storm event over a 10-square-mile area in the vicinity of the site. Significant hazard structures are required to store precipitation associated with the 50% Probable Maximum Precipitation (50% PMP) storm event. Hydrologic/hydraulic analyses for the 50% PMP were provided for the Plant Crist CCW impoundments. Hydrologic and hydraulic (H&H) data provided by Gulf Power and reviewed by CDM Smith indicate the CCW impoundments have adequate capacity to pass and/or store the 50% PMP storm event without overtopping.

1.3.1.3 Conclusions Regarding Adequacy of Supporting Technical Documentation

CDM Smith has the following conclusions based on our review of the supporting technical documentation provided by Gulf Power:

- Steady-state and seismic stability analyses for of Plant Crist Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond embankments are documented.

- Gulf Power provided assessments of the embankments' liquefaction potential for Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond. Gulf Power did not provide stability analyses for rapid drawdown conditions due to the presence of a low-permeability textured HDPE liner system covering the bottom and entire interior slopes of the ponds preventing saturation of underlying soils. CDM Smith agrees that analysis of rapid drawdown is not necessary, based on the presence of the HDPE liner system.

CDM Smith considers the Supporting Technical Documentation provided by Gulf Power for the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond to be adequate.

1.3.1.4 Conclusions Regarding Description of the CCW Impoundments

The description of the CCW impoundments provided by Gulf Power, and design drawings by Southern Company Generation Engineering and Construction Services, dated September, 2008 (revised July, 2010), for the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond were generally consistent with the visual observations by CDM Smith during our site assessment.

1.3.1.5 Conclusions Regarding Field Observations

- <u>Gypsum Storage Pond</u> - CDM Smith observed the following during our site assessment of the Gypsum Storage Pond:

  - ✓ Animal burrows were observed on the exterior slopes of the west and east embankments.

  - ✓ Areas of possible seepage were observed near the south corner of the impoundment, at the toe of the southwest embankment; a second area of possible seepage was observed at the toe of the east embankment.

  - ✓ CDM Smith observed discontinuities and settlement of the riprap-covered west embankment's exterior slope and areas where the underlying filter fabric was exposed.

- <u>Process Sedimentation Pond</u> - CDM Smith observed the following during our site assessment of the Process Sedimentation Pond:

  - ✓ Areas of surface erosion and erosion rills were observed on the exterior slope of the north embankment.

  - ✓ Areas of possible seepage were observed on the northeast embankment, adjacent to the access road to the crest.

- <u>Process Return Water Pond</u> - CDM Smith observed the following during our site assessment of the Process Return Water Pond:

  - ✓ The crest surface is gravel-covered without vegetation. No depressions, ruts, or evidence of settlement were observed on the crests.

- ✓ No signs of tears, leaks, or excessive wear were observed on the interior slopes. The interior slopes appear to be straight and uniform and no signs of bulging were observed.
- ✓ The alignment of the exterior slopes appears to be uniform and consistent. No signs of erosion or animal burrows were observed.

No apparent unsafe conditions or conditions in need of immediate remedial action were observed at the Plant Crist CCW impoundments.

1.3.1.6 Conclusions Regarding Adequacy of Maintenance and Methods of Operation

Current operation and maintenance procedures appear to be adequate. There was no existing evidence of previous spills, significant repairs, or release of impounded coal ash slurry.

1.3.1.7 Conclusions Regarding Adequacy of Surveillance and Monitoring Program

Gulf Power's surveillance program is inadequate. Gulf Power currently performs weekly, monthly, and yearly inspections; however inspections do not include a monitoring program to measure/document the rate, volume, and turbidity of possible seepage flow emerging from the embankment slopes.

Groundwater monitoring, surveillance program, recording, and report preparation for FDEP under the National Pollutant Discharge Elimination System (NPDES) Permit appear to be adequate and complying with FDEP requirements.

1.3.1.8 Conclusions Regarding Suitability for Continued Safe and Reliable Operation

Plant Crist's CCW impoundments' embankments do not show evidence of unsafe conditions requiring immediate remedial efforts, but maintenance to correct deficiencies noted above is recommended.

1.3.2 Recommendations

Based on CDM Smith's visual assessment of CCW impoundments and review of documentation provided by Gulf Power, CDM Smith provides the following recommendations for consideration. CDM Smith recommends that remedial repairs for slope restoration be designed by a registered professional engineer experienced with earthen dam design.

1.3.2.1 Recommendations Regarding the Hydrologic/Hydraulic Safety

CDM Smith does not have any recommendations.

1.3.2.2 Recommendations Regarding the Technical Documentation for Structural Stability

CDM Smith does not have any recommendations.

1.3.2.3 Recommendations Regarding Field Observations

The following recommendations for maintenance repairs, monitoring, and studies are offered to help improve the condition of the Plant Crist's CCW impoundments.

<u>Gypsum Storage Pond</u>

- ✓ Animal burrows – Animal burrows were observed on the west and east exterior slopes of the Gypsum Storage Pond. Although not seen on other areas, vegetation cover may have hidden additional animal burrows. CDM Smith recommends documenting areas disturbed by animal activity, removing the animals and backfilling the burrows with compacted structural fill to protect the integrity of the embankments.

- ✓ Areas of possible seepage – Areas of possible seepage were observed near the south corner of the impoundment, at the toe of the southwest embankment; a second area of possible seepage was observed at the toe of the east embankment. CDM Smith recommends regular monitoring of embankment slopes to detect and monitor seepage. The monitoring program should include measuring/documenting of the rate, volume, and turbidity of flow emerging from the embankment slopes.

- ✓ Voids and missing riprap - Voids within riprap armor and missing riprap were observed on the west embankment's exterior slope. CDM Smith recommends that the existing riprap be removed and the embankment slope restored to no steeper than 2.5H:1V or the original contour (whichever is flatter) with compacted structural fill. Riprap (similar size to existing), consisting of a heterogeneous mixture of irregular-shaped rocks should be placed over the compacted fill and a geotextile fabric.

- <u>Process Sedimentation Pond</u>

  - ✓ Erosion rills – Erosion rills were observed on the north exterior slope of the Process Sedimentation Pond. Structural fill should be placed and compacted in the rills and graded to adjacent existing contours. It is recommended that these areas be covered with sod or hydro-seeded to establish vegetative cover.

  - ✓ Seepage - Areas of possible seepage were observed on the northeast embankment, adjacent to the access road to the crest. CDM Smith recommends regular monitoring of embankment slopes to detect and monitor seepage. The monitoring program should include measuring/documenting of the rate, volume, and turbidity of flow emerging from the embankment slopes.

- <u>Process Return Water Pond</u>

  - ✓ CDM Smith does not have any recommendations.

1.3.2.4 Recommendations Regarding Surveillance and Monitoring Program

Regular monitoring is essential to detect and monitor seepage and to reduce the potential for failure. CDM Smith recommends if seepage areas are observed, services of a qualified engineer should be retained by Gulf Power to assess the area of seepage and recommend remedial actions. Inspections should be made following periods of heavy and/or prolonged rainfall and/or high water events on the Escambia River, and the occurrence of these events should be documented. Inspection records should be retained at the facility for a minimum of three years.

1.3.2.5 Recommendations Regarding Continued Safe and Reliable Operation

Currently the State of Florida does not require Emergency Action Plans (EAPs) for CCW impoundments. Gulf Power provided a copy of Southern Company Generation's Emergency Action Plan dated December 13, 2012. The plan references "Ash Pond/Gypsum Dike Failure" and "Dike Failure" under the heading "Site Specific Occurrence Annexes & Information". The EAP does not include a general location plan, a site plan, names and phone numbers of internal and external emergency contacts, or descriptive information regarding the CCW impoundments. CDM Smith recommends that Gulf Power develop a site-specific EAP for the CCW impoundments.

1.4 Participants and Acknowledgment

1.4.1 List of Participants

CDM Smith representatives William Fox, P.E. and Eduardo Gutiérrez-Pacheco, P.E. were accompanied during the visual assessment of the impoundments by representatives from Gulf Power, USEPA, and FDEP which included the following individuals:

Company	Name and Title
Gulf Power	James O. Vick, Environmental Affairs Director
Gulf Power	Michael Markey, Land and Water Programs Manager
Southern Company	James C. Pegues, P.E., Geotechnical Engineer, Principal
Hopping Green & Sims	Mike Petrovich, Legal Consultant
Beggs & Lane	Russell A. Badders, Legal Consultant
USEPA	Craig Dufficy, Environmental Engineer
FDEP	Dan Stripling, Wastewater Compliance Representative
FDEP	Kim Allen, Wastewater Compliance Representative
FDEP	Tracy Freiwald, P.G., Bureau of Mining and Minerals Regulation
FDEP	Owete S. Owete, PhD, P.E., Program Administrator, Bureau of Mining and Minerals Regulation

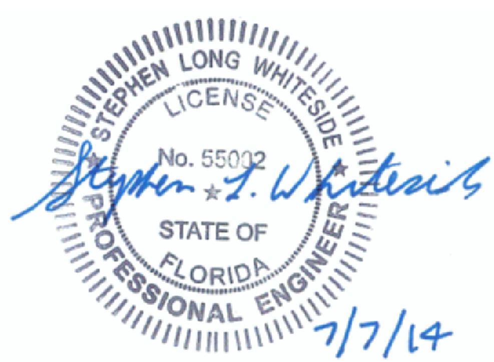
Representatives from USEPA and FDEP were only present during the impoundment assessment on August 20, 2012.

1.4.2 Acknowledgement and Signature

CDM Smith acknowledges that the Ash Pond, Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond referenced herein were assessed by William L. Fox, P.E. and Eduardo Gutiérrez-Pacheco, P.E. As indicated in Section 1.2, the Ash Pond falls outside the scope of this assessment effort. Based on documentation provided, the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond are rated **SATISFACTORY.**

We certify that the CCW impoundments referenced herein have been assessed on August 20 and 21, 2012.

Stephen L. Whiteside, P.E.
Vice President
Florida Registration No. 55002



Section 2

Description of the Coal Combustion Waste Impoundments

2.1 Location and General Description

Plant Crist is located in Escambia County, at 11999 Pate Street, Pensacola, FL 32514 (Latitude: 30° 33' 54.76" N, Longitude: 87° 13' 37.33"W). The plant is located along the west bank of the Escambia River as shown on **Figure 2-1.** Critical infrastructure within approximately five miles downgradient of Plant Crist is shown on **Figure 2-2.** An aerial view of Plant Crist including the CCW impoundments is shown on **Figure 2-3. Table 2-1** shows a summary of the approximate size and dimensions of the CCW impoundments.

Table 2-1 – Summary of CCW Impoundments Approximate Dimensions and Size

	CCW Impoundments		
	Gypsum Storage Pond	Process Sedimentation Pond	Process Return Water Pond
Dam Height (feet)	32	34	23
Average Crest Width (feet)	20	20	20
Length (feet)(1)	3,000	1,300	1,500
Interior Slopes H:V	2:1	3:1	3:1
Exterior Slopes H:V	3:1	3:1	3:1

Note: 1Length was measured along the perimeter embankment crest of each impoundment.

The divider embankment between the Gypsum Storage Pond and the Process Sedimentation Pond is about 600 feet long.

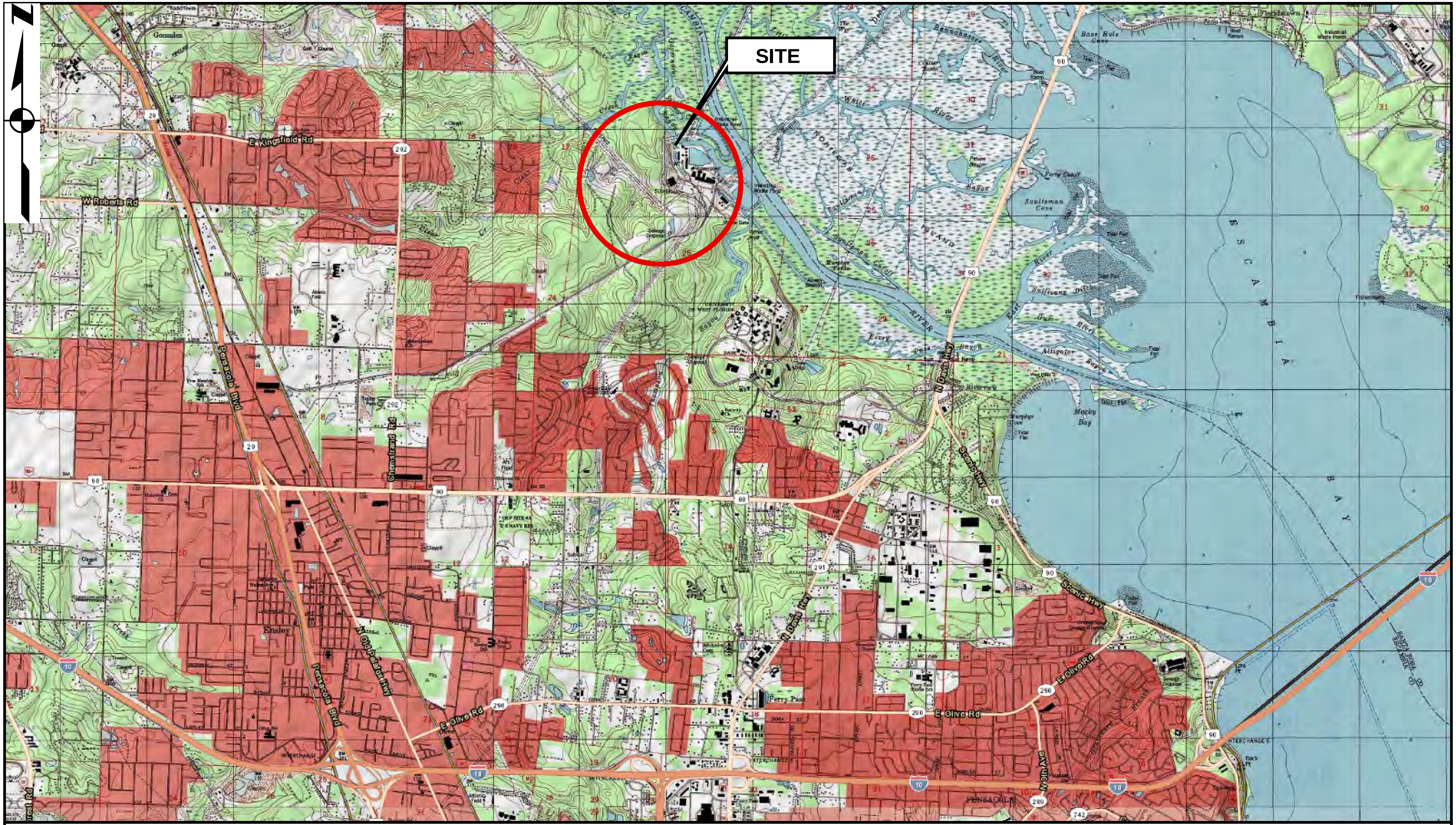
2.1.1 Horizontal and Vertical Datum

Site surveys provided by Gulf Power to CDM Smith used the horizontal and vertical control network established by the National Geodetic Survey (NGS) District. Horizontal survey data in this study reference the North Zone of the Florida State Plane Coordinate System based on North American Datum (NAD) of 1983, 2007 adjustment. Elevations noted herein are in feet and are referenced to 1988 North American Vertical Datum (NAVD 88), unless otherwise noted.

2.1.2 Site Geology

Plant Crist is located along the western bank of the Escambia River. Based on review of the USGS Topographic Map, natural ground surface elevations in the area of the CCW impoundments range from approximately El. 0 to 60. According to the Geologic Map of Florida, Plant Crist is located in the Citronelle Formation that consists of soils deposited in an ancient marine environment. Plant Crist is located in an area of recent alluvial, coastal, and low terrace deposits, water-deposited during the meandering and flooding of the Escambia River. These deposits consist of unconsolidated to poorly consolidated clean to clayey sands and areas containing significant amounts of clay, silt, and gravel.

Boring logs and the subsurface soil profile for the Ash Pond, included in **Appendix A,** indicate that existing soils present within and below the embankments consist of loose to medium dense clayey



CDM Smith

FIGURE 2-1

LOCUS PLAN

GULF POWER - PLANT CRIST

PENSACOLA, FLORIDA

CDM Smith

0 1,000 2,000 4,000 6,000 8,000 Feet

FIGURE 2-2
CRITIDAL INFRASTRUCTURE PLAN
GULF POWER - PLANT CRIST
PENSACOLA, FLORIDA

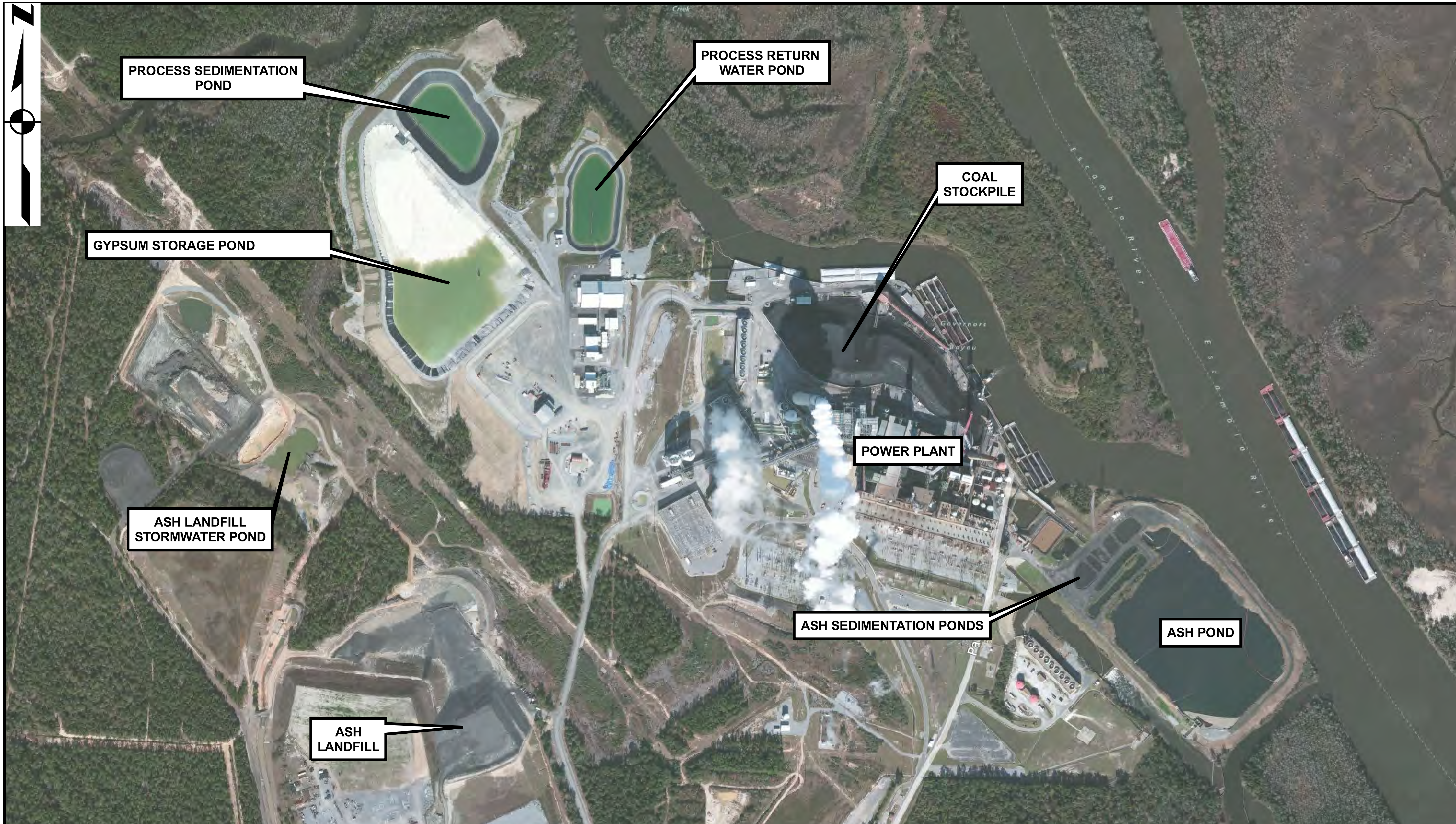


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FIGURE 2-3
AERIAL PLAN
GULF POWER - PLANT CRIST
PENSACOLA, FLORIDA

sand and silty sand, with varying amounts of organic clays and fine sand, underlain by very soft to soft clay and silt layers over a medium dense silty sand stratum.

The June 2007, "*Plant Crist Gypsum Storage Area Hydrogeological and Geotechnical Investigation Report*", prepared by Earth Science and Environmental Engineering Technical Services Southern Company Generation (ES&EE) used historical data from Standard Penetration Tests (SPT.) Subsurface materials encountered were generally a mix of sands, clays and silts, but primarily sandy soils. The June 2007 ES&EE report is included in **Appendix A**.

2.2 Coal Combustion Residue Handling

Bottom ash and fly ash from Plant Crist are hauled by trucks to an on-site landfill located about one-half mile west of the power station. Gypsum is sluiced to the Gypsum Storage Pond where it is dried and stacked. Decant water from the Gypsum Storage Pond overflows to the adjacent Process Sedimentation Pond and Process Return Water Pond. Gulf Power's Plant Crist is not a slag-production type furnace, however a small amount of boiler slag is typically found in the bottom ash. Gulf Power's stated belief is the amount of CCW within the Process Sedimentation Pond and Process Return Water Pond is *de minimis*. CCW was dredged from the Ash Pond approximately 20 years ago. It is currently used as a wastewater pond.

2.3 Size and Hazard Classification

According to the United States Army Corps of Engineers (USACE) Guidelines for Safety Inspection of Dams (1979), the impoundments may be placed in the size classification per **Table 2-2.**

Table 2-2 - USACE ER 1110-2-106 Size Classification

Category	Impoundment	
	Storage (Ac-ft)	Embankment Height (Ft)
Small	50 to < 1000	25 to < 40
Intermediate	1000 to < 50,000	40 to < 100
Large	> 50,000	> 100

Based on storage capacity and embankment height, Plant Crist impoundments are considered SMALL impoundments.

It is not known if Plant Crist impoundments currently have a Hazard Potential Classification. Based on the USEPA classification system as presented on Page 2 of the USEPA checklist (**Appendix B**) and our review of the site and downstream areas, recommended hazard ratings have been assigned to the impoundments as summarized in **Table 2-3.**

Table 2-3 - Recommended Impoundment Hazard Classification Ratings

Impoundment	Recommended Hazard Rating	Basis
Gypsum Storage Pond	Significant Hazard	▪ Failure or miss-operation could result in environmental damage and economic loss and damage to plant infrastructure, operations and utilities. ▪ Loss of human life as a result of failure or miss-operation is not anticipated. ▪ A breach could release waste into the Process Sedimentation Pond which may result in a breach of the Process Sedimentation Pond and cause environmental impacts to the Escambia River and adjacent lands.

Table 2-3 - Recommended Impoundment Hazard Classification Ratings (continued)

Impoundment	Recommended Hazard Rating	Basis
Process Sedimentation Pond	Significant Hazard	▪ Failure or miss-operation could result in environmental damage and economic loss and damage to plant infrastructure, operations and utilities including transmission towers supporting high voltage overhead power circuits within 160 feet of the impoundment. ▪ Loss of human life as a result of failure or miss-operation is not anticipated. ▪ Failure or miss-operation could have an environmental impact on the Escambia River. Discharge from a breach of the east embankment would likely flow into Governor's Bayou, situated 600 feet northeast of the impoundment, and then 0.7 miles south to the Escambia River. Discharge from a breach of the northwest embankment would likely flow into Clear Creek, situated 350 feet northeast of the impoundment, then to Governor's Bayou, and then to the Escambia River.
Process Return Water Pond	Significant Hazard	▪ Failure or miss-operation could result in environmental damage and economic loss and damage to plant infrastructure, operations and utilities including transmission towers supporting high voltage overhead power circuits within 160 feet of the impoundment. ▪ Loss of human life as a result of failure or miss-operation is not anticipated. ▪ Failure or miss-operation could have an environmental impact on the Escambia River. Discharge would likely flow to Governor's Bayou, situated 150 feet east of the impoundment, and then 0.7 miles south to the Escambia River.

2.4 Amount and Type of Residuals Currently Contained in the Unit(s) and Maximum Capacity

At the time of the assessments, CDM Smith did not have information on the amounts of residuals currently stored in the units. The pool area of the Ash Pond is approximately 13 acres. The pool areas of the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond are approximately 14, 3, and 2½ acres, respectively. Currently, the Ash Pond receives runoff from stormwater, plant operations, and the coal stockpile. Gypsum, a by-product from the plant's flue gas desulfurization system (FGD scrubber) is sluiced to the Gypsum Storage Pond for dewatering and storage. Decant water from the Gypsum Storage Pond overflows to the adjacent Process Sedimentation Pond and Process Return Water Pond.

2.5 Principal Project Structures

Principal structures of the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond system include the following:

- Inlet pipes located at the east corner of the Gypsum Storage Pond.
- A riser structure located near the east-central portion of the Gypsum Storage Pond
- A concrete box culvert between the Gypsum Storage Pond and the Process Sedimentation Pond.
- Earthen perimeter embankments composed of compacted soil.

- Composite liner systems and full underdrain systems.
- Concrete pipes and manhole structures between the Gypsum Storage Pond and Process Sedimentation Pond, and between the Process Sedimentation Pond and Process Return Water Pond.

Principal structures of the Ash Pond include the following:

- A set of two, 30-inch-diameter steel inlet pipes located at the north corner of the pond.
- A series of five settling ponds incised in the northwest embankment connected with 36-inch-diameter corrugated HDPE pipes.
- Earthen perimeter embankments composed of compacted soil.
- A concrete spillway outlet structure located near the south corner of the pond.

2.6 Critical Infrastructure within Five Miles Downgradient

Based on available topographic maps, surface drainage in the vicinity of Plant Crist appears to be to the southeast toward Escambia Bay. Critical infrastructure, including schools, hospitals, waterways, roadways and bridges, and other major facilities, identified within five miles downgradient of Plant Crist includes the following:

- University of West Florida campus.
- Nativity of Our Lord Catholic Church.
- East Hill Church of Crist.
- St. Luke United Methodist Church.
- Northridge Church.
- Grace Baptist Church.
- Baptist Health Care Walk-in Center.
- Escambia River Barge Canal,
- Thompson Bayou.
- U.S. Highway 90.
- U.S. Highway 90 Bridge over Escambia River.
- Interstate 10 Bridge over Escambia Bay.

Discharge from the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond will flow into Governors Bayou and eventually into the Escambia River. There is no critical infrastructure between the impoundments and these waterways.

A breach of the impoundment embankments would most likely impact low-lying lands surrounding the plant and is not expected to result in loss of human life.

Section 3

Summary of Relevant Reports, Permits and Incidents

3.1 Summary of Reports on the Safety of the CCW Impoundments

At the time of CDM Smith's onsite assessment, no safety reports on the CCW impoundments were available. However, according to plant representatives, there have been no known structural or operational problems associated with the impoundments. No documentation was available to confirm or disprove this claim.

3.2 Summary of Local, State, and Federal Environmental Permits

Currently, the coal combustion waste (CCW) impoundments are regulated by Florida Department of Environmental Protection (FDEP).

Plant Crist was issued a permit under the National Pollutant Discharge Elimination System (NPDES) authorizing discharge to the Escambia River in accordance with effluent limitations, monitoring requirements, and other conditions set forth in the permit. The Plant's permit was issued on January 28, 2011. The permit number is FL0002275.

3.3 Summary of Spill/Release Incidents

According to plant representatives, there have been no known spills or releases related to the impoundment. No documentation was available to confirm or disprove this claim.

Section 4

Summary of History of Construction and Operation

4.1 Summary of Construction History

4.1.1 Impoundment Construction and Historical Information

The Plant began operation in the 1960's. The coal combustion waste (CCW) is currently generated by Unit 4 (on line since the 1960's), Unit 5 (on line since the 1970's), and Unit 6 and Unit 7 (on line since the 1980's). Units 1 through 3 are currently off line. These units were retired by 2006.

There are currently three CCW impoundments at Plant Crist, as shown on Figure 2-3, designated as Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond. The Ash Pond, the original CCW impoundment, was constructed in about 1960 (actual year was not readily available in the information provided by Gulf Power). As described in Section 1.2, the Ash Pond falls outside the scope of this assessment program.

The Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond were constructed between 2008 and 2010. Based on design drawings by Southern Company Generation Engineering and Construction Services, dated September, 2008 (revised July, 2010) provided by Gulf Power, the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond were constructed with "Compacted Type A Embankment Material". No details or specifications were found regarding the "Compacted Type A Embankment Material". The Gypsum Storage Pond was constructed by excavating to about El. 25 within the pond area and placing "Compacted Type A Embankment Material" up to about El. 57, with a 20-foot-wide embankment crest. An engineered composite liner system covers the bottom and entire interior slopes of the Gypsum Storage Pond. The Process Sedimentation Pond and the Process Return Water Pond bottoms were excavated to about El. 16 and El. 12, and embankment material placed up to El. 50 and El. 35 respectively. Interior slopes for the Process Sedimentation Pond and the Process Return Water Pond were constructed at 2H:1V and exterior slopes were constructed at 3H:1V . An engineered composite liner system covers the bottom and entire interior slopes of the Process Sedimentation Pond and the Process Return Water Pond.

As shown on Figure 2-3, the Gypsum Storage Pond and Process Sedimentation Pond share a common divider embankment.

The Ash Pond was reportedly constructed by excavating soil within the pond area to approximately EL. 0 and constructing embankments with a 15- to 25-foot-wide crest at elevations between about El. 17 and 20. Interior slopes were originally constructed at 4H:1V below the existing ground surface, and at 2H:1V above existing ground surface. Exterior slopes were constructed at 2H:1V. Original design drawings for the Ash Pond were not provided. Based on information provided by Gulf Power, the Ash Pond north embankment crest was re-graded to about El. 20 in 2011 when riprap slope treatment was installed along the toe of the exterior slope of the embankment.

Based on soil boring information available in the Ash Pond area, the embankment soils are mostly comprised of loose to medium dense clayey and silty sands. The foundation soils consist of soft clayey silts and silty clays underlain by very soft to soft clayey soils to a depth of about 20 feet below the original ground surface.

4.2 Summary of Operational Procedures

4.2.1 Current CCW Impoundment Configuration

The Ash Pond impoundment at Plant Crist had historically been used as a settling pond for CCW and reportedly other plant wastes. Wastewater streams that currently discharge into the Ash Pond include:

- Overflow from bottom ash dewatering bins.
- Neutralized demineralizer regeneration wastewater.
- Cooling tower blowdown.
- Boiler blowdown.
- Floor drainage.
- Auxiliary equipment cooling water and seal water.
- Coal pile runoff.
- Yard sump discharge, and treated metal cleaning wastewater.

The Gypsum Storage Pond is used for storage and primary settling and sedimentation of gypsum while the Process Sedimentation Pond and Process Return Water Pond are used for secondary and tertiary settling and sedimentation, respectively. Gypsum product is sluiced into the Gypsum Storage Pond through a 24-inch-diameter HDPE pipe located at the southeast corner pond. Decant water from the Gypsum Storage Pond flows to the Process Sedimentation Pond through either a Decant Riser Structure (located near the southeast corner of the pond) and a series of manhole structures and 30-inch-diameter reinforced concrete pipes (RCPs) or through a 7-foot-wide by 5-foot-high double-barrel concrete box culvert (located at the north corner of the Gypsum Storage Pond). Decant water from the Process Sedimentation Pond flows through a series of manhole structures and 30-inch-diameter RCPs into the Process Return Water Pond.

There is no offsite discharge of water from the Gypsum Storage Pond/Process Sedimentation Pond/Process Return Water Pond system. Water is stored in the Process Return Water Pond and eventually pumped back to the plant for reuse as plant make-up water.

The Ash Pond was used to store CCW until about 1993. Subsequently, CCW was dredged from the Ash Pond. FDEP recognized in their letter of March 28 2014 to Gulf Power, Gulf Power's cessation of coal ash storage and treatment in the Ash Pond. Ash produced at Plant Crist is now stored in a dry stack landfill. The Ash Pond is currently used as a wastewater pond. Prior to entering the Ash Pond, discharge water from the plant operations flows through a series of five (5) Ash Decant/Settling Ponds that have been formed within the northwest portion of the Ash Pond (water is pumped from plant operations into the southernmost and middle ponds). The Ash Decant/Settling Ponds are hydraulically connected by a series of 36-inch-diameter corrugated HDPE corrugated equalizer pipes. Water from the northernmost pond flows by gravity to the Ash Pond through two 30-inch-diameter steel pipes that discharge below an existing walkway/catwalk located at the north corner of the Ash Pond. An aerator/oxygenator device is located near the north corner of the Ash Pond. In addition, a series of turbidity barriers is present on the surface of the Ash Pond to create a baffle-type system and increase residence time. Water flows out of the Ash Pond by gravity through a concrete spillway structure located near the south corner of the pond.

The approximate embankment crest elevations and pond areas are shown in **Table 4-1.**

Table 4-1 – Approximate Elevations and Areas

Pond	Approximate Highest Crest Elevation (Feet)	Approximate Lowest Crest Elevation (Feet)	Approximate Pond Area[1] (Acres)
Gypsum Storage Pond	57	50	14
Process Sedimentation Pond [2]	50	44	3
Process Return Water Pond [2]	35	33	2.5

Notes: [1]Pond areas measured at approximate lowest crest elevation. [2] Lowest elevation located at emergency spillway.

Section 5

Field Observations

5.1 Project Overview and Significant Findings (Visual Observations)

CDM Smith performed visual assessments of the CCW impoundments at the Gulf Power Company Plant Crist site. The impoundments assessed include the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond. The perimeter and divider embankments of the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond are approximately 6,500 feet long with maximum heights of approximately 32, 34, and 23 feet, respectively. CDM Smith also performed a visual assessment of the Ash Pond, but as described in Section 1.2, the Ash Pond falls outside the scope of this assessment program. The perimeter and divider embankments of the Ash Pond, including the Ash Decant/Settling Ponds divider embankments, are approximately 5,100 feet long and are up to approximately 20 feet high.

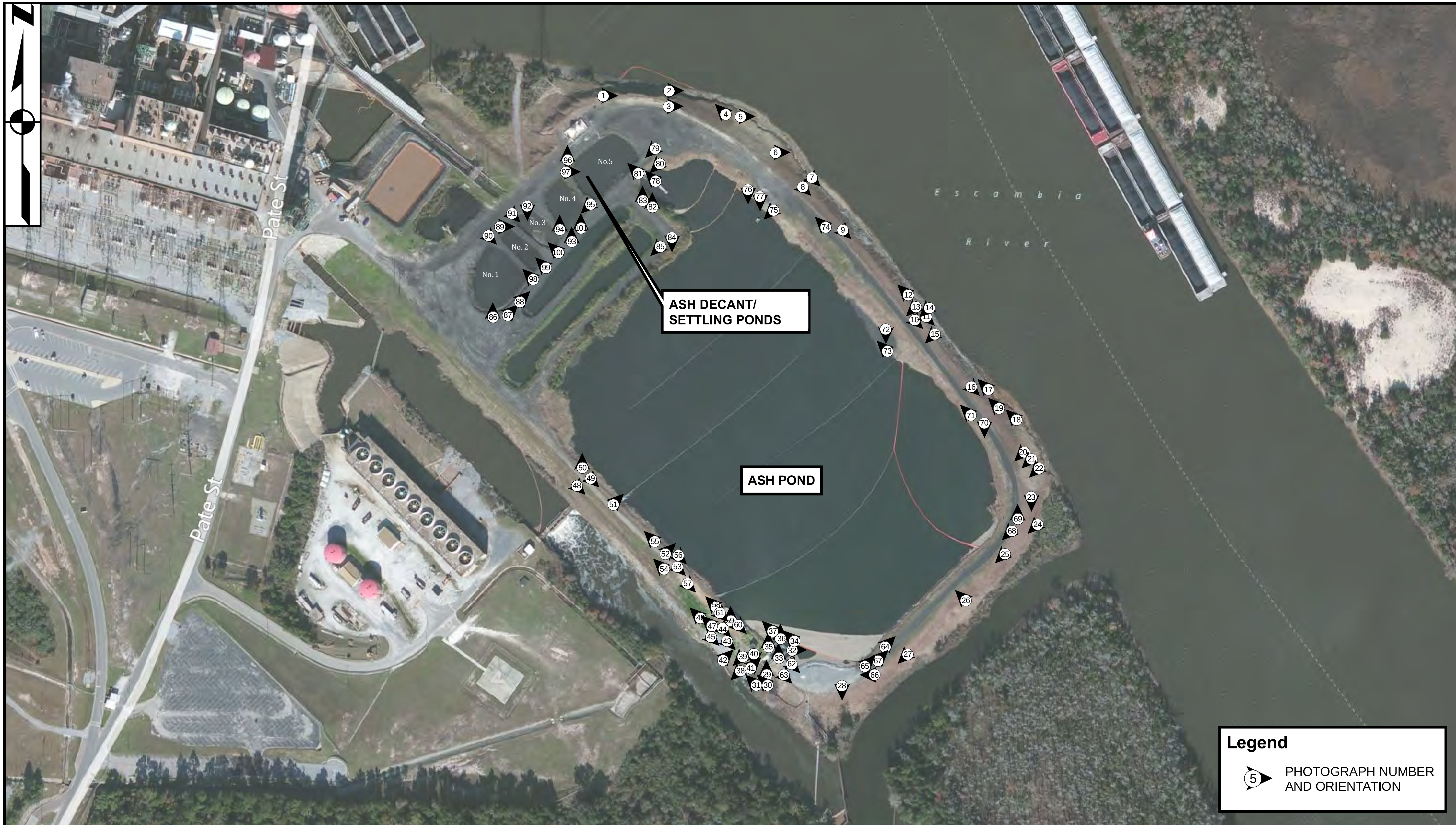
The assessments were completed following the general procedures and considerations contained in Federal Emergency Management Agency's (FEMA's) Federal Guidelines for Dam Safety (April 2004) to make observations concerning settlement, movement, erosion, seepage, leakage, cracking, and deterioration. A Coal Combustion Dam Inspection Checklist Form and a Coal Combustion Waste (CCW) Impoundment Inspection Form, developed by USEPA, were completed for each of the aforementioned impoundments. Copies of these forms are included in Appendix B. Photograph locations are shown on **Figures 5-1A** and **5-1B**, and photographs are included in **Appendix C**. Photograph locations were logged using a handheld GPS device. The photograph coordinates are listed in Appendix C**.**

CDM Smith visited the plant on August 20 and 21, 2012, to conduct visual assessments of the impoundments. The weather was generally cloudy with daytime high temperatures up to 80 degrees Fahrenheit. The daily total precipitation prior to the site visit is shown in **Table 5-1**. The data were recorded at Pensacola Regional Airport Station (13899), approximately 6½ miles south of the Plant.

Table 5-1 – Approximate Precipitation Prior to Site Visit

Dates of Site Visits – August 20, 2012 & August 21, 2012		
Day	**Date**	**Precipitation (inches)**
Sunday	August 19	0.25
Saturday	August 18	0.05
Friday	August 17	0.54
Thursday	August 16	0.55
Wednesday	August 15	1.51
Tuesday	August 14	0.30
Monday	August 13	0.33
Sunday	August 12	0.00
Total	**(August 1 - 19, 2012)**	**8.61**
Total	**Month Prior to Site Visit (July 2012)**	**8.99**

Note: Precipitation data from www.fsu.edu, Station Location: Pensacola Regional Airport (13899), Pensacola, FL Lat. 30.478; Lon. -87.186; EL. 112 ft above sea level.



CDM Smith

0 100 200 400 600 800 Feet

FIGURE 5-1A
PHOTOGRAPH LOCATION PLAN
GULF POWER - PLANT CRIST
PENSACOLA, FLORIDA

0 125 250 500 750 1,000 Feet

FIGURE 5-1B
PHOTOGRAPH LOCATION PLAN
GULF POWER - PLANT CRIST
PENSACOLA, FLORIDA

5.2 Gypsum Storage Pond

The Gypsum Storage Pond photograph locations are shown on Figure 5-1B**.** The pond had areas of standing water and stacked gypsum, with approximately 9 feet of freeboard (Photographs 102 and 103). A portion of the pond's northeast embankment serves as a divider between the Gypsum Storage Pond and the Process Sedimentation Pond. The ponds are hydraulically connected by a 5-foot-high by 7-foot-wide double-barrel concrete box culvert (Photographs 167 to 171).

5.2.1 Crest

The crest of the Gypsum Storage Pond embankments appears to be in **SATISFACTORY** condition (Photographs 104, 172 and 173). The average crest width is approximately 20 feet. The crest surface is gravel-covered without vegetation. No depressions, misalignments, cracks, ruts, or evidence of settlement were observed along the crest of the Gypsum Storage Pond embankments.

5.2.2 Interior Slope

The textured composite HDPE liner (Photographs 174 and 175) is exposed on the interior slopes of the embankments. No signs of tears, leaks, or excessive wear were observed. The interior slopes generally appear be approximately 2H:1V. The embankment interior slopes appear to be in **SATISFACTORY** condition. Slopes appear to be straight and uniform, and no signs of bulging were observed.

5.2.3 Exterior Slope

In general, the exterior slopes of the Gypsum Storage Pond appear to be in **SATISFACTORY** condition. Slopes are approximately 3H:1V with the exception of the west embankment slope which appears to be approximately 2.5H: 1V. Embankment vegetation consisted mainly of well-maintained grass approximately 4 to 6 inches tall, with the exception of the west and northwest embankments (Photographs 117, 119 and 120). The exterior slopes of the west and northwest embankments are armored with a layer of riprap from the toe of the slope, extending approximately 30 feet up the slope then well-maintained grass approximately 4 to 6 inches tall up to the crest (Photographs 121 to 125).

The alignment of the slopes appears to be relatively uniform and consistent. Animal burrows (Photographs 129, 130 and 154) were observed on the west and east embankments. Discontinuities and collapsed areas of the riprap-covered slope (Photographs 122 and 123) and areas where the underlying filter fabric was exposed (Photographs 124 and 125) were also observed on the west embankment.

Two areas of possible seepage were observed. The first is located near the toe of slope of the southwest embankment, adjacent to the south corner (Photographs 109 to 112). The second is located at the toe of slope of the east embankment (Photographs 155 to 158). The first area consisted of saturated soils and standing water on the perimeter road/maintenance bench, and the second area consisted of saturated soils and ponded water observed within the voids of the riprap. No underlying filter fabric was observed in this area.

Monitoring wells were observed beyond the toe of slope of the west and north embankments (Photographs 118 and 139).

5.2.4 Outlet Structure

The Gypsum Storage Pond outlet structure consists of a decant riser (Photographs 105 and 106) located approximately 220 feet from the crest of the northeast embankment. From the limited view due to the distance, the riser appeared to be free of debris and in good operating condition.

5.3 Process Sedimentation Pond

The Process Sedimentation Pond photograph locations are shown on Figure 5-1B**.** The Process Sedimentation Pond contained standing water during the assessment, with approximately 4½ feet of freeboard. The southwest embankment of the pond serves as a divider embankment with the Gypsum Storage Pond. Water levels within this pond are hydraulically connected with the Gypsum Storage Pond by the aforementioned box culvert (Photograph 151).

5.3.1 Crest

The crest of the Process Sedimentation Pond appeared to be in **SATISFACTORY** condition (Photograph 164). The average crest width is approximately 20 feet. The crest surface is gravel-covered without vegetation. No depressions, ruts, or evidence of settlement were observed on the crest. An emergency spillway, approximately 56 feet wide, is located near the northeast corner of the pond. The spillway crest is depressed approximately 3 feet (Photograph 150).

5.3.2 Interior Slope

The interior slopes of the pond appear to be in **SATISFACTORY** condition. The textured HDPE liner (Photograph 164) is exposed on the interior slopes of the pond, and no signs of tear and wear were observed. The interior slopes are approximately 2H:1V. Slopes appear to be straight and uniform, and no signs of bulging were observed.

5.3.3 Exterior Slope

Exterior slopes of the Process Sedimentation Pond appear to be in **SATISFACTORY** condition. Slopes are approximately 2H:1V. With the exception of the northwest embankment, exterior slopes are covered with well-maintained grass about 4 to 6 inches tall (Photograph 146). The exterior slopes of the northwest embankment are covered with riprap from the toe of slope to approximately 30 feet up the slope and then well-maintained grass about 4 to 6 inches tall up to the crest (Photographs 140 and 145). A maintenance road to access the crest is located near the northeast corner of the pond.

The alignment of the slopes appears to be uniform and consistent. No signs of bulging, sloughing or slope failure were observed. Shallow to intermediate surface erosion and erosion rills were observed on the north embankment slope (Photographs 132 to138). No animal burrows were observed. Filter fabric beneath the riprap slope treatment was exposed at several locations (Photograph 141) on the northwest embankment.

The downstream side of the emergency overflow spillway is armored with interlocked articulated concrete block mattresses (Photographs 147 to 150). The mattresses appeared to be in good condition with grass and vegetation growing in the open spaces in and between the blocks.

Areas of possible seepage were observed on the northeast embankment, adjacent to the access road to the crest. These areas were saturated and standing water was observed at the toe of slope (Photographs 142 to 144).

Monitoring wells were observed beyond the toe of slope, in a wooded area south of the Process Sedimentation Pond (Photograph 152).

5.3.4 Outlet Structures

The outlet pipes from the Process Sedimentation Pond to the Process Return Water Pond were submerged at the time of the assessment. Based on information provided by Gulf Power, the pipes are 24- and 30-inch-diameter RCPs.

5.4 Process Return Water Pond

The Process Return Water Pond photograph locations are shown on Figure 5-1B**.** The Process Return Water Pond contained standing water during the assessment, with approximately 8 feet of freeboard and an embankment height of about 23 feet at the west embankment. The pond is incised along the northeast, east, south sides and has earthen embankments along on the northwest and west sides. The pond receives water from the Process Sedimentation Pond.

5.4.1 Crest

The crest appeared to be in **SATISFACTORY** condition (Photographs 184, 186 and 188). The average crest width is approximately 20 feet. The crest surface is gravel-covered without vegetation. No depressions, ruts, or evidence of settlement were observed on the crests. An emergency spillway, approximately 55 feet wide, is located approximately midway along the west embankment of the pond. The spillway crest is depressed approximately 2 feet (Photographs 187 and 188).

5.4.2 Interior Slope

The interior slopes appear to be in **SATISFACTORY** condition. The textured HDPE liner (Photographs 178 and 181) is exposed on the interior slopes of the pond. No signs of tears, leaks, or excessive wear were observed. The interior slopes are approximately 2.5H:1V. Slopes appear to be straight and uniform, and no signs of bulging were observed.

5.4.3 Exterior Slope

Exterior slopes of the west and northwest embankments appear to be in **SATISFACTORY** condition. Slopes are approximately 2H:1V. The exterior slopes of the northwest embankment are armored with a layer of riprap (Photographs 191 and 192) from the toe of slope extending approximately 20 feet up the slope and then well-maintained grass approximately 4 to 6 inches tall up to the crest (Photograph 185). The west embankment exterior slope is covered with well-maintained grass approximately 4 to 6 inches tall.

The alignment of the slopes appears to be uniform and consistent. No signs of erosion or animal burrows were observed in this area. Filter fabric beneath the riprap slope treatment was exposed at several locations (Photograph 192) on the northwest embankment.

The downstream side of the emergency spillway is armored with interlocked articulated concrete block mattresses (Photographs 189 to 190). The mattresses appeared to be in good condition with grass and vegetation growing in the open spaces in and between the blocks.

Monitoring wells were observed beyond the toe of slope on the north embankment (Photograph 183).

5.4.4 Outlet Structures

The Process Return Water Pond does not have an outlet structure or gravity outfall pipes. Water from the Process Return Water Pond is pumped to the plant on an as-needed basis. Pump intake pipe(s) were submerged at the time of the assessment. Based on information provided by Gulf Power, the pipes are 24- to 30-inch-diameter RCPs located near the southwest corner of the pond.

5.5 Ash Pond and Ash Decant/Settling Ponds

The Ash Pond photograph locations are shown on Figure 5-1A. The inspection of the Ash Pond includes five (5) Ash Decant/Settling Ponds that have been formed within the northwest portion of the Ash Pond through construction of divider embankments. The divider embankments appear to be constructed of a mixture of soil and ash. It was indicated by Plant personnel that the Ash Decant/Settling Ponds are dredged as necessary during normal operations to remove accumulated sediments. The Ash Decant/Settling Ponds are inter-connected by 36-inch-diameter HDPE equalizer pipes. The divider embankments that form the two rectangular-shaped ponds, immediately adjacent to the main Ash Pond were inaccessible due to dense vegetation and, therefore, could not be readily observed. At the time of the assessment, the Ash Pond reportedly contained sediment and water with approximately 3 feet of freeboard. The Ash Decant/Settling Ponds contained standing water and waste/sediments with approximately 4 feet of freeboard.

For convenience, observations made regarding Ash Pond embankments are presented separately from observations made regarding the divider embankments that form the Ash Decant/Settling Ponds.

5.5.1 Ash Pond Crest

The crest width ranged from 15 to 25 feet. (Photographs 55, 56 and 66-69). The crest surface consists of compacted granular soils and gravel and is exposed to vehicle traffic. Puddles and shallow ruts (Photograph 57) were observed on the southwest portion of the crest. The crest along the northwest divider embankment between the Ash Pond and the settling ponds is grass covered, with the grass approximately up to 24 inches high (Photographs 84 and 85). A shallow depression caused by erosion on the crest was observed near the south corner of the pond in the vicinity of the former outfall structure (Photographs 59 to 61). The area is located behind the existing sheet pile wall along the interior slope. No other depressions or evidence of settlement were observed on the crest. An animal burrow was also observed in the southwest crest (Photograph 52).

5.5.2 Ash Pond Interior Slope

The exposed portions of the interior slopes on the southwest embankment are steeper than 2H:1V at approximately 1H:1V. Short grass up to 6 inches tall covers the interior slopes. Significant erosion of the embankment starting at the waterline was observed near the south corner of the pond in the southeast embankment (Photograph 64). Scarps and eroded areas were observed along the interior slopes of the southwest embankment (Photographs 49, 53 and 58). A delta is located along the interior slope of the northeast embankment (Photographs 72 and 73).

Inlet pipes are located at the north corner of the Ash Pond and consist of two 30-inch-diameter steel pipes (Photographs 78 and 81 to 83).

5.5.3 Ash Pond Exterior Slope

The exterior slopes of the embankments are approximately 2H:1V. The exterior slopes of the embankments are covered with short grass, approximately 4 to 6 inches tall. The Escambia River

(River) flows along the northeast embankment. Riprap armoring has been placed on the northeast corner and the lower portion of the northeast embankment adjacent to the River (Photographs 1 and 7-11). Areas of erosion and shallow scarps were observed along the toe of the northeast embankment's exterior slope, where riprap armoring had not been placed (Photographs 15 to19). Animal burrows (Photographs 13, 14 and 23) were observed on the northeast slope as well as near the southeast corner of the pond. Tree stumps between 6 and 18 inches in diameter from previous vegetation clearing were also observed (Photographs 20 and 21).

Wet soils were observed at the toe of slope, near the southeast corner of the pond (Photographs 22), but no seepage or flowing water appeared to be associated with this wet area. Due to recent rainfall the observed standing water could not be clearly identified as seepage. Shallow depressions and scarps (Photographs 27 and 29) were observed on the slope and at the toe of slope, respectively, on the southwest corner.

5.5.4 Ash Pond Outlet Structure

The outlet structure consists of a concrete spillway (Photographs 31 to 34) located near the south corner of the pond. The spillway has reportedly been in operation for about 2 years.

5.5.5 Ash Decant/Settling Ponds Crest

The average crest width is approximately15 feet. The crests of the divider embankments between ponds show signs of significant erosion due to concentrated rainfall runoff (Photographs 79, 88 and 98). No depressions, ruts, or evidence of settlement were observed on the crests. Dense vegetation and trees up to 4 inches in diameter were observed on the southeast divider embankment between Ash Decant/Settling pond 7 and the Ash Pond (Photograph 85).

5.5.6 Ash Decant/Settling Ponds Interior Slope

The exposed slopes vary from approximately 1H:1V to 1.5H:1V. Vegetative cover on the interior slopes is sparse. Erosion rills were observed on the interior slopes of all the Decant/Settling Ponds. Interior slopes show signs of deterioration, erosion, and scarped areas. The embankments' interior toe is generally buried (Photographs 98, 99 and 100). At the time of assessment, Pond #3 was receiving discharge water from plant operations (Photograph 92).

5.5.7 Ash Decant/Settling Ponds Exterior Slope

The Ash Decant/Settling Ponds are inside the northwest portion of the embankment for the Ash Pond. Therefore, no exterior slopes are present.

5.5.8 Ash Decant/Settling Ponds Outlet Structures

The outlets from the Ash Decant/Settling Ponds consist of two 30-inch-diameter steel pipes located near the east corner of Pond #5. The pipe inverts were submerged at the time of inspection. Water appeared to be flowing freely through the outlet pipes to the Ash Pond (Photograph 78).

Section 6

Hydrologic/Hydraulic Safety

6.1 Impoundment Hydraulic Analysis

The State of Florida does not currently have requirements related to the hydrologic or hydraulic design of CCW impoundments. FEMA guidelines recommend impoundments to have the capacity to pass and/or store some percentage of the Probable Maximum Precipitation (PMP) for a 6-hour storm event over a 10-square-mile area in the vicinity of the site. Significant hazard structures are required to store the 50% PMP, 6-hour rainfall event.

Based on the USEPA classification system as presented on Page 2 of the USEPA checklist and our review of the site and downstream areas, a recommended hazard rating of SIGNIFICANT has been assigned to the Crist CCW impoundments as summarized in Table 2-3, Section 2.3. Significant hazard structures are required to store precipitation associated with the 50% PMP storm event. Gulf Power provided CDM Smith with hydrologic and hydraulic analyses of Plant Crist CCW impoundments for 25- and 100-year, 24-hour and the 50% PMP storm events.

6.2 Adequacy of Supporting Technical Documentation

H&H documentation has been provided for the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond for the storm events analyzed, including the 50% PMP event.

6.3 Assessment of Hydrologic/Hydraulic Safety

Hydrologic/hydraulic safety of the CCW impoundments appears to be satisfactory under normal operating conditions based on the following:

- Recent H&H analyses of the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond system are well documented and, in general, determined that adequate freeboard and capacity are provided for the 50% PMP storm event.
- During visual observations and site assessments, no signs of plugged, collapsed or blocked pipes, or other detrimental conditions were observed.
- Adequate freeboard was observed at the time of the assessments.

H&H analyses and documentation have been provided, therefore the CCW impoundments are rated as SATISFACTORY.

Section 7

Structural Stability

7.1 Supporting Technical Documentation

Gulf Power provided stability analyses for the Gypsum Storage Pond, Process Sedimentation Pond and Process Return Water Pond, dated January 28, 2014. The analyses were performed by Southern Company Services, Inc. (SCS). Conditions analyzed included steady-state and seismic loading with the pond at maximum surcharge level. Slope stability analyses for rapid drawdown conditions were not provided. Gulf Power also provided CDM Smith with liquefaction potential analyses for the Process Sedimentation Pond, Process Return Pond Ash Pond, Gypsum Storage Pond and Ash Pond, dated January 27, 2014. The January 27, 2014 analyses supersede the liquefaction potential analyses, previously provided to CDM Smith for the Ash Pond and Gypsum Storage Pond, dated September 6, 2012.

Gulf Power provided CDM Smith with slope stability analyses performed for the Ash Pond embankments dated August 17, 2012. The slope stability analyses are based on geotechnical information obtained along the Ash Pond embankments by Gulf Power in 1992 and 2010.

7.1.1 Stability Analyses and Load Cases

Currently the State of Florida does not have regulations regarding CCW impoundments. Procedures established by the United States Army Corps of Engineers (USACE), the United States Bureau of Reclamation, the Federal Energy Regulatory Commission, and the Natural Resources Conservation Service are generally accepted engineering practice. Minimum required factors of safety outlined by the USACE in EM 1110-2-1902, Table 3-1 and seismic factors of safety by FEMA Federal Guidelines for Dam Safety, Earthquake Analyses and Design of Dams are provided in **Table 7-1.**

Table 7-1 Minimum Safety Factors

Load Case	Minimum Required Factor of Safety[1]
Steady-State Condition at Normal Pool or Maximum Storage Pool Elevation	1.5
Rapid Drawdown Condition from Normal Pool Elevation	1.3
Maximum Surcharge Pool (Flood) Condition	1.4
Seismic Condition from at Normal Pool Elevation	1.0
Liquefaction	1.3

Notes: [1]Above factors of safety are based on requirements established by the USACE. Required safety factors have not been established by the State of Florida for CCW impoundments.

7.1.1.1 Gypsum Storage Pond, Process Sedimentation Pond and Process Return Water Pond

Stability analyses for the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond, dated January 28, 2014, were provided to CDM Smith. The analyses were performed by Southern Company Services, Inc. (SCS). Conditions analyzed included steady-state and seismic loading with the pond at maximum surcharge level. Slope stability analyses for rapid drawdown conditions were not provided. Rapid drawdown was not considered due to the low-permeability liners preventing saturation of underlying soil. CDM Smith agrees that analysis of rapid drawdown is not necessary, based on the presence of low permeability liners.

7.1.1.2 Ash Pond

Gulf Power provided CDM Smith with slope stability analyses performed for the Ash Pond embankments dated August 17, 2012. The slope stability analyses are based on geotechnical information obtained along the Ash Pond embankments by Gulf Power in 1992 and 2010. The soil properties used for the analyses were obtained from blow counts from borings drilled on the embankments, dilatometer data, and triaxial shear testing performed in 1992, and additional cone penetration test (CPT) soundings performed in 2010.

As described in Section 1.2, the Ash Pond falls outside the scope of this assessment effort.

7.1.2 Design Parameters and Dam Materials

Gulf Power representatives provided some construction drawings related to the original construction of the Ash Pond, Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond. Soil properties of unit weight, friction angle, and cohesion were taken from a June 2007 Plant Crist Gypsum Storage Area Hydrogeological and Geotechnical Investigation Report by the Earth Science and Environmental Engineering (ES&EE) group of Southern Company Generation.

7.1.2.1 Gypsum Storage Pond, Process Sedimentation Pond and Process Return Water Pond

General soil properties and soil parameters used for the slope stability analyses performed on the Gypsum Storage Pond are presented in Table 7-2.

Table 7-2 - Soil Parameters for the Gypsum Storage Pond Subsurface Profile

Stratum	Unit Weight (psf)	Effective Stress Parameters	
		Φ (degrees)	C (psf)
In Place Sand (base of disposal area)	110	30	100
Sand Berm	110	32	100
Compacted Gypsum Berm	85	40	0
Sluiced Gypsum prior to Consolidation	70	23	0
Sluiced Gypsum after Consolidation	80	25	0

Source: Plant Crist Gypsum Storage Area Hydrogeological and Geotechnical Investigation Report, prepared by ES&EE, June 2007.

The factors of safety computed for the different cases and cross sections of the Gypsum Storage Pond are included in **Table 7-3.**

Table 7-3 - Summary of Computed Factors of Safety for the Gypsum Storage Pond

Condition	Calculated Factor of Safety
Single Level Stack –Steady State	2.4
Single Level Stack –Seismic Loading	2.2
Full Stack –Steady State	2.4
Full Stack –Seismic Loading	2.2

Source: Engineering and Construction Services Calculation – for the Gypsum Storage Pond, Process Sedimentation Pond and Process Return Water Pond, prepared by Southern Company, January 28, 2014.

General soil properties and soil parameters used for the slope stability analyses performed on the Process Sedimentation Pond and Process Return Water Pond are presented in **Table 7-4.**

Table 7-4 - Soil Parameters for the Process Sedimentation Pond and Process Return Water Pond

Stratum	Unit Weight (psf)	Effective Stress Parameters	
		Φ (degrees)	C (psf)
In Place Silty Sand	110	30	100
Compacted Embankment	110	32	100

Source: Engineering and Construction Services Calculation – for the Gypsum Storage Pond, Process Sedimentation Pond and Process Return Water Pond, prepared by Southern Company, January 28, 2014.

The factors of safety computed for the different cases and cross sections of the Process Sedimentation Pond and Process Return Water Pond are included in **Table 7-5**.

Table 7-5 - Summary of Computed Factors of Safety for the Process Sedimentation Pond and Process Return Water Pond

Condition	Calculated Factor of Safety
Process Sedimentation Pond –Steady State	2.07
Process Sedimentation Pond –Seismic Loading	1.85
Process Return Water Pond –Steady State	3.03
Process Return Water Pond –Seismic Loading	2.67

Source: Engineering and Construction Services Calculation – Slope Stability Analyses of Gypsum Facility - Sedimentation and Return Water Ponds, prepared by Southern Company, January 28, 2014

7.1.2.2 Ash Pond

General soil properties and soil parameters used for the slope stability analyses performed on 6 different cross sections for the Ash Pond are presented in **Table 7-6.** The seismic analyses were performed based on Gulf Power's review of the USGS "Map for Peak Acceleration with 2% Probability of Exceedance in 50 Years"; the maximum horizontal acceleration is approximately 0.03g in the vicinity of Plant Crist.

Table 7-6 - Soil Parameters for the Ash Pond Subsurface Soil Profile

Stratum	Unit Weight (psf)	Effective Stress Parameters	
		Φ (degrees)	C (psf)
Clayey Sand 1	120	33	100
Clayey Sand 2	120	28	100
Clayey Silt	115	10	625
Silty Sand	120	30	100
Silty Clay	115	10	385
Silt and Clay	115	10	115
Sand	120	27 to 36	0 to 100
Rip Rap	140	40	0
Fly Ash	80	18	0

Source: Engineering and Construction Services Calculation – Slope Stability Analyses of Ash Pond Dike, prepared by Southern Company, August 17, 2012.

The factors of safety computed for the different cases and cross sections are included in **Table 7-7**.

Table 7-7 – Summary of Computed Factors of Safety for Various Stability Conditions for the Ash Pond

Failure Condition (Load Case)	Computed Factor of Safety	Recommended Minimum Factor of Safety[1]
Section 1 – Barge Canal/River		
Downstream Steady State	1.4	1.5
Downstream Seismic	1.2	1.0
Upstream Steady State	2.4	1.5
Upstream Seismic	2.1	1.0
Downstream 100-Year Storm	1.7	1.4
Upstream 100-Year Storm	2.5	1.4
Upstream Rapid Drawdown	1.2	**1.3**
Section 2 – River Side		
Downstream Steady State	**1.2**	**1.5**
Downstream Seismic	**1.1**	**1.0**
Upstream Steady State	2.5	1.5
Upstream Seismic	2.2	1.0
Downstream 100-Year Storm	1.4	1.4
Upstream 100-Year Storm	2.5	1.4
Upstream Rapid Drawdown	1.3	1.3
Section 3 – Discharge Canal Weir		
Downstream Steady State	2.2	1.5
Downstream Seismic	1.9	1.0
Upstream Steady State	2.4	1.5
Upstream Seismic	2.1	1.0
Downstream 100-Year Storm	2.6	1.4
Upstream 100-Year Storm	2.5	1.4
Upstream Rapid Drawdown	1.3	1.3
Section 4 – Discharge Canal South		
Downstream Steady State – In Bolster	1.4	1.5
Downstream Steady State – In Dike	1.4	1.5
Downstream Seismic	1.2	1.0
Upstream Steady State	2.4	1.5
Upstream Seismic	2.1	1.0
Downstream 100-Year Storm	1.8	1.4
Upstream 100-Year Storm	2.5	1.4
Upstream Rapid Drawdown	1.3	1.3
Section 5 – Discharge Canal North		
Downstream Steady State	1.4	1.5
Downstream Seismic	1.3	1.0
Upstream Steady State	1.9	1.5
Upstream Seismic	1.7	1.0
Downstream 100-Year Storm	1.7	1.4
Upstream 100-Year Storm	1.9	1.4
Upstream Rapid Drawdown	1.0	1.3

Table 7-7 - Summary of Computed Factors of Safety for Various Stability Conditions for the Ash Pond (continued)

Failure Condition (Load Case)	Computed Factor of Safety	Recommended Minimum Factor of Safety
Section 6 – Thompson Bayou		
Downstream Steady State	2.0	1.5
Downstream Seismic	1.7	1.0
Upstream Steady State	2.5	1.5
Upstream Seismic	2.2	1.0
Downstream 100-Year Storm	2.3	1.4
Upstream 100-Year Storm	2.5	1.4
Upstream Rapid Drawdown	1.4	1.3

Source: Engineering and Construction Services Calculation – Slope Stability Analyses of Ash Pond Dike, prepared by Southern Company, August 17, 2012.

7.1.3 Liquefaction Potential

Gulf Power provided CDM Smith with liquefaction potential analyses for the Process Sedimentation Pond, Process Return Pond, Gypsum Storage Pond, and Ash Pond, performed by SCS, dated January 27, 2014. The January 27, 2014 analyses supersede the liquefaction potential analyses, previously provided to CDM Smith, for the Ash Pond and Gypsum Storage Pond, dated September 6, 2012. The January 27, 2014 analyses assumed water at El. 87 for the Gypsum Storage Pond, however no datum was referenced.

7.1.3.1 Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond

The soil properties used in the liquefaction potential analyses of the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond were obtained from blow counts resulting from Standard Penetration Tests performed in 1971 and 1992.

The analyses evaluated the liquefaction potential of the ponds when subjected to loading associated with a seismic event having a 2-percent exceedance over a 50-year period, considering seismic hazards derived from both the Central and Eastern U.S. random faulting source (CEUS) and the New Madrid Source Zone (NMSZ). According to the report submitted, nearly 90 percent of the seismic hazard for Plant Crist is derived from the CEUS and about 11 percent of the hazard is attributed to the NMSZ. The analyses evaluated embankment liquefaction potential for an average earthquake of magnitude 5.8 at 100km (CUES source) and an average earthquake of magnitude 7.8 at 630km (NMSZ source). The site modified zero-period accelerations (ZPA) for the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond were .042g (CEUS) and 0.025g (NMSZ). The factors of safety computed for the different Gypsum Storage Pond cross sections are included in **Table 7-8.**

Table 7-8 - Summary of Computed Factors of Safety for Liquefaction Potential; Gypsum Storage Pond

Gypsum Storage Pond									
	GYP-1S			GYP-16			GYP-36		
Depth	SPT N-value	Factor of Safety, CEUS	Factor of Safety, NMSZ	SPT N- value	Factor of Safety, CEUS	Factor of Safety, NMSZ	SPT N- value	Factor of Safety, CEUS	Factor of Safety, NMSZ
5	11	>5	>5	17	Excavated	Excavated	6	Excavated	Excavated
10	8	>5	>5	3	Excavated	Excavated	9	Excavated	Excavated
15	10	>5	`>5	5	Excavated	Excavated	2	Excavated	Excavated
20	15	>5	>5	7	Excavated	Excavated	9	Excavated	Excavated
25	21	>5	>5	33	Excavated	Excavated	13	>5	>5
30	19	>5	>5	17	Excavated	Excavated	20	>5	>5
35	13	>5	>5	24	Excavated	Excavated	25	>5	>5
40	21	>5	>5	16	Excavated	Excavated	2	4.6	4.1
45	31	>5	>5	27	Excavated	Excavated	5	>5	>5
50	40	>5	>5	23	>5	>5	>5	>5	>5
55	47	>5	>5	45	>5	>5	23	>5	>5
60	15	>5	>5	27	>5	>5	28	>5	>5
65	5	>5	3.7				62	>5	>5

Source: Engineering and Construction Services Calculation – Analysis of Liquefaction Potential for Stormwater Pond Dike and Gypsum Storage Area, January 27, 2014.

At the Gypsum Storage Pond, the analysis indicates liquefaction of the foundation soils is not a threat during either of the scenario earthquakes, for the conditions evaluated.

The factors of safety computed for the different Process Sedimentation Pond and Process Return Water Pond cross sections are included in **Table 7-9.**

Table 7-9 - Summary of Computed Factors of Safety for Liquefaction Potential; Process Sedimentation Pond and Process Return Water Pond

Depth	Process Return Water Pond			Process Sedimentation Pond		
	SPT N- value	Factor of Safety, CEUS	Factor of Safety, NMSZ	SPT N- value	Factor of Safety, CEUS	Factor of Safety, NMSZ
5	11	>5	>5	17	Excavated	Excavated
10	8	>5	>5	16	>5	>5
15	10	>5	>5	14	>5	>5
20	15	>5	>5	12	>5	>5
25	21	>5	>5	27	>5	>5
30	19	>5	>5	16	>5	>5
35	13	>5	>5	32	>5	>5
40	21	>5	>5	18	>5	>5
45	31	>5	>5	29	>5	>5
50	40	>5	>5	13	>5	>5
55	47	>5	>5	24	>5	>5
60	15	>5	>5	15	>5	>5
65	5	>5	3.2	5	>5	3.2

Source: Engineering and Construction Services Calculation – Analyses of Liquefaction Potentialfor Stormwater Pond Dike and Gypsum Storage Area, January 27, 2014.

At the Process Sedimentation Pond and Process Return Water Pond, the analysis indicates liquefaction of the foundation soils is not a threat during either of the scenario earthquakes, for the conditions evaluated.

7.1.3.2 Ash Pond

Gulf Power also provided CDM Smith with liquefaction potential analyses for the Ash Pond, dated January 27, 2014. The January 27, 2014 analysis supersedes the liquefaction potential analyses, previously provided to CDM Smith, for the Ash Pond dated September 6, 2012. The revised calculations assume 3 feet of freeboard for calculation of the Ash Pond's factors of safety, while the September 2012 analyses had assumed water in the Ash Pond was 10 feet below the top of crest. CDM Smith notes there was approximately 3 feet of freeboard in the Ash Pond during our August 20, 2012 condition assessment.

The site modified zero-period accelerations (PGA) for the Ash Pond were .066g (CEUS) and 0.039g (NMSZ). A summary of safety factors computed for the different Ash Pond cross sections is included in **Table 7-10.**

Table 7-10 - Summary of Computed Factors of Safety for Liquefaction Potential; Ash Pond

Ash Pond Dike Centerline (Water at 3 feet below top of dike)									
Depth	APD-6			B-110			APD-7		
	SPT N- value	Factor of Safety, CEUS	Factor of Safety, NMSZ	SPT N- value	Factor of Safety, CEUS	Factor of Safety, NMSZ	SPT N- value	Factor of Safety, CEUS	Factor of Safety, NMSZ
5	13	>5	>5	5	2.2	2.2	20	>5	>5
10	43	>5	>5	5	1.8	1.8	33	>5	>5
15	32	>5	>5	5	1.8	1.7	17	>5	4.9
20	26	>5	>5	5	1.7	1.5	4	1.6	1.4
25	6	1.8	1.5	5	1.7	1.4	8	2.1	1.8
30	5	clay	Clay	4	1.5	1.2	5	Clay	Clay
35	3	1.9	1.5	6	1.1	0.9	1	1.2	1.0
40	3	1.4	1.0	4	1.6	1.2	5	1.7	1.2
45	6	1.7	1.2	4	1.5	1.1	9	2.2	1.6
50				51	>5	>5			

Source: Engineering and Construction Services Calculation – Analyses of Liquefaction Potential for Stormwater Pond Dike and Gypsum Storage Area, January 27, 2014.

The Ash Pond analysis indicates liquefaction of the foundation soils does not appear to be a threat during the CEUS scenario earthquake. During the NMSZ scenario earthquake, soft natural soils encountered immediately below the embankment fill exhibited factors of safety of 0.9 and 1.0. This result suggests some strength loss may occur in this stratum due to earthquake-induced pore pressure build-up.

7.2 Adequacy of Supporting Technical Documentation

Structural stability documentation to support the safety assessment for the embankments at Plant Crist is considered adequate.

7.3 Assessment of Structural Stability

The structural stability of the Gypsum Storage Pond, Process Sedimentation Pond, and Process Return Water Pond is rated **SATISFACTORY** based on the following:

- Slope stability analyses of the embankments are well documented and in general, satisfactory safety factors are reported for the different loading conditions analyzed.

- Recent liquefaction analysis indicates liquefaction of the foundation soils is not a threat for the conditions evaluated.

Section 8

Adequacy of Maintenance and Methods of Operation

8.1 Operating Procedures

The Gypsum Storage Pond receives sluiced gypsum, a by-product from the plant's flue gas desulfurization system (FGD Scrubber). Decant water from the Gypsum Storage Pond overflows through a riser structure to the adjacent Process Sedimentation Pond and Process Return Water Pond.

The Ash Pond includes five (5) Ash Decant/Settling Ponds that have been formed within the northwest portion of the Ash Pond through construction of divider embankments. Currently the Ash Pond is used as wastewater pond and no longer receives sluiced ash material from the plant. In general, the Ash Pond receives runoff from stormwater, plant operations, and the coal stockpile. Before water is discharged into the Escambia River, water goes through the settling ponds into the main pond and then is discharged into Thompson's Bayou by a concrete spillway outlet structure.

8.2 Maintenance of the Dam and Project Facilities

Gulf Power provided CDM Smith with copy of their guidelines and procedures for routine maintenance and inspection of the CCW impoundments described in this report. Also, they provided a copy of "Safety Procedures for Dams and Dikes" by Southern Company, which was reviewed and approved by Southern Company's Executive Vice President on April 30, 2012.

It was indicated by Plant Crist personnel during the site visual assessment by CDM Smith that visual dam inspections are performed at all CCW impoundments every week, and Southern Company performs a general detailed inspection once every year. Copies of the annual inspection reports for the 4 years previous to this assessment were provided to CDM Smith for information.

8.3 Assessment of Maintenance and Methods of Operations

Based on CDM Smith's visual observations and review of documents provided by Gulf Power and Southern Company, maintenance and operations procedures appear to be adequate for Plant Crist. However, several relatively minor deficiencies (i.e. long-established animal burrows, erosion rills, and dense vegetation on the northwest embankment of the Ash Pond) were observed. No major maintenance issues were identified.

Section 9

Adequacy of Surveillance and Monitoring Program

9.1 Surveillance Procedures

Gulf Power is required by Florida Department of Environmental Protection (FDEP) under National Pollutant Discharge Elimination System (NPDES) Permit No. FL0002275 to monitor discharge of wastewater into Thompson's Bayou, and groundwater in the vicinity of the CCW impoundments described in previous sections of this report. Surveillance procedures should be in accordance with the FDEP – NPDES Permit. Based on the information provided to CDM Smith by Gulf Power, it appears that discharge water into Thompson's Bayou is being monitored accordingly. Gulf Power is also required to maintain records and make them available for FDEP inspection for at least three years after report preparation.

Areas of possible seepage were observed near the south corner of the Gypsum Storage Pond, at the toe of the southwest embankment; a second area of possible seepage was observed at the toe of the east embankment and on the northeast embankment of the Process Sedimentation Pond, adjacent to the access road to the crest. Gulf Power does not have a monitoring program to measure/document the rate, volume, and turbidity of possible seepage flow emerging from the embankment slopes.

9.2 Instrumentation Monitoring

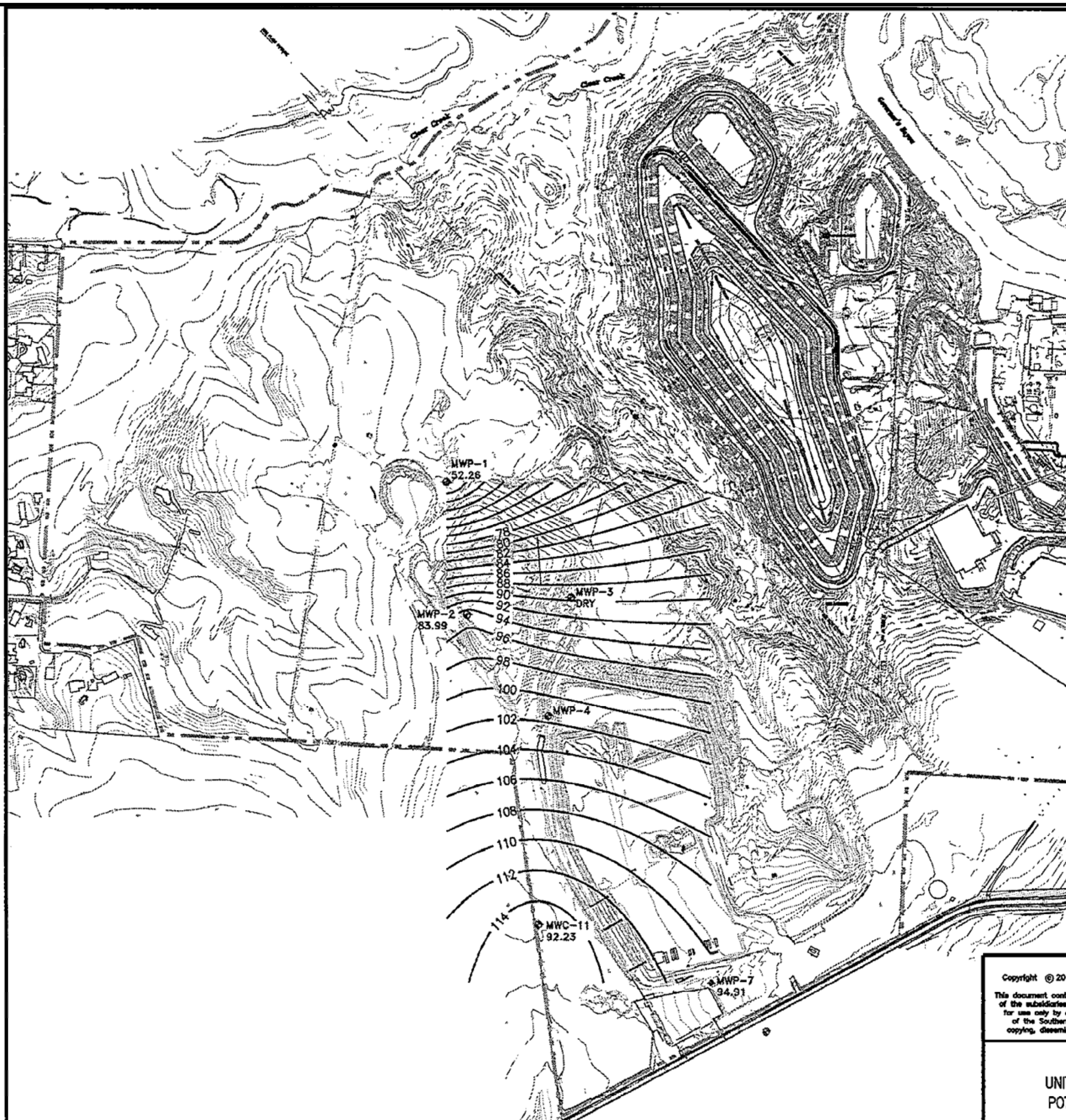
Based on the documents reviewed by CDM Smith, thirty four (34) piezometers/ monitoring wells are installed in the vicinity of the CCW impoundments. Gulf Power submits to FDEP groundwater readings, daily rainfall data, and analytical data for groundwater sampling in a semiannual Groundwater Report. CDM Smith was provided with the last 9 Groundwater Reports submitted to FDEP from 2008 to 2012.

9.3 Assessment of Surveillance and Monitoring Program

Gulf Power surveillance and monitoring program does not include provisions to measure/document the rate, volume, and turbidity of possible seepage flow emerging from the embankment slopes.

Based on the documents reviewed by CDM Smith, a series of monitoring wells have been installed for compliance with FDEP in the vicinity of the CCW impoundments. A summary of the water level readings and potentiometric maps were included in the Groundwater Report by Gulf Power to FDEP dated August 9, 2011. A reproduction of the potentiometric maps and summary table of groundwater levels as presented by Gulf Power to FDEP is presented in **Figure 9-1A** to **Figure 9-1C**. Based on information provided by Gulf Power, Groundwater Reports are delivered semiannually to FDEP.

A summary of groundwater levels collected on March 23, 2012 by Gulf Power as presented in the Groundwater Report to FDEP, dated August 13, 2012 is presented in **Table 9-1.**



Plant Crist Unit 1 Groundwater Elevation Data Summary:

Unit 1	Northing	Easting	GW ELEV.
MWC-11	577223.10	1107440.55	92.23
MWP-1	579678.30	1106935.18	52.26
MWP-2	578946.50	1107048.31	83.99
MWP-3	579043.70	1107622.00	DRY
MWP-4	578385.00	1107496.00	NA
MWP-7	576900.90	1108396.69	94.91

LEGEND:

- GYPSUM STORAGE AREA MONITORING WELLS
- PLANT CRIST PROPERTY BOUNDARY
- EXISTING GROUND CONTOURS
- FENCE
- GROUNDWATER CONTOURS
- GROUNDWATER FLOW DIRECTION

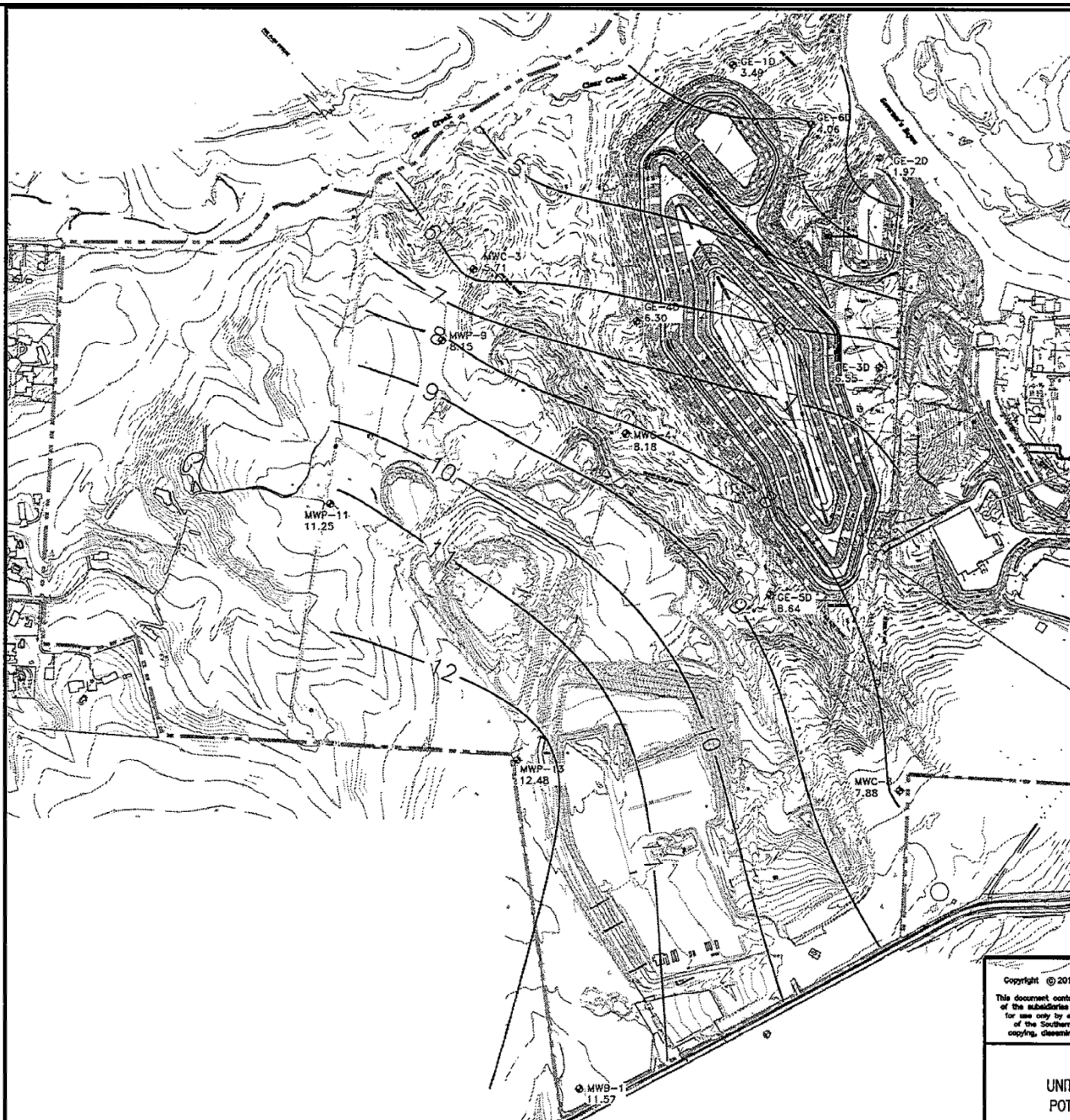
Southern Company Generation
Engineering and Construction Services
FOR
Gulf Power Company

PLANT CRIST
UNIT 1 GYPSUM STORAGE AREA
POTENTIOMETRIC SURFACE MAP
APRIL 14, 2011

SCALE	PROJ I.D.	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 600'		ES2015S1	1	FINAL	0

NOT TO SCALE

FIGURE 9-1A
UNIT 1 - POTENTIOMETRIC SURFACE MAP
GULF POWER - PLANT CRIST
PENSACOLA, FLORIDA



Plant Crist Unit 5 Groundwater Elevation Data Summary:

Unit 5	Northing	Easting	GW ELEV.
MWB–1	576316.33	1107666.84	11.57
MWC–3	580867.2	1107075.8	5.71
MWC–4	579957.03	1107920.6	8.18
MWC–8	577981.55	1109436.25	7.88
MWP–9	580469.48	1106903.63	8.15
MWP–11	579563.75	1106289.79	11.25
MPW–13	578144.59	1107323.19	12.48
GE–1D	582000.42	1108507.74	3.49
GE–2D	581490.11	1109320.21	1.97
GE–3D	580329.88	1109320.79	6.55
GE–4D	580579.82	1107978.14	6.3
GE–5D	579065.76	1108720.19	8.64
GE–6D	581673.14	1108943.44	4.06

LEGEND:

- GYPSUM STORAGE AREA MONITORING WELLS
- PLANT CRIST PROPERTY BOUNDARY
- EXISTING GROUND CONTOURS
- FENCE
- GROUNDWATER CONTOURS
- GROUNDWATER FLOW DIRECTION

PLANT CRIST
UNIT 5 GYPSUM STORAGE AREA
POTENTIOMETRIC SURFACE MAP
APRIL 14, 2011

Southern Company Generation Engineering and Construction Services

FOR

Gulf Power Company

SCALE	PROJ I.D.	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 600'		ES2015S3	1	FINAL	0

CDM Smith

NOT TO SCALE

FIGURE 9-1B
UNIT 5 - POTENTIOMETRIC SURFACE MAP
GULF POWER - PLANT CRIST
PENSACOLA, FLORIDA

Plant Crist Unit 2 Groundwater Elevation Data Summary:

Unit 2	Northing	Easting	GW ELEV.
MWB–2	576320.37	1107675.65	13.46
MWI–1	580866.5	1107082.4	5.8
MWI–2	579957.03	1107905.88	9.05
MWP–8	580426.93	1106880.64	8.67
MWP–10	579577.08	1106284.66	11
MWP–12	578152.04	1107322.62	12.53
GE–1S	582003.37	1108516.39	3.48
GE–2S	581483.15	1109326.43	1.11
GE–3S	580376.89	1109321.13	3.2
GE–4S	580572.7	1107976.09	5.7
GE–5S	579068.53	1108711.13	7.86
GE–6S	581674.53	1108934.89	4.58
GW–1S	578484.47	1106097.19	12.84
MWC–10	577968.69	1109451.94	7.71
MWC–12	578418.02	1106183.31	13.69

LEGEND:

- GYPSUM STORAGE AREA MONITORING WELLS
- PLANT CRIST PROPERTY BOUNDARY
- EXISTING GROUND CONTOURS
- FENCE
- GROUNDWATER CONTOURS
- GROUNDWATER FLOW DIRECTION

Southern Company Generation Engineering and Construction Services

FOR

Gulf Power Company

PLANT CRIST
UNIT 2 GYPSUM STORAGE AREA
POTENTIOMETRIC SURFACE MAP
APRIL 14, 2011

SCALE	PROJ I.D.	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 600'		ES2015S2	1	FINAL	0

CDM Smith

NOT TO SCALE

FIGURE 9-1C
UNIT 2 - POTENTIOMETRIC SURFACE MAP
GULF POWER - PLANT CRIST
PENSACOLA, FLORIDA

Table 9-1 - Monitoring Wells Water Levels

Crist March 2012 Water Levels					
WELL ID	TOC ELEVATION	WATER LEVEL	UNIT	AREA	GW ELEVATION
MWB-1	89.47	80.7	5	Ash Landfill	8.77
MWC-3	33.45	28.06	5	Ash Landfill	5.39
MWC-4	22.29	14.72	5	Ash Landfill	7.57
GE-5D	32.23	24.61	5	Ash Landfill	7.62
MWC-8	109.71	102.86	5	Ash Landfill	6.85
MWP-9	53.73	46.29	5	Ash Landfill	7.44
MWP-11	69.9	59.53	5	Ash Landfill	10.37
MWP-13	103.83	92.65	5	Ash Landfill	11.18
GE-1D	20.78	17.41	5	Gypsum Area 1	3.37
GE-2D	37.79	35.06	5	Gypsum Area 1	2.73
GE-3D	64.04	57.82	5	Gypsum Area 1	6.22
GE-4D	18.61	12.49	5	Gypsum Area 1	6.12
GE-6D	21.25	16.95	5	Gypsum Area 1	4.3
MWB-2	89.59	78.01	2	Ash Landfill	11.58
GW-15	65.53	53.87	2	Ash Landfill	11.66
MWI-1	33.35	28.08	2	Ash Landfill	5.27
MWI-2	22.36	14.29	2	Ash Landfill	8.07
GE-5S	32.22	24.94	2	Ash Landfill	7.28
MWC-10	109.71	102.8	2	Ash Landfill	6.91
MWC-12	70.47	57.95	2	Ash Landfill	12.52
MWP-8	53.71	45.65	2	Ash Landfill	8.06
MWP-10	69.75	59.67	2	Ash Landfill	10.08
MWP-12	103.68	42.44	2	Ash Landfill	61.24
GE-1S	20.97	16.81	2	Gypsum Area 1	4.16
GE-2S	38.56	37.17	2	Gypsum Area 1	1.39
GE-3S	63.65	59.39	2	Gypsum Area 1	4.26
GE-4S	18.62	13.19	2	Gypsum Area 1	5.43
GE-6S	21.13	16.02	2	Gypsum Area 1	5.11
MWC-11	115.55	25.23	1	Ash Landfill	90.32
MWP-1	63.37	Dry	1	Ash Landfill	Dry
MWP-2	95.18	11.46	1	Ash Landfill	83.72
MWP-3	81.78	14.44	1	Ash Landfill	67.34
MWP-4	100.99	11.25	1	Ash Landfill	89.74
MWP-7	110.5	16.52	1	Ash Landfill	93.98
All water levels were collected on 3/23/2012					

9.3.1 Adequacy of Surveillance Program

Gulf Power's surveillance program is inadequate. Gulf Power does not have a monitoring program to measure/document the rate, volume, and turbidity of possible seepage flow emerging from the embankment slopes.

9.3.2 Adequacy of Instrumentation Monitoring Program

Based on the documentation provided by Gulf Power to CDM Smith, the instrumentation monitoring program appears to be adequate for each CCW impoundment. Quantity and locations of piezometers/monitoring wells appear to comply with requirements from FDEP. However, piezometers/monitoring well construction data/logs were not provided to CDM Smith for review.

It should be noted that an earth embankment that is safe under current conditions may not be safe in the future if conditions change. Conditions that may change include changes in the phreatic surface, embankment deformation, or changes in seepage patterns. CDM Smith recommends to routinely monitor for the occurrence of any of these conditions so that preventive measures can be taken in response to any of these observations.

Section 10

Reports and References

The following is a list of reports and drawings that were provided by Gulf Power and Southern Company and were used during the preparation of this report and the development of the conclusions and recommendations presented herein. Gulf Power and Southern Company requested these documents be considered as Confidential Business Information (CBI).

1. Notice of Permit FL0002275, prepared by Florida Department of Environmental Protection to Gulf Power Company, January 26, 2011

2. Environmental Resource Permit and State-owned Submerged Lands Authorization Permit No. 17-724498-002-EI, prepared by Florida Department of Environmental Protection Northwest District, September 1, 2011

3. Groundwater Monitoring Reports and Daily Rainfall Logs and Sampling Logs for Plant Crist - Permit FL 000 2275, prepared by Gulf Power to Florida Department of Environmental Protection Northwest District, July 25, 2008

4. Groundwater Monitoring Reports and Daily Rainfall Logs and Sampling Logs for Plant Crist - Permit FL 000 2275, prepared by Gulf Power to Florida Department of Environmental Protection Northwest District, January 26, 2009

5. Groundwater Monitoring Reports and Daily Rainfall Logs and Sampling Logs for Plant Crist - Permit FL 000 2275, prepared by Gulf Power to Florida Department of Environmental Protection Northwest District, July 27, 2009

6. Groundwater Monitoring Reports and Daily Rainfall Logs and Sampling Logs for Plant Crist - Permit FL 000 2275, prepared by Gulf Power to Florida Department of Environmental Protection Northwest District, February 11, 2010

7. Groundwater Monitoring Reports and Daily Rainfall Logs and Sampling Logs for Plant Crist - Permit FL 000 2275, prepared by Gulf Power to Florida Department of Environmental Protection Northwest District, August 12, 2010

8. Safety Procedure for Dams and Dikes, prepared by Southern Company Generation, April 30, 2012

9. Groundwater Monitoring Reports, Daily Rainfall Log, Potentiometric Maps and Sampling Logs for Plant Crist - Permit FL 000 2275, prepared by Gulf Power to Florida Department of Environmental Protection Northwest District, August 9, 2011

10. Application for Department of the Army permit assigned number SAJ-2005-02502, prepared by the Department of the Army Jacksonville District Corp of Engineers to Gulf Power, July 27, 2011

11. Inspection Checklist, prepared by Florida Department of Environmental Protection to Gulf Power Plant Crist Facility, July 26, 2012

12. Inspection Checklist, prepared by Florida Department of Environmental Protection to Gulf Power Plant Crist Facility, Jun 28, 2011

13. Groundwater Monitoring Reports and Daily Rainfall Logs and Sampling Logs for Plant Crist - Permit FL 000 2275, prepared by Gulf Power to Florida Department of Environmental Protection Northwest District, February 15, 2011

14. Groundwater Monitoring Submittal for Sampling conducted at the Plant Crist, prepared by Gulf Power to Florida Department of Environmental Protection, Northwest District, August 13, 2012

15. Safety Procedure for Dams and Dikes, prepared by Southern Company Generation, April 30, 2012

16. Specific Purpose Survey: Pond Spot Elevations Gulf Power Company Crist Plant, prepared by Pittman, Glaze and Associates, Inc., March 14, 2009

17. Crist Completion of Construction – NPDES Permit #FL0002275, prepared by Gulf Power to Florida Department of Environmental Protection, June 25, 2010

18. Ash Pond Certification Letter for Plant Crist, prepared by Gulf Power to Florida Department of Environmental Protection, December 17, 2008

19. Drawing, Escambia River Condition Survey, prepared by U.S. Army Corps of Engineers, Mobile District, Sheet 10 of 13, March 2012

20. Ash Pond Dike Study, along with drawings, logs, and test data, prepared by Southern Company Services to Gulf Power Company, June 1, 1992

21. Plant Crist Proposed Ash Pond Dike Modifications, Phase 2 Report, prepared by Southern Company Services to Gulf Power Company, November 2, 1992

22. Plant Crist Ash Pond Dike Study, Phase 3 Report, prepared by Southern Company Services to Gulf Power Company, February 23, 1993

23. Test Boring Records – Boring Number: B-109A, obtained from Gulf Power Company, August 29, 1971

24. Soil Boring Log, Ash Pond Dike Stability Analysis, prepared by Southern Company Services, Inc., February 4, 1992

25. Drawing Survey, prepared by Southern Company Services, Inc., for Gulf Power Company, February 9, 1993

26. Drawing D-34344 – Detail – Ash Pond Dike Modifications, Cross Sections

27. Hydrographic Survey of a Portion of Crist Plant – Ash Pond, prepared by Pittman, Glaze and Associates for Gulf Power Company, August 25, 2010

28. Ash Pond Dike Inspection Report, Crist Steam Plant, prepared by Southern Company Services for Gulf Power Company, October 31, 1996

29. Plant Crist Ash Pond Dike Modifications Draft – Inquiry Package including Scope Document, Technical Specification, Proposal Form, Soil Boring Logs, Dilatometer Data Sheets, and Laboratory Test Results, and three Design Drawings, prepared by Southern Company Services, April 22, 1994

30. Design Calculations – Slope Stability Analysis of Gypsum Facility, prepared by Southern Company Services, Inc., August 17, 2012

31. Engineering and Construction Services Calculation – Slope Stability Analyses of Ash Pond Dike, prepared by Southern Company, August 17, 2012

32. Ash Pond Certification Letter for Plant Crist, prepared by Gulf Power to Florida Department of Environmental Protection, December 23, 2009

33. Ash Pond Certification Letter for Plant Crist, prepared by Gulf Power to Florida Department of Environmental Protection, December 20, 2010

34. Drawings – Ash Pond Dike Modifications, Plan by Southern Company Services, April 1994

35. Safety Procedure for Dams and Dikes, prepared by Southern Company Generation, June 29, 2009

36. Plant Crist Hydrologic and Hydraulic Study of the Ash Pond and Skimmer Ponds, August 2011

37. Groundwater Monitoring Reports, Daily Rainfall Log, Field Edd, Lab Edd, Potentiometric Maps, Laboratory Analytical Reports and Sampling Logs for Plant Crist - Permit FL 000 2275, prepared by Gulf Power to Florida Department of Environmental Protection Northwest District, February 14, 2012

38. Dam Safety Inspection Report, prepared by Southern Company, to Gulf Power Company, March 10, 2009

39. Annual 2011 Dam Safety Inspection Report of Plant Crist, prepared by Southern Company to Gulf Power Company, April 14, 2011

40. Annual 2010 Dam Safety Inspection Report and Photograph of Plant Crist, prepared by Southern Company to Gulf Power Company, January 24, 2011

41. Annual 2012 Dam Safety Inspection Report and Photographs of Plant Crist, prepared by Southern Company to Gulf Power Company, May 10, 2012

42. Dam Safety Inspection Weekly Report – Blank Form

43. A Specific Purpose Survey, Pond Cross Section, Gulf Power Company Crist Plant, by Pitman Glaze and Associates, Inc., March 14, 2009

44. CD – Plant Crist Gypsum Storage Area – Specifications – Geo/Hydrogeo - Volume 1 – Volume 4

45. CD – Drawings – Plant Crist Gypsum Storage Area

46. CD – Drawings – Plant Crist Weir Replacement

47. CD – Plant Crist Gypsum Storage Area - Stormwater Calculations

48. ½ PMP Analysis for Former Ash Pond and Gypsum Storage Area, January 27, 2014

49. Calculation Number: TV-CR-FPC30795-003, Analysis of Liquefaction Potential for Stormwater Pond Dike and Gypsum Storage Area, January 27, 2014

50. Calculation Number: TV-CR-FPC104829-001, Slope Stability Analysis of Gypsum Facility – Sedimentation and Return Water Ponds, January 24, 2014

51. Southern Company Generation Emergency Action Plan, December 11, 2012

52. Plant Crist Gypsum Storage Area, Hydrogeological and Geotechnical Investigation Report, June 2007

Appendix A

Documentation from Gulf Power Company, Plant Crist

Appendix A

Doc 01: Soil Borings

Southern Company Services, Inc.
Soil Boring Log

CONFIDENTIAL

HOLE No. APD-4

SHEET 1 OF 1

Project: PLANT CRIST
Location: ASH POND DIKE
Purpose: STABILITY ANALYSIS
Position: E 1,112,743.6 N 578,242.1 Surface Elevation: 90.50
Rig Type: MOBILE Contractor: PENSACOLA TESTING Driller: MATT AND ROBERT
Drilling Method: WASH BORING Boring Depth: 46.0 No. SPT: 8 No. UD Samples: 0
Date Started: 2/4/92 Date Completed: 2/4/92 Logged By: JOEL MILLER Date Logged: 2/4/92
Hole Closure: GROUT

Water Table	Depth (ft)	Elevn. (ft)	Soil Description	Sample Number	Legend	Recovery (%)	SPT Values Blows/6" (N)	Comments	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	K (cm/s)
	0	90.50										
	5		Red-brown slightly clayey fine SAND.				6/13/21 (34)					
		84.50										
	10		Red-brown clayey fine SAND.				4/4/6/8 (14)	DIKE FILL				
		79.50										
	15		Red-tan-gray clayey fine SAND.				10/13/17/17 (34)					
		74.50										
	20		Tan-brown slightly clayey fine to medium SAND				4/3/4/5 (9)					
		67.50										
	25		Brown-gray slightly silty fine to medium SAND (5" wood fragments at top of spoon).				2/8/11/12 (23)					
	30		Brown-gray slightly silty fine to medium SAND with no wood fragments				4/6/7/7 (14)					
		58.50	Bottom of Dike Fill At 32'									
	35		Soft Organic CLAY and SILT.					UD ATTEMPT @ 34-36'.NO SAMPLE.				
		53.50										
	40		Medium gray clayey fine SAND				1/1/1/1 (2)					
	45	46.50	12" medium gray fine sandy CLAY.				WH/1/1/10 (11)					
		45.50	12" light gray silty CLAY.									
		44.90	3" orange-tan slightly clayey fine SAND.									
			Bottom of Hole @ 46'									

SS = Split Spoon; ST = Shelby Tube; D = Dennison; P = Pitcher; O = Other

while drilling / after drilling / after 24 hours

Hole No. APD-4

EXHIBIT GP-CR #24

Southern Company Services, Inc.
Soil Boring Log

CONFIDENTIAL

HOLE No. APD-6

SHEET 1 OF 1

Project: PLANT CRIST
Location: ASH POND DIKE
Purpose: STABILITY ANALYSIS
Position: E 1,112,893.9 N 578,922.7 Surface Elevation: 91.00
Rig Type: MOBLIE Contractor: PENSACOLA TESTING Driller: MATT & ROBERT
Drilling Method: WASH BORING Boring Depth: 46.0 No. SPT: 8 No. UD Samples: 0
Date Started: 2/4/92 Date Completed: 2/4/92 Logged By: JOEL MILLER Date Logged: 2/4/92
Hole Closure: GROUT

WATER TABLE	DEPTH AND ELEVN. (FT)	SYMBOLIC LOG	SOIL DESCRIPTION	SAMPLE NUMBER	LEGEND	RECOVERY (%)	SPT VALUES BLOWS/6" (N)	COMMENTS	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	K (cm/s)
	0 / 91.00		Red-brown clayey fine SAND with occasional clay lense									
	5						4/7/6/7 (13)					
	85.00		Brown-gray slightly clayey fine to medium SAND with occasional clay lense.					DIKE FILL				
	10						3/6/17/26 (43)	OCCASIONAL CLAY LENSES				
	15						10/13/14/18 (32)					
	20						8/9/11/15 (26)					
	69.00		Tan-Medium gray clayey fine to medium SAND (may be very slightly organic).									
	25						3/5/3/3 (6)	CLAY LENSE @ 25'				
	64.00		Bottom of Dike Fill At 27'					BOTTOM OF DIKE @ 27'				
	30		Soft Organic CLAY and SILT					UD ATTEMPT @ 29-31'. NO SAMPLE.				
	59.00		Medium gray clayey fine SAND to sandy CLAY with few wood fragments.									
	35						WH/1/1/2 (3)	UD ATTEMPT @ 36-38'. NO SAMPLE.				
	52.00 / 40		Medium gray slightly clayey to slightly silty fine to medium SAND with very few wood fragments				2/1/2 (3)					
	45						11/4/2/4 (6)	BOTTOM 8" OF HOLE SHOWED ORGANICS AND WOOD FRAGMENTS.				
			Bottom of Hole @ 46'									

SS = Split Spoon; ST = Shelby Tube; D = Dennison; P = Pitcher; O = Other

while drilling / after drilling / after 24 hours

Hole No. **APD-6**

Southern Company Services, Inc.
Soil Boring Log

CONFIDENTIAL

HOLE No. APD-7

SHEET 1 OF 1

Project:	PLANT CRIST				
Location:	ASH POND DIKE				
Purpose:	STABILITY ANALYSIS				
Position:	E 1,112,664.4 N 579,207.2	Surface Elevation:	91.00		
Rig Type:	MOBILE	Contractor:	PENSACOLA TESTING	Driller:	MATT & ROBERT
Drilling Method:	WASH BORING	Boring Depth:	46.0	No. SPT: 8	No. UD Samples: 1
Date Started:	2/3/92	Date Completed:	2/3/92	Logged By: JOEL MILLER	Date Logged: 2/3/92
Hole Closure:	GROUT				

WATER TABLE	DEPTH (FT)	ELEVN.	SOIL DESCRIPTION	SPT VALUES BLOWS/6" (N)	COMMENTS	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	K (cm/s)
	0	91.00	Red-brown slightly clayey Fine to medium grained SAND.						
	5			4/7/10/10 (20)	DIKE FILL				
▼		85.00	Red-brown clayey SAND to sandy CLAY with some plastic clay lenses						
	10			7/8/14/19 (33)					
		80.00	Red-brown slightly clayey fine to medium grained SAND to tan clean SAND		UD ATTEMPT @ 11'. MATERIAL TOO HARD. NO SAMPLE				
	15	76.00		8/9/9/8 (17)					
			Red-tan-gray slightly silty medium grained SAND with few small shells.		UD ATTEMPT @ 16'. OBTAINED 14-16" OF SAMPLE	14	NP	NP	SM
	20			2/1/2/2 (4)					
		70.00	Medium gray slightly silty fine to medium grained SAND with lense of wood fragments						
	25			3/4/3/5 (8)					
					UD ATTEMPT @27.5'. TOO HARD (WOOD?). NO SAMPLE				
		64.00	^Bottom of Dike Fill at 27'						
	30		Soft Organic CLAY and SILT		UD ATTEMPT @29-31'.TOO SOFT. NO SAMPLE				
					REDRILL HOLE TO 32'				
	35	57.00	Medium gray silty clayey fine SAND		UD ATTEMPT 32-34'. TOO SOFT. NO SAMPLE				
				1/2/1/0 (1)					
	40			0/1/2/3 (5)					
		50.00	Medium gray clayey fine to medium SAND						
	45			2/2/4/5 (9)					
			Bottom of Hole @ 46'						

SS = Split Spoon; ST = Shelby Tube; D = Dennison; P = Pitcher; O = Other

▽ while drilling
▼ 8.0 after drilling
☑ after 24 hours

Hole No. **APD-7**

FILE NAME: PLANT CRIST ASH POND DAM
FILE NUMBER: CRIST1D.DAT

CONFIDENTIAL

RECORD OF DILATOMETER TEST NO. 1D-1
USING DATA REDUCTION PROCEDURES IN MARCHETTI (ASCE,J-GED,MARCH 80)
KO IN SANDS DETERMINED USING SCHMERTMANN METHOD (1983)
PHI ANGLE CALCULATION BASED ON DURGUNOGLU AND MITCHELL (ASCE,RALEIGH CONF,JUNE 75)
PHI ANGLE NORMALIZED TO 2.72 BARS USING BALIGH'S EXPRESSION (ASCE,J-GED,NOV 76)
MODIFIED MAYNE AND KULHAWY FORMULA USED FOR OCR IN SANDS (ASCE,J-GED,JUNE 82)

LOCATION: ASH POND DAM
PERFORMED - DATE: 18 MARCH 1992
BY: GILLIAM

CALIBRATION INFORMATION:
DELTA A = .01 BARS DELTA B = .45 BARS GAGE 0 = .15 BARS GWT DEPTH= 1.85 M
ROD DIA.= 3.70 CM FR.RED.DIA.= 5.40 CM ROD WT.= 6.50 KG/M DELTA/PHI= .50 BLADE T=15.00 MM

1 BAR = 1.019 KG/CM2 = 1.044 TSF = 14.51 PSI ANALYSIS USES H2O UNIT WEIGHT = 1.000 T/M3

DEPTH (ft)	Z (M)	THRUST (KG)	A (BAR)	B (BAR)	ED (BAR)	ID	KD	UO (BAR)	GAMMA (T/M3)	SV (BAR)	PC (BAR)	OCR	KO	CU (BAR)	PHI (DEG)	M (BAR)	SOIL TYPE	
	*****	******	*****	*****	*****	*****	*****	******	******	******	*****	*****	*****	*****	*****	******	***********	
20.5'	6.30	125.	.60	1.80	26.	31.76	.39	.437	1.700	.060	.00	.08	.11		36.6	21.8	SAND	
									P01 =	.42	P0 =	.46	P1 =	1.20				
	6.60	110.	.90	3.00	60.	8.13	2.63	.466	1.700	.081	.13	1.64	.53		31.4	20.0	SAND	φ=31°
	6.90	225.	1.15	4.50	105.	8.20	3.65	.496	1.700	.101	.24	2.33	.61		33.9	171.2	SAND	C=0 psi
	7.20	300.	1.85	4.05	63.	1.66	9.12	.525	1.600	.120	1.45	12.05	1.34		30.9	152.9	SANDY SILT	
	7.50	750.	2.20	6.80	151.	3.35	9.21	.554	1.800	.141	1.41	10.02	1.20		37.2	366.3	SAND	
27.3'	8.40	300.	1.00	1.75	11.	1.50	1.02	.643	1.500	.198	.11	.57	.32		33.9	9.0	MUD	
	8.70	200.	1.30	2.10	12.	.76	2.19	.672	1.600	.215	.25	1.16	.60	.053		11.9	CLAYEY SILT	
	9.00	220.	1.80	2.70	16.	.49	4.03	.702	1.600	.232	.39	2.99	.99	.123		25.2	SILTY CLAY	
	9.30	220.	1.80	2.80	20.	.63	3.61	.731	1.600	.250	.63	2.51	.91	.115		28.7	CLAYEY SILT	
	9.60	250.	2.30	3.20	16.	.34	5.15	.761	1.600	.268	1.17	4.37	1.19	.192		29.2	CLAY	C=135ps
31.2'																		
	10.20	2000.	2.80	14.20	399.	8.88	4.19	.819	1.800	.309	.42	1.37	.41		42.6	695.3	SAND	
	10.50	220.	1.40	2.20	12.	.91	1.20	.849	1.600	.329	.15	.45	.30			10.5	SILT	
	10.80	140.	1.10	2.35	29.	19.66	.12	.878	1.700	.349	.20	.56	.40		26.5	24.5	SAND	φ=27°
	11.10	150.	1.10	2.10	20.	22.46	.07	.908	1.700	.369	.20	.54	.39		26.6	16.7	SAND	C=0
	11.40	200.	1.10	2.75	41.	52.18	.06	.937	1.700	.390	.19	.48	.35		28.1	35.1	SAND	
									P01 =	.90	P0 =	.96	P1 =	2.15				
38.0'	11.70	500.	3.75	11.40	262.	3.31	5.53	.967	1.900	.413	2.48	6.00	1.01		28.2	520.0	SAND	
	12.00	1650.	4.20	11.00	231.	2.42	6.25	.996	1.900	.440	2.32	5.27	.88		37.6	479.0	SILTY SAND	
	12.30	1600.	4.70	12.55	269.	2.45	6.79	1.026	1.900	.466	2.98	6.39	.98		36.7	578.8	SILTY SAND	
41.9'	12.60	1200.	3.75	9.00	175.	2.17	4.70	1.055	1.900	.493	1.81	3.67	.76		35.4	314.7	SILTY SAND	φ=36°
	12.90	2600.	4.50	17.50	457.	4.97	5.10	1.084	1.900	.519	1.57	3.02	.65		40.7	375.1	SAND	C=0 ps

END OF SOUNDING

FILE NAME: PLANT CRIST ASH POND DAM
FILE NUMBER: CRIST2D.DAT

RECORD OF DILATOMETER TEST NO. 2D-1
USING DATA REDUCTION PROCEDURES IN MARCHETTI (ASCE,J-GED,MARCH 80)
KO IN SANDS DETERMINED USING SCHMERTMANN METHOD (1983)
PHI ANGLE CALCULATION BASED ON DURGUNOGLU AND MITCHELL (ASCE,RALEIGH CONF,JUNE 75)
PHI ANGLE NORMALIZED TO 2.72 BARS USING BALIGH'S EXPRESSION (ASCE,J-GED,NOV 76)
MODIFIED MAYNE AND KULHAWY FORMULA USED FOR OCR IN SANDS (ASCE,J-GED,JUNE 82)

LOCATION: ASH POND DAM
PERFORMED - DATE: 18 MARCH 1992
BY: GILLIAN

CONFIDENTIAL

CALIBRATION INFORMATION:
DELTA A = .01 BARS   DELTA B = .45 BARS   GAGE 0 = .15 BARS   GWT DEPTH= 1.85 M
ROD DIA.= 3.70 CM   FR.RED.DIA.= 5.40 CM   ROD WT.= 6.50 KG/M   DELTA/PHI= .50   BLADE T=15.00 MM

1 BAR = 1.019 KG/CM2 = 1.044 TSF = 14.51 PSI   ANALYSIS USES H2O UNIT WEIGHT = 1.000 T/M3

DEPTH (ft)	Z (M) *****	THRUST (KG) ******	A (BAR) *****	B (BAR) *****	ED (BAR) *****	ID . *****	KD *****	UO (BAR) ******	GAMMA (T/M3) ******	SV (BAR) ******	PC (BAR) *****	OCR *****	KO *****	CU (BAR) *****	PHI (DEG) *****	M (BAR) ******	SOIL TYPE ************	Notes
20.5'	6.30	190.	1.00	2.95	54.	4.49	5.81	.437	1.700	.060	.27	4.55	.82		34.7	110.1	SAND	
	6.60	360.	1.65	5.50	124.	4.07	10.85	.466	1.700	.081	1.17	14.54	1.44		34.5	318.3	SAND	ϕ=34°
	6.90	525.	1.75	5.30	113.	3.38	9.35	.496	1.800	.103	1.07	10.38	1.22		36.5	274.9	SAND	C=0psf
23.4'	7.20	375.	1.55	4.60	94.	3.68	6.05	.525	1.700	.125	.65	5.22	.89		34.5	194.8	SAND	
	7.50	200.	1.35	3.10	47.	2.29	4.07	.554	1.700	.145	.48	3.32	.76		30.0	78.8	SILTY SAND	ϕ=25°
	7.80	135.	1.55	2.20	7.	.24	5.01	.584	1.500	.163	.68	4.19	1.16	.113		12.4	MUD	
	8.10	125.	1.45	2.95	38.	1.69	3.60	.613	1.600	.179	.60	3.38	.81		25.1	57.8	SANDY SILT	C=0psf
27.3'	8.40	305.	1.80	4.20	71.	2.21	4.64	.643	1.700	.198	.80	4.05	.83		30.5	126.8	SILTY SAND	
	8.70	660.	2.15	5.45	103.	2.49	5.42	.672	1.800	.220	.96	4.33	.81		35.5	201.6	SILTY SAND	
	9.00	725.	2.00	5.00	93.	2.59	4.25	.702	1.700	.243	.67	2.78	.65		36.4	160.5	SILTY SAND	
	9.30	825.	2.80	8.50	191.	3.30	6.30	.731	1.800	.265	1.50	5.68	.93		35.4	400.7	SAND	ϕ=35°
31.2'	9.60	900.	4.40	11.05	226.	2.04	11.01	.761	1.900	.290	4.91	16.95	1.56		32.7	584.4	SILTY SAND	C=0psf
	9.90	1200.	6.25	10.00	120.	.67	16.38	.790	1.800	.315	8.37	26.60	2.48	.959		355.7	CLAYEY SILT	
	10.20	520.	3.75	9.35	187.	2.13	7.46	.819	1.900	.340	3.27	9.62	1.23		28.4	417.4	SILTY SAND	
	10.50	745.	3.90	11.60	264.	2.98	6.96	.849	1.900	.366	2.85	7.79	1.11		31.7	576.4	SILTY SAND	ϕ=29°
	10.80	950.	2.80	7.65	160.	2.95	3.99	.878	1.800	.391	1.08	2.77	.66		35.6	271.9	SILTY SAND	C=0psf
1'	11.10	500.	2.35	4.70	69.	1.64	2.93	.908	1.600	.412	.92	2.22	.64		30.9	91.3	SANDY SILT	
	11.40	350.	3.15	4.75	42.	.59	4.68	.937	1.700	.431	1.62	3.76	1.11	.274		71.5	SILTY CLAY	
	11.70	240.	2.70	4.60	52.	.99	3.38	.967	1.600	.450	1.02	2.27	.86			74.3	SILT	
	12.00	230.	2.65	4.10	36.	.71	3.13	.996	1.600	.468	.94	2.01	.81	.180		47.5	CLAYEY SILT	
	12.30	275.	3.20	5.05	51.	.74	4.04	1.026	1.700	.487	1.46	2.99	.99	.258		79.9	CLAYEY SILT	
	12.60	210.	3.25	4.80	40.	.57	3.94	1.055	1.700	.507	1.46	2.88	.97	.261		61.4	SILTY CLAY	
	12.90	190.	3.50	4.55	21.	.28	4.27	1.084	1.600	.527	1.72	3.26	1.03	.299		35.0	CLAY	C=275ps
	13.20	195.	3.85	5.20	32.	.37	4.68	1.114	1.700	.546	2.05	3.76	1.11	.347		55.8	SILTY CLAY	
	13.50	200.	3.95	5.25	31.	.34	4.63	1.143	1.700	.566	2.10	3.71	1.10	.356		52.4	CLAY	
	13.80	400.	3.35	5.15	49.	.71	3.36	1.173	1.700	.587	1.32	2.24	.86	.247		67.8	CLAYEY SILT	
45.8'	14.10	2100.	2.00	11.50	329.	46.11	.34	1.202	1.700	.608						280.0	SAND	

END OF SOUNDING

FILE NAME: PLANT CRIST ASH POND DAM
FILE NUMBER: CRIST3D.DAT

CONFIDENTIAL

RECORD OF DILATOMETER TEST NO. 3D-1
USING DATA REDUCTION PROCEDURES IN MARCHETTI (ASCE,J-GED,MARCH 80)
KO IN SANDS DETERMINED USING SCHMERTMANN METHOD (1983)
PHI ANGLE CALCULATION BASED ON DURGUNOGLU AND MITCHELL (ASCE,RALEIGH CONF,JUNE 75)
PHI ANGLE NORMALIZED TO 2.72 BARS USING BALIGH'S EXPRESSION (ASCE,J-GED,NOV 76)
MODIFIED MAYNE AND KULHAWY FORMULA USED FOR OCR IN SANDS (ASCE,J-GED,JUNE 82)

CONFIDENTIAL

LOCATION: ASH POND DAM
PERFORMED - DATE: 17 MARCH 1992
BY: GILLIAM

CALIBRATION INFORMATION:
DELTA A = .02 BARS DELTA B = .35 BARS GAGE 0 = .15 BARS GWT DEPTH= 2.00 M
ROD DIA.= 3.70 CM FR.RED.DIA.= 5.40 CM ROD WT.= 6.50 KG/M DELTA/PHI= .50 BLADE T=15.00 MM

1 BAR = 1.019 KG/CM2 = 1.044 TSF = 14.51 PSI ANALYSIS USES H2O UNIT WEIGHT = 1.000 T/M3

DEPTH (ft)	Z (M)	THRUST (KG)	A (BAR)	B (BAR)	ED (BAR)	ID	KD	UO (BAR)	GAMMA (T/M3)	SV (BAR)	PC (BAR)	OCR	KO	CU (BAR)	PHI (DEG)	M (BAR)	SOIL TYPE	
	*****	******	*****	*****	*****	*****	*****	******	******	******	*****	*****	*****	*****	*****	******	***********	
19.5'	6.00	75.	.60	1.70	27.	18.71	.68	.393	1.700	.060	.02	.34	.24		33.1	22.6	SAND	
	6.30	400.	1.25	4.65	110.	5.82	6.78	.422	1.700	.081	.43	5.32	.86		37.4	238.7	SAND	φ=33°
	6.60	380.	1.60	5.15	116.	3.88	8.49	.451	1.700	.101	.95	9.36	1.17		34.5	273.2	SAND	
	6.90	710.	1.45	4.65	103.	4.26	5.73	.481	1.700	.122	.60	4.96	.88		33.4	207.8	SAND	C=0 psf
	7.20	305.	1.30	4.25	94.	5.10	3.73	.510	1.700	.142	.36	2.50	.64		33.7	154.4	SAND	
	7.50	195.	1.20	3.62	75.	5.03	2.62	.540	1.700	.163	.30	1.84	.58		30.3	99.9	SAND	
23.4'	7.80	450.	1.65	4.75	99.	3.52	4.43	.569	1.700	.184	.59	3.23	.71		34.4	178.4	SAND	
	8.10	600.	6.15	9.90	123.	.68	25.53	.599	1.800	.206	10.93	53.14	3.19	1.092		417.2	CLAYEY SILT	
	8.40	300.	4.25	5.70	39.	.33	15.09	.628	1.700	.228	5.33	23.40	2.36	.627		113.7	CLAY	C=625ps
28.3'	8.70	230.	4.10	5.95	54.	.48	13.04	.658	1.700	.248	4.63	18.62	2.16	.569		148.3	SILTY CLAY	
	9.00	720.	1.80	8.20	220.	9.29	2.52	.687	1.800	.271	.32	1.20	.43		37.0	286.2	SAND	
	9.30	1100.	2.90	10.00	245.	4.12	5.84	.716	1.800	.294	1.35	4.60	.83		37.3	498.4	SAND	
	9.60	1060.	2.70	9.55	236.	4.54	4.72	.746	1.800	.318	1.03	3.23	.70		37.2	436.4	SAND	φ=37°
	9.90	975.	2.45	8.58	210.	4.81	3.68	.775	1.800	.341	.76	2.22	.59		36.9	342.6	SAND	C=0 psf
33.2'	10.20	700.	2.05	5.95	129.	3.95	2.57	.805	1.800	.365	.56	1.54	.51		34.8	169.9	SAND	
	10.50	575.	2.35	7.05	158.	3.89	3.01	.834	1.800	.388	.84	2.16	.62		32.3	230.0	SAND	
	10.80	560.	2.20	5.95	123.	3.42	2.52	.864	1.800	.412	.72	1.74	.57		32.2	160.4	SAND	φ=30°
	11.10	450.	2.05	5.25	103.	3.36	2.04	.893	1.700	.434	.65	1.49	.54		30.6	115.4	SAND	C=0 ps
	11.40	435.	2.15	5.35	103.	3.11	2.10	.922	1.700	.455	.72	1.58	.57		29.9	118.2	SILTY SAND	
38.0'	11.70	400.	2.15	4.10	58.	1.68	2.09	.952	1.600	.474	.78	1.65	.59		29.0	57.8	SANDY SILT	
	12.00	320.	2.40	3.55	28.	.66	2.54	.981	1.600	.491	.71	1.46	.68	.146		31.3	CLAYEY SILT	
	12.30	255.	3.15	4.55	38.	.55	3.85	1.011	1.600	.509	1.41	2.77	.96	.254		57.1	SILTY CLAY	C=340ps
	12.60	255.	3.45	4.45	23.	.29	4.27	1.040	1.600	.527	1.72	3.26	1.03	.299		37.4	CLAY	
	12.90	215.	4.00	5.60	45.	.47	5.02	1.070	1.700	.546	2.29	4.20	1.16	.379		80.4	SILTY CLAY	
	13.20	245.	4.15	6.00	54.	.55	5.03	1.099	1.700	.566	2.38	4.21	1.17	.394		96.8	SILTY CLAY	
43.9'	13.50	275.	3.95	5.60	47.	.51	4.48	1.129	1.700	.587	2.06	3.51	1.07	.354		78.2	SILTY CLAY	
	13.80	390.	3.20	6.40	103.	1.68	2.91	1.158	1.700	.608	1.70	2.79	.78		25.7	136.4	SANDY SILT	
	14.10	2100.	3.50	10.60	245.	3.83	2.92	1.187	1.900	.631	.84	1.34	.44		39.5	351.2	SAND	

END OF SOUNDING

GULF POWER COMPANY TEST NO. SD-1

FILE NAME: PLANT CRIST ASH POND DAM
FILE NUMBER: CRIST5D.DAT

RECORD OF DILATOMETER TEST NO. SD-1
USING DATA REDUCTION PROCEDURES IN MARCHETTI (ASCE,J-GED,MARCH 80)
KO IN SANDS DETERMINED USING SCHMERTMANN METHOD (1983)
PHI ANGLE CALCULATION BASED ON DURGUNOGLU AND MITCHELL (ASCE,RALEIGH CONF,JUNE 75)
PHI ANGLE NORMALIZED TO 2.72 BARS USING BALIGH'S EXPRESSION (ASCE,J-GED,NOV 76)
MODIFIED MAYNE AND KULHAWY FORMULA USED FOR OCR IN SANDS (ASCE,J-GED,JUNE 82)

CONFIDENTIAL

LOCATION: ASH POND DAM
PERFORMED - DATE: 17 MARCH 1992
BY: GILLIAM

CALIBRATION INFORMATION:
DELTA A = .02 BARS DELTA B = .35 BARS GAGE 0 = .15 BARS GWT DEPTH= 2.00 M
ROD DIA.= 3.70 CM FR.RED.DIA.= 5.40 CM ROD WT.= 6.50 KG/M DELTA/PHI= .50 BLADE T=15.00 MM

1 BAR = 1.019 KG/CM2 = 1.044 TSF = 14.51 PSI ANALYSIS USES H2O UNIT WEIGHT = 1.000 T/M3

DEPTH (ft)	Z (M) *****	THRUST (KG) ******	A (BAR) *****	B (BAR) *****	ED (BAR) *****	ID *****	KD *****	UO (BAR) ******	GAMMA (T/M3) ******	SV (BAR) ******	PC (BAR) *****	OCR *****	KO *****	CU (BAR) *****	PHI (DEG) *****	M (BAR) ******	SOIL TYPE ***********	
19.5'	6.00	1350.	6.80	12.80	205.	.99	99.93	.393	1.950	.060	26.80	*****	6.60			959.9	SILT	
	6.30	1700.	5.85	17.50	411.	2.50	53.37	.422	2.000	.089	28.24	*****	6.52		35.9	1679.1	SILTY SAND	
	6.60	950.	4.35	10.30	203.	1.68	30.29	.451	1.800	.115	13.20	*****	3.83		33.3	721.6	SANDY SILT	ϕ=34°
	6.90	1500.	1.60	4.60	96.	3.22	6.25	.481	1.700	.137	.25	1.85	.46		44.3	200.4	SILTY SAND	
	7.20	325.	2.80	5.05	68.	.96	13.08	.510	1.700	.158	2.96	18.73	2.17			188.7	SILT	C=0 psf
24.4'	7.50	550.	2.50	4.95	76.	1.27	9.67	.540	1.700	.178	2.32	12.97	1.38		32.8	187.0	SANDY SILT	
	7.80	700.	3.31	5.10	52.	.59	12.76	.569	1.700	.199	3.58	18.00	2.13	.444		141.3	SILTY CLAY	C=390 p
26.3'	8.10	375.	2.85	4.40	43.	.60	9.39	.599	1.700	.220	2.45	11.16	1.77	.334		104.7	CLAYEY SILT	
	8.40	1070.	4.05	13.10	316.	3.19	11.75	.628	1.900	.243	4.28	17.59	1.59		35.2	838.9	SILTY SAND	
	8.70	1075.	3.35	10.00	229.	2.93	8.34	.658	1.900	.270	2.44	9.05	1.15		36.2	535.7	SILTY SAND	
	9.00	1000.	4.25	11.00	232.	2.15	10.51	.687	1.900	.296	4.47	15.09	1.48		33.7	592.1	SILTY SAND	ϕ=34°
	9.30	935.	3.10	8.60	187.	2.70	6.22	.716	1.800	.321	1.83	5.69	.93		35.1	388.3	SILTY SAND	
31.2'	9.60	805.	2.80	8.30	187.	3.23	4.84	.746	1.800	.345	1.34	3.89	.79		34.4	349.3	SILTY SAND	C=0 psf
	9.90	740.	3.75	9.20	185.	2.06	7.00	.775	1.900	.370	2.93	7.92	1.12		31.5	401.4	SILTY SAND	ϕ=31°
33.2'	10.20	465.	2.20	4.75	79.	1.98	2.94	.805	1.700	.393	.88	2.25	.65		30.5	107.6	SILTY SAND	C=0 psf
	10.50	310.	2.50	3.95	39.	.77	3.59	.834	1.600	.413	1.03	2.49	.91	.189		57.5	CLAYEY SILT	
1'	10.80	250.	2.40	3.60	30.	.64	3.17	.864	1.600	.430	.88	2.05	.82	.168		40.1	CLAYEY SILT	C=200 ps
	11.10	285.	1.55	2.85	34.	2.03	1.07	.893	1.700	.449	.45	1.00	.49		28.0	28.8	SILTY SAND	
	11.40	380.	1.50	3.30	52.	3.99	.80	.922	1.700	.470	.34	.73	.40		30.3	44.3	SAND	
	11.70	700.	1.70	6.00	143.	9.79	.86	.952	1.700	.491	.27	.55	.32		34.5	121.7	SAND	
	12.00	1050.	4.25	10.60	218.	2.21	5.52	.981	1.900	.514	2.65	5.15	.91		33.3	425.7	SILTY SAND	ϕ=31°
	12.30	960.	3.90	9.90	205.	2.39	4.58	1.011	1.900	.541	2.11	3.91	.81		32.9	367.4	SILTY SAND	
	12.60	920.	3.45	9.23	197.	2.83	3.54	1.040	1.900	.567	1.52	2.68	.68		33.1	312.8	SILTY SAND	C=0 psf
	12.90	760.	3.05	7.95	165.	2.93	2.74	1.070	1.800	.592	1.19	2.01	.61		32.0	226.2	SILTY SAND	
	13.20	650.	3.05	7.70	156.	2.80	2.61	1.099	1.800	.616	1.24	2.01	.63		30.5	205.1	SILTY SAND	
43.9'	13.50	400.	2.20	4.85	83.	2.89	1.30	1.129	1.700	.638	.76	1.19	.54		27.9	70.6	SILTY SAND	
	13.80	500.	2.35	3.60	32.	.91	1.55	1.158	1.600	.657	.44	.67	.42			27.3	SILT	
	14.10	530.	3.40	5.00	45.	.64	2.99	1.187	1.700	.676	1.27	1.87	.78	.246		56.7	CLAYEY SILT	
	14.40	310.	3.40	4.50	27.	.38	2.90	1.217	1.600	.695	1.24	1.79	.76	.243		32.8	SILTY CLAY	C=275 p
	14.70	255.	3.65	4.85	30.	.39	3.13	1.246	1.600	.713	1.43	2.01	.81	.275		39.6	SILTY CLAY	
	15.00	350.	3.70	5.20	41.	.53	3.06	1.276	1.700	.732	1.42	1.94	.80	.274		52.9	SILTY CLAY	
49.7'	15.30	375.	3.80	5.20	38.	.47	3.07	1.305	1.700	.753	1.47	1.96	.80	.283		48.4	SILTY CLAY	
	15.60	1030.	4.45	13.00	298.	3.33	3.32	1.335	1.900	.776	2.02	2.61	.69		32.1	459.6	SAND	ϕ=32°
52.7'	15.90	1025.	4.30	13.00	304.	3.66	2.98	1.364	1.900	.803	1.82	2.26	.65		32.1	439.3	SAND	C=0 psf
	16.20	750.	2.80	5.80	96.	2.41	1.38	1.394	1.800	.828	.89	1.07	.48		31.1	81.5	SILTY SAND	

END OF SOUNDING

FILE NAME: PLANT CRIST ASH POND DAM
FILE NUMBER: CRIST7D.DAT

CONFIDENTIAL

RECORD OF DILATOMETER TEST NO. 7D-1
USING DATA REDUCTION PROCEDURES IN MARCHETTI (ASCE,J-GED,MARCH 80)
KO IN SANDS DETERMINED USING SCHMERTMANN METHOD (1983)
PHI ANGLE CALCULATION BASED ON DURGUNOGLU AND MITCHELL (ASCE,RALEIGH CONF.JUNE 75)
PHI ANGLE NORMALIZED TO 2.72 BARS USING BALIGH'S EXPRESSION (ASCE,J-GED,NOV 76)
MODIFIED MAYNE AND KULHAWY FORMULA USED FOR OCR IN SANDS (ASCE,J-GED,JUNE 82)

LOCATION: ASH POND DAM
PERFORMED - DATE: 16 MARCH 1992
BY: GILLIAM

CALIBRATION INFORMATION:
DELTA A = .02 BARS DELTA B = .35 BARS GAGE 0 = .15 BARS GWT DEPTH= 2.00 M
ROD DIA.= 3.70 CM FR.RED.DIA.= 5.40 CM ROD WT.= 6.50 KG/M DELTA/PHI= .50 BLADE T=15.00 MM

1 BAR = 1.019 KG/CM2 = 1.044 TSF = 14.51 PSI ANALYSIS USES H2O UNIT WEIGHT = 1.000 T/M3

DEPTH (ft)	Z (M) *****	THRUST (KG) ******	A (BAR) *****	B (BAR) *****	ED (BAR) *****	ID *****	KD *****	UO (BAR) ******	GAMMA (T/M3) ******	SV (BAR) ******	PC (BAR) *****	OCR *****	KO *****	CU (BAR) *****	PHI (DEG) *****	M (BAR) ******	SOIL TYPE ************	
13.0'	4.00	130.	.70	3.45	87.	9.81	4.25	.196	1.700	.060	.18	2.98	.69		32.6	152.3	SAND	
	4.30	145.	.60	2.15	43.	6.69	2.30	.226	1.700	.081	.10	1.25	.46		33.0	52.6	SAND	φ=33°
	4.60	1000.	3.81	11.20	256.	2.40	29.51	.255	1.900	.104	10.71	*****	3.70		34.7	901.5	SILTY SAND	C=0 psf
	4.90	1925.	12.00	40.05	1009.	2.85	75.94	.285	2.150	.134	*****	*****	9.38		30.6	4457.1	SILTY SAND	
	5.20	1100.	3.95	10.70	232.	2.10	19.37	.314	1.900	.165	7.44	45.19	2.49		35.1	726.7	SILTY SAND	
17.9'	5.50	650.	2.25	7.75	187.	3.54	8.02	.343	1.800	.190	1.66	8.76	1.14		34.6	431.4	SAND	
	5.80	200.	1.05	2.20	28.	1.61	2.42	.373	1.600	.210	.39	1.84	.60		28.4	72.4	SANDY SILT	
	6.10	300.	1.05	4.30	105.	8.09	1.63	.402	1.700	.229	.24	1.04	.44		31.9	97.0	SAND	φ=31°
	6.40	285.	.70	4.12	106.	22.07	.55	.432	1.700	.250	.12	.48	.31		32.2	90.0	SAND	C=0 psf
									P0I =	.42	P0 =	.57	P1 =	3.62				
21.8'	6.70	250.	.87	4.14	106.	22.76	.49	.461	1.700	.271	.14	.52	.34		30.8	89.8	SAND	
	7.00	650.	1.05	8.45	256.	94.85	.27	.491	1.700	.291	.04	.12	.14		37.8	217.7	SAND	
	7.30	900.	1.05	4.05	96.	10.29	.86	.520	1.700	.312	.06	.19	.17		39.2	81.5	SAND	
	7.60	1200.	3.70	13.00	325.	3.64	7.68	.550	1.900	.335	2.68	8.00	1.09		35.9	738.7	SAND	φ=36°
25.7'	7.90	650.	2.10	8.55	222.	5.87	3.02	.579	1.800	.360	.73	2.02	.59		33.7	323.2	SAND	C=0 psf
	8.20	450.	2.90	4.65	50.	.69	5.47	.608	1.700	.382	1.84	4.81	1.24	.296		94.8	CLAYEY SILT	
	8.50	350.	3.40	5.09	48.	.54	6.37	.638	1.700	.403	2.45	6.09	1.37	.377		98.0	SILTY CLAY	
	8.80	325.	4.00	5.85	54.	.50	7.39	.667	1.700	.424	3.25	7.68	1.52	.477		118.1	SILTY CLAY	C=38
	9.10	335.	3.45	4.85	38.	.42	5.79	.697	1.700	.444	2.33	5.25	1.29	.369		72.8	SILTY CLAY	
30.6'	9.40	340.	3.45	4.50	25.	.28	5.52	.726	1.600	.463	2.26	4.88	1.25	.363		46.9	CLAY	
	9.70	320.	2.40	3.25	17.	.34	3.10	.756	1.600	.481	.95	1.98	.81	.183		22.7	CLAY	
	10.00	335.	1.90	2.65	14.	.41	1.94	.785	1.600	.499	.47	.95	.53	.105		11.8	SILTY CLAY	
	10.30	370.	2.05	2.70	10.	.27	2.12	.815	1.500	.515	.56	1.10	.58	.122		9.3	MUD	C=115 psf
24.5'	10.60	360.	1.80	2.41	9.	.31	1.54	.844	1.500	.530	.35	.66	.41	.084		7.4	MUD	
	10.90	465.	1.25	2.15	19.	2.53	.40	.873	1.700	.547	.29	.52	.34		31.2	16.4	SILTY SAND	
	11.20	500.	1.20	2.35	28.	6.39	.23	.903	1.700	.568	.25	.43	.31		31.8	24.2	SAND	
	11.50	575.	1.24	1.95	12.	2.22	.27	.932	1.700	.588	.25	.42	.30		32.5	10.5	SILTY SAND	
	11.80	650.	1.30	3.80	78.	21.98	.17	.962	1.700	.609	.22	.35	.28		33.4	66.0	SAND	
	12.10	1030.	3.75	10.40	229.	2.85	3.66	.991	1.900	.633	1.78	2.82	.70		33.1	370.0	SILTY SAND	
	12.40	1130.	3.50	9.80	216.	3.03	3.11	1.021	1.900	.659	1.43	2.17	.62		34.1	321.2	SILTY SAND	
	12.70	1170.	3.65	10.10	222.	2.95	3.16	1.050	1.900	.686	1.53	2.23	.62		34.1	331.2	SILTY SAND	φ=33°
	13.00	1240.	3.60	9.90	216.	2.97	2.94	1.079	1.900	.712	1.42	1.99	.59		34.5	310.0	SILTY SAND	C=0 psf
	13.30	1210.	3.45	9.72	215.	3.23	2.59	1.109	1.900	.739	1.26	1.71	.55		34.4	285.5	SILTY SAND	
	13.60	1185.	3.60	10.10	223.	3.18	2.65	1.138	1.900	.765	1.38	1.80	.57		33.9	300.5	SILTY SAND	
	13.90	1120.	3.50	9.65	211.	3.17	2.42	1.168	1.800	.790	1.31	1.66	.55		33.5	267.1	SILTY SAND	
46.2'	14.20	1070.	3.50	9.65	211.	3.22	2.32	1.197	1.800	.814	1.31	1.62	.55		33.0	258.8	SILTY SAND	

END OF SOUNDING

CONFIDENTIAL

Southern Company Services
Soil Testing for Plant Crist
Fill Material

April 20, 1992

Mr. Joel Miller

Mr. Ray Halbert
Alabama Power Company
PGTS - Civil

Enclosed are the test results for the soil sample delivered to the Central Laboratory on March 30, 1992. Performed test included gradation, hydrometer, specific gravity, Atterberg Limits, soil classification and Consolidated-Undrained (R) triaxial test.

Laboratory soil sample #1, represents fill material from location APD-7 from a depth of 16.0' to 18.0' This sample was classified as a light brown well graded sand with silt or SW-SM by the Unified Soil Classification System. Specific gravity was 2.62. Atterberg Limits were non-applicable. Consolidated-Undrained (R) triaxial test were performed on UD sample with 1 and 2.5 ksf load. The total stress angle of internal friction was 24.5 degrees with a cohesion factor of .3 ksf and the effective stress angle of internal friction was 35.5 degrees with a cohesion of 0.0 ksf. Gradation for the sample was as follows:

Sieve Size:	% Passing:
3/4 in.	100.0
3/8 in.	98.9
#4	94.6
#8	91.0
#10	90.0
#16	88.3
#30	82.8
#50	35.1
#100	16.9
#200	10.5

If you have any questions about the test performed or if we can be of any further assistance to you please contact me at extension 8-255-6266.

Ray Halbert
Alabama Power Company
Supervisor/Concrete and Soils

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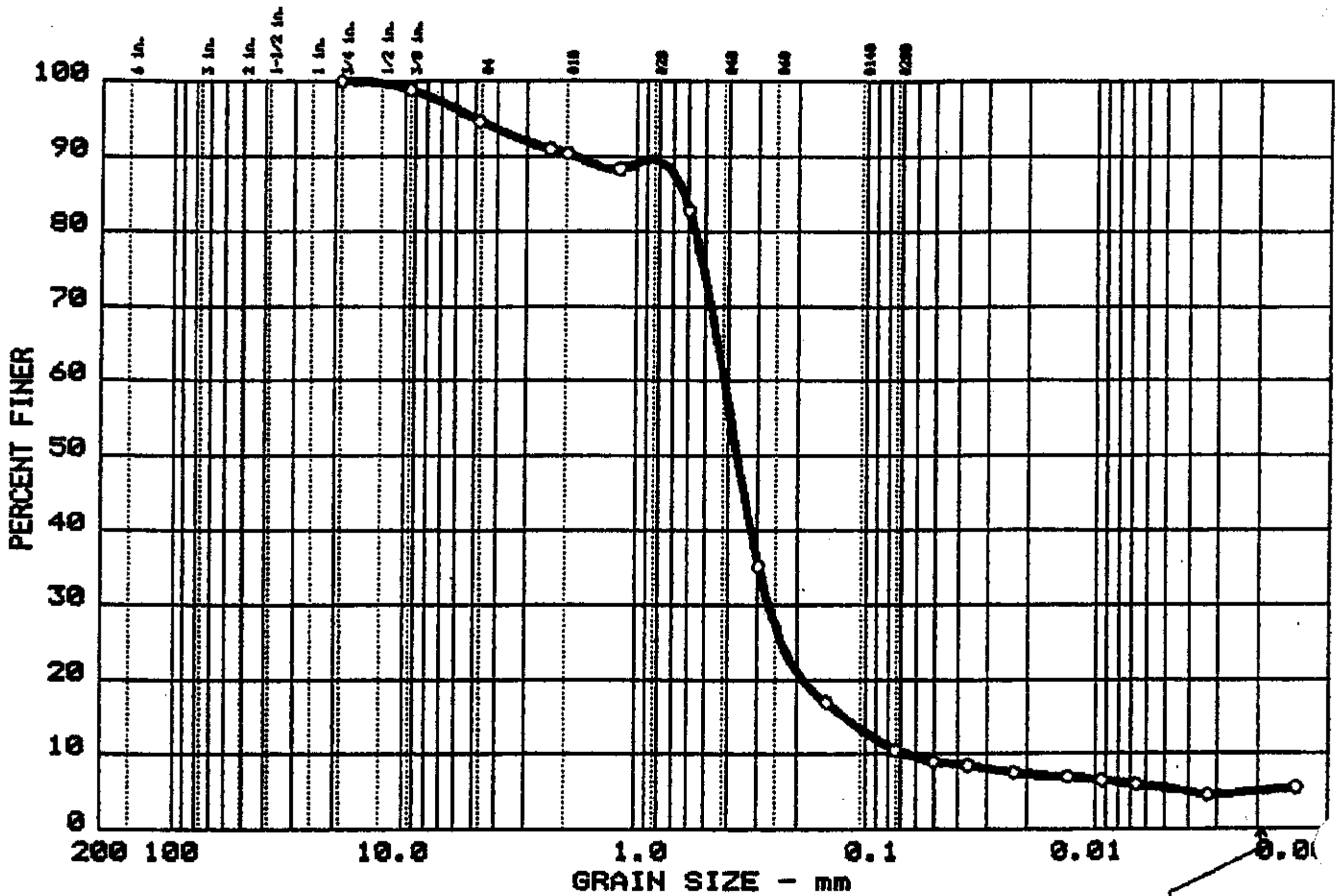
GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
o	1	0.0	5.4	84.1	10.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	NP	NP	0.62	0.42	0.37	0.269	0.1229	0.0652	2.65	6.4

MATERIAL DESCRIPTION	USCS	AASHTO
o LIGHT BROWN WELL GRADED SAND W/SILT	SW-SM	A-2-4(0.4)

Project No.: 1
Project: PLANT CRIST
o Location: APD-7

Date: 04-16-92

ALABAMA POWER COMPANY

Remarks:
BORNING-FILL MILT.
DEPTH(ft)-16.0-18.0
TEST BY-SDM LSJ

Figure No.1

DATE: 04/16/92

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ALABAMA POWER COMPANY
TRIAXIAL SHEAR TEST DATA
CONSOLIDATED-UNDRAINED (R) TEST

Project PLANT CRIST — Lab No. 1

Job FILL MATERIAL — Job Date 03/30/92

Sample Location APD-7 — Depth

SOIL DESCRIPTION: LIGHT BROWN WELL GRADED SAND W/SILT

SOIL CLASSIFICATION: SW-SM LL = NP PI = NP SPECIFIC GRAVITY = 2.62

RECEIVED ON 03/30/92

REPORTED ON 04/16/92

REMARKS:

MINOR PRINCIPAL STRESS	(KSF)	0.99	2.51	0.00
INITIAL CONDITIONS				
WATER CONTENT	(%)	14.0	14.6	0.0
DRY DENSITY	(PCF)	104.1	109.7	0.0
SATURATION	(%)	64.2	78.0	0.0
VOID RATIO	-	0.571	0.491	0.000
DIAMETER	(IN.)	1.400	1.400	0.000
HEIGHT	(IN.)	3.000	3.000	0.000
BEFORE SHEAR				
WATER CONTENT	(%)	21.8	18.7	0.0
DRY DENSITY	(PCF)	104.8	115.3	0.0
SATURATION	(%)	100.0	100.0	0.0
VOID RATIO	-	0.561	0.418	0.000
BACK PRESSURE	(KSF)	12.96	12.96	0.00
RATE OF STRAIN	(%/MIN)	0.130	0.130	0.000

	TOTAL STRESS	EFFECTIVE STRESS (MOHR)	EFFECTIVE STRESS (P-Q)
COHESION C (KSF) =	.3	0.0	
ANGLE OF INTERNAL FRICTION (DEGREES)	24.5	35.5	

ALABAMA POWER COMPANY CONSOLIDATED-UNDRAINED (R) TRIAXIAL TEST DATA

CONFIDENTIAL

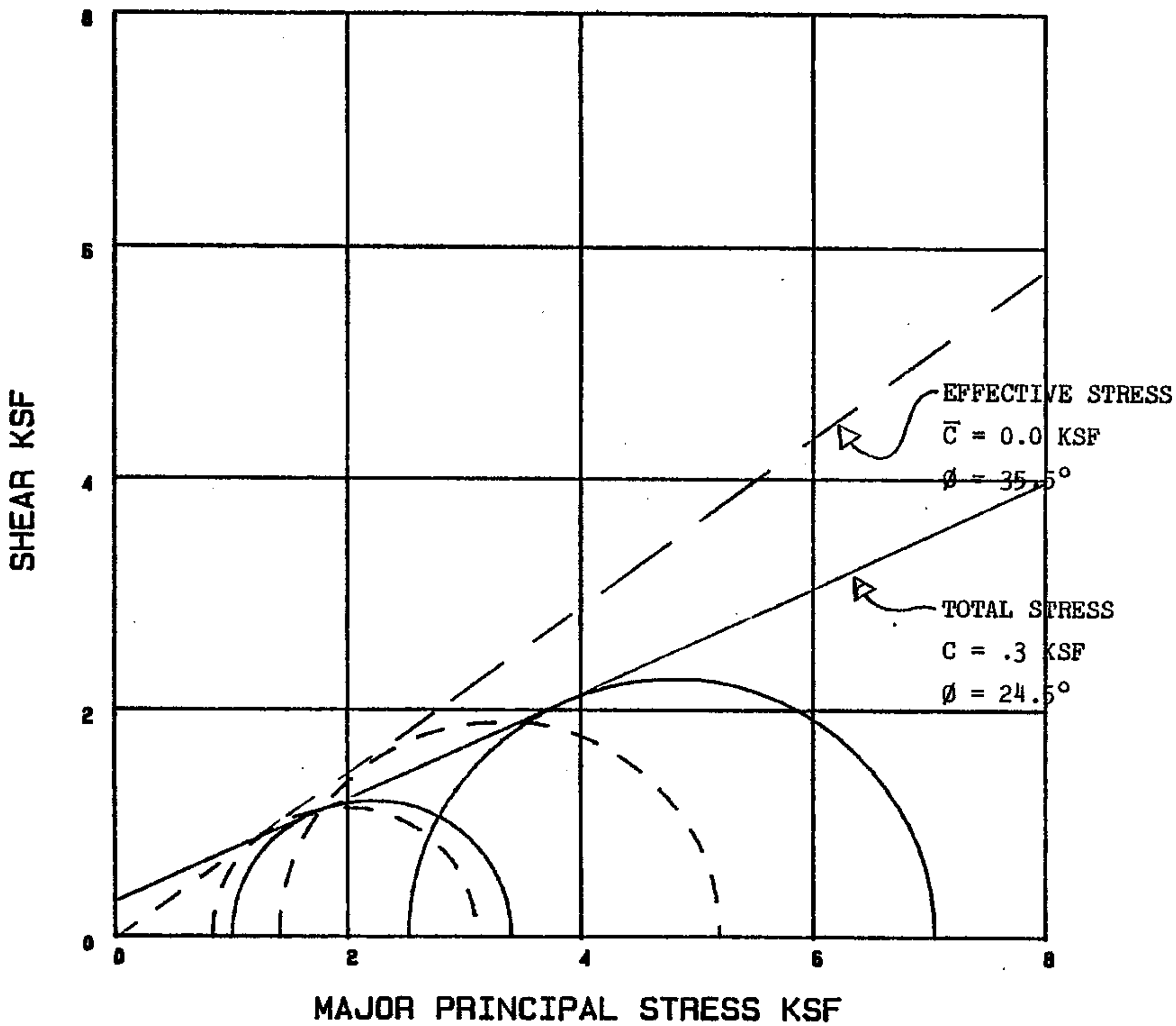
MINOR PRINCIPAL STRESS, KSF: 0.99

STRAIN %	DEVIATOR STRESS KSF	INDUCED PORE PRESSURE KSF	MAJOR PRINCIPAL STRESS KSF	EFFECTIVE PRINCIPAL STRESS major KSF	EFFECTIVE PRINCIPAL STRESS minor KSF	EFFECTIVE PRINCIPAL STRESS RATIO	P KSF	Q KSF
0.0	0.00	0.00	0.99	0.99	0.99	1.00	0.99	0.00
0.2	0.80	0.14	1.80	1.65	0.84	1.95	1.25	0.40
0.3	1.05	0.20	2.04	1.84	0.79	2.33	1.32	0.53
0.7	1.30	0.26	2.29	2.03	0.73	2.76	1.38	0.65
1.7	1.58	0.33	2.58	2.24	0.66	3.39	1.45	0.79
2.7	1.73	0.24	2.72	2.47	0.74	3.31	1.61	0.86
3.7	1.85	0.27	2.84	2.56	0.72	3.56	1.64	0.92
5.0	1.98	0.23	2.97	2.74	0.76	3.59	1.75	0.99
6.7	2.10	0.19	3.09	2.90	0.80	3.60	1.86	1.05
8.3	2.19	0.13	3.18	3.05	0.86	3.53	1.96	1.09
10.0	2.27	0.17	3.27	3.09	0.82	3.77	1.96	1.14
11.7	2.33	0.12	3.32	3.20	0.87	3.65	2.04	1.16
13.4	2.36	0.12	3.35	3.23	0.87	3.68	2.06	1.18
15.0	2.41	0.10	3.40	3.29	0.89	3.70	2.10	1.20

MINOR PRINCIPAL STRESS, KSF: 2.51

STRAIN %	DEVIATOR STRESS KSF	INDUCED PORE PRESSURE KSF	MAJOR PRINCIPAL STRESS KSF	EFFECTIVE PRINCIPAL STRESS major KSF	EFFECTIVE PRINCIPAL STRESS minor KSF	EFFECTIVE PRINCIPAL STRESS RATIO	P KSF	Q KSF
0.0	0.00	0.00	2.51	2.50	2.50	1.00	2.51	0.00
0.2	0.50	0.09	3.01	2.92	2.41	1.21	2.67	0.25
0.3	0.95	0.23	3.45	3.22	2.27	1.42	2.75	0.47
0.7	1.36	0.58	3.86	3.28	1.92	1.70	2.61	0.68
1.7	2.19	0.62	4.69	4.07	1.88	2.16	2.98	1.09
2.7	2.40	0.94	4.90	3.96	1.56	2.53	2.77	1.20
3.7	2.34	1.12	4.85	3.72	1.38	2.70	2.55	1.17
5.0	2.34	1.24	4.85	3.60	1.26	2.85	2.44	1.17
6.7	2.91	1.35	5.41	4.06	1.15	3.52	2.61	1.45
8.4	3.21	1.28	5.72	4.43	1.22	3.62	2.83	1.61
10.0	3.77	1.09	6.27	5.17	1.41	3.67	3.29	1.88
11.7	3.80	1.11	6.31	5.19	1.39	3.72	3.30	1.90
13.4	4.24	0.89	6.75	5.85	1.61	3.63	3.73	2.12
15.0	4.54	0.81	7.05	6.23	1.69	3.67	3.97	2.27

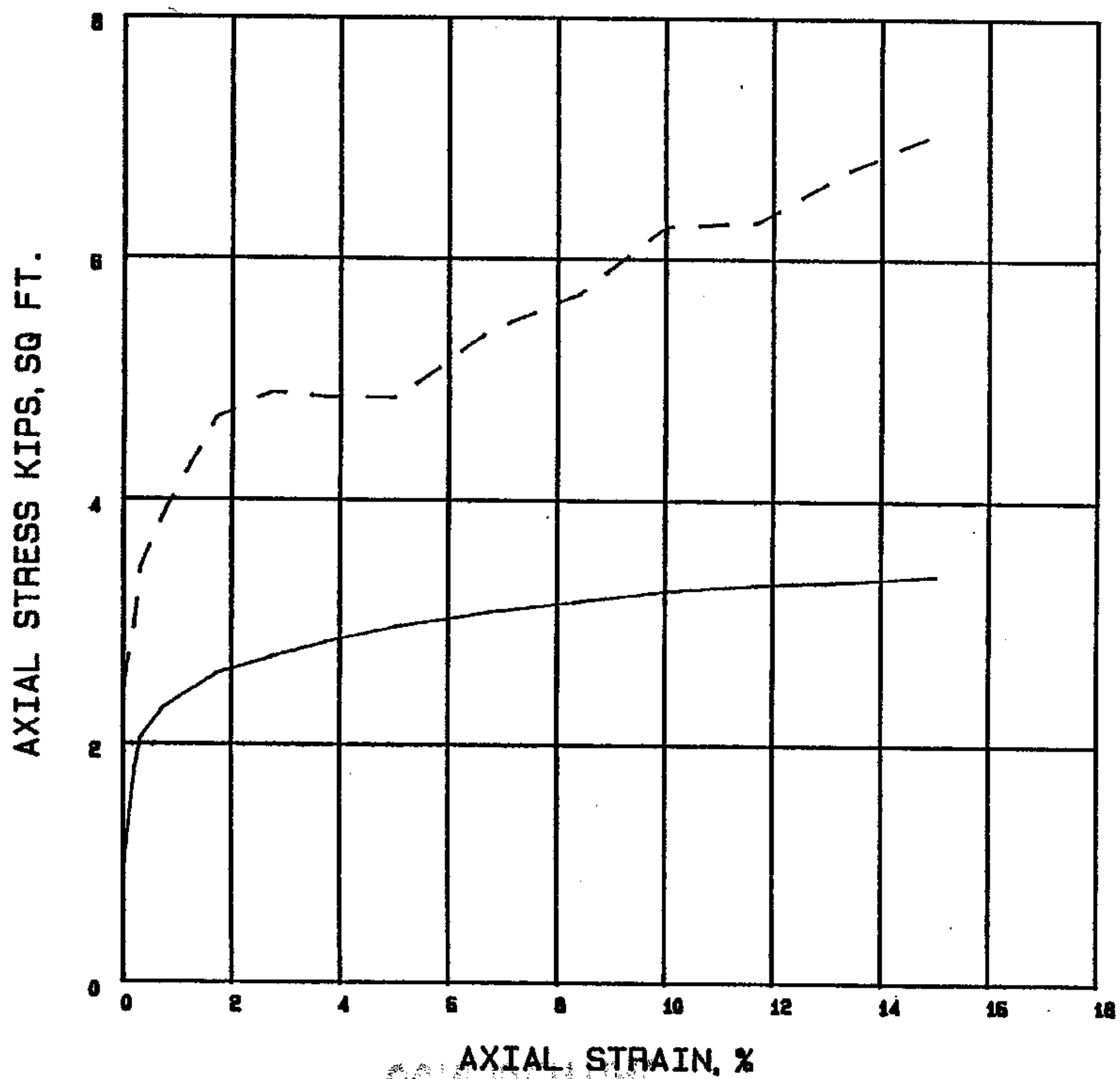
ALABAMA POWER COMPANY
TRIAXIAL SHEAR TEST DATA
CONSOLIDATED-UNDRAINED (R) TEST



SAMPLE NUMBER 1

CONFIDENTIAL

ALABAMA POWER COMPANY
TRIAXIAL SHEAR TEST DATA
CONSOLIDATED-UNDRAINED (R) TEST



SAMPLE NUMBER 1

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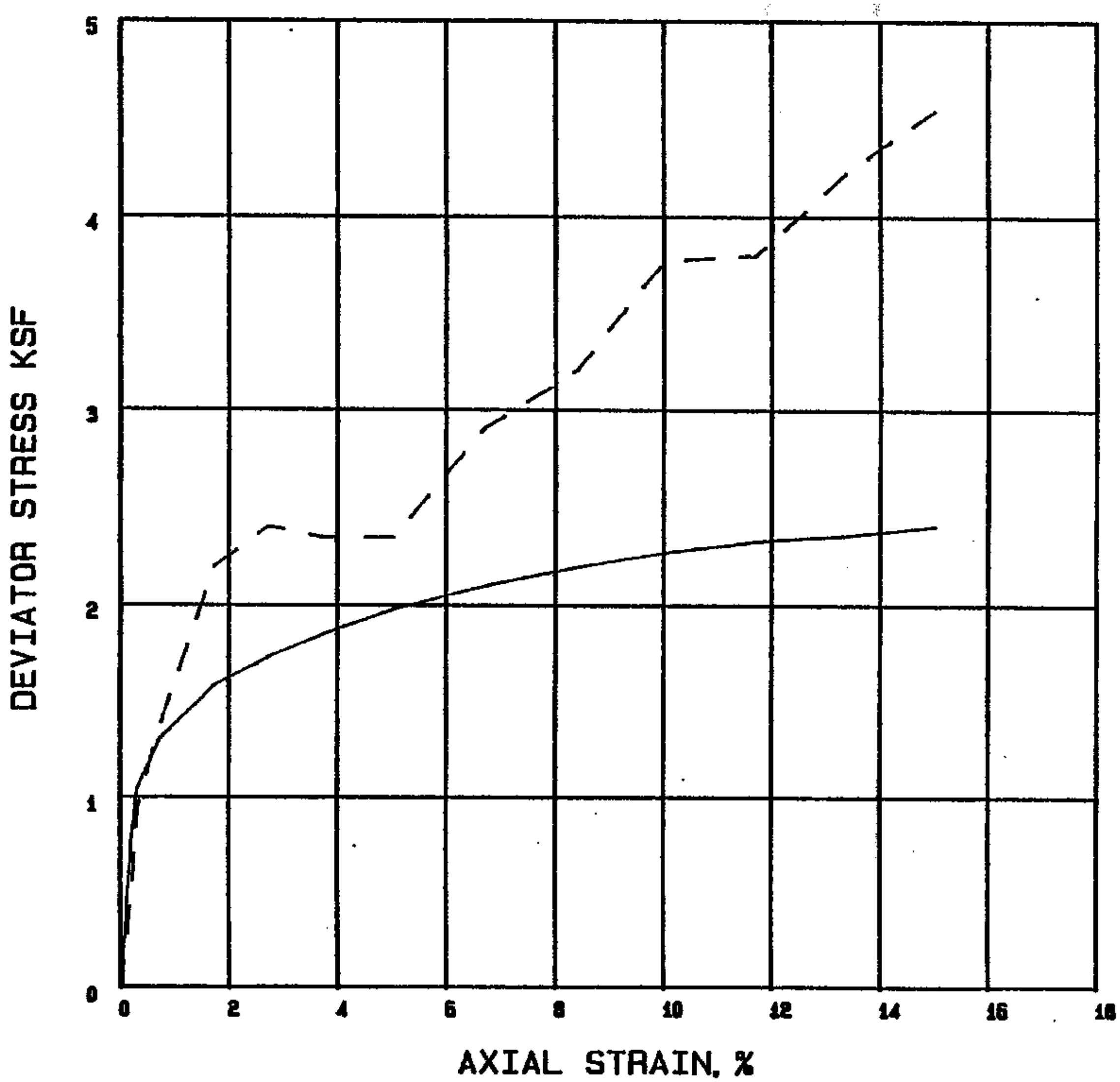
ALABAMA POWER COMPANY
TRIAXIAL SHEAR TEST DATA
CONSOLIDATED-UNDRAINED (R) TEST



SAMPLE NUMBER 1

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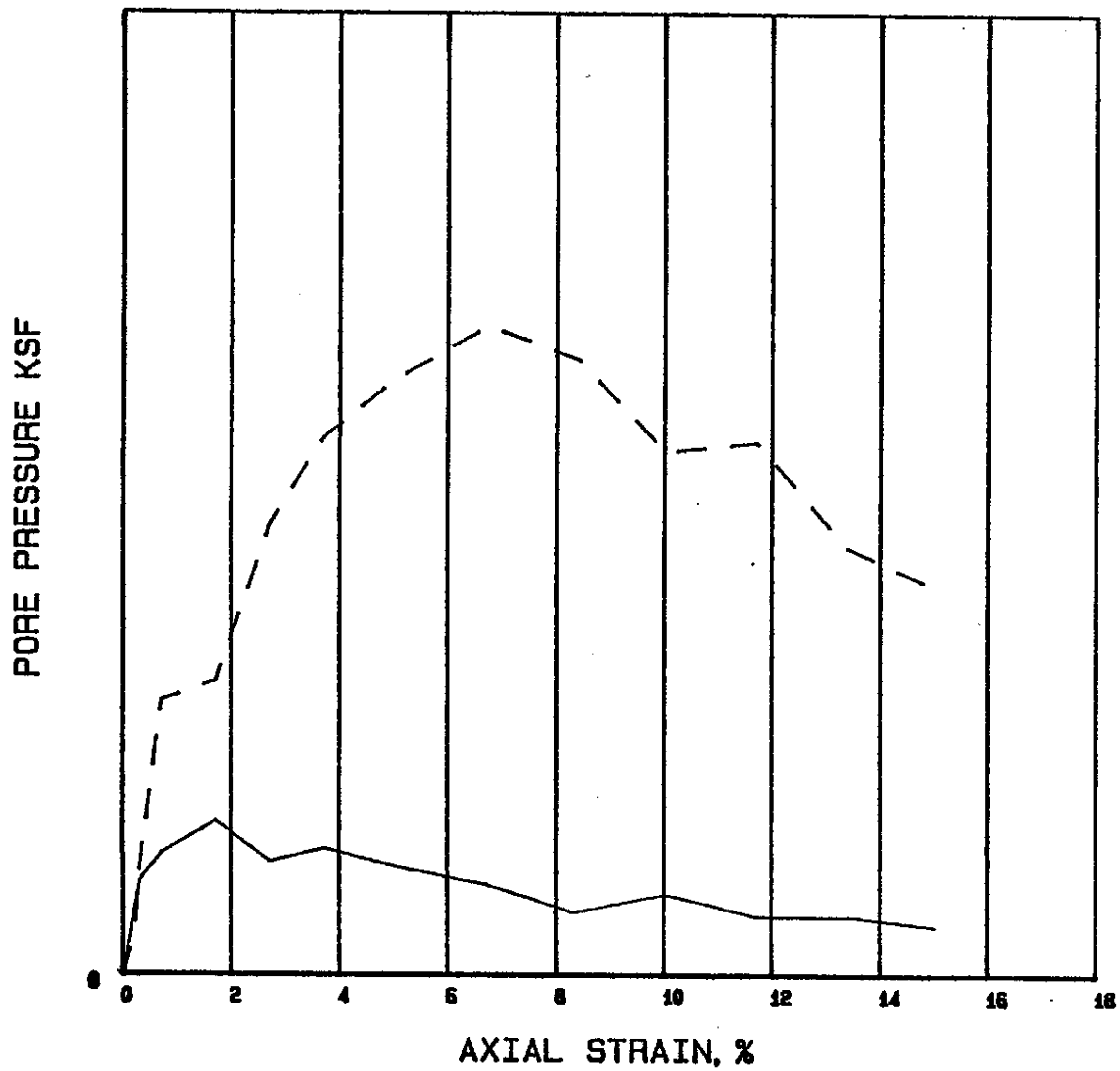
ALABAMA POWER COMPANY
TRIAXIAL SHEAR TEST DATA
CONSOLIDATED-UNDRAINED (R) TEST



SAMPLE NUMBER 1

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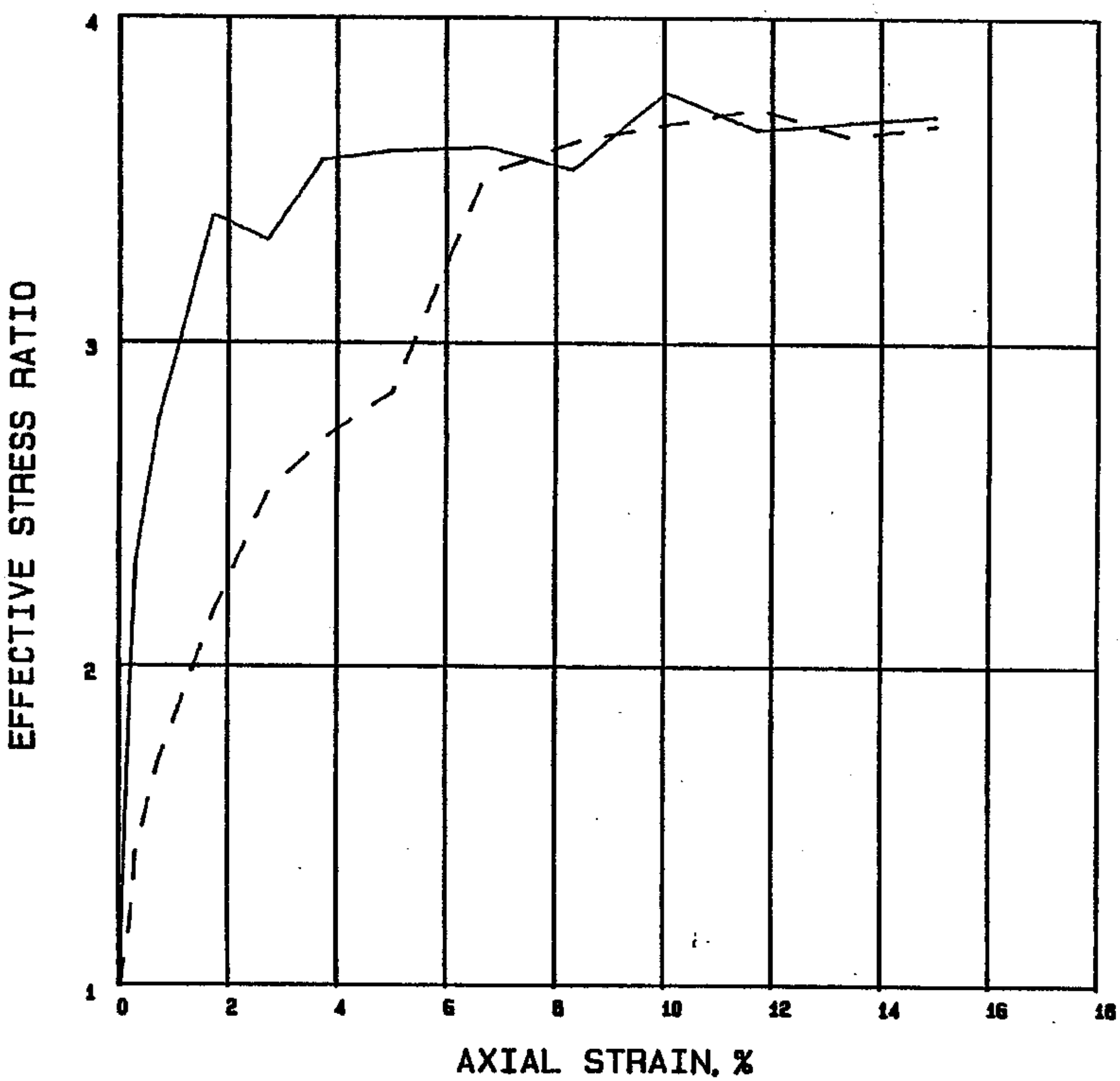
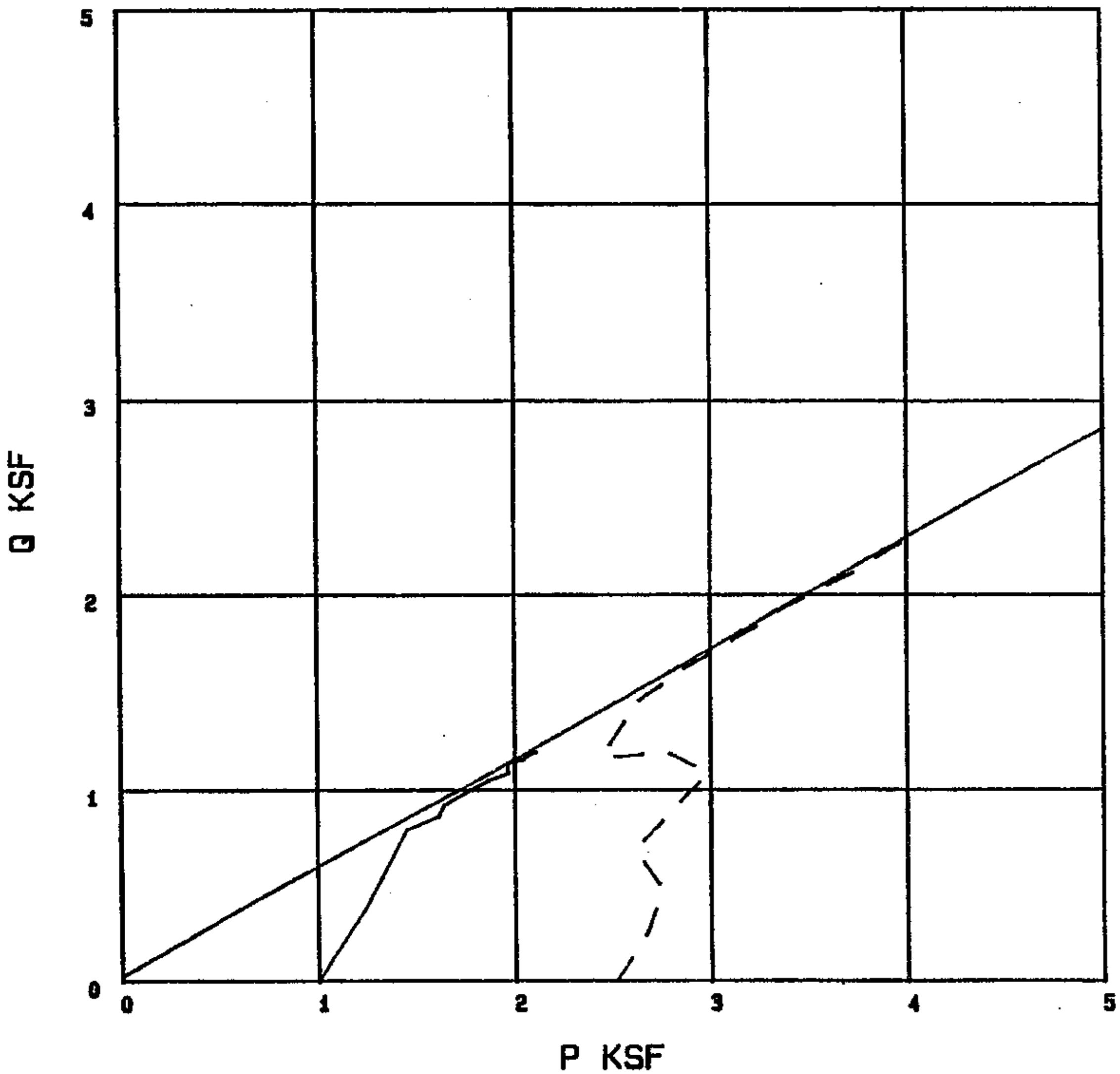
ALABAMA POWER COMPANY
TRIAXIAL SHEAR TEST DATA
CONSOLIDATED-UNDRAINED (R) TEST



SAMPLE NUMBER 1

CONFIDENTIAL

ALABAMA POWER COMPANY
TRIAXIAL SHEAR TEST DATA
CONSOLIDATED-UNDRAINED (R) TEST



SAMPLE NUMBER 1
ALPHA: 29.6 THETA: 34.6
A: 0.03 C: 0.03

CONFIDENTIAL TEST BORING RECORD

ELEV.	DEPTH	DESCRIPTION		N	CR	S	REMARKS
88.7	0.0	EXISTING DIKE					ELEVATIONS OBTAINED FROM GULF POWER COMPANY ELEVATIONS REFERENCED TO PLANT DATUM. 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
						≡ (water table, time of boring)	
6 61.7	27.0	FIRM MEDIUM GRAINED WHITE SAND	27.0	17			
59.7	29.0	SOFT ORGANIC MUCK, DECAYED WOOD AND BLACK CLAY	30.0	4			
55.7	33.0	LOOSE TO FIRM WHITE MEDIUM GRAINED SAND WITH BLACK SILTY CLAY	35.0	4			
			40.0	2			
			45.0	2			
			50.0	9			
37.7	51.0						

DRILLING TERMINATED

BORING NUMBER: B-109 A

DATE DRILLED: 8/29/71

JOB NO: B-1464

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR— IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

5				
18	70 NX	☒	UNDISTURBED SAMPLE, (ASTM D-1587)
	100	≡	WATER TABLE, TIME OF BORING
23	BX	≡	WATER TABLE, 24 HOUR READING
		◄	LOSS OF DRILLING FLUID

EXHIBIT
GP-CR # 23

* There are two B-109 so the one in the old ash pond will be

CONFIDENTIAL

TEST BORING RECORD

ELEV.	DEPTH	DESCRIPTION		N	CR	S	REMARKS
89.7	0.0	EXISTING DIKE	2.5	20			ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM. 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
			5.0	52			
			7.5	35			
			10.0	31		(water table, time of boring)	
			15.0	36			
			20.0	8			
64.7	25.0	SOFT ORGANIC MUCK, DECAYED WOOD AND BLACK CLAY	25.0	5			← VANE SHEAR
67.7	32.0	FIRM WHITE MEDIUM GRAINED SAND WITH BLACK SILTY CLAY	35.0	11			
63.7	36.0	DRILLING TERMINATED					

BORING NUMBER: B-110

DATE DRILLED: 8/26-27/71

JOB NO: B-1464

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR— IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

	CR	S	
5			
18	70 NX	☒	UNDISTURBED SAMPLE. (ASTM D-1587)
	100	(symbol)	WATER TABLE, TIME OF BORING
23	BX	(symbol)	WATER TABLE, 24 HOUR READING
		◀	LOSS OF DRILLING FLUID

TEST BORING RECORD

ELEV.	DEPTH	DESCRIPTION		N	CR	S	REMARKS
90.3	0.0	EXISTING DIKE					ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM, 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
61.3	29.0	SOFT ORGANIC MUCK, DECAYED WOOD & BLACK CLAY	30.0	4			
56.8	33.5	VERY LOOSE TO LOOSE WHITE MEDIUM GRAINED SAND WITH BLACK SILTY CLAY	35.0	*			*HAMMERWEIGHT PUSHED SPOON 12 INCHES
			40.0	4			
			45.0	4			
43.3	47.0	DENSE YELLOWISH TAN MEDIUM GRAINED SAND					
			50.0	51			
39.3	51.0	DRILLING TERMINATED					

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR — IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

- UNDISTURBED SAMPLE, (ASTM D-1587)
- WATER TABLE, TIME OF BORING
- WATER TABLE, 24 HOUR READING
- LOSS OF DRILLING FLUID

(Legend example: 5; 18 — 70 NX; 23 — 100 BX)

BORING NUMBER: B-111

DATE DRILLED: 8/29/71

JOB NO: B-1464

CONFIDENTIAL

TEST BORING RECORD

ELEV.	DEPTH	DESCRIPTION		N	CR	S	REMARKS
90.7	0.0	EXISTING DIKE					ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM. 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
			2.5	23			
			5.0	28			
			7.5	34		water table, time of boring	
			10.0	21			
			15.0	28			
			20.0	25			
66.2	24.5	SOFT ORGANIC MUCK, DECAYED WOOD AND BLACK CLAY	25.0	4			
62.2	28.5	LOOSE WHITE MEDIUM GRAINED SAND WITH BLACK SILTY CLAY					
			35.0	4			
			40.0	2			
			45.0	3			
40.7	50.0	STIFF GRAY CLAY	50.0	11			
39.7	51.0	DRILLING TERMINATED					

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR— IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

5			
18	70 NX	☒	UNDISTURBED SAMPLE, (ASTM D-1587)
	100	water table symbol	WATER TABLE, TIME OF BORING
23	BX	water table symbol	WATER TABLE, 24 HOUR READING
		◄	LOSS OF DRILLING FLUID

BORING NUMBER: B-112

DATE DRILLED: 8/26/71

JOB NO: B-1464

CONFIDENTIAL

TEST BORING RECORD

ELEV.	DEPTH		DESCRIPTION	N	CR	S	REMARKS
91.0	0.0		EXISTING DIKE				ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM. 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
65.5	25.5		SOFT ORGANIC MUCK, DECAYED WOOD AND BLACK CLAY	26.0	6		
61.5	29.5		FIRM WHITE MEDIUM GRAINED SAND WITH BLACK SILTY CLAY	30.0	20		
59.5	31.5		DRILLING TERMINATED				

BORING NUMBER: B-113
DATE DRILLED: 8/29/71
JOB NO: B-1464

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR— IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

UNDISTURBED SAMPLE, (ASTM D-1587)

WATER TABLE, TIME OF BORING

WATER TABLE, 24 HOUR READING

LOSS OF DRILLING FLUID

5		
18	70 NX	☒
	100	
23	BX	
		◄

TEST BORING RECORD

ELEV.	DEPTH	DESCRIPTION		N	CR	S	REMARKS
92.6	0.0	EXISTING DIKE					ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM. 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
			2.5	37			
			5.0	34			
			7.5	58			
			10.0	25			
			15.0	31			
			20.0	28			
			25.0	6			
			30.0	2			
62.1	30.5	SOFT BLACK ORGANIC SILTY CLAY WITH DECAYED WOOD					← BORE HOLE SHEAR
			35.0	8			
54.6	38.0	FIRM WHITE MEDIUM GRAINED SAND WITH BLACK SILTY CLAY					
			40.0	15			
51.1	41.5	DRILLING TERMINATED					

BORING NUMBER: B-114

DATE DRILLED: 8/27/71

JOB NO: B-1464

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR — IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

5			
18	70 NX	☒	UNDISTURBED SAMPLE. (ASTM D-1587)
	100		WATER TABLE, TIME OF BORING
23	BX		WATER TABLE, 24 HOUR READING
		◄	LOSS OF DRILLING FLUID

TEST BORING RECORD

CONFIDENTIAL

ELEV.	DEPTH	DESCRIPTION		N	CR	S	REMARKS
83.3	0.0	EXISTING DIKE					ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM. 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
			2.0	40			
			5.0	37			
			7.5	100+			
			10.0	16			
69.3	14.0	VERY SOFT BLACK ORGANIC SILTY CLAY AND DECAYED WOOD				WATER TABLE, TIME OF BORING	LOSS OF DRILLING FLUID
			15.0	1		UNDISTURBED SAMPLE	NO RECOVERY
			20.0	2			LOSS OF DRILLING FLUID
			25.0	2			
57.8	25.5	VERY LOOSE GRAY MEDIUM GRAINED SAND WITH BLACK SILTY CLAY LAYERS AND DECAYED PLANT PARTS					
			30.0	3			
			35.0	4			
			41.0	3			
38.8	44.5	FIRM GRAY MEDIUM GRAINED SAND WITH TRACES OF ORGANIC MATTER	44.5	25			
37.3	46.0	DRILLING TERMINATED					

BORING NUMBER: B-115

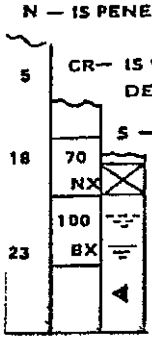
DATE DRILLED: 8/16/71

JOB NO: B-1464

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR— IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:



UNDISTURBED SAMPLE, (ASTM D-1587)

WATER TABLE, TIME OF BORING

WATER TABLE, 24 HOUR READING

LOSS OF DRILLING FLUID

CONFIDENTIAL

TEST BORING RECORD

ELEV.	DEPTH	DESCRIPTION		N	CR	S	REMARKS
87.4	0.0	EXISTING DIKE					ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM. 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
			20.0	8			
63.4	24.0	SOFT BLACK SILTY ORGANIC CLAY	25.0	5		☒	
58.4	29.0	DRILLING TERMINATED					

BORING NUMBER: B-116

DATE DRILLED: 8/20/71

JOB NO: B-1464

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR— IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

5			
18	70 NX	☒	UNDISTURBED SAMPLE, (ASTM D-1587)
	100		WATER TABLE, TIME OF BORING
23	BX		WATER TABLE, 24 HOUR READING
		◀	LOSS OF DRILLING FLUID

CONFIDENTIAL

TEST BORING RECORD

ELEV.	DEPTH	DESCRIPTION		N	CR	S	REMARKS
84.2	0.0	EXISTING DIKE					ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM. 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
69.2	15.0	VERY SOFT BLACK SILTY ORGANIC CLAY	15.0	1			← BORE HOLE SHEAR
						☒	← VANE SHEAR
			25.0	2			
57.2	27.0	VERY LOOSE WHITE MEDIUM GRAINED SAND WITH BLACK SILTY CLAY	30.0	1			
			35.0	1			
45.7	38.5	FIRM WHITE TO TAN COARSE GRAINED SAND WITH QUARTZ PEA GRAVELS	40.0	6			
			45.0	7			
			50.0	17			
53.2	51.0	DRILLING TERMINATED					

BORING NUMBER: B-117

DATE DRILLED: 8/19/71

JOB NO: B-1464

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR— IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

- ☒ UNDISTURBED SAMPLE, (ASTM D-1587)
- WATER TABLE, TIME OF BORING
- WATER TABLE, 24 HOUR READING
- ◄ LOSS OF DRILLING FLUID

N	CR	S
5		
18	70 NX	☒
23	100 BX	

CONFIDENTIAL

TEST BORING RECORD

ELEV.	DEPTH	DESCRIPTION		N	CR	S	REMARKS
85.2	0.0	EXISTING DIKE					ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM. 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
68.2	17.0	SOFT BLACK SILTY ORGANIC CLAY AND DECAYED WOOD	17.0	4		⊠	← BORE HOLE SHEAR ← VANE SHEAR
55.7	29.5	FIRM GRAY MEDIUM GRAINED SAND WITH QUARTZ PEA GRAVELS AND BLACK SILTY CLAYEY ZONES	30.0	3			
			35.0	16			
49.2	36.0	DRILLING TERMINATED					

BORING NUMBER: B-118
DATE DRILLED: 8/19/71
JOB NO: B-1464

N — 15 PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

5 CR— 15 % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

18 70 NX ⊠ UNDISTURBED SAMPLE. (ASTM D-1587)

100 WATER TABLE, TIME OF BORING

13 BX WATER TABLE, 24 HOUR READING

◄ LOSS OF DRILLING FLUID

CONFIDENTIAL

TEST BORING RECORD

ELEV.	DEPTH	DESCRIPTION		N	CR	S	REMARKS
86.3	0.0	EXISTING DIKE					ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM. 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
			2.5	68			
			5.0	45			
			10.0	11			
			15.0	6			
						water table symbol	
69.3	17.0	SOFT BLACK SILTY ORGANIC CLAY AND DECAYED WOOD					← VANE SHEAR
						⊠	← BORE HOLE SHEAR
							← VANE SHEAR
59.3	27.0	LOOSE TO FIRM WHITE MEDIUM GRAINED SAND WITH BLACK SILTY CLAY					
			30.0	8			
			35.0	4			
			40.0	10			
			45.0	17			
40.3	46.0	DRILLING TERMINATED					

BORING NUMBER: B-119

DATE DRILLED: 8/17/71

JOB NO: B-1464

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR— IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

5			
18	70 NX	⊠	UNDISTURBED SAMPLE, (ASTM D-1587)
	100	water table symbol	WATER TABLE, TIME OF BORING
23	BX	water table symbol	WATER TABLE, 24 HOUR READING
		◄	LOSS OF DRILLING FLUID

CONFIDENTIAL

TEST BORING RECORD

ELEV.	DEPTH	DESCRIPTION		N	CR	S	REMARKS
86.0	0.0	EXISTING DIKE	2.5	100+			ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM, 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
			5.0	38			
			7.5	66			
			10.0	16			
			15.0	3			
67.0	19.0	SOFT BLACK SILTY ORGANIC CLAY WITH DECAYED WOOD	20.0	5			←VANE SHEAR
61.5	24.5	VERY LOOSE BLACK SILTY MEDIUM GRAINED SAND	25.0	2		☒	NO RECOVERY
58.0	28.0	VERY SOFT BLACK SILTY SANDY ORGANIC CLAY	30.0	*			*HAMMER WEIGHT PUSHED SPOON 12 INCHES
53.0	33.0	DENSE GRAY MEDIUM GRAINED SAND	35.0	36			
50.0	36.0	DRILLING TERMINATED					

BORING NUMBER: B-120

DATE DRILLED: 8/17/71

JOB NO: B-1464

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR— IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

Depth	CR	S	
5			
18	70 NX	☒	UNDISTURBED SAMPLE. (ASTM D-1587)
	100		WATER TABLE, TIME OF BORING
23	BX		WATER TABLE, 24 HOUR READING
		◄	LOSS OF DRILLING FLUID

CONFIDENTIAL

TEST BORING RECORD

ELEV.	DEPTH	DESCRIPTION		N	CR	S	REMARKS
84.5	0.0	EXISTING DIKE					ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM, 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
64.5	20.0	SOFT BLACK SILTY ORGANIC CLAY	20.0	2			BORE HOLE SHEAR; VANE SHEAR
57.0	27.5	DENSE GRAY MEDIUM GRAINED SAND	28.0	30			
55.0	29.0	DRILLING TERMINATED					

BORING NUMBER: B-121

DATE DRILLED: 8/24/71

JOB NO: B-1464

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR — IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

Depth	CR	S	Description
5			
18	70 NX	⊠	UNDISTURBED SAMPLE, (ASTM D-1587)
	100		WATER TABLE, TIME OF BORING
23	BX		WATER TABLE, 24 HOUR READING
		◄	LOSS OF DRILLING FLUID

CONFIDENTIAL

TEST BORING RECORD

ELEV.	DEPTH	DESCRIPTION		N	CR	S	REMARKS
84.5	0.0	EXISTING DIKE					ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM, 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
66.0	18.5	SOFT BLACK SILTY ORGANIC CLAY WITH DECAYED WOOD	18.5	12			
62.5	22.0	DENSE GRAY MEDIUM GRAINED SAND	25.0	29			
58.5	26.0	DRILLING TERMINATED					

BORING NUMBER: B-122

DATE DRILLED: 8/24/71

JOB NO: B-1464

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR — IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

UNDISTURBED SAMPLE. (ASTM D-1587)

WATER TABLE, TIME OF BORING

WATER TABLE, 24 HOUR READING

LOSS OF DRILLING FLUID

(Legend example: 5; 18 — 70 NX; 100; 23 — BX)

TEST BORING RECORD

CONFIDENTIAL

ELEV.	DEPTH	DESCRIPTION	N	CR	S	REMARKS
85.9	0.0	EXISTING DIKE			≟	ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM. 72.5 FT DATUM = 0.0 FT. MEAN SEA LEVEL
61.9	24.0	LOOSE GRAY FINE GRAINED SAND				
60.9	25.0	SOFT BLACK SILTY ORGANIC CLAY				
	27.0		6			
56.9	29.0	FIRM GRAY FINE GRAINED SAND WITH THIN BLACK SILTY CLAY LENSES				
	32.0		17			
52.4	33.5	DRILLING TERMINATED				

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR— IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

5			
8	70 NX	☒	UNDISTURBED SAMPLE. (ASTM D-1587)
	100	≟	WATER TABLE, TIME OF BORING
3	BX	≡	WATER TABLE, 24 HOUR READING
		◀	LOSS OF DRILLING FLUID

BORING NUMBER: B-124

DATE DRILLED: 8/25/71

JOB NO: B-1464

CONFIDENTIAL

TEST BORING RECORD

ELEV.	DEPTH		DESCRIPTION		N	CR	S	REMARKS
84.4	0.0		EXISTING DIKE				-▽-	ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM. 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
61.4	23.0		FIRM GRAY MEDIUM GRAINED SAND WITH TRACE OF ORGANIC MATERIAL	25.0	15			
58.4	26.0		DRILLING TERMINATED					

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR — IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

- ☒ UNDISTURBED SAMPLE. (ASTM D-1587)
- -▽- WATER TABLE, TIME OF BORING
- ▽ WATER TABLE, 24 HOUR READING
- ◄ LOSS OF DRILLING FLUID

(Example legend column: 5; 18 — 70 NX; 100; 23 — BX)

BORING NUMBER: B-125

DATE DRILLED: 8/20/71

JOB NO: B-1464

CONFIDENTIAL

TEST BORING RECORD

ELEV.	DEPTH		DESCRIPTION		N	CR	S	REMARKS
87.1	0.0		EXISTING DIKE				-.-.-	ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM, 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
				24.0	4			
59.1	28.0			28.0	6			
			DRILLING TERMINATED					

BORING NUMBER: B-126
DATE DRILLED: 8/20/71
JOB NO: B-1464

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR— IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

N	CR	S	
5			
18	70 NX	☒	UNDISTURBED SAMPLE. (ASTM D-1587)
	100	-.-.-	WATER TABLE, TIME OF BORING
23	BX	≡	WATER TABLE, 24 HOUR READING
		◀	LOSS OF DRILLING FLUID

CONFIDENTIAL

TEST BORING RECORD

ELEV.	DEPTH		DESCRIPTION		N	CR	S	REMARKS
82.0	0.0		EXISTING DIKE	2.0	36			ELEVATIONS OBTAINED FROM GULF POWER CO. ELEVATIONS REFERENCED TO PLANT DATUM, 72.5 FT. DATUM = 0.0 FT. MEAN SEA LEVEL
				5.0	22			
				7.5	7			
				10.0	5		◄	
				15.0	2			
							☒	
				20.0	14			
60.0	22.0		SOFT BLACK TO GRAY SILTY CLAYEY FINE GRAINED SAND WITH TRACES OF ORGANIC MATTER					
				25.0	2			
				30.0	3			
				35.0	3			
				40.0	3			
							☒	
40.0	42.0		DENSE WHITE MEDIUM GRAINED SAND	43.5	62			
37.0	45.0		DRILLING TERMINATED					

BORING NUMBER: B-127

DATE DRILLED: 8/16/71

JOB NO: B-1464

N — IS PENETRATION IN BLOWS PER FOOT (ASTM D-1586)

CR— IS % CORE RECOVERY, NX OR BX DESIGNATES BIT SIZE (ASTM D 2113)

S — SYMBOLS DESCRIBED BELOW:

5			
18	70 NX	☒	UNDISTURBED SAMPLE, (ASTM D-1587)
	100		WATER TABLE, TIME OF BORING
23	BX		WATER TABLE, 24 HOUR READING
		◄	LOSS OF DRILLING FLUID

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TABLE I

UNIT WEIGHT AND MOISTURE CONTENT DATA

RING	DEPTH	NATURAL MOISTURE CONTENT, PERCENT	WET UNIT WEIGHT, PCF	MATERIAL TYPE
-110	2.5	15	127	Dike Fill
-112	7.5	16	122	Dike Fill
-115	7.5	11	133	Dike Fill
-119	15.0	13	131	Dike Fill
-120	25.0 Porosity 79%	172	75	Marsh Soil
-117	18.0 Porosity 57%	125*	102	Marsh Soil
-118	23.0 Porosity 57%	95*	99	Marsh Soil
-119	21.0 ~~Porosity 66%~~	207*	**	Marsh Soil
-121	25.0 Porosity 66%	119*	97	Marsh Soil
-122	21.0	108*	**	
-127	19.0	18*	118	Dike Fill
-127	42.0	33*	117	Sand

Average of Moisture Content at Top & Bottom of Tube

Sample Condition Prevented Determination of Unit Weight

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TABLE II

SUMMARY OF FIELD AND LABORATORY SHEAR STRENGTH DATA

A. FIELD VANE TESTS

ORING UMBER	DEPTH, FEET	UNDRAINED SHEAR STRENGTH, PSF PEAK	REMOLDED
-110	27.5	1360	300
-117	18.5	1140	75
-118	24.0	530	225
-119	18.5	760	30
-119	24.5	610	150
-120	22.0	610	150
-121	25.5	980	---

B. BORE HOLE SHEAR TESTS

ORING UMBER	DEPTH, FEET	FRICTION ANGLE, Ø, DEGREES	COHESION, C, PSF	COMPUTED SHEAR STRENGTH AT TEST DEPTH, PSF
-114	32.0	0	980	980
-117	16.5	14	374	820
-118	22.5	10	403	760
-119	20.5	6	202	400
-121	24.0	20	187	890

C. PRESSUREMETER TEST

ORING UMBER	DEPTH, FEET	PRESSUREMETER "COHESION", PSF
-116	25.5	1040
-116	27.5	1200

D. LABORATORY TESTS

ORING UMBER	DEPTH, FEET	FRICTION ANGLE, Ø, DEGREES	COHESION, C, PSF	UNDRAINED SHEAR STRENGTH, PSF	TEST TYPE
-110	25.0	---	---	570	Unconfined
-117	18.0	8	410		Consolidated Undrained
-118	23.0	0	300	300	Unconsolidat Undrained

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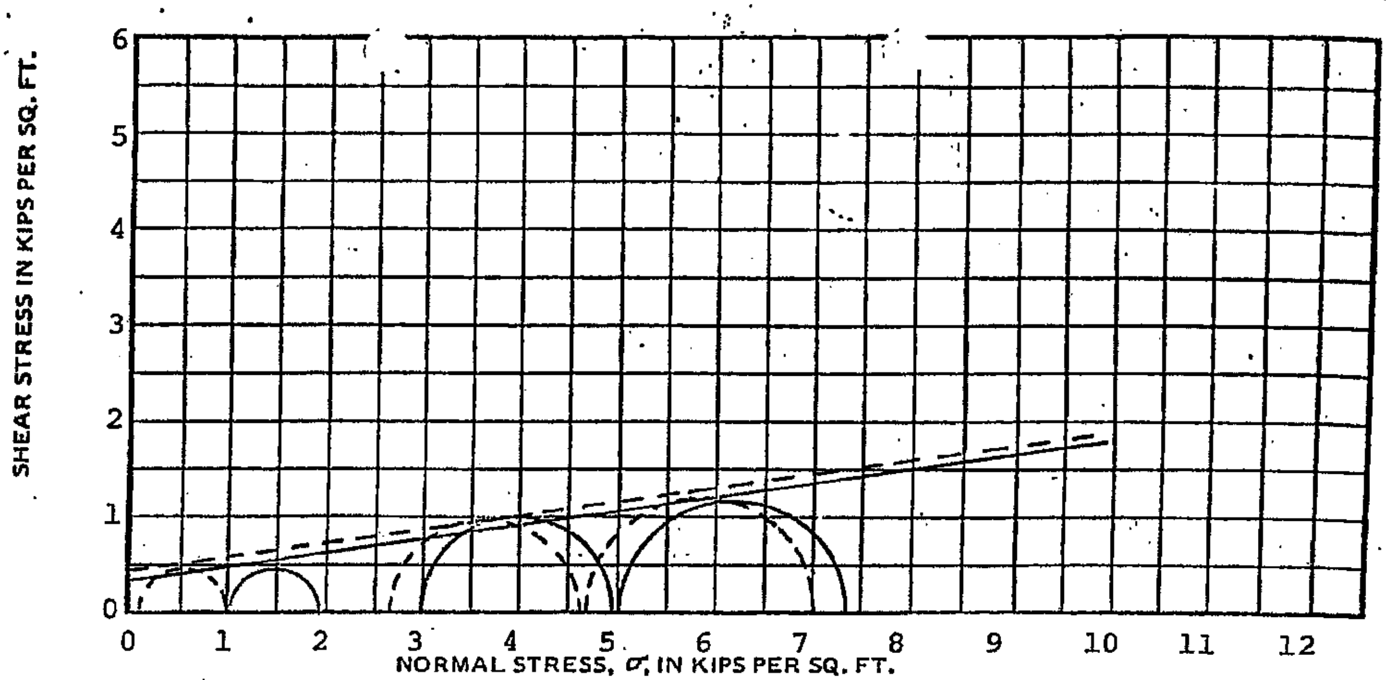
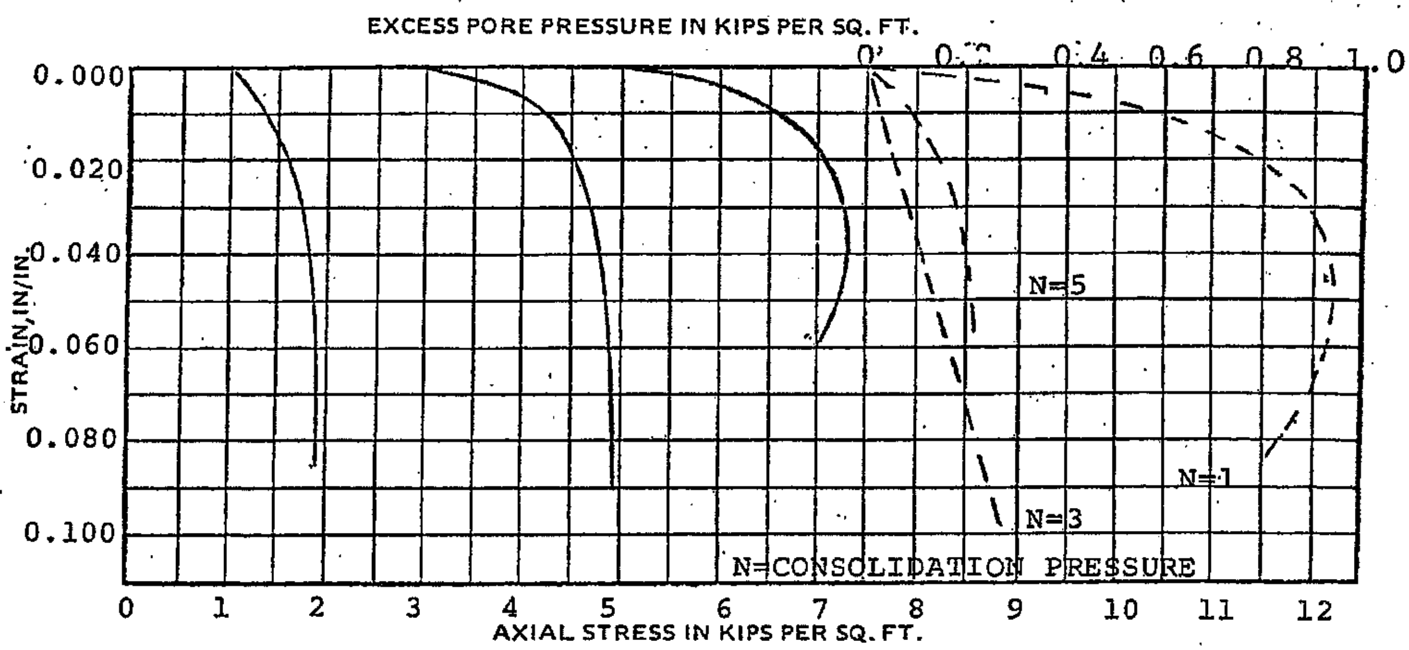


MOHR DIAGRAMS



STRESS-STRAIN AND PORE PRESSURE-STRAIN CURVES

EFFECTIVE COHESION, c̄ 0.48 KSF
EFFECTIVE SHEAR ANGLE, Ø̄ 8°
TOTAL COHESION, c 0.41 KSF
TOTAL SHEAR ANGLE, Ø 8°

SATURATED, CONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST WITH PORE PRESSURE MEASUREMENTS

SAMPLE NO. UD BORING NO. B-117
DEPTH 17-19 JOB NO. B-1464

LAW ENGINEERING TESTING COMPANY
BIRMINGHAM, ALABAMA

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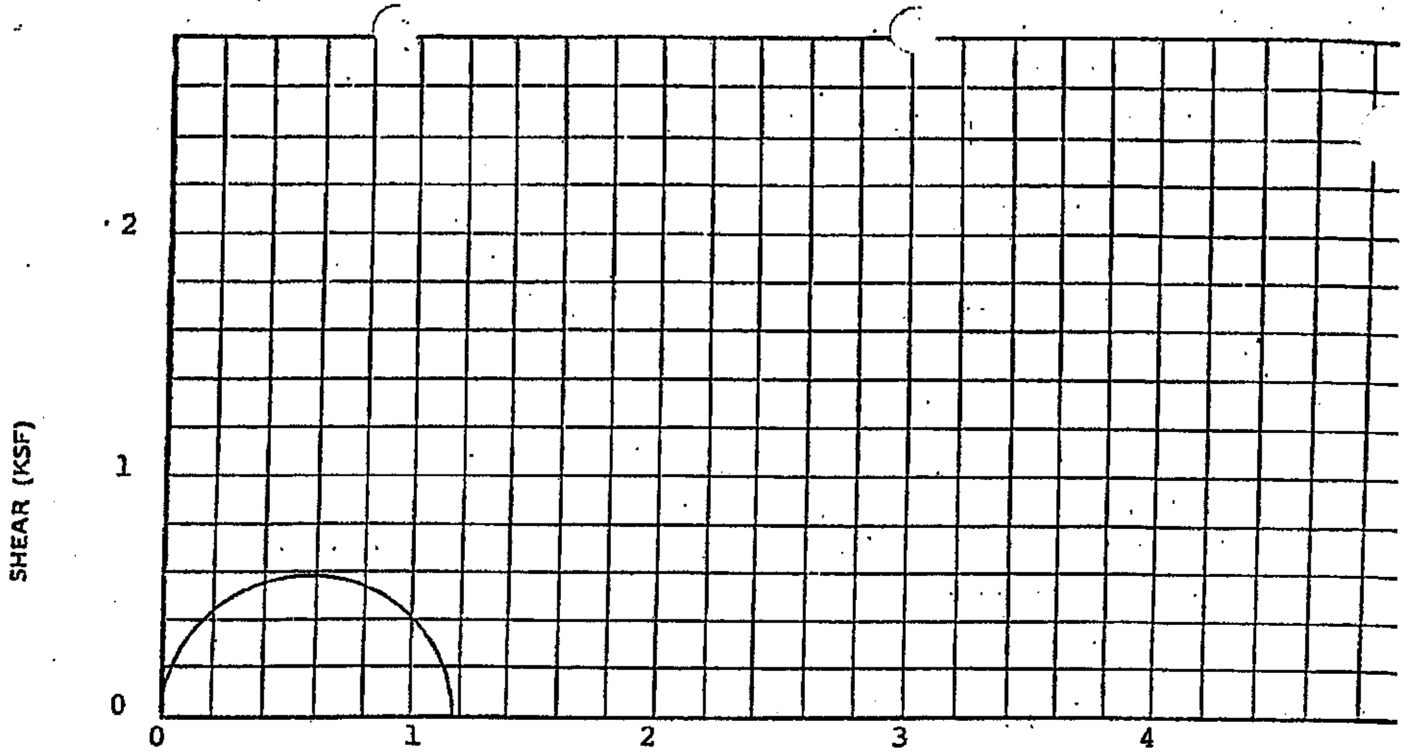
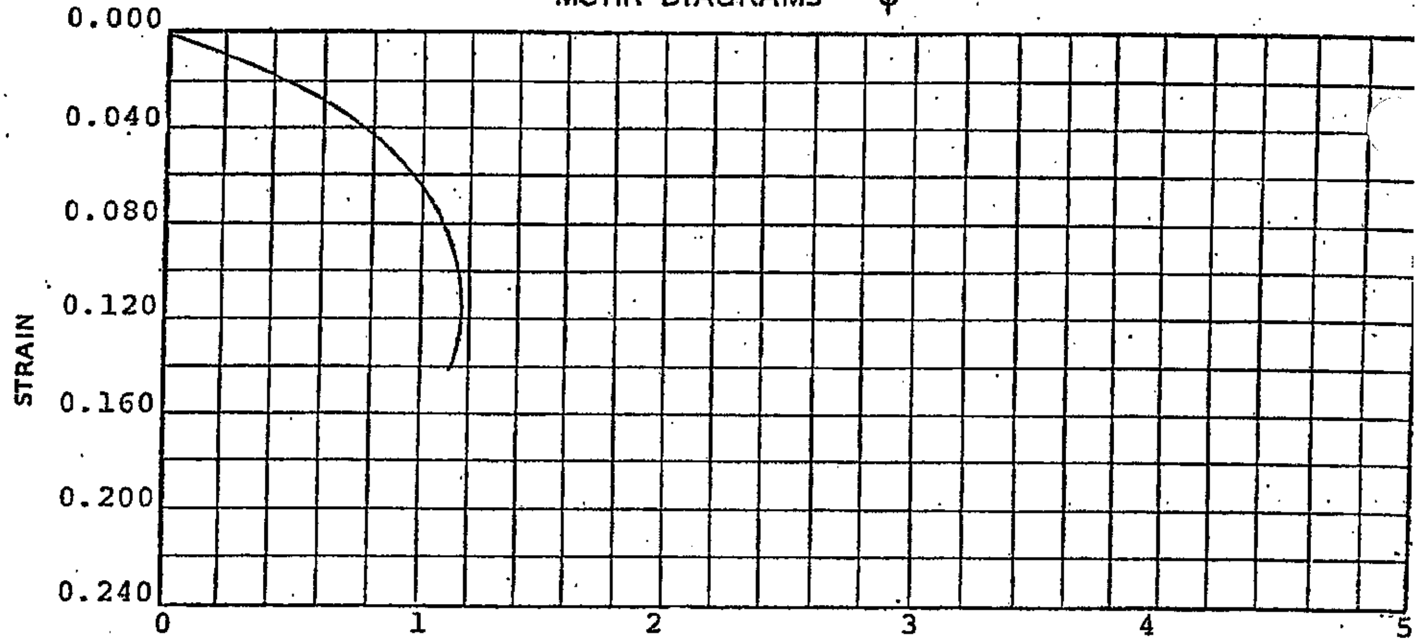


NORMAL STRESS (KSF)

MOHR DIAGRAMS — φ



AXIAL STRESS (KSF)

STRESS — STRAIN CURVES

UNCONFINED COMPRESSION TEST

"COHESION", C 0.57 KSF

WET UNIT WEIGHT, PCF 74.6

WATER CONTENT, % 71.6

SPECIFIC GRAVITY 2.10

VOID RATIO 3.770 ~~SATURATION~~ 95.6

(Porosity 79%)

JOB NUMBER: B-1464

SAMPLE NUMBER: S-25

BORING NUMBER: B-110

DEPTH, FT. 25

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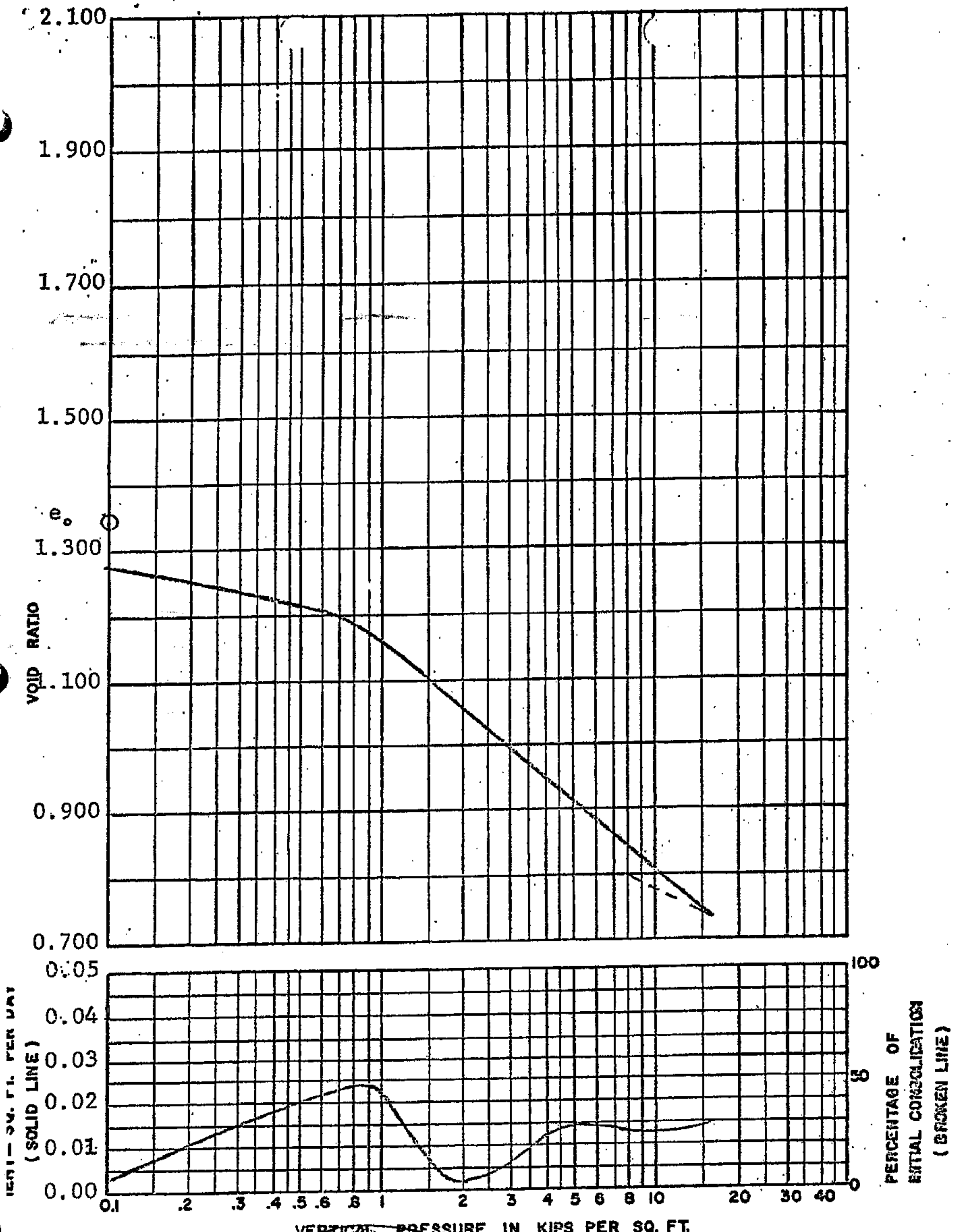


ECIFIC GRAVITY 2.53

IPRESSION INDEX 0.379

T WEIGHT 104.3 PCF (WET)

ER CONTENT 51.2%

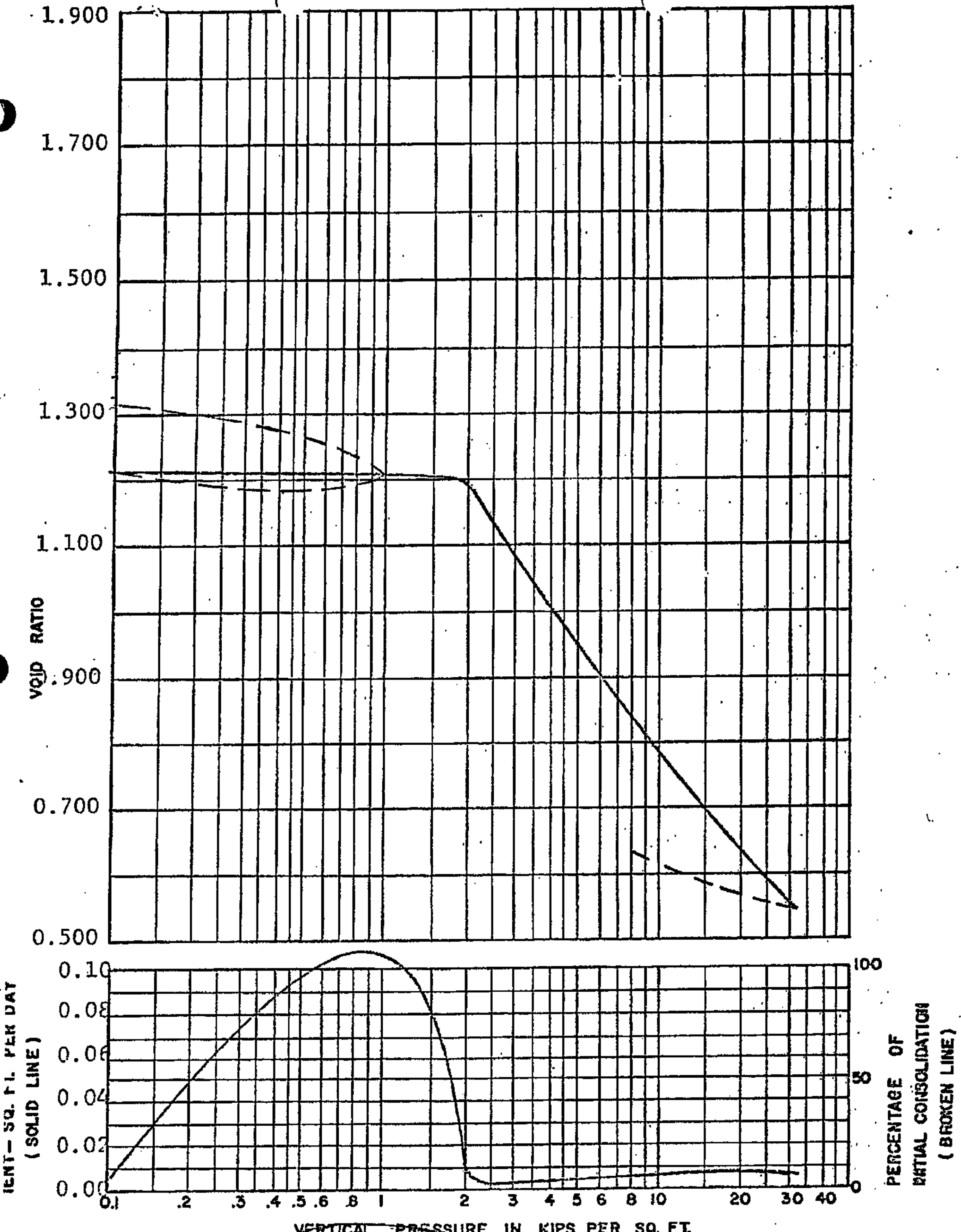
Porosity = 57%

CONSOLIDATION TEST

BORING NO. B-117 SAMPLE NO. UD

ELEV. OR DEPTH 17-19 JOB NO. B-1464

CONFIDENTIAL



ECIFIC GRAVITY 2.55

MPRESSION INDEX 0.599

T WEIGHT 103.8 PCF (WET)

TER CONTENT 45.0%

Porosity = 56.8%

CONSOLIDATION TEST

BORING NO. B-118 SAMPLE NO. UD

ELEV. OR DEPTH 22-24 JOB NO. B-1464

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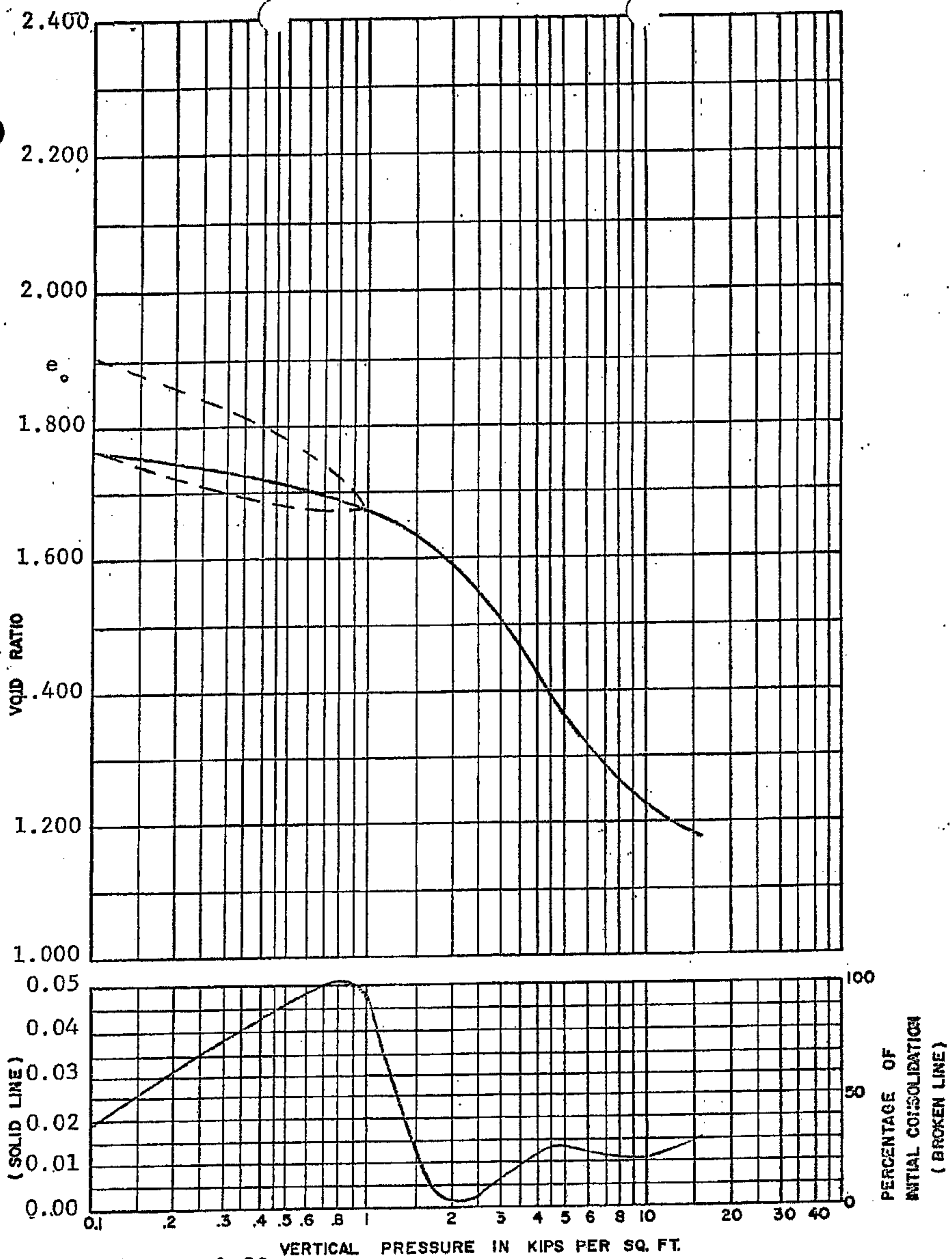


ECIFIC GRAVITY 2.38

PRESSION INDEX 0.570

WEIGHT 101.9 PCF (WET)

ER CONTENT 90.5%

RATION 100.0%

Porosity = 65.5%

CONSOLIDATION TEST

BORING NO. B-121 SAMPLE NO. UD

ELEV. OR DEPTH 24-26' JOB NO. E-1464

Appendix A

Doc 02: Analysis of Liquefaction Potential for Ash Pond

SOUTHERN COMPANY

Engineering and Construction Services Calculation

Calculation Number:
TV-SZ-FPC33667-001

Project/Plant: Plant Crist CCB Facilities	**Unit(s):** Common	**Discipline/Area:** Geotechnical
Title/Subject: Analysis of Liquefaction Potential for Ash Pond		
Purpose/Objective: Evaluate the potential for dike and foundation soils to liquefy under earthquake shaking		
System or Equipment Tag Numbers: NA	**Originator:** Benjamin J. Gallagher, P.E.	

Contents

Revision Record

Rev. No.	Description	Originator Initial / Date	Reviewer Initial / Date	Approver Initial / Date
0	Issued for Information	BJG/09-07-12	JCP/09-07-12	JCP/09-07-12

Notes:

Purpose of Calculation

Plant Crist is a coal-fired steam plant. Pollution controls installed at the plant produce solid materials including ash and scrubber waste (gypsum). The ash is presently stored in a dry stack landfill, and the gypsum is sluiced to a storage multi-cell storage facility where it is dried and stacked. In past times, ash was sluiced to a pond. This pond has been dredged to remove the majority of the ash. This pond is presently used as part of the wastewater treatment process, and is referred to as the Stormwater Pond.

Both the Stormwater Pond and the Gypsum Storage Area are surrounded by dikes made of compacted earth bearing on native soils. The purpose of this calculation is to evaluate the potential for liquefaction of the dikes and foundation soils to occur during earthquake shaking.

Summary of Conclusions

The USGS online map of Quaternary Fault and Fold Database indicates Plant Crist is located within the area of Gulf-margin normal faults. The USGS report indicates there is little evident of Quaternary slip on these faults, and states that is it not clear that slip on these faults would occur seismically. They have a "strikingly low historical seismicity."

At the Gypsum Storage Area, the analysis indicates liquefaction of the foundation soils is not a threat during either of the scenario earthquakes.

At the Stormwater Pond, liquefaction does not appear to be threat during the CEUS scenario earthquake, which comprises nearly 90 percent of the hazard.

During the NMSZ scenario earthquake, some of soft naturals soils encountered immediately beneath the dike exhibited factors of safety between 1.1 and 1.4. This suggests some strength loss may occur in this stratum due to earthquake-induced pore pressure buildup. Evidence suggests the major earthquakes at the NMSZ recur on the order of every 500 years, with last major events happening about 200 years ago. A time-dependant model for the NMSZ hazard is not available at present. However, we believe there is very low likelyhood of an NMSZ scenario earthquake occurring over the life of the plant.

To evaluate the impact of earthquake-induced strength loss in the soft stratum, it would be necessary to perform seismic deformation analysis on the dike. This would be an extensive undertaking including significant additional field and laboratory testing and significant engineering analysis. Given this low risk, and the fact that ash is no longer sluiced to this pond. such an extensive study is unwarranted.

Methodology

Liquefaction potential was assessed using procedures outlined in the 2004 paper by Idriss and Boulanger titled, "Semi-Empirical Procedures for Evaluating *Liquefaction Potential During Earthquakes*".

The SPT test data was used to evaluate liquefaction potential. Supplemental information regarding SPT correction factors was obtained from the 2001 paper by Youd and Idriss " Liquefaction Resistance of Soils: Summary Report From The 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils" and ASTM D 6066-04. The reported factor of safety is the ratio of the cyclic resistance ratio (CRR) to the cyclic stress ratio (CSR).

The deaggregation of the published 2008 PSHA data for the site indicates the nearly 90% of the seismic hazard for Plant Crist is derived from the Central and Eastern US random faulting source (CEUS), and about 11% percent of the hazard is attributed to the distant New Madrid Source Zone. Two scenarios were evaluated for potential liquefaction, the average magnitude and acceleration from the CEUS random source and the distant M7.8 NMSZ event.

Criteria and Assumptions

Based on the historical SPT data (1971 and 1992 borings), the subsurface conditions at the Stormwater Pond are considered consistent with Site Class E, Soft Soils. Based on the SPT data, the subsurface conditions at the Gypsum Storage Area are considered consistent with Site Class D, Stiff Soils.

The deaggregation of the USGS PSHA data (2% chance of exceedance over 50 years) for the Plant Crist indicated an average earthquake of M5.8 at 100km for the CUES source and a M7.8 at 630km for the NMSZ. The corresponding site-modified zero period accelerations (PGA) are 0.066g (CEUS) and 0.039g (NMSZ) for the Stormwater Pond (Site Class E) and 0.042g (CEUS) and 0.025g (NMSZ) for Gypsum Storage Area (Site Class D).

A topographic amplification factor of 1.42 was applied to the site-modified PGA values to determine the acceleration at the crest of the Stormwater Pond Dike.

At the Gypsum Storage Area, the borings predate the construction and the liquefaction analysis considers the foundation soils only. Because the gypsum and dikes are drained, they will not be subject to liquefaction. The overburden pressure of the dikes and gypsum will increase as gypsum is stored, enhancing the liquefaction resistance of the foundation soils.

SPT testing was generally performed at 5-foot increments throughout the borings. The liquefaction potential was analyzed at each SPT test and the results are summarized on the attached table. Liquefaction potential is evaluated as the CRR divided by CSR. Values of less than 1.1 are considered at risk of liquefaction during a design earthquake event, values between 1.1 and 1.4 are considered to have the potential for some pore-pressure induced strength loss, and values greater than 1.4 are considered not likely to liquefy.

Design Inputs/References

1. Southern Company SPT Test Borings APD-6 and APD-7 (1992)
2. Law Engineering SPT Test Boring B-110 (1971)
3. Southern Company SPT Test Borings GYP-1S, GYP-16 and GYP-36
4. USGS Probabilistic Earthquake Hazard Data Interactive Deaggregation (2008 data; 2% exceedance over 50 years)

Body of Calculation

Attached

Plant Crist CCB Facilities

Simplified Evaluation of Liquefaction Potential in SPT Test Borings

Stormwater Pond Dike Centerline									
	APD-6			B-110			APD-7		
Depth	SPT N-value	Factor of Safety, CEUS	Factor of Safety, New Madrid	SPT N-value	Factor of Safety, CEUS	Factor of Safety, New Madrid	SPT N-value	Factor of Safety, CEUS	Factor of Safety, New Madrid
5	13	>5	>5	5	2.8	2.8	20	>5	>5
10	43	>5	>5	5	2.6	2.5	33	>5	>5
15	32	>5	>5	5	2.4	2.2	17	>5	>5
20	26	>5	>5	5	2.1	1.9	4	2.0	1.8
25	6	2.2	1.8	5	2.0	1.7	8	2.5	2.1
30	5	clay	clay	4	1.8	1.5	5	clay	clay
35	3	2.2	1.7	**0**	1.4	**1.1**	**1**	1.5	**1.1**
40	3	1.6	**1.2**	4	1.8	1.4	5	2.0	1.4
45	6	2.0	1.4	4	1.9	**1.3**	9	2.5	1.8
50				51	>5	>5			
55									

Water at 10 feet below top of dike

prepared by Ben Gallagher, 9/6/2012

Gypsum Stroage Area Foundation									
	GYP-1S			GYP-16			GYP-36		
Depth	SPT N-value	Factor of Safety, CEUS	Factor of Safety, New Madrid	SPT N-value	Factor of Safety, CEUS	Factor of Safety, New Madrid	SPT N-value	Factor of Safety, CEUS	Factor of Safety, New Madrid
5	11	Excavated		17	Excavated		6	Excavated	
10	8	>5	>5	3			9		
15	10	>5	>5	5			2		
20	15	>5	>5	7			9		
25	21	>5	>5	33			13	>5	>5
30	19	>5	>5	17			20	>5	>5
35	13	>5	>5	24			25	>5	>5
40	21	>5	>5	16			2	4.6	4.1
45	31	>5	>5	27			5	>5	>5
50	40	>5	>5	23	>5	>5	16	>5	>5
55	47	>5	>5	45	>5	>5	23	>5	>5
60	15	>5	>5	27	>5	>5	28	>5	>5
65	5	>5	3.7				62	>5	>5
70							40	>5	>5
75							25	>5	>5
80							52	>5	>5
85							64	>5	>5

Water at Elev. 15

Reported N-values are uncorrected field values

Factor of Safety = Cyclic Resistance Ratio (CRR) divided by the Cyclic Shear Stress Ratio (CSR)

This evaluation was performed following the using the "Simplified" procedures described by Idriss and Boulanger in the paper titled "Semi-emprical procedures for evaluating liquefaction potential during earthquakes " dated January 2004 and the journal article titled "Liquefaction Resistance of Soils: Summary report fromthe 1996 NCEER and 1998 NCEER/NSF Workshops on evaluation of liquefaction resistance of soils" by Youd and Idriss dated April 2001.

The ground motions were selected based on sources identified using the interactive deaggregation of the USGS-published 2008 PSHA data. For comparison, two earthquake sources were considered, the CEUS gridded random source (88% the hazard) with a average magnitude of 5.8 and distance of 100.6 km and the New Madrid Source Zone (11% of the Hazard) with a magnitude of 7.78 and distance of 627 km. The site-modified zero period accelerations (PGA) are 0.042g (CESU) and 0.025g (NMSZ) for Gypsum Storage Area (Site Class D) and 0.066g and 0.039g (NMSZ) for the Stormwater Pond dike (Site Class E). A topographic amplification factor of 1.42 was applied to the site-modified PGA values to determine the acceleration at the crest of the ash pond dike.

T U-CR-FPC30795-003

*** Deaggregation of Seismic Hazard at One Period of Spectral Accel. ***
*** Data from U.S.G.S. National Seismic Hazards Mapping Project, 2008 version ***
PSHA Deaggregation. %contributions. site: Crist_CCB_Facil long: 87.233 W., lat: 30.568 N.
Vs30(m/s)= 760.0 CEUS atten. model site cl BC(firm) or A(hard).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 2475 yrs. Exceedance PGA =0.04419 g. Weight * Computed_Rate_Ex 0.404E-03
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.00952
#This deaggregation corresponds to Mean Hazard w/all GMPEs

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
13.5	4.60	1.510	0.042	0.250	0.628	0.517	0.071	0.002
34.4	4.60	2.564	0.199	1.165	1.148	0.052	0.000	0.000
61.3	4.61	0.861	0.336	0.525	0.000	0.000	0.000	0.000
88.4	4.61	0.175	0.172	0.004	0.000	0.000	0.000	0.000
116.6	4.61	0.112	0.112	0.000	0.000	0.000	0.000	0.000
13.6	4.79	2.627	0.069	0.412	1.034	0.947	0.160	0.004
34.8	4.80	5.239	0.327	1.956	2.695	0.260	0.000	0.000
61.7	4.80	2.100	0.554	1.514	0.032	0.000	0.000	0.000
88.6	4.81	0.500	0.387	0.112	0.000	0.000	0.000	0.000
118.2	4.81	0.393	0.392	0.001	0.000	0.000	0.000	0.000
13.8	5.03	1.792	0.045	0.266	0.668	0.666	0.141	0.007
35.5	5.03	4.375	0.211	1.263	2.450	0.451	0.000	0.000
62.2	5.03	2.265	0.357	1.608	0.299	0.000	0.000	0.000
88.8	5.04	0.651	0.269	0.382	0.000	0.000	0.000	0.000
119.5	5.04	0.622	0.529	0.094	0.000	0.000	0.000	0.000
166.5	5.05	0.123	0.123	0.000	0.000	0.000	0.000	0.000
13.9	5.21	0.662	0.016	0.095	0.239	0.239	0.069	0.004
35.9	5.21	1.852	0.076	0.452	1.035	0.289	0.000	0.000
62.6	5.21	1.148	0.128	0.720	0.300	0.000	0.000	0.000
88.9	5.21	0.376	0.096	0.280	0.000	0.000	0.000	0.000
120.3	5.21	0.407	0.249	0.158	0.000	0.000	0.000	0.000
168.4	5.21	0.110	0.110	0.000	0.000	0.000	0.000	0.000
13.9	5.39	0.978	0.023	0.138	0.346	0.346	0.117	0.007
36.3	5.39	3.059	0.110	0.655	1.619	0.666	0.009	0.000
63.0	5.40	2.233	0.185	1.106	0.942	0.000	0.000	0.000
89.0	5.40	0.834	0.140	0.672	0.022	0.000	0.000	0.000
121.1	5.40	1.025	0.382	0.642	0.000	0.000	0.000	0.000
169.7	5.41	0.352	0.335	0.017	0.000	0.000	0.000	0.000
217.3	5.41	0.070	0.070	0.000	0.000	0.000	0.000	0.000
14.0	5.61	0.468	0.011	0.065	0.163	0.163	0.062	0.004
36.7	5.61	1.643	0.052	0.309	0.775	0.490	0.018	0.000
63.4	5.62	1.444	0.087	0.522	0.822	0.014	0.000	0.000
89.2	5.62	0.625	0.066	0.393	0.167	0.000	0.000	0.000
121.9	5.62	0.878	0.180	0.678	0.020	0.000	0.000	0.000
170.7	5.62	0.379	0.262	0.116	0.000	0.000	0.000	0.000
219.7	5.62	0.112	0.112	0.000	0.000	0.000	0.000	0.000
14.0	5.80	0.407	0.009	0.056	0.141	0.141	0.056	0.005
36.9	5.80	1.526	0.045	0.266	0.668	0.514	0.033	0.000
63.7	5.80	1.502	0.075	0.450	0.906	0.071	0.000	0.000
89.3	5.81	0.714	0.057	0.338	0.319	0.000	0.000	0.000
122.6	5.81	1.108	0.155	0.802	0.150	0.000	0.000	0.000
171.4	5.81	0.561	0.255	0.306	0.000	0.000	0.000	0.000
220.6	5.82	0.198	0.194	0.004	0.000	0.000	0.000	0.000
269.4	5.82	0.058	0.058	0.000	0.000	0.000	0.000	0.000
13.7	6.01	0.286	0.007	0.039	0.098	0.098	0.039	0.005
36.4	6.01	1.103	0.030	0.177	0.445	0.406	0.045	0.000
61.6	6.00	0.927	0.036	0.215	0.534	0.142	0.000	0.000
85.7	6.01	0.813	0.045	0.267	0.498	0.004	0.000	0.000
123.7	6.01	1.055	0.096	0.576	0.383	0.000	0.000	0.000
172.6	6.01	0.629	0.157	0.468	0.005	0.000	0.000	0.000
221.4	6.01	0.280	0.206	0.074	0.000	0.000	0.000	0.000
271.1	6.02	0.107	0.107	0.000	0.000	0.000	0.000	0.000
13.3	6.21	0.275	0.006	0.038	0.094	0.094	0.037	0.005
36.5	6.21	1.070	0.027	0.164	0.412	0.400	0.066	0.000
60.6	6.21	0.817	0.028	0.165	0.415	0.209	0.000	0.000

379.7	7.39	0.693	0.175	0.454	0.065	0.000	0.000	0.000
624.2	7.45	0.826	0.457	0.369	0.000	0.000	0.000	0.000
628.2	7.42	1.042	0.829	0.213	0.000	0.000	0.000	0.000
721.4	7.39	0.822	0.822	0.000	0.000	0.000	0.000	0.000
126.1	7.59	0.050	0.001	0.008	0.020	0.020	0.001	0.000
176.2	7.59	0.068	0.002	0.012	0.031	0.022	0.000	0.000
224.4	7.59	0.077	0.003	0.018	0.044	0.012	0.000	0.000
274.0	7.59	0.061	0.003	0.019	0.039	0.000	0.000	0.000
380.5	7.59	0.125	0.019	0.077	0.029	0.000	0.000	0.000
627.4	7.70	5.490	2.354	3.135	0.000	0.000	0.000	0.000
627.0	8.00	4.181	1.331	2.230	0.619	0.000	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%): 100.0
Mean src-site R= 164.0 km; M= 6.03; eps0= -0.01. Mean calculated for all sources.
Modal src-site R= 627.4 km; M= 7.70; eps0= 1.51 from peak (R,M) bin
MODE R*= 626.9km; M*= 7.70; EPS.INTERVAL: 1 to 2 sigma % CONTRIB.= 3.135

Principal sources (faults, subduction, random seismicity having > 3% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
New Madrid SZ no clustering	10.99	627.0	7.78	1.42
CEUS gridded	88.12	100.6	5.80	-0.21

Individual fault hazard details if its contribution to mean hazard > 2%:

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)
New Madrid FZ, central	7.61	628.6	7.78	1.43	-30.6

#*********End of deaggregation corresponding to Mean Hazard w/all GMPEs *********#

PSHA Deaggregation. %contributions. site: Crist_CCB_Facil long: 87.233 W., lat: 30.568 N.
Vs30(m/s)= 760.0 CEUS atten. model site cl BC(firm) or A(hard).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 2475 yrs. Exceedance PGA =0.04419 g. Weight * Computed_Rate_Ex 0.938E-04
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.01155
#This deaggregation corresponds to Toro et al. 1997

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
13.7	4.60	0.412	0.042	0.250	0.120	0.000	0.000	0.000
35.0	4.60	0.891	0.199	0.679	0.013	0.000	0.000	0.000
61.9	4.61	0.411	0.298	0.112	0.000	0.000	0.000	0.000
88.2	4.61	0.087	0.087	0.000	0.000	0.000	0.000	0.000
115.6	4.61	0.046	0.046	0.000	0.000	0.000	0.000	0.000
13.8	4.79	0.690	0.069	0.412	0.209	0.000	0.000	0.000
35.3	4.80	1.630	0.328	1.256	0.047	0.000	0.000	0.000
62.2	4.80	0.843	0.515	0.328	0.000	0.000	0.000	0.000
88.3	4.81	0.199	0.198	0.001	0.000	0.000	0.000	0.000
116.9	4.81	0.122	0.122	0.000	0.000	0.000	0.000	0.000
13.9	5.03	0.463	0.045	0.266	0.153	0.000	0.000	0.000
35.9	5.03	1.321	0.211	1.022	0.087	0.000	0.000	0.000
62.7	5.03	0.855	0.357	0.498	0.000	0.000	0.000	0.000
88.5	5.04	0.241	0.212	0.029	0.000	0.000	0.000	0.000
118.4	5.04	0.182	0.182	0.000	0.000	0.000	0.000	0.000
166.7	5.05	0.035	0.035	0.000	0.000	0.000	0.000	0.000
13.9	5.21	0.169	0.016	0.095	0.058	0.000	0.000	0.000
36.3	5.21	0.545	0.076	0.413	0.057	0.000	0.000	0.000
63.0	5.21	0.412	0.128	0.284	0.000	0.000	0.000	0.000
88.7	5.21	0.132	0.093	0.039	0.000	0.000	0.000	0.000
119.2	5.21	0.113	0.111	0.002	0.000	0.000	0.000	0.000
168.9	5.21	0.030	0.030	0.000	0.000	0.000	0.000	0.000
14.0	5.39	0.248	0.023	0.138	0.087	0.000	0.000	0.000
36.6	5.39	0.879	0.110	0.636	0.133	0.000	0.000	0.000
63.4	5.39	0.761	0.185	0.576	0.000	0.000	0.000	0.000
88.8	5.40	0.273	0.140	0.134	0.000	0.000	0.000	0.000
119.9	5.40	0.264	0.238	0.026	0.000	0.000	0.000	0.000
170.2	5.40	0.089	0.089	0.000	0.000	0.000	0.000	0.000
217.5	5.40	0.020	0.020	0.000	0.000	0.000	0.000	0.000
14.0	5.61	0.118	0.011	0.065	0.042	0.000	0.000	0.000

Appendix A

Doc 03: Analysis of Liquefaction Potential for Ash Pond and Gypsum Storage Area (January 27, 2014)

EXHIBIT 2

SOUTHERN COMPANY

Engineering and Construction Services Calculation

Calculation Number:
TV-CR-FPC30795-003

Project/Plant:	Unit(s):	Discipline/Area:
Plant Crist CCB Facilities	Common	Geotechnical
Title/Subject: Analysis of Liquefaction Potential for Stormwater Pond Dike and Gypsum Storage Area		
Purpose/Objective: Evaluate the potential for dike and foundation soils to liquefy under earthquake shaking		
System or Equipment Tag Numbers: NA	**Originator:** Benjamin J. Gallagher, P.E.	

Contents

Revision Record

Rev. No.	Description	Originator Initial / Date	Reviewer Initial / Date	Approver Initial / Date
0	Issued for Information	BJG/09-07-12	JCP/09-07-12	JCP/09-07-12
1	Updated for GSA Ponds	BJG/1-26-2014	JCP/1-27-2014	JCP/1-27-2014

Notes:

JAMES C. PEGUES LICENSE No. 52619 STATE OF FLORIDA PROFESSIONAL ENGINEER

Purpose of Calculation

Plant Crist is a coal-fired steam plant. Pollution controls installed at the plant produce solid materials including ash and scrubber waste (gypsum). The ash is presently stored in a dry stack landfill, and the gypsum is sluiced to a storage multi-cell storage facility where it is dried and stacked. In past times, ash was sluiced to a pond. This pond has been dredged to remove the majority of the ash, and the remaining ash is currently being dredged. This pond is presently used as part of the wastewater treatment process, and is referred to as the Stormwater Pond.

Both the Stormwater Pond and the Gypsum Storage Area are surrounded by dikes made of compacted earth bearing on native soils. The purpose of this calculation is to evaluate the potential for liquefaction of the dikes and foundation soils to occur during earthquake shaking.

Summary of Conclusions

The USGS online map of Quaternary Fault and Fold Database indicates Plant Crist is located within the area of Gulf-margin normal faults. The USGS report indicates there is little evidence of Quaternary slip on these faults, and states that is it not clear that slip on these faults would occur seismically. They have a "strikingly low historical seismicity."

At the Gypsum Storage Area, the analysis indicates liquefaction of the foundation soils beneath Cell 2, Process Sedimentation Pond, and Return Water Pond is not likely during either of the scenario earthquakes.

At the Stormwater Pond, liquefaction does not appear to be threat during the CEUS scenario earthquake. The CEUS comprises nearly 90 percent of the USGS-considered earthquake hazard. However, during the less-likely NMSZ scenario earthquake, some of the soft naturals soils encountered immediately beneath the dike exhibited factors of safety between 0.9 and 1.4, when considering phreatic conditions on in the inboard side of the dike. This suggests some of the natural soils may be vulnerable to liquefaction and strength loss could potential occur in this stratum due to earthquake-induced pore pressure buildup.

However, it is important to note that evidence suggests the major earthquakes at the NMSZ recur on the order of every 500 years, with last major events happening about 200 years ago. A time-dependent model for the NMSZ hazard is not available at present. However, based on our current understanding of NMSZ, there is very low likelihood of an NMSZ earthquake occurring over the remaining life of the plant. Furthermore, much of the ash has been removed from the pond, and any ash remaining after the latest dredging (2011) is nin the process of being removed now. Therefore, in the unlikely event of a release of water due to deformation of the embankments during a NMSZ seismic event, there would be no release of ash.

In addition to the uncertainty of time dependence, our recent experience has indicated that the USGS map data may not be especially well suited for these sorts of very distant events (600+ km). Recent liquefaction remediation work at another facility located approximately 250 miles north of Pensacola revealed appreciably lower ground motions when a site-specific seismic analysis was completed.

Given this low likelihood of a NMSZ event, the relatively conservative nature of the USGS mapped data, and the fact that the pond will soon be cleaned of ash, it is our opinion that neither additional study nor modifications to the pond are warranted.

Methodology

Liquefaction potential was assessed using procedures outlined in the 2004 paper by Idriss and Boulanger titled, "Semi-Empirical Procedures for Evaluating *Liquefaction Potential During Earthquakes*".

The SPT test data collected for was used to evaluate liquefaction potential. Supplemental information regarding SPT correction factors was obtained from the 2001 paper by Youd and Idriss " Liquefaction Resistance of Soils: Summary Report From The 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils" and ASTM D 6066-04. The reported factor of safety is the ratio of the cyclic resistance ratio (CRR) to the cyclic stress ratio (CSR).

The deaggregation of the published 2008 PSHA data for the site indicates the nearly 90% of the seismic hazard for Plant Crist is derived from the Central and Eastern US random faulting source (CEUS), and about 11% percent of the hazard is attributed to the distant New Madrid Source Zone. Two scenarios were evaluated for potential liquefaction, the average magnitude and acceleration from the CEUS random source and the distant M7.8 NMSZ event.

Criteria and Assumptions

Based on the historical SPT data (1971 and 1992 borings), the subsurface conditions at the Stormwater Pond are considered consistent with Site Class E, Soft Soils. Based on the SPT data, the subsurface conditions at the Gypsum Storage Area are considered consistent with Site Class D, Stiff Soils.

The deaggregation of the USGS PSHA data (2% chance of exceedance over 50 years) for the Plant Crist indicated an average earthquake of M5.8 at 100km for the CUES source and a M7.8 at 630km for the NMSZ. The corresponding site-modified zero period accelerations (PGA) are 0.066g (CEUS) and 0.039g (NMSZ) for the Stormwater Pond (Site Class E) and 0.042g (CEUS) and 0.025g (NMSZ) for Gypsum Storage Area (Site Class D).

A topographic amplification factor of 1.42 was applied to the site-modified PGA values to determine the acceleration at the crest of the Stormwater Pond Dike.

At the Gypsum Storage Area, the borings predate the construction and the liquefaction analysis considers the foundation soils only. Because the gypsum and dikes are drained, they will not be subject to liquefaction. The overburden pressure of the dikes and gypsum will increase as gypsum is stored, enhancing the liquefaction resistance of the foundation soils.

SPT testing was generally performed at 5-foot increments throughout the borings. The liquefaction potential was analyzed at each SPT test and the results are summarized on the attached table. Liquefaction potential is evaluated as the CRR divided by CSR. Values of less than 1.1 are considered at risk of liquefaction during a design earthquake event, values between 1.1 and 1.4 are considered to have the potential for some pore-pressure induced strength loss, and values greater than 1.4 are considered not likely to liquefy.

Design Inputs/References

1. Southern Company SPT Test Borings APD-6 and APD-7 (1992)
2. Law Engineering SPT Test Boring B-110 (1971)
3. Southern Company SPT Test Borings GYP-1S, GYP-4S, GYP-5, GYP-16
4. USGS Probabilistic Earthquake Hazard Data Interactive Deaggregation (2008 data; 2% exceedance over 50 years)

Body of Calculation

Attached

Plant Crist CCB Facilities
Simplified Evaluation of Liquefaction Potential in SPT Test Borings

updated by Ben Gallagher, 1/26/2014

Stormwater Pond Dike Centerline									
	APD-6			B-110			APD-7		
Depth	SPT N-value	Factor of Safety, CEUS	Factor of Safety, New Madrid	SPT N-value	Factor of Safety, CEUS	Factor of Safety, New Madrid	SPT N-value	Factor of Safety, CEUS	Factor of Safety, New Madrid
5	13	>5	>5	5	2.2	2.2	20	>5	>5
10	43	>5	>5	5	1.8	1.8	33	>5	>5
15	32	>5	>5	5	1.8	1.7	17	>5	4.9
20	26	>5	>5	5	1.7	1.5	4	1.6	1.4
25	6	1.8	1.5	5	1.7	1.4	8	2.1	1.8
30	5	clay	clay	4	1.5	1.2	5	clay	clay
35	3	1.9	1.5	0	1.1	0.9	1	1.2	1.0
40	3	1.4	1.0	4	1.6	1.2	5	1.7	1.2
45	6	1.7	1.2	4	1.6	1.1	9	2.2	1.6
50				51	>5	>5			
55									

Water at 3 feet below top of dike

Gypsum Storage Area Foundation												
	GYP-1S			GYP-4S			GYP- 5			GYP-16		
Depth	SPT N-value	Factor of Safety, CEUS	Factor of Safety, New Madrid	SPT N-value	Factor of Safety, CEUS	Factor of Safety, New Madrid	SPT N-value	Factor of Safety, CEUS	Factor of Safety, New Madrid	SPT N-value	Factor of Safety, CEUS	Factor of Safety, New Madrid
5	11	Excavated		17	Excavated		11	Excavated		17	Excavated	
10	8	>5	>5	16	>5	>5	16			3		
15	10	>5	>5	14	>5	>5	14			5		
20	15	>5	>5	12	>5	>5	19	>5	>5	7		
25	21	>5	>5	27	>5	>5	25	>5	>5	33		
30	19	>5	>5	16	>5	>5	33	>5	>5	17		
35	13	>5	>5	32	>5	>5	23	>5	>5	24		
40	21	>5	>5	18	>5	>5	18	>5	>5	16		
45	31	>5	>5	29	>5	>5	10	>5	>5	27		
50	40	>5	>5	13	>5	>5	23	>5	>5	23	>5	>5
55	47	>5	>5	24	>5	>5	9	>5	>5	45	>5	>5
60	15	>5	>5	15	>5	>5	27	>5	>5	27	>5	>5
65	5	>5	3.2	5	>5	3.2	29	>5	>5			
70												
75												
80												
85												

Water at Elev. 87

GYP-1S (Return Water Pond)
GYP-4S (Process Sediment Pond)
GYP-5 (Cell 2)
GYP-16 (Cell 1)

Reported N-values are uncorrected field values

Factor of Safety = Cyclic Resistance Ratio (CRR) divided by the Cyclic Shear Stress Ratio (CSR)

This evaluation was performed following the using the "Simplified" procedures described by Idriss and Boulanger in the paper titled "Semi-emprical procedures for evaluating liquefaction potential during earthquakes" dated January 2004 and the journal article titled "Liquefaction Resistance of Soils: Summary report fromthe 1996 NCEER and 1998 NCEER/NSF Workshops on evaluation of liquefaction resistance of soils" by Youd and Idriss dated April 2001.

The ground motions were selected based on sources identified using the interactive deaggregation of the USGS-published 2008 PSHA data. For comparison, two earthquake sources were considered, the CEUS gridded random source (88% the hazard) with a average magnitude of 5.8 and distance of 100.6 km and the New Madrid Source Zone (11% of the Hazard) with a magnitude of 7.78 and distance of 627 km. The site-modified zero period accelerations (PGA) are 0.042g (CESU) and 0.025g (NMSZ) for Gypsum Storage Area (Site Class D) and 0.066g and 0.039g (NMSZ) for the Stormwater Pond dike (Site Class E). A topographic amplification factor of 1.42 was applied to the site-modified PGA values to determine the acceleration at the crest of the ash pond dike.

T U-CR-FPC 30795-003

*** Deaggregation of Seismic Hazard at One Period of Spectral Accel. ***
*** Data from U.S.G.S. National Seismic Hazards Mapping Project, 2008 version ***
PSHA Deaggregation. %contributions. site: Crist_CCB_Facil long: 87.233 W., lat: 30.568 N.
Vs30(m/s)= 760.0 CEUS atten. model site cl BC(firm) or A(hard).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 2475 yrs. Exceedance PGA =0.04419 g. Weight * Computed_Rate_Ex 0.404E-03
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.00952
#This deaggregation corresponds to Mean Hazard w/all GMPEs

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
13.5	4.60	1.510	0.042	0.250	0.628	0.517	0.071	0.002
34.4	4.60	2.564	0.199	1.165	1.148	0.052	0.000	0.000
61.3	4.61	0.861	0.336	0.525	0.000	0.000	0.000	0.000
88.4	4.61	0.175	0.172	0.004	0.000	0.000	0.000	0.000
116.6	4.61	0.112	0.112	0.000	0.000	0.000	0.000	0.000
13.6	4.79	2.627	0.069	0.412	1.034	0.947	0.160	0.004
34.8	4.80	5.239	0.327	1.956	2.695	0.260	0.000	0.000
61.7	4.80	2.100	0.554	1.514	0.032	0.000	0.000	0.000
88.6	4.81	0.500	0.387	0.112	0.000	0.000	0.000	0.000
118.2	4.81	0.393	0.392	0.001	0.000	0.000	0.000	0.000
13.8	5.03	1.792	0.045	0.266	0.668	0.666	0.141	0.007
35.5	5.03	4.375	0.211	1.263	2.450	0.451	0.000	0.000
62.2	5.03	2.265	0.357	1.608	0.299	0.000	0.000	0.000
88.8	5.04	0.651	0.269	0.382	0.000	0.000	0.000	0.000
119.5	5.04	0.622	0.529	0.094	0.000	0.000	0.000	0.000
166.5	5.05	0.123	0.123	0.000	0.000	0.000	0.000	0.000
13.9	5.21	0.662	0.016	0.095	0.239	0.239	0.069	0.004
35.9	5.21	1.852	0.076	0.452	1.035	0.289	0.000	0.000
62.6	5.21	1.148	0.128	0.720	0.300	0.000	0.000	0.000
88.9	5.21	0.376	0.096	0.280	0.000	0.000	0.000	0.000
120.3	5.21	0.407	0.249	0.158	0.000	0.000	0.000	0.000
168.4	5.21	0.110	0.110	0.000	0.000	0.000	0.000	0.000
13.9	5.39	0.978	0.023	0.138	0.346	0.346	0.117	0.007
36.3	5.39	3.059	0.110	0.655	1.619	0.666	0.009	0.000
63.0	5.40	2.233	0.185	1.106	0.942	0.000	0.000	0.000
89.0	5.40	0.834	0.140	0.672	0.022	0.000	0.000	0.000
121.1	5.40	1.025	0.382	0.642	0.000	0.000	0.000	0.000
169.7	5.41	0.352	0.335	0.017	0.000	0.000	0.000	0.000
217.3	5.41	0.070	0.070	0.000	0.000	0.000	0.000	0.000
14.0	5.61	0.468	0.011	0.065	0.163	0.163	0.062	0.004
36.7	5.61	1.643	0.052	0.309	0.775	0.490	0.018	0.000
63.4	5.62	1.444	0.087	0.522	0.822	0.014	0.000	0.000
89.2	5.62	0.625	0.066	0.393	0.167	0.000	0.000	0.000
121.9	5.62	0.878	0.180	0.678	0.020	0.000	0.000	0.000
170.7	5.62	0.379	0.262	0.116	0.000	0.000	0.000	0.000
219.7	5.62	0.112	0.112	0.000	0.000	0.000	0.000	0.000
14.0	5.80	0.407	0.009	0.056	0.141	0.141	0.056	0.005
36.9	5.80	1.526	0.045	0.266	0.668	0.514	0.033	0.000
63.7	5.80	1.502	0.075	0.450	0.906	0.071	0.000	0.000
89.3	5.81	0.714	0.057	0.338	0.319	0.000	0.000	0.000
122.6	5.81	1.108	0.155	0.802	0.150	0.000	0.000	0.000
171.4	5.81	0.561	0.255	0.306	0.000	0.000	0.000	0.000
220.6	5.82	0.198	0.194	0.004	0.000	0.000	0.000	0.000
269.4	5.82	0.058	0.058	0.000	0.000	0.000	0.000	0.000
13.7	6.01	0.286	0.007	0.039	0.098	0.098	0.039	0.005
36.4	6.01	1.103	0.030	0.177	0.445	0.406	0.045	0.000
61.6	6.00	0.927	0.036	0.215	0.534	0.142	0.000	0.000
85.7	6.01	0.813	0.045	0.267	0.498	0.004	0.000	0.000
123.7	6.01	1.055	0.096	0.576	0.383	0.000	0.000	0.000
172.6	6.01	0.629	0.157	0.468	0.005	0.000	0.000	0.000
221.4	6.01	0.280	0.206	0.074	0.000	0.000	0.000	0.000
271.1	6.02	0.107	0.107	0.000	0.000	0.000	0.000	0.000
13.3	6.21	0.275	0.006	0.038	0.094	0.094	0.037	0.005
36.5	6.21	1.070	0.027	0.164	0.412	0.400	0.066	0.000
60.6	6.21	0.817	0.028	0.165	0.415	0.209	0.000	0.000

379.7	7.39	0.693	0.175	0.454	0.065	0.000	0.000	0.000
624.2	7.45	0.826	0.457	0.369	0.000	0.000	0.000	0.000
628.2	7.42	1.042	0.829	0.213	0.000	0.000	0.000	0.000
721.4	7.39	0.822	0.822	0.000	0.000	0.000	0.000	0.000
126.1	7.59	0.050	0.001	0.008	0.020	0.020	0.001	0.000
176.2	7.59	0.068	0.002	0.012	0.031	0.022	0.000	0.000
224.4	7.59	0.077	0.003	0.018	0.044	0.012	0.000	0.000
274.0	7.59	0.061	0.003	0.019	0.039	0.000	0.000	0.000
380.5	7.59	0.125	0.019	0.077	0.029	0.000	0.000	0.000
627.4	7.70	5.490	2.354	3.135	0.000	0.000	0.000	0.000
627.0	8.00	4.181	1.331	2.230	0.619	0.000	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%): 100.0
Mean src-site R= 164.0 km; M= 6.03; eps0= -0.01. Mean calculated for all sources.
Modal src-site R= 627.4 km; M= 7.70; eps0= 1.51 from peak (R,M) bin
MODE R*= 626.9km; M*= 7.70; EPS.INTERVAL: 1 to 2 sigma % CONTRIB.= 3.135

Principal sources (faults, subduction, random seismicity having > 3% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
New Madrid SZ no clustering	10.99	627.0	7.78	1.42
CEUS gridded	88.12	100.6	5.80	0.21

Individual fault hazard details if its contribution to mean hazard > 2%:

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)
New Madrid FZ, central	7.61	628.6	7.78	1.43	-30.6

#*********End of deaggregation corresponding to Mean Hazard w/all GMPEs *********#

PSHA Deaggregation. %contributions. site: Crist_CCB_Facil long: 87.233 W., lat: 30.568 N.
Vs30(m/s)= 760.0 CEUS atten. model site cl BC(firm) or A(hard).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 2475 yrs. Exceedance PGA =0.04419 g. Weight * Computed_Rate_Ex 0.938E-04
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.01155
#This deaggregation corresponds to Toro et al. 1997

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
13.7	4.60	0.412	0.042	0.250	0.120	0.000	0.000	0.000
35.0	4.60	0.891	0.199	0.679	0.013	0.000	0.000	0.000
61.9	4.61	0.411	0.298	0.112	0.000	0.000	0.000	0.000
88.2	4.61	0.087	0.087	0.000	0.000	0.000	0.000	0.000
115.6	4.61	0.046	0.046	0.000	0.000	0.000	0.000	0.000
13.8	4.79	0.690	0.069	0.412	0.209	0.000	0.000	0.000
35.3	4.80	1.630	0.328	1.256	0.047	0.000	0.000	0.000
62.2	4.80	0.843	0.515	0.328	0.000	0.000	0.000	0.000
88.3	4.81	0.199	0.198	0.001	0.000	0.000	0.000	0.000
116.9	4.81	0.122	0.122	0.000	0.000	0.000	0.000	0.000
13.9	5.03	0.463	0.045	0.266	0.153	0.000	0.000	0.000
35.9	5.03	1.321	0.211	1.022	0.087	0.000	0.000	0.000
62.7	5.03	0.855	0.357	0.498	0.000	0.000	0.000	0.000
88.5	5.04	0.241	0.212	0.029	0.000	0.000	0.000	0.000
118.4	5.04	0.182	0.182	0.000	0.000	0.000	0.000	0.000
166.7	5.05	0.035	0.035	0.000	0.000	0.000	0.000	0.000
13.9	5.21	0.169	0.016	0.095	0.058	0.000	0.000	0.000
36.3	5.21	0.545	0.076	0.413	0.057	0.000	0.000	0.000
63.0	5.21	0.412	0.128	0.284	0.000	0.000	0.000	0.000
88.7	5.21	0.132	0.093	0.039	0.000	0.000	0.000	0.000
119.2	5.21	0.113	0.111	0.002	0.000	0.000	0.000	0.000
168.9	5.21	0.030	0.030	0.000	0.000	0.000	0.000	0.000
14.0	5.39	0.248	0.023	0.138	0.087	0.000	0.000	0.000
36.6	5.39	0.879	0.110	0.636	0.133	0.000	0.000	0.000
63.4	5.39	0.761	0.185	0.576	0.000	0.000	0.000	0.000
88.8	5.40	0.273	0.140	0.134	0.000	0.000	0.000	0.000
119.9	5.40	0.264	0.238	0.026	0.000	0.000	0.000	0.000
170.2	5.40	0.089	0.089	0.000	0.000	0.000	0.000	0.000
217.5	5.40	0.020	0.020	0.000	0.000	0.000	0.000	0.000
14.0	5.61	0.118	0.011	0.065	0.042	0.000	0.000	0.000

Appendix A

Doc 04: Slope Stability Analyses of Ash Pond Dike

EXHIBIT 1

SOUTHERN COMPANY

Engineering and Construction Services Calculation

Calculation Number: TV-CR-FPC30795-001

Project/Plant: Plant Crist Ash Pond Dike	**Unit(s):** Units 1-4	**Discipline/Area:** ES&EE
Title/Subject: Slope Stability Analyses of Ash Pond Dike		
Purpose/Objective: Analyze slope stability of Ash Pond Dike		
System or Equipment Tag Numbers: NA	**Originator:** Terri H. Hartsfield	

Contents

Revision Record

Rev. No.	Description	Originator Initial / Date	Reviewer Initial / Date	Approver Initial / Date
0	Issued for Information	THH/8-17-12	JAL/8-17-12	JCP/8-17-12

Notes:

Purpose of Calculation

Gulf Power Company's Plant Crist has one open ash pond located on the east side of the plant next to the Escambia River. The Ash Pond was constructed about 1960 and has been in operation for over 50 years. Currently, the Ash Pond is used as a waste water pond and does not receive sluiced ash material from the plant. The pond has not been used for this purpose for over 20 years. The pond has been dredged and presently contains only residual ash.

The purpose of this calculation is to check the stability of the dikes of the Ash Pond using current software.

Methodology

The calculation was performed using the following methods and software:

GeoStudio 2007 (Version 7.17, Build 4921), Copyright 1991-2010, GEO-SLOPE International, Ltd.

Bishop, Ordinary, Janbu and Morgenstern-Price analytical methods were run. Morgenstern-Price was reported.

Criteria and Assumptions

The slope stability models were run using the following assumptions and design criteria:

- To remain consistent with historic drawings, all elevations are adjusted to plant datum by adding 72.69 feet to any elevations given based on mean sea level.
- The current required minimum criteria (factors of safety) were taken from the US Corps of Engineers Manual EM 1110-2-1902, October 2003.
- The soil properties of unit weight, phi angle, and cohesion were obtained from blow counts obtained during drilling on the dike, dilatometer data, and triaxial shear testing all performed in 1992. Additionally, cone penetrometer testing performed in 2010 in the area of the discharge structure was used to determine soil strength parameters.
- Seismic analyses were performed using a ground motion having a 2% probability of exceedance in 50 years of 0.03 g from the USGS "Map for Peak Acceleration with a 2% Exceedance in 50 Years" for the vicinity of Plant Crist.
- According to the Northwest Florida Water Management website, the flood elevation for the Escambia River at Pensacola Bay is 8.4 feet (or 81.09 feet adjusted to plant datum). This was used as the river flood elevation.
- From the Hydrologic and Hydraulic Study performed in 2011, normal pool elevation in the Ash Pond is 87.03 feet adjusted to plant elevation datum (72.69 ft + Elevation MSL). The 100 year storm maximum pool elevation is 87.58 feet.
- The cross-sections of the Ash Pond were developed using the survey performed in 2010 of the northeast corner of the dike, the survey performed in August 2012, and cross-sections developed for various maintenance performed on the dike over the past 20 years.

Input Data

The following soil properties were used in the analyses.

Soil Description	Moist Unit Weight, pcf	Cohesion, psf	Phi Angle, degrees
Sections 1 & 2 – NE Dike, Barge Canal/River			
Clayey Sand 1	120	100	33
Clayey Sand 2	120	100	28
Silty Clay	115	385	10
Silt & Clay	115	115	10
Sand	120	0	27
Rip Rap	140	0	40
Fly Ash	80	0	18
Section 3 – West Dike at Weir in Discharge Canal			
Clayey Sand	120	100	34
Clayey Silt	115	625	10
Silty Sand	120	100	30
Silt & Clay	115	308	10
Fly Ash	80	0	18
Sand	120	0	36
Sheet Pile	shear force – 50,000 lbs		
Section 4 – West Dike, South of Discharge Canal Weir			
Clayey Sand	120	100	34
Clayey Silt	115	625	10
Silty Sand	120	100	30
Silt & Clay	115	308	10
Fly Ash	80	0	18
Sand	120	0	36
Rip Rap	140	0	40
Section 5 - West Dike, North of Discharge Canal Weir			
Clayey Sand 1	120	100	34
Clayey Sand 2	115	100	31
Clayey Silt	115	135	10
Sand 1	120	100	37
Sand 2	120	0	36
Section 6 – South Dike at Thompson Bayou			
Clayey Sand	120	100	34
Silty Sand	120	100	34
Silty Clay	115	390	10
Clayey Silt	115	200	10
Flay Ash	80	0	18
Silty Sand 2	120	100	31
Silty Clay 2	115	275	10
Sand	120	0	32

Hydrologic Considerations
The following hydrologic information, based on SCS Civil calculation DC-FP-FPC34288-100 dated August 15, 2011, was utilized in the stability analyses.

Minimum Pool	Normal Pool	Maximum Pool Surcharge
87.03 (14.34)	87.03 (14.34)	87.58 (14.89)

Elevations 87.03 (14.34) are relative to plant datum (feet MSL).

Summary of Conclusions

The following table lists the factors of safety for various slope stability failure conditions. All conditions are steady state except where noted. Construction cases were not considered.

Failure Condition (Load Case)	Computed Factor of Safety	Recommended Minimum Factor of Safety[1]
Section 1 – Barge Canal/River		
Downstream Steady State	1.4	1.5
Downstream Seismic	1.2	1.1
Upstream Steady State	2.4	1.5
Upstream Seismic	2.1	1.1
Downstream – 100 Year Storm	1.7	1.4
Upstream – 100 Year Storm	2.5	1.4
Upstream Rapid Drawdown	1.2	1.3
Section 2 – River Side		
Downstream Steady State	1.2	1.5
Downstream Seismic	1.1	1.1
Upstream Steady State	2.5	1.5
Upstream Seismic	2.2	1.1
Downstream – 100 Year Storm	1.4	1.4
Upstream – 100 Year Storm	2.5	1.4
Upstream Rapid Drawdown	1.3	1.3
Section 3 – Discharge Canal Weir		
Downstream Steady State	2.2	1.5
Downstream Seismic	1.9	1.1
Upstream Steady State	2.4	1.5
Upstream Seismic	2.1	1.1
Downstream – 100 Year Storm	2.6	1.4
Upstream – 100 Year Storm	2.5	1.4
Upstream Rapid Drawdown	1.3	1.3
Section 4 – Discharge Canal South		
Downstream Steady State – In Bolster	1.4	1.5
Downstream Steady State – In Dike	1.4	1.5

Downstream Seismic	1.2	1.1
Upstream Steady State	2.4	1.5
Upstream Seismic	2.1	1.1
Downstream – 100 Year Storm	1.8	1.4
Upstream – 100 Year Storm	2.5	1.4
Upstream Rapid Drawdown	1.3	1.3
Section 5 – Discharge Canal North		
Downstream Steady State	1.4	1.5
Downstream Seismic	1.3	1.1
Upstream Steady State	1.9	1.5
Upstream Seismic	1.7	1.1
Downstream – 100 Year Storm	1.7	1.4
Upstream – 100 Year Storm	1.9	1.4
Upstream Rapid Drawdown	1.0	1.3
Section 6 – Thompson Bayou		
Downstream Steady State	2.0	1.5
Downstream Seismic	1.7	1.1
Upstream Steady State	2.5	1.5
Upstream Seismic	2.2	1.1
Downstream – 100 Year Storm	2.3	1.4
Upstream – 100 Year Storm	2.5	1.4
Upstream Rapid Drawdown	1.4	1.3

Design Inputs/References

Federal Emergency Management Agency, Flood Insurance Study Number 12033, September 30, 2006, Accessed from the web on August 10, 2012. http://www.nwfwmdfloodmaps.com/pdf/2008/Escambia%20FIS%20DFIRM%20Update%2001-16-08.pdf

USGS Earthquake Hazards website, http://www.usgs.gov/hazards/earthquakes/.
Southern Company Generation Sketch Number ES1989S1, Plant Crist Barge Canal Slope Repair Limits of Remediation

Calculation Number DC-FP-FPC34288-100, Plant Crist Ash Ponds Hydrologic and Hydraulic Study

Plant Crist Ash Pond Dike Study, internal report prepared by Southern Company Services for Gulf Power Company, 1992.

Cone Penetration Test data performed in 2010 for the replacement of the discharge structure.

Southern Company Services Drawing No D-30512, Crist Steam Plant Units 1through 5, Cooling Tower Reservoir, Modification-Piling Layout, Dike Wing Walls.

Southern Company Services Drawing No D-34344, Plant Crist Ash Pond, Ash Pond Dike Modifications, Cross-Sections.

Southern Company Services Drawing No D-34343, Plant Crist, Ash Pond Dike Modifications, Plan

Southern Company Services Drawing No ES1989S1, Plant Crist, Barge Canal Slope Repair, Limits of Remediation.

Body of Calculation

Calculation consists of Slope-W modeling attached. Basic input data is given for each of the 6 cross-sections.

Attachments

Slope W Computer Runs

Section 1 – Northeast Dike at Barge Canal/River

Clayey Sand 1
120 pcf
100 psf
33 °

Clayey Sand 2
120 pcf
100 psf
28 °

Silty Clay
115 pcf
385 psf
10 °

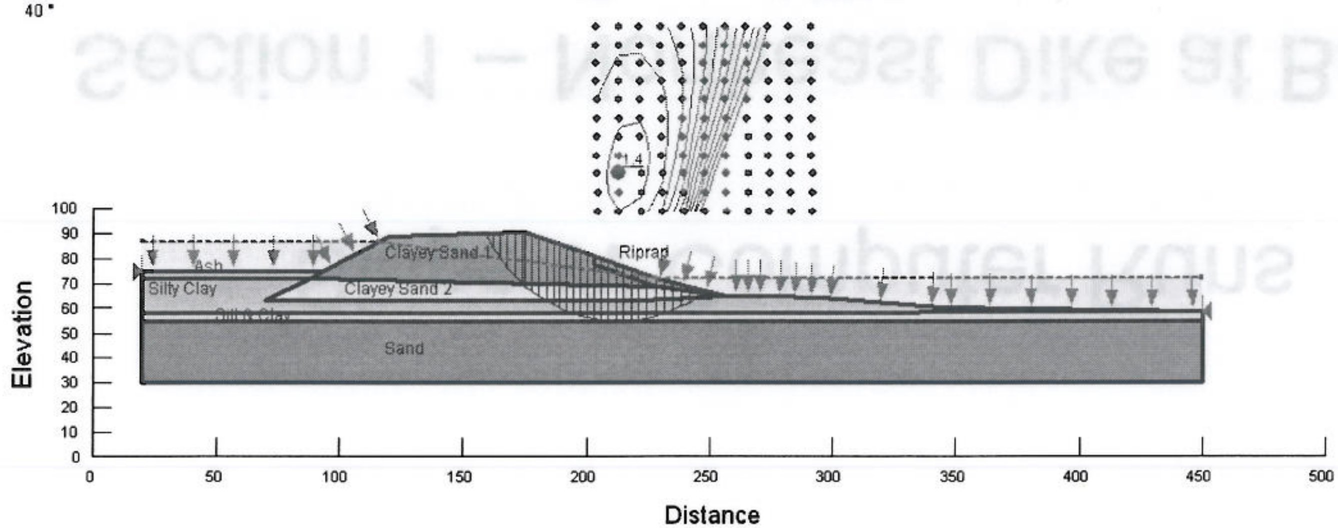
Silty & Clay
115 pcf
115 psf
10 °

Sand
120 pcf
0 psf
27 °

Ash
80 pcf
0 psf
18 °

Rip Rap
140 pcf
0 psf
40 °

Plant Crist Ash Pond dike
Section 1
Steady State
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



Clayey Sand 1
120 pcf
100 psf
33 °

Clayey Sand 2
120 pcf
100 psf
28 °

Silty Clay
115 pcf
385 psf
10 °

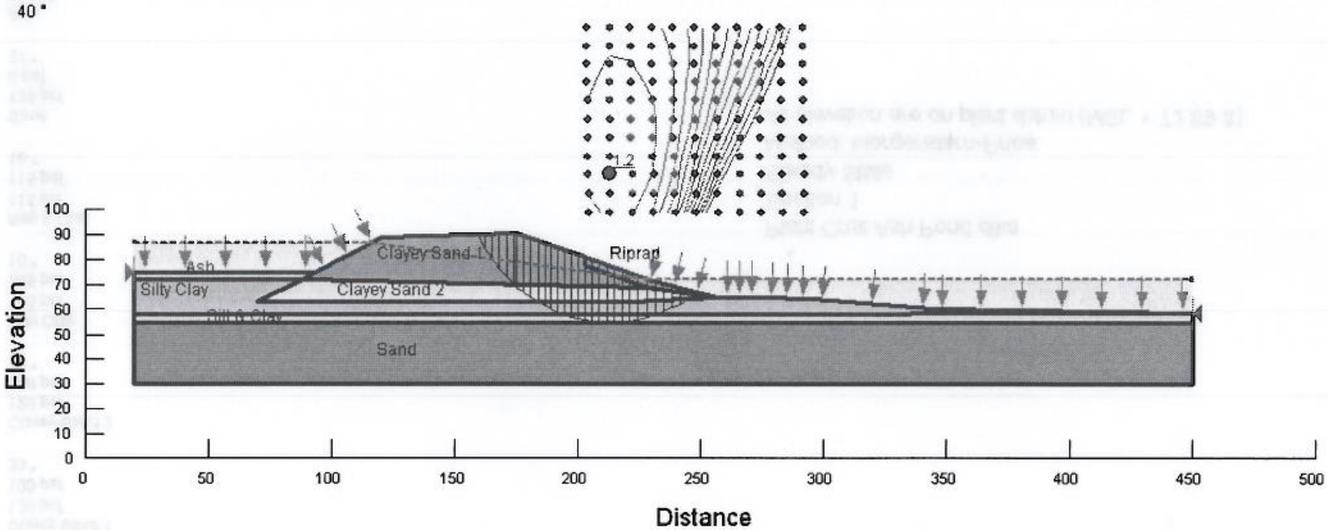
Silty & Clay
115 pcf
115 psf
10 °

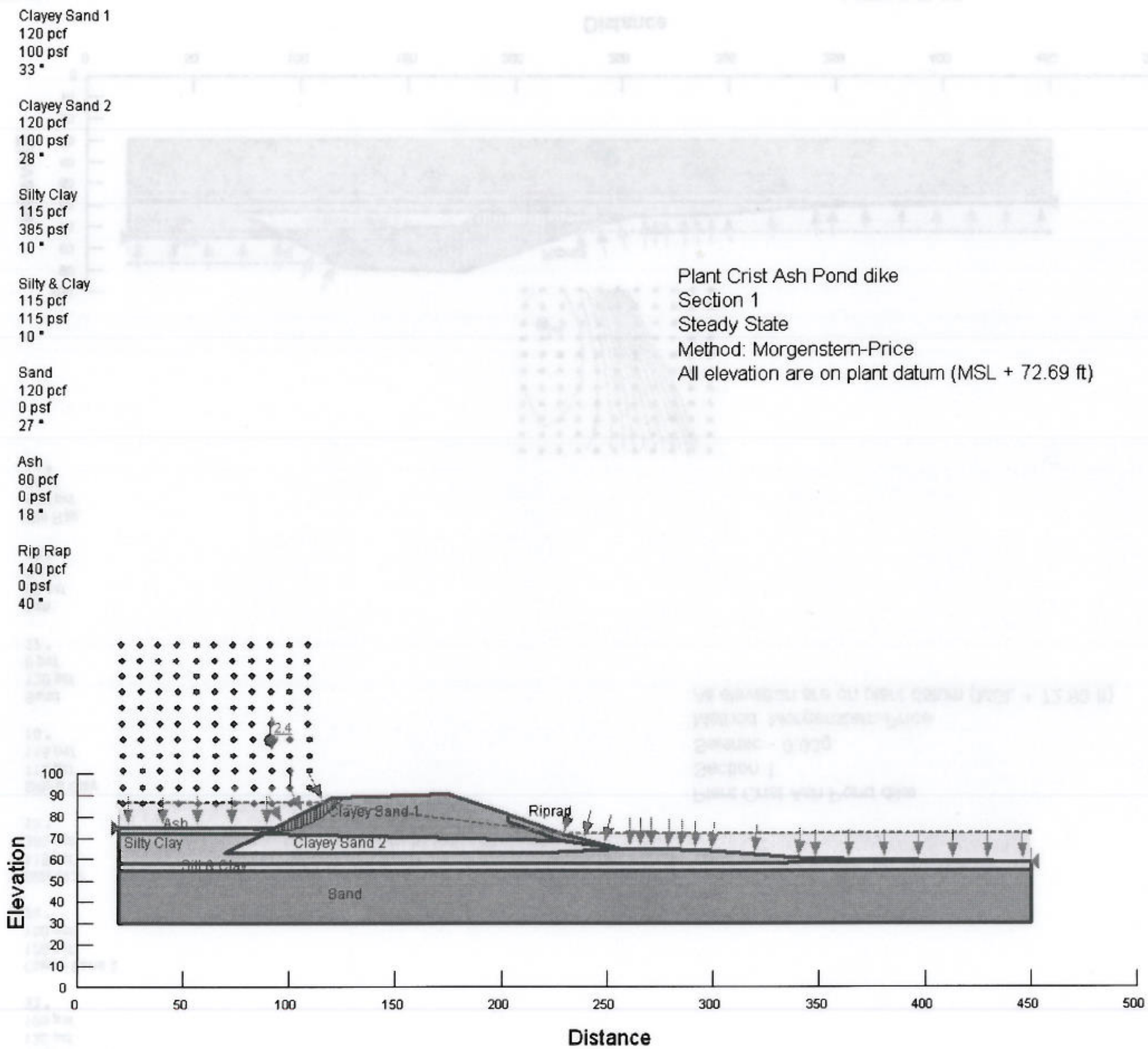
Sand
120 pcf
0 psf
27 °

Ash
80 pcf
0 psf
18 °

Rip Rap
140 pcf
0 psf
40 °

Plant Crist Ash Pond dike
Section 1
Seismic - 0.03g
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)




Clayey Sand 1
120 pcf
100 psf
33 °
Clayey Sand 2
120 pcf
100 psf
28 °
Silty Clay
115 pcf
385 psf
10 °
Silty & Clay
115 pcf
115 psf
10 °
Sand
120 pcf
0 psf
27 °
Ash
80 pcf
0 psf
18 °
Rip Rap
140 pcf
0 psf
40 °
Plant Crist Ash Pond dike
Section 1
Steady State
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
2.4
Ash
Silty Clay
Clayey Sand 1
Clayey Sand 2
Riprap
Sand
Elevation
Distance
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
250
300
350
400
450
500

Clayey Sand 1
120 pcf
100 psf
33 °

Clayey Sand 2
120 pcf
100 psf
28 °

Silty Clay
115 pcf
385 psf
10 °

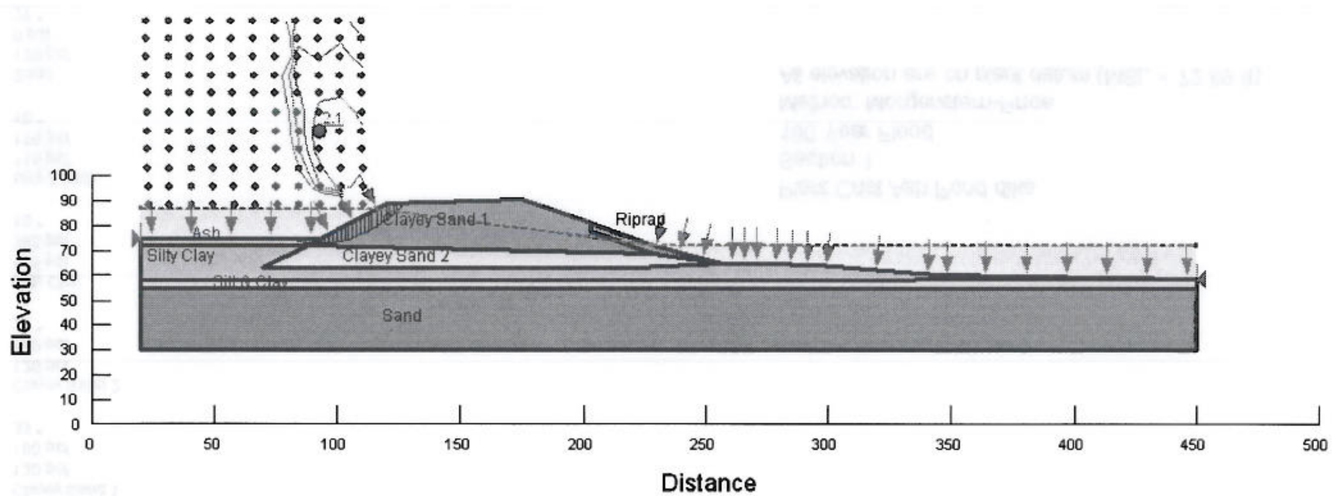
Silty & Clay
115 pcf
115 psf
10 °

Sand
120 pcf
0 psf
27 °

Ash
80 pcf
0 psf
18 °

Rip Rap
140 pcf
0 psf
40 °

Plant Crist Ash Pond dike
Section 1
Seismic - 0.03g
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



Clayey Sand 1
120 pcf
100 psf
33 °

Clayey Sand 2
120 pcf
100 psf
28 °

Silty Clay
115 pcf
385 psf
10 °

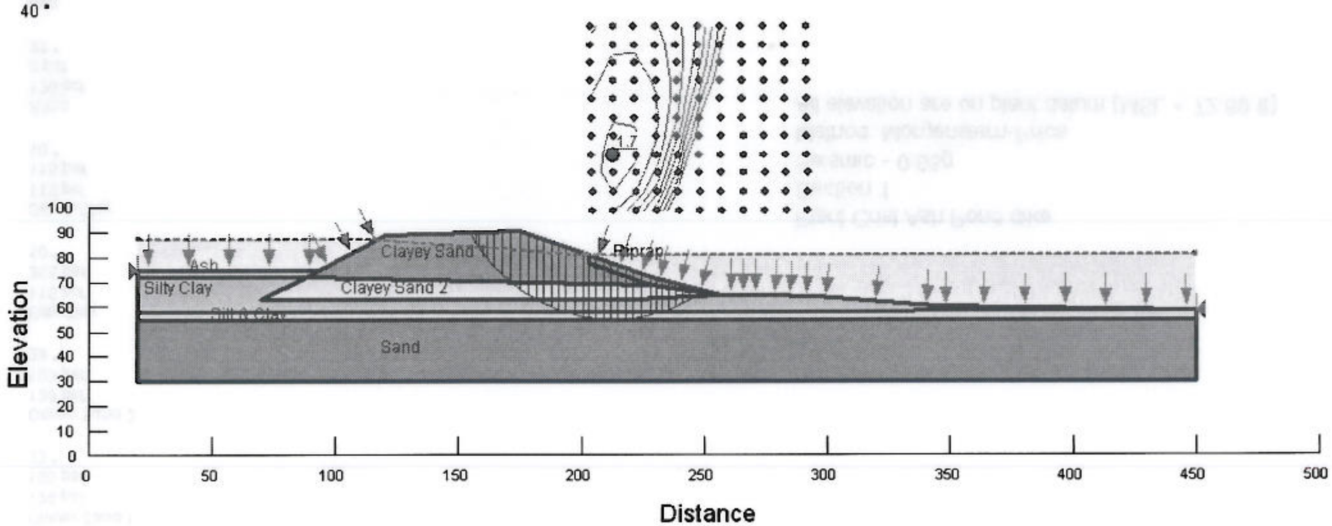
Silty & Clay
115 pcf
115 psf
10 °

Sand
120 pcf
0 psf
27 °

Ash
80 pcf
0 psf
18 °

Rip Rap
140 pcf
0 psf
40 °

Plant Crist Ash Pond dike
Section 1
100 Year Flood
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



Clayey Sand 1
120 pcf
100 psf
33 °

Clayey Sand 2
120 pcf
100 psf
28 °

Silty Clay
115 pcf
385 psf
10 °

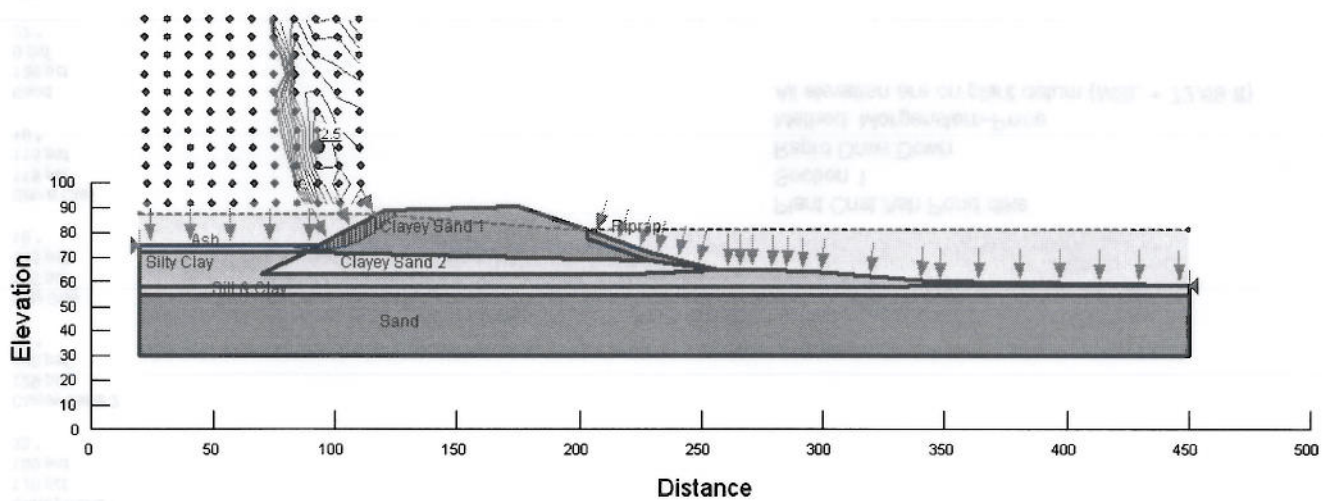
Silty & Clay
115 pcf
115 psf
10 °

Sand
120 pcf
0 psf
27 °

Ash
80 pcf
0 psf
18 °

Rip Rap
140 pcf
0 psf
40 °

Plant Crist Ash Pond dike
Section 1
100 Year Flood
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



Clayey Sand 1
120 pcf
100 psf
33 °

Clayey Sand 2
120 pcf
100 psf
28 °

Silty Clay
115 pcf
385 psf
10 °

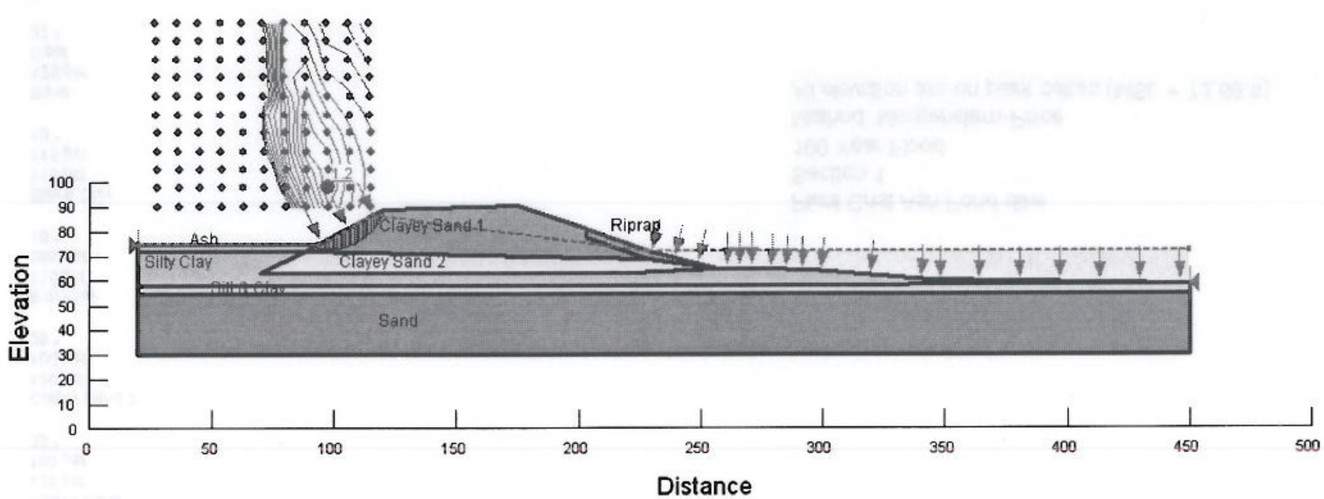
Silty & Clay
115 pcf
115 psf
10 °

Sand
120 pcf
0 psf
27 °

Ash
80 pcf
0 psf
18 °

Rip Rap
140 pcf
0 psf
40 °

Plant Crist Ash Pond dike
Section 1
Rapid Draw Down
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



CONFIDENTIAL BUSINESS INFORMATION

SLOPE/W Analysis

File Information

Created By: Hartsfield, Terri H.
Revision Number: 55
Last Edited By: Hartsfield, Terri H.
Date: 8/15/2012
Time: 8:26:28 AM
File Name: Crist Ash Pond Section 1 - Seis.gsz
Directory: T:\ESEE MAJOR PROJECTS\PROJECTS\CRIST\2012\Attorney-Client Privlege EPA Sub\Slope Stability\Ash Pond\Sect 1-NE\
Last Solved Date: 8/15/2012
Last Solved Time: 8:26:32 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- **Apply Phreatic Correction:** No
- **Side Function**
  - **Interslice force function option:** Half-Sine
- **PWP Conditions Source:** Piezometric Line
- **Use Staged Rapid Drawdown:** No

Slip Surface
- **Direction of movement:** Left to Right
- **Use Passive Mode:** No
- **Slip Surface Option:** Grid and Radius
- **Critical slip surfaces saved:** 1
- **Optimize Critical Slip Surface Location:** No
- **Tension Crack**
  - **Tension Crack Option:** (none)

FOS Distribution

FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Clayey Sand 1

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 100 psf
Phi: 33 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Clayey Sand 2

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 100 psf
Phi: 28 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Silty Clay

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 385 psf
Phi: 10 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Silty & Clay

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 115 psf

Phi: 10 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Ash

Model: Mohr-Coulomb
Unit Weight: 80 pcf
Cohesion: 0 psf
Phi: 18 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Rip Rap

Model: Mohr-Coulomb
Unit Weight: 140 pcf
Cohesion: 0 psf
Phi: 40 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (203.60855, 173.48564) ft
Lower Left: (204.72497, 99.04784) ft
Lower Right: (292.17785, 99.04784) ft
Grid Horizontal Increment: 10
Grid Vertical Increment: 10
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (22.95343, 78.16971) ft
Upper Right Coordinate: (398.55973, 74.48144) ft
Lower Left Coordinate: (22.68571, 32.98223) ft
Lower Right Coordinate: (400.60067, 34.68302) ft

Number of Increments: 10
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (20, 75) ft
Right Coordinate: (450, 59) ft

Piezometric Lines

Piezometric Line 1

Coordinates

X (ft)	Y (ft)
20	87.03
116	87.03
228	72
450	72

Seismic Loads

Horz Seismic Load: 0.03
Vert Seismic Load: 0.03
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft²)
Region 1	Sand	16,17,18,15,14,13	10750
Region 2	Silty & Clay	13,10,11,12,15,14	1404.5
Region 3	Silty Clay	1,3,2,8,20,21,22,23,12,11,10	2249.75
Region 4	Ash	24,25,3,1	212.25
Region 5	Rip Rap	26,27,28,20,9,7	117.05775
Region 6	Clayey Sand 2	20,28,3,2,8	1211.7543
Region 7	Clayey Sand 1	28,27,26,6,5,4,25,3	1891.1879

Points

	X (ft)	Y (ft)
Point 1	20	72
Point 2	70	63
Point 3	88	72
Point 4	120	89

Point 5	157.5	90
Point 6	175	91
Point 7	228	72
Point 8	221	63
Point 9	252.5	66
Point 10	20	58
Point 11	221	58
Point 12	450	59
Point 13	20	55
Point 14	221	55
Point 15	450	55
Point 16	20	30
Point 17	221	30
Point 18	450	30
Point 19	20	87.03
Point 20	257	65
Point 21	275	65
Point 22	295.5	64
Point 23	344	60
Point 24	20	75
Point 25	93.5	75
Point 26	202.95828	80.97722
Point 27	202.99592	77.9756
Point 28	227.97602	69.00992

Critical Slip Surfaces

Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1 259	1.2	(213.247, 113.935)	58.861	(159.423, 90.1099)	(248.682, 66.935)

Slices of Slip Surface: 259

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	259	160.77185	87.438585	-400.4137	84.717614	55.016262	100
2	259	163.46955	82.623015	-122.50739	434.58266	282.22128	100
3	259	166.3306	78.477855	112.19281	822.91072	461.54561	100
4	259	169.355	74.78176	317.49903	1230.2895	592.77305	100
5	259	172.3794	71.6259	489.0978	1592.0531	716.26752	100
6	259	174.4458	69.67933	593.26478	1888.7738	688.83436	100
7	259	176.4578	68.025245	679.619	2040.7038	723.70163	100
8	259	179.3734	65.830545	792.16739	2214.8886	756.47428	100

9	259	182.289	63.90201	888.09258	2366.6913	786.1849	100
10	259	185.14335	62.24077	967.86025	2564.059	281.45291	385
11	259	187.93645	60.8161	1033.3642	2657.6517	286.40571	385
12	259	190.72955	59.572205	1087.5803	2737.8379	290.98494	385
13	259	193.52265	58.496875	1131.3078	2805.2143	295.15488	385
14	259	196.25905	57.596	1164.6195	2879.9644	302.46159	115
15	259	198.93875	56.856135	1188.3388	2908.1704	303.25272	115
16	259	201.61845	56.25018	1203.691	2924.4671	303.41927	115
17	259	204.4346	55.756475	1210.9457	2986.9124	313.15084	115
18	259	207.36835	55.38652	1209.4492	2973.6162	311.07023	115
19	259	210.28325	55.16668	1198.7408	2940.7814	307.16877	115
20	259	213.1982	55.09197	1178.9939	2885.854	300.96549	115
21	259	216.24175	55.171595	1148.5474	2801.9002	291.53072	115
22	259	219.4139	55.419585	1106.5221	2683.5551	278.07347	115
23	259	222.744	55.871995	1050.4026	2520.8814	259.28509	115
24	259	226.244	56.554995	978.46266	2306.1938	234.11482	115
25	259	229.85845	57.49977	904.81224	2090.8395	209.1286	115
26	259	233.3688	58.648	833.16623	2000.4864	205.83004	385
27	259	236.67255	59.9662	750.90142	1769.4663	179.60046	385
28	259	239.9763	61.525665	653.58931	1497.2774	148.76498	385
29	259	243.28005	63.34884	539.83232	1186.4547	114.01697	385
30	259	246.3591	65.30125	417.99129	756.46172	179.96792	100
31	259	248.23415	66.603985	336.71125	416.59073	67.026839	0

Section 2 – East Dike at River

Clayey Sand 1
120 pcf
100 psf
33 °

Clayey Sand 2
120 pcf
100 psf
28 °

Silty Clay
115 pcf
385 psf
10 °

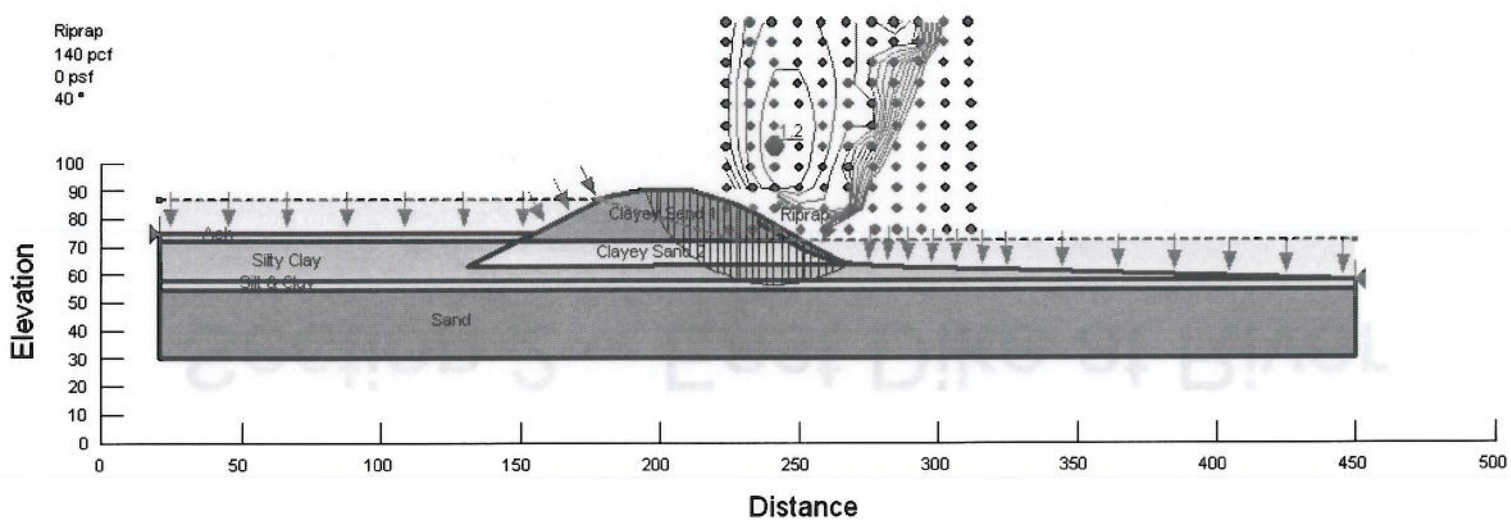
Silty & Clay
115 pcf
115 psf
10 °

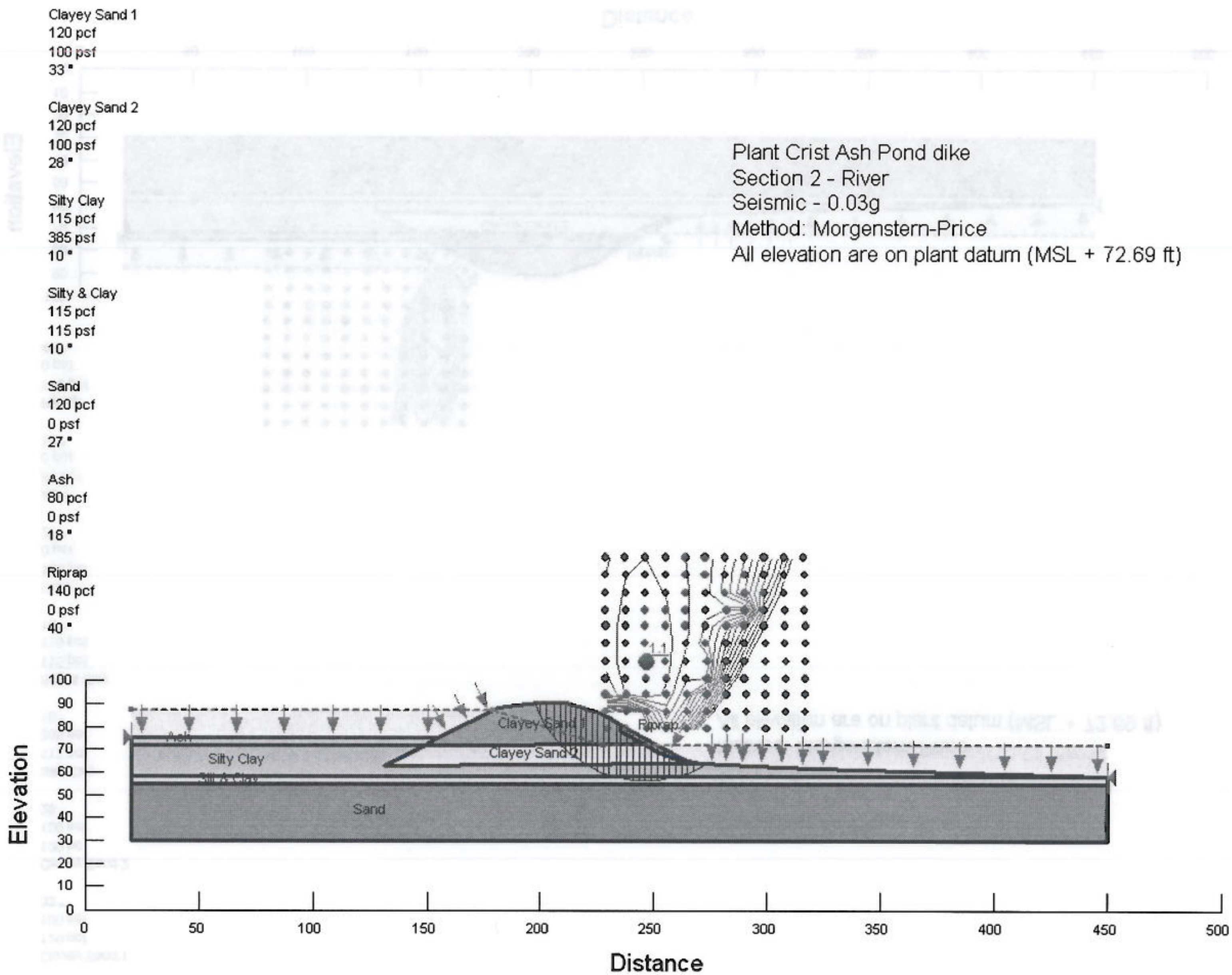
Sand
120 pcf
0 psf
27 °

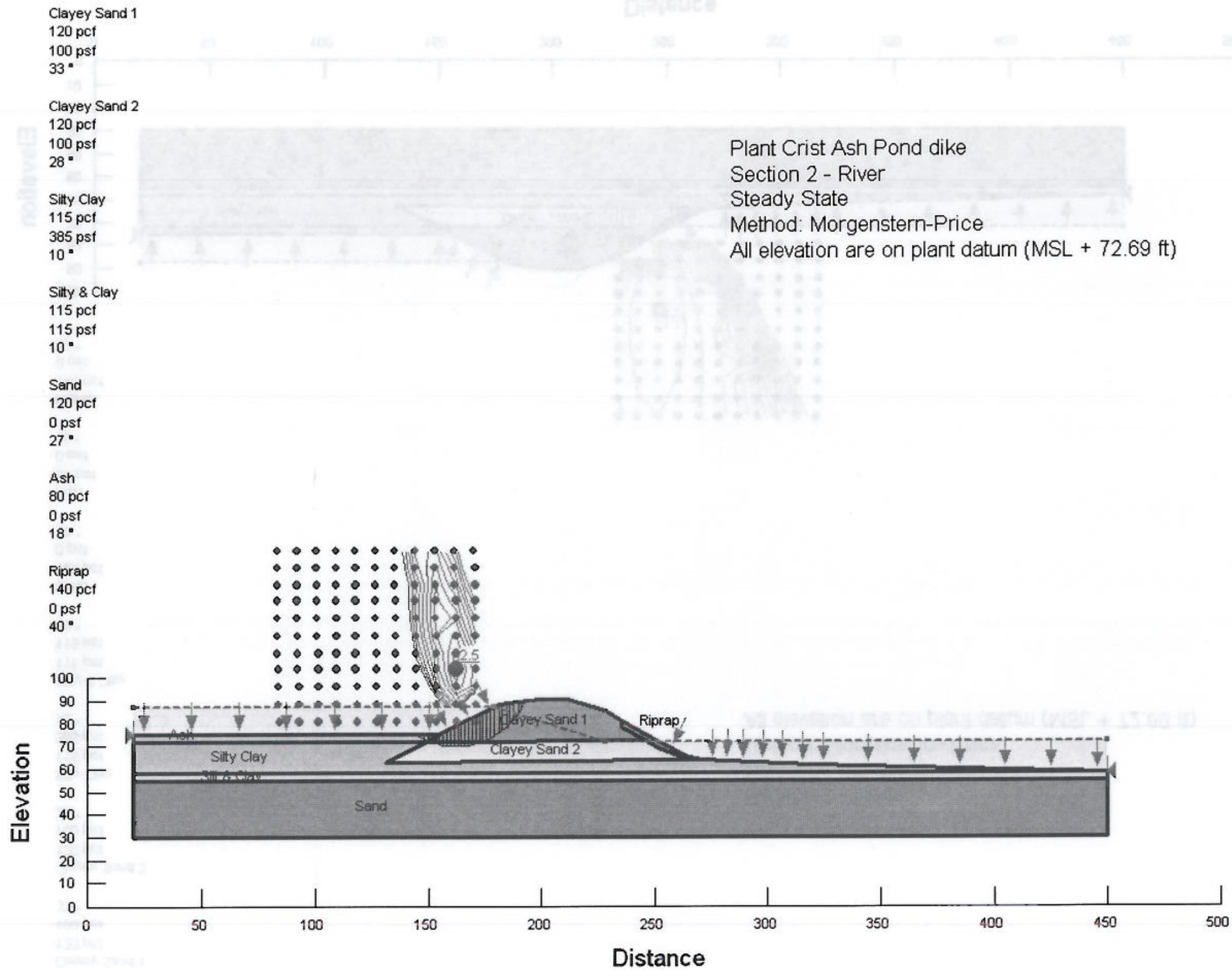
Ash
80 pcf
0 psf
18 °

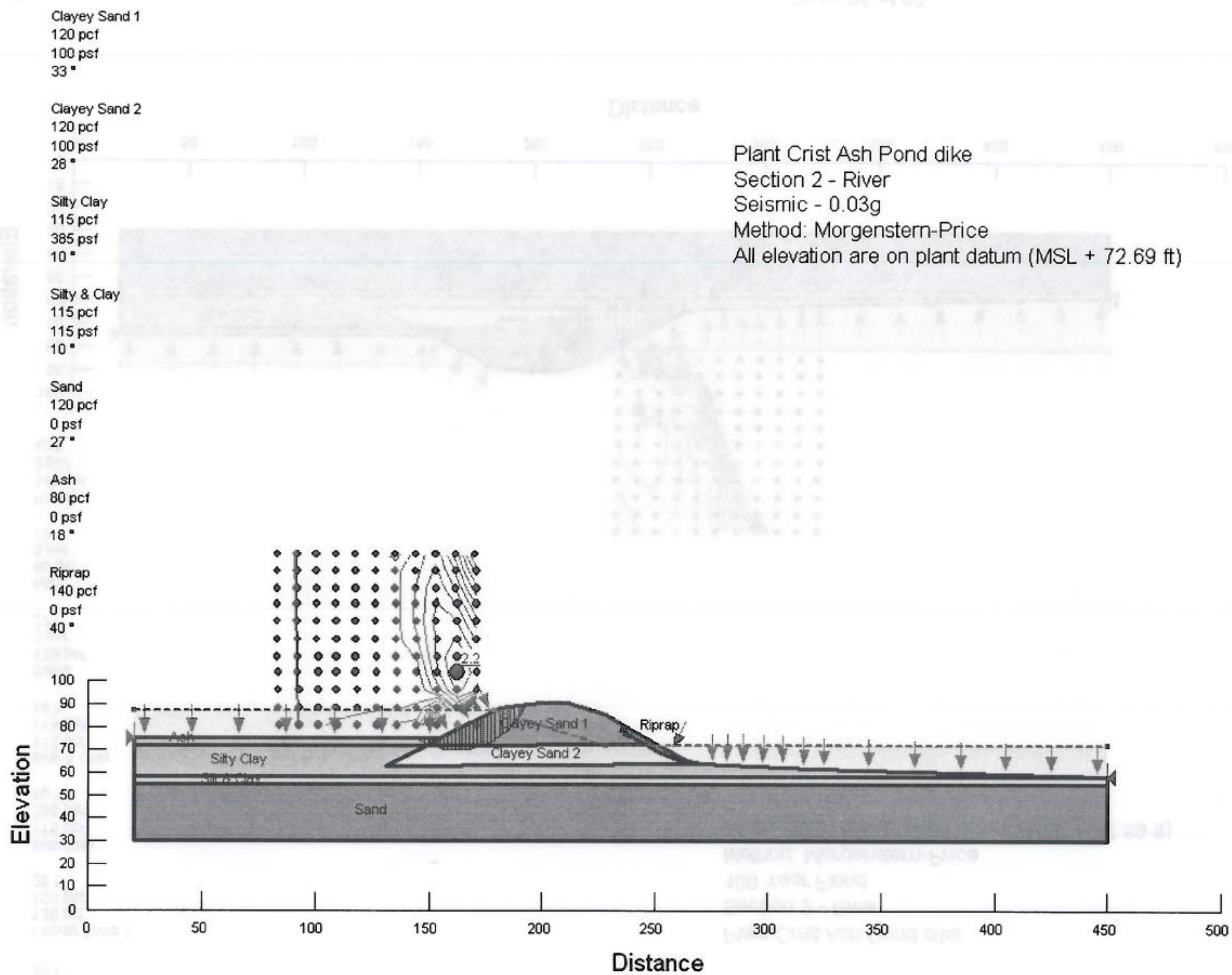
Riprap
140 pcf
0 psf
40 °

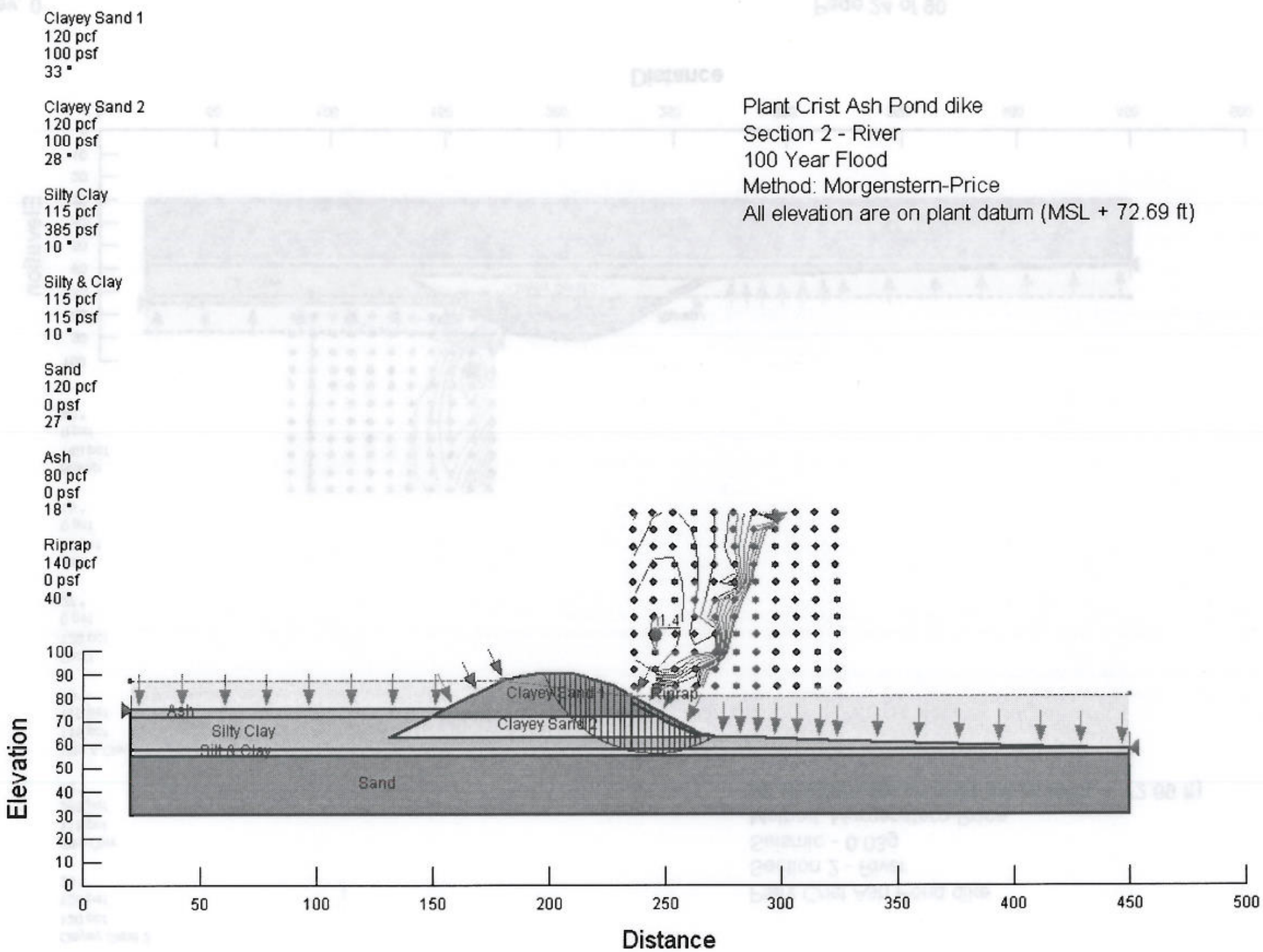
Plant Crist Ash Pond dike
Section 2 - River
Steady State
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)

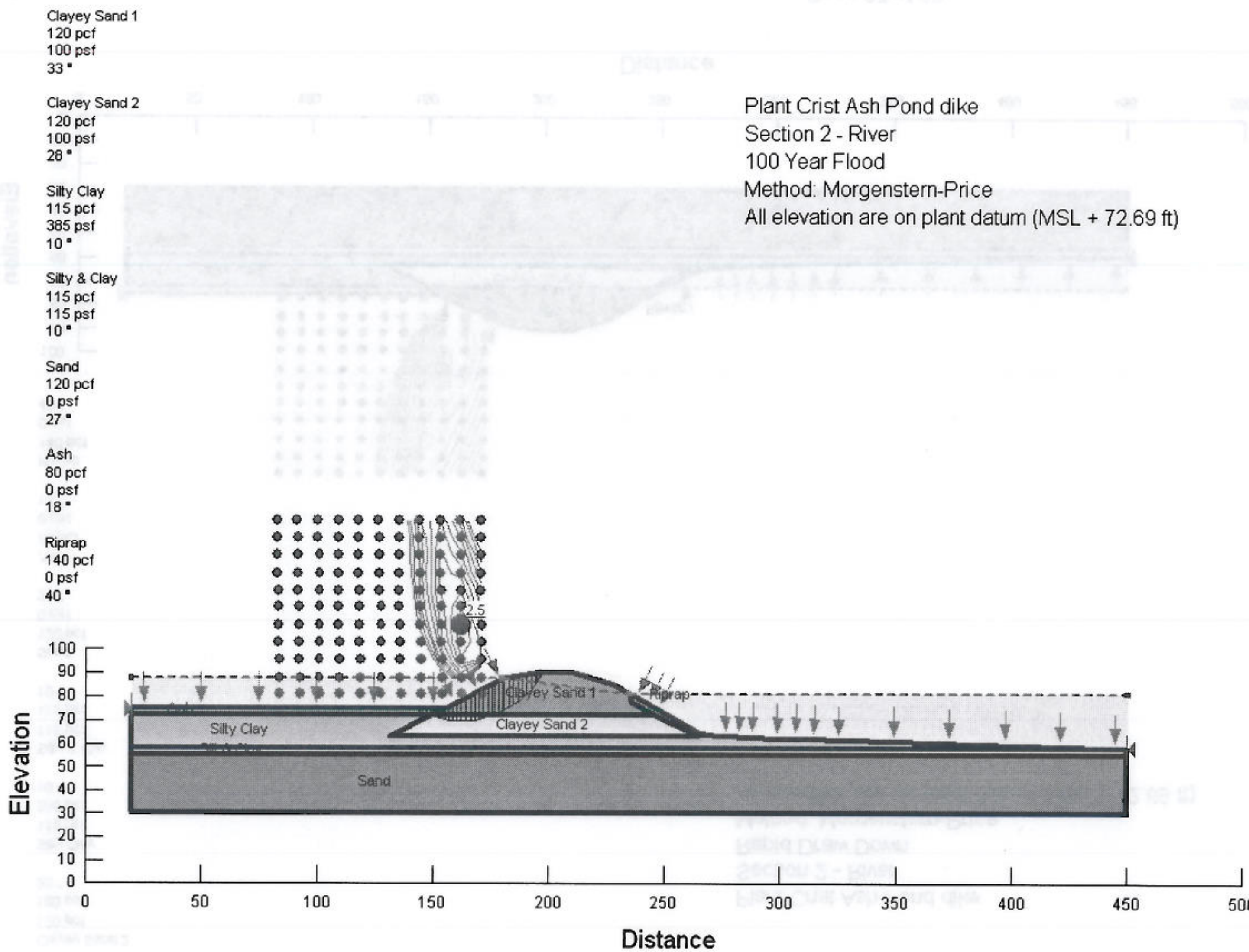



Clayey Sand 1
120 pcf
100 psf
33 °
Clayey Sand 2
120 pcf
100 psf
28 °
Silty Clay
115 pcf
385 psf
10 °
Silty & Clay
115 pcf
115 psf
10 °
Sand
120 pcf
0 psf
27 °
Ash
80 pcf
0 psf
18 °
Riprap
140 pcf
0 psf
40 °
Plant Crist Ash Pond dike
Section 2 - River
Seismic - 0.03g
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
Ash
Silty Clay
Clayey Sand 1
Clayey Sand 2
Riprap
Sand
1.1
Elevation
Distance
0 10 20 30 40 50 60 70 80 90 100
0 50 100 150 200 250 300 350 400 450 500


Clayey Sand 1
120 pcf
100 psf
33 °
Clayey Sand 2
120 pcf
100 psf
28 °
Silty Clay
115 pcf
385 psf
10 °
Silty & Clay
115 pcf
115 psf
10 °
Sand
120 pcf
0 psf
27 °
Ash
80 pcf
0 psf
18 °
Riprap
140 pcf
0 psf
40 °
Plant Crist Ash Pond dike
Section 2 - River
Steady State
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
2.5
Clayey Sand 1
Clayey Sand 2
Riprap
Ash
Silty Clay
Sand
Elevation
Distance
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
250
300
350
400
450
500


Clayey Sand 1
120 pcf
100 psf
33 °
Clayey Sand 2
120 pcf
100 psf
28 °
Silty Clay
115 pcf
385 psf
10 °
Silty & Clay
115 pcf
115 psf
10 °
Sand
120 pcf
0 psf
27 °
Ash
80 pcf
0 psf
18 °
Riprap
140 pcf
0 psf
40 °
Plant Crist Ash Pond dike
Section 2 - River
Seismic - 0.03g
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
2.2
Ash
Silty Clay
Clayey Sand 1
Clayey Sand 2
Riprap
Sand
Elevation
Distance
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
250
300
350
400
450
500


Clayey Sand 1
120 pcf
100 psf
33 °
Clayey Sand 2
120 pcf
100 psf
28 °
Silty Clay
115 pcf
385 psf
10 °
Silty & Clay
115 pcf
115 psf
10 °
Sand
120 pcf
0 psf
27 °
Ash
80 pcf
0 psf
18 °
Riprap
140 pcf
0 psf
40 °
Plant Crist Ash Pond dike
Section 2 - River
100 Year Flood
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
1.4
Ash
Silty Clay
Silt & Clay
Sand
Clayey Sand 1
Clayey Sand 2
Riprap
Elevation
Distance
0
10
20
30
40
50
60
70
80
90
100
0
50
100
150
200
250
300
350
400
450
500



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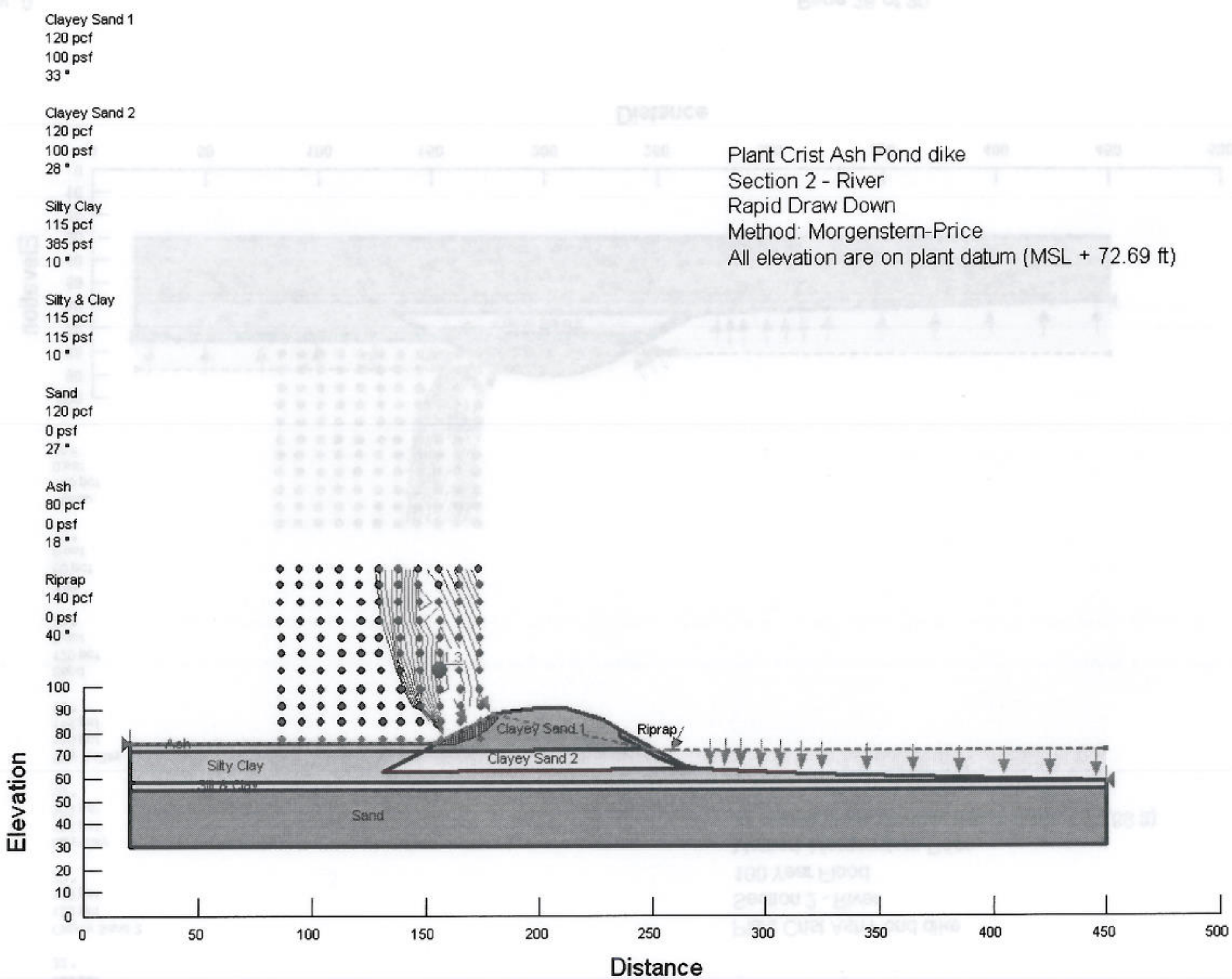


CONFIDENTIAL BUSINESS INFORMATION

SLOPE/W Analysis

File Information

Created By: Hartsfield, Terri H.
Revision Number: 59
Last Edited By: Hartsfield, Terri H.
Date: 8/15/2012
Time: 8:41:11 AM
File Name: Crist Ash Pond Section 2.gsz
Directory: T:\ESEE MAJOR PROJECTS\PROJECTS\CRIST\2012\Attorney-Client Privlege EPA Sub\Slope Stability\Ash Pond\Sect 2-Mid River\
Last Solved Date: 8/15/2012
Last Solved Time: 8:41:18 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- **Apply Phreatic Correction:** No
- **Side Function**
  - **Interslice force function option:** Half-Sine
- **PWP Conditions Source:** Piezometric Line
- **Use Staged Rapid Drawdown:** No

Slip Surface
- **Direction of movement:** Left to Right
- **Use Passive Mode:** No
- **Slip Surface Option:** Grid and Radius
- **Critical slip surfaces saved:** 1
- **Optimize Critical Slip Surface Location:** No
- **Tension Crack**
  - **Tension Crack Option:** (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30

Optimization Tolerance: 0.01

Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000

Optimization Convergence Tolerance: 1e-007

Starting Optimization Points: 8

Ending Optimization Points: 16

Complete Passes per Insertion: 1

Driving Side Maximum Convex Angle: 5 °

Resisting Side Maximum Convex Angle: 1 °

Materials

Clayey Sand 1

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion: 100 psf

Phi: 33 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand 2

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion: 100 psf

Phi: 28 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion: 385 psf

Phi: 10 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Silty & Clay

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion: 115 psf

Phi: 10 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 0 psf
Phi: 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Ash

Model: Mohr-Coulomb
Unit Weight: 80 pcf
Cohesion: 0 psf
Phi: 18 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Riprap

Model: Mohr-Coulomb
Unit Weight: 140 pcf
Cohesion: 0 psf
Phi: 40 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (223.38424, 150.20276) ft
Lower Left: (224.50066, 75.76496) ft
Lower Right: (311.95354, 75.76496) ft
Grid Horizontal Increment: 10
Grid Vertical Increment: 10
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (65.01521, 75.13013) ft
Upper Right Coordinate: (440.62151, 71.44186) ft
Lower Left Coordinate: (64.74749, 29.94265) ft
Lower Right Coordinate: (442.66245, 31.64344) ft

Number of Increments: 10
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (20, 75) ft
Right Coordinate: (450, 58) ft

Piezometric Lines

Piezometric Line 1

Coordinates

X (ft)	Y (ft)
20	87.03
178.80882	87.03686
228	72
450	72

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Ash	10,12,13,11	396
Region 2	Silty Clay	11,10,15,23,7,8,9,18,16	2852.7997
Region 3	Silty & Clay	16,17,19,18	1290
Region 4	Sand	17,20,21,19	10750
Region 5	Riprap	23,7,6,14,24,25,26,22	77.08772
Region 6	Clayey Sand 2	26,22,23,15,10	999.28961
Region 7	Clayey Sand 1	26,25,24,5,4,3,2,1,12,10	1167.8079

Points

	X (ft)	Y (ft)
Point 1	181	88
Point 2	194	90
Point 3	200	90.2
Point 4	211	90.2
Point 5	228	85.2

Point 6	265	64.7
Point 7	271	63.7
Point 8	293.5	62.7
Point 9	320	61.7
Point 10	149	72
Point 11	20	72
Point 12	155	75
Point 13	20	75
Point 14	251.74	72
Point 15	131	63
Point 16	20	58
Point 17	20	55
Point 18	450	58
Point 19	450	55
Point 20	20	30
Point 21	450	30
Point 22	251.97769	69.02989
Point 23	265.03687	63.67018
Point 24	235.47716	81.04252
Point 25	235.50233	77.93455
Point 26	246.4514	72.01676

Critical Slip Surfaces

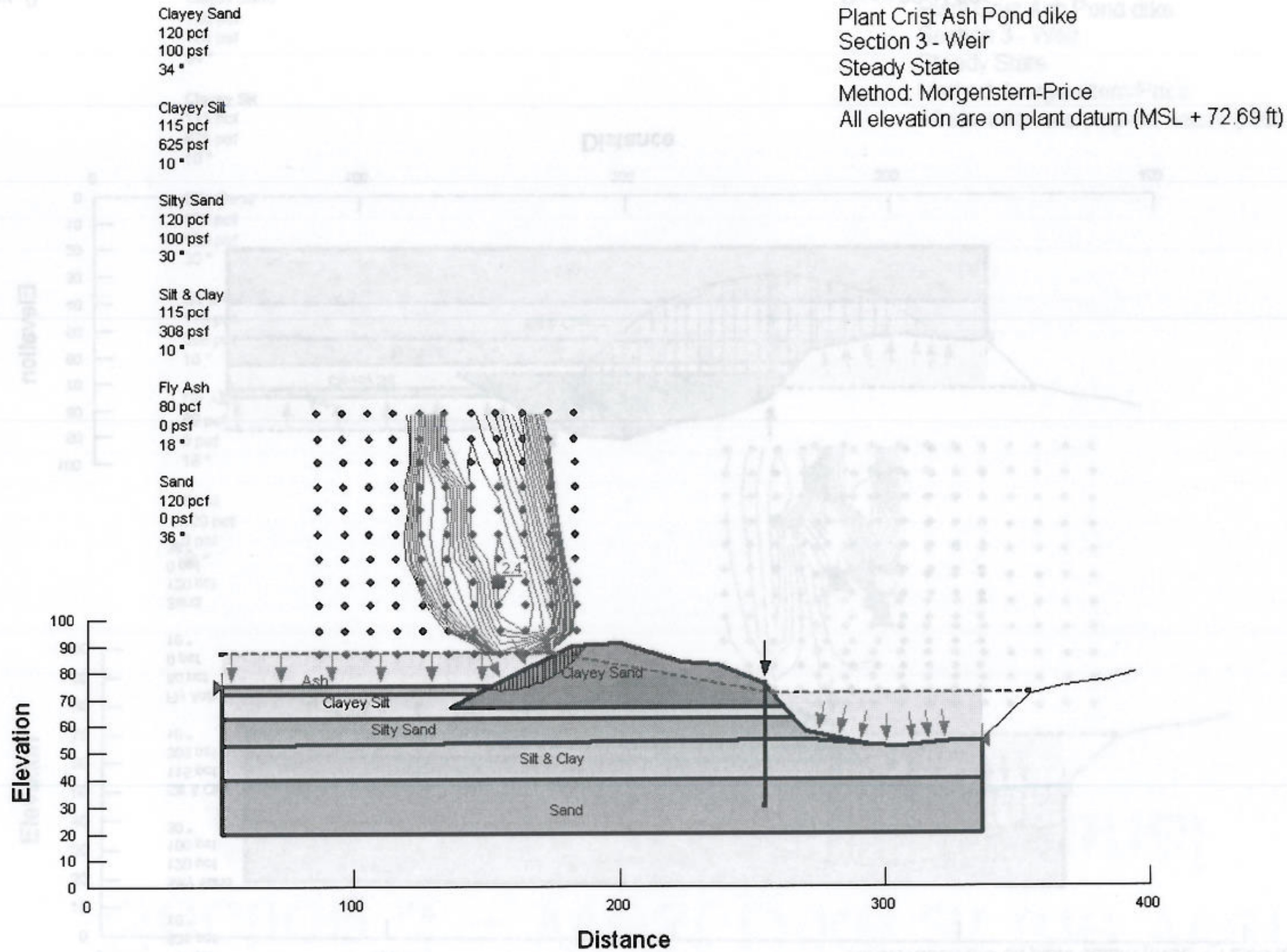
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	511	1.2	(241.545, 105.54)	49.204	(194.85, 90.0283)	(268.181, 64.1698)

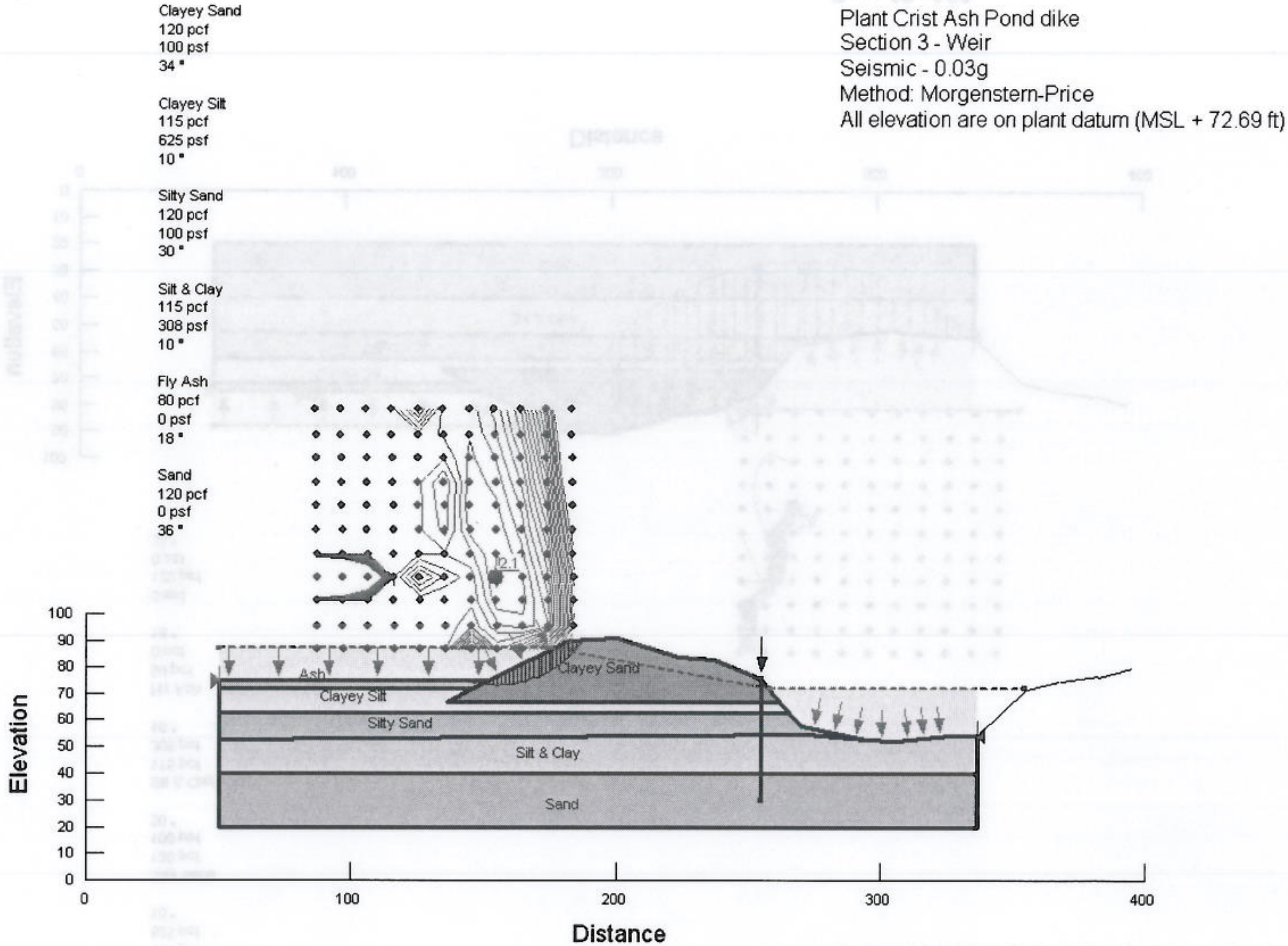
Slices of Slip Surface: 511

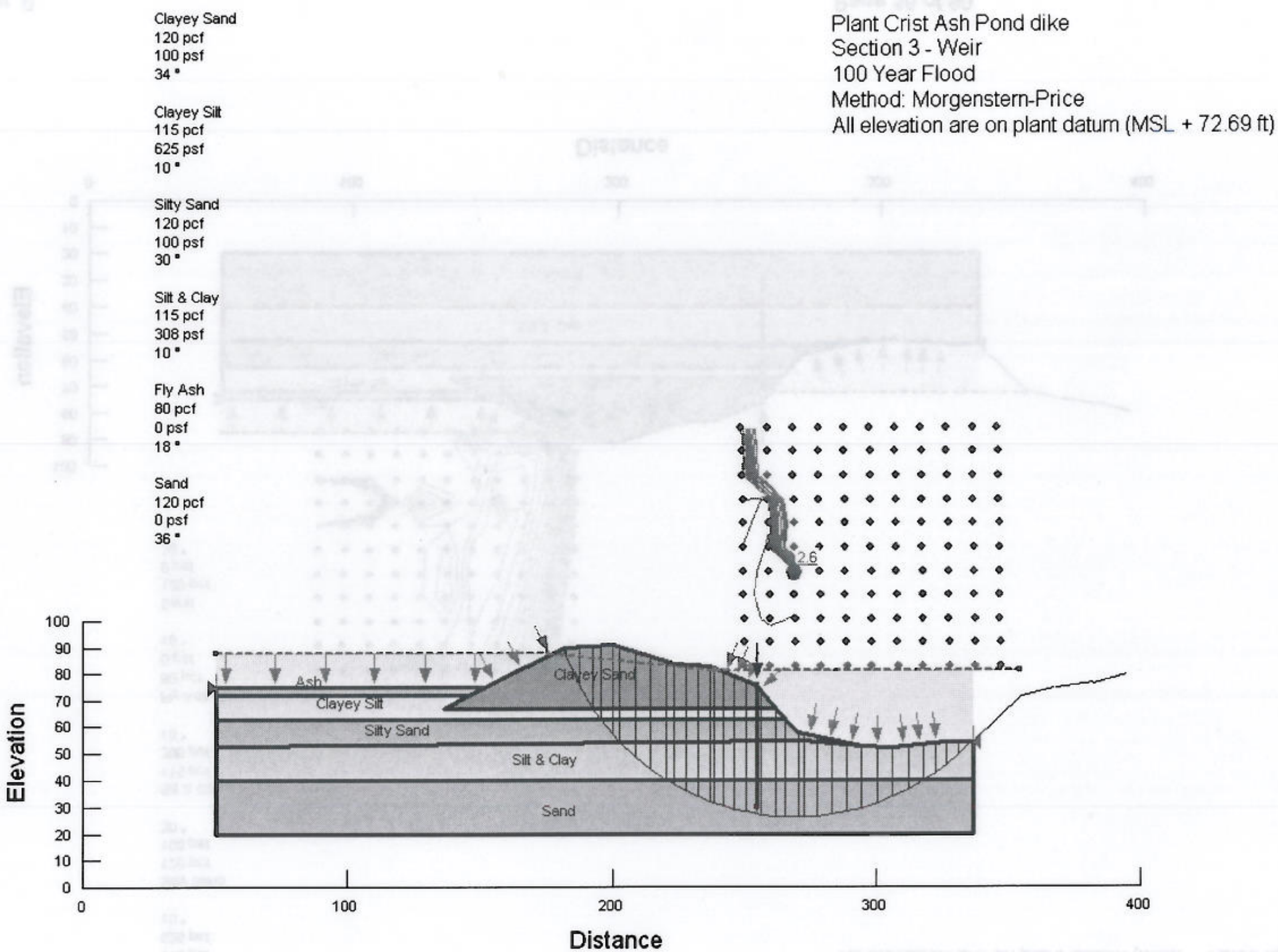
	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	511	195.88025	87.430905	-350.22183	47.021916	30.536389	100
2	511	197.9404	82.853635	-103.89311	346.90032	225.2797	100
3	511	199.48525	80.025255	43.130427	578.90452	347.93576	100
4	511	201.38375	77.21479	182.29151	860.44325	440.39689	100
5	511	204.1512	73.631295	353.11927	1227.5556	567.86562	100
6	511	206.9012	70.65299	486.50624	1604.7305	594.57039	100
7	511	209.63375	68.130805	591.76145	1889.1317	689.82402	100
8	511	212.2754	66.020745	673.0466	2111.9814	765.09522	100
9	511	214.8262	64.250825	734.82172	2276.8085	819.88893	100
10	511	217.287	62.753455	781.34317	2499.2047	302.90533	385

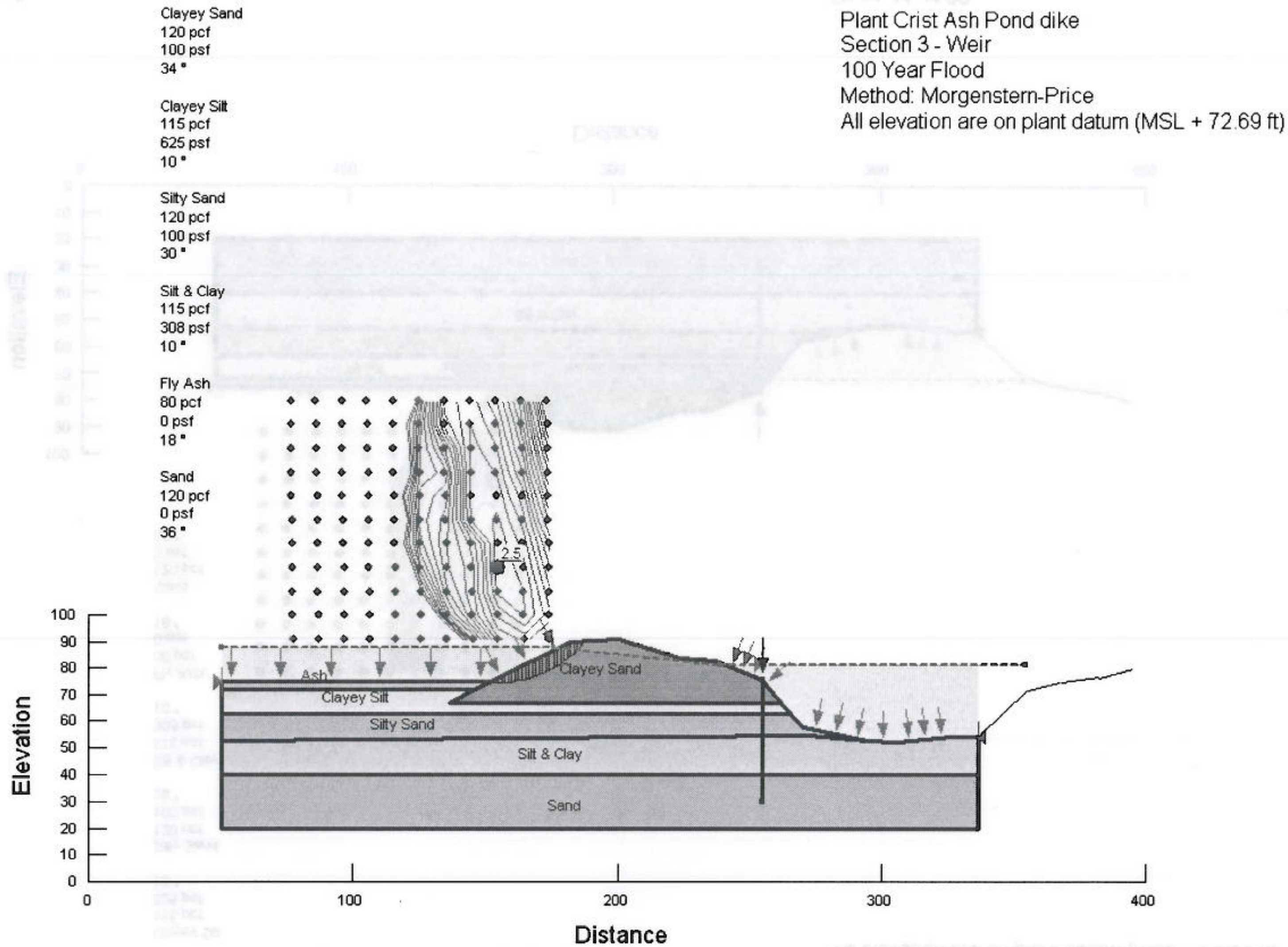
11	511	219.6578	61.492385	814.81789	2614.3601	317.30784	385
12	511	222.0286	60.39097	838.31403	2720.3778	331.85863	385
13	511	224.3994	59.43773	852.56194	2817.5857	346.48672	385
14	511	226.7924	58.617225	858.13516	2906.4658	361.17596	385
15	511	228.42945	58.11878	866.19336	2950.5602	367.53011	385
16	511	229.96195	57.73276	890.26105	2953.8358	363.8639	115
17	511	232.16805	57.25133	920.31337	2934.5724	355.16821	115
18	511	234.37415	56.874615	943.81295	2902.0701	345.29357	115
19	511	236.8584	56.579885	962.21239	2908.0061	343.09592	115
20	511	239.60825	56.393755	973.82958	2822.7442	326.01353	115
21	511	242.3455	56.36212	975.80754	2708.5472	305.52875	115
22	511	245.08275	56.483115	968.27076	2562.0022	281.01786	115
23	511	247.7813	56.751825	951.50083	2383.9731	252.58352	115
24	511	250.4256	57.163125	925.83412	2175.0835	220.27637	115
25	511	251.85885	57.429895	909.16608	2055.1571	202.06914	115
26	511	253.10405	57.727685	890.57454	1982.305	192.50154	115
27	511	255.5766	58.40072	848.58319	1913.7441	187.81661	385
28	511	258.269	59.28822	793.22084	1701.67	160.1841	385
29	511	260.9614	60.35346	726.74969	1453.3629	128.12151	385
30	511	263.6538	61.60943	648.37559	1171.973	92.324345	385
31	511	266.2038	62.98449	562.5694	906.52953	60.64945	385
32	511	267.79425	63.92594	503.81994	551.99705	40.425397	0

Section 3 – West Dike at the Weir Across the Discharge Canal

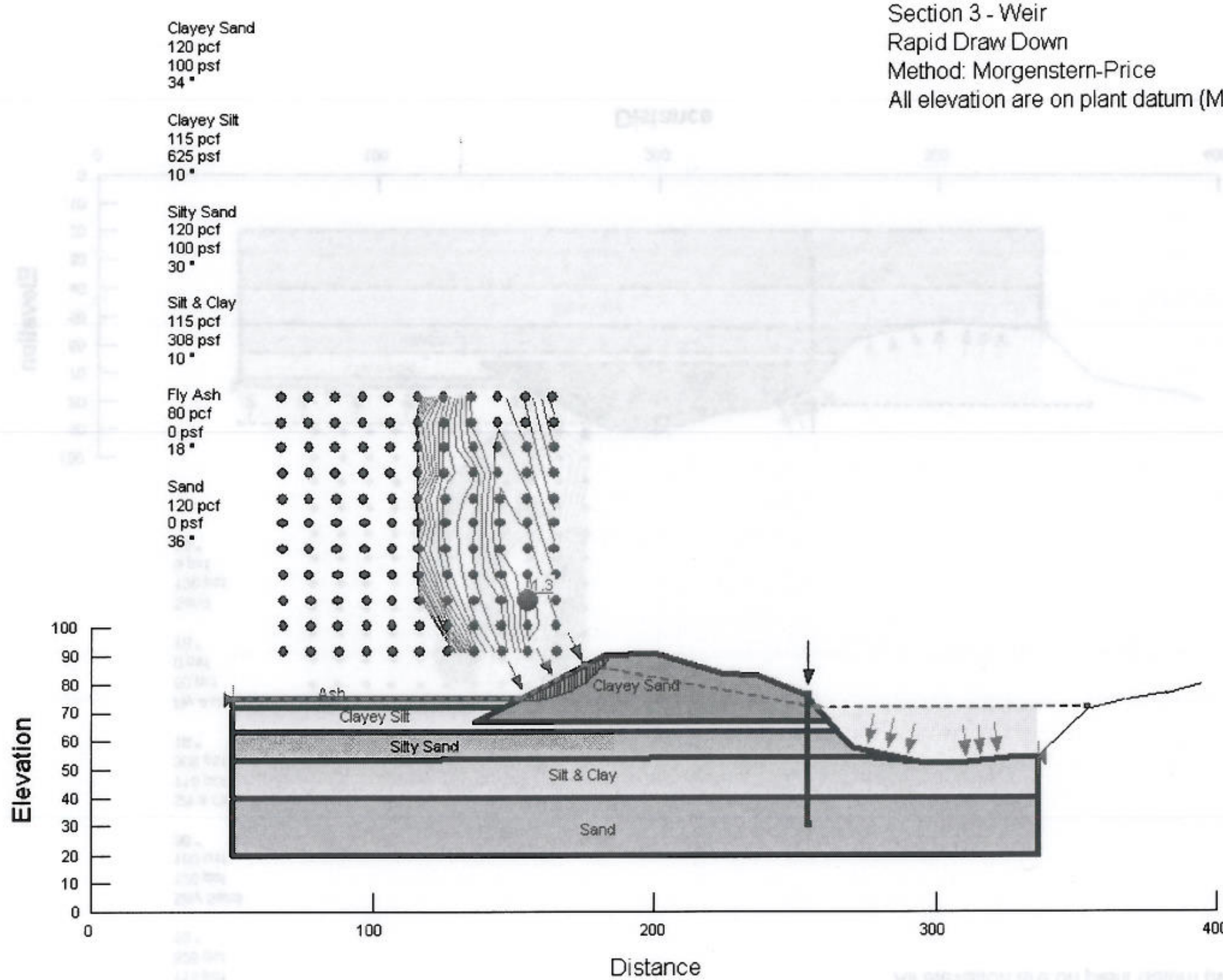

Plant Crist Ash Pond dike
Section 3 - Weir
Steady State
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
Clayey Sand
120 pcf
100 psf
34 °
Clayey Silt
115 pcf
625 psf
10 °
Silty Sand
120 pcf
100 psf
30 °
Silt & Clay
115 pcf
308 psf
10 °
Fly Ash
80 pcf
0 psf
18 °
Sand
120 pcf
0 psf
36 °
2.4
Ash
Clayey Silt
Silty Sand
Clayey Sand
Silt & Clay
Sand
Elevation
Distance
0
10
20
30
40
50
60
70
80
90
100
100
200
300
400


Clayey Sand
120 pcf
100 psf
34 °
Clayey Silt
115 pcf
625 psf
10 °
Silty Sand
120 pcf
100 psf
30 °
Silt & Clay
115 pcf
308 psf
10 °
Fly Ash
80 pcf
0 psf
18 °
Sand
120 pcf
0 psf
36 °
Plant Crist Ash Pond dike
Section 3 - Weir
Seismic - 0.03g
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
2.1
Ash
Clayey Silt
Silty Sand
Clayey Sand
Silt & Clay
Sand
Elevation
Distance
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400


Clayey Sand
120 pcf
100 psf
34 °
Clayey Silt
115 pcf
625 psf
10 °
Silty Sand
120 pcf
100 psf
30 °
Silt & Clay
115 pcf
308 psf
10 °
Fly Ash
80 pcf
0 psf
18 °
Sand
120 pcf
0 psf
36 °
Plant Crist Ash Pond dike
Section 3 - Weir
100 Year Flood
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
2.6
Ash
Clayey Silt
Silty Sand
Silt & Clay
Sand
Clayey Sand
Elevation
Distance
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400


Clayey Sand
120 pcf
100 psf
34 °
Clayey Silt
115 pcf
625 psf
10 °
Silty Sand
120 pcf
100 psf
30 °
Silt & Clay
115 pcf
308 psf
10 °
Fly Ash
80 pcf
0 psf
18 °
Sand
120 pcf
0 psf
36 °
Plant Crist Ash Pond dike
Section 3 - Weir
100 Year Flood
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
2.5
Ash
Clayey Silt
Silty Sand
Clayey Sand
Silt & Clay
Sand
Elevation
Distance
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400

Plant Crist Ash Pond dike
Section 3 - Weir
Rapid Draw Down
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



SLOPE/W Analysis

File Information

Created By: Hartsfield, Terri H.
Revision Number: 34
Last Edited By: Hartsfield, Terri H.
Date: 8/15/2012
Time: 10:40:20 AM
File Name: Crist Ash Pond Weir Seis.gsz
Directory: T:\ESEE MAJOR PROJECTS\PROJECTS\CRIST\2012\Attorney-Client Privlege EPA Sub\Slope Stability\Ash Pond\Sect 4 - Weir\

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Apply Phreatic Correction: No
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Grid and Radius
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution
- FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Clayey Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 100 psf
Phi: 34 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Clayey Silt

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 625 psf
Phi: 10 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Silty Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 100 psf
Phi: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Silt & Clay

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 308 psf
Phi: 10 °
Phi-B: 0 °

Pore Water Pressure
Piezometric Line: 1

Fly Ash

Model: Mohr-Coulomb
Unit Weight: 80 pcf
Cohesion: 0 psf
Phi: 18 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 0 psf
Phi: 36 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (86.15504, 176.11368) ft
Lower Left: (87.39043, 86.75088) ft
Lower Right: (184.16177, 86.75088) ft
Grid Horizontal Increment: 10
Grid Vertical Increment: 10
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (40.30484, 83.07451) ft
Upper Right Coordinate: (415.91114, 79.38624) ft
Lower Left Coordinate: (40.03712, 37.88703) ft
Lower Right Coordinate: (417.95208, 39.58782) ft
Number of Increments: 10
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (50, 75) ft
Right Coordinate: (336.4, 54.4) ft

Piezometric Lines

Piezometric Line 1

Coordinates

X (ft)	Y (ft)
50	87.03
175	87.03
258	72
354	72

Seismic Loads

Horz Seismic Load: 0.03
Vert Seismic Load: 0.03
Ignore seismic load in strength: No

Reinforcements

Reinforcement 1

Type: Pile
Outside Point: (254.9, 75.5) ft
Inside Point: (254.9, 30) ft
Total Length: 45.5 ft
Reinforcement Direction: 90 °
Applied Load Option: Variable
F of S Dependent: No
Pile Spacing: 1 ft
Shear Capacity: 50000 lbs
Shear Safety Factor: 1
Shear Load Used: 50000 lbs
Shear Option: Parallel to Slip

Regions

	Material	Points	Area (ft^2)
Region 1	Fly Ash	17,22,19,18	297
Region 2	Clayey Sand	20,17,22,16,15,1,2,4,5,21	1899.4478
Region 3	Clayey Silt	21,23,24,18,17,20	1309.8555
Region 4	Silty Sand	7,26,23,24,25,6	2030.5737
Region 5	Silt & Clay	28,10,9,8,7,6,25,27	3943.755
Region 6	Sand	29,27,28,30	5728

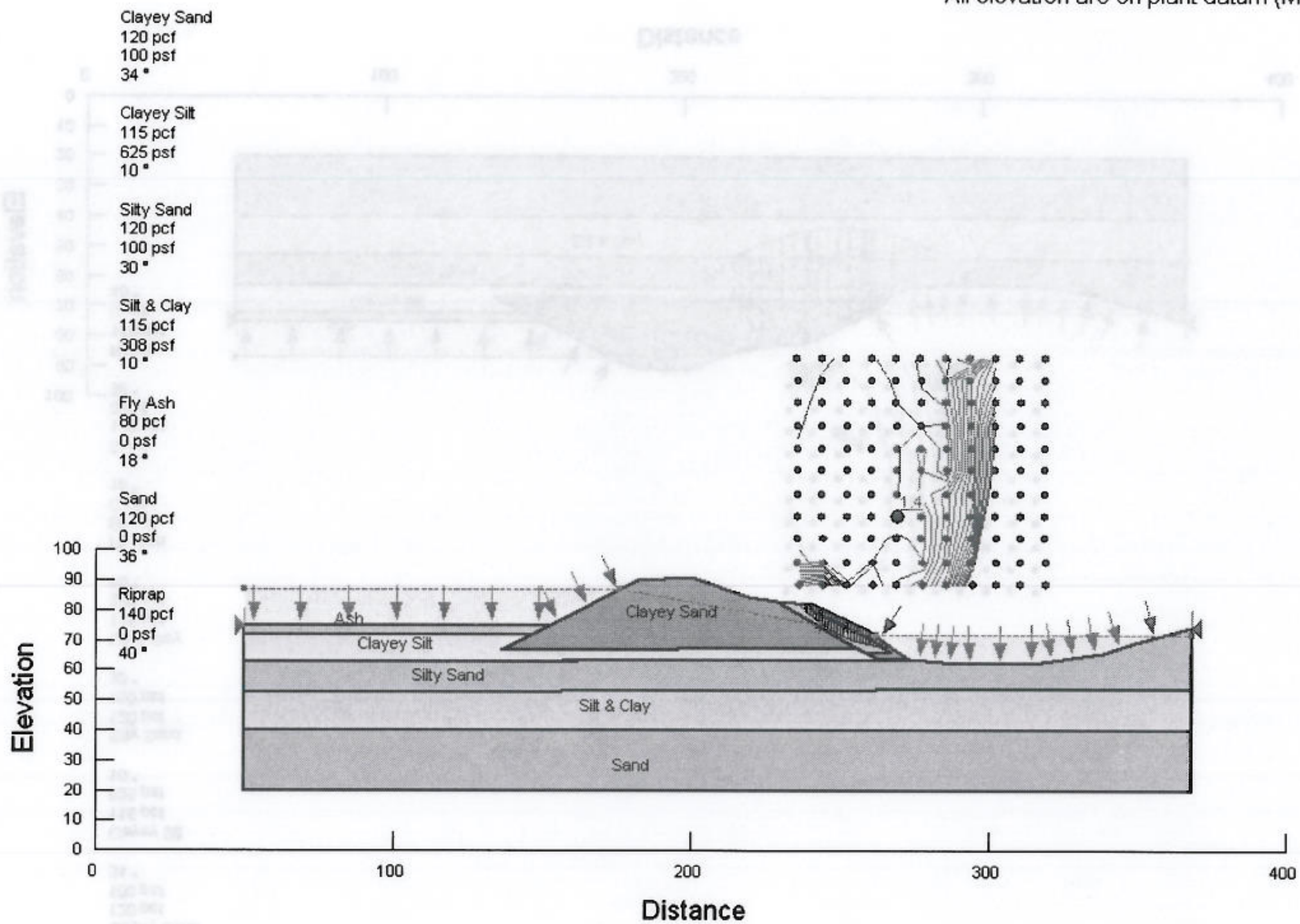
Points

	X (ft)	Y (ft)

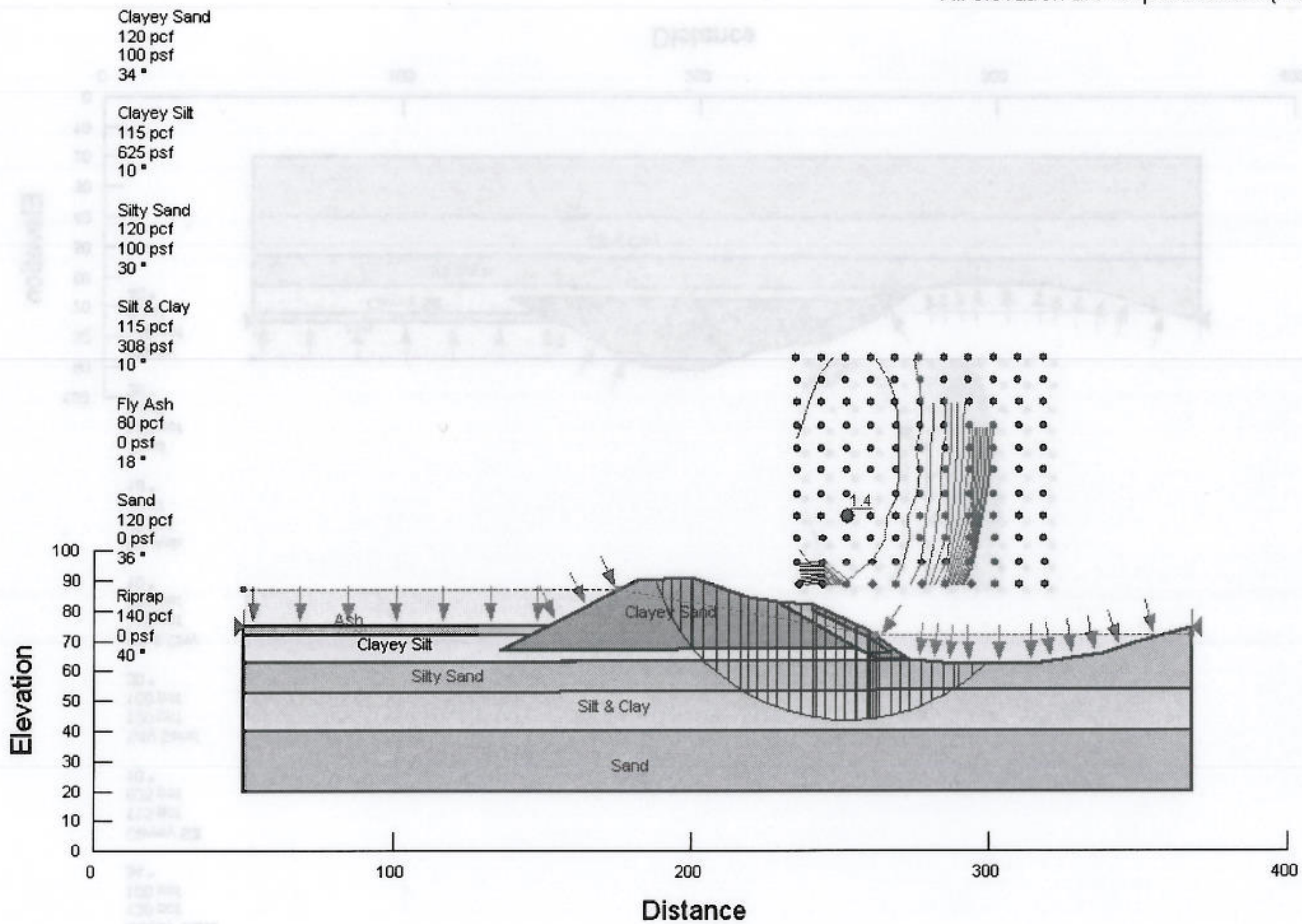
Point 1	223.5	84
Point 2	237.2	83
Point 3	248	78.4
Point 4	254.9	75.5
Point 5	256.5	73.6
Point 6	272.5	54.8
Point 7	294.2	52.4
Point 8	306.3	52.1
Point 9	326.1	54.2
Point 10	336.4	54.4
Point 11	355	71.7
Point 12	368.2	74.6
Point 13	382.5	76.6
Point 14	394.7	79.6
Point 15	200	90.7
Point 16	182	90
Point 17	146	72
Point 18	50	72
Point 19	50	75
Point 20	136	67
Point 21	262.02279	67.02087
Point 22	152	75
Point 23	265.46836	63.01394
Point 24	50	63
Point 25	50	53
Point 26	271.01531	57.65273
Point 27	50	40
Point 28	336.4	40
Point 29	50	20
Point 30	336.4	20

Section 4 – West Dike South of Discharge Canal Weir

Plant Crist Ash Pond dike
Section 4 - Discharge Canal South
Steady State
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)

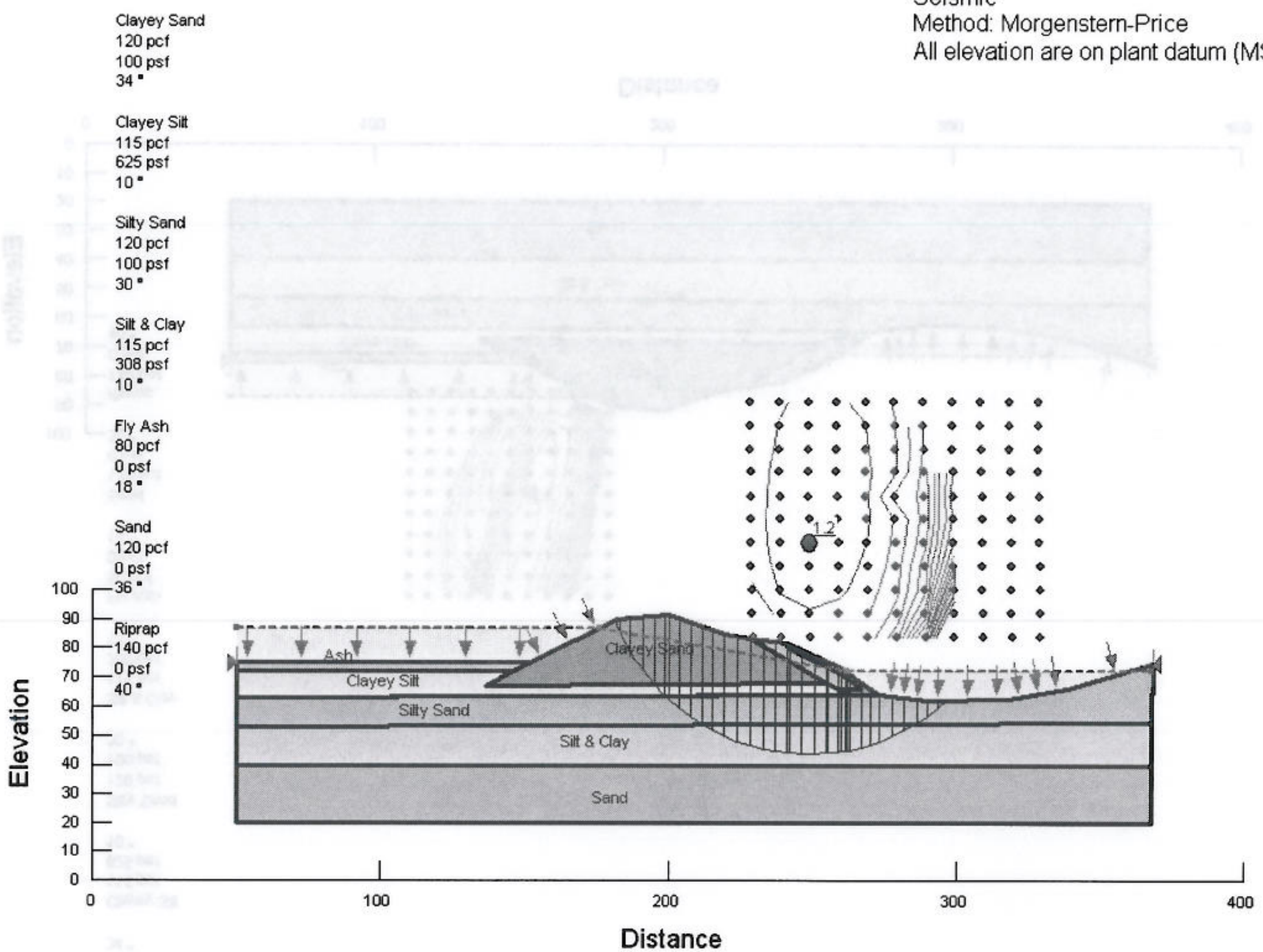


Plant Crist Ash Pond dike
Section 4 - Discharge Canal South
Steady State
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)

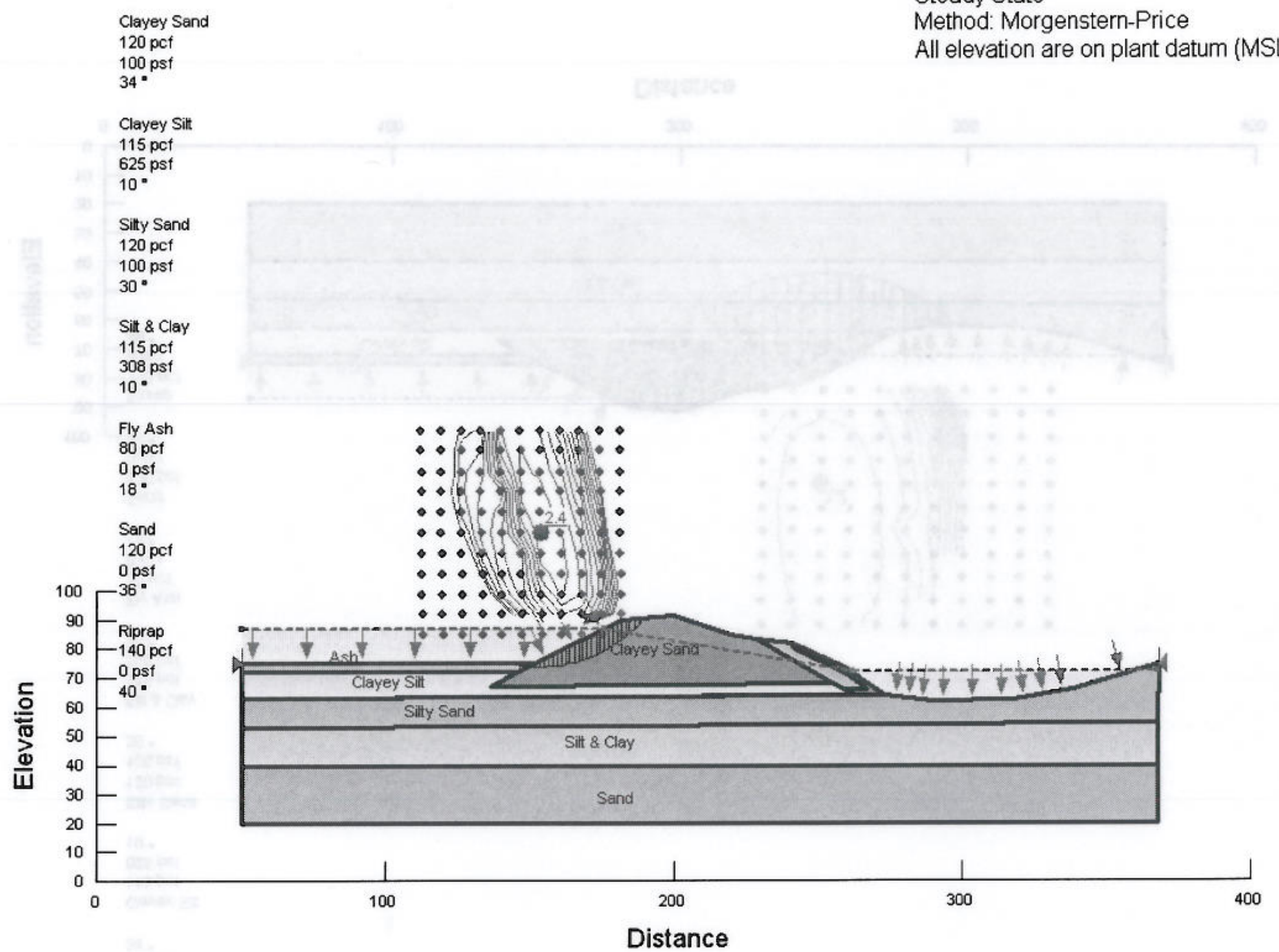


CONFIDENTIAL BUSINESS INFORMATION

Plant Crist Ash Pond dike
Section 4 - Discharge Canal South
Seismic
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)

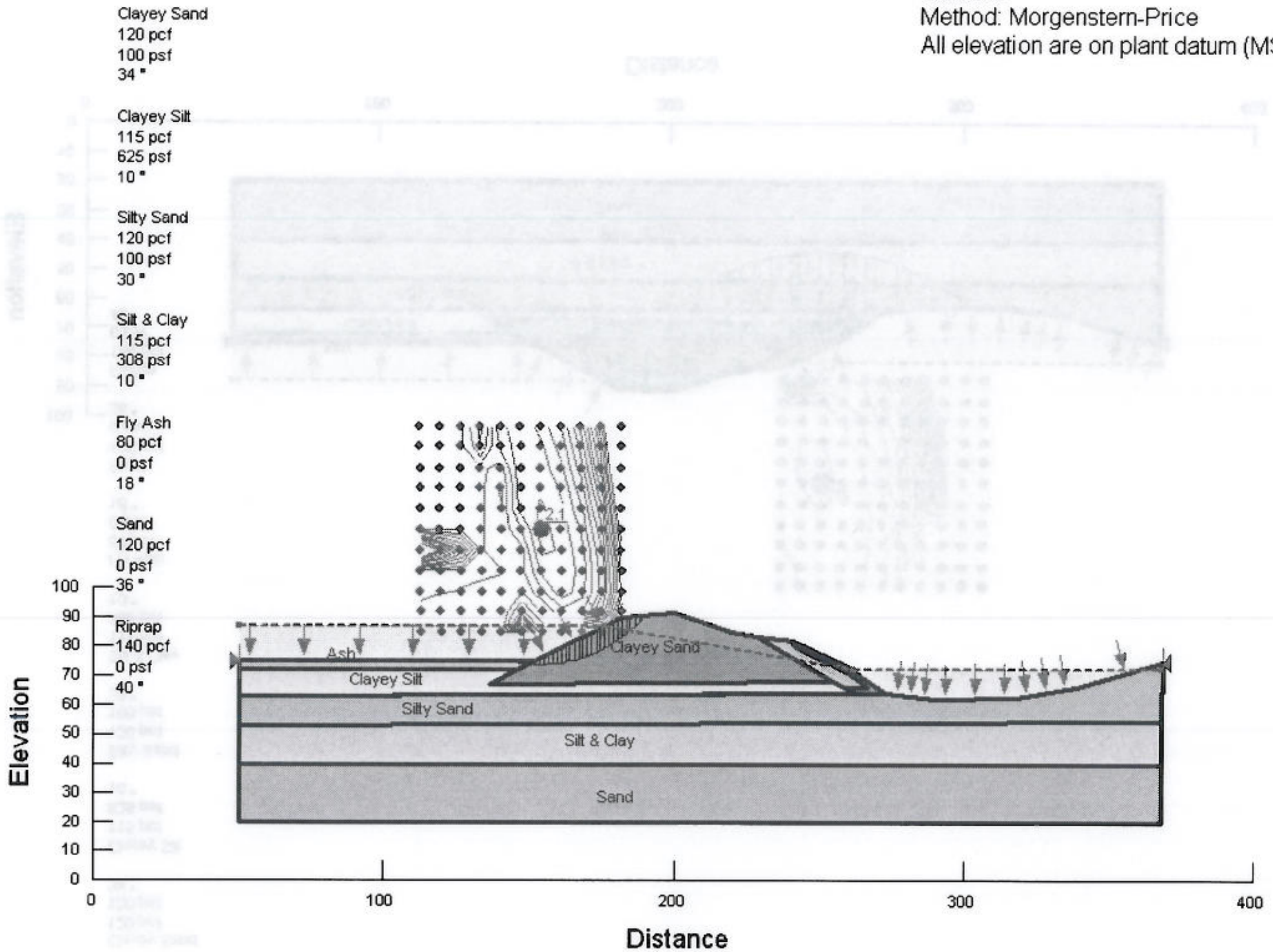


Plant Crist Ash Pond dike
Section 4 - Discharge Canal South
Steady State
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)

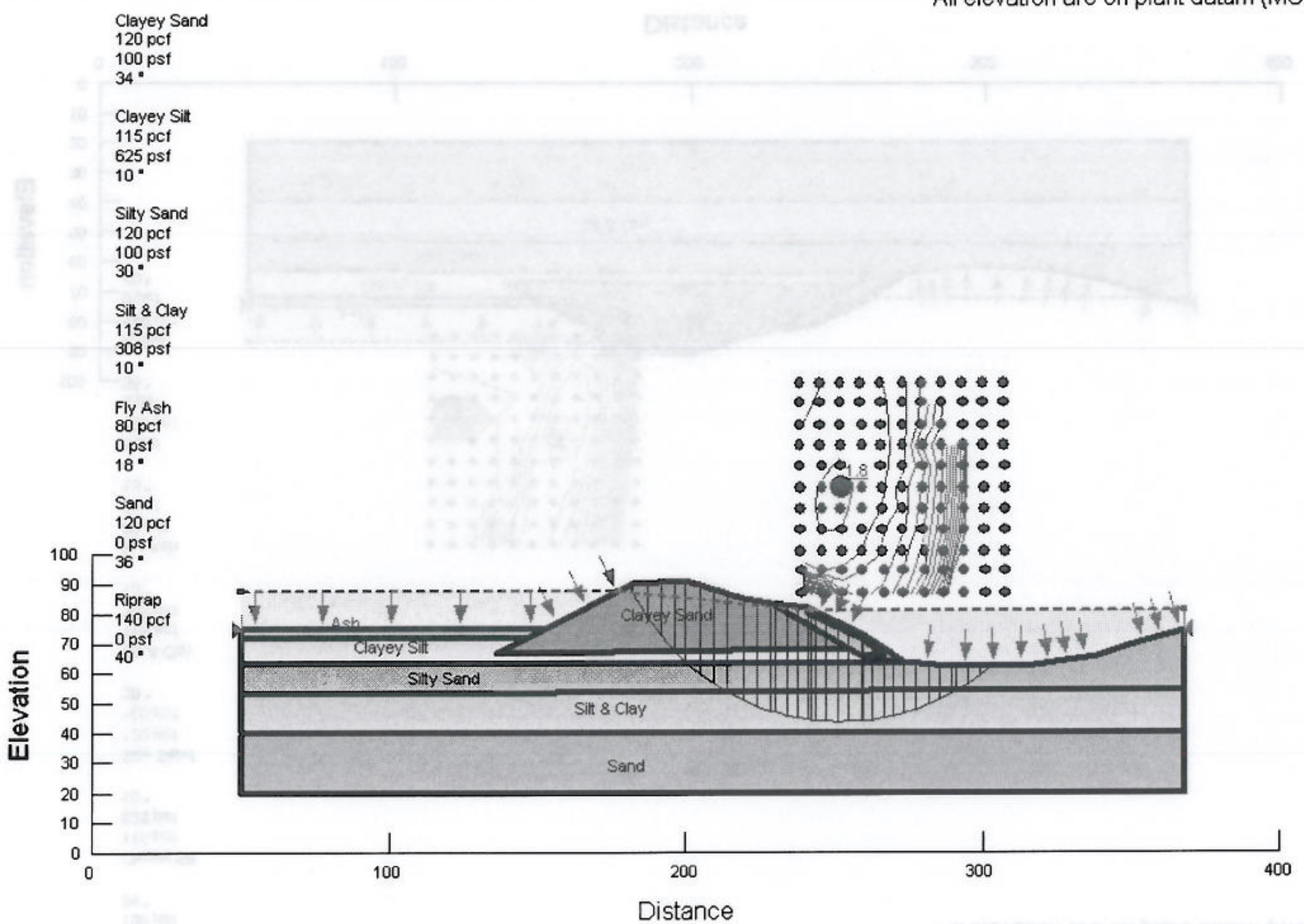


CONFIDENTIAL BUSINESS INFORMATION

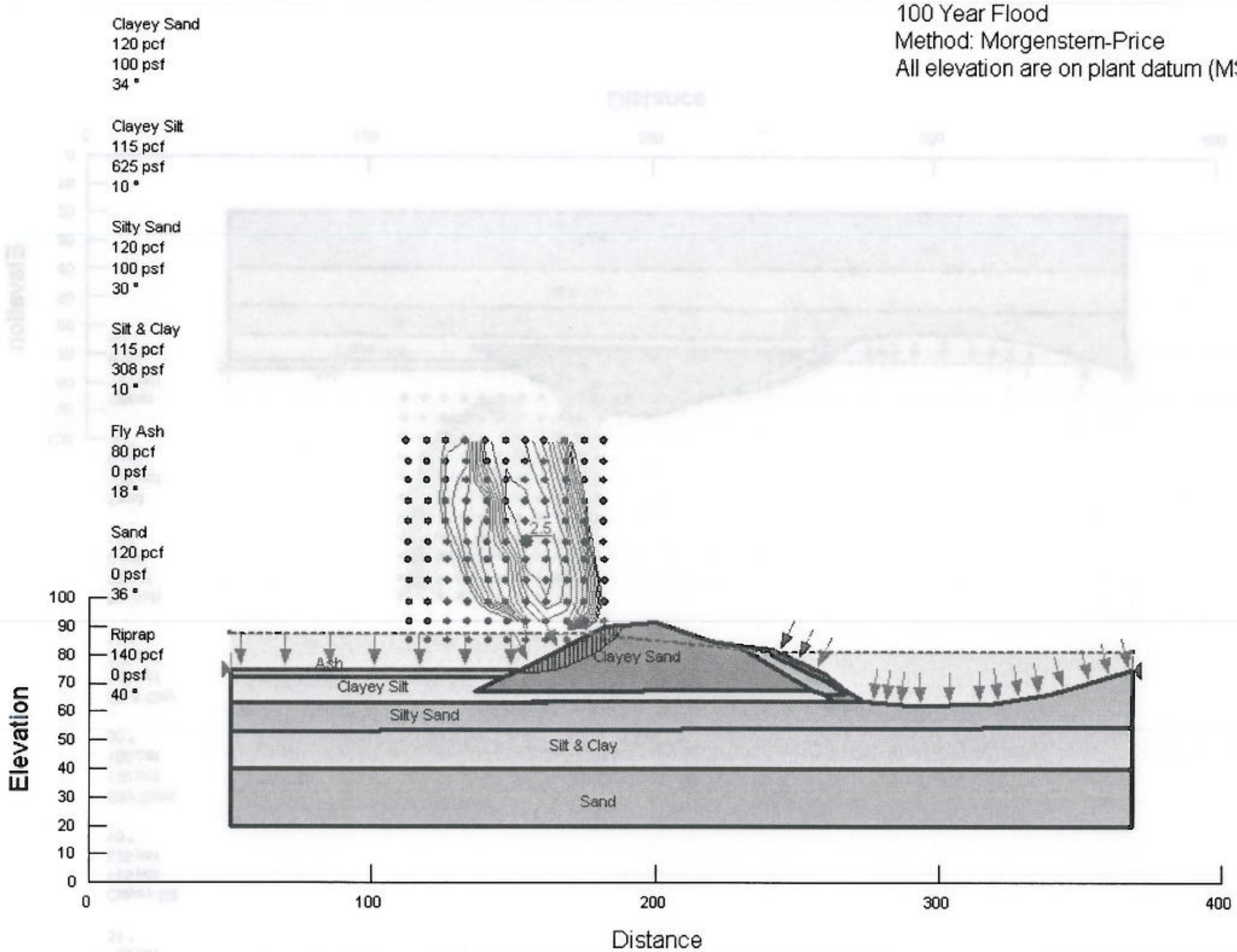
Plant Crist Ash Pond dike
Section 4 - Discharge Canal South
Seismic
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



Plant Crist Ash Pond dike
Section 4 - Discharge Canal South
100 Year Flood
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)

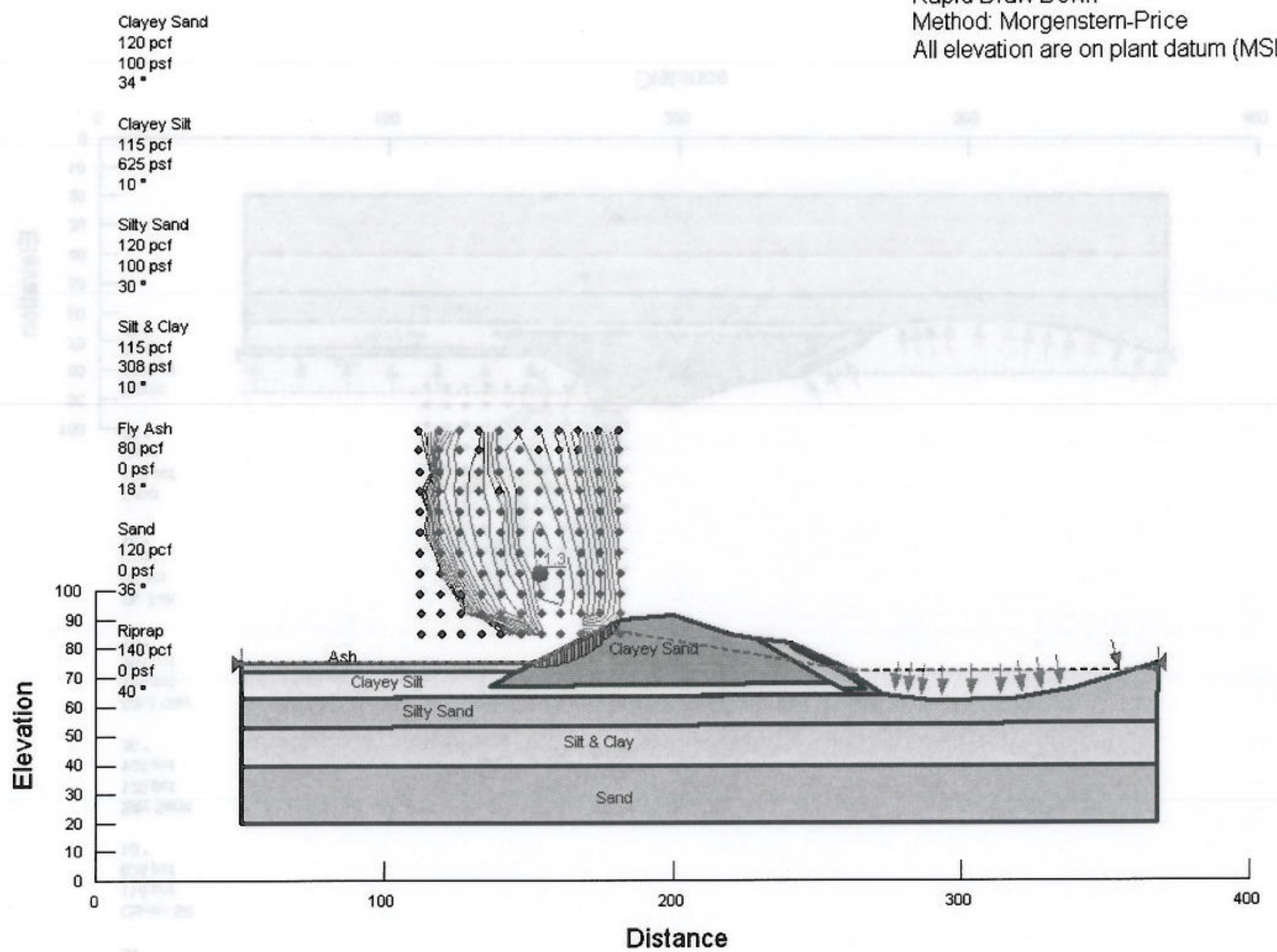


Plant Crist Ash Pond dike
Section 4 - Discharge Canal South
100 Year Flood
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



CONFIDENTIAL BUSINESS INFORMATION

Plant Crist Ash Pond Dike
Section 4 - Discharge Canal South
Rapid Draw Down
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



CONFIDENTIAL BUSINESS INFORMATION

SLOPE/W Analysis

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File Information

- **Created By:** Hartsfield, Terri H.
- **Revision Number:** 39
- **Last Edited By:** Hartsfield, Terri H.
- **Date:** 8/15/2012
- **Time:** 12:38:40 PM
- **File Name:** Crist Ash Pond Disc South.gsz
- **Directory:** T:\ESEE MAJOR PROJECTS\PROJECTS\CRIST\2012\Attorney-Client Privlege EPA Sub\Slope Stability\Ash Pond\Sect 4 - Discharge S\
- **Last Solved Date:** 8/15/2012
- **Last Solved Time:** 12:38:44 PM

Project Settings

- **Length(L) Units:** feet
- **Time(t) Units:** Seconds
- **Force(F) Units:** lbf
- **Pressure(p) Units:** psf
- **Strength Units:** psf
- **Unit Weight of Water:** 62.4 pcf
- **View:** 2D

Analysis Settings

SLOPE/W Analysis

- **Kind:** SLOPE/W
- **Method:** Morgenstern-Price
- **Settings**
  - **Apply Phreatic Correction:** No
  - **Side Function**
    - **Interslice force function option:** Half-Sine
  - **PWP Conditions Source:** Piezometric Line
  - **Use Staged Rapid Drawdown:** No
- **Slip Surface**
  - **Direction of movement:** Left to Right
  - **Use Passive Mode:** No
  - **Slip Surface Option:** Grid and Radius
  - **Critical slip surfaces saved:** 1
  - **Optimize Critical Slip Surface Location:** No
  - **Tension Crack**
    - **Tension Crack Option:** (none)
- **FOS Distribution**

FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 10 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Clayey Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 100 psf
Phi: 34 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Clayey Silt

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 625 psf
Phi: 10 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Silty Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 100 psf
Phi: 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Silt & Clay

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 308 psf

Phi: 10 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Fly Ash

Model: Mohr-Coulomb
Unit Weight: 80 pcf
Cohesion: 0 psf
Phi: 18 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 0 psf
Phi: 36 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Riprap

Model: Mohr-Coulomb
Unit Weight: 140 pcf
Cohesion: 0 psf
Phi: 40 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (235.12413, 164.0137) ft
Lower Left: (236.18235, 88.77793) ft
Lower Right: (319.07563, 88.77793) ft
Grid Horizontal Increment: 10
Grid Vertical Increment: 10
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (44.41235, 75.09635) ft
Upper Right Coordinate: (410.9588, 70.85019) ft
Lower Left Coordinate: (44.15109, 23.07379) ft
Lower Right Coordinate: (412.95051, 25.03184) ft

Number of Increments: 10
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (50, 75) ft
Right Coordinate: (368.2, 74.6) ft

Piezometric Lines

Piezometric Line 1

Coordinates

X (ft)	Y (ft)
50	87.03
176	87
262	72
368	72

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Fly Ash	12,16,14,13	297
Region 2	Sand	21,19,20,22	6360
Region 3	Silty Sand	17,18,7,9,8,6,5,25,23	3290.03
Region 4	Silt & Clay	18,19,20,7	4356.6
Region 5	Clayey Sand	15,12,16,11,10,1,2,26	1684.598
Region 6	Clayey Silt	13,17,27,31,26,15,12	1252
Region 7	Sand	31,30,29,28,3,2,26	147.0305
Region 8	Riprap	31,27,23,24,4,3,28,29,30	79.879

Points

	X (ft)	Y (ft)
Point 1	219.3	84.7
Point 2	228.7	83.1
Point 3	241.01	82.1
Point 4	259.9	73.2

Point 5	317.6	62.8
Point 6	338.6	66
Point 7	368	54.4
Point 8	349.3	69.4
Point 9	368.2	74.6
Point 10	200	91.32
Point 11	182	90
Point 12	146	72
Point 13	50	72
Point 14	50	75
Point 15	136	67
Point 16	152	75
Point 17	50	63
Point 18	50	53
Point 19	50	40
Point 20	368	40
Point 21	50	20
Point 22	368	20
Point 23	273.4	63.9
Point 24	267	68
Point 25	290	62
Point 26	255	68
Point 27	263	64
Point 28	241	80
Point 29	260	71
Point 30	267	66
Point 31	259	66

Critical Slip Surfaces

Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1 392	1.4	(252.444, 111.349)	67.762	(187.988, 90.4391)	(299.161, 62.2655)

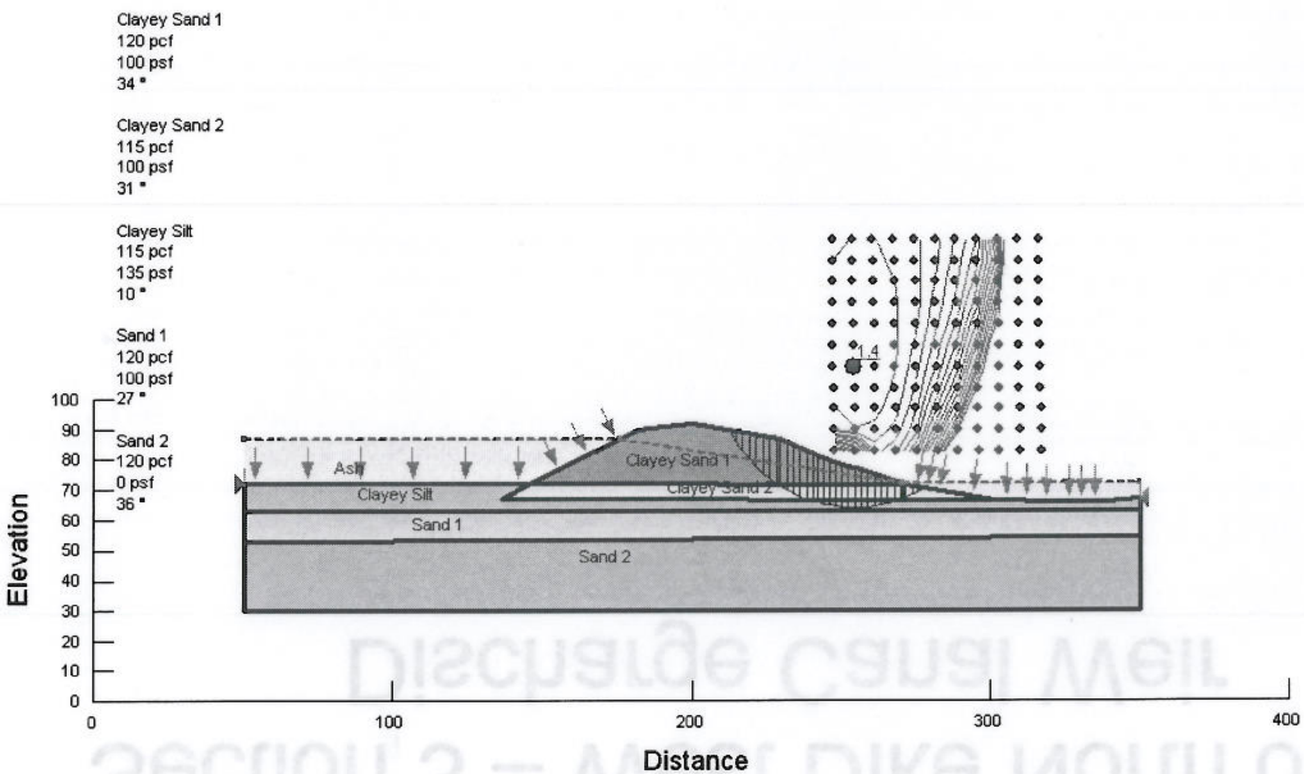
Slices of Slip Surface: 392

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	392	189.1035	87.479555	-172.54007	77.526047	52.291979	100
2	392	191.849	81.239225	186.98173	586.56306	269.52101	100
3	392	195.1094	75.36127	518.27243	1180.1643	446.45169	100
4	392	198.3698	70.600735	779.84745	1677.6439	605.57132	100
5	392	200.3719	67.990735	920.88319	1946.8013	691.99047	100

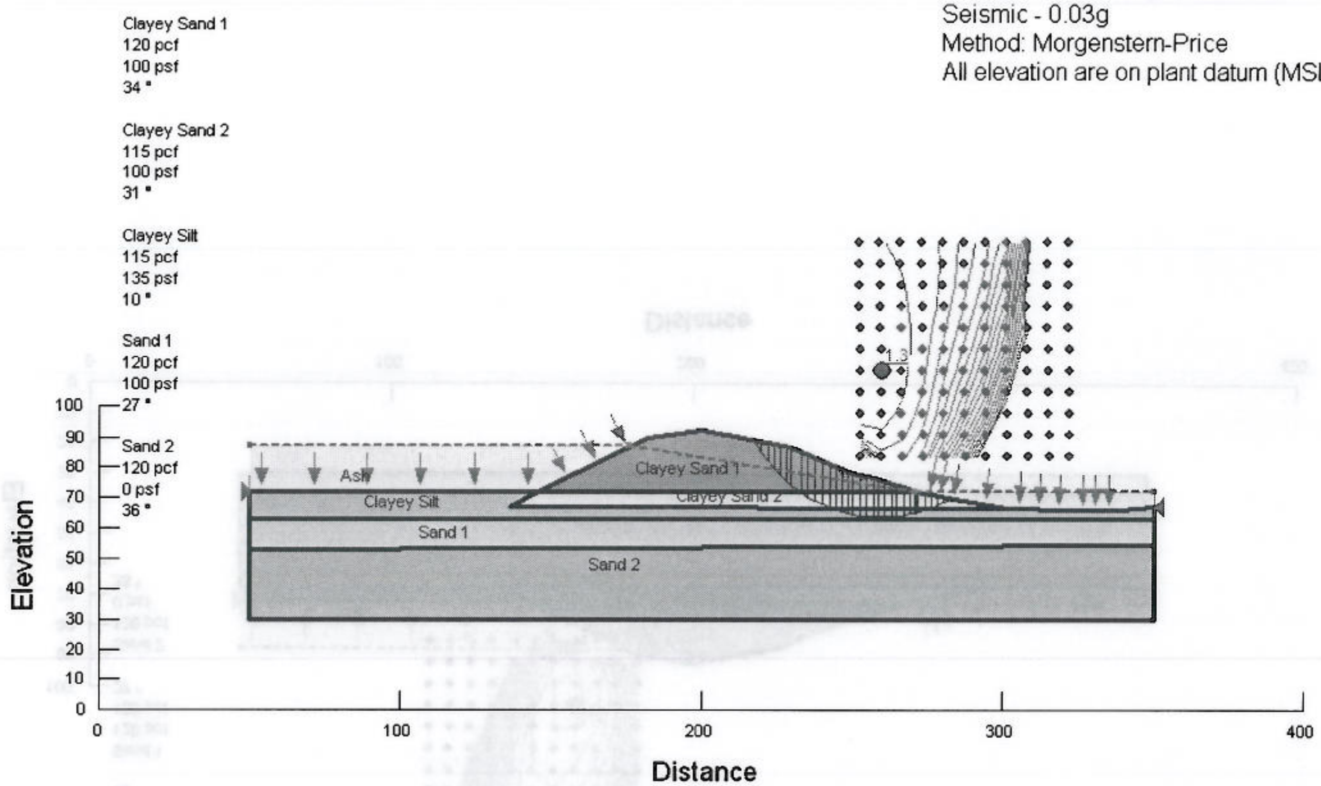
6	392	202.54245	65.63434	1044.3417	2160.1944	196.75493	625
7	392	206.41335	61.70055	1247.6675	2482.9847	713.2107	100
8	392	210.5578	58.14781	1424.2515	2757.8082	769.92937	100
9	392	214.70225	55.12527	1567.7538	2987.5809	819.73758	100
10	392	218.03725	52.989765	1664.7281	3257.9962	280.93615	308
11	392	220.86665	51.419815	1731.8904	3384.2706	291.3592	308
12	392	224	49.869505	1794.5347	3537.2218	307.28275	308
13	392	227.13335	48.51362	1845.0398	3677.054	323.03353	308
14	392	230.75	47.189415	1888.2973	3842.1673	344.51999	308
15	392	234.85	45.94482	1921.334	4030.3852	371.88263	308
16	392	238.955	44.97575	1937.1189	4198.6051	398.76102	308
17	392	241.47435	44.48195	1940.5251	4314.3559	418.57042	308
18	392	243.57135	44.190085	1935.9138	4286.3779	414.45023	308
19	392	246.8367	43.838805	1922.2899	4228.8241	406.70421	308
20	392	250.10205	43.64674	1898.7406	4149.3344	396.84042	308
21	392	253.36735	43.61254	1865.3409	4045.4762	384.41668	308
22	392	255.2464	43.64501	1842.8645	3976.9722	376.30077	308
23	392	257.2464	43.779855	1812.6818	3893.0537	366.82569	308
24	392	259.45	43.951285	1777.9739	3799.3029	356.41485	308
25	392	259.95	44.00364	1769.2431	3777.9034	354.18102	308
26	392	260.6971	44.09476	1755.4576	3721.5729	346.67918	308
27	392	261.6971	44.222065	1736.5974	3657.1564	338.64637	308
28	392	262.5	44.33886	1726.0715	3631.9297	336.05422	308
29	392	265	44.79121	1697.8254	3525.5591	322.27878	308
30	392	268.6	45.56146	1649.7587	3318.2725	294.20401	308
31	392	271.8	46.431475	1595.4615	3082.4545	262.197	308
32	392	275.3023	47.59057	1523.154	2834.4193	231.21145	308
33	392	279.1069	49.08725	1429.7574	2633.6047	212.27076	308
34	392	282.9115	50.8601	1319.1315	2385.9155	188.10281	308
35	392	286.71615	52.934405	1189.6989	2090.7634	158.88198	308
36	392	289.30925	54.498465	1092.0718	1936.8454	487.73027	100
37	392	292.29035	56.61376	960.09274	1603.2373	371.3197	100
38	392	296.871	60.273325	731.74693	1035.6793	175.47542	100

Section 3 – West Dike North of the Discharge Canal Weir

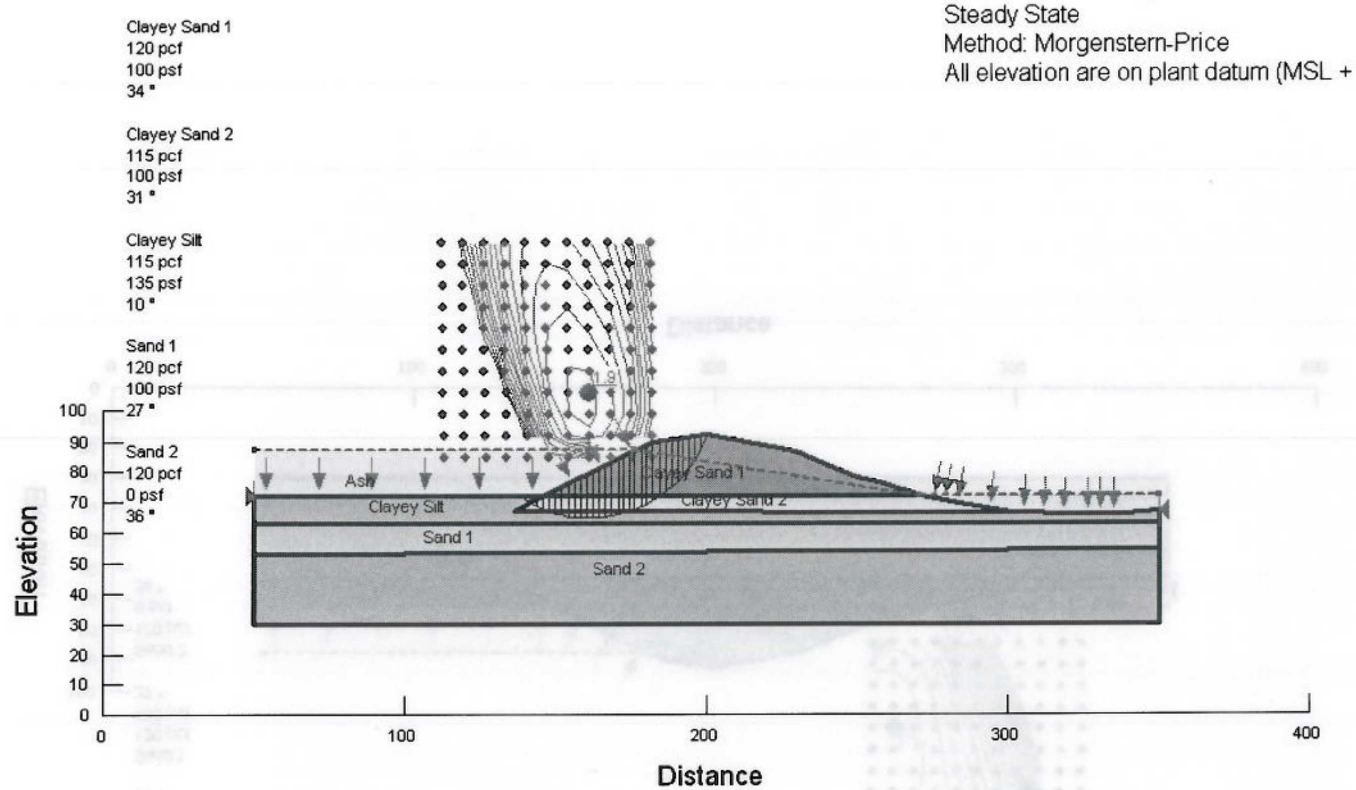
Plant Crist Ash Pond dike
Section 5 - Discharge Canal North
Steady State
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



Plant Crist Ash Pond dike
Section 5 - Discharge Canal North
Seismic - 0.03g
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)

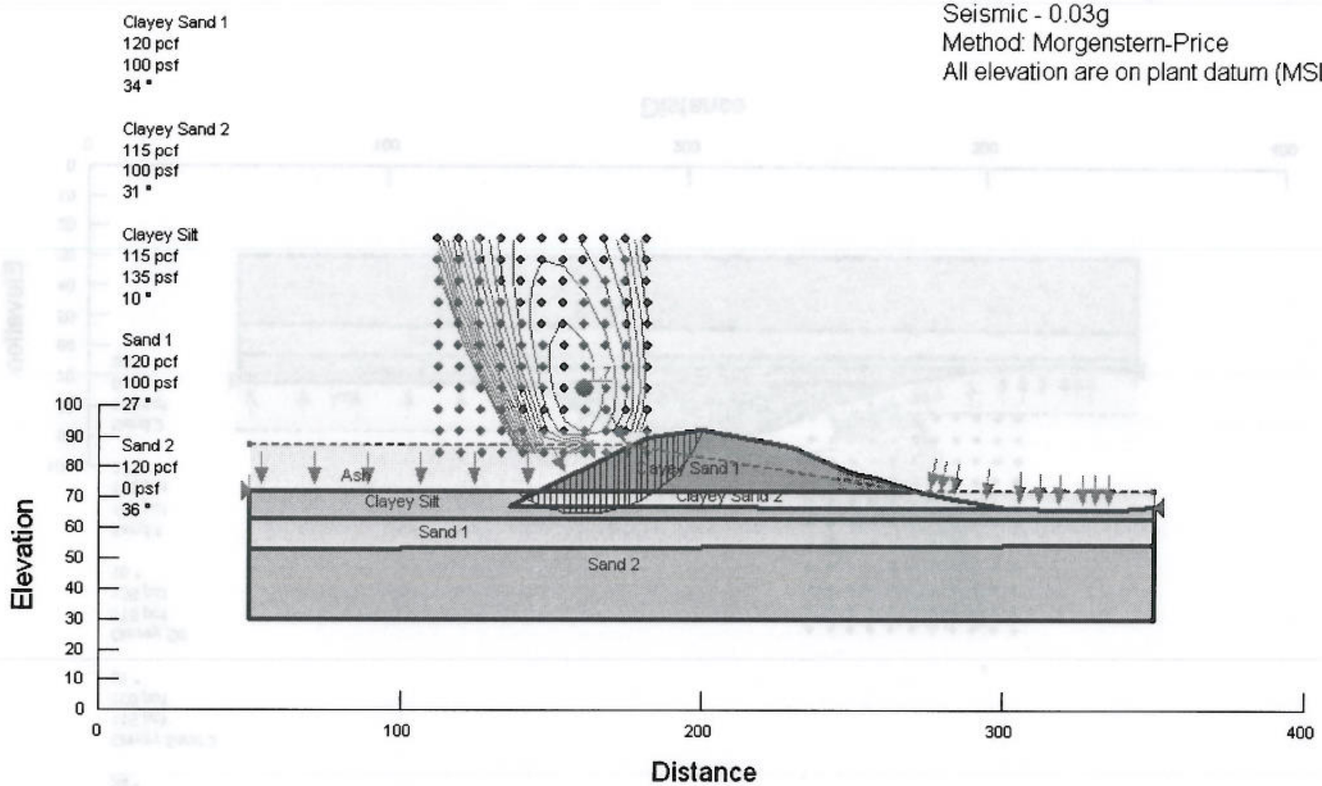


Plant Crist Ash Pond dike
Section 5 - Discharge Canal North
Steady State
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



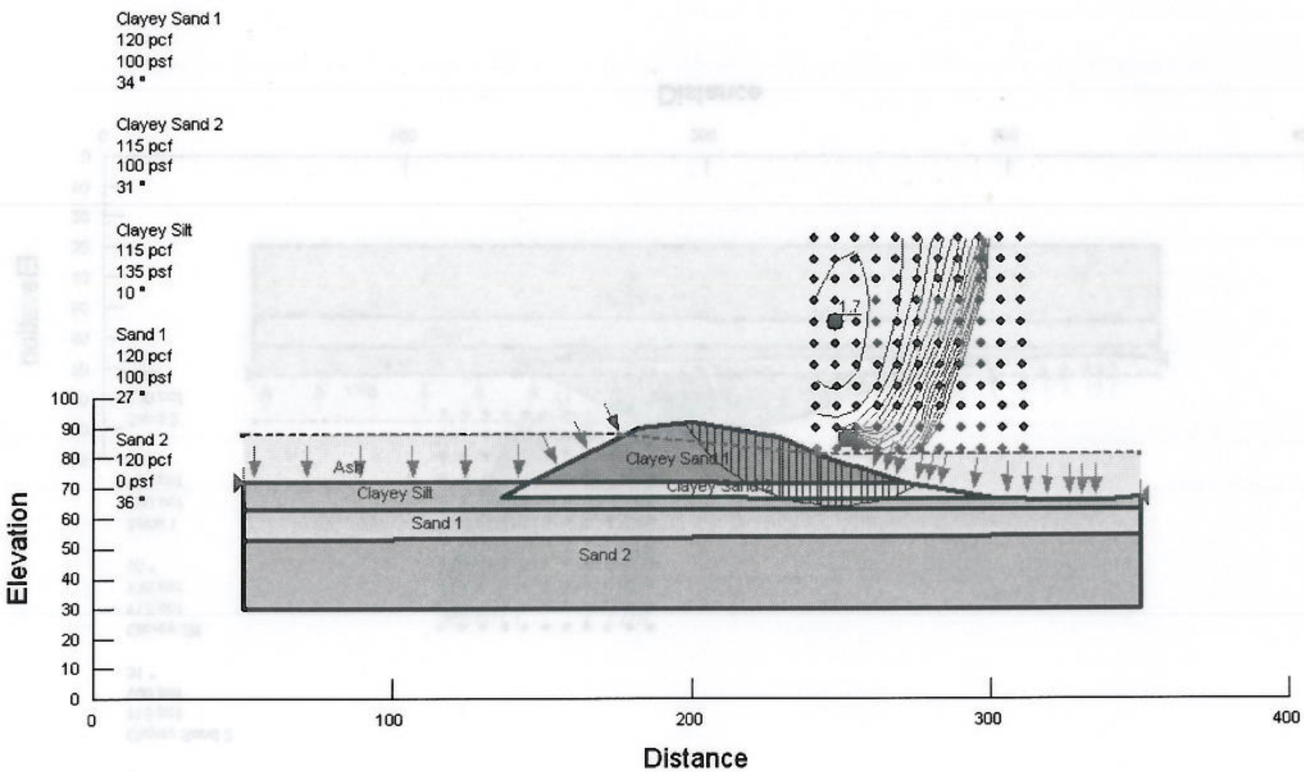
CONFIDENTIAL BUSINESS INFORMATION

Plant Crist Ash Pond dike
Section 5 - Discharge Canal North
Seismic - 0.03g
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)

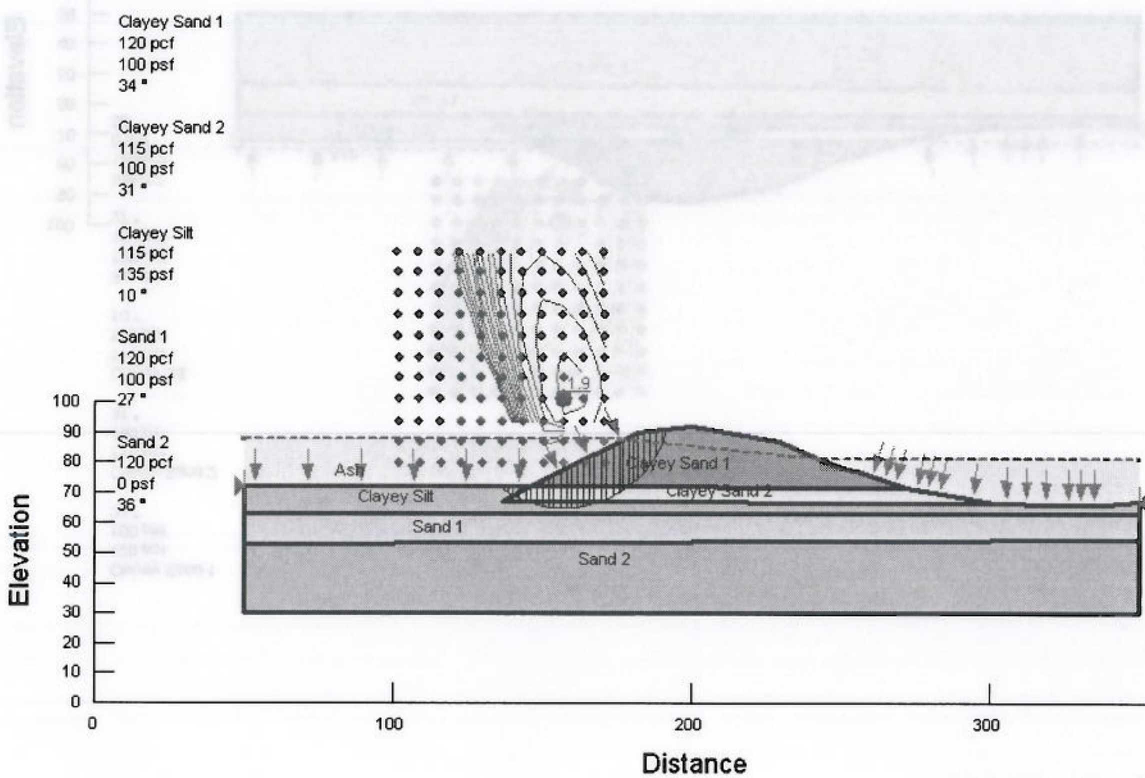


CONFIDENTIAL BUSINESS INFORMATION

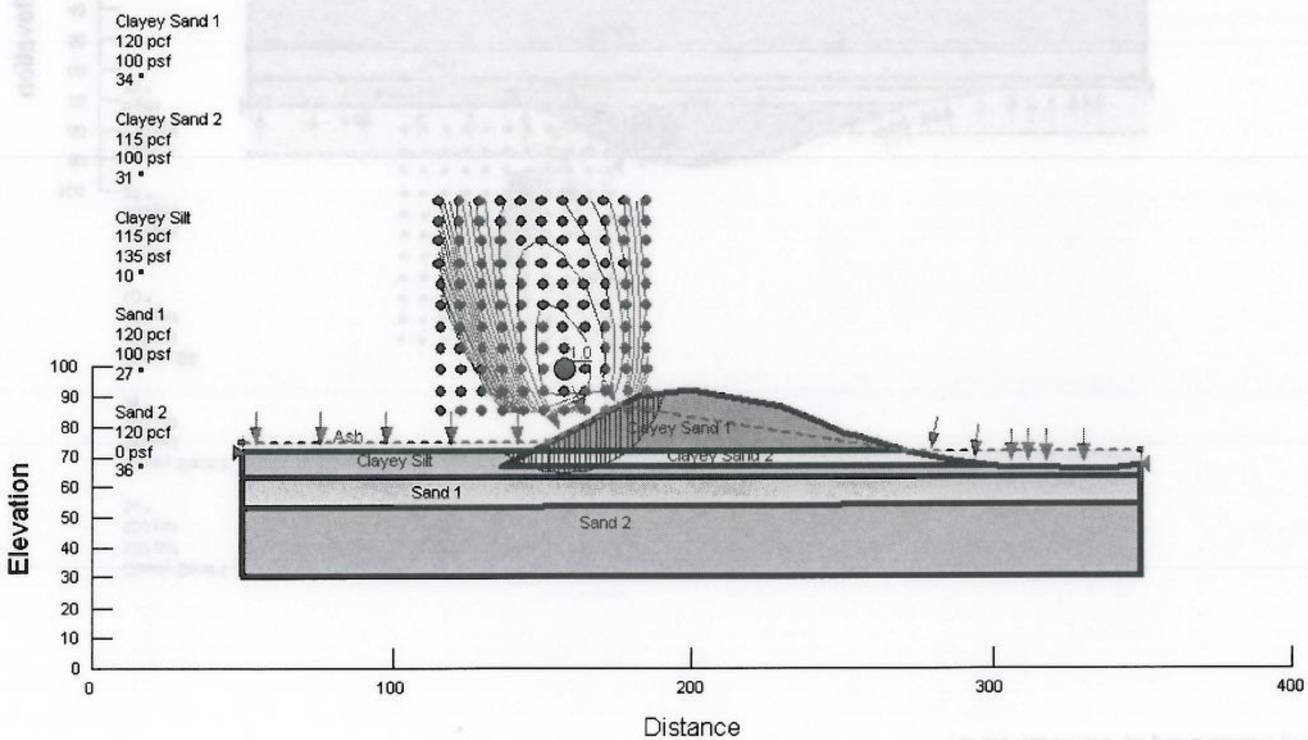
Plant Crist Ash Pond dike
Section 5 - Discharge Canal North
100 Year Flood
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



Plant Crist Ash Pond dike
Section 5 - Discharge Canal North
100 Year Flood
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



Plant Crist Ash Pond dike
Section 5 - Discharge Canal North
Rapid Draw Down
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



SLOPE/W Analysis

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File Information

Created By: Hartsfield, Terri H.
Revision Number: 44
Last Edited By: Hartsfield, Terri H.
Date: 8/15/2012
Time: 1:51:45 PM
File Name: Crist Ash Pond Disc North.gsz
Directory: T:\ESEE MAJOR PROJECTS\PROJECTS\CRIST\2012\Attorney-Client Privlege EPA Sub\Slope Stability\Ash Pond\Sect 4 - Discharge N\
Last Solved Date: 8/15/2012
Last Solved Time: 1:51:53 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

- **Kind:** SLOPE/W
- **Method:** Morgenstern-Price
- **Settings**
  - **Apply Phreatic Correction:** No
  - **Side Function**
    - **Interslice force function option:** Half-Sine
  - **PWP Conditions Source:** Piezometric Line
  - **Use Staged Rapid Drawdown:** No
- **Slip Surface**
  - **Direction of movement:** Right to Left
  - **Use Passive Mode:** No
  - **Slip Surface Option:** Grid and Radius
  - **Critical slip surfaces saved:** 1
  - **Optimize Critical Slip Surface Location:** No
  - **Tension Crack**
    - **Tension Crack Option:** (none)
- **FOS Distribution**

FOS Calculation Option: Constant

Advanced

Number of Slices: 30

Optimization Tolerance: 0.01

Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000

Optimization Convergence Tolerance: 1e-007

Starting Optimization Points: 8

Ending Optimization Points: 16

Complete Passes per Insertion: 1

Driving Side Maximum Convex Angle: 5 °

Resisting Side Maximum Convex Angle: 1 °

Materials

Clayey Sand 1

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion: 100 psf

Phi: 34 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Sand 2

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion: 100 psf

Phi: 31 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Clayey Silt

Model: Mohr-Coulomb

Unit Weight: 115 pcf

Cohesion: 135 psf

Phi: 10 °

Phi-B: 0 °

Pore Water Pressure

Piezometric Line: 1

Sand 1

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion: 100 psf

Phi: 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Sand 2

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 0 psf
Phi: 36 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (112.03625, 154.96093) ft
Lower Left: (112.91943, 84.78302) ft
Lower Right: (182.10104, 84.78302) ft
Grid Horizontal Increment: 10
Grid Vertical Increment: 10
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (40.41235, 81.09635) ft
Upper Right Coordinate: (406.9588, 76.85019) ft
Lower Left Coordinate: (40.15109, 29.07379) ft
Lower Right Coordinate: (408.95051, 31.03184) ft
Number of Increments: 10
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (50, 72) ft
Right Coordinate: (350, 67.2) ft

Piezometric Lines

Piezometric Line 1

Coordinates

X (ft)	Y (ft)
50	87.03

176	87.03
271	72
350	72

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Sand 2	17,18,19,6	7110
Region 2		13,15,11,12	297
Region 3	Clayey Silt	14,11,12,16,23,8,7,5,4	1606.8705
Region 4	Sand 1	17,16,23,6	2790
Region 5	Clayey Sand 2	14,11,20,22,4	721.1455
Region 6	Clayey Sand 1	11,15,10,9,1,2,3,21,20	1470.8655

Points

	X (ft)	Y (ft)
Point 1	229.7	86.6
Point 2	242.3	81.4
Point 3	250.4	78.1
Point 4	301.69	66.8
Point 5	322.4	66.1
Point 6	350	54.4
Point 7	339	66
Point 8	350	67.2
Point 9	200	91.93
Point 10	182	90
Point 11	146	72
Point 12	50	72
Point 13	50	75
Point 14	136	67
Point 15	152	75
Point 16	50	63
Point 17	50	53
Point 18	50	30
Point 19	350	30
Point 20	271.8	71.8
Point 21	256.8	76.5
Point 22	286.9	68.9

Point 23 350 63

Critical Slip Surfaces

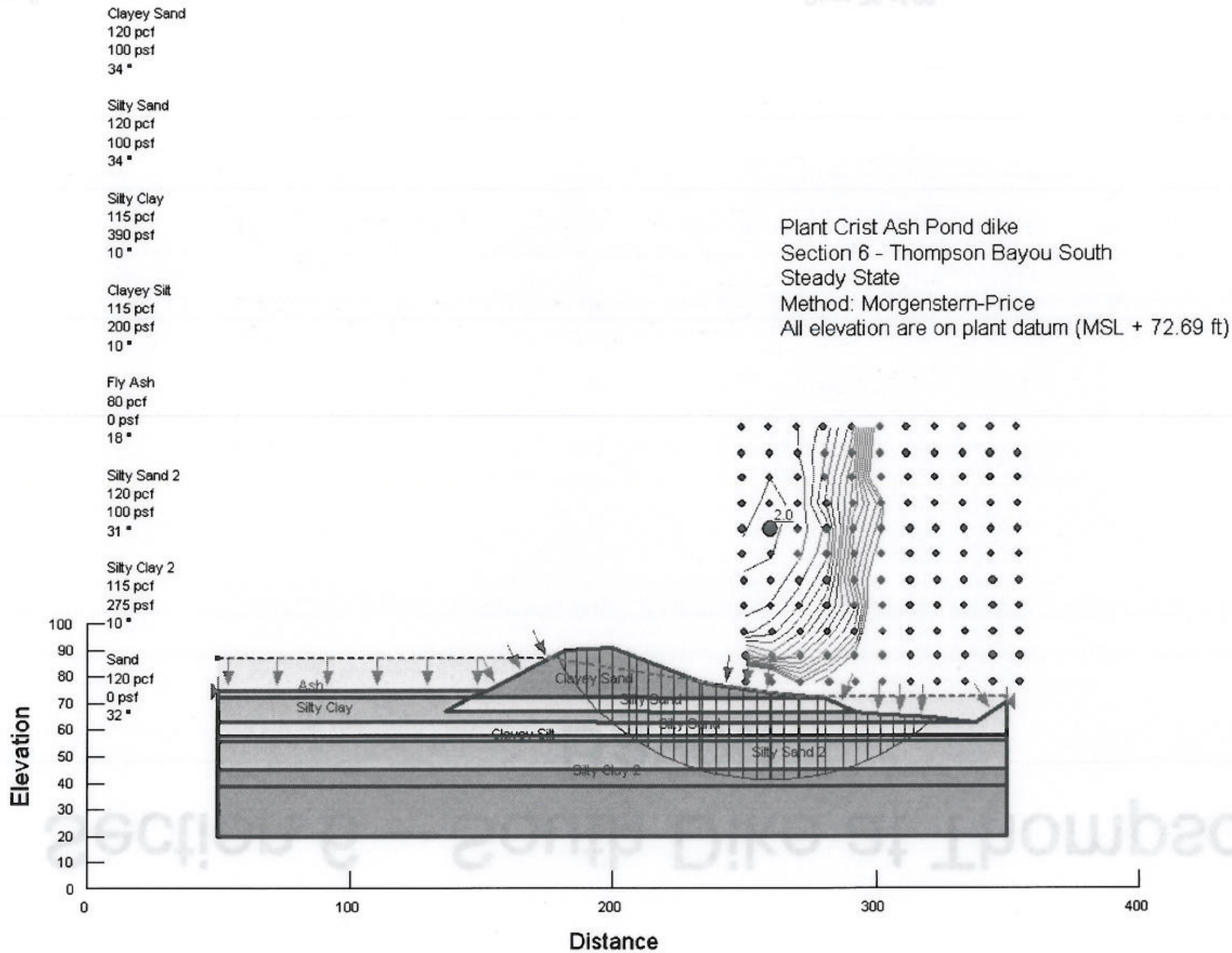
Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1 444	1.9	(161.082, 105.836)	41.13	(199.781, 91.9065)	(137.698, 72)

Slices of Slip Surface: 444

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	444	138.6286	71.393425	975.7022	1065.1922	15.779503	135
2	444	140.4896	70.24845	1047.1825	1209.1784	28.56424	135
3	444	142.56505	69.13243	1116.79	1370.8009	152.62512	100
4	444	144.855	68.062955	1183.5253	1509.5695	195.90713	100
5	444	146.7892	67.27856	1232.4828	1658.8351	256.17826	100
6	444	148.6838	66.636415	1272.5484	1765.1019	86.850467	135
7	444	150.8946	66.00411	1312.0335	1906.8745	104.88653	135
8	444	153.0223	65.51706	1342.3945	2022.1766	119.86392	135
9	444	155.06695	65.16154	1364.5774	2113.4403	132.04473	135
10	444	157.1116	64.9112	1380.2239	2186.6079	142.18727	135
11	444	159.1562	64.764105	1389.3835	2242.4384	150.41658	135
12	444	161.20085	64.719145	1392.1746	2281.8653	156.87649	135
13	444	163.2455	64.775985	1388.6399	2305.9179	161.74085	135
14	444	165.2901	64.93505	1378.7389	2315.575	165.18947	135
15	444	167.33475	65.197545	1362.3551	2311.7934	167.41157	135
16	444	169.3794	65.5655	1339.3933	2295.4253	168.57424	135
17	444	171.424	66.041845	1309.6439	2267.345	168.86854	135
18	444	173.46865	66.63054	1272.9345	2227.9968	168.40325	135
19	444	175.2455	67.230355	1235.488	2139.0075	542.88926	100
20	444	177.0152	67.933945	1181.5675	2105.0643	554.8929	100
21	444	179.0228	68.842005	1105.0803	2080.3725	586.01468	100
22	444	181.0076	69.873145	1021.1524	2041.2912	612.96123	100
23	444	183.18825	71.180995	918.02353	1933.4261	610.11541	100
24	444	185.3339	72.63841	805.87041	1752.0829	638.22837	100
25	444	187.24875	74.127925	694.01787	1585.3656	601.22164	100
26	444	189.1636	75.813535	569.96987	1399.7139	559.6694	100
27	444	191.0784	77.730885	431.41418	1190.7988	512.21141	100
28	444	192.9932	79.93216	275.14384	952.33111	456.76858	100
29	444	194.908	82.49934	96.04634	674.75031	390.34075	100
30	444	196.8443	85.618635	-117.71395	381.47877	257.31068	100

31 444	198.8021	89.628355	-387.2437	77.555614	52.311922	100

Section 6 – South Dike at Thompson Bayou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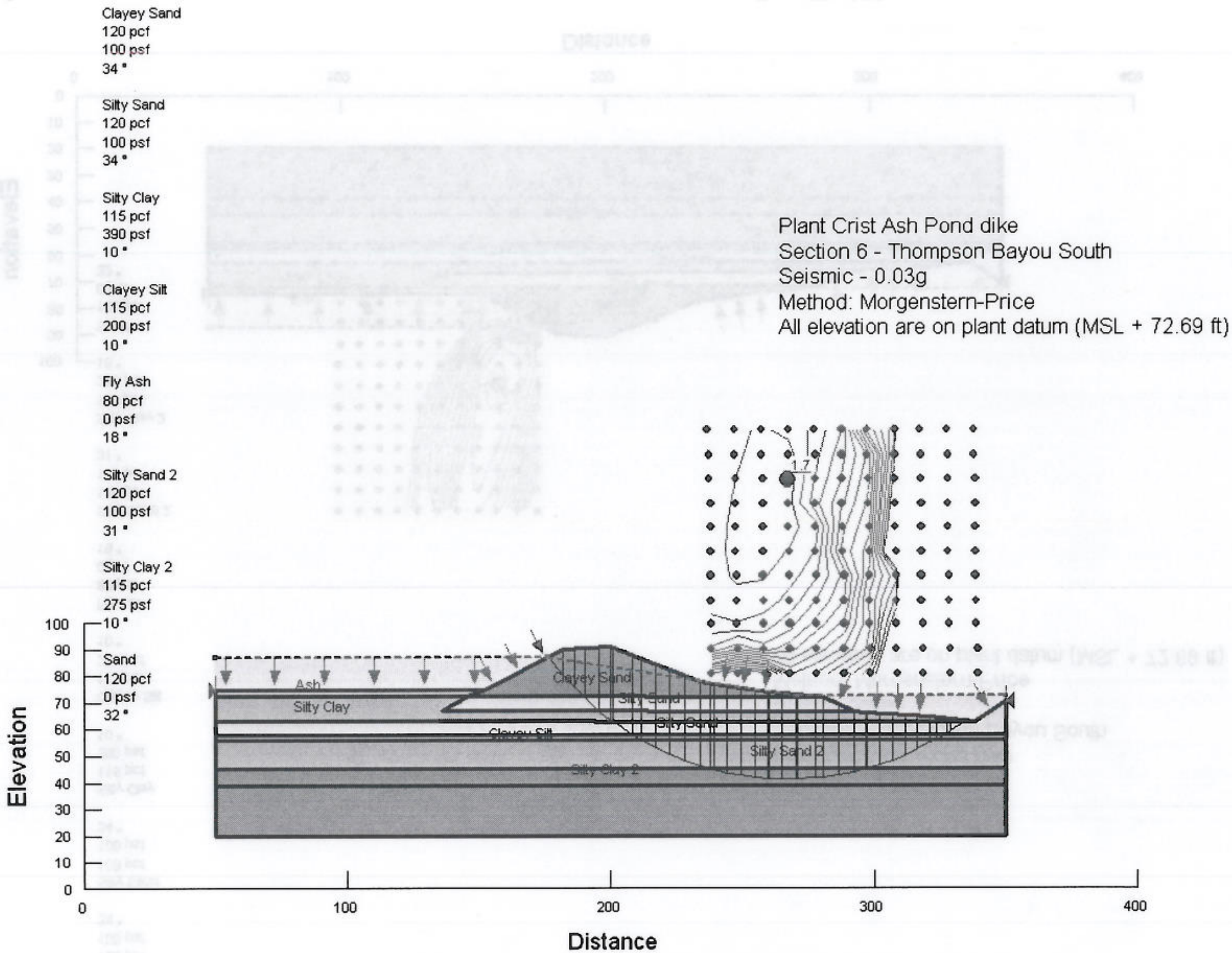
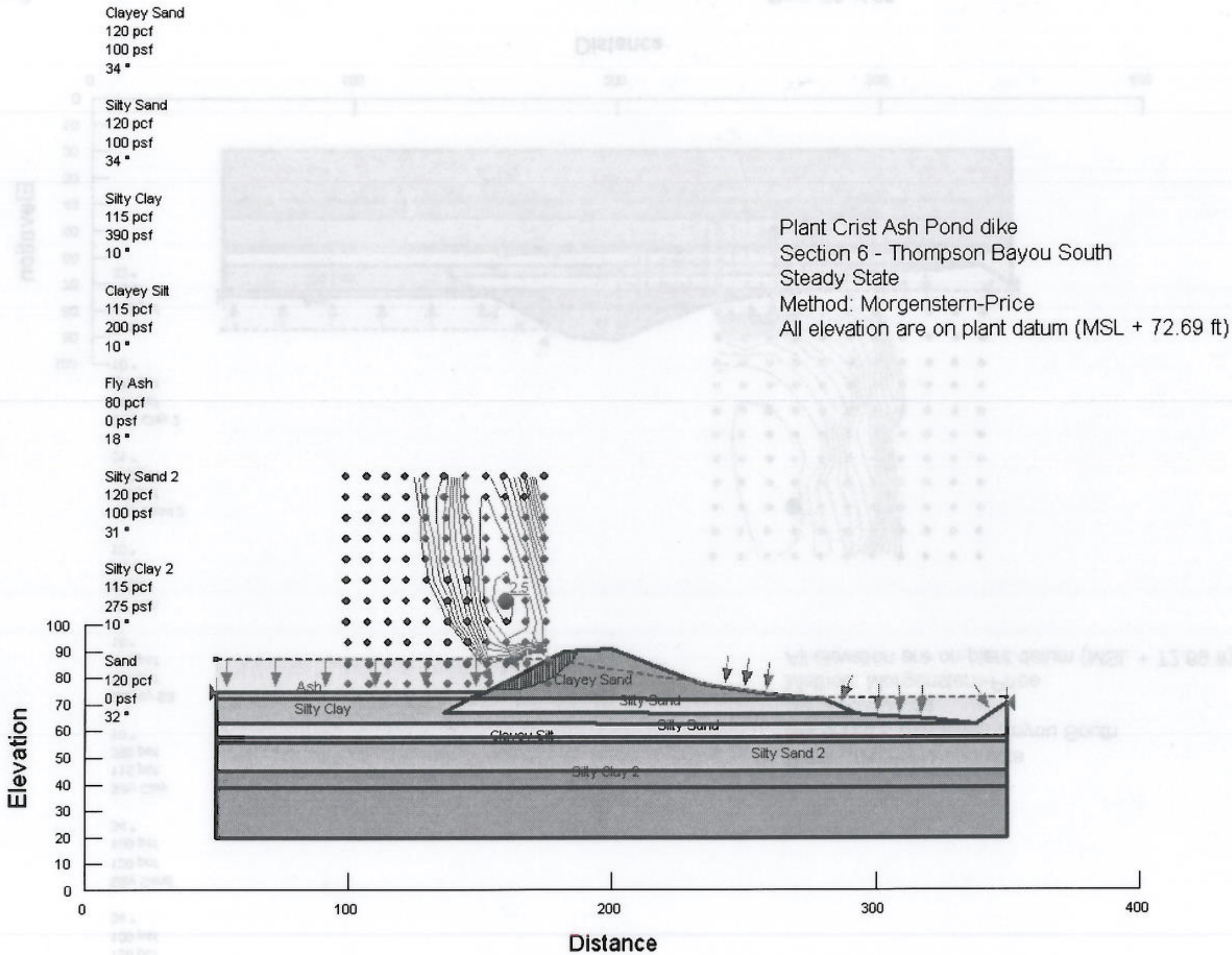
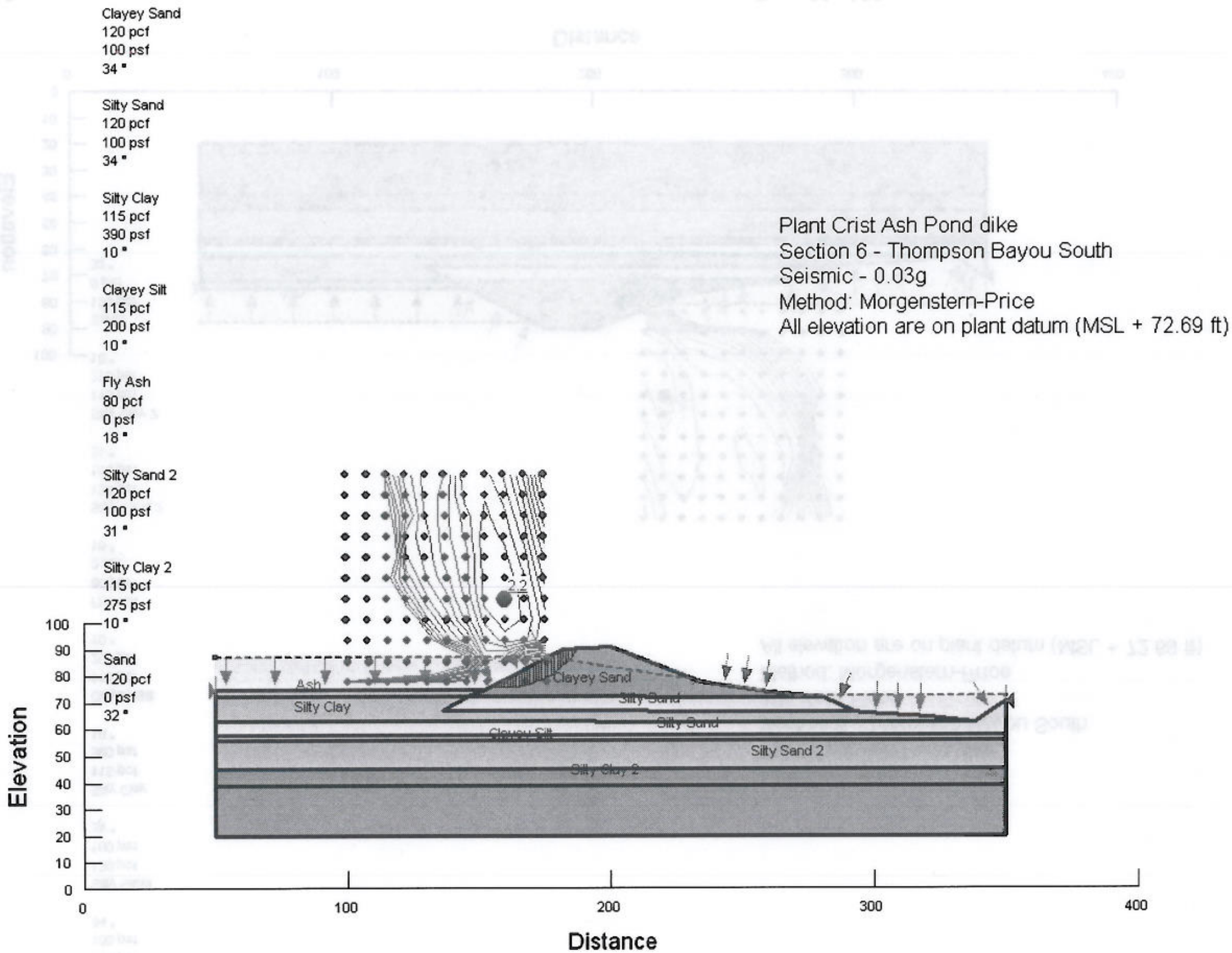
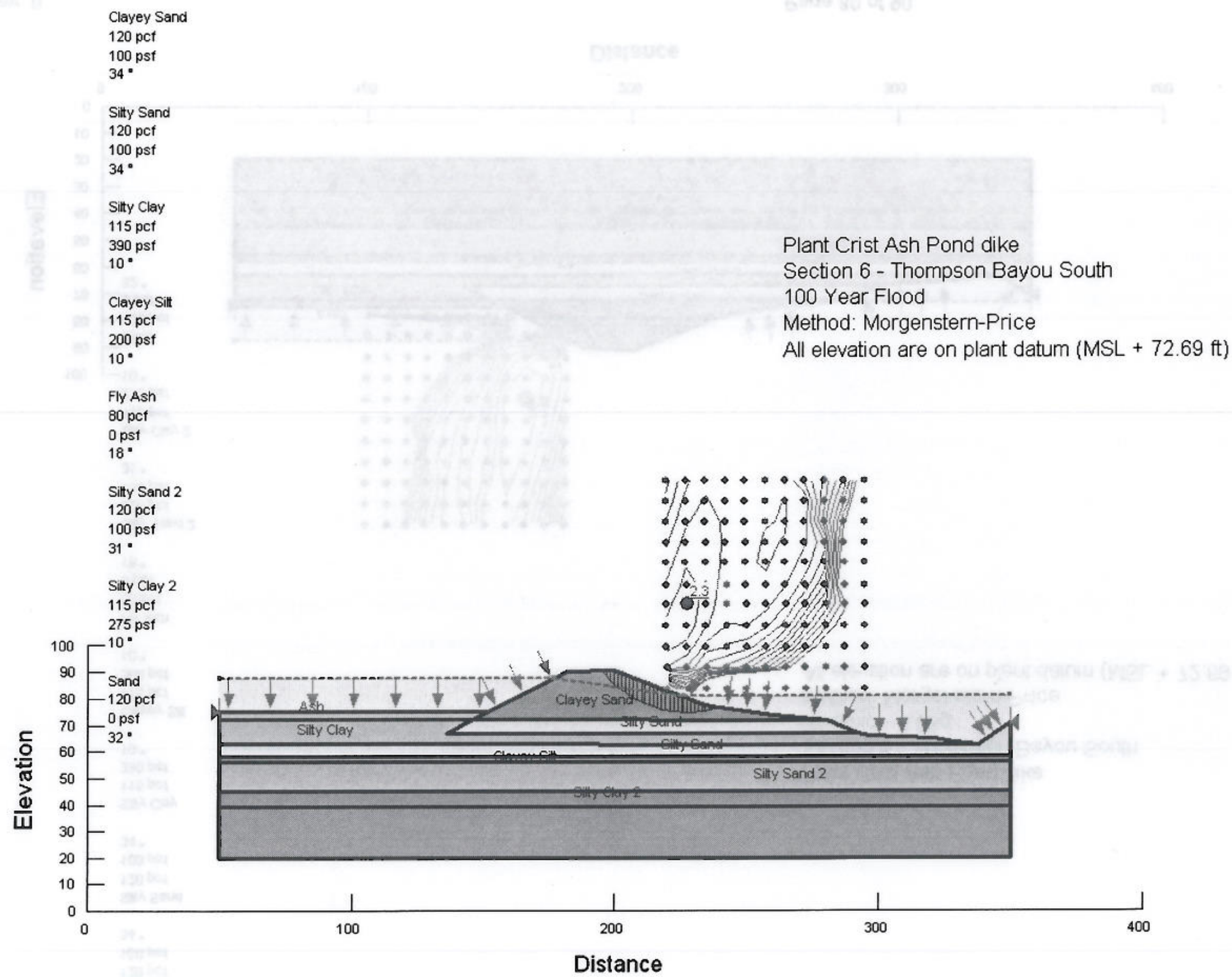
120 pcf
100 psf
34 °
Silty Sand
120 pcf
100 psf
34 °
Silty Clay
115 pcf
390 psf
10 °
Clayey Silt
115 pcf
200 psf
10 °
Fly Ash
80 pcf
0 psf
18 °
Silty Sand 2
120 pcf
100 psf
31 °
Silty Clay 2
115 pcf
275 psf
10 °
Sand
120 pcf
0 psf
32 °
Plant Crist Ash Pond dike
Section 6 - Thompson Bayou South
Steady State
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
2.0
Ash
Silty Clay
Clayey Sand
Silty Sand
Clayey Silt
Silty Sand 2
Silty Clay 2
Elevation
Distance
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400

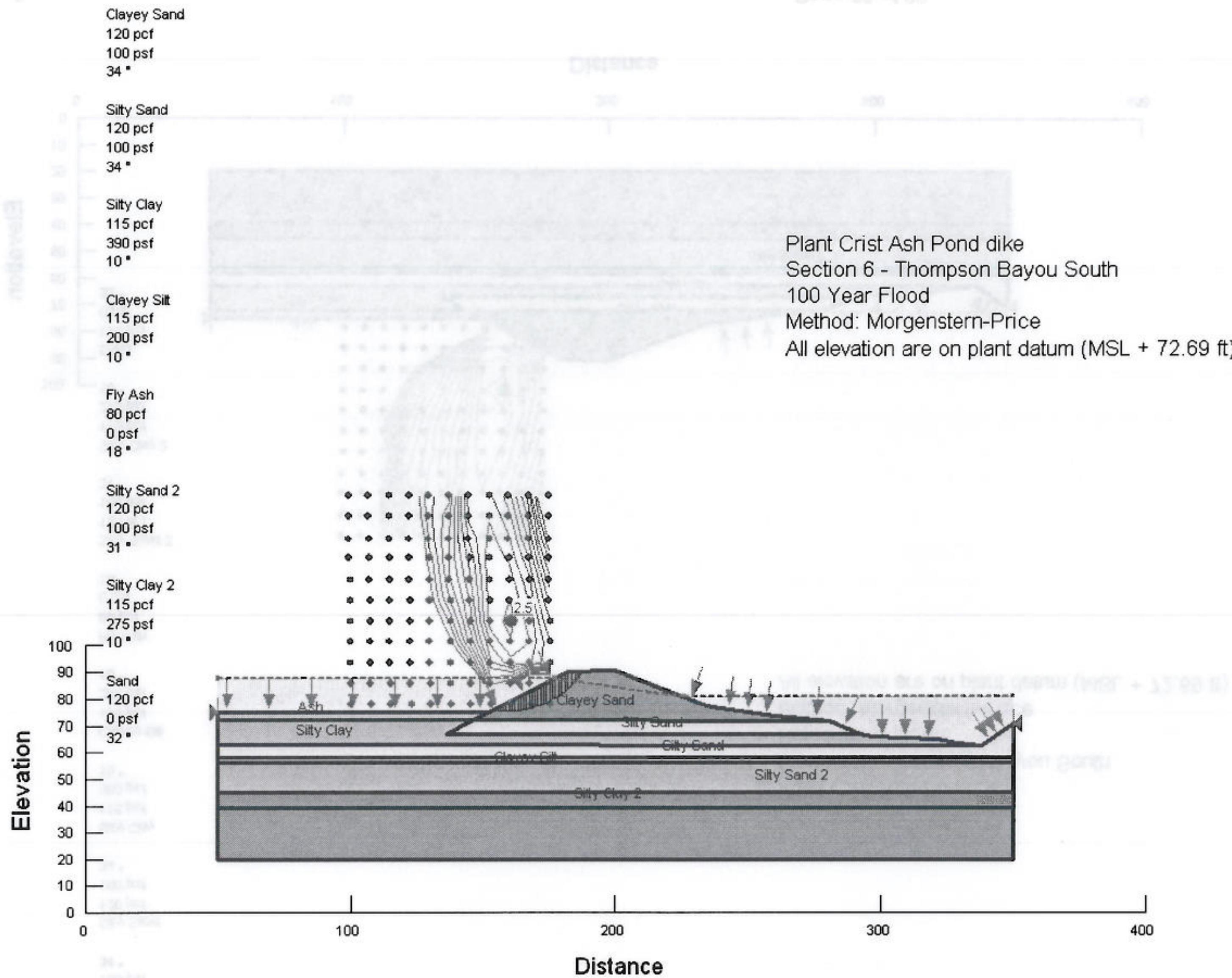

Clayey Sand
120 pcf
100 psf
34 °
Silty Sand
120 pcf
100 psf
34 °
Silty Clay
115 pcf
390 psf
10 °
Clayey Silt
115 pcf
200 psf
10 °
Fly Ash
80 pcf
0 psf
18 °
Silty Sand 2
120 pcf
100 psf
31 °
Silty Clay 2
115 pcf
275 psf
10 °
Sand
120 pcf
0 psf
32 °
Plant Crist Ash Pond dike
Section 6 - Thompson Bayou South
Seismic - 0.03g
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
1.7
Ash
Silty Clay
Clayey Sand
Silty Sand
Clayey Silt
Silty Sand 2
Silty Clay 2
Elevation
Distance
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400

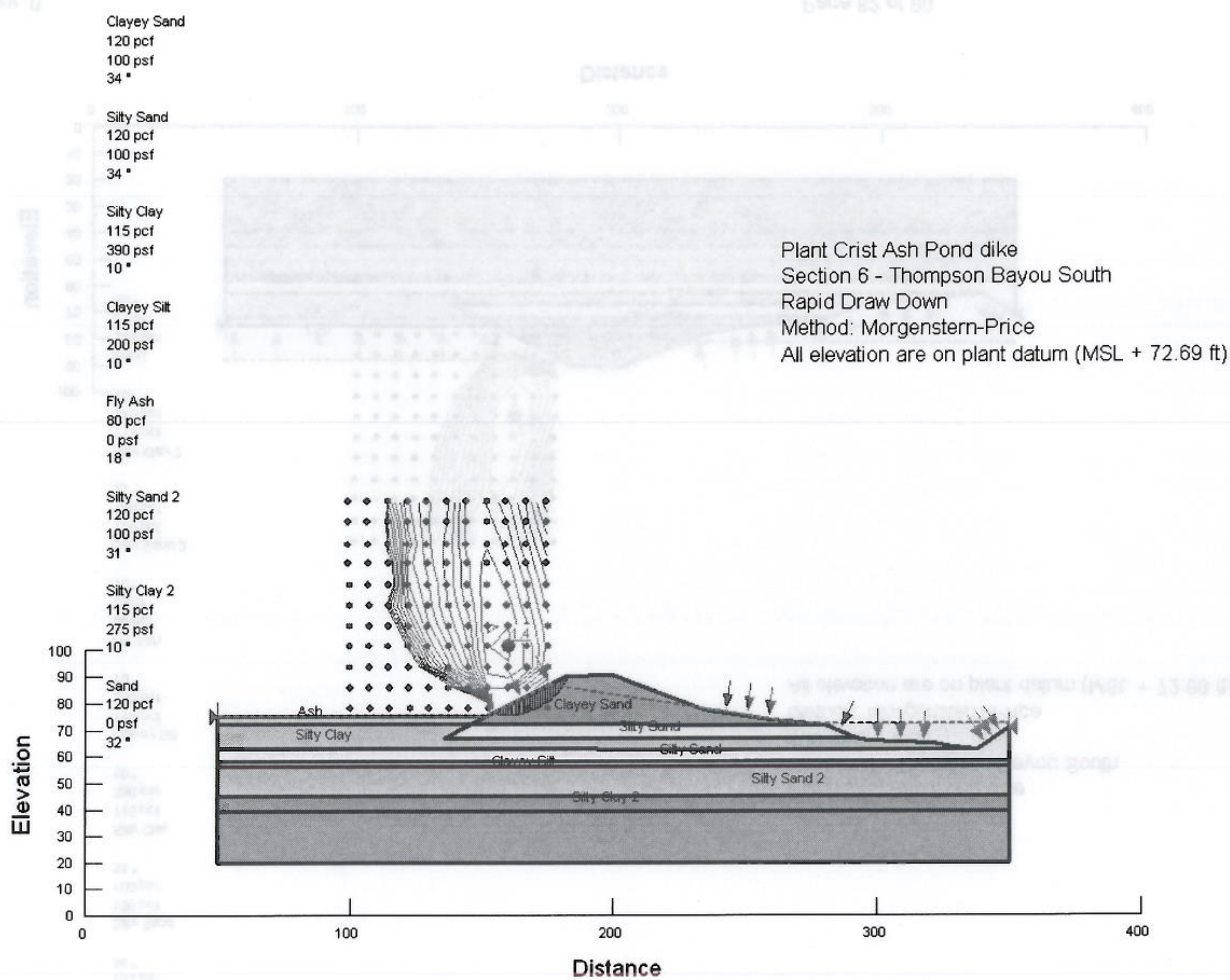

Clayey Sand
120 pcf
100 psf
34 °
Silty Sand
120 pcf
100 psf
34 °
Silty Clay
115 pcf
390 psf
10 °
Clayey Silt
115 pcf
200 psf
10 °
Fly Ash
80 pcf
0 psf
18 °
Silty Sand 2
120 pcf
100 psf
31 °
Silty Clay 2
115 pcf
275 psf
10 °
Sand
120 pcf
0 psf
32 °
Plant Crist Ash Pond dike
Section 6 - Thompson Bayou South
Steady State
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
Ash
Silty Clay
Clayey Sand
Silty Sand
Silty Sand
Clayey Silt
Silty Sand 2
Silty Clay 2
2.5
Elevation
Distance
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400



CONFIDENTIAL BUSINESS INFORMATION


Clayey Sand
120 pcf
100 psf
34 °
Silty Sand
120 pcf
100 psf
34 °
Silty Clay
115 pcf
390 psf
10 °
Clayey Silt
115 pcf
200 psf
10 °
Fly Ash
80 pcf
0 psf
18 °
Silty Sand 2
120 pcf
100 psf
31 °
Silty Clay 2
115 pcf
275 psf
10 °
Sand
120 pcf
0 psf
32 °
Plant Crist Ash Pond dike
Section 6 - Thompson Bayou South
100 Year Flood
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
2.3
Ash
Silty Clay
Clayey Sand
Silty Sand
Silty Sand
Clayey Silt
Silty Sand 2
Silty Clay 2
Elevation
Distance
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400


Clayey Sand
120 pcf
100 psf
34 °
Silty Sand
120 pcf
100 psf
34 °
Silty Clay
115 pcf
390 psf
10 °
Clayey Silt
115 pcf
200 psf
10 °
Fly Ash
80 pcf
0 psf
18 °
Silty Sand 2
120 pcf
100 psf
31 °
Silty Clay 2
115 pcf
275 psf
10 °
Sand
120 pcf
0 psf
32 °
Plant Crist Ash Pond dike
Section 6 - Thompson Bayou South
100 Year Flood
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
2.5
Ash
Silty Clay
Clayey Sand
Silty Sand
Silty Sand 2
Elevation
Distance
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400


Clayey Sand
120 pcf
100 psf
34 °
Silty Sand
120 pcf
100 psf
34 °
Silty Clay
115 pcf
390 psf
10 °
Clayey Silt
115 pcf
200 psf
10 °
Fly Ash
80 pcf
0 psf
18 °
Silty Sand 2
120 pcf
100 psf
31 °
Silty Clay 2
115 pcf
275 psf
10 °
Sand
120 pcf
0 psf
32 °
Plant Crist Ash Pond dike
Section 6 - Thompson Bayou South
Rapid Draw Down
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)
Ash
Silty Clay
Clayey Sand
Silty Sand
Silty Sand 2
Elevation
Distance
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400

SLOPE/W Analysis

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File Information

Created By: Hartsfield, Terri H.
Revision Number: 53
Last Edited By: Hartsfield, Terri H.
Date: 8/15/2012
Time: 2:45:22 PM
File Name: Crist Ash Pond Bayou.gsz
Directory: T:\ESEE MAJOR PROJECTS\PROJECTS\CRIST\2012\Attorney-Client Privlege EPA Sub\Slope Stability\Ash Pond\Sect 3 - Bayou\
Last Solved Date: 8/15/2012
Last Solved Time: 2:45:27 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- **Apply Phreatic Correction:** No
- **Side Function**
  - **Interslice force function option:** Half-Sine
- **PWP Conditions Source:** Piezometric Line
- **Use Staged Rapid Drawdown:** No

Slip Surface
- **Direction of movement:** Right to Left
- **Use Passive Mode:** No
- **Slip Surface Option:** Grid and Radius
- **Critical slip surfaces saved:** 1
- **Optimize Critical Slip Surface Location:** No
- **Tension Crack**
  - **Tension Crack Option:** (none)

CONFIDENTIAL BUSINESS INFORMATION

FOS Distribution
  FOS Calculation Option: Constant
Advanced
  Number of Slices: 30
  Optimization Tolerance: 0.01
  Minimum Slip Surface Depth: 0.1 ft
  Optimization Maximum Iterations: 2000
  Optimization Convergence Tolerance: 1e-007
  Starting Optimization Points: 8
  Ending Optimization Points: 16
  Complete Passes per Insertion: 1
  Driving Side Maximum Convex Angle: 5 °
  Resisting Side Maximum Convex Angle: 1 °

Materials

Clayey Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 100 psf
Phi: 34 °
Phi-B: 0 °
Pore Water Pressure
  Piezometric Line: 1

Silty Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 100 psf
Phi: 34 °
Phi-B: 0 °
Pore Water Pressure
  Piezometric Line: 1

Silty Clay

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 390 psf
Phi: 10 °
Phi-B: 0 °
Pore Water Pressure
  Piezometric Line: 1

Clayey Silt

Model: Mohr-Coulomb
Unit Weight: 115 pcf

Cohesion: 200 psf
Phi: 10 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Fly Ash

Model: Mohr-Coulomb
Unit Weight: 80 pcf
Cohesion: 0 psf
Phi: 18 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Silty Sand 2

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 100 psf
Phi: 31 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Silty Clay 2

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 275 psf
Phi: 10 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Sand

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 0 psf
Phi: 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (99.08672, 155.84778) ft
Lower Left: (100.04696, 77.76695) ft
Lower Right: (175.26482, 77.76695) ft

Grid Horizontal Increment: 10
Grid Vertical Increment: 10
Left Projection Angle: 0 °
Right Projection Angle: 0 °

Slip Surface Radius

Upper Left Coordinate: (44.35387, 82.09635) ft
Upper Right Coordinate: (351.30105, 77.85019) ft
Lower Left Coordinate: (44.13509, 30.07379) ft
Lower Right Coordinate: (352.96891, 32.03184) ft
Number of Increments: 10
Left Projection: No
Left Projection Angle: 135 °
Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (50, 75) ft
Right Coordinate: (350, 70.7) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	50	87.03
	176	87.03
	271	72
	350	72

Seismic Loads

Horz Seismic Load: 0
Vert Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Clayey Silt	17,18,19,6	600
Region 2	Fly Ash	13,15,11,12	297
Region 3	Clayey Sand	11,15,10,9,1,2,3,21,20	1200.28
Region 4	Silty Sand	14,11,20,22	727.525
Region 5	Silty Clay	12,11,14,22,4,5,7,8,16	1523.365

Region 6	Silty Sand	16,17,6,23,8	1500.43
Region 7	Silty Sand 2	18,19,25,24	3300
Region 8	Silty Clay 2	24,25,27,26	1800
Region 9	Sand	26,27,29,28	5700

Points

	X (ft)	Y (ft)
Point 1	234.3	77.7
Point 2	239.3	76.7
Point 3	260.3	73.7
Point 4	296.8	65.7
Point 5	321.3	64.7
Point 6	350	58
Point 7	329	63.7
Point 8	338.2	62.7
Point 9	200	90.7
Point 10	182	90
Point 11	146	72
Point 12	50	72
Point 13	50	75
Point 14	136	67
Point 15	152	75
Point 16	50	63
Point 17	50	58
Point 18	50	56
Point 19	350	56
Point 20	280.8	71.7
Point 21	270.3	72.7
Point 22	292.3	66.7
Point 23	350	70.7
Point 24	50	45
Point 25	350	45
Point 26	50	39
Point 27	350	39
Point 28	50	20
Point 29	350	20

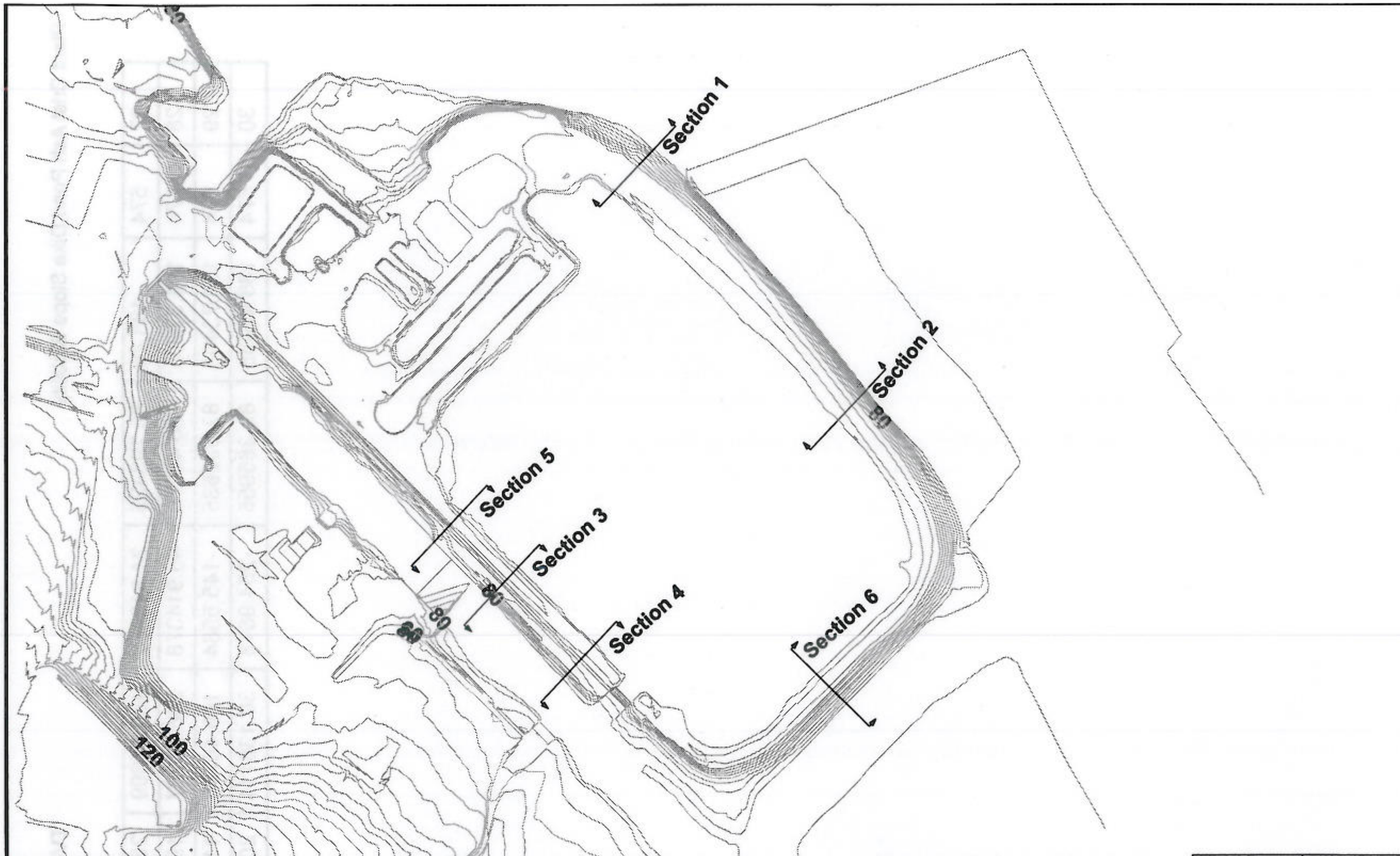
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	574	2.5	(159.837, 108.999)	33.466	(187.535, 90.2152)	(154.068, 76.0339)

Slices of Slip Surface: 574

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	574	154.6162	75.947315	691.55696	728.23488	24.739563	100
2	574	155.7128	75.7926	701.20919	793.80363	62.455736	100
3	574	156.8094	75.67468	708.57596	852.20193	96.876938	100
4	574	157.906	75.593165	713.65885	903.00044	127.71252	100
5	574	159.0026	75.54779	716.48728	945.8963	154.73834	100
6	574	160.0992	75.538405	717.07149	980.72204	177.83454	100
7	574	161.1958	75.56498	715.41749	1007.5507	197.04634	100
8	574	162.2924	75.6276	711.51385	1026.3094	212.33224	100
9	574	163.389	75.72647	705.34385	1037.3237	223.92324	100
10	574	164.4856	75.86192	696.89212	1040.9583	232.07559	100
11	574	165.5822	76.034395	686.12399	1037.698	237.13964	100
12	574	166.6788	76.24448	673.01392	1027.9628	239.41604	100
13	574	167.7754	76.492905	657.5109	1012.2844	239.29773	100
14	574	168.87205	76.78056	639.56822	991.21176	237.18657	100
15	574	169.9687	77.108515	619.10262	965.22127	233.45998	100
16	574	171.0653	77.47802	596.04794	934.88452	228.54816	100
17	574	172.1619	77.890555	570.30149	900.52512	222.73865	100
18	574	173.2585	78.347865	541.76374	862.31452	216.21423	100
19	574	174.3551	78.851995	510.30326	820.64579	209.32868	100
20	574	175.4517	79.40534	475.77646	775.44038	202.12587	100
21	574	176.61825	80.05305	429.25542	738.09542	208.31521	100
22	574	177.8319	80.79131	371.20992	710.47806	228.83925	100
23	574	179.02275	81.58792	309.74091	676.33369	247.26995	100
24	574	180.21365	82.461885	243.45133	634.3468	263.66232	100
25	574	181.40455	83.421165	171.83326	583.30996	277.54453	100
26	574	182.48335	84.367615	102.12987	507.69458	273.55685	100

27	574	183.45	85.293425	34.813258	408.57699	252.10682	100
28	574	184.53355	86.43173	-46.914378	296.06237	199.69659	100
29	574	185.73405	87.822635	-145.5584	169.48768	114.32089	100
30	574	186.93455	89.385955	-254.9618	30.136111	20.327064	100



PLANT CRIST ASH POND
CALC # TV-CR-FPC30795-001
LOCATION OF CROSS SECTIONS

BY	CHK'D	DATE

Southern Company Generation Engineering and Construction Services FOR

Gulf Power Company

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
NONE	**FIGURE 1**	1	FINAL	0

ANSI B: 17x11 CIVIL 2010

Southern Company Services, Inc.
Soil Boring Log

Project: PLANT CRIST	HOLE No. APD-4
Location: ASH POND DIKE	
Purpose: STABILITY ANALYSIS	SHEET 1 OF 1
Position: E 1,112,743.6 N 578,242.1	Surface Elevation: 90.50
Rig Type: MOBILE	Contractor: PENSACOLA TESTING; Driller: MATT AND ROBERT
Drilling Method: WASH BORING	Boring Depth: 46.0; No. SPT: 8; No. UD Samples: 0
Date Started: 2/4/92; Date Completed: 2/4/92	Logged By: JOEL MILLER; Date Logged: 2/4/92
Hole Closure: GROUT	

ELEVN.	DEPTH (FT)	SOIL DESCRIPTION	SPT VALUES BLOWS/6" (N)	COMMENTS
90.50	0			
	5	Red-brown slightly clayey fine SAND.	6/13/21 (34)	
84.50	10	Red-brown clayey fine SAND.	4/4/6/8 (14)	
79.50	15	Red-tan-gray clayey fine SAND.	10/13/17/17 (34)	DIKE FILL
74.50	20	Tan-brown slightly clayey fine to medium SAND	4/3/4/5 (9)	
67.50	25	Brown-gray slightly silty fine to medium SAND (5" wood fragments at top of spoon).	2/8/11/12 (23)	
	30	Brown-gray slightly silty fine to medium SAND with no wood fragments	4/6/7/7 (14)	
58.50		Bottom of Dike Fill At 32'		
	35	Soft Organic CLAY and SILT.		UD ATTEMPT @ 34-36'.NO SAMPLE.
53.50	40	Medium gray clayey fine SAND	1/1/1/1 (2)	
46.50	45	12" medium gray fine sandy CLAY.	WH/1/1/10 (11)	
45.50		12" light gray silty CLAY.		
44.90		3" orange-tan slightly clayey fine SAND.		
		Bottom of Hole @ 46'		

TEST RESULTS: MOISTURE CONTENT (%), LIQUID LIMIT (%), PLASTIC LIMIT (%), K (cm/s)

SS = Split Spoon; ST = Shelby Tube; D = Dennison; P = Pitcher; O = Other

while drilling; after drilling; after 24 hours

Hole No. APD-4

Southern Company Services, Inc.
Soil Boring Log

Project: **PLANT CRIST**
Location: **ASH POND DIKE**
Purpose: **STABILITY ANALYSIS**

HOLE No. APD-6

SHEET 1 OF 1

Position: **E 1,112,893.9 N 578,922.7**		Surface Elevation: **91.00**			
Rig Type: **MOBLIE**		Contractor: **PENSACOLA TESTING**		Driller: **MATT & ROBERT**	
Drilling Method: **WASH BORING**		Boring Depth: **46.0**	No. SPT: **8**	No. UD Samples: **0**	
Date Started: **2/4/92**	Date Completed: **2/4/92**	Logged By: **JOEL MILLER**		Date Logged: **2/4/92**	
Hole Closure: **GROUT**					

WATER TABLE	DEPTH AND ELEVN. (FT)	SYMBOLIC LOG	SOIL DESCRIPTION	SAMPLE NUMBER	SAMPLE LEGEND	RECOVERY (%)	SPT VALUES BLOWS/6" (N)	COMMENTS	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	K (cm/s)
	0 / 91.00		Red-brown clayey fine SAND with occasional clay lense				4/7/6/7 (13)	DIKE FILL				
	85.00		Brown-gray slightly clayey fine to medium SAND with occasional clay lense.				3/6/17/26 (43)	OCCASIONAL CLAY LENSES				
							10/13/14/18 (32)					
							8/9/11/15 (26)					
	69.00		Tan-Medium gray clayey fine to medium SAND (may be very slightly organic).				3/5/3/3 (6)	CLAY LENSE @ 25'				
	64.00		Bottom of Dike Fill At 27'					BOTTOM OF DIKE @ 27'				
			Soft Organic CLAY and SILT					UD ATTEMPT @ 29-31'. NO SAMPLE.				
	59.00		Medium gray clayey fine SAND to sandy CLAY with few wood fragments.				WH/1/1/2 (3)	UD ATTEMPT @ 36-38'. NO SAMPLE.				
	52.00 / 40		Medium gray slightly clayey to slightly silty fine to medium SAND with very few wood fragments				2/1/2 (3)					
	45						11/4/2/4 (6)	BOTTOM 8" OF HOLE SHOWED ORGANICS AND WOOD FRAGMENTS.				
			Bottom of Hole @ 46'									

SS = Split Spoon; ST = Shelby Tube; D = Dennison; P = Pitcher; O = Other

▽ while drilling; ▼ after drilling; ☑ after 24 hours

Hole No. **APD-6**

Southern Company Services, Inc.
Soil Boring Log

Project: PLANT CRIST			**HOLE No. APD-7**
Location: ASH POND DIKE			
Purpose: STABILITY ANALYSIS			SHEET 1 OF 1
Position: E 1,112,664.4 N 579,207.2	Surface Elevation: 91.00		
Rig Type: MOBILE	Contractor: PENSACOLA TESTING	Driller: MATT & ROBERT	
Drilling Method: WASH BORING	Boring Depth: 46.0	No. SPT: 8	No. UD Samples: 1
Date Started: 2/3/92	Date Completed: 2/3/92	Logged By: JOEL MILLER	Date Logged: 2/3/92
Hole Closure: GROUT			

ELEVN. (FT)	DEPTH (FT)	SOIL DESCRIPTION	SPT VALUES BLOWS/6" (N)	COMMENTS	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	K (cm/s)
91.00	0	Red-brown slightly clayey Fine to medium grained SAND.						
	5		4/7/10/10 (20)	DIKE FILL				
85.00		Red-brown clayey SAND to sandy CLAY with some plastic clay lenses						
	10		7/8/14/19 (33)					
80.00		Red-brown slightly clayey fine to medium grained SAND to tan clean SAND		UD ATTEMPT @ 11'. MATERIAL TOO HARD. NO SAMPLE				
76.00	15		8/9/9/8 (17)	UD ATTEMPT @ 16'. OBTAINED 14-16" OF SAMPLE	14	NP	NP	SM
		Red-tan-gray slightly silty medium grained SAND with few small shells.						
	20		2/1/2/2 (4)					
70.00								
	25	Medium gray slightly silty fine to medium grained SAND with lense of wood fragments	3/4/3/5 (8)	UD ATTEMPT @27.5'. TOO HARD (WOOD?). NO SAMPLE				
64.00		^Bottom of Dike Fill at 27'						
	30	Soft Organic CLAY and SILT		UD ATTEMPT @29-31'.TOO SOFT. NO SAMPLE				
				REDRILL HOLE TO 32'				
57.00	35	Medium gray silty clayey fine SAND	1/2/1/0 (1)	UD ATTEMPT 32-34'. TOO SOFT. NO SAMPLE				
	40		0/1/2/3 (5)					
50.00								
	45	Medium gray clayey fine to medium SAND	2/2/4/5 (9)					
		Bottom of Hole @ 46'						

SS = Split Spoon; ST = Shelby Tube; D = Dennison; P = Pitcher; O = Other

▽ while drilling — ▼ 8.0 after drilling — ☑ after 24 hours

Hole No. **APD-7**

FILE NAME: PLANT CRIST ASH POND DAM
FILE NUMBER: CRIST1D.DAT

RECORD OF DILATOMETER TEST NO. 1D-1
USING DATA REDUCTION PROCEDURES IN MARCHETTI (ASCE,J-GED,MARCH 80)
KO IN SANDS DETERMINED USING SCHMERTMANN METHOD (1983)
PHI ANGLE CALCULATION BASED ON DURGUNOGLU AND MITCHELL (ASCE,RALEIGH CONF,JUNE 75)
PHI ANGLE NORMALIZED TO 2.72 BARS USING BALISH'S EXPRESSION (ASCE,J-GED,NOV 76)
MODIFIED MAYNE AND KULHAWY FORMULA USED FOR OCR IN SANDS (ASCE,J-GED,JUNE 82)

LOCATION: ASH POND DAM
PERFORMED - DATE: 18 MARCH 1992
BY: GILLIAM

CALIBRATION INFORMATION:
DELTA A = .01 BARS   DELTA B = .45 BARS   GAGE 0 = .15 BARS   GWT DEPTH= 1.85 M
ROD DIA.= 3.70 CM   FR.RED.DIA.= 5.40 CM   ROD WT.= 6.50 KG/M   DELTA/PHI= .50   BLADE T=15.00 MM

1 BAR = 1.019 KG/CM2 = 1.044 TSF = 14.51 PSI   ANALYSIS USES H2O UNIT WEIGHT = 1.000 T/M3

DEPTH (ft)	Z (M)	THRUST (KG)	A (BAR)	B (BAR)	ED (BAR)	ID	KD	UO (BAR)	GAMMA (T/M3)	SV (BAR)	PC (BAR)	OCR	KO	CU (BAR)	PHI (DEG)	M (BAR)	SOIL TYPE	
	*****	******	*****	*****	*****	*****	*****	******	******	******	*****	*****	*****	*****	*****	******	***********	
20.5'	6.30	125.	.60	1.80	26.	31.76	.39	.437	1.700	.060	.00	.08	.11		36.6	21.6	SAND	
									P01 =	.42	P0 =	.46	P1 =	1.20				
	6.60	110.	.90	3.00	60.	8.13	2.63	.466	1.700	.081	.13	1.64	.53		31.4	20.0	SAND	∅=31°
	6.90	225.	1.15	4.50	105.	8.20	3.65	.496	1.700	.101	.24	2.33	.61		33.9	171.2	SAND	C=0 psi
	7.20	300.	1.85	4.05	63.	1.66	9.12	.525	1.600	.120	1.45	12.05	1.34		30.9	152.9	SANDY SILT	
	7.50	750.	2.20	6.80	151.	3.35	9.21	.554	1.800	.141	1.41	10.02	1.20		37.2	366.3	SAND	
27.3'	8.40	300.	1.00	1.75	11.	1.50	1.02	.643	1.500	.198	.11	.57	.32		33.9	9.0	MUD	
	8.70	200.	1.30	2.10	12.	.76	2.19	.672	1.600	.215	.25	1.16	.60	.053		11.9	CLAYEY SILT	
	9.00	220.	1.80	2.70	16.	.49	4.03	.702	1.600	.232	.69	2.99	.99	.123		25.2	SILTY CLAY	
	9.30	220.	1.80	2.80	20.	.63	3.61	.731	1.600	.250	.63	2.51	.91	.115		28.7	CLAYEY SILT	
31.2'	9.60	250.	2.30	3.20	16.	.34	5.15	.761	1.600	.268	1.17	4.37	1.19	.192		29.2	CLAY	C=135psi
	10.20	2000.	2.80	14.20	399.	8.88	4.19	.819	1.800	.309	.42	1.37	.41		42.6	695.3	SAND	
	10.50	220.	1.40	2.20	12.	.91	1.20	.849	1.600	.329	.15	.45	.30			10.5	SILT	
	10.80	140.	1.10	2.35	29.	19.66	.12	.878	1.700	.349	.20	.56	.40		26.5	24.5	SAND	∅=27°
	11.10	150.	1.10	2.10	20.	22.46	.07	.908	1.700	.369	.20	.54	.39		26.6	16.7	SAND	C=0 psi
	11.40	200.	1.10	2.75	41.	52.18	.06	.937	1.700	.390	.19	.48	.35		28.1	35.1	SAND	
									P01 =	.90	P0 =	.96	P1 =	2.15				
38.0'	11.70	500.	3.75	11.40	262.	3.31	5.53	.967	1.900	.413	2.48	6.00	1.01		28.2	520.0	SAND	
	12.00	1650.	4.20	11.00	231.	2.42	6.25	.996	1.900	.440	2.32	5.27	.88		37.6	479.0	SILTY SAND	
	12.30	1600.	4.70	12.55	269.	2.45	6.79	1.026	1.900	.466	2.98	6.39	.98		36.7	578.8	SILTY SAND	
41.9'	12.60	1200.	3.75	9.00	175.	2.17	4.70	1.055	1.900	.493	1.81	3.67	.76		35.4	314.7	SILTY SAND	∅=36°
	12.90	2600.	4.50	17.50	457.	4.97	5.10	1.084	1.900	.519	1.57	3.02	.65		40.7	375.1	SAND	C=0 psi

END OF SOUNDING

TEST NO. 1D-1   (CONTINUED)

FILE NAME: PLANT CRIST ASH POND DAM
FILE NUMBER: CRIST2D.DAT

RECORD OF DILATOMETER TEST NO. 2D-1
USING DATA REDUCTION PROCEDURES IN MARCHETTI (ASCE,J-GED,MARCH 80)
KO IN SANDS DETERMINED USING SCHMERTMANN METHOD (1983)
PHI ANGLE CALCULATION BASED ON DURGUNOGLU AND MITCHELL (ASCE,RALEIGH CONF,JUNE 75)
PHI ANGLE NORMALIZED TO 2.72 BARS USING BALIGH'S EXPRESSION (ASCE,J-GED,NOV 76)
MODIFIED MAYNE AND KULHAWY FORMULA USED FOR OCR IN SANDS (ASCE,J-GED,JUNE 82)

LOCATION: ASH POND DAM
PERFORMED - DATE: 18 MARCH 1992
BY: GILLIAM

CALIBRATION INFORMATION:
DELTA A = .01 BARS DELTA B = .45 BARS GAGE 0 = .15 BARS GWT DEPTH= 1.85 M
ROD DIA.= 3.70 CM FR.RED.DIA.= 5.40 CM ROD WT.= 6.50 KG/M DELTA/PHI= .50 BLADE T=15.00 MM

1 BAR = 1.019 KG/CM2 = 1.044 TSF = 14.51 PSI ANALYSIS USES H2O UNIT WEIGHT = 1.000 T/M3

DEPTH (ft)	Z (M)	THRUST (KG)	A (BAR)	B (BAR)	ED (BAR)	ID .	KD	UO (BAR)	GAMMA (T/M3)	SV (BAR)	PC (BAR)	OCR	KO	CU (BAR)	PHI (DEG)	M (BAR)	SOIL TYPE	
	*****	******	*****	*****	*****	*****	*****	******	******	******	*****	*****	*****	*****	*****	******	************	
20.5'	6.30	190.	1.00	2.95	54.	4.49	5.81	.437	1.700	.060	.27	4.55	.82		34.7	110.1	SAND	
	6.60	360.	1.65	5.50	124.	4.07	10.85	.466	1.700	.081	1.17	14.54	1.44		34.5	318.3	SAND	∅=34°
	6.90	525.	1.75	5.30	113.	3.38	9.35	.496	1.800	.103	1.07	10.38	1.22		36.5	274.9	SAND	C=0psf
23.4'	7.20	375.	1.55	4.60	94.	3.68	6.05	.525	1.700	.125	.65	5.22	.89		34.5	194.8	SAND	
	7.50	200.	1.35	3.10	47.	2.29	4.07	.554	1.700	.145	.48	3.32	.76		30.0	78.8	SILTY SAND	∅=25°
	7.80	135.	1.55	2.20	7.	.24	5.01	.584	1.500	.163	.68	4.19	1.16	.113		12.4	MUD	
	8.10	125.	1.45	2.95	38.	1.69	3.60	.613	1.600	.179	.60	3.38	.81		25.1	57.8	SANDY SILT	C=0psf
27.3'	8.40	305.	1.80	4.20	71.	2.21	4.64	.643	1.700	.198	.80	4.05	.83		30.5	126.8	SILTY SAND	
	8.70	660.	2.15	5.45	103.	2.49	5.42	.672	1.800	.220	.96	4.33	.81		35.5	201.6	SILTY SAND	
	9.00	725.	2.00	5.00	93.	2.59	4.25	.702	1.700	.243	.67	2.78	.65		36.4	160.5	SILTY SAND	
	9.30	825.	2.80	8.50	191.	3.30	6.30	.731	1.800	.265	1.50	5.68	.93		35.4	400.7	SAND	∅=35°
31.2'	9.60	900.	4.40	11.05	226.	2.04	11.01	.761	1.900	.290	4.91	16.95	1.56		32.7	584.4	SILTY SAND	C=0psf
	9.90	1200.	6.25	10.00	120.	.67	16.38	.790	1.800	.315	8.37	26.60	2.48	.959		355.7	CLAYEY SILT	
	10.20	520.	3.75	9.35	187.	2.13	7.46	.819	1.900	.340	3.27	9.62	1.23		28.4	417.4	SILTY SAND	
	10.50	745.	3.90	11.60	264.	2.98	6.96	.849	1.900	.366	2.85	7.79	1.11		31.7	576.4	SILTY SAND	∅=29°
	10.80	950.	2.80	7.65	160.	2.95	3.99	.878	1.800	.391	1.08	2.77	.66		35.6	271.9	SILTY SAND	C=0psf
36.1'	11.10	500.	2.35	4.70	69.	1.64	2.93	.908	1.600	.412	.92	2.22	.64		30.9	91.3	SANDY SILT	
	11.40	350.	3.15	4.75	42.	.59	4.68	.937	1.700	.431	1.62	3.76	1.11	.274		71.5	SILTY CLAY	
	11.70	240.	2.70	4.60	52.	.99	3.38	.967	1.600	.450	1.02	2.27	.86			74.3	SILT	
	12.00	230.	2.65	4.10	36.	.71	3.13	.996	1.600	.468	.94	2.01	.81	.180		47.5	CLAYEY SILT	
	12.30	275.	3.20	5.05	51.	.74	4.04	1.026	1.700	.487	1.46	2.99	.99	.258		79.9	CLAYEY SILT	
	12.60	210.	3.25	4.80	40.	.57	3.94	1.055	1.700	.507	1.46	2.88	.97	.261		61.4	SILTY CLAY	
	12.90	190.	3.50	4.55	21.	.28	4.27	1.084	1.600	.527	1.72	3.26	1.03	.299		35.0	CLAY	C=275ps
	13.20	195.	3.85	5.20	32.	.37	4.68	1.114	1.700	.546	2.05	3.76	1.11	.347		55.8	SILTY CLAY	
	13.50	200.	3.95	5.25	31.	.34	4.63	1.143	1.700	.566	2.10	3.71	1.10	.356		52.4	CLAY	
	13.80	400.	3.35	5.15	49.	.71	3.36	1.173	1.700	.587	1.32	2.24	.86	.247		67.8	CLAYEY SILT	
45.8'	14.10	2100.	2.00	11.50	329.	46.11	.34	1.202	1.700	.608						280.0	SAND	

END OF SOUNDING

FILE NAME: PLANT CRIST ASH POND DAM
FILE NUMBER: CRIST3D.DAT

RECORD OF DILATOMETER TEST NO. 3D-1
USING DATA REDUCTION PROCEDURES IN MARCHETTI (ASCE,J-GED,MARCH 80)
KO IN SANDS DETERMINED USING SCHMERTMANN METHOD (1983)
PHI ANGLE CALCULATION BASED ON DURGUNOGLU AND MITCHELL (ASCE,RALEIGH CONF,JUNE 75)
PHI ANGLE NORMALIZED TO 2.72 BARS USING BALIGH'S EXPRESSION (ASCE,J-GED,NOV 76)
MODIFIED MAYNE AND KULHAWY FORMULA USED FOR OCR IN SANDS (ASCE,J-GED,JUNE 82)

LOCATION: ASH POND DAM
PERFORMED - DATE: 17 MARCH 1992
BY: GILLIAM

CALIBRATION INFORMATION:
DELTA A = .02 BARS   DELTA B = .35 BARS   GAGE 0 = .15 BARS   GWT DEPTH= 2.00 M
ROD DIA.= 3.70 CM   FR.RED.DIA.= 5.40 CM   ROD WT.= 6.50 KG/M   DELTA/PHI= .50   BLADE T=15.00 MM

1 BAR = 1.019 KG/CM2 = 1.044 TSF = 14.51 PSI   ANALYSIS USES H2O UNIT WEIGHT = 1.000 T/M3

DEPTH (ft)	Z (M)	THRUST (KG)	A (BAR)	B (BAR)	ED (BAR)	ID	KD	UO (BAR)	GAMMA (T/M3)	SV (BAR)	PC (BAR)	OCR	KO	CU (BAR)	PHI (DEG)	M (BAR)	SOIL TYPE	
19.5'	6.00	75.	.60	1.70	27.	18.71	.68	.393	1.700	.060	.02	.34	.24		33.1	22.6	SAND	
	6.30	400.	1.25	4.65	110.	5.82	6.78	.422	1.700	.081	.43	5.32	.86		37.4	238.7	SAND	ϕ=33°
	6.60	380.	1.60	5.15	116.	3.88	8.49	.451	1.700	.101	.95	9.36	1.17		34.5	273.2	SAND	C=0 psf
	6.90	310.	1.45	4.65	103.	4.26	5.73	.481	1.700	.122	.60	4.96	.88		33.4	207.8	SAND	
	7.20	305.	1.30	4.25	94.	5.10	3.73	.510	1.700	.142	.36	2.50	.64		33.7	154.4	SAND	
	7.50	195.	1.20	3.62	75.	5.03	2.62	.540	1.700	.163	.30	1.84	.58		30.3	99.9	SAND	
23.4'	7.80	450.	1.65	4.75	99.	3.52	4.43	.569	1.700	.184	.59	3.23	.71		34.4	178.4	SAND	
	8.10	600.	6.15	9.90	123.	.68	25.53	.599	1.800	.206	10.93	53.14	3.19	1.092		417.2	CLAYEY SILT	
	8.40	300.	4.25	5.70	39.	.33	15.09	.628	1.700	.228	5.33	23.40	2.36	.627		113.7	CLAY	C=625ps
28.3'	8.70	230.	4.10	5.95	54.	.48	13.04	.658	1.700	.248	4.63	18.62	2.16	.569		148.3	SILTY CLAY	
	9.00	720.	1.80	8.20	220.	9.29	2.52	.687	1.800	.271	.32	1.20	.43		37.0	286.2	SAND	
	9.30	1100.	2.90	10.00	245.	4.12	5.84	.716	1.800	.294	1.35	4.60	.83		37.3	498.4	SAND	
	9.60	1060.	2.70	9.55	236.	4.54	4.72	.746	1.800	.318	1.03	3.23	.70		37.2	436.4	SAND	ϕ=37°
	9.90	975.	2.45	8.58	210.	4.81	3.68	.775	1.800	.341	.76	2.22	.59		36.9	342.6	SAND	C=0 psf
33.2'	10.20	700.	2.05	5.95	129.	3.95	2.57	.805	1.800	.365	.56	1.54	.51		34.8	169.9	SAND	
	10.50	575.	2.35	7.05	158.	3.89	3.01	.834	1.800	.388	.84	2.16	.62		32.3	230.0	SAND	
	10.80	560.	2.20	5.95	123.	3.42	2.52	.864	1.800	.412	.72	1.74	.57		32.2	160.4	SAND	ϕ=30°
	11.10	450.	2.05	5.25	103.	3.36	2.04	.893	1.700	.434	.65	1.49	.54		30.6	115.4	SAND	C=0 psf
	11.40	435.	2.15	5.35	103.	3.11	2.10	.922	1.700	.455	.72	1.58	.57		29.9	118.2	SILTY SAND	
38.0'	11.70	400.	2.15	4.10	58.	1.68	2.09	.952	1.600	.474	.78	1.65	.59		29.0	57.8	SANDY SILT	
	12.00	320.	2.40	3.55	28.	.66	2.54	.981	1.600	.491	.71	1.46	.68	.146		31.3	CLAYEY SILT	
	12.30	255.	3.15	4.55	38.	.55	3.85	1.011	1.600	.509	1.41	2.77	.96	.254		57.1	SILTY CLAY	C=340ps
	12.60	255.	3.45	4.45	23.	.29	4.27	1.040	1.600	.527	1.72	3.26	1.03	.299		37.4	CLAY	
	12.90	215.	4.00	5.60	45.	.47	5.02	1.070	1.700	.546	2.29	4.20	1.16	.379		80.4	SILTY CLAY	
	13.20	245.	4.15	6.00	54.	.55	5.03	1.099	1.700	.566	2.38	4.21	1.17	.394		96.8	SILTY CLAY	
3.9'	13.50	275.	3.95	5.60	47.	.51	4.48	1.129	1.700	.587	2.06	3.51	1.07	.354		78.2	SILTY CLAY	
	13.80	390.	3.20	6.40	103.	1.68	2.91	1.158	1.700	.608	1.70	2.79	.78		25.7	136.4	SANDY SILT	
	14.10	2100.	3.50	10.60	245.	3.83	2.92	1.187	1.900	.631	.84	1.34	.44		39.5	351.2	SAND	

END OF SOUNDING

GULF POWER COMPANY TEST NO. 5D-1

FILE NAME: PLANT CRIST ASH POND DAM
FILE NUMBER: CRIST5D.DAT

RECORD OF DILATOMETER TEST NO. 5D-1
USING DATA REDUCTION PROCEDURES IN MARCHETTI (ASCE,J-GED,MARCH 80)
KO IN SANDS DETERMINED USING SCHMERTMANN METHOD (1983)
PHI ANGLE CALCULATION BASED ON DURGUNOGLU AND MITCHELL (ASCE,RALEIGH CONF,JUNE 75)
PHI ANGLE NORMALIZED TO 2.72 BARS USING BALIGH'S EXPRESSION (ASCE,J-GED,NOV 76)
MODIFIED MAYNE AND KULHAWY FORMULA USED FOR OCR IN SANDS (ASCE,J-GED,JUNE 82)

LOCATION: ASH POND DAM
PERFORMED - DATE: 17 MARCH 1992
BY: GILLIAM

CALIBRATION INFORMATION:
DELTA A = .02 BARS DELTA B = .35 BARS GAGE 0 = .15 BARS GWT DEPTH= 2.00 M
ROD DIA.= 3.70 CM FR.RED.DIA.= 5.40 CM ROD WT.= 6.50 KG/M DELTA/PHI= .50 BLADE T=15.00 MM

1 BAR = 1.019 KG/CM2 = 1.044 TSF = 14.51 PSI ANALYSIS USES H2O UNIT WEIGHT = 1.000 T/M3

DEPTH (ft)	Z (M)	THRUST (KG)	A (BAR)	B (BAR)	ED (BAR)	ID	KD	UO (BAR)	GAMMA (T/M3)	SV (BAR)	PC (BAR)	OCR	KO	CU (BAR)	PHI (DEG)	M (BAR)	SOIL TYPE	
	*****	******	*****	*****	*****	*****	*****	******	******	******	*****	*****	*****	*****	*****	******	***********	
19.5'	6.00	1350.	6.80	12.80	205.	.99	99.93	.393	1.950	.060	26.80	*****	6.60			959.9	SILT	
	6.30	1700.	5.85	17.50	411.	2.50	53.37	.422	2.000	.089	28.24	*****	6.52		35.9	1679.1	SILTY SAND	
	6.60	950.	4.35	10.30	203.	1.68	30.29	.451	1.800	.115	13.20	*****	3.83		33.3	721.6	SANDY SILT	
	6.90	1500.	1.60	4.60	96.	3.22	6.25	.481	1.700	.137	.25	1.85	.46		44.3	200.4	SILTY SAND	ϕ=34°
	7.20	325.	2.80	5.05	68.	.96	13.08	.510	1.700	.158	2.96	18.73	2.17			198.7	SILT	C=0 psf
24.4'	7.50	550.	2.50	4.95	76.	1.27	9.67	.540	1.700	.178	2.32	12.97	1.38		32.8	187.0	SANDY SILT	
	7.80	700.	3.31	5.10	52.	.59	12.76	.569	1.700	.199	3.58	18.00	2.13	.444		141.3	SILTY CLAY	C=390 p
26.3'	8.10	375.	2.85	4.40	43.	.60	9.39	.599	1.700	.220	2.45	11.16	1.77	.334		104.7	CLAYEY SILT	
	8.40	1070.	4.05	13.10	316.	3.19	11.75	.628	1.900	.243	4.28	17.59	1.59		35.2	838.9	SILTY SAND	
	8.70	1075.	3.35	10.00	229.	2.93	8.34	.658	1.900	.270	2.44	9.05	1.15		36.2	535.7	SILTY SAND	
	9.00	1000.	4.25	11.00	232.	2.15	10.51	.687	1.900	.296	4.47	15.09	1.48		33.7	592.1	SILTY SAND	
	9.30	935.	3.10	8.60	187.	2.70	6.22	.716	1.800	.321	1.83	5.69	.93		35.1	388.3	SILTY SAND	ϕ=34°
31.2'	9.60	805.	2.80	8.30	187.	3.23	4.84	.746	1.800	.345	1.34	3.89	.79		34.4	349.3	SILTY SAND	C=0 psf
	9.90	740.	3.75	9.20	185.	2.06	7.00	.775	1.900	.370	2.93	7.92	1.12		31.5	401.4	SILTY SAND	ϕ=31°
33.2'	10.20	465.	2.20	4.75	79.	1.98	2.94	.805	1.700	.393	.88	2.25	.65		30.5	107.6	SILTY SAND	C=0 psf
	10.50	310.	2.50	3.95	39.	.77	3.59	.834	1.600	.413	1.03	2.49	.91	.189		57.5	CLAYEY SILT	
35.1'	10.80	250.	2.40	3.60	30.	.64	3.17	.864	1.600	.430	.88	2.05	.82	.168		40.1	CLAYEY SILT	C=200 ps
	11.10	285.	1.55	2.85	34.	2.03	1.07	.893	1.700	.449	.45	1.00	.49		28.0	28.8	SILTY SAND	
	11.40	380.	1.50	3.30	52.	3.99	.80	.922	1.700	.470	.34	.73	.40		30.3	44.3	SAND	
	11.70	700.	1.70	6.00	143.	9.79	.86	.952	1.700	.491	.27	.55	.32		34.5	121.7	SAND	
	12.00	1050.	4.25	10.60	218.	2.21	5.52	.981	1.900	.514	2.65	5.15	.91		33.3	425.7	SILTY SAND	
	12.30	960.	3.90	9.90	205.	2.39	4.58	1.011	1.900	.541	2.11	3.91	.81		32.9	367.4	SILTY SAND	ϕ=31°
	12.60	920.	3.45	9.23	197.	2.83	3.54	1.040	1.900	.567	1.52	2.68	.68		33.1	312.8	SILTY SAND	C=0 psf
	12.90	760.	3.05	7.95	165.	2.93	2.74	1.070	1.800	.592	1.19	2.01	.61		32.0	226.2	SILTY SAND	
	13.20	650.	3.05	7.70	156.	2.80	2.61	1.099	1.800	.616	1.24	2.01	.63		30.5	205.1	SILTY SAND	
43.9'	13.50	400.	2.20	4.85	83.	2.89	1.30	1.129	1.700	.638	.76	1.19	.54		27.9	70.6	SILTY SAND	
	13.80	500.	2.35	3.60	32.	.91	1.55	1.158	1.600	.657	.44	.67	.42			27.3	SILT	
	14.10	530.	3.40	5.00	45.	.64	2.99	1.187	1.700	.676	1.27	1.87	.78	.246		56.7	CLAYEY SILT	
	14.40	310.	3.40	4.50	27.	.38	2.90	1.217	1.600	.695	1.24	1.79	.76	.243		32.8	SILTY CLAY	C=275 p
	14.70	255.	3.65	4.85	30.	.39	3.13	1.246	1.600	.713	1.43	2.01	.81	.275		39.6	SILTY CLAY	
	15.00	350.	3.70	5.20	41.	.53	3.06	1.276	1.700	.732	1.42	1.94	.80	.274		52.9	SILTY CLAY	
49.7'	15.30	375.	3.80	5.20	38.	.47	3.07	1.305	1.700	.753	1.47	1.96	.80	.283		48.4	SILTY CLAY	
	15.60	1030.	4.45	13.00	298.	3.33	3.32	1.335	1.900	.776	2.02	2.61	.69		32.1	459.6	SAND	ϕ=32°
	15.90	1025.	4.30	13.00	304.	3.66	2.98	1.364	1.900	.803	1.82	2.26	.65		32.1	439.3	SAND	
52.7'	16.20	750.	2.80	5.80	96.	2.41	1.38	1.394	1.800	.828	.89	1.07	.48		31.1	81.5	SILTY SAND	C=0 psf

END OF SOUNDING

GULF POWER COMPANY TEST NO. 7D-1

FILE NAME: PLANT CRIST ASH POND DAM
FILE NUMBER: CRIST7D.DAT

RECORD OF DILATOMETER TEST NO. 7D-1
USING DATA REDUCTION PROCEDURES IN MARCHETTI (ASCE,J-GED,MARCH 80)
KO IN SANDS DETERMINED USING SCHMERTMANN METHOD (1983)
PHI ANGLE CALCULATION BASED ON DURGUNOGLU AND MITCHELL (ASCE,RALEIGH CONF.JUNE 75)
PHI ANGLE NORMALIZED TO 2.72 BARS USING BALIGH'S EXPRESSION (ASCE,J-GED,NOV 76)
MODIFIED MAYNE AND KULHAWY FORMULA USED FOR OCR IN SANDS (ASCE,J-GED,JUNE 82)

LOCATION: ASH POND DAM
PERFORMED - DATE: 16 MARCH 1992
BY: GILLIAM

CALIBRATION INFORMATION:
DELTA A = .02 BARS DELTA B = .35 BARS GAGE 0 = .15 BARS GWT DEPTH= 2.00 M
ROD DIA.= 3.70 CM FR.RED.DIA.= 5.40 CM ROD WT.= 6.50 KG/M DELTA/PHI= .50 BLADE T=15.00 MM

1 BAR = 1.019 KG/CM2 = 1.044 TSF = 14.51 PSI ANALYSIS USES H2O UNIT WEIGHT = 1.000 T/M3

DEPTH (ft)	Z (M)	THRUST (KG)	A (BAR)	B (BAR)	ED (BAR)	ID	KD	UO (BAR)	GAMMA (T/M3)	SV (BAR)	PC (BAR)	OCR	KO	CU (BAR)	PHI (DEG)	M (BAR)	SOIL TYPE	
	*****	******	*****	*****	*****	*****	*****	******	******	******	*****	*****	*****	*****	*****	******	************	
13.0'	4.00	130.	.70	3.45	87.	9.81	4.25	.196	1.700	.060	.18	2.98	.67		32.6	152.3	SAND	
	4.30	145.	.60	2.15	43.	6.69	2.30	.226	1.700	.081	.10	1.25	.46		33.0	52.6	SAND	φ=33°
	4.60	1000.	3.81	11.20	256.	2.40	29.51	.255	1.900	.104	10.71	*****	3.70		34.7	901.5	SILTY SAND	C=0 psf
	4.90	1925.	12.00	40.05	1009.	2.85	75.94	.285	2.150	.134	*****	*****	9.38		30.6	4457.1	SILTY SAND	
	5.20	1100.	3.95	10.70	232.	2.10	19.37	.314	1.900	.165	7.44	45.19	2.49		35.1	726.7	SILTY SAND	
17.9'	5.50	650.	2.25	7.75	187.	3.54	8.02	.343	1.800	.190	1.66	8.76	1.14		34.6	431.4	SAND	
	5.80	200.	1.05	2.20	28.	1.61	2.42	.373	1.600	.210	.39	1.84	.60		28.4	72.4	SANDY SILT	
	6.10	300.	1.05	4.30	105.	8.09	1.63	.402	1.700	.229	.24	1.04	.44		31.9	97.0	SAND	φ=31°
	6.40	285.	.70	4.12	106.	22.07	.55	.432	1.700	.250	.12	.48	.31		32.2	90.0	SAND	
									POI =	.42	PO =	.57	P1 =	3.62				C=0 psf
21.8'	6.70	250.	.87	4.14	106.	22.76	.49	.461	1.700	.271	.14	.52	.34		30.8	89.8	SAND	
	7.00	650.	1.05	8.45	256.	94.85	.27	.491	1.700	.291	.04	.12	.14		37.8	217.7	SAND	
	7.30	900.	1.05	4.05	96.	10.29	.86	.520	1.700	.312	.06	.19	.17		39.2	81.5	SAND	
	7.60	1200.	3.70	13.00	325.	3.64	7.68	.550	1.900	.335	2.68	8.00	1.09		35.9	738.7	SAND	φ=36°
25.7'	7.90	650.	2.10	8.55	222.	5.87	3.02	.579	1.800	.360	.73	2.02	.59		33.7	323.2	SAND	C=0 psf
	8.20	450.	2.90	4.65	50.	.69	5.47	.608	1.700	.382	1.84	4.81	1.24	.296		94.8	CLAYEY SILT	
	8.50	350.	3.40	5.09	48.	.54	6.37	.638	1.700	.403	2.45	6.09	1.37	.377		98.0	SILTY CLAY	
	8.80	325.	4.00	5.85	54.	.50	7.39	.667	1.700	.424	3.25	7.68	1.52	.477		118.1	SILTY CLAY	C=385 ps
	9.10	335.	3.45	4.85	38.	.42	5.79	.697	1.700	.444	2.33	5.25	1.29	.369		72.8	SILTY CLAY	
30.6'	9.40	340.	3.45	4.50	25.	.28	5.52	.726	1.600	.463	2.26	4.88	1.25	.363		46.9	CLAY	
	9.70	320.	2.40	3.25	17.	.34	3.10	.756	1.600	.481	.95	1.98	.81	.183		22.7	CLAY	
	10.00	335.	1.90	2.65	14.	.41	1.94	.785	1.600	.499	.47	.95	.53	.105		11.8	SILTY CLAY	
	10.30	370.	2.05	2.70	10.	.27	2.12	.815	1.500	.515	.56	1.10	.58	.122		9.3	MUD	C=115 psf
24.5'	10.60	360.	1.80	2.41	9.	.31	1.54	.844	1.500	.530	.35	.66	.41	.084		7.4	MUD	
	10.90	465.	1.25	2.15	19.	2.53	.40	.873	1.700	.547	.29	.52	.34		31.2	16.4	SILTY SAND	
	11.20	500.	1.20	2.35	28.	6.39	.23	.903	1.700	.568	.25	.43	.31		31.8	24.2	SAND	
	11.50	575.	1.24	1.95	12.	2.22	.27	.932	1.700	.588	.25	.42	.30		32.5	10.5	SILTY SAND	
	11.80	650.	1.30	3.80	78.	21.98	.17	.962	1.700	.609	.22	.35	.28		33.4	66.0	SAND	
	12.10	1030.	3.75	10.40	229.	2.85	3.66	.991	1.900	.633	1.78	2.82	.70		33.1	370.0	SILTY SAND	
	12.40	1130.	3.50	9.80	216.	3.03	3.11	1.021	1.900	.659	1.43	2.17	.62		34.1	321.2	SILTY SAND	
	12.70	1170.	3.65	10.10	222.	2.95	3.16	1.050	1.900	.686	1.53	2.23	.62		34.1	331.2	SILTY SAND	φ=33°
	13.00	1240.	3.60	9.90	216.	2.97	2.94	1.079	1.900	.712	1.42	1.99	.59		34.5	310.0	SILTY SAND	C=0 psf
	13.30	1210.	3.45	9.72	215.	3.23	2.59	1.109	1.900	.739	1.26	1.71	.55		34.4	285.5	SILTY SAND	
	13.60	1185.	3.60	10.10	223.	3.18	2.65	1.138	1.900	.765	1.38	1.80	.57		33.9	300.5	SILTY SAND	
	13.90	1120.	3.50	9.65	211.	3.17	2.42	1.168	1.800	.790	1.31	1.66	.55		33.5	267.1	SILTY SAND	
46.2'	14.20	1070.	3.50	9.65	211.	3.22	2.32	1.197	1.800	.814	1.31	1.62	.55		33.0	258.8	SILTY SAND	

END OF SOUNDING

Southern Company Services
Soil Testing for Plant Crist
Fill Material

April 20, 1992

Mr. Joel Miller

Mr. Ray Halbert
Alabama Power Company
PGTS - Civil

Enclosed are the test results for the soil sample delivered to the Central Laboratory on March 30, 1992. Performed test included gradation, hydrometer, specific gravity, Atterberg Limits, soil classification and Consolidated-Undrained (R) triaxial test.

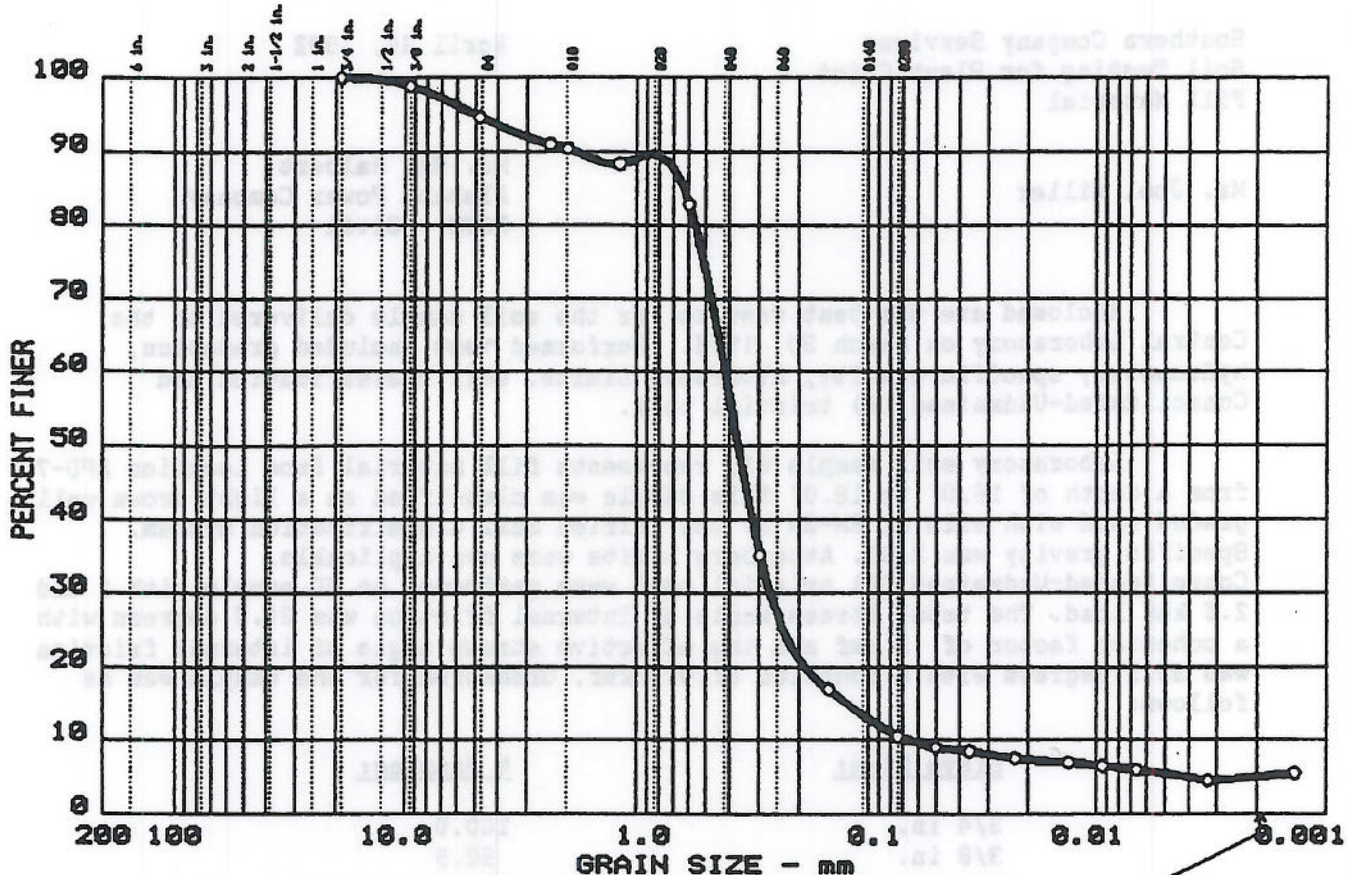
Laboratory soil sample #1, represents fill material from location APD-7 from a depth of 16.0' to 18.0' This sample was classified as a light brown well graded sand with silt or SW-SM by the Unified Soil Classification System. Specific gravity was 2.62. Atterberg Limits were non-applicable. Consolidated-Undrained (R) triaxial test were performed on UD sample with 1 and 2.5 ksf load. The total stress angle of internal friction was 24.5 degrees with a cohesion factor of .3 ksf and the effective stress angle of internal friction was 35.5 degrees with a cohesion of 0.0 ksf. Gradation for the sample was as follows:

Sieve Size:	% Passing:
3/4 in.	100.0
3/8 in.	98.9
#4	94.6
#8	91.0
#10	90.0
#16	88.3
#30	82.8
#50	35.1
#100	16.9
#200	10.5

If you have any questions about the test performed or if we can be of any further assistance to you please contact me at extension 8-255-6266.

Ray Halbert
Alabama Power Company
Supervisor/Concrete and Soils

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
o	1	0.0	5.4	84.1	10.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	NP	NP	0.62	0.42	0.37	0.269	0.1229	0.0652	2.65	6.4

MATERIAL DESCRIPTION	USCS	AASHTO
o LIGHT BROWN WELL GRADED SAND W/SILT	SW-SM	A-2-4(0.4)

Project No.: 1
Project: PLANT CRIST
o Location: APD-7

Date: 04-16-92

Remarks:
BORNING-FILL MILT.
DEPTH(ft)-16.0-18.0
TEST BY-SDM LSJ

ALABAMA POWER COMPANY

Figure No.1

DATE: 04/16/92

ALABAMA POWER COMPANY
TRIAXIAL SHEAR TEST DATA
CONSOLIDATED-UNDRAINED (R) TEST

Project PLANT CRIST — Lab No. 1

Job FILL MATERIAL — Job Date 03/30/92

Sample Location APD-7 — Depth

SOIL DESCRIPTION: LIGHT BROWN WELL GRADED SAND W/SILT

SOIL CLASSIFICATION: SW-SM LL = NP PI = NP SPECIFIC GRAVITY = 2.62

RECEIVED ON 03/30/92

REPORTED ON 04/16/92

REMARKS:

MINOR PRINCIPAL STRESS	(KSF)	0.99	2.51	0.00
INITIAL CONDITIONS				
WATER CONTENT	(%)	14.0	14.6	0.0
DRY DENSITY	(PCF)	104.1	109.7	0.0
SATURATION	(%)	64.2	78.0	0.0
VOID RATIO	-	0.571	0.491	0.000
DIAMETER	(IN.)	1.400	1.400	0.000
HEIGHT	(IN.)	3.000	3.000	0.000
BEFORE SHEAR				
WATER CONTENT	(%)	21.8	18.7	0.0
DRY DENSITY	(PCF)	104.8	115.3	0.0
SATURATION	(%)	100.0	100.0	0.0
VOID RATIO	-	0.561	0.418	0.000
BACK PRESSURE	(KSF)	12.96	12.96	0.00
RATE OF STRAIN	(%/MIN)	0.130	0.130	0.000

	TOTAL STRESS	EFFECTIVE STRESS (MOHR)	EFFECTIVE STRESS (P-Q)
COHESION C (KSF) =	.3	0.0	
ANGLE OF INTERNAL FRICTION (DEGREES)	24.5	35.5	

ALABAMA POWER COMPANY CONSOLIDATED-UNDRAINED (R) TRIAXIAL TEST DATA

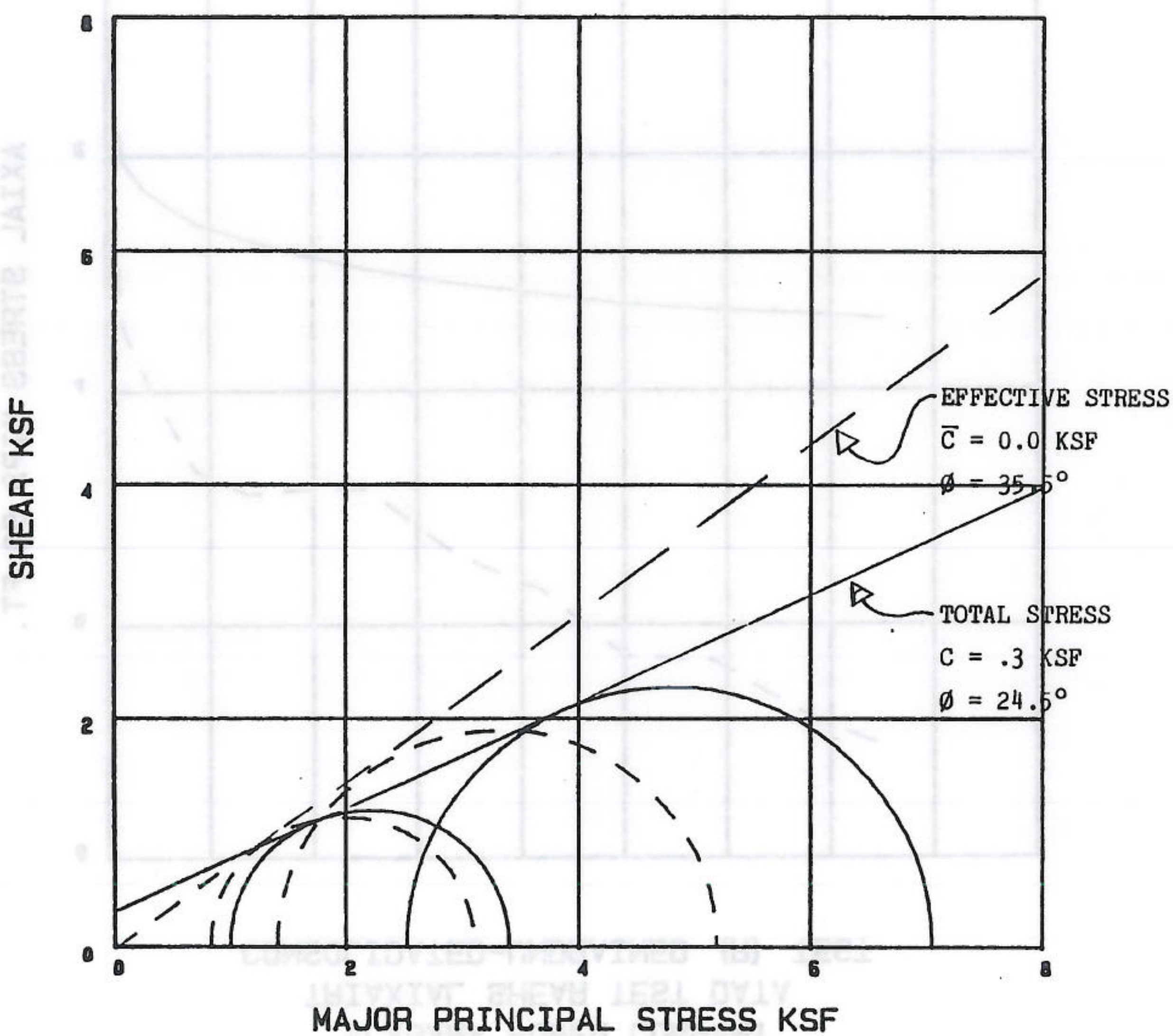
MINOR PRINCIPAL STRESS, KSF: 0.99

STRAIN %	DEVIATOR STRESS KSF	INDUCED PORE PRESSURE KSF	MAJOR PRINCIPAL STRESS KSF	EFFECTIVE PRINCIPAL STRESS major KSF	EFFECTIVE PRINCIPAL STRESS minor KSF	EFFECTIVE PRINCIPAL STRESS RATIO	P KSF	Q KSF
0.0	0.00	0.00	0.99	0.99	0.99	1.00	0.99	0.00
0.2	0.80	0.14	1.80	1.65	0.84	1.95	1.25	0.40
0.3	1.05	0.20	2.04	1.84	0.79	2.33	1.32	0.53
0.7	1.30	0.26	2.29	2.03	0.73	2.76	1.38	0.65
1.7	1.58	0.33	2.58	2.24	0.66	3.39	1.45	0.79
2.7	1.73	0.24	2.72	2.47	0.74	3.31	1.61	0.86
3.7	1.85	0.27	2.84	2.56	0.72	3.56	1.64	0.92
5.0	1.98	0.23	2.97	2.74	0.76	3.59	1.75	0.99
6.7	2.10	0.19	3.09	2.90	0.80	3.60	1.86	1.05
8.3	2.19	0.13	3.18	3.05	0.86	3.53	1.96	1.09
10.0	2.27	0.17	3.27	3.09	0.82	3.77	1.96	1.14
11.7	2.33	0.12	3.32	3.20	0.87	3.65	2.04	1.16
13.4	2.36	0.12	3.35	3.23	0.87	3.68	2.06	1.18
15.0	2.41	0.10	3.40	3.29	0.89	3.70	2.10	1.20

MINOR PRINCIPAL STRESS, KSF: 2.51

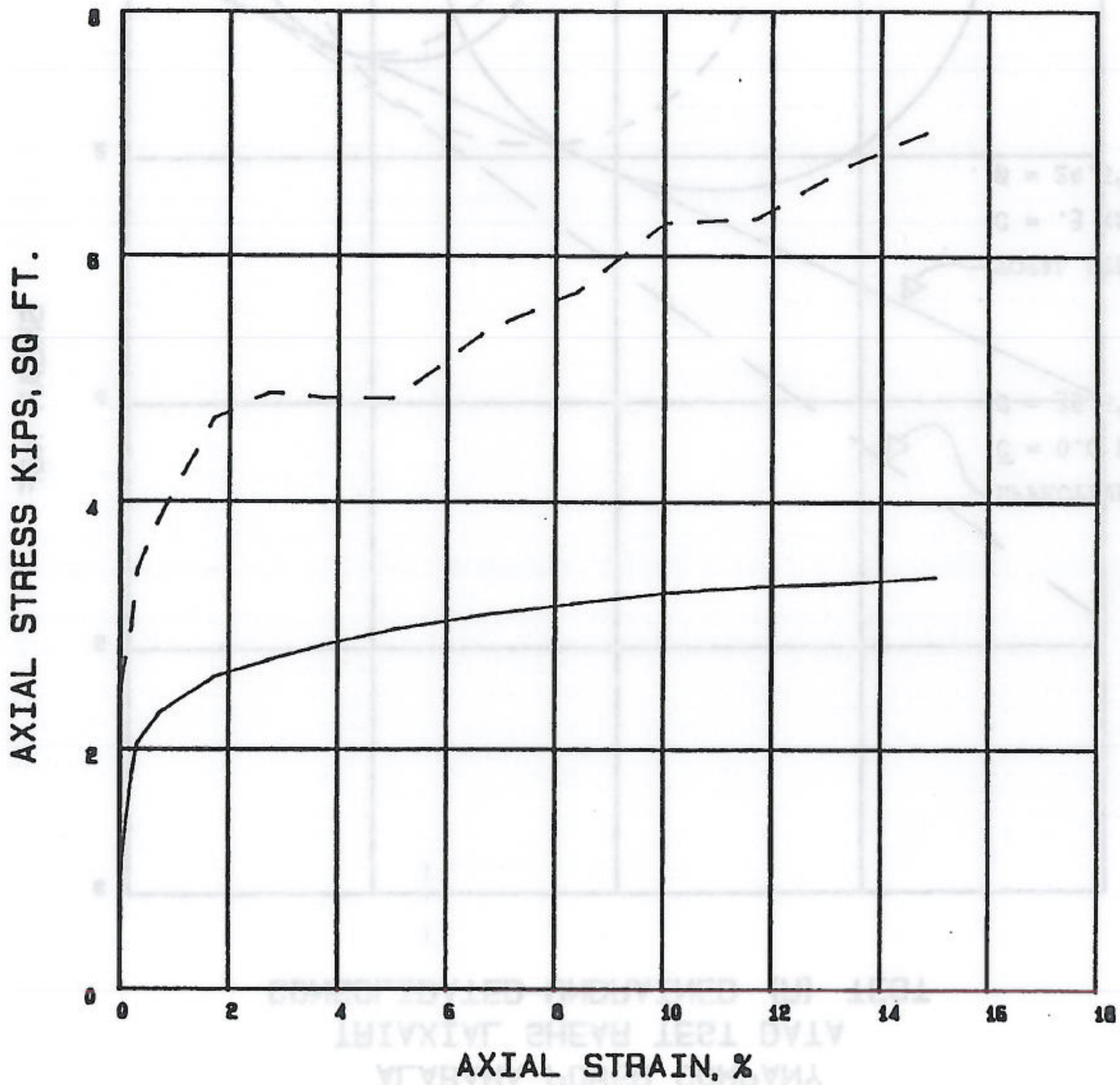
STRAIN %	DEVIATOR STRESS KSF	INDUCED PORE PRESSURE KSF	MAJOR PRINCIPAL STRESS KSF	EFFECTIVE PRINCIPAL STRESS major KSF	EFFECTIVE PRINCIPAL STRESS minor KSF	EFFECTIVE PRINCIPAL STRESS RATIO	P KSF	Q KSF
0.0	0.00	0.00	2.51	2.50	2.50	1.00	2.51	0.00
0.2	0.50	0.09	3.01	2.92	2.41	1.21	2.67	0.25
0.3	0.95	0.23	3.45	3.22	2.27	1.42	2.75	0.47
0.7	1.36	0.58	3.86	3.28	1.92	1.70	2.61	0.68
1.7	2.19	0.62	4.69	4.07	1.88	2.16	2.98	1.09
2.7	2.40	0.94	4.90	3.96	1.56	2.53	2.77	1.20
3.7	2.34	1.12	4.85	3.72	1.38	2.70	2.55	1.17
5.0	2.34	1.24	4.85	3.60	1.26	2.85	2.44	1.17
6.7	2.91	1.35	5.41	4.06	1.15	3.52	2.61	1.45
8.4	3.21	1.28	5.72	4.43	1.22	3.62	2.83	1.61
10.0	3.77	1.09	6.27	5.17	1.41	3.67	3.29	1.88
11.7	3.80	1.11	6.31	5.19	1.39	3.72	3.30	1.90
13.4	4.24	0.89	6.75	5.85	1.61	3.63	3.73	2.12
15.0	4.54	0.81	7.05	6.23	1.69	3.67	3.97	2.27

ALABAMA POWER COMPANY
TRIAXIAL SHEAR TEST DATA
CONSOLIDATED-UNDRAINED (R) TEST



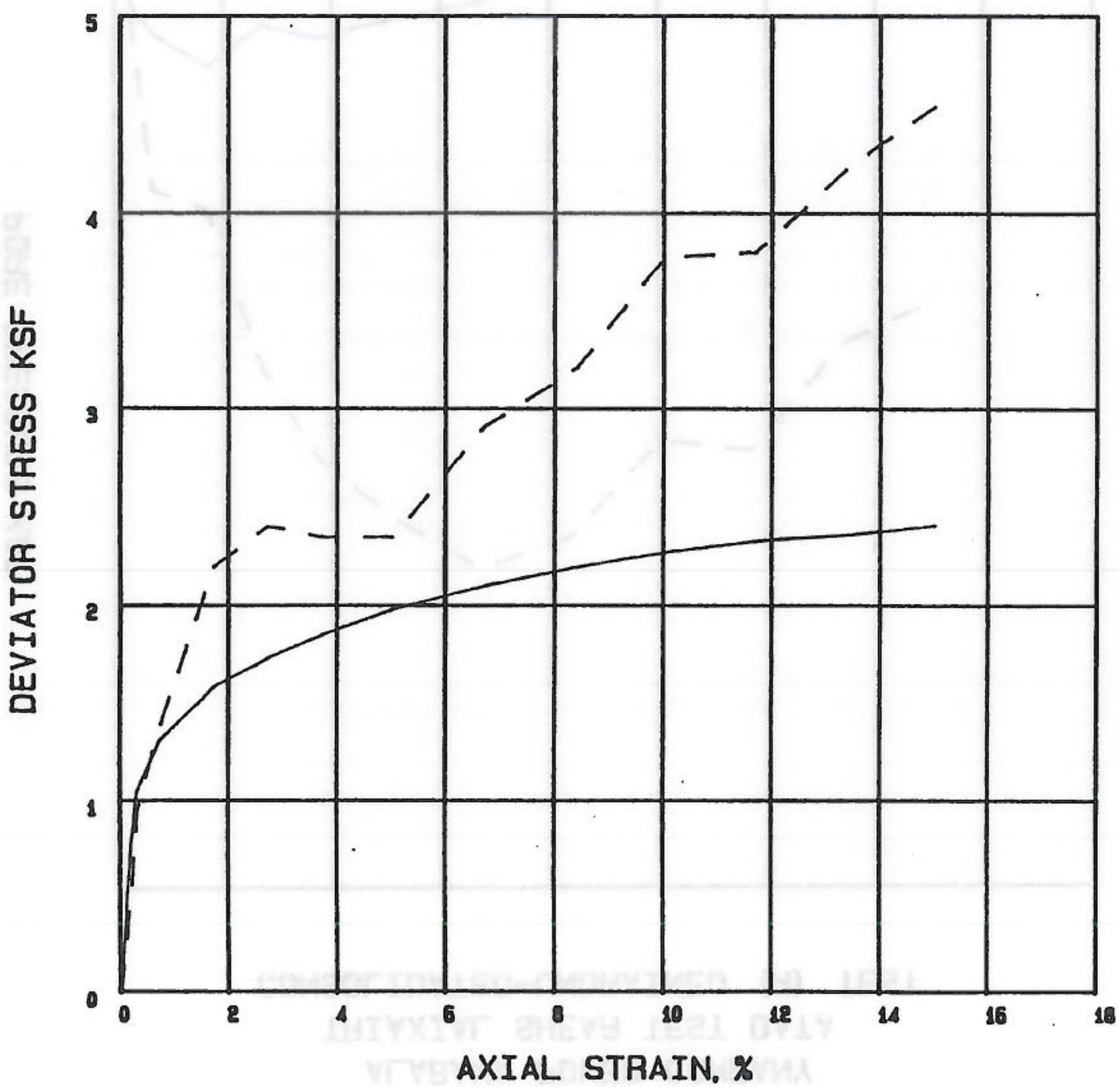
SAMPLE NUMBER 1

ALABAMA POWER COMPANY
TRIAXIAL SHEAR TEST DATA
CONSOLIDATED-UNDRAINED (R) TEST



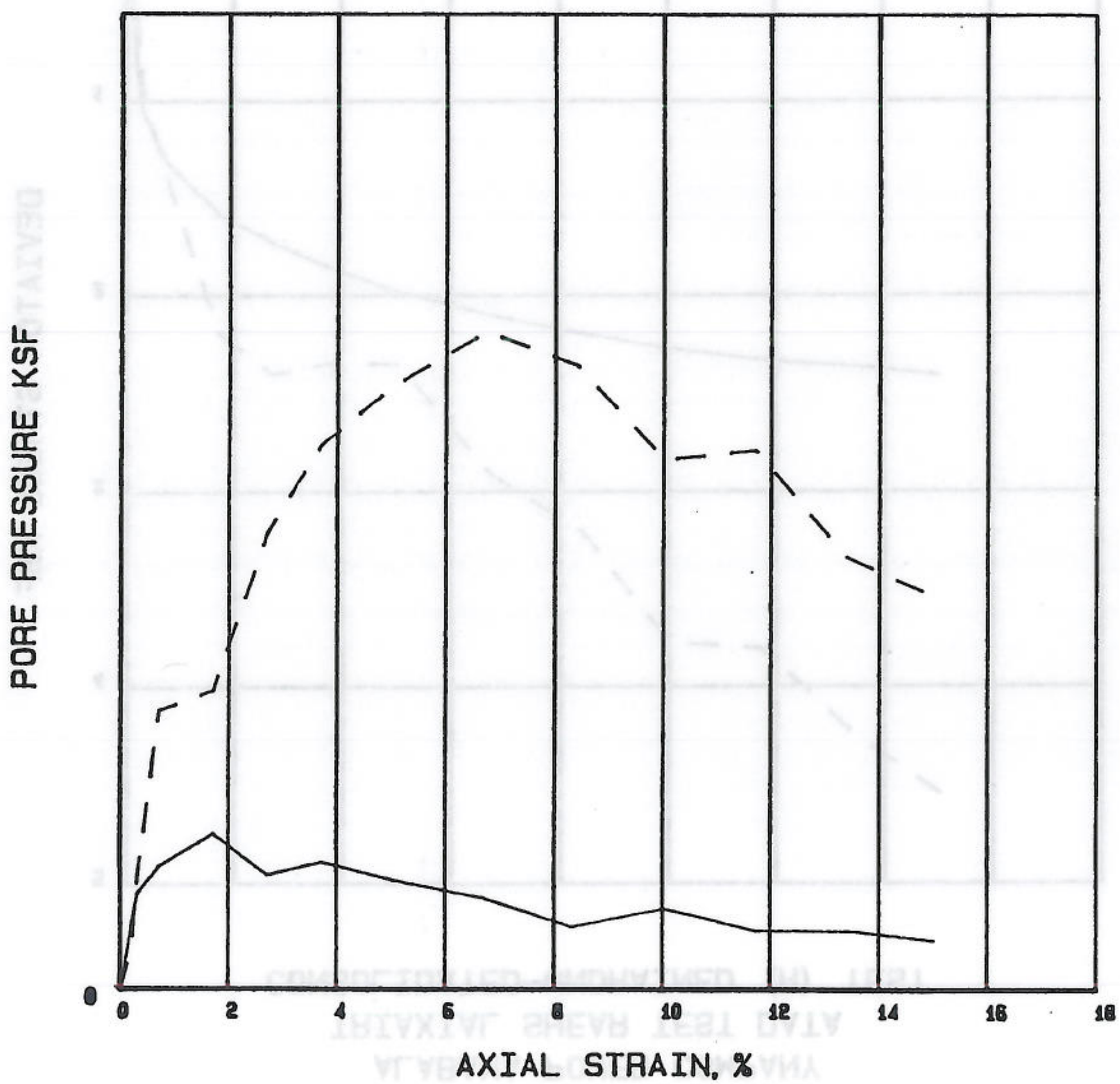
SAMPLE NUMBER 1

ALABAMA POWER COMPANY
TRIAXIAL SHEAR TEST DATA
CONSOLIDATED-UNDRAINED (R) TEST



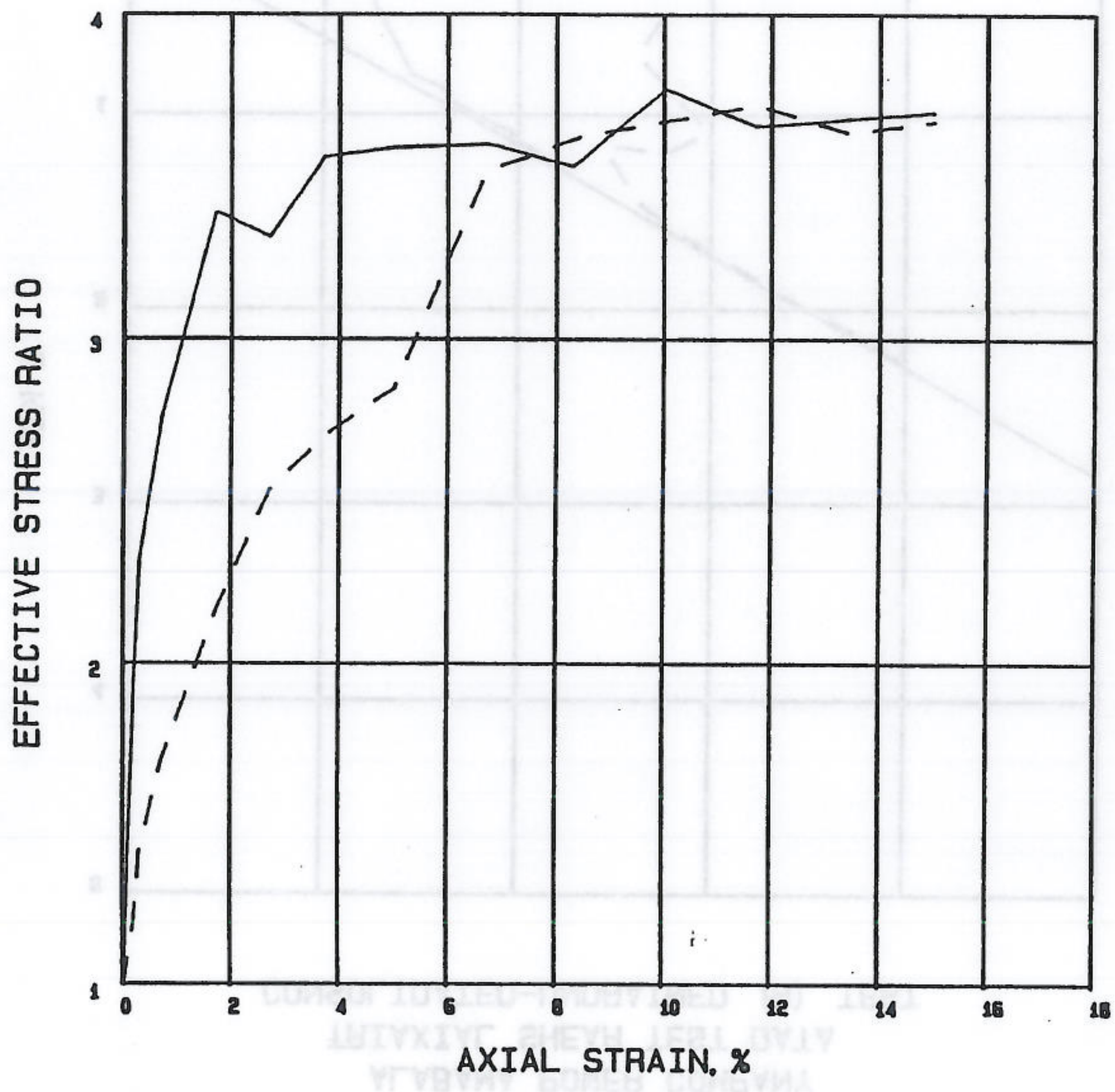
SAMPLE NUMBER 1

ALABAMA POWER COMPANY
TRIAXIAL SHEAR TEST DATA
CONSOLIDATED-UNDRAINED (R) TEST



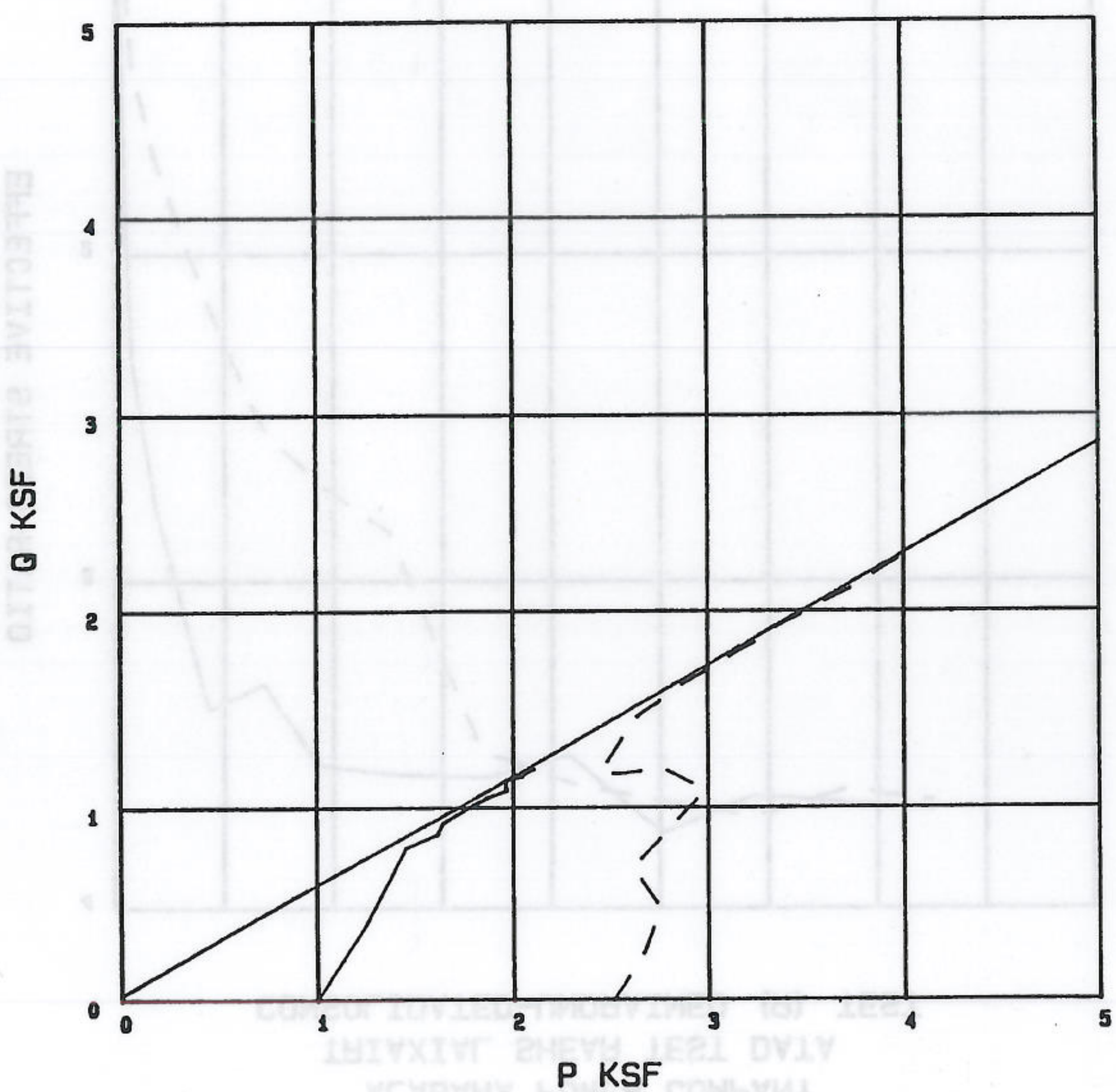
SAMPLE NUMBER 1

ALABAMA POWER COMPANY
TRIAXIAL SHEAR TEST DATA
CONSOLIDATED-UNDRAINED (R) TEST



SAMPLE NUMBER 1

ALABAMA POWER COMPANY
TRIAXIAL SHEAR TEST DATA
CONSOLIDATED-UNDRAINED (R) TEST



SAMPLE NUMBER 1

ALPHA: 29.6 THETA: 34.6

A: 0.03 C: 0.03

"Output file from SITELOG
SoundID: B05-102.DN-1
"==================================
"
"Developed by: FOUNDATION ALTERNATIVES FOR SESI
" Program: Piezocone Interpretation - STRENGHT ONLY
"
"
"Interpreter Name: DOM/SHS
"
"
"SUMMARY SHEET
"-------------
"'a' for calculating Qt: 0.800
"Value for Water Table (in m): 0
"Valid Zone Classification based on: Rf
"Method for calculating Su: Nkt , Su calculated for SBT 1-5 only
"Value of the constant Nkt: 18.000
"Define Zone 6 for Sand Parameters? YES
"Method for Friction Angle: KULHAWY AND MAYNE (1990), Phi Calculated for SBT 6-9 only
"
"Soil Behavior Type Zone Numbers
"For Rf Zone & Bq Zone Classification
"------------------------------------
"Zone #1=Sensitive fine grained Zone #7 =Sand with some Silt
"Zone #2=Organic material Zone #8 =Fine sand
"Zone #3=Clay Zone #9 =Sand
"Zone #4=Silty clay Zone #10=Gravelly sand
"Zone #5=Clayey silt Zone #11=Very stiff fine grained *
"Zone #6=Silty sand Zone #12=Sand to clayey sand *
" * Overconsolidated and/or cemented
"
"NOTE: DATA PRESENTED IS BASED ON GENERALLY ACCEPTED ENGINEERING CORRELATONS. IT IS THE RESPONSIBILTY OF THE USER TO EVALAUATE THE DATA AND METHODS USED FOR APPLICATION TO SPECIFIC PROJECTS. AVERAGING OF DATA WILL CAUSE DISTORTION OF DATA IN LAYERED PROFILES.

Note: --- = NOT A NUMBER - CALCULATION NOT VALID FOR SOIL BEHAVIOR TYPE)
SoundID: B05-102.DN-1
D tot: 14.042 (ft)
"
"

"depth "(feet)	q_tAvg (tsf)	f_sAvg (tsf)	u_2Avg (psi)	Phi (deg)	Su (psf)
0.7	89.229	0.474	0.018	40	---
1.0	103.606	0.617	0.029	40	---
2.0	45.963	0.799	0.027	40	---
3.0	66.227	0.478	0.051	40	---
4.0	73.275	0.483	0.044	40	---
5.0	112.290	0.974	-0.062	40	---
6.0	167.107	0.778	-0.198	40	---
7.0	138.770	1.212	-0.241	40	---
8.0	73.686	0.368	-0.289	40	---
9.0	52.878	0.176	-0.306	40	---
10.0	43.453	0.170	-0.312	39	---
11.0	33.460	0.280	-0.300	37	---
12.0	20.429	0.477	-0.274	---	2189.711
13.0	23.424	1.144	-0.246	---	2516.268
13.5	52.547	0.998	-0.235	---	5748.622

Output file from SITELOG
SoundID: B05-102.DN-2
"======================================
"

"Developed by: FOUNDATION ALTERNATIVES FOR SESI
" Program: Piezocone Interpretation - STRENGHT ONLY
"
"

"Interpreter Name: DOM/SHS
"
"

"SUMMARY SHEET
"-------------
"'a' for calculating Qt: 0.800
"Value for Water Table (in m): 0
"Valid Zone Classification based on: Rf
"Method for calculating Su: Nkt , Su calculated for SBT 1-5 only
"Value of the constant Nkt: 18.000
"Define Zone 6 for Sand Parameters? YES
"Method for Friction Angle: KULHAWY AND MAYNE (1990), Phi Calcualated for SBT 6-9 only
"

"Soil Behavior Type Zone Numbers
"For Rf Zone & Bq Zone Classification
"--

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Note: --- = NOT A NUMBER - CALCULATION NOT VALID FOR SOIL BEHAVIOR TYPE)
SoundID: B05-102.DN-2
D tot: 13.9108 (ft)
"
"

"depth "(feet)	q_tAvg (tsf)	f_sAvg (tsf)	u_2Avg (psi)	Phi (deg)	Su (psf)
0.7	79.624	0.355	0.036	40	---
1.0	111.867	0.633	0.031	40	---
2.0	61.725	1.053	-0.043	40	---
3.0	20.326	0.419	-0.097	---	2238.996
4.0	7.463	0.215	-0.101	---	803.604
5.0	10.637	0.169	-0.096	---	1150.009
6.0	5.526	0.074	-0.015	---	576.292
7.0	3.877	0.013	0.003	---	386.662
8.0	24.462	0.064	0.032	37	---
9.0	21.765	0.122	0.030	36	---
10.0	26.079	0.197	0.053	36	---
11.0	21.429	0.257	0.084	35	---
12.0	15.584	0.528	0.139	---	1655.436
13.0	17.656	0.537	0.177	---	1879.470
13.4	95.458	0.697	0.162	40	---

"Output file from SITELOG
SoundID: B05-102.DN-3
"======================================
"

"Developed by: FOUNDATION ALTERNATIVES FOR SESI
" Program: Piezocone Interpretation - STRENGHT ONLY
"
"

"Interpreter Name: DOM/SHS
"
"

"SUMMARY SHEET
"-------------

"'a' for calculating Qt: 0.800
"Value for Water Table (in m): 0
"Valid Zone Classification based on: Rf
"Method for calculating Su: Nkt , Su calculated for SBT 1-5 only
"Value of the constant Nkt: 18.000
"Define Zone 6 for Sand Parameters? YES
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"

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Note: --- = NOT A NUMBER - CALCULATION NOT VALID FOR SOIL BEHAVIOR TYPE)
SoundID: B05-102.DN-3
D tot: 13.9764 (ft)
"
"

"depth "(feet)	q_tAvg (tsf)	f_sAvg (tsf)	u_2Avg (psi)	Phi (deg)	Su (psf)
0.7	95.475	0.684	-0.020	40	---
1.0	80.464	0.853	-0.028	40	---
2.0	22.836	0.568	-0.032	---	2524.338
3.0	6.990	0.245	-0.044	---	757.019
4.0	5.186	0.113	0.001	---	550.452
5.0	43.480	0.191	0.031	40	---
6.0	136.467	0.577	-0.317	40	---
7.0	116.322	0.870	-0.271	40	---
8.0	99.586	0.316	-0.417	40	---
9.0	32.077	0.298	-0.443	37	---
10.0	31.974	0.116	-0.282	37	---
11.0	25.654	0.156	-0.049	36	---
12.0	9.271	0.242	0.472	---	951.361
13.0	8.736	0.411	-0.459	---	885.773
13.5	75.971	0.444	-0.441	40	---

"Output file from SITELOG
SoundID: B05-102.DS-1
"==
"
"Developed by: FOUNDATION ALTERNATIVES FOR SESI
" Program: Piezocone Interpretation - STRENGHT ONLY
"
"
"Interpreter Name: DOM/SHS
"
"
"SUMMARY SHEET
"-------------
"'a' for calculating Qt: 0.800
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"Valid Zone Classification based on: Rf
"Method for calculating Su: Nkt , Su calculated for SBT 1-5 only
"Value of the constant Nkt: 18.000
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Note: --- = NOT A NUMBER - CALCULATION NOT VALID FOR SOIL BEHAVIOR TYPE)
SoundID: B05-102.DS-1
D tot: 46.7848 (ft)
"
"
"

"depth "(feet)	q_tAvg (tsf)	f_sAvg (tsf)	u_2Avg (psi)	Phi (deg)	Su (psf)
0.7	116.633	0.673	0.038	40	---
1.0	134.666	0.983	0.048	40	---
2.0	74.317	1.401	0.025	40	---
3.0	60.068	0.715	-0.026	40	---
4.0	26.528	0.584	-0.030	39	---
5.0	21.377	0.198	-0.038	37	---
6.0	13.863	0.083	-0.023	35	---
7.0	8.634	0.070	-0.022	---	914.194
8.0	44.570	0.147	-0.084	39	---
9.0	39.441	0.135	-0.150	39	---
10.0	37.590	0.169	-0.147	38	---
11.0	16.689	0.248	-0.095	34	---
12.0	15.844	0.362	-0.027	---	1682.855
13.0	28.733	0.456	0.000	36	---
14.0	145.997	0.667	-0.034	40	---
15.0	148.807	0.875	-0.101	40	---

16.0	171.849	0.757	-0.088	40	---
17.0	146.894	0.841	-0.089	40	---
18.0	105.014	0.576	-0.090	40	---
19.0	57.566	0.333	-0.085	38	---
20.0	53.698	0.277	-0.087	38	---
21.0	34.171	0.428	-0.077	36	---
22.0	31.583	0.248	-0.012	35	---
23.0	35.108	0.261	0.073	36	---
24.0	28.510	0.143	0.125	35	---
25.0	23.375	0.148	0.153	34	---
26.0	18.840	0.151	0.194	32	---
27.0	19.019	0.763	0.455	---	1936.516
28.0	13.076	0.845	0.771	---	1269.588
29.0	7.162	0.419	1.085	---	606.433
30.0	25.648	0.260	0.949	34	---
31.0	46.702	0.315	0.626	36	---
32.0	46.595	0.237	0.571	36	---
33.0	55.040	0.256	0.581	37	---
34.0	64.296	0.273	0.597	38	---
35.0	43.485	0.325	0.613	36	---
36.0	18.425	0.268	0.652	32	---
37.0	10.155	0.152	0.747	---	886.747
38.0	13.595	0.078	0.842	30	---
39.0	12.747	0.115	0.976	30	---
40.0	9.868	0.104	1.107	---	835.661
41.0	6.619	0.104	1.267	---	468.390
42.0	6.667	0.102	1.501	---	467.556
43.0	8.303	0.175	1.674	---	643.111
44.0	6.726	0.118	1.853	---	461.321
45.0	7.198	0.202	2.076	---	507.569
46.0	6.994	0.134	2.304	---	478.726
46.3	21.698	0.159	2.266	---	2110.602

"Output file from SITELOG
"==================================
"

"Developed by: FOUNDATION ALTERNATIVES FOR SESI
"   Program: Piezocone Interpretation   - STRENGHT ONLY
"
"
"Interpreter Name: DOM/SHS
"
"
"SUMMARY SHEET
"-------------
"'a' for calculating Qt: 0.800
"Value for Water Table (in m): 0
"Valid Zone Classification based on: Rf
"Method for calculating Su: Nkt , Su calculated for SBT 1-5 only
"Value of the constant Nkt: 18.000
"Define Zone 6 for Sand Parameters? YES
"Method for Friction Angle: KULHAWY AND MAYNE (1990), Phi Calcualated for SBT 6-9 only
"
"Soil Behavior Type Zone Numbers
"For Rf Zone & Bq Zone Classification
"-----------------------------------
"Zone #1=Sensitive fine grained   Zone #7 =Sand with some Silt
"Zone #2=Organic material   Zone #8 =Fine sand
"Zone #3=Clay   Zone #9 =Sand
"Zone #4=Silty clay   Zone #10=Gravelly sand
"Zone #5=Clayey silt   Zone #11=Very stiff fine grained *
"Zone #6=Silty sand   Zone #12=Sand to clayey sand *
" * Overconsolidated and/or cemented
"

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"Note: --- = NOT A NUMBER - CALCULATION NOT VALID FOR SOIL BEHAVIOR TYPE)
"
"
"

"depth "(feet)	q_tAvg (tsf)	f_sAvg (tsf)	u_2Avg (psi)	Phi (deg)	Su (psf)
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1.0	137.331	1.082	0.038	40	---
2.0	151.789	1.352	0.026	40	---
3.0	116.090	1.101	-0.005	40	---
4.0	129.881	0.690	-0.015	40	---
5.0	61.369	0.632	-0.043	40	---
6.0	32.060	0.323	-0.070	38	---
7.0	4.806	0.150	-0.012	---	487.563
8.0	3.297	0.134	0.027	---	314.828
9.0	12.657	0.096	0.051	33	---
10.0	9.190	0.095	0.071	---	957.759
11.0	5.282	0.081	0.094	---	516.921
12.0	7.842	0.122	0.125	---	795.207
13.0	9.079	0.137	0.169	---	926.468
14.0	6.346	0.154	0.223	---	616.587
15.0	13.976	0.116	0.245	---	1457.730
16.0	54.784	0.207	0.260	39	---
17.0	95.423	0.385	0.281	40	---
18.0	117.052	0.634	0.292	40	---

19.0	100.647	0.569	0.295	40	---
20.0	79.166	0.502	0.295	40	---
21.0	66.548	0.385	0.297	39	---
22.0	50.988	0.293	0.306	38	---
23.0	37.938	0.212	0.316	36	---
24.0	26.665	0.131	0.325	34	---
25.0	15.655	0.269	0.381	---	1577.622
26.0	7.453	0.347	0.519	---	660.204
27.0	7.430	0.282	0.587	---	651.610
28.0	7.539	0.370	0.666	---	657.160
29.0	31.055	0.241	0.662	35	---
30.0	51.046	0.322	0.578	37	---
31.0	71.632	0.264	0.585	38	---
32.0	67.212	0.253	0.590	38	---
33.0	61.795	0.236	0.594	38	---
34.0	58.659	0.242	0.599	37	---
35.0	24.676	0.220	0.600	33	---
36.0	11.285	0.143	0.629	---	1020.732
37.0	10.580	0.080	0.690	---	936.144
38.0	9.941	0.077	0.794	---	858.899
39.0	8.719	0.113	0.923	---	716.910
40.0	7.121	0.114	1.032	---	532.683
41.0	6.804	0.111	1.149	---	491.213
42.0	7.261	0.138	1.405	---	535.796
43.0	7.210	0.139	1.558	---	523.916
44.0	6.787	0.218	1.668	---	470.207
45.0	7.138	0.187	1.794	---	503.110
45.9	103.538	0.360	1.432	39	---

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"Developed by: FOUNDATION ALTERNATIVES FOR SESI
"     Program: Piezocone Interpretation    - STRENGHT ONLY
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"
"Interpreter Name: DOM/SHS
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"SUMMARY SHEET
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"Valid Zone Classification based on:      Rf
"Method for calculating Su:               Nkt , Su calculated for SBT 1-5 only
"Value of the constant Nkt:               18.000
"Define Zone 6 for Sand Parameters?       YES
"Method for Friction Angle:               KULHAWY AND MAYNE (1990), Phi Calcualated
for SBT 6-9 only
"
"Soil Behavior Type Zone Numbers
"For Rf Zone & Bq Zone Classification
"------------------------------------
"Zone #1=Sensitive fine grained      Zone #7 =Sand with some Silt
"Zone #2=Organic material            Zone #8 =Fine sand
"Zone #3=Clay                        Zone #9 =Sand
"Zone #4=Silty clay                  Zone #10=Gravelly sand
"Zone #5=Clayey silt                 Zone #11=Very stiff fine grained *
"Zone #6=Silty sand                  Zone #12=Sand to clayey sand *
"   * Overconsolidated and/or cemented
"
"NOTE: DATA PRESENTED IS BASED ON GENERALLY ACCEPTED ENGINEERING CORRELATONS.
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FOR APPLICATION TO SPECIFIC PROJECTS. AVERAGING OF DATA WILL CAUSE DISTORTION
OF DATA IN LAYERED PROFILES.

 Note: ---  = NOT A NUMBER - CALCULATION NOT VALID FOR SOIL BEHAVIOR TYPE)
 SoundID:       B05-102.DS-4
 D tot: 6.95538 (ft)
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"depth "(feet)	q_tAvg (tsf)	f_sAvg (tsf)	u_2Avg (psi)	Phi (deg)	Su (psf)
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1.0	125.252	0.778	0.033	40	---
2.0	42.784	0.570	0.049	40	---
3.0	56.870	0.428	0.072	40	---
4.0	64.152	0.405	0.071	40	---
5.0	55.823	0.311	0.067	40	---
6.0	79.968	0.569	0.076	40	---
6.5	113.015	0.648	0.085	40	---

"Output file from SITELOG
SoundID: B05-102.DS-4A
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"Developed by: FOUNDATION ALTERNATIVES FOR SESI
" Program: Piezocone Interpretation - STRENGHT ONLY
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"
"Interpreter Name: DOM/SHS
"
"
"SUMMARY SHEET
"-------------
"'a' for calculating Qt: 0.800
"Value for Water Table (in m): 0
"Valid Zone Classification based on: Rf
"Method for calculating Su: Nkt , Su calculated for SBT 1-5 only
"Value of the constant Nkt: 18.000
"Define Zone 6 for Sand Parameters? YES
"Method for Friction Angle: KULHAWY AND MAYNE (1990), Phi Calcualated for SBT 6-9 only
"
"Soil Behavior Type Zone Numbers
"For Rf Zone & Bq Zone Classification
"-----------------------------------
"Zone #1=Sensitive fine grained Zone #7 =Sand with some Silt
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"Zone #3=Clay Zone #9 =Sand
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"
"NOTE: DATA PRESENTED IS BASED ON GENERALLY ACCEPTED ENGINEERING CORRELATONS. IT IS THE RESPONSIBILTY OF THE USER TO EVALAUATE THE DATA AND METHODS USED FOR APPLICATION TO SPECIFIC PROJECTS. AVERAGING OF DATA WILL CAUSE DISTORTION OF DATA IN LAYERED PROFILES.

Note: --- = NOT A NUMBER - CALCULATION NOT VALID FOR SOIL BEHAVIOR TYPE)
SoundID: B05-102.DS-4A
D tot: 47.769 (ft)
"
"
"

"depth "(feet)	q_tAvg (tsf)	f_sAvg (tsf)	u_2Avg (psi)	Phi (deg)	Su (psf)
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1.0	173.599	1.004	0.054	40	---
2.0	96.471	1.457	0.061	40	---
3.0	74.098	1.206	0.038	40	---
4.0	68.051	0.777	0.009	40	---
5.0	58.760	0.531	0.005	40	---
6.0	43.788	0.314	-0.009	40	---
7.0	62.485	0.465	-0.010	40	---
8.0	66.508	0.493	-0.010	40	---
9.0	46.631	0.271	-0.018	39	---
10.0	29.425	0.284	-0.050	37	---
11.0	23.825	0.136	-0.070	36	---
12.0	37.267	0.169	-0.064	37	---
13.0	35.447	0.318	-0.050	37	---
14.0	15.681	0.330	-0.023	---	1650.067
15.0	14.039	0.360	0.004	---	1461.077

16.0	34.758	0.322	0.033	36	---
17.0	124.324	0.366	0.026	40	---
18.0	144.124	0.892	0.006	40	---
19.0	128.513	0.424	-0.046	40	---
20.0	140.519	0.572	-0.042	40	---
21.0	129.982	0.543	-0.048	40	---
22.0	162.034	0.664	-0.034	40	---
23.0	183.852	0.784	-0.022	40	---
24.0	125.592	0.525	-0.030	40	---
25.0	72.991	0.426	-0.032	39	---
26.0	61.262	0.335	-0.019	38	---
27.0	43.782	0.258	-0.006	36	---
28.0	25.318	0.188	0.011	34	---
29.0	21.144	0.517	0.041	---	2156.379
30.0	25.730	1.638	0.125	---	2659.876
31.0	6.361	0.353	0.169	---	502.273
32.0	3.808	0.339	0.232	---	213.293
33.0	4.200	0.300	0.266	---	251.439
34.0	4.195	0.276	0.295	---	245.167
35.0	4.448	0.239	0.347	---	267.243
36.0	4.627	0.223	0.381	---	280.693
37.0	5.641	0.174	0.401	---	387.228
38.0	5.219	0.153	0.425	---	334.261
39.0	5.013	0.142	0.461	---	305.164
40.0	4.778	0.152	0.500	---	272.622
41.0	4.598	0.147	0.558	---	246.585
42.0	5.073	0.166	0.647	---	293.345
43.0	5.294	0.171	0.693	---	311.892
44.0	6.920	0.214	0.743	---	485.985
45.0	5.748	0.349	0.852	---	349.877
46.0	5.547	0.167	0.903	---	321.477
47.0	8.693	0.190	0.955	---	664.893
47.2	29.223	0.218	0.971	---	2944.489

Section 3 – West Dike at the Weir Across the Discharge Canal

Clayey Sand
120 pcf
100 psf
34 °

Clayey Silt
115 pcf
625 psf
10 °

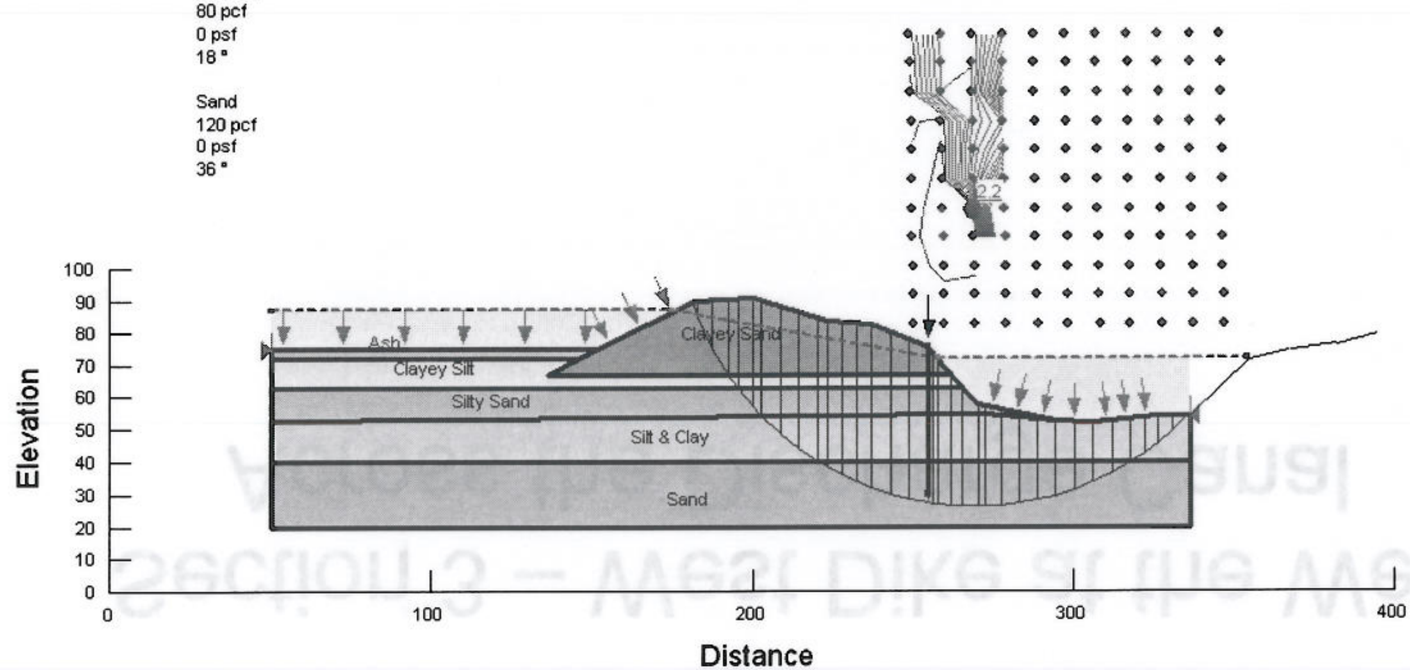
Silty Sand
120 pcf
100 psf
30 °

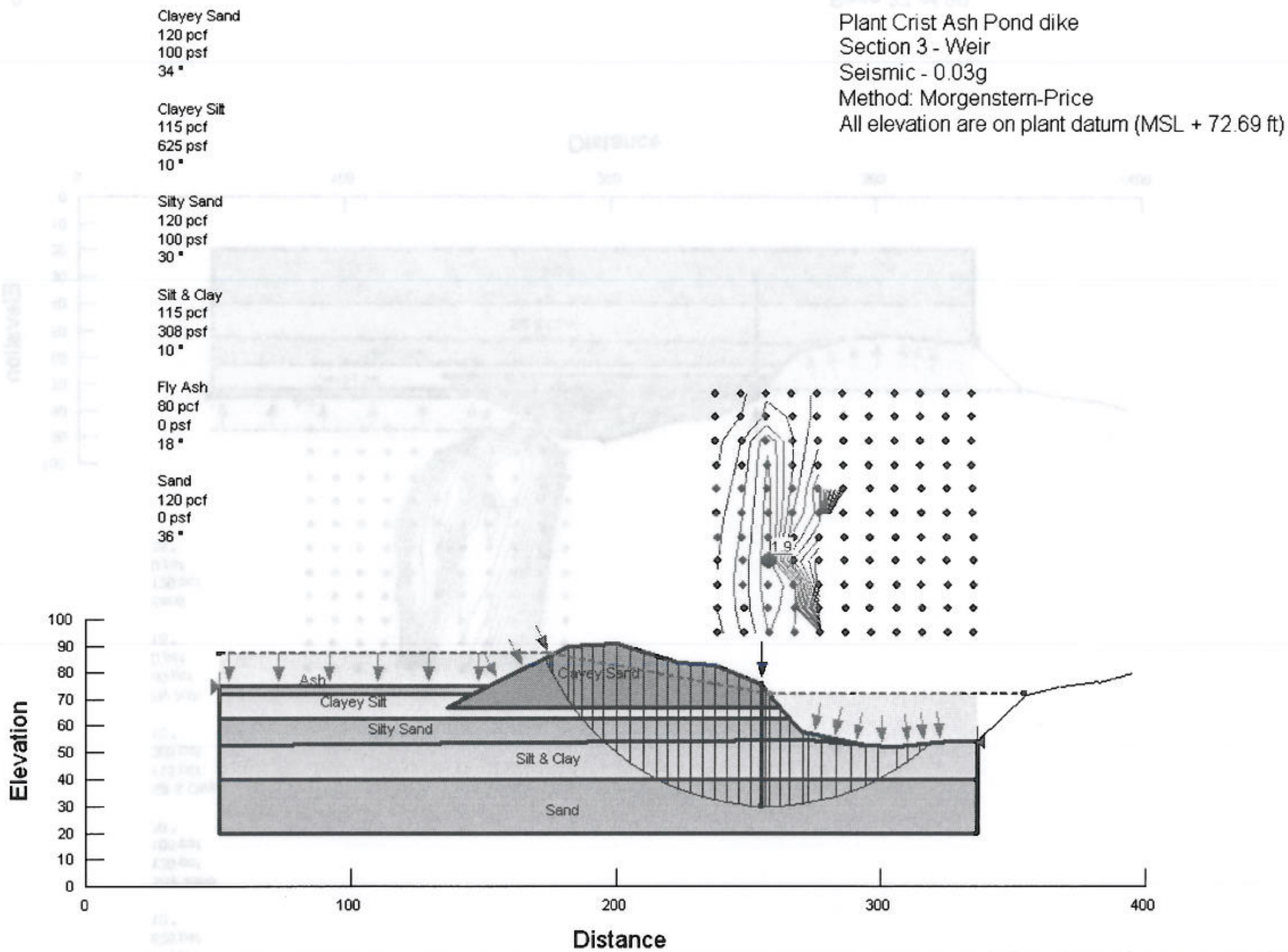
Silt & Clay
115 pcf
308 psf
10 °

Fly Ash
80 pcf
0 psf
18 °

Sand
120 pcf
0 psf
36 °

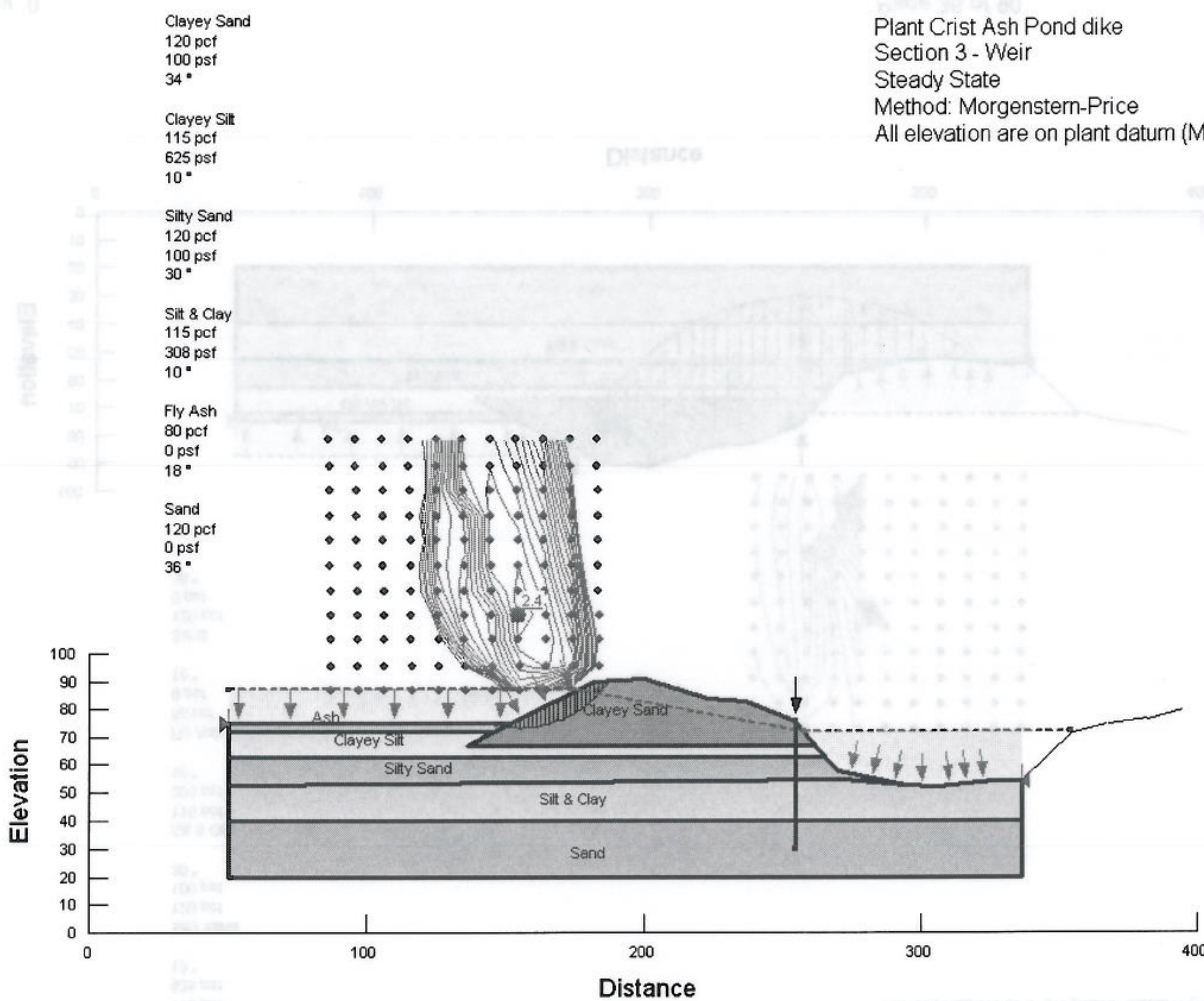
Plant Crist Ash Pond dike
Section 3 - Weir
Steady State
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)





CONFIDENTIAL BUSINESS INFORMATION

Plant Crist Ash Pond dike
Section 3 - Weir
Steady State
Method: Morgenstern-Price
All elevation are on plant datum (MSL + 72.69 ft)



Appendix A

Doc 05: Slope Stability Analyses of Gypsum Facility - Sedimentation and Return Water Ponds

EXHIBIT 5

Design Calculations

Southern Company Services, Inc.

Calculation Number
TV-CR-FPC104829-001

Project Plant Crist – Gypsum Storage Facility	**Discipline** Civil/Geotechnical
Objective Determine factor of safety of the Sedimentation and Return Water Ponds	**Job Number** FPC104829
Subject/Title Slope Stability Analysis of Gypsum Facility – Sedimentation and Return Water Ponds	

Design Engineer's Signature	Date	Last Page Number
Gerrad Wilson	1/24/14	7

Contents

Record of Revisions

Rev. No.	Description	Originator / Date	Reviewer / Date	Supervisor / Date
0	Approved	GWW/1/24/14	BJG/1-28-2014	JCP/1-28-2014

JAMES C. PEGUES LICENSE No. 52519 STATE OF FLORIDA ENGINEER

Purpose/Scope:

While operating as a fossil-fuel power station, Gulf Power Company's Plant Crist utilizes a flue gas desulfurization system (FGD scrubber) on Units 4 through 7 to remove sulfur dioxide (SO_2) from the exhaust flue gases. Through this process, gypsum is produced as a by-product and sluiced to an on-site storage facility for dewatering and long term storage. The Gypsum Storage Facility's clear water ponds were constructed with a compacted soil perimeter berm and a composite liner system, including a full underdrain system. This calculation is intended to calculate the stability of the perimeter berms of the clear water ponds.

Criteria:

The slope stability analyses were based on the most recent design and as-built drawings available at the time of this calculation. Soil and gypsum properties were obtained from the June 2007 *Plant Crist Gypsum Storage Area Hydrogeological and Geotechnical Investigation Report* by the Earth Science and Environmental Engineering (ES&EE) group of Southern Company Generation.

The following scenarios were evaluated for the maximum dike sections at the spillways. The locations of the stability sections are sketched on Figure 1

1. Steady State – Surcharge water elevation based ½ PMP.
2. Seismic Loading – Surcharge water elevation (½ PMP) plus pseudostatic horizontal seismic acceleration based on the USGS 2% probability of exceedance in 50 years hazard map.

Assumptions:

The slope stability model was run using the following assumptions:

- Pond water was treated as a surcharge load on the HDPE liner.
- Rapid drawdown not considered due to the interior HDPE liner preventing saturation of the underlying dike soil.
- Groundwater was assumed to be immediately below the liner.
- The properties of unit weight, phi angle, and cohesion of the soil and gypsum were taken from Table 4-7 of the geotechnical report.

Material properties are as follows:

Soil Type	Unit Weight, pcf	Cohesion, psf	Phi Angle, deg
In-place Silty Sand	110	100	30
Compacted Embankment	110	100	32

Equation Sources/Derivation Methods:

The calculation was performed using the following method and software:

GeoStudio 2012, Version 8.12.2.7663, Copyright 1991-2013 GEO-SLOPE International Ltd., Calgary, Alberta, Canada, using the Morgenstern-Price method.

Summary of Conclusions:

The results of the analyses are summarized below. Output graphics are located in the body of the calculations. The analyses indicate that the exterior pond dikes have adequate factors of safety for all analyzed cases.

Condition	Calculated Factor of Safety	Reference Factor of Safety
Sedimentation Pond - Steady State	2.07	1.5[1]
Sedimentation Pond - Seismic	1.85	1.1
Return Water Pond - Steady State	3.03	1.5[1]
Return Water Pond - Seismic	2.67	1.1

[1] US Army Corps of Engineers criteria for new earthen embankments (EM 1110-2-1902)

References:

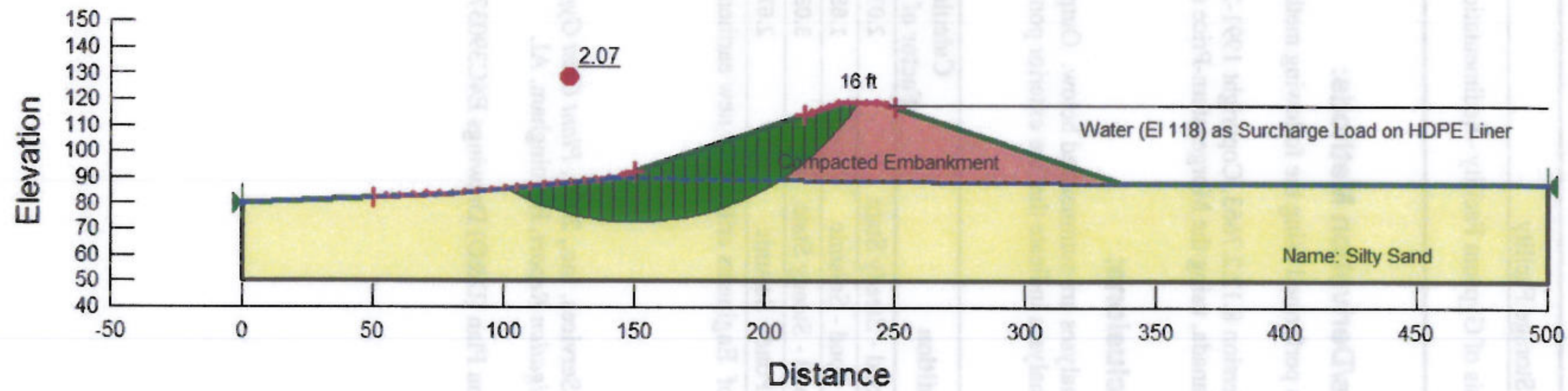
Southern Company Services, Inc., 2007, *Plant Crist Gypsum Storage Area, Hydrogeological and Geotechnical Investigation Report*, Birmingham, AL

Design and Operation Plan (D&O) Drawings E4C39037, E4C39039, and E4C39048

Calculation:

Project	Calculation Number
Plant Crist – Gypsum Storage Facility	TV-CR-FPC104829-001
Subject/Title	**Sheet**
Slope Stability Analysis of Gypsum Facility –Sedimentation/Return Water Pond(s)	4 of 7

Description: Plant Crist Gypsum Storage Facility
Comments: Process Sedimentation Pond
File Name: Crist ProcessSedimentation Pond Rev.gsz
Analysis Scenario: Steady State, 1' Freeboard
Analysis Method: Morgenstern-Price
Seismic Coefficient: horz: 0, vert: 0



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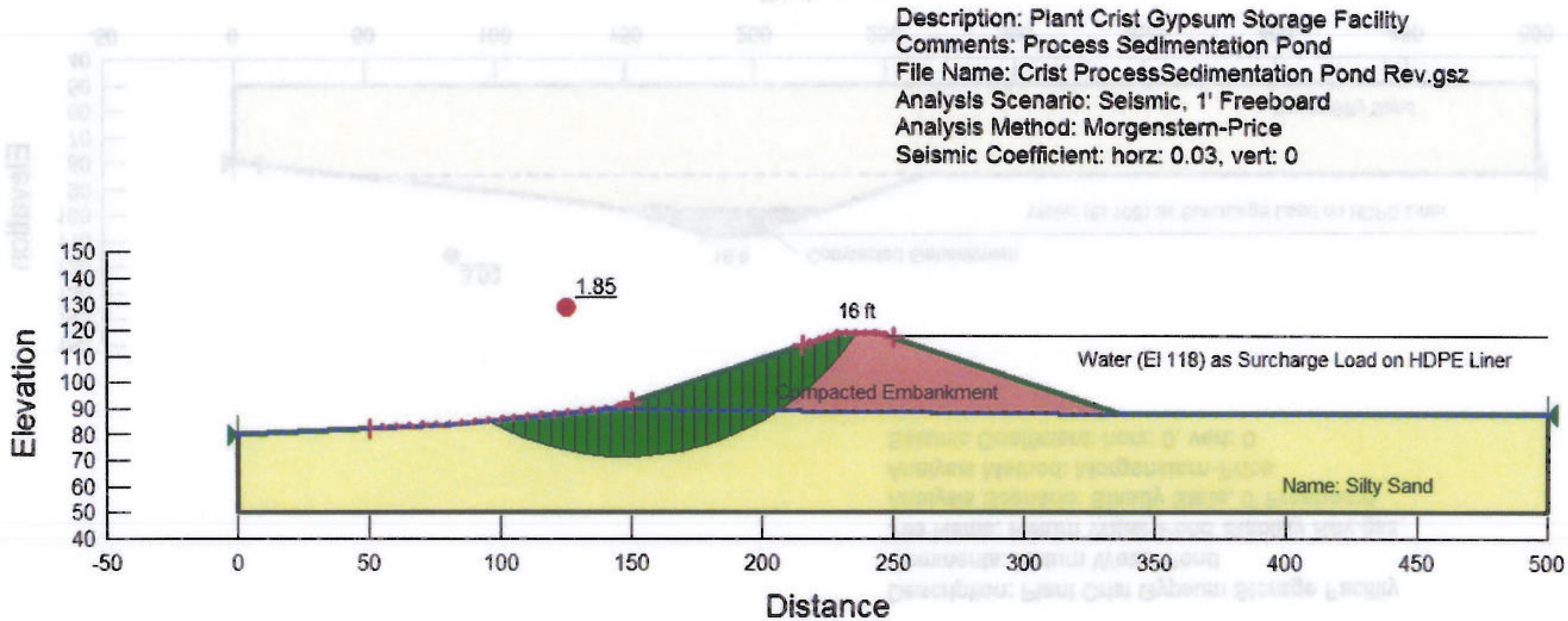
Name: Silty Sand Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 100 psf Phi': 30 °

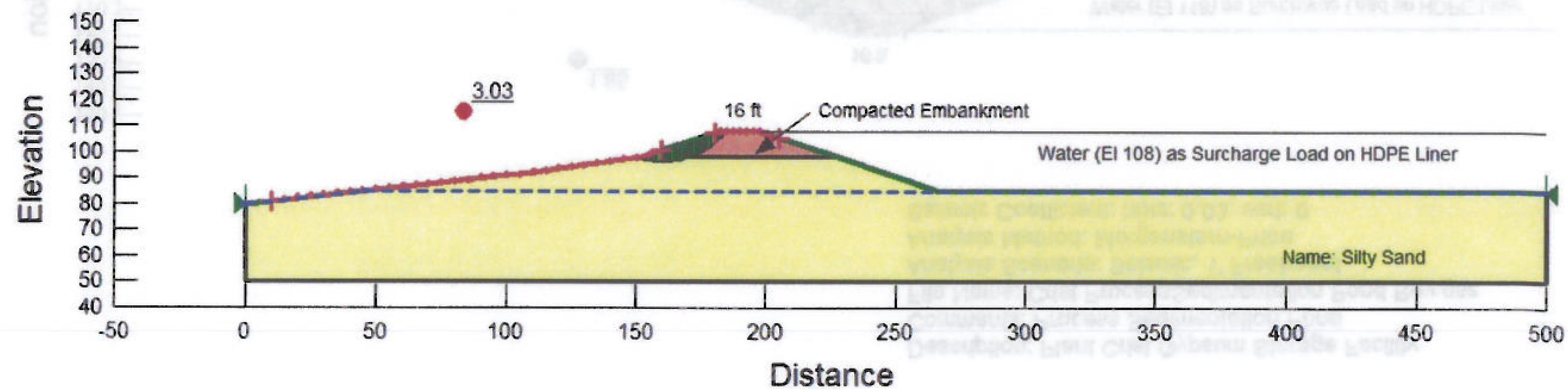
Project	Calculation Number
Plant Crist – Gypsum Storage Facility	TV-CR-FPC104829-001
Subject/Title	**Sheet**
Slope Stability Analysis of Gypsum Facility –Sedimentation/Return Water Pond(s)	5 of 7



Name: Compacted Backfill Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 100 psf Phi': 32 °
Name: Silty Sand Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 100 psf Phi': 30 °

Project	Calculation Number
Plant Crist – Gypsum Storage Facility	TV-CR-FPC104829-001
Subject/Title	**Sheet**
Slope Stability Analysis of Gypsum Facility –Sedimentation/Return Water Pond(s)	6 of 7

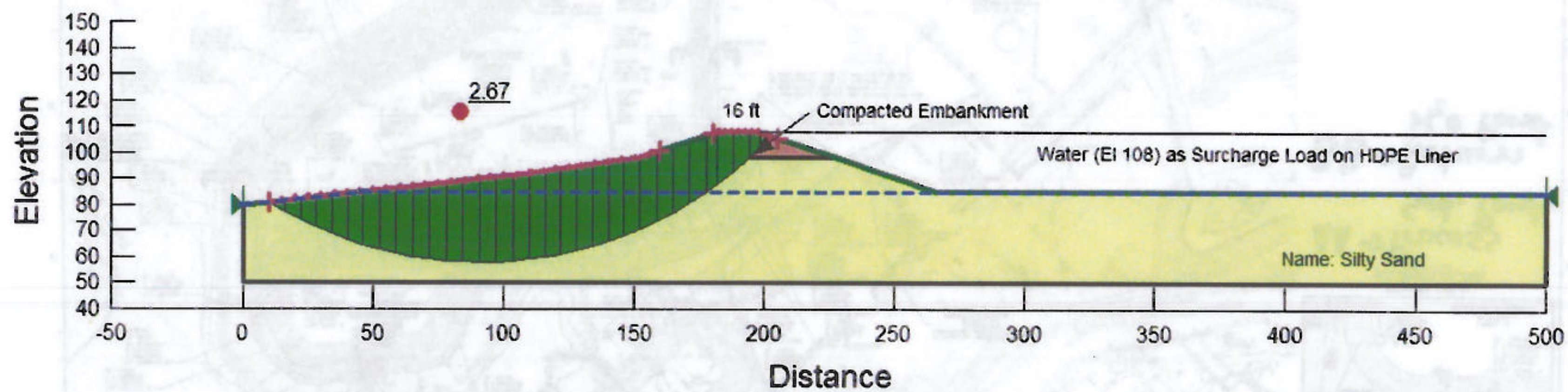
Description: Plant Crist Gypsum Storage Facility
Comments: Return Water Pond
File Name: Return Water Pond Stability Rev.gsz
Analysis Scenario: Steady State, 0' Freeboard
Analysis Method: Morgenstern-Price
Seismic Coefficient: horz: 0, vert: 0



Name: Compacted Embankment Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 100 psf Phi': 32 °
Name: Silty Sand Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 100 psf Phi': 30 °

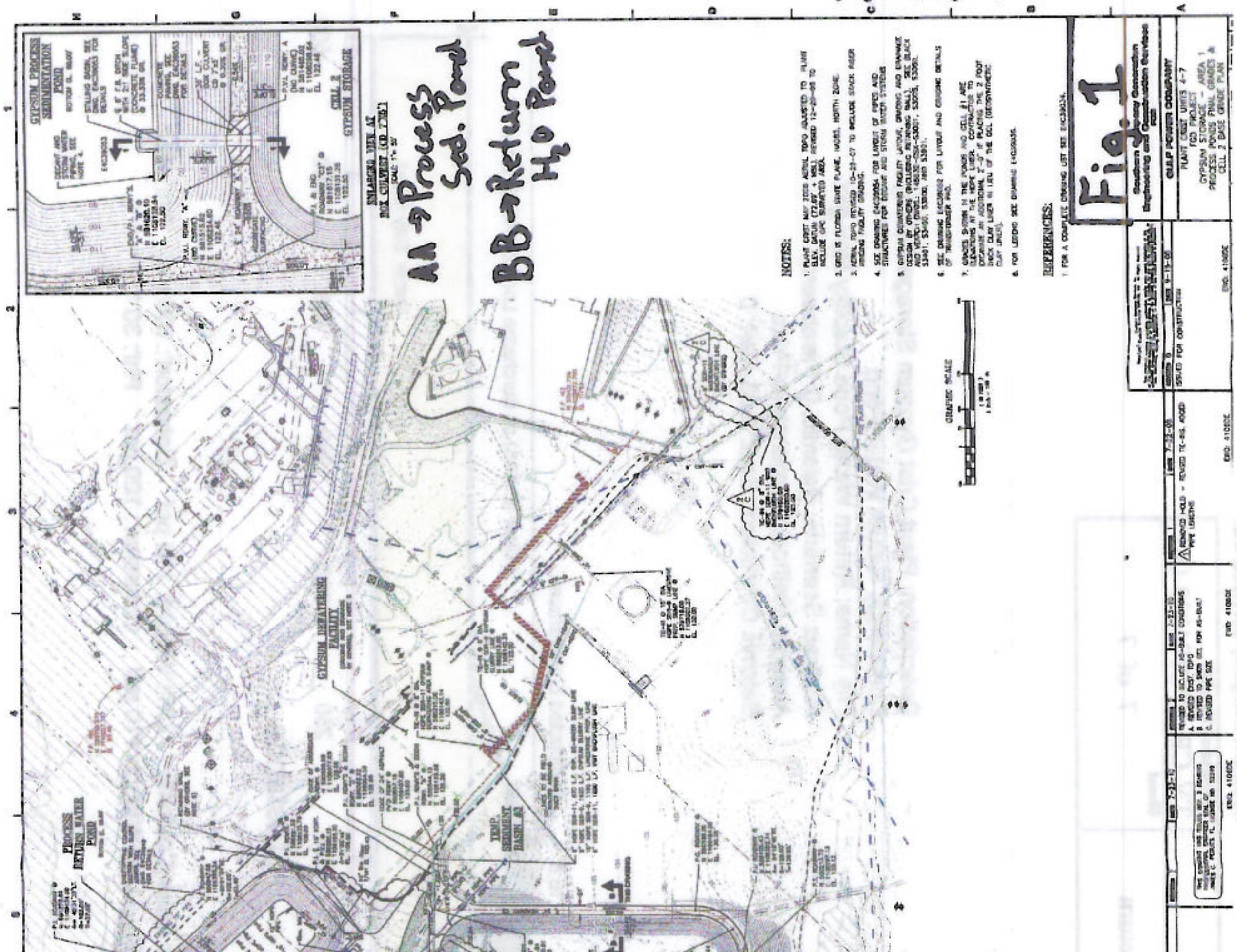
Project	Calculation Number
Plant Crist – Gypsum Storage Facility	TV-CR-FPC104829-001
Subject/Title	**Sheet**
Slope Stability Analysis of Gypsum Facility –Sedimentation/Return Water Pond(s)	7 of 7

Description: Plant Crist Gypsum Storage Facility
Comments: Return Water Pond
File Name: Return Water Pond Stability Rev.gsz
Analysis Scenario: Seismic, 0' Freeboard
Analysis Method: Morgenstern-Price
Seismic Coefficient: horz: 0.03, vert: 0



Name: Compacted Embankment Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 100 psf Phi': 32 °
Name: Silty Sand Model: Mohr-Coulomb Unit Weight: 110 pcf Cohesion': 100 psf Phi': 30 °

TV-CR-FPC104829



Appendix A

Doc 06: 50% PMP Analyses

for

Former Ash Pond and Gypsum Storage Area

EXHIBIT 4

SOUTHERN COMPANY

Energy to Serve Your World®

JAMES C. PEGUES LICENSE No. 52519 STATE OF FLORIDA PROFESSIONAL ENGINEER

Date: January 27, 2014

To: Mike Markey, Gulf Power

From: Ben Gallagher, PE
Jim Pegues, PE

Subject: **½ PMP Analysis for Former Ash Pond and Gypsum Storage Area**

We reviewed the hydrology of the Ash Pond and Gypsum Storage Area with respect to ½ PMP rainfall. Probable Maximum Precipitation (PMP) values are generalized estimates of theoretical maximum precipitation values for specific locations and durations. These values were published by the National Weather Service for use in hydrological evaluation.

At the Gypsum Storage Area (GSA), we found the active cell (Cell 2), process sedimentation pond, and return water pond each have adequate freeboard during a ½ PMP event. In the case of the return water pond, extreme conditions could result in freeboards less than 1 foot. However, this pond is lined with HDPE and the top of the dike is covered by gravel. Based on the small area of the pond and the protection provided by liner and gravel road, the freeboard is considered adequate, especially considering the overall capacity of the armored embankment spillway.

A summary of the results of our GSA review is present in the following table:

Area	Minimum Freeboard	Notes
Cell 2 – GSA	2.5 ft	
Process Sed. Pond – GSA	0.9 ft	Pond is lined and dike is gravel topped, and has emergency spillway
Return Water Pond - GSA	0.5 ft	Pond is lined and dike is gravel topped, and has emergency spillway.

We reviewed the previous hydrologic calculation for the former ash pond. In that calculation, the minimum freeboard was found to be 2.4 feet for the 100-year, 24-hour storm (14 inches total rainfall). Assuming no additional discharge, 1/2 PMP storm (23.6 inches total) will result in a 14-inch increase in water to a freeboard 1.3 feet, based on total drainage area to pond area ratio of 1.4 (that is, 1.4 times 9.6 inches, the difference between 23.6 inches and 14 inches.) A freeboard of 1.4 feet is adequate for this relatively small pond size.

Plant Crist Gypsum Storage Area Hydrologic and Hydraulic Analysis
Cell 2 Worst Case Rational Method Runoff

By: BJG **21-Jan-14**

The gypsum storage facility consists of a constructed, operating storage cell (Cell 2) and two ponds. Cell 1 is planned, if needed in the future, but has not been constructed. Cell 2 is drained by a concrete drop inlet decant structure connected to a 30" dia. HDPE pipe and a concrete box culvert and chute spillway. As Cell 2 is filled with gypsum, storage capacity is decreased and contributory area to the decant structure is reduced. The worst case stormwater condition is when Cell 2 is nearing completion, and there is negligible storage volume in the cell. In this case, all storm water flows overland to ditches and is discharged through the spillway. Use rational method to determine peak runoff and compare with spillway discharge curve to determine minimum freeboard at peak storm flow. Cell 2 phase II drawing E4C39039. Spillway drawing E4C39053.

Cell 2 Phase II Full - Time of Concentration Estimate				
	Sheetflow	Rills	Perimeter ditch	
Intensity	22.0			in/hr
Length	210	175	1500	ft
Roughness	0.1		0.018	
Slope	0.03	0.33333333	0.004	
Bottom			12	ft
Side Slope			1.5	
Depth			2.34	ft
Area			36.29	sf
Perimeter			20.44	ft
Hydraulic Radius			1.78	
Velocity			7.67	fps
Flow			278	cfs
Overland Travel Time	4.8			min
Shallow Channel Travel Time		3.1		min
Main Ditch Travel Time			3.3	min
Total Time of Concentration			11.2	min

Cell 2 Rainfall Intensity		
60-minute, 1-sq mile PMP (HMR 52 Fig 24)		19.4 in
5 minute to 60 minute ratio (HMR 52 Fig 36)		0.319
15 minute to 60 minute ratio (HMR 52 Fig 37)		0.49
Interpolated ratio for time of concentration:	11.2 min	0.43
PMP (inches) for time of concentration:	11.2 min	8.2 in
PMP Intensity		44 in/hr
1/2 PMP Intensity		22.1 in/hr

Rational Method Peak Runoff - Cell 2 Phase II Full		
Runoff Coefficent	0.9	(relatively impervious)
Rainfall Intensity	22	in/hr
Area	14	acres
Peak Runoff at Cell 2 Spillway	278	cfs

Cell 2 Spillway Discharge Curve
Spillway is a 7'x5' concrete box culvert
Control is as broadcrested weir

Roughness	0.012
Slope	0.003

Elevation	Depth ft	Discharge cfs	Min. Freeboard ft
115.73	0		
115.93	0.2	15	
116.13	0.4	30	
116.33	0.6	45	
116.53	0.8	60	
116.73	1	75	
116.93	1.2	90	
117.13	1.4	106	
117.33	1.6	121	
117.53	1.8	136	
117.73	2	151	
117.93	2.2	166	
118.13	2.4	181	
118.33	2.6	196	
118.53	2.8	211	
118.73	3	226	
118.93	3.2	241	
119.13	3.4	256	
119.33	3.6	271	
119.53	*3.8*	*286*	*2.5*
119.73	4	301	
119.93	4.2	317	
120.13	4.4	332	
120.33	4.6	347	
120.53	4.8	362	
120.73	5	377	

Cell 2 Spillway can discharge the peak flow from 1/2 PMP event with a minimum freeboard of 2.5 feet.

Calculation Number:

Plant Crist Gypsum Process Sedimentation Pond

Storage Routing Analysis

date: 1-24-2014 by: BJG

The gypsum storage facility consists of a constructed, operating storage cell (Cell 2) and two ponds. Cell 1 is planned, if needed in the future, but has not been constructed. The process sedimentation pond and return water pond manage all stormwater runoff for the gypsum storage area. The combined ponds are sized to zero discharge back to back 100-year, 24-hour storm flows from entire facility, including potential future Cell 1

Process Pond:

Receives runoff from Gypsum Storage Area Cell 2 via box culvert and concrete chute spillway

Primary discharge is concrete drop inlet with 36" HDPE to Return Water Pond

Water level in process pond is normally controlled by pumping from return water pond

For events in excess of design, overtopping control provided by gravel covered broad crest spillway

Process Pond Storage Curve (from as-built data)			
Notes	Water Elevation	Incremental Volume	Total Volume
		1000 cf	1000 cf
Top of Dike	119	206	4305
	118	205	4099
Spillway	117	202	3894
	116	197	3692
	115	192	3495
	114	187	3304
	113	182	3117
	112	177	2935
	111	172	2758
	110	167	2586
	109	162	2419
	108	158	2257
	107	153	2099
	106	149	1946
	105	144	1797
	104	140	1653
	103	135	1513
	102	131	1378
	101	127	1247
	100	122	1121
	99	118	998
	98	114	880
	97	110	766
	96	106	656
	95	102	549
	94	98	447
	93	94	349
	92	91	255
	91	87	164
	90	55	77
	89	22	22
Bottom of Pond	88	0	0

Process Pond Overtopping Control Broadcrested Spillway Curve (SCS TR39 spillway from Haan, Barfield, Hayes 1994)		
Freeboard	Head	Discharge
Feet	Feet	cfs
0	2	177
0.1	1.9	161
0.2	1.8	145
0.3	1.7	131
0.4	1.6	117
0.5	1.5	104
0.6	1.4	92
0.7	1.3	80
0.8	1.2	69
0.9	1.1	59
1	1	50
1.1	0.9	41
1.2	0.8	33
1.3	0.7	25
1.4	0.6	19
1.5	0.5	14
1.6	0.4	9.4
1.7	0.3	5.4
1.8	0.2	2.3
1.9	0.1	0.2

HMR 52 Data, 1-sq mile, 1/2 PMP			
Duration	Rainfall	Intensity	Notes
min	in	in/hr	
5	3.1	37.1	
11.2	4.1	22.1	by interpolation
15	4.8	19.0	
30	7.1	14.2	
45	8.4	11.2	by interpolation
60	9.7	9.7	
120	11.0	5.5	by interpolation
240	13.6	3.4	by interpolation
360	16.2	2.7	HMR51, 10-sq mile

Calculation Number:

Plant Crist Gypsum Process Sedimentation Pond

Storage Routing Analysis

date: 1-24-2014 by: BJG

Cell 2 Worst Case Peak Flow is 278 cfs based on Rational Method Analysis of 1/2 PMP rain with time of concentration of 11.2 min for peak of storm. Use modfied rational triangle hydrograph and storage routing to evaluate process pond spillway flow during peak. Spillway design from drawing E4C39049.

Assumptions:

- Drop inlet is plugged (no flow to Return Water Pond)
- Peak occurs when pond is holding water from in back to back 100-year, 24-hour events
- Beginning water elevation is at the spillway (El 117), 2 feet below low point of dike (El 119).

	Inflow		Pond				Outflow		
Time	Incremental Cell 2 Discharge	Incremental Pond Rainfall	Additional Stored Volume	Water Elevation	Freeboard	Head	Spillway Discharge	Incremental Volume Dischaged	
minutes	cf	cf	cf		ft	ft	cfs	cf	
0	0	0	0	116.0	3.0	0	0	0	
2	2979	6000	8979	117.0	2.0	0.0	0	0	
4	8936	6000	23914	117.1	1.9	0.1	0	0	
6	14893	6000	44669	117.2	1.8	0.2	2.3	138	
8	20850	6000	71057	117.3	1.7	0.3	5.4	462	
10	26807	6000	102700	117.5	1.5	0.5	14	1164	
11.2	18944	3600	124056	117.6	1.4	0.6	19	1188	
13	28579	5400	155227	117.8	1.2	0.8	33	2808	
15	27086	6000	183873	117.9	1.1	0.9	41	4440	
17	20297	6000	204710	118.0	1.0	1.0	50	5460	
19	13115	6000	217285	118.1	0.9	1.1	59	6540	
21	7128	6000	223333	118.1	0.9	1.1	59	7080	
23	*3147*	*6000*	*225400*	*118.1*	*0.9*	*1.1*	*59*	*7080*	-min. freeboard
25	1070	6000	225391	118.1	0.9	1.1	59	7080	
27	257	6000	224567	118.1	0.9	1.1	59	7080	
29	36	6000	223523	118.1	0.9	1.1	59	7080	
29.9	1	2700	223038	118.1	0.9	1.1	59	3186	
30	0	300	222984	118.1	0.9	1.1	59	354	
40	0	0	190284	117.9	1.1	0.9	50	32700	
50	0	0	162984	117.8	1.2	0.8	41	27300	
60	0	0	143184	117.7	1.3	0.7	25	19800	
70	0	0	129984	117.6	1.4	0.6	19	13200	
80	0	0	118584	117.6	1.4	0.6	19	11400	
90	0	0	108684	117.5	1.5	0.5	14	9900	
180	0	0	56304	117.3	1.7	0.3	5.4	52380	
360	0	0	14724	117.1	1.9	0.1	2.3	41580	
540	0	0	2304	117.0	2.0	0.0	0	12420	

Calculation Number:

Plant Crist Gypsum Return Water Pond

Inflow and Outflow Capacity Comparison

date: 1-24-2014 by: BJG

The gypsum storage facility consists of a constructed, operating storage cell (Cell 2) and two ponds. Cell 1 is planned, if needed in the future, but has not been constructed. The process sedimentation pond and return water pond manage all stormwater runoff for the gypsum storage area. The combined ponds are sized to zero discharge back to back 100-year, 24-hour storm flows from entire facility, including potential future Cell 1

Return Pond:

Recieves runoff from the process sedimentation pond and dewatering area via 30"/42" HDPE pipe system

Primary drainage from pond is recycle to plant via pumps

For events in excess of design, overtopping control provided by gravel covered broad crest spillway

Flow of stormwater into return water pond is limited by hydraulic capacity of HDPE pipe system from the process sediment pond and dewatering area. Worst case condition is process sediment pond flooded to 1.4 foot of freeboard (see process sedimentation pond analysis), return water pond is already flooded to spillway due to previous storms, and the gate valve between ponds is open. *The gate valve between ponds is normally closed before the return pond reaches spillway elevation to maximize storage capacity. Closing the valve would significant reduce needed spillway capacity in the return pond, making this analysis conservative.* Compare discharge curve for HDPE pipe system with broad-crested spillway discharge curve to determine minimum freeboard. Process sediment pond discharge pipe from drawings E4C39050 through E4C39054. Spillway design from drawing E4C39049. Storage capacity of return water pond is ignored. Normal capacity of recycle pumps is negligble (5 cfs) and is ignored.

Process Sediment Pond and Dewatering Area Discharge Curve (Darcy-Weisbach pipe flow with minor losses for junction boxes by FHWA approximate method)					Return Pond Overtopping Control Broadcrested Spillway Curve (SCS TR39 spillway from Haan, Barfield, Hayes 1994)		
Process Pond Water Elev.	Return Water Elev.	Pipe Velocity (42-inch HDPE)	Discharge		Freeboard	Head	Discharge
		fps	cfs		Feet	Feet	cfs
118.1	108	9.9	96		0	2	177
118.1	107.9	10.0	96		0.1	1.9	161
118.1	107.8	10.0	96		0.2	1.8	145
118.1	107.7	10.1	97		0.3	1.7	131
118.1	107.6	10.1	97		0.4	1.6	117
118.1	*107.5*	*10.2*	*98*	*- minimum freeboard -*	*0.5*	*1.5*	*104*
118.1	*107.4*	*10.2*	*98*		*0.6*	*1.4*	*92*
118.1	107.3	10.2	99		0.7	1.3	80
118.1	107.2	10.3	99		0.8	1.2	69
118.1	107.1	10.3	99		0.9	1.1	59
118.1	107	10.4	100		1	1	50
118.1	106.9	10.4	100		1.1	0.9	41
118.1	106.8	10.5	101		1.2	0.8	33
118.1	106.7	10.5	101		1.3	0.7	25
118.1	106.6	10.5	101		1.4	0.6	19
118.1	106.5	10.6	102		1.5	0.5	14
118.1	106.4	10.6	102		1.6	0.4	9.4
118.1	106.3	10.7	103		1.7	0.3	5.4
118.1	106.2	10.7	103		1.8	0.2	2.3
118.1	106.1	10.7	103		1.9	0.1	0.2

Appendix A

Doc 07: Gypsum Storage Area Hydrogeological and Geological Report June 2007

PLANT CRIST
GYPSUM STORAGE AREA

HYDROGEOLOGICAL AND GEOTECHNICAL INVESTIGATION REPORT

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June 2007

David W. Morris Approval	Date
Revision #	Date

PLANT CRIST
GYPSUM STORAGE AREA

HYDROGEOLOGICAL AND GEOTECHNICAL INVESTIGATION REPORT

for

Gulf Power Company

Prepared by

Earth Science and Environmental Engineering
Southern Company Generation

June 2007

PLANT CRIST
GYPSUM STORAGE AREA

HYDROGEOLOGICAL AND GEOTECHNICAL INVESTIGATION REPORT

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EXECUTIVE SUMMARY

The Gulf Power Company Crist Electric Generating Plant is located in Escambia County, approximately three miles above the mouth of the Escambia River. The plant has four coal-fired, electric-generating units. A Flue Gas Desulfurization (FGD) system is being installed on these units in order to reduce the sulfur dioxide emission from the plant. Gulf Power plans to sell and/or beneficially re-use greater than 50% of gypsum that is produced in the FGD process. Gypsum that is not sold will be stored at the site, which has been permitted for ash storage. This evaluation is being supplied for informational purposes since this site is exempt from Chapter 62-701 requirements due to selling or re-use of greater than 50% of gypsum.

Significant results of the hydrogeologic investigation include the following:

1. Five hydrogeologic units occur at Plant Crist:
    a. Unit 1/1A sandy perched aquifer and clay aquitard
    b. Unit 2 unconfined sandy aquifer
    c. Unit 3 silty clay aquitard
    d. Unit 4 silt and sandy clay semi-confining unit
    e. Unit 5 sandy lower aquifer
2. In the proposed gypsum storage areas:
    a. The Unit 1 perched aquifer does not occur in Area 1, and occurs over a limited portion of Area 2. The Unit 1A aquitard occurs in both areas.
    b. The Unit 3 does not occur beneath the gypsum storage areas.
    c. The Unit 4 occurs, but is discontinuous across the gypsum storage areas.
    d. The Unit 2 and Unit 5 aquifers are hydraulically connected across the site.
3. Groundwater flow direction occurs predominantly to the north and east toward surface water bodies Clear Creek, Governor's Bayou and the Escambia River with little seasonal variation. Average calculated horizontal hydraulic conductivities of the hydrogeologic Unit 2 and Unit 5 are 1.09×10^{-2} cm/sec and 1.37×10^{-2} cm/sec, respectively. Laboratory determined vertical hydraulic conductivities of the Unit 2 and Unit 5 are 2.39×10^{-3} cm/sec and 1.19×10^{-3} cm/sec, respectively.
4. Groundwater discharges into adjacent surface water bodies and flows east and south toward the Escambia River, and ultimately to Escambia Bay.
5. Background water quality has been monitored for ten years at the site as part of the groundwater monitoring program implemented for ash storage.

Significant results of the geotechnical investigation include the following:

1. The proposed site is located in Area IV indicating greater than 200 ft. of soil cover over the limestone bedrock. Sinkhole formation is not likely to occur.
2. The site is in a stable seismological area indicating that earthquakes are not probable in Florida and even with the largest expected, distant earthquake, damage would only be minor.
3. Due to the large spatial extents of the storage areas, bearing capacity failures should not occur
    a. The factor of safety against local bearing capacity failure for all cases is on the order of 10.
    b. The factor of safety against global bearing capacity failure for all cases is on the order of 50.
4. Subgrade settlements will occur as a result of the gypsum stacking operations.
    a. Total long term settlements in Area 1 may approach 45 inches when stacked to the design heights of less than 100 feet (actual stack design height is 91 feet).
    b. Total long term settlements in Area 2 may approach 50 inches when stacked to the design heights of less than 100 feet (actual stack design height is 88 feet).
5. Sand and gypsum berms will be constructed to store the gypsum.
    a. The factor of safety against sliding failure is greater than 1.3 for exterior berm heights to 80 feet above existing grade constructed on a 3 (H) : 1 (V) slope, with a single toe drain. The factor of safety against sliding failure is greater than 1.5 for exterior berm heights to 100 feet above existing grade constructed on a 3 (H) : 1 (V) slope, with multiple toe drains, one beneath each constructed berm.
    b. The factor of safety against sliding failure is greater than 2.3 for all interior berm heights constructed on a 3 (H) : 1 (V) slope, with a single toe drain. The factor of safety against sliding failure is greater than 2.5 for interior berm heights to 100 feet above existing grade constructed on a 3 (H) : 1 (V) slope, with multiple toe drains, one beneath each constructed berm.

These results should not be taken independent from the remainder of the report. Additional explanation of these results is contained in the body of the report.

TABLES

FIGURES

APPENDICES

1.0 General site information

1.1 Background and location

Plant Crist is a 970-megawatt electric-generating plant owned by Gulf Power Company (Gulf). The plant is located in northeast Pensacola, Florida, at the mouth of the Escambia River on Governor's Bayou (**Figure 1-1**). The plant has four coal-fired, electric-generating units. A Flue Gas Desulfurization (FGD) system is being installed in order to remove sulfur dioxide from the flue gas stream by mixing with limestone and water. This process produces substantial amounts of gypsum ($CaSO_4 \cdot 2H_2O$), the amount depending upon the sulfur content of the coal used for combustion.

Gypsum produced by the FGD system that is not sold will be stored at the site, which has been permitted for ash storage. This site is exempt from Chapter 62-701, Florida Administrative Code (F.A.C), *Solid Waste Management Facilities* requirements because Gulf plans to landfill less than 50% of the gypsum.

1.2 General siting criteria

1.2.1 Proximity to floodplains, streams and wetlands

The proximity of the proposed gypsum storage areas to floodplains, streams and wetlands is illustrated in **Figure 1-2**. The proposed gypsum storage areas at Plant Crist – Area 1 and Area 2 – are located adjacent to Clear Creek and Governor's Bayou, which discharge into the Escambia River. The Escambia River flows south and discharges into Escambia Bay. The 100-year floodplain reaches into Plant Crist property immediately west of the proposed gypsum storage Area 1 and along Clear Creek in Area 2. Regulated wetland areas were delineated at the beginning of the investigation by Bosso, Dentzau, and Imhof, Inc. of Pensacola, Florida in cooperation with Gulf Power Company Environmental Affairs personnel. A delineated wetland area occurs in Area 2, and wetland species were identified outside of Area 1. Wetland sketches provided by Bosso, Dentzau and Imhof, Inc. and an EDR NEPA Check® report provided by EDR® Environmental Data Resources, Inc. are provided in **Appendix A**. No threatened or endangered species were located in the proposed gypsum storage areas at Plant Crist (**Appendix A**).

1.2.2 Proximity to public and domestic water wells

Based upon water well inventory data provided by the Northwest Florida Water Management District, no registered public or domestic water supply wells were identified within 1,000 feet of the proposed gypsum storage areas (**Appendix A**). Plant Crist owns and operates five water supply wells on site, WSW-3 through WSW-7 (**Figure 1-3**). These wells are screened in the deep Unit 5 aquifer, beneath the Unit 1A aquitard and Unit 4 semi-confining layers. Additional domestic wells were located by Southern Company Generation in the western portion of the suggested 1,000 ft survey radius (**Figure 1-3)**.

1.2.3 Land use and local zoning

Land use and local zoning immediately surrounding the proposed gypsum storage areas are characterized by a mixture of residential and industrial, or mixed use zoning (**Figure 1-4**). Property to the north of the proposed gypsum storage areas across Clear Creek is zoned as agricultural, and property to the south is zoned as retail or commercial.

2.0 Investigation methods

Historical data were used in an effort to minimize environmental disturbance during the current field investigation. Locations of all referenced investigation boreholes, groundwater wells, and surface water monitoring locations are shown on **Figure 2-1**. Specific field and laboratory methods are described in detail in the following sections.

2.1 Subsurface investigation

2.1.1 Cone penetrometer testing

Cone Penetrometer testing (CPT) was performed at a density of 1 boring per 5 acres to provide detailed *in situ* quantitative measurements of soil strength in the overburden and to determine soil stratification (layer depth and thickness) to a very accurate (+/- 0.1 foot) degree. The cone was advanced by a track-mounted, self-anchoring 20-ton Geoprobe 6625CPT reaction unit. Data from the strain-gage equipped cone is transmitted by cable or audio signal continuously to the surface where it is translated real-time to point resistance, friction resistance, and pore water pressure readings. This testing and the equipment were in accordance with ASTM D 5778. For this investigation, CPT testing was performed by Southern Earth Sciences with a Hogentogler electronic Dutch cone penetrometer equipped with a piezocone. Color-graphics logs of these cone test soundings are provided in **Appendix B**. All borings were sealed with neat cement from the bottom of the hole to the surface.

2.1.2 Standard penetration test drilling

Standard penetration test (SPT) borings were performed at an approximate density of 1 per 10 acres in order to supplement CPT data. Geotechnical SPT borings were performed using a CME 550X drilling rig. Borings were advanced to groundwater using 3.5-inch inner diameter (ID) hollow stem (HS) augers. Below the water table, biodegradable Revert® drilling fluid was used in conjunction with a 3.25-inch roller bit. Split spoon samples were collected every five feet for geologic logging and geotechnical testing. Undisturbed samples were collected with Shelby tubes in silt or clay-rich intervals. The SPT test borings with split-spoon sampling were performed per ASTM D-1586. Standard penetration test results, or "N" values, were obtained with an automatic hammer, yielding what we consider to be a minimum of equivalent N_{70} values. Soils encountered in all test boreholes were logged and classified by a Southern Company Generation geologist or geotechnical engineer. The geologic boring logs for this investigation are attached in **Appendix C**. Once each boring was terminated, it was immediately grouted from the bottom up using neat cement grout unless a piezometer or monitoring well was installed.

2.2 Laboratory soil analyses

Selected split spoon and undisturbed (UD) samples were submitted to the Southern Company Generation Central Soils Laboratory for the tests summarized in **Table 2-1**. Undisturbed samples were collected as two-foot length Shelby tubes. Results of all tests are provided as **Appendix D**.

Table 2-1. Soil sample analyses and test methods

Analysis	Method
Particle Size	ASTM D-422
Atterberg Limits	ASTM D-4318
Engineering Soil Classification	ASTM D-2487
Specific Gravity	ASTM D-854
Moisture Content	ASTM D-2216
Standard Proctor Density Test	ASTM D-698
Vertical Hydraulic Conductivity	ASTM D-5084
Consolidation	ASTM D-2435

2.3 Groundwater and surface water investigation

2.3.1 Well installations

Twelve groundwater level observation wells were installed for the purposes of supplementing historical groundwater monitoring data and providing adequate spatial coverage. Well installation borings were advanced using the same procedures as SPT borings. Upon boring termination, the 3.5-inch ID HS augers were removed, 4.25-inch ID augers were advanced to bottom, and wells were installed through the augers.

The well screens are a 2-inch diameter, 5-foot length Schedule 40 polyvinyl chloride (PVC) pipe with 0.01 inch slots. Schedule 40 PVC, 2-inch diameter flush-threaded riser pipe was installed in each well to above ground surface. Once the well was in place, 20/30 (1A) grade filter sand was installed to at least 2 feet above the top depth of the well screen. The following steps were followed to select a filter pack material for all wells (from Driscoll, 1986):

1. A split-spoon sample was collected from the target well-screening zone
2. Grain size analysis was conducted on the sample
3. The 70% retained (30% finer as D_{30}) size was multiplied by a factor of 4-6 (5 was chosen)
4. The result was plotted on the sample grain size curve, and a curve with a uniformity coefficient of <2.5 (1.5 was chosen)
5. The appropriate commercial filter pack was chosen to best fit the resulting curve (20/30 1A grade filter sand was chosen)

Bentonite pellets (3/8" diameter) were placed above the filter pack to form a seal at least 2 feet thick. Neat cement grout was used to fill the well annulus from the top of the bentonite to the ground surface. A 2 ft. x 2 ft. x 4 in. concrete pad was installed around each piezometer. Four protective posts were placed surrounding each concrete pad to protect the above-ground casing.

Wells GYP-36, GYP-11S and GYP-11D were installed with a steel surface shroud for additional protection, with intentions of using these wells as permanent monitoring points. For GYP-11D, a 6-inch diameter PVC surface casing was installed into the Unit 4 clayey aquitard to prevent migration between aquifers. This was done because of the proximity of GYP-11 to existing ash storage and the stormwater retention basin. These wells were installed using 3.5-inch diameter pre-packed well screens, 20/30 1A filer sand, and 2-inch diameter Schedule 40 PVC riser casing.

At the completion of well installation activities, each well was developed using a Grunfos® pump. Development continued until either ten well volumes had been removed, or until pH, conductivity, and temperature were stable. Well construction and development forms and details are included in **Appendix E**.

2.3.2 Groundwater flow direction and flow rate determination

Groundwater flow direction and rate were determined using data obtained from water table elevation measurements and aquifer hydraulic conductivity testing. Water elevations were collected monthly from each monitoring well and piezometer in the monofill area. Water elevations were collected to the nearest 0.01 foot using an electronic water level indicator.

Horizontal permeability of site formations was tested in 1999 using a field slug test method. The test procedure consisted of quickly raising or lowering the head in the well using a solid slug of known volume. Time-series head data were collected for each rising/falling head test using digital data logging equipment set to record elevations on an exponential scale. The initial time between records is 0.001 seconds, and exponentially increases to 1 second between readings. The test is considered complete when the water level has returned to at least 90 percent of the initial head. Records from the data logger were reduced and loaded into Aqtesolv® hydraulic conductivity analysis software.

Vertical permeability at the site was analyzed from undisturbed samples and remolded bag samples collected from representative aquifers and aquitards at the site. These samples were sent to the Alabama Power Company Soils Laboratory for testing. Vertical permeability testing was completed in accordance with ASTM standard D-5084.

2.3.3 Groundwater and surface water quality determination

Groundwater wells were sampled by purging the well with a submersible bladder pump until pH, conductivity, temperature, oxidation/reduction potential (ORP), and dissolved oxygen (DO) were stable, and turbidity was below 10 NTUs. Samples were then collected through the submersible pump in plastic bottles with the appropriate preservative. Samples jars were placed on ice and shipped to Severn Trent Laboratories, Pensacola, FL with appropriate chain of custody. Surface water sampling locations were selected based on the direction of surface water drainage across the site. Samples were collected following all procedures from DEP-SOP-001/01, FS 2100. Field parameters of pH, conductivity, temperature, dissolved oxygen (DO), turbidity, color, and sheen were measured and/or noted for each sample collection event. Surface water samples were analyzed for the same constituents as groundwater, with some additional constituents (**Table 2-2**). Water sampling field records and laboratory analyses are provided in **Appendix F**.

Table 2-2. Groundwater and surface water sample analytes and test methods

Analyte	Method
Groundwater and surface water	
Total Ammonia – N	MCAWW 350.1
Nitrate	MCAWW 353.2
Total Dissolved Solids	MCAWW 160.1
Chloride	MCAWW 325.2
Sulfate	MWAWW 375.4
Cations*	SW846 3010A/6010B
Antimony	SW846 3020A/7041
Thallium	SW846 3020A /7841
Mercury	SW846 7470A/7470A
Additional surface water	
Total Hardness	MCAWW 130.2
Total Phosphates	EPA 365.4
Biochemical Oxygen Demand (BOD5)	MCAWW 405.1
Chemical Oxygen Demand	MCAWW 410.4
Total Suspended Solids	MCAWW 160.2
Total Organic Carbon	MCAWW 415.1
Fecal Coliform	SM18 9222D
Chlorophyll A	SM20 10200H

*Cations include arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, nickel, potassium, selenium, silver, sodium, vanadium and zinc.

SW846 – "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," Third Edition, November 1986 and its updates.

MCAWW – "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1983 and subsequent revisions.

3.0 Hydrogeological investigation

3.1 Regional geology and hydrogeology

3.1.1 Geomorphology

Plant Crist lies at the western end of the northern or proximal geomorphic zone of Florida in Escambia County (White, 1970). This portion of the Northern Zone is divided primarily into the Western Highlands and the Gulf Coastal Lowlands (**Figure 3-1**). The Western Highlands are the western extension of a series of topographic highlands spanning northern Florida and encompassing the northern three-quarters of Escambia County. The terrain is characterized by gently rolling, clayey-sand hills and ridges that are punctuated by a series of deeply-incised, dendritic streams. The Gulf Coastal Lowlands comprise the southern quarter of Escambia County. The Lowlands include the Escambia River Valley and the modern coastal barrier islands, and are bounded to the north by a relict marine escarpment at approximately 100 to 120 feet above MSL. The flat and sandy terrain of the Lowlands results from erosion and deposition by high-standing Pleistocene seas (Rupert, 2004).

3.1.2 Hydrostratigraphy

Lithostratigraphy and hydrostratigraphy of the Florida Panhandle are represented in **Figure 3-2**. The majority of the sequence of Tertiary sediments underlying the county is composed of continental siliciclastics and marginal marine units (Rupert, 2004). Four hydrogeologic units are currently recognized in the Florida Panhandle (listed from oldest to youngest): 1) the Sub-Floridan Confining Unit, 2) the Floridan Aquifer system, 3) the Intermediate Aquifer system or Intermediate Confining Unit, and 4) the Surficial Aquifer (Southeastern Geological Society, 1986).

The Sub-Floridan Confining Unit is composed of low-permeability rocks that occur below the Floridan Aquifer. The unit consists of fine-grained clastic deposits belonging to Middle Eocene and older series. The top of the unit is characterized by a very sharp contact with the overlying Floridan Aquifer while the base is poorly defined due to the lack of stratigraphic and lithologic control.

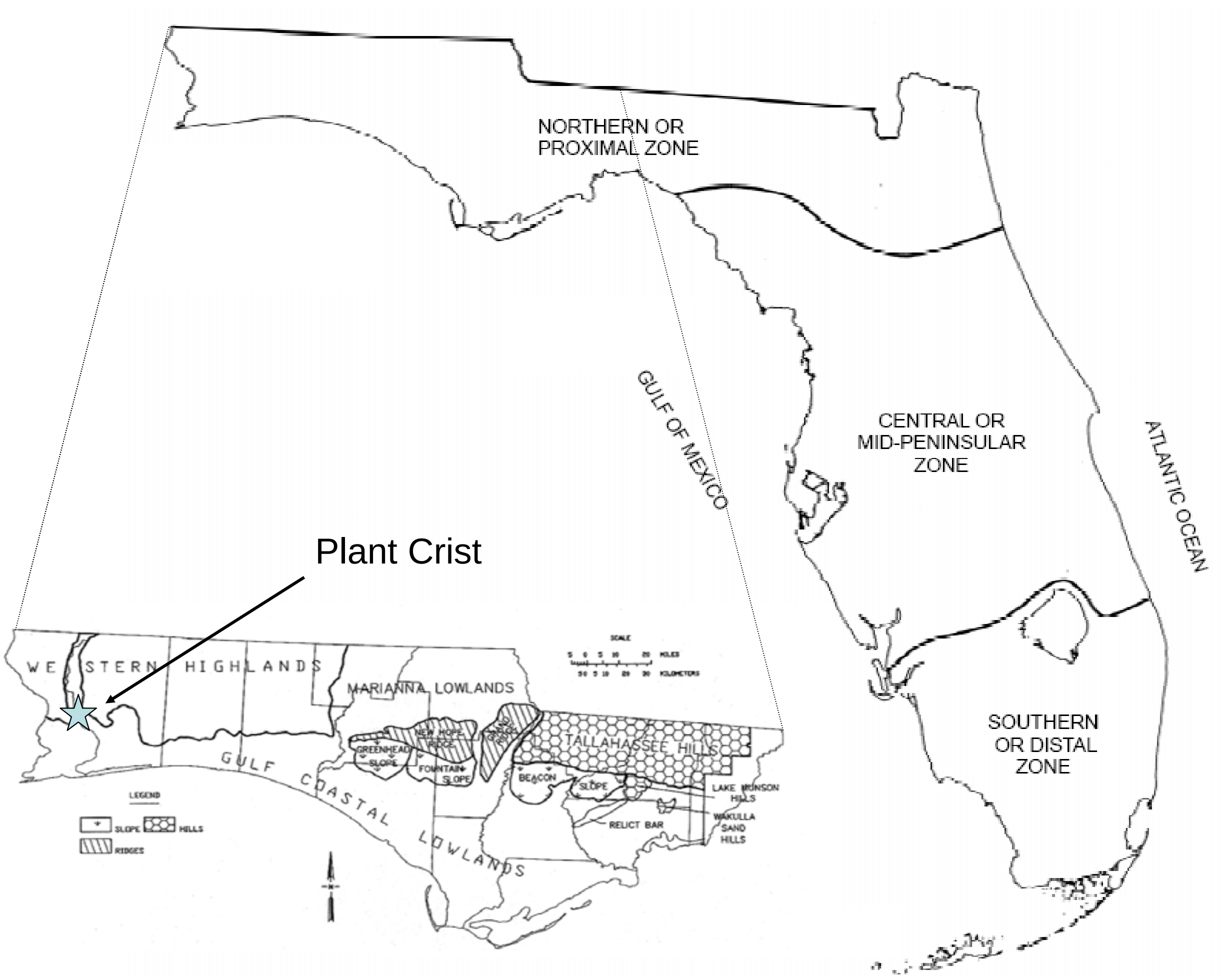

Figure 3-1. Geomorphologic zones of Florida (modified after Maddox et al., 1992)

The rocks of the Floridan Aquifer in Escambia County are composed of coquina, a porous and permeable fossiliferous limestone. The lower limestone of the Floridan Aquifer consists of the Ocala Limestone and other limestones of Eocene age. The upper limestone of the Floridan Aquifer is chiefly the Chickasawhay Limestone, which is overlain unconformably by the Tampa Limestone. Most water in the upper and lower limestones of the Floridan Aquifer is confined above and below by relatively impermeable beds. Both upper and lower limestones are recharged by rain falling in Conecuh, Escambia, and Monroe counties, Alabama (Musgrove, Barraclough, and Grantham, 1965).

		PANHANDLE FLORIDA	
SYSTEM	SERIES	LITHOSTATIGRAPHIC UNIT	HYDROSTRATI-GRAPHIC UNIT
QUATERNARY	HOLOCENE	UNDIFFERENTIATED PLEISTOCENE-HOLOCENE SEDIMENTS	SURFICIAL AQUIFER SYSTEM
	PLEISTOCENE		
TERTIARY	PLIOCENE	CITRONELLE FORMATION MICCOSUKEE FORMATION COARSE CLASTICS	
	MIOCENE	ALUM BLUFF GROUP PENSACOLA CLAY INTRACOASTAL FORMATION HAWTHORN GROUP BRUCE CREEK LIMESTONE ST. MARKS FORMATION CHATTAHOOCHEE FORMATION	INTERMEDIATE CONFINING UNIT
	OLIGOCENE	CHICKASAWHAY LIMESTONE SUWANNEE LIMESTONE MARIANNA LIMESTONE BUCATUNNA CLAY	FLORIDAN AQUIFER SYSTEM
	EOCENE	OCALA LIMESTONE CLAIBORNE GROUP UNDIFFERENTIATED SEDIMENTS	
	PALEOCENE	UNDIFFERENTIATED PALEOCENE ROCKS	SUB-FLORIDAN CONFINING UNIT
CRETACEOUS AND OLDER		UNDIFFERENTIATED	

Figure 3-2. Lithostratigraphy and hydrostratigraphy in the Florida Panhandle (modified after Maddox et al., 1992)

During the middle Miocene, sedimentation shifted to siliciclastic deposition with minor carbonates. From the middle to late Miocene, the Pensacola Clay was deposited and forms the Intermediate Confining Unit in the Plant Crist area. This unit is a dark or light gray to brownish gray, silty, variably sandy clay and quartz sand unit underlying central and southern Escambia County. The Floridan Aquifer below Plant Crist is separated from the Surficial Aquifer by as much as 800 feet of Miocene clay (Marsh, 1966).

The majority of water wells in Escambia County draw from the Surficial Aquifer system, also called the Sand and Gravel aquifer. This aquifer is composed of the Coarse Clastics, the Citronelle Formation and the undifferentiated sand and clay units that were deposited in a series of marine terraces. The Coarse Clastics are extensive beds of light-brown to light-gray, poorly sorted, fine to very coarse sand, granules and small quartz pebbles and mollusk shells. They are differentiated from the overlying Citronelle Formation by the abundance of small marine mollusk shells. The Citronelle Formation, a deltaic formation (Coe, 1979), is composed predominantly of light yellowish-brown, reddish-brown, light gray and white quartz sand with lenses and beds of clay and chert and quarts gravel (Rupert, 2004). Fossils in the Citronelle are generally rare, but may be found as scattered mollusks, foraminifera, shrimp burrows, fossil pollen, and wood remnants in various parts of the county. Abundant iron oxide in the Citronelle Formation may concentrate in sand beds, forming hardpan layers up to several feet in thickness and generally paralleling the bedding of enclosing sediments. The undifferentiated sands and clays overlying the Citronelle generally cap the hills of the Western Highlands and accumulate in streams channels as alluvium (Rupert, 2004).

3.2 Site geology and hydrogeology

3.2.1 Topography and surface water drainage

Plant Crist is located adjacent to the Escambia River, and elevation in the proposed gypsum storage areas ranges from sea level at the Escambia River to approximately 107 feet above sea level in the southeastern corner of Area 2. The site is situated primarily in the aforementioned Gulf Coastal Lowlands geomorphic province (refer to Section 3.1.1).

The Escambia River is the single largest source of surface water in Escambia County. The main channel of the Escambia River starts near Union Springs, Alabama, as the Conecuh River, and flows southwestward to the Florida-Alabama boundary near Century, Florida. Near the state line, the name changes to the Escambia River. The Escambia flows southward, forming the eastern boundary of Escambia County and emptying into

Escambia Bay north of Pensacola. Other streams in the vicinity of Plant Crist include Clear Creek, Governor's Bayou, and Thompson's Bayou.

Current drainage systems at Plant Crist are designed to control: 1) flooding, 2) soil erosion, and 3) surface water runoff. Surface water drainage controls at Plant Crist include: graded, contoured and grassed slopes, concrete and asphalt paved ditches, rip-rap, drain-pipes, french drains and several sumps and catch basins, as well as detention dikes and a holding pond at the ash landfill area.

3.2.2 Soil types

Plant Crist soils are discussed in this section adopting nomenclature from the 2004 Soil Survey of Escambia County (NCSS, 2004), an updated version of that produced in 1960 (USDS-SCS, 1960). According to NCSS (2004), eight soil types have been described at Plant Crist: 1) Arents urban land complex; 2) Poarch sandy loams (2-5% slopes); 3) Troup sand (0-5% slopes); 4) Troup sand (5-8% slopes); 5) Bonifay loamy sand (0-5% slopes); 6) Dorovan muck and fluaquents; 7) Troup-Poarch complex (8-12% slopes); 8) Troup-Poarch complex (2-5% slopes); and Troup-Poarch complex (5-8% slopes). Illustrated in **Figure 3-3**, these soil units are described below retaining the numerical identification of NCSS (2004)[1].

The Arents urban land complex (16) is comprised of soils that have been modified by construction activities and cannot be classified according to natural soil formation processes. This soil unit is found in the main Plant area adjacent to the Escambia River (NCSS, 2004). The Poarch sandy loam unit (25), located primarily in the upland portion of Area 1, is described as a very deep, well-drained soil found on gently sloping shoulder slopes and side slopes of ridges. The middle and lower parts of the subsoil contain masses of plinthite (also known as hardpan). Permeability is considered moderately slow and water can be perched at a depth of 2.5 to 5 feet from December to April. Slopes with Poarch sandy loam soils are generally long, smooth, and irregular in shape, and range from 5 to 90 acres in size (NCSS, 2004).

The Troup sands unit (32 and 33) occurs over limited portions of the site, restricted to Area 2 to the west and south. Troup sands are described as very deep, excessively drained soils found on nearly level summits and gently sloping shoulder slopes of ridges.

[1] Soil descriptions are provided as typical characteristics of these soils as reported in *Soil Survey of Escambia County*, and are site-specific only with respect to their spatial occurrence.

Permeability is considered rapid to moderate with a seasonal high water table deeper than 6 feet. The Bonifay loamy sand unit (38) is found in the eastern portion of Area 1. This unit is described as a deep, well-drained soil on nearly level summits and gently sloping shoulder slopes or ridges. Permeability is considered rapid in the surface and subsurface, but moderately slow in the subsoil. Water can be found perched at a depth of 3.5 to 5 feet from December to April. Slopes are generally long and smooth, and can be irregular in shape.

The Dorovan muck and fluvaquents soil unit (49) is found adjacent to surface water bodies across the site. This soil is found in floodplains along streams and is subject to frequent ponding for very long periods. Permeability is considered moderate and the seasonal high water table can be exposed at the surface or to a depth of 0.5 feet from December to July. Fluvaquents soils are typically found at higher elevations of the floodplain, and are mineral soils with variable composition. Fluvaquents have variable permeability but seasonal high water tables similar to Dorovan soils (NCSS, 2004).

Areas of the site containing Troup-Poarch complex (54, 55 and 56) soils contain both Troup and Poarch soil units that are intermingled so closely that they are not mapped as separate units (NCSS, 2004). This soil complex covers a majority of the land surface in Area 2, and much of the lowland portion of Area 1.

3.2.3 Hydrogeology

The geology and hydrogeology at Plant Crist have been characterized as a result of many previous subsurface investigations. Subsurface data have been collected since 1948 when water supply wells were first drilled on the site. Investigations most relevant to the current study include the following (see **Figure 2-1** for boring locations):

- 1977, 1980, 1983 and 1984 ash landfill studies and monitoring well installations (borings labeled LF and J-J through T-T);
- 1992 piezometer installations for 1993 groundwater monitoring report (borings labeled I and D); and
- 1995 installation of monitoring wells for the ash landfill (borings MW).

Previous investigations have identified five hydrogeologic units at the Plant:

- Unit 1/1A sandy perched aquifer and clay aquitard
- Unit 2 unconfined sandy aquifer
- Unit 3 silty clay aquitard

- Unit 4 silt and sandy clay semi-confining unit
- Unit 5 sandy lower aquifer

All previously defined units were encountered in the current investigation with the exception of Unit 3. The Unit 3 is found only in the vicinity of Governor's Island and is absent west of the plant operations area in both the ash landfill area and current investigation area (GWMP, 1993). The 1993 Groundwater Monitoring Plan divided the Unit 1 into two distinct units to reflect the separation of a perched aquifer (Unit 1) and aquitard (Unit 1A). In general, stratigraphic separation between the Unit 1 and Unit 1A is difficult, due to the complex and interfingering distribution of sand, clay and silt of these units. Hydrogeologically, however, the two are separate due to the occurrence of perched water in the topographically high Unit 1 sand. In the current investigation, the Unit 1A is designated as a surficial aquitard, restricting vertical (downward) migration of infiltrating rainwater.

In the following discussion, hydrogeologic units are described in greater detail with respect to their general occurrences across the plant property and to their specific occurrences within Area 1 and Area 2 of the current investigation. Geologic cross-sections of the current investigation area are provided as A-A' through G-G' (**Figures 3-4 through 3-7**). Cross-sections A-A', B-B' and C-C' provide an overview of the site area. Area 1 is represented by sections D-D' and E-E,' and Area 2 by F-F' and G-G.' Pertinent aquifer and aquitard property data collected during the current investigation are provided on cross-sections and in **Tables 3-1 and 3-2**.

3.2.3.1 Unit 1 sandy perched aquifer

General occurrence: The Unit 1 surficial aquifer is the uppermost hydrogeologic unit at Plant Crist, representing an unconfined, heterogeneous, perched aquifer. The unit consists primarily of red, tan and orange silty, poorly sorted sands with minor clay. Limonite-cemented hardpan layers are encountered within the unit in some areas, and range from less than 1 inch to 3 inches in thickness. The Unit 1 typically occurs at high elevations (>60 feet above sea level), limiting its spatial extent across the site. The saturated thickness of the Unit 1 aquifer is considered very thin, no more than 4 to 5 feet (GWMP, 1993). Groundwater flow direction in the Unit 1 follows surface topography, from topographically high areas to low areas.

Area 1: The Unit 1 sandy perched aquifer does not occur in Area 1. Clayey sands and silts within the Unit 1A were found to be moist or wet in borings GYP-16, GYP-5, and GYP-11.

Area 2: The Unit 1 occurs over a limited portion of Area 2 to the south. Perched water was observed in boring GYP-34 and is known to occur at existing well MWC-12, a monitoring well screened within the Unit 1.

Table 3-1. Aquifer properties

Boring	Depth (ft bgs*)	Porosity (%)	Vertical Permeability (cm/sec)	Sand (%)	Silt/Clay (%)	Gravel (%)
Unit 1						
GYP-34	4.5-6	39.0	4.2×10^{-4}	82.9	16.2	0.9
Unit 2						
GYP-24S	59.5-61	37.0	8.7×10^{-4}	92.9	7.0	0.1
GYP-20S	29.5-31	36.7	3.9×10^{-3}	96.6	3.3	0.1
Unit 5						
GYP-1D	79.5-81	37.7	1.9×10^{-3}	94.5	5.5	0.0
GYP-24D	119.5-121	35.2	4.7×10^{-4}	89	11.0	0.0
Averages						
Unit 1		39.0	4.2×10^{-4}	82.9	16.2	0.9
Unit 2		36.8	2.4×10^{-3}	94.8	5.2	0.1
Unit 5		36.5	1.2×10^{-3}	91.8	8.3	0.1

*ft bgs = Depth reported in feet below ground surface.

Table 3-2. Aquitard properties

Boring	Depth (ft bgs*)	Porosity (%)	Vertical Permeability (cm/sec)	Sand (%)	Silt/Clay (%)	Sample type**
Unit 1A						
GYP-9	10-12	34.2	7.7×10^{-8}	54.9	45.1	UD
GYP-16	14.5-16.5	49.5	9.4×10^{-8}	15.8	84.2	UD
GYP-21	4.5-6.0	63.3	4.9×10^{-8}	52.2	47.8	Bag
GYP-26	4.5-6.0	29.5	1.2×10^{-6}	67.2	32.8	Bag
GYP-24	34.5-36	52.9	5.2×10^{-8}	2.9	97.1	Bag
Unit 4						
GYP-4D	99.5-101.0	42.3	8.0×10^{-7}	43.5	56.5	Bag
GYP-4D	74.5-76.0	43.2	1.9×10^{-7}	17.5	82.5	Bag
GYP-14	79.5-81.5	32.1	2.0×10^{-6}	55.6	43.8	UD
GYP-24	104.5-106.0	56.1	1.9×10^{-7}	27.9	72.1	Bag
GYP-22	35.0-37.0	41.7	4.1×10^{-6}	56.5	43.3	UD
Averages						
Unit 1A		37.7	2.94×10^{-7}	38.6	61.4	
Unit 4		43.1	1.77×10^{-6}	45.9	53.9	

*ft bgs = Depth reported in feet below ground surface.
**Sample type: UD = undisturbed Shelby tube; Bag = remolded split-spoon sample.

3.2.3.2 Unit 1A aquitard

General occurrence: The Unit 1A is closely associated with the Unit 1, and primarily lies beneath the Unit 1. Unit 1A is composed of tan, orange and gray clay, clayey silt and clayey sand. This unit is considered an aquitard due to low measured vertical permeability values (averaging 2.94×10^{-7} cm/sec) and fine grain size (**Table 3-2**).

Area 1: The highest elevations of Area 1 are composed of gray, slightly moist to dry clayey sand and clayey silt. The Unit 1A in Area 1 exhibited laboratory-determined vertical permeabilities of 7.7×10^{-8} cm/sec and 9.4×10^{-8} cm/sec at GYP-9 and GYP-16, respectively.

Area 2: The Unit 1A in Area 2 is characterized by a mixture of orange, red and tan clayey silt, dark gray organic clay, and light gray clayey sand. The Unit 1A in Area 2 exhibited measured vertical permeabilities of 4.9×10^{-8} cm/sec and 1.2×10^{-6} cm/sec at GYP-21 and GYP-24, respectively. A variably thick layer of light tan and orange, silty, very-fine- to fine-grained sand occurs within Unit 1A.

3.2.3.3 Unit 2 sandy unconfined aquifer

General occurrence: The Unit 2 is an unconfined heterogeneous aquifer, consisting of multicolored (red, orange, tan, pink, maroon, and brown), poorly-sorted sand of fine- to coarse-grained texture and variable silt content. The predominant color of Unit 2 sand is orange. Fine gravel layers are commonly observed within the Unit 2, and clay also occurs as thin seams interbedded with fine-grained sand or as clayey sand. The occurrence of hardpan and/or clay-rich sediment of the Unit 1A denote a stratigraphic upper limit to the Unit 2 across some areas of the site. In other areas of lower elevation, the Unit 2 is exposed at the ground surface. The lower limit of the Unit 2 is marked by clay-rich sediment of the Unit 4, or by a transition into the fine-grained, lighter-colored, dense Unit 5 sand. Average horizontal hydraulic conductivity of the Unit 2 measured by slug testing is 1.09×10^{-2} cm/sec, or 30.897 ft/day.

Area 1: The Unit 2 aquifer consists of red, tan, orange and light gray, slightly silty to very silty fine- to coarse-grained sand. Sand layers containing fine gravel (up to 0.3% by weight) are typically encountered, and mica is a common accessory mineral.

Area 2: The Unit 2 in Area 2 is composed of light brown, light tan, orange and maroon silty, fine- to coarse-grained sand with trace mica and occasional fine gravel. The potentiometric surface of the Unit 2 aquifer exceeds the base of the Unit 1A near the wetland, indicated by saturated clayey sand and silt in boring GYP-36.

3.2.3.4 Unit 3 confining bed

General occurrence: The Unit 3 aquitard is a soft, gray to black, organic-rich clay that may contain abundant silt and wood fragments. Historical investigations found that the unit is restricted to a narrow, northwest-to-southeast trending belt in the vicinity of Governor's Island and the ash pond (GWMP, 1993). Where the unit exists, it is encountered below the Unit 1A and above the Unit 2.

Area 1: Not encountered (considered absent based upon depth of drilling).

Area 2: Not encountered (considered absent based upon depth of drilling).

3.2.3.5 Unit 4 semi-confining bed

General occurrence: The Unit 4 semi-confining bed is composed of mottled tan, gray, and maroon clayey sediments (clay, clayey silt and clayey sand). However, in some areas, the Unit 4 is composed of dark gray to black silty clay. Where present, the Unit 4 separates the Unit 2 and Unit 5 aquifers. The Unit 4 is considered semi-confining for at least two reasons: 1) historical potentiometric surface elevations of the Unit 2 aquifer and Unit 5 aquifer are similar, suggesting hydraulic connection; and 2) the Unit 4 is not encountered in all deep borings performed on site. The average vertical hydraulic conductivity of the Unit 4 is 1.77×10^{-6} cm/sec.

Area 1: The Unit 4 semi-confining unit was found to be continuous across Area 1, with the exception of thinning to slightly clayey sand at GYP-9. In most of Area 1, the Unit 4 is a combination of mottled tan, maroon and gray clayey silt to clayey sand, and mottled purple and white slightly sandy clay. A dark-gray, organic-rich, silty clay was encountered closely associated with the Unit 4 in GYP-4D. This organic-rich clay is considered too closely associated with the Unit 4 to be delineated as a separate unit and is included in this description as part of Unit 4.

Area 2: The Unit 4 semi-confining bed in Area 2 occurs at a maximum thickness from elevation -20 feet below MSL to approximately -50 feet below MSL. The unit thins to the south toward the wetland area and pinches out near MWB-3 and GYP-36. The unit is composed of a thin layer of mottled red, tan and gray clayey to sandy clay overlying dark gray/brown silty clay.

3.2.3.6 Unit 5 sandy lower aquifer

General occurrence: The Unit 5 aquifer is the lowermost stratigraphic unit encountered at the site, and provides the potable water source for the plant. Unit 5 sediments are multicolored (light gray, tan, light brown and occasionally red) fine- to medium-grained, silty, poorly-sorted sand. In the absence of the Unit 4 semi-confining unit, the Unit 5 can be differentiated from the Unit 2 in the field by the following characteristics: gravel and coarse-grained sand are less common in Unit 5; Unit 5 sand is more dense; and orange and reddish-orange silty sand is more typical of Unit 2, whereas light gray to tan slightly silty sand is more common in Unit 5. The actual depth and thickness of the Unit 5 are unknown. The average horizontal hydraulic conductivity of Unit 5 measured by slug testing is 1.37 x 10^{-2} cm/sec, or 38.834 ft/day.

Area 1: The Unit 5 aquifer lies stratigraphically below the Unit 4 semi-confining unit, and consists of light gray to tan silty very fine- to medium-grained sand with occasional dark red to purple mottling.

Area 2: The Unit 5 aquifer in Area 2 is characterized by yellow, white, tan to light brown slightly silty very fine- to medium-grained sand with occasional deep red mottling. It is separated from the Unit 2 in the northern portion, but hydraulically connected to the Unit 2 in the wetland area and to the south.

3.3 Direction and rate of groundwater and surface water flow

3.3.1 Groundwater

Groundwater flow direction is known from 10 years of monitoring data, supplemented by recent measurements. Groundwater level data in Units 2 and 5 have been collected from June 1995 to May 2005 using existing monitoring wells (**Table 3-3**). **Figures 3-8 and 3-9** illustrate the temporal trend of groundwater levels in the Unit 2 and Unit 5 aquifers over this time period. During the current investigation, monitoring wells were installed in Area 1 and Area 2 to supplement historical data (**refer to Figure 2-1**). Water levels were monitored monthly for six months, beginning in July 2006 and ending in December 2006 (**Table 3-4 and 3-5**). Potentiometric maps for the Units 2 and 5 aquifers are shown in **Figures 3-10 through 3-15** for all monthly sampling events. Flow direction in the Unit 2 and Unit 5 aquifer occurs to the northeast toward Clear Creek and Governor's Bayou, with little variation. These flow directions are consistent with previous water level events at the site.

Table 3-3. Groundwater elevation data from June 1995 to May 2005

Well	Minimum (ft NGVD)	Maximum (ft NGVD)	Average (ft NGVD)	Maximum fluctuation (ft)	No.
Unit 2					
MWB-2	7.68	15.91	12.24	8.23	27
MWB-3	11.20	17.13	14.28	5.93	26
MWI-1	4.34	8.39	5.98	4.05	27
MWI-2	6.53	12.28	9.46	5.75	28
MWI-3	4.23	11.55	8.60	7.32	28
MWC-10	5.09	10.41	7.95	5.32	28
Unit 5					
MWB-1	5.55	15.07	10.82	9.52	27
MWC-3	4.35	7.82	5.91	3.47	28
MWC-4	5.48	12.23	8.42	6.75	28
MWC-5	4.37	10.85	8.32	6.48	28
MWC-8	4.09	10.42	7.53	6.33	28

Slug testing of Plant Crist monitoring wells was performed in 1999 following methods of Bouwer and Rice (1976). Resulting calculated hydraulic conductivity values for Unit 2 and Unit 5 are shown in **Table 3-6**, along with calculated transmissivity values and associated aquifer thicknesses. Hydraulic conductivity measured at MWI-2 (formerly MW-4S) is lower than that of MWI-1 (formerly MW-3S) and MWI-3 (formerly MW-5S). Based on Unit 2 potentiometric surface maps, MWI-2 is located near a groundwater flow divide where flow direction diverges northward and eastward and hydraulic gradient decreases.

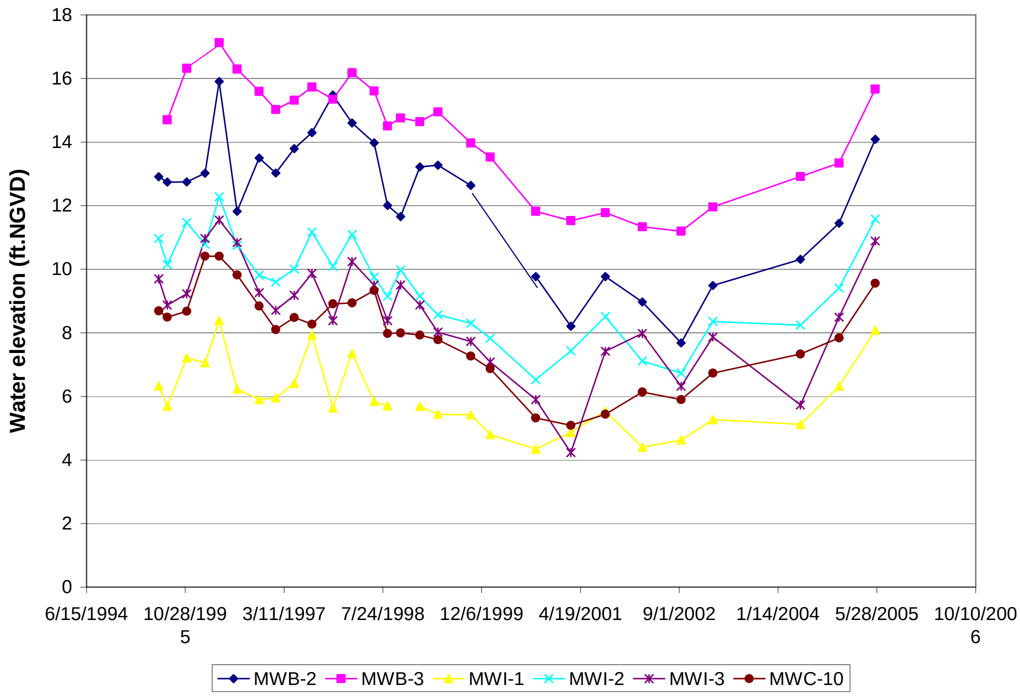

Figure 3-8. Temporal trend of Unit 2 groundwater elevations

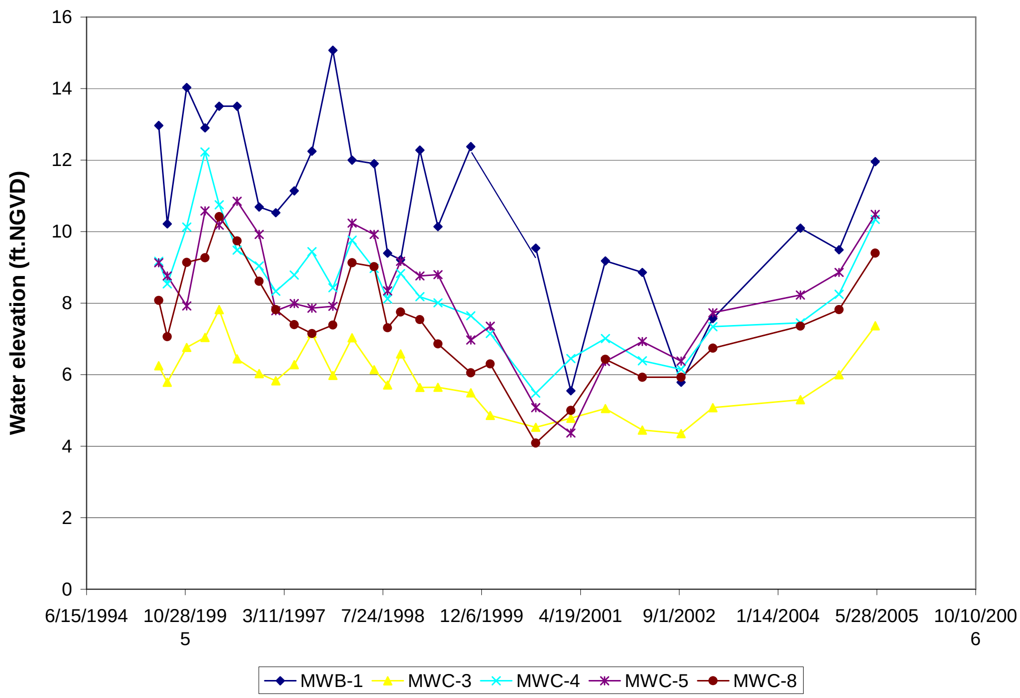

Figure 3-9. Temporal trend of Unit 5 groundwater elevations

Table 3-4. Unit 2 groundwater elevations from July 2006 to December 2006

Well	7/06	8/06	9/06	10/06	11/06	12/06	Average
MWB-2	11.43	14.88	10.17	10.34	11.38	11.57	11.63
MWB-3	NS	13.13	12.76	12.76	12.92	12.86	12.87
MWI-1	5.04	4.93	5.24	4.88	5.02	4.71	4.97
MWI-2	8.25	7.92	7.90	7.41	7.45	7.08	7.67
MWI-3	7.88	7.53	6.81	6.56	6.24	6.20	6.87
MWC-10	NS	6.36	6.62	6.41	6.18	5.99	6.31
GYP-1S	2.41	2.88	2.96	2.73	2.81	2.58	2.73
GYP-4S	1.5	1.53	1.62	1.44	1.51	1.08	1.45
GYP-9S	4.53	4.35	3.82	3.73	3.76	3.79	3.99
GYP-11S	5.15	4.93	4.48	4.31	4.28	4.26	4.57
GYP-20S	4.23	4.21	4.44	4.19	4.53	4.38	4.33
GYP-24S	8.85	8.53	8.36	8.23	8.25	8.15	8.40
GYP-36S	12.69	12.37	12.24	12.15	12.31	12.24	12.33

NS – Not Sampled

Table 3-5. Unit 5 groundwater elevations from July 2006 to December 2006

Well	7/06	8/06	9/06	10/06	11/06	12/06	Average
MWB-1	NS	9.04	8.36	8.62	9.15	9.57	8.95
MWC-3	5.45	5.30	5.36	4.97	5.06	4.84	5.16
MWC-4	7.65	7.32	7.13	6.83	6.78	6.58	7.05
MWC-5	8.22	7.76	7.26	6.65	5.39	5.36	6.77
MWC-8	NS	6.38	6.20	5.9	4.88	4.85	5.64
GYP-1D	2.41	2.32	2.30	1.98	2.02	1.86	2.15
GYP-4D	4.4	4.23	4.06	3.72	3.68	3.58	3.95
GYP-11D	6.14	5.91	5.55	5.31	5.24	5.14	5.55
GYP-20D	6.83	6.72	6.89	6.64	6.86	6.71	6.78
GYP-24D	8.94	8.64	8.51	8.36	8.42	8.05	8.49

NS – Not Sampled

Table 3-6. Unit 2 and Unit 5 hydraulic conductivity and transmissivity

Unit	Boring	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity (ft/day)	Thickness* (ft)	Transmissivity (ft^2/day)
2	MWI-1	0.0146	41.385	30.28	1,253.14
2	MWI-2	0.0061	17.291	33.96	587.20
2	MWI-3	0.0119	33.732	40.4	1,362.77
5	MWC-3	0.00953	27.014	NA	NA
5	MWC-4	0.0176	49.889	NA	NA
5	MWC-5	0.0141	39.968	NA	NA
Unit 2 Average		0.0109	30.897	34.88	1,067.70
Unit 5 Average		0.0137	38.834	NA	NA

NA – Not Applicable

* Saturated thickness determined from average water table elevation from June 1995 through May 2005 and depth to the Unit 4 confining layer in borings penetrating Unit 5. Unit 5 aquifer thickness is unknown.

3.3.2 Surface water

Major surface water flow occurs to the north and east adjacent to the proposed gypsum storage areas (refer to **Figure 1-2**). Clear Creek flows northeastward from Area 2 and discharges to Governor's Bayou. Governor's Bayou flows to the northeast, bending toward the southeast, before discharging into the southward-flowing Escambia River. The Escambia River flows into Escambia Bay.

Current data from United States Geological Survey monitoring location 02376033, located on the Escambia River near Molino, Florida monitors a total drainage area of 4,147 square miles. The discharge rate during the month of August 2006 ranged from approximately 500 cfs to 3,000 cfs. The discharge of the Escambia River at this location is considered tidally influenced when flow is less than 5,000 cfs (USGS, 2006).

3.4 Background water quality

3.4.1 Groundwater

Background water quality has been monitored at Plant Crist since 1995 as part of the current groundwater monitoring plan (GWMP, 1993). The locations of these wells are shown in **Figure 2-1**. Available data from these wells are provided in **Tables 3-7, 3-8 and 3-9.**

In addition, all recently installed wells (except GYP-11S and GYP-11D) were sampled for constituents listed in **Table 3-10**. Wells GYP-11S and GYP-11D were not sampled for background chemistry due to their proximity to the ash storage area. All others were considered reasonably outside of the area of influence from plant operations.

Wells GYP-1D, GYP-4D and GYP-24D exhibited higher conductivity, pH, Na and Cl than other wells. They also exhibited lower dissolved oxygen and ORP values. This is likely due to two factors: 1) increase of dissolved constituents in Unit 5 due to salt water influence, and 2) natural restriction of atmospheric oxygen into Unit 5 groundwater due to aquifer depth and confining nature of Units 4 and 1A. Due to the proximity of Plant Crist to the Escambia River and Escambia Bay, it is reasonable to conclude that the Unit 5 aquifer is affected by fluctuating tidal influence. MWB-1 (formerly MW-1D) does not exhibit the same degree of tidal influence, likely due to its distance from the Escambia River.

3.4.2 Surface water

In order to constrain variations in surface water quality, eight surface water locations were sampled for constituents listed in **Table 3-11**. Sample locations were chosen to represent upstream and downstream conditions in both areas. SW-6 was dry at all times, but was investigated each sampling event for the presence of water.

Surface water data illustrate the temporal and spatial variability in field parameters such as pH, dissolved oxygen, turbidity, conductivity and ORP; as well as in dissolved constituents such as Na, K, Ca, Mg, Cl, SO_4 and $CaCO_3$-hardness. The importance of these variations is that background conditions must be assessed in the framework of natural water quality variability, mainly tidal fluctuations.

These surface water variations also affect groundwater quality (discussed in the previous section) to the extent that a true background condition may not be hydraulically upgradient. Rather, downgradient water quality analyses will likely need to be supplemented with surface water quality analyses in order to constrain a source of constituents to groundwater.

Table 3-7. Historical background chemistry of Unit 1 aquifer at Plant Crist.

Well	Date	pH (s.u.)	D.O. (mg/L)	Turbidity (n.t.u.)	Cond (umhos/cm)	Temp (^{o}C)	ORP (mV)	Depth to Water (ft BTOC)	As (mg/L)	Ba (mg/L)	Be (mg/L)	Cd (mg/L)	Cr (mg/L)	Co (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Na (mg/L)	V (mg/L)	Zn (mg/L)	Sb (mg/L)	Hg (mg/L)	Tl (mg/L)	Cl (mg/L)	NH3 (mg/L)	NO3 (mg/L)	SO4 (mg/L)	TDS (mg/L)
MW-1P	6/17/1995	5.5	NA	19.7	30	NA	NA	21.05	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	2.1	<0.010	NS	<0.0020	NA	2.7	NA	<0.020	NA	<0.00020	NA	5.2	NA	NS	<1.0	28
MW-1P	7/28/1995	5.7	NA	17	35	NA	NA	22.86	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.28	<0.010	NS	<0.0020	NA	2.8	NA	<0.020	NA	<0.00020	NA	5.4	NA	<0.10	1.2	22
MW-1P	11/14/1995	6	NA	73	85	NA	NA	17.19	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	2	<0.0050	NS	<0.010	NA	9.5	NA	<0.020	NA	<0.00020	NA	8.1	NA	NS	9.9	53
MW-1P	2/8/1996	6.4	NA	28	35	NA	NA	18.91	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.53	<0.0050	NS	<0.0040	NA	2.9	NA	<0.020	NA	<0.00020	NA	5.4	NA	NS	<1.0	29
MW-1P	4/18/1996	5.9	NA	20	92	NA	NA	17.45	0.0058	NA	NA	<0.0050	<0.010	NA	<0.010	9.4	<0.0050	NS	<0.0020	NA	2.9	NA	<0.020	NA	<0.00020	NA	7.2	NA	NS	11	40
MW-1P	7/17/1996	5.7	NA	2.1	40	NA	NA	22.7	0.014	NA	NA	<0.0050	0.047	NA	<0.010	46	0.01	NS	<0.0020	NA	2.4	NA	<0.020	NA	<0.00020	NA	25	NA	NS	4.9	20
MW-1P	11/5/1996	5.7	NA	1000	24	NA	NA	23.83	0.024	NA	NA	<0.0050	0.1	NA	0.014	89	0.016	NS	<0.0020	NA	2.1	NA	0.027	NA	<0.00020	NA	9.1	NA	NS	35	82
MW-1P	1/3/1997	7.3	NA	323	26	NS	NS	24.86	NS	NS	NS	NS	NS	NS	NS	NS	<0.0050	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-1P	1/28/1997	5.6	NA	140	24	NA	NA	24.31	0.0062	NA	NA	<0.0050	0.041	NA	<0.010	38	0.0099	NS	<0.0020	NA	2.2	NA	<0.020	NA	<0.00020	NA	13	NA	NS	8.8	41
MW-1P	5/2/1997	5.5	NA	610	20	NA	NA	21.69	0.003	NA	NA	0.0050	0.015	NA	<0.010	12	<0.0050	NS	<0.0020	NA	2.9	NA	<0.020	NA	<0.00020	NA	7.7	NA	NS	8.4	110
MW-1P	7/30/1997	5.8	NA	54	160	NA	NA	19.15	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	2	<0.0050	NS	<0.0020	NA	28	NA	<0.020	NA	<0.00020	NA	7.5	NA	NS	56	120
MW-1P	11/13/1997	5.9	NA	287	40	NA	NA	24.08	0.012	NA	NA	<0.0050	0.058	NA	0.012	67	0.0053	NS	<0.0020	NA	2.7	NA	<0.020	NA	<0.00020	NA	7.9	NA	NS	<5.0	32
MW-1P	2/18/1998	5.2	NA	40	50	NA	NA	18.71	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	1.2	<0.0050	NS	<0.010	NA	9	NA	0.02	NA	<0.00020	NA	5.5	NA	NS	12	49
MW-1P	6/10/1998	5.3	NA	8.84	30	NA	NA	22.68	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	0.18	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	4.6	NA	NS	<5.0	16
MW-1P	8/18/1998	5.2	NA	31	30	NA	NA	25.02	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	0.41	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	4.9	NA	NS	<5.0	34
MW-1P	10/21/1998	5.7	NA	57	70	NA	NA	20.56	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	1.5	<0.0050	NS	<0.010	NA	16	NA	<0.020	NA	<0.00020	NA	3.9	NA	NS	29	53
MW-1P	1/27/1999	5.2	NA	13	20	NA	NA	22.88	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	0.16	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	5.2	NA	NS	<5.0	31
MW-1P	4/29/1999	5.3	NA	8.9	20	NA	NA	23.72	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.27	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	6.2	NA	NS	<5.0	8
MW-1P	10/12/1999	5.2	NA	6.6	40	NA	NA	23.99	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.15	<0.0050	NS	<0.010	NA	3.6	NA	<0.020	NA	<0.00020	NA	6.8	NA	NS	<5.0	9
MW-1P	1/18/2000	5.3	NA	220	28	NA	NA	26.22	<0.010	NA	NA	<0.0050	0.013	NA	0.031	11	0.0086	NS	<0.010	NA	8.6	NA	<0.020	NA	<0.00020	NA	9.6	NA	NS	8.6	180
MW-1P	9/5/2000	NS	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.040	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-1P	3/1/2001	NS	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<0.040	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-1P	8/23/2001	5.3	NA	62	35	NA	NA	23.35	0.014	NA	NA	<0.0050	0.18	NA	<0.020	50	0.014	0.1	<0.010	NA	3.8	NA	<0.020	NA	<0.00020	NA	7.4	NA	NS	<5.0	42
MW-1P	2/26/2002	5.3	NA	>1000	35	NA	NA	26.48	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	24	<0.0050	<0.040	<0.010	NA	2.5	NA	<0.020	NA	<0.00020	NA	6.1	NA	NS	7	71
MW-1P	9/11/2002	5.3	NA	150	35	NA	NA	19.1	<0.010	NA	NA	0.012	0.11	NA	0.031	120	0.034	<0.040	0.015	NA	<2.5	NA	0.049	NA	<0.00020	NA	14	NA	NS	<5.0	60
MW-1P	11/1/2002	NS	NA	NS	NS	NA	NA	NS	<0.010	NA	NA	<0.0050	0.04	NA	<0.020	0.59	<0.0050	<0.040	<0.010	NA	3.4	NA	<0.020	NA	NS	NA	NS	NA	NS	NS	NS
MW-1P	2/17/2003	6.5	NA	6	40	NA	NA	22.34	<0.010	NA	NA	<0.0050	0.04	NA	<0.020	1.5	<0.0050	<0.040	<0.010	NA	4.5	NA	<0.020	NA	<0.00020	NA	5.9	NA	NS	9	37
MW-1P	5/5/2004	5.2	NA	5.2	40	NA	NA	24.7	<0.010	NA	NA	<0.0050	0.04	NA	<0.020	0.68	<0.0050	<0.040	<0.010	NA	5.9	NA	<0.020	NA	<0.00020	NA	6.3	NA	NS	<5.0	21
MW-1P	11/17/2004	3.7	NA	14.2	40	NA	NA	20	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.35	<0.0050	<0.040	<0.010	NA	4.2	NA	<0.020	NA	<0.00020	NA	8.9	NA	NS	<5.0	22

Table 3-7, continued. Historical background chemistry of Unit 1 aquifer at Plant Crist.

Well	Date	pH (s.u.)	D.O. (mg/L)	Turbidity (n.t.u.)	Cond (umhos/cm)	Temp (°C)	ORP (mV)	Depth to Water (ft BTOC)	As (mg/L)	Ba (mg/L)	Be (mg/L)	Cd (mg/L)	Cr (mg/L)	Co (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Na (mg/L)	V (mg/L)	Zn (mg/L)	Sb (mg/L)	Hg (mg/L)	Tl (mg/L)	Cl (mg/L)	NH3 (mg/L)	NO3 (mg/L)	SO4 (mg/L)	TDS (mg/L)
MW-2P	6/17/1995	6.1	NA	2.19	75	NA	NA	9.4	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	2.1	<0.010	NS	<0.0020	NA	2.7	NA	<0.020	NA	<0.00020	NA	3.9	NA	NA	<1.0	63
MW-2P	7/29/1995	5.4	NA	21	35	NA	NA	9.4	0.0031	NA	NA	<0.0050	<0.010	NA	<0.010	3.2	<0.010	NS	<0.0020	NA	2.6	NA	<0.020	NA	<0.00020	NA	4.3	NA	NA	<1.0	15
MW-2P	11/14/1995	5.4	NA	80	30	NA	NA	7.19	<0.0024	NA	NA	<0.0050	<0.010	NA	<0.010	0.19	<0.0050	NS	<0.010	NA	2.8	NA	<0.020	NA	<0.00020	NA	4	NA	NA	2.5	23
MW-2P	2/7/1996	5.8	NA	47	40	NA	NA	6.5	<0.0040	NA	NA	<0.0050	<0.010	NA	<0.010	1	<0.0050	NS	<0.0040	NA	3	NA	<0.020	NA	<0.00020	NA	4.3	NA	NA	<1.0	25
MW-2P	4/18/1996	5.3	NA	13	25	NA	NA	5.42	0.0034	NA	NA	<0.0050	<0.010	NA	<0.010	0.33	<0.0050	NS	<0.0020	NA	3.2	NA	<0.020	NA	<0.00020	NA	4	NA	NA	1.6	30
MW-2P	7/17/1996	5.9	NA	5.8	40	NA	NA	7.92	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.52	<0.0050	NS	<0.0020	NA	2.4	NA	<0.020	NA	<0.00020	NA	<1.0	NA	NA	1.4	21
MW-2P	11/5/1996	5.4	NA	17	24	NA	NA	9.2	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.22	<0.0050	NS	<0.0020	NA	2.3	NA	<0.020	NA	<0.00020	NA	5.8	NA	NA	1.6	19
MW-2P	1/28/1997	7.1	NA	260	22	NA	NA	7.41	0.038	NA	NA	0.0056	0.11	NA	<0.010	0.52	<0.0050	NS	<0.0020	NA	2.4	NA	<0.020	NA	<0.00020	NA	<1.0	NA	NA	1.4	21
MW-2P	4/10/1997	NS	NA	NS	NS	NA	NA	NS	NS	NS	NS	<0.0050	<0.010	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-2P	5/2/1997	5	NA	7.4	20	NA	NA	7.59	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.23	<0.0050	NS	<0.0020	NA	2.3	NA	<0.020	NA	<0.00020	NA	4.3	NA	NA	1.8	11
MW-2P	7/30/1997	5.7	NA	36	20	NA	NA	6.26	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.84	<0.0050	NS	<0.0020	NA	2.6	NA	<0.020	NA	<0.00020	NA	4.4	NA	NA	5.4	30
MW-2P	11/13/1997	4.7	NA	5.3	40	NA	NA	8.44	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.18	<0.0050	NS	<0.010	NA	2.2	NA	<0.020	NA	<0.00020	NA	4.1	NA	NA	<5.0	24
MW-2P	2/19/1998	4.5	NA	23	10	NA	NA	6.16	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	14	0.0068	NS	<0.010	NA	<5.0	NA	0.053	NA	<0.00020	NA	5	NA	NA	<5.0	48
MW-2P	6/10/1998	5.2	NA	259	30	NA	NA	9.56	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	1.7	<0.0050	NS	<0.0020	NA	<5.0	NA	<0.020	NA	<0.00020	NA	3.2	NA	NA	<5.0	23
MW-2P	8/10/1998	5	NA	42	20	NA	NA	8.66	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	1.8	<0.0050	NS	<0.0020	NA	<5.0	NA	<0.020	NA	<0.00020	NA	3.6	NA	NA	12	25
MW-2P	10/21/1998	4.9	NA	10	20	NA	NA	7.61	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	1.4	0.0068	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	3.9	NA	NA	<5.0	14
MW-2P	1/27/1999	5	NA	19	20	NA	NA	7.7	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	1.2	0.0068	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	3	NA	NA	<5.0	23
MW-2P	4/29/1999	5.1	NA	26	20	NA	NA	9.37	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.85	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	4	NA	NA	<5.0	16
MW-2P	10/13/1999	5.2	NA	14	20	NA	NA	9.35	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	1.3	<0.0050	NS	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	4.7	NA	NA	9	5
MW-2P	1/18/2000	5	NA	74	19	NA	NA	9.37	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	2.8	<0.0050	NS	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	3.9	NA	NA	7.4	6
MW-2P	9/5/2000	4.9	NA	2.5	22	NA	NA	10.45	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.44	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	3	NA	NA	<5.0	24
MW-2P	3/2/2001	5.3	NA	1.9	20	NA	NA	7.85	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	3.1	NA	NA	<5.0	4
MW-2P	8/23/2001	4.7	NA	39	30	NA	NA	7.4	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.12	<0.0050	<0.040	<0.010	NA	2.7	NA	<0.020	NA	<0.00020	NA	3.8	NA	NA	<5.0	11
MW-2P	2/26/2002	4.7	NA	17	30	NA	NA	9.08	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.76	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	3.5	NA	NA	<5.0	6
MW-2P	9/11/2002	4.9	NA	320	20	NA	NA	8.02	0.019	NA	NA	<0.0050	0.029	NA	<0.020	18	0.0099	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	11	NA	NA	<5.0	33
MW-2P	2/18/2003	4.8	NA	4	25	NA	NA	8.02	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	1.3	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	3.4	NA	NA	<5.0	20
MW-2P	5/5/2004	5	NA	0	22	NA	NA	9.23	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.13	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	4	NA	NA	<5.0	15
MW-2P	11/18/2004	4.5	NA	7.9	22	NA	NA	7.14	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.29	<0.0050	<0.040	<0.010	NA	2.5	NA	<0.020	NA	<0.00020	NA	4.7	NA	NA	<5.0	13

Table 3-8. Historical background chemistry of Unit 2 aquifer at Plant Crist.

Well	Date	pH	D.O.	Turbidity	Cond	Temp	ORP	Depth to Water	As	Ba	Be	Cd	Cr	Co	Cu	Fe	Pb	Ni	Se	Ag	Na	V	Zn	Sb	Hg	Tl	Cl	NH3	NO3	SO4	TDS
		(s.u.)	(mg/L)	(n.t.u.)	(umhos/cm)	(°C)	(mV)	(ft BTOC)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
MW-1S	6/16/1995	5.80	NA	5.31	75	NA	NA	76.68	<0.0020	NA		<0.0050	<0.010	NA	<0.010	0.68	<0.010	NS	<0.0020	NA	4.00	NA	<0.020	NA	<0.00020	NA	4.3	NA	NS	<1.0	96
MW-1S	7/29/1995	6.20	NA	2.50	55	NA	NA	76.85	0.0027	NA	NA	<0.0050	<0.010	NA	<0.010	4.40	<0.010	NS	<0.0020	NA	2.50	NA	<0.020	NA	<0.00020	NA	5.8	NA	<0.10	1.00	26
MW-1S	11/04/95	6.10	NA	5.60	40	NA	NA	76.84	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.07	<0.010	NS	<0.0020	NA	2.70	NA	<0.020	NA	<0.00020	NA	5.0	NA	NS	5.40	45
MW-1S	2/7/1996	5.60	NA	9.10	50	NA	NA	76.57	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.18	<0.0050	NS	<0.0040	NA	2.60	NA	<0.020	NA	<0.00020	NA	4.6	NA	NS	<1.0	30
MW-1S	4/17/1996	5.50	NA	0.46	30	NA	NA	73.68	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	<0.030	<0.0050	NS	<0.0020	NA	2.50	NA	<0.020	NA	<0.00020	NA	4.5	NA	NS	6.60	13
MW-1S	7/16/1996	5.60	NA	7.70	70	NA	NA	77.77	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.11	<0.0050	NS	<0.0020	NA	2.40	NA	<0.020	NA	<0.00020	NA	4.7	NA	NS	1.00	20
MW-1S	11/5/1996	5.40	NA	0.67	24	NA	NA	76.09	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.06	<0.0050	NS	<0.0020	NA	2.40	NA	<0.020	NA	<0.00020	NA	5.6	NA	NS	1.60	16
MW-1S	1/28/1997	4.90	NA	0.70	29	NA	NA	76.56	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	<0.030	<0.0050	NS	<0.0020	NA	2.60	NA	<0.020	NA	<0.00020	NA	4.0	NA	NS	5.40	20
MW-1S	5/1/1997	5.00	NA	2.40	30	NA	NA	75.79	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.06	<0.0050	NS	<0.0020	NA	2.50	NA	<0.020	NA	<0.00020	NA	4.6	NA	NS	<2.0	15
MW-1S	7/29/1997	5.00	NA	1.50	30	NA	NA	75.29	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.08	<0.0050	NS	<0.0020	NA	2.10	NA	<0.020	NA	<0.00020	NA	4.6	NA	NS	1.40	17
MW-1S	11/13/1997	6.30	NA	0.61	60	NA	NA	74.11	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	<0.030	<0.0050	NS	<0.0020	NA	2.40	NA	<0.020	NA	<0.00020	NA	5.2	NA	NS	5.40	32
MW-1S	2/18/1998	5.00	NA	0.81	20	NA	NA	74.99	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	<0.050	<0.0050	NS	<0.0020	NA	<5.0	NA	<0.020	NA	<0.00020	NA	4.1	NA	NS	<5.0	21
MW-1S	6/10/1998	5.20	NA	0.99	20	NA	NA	75.61	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	<0.050	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	3.6	NA	NS	<5.0	22
MW-1S	8/12/1998	5.00	NA	15.00	30	NA	NA	77.58	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	<0.050	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	3.8	NA	NS	<5.0	28
MW-1S	10/22/1998	4.90	NA	0.88	20	NA	NA	77.93	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	<0.050	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	2.5	NA	NS	<5.0	14
MW-1S	1/27/1999	5.50	NA	2.30	20	NA	NA	76.37	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	<0.050	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	3.6	NA	NS	<5.0	34
MW-1S	4/29/1999	5.20	NA	0.63	20	NA	NA	76.32	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	4.8	NA	NS	<5.0	13
MW-1S	10/12/1999	5.40	NA	1.50	30	NA	NA	76.95	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	NS	<0.010	NA	2.50	NA	<0.020	NA	<0.00020	NA	4.3	NA	NS	61.00	21
MW-1S	1/17/2000	5.20	NA	0.63	27	NA	NA	NA	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	NS	<0.010	NA	12.00	NA	<0.020	NA	<0.00020	NA	3.2	NA	NS	<5.0	10
MW-1S	9/5/2000	4.70	NA	3.50	28	NA	NA	79.82	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	4.10	NA	<0.020	NA	<0.00020	NA	3.8	NA	NS	<5.0	19
MW-1S	3/1/2001	5.00	NA	5.10	26	NA	NA	81.38	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	3.6	NA	NS	<5.0	13
MW-1S	8/23/2001	4.80	NA	3.20	30	NA	NA	79.82	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.07	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	4.2	NA	NS	<5.0	14
MW-1S	2/26/2002	4.80	NA	1.90	30	NA	NA	80.62	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	4.1	NA	NS	<5.0	7
MW-1S	9/10/2002	4.80	NA	2.10	26	NA	NA	81.91	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	4.3	NA	NS	<5.0	10
MW-1S	2/18/2003	4.60	NA	6.00	25	NA	NA	80.10	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	3.10	NA	<0.020	NA	<0.00020	NA	3.7	NA	NS	<5.0	24
MW-1S	5/6/2004	4.80	NA	2.90	31	NA	NA	79.28	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	4.8	NA	NS	<5.0	17
MW-1S	11/18/2004	4.80	NA	0.00	27	NA	NA	78.14	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.06	<0.0050	<0.040	<0.010	NA	2.50	NA	<0.020	NA	<0.00020	NA	4.7	NA	NS	<5.0	16

Table 3-8, continued. Historical background chemistry of Unit 2 aquifer at Plant Crist.

Well	Date	pH (s.u.)	D.O. (mg/L)	Turbidity (n.t.u.)	Cond (umhos/cm)	Temp (°C)	ORP (mV)	Depth to Water (ft BTOC)	As (mg/L)	Ba (mg/L)	Be (mg/L)	Cd (mg/L)	Cr (mg/L)	Co (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Na (mg/L)	V (mg/L)	Zn (mg/L)	Sb (mg/L)	Hg (mg/L)	Tl (mg/L)	Cl (mg/L)	NH3 (mg/L)	NO3 (mg/L)	SO4 (mg/L)	TDS (mg/L)
MW-2S	6/16/1995	5.7	NA	7.6	25	NA	NA	8.57	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.13	<0.010	NS	<0.0020	NA	2.7	NA	<0.020	NA	<0.00020	NA	4.1	NA	NA	<1.0	72
MW-2S	7/29/1995	6.5	NA	4.6	50	NA	NA	56.49	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	1.1	<0.010	NS	<0.0020	NA	2.5	NA	0.026	NA	<0.00020	NA	4.3	NA	NA	<1.0	22
MW-2S	11/04/95	5.9	NA	2.1	29	NA	NA	54.87	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.01	0.22	<0.0050	NS	<0.010	NA	2.3	NA	<0.020	NA	<0.00020	NA	3.8	NA	NA	1.4	30
MW-2S	2/7/1996	6	NA	2.2	70	NA	NA	16.75	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.099	<0.0050	NS	<0.040	NA	2.5	NA	<0.020	NA	<0.00020	NA	3.6	NA	NA	<1.0	30
MW-2S	4/17/1996	5.8	NA	2.2	60	NA	NA	54.06	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	<0.030	<0.0050	NS	<0.0020	NA	2.5	NA	<0.020	NA	<0.00020	NA	4.1	NA	NA	1.4	36
MW-2S	7/16/1996	5.7	NA	6	30	NA	NA	54.89	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.031	<0.0050	NS	<0.0020	NA	2.4	NA	<0.020	NA	<0.00020	NA	4	NA	NA	<1.0	25
MW-2S	11/5/1996	5.8	NA	2	27	NA	NA	55.59	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	<0.030	<0.0050	NS	<0.0020	NA	2.4	NA	<0.020	NA	<0.00020	NA	4.4	NA	NA	2.9	21
MW-2S	1/28/1997	7.3	NA	1.1	25	NA	NA	56.16	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.06	<0.0050	NS	<0.0020	NA	2.5	NA	<0.020	NA	<0.00020	NA	3.3	NA	NA	3.3	22
MW-2S	5/1/1997	5.3	NA	4.4	20	NA	NA	55.87	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.12	<0.0050	NS	<0.0020	NA	2.5	NA	<0.020	NA	<0.00020	NA	4.1	NA	NA	<1.0	15
MW-2S	7/29/1997	5.8	NA	1.6	30	NA	NA	55.46	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	<0.030	<0.0050	NS	<0.0020	NA	2.4	NA	<0.020	NA	<0.00020	NA	4.3	NA	NA	<1.0	14
MW-2S	11/13/1997	5.4	NA	0.72	30	NA	NA	55.84	<0.010	NA	NA	<0.0050	<0.010	NA	<0.010	<0.030	<0.0050	NS	<0.010	NA	2.5	NA	<0.020	NA	<0.00020	NA	4.1	NA	NA	<5.0	21
MW-2S	2/18/1998	4.9	NA	1.2	20	NA	NA	55.01	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	0.07	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	4.2	NA	NA	<5.0	17
MW-2S	6/10/1998	5.3	NA	1.33	30	NA	NA	55.58	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	<0.050	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	3.5	NA	NA	<5.0	19
MW-2S	8/12/1998	5.3	NA	2.8	30	NA	NA	56.68	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	<0.050	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	3.4	NA	NA	<5.0	42
MW-2S	10/22/1998	5.2	NA	1.3	20	NA	NA	56.43	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	<0.050	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	3.8	NA	NA	<5.0	24
MW-2S	1/27/1999	5.2	NA	0.62	20	NA	NA	56.55	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	<0.050	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	3.1	NA	NA	<5.0	7
MW-2S	4/29/1999	5.2	NA	0.42	20	NA	NA	56.24	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	4.4	NA	NA	<5.0	14
MW-2S	10/12/1999	5.2	NA	1.6	30	NA	NA	57.22	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	NS	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	4.5	NA	NA	<5.0	<5.0
MW-2S	1/17/2000	5.2	NA	6.3	33	NA	NA	57.66	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	NS	<0.010	NA	2.8	NA	<0.020	NA	<0.00020	NA	3.9	NA	NA	<5.0	7
MW-2S	9/5/2000	4.8	NA	3.4	27	NA	NA	59.37	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	2.8	NA	<0.020	NA	<0.00020	NA	3.2	NA	NA	<5.0	17
MW-2S	3/1/2001	5.3	NA	3.5	25	NA	NA	59.66	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	3.2	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	3.2	NA	NA	<5.0	5
MW-2S	8/23/2001	4.8	NA	7	30	NA	NA	59.41	0.017	NA	NA	<0.00050	0.24	NA	<0.020	24	0.0082	<0.040	<0.010	NA	<2.5	NA	0.036	NA	<0.00020	NA	140	NA	NA	<5.0	13
MW-2S	2/26/2002	4.8	NA	1.2	30	NA	NA	59.85	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	2.7	NA	<0.020	NA	<0.00020	NA	3.9	NA	NA	<5.0	11
MW-2S	9/10/2002	5	NA	7.2	29	NA	NA	59.99	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	2.7	NA	<0.020	NA	<0.00020	NA	4	NA	NA	<5.0	14
MW-2S	2/18/2003	4.7	NA	0.8	25	NA	NA	59.23	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	3.4	NA	<0.020	NA	<0.00020	NA	3.2	NA	NA	<5.0	24
MW-2S	5/6/2004	4.8	NA	0	28	NA	NA	58.27	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	2.6	NA	<0.020	NA	<0.00020	NA	4.4	NA	NA	<5.0	18
MW-2S	11/18/2004	4.4	NA	0	27	NA	NA	57.85	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.1	<0.0050	<0.040	<0.010	NA	3	NA	<0.020	NA	<0.00020	NA	4.7	NA	NA	<5.0	18

Table 3-9. Historical background chemistry of Unit 5 aquifer at Plant Crist.

Well	Date	pH (s.u.)	D.O. (mg/L)	Turbidity (n.t.u.)	Cond (umhos/cm)	Temp (°C)	ORP (mV)	Depth to Water (ft BTOC)	As (mg/L)	Ba (mg/L)	Be (mg/L)	Cd (mg/L)	Cr (mg/L)	Co (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Na (mg/L)	V (mg/L)	Zn (mg/L)	Sb (mg/L)	Hg (mg/L)	Tl (mg/L)	Cl (mg/L)	NH3 (mg/L)	NO3 (mg/L)	SO4 (mg/L)	TDS (mg/L)
MW-1D	6/16/1995	6	NA	5.66	150	NA	NA	76.5	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	1.8	<0.010	NS	<0.0020	NA	29	NA	<0.020	NA	<0.00020	NA	5.1	NA	NA	5.6	140
MW-1D	7/29/1995	6.2	NA	7.4	60	NA	NA	79.25	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	3.8	<0.010	NS	<0.0020	NA	3	NA	<0.020	NA	<0.00020	NA	4.8	NA	NA	1.8	28
MW-1D	11/04/95	5.9	NA	14	30	NA	NA	75.44	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.068	<0.0050	NS	<0.0020	NA	2.6	NA	<0.020	NA	<0.00020	NA	3.7	NA	NA	5.4	45
MW-1D	2/7/1996	5.6	NA	9.1	50	NA	NA	76.57	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.17	<0.0050	NS	<0.0040	NA	2.6	NA	<0.020	NA	<0.00020	NA	3.7	NA	NA	<1.0	24
MW-1D	4/17/1996	5.6	NA	3	28	NA	NA	75.96	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.091	<0.0050	NS	<0.0020	NA	2.5	NA	<0.020	NA	<0.00020	NA	4	NA	NA	1.4	18
MW-1D	7/16/1996	5.6	NA	3	28	NA	NA	75.96	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.071	<0.0050	NS	<0.0020	NA	2.5	NA	<0.020	NA	<0.00020	NA	4	NA	NA	<1.0	24
MW-1D	11/5/1996	5.5	NA	2	23	NA	NA	78.78	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.057	<0.0050	NS	<0.0020	NA	2.4	NA	<0.020	NA	<0.00020	NA	4.7	NA	NA	2.7	52
MW-1D	1/28/1997	5.1	NA	7.5	26	NA	NA	78.94	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.081	<0.0050	NS	<0.0020	NA	2.5	NA	<0.020	NA	<0.00020	NA	3.7	NA	NA	4.3	26
MW-1D	5/1/1997	5.2	NA	10	20	NA	NA	78.33	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.089	<0.0050	NS	<0.0020	NA	2.5	NA	<0.020	NA	<0.00020	NA	4.1	NA	NA	<1.0	18
MW-1D	7/29/1997	5.7	NA	15	30	NA	NA	77.22	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.34	<0.0050	NS	<0.0020	NA	2.6	NA	<0.020	NA	<0.00020	NA	4.8	NA	NA	<1.0	31
MW-1D	11/13/1997	5	NA	6	40	NA	NA	74.4	<0.0020	NA	NA	<0.0050	<0.010	NA	<0.010	0.08	<0.0050	NS	<0.0020	NA	2.4	NA	<0.020	NA	<0.00020	NA	4.2	NA	NA	<5.0	26
MW-1D	2/18/1998	5.7	NA	7.3	20	NA	NA	77.47	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	0.15	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	4	NA	NA	<5.0	30
MW-1D	6/10/1998	5.1	NA	6.4	30	NA	NA	77.57	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	0.064	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	4.1	NA	NA	<5.0	19
MW-1D	8/12/1998	5.1	NA	9.1	30	NA	NA	80.07	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	<0.050	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	3.5	NA	NA	<5.0	37
MW-1D	10/22/1998	5	NA	3.2	20	NA	NA	80.26	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	<0.050	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	3.2	NA	NA	<5.0	32
MW-1D	1/27/1999	5.2	NA	6	20	NA	NA	77.19	<0.010	NA	NA	<0.0050	<0.010	NA	<0.025	0.085	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	<0.00020	NA	2.8	NA	NA	<5.0	25
MW-1D	4/29/1999	5.1	NA	2	20	NA	NA	79.33	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.065	<0.0050	NS	<0.010	NA	<5.0	NA	<0.020	NA	0.0002	NA	4.7	NA	NA	<5.0	22
MW-1D	10/12/1999	4.9	NA	4.1	30	NA	NA	77.09	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	NS	<0.010	NA	<2.5	NA	<0.020	NA	0.0002	NA	4.6	NA	NA	<5.0	5
MW-1D	1/17/2000	5.1	NA	1.7	26	NA	NA	NS	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	NS	<0.010	NA	3.6	NA	<0.020	NA	0.0002	NA	3.1	NA	NA	<5.0	<5.0
MW-1D	9/5/2000	4.5	NA	5.9	29	NA	NA	79.93	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	2.9	NA	<0.020	NA	<0.00020	NA	3.6	NA	NA	<5.0	36
MW-1D	3/1/2001	5	NA	3.2	24	NA	NA	83.92	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.086	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	3	NA	NA	<5.0	14
MW-1D	8/23/2001	4.5	NA	3.1	30	NA	NA	80.29	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.38	<0.0050	<0.040	<0.010	NA	2.6	NA	<0.020	NA	<0.00020	NA	3.8	NA	NA	<5.0	13
MW-1D	2/26/2002	4.5	NA	2.1	35	NA	NA	80.61	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.15	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	3.9	NA	NA	<5.0	7
MW-1D	9/10/2002	5.2	NA	3.5	25	NA	NA	83.68	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	3.4	NA	NA	<5.0	32
MW-1D	2/18/2003	5.2	NA	1.1	25	NA	NA	81.9	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	3.4	NA	<0.020	NA	<0.00020	NA	3.1	NA	NA	<5.0	45
MW-1D	5/6/2004	4.5	NA	0	31	NA	NA	79.37	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	<0.050	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	4.2	NA	NA	<5.0	21
MW-1D	11/18/2004	5	NA	7	24	NA	NA	79.98	<0.010	NA	NA	<0.0050	<0.010	NA	<0.020	0.1	<0.0050	<0.040	<0.010	NA	<2.5	NA	<0.020	NA	<0.00020	NA	6	NA	NA	<5.0	13

Table 3-10. Background chemistry of gypsum storage area Unit 2 and Unit 5 wells.

Well	Date	pH s.u.	DO mg/L	Turbidity n.t.u.	Cond µmhos/cm	Temp °C	ORP mV	TDS mg/L	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Cl mg/L	SO_4 mg/L	NO_3 mg/L	Total Ammonia mg/L	As mg/L	Ba mg/L	Be mg/L	Cd mg/L	Cr mg/L	Co mg/L	Cu mg/L	Fe mg/L	Pb mg/L	Ni mg/L	Se mg/L	Ag mg/L	V mg/L	Zn mg/L	Sb mg/L	Hg mg/L	Tl mg/L
GYP-1S	8/9/2006	4.18	7.18	1.09	70	21.9	286	36	0.36	0.62	8.10	<MDL	16.00	<MDL	0.11	<MDL	<MDL	0.013	<MDL	<MDL	0.002	<MDL	<MDL	<MDL	0.002	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
GYP-1D	8/9/2006	5.71	3.23	1.31	159	21.3	39	74	3.50	2.40	14.00	0.53	25.00	9.40	0.16	0.16	<MDL	0.045	<MDL	<MDL	<MDL	<MDL	<MDL	8.70	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
GYP-4S	8/7/2006	4.52	6.13	1.57	57	22.3	317	38	1.80	1.00	4.40	0.28	12.00	<MDL	0.06	<MDL	<MDL	0.014	<MDL	<MDL	0.006	<MDL	<MDL	0.10	0.002	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
GYP-4D	8/7/2006	5.83	2.10	2.59	236	21.8	14	130	2.60	1.40	24.00	1.10	49.00	<MDL	0.10	0.07	<MDL	0.033	<MDL	<MDL	0.003	0.003	<MDL	18.00	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
GYP-9S	8/7/2006	4.92	3.83	4.20	59	23.6	128	40	0.90	1.00	4.40	1.10	8.60	2.30	0.05	<MDL	<MDL	0.017	<MDL	<MDL	0.003	<MDL	<MDL	3.00	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
GYP-20S	8/8/2006	4.47	7.89	0.43	30	21.6	338	18	0.50	0.47	2.70	0.19	4.50	<MDL	0.55	<MDL	<MDL	0.011	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.002	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
GYP-20D	8/8/2006	4.39	8.22	0.83	30	22.0	322	20	0.49	0.43	2.90	0.17	4.50	<MDL	0.75	<MDL	<MDL	0.010	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
GYP-24S	8/8/2006	4.59	6.55	0.47	45	22.4	209	22	0.26	0.45	3.50	0.52	6.60	<MDL	0.05	0.11	<MDL	0.008	<MDL	<MDL	<MDL	<MDL	<MDL	2.80	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
GYP-24D	8/9/2006	6.00	2.50	7.96	106	22.4	-27	60	3.00	0.79	2.40	0.39	4.40	<MDL	0.12	0.09	<MDL	0.013	<MDL	<MDL	0.002	<MDL	<MDL	20.00	<MDL	<MDL	<MDL	<MDL	0.002	<MDL	<MDL	<MDL	<MDL
GYP-36	8/8/2006	4.68	6.01	1.15	44	22.8	152	22	0.74	0.72	3.50	0.21	6.90	<MDL	0.23	<MDL	<MDL	0.014	<MDL	<MDL	0.003	<MDL	<MDL	1.70	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
Method Detection Limit (MDL)								5	0.02	0.03	0.5	0.1	0.42	1.1	0.04	0.018	0.004	0.001	0.001	0.001	0.002	0.003	0.002	0.05	0.002	0.003	0.003	0.002	0.002	0.008	0.002	0.00007	0.0018
Method Reporting Limit (MRL)								5	0.5	0.5	1	1	2	5	0.1	0.05	0	0.01	0.003	0.005	0.005	0.01	0.01	0.1	0.005	0.005	0.01	0.005	0.01	0.02	0.005	0.0002	0.002

Table 3-11. Background chemistry of surface water at Plant Crist.

Location	Date	pH	DO	Turbidity	Cond	Temp	ORP	TDS	Ca	Mg	Na	K	Cl	SO_4	NO_3	Unionized Ammonia	As	Ba	Be	Cd	Cr	Co	Cu	Fe	Pb	Ni	Se	Ag	V	Zn	Sb	Hg	Tl
		s.u.	mg/L	n.t.u.	μmhos/cm	°C	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
SW-1	9/15/2006	4.15	5.36	0.97	46	26.9	217	18	0.67	0.64	3.7	0.2	8.7	4	<MDL	<MDL	<MDL	0.026	<MDL	<MDL	<MDL	<MDL	<MDL	0.33	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-1	10/13/2006	4.18	5.23	1.62	40	18.8	323	10	0.49	0.54	3.4	0.1	7.6	<MDL	<MDL	<MDL	<MDL	0.018	<MDL	<MDL	<MDL	<MDL	<MDL	0.47	0.002	<MDL	<MDL	<MDL	<MDL	0.12	<MDL	<MDL	<MDL
SW-1	11/9/2006	4.23	7.41	0.74	61	21.0	217	38	0.60	0.65	3.6	0.1	8.2	3.1	<MDL	<MDL	<MDL	0.023	<MDL	<MDL	<MDL	<MDL	<MDL	0.15	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-1	12/14/2006	4.41	6.20	0.46	54	17.1	233	32	0.58	0.65	3.8	0.2	8.3	3.2	<MDL	<MDL	<MDL	0.023	<MDL	<MDL	<MDL	<MDL	<MDL	0.12	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-1	1/10/2007	4.04	7.49	0.57	51	13.7	400	26	0.63	0.69	3.8	0.2	8.2	3.4	<MDL	<MDL	<MDL	0.028	<MDL	<MDL	<MDL	<MDL	<MDL	0.1	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-1	2/9/2007	4.05	7.67	0.37	46	16.0	378	36	0.46	0.60	3.7	0.2	3.8	2.7	<MDL	<MDL	<MDL	0.024	<MDL	<MDL	<MDL	<MDL	<MDL	0.08	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-2	9/15/2006	3.95	3.98	0.90	65	24.9	330	36	1.10	1.40	4.0	0.1	8.1	9.6	<MDL	<MDL	<MDL	0.043	<MDL	<MDL	<MDL	<MDL	<MDL	0.11	0.004	<MDL	<MDL	<MDL	0.002	<MDL	<MDL	<MDL	<MDL
SW-2	10/13/2006	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
SW-2	11/9/2006	4.16	5.90	1.31	49	18.4	314	40	0.64	0.91	3.4	<MDL	8.2	3	<MDL	<MDL	<MDL	0.022	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.002	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-2	12/14/2006	4.49	4.31	0.26	59	14.9	307	28	0.59	0.93	3.6	<MDL	8	4.3	<MDL	<MDL	<MDL	0.02	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.004	<MDL	<MDL	<MDL	0.002	<MDL	<MDL	<MDL	<MDL
SW-2	1/10/2007	4.08	6.98	0.47	46	14.2	428	28	0.52	0.79	3.3	<MDL	7.6	3.3	<MDL	<MDL	<MDL	0.019	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-2	2/9/2007	4.00	7.39	0.25	44	15.6	431	32	0.41	0.76	3.4	<MDL	3.7	3	<MDL	<MDL	<MDL	0.028	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.003	<MDL	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-3	9/15/2006	6.42	6.97	4.21	146	26.6	80	110	17.00	3.10	5.6	0.9	7.2	29	0.058	<MDL	<MDL	0.06	<MDL	<MDL	<MDL	<MDL	<MDL	0.44	0.003	<MDL	<MDL	<MDL	<MDL	0.02	<MDL	<MDL	<MDL
SW-3	10/13/2006	5.70	4.36	1.82	76	18.9	144	26	3.20	0.78	4.2	0.3	7.6	6	0.072	<MDL	<MDL	0.016	<MDL	<MDL	<MDL	<MDL	<MDL	1.5	<MDL	<MDL	<MDL	<MDL	<MDL	0.1	<MDL	<MDL	<MDL
SW-3	11/9/2006	5.18	4.50	1.11	48	19.4	131	44	1.10	0.71	4.1	<MDL	8.3	<MDL	<MDL	<MDL	<MDL	0.015	<MDL	<MDL	<MDL	<MDL	<MDL	0.8	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-3	12/14/2006	5.15	5.29	0.55	50	17.4	194	22	0.93	0.70	4.5	0.2	8.5	1.4	<MDL	<MDL	<MDL	0.014	<MDL	<MDL	<MDL	<MDL	<MDL	0.37	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-3	1/10/2007	5.67	7.12	7.67	52	14.5	302	34	2.70	0.82	3.3	0.5	6.4	4.5	<MDL	<MDL	<MDL	0.02	<MDL	<MDL	<MDL	<MDL	<MDL	0.4	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-3	2/9/2007	4.64	5.51	0.62	46	17.1	293	38	1.10	0.71	4.3	0.1	4	1.8	0.07	<MDL	<MDL	0.02	<MDL	<MDL	<MDL	<MDL	<MDL	0.32	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-4	9/15/2006	5.96	6.73	4.17	71	25.6	91	48	5.10	1.10	5.6	1.1	9.5	3.7	0.25	<MDL	<MDL	0.018	<MDL	<MDL	<MDL	<MDL	<MDL	0.92	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-4	10/13/2006	5.30	6.88	2.41	56	18.5	277	30	3.10	0.94	4.7	0.6	7.6	<MDL	0.36	<MDL	<MDL	0.017	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.025	<MDL	<MDL	<MDL
SW-4	11/9/2006	5.88	8.88	3.60	72	19.4	126	52	4.60	1.10	5.3	1.0	9.1	3.3	0.31	<MDL	<MDL	0.016	<MDL	<MDL	<MDL	<MDL	<MDL	0.43	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-4	12/14/2006	5.98	6.53	1.43	79	17.1	137	52	4.20	1.00	5.5	1.0	9.2	4.4	0.31	<MDL	<MDL	0.016	<MDL	<MDL	<MDL	<MDL	<MDL	0.36	0.004	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-4	1/10/2007	5.76	8.29	3.45	69	14.4	330	40	4.50	1.10	5.3	1.1	8.2	4.8	0.33	<MDL	<MDL	0.017	<MDL	<MDL	<MDL	<MDL	<MDL	0.54	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-4	2/9/2007	5.55	8.51	1.30	77	16.8	370	44	3.80	0.99	5.4	0.8	4.2	4.9	0.45	<MDL	<MDL	0.016	<MDL	<MDL	<MDL	<MDL	<MDL	0.31	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-5	9/15/2006	6.13	7.38	3.19	422	30.4	149	250	6.30	7.60	64.0	3.4	110	17	0.1	<MDL	<MDL	0.016	<MDL	<MDL	<MDL	<MDL	<MDL	0.64	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-5	10/13/2006	6.14	6.63	1.65	1540	18.6	227	860	12.00	30.00	250.0	13.0	420	49	0.26	<MDL	<MDL	0.029	<MDL	<MDL	<MDL	<MDL	<MDL	0.48	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-5	11/9/2006	5.84	8.71	4.91	428	18.0	148	300	6.50	9.60	82.0	4.1	120	20	0.14	<MDL	<MDL	0.015	<MDL	<MDL	<MDL	<MDL	<MDL	0.44	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-5	12/14/2006	5.99	6.78	1.53	258	16.5	149	130	4.20	4.00	30.0	1.9	60	10	0.17	<MDL	<MDL	0.015	<MDL	<MDL	0.002	<MDL	<MDL	0.3	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-5	1/10/2007	5.75	7.68	5.66	104	12.8	376	80	3.80	2.10	12.0	1.4	22	8.2	0.11	<MDL	<MDL	0.014	<MDL	<MDL	<MDL	<MDL	<MDL	0.56	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-5	2/9/2007	5.22	8.02	2.15	93	15.5	363	70	3.10	2.10	13.0	1.0	11	7.5	0.25	<MDL	<MDL	0.016	<MDL	<MDL	<MDL	<MDL	<MDL	0.33	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-7	9/15/2006	6.71	4.95	3.86	2623	28.2	179	1800	28.00	61.00	490.0	19.0	940	110	0.22	<MDL	<MDL	0.033	<MDL	<MDL	<MDL	<MDL	<MDL	0.75	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-7	10/13/2006	6.54	5.62	1.87	8380	20.8	339	5400	65.00	180.00	1500.0	70.0	2200	290	0.067	<MDL	<MDL	0.072	<MDL	<MDL	<MDL	<MDL	<MDL	0.26	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-7	11/9/2006	6.12	6.25	7.44	1224	16.4	115	800	13.00	26.00	220.0	12.0	370	49	<MDL	<MDL	<MDL	0.019	<MDL	<MDL	<MDL	<MDL	<MDL	0.48	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-7	12/14/2006	6.32	6.91	3.00	988	14.8	148	760	12.00	23.00	180.0	9.7	370	88	0.2	<MDL	<MDL	0.022	<MDL	<MDL	<MDL	<MDL	<MDL	0.39	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-7	1/10/2007	5.89	7.08	10.80	207	13.0	377	150	6.00	3.80	29.0	2.5	52	13	<MDL	<MDL	<MDL	0.022	<MDL	<MDL	<MDL	<MDL	<MDL	0.87	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-7	2/9/2007	5.55	9.58	6.23	137	11.9	381	96	5.20	2.20	16.0	1.3	13	9.4	0.18	<MDL	<MDL	0.019	<MDL	<MDL	<MDL	<MDL	<MDL	0.62	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-8	9/15/2006	6.30	5.71	3.78	2822	27.4	390	1900	29.00	66.00	540.0	21.0	940	120	0.15	<MDL	<MDL	0.031	<MDL	<MDL	<MDL	<MDL	<MDL	0.68	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-8	10/13/2006	6.62	5.48	2.96	9480	21.7	350	6400	77.00	220.00	1800.0	88.0	2700	360	0.14	<MDL	<MDL	0.062	<MDL	<MDL	<MDL	<MDL	<MDL	0.38	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-8	11/9/2006	6.70	6.91	5.66	1930	17.3	406	1600	23.00	52.00	440.0	19.0	720	96	0.1	<MDL	<MDL	0.027	<MDL	<MDL	<MDL	<MDL	<MDL	0.51	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-8	12/14/2006	6.71	6.76	2.82	2036	14.1	158	530	10.00	18.00	140.0	7.7	260	40	0.24	<MDL	<MDL	0.02	<MDL	<MDL	<MDL	<MDL	<MDL	0.37	0.003	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-8	1/10/2007	5.74	7.03	10.90	239	13.2	281	140	6.60	4.40	35.0	2.7	63	15	<MDL	<MDL	<MDL	0.025	<MDL	<MDL	<MDL	<MDL	<MDL	0.95	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
SW-8	2/9/2007	5.49	9.67	8.83	112	10.4	272	84	6.30	1.70	12.0	1.1	9	9.3	0.099	<MDL	<MDL	0.028	<MDL	<MDL	<MDL	<MDL	<MDL	0.91	0.002	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
Method Detection Limit (MDL)								5	0.02	0.03	0.5	0.1	0.42	1.1	0.04	0.018	0.004	0.001	0.001	0.001	0.002	0.003	0.002	0.05	0.002	0.003	0.003	0.002	0.002	0.008	0.002	0.00007	0.0018
Method Reporting Limit (MRL)								5	0.5	0.5	1	1	2	5	0.1	0.05	0	0.01	0.003	0.005	0.005	0.01	0.01	0.1	0.005	0.005	0.01	0.005	0.01	0.02	0.005	0.0002	0.002

Table 3-11, continued. Background chemistry of surface water at Plant Crist.

Location	Date	CaCO3 Hardness mg/L	TSS mg/L	Total P mg/L	COD mg/L	TOC mg/L	Fecal coliform cfu/100mL	Total N mg/L	Chlorophyll-a mg/m^3	BOD mg/L
SW-1	9/15/2006	9.6	<MDL	0.069	9.2	3.3	29	0.33	<MDL	<MDL
SW-1	10/13/2006	<MDL	10	0.037	8.2	2.6	13	0.42	<MDL	<MDL
SW-1	11/9/2006	8.1	<MDL	0.047	3.7	3	63	0.21	<MDL	<MDL
SW-1	12/14/2006	7.2	<MDL	0.038	9	2.7	35	<MDL	<MDL	<MDL
SW-1	1/10/2007	9.6	<MDL	0.057	9.7	3.2	12	0.21	<MDL	<MDL
SW-1	2/9/2007	3.6	<MDL	0.048	4	2.3	400	0.32	<MDL	<MDL
SW-2	9/15/2006	13	<MDL	0.067	9.5	3.6	23	0.4	<MDL	<MDL
SW-2	10/13/2006	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
SW-2	11/9/2006	9	<MDL	0.039	<MDL	2.7	23	0.13	<MDL	<MDL
SW-2	12/14/2006	7.2	<MDL	0.027	4.3	2.3	5	<MDL	<MDL	<MDL
SW-2	1/10/2007	9	<MDL	0.053	4.3	2.6	24	0.22	<MDL	<MDL
SW-2	2/9/2007	4.1	<MDL	0.051	<MDL	1.9	2	0.15	<MDL	<MDL
SW-3	9/15/2006	84	<MDL	0.072	17	6.3	60	0.68	<MDL	<MDL
SW-3	10/13/2006	26	<MDL	0.037	7	2.7	250	0.3	<MDL	<MDL
SW-3	11/9/2006	10	<MDL	0.04	<MDL	1.6	45	0.2	<MDL	<MDL
SW-3	12/14/2006	11	<MDL	0.034	4	1.3	28	<MDL	<MDL	<MDL
SW-3	1/10/2007	21	<MDL	0.064	13	4.6	33	0.39	2.7	<MDL
SW-3	2/9/2007	5.7	<MDL	0.055	<MDL	1.6	4	0.36	<MDL	<MDL
SW-4	9/15/2006	28	<MDL	0.068	13	3.6	560	0.6	<MDL	<MDL
SW-4	10/13/2006	12	<MDL	0.034	3.1	1.8	180	0.62	<MDL	<MDL
SW-4	11/9/2006	22	<MDL	0.039	1.6	3.2	160	0.6	<MDL	<MDL
SW-4	12/14/2006	18	<MDL	0.037	8.4	2.3	32	0.4	<MDL	<MDL
SW-4	1/10/2007	26	<MDL	0.061	11	3.6	52	0.75	<MDL	<MDL
SW-4	2/9/2007	14	<MDL	0.049	<MDL	1.9	15	0.67	<MDL	<MDL
SW-5	9/15/2006	62	<MDL	0.064	9.5	5.3	210	0.51	<MDL	<MDL
SW-5	10/13/2006	180	<MDL	0.038	8.6	1.9	200	0.52	<MDL	<MDL
SW-5	11/9/2006	68	<MDL	0.053	6	3.9	410	0.42	<MDL	<MDL
SW-5	12/14/2006	32	<MDL	0.036	11	3	56	0.33	<MDL	<MDL
SW-5	1/10/2007	44	<MDL	0.059	15	4.8	97	0.44	<MDL	<MDL
SW-5	2/9/2007	16	<MDL	0.048	<MDL	2.1	12	0.5	<MDL	<MDL
SW-7	9/15/2006	330	7	0.098	20	5.9	460	0.72	<MDL	<MDL
SW-7	10/13/2006	960	9	0.049	33	2.5	210	0.43	6.2	<MDL
SW-7	11/9/2006	150	<MDL	0.053	14	6.1	900	0.34	<MDL	<MDL
SW-7	12/14/2006	140	<MDL	0.042	9.7	3.9	240	0.35	<MDL	<MDL
SW-7	1/10/2007	57	<MDL	0.071	21	8.4	210	0.47	<MDL	<MDL
SW-7	2/9/2007	22	<MDL	0.053	7.4	4.7	16	0.47	<MDL	<MDL
SW-8	9/15/2006	350	7	0.088	16	5.9	270	0.6	<MDL	<MDL
SW-8	10/13/2006	1100	10	0.051	44	2.5	1200	0.44	4.5	<MDL
SW-8	11/9/2006	280	<MDL	0.06	16	5.6	1100	0.43	<MDL	<MDL
SW-8	12/14/2006	110	<MDL	0.035	13	3.3	220	0.4	<MDL	<MDL
SW-8	1/10/2007	63	<MDL	0.077	27	9.3	100	0.48	<MDL	<MDL
SW-8	2/9/2007	23	5	0.061	14	6.4	23	0.47	<MDL	<MDL
Method Detection Limit (MDL)		5	5	0.021	1.2	0.098	1	0.014	0.5	2
Method Reporting Limit (MRL)		5	5	0.05	10	1	1	0.5	0.5	2

4.0 Geotechnical investigation

The required elements to address the geotechnical portion of the permit application are as follows:

- Describe subsurface conditions including soil stratigraphy and groundwater table conditions
- Address presence of muck, previously filled upland areas, soft ground, lineaments, and sinkholes
- Address faults, seismic impact zones, and unstable areas
- Estimate average and maximum high groundwater table
- Foundation analysis to determine ability to support loads and stresses to include:
    - Foundation Bearing Capacity
    - Subgrade Settlements, total and differential
    - Slope Stability

4.1 Subsurface conditions

Subsurface conditions at the site are described using data previously collected from the site in addition to any relevant data collected to meet the requirements of the hydrogeologic investigation. The subsurface materials encountered were generally a mix of sands, clays and silts, but primarily sandy soils. A very detailed explanation of the subsurface conditions has been given in Section 3, Hydrogeological Investigation. Individual cone penetrometer logs and boring logs are attached describing subsurface conditions encountered at each test location as **Appendix B** and **Appendix C**, respectively. The location of the Cone Penetrometer Tests (CPT) and the Standard Penetration Test (SPT) borings and wells are shown on **Figure 2-1**. In addition, cross sections were created to illustrate the generalized conditions across the site. These are attached as cross sections A-A' to G-G' on **Figures 3-4** to **3-7**.

4.2 Muck, previously filled upland areas, soft ground, lineaments, and sinkholes

The presence of muck, previously filled upland areas, and soft ground was investigated by walking the site and looking for signs of standing water or other indicators, in addition to consultation with Plant Crist personnel who would be aware of such areas. Muck and soft ground was present in certain low lying, wet areas of the sites in Area 2. Muck was defined as, "Dark, finely divided, well decomposed organic soil material." The muck and soft areas were along small streams present on the site. A previously filled upland area was also present in Area 1 from a dredging operation performed by the Corps of Engineers. The material from the dredge operations will be removed by Escambia County prior to development of the storage facility. The locations of the muck, soft ground and previously filled upland areas are shown on **Figure 1-2.**

The presence or absence of lineaments and sinkholes was investigated first by examining aerial photographs and remotely-sensed imagery of the site. No suspected lineaments or sinkholes were present on the aerials. In addition, a review of the U.S Geological Survey Map Series No. 110, "Sinkhole Type, Development, and Distribution in Florida" indicates the project site is located in Area IV. This map indicates that Area IV has cover over the carbonate rock of greater than 200 feet. No history or indication of sinkhole formation was present on the site. This map is included as **Figure 4-1**.

The Florida Department of Environmental Protection Sinkhole database materials were also reviewed for sinkhole formation in the area. This data indicated that no documented sinkhole has formed within Escambia or Santa Rosa counties.

4.3 Seismic impact areas, faults, and unstable areas

The presence or absence of seismic impact zones was researched using the most recent data available from the United States Geological Survey and the Florida Geological Survey. No faults were located at the site using aerial photography and a review of the geologic literature. The USGS Earthquake Hazards Program map for peak acceleration in percent gravity with a 10 percent probability of exceedance in 50 years is shown as **Figure 4-2**. This figure indicates the peak acceleration would be between 1 and 2 percent g. The approximate latitude and longitude of the site were entered into the USGS Earthquake Hazards Program "Interpolated Probabilistic Ground Motion for the Conterminous 48 States by Latitude Longitude, 2002 Data" to have interpolated ground motion values, expressed as a percent of the acceleration of gravity, (%g), returned. The ground motion values returned were Peak Ground Acceleration, (PGA), 0.2 second period spectral acceleration, (SA), and 1.0 second period (SA) for 10%, and 2% probability of exceedance, (PE), in 50 years. These results are indicated in **Table 4-1** below.

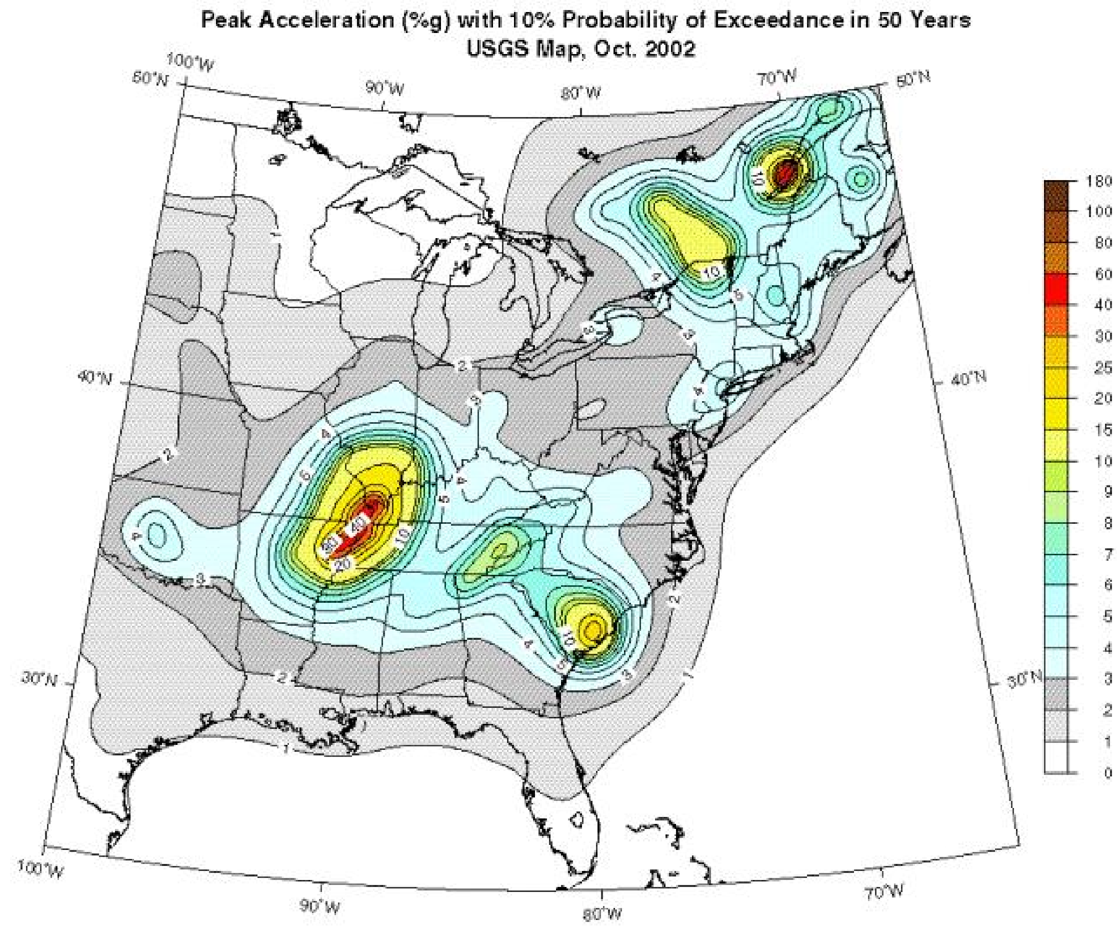

Figure 4-2. 2002 National seismic hazard map of the central and eastern United States

Table 4-1. Probabilistic ground motion values in percent g

	10% PE in 50 years	2% PE in 50 years
PGA	1.62	4.79
0.2 second SA	3.65	10.41
1.0 second SA	1.96	4.97

Several sources published by the Florida Geological Survey indicate that Florida is in a "stable" geological area (Lane, 1994). This indicates that earthquakes are not probable in Florida and even with the largest expected distant earthquake, damage would only be minor.

4.4 Groundwater elevation

Average and maximum high groundwater elevation across the site were determined as part of the hydrogeologic investigation requirements in Section 3.0. Average and maximum groundwater elevations at the site are summarized in **Table 3-3** for the time period June 1995 to May 2005. The maximum ground water elevation from those measurements was 17.13 ft NGVD and the minimum was 4.09 ft NGVD.

Groundwater in Unit 2 or Unit 5 should not exceed 17.13 ft NGVD. The two are hydraulically connected across the site. The Unit 4 is not a confining unit, but a discontinuous semi-confining unit. The maximum groundwater fluctuation is approximately 10 ft over a 10-year period in the Unit 2 and Unit 5.

4.5 Foundation suitability

Potential foundation subgrade and gypsum construction soils have been investigated for short-term, end of construction, and long-term stability and settlement conditions. The information required for foundation soil analysis with respect to its ability to support the loads and stresses of the landfill is discussed below.

4.5.1 Foundation soil bearing capacity

Foundation soil bearing capacity was investigated by a combination of field and laboratory analyses. Previously gathered soil data from the site were reviewed for applicability to the current investigation. New soil strength information was collected from areas where little or no previous soil strength information was available. Collection of new data was performed first with Dutch Cone Penetrometer tests (CPT) and second with a conventional drilling rig to collect Standard Penetration Test (SPT) data and physical samples. The methodology was explained in detail in Section 2.1, Subsurface Investigation.

A representative portion of the collected samples was then analyzed in a laboratory to further determine soil strength and characteristics. Laboratory testing performed included the following:

- Atterberg limits (ASTM D-4318),
- Particle size distribution (ASTM D-422),
- Clay consolidation (ASTM D-2435),
- Proctor density tests (ASTM D-698), and
- Moisture content (ASTM D-2216)

The results of the geotechnical laboratory testing are shown below in **Table 4-2**. More detailed laboratory reporting sheet results of all tests are provided as **Appendix D**.

Table 4-2. Laboratory test results – Area 1

Boring	Elevation (ft MSL)		Moisture Content (%)	Atterberg Limits		Particle Size				Unified Soil Class[3]	Standard Proctor Density	Permeability (cm/sec)	Porosity	Consolidation Results (tsf) ASTM D-2435			
			ASTM D-2216	ASTM D-4318		ASTM D-422				ASTM D-2487	ASTM D-698 Pcf @ Optimum % moisture						
	Top	Bottom		LL[1]	PI[2]	% Gravel	% Sand	% Silt	% Clay					P_c[4]	C_c[5]	C_r[6]	e_o[7]
GSA-1 Composite						0	82.2	17.8		SM							
GYP-1D	-46.32	-47.82				6.1	85.6	8.3		SP-SM	115.7 @ 12.3						
GYP-1D	-51.32	-52.82				0	94.5	5.5		SP-SM	100.3 @ 17.3	1.90 E-3	0.393				
GYP-4S	-6.62	-8.12				0.3	91.4	8.3		SP-SM							
GYP-4D	-36.24	-37.74				0	17.5	82.5		ML	94.6 @ 28	1.90 E-7	0.432				
GYP-4D	-41.24	-43.24				0.6	55.6	43.8		SM	112.6 @ 17.8	2.00 E-6	0.321				
GYP-4D	-61.24	-62.74				0	43.5	56.5		ML	95.8 @ 27.4	8.00 E-7	0.423				
GYP-4D	-76.24	-76.74				0	92.7	7.3		SP-SM							
GYP-4D	-86.24	-87.74	23.9	41	25	0	6	53.7	40.3	CL			0.551	1.38	0.16	0.04	0.657
GYP-9	44.86	42.86				0	54.9	45.1		SM	109.6 @ 19.4	7.70 E-8	0.342				
GYP-9	-9.64	-11.14				0.2	92.9	6.9		SP-SM							
GYP-11S	-11.84	-13.34				0.3	93.5	6.2		SP-SM							
GYP-11D	-42.69	-44.19	27.1	38	20	0	24	39.5	36.5	CL							
GYP-11D	-62.69	-64.19				0	92	8		SP-SM							
GYP-16	61.08	59.58	16.1			0.5	29.6	31.7	38.2	ML							
GYP-16	51.08	49.08	38.7	55	30	0	15.8	84.2		CH	82.3 @ 39.3	9.40 E-8	0.495	2.44	0.38	0.07	1.053
GYP-16	49.08	47.58	35	46	25	0	17.5	31.4	51.1	CL							

[1] LL stands for Liquid Limit of the soil

[2] PI stands for Plasticity Index of the soil

[3] Unified Soil Classifications according to ASTM D-2487
SP- Poorly graded Sand, SM-Silty Sand,
CL-Lean Clay, CH-Fat Clay
ML - Silt

[4] P_c is the Preconsolidation pressure of the soil

[5] C_c is the Compression Index of the soil

[6] C_r is the rebound or swell index of the soil

[7] e_o is the initial void ratio of the soil

Table 4-2 Continued. Laboratory test results – Area 2

Boring	Elevation (ft MSL)		Moisture Content (%)	Atterberg Limits		Particle Size				Unified Soil Class[3]	Standard Proctor Density	Permeability (cm/sec)	Porosity	Consolidation Results (tsf) ASTM D-2435			
			ASTM D-2216	ASTM D-4318		ASTM D-422				ASTM D-2487	ASTM D-698 Pcf @ Optimum % moisture						
	Top	Bottom		LL[1]	PI[2]	% Gravel	% Sand	% Silt	% Clay					P_c[4]	C_c[5]	C_r[6]	e_o[7]
GSA-2 Composite						9.2	78.2	12.6		SM	113.9 @ 10.8						
GYP-17	54.516	53.016				0.2	39.6	30.8	29.4	CL							
GYP-17	49.516	48.016	19.3	48	27	0	18.6	37.1	44.3	CL							
GYP-17	44.516	43.016	22	55	31	0	16.5	32.9	50.6	CH			0.627	2.59	0.15	0.04	0.60
GYP-17	24.516	23.016	18.6	43	25	0	16.5	44.5	39	CL							
GYP-20S	-13.72	-15.22				0.1	95.3	4.6		SP							
GYP-20S	-18.72	-20.22				0.1	96.6	3.3		SP	96 @ 18.3	3.90 E-3	0.42				
GYP-20D	-48.47	-49.97				0.3	95.7	4		SP							
GYP-21	58.33	56.83				0	52.2	47.8		SM	105.8 @ 18	4.90 E-8	0.633				
GYP-21	-21.67	-23.17				0.3	74.9	24.8		SM	108.3 @ 17.4	5.40 E-6	0.647				
GYP-22	-17.23	-18.73	28.3			0	66.2	18.9	14.9	SM							
GYP-22	-22.73	-24.73				0.2	56.5	43.3		SM	96.1 @ 31	4.10 E-6	0.417				
GYP-24	54.71	53.21	16.6	38	17	0.2	57.3	13.8	28.7	SC							
GYP-24	24.71	23.21				0	2.9	97.1		ML	87.8 @ 32.7	5.20 E-8	0.471				
GYP-24	19.71	18.21	28.8	33	12	0.7	13.1	59.5	26.7	CL							
GYP-24S	-5.29	-6.79				0	90.6	9.4		SP-SM							
GYP-24S	-0.29	-1.79				0.1	92.9	7		SP-SM	96.9 @ 22.1	8.70 E-4	0.412				
GYP-24D	-45.28	-46.78				0	27.9	72.1		ML	94.5 @27.7	1.90 E-7	0.561				
GYP-24D	-55.28	-56.78				0	91.8	8.2		SP-SM							
GYP-24D	-60.28	-61.78				0	89	11		SP-SM	89.7 @ 27.7	4.70 E-4	0.455				
GYP-26	25.699	24.199				0	67.2	32.8		SM	113.9 @ 15.4	1.20 E-6	0.295				
GYP-34	94.797	93.297				0.9	82.9	16.2		SM	107.4 @ 11.5	4.20 E-4	0.36				
GYP-34	47.297	45.297	21.7	40	19	0	14.2	49.9	35.9	CL	104.2 @ 21.7	5.20 E-8	0.619	3.78	0.14	0.03	0.621
GYP-36	19.38	17.88	40.4	62	33	0	11.5	29.4	59.1	CH							
GYP-36	-0.62	-2.12	30.3	35	13	0	15.6	56.9	27.5	CL							

[1] LL stands for Liquid Limit of the soil

[2] PI stands for Plasticity Index of the soil

[3] Unified Soil Classifications according to ASTM D-2487

SP- Poorly graded Sand, SM-Silty Sand,
CL-Lean Clay, CH-Fat Clay; ML-Silt

[4] P_c is the Preconsolidation pressure of the soil

[5] C_c is the Compression Index of the soil

[6] C_r is the rebound or swell index of the soil

[7] e_o is the initial void ratio of the soil

The field investigation indicated that the sands were generally firm to very dense. The results of the laboratory tests revealed that the sand soils are silty sands (SM) and poorly graded sands (SP and SP-SM). The laboratory tests also revealed that the average maximum dry density (ASTM D-698) of the sand soils was on the order of 104 pounds per cubic foot (pcf) at 27 percent optimum moisture.

The field investigation indicated that the fine grained soils on site consisted of clays and silts of varying plasticity. The find grained soils were soft to hard. The laboratory results indicated the fine grained soils were low plasticity clay (CL), high plasticity clay (CH), and silts (ML). The laboratory tests also revealed that the low plasticity clay (CL) soils had an average maximum dry density on the order of 104 pcf at an optimum moisture of 21 percent, the higher plasticity clays (CH) had a maximum dry density on the order of 82 pcf at an optimum moisture of 39 percent, and the silt (ML) soils had an average maximum dry density on the order of 93 pcf at an optimum moisture of 29 percent.

The laboratory results were reviewed and utilized to determine the soil bearing capacity. Soil bearing capacity was analyzed to determine its effect on the storage facility. Due to the large spatial dimensions of the storage facility, bearing capacity will not be of concern. The existing underlying soils, when the foundations are placed in "cut" areas, will adequately support bearing of the storage area. Likewise, the sand and clay soils present at the site, when placed as properly engineered "fill" soils, will also provide adequate bearing support for the storage area. Calculation of the bearing capacity up to a maximum stack height of 100 feet would still maintain an adequate factor of safety against failure. For the various stack heights and widths analyzed, it appeared the factor of safety against local bearing capacity failure would be on the order of 10, with factors of safety against global failure on the order of 50. The calculations are attached in **Appendix G.**

4.5.2 Settlements

Subgrade settlements were analyzed for the facility. These settlements included short-term, end of construction, and long-term settlement conditions. This analysis addressed settlements related to any cut and fill operations required for the construction of the facility as well as settlements that may occur as a results of storing a large quantity of gypsum. As these are primarily sandy soils, most of the settlements will occur during construction and immediately during and following placement of the gypsum. The settlement of the clay soils present beneath the storage area will take longer to occur. The settlements will occur as the gypsum is stacked within the storage area.

Consolidation tests were performed on clay soil samples obtained by relatively undisturbed Shelby tube samples. The consolidation tests were performed according to ASTM D-2435. These tests revealed that the clay soils exhibited an over consolidation ratio (OCR) of 1 to greater than 4. This indicates that the clay soils have been exposed to much more pressure in the past than they are currently exposed to. As such, settlements in the clay should not occur until the pressure from the gypsum stack exceeds what the clay has previously been exposed to. The stack height that must be exceeded to cause significant settlement of the clay can vary from 25 to over 40 feet.

The immediate, short-term settlement calculations were performed for the sand soils based on Schmertman's settlement method. Long-term settlement calculations for any clay soils were based on consolidation data gathered during the laboratory testing. The settlement will take place as the gypsum is stacked to different heights. The subsurface soils were slightly different in Area 1 and Area 2. As such, the expected settlements are listed separately in the tables below. The different short and long-term settlements for Area 1 and Area 2 are shown in **Table 4-3** and **Table 4-4**, respectively.

Table 4-3 Short-term and long-term foundation settlements Area 1

Stack Height (ft)	Short-Term Settlement Sand (inches)	Long-Term Settlement Clay (inches)
20	5.0	0
40	10.0	0
60	15	16.7
80	20	18.5
100 (Design Stack height of 91 feet)	24.9	19.9

Table 4-4 Short-term and long-term foundation settlements Area 2

Stack Height (ft)	Short-Term Settlement Sand (inches)	Long-Term Settlement Clay (inches)
20	5.9	0
40	11.7	0
60	17.6	15.7
80	23.4	18
100 (Design Stack height of 88 feet)	29.3	20.0

The combination of the short term and end of construction settlements from the sand soils and the long term settlements from the clay soils would be the total settlement. Differential settlement is usually taken as one-half of the total settlement of a uniformly loaded foundation. However, with the situation of a gypsum stack, the loading at the center will be the full height of the stack, while the loading at the edges will be much less. The difference in the two settlements from the center and the edge would be the differential settlement. The total foundation settlements for Area 1 and Area 2 are shown in **Table 4-5** and **Table 4-6**, respectively. The calculations to determine settlements are attached in **Appendix G**.

Table 4-5 Total and differential foundation settlement Area 1

Stack Height (ft)	Total Settlement (inches)	Differential Settlement (inches)
20	5.0	2.5
40	10.0	5.0
60	31.6	22.3
80	38.4	26.6
100 (Design Stack height of 91 feet)	44.8	30.5

Table 4-6 Total and differential foundation settlement Area 2

Stack Height (ft)	Total Settlement (inches)	Differential Settlement (inches)
20	5.9	2.9
40	11.7	5.9
60	33.2	23.1
80	41.4	28.4
100 (Design Stack height of 88 feet)	49.2	33.3

These settlements were then analyzed to determine the effect on the liner system. We understand that certain geomembrane liners that will be used to line the facility can withstand strain values over 3 percent. Our analyses revealed that from the calculated settlements, the liners would only experience strains on the order of 0.02 percent. Alternatively, settlements of 60 feet to greater than 300 feet beneath the liners would have to occur to cause the 3 percent strain in the liner. The calculations to determine strain on the liner related to the subgrade settlements are attached in **Appendix G**.

4.5.3 Soil slope stability

Potential foundation soils have been investigated for short-term, end of construction, and long-term stability. In addition, subgrade and constructed slope stability was also analyzed.

The foundation soils are a mixture of sand, silt and clay; but primarily sand soils. As such, these materials would be classified as “Type C” soil according to the Occupational Safety and Health Administration (OSHA) guidelines for excavations. This means that for short term excavations and slopes, these soils should may be excavated on a maximum allowable slope of 1.5 (H) : 1 (V) for a depth up to 20 feet. This is for short-term excavations only.

From the results of our soil testing and the proposed slope geometry, we analyzed the slope stability. The stability was predicted utilizing computer software called Seep W and SlopeW version 5.12, developed by Geo-Slope International, Ltd. Various conditions were analyzed to depict various heights of construction. The first berm will be constructed out of on-site soils. Each subsequent berm raise will be constructed out of gypsum from the disposal area. All new exterior slopes were constructed on a 3 (H) : 1

(V) slope with the interior of the initial sand berm cell also being constructed at a 3 (H) : 1 (V) slope. As these analyses looked at the constructed gypsum cells, differences in the subsurface soils between areas 1 and 2 were not taken into account. The input soil parameters are given in **Table 4-7** below.

Table 4-7 Soil parameters for slope stability

Soil Type	Unit Weight, γ pcf	Cohesion, C psf	Internal Angle of Friction, Φ degrees
In-Place Sand (base of disposal area)	110	100	30
Sand Berm	110	100	32
Compacted Gypsum Berm	85	0	40
Sluiced Gypsum prior to consolidation	70	0	23
Sluiced Gypsum after consolidation	80	0	25

Drainage of the gypsum stack greatly influences the slope stability. As such, various methods of drainage from the interior of the stack were considered and analyzed. Two cases were chosen as possible means of construction and operations. These two methods of drainage include a single drain beneath the constructed berm and multiple drains, constructed beneath each new berm rise.

End of construction and long term stability calculations were analyzed at the maximum proposed stack height of 100 feet above grade. The results of the slope stability analyses for various heights and drainage scenarios are given in **Table 4-8** below. The calculations to determine slope stability are attached in **Appendix G**.

Table 4-8 Calculated slope stability values

Soil Type	Slope	Slope Stability Factor of Safety	
		Single Drain	Multiple Drains
20 ft Sand (Initial Berm Construction)	Exterior	2.64*	
	Interior	5.51*	
40 ft Sand (Sand Berm plus Gypsum Berm)	Exterior	2.25**	
	Interior	2.37**	
60 ft Sand (Sand Berm plus Gypsum Berm)	Exterior	1.90	2.10
	Interior	2.65	2.54
80 ft Sand (Sand Berm plus Gypsum Berm)	Exterior	1.38	1.81
	Interior	2.46	3.44
100 ft Sand (Sand Berm plus Gypsum Berm)	Exterior	1.09	1.53
	Interior	2.73	4.25

* The first 20 foot lift appeared to be stable without any drains. Therefore, additional drainage cases were not analyzed.

** The values presented appeared to be stable with a single drain. Therefore, the additional multiple drainage case was not analyzed.

These analyses indicate that both the interior and exterior berms will be stable against slope failure with the appropriate drainage. All conditions were analyzed for each stage of cell construction.

5.0 References

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Appendix B

USEPA Checklists

Coal Combustion Dam Inspection Checklist Form

US Environmental
Protection Agency

Site Name: Gulf Power - Plant Crist	Date: August 21, 2012
Unit Name: Gypsum Stacking/Storage Pond	Operator's Name: Gulf Power
Unit I.D.:	Hazard Potential Classification: High (Significant) Low
Inspector's Name: William Fox/ Eduardo Gutierrez	

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?	Weekly		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	113.0		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	DNA		20. Decant Pipes: DNA		
4. Open channel spillway elevation (operator records)?	DNA		Is water entering inlet, but not exiting outlet?		
5. Lowest dam crest elevation (operator records)?	122.0		Is water exiting outlet, but not entering inlet?		
6. If instrumentation is present, are readings recorded (operator records)?	DNA		Is water exiting outlet flowing clear?		
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	DNA		From underdrain?		X
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?	X	
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?	X	
12. Are decant trashracks clear and in place?	DNA		From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?	DNA		23. Water against downstream toe?		X
17. Cracks or scarps on slopes?	X		24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue #	Comments

1. Weekly by plant personnel, annually by Southern Company Services.

2,5. Referenced to plant datum.

6. Instrumentation is not present.

12. Trashracks are not present.

17. Minor erosion scarps and small erosion gullies observed at isolated locations on the west outboard slope.

21. Wet areas were observed at and near the toe of slope along southwest and west outboard slopes.

EPA FORM -XXXX

NA = Not Available
DNA = Does Not Apply

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # 0002275

INSPECTOR William Fox and Eduardo Gutierrez

Date August 21, 2012

Impoundment Name Gypsum Stacking/Storage Pond

Impoundment Company Gulf Power Company

EPA Region 4

State Agency (Field Office) Addresss 61 Forsyth Street, SW
Atlanta, Ga 30303-8960

Name of Impoundment Gypsum Stacking/Storage Pond

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New X Update ______

	Yes	No
Is impoundment currently under construction?		X
Is water or ccw currently being pumped into the impoundment?	X	

IMPOUNDMENT FUNCTION: Disposal and primary settling of gypsum

Nearest Downstream Town : Name Pensacola, Florida

Distance from the impoundment 0.5 miles

Impoundment Location:

Longitude 87 Degrees 13 Minutes 58.72W Seconds

Latitude 30 Degrees 34 Minutes 6.54N Seconds

State Florida County Escambia County

Does a state agency regulate this impoundment? YES X NO ______

If So Which State Agency? Florida Department of Environmental Protection

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.

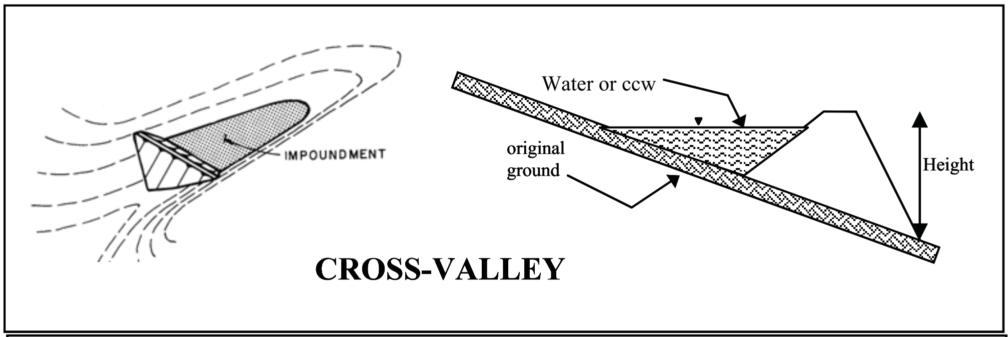
__X___ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. 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.

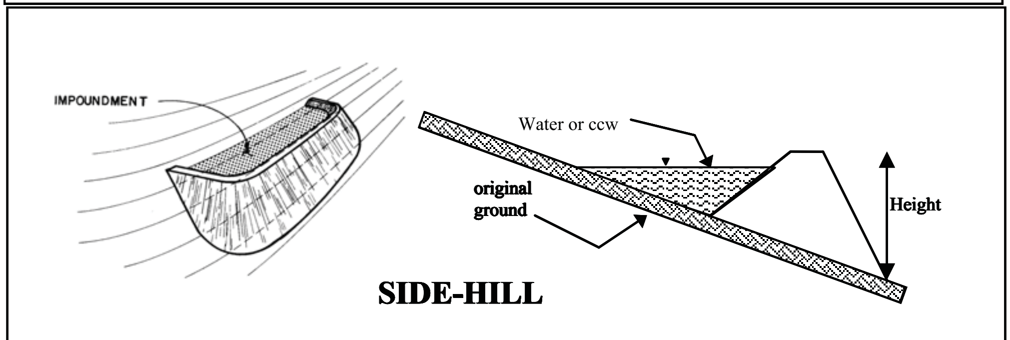
______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

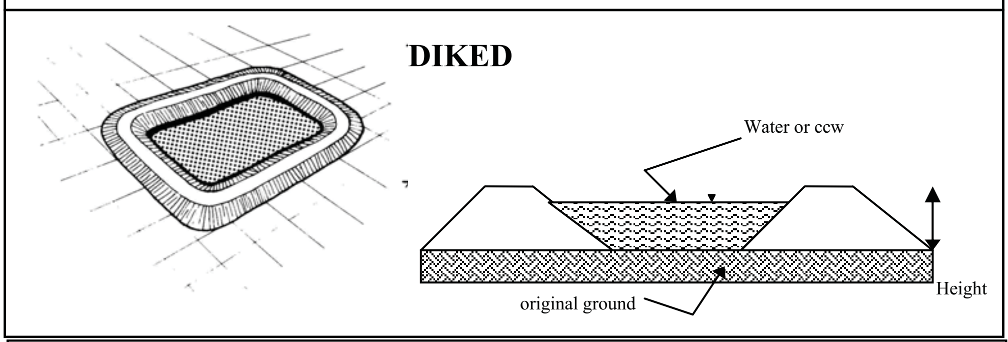
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

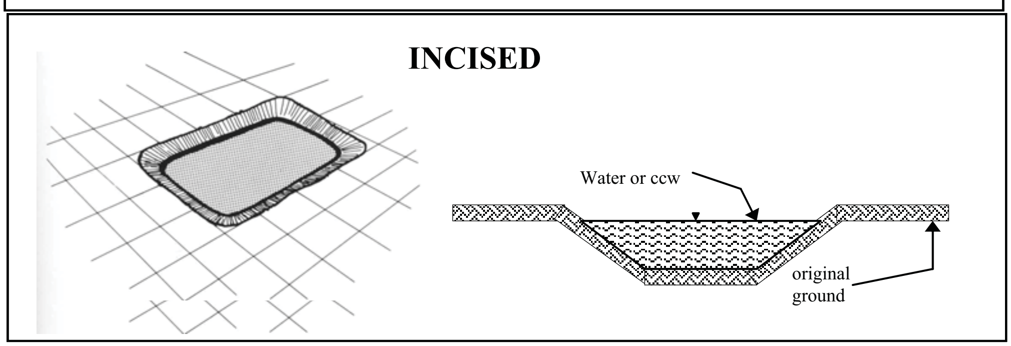
Failure or misoperation could result in environmental damage and economic loss and damage to plant infrastructure, operations and utilities. Loss of human life as a result of failure or misoperation is not anticipated.

CONFIGURATION:









______ Cross-Valley
______ Side-Hill
X Diked
______ Incised (form completion optional)
______ Combination Incised/Diked

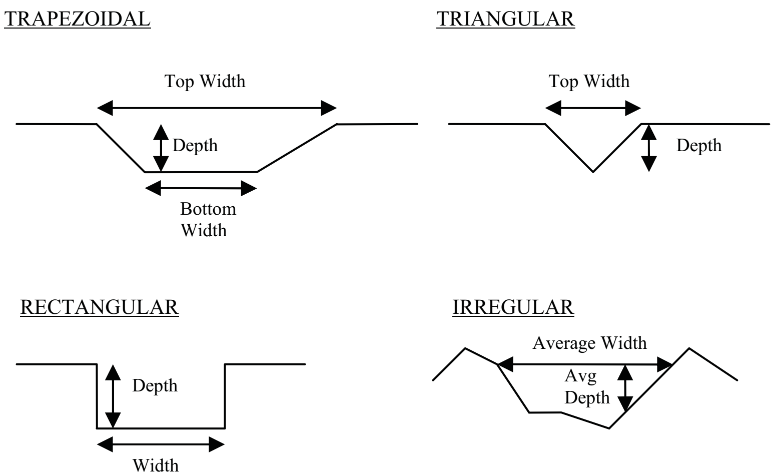
Embankment Height 32 feet   Embankment Material Earthen
Pool Area 14 acres   Liner Composite (bottom and inboard slopes)
Current Freeboard 9 feet   Liner Permeability 1.0 E-7 cm/sec for clay
1.0 E-9 cm/sec for GCL
1.0 E-12 cm/sec for liner

NA = Not Available
DNA = Does Not Apply

TYPE OF OUTLET (Mark all that apply)

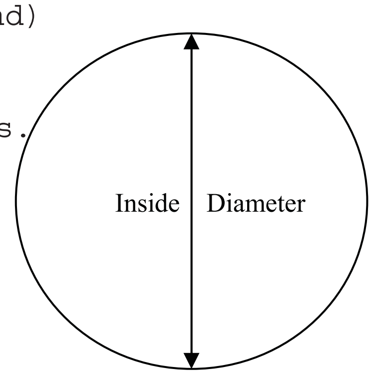
DNA **Open Channel Spillway**
______ Trapezoidal
______ Triangular
______ Rectangular
______ Irregular

______ depth
______ bottom (or average) width
______ top width



X **Outlet** (to Process Sedimentation Pond)

36" inside diameter
(Decant Riser Pipe/Structure with stop logs. Pipe size reduces to 30" inside diameter.)



Material
______ corrugated metal
______ welded steel
______ concrete
X plastic (hdpe, pvc, etc.)
______ other (specify) ____________________

Is water flowing through the outlet? YES X NO _______

______ **No Outlet**

X **Other Type of Outlet** (specify) 36-foot long, twin 7'W x 5'H concrete box culvert at NE corner of pond connecting to Process Sedimentation Pond

The Impoundment was Designed By Southern Company Services

NA = Not Available
DNA = Does Not Apply

Has there ever been a failure at this site? YES ___________ NO ____X_______

If So When? ______________________________

If So Please Describe : ____

Has there ever been significant seepages at this site? YES _______ NO X

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 __X______

If so, which method (e.g., piezometers, gw pumping,...)? ______________________

If so Please Describe : ____

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

It is unknown if the embankment construction was over wet ash, slag or other unsuitable material.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

The assessor did not meet with, or have documentation from, the design Engineer of Record concerning foundation preparation.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

There was no indication of prior releases, failures or patchwork on the embankments.

Coal Combustion Dam Inspection Checklist Form

US Environmental
Protection Agency

Site Name:	Gulf Power - Plant Crist	Date:	August 21, 2012
Unit Name:	Process Return Water Pond	Operator's Name:	Gulf Power
Unit I.D.:		Hazard Potential Classification:	High (Significant) Low
Inspector's Name:	William Fox/ Eduardo Gutierrez		

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?	Weekly		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	98.0		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	85.3		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	DNA		Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	106.0		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?	DNA		Is water exiting outlet flowing clear?	NA	
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	DNA		From underdrain?		X
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?	DNA		From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?	DNA		23. Water against downstream toe?		X
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue #	Comments
1.	Weekly by plant personnel, annually by Southern Company Services.
2,3,5.	Referenced to plant datum.
6.	Instrumentation is not present.
12.	Trashracks are not present.
20.	Water is pumped from pond to plant for reuse.

EPA FORM -XXXX

NA = Not Available
DNA = Does Not Apply

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # 0002275 INSPECTOR William Fox and Eduardo Gutierrez

Date August 21, 2012

Impoundment Name Process Return Water Pond
Impoundment Company Gulf Power Company
EPA Region 4
State Agency (Field Office) Addresss 61 Forsyth Street, SW
Atlanta, Ga 30303-8960
Name of Impoundment Process Return Water Pond
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New X Update ____

	Yes	No
Is impoundment currently under construction?		X
Is water or ccw currently being pumped into the impoundment?	X	

IMPOUNDMENT FUNCTION: Tertiary sedimentation and settling of gypsum

Nearest Downstream Town : Name Pensacola, Florida
Distance from the impoundment 0.5 miles
Impoundment
Location: Longitude 87 Degrees 13 Minutes 49.27W Seconds
Latitude 30 Degrees 34 Minutes 10.90N Seconds
State Florida County Escambia County

Does a state agency regulate this impoundment? YES X NO ____

If So Which State Agency? Florida Department of Environmental Protection

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.

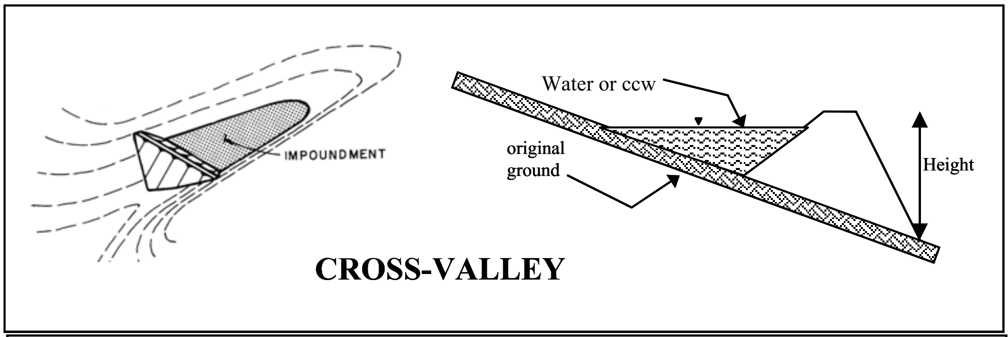
__x___ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. 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.

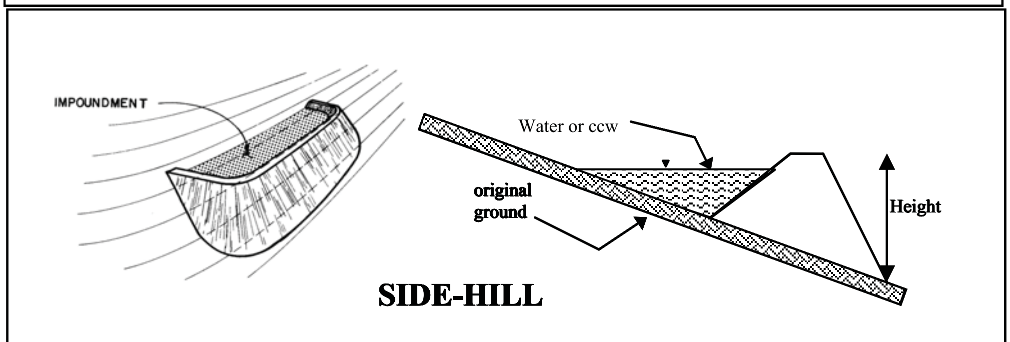
______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

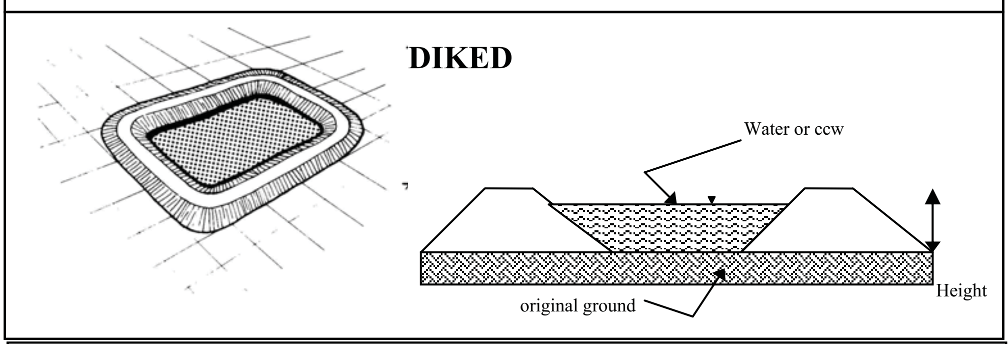
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

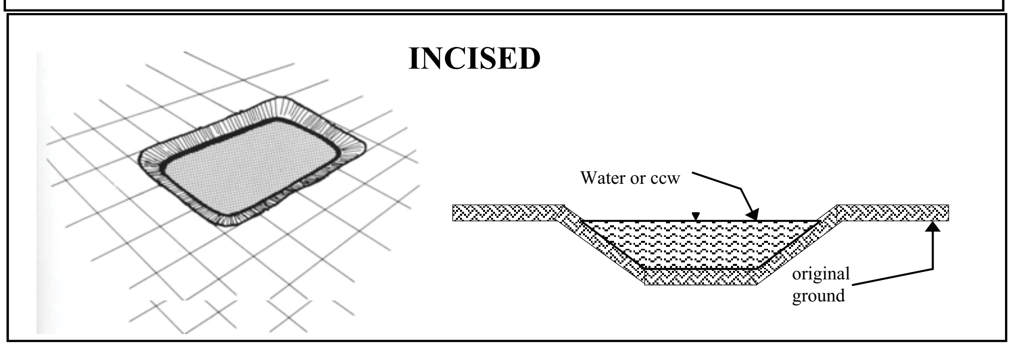
Failure or misoperation could result in environmental damage and economic loss and damage to plant infrastructure, operations and utilities. Loss of human life as a result of failure or misoperation is not anticipated.

CONFIGURATION:









______ Cross-Valley
______ Side-Hill
______ Diked
______ Incised (form completion optional)
X Combination Incised/Diked

Embankment Height 23 feet
Pool Area 2.5 acres
Current Freeboard 8 feet

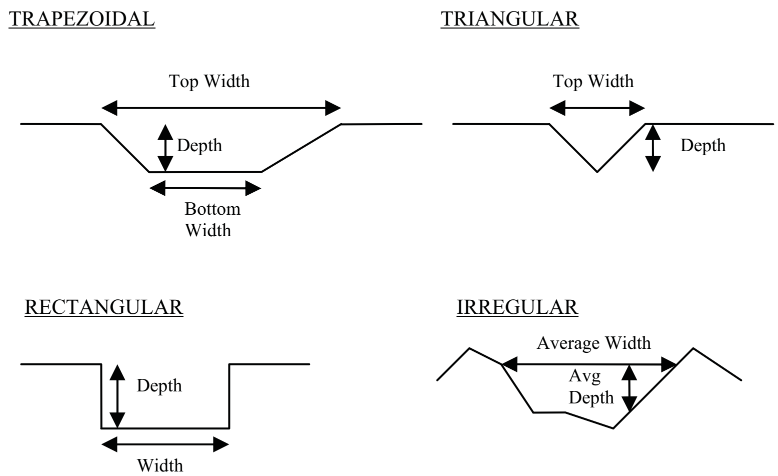
Embankment Material Earthen
Liner Composite (bottom and inboard slopes)
Liner Permeability 1.0 E-7 cm/sec for clay
1.0 E-9 cm/sec for GCL
1.0 E-12 cm/sec for liner

NA = Not Available
DNA = Does Not Apply

TYPE OF OUTLET (Mark all that apply)

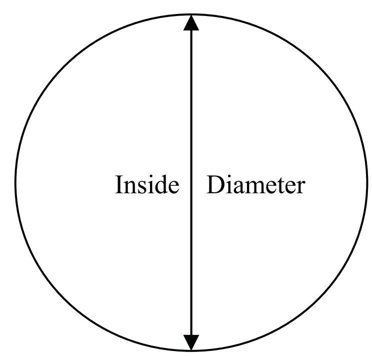
_____ **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

_____ depth
_____ bottom (or average) width
_____ top width



_____ **Outlet**

_____ inside diameter



Material
_____ corrugated metal
_____ welded steel
_____ concrete
_____ plastic (hdpe, pvc, etc.)
_____ other (specify) ____________________

Is water flowing through the outlet? YES __X__ NO _______

__X__ **No Outlet** (Water is pumped from pond to plant for reuse)

_____ **Other Type of Outlet** (specify) Emergency spillway approximately 20 feet wide on West Side of Pond. Downstream slope is articulated concrete block armoring.

The Impoundment was Designed By Southern Company Services

NA = Not Available
DNA = Does Not Apply

Has there ever been a failure at this site? YES __________ NO ____X____

If So When? ____________________________

If So Please Describe : ____

Has there ever been significant seepages at this site? YES _______ NO __X_____

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 __X______

If so, which method (e.g., piezometers, gw pumping,...)? ____________________

If so Please Describe : ____

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

It is unknown if the embankment construction was over wet ash, slag or other unsuitable material.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

The assessor did not meet with, or have documentation from, the design Engineer of Record concerning foundation preparation.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

There was no indication of prior releases, failures or patchwork on the embankments.

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	Gulf Power - Plant Crist	Date:	August 21, 2012
Unit Name:	Process Sedimentation Pond	Operator's Name:	Gulf Power
Unit I.D.:		Hazard Potential Classification:	High (Significant) Low
Inspector's Name:	William Fox/ Eduardo Gutierrez		

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?	Weekly		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	112.5		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	88.0		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	DNA		Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	117.0		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?	DNA		Is water exiting outlet flowing clear?	NA	
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	DNA		From underdrain?		X
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?	X	
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?	DNA		From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?	DNA		23. Water against downstream toe?		X
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue #	Comments

1. Weekly by plant personnel, annually by Southern Company Services.

2,3,5. Referenced to plant datum.

6. Instrumentation is not present.

12. Trashracks are not present.

20. No water flow was observed.

21. Wet areas were observed at and near the toe of slope along the northeast outboard slopes.

EPA FORM -XXXX

NA = Not Available
DNA = Does Not Apply

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # 0002275 INSPECTOR William Fox and Eduardo Gutierrez

Date August 21, 2012

Impoundment Name Process Sedimentation Pond

Impoundment Company Gulf Power Company

EPA Region 4

State Agency (Field Office) Addresss 61 Forsyth Street, SW

Atlanta, Ga 30303-8960

Name of Impoundment Process Sedimentation Pond

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New X Update ____

	Yes	No
Is impoundment currently under construction?		X
Is water or ccw currently being pumped into the impoundment?	X	

IMPOUNDMENT FUNCTION: Sedimentation and secondary settling of gypsum

Nearest Downstream Town : Name Pensacola, Florida

Distance from the impoundment 0.5 miles

Impoundment Location: Longitude 87 Degrees 13 Minutes 58.55W Seconds

Latitude 30 Degrees 34 Minutes 14.62N Seconds

State Florida County Escambia County

Does a state agency regulate this impoundment? YES X NO ____

If So Which State Agency? Florida Department of Environmental Protection

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.

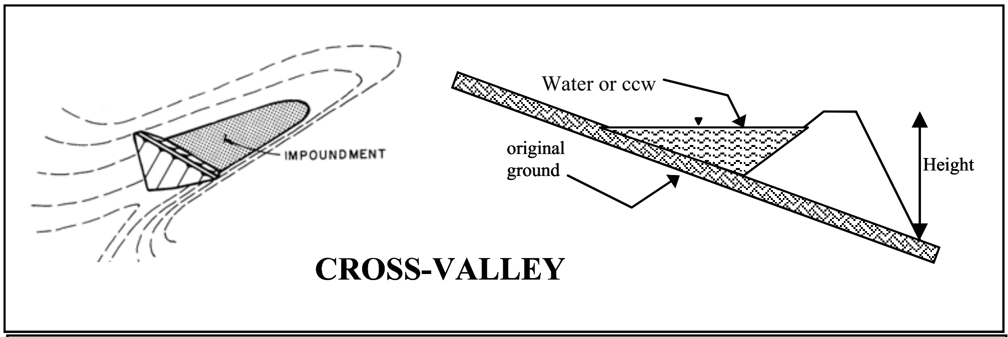
__x___ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. 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.

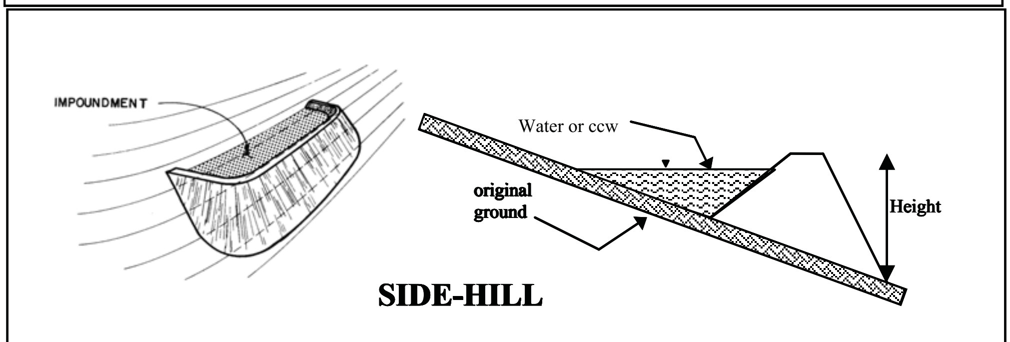
______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

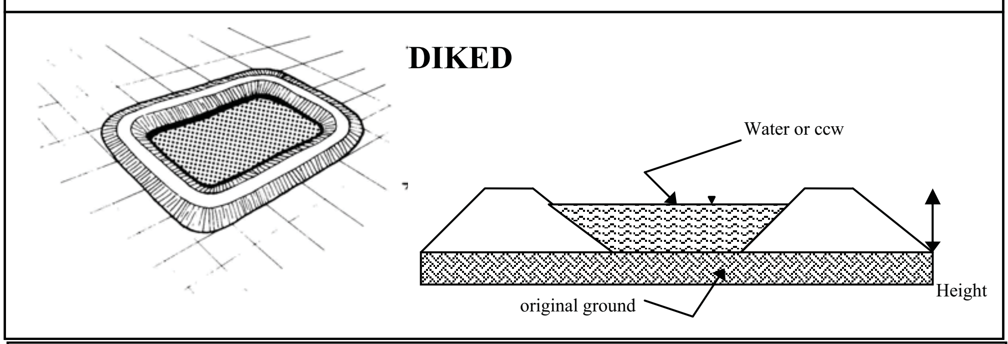
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

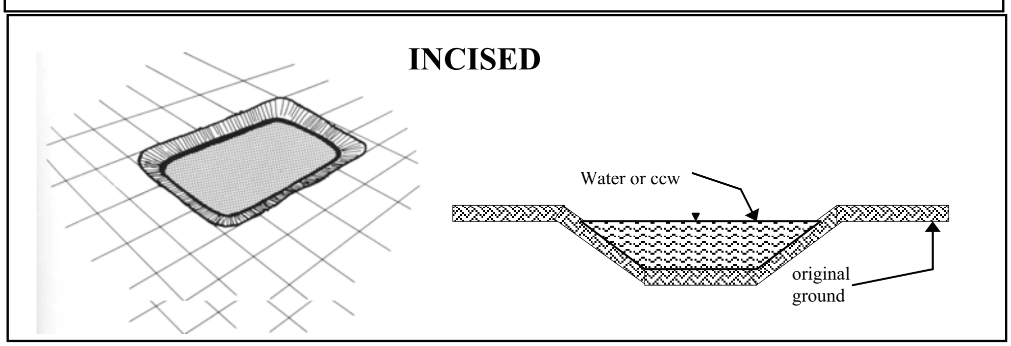
Failure or misoperation could result in environmental damage and economic loss and damage to plant infrastructure, operations and utilities. Loss of human life as a result of failure or misoperation is not anticipated.

CONFIGURATION:









______ Cross-Valley
______ Side-Hill
__X__ Diked
______ Incised (form completion optional)
______ Combination Incised/Diked

Embankment Height __34__ feet
Pool Area __3__ acres
Current Freeboard __4.5__ feet

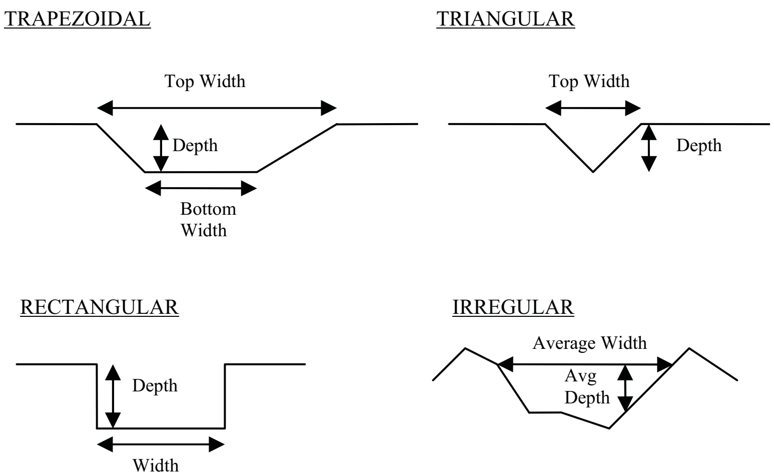
Embankment Material __Earthen__
Liner Composite (bottom and inboard slopes)
Liner Permeability 1.0 E-7 cm/sec for clay
1.0 E-9 cm/sec for GCL
1.0 E-12 cm/sec for liner

NA = Not Available
DNA = Does Not Apply

TYPE OF OUTLET (Mark all that apply)

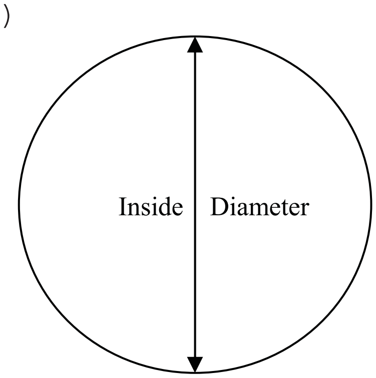
_____ **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

_____ depth
_____ bottom (or average) width
_____ top width



X **Outlet** (to Process Return Water Pond)

30" inside diameter



Material
_____ corrugated metal
_____ welded steel
_____ concrete
X plastic (hdpe, pvc, etc.)
_____ other (specify) ____________________

Is water flowing through the outlet? YES X NO _______

_____ **No Outlet**

X **Other Type of Outlet** (specify) Emergency spillway approximately 20 feet wide on East Side of Pond. Downstream slope is articulated concrete block armoring.

The Impoundment was Designed By Southern Company Services

NA = Not Available
DNA = Does Not Apply

Has there ever been a failure at this site? YES __________ NO ____X____

If So When? ____________________________

If So Please Describe : ____

Has there ever been significant seepages at this site? YES ________ NO __X______

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 __X______

If so, which method (e.g., piezometers, gw pumping,...)? ____________________

If so Please Describe : ____________________

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

It is unknown if the embankment construction was over wet ash, slag or other unsuitable material.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

The assessor did not meet with, or have documentation from, the design Engineer of Record concerning foundation preparation.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

There was no indication of prior releases, failures or patchwork on the embankments.

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	Gulf Power- Plant Crist	Date:	August 20, 2012
Unit Name:	Ash Pond	Operator's Name:	Gulf Power
Unit I.D.:		Hazard Potential Classification:	High Significant Low
Inspector's Name:	William Fox/ Eduardo Gutierrez		

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?	Weekly		18. Sloughing or bulging on slopes?	X	
2. Pool elevation (operator records)?	87.0		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	87.5		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	87.0		Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	90.0		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?	DNA		Is water exiting outlet flowing clear?	X	
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	DNA		From underdrain?		X
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?	DNA		From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?	DNA		23. Water against downstream toe?	X	
17. Cracks or scarps on slopes?	X		24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue #	Comments

1. Weekly by plant personnel, annually by Southern Company Services.

2,3,4,5. Referenced to plant datum.

6. Instrumentation is not present.

12. Trashracks are not present.

17,18. Minor erosion scarps and minor bulging at the Rip-Rap area on the northeast outboard toe of slope.

21. Wet areas were observed along the toe of slope on the southeast adjacent to Thompson Bayou (Outflow Canal).

EPA FORM -XXXX

NA = Not Available
DNA = Does Not Apply

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # 0002275 INSPECTOR William Fox and Eduardo Gutierrez

Date August 20, 2012

Impoundment Name Ash Pond

Impoundment Company Gulf Power Company

EPA Region 4

State Agency (Field Office) Addresss 61 Forsyth Street, SW
Atlanta, Ga 30303-8960

Name of Impoundment Ash Pond

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New X Update ______

	Yes	No
Is impoundment currently under construction?		X
Is water or ccw currently being pumped into the impoundment?		X

IMPOUNDMENT FUNCTION: Wastewater treatment

Nearest Downstream Town : Name Pensacola, Florida

Distance from the impoundment 0.5 miles

Impoundment Location:

Longitude 87 Degrees 13 Minutes 11.70W Seconds

Latitude 30 Degrees 33 Minutes 47.95N Seconds

State Florida County Escambia County

Does a state agency regulate this impoundment? YES X NO ______

If So Which State Agency? Florida Department of Environmental Protection

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:

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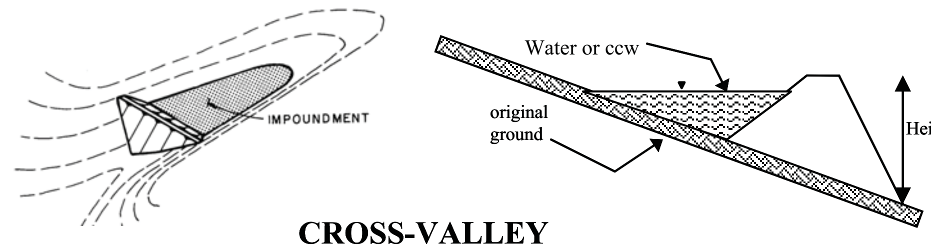
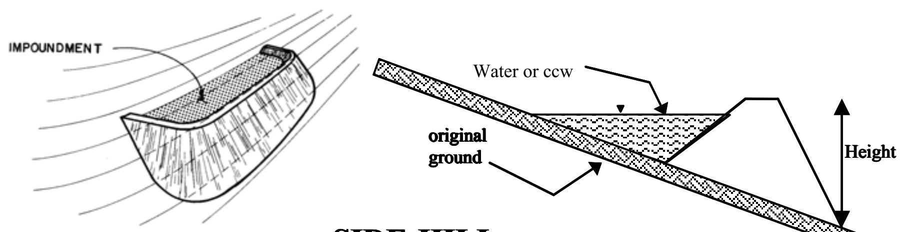
<u>CONFIGURATION</u>:

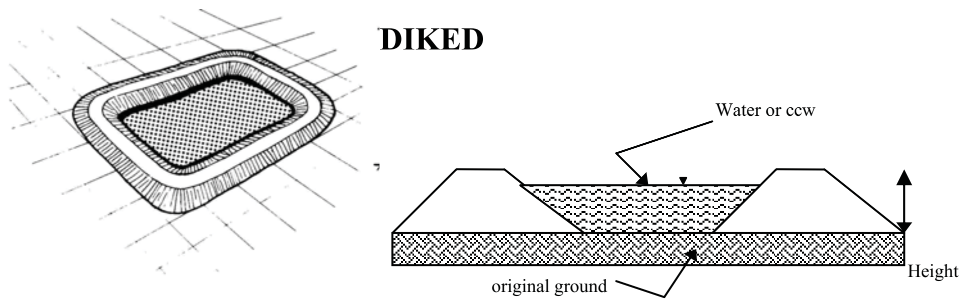


CROSS-VALLEY

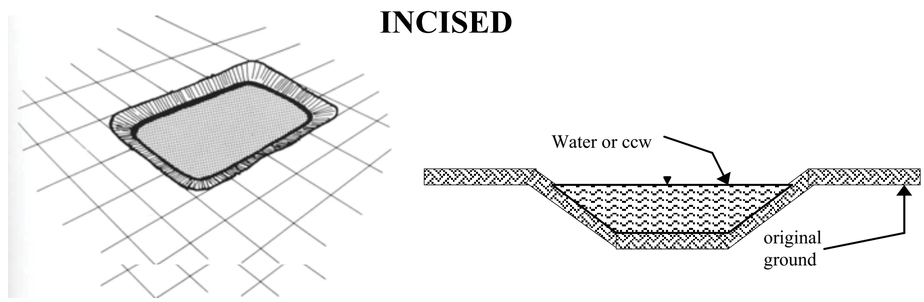


SIDE-HILL

DIKED



INCISED



______ Cross-Valley
______ Side-Hill
__X___ Diked
______ Incised (form completion optional)
______ Combination Incised/Diked

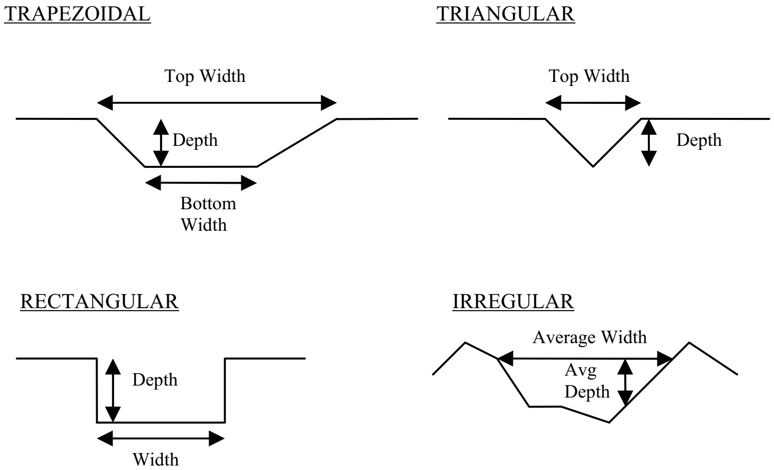
Embankment Height __24__ feet   Embankment Material __Earthen__
Pool Area __13__ acres   Liner __None__
Current Freeboard __3__ feet   Liner Permeability __DNA__

DNA = Does Not Apply

TYPE OF OUTLET (Mark all that apply)

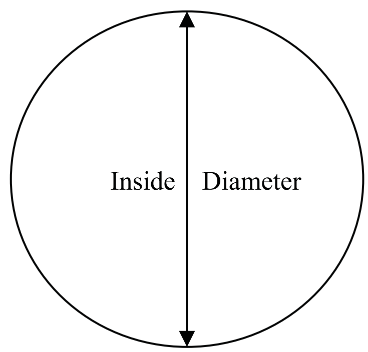
__X__ **Open Channel Spillway**
______ Trapezoidal
______ Triangular
__X__ Rectangular (concrete)
______ Irregular

__2'__ depth
__20'__ bottom (or average) width
__20'__ top width



__DNA__ **Outlet**

______ inside diameter



Material
______ corrugated metal
______ welded steel
______ concrete
______ plastic (hdpe, pvc, etc.)
______ other (specify) ______________________

Is water flowing through the outlet? YES __X__ NO _______

______ **No Outlet**

__DNA__ **Other Type of Outlet** (specify) ____________________________________

The Impoundment was Designed By __Southern Company Services__

NA = Not Available
DNA = Does Not Apply

Has there ever been a failure at this site? YES __________ NO ___X___

If So When? ____________________________

If So Please Describe : ____

Has there ever been significant seepages at this site? YES _______ NO __X__

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 __X______

If so, which method (e.g., piezometers, gw pumping,...)? ______________________

If so Please Describe : ____

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

CDM Smith's review of the available limited subsurface information indicates the embankment construction was not over wet ash or slag, however there is a layer of wet, loose, fine to medium sand immediately below the embankment fill.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

The assessor did not meet with, or have documentation from, the design Engineer of Record concerning foundation preparation.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

There was no indication of prior releases, failures or patchwork on the embankments.

Appendix C

Photographs

Appendix C
Photographs GPS Locations

Site: Gulf Power - Plant Crist
Datum: NAD83
Coordinate Units: Decimal Degrees

Photograph No.	Latitude	Longitude
1	30.565318	-87.221083
2	30.565293	-87.220632
3	30.565293	-87.220632
4	30.565213	-87.220134
5	30.565213	-87.220134
6	30.565005	-87.219888
7	30.564816	-87.219679
8	30.564816	-87.219679
9	30.564551	-87.219411
10	30.564026	-87.218901
11	30.564046	-87.218822
12	30.564174	-87.218947
13	30.564103	-87.218892
14	30.564101	-87.218799
15	30.563944	-87.218759
16	30.563634	-87.218498
17	30.563621	-87.218381
18	30.563444	-87.218181
19	30.563510	-87.218305
20	30.563253	-87.218122
21	30.563213	-87.218070
22	30.563159	-87.218018
23	30.562986	-87.218068
24	30.562824	-87.218019
25	30.562642	-87.218239
26	30.562360	-87.218502
27	30.562030	-87.218894
28	30.561834	-87.219340
29	30.561888	-87.219861
30	30.561825	-87.219853
31	30.561824	-87.219932
32	30.562037	-87.219692
33	30.561989	-87.219782
34	30.562092	-87.219677
35	30.562054	-87.219855
36	30.562105	-87.219771
37	30.562148	-87.219826
38	30.561908	-87.220044
39	30.561992	-87.220030
40	30.562010	-87.219953
41	30.561925	-87.219974
42	30.561969	-87.220166
43	30.562083	-87.220138
44	30.562159	-87.220175
45	30.562107	-87.220251
46	30.562217	-87.220329
47	30.562171	-87.220248
48	30.562990	-87.221200
49	30.563035	-87.221107

Appendix C
Photographs GPS Locations

Site: Gulf Power - Plant Crist
Datum: NAD83
Coordinate Units: Decimal Degrees

Photograph No.	Latitude	Longitude
50	30.563096	-87.221164
51	30.562881	-87.220946
52	30.562594	-87.220579
53	30.562520	-87.220496
54	30.562505	-87.220586
55	30.562668	-87.220656
56	30.562588	-87.220490
57	30.562422	-87.220421
58	30.562285	-87.220221
59	30.562205	-87.220119
60	30.562181	-87.220065
61	30.562251	-87.220196
62	30.561946	-87.219699
63	30.561890	-87.219745
64	30.562070	-87.219049
65	30.561996	-87.219162
66	30.561903	-87.219118
67	30.561987	-87.219098
70	30.563421	-87.218402
71	30.563464	-87.218496
68	30.562782	-87.218194
69	30.562854	-87.218156
73	30.563836	-87.219082
72	30.563966	-87.219098
74	30.564567	-87.219529
75	30.564661	-87.219891
76	30.564781	-87.220071
77	30.564741	-87.219988
78	30.564817	-87.220709
79	30.565012	-87.220717
80	30.564922	-87.220683
81	30.564859	-87.220829
82	30.564662	-87.220726
83	30.564699	-87.220793
84	30.564483	-87.220588
85	30.564427	-87.220665
86	30.563983	-87.221806
87	30.563996	-87.221706
88	30.564077	-87.221626
89	30.564523	-87.221775
90	30.564467	-87.221852
91	30.564604	-87.221694
92	30.564650	-87.221591
93	30.564445	-87.221277
94	30.564515	-87.221362
95	30.564669	-87.221151
96	30.564929	-87.221318
97	30.564858	-87.221329
98	30.564214	-87.221535

Appendix C
Photographs GPS Locations

Site: Gulf Power - Plant Crist
Datum: NAD83
Coordinate Units: Decimal Degrees

Photograph No.	Latitude	Longitude
99	30.564284	-87.221449
100	30.564377	-87.221365
101	30.564525	-87.221214
102	30.568349	-87.231398
103	30.568234	-87.231295
104	30.568151	-87.231393
105	30.567546	-87.232198
106	30.567546	-87.232198
107	30.566900	-87.233081
108	30.566883	-87.233501
109	30.566839	-87.233345
110	30.566754	-87.233518
111	30.566587	-87.233366
112	30.566669	-87.233539
113	30.567360	-87.233976
114	30.567550	-87.234153
115	30.567584	-87.234378
116	30.567499	-87.234314
117	30.567806	-87.234177
118	30.568022	-87.234353
119	30.568598	-87.234294
120	30.568689	-87.234297
121	30.568789	-87.234423
122	30.569115	-87.234588
123	30.569115	-87.234588
124	30.569241	-87.234538
125	30.569286	-87.234609
126	30.569539	-87.234577
127	30.569639	-87.234584
128-130	30.570349	-87.234691
131	30.571015	-87.234279
132	30.571075	-87.234193
133	30.571143	-87.234128
134	30.571477	-87.233760
135	30.571543	-87.233678
136	30.571664	-87.233417
137	30.571740	-87.233114
138	30.571741	-87.233218
139	30.571976	-87.232849
140	30.571845	-87.232853
141	30.571712	-87.233701
142	30.571710	-87.232739
143	30.571680	-87.232846
144	30.571436	-87.232524
145	30.571491	-87.232437
146	30.571325	-87.232450
147	30.571199	-87.232297
148	30.571307	-87.232261
149	30.571107	-87.232452

Appendix C
Photographs GPS Locations

Site: Gulf Power - Plant Crist
Datum: NAD83
Coordinate Units: Decimal Degrees

Photograph No.	Latitude	Longitude
150	30.571019	-87.232368
151	30.571222	-87.232540
152	30.571074	-87.231494
153	30.568386	-87.231037
154	30.569099	-87.231730
155	30.568932	-87.231716
156	30.569033	-87.231654
157	30.569059	-87.231544
158	30.568962	-87.231580
159	30.569500	-87.232165
160	30.569603	-87.232195
161	30.570487	-87.231814
162	30.570352	-87.231804
163	30.570324	-87.231940
164	30.569760	-87.232725
165	30.569779	-87.232594
166	30.570285	-87.233380
167-171	30.570561	-87.233651
172	30.569467	-87.234351
173	30.569574	-87.234358
174	30.567644	-87.233871
175	30.567760	-87.233943
176	30.568453	-87.231340
177	30.568332	-87.231198
178	30.568871	-87.230638
179	30.568872	-87.230909
180	30.568881	-87.230793
181	30.568899	-87.230055
182	30.569238	-87.229918
183	30.570563	-87.230215
184	30.570465	-87.230212
185	30.570444	-87.230595
186	30.569995	-87.230903
187	30.569829	-87.230872
188	30.569664	-87.230903
189	30.569763	-87.231019
190	30.569973	-87.231052
191	30.570109	-87.231038
192	30.570448	-87.230780
193	30.569071	-87.230866
194	30.569017	-87.230762
195	30.565560	-87.235081
196	30.565456	-87.235136

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Photo 1: Ash Pond – (typical) riprap along exterior slope of north embankment adjacent to Escambia River looking east.

Photo 2: Ash Pond - Minor scour/erosion along toe of exterior slope of northeast embankment looking east.

Photo 3: Exterior slope and crest of north embankment of Ash Pond showing minor scarp at toe of slope looking east.

Photo 4: Close up of eroded area at exterior toe of slope adjacent to Escambia River looking northwest.

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Photo 5: Scarps and erosion along the exterior slope of Ash Pond north embankment looking east.

Photo 6: View of exterior slope of Ash Pond north embankment looking east.

Photo 7: Ash Pond north embankment looking southeast. Note steep slope and apparent remedial works (riprap) where previous sloughing occurred.

Photo 8: Ash Pond north embankment looking southeast. Note steep slope and apparent remedial works (riprap) where previous sloughing occurred.

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Photo 9: View of exterior slope of Ash Pond north embankment looking east.

Photo 10: Erosion at toe of northeast embankment exterior slope looking southeast.

Photo 11: General view of exterior slope of Ash Pond northeast embankment looking southeast.

Photo 12: General view of exterior slope of Ash Pond northeast embankment looking northwest.

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Photo 13: Animal burrow on exterior slope of Ash pond northeast embankment.

Photo 14: Animal burrow on exterior slope of Ash pond northeast embankment.

Photo 15: View of rill at exterior toe of slope of Ash Pond along Northeast embankment looking east.

Photo 16: Erosion along toe of slope Ash Pond northeast embankment looking southeast.

Photo 17: Scarp with sand fan at toe of slope of Ash Pond along northeast embankment.

Photo 18: Scarp with sand fan at toe of slope of Ash Pond along northeast embankment.

Photo 19: Exterior slope of Ash Pond along northeast embankment showing scarp with sand fan at toe of slope looking northwest.

Photo 20: Tree stump found on exterior slope of Ash Pond.

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Photo 21: Tree stump found on exterior slope of Ash Pond.

Photo 22: Area of saturation along exterior toe of slope of Ash Pond near southeast corner.

Photo 23: Animal Burrow at southeast corner of Ash Pond.

Photo 24: Exterior slope of Ash Pond along southeast embankment looking southwest.

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Photo 25: Southeast embankment exterior slope looking southwest.

Photo 26: Southeast embankment exterior slope, tree stump and abandoned silt fence.

Photo 27: Exterior slope of Ash Pond along southeast embankment looking southwest. Note depression due to erosion.

Photo 28: View of sheet pile discharge weir looking south.

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Photo 29: Scarp at toe of slope of Ash Pond along southwest corner.

Photo 30: Downstream view of discharge weir for outfall looking southeast.

Photo 31: Spillway and discharge channel of outfall structure.

Photo 32: Spillway and discharge channel of outfall structure.

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Photo 33: Downstream side and west wall of Ash Pond looking north.

Photo 34: Ash Pond spillway looking north.

Photo 35: View of Ash Pond from spillway structure looking north.

Photo 36: View of Ash Pond spillway structure looking northwest.

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Photo 37: Walkway on upstream side of spillway structure looking northwest.

Photo 38: Spillway structure looking downstream.

Photo 39: Spillway structure looking downstream.

Photo 40: Spillway structure looking downstream.

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Photo 41: Downstream side of Ash Pond spillway.

Photo 42: Downstream side of Ash Pond spillway.

Photo 43: East wall of Ash Pond spillway channel.

Photo 44: East wall of Ash Pond spillway channel.

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Photo 45: Exterior slope of Ash Pond along southwest embankment.

Photo 46: Exterior toe of slope of Ash Pond along southwest embankment looking northwest.

Photo 47: Exterior embankment slope of Ash Pond along southwest embankment.

Photo 48: Exterior slope of Ash Pond along southwest embankment looking southeast.

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Photo 49: Interior slope and crest of Ash Pond along southwest embankment looking southeast.

Photo 50: Interior slope of Ash Pond looking north.

Photo 51: Electrical pull box located along Ash Pond crest of southeast embankment.

Photo 52: Animal ōurrow located on crest of Ash Pond.

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Photo 53: Interior slope scarps along Ash Pond southwest embankment looking southeast.

Photo 54: Interior slope scarps along Ash Pond southwest embankment looking northwest. Note steepness and discontinuity of eroded slope.

Photo 55: Crest of Ash Pond along southwest embankment looking northwest.

Photo 56: Crest of Ash Pond along southwest embankment looking southeast.

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Photo 57: Ruts and ponding of water on crest southwest embankment of Ash Pond.

Photo 58: Southwest embankment interior slope looking northwest. Note scarp and erosion at waterline.

Photo 59: Settlement erosion behind sheet pile wall and riprap on crest of Ash Pond southwest embankment. Note isolated area of loss of soil support.

Photo 60: Settlement erosion area behind sheet pile wall and riprap on crest of Ash Pond southwest embankment. Note isolated area of loss of soil support.

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Photo 61: Erosion area behind sheet pile wall and riprap on crest of Ash Pond southwest embankment. Note isolated area of loss of soil support.

Photo 62: Portion of abandoned sheet pile cofferdam left in place on south side of spillway used to construct spillway.

Photo 63: Portion of abandoned sheet pile cofferdam left in place on south side of spillway used to construct spillway.

Photo 64: Interior slope and crest of Ash Pond along southeast embankment looking northeast.

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Photo 65: Erosion at interior slope and crest of Ash Pond along southeast embankment looking northeast.

Photo 66: Crest of Ash Pond near south corner of pond looking west.

Photo 67: Crest of Ash Pond near south corner of pond looking northeast.

Photo 68: Crest of Ash Pond near east corner of pond looking southwest.

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Photo 69: Crest of Ash Pond near east corner of pond looking north.

Photo 70: Interior slope and crest of Ash Pond along northeast embankment looking south.

Photo 71: Interior slope and crest of Ash Pond along northeast embankment looking northwest.

Photo 72: Ash delta located along interior slope of northeast embankment of Ash Pond looking south.

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Photo 73: Ash delta located along interior slope of northeast embankment of Ash Pond looking northwest.

Photo 74: Emergency response materials (gravel, sand, riprap) located near north corner of Ash Pond.

Photo 75: Aerator/oxygenator located near north corner of Ash Pond.

Photo 76: General view of Ash Pond surface from north corner of pond looking south. Note presence of turbidity barriers.

Photo 77: General view of Ash Pond surface from north corner of pond looking west.

Photo 78: 30-inch diameter inlet pipes at north corner of Ash pond looking northwest.

Photo 79: Crest and southeast interior slope of Decant/Settling Pond #5.

Photo 80: Surface and southeast interior slope of Decant/Settling Pond #5.

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Photo 81: 30-inch diameter inlet pipes located below walkway/catwalk at north corner of Ash pond looking northwest.

Photo 82: 30-inch diameter inlet pipes located below walkway/catwalk at north corner of Ash pond looking northwest.

Photo 83: 30-inch diameter inlet pipes located below walkway/catwalk at north corner of Ash pond looking northwest.

Photo 84: Crest of Ash Pond along northwest side. Note dense vegetation.

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Photo 85: Crest of Ash Pond along northwest side. Note dense vegetation.

Photo 86: Interior slopes and surface of Decant/Settling Pond #1 looking north.

Photo 87: Interior slopes and surface of Decant/Settling Pond #1 looking northeast. Note equalizer pipe between ponds.

Photo 88: Interior slopes and surface of Decant/Settling Pond #1 looking northeast.

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Photo 89: Interior slopes, divider ŜƳōl·ƴƖƳŜƴű and surface of Decant/Settling Pond #3 looking east.

Photo 90: Interior slopes, divider ŜƳōl·ƴƖƳŜƴű and surface of Decant/Settling Pond #2 looking southeast. Note presence of ash/CCW.

Photo 91: Interior slopes and surface of Decant/Settling Pond #3 looking southeast.

Photo 92: Discharge water from plant operations into Decant/Settling Pond #3.

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Photo 93: Interior slope, divider ŜϒōŀɣʅϒŜɣ́ and equalizer pipe between Decant/ Settling Ponds #3 and 4 looking northwest.

Photo 94: Surface of Settling Pond #4 and divider ŜϒōŀɣʅϒŜɣ́ between Decant/ Settling Ponds #4 and #5 looking north.

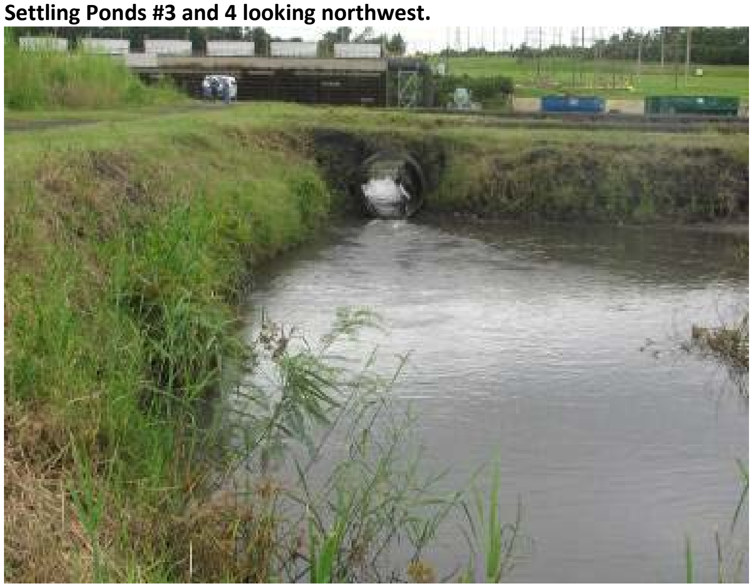

Photo 95: Interior slope and surface of Decant/Settling Pond #4 looking southwest.

Photo 96: Chemical storage area located near north corner of Ash Pond.

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Photo 97: Surface of Decant/Settling Pond #5 looking east.

Photo 98: Divider dike between Decant/Settling Ponds #1 and #2 looking northwest.

Photo 99: Surface of Decant/Settling Pond #2 looking northwest.

Photo 100: Surface of Decant/Settling Pond #3 looking northwest.

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Photo 101: Surface of Decant/Settling Pond #4 looking north.

Photo 102: View of surface and south interior slope of Gypsum Pond looking northwest. Note discharge pipe and deposition of gypsum in foreground.

Photo 103: View of surface of Gypsum {ű2ǊI·ƎŜ Pond looking west. Note discharge pipe & deposition of gypsum in foreground and Decant Riser in center of photo.

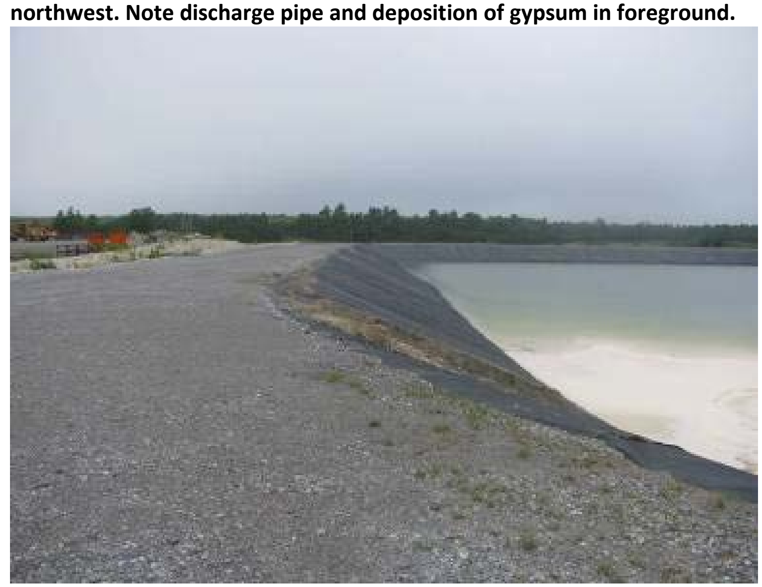

Photo 104: Crest and interior slope of south embankment of Gypsum {ű2ǊI·ƎŜ Pond looking southwest.

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Photo 105: Surface of Gypsum {ű2ǁl·ƎŜ Pond and Decant Riser looking north.

Photo 106: Surface of Gypsum {ű2ǁl·ƎŜ Pond and Decant Riser looking north.

Photo 107: Piezometers on south exterior slope of Gypsum {ű2ǁl·ƎŜ Pond looking south.

Photo 108: Exterior slope and perimeter road/maintenance bench along southwest side of Gypsum {ű2ǁl·ƎŜ Pond looking northwest.

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Photo 109: Perimeter road/maintenance bench at toe of southwest slope of Gypsum {ű2ǊI·ƎŜ Pond looking southwest. Note standing water at toe.

Photo 110: Perimeter road/maintenance bench at toe of SW slope of Gypsum {ű2ǊI·ƎŜ Pond looking northwest. Note standing water at toe.

Photo 111: Perimeter road/maintenance bench at toe of southwest slope of Gypsum {ű2ǊI·ƎŜ Pond looking southwest. Note standing water at toe.

Photo 112: Close-up of wet area/possible seepage at toe of southwest Slope of Gypsum {ű2ǊI·ƎŜ Pond.

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Photo 113: Exterior slope along southwest side of Gypsum {ű2ǋI·ƎŜ Pond looking southwest.

Photo 114: Trash and grass cuttings on southwest exterior slope of Gypsum {ű2ǋI·ƎŜ Pond.

Photo 115: General view from toe of exterior slope on southwest side of Gypsum {ű2ǋI·ƎŜ Pond looking east. Note area of wet area at toe of slope.

Photo 116: General view from toe of exterior slope on southwest side of Gypsum {ű2ǋI·ƎŜ Pond looking east.

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Photo 117: Exterior slope along west side of Gypsum {ű2ǋl·ƎŜ Pond looking north.

Photo 118: Monitoring Wells located beyond exterior toe of slope on west Side of Gypsum {ű2ǋl·ƎŜ Pond.

Photo 119: Exterior slope along west side of Gypsum {ű2ǋl·ƎŜ Pond looking south.

Photo 120: Exterior slope along west side of Gypsum {ű2ǋl·ƎŜ Pond looking north.

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Photo 121: Start of riprap slope protection along toe of west exterior Slope of Gypsum {ů2ǁl·ƎŜ Pond looking north. Slope in this area is about 2.5H:1V.

Photo 122: Riprap slope protection along toe of west exterior slope of Gypsum {ů2ǁl·ƎŜ Pond looking east. Note depressed area at center.

Photo 123: Riprap slope protection along toe of west exterior slope of Gypsum {ů2ǁl·ƎŜ Pond looking east. Note depressed area at center.

Photo 124: Riprap slope protection along toe of west exterior slope of Gypsum {ů2ǁl·ƎŜ Pond looking east. Note exposed filter fabric.

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Photo 125: Riprap slope protection along toe of west exterior slope of Gypsum {ű2ℕl·ƎŜ Pond looking east. Note exposed filter fabric.

Photo 126: Exterior slope along west side of Gypsum {ű2ℕl·ƎŜ Pond looking south.

Photo 127: Exterior slope along west side of Gypsum {ű2ℕl·ƎŜ Pond looking north.

Photo 128: Rill located at approximate mid-face of west exterior slope of Gypsum {ű2ℕl·ƎŜ Pond. Depth is about 4 to 6 inches.

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Photo 129: Animal ōurrow located at approximate mid-face of west exterior slope of Gypsum {ű2ǁl·ƎŜ Pond.

Photo 130: Animal ōurrow on west exterior slope of Gypsum {ű2ǁl·ƎŜ Pond.

Photo 131: 16-foot long rill on north exterior slope of Gypsum {ű2ǁl·ƎŜ Pond (Depth x Width ~ 1 foot, respectively). Note adjacent, parallel 5-foot long rill.

Photo 132: Approximate 16-foot long rill erosion on north exterior slope of Process Sedimentation Pond (Depth x Width ~1 foot, respectively).

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Photo 133: Approximate 16-foot long rill erosion on north exterior Slope of Process Sedimentation Pond (width is about 1 foot).

Photo 134: Rill located on north exterior slope of Process Sedimentation Pond (typical of six).

Photo 135: Rill located on north exterior slope of Process Sedimentation Pond (typical of six).

Photo 136: Rill located near toe of north exterior slope of Process Sedimentation Pond looking southeast (up slope).

Photo 137: Three rills located along toe of north exterior slope of Process Sedimentation Pond looking east.

Photo 138: Three rills located along toe of north exterior slope of Process Sedimentation Pond looking north (down slope).

Photo 139: Groundwater monitoring wells located beyond toe of slope of north embankment of Process Sedimentation Pond looking north.

Photo 140: Northeast exterior slope of Process Sedimentation Pond looking south.

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Photo 141: Exposed filter fabric beneath riprap where a depression is located.

Photo 142: Wet area/saturation located at toe of slope adjacent to access road on northeast exterior slope of Process Sedimentation Pond looking north.

Photo 143: Wet area/saturation located at toe of slope adjacent to access road on northeast exterior slope of Process Sedimentation Pond looking east.

Photo 144: Wet area/possible seepage located approximately mid-slope along east exterior slope of Process Sedimentation Pond looking west.

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Photo 145: Area of wet area/possible seepage located approximately mid-slope along east exterior slope of Process Sedimentation Pond looking east.

Photo 146: East exterior slope of Process Sedimentation Pond looking northwest.

Photo 147: Emergency spillway/articulated concrete block mattress located on east ext.slope of Process Sed. Pond looking west (up slope).

Photo 148: Emergency spillway/articulated concrete block mattress located on east ext. slope of Process Sed. Pond looking south.

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Photo 149: Emergency spillway/ articulated concrete block mattress located on east exterior slope of Process Sedimentation Pond looking east (down slope).

Photo 150: Top of emergency spillway along crest of east embankment of Process Sedimentation Pond.

Photo 151: Concrete box culvert discharge between Gypsum Storage Pond and Process Sedimentation Pond.

Photo 152: Monitoring well pairs located near wooded area east of Process Sedimentation Pond.

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Photo 153: East exterior slope of Gypsum Storage Pond looking northwest.

Photo 154: Animal burrow located at toe of slope east exterior slope of Gypsum Storage Pond.

Photo 155: Wet area at toe of slope along east exterior slope of Gypsum Storage Pond looking northwest.

Photo 156: Wet area at toe of slope along east exterior slope of Gypsum Storage Pond.

Photo 157: Wet area at toe of slope along east exterior slope of Gypsum Storage Pond.

Photo 158: Wet area at toe of slope along east exterior slope of Gypsum Storage Pond.

Photo 159: Exterior slope of east embankment of Gypsum Storage Pond looking southeast.

Photo 160: Exterior slope of south embankment of Process Sedimentation Pond looking east.

Photo 161: Scarp located on exterior slope of southeast embankment of Process Sedimentation Pond looking northwest.

Photo 162: Wet area/potential seepage located on exterior slope near southeast corner Process Sedimentation Pond.

Photo 163: East exterior slope of Process Sedimentation Pond showing sloughed area looking north.

Photo 164: Intermediate embankment between Gypsum Pond and Process Sedimentation Pond looking northwest.

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Photo 165: Surface of Process Sedimentation Pond looking north.

Photo 166: Discharge pipe into Gypsum Storage Pond. Gypsum and water currently at approximate Elevation 113 feet.

Photo 167: Concrete box culvert outlet between Gypsum Storage Pond and Process Sedimentation Pond.

Photo 168: South wingwall of concrete box culvert outlet between Gypsum Storage Pond and Process Sedimentation Pond.

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Photo 169: North wingwall concrete box culvert outlet between Gypsum Storage Pond and Process Sedimentation Pond.

Photo 170: Concrete box culvert outlet between Gypsum Storage Pond and Process Sedimentation Pond.

Photo 171: Concrete apron on top of concrete box culvert between Gypsum Storage Pond and Process Sedimentation Pond.

Photo 172: Crest of west embankment of Gypsum Storage Pond looking south.

Photo 173: Crest of west embankment of Gypsum Storage Pond looking north.

Photo 174: Textured HDPE liner on interior slope of Gypsum Storage Pond looking southeast (typical of entire pond).

Photo 175: Textured HDPE liner on interior slope of Gypsum Storage Pond looking northwest (typical of entire pond).

Photo 176: Inflow of water into Gypsum Storage Pond looking northwest. Note presence of textured HDPE liner on interior slope of (typical of entire pond).

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Photo 177: Surface of Gypsum Storage Pond looking west.

Photo 178: South crest and interior slope of Process Return Water Pond looking east. Note presence of textured HDPE liner on interior slope (typical).

Photo 179: Surface of Process Return Water Pond looking northeast.

Photo 180: West crest and interior slope of Process Return Water Pond looking north.

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Photo 181: South crest and interior slope of Process Return Water Pond looking west.

Photo 182: East crest and interior slope of Process Return Water Pond looking north.

Photo 183: Monitoring well pairs located beyond exterior toe of slope of Process Return Water Pond looking north.

Photo 184: General view of Process Return Water Pond looking south.

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Photo 185: Northwest exterior slope of Process Return Water Pond looking southwest.

Photo 186: West exterior slope of Process Return Water Pond looking south.

Photo 187: Crest and emergency spillway along west embankment of Process Return Water Pond looking south.

Photo 188: Emergency spillway/ACBM located on west exterior Slope of Process Return Water Pond looking west (down slope).

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Photo 189: Emergency spillway/ACBM located on west exterior slope of Process Return Water Pond looking west (down slope).

Photo 190: Emergency spillway/ACBM located on west exterior slope of Process Return Water Pond looking east (up slope).

Photo 191: Riprap slope treatment along toe of slope of northwest, exterior of Process Return Water Pond looking north.

Photo 192: Riprap slope on toe of slope of northwest, exterior of Process Return Water Pond looking north. Note exposed filter fabric.

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Photo 193: Manhole structure located at southwest corner of Process Return Water Pond looking east.

Photo 194: Textured HDPE liner on interior slope of Process Return Water Pond looking north. Note elevation data on slope.

Photo 195: General view of fly Ash Landfill stormwater pond area looking northwest.

Photo 196: General view of fly Ash Landfill stormwater pond area looking west.