PERIODIC SAFETY FACTOR ASSESSMENT
391-3-4-.10(4) and 40 C.F.R. § 257.73 PLANT
SCHERER ASH POND (AP-1) GEORGIA
POWER COMPANY

The Federal CCR Rule, and, for Existing Surface Impoundments where applicable, the Georgia CCR Rule (391-3-4-.10) require the owner or operator of a CCR surface impoundment to conduct initial and periodic safety factor assessments. *See* 40 C.F.R. § 257.73(e); Ga. Comp. R. & Regs. r. 391-3-4-.10(4)(b). The owner or operator must conduct an assessment of the CCR unit and document that the minimum safety factors outlined in 40 C.F.R. § 257.73(e)(1)(i) through (iv) for the critical dam section are achieved. In addition, the Rules require a subsequent assessment be performed within 5 years of the completion of the previous assessment. *See* 40 C.F.R. § 257.73(f)(3); Ga. Comp. R. & Regs. r. 391-3-4-.10(4)(b). The previous Periodic Safety Factor Assessment was placed in the Operating Record on October 15, 2021.

The CCR surface impoundment known as the Plant Scherer Ash Pond 1 (AP-1) is located on Georgia Power's Plant Scherer property, approximately 8 miles northeast of Forsyth, Georgia. AP-1 was formed by engineered cross-valley dams. The critical section of this CCR unit was previously determined to be the dam located on the east side of the impoundment. Under current conditions, the east side dam remains the critical section.

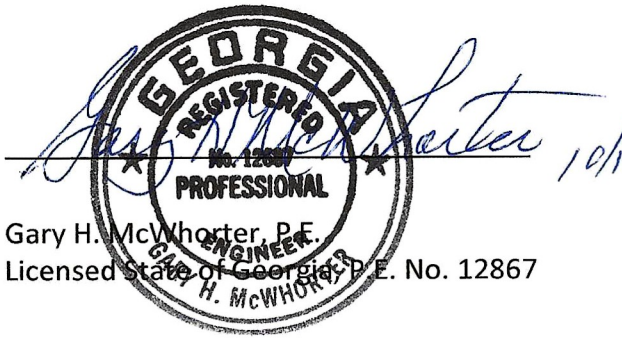
The Notification of Intent to Initiate Closure for AP-1 was placed in the Operating Record on October 30, 2020, and closure is not anticipated to negatively impact the stability of the perimeter dams. AP-1 is currently undergoing closure activities. Dewatering and CCR removal in the North Slope area along Berry Creek and along the Eastern Drainage Ditch of AP-1 have been completed. CCR excavations are ongoing to the south of the North Area. Because of the closure-related site work at AP-1, the normal pool elevation is now approximately 450 ft, which is significantly lower than the previous normal pool elevation of 496 ft. A recently updated hydrology and hydraulic analysis also estimated the maximum surcharge pool elevation at 475.5 ft, lower than the previously calculated elevation of 501.6 ft.

The updated stability analysis resulted in the following minimum safety factors for the critical section for the stipulated load cases:

Loading Condition	Minimum Calculated Safety Factor	Minimum Required Safety Factor
Long-term Maximum Storage Pool (Static)	2.09	1.50
Maximum Surcharge Pool (Static)	2.09	1.40
Seismic	2.01	1.00

The AP-1 dams are constructed of clays, silts and silty sands that are not susceptible to liquefaction. Therefore, a minimum liquefaction safety factor determination was not required.

I hereby certify that the safety factor assessment was conducted in accordance with 40 C.F.R. § 257.73(e)(1).



10/12/2020

Gary H. McWhorter, P.E.
Licensed State of Georgia P.E. No. 12867

Southern Company

Technical and Project Solutions Calculation

Calculation Number: TV-SH-GPC10234749-002

Project/Plant: Plant Scherer Ash Pond	**Unit(s):** -	**Discipline/Area:** Env. Solutions
Title/Subject: Periodic Factor of Safety Assessment for CCR Rule - 391-3-4-.10(4) and 40 C.F.R. PART 257.73		
Purpose/Objective: Assess the Factor of Safety of the Ash Pond Dam		
System or Equipment Tag Numbers: n/a	**Originator:** Henok Tiruneh, Ph.D., P.E., P.G.	

Contents

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Body of Calculation	6-8		
Total # of pages including cover sheet & attachments:	28		

Revision Record

Rev. No.	Description	Originator Initial / Date	Reviewer Initial / Date	Approver Initial / Date
0	Issued for Information	HWT/08-27-26	LJ/08-27-26	GHM/09-01-26

Notes:

Purpose of Calculation

Plant Scherer historically disposed of Coal Combustion Residuals (CCR) in Ash Pond 1 (AP-1) that was commissioned in 1980. The AP-1 dam was constructed to a crest elevation of 505 feet, with 3(H):1(V) upstream and downstream slopes, intermediate berms, and an approximate maximum height of 100 feet. In accordance with 40 CFR §257.73(e), safety factor assessments were performed in 2016 and 2021 for the critical dam section to verify compliance with the minimum required factors of safety for maximum storage pool, maximum surcharge pool, and seismic loading conditions. This calculation package updates the AP-1 dam stability analysis based on revised Hydrologic and Hydraulic (H&H) results and ongoing closure activities.

Summary of Conclusions

The following table lists the factors of safety for various slope stability loading conditions. The analysis results indicate that the computed factors of safety exceed the required minimum values for all evaluated conditions.

Load Conditions	Computed Factor of Safety	Required Minimum Factor of Safety
Long-term Maximum Storage (Static)	2.09	1.50
Maximum Surcharge Pool (Static)	2.09	1.40
Seismic (Pseudo-static)	2.01	1.00

Methodology

The calculation was performed using the following methods and software:

- GeoStudio 2022.1 version 11.4.2.250 Copyright ®2022, Bentley Systems, Incorporated.
- USGS earthquake hazard toolbox, Conterminous U.S. 2023.R2.
- General limit equilibrium using Morgenstern-Price method.

Criteria and Assumptions

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

- The current required minimum design criteria (factors of safety) for the respective loading conditions were taken from the Structural Integrity Criteria for existing CCR surface impoundment from 40 CFR 257.73(e).
- The maximum-height section of the dam crosses the old Berry Creek valley along the eastern side of AP-1 near Station 46+00 (see Section A-A in Attachment 1). The dam height at this location is approximately 100 feet. Accordingly, this section was selected as the critical section for stability analysis. The cross-section of the dam was developed using the following sources:
    1. Original design Drawing No. E1H1058 Section A-A – Attachment A.
    2. Exploration borings (Borings S-1 and S-2) conducted in July 2010 – Attachment A.
    3. Plant Scherer Ash Pond topographic surface DTM 1ft Contours – Surveyed 2024.

4. Plant Scherer Ash Pond aerial topographic survey. Propeller Platform. Exported August 14, 2026.
5. Previous Southern Company Services Slope Stability Analyses (2010, 2016, and 2021).

- Factors of safety for stability under seismic loading conditions were calculated based on the earthquake hazard corresponding to a probability of exceedance of 2% in 50 years (2475-year return period). A site-specific seismic response analysis was conducted using the United States Geological Survey (USGS) Earthquake Hazard Toolbox (Conterminous U.S. 2023.R2) with the 2023 Conterminous U.S. National Seismic Hazard Model. Site Class B/C conditions were assumed to obtain the reference Uniform Hazard Response Spectrum (UHRS) and peak ground acceleration for the foundation of the dam. The representative earthquake magnitude was taken as the hazard-weighted mean magnitude from the seismic hazard disaggregation.
- The pseudostatic seismic coefficient for the seismic stability analysis was developed using the approach suggested by Bray and Macedo (2019). An allowable horizontal displacement of 1.0 foot, and a probability of exceedance of 16% were selected, providing a seismic coefficient of 0.011 for use in the seismic slope stability analysis.
- Because the ash pond is actively being dewatered, the phreatic surface within the dam was modeled for the maximum storage pool condition using piezometric water level data collected on July 22, 2026, from the piezometers: Piezo AP1R, AP-2, AP-3, AP-4, AP-5, AP-8, and AP-9 along the critical cross section.
- The US Army Corps of Engineers Manual (USACE EM) 1110-2-1902 (October 2003) allows the phreatic surface established for the maximum storage pool loading condition to be used in the maximum surcharge loading condition because the duration of surcharge loading is generally short relative to the permeability of the dam and foundation materials. Accordingly, insignificant changes to the phreatic surface are expected during surcharge conditions.
- Future construction cases were not considered in the analysis.

Material Properties

Material properties used in the stability analysis were referenced primarily from AECOM's 2024 Engineering Report, Appendix A1, *Geotechnical Data and Properties.* AECOM's *Geotechnical Data and Properties* document is provided in Attachment B. The document summarizes historical subsurface investigations, characterizes the site stratigraphy, reviews laboratory testing results, and establishes geotechnical material properties for slope stability analysis and closure design analyses. The material properties were developed based on historical explorations conducted between 1974 and 2016. The primary material units used in the stability evaluation along with their description are provided below.

Dam Fill: Constructed primarily from compacted on-site residual soils. The fill material is generally classified as stiff to very stiff elastic silt (MH) with some lean clay (CL) and fat clay (CH). Typical SPT N-values are approximately 15 blows per foot, indicating good compaction.

Foundation Soil: The foundation soil unit, referred to as residuum, generally consists of sandy medium stiff to very stiff elastic silt (MH) with trace amounts of mica resulting from the weathering of the parent metamorphic bedrock. Some zones of fat clay (CH), lean clay (CL), and silty sand (SM) were also identified.

Ash: This unit consists of a mixture of fly ash and bottom ash and is generally classified as very loose, nonplastic silt (ML) with some isolated zones of medium dense material or silty sand (SM).

Rock Bolster: Material properties for the rock bolster were assumed based on previous project experience.

The table below summarizes the material properties used in the stability analysis.

Soil Materials	Unit Weight (pcf)	Drained Shear Strength Parameters		Peak Undrained Shear Strength Parameters		Data Source
		Internal Friction Angle	Cohesion (psf)	Internal Friction Angle	Cohesion (psf)	
Dam Fill	116	33	100	13	900	AECOM, 2024
Foundation Soil	114	32	100	20	50	AECOM, 2024
Sluiced Ash	95	32	0	10	430	AECOM, 2024
Rock Bolster	110	42	0	42	0	Project experience

Note: For the seismic slope stability analysis, a drained shear strength parameter was used for the dam fill and foundation soil.

Hydrologic Considerations

The stability analyses incorporated the updated calculation package, 2026 *Inflow Design Control System Plan: Hydrologic and Hydraulic Calculation Summary for Plant Scherer Ash Pond*, prepared by AECOM.

The updated analysis demonstrates that the AP-1 can store the full Probable Maximum Precipitation (PMP) event, with a maximum surcharge pool elevation of 475.5 feet. This represents a substantial reduction from the previously calculated elevation of 501.6 feet in 2016. The reduction is primarily attributed to the ongoing closure activities, including dewatering and CCR removal in the North Slope area. Similarly, AP-1 site work completed to date as part of closure activities has lowered the normal pool elevation to approximately 450 feet, significantly lower than the previous elevation of 496 feet. The water surface elevation is now managed by a pumping system rather than the original spillway features.

Loading Conditions

In accordance with 40 CFR §257.73(e), safety factor assessments were performed for the AP-1 critical dam section for the maximum storage pool, maximum surcharge pool, and seismic loading conditions to verify compliance with the applicable minimum factors of safety for each required loading conditions as required by the CCR Rule.

Design Inputs/References

AECOM. 2026. *Inflow Design Control System Plan: Hydrologic and Hydraulic Calculation Summary for Plant Scherer Ash Pond*. August 2026.

AECOM. 2024. *Engineering Report: Plant Scherer Ash Pond 1 (AP-1)*. *Appendix A1 Geotechnical Data and Properties.* Rev. 3. September 2024.

Bray, J.D., and Macedo, J. 2019. "Procedure for Estimating Shear-Induced Seismic Slope Displacement for Shallow Crustal Earthquakes." *Journal of Geotechnical and Geoenvironmental Engineering*, Vol. 145, No. 12.

Georgia Power Company (GPC). 1995. *Plant Scherer Ash Disposal Pond Dam Plan, Sections, and Details of Instrumentation*. Drawing E1H1058. April 13, 1995.

Schnabel Engineering. 2016. *Hydrologic and Hydraulic Support Services, Coal Combustion Residuals Storage Analysis*. Prepared for Georgia Power Company. August 15, 2016.

Southern Company Services (SCS). 2010. *Slope Stability Analyses of Ash Pond and Retention Pond Dikes Calculation Package*.

Southern Company Services (SCS). 2016. *Slope Stability Analyses of Ash Pond Dike Calculation Package*.

Southern Company Services (SCS). 2021. *Plant Scherer Periodic Factor of Safety Assessment for CCR Rule Calculation Package*.

U.S. Army Corps of Engineers (USACE). 2003. *Engineering and Design: Slope Stability*. Engineer Manual EM 1110-2-1902. Washington, DC: U.S. Army Corps of Engineers.

U.S. Geological Survey (USGS). 2026. *Earthquake Hazard Toolbox: Dynamic U.S. 2023 R2 National Seismic Hazard Model (NSHM)*. U.S. Geological Survey Earthquake Hazards Program. Available at: USGS Earthquake Hazard Toolbox. Accessed August 27, 2026.

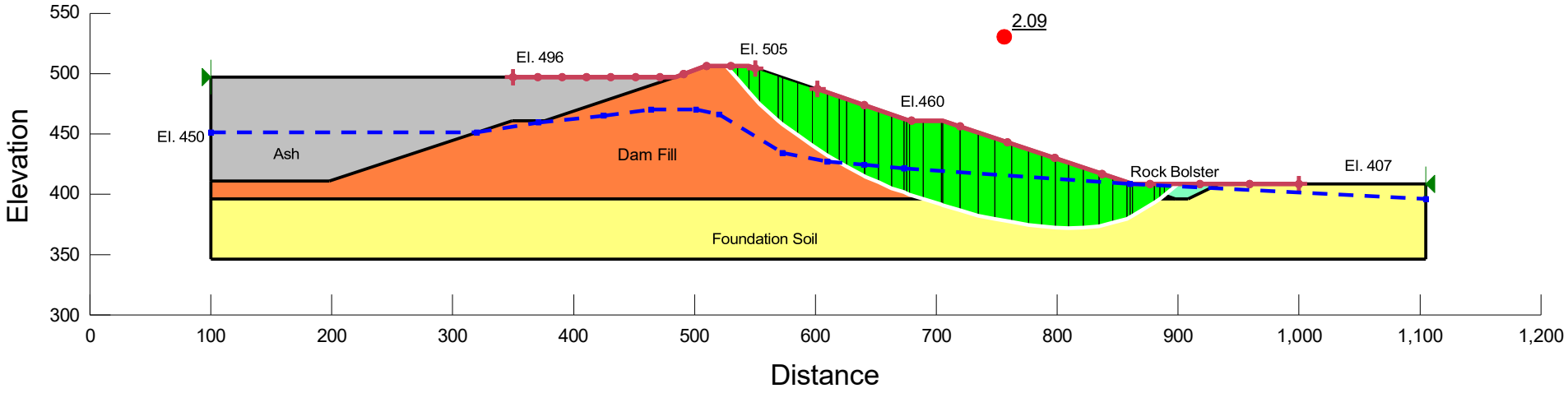
Body of Calculation

SLOPE/W modeling attached.

Plant Scherer Ash Pond Dam Stability Analysis (Section A-A)

Downstream Long-term Maximum Storage Pool

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface
	Ash	Mohr-Coulomb	95	0	32	1
	Dam Fill	Mohr-Coulomb	116	100	33	1
	Foundation Soil	Mohr-Coulomb	114	100	32	1
	Rock Bolster	Mohr-Coulomb	110	0	42	1



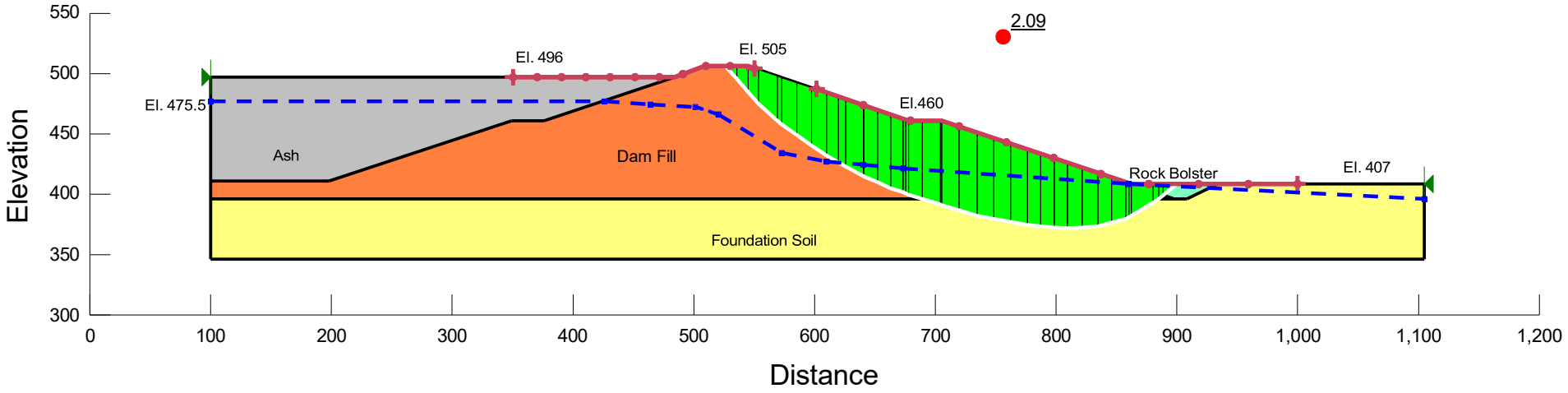
Method: Morgenstern-Price

Optimization of slip surface location

Plant Scherer Ash Pond Dam Stability Analysis (Section A-A)

Downstream Max. Surcharge Pool

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface
	Ash	Mohr-Coulomb	95	0	32	1
	Dam Fill	Mohr-Coulomb	116	100	33	1
	Foundation Soil	Mohr-Coulomb	114	100	32	1
	Rock Bolster	Mohr-Coulomb	110	0	42	1



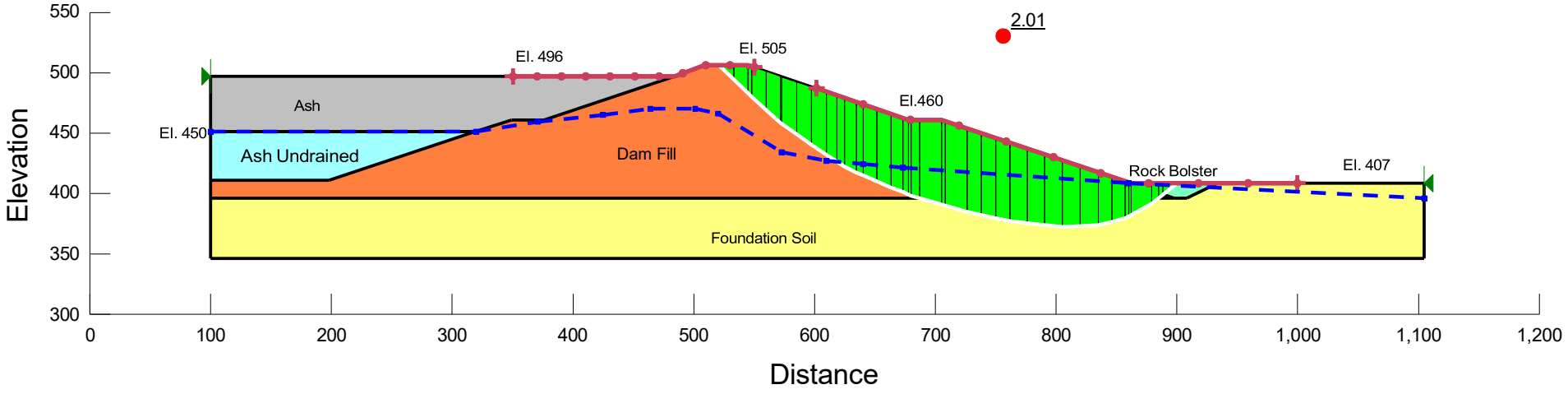
Method: Morgenstern-Price

Optimization of slip surface location

Plant Scherer Ash Pond Dam Stability Analysis (Section A-A)

Downstream Seismic (1 ft disp)

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Piezometric Surface
	Ash	Mohr-Coulomb	95	0	32	1
	Ash - Undrained	Mohr-Coulomb	95	430	10	1
	Dam Fill	Mohr-Coulomb	116	100	33	1
	Foundation Soil	Mohr-Coulomb	114	100	32	1
	Rock Bolster	Mohr-Coulomb	110	0	42	1



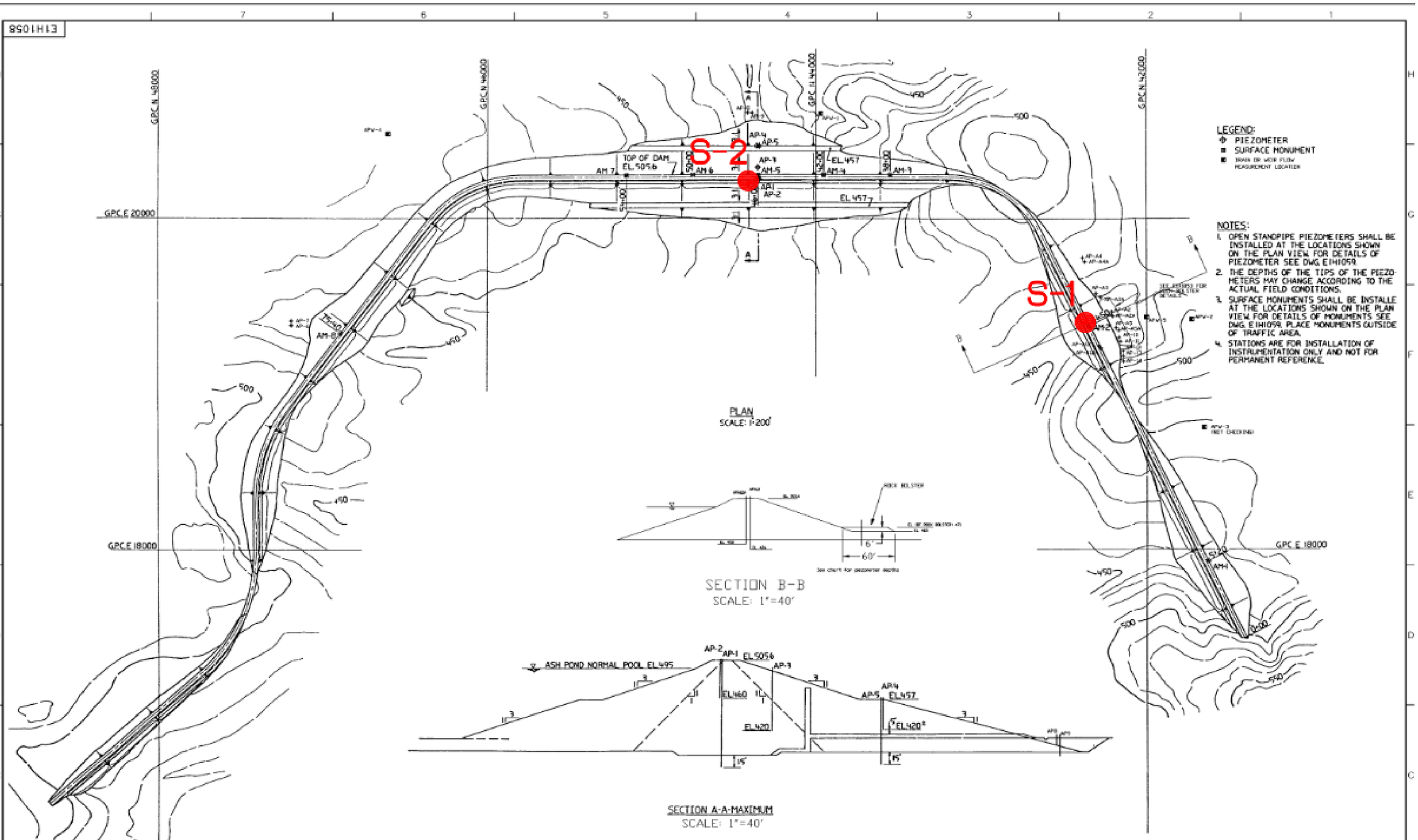
Method: Morgenstern-Price

Optimization of slip surface location

Attachment A

Figure – Historical Drawing

E1H1058



LEGEND:
- PIEZOMETER
- SURFACE MONUMENT
- TRIAN OR WEIR FLOW MEASUREMENT LOCATION

NOTES:
1. OPEN STANDPIPE PIEZOMETERS SHALL BE INSTALLED AT THE LOCATIONS SHOWN ON THE PLAN VIEW. FOR DETAILS OF PIEZOMETER SEE DWG. E1H1059.
2. THE DEPTHS OF THE TIPS OF THE PIEZOMETERS MAY CHANGE ACCORDING TO THE ACTUAL FIELD CONDITIONS.
3. SURFACE MONUMENTS SHALL BE INSTALLE AT THE LOCATIONS SHOWN ON THE PLAN VIEW. FOR DETAILS OF MONUMENTS SEE DWG. E1H1059. PLACE MONUMENTS OUTSIDE OF TRAFFIC AREA.
4. STATIONS ARE FOR INSTALLATION OF INSTRUMENTATION ONLY AND NOT FOR PERMANENT REFERENCE.

PIEZOMETER NUMBER	TOP OF PIPE ELEVATION	TIP OF PIPE ELEVATION	ZONE
AP1	506.38	325.6	FOUNDATION
AP2	506.19	459.8	FILL
AP3	496.95	420.0	FILL
AP4	457.63	420.0	FILL
AP5	457.79	378.8	FOUNDATION
AP6	478.89	425.1*	FOUNDATION
AP7	478.44	441.1*	FOUNDATION
AP8	480.47	368.0	FOUNDATION
AP9	481.90	397.0	FOUNDATION
AP10	472.03	418.0	FOUNDATION
AP11	471.82	444.0	FOUNDATION
AP12	475.75	461.0+	FOUNDATION
AP13	475.19	443.8#	FOUNDATION
AP14	476.03	431.0*	FOUNDATION
APA4	485.80	427.0	FOUNDATION
APA4A	485.59	456.3	FOUNDATION
APA3	476.08	448.0	FOUNDATION
APA3A	476.67	467.4	FOUNDATION
APA2	479.81	439.9	FOUNDATION
APA2A	475.82	454.0	FOUNDATION
APA5	472.03	425.0	FOUNDATION
APA5A	472.03	443.8	FOUNDATION

REFERENCES:
- E1H1001 ASH DISPOSAL POND DAM GENERAL ARRANGEMENT
- E1H1002 ASH DISPOSAL POND DAM GENERAL SECTIONS AND DETAILS
- E1H1059 RETENTION (SETTLING) POND PLAN, SECTIONS AND DETAILS OF INSTRUMENTATION
- E1H1060 WATER STORAGE POND DAM PLAN, SECTIONS AND DETAILS OF INSTRUMENTATION
- C1X1053 ROCK BOLSTER DETAILS

CAD E1H1058 | CADOVERLAY | LVG-0

"CONFIDENTIAL BUSINESS INFORMATION"

REVISION	DATE	BY	CHK'D	APPR.1	APPR.2	APPR.3	APPR.4	APPR.5
1	4-13-95	LVG	HAF	FOR APPROVAL SEE DRF 950403				
PIEZOMETERS ADDED								
0	4-8-80	BJB	RDP	RMF	FCJ			JFG
ISSUED FOR CONSTRUCTION								

Southern Company Services Inc. for GEORGIA POWER COMPANY

PLANT SCHERER
ASH DISPOSAL POND DAM
PLAN, SECTIONS AND DETAILS OF INSTRUMENTATION

DESIGNED BEN	DRAWN BJB	CHECKED RDP		
SCALE	LOCATION	DRAWING NUMBER		REV.
AS SHOWN	10-505	E1H1058		1

05-24-95 10:35a

Attachment B

Material Properties Source: AECOM 2024 Geotechnical Data and Properties

Appendix A1

Job	**Plant Scherer - Ash Pond Closure**	Project No.	**60563110**	Sheet	**1**	of	**16**
Description	**Geotechnical Data and Material**	Computed by	**SAL**	Date	**09/05/18**		
	Properties	Checked by	**JLM**	Date	**05/22/18**		

I. Objective

This calculation appendix to the Engineering Report summarizes the geotechnical data and material characteristics of the subsurface strata encountered from historic explorations and a review of historic construction documents of the Ash Pond at Georgia Power's Plant Scherer in Monroe County, Georgia. Selection of material properties for slope stability is also developed and summarized within this package.

II. Ash Pond Historic Subsurface Explorations

Numerous subsurface explorations were performed within the vicinity and along the perimeter of the ash pond since the 1970's. Thirty of the historic exploratory locations were performed by AECOM in 2016 in an effort to establish additional information to better evaluate closure options. Approximately 722 other known historic subsurface exploration locations were explored from 1974 to 2016. The historic exploration locations advanced near the ash pond are shown on **Attachment A – Plant Scherer Geotechnical Site Plan** of this calculation appendix.

Historic documentation of the subsurface explorations performed prior to 2016 was provided to AECOM by Georgia Power Company (GPC) and Southern Company Services (SCS) and generally consisted of exploration logs and laboratory test results in a geotechnical data format. AECOM was not given specific embankment construction records or geotechnical recommendations or analyses. AECOM has reviewed the data provided to establish a general understanding of site history and subsurface conditions and has summarized pertinent information pertaining to each of the historic subsurface explorations in the list below:

- *1974 to 1976 Law Engineering Testing Company Exploration* included forty-one (41) subsurface exploration locations that extended within and near the vicinity of the ash pond southern and eastern perimeter embankment prior to embankment construction. The subsurface exploration included split-spoon sampling via standard penetration testing (SPT) through the soil overburden with majority of the borings being terminated at auger refusal or top of rock materials. Exploration depths varied between 24 to 168 feet below the ground surface. Select borings were rock cored using an NX-size core to sample the underlying rock materials. Exploration locations for the 1974 Law Engineering investigation are denoted as C-101 through C-179 and are shown on **Attachment A**.
- *1978 and 1979 Alabama Power Company Laboratory Testing* included test results from seven different types of laboratory testing performed on materials collected at Plant Scherer for ash pond construction random fill materials. Laboratory testing included Atterberg limits, specific gravity, grain size analysis, compaction testing (standard and modified), swell testing, and direct shear testing. The location where these materials were procured and the materials utilized for embankment construction could not be verified, therefore AECOM used the results of the laboratory testing to supplement a general understanding of site soils characteristics.
- *2010 Southern Company Services* subsurface exploration included two exploration boring locations denoted S-1 and S-2. These two explorations were explored within the southern and eastern embankments.
- *2015 to 2016 Southern Company Services* subsurface exploration included twelve exploratory borings denoted SPT-01 through SPT-12 and seven cone penetration tests denoted CPT-01

through CPT-07 were explored within the ash delta, perimeter embankment, and regions surrounding the ash pond. Additionally, fifty-eight groundwater monitoring piezometers were installed across perimeter of the ash pond with majority installed near the northern and eastern perimeter embankment. Some of these wells were then converted to the CCR monitoring wells, which are denoted as SGWA-1 through SGWA-25. The SPT borings were extended to depths varying from 43 to 170 feet below the existing ground surface. Each of the SPT borings encountered granitic bedrock (predominately classified as gneiss) and representative rock samples were collected to determine rock quality designation (RQD).

- *2016 AECOM subsurface exploration* (AECOM, 2016) included a total of thirty subsurface locations extended through the ash pond ash delta, within the free water pond, and perimeter embankment. AECOM's 2016 field exploration program included performing 16 SPT borings at the site. This included 2 borings on the ash pond Dike (B-100 and B-101), 3 borings in the ash delta (B-102 through B-104), and 11 barge-based borings in the free water portions of the ash pond (B-105 through B-114, and one offset boring, B-105A). Six standpipe piezometers were also installed within the ash delta (B-102A/B through B-104A/B). AECOM's exploration also included performing 14 cone penetration tests (CPT's) with seismic shear wave velocity measurements (SCPTu) and pore pressure dissipation testing (PPD). The CPT investigation was performed by ConeTec Inc. under supervision of AECOM. This included a total of 9 CPTs on the ash pond perimeter embankment (performed on the eastern and southern dike) and 5 CPTs in the ash delta.

Tables 8-3 and 8-4 in **Attachment 8** summarize the findings for each of the historic subsurface exploration locations and a breakdown to the materials encountered. A full set of historic boring logs, including soil descriptions, types of sampling, and choice laboratory test results, is also provided in **Attachment 8** of this appendix. Cone penetrometer testing logs and a report provided by ConeTec from the 2016 AECOM exploration that summarizes the findings of the 2016 CPT exploration (including the graphical CPT logs and the results of the SCPTu and PPD tests) are also included in the attachment.

III. Subsurface Conditions

Based on AECOM's review of the historic subsurface explorations, six stratigraphic materials were identified at the site. Particular consideration for subsurface findings and conditions were made for borings collected from the 2016 AECOM exploration and historic exploration locations advanced within the ash pond and perimeter embankment. The summarized description of each of the six identified subsurface strata are briefly summarized and provided below:

Embankment Fill: Embankment fill materials were encountered in AECOM 2016 boring B-100 at the ash pond dike and in CPTs C-100 through C-103 at the ash pond south dike and C-104 through C-108 at the ash pond dike. In addition, historic borings S-1 and S-2 taken from the 2010 SCS exploration were advanced through the existing embankment crest and extended to the underlying foundation soils. Based on the results of these borings, the embankment fill primarily consists of compacted onsite fill materials, which are assumed to originate from residual soils excavated from in and around the current ash pond. Fill depths extended from up to 100 ft (C-104, at the maximum height of the ash pond dike) to a nominal thickness for CPTs advanced near the toe of the ash pond dike.

Most CPTs advanced from the crest of the ash pond dike (C-100, C-102, and C-105) identified a granular layer beneath the bottom of the embankment fill. Based on historic construction drawings provided by

SCS/GPC, it is likely that this material is the internal drainage system. Actual soil samples of this material were not collected by AECOM in the 2016 exploration, as the material was likely located between sample intervals in boring B-100, which is the only ash pond dike boring that would have penetrated the internal drainage system. Where the granular layer was not encountered (C-104, C-106, and C-107), it is likely that the CPT was advanced beyond the maximum upstream extents of the internal drainage system. A typical section of the ash pond dam showing the internal drainage system is in **Figure 1**.

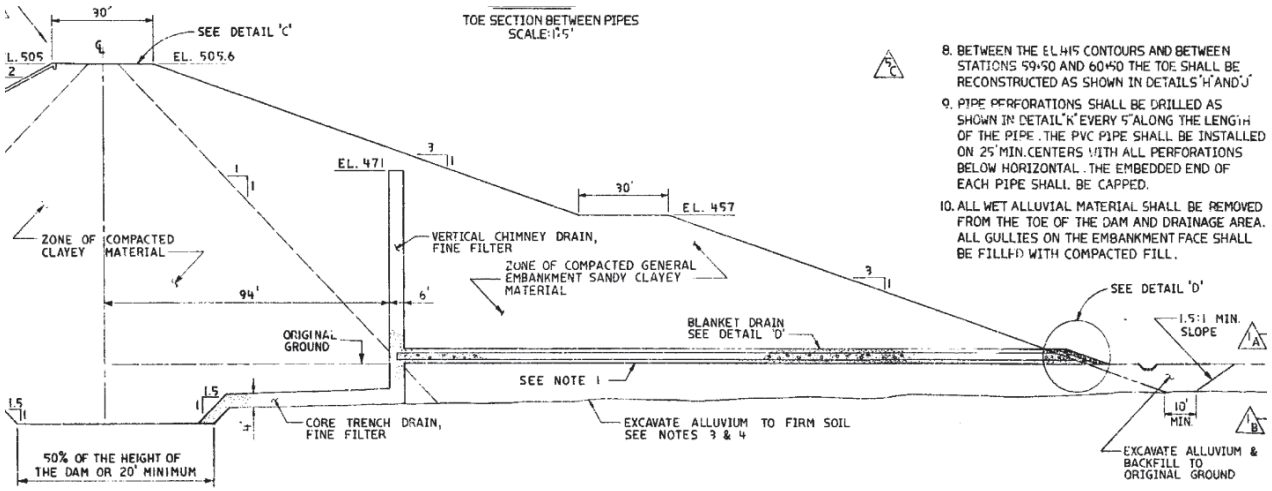


Figure 1 – Typical Section of Ash Pond Dam Showing Internal Drainge System
(from GPC Drawing E1H1002, 1982)

Based on field and laboratory testing, the fill materials generally consist of stiff to very stiff elastic silt (MH), with trace sand and mica. Some zones of fat clay (CH) and lean clay (CL) were identified as well. Both SPT and CPT penetration resistances indicate that the embankment fill is relatively uniform across the site, with typical SPT N-values of around 15 blows per foot and CPT tip resistances of around 30 tons per square foot, although isolated zones of soft soil were found. This is indicative of a well-compacted material with good compaction control during construction.

Additionally, some material classified as general fill was encountered beyond the toe of the ash pond dike in boring B-101, and was not encountered in other explorations advanced by AECOM. The general fill consists of material used to backfill excavations beyond the toe of the ash pond dike, where alluvial soils existing beyond the toe were removed during construction of the ash pond dike, as shown on historic drawings (Figure 1). At boring B-101, the fill general fill extended to a depth of 5.0 feet.

Based on field and laboratory testing, the general fill material consists of soft lean clay (CL) with trace sand and mica. SPT penetration resistances were 4 blows per foot for both SPTs performed in this material.

Alluvium: Alluvium was encountered beyond the toe of the ash pond dike in boring B-101, beneath ash in ash delta borings B-103 and B-104, and beneath a surficial layer of CCR in ash pond borings B-106, B-108, B-109, B-112, and SPT-02. Alluvium was also likely encountered in ash pond CPTs C-109 through C-112, but could not be definitively identified due to the lack of soil samples collected from the CPT's.

The alluvium consists of residual soils that were eroded and redeposited along historic creek channels that originally flowed beneath the current footprint of the ash pond. Where encountered,

alluvium thicknesses were typically around 5 ft, reaching a maximum thickness of 5.7 ft in ash pond free water boring B-112.

Based on field and laboratory testing, the alluvium materials are variable in nature but generally consist of very soft to medium stiff lean clay (CL) and fat clay (CH) and very loose to medium dense, silty sand (SM) and clayey sand (SC). SPT and CPT penetration resistances are highly variable due to the variations in soil type, location, and the depositional environment where the soil was formed.

At ash pond dike boring B-101, a 10 ft thick zone of soft alluvial clay and silt was encountered beyond the toe of the dike. This material was not encountered underneath the ash pond dike in borings advanced by AECOM nor in any historic borings after the embankment was constructed. Historic slope stability analyses appeared to account for this zone (SCS, 1976 and SCS, 1986), but it is unclear if the zone was accounted for in recent slope stability analyses (SCS, 2010). In 2016 AECOM attempted to collect a Shelby tube sample of this material (B-101, S-3), but laboratory investigation found the tube to be disturbed and comprised of what appeared to be general fill and organics, as the tube was obtained near the interface between the general fill and the alluvium.

Residuum: Residuum was encountered in ash pond dike boring B-100, all of the preconstruction historic borings (C-100 and C-149), and the ash pond free water borings (B-105 through B-114). Residuum was likely encountered in most or all CPT soundings, but cannot be definitively identified or distinguished from saprolite due to the lack of obtained soil samples. Residuum was not encountered in the ash delta borings, where it had likely been eroded away as saprolite was found directly beneath alluvium and CCR materials. Where encountered, the residuum thickness varied significantly, from up to 18.2 feet in boring B-110 to 3 feet in borings B-111 and B-106.

The residuum consists of residual soils developed by the in-place weathering of the parent metamorphic bedrock, and corresponds to a reddish brown soil with trace sand and mica content. Residuum is distinguished from the less weathered saprolite and partially weathered rock materials in that the residuum does not retain relict structure from the parent bedrock (e.g. banding common in metamorphic rocks is missing and the soil has a deep orange-red appearance). In locations where the residuum was not encountered, it was likely eroded away by historic creeks that existed before the ash pond was constructed.

Based on field and laboratory testing, the residuum generally consists of sandy medium stiff to very stiff elastic silt (MH) with trace mica. Some zones of fat clay (CH), lean clay (CL), and silty sand (SM) were also identified. In some of the ash pond borings, the residuum encountered was sometimes soft to very soft, rather than stiff. CPT tip resistances were typically on the order of 30 to 50 tsf, while a zone of approximately 20 tsf material was noted in C-106, between approximately 55 and 70 feet below grade.

Saprolite: Saprolite was encountered in all the 2016 AECOM borings except ash delta boring B-104 and ash pond free water borings B-107, B-109, and B-114. The 2015 SCS borings indicated saprolite was encountered in the borings, but did not specify a distinctive material break between residuum and saprolite. All other historic borings advanced did not distinguish between residuum and saprolite materials and therefore, the limit of saprolite materials is unknown in those borings. Saprolite was likely encountered in most or all the historic CPT soundings, but cannot be definitively identified or distinguished from residuum due to the lack of obtained soil samples. Where encountered and classified, the saprolite thickness varied significantly, from up to 27 feet in borings B-101 and B-112 to 6 feet in boring B-113.

The saprolite is the product of extensive in-place weathering of the parent metamorphic bedrock. Although the saprolite can be sampled as a soil, it retains relict structure from the parent bedrock, including banding of various minerals, and a relatively high mica content. Essentially, the saprolite retains the visual appearance of bedrock, but can easily be penetrated and broken by hand due to nearly complete disintegration of the bonds between individual mineral grains. Saprolite is distinguished from the more weathered residuum by the presence of relict structure and lack of deep orange-red coloration, and from partially weathered rock by SPT N-values that are less than 50 blows per foot (Sowers, 1963). In locations where the saprolite was not encountered, it was likely eroded away by historic creeks that existed before the ash pond was constructed.

Based on field and the 2016 AECOM laboratory testing program, saprolite generally consists of very loose to very dense silty sand (SM) with mica or soft to stiff sandy silt (ML) with mica, although some zones of sandy clay (CL) were also identified.

Partially Weathered Rock (PWR): Partially weathered rock was encountered in the 2016 AECOM ash pond dike boring B-100, ash delta boring B-103, and in all ash pond free water borings except B-105, B-105A, and B-106. Most of the 2015 SCS borings (except SPT-02, 08, 11 and SPT-12) did not encounter PWR materials beneath the residual and saprolite materials. In some cases the partially weathered rock was not encountered due to the boring termination prior to auger refusal. In other cases, the PWR may have been a thin layer that the auger may have encountered refusal prior to attempting to collect a sample. Some of the borings may have also been terminated upon auger refusal and a SPT sample attempted, but no sample recovery was obtained. This effectively means that the boring was likely terminated at the top of partially weathered rock. Partially weathered rock was likely encountered in all CPT soundings, and corresponded to the material in which CPT refusal was met.

The partially weathered rock corresponds to slightly or moderately weathered parent bedrock, which was found to be gneiss. The material is distinguished from saprolite by SPT N-values that are 50 blows per foot or higher (Sowers, 1963). In some areas, auger drilling was successfully able to penetrate the partially weathered rock for up to 15.7 feet prior to auger refusal (boring B-100). In other areas, auger refusal occurred at or just a few feet below the top of the partially weathered rock.

Based on field and laboratory testing, the partially weathered rock generally classified as very dense silty sand (SM) with mica, feldspar, and gravel. SPT N-values were 50 blows per foot or higher, and CPT tip resistances were on the order of 200 tsf or higher.

CCR: CCR was encountered in all the 2016 AECOM ash delta borings, SPT-01 through SPT-03 of the 2015 SCS exploration, and all ash delta CPTs. In the 2016 AECOM ash pond free water borings, only a very limited amount of CCR was encountered. Maximum CCR thicknesses at the bottom of the ash pond were 1.6 feet in boring B-111, while the CCR was found to be 1 ft or less in thickness in all other ash pond free water borings. Within the ash delta, the CCR ranged from 68 to 83.5 feet thick. CCR was not encountered in the ash pond dike borings or could not be distinguished from the soil materials in the CPT's.

The CCR consists of fly ash and bottom ash created by coal combustion at Plant Scherer. The top 5 to 10 ft of the CCR column was found to consist of a mixture of fly ash and bottom ash, which was likely mechanically stacked rather than sluiced. Below that, the material appeared to be wet-sluiced and consisted mainly of fly ash with only limited amounts of bottom ash. Based on field and laboratory testing, the CCR generally consists of a very loose nonplastic silt (ML), with some isolated zones of

medium dense material or silty sand (SM). SPT values were typically weight-of-hammer or weight-of-rods, and CPT tip resistances were on the order of 10 to 20 tsf. Both the CPTs and the SPTs identified a higher-strength crust over the top of the CCR, extending to approximately 10 feet below grade. The crust likely corresponds to desiccated or mechanically-stacked CCR, relative to the saturated sluiced CCR present at depth.

IV. Laboratory Testing Program

Historic laboratory testing was found to be predominately performed on samples collected from the 2016 AECOM exploration activities. Representative samples collected from the 2016 exploration and other historic explorations generally consisted of selected split-spoon, Shelby tube, and piston samples. Historic testing included index, permeability, strength, consolidation, and dispersion testing. AECOM reviewed the laboratory results to determine specific soil and CCR material parameters needed to perform the geotechnical analysis and evaluation of the closure design.

Historic laboratory test results are summarized in **Tables C.1, C.2, and C.3** in **Attachment C.** Based on historic laboratory information provided to AECOM, **Table A1-1** below summarizes the total number of historic laboratory tests performed on samples collected at Plant Scherer.

Table A1-1: Historic Laboratory Testing For Plant Scherer Ash Pond

	ASTM Method	Number of Tests							
		Total	CCR	Emb. Fill	Alluv-ium	Resid-uum	Saprolite	PWR	Other
Moisture Content	D2216	123	42	12	9	28	22	7	3
Atterberg Limits	D4318	37	3	6	6	14	6	-	2
Grain Size Analysis	D422	75	35	7	3	10	16	4	-
Specific Gravity	D854	8	8	-	-	-	-	-	-
Unit Weight	D7263	32	18	6	1	6	1	-	-
Consolidation	D4186	5	5	-	-	-	-	-	-
Unconsolidated Undrained (UU)	D2850	2	-	-	-	2	-	-	-
Consolidated Undrained (CIU)	D4767	15	8	3	-	3	1	-	-
Permeability	D5084	13	10	2	-	1	-	-	-
Crumb Dispersion	D6572	4	-	2	-	2	-	-	-
Double Hydrometer Dispersion	D4221	1	-	-	-	1	-	-	-

Compete results of the laboratory tests are included in **Attachment C** of the report.

V. Material Properties

Material properties for slope stability analyses were developed using both laboratory testing data (index and strength testing) and strength correlations from SPT and CPT data.

The following specific material properties were developed for the stacked ash, sluiced ash, berm fill, residuum, saprolite, and partially weathered rock materials, for use in the various stability analyses performed as part of this study:

- Unit Weight
- Drained and Undrained Shear Strength of Native Soil Strata
- Drained and Undrained Shear Strength of CCR Material
- Post-Earthquake Shear Strength of Sluiced Ash

Material properties for the stacked ash (drained), sluiced ash (undrained), residuum, and embankment fill were based material properties presented in the Geotechnical Data Report. The Geotechnical Data Report characterized these material strengths with p-q plots. The undrained material properties for stacked ash and sluiced ash were based on CPT data, while material properties for the saprolite and drained properties for the sluiced ash were based on SPT results. Partially weathered rock properties were based on regional characteristics.

Unit Weight

Unit weight for the sluiced ash, embankment fill, and residuum materials were evaluated using measured results from samples collected. **Table A1-2** below summarizes the unit weights as measured from samples collected:

Table A1-2: Total Unit Weight from Laboratory Testing Program

Strata	No. Tests	Min.	Max.	Average
Sluiced Ash Materials	18	59.9	109.5	91.8
Embankment Fill	6	114.3	127.0	117.8
Residuum	5	102.6	122.7	112.6

For predominantly granular materials that could not be directly measured for unit weight or shear strength (stacked ash, saprolite, and partially weathered rock), estimates based on the available data were utilized. The stacked ash unit weight and shear strength was based on sluiced ash materials. Typical regional values and SPT data in saprolite and partially weathered rock were used to determine the unit weight and shear strength of those materials.

Based on the results presented in the **Table A1-2** and regional values, the following total unit weights were selected for use in stability analyses:

- Stacked ash materials: 95 pounds per cubic foot (pcf),
- Sluiced ash materials: 95 pcf,
- Embankment and berm fill materials: 116 pcf,
- Residuum material: 114 pcf,
- Saprolite material: 105 pcf, and
- Partially weathered rock: 135 pcf.

Drained and Undrained Shear Strength - SPT Blow Counts

The shear strength parameters (drained) of the sluiced ash and saprolite encountered across the site were estimated using SPT-N values established in the field investigation and the piezometer logs. The parameters assigned to the materials were conservatively estimated based on engineering judgement and previous experience.

Drained and Undrained Shear Strength - Triaxial Testing

Shear Strength From Laboratory Triaxial Testing

Multiple historic laboratory triaxial tests (predominately from the 2016 AECOM exploration) were performed for the sluiced ash, embankment fill, and residuum over a range of confining pressures. In analyzing the test results, a number of definitions of failure were considered, including the point of peak deviator stress during the test, the deviator stress corresponding to an axial strain of 10%, and the point of the test with the maximum effective principle stress ratio (obliquity) from the tabulated CU test data. For both effective and total strength conditions, defining the failure point to coincide with the point of maximum deviator stress or the deviator stress at 10% strain (whichever came first) resulted in the most conservative interpretation of strength parameters, and this criterion was utilized herein. For UU testing, failure under undrained conditions was assumed to take place at the maximum deviator stress or at a maximum of 10% strain if there was no distinct maximum deviator stress.

As a result of having multiple laboratory CU tests, a failure envelope was defined for each material by plotting the failure points on a Modified Mohr-Coulomb plot (a p-q and p'-q plot), as described in Appendix D of the United States Corps of Engineers Engineer Manual EM-1110-2-1902 "Slope Stability."

For Plant Scherer, p-q and p'-q plots were constructed for each of the following materials based on multiple CU laboratory test data:

- Sluiced Ash
- Embankment Fill
- Residuum

The p-q relationship is as follows:

$p = \frac{1}{2} (cr_3 + cr_1)$

$p' = \frac{1}{2} (cr'_3 + cr'_1)$

$q = \frac{1}{2} (cr_1 - cr_3)$

Where:

cr_1 = total major principal stress at failure (axial stress)
cr'_1 = effective major principal stress at failure (axial stress)
cr_3 = total minor principal stress at failure (confining stress)
cr'_3 = effective minor principal stress at failure (confining stress)
p = mean total normal stress at failure
p' = mean effective normal stress at failure
q = shear stress at failure

A best fit line through the p-q and p'-q failure points will have an intercept of d and a slope of tangent a (or d' and a' for effective stress conditions). Equivalent Mohr-Coulomb parameters can then be computed as follows:

sin <I = tan y or sin <I' = tan y'
c = (d / cos <I) or c' = (d' / cos <I')

In fitting strength parameters to multiple test results, the US Army Corps of Engineers recommends selecting design parameters such that about two thirds of the total tests are above the failure envelope.

Total and effective stress p-q plots for the sluiced ash, embankment fill, and residuum materials are shown on **Figures 3 through 8** below. The calculated shear strength parameters are also shown.

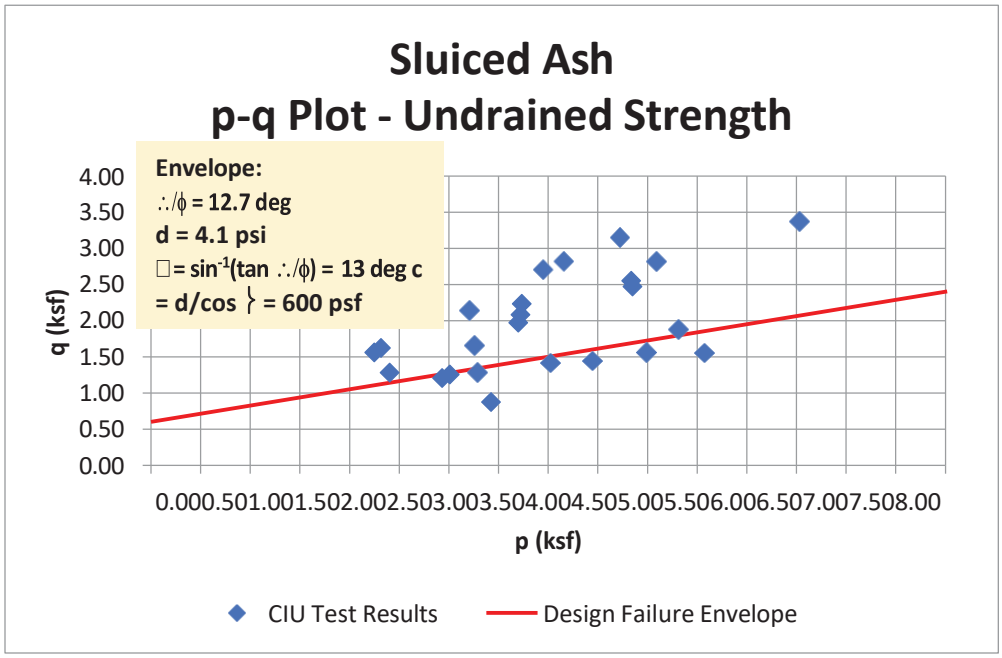


Figure 3. Total Strength P-Q Plot for Sluiced Ash at Plant Scherer

To be conservative, the results from the P-Q plot for the total stress of sluiced ash were further reduced by 30%. A conservative lower value consisting of a 10 degree friction angle with cohesion of 430 psf was used to represent the total stress of the sluiced ash.

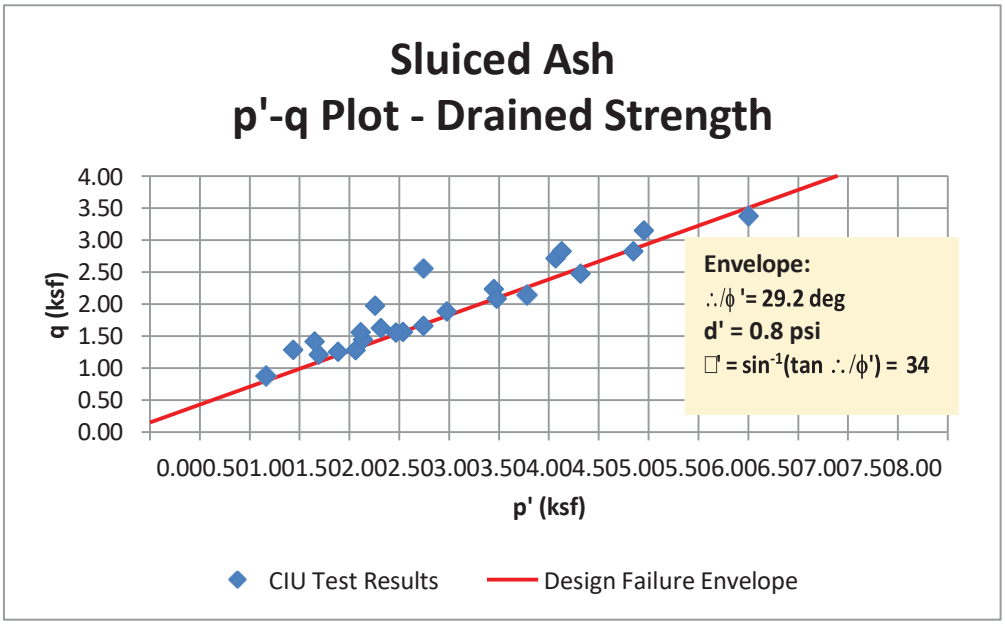


Figure 4. Effective Strength P-Q Plot for Sluiced Ash at Plant Scherer

To be conservative, the results from the P-Q plot for the effective stress of sluiced ash were applied to the proposed stacked ash for the analysis. A conservative lower value consisting of a 32 degree friction angle with no cohesion was used to represent the sluiced ash.

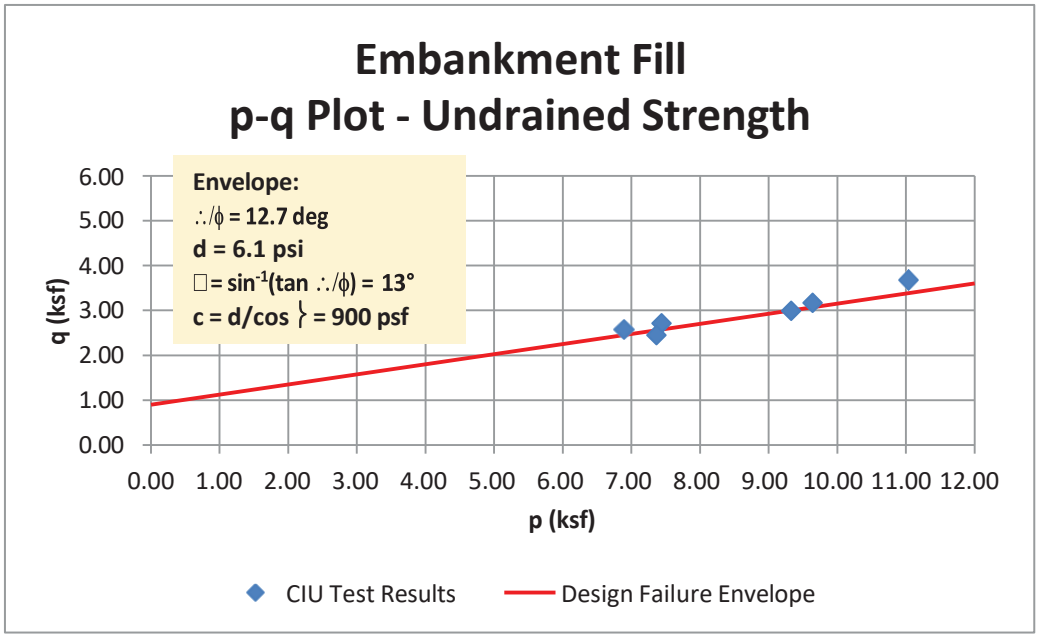


Figure 5. Total Strength P-Q Plot for Embankment FIll at Plant Scherer

Job	Plant Scherer - Ash Pond Closure	Project No.	60563110	Sheet	11	of	16
Description	Geotechnical Data and Material	Computed by	SAL	Date	09/05/18		
	Properties	Checked by	JLM	Date	05/22/18		

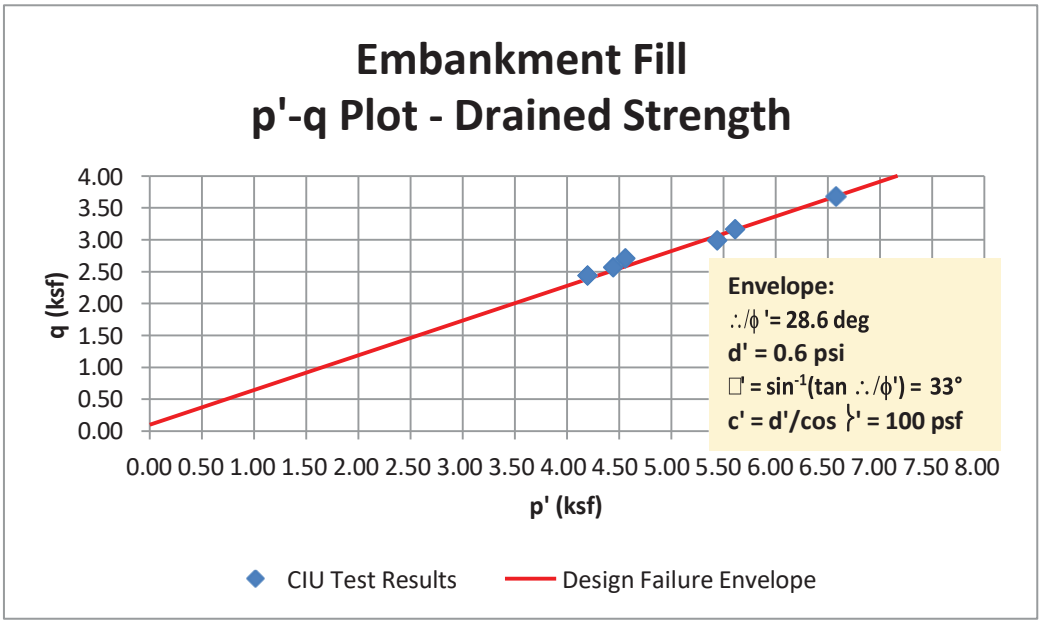


Figure 6. Effective Strength P-Q Plot for Embankment FIll at Plant Scherer

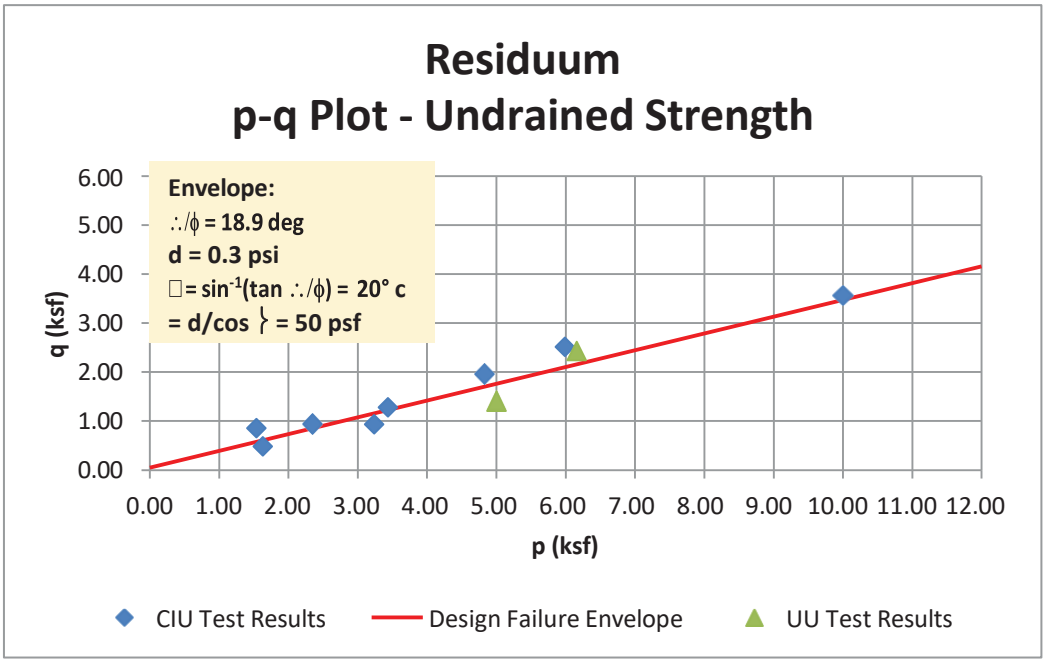


Figure 7. Total Strength P-Q Plot for Residuum at Plant Scherer

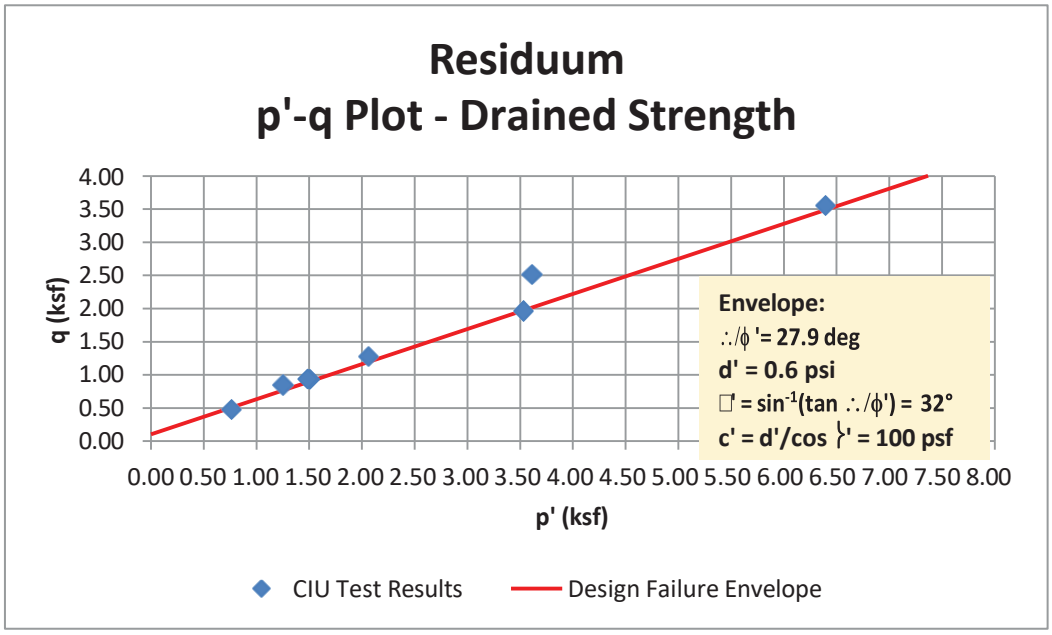


Figure 8. Effective Strength P-Q Plot for Residuum at Plant Scherer

Post-Earthquake Shear Strength of Sluiced Ash

The liquefied strength (residual strength) of ash was estimated following procedures in Idriss and Boulanger (2008, 2014). Strength estimates presented in those references are based on empirical observations and back-analyses made at actual sites that have experienced liquefaction in past earthquakes and is based on correlations with SPT and CPT results. It relates the residual strength of a liquefied sand or silt (non- or low-plasticity material) to the normalized, fines-corrected resistance (SPT N-value or CPT tip resistance). For the current evaluation, CPT-based correlations were utilized, as the available data set for CPT in the ash is substantially larger than SPT. CPT data points were taken every 0.05 meter (0.16 foot), essentially creating a continuous profile of data which were used to select the residual strength of the ash deposit.

The equivalent fines-corrected and normalized clean sand tip resistance, $q_{c1Ncs\text{-}Sr}$ taken from each CPT data point were calculated for all intervals within the sluiced ash as part of the liquefaction triggering analyses presented in **Appendix A3**. The values were plotted on a single graph, shown in **Figure 9** below. The corrected tip resistance for which 50% of the collective data points are larger (median value) is also shown on the figure as a heavy line ($q_{c1Ncs\text{-}Sr}$ = 72). This value was conservatively selected as the basis for determining the residual strength of ash for modelling purposes.

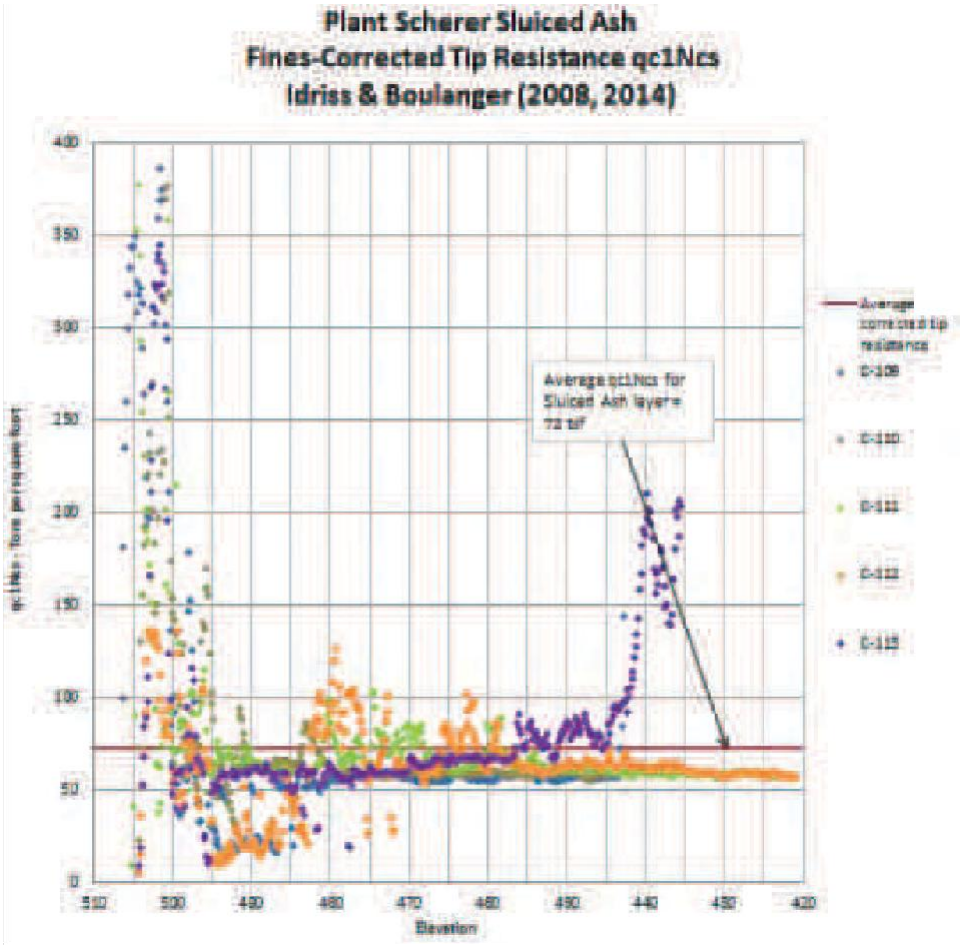


Figure 9. Calculated Equivalent Clean Sand Normalized Tip Resistance - Ash Pond Sluiced Ash

Figure 10, reproduced from Idriss and Boulanger (2008), relates $q_{c1Ncs\ -Sr}$ to the residual shear strength. The strength is expressed as a ratio of the existing vertical overburden stress at any point in the layer, i.e., S_r / cr'_v. For $q_{c1Ncs\ -Sr}$ of 72, the estimated strength ratio is 0.075. Therefore, the ratio of 0.08 was selected to represent that portion of the sluiced ash material that is anticipated to liquefy, for use in the post-liquefaction stability analyses.

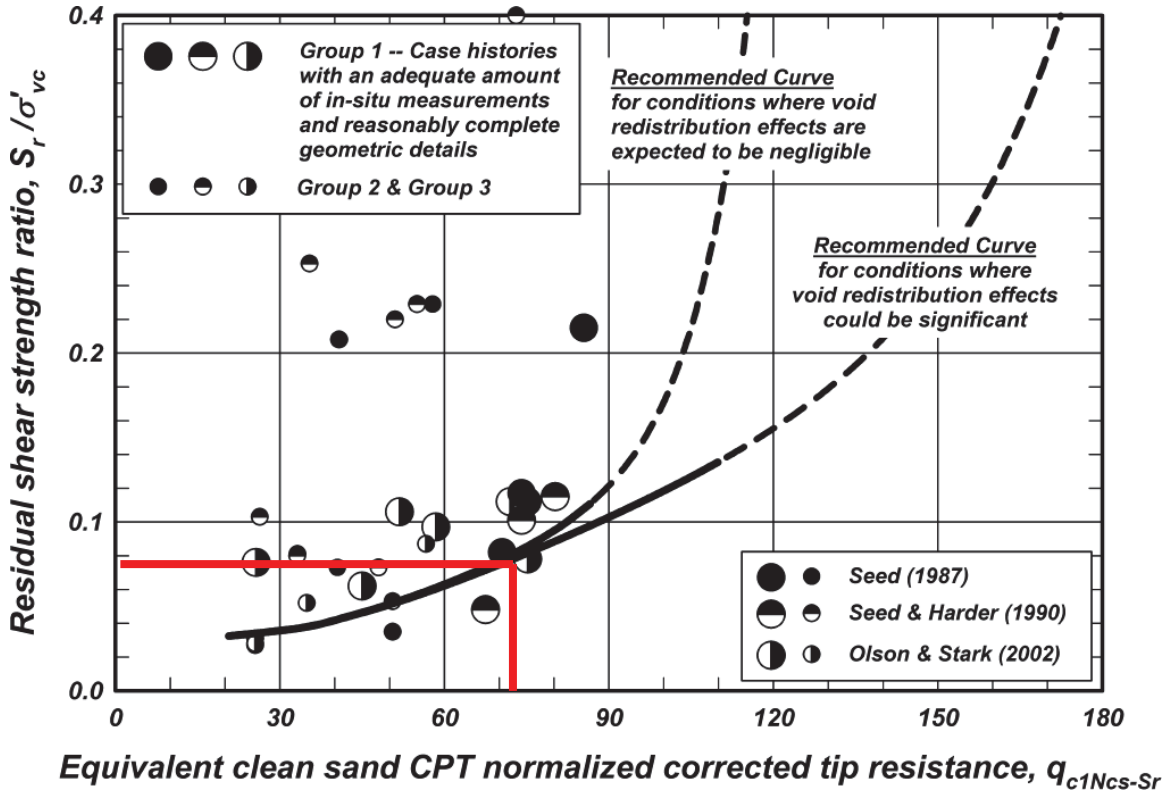


Figure 10. Steady-State Strength Ratio vs. Equivalent Clean Sand CPT Tip Resistance (Idriss and 8oulanger, 2008)

VI. Material Properties for Analysis

The table below summarizes the material parameters used in the slope stability and veneer stability analyses based on the analysis and strength selection procedures and considerations presented in the preceding sections.

Table F-9: Summary of Material Parameters used in Stability Analysis

Material	Unit Weight (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters		Post-Liquefaction Shear Strength Parameters	
		c' (psf)	⊄>' (0)	c (psf)	⊄> (0)	τ/ *a ratio*	Minimum strength (psf)
Stacked Ash	95	150	34	150	34	-	-
Sluiced Ash	95	0	32	430	10	0.08	32
Embankment Fill	116	100	33	900	13	-	-
Berm Fill	116	100	33	900	13	-	-
Residuum	114	100	32	50	20	-	-
Saprolite	105	0	32	0	32	-	-
Partially Weathered Rock	135	300	35	300	35	-	-

VII. Limitations

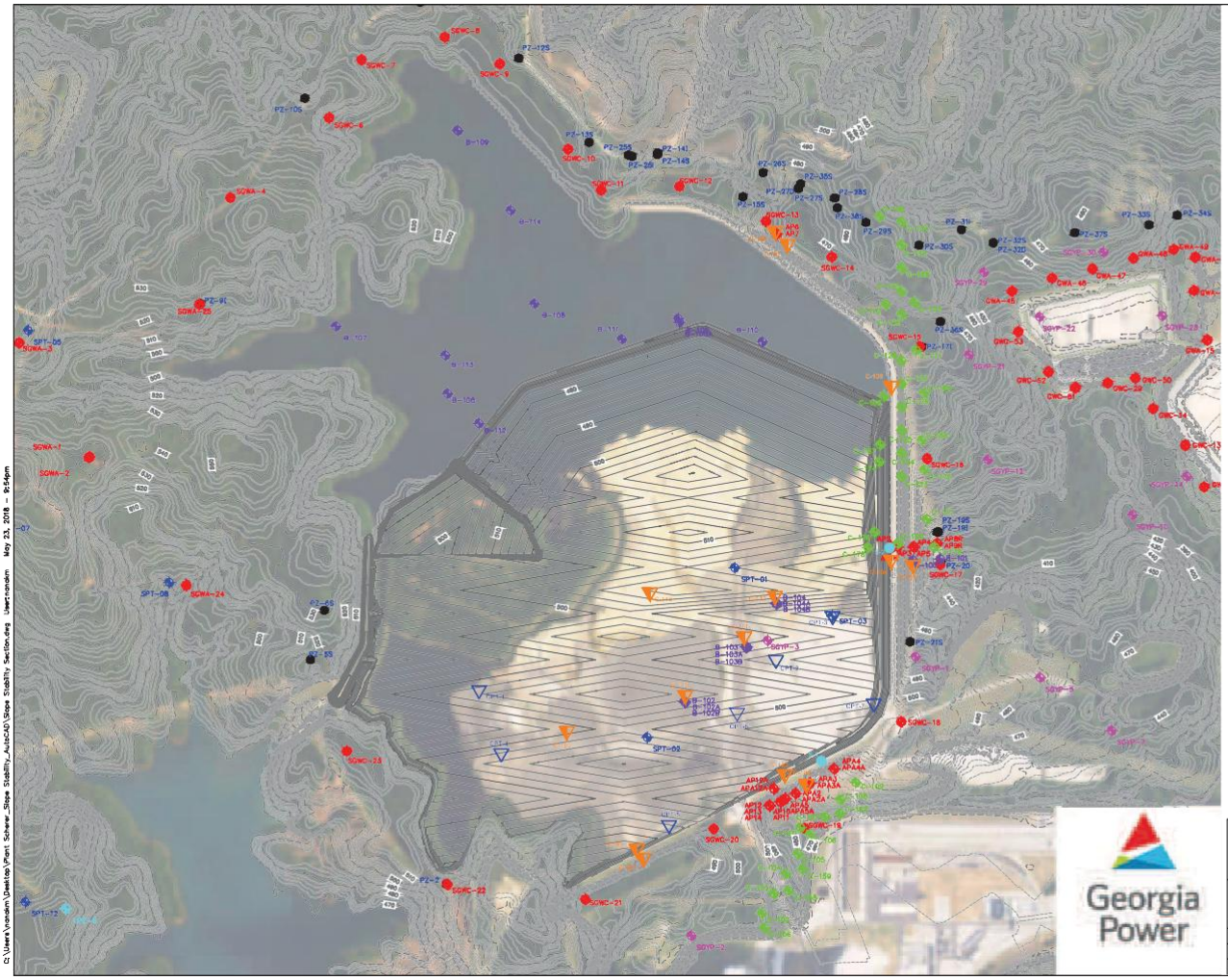
This material properties report and AECOM geotechnical investigation was performed in accordance with the standard of care commonly used as state-of-practice in our profession. Specifically, our services have been performed in accordance with generally accepted principles and practices of the geological and geotechnical engineering profession. This warranty is in lieu of all other warranties, either express or implied. The conclusions presented in this report are professional opinions based on the indicated project criteria and data available at the time this report was prepared.

Background information, design basis, and other data have been furnished to AECOM by third parties, which AECOM has used in preparing this report. This includes logs of borings performed by other consultant for the project. AECOM has relied on this information as furnished, and is neither responsible for nor has confirmed the accuracy of this information. Our recommendations are based on available information from previous and current investigations. These recommendations will be updated as future investigations are performed.

The conclusions presented in this report are intended only for the purpose, site location, and project indicated. The recommendations made in this report are based on the assumption that the subsurface soil, rock, and groundwater conditions do not deviate appreciably from those disclosed in the site-specific exploratory borings. If any variations or undesirable conditions are encountered during construction, we should be notified so that additional recommendations can be made, if necessary.

VIII. References

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CCR CLOSURE
FOR
GEORGIA POWER
PLANT SHERER ASH POND 1
MONROE COUNTY, GEORGIA

AECOM
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SUITE 400
MORRISVILLE, NC 27560
(919) 461-1100
WWW.AECOM.COM

PROJ. NO.: 60563110	DWN.	CHK.
SCALE: 1" = 400'	GEOTECHNICAL SITE PLAN	
DATE: JUNE 5, 2018		

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