INITIAL SAFETY FACTOR ASSESSMENT
40 C.F.R. § 257.100(f)(2)(iv) and 40 C.F.R. § 257.73(e)
PLANT HARLLEE BRANCH ASH POND C (AP-C)
GEORGIA POWER COMPANY

A rule amendment to the Federal CCR Rule became effective on November 8, 2024. S*ee* Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Legacy CCR Surface Impoundments, 89 Fed. Reg. 38950 ("Legacy Rule"). The Legacy Rule defines the term "legacy CCR surface impoundment" and establishes regulatory requirements for units that meet the definition of a legacy CCR surface impoundment. The Legacy Rule requires the owner or operator of a legacy CCR impoundment to conduct an initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each unit achieve the minimum safety factors specified in § 257.73(e)(1)(i) through (iv) for the critical section of the dam. *See* 40 C.F.R. Part 257, §257.100(f)(2)(iv) and §257.73(d). In addition, the Rules require a subsequent assessment be performed within 5 years of the previous assessment. *See* 40 C.F.R. § 257.73(f)(3).

The legacy CCR surface impoundment known as Ash Pond C (AP-C) at Georgia Power Company's (Georgia Power) Plant Harllee Branch (Plant Branch) property is located on the northern shore of Lake Sinclair, off State Route 24 (US 441) near Milledgeville and Eatonton in Putnam County, Georgia. AP-C is impounded by earth dams on the west, south, and east sides and by natural ground on the north side. Original construction of the AP-C dams consisted of two major phases: (1) raising the dams to elevation (El.) 380 feet (ft) by placing fill materials where the existing ground elevation was below El. 380 ft; and (2) raising the dams to approximate El. 400 ft. The design drawings show 2 horizontal to 1 vertical (2H:1V) slopes on both the exterior and interior sides of the AP-C dams, and a crest width of 15 ft. The constructed slopes on the exterior side of the AP-C dams range from 1.6H:1V to 2.0H:1V based on the site's topographic maps. The exterior slope of the upper portion of the south AP-C dam was refaced and armored with riprap in 2009 to mitigate observed shallow veneer (planar) slip surfaces. The AP-C dam is regulated as a Category II Dam under the Georgia Environmental Protection Agency Safe Dams Program. AP-C does not currently hold ponded water and is covered with surface vegetation. AP-C is currently not receiving any CCR.

The original slope stability analysis of the AP-C dams was performed by Southern Company in 1970 as part of the original design. In 2010, Southern Company reviewed the original slope stability analysis and performed updated analyses for the south AP-C dam for maximum storage pool, maximum surcharge pool, rapid drawdown, and seismic loading conditions. The south AP-C dam was identified to include the critical section in the 2010 analyses and under current conditions, the critical section remains the same because it has the greatest height (approximately 83 ft) and steepest slopes (1.6H:1V to 2.0H:1V on the exterior side). For the initial safety factor assessment, slope stability analyses were performed on the critical section under long-term, maximum storage pool, maximum surcharge pool, and seismic loading conditions to calculate the minimum safety factors. The results of the slope stability analyses are summarized below:

Loading Condition	Minimum Calculated Safety Factor	Minimum Required Safety Factor
Long-Term, Maximum Storage Pool (Static)	2.20	1.50
Maximum Surcharge Pool (Static)	2.16	1.40
Seismic	1.93	1.00

The dam consists of saprolite, gravel, and boulders, and its foundation consists of saprolite, which are not susceptible to liquefaction. Therefore, the safety factor assessment did not include the liquefaction loading condition.

The safety factor assessment is supported by the attached engineering calculation packages.

I hereby certify that the safety factor assessment was conducted in accordance with 40 C.F.R. § 257.100(f)(2)(iv) and 40 C.F.R. § 257.73(e).

05/06/2026

Mehmet Iscimen, P.E.
Licensed State of GA, PE No. 034164

ATTACHMENT A
Ash Pond C Slope Stability Analysis

Geosyntec consultants

CALCULATION PACKAGE COVER SHEET

Client: Georgia Power **Project:** Design and Operating Criteria Assessments for Plant Branch Legacy CCR Units **Project #:** GW11718

TITLE OF PACKAGE: **ASH POND C SLOPE STABILITY ANALYSIS**

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		Name	Clinton Carlson, Ph.D.	Date
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REVISION HISTORY:

NO.	DESCRIPTION	DATE	CP	APC	CC	CA
0	Final Issue	05/06/2026	CG/YZ	MGB	CPC	MI

ASH POND C SLOPE STABILITY ANALYSIS

INTRODUCTION AND PURPOSE

The purpose of this *Ash Pond C Slope Stability Analysis* calculation package (Package) is to present the methods and results of slope stability analyses for the Ash Pond C (AP-C) dam at Georgia Power Company's (Georgia Power) Plant Harllee Branch (Plant Branch) in Putnam County, Georgia. The slope stability analyses were performed to support the *Initial Safety Factor Assessment* report for AP-C in compliance with the United States Environmental Protection Agency's (USEPA's) Coal Combustion Residuals (CCR) Rule contained in 40 C.F.R. §257 (USEPA, 2015).

The remainder of this Package is organized to present: (i) minimum required safety factors; (ii) method of analysis; (iii) input parameters; (iv) results; and (v) conclusions and recommendations.

MINIMUM REQUIRED SAFETY FACTORS

Slope stability analyses were performed to assess whether the AP-C dam satisfies the safety factor requirements in §257.73(e)(1) of the CCR Rule. §257.73(e)(1) requires that:

"The safety factor assessments must be supported by appropriate engineering calculations.

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

METHOD OF ANALYSIS

Two-dimensional (2-D) slope stability analyses of non-circular slip surfaces were performed using Spencer's method (Spencer, 1973), as implemented in the software Slide2 version 9.040 (Rocscience, 2025). Spencer's method was used because the method satisfies vertical and horizontal force equilibrium and moment equilibrium. The Slide2 software generates potential slip surfaces, calculates the safety factor for each of these surfaces, and identifies the slip surface with the lowest calculated safety factor (termed as the critical slip surface). Slip

surfaces with depths less than 5 feet (ft) were filtered out in the Slide2 software because such failures would be localized, could be repaired through standard maintenance procedures, and would not affect the overall stability of the dam. Searches for the critical slip surface in Slide2 were performed with the optimization feature enabled.

INPUT PARAMETERS

Subsurface Stratigraphy and Material Properties

The south AP-C dam was constructed on top of "existing fill" adjacent to Lake Sinclair as shown in the historical design drawings (Georgia Power, 1970). The existing fill was reported to be similar to the fill materials used for the construction of the Ash Pond B dam (Georgia Power, 1962) and consist of boulders, gravel, construction debris, and soil overburden spoil from the plant excavation, and was confirmed by the historical borings (Hastings Foundation and Exploration Company, 1969). The *Slope Stability Analyses of Ash Pond Dikes B, C, D-1, and E* calculation package (Southern Company Services [SCS], 2010) also described the existing fill, referred to as Dike Soil 4 in the calculation package, for the base of the south AP-C dam as containing a large amount of gravel and boulder. The AP-C dam was first constructed to approximate elevation (El.) 380 ft using material referred to as Dike Soil 3 by SCS (2010) and then raised to approximate El. 400 ft by placing fill materials, referred to as Dike Soil 2 by SCS (2010), from on-site borrow areas. The upper portion (i.e., above the bench) of the downstream face of the south AP-C dam and the south portion of the downstream face of the east AP-C dam were "refaced" with riprap (referred to as Dike Soil 1) in 2009 (CHA, 2010). The subsurface stratigraphy beneath the AP-C dam consists of the following units, from top to bottom: (i) saprolite, classified under the Unified Soil Classification System (USCS) as sandy elastic silt and elastic silt with sand (MH), as well as silty sand (SM); (ii) partially weathered rock (PWR), which generally exhibits the same characteristics of the underlying bedrock and is classified as silty sand (SM), clayey sand (SC), or well-graded sand (SW); and (iii) competent bedrock consisting of poorly-jointed feldspathic biotite gneiss.

The geotechnical properties (unit weights and shear strengths) of the subsurface and dam materials used in the slope stability analysis are summarized in **Table 1**. Geotechnical properties for the AP-C dam materials (Dike Soils 1 to 4) were based on the *Slope Stability Analyses of Ash Pond Dikes B, C, D-1, and E* calculation package (SCS, 2010), and additional information obtained from various subsurface investigations at Plant Branch summarized in the *Summary of Geotechnical Design Parameters* calculation package (Geosyntec, 2023). The

geotechnical properties for the CCR impounded by the AP-C dam were selected based on tests performed on CCR impounded at Plant Branch (Golder, 2014) and Geosyntec's professional experience at Plant Branch and other CCR impoundments (Geosyntec, 2023). The geotechnical properties selected for the saprolite and PWR are based on the results of historical field and laboratory testing performed on the saprolite encountered at all Plant Branch ash ponds, as summarized in the *Summary of Geotechnical Design Parameters* calculation package (Geosyntec, 2023). The undrained shear strength (S_u) for saprolite is defined as a linear function of effective vertical overburden pressure (σ'_v). The bedrock represents the lowermost layer of the subsurface stratigraphy and was modeled as an "infinite strength material" in Slide2, which prevents potential slip surfaces from passing through this material.

Cross Section

The location of the selected cross section is presented in **Figure 1**. This selected location is the same as the location of the cross section previously analyzed along the south AP-C dam (SCS, 2010). The selected cross section represents the critical section for the slope stability analysis because it corresponds to the maximum height for the AP-C dam.

The ground surface for the top of CCR and the crest and downstream face (above the Lake Sinclair water level) of the south AP-C dam are based on a recent LiDAR survey conducted on January 22, 2024 (and provided by SCS on March 5, 2024). The crest is at approximately El. 400 ft and the slopes on the downstream side range from approximately 1.6 horizontal to 1 vertical (1.6H:1V) to 2.0H:1V, which correspond to the historical design drawings shown in **Figures 2** and **3** (Georgia Power, 1970; and Georgia Power, undated), the previous model for slope stability analyses used by SCS (2010). The downstream side of the existing fill (Dike Soil 4) was modeled with a 2H:1V slope below the Lake Sinclair water level (i.e., approximate El. 338.5 ft to approximate El. 317 ft), consistent with the previous model for slope stability analyses used by SCS (2010). As described above, the south AP-C dam was constructed in two phases on top of "existing fill" as shown in the historical design drawings (Georgia Power, 1970). The first construction phase of the AP-C dam (Dike Soil 3) was modeled with 2H:1V slopes on both downstream and upstream sides to approximate El. 380 ft, and the second phase (Dike Soil 2) was modeled with a 2H:1V slope on the upstream side to the crest (approximate El. 400 ft), consistent with the previous model for slope stability analyses used by SCS (2010). A 2-ft-thick layer of riprap (Dike Soil 1) extending from crest to approximate El. 369 ft along the downstream face of the dam was included in the model to represent the refacing of the south AP-C dam with riprap. The total dam height at the selected location is estimated to be

approximately 83 ft, based on Geosyntec's 2021 site investigation (Geosyntec, 2021). The elevations for the top of the PWR and bedrock are based on the surfaces developed by Geosyntec for the Plant Branch hydrogeologic model (Geosyntec, 2021). The model for the south AP-C dam used in the slope stability analysis is presented in **Figure 4**.

Water Elevations

There are six piezometers, PZ-1 through PZ-6, along the AP-C dam that monitor water elevations (**Figure 5**). Piezometers PZ-1 through PZ-3 are installed near the center of the south AP-C dam along the selected cross section, while piezometers PZ-4 through PZ-6 are installed near the center of the west AP-C dam. PZ-1 and PZ-2 are located adjacent to each other on the crest of the south AP-C dam with PZ-1 screened approximately 30 to 35 ft below ground surface and PZ-2 screened approximately 55 to 60 ft below ground surface. PZ-3 is located on the downstream side of the dam on the bench just below the riprap. There are also six monitoring wells, CD-1 through CD-6, along the south AP-C dam as shown in **Figure 6** that were installed by Geosyntec in 2021 (Geosyntec, 2021). CD-1 through CD-3 are installed along the crest and CD-4 through CD-6 are installed along the bench just below the riprap. The phreatic surfaces used for the slope stability analyses were generally derived from the historical water level data collected from piezometers PZ-1 through PZ-3 between August 2013 and May 2025 and provided by SCS on June 19, 2025, as shown in **Figure 7**. The average water level measurements collected from monitoring wells CD-1 through CD-3 (i.e., crest of the dam) and CD-4 through CD-6 (i.e., bench just below the riprap) on March 21, 2021, and July 31, 2025, are shown in **Figure 7** for comparison.

Average high-water levels for piezometers PZ-1 through PZ-3 prior to July 2021 were selected to represent maximum storage pool and maximum surcharge pool elevations within the AP-C dam, as summarized in **Table 2**. For the pair of piezometers on the crest of the south AP-C dam (PZ-1 and PZ-2), the water level measured by PZ-2 was used to model the phreatic surface for the loading conditions because the measured water levels are more consistent with the water levels measured at CD-1 through CD-3 (**Figure 7**). For the long-term, maximum storage pool loading condition, the water level within the AP-C impoundment was conservatively modeled at approximately the existing ground surface. For the maximum surcharge pool loading condition, the water level within the AP-C impoundment was modeled at El. 399.5 ft, which is approximately the crest elevation of the AP-C dam.

The water level within Lake Sinclair was modeled at El. 338.5 ft based on historical data between 2020 and 2025 shown in **Figure 7**. The phreatic surface was modeled by connecting the water level measured within the south AP-C dam by piezometers PZ-2 and PZ-3 to the

Lake Sinclair water level at the downstream face of the dam.

Pseudostatic Coefficient

As detailed in the *Ash Pond C Pseudostatic Coefficient* calculation package included as Attachment B with this Initial Safety Factor Assessment report, the pseudostatic coefficient for the south AP-C dam was estimated using the United States Geological Survey (USGS) Hazard Toolbox (USGS, 2025) and the Bray and Macedo (2019) approach. The pseudostatic coefficient estimated for the south AP-C dam is 0.03.

Loading Conditions

The following loading conditions must be analyzed to satisfy the safety factor requirements in §257.73(e)(1) of the CCR Rule.

- Static, long-term, maximum storage pool. This generally corresponds to normal operating conditions.
- Static, maximum surcharge pool. This generally corresponds to flood conditions.
- Seismic.
- Post-seismic liquefaction.

Drained shear strength properties were used for Dike Soils 1 and 4, CCR, and PWR for all the loading conditions because these materials are granular and considered to be freely draining. The saprolite was modeled with drained shear strength properties for the static loading conditions representing steady-state conditions. However, undrained shear strength properties were used for the saprolite for the seismic loading condition, which is expected to be rapid and generate excess porewater pressures within the fine-grained saprolite. Although Dike Soils 2 and 3 are comprised of compacted saprolite, drained shear strength properties were used for these materials for the seismic loading condition based on the properties reported in the design drawings and previous slope stability analyses (SCS, 2010) and no other information on the undrained shear strength properties being available.

The water levels within the AP-C impoundment and dam selected to represent the maximum storage pool were used for both the long-term, maximum storage pool and seismic loading conditions. The water levels selected to represent the maximum surcharge pool were used for the maximum surcharge pool loading condition.

The pseudostatic coefficient was applied for the seismic loading condition only.

The liquefaction loading condition was not analyzed for the south AP-C dam. As indicated in

§257.73(e)(1)(iv) of the CCR Rule, only embankments constructed of soils that have susceptibility to liquefaction must satisfy the requirements for the liquefaction loading condition. The large, granular materials comprising the existing fill at the base of the south AP-C dam are freely draining and not likely to undergo liquefaction during an earthquake event. Youd and Perkins (1978) indicate that residual saprolite soils have a very-low to low susceptibility to liquefaction because of their fine-grained nature. The south AP-C dam is constructed of compacted saprolite and founded on native saprolite and thus, the dam and the saprolite foundation are not susceptible to liquefaction. Further supporting this point, safety factors against triggering of liquefaction were calculated for cone penetration tests into the saprolite below Ash Pond E and the calculated safety factors were greater than 1.5 as shown in **Figure 8**.

RESULTS

The results of the slope stability analyses for the south AP-C dam are summarized in **Table 3**. **Figures 9** through **11** present the critical slip surfaces (i.e., lowest calculated safety factors) for each loading condition. As shown in **Figures 9** through **11**, shallower slip surfaces (approximately 10 ft deep or less) with lower calculated safety factors, but still greater than the target, are observed within the existing fill (Dike Soil 4) near the Lake Sinclair water level. These slip surfaces are not considered the most critical because they are not expected to affect the global stability of the AP-C dam and its ability to retain the impounded CCR. Additionally, the slip surfaces are small enough that, if observed during regular inspections (i.e., semi-annually by professional dam safety engineers, weekly by trained plant personnel or qualified staff, or after any unusual circumstances), standard maintenance procedures can be used to prevent additional movements.

Based on the results of the slope stability analyses, the AP-C dam meets the safety factor criteria for the loading conditions presented in §257.73(e)(i) through (iii) of the CCR Rule.

CONCLUSIONS AND RECOMMENDATIONS

The results indicate that the AP-C dam meets the requirements for the initial safety factor assessment in §257.73(e) of the CCR Rule. If there is a change in the AP-C dam that affects the input parameters considered in this Package, additional slope stability analyses must be conducted to assess compliance with the CCR Rule. Currently, no changes to the AP-C dam are required to meet the safety factor criteria.

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TABLES

Table 1. Summary of Material Properties Used in Slope Stability Analyses

Material	Unit Weight [pcf]	Drained Shear Strength		Undrained Shear Strength, S_u [psf]
		Cohesion [psf]	Friction Angle [degrees]	
Dike Soil 1 (Riprap) [1,2]	140	0	40	-
Dike Soil 2 [1,2]	120	200	34	-
Dike Soil 3 [1,2]	119	0	35	-
Dike Soil 4 [1,2]	140	0	45	-
Coal Combustion Residuals (CCR) [3]	90	0	32	-
Saprolite [4]	115	0	35	$S_u = 500psf + 0.5\sigma'_v$
Partially Weathered Rock (PWR) [4]	125	0	40	-
Bedrock [5]	161	-	-	-

Notes:

1. Material and name correspond to the *Slope Stability Analyses of Ash Pond Dikes B, C, D-1, and E* calculation package (SCS, 2010)
2. Properties based on the *Slope Stability Analyses of Ash Pond Dikes B, C, D-1, and E* calculation package (SCS, 2010) and additional information obtained from various subsurface investigations at Plant Branch summarized in the *Summary of Geotechnical Design Parameters* calculation package (Geosyntec, 2023).
3. Properties selected based on tests performed on CCR impounded at Plant Branch (Golder, 2014) and Geosyntec's professional experience at Plant Branch and other CCR impoundments.
4. Properties were obtained from the *Summary of Geotechnical Design Parameters* calculation package (Geosyntec, 2023).
5. Bedrock was modeled as an "infinite strength material" to prevent potential slip surfaces from passing through this material.

pcf = pounds per cubic foot; psf = pounds per square foot; σ_v' = vertical effective stress.

Table 2. Summary of Selected Piezometric Elevations for Phreatic Surface

Piezometer	Location	Average High-Water Level Elevation (ft)
PZ-1	South AP-C Dam Crest	378.5
PZ-2		351.0 [1]
PZ-3	South AP-C Dam Downstream Slope	346.6 [1]

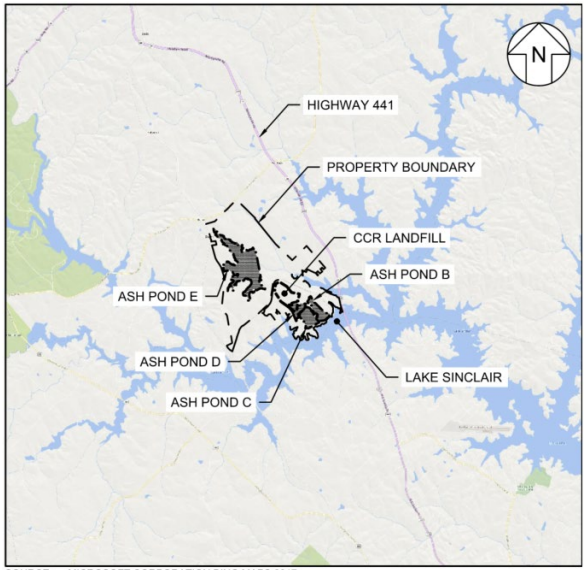
Note:

1. Value was used for all loading conditions in the slope stability analysis model.

Table 3. Results of Slope Stability Analyses

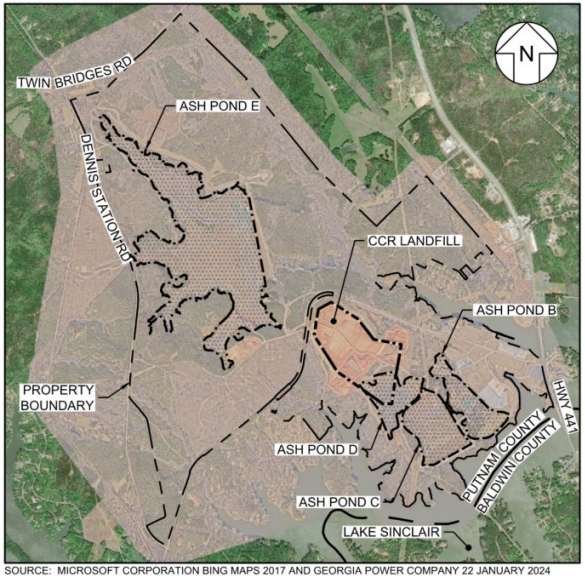
Loading Condition	Minimum Calculated Safety Factor	Minimum Required Safety Factor	Figure
Long-term, Maximum Storage Pool (Static)	2.20	1.50	9
Maximum Surcharge Pool (Static)	2.16	1.40	10
Seismic	1.93	1.00	11

FIGURES



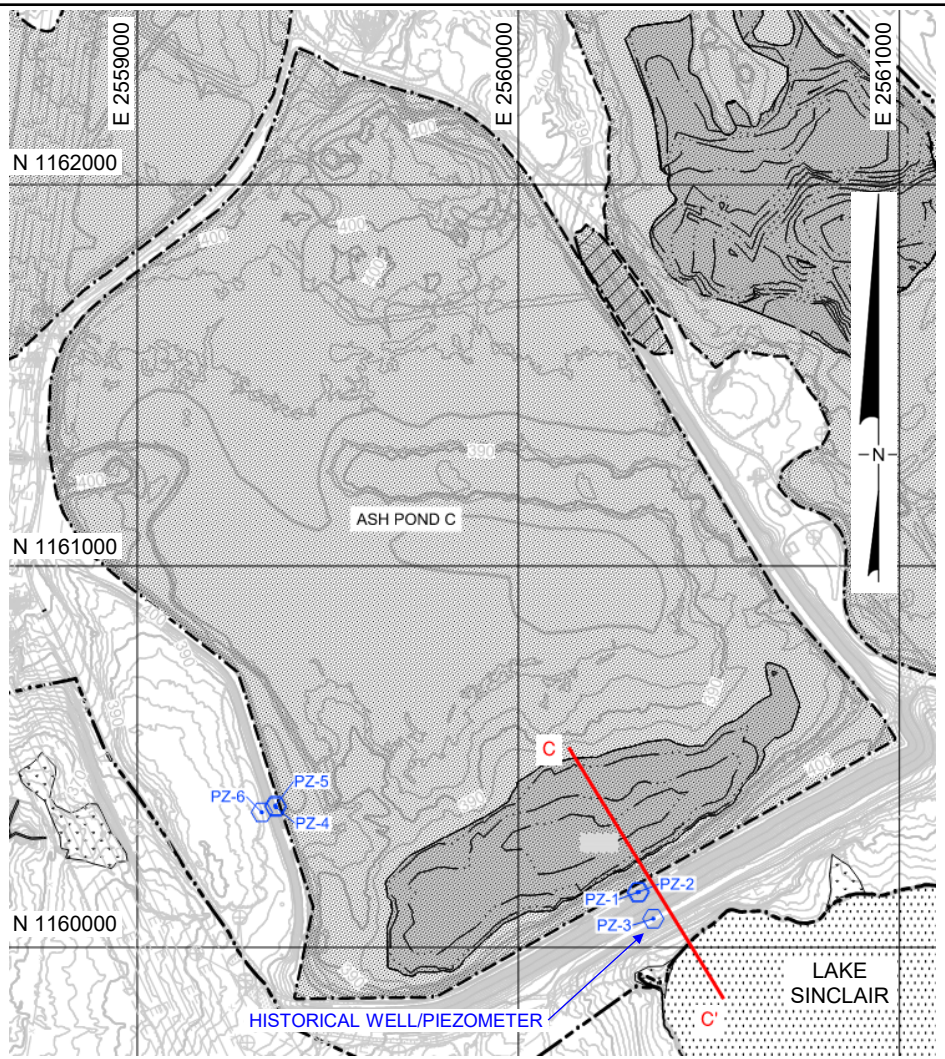
SOURCE: MICROSOFT CORPORATION BING MAPS 2017

Location map



SOURCE: MICROSOFT CORPORATION BING MAPS 2017 AND GEORGIA POWER COMPANY 22 JANUARY 2024

Vicinity map



Analyzed Cross Section

South AP-C Dam
Location of the Selected Cross Section
Initial Safety Factor Assessment
Georgia Power Plant Branch

Geosyntec consultants

Figure 1

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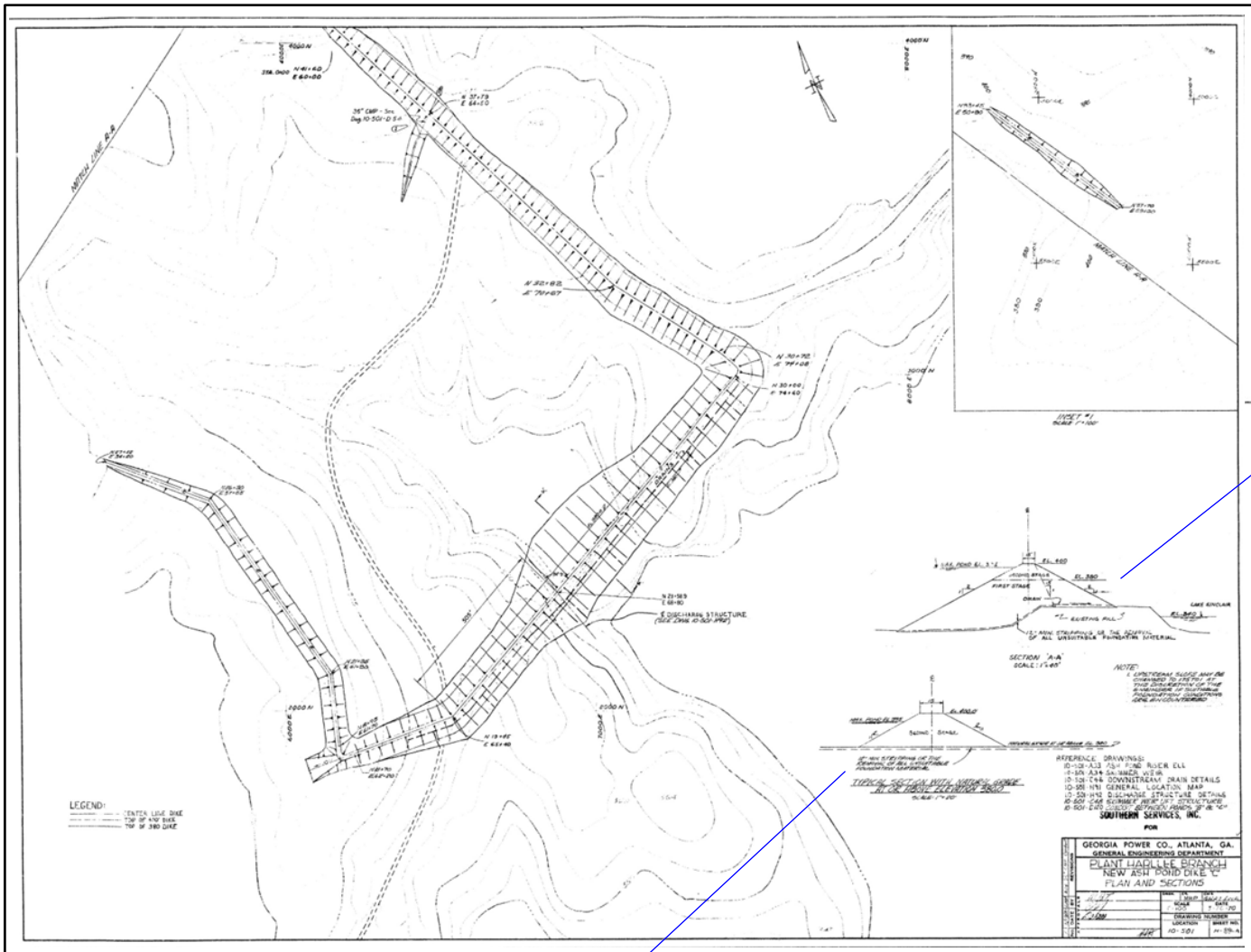
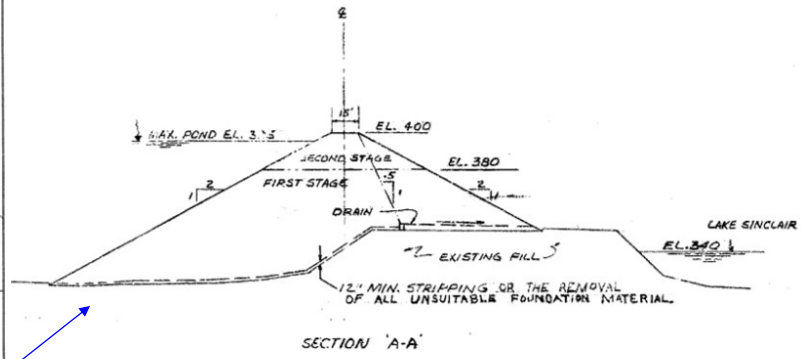
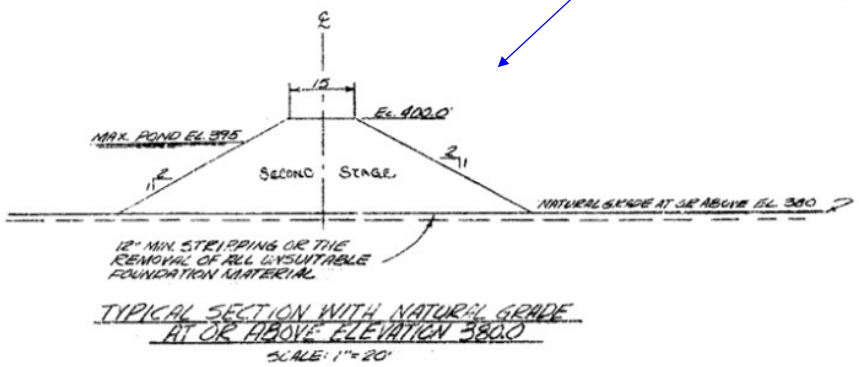






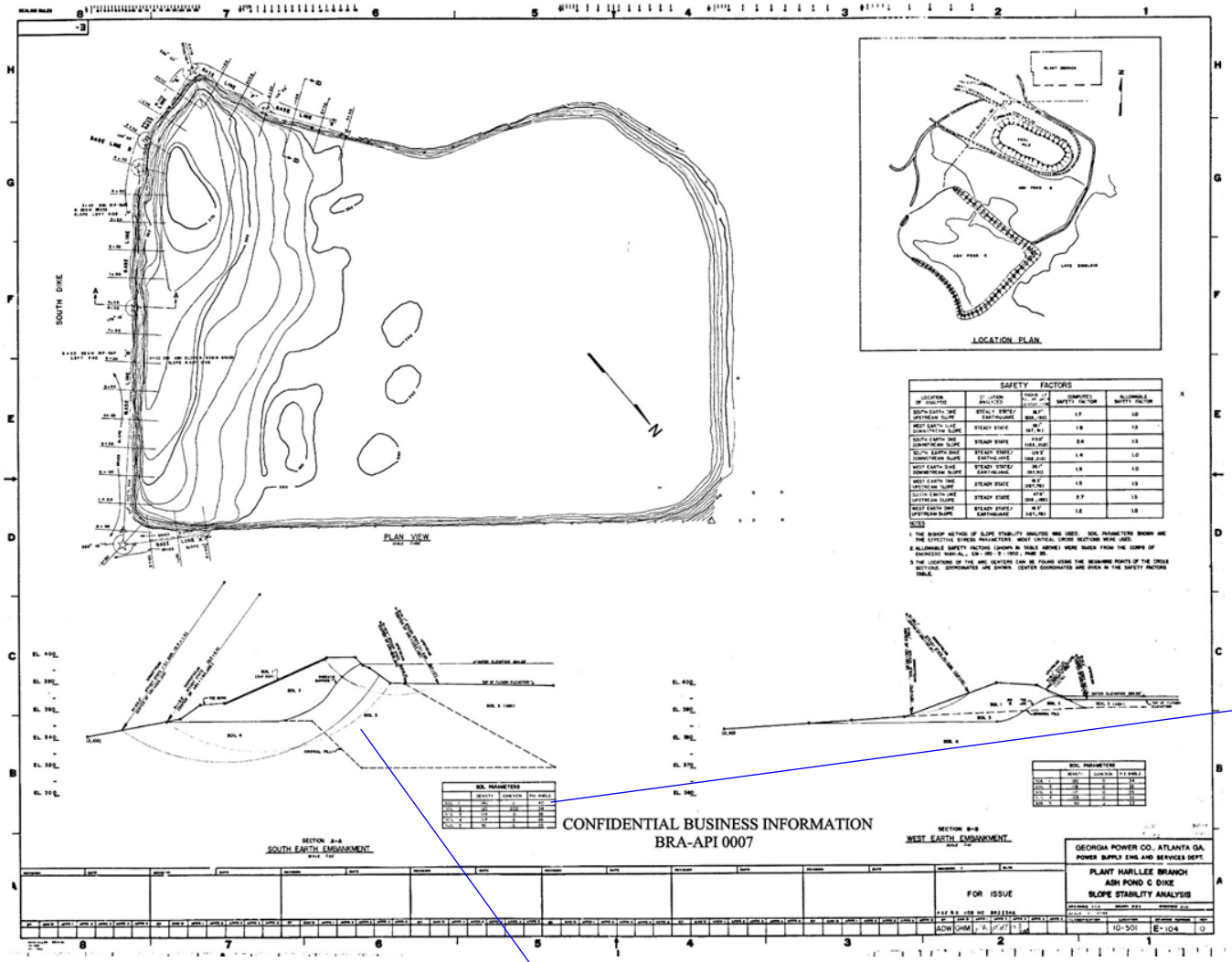
South AP-C Dam
Plan and Sections (Sheet H-89A, dated 3/16/1970)
Initial Safety Factor Assessment
Georgia Power Plant Branch

Geosyntec consultants

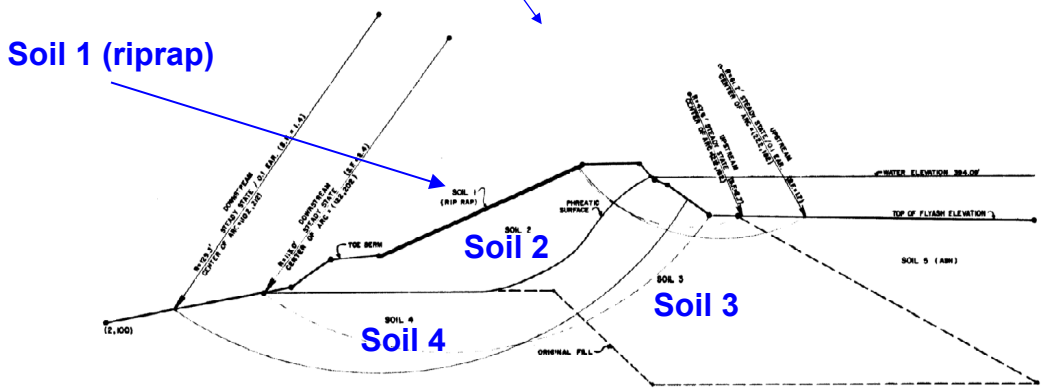
Figure 2

Project No.: GW11718

May 2026



SOIL PARAMETERS			
	DENSITY	COHESION	PHI ANGLE
SOIL 1	140	0	40
SOIL 2	120	200	34
SOIL 3	119	0	35
SOIL 4	117	0	35
SOIL 5	90	0	33



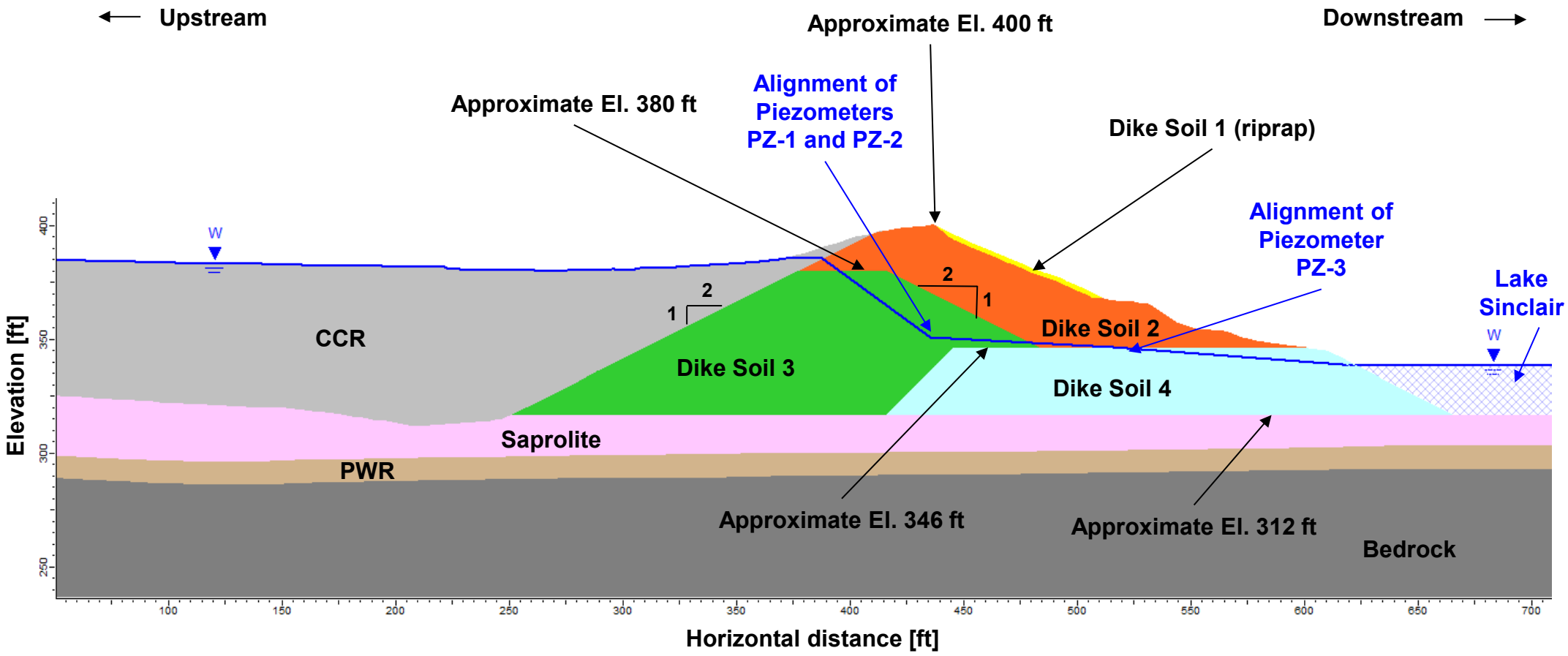
South AP-C Dam
Slope Stability Analysis (Sheet E-104, undated)
Initial Safety Factor Assessment
Georgia Power Plant Branch

Geosyntec consultants

Figure 3

Project No.: GW11718

May 2026



Notes:

1. The ground surface shown is obtained from a LiDAR survey conducted on January 22, 2024.
2. The AP-C dam geometry is derived from multiple sources, including historical drawings (GPC, 1970; GPC, undated), previous slope stability models (SCS, 2010), and Geosyntec's site investigation (2021).
3. Piezometer locations are shown as projected onto the analyzed cross section.

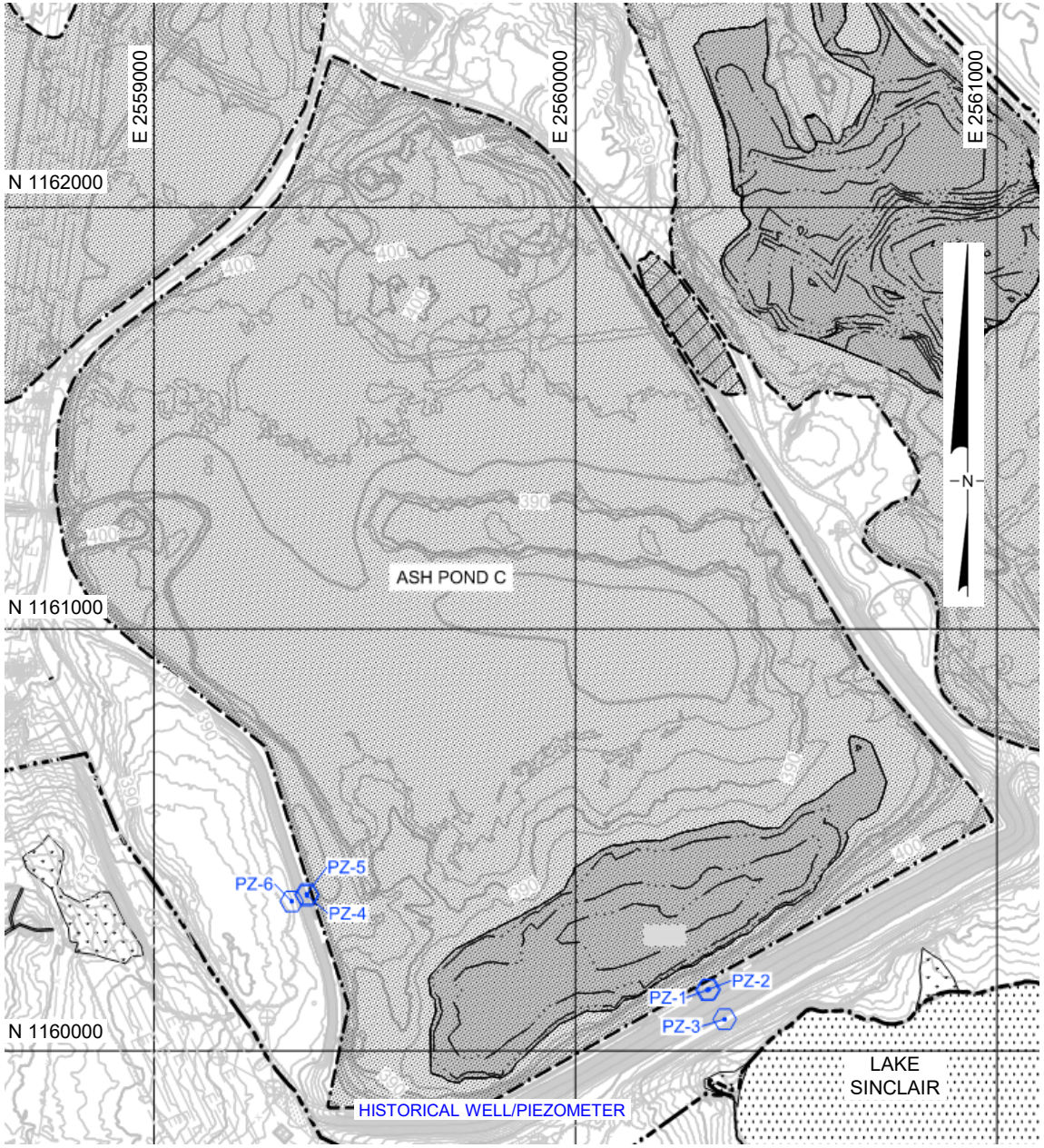
South AP-C Dam Subsurface Stratigraphy and Geometry along the Analyzed Cross Section
Initial Safety Factor Assessment
Georgia Power Plant Branch

Geosyntec consultants

Figure 4

Project No.: GW11718

May 2026



HISTORICAL WELL ID	NORTHING	EASTING
PZ-1	1160144.04	2560313.07
PZ-2	1160145.41	2560316.29
PZ-3	1160075.00	2560354.13
PZ-4	1160367.91	2559363.61
PZ-5	1160371.76	2559362.54
PZ-6	1160354.24	2559326.90

Note:

1. Piezometer location data was provided by SCS via email on March 27, 2025.

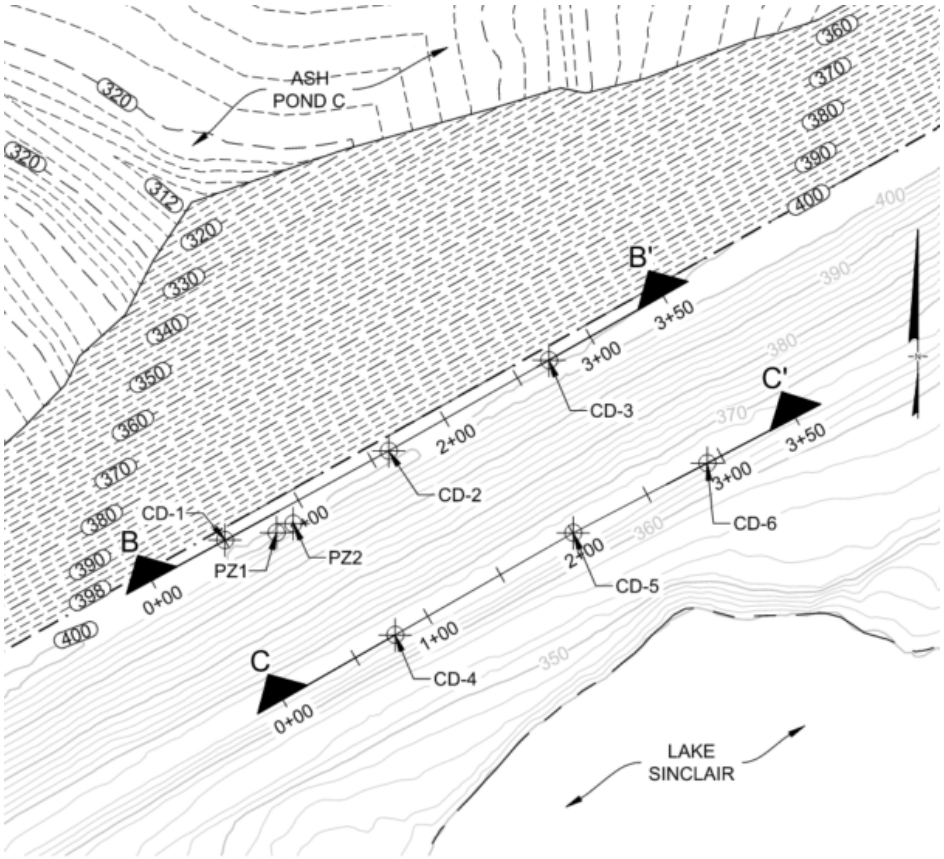
Piezometer Locations along AP-C Dams
Initial Safety Factor Assessment
Georgia Power Plant Branch

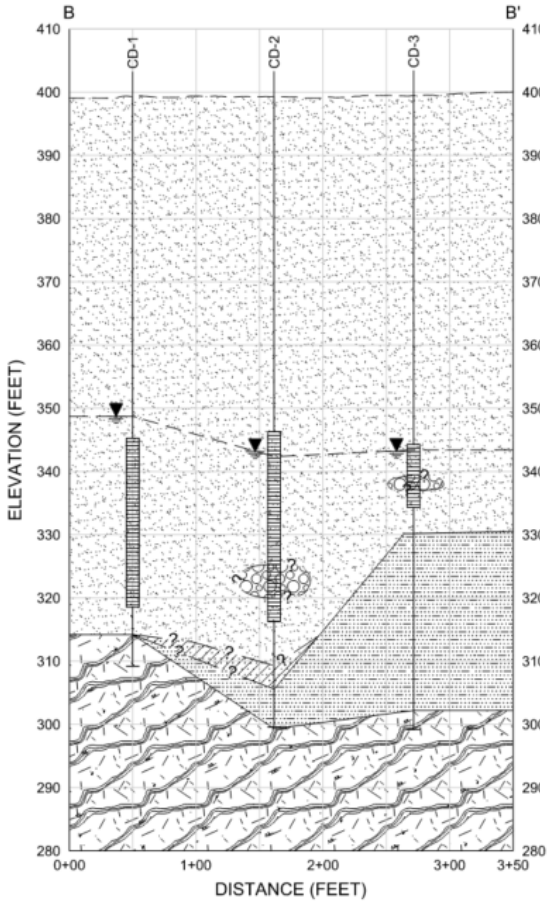
Geosyntec consultants

Figure 5

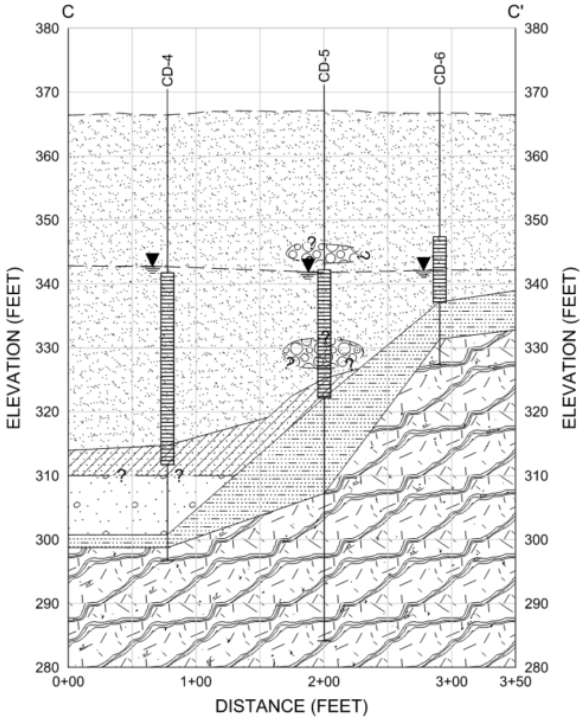
Project No.: GW11718

May 2026





B 2-3 SECTION ASH POND C



C 2-4 SECTION ASH POND C

Geosyntec Monitoring Well Locations along South AP-C Dam

Initial Safety Factor Assessment

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Geosyntec consultants

Figure 6

Project No.: GW11718

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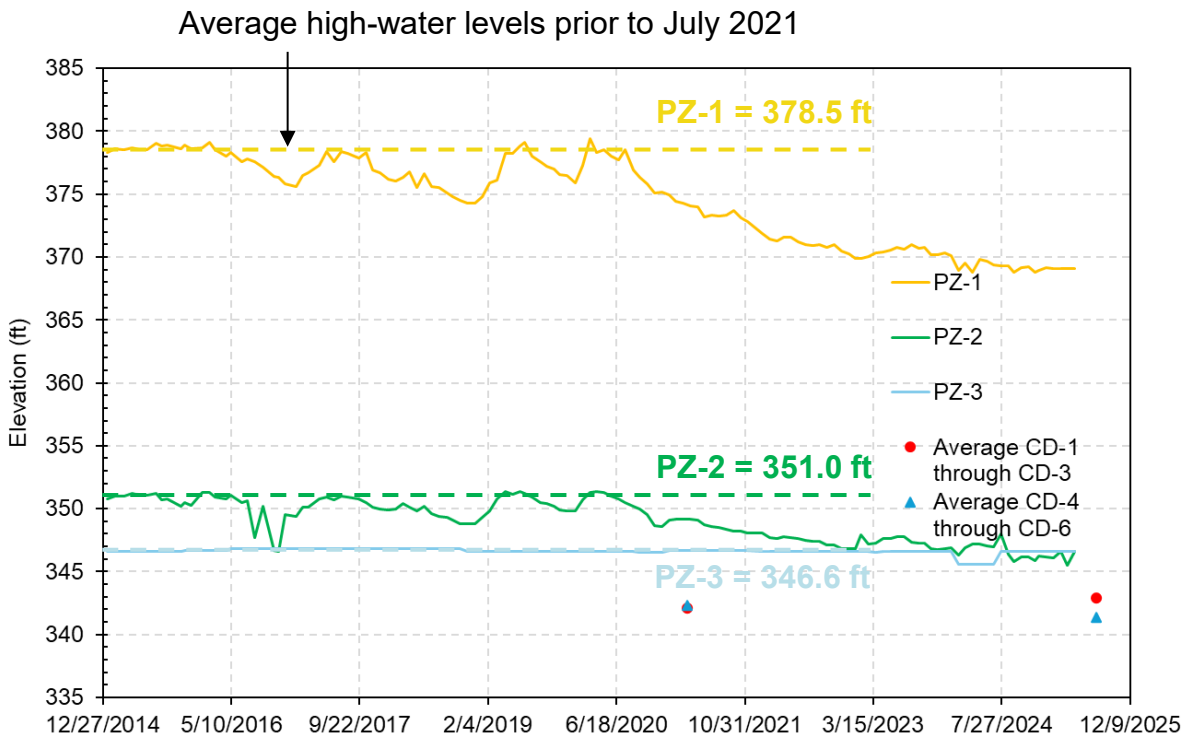
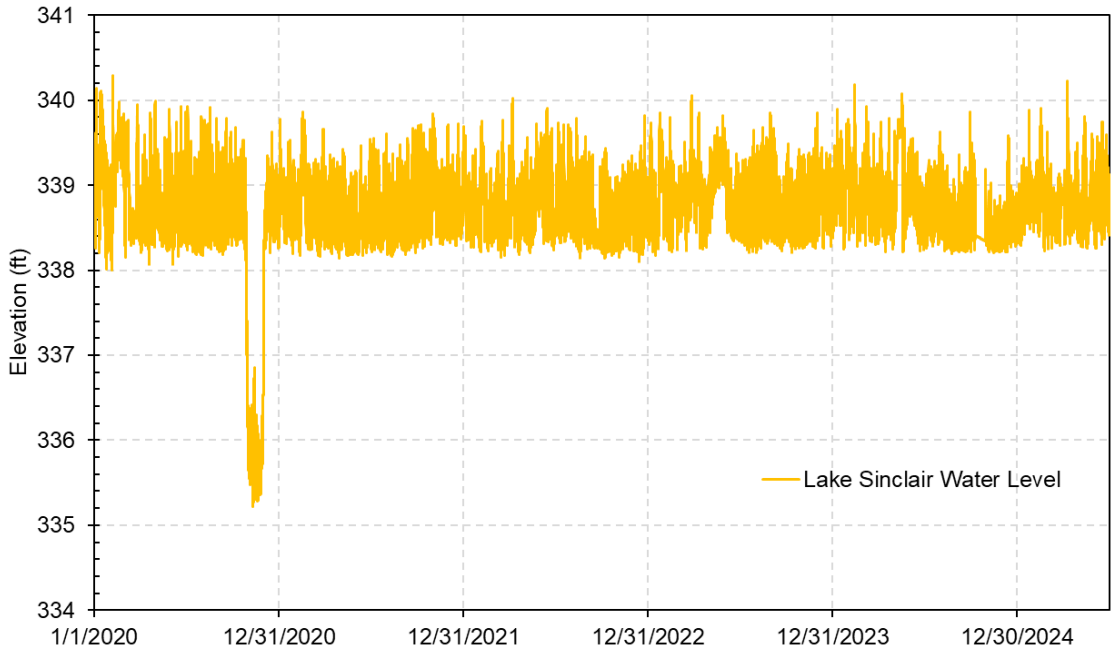




Note:

1. Colored dashed lines represent the average high-water levels prior to July 2021.

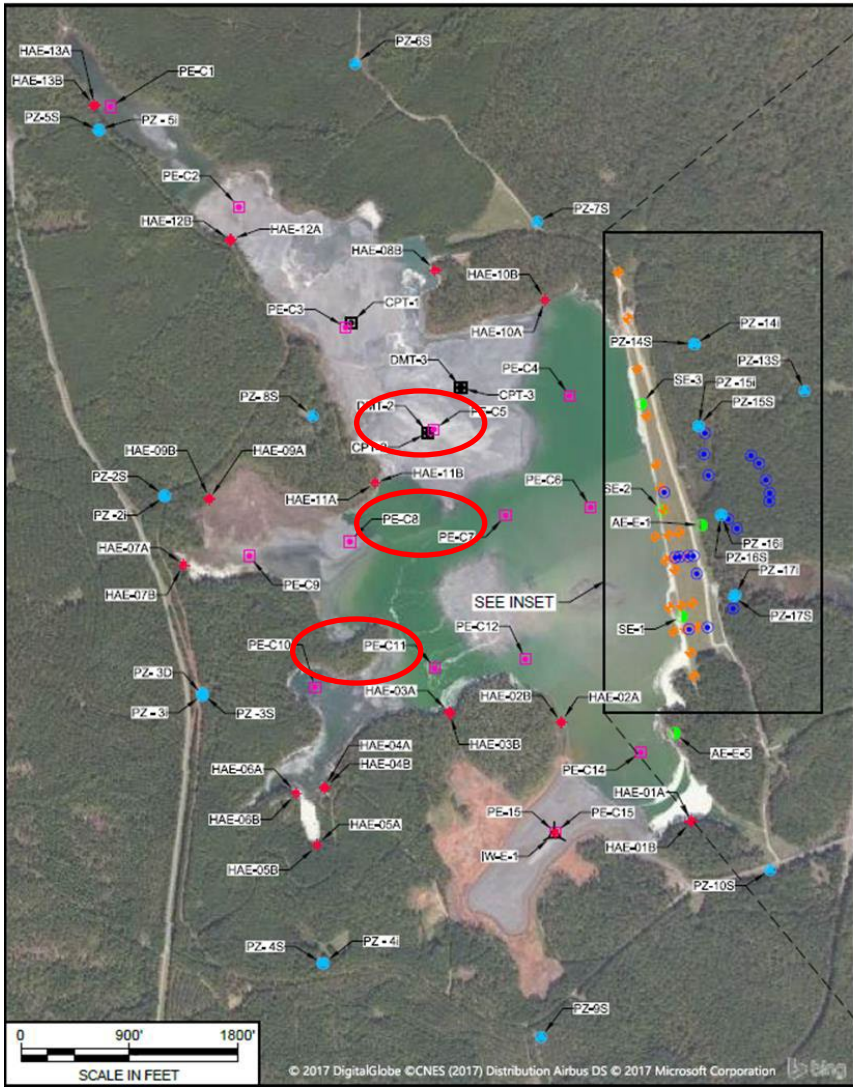
Historical Water Level Data
South AP-C Dam and Lake Sinclair
Initial Safety Factor Assessment
Georgia Power Plant Branch

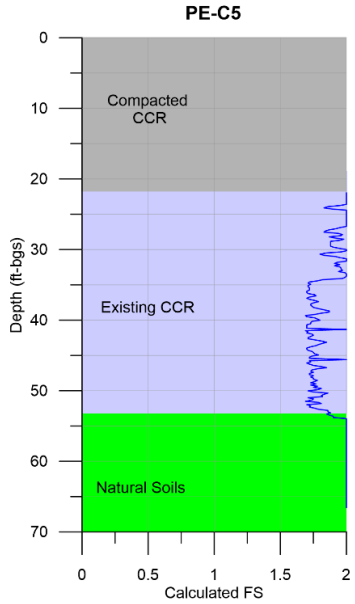
Geosyntec consultants

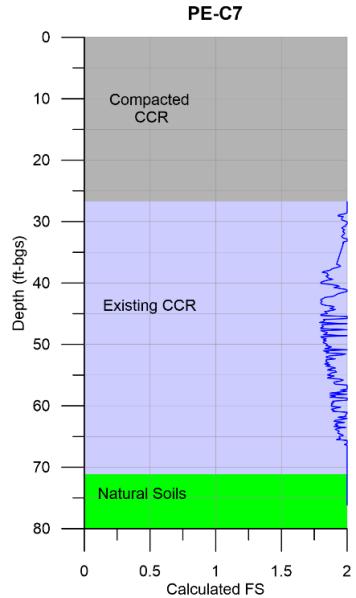
Figure 7

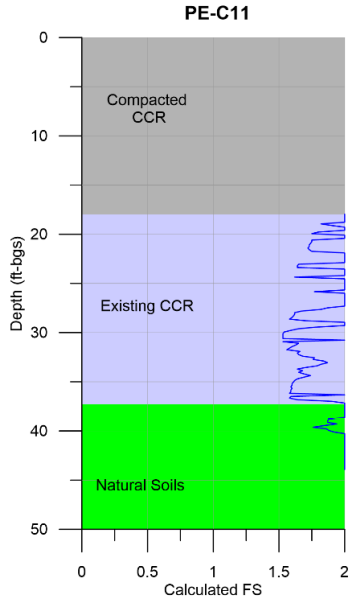
Project No.: GW11718

May 2026









Note:

1. Calculated safety factors (FS) for the natural soils (saprolite) are greater than 1.5

Calculated Safety Factors Against Liquefaction at the Highlighted CPT Locations

Initial Safety Factor Assessment

Georgia Power Plant Branch

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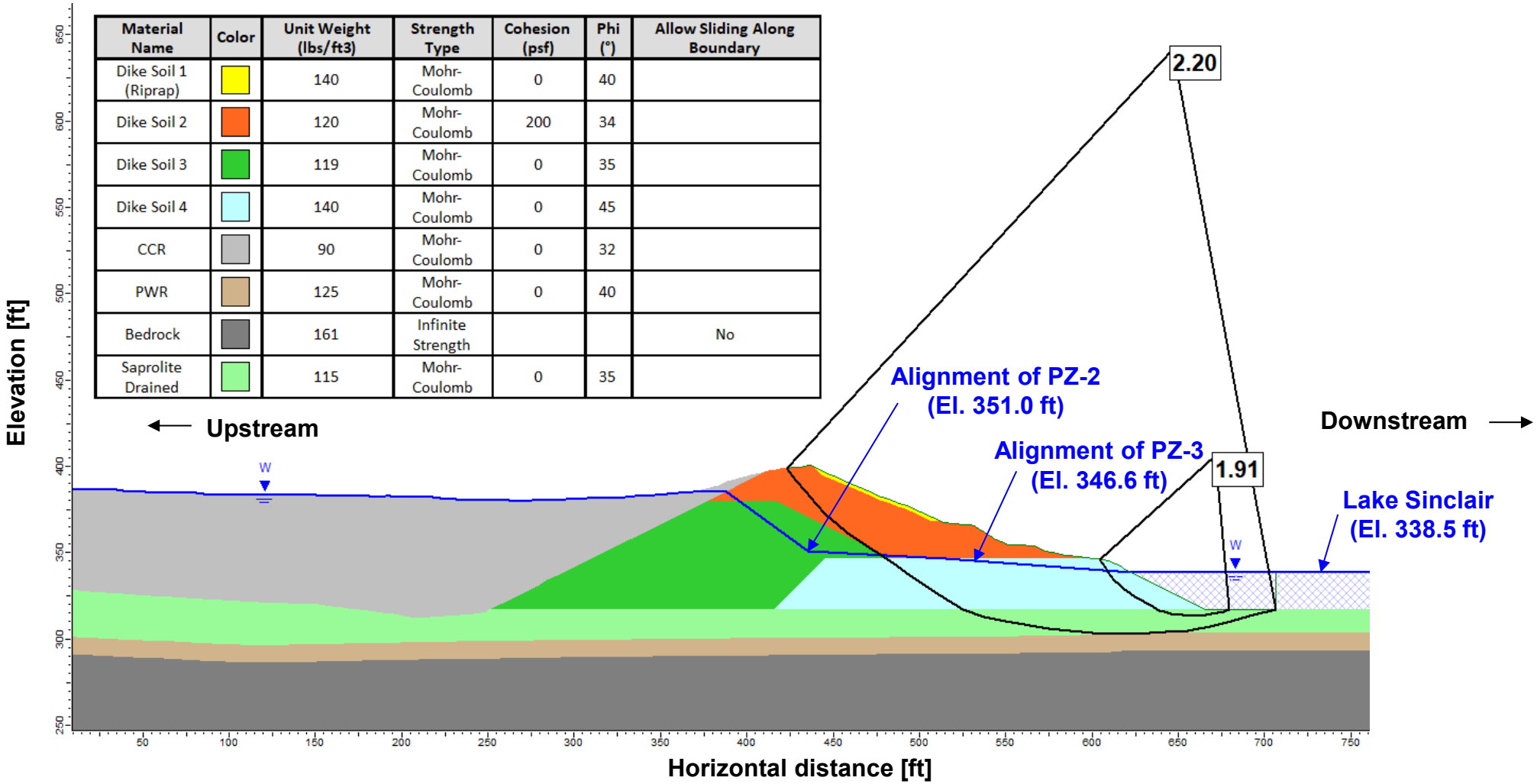
Figure 8

Project No.: GW11718

May 2026

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	Allow Sliding Along Boundary
Dike Soil 1 (Riprap)		140	Mohr-Coulomb	0	40	
Dike Soil 2		120	Mohr-Coulomb	200	34	
Dike Soil 3		119	Mohr-Coulomb	0	35	
Dike Soil 4		140	Mohr-Coulomb	0	45	
CCR		90	Mohr-Coulomb	0	32	
PWR		125	Mohr-Coulomb	0	40	
Bedrock		161	Infinite Strength			No
Saprolite Drained		115	Mohr-Coulomb	0	35	



South AP-C Dam
Critical Slip Surface and Calculated Safety Factors
Long-term Maximum Storage Pool Loading Condition
Initial Safety Factor Assessment
Georgia Power Plant Branch

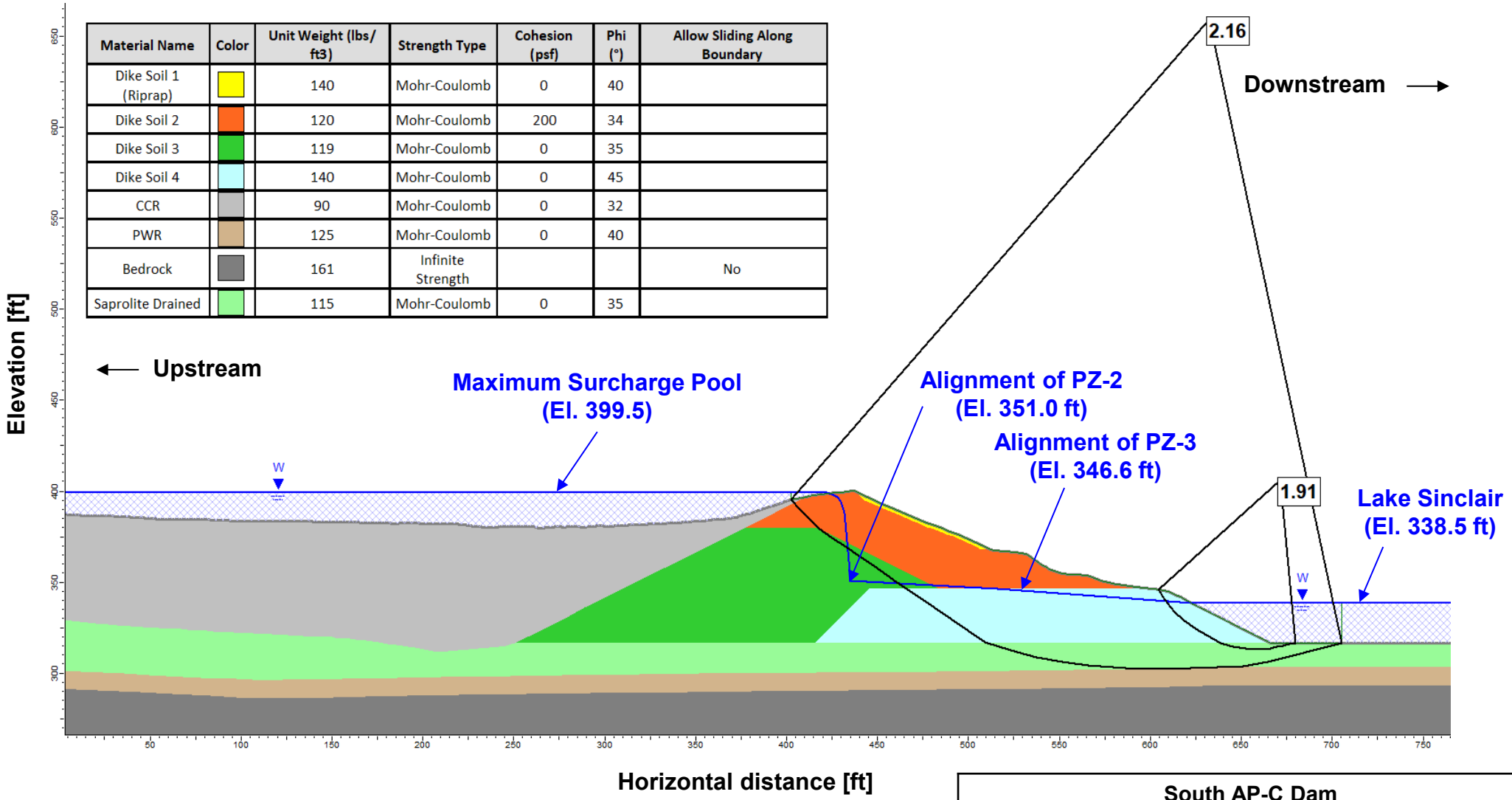
Geosyntec consultants

Figure 9

Project No.: GW11718

May 2026

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	Allow Sliding Along Boundary
Dike Soil 1 (Riprap)		140	Mohr-Coulomb	0	40	
Dike Soil 2		120	Mohr-Coulomb	200	34	
Dike Soil 3		119	Mohr-Coulomb	0	35	
Dike Soil 4		140	Mohr-Coulomb	0	45	
CCR		90	Mohr-Coulomb	0	32	
PWR		125	Mohr-Coulomb	0	40	
Bedrock		161	Infinite Strength			No
Saprolite Drained		115	Mohr-Coulomb	0	35	



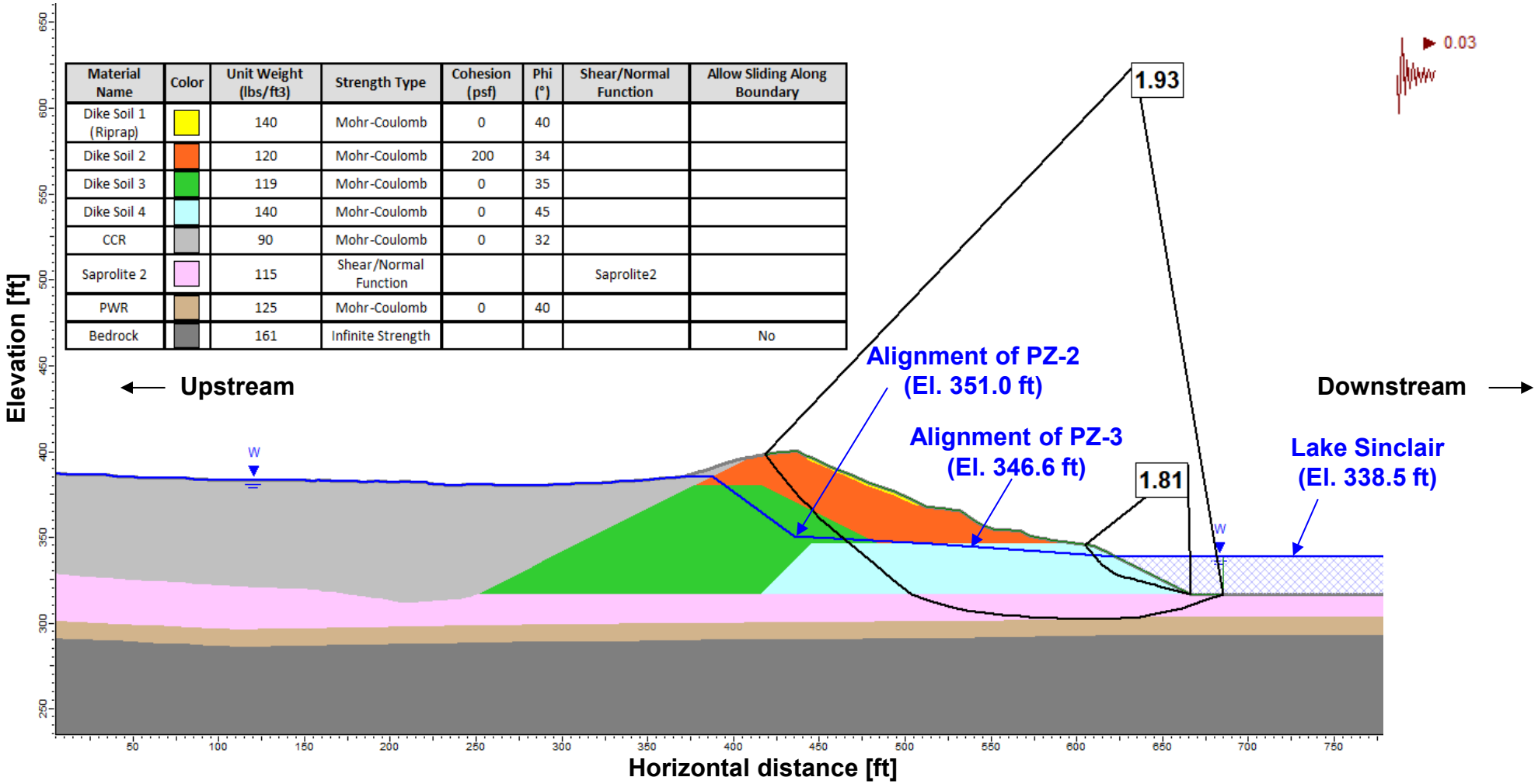
South AP-C Dam
Critical Slip Surface and Calculated Safety Factors
Maximum Surcharge Pool Loading Condition
Initial Safety Factor Assessment
Georgia Power Plant Branch

Geosyntec consultants

Figure 10

Project No.: GW11718 | May 2026

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	Shear/Normal Function	Allow Sliding Along Boundary
Dike Soil 1 (Riprap)		140	Mohr-Coulomb	0	40		
Dike Soil 2		120	Mohr-Coulomb	200	34		
Dike Soil 3		119	Mohr-Coulomb	0	35		
Dike Soil 4		140	Mohr-Coulomb	0	45		
CCR		90	Mohr-Coulomb	0	32		
Saprolite 2		115	Shear/Normal Function			Saprolite2	
PWR		125	Mohr-Coulomb	0	40		
Bedrock		161	Infinite Strength				No



Note:

1. The undrained shear strength function *Saprolite2* for the saprolite material was simulated in Slide2 as $S_u = 500psf + 0.5'\sigma_v$

South AP-C Dam
Critical Slip Surface and Calculated Safety Factors Seismic Loading Condition
Initial Safety Factor Assessment
Georgia Power Plant Branch

Geosyntec consultants

Figure 11

Project No.: GW11718 | May 2026

ATTACHMENT B
Ash Pond C Pseudostatic Coefficient Calculations

Geosyntec consultants

CALCULATION PACKAGE COVER SHEET

Client: Georgia Power **Project:** Design and Operating Criteria Assessments for Plant Branch Legacy CCR Units **Project #:** GW11718

TITLE OF PACKAGE: **ASH POND C PSEUDOSTATIC COEFFICIENT CALCULATIONS**

PREPARATION	**CALCULATION PREPARED BY:** (Calculation Preparer, CP)	Signature	Camilo Guerrero / Yi Zhong	05/06/2026
		Name	Camilo Guerrero, Ph.D. Yi Zhong, Ph.D.	Date
REVIEW	**ASSUMPTIONS & PROCEDURES CHECKED BY:** (Assumptions & Procedures Checker, APC)	Signature	Clinton Carlson	05/06/2026
		Name	Clinton Carlson, Ph.D.	Date
	COMPUTATIONS CHECKED BY: (Computation Checker, CC)	Signature	Clinton Carlson	05/06/2026
		Name	Clinton Carlson, Ph.D.	Date
BACK-CHECK	**BACK-CHECKED BY:** (Calculation Preparer, CP)	Signature	Camilo Guerrero	05/06/2026
		Name	Camilo Guerrero, Ph.D.	Date
APPROVAL	**APPROVED BY:** (Calculation Approver, CA)	Signature	GEORGIA REGISTERED No. PE040976 PROFESSIONAL ENGINEER GLENN JAY RIX	05/06/2026
		Name	Glenn J. Rix, Ph.D., P.E.	Date

REVISION HISTORY:

NO.	DESCRIPTION	DATE	CP	APC	CC	CA
0	Final Issue	05/06/2026	CG/YZ	CPC	CPC	GJR

ASH POND C PSEUDOSTATIC COEFFICIENT CALCULATIONS

PURPOSE

The purpose of the *Ash Pond C Pseudostatic Coefficient Calculations* package (Package) is to present the pseudostatic coefficient estimates required for the slope stability analysis of the Ash Pond C (AP-C) dam at Georgia Power Company's (Georgia Power) Plant Harllee Branch (Plant Branch) in Putnam County, Georgia under a seismic loading condition. The analyses were performed to support the *Initial Safety Factor Assessment* report for AP-C in compliance with the United States Environmental Protection Agency's (USEPA's) Coal Combustion Residuals (CCR) Rule contained in 40 C.F.R. §257 (USEPA, 2015).

The remainder of this Package is organized to present: (i) design criteria; (ii) methods for analysis; (iii) calculations; and (iv) conclusions.

DESIGN CRITERIA

Plant Branch is located within a seismic impact zone per the USEPA CCR Rule. The USEPA CCR Rule (40 CFR §257) (USEPA, 2015) defines a seismic impact zone as "an area having a 2 percent or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10g in 50 years." Under §257.73(e)(1), owners or operators are required to conduct initial and periodic safety factor assessments for each CCR unit. The seismic factor of safety calculated in slope stability analyses must equal or exceed 1.00.

The preamble to the USEPA CCR Rule (USEPA, 2015) states that the seismic design of existing CCR impoundments should be based on a "withstand without discharge" standard which they describe as requiring (Federal Register, Vol. 80, No. 74, p. 21366) "any new CCR unit located in a seismic impact zone to be designed to withstand seismic motion from a credible earthquake without damage to the foundation or to the structures that control leachate, surface drainage, or erosion." In other words, "the CCR unit must be able to withstand an expected earthquake without discharging waste or contaminants." The calculations presented in this Package address the "withstand without discharge" criterion by limiting permanent displacements of the AP-C dike to tolerable displacements for solid-waste containment facilities (**Table 1**; Kavazanjian, 1999), as referenced in the preamble of the USEPA CCR Rule (USEPA, 2015). A permanent displacement of 0.5 feet (ft), or 15 centimeters (cm), was

considered tolerable for the calculations presented in this Package. The selected tolerable displacement is less than typical allowable displacements for embankments (1 to 3 ft) as shown in **Table 1**. The more stringent requirement for tolerable displacement was selected to account for the uncertainty in the properties of the Ash Pond C dike materials.

METHODS FOR ANALYSIS

Seismic Hazard

The seismic hazard at the AP-C dam was defined by ground motions with 2 percent probability of exceedance in 50 years (i.e., return period of approximately 2,500 years), as represented by the uniform hazard spectrum (UHS). The United States Geological Survey (USGS) Hazard Toolbox (2025) based on the 2023 National Seismic Hazard Maps for the Conterminous United States was used to obtain the UHS at the base of the critical slip surface observed in the results of the slope stability analysis for the static, long-term maximum storage pool loading condition presented in the *Ash Pond C Slope Stability Analysis* calculation package included as Attachment A to this *Initial Safety Factor Assessment* report. The USGS Hazard Toolbox is able to estimate the UHS for a site-specific shear-wave velocity. The site-specific shear-wave velocity ($V_{S,100}$) for the south AP-C dam was estimated by calculating a travel-time-weighted average of the shear-wave velocity profile for a depth of 100 ft below the base of the critical slip surface using the equation below.

$$V_{S,100} = \frac{100ft}{\sum_i \frac{H_i}{V_{S,i}}} \tag{1}$$

where:

H_i = thickness of subsurface layer, *i* (ft); and

$V_{S,i}$ = shear-wave velocity of subsurface layer, *i* (feet per second [ft/sec]).

Because no shear-wave velocity measurements are available for the AP-C dam, values for the AP-C dam and subsurface materials were selected based on observed data from materials with similar descriptions. The shear-wave velocity for the saprolite foundation was chosen as 850 ft/sec based on shear-wave velocity measurements from seismic cone penetration tests (SCPT) performed at Plant Branch (Geosyntec, 2023). **Figure 1** shows the location of the SCPT

soundings performed and the measured shear-wave velocities within the saprolite. The materials composing the AP-C dam were characterized as having an average shear-wave velocity of 650 ft/sec based on shear-wave velocity measurements of compacted earth embankments at other sites. Similarly, the shear-wave velocity for the partially weathered rock (PWR) was estimated to be 1,750 ft/sec based on observed measurements at other Georgia Power sites. A shear-wave velocity of 2,300 ft/sec was used for the bedrock layer based on the lower bound value in the model presented by Frankel et al. (1996).

The USGS Hazard Toolbox was also used to obtain a design earthquake moment magnitude (M_w) from a site-specific hazard disaggregation. The disaggregation was performed on approximately the degraded spectral period for the sliding mass of the critical slip surface (discussed in the next section) for a 2% probability of exceedance in 50 years. The design earthquake was selected as the mean earthquake event estimated by the disaggregation.

Pseudostatic Coefficient

The approach suggested by Bray and Macedo (2019) was used to estimate the pseudostatic coefficient (k) for a tolerable displacement of 0.5 ft (i.e., 15 cm) through the following equations:

$$k = \exp\left[\frac{-a + \sqrt{b}}{0.49}\right] \tag{2}$$

$$a = 2.491 - 0.344 \ln\left(S_a(1.3T_s)\right) \tag{3}$$

For $T_s \geq 0.10\ s$:

$$\begin{aligned} b = \ a^2 - 0.98 \Big\{ & \ln(D_a) + 5.894 - 2.703 \ln\left(S_a(1.3T_s)\right) + 0.089\left[\ln\left(S_a(1.3T_s)\right)\right]^2 \\ & - 3.152T_s + 0.910{T_s}^2 - 0.6070M_w - \epsilon \Big\} \end{aligned} \tag{4}$$

For $T_s < 0.10\ s$:

$$\begin{aligned} b = \ a^2 - 0.98 \Big\{ & \ln(D_a) + 4.551 - 2.703 \ln\left(S_a(1.3T_s)\right) + 0.089\left[\ln\left(S_a(1.3T_s)\right)\right]^2 \\ & + 9.688T_s - 0.6070M_w - \epsilon \Big\} \end{aligned} \tag{5}$$

where:

T_s = initial fundamental spectral period of the sliding mass (seconds [sec]);

$S_a(1.3T_s)$ = spectral acceleration for 5 percent damping, at a degraded spectral period (i.e., $1.3T_s$) (units of gravitational acceleration constant [g]);

D_a = tolerable displacement = 15 cm;

M_w = moment magnitude of design earthquake; and

ϵ = normally distributed random variable with a mean of zero and standard deviation of 0.74.

The initial fundamental spectral period of the sliding mass for the critical slip surface was calculated using the following equation:

$$T_s = C\frac{H}{V_s} \tag{6}$$

where:

C = a coefficient of 4 for circular-type critical slip surfaces;

H = height of sliding mass for observed critical slip surface (ft); and

V_s = travel-time-weighted average shear-wave velocity for the height of the sliding mass (ft/sec).

The travel-time-weighted average shear-wave velocity for the sliding mass was calculated using Equation 1 with the height of the sliding mass replacing the 100 ft in Equation 1.

The spectral acceleration and the moment magnitude were obtained from the site-specific UHS and disaggregation, respectively, detailed in Section 3.1. The pseudostatic coefficient

was conservatively estimated as the plus one standard deviation value (i.e., ϵ = 0.74) to account for the uncertainty in the shear-wave velocities of the AP-C dam and subsurface materials.

CALCULATIONS

Critical Slip Surface and Sliding Mass

The critical slip surface and sliding mass observed for the south AP-C dam under the static, long-term maximum storage pool loading condition is presented in **Figure 2**. The depth of the critical slip surface and the thicknesses of the layers below the base of the critical slip surface are also shown on **Figure 2**. Based on the observed critical slip surface and selected shear-wave velocities for the AP-C dam, the estimated site-specific shear-wave velocity (Equation 1) is 2,230 ft/sec and the estimated fundamental spectral period of the sliding mass (Equation 6) is approximately 0.58 sec. The degraded spectral period of the sliding mass ($1.3T_s$) is approximately 0.76 sec.

Seismic Hazard

The seismic hazard for the AP-C dam was obtained at site coordinates of 33.196°N, - 83.315°W. These coordinates approximately correspond to a location at Plant Branch that is between Ash Ponds B, C, D, and E. The seismic hazard at the top of rock is not expected to vary significantly across Plant Branch.

The site-specific UHS for a shear-wave velocity of 2,230 ft/sec at the base of the critical slip surface and a hazard of 2% probability of exceedance in 50 years is shown in **Figure 3**. The spectral acceleration along the base of the critical slip surface at the degraded spectral period for the sliding mass is approximately 0.12g.

The resulting site-specific disaggregation on a spectral period of 0.75 sec (approximately equal to the degraded period 0.76 sec for the sliding mass) for a hazard of 2% probability of exceedance in 50 years and the summary are presented in **Figure 4**. The mean moment magnitude is 7.1.

Pseudostatic Coefficient

The fundamental spectral period for the sliding mass (0.58 sec), spectral acceleration at the

degraded spectral period for the sliding mass (0.12g), and the moment magnitude for the design earthquake event (7.1) were input to Equations 2 through 5 to estimate the pseudostatic coefficient. The estimated pseudostatic coefficient is approximately 0.03. This pseudostatic coefficient was applied in the slope stability analysis of the south AP-C dam to represent the seismic loading condition.

CONCLUSIONS

The pseudostatic coefficient for the APC dam was estimated using site-specific estimations for the seismic hazard and the Bray and Macedo (2019) method. For the critical slip surface observed in the slope stability analysis under the static, long-term maximum storage pool loading condition and a tolerable displacement of 0.5 ft, the estimated pseudostatic coefficient is **0.03**. This pseudostatic coefficient is used in the *Ash Pond C Slope Stability Analysis* calculation package included as Attachment A to this *Initial Safety Factor Assessment* report, to represent the seismic loading condition in the slope stability analysis of the south AP-C dam.

REFERENCES

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, 145(12), 04019106.

Frankel, A., Mueller, C., Barnhard, T., Perkins, D., Leyendecker, E.V., Dickman, N., Hanson, S., and Hopper, M. (1996). "National Seismic Hazard Maps, June 1996, Documentation," United States Geological Survey Open-File Report 96-532, Reston, VA, 100 p.

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Kavazanjian, E. (1999). "Seismic Design of Solid Waste Containment Facilities," Proceedings of the 8th Canadian Conference on Earthquake Engineering, Vancouver, BC, June, pp. 51-89.

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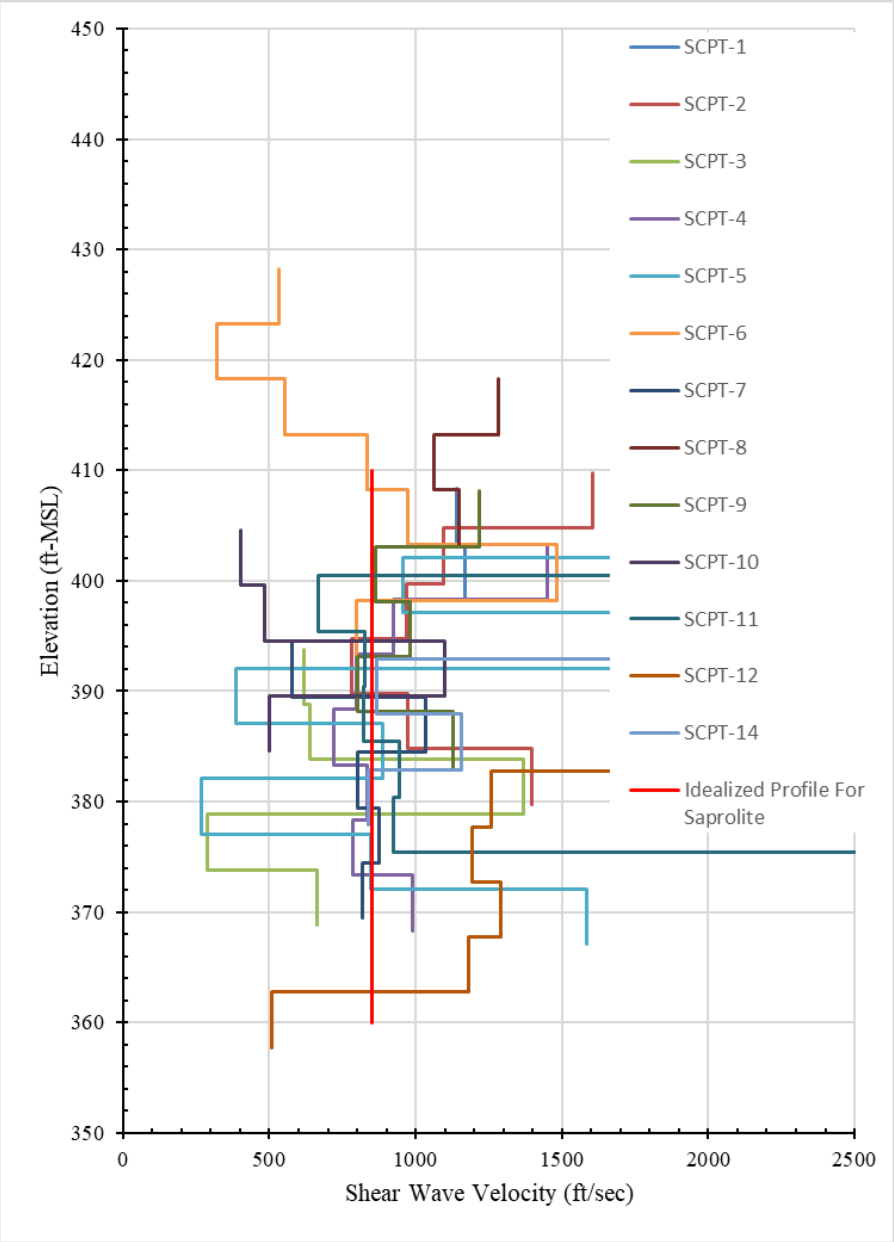
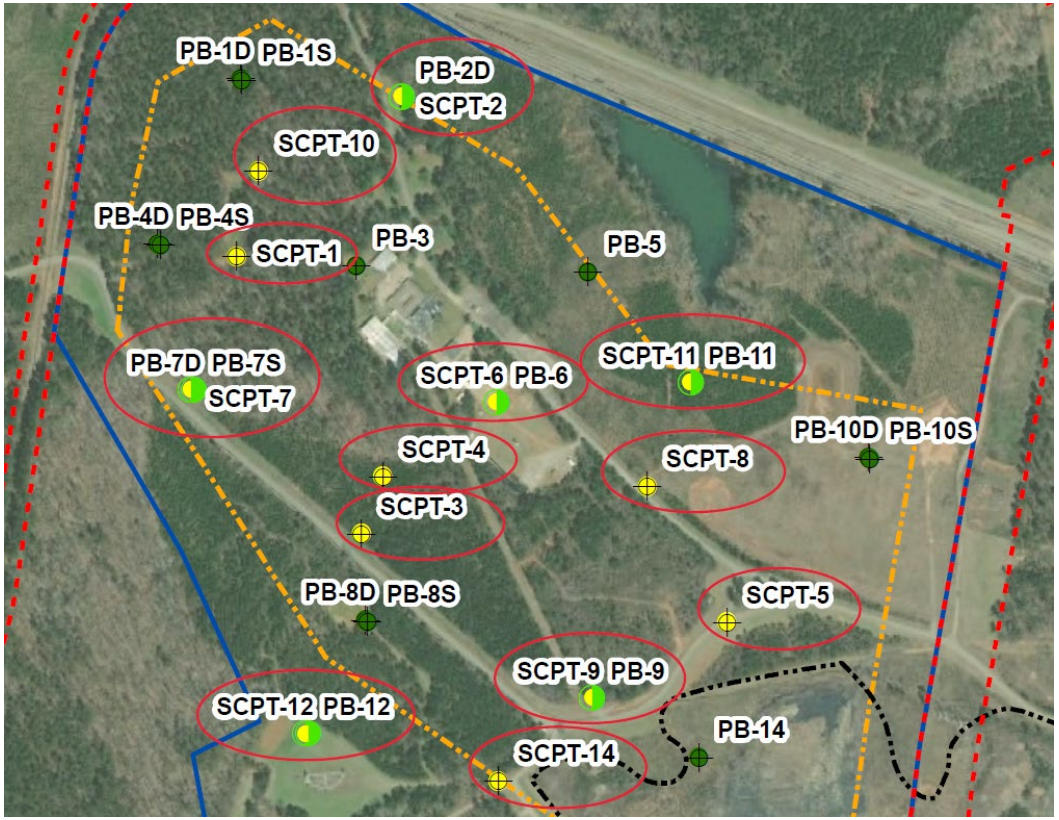
TABLE

Table 1. Typical Tolerable Seismic Displacements for Solid Waste Containment Facilities (Kavazanjian, 1999)

Component	Allowable Calculated Displacement	Comment
Liner System	150 to 300 mm	Actual expected deformation is very small.
Cover System	300 mm to 1 m	Damage is repairable.
Waste Mass	1 m	For displacement not impacting cover or liner.
Roadways, Embankments	1 m	Conventional geotechnical criteria.
Surface Water Controls	1 m	Conventional geotechnical criteria.
Gas Collection System	No Limit	Breakage common under normal operating conditions.

FIGURES





Notes:

1. Idealized profile for saprolite indicates shear-wave velocity selected for saprolite (850 ft/sec).
2. Comprehensive information on the seismic cone penetration tests (SCPT) is provided in Geosyntec (2023).

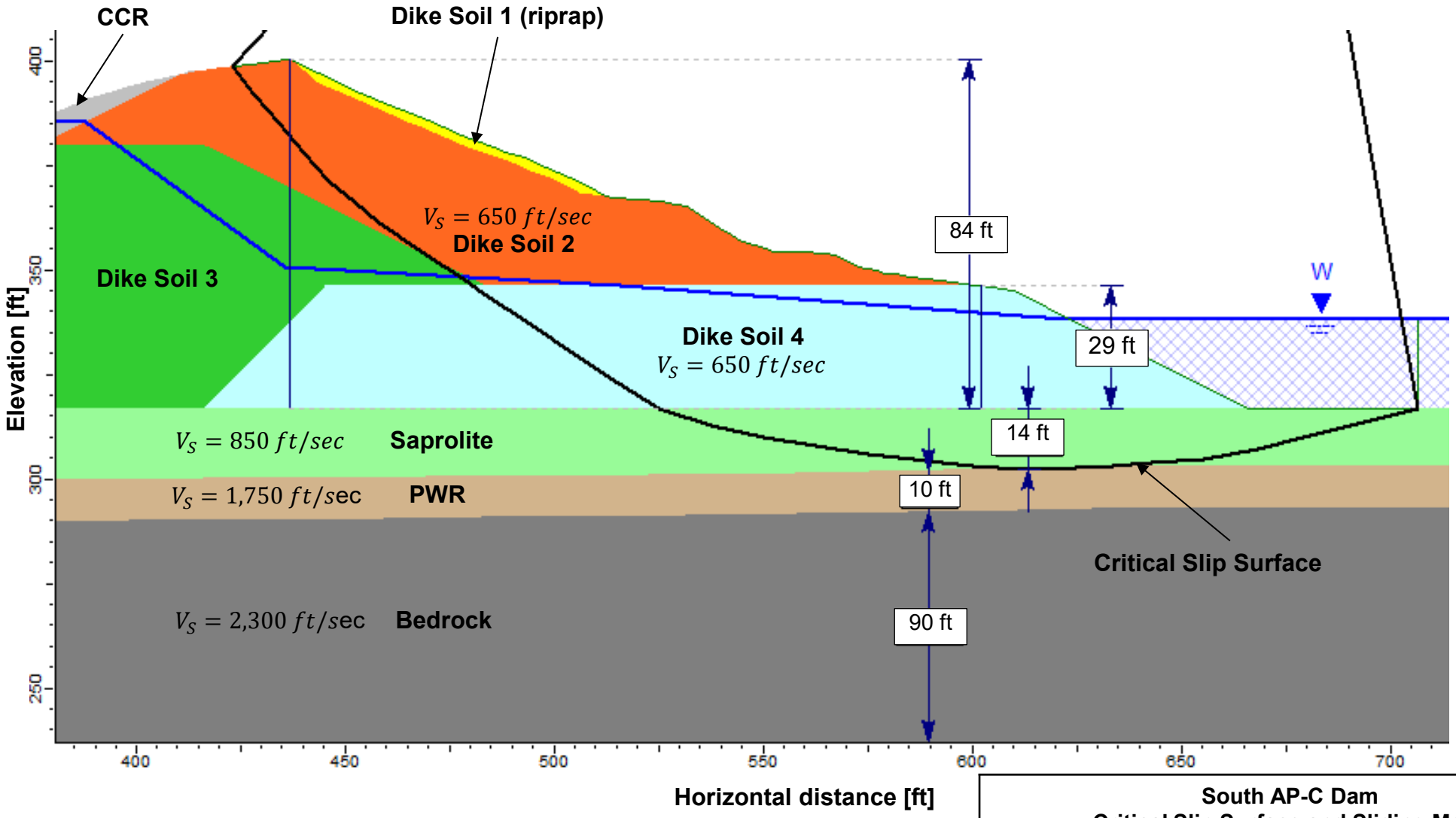
Locations of Seismic Cone Penetration Test (SCPT) Soundings and Measured Shear-Wave Velocities
Initial Safety Factor Assessment
Georgia Power Plant Branch

Geosyntec consultants

Figure 1

Project No.: GW11718

May 2026



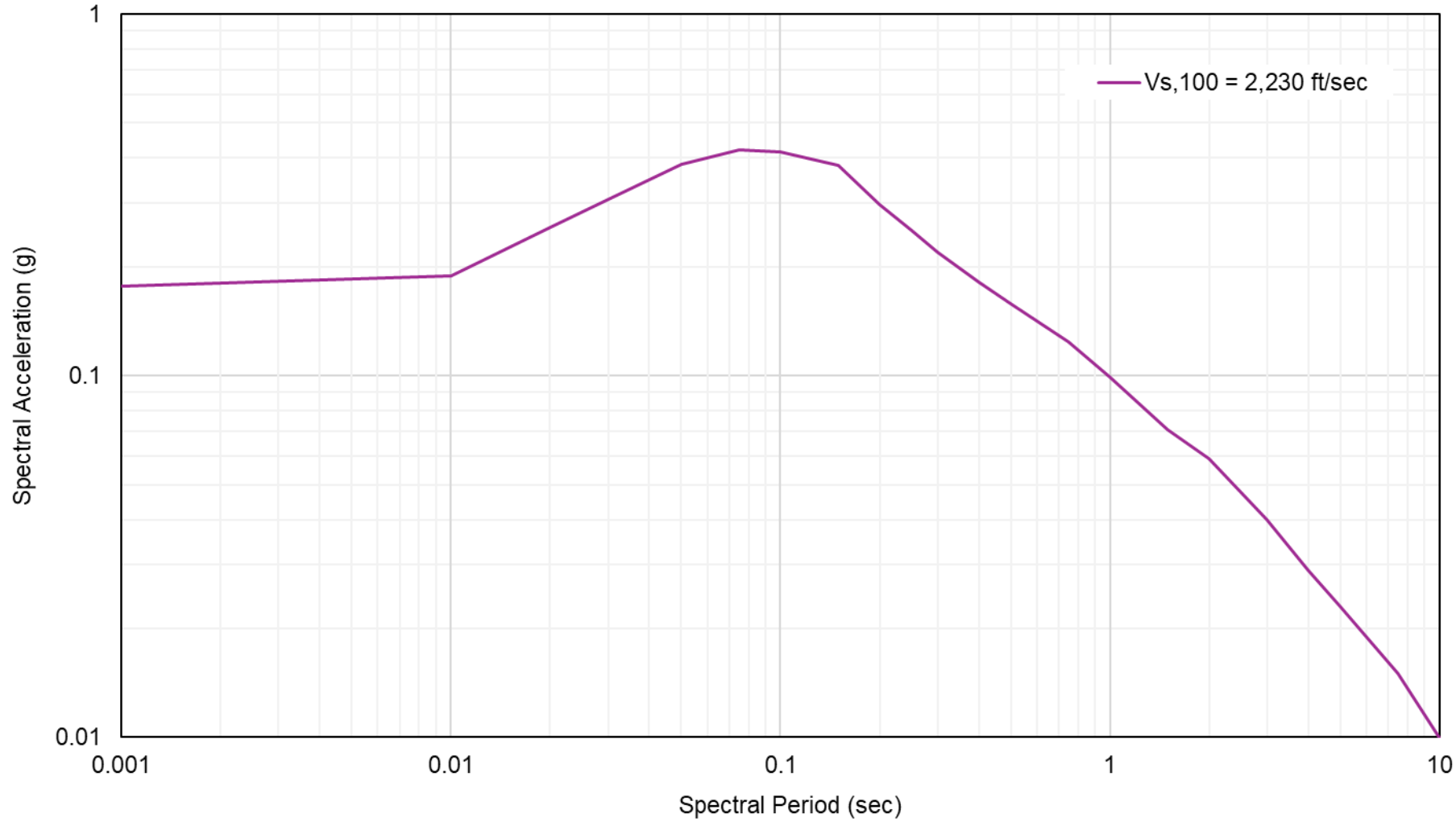
South AP-C Dam
Critical Slip Surface and Sliding Mass
Long-term Maximum Storage Pool Loading Condition
Initial Safety Factor Assessment
Georgia Power Plant Branch

Geosyntec consultants

Figure 2

Project No.: GW11718

May 2026



AP-C Site-Specific Uniform Hazard Spectrum at the Base of the Critical Slip Surface (5 percent Damping)
Initial Safety Factor Assessment
Georgia Power Plant Branch

Geosyntec consultants

Figure 3

Project No.: GW11718

May 2026

Model *
NSHM Conterminous U.S. 2023

Latitude (°) *
33.19627
[24.4, 50]

Longitude (°) *
-83.3148
[-125, -65]

Select Site

Vs30 (m/s) *
680

Presets

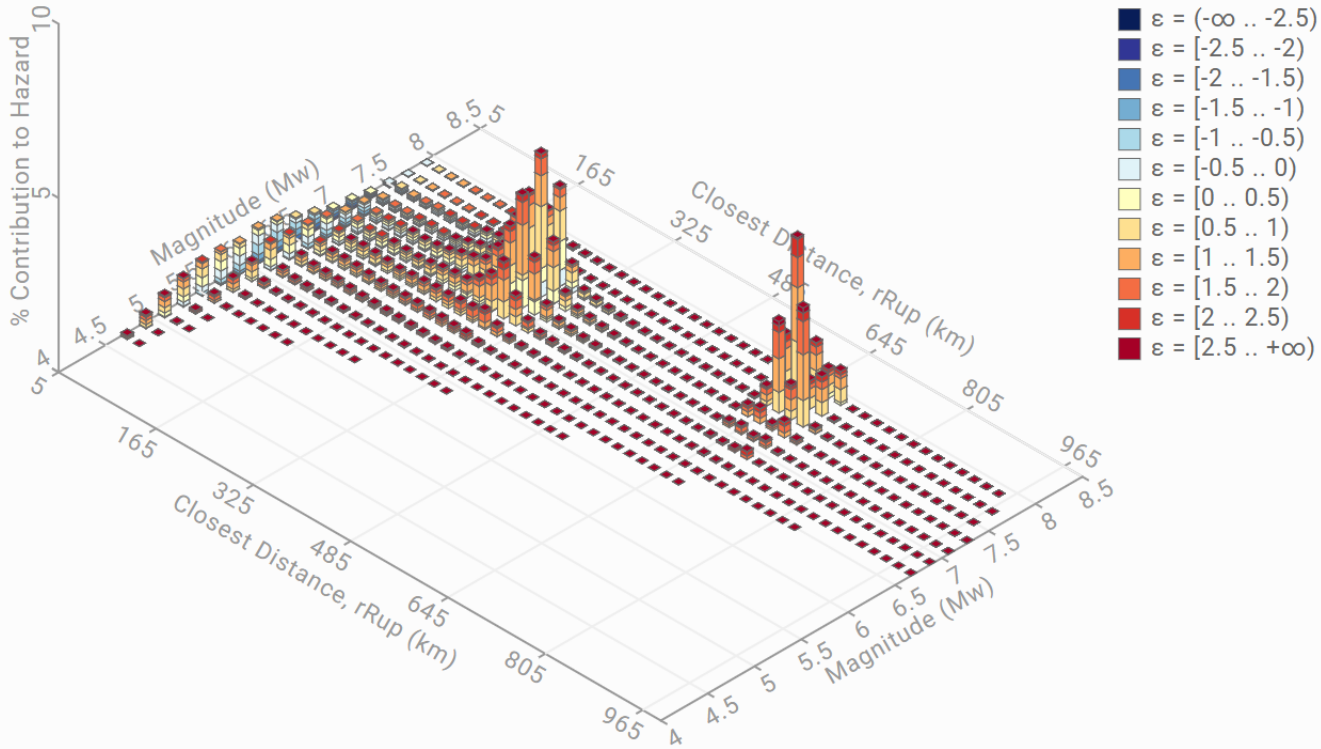
Intensity Measure Type *
0.75 s

Return Period (yr) *
2475

Presets
2475 (2% in 50)

Intensity Measure Level (

Max Direction



Disaggregation targets	Recovered targets	Totals	Mean (over all sources)
Return period : 2475 yrs	**Return period** : 2454.6883 yrs	**Binned** : 100 %	**m** : 7.07
Exceedance rate : 4.040e-4 yr⁻¹	**Exceedance rate** : 4.074e-4 yr⁻¹	**Residual** : 0 %	**r** : 307.15 km
0.75 s SA ground motion : 1.242e-1 g		**Trace** : 3.61 %	**ε_0** : 0.91 σ

Mode (largest m-r bin)	Mode (largest m-r-ε_0 bin)	Discretization	Epsilon keys
m : 7.75	**m** : 7.3	**r** : min = 0.0, max = 1000.0, Δ = 20.0 km	**ε0** : [-∞ .. -2.5)
r : 657.9 km	**r** : 289.49 km	**m** : min = 4.4, max = 9.4, Δ = 0.2	**ε1** : [-2.5 .. -2.0)
ε_0 : 1.27 σ	**ε_0** : 0.78 σ	**ε** : min = -3.0, max = 3.0, Δ = 0.5 σ	**ε2** : [-2.0 .. -1.5)
Contribution : 4.71 %	**Contribution** : 1.78 %		**ε3** : [-1.5 .. -1.0)
			ε4 : [-1.0 .. -0.5)
			ε5 : [-0.5 .. 0.0)
			ε6 : [0.0 .. 0.5)
			ε7 : [0.5 .. 1.0)
			ε8 : [1.0 .. 1.5)
			ε9 : [1.5 .. 2.0)
			ε10 : [2.0 .. 2.5)
			ε11 : [2.5 .. +∞]

Note:

1. Data obtained from the United States Geological Survey (USGS) Hazard Toolbox (2025).

AP-C Site-specific Disaggregation on a Period of 0.75 sec for 2% Probability of Exceedance in 50 Years
Initial Safety Factor Assessment
Georgia Power Plant Branch

Geosyntec consultants

Figure 4

Project No.: GW11718

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