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 E (AP-E)
GEORGIA POWER COMPANY

A rule amendment to the Federal CCR Rule became effective on November 8, 2024. *See* 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 E (AP-E) at Georgia Power Company's (Georgia Power) Plant Harllee Branch (Plant Branch) property is located near Beaverdam Creek, off State Route 24 (US 441) near Milledgeville and Eatonton in Putnam County, Georgia. AP-E encompasses approximately 348 acres and is impounded by a dam on the east side and by natural ground on the remaining sides. Construction of the earthen dam was completed in 1982 with CCR placement commencing in 1983. The dam consists of three distinct zones perpendicular to its axis: an upstream zone, a central core, and a downstream zone, with finer graded material used in the central core and coarser graded material in the outer zones. The central core was compacted with side slopes of 1 horizontal to 1 vertical (1H:1V) on both upstream and downstream faces. The upstream and downstream zones were compacted with outer side slopes of approximately 2.5H:1V and 3H:1V, respectively. From Station 20+70 to Station 30+50, a layer of soft foundation material (i.e., blow counts less than 8) was excavated prior to constructing the AP-E dam. The AP-E dam impounds CCR and water and is regulated as a Category I Dam under the Georgia Environmental Protection Agency Safe Dams Program. Ponded water is concentrated in sections of low areas and is seasonally varying in elevation. AP-E is currently not receiving any CCR.

The original slope stability analysis of the AP-E dam was performed by Southern Company Services (SCS) in 1980 as part of the original design and included sections at Station 20+00 and Station 25+00. Additional slope stability analyses were conducted by SCS in 2010 using cross sections at the same stations for the maximum storage pool, maximum surcharge pool, and seismic loading conditions. Two sections were assessed in these analyses to evaluate the different geometries of the AP-E dam foundation for the maximum height of the dam within each area (i.e., with and without excavation of soft foundation materials). The two cross sections preliminarily evaluated for this initial safety factor assessment of the AP-E dam are at approximately the same locations (i.e., Station 20+00 and Station 25+00). The cross section similar in geometry to the Station 25+00 section was identified as more critical because it has the greatest height for the dam (approximately 67 feet). The analyzed cross section is also approximately located through a line of piezometers to model the measured phreatic surface within the dam. Slope stability analyses were performed for 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)	2.25	1.50
Maximum Surcharge Pool (Static)	2.09	1.40
Seismic	1.86	1.00

The dam soils consist of compacted saprolite, which also forms the foundation soil, and is 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.
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ATTACHMENT A
Ash Pond E 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 E SLOPE STABILITY ANALYSIS**

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REVISION HISTORY:

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

CP:	CG	Date:	05/06/26	APC:	MGB	Date:	05/06/26	CC:	CPC	Date:	05/06/26

Client:	Georgia Power	Project:	Design and Operating Criteria Assessments for Plant Branch Legacy CCR Units	Project No:	GW11718

ASH POND E SLOPE STABILITY ANALYSIS

INTRODUCTION AND PURPOSE

The purpose of this *Ash Pond E Slope Stability Analysis* calculation package (Package) is to present the methods and results of slope stability analyses for the Ash Pond E [AP-E] 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-E 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-E 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 AP-E dam was constructed with three distinct zones perpendicular to its axis, as indicated in historical design drawings (Georgia Power, 1982): an upstream zone, a central core, and a downstream zone. The upstream zone was designed to consist of soils classified under the Unified Soil Classification System (USCS) as low-plasticity silt (ML), low-plasticity clay (CL), and/or clayey sand (SC), as described in the *Slope Stability Analyses of Ash Pond Dikes B, C, D-1, and E* calculation package (Southern Company Services [SCS], 2010) which refers to this material as Soil 1. The central core, referred to as Soil 2 by SCS (2010), was designed with soils classified as elastic silt (MH) and/or high-plasticity clay (CH). The downstream zone, referred to as Soil 3 by SCS (2010), was designed with soils classified as silty sand (SM). There is also a blanket drain consisting of sandy material beneath the downstream toe of the central core. The subsurface stratigraphy beneath the AP-E 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-E dam materials (Soils 1, 2, and 3 and blanket drain) 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-E 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 original slope stability analysis of the AP-E dam was performed by SCS in 1980 as part of the original design and included sections at Station 20+00 and Station 25+00. Additional slope stability analyses were conducted by SCS in 2010 using cross sections at the same stations for the maximum storage pool, maximum surcharge pool, and seismic loading conditions. Two sections were assessed in these analyses to evaluate the different geometries of the AP-E dam foundation for the maximum height of the dam within each area (i.e., with and without excavation of soft foundation materials). The two cross sections preliminarily evaluated for this initial safety factor assessment of the AP-E dam are at approximately the same locations (i.e., Station 20+00 and Station 25+00). The cross section similar in geometry to the Station 25+00 section was identified as more critical because it has the greatest height for the dam (approximately 67 feet). The analyzed cross section is also approximately located through a line of piezometers to model the measured phreatic surface within the dam. Slope stability analyses were performed for the critical section under long-term, maximum storage pool, maximum surcharge pool, and seismic loading conditions. The location of the selected cross section is presented in **Figure 1**.

The ground surface for the top of CCR, the crest, and the downstream face of the AP-E dam are based on a recent LiDAR survey conducted on January 22, 2024 (and provided by SCS on March 5, 2024). The approximate crest elevation (El.) is approximately 431.4 ft and the downstream face has a slope of approximately 3.0 horizontal to 1.0 vertical (3H:1V), which is the same as the 3H:1V slope shown in the design drawing (**Figure 2**; Georgia Power, 1982a). The upstream slope of 2.5H:1V was derived from historical design drawings (Georgia Power, 1982a). The dam core was compacted using Soil 2 with side slopes of 1H:1V on both upstream and downstream faces (Georgia Power, 1982a). According to Georgia Power (1982a) and SCS (2010), a 3-ft-thick blanket drain was constructed within the dam embankment to control seepage and limit pore-pressure development. Historical drawings show that the blanket drain extends 45 ft along the dam cross section (Georgia Power, 1982a).

Based on the historical design drawings (Georgia Power, 1982b) and previous reports (SCS, 2010), the selected cross section lies between Stations 20+70 and 25+00, so an upstream foundation slope of 2H:1V was applied to account for excavation of soft foundation materials, following historical drawings (Georgia Power, 1980), down to the base of the dam at El. 365 ft, consistent with the historical drawing in **Figure 3** (Georgia Power, 1981). The total dam height at the selected location is approximately 67 ft. 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 AP-E dam model used in the slope stability analysis is presented in **Figure 4**.

Water Elevations

There are 19 piezometers that monitor water levels within the AP-E dam and downstream toe as shown in **Figure 5**. Four piezometers, PZ-2 through PZ-5, are approximately located along the selected cross section (**Figure 5**). Given the proximity of PZ-5 and PZ-8 when projected onto the cross section (i.e., less than 0.5 ft), the measured water levels at PZ-5 were selected for analysis due to the historically higher water level readings. The phreatic surfaces used for the slope stability analyses were derived from the historical water level data collected between August 2013 and May 2025 and provided by SCS on June 19, 2025, as shown in **Figure 6**.

Average high-water levels for piezometers PZ-2 through PZ-5 were selected to represent maximum storage pool and maximum surcharge pool elevations within the AP-E dam, as summarized in **Table 2**. For the long-term, maximum storage pool loading condition, the water level within the AP-E impoundment was conservatively modeled at approximate El. 426.4 ft, which is representative of the existing CCR surface elevation near the AP-E dam. For the maximum surcharge pool loading condition, the water level within the AP-E impoundment was conservatively modeled at El. 431.4 ft which is approximately the crest elevation of the AP-E dam.

The water level at locations downstream of the AP-E dam toe was modeled near the ground surface. These locations are sufficiently far away from the toe of the AP-E dam that the water level is not expected to influence the results of the slope stability analyses.

Pseudostatic Coefficient

As detailed in the *Ash Pond E Pseudostatic Coefficient* calculation package included as Attachment B with this *Initial Safety Factor Assessment* report, the pseudostatic coefficient for the AP-E 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 AP-E dam is 0.04.

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 the blanket drain and PWR for all the loading conditions because these materials are granular and considered to be freely drained. CCR was modeled as a drained material under all loading conditions, consistent with Geosyntec's professional experience and established practices for other CCR impoundments. 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 conditions, which is expected to be rapid and generate excess porewater pressures within the fine-grained saprolite. Dam Soils 1, 2, and 3 were modeled with drained shear strength properties for the static loading conditions. The dam soils are compacted saprolite and may experience an increase in porewater pressure under the seismic loading condition. Therefore, both drained and undrained shear strength properties were used for Dam Soils 1, 2, and 3 for the seismic loading condition to identify the lowest calculated safety factor. The drained shear strength properties for Dam Soils 1, 2, and 3, resulted in the lower calculated safety factor for the seismic loading condition.

The water levels within the AP-E 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 AP-E 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. 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 AP-E dam is constructed of compacted saprolite and founded on native saprolite and thus, the dam and the foundation are not susceptible to liquefaction. Further supporting this point, safety factors against triggering 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 7**.

RESULTS

The results of the slope stability analyses for the AP-E dam are summarized in **Table 3**. **Figures 8** through **10** present the critical slip surfaces (i.e., lowest calculated safety factors) for each loading condition.

Based on the results of the slope stability analyses, the AP-E 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-E 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-E 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-E 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		
		Effective Cohesion [psf]	Effective Friction Angle [degrees]	Undrained Shear Strength, S_u [psf]	Total Cohesion [psf]	Total Friction Angle [degrees]
Soil 1 (Dam) [1,2]	109	0	36	-	800	14
Soil 2 (Dam) [1,2]	95	400	30	-	1000	13
Soil 3 (Dam) [1,2]	85	800	24	-	1700	8
Blanket Drain [2]	135	0	25	-	-	-
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 prepared by 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

CP:	CG	Date:	05/06/26	APC:	MGB	Date:	05/06/26	CC:	CPC	Date:	05/06/26

Client:	Georgia Power	Project:	Design and Operating Criteria Assessments for Plant Branch Legacy CCR Units	Project No:	GW11718

Table 2. Summary of Selected Piezometric Elevations for Phreatic Surface

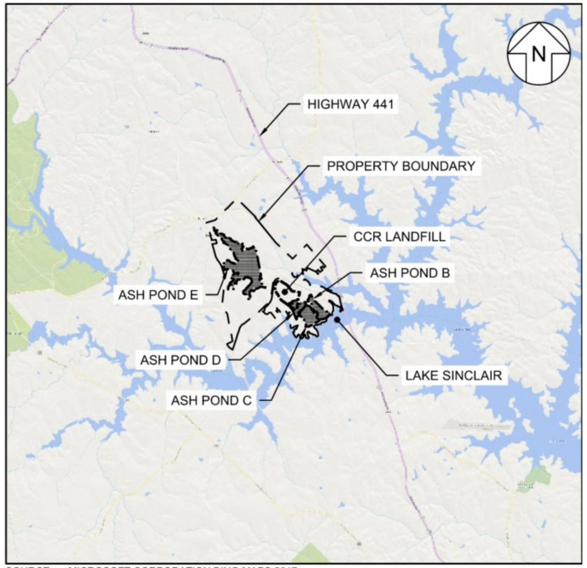
Piezometer	Location	Average High-Water Level Elevation (ft) [1]
PZ-2	AP-E Dam Crest	383.0
PZ-3	AP-E Dam Downstream Slope	375.0
PZ-4		370.0
PZ-5		368.2

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

Table 3. Results of Slope Stability Analyses

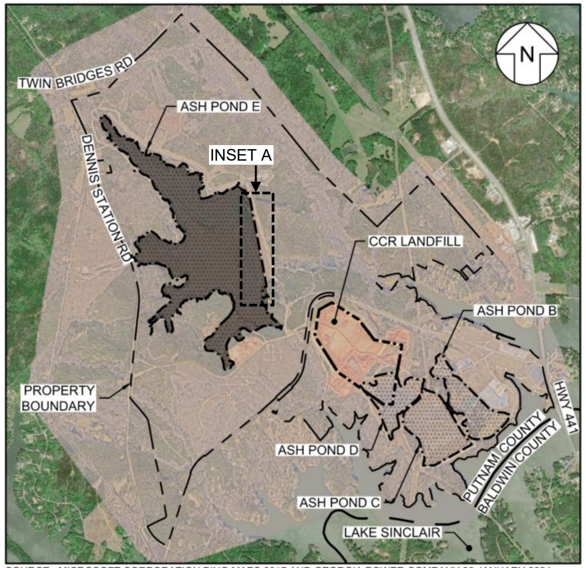
Loading Condition	Minimum Calculated Safety Factor	Minimum Required Safety Factor	Figure
Long-term, Maximum Storage Pool (Static)	2.25	1.50	8
Maximum Surcharge Pool (Static)	2.09	1.40	9
Seismic	1.86	1.00	10

FIGURES



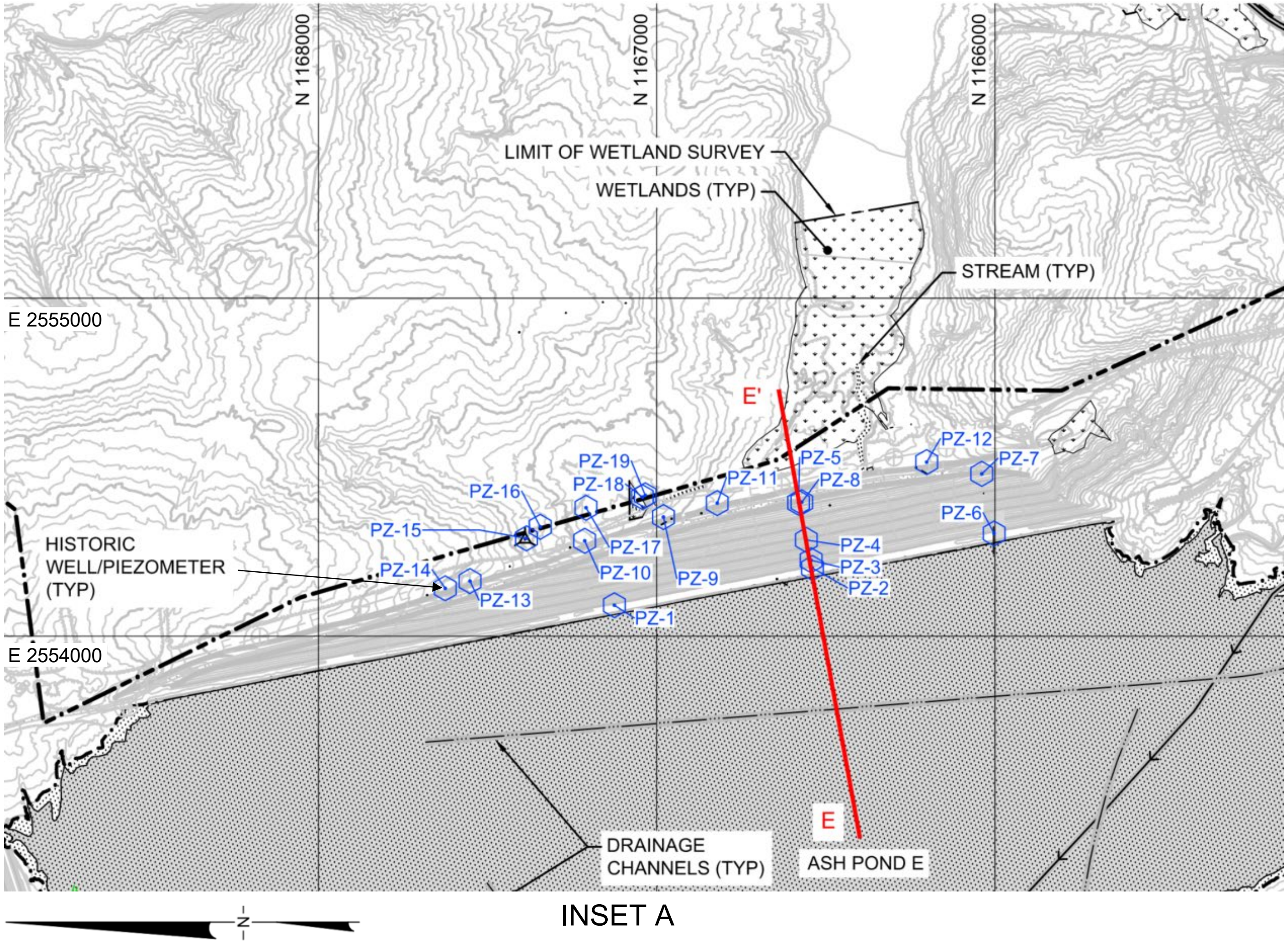
SOURCE: MICROSOFT CORPORATION BING MAPS 2017

LOCATION MAP



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

VICINITY MAP



INSET A

Analyzed Cross Section

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

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Figure 1

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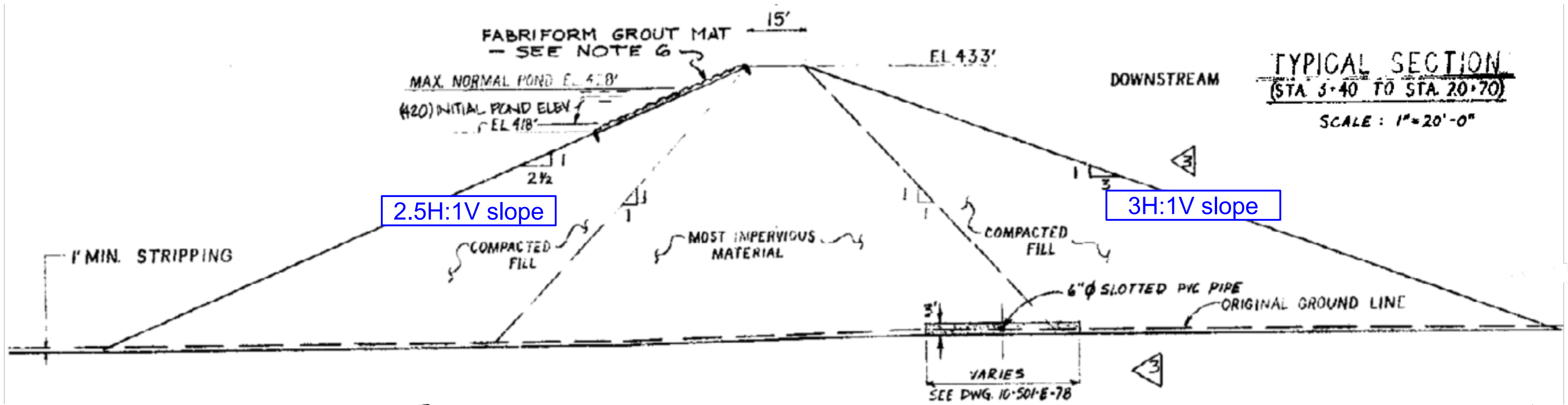
(a)



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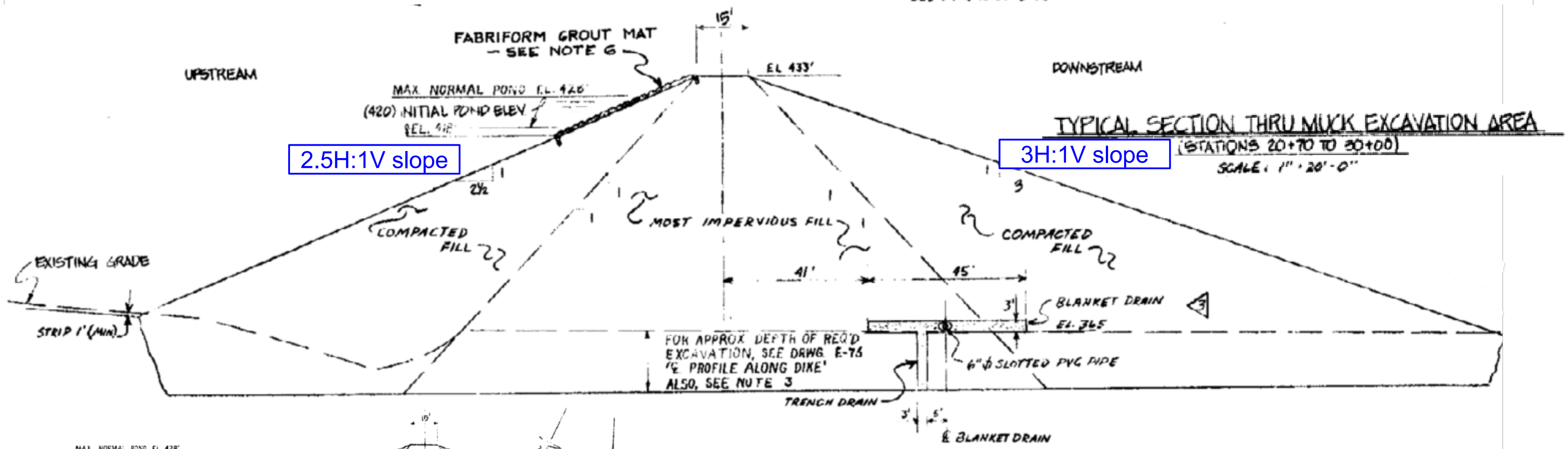

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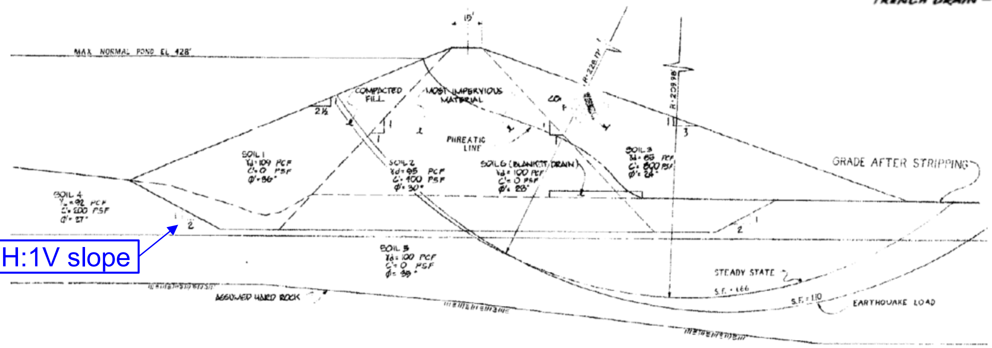

Notes:

1. Cross sections were obtained from Drawing E-81, Revision 5, dated 5/27/1982, Georgia Power Company (Georgia Power, 1982a).
2. The cross section presented in (a) applies to the alignment from Sta 3+40 to Sta 20+70, while the cross section in (b) applies to the alignment from Sta 20+70 to 30+00, as detailed in Drawing E-81 (Georgia Power, 1982a).
3. Cross section presented in (c) was obtained from Drawing E-80 (Georgia Power, 1980). Notes in blue have been included solely to enhance readability.

Historical Drawings: AP-E Dam Section
Initial Safety Factor Assessment
Georgia Power Plant Branch

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Figure 2

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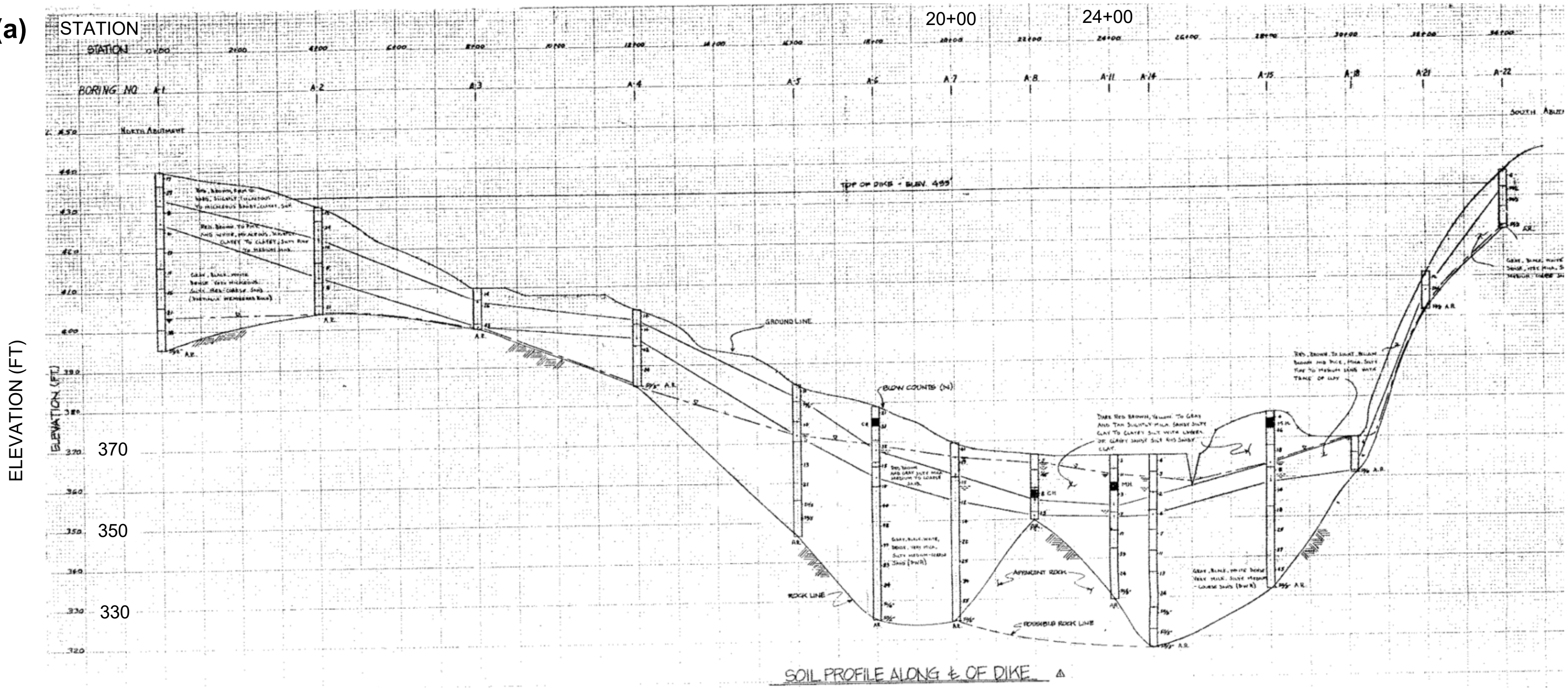
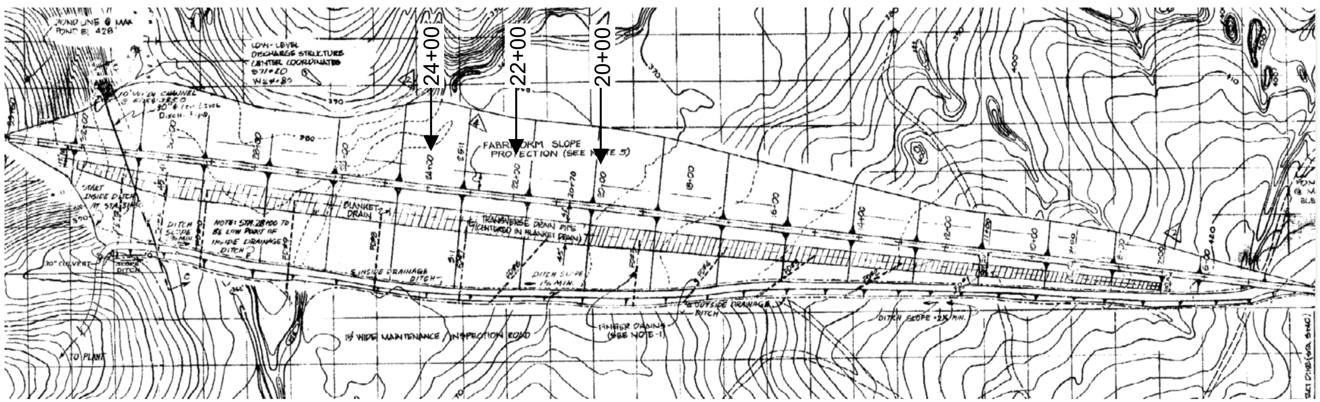
(a)



(b)



Notes:

1. The soil profile shown in (a) was obtained from Drawing E-77, Revision 2, dated 1/20/1981, Georgia Power Company (Georgia Power, 1981). Additional notes have been included solely to enhance readability.
2. Historical drawing in (b) was obtained from Drawing E-78, Revision 4, dated 5/27/1982, Georgia Power Company (Georgia Power, 1982b). Additional notes have been included solely to enhance readability.

Historical Drawings: AP-E Dam Foundation Soil Profile and Plan View

Initial Safety Factor Assessment

Georgia Power Plant Branch

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Figure 3

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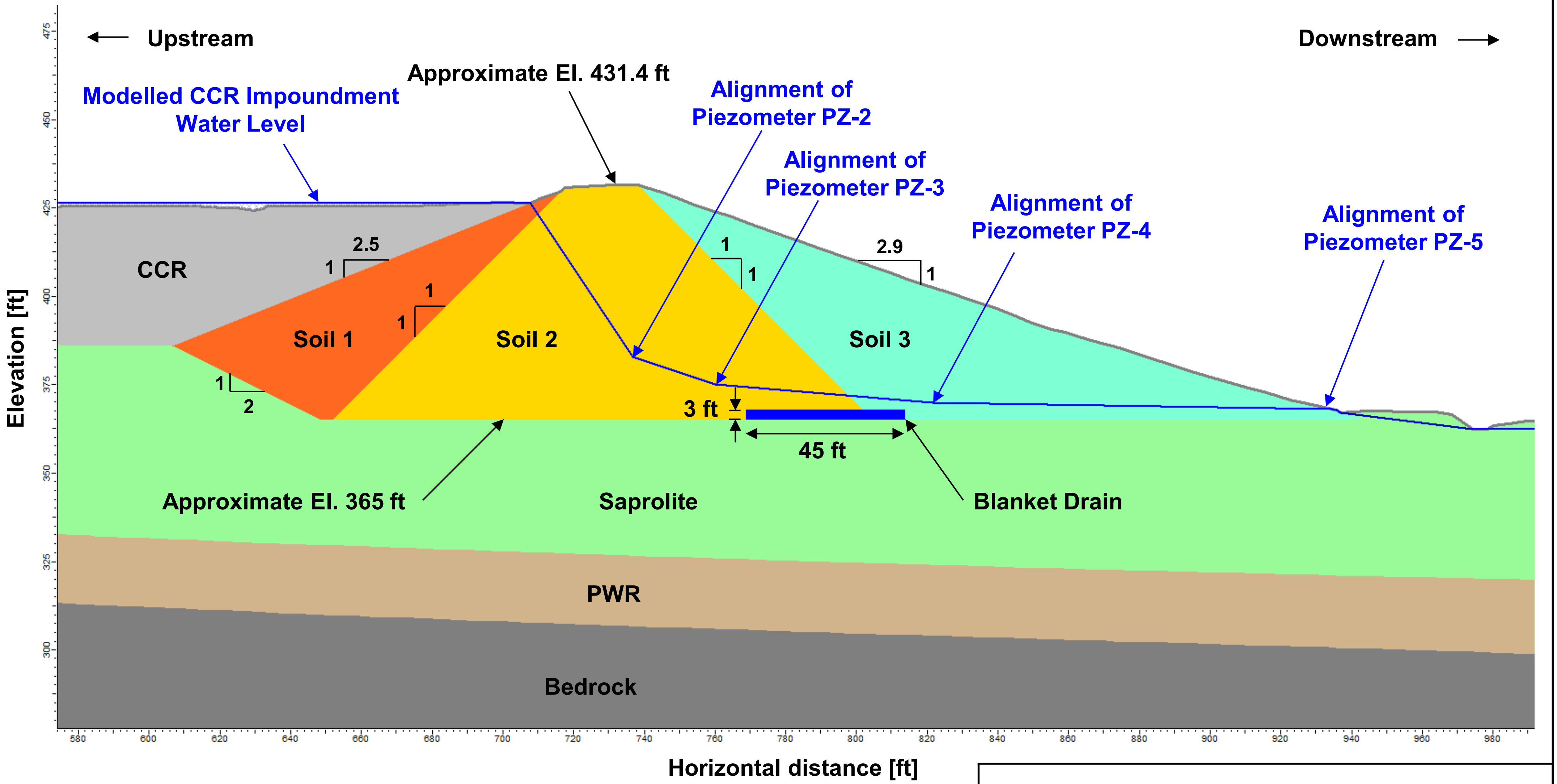
May 2026



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

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Figure 4

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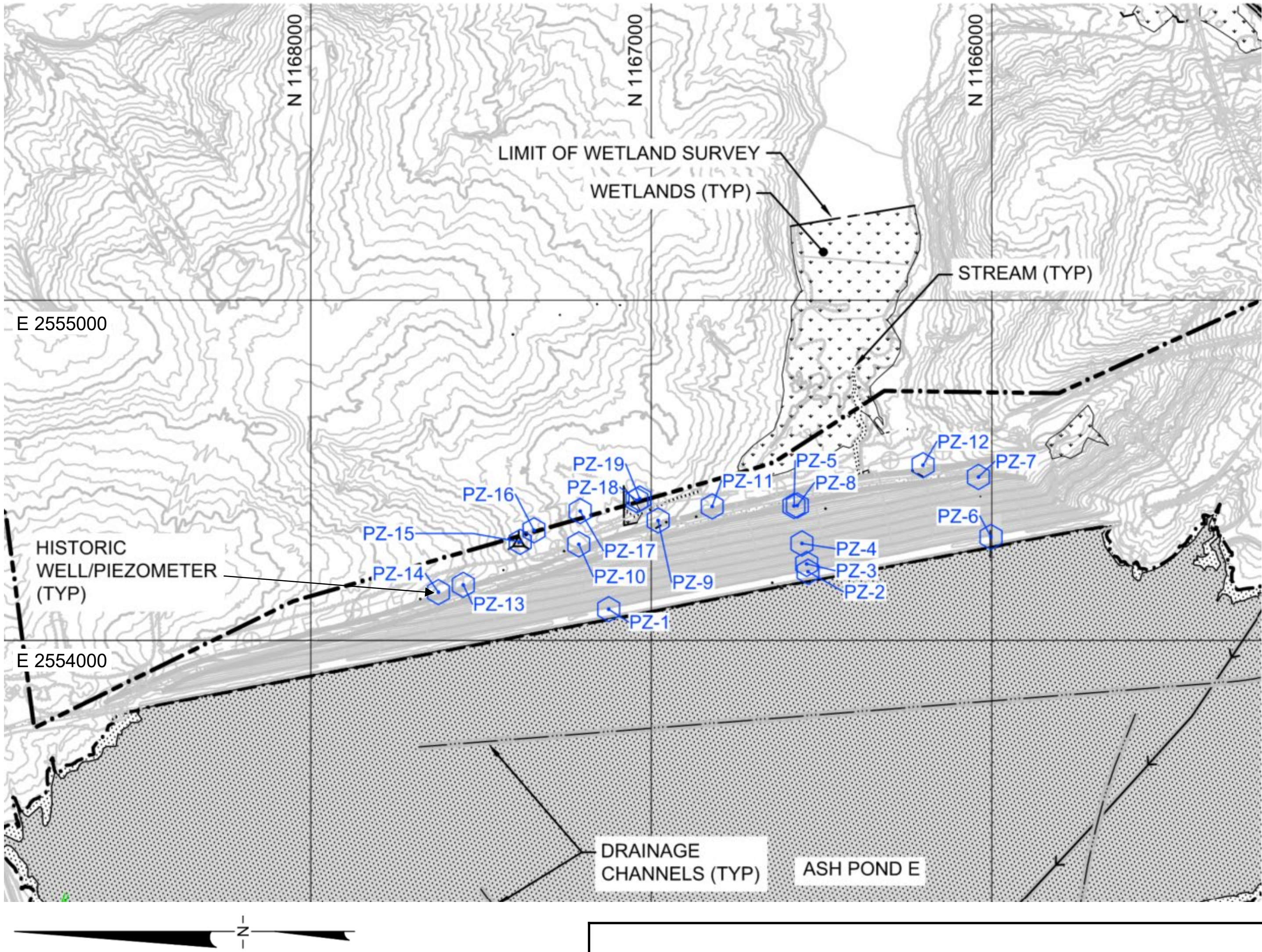
Notes:

1. The ground surface shown is obtained from a LiDAR survey conducted on January 22, 2024.
2. The AP-E dam geometry is derived from multiple sources, including historical drawings (Georgia Power, 1980, 1981, 1982a, 1982b), previous slope stability models (SCS, 2010), and Geosyntec's site hydrogeologic model (2021).
3. Piezometer locations are shown as projected onto the analyzed cross section.

HISTORICAL WELL ID	NORTHING	EASTING
PZ-1	1167125.17	2554091.76
PZ-2 (Note 1)	1166539.59	2554201.89
PZ-3 (Note 1)	1166543.64	2554224.81
PZ-4 (Note 1)	1166557.37	2554284.97
PZ-5 (Note 1)	1166580.81	2554395.22
PZ-6	1166002.32	2554303.97
PZ-7	1166038.81	2554480.41
PZ-8	1166571.20	2554396.45
PZ-9	1166979.95	2554352.56
PZ-10	1167212.84	2554282.32
PZ-11	1166821.11	2554393.87
PZ-12	1166201.74	2554515.07
PZ-13	1167552.08	2554163.18
PZ-14	1167625.19	2554141.86
PZ-15	1167385.27	2554289.61
PZ-16	1167344.36	2554323.64
PZ-17	1167208.81	2554380.25
PZ-18	1167042.12	2554411.78
PZ-19	1167033.82	2554417.06



Note:

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

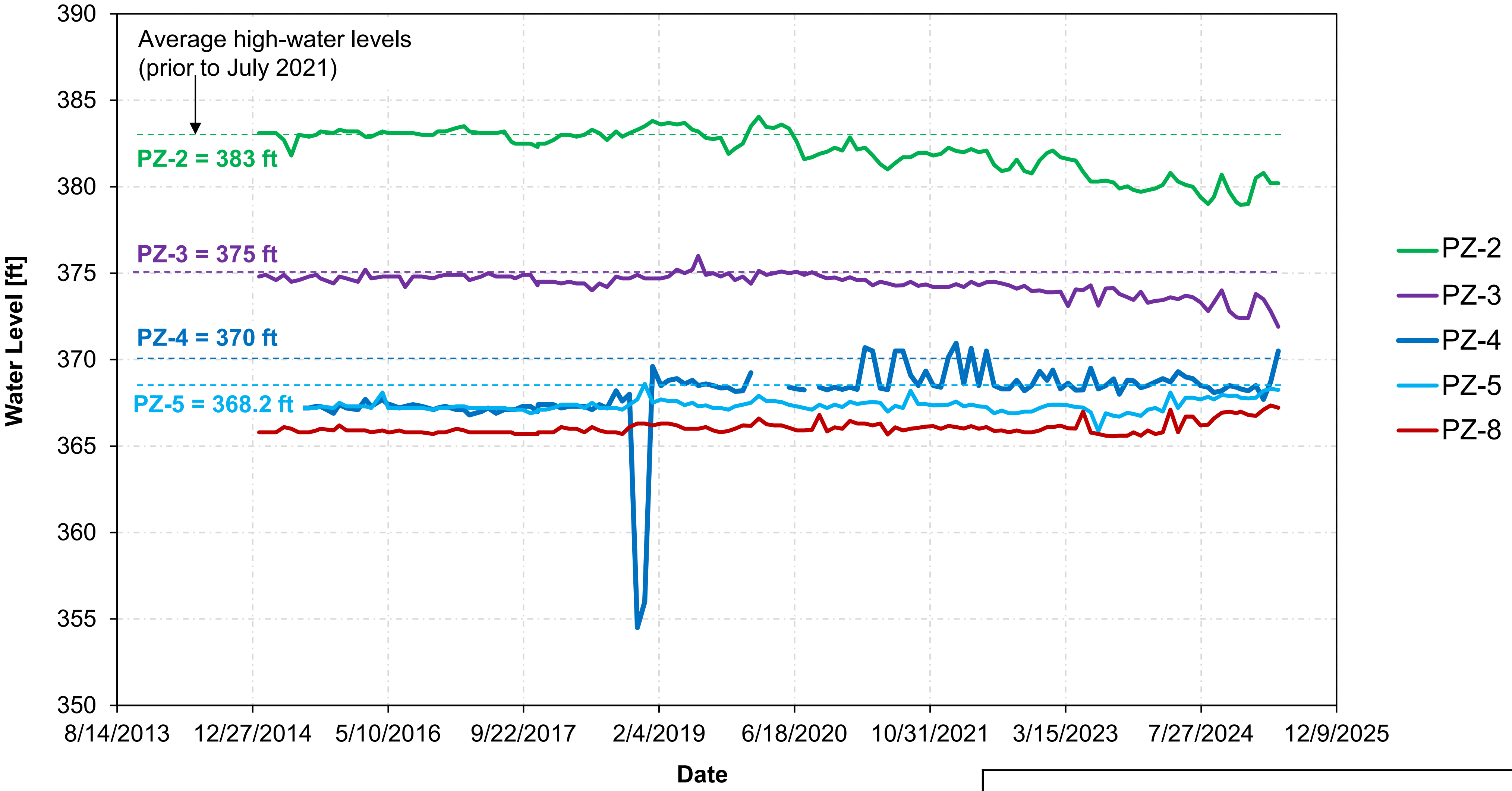
Piezometer Locations in the AP-E Dam
Initial Safety Factor Assessment
Georgia Power Plant Branch

Geosyntec consultants

Figure 5

Project No.: GW11718

May 2026



Historical Water Level Data
Piezometers Within AP-E Dam
Initial Safety Factor Assessment
Georgia Power Plant Branch

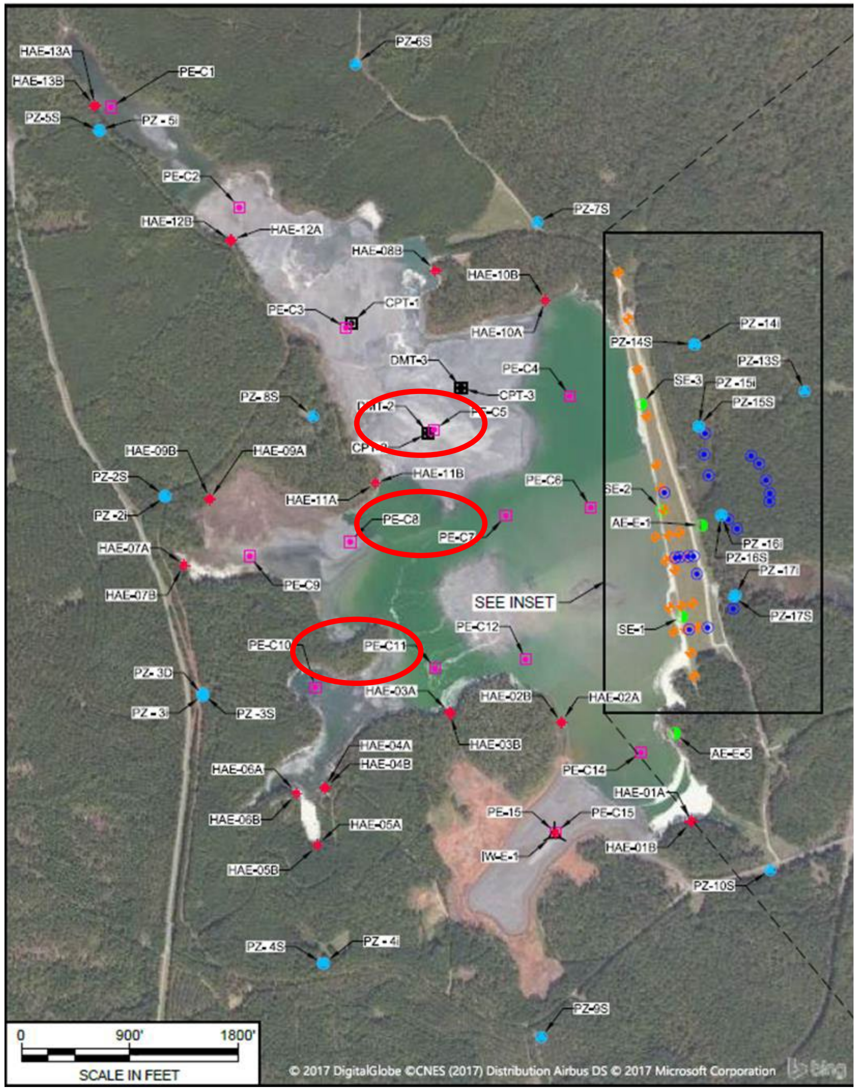
Geosyntec consultants

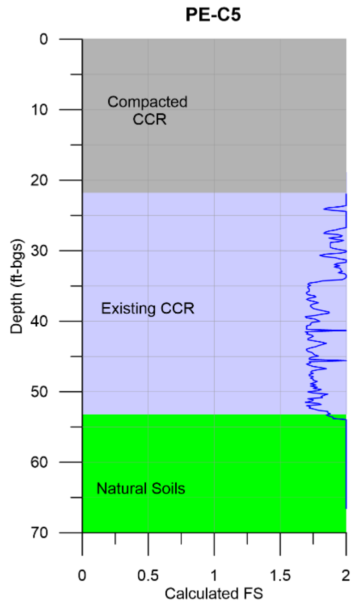
Figure 6

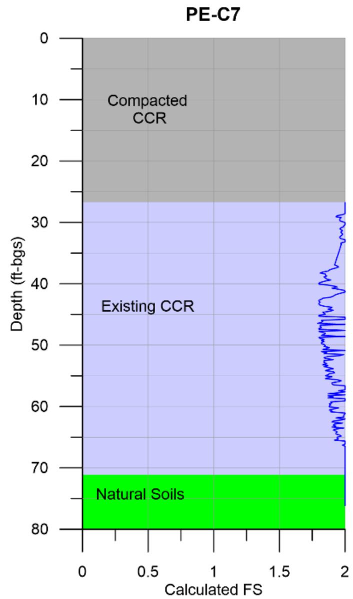
Project No.: GW11718 | May 2026

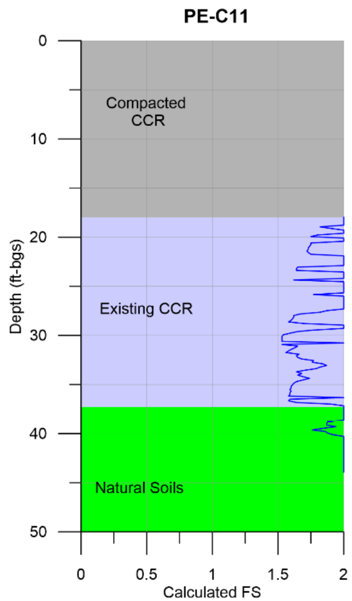
Note:

1. Given the proximity of PZ-5 and PZ-8, less than 0.5 ft apart when projected onto the slope stability cross section, PZ-5 was selected for analysis due to its historically higher water level readings.









Notes:

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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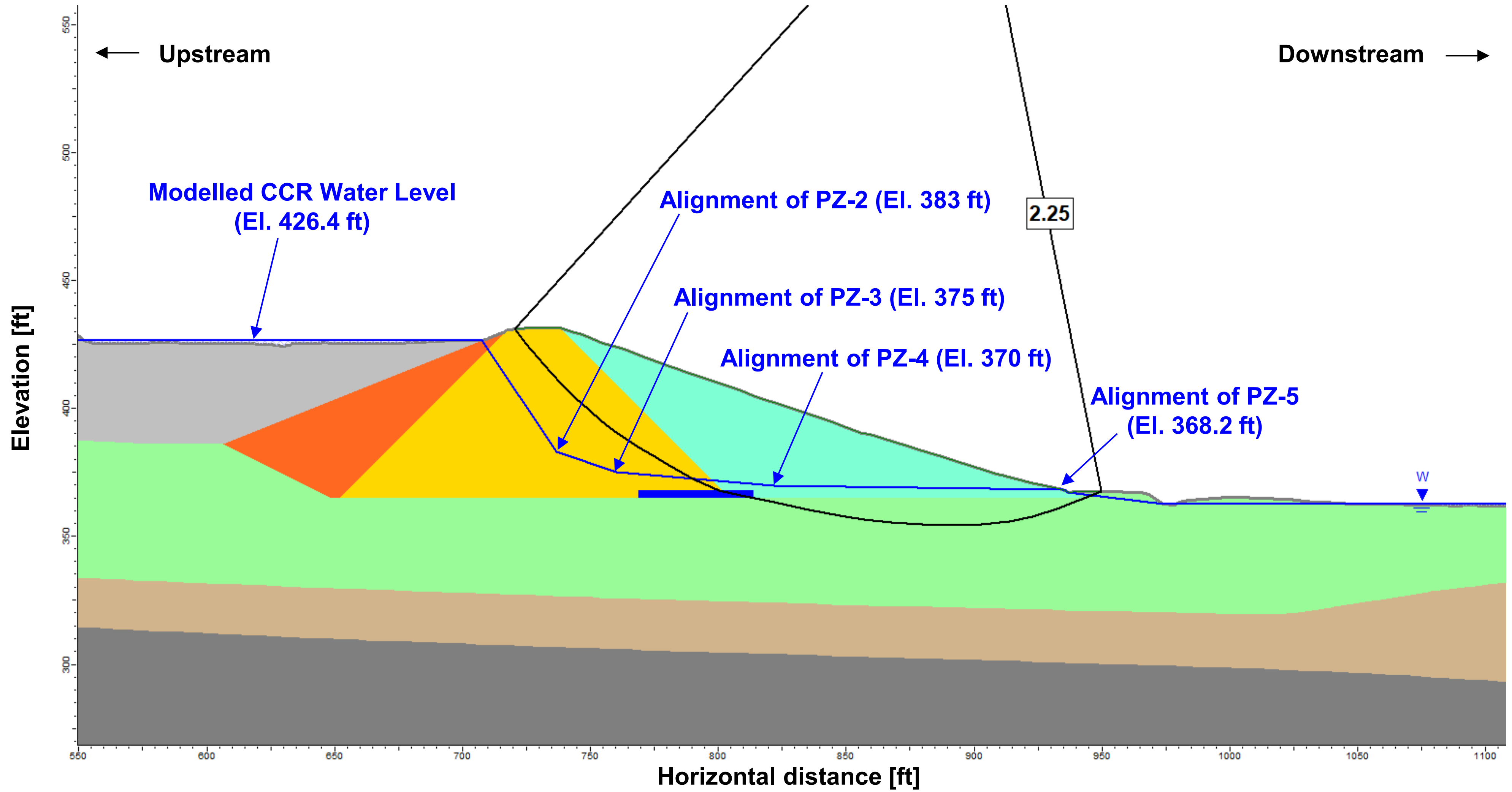
Figure 7

Project No.: GW11718

May 2026



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	Allow Sliding Along Boundary	Water Surface	Hu
Soil 1		109	Mohr-Coulomb	0	36		Water Table	1
Soil 2		95	Mohr-Coulomb	400	30		Water Table	1
Soil 3		85	Mohr-Coulomb	800	24		Water Table	1
Blanket Drain		135	Mohr-Coulomb	0	25		Water Table	1
CCR		90	Mohr-Coulomb	0	32		Water Table	1
PWR		125	Mohr-Coulomb	0	40		Water Table	1
Bedrock		161	Infinite Strength			No	Water Table	1
Saprolite Drained		115	Mohr-Coulomb	0	35		Water Table	1

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

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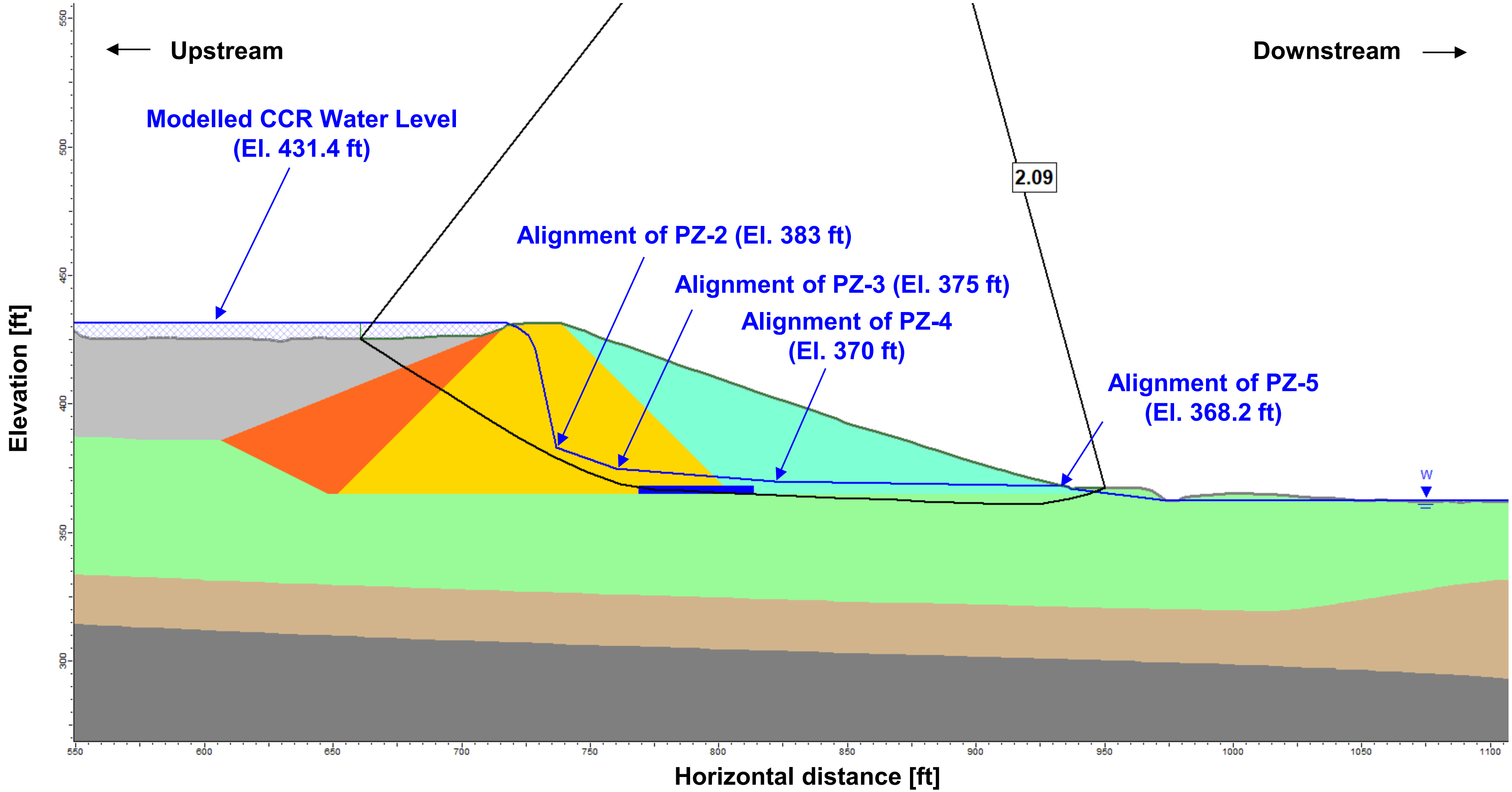
Figure 8

Project No.: GW11718

May 2026



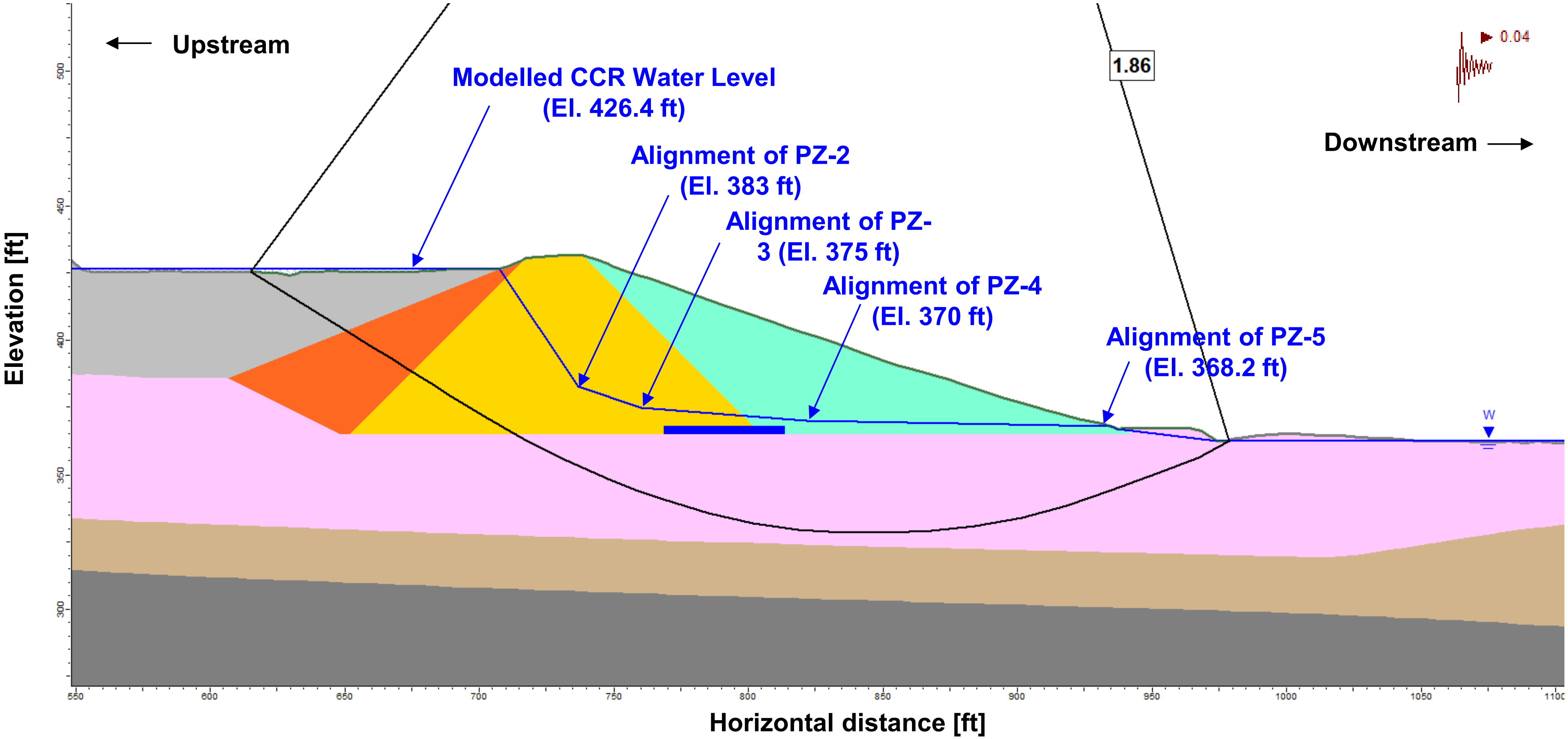
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	Allow Sliding Along Boundary	Water Surface	Hu
Soil 1		109	Mohr-Coulomb	0	36		Water Table	1
Soil 2		95	Mohr-Coulomb	400	30		Water Table	1
Soil 3		85	Mohr-Coulomb	800	24		Water Table	1
Blanket Drain		135	Mohr-Coulomb	0	25		Water Table	1
CCR		90	Mohr-Coulomb	0	32		Water Table	1
PWR		125	Mohr-Coulomb	0	40		Water Table	1
Bedrock		161	Infinite Strength			No	Water Table	1
Saprolite Drained		115	Mohr-Coulomb	0	35		Water Table	1

AP-E Dam
Critical Slip Surface and Calculated Safety Factor
Maximum Surcharge 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 (°)	Shear/Normal Function	Allow Sliding Along Boundary	Water Surface	Hu
Soil 1		109	Mohr-Coulomb	0	36			Water Table	1
Soil 2		95	Mohr-Coulomb	400	30			Water Table	1
Soil 3		85	Mohr-Coulomb	800	24			Water Table	1
Blanket Drain		135	Mohr-Coulomb	0	25			Water Table	1
CCR		90	Mohr-Coulomb	0	32			Water Table	1
Saprolite UD		115	Shear/Normal Function			Saprolite UD		Water Table	1
PWR		125	Mohr-Coulomb	0	40			Water Table	1
Bedrock		161	Infinite Strength				No	Water Table	1

Note:

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

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

Geosyntec consultants

Figure 10

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May 2026

ATTACHMENT B

Ash Pond E Pseudostatic Coefficient Calculations

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 E PSEUDOSTATIC COEFFICIENT CALCULATIONS

PREPARATION	**CALCULATION PREPARED BY:** (Calculation Preparer, CP)	Signature [signature] Name Camilo Guerrero, Ph.D.	05/06/2026 Date
REVIEW	**ASSUMPTIONS & PROCEDURES CHECKED BY:** (Assumptions & Procedures Checker, APC)	Signature [signature] Name Clinton Carlson, Ph.D.	05/06/2026 Date
REVIEW	**COMPUTATIONS CHECKED BY:** (Computation Checker, CC)	Signature [signature] Name Clinton Carlson, Ph.D.	05/06/2026 Date
BACK-CHECK	**BACK-CHECKED BY:** (Calculation Preparer, CP)	Signature [signature] Name Camilo Guerrero, Ph.D.	05/06/2026 Date
APPROVAL	**APPROVED BY:** (Calculation Approver, CA)	Signature [signature] Name Glenn J. Rix, Ph.D., P.E.	05/06/2026 Date

GEORGIA REGISTERED No. PE040976 PROFESSIONAL ENGINEER GLENN JAY RIX

REVISION HISTORY:

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

CP:	CG	Date:	05/06/26	APC:	CPC	Date:	05/06/26	CC:	CPC	Date:	05/06/26
Client:	Georgia Power	Project:	Design and Operating Criteria Assessments for Plant Branch Legacy CCR Units				Project No:	GW11718			

ASH POND E PSEUDOSTATIC COEFFICIENT CALCULATIONS

PURPOSE

The purpose of the *Ash Pond E Pseudostatic Coefficient Calculations* package (Package) is to present the pseudostatic coefficient estimates required for the slope stability analysis of the Ash Pond E (AP-E) 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-E 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 (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-E dam 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 AP-E dam materials.

METHODS FOR ANALYSIS

Seismic Hazard

The seismic hazard at the AP-E 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 E 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 AP-E 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.

$$V_{S,100} = \frac{100ft}{\sum_i \frac{H_i}{V_{S,i}}} \quad (1)$$

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-E dam, values for the AP-E 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-E 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 $T_s < 0.10\ s$:

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

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:

$$T_s = C\frac{H}{V_s} \quad (6)$$

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-E dam and subsurface materials.

CALCULATIONS

Critical Slip Surface and Sliding Mass

The critical slip surface and sliding mass observed for the AP-E 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-E dam, the estimated site-specific shear-wave velocity (Equation 1) is 2,003 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 0.75 sec.

Seismic Hazard

The seismic hazard for the AP-E 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 2,003 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 period for the sliding mass is approximately 0.13g.

The resulting site-specific disaggregation on a period of 0.75 sec 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 period for the sliding mass (0.58 sec), spectral acceleration at the degraded period for the sliding mass (0.13g), 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 0.04. This pseudostatic coefficient was applied in the slope stability analysis of the AP-E dam to represent the seismic loading condition.

CONCLUSIONS

The pseudostatic coefficient for the AP-E 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 **0.04**. This pseudostatic coefficient is used in the *Ash Pond E 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 AP-E dam.

CP:	CG	Date:	05/06/26	APC:	CPC	Date:	05/06/26	CC:	CPC	Date:	05/06/26

Client:	Georgia Power	Project:	Design and Operating Criteria Assessments for Plant Branch Legacy CCR Units	Project No:	GW11718

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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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United States Geological Survey (USGS). National Seismic Hazard Model (NSHM) Hazard Tool. (2025). "Model: NSHM Conterminous U.S. 2023," <https://earthquake.usgs.gov/nshmp/>

TABLE

CP:	CG	Date:	05/06/26	APC:	CPC	Date:	05/06/26	CC:	CPC	Date:	05/06/26

Client:	Georgia Power	Project:	Design and Operating Criteria Assessments for Plant Branch Legacy CCR Units	Project No:	GW11718

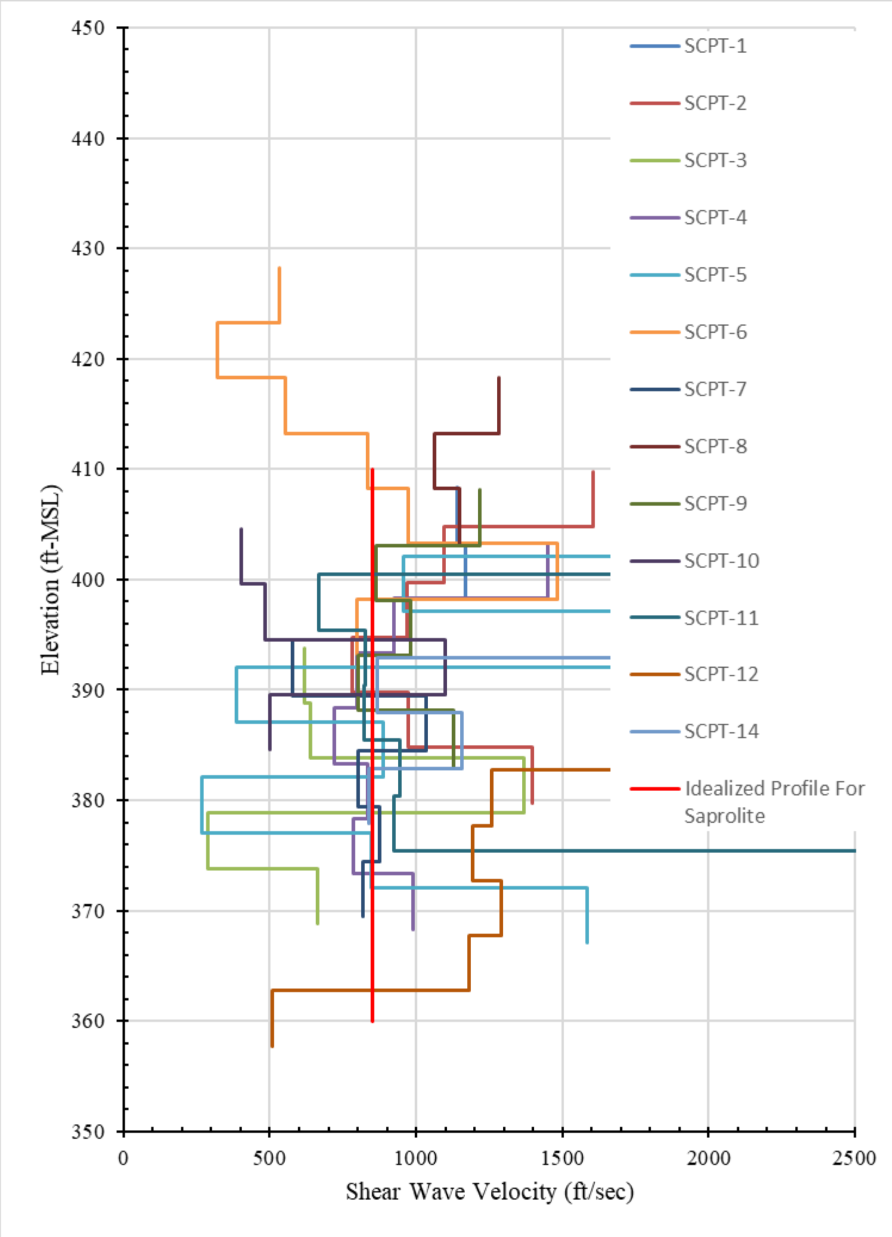
Table 1. Typical Tolerable Seismic Displacements for Solid Waste Containment Facilities (Kavazanjian, 1999)

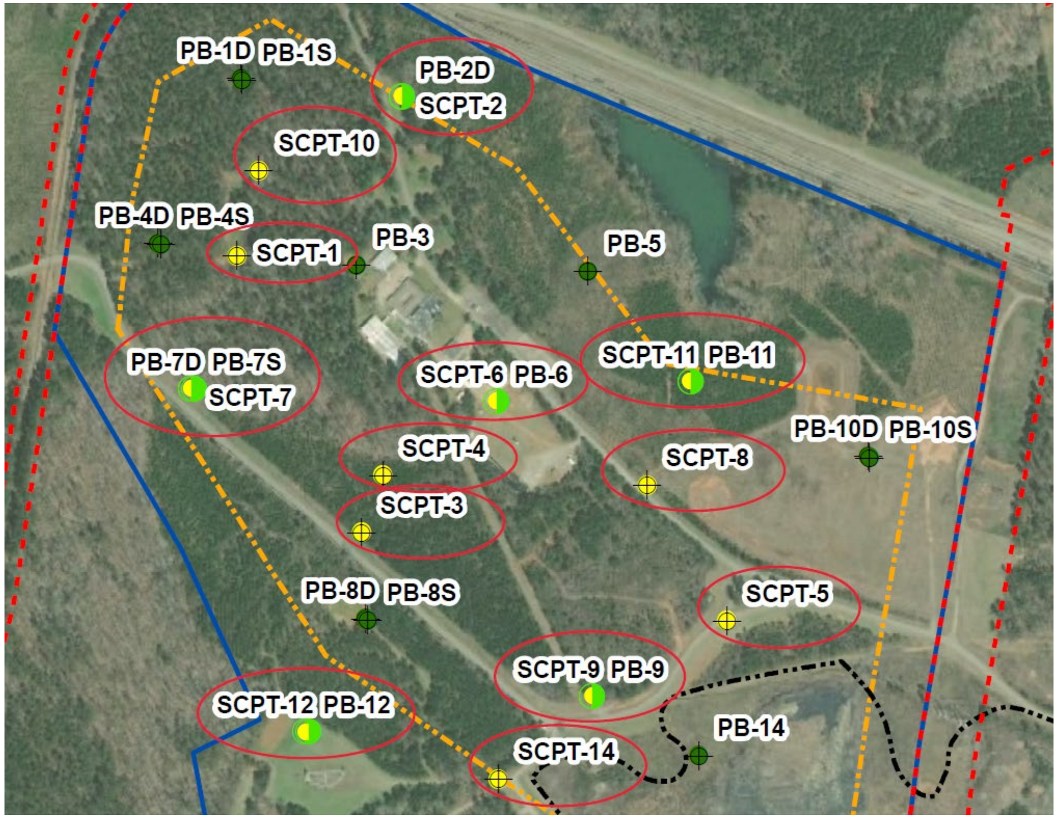
Component	Allowable Calculated Displacement	Comment
Liner System	150 to 300 mm	Actual expected deformation is very small.
Cover System	300 mm to 1 m	Damage is repairable.
Waste Mass	1 m	For displacement not impacting cover or liner.
Roadways, Embankments	1 m	Conventional geotechnical criteria.
Surface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

CP:	CG	Date:	05/06/26	APC:	CPC	Date:	05/06/26	CC:	CPC	Date:	05/06/26

Client:	Georgia Power	Project:	Design and Operating Criteria Assessments for Plant Branch Legacy CCR Units	Project No:	GW11718

FIGURES

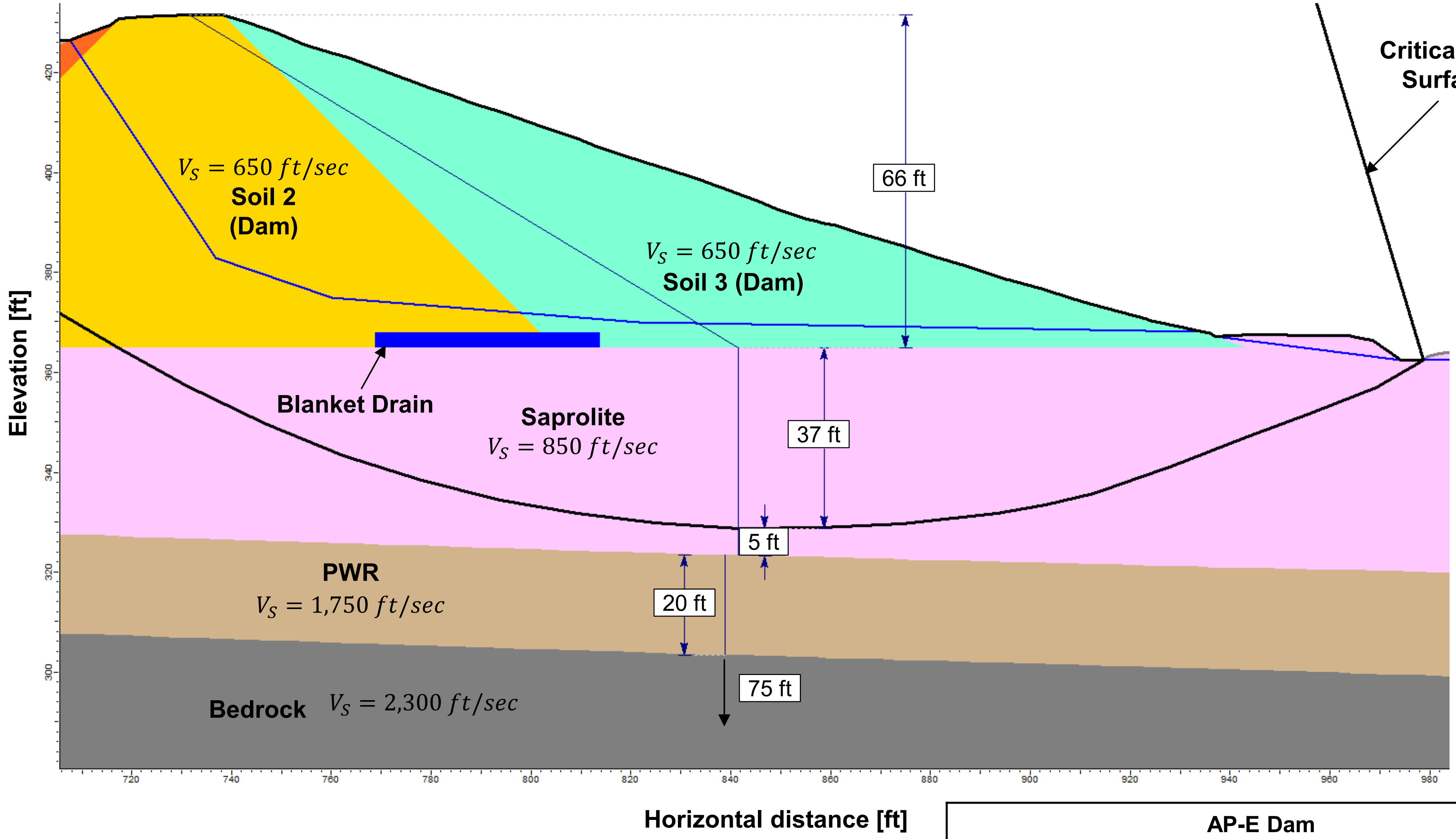




Notes:

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	



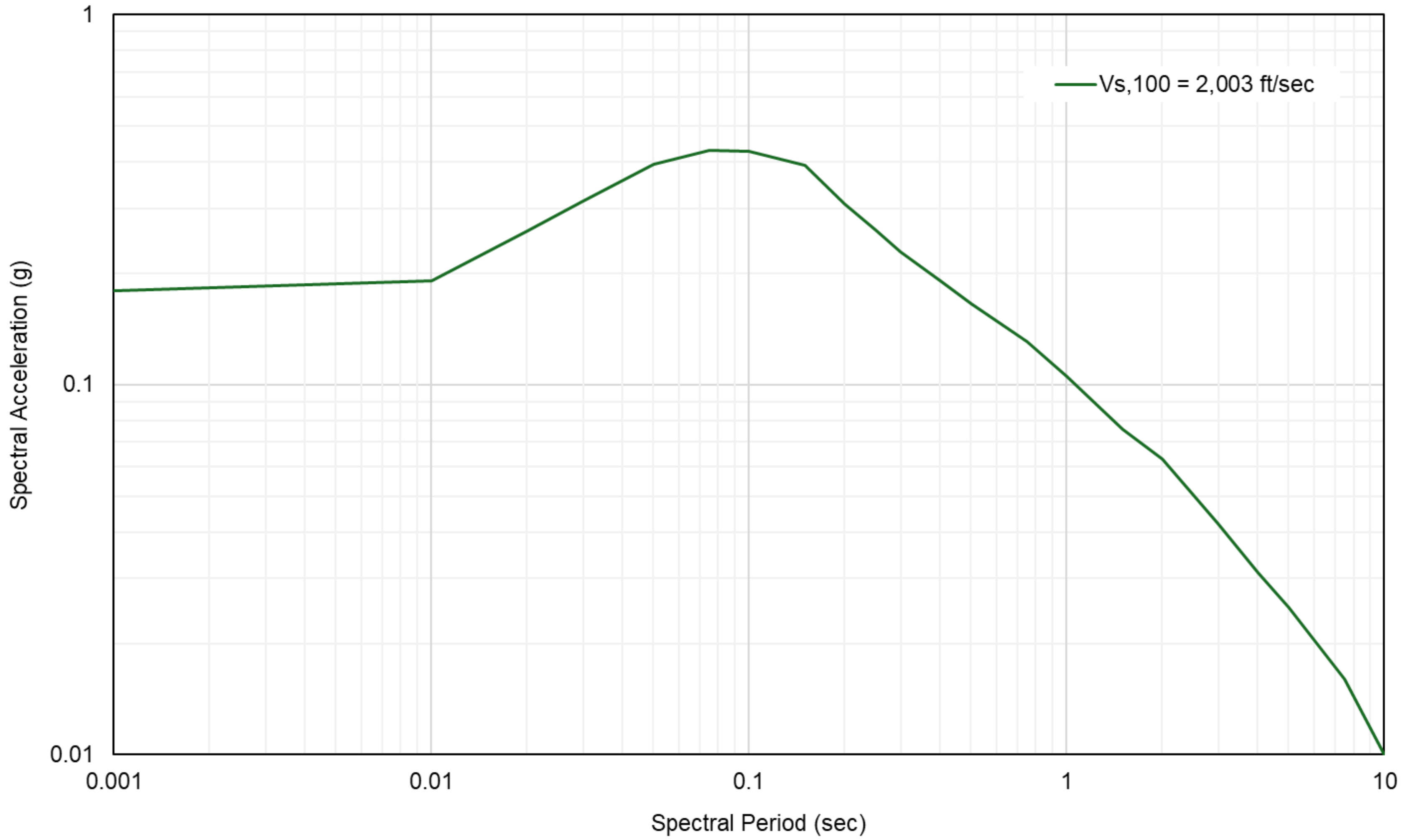
AP-E Dam
Critical Slip Surface and Sliding Mass
Long-Term, Maximum Storage Pool Loading Condition
Initial Safety Factor Assessment
Georgia Power Plant Branch

Geosyntec consultants

Figure 2

Project No.: GW11718

May 2026



AP-E 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 (°) *
33.196
[24.4, 50]

Longitude (°) *
-83.315
[-125, -65]

Select Site

Vs30 ($^{m}/_{s}$) *: 611

Presets: --------

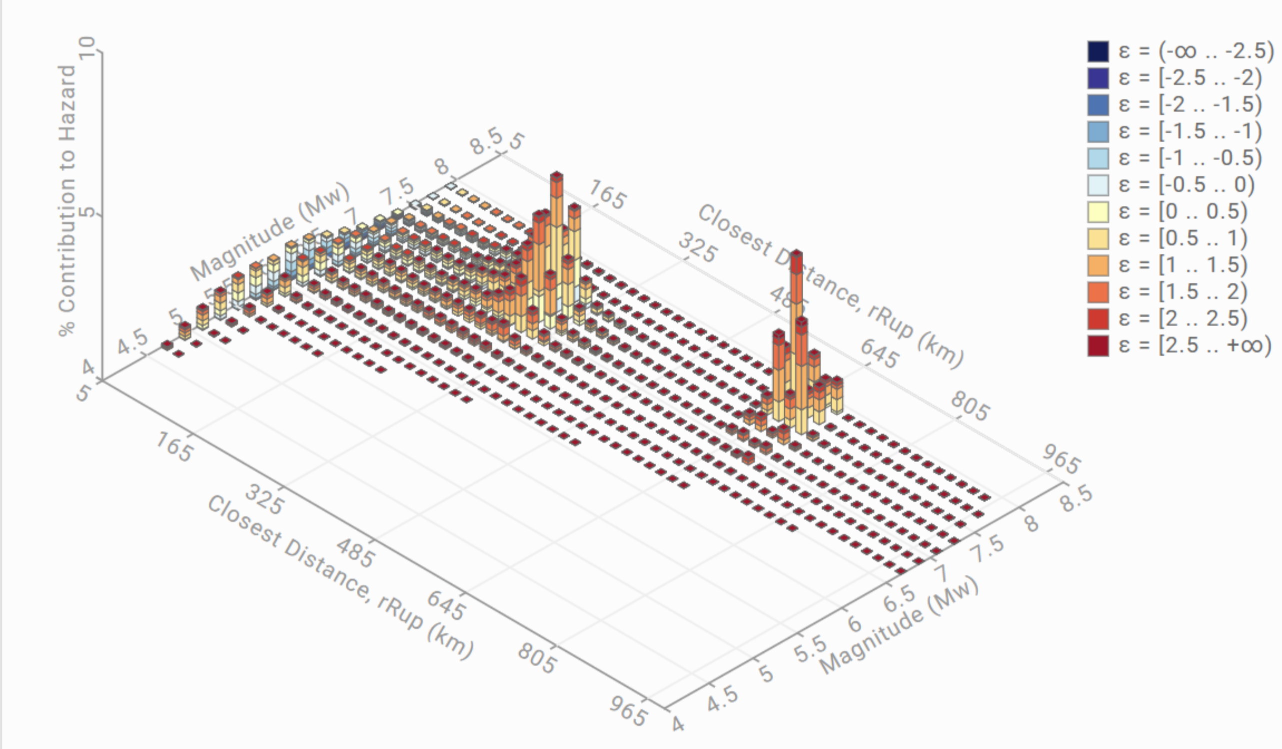
Intensity Measure Type *
0.75 s

Return Period (yr) *: 2475

Presets: 2475 (2% in 50)

Intensity Measure Level (

Max Direction



Disaggregation targets

Return period : 2475 yrs
Exceedance rate : 4.040e-4 yr⁻¹
0.75 s SA ground motion : 1.314e-1 g

Recovered targets

Return period : 2459.4258 yrs
Exceedance rate : 4.066e-4 yr⁻¹

Totals

Binned : 100 %
Residual : 0 %
Trace : 3.59 %

Mean (over all sources)

m : 7.07
r : 307.47 km
ε_0 : 0.91 σ

Mode (largest m-r bin)

m : 7.75
r : 657.9 km
ε_0 : 1.27 σ
Contribution : 4.74 %

Mode (largest m-r-ε_0 bin)

m : 7.3
r : 289.5 km
ε_0 : 0.78 σ
Contribution : 1.77 %

Discretization

r : min = 0.0, max = 1000.0, Δ = 20.0 km
m : min = 4.4, max = 9.4, Δ = 0.2
ε : min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0 : [-∞ .. -2.5)
ε1 : [-2.5 .. -2.0)
ε2 : [-2.0 .. -1.5)
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-E 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 | May 2026