REPORT

Advanced Engineering Methods Feasibility Evaluation

Plant McDonough CCR Unit Ash Pond 1 (AP-1)

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At the request of GA EPD, this document has been sealed by the overseeing professional engineer on June 26, 2025. As no changes to the document have been made other than adding the seal and this clarifying note, all other dates / pages remain as per the original March 29, 2024 submittal.

Table of Contents

Tables

Figures

Appendices

1.0 INTRODUCTION

1.1 Background and Purpose

Plant McDonough-Atkinson (Plant McDonough; Site) is a power generating facility owned and operated by Georgia Power Company (Georgia Power) and located in Cobb County, Georgia (GA). Plant McDonough historically operated coal-fired units which were retired in 2011 and 2012 and the plant subsequently switched to natural gas combined cycle. There are four on-site CCR surface impoundments, Ash Pond 1 (AP-1), Ash Pond 2 (AP-2), Ash Pond 3 (AP-3), and Ash Pond 4 (AP-4), which were utilized for storage of CCR material over the duration of Plant McDonough's coal fired operations and are being closed in accordance with State of Georgia Solid Waste Management Rule (State Rules) 391-3-4-.10(7) [40 C.F.R. Part 257.102].

This report is WSP USA Inc.'s (WSP's) report on the feasibility considerations of advanced engineering method (AEM) options for implementation as part of the closure in place of AP-1 (see Figure 1), including presenting the feasibility considerations associated with refining Georgia Power's selection of a fully encompassing barrier wall an AEM for the closure. Here, the term AEM is used to refer to engineering controls that are designed to enhance the protection of groundwater and closure effectiveness, and/or further minimize future maintenance of the closed CCR unit.

This report summarizes the conceptual site model (CSM) for the Site CCR Units; presents an overview of the available and relevant AEM options; provides an initial screening of AEM options; and provides an evaluation of the feasibility, including relative effectiveness and constructability. of AEM options that remained after initial screening. The relative effectiveness of AEM options is evaluated by using a three-dimensional, steady state numerical groundwater flow model (groundwater model) constructed for the Site, with constructability (the ability to implement the AEM options and quality assurance / performance) and potential construction impacts noted and used in the overall evaluation of the feasibility of potential AEM options. The groundwater flow model calculations used to evaluate the AEM options are presented in Appendix A.

Closure activities for AP-1 under the CCR rules were initiated in January 2016, and AP-1 was substantially closed in place in 2017 through consolidation and installation of the final cover system designed to satisfy the applicable requirements of 257.102(d). Additional details related to the closure of AP-1 are presented in Section 3.0 of this report.

This feasibility considerations presented in this report support Georgia Power's selection of a fully encompassing wall as an AEM for the closure of AP-1 and also support the use of a design depth to the top of partially weathered rock.

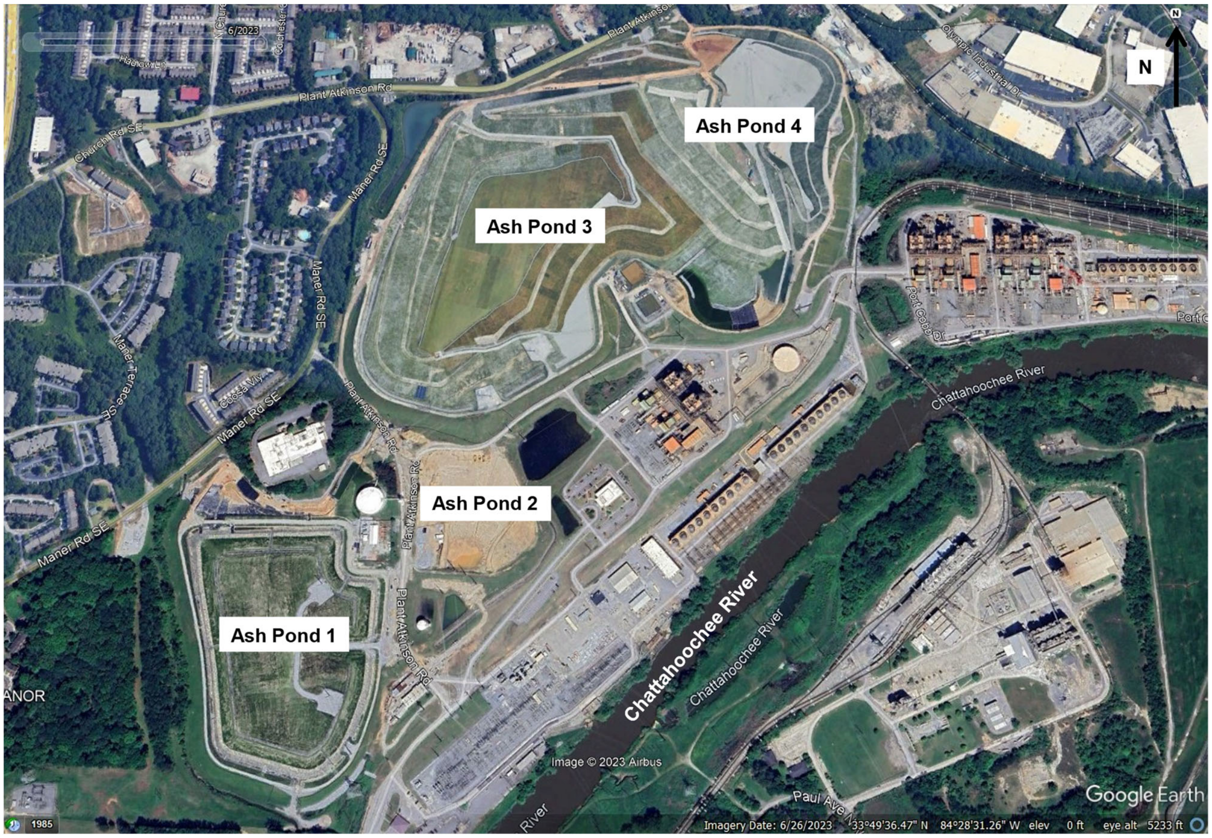

Figure 1: Plant McDonough Layout of Ash Ponds 1 to 4

2.0 CONCEPTUAL SITE MODEL

A detailed CSM for AP-1 is presented in the Hydrogeologic Assessment Report (HAR) (WSP, 2023) and is incorporated into this document by reference. The following section and subsections provide a summary of the information provided in the HAR and include a general description of regional geologic and hydrogeologic characteristics of formations that occur beneath the site. Sheets GW-3a through GW-3j of the HAR present a series of subsurface profiles for the site and depict a summary of the geologic and hydrogeologic information for Plant McDonough.

2.1 Regional Geologic and Hydrogeologic Setting

The Site is located in the Piedmont/Blue Ridge geologic province, which contains some of the oldest rock formations in the southeastern United States. These late Precambrian to late Paleozoic rocks have undergone repeated cycles of igneous intrusions and extrusions, metamorphism, folding, faulting, shearing, and silicification. Rock outcrops near the site consist of biotite gneiss, porphyritic gneiss, mica schist, and quartzite.

Residual soils, primarily clayey/sandy silt, sandy silt with clay, and silty sand, occur as a variably-thick blanket overlying bedrock across most of the site. These residual saprolitic soils along with saprolitic transitionally or partially weathered rock, collectively the regolith, range between approximately 9 to 61 feet in thickness across the site, with an average thickness of approximately 38 feet. Saprolitic rock is considered to be transitionally weathered rock (TWR) or partially weathered rock (PWR). PWR is defined by Standard Penetration Test (SPT) blow counts that exceed 50 blows/six inches.

A regional, unconfined surficial aquifer system is present at the site, existing within the regolith soils and weathered and fractured upper bedrock (e.g., approximately the first 30 feet), depending on topographic location. Recharge primarily occurs through precipitation and subsequent infiltration. Generally, groundwater flow occurs through intergranular pore spaces in the regolith and is controlled by topography and top of rock variations. However, a relatively higher transmissive zone is interpreted to occur at the base of the regolith, at the interface of weathered bedrock and competent bedrock and is believed to be the primary groundwater flow path. The regolith has an average horizontal hydraulic conductivity of 10-4 centimeters per second (cm/s) and is interpreted to flow south-southeast. A small unnamed creek originally flowed through the footprint of the AP-1 area and was rerouted into an engineered stream channel that now flows to the south, parallel and adjacent to the western and southern boundary of AP-1.

A limited and localized bedrock aquifer system also occurs beneath the site. The upper bedrock is fractured and weathered, connected hydraulically with groundwater in regolith soils, and is considered part of the unconfined surficial aquifer. The silt/clay-rich soils of the regolith may act to retard recharge into the aquifer system. Deeper bedrock (i.e., approximately greater than 30 feet into the bedrock) is unweathered with few discontinuities (e.g., fractures) available to store groundwater.

2.2 Uppermost Groundwater Aquifer

Material types that comprise the uppermost groundwater aquifer include residual soils, saprolitic soils, saprolitic rock, PWR/TWR, and competent bedrock. Based on review of the logs, the screen/filter pack interval for most of the piezometers and monitoring wells installed on site provides connection to the regolith, indicating that the site is underlain by a regional groundwater aquifer that occurs within the regolith and upper bedrock, depending on topographic location.

Field hydraulic conductivity tests (i.e., slug tests) and soil classification testing and information from a range of the site geologic materials are summarized in detail in the Hydrogeologic Assessment Report (WSP, 2023).

According to water level measurements recorded between August 2016 and January 2023 from wells and piezometers screened in the overburden and upper bedrock, the water table elevation ranges between approximately 834 feet to approximately 742 feet North American Vertical Datum of 1988 (NAVD88) and is summarized in Table GW-1 of the HAR. Localized groundwater flow directions within this aquifer are influenced by topographic and top of rock variations on site. As illustrated on Sheets GW-3a through GW-3j of the HAR and the January 31, 2023 Potentiometric Surface shown on Sheet GW-7, the water table surface is a subdued reflection of topography at the Site, with groundwater generally flowing towards the south and west of the ash ponds. The top of rock surface generally follows pre-development topography and likely controls groundwater flow direction in the uppermost aquifer.

Local complexities in groundwater flow within this aquifer are influenced by topography and related top of rock variations on site. Review of the potentiometric surface shows groundwater flow across AP-1 is to the south southwest across AP-1. Combined CCR unit AP-3/4 is on a topographic high, historically creating radial flow around AP-3/4 prior to closure, with the exception of the one upland high upgradient northwest of AP-3/4. As a result of localized water extraction associated with AP-3/4 closure activities, groundwater flow in the northeast portion of AP-3/4 is inward toward the ash pond. CCR unit AP-2 has a side-hill embankment, 16 feet high with an original pond area of 7 acres. Regionally groundwater is interpreted to flow south-southeast from the topographic high northwest of AP-3/4 towards AP-2. The groundwater flow pattern interpreted using the January 2023 elevation data is consistent with previous observations.

2.3 Groundwater Flow Conditions

Relatively thick silt/clay-rich overburden is present across most of the Site which may retard recharge from the uppermost aquifer into the underlying bedrock aquifer systems. Additionally, boring logs indicate that some areas, particularly topographic highs, correlate with bedrock that is more resistant to weathering and massive (i.e., few discontinuities); consequently, bedrock aquifer systems are likely not well-developed and/or interconnected in these areas. Preferential groundwater flow in bedrock is anticipated along lineaments and discontinuities. The faulted intrusive contacts in and around the Site may also be preferential flow pathways; however, no evidence obtained to date indicates preferential flow along the faulted intrusive contact onsite.

The majority of groundwater flow beneath the Site occurs laterally in the overburden, which is typical of the Piedmont, as discussed in Fetter (1988). Based on site-specific hydrogeologic characteristics, groundwater is expected to move laterally more than vertically within the TWR/PWR unit. Based on available boring logs for wells screened in the upper bedrock, the upper 30 feet of bedrock are fractured and appear to conduct groundwater horizontally on the same order of magnitude as the overburden/regolith. The upper bedrock appears to be connected hydraulically with the overburden. Groundwater elevations in site wells reflect topographic and weathering effects (e.g., depth to bedrock variations), and groundwater flow that is predominately horizontal rather than vertically through the aquifer. The vertical hydraulic gradient is dependent on topographic location (e.g., a downward vertical gradient is generally observed in topographically high areas). Based on drilling at the Site, borings completed deeper in the bedrock aquifer (i.e., greater than 30 feet into the bedrock unit) exhibit minimal and likely isolated fractures. The occurrence and water production of fractures generally decreases with depth as is typical of Piedmont hydrogeologic settings. Fractures within the bedrock at the Site are not well connected and the predominant groundwater flow at the Site occurs in the overburden and upper bedrock at the Site.

Groundwater located on the upland high west of the engineered stream channel located on the west boundary of AP-1 is considered upgradient of the plant property. This upland area and the upland high northwest of AP-2 and AP-3/4 represent the only upgradient locations on the property near the units with the pre-closure pond configurations. It has been observed that as a result of AP-3/4 closure activities, portions of the northern and northeastern corner of the property have become upgradient over time, returning to the historical regional groundwater flow pattern, corresponding to historical pre-ash pond construction regional topography.

Based on a review of the potentiometric contours (Sheet GW-7), horizontal hydraulic gradient is also variable and generally reflects topography at the Site. The horizontal gradient appears steeper around the downgradient perimeter of the ash ponds, particularly along embankments where groundwater flow lines are influenced by the constructed slopes for the impoundment dams. Hydraulic gradient, calculated as the difference in groundwater elevation (in feet) divided by the lateral distance between those measured elevations (in feet), is on average 0.026 feet/feet for AP-1. Field hydraulic conductivity tests (i.e., slug tests) performed in a variety of geologic materials indicate an average hydraulic conductivity for the uppermost aquifer of 3.45×10^{-4} centimeters per second (cm/s); 4.9×10^{-4} cm/s in the overburden and 2.0×10^{-4} cm/s in the upper bedrock.

3.0 OVERVIEW OF AP-1 CLOSURE

AP-1 is an inactive CCR surface impoundment currently undergoing closure in accordance with State Rules 391-3-4-.10(6) [40 C.F.R. Part 257.102(d)]. The AP-1 Closure Plan is provided in the updated Plant McDonough AP-1 CCR Solid Waste Handling Permit Application submitted to the GA EPD in March 2023.

AP-1 is consolidated and closed in place and includes CCR excavated from AP-2, and a portion of the CCR excavated from AP-3. Installation of the AP-1 final cover system was substantially completed in 2017. The final cover system consists of ClosureTurf™ (combined geotextile and engineered turf layer) and turf infill or other overlying protective layer [i.e. rip rap, articulated concrete block, or concrete infill]). The cover system is designed to minimize erosion and infiltration to the maximum extent feasible and to satisfy the applicable requirements of 40 C.F.R. Part 257.102(d). The final closed geometry minimizes maintenance after closure and provides gravity drainage of surface water runoff from the unit in a controlled manner.

To enhance the closure of AP-1, the permit application includes Georgia Power's selection of a laterally continuous (perimeter) hydraulic barrier wall around the Unit as an AEM. The intent of the wall is to control, minimize, or eliminate groundwater flow through the CCR material and to divert groundwater flow around the wall or through native material below the bottom of CCR in AP-1 to the maximum extent feasible. Once the cover system and hydraulic barrier wall are in place and the system reaches equilibrium, flow into and out of the unit is effectively stagnated and isolates CCR contained within the closed unit from lateral flow and the surrounding environment. While the closure of AP-1 is designed independently from a groundwater corrective action, the closure of AP-1 with the hydraulic barrier wall will compliment future groundwater corrective action and provide a benefit to groundwater quality at the site. Georgia Power will continue to perform routine maintenance as well as groundwater monitoring and reporting at AP-1 for at least 30 years during post-closure care after the unit is closed.

As discussed in greater detail in the Groundwater Model AEM Evaluation Calculation Package (Appendix A of this Report), Site groundwater modelling reports (WSP 2023), and in Sections 4.0 through 6.0 of this report, the implementation of a perimeter barrier wall around AP-1 will substantially enhance the protection of groundwater and closure effectiveness. Groundwater model scenarios compared the relative effects of potential AEM options for AP-1 and are discussed in Section 4.0 of this report. The groundwater modeling scenarios generally included: (i) pre-closure conditions, (ii) AP-1 closure conditions without the implementation of any AEM, and (iii) AP-1 closures with each of the modeled AEM options installed.

4.0 EVALUATION OF ADVANCED ENGINEERING METHODS AND TECHNOLOGIES

4.1 Overview

The purpose of this section is to provide an overview of various AEM options that were considered for the in-place closure of AP-1. For the purpose of this report, AEMs are grouped into three categories: (i) low-permeability barriers (e.g., slurry walls), (ii) groundwater extraction systems (e.g., extraction wells, or drains) and (iii) in-situ stabilization (ISS) (e.g., deep soil mixing). Some of the evaluated AEM scenarios consider a combination of the three primary categories, such as a barrier in combination with a drain.

The selection and design of an AEM generally depends on a variety of factors, including effectiveness, implementability, potential impacts associated with construction, and long-term operations and maintenance. In the following sections, potential AEMs for AP-1 are initially screened against these criteria. Based on the screening of these general engineering technologies, seven AEM option configurations are evaluated in more detail to compare the relative effects on the post closure groundwater conditions (i.e., potentiometric surface and downgradient flow) resulting from potential implementation of each AEM option.

As described above, this report describes the screening and feasibility level considerations relating to Georgia Power's selection of an AEM for AP-1. These considerations support Georgia Power's selection of a fully encompassing subsurface barrier wall at AP-1.

4.2 Initial Screening of Methods

4.2.1 Low-Permeability Barriers

Subsurface low permeability barriers (or walls) typically include the installation of physical barriers (e.g., slurry walls, sheet pile walls, secant walls, etc.) or creation of a subsurface barrier through grouting or in-situ mixing of some combination of soil, bentonite, and pozzolanic reagents (i.e., Portland cement, ground-granulated blast furnace slag, etc.) to construct the below-grade barrier. Methods for the design and construction of barrier walls are well established, and when properly designed and installed, they can be an effective long-term solution for inhibiting groundwater migration (Gerber and Fayer, 1994).

The five types of low-permeability barrier installation techniques initially screened for consideration at AP-1 include: slurry walls, grout curtains, deep soil mix (DSM) walls, sheet pile walls, and vertically installed geomembrane barriers. The major design and/or implementation considerations for low permeability barriers are:

- Wall alignment limiting factors, including accessibility for installation, overhead and underground utility locations, elevation changes along the alignment, geometric complexity of the alignment, and distance from existing slopes;
- Need for a working platform or bench (25 to 60 feet wide, width dependent on installation technique) along the entire alignment of the wall to allow for installation;
- The changes in subsurface groundwater conditions (e.g., potentiometric surface and flow direction) following the installation; and
- Ability of barrier walls to be successfully installed to reach the target depths/ geologic strata below ground surface, especially in areas where penetration into saprolite, PWR, and/or weathered bedrock is needed to achieve performance goals, which may require specialized or multi-stage equipment.

Based on the understanding of the site conditions, sheet pile walls and geomembrane barriers are screened out due to one or more major implementability and/or effectiveness challenges associated with these engineering technologies. The following bullets summarize the reasons these engineering technologies were screened out:

- Sheet piles are generally comprised of separate stiff, low permeability elements (made from metal, plastic, or fiber reinforced polymer (FRP)) installed in an interlocking sequence of vertically installed elements. Stiff or dense ground conditions, as found in portions of the site across the target installation depths for the barrier, would require the stiffer metal (as opposed to the less stiff plastic / FRP) sheet pile elements to reach design depths of penetration. These sheet pile elements would be limited in their ability to reach deeper target depths along portions of the wall alignment and are not capable of penetrating into PWR or bedrock. Additionally, sheet pile systems can provide less effective hydraulic control along the sheet interlocks between elements as opposed to uniform section barrier systems (e.g., slurry walls, DSM, etc.).
- Vertically installed geomembrane systems are most practically / effectively installed in soft / loose ground conditions where installation is of a consistent depth of penetration. For sites like AP-1 that have stiff / dense subsurface soil conditions within the range of target depths of installation, and where the target depth and surface topographic conditions would require variable wall depths, these systems are considered less implementable than the other available engineering technologies. Additionally, these systems alone do not have the capability to extend into dense / stiff soils, PWR, or bedrock.

The DSM and slurry wall options through soil strata are considered the most constructible and effective of the subsurface barrier wall technologies and are included in the below detailed evaluation of the relative effectiveness of the AEM options using the groundwater flow model. Additionally, greater depths may require grout curtain techniques, and the constructability implications of those techniques are described and considered below where appropriate.

A more detailed evaluation of the modelling of the hydraulic barrier wall options is presented in Section 4.4.

4.2.2 Groundwater Extraction Systems

Configurations of groundwater extraction systems include groundwater extraction well arrays, interceptor trenches (both upgradient and downgradient to the Unit), and a combination of these elements in parallel with low-permeability barrier elements.

Conventional groundwater extraction systems generally involve installing an array of vertical extraction wells designed to extract groundwater. This is an active approach used to remove, divert, or contain groundwater. These extraction systems would be intended to reduce groundwater levels and flow through the area of AP-1 by lowering the groundwater elevation rather than by impeding groundwater flow.

An alternative to conventional vertical extraction wells is to install an interceptor trench in order to capture a continuous linear cross-section of the groundwater flow. As the groundwater flows into the trench, elevation-controlled pumps or sumps (typically installed at low points in the trench system) or gravity piping allow for the extraction of the groundwater from the trench, thereby resulting in a lower groundwater elevation (drawdown) near the point(s) of extraction. Interceptor trenches can offer more uniform control of groundwater levels if conditions support their installation (i.e., target depths able to be near surface at some point during construction, and/or ground conditions that allow for continuous trenching / high permeability media [e.g., sand, gravel, etc.] installations) as compared to vertical extraction wells, which offer flexibility on depth installations but the potential for variations in controls between extraction points and the need to install separate pumping features per well.

The major design considerations for groundwater extraction systems are:

- Planned system alignment limiting factors, including accessibility, overhead and underground utility locations, distance from existing slopes, and surrounding features (e.g., the stream to the west of AP-1).
- The changes in subsurface groundwater conditions (e.g., groundwater levels and flow direction) following installation / operation.
- Ability of interceptor trenches to be effectively installed to reach the target depths below ground surface, especially in areas where penetration into saprolite and/or weathered rock is needed.
- Flow capacity of extraction features to convey the necessary throughput volume of water to provide effective controls, with interceptor trenches potentially allowing for significantly greater flow capacity than vertical wells for the same relative cost where installation is feasible.
- Long term operations and maintenance considerations. Trenches can be favorable with respect to maintenance as they can use either gravity (lowest maintenance) or a single / few extraction locations as compared to well systems that will require regular maintenance at each well location. It should be noted that groundwater extraction systems may result in water treatment needs that can have both initial capital and longer-term operations and maintenance considerations.

Both interceptor trench and well system options are included in the below detailed evaluation of the relative effectiveness of the AEM scenarios using the groundwater flow model. Trenches are evaluated along both the upgradient and downgradient perimeter of the unit in combination with low permeability barrier systems.

Vertical well options were limited to wells located within the lowest elevation portions of the closure footprint, as opposed to along the downgradient perimeter areas (along the western and southern perimeter) to minimize the potential to affect the water level in the unnamed tributary to the west and south of AP-1. The depths of extraction systems considered are targeted to provide for groundwater lowering and flow control. A more detailed evaluation of the modeling of these wells and trench drain options is presented in Section 4.4.

4.2.3 In-Situ Stabilization

ISS is a method applied to create a lower permeability and typically higher strength monolith in the subsurface. The major design considerations for ISS are:

- ISS footprint limiting factors, including the size of the target footprint, surface obstructions that would prevent full coverage installation, accessibility, overhead and underground utility locations, and distance from existing slopes.
- Need for a relatively wide and continuous working platform above the entire footprint of the ISS treatment zone during installation.
- Ability of the selected method to effectively reduce permeability and groundwater flows / flux through the targeted CCR.
- The changes in subsurface groundwater conditions (e.g., groundwater levels and flow direction) following the installation; and
- The ability of the selected ISS installation method to reach the target depths of CCR below the potentiometric surface, which may require specialized equipment depending on the depth and penetration requirements.

ISS typically involves many of the same installation constructability evaluations considered for slurry and DSM barrier wall evaluations, but with the target installation zone being within the CCR mass itself and not along the perimeter of the closed unit. The targets for ISS AEM considerations at AP-1 would be the potentially remnant portion of the CCR below the potentiometric surface following closure, within lower elevation portions of the unit. Implementation of ISS would have been most practical / constructable during early stages of closure that saw the lowest ground surface elevations over the installation area footprint rather than after final geometric slope shaping and capping of the unit. However, this approach became infeasible due to the advancement of construction concurrent with AEM option evaluations. Based on the common consideration of ISS as an engineering measure, modeling results related to ISS are further presented in Section 4.4 for comparison purposes.

4.3 Groundwater Modeling Objectives

The objective of the steady state numerical groundwater flow modeling is to simulate post-closure groundwater conditions at the Site with the incorporation of the AEM designs being evaluated. The numerical groundwater model developed for the AP-1 area is described in detail in the Three-Dimensional Numerical Groundwater Modeling Summary Report Revision 06 (Model Report), included as Appendix A of the HAR (WSP, 2023). Detailed groundwater evaluations of the AEM scenarios are summarized in Appendix A to this report.

The steady state model provides a consistent tool to compare the relative effectiveness of the AEM options and configurations. The model is well calibrated and model projections with the cover installed (current conditions at the site) based on 2016 model inputs are consistent with recent field measurements. For these reasons, this steady state model is well suited for this evaluation.

4.4 Detailed Evaluation of Methods

The AEM scenarios that passed through the initial screening as described above are evaluated below using the predictive model. The following effectiveness criteria are considered below:

- The maximum thickness of CCR below the potentiometric surface.
- The post-closure long term volume of CCR below the potentiometric surface.
- Total modelled flow from CCR to Residuum, if applicable.
- Flow path length and travel time from the middle of CCR to the permit boundary of AP-1.
- Implementability considerations, including constructability, operations and maintenance considerations, and potential impacts or adverse effects of the AEM.

Table 1: Summary of AEM Modelled Scenarios

AEM Scenario #	Description of Modelled Scenario
0	Pre-Closure (circa January 2016) Conditions
1	Initial Closure (no AEM, 2017 – present) Conditions
2	Upgradient Barrier and Upgradient Drain
3	Downgradient Barrier to PWR and Downgradient Underdrain
4	Downgradient Barrier to PWR and Internal Dewatering Wells
5	Fully Encompassing Barrier to PWR and Downgradient Drain
6	Fully Encompassing Barrier to PWR or Bedrock
7	In-Situ Stabilization/Solidification

Table 2: Summary of AP-1 AEM Modeling Results (attached) present a summary of the predictive scenario results obtained from the groundwater flow modeling simulations and potential impacts of each modelled scenario.

4.4.1 AP-1 Closure Conditions

CCR within the northern-most portion of AP-1 was excavated and consolidated within the AP-1 footprint. Current closure conditions consist of a cover system over CCR with associated surface water controls, cover surface drains, and adjoining constructed drainage features. The in-place cover system has lowered groundwater elevations in the vicinity of AP-1, reducing the amount of CCR below the potentiometric surface. At AP-1, groundwater flow is generally from the north and east toward the west and south.

The effectiveness of the initial closure and the evaluated AEM scenarios are assessed by steady state model simulations in comparison to the pre-closure conditions (Scenario 0) model results as reported in Table 2 (attached). The change in simulated groundwater flow across a plane representing the CCR contact with adjacent residuum for each of the modelled post closure scenarios, and the change in volume and maximum height of CCR below the modelled potentiometric surface are reported in Table 2.

- **Scenario 1: Initial Closure:**
  - The volume of CCR below the potentiometric surface decreased by 65%, with a remaining maximum thickness of CCR below the potentiometric surface of 10.2 feet (approximately 8.4 ft less than pre-closure), and an area of 11.2 acres.

- Modeled flow out of the CCR and into residuum is approximately 90% less than pre-closure (Scenario 0).
- Estimated water particle travel time from the middle of CCR to the downgradient permit boundary is 90 years (approximately 2.3 times longer than for pre-closure).

4.4.2 Groundwater Extraction Systems

Groundwater extraction system scenarios advanced through initial screening, and further evaluation of the following four configurations of AEMs containing groundwater extraction systems was completed using numerical groundwater modelling:

- **Scenario 2: Upgradient Barrier and Upgradient Drain:**
  - The volume of CCR below the potentiometric surface decreased by 68%, with a remaining maximum thickness of CCR below the potentiometric surface of 9.3 feet, and an area of 10.8 acres.
  - Modeled flow out of the CCR and into residuum is about 93% less than pre-closure (Scenario 0).
  - Estimated water particle travel time from the middle of CCR to the downgradient permit boundary is 100 years (approximately 2.5 times longer than for pre-closure).
- **Scenario 3: Side/Down-gradient Barrier and Underdrain:**
  - The volume of CCR below the potentiometric surface decreased by 57%, with a remaining maximum thickness of CCR below the potentiometric surface of 11.2 feet and an area of 11.5 acres.
  - Modeled flow out of the CCR and into residuum is about 91% less than pre-closure (Scenario 0).
  - Estimated water particle travel time from the middle of CCR to the downgradient permit boundary is 160 years (approximately 4.0 times longer than for pre-closure).
- **Scenario 4: Side/Down-gradient Barrier and Internal Dewatering Wells:**
  - The volume of CCR below the potentiometric surface decreased by 68%, with a remaining maximum thickness of CCR below the potentiometric surface of 10.1 feet and an area of 11.2 acres.
  - Modeled flow out of the CCR and into residuum is > 99% less than pre-closure (Scenario 0).
  - Estimated water particle travel time from the middle of CCR to the downgradient permit boundary is not applicable for this scenario as the particles get captured by the internal dewatering wells.
  - Modelling results of this scenario showed potential for significant negative impacts on water levels in proximate surface features (e.g., potential drying of nearby surface water features).
- **Scenario 5: Fully Encompassing Barrier and Side/Down-gradient Drain:**
  - The volume of CCR below the potentiometric surface decreased by 54%, with a remaining maximum thickness of CCR below the potentiometric surface of 11.5 feet, and an area of 11.7 acres.
  - Modeled flow out of the CCR and into residuum is about 91% less than pre-closure (Scenario 0).
  - Estimated water particle travel time from the middle of CCR to the downgradient permit boundary is 140 years (approximately 3.5 times longer than for pre-closure).

4.4.3 Low-Permeability Barriers

A low permeability subsurface barrier scenario advanced through initial screening, and further evaluation of the following AEM configurations was completed using numerical groundwater modelling:

- **Scenario 6 - Fully Encompassing Barrier Wall to PWR:**
  - The volume of CCR below the potentiometric surface decreased by 54%, with a remaining maximum thickness of CCR below the potentiometric surface of 11.6 feet, and an area of 11.7 acres as shown on Figure 2.
  - Modeled flow out of the CCR and into residuum is about 91% less than pre-closure (Scenario 0).
  - Estimated water particle travel time from the middle of CCR to the downgradient permit boundary is 140 years (approximately 3.5 times longer than for pre-closure).

4.4.4 In-Situ Stabilization

In-situ stabilization (ISS) of CCR materials below the water table surface was advanced through initial screening, and evaluation of one configuration of AEM ISS considering in-situ stabilization of CCR materials below the water table was completed using numerical groundwater modelling:

- **Scenario 7: In-Situ Stabilization/Solidification:**
  - The volume of non-ISS stabilized CCR materials below the potentiometric surface decreased by 100%, with a remaining maximum thickness of non-ISS stabilized CCR materials below the potentiometric surface of 0.0 feet.
  - Modeled flow out of the CCR and into residuum is > 99% less than pre-closure (Scenario 0).
  - Estimated water particle travel time from the middle of CCR to the downgradient permit boundary is greater than 500 years (more than 12.5 times greater than for pre-closure).

5.0 COMPARISON OF OPTIONS

5.1 Relative Comparison of AEMs

Based on the modeled scenarios presented, improvement to groundwater elevations and flow conditions post-closure at AP-1 can be achieved by AEM implementation. Each of the modelled AEM options are compared to the pre-closure conditions and each other with respect to relative effectiveness and implementability in the following sub-sections.

5.1.1 Groundwater Extraction Systems

Incorporation of groundwater extraction with fully- or partially-encompassing barriers (AEM Scenarios 2 through 5) installed to the top of PWR is predicted to reduce the volume of CCR below the potentiometric surface (between 57% and 68%) compared to pre-closure conditions.

It is noted that Scenarios 2, 3 and 5 included groundwater extraction systems in the form of drains combined with barrier elements; while Scenario 4 included a groundwater extraction system in the form of dewatering wells combined with barrier elements. The comparative results of the groundwater modelling for these systems were discussed in Section 4.4.3, with the implementability and constructability considerations for those drains and wells discussed below.

In addition to implementability and constructability considerations for the groundwater extraction system options outlined in Section 4.2, the following need to be considered:

- The target base elevations of 758 to 760 ft (NAVD 88) for the upgradient drain, and 741 to 742 ft (NAVD 88) for the down- and side-gradient drains would require significant below grade excavations into residuum and/or alluvium for installation. Although potentially manageable, temporary dewatering and shoring technologies would be required for construction. Well installation and maintenance require access to each well location for both installation and maintenance during operations, and, as such, wells would need to be located on benches or other flat terrain within the closure geometry and not mid-slope along stacks.
- The internal dewatering well scenario was modeled to cause significant negative impacts (drying out) to nearby surface water features, making this option infeasible to permit and implement.
- Long-term maintenance during construction and post-closure care of the system would be required for management of extracted water, and maintenance of any pumping equipment and conveyance systems installed. These AEMs require operations and maintenance (O&M) once installed.

5.1.2 Low-Permeability Barriers

Several low-permeability subsurface barrier configurations were considered as AEM options for AP- 1, as described in Section 4.4. An AEM barrier installed without a drain with embedment depth to the top of PWR (Scenario 6) is predicted to reduce the volume of CCR below the potentiometric surface by 54%.

When comparing the predicted flow from CCR to residuum post-closure, the simulated low permeability barrier wall AEM configuration was estimated to reduce groundwater flow from the CCR by more than 90% compared to pre-closure.

In addition to implementability and constructability considerations for the barrier wall option installations outlined in Section 4.2, the following need to be considered:

- Barrier installations deeper than to the top of PWR would involve supplemental installation technologies for each deeper option with minimal corresponding additional benefit.
- Construction working platform requirements may require modifications to the existing embankment surrounding AP-1 or other Unit and site infrastructure.

One major advantage of a properly designed and installed barrier wall is that it requires no O&M once installed, compared with groundwater extraction, which requires O&M.

5.1.3 In-Situ Stabilization

One ISS configuration (Scenario 7) was modelled as a potential AEM for AP-1. The footprint of the ISS corresponds to the area of modeled post-closure CCR below the potentiometric surface, resulting in no volume of non-ISS stabilized CCR left below the modeled potentiometric surface. The ISS configuration also has the effect of reducing horizontal groundwater flow through the ISS stabilized CCR by greater than 99%.

In addition to implementability and constructability considerations for the ISS option outlined in Section 4.2, the following need to be considered:

- ISS typically involves many of the same installation constructability evaluations considered for slurry and DSM barrier wall evaluations, but with the target installation zone being within the CCR mass itself and not along the perimeter of the closed unit.
- ISS treatment would likely require deep ISS techniques such as permeation, compaction grouting or large diameter augers (i.e., DSM technology). Areas for ISS treatment have increased in depth due to closure progression to raise the elevation of the final cover to achieve positive drainage and would result in

significant damage to cover components generating significant waste material requiring disposal and requiring rework and reinstallation of supplemental cover components.

- Variations in the in-situ make-up of CCR materials and chemistry may require variations in the ISS mix recipes to achieve the required hydraulic conductivity of the CCR materials. Due to the uncertainty related to this variability, it would be unlikely a uniform permeability could be achieved throughout the ISS volume.
- The large area requiring ISS treatment would cause damage to an installed cover system, requiring its removal and replacement. This would require disposal along with ISS spoil/swell that may be up to 40% of the ISS volume, which would result in increased truck traffic and a need for significant geosynthetics and soil disposal at off-site facilities. Additionally, ISS would require significant increase in schedule, pozzolans, and a need to import clean borrow materials for only a minimal/insignificant potential increase in effectiveness and un-necessarily delay completion of the AP-1 closure construction.
- A properly designed and executed ISS program requires no operation and maintenance (O&M) once installed, compared with groundwater extraction which requires O&M.

Due to the considerations presented in this section, ISS treatment is considered infeasible for CCR Unit AP-1 as an AEM.

5.2 Summary Evaluation and Selection of AEM Option

Based on the evaluations presented in this report, the in-place closure of AP-1 (Scenario 1) (evaluated in conjunction with the closures of adjacent CCR Units AP-2 and AP-3/4) provides a number of positive effects as compared to pre-closure conditions, including:

- Greatly reduced volume of CCR below the potentiometric surface (65% less),
- Significant reductions in total groundwater flow from CCR Unit AP-1 (90% less),

The AEM options discussed in this report are each predicted to offer some level of additional improvements in post closure performance as compared to the initial closure conditions and would enhance the protection of groundwater and closure effectiveness for the AP-1 closure.

- Greatly improved post-closure metrics with AEMs as compared to pre-closure as summarized in Table 1.
- Particle track modeling shows that:
  - AEMs serve to divert groundwater flow paths from intersecting CCR and
  - Provide for stagnation of waters within AP-1 as seen in the increased groundwater travel times and reduced groundwater flow out of CCR.

In completing summary evaluations of the potential AEM options to supplement initial closure of AP-1 both performance metrics in the form of groundwater modelling metric improvements and consideration of constructability and implementability challenges were considered and used to evaluate the options.

Regardless of groundwater modeling results, the ISS option is not recommended for implementation due to the significant barriers to implementation that exist, including requiring removal of the cover system, the generation of significant waste materials that would need to be transported offsite, regrading and CCR handling over a large footprint, and the longest construction schedule of the options for potential implementation. The volume of material requiring ISS would be quite large compared to instances when ISS is typically used and is considered infeasible relative to the marginal potential added benefit as compared to other AEM options.

The low-permeability barrier options (both with and without groundwater extraction) were found to all offer supplemental benefits. The low-permeability barrier and groundwater extraction combination options are all calculated to provide greatly reduced flows from CCR compared to pre-closure.

- The upgradient barrier and upgradient drain AEM (Scenario 2) is predicted to reduce total flows from CCR as compared to pre-closure, but this AEM is less favorable as compared to other options based on not providing a physical barrier between the CCR and downgradient features.
- The down/side-gradient barrier with dewatering wells AEM (Scenario 4) is predicted to reduce total flows from CCR as compared to pre-closure but is less favorable as compared to other options based on the significant modelled negative impacts to water levels in proximate surface features (e.g., potential drying of nearby surface water features). It is also less favorable due to the post closure O&M efforts associated with this option.
- The fully encompassing barrier with underdrain AEM (Scenario 5) has essentially equivalent predicted outflows to the those of the fully encompassing barrier AEM (Scenario 6), with significant increases in post closure O&M considerations related to the underdrain without comparative benefits. Therefore, this AEM is less favorable as compared to other options.
- The down/side-gradient barrier with underdrain AEM (Scenario 3) indicated favorable reductions in the tabulated groundwater metrics, but like AEM Scenario 5, was very similar to the low permeability barrier without groundwater extraction results without the benefit of a fully encompassing physical barrier and is not recommended for implementation due to the significantly higher post closure O&M efforts without comparative benefits. Therefore, this AEM is less favorable as compared to other options.

Based on the evaluation of the range of AEM options listed above, feasibility considerations support the fully encompassing barrier wall option (Scenario 6) for implementation. The use of Scenario 6 (fully encompassing low permeability barrier) as the selected AEM for AP-1 is reinforced by:

- The very low magnitude of predicted flows from CCR (greater than 90% decrease from pre-closure), and
- The installation of a physical barrier to be constructed between the CCR and downgradient features.

Thus, the balance of implementation considerations and predicted effectiveness support Georgia Power's selection of closure of AP-1 with an engineered cover system supplemented with the installation of a fully encompassing low permeability barrier wall as an AEM. To supplement this selection, additional analyses were undertaken to evaluate different target depths of the selected AEM as discussed in Section 6.

6.0 DESIGN EVALUATION OF SELECTED AEM

This section presents an evaluation of different target construction depths for the selected fully encompassing barrier wall AEM scenario. For the AP-1 area, a range of depth options for the wall alignment are evaluated to compare the relative effects on the potentiometric surface and the resulting downgradient flow. For all options, the actual wall materials were not differentiated, and it was assumed that a hydraulic conductivity of 1 x 10^{-7} centimeters per second would be achieved, which is within the normal expected range of a slurry wall.

For the selected AEM of a fully encompassing barrier wall, six differing wall depths were evaluated as follows: (a) wall extending from ground surface to the top of PWR, (b) wall extending from ground surface to two feet into PWR, (c) wall extending from ground surface to five feet into PWR, (d) wall extending from ground surface to the top of bedrock, (e) wall extending from ground surface to two feet into bedrock, and (f) wall extending from ground surface to five feet into bedrock.

Table 3: Summary of AEM Design Evaluation Modelled Scenarios

AEM Scenario #	Description of Modelled Scenario
0	Pre-Closure (circa January 2016) Conditions
1	Initial Closure (no AEM, 2017 – present) Conditions
6A	Fully Encompassing Barrier to PWR (Same as Scenario 6 above)
6B	Fully Encompassing Barrier 2 feet into PWR
6C	Fully Encompassing Barrier 5 feet into PWR
6D	Fully Encompassing Barrier to Bedrock
6E	Fully Encompassing Barrier 2 feet into Bedrock
6F	Fully Encompassing Barrier 5 feet into Bedrock

6.1 Depth of Barrier Wall AEM Groundwater Modelling Results

Low permeability subsurface barrier scenarios evaluated via further modeling of a range of target depths of the above AEM configurations was completed using numerical groundwater modelling, and provided the following summary results:

- **Scenario 6A - Fully Encompassing Barrier Wall to PWR:**
  - The volume of CCR below the potentiometric surface decreased by 54%, with a remaining maximum thickness of CCR below the potentiometric surface of 11.6 feet, and an area of 11.7 acres.
  - Modeled flow out of the CCR and into residuum is about 91% less than pre-closure (Scenario 0).
  - Estimated average water particle travel time from the middle of CCR to the downgradient permit boundary is 140 years (approximately 3.5 times greater than for pre-closure).
- **Scenario 6B: Fully Encompassing Barrier 2 feet into PWR:**
  - The volume of CCR below the potentiometric surface decreased by 52%, with a remaining maximum thickness of CCR below the potentiometric surface of 11.8 feet, and an area of 11.8 acres.
  - Modeled flow out of the CCR and into residuum is about 91% less than pre-closure (Scenario 0).
  - Estimated average water particle travel time from the middle of CCR to the downgradient permit boundary is 140 years (approximately 3.5 times greater than for pre-closure).
- **Scenario 6C: Fully Encompassing Barrier 5 feet into PWR:**
  - The volume of CCR below the potentiometric surface decreased by 51%, with a remaining maximum thickness of CCR below the potentiometric surface of 11.9 feet, and an area of 11.8 acres.
  - Modeled flow out of the CCR and into residuum is about 92% less than pre-closure (Scenario 0).

- Estimated average water particle travel time from the middle of CCR to the downgradient permit boundary is 150 years (approximately 3.8 times greater than for pre-closure).

- **Scenario 6D: Fully Encompassing Barrier to top of bedrock**:
  - The volume of CCR below the potentiometric surface decreased by 50%, with a remaining maximum thickness of CCR below the potentiometric surface of 12.0 feet, and an area of 11.9 acres.
  - Modeled flow out of the CCR and into residuum is about 92% less than pre-closure (Scenario 0).
  - Estimated average water particle travel time from the middle of CCR to the downgradient permit boundary is 150 years (approximately 3.8 times greater than for pre-closure).
- **Scenario 6E**: **Fully Encompassing Barrier 2 feet into bedrock:**
  - The volume of CCR below the potentiometric surface decreased by 46%, with a remaining maximum thickness of CCR below the potentiometric surface of 12.7 feet, and an area of 12.0 acres.
  - Modeled flow out of the CCR and into residuum is about 93% less than pre-closure (Scenario 0).
  - Estimated average water particle travel time from the middle of CCR to the downgradient permit boundary is 170 years (approximately 4.3 times greater than for pre-closure).
- **Scenario 6F**: **Fully Encompassing Barrier 5 feet into bedrock:**
  - The volume of CCR below the potentiometric surface decreased by 43%, with a remaining maximum thickness of CCR below the potentiometric surface of 13.3 feet, and an area of 12.2 acres.
  - Modeled flow out of the CCR and into residuum is about 94% less than pre-closure (Scenario 0).
  - Estimated average water particle travel time from the middle of CCR to the downgradient permit boundary is 200 years (approximately 5 times greater than for pre-closure).

6.2 Depth of Barrier Wall AEM Constructability Considerations

In addition to evaluating and comparing the groundwater modelling performance metrics, it is important to consider that deeper subsurface barrier walls present constructability challenges as they are more complex to build, which creates difficulty demonstrating conformance with design and performance of the installed barrier wall.

Installation techniques that are relevant to the construction of the perimeter barrier wall may include one or more of the following: Conventional Slurry Walls (excavator or clam shell), Deep One Pass Trench®, Deep Soil Mixing (DSM), Cutter Soil Mixing (CSM), Trench Cutting and Remixing Deep (TRD), Hydro-Mill/Hydro-Fraise, Jet Grouting, and Secant Walls. Constructability considerations for the range of barrier wall installation depths (Scenarios 6A to 6F) include:

- Wall Depth – techniques available to install the proposed barrier walls become limited as the proposed depth of the wall is increased:
  - Excavator reach is generally limited to < 60 ft
  - Fixed mast equipment (e.g., One Pass, DSM, CSM, and TRD) is generally limited to < 80 to 100 ft.
- Subsurface Penetration – techniques available to install the proposed barrier walls become limited as the proposed depth of the wall is increased and equipment must penetrate harder material. This limits

implementation to select specialty contractors. In general, the range of installation methods available can be divided by ability to penetrate to or into three material types present at AP-1:

- Typical Soils (e.g. Residuum) (SPT N-values up to 25 bpf) – most of the techniques can be effectively used.
- Hard Soils (e.g. Residuum) to PWR (N-values up to 100 bpf) – smaller group of effective techniques.
- Rock – limited to drillhole grouting or hydromill/hydrofraise techniques.

- Construction quality control / assurance – CQC / CQA becomes more complex with increasing wall depth and penetration into hard soils, PWR, and rock to verify penetration resistance, wall depth, wall integrity (e.g., maintaining full thickness and homogeneous properties) and performance (e.g., achieving permeability targets). Furthermore, if two or more techniques are required for construction, it becomes increasingly complex to complete CQC and CQA checks for integrity and performance metrics of the installed barrier wall. These additional checks often require additional drill holes which may serve to increase the secondary porosity of the surrounding subsurface soils and rocks, which is undesirable.
- Subsurface Variability – the subsurface at AP-1 is highly variable (thickness, strength, composition, depth to PWR, depth to Rock) along the alignment of the barrier wall thus requiring the selected technique(s) to have a means to adjust the installation depth and track penetration resistance. Because of the undulating bedrock, barrier wall installations in the Piedmont geology are inherently more complex than constant depth walls more often found in alluvial / coastal geologies.
- Subsurface and Overhead Utilities – Portions of the barrier wall alignment have subsurface utility conflicts that limit continuous lateral installation and/or overhead power line conflicts that limit the height of wall equipment in these zones, eliminating the potential to use some techniques in those portions of the alignment.
- Stability – Wall installation and quality assurance equipment requires a stable working and installation platform and must consider the stability of the dikes and other nearby slopes / structures during and after the construction process. Equipment stability requirements generally increase for deeper walls and walls that need to penetrate denser materials (e.g., PWR and rock) due to the increased down force and weight of equipment needed to penetrate these layers.
  - Temporary shoring, reinforcement, dewatering, and/or construction sequencing may be required in some segments or wall conditions.
  - Increased safety risks during construction, and additional measures such as instrumentation may be required to monitor stability during the construction of some areas.

In summary, the complexity of installation and CQC/CQA increases significantly with wall depth (i.e., complexity increases for wall options 6B through 6F) for the Plant McDonough AP-1 site conditions. The number of available installation techniques and contractors qualified to provide installation similarly decreases as the target wall depth penetration increases. Additionally, wall installation depth options into PWR and/or into rock (6C to 6F) will generally require a combination of multiple techniques (e.g., conventional soil techniques followed by drilling through the upper wall sections to complete grouting of the target deep PWR / rock zones below). This use of multiple techniques results in the potential to compromise the upper wall sections, which are modeled to be responsible for the overwhelming majority (91%) of flow reduction.

6.3 Depth of Barrier Wall AEM Summary Evaluation

The fully encompassing barrier wall AEMs to or into PWR (Scenario 6A to 6C) and bedrock (Scenario 6D to 6F) are all predicted to provide similarly favorable post closure groundwater metrics. Each is predicted to reduce groundwater flow from the CCR by more than 90%. The deeper wall options (6B to 6F) do not result in appreciable flow reductions compared to the fully encompassing wall to PWR AEM (6A) and introduce additional construction challenges that have the potential to compromise the upper wall and soils, which results in greater performance uncertainty for the deeper, more complex barrier wall options.

Thus, a fully encompassing wall to PWR AEM (Scenario 6A) achieves the AEM goals to the maximum extent feasible, especially considering the significant relative constructability and CQC/CQA complexity associated with installing a low permeability barrier below the top of PWR at the site.

Based on the evaluation of the range of AEM options listed above, both comparative performance metrics and feasibility considerations support the fully encompassing barrier wall option Scenario 6A for implementation and is reinforced by:

- High percentage reduction in predicted flows from CCR (greater than 90% decrease from pre-closure) in all downgradient directions, and
- The selected AEM will provide for a physical, low permeability barrier between the CCR and downgradient features.

7.0 CONCLUSIONS

This report presents an overview of the performance (relative) and feasibility of relevant AEM options and supports Georgia Power's selection of a fully encompassing barrier wall installed to the top of PWR as an AEM for the closure of AP-1. As demonstrated by the groundwater model and the feasibility consideration discussed above, a fully encompassing barrier wall installed to the top of PWR reduces lateral flow through AP-1 to the maximum extent feasible. Once the cover system and wall to PWR are in place and the system reaches equilibrium, flow into and out of the unit is effectively stagnated. The particle tracking shown on Figure 3 (for Scenario 6A – Wall to PWR), illustrates that the barrier wall will divert groundwater flow upgradient of the permitted boundary around the wall, through the partially weathered rock below the base of CCR in AP-1. With the wall installed, flow from the CCR is reduced by over 90%, and CCR contained within the closed unit is effectively isolated from lateral flow and the surrounding environment.

In addition, the minimal flow out of AP-1 will follow an extended flow path that will provide for attenuation of Appendix IV parameters. Groundwater quality at AP-1 is and will continue to be monitored in accordance with federal and state requirements, and statistical exceedances are being addressed through the regulatory assessment of corrective measures (ACM) process. While the closure of AP-1 is designed independently from a groundwater corrective action, the closure of AP-1 with the wall to PWR will compliment future groundwater corrective action and will have an overall benefit to groundwater quality. Georgia Power will continue to perform groundwater monitoring and reporting at AP-1 for at least 30 years during post-closure care after the unit is closed.

8.0 REFERENCES

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WSP, 2023. Hydrogeologic Assessment Report, Plant McDonough-Atkinson CCR Surface Impoundment (CCR Unit AP-1), Revision 06. December 2023.

WSP USA, Inc.

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BJ/VT/SS/GLH/wg/cb/glh/ls

Tables

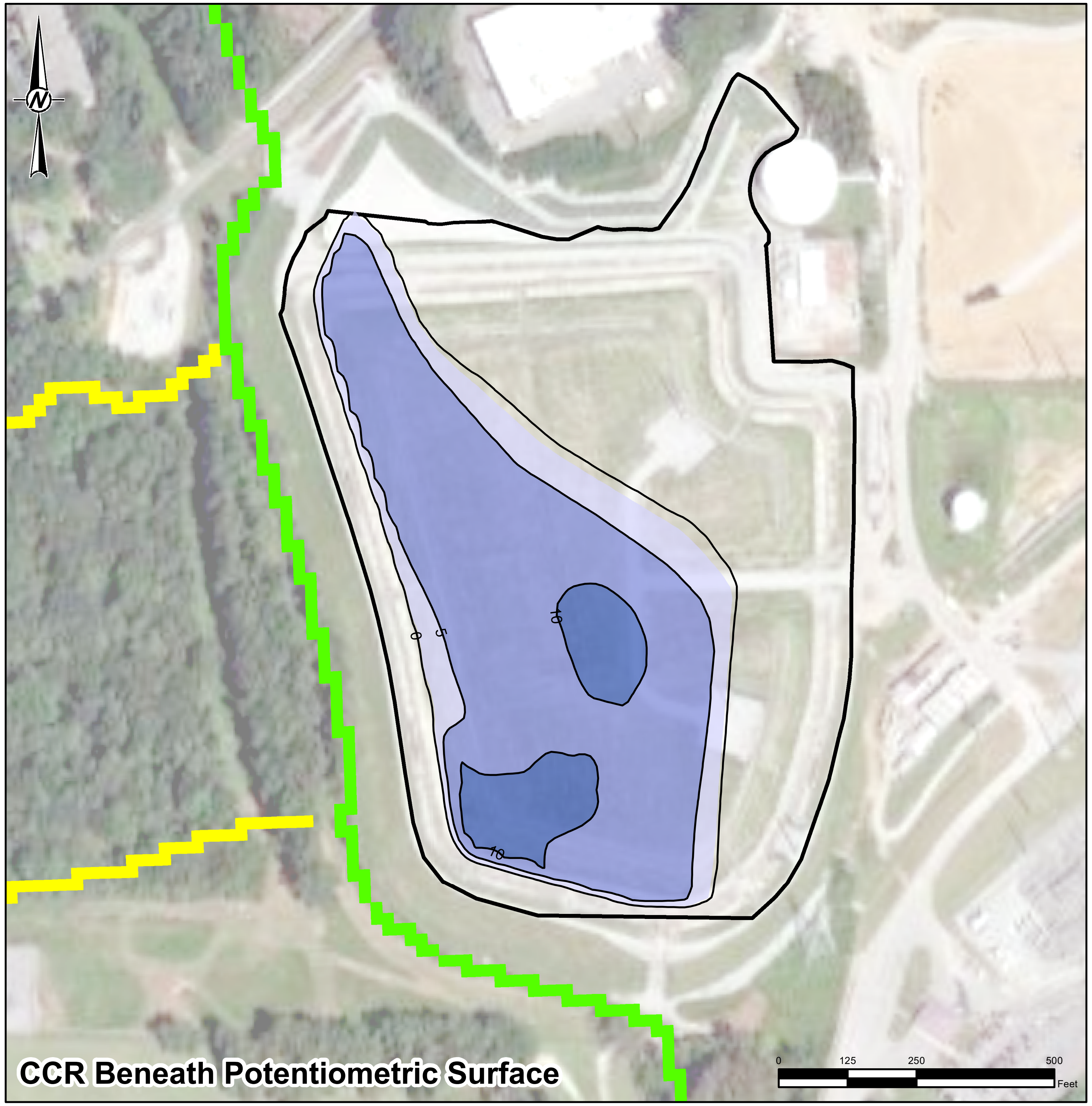
Table 2
Summary of AP-1 AEM Modeling Results
Groundwater Model AEM Evaluation
Plant McDonough Ash Pond 1 (AP-1)

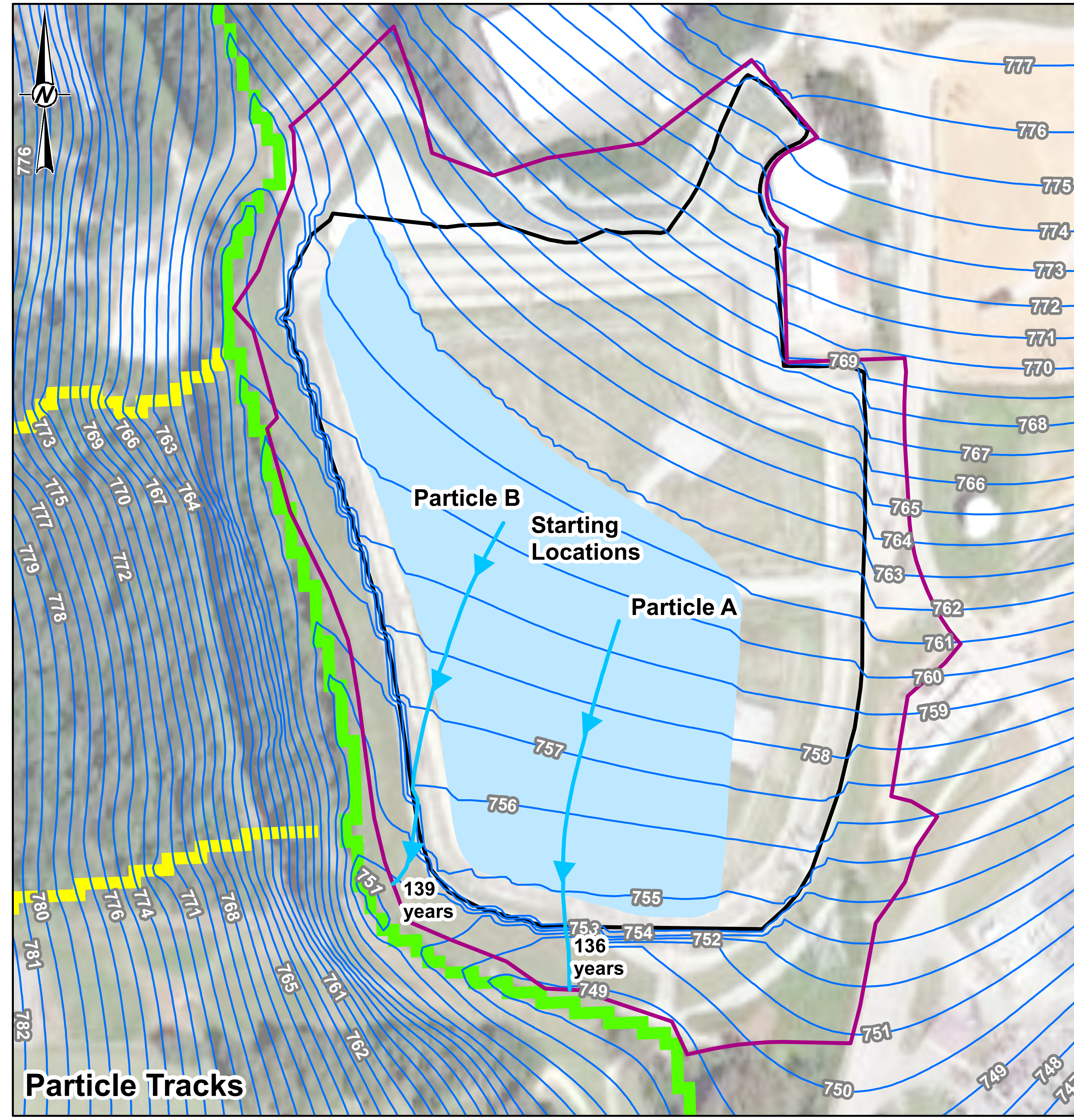
Scenario No.	AP-1 Conditions	Description of Enhancement	Effectiveness						
			Maximum Height of Potentiometric Surface Above Bottom of Unit (feet)	Volume of CCR Below the Potentiometric Surface (cubic yards)	Percent (%) Reduction in Volume of CCR Below the Potentiometric Surface	Percent (%) Reduction of Area of CCR Below the Potentiometric Surface	Percent Reduction of Total Flow From Pre-Closure CCR Base Area	Particle Track A travel time to permit boundary (Years)	Particle Track B travel time to permit boundary (Years)
0	No Cover	Pre-closure Conditions	18.6	289,834	-	-	-	40	20
1	Cover Installed	Cover Installed (Initial Closure)	10.2	101,174	65%	40%	90%	90	50
2	Cover Installed	Upgradient Barrier and Upgradient Drain	9.3	92,434	68%	42%	93%	100	70
3	Cover Installed	Side/Down-gradient Barrier and Underdrain	11.2	123,262	57%	39%	91%	160	50
4	Cover Installed	Side/Down-gradient Barrier and Internal Dewatering Wells	10.1	93,456	68%	40%	100%	NA	NA
5	Cover Installed	Fully Encompassing Barrier and Side/Down-gradient Drain	11.5	132,240	54%	38%	91%	140	140
6A	Cover Installed	Fully Encompassing Barrier to top of PWR	11.6	133,221	54%	38%	91%	140	140
6B	Cover Installed	Fully Encompassing Barrier 2 feet into PWR	11.8	138,087	52%	37%	91%	140	170
6C	Cover Installed	Fully Encompassing Barrier 5 feet into PWR	11.9	142,091	51%	37%	92%	150	180
6D	Cover Installed	Fully Encompassing Barrier to Top of Bedrock	12.0	145,519	50%	36%	92%	150	200
6E	Cover Installed	Fully Encompassing Barrier 2 feet into Bedrock	12.7	155,268	46%	36%	93%	170	220
6F	Cover Installed	Fully Encompassing Barrier 5 feet into Bedrock	13.3	164,370	43%	35%	94%	200	240
7	Cover Installed	In-Situ Stabilization/Solidification	11.7	125,863	57%	37%	100%	>500	460

Notes:

1. These values were obtained from groundwater flow modeling results, which are necessarily simplified mathematical representations of complex natural systems. Because of this, all groundwater models have limits to their accuracy.
2. CCR = Coal Combustion Residuals
3. These model results were intended for use as relative comparisons between scenarios, and not as precise predictions of post closure conditions.
4. Outflow from layer 1 in the Side/Down-gradient Barrier and Internal Dewatering Wells model (Scenario 4) occurs primarily via extraction wells, and not through the base of CCR.
5. Penetration depths into specified media only apply where sufficient thickness occurs. Otherwise penetration depth truncates at the top of the underlying layer.
6. Particle A starts half way between the water table and the base of CCR above the lowest point in AP-1
7. Particle B starts half way between the water table and the base of CCR to the northwest of location A.
8. NA = Not Applicable (particle tracks terminate at dewatering wells).

Figures





LEGEND

CCR Thickness Below Potentiometric Surface (ft)

- 12 to10
- 10 to 5
- 5 to 0
- Post-Closure Waste Boundary
- River Boundary Conditions
- Drain Boundary Conditions
- Area With Water Table Above The Base of CCR
- Particle Tracks
- Water Table Contours
- AP-1 Permit Boundary

NOTE(S)
1. NAVD 88 - NORTH AMERICAN VERTICAL DATUM OF 1988.
2. CCR - COAL COMBUSTION RESIDUALS.
3. CONTOUR INTERVAL = 1 FOOT
4. ARROWS INDICATE PARTICLE TRACK DIRECTION, NOT VELOCITY.

REFERENCE(S)
1. AERIAL IMAGERY FROM NAIP DATASET, DATED 2019-09-10 THROUGH 2019-10-04.

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

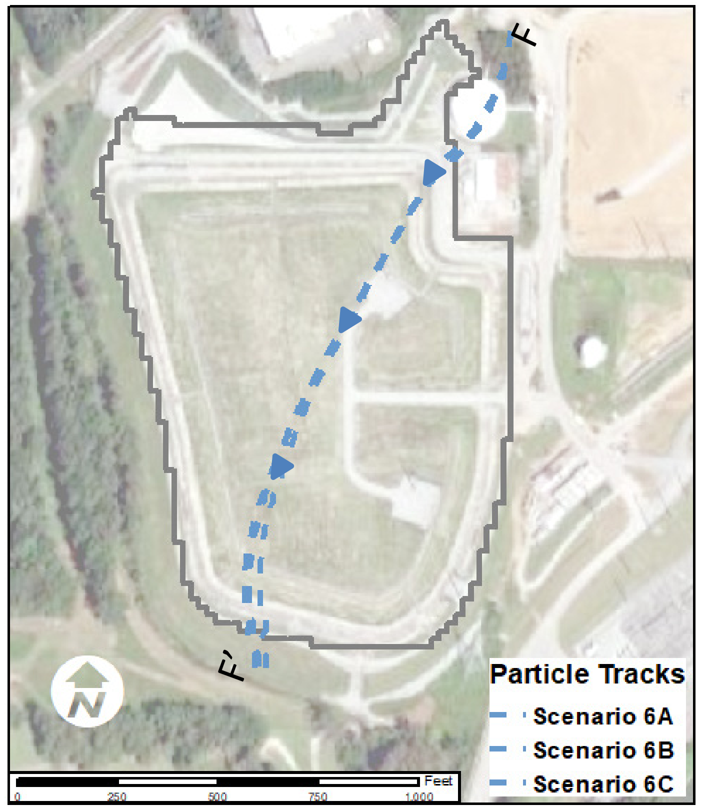
PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

CONSULTANT
wsp

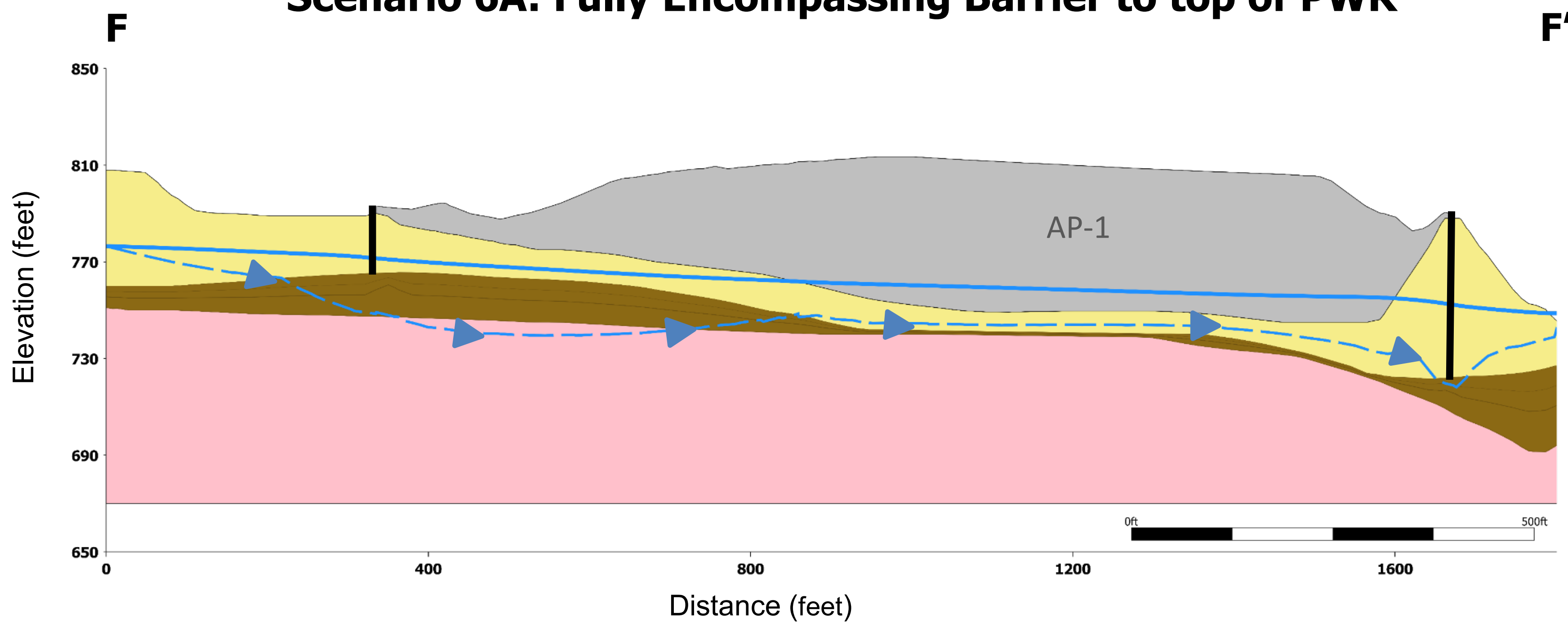
YYYY-MM-DD	2024-03-28
DESIGNED	JDV
PREPARED	AFS
REVIEWED	WG
APPROVED	CB

TITLE
MODEL OUTPUTS FOR SCENARIO 6A (WALL TO TOP OF PWR)

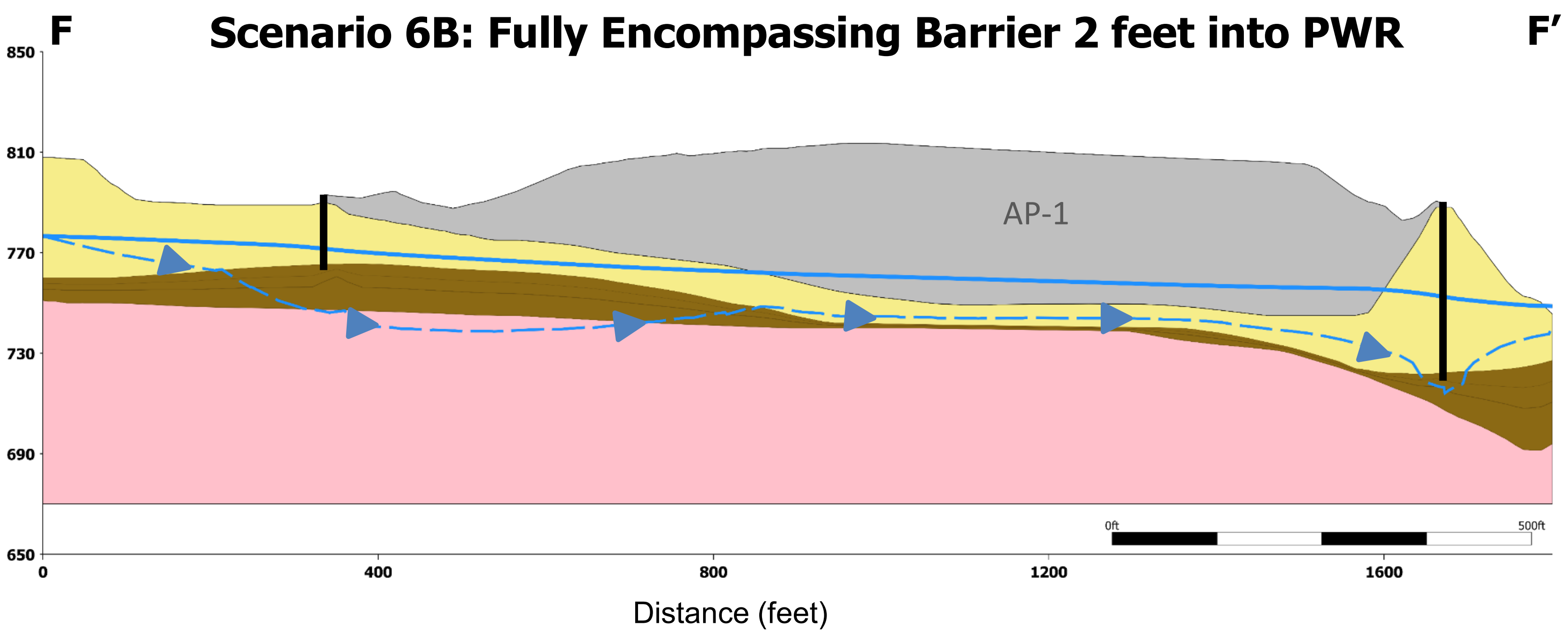
PROJECT NO.	SCS PROJECT ID.	REV.	FIGURE
31406440.000	MCD15017	0	2



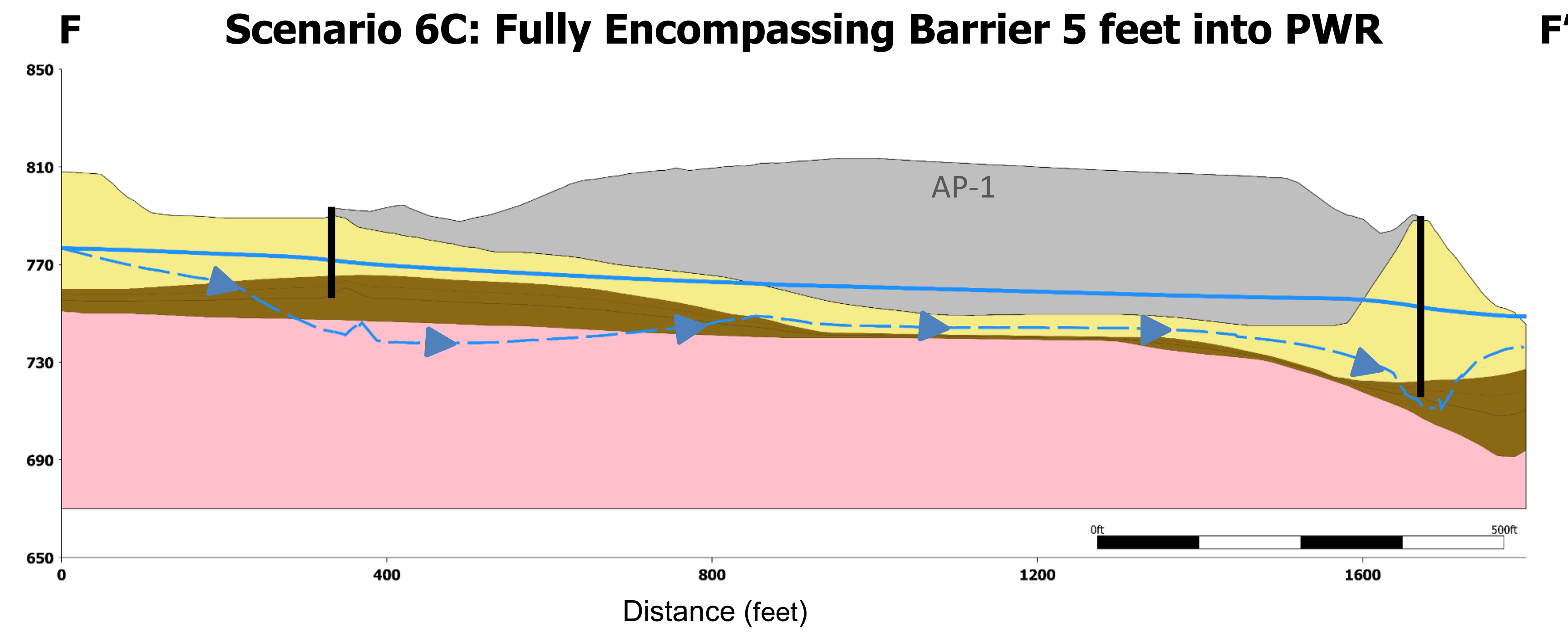
Scenario 6A: Fully Encompassing Barrier to top of PWR



Scenario 6B: Fully Encompassing Barrier 2 feet into PWR



Scenario 6C: Fully Encompassing Barrier 5 feet into PWR



Key

Geologic units

- Layer 1 - Coal Combustion Residuals
- Layer 2 - Residuum
- Layers 3-5 – Partially Weathered Rock
- Layers 6-8 - Bedrock

Hydraulic features

- Simulated Water table
- Scenario Particle Track
- Hydraulic Barrier Wall

Notes:
- F-F' profile line is Scenario 6A particle track
- Arrows indicate particle track direction, not velocity
- Elevations are shown in the North American Vertical Datum of 1988 (NAVD88)
- Vertical Exaggeration: 3x

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

CONSULTANT

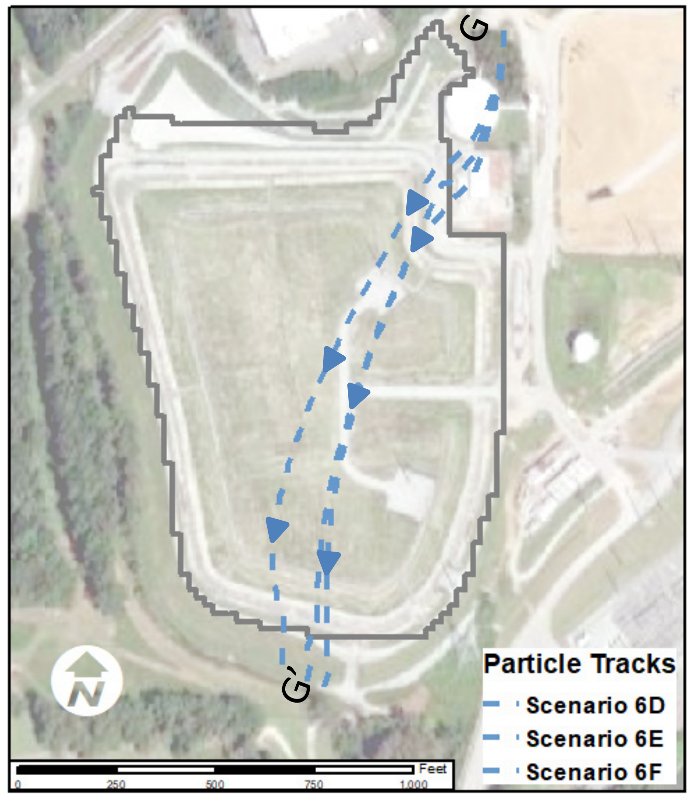
wsp

YYYY-MM-DD	2024-03-27
PREPARED	NP
DESIGNED	NP
CHECKED	WG
REVIEWED / APPROVED	DLP

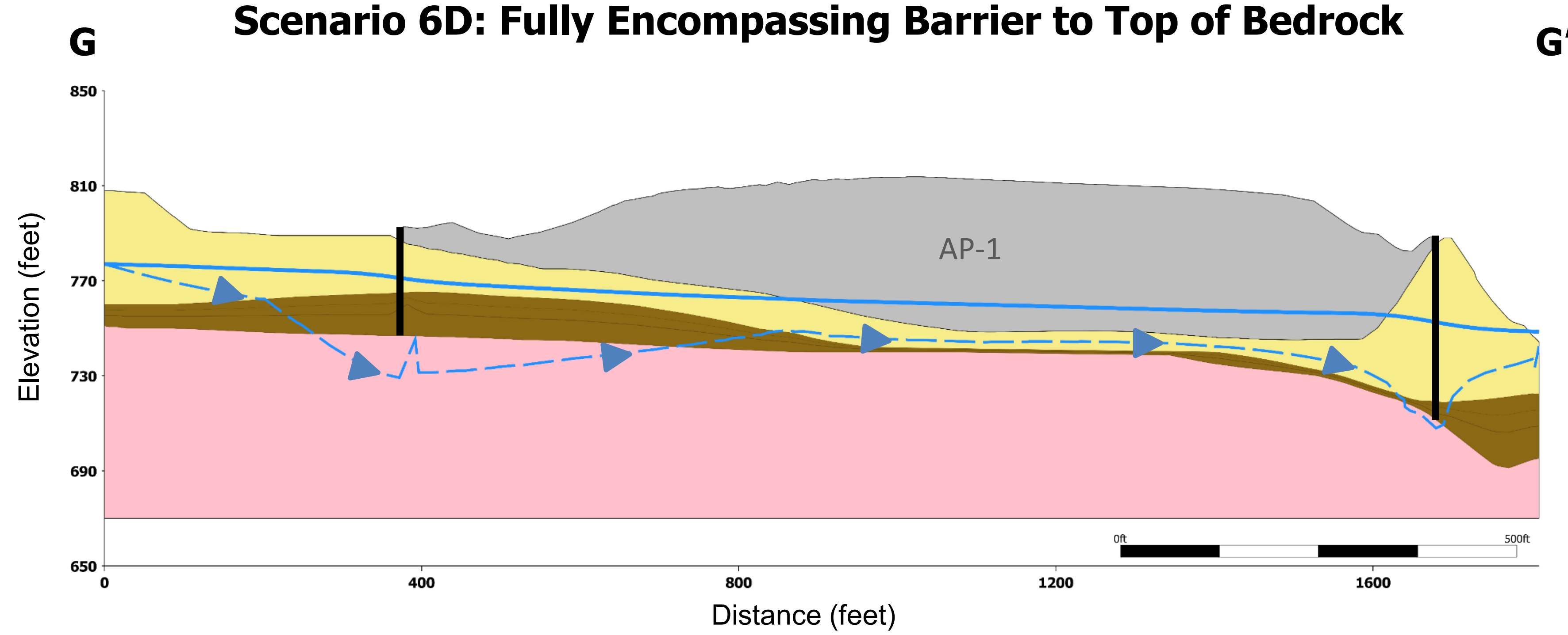
TITLE
PARTICLE TRACK CROSS SECTION F-F' FOR SCENARIOS 6A-6C

PROJECT NO.	SCS PROJECT ID	REV.	FIGURE
31406440.000	MCD15017	0	3

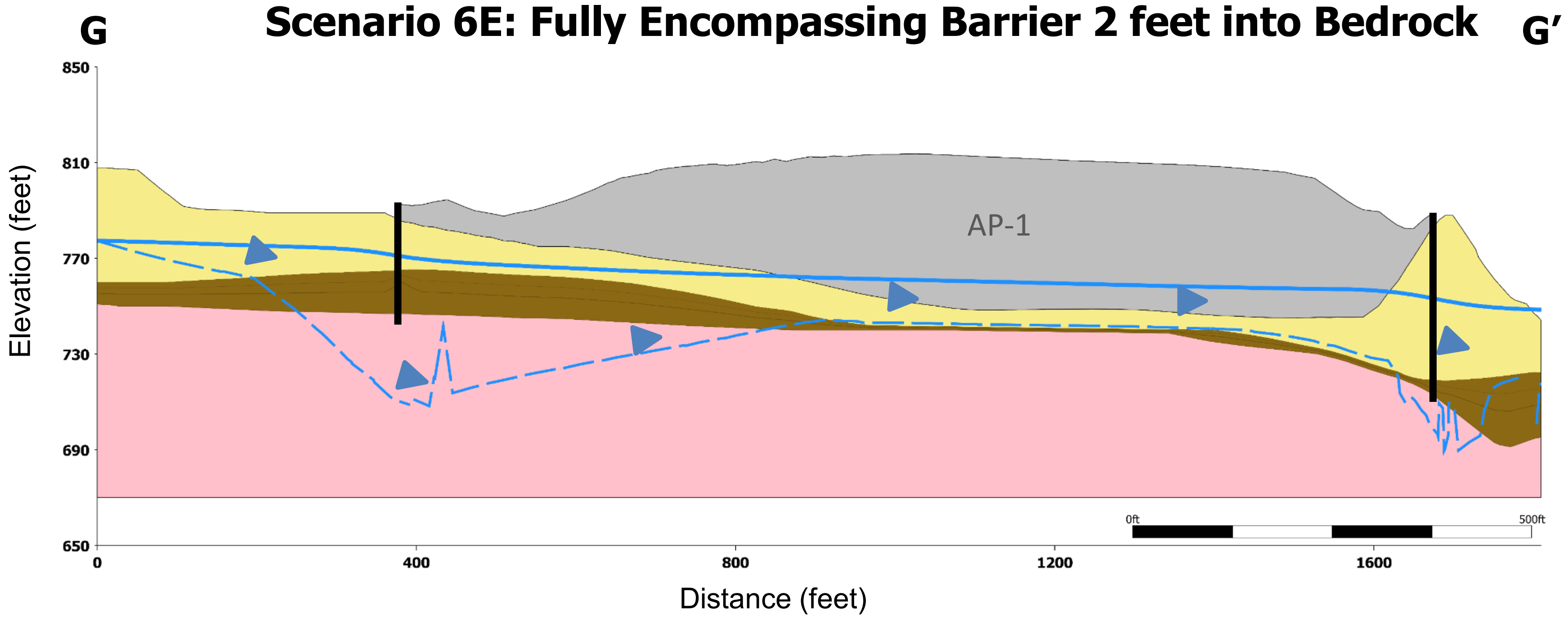
Path: document1 | FileName: DOCUMENT1



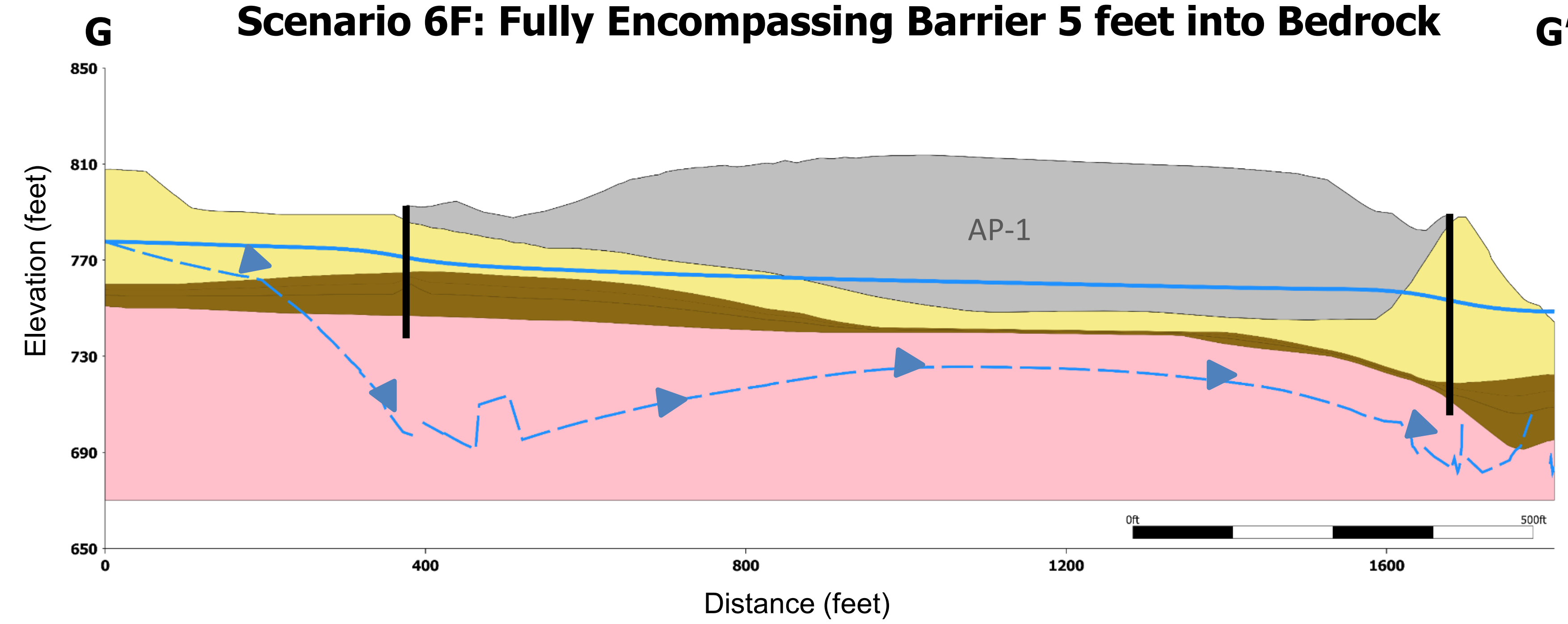
Scenario 6D: Fully Encompassing Barrier to Top of Bedrock



Scenario 6E: Fully Encompassing Barrier 2 feet into Bedrock



Scenario 6F: Fully Encompassing Barrier 5 feet into Bedrock



Key

Geologic units

- Layer 1 - Coal Combustion Residuals
- Layer 2 - Residuum
- Layers 3-5 – Partially Weathered Rock
- Layers 6-8 - Bedrock

Hydraulic features

- Simulated Water table
- Hydraulic Barrier Wall
- Scenario Particle Track

Notes:
- G-G' profile line is the Scenario 6D particle track
- Arrows indicate particle track direction, not velocity
- Elevations are shown in the North American Vertical Datum of 1988 (NAVD88)
- Vertical Exaggeration: 3x

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

CONSULTANT

YYYY-MM-DD	2024-03-27
PREPARED	NP
DESIGNED	NP
CHECKED	WG
REVIEWED / APPROVED	DLP

TITLE
PARTICLE TRACK CROSS SECTION G-G' FOR SCENARIOS 6D-6F

PROJECT NO.	SCS PROJECT ID	REV.	FIGURE
31406440.000	MCD15017	0	4

APPENDIX A

AP-1 AEM Options Groundwater Model Calculation

Groundwater Model AEM Evaluation Calculation Package

Plant McDonough CCR Unit Ash Pond 1 (AP-1)

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March 29, 2024

Table of Contents

Tables

Figures

1.0 INTRODUCTION

Plant McDonough-Atkinson (Plant McDonough; the Plant) is a power generating facility, owned and operated by Georgia Power, located in Cobb County, GA (Figure 1-1). Plant McDonough historically operated as a coal fired facility, and four on-site CCR surface impoundments were utilized for CCR material over the duration of Plant McDonough's coal fired operations: Ash Pond 1 (AP-1), Ash Pond 2 (AP-2), Ash Pond 3 (AP-3), and Ash Pond 4 (AP-4). In 2011, Plant McDonough ceased coal-fired electric generating activities, and subsequently ceased placing CCR in the units. A previous groundwater model was constructed to assess potentiometric heads and subsurface flow paths in the vicinity of the site, and the effect of closure on CCR units. This model was submitted to the Georgia Environmental Protection Division (EPD) in 2020 (WSP, 2023A).

On behalf of Georgia Power Company (Georgia Power), WSP USA Inc. (WSP) has prepared this Groundwater Model Calculation Package (Report) documenting the results of pre- and post-closure modeling performed in support of the Advanced Engineering Methods (AEM) Feasibility Evaluation for CCR Unit AP-1. The post-closure scenarios presented herein simulate potential post-closure conditions in AP-1 CCR for different Advanced Engineering Methods.

1.1 Modeling Objective

The modeling objective is to simulate long-term (steady-state) hydraulic conditions in the AP-1 CCR assuming closure conditions corresponding to the following AEM scenarios. In each AP-1 closure scenario (Scenarios 1 through 7) below, AP-2 is simulated as closed by CCR removal, and AP-3/4 is simulated as closed with an engineered cover and buttress drainage system that is designed to prevent the future impoundment of water, with measures to prevent infiltration and sloughing, and minimize erosion and settling.

Scenario 0: Pre-closure Conditions – Represents the January 2016 hydraulic conditions before installation of the final cover system at AP-1.

Scenario 1: Cover Installed (Initial Closure) – Represents 2018 hydraulic conditions after installation of the final cover system at AP-1.

Scenario 2: Upgradient Barrier and Upgradient Drain - The simulated barrier wall for this scenario extends to the top of the PWR and is approximately 2,750 feet in length. The simulated gravity drain is upgradient of barrier wall and about 1,100 feet in length.

Scenario 3: Side/Down-gradient Barrier and Underdrain - Construction of a side/down-gradient barrier wall with a side/down-gradient drain system. Wall length is approximately 1,500 feet, and would extend to the top of PWR. The drain system is upgradient of the wall footprint and is approximately 2,500 feet long.

Scenario 4: Side/Down-gradient Barrier and Internal Dewatering Wells - Construction of a barrier wall extending to the top of PWR along the southern side and a portion of the western side of AP-1, with a length of approximately 1,500 feet. Installation of dewatering wells at approximate 150-foot centers along the western impoundment berm. Dewatering well depths in the model extend to the bottom of CCR.

Scenario 5: Fully Encompassing Barrier and Side/Down-gradient Drain - Construction of a fully encompassing barrier wall with a side/down-gradient drain system. Wall length is approximately 5,000 feet extending to the top of PWR. Drain length is approximately 2,500 feet and is equipped with collection sump.

- **Scenario 6A: Fully Encompassing Barrier to top of PWR** - Fully encompassing barrier wall installed to the top of PWR without accompanying drain or pumping system.
- **Scenario 6B: Fully Encompassing Barrier 2 feet into PWR** - Fully encompassing barrier wall installed 2 feet below top of PWR. Installed to top of bedrock where PWR is less than 2 feet thick.
- **Scenario 6C: Fully Encompassing Barrier 5 feet into PWR** - Fully encompassing barrier wall installed 5 feet below top of PWR. Installed to bedrock where PWR is less than 5 feet thick.
- **Scenario 6D: Fully Encompassing Barrier to top of Bedrock** - Fully encompassing barrier wall installed to top of bedrock.
- **Scenario 6E**: **Fully Encompassing Barrier 2 feet into Bedrock -** Fully encompassing barrier wall installed 2 feet below top of bedrock.
- **Scenario 6F**: **Fully Encompassing Barrier 5 feet into Bedrock -** Fully encompassing barrier wall installed 5 feet below top of bedrock.
- **Scenario 7: In-Situ Stabilization/Solidification** - Removal of the existing cover and deep soil mixing of CCR in areas where CCR is present beneath the potentiometric surface. Re-install cover over remaining CCR.

The volume, area, and maximum height of remaining CCR below the potentiometric surface were calculated for each scenario, as well as the total flow out of CCR, to compare AEM effectiveness.

2.0 MODEL CONSTRUCTION

Detailed model construction and calibration information was previously documented in the October 2020 Model Report that was included as Appendix A in the most recent Hydrogeologic Assessment Report (HAR; WSP, 2023A), and the November 2021 Model Report Addendum. The following sections document changes to the previously documented closure model to facilitate simulation of the various AEM scenarios described above in Section 1.1. Four new model layers were added to the previous 4-layer model to facilitate the simulation of barrier walls extending various depths into PWR and bedrock. All model results reported in this Report are based on steady state hydrologic conditions.

Model Code

The previous model submission to the EPD was a calibrated, steady state flow model that used the MODFLOW-NWT model code, which is a refinement of the MODFLOW 2005 groundwater model code (Niswonger et al., 2011). The model consisted of four layers (one each for CCR, residuum, PWR and bedrock), with fully penetrating hydraulic barrier walls (i.e., extending the full height of each containing layer). This evaluation considers both fully- and partially penetrating barrier wall methods, as discussed in Section 2.5. Additional model layers were needed within the PWR and bedrock model layers to facilitate simulation of the partially penetrating wall alignments. These layer modifications resulted in some model cells along the wall alignment with very small cell thicknesses ranging from 0.0 to 0.1 foot. Therefore, the model code was updated from MODFLOW-NWT to MODFLOW-USG Transport (USG), to permit cell pinch-outs. A comparison of the calibrated MODFLOW-NWT results with the same build in USG is discussed in Section 2.2.

Section 2.2 provides a brief overview of the process used to validate the model code and layer modifications.

Model Update Summary

Model code, boundary condition (BC), and layer modifications were validated by comparing results in the four-layer wall to PWR model from the HAR to the eight-layer wall to PWR model in the Report. Cumulative flow balances for both models are shown in Table 1, demonstrating negligible changes in flow due to changing model structure. Simulated heads were also compared for the two models for monitoring well locations screened in active cells (Figure 2-1; Table 2). Overall, differences in water level elevation were approximately 0.6 foot or less. Together, these results indicate that the change from MODFLOW-NWT to MODFLOW-USG Transport, along with the change from four to eight model layers did not notably change the model predictions or performance of the model.

Model Domain

The active model domain shown on Figure 2-2 covering 2.04 square miles applies to model layers 2 to 8. The domain includes the plant and adjoining areas to the west, north, and east. The Layer 1 (CCR) active model domain denoted on Figure 2-2 is limited to the AP-1, AP-2, and AP-3/4 footprints. The western, northern, and eastern domain boundaries in model layers 2 to 8 are assigned as no flow. Layer 2 (residuum) model cells along the southern boundary are assigned river BC cells. Layers 3 to 8 (PWR and bedrock) along the southern model boundary are assigned as no flow.

Model Grid and Layering

The full model grid covers 3.23 square miles of which 2.04 square miles are active. The entire model grid consists of a finite difference grid with eight layers of 500 rows and 450 columns. Model layer thickness varies based on interpreted geologic unit thicknesses.

The model grid top in the pre-closure model presented in this Report represents the pre-closure ground surface. The pre-closure model top geometry is modified from the model top documented in Appendix A of the HAR and is consistent with pre-closure Power Plant topography. Layer 1 pre-closure bottom surface model geometry is modified from the October 2020 Model Report in AP-2 based on post removal topography shown on Figure 1 of the CCR Removal Certification Report dated February 2020. Post closure grading represented by closure model surfaces are unchanged from the October 2020 Model Report. The pre-closure and post-closure model grid tops for AP-1 are shown on Figure 2-3.

Model Boundaries

The following BC modifications were made to the previously documented pre-closure model (WSP, 2023B) and previously documented closure model (WSP, 2023A) for the AP-1 pre-closure model and post-closure AEM scenarios. BCs for Scenarios 0, 2 and 3 are shown on Figure 2-4, and BCs for Scenarios 4,5,6, and 7 are shown on Figure 2-5.

Scenario 0: Pre-closure Conditions – Constant head BCs were converted to river BCs to reflect the pre-closure open water in AP-2 and the observed, relatively constant, pre-closure groundwater elevation of 830 feet NAVD 88 in AP-3/4. River and drain BCs also represent the Chattahoochee River and tributary streams.

Scenario 1: Cover Installed (Initial Closure) – The initial closure model contains the same BCs for the Chattahoochee River and tributary streams, with ash pond surface water removed. Property zones were used to simulate the covers over AP-1 and AP-3/4, and an enhanced underdrain was placed underneath the AP-3/4 buttress via drain BCs, with no additional closure elements.

Scenario 2: Upgradient Barrier and Upgradient Drain – Scenario 2 uses the same model structure, property zones, and BCs as Scenario 1, with the addition of an upgradient drain and hydraulic barrier wall. The drain runs west to east, sloping from 760 to 758 feet NAVD88, with a width and thickness of one foot and a conductivity of 20 feet/day. The wall partially encapsulates the northern portion of AP-1 at the base of the constructed berm, extending vertically from ground surface down to the top of PWR. The thickness is three feet, and the hydraulic conductivity is 0.000284 feet/day, aligning with the engineering design (Golder, 2021).

Scenario 3: Side/Down-gradient Barrier and Underdrain – Scenario 3 uses the same model structure, property zones, and BCs as Scenario 1, with the addition of a side- and down-gradient drain, and hydraulic barrier wall. The drain runs north to south along the western edge of AP-1, sloping from 742 to 741 feet NAVD88, and east to west along the southern edge of AP-1, sloping from 742 to 741 feet NAVD88. Both segments of the drain have a width and thickness of one foot, with a hydraulic conductivity of 20 feet/day. The wall partially encapsulates the southern portion of AP-1 at the base of the constructed berm, extending from ground surface to the top of PWR. The thickness is three feet, and the hydraulic conductivity is 0.00026 feet/day, aligning with the engineering design (Golder, 2021).

Scenario 4: Side/Down-gradient Barrier and Internal Dewatering Wells – Scenario 4 uses the same model structure, property zones, and BCs as Scenario 1, with the addition of a side/down-gradient barrier wall and internal extraction wells. The barrier wall partially encapsulates the southern portion of AP-1, with the same extent and properties as in Scenario 3. Eleven extraction wells line the western and southern extents of CCR within AP-1 and are represented as fully screened across layer 1 (CCR). They individually extract 770 cubic feet per day (CFD) or 4.0 gallons per minute (GPM).

Scenario 5: Fully Encompassing Barrier and Side/Down-gradient Drain – Scenario 5 uses the same model structure, property zones, and BCs as Scenario 1, with the addition of a fully encompassing hydraulic barrier wall, and a side-/down-gradient drain within its perimeter. The barrier wall in this scenario runs along the top of the constructed berm, a three-foot width, and a hydraulic conductivity of 0.000284 foot/day. The shift from the base of the berm to the top of the berm is a change from earlier renditions of this scenario, to better align with the other fully encompassing wall scenarios in Scenarios 5 and 6. The drain runs from north to south along the western interior of the wall, sloping from 743 to 742 feet NAVD88, and from east to west along the southern interior, also sloping from 743 to 742 feet. Both segments of the drain have a width and thickness of one foot, with a hydraulic conductivity of 20 feet/day.

Scenario 6A - Fully Encompassing Barrier to top of PWR – Scenario 6A uses the same model structure, property zones, and BCs as Scenario 1, with the addition of a fully encompassing barrier wall at the top of the constructed closure berm. The wall extends vertically from ground surface to the top of PWR as in Scenario 5, but without the presence of an interior drain.

Scenario 6B: Fully Encompassing Barrier 2 feet into PWR – Scenario 6B uses the same model structure, property zones, and BCs as Scenario 6A, aside from the vertical extent of the wall, which in this scenario extends to top of new model layer 4 (two feet below the top of PWR surface or top of bedrock, whichever is higher).

Scenario 6C: Fully Encompassing Barrier 5 feet into PWR – Scenario 6C uses the same model structure, property zones, and BCs as Scenario 6A, aside from the vertical extent of the wall, which in this scenario extends to top of new model layer 5 (five feet below the top of PWR surface or top of bedrock, whichever is higher).

Scenario 6D: Fully Encompassing Barrier to top of Bedrock – Scenario 6D uses the same model structure, property zones, and BCs as Scenario 6A, aside from the vertical extent of the wall, which in this scenario extends to top of new model layer 6 (top of bedrock surface).

Scenario 6E: **Fully Encompassing Barrier 2 feet into Bedrock** – Scenario 6E uses the same model structure, property zones, and BCs as Scenario 6A, aside from the vertical extent of the wall, which in this scenario extends to top of new model layer 7 (two feet below the top of bedrock surface).

Scenario 6F: **Fully Encompassing Barrier 5 feet into Bedrock** – Scenario 6F uses the same model structure, property zones, and BCs as Scenario 6A, aside from the vertical extent of the wall, which in this scenario extends to top of new model layer 8 (five feet below the top of bedrock surface).

Scenario 7: In-Situ Stabilization/Solidification – Scenario 7 uses the same model structure, property zones, and BCs as Scenario 1, with the addition of an in-situ stabilization area represented via a property zone with a reduced hydraulic conductivity of 0.000756 feet/day within the modeled zone of CCR below the potentiometric surface. The hydraulic conductivity of the ISS zone was selected in line with typical values from WSP's experience.

2.1.1 Model Recharge

No modifications were made to the recharge zone footprints or rates from the previously documented pre-closure model (WSP, 2023B) and previously documented closure model (WSP, 2023A) for the AP-1 pre-closure model and post-closure AEM scenarios.

Recharge zones and associated values are shown on Figure 2-6. Post-closure recharge zones are unchanged from the 2021 Addendum Closure Model (WSP, 2023A).

Hydraulic Conductivity Zone

Model hydraulic conductivity zones are unchanged from the 2021 Addendum Closure Model in the HAR, except for the ISS and pre-closure models. The ISS model hydraulic conductivity zones are shown on Figure 2-7. The pre-closure hydraulic conductivity zones are based on the May 2023 Pre-Closure Model included in the AP-3/4 FS (WSP, 2023B) and are shown on Figure 2-7.

Model Calibration

The four-layer MODFLOW-NWT model as documented in the HAR (WSP, 2023A) was calibrated prior to submission to EPD. That model calibration meets industry standards, including a root mean square error of 3.87 feet (less than 10% of the range of measured water elevations) and a mass balance discrepancy of less than 1.0 percent. Refer to the October 2020 Model Report for a complete model calibration discussion. Modifications to the model code and layering result in negligible changes to the model predictions and model performance based on model validation performed by comparing results of the four- and eight-layer versions of the closure model, as discussed in Section 0.

MODPATH Particle Tracking

Particle tracking helps to visualize groundwater flow fields, yielding insights into transit time and flow pathways. Principal velocity vectors are computed for each model cell and govern the course of groundwater particles. Conceptual water particles are added to the model using the particle track code MODPATH 7 (Pollock, 2016) to visualize groundwater flowlines and evaluate water particle travel times in the vicinity of AP-1 by releasing particles in multiple configurations, including:

Upgradient Water Particle - A single water particle was released in residuum upgradient of AP-1 in forward mode for each scenario considered in this Report to track the relative effects of closure alternatives on groundwater migration entering the AP-1 area from upgradient. The upgradient particle is placed 170 feet off the northeast corner of the planned AEM wall footprint.

Water Particles Within CCR – Water particles were also released between the base of CCR and the potentiometric surface in AP-1 in forward mode, to assess potential flow pathways associated with CCR. Particles were released in two model grid cells in the deepest areas of CCR representing southerly (particle A) and westerly (particle B) flow pathways. The same particle placement procedure was used in all scenarios.

3.0 PREDICTIVE SIMULATIONS

Thirteen steady-state simulations were conducted to analyze AEM alternatives. Simulation results with respect to effectiveness metrics and particle tracks are summarized in Table 3. Each of the post-closure simulations were compared to pre-closure conditions. Selected model results for each scenario simulation are presented in the bullets that follow:

- **Scenario 0: Pre-closure Conditions** – The pre-closure model represents conditions prior to closure activities (circa Jan 2016) and serves as a reference for comparison with the different AEM closure scenarios.
  - CCR below the potentiometric surface covers an area of nearly 18.8 acres, with a maximum thickness of 18.6 feet and a total volume of 289,834 cubic yards.
  - Modeled flow per unit area out of the CCR and into Residuum is approximately 3,888 gallons per day (gpd).
  - The upgradient water particle passes underneath AP-1, close to the base of CCR, as shown on Figure 3-1. Water particle A within CCR arrives at the permit boundary after 40 years, and water particle B arrives after 20 years.
- **Scenario 1: Cover Installed (Initial Closure)**
  - The volume of CCR below the potentiometric surface decreases by 65%, with a remaining maximum thickness of CCR below the potentiometric surface of 10.2 feet (~8.4 feet less than pre-closure), and an area of 11.2 acres.
  - Modeled flow per unit area out of the CCR and into Residuum decreases by 90% compared to pre-closure conditions (Scenario 0).

  - The upgradient water particle passes underneath AP-1, farther from the base of CCR, as shown on Figure 3-1. Water particle A within CCR arrives at the permit boundary after 90 years, and water particle B arrives after 50 years.

- **Scenario 2: Upgradient Barrier and Upgradient Drain**
  - The volume of CCR below the potentiometric surface decreases by 68%, with a remaining maximum thickness of CCR below the potentiometric surface of 9.3 feet, and an area of 10.8 acres.
  - Modeled flow per unit area out of the CCR and into Residuum decreases by 93% compared to pre-closure conditions (Scenario 0).
  - The upgradient water particle passes underneath AP-1, farther from the base of CCR, as shown on Figure 3-2. Water particle A within CCR arrives at the permit boundary after 100 years, and water particle B arrives after 70 years.
- **Scenario 3: Side/Down-gradient Barrier and Underdrain** –
  - The volume of CCR below the potentiometric surface decreases by 57%, with a remaining maximum thickness of CCR below the potentiometric surface of 11.2 feet and an area of 11.5 acres.
  - Modeled flow per unit area out of the CCR and into Residuum decreases by 91% compared to pre-closure conditions (Scenario 0).
  - The upgradient water particle passes underneath AP-1, farther from the base of CCR, as shown on Figure 3-3. Water particle A within CCR arrives at the permit boundary after 160 years, and water particle B arrives after 50 years.
- **Scenario 4: Side/Down-gradient Barrier and Internal Dewatering Wells**
  - The volume of CCR below the potentiometric surface decreases by 68%, with a remaining maximum thickness of CCR below the potentiometric surface of 10.1 feet and an area of 11.2 acres.
  - Modeled flow per unit area out of the CCR and into Residuum decreases by greater than 99% compared to pre-closure conditions (Scenario 0).
  - The upgradient water particle passes underneath AP-1, farther from the base of CCR, as shown on Figure 3-4. Groundwater particles are predicted to flow upward into the CCR where they are captured by the internal dewatering wells. The dewatering wells would be installed in CCR only. The simulated capture zone of the dewatering wells extends below the CCR and captures water particles within the influence of the capture zone.
- **Scenario 5: Fully Encompassing Barrier and Side/Down-gradient Drain**
  - The volume of CCR below the potentiometric surface decreases by 54%, with a remaining maximum thickness of CCR below the potentiometric surface of 11.5 feet, and an area of 11.7 acres.

  - Modeled flow per unit area out of the CCR and into Residuum decreases by 91% compared to pre-closure conditions (Scenario 0).
  - The upgradient water particle passes underneath AP-1, farther from the base of CCR, as shown on Figure 3-5. Both water particles within CCR arrive at the permit boundary after 140 years.

- **Scenario 6A: Fully Encompassing Barrier to top of PWR**
  - The volume of CCR below the potentiometric surface decreases by 54%, with a remaining maximum thickness of CCR below the potentiometric surface of 11.6 feet, and an area of 11.7 acres. CCR thickness below potentiometric surface is shown on Figure 3-6.
  - Modeled flow per unit area out of the CCR and into Residuum decreases by 91% compared to pre-closure conditions (Scenario 0).
  - The upgradient particle passes underneath AP-1, farther from the base of CCR, as shown on Figure 3-7. Both water particles within CCR arrive at the permit boundary after 140 years.
- **Scenario 6B: Fully Encompassing Barrier 2 feet into PWR**
  - The volume of CCR below the potentiometric surface decreases by 52%, with a remaining maximum thickness of CCR below the potentiometric surface of 11.8 feet, and an area of 11.8 acres.
  - Modeled flow per unit area out of the CCR and into Residuum decreases by 91% compared to pre-closure conditions (Scenario 0).
  - The upgradient water particle passes underneath AP-1, farther from the base of CCR, as shown on Figure 3-7. Water particle A within CCR arrives at the permit boundary after 140 years, and water particle B arrives after 170 years.
- **Scenario 6C: Fully Encompassing Barrier 5 feet into PWR**
  - The volume of CCR below the potentiometric surface decreases by 51%, with a remaining maximum thickness of CCR below the potentiometric surface of 11.9 feet, and an area of 11.8 acres.
  - Modeled flow per unit area out of the CCR and into Residuum decreases by 92% compared to pre-closure conditions (Scenario 0).
  - The upgradient water particle passes underneath AP-1, farther from the base of CCR, as shown on Figure 3-7. Water particle A within CCR arrives at the permit boundary after 150 years, and particle B arrives after 180 years.
- **Scenario 6D: Fully Encompassing Barrier to Top of Bedrock**
  - The volume of CCR below the potentiometric surface decreases by 50%, with a remaining maximum thickness of CCR below the potentiometric surface of 12.0 feet, and an area of 11.9 acres.

  - Modeled flow per unit area out of the CCR and into Residuum decreases by 92% compared to pre-closure conditions (Scenario 0).
  - The upgradient water particle passes underneath AP-1, farther from the base of CCR, as shown on Figure 3-8. Water particle A within CCR arrives at the permit boundary after 150 years, and particle B arrives after 200 years.
- **Scenario 6E: Fully Encompassing Barrier 2 feet into Bedrock**
  - The volume of CCR below the potentiometric surface decreases by 46%, with a remaining maximum thickness of CCR below the potentiometric surface of 12.7 feet, and an area of 12.0 acres.
  - Modeled flow per unit area out of the CCR and into Residuum decreases by 93% compared to pre-closure conditions (Scenario 0).
  - The upgradient water particle passes underneath AP-1, farther from the base of CCR, as shown on Figure 3-8. Water particle A within CCR arrives at the permit boundary after 170 years, and particle B arrives after 220 years.
- **Scenario 6F: Fully Encompassing Barrier 5 feet into Bedrock**
  - The volume of CCR below the potentiometric surface decreases by 43%, with a remaining maximum thickness of CCR below the potentiometric surface of 13.3 feet, and an area of 12.2 acres.
  - Modeled flow per unit area out of the CCR and into Residuum decreases by 94% compared to pre-closure conditions (Scenario 0).
  - The upgradient water particle passes underneath AP-1, farther from the base of CCR, as shown on Figure 3-8. Water particle A within CCR arrives at the permit boundary after 200 years, and particle B arrives after 240 years.
- **Scenario 7: In-Situ Stabilization/Solidification**
  - The volume of non-ISS stabilized CCR materials below the potentiometric surface decreases by 100%, with a remaining maximum thickness of non-ISS stabilized CCR materials below the potentiometric surface of 0.0 feet.
  - Modeled flow per unit area out of the CCR and into Residuum decreases by greater than 99% compared to pre-closure conditions (Scenario 0).
  - The upgradient water particle passes underneath AP-1, farther from the base of CCR, as shown on Figure 3-9. Water particle A within CCR arrives at the permit boundary after a much longer timeframe (>500 years) and particle B arrives after 460 years due to the changes associated with ISS.

Particle track results show that every closure scenario, except Downgradient Barrier and Internal Dewatering Wells (Scenario 4), forces upgradient residuum groundwater to flow through residuum, PWR and bedrock beneath the CCR. The effect of the closure design features on upgradient residuum groundwater flow pathways is a factor in the simulated reduction of CCR volumes below the potentiometric surface compared to pre-closure conditions.

4.0 CONCLUSIONS

The modeled closure design scenarios are predicted to decrease the volume of CCR below the potentiometric surface in AP-1 by 43 (Barrier 5 feet into Bedrock [Scenario 6F]) to 68 percent (upgradient barrier and upgradient drain [Scenario 2] and down/side-gradient barrier with dewatering wells [Scenario 4]) compared to the pre-closure model. Reduction in predicted flow out of CCR in AP-1 post-closure ranges from 91 percent (Scenarios 3, 5, 6A, and 6B) to nearly 100 percent (Scenarios 4 & 7) compared to the pre-closure model. Each of the fully encompassing barrier scenarios, whether installed to top of PWR or into bedrock, achieve greater than 90 percent decreases in flow from the CCR to Residuum, indicating there is effectively no additional benefit from a flow reduction perspective for installing a deeper barrier than the top of PWR.

Modelling results indicate that closure design scenarios combining a cover with a barrier wall are effective with respect to reducing the volume of CCR below the potentiometric surface and reducing flow from AP-1. These scenarios improve groundwater protection by virtually eliminating flow (>90% decrease) from CCR into residuum and PWR across the entire base of AP-1.

5.0 REFERENCES

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TABLES

Table 1 - Flow Balance Comparison for 4-Layer and 8-Layer Wall-to-PWR Models
Plant McDonough
Groundwater Model AEM Evaluation
Plant McDonough Ash Pond 1 (AP-1)

Description	4-Layer (NWT) Wall-to-PWR Model		8-Layer (USG) Wall-to-PWR Model		Percent Difference	
	Cumulative Inflow (ft3)	Cumulative Outflow (ft3)	Cumulative Inflow (ft3)	Cumulative Outflow (ft3)	Cumulative Inflow (ft3)	Cumulative Outflow (ft3)
Recharge	28510.2	0.0	28510.2	0.0	0.00%	-
Drain Boundaries (Minor Tributaries)	0.0	10306.5	0.0	10320.1	-	0.13%
River Boundaries (Chattahoochee River, trunk channels of large tributary creeks)	510.3	18717.1	537.8	18719.1	5.40%	0.01%
Total	29020.5	29023.6	29048.1	29039.2	0.10%	0.05%
Model Percent Error	0.01%		-0.03%		-	

Plant McDonough
Groundwater Model AEM Evaluation
Plant McDonough Ash Pond 1 (AP-1)

Well Name	Easting (feet)	Northing (feet)	4-Layer Simulated Water Elevations (feet)	8-Layer Simulated Water Elevations (feet)	Difference (feet)
B4	2202662.203	1394170.481	787.2	787.0	0.25
B5	2202962.793	1394309.251	781.4	781.2	0.16
B6	2203255.163	1394424.071	784.3	784.2	0.13
B7	2203595.173	1394375.951	790.2	789.8	0.37
B8	2203881.823	1394325.091	794.7	794.1	0.58
B11	2204167.653	1393547.501	771.4	771.2	0.20
B12	2204125.013	1393151.161	762.7	762.6	0.08
B13	2204084.663	1392881.611	761.0	760.8	0.25
B20	2202315.153	1392166.891	778.9	778.3	0.62
B21	2202062.543	1392068.121	778.2	777.6	0.54
B22	2201790.513	1392124.821	778.5	778.0	0.52
B23	2201582.863	1392242.101	779.7	779.1	0.55
B28	2201677.593	1391970.421	776.9	776.4	0.55
B29	2201420.253	1391891.931	772.8	772.4	0.44
B31	2200926.823	1392035.971	767.2	766.7	0.54
B37	2200919.393	1390483.941	751.6	751.6	-0.01
B38	2201147.653	1390364.531	749.1	749.1	-0.05
B39	2201538.453	1390303.391	750.9	750.8	0.09
B40	2201826.763	1390625.631	756.1	755.9	0.21
B41	2201749.843	1390928.391	760.9	760.5	0.34
B42	2201866.973	1391328.161	768.2	767.7	0.47

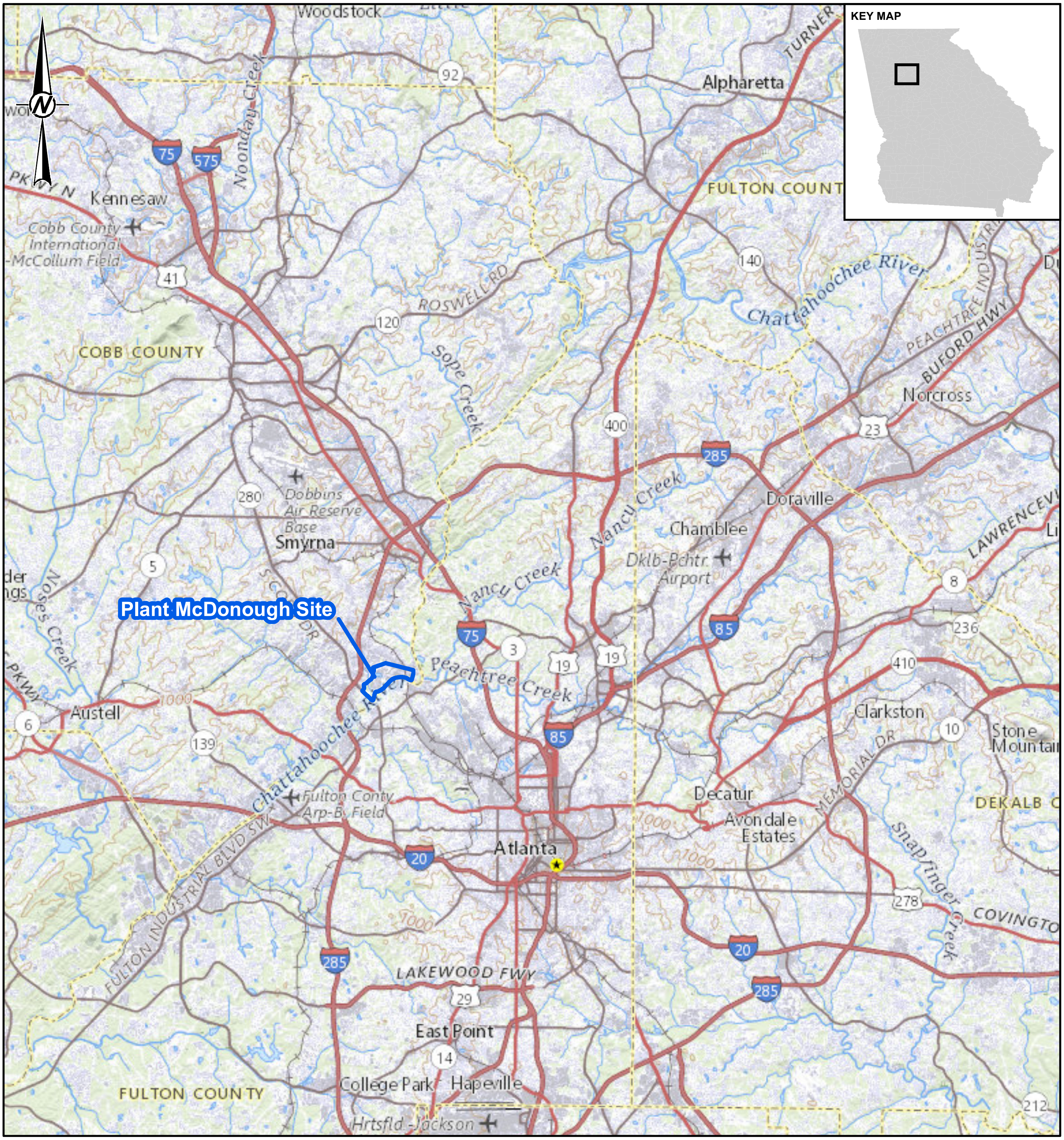
Table 3
Summary of AP-1 AEM Modeling Results
Groundwater Model AEM Evaluation
Plant McDonough Ash Pond 1 (AP-1)

Scenario No.	AP-1 Conditions	Description of Enhancement	Effectiveness						
			Maximum Height of Potentiometric Surface Above Bottom of Unit (feet)	Volume of CCR Below the Potentiometric Surface (cubic yards)	Percent (%) Reduction in Volume of CCR Below the Potentiometric Surface	Percent (%) Reduction of Area of CCR Below the Potentiometric Surface	Percent Reduction of Total Flow From Pre-Closure CCR Base Area	Particle Track A travel time to permit boundary (Years)	Particle Track B travel time to permit boundary (Years)
0	No Cover	Pre-closure Conditions	18.6	289,834	-	-	-	40	20
1	Cover Installed	Cover Installed (Initial Closure)	10.2	101,174	65%	40%	90%	90	50
2	Cover Installed	Upgradient Barrier and Upgradient Drain	9.3	92,434	68%	42%	93%	100	70
3	Cover Installed	Side/Down-gradient Barrier and Underdrain	11.2	123,262	57%	39%	91%	160	50
4	Cover Installed	Side/Down-gradient Barrier and Internal Dewatering Wells	10.1	93,456	68%	40%	100%	NA	NA
5	Cover Installed	Fully Encompassing Barrier and Side/Down-gradient Drain	11.5	132,240	54%	38%	91%	140	140
6A	Cover Installed	Fully Encompassing Barrier to top of PWR	11.6	133,221	54%	38%	91%	140	140
6B	Cover Installed	Fully Encompassing Barrier 2 feet into PWR	11.8	138,087	52%	37%	91%	140	170
6C	Cover Installed	Fully Encompassing Barrier 5 feet into PWR	11.9	142,091	51%	37%	92%	150	180
6D	Cover Installed	Fully Encompassing Barrier to Top of Bedrock	12.0	145,519	50%	36%	92%	150	200
6E	Cover Installed	Fully Encompassing Barrier 2 feet into Bedrock	12.7	155,268	46%	36%	93%	170	220
6F	Cover Installed	Fully Encompassing Barrier 5 feet into Bedrock	13.3	164,370	43%	35%	94%	200	240
7	Cover Installed	In-Situ Stabilization/Solidification	11.7	125,863	57%	37%	100%	>500	460

Notes:

1. These values were obtained from groundwater flow modeling results, which are necessarily simplified mathematical representations of complex natural systems. Because of this, all groundwater models have limits to their accuracy.
2. CCR = Coal Combustion Residuals
3. These model results were intended for use as relative comparisons between scenarios, and not as precise predictions of post closure conditions.
4. Outflow from layer 1 in the Side/Down-gradient Barrier and Internal Dewatering Wells model (Scenario 4) occurs primarily via extraction wells, and not through the base of CCR.
5. Penetration depths into specified media only apply where sufficient thickness occurs. Otherwise penetration depth truncates at the top of the underlying layer.
6. Particle A starts half way between the water table and the base of CCR above the lowest point in AP-1
7. Particle B starts half way between the water table and the base of CCR to the northwest of location A.
8. NA = Not Applicable (particle tracks terminate at dewatering wells).

FIGURES



LEGEND

Site Boundary

0 5 10

1 " = 5 mi MILES

REFERENCE(S)

1. BASEMAP FROM USGS THE NATIONAL MAP: NATIONAL BOUNDARIES DATASET, 3DEP ELEVATION PROGRAM, GEOGRAPHIC NAMES INFORMATION SYSTEM, NATIONAL HYDROGRAPHY DATASET, NATIONAL LAND COVER DATABASE, NATIONAL STRUCTURES DATASET, AND NATIONAL TRANSPORTATION DATASET; USGS GLOBAL ECOSYSTEMS; U.S. CENSUS BUREAU TIGER/LINE DATA; USFS ROAD DATA; NATURAL EARTH DATA; U.S. DEPARTMENT OF STATE HUMANITARIAN INFORMATION UNIT; AND NOAA NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION, U.S. COASTAL RELIEF MODEL. DATA REFRESHED AUGUST, 2021.

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

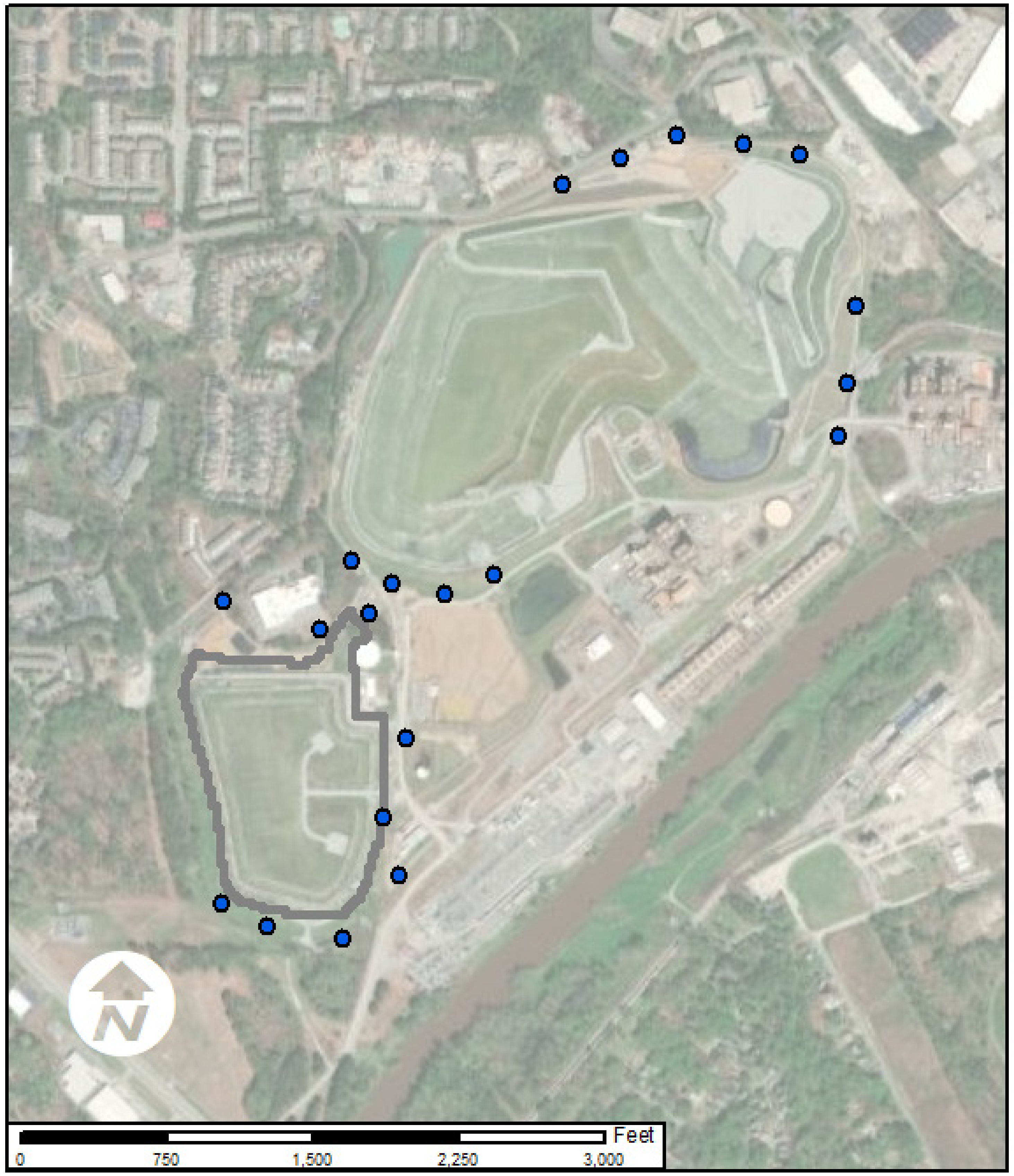
TITLE
SITE LOCATION

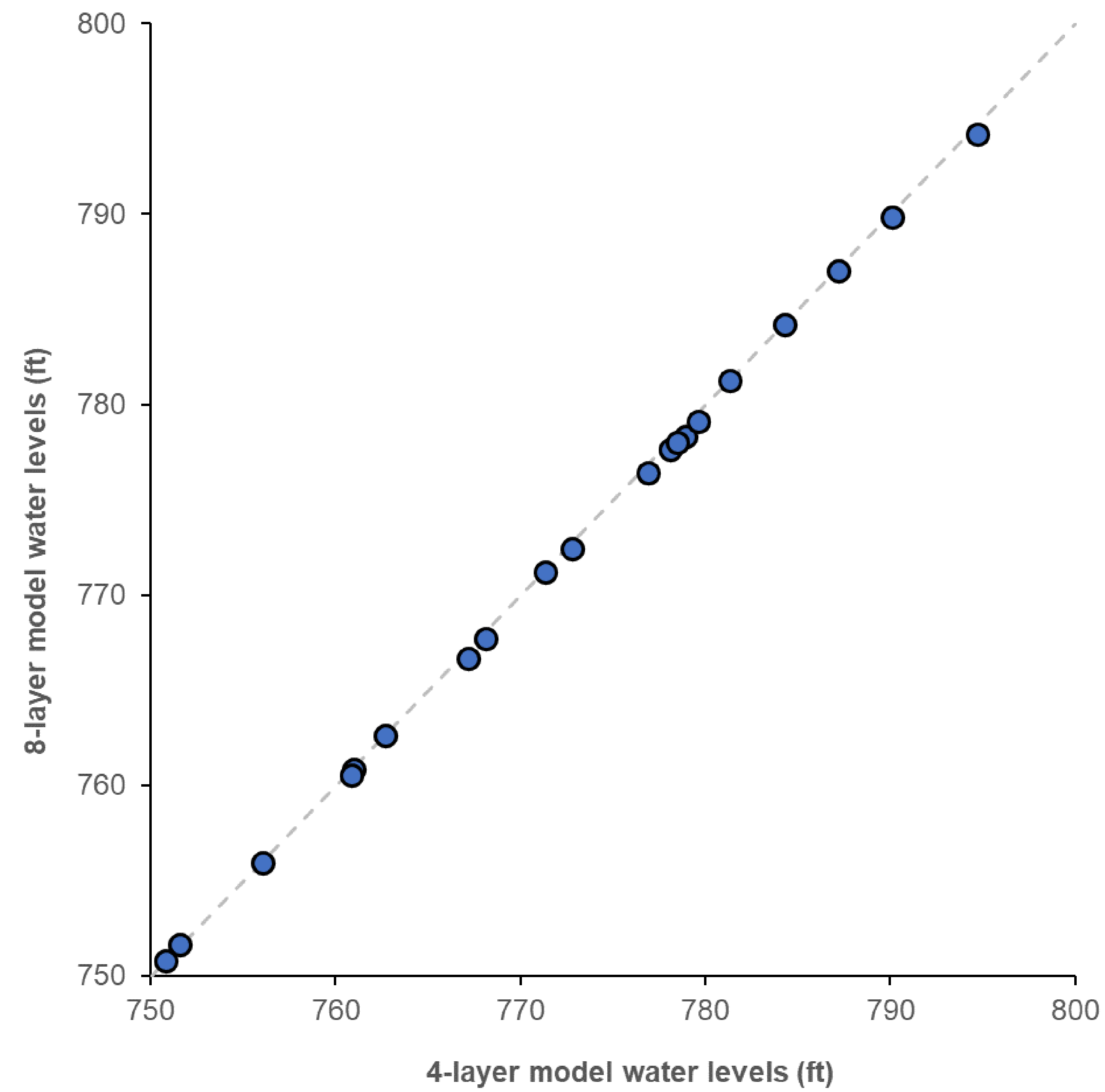
CONSULTANT

YYYY-MM-DD	2024-03-28
DESIGNED	SJS
PREPARED	AFS
CHECKED	WG
REVIEWED / APPROVED	CB

PROJECT NO.	SCS PROJECT ID	REV.	FIGURE
31406440.000	MCD15017	0	1-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A





Note:
Elevations are shown in the North American Vertical Datum of 1988 (NAVD88)

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

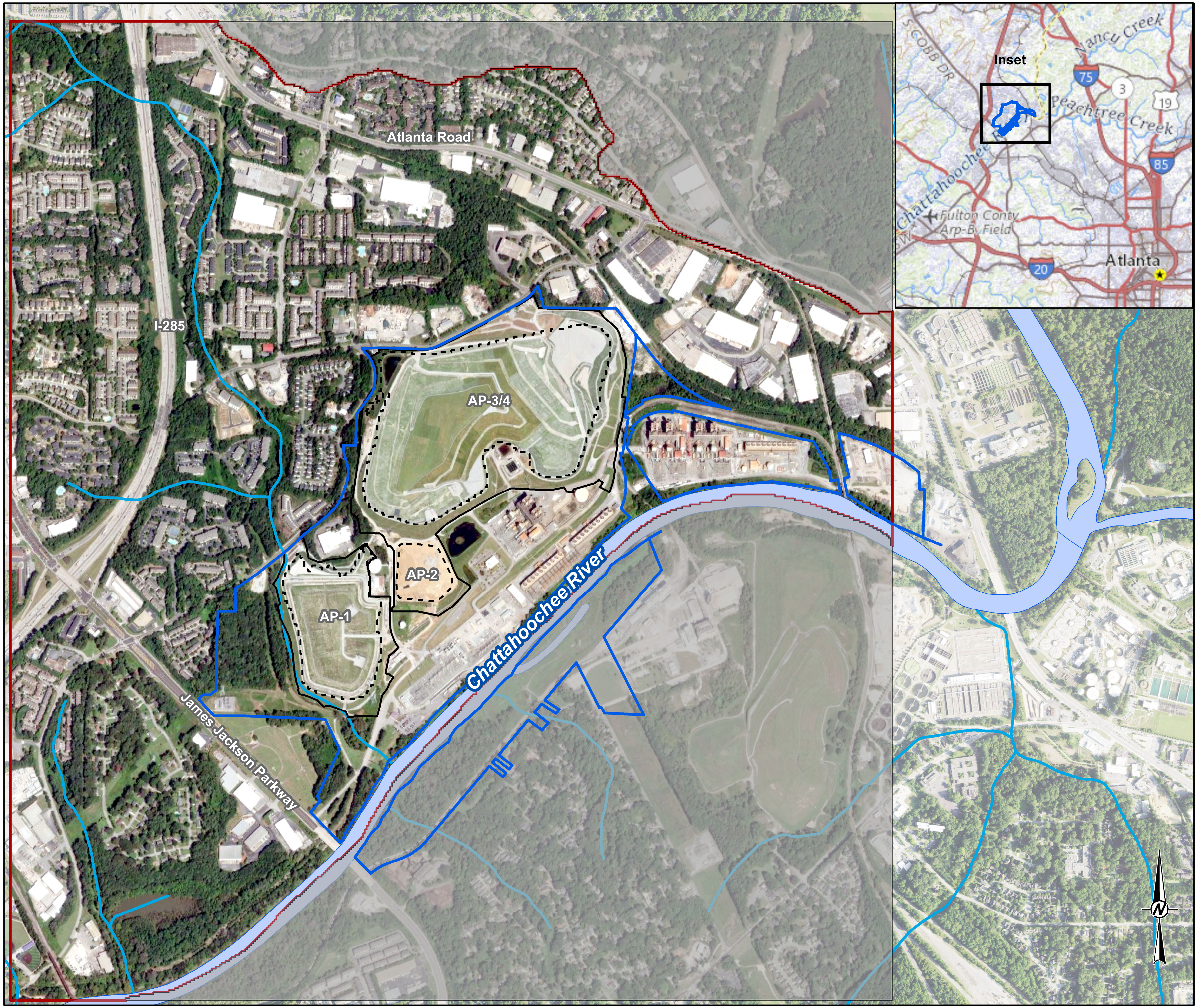
CONSULTANT

wsp

YYYY-MM-DD	2024-03-27
PREPARED	SJS
DESIGNED	SJS
CHECKED	WEG
REVIEWED / APPROVED	DLP

TITLE
COMPARISON OF SIMULATED WATER LEVELS IN 4-LAYER (NWT) VS. 8-LAYER (USG) WALL-TO-PWR MODELS

PROJECT NO.	SCS PROJECT ID	REV.	FIGURE
31406440.000	MCD15017	0	2-1



LEGEND

- Property Boundary
- Permitted Closure Extent
- Pre-Closure Waste Boundary
- National Hydrography Dataset Streams
- National Hydrography Dataset River

Model Domain

- Active cells
- Unused cells

0 1,000 2,000 3,000

1 in = 1,000 feet Feet

NOTE(S)

1. CCR = COAL COMBUSTION RESIDUALS.

REFERENCE(S)

1. AERIAL IMAGERY FROM NAIP DATASET, DATED 2019-09-10 THROUGH 2019-10-04.
2. INSET BASEMAP FROM USGS THE NATIONAL MAP: NATIONAL BOUNDARIES DATASET, 3DEP ELEVATION PROGRAM, GEOGRAPHIC NAMES INFORMATION SYSTEM, NATIONAL HYDROGRAPHY DATASET, NATIONAL LAND COVER DATABASE, NATIONAL STRUCTURES DATASET, AND NATIONAL TRANSPORTATION DATASET; USGS GLOBAL ECOSYSTEMS; U.S. CENSUS BUREAU TIGER/LINE DATA; USFS ROAD DATA; NATURAL EARTH DATA; U.S. DEPARTMENT OF STATE HUMANITARIAN INFORMATION UNIT; AND NOAA NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION, U.S. COASTAL RELIEF MODEL. DATA REFRESHED AUGUST, 2021.

CLIENT

GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

PROJECT

GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

TITLE

MODEL DOMAIN

CONSULTANT

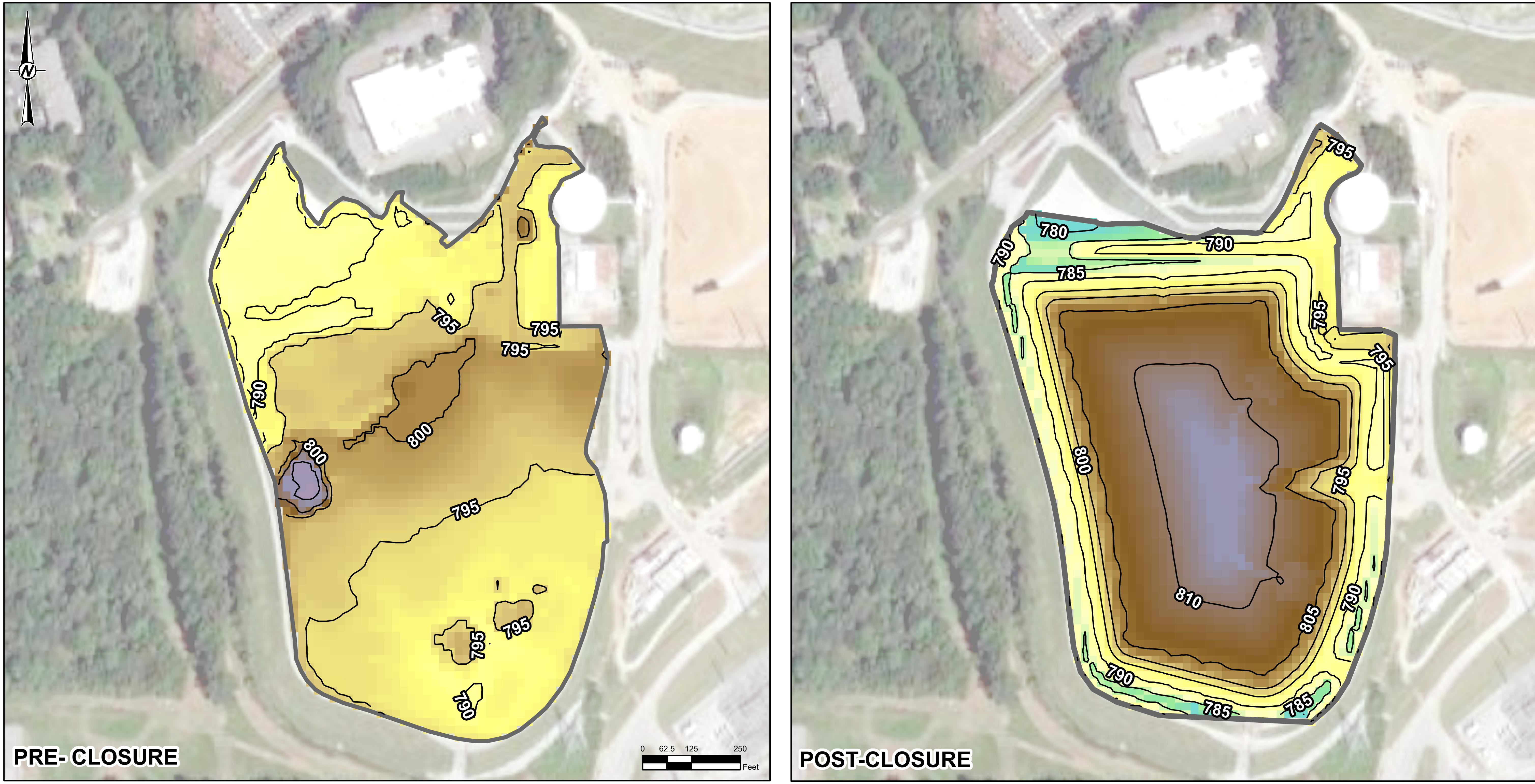
wsp

YYYY-MM-DD	2024-03-28
DESIGNED	SJS
PREPARED	AFS
CHECKED	WG
REVIEWED / APPROVED	CB

PROJECT NO.	SCS PROJECT ID	REV.	FIGURE
31406440.000	MCD150170	0	2-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 1 in



LEGEND

Top Elevation Contours (ft NAVD 88)

Waste Boundary

Top Elevation (ft NAVD 88)

High : 820

Low : 780

NOTE(S)

1. NAVD 88 - NORTH AMERICAN VERTICAL DATUM OF 1988.
2. CCR - COAL COMBUSTION RESIDUALS.
3. CONTOUR INTERVALS = 5 FEET

REFERENCE(S)

1. AERIAL IMAGERY FROM NAIP DATASET, DATED 2019-09-10 THROUGH 2019-10-04.

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

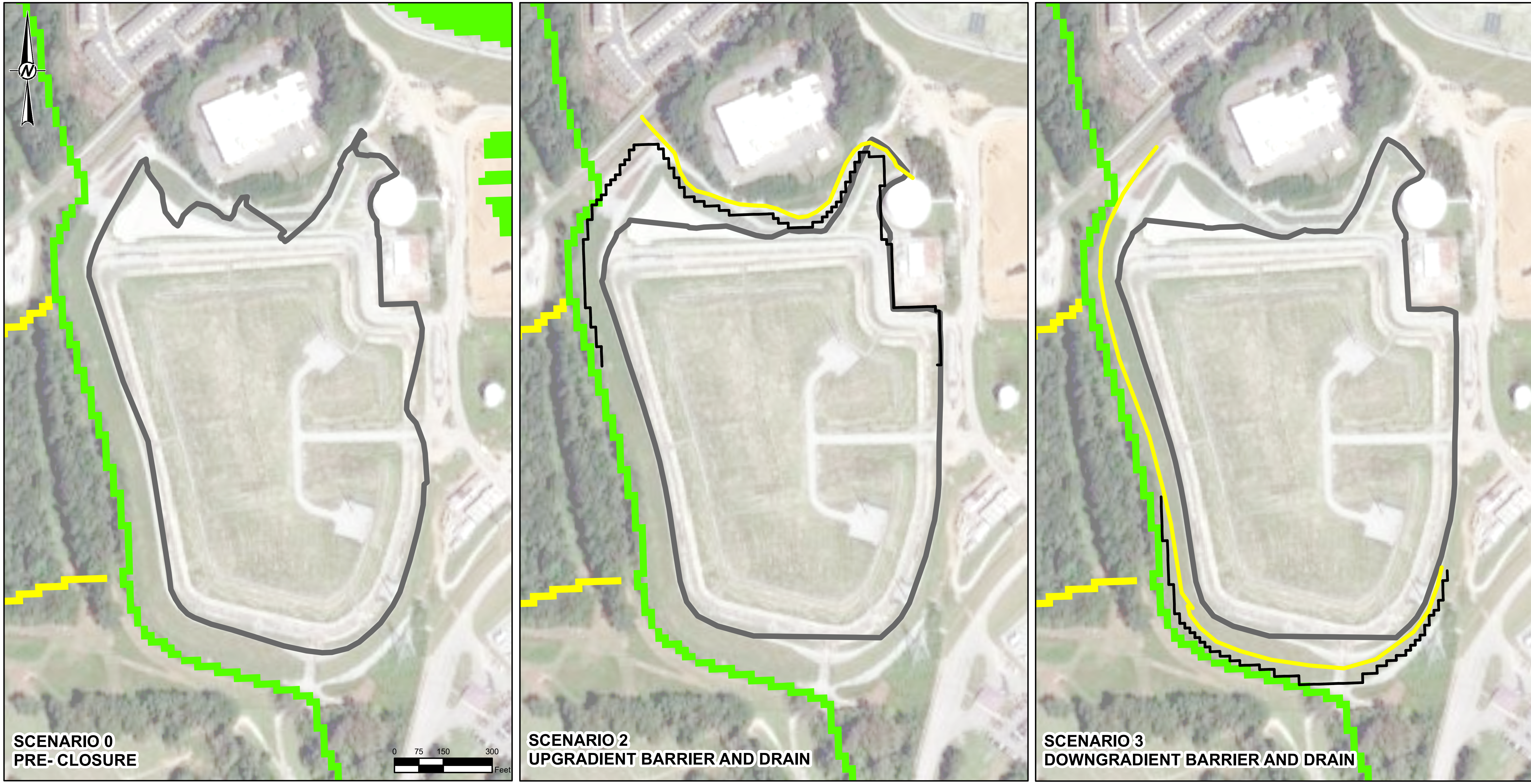
PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

CONSULTANT

YYYY-MM-DD	2024-03-28
DESIGNED	AFS
PREPARED	AFS
REVIEWED	WG
APPROVED	CB

TITLE
MODEL GRID TOP ELEVATIONS

PROJECT NO.	SCS PROJECT ID.	REV.	FIGURE
31406440.000	MCD150170	0	2-3



LEGEND

- Waste Boundary
- River Boundary Conditions
- Drain Boundary Conditions
- Hydraulic Barrier Wall

NOTE(S)
1. CCR - COAL COMBUSTION RESIDUALS.
2. SCENARIOS 2 AND 3 INCORPORATE BOUNDARY CONDITIONS FROM SCENARIO 1 (INITIAL CLOSURE).

REFERENCE(S)
1. AERIAL IMAGERY FROM NAIP DATASET, DATED 2019-09-10 THROUGH 2019-10-04.

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

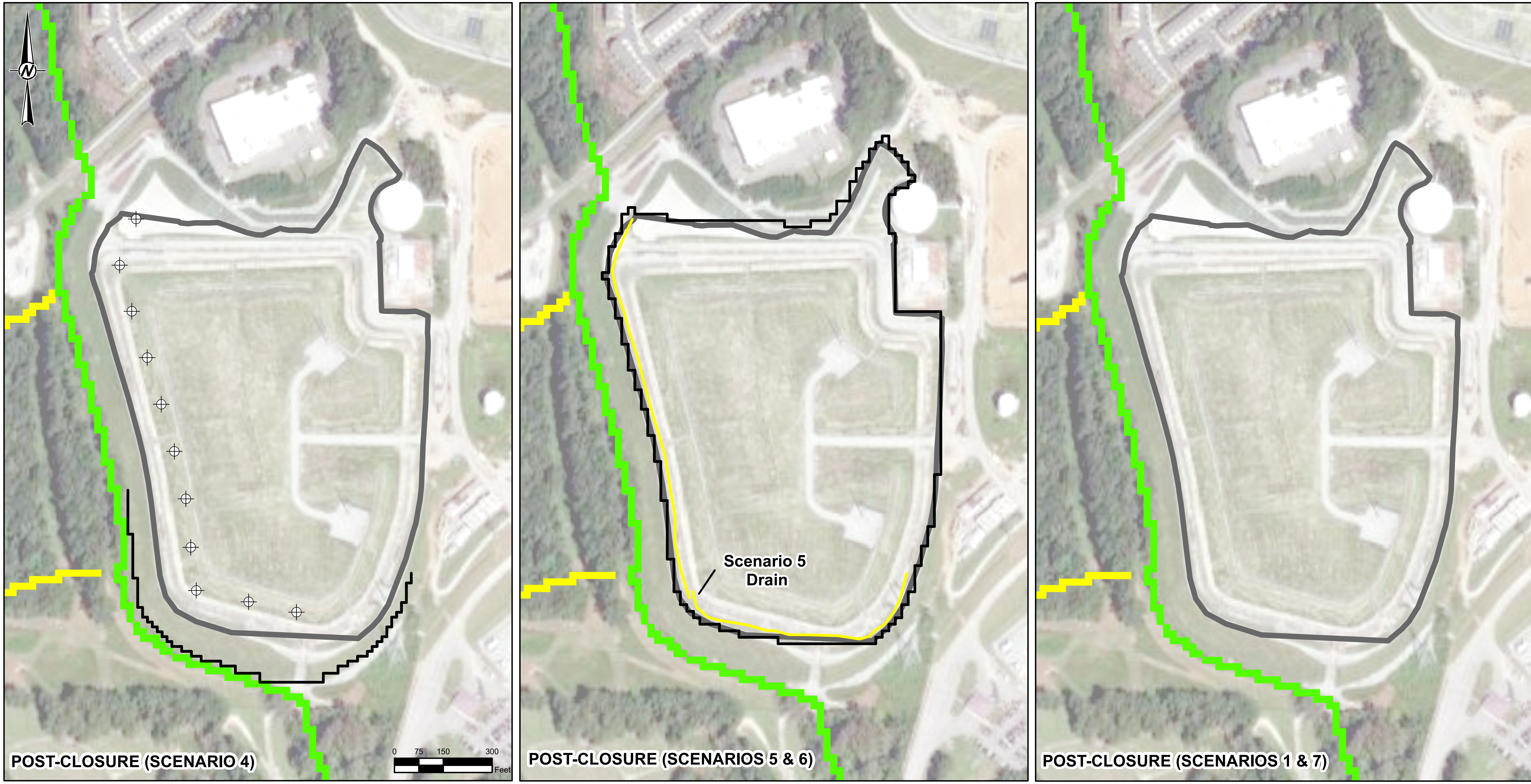
PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

CONSULTANT
wsp

YYYY-MM-DD	2024-03-28
DESIGNED	AFS
PREPARED	AFS
REVIEWED	WG
APPROVED	CB

TITLE
BOUNDARY CONDITIONS: SCENARIOS 0,2,3

PROJECT NO.	SCS PROJECT ID.	REV.	FIGURE
31406440.000	MCD150170	0	2-4



LEGEND

- Extraction Wells
- Waste Boundary
- Hydraulic Barrier Wall
- River Boundary Conditions
- Drain Boundary Conditions

REFERENCE(S)
1. AERIAL IMAGERY FROM NAIP DATASET, DATED 2019-09-10 THROUGH 2019-10-04.

NOTE(S)
1. CCR - COAL COMBUSTION RESIDUALS.
2. SCENARIOS 4, 5, 6, AND 7 INCORPORATE BOUNDARY CONDITIONS FROM SCENARIO 1 (INITIAL CLOSURE).

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

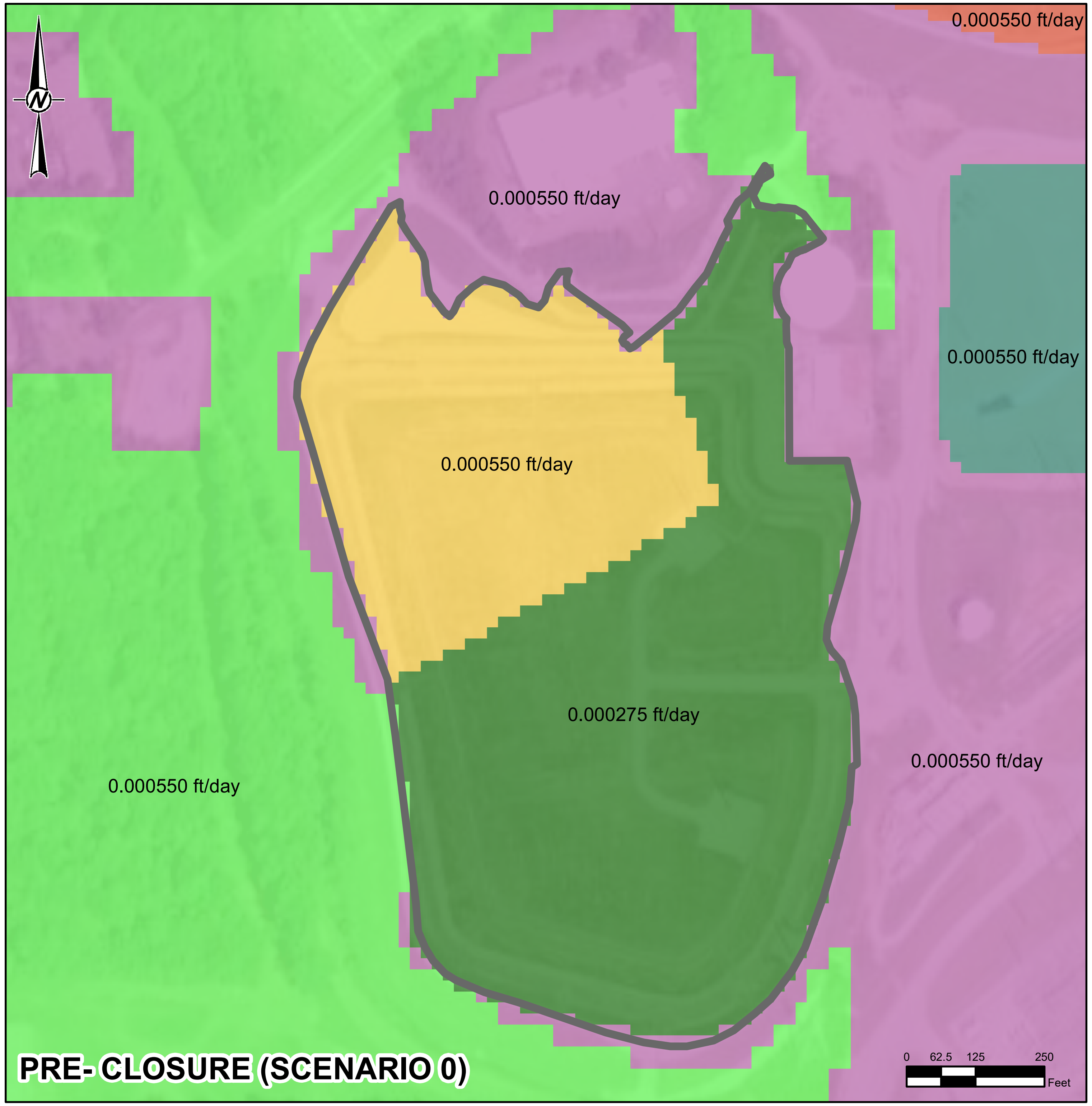
CONSULTANT

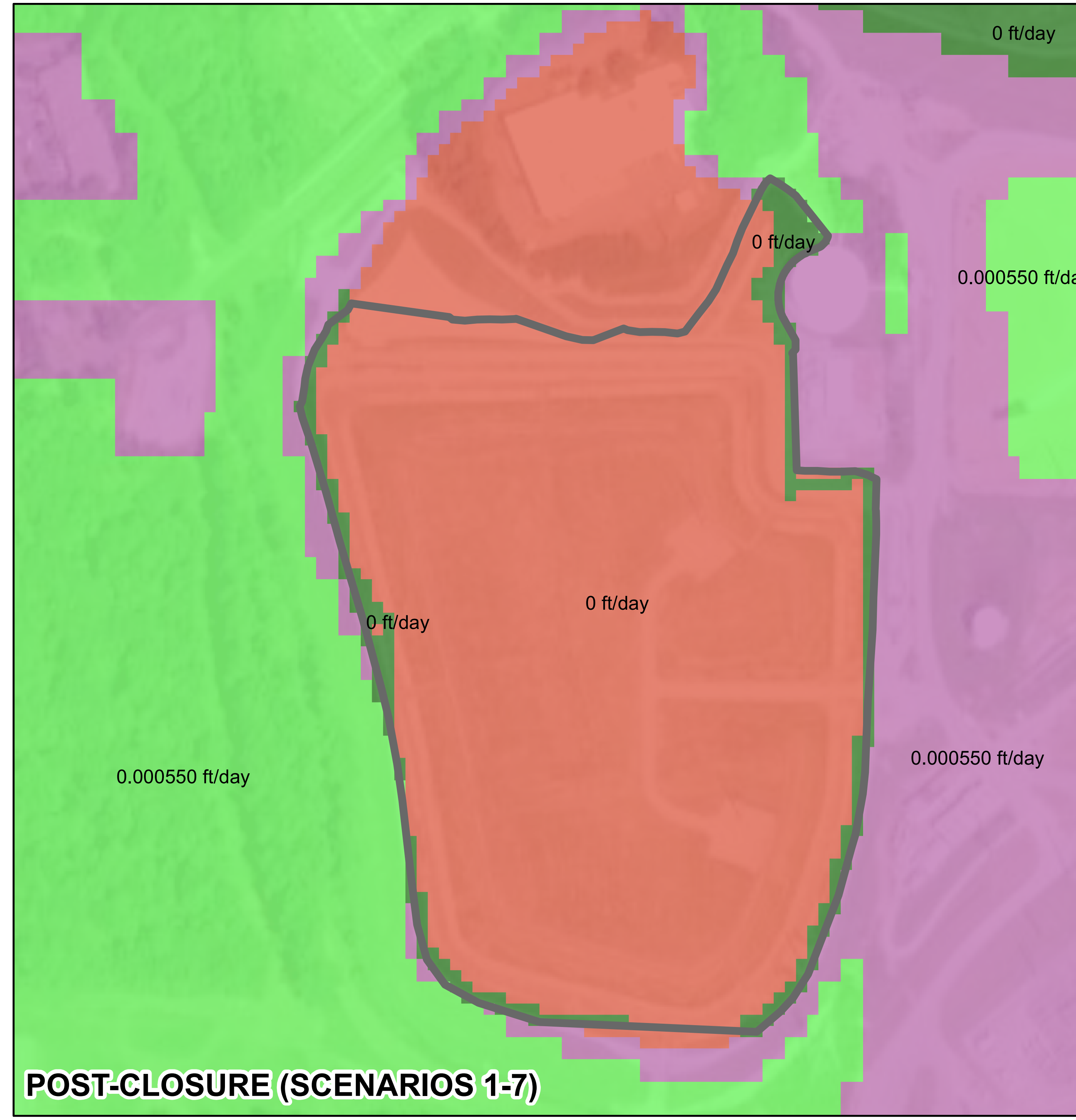
wsp

YYYY-MM-DD	2024-03-28
DESIGNED	AFS
PREPARED	AFS
REVIEWED	WG
APPROVED	CB

TITLE
BOUNDARY CONDITIONS: SCENARIOS 4,5,6,7

PROJECT NO.	SCS PROJECT ID.	REV.	FIGURE
31406440.000	MCD150170	0	2-5





LEGEND

Waste Boundary

Recharge Zones

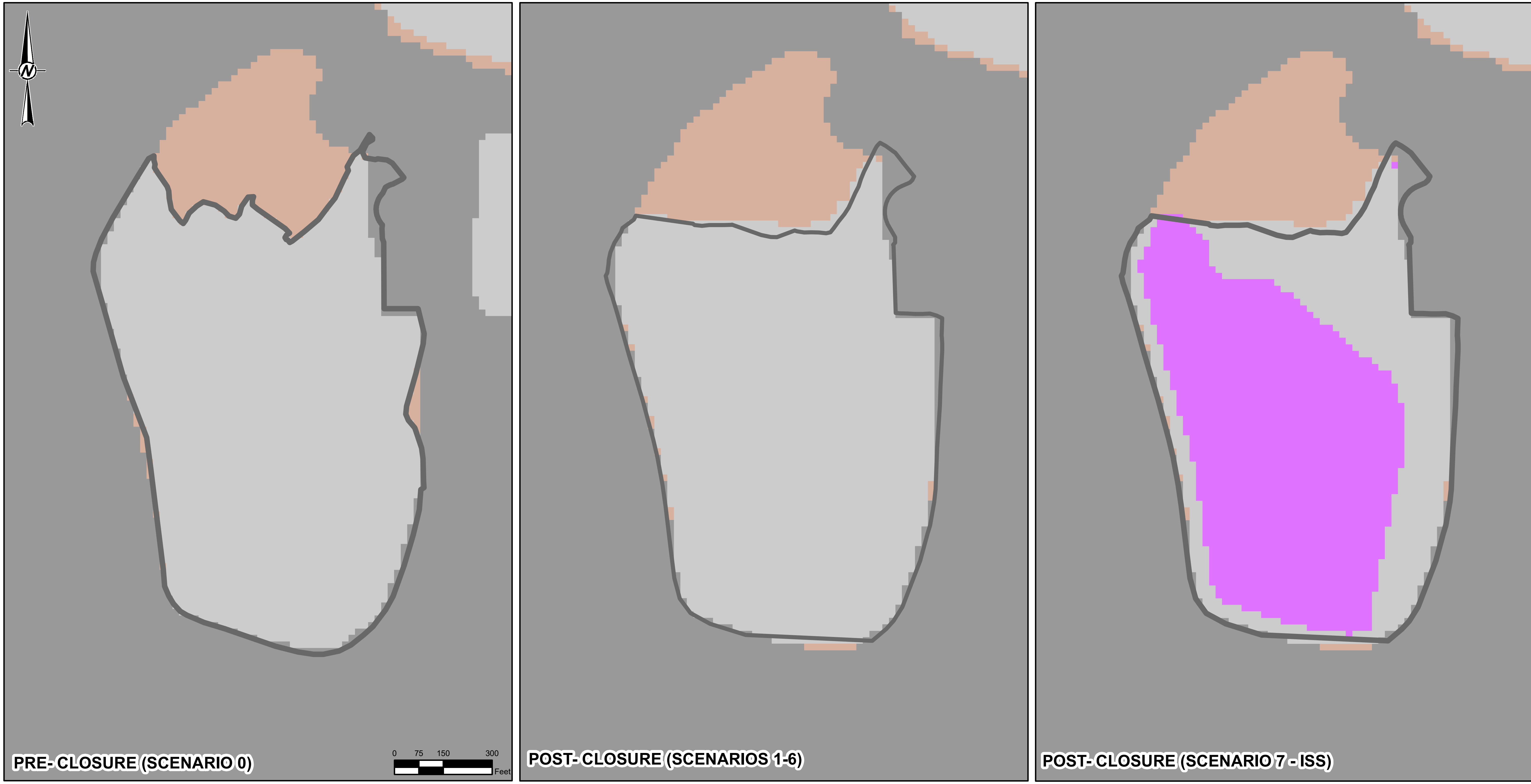
- 1: 0.00055 ft/day
- 3: 0.00055 ft/day
- 6: 0.000275 ft/day (0 post-closure)
- 7: 0.00055 ft/day (0 post-closure)
- 10: 0.00055 ft/day
- 12: 0.00055 ft/day

NOTE(S)
1. CCR - COAL COMBUSTION RESIDUALS.

REFERENCE(S)
1. AERIAL IMAGERY FROM NAIP DATASET, DATED 2019-09-10 THROUGH 2019-10-04.

CLIENT GEORGIA POWER COMPANY SOUTHERN COMPANY SERVICES		PROJECT GROUNDWATER MODEL AEM EVALUATION PLANT MCDONOUGH ASH POND 1 (AP-1)	
CONSULTANT	YYYY-MM-DD: 2024-03-28	TITLE **RECHARGE ZONES**	
	DESIGNED: AFS		
	PREPARED: AFS		
	REVIEWED: WG	PROJECT NO. 31406440.000	SCS PROJECT ID. MCD150170
	APPROVED: CB	REV. 0	FIGURE 2-6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

Waste Boundary

Unused Cells in Layer 1

Hydraulic Conductivity Zones

Zone	Kx (ft/day)	Ky (ft/day)	Kz (ft/day)
1	0.700	0.700	0.140
4	0.550	0.550	0.0370
7	0.000756	0.000756	0.000756

NOTE(S)
1. CCR - COAL COMBUSTION RESIDUALS.
2. ISS - IN SITU STABILIZATION

REFERENCE(S)
1. AERIAL IMAGERY FROM NAIP DATASET, DATED 2019-09-10 THROUGH 2019-10-04.

CLIENT
GEORGIA POWER COMPANY
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PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

CONSULTANT

YYYY-MM-DD	2024-03-28
DESIGNED	AFS
PREPARED	AFS
REVIEWED	WG
APPROVED	CB

TITLE
LAYER 1 HYDRAULIC CONDUCTIVITY ZONES

PROJECT NO.	SCS PROJECT ID.	REV.	FIGURE
31406440.000	MCD150170	A	2-7

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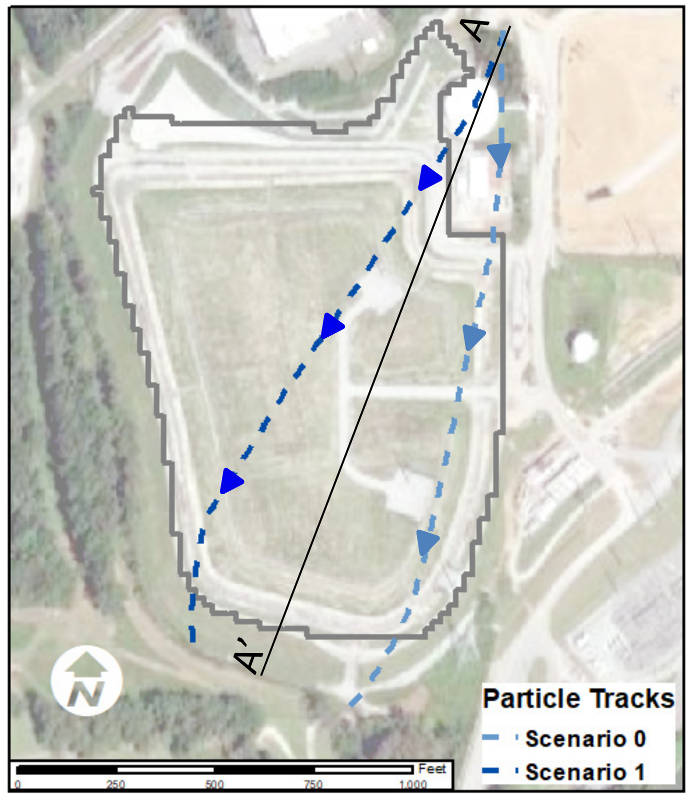
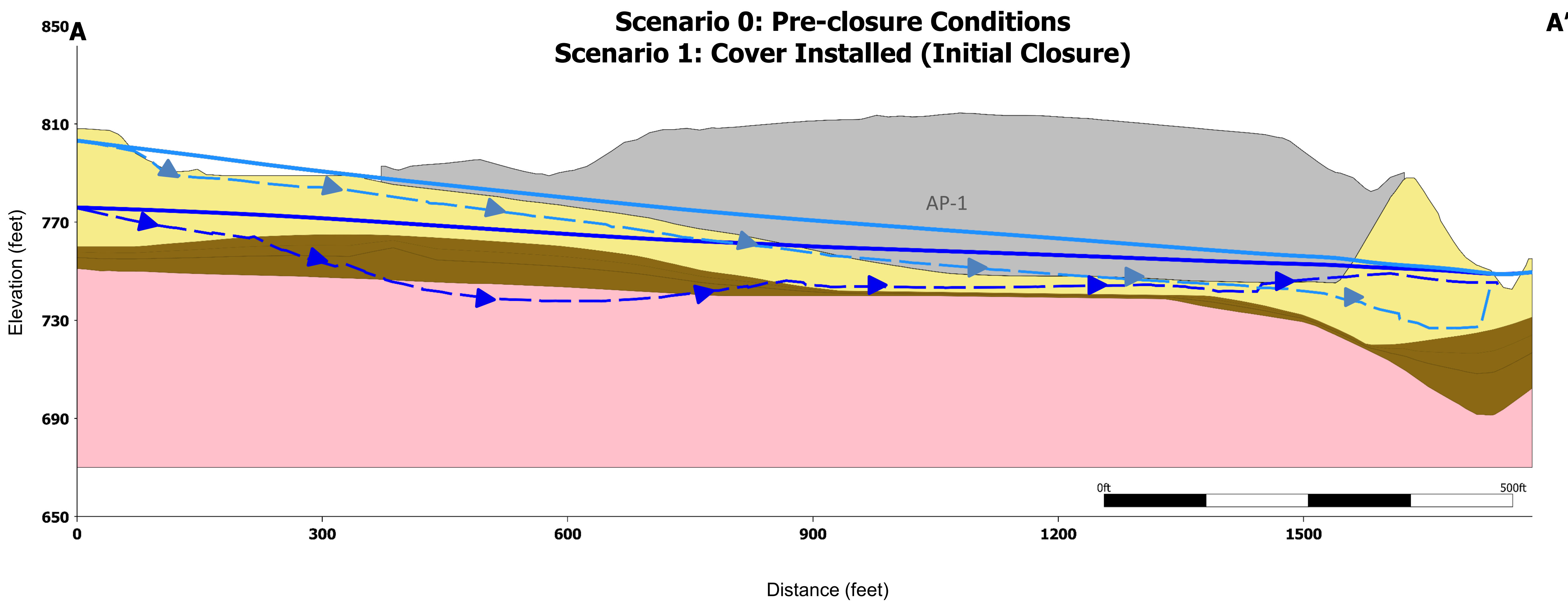




Key

Geologic units

- Layer 1 - Coal Combustion Residuals
- Layer 2 - Residuum
- Layers 3-5 – Partially Weathered Rock
- Layers 6-8 - Bedrock

Hydraulic features

- Scenario 0 Simulated Water table
- Scenario 1 Simulated Water Table
- Pre-Closure (Scenario 0) Particle Track
- Initial Closure (Scenario 1) Particle Track

Notes:

- Arrows indicate particle track direction, not velocity
- Elevations are shown in the North American Vertical Datum of 1988 (NAVD88)
- Vertical Exaggeration: 3x

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

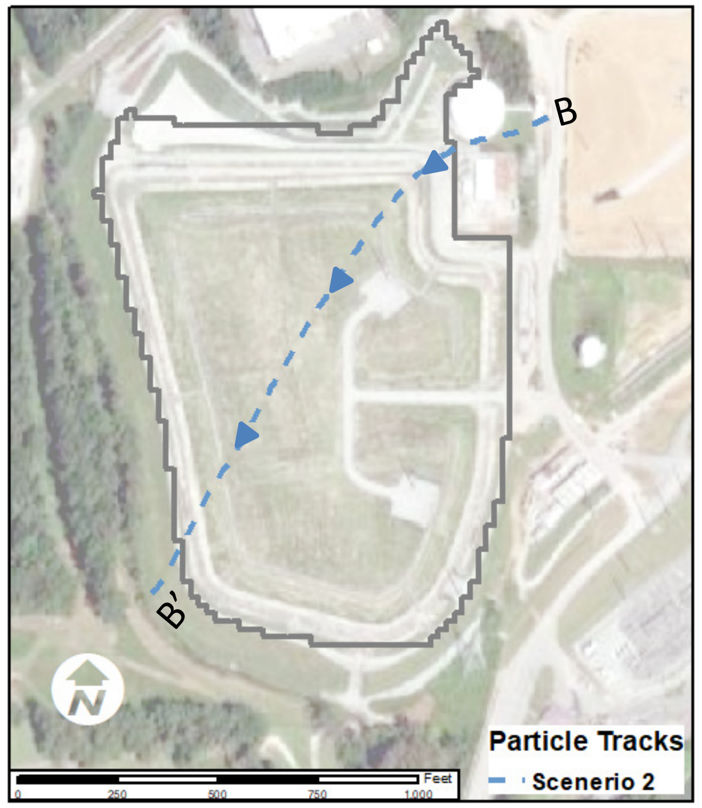
CONSULTANT

YYYY-MM-DD	2024-03-27
PREPARED	NP
DESIGNED	NP
CHECKED	WG
REVIEWED / APPROVED	DLP

PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

TITLE
PARTICLE TRACK CROSS SECTION A-A' FOR SCENARIO 0 (PRE-CLOSURE) AND SCENARIO 1 (INITIAL CLOSURE)

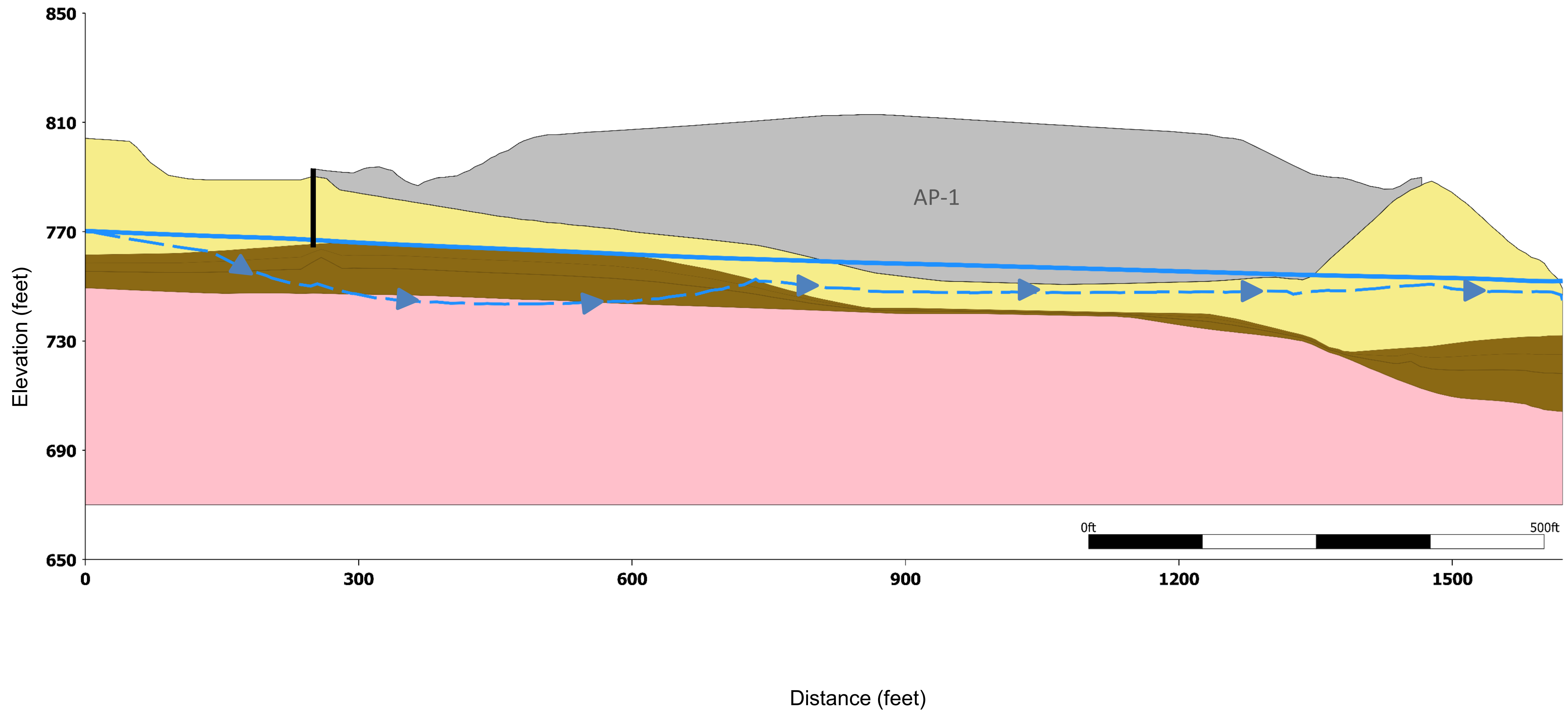
PROJECT NO.	SCS PROJECT ID	REV.	FIGURE
31406440.000	MCD15017	0	3-1



B

Scenario 2: Upgradient Barrier and Upgradient Drain

B'



Key

Geologic units

- Layer 1 - Coal Combustion Residuals
- Layer 2 - Residuum
- Layers 3-5 – Partially Weathered Rock
- Layers 6-8 - Bedrock

Hydraulic features

- Simulated Water table
- Scenario Particle Track
- Hydraulic Barrier Wall

Note:
- B-B' profile line is the Scenario 2 particle track
- Arrows indicate particle track direction, not velocity
- Elevations are shown in the North American Vertical Datum of 1988 (NAVD88)
- Vertical Exaggeration: 3x

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

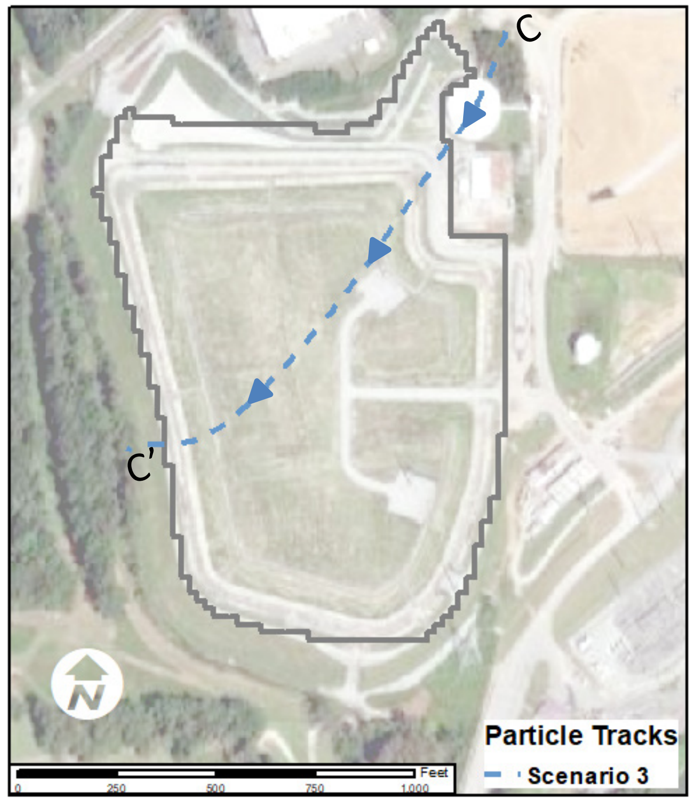
CONSULTANT

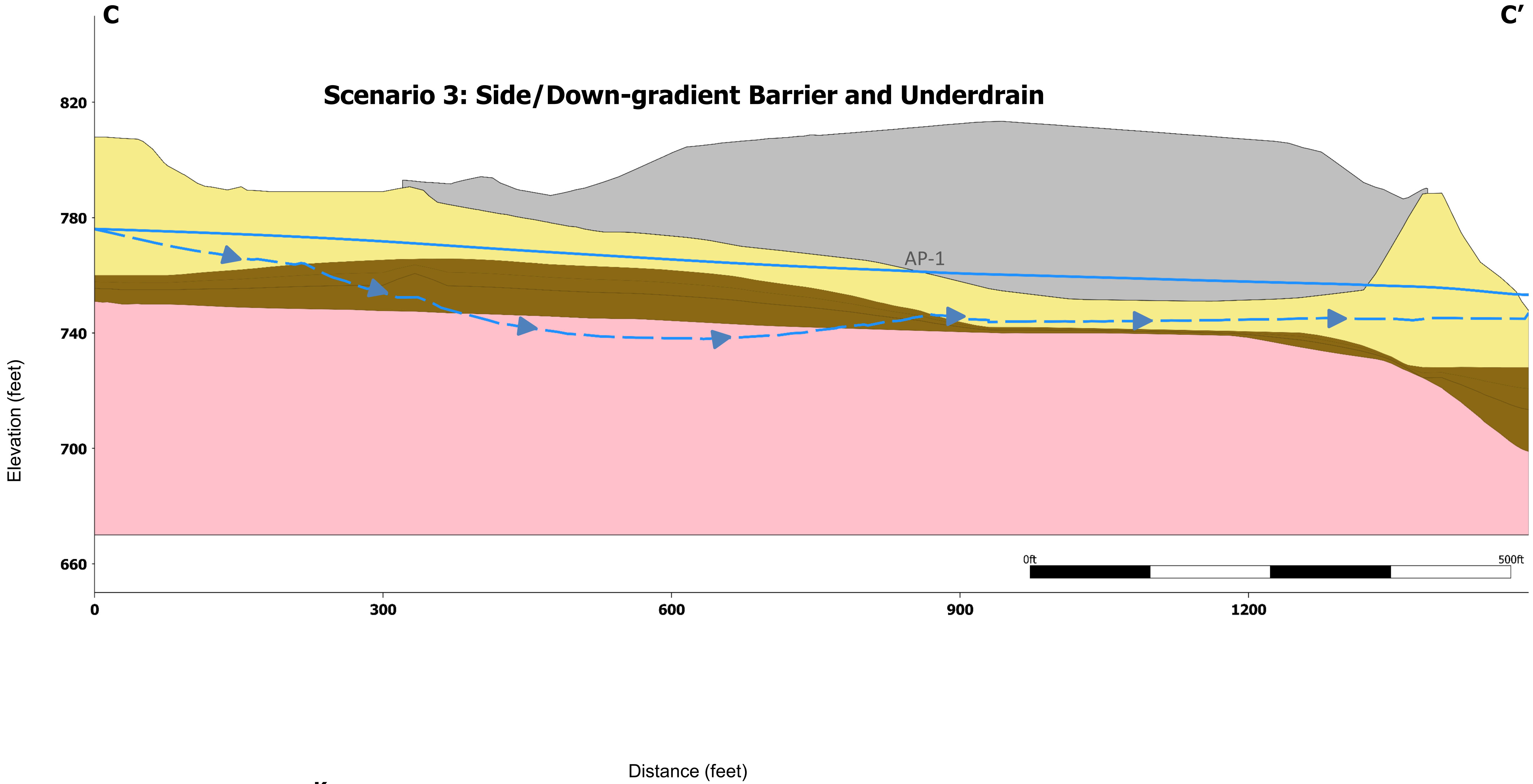
wsp

YYYY-MM-DD	2024-03-27
PREPARED	NP
DESIGNED	NP
CHECKED	WG
REVIEWED / APPROVED	DLP

TITLE
PARTICLE TRACK CROSS SECTION B-B' FOR SCENARIO 2

PROJECT NO.	SCS PROJECT ID	REV.	FIGURE
31406440.000	MCD15017	0	3-2





Key

Geologic units

- Layer 1 - Coal Combustion Residuals
- Layer 2 - Residuum
- Layers 3-5 – Partially Weathered Rock
- Layers 6-8 - Bedrock

Hydraulic features

- Simulated Water table
- Scenario Particle Track
- Hydraulic Barrier Wall

Notes:
- C-C' profile line is the Scenario 3 particle track
- Arrows indicate particle track direction, not velocity
- Elevations are shown in the North American Vertical Datum of 1988 (NAVD88)
- Vertical Exaggeration: 3x
- The particle track passes around the downgradient wall, which is not shown.

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

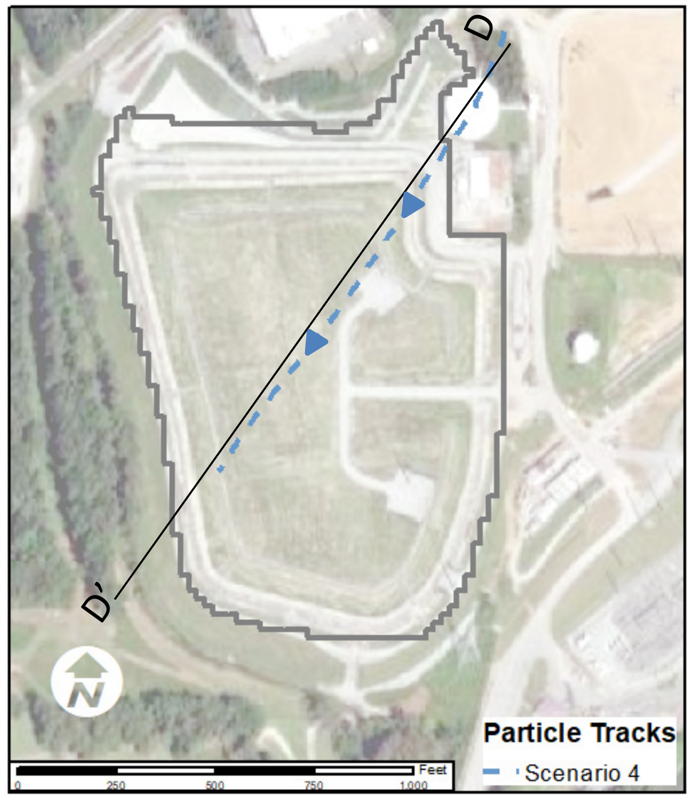
PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

CONSULTANT

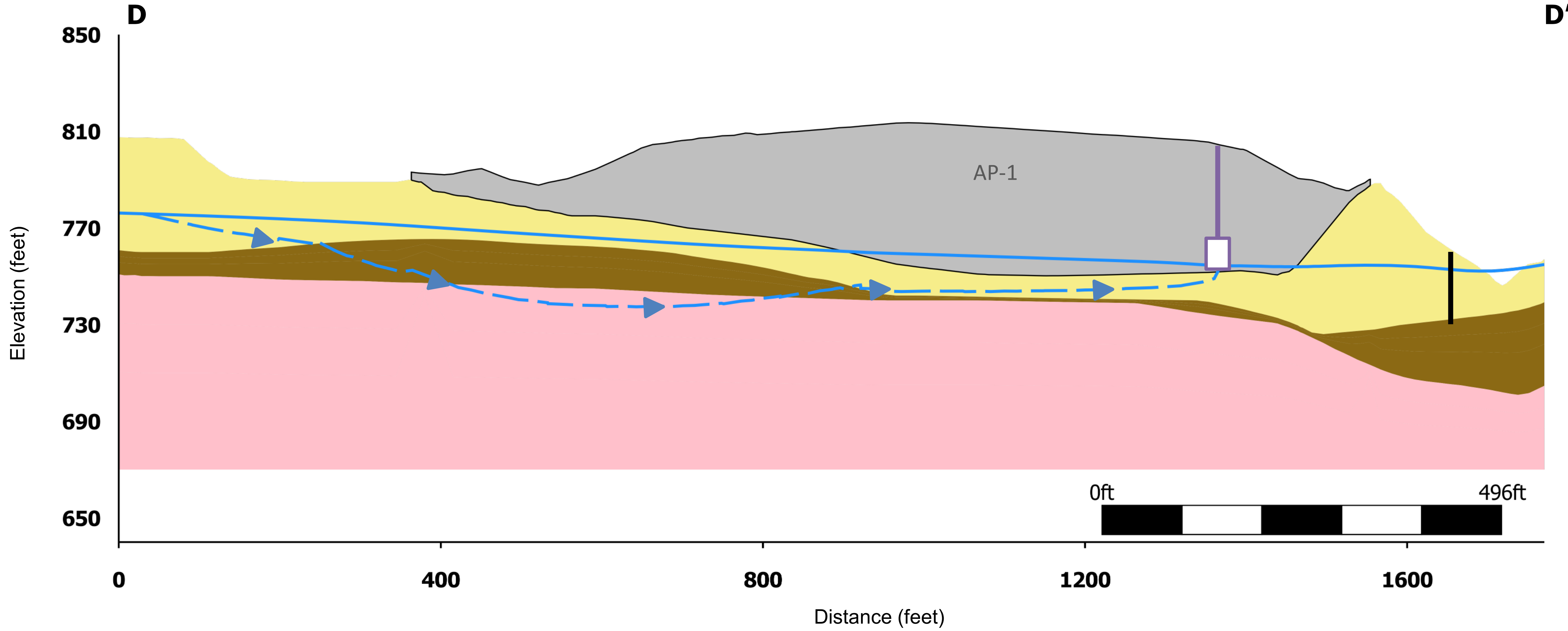
YYYY-MM-DD	2024-03-27
PREPARED	NP
DESIGNED	NP
CHECKED	WG
REVIEWED / APPROVED	DLP

TITLE
PARTICLE TRACK CROSS SECTION C-C' FOR SCENARIO 3

PROJECT NO.	SCS PROJECT ID	REV.	FIGURE
31406440.000	MCD15017	0	3-3



Scenario 4: Side/Down-gradient Barrier and Internal Dewatering Wells



Key

Geologic units

- Layer 1 - Coal Combustion Residuals
- Layer 2 - Residuum
- Layers 3-5 – Partially Weathered Rock
- Layers 6-8 - Bedrock

Hydraulic features

- Simulated Water table
- Hydraulic Barrier Wall
- Scenario Particle Track
- Extraction Well

Note:
- D-D' profile line is the Scenario 4 parallel to the Transect D particle track
- Arrows indicate particle track direction, not velocity
- Elevations are shown in the North American Vertical Datum of 1988 (NAVD88)
- Vertical Exaggeration: 3x

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

CONSULTANT

wsp

YYYY-MM-DD	2024-03-27
PREPARED	NP
DESIGNED	NP
CHECKED	WG
REVIEWED / APPROVED	DLP

PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

TITLE
PARTICLE TRACK CROSS SECTION D-D' FOR SCENARIO 4

PROJECT NO.	SCS PROJECT ID	REV.	FIGURE
31406440.000	MCD15017	0	3-4

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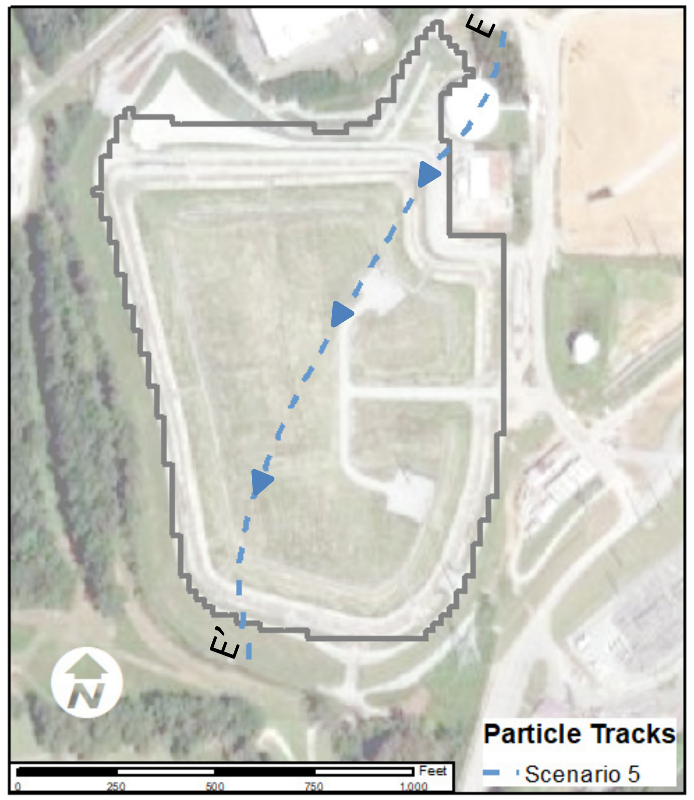
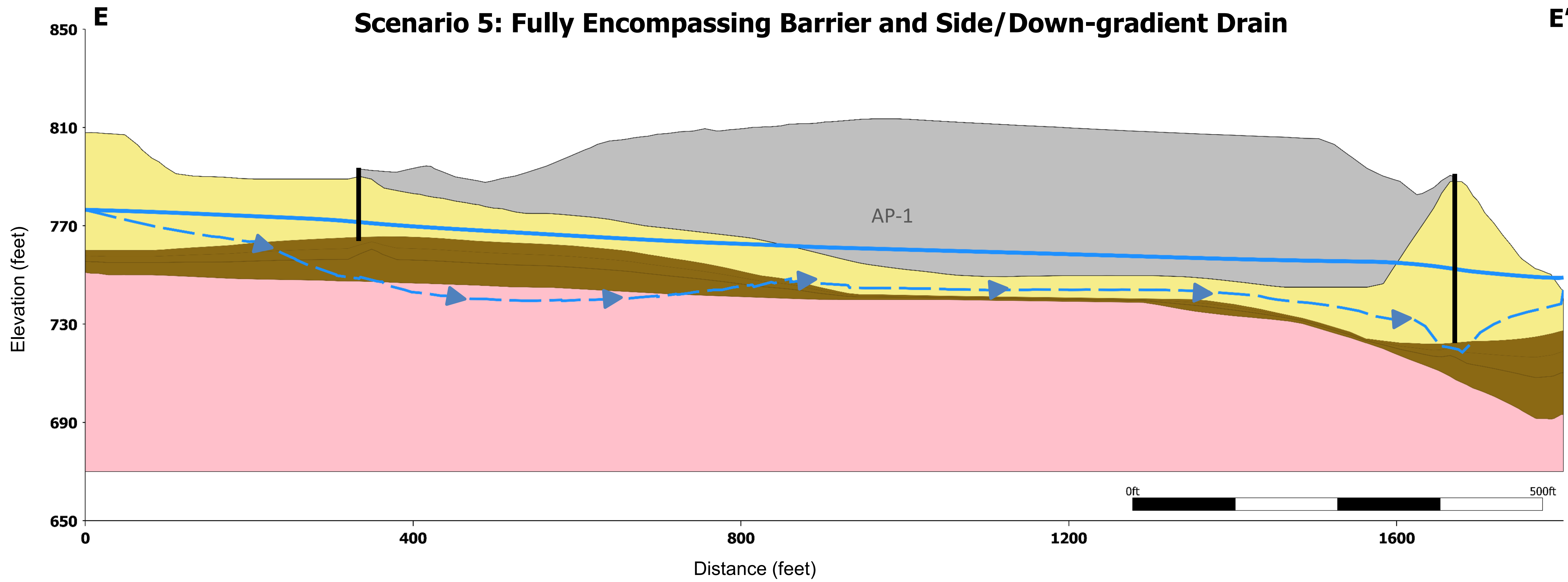




Key

Geologic units

- Layer 1 - Coal Combustion Residuals
- Layer 2 - Residuum
- Layers 3-5 – Partially Weathered Rock
- Layers 6-8 - Bedrock

Hydraulic features

- Simulated Water table
- Hydraulic Barrier Wall
- Scenario Particle Track

Notes:
- E-E' profile line is the Scenario 5 particle track
- Arrows indicate particle track direction, not velocity
- Elevations are shown in the North American Vertical Datum of 1988 (NAVD88)
- Vertical Exaggeration: 3x

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

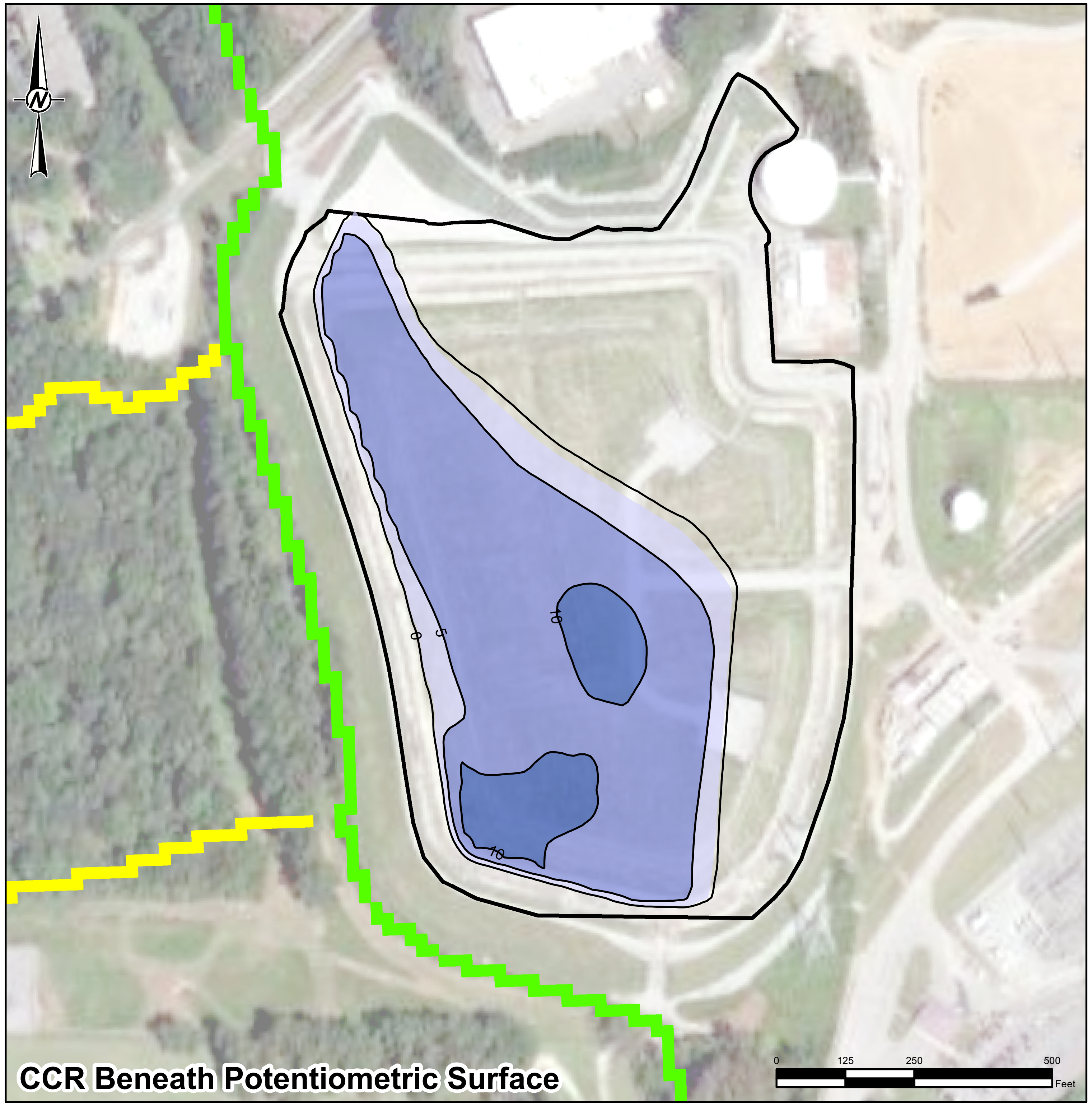
CONSULTANT

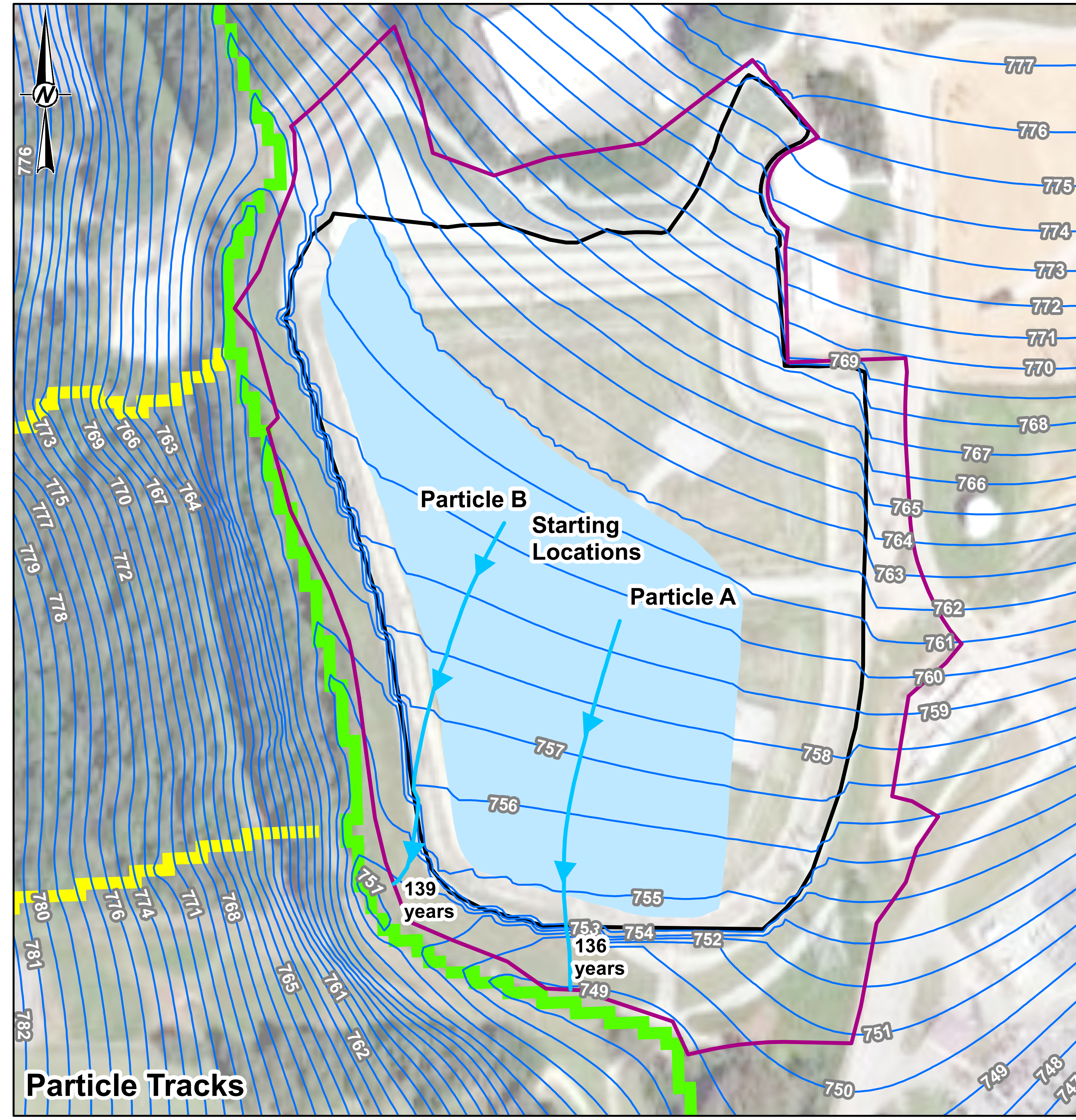
YYYY-MM-DD	2024-03-27
PREPARED	NP
DESIGNED	NP
CHECKED	WG
REVIEWED / APPROVED	DLP

PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

TITLE
PARTICLE TRACK CROSS SECTION E-E' FOR SCENARIO 5

PROJECT NO.	SCS PROJECT ID	REV.	FIGURE
31406440.000	MCD15017	0	3-5





LEGEND

CCR Thickness Below Potentiometric Surface (ft)

- 12 to10
- 10 to 5
- 5 to 0
- Post-Closure Waste Boundary
- River Boundary Conditions
- Drain Boundary Conditions
- Area With Water Table Above The Base of CCR
- Particle Tracks
- Water Table Contours
- AP-1 Permit Boundary

REFERENCE(S)

1. AERIAL IMAGERY FROM NAIP DATASET, DATED 2019-09-10 THROUGH 2019-10-04.

NOTE(S)

1. NAVD 88 - NORTH AMERICAN VERTICAL DATUM OF 1988.
2. CCR - COAL COMBUSTION RESIDUALS.
3. CONTOUR INTERVAL = 1 FOOT
4. ARROWS INDICATE PARTICLE TRACK DIRECTION, NOT VELOCITY.

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

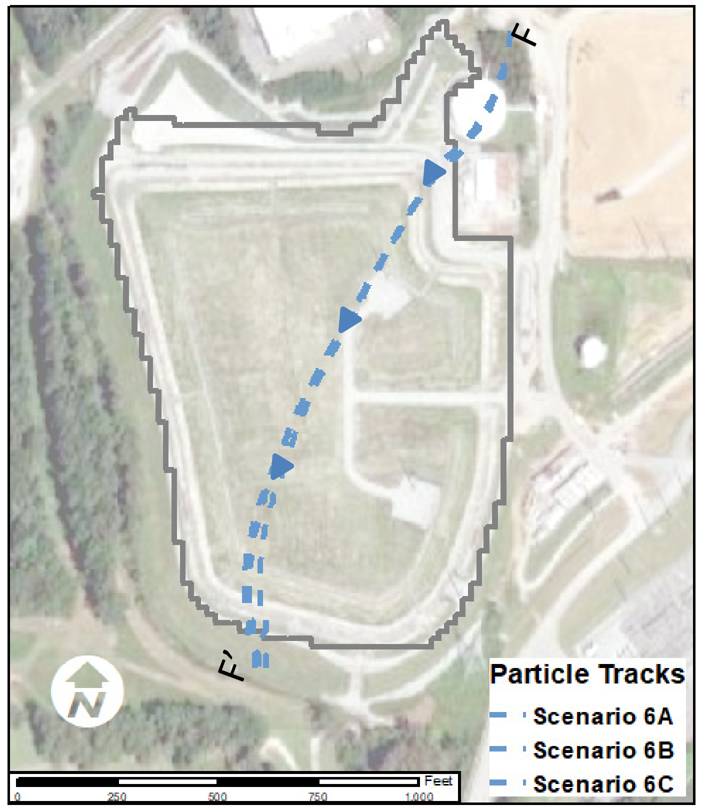
CONSULTANT
wsp

YYYY-MM-DD	2024-03-28
DESIGNED	JDV
PREPARED	AFS
REVIEWED	WG
APPROVED	CB

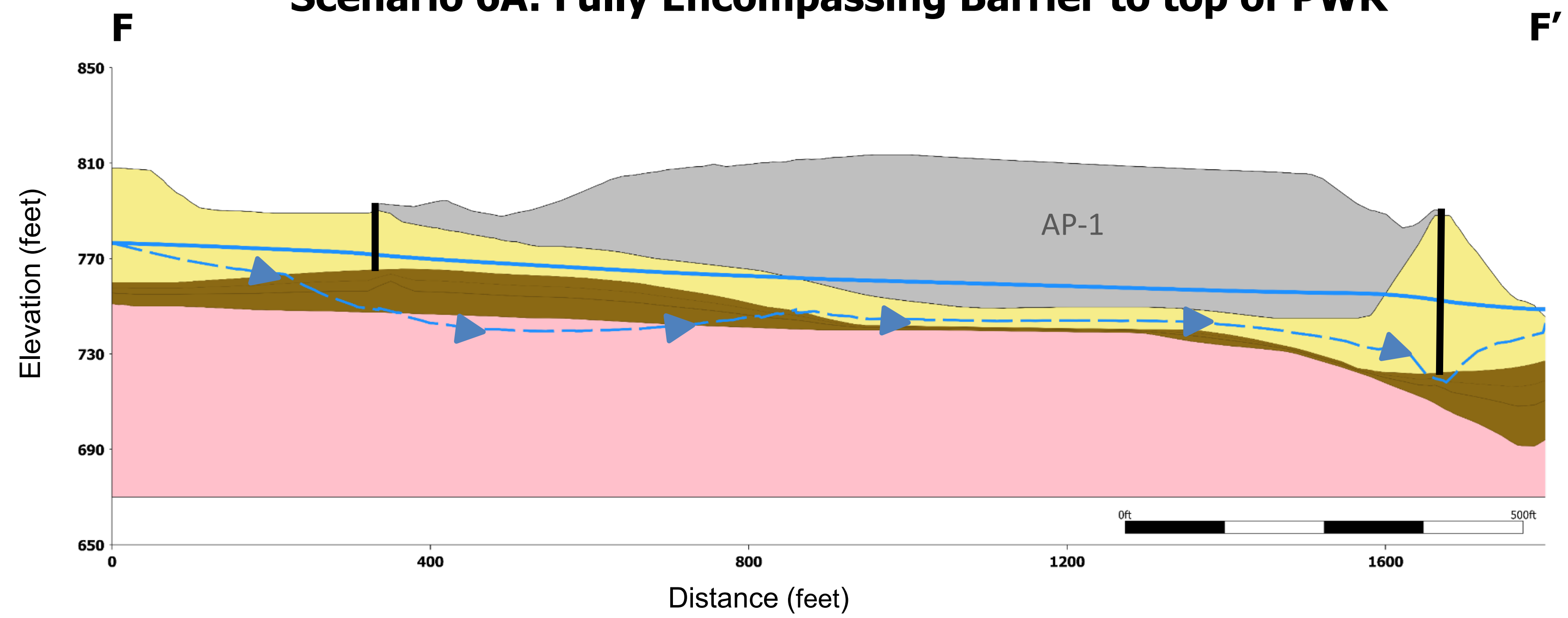
PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

TITLE
MODEL OUTPUTS FOR SCENARIO 6A (WALL TO TOP OF PWR)

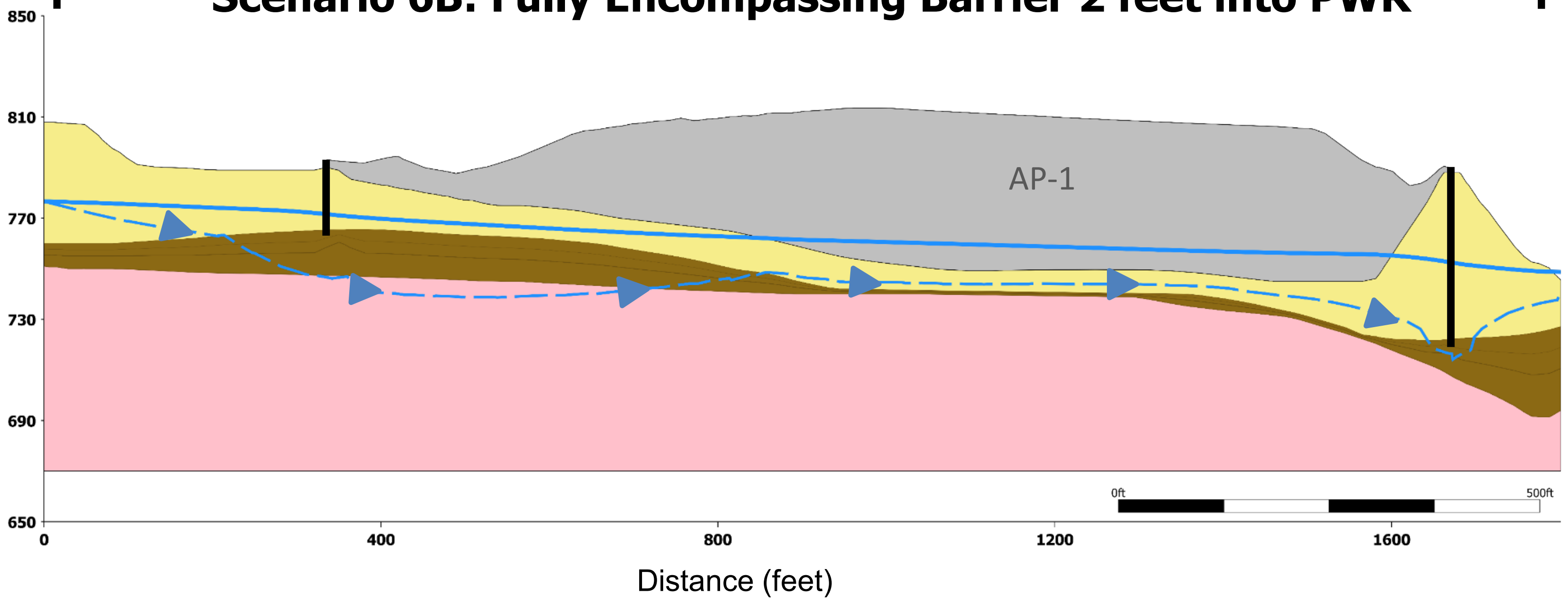
PROJECT NO.	SCS PROJECT ID.	REV.	FIGURE
31406440.000	MCD15017	0	3-6



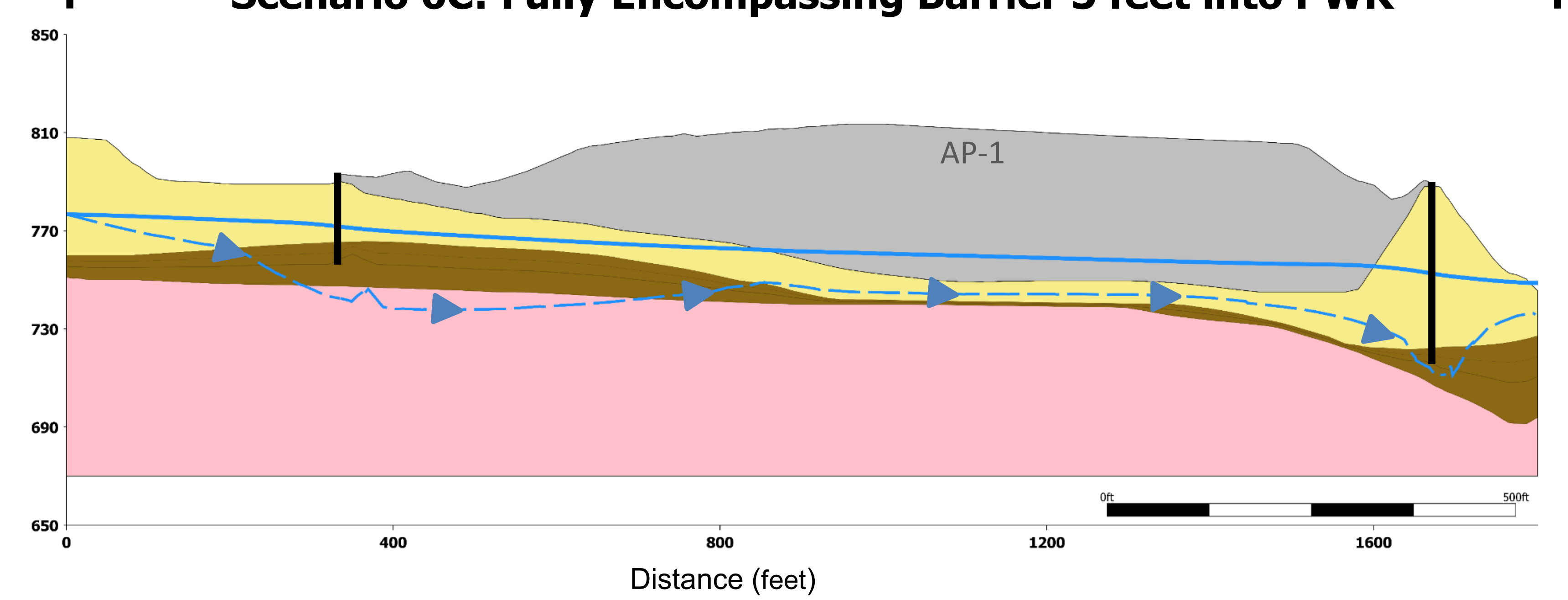
Scenario 6A: Fully Encompassing Barrier to top of PWR



Scenario 6B: Fully Encompassing Barrier 2 feet into PWR



Scenario 6C: Fully Encompassing Barrier 5 feet into PWR



Key

Geologic units

- Layer 1 - Coal Combustion Residuals
- Layers 3-5 – Partially Weathered Rock
- Layer 2 - Residuum
- Layers 6-8 - Bedrock

Hydraulic features

- Simulated Water table
- Scenario Particle Track
- Hydraulic Barrier Wall

Notes:
- F-F' profile line is Scenario 6A particle track
- Arrows indicate particle track direction, not velocity
- Elevations are shown in the North American Vertical Datum of 1988 (NAVD88)
- Vertical Exaggeration: 3x

CLIENT
GEORGIA POWER COMPANY
SOUTHERN COMPANY SERVICES

PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

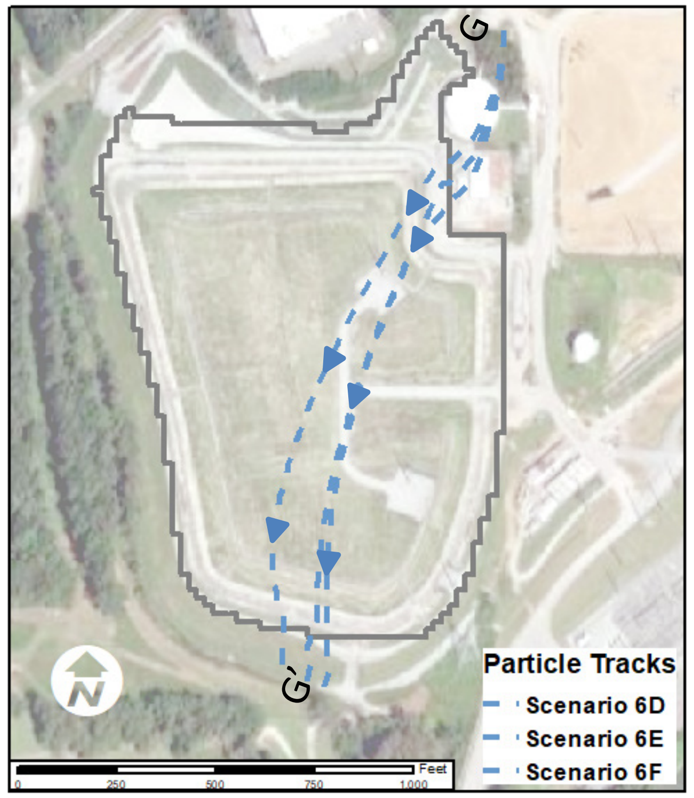
CONSULTANT

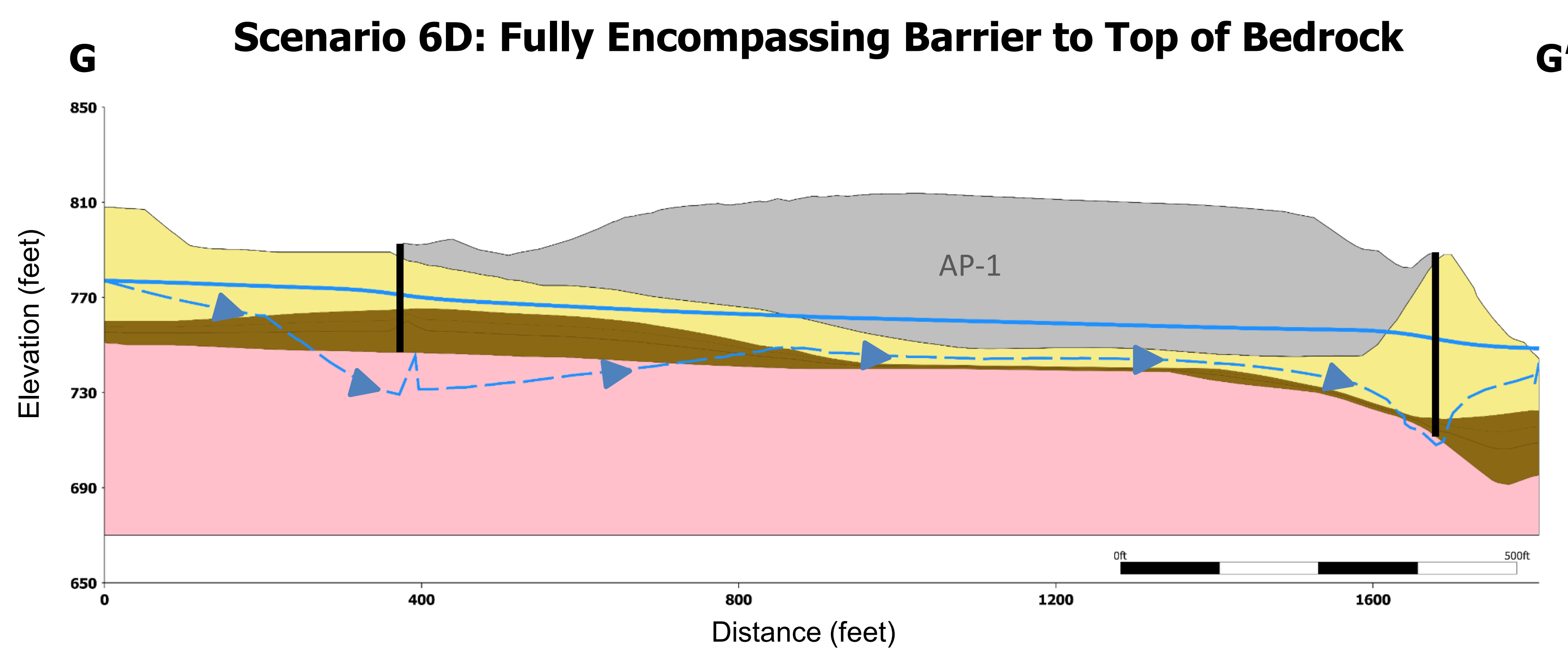
wsp

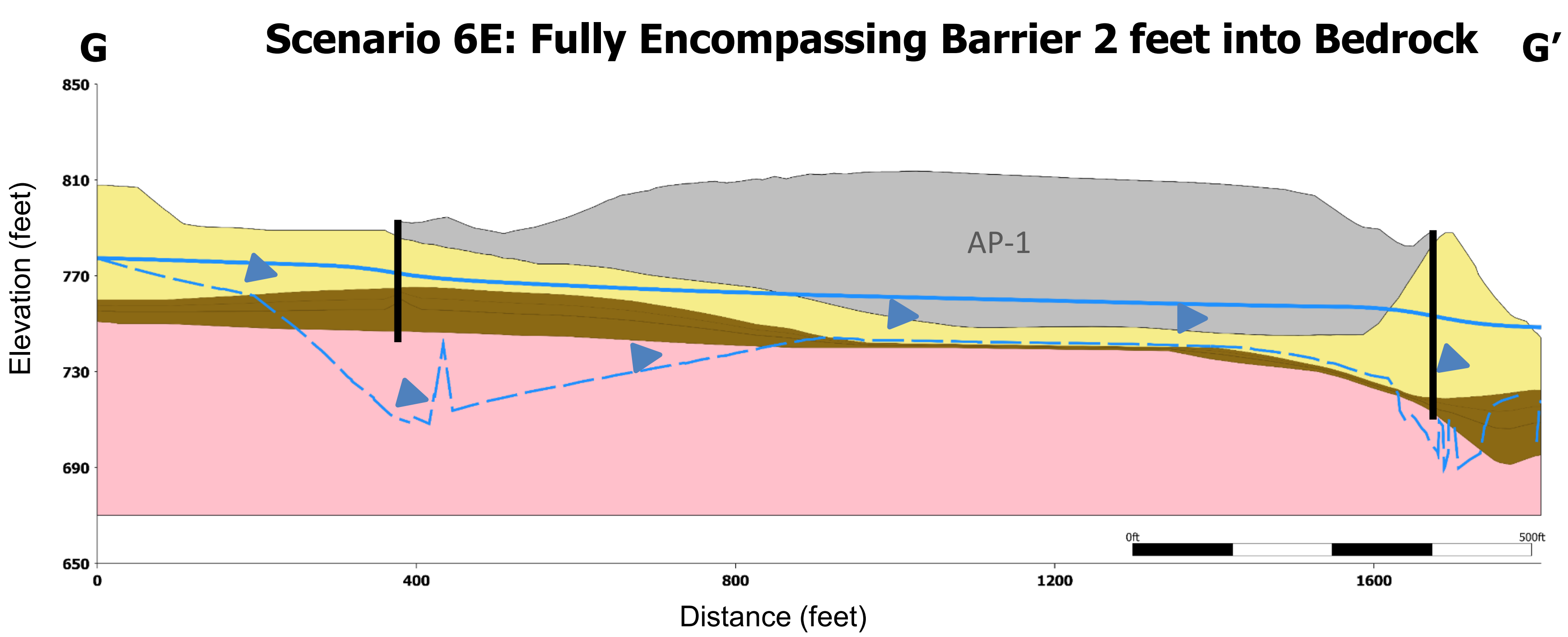
YYYY-MM-DD	2024-03-27
PREPARED	NP
DESIGNED	NP
CHECKED	WG
REVIEWED / APPROVED	DLP

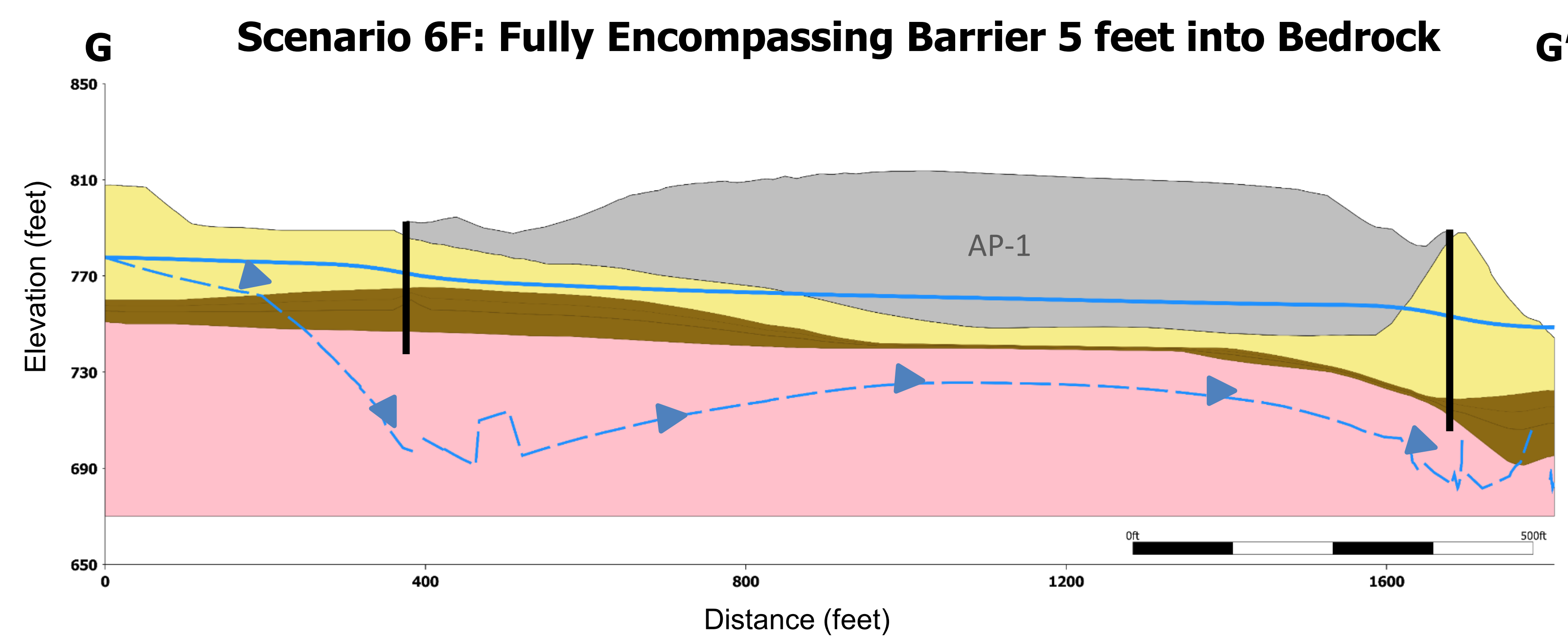
TITLE
PARTICLE TRACK CROSS SECTION F-F' FOR SCENARIOS 6A-6C

PROJECT NO.	SCS PROJECT ID	REV.	FIGURE
31406440.000	MCD15017	0	3-7









Key

Geologic units

- Layer 1 - Coal Combustion Residuals
- Layer 2 - Residuum
- Layers 3-5 – Partially Weathered Rock
- Layers 6-8 - Bedrock

Hydraulic features

- Simulated Water table
- Hydraulic Barrier Wall
- Scenario Particle Track

Notes:
- G-G′ profile line is the Scenario 6D particle track
- Arrows indicate particle track direction, not velocity
- Elevations are shown in the North American Vertical Datum of 1988 (NAVD88)
- Vertical Exaggeration: 3x

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PROJECT
GROUNDWATER MODEL AEM EVALUATION
PLANT MCDONOUGH ASH POND 1 (AP-1)

CONSULTANT

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YYYY-MM-DD	2024-03-27
PREPARED	NP
DESIGNED	NP
CHECKED	WG
REVIEWED / APPROVED	DLP

TITLE
PARTICLE TRACK CROSS SECTION G-G′ FOR SCENARIOS 6D-6F

PROJECT NO.	SCS PROJECT ID	REV.	FIGURE
31406440.000	MCD15017	0	3-8

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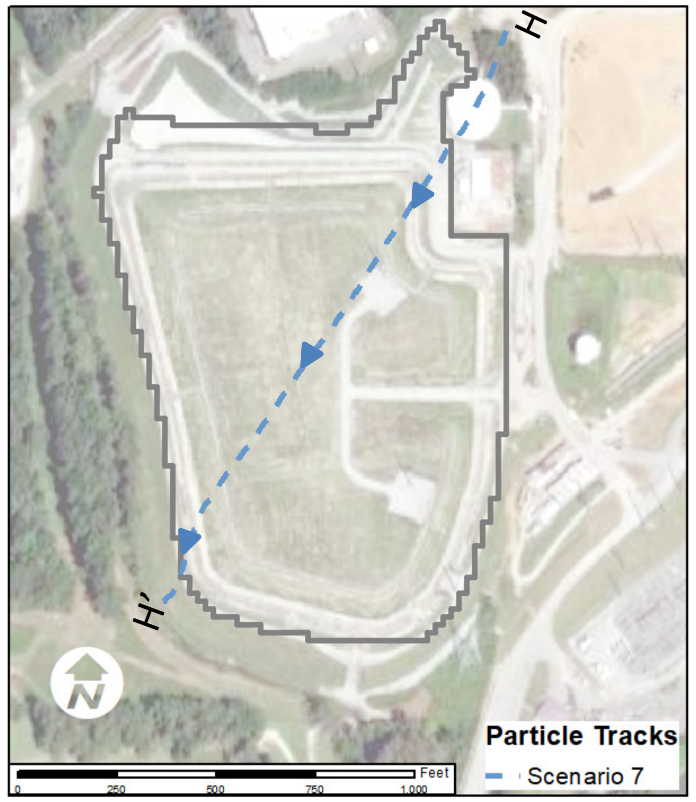

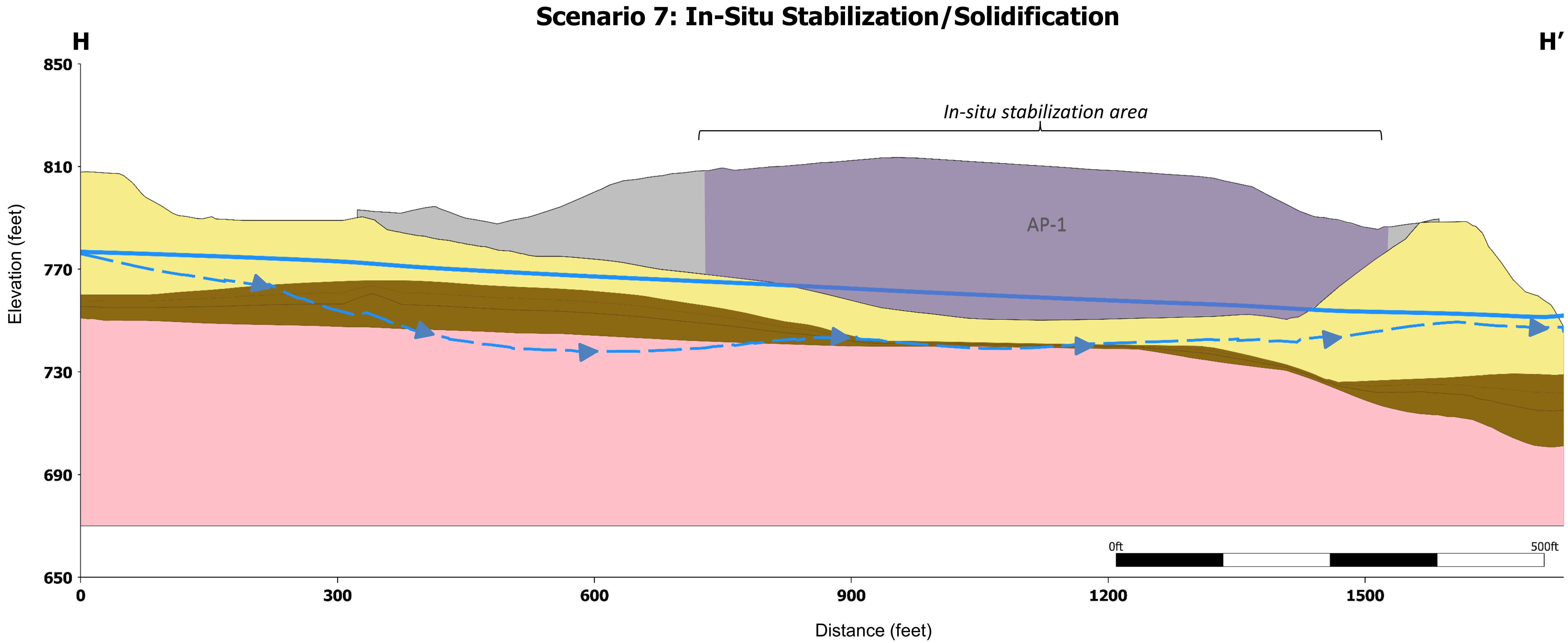

Key

Geologic units

- Layer 1 - Coal Combustion Residuals
- Layer 2 - Residuum
- Layers 3-5 – Partially Weathered Rock
- Layers 6-8 - Bedrock

Hydraulic features

- Simulated Water table
- Scenario Particle Track

Notes:
- H-H' profile line is the Scenario 7 particle track
- Arrows indicate particle track direction, not velocity
- Elevations are shown in the North American Vertical Datum of 1988 (NAVD88)
- Vertical Exaggeration: 3x

CLIENT	GEORGIA POWER COMPANY SOUTHERN COMPANY SERVICES
PROJECT	GROUNDWATER MODEL AEM EVALUATION PLANT MCDONOUGH ASH POND 1 (AP-1)
CONSULTANT	WSP
YYYY-MM-DD	2024-03-27
PREPARED	NP
DESIGNED	NP
CHECKED	WG
REVIEWED / APPROVED	DLP
TITLE	PARTICLE TRACK CROSS SECTION H-H' FOR SCENARIO 7

PROJECT NO.	SCS PROJECT ID	REV.	FIGURE
31406440.000	MCD15017	0	3-9

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