Compliance with the Closure Performance Standards Required by Coal Combustion Residuals (CCR) Rule Plant McDonough CCR Surface Impoundments Ash Ponds 3 and 4 (AP-3 and AP-4) (Combined CCR Unit AP-3/4)

This report supplements the closure application submitted to the Georgia Environmental Protection Division (GAEPD) by Georgia Power Company. The report further demonstrates that the closure in place methods selected for Plant McDonough-Atkinson (Plant McDonough) Ash Ponds 3 and 4 (AP-3 and AP-4), closing as Combined CCR Unit AP-3/4, comply with the closure performance standards of the federal and state CCR regulations (i.e., CCR rules).

I. Introduction to the regulated unit, closure method, and conceptual site model

A. Regulated Unit and Site Location

Plant McDonough is a power generating facility, owned and operated by Georgia Power, located in Cobb County, GA. 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), AP-3, and AP-4. In 2011, Plant McDonough ceased coal-fired electric generating activities, and subsequently ceased placing CCR in the units.

AP-3 and AP-4 were constructed to receive and store CCR from the coal fired generating process at Plant McDonough as permitted wastewater treatment units and have been used for sluiced fly ash, as well as dry stacking. Construction of AP-3 and AP-4 was completed in 1969 and 1974, respectively, and the units operated concurrently. CCR placement in AP-3 and AP-4 ceased in 2011 after Plant McDonough retired its coal units. Historical details for Plant McDonough AP-3 and AP-4, including location coordinates and physical and engineering properties are presented in the Combined Unit AP-3/4 History of Construction document submitted to EPD and located on Georgia Power's CCR Rule Compliance Information website for Plant McDonough.

B. Summary of Closure Method

CCR placement in AP-3 and AP-4 ceased in 2011 after Plant McDonough retired its coal units. Closure activities in accordance with Federal Regulation 40 CFR 257.100 were initiated in January 2016 for Combined Unit AP-3/4, before Georgia promulgated its state CCR program, and are currently ongoing. Closure construction activities for Combined Unit AP-3/4, which are close to completion as described in Section II.E below, consist of a combination of closure by removal and consolidation of CCR within the limits of the CCR Unit for closure in place. Additionally, Combined Unit AP-3/4 was subject to the Federal CCR Rule timelines for sites with early closures announced in 81 Fed. Reg. 51802 (Aug. 5, 2016).

Combined Unit AP-3/4 closure construction activities consist of liquid removal, consolidating CCR into a reduced footprint, and after the consolidated closure of AP-3 and AP-4 in place, lowering of the eastern dam containment structure. Consolidation is being conducted within the pre-closure limits of Combined Unit AP-3/4, by relocating CCR to the central portions of the contiguous AP-3 and AP-4. Additionally, a portion of CCR material from AP-3 was incorporated into AP-1 to help achieve final closure grades of AP-1 (further details are provided in Permit Application and other submissions specific to AP-1). The Combined CCR Unit AP-3/4 closure is designed such that the final closed geometry

provides for gravity drainage of surface water (e.g., non-contact stormwater) from the unit in a controlled manner. The Combined CCR Unit AP-3/4 State Permit Application (Permit Application), Part A, Section 7 Closure Plan presents details for the closure of AP-3 and AP-4 as Combined Unit AP 3/4. Installation of the final cover system at Combined Unit AP-3/4 is currently ongoing and is scheduled for completion in 2021.

While the closure design and permit application also included other final cover options, such as a vegetative soil cover option overlying a geomembrane flexible membrane liner ("FML") system, the closure system under construction at Combined Unit AP-3/4 is the ClosureTurf™ cover system. As described in the permit application, that system consists of the following features, from the bottom layer to the top layer:

- 18-inch thick (min.) layer of compacted CCR or earthen subgrade material
- 40-mil minimum thickness linear low-density polyethylene (LLDPE) FML geomembrane
- ClosureTurf™ (combined geotextile and engineered turf layer)
- Turf Infill or Overlying Protective Layer Options. Examples include:
  - Sand infill for general areas
  - Sand infill with a tackifier (Armorfill E)
  - Concrete infill (Hydrobinder)
  - Articulated Concrete Block (ACB) armoring
  - Drainage stone (riprap, gravel, etc.) overlying a geosynthetic separation / protection layer
  - Roadway stone overlying a geosynthetic separation / protection layer

Following closure completion, Combined Unit AP-3/4 will enter into post-closure care for a minimum period of thirty (30) years. Post-closure care is detailed in the Permit Application, Part A, Section 8. In addition, Georgia Power has elected to implement advanced engineering methods (AEMs) to supplement the closure design. The AEMs selected for Combined Unit AP-3/4 include (1) the under-slope drainage system presented in the permit application, which is currently under construction, for the collection and conveyance of subsurface water that may be present above the bottom elevation of the drainage system for discharge in accordance with applicable NPDES requirements and (2) the continued use of temporary AEM wells for enhanced water removal during closure and in the years directly following closure to accelerate the pace at which the groundwater table will lower to the modeled expected long-term post-closure level, which is below the base of the Combined Unit AP-3/4.

C. Conceptual Site Model

This section presents a summary of the conceptual site model (CSM) provided in full in the Hydrogeological Assessment Report REV02 (HAR) submitted to GAEPD in November 2020 supporting Section 1 of Part B of the Permit Application. A regional, unconfined aquifer system is present at Plant McDonough, consisting of residual soils and transitionally weathered rock. Interconnected fractures in the transition zone transmit groundwater stored in the overburden soils to underlying bedrock. Localized groundwater flow directions within this aquifer are influenced by topographic and top of rock variations on site, which are consistent with the slope-aquifer conceptual model for groundwater flow in

the Piedmont (Robinson et al. 1996[1], LeGrand, 2004[2]).

Other attributes of the site-specific CSM include:

- The site is directly underlain by a variably thick blanket of overburden (typically observed between 9 to 61-feet thick), which is comprised of residual and saprolitic soils, saprolitic rock, partially weathered rock (PWR), and transitionally weathered rock.

- Bedrock in the northwestern part of the site is primarily characterized by Ordovician-age Long Island Creek Gneiss described as felsic sphene-epidote-biotite-quartz-feldspar gneiss with well-developed foliation and an augen texture.

- Bedrock in the southeastern portion of the site is primarily characterized by interlayered Ordovician-age phyllonite, button schist with well-developed shear foliation, fine-grained mylonite with poorly developed foliation, and very fine-grained mylonitic biotite gneiss with well-developed shear foliation.

- The uppermost aquifer occurs within the overburden and upper bedrock at the site. Although the degree of connection between the overburden and underlying bedrock aquifer systems is not fully understood, the bedrock is generally massive with few joints available to receive groundwater from the overlying overburden. In general, the majority of groundwater flow across the site occurs laterally in the overburden zone generally towards the southeast and/or south. Based on site-specific hydrogeologic characteristics, groundwater is expected to move laterally more than vertically within the PWR strata within the overburden unit and it is likely that there is limited groundwater movement from the PWR strata to the aquifer occurring in the bedrock unit.

II. CCR Rule Performance Standards

A. Post-Closure Infiltration of Liquids and Releases – CCR Performance Standard 40 C.F.R. § 257.102(d)(1)(i)

Section 257.102(d)(1)(i) requires the final cover system to control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.

[1] Robinson, J. L., Journey, C. A., Atkins, J B, 1996, Ground-Water Resources of the Coosa River Basin in Georgia and Alabama - Subarea 6 of the Apalachicola-Chattahoochee-Flint and Alabama-Coosa-Tallapoosa River Basins, USGS Report 96-177.

[2] Legrand, Sr., H. E.,2004, Master Conceptual Model for Hydrogeological Site Characterization in the Piedmont and Mountain Region of North Carolina: A Guidance Manual.

1 **Infiltration is controlled, minimized, or eliminated, to the maximum extent feasible.**

Infiltration is the process by which surface water enters into the subsurface. Infiltration is further defined in the text titled *Groundwater*[3] (Freeze and Cherry) as "the entry into soil of water made available at the ground surface, together with the associated flow away from the ground surface within the unsaturated zone." EPA additionally states that infiltration is how "water applied to the soil surface through rainfall and irrigation events subsequently enters the soil" and that "this term can be used in the estimation of water available for downward percolation.[4]

Based on these and other technical definitions of infiltration, to meet the performance standard, the engineered final cover system must control, minimize, or eliminate, to the maximum extent feasible, the vertical migration of water from the surface into the underlying CCR. This performance standard does not address lateral movement of water in the subsurface because lateral movement is not considered infiltration.

The control and minimization of infiltration in the post-closure state of the unit is achieved by the final grading configuration and the installation of the final cover system. The closure method for Combined Unit AP-3/4 consists of consolidation and closure in place of CCR. The design of the final cover system of Combined Unit AP-3/4 was prepared following the requirements outlined in §257.102(d), including the final cover system requirements of §257.102(d)(3), as summarized above in Section I.B.

The final cover system engineering design is outlined in detail in the Engineering Report submitted with the Permit Application for Combined Unit AP-3/4. The final cover system includes measures to prevent infiltration, serve as a stable containment system under post-closure conditions, and to prevent releases of CCR. Specifically, ClosureTurf™, a cover system consisting of an engineered combination of a flexible membrane liner and synthetic turf, was designed and is being utilized as the final cover system for Combined Unit AP-3/4 to control, minimize, or eliminate to the maximum extent feasible infiltration (from, e.g., precipitation) into the unit. In addition, final slopes of the closure are engineered for long term stability and drainage, with 3% grades across the top deck of the unit, and maximum 4H:1V slopes in CCR placement areas.

An evaluation of the permeability of the designed final cover system at Combined Unit AP-3/4 using the Hydrologic Evaluation of Landfill Performance (HELP) model was conducted, comparing the implemented ClosureTurf™ cover system to a traditional, earthen cover system that is the baseline requirement under § 257.102(d)(3).[5] While the baseline earthen cover system would be permissible, the ClosureTurf™ actually results in 99.99% less calculated infiltration potential than the baseline earthen cover system. Appendix F of the Engineering Report (Part B Section 2) presents the detailed HELP evaluations.

The surface water management system for Combined Unit AP-3/4 further minimizes the potential for infiltration. This system includes several controls for stormwater management at the closed unit. Stormwater runoff from the closed surface is routed over the cover system through a system of perimeter and downslope channels to a series of three detention ponds outside the consolidated footprint of CCR closed in place. From there, stormwater is routed to the site's permitted

[3] Freeze and Cherry, *Groundwater* 1979

[4] https://www.epa.gov/water-research/infiltration-models

[5] The HELP model also evaluated the lined vegetated cover system included in the permit application and found that it would also significantly outperform the baseline cover system described at 40 CFR § 257.102(d)(3).

outfall points. Surface water management design was performed using the TR-55 – Urban Hydrology for Small Watersheds method. The data was then evaluated with the use of Autodesk Storm and Sanitary Analysis software. The surface water management system evaluation is presented in the Engineering Report (Part B Section 2) and describes the design features that provide for controlled conveyance of stormwater off of the unit cover system through the use of perimeter channels, culverts, and outfall structures.

As demonstrated above and presented in more detail in the Permit Application, the AP-3/4 closure design includes measures to establish that the infiltration performance standard is met as required by 40 C.F.R. § 257.102(d)(1)(i).

In addition, the under-slope drainage system AEM runs along the face and toe of the eastern slope was designed and its construction is substantially complete. It is designed to collect and convey subsurface water that may be present above the bottom elevation of the drainage system within Combined Unit AP-3/4. The under-slope drainage system is detailed in the Permit Application for Combined Unit AP-3/4 Closure Plan (Part A Section 7) and Engineering Report (Part B Section 2) and serves to lower the elevation of the groundwater table in the area of Combined Unit AP-3/4.

There are four main components of the under-slope drainage system: geocomposite strips, sand and gravel trench drains, perforated HDPE collection pipes, and an under-slope collection sump. The geocomposite strips are designed as a backup component for the under-slope drainage system and will convey collected water from within the eastern limits of Combined Unit AP-3/4 to the sand and gravel trench drains. The sand and gravel trench drains, which are the primary component of the under-slope system, collect water via direct flow and from the geocomposite strips, and with assistance from the HDPE pipes, convey that water to the under-slope collection sump for removal from the closed system. The under-slope drainage system has been designed to extract and manage groundwater at a capacity significantly exceeding the modelled long-term groundwater generation rate of 7 gallons per minute, and also includes redundant storage capacity, if needed. The under-slope drainage system capacity is detailed in the Engineering Report (Part B Section 2) and the modelled long-term groundwater generation rate is detailed in the Hydrogeological Assessment Report REV02 (HAR) submitted to GAEPD in November 2020 supporting Section 1 of Part B of the Permit Application.

While controlling or minimizing lateral migration of groundwater is not a requirement of the infiltration performance standard because lateral migration is, by definition, not infiltration, the selected closure methods also provide controls to minimize lateral migration. The Hydrogeological Assessment Report REV02 (Golder, 2020) (supplementing Part B Section 1 of the Permit Application) details the three-dimensional post-closure numerical groundwater modeling for the site. The steady state groundwater modelling predicts that the closure plans, with implementation of the designed under-slope collection system AEM, will result in water levels declining to elevations at or below the bottom of the unit. Additional details regarding the groundwater modeling are presented in Appendix A of the Hydrogeological Assessment Report in Part B Section 1 of the Permit Application and are subject to updates and refinements, including as additional site data are collected. In addition, the proposed AEMs for Combined Unit AP-3/4 include the continued use of the temporary AEM wells for enhanced water removal for a temporary period after closure to accelerate the rates at which the post-closure groundwater table elevation is reached.

2 **Releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere are controlled, minimized, or eliminated to the maximum extent possible.**

The selected closure method for Combined Unit AP-3/4 was designed and constructed to control, minimize, or eliminate, to the maximum extent feasible, releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere, as required by the performance standard in 40 C.F.R. § 257.102(d)(1)(i). The defined term "groundwater" is not included among the media listed in this performance standard. Matters related to the potential CCR groundwater impacts are instead regulated by other parts of the CCR Rule. Thus, the basis for evaluating compliance with this performance standard is the degree to which the closure design controls, minimizes, or eliminates these releases to the ground, surface waters, and the atmosphere.

The capping of Combined Unit AP-3/4 utilizing ClosureTurf™ provides a barrier that isolates the CCR closed in place from the surface environment, thereby preventing releases from occurring to the ground, atmosphere, or surface waters. The use of the ClosureTurf™ system provides an engineered means to minimize releases of CCR following closure through the use of an FML placed over engineered slopes to cover CCR and optimize drainage of surface water. Details of the closure design including details of the ClosureTurf™ system are presented in Section I.B above, as well as the Closure Plan in Part A Section 7 of the Permit Application and the Engineering Report in Part B, Section 2 of the Permit Application. The selected closure method will control, minimize or eliminate, to the maximum extent feasible, releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.

Additionally, a Fugitive Dust Control Plan was prepared in order to identify dust control measures used throughout construction. Details on the Fugitive Dust Control Plan are presented in the Closure Plan in Part A Section 7 of the permit application, as well as on Georgia Power's CCR website for Plant McDonough. Following closure, the ClosureTurf™ system fully separates CCR from exposure to the atmosphere and the liner eliminates, to the maximum extent feasible, release of CCR to the atmosphere.

As demonstrated above and presented in more detail in the Permit Application, the Combined Unit AP-3/4 closure design includes measures to establish that the post-closure releases performance standard is met as required by 40 C.F.R. § 257.102(d)(1)(i).

B. The closure method precludes the probability of future impoundment of water, sediment, or slurry, per 40 C.F.R. § 257.102(d)(1)(ii).

The final cover system must be designed to "preclude the probability of future impoundment of water, sediment, or slurry" as required by 40 C.F.R. § 257.102(b)(iii); (d)(1)(ii). Technical and regulatory references show that the term, "impoundment" means the surface accumulation of water, sediment, or slurry. Prior to closure as Combined Unit AP-3/4, AP-3 and AP-4 were surface impoundments during the operational life of the units, because the units were formed through the construction of earthen dikes used to contain CCR materials. AP-4 is bounded to the east by an earthen dam, currently classified as a Category I High Hazard dam that is regulated by the Georgia Safe Dams Program. As part of the closure process, the earthen embankment across the majority of AP-4 will be lowered to the point that it can be reclassified as a Category II Dam, and the Georgia Safe Dams Program has already approved the reduction in hazard classification for the post-closure configuration.

The CCR Rule closure performance standards follow the Mine Safety and Health Administration (MSHA) regulations for closure of impoundments under MSHA jurisdiction. Specifically, MSHA regulation 30 C.F.R. 77.216-5 uses the same language as the impoundment performance standard, requiring closure

plans to “preclude the probability of future impoundment of water, sediment, or slurry.” As stated in MSHA’s Coal Mine Impoundment Inspection and Plan Review Handbook (October 2007), precluding surface accumulations is “typically done by breaching and/or capping,” which eliminate surface accumulations. EPA also indicates that the impoundment performance standard is met by precluding future surface accumulations through final cover system grades that promote surface water runoff (80 Fed. Reg. at 21,411).” As such, “future impoundment” refers to potential surface accumulations above a cap.

The final cover system precludes the probability of impounding water, sediment, and slurry because its engineering and construction are designed to prevent the surface accumulation of water, sediment, and slurry. Closure plans for Combined Unit AP-3/4 include engineered surface grading plans that were prepared using AutoCAD Civil 3D. The grades were designed to eliminate the accumulations of water, sediment, or slurry on the capped surface of Combined Unit AP-3/4, and the designed perimeter drainage channels were engineered to move runoff away from the closed unit to the three designed detention ponds at the perimeter of the closed unit, from which the water will be discharged in a controlled manner until emptied. These closure plans are presented in Part A Section 9 of the Permit Application.

More specifically, and as already noted above, the Combined Unit AP-3/4 surface water management system manages stormwater runoff from the closed surface by routing stormwater from the closure system’s engineered turf through a system of perimeter channels and downchutes to three detention ponds located at the perimeter of the closed unit: Detention Pond 3 to the south, Detention Pond 1 to the northwest, and Detention Pond 2 to the east. These three detention ponds are designed for the attenuation and controlled management of stormwater. There are the two outfall points identified in the Closure Plans (Part A, Section 9). Detention Pond 3 is designed to attenuate flow from the closed surface and drain within 24 hours for the design 100-year, 24-hour storm event, and discharges to the south of the unit into an existing site stormwater pond and permitted discharge point. Detention Pond 1 discharges to Detention Pond 2 via the perimeter channel network and a series of pipes designed as part of the unit closure. Detention Pond 2 is the primary detention pond for the unit and discharges through existing plant infrastructure.

Design of this surface water management system was performed using the TR-55 – Urban Hydrology for Small Watersheds method for generating rainfall information and was also evaluated with the use of Autodesk Storm and Sanitary Analysis. The detailed surface water management system evaluation is presented in the Engineering Report (Part B Section 2), which provides additional details on how the designed Combined Unit AP-3/4 stormwater management system meets the CCR rule requirements and design objectives of the closure.

In addition, long-term settlement potential for Combined Unit AP-3/4 was calculated and used to evaluate the potential for future impoundment subject to this performance standard. In general, CCR is much less susceptible to long term settlement than municipal solid waste (MSW) and Construction & Demolition (C&D) waste masses, and as such, cover system components and drainage grades are less prone to settlement induced issues in CCR closures. In fact, the maximum calculated post-closure settlement in Combined Unit AP-3/4 is less than 0.1 feet (< 1 inch). Therefore, settlement is expected to have minimal impact to the final grades after closure. Details of the evaluation for settlement potential for Combined Unit AP-3/4 are presented in Appendix E of the Engineering Report (Part B Section 2 of the Permit Application). Thus, these settlement evaluations confirm that the final cover system will preclude the probability of future impoundment of water, sediment, or slurry.

As demonstrated above and presented in more detail in the Permit Application, the Combined Unit AP-3/4 closure is designed to preclude the probability of future impoundment of water, sediment, or slurry is met, as required by 40 C.F.R. § 257.102(d)(1)(ii).

C. The closure method provides for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period, per 40 C.F.R. § 257.102(d)(1)(iii).

As demonstrated in detail in the Engineering Report included in Part B of the Permit Application, Combined Unit AP-3/4 at Plant McDonough has been evaluated across a wide range of global (deep) and veneer (shallow) stability conditions. Slope stability evaluations include a range of short- and long-term conditions, including provision for impacts from design storm events and from the theoretical potential seismic (earthquake) hazard at the site. Stability and integrity were evaluated using common commercial analysis software packages, including: RocScience SLIDE, AutoCAD Civil 3D, and in-house analytical calculation worksheets and procedures. As demonstrated in the Permit Application, the closure of Combined Unit AP-3/4 exceeds all regulatory requirements for closed unit stability. Thus, the Combined Unit AP-3/4 closure is designed to prevent the sloughing or movement of the final cover system during the closure and post-closure care period, as required by 40 C.F.R. § 257.102(d)(1)(iii).

D. The closure method minimizes the need for further maintenance of the CCR unit, per 40 C.F.R. § 257.102(d)(1)(iv).

The maintenance performance standard as required by 40 C.F.R. § 257.102(d)(1)(iv) is met because the final cover system has been designed to need minimal maintenance after placement. The 30-year post-closure care period provides sufficient time to ensure that the final cover system is properly maintained (80 Fed. Reg. at 21,426).

As summarized above, the closure of Combined Unit AP-3/4 incorporates a synthetic liner and engineered turf cover system known commercially as ClosureTurf™. The ClosureTurf™ cover system consists of a structured geomembrane, overlain by an engineered synthetic turf and a specified sand infill in areas not otherwise overlain by supplemental cover materials (e.g., stone, riprap, etc.). While sand infill for a ClosureTurf™ system can warrant replenishment or maintenance, use of an engineered turf closure system does not involve maintenance associated with traditional soil covers related to potential deeper erosion repairs and revegetation. Veneer stability calculations were completed and demonstrate that the selected cover system material is stable; additional details can be found in Appendix H of the Engineering Report (Part B Section 2 of the Permit Application). In addition, migration of sand infill on the ClosureTurf™ was assessed in accordance with manufacturers guidelines. Additional details can be found in Appendix J of the Engineering Report (Part B Section 2 of the Permit Application.

Similarly, the final grades of Combined Unit AP-3/4 were designed to minimize maintenance by limiting long-term settlement potential of the surface water conveyance system from the unit to the detention ponds and outlet structures. Details of the evaluation for settlement potential for Combined Unit AP-3/4 are presented in Appendix E of the Engineering Report (Part B Section 2 of the Permit Application), indicating that for the closed Combined Unit AP-3/4 conditions there is both minimal potential for post capping settlement and post closure inspection and maintenance protocols in place to rectify any minimal settlement that may occur during the post closure care period.

Surface water is routed to the three detention ponds for the unit located to the south, northwest, and east of the closed unit, through a series of flat bottom bench and perimeter channels

designed and constructed as concrete infilled turf (HydroTurf) and drainage stone (riprap and stone) lined channels. The closure configuration and engineered stormwater features are designed to safely manage stormwater while limiting erosion from stormwater flow on the cover and in the channel and ponds through channel and pond layout and dissipation and armoring features. Estimates of the anticipated post closure flow velocities and shear stresses, and selected channel lining's resistance to the shear stresses were calculated and are provided in Appendix J of the Engineering Report (Part B Section 2 of the Permit Application). In addition, the pumps identified for long-term use as part of the Combined Unit AP-3/4 AEMs are designed for connection to a sump for ease of maintenance in its long-term use.

Through this combination of features and presented in more detail in the Permit Application, the closure method minimizes the need for further maintenance of the CCR unit, as required by 40 C.F.R. § 257.102(d)(1)(iv). See also the Post-Closure Care Plan presented in Part A Section 8 of the Permit Application.

E. The closure method will be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices, per 40 C.F.R. § 257.102(d)(1)(v).

Closure of Combined Unit AP-3/4 was initiated in 2016, following the submission of the Notification of Intent to Initiate Closure in December 2015. Closure in place, along with the selection of ClosureTurf™ as the final cover system, allowed for an accelerated construction schedule when compared to, for example, the construction schedules associated with traditional soil and soil-synthetic composite covers.

Closure Activity	Completion Date																											
	2015				2016				2017				2018				2019				2020				2021			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Notification of Intent to Initiate Closure																												
Liquid Removal Prior to Final Cover Placement																												
Grading and Final Closure Construction Activities																												
Permit Boundary Survey																												
Permit Submittal to EPD																												
Closure Certification Report Submittal																												

Closure construction activities for Combined Unit AP-3/4 are ongoing. AEM design is complete, AEM construction is substantially complete, and the AEM systems are operational. As demonstrated in the above schedule and presented in more detail in the Permit Application, the Combined Unit AP-3/4 closure is designed to be completed expeditiously while consistent with recognized and generally accepted good engineering practices, as required by 40 C.F.R. §257.102(d)(1)(v).

F. The closure method will provide stability for the final cover system, per 40 C.F.R. § 257.102(d)(2).

40 C.F.R. §257.102(d)(2) provides that the owner or operator of a CCR surface impoundment must meet the drainage and stabilization requirements of paragraphs (d)(2)(i) and (ii) of this section prior to installing the final cover system required under paragraph (d)(3). This work is required for the purpose of ensuring that the final cover system subgrade will provide sufficient support for the cover system. Specifically, the performance standard calls for the elimination of free liquids by removing liquid waste or solidifying the remaining wastes and waste residues and stabilizing the remaining wastes to a sufficient degree to support the final cover system. Consistent with standard good engineering practices, the performance standard requires the removal of standing water and additional liquids as needed to accomplish a stable in place closure, considering other stabilization work that may be performed, if necessary. Prior to completing installation of the Combined Unit AP-3/4 final cover system in accordance with 40 C.F.R. § 257.102(d)(2), free liquids will have been removed and the remaining wastes stabilized as may be necessary to support the final cover system.

Free liquids are defined as "liquids that readily separate from the solid portion of waste under ambient temperature and pressure" (40 C.F.R. § 257.53). Per the CCR Rule, the requirement to eliminate free liquids by removing liquid wastes is focused on eliminating ponded (standing) water. Removal of ponded water facilitates the proper installation of the final cover system. Further benefits of removing ponded water per the EPA have been identified, specifically "during operations, free liquids that are ponded in the impoundment create a strong hydraulic head that acts to increase infiltration through the base of the impoundment. The removal of free liquids and capping during closure reduces the hydraulic head…" (EPA, Human and Ecological Risk Assessment of Coal Combustion Residuals, Appendix K (Dec 2014)). Unlike ponded water, groundwater, for example, is not considered free liquid as it is defined separately from free liquids as "water below the land surface in a zone of saturation" (40 C.F.R. § 257.53). Accordingly, the free liquids requirement of the CCR Rule is addressed by removing ponded water and implementing the Ash Pond Dewatering Plan approved by the GAEPD.

Thus, the free liquid requirement of Subsection (d)(2)(i) is satisfied if standing water and sufficient additional liquids are removed as needed to, in conjunction with other stabilization efforts, ensure the stability of the final cover system. Per subsection (d)(2)(i), the closure method eliminated free liquids by removal, and the removed liquids were treated prior to discharge in accordance with the GAEPD-approved Dewatering Plan. Confirmation of adequate subgrade stability was additionally provided by the required compaction and proof-rolling of the final cover system subgrade areas that was performed in the manner documented in the project Construction Quality Assurance Plan. Details of free liquid removal and subgrade preparation performed for Combined Unite AP-3/4 are presented in the Closure Plan (Part A, Section 7) and satisfy this standard. The GAEPD-approved Ash Pond Dewatering Plan (Dewatering Plan) also provides a summary of previously completed liquid removal activities.

Liquid removal associated with closure activities consisted of removing water using a variety of methods, including but not limited to passive, gravity-based methods (e.g., rim ditches) and active dewatering methods (e.g., pumps and well points) as needed to allow for CCR consolidation. In addition to dewatering, Georgia Power developed and implemented a plan for treating removed CCR contact water at the site during closure consisting of a range of treatment technologies, compliance sampling (constituents, frequency, and locations) for compliance with both the site's National Pollutant Discharge Elimination System (NPDES) permit and the CCR Rule. Removed CCR contact water continues to be

treated by an on-site wastewater treatment system (WWTS) to support closure activities in compliance with the GAEPD approved Dewatering Plan.

Furthermore, and although this effect is not required under subsection (d)(2)(i), capping of areas also contributed to lowering the groundwater elevation in the area of Combined Unit AP-3/4. In addition, and similarly not required under subsection (d)(2)(i), the AEMs summarized above are expected to contribute to a significant accelerated lowering of the groundwater elevation within Combined Unit AP-3/4, to achieve long term post-closure conditions.

Subsection (d)(2)(ii) is satisfied because, along with the elimination of free liquids as described above, the closure method stabilizes the remaining CCR sufficiently to support the final cover system. As described above and provided in detail in the Engineering Report included in Part B of the Permit Application, Combined Unit AP-3/4 has been evaluated across a wide range of global (deep) and veneer (shallow) stability conditions. Slope stability evaluations included a range of short- and long-term conditions, including provision for impacts from design storm events and from the theoretically potential seismic (earthquake) hazard based on the site location. Stability and integrity were evaluated using common commercial analysis software packages, including: RocScience SLIDE, AutoCAD Civil 3D, and in-house analytical calculation worksheets and procedures. As demonstrated in the Permit Application, the closure of Combined Unit AP-3/4 meets or exceeds all regulatory requirements for closed unit stability. Additionally, materials that are not fully saturated are not susceptible to liquefaction. Therefore, a factor of safety against liquefaction was not calculated for the CCR materials impounded in Combined Unit AP-3/4 since the CCR closed in place is, as discussed above, modelled to be above long-term groundwater levels.

Finally, the ClosureTurf ™ system cover veneer stability analyses for gravel access roads calculated an acceptable factor of safety against veneer failure, as reflected in the Engineering Report contained in Part B of the Permit Application.

As demonstrated above and presented in more detail in the Permit Application, the Combined Unit AP-3/4 closure is designed to satisfy the performance standard requirement for drainage and stabilization of AP-1 prior to the installation of the final cover system, as required by 40 C.F.R. § 257.102(d)(2).

G. Per 40 C.F.R. § 257.102(d)(3), the closure method includes a final cover system that is designed to minimize infiltration and erosion and meets the criteria specified in 40 C.F.R. § 257.102(d)(3)(ii) and (iii).

The final cover system of Combined Unit AP-3/4 meets the requirements of §257.102(d)(3)(ii)(A) through the design permeability of the final cover system, which will be limited by a flexible membrane liner with a permeability less than the maximum allowed permeability of 1×10^{-5} cm/sec. The flexible membrane liner of the ClosureTurf™ cover system is modelled to have a permeability of 4×10^{-12} cm/sec, far below the maximum permissible permeability specified by the CCR Rule for final cover systems.

The final cover system also meets the requirements of § 257.102(d)(3)(ii)(A) because the ClosureTurf™ cover system constructed at Combined Unit AP-3/4 provides equivalent or superior reduction of infiltration as compared to an infiltration layer that contains a minimum of 18 inches of earthen material. Specifically, the ClosureTurf™ system for Combined Unit AP-3/4 was modeled to result

in 99.99% less infiltration than that modeled for the baseline soil cover system that includes an infiltration layer of 18 inches of earthen material. This evaluation is detailed in the Alternative Cover Evaluation (Appendix F) of the Engineering Report (Part B, Section 2 of Permit Application).

The final cover system for Combined Unit AP-3/4 meets the requirements of §257.102(d)(3)(ii)(B) because it provides equivalent or superior protection from wind and water erosion as compared to a 6-inch vegetated erosion layer due to the fact that the synthetic engineered turf does not have the erosion potential attributable to biological growth cycles and climatic conditions. That is, the ClosureTurf™ will retain the synthetic grass strands regardless of rainfall, drought, freeze-thaw cycles, lack of fertilization, soil augmentation, and other factors necessary to maintain a vegetative cover. See the Engineering Report for additional detail on the performance of the ClosureTurf™ cover system. In addition, as demonstrated in the Permit Application, the closure of Combined Unit AP-3/4 meets all the regulatory requirements to satisfy the industry standard for closed unit stability, resulting in minimized disruption of the integrity of the final cover system.

The final cover system meets the requirement of §257.102(d)(3)(ii)(C) to accommodate settling and subsidence because it relies on proven materials, design practices, and construction techniques (e.g., geosynthetic FMLs, earthen dikes, rock armored stormwater channels, etc.). As discussed in detail in the Engineering Report, and as summarized above, the selected closure method for Combined Unit AP-3/4 has been evaluated across a range of global (deep) and veneer (shallow) stability conditions and meets or exceeds applicable requirements. Satisfactory slope stability evaluations were completed for both short- and long-term conditions, including provision for impacts from design storm events and from the theoretically potential seismic (earthquake) hazard at the site based on its location. Also, the modeled potential settlement is well within the specifications for the cover system, and similar cover systems are regularly and successfully used at sites where settlements are typically up to ten or more times higher than those predicted through modeling for the Combined Unit AP-3/4 closure. As discussed earlier, the Combined Unit AP-3/4 closure provides for minimal calculated post-closure settlement, low seismic hazard risk, and well known and understood subsurface conditions without a history of subsidence risk. The low calculated potential settlement and subsidence magnitudes and the absence of known geologic subsidence risks at the site, combined with the ability of the final cover system materials and design and construction techniques to accommodate much higher displacements and seismic loadings (well above those predicted) show that this regulatory requirement has been met.

As required by §257.102(d)(3)(iii), a Georgia-registered professional engineer has certified that the design of the final cover system meets the requirements of 257.102 (See Professional Engineer Certification in Section 3 of Part A of the Permit Application and the certified Engineering Report in Section 2 of Part B of the Permit Application). In addition, the certification is reaffirmed as provided by the engineer stamp on this report.

III. Professional Engineer Certification

As required by 40 CFR 257.102(b)(4), a professional engineer registered in Georgia has certified that the closure design in the Permit Application meets the requirements of the CCR rule. Additionally, the certification is reaffirmed as provided by the professional engineer stamp on this report.

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I do hereby certify that the application requirements of the Georgia Environmental Protection Division Solid Waste Rule 391-3-4-.10 for Management of Coal Combustion Residuals have been met."

ATTEST:

Golder Associates Inc.
Engineering Firm

Gregory L. Hebeler, P.E.
Name of Professional Engineer

Signature

02 April 2021
Date