JOHN ELNITSKY
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Ash Basin Strategy

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December 15, 2015

VIA ELECTRONIC AND U.S. MAIL

Jeffrey deBessonet, Director
Water Facilities Permitting Division
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201

Re: W.S. Lee Steam Station
Conceptual Closure Plan: Primary Ash Basin, Secondary Ash Basin, and Structural Fill Area

Dear Director deBessonet:

On December 18, 2014, Duke Energy Carolinas, LLC (Duke Energy) communicated its decision regarding the long-term strategy for the Primary and Secondary Ash Basins at the W.S. Lee Steam Station. This decision involved the commitment to excavate the Primary Ash Basin and the Secondary Ash Basin, as well as the Structural Fill Area, and consolidate this ash material into a lined long-term solution. In that communication, Duke Energy also committed to submitting a conceptual closure plan, including a potential on-site lined landfill, by December 15, 2015. This letter fulfills this commitment and transmits this conceptual closure plan to the South Carolina Department of Health and Environmental Control (SC DHEC).

The attached conceptual closure plan is based on our commitment to excavate ash from the Primary Ash Basin, Secondary Ash Basin, and Structural Fill Area and provide safe and efficient long-term management of these materials in a lined landfill. General performance objectives for the proposed closure activities have been outlined in the attached conceptual closure plan. In consideration of these objectives, Duke Energy contends the best solution for the Primary and Secondary Ash Basins and Structural Fill Area is consolidation of this ash within a fully-permitted Class Three landfill constructed within the vicinity of the current Secondary Ash Basin.

In accordance with South Carolina Code of Regulations Section 61-82, this conceptual closure plan has been prepared to address closeout of the existing wastewater treatment facilities (Primary and Secondary Ash Basins). As such, a completed Industrial Wastewater Facility Closure Plan Form (Form D1795) is attached to this letter.

Duke Energy remains fully committed to the health, safety and welfare of employees, contractors and the public, and to protecting the environment and natural resources.

If you have further questions on this matter, please contact Mehdi Maibodi at 980-373-6616 or via email Mehdi.Maibodi@duke-energy.com

Respectfully submitted,

John Elnitsky
Senior Vice President

cc: George Hamrick
Harry Sideris
Charlie Gates
Garry Miller
Mehdi Maibodi

INDUSTRIAL WASTEWATER FACILITY CLOSURE FORM

Form purpose: This form is intended to facilitate the development and review of industrial wastewater closure plans. Although recommended, it is not required by regulation that you use this form. Please note: All closure plans must be approved by the Department as a prerequisite to closure as per R.61-67.300.F.17 of the Standards for Wastewater Facility Construction.

1. Name of Facility	Name of Facility: William States (W.S.) Lee Steam Station		
2. Facility Contact	First Name: Robert	MI: R	Last Name: Wylie
	Title: Lead Environmental Specialist	Phone: 704-382-4669	E-mail: robert.wylie@duke-energy.com
3. Facility Contact Mailing Address	Street or P.O. Box: 526 South Church Street ,(EC13-K) Mail Code		
	City: Charlotte	State: NC	Zip Code: 28202
4. Facility Location Address	Street, Route, or Other Specific Identifier: 205 Lee Steam Plant Road		
	City: Belton	State: SC	Zip Code: 29627
5. Legal Owner	Name: Duke Energy Carolinas, LLC	Phone: 980-373-6619	
6. Legal Owner Mailing Address (If different from Facility Contact Mailing Address in Item 3 above)	Street or P.O. Box: 550 South Tryon Street		
	City: Charlotte	State: NC	Zip Code: 28202
7. Wastewater Facility Existence Date	Facility Existence Date (mm/dd/yyyy): 1974		
8. SIC or NAICS Codes	Primary: 4911	2nd:	3rd: / 4th:
9. Facility Type	Pretreatment: ☐ yes ☑ no	NPDES: ☑ yes ☐ no	Land Application: ☐ yes ☑ no If yes, check type: ☐ wastewater ☐ sludge
10. Applicable NPDES and/or ND Permits (List All)	NPDES or ND: SC0002291	NPDES or ND:	NPDES or ND:
11. Wastewater Construction Permits (List All)	Permit #: 2705-C	Permit #: 10831	Permit #: 10901
	Permit #: 17491-IW	Permit #: 17551-IW	Permit #: 18622-IW
	Permit #: 18868-IW	Permit #: 19073-IW	Permit #: 19818-IW 19935-IW
12. Satellite Sewer Permit Coverage (If Applicable)	S S S		
13. Current Pump and Haul Approvals (List All)	Date or LOA #:	Date or LOA #:	Date or LOA #:
14. EPA ID Number (If Applicable)	S C D 3 6 2 4 1 2 9 7		
15. RCRA/HSWA Corrective Action	Is this facility subject to RCRA/HSWA corrective action requirement via a permit or an order? ☐ yes ☑ no		
16. Groundwater Questions	Any known releases to soil or groundwater from the wastewater treatment unit? ☑ yes ☐ no (See Section 4.6)		
	Depth to groundwater (in feet): 0-38		
	Is this facility subject to groundwater monitoring requirements via a permit, order or other agreement? ☑ yes ☐ no		
	If yes, list permit number, order, number, or date of agreement: SC0002291		

17. List below the name, physical address, and telephone number for each facility that is receiving wastewater, sludge, soil, etc. as a result of this closure. Additionally, please attach a letter of acceptance from each facility. The letter of acceptance should clearly state the amount and type of waste to be received.

Name of Receiving Facility: N/A (Waste to be received by new on-site landfill)	Name of Receiving Facility:
Address (Street, Route, or Other Specific Identifier):	Address (Street, Route, or Other Specific Identifier):
City: State: Zip:	City: State: Zip:
Phone: Contact: Waste types to be received: ☐ Wastewater ☐ Sludge ☐ Soils ☐ Other (specify _____)	Phone: Contact: Waste types to be received: ☐ Wastewater ☐ Sludge ☐ Soils ☐ Other (specify _____)
Name of Receiving Facility:	Name of Receiving Facility:
Address (Street, Route, or Other Specific Identifier):	Address (Street, Route, or Other Specific Identifier):
City: State: Zip:	City: State: Zip:
Phone: Contact: Waste types to be received: ☐ Wastewater ☐ Sludge ☐ Soils ☐ Other (specify _____)	Phone: Contact: Waste types to be received: ☐ Wastewater ☐ Sludge ☐ Soils ☐ Other (specify _____)

18. Provide a topographic map or maps of the area extending to at least one mile beyond the property boundaries of the facility.

The map should clearly show the following:

- The legal boundaries of the facility;
- The location of any intake and discharge structures;
- The location of any wastewater treatment facilities;
- All land application sites;
- All groundwater monitoring, recovery, or injection wells (not just those associated with the wastewater treatment plant);
- All surface water bodies in the area;
- All drinking water wells within 1/4 mile of the facility identified in the public record or otherwise known to you.

On each map, include the map scale, a meridian arrow showing north, and latitude and longitude at the nearest whole second of the wastewater treatment plant and any outfall structures. Use a 7-1/2 minute series map published by the U.S. Geological Survey. If a 7-1/2 minute series map has not been published for your facility site, then you may use a 15-minute series map from the U.S. Geological Survey. If neither a 7-1/2 nor 15-minute series map has been published for your facility site, use a plant map or other appropriate map, and include all the requested information.

19. Provide a drawing showing the general layout of the wastewater treatment facility.

This drawing should be approximately to scale and should clearly show the following:

- All components of the wastewater treatment plant, each clearly labeled;
- Dimensions and materials of construction;
- The locations of any known leaks or spills; and
- The locations of any proposed soil sample or groundwater monitoring locations.

20. Provide photographs that clearly delineate all existing wastewater structures.

Photographs may be color or black and white, ground-level or aerial. Indicate the date each photograph was taken.

21. On Appendix A of this document, identify all pollutants that may be present in the wastewater treatment system by placing a check mark '√' in the 'Believed Present' column. Additionally, please list below any pollutants that may be present that are not listed on Appendix A.

Constituent	Believed Present	Constituent	Believed Present	Constituent	Believed
See Conceptual Closure Plan					

22. Please provide a detailed description of how each wastewater treatment component will be closed.

Additionally, in your description, please include the following:

- Your reasons for closing the system;
- If this is to be a closure of the entire wastewater treatment system or if only certain components are to be closed; and
- If the closure plan is intended to be a clean-out plan rather than a complete closure of the system (for example, if the system is being cleaned out for resale to another owner).

Use the space below and attach additional sheets as necessary; or provide as a separate attachment.

See Conceptual Closure Plan.

DUKE ENERGY COAL COMBUSTION RESIDUALS MANAGEMENT PROGRAM

CONCEPTUAL CLOSURE PLAN – PRIMARY ASH BASIN, SECONDARY ASH BASIN AND STRUCTURAL FILL AREA
W.S. LEE STEAM STATION
ANDERSON COUNTY, SOUTH CAROLINA

Prepared for

Duke Energy Carolinas, LLC
550 South Tryon Street
Charlotte, North Carolina 28202

December 15, 2015

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym/ Abbreviation	Definition
bgs	Below Ground Surface
BMPs	Best Management Practices
Cc'	Compression Ratio
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
cm/s	Centimeters per Second
COCs	Constituents of Concern
CQACP	Construction Quality Assurance and Control Plan
Cr'	Recompression Ratio
DO	Dissolved Oxygen
DON	Determination of Need
Duke Energy	Duke Energy Carolinas, LLC
EDR	Environmental Data Resources
El.	Elevation
Facility	William States Lee Steam Station
gpm	Gallons per Minute
IAB	Inactive Ash Basin
MCL	Maximum Contaminant Level
mg/L	Milligram Per Liter
MH	Sandy Silt
MODFLOW	USGS Three-Dimensional Finite-Difference Ground-Water Model
MT3D	Modular Structure to Permit Simulation of Transport Components
NOI	Notice of Intent
NP	Non-Plastic
NPDES	National Pollutant Discharge Elimination System
NS	Not Sampled
O&G	Oil & Gas
ORP	Oxidation Reduction Potential
PCN	Pre-Construction Notification
PER	Preliminary Engineering Report
PEST	Model-Independent Parameter Estimation
Plan	Conceptual Closure Plan
PPR	Pocket Penetrometer Resistance
psf	Pound Per Square Foot
psi	Pounds per Square Inch
RCRA	Resource Conservation and Recovery Act
SC DHEC	South Carolina Department of Health and Environmental Control
SCM	Site Conceptual Model
Site	William States Lee Steam Station
SM	Silty Sand
SMCLs	Secondary Maximum Contaminant Level
SPT	Standard Penetration Test
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TSF	Ton Per Square Foot
TSS	Total Suspended Solids

Acronym/ Abbreviation	Definition
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USGS	United States Geologic Survey
USEPA	United States Environmental Protection Agency
W.S. Lee	William States Lee Steam Station

EXECUTIVE SUMMARY

This Conceptual Closure Plan (plan) has been prepared to address the closeout of the primary ash basin, secondary ash basin and structural fill area at the William States Lee (W.S. Lee) Steam Station (facility, station or site), located at 205 Lee Steam Plant Road in Belton, Anderson County, South Carolina. The station is a former coal-fired electric generating facility (retired November 6, 2014) and is owned by Duke Energy Carolinas, LLC (Duke Energy). This plan has been prepared for the review and approval of the South Carolina Department of Health and Environmental Control (SC DHEC). This Conceptual Closure Plan has been prepared in accordance with South Carolina Code of Regulations Section 61-82, Proper Closeout of Wastewater Treatment Facilities (R.61-82).

This Conceptual Closure Plan is based on and consistent with Duke Energy's commitment letter dated December 18, 2014, which indicated that ash would be excavated from the existing units and long-term management of these materials would be provided in a fully-lined landfill. Therefore, this Conceptual Closure Plan provides for closure of the units by removal.

The general performance objectives of this Conceptual Closure Plan are as follows:

- Provide for safe and efficient dewatering and handling of the ash material;
- Minimize material handling and associated receptor contact during consolidation activities;
- Minimize use of public roads for material hauling;
- Eliminate existing impoundments and long-term dam risks to the public and the environment; and
- Protect groundwater through long-term ash management in a lined unit with leachate management systems.

More specifically, the Conceptual Closure Plan proposes the following activities to achieve these objectives:

- Divert surface water around the basins to the extent practical in order to facilitate drying of the ash and minimize the volume of stormwater subject to management as contact water;
- Consolidate material in a single, lined, permitted landfill in close proximity to the material source that meets or exceeds Class III landfill siting and design criteria;
- Facilitate pre-construction stormwater removal within existing impoundments through permitted outlet structures;
- Manage contact water during excavation/construction activities (i.e., stormwater and dewatering water) through proposed treatment system until closure is achieved;
- Decommission dams utilizing existing soil material from the primary ash basin dam for landfill cover system;
- Provide demonstration of closure by removal following ash excavation;

- Provide surface water management improvements to accommodate a 25-year, 24-hour storm during post-closure conditions;
- Provide for post-closure access to landfill and associated leachate management systems; and
- Reclaim the primary ash basin and structural fill area for potential future use.

As stated above, this Conceptual Closure Plan has been prepared for approval by SC DHEC for the closeout of the existing wastewater treatment facility.

Following submission and approval of this Conceptual Closure Plan, Duke Energy will continue development of the concepts presented in this document and this information will be presented in the final closure plan. The final closure plan will be prepared with additional detail sufficient to demonstrate compliance with the requirements of the United States Environmental Protection Agency's (USEPA's) recently effective Coal Combustion Residuals (CCRs) Rule, which are independent of the requirements for this plan under South Carolina regulations. In addition, a separate permit application to SC DHEC will be prepared for the proposed on-site Class III lined landfill system.

1. INTRODUCTION

This Conceptual Closure Plan (plan) has been prepared to address the closeout of the wastewater treatment facility located at the William States Lee (W.S. Lee) Steam Station (facility, station or site), located at 205 Lee Steam Plant Road in Belton, Anderson County, South Carolina (see Figure 1, Site Vicinity Map). The station is a former coal-fired electric generating facility (retired November 6, 2014) which has been converted to burn natural gas in Unit 3. A 750-megawatt natural gas combined cycle plant is also being constructed on the property. The facility is owned and is operated by Duke Energy Carolinas, LLC (Duke Energy). This plan has been prepared for the review and approval of the South Carolina Department of Health and Environmental Control (SC DHEC).

During operation as a coal-fired facility, coal combustion residuals (CCRs), or ash, were managed at a number of on-site locations. Prior to 1974, CCRs were placed in what is now referred to as the inactive ash basin (IAB), to the southeast of the plant. The CCR materials from the IAB and old ash fill area are being addressed under the September 2014 Consent Agreement (14-13-HW) between Duke Energy and SC DHEC. From 1974 until partial decommissioning of the station and termination of coal combustion generation in November 2014, treatment of CCRs produced by the facility station was managed within the wastewater treatment facility consisting of two ash surface impoundments located west of the station. These two surface impoundments, referred to as the primary ash basin and secondary ash basin, are the subject of this Conceptual Closure Plan. Periodically, CCR materials were removed from the surface impoundments and placed in an ash structural fill area south of the impoundments. The management of materials at the structural fill area is also a subject of this plan. A site overview map is provided in Figure 2.

This Conceptual Closure Plan has been prepared in accordance with South Carolina Code of Regulations Section 61-82, Proper Closeout of Wastewater Treatment Facilities (R.61-82). This plan is based on and consistent with Duke Energy's commitment letter dated December 18, 2014, which indicated that ash would be excavated from the existing units and long-term management of these materials would be provided in a fully-lined landfill. Duke Energy proposes to construct this landfill at the site, within the area of the current secondary ash basin. This plan was discussed with SC DHEC representatives at meetings held on August 21, 2015 and October 23, 2015.

1.1 Closure Plan Objectives

The objective of this Conceptual Closure Plan is to describe the anticipated activities necessary to remove residual wastewater treatment solids and sludges from existing basins prior to closure, to provide a proposed schedule for completion of these activities and to describe the intended final disposal locations for the removed materials. More specifically, this plan focuses on excavation practices, stormwater management, contact water (wastewater) management, methodologies for closure by removal and permitting requirements/timelines.

In addition, because treatment residuals are contained within the structural fill area and this area was also included in Duke Energy's December 18, 2014 commitment letter, the excavation of the structural fill area is also included within the scope of this document.

It should be noted that the wastewater treatment facility (the two surface impoundments) identified in this plan are also subject to the United States Environmental Protection Agency's (USEPA's) Disposal of Coal Combustion Residuals from Electric Utilities Final Rule (CCR Rule) effective October 19, 2015. Under the CCR Rule, the concepts of the plan will be expanded and a final closure plan will also need to be developed on or before October 17, 2016 and uploaded to a publically-available website. This Conceptual Closure Plan has been prepared specifically to address SC DHEC requirements.

1.2 Report Organization

The following chapters are included in this Conceptual Closure Plan:

1. Introduction
2. Governing Regulations
3. Facility Description and Existing Site Features
4. Results of Hydrogeologic, Geologic and Geotechnical Investigations
5. Groundwater Modeling Analysis
6. Beneficial Reuse and Future Use
7. Closure Design Documents
8. Management of Wastewater and Stormwater
9. Description of Final Disposition of CCR Materials
10. Applicable Permits for Closure
11. Project Milestones
12. Referenced Documents

1.3 Proposed Closure Activities

This Conceptual Closure Plan has been developed to address the excavation and management of CCR materials in place at the primary ash basin, secondary ash basin and structural fill area of the W.S. Lee Steam Station. The proposed plan is anticipated to include the following milestone activities:

- Reduction of free water/surface water volume via discharge to permitted Outfall 004;
- Construction of stormwater run-on and other temporary stormwater controls and best management practices (BMPs);
- Installation and operation of a wastewater treatment system to manage interstitial/ dewatering waters and contact stormwaters during construction;

- Development of sump areas in both ash basins to collect and convey waters to the treatment system;
- Dewatering and excavation of secondary ash basin, temporarily staging materials within the primary ash basin;
- Construction of a new Class III permitted (lined) landfill within the vicinity of the former secondary ash basin;
- Excavation of structural fill area materials and placement in new landfill;
- Dewatering and excavation of primary ash basin materials, and placement in new landfill;
- Deconstruction of existing primary ash basin dam and utilization of excavated materials to construct cap system at new landfill;
- Construction of permanent stormwater conveyances and other stormwater management improvements; and
- Preparation of former primary ash basin and structural fill area for potential future use.

These closure activities are anticipated to require several permitting activities, which are further discussed in Section 10.

These proposed closure activities allow for the consolidation of CCR materials in a single, on-site permitted, engineered and lined landfill system. Furthermore, this plan reduces material handling activities and environmental impact of transport and disposal to an off-site landfill. It also allows for the elimination of the existing impoundment structures and associated dam safety considerations. The activities will result in the preparation of the primary ash basin and structural fill area for potential future use.

The landfill siting and design activities are being conducted in parallel with the preparation of this Conceptual Closure Plan, and the Landfill Site Suitability and Determination of Need (DON) was provided to SC DHEC as part of a separate submittal on November 16, 2015.

2. GOVERNING REGULATIONS

2.1 South Carolina Rules

This Conceptual Closure Plan has been developed to address the removal of ash and other residuals from the primary ash basin, secondary ash basin and nearby structural fill area. This Conceptual Closure Plan will require modification of the facility's existing National Pollutant Discharge Elimination System (NPDES) permit as a result of such proposed activities as eliminating the discharge at Outfall 004 and utilizing new outfalls for post-closure stormwater discharges. This plan considers South Carolina NPDES Regulations for industrial wastewater ponds, R.61-82 and R.61-67.300.F.17. In addition, the excavated materials will be disposed in accordance with R. 61-9.504. The Conceptual Closure Plan is also anticipated to require work with other divisions of the SC DHEC regarding the permitting of a new Class III Landfill (Land and Waste) and the alteration/demolition of the existing impoundment dams (Water Quality, Dams and Reservoirs).

Final deposition of CCR in a Class III landfill will be conducted in conformance with SC DHEC Bureau of Land and Waste Management Regulation 61-107.19, Part V, Subpart F. A demonstration of compliance with these solid waste requirements will be addressed in the Application for Permit to Construct a Solid Waste Management System scheduled to be provided to SC DHEC in 2016. In support of the landfill application, a DON was submitted to SC DHEC on November 16, 2015.

The impoundments are permitted under the Dams and Reservoirs Safety Act Regulations, R.72-1 through R.72-9, and will be decommissioned according to these safety requirements. The primary ash basin Dam is classified by SC DHEC as an Intermediate Size, Significant Hazard dam (D4887). The secondary ash basin dam is also classified by SC DHEC as an Intermediate Size, Significant Hazard dam (D4888).

2.2 Federal CCR Rules

The Federal CCR Rule is a governing regulation for the existing ash basins, but this Conceptual Closure Plan is intended to primarily address requirements under the NPDES program (R.61-82). A short overview of the rule is provided herein because Duke Energy will ultimately need to address and demonstrate compliance with the requirements of this rule in the final closure plan for management of the CCR materials within the primary and secondary ash basins.

The Final CCR Rule was published in the Federal Register on April 17, 2015. The rule regulates CCR materials as non-hazardous wastes under Subtitle D of the Resource Conservation and Recovery Act (RCRA). The effective date of the rule is October 19, 2015. The CCR Rule requires the development of a written Closure Plan in accordance with 40 Code of Federal Regulations (CFR) 257.102(b)(i-vi). The written Closure Plan must be prepared and uploaded to Duke Energy's website for public viewing within 18 months of the rule publication date, or on or before October 17, 2016.

3. FACILITY DESCRIPTION AND EXISTING SITE FEATURES

3.1 Surface Impoundment Description

3.1.1 Site History and Operations

The W.S. Lee Steam Station began producing electricity via two coal-fired units in 1951. A third unit was constructed in 1959, bringing the total power output to 370 megawatts. Until 1974, the areas referred to as the IAB and old ash fill area was used to manage CCR materials generated as part of facility operations. Ash materials in this area are being excavated under the terms of a Consent Agreement (14-13-HW) and are currently being transported to a permitted landfill in Homer, Georgia. After 1974 until partial decommissioning of the station in November 2014, treatment of CCR produced by the station was managed at two surface impoundments located west of the station, with a total ash holding capacity of approximately 3.62 million tons. These surface impoundments are known as the primary ash basin and secondary ash basin, and are described in more detail below.

Primary Ash Basin

Until November 2014, the primary ash basin received sluiced ash that traveled through piping to two different locations approximately 1,300 feet apart along the southeast edge of the basin. The primary ash basin dam is constructed as a homogeneous compacted embankment of local residual soils. The dam was constructed to elevation 725 feet above mean sea level (El. 725 feet) at 2 feet horizontal to 1 foot vertical (2H:1V) upstream and downstream side slopes, in the 1973-1974 timeframe. The dam was raised to El. 733 feet in 1975. Existing historic drawings indicate the improvement was implemented on the downstream slope. The downstream slopes were flattened to 2.25H:1V in the 1978 to 1981 timeframe. During operation of the coal-fired units, the influent to the primary ash basin was composed of hydraulically sluiced fly ash, bottom ash, boiler slag and flue gas emission control residuals. The primary ash basin has a surface area of approximately 48.3 acres and the total storage capacity of approximately 1,444.8 acre-feet.

Secondary Ash Basin

The secondary ash basin was constructed to function as a polishing pond for the W.S. Lee Steam Station. Effluent from the primary ash basin flows through a 36-inch reinforced concrete decant pipe, protected by a skimmer extending downward several feet and discharging to a rip-rap lined channel. Flow is controlled via a reinforced concrete box structure with removable 9- to 12-inch stop logs surrounding the inlet. The secondary ash basin dam is constructed as a homogeneous compacted embankment of local residual soils. The dam was constructed to El. 725 feet at 2H:1V upstream and downstream side slopes in the 1973 to 1974 timeframe. Similar to the primary ash basin dam, the secondary ash basin dam was raised to El. 733 ft. in 1975, and flattening of the downstream slopes to 2.25H:1V occurred in the 1978 to 1981 timeframe. The secondary ash basin has a surface area of approximately 36.7 acres and the total storage capacity of approximately 924.8 acre-feet.

3.1.2 Estimated Volume of CCR Materials in Impoundments

This section presents the estimated volume of CCR materials within the existing impoundments to be managed as part of this Conceptual Closure Plan. It is impractical based on the long history of site operations and data source limitations to provide a precise volume, but the volumes presented herein are currently being used as the design basis. The landfill design will provide flexibility to accommodate the range of possible ash management volumes.

The primary ash basin contains the majority of materials that will ultimately need to be excavated as part of this Conceptual Closure Plan. The secondary ash basin has been utilized as a polishing pond and contains a much lesser volume of material. The structural fill area to the south of these impoundments has been used to manage dredged and dried ash materials from the ash basins. While not subject to the requirements for closure under R.61-82, Duke Energy also intends to excavate the dry materials in the structural fill area as part of the impoundment closure activities. The estimated volume of materials to be addressed is provided below.

Table 1: Design Basis Volume of CCR Materials to be Addressed

Unit	Design Basis CCR Volume (Tons)	Design Basis CCR Volume (Cubic Yards)
Primary Ash Basin	1,334,400	1,112,000
Secondary Ash Basin	28,800	24,000
Structural Fill Area	859,200	716,000
Total	**2,222,400**	**1,852,000**

3.1.3 Sources of Discharges into Surface Impoundments

Historical reports suggest that the past influent to the primary ash basin was composed of hydraulically sluiced fly ash, bottom ash, boiler slag and CCRs; other low-volume wastewater streams including water treatment, floor drains, boiler chemical cleaning, fire protection, mill reject and equipment cleaning wastewaters; boiler blowdown; stormwater and coal pile runoff. These waste streams were combined at the plant and conveyed to one of two locations on the southeast side of the primary ash basin. After conversion of the plant to natural gas in 2014, wastewaters from these operations and other associated facility wastewaters have continued to be conveyed to the primary ash basin under the provisions of the facility's NPDES permit (see Section 8).

Decanted effluent from the primary ash basin is the primary influent to the secondary ash basin, in addition to stormwater runoff.

3.2 Site Maps

The following site maps are provided with this Conceptual Closure Plan and referenced herein.

1 – Site Vicinity Map

2 – Site Overview Map

3 – Groundwater Elevation Contour Summary

4 – Cross-Section Location Map

5 – Cross-Section A-A'

6 – Cross-Section B-B'

7 – Landfill Siting Summary

4. RESULTS OF HYDROGEOLOGIC, GEOLOGIC, AND GEOTECHNICAL INVESTIGATIONS

4.1 Hydrogeology and Geologic Descriptions

The site is situated on the west bank of the Saluda River within the Six Mile Thrust Sheet of the Piedmont physiographic province (Nelson, 1990) of South Carolina. It is located within the Inner Piedmont geologic terrain, a northeast trending belt of medium- to high-grade metamorphic rocks along with a complicated sequence of igneous rock intrusions. These igneous and metamorphic (crystalline) rocks are collectively referred to as bedrock herein. The predominant rock types in the area of the site are undifferentiated granitoid gneisses (Overstreet and Bell, 1965; Horton and Dicken, 2001). Native soils above the bedrock consist of completely weathered rock (saprolite) and Quaternary period alluvial sediments deposited in the floodplain of the Saluda River and associated tributaries.

In general, groundwater flow mimics topography. Upland areas act as the primary areas for groundwater recharge, and perennial surface water bodies act as discharge areas where groundwater flows to the surface. Groundwater at the W.S. Lee site flows generally toward the northeast from the upland recharge area toward the Saluda River. Localized groundwater flow directions may be affected by surface water elevations in the primary and secondary ash basins. There is little evidence of significant vertical hydraulic gradients in the water level data currently available, except for an isolated gradient measured about the monitoring well MW-9 vertical well cluster. Seasonal changes in groundwater are relatively minimal and do not appear to alter site-wide groundwater flow trends, based on available data.

The hydrogeologic system in the Piedmont can basically be divided into two zones. The first zone, the regolith, extends from the ground surface to the top of the bedrock surface. The second zone occurs within zones of secondary porosity within the bedrock.

Regolith is characterized by a mixture of unconsolidated material, including saprolite (in-place weathering byproduct of bedrock), alluvium (surface water deposits) and soil. Typically, the regolith contains both zones of unsaturated soils and saturated soils under unconfined (i.e., water table) conditions. Groundwater in the regolith occurs within pore spaces of the unconsolidated medium. Local groundwater flow systems exist within the regolith, often providing preferential flow paths in coarser lenses and in the remnants of geologic structural features in the weathered rock. Due to the typical fine-grained nature of saprolite, the formation normally possesses a relatively low permeability and is not usually utilized for groundwater production. The overburden is recharged by the infiltration of precipitation where the formation is exposed and acts as a storage medium for groundwater that is slowly released to surface water bodies and the underlying bedrock.

Bedrock in the area is comprised of metamorphic and/or igneous rocks. Depth-to-bedrock varies at the site, with soil borings indicating bedrock encountered from depths of 25 to 40 feet below ground surface (bgs). Groundwater in the underlying bedrock occurs along zones of secondary porosity, such as fractures, bedding planes, foliations and solution voids (Horton and Zullo, 1991). As a general rule, the frequency of fracture occurrence, especially horizontal fractures, tends to decrease with depth; although, very productive fractures and fracture zones are often

encountered at greater bedrock depths (up to 500 feet bgs). Groundwater in the underlying bedrock occurs under both unconfined and confined conditions.

4.2 Stratigraphy of the Geologic Units Underlying Surface Impoundments

The typical vertical profile of sediments and bedrock at the site includes sediment and residual soils, transitioning downward to saprolite/weathered bedrock, all of which is underlain by bedrock material. Residual soil and saprolite in the area are generally comprised of varying quantities of silt, fine to coarse sands and non-plastic clay commonly with weathered biotite and weathered feldspar. Saprolite is a product of in-place mechanical and chemical weathering of the granitoid parent bedrock. The extent of weathering is typically greatest in the shallow saprolite, with decreasing weathering toward the transition to bedrock. The weathering has the effect of increasing permeability and porosity in the saprolite relative to the properties of the unweathered bedrock.

The stratigraphy in the vicinity of the primary and secondary ash basins is variable due to the use history as indicated by historical boring logs, dam construction activities and soil borings completed by AECOM and other consultants. The primary stratigraphic units identified in the vicinity of the ash basins are undifferentiated fill material (e.g., material imported or excavated on-site to construct the embankment), ash, alluvial sands/silts/clays (limited, near the Saluda River), residual soils (which include saprolite), partially weathered rock and bedrock.

4.3 Hydraulic Conductivity Information

Laboratory testing was performed in 2014 on materials obtained from split-spoon samples and relatively undisturbed Shelby tube samples, collected during AECOM soil boring exploration activities. Geotechnical analyses provided insight on several aspects of the subsurface conditions.

In the embankment fill, standard penetration tests and pocket penetrometer test results indicated firm to very stiff conditions. Flexible wall permeability tests on relatively undisturbed samples indicated hydraulic conductivities ranging from 2×10^{-6} centimeters per second (cm/s) to approximately 9×10^{-8} cm/s in the stiffest material. Five pinhole dispersion testing of embankment materials all indicated “non-dispersive.”

Residual soils generally consisted of silty sand and occasional sandy silts. Silty sands and sandy silts generally have permeabilities on the order of 10^{-3} to 10^{-6} cm/s, depending on particle size and degree of lithification (Fetter, 1994).

Bedrock materials at the site were evaluated from bedrock cores recovered from two test borings. The gneiss and schistose rock materials are relatively impermeable. Secondary permeability may occur, though, in isolated fractures that may be present in the shallower bedrock.

Field investigation is on-going to collect additional site-specific hydraulic conductivity, porosity and aquifer storage measurements. These data will be incorporated into ensuing numerical and analytical modeling investigation during the landfill design and permitting process.

4.4 Geotechnical Properties

4.4.1 Residual Soils

The primary and secondary ash basin foundation/underlying materials are native to the site and generally consist of residual silty sand (SM) materials, with occasional sandy silts (MH). These residual soils extend to elevations of approximately El. 640 to 655 feet, generally about 25 to 40 feet in overall thickness. With increased depth, the foundation soils transition to decomposed rock with evidence of relict rock structure.

Standard Penetration Test (SPT) values typically ranged from 5 to 40 blows per foot with 50 blows per foot in decomposed rock. Typically, this material was found in a loose to medium dense condition, becoming denser with depth. The natural water content of this material typically ranged from 20 to 28 percent.

The laboratory testing indicated that the majority of the samples tested in this stratum typically had 15 to 46 percent passing the No. 200 sieve. The samples typically classified in the Unified System Classification System (USCS) as SM.

4.4.2 Embankment Fill

The embankment fill materials at the primary and secondary ash basins generally consist of sandy silts (MH) and silty sands (SM). Overall, the embankment fill extends from the crest elevation of El. 733 feet to elevations of approximately El. 670 to 690 feet, resulting in an embankment varying from 45 to 65 feet in height at the crest.

SPT values typically ranged from 5 to 18 blows per foot. Pocket Penetrometer Resistance (PPR) values typically ranged from 0.8 to 3.5 tons per square foot (tsf), which is indicative of a firm to very stiff condition. Typically, this material was found in a stiff condition. The natural water content of this material typically ranged from 18 to 30 percent, with values as high as about 40 percent at greater depths.

The laboratory testing indicated that the majority of the samples tested in this stratum typically had 25 to 60 percent passing the No. 200 sieve. Liquid limits ranged from non-plastic (NP) to 71, with typical values ranging from 50 to 60 for the MH materials. The plasticity index ranged from NP to 26.

Five unconsolidated-undrained triaxial compression tests indicate undrained shear strengths ranging from 1,200 to 3,500 pounds per square foot (psf), indicative of a stiff to very stiff consistency. Three consolidation tests indicated pre-consolidation pressures of 2 to 6 tsf, which is indicative of slight to moderate over-consolidation. Compression ratios (Cc' on a strain basis) ranging from 0.16 to 0.25, and recompression ratios (Cr' on a strain basis) ranging from 0.022 to 0.033.

4.4.3 Bedrock

Bedrock was typically found to be slightly weathered to fresh light gray to gray felsic gneiss/ sillimanite mica schist, with fractures ranging from 10 to 70 degrees from horizontal. The recovery for the rock cores conducted at two of the test borings ranged from 96 to 100 percent,

and the Rock Quality Designation ranged from 66 to 81 percent. Unconfined compressive strength tests on three specimens ranged from 12,400 to 28,300 pounds per square inch (psi).

4.5 Chemical Analysis of Impoundment Water, CCR Materials and CCR Affected Soil

In early 2015, AECOM conducted sampling activities to evaluate the quality/chemical analysis of surface water and interstitial waters at the primary and secondary ash basins. This section provides a summary of the impoundment water sampling activities.

The sampling activities were conducted on February 12, 2015. Free water samples were collected using a peristaltic pump from standing water in the primary and secondary ash basins, at sampling locations E-1 and F-3, respectively. Interstitial water samples were collected from a temporary well installed to a depth of approximately 6 feet in the primary ash basin using a peristaltic pump, at sampling location E-2. USEPA methods 200.7 and 200.8 were used in the analysis of metals and trace elements. The interstitial water sample was split and filtered at 20, 10 and 0.45-micron filter sizes. Analysis of halogens and sulfate was conducted using USEPA method 300.0. Mercury was analyzed via cold vapor atomic fluorescence spectroscopy (USEPA method 1631E). Oil and Grease analysis followed USEPA method 1664B. Monitoring of pH was conducted according to SM 4500B. Total dissolved solids (TDS) were analyzed using SM 2540C. USEPA method 351.2 was used in analysis of total kjeldahl nitrogen (TKN).

At the primary ash basin free water sampling location E-1, the following parameters were identified above laboratory detection limits: aluminum, calcium, chloride, iron, magnesium, mercury, nitrogen (as nitrite and nitrate) and sulfate. At the secondary ash basin free water sampling location F-3, the parameters identified at E-1 in addition to the following parameters were identified above laboratory detection limits: barium and fluoride. The results of the interstitial sampling activities and lab filtering are provided below. A complete list of parameters analyzed and results are included in Tables 2 and 3 below.

Table 2: Free Water Sample Analytical Results

Analyte	Units	E-1 Primary Basin Surface Water	F-3 Secondary Basin Surface Water
Aluminum (Al)	mg/L	0.261	0.379
Antimony (Sb)	µg/L	<10	<10
Arsenic (As)	µg/L	<10	<10
Barium (Ba)	mg/L	<0.05	0.063
Boron (B)	mg/L	<0.5	<0.5
Bromide	mg/L	<0.1	<0.1
Cadmium (Cd)	µg/L	<10	<10
Calcium (Ca)	mg/L	4.35	5.83
Chloride	mg/L	2.885	3.056

Analyte	Units	E-1 Primary Basin Surface Water	F-3 Secondary Basin Surface Water
Chromium (Cr)	µg/L	<10	<10
Conductivity	mS/cm	0.044	0.055
Copper	µg/L	<10	<10
Dissolved Oxygen (DO)	mg/L	10.26	11.62
Fluoride	mg/L	<0.1	0.1137
Iron (Fe)	mg/L	0.511	0.527
Lead (Pb)	µg/L	<10	<10
Magnesium (Mg)	mg/L	1.55	1.86
Manganese (Mn)	mg/L	<0.05	<0.05
Mercury (CVAFS)	ng/L	2.15	1.18
Molybdenum (Mo)	µg/L	<10	<10
Nickel (Ni)	µg/L	<10	<10
Nitrite + Nitrate (Colorimetric)	mg-N/L	0.28	0.197
Oil and Grease (O&G)	mg/L	<5	<5
Oxidation Reduction Potential (ORP)	mV	19.6	2.7
pH	SI Units	7.72	7.59
Phosphorus (P)	mg/L	<0.2	<0.2
Selenium (Se)	µg/L	<10	<10
Sulfate	mg/L	9.759	17.53
Total Dissolved Solids (TDS)	mg/L	56	63
Temperature	°C	13.01	10.92
Thallium (Tl) Low Level	µg/L	<2	<2
Total Kjeldahl Nitrogen (Colorimetric)	mg-N/L	<0.15	<0.15
Total Suspended Solids (TSS)	mg/L	<5	8
Turbidity	NTU	9.27	13.5
Vanadium (V)	µg/L	<10	<10
Zinc (Zn)	mg/L	<0.05	<0.05

Note: The "<" symbol indicates the value is less than the method detection level for that analyte.

Table 3: Interstitial Water Sample Analytical Results

Analyte	Units	E-2 Primary Basin Interstitial Water	E-2 with 0.45u Filter	E-2 with 10u Filter	E-2 with 20u Filter
Aluminum (Al)	mg/L	20.5	<0.05	0.151	0.84
Antimony (Sb)	µg/L	<10	3.04	3.08	3.17
Arsenic (As)	µg/L	106	41.3	41.2	42.8
Barium (Ba)	mg/L	0.709	0.248	0.249	0.265
Boron (B)	mg/L	<0.5	<0.5	<0.5	<0.5
Bromide	mg/L	<0.1	<0.1	<0.1	<0.1
Cadmium (Cd)	µg/L	<10	<1	<1	<1
Calcium (Ca)	mg/L	37.2	33.7	33.5	34
Chloride	mg/L	4.013	4.003	3.999	4.005
Chromium (Cr)	µg/L	19.5	<1	<1	<1
Conductivity	mS/cm	0.186	-	-	-
Copper	µg/L	68.9	<1	<1	2.86
Dissolved Oxygen (DO)	mg/L	2.79	-	-	-
Fluoride	mg/L	0.2262	0.226	0.226	0.2267
Iron (Fe)	mg/L	9.3	<0.1	<0.1	0.371
Lead (Pb)	µg/L	35	<1	<1	1.33
Magnesium (Mg)	mg/L	7.41	5.79	5.77	5.86
Manganese (Mn)	mg/L	0.72	0.626	0.624	0.628
Mercury (CVAFS)	ng/L	14.1	<0.500	<0.500	1.06
Molybdenum (Mo)	µg/L	17.3	16.8	16.5	16.7
Nickel (Ni)	µg/L	33	1.84	1.96	2.65
Nitrite + Nitrate (Colorimetric)	mg-N/L	<0.01	<0.01	<0.01	<0.01
Oil and Grease	mg/L	NS	NS	NS	NS
Oxidation Reduction Potential (ORP)	mV	-59.8	-	-	-
pH	SI Units	7.78	-	-	-

Analyte	Units	E-2 Primary Basin Interstitial Water	E-2 with 0.45u Filter	E-2 with 10u Filter	E-2 with 20u Filter
Phosphorus (P)	mg/L	0.58	<0.2	<0.2	<0.2
Selenium (Se)	µg/L	<10	<1	<1	<1
Sulfate	mg/L	25.66	26.33	25.36	25.51
Total Dissolved Solids (TDS)	mg/L	180	180	180	180
Temperature	°C	12.22	NS[1]	NS[1]	NS[1]
Thallium (Tl) Low Level	µg/L	<2	<0.2	0.214	0.269
Total Kjeldahl Nitrogen (Colorimetric)	mg-N/L	0.64	<0.15	<0.15	<0.15
Total Suspended Solids (TSS)	mg/L	890	<5	<5	53
Turbidity	NTU	451	-	-	-
Vanadium (V)	µg/L	90	9.13	9.73	11.7
Zinc (Zn)	mg/L	0.057	<0.05	<0.05	<0.05

Notes:
(1) NS Denotes "Not Sampled"
(2) The "<" symbol indicates the value is less than the method detection level for that analyte.
(3) "-" Denotes "Not Analyzed"

4.6 Historical Groundwater Sampling Results

AECOM reviewed available routine annual and semi-annual groundwater monitoring data for the period between 1993 and 2015 for 15 monitoring wells located in the vicinity of the primary and secondary ash basins. Of the parameters analyzed, eight constituents have exceeded the Maximum Contaminant Level (MCL), Secondary MCL or drinking water advisory standards. These groundwater standards were exceeded for pH, TDS, nitrate, sodium, sulfate, cadmium, iron and manganese.

The pH of the groundwater at the site is within the typical circumneutral range (5 to 6.5 for groundwater), albeit below the Secondary MCL, with the exception of groundwater from monitoring well MW-18. Groundwater from monitoring well MW-18 is also the only groundwater at the site that exceeds the Secondary MCL for TDS and the drinking water advisory for sodium. This well is being replaced because it is believed that groundwater quality in this well is being adversely affected by improperly installed Portland cement grout collar. The pH in groundwater from monitoring well MW-18 has measured as high as 12.68 standard units.

Nitrate's MCL was exceeded twice in groundwater from monitoring well MW-12, on September 26, 2000 and September 25, 2001. Cadmium's MCL was exceeded on September 24, 1997 in groundwater from monitoring well MW-9. The September 24, 1997 groundwater sampling event is the only time that monitoring well MW-9 contained cadmium at a detectable concentration,

which indicates that there was possibly an error in the reporting of this concentration. There have been no other exceedances of applicable drinking water standards for nitrate and cadmium. Sulfate's Secondary MCL exceedances occurred only in groundwater from monitoring well MW-5. The last exceedance of sulfate's Secondary MCL was measured in a groundwater sample from the September 25, 2001 sampling event.

Groundwater from monitoring wells MW-9 and MW-11 exceeds the Secondary MCL standard for iron and manganese; respectively. The highest concentrations of iron and manganese have been consistently detected in groundwater from the monitoring well MW-9 cluster, located approximately 325 feet downgradient of the primary ash basin.

Currently, only iron, manganese, and pH exceed applicable drinking water standards at the site. These constituents are also commonly observed at concentrations above their respective Secondary MCLs (SMCLs) naturally occurring in the region. These exceedances of SMCLs are not anticipated to have an adverse impact on human health or the environment.

4.7 Groundwater Potentiometric Contour Maps

Groundwater monitoring data were provided by Duke Energy for a network of observation/ monitoring wells situated about the site. The data represent annual and semi-annual measurements of groundwater across the network; the data sets are more complete for the period from 2007 to the present. Maximum, minimum and median groundwater elevations were identified for each monitoring well in the data set. Overall, the elevations are relatively steady with little variation except in a limited number of deeper wells. There is little evidence of vertical hydraulic gradients in the data, except for one well cluster located closest to the Saluda River (MW-9 cluster). A conceptual groundwater potentiometric surface map is provided as Figure 3. This map is based on limited available data, and the information will be refined as part of the landfill site characteristic activities.

Potentiometric surface and cross-section water table mapping were developed to provide a conservative prediction of seasonal high groundwater elevations in the area of the secondary ash basin, which is the proposed location of a future lined landfill system. The following assumptions were applied:

- The Saluda River is the discharge point for groundwater flowing northeast across the site;
- The approximate normal pool elevation of the Saluda River is El. 652 feet at the site;
- The groundwater elevation at MW-18 represents the highest available groundwater data for the site. Groundwater elevation data are relatively small in range, providing little substantial difference given the spatial scale of the analysis;
- Groundwater elevations for monitoring wells offset from the cross-sections were considered applicable for use in the mapping analysis. These nearby monitoring wells were artificially placed along the cross-sections;
- Potential future groundwater elevations would be unaffected at the discharge to the Saluda River;

- The removal of the primary and secondary cells would remove 20 to 30 feet of head from the groundwater system. This will result in a corresponding drop in groundwater elevations in the up-gradient direction and beneath the drained cells; and
- Potential future groundwater surfaces were mapped assuming the minimum 20-foot drop in head. This is believed to be a conservative assumption since the head driven by the units appears to be closer to 30 feet based on interpreted bathymetry and thicknesses.

It is important to note that this analysis was developed based on available data and using the broad assumptions identified above. Further refinement of the potential future groundwater surface may be performed as additional data and monitoring points are developed, and as groundwater models become available.

Existing and predicted future groundwater elevations at the site were projected along two cross-sections using the groundwater elevation data described in Section 4.7 (Figure 4). Cross-section A-A' extends in an east-northeast direction from the upland area, through the secondary cell and to the Saluda River. Cross-section B-B' extends from the upland area and MW-18, through the primary cell, past MW-5 and to the Saluda River. Median groundwater elevation data were used for MW-18, MW-27 and MW-5, and water elevation data for the Saluda River were utilized to develop the mapped water table elevations.

Cross-section A-A' (Figure 5) depicts a steep groundwater slope from the dam to MW-27. There have not been any substantial or broadly flowing groundwater seeps observed in this area to contradict the interpreted water table. The topographic data indicate approximately 20 to 30 feet of water in the secondary ash basin.

Similarly, cross section B-B' (Figure 6) depicts a steep slope in the water table from the edge of the ash basin toward MW-5 and the Saluda River. Again, no substantial and/or widespread groundwater breakout or seeps are evident in this area, further supporting the interpreted steep slope. The potential future water table surface follows the same pattern, with a gentler slope from the upland areas towards the Saluda River, as the surface features otherwise driving groundwater conditions and the hydraulic gradient are eliminated.

Additional evaluation of likely future groundwater elevations was performed as a complement to the mapping described above. Historical topographic maps from 1957 and 1983 (Environmental Data Resources (EDR), 2015) were used to identify the current ash basin locations and assess the pre-development topography as it relates to anticipated natural groundwater conditions within the area of the secondary ash basin.

Based upon information obtained from the 1957 topographic map, a Y-shaped valley was formerly located in the area now occupied by the secondary ash basin. Branches of the stream valley extended to the northeast and east and are evident in the shape of the secondary ash basin. Two valleys also existed within the area that is currently the primary ash basin at the site. The water table, prior to primary basin construction, would reasonably be expected to generally mimic the topography between the two existing basins.

Based on the evaluation of the topography of this valley, the stream would have had an estimated elevation of El. 688 feet at the toe of the existing dam, with elevations in the stream valley extending up to approximately El. 720 feet in the upland direction (east and northeast). These estimates, developed using historical mapping, correlate well with the analytical approach described above for estimating post-closure groundwater elevations at the site.

5. GROUNDWATER MODELING ANALYSIS

Groundwater modeling analysis activities are currently being conducted. Ultimately, the resulting model will be used to perform predictive analysis of closure and post-closure groundwater elevations, groundwater flow directions, vertical hydraulic gradients, flow velocities and the effects on and from potential down-gradient receptors at the site. In this case, the primary receptor is the Saluda River. The transport model will be used to predict estimated post-closure concentrations at the compliance boundary and identify possible exceedances as simulated in the model.

The numerical modeling analysis will be performed using a MODFLOW groundwater flow model and MT3D solute transport model. MODFLOW is a three-dimensional finite difference groundwater model created by the United States Geological Survey (USGS) and is considered the universal standard for groundwater modeling investigations (McDonald and Harbaugh, 1988). MT3D is a three-dimensional solute transport model and is similarly the standard model of choice for solute transport modeling projects (Zheng and Wang, 1999). MT3D uses the groundwater field data from MODFLOW to simulate the three-dimensional advection and dispersion of dissolved constituents, including effects of retardation due to adsorption to the soil matrix. The modeling process is anticipated to include multiple phases: site conceptual model development, development of a calibrated groundwater flow model, evaluation of existing chemical data to determine appropriate solute transport parameters and predictive simulations of the closure and post-closure activities.

Following development and refinement of the site conceptual model (SCM), the SCM may be translated into the numerical MODFLOW model. The model should be calibrated to steady state conditions using measured hydraulic heads and flows at the site. Calibration may be performed manually and may be supplemented with use of a model-independent parameter estimation-type (PEST) automated parameter estimation tool. Ideally, a transient simulation will also be performed to validate the model's performance beyond a steady state "snapshot in time" set of calibration values.

The numerical modeling investigation is currently underway and will be refined as needed to provide appropriate focus and to identify and eliminate potential data gaps. Key site inputs and outputs are currently under consideration and will be reflected in the ensuing model development. As the modeling investigation continues to develop, processes will be refined and documented in the final report and closure plan documents.

6. BENEFICIAL REUSE AND FUTURE USE

6.1 CCR Material Reuse

When practical, the beneficial reuse of CCR materials in accordance with environmental regulations is a preferred alternative to disposal in a landfill. Given the volume of materials to be managed and the current level of site development at the W.S. Lee Steam Station, no practical uses for the CCR materials on-site have been identified at this time.

6.2 Site Future Use

The W.S. Lee Steam Station will continue to operate as a natural gas-fired (Unit 3 and combined-cycle) power generation facility. The primary ash basin and structural fill area are anticipated to be prepared for potential future use. The primary ash basin will also be a stormwater conveyance. The area of the current secondary ash basin is planned to be converted to a Class III SC DHEC-permitted landfill and will receive the CCR material excavated from the secondary ash basin, primary ash basin and structural fill area. Following material consolidation, the landfill will be closed and vegetated.

7. CLOSURE DESIGN DOCUMENTS

In order to develop this Conceptual Closure Plan, several design activities were conducted, including engineering evaluations and analyses, the development of preliminary design drawings, the preparation of a proposed methodology for achieving closure by removal and the development of a construction quality assurance/control plan (CQACP). Each of these items is discussed in more detail within this section.

7.1 Engineering Evaluations and Analyses

The primary design components for this Conceptual Closure Plan include the following:

- Stormwater management (Appendix A);
- Dewatering methodology (Appendix B);
- Wastewater management/treatment (Appendix C);
- Excavation practices; and
- Preliminary on-site landfill layout activities.

An overview of the objectives of each of these design related activities is presented within this section. Further technical information is provided in the calculations and design basis narratives, provided in the referenced appendices.

7.1.1 Stormwater Management

AECOM has prepared two stormwater management plans related to the closure activities, one to be implemented prior to the commencement of construction activities (pre-construction) and one to manage stormwater following closure of the primary ash basin, secondary ash basin and structural fill area (post-closure). In addition, the free water volume will be reduced via lowering the water level in both ash basins, prior to the commencement of any construction activities, to reduce the potentiometric surface in the area as well as minimize the total volume of water that will require management in the proposed treatment system. These stormwater management design and planning activities were conducted in consideration of several objectives, including the following:

- Reduce the free water/surface water volume within the primary ash basin prior to the commencement of construction and dewatering activities. The maximum allowable drawdown is 6 inches per day under South Carolina's Dam Safety Regulations;
- Minimize run-on to the primary ash basin, secondary ash basin and structural fill area during construction activities to reduce the volume of contact water that requires treatment;

- Evaluate stormwater flow direction, rates and velocities to identify preliminary BMPs and erosion and sedimentation controls for use during construction. For temporary stormwater controls, consider the 25-year, 24-hour frequency storm event. The SC DHEC published a BMP Handbook for stormwater runoff from construction activities, which will be used as guidance throughout the closure project; and
- Evaluate post-closure topographical conditions and prepare a stormwater design to accommodate a 25-year, 24-hour storm. The post-closure stormwater design is specific to the primary ash basin and structural fill areas. Additional detailed design activities will be conducted for the landfill as part of the permitting process for that unit. The post-closure stormwater management plan has been prepared to comply with R. 258.26 and R.258.27 of SC DHEC Solid Waste Regulations.

HydroCAD Version 9.1 was used to conduct the stormwater related design activities. These design activities are further described in Appendix A and the Conceptual Closure Plan Drawings.

7.1.2 Dewatering Methodologies

The conceptual plan for dewatering of the materials within the primary and secondary ash basins is presented in the Conceptual Closure Plan Drawings and further described in Appendix B. The objective of the dewatering activities is to condition the ash materials to a desired moisture content in order to allow for the placement of the dried material as fill within the proposed landfill. This is anticipated to be accomplished via a systematic approach beginning at the up-gradient or southernmost parts of the ash basins and creating a series of access roads, trenches and windrows to allow seepage of free water and drying of the material. As necessary, materials may also be excavated and stacked in a cleared area of the primary ash basin and/or an area within the structural fill area to facilitate additional drying or conditioning. This conceptual plan will be subject to modification based on pilot studies, encountered conditions and refined as further evaluations of the behavior of the fly and bottom ash materials within the primary and secondary ash basin are conducted.

7.1.3 Wastewater Management/Treatment

Surface water from the primary and secondary ash basins is currently discharged through Outfall 004 under the terms of the facility's NPDES Permit. Approval will be obtained from SC DHEC prior to basin drawdown and dewatering activities. As the dewatering activities commence, contact water from the ash basins (commingled stormwater, interstitial waters, etc.) will need to be managed as wastewater and may require treatment prior to discharge. The primary constituents of concern (COCs) for this treatment system include the existing parameters from the facility's NPDES permit for Outfall 004 (pH, TSS, O&G). It is currently proposed to construct and operate an on-site wastewater treatment facility to the north of the primary and secondary ash basins just downgradient of the existing dam systems. The facility will be sized to accommodate a flow rate on the order of 250 gallons per minute (gpm) based on Duke Energy's experience at other facilities. Treated effluent will be discharged through a manhole, northeast of the rail spur, which discharges through Outfall 004. Alternately, management and treatment of contact water from the ash basins may be accommodated in the

plant process water treatment system (currently under evaluation/design). These activities will be subject to a NPDES permit modification. Additional information on the proposed wastewater management and treatment plan is provided in Appendix C.

7.1.4 Excavation Practices

Duke Energy intends to adopt safe excavation practices similar to those currently being implemented at the IAB. This will primarily include an emphasis on excavation practices that protect the safety of contractor's personnel as well as prevent losses to equipment/materials. The excavation practices and plan depicted on the conceptual closure plan drawings are intended to minimize material handling and rehandling activities, as well as to limit the number of routes/trips required to complete the activities, providing additional environmental protection.

7.1.5 Volume of CCR Materials/Estimated Volume of Proposed Landfill

As noted in Section 3.1.2, it is estimated that a total of 2.2-million tons of ash materials are present within the limits of the primary ash basin, secondary ash basin and structural fill area. The exact limits or extents of these units are estimated based on historical topography and may be further refined during subsequent design and construction, resulting in additional volumes. In order to accommodate these unknowns, the preliminary landfill design has been sized to allow for the disposition of up to 3.6-million tons of materials. The landfill design will be optimized as design activities proceed.

7.2 Closure Plan Drawings

The conceptual closure plan drawings have been developed to describe the construction sequence and methodologies anticipated to be required to meet the objectives of this plan. The drawings present the existing site conditions, anticipated site preparation activities, proposed pre-and post-stormwater management controls, initial and final excavation site conditions at the primary ash basin, secondary ash basin and structural fill area and the proposed landfill final grade. A drawing list is provided below:

Drawing No.	
01	Cover Sheet
02	General Notes
03	Existing Site Features
04	Existing Site Conditions Plan – Topographic Contours
05A/B	Construction Sequence
06	Site Plan
07	Site Preparation Plan
08	Pre-Construction Stormwater Management Plan
09	Post-Closure Stormwater Management Plan
10	Secondary Ash Basin Excavation and Conceptual Dewatering Plan

11 Primary Ash Basin Conceptual Dewater Plan

12 Structural Fill Area Excavation Plan

13 Primary Ash Basin Excavation

14 Proposed Landfill Conceptual Final Grade

15 Erosion and Sediment Control Details

16 Conceptual Stormwater Management Controls

7.3 Closure by Removal Methodology

A program will be implemented for the closure of the primary ash basin, secondary ash basin and structural fill area that achieves the objectives of demonstrating removal of ash, providing for long-term protection of groundwater, and being protective of human health by minimizing exposure through institutional controls.

Excavation activities within the ash management units will continue until visual confirmation that ash has been removed. Visible ash removal will be evaluated by inspection in the field by technicians experienced in ash identification/soil classification. Following removal of ash, remaining soil constituent concentrations will be documented and evaluated (at an approximate 300 foot grid). Soils remaining in place will be sampled (with a minimum of one soil sample collected for each 2-acre area of excavation) and analyzed for CCR Appendix IV constituents using USEPA Method 6010/6020. This data will be used to document any remaining constituent concentrations and demonstrate that source-removal results in conditions that continue to be protective of groundwater. The groundwater evaluation will be performed using the groundwater models developed for the site. In the event that the evaluation indicates constituent concentrations that are not protective of groundwater, corrective action and appropriate institutional controls (groundwater use restrictions) will be further evaluated. In the event that analyses indicate remaining soils are not protective of human health, clean soil covers and/or institutional controls may be implemented.

It should be also noted that it is anticipated that closure will be achieved and demonstrated in stages/defined areas throughout the excavation/removal activities. Areas will be cleared in a logical sequence such that following demonstration of closure by removal, areas will no longer be subject to contamination by contact water, adjacent excavation activities or operating equipment. This will generally be performed by excavating/clearing upgradient areas prior to downgradient areas. However, diversion of potentially contaminated storm water may also be performed to accomplish this goal. Further, storm water from the cleared areas may be diverted away from contact area management sumps and discharged directly to permitted site stormwater outfalls, following management through appropriate sedimentation control BMPs.

8. MANAGEMENT OF WASTEWATER AND STORMWATER

On-site management of wastewater and stormwater is handled by the existing surface impoundments and ancillary structures. Collected stormwater and wastewater streams are conveyed to the primary impoundments via pipe network and discharged to the Saluda River via NPDES permitted Outfall 004. Outlet structures at both the primary and secondary ash basins consist of a reinforced concrete box with removable stop logs, skimmer, 36-inch decant pipe and monitoring equipment. Wastewater is conveyed from the primary ash basin decant pipe to the secondary ash basin via a rip-rap lined channel.

CCR wastewater streams ceased in November 2014. Currently, non-CCR wastewater flows from the facility continue to be treated in the ash basins. Duke Energy is performing evaluations to identify waste and stormwater streams to the ash basins (including flow rates) and preparing a design to reroute these flows from the ash basins and treat to meet NPDES Permit conditions (the subject of a future permit modification). These activities are being conducted separate from the closure activities.

Discharges to waters of the State are permitted under NPDES permit SC002291. Three permitted outfalls are regulated under this permit: Outfall 001, Outfall 003 and Outfall 004. Ash basin effluent is discharged via Outfall 004.

During the implementation of closure activities, various stormwater improvements are anticipated. These features have been sized on a preliminary basis (see Appendix A) and are depicted on the drawings. In addition, these improvements have been designed considering post-closure conditions. Following the completion of closure activities, it is anticipated that Outfall 004 will be terminated and removed from the NPDES permit, and stormwater will be routed through the current stormwater outfalls 006 and 007 (with stormwater management improvements).

9. DESCRIPTION OF FINAL DISPOSITION OF CCR MATERIALS

On December 18, 2014, Duke Energy submitted a letter to SC DHEC committing to consolidation and long-term management of ash from the primary ash basin, secondary ash basin, and structural fill area. Following submission of that communication, Duke Energy has reviewed possible long-term management locations, and has concluded that the optimum location would be within the vicinity of the current secondary ash basin. This area fully supports development of a landfill which will meet or exceed the SC DHEC requirements for a Class III Landfill.

The primary basis for a landfill in this location is as follows:

- This landfill location conforms to the Location Restrictions of Regulation 61-107.19, Part V, Subpart B;
- Existing soil materials and geologic setting of the secondary basin are suitable for landfill development;
- Development of a landfill in this area would minimize material handling, transport and exposure to the environment as the majority of the ash material is within the primary ash basin and structural fill area (both within approximately 2,000 feet of the proposed landfill site);
- This landfill location would allow for utilization of the area topography and use of the majority of the existing secondary ash basin dam for landfill construction, providing for efficient utilization of airspace; and
- Project sequencing will allow for soil materials from the primary ash basin dam to be utilized for landfill cover materials, thereby minimizing the amount of borrow material required for landfill closure.

In order to support development of the landfill in this area, a DON was submitted to SC DHEC. The DON demonstrates compliance with the various buffer zone requirements of Part V, Subpart B, 258.18, including the following:

- The boundary of the fill area is located at least 1,000 feet from any residence, day-care center, church, school, hospital or publicly-owned recreational park area;
- The boundary of the fill area is located at least 200 feet from any property line not under control of the permittee;
- The boundary of the fill area is located at least 200 feet from any surface water that holds visible water for greater than 6 consecutive months, excluding ditches, sediment ponds and other operational features on the site; and
- The boundary of the fill area is not located within the defined setback distances from any well used as a source of water for human consumption.

A landfill siting map illustrating compliance with these buffer criteria is provided as Figure 7.

In addition to the DON, a Site Suitability report was prepared to demonstrate that the area of the secondary ash basin in suitable for landfill development based on currently available site information. It should be noted that additional geologic and hydrogeologic characterization activities will be performed to provide continued technical support for development of the proposed landfill. These efforts will be performed as part of the landfill permit application process.

10. APPLICABLE PERMITS FOR CLOSURE

10.1 Permit-to-Install (or Construct)

In accordance with SC DHEC Bureau of Water Regulation 61-67, Standards for Wastewater Facility Construction, a Permit-to-Construct will be required for the installation of the proposed wastewater treatment system to manage contact waters generated during construction. Application will involve the submission of a preliminary engineering report (PER), NPDES permit modification (see Section 10.2.1), construction permit application containing Form 1970 and engineering plans and specifications. This permit will be applied for and obtained prior to commencing the wastewater treatment system construction activities.

10.2 Permit Modifications

10.2.1 NPDES Permit Modifications

As promulgated in SC DHEC Bureau of Water Regulation 61-9.122.62, a modification to the existing NPDES permit SC0002291 is required due to the alteration of the facility, including the closure of the ash management units and construction of the Class III landfill. Application for the modification of the NPDES permit will be in accordance with R61-9.124.5 and R61-9.122.21(g). The application will contain the proposed physical facility modifications and any changes to outfall locations, the facility water balance diagram, average flows and treatment, compliance schedules, effluent characteristics, used toxic pollutants, biological toxicity tests, contract analyses and any additional information for the assessment of the toxicity of facility discharges. The NPDES permit modifications specific to the closure activities are anticipated to include the management of contact wastewaters during construction, stormwater discharges following construction and ultimately the management of landfill leachate.

10.2.2 Air Permit Modifications

Prior to construction, potential closure-related air emission point sources (such as diesel generators and/or pumps) will be evaluated and addressed in the facility's air permit, if required. Air permit modifications may be required for the new Class III landfill.

10.3 New Permits

10.3.1 Section 404/401 Clean Water Act

As set forth in 33 CFR 328.3(b)(1), amended by the Clean Water Rule, Sections 404/401 of the Clean Water Act do not apply to the primary and secondary ash basins, as they are considered waste treatment systems. Additionally, no work will take place within a floodway. A United States Army Corps of Engineers (USACE) nationwide permit may be necessary for the potential impacts to Wetland 5 and 6. The project activities will also be evaluated for other water-related impacts. If needed, a pre-construction notification (PCN) will be sent to the USACE and SC DHEC 401 Water Quality Section for approval prior to project commencement.

10.3.2 Solid Waste Permits

Under SC DHEC Bureau of Land and Waste Management Regulation 61-107.19, Part V, new solid waste permits will be required for the construction, operation, and closure/post-closure care of the new Class III landfill. A solid waste permit application shall be prepared that addresses all sections of the Solid Waste Management Class III Landfill regulations. The application must include proof of compliance with location restrictions and buffer zones, operating criteria, design criteria, groundwater monitoring and corrective action plans, closure/post-closure care, financial assurance criteria, determination of need, consistency determination and engineering drawings and plans.

10.3.3 NPDES for Construction Activities

As set forth under SC DHEC Bureau of Water Regulations 72-305 and 72-307, land disturbing activities will require preparation of a Notice of Intent (NOI) and a stormwater management and sediment control plan for review and approval by the appropriate review agency. The plan will contain supporting calculations, drawings and sufficient information describing the manner, location, and types of measures in which stormwater runoff will be managed from the entire land disturbing activity. The plan will adhere to the stormwater ordinances set forth by the Anderson County Department of Stormwater. In addition, the project site will be evaluated for the presence of threatened and endangered species.

10.3.4 Air Permits

As set forth in Section 258.24 of Part V of SC DHEC Regulation 61-107-19 and SC DHEC Regulation 61-62.1, Section II, construction of the Class III landfill will likely require application for modification of the facility's Bureau of Air Quality Construction Permit prior to commencement of construction-related activities, and modification of the facility's current Operating Permit prior to commencement of operations at the landfill.

10.3.5 Dam Removal

As inventoried under South Carolina Dams and Reservoirs Safety Act, the primary ash basin (D4887) is a significant hazard dam. The Secondary ash basin (D4888) is also inventoried as a significant hazard dam. Removal of the primary basin dam and breaching of the secondary basin dam will require application for permits as required by Section 49-11-200 of SC Code. Application will be made according to the SC DHEC provided form, detailing the location, ownership, dimensions, watershed characteristics, future use and other relevant information. Additionally, a site location map, plans and specifications and a design report will be included in the application submittal.

11. PROJECT MILESTONES

An anticipated closure plan implementation schedule is provided on Figure 8, Anticipated Closure Implementation Schedule.

12. REFERENCED DOCUMENTS

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