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December 30, 2019

HAND DELIVERY AND ELECTRONIC MAIL

Ms. Shelia Holman
Assistant Secretary
North Carolina Department of Environmental Quality
1611 Mail Service Center
Raleigh, NC 27699-1611

RE: H.F. Lee Energy Complex Ash Basin Closure Plan

Dear Ms. Holman:

In accordance with the requirements of North Carolina General Statue § 130A-309. 214(a)(4), Closure of Coal Combustion Residuals Surface Impoundments, Duke Energy provides the attached plan for ash basin closure by excavation.

Duke Energy remains committed to safely and permanently closing basins in ways that continue to protect people and the environment and welcomes the opportunity to work constructively with NCDEQ to move forward.

Respectfully submitted,

George T. Hamrick
Senior Vice President

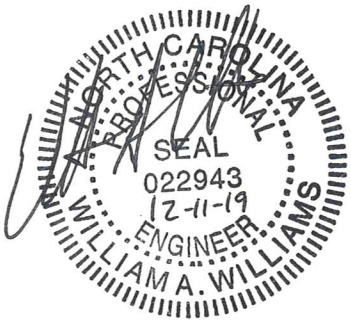
NCDEQ cc: damsafety@ncdenr.gov, deq.coalash@ncdenr.gov, Ed Mussler, Steven Lanter, Toby Vinson

Duke Energy cc: Jessica Bednarcik, Dave Renner, Dan Mc Rainey, Jim Wells, Ed Sullivan, Michael Kafka, Randy Hart

DUKE ENERGY
H.F. LEE STATION
COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENT CLOSURE PLAN

CLOSURE BY EXCAVATION

1982 Ash Basin
Basins 1, 2 and 3
Closure Plan Report
Final Submittal



Prepared for

DUKE ENERGY®

550 South Tryon Street
Charlotte, North Carolina 28202

Revision 0
Issue Date 11 December 2019

Prepared by

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Project No. 7812180091

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EXECUTIVE SUMMARY

In accordance with N.C.G.S. § 130A-309.214(a)(4), Duke Energy has prepared this Closure Plan to describe the closure of the coal combustion residuals (CCR) surface impoundments (Basins) at the H.F. Lee Station (HF Lee). The HF Lee Basins closure will consist of closure by excavation, whereby CCR in the Basins will be excavated, processed, and transported off-site for beneficial re-use as a concrete amendment. The removal of CCR and closure of the Basins will be in accordance with all applicable provisions of the North Carolina Coal Ash Management Act of 2014, Sess. L. 2014-122, as amended (codified at N.C.G.S. § 130A-309.200, *et seq.*) (CAMA). CCR processing will be done using on-site STAR® (Staged Turbulent Air Reactor) Technology, a patented thermal beneficiation process to transform coal ash from CCR surface impoundments into a high-quality, sustainable product for the concrete industry.

Duke Energy will periodically review the progress of the excavation and STAR® processing as it relates to achieving full CCR removal by the required end date of December 31, 2029. Duke Energy will implement a concurrent excavation plan in which the remaining excavated CCR will be transported to an approved landfill facility in order to meet the end date of December 31, 2029 for complete removal.

HF Lee is owned and operated by Duke Energy Progress, LLC (Duke Energy). The approximately 2,200-acre HF Lee site is located at 1677 Old Smithfield Road, Wayne County, approximately 4 miles west of Goldsboro, North Carolina.

Commercial operations of the station began in 1951. The three coal-fired units were retired in September 2012 followed by the retirement of four oil-fueled combustion turbine units in October 2012. A natural gas-fired combined cycle plant started operations in December 2012. Demolition of the plant was completed in 2017. There are no coal-fired units currently in operation at HF Lee and CCR disposal operations ceased in 2012.

This Closure Plan covers the four Basins located at HF Lee identified in the North Carolina Department of Environmental Quality (NCDEQ) Dam Safety Inventory of Dams as follows:

- HF Lee Active Ash Basin Dike - NC Dam Safety ID WAYNE-022 (identified in this report as the 1982 Basin and in some references as the Active Ash Basin or Active Ash Pond)
- HF Lee Inactive Ash Basin #1 Dike - NC Dam Safety ID WAYNE-031 (identified in this report as Basin 1 and in some references as the Inactive Ash Pond 1)
- HF Lee Inactive Ash Basin #2 Dike - NC Dam Safety ID WAYNE-032 (identified in this report as Basin 2 and in some references as Inactive Ash Pond 2)
- HF Lee Inactive Ash Basin #3 Dike - NC Dam Safety ID WAYNE-033 (identified in this report as the Basin 3 and in some references as Inactive Ash Pond 3)

During operation, CCR was transported from the plant to the Basins by hydraulic (wet) sluicing. With the permanent retirement of the coal-fired generating units, there are no longer any CCR disposal operations within the Basin areas.

The four Basins are unlined and the depth of CCR within these basins varies between 10 to 40 feet. Information provided by Duke Energy (with updated inventory data through July 31, 2019) indicates that the current estimated volume of CCR in the four Basins is approximately 6.23 million

tons (5.2 million cubic yards assuming a conversion factor of 1.2 tons/cy). It should be noted that the CCR volume/tonnage estimates are approximations since they are based on assumed pre-basin grades.

Upon approval of the Closure Plan by NCDEQ, additional activities to complete closure of the Basins will commence, including beginning excavation of the CCR from the Basins, establishing final grades using soil fill where required to properly drain the Basin areas, breaching/removing the Basin dikes following removal of CCR (soil material removed from the Basin dikes will remain on-site and will be incorporated into the final site grading plan), and development of stormwater features and vegetative covers.

This document also includes a description of the future Post-Closure Care Plan, which provides a description of the inspection, monitoring and maintenance activities required to be performed for the HF Lee site for a minimum of 30 years.

This document provides a summary of properties of the site, as well as geotechnical properties of CCR and natural soils to support engineering analyses of the selected closure design. These analyses indicate that closure by excavation, as detailed in the Closure Plan, meets regulatory requirements for the stability of the site, management of stormwater runoff, and access for effective maintenance over the post-closure care period. The CCR basin dikes are proposed to be removed or breached as part of closure and will be removed from the state's regulatory jurisdiction inventory.

In a letter dated April 5, 2019, NCDEQ established submittal dates for an updated Comprehensive Site Assessment (CSA) and updated Corrective Action Plan (CAP) for CCR surface impoundments and other primary and secondary sources. Consistent with this direction, Duke Energy will submit to NCDEQ the updated CSA for HF Lee by October 1, 2020, and the updated CAP by July 1, 2021. The CAP sets out corrective action measures for the restoration of groundwater quality as required under CAMA and the state's groundwater quality regulations. Although this Closure Plan contains references to the CAP, all specific relevant details to groundwater and related actions will be contained in the CAP and not in this Closure Plan.

1.0 INTRODUCTION

1.1 Background

The approximately 2,200-acre HF Lee site is located at 1677 Old Smithfield Road, Wayne County, near Goldsboro, North Carolina, adjacent to the Neuse River. Commercial operations at the station began in 1951. The three coal-fired units were retired in September 2012 followed by the retirement of four oil-fueled combustion turbine units in October 2012. A natural gas-fired combined cycle plant started operations in December 2012. The HF Lee Plant ceased all waste flows to the Basins in 2012, and demolition of the coal-fired plant was completed in 2017.

This Closure Plan is being submitted for approval by NCDEQ and reflects closure by excavation of the CCR from the HF Lee site. Processing of the excavated CCR will be done using STAR® Technology, a patented thermal beneficiation process to transform CCR from the Basins into a high-quality, sustainable product for the concrete industry. **Figure 1-1** presents a Vicinity Map and Site Plan of HF Lee.

The HF Lee site has four regulated impoundment structures (**Figures 1-1** and **1-2**). This Closure Plan covers the four CCR Basins at HF Lee that are identified (and regulated by) the North Carolina Department of Environmental Quality (NCDEQ) Dam Safety as follows:

- HF Lee Active Ash Basin Dam - NC Dam Safety ID WAYNE-022 (identified in this report as the 1982 Basin and in some references as the Active Ash Basin or Active Ash Pond)
- HF Lee Inactive Ash Basin #1 Dike - NC Dam Safety ID WAYNE-031 (identified in this report as Basin 1 and in some references as the Inactive Ash Pond 1)
- HF Lee Inactive Ash Basin #2 Dike - NC Dam Safety ID WAYNE-032 (identified in this report as Basin 2 and in some references as the Inactive Ash Pond 2)
- HF Lee Inactive Ash Basin #3 Dike - NC Dam Safety ID WAYNE-033 (identified in this report as Basin 3 and in some references as the Inactive Ash Pond 3)

This Closure Plan has been prepared for the review and approval of NCDEQ.

1.2 Closure Plan Objectives

The primary objective of this Closure Plan is to address the closure by excavation of the CCR from the Basins at HF Lee pursuant to North Carolina Coal Ash Management Act of 2014, Session L. 2014-122, as amended (CAMA). A further objective is to obtain approval from the NCDEQ to proceed and develop the additional details (as described further within this Closure Plan) and working documents necessary to complete the closure actions. Duke Energy is requesting approval of this Closure Plan with the knowledge that other details will follow. This Closure Plan describes and communicates the key actions and activities necessary to close the Basins in accordance with the requirements for written closure plans for CCR surface impoundments in N.C.G.S. § 130A-309.214(a)(4). Planned closure activities include:

- Removal of free water/bulk water volume via permitted outfall (i.e., decanting)
- Construction/installation of stormwater management best management practices features

- Installation and operation of a temporary water management system (WMS) to manage discharges in compliance with the NPDES permit during closure
- Development of infrastructure for CCR excavation, construction of haul roads for transportation, and construction of the STAR® Unit for processing of CCR for beneficial re-use
- Development of sump areas in the Basins to collect and convey waters to the water management system
- Dewatering the CCR to allow for safe access. CCR excavation and conditioning prior to transport to the STAR® unit
- Excavate CCR from the basin, with sequencing determined for optimal progression. Stockpile CCR and provide conditioning prior to transport to the on-site STAR® system. Construction dewatering to be used as needed to provide safe and stable work areas and slopes
- Complete closure by excavation verification
- Breaching of the Basin dikes
- Grading the perimeter dikes into each of the four Basins with a grading plan that will establish drainage to promote flow of stormwater away from the former Basins in a manner protective of area soils and water

1.3 Report Organization

This document is structured to follow the requirements of N.C.G.S. § 130A-309.214(a)(4).

2.0 GOVERNING LAWS

In August 2014, the North Carolina General Assembly enacted CAMA, which contains specific statutory requirements applicable to CCR surface impoundments. Relative to the HF Lee Station, “coal combustion residuals surface impoundment,” as defined in N.C.G.S. § 130A-309.201(6), is interpreted to include the plant’s Basins.

In July 2016, the North Carolina General Assembly enacted House Bill 630, which added N.C.G.S. §130A-309.216 requiring Duke Energy to identify three sites in North Carolina at which to install and operate Ash Beneficiation projects capable of processing CCR to specifications appropriate for cementitious products. The statute requires Duke Energy to use commercially reasonable efforts to produce 300,000 tons of useable CCR at each site annually. On December 13, 2016, Duke Energy selected HF Lee as one of the three Ash Beneficiation sites. Pursuant to subsection (c) of N.C.G.S. § 130A-309.216, CCR surface impoundments located at a site at which an Ash Beneficiation project is installed, and operating shall be closed no later than December 31, 2029.

The Excavation Soil Sampling Plan for HF Lee (presented in Appendix E), represents activities to satisfy the requirements set forth in the NCDEQ’s November 4, 2016 letter and attachment titled “CCR Surface Impoundment Closure Guidelines for Protection of Groundwater.”

In a letter dated April 5, 2019, NCDEQ established submittal dates for an updated CSA and updated CAP for CCR surface impoundments and other primary and secondary sources.

Consistent with this direction, Duke Energy will submit to NCDEQ the updated CSA for HF Lee by October 1, 2020, and the updated CAP by July 1, 2021.

In addition to the above requirements, National Pollutant Discharge Elimination System (NPDES) permit program compliance, Special Order by Consent (which commits Duke Energy to initiate and complete decanting of the Basins by certain dates) compliance, dam safety approvals for modifications to regulated CCR Basin dikes, and environmental permitting requirements must be considered during closure.

3.0 FACILITY DESCRIPTION AND EXISTING SITE FEATURES

3.1 Surface Impoundment Description

This section provides details on the CCR-related features at HF Lee.

3.1.1 Site History and Operations

Figure 1-1 shows locations of the four CCR Basins (1982 Basin, Basin 1, Basin 2, and Basin 3) at the HF Lee site. **Figure 1-2** shows the overall existing conditions at the HF Lee Station.

The HF Lee Station is located adjacent to the Neuse River in Wayne County, North Carolina near the city of Goldsboro. Review of available information indicates that the property, totaling approximately 2,200 acres, is owned by Duke Energy, and is reported to have begun commercial operation in 1951 with of three coal fired units. Cooling was provided by cycling water through a cooling pond, the level of which is controlled by pumping water into the cooling pond from the intake canal off the bypass canal of the Neuse River. CCR generated from coal combustion was transported by sluicing to and stored in four on-site Basins. Basins 1, 2, and 3 have been historically referenced as the 1950 Pond, the 1955 Pond, and the 1962 Pond respectively, for the assumed start-of-service dates. Basins 1 and 2 were both taken out of service around 1969. Basin 3 was used to deposit CCR until construction of the 1982 Basin was completed. Construction of the 1982 Basin started around 1978 and was completed around 1980. In 2012, the coal burning plant was taken out of service and was replaced with new gas-fired combined cycle units across the bypass canal from the original plant. There are no longer any CCR disposal operations within the Basins with the permanent retirement of the coal-fired generating units. The 1982 Basin has been inactive since April 2019. Elements of the coal plant (boilers and stacks) were demolished in 2013 and 2014, with final demolition of the plant completed in 2017.

3.1.2 Estimated Volume of CCR in Impoundments

Based on CCR inventory data provided by Duke Energy as of July 31, 2019, the approximate volume of CCR in the Basins is listed in the table below. To compute the estimated volume of CCR in place, an assumed density of 1.2 tons per cubic yard was used, which is the Duke Energy fleet-wide assumption. See **Appendix A** for the Estimated Volume of CCR in the Impoundments data sheet.

Impoundment	Estimated CCR Material Volume (cy)	Estimated CCR Material Weight (tons)*
1982 Basin	3,763,333	4,516,000
Basin 1	224,167	269,000
Basin 2	440,833	529,000
Basin 3	759,167	911,000
TOTAL	5,187,500	6,225,000

* Estimated CCR Material is based on updated CCR Inventory Data provided by Duke Energy as of July 31, 2019. To compute the estimated volume of CCR in place an assumed density of 1.2 tons per cubic yard was used, which is the Duke Energy fleet wide assumption.

3.1.3 Description of Surface Impoundments Structural Integrity

The purpose of this section is to summarize the Basins' structural integrity evaluations based on current existing information. This section includes brief summaries of the Geotechnical and Hydrology and Hydraulics (H&H) capacity analyses results. Duke Energy provided Wood with pertinent information regarding the integrity of the embankments, which had already been compiled and analyzed. In summary, the structural integrity of the CCR impoundments and subsequent dike inspection reports meet the regulatory requirements of EPA's CCR Rule (40 CFR 257.73). Duke Energy's certifications of these requirements for the 1982 Basin are available on Duke Energy's publicly-accessible CCR Rule Compliance Data and Information website.

Slope Stability:

Slope stability was analyzed by Wood in 2015 at critical cross section locations for the Basins at HF Lee. Two of the cross sections located on the southern side of Basin 1/2 (along Half-Mile Branch) indicated low factors of safety. Geosyntec performed remedial action of armoring the slope with riprap. Subsequent slope stability analyses by Geosyntec showed acceptable factors of safety. Low (but acceptable) factors of safety identified for the 1982 Basin were remediated in 2016. The slope stability analysis results indicate that minimum factors of safety for static long-term maximum storage pool, static maximum surcharge pool, sudden drawdown conditions, and pseudo-static seismic conditions meet regulatory and programmatic criteria.

- **Liquefaction Conditions (where susceptible) and Liquefaction Potential:**
  Embankment and foundation soils associated with these dikes are not susceptible to liquefaction or cyclic softening, and risk of excessive deformation or settlement of the embankments is considered negligible during the Maximum Design Earthquake (MDE).

- **Hydrology and Hydraulics (H&H) Capacity Analyses:**
  In April 2019, the NCDEQ promulgated new dam safety rules and, per the dam safety High Hazard Classification, each basin is required to pass a full Probable Maximum Precipitation (PMP). Each basin is classified as high hazard by NCDEQ due to the potential for environmental impacts greater than $200,000, if the basin failed. In response, Wood performed H&H analysis for each of the basins at the HF Lee site. Based upon the results of

these analyses, Basins 1, 2, and 3 will flood from overtopping of the Neuse River (within the 100-year flood zone). The 1982 Basin has the capacity to contain and release 80 percent of the detained storm volume within 15 days following the design storm peak (6-hour PMP) as required by the North Carolina dam safety rules. These analyses are included in **Appendix C**.

3.1.4 Sources of Discharges into Surface Impoundments

Duke Energy has decommissioned the coal-fired power plant at this site. Since it is now permanently retired from service, CCR is no longer sluiced into the Basin system, and the Basin system is inactive. Because the Basins are surrounded by perimeter dikes, stormwater runoff from adjacent drainage areas does not enter the Basins. As a result, only direct precipitation on the pond surface collects within the Basins. Basins 1, 2, and 3 are surrounded by perimeter dikes and runoff from adjacent areas does not enter the Basins except during extreme rain events when the Neuse River floods.

3.1.5 Existing Liner System

The Basins located at HF Lee do not include geomembrane or clay liner systems and are considered to be unlined.

3.1.6 Inspection and Monitoring Summary

Duke Energy conducts routine weekly, monthly, and annual inspections of the Basins, consistent with North Carolina's dam safety requirements and the federal CCR rule.

Weekly Basin inspections have been on-going since 2014, and include observation of upstream slopes and shorelines, crest, downstream slopes, toes, abutment contacts and adjacent drainage way(s), spillway(s) and associated structure(s), and other structures and features of the dikes.

Monthly inspections of the Basins include the weekly monitoring elements with the addition of piezometer and observation well readings, water level gauges/sensors, and visual observations and documentation.

Daily inspections of the Basins are not routinely required; however, on a case-by-case basis, the Basins may be inspected daily beginning at such times and continued for the duration as specified by plant management. Such daily inspections might be initiated during a repair activity on the dike or in response to a specific imposed regulatory agency requirement.

The Basins are inspected annually by an independent third-party consultant. In a letter dated August 13, 2014, NCDEQ requires these inspections to be conducted annually at all of Duke Energy's CCR impoundments in North Carolina. These inspections are intended to confirm adequacy of the design, operation, and maintenance of the surface impoundments in accordance with accepted engineering standards. Reports are to be submitted to the NCDEQ within 30 days of the completion of the inspection.

The results for the annual inspections are used to identify needed repairs, repair schedules, to assess the safety and operational adequacy of the dike, and to assess compliance activities regarding applicable permits and environmental and dam regulations. Annual inspections are also

performed to evaluate previous repairs. The annual inspections of the dikes have been ongoing since 2012, with five-year inspections conducted between 1999 and 2009.

The 2015 through 2019 annual inspections did not identify features or conditions in the Basin dikes or their outlet structures or spillways, that indicate an imminent threat of impending failure hazard. Review of analyses indicated the design conforms to current engineering state of practice to a degree that no immediate actions are required other than the recent and ongoing surveillance and monitoring activities already underway.

Special inspections of the HF Lee Basins may be performed during episodes of high-flow, earthquake, emergency, or other extraordinary events. Visual inspections are performed after a heavy precipitation event when accumulation of four inches of rainfall or greater occurs within a 24-hour period. An internal inspection will be performed if an earthquake is felt locally or detected by the US Geological Survey measuring greater than a Magnitude 3 and with an epicenter within 50 miles of the dikes. A special inspection would also be performed during an emergency, such as when a potential dike breach condition might be identified or when construction activities (e.g., basin cleanout) are planned on or near the dikes. Special inspections are also conducted when the ongoing surveillance program identifies a condition or a trend that warrants special evaluation.

3.2 Site Maps

3.2.1 Summary of Existing CCR Impoundment Related Structures

A site map showing property boundary, location of HF Lee Station and Basins with their boundaries, and topographic and bathymetric contours are shown on **Figure 1-2**.

3.2.2 Receptor Survey

This information is included as part of the updated CAP being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by July 1, 2021. The CAP is herein incorporated by this reference, but its content is not the work product of Wood.

3.2.3 Existing On-Site Landfills

There are no known on-site landfills at the HF Lee Station.

3.3 Monitoring and Sampling Location Plan

This information is included as part of the updated CAP being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by July 1, 2021. The CAP is herein incorporated by this reference, but its content is not the work product of Wood.

Locations of the existing groundwater monitoring wells are shown in the Closure Plan Drawings included in **Appendix D**, but the CAP should be consulted for details of well locations, names, and status.

4.0 RESULTS OF HYDROGEOLOGIC, GEOLOGIC, AND GEOTECHNICAL INVESTIGATIONS

4.1 Background

An overall boring and existing monitoring well location plan, indicating the locations of recent and historical borings, monitoring wells, piezometers, and Cone Penetration Test (CPT) soundings, is shown on drawing **Figure 4** in **Appendix D**.

This chapter summarizes the site geology and hydrogeology; site stratigraphy of the geologic units underlying the surface impoundments; hydraulic conductivity of CCR and the soils underlying the surface impoundment; geotechnical properties of the CCR and the uppermost stratigraphic unit under the surface impoundment; and the CCR and CCR-affected soils. Duke Energy provided Wood with pertinent documentation regarding the site geology and hydrologic information, which had already been compiled.

4.2 Hydrogeology and Geologic Descriptions

This information is included as part of the updated CSA being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by October 1, 2020. The CSA is herein incorporated by this reference, but its content is not the work product of Wood.

4.3 Stratigraphy of the Geologic Units Underlying Surface Impoundments

This information is included as part of the updated CSA being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by October 1, 2020. The CSA is herein incorporated by this reference, but its content is not the work product of Wood.

4.4 Geotechnical Properties

This section provides a summary of geotechnical conditions and properties found from investigations performed within the Basins and Basin dike areas. The presented information was obtained from previous geotechnical investigations at the site and recent investigation activities conducted to support the Closure Plan development. The geotechnical conditions within the Basins generally consist of CCR material (primarily interbedded layers of fly ash and bottom ash, along with coal slag, unburned coal, and plant stormwater) placed in the basin primarily by hydraulic sluicing, underlain by residual soil, saprolite, partially weathered rock (PWR), and bedrock.

For purposes of discussion of the geotechnical properties of the materials, the saprolite material is described as residual material. General properties of the various materials encountered within and surrounding the Basins are described below. A range of measured material properties of laboratory tests performed by Wood and SynTerra for the subsurface explorations completed within the Basins is presented in **Appendix B**. A summary of typical measured properties for different material types is presented in **Table 4-1**. A summary of laboratory test data obtained in support of the closure design is also presented in **Appendix B**.

4.4.1 CCR Within the Basins

The CCR within the Basins consist primarily of layers and mixtures of bottom ash and fly ash. Other CCR materials such as slag are also typically encountered. The bottom ash generally consists of very loose to loose, moist to wet, dark gray to gray, silty sand (SM) or silt and sandy silt (ML). At some drilling locations, a surficial layer of CCR fill material (SP or SW or SW-SM) was encountered that was used for boring access road construction.

The fly ash generally consists of very soft to soft, moist to wet, light to medium gray sandy silt and silt (ML).

Further information is included as part of the updated CSA being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by September 1, 2020. The CSA is herein incorporated by this reference, but its content is not the work product of Wood.

4.4.2 Liner Material Properties

The Basins at the HF Lee Station are unlined, so there are no associated material properties.

4.4.3 Subsurface Soil Properties

The site is in the transition from the Piedmont to the Coastal Plan physiographic provinces. The surficial materials are interlayered sandy clays and clayey sands that are typical of the Inner Coastal Plain while the deeper materials are residual silty soils derived from chemical and physical weathering of metavolcanic rocks. With increasing depth, the residual soils become hard and transition to partially weathered rock and rock. Partially weathered rock is a term applied for engineering used to designate residual materials having Standard Penetration Test (SPT) N-values greater than 100 blows per foot.

Based on review of the deep borings performed at the 1982 Basin, it appears that the transition from the coastal deposits to the residual soils (Piedmont) is 20 to 40 feet below the bottom of the basin embankments. Around Basins 1, 2 and 3, it appears that the transition is 10 to 20 feet below the bottom of the basin embankments.

The foundation soils consist of interbedded layers of sand with varying amounts of fines, silt, and clay. The foundation soils were found to be about 10 to 40 feet thick below the pond dikes or CCR. The SPT N-values of the foundation soils indicate that the soils range from loose to dense and soft to stiff. The soils become denser/stiffer with depth.

Partially Weathered Rock (PWR) was encountered in eight of the exploratory borings at Basins 1, 2, and 3, and in four borings performed at the 1982 Basin. The PWR was sampled as sandy silt with rock fragments. At the 1982 Basin, the PWR was encountered at depths ranging from 42 to 87 feet below the crest of the dikes (Elevations 4 to 47 feet. The PWR was shallowest at the northwest corner of the basin and was deeper toward the southeast corner. At Basins 1, 2 and 3, the PWR was encountered at depths ranging from 11 to 27 feet below the ground surface (Elevations 69 to 52 feet).

Surficial deposits overlie the Cape Fear Formation near Basins 1, 2, and 3 and in the area west of the 1982 Basin. The Black Creek Formation underlies surficial deposits at the 1982 Basin and to the east. The contact between the CCR and underlying soils in Basin borings was visually

distinct. Surficial deposit material west of the 1982 Basin were determined by grain size analysis to be silty fine to medium sands and silty fine to coarse sands. Surficial deposit sediments identified as Cape Fear Formation to the northwest of the 1982 Basin were determined to be silty fine to coarse sands.

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

This information is included as part of the updated CSA being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by October 1, 2020. The CSA is herein incorporated by this reference, but its content is not the work product of Wood.

4.6 Historical Groundwater Sampling Results

This information is included as part of the updated CSA being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by October 1, 2020. The CSA is herein incorporated by this reference, but its content is not the work product of Wood.

4.7 Groundwater Potentiometric Contour Maps

This information is included as part of the updated CSA being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by October 1, 2020. The CSA is herein incorporated by this reference, but its content is not the work product of Wood.

4.8 Estimated Vertical and Horizontal Extent of CCR within the Impoundments

This information is included as part of the updated CSA being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by October 1, 2020. The CSA is herein incorporated by this reference, but its content is not the work product of Wood.

5.0 GROUNDWATER MODELING ANALYSIS

This information is included as part of the updated CAP being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by July 1, 2021. The CAP is herein incorporated by this reference, but its content is not the work product of Wood.

5.1 Site Conceptual Model Predictions

This information is included as part of the updated CAP being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by July 1, 2021. The CAP is herein incorporated by this reference, but its content is not the work product of Wood.

5.2 Geochemical Site Conceptual Model

This information is included as part of the updated CAP being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by July 1, 2021. The CAP is herein incorporated by this reference, but its content is not the work product of Wood.

5.3 Groundwater Trend Analysis

This information is included as part of the updated CAP being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by July 1, 2021. The CAP is herein incorporated by this reference, but its content is not the work product of Wood.

6.0 BENEFICIAL USE AND FUTURE USE

6.1 CCR Use

Duke Energy has developed plans for on-site recovery and reclamation/recycling of a significant portion of the CCR at HF Lee, in accordance with rate established by N.C.G.S. § 130A-309.216. Duke Energy will implement a concurrent excavation plan in which the remaining excavated CCR will be transported to an approved landfill facility in order to meet the end date of December 31, 2029 for complete removal.

The beneficial use activities consist of removing and transporting CCR from the Basins for processing at a STAR® facility to be constructed on-site west of the combined cycle plant. The STAR® facility will process the reclaimed CCR to a level of quality and condition suitable for future reuse in the concrete industry.

6.2 Site Future Use

At this time, Duke Energy has not identified any future use of the land reclaimed by the dewatering and excavation of the Basins.

Since this Closure Plan details a closure by excavation method, no recording of a notation on the deed to the property is required.

7.0 CLOSURE DESIGN DOCUMENTS

Closure of the HF Lee Basins will be completed in two phases. Phase 1 is excavation (and beneficiation program) and Phase 2 will be the final decommissioning of the basin dikes and final grading.

7.1 Engineering Evaluations and Analyses

Engineering evaluations and analyses to support closure of the Basins at HF Lee, as detailed in this Closure Plan, are provided in **Appendix C**. Based on the final post-closure configuration of the Basins and absence of engineered fill features, no geotechnical calculations accompany the Closure Plan presented herein. Calculations related to dike removal will be included in the dike modification permit applications.

Safe and effective access to the Basins is critical to CCR excavation and the completion of closure. Access road locations into or across the Basins cannot be reliably established until detailed phasing of closure is developed, and a contractor is selected to complete the work. A variety of mitigation techniques are commonly applied, such as installation of a geogrid and crushed stone aggregate, placement and spreading of dry CCR over the Basin surfaces to establish access and use of low ground pressure or light weight construction equipment.

Areas for stockpiling or conditioning(drying) of CCR are generally needed. These areas must be established within the limits of the CCR unit and require placement or stacking of CCR excavated from other areas of the Basins. They can be established in areas where all or most of the CCR has been removed, or on areas where a significant depth of CCR remains in place. Sluiced CCR forming the foundation of stockpiles or conditioning(drying) areas may be subject to bearing

capacity or slope failures from the additional vertical compressive stress imparted by the stacked CCR and hauling equipment.

During excavation of CCR, interim or temporary excavated CCR slopes are commonly created. These slopes vary in height and the duration they will have to stand. Some slopes are subject to potential loading from hauling or stockpiling operations. The location and geometry of such slopes generally cannot be established during design. These elements depend on the means and methods employed by the construction contractor, site conditions, schedule, and other site conditions. Excavation in CCR creates significant safety risks that need further evaluation and will require the means and methods inputs from a contractor to fully address before closure excavation work commences. A detailed phasing and excavation plan will be developed after this Closure Plan is approved by NCDEQ.

7.2 Closure Plan Activities

The primary activities associated with closure by excavation are as follows:

- Decant by using floating pumps, screened intakes, and pumping through the existing NPDES discharge outlet.
- Construct required haul roads and the STAR® unit for processing the CCR for beneficial re-use.
- Install stormwater diversion or retention controls to minimize stormwater flow impacts to the CCR within the Basins.
- Operate the on-site pumping and water management system to manage interstitial/pore water and contact stormwater during construction.
- Dewatering the CCR to allow for safe access. CCR excavation and conditioning prior to transport to the STAR® unit.
- Start CCR excavation from the basin, with sequencing determined for optimal progression. Stockpile CCR and provide conditioning prior to transport to the on-site STAR® system. Construction dewatering to be used as needed to provide safe and stable work areas and slopes.
- Maintain required hydraulic storage capacity throughout the excavation process.
- Manage dusting from closure activities through the use of appropriate controls.
- Complete closure by excavation verification (see **Appendix E** for sampling grid). Grade the area to promote positive drainage and seed for vegetative growth.
- Sequence final dike breach with inflow design flood management.

Additional information and details pertaining to the closure design are provided in the Closure Plan drawings, which can be found in **Appendix D**.

7.3 Design Drawings

Closure Plan drawings are provided for the 1982 Basin and Basins 1, 2, and 3. The Closure Plan drawings found in **Appendix D** include the following for the 1982 Basin:

- Sheet 1 – Cover sheet
- Sheet 2 – General Project Notes

- Sheet 3 – Existing Overall Aerial
- Sheet 4 – Existing Conditions
- Sheet 5 – Estimated Bottom of Ash Grades
- Sheet 6 – Proposed Final Conditions
- Sheet 7 – Cross-Sections

The Closure Plan drawings found in **Appendix D** include the following for Basins 1, 2, and 3:

- Sheet 1 – Cover sheet
- Sheet 2 – General Project Notes
- Sheet 3 – Existing Overall Aerial
- Sheet 4 – Existing Conditions
- Sheet 5 – Estimated Bottom of Ash Grades
- Sheet 6 – Basins 1 & 2 Proposed Final Conditions
- Sheet 7 – Basins 1 & 2 Cross-Sections
- Sheet 8 – Basin 3 Proposed Final Conditions
- Sheet 9 – Basin 3 Cross-Section

These Closure Plan drawings will be further developed and refined to develop construction-level drawings during subsequent stages following NCDEQ approval of the Closure Plan. In addition, supplemental drawing sets will be prepared on an as-needed basis to support dike modification and/or decommissioning permits, erosion, and sediment control permits, NPDES permit modifications, and any other related permits.

Once the excavation grades shown on the Closure Plan drawings have been achieved, the procedures described in the Duke Energy Excavation Soil Sampling Plan (Appendix E) will be followed to confirm that closure by excavation has been achieved.

7.4 Description of Construction Quality Assurance and Plan

A Construction Quality Assurance (CQA) Plan will be developed following NCDEQ approval of the Closure Plan for closure of the CCR Basins located at the HF Lee Station site. This CQA Plan description has been prepared to address N.C.G.S. § 130A-309.214(a)(4)(g) of CAMA, and its purpose is to provide a description of the CQA program to be adhered to in execution of the final closure activities at the HF Lee Station, being the construction of the dike breach and stormwater channels. The CQA Plan will be a component of the dam decommissioning package and will include a description of the roles and responsibilities for monitoring and testing activities and provides guidance on the methodology to be used for evaluating whether the construction has been performed in accordance with the approved Closure Plan. The CQA Plan will also detail the material testing frequencies; methods for transportation, handling, and storage of materials; test methods and verifications; manufacturer, field, and laboratory testing; field activities for construction monitoring and oversight; and reporting and documentation requirements. Technical specifications to be developed as part of the construction-level design packages for contractor bidding will present specific material properties and specifications.

The items that will be included in the CQA Plan will address materials and CQA activities associated with the following components:

- Earthwork
- Stormwater Channels
- HDPE Piping
- As-Built Conditions
- Record Documentation Report

8.0 MANAGEMENT OF WASTEWATER AND STORMWATER

- **Existing Wastewater and Stormwater Conditions**

The Basins at HF Lee are impounded by raised perimeter dikes. There are no surface water run-on flows into the Basins. However, Basins 1, 2, and 3 may become inundated during Neuse River flooding events.

In April 2019, NCDEQ promulgated new dam safety requirements and, per the dam safety High Hazard Classification, each CCR basin is now required to pass a full PMP storm event. The HF Lee Basins are classified as High Hazard by NCDEQ due to the potential for environmental impacts greater than $200,000, if the Basins failed. The PMP event will produce 29.5 inches of rainfall (HMR-51, 6-hour, 10 mi^2, All-Season PMP Isopluvial Map) at HF Lee.

Wood evaluated the site for the full PMP rainfall event and results indicated that the 1982 Basin has the capacity to contain and release the full PMP storm event. The Basins 1, 2, and 3 do not have operating outlet structures. Therefore, pursuant to the 2019 dam safety rules, these Basins would require the capacity to capture and store back-to-back design storm events. However, these basins are located adjacent to the Neuse River, and within the 100-year flood zone. In the event of a storm event exceeding the 100-year storm, waters from the Neuse River would flow into Basins 1, 2 and 3, until such time as the Neuse River receded to below flood stage. The modeling results that indicate that the 1982 Basin has the storage capacity to hold and release the full PMP storm event are included in **Appendix C**.

The HF Lee Station operates under a NPDES permit issued by the NCDEQ. Permit number NC0003417, effective July 1, 2019 through March 31, 2024, authorizes four discharge points that flow into the Neuse River. Outfall 001 is the associated outfall for the 1982 Basin discharges. None are associated with discharges from Basins 1, 2, or 3.

- **Wastewater and Stormwater Management During CCR Excavation**

The 1982 Basin discharges will continue to be in service to meet the NPDES permit discharge requirements as it goes through the phases of: (1) free (bulk) water removal, treatment, and discharge via the permitted outfall during closure initiation (decanting); and (2) interstitial water treatment and discharge via permitted outfall during closure construction (dewatering and groundwater extraction), and (3) interstitial water treatment and discharge via permitted outfall during final closure construction (groundwater extraction). Dewatering is currently proceeding via mechanical pumping. The pumping system is expected to draw down the stored water after storm events, route through the treatment system if necessary, and discharge via the permitted outfall.

When dewatering of the CCR begins, all discharge flows are anticipated to be routed through the water management system (WMS) in order to meet the permitted discharge limits. The WMS

utilizes submersible pumps installed on floating structures in the 1982 Basins to supply feed water to the system. WMS at HF Lee includes a physical-chemical treatment system designed to meet the requirements of the discharge permit, including continuous monitoring for pH and Total Suspended Solids. The system is setup for remote monitoring of flows, basin level, chemical levels, pressures, and alarms.

The discharge of the WMS must be under the outfall limits prescribed in the NPDES permit. It is expected that bulk water from the basins will meet discharge limits without treatment as the untreated free water is expected to meet permitted discharge limits. Duke Energy is in the process of applying for additional NPDES outfalls to facilitate dewatering during closure of Basins 1, 2, and 3.

Dewatering will be performed to remove the interstitial or pore water from the CCR to facilitate excavation, to access in-place CCR or to establish safe slopes prior to and after CCR excavation. It is anticipated that performance criteria will be established in the construction-level documentation to identify required vertical and horizontal limits of interstitial water removal at critical locations and for critical conditions during closure.

Excavated CCR will have to be conditioned (screened) prior to transport to the STAR® unit. Consideration of required conditioning and management of contact water during excavation will be included in the development of closure phasing.

- **Post-Closure Stormwater Management**

The post-closure grading is anticipated to provide sheet flow to discharge points flowing to the Neuse River with no detention. Up to and including the last phase of closure before the basin dikes are breached, the Basins will maintain the capacity to contain the required storm size/flows.

The concept plans for post-closure grading are based conservatively on 100-year storm events. Appendix C presents the results of the post-closure stormwater management calculations.

8.1 Anticipated Changes in Wastewater and Stormwater Management

Closure of the Basins has necessitated changes in the management of a number of wastewater and process streams. Wastewater and process streams previously discharging to the Basins have been rerouted to new station outfalls.

A temporary WMS will be installed for the closure of the Basins. A floating intake suction pump and screen (followed by a sump upon sufficient dewatering), will be placed at the location of the lowest elevation within the Basins. The system design, including pump capacity and filter size, are such that the existing NPDES Outfall 001 effluent discharge limits (or future NPDES Outfalls), or other limits as directed by the NCDEQ, will be met throughout the duration of dewatering and closure.

Erosion and Sediment Control Plans for different phases of the excavation will be developed as part of the excavation packages for field implementation and formal Erosion and Sediment Control Plan permit submittal. The Basins are NPDES permitted wastewater treatment units. Therefore, only activities that can impact the areas outside the Basins will need to be addressed as part of the Erosion and Sediment Control Plan. However, water quality of discharges from the Basins

during excavation may be impacted due to activities within the Basins, and appropriate planning and control measures will need to be implemented. This will be addressed during subsequent stages of the design, and calculations to support the Erosion and Sediment Control Plans will be developed during future stages of the design, which will follow NCDEQ approval of this Closure Plan. In addition, erosion and sediment control measures may be installed and removed in phases as stabilization is achieved.

8.2 Wastewater and Stormwater Permitting Requirements

Information on required permits is described in **Section 10**.

9.0 DESCRIPTION OF FINAL DISPOSITION OF CCR

CCR materials in the Basins at the HF Lee Station will be excavated, processed, and beneficially reused for HF Lee to achieve project goals in accordance with applicable state and federal requirements and beneficial reuse contracts. CCR processing will be done using STAR® Technology, a patented thermal beneficiation process to transform CCR into a high-quality, sustainable product for the concrete industry.

An estimate of 6.2 million tons (5.17 million cubic yards) of CCR are currently stored in the Basins at the HF Lee Station (refer to section 3.1.2 for a detailed discussion and to **Appendix A** for quantities). At full production, the STAR® facility is designed to process 400,000 tons of CCR material per year (based on information provided by Duke Energy). Assuming 10-years of processing (2020-2029), this would allow approximately 4 million tons of CCR material to be processed for beneficial re-use, leaving 2.2 million tons which would potentially require handling by another process.

In order to meet the CCR removal deadline, Duke Energy will periodically review the progress of the excavation and STAR® processing as it relates to achieving full CCR removal by the required end date of December 31, 2029. Duke Energy will implement a concurrent excavation plan in which excavated CCR will be transported to a permitted facility in order to meet the end date of December 31, 2029 for complete removal.

Vegetation encountered or removed during the progression of the work will be managed in accordance with state regulations for handling and disposal.

10.0 APPLICABLE PERMITS FOR CLOSURE

Refer to **Table 10-1** for detailed information on the potential and applicable permitting/approval needed to implement this Closure Plan. Development of permitting package submittals and/or regulatory approval requests will follow NCDEQ approval of the Closure Plan.

11.0 DESCRIPTION OF POST-CLOSURE MONITORING AND CARE

A Post-Closure Care Plan will be developed following NCDEQ approval of the Closure Plan for closure of the CCR Basins located at the HF Lee Station site. The purpose of the Post-Closure Care Plan will be to provide a description of the inspection, monitoring, and maintenance activities required to be performed throughout the minimum 30-year post-closure care period for the closed

CCR Basins at the HF Lee site. The Basins at the HF Lee site are detailed in this Closure Plan as being closed by excavation.

The Post-Closure Care Plan will be developed to meet the requirements of N.C.G.S. § 130A-309.214(a)(4)(k). The items that are included in the Post-Closure Care Plan for HF Lee include:

- Name, address, phone number, and email address of the responsible office or person;
- Means and methods of managing affected groundwater and stormwater;
- Maintenance of the groundwater monitoring systems;
- Regular inspection and maintenance of the final cover system;
- Groundwater and surface water monitoring and assessment program;
- Post-closure inspection checklist to guide post-closure inspections;
- Description of planned post-closure uses; and
- Financial assurance estimates for post-closure operations and maintenance and remedial action.

11.1 Groundwater Monitoring Program

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by June 1, 2021. The CAP is herein incorporated by this reference, but its content is not the work product of Wood.

12.0 PROJECT MILESTONES AND COST ESTIMATES

12.1 Project Schedule

In December 2016, Duke Energy selected HF Lee as an Ash Beneficiation site as required by N.C.G.S. § 130A-309.216. Excavation of CCR from the HF Lee site for beneficial use will occur over multiple project phases. Activities started in 2018 and will continue until all CCR is removed in 2029, then continuing until approximately 2030, when final site restoration is completed.

A Closure Project high-level milestone schedule has been prepared by Duke Energy and the major activities and milestones are provided below:

Engineering, Dewatering	Ongoing
Complete CCR Excavation	Q4-2029
Site Restoration	Q4-2030

12.2 Closure and Post-Closure Cost Estimate

Cost estimates for closure and post-closure care of the CCR Basins at HF Lee were developed by Duke Energy and provided to Wood. These cost estimates are not a work product of Wood. These are Class 5 estimates as the detailed and final design has not been developed at this stage of the closure project. Following approval of this Closure Plan by NCDEQ and further development of the project plans and engineering designs, the cost estimate will be refined and updated.

The cost to complete the closure by excavation is estimated to be $524 million.

The cost to perform the 30-year post-closure activities and monitoring is estimated as $33 million.

The cost estimates include the following major activities:

- Mobilization and Site Preparation
- Dewatering, Earthwork, and Subgrade Preparation
- CCR Excavation
- Stormwater Management, Erosion and Sediment Control, and Site Restoration
- Engineering Support (Design and CQA)
- Post-Closure – Groundwater Monitoring
- Post-Closure – Operations and Maintenance
- Contingency

Corrective action costs are included as part of the CAP being prepared separately by SynTerra for Duke Energy and will be submitted to NCDEQ by June 1, 2021. The CAP is herein incorporated by this reference, but its content is not the work product of Wood.

13.0 REFERENCES

North Carolina General Assembly, Session Law 2014-122, Coal Ash Management Act, as amended

North Carolina Department of Environmental Quality report, “Coal Combustion Residual Impoundment Risk Classification” (2016)

North Carolina Department of Environmental Quality, 15A N.C.A.C 02K – North Carolina dam safety rules

North Carolina Department of Environmental Quality, 15A N.C.A.C. 02L - North Carolina groundwater rules

United States Environmental Protection Agency, Coal Combustion Residuals (CCR) Rule 40 C.F.R. Part 257, subpart D

TABLES

Table 2-1: CAMA Closure Plan Requirements Summary and Cross Reference Table Duke Energy, HF Lee Station

No.	Description	Corresponding Closure Plan Section
Part II. Provisions for Comprehensive Management of Coal Combustion Residuals § 130A-309.212(a)(4) Closure Plans for all impoundments shall include all of the following:		
a. Facility and coal combustion residuals surface impoundment – A description of the operation of the site that shall include, at a minimum, all of the following:		
1	Site history and history of site operations, including details on the manner in which coal combustion residuals have been stored and disposed of historically.	3.1.1
2	Estimated volume of material contained in the impoundment.	3.1.2
3	Analysis of the structural integrity of dikes or dams associated with impoundment.	3.1.3
4	All sources of discharge into the impoundment, including volume and characteristics of each discharge.	3.1.4
5	Whether the impoundment is lined, and, if so, the composition thereof.	7.1
6	A summary of all information available concerning the impoundment as a result of inspections and monitoring conducted pursuant to this Part and otherwise available.	3.1.6
b. Site maps, which, at a minimum, illustrate all of the following:		
1	All structures associated with the operation of any coal combustion residuals surface impoundment located on the site. For purposes of this sub-subdivision, the term "site" means the land or waters within the property boundary of the applicable electric generating station.	3.2.1
2	All current and former coal combustion residuals disposal and storage areas on the site, including details concerning coal combustion residuals produced historically by the electric generating station and disposed of through transfer to structural fills.	3.3

No.	Description	Corresponding Closure Plan Section
3	The property boundary for the applicable site, including established compliance boundaries within the site.	3.3
4	All potential receptors within 2,640 feet from established compliance boundaries.	3.2.2
5	Topographic contour intervals of the site shall be selected to enable an accurate representation of site features and terrain and in most cases should be less than 20-foot intervals.	3.3
6	Locations of all sanitary landfills permitted pursuant to this Article on the site that are actively receiving waste or are closed, as well as the established compliance boundaries and components of associated groundwater and surface water monitoring systems.	3.2.3
7	All existing and proposed groundwater monitoring wells associated with any coal combustion residuals surface impoundment on the site.	3.3
8	All existing and proposed surface water sample collection locations associated with any coal combustion residuals surface impoundment on the site.	3.3
c. The results of a hydrogeologic, geologic, and geotechnical investigation of the site, including, at a minimum, all of the following:		
1	A description of the hydrogeology and geology of the site.	4.1
2	A description of the stratigraphy of the geologic units underlying each coal combustion residuals surface impoundment located on the site.	4.2
3	The saturated hydraulic conductivity for (i) the coal combustion residuals within any coal combustion residuals surface impoundment located on the site and (ii) the saturated hydraulic conductivity of any existing liner installed at an impoundment, if any.	4.3

No.	Description	Corresponding Closure Plan Section
4	The geotechnical properties for (i) the coal combustion residuals within any coal combustion residuals surface impoundment located on the site, (ii) the geotechnical properties of any existing liner installed at an impoundment, if any, and (iii) the uppermost identified stratigraphic unit underlying the impoundment, including the soil classification based upon the Unified Soil Classification System, in-place moisture content, particle size distribution, Atterberg limits, specific gravity, effective friction angle, maximum dry density, optimum moisture content, and permeability.	4.4
5	A chemical analysis of the coal combustion residuals surface impoundment, including water, coal combustion residuals, and coal combustion residuals-affected soil.	4.5
6	Identification of all substances with concentrations determined to be in excess of the groundwater quality standards for the substance established by Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code, including all laboratory results for these analyses.	4.6
7	Summary tables of historical records of groundwater sampling results.	4.6
8	A map that illustrates the potentiometric contours and flow directions for all identified aquifers underlying impoundments (shallow, intermediate, and deep) and the horizontal extent of areas where groundwater quality standards established by Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code for a substance are exceeded.	4.7
9	Cross-sections that illustrate the following: the vertical and horizontal extent of the coal combustion residuals within an impoundment; stratigraphy of the geologic units underlying an impoundment; and the vertical extent of areas where groundwater quality standards established by Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code for a substance are exceeded.	4.8
d. The results of groundwater modeling of the site that shall include, at a minimum, all of the following:		

No.	Description	Corresponding Closure Plan Section
1	An account of the design of the proposed Closure Plan that is based on the site hydrogeologic conceptual model developed and includes (i) predictions on post-closure groundwater elevations and groundwater flow directions and velocities, including the effects on and from the potential receptors and (ii) predictions at the compliance boundary for substances with concentrations determined to be in excess of the groundwater quality standards for the substance established by Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code.	5.1
2	Predictions that include the effects on the groundwater chemistry and should describe migration, concentration, mobilization, and fate for substances with concentrations determined to be in excess of the groundwater quality standards for the substance established by Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code pre- and post-closure, including the effects on and from potential receptors.	5.2
3	A description of the groundwater trend analysis methods used to demonstrate compliance with groundwater quality standards for the substance established by Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code and requirements for corrective action of groundwater contamination established by Subchapter L of Chapter 2 of Title 15A of the North Carolina Administrative Code.	5.3
e.	A description of any plans for beneficial use of the coal combustion residuals in compliance with the requirements of Section .1700 of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code (Requirements for Beneficial Use of Coal Combustion By-Products) and Section .1205 of Subchapter T of Chapter 2 of Title 15A of the North Carolina Administrative Code (Coal Combustion Products Management).	6.1
f.	All engineering drawings, schematics, and specifications for the proposed Closure Plan. If required by Chapter 89C of the General Statutes, engineering design documents should be prepared, signed, and sealed by a professional engineer.	7.1, 7.2
g.	A description of the construction quality assurance and quality control program to be implemented in conjunction with the Closure Plan, including the responsibilities and authorities for monitoring and testing activities, sampling strategies, and reporting requirements.	7.3

No.	Description	Corresponding Closure Plan Section
h.	A description of the provisions for disposal of wastewater and management of stormwater and the plan for obtaining all required permits.	8
i.	A description of the provisions for the final disposition of the coal combustion residuals. If the coal combustion residuals are to be removed, the owner must identify (i) the location and permit number for the coal combustion residuals landfills, industrial landfills, or municipal solid waste landfills in which the coal combustion residuals will be disposed and (ii) in the case where the coal combustion residuals are planned for beneficial use, the location and manner in which the residuals will be temporarily stored. If the coal combustion residuals are to be left in the impoundment, the owner must (i) in the case of closure pursuant to sub-subdivision (a)(1)a. of this section, provide a description of how the ash will be stabilized prior to completion of closure in accordance with closure and post-closure requirements established by Section .1627 of Subchapter B of Chapter 13 of Title 15A of the North Carolina Administrative Code and (ii) in the case of closure pursuant to sub-subdivision (a)(1)b. of this section, provide a description of how the ash will be stabilized pre- and post-closure. If the coal combustion residuals are to be left in the impoundment, the owner must provide an estimate of the volume of coal combustion residuals remaining.	9
j.	A list of all permits that will need to be acquired or modified to complete closure activities.	10
k.	A description of the plan for post-closure monitoring and care for an impoundment for a minimum of 30 years. The length of the post-closure care period may be (i) proposed to be decreased or the frequency and parameter list modified if the owner demonstrates that the reduced period or modifications are sufficient to protect public health, safety, and welfare; the environment; and natural resources and (ii) increased by the Department at the end of the post-closure monitoring and care period if there are statistically significant increasing groundwater quality trends or if contaminant concentrations have not decreased to a level protective of public health, safety, and welfare; the environment; and natural resources. If the owner determines that the post-closure care monitoring and care period is no longer needed and the Department agrees, the owner shall provide a certification, signed and sealed by a professional engineer, verifying that post-closure monitoring and care has been completed in accordance with the post-closure plan. If required by Chapter 89C of the General Statutes, the proposed plan for post-closure monitoring and care should be signed and sealed by a professional engineer. The plan shall include, at a minimum, all of the following:	11
1	A demonstration of the long-term control of all leachate, affected groundwater, and stormwater.	11.1

No.	Description	Corresponding Closure Plan Section
2	A description of a groundwater monitoring program that includes (i) post-closure groundwater monitoring, including parameters to be sampled and sampling schedules; (ii) any additional monitoring well installations, including a map with the proposed locations and well construction details; and (iii) the actions proposed to mitigate statistically significant increasing groundwater quality trends.	11.2
l.	An estimate of the milestone dates for all activities related to closure and post-closure.	12.1
m.	Projected costs of assessment, corrective action, closure, and post-closure care for each coal combustion residuals surface impoundment.	12.2
n.	A description of the anticipated future use of the site and the necessity for the implementation of institutional controls following closure, including property use restrictions, and requirements for recordation of notices documenting the presence of contamination, if applicable, or historical site use.	6.2
§ 130A-309.212(b)(3) No later than 60 days after receipt of a proposed Closure Plan, the Department shall conduct a public meeting in the county or counties proposed Closure Plan and alternatives to the public.		
§ 130A-309.212(d) Within 30 days of its approval of a Coal Combustion Residuals Surface Impoundment Closure Plan, the Department shall submit the Closure Plan to the Coal Ash Management Commission.		

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Table 4-1: Summary of Typical Material Properties
Duke Energy, HF Lee Station

Properties	CCR within the Basins[1,2]		Foundation Soil (Residual) below the CCR Basins[1,2]		Fill Soil within the Embankment Dikes	Foundation Soil (Residual) below the Embankment Dikes	Weathered Rock (WR)[3]
Soil Type	Silt/Sandy Silt (ML) - Predominantly Fly Ash, Silty Sand (SM) - Predominantly Bottom Ash		SC, SM, ML, CH, and CL		SC, SM, SP-SM, CH, CL, and ML	SC, SM, CH, CL, and ML	Breaks down to Sandy Silt and Silty Sand with rock fragments
Color	Gray, dark gray, and black		Brown, tan, gray, white, and red		Tan, red, orange, and gray	Brown, tan, gray, and red	Brown, gray, and red
Plasticity	Predominantly Non Plastic		19 - 32		NP - 18	NP - 28	-
Liquid Limit	Predominantly Non Plastic		28 - 56		NP - 39	NP -74	-
Plasticity Index	Predominantly Non Plastic		8-25		NP - 22	NP - 53	-
	Representative Range	Geometric Mean	Representative Range	Geometric Mean	Representative Range		
Natural Moisture Content (%)	23% - 77%	43%	17% - 29%	21%	12% - 30%	12% - 43%	**
Fines Content	39% - 85%	69%	8% 46%	28%	1% - 67%	2% - 72%	**
Clay Content	2% - 48%	12%	2% - 47%	205%	2% - 51%	0% - 68%	**
Blow Count - Uncorrected N Value (bpf)	WOH - 8	2	2 - 26	9	4 - 39	2 - 85	50/0" - 50/5"
Moist Unit Weight	55 - 98 pcf	83 pcf	132 pcf	*	118 - 140 pcf	126 - 132 pcf	**
Dry Unit Weight	45 - 62 pcf	55 pcf	112 pcf	*	89 - 125 pcf	89 - 108 pcf	**
Specific Gravity	2.1 - 2.7	2.3	2.9	*	**	**	**
Horizontal Hydraulic Conductivity (cm/sec)	9.5E-05 - 2.0E-04	7.1E-05	9.5E-08	*	**	**	**
Vertical Hydraulic Conductivity (cm/sec)	**	**	**	**	**	**	**

Notes:
Outlier values were not inlcuded in the table above. For additional laboratory testing information, see attached Appendix
NP: Non Plastic
pcf: Pounds per cubic foot (lb/ft^3)
bpf: blows per foot
WOH: Weight of hammer
*Only one lab test available
**No lab data available
[1]Laboratory information and results for the Ash Basin and Ash Basin Foundation Soil were obtained from the following field explorations/reports: 2015 Synterra, 2015 Geosyntec, and 2013 Geosyntec.
[2]Information for the uncorrected N Values of Ash and Ash Basin Foundation Soil were obtained from within the 2013 Geosyntec Field Exploration and Report.
[3]Data obtained for the uncorrected N Values of Weathered Rock were obtained from the 2014 Amec Foster Wheeler Field Exploration.

Table 10-1: Regulatory Permits, Approvals, or Requirements for Basin Closure by Excavation Duke Energy, HF Lee Station

General Permit Name or Subject	Regulating Agency	Existing Permit No. (if applicable)	Permit/Approval Type of Regulatory Approval Mechanism or Not Required	Comments
Air Quality	NCDEQ		Not Anticipated	
Building Permit	Wayne County		Not Anticipated	
CAMA Monitoring Plan	NCDEQ		Written NCDEQ DWR approval	Modification or abandonment of CAMA program monitoring wells require the approval of the Division of Water Resources (DWR)
CCR Impoundment Closure	US EPA CCR Rule		Self-Regulating	Required postings to Public Record
CCR Impoundment Monitoring Network	US EPA CCR Rule		Self-Regulating	Maintain CCR GW monitoring network and requirements as stated in 257.90 - 257.98
Clean Water Act 401			Not Anticipated	
Clean Water Act 404			Not Anticipated	
Cutting Trees			Not Anticipated	

Dam Safety	NCDEQ	WAYNE-022 WAYNE-031 WAYNE-032 WAYNE-033	Certificate of Approval to Modify	Permitting is required to modify or abandon wells and instrumentation on regulatory dams through the Division of Energy, Mineral, and Land Resources (DEMLR)
Dam Safety	NCDEQ	WAYNE-022 WAYNE-031 WAYNE-032 WAYNE-033	Certificate of Approval to Modify	Ash Basin Dam - Permitting is required to modify the dam in accordance with the Dam Safety Law of 1967, 15A NCAS 02K.0201 (b)(2); an application must be filed with the Division of Energy, Mineral, and Land Resources (DEMLR)
DOT - General			Not Anticipated	
Driveway Permit	NCDOT		Not Anticipated	
Erosion and Sediment Control (E&SC)	NCDEQ and Wayne County		Not Anticipated	No land disturbance activities outside of the ash basin are anticipated. In conformance with 15A NCAC 04, no E&SC Permit is anticipated to be required from Land Quality.

Fire Ants			Restriction not likely	Removal from or import of material could be restricted dependent on the potential for fire ants and geographic regions involved
Floodplain Development	Wayne County		Not Anticipated	No development activities are anticipated within FEMA mapped Special Flood Hazard Areas for the Flood Insurance Rate Maps
Multi-State Agreement			Not Anticipated	
NPDES (National Pollution Discharge Elimination System)	NCDEQ	NC0003417	Not Anticipated	
Noxious Weeds			Not Anticipated	Removal from or import of vegetated material could be restricted dependent on the vegetation and geographic regions involved
Railroad Easement, Access, or Crossing Permit			Not Anticipated	Construction activities adjacent to tracks/ballast or a new railroad crossing require an agreement or permit

SPCC (Spill Prevention Control and Countermeasure) Plan	NCDEQ		Not Anticipated	In accordance with the federal Water Pollution Control Act (Clean Water Act) of 1974, Title 40, Code of Federal Regulations, Part 112.
Threatened or Endangered Species: Candidate Conservation Agreement Avian Protection Plan(s) Bird and Bat Conservation Strategies Eagle Conservation Plan Eagle Take Permit	NCDEQ And EPA		Not Anticipated	Federal and/or state regulations may apply including agency consultation and performing site-specific surveys within the proper survey period (e.g., flowering period for listed plant) to determine if Threatened or Endangered Species or their habitat exist within the limits of disturbance
Solid Waste Site Suitability	NCDEQ		Not Anticipated	No new CCR Landfill planned
Solid Waste Permit to Construct	NCDEQ		Not Anticipated	No new CCR Landfill planned
Solid Waste Permit to Operate	NCDEQ		Not Anticipated	No new CCR Landfill planned
County Approval - zoning	Wayne County		Not Anticipated	No new CCR Landfill planned

FIGURES

FIGURE 1-1

REV.

OLD SMITHFIELD ROAD

HF LEE ENTRANCE ROAD

TRIANGLE POND (WAYNE-034)
(BREACHED IN MAY 2019)

1982 BASIN
(WAYNE-022)

NEUSE RIVER

LOLA

BASIN 1
(WAYNE-031)

BASIN 2
(WAYNE-032)

HF LEE ACCESS BRIDGE
(CURRENTLY NOT IN
SERVICE)

POLISHING POND

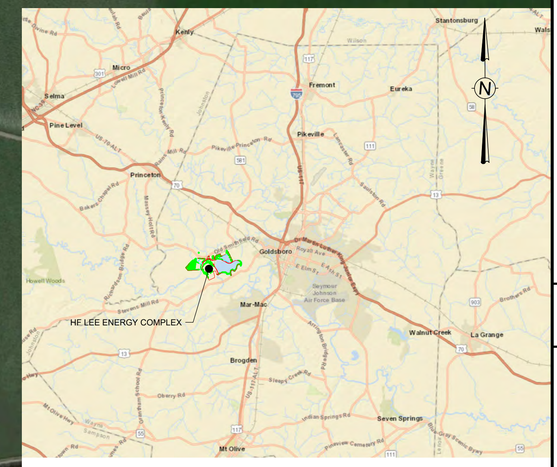
WETLANDS
(TYP.)

HF LEE ENERGY COMPLEX COOLING POND
(WAYNE-009)

BASIN 3
(WAYNE-033)

HF LEE ENERGY COMPLEX

PROPOSED
STAR UNIT
FACILITY



SITE VICINITY MAP - 1" = 5 MILES
MAP SOURCE: ESRI WORLD TOPOGRAPHIC BASEMAP

LEGEND

- WETLANDS
- APPROXIMATE LIMIT OF WASTE
- APPROXIMATE PROPERTY LINE

VICINITY MAP AND SITE PLAN
SCALE:1" = 400'
400 0 400 800 FT

REV	DATE	JOB NO.	PROJECT TYPE	DES	DFTR	CHKD	ENGR	APPD	DESCRIPTION

wood.
Environment & Infrastructure Solutions
4021 STIRRUP CREEK DRIVE, SUITE 100
DURHAM NC 27703
TEL: (919) 381-9900
FAX: (919) 381-9901
LICENSURE:
NC ENG: F-1253
NC GEOLOGY: C-247

SEAL

ISSUED FOR
REVIEW
NOT FOR
CONSTRUCTION

TITLE
COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENT CLOSURE PLAN
HF LEE ENERGY COMPLEX

VICINITY MAP AND SITE PLAN

FOR
ISSUED FOR REVIEW - NOT FOR CONSTRUCTION

DUKE ENERGY®

SCALE: AS SHOWN	DES: WMN
DWG TYPE: DWG	DFTR: WMN
JOB NO: 7812180091	CHKD: BBC
DATE: 12/10/2019	ENGR: WAW
FILENAME: HFL_ EXISTING OVERALL AERIAL.dwg	APPD: CRK

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"X34"	FIGURE 1-1	

FIGURE 1-1

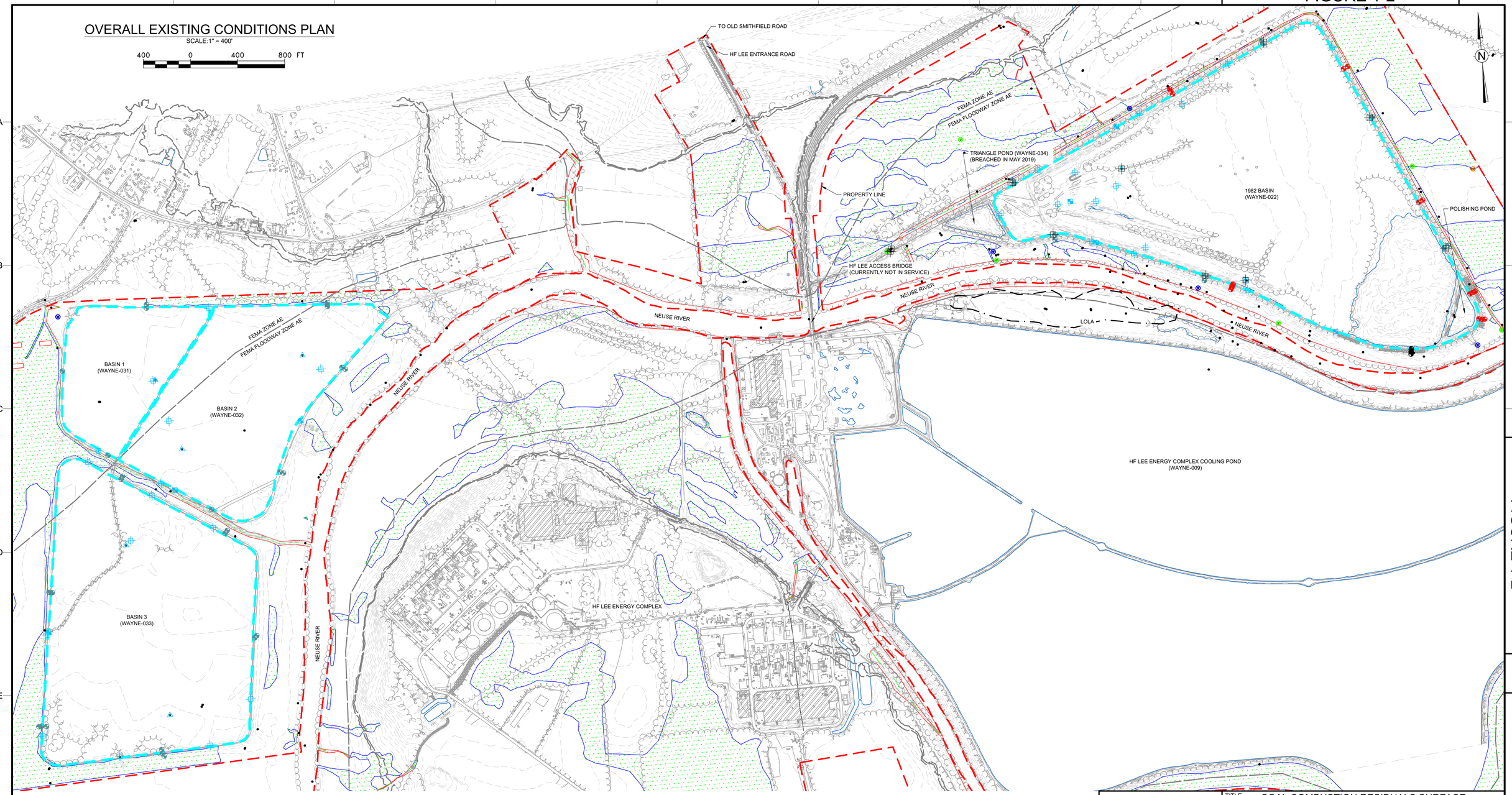
INCHES 1 2 3 TENTHS 10 20 30

Plotted By:Nichols, William Sheet Set:HF Lee Layout:EXISTING OVERALL AERIAL December 10, 2019 10:18:03am Q:\Duke Energy\HF Lee_7812180091_HF Lee CAMA Closure Plan\Concept\HFL_ EXISTING OVERALL AERIAL.dwg

OVERALL EXISTING CONDITIONS PLAN

SCALE:1" = 400'

400 0 400 800 FT



LEGEND

- EXISTING MAJOR CONTOURS
- EXISTING MINOR CONTOURS
- EXISTING GRAVEL ROAD
- EXISTING ROAD
- EXISTING TREE LINE
- EXISTING SITE FENCE
- EXISTING OVERHEAD ELECTRIC LINES
- EXISTING WATER
- EXISTING WETLANDS
- EXISTING RIP RAP
- EXISTING STRUCTURES (VARIOUS)
- EXISTING UTILITY LIGHT
- EXISTING FIRE HYDRANT
- EXISTING SEWER MANHOLE
- EXISTING ELECTRIC UTILITY POLE
- EXISTING ELECTRIC UTILITY TOWER
- EXISTING MONITORING WELL
- EXISTING WATER UTILITY
- EXISTING UTILITY TELEPHONE
- FLOOD HAZARD LINE
- APPROXIMATE PROPERTY LINE
- APPROXIMATE LIMIT OF WASTE
- EXISTING STREAMS
- WELL LOCATIONS AS PROVIDED BY SYNTERRA TO DUKE ENERGY/WOOD
- EXISTING MONITORING WELL
- AMEC BORINGS
- MACTEC BORINGS
- LAW BORINGS
- GEOSYNTEC BORINGS
- GEOSYNTEC CPTS & SCPTS
- GEOSYNTEC PIEZOMETERS
- SYNTERRA MONITORING WELLS
- S&ME MONITORING WELLS
- CATLIN MONITORING WELLS
- EXISTING PIEZOMETERS

REFERENCES:

1. EXISTING TOPOGRAPHY AND SURVEY PROVIDED BY WSP DATED JULY 2015.
2. EDGE OF WATER PROVIDED IN SURVEY BY WSP FOR DUKE ENERGY PROGRESS, LLC. TITLED "AERIAL TOPOGRAPHIC SURVEY HF LEE ENERGY COMPLEX," REVISION 1, DATED 24 JULY 2015, FILE NAME: "HF LEE FINAL - REV 07-27-2015.DWG".
3. LOCATION OF ANY AND ALL UTILITIES SHOWN IS BASED ON PHOTOGRAMMETRIC MAPPING AND IS APPROXIMATE. CONTRACTOR SHALL VERIFY LOCATION OF UTILITIES PRIOR TO COMMENCEMENT OF CONSTRUCTION.
4. EXISTING STREAMS AND WETLANDS PROVIDED BY MCKIM & CREED DATED OCTOBER 9, 2017.

REV	DATE	JOB NO.	PROJECT TYPE	DES	DFTR	CHKD	ENGR	APPD	DESCRIPTION

wood.
Environment & Infrastructure Solutions
4021 STIRRUP CREEK DRIVE, SUITE 100
DURHAM NC 27703
TEL: (919) 381-9900
FAX: (919) 381-9901
LICENSURE:
NC ENG: F-1253
NC GEOLOGY: C-247

SEAL

ISSUED FOR REVIEW NOT FOR CONSTRUCTION

TITLE: COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENT CLOSURE PLAN
HF LEE ENERGY COMPLEX
OVERALL EXISTING CONDITIONS PLAN

FOR: ISSUED FOR REVIEW - NOT FOR CONSTRUCTION

DUKE ENERGY®

SCALE: AS SHOWN	DES: WMN		
DWG TYPE: DWG	DFTR: WMN		
JOB NO: 7812180091	CHKD: BBC		
DATE: 12/10/2019	ENGR: WAW		
FILENAME: HFL_EXISTING OVERALL TOPOGRAPHY.dwg	APPD: CRK		
DWG SIZE: ANSI D 22"x34"	DRAWING NO.: FIGURE 1-2	REVISION	

FIGURE 1-2

REV.

INCHES 1 2 3 TENTHS 10 20 30