Paul Draovitch
Senior Vice President
Environmental, Health & Safety
526 S. Church Street
Mail Code: EC3XP
Charlotte, NC 28202
(980) 373-0408

December 30, 2019

Ms. Sheila Holman
Assistant Secretary for Environment
North Carolina Department of Environmental Quality
1611 Mail Service Center
Raleigh, North Carolina 27699-1611

Subject: Submittal of Ash Basin Closure Plan and Corrective Action Plan Update
Marshall Steam Station

Dear Ms. Holman:

In accordance with the requirements of N.C.G.S. §§ 130A-309.211(b) and .214(a)(4), Duke Energy provides the following documents: (1) a plan for basin closure by excavation, and (2) a corrective action plan (CAP) for the Marshall site, which will address groundwater impacts within 9 years of full-scale operation, regardless of the specific closure method.

Closure by Excavation
The enclosed excavation plan is in response to NCDEQ's April 1 order requiring excavation of the Marshall coal ash basin. After regulatory approval, excavating the basin ash would require 14 years to move the ash to a new lined landfill within plant property. The landfill would be located partially within the prior footprint of the ash basin near Island Point Road, rising about 200 feet above Island Point Road.

Continuing to Protect Water Resources
Robust scientific study, conducted under the direction of NCDEQ, demonstrates that drinking and recreational water supplies around the Marshall facility are well-protected from coal ash impacts and will only continue to improve during and after closure. Ongoing research and monitoring also provide a detailed understanding of groundwater conditions at the site, indicating that the impact is highly localized and will be addressed through the planned CAP approach. The CAP designed for Marshall will achieve groundwater remediation through a combination of strategically placed groundwater extraction wells coupled with clean water infiltration wells.

Prior to submission, the closure plan was reviewed by the National Ash Management Advisory Board (NAMAB), which consists of nationally and internationally recognized and published experts with practical experience working with and for the private sector, federal government, and academia. NAMAB helped develop the guiding principles for safe basin closure and their feedback is incorporated herein.

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.

Sincerely,

Paul Draovitch
Senior Vice President
Environmental, Health & Safety

Enclosure:

- Corrective Action Plan Update
- Closure by Excavation Closure Plan

DUKE ENERGY
MARSHALL STEAM STATION
COAL COMBUSTION RESIDUALS SURFACE IMPOUNDMENT CLOSURE PLAN

CLOSURE BY EXCAVATION

CCR BASIN

Prepared for

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

December 18, 2019

Prepared by

1600 Perimeter Park Dr.
Morrisville, North Carolina 27560

TABLE OF CONTENTS

Tables

Figures

Appendices

EXECUTIVE SUMMARY

As required by the North Carolina Department of Environmental Quality's (NCDEQ) April 1, 2019 "Coal Combustion Residuals Surface Impoundment Closure Determination," (Closure Determination), Duke Energy Carolinas, LLC (Duke Energy) has prepared this Closure Plan to describe the closure of the coal combustion residuals (CCR) surface impoundment (Basin) at the Marshall Steam Station (MSS). This plan details closure by excavation of the MSS Basin and placement of the excavated CCR in an on-site lined CCR landfill. The excavation of CCR and the closure of the Basin will be in accordance with applicable provisions of the North Carolina Coal Ash Management Act of 2014, as amended (CAMA) (codified at N.C.G.S. § 130A-309.200 *et seq.*), and the federal Disposal of Coal Combustion Residuals from Electric Utilities rule (CCR Rule) (codified at 40 C.F.R. § 257.50 *et seq.*).

The MSS is owned and operated by Duke Energy in Catawba County on the west bank of Lake Norman (Catawba River), near the town of Terrell, North Carolina. The MSS is a four-unit, 2,090 MW, coal-fired station. Units 1 and 2 began operation in 1965 and 1966, respectively, while units 3 and 4 began operation in 1969 and 1970, respectively.

Duke Energy has historically operated a single impoundment for storing wet sluiced coal ash referred to as the Basin at the MSS. The Basin was constructed in conjunction with MSS construction in 1965 and is impounded by an earthen dike (Basin Dam) located at the southeastern end of the Basin, adjacent to Lake Norman. Based upon the CCR unit boundary, the MSS Basin historically had a surface area of approximately 394 acres, and is now approximately 360-acres, due to the construction of three permitted disposal facilities over areas of the original Basin limits. Based on CCR inventory data provided by Duke Energy as of July 2019, the Basin is estimated to contain approximately 14 million cubic yards of CCR or an estimated 16.8 million tons.

Closure activities for the Basin has have already begun with the initiation of decanting under the Special Order by Consent (SOC). Upon approval of the Closure Plan by NCDEQ additional actions will commence, including finalization of detailed designs, dewatering and removal of interstitial water, contracting and detailed planning for the closure work, development of the new lined landfill in conjunction with excavation of the CCR, final grading of the site, and development of stormwater features and vegetative covers.

Figures ES-1 and **ES-2** illustrate the current state, and post-closure state of the CCR Basins as detailed by this Closure Plan.

Figure ES-1 Current View

Figure ES-2 Post Closure View

The Basin CCR will be removed to a new lined landfill on the plant property, located partially within the prior footprint of the ash basin near Island Point Road. The landfill will rise approximately 200 feet above Island Point Road. Post-excavation, the Basin site will resemble the land's valley shape before the basin was created. Soil will be graded to restore contours for stormwater flows, then planted with native grasses for erosion control. The existing Basin dam will remain, with a new stormwater pathway cut to a cove of Lake Norman. The stormwater outlet elevation will impound stormwater over approximately 100 acres within the former Basin footprint. The existing Structural Fill and Landfills will remain in place, with structural features added to ensure long-term stability against adjacent areas of excavation.

The on-site CCR landfill represents a lateral and vertical expansion of the existing Industrial Landfill (ILF) in accordance with North Carolina Solid Waste regulations.

This document also includes a description of the Post-Closure care plan, which provides a description of the inspection, monitoring, and maintenance activities required to be performed throughout the 30-year post-closure care period for the closed Basin at the MSS.

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 closure design. These analyses indicate that the closure by excavation, as detailed in the Plan, meets regulatory requirements for the stability of the site, management of surface water runoff, and access for effective maintenance over the post closure care period.

In accordance with the requirements of N.C.G.S. § 130A-309.211(b)(1), Duke Energy separately submitted an updated Corrective Action Plan (CAP) in parallel with this Closure Plan; the updated CAP is herein incorporated in its entirety by this reference. Neither the updated CAP nor its content is the work product of AECOM. Although the Closure Plan contains references to the updated CAP, all specific relevant details to groundwater and related actions are found in the updated CAP itself and not in this Closure Plan.

As detailed in the updated CAP, Duke Energy has begun to implement, and will continue implementing, source control measures at the site, including (i) complete Basin decanting to lower the hydraulic head within the Basin and decrease hydraulic gradients, reducing groundwater seepage velocities and COI transport potential; and (ii) complete Basin closure, as well as closure

of adjacent ash management areas. In addition, Duke Energy intends to implement a robust groundwater remediation program that includes actively addressing COI in groundwater above applicable standards at or beyond the compliance boundary using a combination of groundwater extraction and clean water infiltration. The CAP provides that these corrective action measures will most effectively achieve remediation of the groundwater through the use of groundwater extraction wells along the Basin dam and to the east and north of the dam; and (ii) clean water infiltration wells to the north of the Basin dam and east of the Basin. Significantly, groundwater modeling simulations indicate (i) these measures will address COI at or beyond the compliance boundary; and (ii) at such time the site-specific considerations detailed within the CAP have been satisfied, including, but not limited to, securing all required state approvals, installing the necessary equipment, and commencing full-scale system operation, COI at or beyond the compliance boundary will meet the remedial objectives in nine years.

1. INTRODUCTION

1.1 Background

The Marshall Steam Station (MSS) is located at 8320 NC Highway 150, in Catawba County, North Carolina, and is a four-unit, 2,090 MW coal-fired station. Units 1 and 2 began operation in 1965 and 1966, respectively, while units 3 and 4 began operation in 1969 and 1970, respectively. CCR has historically been managed in the MSS's on-site Basin. The MSS ceased all process water and waste stream flows to the Basin in 2019

Figure 1-1 presents a site plan of the MSS.

The Basin is used to manage CCR at the MSS and includes a dam regulated by the NCDEQ and Dam Safety:

1. The Basin Dam (NCDEQ ID: CATAW-054)

As further discussed in Section 2 below, the Closure method mandated by order of the NCDEQ for the Basin is closure by excavation.

1.2 Closure Plan Objectives

The objective of this Closure Plan is to address the closure by excavation of CCR from the Basin as directed by order of NCDEQ. Duke Energy does so without prejudice of its position that closure by excavation is neither necessary nor appropriate for Basin. Duke Energy also notes that approval from NCDEQ is required to proceed and develop the additional details as described further within this Closure Plan to complete the necessary working documents to complete the closure actions. Duke Energy submits this Closure Plan with the knowledge that other details will follow, as necessary. This Closure Plan describes and communicates the key actions and activities necessary to close the Basin in accordance with the requirements for written Closure Plans for CCR surface impoundments presented in N.C.G.S. §130A-309.214(a)(4). Planned closure activities include:

- Decanting the Basin;
- Construction and operation of a temporary water management system (WMS) to manage all discharges in compliance with the NPDES permit during closure.;
- Dewatering to support safe excavation of CCR from the Basin;
- Excavation of the CCR and establishing post-excavation final grades using soil fill where required;
- Construction of haul roads, and stormwater management systems,
- Construction of an on-site CCR landfill to permanently store the excavated CCR;
- Modification of the Basin spillways; and
- Restoration of disturbed areas.

1.3 Report Organization

This document is structured to follow the requirements provided in CAMA (G.S. §130A-309.214(a)(4)).

2. GOVERNING LAWS

In August 2014, the North Carolina General Assembly enacted CAMA, which contains specific statutory requirements applicable to the CCR basins. Subsequently, in July 2016, the North Carolina General Assembly enacted H.B. 630, Session Law 2016-95, which provides that impoundments be classified as "low-risk" if, by certain deadlines, the owner has established permanent alternative water supplies, as required, and has rectified any deficiencies identified by, and has otherwise complied with requirements of, any dam safety order. NCDEQ determined that Duke Energy met these criteria on November 14, 2018, and officially classified the Basin at the MSS as "low-risk."

On April 1, 2019, NCDEQ issued its Closure Determination mandating that the Basin be closed by excavation of the CCR pursuant to N.C.G.S. § 130A-309.214(a)(3)a. A closure plan is required for each CCR surface impoundment regardless of the risk classification. CAMA's closure plan requirements and cross-referenced sections of this Closure Plan are summarized in **Table 2-1**. On April 26, 2019, Duke Energy filed a Petition for Contested Case Hearing before the North Carolina Office of Administrative Hearings appealing this determination, on May 24, 2019 Duke Energy filed amended petitions in the case. The petitions allege that in issuing its Closure Determination, NCDEQ failed to (i) follow the mandatory process and procedure outlined in CAMA and (ii) consider or apply the scientific and engineering evidence submitted and available to it in reaching its decision to require the most expensive closure method available despite scientific and engineering evidence demonstrating the availability of less expensive and more rapid closure options that would continue to fully protect human health and the environment. Certain decisions by the administrative law judge in that case are currently under appeal to the North Carolina Superior Court.

In addition to the closure plan requirements, CAMA sets out groundwater assessment and corrective action requirements. A Comprehensive Site Assessment report was submitted to NCDEQ in September 2015, with supplemental reports submitted August 2016 and January 2018. Duke Energy intends that an updated CAP will be submitted in parallel with this Closure Plan.

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

3. FACILITY DESCRIPTION AND EXISTING SITE FEATURES

3.1 Surface Impoundment Description

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

3.1.1 Site History and Operations

Figure 1-1 shows locations of the MSS plant, the Basin, and the Basin Dam, while **Figure 3-1** also presents overall existing conditions including topography and bathymetry of the Basin. The Basin is described in more detail below.

Basin (CCR Unit): The Basin was constructed in 1965 and is located north of the MSS and adjacent to Lake Norman. It is situated between topographic divides located along Sherrills Ford Road to the west, Island Point Road to the north, and the Duke Energy property boundary to the east. The natural topography at the site generally slopes downward from these divides to the Basin and subsequently toward Lake Norman. The Basin consists of a single basin impoundment behind an earthen dam located at the historical intersection of Holdsclaw Creek and the Catawba River, on the southeastern end of the Basin. The Basin is dendritic in shape and is generally located in a historical depression formed by Holdsclaw Creek and small tributaries to the creek. The Basin includes coves of deposited CCR, interior dikes that impounded CCR in portions of the Basin, and various areas of ponded water. The Basin waste boundary historically occupied an area of approximately 394 acres, and the current CAMA CCR boundary occupies an area of approximately 360 acres, due to the construction of three permitted disposal facilities (the ILF, the Structural Fill and Phase II of the 1804 Landfill, further discussed below) over areas of the original Basin limits. Water discharges through a weir box type principal spillway, located near the northeastern abutment of the dam. The discharge flow is conveyed through a 36-inch diameter high density polyethylene (HDPE) pipe into Lake Norman. This principal spillway, discharge piping and outlet structure were constructed in 2016 as a replacement for the original principal spillway riser, which was abandoned due to structural deficiencies under earthquake conditions. The Basin water surface elevation is controlled through the use of stop logs located within the inlet structure.

The CCR from the MSS coal combustion process, including flyash and bottom ash, has been sluiced to the Basin since 1965. Flyash was collected primarily via dry handling starting in 1984. Bottom ash sluiced to the Basin was periodically excavated. Flue Gas Desulfurization (FGD) residue, which consists primarily of gypsum, has not been disposed in the Basin.

In early 2019, the Bottom Ash Handling Facility came on line to manage bottom ash generated at the MSS. Once this facility became active, CCR was no longer sluiced to the Basin.

Contact stormwater and leachate from the FGD and Industrial Landfills as well as FGD wastewater treatment system effluent was historically routed to the Basin. As of early 2019 these flows have been redirected to the Lined Retention Basin for treatment prior to disposal.

Additional Facilities

The existing ILF was permitted pursuant to the authority of N.C.G.S. § 130A-295.4 (combustion products landfills constructed partially or entirely within areas formerly used for the storage or disposal of CCR) and in accordance with North Carolina's rules governing the siting, design, and construction of sanitary landfills, and includes a double-liner system with a leak detection system between the liners. It is Duke Energy's position that at such time the area of the former Basin underlying the ILF were permitted under NCDEQ Permit No. 1812-INDUS-2008, they became an intrinsic part of the landfill's base and ceased being "surface impoundment" under North Carolina law. Accordingly, closure of the permitted ILF is not subject to CAMA's CCR surface impoundment closure requirements and, thus, is not addressed under this Closure Plan. Instead, closure of the permitted ILF will be conducted pursuant to a separate regulatory process in accordance with 15A N.C.A.C. 13B § .0500.

The 1804 Landfill (Permit No. 1804-INDUS-1983) was subject to North Carolina's rules, 15A N.C.A.C. 13B § .0500, governing the permitting of solid waste disposal sites in the state, and was closed pursuant to those rules. As detailed in the documents developed as part of the permit

process that culminated in NCDEQ's issuance of Permit No. 1804-INDUS-1983, the area underlying the 1804 Landfill became an intrinsic part of its design and ceased being "surface impoundment" at such time the unit was permitted by NCDEQ. Accordingly, the permitted 1804 Landfill is not subject to CAMA and, thus, is not addressed under this Closure Plan. However, Duke Energy will undertake additional closure measures exceeding the standards set forth in 15A N.C.A.C. 13B § .0500 as part of a separate regulatory process.

The Structural Fill was constructed and closed pursuant to 15A N.C.A.C. 13B § .1700 (Requirements for Beneficial Use of Coal Combustion By-Products), which sets out siting, design, construction, operation, closure, and recordation requirements for such facilities. Permit No. CCB0031 approved the utilization of coal combustion products to construct a structural fill on land that was formerly an ash basin. As a result, the area underlying the fill became an intrinsic part of its design and ceased being "surface impoundment" at such time NCDEQ approved construction of the unit. Accordingly, the Structural Fill is not subject to CAMA and, therefore, is not addressed under this Closure Plan. However, Duke Energy will undertake additional closure measures exceeding the standards set forth in 15A N.C.A.C. 13B § .1700 as part of a separate regulatory process.

3.1.2 Estimated Volume of CCR in Impoundments

Based on CCR Inventory Data provided by Duke Energy as of July 31, 2019, and upon a surface comparison calculation, performed within AutoCAD Civil 3D, comparing the approximate pre-development topography to the 2014 topographic and bathymetric survey, the approximate volume of CCR in the Basin is listed in the table below. To compute the estimated mass of CCR in place an assumed density of 1.2 tons per CY was used, which is the Duke Energy fleet wide assumption. See **Appendix A** for the Estimated Volume of CCR in Impoundment calculation.

Impoundment	Estimated CCR Volume (CY)	Estimated CCR Weight (Tons)
Basin	14,030,000	16,836,000

* The Basin boundary used to estimate in-place CCR is based on the unit boundary as prepared by SynTerra, but excluded the dam area.

3.1.3 Description of Surface Impoundment Structural Integrity

The purpose of this section is to summarize the CCR Basin's structural integrity evaluations based on current existing information. This section includes the geotechnical, and hydrology and hydraulics (H&H) capacity analyses results. In summary, the structural integrity of the CCR impoundments and subsequent dam inspection reports meets the regulatory requirements of EPA's CCR Rule (40 § CFR 257.73). Duke Energy's certifications of these requirements are available on Duke Energy's publicly-accessible CCR Rule Compliance Data and Information website.

- **Slope Stability**

For the Basin Dam embankment, slope stability analysis results for the existing conditions global 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**

In 2016, AECOM performed liquefaction screening analyses for the Basin Dam embankment, including a Probabilistic Seismic Hazard Analysis (PSHA) and Dynamic Response Analysis using QUAD4M. Data from the PSHA and QUAD4M analyses indicate that the foundation and embankment soils for the Basin Dam embankment meet liquefaction screening regulatory requirements for minimum factor of safety. It is concluded that these soils are not subject to liquefaction during the 2,500-year return period seismic event.

- **Hydrology and Hydraulics (H&H) Capacity Analyses**

As part of the design of the new Principal Spillway in 2016, AECOM modeled the 6-hour ¾ Probable Maximum Precipitation (PMP) using the most current bathymetric and topographic survey information for the basin, dam crest, and auxiliary spillway. AECOM's analyses indicate that the auxiliary spillway will not activate during the 500-year storm event and that the spillway system can pass the SDF based on the 6-hour ¾ PMP without overtopping.

Per direction from NCDEQ, additional hydrologic modeling was conducted to evaluate whether the existing Basin and spillway system could convey the SDF generated during the full PMP event without overtopping the dam. The PMP used for this analysis was developed and provided by Applied Weather Associates (AWA) in July 2019. The evaluation involved incorporation of updated drainage area characteristics, including upstream stormwater ponds under construction and other storage areas. The evaluation showed that the Basin and existing spillway system could convey the SDF generated during the full PMP without overtopping the dam.

3.1.4 Sources of Discharges into Surface Impoundments

Process flows no longer discharge to the Basin. Process flows are directed toward newly-constructed lined retention basins. The MSS currently employs a dry ash handling system and transports CCR to the on-site ILF.

Historically, wastewater or process water inputs to the Basin from the MSS included CCR sluice water, equipment cooling wastewater, boiler and turbine sumps, sanitary wastes, and other low volume wastes.

3.1.5 Existing Liner System

The Basin does not include a geomembrane or clay liner system and is considered to be unlined. The Basin was constructed directly over the natural existing ground surface.

3.1.6 Inspection and Monitoring Summary

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 dam.

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

Daily inspections of the Basin are not routinely required, however, on a case-by-case basis, the Basin 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 dam or in response to a specific imposed regulatory agency requirement.

The Basin is 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 of the annual inspections are used to identify needed repairs, repair schedules, to assess the safety and operational adequacy of the dam, and to assess compliance activities regarding applicable permits, environmental and dam regulations. Annual inspections are also performed to evaluate previous repairs. The annual inspections of the dikes have been ongoing since 2009, with 5-year inspections conducted between 1979 and 2009.

The 2015 through 2019 annual inspections did not identify features or conditions in the Basin Dams, or their outlet structures or spillways that indicate an imminent threat of impending failure hazard. Review of critical 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, episodic inspections of the Basin may be performed during episodes of 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 dams. A special inspection would also be performed during an emergency, such as when a potential dam breach condition might be identified or when construction activities (e.g., basin cleanout) are planned on or near the dams. 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 Existing CCR Impoundment Related Structures

A site map showing property boundary, location of the MSS, Basin with its boundaries and topographic and bathymetric contours are shown on **Figure 3-1**.

3.2.2 Receptor Survey

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

3.2.3 Existing On-Site Landfills

The existing on-site landfills at the MSS are presented in the table below and are shown on the attached **Figures 1-1** and **3-1.**

Unit	Permit Number	Comment
Phase I of 1804 Landfill	1804-INDUS	Closed prior to the CCR Rule
Phase II of 1804 Landfill	1804-INDUS	Closed prior to the CCR Rule
Asbestos Landfill	1804-INDUS	Non CCR, Closed
Demolition Landfill	1804-INDUS	Non CCR, Closed
Structural Fill	CCB0031	Closed prior to the CCR Rule
Structural Fill Access Road	CCB0030	Closed prior to the CCR Rule
Industrial Landfill	1812-INDUS	CCR Rule, Active
Structural Fill Beneath Industrial Landfill	CCB0072	Closed prior to the CCR Rule
FGD Landfill	1809-INDUS	Closed prior to the CCR Rule

3.3 Monitoring and Sampling Location Plan

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

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

4. 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 locations are shown on Drawing MAR_C999.002.009 included in **Appendix D**.

This section summarizes the site geology and hydrogeology; site stratigraphy of the geologic units underlying the surface impoundments; as well as geotechnical properties of the CCR and the uppermost stratigraphic unit under the surface impoundment. Descriptions of the geotechnical and hydrogeological explorations, data and results are focused on those conducted on or adjacent to the Basin, including the Basin Dam.

4.2 Hydrogeology and Geologic Descriptions

Hydrological and geologic descriptions, including descriptions of regional geology, site specific geology, and regional and site hydrogeology are included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

4.3 Stratigraphy of the Geologic Units Underlying Surface Impoundments

Descriptions of geologic units underlying the Basin are included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

4.4 Geotechnical Properties

This section provides a summary of geotechnical conditions and properties found from investigations performed within the Basin and Basin Dam 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 Basin generally consist of CCR (interbedded layers of fly ash and bottom ash) placed in the basin primarily by hydraulic sluicing underlain by residual soil, saprolite, partially weather rock (PWR), and bedrock.

For the 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 Basin are described below. A range of measured material properties of laboratory tests performed by AECOM, SynTerra, and others for the subsurface explorations completed within the Basin is presented on **Table 4-1.** A summary of laboratory tests data performed at the MSS in support of the closure design is presented in **Appendix B**.

4.4.1 CCR Within Basin

- *Sluiced CCR (Fill)*: Sluiced CCR was encountered within the Basin in multiple borings completed by AECOM, HDR, SynTerra and S&ME. The CCR was classified as moist to wet,

gray and dark gray to black, bottom ash as silty sand (SM) or fly ash as sandy silt (ML). The thickness of the sluiced CCR ranged from 4 to 85 ft. The uncorrected N-values recorded in the sluiced CCR ranged from WOH to 7 bpf, but much of the material was 1 bpf or less.

4.4.2 Liner Material Properties

The Basin is unlined so there are no associated material properties.

4.4.3 Subsurface Soil Properties

- *Compacted Fill*: Soil fill, and in some cases bottom ash, fill was encountered at the ground surface in multiple borings completed by AECOM, HDR, SynTerra and S&ME. Fill materials are associated with saddle dikes constructed at the time the Basin was being developed (SB-102, P-5/B-2, STB-14), FGD Wetlands treatment area (SB-103, AB-21S/D), roadway embankments (B-4), and ILF construction (AB-15S/SL/D/BR, P-6).

  The soil fill varies and generally consists of loose to medium dense, moist to wet, reddish brown to grayish brown, sandy silt (ML), silty sand (SM), or sand with silt (SW-SM). CCR used as fill is generally classified as bottom ash (SM). The fill thickness ranged from 4 to 53.5-ft. The uncorrected N-values recorded in the fill ranged from 1 to 22 bpf.

- *Alluvium*: Alluvial soils were encountered beneath the sluiced or stacked CCR or beneath embankment fill material in several borings in the vicinity of the Basin. The alluvium deposits consisted of very loose, moist, sandy silt (ML) to wet, gray or brown, silty sand (SM). The thickness of this layer ranged from 4 to 10 ft. The uncorrected N-values recorded in the alluvium ranged from WOH to 11 bpf.

- *Residuum*: Residual soils encountered in numerous borings beneath sluiced or stacked CCR, beneath embankment fill material and beneath alluvial soils, where encountered. The residual soils vary widely and classify as moist to wet, brown to brownish yellow, sandy silt (ML) or sand with silt (SW-SM) with varying quantities of quartz and mica. Occasionally, soils in this deposit were classified as elastic silt (MH), silty sand (SM), sand with clay (SW-SC), sand (SW), clayey sand (SC), lean clay (CL) and fat clay (CH). The thickness of this layer ranged from 5 to 42-ft and uncorrected N-values recorded in the residuum ranged from 3 to 72 bpf.

- *Partially Weathered Rock (PWR)*: PWR was encountered in numerous borings underlying residual soils. PWR is classified as dark yellowish brown, sand (SW) or sand with silt and gravel (SW-SM). When classified as bedrock, the PWR primarily consisted of meta-quartz diorite and quartz biotite schist. The thickness of the PWR ranged from less than 1-ft to 22-ft. The PWR is very stiff and resulted in refusal to advance of soil drilling tools in several borings.

- *Bedrock*: Bedrock was encountered beneath PWR and was sampled by coring at nine locations by AECOM and HDR. The bedrock encountered consisted of black and white to dark gray, medium to very strong, thinly foliated Biotite Gneiss or Amphibolite gneiss bedrock. Meta-quartz diorite and biotite schist bedrock was occasionally encountered as well.

Percent core recovery varied from 4 to 100%, with an average of 94%. RQD varied from 0 to 100% with an average RQD of 88%.

4.4.4 Basin Dam Soil Properties

- *Embankment Compacted Fill:* The compacted fill materials used to construct the Basin Dam generally consist of stiff sandy silt (ML), varying to medium to dense moist, silty sand (SM). Although the embankment soils were relatively homogeneous, isolated intervals of limited thickness were classified as elastic silt (MH). The compacted fill extends from the current crest elevation (approximately El. 800 ft.) to approximate El. 710 ft., resulting in a maximum embankment height of approximately 90 feet.

- *Dumped Fill Berm*: The berms constructed on the upstream and downstream sides of the Basin Dam embankment are referred to in the design drawings as being constructed using "Dumped Fill". This reference apparently reflects the compactive effort used during construction. This layer was placed after construction of the Embankment Compacted Fill. The dumped fill berm downstream of the embankment dam exists from the southern end of the dam to just north of the former principal spillway. The dumped fill berm materials downstream of the Basin Dam generally consist of loose to dense, moist to wet, silty sand (SM) with lesser amounts of soft to stiff sandy silt (ML). The dumped fill materials were relatively heterogeneous in nature and materials encountered included rip-rap, shot rock, concrete debris and limited amounts of organics. The dumped fill extends from the current bench elevation (from El. 780 to El. 772 ft) to approximately El. 712 ft., resulting in a maximum embankment height of approximately 60 ft.

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

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference, but its content is not the work product of AECOM.

4.6 Historical Groundwater Sampling Results

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

4.7 Groundwater Potentiometric Contour Maps

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

4.8 Estimated Vertical & Horizontal Extent of CCR within the Impoundments

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

5. GROUNDWATER MODELING ANALYSES

In accordance with the requirements of N.C.G.S. § 130A-309.211(b)(1), Duke Energy separately submitted an updated Corrective Action Plan (CAP) in parallel with this Closure Plan; the updated CAP is herein incorporated in its entirety by this reference. Neither the updated CAP nor its content is the work product of AECOM. Although the Closure Plan contains references to the updated CAP, all specific relevant details to groundwater and related actions are found in the updated CAP itself and not in this Closure Plan.

The updated CAP evaluates the extent of, and remedies for, constituents of interest (COI) in groundwater associated with the Basin and certain adjacent additional source areas, focusing on constituent concentrations detected above the applicable 02L Standards, Interim Maximum Allowable Concentrations, or approved background threshold values at or beyond the compliance boundary to the north and east of the Basin. In addition, the updated CAP considers the federal groundwater corrective action requirements at 40 C.F.R. §§ 257.96-.98.

As detailed in the updated CAP, Duke Energy has begun to implement, and will continue implementing, source control measures at the site, including (i) complete Basin decanting to lower the hydraulic head within the Basin and decrease hydraulic gradients, reducing groundwater seepage velocities and COI transport potential; and (ii) complete Basin closure, as well as closure of adjacent ash management areas. In addition, Duke Energy intends to implement a robust groundwater remediation program that includes actively addressing COI in groundwater above applicable standards at or beyond the compliance boundary using a combination of groundwater extraction and clean water infiltration. The CAP provides that these corrective action measures will most effectively achieve remediation of the groundwater through the use of groundwater extraction wells along the Basin dam and to the east and north of the dam; and (ii) clean water infiltration wells to the north of the Basin dam and east of the Basin. Significantly, groundwater modeling simulations indicate (i) these measures will address COI at or beyond the compliance boundary; and (ii) at such time the site-specific considerations detailed within the CAP have been satisfied, including, but not limited to, securing all required state approvals, installing the necessary equipment, and commencing full-scale system operation, COI at or beyond the compliance boundary will meet the remedial objectives in nine years.

5.1 Site Conceptual Model Predictions

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

5.2 Groundwater Chemistry Effects

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

5.3 Groundwater Trend Analysis Methods

This information is included as part of the CAP being prepared separately by SynTerra for Duke Energy and is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

6. BENEFICIAL AND FUTURE USE

6.1 CCR Use

At this time, Duke Energy has not identified a beneficial use of CCR from the Basin at the MSS.

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 Basin, except for the proposed expansion of the ILF, which is proposed to be partially built within the northern footprint of the excavated Basin.

7. CLOSURE DESIGN DOCUMENTS

7.1 Engineering Evaluations and Analyses

Engineering evaluations and analyses to support closure of the Basin at the MSS, as detailed in this Closure Plan, are provided in **Appendix C**.

After approval of this Closure Plan by NCDEQ and based on additional information about constructability, geotechnical slope stability calculations will be performed to support interim excavation stability requirements and permanent closure conditions. Geotechnical calculations for the proposed CCR landfill design will be performed separately as part of its permit application, which will follow NCDEQ approval of this Closure Plan. Dam modification related calculations will be included in the dam modification permit applications, which will follow NCDEQ approval of this Closure Plan.

Safe and effective access to the Basin is critical to CCR excavation and the completion of closure. Access road locations into or across the Basin 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 can be applied, such as installation of a geogrid and crushed stone aggregate, placement and spreading of dry CCR over the Basin surface to establish access, and use of low ground pressure or light weight construction equipment.

Areas for stockpiling or conditioning of CCR are generally needed. These areas must be established within the limits of the Basin and require placement or stacking of CCR excavated from other areas of the Basin. They can be established in areas where all or most of the CCR has been excavated, or on areas where a significant depth of CCR remains in place. Sluiced CCR forming the foundation of stockpiles or conditioning areas may be subject to bearing capacity or slope failures from the additional vertical compressive stress imparted by the stacked CCR and hauling equipment. Excavated slopes in sluiced CCR adjacent to or forming access roads, stockpiles or conditioning areas are subject to the same analyses outlined below for interim CCR excavation slopes.

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

cannot be established during design. These elements depend on the means and methods employed by the construction contractor, potentiometric surfaces, schedule, and other site conditions. Geotechnical analyses will be completed and performance criteria related to the allowable height, slope and preparation (dewatering, etc.) for temporary or interim CCR slopes will be established prior to commencement of construction.

Dewatering is necessary to remove the interstitial (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 to identify required vertical and horizontal limits of interstitial water removal at critical locations and for critical conditions during closure.

Excavation in a deep valley fill creates significant safety risks that need further evaluation and will require the means and methods input 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:

- Lower free water level through the riser outlet by removing stoplogs under the existing NPDES permit (completed).
- Decant the Basin by using floating pumps, screened intakes, and pumping through the discharge to the existing NPDES-permitted Outfall 002 or to the WMS (ongoing).
- Construction and operation of a temporary water management system to manage all discharges in compliance with the NPDES permit during closure.
- Dewater the CCR to allow for safe access. CCR excavation and conditioning prior to placement in the ILF.
- Start CCR excavation from the Basin, with sequencing determined for optimal progression. Manage and control of dust-generating activities through specific site planning and mitigation. Construct landfill cells in coordination with CCR excavation. Place the excavated CCR in the ILF, and compact. Instrumentation and monitoring requirements to be developed prior to construction will be followed to verify construction phase stability. Construction dewatering to be used as needed to provide stable work areas and slopes.
- Maintain required hydraulic storage capacity through the excavation process and progressively install the primary stormwater outlet as excavation advances
- Complete closure by excavation verification. Grade the area to promote positive drainage and seed for vegetative growth.

Additional information and details pertaining to this Closure Plan for the MSS Basin are provided in the Closure Plan Drawings, which can be found in **Appendix D**.

7.3 Closure Plan Drawings

The Closure Plan drawings found in **Appendix D** include the following:

- Cover Sheet
- General Notes
- Existing Conditions Plan with Aerial Photograph
- Existing Conditions Plan(s) with Topography
- Exploration Location Plan(s)
- Demolition Plan(s)
- Estimated Bottom of CCR Plan(s)
- Final Closure Grading Plan(s)
- Final Closure Grading Profile, Cross-Sections, and Details
- On-Site Landfill Schematic Plan(s)
- On-Site Landfill Schematic Cross-Sections

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 dam modification permits, erosion and sediment control permits, NPDES permit modifications, and other related permits.

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

7.4 Description of the Construction Quality Assurance Plan

A Construction Quality Assurance (CQA) Plan will be developed following NCDEQ approval of the Closure Plan for closure of the Basins at the MSS. The CQA Plan will be prepared to address N.C.G.S. §130A-309.214(a)(4)(g). Its purpose is to provide a description of the CQA program to be adhered to in execution of closure activities. The CQA Plan will present 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 properties and specifications; 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 CQA Plan will address materials and CQA activities associated with the following components:

- Earthwork
  - CCR Excavation
  - Structural Soil Fill

- HDPE Piping
- As-Built Conditions
- Record Documentation Report

8. MANAGEMENT OF WASTEWATER AND STORMWATER

A Temporary Stormwater Pond was constructed as a part of the Structural Fill Stormwater Redirect Project to divert stormwater flows from beneath the Structural Fill, from the ILF, and from areas tributary to the northern most fingers of the Basin that formerly drained to the Basin. This diverted stormwater is now collected in the Temporary Stormwater Pond and pumped to a newly established NPDES Stormwater Outfall (SW025), located east of Phase II of the 1804 Landfill, which is tributary to a finger of Lake Norman northeast of the Basin. Additional temporary diversions of surface water may also be provided in certain areas and within the Basin (as needed) during CCR excavation.

The MSS manages wastewater and stormwater under two NPDES permits issued by the NCDEQ. Permit number NC0004987, issued May 5, 2015 (NCDEQ, 2015a) and modified April 2, 2018 (NCDEQ, 2018a) addresses the discharge of various process-related wastewaters in accordance with specified limits and monitoring requirements. Permit number NCS000548, issued May 15, 2015 (NCDEQ, 2015b), and modified January 24, 2017 and September 20, 2018, provides monitoring and best management practice requirements for industrial stormwater discharges from the MSS. The limits and requirements stipulated in the aforementioned permits can be found in the permit documents discussed above. Discharges to surface waters and treated process-related wastewaters flow directly or indirectly to Lake Norman, but as April 11, 2019, no process flows are discharged to the Basin.

The Basin discharge will continue to be in service during closure to meet the NPDES permit discharge requirements as it goes through the phases of decanting and dewatering. With decanting underway discharges from the Basin via the existing passive gravity discharge system have stopped. Decanting is proceeding via mechanical pumping. The pumping system is expected to draw down the stored water after storm events, route through the water management process if necessary, and discharge via the permitted outfall. When dewatering of the CCR begins, all discharge flows are anticipated to be routed though the water management process in order to meet the permitted discharge limits.

The Basin currently has the capacity to contain the PMP storm event by maintaining the water surface level elevation at or below El. 788.20 ft, which provides a minimum freeboard of 0.94 ft. As part of the closure, the discharge riser structure from the abandoned principal spillway and the existing Principal Spillway will be removed. The post-closure grades will include several stormwater channels within the fingers of the Basin that convey stormwater from the outer edges of the watershed to a permanent stormwater pond located within the southern half of the Basin. A new surface water outlet structure will be constructed northeast of the Basin Dam in the vicinity of the existing Auxiliary Spillway. The stormwater pond will then discharge through the new surface water outlet structure, and flow into Lake Norman through a newly established NPDES Stormwater Outfall. Under this post closure condition, there will be increased flow into Lake

Norman compared with existing conditions, and energy dissipation will be provided at the outlet point to minimize erosion of the Lake Norman bank.

Wastewater from the Basin will be pumped, treated and discharged in two phases; the Decanting phase and Dewatering phase. In the Decanting phase, free water above the settled CCR layer will be removed from the Basin without the mechanical disturbance of the ash. The MSS water management process has a designed flow rate of 1750 GPM. Following the decanting phase and as the Closure schedule dictates, the MSS will advance into the dewatering phase to remove interstitial water from the Basin. During this phase, additional physical-chemical treatment processes will be added to the WMS as necessary to maintain compliance with the requirements of the discharge permit. During the Dewatering phase, the MSS WMS will have a designed flow rate of 400-500 GPM.

Dewatering is 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.

Appendix C1 presents the results of the Post-Closure Stormwater Management calculations.

8.1 Anticipated Changes in Wastewater and Stormwater Management

Closure of the Basin has necessitated changes in the management of a number wastewater and process streams. Wastewater and process streams previously discharging to the Basin have been rerouted to new lined retention basins as separate treatment systems.

A temporary WMS will be utilized such that the NPDES Outfall 002 effluent discharge limits will be met throughout the duration of decanting/dewatering and closure.

Duke Energy will obtain necessary permit coverage for any flows associated with post closure cap in place conditions as plans are finalized (e.g. groundwater remediation, cap underdrains, etc.). A water management process will be utilized such that the permit terms can be met throughout the duration of dewatering, closure and post-closure timeframes.

Erosion and Sediment Control Plans for different phases of the construction will be developed as part of the construction-level packages and formal erosion and sediment control plan permit submittal. The details for the erosion and sediment control measures depicted on the drawings in this Closure Plan submittal will be re-evaluated after the specific construction phasing is established, 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

Additional information on required permits is described in **Section 10**.

9. DESCRIPTION OF FINAL DISPOSITION OF CCR

CCR will be dispositioned by placement into an approved and permitted lined CCR landfill. Duke Energy intends to expand/construct a new on-site Landfill to accept CCR in completion of the NCDEQ mandated closure by excavation. Duke Energy intends to construct a new on-site Landfill

to accommodate CCR dispositioned in completion of the NCDEQ mandated closure by excavation. A permit application for construction of the on-site landfill will be prepared and submitted to NCDEQ Division of Waste Management following approval of this Closure Plan. Vegetation encountered or removed during the progression of the work will be managed in accordance with state regulations for handling and disposal.

10. 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 would follow NCDEQ approval of the Closure Plan.

11. DESCRIPTION OF POST-CLOSURE MONITORING AND CARE

A post-closure plan will be developed following NCDEQ approval of the Closure Plan for closure of the Basin. The purpose of the post-closure plan will be to provide a description of the inspection, monitoring, and maintenance activities required to be performed throughout the 30-year post-closure care period for the closed Basin

The post-closure plan will be developed to meet the requirements of CAMA (G.S. §130A-309.214(a)(4)(k)). The items that will be in the post-closure plan for the MSS 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;
- Groundwater and surface water monitoring and assessment program (included as part of the CAP);
- 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 is being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference but its content is not the work product of AECOM.

12. PROJECT MILESTONES AND COST ESTIMATES

12.1 Project Schedule

A Closure project schedule has been prepared by Duke Energy and is provided below. The schedule defines the following anticipated activities and milestones:

- Engineering, decanting, dewatering — Ongoing
- Submit plan and design for landfill construction permit — Q4-2020
- Start CCR excavation using existing landfill airspace — Q1-2021
- Landfill Permit Approval — Q4-2021
- Start new landfill construction — Q4-2021
- Complete CCR excavation — Q4-2034
- Complete final closure and cover system of new landfill — Q4-2035
- Site final grading and vegetative cover — Q4-2036

A detailed construction schedule will be developed following NCDEQ approval of this Closure Plan.

12.2 Closure and Post-Closure Cost Estimate

Cost estimates for closure and post-closure of the Basin at MSS were developed by Duke Energy and provided to AECOM. These cost estimates are not a work product of AECOM. These are Class 5 estimates as the detailed and final design is not 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, including the new CCR landfill, is estimated to be $674 million.

The cost to perform the 30-year post-closure activities and monitoring is estimated as to be $165 million.

The cost estimates prepared by Duke Energy includes 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 are being submitted in parallel to this Closure Plan. The CAP is herein incorporated by this reference, but its content is not the work product of AECOM.

13. REFERENCED DOCUMENTS

ESP Associates, P.A. (ESP). (2012a). Hydrologic Analysis, Marshall Steam Station, Catawba County, North Carolina, July 6, 2012.

ESP Associates, P.A. (ESP). (2012b). Dam Breach Analysis, Marshall Steam Station, Catawba County, North Carolina, October 10, 2012.

North Carolina Department of Environmental Quality (NCDEQ). (2015a). Draft Permit to Discharge Wastewater under the NPDES, Duke Energy Marshall Steam Station, Permit No. NC0004987, May 5, 2015.

North Carolina Department of Environmental Quality (NCDEQ). (2015b). Permit to Discharge Stormwater under the NPDES, Duke Energy Marshall Steam Station, Permit No. NCS000548, May 15, 2015.

North Carolina Department of Environmental Quality (NCDEQ). (2018a). SPECIAL ORDER BY CONSENT SOC No. S17-009, Duke Energy Carolinas LLC Allen Steam Station, Marshall Steam Station, & Rodgers Energy Complex NDPES Permits NC0004979, NC0004987 & NC0005088 Gaston, Catawba & Rutherford Counties April 25, 2018

PROFESSIONAL ENGINEER CERTIFICATION

I, John Angelo Bove, being a registered Professional Engineer in the state of North Carolina, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this Closure Plan dated December 18, 2019, was developed pursuant to the requirements of N.C.G.S. § 130A-309-214(a)(4) and has been prepared pursuant to recognized and generally accepted good engineering practices.

NORTH CAROLINA PROFESSIONAL SEAL 19391 ENGINEER JOHN A. BOVE

SIGNATURE DATE December 18, 2019

TABLES

Table 2-1: NC CAMA Closure Plan Requirements
Summary and Cross Reference Table
Duke Energy, Marshall Steam Station

No.	Description	Corresponding Closure Plan Section
Part II. Provisions for Comprehensive Management of Coal Combustion Residuals		
§ 130A-309.214(a)(4) Closure Plans for all impoundments shall include all of the following:		
a. Facility and coal combustion residuals surface impoundment description. – 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
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
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

Table 2-1: NC CAMA Closure Plan Requirements
Summary and Cross Reference Table
Duke Energy, Marshall Steam Station

No.	Description	Corresponding Closure Plan Section
d.	**The results of groundwater modeling of the site that shall include, at a minimum, all of the following:**	
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
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
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

Table 2-1: NC CAMA Closure Plan Requirements
Summary and Cross Reference Table
Duke Energy, Marshall Steam Station

No.	Description	Corresponding Closure Plan Section
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-309.214(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.		

Note 1
Reports Prepared by Other Consultants Include:
1 Synterra Groundwater Assessment Work Plan
2 HDR Groundwater Assessment Work Plan

Table 4-1A - Summary of Soil Laboratory Test Results for CCR (by AECOM and Other Consultants)**

Consultant	Test Area	Boring Number	Sample Type	Sample ID	Sample Depth (ft.)	USCS Classification	Moisture Content (%)	Atterberg Limits			Grain Size Analysis					Standard Proctor Test		Specific Gravity	Unit Weight (pcf)		Coefficient of Permeability, k (cm/sec)	Consolidation Testing	Strength Testing		
								LL	PL	PI	< #200 Sieve (%)	% Gravel	% Sand	% Silt	% Clay	Max. Dry Density (pcf)	Optimum Moisture (%)		Wet	Dry			CU Triaxial Shear Strength	Undrained Shear Strength	Unconfined Compressive Strength
AECOM	Ash Basin	SB-102	Shelby Tube	ST-4	26.0 - 28.0	Bottom Ash as SILTY SAND (SM)	49.3	NP	NP	NP	22.0	6.2	71.8					2.210	95	64		*			
			Shelby Tube	ST-5	33.0 - 35.0	Bottom Ash as SANDY SILT (ML)	45.2	NP	49	NP	10.3	5.3	84.4					2.179	89	54		*			
		SB-213	Shelby Tube	ST-3	28.0 - 30.0	Bottom Ash as SILTY SAND (SM)	61.2				28.0	3.5	68.5						92	57		*	*		
		SB-214	Shelby Tube	ST-5	4.0 - 6.0	Bottom Ash as Poorly-Graded SAND (SP-SM)	37.6				7.1	11.8	81.1						84	61			*		
			Shelby Tube	ST-6	8.0 - 10.0	Bottom Ash as Poorly-Graded SAND (SP-SM)	47.3				7.0	8.7	84.3						89	61		*	*		
			Shelby Tube	ST-9	38.0 - 40.0	Fly Ash as SANDY SILT (ML)	36.8				64.7	0.6	34.7						102	75		*			
S&ME	Ash Basin	P-5/B-2	Split Spoon	SS-3	13.5 - 15.0	Black SANDY SILT (ML), ash	47.8	NP	NP	NP	78.6	0.0	21.4	69.8	8.8										
			Split Spoon	SS-4	33.5 - 35.0	Gray Black SILTY SAND (SM), ash	35.6	NP	NP	NP	16.3	16.1	67.6	15.1	1.2										
		B-4A	Shelby Tube	UD-1	13.5 - 15.5	Brown Tan Gray SILTY SAND (SM), ash	22.5	NP	NP	NP	38.8	2.8	58.4	28.4	10.4			2.790		91	4.18E-05		*		
		P-3	Bag	BAG-1	0.0 - 10.0	Gray SILT (ML), ash		NP	NP	NP	69.5	0.3	30.2	58.6	10.9	75.7	17.4	2.230							
			Split Spoon	SS-6	1.0 - 2.5	Gray SILT (ML), ash	38.2	NP	NP	NP	70.5	0.9	28.6	65.0	5.5										
			Shelby Tube	UD-2	10.0 - 12.0	Gray SILT (ML), ash	28.0	NP	NP	NP	95.5	0.0	4.5	85.2	10.3			2.270		73	1.97E-04	*	*		
			Split Spoon	SS-6	18.5 - 20.0	Gray Brown SANDY SILT (ML), ash	37.5	NP	NP	NP	70.5														
		P-6	Split Spoon	SS-7	6.0 - 7.5	Gray SILTY SAND (SM), ash	49.2																		
			Shelby Tube	UD-3	10.0 - 12.0	Gray SILT (ML), ash	41.9	NP	NP	NP	30.2	17.8	52	27.0	3.2			2.320				*			
			Split Spoon	SS-8	18.5 - 20.0	Gray SILTY SAND (SM), ash	42.3	NP	NP	NP	16.8	4.0	79.2	13.7	3.1										
		M-5	Split Spoon	85	8.6 - 10.1	Dark Gray SILT, ash					77.4	0.1	22.5	73.1	4.3						1.03E-03				
		STB-2	Split Spoon		1.0 - 2.5	Ash	43.8																		
			Split Spoon		3.5 - 5.0	Ash	39.4																		
			Split Spoon		6.0 - 7.0	Ash	35.3																		
			Split Spoon		8.0 - 9.0	Ash	28.0																		
			Split Spoon		13.0 - 14.0	Ash	44.6																		
			Split Spoon		18.0 - 19.0	Ash	45.2																		
			Split Spoon		23.0 - 24.0	Ash	33.5				77.8			69.8	8.0										
			Split Spoon		33.0 - 34.0	Ash	30.0																		
			Split Spoon		38.0 - 39.0	Ash	29.4																		
		STB-3	Split Spoon		1.0	Ash	25.4																		
			Split Spoon		3.0 - 4.0	Ash	43.9																		
			Split Spoon		5.0 - 6.0	Ash	32.5																		
			Split Spoon		13.0 - 14.0	Ash	48.6																		
			Split Spoon		18.0 - 19.0	Ash	54.3																		
			Split Spoon		23.0 - 24.0	Ash	55.1																		
			Split Spoon		28.0 - 29.0	Ash	54.1																		
			Split Spoon		33.0 - 34.0	Ash	53.6																		
			Split Spoon		38.0 - 39.0	Ash	116.0																		
			Split Spoon		43.0 - 44.0	Ash	35.0				97.1			81.1	16.0										
			Split Spoon		48.0 - 49.0	Ash	34.1																		
		VS-1	FPS		6.0 - 8.0	Ash					88.2			75.2	13.0										*
			FPS		16.0 - 18.0	Ash					88.6			78.1	10.5										*
		VS-2	FPS		24.0 - 26.0	Ash					79.7			72.2	7.5								*		
		VS-3	FPS		30.0 - 32.0	Ash					95.4			75.9	19.5								*		
HBR	Ash Basin	AB-3D	Split Spoon	Jar	29.0 - 30.5	Fly Ash	45.1				20.8	11.2	68.4	19.4	1.4										
		AB-4D	Split Spoon	Jar	19.0 - 20.5	Fly Ash	86.7				30.5	0.6	68.9	29.1	1.4										
		AB-6D	Split Spoon	Jar	9.0 - 10.5	Fly Ash	56.1				50.9	0.3	48.8	49.6	1.3										
		AB-7D	Shelby Tube	UD	0.0 - 2.5	Fly Ash (ML)		NP	NP	NP	85.7	0.0	14.3	70.8	14.9			2.164			1.19E-04				
		AB-12D	Split Spoon	Jar	39.0 - 40.5	Fly Ash	32.1				77.3	0.0	22.7	68.0	9.3										
		AB-15D	Sonic	Jar	44.0 - 45.0	Fly Ash	28.7				86.6	0.0	13.4	72.4	14.2										
		AB-18D	Split Spoon	Jar	9.0 - 10.5	Fly Ash	59.8				72.0	1.2	26.8	67.4	4.6										

Notes:
* Refer to corresponding laboratory test data sheets for test results
** The data shown in this table is representative of material within the limits of impountment.

Table 4-1B - Summary of Soil Laboratory Test Results for Alluvial Soils (by AECOM and Other Consultants)**

Consultant	Test Area	Boring Number	Sample Type	Sample ID	Sample Depth (ft.)	USCS Classification	Moisture Content (%)	Atterberg Limits			Grain Size Analysis					Standard Proctor Test		Specific Gravity	Unit Weight (pcf)		Coefficient of Permeability, k (cm/sec)	Consolidation Testing	Strength Testing		
								LL	PL	PI	< #200 Sieve (%)	% Gravel	% Sand	% Silt	% Clay	Max. Dry Density (pcf)	Optimum Moisture (%)		Wet	Dry			CU Triaxial Shear Strength	Undrained Shear Strength	Unconfined Compressive Strength
AECOM	Ash Basin	SB-106	Shelby Tube	ST-2	6.0 - 8.0	SILTY SAND (SM), alluvium	24.6	39	31	8	34.1	0.1	65.8					2.703	116	93		*			
S&ME	Ash Basin	STB-2	Split Spoon		43.0 - 44.0	alluvium	23.2																		
		STB-3	Split Spoon		53.0 - 54.0	alluvium	28.9																		
HDR	Ash Basin	AB-9BR	Shelby Tube	UD	11.0 - 12.5	Olive-Brown SILTY SAND (SM), Alluvium		NP	NP	NP	13.9	0.0	86.1	9.0	4.9			2.802			5.92E-05				
		AB-11D	Split Spoon	Jar	12.3 - 13.3	Red-Brown SILTY SAND, Alluvium	17.6				13.0	0.0	87.0	9.4	3.6										
			Shelby Tube	UD	12.5 - 13.5	Tan-Brown SILTY SAND (SM), Alluvium		NP	NP	NP	17.9	0.2	81.9	13.9	4.0			2.622			5.64E-05				

Notes:

* Refer to corresponding laboratory test data sheets for test results

** The data shown in this table is representative of material within the limits of impountment.

Table 4-1C - Summary of Soil Laboratory Test Results for Residual Soils (by AECOM and Other Consultants)**

Consultant	Test Area	Boring Number	Sample Type	Sample ID	Sample Depth (ft.)	USCS Classification	Moisture Content (%)	Atterberg Limits			Grain Size Analysis					Standard Proctor Test		Specific Gravity	Unit Weight (pcf)		Coefficient of Permeability, k (cm/sec)	Consolidation Testing	Strength Testing		
								LL	PL	PI	< #200 Sieve (%)	% Gravel	% Sand	% Silt	% Clay	Max. Dry Density (pcf)	Optimum Moisture (%)		Wet	Dry			CU Triaxial Shear Strength	Undrained Shear Strength	Unconfined Compressive Strength
AECOM	Ash Basin	SB-101	Split Spoon	S-9	44.0 - 46.0	Brown SANDY SILT (ML), residuum	21.9	47	30	17	57.5	0.0	42.5	35.5	22.0										
			Split Spoon	S-10	49.0 - 51.0	Reddish Brown CLAYEY ELASTIC SILT (MH), residuum	24.4	52	24	28	29.6	8.4	42.0	23.6	26.0										
		SB-102	Split Spoon	S-11	60.0 - 62.0	Light Brown SILTY SAND (SM), residuum	31.5	40	36	4	38.0	0.5	61.5	34.0	4.0										
		SB-103	Shelby Tube	ST-3	21.0 - 23.0	SANDY SILT (ML), residuum	33.6	49	38	11	54.6	2.7	42.7					2.320	118.2	88.5		*			
			Split Spoon	S-5	24.0 - 26.0	Orangish SANDY ELASTIC SILT (MH), residuum	32.2	53	36	17	59.9	0.0	40.1	32.9	27.0										
			Split Spoon	S-8	38.0 - 40.0	Brown SILTY SAND (SM), residuum	12.9	NP	NP	NP	32.5	0.0	67.5	29.5	3.0										
		SB-104	Split Spoon	S-4	19.0 - 21.0	Brown SILTY SAND (SM), residuum	27.2	44	44	0	29.8	0.4	69.8	25.8	4.0										
			Split Spoon	S-6	29.0 - 31.0	Brown SILTY SAND (SM), residuum	17.7	42	48	NP	29.9	0.5	69.6	26.9	3.0										
			Split Spoon	S-7	34.0 - 36.0	Brown SILTY SAND (SM), residuum	11.0				36.1	0.6	63.3	33.1	3.0										
	Ash Basin Dam	B-100	Shelby Tube	2	35.0 - 37.0	Brown and White SILTY SAND (SM), residuum	21.0	43	30	13									125.0	104.5			*		*
			Split Spoon	12	45.0 - 47.0	Red Brown SILTY SAND (SM), residuum	40.8	NP	NP	NP	31.7	0.0	68.3										*		
			Split Spoon	13	50.0 - 52.0	Red Brown SILTY SAND (SM), residuum	37.4																		
			Shelby Tube	3	55.0 - 57.0	Red Brown SILTY SAND (SM), residuum	28.1	NP	NP	NP	32.1	0.0	67.9	29.9	2.2				116.0				*		
			Split Spoon	15	60.0 - 62.0	Mottled Brown SILTY SAND (SM), residuum	22.7	NP	NP	NP	21.0	0.3	78.8												
			Split Spoon	16	65.0 - 67.0	Mottled Brown SANDY SILTY (ML), residuum	26.9																		
		B-101	Shelby Tube	2	35.0 - 37.0	Red Brown Sandy SILTY (ML), residuum	37.4	NP	NP	NP	59.8	0.0	40.2	56.4	3.4				107.0				*		
			Split Spoon	9	50.0 - 52.0	Mottled Brown SILTY SAND (SM), residuum	17.5				26.6	0.0	73.4												
		B-102	Shelby Tube	3	43.0 - 45.0	Brown SANDY SILT (ML), residuum	28.3	NP	NP	NP	53.0	0.0	47.0	45.6	7.4				115.0		3.50E-07		*		
			Split Spoon	10	49.0 - 51.0	Brown SANDY SILT (ML), residuum	6.9																		
			Split Spoon	12	59.0 - 61.0	Brown SILTY SAND (SM), residuum	37.1				33.2	0.0	66.8												
		B-105	Split Spoon	13	70.0 - 72.0	Gray Brown SILTY SAND (SM), residuum	16.5				23.0	0.3	76.7												
		B-106	Shelby Tube	2	23.0 - 25.0	Brown to Dark Brown SILTY SAND (SM), residuum	23.3	NP	NP	NP	32.8	0.0	67.2	28.2	4.6				110.0		1.40E-04				
			Split Spoon	8	29.0 - 31.0	Brown to Dark Brown SILTY SAND (SM), residuum	40.9	43	38	5	35.5	0.0	64.5												
			Shelby Tube	3	43.0 - 45.0	Brown to Dark Brown SILTY SAND (SM), residuum	43.5	NP	NV	NP	26.2	0.0	73.8	24.0	2.2				109.0		3.60E-04				
			Split Spoon	11	49.0 - 51.0	Orange to Light Brown SILTY SAND (SM), residuum	35.6	33	NP	1	43.6	0.0	56.4												
			Split Spoon	13	59.0 - 61.0	Brown SAND with SILT (SP-SM), residuum	30.5				10.4	0.0	89.6												
			Split Spoon	15	69.0 - 69.3	Brown SILTY SAND (SM), residuum	16.2	33	28	5	23.0	0.4	76.6												
		B-107	Split Spoon	2	10.0 - 12.0	Orange Brown CLAYEY SANDY SILT (ML), residuum	39.7	37	33	4	53.7	0.0	46.3												
			Split Spoon	3	15.0 - 17.0	Mottled Brown SILTY SAND (SM), residuum	40.9	NP	NP	NP	22.7	0.1	77.3												
			Shelby Tube	2	20.0 - 22.0	Mottled Brown SILTY SAND (SM), residuum	38.3	46	30	16	64.6	0.0	35.4	27.7	36.9				111.0				*		
							19.0	NP	NP	NP	27.4	0.0	72.6										*		
			Split Spoon	6	30.0 - 32.0	Brown to Orange Brown SANDY SILT (ML), residuum	25.3	NP	NP	NP	61.9	0.0	38.1												
			Split Spoon	8	40.0 - 41.0	Brown to Orange Brown SANDY SILT (ML), residuum	17.6																		
		B-108	Split Spoon	2	2.0 - 4.0	Mottled Brown LEAN CLAY (CL), residuum	14.3	33	22	11	21.6	16.1	62.3												
			Split Spoon	3	4.0 - 6.0	Orange Brown SILTY SANDY GRAVEL (GW), residuum	22.9																		
			Split Spoon	5	8.0 - 10.0	Orange Brown SANDY SILT (ML), residuum	17.0	NP	NP	NP	28.9	4.8	66.3												
			Split Spoon	6	15.0 - 17.0	Orange Brown SANDY SILT (ML), residuum	10.2																		
			Split Spoon	7	20.0 - 22.0	Orange Brown SANDY SILT (ML), residuum	25.7	28	25	3	29.8	0.6	69.6												
			Split Spoon	8	25.0 - 27.0	Brown, White, and Light Gray CLAYEY SILT (ML), residuum	26.6																		
			Split Spoon	9	30.0 - 32.0	Pale Green SILTY SAND (SM), residuum	36.7	NP	NP	NP	39.8	0.0	60.2												
			Split Spoon	10	35.0 - 37.0	Pale Green SILTY SAND (SM), residuum	32.2																		
			Split Spoon	12	45.0 - 47.0	Dark Brown SILTY SAND (SM), residuum	16.5	NP	NP	NP	25.5	0.0	74.5												
		B-109	Split Spoon	2	2.0 - 4.0	Orange Red SANDY SILT (ML), residuum	21.6	46	29	17	61.3	0.0	38.7						115.0						
			Split Spoon	5	8.0 - 10.0	Orange Red SANDY SILT (ML), residuum	29.2	45	40	5	43.6	0.0	56.5												
			Split Spoon	13	49.0 - 51.0	Light Brown to White SILTY SAND (SM), residuum	19.1	NP	NP	NP	23.4	0.0	76.6						128.0	107					

Notes:
* Refer to corresponding laboratory test data sheets for test results
** The data shown in this table is representative of material within the limits of impoundment.

Table 4-1C - Summary of Soil Laboratory Test Results for Residual Soils (by AECOM and Other Consultants)**

Consultant	Test Area	Boring Number	Sample Type	Sample ID	Sample Depth (ft.)	USCS Classification	Moisture Content (%)	Atterberg Limits			Grain Size Analysis					Standard Proctor Test		Specific Gravity	Unit Weight (pcf)		Coefficient of Permeability, k (cm/sec)	Consolidation Testing	Strength Testing		
								LL	PL	PI	< #200 Sieve (%)	% Gravel	% Sand	% Silt	% Clay	Max. Dry Density (pcf)	Optimum Moisture (%)		Wet	Dry			CU Triaxial Shear Strength	Undrained Shear Strength	Unconfined Compressive Strength
AECOM	Ash Basin	B-110	Split Spoon	2	2.0 - 4.0	Brown CLAYEY SILT (ML), residuum	28.9	45	41	4	61.2	0.0	38.8												
			Split Spoon	3	4.0 - 6.0	Brown CLAYEY SILT (ML), residuum	26.9				50.0	3.5	46.5												
			Split Spoon	5	8.0 - 10.0	Brown CLAYEY SILT (ML), residuum	38.6	44	42	2	64.5	0.0	35.5						102.0	74					
			Split Spoon	6	14.0 - 16.0	Brown CLAYEY SILT (ML), residuum	30.3																		
			Split Spoon	8	24.0 - 26.0	Red Brown SILT (ML), residuum	49.6	NP	NP	NP	53.0	0.0	47.0												
			Split Spoon	10	34.0 - 36.0	Red Brown SILT (ML), residuum	42.1	NP	NP	NP															
			Split Spoon	12	44.0 - 46.0	Gray SILTY SAND (SM), residuum	22.3				23.5	0.0	76.5												
		B-111	Split Spoon	S-6	29.0 - 31.0	Brown SILTY SAND (SM), residuum	25.3	NP	NP	NP	40.0														
			Split Spoon	S-7	34.0 - 36.0	Brown SILTY SAND (SM), residuum		NP	NP	NP	36.0														
			Split Spoon	S-8	36.0 - 38.0	Brown SILTY SAND (SM), residuum	34.9	NP	NP	NP	29.6														
			Split Spoon	S-9	38.0 - 40.0	Brown SILTY SAND (SM), residuum		NP	NP	NP	23.9														
			Split Spoon	S-10	42.0 - 44.0	Brown SILTY SAND (SM), residuum		NP	NP	NP	34.3														
		B-112	Split Spoon	S-3	14.0 - 16.0	Brown SILTY SAND (SM), residuum	33.5	NP	NP	NP	24.8							2.680							
			Shelby Tube	ST-9	16.0 - 18.0	Brown SILTY SAND (SM), residuum	30.0	43	41	2	22.0							2.677	112.1						
								NP	NP	NP	24.0							2.682							
								45	39	6								2.677							
			Split Spoon	S-4	18.0 - 20.0	Brown SILTY SAND (SM), residuum		NP	NP	NP	24.0														
			Split Spoon	S-5	20.0 - 22.0	Brown SILTY SAND (SM), residuum		NP	NP	NP	24.2														
			Split Spoon	S-6	22.0 - 24.0	Brown SILTY SAND (SM), residuum		NP	NP	NP	22.0														
			Shelby Tube	ST-10	24.0 - 26.0	Brown SILTY SAND (SM), residuum	27.8	NP	NP	NP	20.0								116.1						
							28.4	NP	NP	NP	21.0								120.8						
			Shelby Tube	S-8	28.0 - 30.0	Brown SILTY SAND (SM), residuum					23.0														
		B-113	Split Spoon	S-7	34.0 - 36.0	Brown SILT (ML), residuum	25.8	36	30	6	47.5														
			Shelby Tube	ST-2	36.0 - 38.0	Gray SILTY SAND (SM), residuum																			
			Split Spoon	S-8	38.0 - 40.0	Brow and White SILTY SAND (SM), residuum		NP	NP	NP	32.0														
		B-114	Split Spoon	S-8	39.0 - 41.0	Brown to Grayish SILTY SAND (SM), residuum		NP	NP	NP	20.5														
			Shelby Tube	ST-8	41.0 - 43.0	Brown to Grayish SILTY SAND (SM), residuum																			
			Split Spoon	S-12	59.0 - 61.0	Brown to Grayish SILTY SAND (SM), residuum					22.0														
Duke	Ash Basin Dam	C-4	Shelby Tube	749	50.0 - 52.0	Brown Gray SILTY SAND (SM), residuum	27.5	NP	NP	NP	19.9	0.0	80.1	16.9	3.0			2.700	112.0				*		
		C-7	Shelby Tube	759	39.1 - 41.1	Yellow Brown/Gray SILTY SAND (SM), residuum	21.6	NP	NP	NP	41.6	0.0	58.4	36.8	4.8			2.700	118.8	99	2.96E-06	*	*		
			Shelby Tube	719	79.1 - 81.1	Yellow Gray SILTY SAND (SM), residuum	36.0	NP	NP	NP	29.6	0.0	70.4	27.6	2.0			2.730	111.0		3.70E-04		*		
		C-10	Shelby Tube	755	40.0 - 42.0	Reddish Gray SILTY SAND (SM), residuum	31.0	45	35	10	46.0	0.0	54.0	38.1	7.9			2.700	110.2	80	5.34E-06		*		
S&ME	Ash Basin	B-1	Split Spoon	SS-1	8.5 - 10.0	Brown Tan Gray SILTY SAND (SM), residuum	38.1	NP	NP	NP	37.9	0.0	62.1	28.5	9.4										
		STB-3	Split Spoon		58.0 - 59.0	residuum	14.2																		
HDR	Ash Basin	AB-3D	Shelby Tube	UD	76.0 - 78.2	Orange-Gray SILTY SAND (SM), saprolite		24	31	7	39.9	0.0	60.1	19.1	20.8			2.615			6.52E-07				
		AB-4D	Shelby Tube	UD	55.5 - 56.5	Tan-Brown SILTY SAND (SM), saprolite		NP	NP	NP	17.0	1.2	81.8	13.8	3.2			2.653			6.42E-05				
		AB-6D	Split Spoon	Jar	51.0 - 53.0	Tan-Brown and Black SILTY SAND, saprolite	19.6				18.8	2.1	79.1	16.4	2.4										
		AB-8D	Shelby Tube	UD	30.5 - 32.1	Orange-Brown CLAYEY SAND (SC), saprolite		25	40	15	46.4	0.0	53.6	20.5	25.9			2.575			6.23E-07				
		AB-10D	Sonic	Jar	52.0	Brown CLAYEY SAND, saprolite	20.9				40.1	0.0	59.9	18.9	21.2										
		AB-11D	Shelby Tube	UD	9.0 - 11.5	Orange-Brown CLAYEY SAND (SC), saprolite		24	50	26	34.5	0.8	64.7	9.1	25.4			2.615			9.73E-06				
		AB-12D	Split Spoon	Jar	49.0 - 50.5	Gray-Brown SILTY SAND, saprolite	31.9				13.6	0.7	85.7	7.0	6.6										
		AB-14D	Shelby Tube	UD	45.0 - 45.8	Olive-Gray SILTY SAND (SM), saprolite		NP	NP	NP	22.1	0.0	77.9	20.0	2.1			2.706			1.33E-04				
		AB-15D	Sonic	Jar	48.0 - 49.0	Orange-Brown Elastic SILT, saprolite	24.7				55.3	0.0	44.7	19.4	35.9										
		AB-18D	Shelby Tube	UD	39.0 - 39.5	Olive-Brown SILTY SAND (SM), saprolite		NP	NP	NP	18.8	0.0	81.2	16.1	2.7			2.648							
		AB-21D	Shelby Tube	UD	37.0 - 39.0	Olive-Tan SILTY SAND (SM), saprolite		NP	NP	NP	19.7	0.0	80.3	13.0	6.7			2.731			1.68E-06				

Table 4-1C - Summary of Soil Laboratory Test Results for Residual Soils (by AECOM and Other Consultants)**

Consultant	Test Area	Boring Number	Sample Type	Sample ID	Sample Depth (ft.)	USCS Classification	Moisture Content (%)	Atterberg Limits			Grain Size Analysis					Standard Proctor Test		Specific Gravity	Unit Weight (pcf)		Coefficient of Permeability, k (cm/sec)	Consolidation Testing	Strength Testing		
								LL	PL	PI	< #200 Sieve (%)	% Gravel	% Sand	% Silt	% Clay	Max. Dry Density (pcf)	Optimum Moisture (%)		Wet	Dry			CU Triaxial Shear Strength	Undrained Shear Strength	Unconfined Compressive Strength

Notes:
* Refer to corresponding laboratory test data sheets for test results
** The data shown in this table is representative of material within the limits of impountment.

Table 4-1D - Summary of Soil Laboratory Test Results for Partially Weathered Rock (by AECOM and Other Consultants)**

Consultant	Test Area	Boring Number	Sample Type	Sample ID	Sample Depth (ft.)	USCS Classification	Moisture Content (%)	Atterberg Limits			Grain Size Analysis					Standard Proctor Test		Specific Gravity	Unit Weight (pcf)		Coefficient of Permeability, k (cm/sec)	Consolidation Testing	Strength Testing		
								LL	PL	PI	< #200 Sieve (%)	% Gravel	% Sand	% Silt	% Clay	Max. Dry Density (pcf)	Optimum Moisture (%)		Wet	Dry			CU Triaxial Shear Strength	Undrained Shear Strength	Unconfined Compressive Strength
AECOM	Ash Basin Dam	B-100	Split Spoon	18	75.0 - 76.0	Orange Brown SAND with SILT (SP-SM)	14.7	NP	NP	NP	7.8	2.3	89.9												
			Split Spoon	19	80.0 - 81.0	Orange Brown SILTY SAND (SM)	19.4	NP	NP	NP	31.0	0.0	69.0												
		B-101	Split Spoon	11	60.0 - 61.5	Brown, Gray, and White SILTY SAND (SM)	20.5				31.2	0.0	68.8												
		B-102	Split Spoon	14	69.0 - 69.3	SILTY SAND (SM)	14.7				23.9	0.5	75.6												
			Split Spoon	16	79.0 - 79.3	SILTY SAND (SM)	16.1				27.9	1.5	70.6						129	111					
		B-103	Split Spoon	21	99.0 - 100.3	Brown to Light Brown SILTY SAND (SM)	16.5	32	24	8	30.5	0.0	69.5												

Notes:
* Refer to corresponding laboratory test data sheets for test results
** The data shown in this table is representative of material within the limits of impountment.

Table 4-1E - Summary of Soil Laboratory Test Results for Embankment Fill Material (by AECOM and Other Consultants)**

Consultant	Test Area	Boring Number	Sample Type	Sample ID	Sample Depth (ft.)	USCS Classification	Moisture Content (%)	Atterberg Limits			Grain Size Analysis					Standard Proctor Test		Specific Gravity	Unit Weight (pcf)		Coefficient of Permeability, k (cm/sec)	Consolidation Testing	Strength Testing		
								LL	PL	PI	< #200 Sieve (%)	% Gravel	% Sand	% Silt	% Clay	Max. Dry Density (pcf)	Optimum Moisture (%)		Wet	Dry			CU Triaxial Shear Strength	Undrained Shear Strength	Unconfined Compressive Strength
AECOM	Ash Basin Dam	B-100	Split Spoon	3	4.0 - 6.0	Light Brown SILTY SAND (SM), fill	17.3	NP	NP	NP	45.5	0.1	54.4												
			Shelby Tube	1	10.0 - 12.0	Light Brown SANDY SILT (ML), fill	22.5	NP	NP	NP	52.0	0.0	48.0	45.4	6.6				121	100					*
			Split Spoon	6	15.0 - 17.0	Light Brown SILTY SAND (SM), fill	18.5	NP	NP	NP	46.7	0.0	53.3												
			Split Spoon	7	20.0 -22.0	Light Brown SILTY SAND (SM), fill	18.2																		
			Split Spoon	8	25.0 - 27.0	Light Brown SILTY SAND (SM), fill	19.1	NP	NP	NP	45.4	0.3	54.3												
			Split Spoon	9	30.0 - 32.0	Light Brown SILTY SAND (SM), fill	21.1				48.5	0.2	51.3												
		B-101	Split Spoon	2	15.0 - 17.0	Orange Brown SANDY SILT (ML), fill	18.2	34	30	4	60.1	0.7	39.2												
			Shelby Tube	1	20.0 - 22.0	Orange Brown SILTY SAND (SM), fill	27.7	NP	NP	NP	29.8	4.8	65.4						114		4.80E-04				
		B-102	Split Spoon	2	2.0 - 4.0	Brown SANDY SILT (ML), fill	15.1																		
			Split Spoon	4	6.0 - 8.0	Light Brown to Light Gray SILTY SAND (SM), fill	24.9	NP	NP	NP															
			Shelby Tube	1	13.0 - 15.0	Light Brown to Light Gray CLAYEY SAND (SC), fill	12.8	28	20	8	43.1	16.1	40.8	30.5	12.6										
			Shelby Tube	2	23.0 -25.0	Brown to Red Brown SILTY SAND (SM), fill	34.7	NP	NP	NP	36.5	0.2	63.3					2.680	111	82	1.60E-05				
			Split Spoon	7	29.0 - 31.0	Brown to Orange Brown SANDY SILT (ML), fill	33.5				52.2	0.0	47.8												
			Split Spoon	8	34.0 - 36.0	Brown to Orange Brown SILTY SAND (SM), fill	34.7	NP	NP	NP	38.8	0.2	61.0												
			Split Spoon	9	39.0 - 41.0	Brown to Orange Brown SILTY SAND (SM), fill	34.9																		
		B-103	Split Spoon	3	5.0 - 6.0	Light Brown SILTY SAND (SM), fill	20.6	33	25	8									119	98					
			Split Spoon	4	6.0 - 8.0	Light Brown SILTY SAND (SM), fill	21.0	33	25	8															
			Shelby Tube	1	10.0 - 12.0	Light Brown SILTY SAND (SM), fill	19.8	NP	NP	NP	46.3	0.2	53.4	39.9	6.4				130	104					*
			Split Spoon	6	14.0 - 16.0	Light Orange Brown SANDY SILT (ML)	22.4	41	28	13	55.7	0.0	44.3						118						
			Shelby Tube	2	23.0 - 25.0	Light Brown SILTY SAND (SM), fill	17.3	35	29	6	37.5	24.1	38.4	28.4	9.1				126				*		
			Split Spoon	8	29.0 - 31.0	Light Brown SANDY SILT (ML), fill	27.2	43	35	8	58.2	0.1	41.7												
			Split Spoon	9	34.0 - 36.0	Light Orange Brown SILTY SAND (SM), fill	25.2												120	95					
			Shelby Tube	3	43.0 - 45.0	Light Orange Brown SILTY SAND (SM), fill	22.1	NP	NP	NP	44.5	0.5	55.0	35.2	9.3				120		3.50E-07		*		
			Split Spoon	11	49.0 - 51.0	Light Orange Brown SILTY SAND (SM), fill	22.0	34	29	5	42.2	0.3	57.5												
			Split Spoon	13	59.0 - 61.0	Light Orange Brown SILTY SAND (SM), fill	22.8	34	32	2	42.8	0.0	57.3						117	95					
			Split Spoon	15	69.0 - 71.0	Brown to Orange SANDY SILT (ML), fill	28.6	45	29	16															
			Split Spoon	18	84.0 - 86.0	Red Brown SANDY SILT (MH), fill	35.1	67	40	27	70.8	0.8	28.5												
			Split Spoon	19	89.0 - 91.0	Red Brown SANDY SILT (MH), fill	38.2												98	71					
		B-104	Split Spoon	1	10.0 - 12.0	Brown SILTY SAND (SM), fill	22.7				40.9	0.5	58.7												
			Split Spoon	3	20.0 - 22.0	Brown SILTY SAND (SM), fill	21.4				34.8	2.3	62.9												
			Split Spoon	4	30.0 - 32.0	Red Brown SILT (ML), fill	20.9	48	34	14	60.2	1.7	38.1												
			Split Spoon	6	40.0 - 42.0	Red Brown to Brown SILTY SAND (SM), fill	22.7				42.4	0.5	57.1												
			Split Spoon	8	50.0 - 52.0	Red Brown to Brown SILTY SAND (SM), fill	28.5	43	33	10	49.3	0.1	50.7												
			Split Spoon	9	55.0 - 57.0	Red Brown to Brown SILTY SAND (SM), fill	31.6												101	76					
			Split Spoon	11	65.0 - 67.0	Red Brown CLAYEY ELASTIC SILT (MH), fill	29.6	66	41	25	58.5	3.5	38.0												
		B-105	Split Spoon	3	15.0 - 17.0	Light Brown SILTY SAND (SM), fill	19.5	NP	NP	NP	34.4	1.2	64.3												
			Split Spoon	5	25.0 - 27.0	Light Brown CLAYEY SAND (SC), fill	20.9	24	15	9	33.1	1.6	65.3												
			Split Spoon	6	30.0 - 32.0	Light Brown SILTY SAND (SM), fill	20.3				35.3	1.8	62.9												
			Split Spoon	8	40.0 - 42.0	Light Brown to Light Gray SILTY SAND (SM), fill	20.7	NP	NP	NP	22.8	3.0	74.2												
			Split Spoon	10	50.0 - 52.0	Light Brown to Light Gray SILTY SAND (SM), fill	21.8																		
			Split Spoon	11	60.0 - 62.0	Light Brown to Light Gray SILTY SAND (SM), fill	35.4	NP	NP	NP	34.3	0.1	65.6												
		B-106	Split Spoon	3	4.0 - 6.0	Brown SANDY SILT (ML), fill	23.7	39	31	8	51.2	0.5	48.4						114	92					
			Shelby Tube	1	10.0 - 12.0	Brown SANDY SILT (ML), fill	22.2	39	35	4	53.0	0.0	47.0	38.8	14.2				119				*		
			Split Spoon	6	14.0 - 16.0	Brown SANDY SILT (ML), fill	23.9	45	33	12	55.7	0.5	43.9						151	122					
		B-107	Shelby Tube	1	5.0 - 7.0	Red Brown CLAYEY SILT (MH), fill	28.4	54	40	14	66.2	0.0	33.8	28.4	37.8				116				*		
			Split Spoon	1	7.0 - 9.0	Red Brown CLAYEY SILT (MH), fill	34.3	49	38	11	58.3	0.0	41.8												
		B-110	Bulk	Bulk	0.0 - 10.0	Red SILT (ML), fill	19.7	41	27	14	50.0	3.5	46.5			107.1	15.1								
		B-114	Shelby Tube	ST-6	6.0 - 8.0	SANDY SILT (ML), fill	19.3	NP	NP	NP	35.0	0.0	64.6												
			Shelby Tube	ST-7	16.0 - 18.0	SILTY SAND (SM), fill	19.2	NP	NP	NP	37.0	0.0	62.8												
							22.1	NP	NP	NP	35.0								119	98		*			
	Ash Basin	SB-102	Split Spoon	S-3	14.0 - 16.0	Brown SILTY SAND (ML), fill	17.5	44	30	14	48.3	1.0	50.7	35.3	13.0										

Table 4-1E - Summary of Soil Laboratory Test Results for Embankment Fill Material (by AECOM and Other Consultants)**

Consultant	Test Area	Boring Number	Sample Type	Sample ID	Sample Depth (ft.)	USCS Classification	Moisture Content (%)	Atterberg Limits			Grain Size Analysis					Standard Proctor Test		Specific Gravity	Unit Weight (pcf)		Coefficient of Permeability, k (cm/sec)	Consolidation Testing	Strength Testing		
								LL	PL	PI	< #200 Sieve (%)	% Gravel	% Sand	% Silt	% Clay	Max. Dry Density (pcf)	Optimum Moisture (%)		Wet	Dry			CU Triaxial Shear Strength	Undrained Shear Strength	Unconfined Compressive Strength
Duke	Ash Basin Dam	C-4	Shelby Tube	789	9.5 - 11.5	Olive Yellow SILTY SAND (SM), fill	20.6	NP	NP	NP	46.7	0.0	53.3	41.8	4.9			2.730	123				*		
		C-6	Shelby Tube	771	3.0 - 6.6	Light Brown Gray SILTY SAND (SM), fill	16.7	NP	NP	NP	30.7	2.5	66.8	65.0	1.8			2.750	134				*		
			Shelby Tube	770	5.0 - 6.6	SILT (ML)	17.8	30	23	7									128	108	4.69E-07	*			
		C-7	Shelby Tube	777	19.1 - 21.1	Yellow Brown CLAYEY SANDY SILT (SM-ML), fill	19.6	38	28	10	47.6	1.2	51.2	40.7	6.9			2.700	127				*		
		C-8	Shelby Tube	776	9.4 - 11.4	Yellowish Gray SILTY SAND (SM), fill	18.2	NP	NP	NP	25.3	0.0	74.7	22.5	2.8			2.730	122	103	5.28E-07	*	*		
		C-10	Shelby Tube	790	5.0 - 7.0	Yellowish Brown SILTY SAND (SM), fill	23.3	NP	NP	NP	48.7	0.0	51.3	43.7	5.0			2.720	121		1.38E-06	*	*		
			Shelby Tube	775	20.0 - 22.0	Light Yellow Brown SILTY SAND (SM), fill	20.9	30	26	4	42.0	0.0	58.0	33.4	8.6			2.670	126		1.05E-06		*		
S&ME	Ash Basin	P-5/B-2	Split Spoon	SS-2	8.5 - 10.0	Red Brown SANDY SILT (ML), fill	27.9																		
		B-4	Split Spoon	SS-5	6.0 - 7.5	Red Brown SAND CLAYEY SILT (MH), fill	19.6																		
HDR	Ash Basin Dam	AB-1BR	Sonic	Jar	4.0 - 5.0	Brown CLAYEY SILTY SAND, fill	15.1				40.1	0.1	59.8	22.0	18.1										
			Sonic	Jar	9.0 - 10.0	Red-Brown CLAEY SILTY SAND, fill	23.9				44.7	0.0	55.3	24.2	20.5										
			Sonic	Jar	14.0 - 15.0	Red-Brown SANDY SILT, fill	28.1				52.2	0.0	47.8	30.9	21.3										
			Shelby Tube	UD	10.0 - 12.0	Red-Brown SANDY SILT (ML), fill		30	42	12	52.7	0.0	47.3	22.2	30.5			2.646			1.68E-05				
			Shelby Tube	UD	20.0 - 22.0	Tan-Brown SILTY SAND (SM), fill		NP	32	NP	28.7	0.0	71.3	23.5	5.2			2.643			1.12E-04				
		AB-1S	Shelby Tube	UD	32.0 - 34.0	Tan-Brown SILTY SAND (SM), fill		31	36	5	49.7	1.8	48.5	29.7	20.0			2.655							
		AB-2D	Sonic	Jar	20.0 - 22.0	Orange-Brown CLAYEY SILTY SAND, fill	27.9				44.0	1.5	54.5	29.6	14.4										
			Sonic	Jar	25.0 - 27.0	Red-Brown SANDY CLAYEY SILT, fill	24.1				53.2	0.4	46.4	32.5	20.7										
			Sonic	Jar	35.0 - 37.0	Red-Brown SILTY SNAD, fill	20.8				45.3	0.2	54.5	29.5	15.8										
			Sonic	Jar	40.0 - 42.0	Tan-Brown SILTY SAND, fill	21.1				50.4	0.0	49.6	25.7	24.7										

Notes:
* Refer to corresponding laboratory test data sheets for test results
** The data shown in this table is representative of material within the limits of impountment.

Notes:
* Refer to corresponding laboratory test data sheets for test results
** The data shown in this table is representative of material within the limits of impountment.

Table 10-1: Marshall Steam Station Regulatory Permits, Approvals, or Requirements for Ash Basin Closure by Excavation

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		Permit Modification Likely Required	Permit modification likely needed due to the increased heavy equipment vehicle traffic and potential dust generated during closure activities
Building Permit	Catawba County		New Permit	A local building permit is required for installation of construction trailers
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	
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	USACOE NCDEQ		Individual Permit likely required	Jurisdictional Areas impacts associated with Ash Basin Closure
Clean Water Act 404	USACOE NCDEQ		Individual Permit likely required	Jurisdictional Areas impacts associated with Ash Basin Closure
Closure Plan	NCDEQ		Approval by Letter	
Cutting Trees	USACOE NCDEQ		Permit associated with other permits likely	See permitting for sedimentation/erosion control, Threatened or Endangered Species, and Wetlands. Tree cutting could be covered under some or all of these permits.
Dam Safety	NCDEQ	CATAW-054	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	CATAW-054	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)

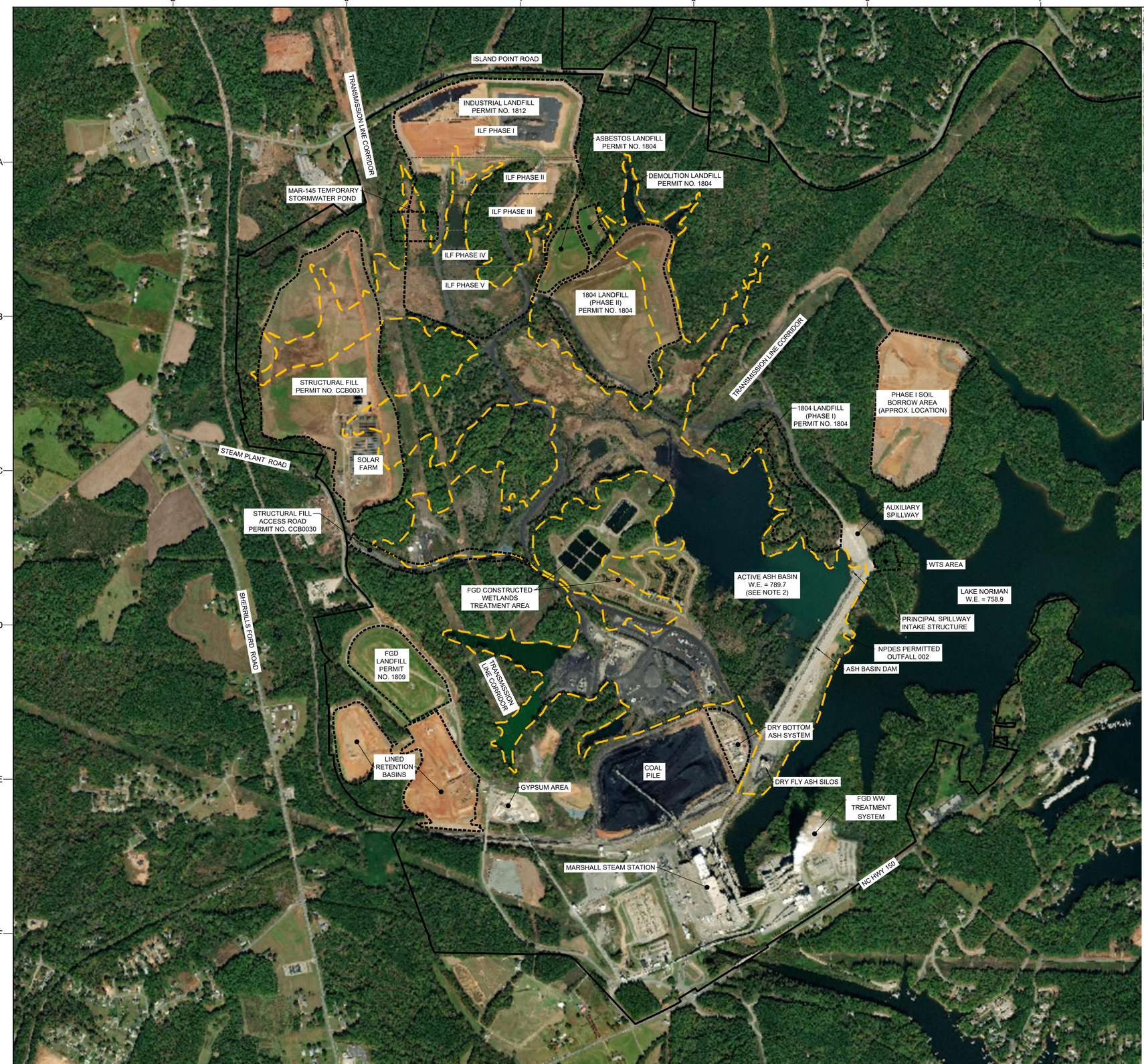
DOT - General				Utilization of or modification to state or federal highways to transport CCR will require consultation or notification to relevent DOT agency (if off-site removal is required)
Driveway Permit	NCDOT		New Permit possible	
Erosion and Sediment Control (E&SC)	NCDEQ		New Permit	Land disturbance activities outside of the ash basin will exceed one acre, therefore in conformance with 15A NCAC 04, an E&SC Permit is required from Land Quality prior to commencement of construction in those areas. Note that land disturbance includes tree clearing and grubbing and vehicular wheel or tracking as disturbance.
FERC (Ferderal Energy Regulatiory Commission)	FERC		Approval by Letter	Requirements set forth in the Duke Energy Catawba-Wateree Shoreline Management Plan will be met. As required by the FERC Catawba-Wateree Project License P-2232, issued November 25, 2015, approval for any placement of fill into Lake Norman will be obtained by FERC prior to commencing closure construction activities.
Fire Ants			Restriction not likely	Removal from or import of material could be restricted dependant on the potential for fire ants and geographic regions involved
Floodplain Development	Catawba County		New Permit	Section 44-429 of the Catawba County Code of Ordinances, requires a Floodplain Development Permit prior to any development activities within FEMA mapped Special Flood Hazard Areas for the Flood Insurance Rate Maps

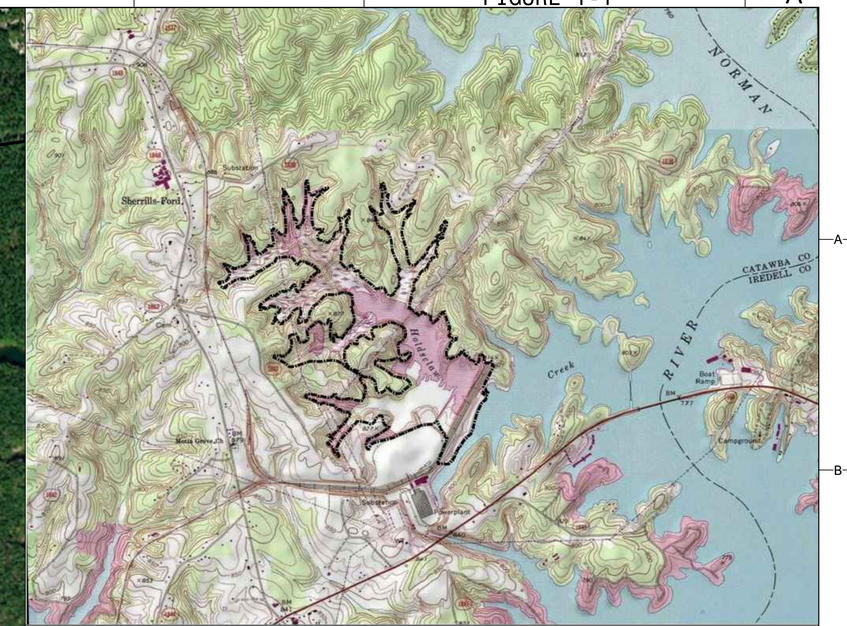
Floodplain Development	DHS FEMA		Floodplain Map Revision	MT-2 Form 1, Form 2, Form 3, and associated documentation for the request of a Conditional Letter of Map Revision (C-LOMR) will be completed and submitted to the Department of Homeland Security Federal Emergency Management Agency (DHS FEMA) prior to closure activities. Upon completion of Ash Basin closure activities, a Letter of Map Revision (LOMR) will be requested from DHS FEMA through submittal of the aforementioned forms and a copy of the as-built plans.
Large Capacity Water Supply Well	NCDEQ		New Permit possible	Permits are required to construct any water supply well or water well system with a design capacity equal to or greater than 100,00 gallons per day - for dewatering outside of the ash basin
Multi-State Agreement				If movement of CCR will cross state lines, multi-state regulations might apply
NPDES (National Pollution Discharge Elimination System) Wastewater	NCDEQ	NC0004987	Permit modification likely	Modification of NPDES may be necessary if new source or outfall is created.
NPDES (National Pollution Discharge Elimination System) Industrial Stormwater	NCDEQ	NCS000548	Permit modification likely	Revision to existing sitewide permit or new permit may be required for access roads, staging areas, etc.
NPDES (National Pollution Discharge Elimination System) Stormwater	NCDEQ		New Permit possible	Permit required for temporary and permanent stormwater rerouting.
Noxious Weeds				Removal from or import of vegetated material could be restricted dependant on the vegetation and geographic regions involved
Railroad Easement, Access, or Crossing Permit				Construction activities adjacent to tracks/ballast or a new railroad crossing require an agreement or permit
SPCC (Spill Prevention Control and Countermeasure) Plan	US EPA		Modification of existing plan	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	US EPA NCDEQ			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	NCDEQ	CCB0030	Approval by Letter	According to 15A NCAC 13B .1625, disturbance of any closed landfill or permitted beneficial use facility will be subject to approval by the Division of Waste Management (DWM). Required for the excavation of the Structural Fill Access Road.

FIGURES

FIGURE 1-1 REV. A





8320 NC-150
SHERRILLS FORD, NORTH CAROLINA 28673

LEGEND

———	PROPERTY BOUNDARY
— — —	ASH BASIN WASTE BOUNDARY (APPROXIMATE)
- - - - -	EXISTING SITE FEATURE (APPROXIMATE)
- - - - -	INDUSTRIAL LANDFILL (ILF) PHASE BOUNDARY (APPROXIMATE)
W.E.	WATER ELEVATION

REFERENCES

1. THE AERIAL PHOTOGRAPH WAS OBTAINED FROM BING (MICROSOFT CORPORATION, 2018).
2. EXISTING FREE WATER ELEVATIONS WITH THE ASH BASIN REPRESENT PRE-DECANTING WATER ELEVATIONS.

N

0 600 1200 1800
GRAPHIC SCALE (IN FEET)

AECOM

TITLE
VICINITY MAP AND SITE PLAN

MARSHALL STEAM STATION
CLOSURE BY EXCAVATION CLOSURE PLAN
CATAWBA COUNTY, NORTH CAROLINA

FOR
ISSUED FOR APPROVAL

DUKE ENERGY®

SCALE: 1"=600'	DES: MSR
DWG TYPE: .DWG	DFTR: MSR
JOB NO: 60572849	CHKD: GL
DATE: 10-4-19	ENGR: RJB
FILENAME: FIGURE 1-1.DWG	APPD: JB

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22.0"x34.0"	FIGURE 1-1	A

FIGURE 1-1 REV. A

FIGURE 3-1 REV. A

LEGEND

———	PROPERTY BOUNDARY
— — —	ASH BASIN WASTE BOUNDARY (APPROXIMATE)
- - - - -	EXISTING SITE FEATURE (APPROXIMATE)
— — — —	EXISTING MAJOR TOPOGRAPHIC CONTOUR
- - - - -	EXISTING MINOR TOPOGRAPHIC CONTOUR
- - - - -	INDUSTRIAL LANDFILL (ILF) PHASE BOUNDARY (APPROXIMATE)
W.E.	WATER ELEVATION

NOTES

1. BASIS OF BEARINGS: NC GRID NAD83/2011. ELEVATIONS ARE BASED ON NAVD88.
2. WATER SURFACE ELEVATION WILL VARY DUE TO ONGOING DECANTING PROCESS.

REFERENCES

1. THE EXISTING SURVEY INFORMATION (TOPOGRAPHY, PLANIMETRICS, ETC.) IS BASED ON THE TOPOGRAPHIC SURVEY PERFORMED BY WSP IN APRIL 2014 AND SUBMITTED TO DUKE ENERGY IN JULY 2015, AS WELL AS AN ADDITIONAL TOPOGRAPHIC SURVEY PERFORMED BY WSP IN JANUARY 2016. IT WAS FURTHER SUPPLEMENTED BY THE MARSHALL STEAM STATION ACTIVE ASH BASIN DAM, PRINCIPAL SPILLWAY REPLACEMENT AND AUXILIARY SPILLWAY MODIFICATION RECORD DRAWINGS, DATED NOVEMBER 11, 2016, BY THE EXISTING DAM TOPOGRAPHIC SURVEY AS-BUILT DRAWINGS SUBMITTED BY ESP TO DUKE ENERGY ON AUGUST 20, 2015, AND BY THE MARSHALL 2018 ANNUAL SURVEY, DATED MAY 8, 2018.
2. WATER ELEVATIONS PRESENTED IN THIS FIGURE ARE BASED ON THE TOPOGRAPHIC SURVEY PERFORMED BY WSP IN APRIL 2014 AND SUBMITTED TO DUKE ENERGY IN JULY 2015.
3. THE ASH BASIN WASTE BOUNDARY, THE PERIMETERS OF THE 1804 LANDFILL (PHASES I AND II), STRUCTURAL FILL, FGD LANDFILL, ASBESTOS LANDFILL, AND DEMOLITION LANDFILL PRESENTED IN THIS FIGURE ARE BASED ON THE "2018 COMPREHENSIVE SITE ASSESSMENT UPDATE," PREPARED BY SYNTERRA FOR DUKE ENERGY AND SUBMITTED TO NCDEQ (NPDES PERMIT NO. NC0004987) ON JANUARY 31, 2018.
4. PROPERTY BOUNDARIES AND THE EXTENTS OF LAKE NORMAN PRESENTED IN THIS FIGURE ARE BASED ON THE CATAWBA COUNTY GIS, THE TOPOGRAPHIC SURVEY PERFORMED BY WSP IN APRIL 2014 AND SUBMITTED TO DUKE ENERGY IN JULY 2015, AND THE "BOUNDARY SURVEY OF PROPERTY TO BE ACQUIRED FROM DELMAR SHERRILL AND GEORGE C. SHERRILL" DATED JANUARY 27, 2016.
5. THE PERIMETER OF THE STRUCTURAL FILL ACCESS ROAD PRESENTED IN THIS FIGURE IS BASED ON THE "MARSHALL STEAM STATION STRUCTURAL FILL CLOSURE REQUIREMENT AND RECORDATION (RECORD NUMBER: 006021MS)" LETTER SUBMITTED TO THE NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES BY DUKE POWER ON JULY 8, 1998.
6. THE PERIMETER OF THE INDUSTRIAL LANDFILL PRESENTED IN THIS FIGURE WAS PROVIDED BY DUKE ENERGY.

AECOM

TITLE
EXISTING ON-SITE LANDFILLS AND STRUCTURAL FILLS
MARSHALL STEAM STATION
CLOSURE BY EXCAVATION CLOSURE PLAN
CATAWBA COUNTY, NORTH CAROLINA

FOR
ISSUED FOR APPROVAL

DUKE ENERGY®

SCALE: 1"=600'	DES: MSR	
DWG TYPE: .DWG	DFTR: JMW	
JOB NO: 60572849	CHKD: GL	
DATE: 10-4-19	ENGR: RJB	
	APPD: JAB	

FILENAME: FIGURE 3-1.DWG

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22.0"x34.0"	FIGURE 3-1	A

FIGURE 3-1 REV. A

APPENDICES