GROUNDWATER ASSESSMENT WORK PLAN

FOR

H.F. LEE ENERGY COMPLEX
1199 BLACK JACK CHURCH ROAD
GOLDSBORO, NORTH CAROLINA 27530
NPDES PERMIT #NC0003417
N 35.373212/W -78.089031W

PREPARED FOR

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
<td></td>
</tr>
<tr>
<td>1.0 Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2.0 Site History and Source Characterization</td>
<td>3</td>
</tr>
<tr>
<td>2.1 Plant Description</td>
<td>3</td>
</tr>
<tr>
<td>2.2 Ash Basins</td>
<td>3</td>
</tr>
<tr>
<td>2.3 Groundwater Monitoring System</td>
<td>3</td>
</tr>
<tr>
<td>3.0 Receptor Information</td>
<td>5</td>
</tr>
<tr>
<td>4.0 Regional Geology and Hydrogeology</td>
<td>7</td>
</tr>
<tr>
<td>5.0 Site Geology and Hydrogeology</td>
<td>8</td>
</tr>
<tr>
<td>6.0 Groundwater Monitoring Results</td>
<td>9</td>
</tr>
<tr>
<td>6.1 Groundwater Analytical Results</td>
<td>9</td>
</tr>
<tr>
<td>6.2 Preliminary Statistical Evaluation Results</td>
<td>9</td>
</tr>
<tr>
<td>7.0 Assessment Work Plan</td>
<td>12</td>
</tr>
<tr>
<td>7.1 Anticipated Ash Basin Boring Locations</td>
<td>12</td>
</tr>
<tr>
<td>7.2 Anticipated Soil Boring Locations</td>
<td>13</td>
</tr>
<tr>
<td>7.2.1 Inside Ash Basins</td>
<td>13</td>
</tr>
<tr>
<td>7.2.2 Outside Ash Basins</td>
<td>13</td>
</tr>
<tr>
<td>7.3 Anticipated Sediment and Surface Water Locations</td>
<td>13</td>
</tr>
<tr>
<td>7.4 Anticipated Groundwater Monitoring Wells and Piezometers</td>
<td>13</td>
</tr>
<tr>
<td>7.4.1 General Construction, Development, Aquifer Testing</td>
<td>14</td>
</tr>
<tr>
<td>7.4.2 Background Wells</td>
<td>15</td>
</tr>
<tr>
<td>7.4.3 Ash Management Areas</td>
<td>16</td>
</tr>
<tr>
<td>7.4.4 Downgradient Assessment Areas</td>
<td>16</td>
</tr>
<tr>
<td>7.4.5 Groundwater Sampling</td>
<td>17</td>
</tr>
<tr>
<td>7.5 Influence of Pumping Wells on Groundwater System</td>
<td>17</td>
</tr>
<tr>
<td>7.6 Site Conceptual Model</td>
<td>17</td>
</tr>
<tr>
<td>7.7 Development of Groundwater Computer Model</td>
<td>18</td>
</tr>
<tr>
<td>8.0 Implementation Schedule and Report Submittal</td>
<td>19</td>
</tr>
<tr>
<td>9.0 References</td>
<td>21</td>
</tr>
</tbody>
</table>
List of Figures

Figure 1 - Site Location Map
Figure 2 - Site Layout-Inactive Ash Basins
Figure 3 - Site Layout-Active Ash Basin
Figure 4 - Geology Map
Figure 5 - Anticipated Sample Locations-Inactive Ash Basins
Figure 6 - Anticipated Sample Locations-Active Ash Basin

List of Tables

Table 1 - Summary of Concentration Ranges for Constituents Detected Greater than 2L Standards
Table 2 - Groundwater Assessment Parameter List
Table 3 - Assessment Sample Plan

List of Appendices

Appendix A - NCDENR Letter of August 13, 2014
EXECUTIVE SUMMARY

Duke Energy Progress, Inc. (Duke Energy) owns and operates the H.F. Lee Energy Complex located in central eastern North Carolina near Goldsboro, North Carolina. The Lee Plant began operations in 1951, adding coal-fired units in the early 1950s and 1960s. The Lee Plant employed various combinations of three coal-fired units along with four oil-fueled combustion turbine units to produce energy. Ash generated from coal combustion was stored on-site in ash management basins. The three coal-fired units were retired in September 2012 followed by four oil-fueled combustion turbine units in October 2012. In December 2012, the H.F. Lee Combined Cycle Plant was brought on-line. Ash is no longer produced as part of electricity generation at the site.

Wastewater discharges from the active ash basin is permitted by the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Resources (DWR) under National Pollution Discharge Elimination System (NPDES) Permit NC0003417.

In a letter dated August 13, 2014, the DWR issued a Notice of Regulatory Requirements (NORR) letter to Duke Energy pursuant to Title 15A North Carolina Administrative Code Chapter 02L.0106. The NORR stipulates that for each coal-fueled plant owned, Duke Energy will conduct a comprehensive site assessment (CSA) that includes a Groundwater Assessment Work Plan (Work Plan) and a receptor survey. This work plan has also been prepared to fulfill the requirements stipulated in Coal Ash Management Act 2014 – North Carolina Senate Bill 729 (August, 2014).

The following assessment plan anticipates:

- Implementation of a receptor survey to identify water supply wells, public water supplies, surface water bodies, and wellhead protection areas (if present) within a 0.5 mile radius of the Lee Plant waste compliance boundary;
- Installation of borings within the ash basins for chemical and geotechnical analysis of residuals and in-place soils;
- Installation of background soil borings;
- Installation of monitoring wells and piezometers;
- Collection and analysis of groundwater samples from existing site wells and newly installed monitoring wells;
- Statistical evaluation of groundwater analytical data; and
- Development of a groundwater model to evaluate the long term fate and transport of constituents of concern in groundwater associated with the ash management units.

The information obtained through this Work Plan will be utilized to prepare a CSA report in accordance with the Notice of Regulatory Requirements (NORR). In addition to the components listed above, a human health and ecological risk assessment will be conducted. This assessment will include the preparation of a conceptual site model illustrating potential pathways from the source to possible receptors.

During the CSA process if additional investigations are required, NCDENR will be notified.
1.0 INTRODUCTION

Duke Energy Progress, Inc. (Duke Energy) owns and operates the H.F. Lee Energy Complex (Lee Plant) located at 1199 Black Jack Church Road, Goldsboro, North Carolina. The property encompasses approximately 2,100 acres, including the approximately 314-acre ash basins (171-acre inactive ash basins and 143-acre active ash basin). The property includes the cooling pond (Quaker Neck Lake), located to the east of the plant operations area. The Neuse River flows through the property as shown on Figure 1.

The Lee Plant began commercial operation in 1951. Three coal-fired units were retired in September 2012 followed by four oil-fueled combustion turbine units in October 2012. In December 2012, the H.F. Lee Combined Cycle Plant was brought on-line. The Combined Cycle Plant applies two sources of energy – combustion and steam turbines – to convert natural gas to electricity.

Coal combustion residues (CCR) have been managed in the Plant’s on-site ash basins, which includes three inactive ash basins located to the west of the plant operations area and an active ash basin northeast of the operations area (Figure 1). The individual ash management areas are shown on Figures 2 and 3. Discharges from the ash basins are permitted by the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Resources (DWR) under the National Pollution Discharge Elimination System (NPDES).

Groundwater monitoring has been performed in accordance with the conditions of NPDES Permit #NC0003417 beginning in December 2010. Current groundwater compliance monitoring for the Lee Plant ash basins includes the sampling of five (5) wells at the inactive ash basins, one (1) background well and four (4) compliance boundary wells, and eight (8) wells at the active ash basin, two background wells and six (6) compliance boundary wells.

The compliance boundary for the Plant is defined in accordance with NCAC Title 15A Chapter 02L.0107(a) (T15 A NCAC 02L .0107(a)) as being established at either 500 feet from the waste boundary or at the property boundary, whichever is closest.

In a Notice of Regulatory Requirements (NORR) letter dated August 13, 2014, the DWR of the NCDENR requested that Duke Energy prepare a Groundwater Assessment Plan to conduct a Comprehensive Site Assessment (CSA) in accordance with 15A NCAC 02L .0106(g) to address groundwater constituents detected at concentrations greater than 2L Standards at the compliance boundary and develop a Corrective Action Plan (CAP). A
summary of these concentrations is provided in Table 1 and a copy of the DWR letter is provided in Appendix A.

SynTerra has prepared this Work Plan on behalf of Duke Energy to fulfill the DWR letter request and to satisfy the requirements of NC Senate Bill 729 as ratified August 2014.

Specifically, this document describes the plans to meet the requirements of 15A NCAC 02L .0106 including the following:

- Identify the source and cause of contamination;
- Identify any imminent hazards to public health and safety and actions taken to mitigate them in accordance to 15A NCAC 02L .0106(f);
- Identify receptors and significant exposure pathways;
- Determine the horizontal and vertical extent of soil and groundwater contamination and significant factors affecting contaminant transport; and
- Determine geological and hydrogeological features influencing the movement, chemical, and physical character of the contaminants.

The information obtained through this Work Plan will be utilized to prepare a CSA report in accordance with the requirements of the NORR. In addition to the components listed above, a human health and ecological risk assessment will be conducted. This assessment will include the preparation of a conceptual site model illustrating potential pathways from the source to possible receptors.

During the CSA process if additional investigations are required, NCDENR will be notified.
2.0 SITE HISTORY AND SOURCE CHARACTERIZATION

2.1 Plant Description
The Lee Plant was a coal-fired electricity-generating facility located west of Goldsboro in Wayne County, North Carolina, as shown on Figure 1.

The Lee Plant began commercial operation in 1951. Additional coal units were added in the late 1950s and early 1960s, and four oil-fueled combustion turbine units in the late 1960s and early 1970s. The three coal-fired units were retired in September 2012 followed by four oil-fueled combustion turbine units in October 2012. In December 2012 the H.F. Lee Combined Cycle Plant was brought on-line. The Combined Cycle Plant applies two sources of energy – combustion and steam turbines – to convert natural gas to electricity.

Surface topography slopes downward toward the Neuse River, which bisects the Lee Plant property, entering along the southern property line at a point approximately 500 feet west of the plant. The river then flows north through the plant property before gradually bending eastward around the north side of the plant. A diversion canal with flow control structures connects the northern and southern sections of the river.

2.2 Ash Basins
Ash generated from coal combustion was conveyed to the ash basins, which include the inactive and active basins. Combined, the active and inactive ash basins encompass approximately 314-acres (171-acres for the inactive ash basins and 143-acres for the active ash basin). The inactive ash basins were built as three cells in approximately the late 1950s and early 1960s. The active ash basin was constructed in the late 1970s. Sluicing fly ash and bottom ash at the active basin was discontinued in late 2012 to early 2013 due to the plant no longer generating coal combustion residuals.

Discharges from the ash basins are permitted by the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Resources (DWR) under the National Pollution Discharge Elimination System (NPDES) Permit NC0003417.

2.3 Groundwater Monitoring System
Current groundwater compliance monitoring for the Lee Plant ash basins consists of sampling of five (5) wells at the inactive ash basins, one (1) background well and four (4) compliance boundary wells, and eight (8) wells at the active ash basin, two background wells and six (6) compliance boundary wells. The locations of the monitoring wells, the waste boundary, and the compliance boundary are shown on Figures 2 and 3.
The compliance monitoring network at the inactive ash basin includes one background well, BW-1, and four monitoring wells located at downgradient positions along the compliance boundary.

The compliance monitoring network at the active ash basin includes two background monitoring wells, BGMW-9 and BGMW-10, plus six monitoring wells located at side-gradient and down-gradient positions along the compliance boundary. Background well BGMW-10 and compliance boundary well CMW-6R were installed in September 2012. BGMW-10 was installed to provide additional background groundwater quality data and CMW-6R was installed as a replacement for well CMW-6 to reflect the revised compliance boundary.

Monitoring wells at the inactive and active ash basins were installed as shallow, water table wells, with the exception of well CTMW-1, which was installed as a deep well, paired with adjacent shallow well CMW-5, to monitor the vertical hydraulic gradient in the area.

Groundwater monitoring for the active ash basin compliance wells began in December 2010, with the exception of wells CMW-6R and BGMW-10, which were first sampled in October, 2012. Groundwater monitoring for the inactive basins began in 2011.

In accordance with the current NPDES permit, the monitoring wells are sampled three times per year in March, June, and October. Analytical results for the compliance monitoring program are compared to the 2L Standards or site-specific background concentrations. A summary of the NPDES monitoring requirements is provided below.

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</thead>
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<td>CMW-6R, CMW-7, CMW-8, and CMW-10</td>
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<td>(Inactive Basins) BW-1, CW-1, CW-2,</td>
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3.0 RECEPTOR INFORMATION

The August 13, 2014 NORR states:

No later than October 14th, 2014 as authorized pursuant to 15A NCAC 02L.0106(g), the DWR is requesting that Duke perform a receptor survey at each of the subject facilities and submitted to the DWR. The receptor survey is required by 15A NCAC 02L.0106(g) and shall include identification of all receptors within a radius of 2,640 feet (one-half mile) from the established compliance boundary identified in the respective National Pollutant Discharge Elimination System (NPDES) permits. Receptors shall include, but shall not be limited to, public and private water supply wells (including irrigation wells and unused or abandoned wells) and surface water features within one-half mile of the facility compliance boundary. For those facilities for which Duke has already submitted a receptor survey, please update your submittals to ensure they meet the requirements stated in this letter and referenced attachments and submit them with the others. If they do not meet these requirements, you must modify and resubmit the plans.

The results of the receptor survey shall be presented on a sufficiently scaled map. The map shall show the coal ash facility location, the facility property boundary, the waste and compliance boundaries, and all monitoring wells listed in the respective NPDES permits. Any identified water supply wells shall be located on the map and shall have the well owner’s name and location address listed on a separate table that can be matched to its location on the map.

In accordance with the requirements of the NORR, SynTerra is in the process of conducting a receptor survey to identify water supply wells, public water supplies, surface water bodies, and wellhead protection areas (if present) within a 0.5 mile radius of the Lee Plant compliance boundary. The compliance boundary for groundwater quality, in relation to the ash basins, is defined in accordance with 15A NCAC 02L.0107(a) as being established at either 500 feet from the waste boundary or at the property boundary, whichever is closer to the source. The receptors include public and private water supply wells (including irrigation wells and unused or abandoned wells) and surface water features within a 0.5-mile radius of the Lee Plant compliance boundary.

The survey consists of a review of publicly available data from NCDENR Department of Environmental Health (DEH), NC OneMap GeoSpatial Portal, DWR Source Water Assessment Program (SWAP) online database, City of Goldsboro, Wayne County, Fork Township Sanitary District (FTSD), Wayne Water Districts, Environmental Data...
Resources, Inc. (EDR) Records Review, the USGS National Hydrography Dataset (NHD), as well as a vehicular survey along public roads located within 0.5 mile radius of the compliance boundary.

Additional receptor information will be collected as part of the anticipated assessment to comply with the CSA guidelines (NCDENR August 2014).
4.0 REGIONAL GEOLOGY AND HYDROGEOLOGY

Geographically, the Lee Plant lies within the Coastal Plain Physiographic Province (North Carolina Department of Natural Resources and Community Development, 1985), which is approximately 90 to 150 miles wide from the Atlantic Ocean westward to its boundary with the Piedmont province (Winner, Jr. and Coble, 1989). Two natural subdivisions of the Coastal Plain were described by Stuckey (1965): the Tidewater region and the Inner Coastal Plain. The Lee Plant is located within the Inner Coastal Plain, which consists of the gently rolling land surface between the Tidewater region and the Fall Line (Winner, Jr. and Coble, 1989), which is located approximately 20 miles west of the Plant.

The geology at the site consists of surficial sand of post Miocene age, which is typically less than 40 feet thick. Underlying the surficial sand is the Yorktown and Duplin Formation (undifferentiated) of late Miocene age (Figure 4). The Yorktown Formation is a fossiliferous clay with varying amounts of fine-grained sand, bluish gray, and shell material commonly concentrated in lenses; mainly in areas north of Neuse River. The Duplin Formation consists of shelly, medium- to coarse-grained sand, sandy marl, and limestone, bluish gray; mainly in areas south of Neuse River. The thickness of this unit varies, but, based on previous site work, is typically less than 60 feet thick in the vicinity of the Lee Plant.

Below the Yorktown/Duplin Formations is the Cape Fear Formation. The lithology and the thickness of this unit varies regionally but has been described as a yellow conglomeritic marl containing abundant phosphate and quartz pebbles, sharks teeth and fish vertebrae.

The Coastal Plain groundwater flow system consists of aquifers made of relatively permeable sand, gravel and limestone separated by confining units of relatively low hydraulic conductivity. The flow of groundwater is controlled by boundary conditions such as streams and rivers that have cut into the aquifer, lakes, extraction wells, etc., but generally moves to the southeast following the flow direction of the Neuse River. The average estimated hydraulic conductivity is 29 feet per day (Winner, Jr. and Coble, 1989).

In the general vicinity of the Lee Plant, precipitation ranges from 45 to 50 inches per year with recharge averaging from 7.9 to 9.8 inches per year, or 17.5% to 19.6% of the precipitation total [NCDENR, 2013a].
5.0 SITE GEOLOGY AND HYDROGEOLOGY

Field activities at the Plant site indicate that the lithology generally consists of a layer of silty to clayey surficial deposits underlain by interbedded clay and sand of the Yorktown Formation. The data suggest that the base of the surficial aquifer is a clay aquitard present at approximately 30 ft. MSL elevation.

The Plant property is bisected by the Neuse River, which flows along the southern property line to approximately 500 feet west of the plant and then flows north through the property before gradually bending eastward and then south. A diversion canal, with flow control structures, connects the northern and southern sections of the river.

Groundwater flow is toward the Neuse River, which will be the primary downgradient hydraulic boundary for the site. Vertical groundwater flow is anticipated to be limited by a local clay confining layer within the Yorktown Formation at an elevation of approximately 30 feet MSL.

Surface topography at the Plant slopes downward toward the Neuse River. The Neuse River near the Site is not tidally influenced, but the river stage does respond to overland flow and groundwater flow to the river. Measurements taken at the nearby USGS gauging Station 02089000 (Neuse River near Goldsboro, NC [USGS, 2013]), show that the Neuse River water level elevation has ranged between approximately 45 feet and 63 feet NAVD88.

Other surface water features include the Lee Plant diversion canal, Halfmile Branch, and Beaverdam Creek. Each of these features feeds the Neuse River.
6.0 GROUNDWATER MONITORING RESULTS

6.1 Groundwater Analytical Results
For most of the active ash basin compliance monitoring wells, June 2014 was the twelfth monitoring event conducted in accordance with the NPDES Permit. Analytical data indicates that elevated concentrations of boron, iron, manganese, and pH are routinely detected at the inactive active ash basins, while elevated concentrations of arsenic, boron, iron, manganese, and pH are routinely detected at the active ash basin. Concentration ranges for these constituents are provided in Table 1.

- Arsenic tends to be detected at concentrations near or greater than the 2L Standard in compliance boundary well CMW-6R at the active ash basin. It has not been detected at greater than the 2L Standard at the inactive ash basin compliance boundary wells.

- Boron tends to be detected at concentrations near or greater than the 2L Standard in compliance boundary well CW-3 at the inactive ash basins and routinely greater than the 2L Standard at compliance boundary wells CMW-5 and CMW-6R at the active ash basin with infrequent elevated concentrations detected at well CMW-8.

- Iron tends to be detected at concentrations greater than the 2L Standard in the background and compliance boundary wells at the active and inactive ash basins.

- Manganese tends to be detected at concentrations greater than the 2L Standard in the background and compliance boundary wells at the active and inactive ash basins.

- In general, groundwater pH tends to be slightly below 6.5 Standard Units (SU) at background and compliance wells for the active and inactive basins, which is below the lower end of the 2L Standard range.

Chromium, lead, selenium and total dissolved solids (TDS) have each been detected in at least one background or compliance boundary well at concentrations greater than the 2L Standard. However, these constituents have not been detected at an elevated concentration with regularity and are believed to be related to sample turbidity or represent data outliers.

6.2 Preliminary Statistical Evaluation Results
As a preliminary evaluation tool, statistical analysis was conducted on the groundwater analytical data collected between December 2010 and June 2014. The statistical analysis was conducted in accordance with US EPA, *Statistical Training Course for Ground Water Monitoring Data Analysis*, EPA530-R-93-003, 1992 and US EPA’s *Statistical Analysis of...*
An inter-well prediction interval statistical analysis was utilized to evaluate the groundwater data. The inter-well prediction interval statistical evaluation involves comparing background well data to the results for the most recent sample date from compliance boundary wells.

Monitoring well BW-1 is the upgradient background well for the inactive basins and monitoring wells CW-1, CW-2, CW-3, and CW-4 are considered downgradient compliance boundary wells for the inactive basins. Wells BGMW-9 and BGMW-10 are the upgradient background wells for the active ash basin, while monitoring wells CTMW-1, CMW-5, CMW-6R, CMW-7, CMW-8, and CMW-10 are considered downgradient compliance boundary wells for the active ash basin. Statistical analysis was performed on the inorganic constituents with detectable concentrations for the most recent routine sampling event (June 2014).

The statistical analysis indicated statistically significant increases (SSIs) over background concentrations at the inactive and active basins at the following wells for the listed constituents:

**Inactive Ash Basins**

- CW-1 - chloride and nickel (however, concentrations for both constituents are consistently less than the 2L Standard);
- CW-2 - chloride, nickel, and zinc (however, concentrations for all three constituents are consistently less than the 2L Standard);
- CW-3 and CW-4 – none of the constituents detected were indicated to be SSIs.

**Active Ash Basin**

- CTMW-1 - boron (however, the concentration is consistently much less than the 2L Standard);
- CMW-5 - boron (boron is routinely detected at concentrations greater than the 2L Standard);
- CMW-6R - arsenic, boron, iron, manganese, and total dissolved solids (TDS) (arsenic, boron, iron and manganese are routinely detected at concentrations greater than the 2L Standard. TDS has only been detected at a concentration greater than the 2L Standard during one sampling event);
• CMW-7 - iron and manganese (iron and manganese are routinely detected at concentrations greater than the 2L Standard);

• CMW-8 - boron (boron has occasionally been detected at concentrations greater than the 2L Standard).

• CMW-10 – none of the constituents detected were indicated to be SSIs.

A more robust statistical analysis will be completed as part of the CSA using data from additional background wells.
7.0 ASSESSMENT WORK PLAN

The scope of work discussed in this plan is designed to meet the requirements of 15A NCAC 02L .0106(g) and to:

- Identify the source and cause of contamination;
- Identify any imminent hazards to public health and safety and actions taken to mitigate them in accordance to 15A NCAC 02L .0106(f);
- Identify all receptors and significant exposure pathways;
- Determine the horizontal and vertical extent of soil and groundwater contamination and all significant factors affecting contaminant transport; and
- Determine geological and hydrogeological features influencing the movement, chemical, and physical character of the contaminants.

The following sections generally describe anticipated assessment activities to fill data gaps associated with the source and vertical and horizontal extent, in soil and groundwater, for the constituents that have exceeded the 2L Standards. The assessment may be iterative with possible additional assessment activities prior to the preparation of the CSA. Groundwater samples collected will generally be analyzed for the constituents listed in Table 2. The following activities are anticipated at this time.

7.1 Anticipated Ash Basin Boring Locations

Based on assessment data available from previous studies at the Lee Plant, no additional borings are anticipated within the inactive ash basin. Four borings are anticipated within the active ash basin to determine the thickness of ash as well as to determine the current residual saturation. The anticipated boring locations are shown on Figure 6.

Borings may be conducted using Direct Push Technology (DPT) or Roto-Sonic drilling (or similar methods), to provide continuous soil cores through ash and into the underlying native soil. Drilling will be extended to approximately 20 feet below the bottom of the ash to allow for characterization of the underlying native soil.

Ash samples will be collected for laboratory analysis of total metals. Samples will also be analyzed for metals using the synthetic precipitation leaching procedure (SPLP) which is a method used to determine the potential mobility of the metals in the environment. To characterize the variation in ash composition, two samples, a shallow
and a deep, are anticipated at each location, if the ash thickness is less than 20 feet. If the thickness is greater than 20 feet, three samples (shallow, intermediate, and deep), may be collected. A summary of the boring details is provided in Table 3. The depths at which the samples are collected will be noted on sample IDs.

### 7.2 Anticipated Soil Boring Locations

#### 7.2.1 Inside Ash Basins

As discussed above, continuous soil sample drilling techniques may be used to conduct borings within the active ash basin. These borings are anticipated to extend to a depth of approximately 20 feet below the ash to characterize the native material below the active ash basin. No soil borings are anticipated within the inactive ash basin based on available data from previous investigations.

Soil samples are anticipated at each of the boring locations immediately below the ash and at the bottom of the borings to provide information on the vertical distribution of metals beneath the basin. Soil samples will be analyzed for total metals, SPLP metals, and geotechnical parameters. A summary of the anticipated boring details is provided in Table 3.

Following soil sample collection, the borings will be abandoned by filling with a bentonite-grout mixture or may be converted to a piezometer to measure groundwater fluctuations beneath the active ash basin.

#### 7.2.2 Outside Ash Basins

Based on assessment data available from previous studies at the Lee Plant, no borings are anticipated outside of the ash basin boundaries. However, after a thorough review of available data is completed, borings may be completed to address potential data gaps, if identified.

### 7.3 Anticipated Sediment and Surface Water Locations

Surface water and sediment samples are not anticipated at this time. Data associated with recent (August 2014) seep sampling will be used to infer preferential pathways and migration from groundwater to surface water in various areas of the plant. Seep data analysis may be used to guide the collection of additional sediment or surface water data in the future.

### 7.4 Anticipated Groundwater Monitoring Wells and Piezometers

A number of monitoring wells and piezometers are present at the site. These existing wells will be supplemented with additional wells to complete the CSA.
7.4.1 General Construction, Development, Aquifer Testing

Monitoring wells and piezometers will be constructed by North Carolina-licensed well drillers. Drilling equipment will be decontaminated prior to use at each location using a high pressure steam cleaner.

Monitoring wells will be constructed of 2-inch ID, National Sanitation Foundation (NSF) grade polyvinyl chloride (PVC) (ASTM 2012a,b) schedule 40 flush-joint threaded casing and 0.010-inch machine-slotted pre-packed screens appropriately sized sand for a gravel pack around the screen. Piezometers will be constructed of 1-inch ID, NSF Schedule 40 PVC flush-joint threaded casing and pre-packed screens.

Monitoring wells will be installed as nested Type II wells or as single wells. Nested wells will consist of a shallow well installed with the top of the well screen approximately five feet below the water table. The deeper well will be installed to a depth of approximately 50 feet below land surface, which is below the shallow confining unit and consistent with existing deep monitoring wells at the plant. This will provide information on the vertical distribution of aquifer characteristics (chemistry and aquifer parameters) as well was determining the magnitude of vertical hydraulic gradients.

For nested Type II wells, well screen intervals will typically be a 10 foot length for the shallow well and a 5-foot length for the deeper well. The deeper of the nested wells will be installed first. The monitoring wells will be constructed in accordance with 15A NCAC 02C (Well Construction Standards).

The monitoring wells will be completed with either steel above ground protective casings with locking caps or steel flush-mount manholes with locking expansion caps, and well tags. The protective covers will be secured and completed in a concrete collar and 2-foot square concrete pad.

Piezometers will be installed in a similar manner, but with 1-inch ID, NSF Schedule 40 PVC flush-joint threaded casing and pre-packed screens. A pelletized bentonite seal will be placed above the filter pack and the remainder of the annular space will be filled with a neat cement grout from the top of the upper bentonite seal to near ground surface. The piezometers will be completed with either steel above ground protective casings with locking caps or steel flush-mount manholes with locking expansion caps, and well tags. The protective covers will be secured and completed in a concrete collar and 1-foot square concrete pad.
Following installation, the monitoring wells will be developed in order to remove drill fluids, clay, silt, sand, and other fines which may have been introduced into the formation or sand pack during drilling and well installation, and to establish communication of the well with the aquifer. Well development will be performed using a portable submersible pump, which will be repeatedly moved up and down the well screen interval until the water obtained is relatively clear. Development will be continued by sustained pumping until monitoring parameters (e.g., conductivity, pH, temperature) are generally stabilized; estimated quantities of drilling fluids, if used, are removed; and, turbidity decreases to acceptable levels.

After the wells have been developed, hydraulic conductivity tests (rising head slug tests) will be conducted on each of the wells. The slug tests will be performed in general accordance with ASTM D4044-96 Standard Test Method (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers and NCDENR Performance and Analysis of Aquifer Slug Tests and Pumping Test Policy, dated May 31, 2007.

The data obtained during the slug tests will be reduced and analyzed using AQTESOLV™ for Windows, version 4.5, software to determine the hydraulic conductivity of the soils in the vicinity of wells.

Data loggers may also be placed in select wells for extended periods of time to monitor groundwater fluctuations in the shallow and deep zones along the Neuse River and monitor the influence of recharge from precipitation to the aquifer system.

### 7.4.2 Background Wells
Existing background wells BW-1 (inactive ash basins) and BGMW-9 and BGMW-10 (active ash basin) are intended to provide representative data for comparison with background groundwater conditions. Additional background well data will be useful to broaden the range of potential background groundwater concentrations. Therefore, three additional background well pairs BW-2S/BW-2D, BW-3S/BW-3D, and BW-4S/D along with one deep well (AW-2D), installed adjacent to shallow background well BGMW-9, are anticipated at the locations shown on Figures 5 and 6. Wells BW-2S/BW-2D and BW-3S/BW-3D will be background wells for the inactive ash basin and wells BW-4S/D and AW-2D will be background wells for the active ash basin. AW-2D will be installed adjacent to existing background well BGMW-9, but will be installed as a deep well, since BGMW-9 is shallow. BW-2S/D and BW-3S/D will be installed west of
the inactive ash basin, on either side of Halfmile Branch. BW-4S/D will be installed between the inactive and active ash basin. A summary of the boring details is provided in Table 3.

In addition to the background wells, sentinel well pairs (SW-1S/D, SW-2S/D and SW-3S/D) are anticipated to be installed at the locations shown on Figures 5 and 6. The sentinel wells will be used to monitor groundwater conditions between nearby upgradient sensitive receptors and the Lee Plant.

### 7.4.3 Ash Basins
Currently, there are five shallow piezometers installed within the inactive ash basin to provide residual ash saturation and the depth to groundwater information, but no deep piezometers. Therefore, one deep piezometer will be installed adjacent to existing piezometer PZ-4 to provide vertical hydraulic gradient information from within the ash basin.

No piezometers were installed within the active ash basin as part of the previous site investigations. Therefore, two piezometer pairs (APZ-2S/D and APZ-3S/D) and one deep piezometer (APZ-1D) are anticipated within the active ash basin as shown on Figure 6. A shallow piezometer, screened at the base of the ash, will be used to monitor residual saturation. A deeper piezometer, screened approximately 20 feet below the basin, will be used to monitor groundwater levels below the basin.

### 7.4.4 Downgradient Assessment Areas
A preliminary review of site data and existing monitoring well locations indicate that horizontal and vertical coverage around the compliance boundary is mostly adequate to complete a CSA of the Lee Plant with the following exceptions.

At the northwest corner of the active ash basin, a deep monitoring well will be installed adjacent to compliance boundary well CMW-10 to monitor groundwater conditions in the deeper portion of the surficial aquifer at this location. A deep monitoring well will also be installed adjacent to compliance boundary well CMW-6R to monitor groundwater conditions in the deeper portion of the surficial aquifer at this location.

To the east of the active ash basin, an additional well pair (AW-1S/D) is anticipated to refine groundwater flow east of the active ash basin and provide additional groundwater chemistry data east of CMW-6R. Wells AW-1S/D are anticipated to be located on off-site property not owned by Duke Energy and will require access permission for well installation and monitoring.
The approximate locations of the additional monitoring wells are shown on Figure 6. A summary of the boring details is provided in Table 3.

7.4.5 Groundwater Sampling

It is anticipated that groundwater samples will be collected using a low-flow sampling technique consistent with compliance monitoring well sampling protocol. The groundwater samples will be analyzed for the parameters listed in Table 2. Total and dissolved metals analysis will be conducted. In addition to the groundwater samples collected from the new monitoring wells, it is anticipated that groundwater samples will be collected from one or more of the existing site monitoring wells. A summary of the anticipated groundwater samples is included in Table 3.

During groundwater sampling activities, water level measurements will be made at the existing site monitoring wells, observation wells, and piezometers, along with the new wells. The data will be used to generate water table and potentiometric maps of the upper and lower portions of the surficial aquifer zones, as well as to determine the degree of residual saturation beneath the ash basin.

7.5 Influence of Pumping Wells on Groundwater System

There are no private water supply wells located within a 0.5 mile radius of the compliance boundary for the ash basins. Preliminary information indicates 77 potential private water supply wells may be located within a 0.5 mile radius of the compliance boundary. The wells are located upgradient from the ash basins. It is anticipated that due to the distance from the ash basins and likely limited withdrawal rates, the use of the off-site wells should not substantially affect the groundwater flow system near the ash basins. Additional information on the potential off-site water supply wells will also be collected as part of the assessment.

7.6 Site Conceptual Model

Existing and new hydrogeological data will be used to develop a Site Conceptual Model (SCM). The SCM will be developed in accordance with “Evaluating Metals in Groundwater at DWR Permitted Facilities” (July 2012) and the May 31, 2007 NCDENR Memorandum entitled Hydrogeologic Investigation and Reporting Policy. The SCM will define the groundwater flow systems at the site, horizontally and vertically, and provide a better understanding of the fate and transport of constituents of concern in groundwater. This information will be used to develop a groundwater computer model. Figures 5 and 6 shows the proposed locations for Geologic Cross Sections anticipated for the SCM.
7.7 Development of Groundwater Computer Model

Data from existing and new monitoring wells will be used to develop a groundwater computer model of the system. The groundwater modeling will be conducted in accordance with the requirements of the May 31, 2007 NCDENR Memorandum entitled *Groundwater Modeling Policy*.

At this time, it is anticipated that a numerical groundwater flow model will be developed using the MODFLOW finite difference model that was developed by the USGS and is one of the most widely accepted and widely used groundwater flow models. The MODFLOW model will be created as a multi-layer flow model to better determine the vertical flow component of the aquifer system which will allow for more accurate fate and transport modeling. Once the model is created, it will be calibrated to site conditions by modifying model inputs, such as hydraulic conductivity, within established limits based on actual site data, until a reasonable match between the model and actual site conditions is accomplished.

After the MODFLOW model is calibrated, the modeled flow data will be imported into MT3D or RT3D and a fate and transport model will be created. MT3D and RT3D are three-dimensional numerical solute fate and transport model, which will be used to predict the short and long-term movement of the constituents of interest in groundwater at the site and under the various predictive scenarios discussed above.

Due to the data requirements of the computer modelling, the computer model will be performed after the majority of the groundwater assessment activities are completed. The results of the groundwater modelling are anticipated as an appendix to the CSA Report.
8.0 IMPLEMENTATION SCHEDULE AND REPORT SUBMITTAL

Implementation will take place immediately following approval of this Groundwater Assessment Plan by DWR. The anticipated schedule of activities and project completion following plan approval is provided below.

- 10 days to begin field activities upon approval of plan
  (Including, but not limited to, notification of public utility locate services, road access clearing, container requests from laboratories for the soil and groundwater samples, assemble information on existing site wells and piezometers in addition to compliance boundary well information)

- 60 days to complete field activities
  - Complete drilling activities
  - Conduct slug tests
  - Survey soil borings, wells, and other assessment locations
  - Collect groundwater and other assessment samples
  - Collect site-wide water levels
  - Setup groundwater computer model

- 30 days after completion of field activities receive analytical data

- 60 days after receipt of analytical data evaluate results, conduct statistical evaluation, prepare summary tables, develop CSM, and calibrate computer model.

- 20 days to complete Assessment Report, per NC Senate Bill 729, August 2014.

- 90 days (up to 180 days) to complete computer modeling and Corrective Action Plan.

- Conduct additional work as may be required to complete the CSA.

- 90 days to complete CSA preparation, review, and submittal, in accordance with NCDENR guidance (August 2014).

Project Assumptions Include:

- No more than one iterative assessment step will be required;
• Off-site assessment or access agreements are anticipated for the property located adjacent to the active ash basin to the east;

• DEP will make a diligent effort to collect all receptor information in accordance with NCDENR guidance (August 2014); however, it is anticipated that all such information may not be available;

• If off-site water supply wells sampling is deemed necessary, NCDENR staff may be requested to assist with access;

• No special permitting is anticipated;

• Data may not reflect all seasonal or extreme hydrologic conditions; and

• During the CSA process if additional investigations are required NCDENR, will be notified.

• In addition to the components listed above, a human health and ecological risk assessment will be conducted.
9.0 REFERENCES

ASTM D4044-96 Standard Test Method (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers


FIGURES
FIGURE 1
SITE LOCATION MAP
H.F. LEE ENERGY COMPLEX
1199 BLACK JACK CHURCH ROAD
GOLDSBORO, NORTH CAROLINA
SOUTH AND NORTH GOLDSBORO, NC QUADRANGLES

SOURCE:
USGS TOPOGRAPHIC MAP OBTAINED FROM THE NRCS GEOSPATIAL DATA GATEWAY AT http://datagateway.nrcs.usda.gov/

148 RIVER STREET, SUITE 220
GREENVILLE, SOUTH CAROLINA
PHONE 864-421-9999
www.synterracorp.com

DRAWN BY: S. ARLEDGE
PROJECT MANAGER: KATHY WEBB
LAYOUT: FIG 1 (USGS SITE LOCATION)
DATE: 2014-09-25
CONTINUOUS SCALE: 10 FEET
MAP DATE: 1974

IN FEET
FIGURE 2
SITE LAYOUT
INACTIVE ASH BASINS

LEGEND
- BACKGROUND MONITORING WELL
- COMPLIANCE MONITORING WELL
- INACTIVE ASH BASIN
- INACTIVE ASH BASIN

SOURCES:
1. 2014 AERIAL PHOTOGRAPH WAS OBTAINED FROM DPR FLOWN ON APRIL 17, 2014.
3. DRAWING HAS BEEN SET WITH A PROJECTION OF NORTH CAROLINA STATE PLANE COORDINATE SYSTEM FIPS 3200 (NAD 83).

FIG 2 (SITE LAYOUT)
2014-09-25
H. FRANK
S. ARLEDGE
PROJECT MANAGER:
LAYOUT NAME:
DRAWN BY:
CHECKED BY:
K. WEBB
DATE:
DATE:

WWW.SYNTERRACORP.COM
148 RIVER STREET, SUITE 220
GREER, SOUTH CAROLINA 29601
864-421-9999

H.F. LEE ENERGY COMPLEX
1199 BLACK JACK CHURCH ROAD
GOLDSBORO, NORTH CAROLINA

NEUSE RIVER
SIMPLE CYCLE COMBUSTION TURBINE
ENERGY PRODUCTION AREA

INACTIVE ASH BASIN 1
INACTIVE ASH BASIN 2
INACTIVE ASH BASIN 3

FERRY BRIDGE RD
OLD SMITHFIELD RD
ROSEWOOD RD

SOURCE: 7-08-43-2-10N-2W

GRAPHIC SCALE
IN FEET
0 300 600

500 ft COMPLIANCE BOUNDARY
DUKE ENERGY PROGRESS LEE PLANT
WASTE BOUNDARY

BACKGROUND MONITORING WELL (SURVEYED)
COMPLIANCE MONITORING WELL (SURVEYED)

BW-1
CW-1
CW-2
CW-3
CW-4
3000 300 600 GRAPHIC SCALE IN FEET

FIG 3 (SITE LAYOUT)

2014-09-25
H. FRANK S. ARLEDGE

PROJECT MANAGER:

LAYOUT NAME:

DRAWN BY:

CHECKED BY:

K. WEBB

DATE: DATE:

FIGURE 3
SITE LAYOUT

ACTIVE ASH BASIN

www.synterracorp.com
148 River Street, Suite 220
Greenville, South Carolina 29601
864-421-9999

LEGEND

[Legend includes various symbols and boundaries like Compliance Boundary, Duke Energy Progress Lee Plant, Waste Boundary, etc.]

SOURCES:
1. 2014 AERIAL PHOTOGRAPH WAS OBTAINED FROM ESRI FLOWN ON APRIL 17, 2014.
2. PARCEL BOUNDARY WAS OBTAINED FROM WAYNE COUNTY GIS DATA AT http://www.waynegov.com/page/214
3. DRAWING HAS BEEN SET WITH A PROJECTION OF NORTH CAROLINA STATE PLANE COORDINATE SYSTEM FIPS 3200 (NAD 83).
LEGEND - UNIT NAME

- CZfv: FELISC METAVOLCANIC ROCK
- Kb: BLACK CREEK FORMATION
- Kc: CAPE FEAR FORMATION
- Tpy: YORKTOWN FORMATION & DUPLIN FORMATION, UNDIVIDED

GEOLOGY SOURCE NOTE:

DISCLAIMER AND SOURCE NOTE:
The information on this map was derived from digital databases at the NC Department of Transportation Website. Care was taken in the creation of this map. SYNTERRA cannot accept any responsibility for errors, omissions, or positional accuracy. There are no warranties, expressed or implied, including the warranty of merchantability or fitness for a particular purpose, accompanying this product. However, notification of any errors will be appreciated.

FIGURE 4
GEOLOGY MAP
DUKE ENERGY PROGRESS
H. F. LEE ENERGY COMPLEX
1199 BLACK JACK CHURCH ROAD
GOLDSBORO, NORTH CAROLINA
FIGURE 5
ANTICIPATED SAMPLE LOCATIONS
INACTIVE ASH BASINS

LEGEND

- BACKGROUND MONITORING WELL (SURVEYED)
- COMPLIANCE MONITORING WELL (SURVEYED)
- COMPLIANCE BOUNDARY
- DUKE ENERGY PROGRESS LEE PLANT
- 500 ft COMPLIANCE BOUNDARY
- 1000 ft COMPLIANCE BOUNDARY
- 2014 LEASE CONTOUR MAJOR
- LEASE CONTOUR MINOR
- PARCEL BOUNDARY (WAYNE CO GIS)
- FLOW DIRECTION
- GENERALIZED GROUNDWATER FLOW

SOURCES:
2. 2014 AERIAL PHOTOGRAPH WAS OBTAINED FROM WSP FLOWN ON APRIL 17, 2014.
3. PARCEL BOUNDARY WAS OBTAINED FROM WAYNE COUNTY GIS DATA AT http://www.waynegov.com/page/214
4. DRAWING HAS BEEN SET WITH A PROJECTION OF NORTH CAROLINA STATE PLANE COORDINATE SYSTEM FIPS 3200 (NAD 83).
6. SUPPORTED BY GROUNDWATER ELEVATION DATA POINTS OR TOPOGRAPHIC DATA

NOTE:
1. CONTOUR LINES ARE USED FOR REPRESENTATIVE PURPOSES ONLY AND ARE NOT TO BE USED FOR DESIGN OR CONSTRUCTION PURPOSES.
FIGURE 6
ANTICIPATED SAMPLE LOCATIONS
ACTIVE ASH BASIN

SOURCES:
1. 2012 AERIAL PHOTOGRAPH OBTAINED FROM THE U.S. Geological Survey at
   http://nationalmap.gov/
2. 2012 AERIAL PHOTOGRAPH OBTAINED FROM USGS
   FLIGHTS (DECEMBER 17, 2012).
3. PARCEL BOUNDARY WAS OBTAINED FROM WAYNE COUNTY
   GIS DATA AT
   http://www.waynegov.com/page/214
4. DRAWING HAS BEEN SET WITH A PROJECTION OF NORTH
   CAROLINA STATE PLANE COORDINATE SYSTEM FIPS 3200
   (NAD 83).
5. 2FT CONTOUR INTERVALS FROM NCDOT LiDAR DATED 2007

NOTE:
1. CONTOUR LINES ARE USED FOR REPRESENTATIVE PURPOSES
   ONLY AND ARE NOT TO BE USED FOR DESIGN OR
   CONSTRUCTION PURPOSES.
Tables
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<th>Well ID</th>
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**Notes:**
- CB - Compliance Boundary
- < 2L - Constituent has not been detected above the 2L Standard or beyond the range for pH
- Shown concentration ranges only include concentrations detected above the laboratory's reporting limit

Prepared by: RBI  Checked by: BER
# Table 2
## Assessment Parameter List
### H.F. Lee Energy Complex
DUKE ENERGY PROGRESS, INC., GOLDSBORO, NORTH CAROLINA

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<tr>
<th>Parameter</th>
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<td>EPA 5310</td>
</tr>
<tr>
<td>Alkalinity (as CaCO3)</td>
<td>mg/L</td>
<td>SM 2320B</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>mg/L</td>
<td>SM 2540C</td>
</tr>
</tbody>
</table>

**Notes:**
- SU - Standard Units
- µS/cm - microsiemens per centimeter
- °C - degrees Celsius
- mV - millivolts
- mg/L - milligrams per liter
- NTU - Nephelometric Turbidity Units
- µg/L - micrograms per liter
- mg-N/L - milligrams nitrate (as nitrogen) per liter

Prepared by: RBI  Checked by: BER
**Table 2 List - Parameter List**

<table>
<thead>
<tr>
<th>ASH MANAGEMENT AREA</th>
<th>BORING / WELL ID</th>
<th>ESTIMATED BORING DEPTH (ft bgs)</th>
<th>ESTIMATED NO. OF SAMPLES</th>
<th>SAMPLE MEDIA</th>
<th>SAMPLE DEPTHS/INTERVALS/ TARGET ZONES</th>
<th>LAB ANALYSIS</th>
<th>PURPOSE/NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background Soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BW-25/D</td>
<td>20 50</td>
<td>4 Soil, Soil, Water, Water</td>
<td>Just above the water table Within lower screen interval 15 feet 45 feet</td>
<td>Total metals Total metals Table 2 List Table 2 List</td>
<td>Additional background well, groundwater modeling, and statistical evaluation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW-15/D</td>
<td>20 50</td>
<td>4 Soil, Soil, Water, Water</td>
<td>Just above the water table Within lower screen interval 15 feet 45 feet</td>
<td>Total metals Total metals Table 2 List Table 2 List</td>
<td>Additional background well, groundwater modeling, and statistical evaluation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW-20/D</td>
<td>50</td>
<td>2 Soil, Soil, Water</td>
<td>Within lower screen interval 45 feet</td>
<td>Total metals Total metals Table 2 List Table 2 List</td>
<td>Sentinel and background wells, groundwater modeling and statistical evaluation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existing Monitoring Wells / Piezometers</td>
<td>TBD</td>
<td>Variable</td>
<td>TBD</td>
<td>Water</td>
<td>Well Screen Interval (variable)</td>
<td>Table 2 List</td>
<td>Groundwater modeling and statistical evaluation</td>
</tr>
</tbody>
</table>

**Notes:**
- Total Metals - As, B, Ba, Cd, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, Tl, and Zn.
- SPPLP (Synthetic Precipitation Leaching Procedure) Metals - As, Ba, Cd, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, Tl, and Zn.
- Geotech - Geotechnical parameters include moisture content, particle size distribution, Atterberg limits, specific gravity, and permeability.
- Table 2 List - Parameter list presented in Table 2 of this document.
- ft bgs - Feet below ground surface.
- TBD - To be determined.
APPENDIX A

NCDENR LETTER OF AUGUST 13, 2014
August 13, 2014

CERTIFIED MAIL 7004 2510 0000 3651 1168
RETURN RECEIPT REQUESTED

Paul Newton
Duke Energy
526 South Church Street
Charlotte, NC  28202

Subject: Notice of Regulatory Requirements
Title 15A North Carolina Administrative Code (NCAC) 02L .0106
14 Coal Ash Facilities in North Carolina

Dear Mr. Newton:

Chapter 143, North Carolina General Statutes, authorizes and directs the Environmental Management Commission of the Department of Environment and Natural Resources to protect and preserve the water and air resources of the State. The Division of Water Resources (DWR) has the delegated authority to enforce adopted pollution control rules.

Rule 15A NCAC 02L .0103(d) states that no person shall conduct or cause to be conducted any activity which causes the concentration of any substance to exceed that specified in 15A NCAC 02L .0202. As of the date of this letter, exceedances of the groundwater quality standards at 15A NCAC 02L .0200 Classifications and Water Quality Standards Applicable to the Groundwaters of North Carolina have been reported at each of the subject coal ash facilities owned and operated by Duke Energy (herein referred to as Duke).

Groundwater Assessment Plans

No later than September, 26 2014 Duke Energy shall submit to the Division of Water Resources plans establishing proposed site assessment activities and schedules for the implementation, completion, and submission of a comprehensive site assessment (CSA) report for each of the following facilities in accordance with 15A NCAC 02L .0106(g):

- Asheville Steam Electric Generating Plant
- Belews Creek Steam Station
- Buck Steam Station
- Cape Fear Steam Electric Generating Plant
- Cliffside Steam Station
Dan River Combined Cycle Station
H.F. Lee Steam Electric Plant
Marshall Steam Station
Mayo Steam Electric Generating Plant
Plant Allen Steam Station
Riverbend Steam Station
Roxboro Steam Electric Generating Plant
L.V. Sutton Electric Plant
Weatherspoon Steam Electric Plant

The site assessment plans shall include a description of the activities proposed to be completed by Duke that are necessary to meet the requirements of 15A NCAC 02L .0106(g) and to provide information concerning the following:

(1) the source and cause of contamination;
(2) any imminent hazards to public health and safety and actions taken to mitigate them in accordance to 15A NCAC 02L .0106(f);
(3) all receptors and significant exposure pathways;
(4) the horizontal and vertical extent of soil and groundwater contamination and all significant factors affecting contaminant transport; and
(5) geological and hydrogeological features influencing the movement, chemical, and physical character of the contaminants.

For your convenience, we have attached guidelines detailing the information necessary for the preparation of a CSA report. The DWR will review the plans and provide Duke with review comments, either approving the plans or noting any deficiencies to be corrected, and a date by which a corrected plan is to be submitted for further review and comment or approval. For those facilities for which Duke has already submitted groundwater assessment plans, please update your submittals to ensure they meet the requirements stated in this letter and referenced attachments and submit them with the others.

Receptor Survey

No later than October 14th, 2104 as authorized pursuant to 15A NCAC 02L .0106(g), the DWR is requesting that Duke perform a receptor survey at each of the subject facilities and submitted to the DWR. The receptor survey is required by 15A NCAC 02L .0106(g) and shall include identification of all receptors within a radius of 2,640 feet (one-half mile) from the established compliance boundary identified in the respective National Pollutant Discharge Elimination System (NPDES) permits. Receptors shall include, but shall not be limited to, public and private water supply wells (including irrigation wells and unused or abandoned wells) and surface water features within one-half mile of the facility compliance boundary. For those facilities for which Duke has already submitted a receptor survey, please update your submittals to ensure they meet the requirements stated in this letter and referenced attachments and submit them with the others. If they do not meet these requirements, you must modify and resubmit the plans.
The results of the receptor survey shall be presented on a sufficiently scaled map. The map shall show the coal ash facility location, the facility property boundary, the waste and compliance boundaries, and all monitoring wells listed in the respective NPDES permits. Any identified water supply wells shall be located on the map and shall have the well owner’s name and location address listed on a separate table that can be matched to its location on the map.

Failure to comply with the State's rules in the manner and time specified may result in the assessment of civil penalties and/or the use of other enforcement mechanisms available to the State.

We appreciate your attention and prompt response in this matter. If you have any questions, please feel free to contact S. Jay Zimmerman, Water Quality Regional Operations Section Chief, at (919) 807-6351.

Sincerely,

John E. Skvarla, III

Attachment enclosed

cc:    Thomas A. Reeder, Director, Division of Water Resources
      Regional Offices – WQROS
      File Copy
GUIDELINES FOR COMPREHENSIVE SITE ASSESSMENT

This document provides guidelines for those involved in the investigation of contaminated soil and/or groundwater, where the source of contamination is from:

- Incidents caused by activities subject to permitting under G.S. 143-215.1
- Incidents caused by activities subject to permitting under G.S. 87-88
- Incidents arising from agricultural operations, including application of agricultural chemicals, but not including unlawful discharges, spills or disposal of such chemicals

Comprehensive Site Assessment (CSA)

NOTE: Regional Offices may request additional information in support of the CSA to aid in their review and will not approve the CSA if any of the elements specified below have not been included or have not been sufficiently addressed.

Minimum Elements of the Comprehensive Site Assessment Report:

A. Title Page
   - Site name, location and Groundwater Incident number (if assigned) and Permit Number;
   - Date of report;
   - Responsible Party and/or permittee, including address and phone number;
   - Current property owner including address and phone number;
   - Consultant/contractor information including address and phone number;
   - Latitude and longitude of the facility; and
   - Seal and signature of certifying P.E. or P.G., as appropriate.

B. Executive Summary
   The Executive Summary should provide a brief overview of the pertinent site information (i.e., provide sufficient information to acquaint the reader with the who, what, when, where, why and how for site activities to date).

   1. Source information:
      - Type of contaminants
   2. Initial abatement/emergency response information.
3. Receptor information:
   - Water supply wells;
   - Public water supplies (wells, surface water intakes);
   - Surface water bodies;
   - Wellhead protection areas;
   - Deep aquifers in the Coastal Plain physiographic region;
   - Subsurface structures; and
   - Land use.

4. Sampling/investigation results:
   - Nature and extent of contamination;
   - Maximum contaminant concentrations;
   - Site hydrogeology.

5. Conclusions and recommendations.

C. Table of Contents
   - First page number for each section listed.
   - List of figures (all referenced by number and placed in a single section following contents text).
   - List of tables (all referenced by number and placed in a single section following contents text).
   - List of appendices.

D. Site History and Source Characterization
   - Provide a history of property ownership and use. Indicate dates of ownership, uses of the site, and potential sources of contaminants.
   - Discuss the source(s) of contamination, including primary and secondary sources.
   - For permitted activities, describe nature of activity, permitted waste, application of all instances of over-application/irrigation of wastes or water
   - Summarize assessment activities and corrective actions performed to date including emergency response, initial abatement, primary and secondary source removal.
   - Discuss geographical setting and present/future surrounding land uses.

E. Receptor Information
   - Provide a site map showing labeled well locations within a
minimum of 1500 feet of the known extent of contamination. Key to the table and maps described.

NOTE: As the known extent of contamination changes, the receptor survey must be updated to reflect the change. This applies throughout the Receptor Information section.

- In table format, list all water supply wells, public or private, including irrigation wells and unused wells, (omit those that have been properly abandoned in accordance with 15A NCAC 2C .0100) within a minimum of 1500 feet of the known extent of contamination. Note whether well users are also served by a municipal water supply.
- For each well, include well number, well owner and user names, addresses and telephone numbers, use of the well, well depth, well casing depth, well screen interval, and distance from source of contamination;

NOTE: It will often be necessary to conduct any or all of the following in order to ensure reliability in a water supply well survey:

  o Call the city/county water department to inquire about city water connections;
  o Visit door-to-door (make sure that you introduce yourself and state your purpose to residents prior to examining their property) to obtain accurate description of water usage, and if some residents are not at home, ask surrounding neighbors who are home about the water usage at those residences. Even if a public water line is available, some residents still use their well water and are not connected to the public water system; and
  o Search for water meters and well houses.

- Site map showing location of subsurface structures (e.g., sewers, utility lines, conduits, basements, septic tanks, drain fields, etc.) within a minimum of 1,500 feet of the known extent of contamination;
- Table of surrounding property owner addresses;
- Discuss the availability of public water supplies within a minimum of 1,500 feet of the source area, including the distance and location to the nearest public water lines and the source(s) of the public water supply;
- Identify all surface water bodies (e.g., ditch, pond, stream, lake, river) within a minimum of 1,500 feet of the source of contamination;
- Determine the location of any designated wellhead protection areas as defined in 42 USC 300h-7(e) within a minimum of 1,500 feet of the source of contamination. Identify and discuss the location of the water supply well(s) for which the area was designated a wellhead protection area, and the extent of the protected area. Include information about the well owner, well-construction specifications (especially at screened intervals), pumping rate and pumping schedule. Information regarding designated wellhead protection areas may be obtained by contacting the Public Water Supply Section at (919) 707-9083;
- Discuss the uses and activities (involving possible human exposure to contamination) that could occur at the site and adjacent properties. Examples of such activities and uses include but are not limited to use of a property for an office, manufacturing operation, residence, store, school, gardening or farming activities, recreational activities, or undeveloped land;
- Determine whether the contaminated area is located in an area where there is recharge to an unconfined or semi-confined deeper aquifer that is being used or may be used as a source of drinking water. Based on a review of scientific literature on the regional hydrogeology and well construction records and lithological logs for deeper wells in the area, identify and describe the deep aquifers underlying the source of contamination. Include information on the depth of the deep aquifer in relation to the surficial saturated zone, the lithology and hydraulic conductivity of the strata between the surficial aquifer and the deeper aquifer, and the difference in groundwater head between the surficial aquifer and the deeper aquifer. Discuss the local and regional usage of the deep aquifer and the draw down from major pumping influences. Also, specify the distance from the source of contamination to major discharge areas such as streams and rivers. Cite all sources and references used for this discussion.

NOTE: This requirement (last bullet) only pertains to
contamination sources in the Coastal Plain physiographic region as designated on a map entitled “Geology of North Carolina” published by the Department in 1985. However, recharge/discharge, hydraulic conductivity, lithology, head difference, etc. is also important information at mountains and piedmont sites.

F. Regional Geology and Hydrogeology

Provide a brief description of the regional geology and hydrogeology. Cite all references.

G. Site Geology and Hydrogeology

- Describe the soil and geology encountered at the site. Use the information obtained during assessment activities (e.g., lithological descriptions made during drilling, probe surveys, etc.). This information should correspond to the geologic cross sections required in N. below; and
- Based on the results of the groundwater investigation, describe the site hydrogeology, including a discussion of groundwater flow direction, hydraulic gradient, hydraulic conductivity and groundwater velocity. Discuss the effects of the geologic and hydrogeological characteristics on the migration, retardation, and attenuation of contaminants.

H. Soil Sampling Results

Using figures and tables to the extent possible, describe all soil sampling performed to date and provide the rationale for sample locations, number of samples collected, etc. Include the following information:

- Location of soil samples;
- Date of sampling;
- Type of soil samples (from excavation, borehole, Geoprobe, etc.);
- Soil sample collection procedures (split spoon, grab, hand auger, etc.)
- Depth of soil samples below land surface;
- Soil sample identification
- Soil sample analyses;
- Soil sample analytical results (list any contaminant detected above the method detection limit); and
Identify any sample analytical results that exceed the applicable cleanup levels.

NOTE: Information related to H. above should correspond to the sampling location and sampling results maps required in N. below.

I. Groundwater Sampling Results

Using figures and tables to the extent possible describe the groundwater sampling performed to date and provide the rationale for sample locations (based on source and contaminant type), number of samples collected, etc. Include the following information:

- Location of groundwater samples and monitoring wells;
- Date of sampling;
- Groundwater sample collection procedures (bailer, pump, etc.);
- Groundwater sample identification and whether samples were collected during initial abatement, CSA, etc.;
- Groundwater sample analyses;
- Groundwater sample analytical results (list any contaminant detected above the method detection limit; and
- Identify all sample analytical results that exceed 15A NCAC 2L or interim standards.

NOTE: Information related to I. above should correspond to the sampling location and sampling results maps required in N. below.

J. Hydrogeological Investigation

Describe the hydrogeological investigation performed including all methods, procedures and calculations used to characterize site hydrogeological conditions. The following information should be discussed and should correspond to the maps and figures required below:

- Groundwater flow direction;
- Hydraulic gradient (horizontal and vertical);
- Hydraulic conductivity;
- Groundwater velocity;
- Contaminant velocity;
- Slug test results; *
- Aquifer test results; *
- Plume’s physical and chemical characterization; and
- Fracture trace study if groundwater in bedrock is impacted. *
* Check with the Regional Office prior to performing these tests and study to see if necessary for the site.

K. Groundwater Modeling Results

Groundwater modeling or predictive calculations may be necessary at some sites (source area proximate to surface water, source area located within wellhead protection area or source area overlying semi-confined or unconfined deeper Coastal Plain aquifer) to verify, based on site specific hydrogeological conditions, whether groundwater contamination poses a risk to receptors. For contamination shown to pose a risk to receptors, groundwater modeling may be necessary to determine an appropriate cleanup level for contaminated groundwater. Modeling should illustrate the input data used to complete the model and will generally be required for natural attenuation proposals (see Groundwater Modeling Policy at http://portal.ncdenr.org/web/wq/aps/gwpro/policy).

NOTE: Input data for models should be derived from site specific information with limited assumptions or estimates. All assumptions and estimated values including biodegradation rates must be conservative (predict reasonable worst-case scenarios) and must be well documented.

L. Discussion

- Nature and extent of contamination, including primary and secondary source areas, and impacted groundwater and surface water resources;
- Maximum contaminant concentrations;
- Contaminant migration and potentially affected receptors

M. Conclusions and Recommendations

If corrective action will be necessary, provide a preliminary evaluation of remediation alternatives appropriate for the site. Discuss the remediation alternatives likely to be selected. Note that for impacts to groundwater associated with permitted activities, corrective action pursuant to 15A NCAC 2L .0106(k), (l) and (m) is not applicable, unless provided for pursuant to 15A NCAC 2L .0106(c) and (e) or through a variance from the Environmental Management Commission (EMC).

N. Figures

- 71/2 minute USGS topographic quadrangle map showing an area
within a minimum of a 1,500-foot radius of the source of contamination and depicting the site location, all water supply wells, public water supplies, surface water intakes, surface water bodies, designated well head protection areas, and areas of recharge to deeper aquifers in the Coastal Plain that are or may be used as a source for drinking water;

- Site map locating source areas, site boundaries, buildings, all water supply wells within a minimum of 1,500 feet, named roads/easements/right-of-ways, subsurface utilities, product or chemical storage areas, basements and adjacent properties, scale and north arrow;

- At least two geologic cross sections through the saturated and unsaturated zones intersecting at or near right angles through the contaminated area using a reasonable vertical exaggeration. Indicate monitoring well/sample boring/sample locations and analytical results for soil samples. Identify the depth to the water table. Provide a site plan showing the locations of the cross sections;

- Site map(s) showing the results of all soil sampling conducted. Indicate sampling identifications, sampling depths, locations and analytical results;

- Site map(s) showing the results of all groundwater sampling conducted. Indicate sampling locations, monitoring well identifications, sample identifications, and analytical results;

- Separate groundwater contaminant iso-concentration contour maps showing total volatile organic compound concentrations, total semi-volatile organic compound concentrations and concentrations for the most extensive contaminant. Maps should depict the horizontal and vertical extent. Contour line for applicable 2L standard should be shown in bold;

- Site map(s) showing the elevation of groundwater in the monitoring wells and the direction of groundwater flow. Contour the groundwater elevations. Identify and locate the datum (arbitrary
100', USGS, NGVD) or benchmark. Indicate the dates that water level measurements were made. There should be one map for each series of water level measurements obtained:

- Groundwater contaminant iso-concentration contour cross-section; and

- Site map(s) showing the monitoring wells.

NOTE: If possible, use a single base map to prepare site maps using a map scale of 1 inch = 40 feet (or a smaller scale for large sites, if necessary). Maps and figures should include conventional symbols, notations, labeling, legends, scales, and north arrows and should conform to generally accepted practices of map presentation such as those enumerated in the US Geological Survey pamphlet, "Topographic Maps".

O. Tables

- List all water supply wells, public or private, including irrigation wells and unused wells, (omit those that have been properly abandoned in accordance with 15A NCAC 2C .0100) within a minimum of 1500 feet of the known extent of contamination. For each well, include the well number (may use the tax map number), well owner and user names, addresses and telephone numbers, use of the well, well depth, well casing depth, well screen interval and distance from the source of contamination;

- List the names and addresses of property owners and occupants within or contiguous to the area containing contamination and all property owners and occupants within or contiguous to the area where the contamination is expected to migrate;

- List the results for groundwater samples collected including sample location; date of sampling; sample collection procedures (bailer, pump, etc.); sample identifications; sample analyses; and sample analytical results (list any contaminant detected above the method detection limit in bold); and

- List for each monitoring well, the monitoring well identification
numbers, date water levels were obtained, elevations of the water levels, the land surface, top of the well casing, screened interval and bottom of the well.

Appendices

- Boring logs and lithological descriptions;
- Well construction records;
- Standard procedures used at site for sampling, field equipment decontamination, field screening, etc.;
- Laboratory reports and chain-of-custody documents;
- Copies of any permits or certificates obtained, permit number, permitting agency, and
- Modeling data and results;
- Slug/pumping test data; and
- Certification form for CSA
DIVISION OF WATER RESOURCES
Certification for the Submittal of a Comprehensive Site Assessment

Responsible Party and/or Permittee: ________________________________
Contact Person: ________________________________
Address: ________________________________
City: __________________ State: _______ Zip Code: _______

Site Name: ________________________________
Address: ________________________________
City: __________________ State: _______ Zip Code: _______

Groundwater Incident Number (applicable): ________________________________

I, ________________________________, a Professional Engineer/Professional Geologist (circle one) for ________________________________ (firm or company of employment) do hereby certify that the information indicated below is enclosed as part of the required Comprehensive Site Assessment (CSA) and that to the best of my knowledge the data, assessments, conclusions, recommendations and other associated materials are correct, complete and accurate.

(Each item must be initialed by the certifying licensed professional)

1. _________ The source of the contamination has been identified. A list of all potential sources of the contamination are attached.

2. _________ Imminent hazards to public health and safety have been identified.

3. _________ Potential receptors and significant exposure pathways have been identified.

4. _________ Geological and hydrogeological features influencing the movement of groundwater have been identified. The chemical and physical character of the contaminants have been identified.

5. _________ The CSA sufficiently characterizes the cause, significance and extent of groundwater and soil contamination such that a Corrective Action Plan can be developed. If any of the above statements have been altered or items not initialed, provide a detailed explanation. Failure to initial any item or to provide written justification for the lack thereof will result in immediate return of the CSA to the responsible party.

(Please Affix Seal and Signature)