L.V. Sutton Energy Complex

Groundwater Mitigation and Monitoring Plan

In Response to NCDENR Notice of Regulatory Requirements dated June 9, 2015

July 9, 2015

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Section 1 – Introduction

On June 9, 2015, the North Carolina Department of Environment and Natural Resources (NCDENR) issued a Notice of Regulatory Requirement (NORR) to Duke Energy Progress, Inc. (DEP) for the L.V. Sutton Energy Complex (Sutton Plant) directing Duke Energy to control and prevent further migration of coal ash contaminants from the ash basins located at the Sutton Plant.

On August 26, 2014, Duke Energy was issued a Notice of Violation and Notice of Intent to Enforce for violations of Title 15A NCAC Subchapter 02L.0202 Groundwater Quality Standards (2L Standards) in monitoring wells located at or beyond the ash basins compliance boundary at the Sutton Plant. Specifically, boron concentrations that exceeded the 2L Standards were reported in samples collected from monitoring wells MW-12, MW-19, MW-21C, MW-22C, MW-23B, MW-23C, MW-24B, MW-24C, and MW-31C. These wells are located at or beyond the compliance boundary to the east of the ash basins. Boron concentrations were reported below laboratory detection levels in background wells at the site.

A comprehensive site assessment (CSA) required by NCDENR (pursuant to a separate August 13, 2014 NORR issued to Duke Energy) is ongoing at the site, but is not complete. That CSA, when completed, will provide the information needed to construct an appropriate response to constituents in the groundwater. In the absence of such information, the actions required by the June 9, 2015 NORR create the risk of altering the groundwater flow at and around the site in ways that may adversely affect wells both on and near the site, including drawing contaminants from other potential sources onto the site. It would be more appropriate to complete the CSA before undertaking the type of activities required by the June 9, 2015 NORR. However, given that DEP has been required by the June 9, 2015 NORR to take action based on the assertion that water supply wells located east and potentially down-gradient of the Sutton Plant show elevated concentrations of boron approaching the 2L Standard of 700 ug/L, DEP is submitting this proposed plan in response.

The June 9, 2015 NORR also indicates that Title 15A NCAC 02L.0106(f)(2) states that corrective action is required following discovery of an unauthorized release of contaminant to the surface or subsurface of the land, and prior to or concurrent with the assessment activities required in Paragraphs (c) and (d) of this rule, shall include but is not limited to “abatement, containment, or control of the migration of contaminants”.

This preliminary plan for a hydraulic containment system and performance monitoring has been developed to control and prevent further migration of boron in groundwater from the Sutton Plant. Included in this plan are the following: background information, descriptions of the preliminary design of the hydraulic containment system proposed along the east side of the Sutton property, preliminary drawings, typical well construction details, and an introduction to anticipated aquifer testing which will be needed for final system design.

Section 2 – Site Information

Information included in the sections below has been adapted from the *Proposed Groundwater Assessment Work Plan Revision 1* (GWAP Work Plan) dated December 2014 prepared by SynTerra Corporation (SynTerra) and from compliance groundwater monitoring results provided by Duke Energy (for October 2014 and March 2015 monitoring events).

2.1 Site Description

The Sutton Plant is a former coal-fired electricity-generating facility located in New Hanover County, North Carolina, near the City of Wilmington. The facility is located northwest of Wilmington on the west side of Highway 421 (**Figure 1**).

The Sutton Plant started operations in 1954. The coal-fired units at the facility were retired in November 2013 when a new natural gas-fired combined-cycle unit began operation. The topography around the property is relatively flat and generally slopes downward toward the Cape Fear River, which is located along the west property boundary. The Northeast Cape Fear River is located approximately 6,000 feet east of the eastern site boundary.

The Sutton Plant utilizes an approximate 1,100-acre cooling pond, referred to as Sutton Lake, located adjacent to the Cape Fear River west of the ash basins. The ash basins are located adjacent to the cooling pond and north of the Sutton Plant (**Figure 2**). The discharge from the cooling pond and the ash basins is permitted by the NCDENR Division of Water Resources (DWR) under the National Pollutant Discharge Elimination System (NPDES).

A proposed landfill (site suitability currently under review by NCDENR Solid Waste Section) is to be located east of the ash basins near the east property boundary.

2.2 Ash Management Area Description

The ash management area consists of the following three units:

- The 1971 ash basin (also referred to as the old ash basin) is an unlined ash basin that contains fly ash, bottom ash, boiler slag, stormwater ash sluice water, coal pile runoff, and low volume wastewater.
- The 1984 ash basin (also referred to as the new ash basin) was constructed with a 12 inch clay liner and is located toward the north portion of the ash management area. This ash basin operated from 1984 to 2013 and contains fly ash, bottom ash, boiler slag, stormwater, ash sluice water, coal pile runoff, and low volume wastewater.
- The former ash disposal area (FADA) is located south of the ash basins on the south side of the discharge canal. It is reported that ash was placed in this area between approximately 1954 and 1972. Previous investigations suggest that a 1-foot thick soil layer may overlay 2 to 3 feet of ash in some parts of the FADA.

The 1971 and 1984 ash basins are impounded by an earthen dike. According to Duke Energy, the 1971 and 1984 ash basins and the FADA contain approximately 6,320,000 and 840,000 tons of ash, respectively. No other types of waste other than NPDES permitted waste are believed to have been placed in the basins or FADA.

2.3 Geology and Hydrogeology

2.3.1 Regional Geology

According to the Geologic Map of North Carolina, published by the North Carolina Department of Natural Resources and Community Development (1985), the Sutton Plant lies within the Coastal Plain Physiographic Province. The North Carolina Coastal Plain is approximately 90 to 150 miles wide from the Atlantic Ocean westward to its boundary with the Piedmont province. Two natural subdivisions of the Coastal Plain were described by Stuckey (1965): the Tidewater region and the Inner Coastal Plain. The Sutton Plant is located within the Tidewater region, which consists of the coastal area where large streams and many of their tributaries are affected by ocean tides (Winner, Jr. and Coble, 1989). The Sutton Plant is located on the east side of the Cape Fear River within the alluvial plain between the coastal dunes and the interior uplands (NUS Corporation, 1989).

The Coastal Plain comprises a wedge shaped sequence of stratified marine and non-marine sedimentary rocks deposited on crystalline basement. The sedimentary sequences range in age from recent to lower Cretaceous (Narkunas, 1980).

The Coastal Plain groundwater system consists of aquifers comprised of permeable sands and gravels separated by confining units of less permeable material. In the eastern part of the North Carolina Coastal Plain, groundwater is obtained from the surficial Castle Hayne and Peedee aquifers. The Castle Hayne aquifer is composed of fine-grained sand interbedded with gray shell limestone and shell fragments. Sand beds contain varying amounts of dark green weathered glauconite. Shells are common throughout the aquifer. The average thickness of the aquifer is 60 feet in the northern Wilmington area. Unconformably, underlying the surficial aquifer, which has an average thickness of 35 feet, is the Castle Hayne confining unit, with an average thickness of 20 feet.

The Peedee Formation, which underlies the Upper Castle Hayne Formation, contains fine to medium grained sand interbedded with gray to black marine clay and silt. Sand beds are commonly gray or greenish gray and contain varying amounts of glauconite. Thin beds of consolidated calcareous sandstone and impure limestone are interlayered with the sands in some places. In the Wilmington area, the Peedee confining unit has an average thickness of 10 feet.

2.3.2 Site-Specific Geology and Hydrogeology

Previous site investigations indicate that the Sutton Plant is underlain by unconsolidated sediments consisting primarily of well drained sands of the surficial aquifer (Geosyntec, July 2014). Based on monitoring well logs, the surficial aquifer at the Sutton Plant consists generally of brown to tan poorly graded sand with gray, well to poorly graded sand at depth, and gray clay lenses and fine gravel. The total thickness of the surficial aquifer has not been defined to date.

A cross section (provided by Geosyntec) showing the local geology from the south end of the old ash basin beyond to the southeast is presented as **Figure 3**.

Based on previous investigations, it appears that the Castle Hayne formation is either missing or unidentified at the Sutton Plant and the Cretaceous Peedee Formation underlies the surficial aquifer in the area. The Peedee Formation typically consists of unconsolidated green to dark-gray silt, olive-green to gray sand, and massive black clay with unconsolidated calcareous sandstone and limestone. The Peedee Formation is approximately 700 feet thick in New Hanover County (Geosyntec, July 2014).

The surface of groundwater at the Sutton Plant is typically located at depths of less than 2 feet below ground surface (bgs) to greater than 20 feet bgs based on topography. An average transmissivity value of 11,000 square feet per day (ft^2/day) was estimated by Heath (1989) for the surficial sand aquifer in the region. Specific capacity measurements collected in nearby water supply wells show that the hydraulic conductivity of the surficial aquifer near the Sutton Plant ranges from 50 to 150 feet per day.

Based on the results of work conducted by others (BBL, 2004), the average linear groundwater flow velocity near the Sutton site area ranges from 109 to 339 feet per year. Monitoring wells at the Site have been installed to assess three depth intervals. Many of the monitoring wells are installed as clusters. Monitoring wells with the “A” designation are generally screened five to 15 feet bgs, “B” wells are screened generally between 22 and 27 feet bgs, and “C” wells are screened between 40 to 45 feet bgs. There is a slight downward vertical gradient among the well clusters of generally less than 0.05 feet difference. Of the twelve well pairs gauged in May 2014, ten of the twelve wells exhibited a downward vertical gradient (Geosyntec, July 2014 DRAFT).

Water level measurements and corresponding elevations from June 2014 indicate the general direction of groundwater flow appears to be radial from the ash management area with flow toward the north, east, and south (**Figure 4**). However, the water level elevation of the cooling pond is lower than the groundwater elevation measured in a number of nearby monitoring wells, indicating a component of groundwater flow from the ash management area would also be toward the west.

2.4 Boron in Groundwater

Groundwater samples have historically been collected from a number of monitoring wells associated with ash basin monitoring and have been analyzed for metals and other constituents as summarized in the GWAP Work Plan. Results show that groundwater collected from 15 monitoring wells have contained boron concentrations above the 2L Standard. A summary of approximate sampling dates and concentration ranges for boron that have been previously detected above 2L Standards is provided as **Table 1**. Based on March 2015 groundwater sampling results, the concentration of boron in groundwater at or above the 2L Standard extends approximately 6,000 feet along the compliance boundary east of the ash basins and about 4,000 feet along the east property boundary (**Figure 5**). Note that the ongoing assessment will provide additional data to confirm the extent of boron-impacted groundwater at the site.

The vertical extent of boron in groundwater from MW-7C to MW-31C has not been defined with the existing groundwater quality data. Many monitoring wells identified as “C” wells (e. g., MW-31C) that are screened in the “intermediate-lower zone” (total depth ranges from 40 to 50 feet bgs) contain boron above the 2L Standard.

Section 3 – Preliminary Groundwater Extraction System

3.1 Preliminary System Description

Preliminary design for the groundwater extraction system consists of 12 extraction wells, transmission piping, pump station(s), and discharge structures. The proposed well locations and transmission piping route to the discharge location are shown on **Figure 6**. Groundwater will be extracted from the eastern property boundary at a rate aimed to achieve hydraulic control of the aquifer and prevent further migration of boron from the site. Submersible pumps will be located in each of the extraction wells and will pump groundwater to a centrally located pump station. The extracted groundwater will then be transferred via force main to a discharge location along the discharge canal which flows to the site cooling pond (Lake Sutton). Based on existing site groundwater monitoring data, concentrations of monitored constituents of concern do not exceed North Carolina Surface Water Quality Standards. Therefore, treatment of the groundwater prior to discharge to the cooling pond (which will require an NPDES permit modification prior to operation) is expected to be minimal (e.g. pH adjustment). This preliminary plan does not include details for treatment of the groundwater. Electrical power supply is not currently available near the proposed location of the preliminary extraction system. Electrical power supply appropriate for the system equipment will be required for the groundwater extraction system upon final design and approval.

Included in the sections below are preliminary capture zone calculations and preliminary design details. The preliminary calculations and design approach for the hydraulic containment system are based on information provided by Duke Energy and SynTerra.

Note that the preliminary design revealed data gaps that should be filled prior to a final system design. In addition to investigating the vertical extent of boron and the presence of a confining unit, aquifer testing is highly recommended to determine site-specific physical properties of the shallow aquifer. The ongoing assessment activities at the site may provide information related to the presence of a confining unit; however, that information is currently unavailable. Following aquifer testing, the preliminary design should be adjusted as necessary to transition to the final system design phase. The final system design would be based on site-specific conditions determined from a combination of the ongoing site assessment results, aquifer testing/pump testing, and additional assessment activities, if needed.

3.2 Capture Zone Calculations

The number of and spacing of extraction wells needed to capture groundwater containing boron at the Sutton Plant was estimated using an analytical model (Grubb, 1993). The physical parameters of the aquifer, as shown below, were used in the analytical model to estimate the pumping rate needed to achieve capture of groundwater containing boron. For those parameters where there is a range of values, the median value was used in the model for the hydraulic capture zone calculation.

The physical parameters include:

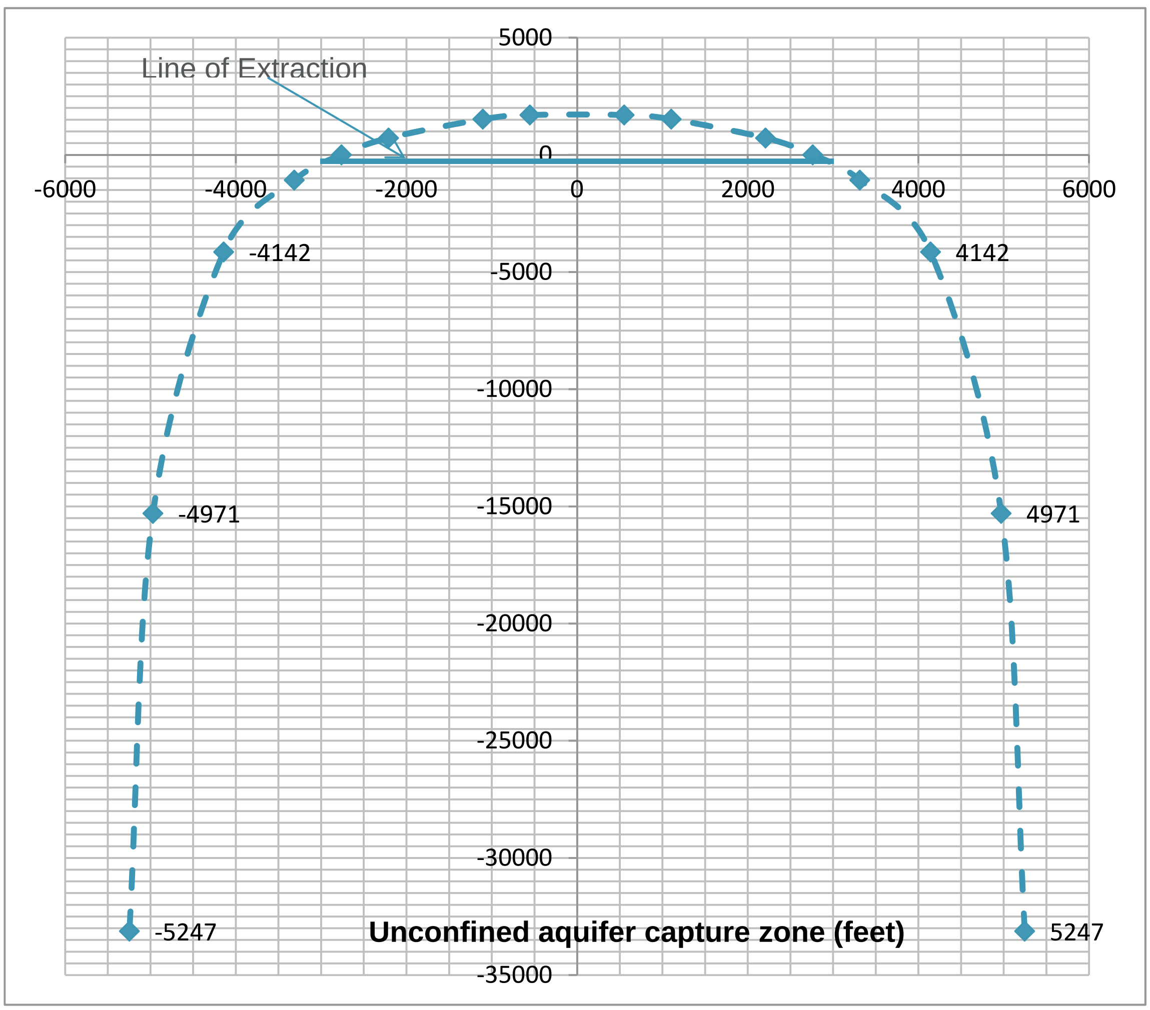
Hydraulic Conductivity (k) (feet/day)	50 to 150 feet/day (median = 100 feet/day)
Aquifer Thickness (b) (feet)	60 feet
Hydraulic Gradient (i) (feet/foot)	0.001 feet/foot

The results show that a minimum pumping rate of 350 gallons per minute (gpm) would be needed to create a 6,000 foot capture zone located 500 feet down-gradient of the line of extraction wells. According to the calculation, pumping 350 gpm will create a stagnation point that is 1,700 feet down-gradient from the centerline of the pumping wells. One well pumping at 350 gpm was used in the calculation. However, this analysis can be applied to any number of wells totaling a 350 gpm pumping rate and is consistent with 12 wells pumping a minimum 25 gpm.

$$\mathbf{x}_{stag} = \frac{QL}{\pi K(h1^2 - h2^2)}$$

$$\mathbf{x}_{stag} = 1{,}700 \text{ feet}$$

The figure below shows the extraction line, capture zone, and stagnation point for pumping 350 gpm from one well at the 0,0 location.



3.3 Preliminary System Design Details

Based on the hydraulic capture calculations, this preliminary design includes 12 extraction wells each capable of pumping a minimum of 25 gpm. These wells will be capable of creating a capture zone that is approximately 6,000 feet long. The 12 wells will be located between the ash basins and the property boundary, approximately 50 feet west of the eastern property boundary. The extraction wells will be approximately 60 feet deep. Each well will be constructed with 20 feet of 6-inch diameter wire-wrap screen and sufficient casing to reach land surface. The well screen will be surrounded by appropriately sized filter pack to withhold the surrounding formation and filter groundwater as it enters the well. A minimum of two feet of bentonite pellets will be placed on top of the filter pack to form a seal. The remainder of the well annulus will be filled with cement grout. The wells will be equipped with 4 -inch diameter submersible pumps. The wells will be designed and installed in accordance with 15A NCAC .002C rules. Typical well construction details are included on **Figure 7**.

Groundwater extracted from the wells will be conveyed through an approximate 1-inch diameter high-density polyethylene (HDPE) pipe to a wet well type pump station. There will likely be two pump stations: one dedicated to the northern extraction wells and one for the southern extraction wells. The pump stations would likely be 8-feet in diameter and provide approximately 3,500 gallons of working wet volume for the submersible pumps. The pump stations would convey water from the extraction area to the discharge canal via 6-inch diameter HDPE pipes. The discharge area will consist of a concrete headwall and rip-rap energy dissipater discharge pad. The HDPE pipes conveying water from the wells to the pump stations and then to the discharge location will be set inside a concrete and steel-grate covered utility trench installed just below the ground surface.

3.4 Data Gap Investigation and Aquifer Testing

The completion of the preliminary design contained herein revealed data gaps that must be filled before the completion of the final system design. These data gaps include delineation of the vertical extent of boron in groundwater, evaluation of the presence of a confining unit, and formulation of site-specific physical properties of the shallow aquifer. The vertical extent of boron will be assessed by completing a vertical profile boring at each of the extraction well locations. These vertical profile borings will also be used to confirm the presence of a confining layer. Soil samples will be collected to detect the confining layer. Groundwater samples will be collected at 10 to 20 foot intervals from the water table to 120 feet below ground surface to determine the vertical extent of boron at each extraction well, where needed. In addition, soil samples will be collected and sent to a laboratory for sieve analysis. These data will be used to design the filter pack and well screen.

After the vertical profile borings have been completed and the data analyzed and evaluated, a test extraction well will be installed. The test well will be used to complete an aquifer test to evaluate the site-specific physical properties of the aquifer. The aquifer test will be conducted for up to 3 days. Water levels will be measured in the test well and nearby performance monitoring wells. Before the start of the aquifer test, background water level monitoring will be conducted to document any regional trends in the water level elevation. Background water level monitoring will also be completed to evaluate the potential effect that nearby water supply wells could have on the test well during the aquifer test, and the effect that the test well could have on nearby water supply wells. The amount of precipitation and the changes in barometric pressure will also be monitored during the aquifer test.

3.5 Final System Design

Should the results of the ongoing site assessment activities and aquifer testing indicate that groundwater extraction is the most suitable measure for preventing offsite migration of boron from the Sutton Plant, final system design will be implemented as generally described below. If groundwater extraction is determined to not be a suitable measure, other alternatives may be evaluated as necessary.

It is anticipated that final design documents for the groundwater extraction system will consist of an engineering design report, construction plans, technical specifications, and an engineer's cost estimate as described below.

Engineering Design Report

The engineering design report will include a detailed description of design methodologies, calculations and equipment selection for the extraction system. The hydraulic calculations discussed in the previous section will be included in the design report and updated based on site-specific conditions. Construction QA/QC plan, site specific health and safety plan, permit applications, and erosion and sedimentation control plan will be included as appendices to the engineering design report, as necessary.

Construction Drawings

The final system construction drawing submittal is anticipated to include the following drawings:

- Cover sheet with drawing list;
- Legend and symbol sheet;
- Site layout;
- Pumping well location and details;
- Transmission piping routes and details;
- Geological cross-sections and force main profiles;
- Pump station details;
- Piping and instrumentation diagram;
- Effluent discharge pipe line and discharge structure;
- Electrical power, lighting, and instrumentation details;
- Design details; and,
- Erosion and sedimentation control plan and details.

Technical Specifications

The final system technical specifications submittal is anticipated to include the following:

- Division 1 general requirements specifications including: summary of work, measurement and payment, submittal procedures, environmental controls, and project close out;
- Division 2 earthwork including: clearing and grubbing, excavation and fill, subsurface drilling, sampling and testing extraction wells, groundwater monitoring wells, and soil and erosion controls;
- Division 3 concrete;
- Division 4 masonry;
- Division 5 metals including structural steel;
- Division 8 openings including windows and doors, if needed; and
- Division 11 equipment specifying requirements for the pumping system components.

Engineer's Cost Estimate

HDR will prepare a detailed engineer's cost estimate with back up documentation as part of the remedial design. Quantity take-off sheets and the basis for the development of unit and lump sum prices used in the estimate will be provided.

3.6 Approximate Implementation Schedule

The approximate schedule for implementing the project design is as follows:

- Submit Groundwater Mitigation and Montioring Plan to NCDENR – July 9, 2015
- Conduct aquifer testing and report results – within 3 months after approval/notice to proceed
- Complete final design of extraction system – 6 months after approval/notice to proceed
- Complete bid package and select construction contractor – 2 months after final design approval
- Begin construction/contractor mobilization – 1 month after notice to proceed
- Complete extraction well installation – 2 to 3 months
- Complete conveyance system constrcution – 2 to 3 months
- System start-up – 1 month
- Submit certification report to NCDENR – 2 months after system startup

3.7 Permitting

Currently, the following permits are anticipated to be required for aquifer testing and following final design:

- Non-Discharge Groundwater Remediation Permit (aquifer testing and final design)
- Erosion and Sedimentation Control Permit (final design)
- NPDES Permit Modification

Section 4 – Performance Monitoring

Performance monitoring for the groundwater extraction system will consist of operation and maintenance of the system, groundwater monitoring, hydraulic capture evaluations, and boron groundwater concentration evaluations, as described below.

4.1 Operation and Maintenance

All extraction system components and structures will be periodically inspected to ensure proper and efficient operation. System specific inspection tasks include leak detection, basic system adjustments and recording water levels and flow rates.

The extraction wells will be inspected quarterly to make sure that the equipment is working properly. A water level measurement will be collected monthly from each well and subtracted from their respective static water level to calculate drawdown. The flow rate from each well will also be measured monthly. The flow rate from each well will be divided by the drawdown in each well to calculate the specific capacity or the number of gallons per minute the wells pump per foot of water level drawdown (gpm/ft). This value will be plotted to track the efficiency of each well. When the histogram shows that specific capacity has decreased over 30 percent from the original specific capacity of the extraction well, well rehabilitation using mechanical or chemical techniques will be considered. Other rehabilitation techniques may be used. Valves associated with the water conveyance system will be exercised annually to ensure efficient operation.

4.2 Groundwater Monitoring Plan

Water levels will be measured and groundwater samples for boron only will be collected from the performance monitoring wells listed below to assess the effectiveness of the hydraulic capture system (**Figure 8**). Note that the AW- and SWA-designated wells (listed below) are proposed wells that are part of the GWAP Work Plan. It is anticipated that water level measurements will be taken and groundwater sampling conducted on a quarterly basis for the first year, semi-annually for the next two years and then annually thereafter. The concentration of boron in selected wells will be plotted against time to show concentration trends in the data. The concentration of boron in each well will also be plotted on plan view maps. The water level measurements and water quality data collected from these wells will be evaluated periodically to determine if the monitoring well network should be increased or decreased and if the groundwater sampling frequency should be changed. During this evaluation, the water level measurements and water quality data will also be evaluated to determine if the overall extraction rate of the groundwater system or the individual pumping rate of each well should be increased or decreased to effectively capture the boron. In addition, the water level measurements from offsite performance monitoring wells will be evaluated to determine if the extraction system wells would affect downgradient nearby water supply wells.

Performance Monitoring Wells:

MW-7C	AW-1B	SMW-1B
MW-11	AW-1C	SMW-1C
MW-12	AW-2B	SMW-2B
MW-19	AW-2C	SMW-2C
MW-21C	AW-2D	SMW-3B
MW-22B	AW-3B	SMW-3C
MW-22C	AW-3C	SMW-4B
MW-23B	AW-4B	SMW-4C
MW-23C	AW-4C	SMW-5B
MW-23E	AW-5B	SMW-5C
MW-24B	AW-5C	SMW-6B
MW-24C	AW-5D	SMW-6C
MW-27B	AW-5E	SMW-6D
MW-28B	AW-6B	
MW-28C	AW-6D	
MW-31C	AW-6E	
MW-32C	AW-7B	
MW-33C	AW-7D	
MW-37B	AW-8B	
MW-37C	AW-8C	
	AW-9B	
	AW-9C	
	AW-9D	

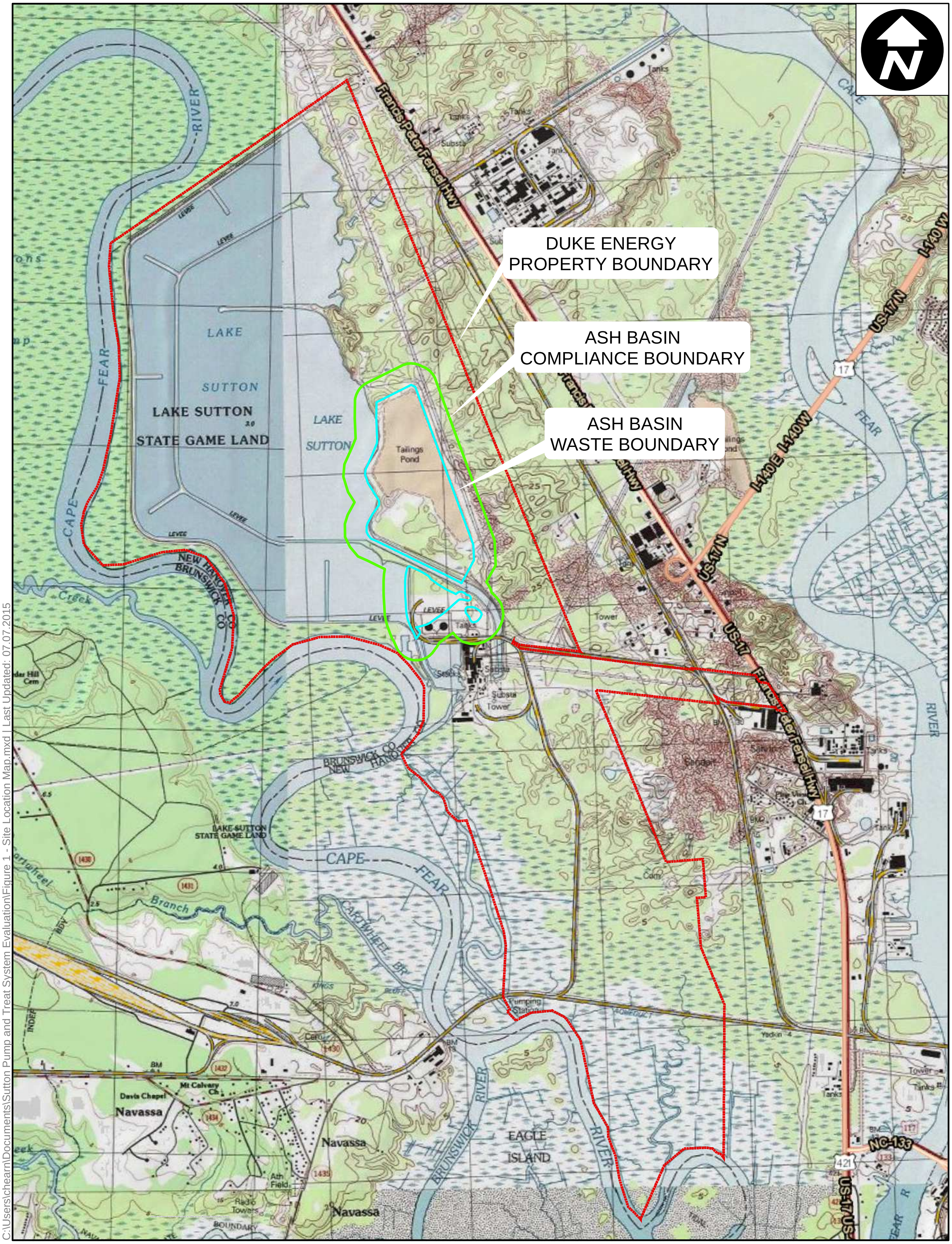
4.3 Evaluation of the Effectiveness of Hydraulic Capture

The capture zone created by pumping the extraction wells will be evaluated annually to confirm the capture zone is of sufficient size to capture groundwater containing boron above the 2L Standard. This will be completed by mapping the piezometric surface of the aquifer and illustrating flow lines and the capture zone. Hydraulic capture will also be evaluated by calculating the hydraulic gradient between two sets of monitoring wells that are cross-gradient to the extraction wells. These hydraulic gradients will be compared to the hydraulic gradients measured during baseline operation.

4.4 Evaluation of Boron Concentrations in Groundwater

The influent concentration of boron will also be used to monitor the hydraulic capture. The concentration of boron in groundwater samples collected from extraction wells will be plotted against time to track the concentration of the boron in each extraction well. This information will be used to evaluate the value each extraction well provides to overall capture of boron. In addition, the concentration of boron in each monitoring well will also be plotted against time to track the boron concentration and the effectiveness of the hydraulic containment system.

Figures

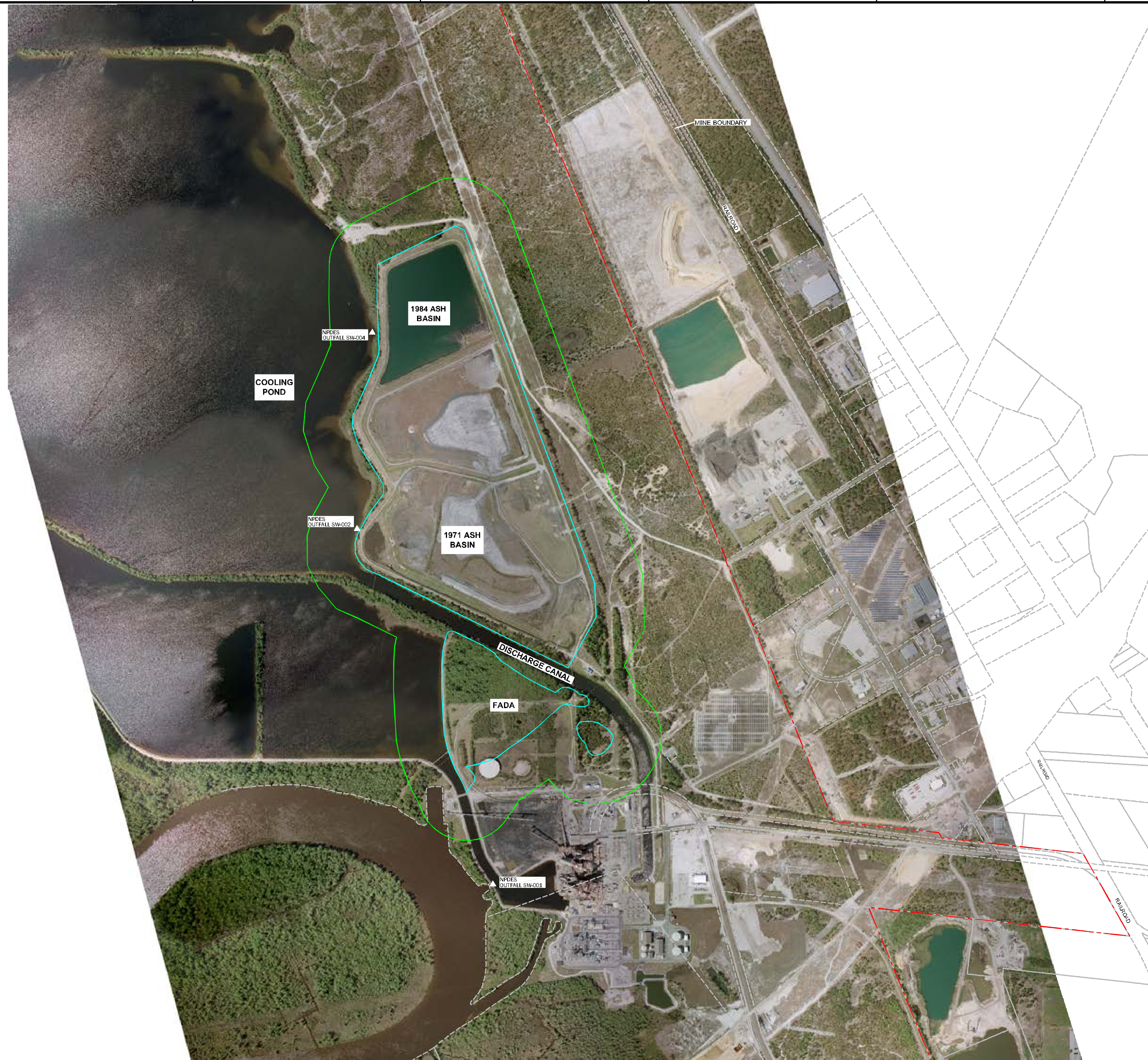


SITE LOCATION MAP

Figure 1

L.V. SUTTON ENERGY COMPLEX | 801 SUTTON POWER PLANT ROAD | WILMINGTON, NC

C:\Users\chearn\Documents\Sutton Pump and Treat System Evaluation\Figure 1 - Site Location Map.mxd | Last Updated: 07.07.2015



LEGEND

- DUKE PROPERTY BOUNDARY
- APPROXIMATE ASH BASIN WASTE BOUNDARY
- ASH BASIN COMPLIANCE BOUNDARY

SOURCES:

1. 2014 AERIAL PHOTOGRAPH WAS OBTAINED FROM WSP FLOWN ON APRIL 17, 2014
2. DRAWING HAS PROJECTION OF NORTH CAROLINA STATE PLANE COORDINATE SYSTEM FIPS 3200 (NAD 83).
3. PARCEL DATA WAS OBTAINED FROM THE NORTH CAROLINA STATE LIBRARIES AT http://www.lib.ncsu.edu/gis/counties.html FOR NEW HANOVER COUNTY.
4. WELL LOCATIONS AND MEASURING POINTS WERE BASED ON A SURVEY BY JAMES L. HAINES & ASSOCIATES FOR ISH, INC. DATED DECEMBER 23, 2008. ISH DRAWING IS TITLED "POTENTIAL LOCATIONS FOR PROPOSED GEOPROBE AND WELL INSTALLATIONS", DATED FEBRUARY 25, 2009 WITH A CAD FILE NAME Figure 22.dwg
5. NEW WELL LOCATIONS AND MEASURING POINTS WERE BASED ON A TABLE BY PARAMOUNTE ENGINEERING, WILMINGTON NC DATED 2012-03-05 SUPPLIED BY PROGRESS ENERGY. HORIZONTAL DATUM IS NAD83(NSRS2007) AND THE VERTICAL DATUM IS NGVD29.
6. THE PROPERTY BOUNDARY FOR THE L.V. SUTTON STEAM ELECTRIC PLANT WAS BASED ON A COMPOSITE MAP PREPARED BY DAVIS-MARTIN-POWELL & ASSOC., INC. THE DRAWINGS ARE DATED JUNE, 1995 WITH REVISION NOTE FOR MARCH 4, 2004. FILE NAME IS L-D-9022-7.DWG. HORIZONTAL DATUM IS NAD83 AND THE VERTICAL DATUM IS NGV 29.
7. THE LOCATION OF THE FORMER ASH DISPOSAL AREAS WAS BASED ON A FIGURE 2-2 PREPARED BY BLASLAND, BOUCK & LEE, INC. THE FIGURE IS TITLED "HORIZONTAL EXTENT OF THE ASH WITHIN THE FORMER DISPOSAL AREA".
8. MONITORING WELLS/PIEZOMETERS/SOIL BORINGS COMPLETED AT PART OF PREVIOUS ASSESSMENT ACTIVITIES. LOCATIONS ARE APPROXIMATE.

GRAPHIC SCALE

600 0 300 600 1200

(IN FEET)

HDR

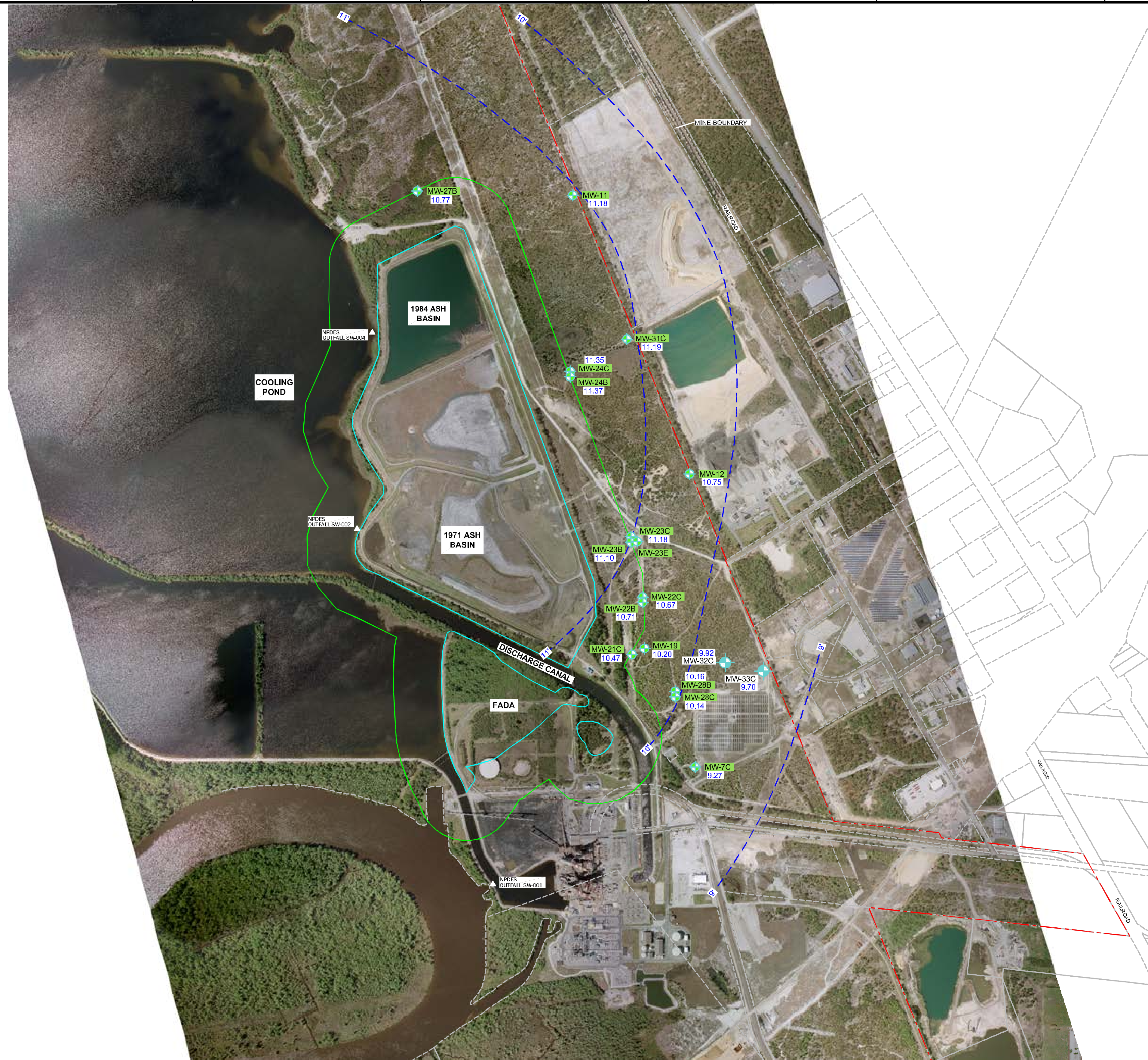
ISSUE	DATE	DESCRIPTION	PROJECT MANAGER
			PROJECT NUMBER

L.V. SUTTON ENERGY COMPLEX
WILMINGTON, NORTH CAROLINA 28401
DUKE ENERGY

SITE LAYOUT MAP

DATE JULY 8, 2015

SHEET FIGURE 2



LEGEND

- MW-11 — EXISTING COMPLIANCE MONITORING WELL (SURVEYED)
- MW-32C — MONITORING WELL (SURVEYED)
- 11.19 — GROUNDWATER ELEVATION (FT-MSL)
- 10' — GROUNDWATER ELEVATION CONTOUR (FT-MSL)
- DUKE PROPERTY BOUNDARY
- APPROXIMATE ASH BASIN WASTE BOUNDARY
- ASH BASIN COMPLIANCE BOUNDARY

SOURCES:

1. 2014 AERIAL PHOTOGRAPH WAS OBTAINED FROM WSP FLOWN ON APRIL 17, 2014
2. DRAWING HAS PROJECTION OF NORTH CAROLINA STATE PLANE COORDINATE SYSTEM FIPS 3200 (NAD 83).
3. PARCEL DATA WAS OBTAINED FROM THE NORTH CAROLINA STATE LIBRARIES AT http://www.lib.ncsu.edu/gis/counties.html FOR NEW HANOVER COUNTY.
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8. MONITORING WELLS/PIEZOMETERS/SOIL BORINGS COMPLETED AT PART OF PREVIOUS ASSESSMENT ACTIVITIES. LOCATIONS ARE APPROXIMATE.
9. GROUNDWATER ELEVATIONS SHOWN ARE FROM JUNE 2014 GROUNDWATER SAMPLING EVENT (PROVIDED IN SYNTERRA GWAP REV1 WORK PLAN DATED DECEMBER 2014).

GRAPHIC SCALE
600 0 300 600 1200
(IN FEET)

C:\pwworking\tpa\d0738984\Figures 2, 5, 6 and 8.dwg, FIGURE 5 (2), 7/8/2015 1:30:16 PM, cheam

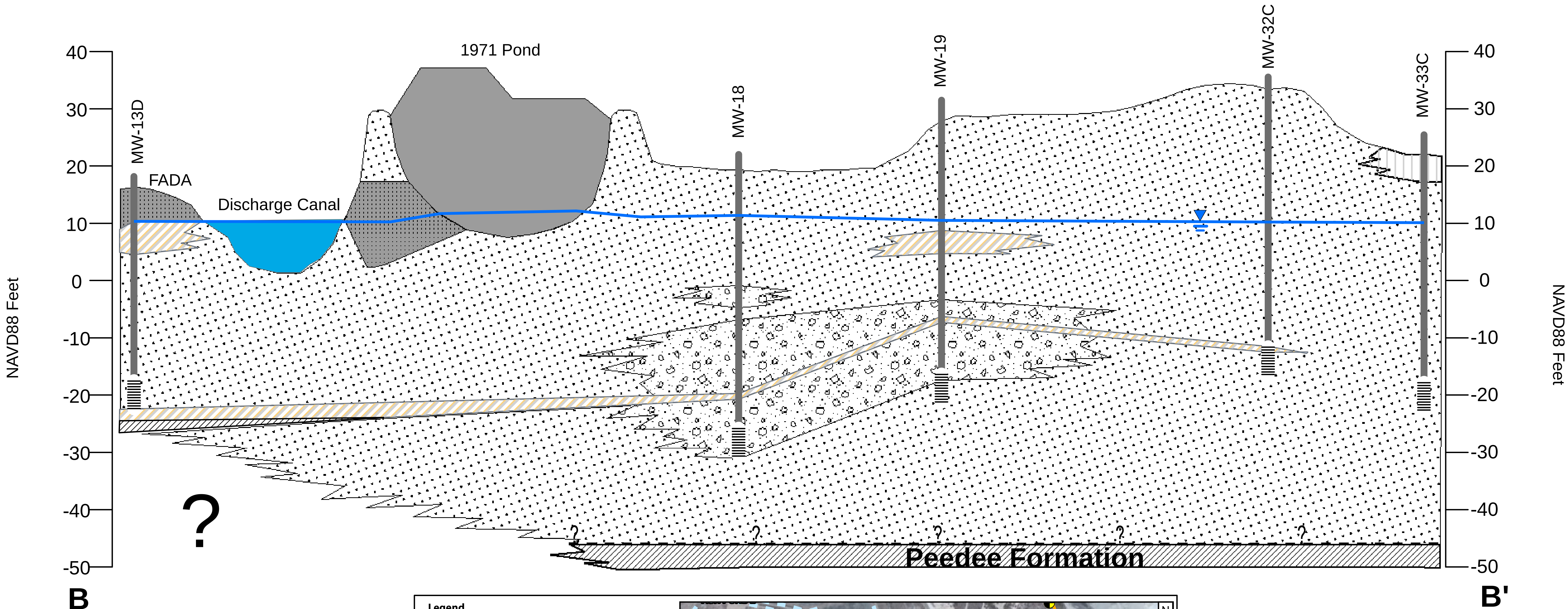
ISSUE	DATE	DESCRIPTION	PROJECT MANAGER
			PROJECT NUMBER

L.V. SUTTON ENERGY COMPLEX
WILMINGTON, NORTH CAROLINA 28401
DUKE ENERGY

WATER LEVEL MAP
JUNE 2014

DATE: JULY 8, 2015

SHEET: FIGURE 3



Legend

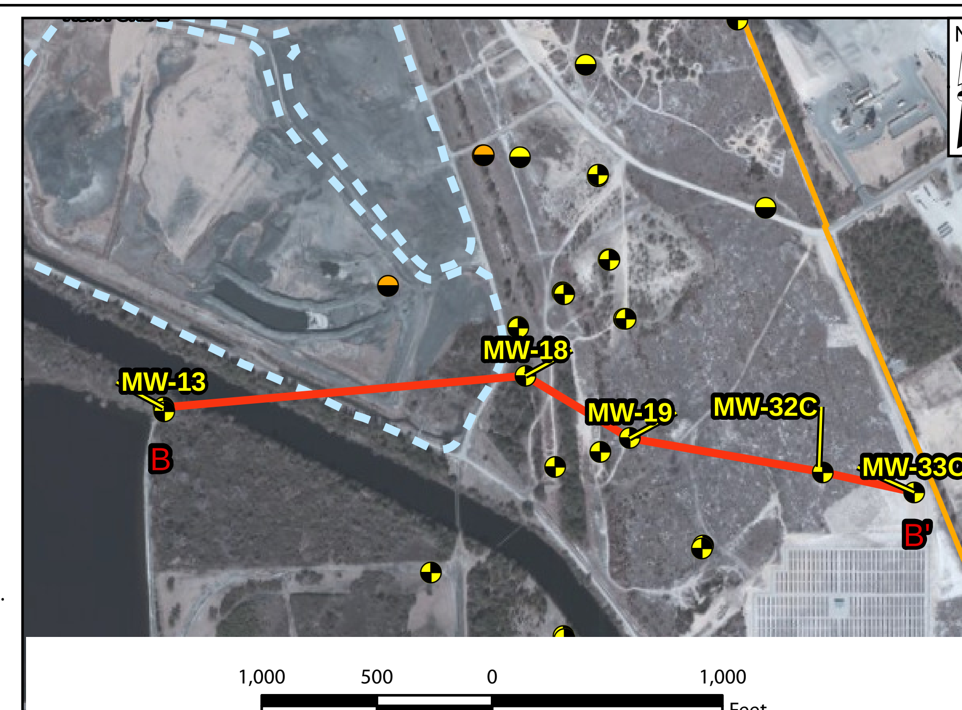
- Water Elevation (NAVD88)
- ? - - Estimated Location (See Note 3)
- Clean Sands (SP)
- CCR
- Sand and CCR Mixture
- Clayey Sand (SC)
- Clay (CH)
- Sand and Gravel (SP/GP)
- Silt (ML)
- Water
- Monitoring Well Location
- Screen

Notes:
1. CCR designates coal combustion residual.
2. Water levels collected during the May 2014 sampling event.
3. Location of the Peedee formation is infered from Geology and Ground-water Resources of New Hanover County, North Carolina (USGS, 1970). No borings in this area reached the Peedee formation.
4. NAVD88 indicates North American Vertical Datum of 1988.

Legend

- New Piezometer
- Existing Monitoring Well
- Existing Piezometer
- B—B' Transect
- Pond Locations
- Property Boundary

Notes:
1. Existing monitoring well and piezometer locations determined from northings and eastings reported on boring logs by Blasland, Bolick & Lee, Synterra, Golder Associates and Catlin Engineers and Scientists.
2. Horizontal coordinate system US State Plane 1983 North Carolina, US survey feet.
3. 2011 World Imagery - Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.



0 125 250 500 750 1,000 Feet

Vertical Exaggeration = 18

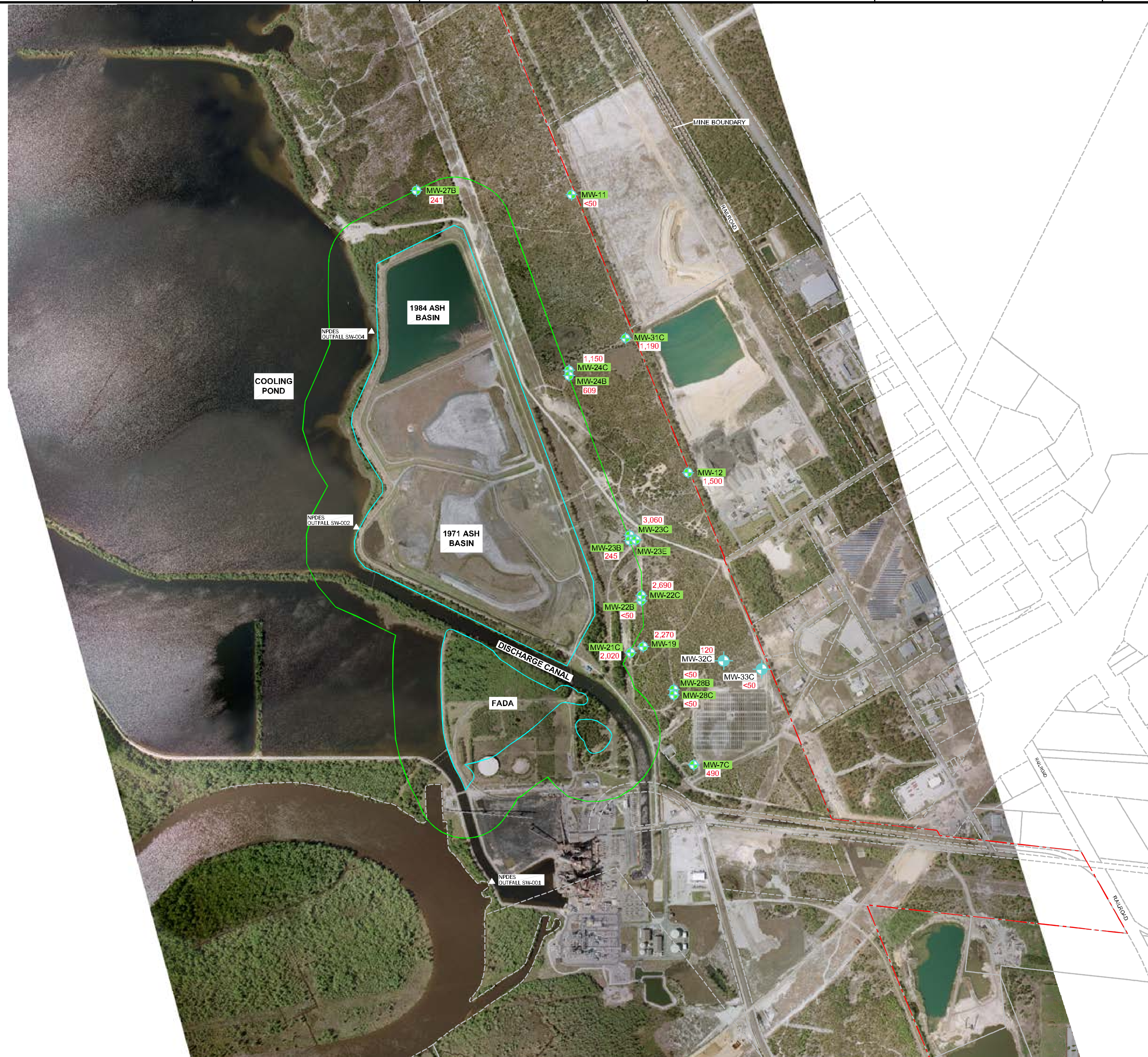
Lithologic Cross Section B to B'

L.V. Sutton Plant

Geosyntec
Consultants of NC, PC
NC License No.: C-3500

Raleigh, NC | July 2014

Figure 4



LEGEND

MW-11	EXISTING COMPLIANCE MONITORING WELL (SURVEYED)
MW-32C	MONITORING WELL (SURVEYED)
1,190	BORON CONCENTRATION (ug/L)
	DUKE PROPERTY BOUNDARY
	APPROXIMATE ASH BASIN WASTE BOUNDARY
	ASH BASIN COMPLIANCE BOUNDARY

SOURCES:

1. 2014 AERIAL PHOTOGRAPH WAS OBTAINED FROM WSP FLOWN ON APRIL 17, 2014
2. DRAWING HAS PROJECTION OF NORTH CAROLINA STATE PLANE COORDINATE SYSTEM FIPS 3200 (NAD 83).
3. PARCEL DATA WAS OBTAINED FROM THE NORTH CAROLINA STATE LIBRARIES AT http://www.lib.ncsu.edu/gis/counties.html FOR NEW HANOVER COUNTY.
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8. MONITORING WELLS/PIEZOMETERS/SOIL BORINGS COMPLETED AT PART OF PREVIOUS ASSESSMENT ACTIVITIES. LOCATIONS ARE APPROXIMATE.
9. BORON ANALYTICAL RESULTS SHOWN ARE FROM MARCH 2015 GROUNDWATER SAMPLING EVENT.

GRAPHIC SCALE
600 0 300 600 1200
(IN FEET)

PROJECT MANAGER

ISSUE DATE DESCRIPTION

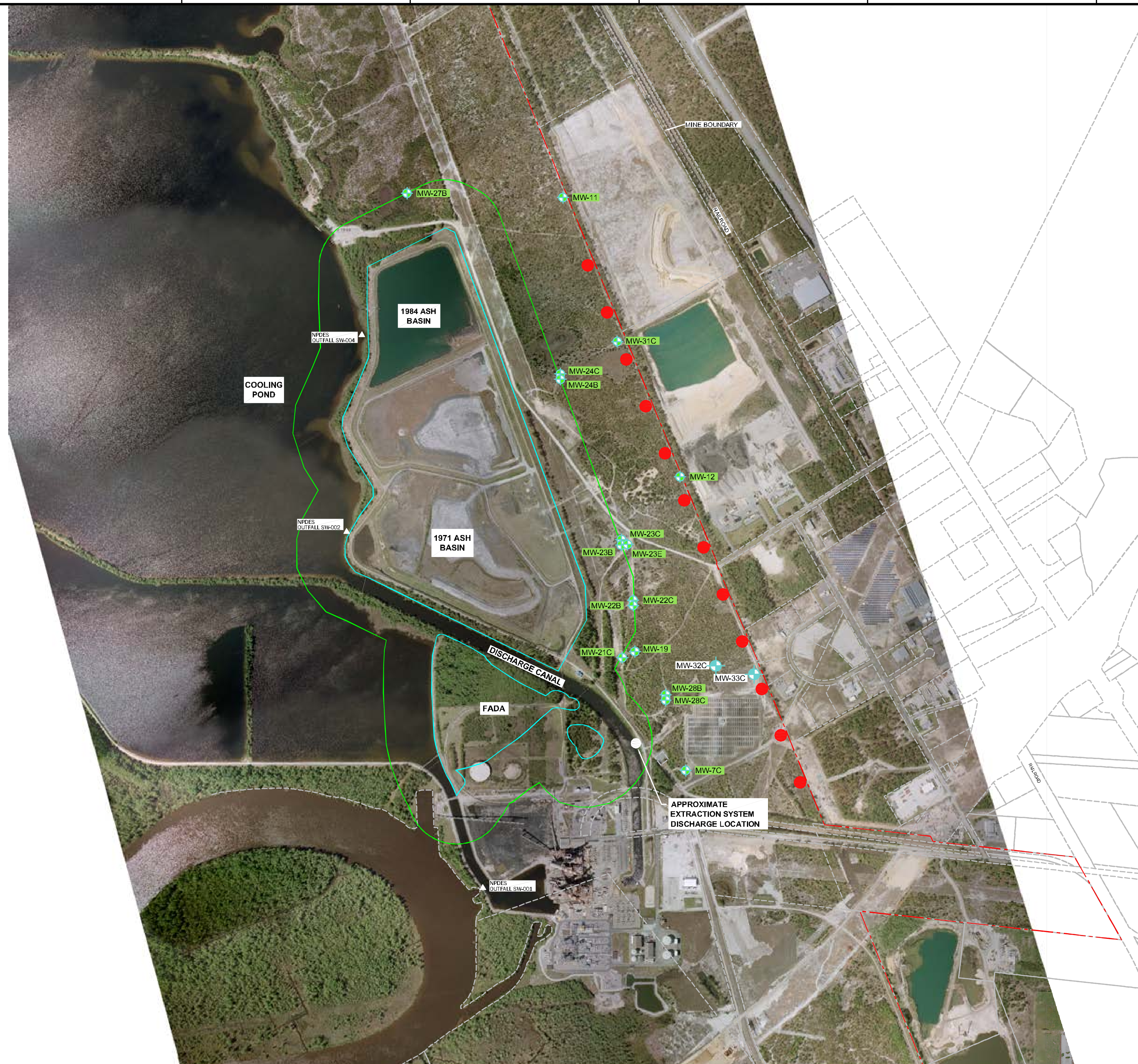
PROJECT NUMBER

L.V. SUTTON ENERGY COMPLEX
WILMINGTON, NORTH CAROLINA 28401
DUKE ENERGY

DISTRIBUTION OF BORON IN GROUNDWATER

DATE JULY 8, 2015

SHEET FIGURE 5



LEGEND

- MW-11 — EXISTING COMPLIANCE MONITORING WELL (SURVEYED)
- MW-32C — MONITORING WELL (SURVEYED)
- EXTRACTION WELLS
- DUKE PROPERTY BOUNDARY
- APPROXIMATE ASH BASIN WASTE BOUNDARY
- ASH BASIN COMPLIANCE BOUNDARY

SOURCES:

1. 2014 AERIAL PHOTOGRAPH WAS OBTAINED FROM WSP FLOWN ON APRIL 17, 2014
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GRAPHIC SCALE
600 0 300 600 1200
(IN FEET)

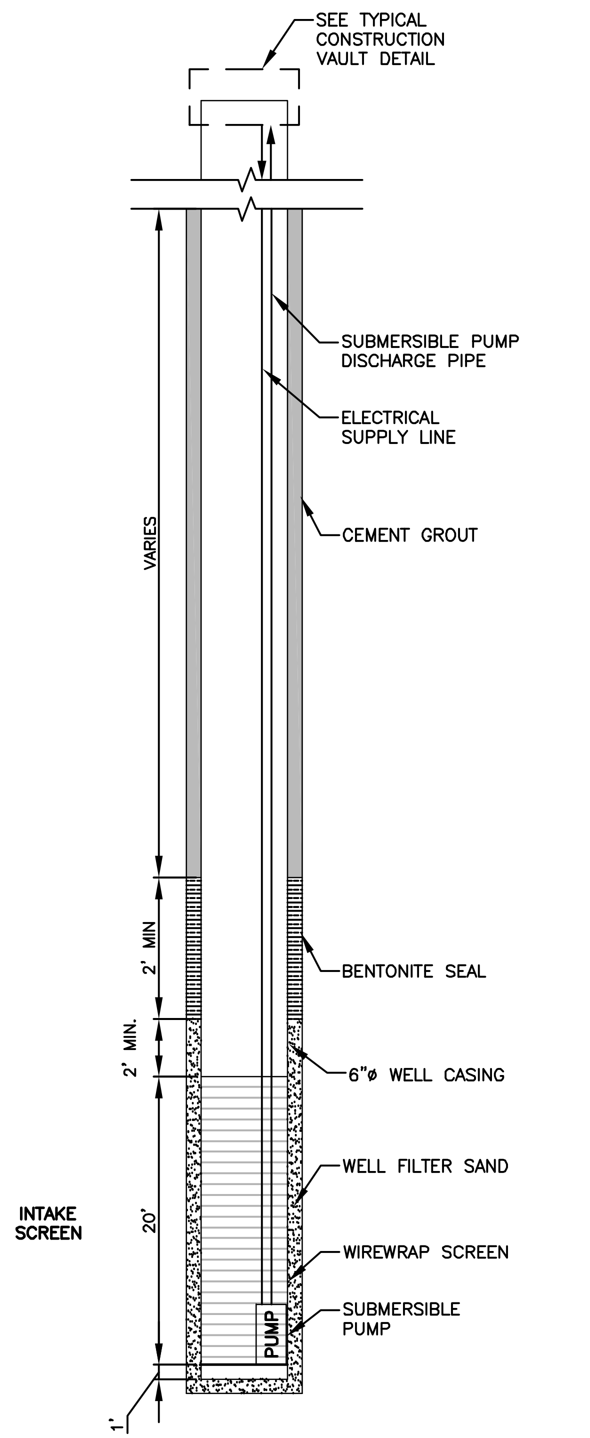
ISSUE	DATE	DESCRIPTION	PROJECT MANAGER
			PROJECT NUMBER

L.V. SUTTON ENERGY COMPLEX
WILMINGTON, NORTH CAROLINA 28401
DUKE ENERGY

PRELIMINARY GROUNDWATER EXTRACTION WELL LAYOUT

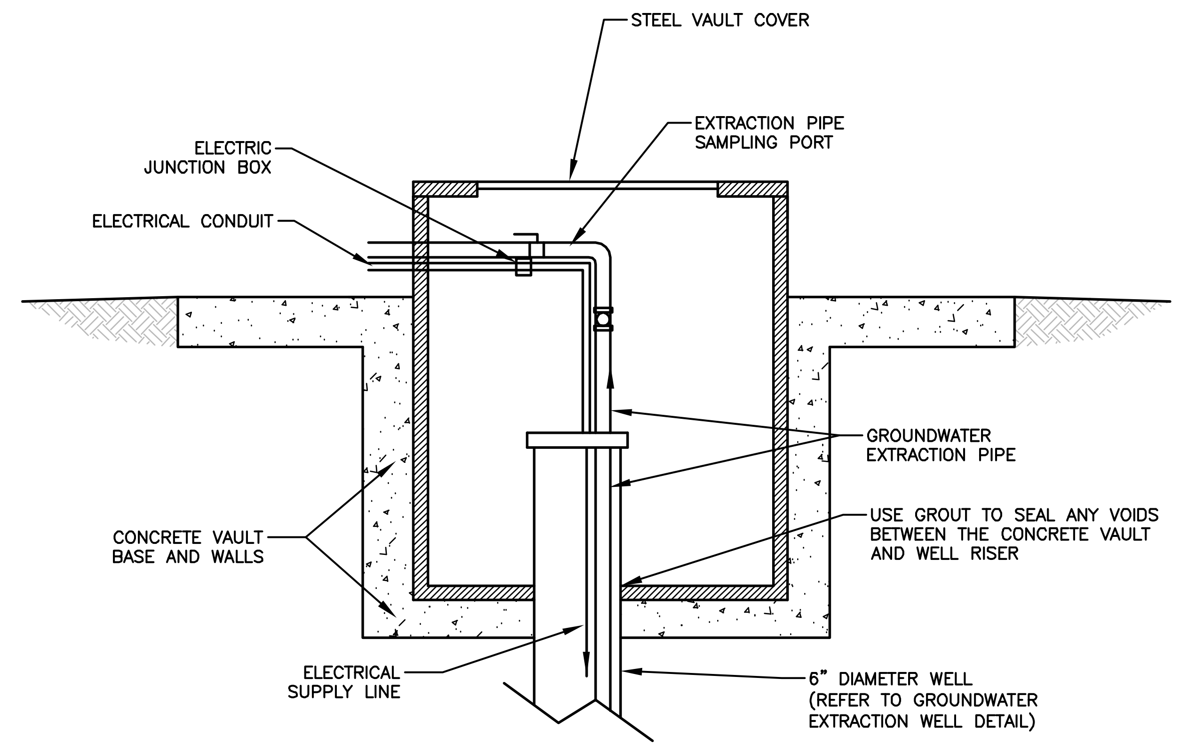
DATE: JULY 8, 2015

SHEET: FIGURE 6



TYPICAL GROUNDWATER EXTRACTION WELL

SCALE: NOT TO SCALE



PRELIMINARY TYPICAL CONCRETE VAULT

SCALE: NOT TO SCALE

C:\pwworking\tpa\d0738984\Figures 2, 5, 6 and 8.dwg, fIGURE 7, 7/8/2015 1:26:36 PM, cheam

HDR

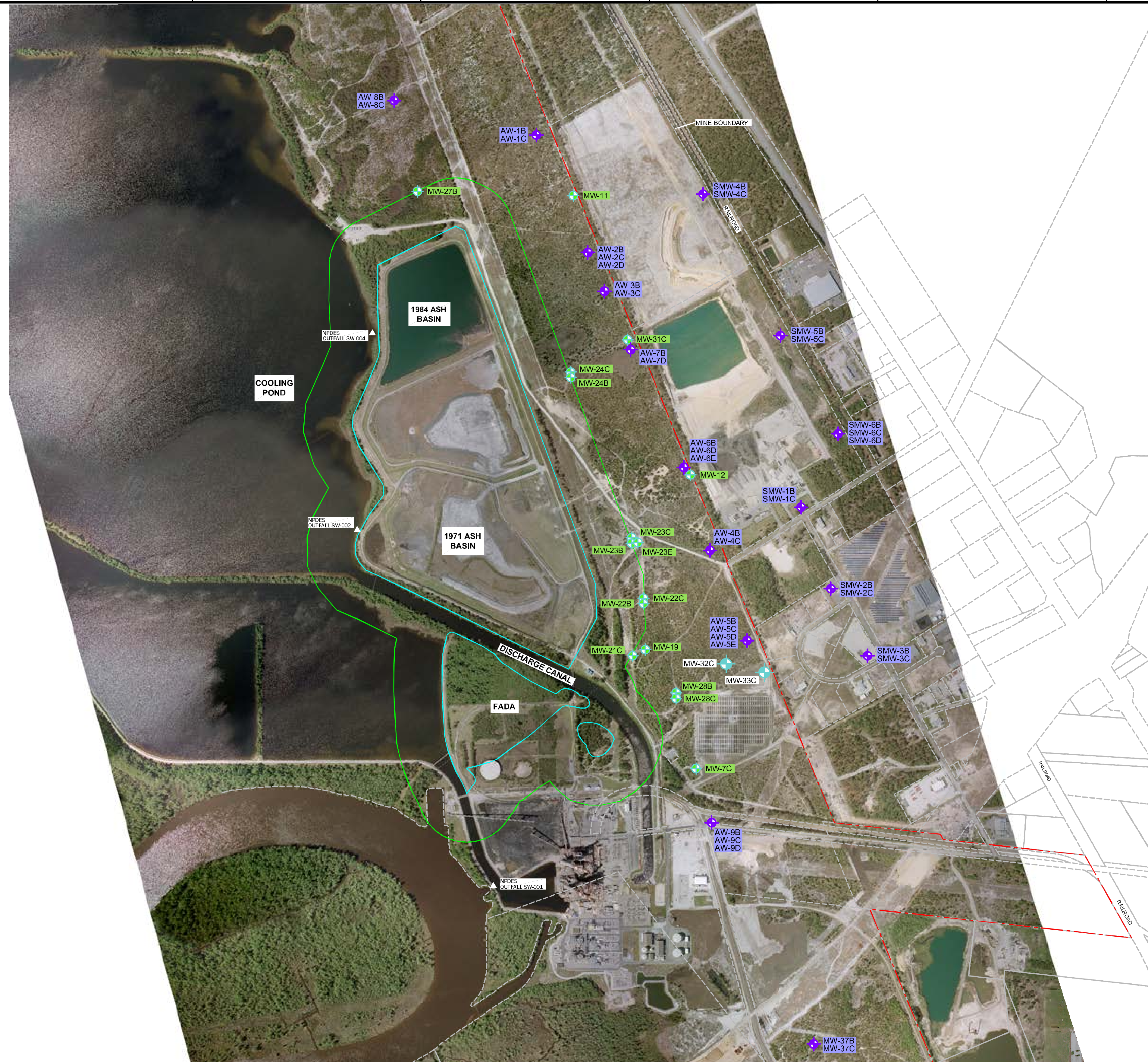
ISSUE	DATE	DESCRIPTION	PROJECT MANAGER
			PROJECT NUMBER

L.V. SUTTON ENERGY COMPLEX
WILMINGTON, NORTH CAROLINA 28401
DUKE ENERGY

TYPICAL EXTRACTION WELL AND VAULT CONSTRUCTION DETAILS

DATE JULY 8, 2015

SHEET FIGURE 7



LEGEND

- MW-11 — EXISTING COMPLIANCE MONITORING WELL (SURVEYED)
- MW-32C — MONITORING WELL (SURVEYED)
- MW-3D / MW-3BR — PROPOSED MONITORING WELL LOCATION (PROPOSED GROUNDWATER ASSESSMENT WORK PLAN DATED DEC. 2014)
- DUKE PROPERTY BOUNDARY
- APPROXIMATE ASH BASIN WASTE BOUNDARY
- ASH BASIN COMPLIANCE BOUNDARY

SOURCES:

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GRAPHIC SCALE

600 0 300 600 1200

(IN FEET)

HDR

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER

PROJECT NUMBER

L.V. SUTTON ENERGY COMPLEX
WILMINGTON, NORTH CAROLINA 28401
DUKE ENERGY

PERFORMANCE MONITORING WELLS MAP

DATE: JULY 8, 2015

SHEET: FIGURE 8

Tables

TABLE 1
BORON CONCENTRATION RANGES DETECTED ABOVE 2L STANDARD
L.V. SUTTON ENERGY COMPLEX
DUKE ENERGY PROGRESS, INC., WILMINGTON, NORTH CAROLINA

		PARAMETER	**BORON**
		2L STANDARD (eff. 4/1/2013)	**700**
		Units	(ug/l)
Well ID	**Well Location Relative to Compliance Boundary**	**Range of Sample Dates**	**Range of Sample Results**
Ash Basin Compliance Monitoring Wells			
MW-4B	Background	Dec 2006 - March 2015	<2L
MW-5C	Background	March 2012 - March 2015	<2L
MW-7C	Beyond CB	March 2012 - March 2015	157 - 767
MW-11	Beyond CB	March 2012 - March 2015	<2L
MW-12	Beyond CB	March 2012 - March 2015	928 - 1,560
MW-19	CB	March 2007 - March 2015	850 - 2,270
MW-21C	CB	Oct 2011 - March 2015	1,490 - 2,210
MW-22B	CB	Oct 2011 - March 2015	<2L
MW-22C	CB	Oct 2011 - March 2015	1,650 - 2,690
MW-23B	CB	Oct 2011 - March 2015	245 - 1,830
MW-23C	CB	Oct 2011 - March 2015	1,640 - 3,600
MW-24B	CB	Oct 2011 - March 2015	609 - 1,500
MW-24C	CB	Oct 2011 - March 2015	988 - 1,240
MW-27B	CB	Oct 2011 - March 2015	<2L
MW-28B	Beyond CB	Oct 2011 - March 2015	<2L
MW-28C	Beyond CB	Oct 2011 - March 2015	83 - 1,260
MW-31C	Beyond CB	Oct 2011 - March 2015	985 - 1,410
MW-32C	Beyond CB	Nov 2013 - March 2015	<2L
MW-33C	Beyond CB	Nov 2013 - March 2015	<2L
Additional Site Monitoring Wells (Not Ash Basin Compliance Monitoring Wells)			
MW-2C	RB	Dec 2006 - May 2014	1,600 - 2,790
MW-6C	RB	March 2007 - May 2014	739 - 1,690
MW-8	Beyond CB	March 2012 - June 2012	<2L
MW-9	Beyond CB	March 2012 - June 2012	<2L
MW-10	Beyond CB	March 2012 - June 2012	<2L
MW-17	RB	March 2007 - June 2012	2,000 - 3,060
MW-18	Between WB & RB	March 2011 - June 2012	1,150 - 1,550

Notes:

Sample results included in this table through June 2014 are from Synterra's GWAP Work Plan Rev1 dated Dec 2014.

Sample results for compliance monitoring wells after June 2014 through March 2015 were provided by Duke Energy.

CB - Compliance Boundary

RB - Review Boundary

WB - Waste Boundary

< 2L - Constituent has not been detected above the 2L Standard