

ALTAMONT ENVIRONMENTAL, INC.

ENGINEERING & HYDROGEOLOGY



Groundwater Sampling and Analysis Plan

Marshall Steam Station
Flue Gas Desulphurization (FGD) Residue Landfill
Phase 1, Cell 1
Permit No. 18-09

August 19, 2011

Prepared for
Duke Energy Carolinas, LLC
Marshall Steam Station
Catawba County, NC
Project Number: 2371.1101

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Table of Contents

1.0	Program Description	1
1.1	Scope of Work	1
1.2	Background and Site Hydrogeological Description	1
1.3	Well Locations and Installation	2
1.4	Surface Water Sample Location	3
1.5	Monitoring Frequency	3
1.6	Parameters	3
1.7	Data Quality Objectives	3
2.0	Sampling Procedures	5
2.1	Sampling Equipment	5
2.1.1	Equipment Cleaning Procedures	5
2.2	Groundwater Sampling	5
2.2.1	Development of Wells	5
2.2.2	Groundwater Level and Total Depth Measurements	5
2.2.3	Well Purging and Sampling	6
2.2.4	Sample Collection	7
2.2.5	Sample Containers, Volume, Preservative, and Holding Time	7
2.3	Surface Water Sampling	8
2.4	Sample Tracking	8
2.5	Sample Labeling	8
2.6	Field Documentation	8
2.7	Chain-of-Custody Record	9
2.8	Sample Custody, Shipment, and Laboratory Receipt	9
3.0	Analytical Procedures	11
4.0	Internal Quality Control Checks	11
5.0	Validation of Field Data Package	12
6.0	Report Submittal	12

Figures

1. Site Location Map
2. Sample Locations
3. Typical Monitoring Well Construction Details
4. Groundwater Monitoring Data Sheet

5. Field Sampling Calibration Form
6. Chain-of-Custody Form
7. Groundwater Sampling Site Checklist

Tables

1. Monitoring Well Information
 - 1.1. Surface Water Sample Location
 2. Sample Parameters, Analytical Methods, and Detection Limits
 3. Sample Containers, Preservatives, and Holding Times

Appendices

- A. Monitoring Well Construction Records

1.0 Program Description

1.1 Scope of Work

This Groundwater Sampling and Analysis Plan is designed to guide the monitoring efforts that are used to evaluate the effects of the Marshall Steam Station Flue Gas Desulfurization (FGD) Residue Landfill, Phase 1, Cell 1, on the groundwater in the area. This plan has been prepared according to the guidelines set forth by the North Carolina Department of Environment and Natural Resources (DENR) Water Quality Guidance Document for Solid Waste Facilities (SW-1001-87), and by the Environmental Protection Agency (EPA) in "Interim Guidelines and Specifications for Preparing Quality Assurance Plans" (QAMS-500/80), and documents the methodologies of field sampling, record-keeping protocols, data quality objectives, and data validation procedures that will be used in this program.

1.2 Background and Site Hydrogeological Description

Marshall Steam Station (Marshall) is located in Catawba County, on Highway NC 150, just west of Lake Norman. The station is owned and operated by Duke Energy Carolinas, LLC (Duke). Marshall is located in the Piedmont physiographic region. Figure 1 shows the location of the plant and the location of the FGD landfill, Phase 1, Cell 1.

The Marshall Steam Station has a generating capacity of 2,090 megawatts (MW) of electric power by the combustion of coal. Therefore, the Marshall station generates enough electricity to power over one-and-a-half million homes.

The FGD Residue Landfill will consist of two cells. When completed, the landfill footprint will contain approximately 31.9 acres. Construction of Cell 1 was completed in 2006, and a Permit to Operate was issued on November 21, 2006. Duke has not requested a Permit to Construct for Cell 2.

Cell 1 has a footprint of approximately 14.8 acres. In general the landfill is permitted to receive industrial wastes generated by Duke at Marshall and at other Duke facilities. The waste received at the FGD residue landfill consists primarily of gypsum. The FGD residue is conveyed to the landfill site by truck, where the material is spread and compacted.

The landfill was constructed with a leachate collection and removal system and an engineered liner system to prevent impacts to groundwater. When closed, the completed landfill will receive an engineered cover system to minimize infiltration.

The FGD landfill is located entirely on Duke property, northwest of the Marshall station and to the west of the Marshall Ash Basin. The landfill is located to the east of a north-south trending railroad line. . Located to the west of this railroad line is Sherrill's Ford Road, which also runs north-south along a surface water divide. Located between the landfill footprint and the railroad line is a surface water drainage feature. This feature drains to the south, to an intermittent stream that drains to Lake Norman. There is a topographic divide running north-northwest through the landfill footprint, along Steam Plant Road. Surface drainage to the west of Steam Plant Road drains to the surface drainage feature and surface drainage to the east of Steam Plant Road drains to the Marshall Ash Basin.

As described in the site hydrogeological study ([Hydrogeological Study FGD Scrubber Landfill, Duke Power--Marshall Steam Station, Terrell, North Carolina, S&ME Project No: 1264-02-578, May 30, 2003](#)), the subsurface conditions in the landfill area consist of residual soils and partially to fully weathered rock (saprolite), which have formed by the in-place weathering of the parent rock. As is typical in the groundwater systems located in the Piedmont region, groundwater at the landfill site occurs within the

residuum and saprolite under unconfined aquifer conditions. The predominant discharge areas for groundwater in the landfill area are expected to be the drainage feature and the ash basins located to the east of the landfill.

The subsurface conditions at the landfill were described by S&ME as follows:

- Residuum: Beneath the ground surface, residual material consisting of silts, silty clays, clayey silts, and silty sands. Sandy silts were found at depths ranging from 2.5 to 14 feet below ground surface.
- Saprolite: Saprolite material was found at depths ranging from 13.5 feet to 68.5 feet below ground surface. This material is a product of weathered bedrock, consisting of silts to clayey silts and sandy silts to silty sands, having a Standard Penetration Test (SPT) resistance of 50 blows per foot or more.
- Partially Weathered Rock: This material is defined as material exhibiting SPT resistances in excess of 100 blows per foot. This material was found at depths ranging from 25.5 feet to 90 feet below ground surface.
- Bedrock: Bedrock was found at depths ranging from 25.5 feet to 79.5 feet. When sampled, this material was classified as granite, schist, and gneiss. Horizontal to high-angle fractures were found in the upper ten feet of the bedrock areas. Many fractures were found to be iron stained, indicating flow of water into the fractures.

1.3 Well Locations and Installation

Groundwater and surface water conditions at the landfill are monitored using nine groundwater monitoring wells and one surface water sampling location. Monitoring well locations and construction information are provided in Table 1. The locations of these wells are shown on Figure 2. Monitoring well MS-8 will be used as the background well for this sampling program.

The wells were constructed of two-inch diameter polyvinyl chloride (PVC) well screen and casing. The well screens were placed where they would intercept the aquifer and have slot sizes of 0.010 inch. The screen lengths are shown in Table 1.

The wells were installed by a well driller registered in North Carolina in accordance with applicable DENR regulations. The locations of the wells and the elevations of the tops of the casings were surveyed under the direction of a Professional Surveyor, licensed in North Carolina.

Figure 3 shows a typical construction diagram for the wells. All wells are equipped with dedicated bladder-type pump systems. Well construction records for the existing wells are included in Appendix A.

A brief description of the monitoring locations and their monitoring function is provided below.

Monitoring Well MS-8—Background Well

Monitoring well MS-8 will be used as a background monitoring well. This well is located approximately 250 feet north of the landfill, on the west side of Steam Plant Road. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-9

This existing well is located north of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-10

This well is located west of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-11

This well is located west of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-12 (Formerly Designated as Well OW-3)

This well is located south of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-13 (Formerly Designated as Well MS-6)

This well is located south of the landfill. The well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-14 (Formerly Designated as Well B-5)

This well is located to the southeast of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-15 (Formerly Designated as Well B-4)

This well is located to the east of the landfill. This well is screened to monitor groundwater in the saprolite layer.

Monitoring Well MS-16

This well is located to the northeast of the landfill. This well is screened to monitor groundwater in the saprolite layer.

1.4 Surface Water Sample Location

A surface water sample will be collected from location SW-1. This surface water sampling location is located south of the landfill, between wells MS-12 and MS-13, as shown on Figure 2. The North Carolina State Plane coordinates and elevation for this sampling location are shown in Table 1.1.

1.5 Monitoring Frequency

The wells and surface water sample location will be sampled semiannually in March and September.

1.6 Parameters

The parameters to be sampled and analyzed, units of measure, methods, and detection limits are presented in Table 2.

1.7 Data Quality Objectives

The overall Quality Assurance (QA) objective is to ensure that reliable data of known and acceptable quality are provided. All measurements will be documented to yield results that are representative of the groundwater and surface water quality. Data will be calculated and reported in units as required by DENR.

The analytical QA objectives for precision, accuracy, and completeness have been established by the laboratories in accordance with EPA or other accepted agencies for each measurement variable, where possible. The objectives are outlined in the Duke Energy Analytical Laboratory Procedures Manual and are available upon request.

Detection limits for the water analyses presented in Table 2 are generally specified by the analytical methods. As stated above, appropriate methods have been selected to meet applicable standards for groundwater quality. Instances may occur, however, in which the condition of the sample will not allow

detection of the desired limits for various parameters either because of matrix interference or high analyte concentrations requiring sample dilution. The laboratory(s) will provide sufficient documentation with each data package to notify reviewers about any analytical problems with the data, if needed.

2.0 Sampling Procedures

2.1 Sampling Equipment

Development, purging, and sampling equipment are selected to ensure materials are compatible with the sample parameters and comply with state and federal regulatory requirements for sampling. Positive-gas-displacement fluorocarbon resin bladder pumps are installed in each monitoring well and are dedicated purging and sampling systems.

2.1.1 Equipment Cleaning Procedures

Dedicated sampling equipment has been installed in each monitoring well. In the event non-dedicated equipment is used between wells, equipment will be cleaned before and after use in each well in accordance with standard EPA-approved cleaning procedures for field equipment. This standard is outlined in the *Standard Operating Procedures and Quality Assurance Manual*, Engineering Support Branch, EPA Region IV, February 1, 1991.

2.2 Groundwater Sampling

2.2.1 Development of Wells

All nine wells addressed in this sampling plan have been developed. If new wells are installed they will be developed before they are sampled.

After installation of new wells, and prior to initial sampling, the monitoring wells will be developed. Development removes silt that has settled into the bottom of the well following installation, and removes fine silt and clay particles from the well screen and sandpack surrounding the screen. Well development is necessary to eliminate potential clogging and enhance well performance. Development involves removing an estimated ten or more well volumes from the well using a positive-gas-displacement fluorocarbon resin bladder pump with up-and-down agitation to loosen particles from the well screen. After development of a well, a true well depth is recorded, referenced to the top of well casing (TOC).

2.2.2 Groundwater Level and Total Depth Measurements

Water level measurements are collected and recorded to determine the groundwater elevations, determine groundwater flow direction, and to calculate the volume of standing water in the well. All monitoring wells have been surveyed to determine the elevation of the TOC. All depth and water level measurements are referenced to the TOC and recorded to the nearest one-hundredth of a foot.

Water level measurements are made with an electronic measuring device consisting of a spool of dual conductor wire and sensor. When the sensor comes in contact with water, the circuit is closed and a meter light and/or buzzer is attached to the spool to signal the contact. The sensor is lowered further until it rests on the bottom of the well to determine the total depth of the well reference to the TOC. The depth and water level measurements are used to verify that the well has not filled with silt and to calculate the volume of water in the well. The volume of well water (in gallons) is calculated using the following equation:

$$V = h * \pi r^2 * (7.48052 \text{ gal/ft}^3)$$

where V = volume of water in the well screen and casing (gallons)
h = height of standing water (feet) = total well depth - water level
r = radius of well casing (feet)

In dedicated sampling systems, an accurate well depth is determined, as indicated above, after development of the well and prior to installation of the dedicated bladder pump. The well depth, water level measurement, and calculated well volume are recorded on the Groundwater Monitoring Data Sheet (Figure 4).

2.2.3 Well Purging and Sampling

The selection of purging technique is dependent on the hydrogeologic properties of the aquifer and hydraulic characteristics of each well. Hydraulic conductivity, water column, well volume, screen length, and other information are evaluated to select the purging technique to acquire groundwater representative of the aquifer conditions. The Groundwater Monitoring Data Sheet (Figure 4) is used to record purging methods and measurements.

A multi-parameter water quality monitoring instrument is used to measure field stabilization or indicator parameters for determining representative groundwater during purging. These instruments measure pH, specific conductance, temperature, dissolved oxygen (DO), and oxidation-reduction potential (ORP). Instrument calibration must be performed and documented before and after each sampling event. The pH subsystem will be calibrated with two pH standards (pH 7.0 and 4.0) bracketing the expected groundwater pH. The specific conductance subsystem will be calibrated using two standards bracketing the expected groundwater conductivity. Calibration results will be recorded on a Field Sampling Calibration Form (Figure 5).

Various well purging techniques are described below. Currently, all wells are fitted with dedicated pumps. The purging method utilized at any particular well will be selected after considering the characteristics of the well and the purging method(s) used during previous sampling events.

Conventional Purging

This technique entails removing one equivalent well volume and measuring the indicator parameters (temperature, pH, and specific conductance). When the parameters have stabilized to within ± 0.2 pH units and $\pm 10\%$ for temperature and conductivity over three to five well volumes, representative groundwater has been achieved for sampling. It is acceptable to begin sampling after five complete well volumes have been removed, even when indicator parameters have not stabilized. Groundwater is pumped into a graduated container to measure the volume of water purged. Under normal rates of recovery, samples should be collected immediately after purging, in accordance with EPA guidelines.

For low-yield wells, incapable of yielding three to five well volumes in a reasonable amount of time (e.g., 2 hours or less), groundwater is purged to the elevation of the pump intake while measuring indicator parameters. Typically, low-yield wells are evacuated to dryness one time and sampled when sufficient water level recovery occurs.

Low-Flow Purging

Low-flow purging and sampling are appropriate when the recharge rate of the well approximates or equals the discharge rate of the pump with minimal drawdown of the water column (≤ 1 foot).

During low-flow purging and sampling, groundwater is pumped into a flow-through chamber at flow rates that minimize or stabilize water level drawdown within the well. Indicator parameters are measured over time (usually at five-minute intervals). When parameters have stabilized within ± 0.2 pH units and $\pm 10\%$ for temperature, conductivity, and DO, and ± 10 milli-Volts (mV) for ORP over three consecutive readings, representative groundwater has been achieved for sampling. Turbidity is

not included as a stabilization parameter, but turbidity levels of 10 nephelometric turbidity units (NTU) or less should be targeted.

Modified Low-Flow Purging

This technique is considered a viable option particularly in the Piedmont region due to clay soils where water level drawdown cannot be stabilized while pumping.

When the well recharge rate is less than the pump discharge rate, excessive drawdown (> 1 foot) of the water column occurs and mixes with stagnant water located above the screened interval. One equivalent well volume is removed initially before measuring indicator parameters. Frequently, removal of the initial well volume reduces the hydraulic head and allows for matching of the recharge rate with the pumping rate, providing stabilization of drawdown. Indicator parameters should be measured, at five-minute intervals, using a flow-through chamber attached to a multi-parameter water quality instrument. When parameters have stabilized to within ± 0.2 pH units, $\pm 10\%$ for temperature, conductivity, and DO, and ± 10 mV for ORP over three consecutive readings, representative groundwater has been achieved for sampling. Turbidity is not included as a stabilization parameter, but turbidity levels of 10 NTU or less should be targeted.

Very Low Yield Well Purging

This technique provides the best option for wells that historically purge to dryness and do not sufficiently recharge to provide adequate volume for sample collection. The volume of the pumping system (i.e., the pump bladder, tubing, and flow-through chamber) is calculated for removal. Two volumes will be removed by the pumping system if pumping occurs at the lowest possible rate (≤ 100 milliliters per minute [mL/min]). Indicator parameters will be measured and recorded initially, and then sample collection will begin.

2.2.4 Sample Collection

After representative groundwater has been obtained by purging and the indicator parameters have stabilized, sampling may begin. Sampling personnel must wear new, clean, disposable, non-powdered latex gloves during sample collection for each well. Samples are collected in the order of the volatilization sensitivity of the parameters:

- Metals
- Sulfate and chloride
- Nitrate
- Total dissolved solids

All pertinent notations, water-level measurements, removed well volumes, and indicator parameters are documented on the Groundwater Monitoring Data Sheet.

2.2.5 Sample Containers, Volume, Preservative, and Holding Time

All sample containers supplied by the laboratory for the collection of groundwater samples are new and precleaned, as approved by EPA procedures appropriate for the parameters of interest. Table 3 summarizes the sample containers, sample volume, preservation procedures, and holding times required for each type of sample and parameter. Sample containers are kept closed until used. All sample containers are provided by Duke or vendor laboratories.

2.3 Surface Water Sampling

Surface water samples are collected using techniques and equipment that preserve characteristics of the water body being investigated and minimizes the chance for sample contamination. Typically, samples are collected by grab or peristaltic pump.

When filling a sample container by grab, always use new, clean, non-powdered latex gloves. Grasp the sample container by the lower half and position the container opening to face upstream. When using a peristaltic pump to collect a surface water sample, position the intake opening above the stream bottom to minimize the potential for collecting sediment. Run the pump for several minutes to ensure representative water is being collected after positioning the intake opening.

2.4 Sample Tracking

The Chain-Of-Custody (COC) program allows for tracing the possession and handling of individual samples from the time of field collection through laboratory analysis and report preparation. Samples are pre-logged prior to sample collection. This process assigns a unique tracking number for each sample and generates corresponding labels. An example of the COC Record is provided as Figure 6.

2.5 Sample Labeling

Sample containers are pre-labeled and organized prior to field activities as part of the pre-sampling staging process. As samples are actually collected, the sampling personnel write the following information directly on the label: sampling date and time, and initials of sample collector. This information is also recorded on the Groundwater Monitoring Data Sheet (Figure 4) and the COC Record (Figure 6).

2.6 Field Documentation

Field documentation from each sampling event is recorded on the Groundwater Monitoring Data Sheets, the Field Sampling Calibration Form, and the Chain-of-Custody Record. These loose-leaf sheets are arranged in sequential order and filed by project and date. Additionally, a Groundwater Sampling Site Checklist (Figure 7) is completed indicating information of the monitoring well such as proper identification (ID) tag, condition of protective casing and pad. Field notations are made during the course of the field work to document the following information:

- Identification of well
- Well depth
- Static water level depth and measurement technique
- Presence of immiscible layers and detection method
- Well yield—high or low
- Purge volume or pumping rate
- Sample identification numbers
- Well evacuation procedure/equipment
- Sample withdrawal procedure/equipment
- Date and time of collection

- Types of sample containers used
- Identification of replicates or blind samples
- Preservative(s) used
- Parameters requested for analysis
- Field analysis data and methods
- Sample distribution and transporter
- Field observations during sampling event
- Name of sample collector(s)
- Climatic conditions including estimate of air temperature

All recorded entries are made in indelible ink. Errors should be corrected by drawing one line through the error, initialing and dating the correction, and starting a new entry on the next line (if necessary).

2.7 Chain-of-Custody Record

The chain-of-custody (COC) Record (Figure 6) accompanies the sample(s), traces sample possession from time of collection to delivery to the laboratory(s), and clearly identifies which sample containers have been designated for each requested parameter. The record includes the following types of information:

- Sample identification number
- Signature of collector
- Date and time of collection
- Sample type (e.g., groundwater, immiscible layer)
- Identification of well
- Number of containers
- Parameters requested for analysis
- Preservative(s) used
- Signature of persons involved in the chain of possession
- Inclusive dates of possession

2.8 Sample Custody, Shipment, and Laboratory Receipt

For the purpose of these procedures, a sample is considered in custody if it is:

- In actual possession of the responsible person
- In view, after being in physical possession
- Locked or sealed in a manner so that no one can tamper with it, after having been in physical custody; or in a secured area, restricted to authorized personnel

All samples are maintained in the custody of the sampling crew during the sampling event. At the end of each sampling day and prior to the transfer of the samples off-site, COC entries are completed on the COC

for all samples. Upon transfer of custody, the COC form is signed by a sampling crew member, including the date and time. If outside vendor laboratories are utilized, samples are delivered to these facilities by Duke personnel or courier.

All COC forms received by the laboratory(s) are signed and dated by the respective supervising scientist(s) or their designee (at the Duke Energy lab), or the laboratory sample custodian (at vendor labs) immediately following receipt by the laboratory.

The analysts at the laboratory(s) maintain a sample-tracking record that will follow each sample through all stages of laboratory processing. The sample tracking records show the date of sample extraction or preparation, and analysis. These records are used to determine compliance with holding time limits during lab audits and data validation.

Custody procedures followed by Duke laboratory personnel are described in detail in the Duke Energy Laboratory Services Procedures Manual.

3.0 Analytical Procedures

The main analytical laboratory used in this program is the Duke Energy Laboratory Services Laboratory, which has North Carolina Drinking Water (NC37804) and Wastewater (#248) Certifications. The organizational structure and staff qualifications of the laboratory are discussed in its generic Quality Assurance Program (QAP). The QAP and Laboratory Services Procedures Manual are available for review upon request.

Vendor laboratories that meet EPA and North Carolina certification requirements may be used for analyses which cannot be performed in-house.

The analytical procedures are listed in Table 2. Indicator parameters are measured in the field according to *Duke Energy Scientific Services Section Quality Assurance Plan and Procedure 3210.X*.¹

4.0 Internal Quality Control Checks

Internal laboratory quality control (QC) checks used by the laboratories are described in their generic QAP and procedures manual. The laboratories demonstrate the ability to produce acceptable results using the methods specified.

Internal quality control checks for sampling procedures and laboratory analyses will be conducted with each sampling event. These checks will consist of the preparation and submittal of field blanks, trip (travel) blanks, and/or field replicates for analysis of all parameters at frequencies described in the laboratory(s) procedures manuals. Equipment rinse blanks for laboratory-cleaned equipment will be collected quarterly.

The field QC blanks and replicates may be included as internal QC checks as described as below. The specific type and number of blanks used may vary depending on the sampling event and will be determined by the Duke field sampling personnel:

- **Field Blanks:** A field blank consists of a sample container filled in the field with organic-free, deionized, or distilled water prepared and preserved in the same manner as the samples. The field blank is transported to the laboratory with the samples and analyzed along with the field samples for the constituents of interest to check for contamination imparted to the samples by the sample container, preservative, or other exogenous sources.
- **Trip Blanks:** A trip (travel) blank is a sample container filled with organic-free water in the laboratory that travels unopened with the sample bottles. It is returned to the laboratory with the field samples, and analyzed along with the field samples for parameters of interest.
- **Field Replicates:** A field replicate is a duplicate sample prepared at the sampling locations from equal portions of all sample aliquots combined to make the sample. Both the field replicate and the sample are collected at the same time, in the same container type, preserved in the same way, and analyzed by the same laboratory as a measure of sampling and analytical precision.
- **Equipment Blanks:** If non-dedicated equipment is used between wells, it is recommended that equipment blanks be collected. The field equipment is cleaned following documented cleaning protocols. An aliquot of the final control rinse water is passed over the cleaned equipment directly into a sample container and submitted for analyses.

¹ "X" indicates the most current revision of the procedure.

5.0 Validation of Field Data Package

The field data package includes all of the field records and measurements developed by the sampling team personnel. The field data package validation procedure consists of the following:

- A review of field data contained on the Groundwater Monitoring Data Sheet for completeness
- Verification that equipment blanks, field blanks, and trip blanks were properly prepared, identified, and analyzed
- A check of the Field Sampling Calibration Form for equipment calibration and instrument conditions
- A review of the Chain-Of-Custody Record for proper completion, signatures of field personnel and the laboratory sample custodian, dates, and for verification that the correct analyses were specified.

6.0 Validation of Laboratory Data

The laboratory will perform a validation review of the submitted samples and analytical results to ensure that the laboratory QA/QC requirements are acceptable.

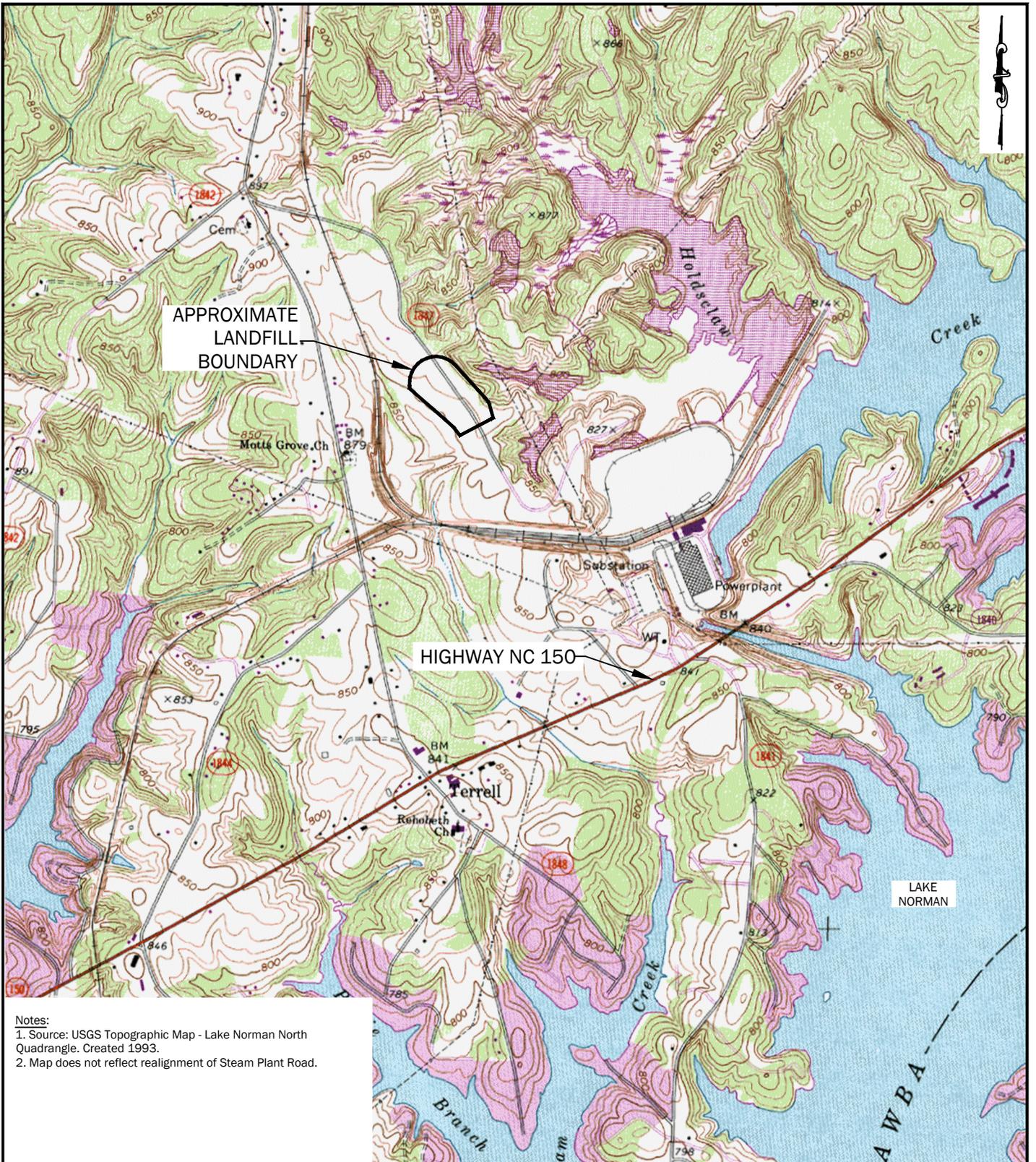
7.0 Report Submittal

A report of monitoring results will be submitted to the DENR Division of Waste Management (DWM) within 90 days following the date of sampling. The report submittal will consist of the following:

- Environmental Monitoring Reporting Form (DENR Form)
- Table of Detections and Discussion of 2L Exceedances
- Groundwater Elevation Contour Map
- Electronic Data Deliverable (EDD) in Excel Format

DENR will be notified in the event that vendor lab analyses have not been completed within this time frame. All Groundwater Monitoring Data Sheet, Field Calibration Forms, Chain-of-Custody Records, Laboratory(s) QA data, and Data Validation Checklists are kept on file by Duke and are available upon request.

FIGURES



Notes:
 1. Source: USGS Topographic Map - Lake Norman North Quadrangle. Created 1993.
 2. Map does not reflect realignment of Steam Plant Road.

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 ENGINEERING & HYDROGEOLOGY

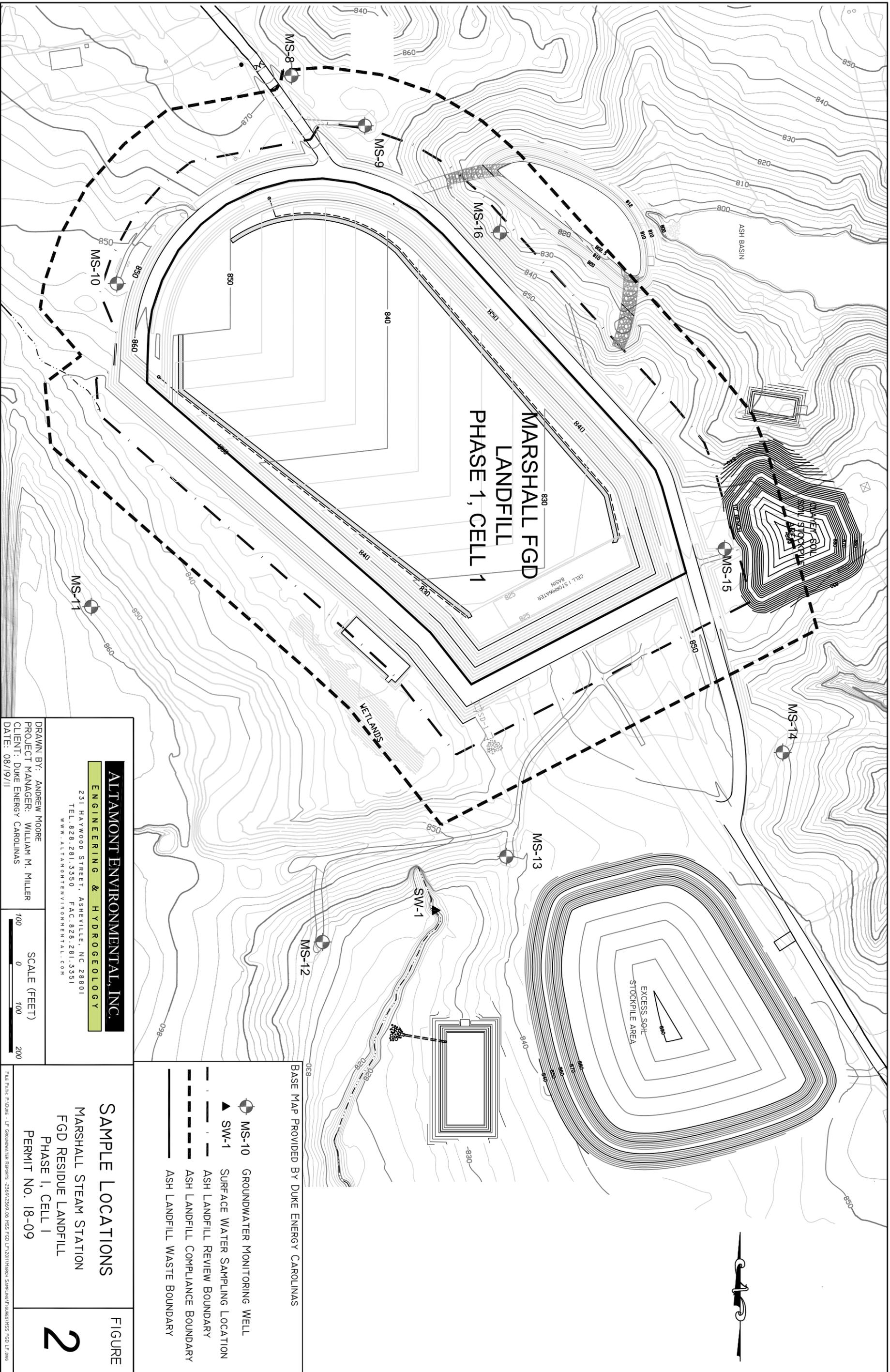
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SITE LOCATION MAP
 MARSHALL STEAM STATION
 FGD RESIDUE LANDFILL
 PHASE I, CELL I
 PERMIT No. 18-09

FIGURE
1

DRAWN BY: ANDREW MOORE
 PROJECT MANAGER: WILLIAM M. MILLER
 CLIENT: DUKE ENERGY CAROLINAS
 DATE: 08/11/11





**MARSHALL FGD
LANDFILL
PHASE 1, CELL 1**

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DRAWN BY: ANDREW MOORE
PROJECT MANAGER: WILLIAM M. MILLER
CLIENT: DUKE ENERGY CAROLINAS
DATE: 08/19/11

SCALE (FEET)
0 100 200

- MS-10 GROUNDWATER MONITORING WELL
- SW-1 SURFACE WATER SAMPLING LOCATION
- ASH LANDFILL REVIEW BOUNDARY
- ASH LANDFILL COMPLIANCE BOUNDARY
- ASH LANDFILL WASTE BOUNDARY

BASE MAP PROVIDED BY DUKE ENERGY CAROLINAS

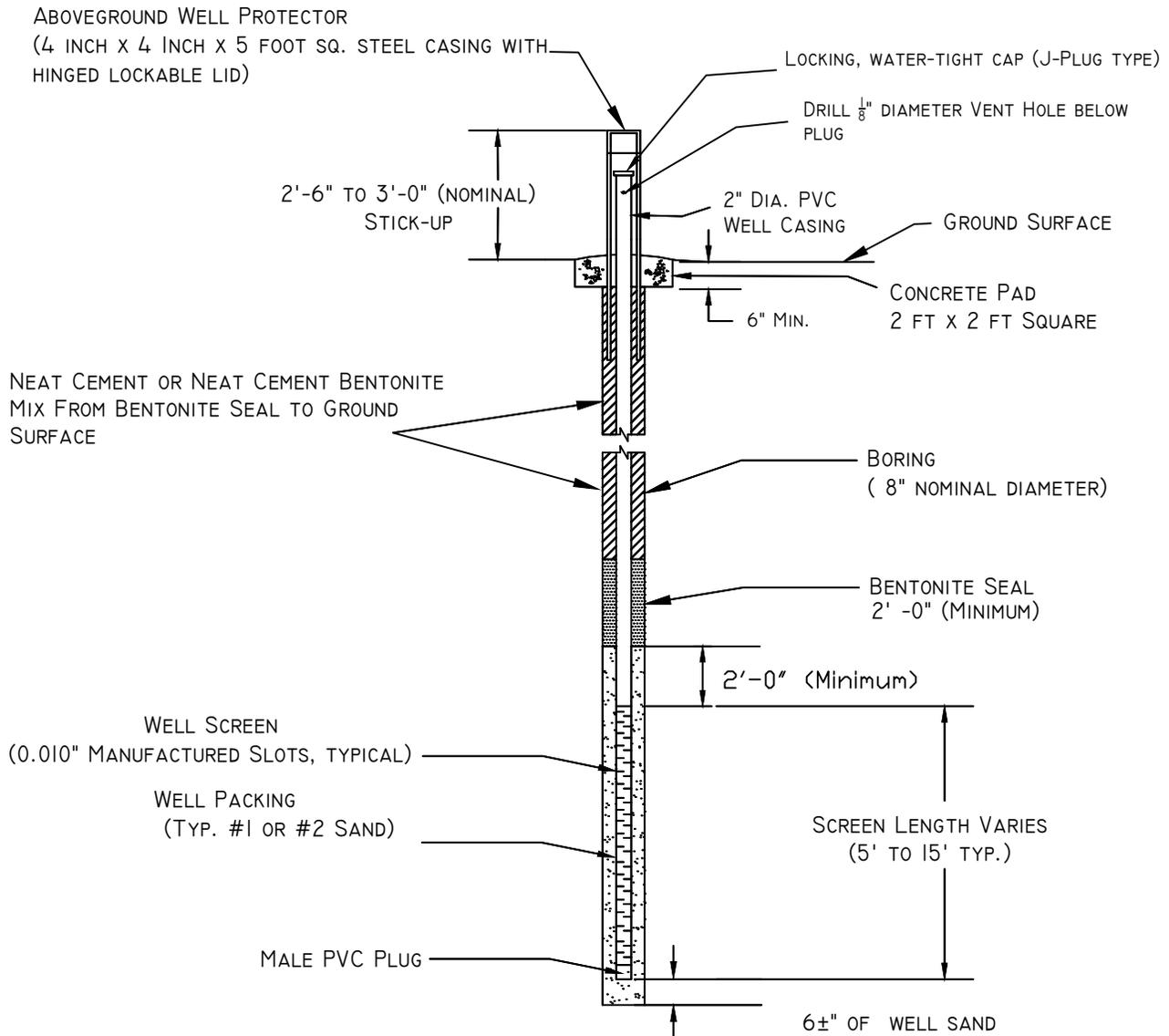
SAMPLE LOCATIONS

MARSHALL STEAM STATION
FGD RESIDUE LANDFILL
PHASE I, CELL I
PERMIT NO. 18-09

FIGURE

2

FILE PATH: P:\DUKE - LF GROUNDWATER REPORTS - 2869\2869_06 HSS FGD LF\2011\MARCH SAMPLING\FIGURES\HSS_FGD_LF_06



Typical Well Construction Details
(no scale)

INFORMATION PROVIDED BY DUKE ENERGY CAROLINAS

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TYPICAL
MONITORING WELL
CONSTRUCTION
DETAILS

FIGURE

3

DRAWN BY: ANDREW MOORE
PROJECT MANAGER: WILLIAM M. MILLER
CLIENT: DUKE ENERGY CAROLINAS
DATE: 8/15/11

NO SCALE



DUKE ENERGY
GROUNDWATER MONITORING DATA SHEET
FOR CONVENTIONAL SAMPLING

LOCATION:	MARSHALL STEAM STATION	PROCEDURE NO:	3175.0
PROJECT NAME:	FGD LANDFILL GROUNDWATER	WATER LEVEL METER SERIAL #:	46641
SAMPLING DATE(s):	22-Mar-2011	PRODUCT LEVEL METER SERIAL #:	N/A

MONITORING WELL NUMBER:	MS-8	FIELD CREW:	LDC, RLW
PERMIT #	18-09	TOC Elev.:	872.34

WELL DIAMETER (in)	WELL DEPTH (ft)	-	DEPTH TO WATER (ft)	=	WATER COLUMN (ft)	X	CONVERSION FACTOR	=	WELL VOLUME (gal)
2	51.58	-	44.72	=	6.86	X	0.1631	=	1.12

SCREEN Length (ft)	10	MIDDLE OF WETTED SCREEN (FT TOC)	48.2
FROM	41.58	TO	51.58
		PUMP INTAKE DEPTH (FT TOC)	50.6

SAMPLING EQUIPMENT	QED PUMP	PURGE METHOD	Conventional
--------------------	----------	--------------	--------------

VOLUME (gal)	CUMULATIVE VOLUME (gal)	COMPLETE EVACUATION (YES/NO)	TEMP (deg C)	SPECIFIC COND. (umho/cm)	pH (SU)	TURBIDITY (NTU)	ORP (mV-NHE)	DISSOLVED OXYGEN (mg/L)
1.12								
1.25	1.25	NO	16.05	38	6.34	33.8	N/A	N/A
1.25	2.50	NO	16.11	38	6.35	38.3		
1.25	3.75	NO	16.09	38	6.32	33.4		

COLLECT SAMPLE	SAMPLE COLLECTED BY	DATE / TIME	Chlorine
	<i>OC by USC</i>		NA
	Sampling Criteria Satisfied	rtw	3-22-11 0955

DETECTED ODORS	NA	NA
----------------	----	----

PID READING (ppm)	NA
-------------------	----

FREE PRODUCT MEASUREMENT	DEPTH TO PRODUCT		DEPTH TO WATER		PRODUCT THICKNESS	
	N/A	(ft)	N/A	(ft)	N/A	(ft)
If Product Thickness Is ≥ 0.1 ft, -- DO NOT SAMPLE --						

WELL CONDITION		NOTES
PROTECTIVE CASING	Good Condition	Pressure (psi): 20
WELL PAD	Good Condition	15 & 5
WELL CASING	Good Condition	
WELL TAG	Good Tag	

FIGURE 4

FIELD SAMPLING CALIBRATION FORM

STUDY: MARSHALL STEAM STATION - FGD LANDFILL GROUNDWATER MONITORING
DATE (s): March 22, 2011 **SURFACE UNIT READER:** LDC
COLLECTORS: LDC, RLW **SURFACE UNIT SERIAL #:** S0205
ANALYZER MODEL#: MS5 **ANALYZER SERIAL #:** 47630
OTHER EQUIPMENT: TURBIDIMETER NO.1 - 3260.1 **WEATHER CONDITIONS:** Clear, 55 to 75 deg F, calm

PROCEDURE #: HYDROLAB 3210.3 **VALIDATED BY:** USC 3/23/11

Calibration Date / Time		DATE:	22-Mar-11		TIME:	645		DATE:	22-Mar-11		TIME:	1140					
		BP (mmHg)				717.2				BP (mmHg)				719.4			
Parameter	Calibration Standard	Instrument Value		Standard Value	Calibration Results		Instrument Value		Standard Value	Calibration Results							
SPEC. COND. (uS/cm)	SS	0.0	—/—>	0.0	Instrument Zeroed Calibration Accepted Calibration Accepted		0.0	—/—>	0.0	Zero Pass Calibration Pass Calibration Pass							
	SS	231.8	—>	227			220.5	—/—>	227								
	SS	75.2	—/—>	75			74.2	—/—>	75								
pH (units)	B (7.00)	6.95	—>	7.02	Calibration Accepted Calibration Accepted Calibration Accepted		7.07	—/—>	7.01	Calibration Pass Calibration Pass Calibration Pass							
	B (4.00)	4.05	—>	4.00			4.07	—/—>	4.00								
	B (10.00)	10.14	—/—>	10.06			10.14	—/—>	10.02								
		Buffer Temp.		20.29			Buffer Temp.		22.94								
<input type="checkbox"/> ORP (mV)	SS (7.00) SS (4.00)	N/A N/A	—/—> —/—>	N/A N/A			N/A N/A	—/—> —/—>	N/A N/A								
<input type="checkbox"/> DO (mg/L)	W W AW	N/A	—/—>	N/A			N/A	—/—>	N/A								
<input checked="" type="checkbox"/> TURB (ntu)	SS	52.7	—/—>	52.8	Calibration Accepted		53.0	—/—>	52.8	Calibration Accepted							
Temp Cert Device #																	
TEMP (deg C)	NIST	N/A	—/—>	N/A	Adjustment Not Available		N/A	—/—>	N/A	Adjustment Not Available							
AMMONIUM (mg/L)	SS	N/A	—/—>	N/A			N/A	—/—>	N/A								
	SS	N/A	—/—>	N/A			N/A	—/—>	N/A								

INSTRUMENT MAINTENANCE	DATE / TIME
Conductance Subsystem <input type="checkbox"/> Cleaned Electrodes <input type="checkbox"/> Tested - OK <input type="checkbox"/> See Notes	pH Subsystem <input type="checkbox"/> Cleaned Electrodes <input type="checkbox"/> Replaced ref Electrode KCL <input type="checkbox"/> Replaced Ref. Electrode Tip <input type="checkbox"/> Tested - OK <input type="checkbox"/> See Notes
Dissolved Oxygen Subsystem <input type="checkbox"/> Replaced Teflon Membrane <input type="checkbox"/> Replaced DO electrolyte <input type="checkbox"/> Cleaned Electrode <input type="checkbox"/> See Notes	Ammonium Subsystem <input type="checkbox"/> Cleaned Electrode Tip <input type="checkbox"/> Installed New Electrode <input type="checkbox"/> Removed Electrode / Installed Plug <input type="checkbox"/> Tested - OK <input type="checkbox"/> See Notes
Oxidation Reduction Subsystem <input type="checkbox"/> Cleaned Electrode <input type="checkbox"/> Tested - OK <input type="checkbox"/> See Notes	Turbidity Subsystem <input type="checkbox"/> Cleaned Electrode & Wiper <input type="checkbox"/> Tested - OK <input type="checkbox"/> See Notes
Temperature Subsystem <input type="checkbox"/> Cleaned Electrode <input type="checkbox"/> Tested - OK <input type="checkbox"/> See Notes	Depth Subsystem <input type="checkbox"/> Reset / Calibrated <input type="checkbox"/> Tested - OK <input type="checkbox"/> See Notes

KEY: B = Buffer W = Winkler —> = Adjusted To N/A = Not Applicable
 SS = Standard solution AW = Average Winkler —/—> = Not Adjusted To

NOTES:

FIGURE 5

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST FORM



For Detailed Instructions, see:
http://dewww/essenv/coc/

Duke Energy Analytical Lab Services
Mail Code MGO3A2 (Building 7405)
13339 Hagers Ferry Rd
Huntersville, N. C. 28078
(704) 875-5245
Fax: (704) 875-5038

Analytical Laboratory Use Only			
LIMS #	MATRIX: GW-RCRA	Samples Originating From	NC <input checked="" type="checkbox"/> SC <input type="checkbox"/>
Logged By	Date & Time	SAMPLE PROGRAM Ground Water <input checked="" type="checkbox"/> NPDES <input type="checkbox"/> Drinking Water <input type="checkbox"/> UST <input type="checkbox"/> RCRA Waste <input type="checkbox"/>	
VENDOR		Cooler Temp (C)	
PO #	¹⁵ Preserv.: 1=HCl 2=H ₂ SO ₄ 3=HNO ₃ 4=Ice 5=None		
MR #	Customer to complete all appropriate NON-SHADED areas.		
¹⁶ Analyses Required			

¹⁹Page 1 of 1
DISTRIBUTION
ORIGINAL to LAB,
COPY to CLIENT

rev Aug 2011

Customer must Complete

1) Project Name MARSHALL FGD LANDFILL Permit # 18-09	2) Phone No: 875-5257
3) Client LDC / TSH / Ed Sullivan	4) Fax No: 875-4349
5) Business Unit: 20035	6) Process: BENVWS
8) Project ID:	7) Resp. To: MS00
9) Activity ID:	10) Mail Code: MGO3A3

LAB USE ONLY	¹¹ Lab ID	¹² Chem Desktop No.	¹³ Sample Description or ID	¹⁴ Collection Information			¹⁷ Comp.	¹⁸ Grab	Alk (4-5)	NO ₃ -N, Cl, F, SO ₄ (IC)	Hg (EPA 245.1)	Metals Prep - 3030C (ICP - EPA 200.7) Ag, B, Ba, Ca, Cu, Fe, K, Mg, Mn, Na, Ni, Zn (IMS - EPA 200.8) As, Cd, Cr, Pb, Se				TDS	Total # of Containers
				Date	Time	Signature											
			MS-8				X	1	1			1				1	4
			MS-9				X	1	1			1				1	4
			MS-10				X	1	1			1				1	4
			MS-11				X	1	1			1				1	4
			MS-12				X	1	1			1				1	4
			MS-13				X	1	1			1				1	4
			MS-14				X	1	1			1				1	4
			MS-15				X	1	1			1				1	4
			MS-16				X	1	1			1				1	4
			SW-1				X	1	1			1				1	4
			FIELD BLANK				X	1	1			1					3

Customer to complete appropriate columns to right

Customer to sign & date below

21) Relinquished By	Date/Time	Accepted By:	Date/Time	Customer, important please indicate desired turnaround	²² Requested Turnaround 14 Days <input checked="" type="checkbox"/> *7 Days _____ *48 Hr _____ *Other _____ * Add. Cost Will Apply
Relinquished By	Date/Time	Accepted By:	Date/Time		
Relinquished By	Date/Time	Accepted By:	Date/Time		
23) Seal/Locked By	Date/Time	Sealed/Lock Opened By	Date/Time		
24) Comments					

Regulatory Agency : NCDENR/DWM -SW Section - State EDD Format Required / Permit # 18-09
Use indicated or comparable analytical methods

FIGURE 6

NORTH CAROLINA GROUNDWATER SAMPLING SITE CHECKLIST

LOCATION / SITE Marshall Steam Station - FGD Landfill Groundwater Monitoring
SITE CONTACT Donna Burrell
WEATHER Clear, 55 to 75 deg F, calm
PAGE 1 OF 1

PERMIT # 18-09

SAMPLE DATE March 22, 2011
FIELD CREW LDC, RLW

	MS-8	MS-9	MS-10	MS-11	MS-12	MS-13	MS-14	MS-15	MS-16	SW-1								
ACCESS TO WELLS																		
Access cleared into well	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES								
Access cleared around well	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES								
Tall grass or weeds - needs mowing																		
Road washing out / muddy / needs grading																		
Fallen tree blocking access																		
WELL SECURITY																		
Well found locked	YES	YES	YES	YES	YES	YES	YES	YES	YES	N/A								
Well found unlocked																		
WELL LOCK CONDITION																		
Lock in good condition	YES	YES	YES	YES	YES	YES	YES	YES	YES	N/A								
Lock rusted, difficult to open / needs replacing																		
Replaced damaged lock																		
WELL CASINGS																		
Casing in good condition	YES	YES	YES	YES	YES	YES	YES	YES	YES	N/A								
Damaged casing / still functional																		
Damaged casing / repair required																		
CONCRETE PADS																		
Pad in good condition	YES	YES	YES	YES	YES	YES	YES	YES	YES	N/A								
Minor cracks																		
Major cracks / broken / repair required																		
Undermined / washing out																		
Fire ants around concrete pad																		
WELL PROTECTIVE CASINGS																		
Casing in good condition	YES	YES	YES	YES	YES	YES	YES	YES	YES	N/A								
Damaged casing / still functional																		
Damaged casing / repair required																		
Broken hinge on protective lid																		
Wasp nest inside protective casing																		
Ants inside protective casing																		
WELL CAPS																		
Well cap in good conditon	YES	YES	YES	YES	YES	YES	YES	YES	YES	N/A								
Damaged / needs replacement																		
Replaced damaged well cap																		
FLUSH MOUNT WELLS																		
Vault in good condition	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A								
Water inside vault																		
Vault bolt holes broken or stripped																		
Bolts stripped																		
Vault lid cracked or broken																		
WELL ID TAGS																		
Well tag in good condition	YES	YES	YES	YES	YES	YES	YES	YES	YES	N/A								
Well tag missing																		
Well tag damaged / illegible																		
Lacks required information - Driller Reg #																		
Lacks required information - Completion date																		
Lacks required information - Total well depth																		
Lacks required information - Depth to screen																		
Lacks required information - Non potable tag																		

NOTE:

FIGURE 7

TABLES

**Table 1
Monitoring Well Information**

	MS-8	MS-9	MS-10	MS-11	MS-12	MS-13	MS-14	MS-15	MS-16
Previous Well Name	N/A	N/A	N/A	N/A	OW-3	MS-6	B-5	B-4	N/A
North (ft)	680,717.89	681,384.45	681,027.65	680,297.49	679,540.04	679,732.80	679,968.41	680,428.02	681,143.02
East (ft)	1,412,027.98	1,412,181.74	1,411,622.46	1,411,564.82	1,412,086.50	1,412,500.68	1,413,123.89	1,412,993.27	1,412,486.19
Top of PVC Casing Elevation (ft)	872.34	868.04	851.29	859.78	835.66	841.90	844.07	861.47	836.98
Well Diameter	2"	2"	2"	2"	2"	2"	2"	2"	2"
Well Stick-up (ft)	3.0	2.68	3.0	2.91	2.96	2.71	2.80	3.05	3.0
Type of Casing	PVC								
Total Depth (ft)	48.5	50.0	20.0	39.0	27.0	38.0	41.0	59.0	35
Screen Length (ft)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Screen Interval (ft below ground surface)	38 to 48	40.0 to 50.0	10.0 to 20.0	29.0 to 39.0	17.0 to 27.0	28.0 to 38.0	31.0 to 41.0	49.0 to 59.0	24 to 34

Notes:
 As-built well coordinates and top of PVC casing elevations provided by Duke Energy
 Well depth and screen information was obtained from the Well Installation Records
 Coordinates: NC State Plane Grid, NAD83
 Elevations: NAVD 88
 N/A – Not Applicable

**Table 1.1
Surface Water Sample Location**

	North	East	Elevation (ft)
SW-1	679,611.0	1,412,341.3	822.3

Notes:
 As-built coordinates and elevation provided by Duke Energy.
 Coordinates: NC State Plane Grid, NAD83
 Elevations: NAVD 88

Table 2
Sample Parameters, Analytical Methods, and Detection Limits

PARAMETER	UNITS	ANALYTICAL METHOD	DETECTION LIMITS
<i>In Situ Parameters</i>			
Field pH	pH Units	Hydrolab	N/A
Specific Conductance	µmhos/cm	Hydrolab	N/A
Temperature	°C	Hydrolab	N/A
Turbidity	NTU	HACH	N/A
Water Level	ft	Water Level Meter	0.01
<i>Laboratory Analyses</i>			
Nitrate	µg/L	EPA 300.0	5.4
Chloride	µg/L	EPA 300.0	22
Arsenic	µg/L	EPA 200.8/EPA 6020	0.08
Barium	µg/L	EPA 200.7/EPA 6010	0.1
Boron	µg/L	EPA 200.7/EPA 6010	3.3
Cadmium	µg/L	EPA 200.8/EPA 6020	0.1
Chromium	µg/L	EPA 200.7/EPA 6010	0.5
Copper	µg/L	EPA 200.7/EPA 6010	1.0
Iron	µg/L	EPA 200.7/EPA 6010	1.3
Lead	µg/L	EPA 200.8/EPA 6020	0.7
Manganese	µg/L	EPA 200.7/EPA 6010	0.2
Mercury	µg/L	EPA 7470	0.03
Nickel	µg/L	EPA 200.7/EPA 6010	0.5
Selenium	µg/L	EPA 200.8/EPA 6020	0.09
Silver	µg/L	EPA 200.7/EPA 6010	0.7
Zinc	µg/L	EPA 200.7/EPA 6010	2.6
Sulfate	µg/L	EPA 300.0	18
Fluoride	µg/L	EPA 300.0	17
TDS	µg/L	SM 2540C	6,670

Notes:

N/A - Not Applicable

µmhos/cm - micro-ohms per centimeter

NTU - nephelometric turbidity units

ft - feet

mg/L - milligrams per liter

µg/L - micrograms per liter

TDS - total dissolved solids

Table 3
Sample Containers, Preservatives, and Holding Times

PARAMETER	CONTAINERS	PRESERVATIVES	HOLDING TIMES
<i>In Situ Parameters</i>			
Field pH	In Situ	None	Analyze Immediately
Specific Conductance	In Situ	None	Analyze Immediately
Temperature	In Situ	None	Analyze Immediately
Turbidity	In Situ	None	Analyze Immediately
ORP	In Situ	None	Analyze Immediately
<i>Laboratory Analyses</i>			
Nitrate	500 mL HDPE	Cool to 4°C	48 hours
Chloride	500 mL HDPE	Cool to 4°C	28 days
Arsenic	500 mL HDPE	pH<2 HNO ₃	6 months
Barium	500 mL HDPE	pH<2 HNO ₃	6 months
Boron	500 ml HDPE	pH<2 HNO ₃	6 months
Cadmium	500 mL HDPE	pH<2 HNO ₃	6 months
Chromium	500 mL HDPE	pH<2 HNO ₃	6 months
Copper	500 mL HDPE	pH<2 HNO ₃	6 months
Iron	500 mL HDPE	pH<2 HNO ₃	6 months
Lead	500 mL HDPE	pH<2 HNO ₃	6 months
Manganese	500 mL HDPE	pH<2 HNO ₃	6 months
Nickel	500 mL HDPE	pH<2 HNO ₃	6 months
Mercury	500 mL HDPE	pH<2 HNO ₃	6 months
Selenium	500 mL HDPE	pH<2 HNO ₃	6 months
Silver	500 mL HDPE	pH<2 HNO ₃	6 months
Zinc	500 mL HDPE	pH<2 HNO ₃	6 months
Sulfate	500 mL HDPE	Cool 4°C	28 days
Fluoride	500 mL HDPE	pH<2 HNO ₃	6 months
Total Dissolved Solids	500 mL HDPE	Cool 4°C	7 days

Notes:

ORP – oxidation-reduction potential

mL HDPE – milliliter high density polyethylene

HNO₃ – nitric acid

APPENDIX A

Monitoring Well Construction Records

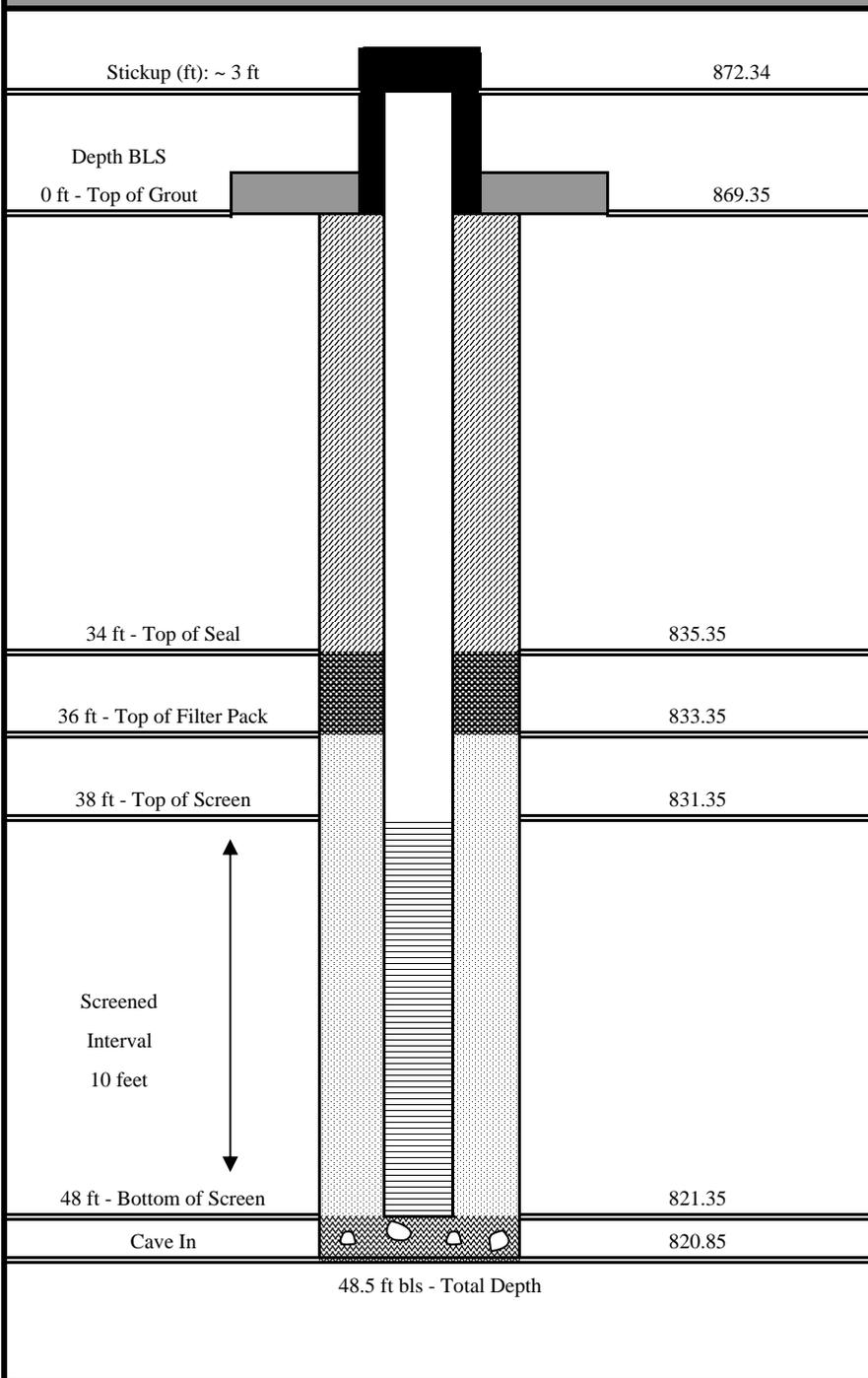
MONITORING WELL CONSTRUCTION



WELL ID: MS-8

TOTAL DEPTH: 48.5 ft bls

S&ME PROJECT AND NO: Marshall Steam Station, 1356-06-728		WELL USE / TYPE: Monitoring	INSTALLATION DATE: 9/12/2006
DRILLING CONTRACTOR: S&ME, Inc.	DRILLER AND LICENCE NO.: Larry Shrader, 3349		DRILLING METHOD: 4.25 H.S.A.
WATER LEVEL AT TOB: 42.45 ft bls	NORTHING: 681496.7	EASTING: 1412015.4	TOP OF CASING ELEV.: 872.34
			GROUND SURFACE ELEV.: 869.35



PAD TYPE: 2'x2' Concrete
PROTECTIVE CASING: 4"x4" Lockable Steel
CASING TYPE: 2-inch Sch. 40 PVC
CASING INTERVAL: 0 to 38 ft bls
SCREEN TYPE: 2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL: 38 to 48 ft bls
GROUT TYPE: Neat Cement
GROUT INTERVAL: 0 to 34 ft bls
SEAL TYPE: Bentonite
SEAL INTERVAL: 36 to 38 ft bls
FILTER PACK: #1 Filter Sand
FILTER PACK INTERVAL: 36 to 48 ft bls
DEVELOPMENT: Purged ~15 Gallons
NOTES: TBD - To Be Determined For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-8)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Larry Shrader **CERTIFICATION #** 3349
WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726
STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____
 (if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential Municipal/Public Industrial Agricultural
 Monitoring Recovery Heat Pump Water Injection Other If Other, List Use _____

2. WELL LOCATION:
 Nearest Town: Terrell County Iredell
Marshall Steam Station
 (Street Name, Numbers, Community, Suidivision, Lot No., Zip Code)

Topographic/Land setting
 Ridge Slope Valley Flat
 (check appropriate box)

Latitude/longitude of well location
35°-36'-23.134 N / 78°-58'-41.729 W
 (degrees/minutes/seconds)

3. OWNER: Duke Power
 Address 526 South Church Street
 (Street or Route No.)
Charlotte NC 28202
 City or Town State Zip Code
(704) 373-7900
 Area code - Phone Number

Latitude/longitude source: GPS Topographic Map
 Physical Survey (check box)

DEPTH		DRILLING LOG
From	To	Formation Description
0 to 3		M/F Sandy Clay
3 to 8.5		Silty M/F Sand
8.5 to 39		Silty C/V. Fine Sand
39 to 43.5		Silty F/V. Fine Sand
		w/ Co. Sand Lenses
43.5 to 48		Silty F/V. Fine Sand
48 to 48.5		PWR

4. DATE DRILLED 9/12/2006
 5. TOTAL DEPTH 48 ft bls
 6. DOES WELL REPLACE EXISTING WELL? YES NO
 7. STATIC WATER LEVEL Below Top of Casing: 42.77 ft.
 (Use "+" if Above Top of Casing)
 8. TOP OF CASING IS ~ 3.0 FT. Above Land Surface*
 *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
 9. YIELD (gpm) n/a METHOD OF TEST n/a
 10. WATER ZONES (depth): n/a

11. DISINFECTION: Type n/a Amount n/a
 12. CASING:

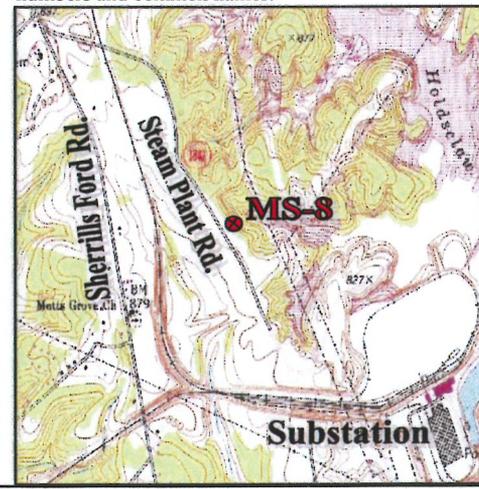
Depth	Diameter	Wall Thickness or Weight/Ft.	Material
From <u>0</u> To <u>38</u> Ft.	<u>2-inch</u>	<u>Sch. 40</u>	<u>PVC</u>
From _____ To _____ Ft.	_____	_____	_____
From _____ To _____ Ft.	_____	_____	_____

Depth	Material	Method
From <u>0</u> To <u>34</u> Ft.	<u>Neat Cement</u>	<u>Pour</u>
From <u>34</u> To <u>36</u> Ft.	<u>Bentonite</u>	<u>Pour</u>

Depth	Diameter	Slot Size	Material
From <u>38</u> To <u>48</u> Ft.	<u>2-inch</u> in.	<u>0.01</u> in.	<u>PVC</u>
From _____ To _____ Ft.	_____ in.	_____ in.	_____

Depth	Size	Material
From <u>36</u> To <u>48</u> Ft.	<u>#1</u>	<u>Silica Sand</u>
From _____ To _____ Ft.	_____	_____

LOCATION SKETCH
 Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



16. REMARKS: _____
 I DO HERBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER
Larry W. Shrader 9-25-06
 SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

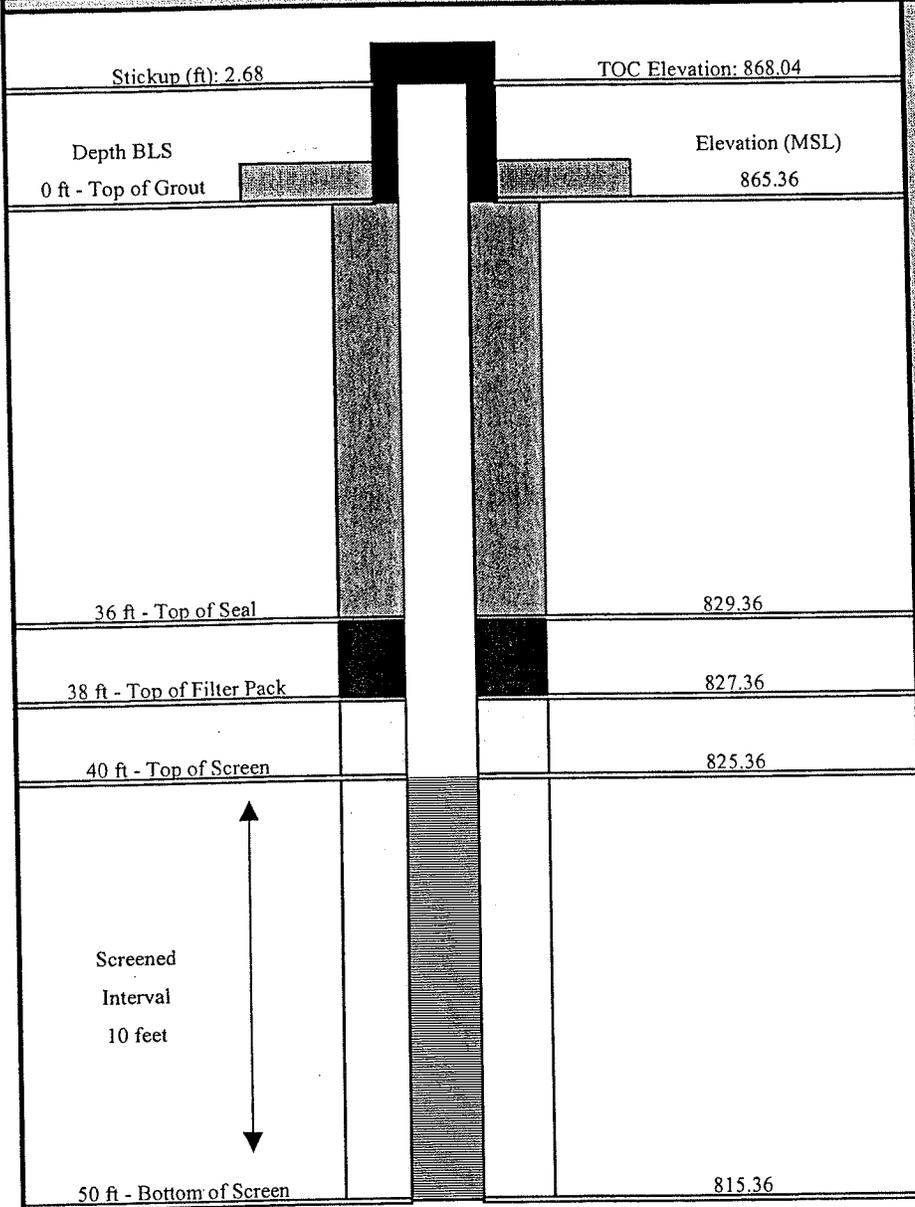
MONITORING WELL CONSTRUCTION



WELL ID: MS-9

TOTAL DEPTH: 50 ft bls

S&ME PROJECT AND NO: Marshall Steam Station - Beneficial Fill, 1264-03-072		WELL USE / TYPE: Observation	INSTALLATION DATE: 01/16/2003
DRILLING CONTRACTOR: S&ME, Inc.	DRILLER AND LICENCE NO.: Brian Wilson, 2718		DRILLING METHOD: 4.25 HSA
STATIC WATER LEVEL: 44.5 ft bls at 24-hrs	NORTHING: 681384.5	EASTING: 1412181.7	TOP OF CASING ELEV.: 868.04
			GROUND SURFACE ELEV.: 865.36



PAD TYPE: 2'x2' Concrete
PROTECTIVE CASING: 4"x4" Lockable Steel
CASING TYPE: 2-inch Sch. 40 PVC
CASING INTERVAL: 0 to 40 ft bls
SCREEN TYPE: 2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL: 40 to 50 ft bls
GROUT TYPE: Neat Cement
GROUT INTERVAL: 0 to 36 ft bls
SEAL TYPE: Bentonite
SEAL INTERVAL: 36 to 38 ft bls
FILTER PACK: #1 Filter Sand
FILTER PACK INTERVAL: 38 to 50 ft bls
DEVELOPMENT: Purged minimum 5 well volumes
NOTES: For Lithologic Information See Attached Boring Log

50 ft bls - Total Depth of Well

WELL CONSTRUCTION RECORD

(MS-9)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson CERTIFICATION # 2718
WELL CONTRACTOR COMPANY NAME S&ME, Inc. PHONE # 704-523-4726
STATE WELL CONSTRUCTION PERMIT# _____ ASSOCIATED WQ PERMIT# _____
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential Municipal/Public Industrial Agricultural
Monitoring Recovery Heat Pump Water Injection Other If Other, List Use observation well

2. WELL LOCATION:
Nearest Town: Terrell County Catawba Ridge Slope Valley Flat
Marshall Steam Station
(Street Name, Numbers, Community, Suidivision, Lot No., Zip Code) (check appropriate box)
Latitude/longitude of well location _____
(degrees/minutes/seconds)

3. OWNER: Duke Power
Address 526 South Church Street
(Street or Route No.)
Charlotte NC 28202
City or Town State Zip Code
(704) 373-7900
Area code - Phone Number
Latitude/longitude source: GPS Topographic Map
(check box)

DEPTH		DRILLING LOG
From	To	Formation Description
	0 to 4	Silty Clay
	4 to 9	Fine Sandy Silt
	9 to 50	Silty Very Fine Sand

4. DATE DRILLED 01/16/2003

5. TOTAL DEPTH 50 ft bls

6. DOES WELL REPLACE EXISTING WELL? YES NO

7. STATIC WATER LEVEL Below Top of Casing: 48.5 ft.
(Use "+" if Above Top of Casing)

8. TOP OF CASING IS ~ 3.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.

9. YIELD (gpm) n/a METHOD OF TEST n/a

10. WATER ZONES (depth): n/a

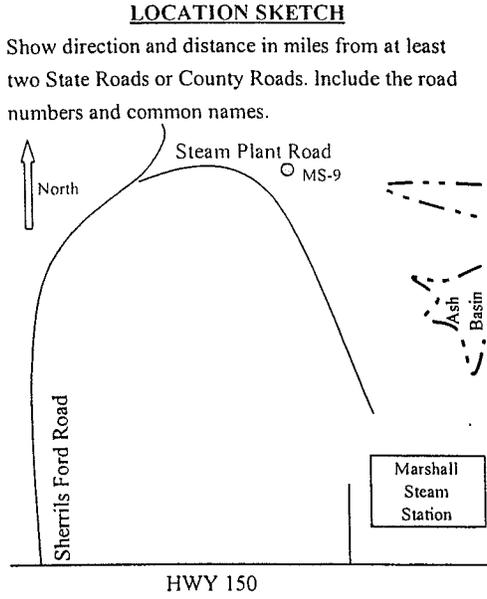
11. DISINFECTION: Type n/a Amount n/a

12. CASING:		Wall Thickness	Material
Depth	Diameter	or Weight/Ft.	
From <u>0</u> To <u>40</u> Ft.	<u>2-inch</u>	<u>Sch. 40</u>	<u>PVC</u>
From _____ To _____ Ft.	_____	_____	_____
From _____ To _____ Ft.	_____	_____	_____

13. GROUT:		Material	Method
Depth	Diameter		
From <u>0</u> To <u>36</u> Ft.	<u>2-inch</u>	<u>Neat Cement</u>	<u>Pour</u>
From <u>36</u> To <u>38</u> Ft.	<u>2-inch</u>	<u>Bentonite</u>	<u>Pour</u>

14. SCREEN:		Slot Size	Material
Depth	Diameter		
From <u>40</u> To <u>50</u> Ft.	<u>2-inch</u> in.	<u>0.01</u> in.	<u>PVC</u>
From _____ To _____ Ft.	_____ in.	_____ in.	_____

15. SAND/GRAVEL PACK:		Material
Depth	Size	
From <u>38</u> To <u>50</u> Ft.	<u>#1</u>	<u>Silica Sand</u>
From _____ To _____ Ft.	_____	_____



16. REMARKS: _____

I DO HERE BY CERTIFYING THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER
Brian E. Wilson 2-7-03
SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

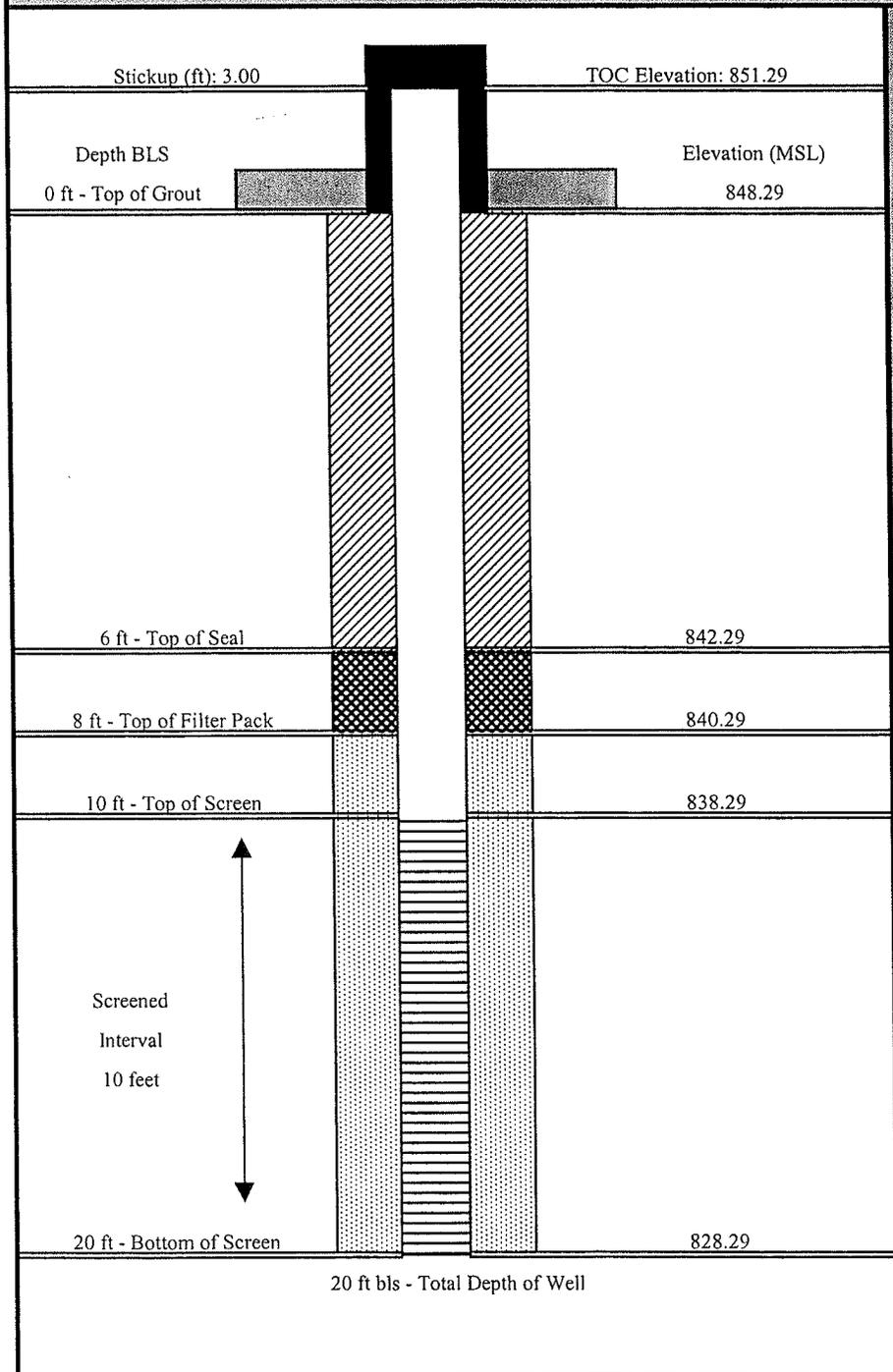
MONITORING WELL CONSTRUCTION



WELL ID: MS-10

TOTAL DEPTH: 20 ft bls

S&ME PROJECT AND NO: MSS-FGD Scrubber Landfill, 1264-02-578		WELL USE / TYPE: Observation	INSTALLATION DATE: 07/08/2003
DRILLING CONTRACTOR: S&ME, Inc.	DRILLER AND LICENCE NO.: Jay Little, 2717		DRILLING METHOD: 4.25 HSA
STATIC WATER LEVEL: 12 ft bls at 24-hrs	NORTHING: 681027.6	EASTING: 1411622.5	TOP OF CASING ELEV.: 851.29
			GROUND SURFACE ELEV.: 848.29



PAD TYPE:	2'x2' Concrete
PROTECTIVE CASING:	4"x4" Lockable Steel
CASING TYPE:	2-inch Sch. 40 PVC
CASING INTERVAL:	0 to 10 ft bls
SCREEN TYPE:	2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL:	10 to 20 ft bls
GROUT TYPE:	Neat Cement
GROUT INTERVAL:	0 to 6 ft bls
SEAL TYPE:	Bentonite
SEAL INTERVAL:	6 to 8 ft bls
FILTER PACK:	#1 Filter Sand
FILTER PACK INTERVAL:	8 to 20 ft bls
DEVELOPMENT:	Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-10)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little CERTIFICATION # 2717
WELL CONTRACTOR COMPANY NAME S&ME, Inc. PHONE # 704-523-4726
STATE WELL CONSTRUCTION PERMIT# _____ ASSOCIATED WQ PERMIT# _____
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential Municipal/Public Industrial Agricultural
Monitoring Recovery Heat Pump Water Injection Other If Other, List Use observation well

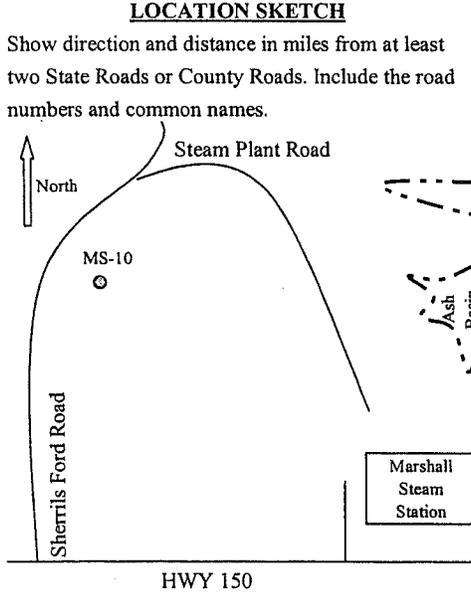
2. WELL LOCATION:
Nearest Town: Terrell County Catawba Ridge Slope Valley Flat
Marshall Steam Station (check appropriate box)
(Street Name, Numbers, Community, Suidivision, Lot No., Zip Code) Latitude/longitude of well location

3. OWNER: Duke Power
Address 526 South Church Street
(Street or Route No.)
Charlotte NC 28202
City or Town State Zip Code
(704) 373-7900
Area code - Phone Number
Latitude/longitude source: GPS Topographic Map (check box)

DEPTH		DRILLING LOG
From	To	Formation Description
0	7	Fine Sandy Clay
7	12	Silty Clay
12	20	Fine Sandy Silt

4. DATE DRILLED 07/08/2003
5. TOTAL DEPTH 20 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES NO
7. STATIC WATER LEVEL Below Top of Casing: 12 ft.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~ 3.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

11. DISINFECTION: Type n/a Amount n/a
12. CASING: Wall Thickness or Weight/Ft. Material
Depth Diameter
From 0 To 10 Ft. 2-inch Sch. 40 PVC
From _____ To _____ Ft. _____
From _____ To _____ Ft. _____
13. GROUT: Depth Material Method
From 0 To 6 Ft. Neat Cement Pour
From 6 To 8 Ft. Bentonite Pour
14. SCREEN: Depth Diameter Slot Size Material
From 10 To 20 Ft. 2-inch in. 0.01 in. PVC
From _____ To _____ Ft. _____ in. _____ in. _____
15. SAND/GRAVEL PACK: Depth Size Material
From 8 To 20 Ft. #1 Silica Sand
From _____ To _____ Ft. _____



16. REMARKS: _____
I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER
Jay A. Little SIGNATURE OF PERSON CONSTRUCTING THE WELL 7-17-03 DATE

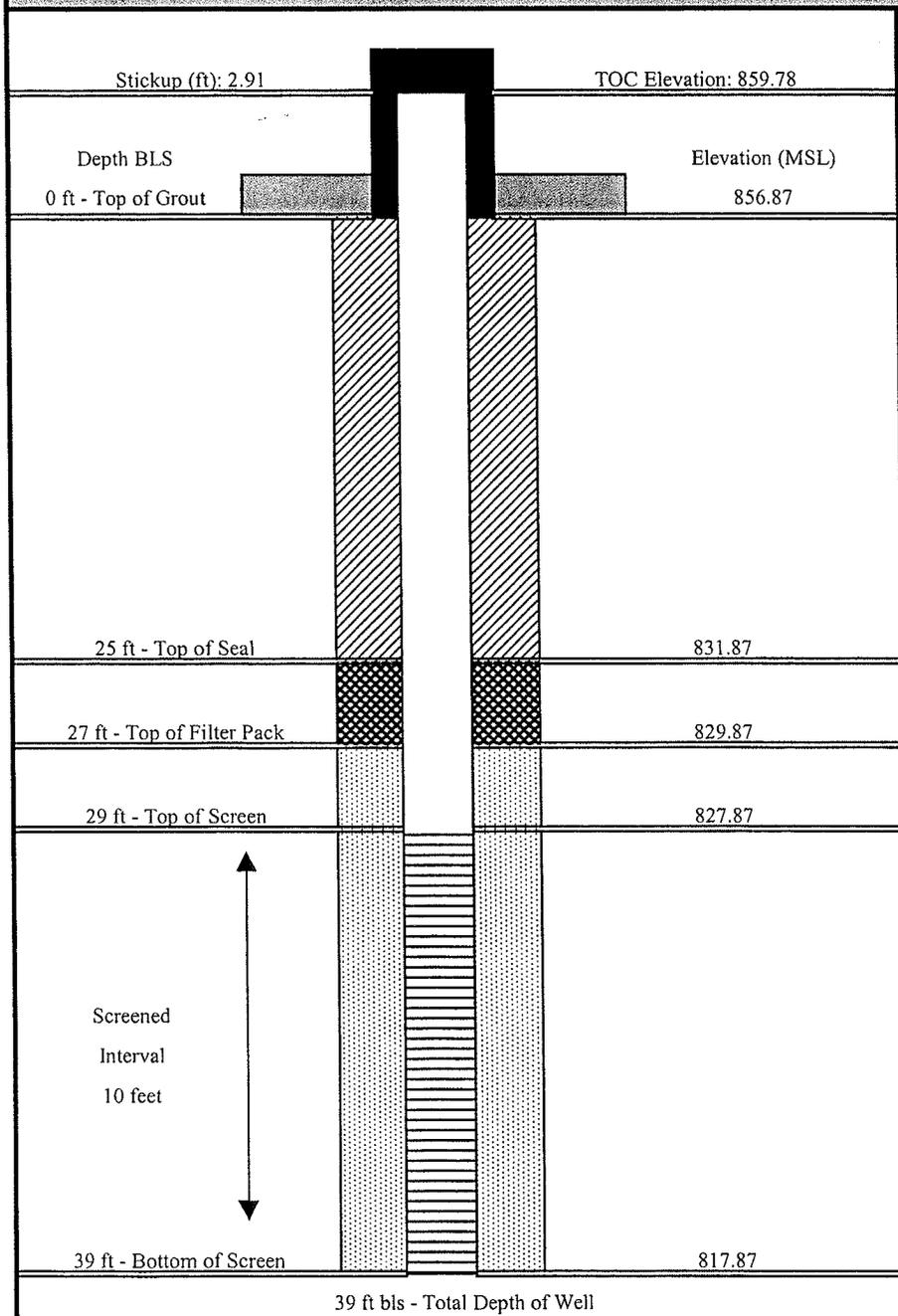
MONITORING WELL CONSTRUCTION



WELL ID: MS-11

TOTAL DEPTH: 39 ft bls

S&ME PROJECT AND NO: MSS-FGD Scrubber Landfill, 1264-02-578		WELL USE / TYPE: Observation		INSTALLATION DATE: 07/09/2003	
DRILLING CONTRACTOR: S&ME, Inc.		DRILLER AND LICENCE NO.: Jay Little, 2717		DRILLING METHOD: 4.25 HSA	
STATIC WATER LEVEL: 33 ft bls at 24-hrs	NORTHING: 680297.5	EASTING: 1411564.8	TOP OF CASING ELEV.: 859.78	GROUND SURFACE ELEV.: 856.87	



PAD TYPE:	2'x2' Concrete
PROTECTIVE CASING:	4"x4" Lockable Steel
CASING TYPE:	2-inch Sch. 40 PVC
CASING INTERVAL:	0 to 29 ft bls
SCREEN TYPE:	2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL:	29 to 39 ft bls
GROUT TYPE:	Neat Cement
GROUT INTERVAL:	0 to 25 ft bls
SEAL TYPE:	Bentonite
SEAL INTERVAL:	25 to 27 ft bls
FILTER PACK:	#1 Filter Sand
FILTER PACK INTERVAL:	37 to 39 ft bls
DEVELOPMENT:	Purged minimum 5 well volumes

NOTES:
For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-11)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little CERTIFICATION # 2717

WELL CONTRACTOR COMPANY NAME S&ME, Inc. PHONE # 704-523-4726

STATE WELL CONSTRUCTION PERMIT# _____ ASSOCIATED WQ PERMIT# _____

(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential Municipal/Public Industrial Agricultural
Monitoring Recovery Heat Pump Water Injection Other If Other, List Use observation well

2. WELL LOCATION:
Nearest Town: Terrell County Catawba
Marshall Steam Station
(Street Name, Numbers, Community, Suidivision, Lot No., Zip Code)
Topographic/Land setting
 Ridge Slope Valley Flat
(check appropriate box)
Latitude/longitude of well location _____
(degrees/minutes/seconds)

3. OWNER: Duke Power
Address 526 South Church Street
(Street or Route No.)
Charlotte NC 28202
City or Town State Zip Code
(704) 373-7900
Area code - Phone Number
Latitude/longitude source: GPS Topographic Map
(check box)

DEPTH		DRILLING LOG
From	To	Formation Description
0 to 7		Silty Clay
7 to 12		Fine Sandy Silt
12 to 22		Silty Fine Sand
22 to 27		Silty Coarse/Fine Sand
27 to 32		Fine Sandy Silt
32 to 37		Silty Med/Fine Sand
37 to 39		Silty Coarse/Fine Sand

4. DATE DRILLED 07/09/2003
5. TOTAL DEPTH 39 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES NO
7. STATIC WATER LEVEL Below Top of Casing: 33 ft.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS ~ 3.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

11. DISINFECTION: Type n/a Amount n/a

12. CASING:

Depth	Diameter	Wall Thickness or Weight/Ft.	Material
From <u>0</u> To <u>29</u> Ft.	<u>2-inch</u>	<u>Sch. 40</u>	<u>PVC</u>
From _____ To _____ Ft.	_____	_____	_____
From _____ To _____ Ft.	_____	_____	_____

13. GROUT:

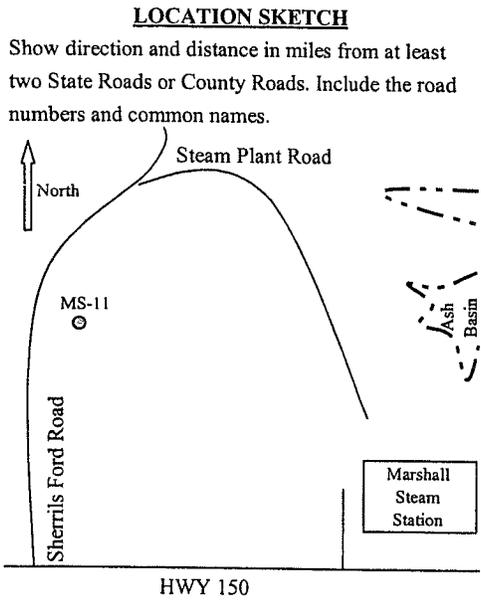
Depth	Material	Method
From <u>0</u> To <u>25</u> Ft.	<u>Neat Cement</u>	<u>Pour</u>
From <u>25</u> To <u>27</u> Ft.	<u>Bentonite</u>	<u>Pour</u>

14. SCREEN:

Depth	Diameter	Slot Size	Material
From <u>29</u> To <u>39</u> Ft.	<u>2-inch</u> in.	<u>0.01</u> in.	<u>PVC</u>
From _____ To _____ Ft.	_____ in.	_____ in.	_____

15. SAND/GRAVEL PACK:

Depth	Size	Material
From <u>27</u> To <u>39</u> Ft.	<u>#1</u>	<u>Silica Sand</u>
From _____ To _____ Ft.	_____	_____



16. REMARKS: _____

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

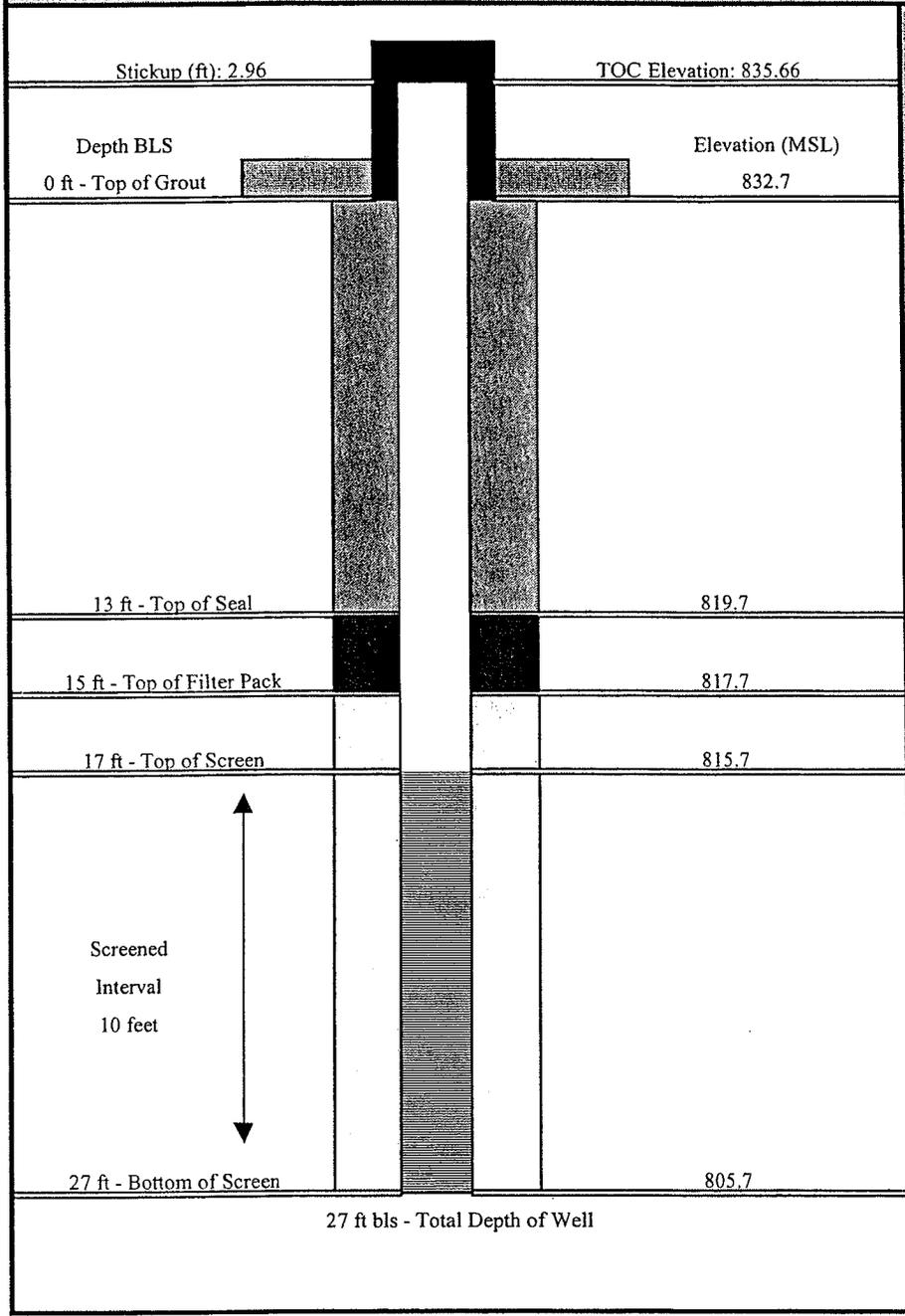
Jay Little SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE 7-17-03

MONITORING WELL CONSTRUCTION



WELL ID: OW-3 (MS-12) TOTAL DEPTH: 27 ft bls

S&ME PROJECT AND NO: Marshall Steam Station - Beneficial Fill, 1264-03-072		WELL USE / TYPE: Observation		INSTALLATION DATE: 02/11/2003	
DRILLING CONTRACTOR: S&ME, Inc.		DRILLER AND LICENCE NO.: Brian Wilson, 2718		DRILLING METHOD: 4.25 HSA	
STATIC WATER LEVEL: 17.89 ft bls at 24-hrs	NORTHING: 679540.0	EASTING: 1412086.5	TOP OF CASING ELEV.: 835.66	GROUND SURFACE ELEV.: 832.7	



PAD TYPE: 2'x2' Concrete
PROTECTIVE CASING: 4"x4" Lockable Steel
CASING TYPE: 2-inch Sch. 40 PVC
CASING INTERVAL: 0 to 17 ft bls
SCREEN TYPE: 2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL: 17 to 27 ft bls
GROUT TYPE: Neat Cement
GROUT INTERVAL: 0 to 13 ft bls
SEAL TYPE: Bentonite
SEAL INTERVAL: 13 to 15 ft bls
FILTER PACK: #1 Filter Sand
FILTER PACK INTERVAL: 15 to 27 ft bls
DEVELOPMENT: Purged minimum 5 well volumes
NOTES: For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

OW-3 - MS-12

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson CERTIFICATION # 2718
WELL CONTRACTOR COMPANY NAME S&ME, Inc. PHONE # 704-523-4726
STATE WELL CONSTRUCTION PERMIT# ASSOCIATED WQ PERMIT#
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential [] Municipal/Public [] Industrial [] Agricultral []
Monitoring [] Recovery [] Heat Pump Water Injection [] Other [x] If Other, List Use observation well

2. WELL LOCATION:
Nearest Town: Terrell County Catawba
Marshall Steam Station
Topographic/Land setting
[] Ridge [] Slope [x] Valley [] Flat
(check appropriate box)
Latitude/longitude of well location
(degrees/minutes/seconds)
Latitude/longitude source: [] GPS [] Topographic Map
(check box)

3. OWNER: Duke Power
Address 526 South Church Street
(Charlotte NC 28202)
City or Town State Zip Code
(704) 373-7900
Area code - Phone Number

4. DATE DRILLED 02/11/2003
5. TOTAL DEPTH 27 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES [] NO [x]
7. STATIC WATER LEVEL Below Top of Casing: 25 ft.
(Use "+" if Above Top of Casing)

8. TOP OF CASING IS ~3.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a
variance in accordance with 15A NCAC 2C .0118.

9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

11. DISINFECTION: Type n/a Amount n/a

12. CASING:
Depth Diameter or Weight/Ft. Material
From 0 To 17 Ft. 2-inch Sch. 40 PVC
From To Ft.
From To Ft.

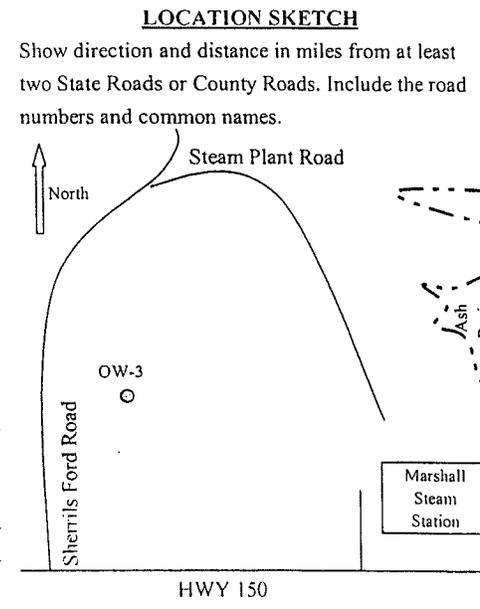
13. GROUT:
Depth Material Method
From 0 To 13 Ft. Neat Cement Pour
From 13 To 15 Ft. Bentonite Pour

14. SCREEN:
Depth Diameter Slot Size Material
From 17 To 27 Ft. 2-inch in. 0.01 in. PVC
From To Ft. in. in.

15. SAND/GRAVEL PACK:
Depth Size Material
From 15 To 27 Ft. #1 Silica Sand
From To Ft.

16. REMARKS:

Table with columns: DEPTH, DRILLING LOG, Formation Description. Rows: 0 to 9 Sandy Clay, 9 to 14 Fine Sandy Silt, 14 to 19 Silty Med/Fine Sand, 19 to 22 Fine Sandy Silt, 22 to 27 Silty Med/Fine Sand.



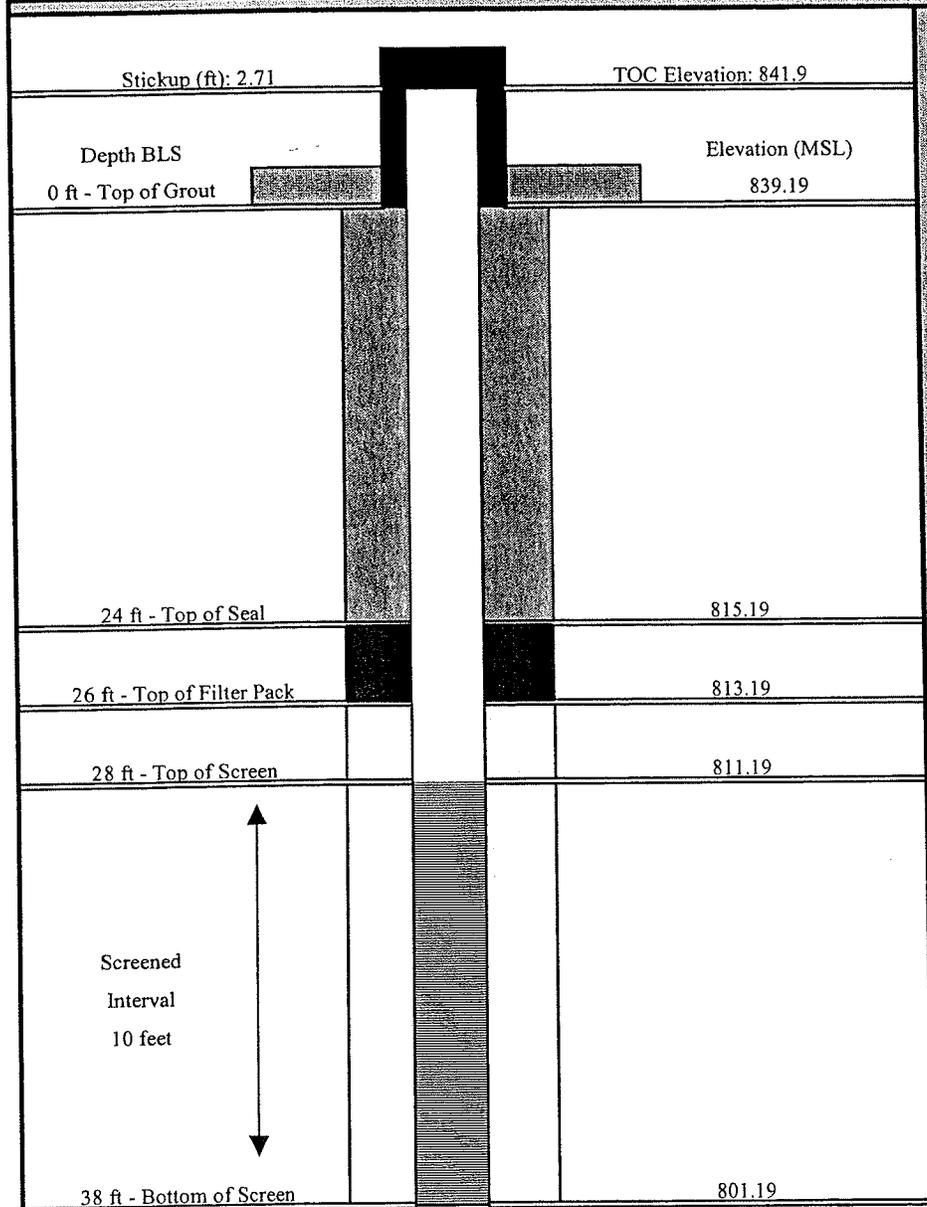
I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER
Signature of Brian Wilson DATE 2/17/03

MONITORING WELL CONSTRUCTION



WELL ID: MS-6 (MS-13) TOTAL DEPTH: 38 ft bls

S&ME PROJECT AND NO: Marshall Steam Station - Beneficial Fill, 1264-03-072		WELL USE / TYPE: Observation		INSTALLATION DATE: 12/17/2002	
DRILLING CONTRACTOR: S&ME, Inc.		DRILLER AND LICENCE NO.: Jay Little, 2717		DRILLING METHOD: 4.25 HSA	
STATIC WATER LEVEL: 26.89 ft bls at 24-hrs	NORTHING: 679732.8	EASTING: 1412500.7	TOP OF CASING ELEV.: 841.9	GROUND SURFACE ELEV.: 839.19	



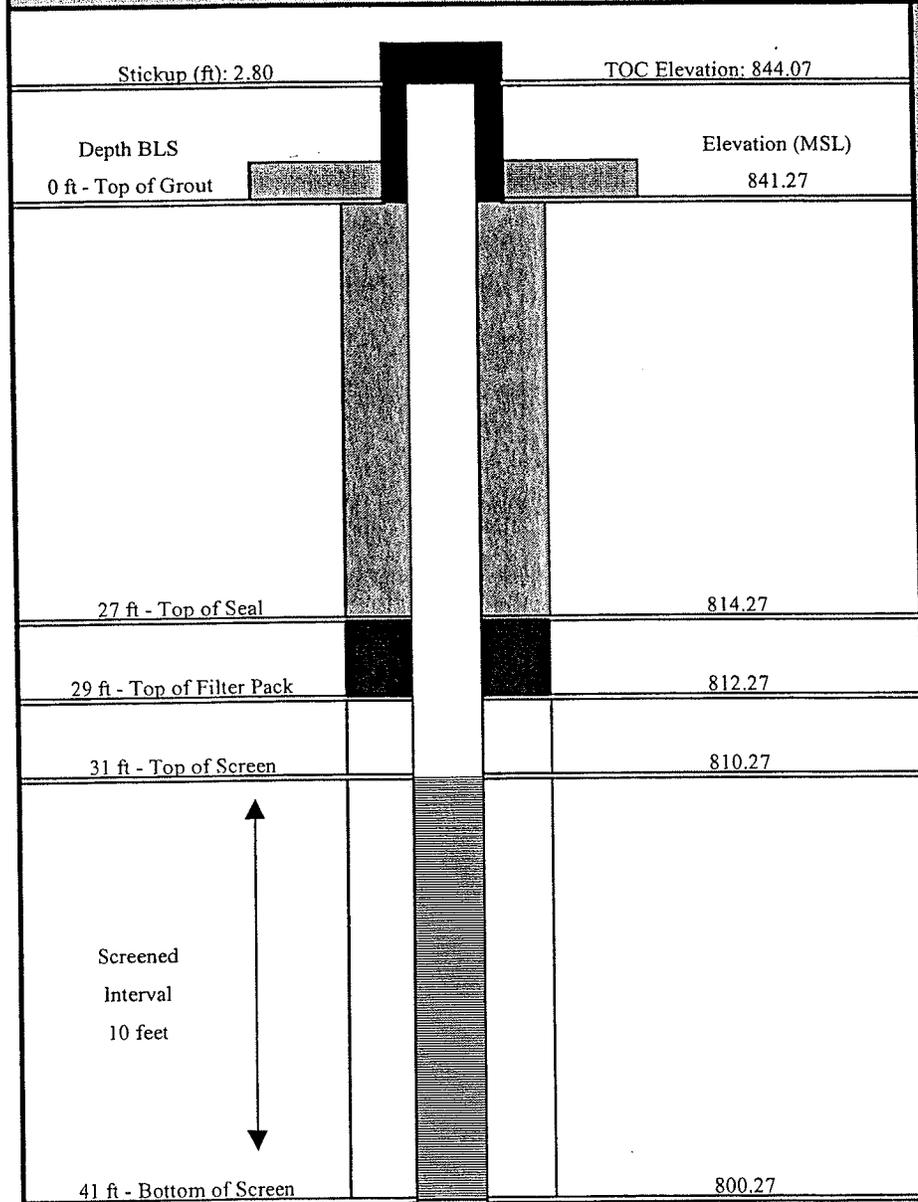
PAD TYPE: 2'x2' Concrete
PROTECTIVE CASING: 4"x4" Lockable Steel
CASING TYPE: 2-inch Sch. 40 PVC
CASING INTERVAL: 0 to 28 ft bls
SCREEN TYPE: 2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL: 28 to 38 ft bls
GROUT TYPE: Neat Cement
GROUT INTERVAL: 0 to 24 ft bls
SEAL TYPE: Bentonite
SEAL INTERVAL: 24 to 26 ft bls
FILTER PACK: #1 Filter Sand
FILTER PACK INTERVAL: 26 to 38 ft bls
DEVELOPMENT: Purged minimum 5 well volumes
NOTES: For Lithologic Information See Attached Boring Log

MONITORING WELL CONSTRUCTION



WELL ID: B-5 (M5-14) TOTAL DEPTH: 41 ft bls

S&ME PROJECT AND NO: Marshall Steam Station - Beneficial Fill, 1264-03-072		WELL USE / TYPE: Observation	INSTALLATION DATE: 01/07/2003
DRILLING CONTRACTOR: S&ME, Inc.		DRILLER AND LICENCE NO.: Brian Wilson, 2718	DRILLING METHOD: 4.25 HSA
STATIC WATER LEVEL: 36.3 ft bls at 24-hrs	NORTHING: 679968.4	EASTING: 1413123.9	TOP OF CASING ELEV.: 844.07
			GROUND SURFACE ELEV.: 841.27



PAD TYPE: 2'x2' Concrete
PROTECTIVE CASING: 4"x4" Lockable Steel
CASING TYPE: 2-inch Sch. 40 PVC
CASING INTERVAL: 0 to 31 ft bls
SCREEN TYPE: 2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL: 31 to 41 ft bls
GROUT TYPE: Neat Cement
GROUT INTERVAL: 0 to 27 ft bls
SEAL TYPE: Bentonite
SEAL INTERVAL: 27 to 29 ft bls
FILTER PACK: #1 Filter Sand
FILTER PACK INTERVAL: 29 to 41 ft bls
DEVELOPMENT: Purged minimum 5 well volumes
NOTES: For Lithologic Information See Attached Boring Log

41 ft bls - Total Depth of Well

WELL CONSTRUCTION RECORD

(B-5) - M5-14

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Brian Wilson CERTIFICATION # 2718

WELL CONTRACTOR COMPANY NAME S&ME, Inc. PHONE # 704-523-4726

STATE WELL CONSTRUCTION PERMIT# ASSOCIATED WQ PERMIT#

(if applicable)

(if applicable)

1. WELL USE (Check Applicable Box): Residential [] Municipal/Public [] Industrial [] Agricultral [] Monitoring [] Recovery [] Heat Pump Water Injection [] Other [x] If Other, List Use observation well

2. WELL LOCATION: Nearest Town: Terrell County Catawba Topographic/Land setting [] Ridge [x] Slope [] Valley [] Flat (check appropriate box)

(Street Name, Numbers, Community, Suidivision, Lot No., Zip Code)

Latitude/longitude of well location

3. OWNER: Duke Power

Address 526 South Church Street

(Street or Route No.)

Charlotte NC 28202

City or Town State Zip Code

(704) 373-7900

Area code - Phone Number

Latitude/longitude source: [] GPS [] Topographic Map (check box)

Table with columns: DEPTH, DRILLING LOG, From, To, Formation Description. Rows include: 0 to 3.5 Silty Clay, 3.5 to 9.5 Clayey Silt, 9.5 to 12 Silty Fine Sand, 12 to 37 Fine Sandy Silt, 37 to 41 Silty Fine Sand.

4. DATE DRILLED 01/07/2003

5. TOTAL DEPTH 41 ft bls

6. DOES WELL REPLACE EXISTING WELL? YES [] NO [x]

7. STATIC WATER LEVEL Below Top of Casing: 39.3 ft.

(Use "+" if Above Top of Casing)

8. TOP OF CASING IS ~ 3.0 FT. Above Land Surface*

*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.

9. YIELD (gpm) n/a METHOD OF TEST n/a

10. WATER ZONES (depth): n/a

11. DISINFECTION: Type n/a Amount n/a

12. CASING: Wall Thickness

Table with columns: Depth, Diameter, Wall Thickness, Material. Rows include: From 0 To 31 Ft. 2-inch Sch. 40 PVC.

13. GROUT: Depth Material Method

Table with columns: Depth, Material, Method. Rows include: From 0 To 27 Ft. Neat Cement Pour, From 27 To 29 Ft. Bentonite Pour.

14. SCREEN: Depth Diameter Slot Size Material

Table with columns: Depth, Diameter, Slot Size, Material. Rows include: From 31 To 41 Ft. 2-inch in. 0.01 in. PVC.

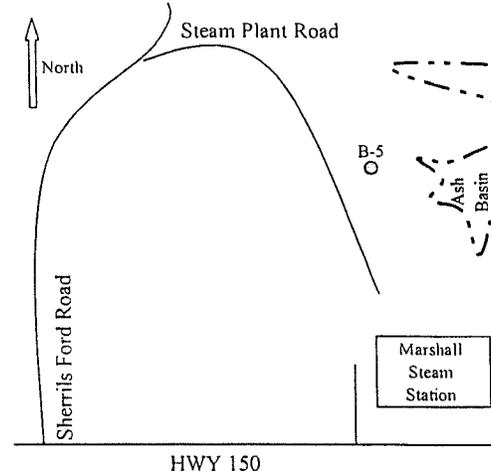
15. SAND/GRAVEL PACK: Depth Size Material

Table with columns: Depth, Size, Material. Rows include: From 29 To 41 Ft. #1 Silica Sand.

16. REMARKS:

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

SIGNATURE OF PERSON CONSTRUCTING THE WELL

DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

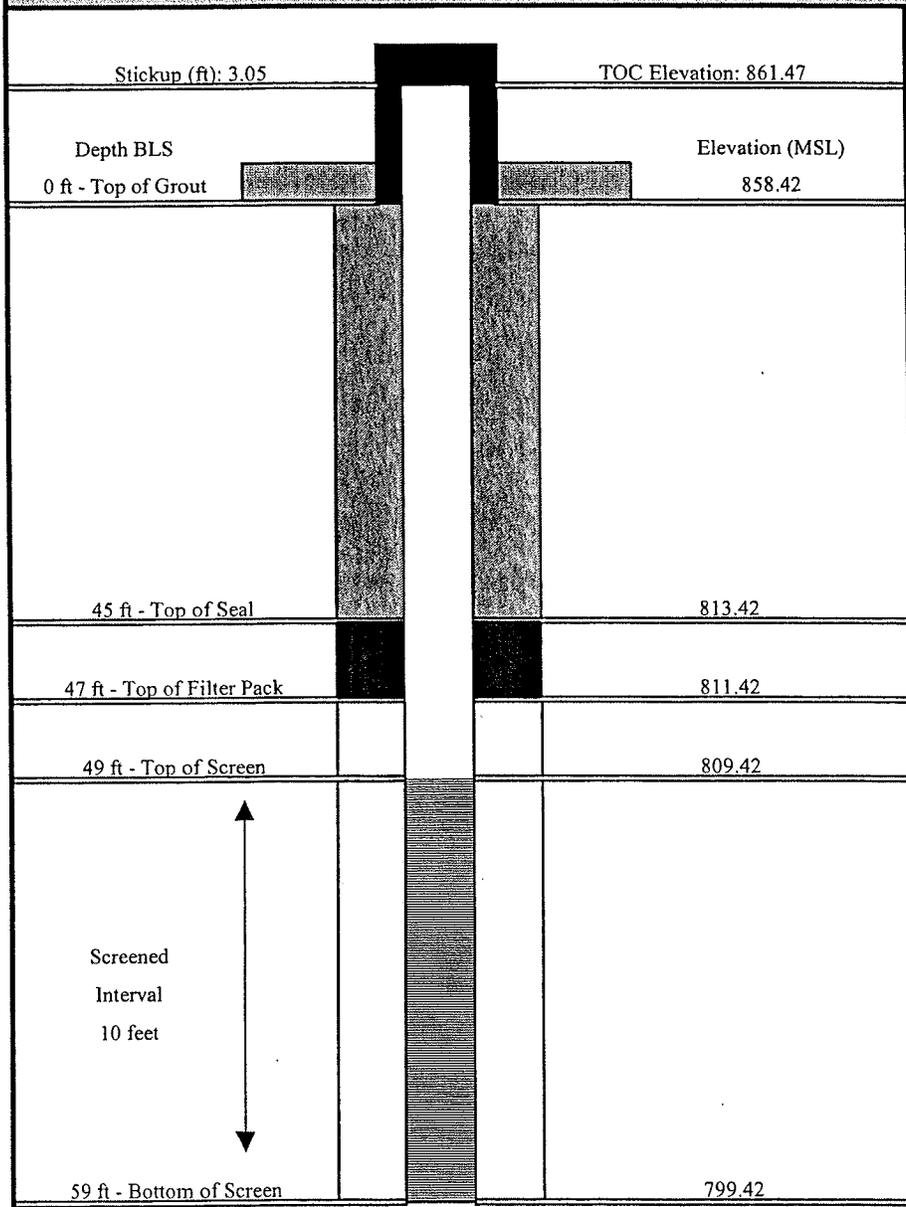
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION



WELL ID: B-4 (MS-15) TOTAL DEPTH: 59 ft bls

S&ME PROJECT AND NO: Marshall Steam Station - Beneficial Fill, 1264-03-072		WELL USE / TYPE: Observation	INSTALLATION DATE: 12/03/2002
DRILLING CONTRACTOR: S&ME, Inc.	DRILLER AND LICENCE NO.: Jay Little, 2717		DRILLING METHOD: 4.25 HSA
STATIC WATER LEVEL: 52 ft bls at 24-hrs	NORTHING: 680428.0	EASTING: 1412993.3	TOP OF CASING ELEV.: 861.47 GROUND SURFACE ELEV.: 858.42



PAD TYPE: 2'x2' Concrete
PROTECTIVE CASING: 4"x4" Lockable Steel
CASING TYPE: 2-inch Sch. 40 PVC
CASING INTERVAL: 0 to 49 ft bls
SCREEN TYPE: 2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL: 49 to 59 ft bls
GROUT TYPE: Neat Cement
GROUT INTERVAL: 0 to 45 ft bls
SEAL TYPE: Bentonite
SEAL INTERVAL: 45 to 47 ft bls
FILTER PACK: #1 Filter Sand
FILTER PACK INTERVAL: 47 to 59 ft bls
DEVELOPMENT: Purged minimum 5 well volumes
NOTES: For Lithologic Information See Attached Boring Log

59 ft bls - Total Depth of Well

WELL CONSTRUCTION RECORD

(B-4) - MS-15

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (prin Jay Little CERTIFICATION # 2717
WELL CONTRACTOR COMPANY NAME S&ME, Inc. PHONE # 704-523-4726
STATE WELL CONSTRUCTION PERMIT# ASSOCIATED WQ PERMIT#
(if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential [] Municipal/Public [] Industrial [] Agricultural []
Monitoring [] Recovery [] Heat Pump Water Injection [] Other [x] If Other, List Use observation well

2. WELL LOCATION:
Nearest Town: Terrell County Catawba
Marshall Steam Station
(Street Name, Numbers, Community, Suidivision, Lot No., Zip Code)
Topographic/Land setting
[x] Ridge [] Slope [] Valley [] Flat
(check appropriate box)
Latitude/longitude of well location
(degrees/minutes/seconds)
Latitude/longitude source: [] GPS [] Topographic Map
(check box)

3. OWNER: Duke Power
Address 526 South Church Street
(Charlotte, NC 28202)
City or Town State Zip Code
(704) 373-7900
Area code - Phone Number

Table with 3 columns: DEPTH, DRILLING LOG, Formation Description. Rows show depth ranges from 0 to 7, 7 to 42, 42 to 47, 47 to 52, 52 to 59 and corresponding formation descriptions like Clayey Silt, Fine Sandy Silt, Silty Fine Sand.

4. DATE DRILLED 12/03/2002
5. TOTAL DEPTH 59 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES [] NO [x]
7. STATIC WATER LEVEL Below Top of Casing: 55 ft.
(Use "+" if Above Top of Casing)

8. TOP OF CASING IS ~ 3.0 FT. Above Land Surface*
*Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.

9. YIELD (gpm) n/a METHOD OF TEST n/a
10. WATER ZONES (depth): n/a

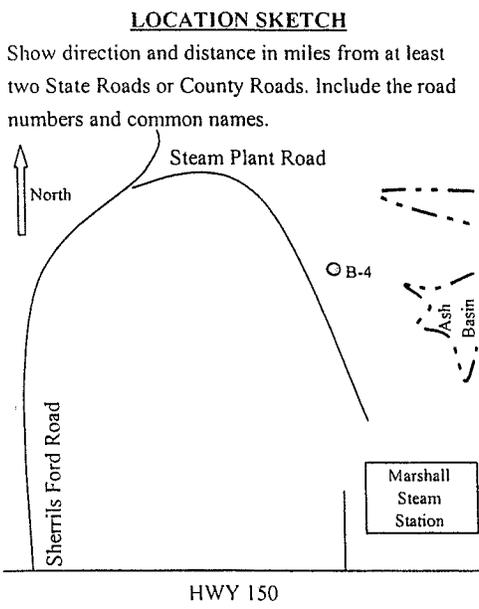
11. DISINFECTION: Type n/a Amount n/a

12. CASING:
Depth Diameter Wall Thickness Material
From 0 To 49 Ft. 2-inch Sch. 40 PVC
From To Ft.
From To Ft.

13. GROUT:
Depth Diameter Material Method
From 0 To 45 Ft. Neat Cement Pour
From 45 To 47 Ft. Bentonite Pour

14. SCREEN:
Depth Diameter Slot Size Material
From 49 To 59 Ft. 2-inch in. 0.01 in. PVC
From To Ft. in. in.

15. SAND/GRAVEL PACK:
Depth Size Material
From 47 To 59 Ft. #1 Silica Sand
From To Ft.



16. REMARKS:

I DO HERE BY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER
Signature of Jay A. Little DATE 2-7-03

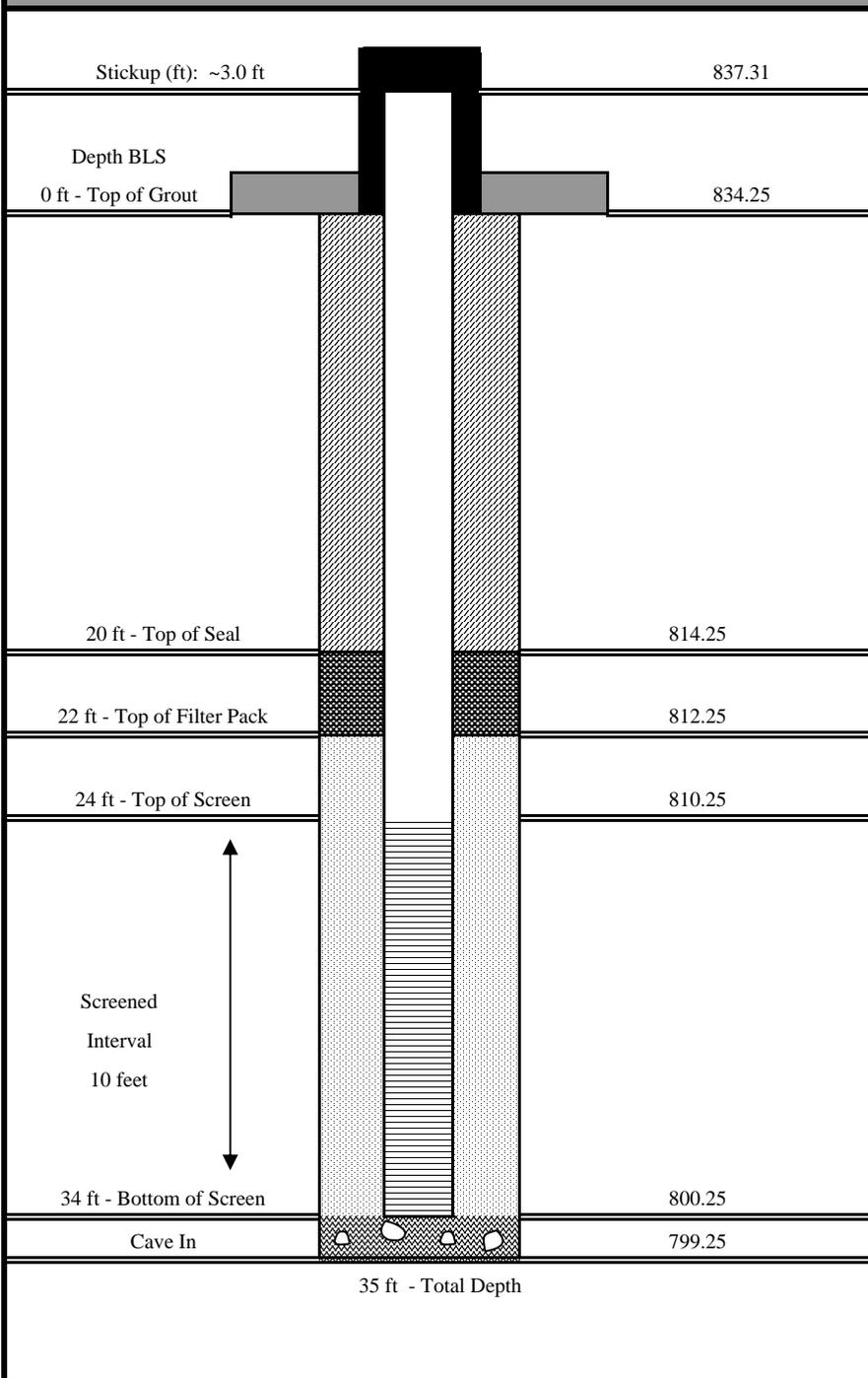
MONITORING WELL CONSTRUCTION



WELL ID: MS-16

TOTAL DEPTH: 35 ft bls

S&ME PROJECT AND NO: Marshall Steam Station, 1356-06-728		WELL USE / TYPE: Monitoring		INSTALLATION DATE: 9/11/2006	
DRILLING CONTRACTOR: S&ME, Inc.		DRILLER AND LICENCE NO.: Larry Shrader, 3349		DRILLING METHOD: 4.25 H.S.A.	
WATER LEVEL AT TOB: 26 ft bls	NORTHING: 681142.3	EASTING: 1412485.1	TOP OF CASING ELEV.: 837.31	GROUND SURFACE ELEV.: 834.25	



PAD TYPE: 2'x2' Concrete
PROTECTIVE CASING: 4"x4" Lockable Steel
CASING TYPE: 2-inch Sch. 40 PVC
CASING INTERVAL: 0 to 24 ft bls
SCREEN TYPE: 2-inch 0.010 Slot Sch. 40 PVC
SCREEN INTERVAL: 24 to 34 ft bls
GROUT TYPE: Neat Cement
GROUT INTERVAL: 0 to 20 ft bls
SEAL TYPE: Bentonite
SEAL INTERVAL: 20 to 22 ft bls
FILTER PACK: #1 Filter Sand
FILTER PACK INTERVAL: 22 to 34 ft bls
DEVELOPMENT: Purged ~15 Gallons
NOTES: TBD - To Be Determined For Lithologic Information See Attached Boring Log

WELL CONSTRUCTION RECORD

(MS-16)

North Carolina - Department of Environment and Natural Resources - Division of Water Quality - Groundwater Section

WELL CONTRACTOR (INDIVIDUAL) NAME (print Larry Shrader **CERTIFICATION #** 3349
WELL CONTRACTOR COMPANY NAME S&ME, Inc. **PHONE #** 704-523-4726
STATE WELL CONSTRUCTION PERMIT# _____ **ASSOCIATED WQ PERMIT#** _____
 (if applicable) (if applicable)

1. WELL USE (Check Applicable Box): Residential Municipal/Public Industrial Agricultural
 Monitoring Recovery Heat Pump Water Injection Other If Other, List Use _____

2. WELL LOCATION:
 Nearest Town: Terrell County Iredell
Marshall Steam Station
 (Street Name, Numbers, Community, Subdivision, Lot No., Zip Code)

Topographic/Land setting
 Ridge Slope Valley Flat
 (check appropriate box)

Latitude/longitude of well location
35°-36'-19.714"N / 80°-58'-35.966"W
 (degrees/minutes/seconds)

3. OWNER: Duke Power
 Address 526 South Church Street
 (Street or Route No.)
Charlotte NC 28202
 City or Town State Zip Code
(704) 373-7900
 Area code - Phone Number

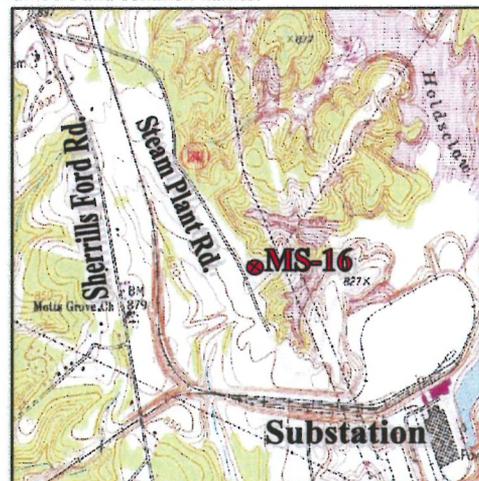
Latitude/longitude source: GPS Topographic Map
 Physical Survey (check box)

DEPTH		DRILLING LOG
From	To	Formation Description
0	3	Slightly Clayey, M/F Sand
3	9.5	Fine Sandy Silt
9.5	13.5	Silty, Fine/V. Fine Sand
13.5	18.5	Medium to Fine Sand
18.5	23.5	Very Fine Sandy Silt
23.5	29	PWR
29	35	PWR

4. DATE DRILLED 9/11/2006
 5. TOTAL DEPTH 34 ft bls
 6. DOES WELL REPLACE EXISTING WELL? YES
 7. STATIC WATER LEVEL Below Top of Casing: 24.7 ft.
 (Use "+" if Above Top of Casing)
 8. TOP OF CASING IS ~ 3.0 FT. Above Land Surface*
 *Top of casing terminated at/or below land surface requires a variance in accordance with 15A NCAC 2C .0118.
 9. YIELD (gpm) n/a METHOD OF TEST _____ n/a
 10. WATER ZONES (depth): _____ n/a

LOCATION SKETCH

Show direction and distance in miles from at least two State Roads or County Roads. Include the road numbers and common names.



11. DISINFECTION: Type n/a Amount n/a
 12. CASING: Wall Thickness or Weight/Ft. Material
 Depth Diameter
 From 0 To 24 Ft. 2-inch Sch. 40 PVC
 From _____ To _____ Ft. _____
 From _____ To _____ Ft. _____
 13. GROUT: Depth Material Method
 From 0 To 20 Ft. Neat Cement Pour
 From 20 To 22 Ft. Bentonite Pour
 14. SCREEN: Depth Diameter Slot Size Material
 From 24 To 34 Ft. 2-inch in. 0.01 in. PVC
 From _____ To _____ Ft. _____ in. _____ in. _____
 15. SAND/GRAVEL PACK: Depth Size Material
 From 22 To 34 Ft. #1 Silica Sand
 From _____ To _____ Ft. _____ _____

16. REMARKS: _____

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER

Larry M. Shrader 9-25-06
 SIGNATURE OF PERSON CONSTRUCTING THE WELL DATE

Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.