Permit No.	Scan Date	DIN
1809-INDUS-	**August 11, 2016**	**26608**

526 South Church Street
Charlotte, NC 28202
Mail Code: EC13K

980-373-5697

RECEIVED
August 11, 2016
Solid Waste Section
Asheville Regional Office

August 11, 2016

North Carolina Department of Environmental Quality
Division of Waste Management
Solid Waste Section
2090 U.S. Highway 70
Swannanoa, North Carolina 28778

Attn: Mr. Larry Frost

Re: FGD Landfill Permit Renewal Resubmittal
Permit No.: 1809-INDUS
Marshall Steam Station
Catawba County
Terrell, North Carolina 28682

Dear Mr.Frost,

Attached you will find the updated information for the permit renewal of the Marshall Steam Station FGD Landfill , Phase 1, Cell 1 (Permit No. 1809-INDUS). The current operating permit expires on November 21, 2016.

This permit renewal application was prepared by Amec Foster Wheeler under the direction of Duke Energy. The application resubmittal consists of updates to the Water Quality Monitoring Plan, as requested in a letter from the Department on June 17, 2016 *Determination of Completeness and Technical ReviewOperations Plan,* and updated figures to reflect the most recent survey of the FGD Landfill on May 7, 2016.

Updates to the Water Quality Monitorig Plan include adding Antimony, Beryllium, Cobalt, Thallium, and Vanadium to the consistuent list in Table 2 and correcting the rule reference from 15A NCAC 13B .1617(b)(5) to 15A NCAC 13B .0504(1)(g)(iv).

Pending the approval of the Proposed .0201, .0206, and .0207 Life of Site Permit Rules, Duke Energy requests a life of site permit be issued for the landfill.

Please feel free to contact me at 980-373-5697 with any questions or comments.

Respectfully submitted,

B. Tyler Hardin

Tyler Hardin, EIT
Environmental Services

Attachments: Electronic Copy

cc (letter only, via e-mail): Ed Mussler, NCDENR
Elizabeth Werner, NCDENR
Kyle Baucom, Duke Energy
Tim Russell, Duke Energy
Dan Zakary, Duke Energy
Scott LaSala, Duke Energy
Chris Randazzo, Duke Energy
Ed Sullivan, Duke Energy

Landfill Operations Plan

Marshall Flue Gas Desulfurization Residue Landfill (Permit No. 1809-INDUS)

Duke Energy Carolinas – Marshall Steam Station

Terrell, Catawba County, North Carolina

Amec Foster Wheeler Project No. 7810160654

M.A. “Mark” Shumpert, PE
Amec Foster Wheeler
North Carolina Professional Engineering Firm No. F-1253

Prepared For:	Duke Energy Carolinas, LLC 526 S. Church St., Charlotte, NC 28202
Date	August 10, 2016
Prepared By:	Amec Foster Wheeler 2801 Yorkmont Rd., Suite 100, Charlotte, NC 28208

DESCRIPTION OF REVISIONS

The Operations Plan was originally submitted to the North Carolina Department of Environmental Quality (NCDEQ) in August of 2011 and modified as shown in the following table:

Revision	***Date of Document***	***Description of Revisions***
Initial Issue	August 19, 2011	Initial issuance of document.
Revision 1	December 9, 2011	The following revisions were performed to respond to the Permit to Operate *Completeness Determination and Technical Review* performed by DENR and to provide consistent requirements for Operational and Intermediate Cover between this landfill and the Marshall Steam Station Industrial Landfill No. 1 Permit No. 1812 (MSS ILF#1). Editorial changes to the text are not noted. Landfill Operations Plan • Section 2.1.1—Revised acreage for landfill footprint to 17.9 acres to include stormwater basin. • Section 2.1.6.3—Revised to delete reference to cover requirements for asbestos from this section. • Section 2.1.8.1—Revised cover requirements for asbestos per NCDEQ comments • Section 2.1.8.3 – Revised cover requirements to be consistent with MSS ILF #1 Operations Plan. • Section 2.1.8.3—Revised cover requirements to be consistent with MSS ILF#1 Operations Plan. • Section 2.1.8.4—Revised cover requirements to be consistent with MSS ILF#1 Operations Plan. • Section 2.1.8.5—Deleted previous section (Interim Cover) to be consistent with MSS ILF#1 Operations Plan. (Initial Issue Section 2.1.8.6 Final Cover becomes Section 2.1.8.5). • Section 2.7—Revised wording to state that monitoring of landfill gas is not required until the final cover system is installed. • Section 6.0—Revised section for 10-Year Waste Management Plan to include annual submittal of implementation report per NCDEQ comments Appendix A Dust Control Plan • Section 1.0—Deleted acreage of landfill footprint. • Section 2.0—Revised section to delete reference to thickness of soil cover • Section 4.0—Revised cover requirements for asbestos per NCDEQ comments

Revision	***Date of Document***	***Description of Revisions***
Revision 1	December 9, 2011	Appendix C • Added Letter from Mr. Larry Frost, DENR to Mr. Ed Sullivan, P.E., Duke Energy Carolinas, LLC, dated September 27, 2011, Permit to Operate, Amendment, Five (5) Year Renewal, Completeness Determination and Technical Review, Marshall Steam Station Flue Gas Desulfurization (FGD) Residue Landfill, Permit No. 1809, Catawba County, DIN 15221
Revision 2	November 13, 2013	Landfill Operations Plan Section 1.5 Operating Hours – Included language for Operational Flexibility Section 2.1 Waste Acceptance • Revised approved waste and operational process for handling waste • Updated intermediate cover requirements Section 2.3 Leachate Collection System – Included chimney drain system and modified leachate collection pipe maintenance plan. Phasing Diagrams – Added chimney drain locations and added Drawing PD-9 for chimney drain details.
Revision 3	August 10, 2016	Landfill Operations Plan Section 2.1 Waste Handling and Landfill Sequencing – • 2.1.2 Added soil material and geotextile • 2.1.5 Updated landfill sequencing • 2.1.6.5 Added vacuum truck waste Section 2.5 Stormwater Basin Maintenance Requirements – Removed from Plan Section 4 Vegetation – Updated to site specific vegetation management plan Section 6 Required Regulatory Submittals – Updated the timeline for reporting sampling events Existing Conditions and Dust Control Plan figures updated with 2016 topographic survey mapping

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1 General Facility Operations

1.1 Overview

The purpose of this Operations Plan is to outline a plan for the safe and efficient operations of the Marshall Flue Gas Desulfurization (FGD) Residue Landfill. This Operations Plan presents the operational requirements for: 1) General Facility Operations, 2) Operations Management, 3) Erosion and Sedimentation Control, and 4) Vegetation Management, along with guidance for Landfill Closure and Required Regulatory Submittals. The Operations Plan was prepared consistent with 15A NCAC 13B .0505 Operational Requirements for Sanitary Landfills rules.

The Marshall Steam Station is located at 8320 East North Carolina Highway 150 in Terrell, Catawba County, North Carolina. The Marshall FGD Landfill is owned and operated by Duke Energy Carolinas, LLC (Duke). The landfill is located on Marshall Steam Station property, northwest of the Marshall plant and bounded by Steamplant Road to the east and existing railroad track to the west.

1.2 Contact Information

Correspondence and questions concerning the operation of the Marshall FGD Landfill should be directed to the appropriate entity as follows:

Owner

Duke Energy Carolinas, LLC – Marshall Steam Station
8320 East NC Hwy 150, Terrell, NC 28682
(828) 478-7622
Facility Contact: Landfill System Owner

State Regulatory Agency

North Carolina Department of Environmental Quality
Division of Waste Management, Solid Waste Section
Asheville Regional Office
2090 US Highway 70, Swannanoa, North Carolina 28778
Permitting Engineer: Mr. Larry Frost

1.3 Safety

Landfill operations at the Marshall FGD Landfill were developed considering the health and safety of the facility's operating staff. The operating staff receives site-specific safety training prior to landfill operations, and on-site activities are conducted according to the applicable sections of Duke's Safe Work Practices.

1.4 Access and Security Requirements

The Marshall FGD Landfill is located entirely within Duke's property limits. Security for the site is currently in place, consisting of fencing, gates, wooded buffers and security check stations. Unauthorized vehicle access to the site is prevented around the landfill property by security check stations, wooded buffers, fencing, gates and stormwater conveyance features.

The access road to the site is of all-weather construction and will be maintained in good condition. Potholes, ruts, and debris on the road(s) will receive attention as soon as practical in order to avoid damage to vehicles.

1.5 Operating Hours

The Marshall FGD Landfill is operated seven days a week, as needed. On weekends and holidays when the Landfill Operator may be offsite but when the station wastewater treatment system remains operational, the following conditions apply:

- The Landfill Operator shall place and compact all existing waste in the landfill prior to leaving the site.
- The Landfill Operator shall clearly and visibly indicate the location for weekend clarifier sludge placement in the landfill through use of signs, barrels, or other delineation aid prior to leaving the site.
- Only designated station personnel who are properly equipped and informed shall transport and place clarifier sludge in the landfill during the weekend or holiday.
- A certified Landfill Operator shall be available by phone to address issues should they arise during the weekend or holiday.
- On the first business day following the weekend or holiday, the Landfill Operator shall incorporate any clarifier sludge placed in the FGD Landfill during the weekend or holiday in accordance with the Operations Plan.

1.6 Signs

A sign providing the landfill permit number, hours of operation, and a statement reading, “NO HAZARDOUS OR LIQUID WASTE PERMITTED” is posted at the site entrance, and shall be maintained in good condition.

Directional signs are placed along the access road to the landfill and shall be maintained in good condition at all times.

Edge-of-waste markers are installed and delineate the edge of waste. These markers shall be maintained in good condition and remain visible at all times.

1.7 Training

Due to the diversity and nature of job tasks required at the Marshall FGD Landfill, personnel shall be adequately trained to handle facility operations and maintenance.

The System Owner for Landfill Operations shall have a general understanding of all the tasks required for site operations. Individuals performing the various tasks shall have adequate training for the site-specific tasks to which they are assigned. Duke shall offer a site-specific training program for facility personnel.

Noteworthy operations and maintenance tasks to be addressed in training include:

- Maintaining accurate records of waste loading (quantitative and qualitative)
- Operating requirements for stormwater segregation from exposed waste areas
- Operating and maintaining the leachate collection system (LCS)

All training will be documented and training records will be kept on-site. The System Owner for Landfill Operations will conduct Operations Plan training courses in accordance with the permit requirements.

1.8 Record Keeping for Operations Plan

An operating record is to be maintained on-site and include the following records:

- Leachate Collection Systems (LCS) – Periodic Maintenance Documentation
- Stormwater Maintenance and Inspection Logs

- Erosion and Sedimentation Control Inspection Logs
- Periodic Landfill Inspection Reports
- Dust Control Monitoring Logs
- Groundwater Monitoring (and Sampling) Documentation
- Operations Plan

The above records are to be kept in the operating record for the active life of the Marshall FGD Landfill and the post-closure care period. Information contained in the operating record must be furnished upon request to the North Carolina Department of Environmental Quality (NCDEQ), Division of Waste Management, Solid Waste Section (Division) or be made available for inspection by the Division. Additional records kept on-site, or made accessible electronically at the site, should include:

- Solid waste facility permits
- Record of the amount of solid waste received summarized on a monthly basis based on scale records
- Documentation of LCS system performance observations
- Documentation of erosion and sedimentation control observations
- Regulatory agency inspection reports
- Permit-to-Construct Application
- Employee training program and records
- Landfill drawings and specifications

1.9 Design Drawings

Landfill design drawings are listed in the table below. The design drawings display the location of landfill features, landfill construction details, and technical design and construction notes.

Table 1 – Design Drawings

2005 Approved Design Drawings

M-6024-02.00	Cell 1 Excavation
M-6024.03.00	Cell 1 Profile and Sections
M-6024.04.00	Cell 1 Perimeter Road Realignment
M-6024-08.00	Cell 1 and Cell 2 Perimeter Road Sections
M-6024-09.00	Cell 1 and Cell 2 Perimeter Road Profile
MM6451.00-0002.001*	Gas Venting System Plan
MM6451.01-0001.001	Cell 1 Erosion and Sediment Control Plan
MM6451.01-0002.001	Cell 2 Erosion and Sediment Control Plan
MM6451.01-0003.001	Final Closure Erosion and Sediment Control Plan
MM6451.01-0004.001*	Gypsum Landfill Erosion Control Details
MM6451.00-0001.001*	Final Closure Details
MM6451.00-0003.001*	Cell 1 Leachate Collection and Removal System
MM6451.00-0004.001	Cell 1 Operational Cover Grading Plan
MM6451.00-0005.001*	Cell 1 Final Configuration
MM6451.00-0006.001	Cell 1 Stormwater Basin
MM6451.00-0007.001**	Cell 1 and Cell 2 Details
MM6451.00-0008.001	Cell 1 and Cell 2 Leachate Collection and Removal System
MM6451.00-0009.001	Cell 2 Landfill Excavation
MM6451.00-0010.001	Cell 2 Leachate Collection and Removal System
MM6451.00-0011.001	Cell 2 Operational Cover Grading Plan
MM6451.00-0012.001	Cell 2 Stormwater Basin

MM6451.00-0012.001	Cell 1 Cell 2 Final Configuration
MM6451.00-0014.001	Cell 1 and Cell 2 Sections

Notes:
1. Unless otherwise noted, the design drawing is from the *Construction Plan Application* dated December 15, 2005.
2. * indicates design drawing revised August 19, 2011 and April 6, 2012.
3. ** indicates sump closure detail revised November 1, 2013.

2005 Approved Phasing Drawings

PD-1 – PD-7	Phasing Plan
PD-8	Cell 1 Final Closure
PD-9	Chimney Drain Details

2 Operations Management

The primary objective of operations management at the Marshall FGD Landfill is to dispose of waste material in compliance with permit conditions while operating in a safe manner.

As needed, soil diversion berms will be used to divert non-contact stormwater away from exposed ash. Areas of exposed ash will be graded to direct contact water to chimney drains. Intermediate cover will be placed on exterior slopes as each slope section reaches a height of approximately 10 feet.

In general, the landfill operations contractor will limit the area of exposed CCR (i.e., the active area) to 2 acres or less, at the operator's discretion and CCR in other areas will be covered with stabilizing agent or operational or intermediate cover in accordance with the Dust Control Plan. Contact water from the active area will be directed to chimney drains in the landfill interior.

2.1 Waste Handling and Landfill Sequencing

2.1.1 Landfill Capacity

The Marshall FGD Landfill Phase I, Cell 1 was permitted to operate on November 21, 2006. The Cell 1 footprint consists of approximately 17.9 acres.

The capacity of the landfill is presented in Table 2 below.

Table 2 – Lined Landfill Capacity

Landfill Phase	Gross Volume (CY)
Previously Permitted Gross Volume for Phase 1 Cell 1	1,170,000

2.1.2 Waste Acceptance, Disposal, and Screening Requirements

The Marshall FGD Landfill is permitted to accept CCR (including fly and bottom ash, pyrites, and coal mill rejects) generated at Duke Energy Corporation facilities. The Marshall Steam Station generated waste includes the following:

- Gypsum produced during the Flue Gas Desulfurization (FGD) process
- FGD clarifier sludge
- Waste limestone material, broiler slag, and sand blast material
- Ball mill rejects
- Asbestos
- Construction and demolition debris
- Land clearing and inert debris
- Waste water treatment sludge, and other waste streams produced by coal-fired electric or steam generation unit wastes
- Soil material that contains any of the above material and soil used for operations
- Incidental amounts of geotextile used in the management of CCPs

The landfill owner or operator shall notify the Division within 24 hours of attempted disposal of any wastes the landfill is not permitted to receive. At a minimum, hazardous waste, yard waste, liquid wastes, regulated medical waste, sharps not properly packaged, polychlorinated biphenyls (PCB) waste as defined in 40 Code of Federal Regulations (CFR) 761, and wastes banned from disposal in North Carolina by General Statute 130A-309.10(f), must not be accepted at the landfill.

The removal of waste from the landfill is prohibited without owner approval. See Section 2.1.6 – Waste Placement for storage and removal (mining) of gypsum. Waste will be hauled and disposed of by dedicated and consistent operators from the waste source to the landfill. Access to the interim waste storage locations (i.e. fly ash silos, gypsum storage areas, etc.), haul roads, and landfill are restricted; therefore, no screening of waste is recommended.

2.1.3 Dust, Litter, Odor, and Vector Control

Litter, odors, and vectors are not anticipated to be concerns at the Marshall FGD Landfill. The waste placed in the landfill does not attract vectors, and windblown material is not anticipated to be a problem. Odors are typically not a problem at CCR waste landfills.

Dust control is addressed in the Dust Control Plan included as Appendix I. Generally, dust control measures will be implemented when necessary, and will include at a minimum, watering of dusty roads with non-contact water and the active area with contact or non-contact water. Other measures include physical measures such as fencing and/or berms, temporary covers (like tarps), spraying dust suppressants, and modifying the active area. Additionally, interim cover will be vegetated as soon as practical in order to minimize the blowing of dust on-site.

2.1.4 Fire Control

No open burning shall be permitted at the Marshall FGD Landfill. There are limited explosive gas concerns with aforementioned permitted waste types; therefore, the threat of fire is considered to be minimal.

Although it is unlikely, if a fire occurs at the landfill, the Station Control Room (phone number: 828-478-7521) shall be notified, and equipment and stockpiled soil shall be furnished to control accidental fires. Marshall Plant will notify the local fire department, which will be immediately dispatched to assist with fire control. Any fire that occurs at the landfill shall be reported to the Division within 24 hours, and a written notification will be submitted within 15 days by the Station Sponsor for Landfill Operations.

2.1.5 Landfill Sequencing

The Marshall FGD Landfill is developed within the area shown on Figure 1. A 200-foot buffer will be maintained around the entire perimeter of the landfill. A 500-foot buffer will be maintained from existing residences and water supply wells. The majority of the areas within the buffer will remain in its current condition. In order to effectively manage leachate, temporary perimeter berms will be maintained around the active area. The active area surface shall be graded to promote surface water drainage to the contact water collection system. No waste shall be placed in standing water. The actual filling sequence, fill heights, and grades may be modified at the Owner's discretion.

2.1.6 Waste Placement

2.1.6.1 Fly Ash, Bottom Ash, and FGD Gypsum

Fly ash, bottom ash, and FGD Gypsum shall be compacted using compactors and dozers in approximate 1-foot lifts to achieve a vertical operational lift thickness of 10 feet.

In order to protect the liner system and leachate components, gypsum placed in the active landfill with the potential of future mining will be stored in designated areas with a minimum separation of:

- Horizontal: 50'-0" from the landfill side slope or anchor trench
- Vertical: 10'-0" vertical separation from the top of protective cover (drainage layer). The vertical separation layer typically consists of ash or other waste material

2.1.6.2 FGD Clarifier Sludge, Coal Mill Rejects, Waste Limestone Material, Boiler Slag, Sand Blast Material, Ball Mill Rejects, Coal Waste, Wastewater Sludge, and Pyrites

FGD clarifier sludge, coal mill rejects, waste limestone material, boiler slag, sand blast material, ball mill rejects, coal waste, wastewater sludge, and pyrites will be spread in 6-inch lifts in the center of the operational area and shall not be placed within 25 feet of the exterior slopes. FGD clarifier sludge shall be blended with the other waste (i.e. ash) prior to placement of the next fill lift. FGD clarifier sludge, coal mill rejects, waste limestone material, boiler slag, sand blast material, ball mill rejects, coal waste, and pyrites shall be compacted as densely as practical. In-place density testing of these materials is not required.

2.1.6.3 Asbestos

Asbestos waste shall be packaged in accordance with 40 CFR 61, and it shall be disposed of away from the working face or in an area not contiguous with other disposal areas. Separate areas shall be clearly marked so that asbestos is not exposed by future land-disturbing activities. From lift to lift, if asbestos disposal areas are relocated, records of the areas must be maintained.

Asbestos material shall not be placed within 25 feet of the exterior slopes. Asbestos material shall be placed in relatively thin lifts limited to only a few feet thick. Asbestos material shall be compacted as densely as practical and specific monitoring and in-place density testing for asbestos materials is not required. Asbestos material shall be covered as described in Section 2.1.8.1.

2.1.6.4 Construction and Demolition (C&D) Waste and Land Clearing and Inert Debris (LCID)

The landfill may receive construction and demolition waste, land clearing waste, inert debris, untreated wood, and yard trash (leaves, sticks). These materials shall not be placed within 25 feet of the exterior slopes. Waste will be placed on the smallest active face as practical and compacted with a dozer as densely as practical. Specific monitoring and in-place density testing of C&D waste and LCID is not required. Compacted C&D waste and LCID will be covered as described in Section 2.1.8.2.

2.1.6.5 Vacuum Truck Waste

Vacuum trucks are used to remove waste materials from the plant areas that consist of various permitted CCR. The origin of the vacuum truck waste materials is typically from various sumps, catch basins, wheel wash stations, and coal pile sumps located within the plant.

The moisture contents of the vacuum truck waste materials may vary considerably with the waste varying in consistency from a relatively dry state to a wet, fluid-like state depending on the amount of liquid present in the sumps or vacuumed areas.

Vacuum trucks used to transport CCR will be dedicated to Duke operations or documentation will be obtained to ensure that the vacuum truck contains no human or other non-permitted waste streams. Vacuum truck waste could also mean similar waste material transported in smaller water tight units.

Vacuum truck waste shall consist of permitted waste materials. Non-permitted waste materials inadvertently included with the vacuum truck waste, including but not limited to, yard trash (paper, plastic, wood, aluminum, Styrofoam, etc.) shall be visually screened and immediately removed from the vacuum truck waste after the waste material is dumped in the operational area by vacuum contractor.

Vacuum truck waste shall only be placed within the landfill during landfill operating hours when landfill operator personnel are present. The vacuum contractor shall coordinate vacuum truck waste placement with landfill operator personnel.

A Vacuum Truck Waste Disposal Log shall be used to document vacuum waste placement within the landfill. A Vacuum Truck Waste Disposal Log shall be used to verify the origin of vacuum truck waste and will include the date, time, weather conditions, estimated waste volume, visual waste screening and non-permitted waste removal, and Operator representative approval. The Vacuum Truck Waste Disposal Log

may be modified as needed by the Owner or Operator to supply additional site specific operations information.

The estimated volume of vacuum truck waste generated will be documented by the landfill operator along with monthly truck scale log records to estimate the cumulative vacuum truck waste transported and placed within the landfill.

The consistency of the vacuum truck waste may vary from a relatively dry state to a relatively wet, fluid-like state. Vacuum truck waste material shall be moisture conditioned by initial decanting of excess moisture from the waste or by mixing the waste with fly ash, bottom ash, or gypsum materials depending on its consistency. The vacuum truck waste shall be placed and spread in maximum 6-inch lifts near the center of the operational area. The vacuum truck waste shall not be placed within 50 feet horizontally from exterior landfill slopes or within 50 feet of chimney drain structure locations. The vacuum truck waste material shall be thoroughly mixed with fly ash, bottom ash, or gypsum material during waste placement using a dozer or other similar grading equipment to produce additional moisture conditioning prior to compaction. In-place density testing of the vacuum truck waste material is not required.

2.1.7 Compaction Requirements and Testing

2.1.7.1 In-Place Density and Moisture Content Testing

In-place density and moisture content testing shall be performed at a minimum frequency of one test per 10,000 cubic yards. Waste shall be compacted to a minimum 95 percent of its Standard Proctor (ASTM D698) maximum dry density. Compacted moisture content shall be within 5 percent of the material's optimum moisture content as determined by ASTM D698.

In-place density tests shall be performed using the Drive-Cylinder Method (ASTM D2937), or Nuclear Method (ASTM D6938). If the nuclear method is selected, a minimum of one comparison density test using the Drive Cylinder method shall be performed for every 10 nuclear density tests. All test results shall be reported to the Engineer of Record for the landfill. A sample of ash material shall be collected from each density test location and placed in a sealed container for subsequent field and laboratory moisture testing. The reported dry density shall be calculated based on the results of laboratory moisture testing.

A family of Proctor curves shall be developed for the on-site ash material as standard Proctor moisture-density tests are performed as a reference for the field density testing. A minimum of one (1) one-point field Proctor test shall be performed during each compaction testing event. If the estimated standard Proctor maximum dry density based on the results of one-point Proctor testing indicates that the maximum dry density varies by more than 5 pounds per cubic foot (pcf) from the nearest representative standard Proctor moisture-density relationship, an additional bulk sample of ash material shall be obtained and standard Proctor testing shall be performed and used to evaluate the degree of compaction for the related in-place density tests. If in the course of testing, the technician believes that due to changes in material a Proctor curve should be referenced other than that indicated by the initial one-point field Proctor, then an additional one-point field Proctor shall be performed.

2.1.7.2 Laboratory Testing

Laboratory moisture content testing shall be performed in conjunction with the field density testing as described above. The laboratory moisture content testing shall be performed using the Oven Method (ASTM D2216), at an oven temperature of 60 degrees Celsius.

Standard Proctor moisture-density relationship (ASTM D698) testing shall be performed at a minimum frequency of one test for every 50,000 cubic yards of material placed. As previously mentioned, additional standard Proctor samples shall be obtained and tested if one-point Proctor testing indicates that the estimated maximum dry density of the material varies by more than 5 pcf from the nearest representative standard Proctor moisture-density relationship.

2.1.8 Cover Requirements

2.1.8.1 Operational Cover – Asbestos Material

Asbestos waste material that has been deposited in the Marshall FGD Landfill will be covered within eight hours of placement with at least 6 inches of soil, ash, and/or gypsum material and compacted by a dozer.

2.1.8.2 Operational Cover – C&D Waste

When the C&D waste disposal area exceeds one-half acre, and at least weekly, the compacted C&D waste will be covered with a minimum of 6 inches of earthen material (i.e., soil, ash and/or gypsum material).

2.1.8.3 Operational Cover

For wastes other than asbestos waste and C&D waste, operational soil cover should be applied, as needed, for dust control and stormwater management. The operational cover may be applied at a thickness suited to its purpose. For example, operational soil cover may be applied thinner to achieve dust control and it may be applied in thicker layers where protection from surface erosion is desired. Operational soil cover is not required, provided the Dust Control Plan included as Appendix I is followed.

2.1.8.4 Intermediate Cover

A 12-inch thick intermediate cover layer shall be placed on exterior slopes and areas where final grades have been reached. Intermediate cover material shall be free of protruding roots, stumps, and debris. Intermediate cover may not contain more than 5 percent gravel (particle sizes larger than 0.5 inches) by weight as determined by ASTM D422. Isolated rock fragments not exceeding 6 inches in diameter may be placed within the intermediate cover if completely surrounded by compacted soil if approved by the Engineer. Rock fragments shall not protrude more than 3 inches from the intermediate cover surface. Intermediate cover will be seeded within 7 days in accordance with Erosion and Sediment Control requirements. Vegetation shall be removed and the intermediate cover soil shall be scarified or removed prior to placing any overlying waste. For areas where waste placement will be inactive for 12 months or more within interior landfill areas (excluding exterior slope area), will not require intermediate soil cover, provided the Dust Control Plan included in Appendix I is followed.

2.1.8.5 Final Cover

The final cover system for the Marshall FGD Landfill will be completed within 180 days following the beginning of closure activities unless otherwise approved by the Division.

The final cover system will consist of the following components, from top to bottom:

- A 24-inch thick final cover soil layer (i.e., a 6-inch thick vegetative support layer overlying an 18-inch thick cover soil layer) consisting of a soil capable of supporting native plant growth
- A double-sided geocomposite drainage layer
- A 40-mil thick double-sided textured linear low density polyethylene (LLDPE) geomembrane
- Intermediate soil cover layer (may be thinner than the initial 12-inch thickness; geomembrane may be installed directly on waste)

The soil components will yeild a surface suitable to sustain vegetative growth while protecting the underlying geosynthetic components of the cover system. Infiltration through the cover soils will be collected by the geocomposite drainage layer, while the geomembrane will function as a hydraulic barrier to reduce infiltration into the waste mass. The cover system stormwater management structures will collect both infiltration and surface water runoff. The final cover will be vegetated within six months following closure.

Refer to the Appendix III, Closure and Post-Closure Plan for final cover specifications and maintenance and operations requirements.

2.1.9 Groundwater Monitoring Well Access Requirements

Groundwater monitoring wells will be located around the landfill perimeter. A readily accessible, unobstructed path shall be maintained so that monitoring wells may be accessed using four-wheel drive vehicles. Care must be taken around the wells to prevent any damage to the wells.

2.2 Leachate and Stormwater Management

A leachate collection system (LCS) is in place to gravity drain the leachate from the landfill. A 12-inch thick layer of operational cover is over the geomembrane liner and leachate collection and removal system.

Leachate and stormwater are conveyed by pipe to the Marshall Ash Basin, which discharges in accordance with the MSS plant's National Pollutant Discharge Elimination System (NPDES) permit.

2.3 Leachate Collection System (LCS)

The leachate collection system consists of a geonet/geotextile with a perforated collection/header piping system that drains by gravity into a pipe at the previous location of the stormwater storage basin riser. The leachate is then directed by gravity flow to the Marshall Ash Basin.

Two chimney drains with a header pipe are designed through the center of the landfill and are connected to the sump. The landfill grading will be sloped toward each chimney drain to facilitate drainage of contact storm water through the landfill. As each lift of waste is filled, a section of chimney drain will be added until final landfill grades are achieved. The chimney drain will have an inverted filter with No. 57 stone, No. 78M stone, and C-33 sand or bottom ash. The inverted filter will reduce the clogging potential of the chimney drain. The chimney drain design and details are presented in the Phasing Diagrams.

2.3.1 LCS Maintenance

The maintenance of the leachate management system's physical facilities (consisting of high-density polyethylene (HDPE) piping) and records will be performed by or under the direct supervision of Duke. Visual observations of the LCS system performance will be made monthly by Duke staff to verify that the LCS is performing properly.

Clean-out pipes will be located on the LCS leachate pipes and header pipes. LCS pipes will be cleaned out by the use of a clean-out snake or high-pressure water flushing at least once a year, and the LCS piping will be remote-camera monitored at least once every 5 years. The frequency of clean-out and camera inspections may be modified based on consecutive inspection results and observed operating conditions.

2.3.2 LCS Record Keeping and Sampling

Records will be maintained documenting the leachate line cleanout and camera monitoring. Untreated leachate shall be sampled and analyzed at least semi-annually concurrent with the groundwater water sampling. A grab sample will be obtained from the outlet of each leachate pipe. The leachate must be analyzed for the same constituents as the groundwater monitoring wells in the approved Water Quality Monitoring Plan. The results must be submitted to NCDEQ Solid Waste with groundwater results.

2.3.3 Contingency Plan

In the unlikely event that leachate cannot be drained to the Marshall Ash Basin, leachate will be temporarily stored within the landfill until such time that draining operations to the active ash basin can be restored. In such an event, the Division shall be notified in writing, within 30 days, about the events and corrective actions taken.

2.4 Stormwater Collection and Conveyance

Stormwater that does not come in contact with waste will be treated as non-contact water. Non-contact water will be managed separately from contact water and may be used for dust control or other operational purposes. The stormwater collection system has been designed to pass the 25-year, 24-hour storm event, and generally consists of the following components:

- Diversion Berms
- Subsurface drains
- Slope drains
- Perimeter ditches

Intermediate cover will be placed over waste at the exterior side slopes. Diversion berms will be placed to convey non-contact surface water from the exterior side slopes to slope drains. The diversion berms and slope drains will be constructed and extended as operations progress. The slope drains discharge to perimeter ditches, which in turn ultimately discharge to the Marshall Ash Basin via a system of culverts and channels.

Stormwater collection and conveyance measures will be checked regularly and maintained such that necessary repairs can be made as early as practical.

2.4.1 Stormwater Discharge

The stormwater system at the landfill was designed to assist in prevention of the discharge of pollutants. Landfill operation shall not cause a discharge of pollutants into waters of the United States, including wetlands, that violates any requirement of the Clean Water Act, including but not limited to NPDES requirements, pursuant of Section 402. In addition, under the requirements of Section 404 of the Clean Water Act, the discharge of dredge or fill material into waters of the state would be a violation of the requirements and shall not be allowed by landfill operations.

Operations of the landfill shall not cause the discharge of a non-point source of pollution to waters of the United States, including wetlands, that violates any requirements of an area-wide or statewide water quality management plan that has been approved under Section 208 or 319 of the Clean Water Act, as amended.

A jurisdictional wetland and stream are located to the west of the landfill. Maintenance of the stormwater system shall be performed to ensure these areas are not impacted by stormwater or sediment.

2.5 Landfill Gas Management

Because the nature of the waste to be placed in the Marshall FGD Landfill, the Owner does not anticipate that methane or hydrogen sulfide will be generated or that odor will be an issue during operations. Therefore, landfill gas monitoring and management is not proposed.

3 Erosion and Sediment Control

Erosion and sediment control (E&SC) during landfill operations will consist of monitoring and repairing E&SC stormwater conveyance features and surface erosion as defined in this Operations Plan and the E&SC measures included on Drawing No. MM6451.00-0005.001 (Cell 1 Final Configuration) and Drawing No. MM6451.01-0004.001 (Gypsum Landfill Erosion Control Details), both dated August 19, 2011.

3.1 E&SC Measures Monitoring and Maintenance

Erosion control principles include:

- Disturbing as little area as possible at any one time for landfilling operations

- Seeding/mulching of disturbed areas commencing as soon as practically possible. Employing erosion control matting or seeding and mulch on steep slopes and other erosion prone areas
- Use of earthen berms, hay bales, wattles, silt fences, riprap, or equivalent devices down gradient of disturbed areas, stockpiles, drainage pipe inlets and outlets, and at intervals along grassed waterways, until such time as permanent vegetation is established
- Placement of riprap at the inlets and outlets of stormwater piping

Erosion and sedimentation control structures include stormwater best management practice (BMP) systems, settling basins, and channels. Stormwater BMP's shall be inspected every 7 days and within 24 hours of rainfall events 0.5 inches or greater. Sediment shall be removed from each structure when sediment accumulates to one half of the design depth. Sediment removal shall bring BMP's to their original design depth. The BMP's, embankments, spillways and outlets shall also be observed for erosion damage. Necessary repairs shall be made immediately. Trash or debris within the riser structures or outfalls shall be removed.

Channels shall be observed for damage every 7 days and within 24 hours of rainfall events 0.5 inches or greater. Riprap-lined channels and outlet protection aprons used to prevent damage to channel vegetation shall be observed for washouts. Riprap shall be added to those areas, as needed, to maintain the integrity of the structure.

Embankment slopes shall be inspected for erosion every 7 days and within 24 hours of rainfall events 0.5 inches or greater. The embankment slopes shall be mowed at least three times a year. The embankment slopes shall be fertilized in the second year unless vegetation growth is fully adequate. Damaged areas shall be reseeded, fertilized and mulched immediately. Seeding, fertilizing, and mulching shall be in accordance with the North Carolina Erosion and Sedimentation Control Guidelines and in accordance with the active Erosion and Sediment Control Plan, furnished in the Engineering Plan drawings.

Ground stabilization shall be performed within 7 calendar days on perimeter areas and slopes greater than 3H:1V. Ground stabilization shall be performed within 14 calendar days in other areas. Seedbed preparation, seeding, soil amendments, and mulching for the establishment of vegetative ground cover will be applied in accordance with North Carolina Erosion and Sedimentation Control Guidelines.

3.2 Surface Erosion Monitoring

Adequate erosion control measures shall be practiced to prevent sediment from leaving the site. Channels will be observed once every seven days and within 24 hours after any rainfall event of 0.5 inches or greater.

Slopes will be periodically checked for erosion and vegetative quality, fertilized, and mowed. A slope or portion thereof shall be identified as needing maintenance if it meets one of the following conditions:

- Exposed waste on exterior slopes
- Areas of cracking, sliding, or sloughing
- Areas of seepage

Slopes identified as needing maintenance shall be repaired as soon as practical and as appropriate to correct deficiencies. Repair activities may include re-dressing the slope, filling in low areas, and/or seeding.

4 Vegetation Management

Within six months after final termination of disposal operations at the site, the area shall be stabilized with vegetation as required by the Closure and Post-Closure Plan, included in Appendix III. Temporary seeding will be applied as required.

Temporary methods of erosion control may be required until vegetation is established. Mulching, until a vegetative cover is established, can stabilize areas where final grade has been reached. Soil mulching can be achieved using wood chips, straw, hay, asphalt emulsion, jute matting, and synthetic fibers. Mulches allow for greater water retention; reduce the amount of runoff; retain seeds, fertilizer, and lime in place; and improve soil moisture and temperature conditions.

4.1 Temporary Seeding

Temporary seeding will be applied as follows or as required by the site's vegetation management plan:

SUMMER (May – August)

Seeds	Pounds Per Acre
German Millet	50

FALL, WINTER, (September – December)

Seeds	Pounds Per Acre
Rye (grain)	125

SPRING (January - April)

Seeds	Pounds Per Acre
Annual Rye	50
Rye (Grain)	125

4.2 Permanent Seeding

Permanent Seeding will be applied as follows or as required by the site's vegetation management plan:

Warm Season Planting (May – Aug)

Nurse Crop Seed	Pounds Per Acre
German Millet	50

SPRING (January - April)

Seeds	Pounds Per Acre
Kentucky 31 Tall Fescue	150
Rye (Grain)	50

Soil Amendments	Application Rate
Agricultural limestone	Per soil test **or** 1 ton/ac
Fertilizer (10-10-10)	Per soil test **or** 1000 lbs/ac
Mulch	2 tons/ac

Note: Perform soil test to determine proper soil amendments; if not available, use the quantities above, and are applicable year round

4.3 Over-Seeding

Over-seeding will be applied as follows:

SUMMER (May – August)

Seeds	Pounds Per Acre
German Millet	25

FALL, WINTER, (September – December)

Seeds	Pounds Per Acre
Kentucky 31 Tall Fescue	50
Rye (Grain)	25

SPRING (January - April)

Seeds	Pounds Per Acre
Kentucky 31 Tall Fescue	50
Rye (Grain)	25

Note: Cut the existing turf to be over-seeded to an approximate 1-inch height. Aerate the soil and turf area to be over-seeded. Apply soil amendments pursuant to nutrient testing results.

5 Landfill Closure

The Marshall FGD Landfill will be closed in accordance with the design drawings and Closure and Post-Closure Plan. The Closure and Post-Closure Plan outlines the sequence for closing the landfill and the post-closure maintenance activities. Closure is designed to minimize the need for long-term maintenance and control the post-closure release of contaminants. Closure activities may be revised as appropriate for materials, specifications, technology advancements, or changes in regulations at the time the landfill is closed or in post-closure. In general, the landfill development is designed so that final cover can be established as soon as practical.

6 Required Regulatory Submittals

Table 3 – Required Regulatory Submittals

Submittal	Requirement	Reporting/Action Frequency
Groundwater Monitoring Reports	Maintain a record of all monitoring events and analytical data in accordance with the Water Quality Monitoring Plan. Reports of the analytical data for each water quality monitoring sampling event shall be submitted to DEQ Division of Waste Management (DWM) within 120 days of sampling event.	Semiannually
Annual Tonnage Reports	Tons of waste received and disposed of in the landfill shall be reported to the DWM and to all counties from which waste was accepted on forms prescribed by the DWM. Refer to the Permit to Operate for annual reporting requirement information.	Annually Must be submitted no later than August 1 each year
10-Year Waste Management Plan	Per North Carolina G.S. 130A-309.09D (c): ► A 10-year waste management plan shall be developed for this landfill and submitted to DWM. ► The plan shall be updated and submitted to DWM at least every three years. ► A report on the implementation of the plan is required to be submitted to DWM by August 1 of each year.	10-year plan prepared every 10 years 10-year plan updated every 3 years Implementation report annually

FIGURES

EXISTING CONTOURS BETWEEN APPROXIMATE BOUNDARY SEE REF. 2

EXISTING CONTOURS OUTSIDE OF APPROXIMATE BOUNDARY SEE REF. 1

LEGEND

EXISTING MAJOR CONTOUR (10')

EXISTING MINOR CONTOUR (2')

100 0 100 200 FT

REFERENCES:

1. EXISTING TOPOGRAPHIC INFORMATION WAS PRODUCED FROM PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY OBTAINED ON APRIL 4, 2014 BY WSP GROUP.
2. EXISTING TOPOGRAPHIC INFORMATION WAS PRODUCED FROM PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY OBTAINED ON MAY 7, 2016 BY WSP GROUP. HATCHED AREAS ARE OBSCURED AS REPORTED BY SURVEYOR.

REV	DATE	JOB NO.	PROJECT TYPE	DES	DFTR	CHKD	ENGR	APPD	DESCRIPTION
1	8/10/2016	7810160654		RFK	RFK	MAS	MAS	MAS	UPDATED WITH 2016 TOPOGRAPHIC SURVEY
0	5/19/2016	7810160654		RFK	RFK	MAS	MAS	MAS	FOR PERMIT AMENDMENT

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FAX: (704) 357-8638
LICENSURE:
NC ENG: F-1253
NC GEOLOGY: C-247

amec foster wheeler

SEAL

NOT FOR CONSTRUCTION

TITLE

EXISTING CONDITIONS
LANDFILL OPERATIONS PLAN

FGD RESIDUE LANDFILL

MARSHALL STEAM STATION
TERRELL, CATAWBA COUNTY, NORTH CAROLINA

FOR

ISSUED FOR PERMIT AMENDMENT

DUKE ENERGY®

SCALE: AS SHOWN	DES: RFK
DWG TYPE: DWG	DFTR: RFK
JOB NO: 7810160654	CHKD: MAS
DATE: 04/20/2016	ENGR: MAS
FILENAME: FGD.dwg	APPD: MAS

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"x34"	FIGURE 1	1

001 REV. 1

INCHES 1 2 3 TENTHS 10 20 30

Plotted By:King, Robert Sheet Set:New Sheet Set (3) Layout:.001 cover sheet August 10, 2016 02:10:53pm Q:\Duke\Marshall\7810160654_Marshall_FGD Permit Renewal\Work\FGD.dwg

APPENDIX I

Dust Control Plan

Dust Control Plan

Marshall Flue Gas Desulfurization Residue Landfill (Permit No. 1809-INDUS)

Duke Energy Carolinas– Marshall Steam Station

Terrell, Catawba County, North Carolina

Amec Foster Wheeler Project No. 7810160654

Prepared For:	Duke Energy Carolinas, LLC 526 S. Church St. Charlotte, NC 28202
Date	August 10, 2016
Prepared By:	Amec Foster Wheeler 2801 Yorkmont Rd., Charlotte, NC 28208

Table of Contents

List of Figures

List of Attachments

1 Introduction and Site Description

This Dust Control Plan is for the Marshall FGD Landfill at Duke Energy's Marshall Steam Station. This Plan outlines dust control methods for managing dust emissions at the landfill. The Plan also establishes a monitoring program and corrective action responses to contain coal combustion residuals (CCR) on site and to prevent dust nuisances to employees and the public. The monitoring program will aid Duke Energy and the landfill operator in evaluating the dust control methods, or combination of dust control methods, that prove effective with site specific conditions.

The Marshall FGD Landfill is principally used for CCR management. CCR managed by the landfill primarily consist of FGD residue (i.e., gypsum, clarifier sludge), fly ash, bottom ash, and mill rejects. The landfill is also used for asbestos and construction and demolition debris (C&D) waste management.

This Plan is included as an Appendix to the Landfill Operations Plan. Please refer to the Operations Plan for a description of revisions as necessary.

2 Dust Control Methods

The primary potential source of dust emissions from the landfill is the active area of waste placement. This area is at a higher risk for producing dust due to exposed ash surfaces, vehicular and equipment traffic and earthworks such as dumping and spreading ash. Exterior landfill slopes are less of a dust control concern, as they have intermediate or operational soil cover which is vegetated as required in the Operations Plan.

Dust emissions from the landfill can be controlled through a variety of dust control methods. Possible dust control methods are identified herein. Dust control methods may be characterized as products and/or applications, structural wind breaks and/or covers, and operational methods.

Dust control methods for the landfill area include:

- Watering;
- Establishing vegetative cover;
- Mulching;
- Structural controls consisting of:
  - Wind breaks (i.e. fencing and/or berms); and
  - Temporary coverings (i.e. tarps);
- Spray applied dust suppressants consisting of, and not limited to:
  - Anionic asphalt emulsion;
  - Latex emulsion;
  - Resin in water;
  - Polymer based emulsion; and
  - Mineral mortar coatings (i.e. posi-shell);
- Calcium chloride;
- Soil stabilizers (e.g. soil cement);
- Operational soil cover;
- Modifying the active working area; and
- Modifying operations during dry and windy conditions.

The operator may use, and is not limited to, combinations of these dust control methods or any method that is technically sound to control dust for specific site conditions. If the operator intends to use a dust control method not presented above, the proposed dust control method will be evaluated on a case by case basis to assess the effectiveness with specific site conditions. For the purposes of this Plan, operational soil cover will be defined as soil material applied at a suitable thickness to result in dust control. The effectiveness of the dust control methods implemented should be evaluated through a dust monitoring program outlined in Section 3.

Operational equipment may consist of dump trucks, vibratory smooth drum rollers, sheepsfoot compactors, bulldozers, water trucks, spray trailers, track hoes, and service trucks. Operational equipment will be used to construct, install, apply, and/or repair dust control methods. The operator will make provisions to alleviate any on-site issues that arise when primary equipment is being maintained or is inoperable. In the event that the landfill site contains multiple facilities in the future, the landfill operator will make provisions to have the necessary equipment to control multiple fugitive CCR dust emission events.

3 Monitoring and Corrective Action Response

This section describes the dust monitoring program and suggests corrective action responses should fugitive emissions be observed.

3.1 Monitoring

During landfill operations, a dust monitoring program will be implemented to evaluate the performance of dust control measures. The dust monitoring program will consist of performing visual observations of dust prone areas, dust control measures, and monitoring existing and forecasted weather conditions.

Dust emissions can occur under many conditions. For the purposes of this Plan, dust emissions are characterized as fugitive emissions, where CCR dust may be transported outside the limit of landfill waste. This is most likely to occur during windy, dry, and hot weather conditions. Therefore, the operator will monitor both existing and forecasted weather conditions and use dust control measures accordingly. The dust control measures shall be implemented prior to the forecasted weather conditions.

Equipment operators shall continuously observe the active face and other areas within the landfill limit for dust emissions. In addition, preventative dust control measures should be observed and documented at least twice daily (morning and afternoon) when the landfill is in operation, to evaluate the dust control measure performance. Observations will be recorded using a form such as the one furnished in Appendix I. Additional observations may be necessary as site and weather conditions dictate.

Observations will be documented on the attached "*Monitoring Worksheet*," or online database/worksheet, etc. Due to the frequent maintenance necessary on exposed ash areas (i.e., moisture conditioning or spray-application of dust suppressants), the operator shall pay particular attention to these areas. Structural controls shall be observed to monitor that they are achieving their intended purpose. Observations in the landfill area may be made with reference to the Operations Grid system shown in the attached Figure 1.

Monitoring will be conducted during times when the landfill is in operation. The operator shall continue to deliver necessary dust control measures during periods when operations are inactive (i.e. outages, weekends, and holidays). Operators are to establish appropriate measures so that dust emissions are not reasonably likely to occur during inactive operation periods when monitoring is not being conducted.

3.2 Corrective Action Response

If fugitive dust emissions are observed and observations indicate dust control measures are not achieving their intended purpose, then appropriate corrective actions will be taken. Dust control measures should be reapplied, repaired, or added, as necessary, to control dust emissions. The operator will construct, install, apply, and/or repair dust control measures prior to the end of the work day to control dust emissions during non-operating hours. The operator will implement dust control measures as preventative controls rather than in response to fugitive dust emissions.

FIGURES

001 REV. 1

EXISTING CONTOURS OUTSIDE OF APPROXIMATE BOUNDARY SEE REF. 1

EXISTING CONTOURS BETWEEN APPROXIMATE BOUNDARY SEE REF. 2

LEGEND

EXISTING MAJOR CONTOUR (10')

EXISTING MINOR CONTOUR (2')

REFERENCES:

1. EXISTING TOPOGRAPHIC INFORMATION WAS PRODUCED FROM PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY OBTAINED ON APRIL 4, 2014 BY WSP GROUP.
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REV	DATE	JOB NO.	PROJECT TYPE	DES	DFTR	CHKD	ENGR	APPD	DESCRIPTION
1	8/10/2016	7810160654		RFK	RFK	MAS	MAS	MAS	UPDATED WITH 2016 TOPOGRAPHIC SURVEY
0	5/19/2016	7810160654		RFK	RFK	MAS	MAS	MAS	FOR PERMIT AMENDMENT

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NC ENG: F-1253
NC GEOLOGY: C-247

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SEAL

NOT FOR CONSTRUCTION

TITLE

LANDFILL OPERATIONS GRID DUST CONTROL PLAN

FGD RESIDUE LANDFILL

MARSHALL STEAM STATION
TERRELL, CATAWBA COUNTY, NORTH CAROLINA

FOR

ISSUED FOR PERMIT AMENDMENT

DUKE ENERGY®

SCALE: AS SHOWN	DES: RFK
DWG TYPE: DWG	DFTR: RFK
JOB NO: 7810160654	CHKD: MAS
DATE: 04/20/2016	ENGR: MAS
FILENAME: Dust Control Grid.dwg	APPD: MAS

DWG SIZE	DRAWING NO.	REVISION
ANSI D 22"x34"	FIGURE 1	1

ATTACHMENT I

Dust Monitoring Form

FGD Residue Landfill
Permit No. 1809-INDUS

Dust Control Monitoring Form

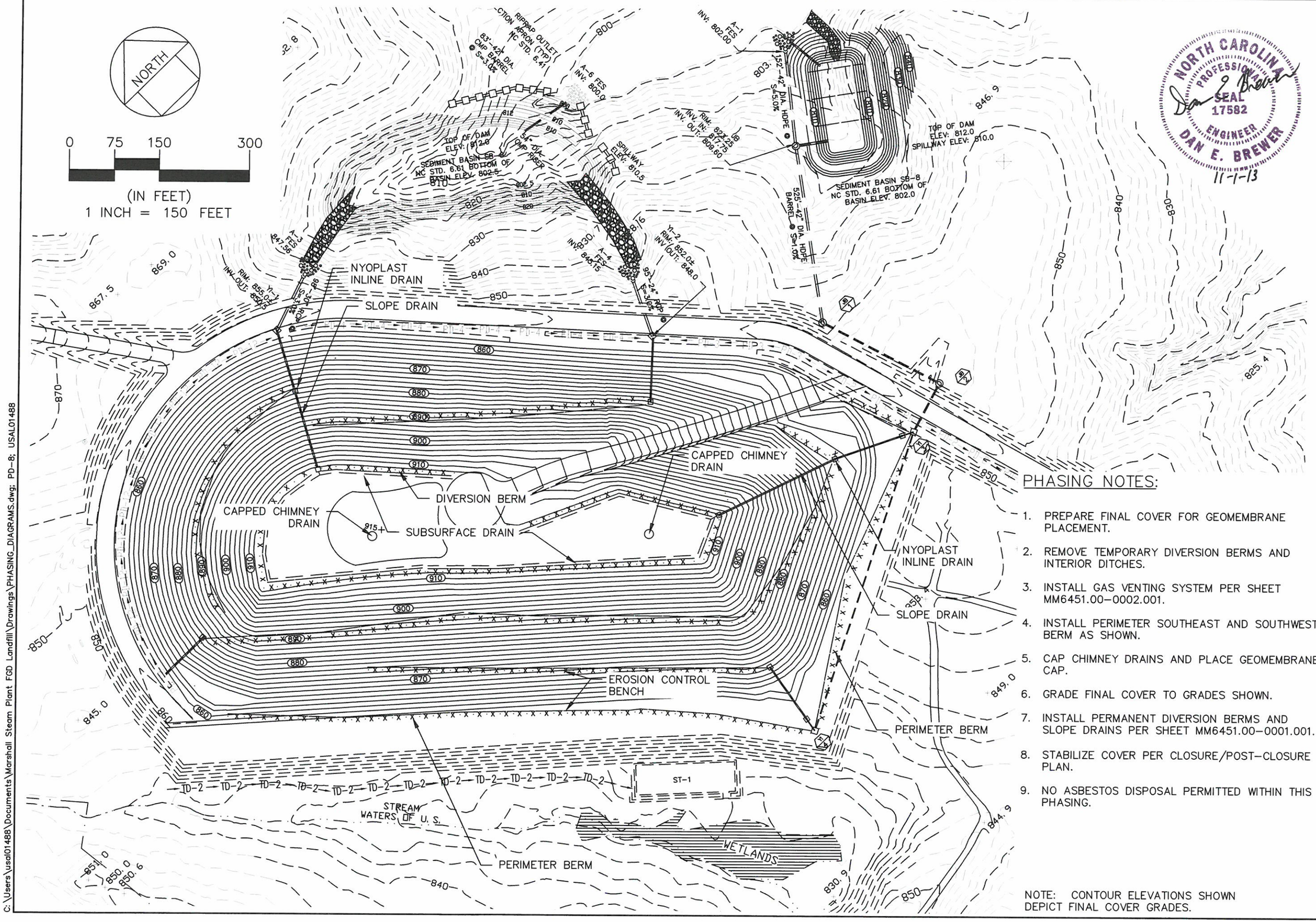
Marshall Steam Station
Terrell, North Carolina

Week:

Date/Time	Dust Control Method in Use	Effective Yes/No	Observation Location	Preventative or Corrective Action Taken Yes/No	Observations/comments including: weather conditions, wind speeds, precipitation, forecase, preventative or corretive actions taken (if needed), additional operational notes	Name of Observer

APPENDIX II

Engineering Drawings
(Included are PD-8 and PD-9, others by reference only)



PHASING NOTES:

1. PREPARE FINAL COVER FOR GEOMEMBRANE PLACEMENT.
2. REMOVE TEMPORARY DIVERSION BERMS AND INTERIOR DITCHES.
3. INSTALL GAS VENTING SYSTEM PER SHEET MM6451.00-0002.001.
4. INSTALL PERIMETER SOUTHEAST AND SOUTHWEST BERM AS SHOWN.
5. CAP CHIMNEY DRAINS AND PLACE GEOMEMBRANE CAP.
6. GRADE FINAL COVER TO GRADES SHOWN.
7. INSTALL PERMANENT DIVERSION BERMS AND SLOPE DRAINS PER SHEET MM6451.00-0001.001.
8. STABILIZE COVER PER CLOSURE/POST-CLOSURE PLAN.
9. NO ASBESTOS DISPOSAL PERMITTED WITHIN THIS PHASING.

NOTE: CONTOUR ELEVATIONS SHOWN DEPICT FINAL COVER GRADES.

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Mooresville, NC 28117
(704) 662-0100
www.wspgroup.com/usa

MARSHALL STEAM STATION FGD RESIDUE LANDFILL

CATAWBA COUNTY, NC PERMIT NO. 18-09

DUKE ENERGY CAROLINAS, LLC
526 SOUTH CHURCH STREET
CHARLOTTE, NC, 28202

REVISIONS		
10.30.13	ADDED CHIMNEY DRAINS	
10.9.12	MOVED ACCESS ROAD	
4.6.12	UPDATED PER DUKE COMMENTS	
3.21.12	ADDED SLOPE DRAIN NW NEAR ACCESS ROAD	
3.9.12	REVISED PER DUKE COMMENTS	
2.29.12	REVISED ASBESTOS AREA	
2.3.12	ADDED ASBESTOS AREA	

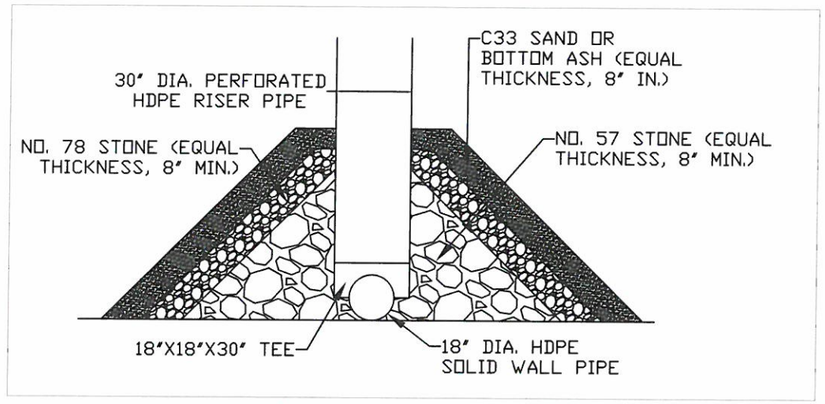
PROJECT #: 10-6014 DATE: 8-12-11

DRAWN BY: JAC CHECKED BY: DEB

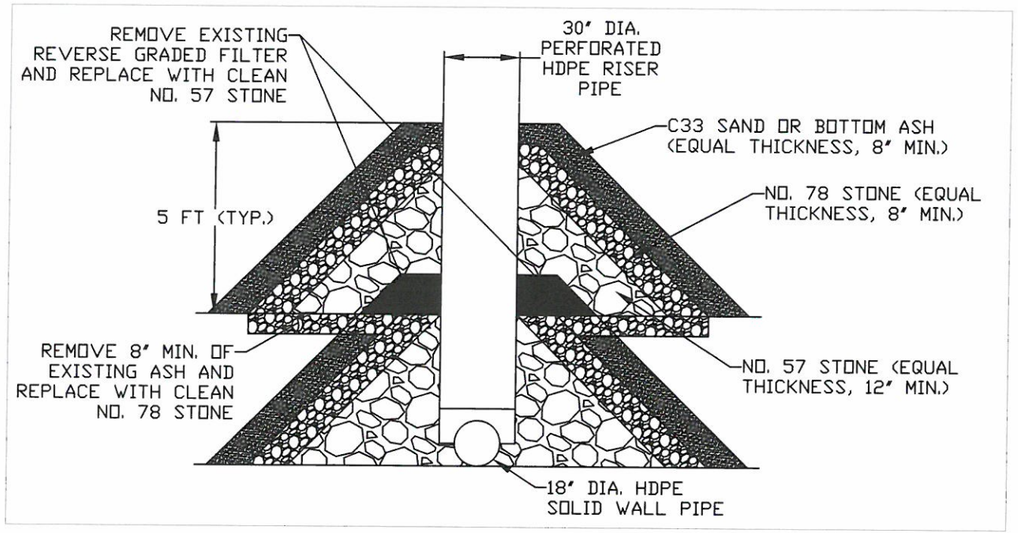
TITLE
CELL 1
FINAL CLOSURE

SHEET
PD-8

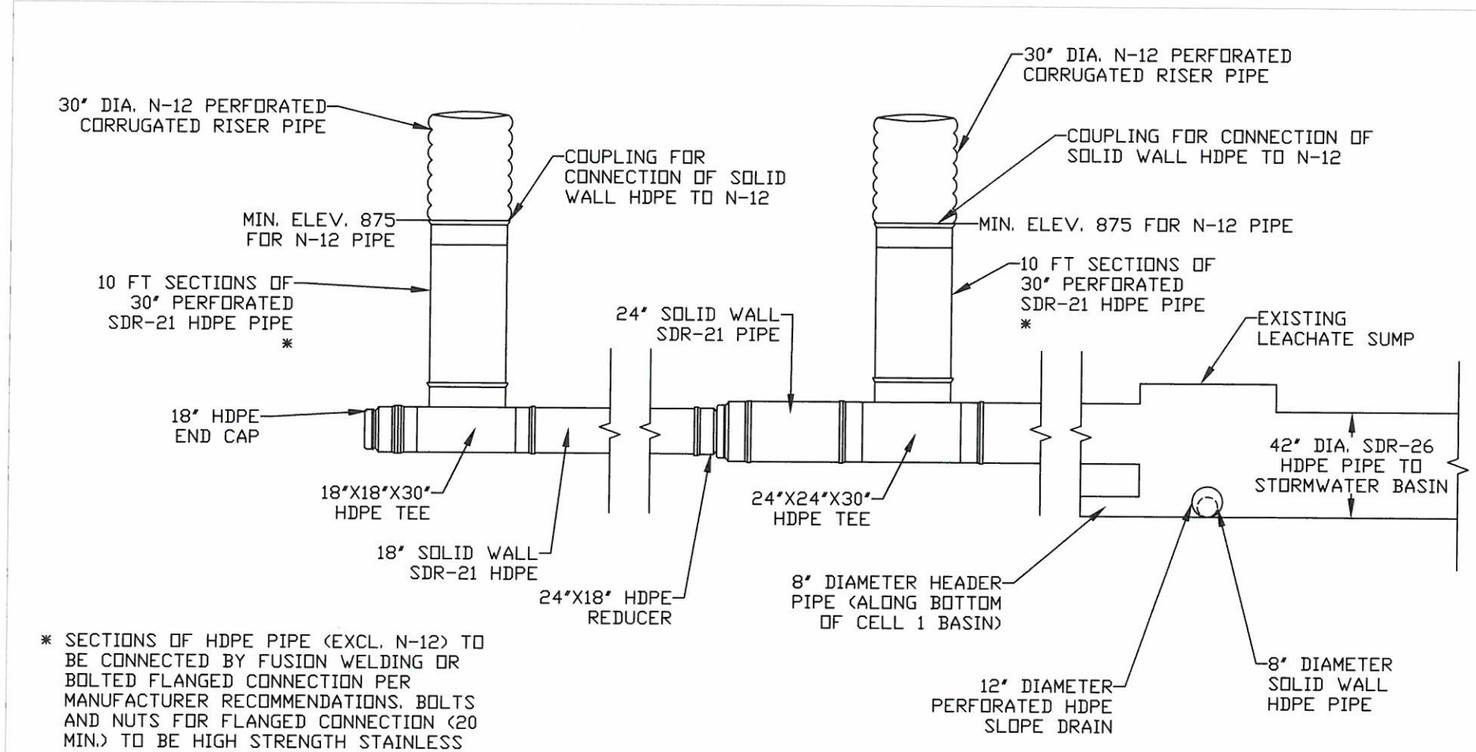
C:\Users\usal01488\Documents\Marshall Steam Plant FGD Landfill\Drawings\PHASING_DIAGRAMS.dwg; PD-8; USAL01488



CHIMNEY DRAIN DETAIL – FIRST LIFT
NTS



CHIMNEY DRAIN DETAIL – REMAINING LIFTS
NTS



* SECTIONS OF HDPE PIPE (EXCL. N-12) TO BE CONNECTED BY FUSION WELDING OR BOLTED FLANGED CONNECTION PER MANUFACTURER RECOMMENDATIONS. BOLTS AND NUTS FOR FLANGED CONNECTION (20 MIN.) TO BE HIGH STRENGTH STAINLESS STEEL 1.25" DIA. BOLTS AND NUTS.

NOTE: IF FLANGED CONNECTIONS ARE TO BE USED, PIPE SECTIONS MUST BE SUPPLIED WITH HDPE FLANGE PRE-WELDED TO PIPE ENDS.

CHIMNEY DRAIN CONNECTIONS DETAIL
NTS

NORTH CAROLINA PROFESSIONAL SEAL 17582 ENGINEER DAN E. BREWER
11-1-13

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MARSHALL STEAM STATION FGD RESIDUE LANDFILL

CATAWBA COUNTY, NC PERMIT NO. 18-09

DUKE ENERGY CAROLINAS, LLC
526 SOUTH CHURCH STREET
CHARLOTTE, NC, 28202

REVISIONS

10.30.13	ADDED CHIMNEY DRAIN DETAILS	

PROJECT #: 10-8014 DATE: 10-30-13

DRAWN BY: ALL CHECKED BY: DEB

TITLE
CHIMNEY DRAIN DETAILS

SHEET
PD-9

APPENDIX III

Closure/Post-Closure Plan

Closure and Post-Closure Plan

Marshall Flue Gas Desulfurization Residue Landfill (Permit No. 1809-INDUS)

Duke Energy Carolinas– Marshall Steam Station

Terrell, Catawba County, North Carolina

Amec Foster Wheeler Project No. 7810160654

Prepared For:	Duke Energy Carolinas, LLC 526 S. Church St. Charlotte, NC 28202
Date	May 19, 2016
Prepared By:	Amec Foster Wheeler 2801 Yorkmont Rd., Suite 100, Charlotte, NC 28208

Table of Contents

List of Figures

List of Appendices

1 Introduction

This Closure and Post-Closure (Closure/Post-Closure) Plan is being submitted as part of the Landfill Operations Plan and was prepared for the Marshall FGD Landfill in accordance with Title 15A Subchapter 13B of the North Carolina Administrative Code (NCAC) to meet the requirements of .0503(2), .0504(2), and .0505 for industrial landfills. The information contained in this plan will be used to assist Duke Energy Carolinas (Duke) in the closure of the landfill and the maintenance and monitoring required during the post-closure care period.

1.1 Project Information

The Marshall FGD Landfill consists of Phase1, Cell 1 approximately 17.9 acres of lined area. The general location of the Marshall FGD Landfill is shown on Figure 1.

2 Closure Plan

The landfill cover system has been designed to reduce infiltration into the landfill and to resist erosion. The proposed landfill cover system components, size, and closure schedule are described in the following sections of this report.

2.1 Description of Cover System

The proposed cover system will consist of the following components, from top to bottom:

- 6-inch thick vegetative soil cover;
- 18-inch thick final cover soil;
- Geocomposite drainage layer;
- 40-mil thick double-sided textured linear low density polyethylene (LLDPE) geomembrane; and
- Intermediate soil cover layer (no minimum thickness).

2.1.1 Vegetative Soil Cover

The vegetative soil layer will consist of 6 inches of soil materials capable of sustaining vegetation, which will promote the integrity of the cover system by resisting erosion.

2.1.2 Final Cover Soil

The final cover soil layer will consist of 18 inches of soil materials. The final cover soil layer will protect the geosynthetic components of the cover system from exposure.

2.1.3 Geocomposite Drainage Layer

A geocomposite drainage layer will be located beneath the final cover soil layer. The geocomposite will promote veneer stability and reduce infiltration through the closed landfill by conveying infiltration to regularly spaced geocomposite outlets.

2.1.4 Geomembrane

A 40-mil thick double-sided textured LLDPE geomembrane barrier will be installed between the geocomposite drainage layer and the interim cover to minimize infiltration through the closed landfill. The geomembrane will have texturing on both sides to improve veneer stability.

2.1.5 Intermediate Cover

A 12-inch thick intermediate soil cover will be placed during landfill operations prior to cover system construction. At the time of final closure, there is no minimum thickness of intermediate cover required.

2.2 Gas Management System

The majority of waste disposed in the Marshall FGD Landfill will consist CCR materials consisting of fly ash and bottom ash. Based on the nature of CCR materials and our experience, it is not anticipated that landfill gases such as methane or hydrogen sulfide gas will be generated or that nuisance odors will be an issue. Therefore, Duke does not propose monitoring for landfill gas or landfill gas management measures.

2.3 Stormwater Management System

The proposed Marshall FGD Landfill is designed with stormwater conveyances to manage runoff for active landfill operations, interim closure, and final closure conditions. Upon final closure, stormwater will be collected by diversion berms and conveyed to a series of slope drains which will discharge to the perimeter channel system. Plans and details illustrating the stormwater management system are illustrated in the Engineering Plan drawings.

2.4 Largest Area Requiring Cover System

The proposed Marshall FGD Landfill will be operated until closure. The largest area requiring cover system construction is the entire footprint of the proposed landfill which is approximately 17.9 acres in plan area.

2.5 Estimated Maximum Waste Inventory

The proposed landfill design yields approximately 1,170,000 cubic yards of gross capacity as measured from the top of the protective cover soil to the top of final cover.

2.6 Closure Schedule

Following the completion of waste placement, a final cover system will be constructed. The primary purpose of a final cover system is to minimize infiltration into the waste. The proposed final cover system cross section is presented in the Engineering Plan Drawings.

Final closure of the landfill will commence when final design grades are achieved, Duke declares that no more waste will be accepted, or as directed by the North Carolina Department of Environmental Quality (NCDEQ) Division of Waste Management – Solid Waste Section (the Division). Duke may elect to close the landfill incrementally during landfill operations once an area large enough to warrant cover system construction has reached final grades. Prior to beginning closure of the proposed landfill, the Owner or Operator shall notify the Division that a notice of intent to close the landfill has been placed in the operating record.

Closure activities for the landfill shall begin no later than 30 days after final receipt of waste unless otherwise approved by the Division or, if the landfill has remaining capacity and there is a reasonable likelihood that the landfill will receive additional wastes, no later than one year after the most recent receipt of wastes. Extensions beyond the one-year deadline for beginning closure may be granted by the Division if the Owner or Operator demonstrates that the landfill has the capacity to receive additional wastes and the Owner or Operator has taken and will continue to take the steps necessary to prevent threats to human health and the environment from the unclosed landfill.

The final cover system will be finished within 180 days following the beginning of closure activities unless otherwise approved by the Division. Extensions of the closure period may be granted by the Division if the Owner or Operator demonstrates that closure will, of necessity, take longer than 180 days and they have taken and will continue to take the necessary steps to prevent threats to human health and the environment from the unclosed landfill unit. The final cover system for the closed phase will be certified by a professional engineer as being completed. Duke Energy shall record a notation on the deed to the landfill property stating that the property has been used as a landfill and its use is restricted under the Closure/Post-Closure Plan approved by the Division. The Division will be notified by Duke Energy of the closure completion, certification, deed notation, and placement of these records into the landfill's operating record.

Following cover system construction, the landfill will be vegetated with grass and maintained. If the landfill must be closed prior to reaching the final contours, the surface of the landfill will be sloped to a minimum grade of 5 percent and maximum grade of 33.33 percent (3H:1V). A final cover will be established over the landfill unit being closed. The maximum waste-filled area of the proposed landfill that would require closure operations at any one time is approximately 17.9 acres in plan area, which is the entire footprint of the proposed Marshall FGD Landfill.

3 Post-Closure Plan

The Post-Closure Plan outlines the monitoring and maintenance activities intended to maintain cover system integrity during the post-closure care period. Consistent with the requirements of MSW landfill rules, the proposed post-closure period is 30 years. During the post-closure period, the landfill cover system and related facilities must be monitored and maintained.

3.1 Maintenance Activities

Maintenance activities will be conducted as soon as practical to address items of concern identified during monitoring events. Mowing will occur at a minimum once per year, other maintenance activities will be performed as needed and are anticipated to include the following:

- Filling in animal burrows and re-locating the animal;
- Localized placement of fill to prevent ponding of water caused by differential settlement;
- Removal of trees or brushy vegetation within the cover system limits;
- Application of seed and soil amendments to maintain a healthy vegetative cover; and
- Repair of stormwater conveyance measures.

Any disturbed areas will be seeded and soil amendments applied as necessary to establish a healthy vegetative cover.

3.2 Inspection Activities

Post-closure inspection events will be conducted quarterly for the first two years and semi-annually thereafter during the post-closure care period. Post-closure inspections will include a review of the following:

- The condition of site security features such as gates and/or fencing;
- Evidence of erosion, settlement, and/or animal burrows within the cover system;
- Type and quality of vegetation within the cover system;
- Evidence of erosion and integrity of stormwater conveyance features; and
- Integrity of the leachate collection and removal system (LCRS).

The inspection events will be documented. The form included in Appendix I may be used. Completed post-closure inspection forms will be maintained in the facility operating record.

3.2.1 Groundwater and Surface Water Monitoring

Groundwater and surface water monitoring requirements are described in the Water Quality Monitoring Plan dated May 2016.

3.3 Facility Contact Information

Duke will be responsible for post-closure inspections, maintenance and monitoring. Correspondence regarding the Marshall FGD Landfill should be directed to:

Duke Energy Carolinas, LLC
Marshall Steam Station
8320 East NC Hwy 150
Terrell, North Carolina 28682
(828) 478-7622
System Owner for Landfill Operations

The physical address of the Marshall FGD Landfill is the same as above.

3.4 Anticipated Post-Closure Use

The Marshall FGD Landfill will be vegetated following closure. Site access to the public will remain restricted throughout landfill closure and the post-closure care period. There are no current anticipated post-closure uses for the Marshall FGD Landfill. Duke Energy will obtain approval from NCDEQ if a proposed post-closure use is identified.

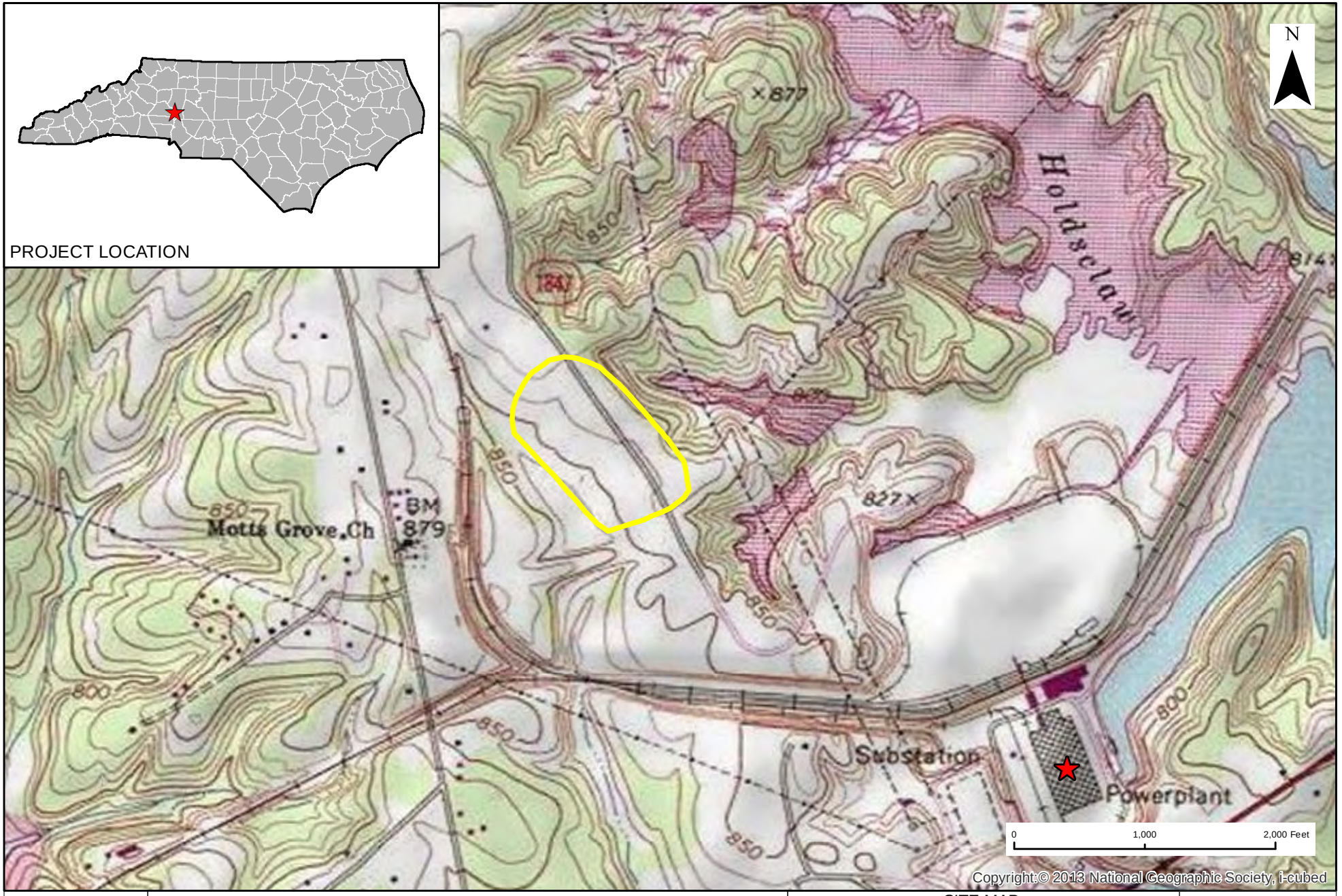
3.5 Cost Estimate for Closure and Post-Closure Activities

Preliminary cost estimates for landfill closure and for post-closure care activities are presented in Appendix II. In accordance with North Carolina Solid Waste Management Rules, Duke Energy Carolinas provides financial assurance in the form of the Corporate Financial Test. Cost estimates for financial assurance will be updated annually to incorporate changes to unit costs and changes in closed landfill area.

3.6 Certification

Consistent with regulations, the end of the closure/post-closure care period must be certified by a registered professional engineer. To accomplish certification over the required 30-year duration, a registered professional engineer will prepare annual certifications. The annual certifications will document that the cover system has been monitored and maintained in accordance with the Post-Closure Plan. The annual certifications shall be based on observations and results documented on regular post-closure monitoring reports, maintenance records, and compliance monitoring reports maintained in the Operating Record.

FIGURES



LEGEND

MARSHALL STEAM STATION

CELL 1 APPROXIMATE BOUNDARY

NOTE: THIS FIGURE IS FOR REFERENCE ONLY.

SITE MAP
CLOSURE AND POST-CLOSURE PLAN
FGD RESIDUE LANDFILL
MARSHALL STEAM STATION
CATAWBA COUNTY, NORTH CAROLINA

PROJECT NO: 7810-16-0654

FIGURE NO: 1

F:\AMEC_Projects\2016\7810-16-0654 Marshall\GIS\MXDs\SiteMap.mxd, User: maddison.sutton; Date: 5/3/2016 4:18:07 PM, Checked by: RK Date: 5/03/2016

APPENDIX I

Post-Closure Inspection Form

Duke Energy Carolinas - Marshall FGD Residue Landfill
Post-Closure Inspection Form

Date/Time: _____
Observation Personnel: _____
Weather/Temperature: _____

Question	No	Yes	If yes, location	Description	Corrective Actions Recommended	Date Corrected
Is there evidence of erosion, settlement, rutting, or potholes?						
Is there evidence of cover system intrusion (ruts, burrows, excavation)?						
Is there evidence of stressed vegetation or bare spots, or evidence of woody vegetation (small trees and/or shrubs)?						
Is there evidence of erosion or sedimentation in storm water channels, down drain pipes, or other stormwater features?						
Is there evidence of penetrations (poles, posts, stakes)?						
Is there evidence of human encroachment (trash, fire pits, tire/footprints)?						

General Notes:

APPENDIX II

Cost Estimate for
Closure and Post-Closure Activities

Table 1
Closure Cost Estimate
Marshall FGD Landfill
Permit No. 1809-INDUS
Terrell, North Carolina
May 2016

	Quantity	Unit	Cost[1]	Total
Final Cover System				
Demolition of Interim Cover Measures	17.9	AC	$ 1,000.00	$ 17,900
Fine Grading of Interim Cover	17.9	AC	$ 3,800.00	$ 68,020
Vegetative Layer (6" thick)	14,500	CY	$ 11.00	$ 159,500
Protective Cover (18" thick)	43,300	CY	$ 5.50	$ 238,150
Drainage Geocomposite	780,000	SF	$ 0.98	$ 764,400
40-mil Text. LLDPE Geomembrane	780,000	SF	$ 0.63	$ 491,400
Stormwater Management				
Erosion Control Bench w/ Toe Drain	6,400	LF	$ 65.00	$ 416,000
30" Nyoplast Inline Drain	9	EA	$ 1,000.00	$ 9,000
Slope Drains (18" CPP)	1,030	LF	$ 35.00	$ 36,050
Subsurface Drains	1,600	LF	$ 50.00	$ 80,000
RCP Headwall	1	EA	$ 2,745.00	$ 2,745
Surveying	17.9	AC	$ 1,400.00	$ 25,060.00
Permanent Vegetative Stabilization	17.9	AC	$ 1,800.00	$ 32,220.00
Subtotal				$ 2,340,445
Mobilization (5% of Subtotal)				$ 117,022
Engineering and CQA (12% of Subtotal)				$ 280,853
Contingency (15% of Subtotal)				$ 351,067

TOTAL	**$ 3,089,387**
COST PER ACRE	**$ 172,591**

Notes:
1. Costs are based on 2016 dollars.

Table 2
Post-Closure Cost Estimate
Marshall FGD Landfill
Permit No. 1809-INDUS
Terrell, North Carolina
May 2016

	Quantity	Unit	Unit Cost[1]	Annual Cost
Compliance Monitoring Reporting[2]				
Reporting and Administration	1	LS	$ 9,600	$ 9,600
Compliance Monitoring Sampling and Analytical (semi-annual)[2]				
Groundwater[3]	9	Well	$ 1,500	$ 13,500
Leachate[4]	1	Location	$ 500	$ 500
Maintenance (annual)				
Fencing, Gates, Signs, etc.	1	LS	$ 1,000	$ 1,000
Access Roads	1	LS	$ 5,000	$ 5,000
Mowing	17.9	AC	$ 100	$ 1,790
Stormwater Structures	1	LS	$ 5,000	$ 5,000
Leachate Collection Pipe Cleaning and Camera Inspection[5]	Every 5th Year	Event	$ 5,000	$ 1,000
Groundwater Monitoring Wells	1	LS	$ 4,500	$ 4,500
Final Cover System[6]	17.9	AC	$ 1,500	$ 26,850
Annual Permit Fee	1	EA	$ 500	$ 500
Subtotal				$ 69,240
Mobilization (5% of Subtotal)				$ 3,462
Engineering and CQA (12% of Subtotal)				$ 8,309
Contingency (15% of Subtotal)				$ 10,386

ANNUAL TOTAL	**$ 91,397**
30-YEAR TOTAL	**$ 2,741,904**

Notes:
1. Costs are based on 2016 dollars.
2. The sampling, analytical and reporting costs are based on actual 2016 costs.
3. The monitored wells are MS-8, 9, 10, 11, 12, 13, 14, 15, and 16.
4. Leachate discharge point is monitored.
5. It is assumed that a post-closure pipe cleaning schedule of every 5 years will be approved.
6. Final cover system maintenance assumes erosion repair and seeding for 25 percent of the cover annually.

Table 3
Potential Assessment and Corrective Action Costs
Marshall FGD Landfill
Permit No. 1809-INDUS
Terrell, North Carolina
May 2016

	Quantity	Unit	Unit Cost[1]	Annual Cost
Assessment Monitoring Reporting				
Reporting and Administration[2]	1	LS	$ 19,000	$ 19,000
Assessment Monitoring Sampling and Analytical (annual)				
Groundwater[3,4]	9	Well	$ 1,500	$ 13,500
Subtotal				$ 32,500
Contingency (15% of Subtotal)				$ 4,875

ANNUAL TOTAL	**$ 37,375**
30-YEAR TOTAL	**$ 1,121,250**
REQUIRED MINIMUM	**$ 2,000,000**

Notes:
1. Costs are based on 2016 dollars.
2. The assessment reporting cost is assumed to be twice the cost for routine reporting.
3. The monitored wells are MS-8, 9, 10, 11, 12, 13, 14, 15, and 16.
4. The assessment sampling and analytical costs are estimated to be twice the routine cost per well.

Water Quality Monitoring Plan

Revised July 28, 2016

Marshall Flue Gas Desulfurization Residue Landfill, Phase 1, Cell 1, Permit No. 18-09

Duke Energy – Marshall Steam Station

Terrell, North Carolina

Amec Foster Wheeler Project No. 7810160654

To:	Duke Energy Carolinas, LLC
Date	7/28/2016
From:	Amec Foster Wheeler

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Appendix

Executive Summary

The following Water Quality Monitoring Plan (WQMP) – Revised July 28, 2016, represents the second 5-year update to the WQMP for the Duke Energy (Duke) Flue Gas Desulfurization (FGD) Residue Landfill at Marshall Steam Station.

The original WQMP was approved in November 2006. The current WQMP (the first 5-year update) was prepared by Altamont Environmental, Inc. (Altamont) and titled *Groundwater Sampling and Analysis Plan*, dated August 19, 2011.

The current Permit to Operate is scheduled to expire on November 21, 2016. As part of the permit amendment (renewal), Amec Foster Wheeler was requested to review and update the current WQMP as needed per the requirements stated in 15A NCAC 13B .0504 (1)(g)(iv).

The water quality monitoring network remains unchanged for the Marshall FGD Landfill facility since the last update; therefore, the overall content of the current WQMP remains relevant and applicable. In general, Amec Foster Wheeler retained Altamont's 2011 plan content and organization for this WQMP update with the exception of the following revisions:

- Minor text edits, primarily changing absolute terms to qualifier terms
- Updated Department of Environment and Natural Resources (DENR) references to Department of Environmental Quality (DEQ)
- Table 1 total depths for MS-8 and MS-16 were revised to reflect the bottom of the well and not the bottom of the borehole.
- Table 2 detection limits column was removed since it is lab-specific. Detection limits are generally specified by the analytical methods which are still listed.
- Table 2 dissolved oxygen (DO) and oxidation reduction potential (ORP) rows were added under in situ parameters.
- Table 2 analytical method for in situ parameters was changed to "Multi-Parameter Water Quality Meter" and "Turbidimeter" as appropriate instead of listing a specific brand of equipment.
- Table 2 units were changed for chloride, fluoride, nitrate, sulfate, and total dissolved solids from micrograms per liter to milligrams per liter, which is the more common laboratory reporting format for those parameters.
- Table 2 and 3 parameters Antimony, Beryllium, Thallium, and Vanadium were added as requested in a Permit to Operate Renewal Application letter from the North Carolina Department of Environmental Quality (DEQ), Division of Waste Management (DWM), Solid Waste Section (SWS) dated June 17, 2016.
- Table 2 and 3 parameter Cobalt was added as requested in an email to Mr. Mark Shumpert of Amec Foster Wheeler from Ms. Tyler Hardin of Duke Energy dated July 19, 2016.
- Table 3 ORP row added under in situ parameters.
- Table 3 holding times corrected from 6 months to 28 days for mercury and fluoride.

- Replaced Duke Energy Field Sampling Forms, as provided by Duke (Figures 4 through 7)
- Revised report submittal timeframe from within 90 days post-sampling to within 120 days post-sampling to be consistent with requirement stated in the facility's Permit to Operate.

Amec Foster Wheeler included Figures 1 through 3 and Appendix A as unrevised from Altamont's 2011 WQMP.

Courtney W. Murphy, P.G.
Amec Foster Wheeler
NC Geology Firm License C-247

1 Program Description

1.1 Scope of Work

This Water Quality Monitoring Plan (WQMP) is designed to guide the monitoring efforts that are used to evaluate the effects of the Marshall Steam Station (Marshall) 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 Environmental Quality (DEQ) 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 reduce 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 DEQ 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. Each well is 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, and analytical methods are presented in Table 2.

1.7 Data Quality Objectives

The overall Quality Assurance (QA) objective is to provide reliable data of known and acceptable quality. 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 DEQ.

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 are generally specified by the analytical method. 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 may not allow detection of the desired limits for various parameters either because of matrix interference or elevated analyte concentrations requiring sample dilution. The laboratory(s) will provide sufficient documentation with each data package to notify reviewers about any analytical issues with the data, if needed.

2 Sampling Procedures

2.1 Sampling Equipment

Development, purging, and sampling equipment are selected so that 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

Each of the nine wells addressed in this WQMP 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 reduces silt that has settled into the bottom of the well following installation, and reduces fine silt and clay particles from the well screen and sandpack surrounding the screen. Well development is performed to reduce potential for clogging and promote 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. Each monitoring well has been surveyed to determine the elevation of the TOC. Total well depth and water level measurements are referenced to the TOC and recorded to the nearest one-hundredth of a foot.

Water level measurements are collected 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:

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

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, each well is 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 ±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 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 ±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, ±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 or nitrile gloves during sample collection for each well. Samples are collected in the following order:

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

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

Sample containers supplied by the laboratory for the collection of groundwater samples shall be 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. Sample containers are provided by Duke or vendor laboratories.

2.3 Surface Water Sampling

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

When filling a sample container by grab, use new, clean, non-powdered latex or nitrile 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 reduce the potential for collecting sediment. Run the pump for several minutes so that 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 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

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

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 each sample. 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.

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 each stage 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 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 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.

[1] "X" indicates the most current version of the procedure

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 each parameter at frequencies described in the laboratory(s) procedures manuals. Equipment rinsate blanks for laboratory-cleaned equipment will be collected quarterly.

The field QC blanks and replicates may be included as internal QC checks are 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 each 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.

5 Validation of Field Data Package

The field data package includes complete 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 Validation of Laboratory Data

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

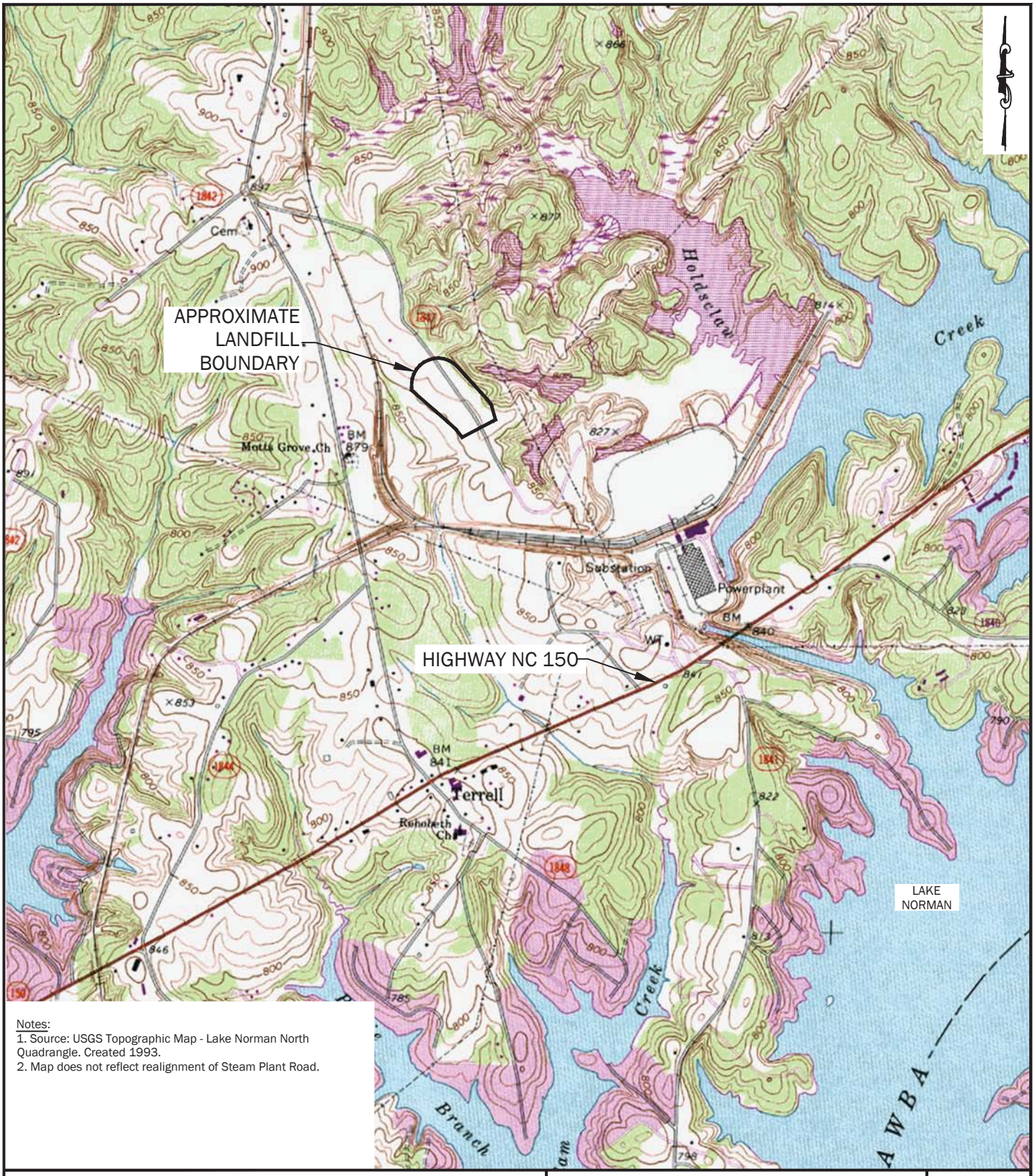
7 Report Submittal

A report of monitoring results will be submitted to the DEQ Division of Waste Management (DWM) within 120 days following the date of sampling. The report submittal will consist of the following:

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

DEQ will be notified in the event that vendor lab analyses have not been completed within this time frame. The 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.

ALTAMONT ENVIRONMENTAL, INC.
ENGINEERING & HYDROGEOLOGY
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SITE LOCATION MAP

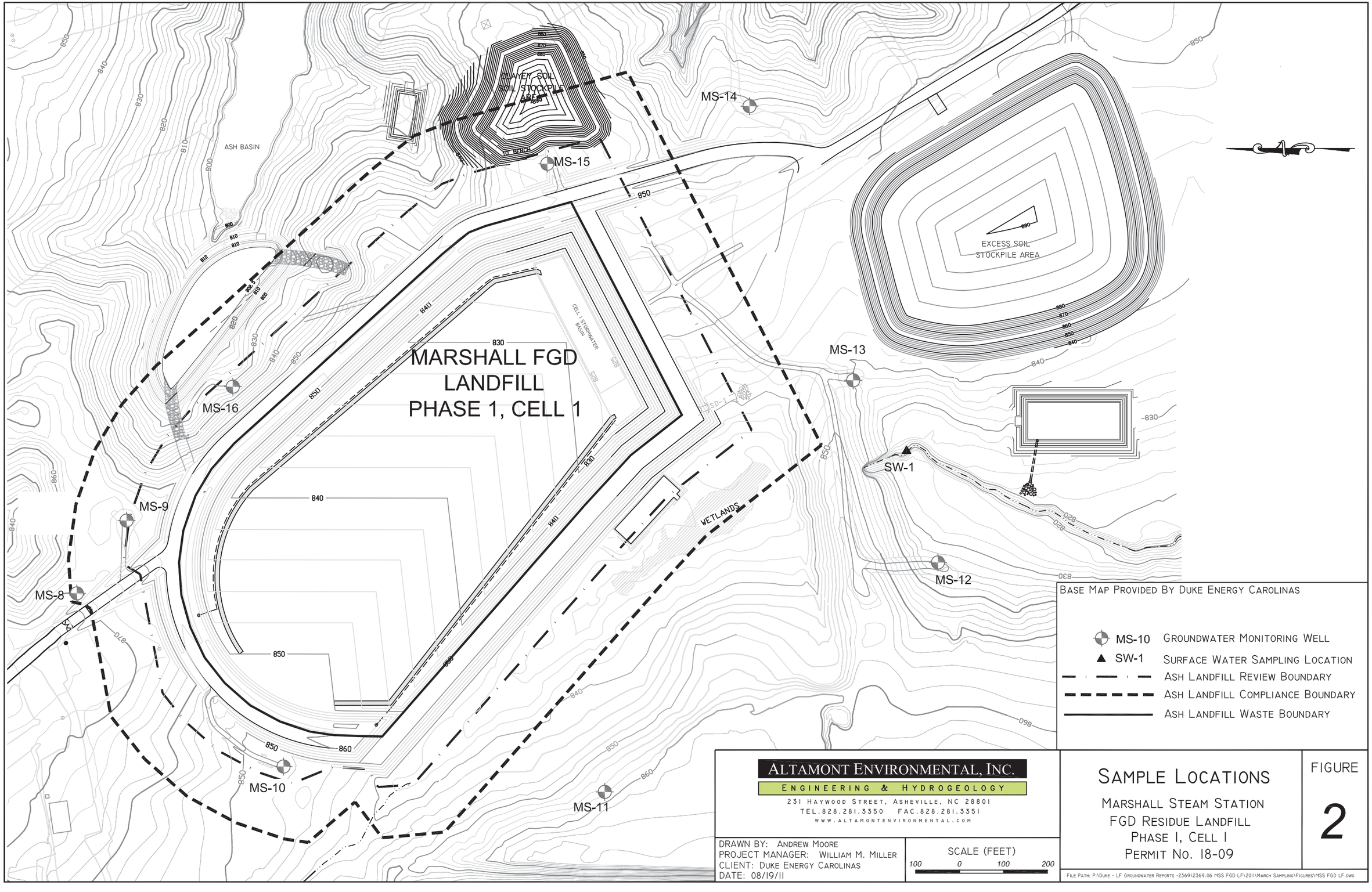
MARSHALL STEAM STATION
FGD RESIDUE LANDFILL
PHASE 1, CELL 1
PERMIT NO. 18-09

FIGURE
1

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

SCALE (FEET)
1000 0 1000 2000

FILE PATH: P:\DUKE - LF GROUNDWATER REPORTS -2369\2369.06 MSS FGD LF\FIGURES\SITE LOCATION MAP.DWG



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

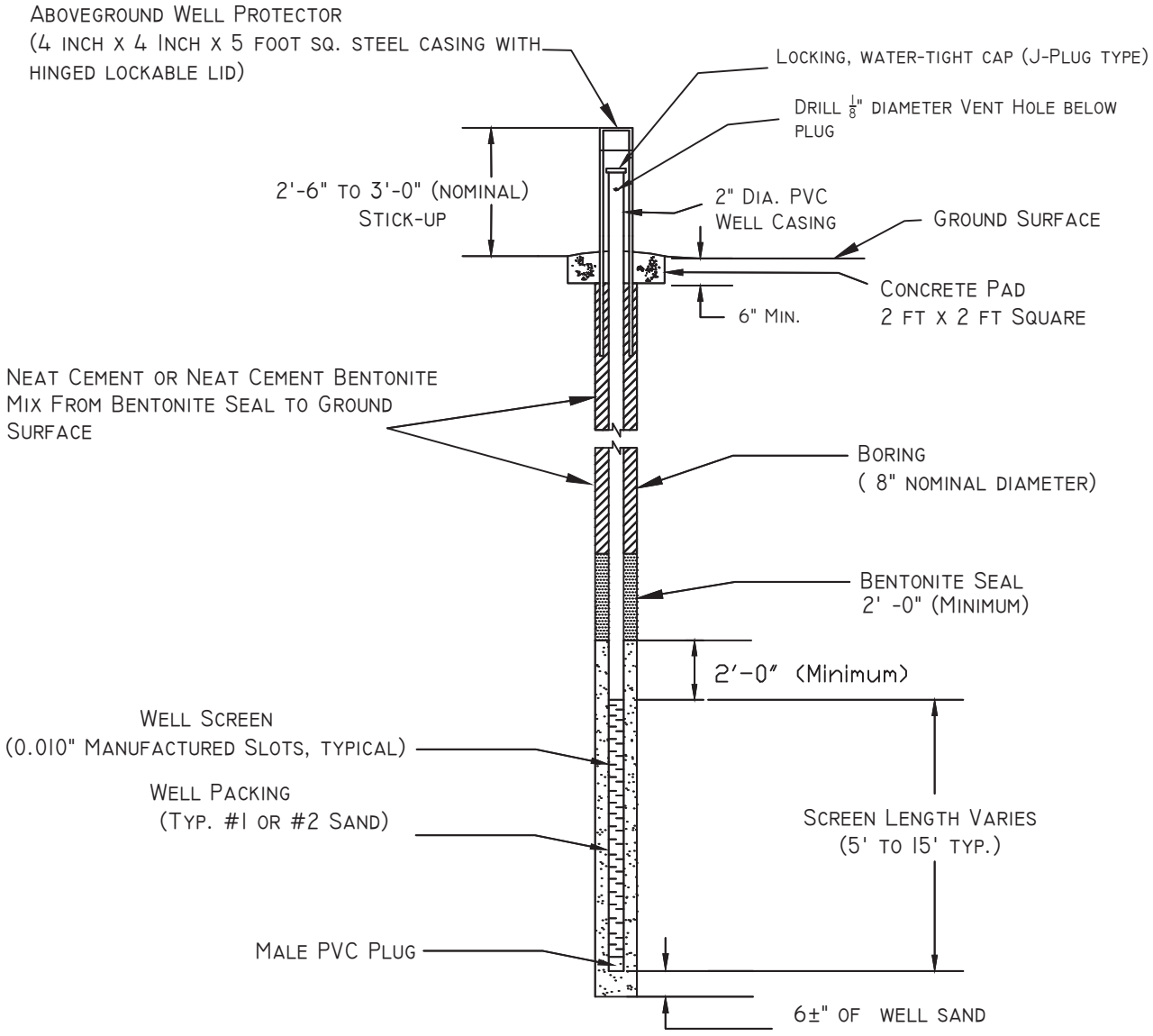
SCALE (FEET)
100 0 100 200

SAMPLE LOCATIONS

MARSHALL STEAM STATION
FGD RESIDUE LANDFILL
PHASE 1, CELL 1
PERMIT NO. 18-09

FIGURE
2

FILE PATH: P:\DUKE - LF GROUNDWATER REPORTS -2369\2369.06 MSS FGD LF\2011\MARCH SAMPLING\FIGURES\MSS FGD LF.DWG



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

File Path: P:\Duke - Environmental Engineering - 2371\2371.11 Landfill SAPs\2371.1101 MSS FGD\Figure 3 Typical MW-2004.dwg

DUKE ENERGY

GROUNDWATER MONITORING DATA SHEET

FOR LOW FLOW SAMPLING

PROCEDURE NO	3175.3

SITE NAME		PERMIT #		SITE ID	
PROJECT NAME		FIELD CREW			
SAMPLING DATE(s)	☐ ☐ ☐ ☐	WELL/LOCATION NAME			

MONITORING WELL INFORMATION

WELL DIAMETER (in)		TOC ELEV (ft msl)		MIDDLE OF WETTED SCREEN (ft toc)			0.00
WELL DEPTH (ft TOC)		GS ELEV (ft msl)		PUMP INTAKE DEPTH (ft TOC)			
SCREEN LENGTH (ft)		ELEV REF		SCREEN INTERVAL (ft TOC)	0.00	TO	0.00

EQUIPMENT INFORMATION

LEVEL METER SERIAL#		SAMPLING EQUIPMENT	QED T1200		PURGE METHOD
		TUBING DIAMETER (in)	1/2 OD		Low Flow

PUMP CONTROLLER SETTINGS								
PRESSURE		(psi)	RECHARGE		(sec)	DISCHARGE		(sec)

SAMPLING INFORMATION

INITIAL DEPTH TO WATER (ft TOC)		WATER COLUMN (ft)		*Well Volume = water column X conversion factor*	
WATER ELEVATION (ft msl)		WELL VOLUME (gal)		(Conversion factor dependent on well diameter and selected well volume units)	
DETECTED ODOR	None	CONVERSION FACTOR			
APPEARANCE	Normal				

TIME (hh:mm)	WATER LEVEL (ft)	FLOWRATE (ml/min)	☐ TEMP (deg C)	☐ SPECIFIC COND. (umho/cm)	☐ pH (SU)	☐ TURBIDITY (NTU)	☐ ORP (mV -NEH)	☐ DISSOLVED OXYGEN (mg/L)	☐ (gal) WELL VOL (recalculates on current water level)

DRAW-DOWN	0.00	(ft)				CHLORINE (mg/l)
INITIAL PURGE VOLUME		(gal)	SAMPLE COLLECTED BY	DATE	TIME	
TOTAL PURGE VOLUME	0.00	(gal)			@	NA

QC By:		Sample preservation verified to pH (units)	< 2.0

WELL CONDITION			ADDITIONAL WELL CONDITION NOTES
PROTECTIVE CASING	Good Condition		
WELL PAD	Good Condition		
WELL CASING	Good Condition		
WELL TAG	Good Tag		

SAMPLING NOTES

FIGURE 4

FIELD SAMPLING CALIBRATION FORM

STUDY:

DATE (s): | **SURFACE UNIT READER:**

COLLECTORS: | **SURFACE UNIT SERIAL #:**

ANALYZER MODEL#: | **ANALYZER SERIAL #:**

OTHER EQUIPMENT: TURBIDIMETER NO.2 - 3260-GW | **WEATHER CONDITIONS:**

PROCEDURE #: HYDROLAB 3210.6 **VALIDATED BY:**

Calibration Date / Time		DATE:		TIME:		DATE:		TIME:	
		CALIBRATION BP (mmHg)		0.00		CALIBRATION BP (mmHg)		0.00	
Parameter	**Calibation Standard**	**Instrument Value**		**Standard Value**	**Calibration Results**	**Instrument Value**		**Standard Value**	**Calibration Results**
SPEC. COND. (uS/cm)	SS	0.0	—/—►	0.0	INSTRUMENT ZEROED	0.0	—/—►	0.0	INSTRUMENT ZEROED
	SS		——►	227			——►	227	
	SS		—/—►	75			—/—►	75	
Specifc conductance checkpoint (used if sampled well is outside of initial calibration range).									
SPEC. COND. CHECK (uS/cm)	SS		—/—►	1410			—/—►	1410	
pH (units)	B (7.00)		——►	7.13			——►	7.13	
	B (4.00)		——►	4.01			——►	4.01	
	B (10.00)		—/—►	10.24			—/—►	10.24	
			Buffer Temp.	0.00			Buffer Temp.	0.00	
pH Check	B (7.00)		——►	7.13					
Time:			Buffer Temp.	0.00					
☑ ORP			——►	489			—/—►	489	
		N/A	—/—►	N/A		N/A	—/—►	N/A	
Zobell's			ORP Temp.	0.00			ORP Temp.	0.00	
☑ DO (mg/L)	TEMP (C^O) BP (mmHg) COND								
	100 % mg/L		——►	-0.09			——►	-0.09	
	After Cal LCS LCSD				After Cal % SAT				After Cal % SAT
☑ TURB (ntu)	SS		—/—►				—/—►		
Temp Cert Device #									
TEMP (deg C)	NIST	N/A	—/—►	N/A	Adjustment Not Available	N/A	—/—►	N/A	Adjustment Not Available

INSTRUMENT MAINTENANCE	**DATE / TIME**

Conductance Subsystem

- ☐ Cleaned Electrodes
- ☐ Tested - OK
- ☐ See Notes

pH Subsystem

- ☐ Cleaned Electrodes
- ☐ Replaced ref Electrode KCL
- ☐ Replaced Ref. Electrode Tip
- ☐ Tested - OK ☐ See Notes

Oxidation Reduction Subsystem

- ☐ Cleaned Electrode
- ☐ Tested - OK ☐ See Notes

Temperature Subsystem

- ☐ Cleaned Electrode
- ☐ Tested - OK ☐ See Notes

Dissolved Oxygen Subsystem

- ☐ Replaced Teflon Membrane
- ☐ Replaced DO electrolyte
- ☐ Cleaned Electrode
- ☐ See Notes

Field Barometric Pressure

Beginning BP	(mmHg)	Ending BP	(mmHg)

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

NOTES:

FIGURE 5

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST FORM

Duke Energy Analytical Laboratories
Mail Code MG03A2 (Building 7405)
13339 Hagers Ferry Rd
Huntersville, N. C. 28078
(980) 875-5245
Fax: (980) 875-5038

Analytical Laboratory Use Only

LIMS #	MATRIX: GW-WW	Samples Originating From	NC__ SC__	
Logged By	Date & Time	SAMPLE PROGRAM Ground Water __ NPDES ____ Drinking Water ____ UST ____ RCRA Waste ____		
Vendor:	Cooler Temp (C)			
PO #	[15]Preserv.:1=HCL 2=H_2SO_4 3=HNO_3 4=Ice 5=None			
MR #	Volume			

[19]Page _1_ of _1_
DISTRIBUTION
ORIGINAL to LAB,
COPY to CLIENT

Revised: 10/21/15

Customer must Complete

1)Project Name:		2)Phone No:
3)Client		4)Fax No:
5)Business Unit:	6)Process:	7)Resp. To:
8)Task ID:	9)Activity ID:	10)Mail Code:

Customer to complete all appropriate NON-SHADED areas.

[16]Analyses Required

LAB USE ONLY

Customer to complete appropriate columns to right

[11]Lab ID	[13]Sample Description or ID	[14]Collection Information: Date	Time	Signature	TESTS	[18]Grab							[20]Total # of Containers

Customer to sign & date below

21)Relinquished By	Date/Time	Accepted By:	Date/Time
21)Relinquished By	Date/Time	Accepted By:	Date/Time
21)Relinquished By	Date/Time	Accepted By:	Date/Time
23)Seal/Locked By	Date/Time	Sealed/Lock Opened By	Date/Time
24)Comments:			

Customer, important please indicate desired turnaround

[22]Requested Turnaround

14 Days ____√____

*7 Days ____________

*48 Hr ____________

*Other ____________

* Add. Cost Will Apply

FIGURE 6

NORTH CAROLINA GROUNDWATER SAMPLING SITE CHECKLIST

LOCATION / SITE PERMIT # **SAMPLE DATE**
SITE CONTACT **FIELD CREW**
WEATHER
PAGE 1 OF 1

ACCESS TO WELLS																
Access cleared into well																
Access cleared around well																
Tall grass or weeds - needs mowing																
Road washing out / muddy / needs grading																
Fallen tree blocking access																
WELL SECURITY																
Well found locked																
Well found unlocked																
WELL LOCK CONDITION																
Lock in good condition																
Lock rusted, difficult to open / needs replacing																
Replaced damaged lock																
WELL CASINGS																
Casing in good condition																
Damaged casing / still functional																
Damaged casing / repair required																
CONCRETE PADS																
Pad in good condition																
Minor cracks																
Major cracks / broken / repair required																
Undermined / washing out																
Fire ants around concrete pad																
WELL PROTECTIVE CASINGS																
Casing in good condition																
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																
Damaged / needs replacement																
Replaced damaged well cap																
FLUSH MOUNT WELLS																
Vault in good condition																
Water inside vault																
Vault bolt holes broken or stripped																
Bolts stripped																
Vault lid cracked or broken																
WELL ID TAGS																
Well tag in good condition																
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
Northing	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
Easting	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
Type of Casing	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Top of Casing Elevation (ft)	872.34	868.04	851.29	859.78	835.66	841.90	844.07	861.47	836.98
Well Diameter (inches)	2	2	2	2	2	2	2	2	2
Well Stick-up (ft-ags)	3	2.68	3	2.91	2.96	2.71	2.80	3.05	3
Total Depth (ft-bgs)	48	50	20	39	27	38	41	59	34
Screen Length (ft)	10	10	10	10	10	10	10	10	10
Screen Interval (ft-bgs)	38 to 48	40 to 50	10 to 20	29 to 39	17 to 27	28 to 38	31 to 41	49 to 59	24 to 34

Table 1.1
Surface Water Sample Location

	SW-1
Northing	679,611.00
Easting	1,412,341.30
Elevation (ft-MSL)	822.30

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 Construction Records

Coordinates are NC State Plane Grid, NAD83

Elevations are NAVD88

N/A = Not Applicable

ft = feet

ft-ags = feet above ground surface

ft-bgs = feet below ground surface

Table 2
Sample Parameters and Analytical Methods

PARAMETER	UNITS	ANALYTICAL METHOD
In Situ Parameters		
Field pH	pH Units	Multi-Parameter Water Quality Meter
Field Specific Conductance	µmhos/cm	Multi-Parameter Water Quality Meter
Field Temperature	°Celsius	Multi-Parameter Water Quality Meter
Field Dissolved Oxygen	mg/L	Multi-Parameter Water Quality Meter
Field Oxidation Reduction Potential	mV	Multi-Parameter Water Quality Meter
Field Turbidity	NTU	Turbidimeter
Water Level	ft	Water Level Meter
Laboratory Analyses		
Antimony	µg/L	EPA 200.7/EPA 6010
Arsenic	µg/L	EPA 200.8/EPA 6020
Barium	µg/L	EPA 200.7/EPA 6010
Beryllium	µg/L	EPA 200.7/EPA 6010
Boron	µg/L	EPA 200.7/EPA 6010
Cadmium	µg/L	EPA 200.8/EPA 6020
Chloride	mg/L	EPA 300.0
Chromium	µg/L	EPA 200.7/EPA 6010
Cobalt	µg/L	EPA 200.7/EPA 6010
Copper	µg/L	EPA 200.7/EPA 6010
Fluoride	mg/L	EPA 300.0
Iron	µg/L	EPA 200.7/EPA 6010
Lead	µg/L	EPA 200.8/EPA 6020
Manganese	µg/L	EPA 200.7/EPA 6010
Mercury	µg/L	EPA 7470
Nickel	µg/L	EPA 200.7/EPA 6010
Nitrate	mg/L	EPA 300.0
Selenium	µg/L	EPA 200.8/EPA 6020
Silver	µg/L	EPA 200.7/EPA 6010
Sulfate	mg/L	EPA 300.0
Thallium	µg/L	EPA 200.8/EPA 6020
Total Dissolved Solids	mg/L	SM 2540C
Vanadum	µg/L	EPA 200.8/EPA 6020
Zinc	µg/L	EPA 200.7/EPA 6010

Notes:

µmhos/cm = micro-ohms per centimeter

mg/L = milligrams per liter

mV = millivolts

NTU = nephelometric turbidity units

ft = feet

µg/L = micrograms per liter

Table 3
Sample Containers, Preservatives, and Holding Times

PARAMETER	CONTAINERS	PRESERVATIVES	HOLDING TIMES
In Situ Parameters			
Field pH	In Situ	None	Analyze Immediately
Field Specific Conductance	In Situ	None	Analyze Immediately
Field Temperature	In Situ	None	Analyze Immediately
Field Dissolved Oxygen	In Situ	None	Analyze Immediately
Field Oxidation Reduction Potential	In Situ	None	Analyze Immediately
Field Turbidity	In Situ	None	Analyze Immediately
Laboratory Analyses			
Antimony	500 mL HDPE	pH<2 HNO_3	6 months
Arsenic	500 mL HDPE	pH<2 HNO_3	6 months
Barium	500 mL HDPE	pH<2 HNO_3	6 months
Beryllium	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
Chloride	500 mL HDPE	Cool to 4°Celsius	28 days
Chromium	500 mL HDPE	pH<2 HNO_3	6 months
Cobalt	500 mL HDPE	pH<2 HNO_3	6 months
Copper	500 mL HDPE	pH<2 HNO_3	6 months
Fluoride	500 mL HDPE	pH<2 HNO_3	28 days
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
Mercury	500 mL HDPE	pH<2 HNO_3	28 days
Nickel	500 mL HDPE	pH<2 HNO_3	6 months
Nitrate	500 mL HDPE	Cool to 4°Celsius	48 hours
Selenium	500 mL HDPE	pH<2 HNO_3	6 months
Silver	500 mL HDPE	pH<2 HNO_3	6 months
Sulfate	500 mL HDPE	Cool to 4°Celsius	28 days
Thallium	500 mL HDPE	pH<2 HNO_3	6 months
Total Dissolved Solids	500 mL HDPE	Cool to 4°Celsius	7 days
Vanadium	500 mL HDPE	pH<2 HNO_3	6 months
Zinc	500 mL HDPE	pH<2 HNO_3	6 months

Notes:

mL = milliliter

HDPE = high density polyethylene

HNO_3 = nitric acid

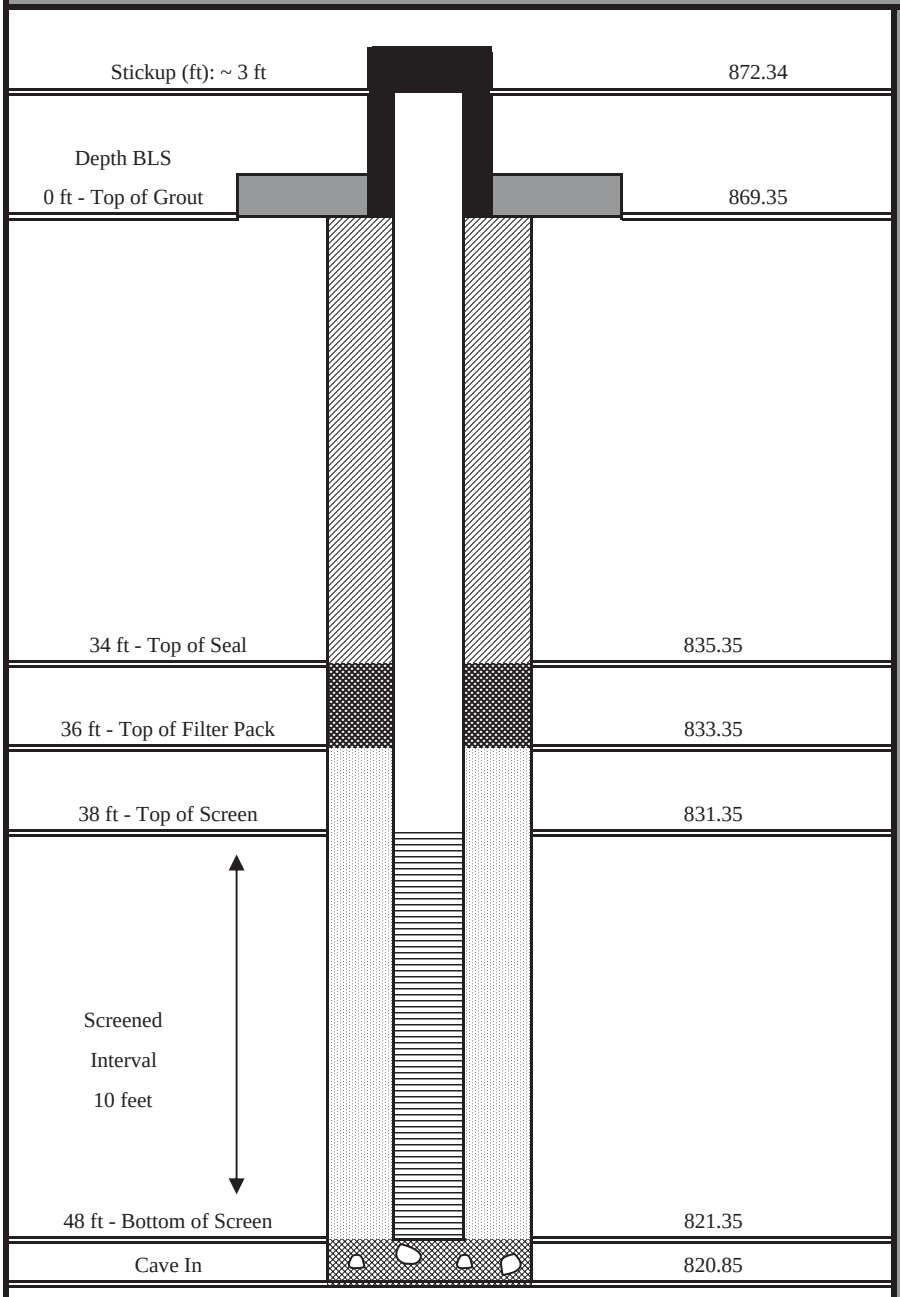
APPENDIX A

Monitoring Well Construction Records

MONITORING WELL CONSTRUCTION

WELL ID: MS-8 **TOTAL DEPTH: 48.5 ft bls**

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

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

   Latitude/longitude of well location
   35°-36'-23.134 N / 80°-58'-41.729W
   (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   ↳ Physical Survey (check box)

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

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

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

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

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

13. GROUT:

	Depth From	To	Ft.	Material	Method
	0	34		Neat Cement	Pour
	34	36		Bentonite	Pour

14. SCREEN:

	Depth From	To	Ft.	Diameter		Slot Size		Material
	38	48		2-inch	in.	0.01	in.	PVC
					in.		in.	

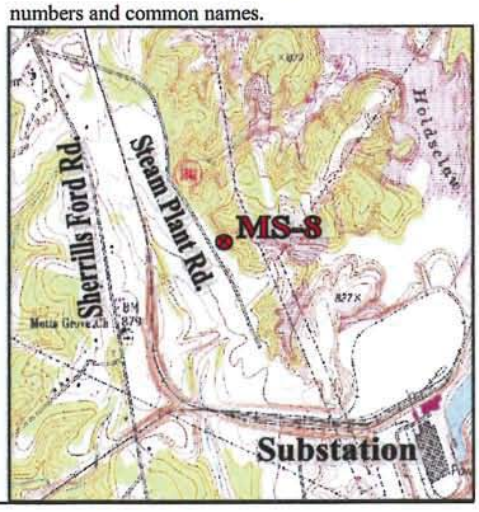
15. SAND/GRAVEL PACK:

	Depth From	To	Ft.	Size	Material
	36	48		#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

Larry W. 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.

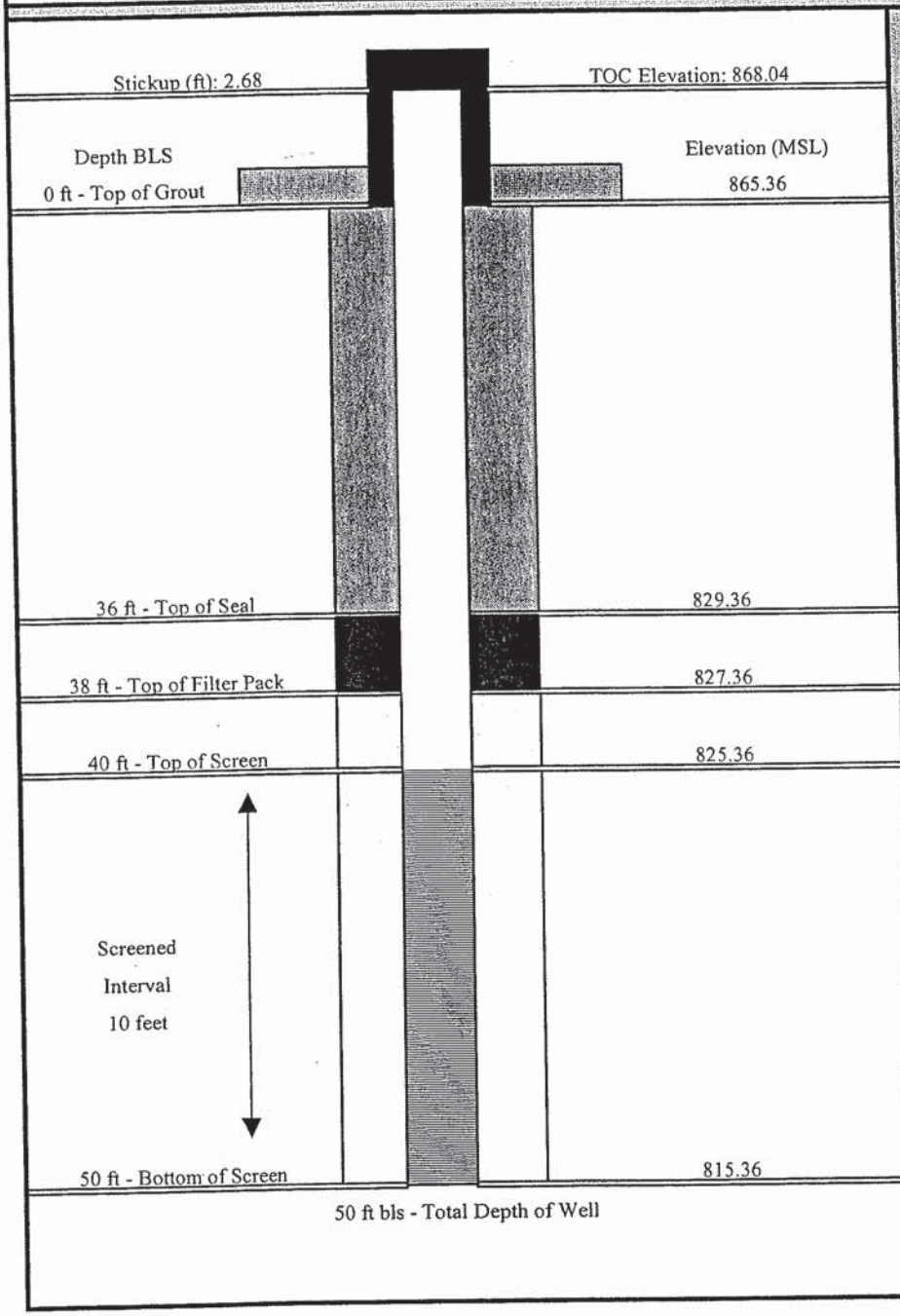
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

WELL ID: MS-9 **TOTAL DEPTH: 50 ft bls**

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

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

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# (if applicable): — ASSOCIATED WQ PERMIT# (if applicable):

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   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, Sudivision, Lot No.,Zip Code)

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

   Latitude/longitude of well location
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

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

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:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 40 Ft.	2-inch	Sch. 40	PVC
From		To Ft.			
From		To Ft.			

13. GROUT:

	Depth		Material	Method
From	0	To 36 Ft.	Neat Cement	Pour
From	36	To 38 Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From	40	To 50 Ft.	2-inch in.	0.01 in.	PVC
From		To Ft.	in.	in.	

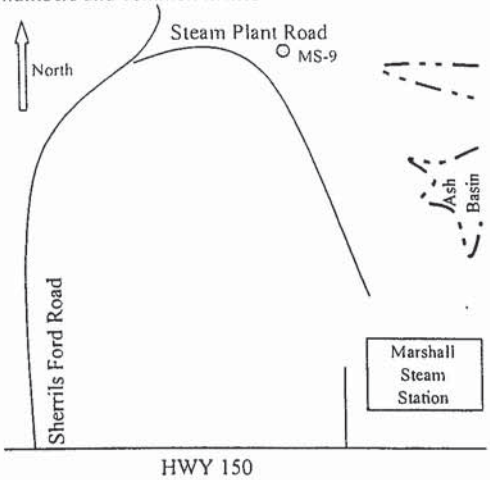
15. SAND/GRAVEL PACK:

	Depth		Size	Material
From	38	To 50 Ft.	#1	Silica Sand
From		To Ft.		

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

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 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

Brian E. Wilson — SIGNATURE OF PERSON CONSTRUCTING THE WELL

2-7-03 — 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.

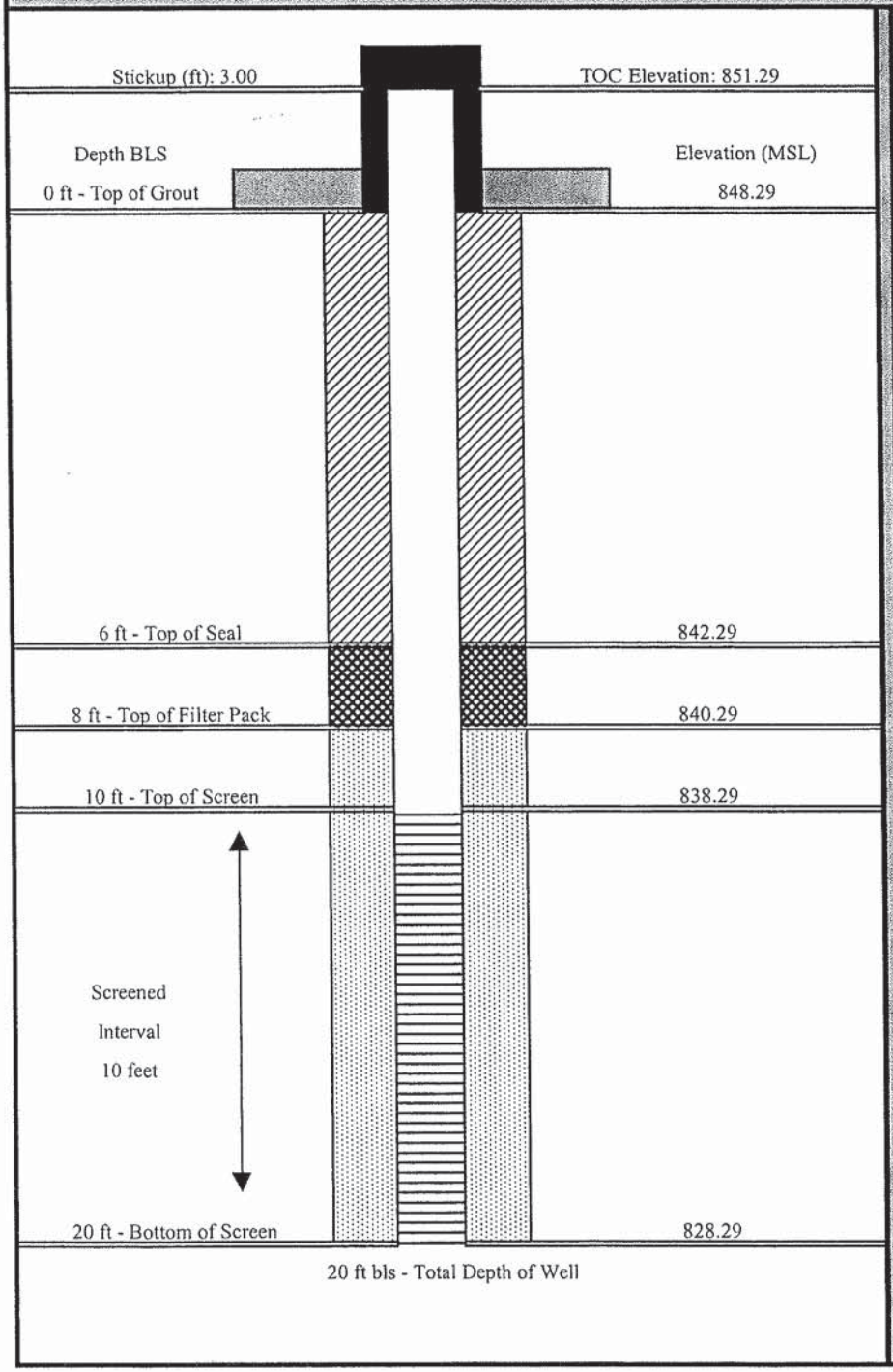
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

WELL ID: MS-10 **TOTAL DEPTH: 20 ft bls**

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

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

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

   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

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

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

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

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

	Depth From	To		Diameter	Wall Thickness or Weight/Ft.	Material
	0	10	Ft.	2-inch	Sch. 40	PVC
			Ft.			
			Ft.			

13. GROUT:

	Depth From	To		Material	Method
	0	6	Ft.	Neat Cement	Pour
	6	8	Ft.	Bentonite	Pour

14. SCREEN:

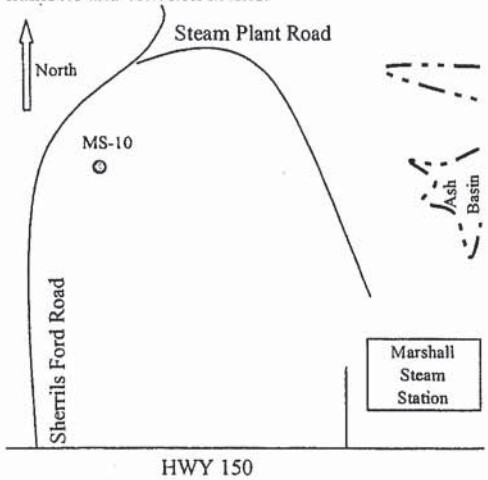
	Depth From	To		Diameter		Slot Size		Material
	10	20	Ft.	2-inch	in.	0.01	in.	PVC
			Ft.		in.		in.	

15. SAND/GRAVEL PACK:

	Depth From	To		Size	Material
	8	20	Ft.	#1	Silica Sand
			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 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 7-17-03

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.

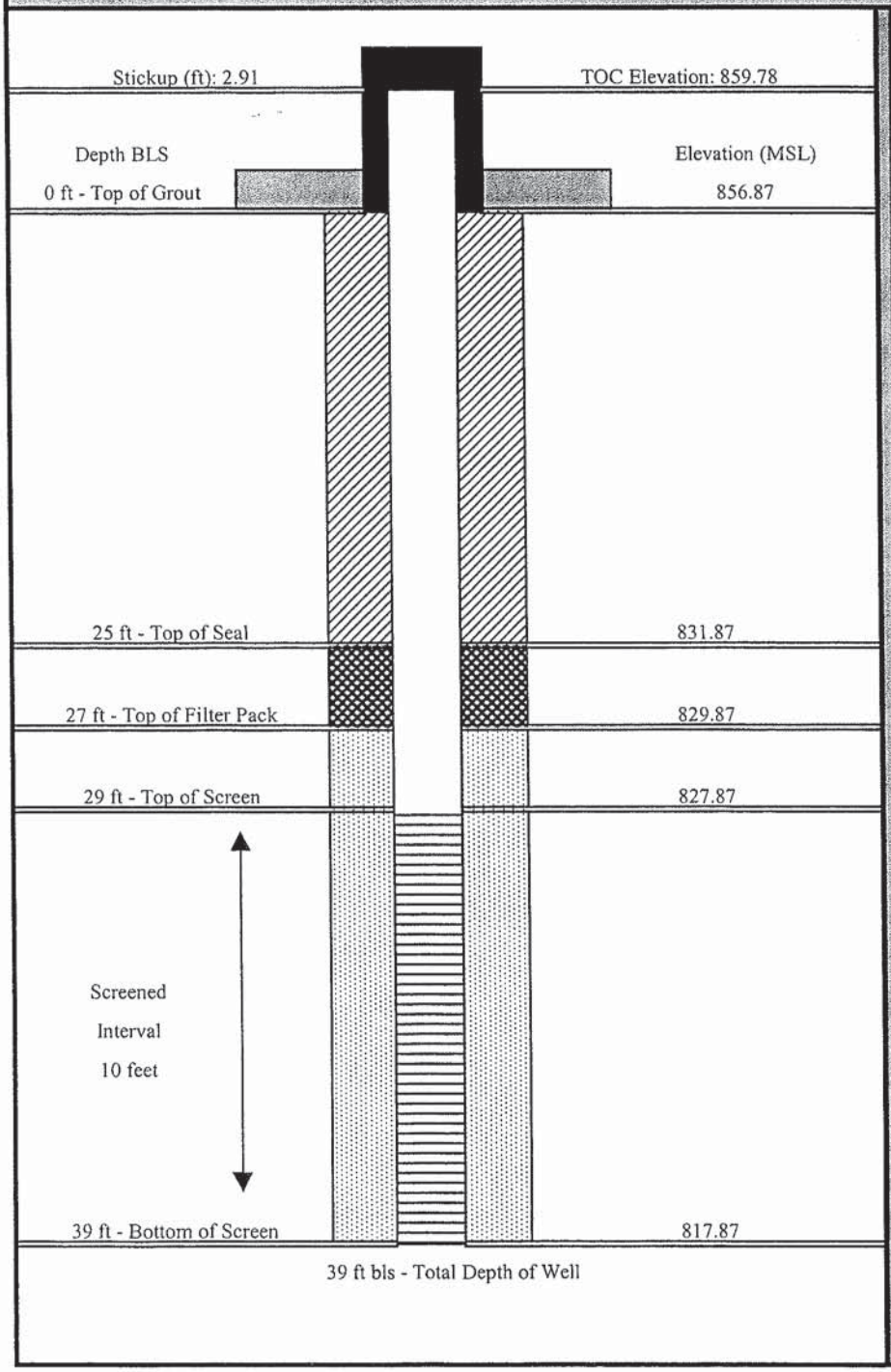
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

WELL ID: MS-11 **TOTAL DEPTH: 39 ft bls**

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

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

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

   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

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

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 0	To 29	Ft.	2-inch	Sch. 40	PVC
From	To	Ft.			
From	To	Ft.			

13. GROUT:

	Depth		Material	Method
From 0	To 25	Ft.	Neat Cement	Pour
From 25	To 27	Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From 29	To 39	Ft.	2-inch in.	0.01 in.	PVC
From	To	Ft.	in.	in.	

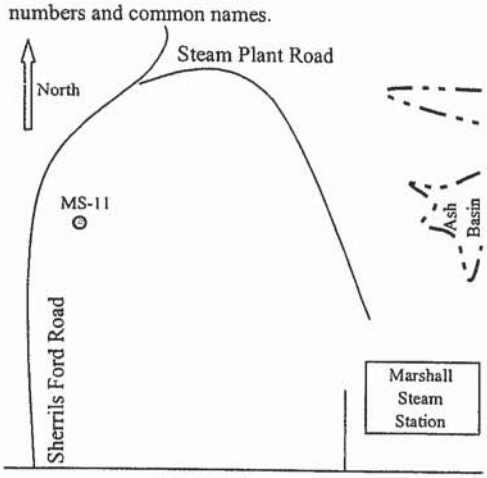
15. SAND/GRAVEL PACK:

	Depth		Size	Material
From 27	To 39	Ft.	#1	Silica Sand
From	To	Ft.		

DEPTH From	To	DRILLING LOG Formation Descrpition
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

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 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 7-17-03

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.

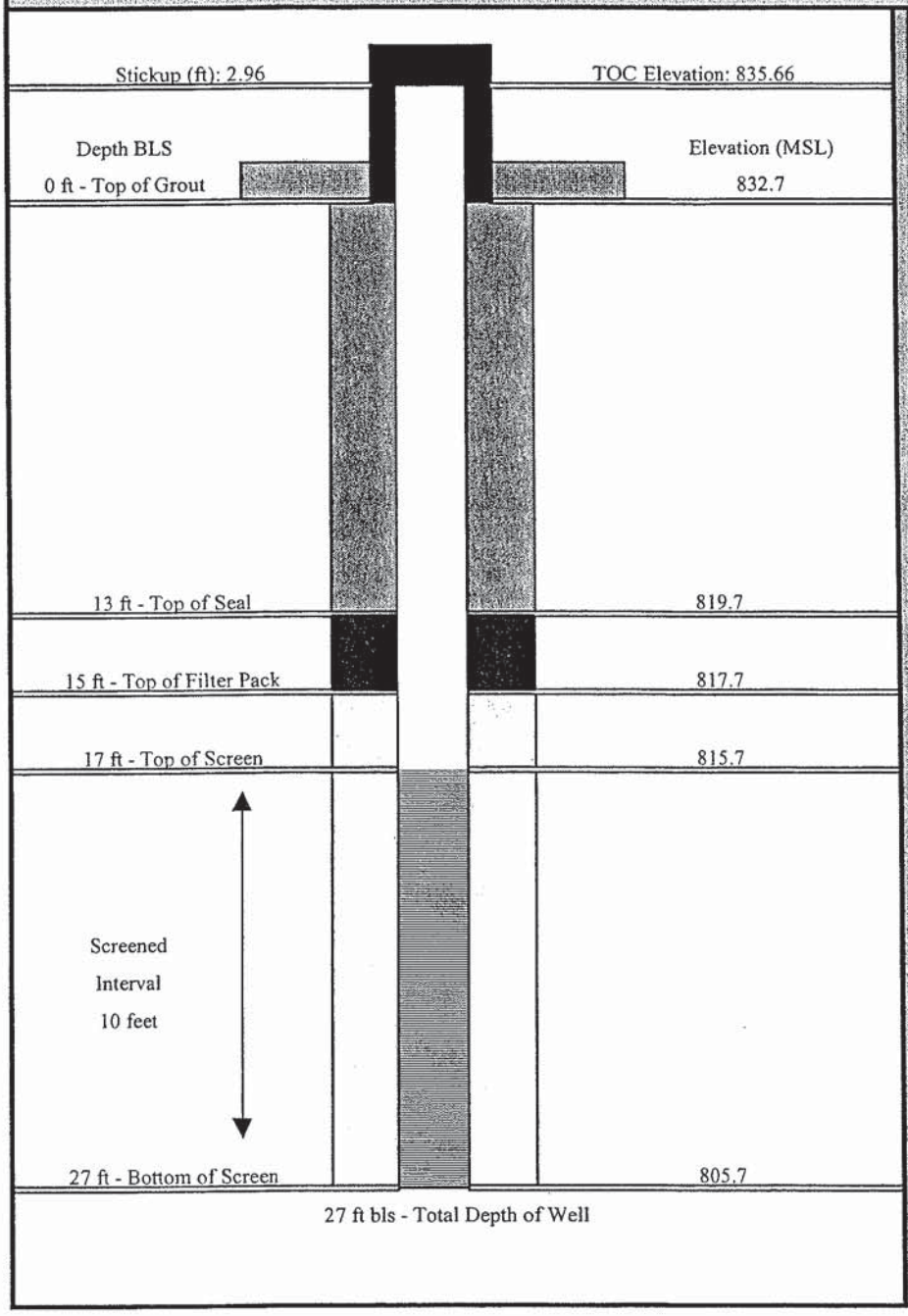
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

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

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

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

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐ 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, Sudivision, Lot No.,Zip Code)

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

Latitude/longitude of well location
(degrees/minutes/seconds)
Latitude/longitude scource: ☐GPS ☐Topographic Map
(check box)

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

4. DATE DRILLED: 02/11/2003
5. TOTAL DEPTH: 27 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
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

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	9	Sandy Clay
9	14	Fine Sandy Silt
14	19	Silty Med/Fine Sand
19	22	Fine Sandy Silt
22	27	Silty Med/Fine Sand

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

12. CASING:

	Depth		Diameter	Wall Thickness 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:

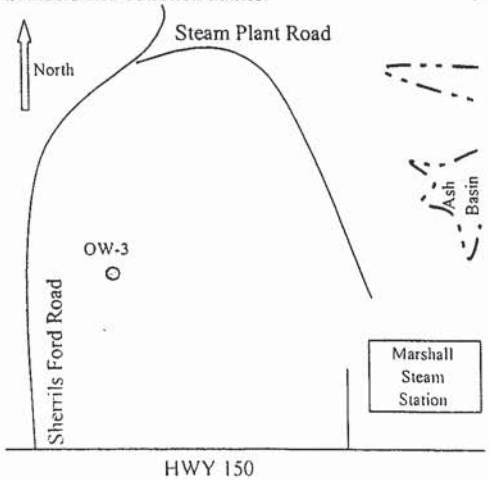
	Depth		Diameter	Slot Size	Material
From 17	To 27	Ft.	2-inch in.	0.01 in.	PVC
From	To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth		Size	Material
From 15	To 27	Ft.	#1	Silica Sand
From	To	Ft.		

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 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

Brian W. Wilson — 2/17/03

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.

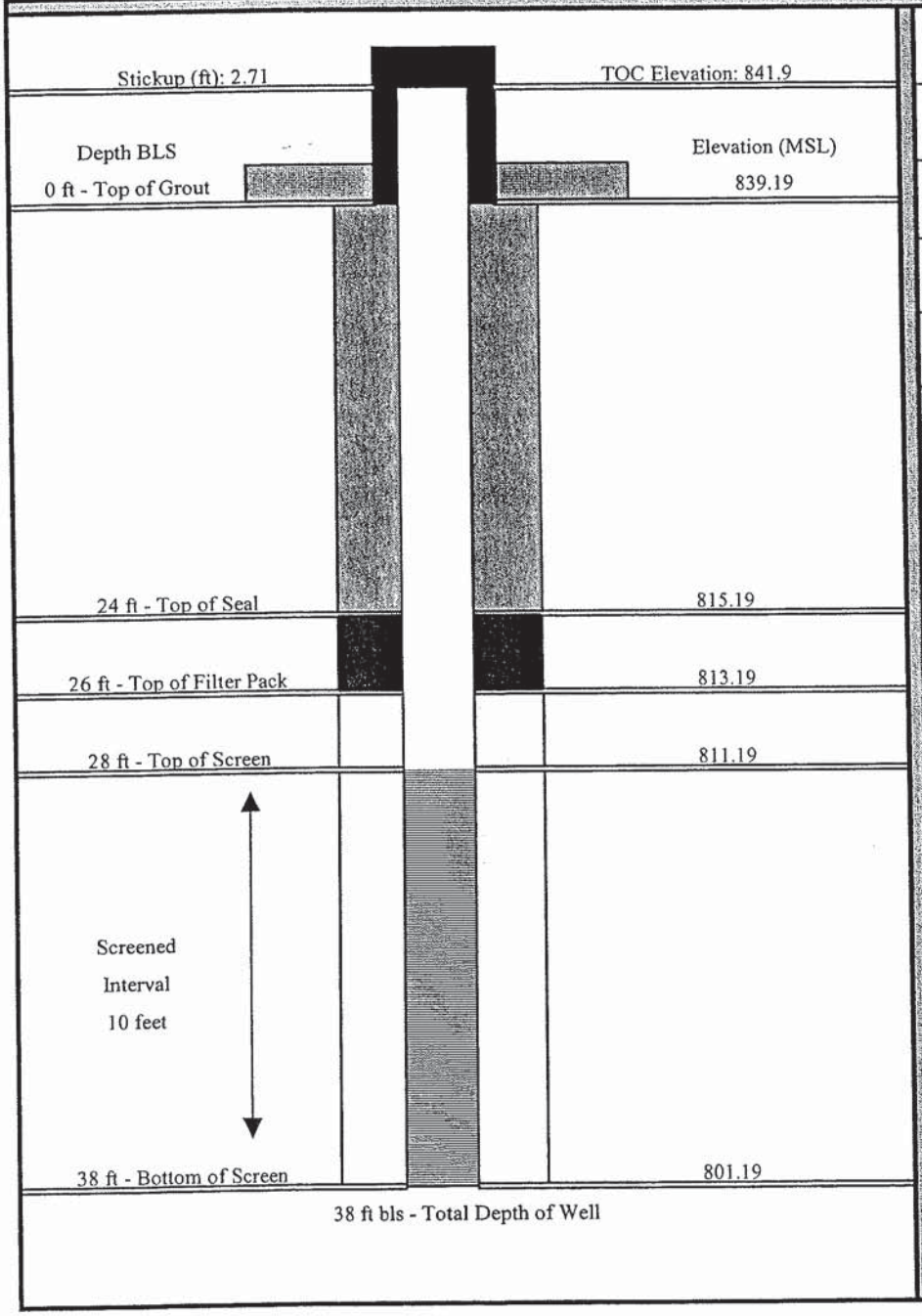
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

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

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

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

WELL CONSTRUCTION RECORD

(MS-6) - MS-13

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# (if applicable): _____ — ASSOCIATED WQ PERMIT# (if applicable): _____

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   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, Sudivision, Lot No.,Zip Code)

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

   Latitude/longitude of well location
   _____
   (degrees/minutes/seconds)

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

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

4. DATE DRILLED: 12/17/2002
5. TOTAL DEPTH: 38 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
7. STATIC WATER LEVEL Below Top of Casing: 31.36 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	0	To 28 Ft.	2-inch	Sch. 40	PVC
From		To Ft.			
From		To Ft.			

13. GROUT:

	Depth		Material	Method
From	0	To 24 Ft.	Neat Cement	Pour
From	24	To 26 Ft.	Bentonite	Pour

14. SCREEN:

	Depth		Diameter	Slot Size	Material
From	28	To 38 Ft.	2-inch in.	0.01 in.	PVC
From		To Ft.	in.	in.	

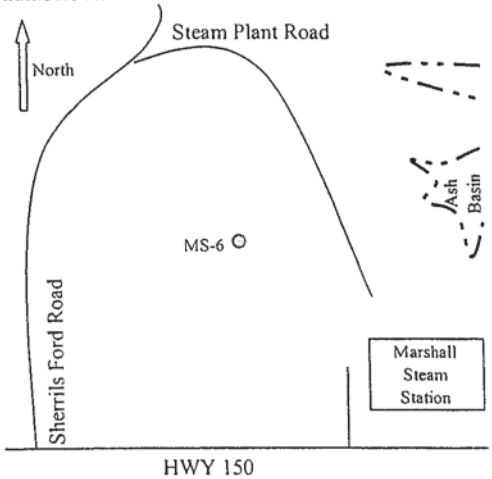
15. SAND/GRAVEL PACK:

	Depth		Size	Material
From	26	To 38 Ft.	#1	Silica Sand
From		To Ft.		

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	0.5	Fine Sandy Silt
0.5	9	Silty Clay
9	17	Fine Sandy Silt
17	27	Silty Fine Sand
27	38	Silty Med/Fine Sand

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 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 — 2-7-03

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.

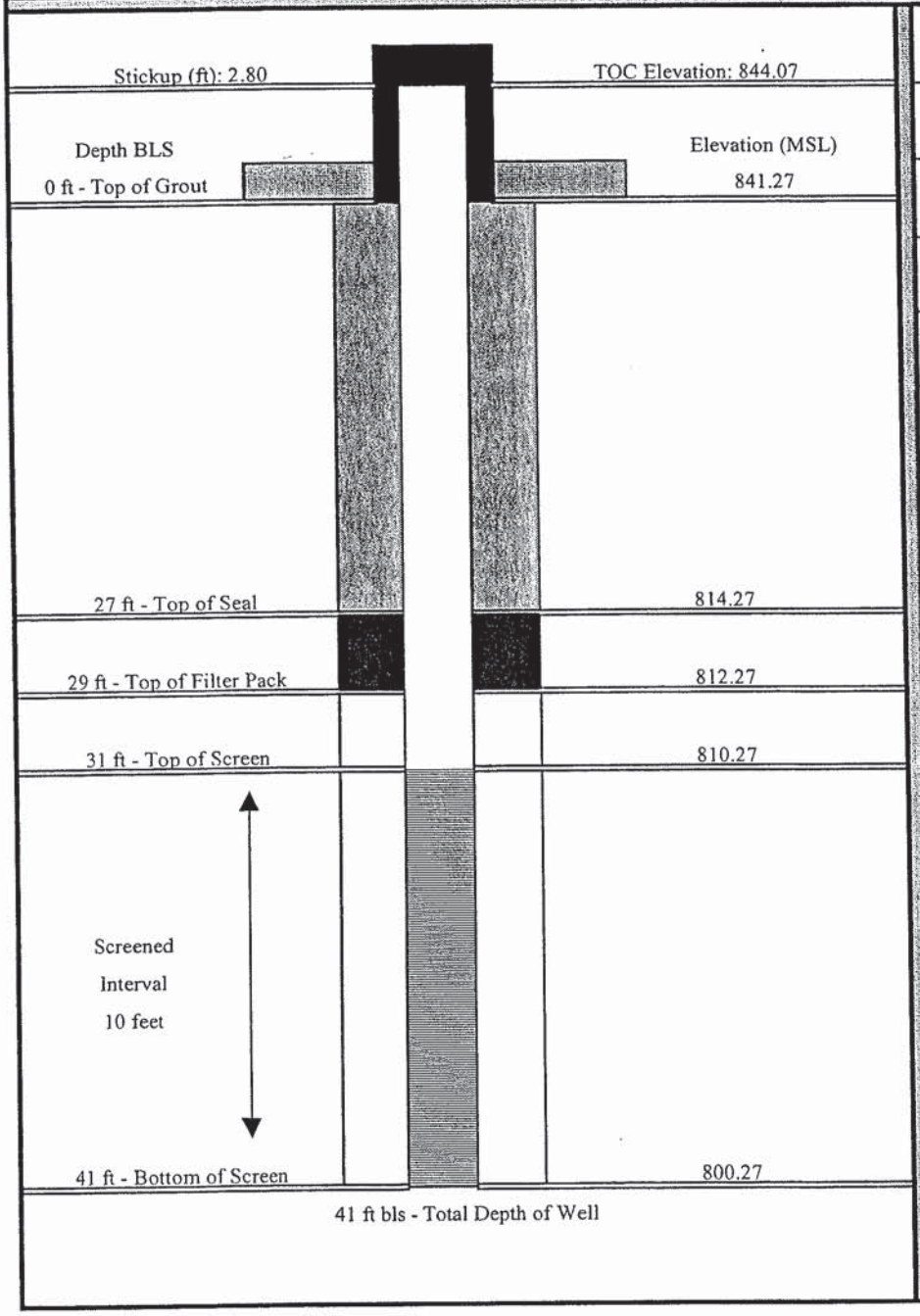
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

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

S&ME
ENVIRONMENTAL SERVICES • ENGINEERING • TESTING

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

WELL CONSTRUCTION RECORD

(B-5) - MS-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# (if applicable): — ASSOCIATED WQ PERMIT# (if applicable):

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   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, Sudivision, Lot No.,Zip Code)

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

   Latitude/longitude of well location
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

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

4. DATE DRILLED: 01/07/2003
5. TOTAL DEPTH: 41 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
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

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	3.5	Silty Clay
3.5	9.5	Clayey Silt
9.5	12	Silty Fine Sand
12	37	Fine Sandy Silt
37	41	Silty Fine Sand

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

	Depth			Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To	31 Ft.	2-inch	Sch. 40	PVC
From		To	Ft.			
From		To	Ft.			

13. GROUT:

	Depth			Material	Method
From	0	To	27 Ft.	Neat Cement	Pour
From	27	To	29 Ft.	Bentonite	Pour

14. SCREEN:

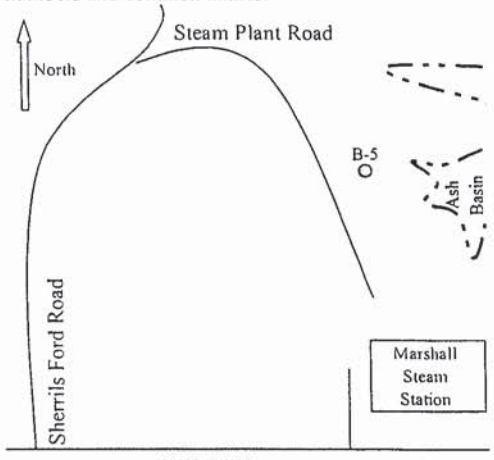
	Depth			Diameter	Slot Size	Material
From	31	To	41 Ft.	2-inch in.	0.01 in.	PVC
From		To	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

	Depth			Size	Material
From	29	To	41 Ft.	#1	Silica Sand
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 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

Brian E. Wilson — SIGNATURE OF PERSON CONSTRUCTING THE WELL

2/6/03 — 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.

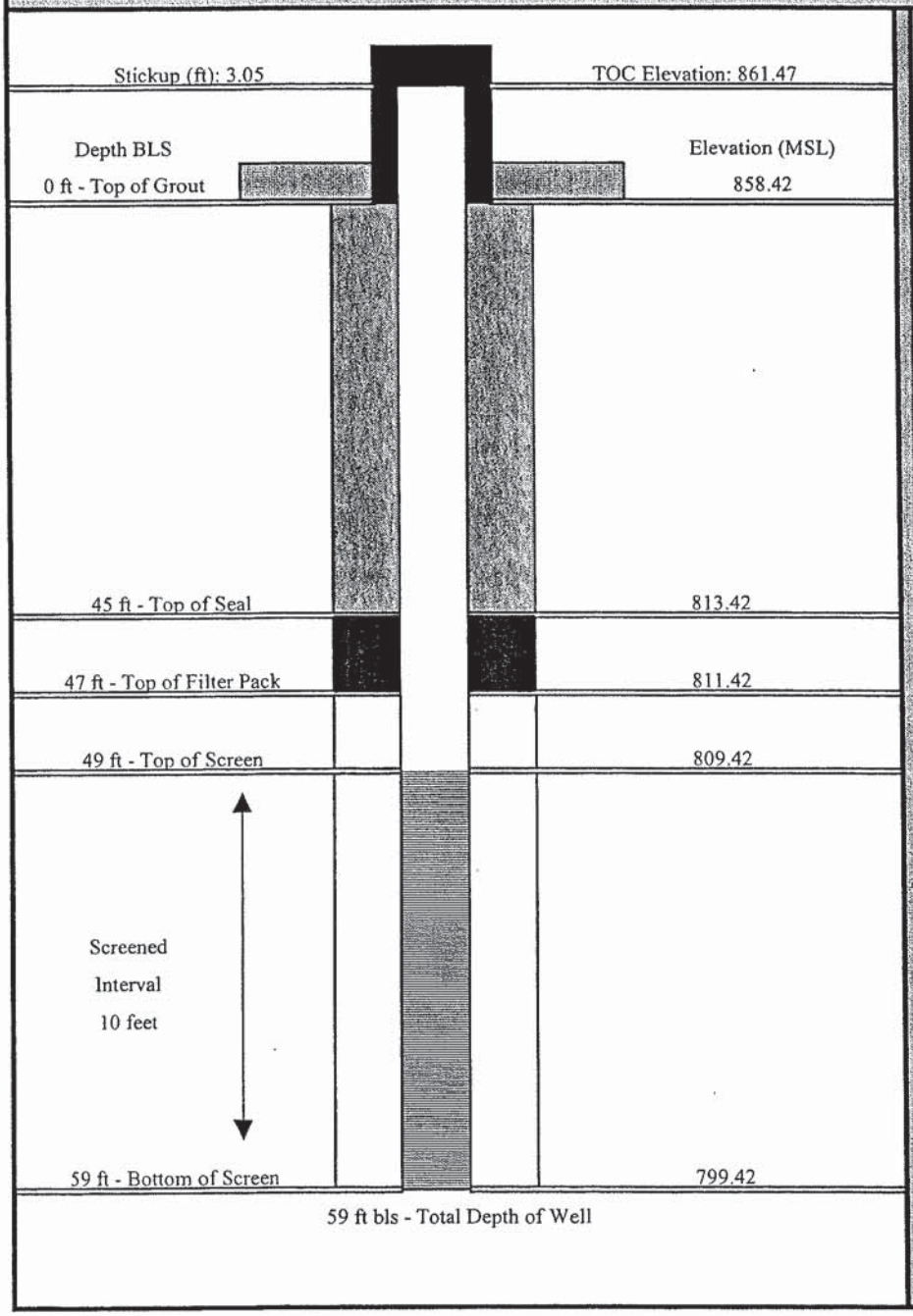
GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

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

S&ME
ENVIRONMENTAL SERVICES · ENGINEERING · TESTING

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

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# (if applicable): — ASSOCIATED WQ PERMIT# (if applicable):

1. WELL USE (Check Applicable Box): Residential ☐ Municipal/Public ☐ Industrial ☐ Agricultral ☐
   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, Sudivision, Lot No.,Zip Code)

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

   Latitude/longitude of well location
   (degrees/minutes/seconds)
   Latitude/longitude scource: ☐GPS ☐Topographic Map
   (check box)

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

4. DATE DRILLED: 12/03/2002
5. TOTAL DEPTH: 59 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☑
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 or Weight/Ft.	Material
From	0	To 49 Ft.	2-inch	Sch. 40	PVC
From		To Ft.			
From		To Ft.			

13. GROUT:

	Depth		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.	

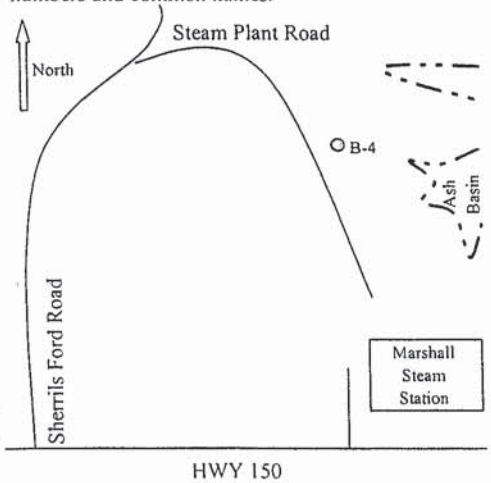
15. SAND/GRAVEL PACK:

	Depth		Size	Material
From	47	To 59 Ft.	#1	Silica Sand
From		To Ft.		

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
0	7	Clayey Silt
7	42	Fine Sandy Silt
42	47	Silty Fine Sand
47	52	Fine Sandy Silt
52	59	Silty Fine Sand

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 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 — 2-7-03

SIGNATURE OF PERSON CONSTRUCTING THE WELL — DATE

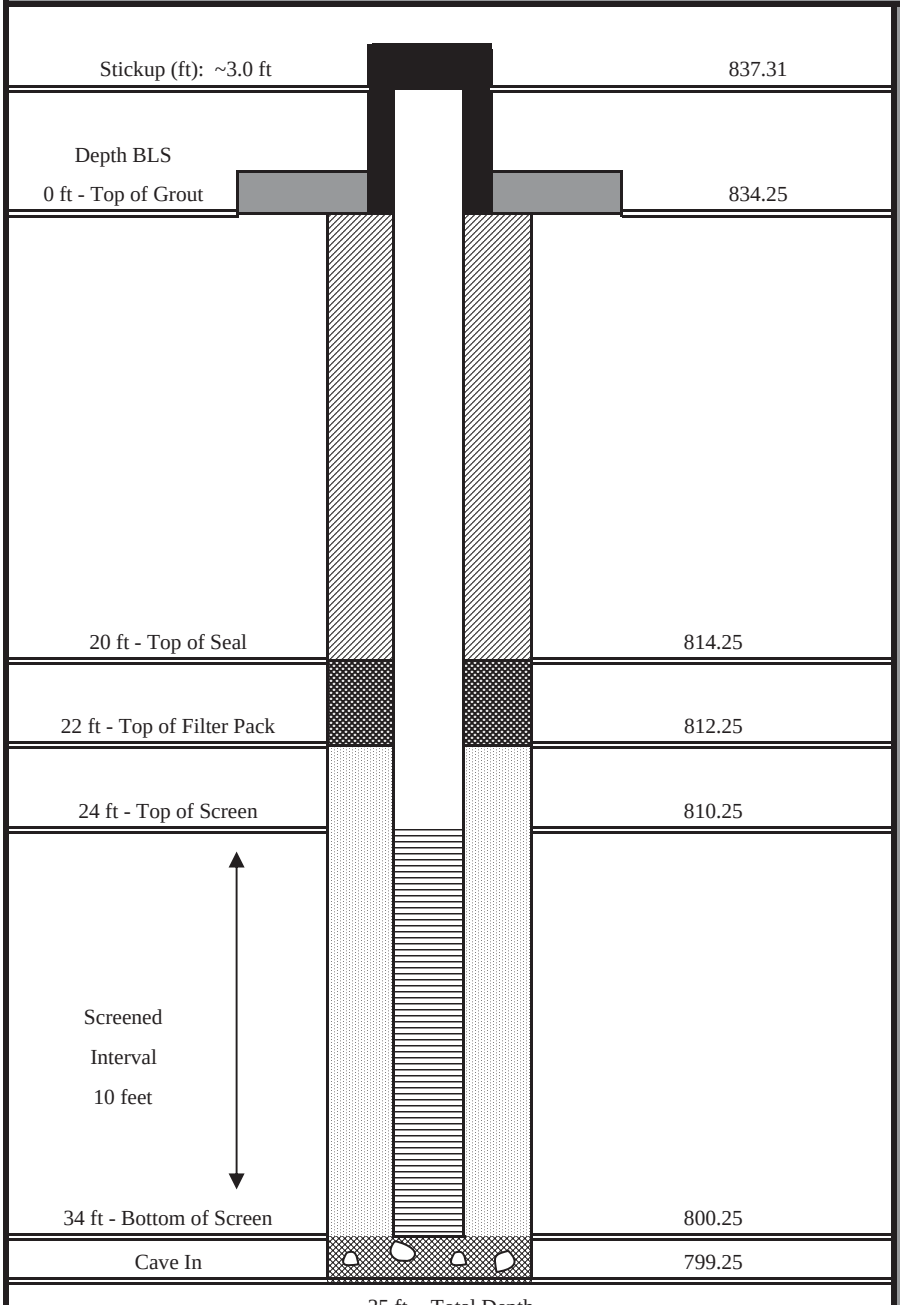
Submit the original to the Division of Water Quality, Groundwater Section, 1636 Mail Service Center - Raleigh, NC 27699-1636 Phone No. (919) 733-3221, within 30 days.

GW-1 REV. 07/2001

MONITORING WELL CONSTRUCTION

WELL ID: MS-16 **TOTAL DEPTH: 35 ft bls**

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

   Latitude/longitude scource: ☐GPS ☐Topographic Map
   → Physical Survey (check box)

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

4. DATE DRILLED 9/11/2006
5. TOTAL DEPTH 34 ft bls
6. DOES WELL REPLACE EXISTING WELL? YES ☐ NO ☐
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

DEPTH From	DEPTH To	DRILLING LOG Formation Descrpition
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

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

	Depth From	To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	0	24		2-inch	Sch. 40	PVC

13. GROUT:

	Depth From	To	Ft.	Material	Method
	0	20		Neat Cement	Pour
	20	22		Bentonite	Pour

14. SCREEN:

	Depth From	To	Ft.	Diameter		Slot Size		Material
	24	34		2-inch	in.	0.01	in.	PVC
					in.		in.	

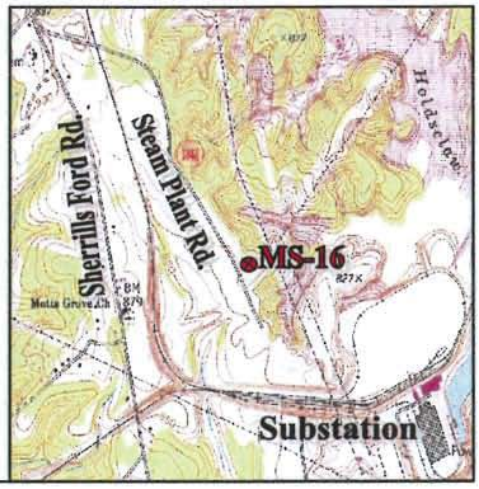
15. SAND/GRAVEL PACK:

	Depth From	To	Ft.	Size	Material
	22	34		#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

Larry W. 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.

GW-1 REV. 07/2001