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NC DENR
Division of Waste Management - Solid Waste

Environmental Monitoring Reporting Form

Notice: This form and any information attached to it are "Public Records" as defined in NC General Statute 132-1. As such, these documents are available for inspection and examination by any person upon request (NC General Statute 132-6).

Instructions:

- **Prepare one form for each individually monitored unit.**
- **Please type or print legibly.**
- Attach a notification table with values that attain or exceed NC 2L groundwater standards or NC 2B surface water standards. The notification must include a preliminary analysis of the cause and significance of each value. (e.g. naturally occurring, off-site source, pre-existing condition, etc.).
- Attach a notification table of any groundwater or surface water values that equal or exceed the reporting limits.
- Attach a notification table of any methane gas values that attain or exceed explosive gas levels. This includes any structures on or nearby the facility (NCAC 13B .1629 (4)(a)(i).
- In accordance with NC General Statutes Chapter 89C and 89E and NC Solid Waste Management Rules 15A NCAC 13B, be sure to affix a seal to the bottom of this page, when applicable.
- Send the original signed and sealed form, any tables, and Electronic Data Deliverable to: Compliance Unit, NCDENR-DWM, Solid Waste Section, 1646 Mail Service Center, Raleigh, NC 27699-1646.

Solid Waste Monitoring Data Submittal Information

Name of entity submitting data (laboratory, consultant, facility owner):

S&ME, Inc. (Consultant)

Contact for questions about data formatting. Include data preparer's name, telephone number and E-mail address:

Name: Willam M. Miller Phone: 828-687-9080 Ext 315

E-mail: wmiller@smeinc.com

Facility name:	Facility Address:	Facility Permit #	NC Landfill Rule: (.0500 or .1600)	Actual sampling dates (e.g., October 20-24, 2006)
Belews Creek Pine Hall Road Ash Landfill	Duke Energy Belews Creek Steam Station 3195 Pine Hall Rd Belews Creek, NC 27009	85-03	.0500	April 21 - 22, 2009

Environmental Status: (Check all that apply)

☐ Initial/Background Monitoring ☒ Detection Monitoring ☐ Assessment Monitoring ☐ Corrective Action

Type of data submitted: (Check all that apply)

☒ Groundwater monitoring data from monitoring wells
☐ Groundwater monitoring data from private water supply wells
☐ Leachate monitoring data
☐ Surface water monitoring data
☐ Methane gas monitoring data
☐ Corrective action data (specify) _____
☐ Other(specify)

Notification attached?

☐ No. No groundwater or surface water standards were exceeded.
☒ Yes, a notification of values exceeding a groundwater or surface water standard is attached. It includes a list of groundwater and surface water monitoring points, dates, analytical values, NC 2L groundwater standard, NC 2B surface water standard or NC Solid Waste GWPS and preliminary analysis of the cause and significance of any concentration.
☐ Yes, a notification of values exceeding an explosive methane gas limit is attached. It includes the methane monitoring points, dates, sample values and explosive methane gas limits.

Certification

To the best of my knowledge, the information reported and statements made on this data submittal and attachments are true and correct. Furthermore, I have attached complete notification of any sampling values meeting or exceeding groundwater standards or explosive gas levels, and a preliminary analysis of the cause and significance of concentrations exceeding groundwater standards. I am aware that there are significant penalties for making any false statement, representation, or certification including the possibility of a fine and imprisonment.

William M. Miller — Facility Representative Name (Print)

Senior Project Engineer — Title

828-687-9080 Ext 315 — (Area Code) Telephone Number

William M. Miller — Signature

June 5, 2009 — Date

Affix NC Licensed/ Professional Geologist/Engineer Seal here:

NORTH CAROLINA PROFESSIONAL SEAL 17661 ENGINEER WILLIAM M. MILLER

S+ME
44 Buck Shoals Rd Suite C-3
Arden NC 28704
NC PE Firm # F-0176

Revised 01/2007

DUKE ENERGY
BELEWS CREEK STEAM STATION
PINE HALL ROAD ASH LANDFILL PERMIT #85-03
GROUNDWATER MONITORING REPORT
APRIL 2009 SAMPLING EVENT
S&ME Project No. 1411-09-047

Prepared For:

Prepared By:

S&ME, Inc.
44 Buck Shoals Road Suite C-3
Arden, North Carolina 28704

June 5, 2009

S&ME

Celebrating 35 Years
1973 • 2008

June 5, 2009

Ms. Jackie Drummond
North Carolina Department of Environment and Natural Resources
Division of Waste Management
Solid Waste Section
1646 Mail Service Center
Raleigh, N.C. 27699-1646

Reference: **Duke Energy Carolinas – Belews Creek Steam Station**
Pine Hall Road Ash Landfill
Permit # 85-03
Semi-Annual Groundwater Monitoring Report

Dear Ms. Drummond:

This report presents the semi-annual groundwater monitoring for the Pine Hall Road Ash Landfill (Permit #85-03). The landfill is located at Duke Energy's Belews Creek Steam Station in Stokes County. Groundwater sampling for the landfill was performed on April 21 and 22, 2009. S&ME is submitting this report on the behalf of Duke Energy.

The Groundwater Monitoring Report for the sampling event includes a summary of the analytical results, a figure showing groundwater contours at the site, and preliminary evaluation of values in excess of the NCAC 2L groundwater standards. Also attached is the Environmental Monitoring Reporting Form. An EXCEL file containing the laboratory results in the Electronic Data Deliverable format will be sent to you by e-mail.

If you have questions or require additional information, please contact me at 828-687-9080.

Sincerely,

S&ME, Inc.

NORTH CAROLINA PROFESSIONAL SEAL 17661 ENGINEER WILLIAM M. MILLER

William M. Miller, P.E.
Senior Project Engineer

Larry Armstrong, P.E.
Senior Engineer

North Carolina Professional Engineering Firm License No. F-0176

WMM/LA/

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Chain of Custody Form

1.0 EXECUTIVE SUMMARY

Thirteen (13) monitoring wells were sampled at the Pine Hall Road Ash Landfill on April 21 and 22, 2009, as the semi-annual sampling for the landfill.

The landfill at the Duke Energy Carolinas Belews Creek Steam Station is located in Stokes County, North Carolina. The following groundwater monitoring wells comprise the groundwater monitoring system for the landfill permitted under NCDENR Solid Waste Permit #85-03.

MW-1	MW2-7
MW-2	MW2-9
MW-3	OB-4
MW-4	OB-5
MW-5	OB-9
MW-6	MW-1D
MW-7	

Monitoring well MW-3 is considered to represent "background" groundwater quality. MW-1D is installed as a deep or rock well.

In addition to the compounds analyzed during the previous semi-annual groundwater monitoring events, the groundwater samples were analyzed for Appendix I compounds. Appendix I sampling and analysis was performed as part of the requirements contained in the Closure Plan Approval letter dated December 7, 2007, Document ID RC03425. Condition 11 of that document states:

> *Ground-water and surface water samples should be analyzed for Appendix I constituents in addition to currently analyzed constituents semi-annually. Appendix I analytical data will be evaluated, and based on results, the compliance Branch of the SWS may not require continued Appendix I analysis.*

Surface water sample locations SW-1 and SW-2 are included in the monitoring system. However, for the April 2009 sampling event, no surface water samples were collected at either location. No flow was observed at location SW-1 and no sample was collected. Location SW-2 is located on the side slope of a steep drainage feature and no sample was collected due to safety concerns.

Groundwater elevations were measured at the sampled monitoring wells on the day that the groundwater samples were collected.

The sampling was conducted by Duke Energy according to North Carolina Solid Waste Management Guidelines and the parameters were sampled and analyzed for compounds determined by Duke and NCDENR Division of Solid Waste. Samples were analyzed by a North Carolina certified laboratory.

Semi-Annual Compounds

Results were below the corresponding NCAC 2L groundwater quality standards from the sampled monitoring wells with the exceptions noted below:

- pH – pH values below 6.5 were measured wells MW-1, MW-2, MW-3,MW-4, MW-5, MW-6, MW-7, MW2-7, MW2-9, OB-5, and OB-9.
- Arsenic – A concentration in excess of the NCAC 2L groundwater quality standard for arsenic of 50 µg/L was measured in well OB-4.
- Boron - Concentrations in excess of the NCAC 2L groundwater quality standard for boron of 315 µg/L were measured in wells MW2-7, MW2-9, OB-4, and OB-9.
- Cadmium – A concentration in excess of the NCAC 2L groundwater quality standard for cadmium of 1.75 µg/L was measured in well OB-9.
- Iron – Concentrations in excess of the NCAC 2L groundwater quality standard for iron of 300 µg/L were measured in wells MW-1, MW-2, MW-3, MW-5,MW-6, MW-7, MW2-9, and OB-5.
- Manganese – Concentrations in excess of the NCAC 2L groundwater quality standard for manganese of 50 µg/L were measured in monitoring wells MW-1D, MW-7, MW2-7, MW2-9, OB-4, and OB-9.
- Nitrate (as Nitrogen) – A concentrations in excess of the NCAC 2L groundwater quality standard for nitrate (as nitrogen) 10000 µg/L was measured in monitoring well MW2-7.
- Selenium – Concentrations in excess of the NCAC 2L groundwater quality standard for selenium of 50 µg/L were measured in monitoring wells MW2-7, OB-4, and OB-9.
- Sulfate – Concentrations in excess of the NCAC 2L groundwater quality standard for sulfate of 250,000 µg/L were measured in monitoring wells MW2-7, OB-4, and OB-9.
- Total Dissolved Solids – Concentrations in excess of the NCAC 2L groundwater quality standard for total dissolved solids of 500,000 µg/L were measured in monitoring wells MW2-7, OB-4, and OB-9.

Results were below the corresponding Solid Waste Section Limits (SWSL) for all of the sampled wells with the exceptions noted below:

- Arsenic – A concentration of arsenic in excess of the SWSL standard of 10 µg/l was measured in well OB-9.
- Barium - Concentrations of barium in excess of the SWSL standard of 100 µg/l were measured in wells MW2-7, and OB-5.
- Chromium – Concentrations of chromium in excess of the SWSL standard of 10 µg/l were measured in wells MW-4, and MW-7.

- Copper – A concentration of copper in excess of the SWSL standard of 10 µg/l was measured in well MW-5.
- Lead – A concentration of lead in excess of the SWSL standard of 10 µg/l was measured in well MW-7.
- Nitrate (as Nitrogen) – Concentrations of nitrate (as nitrogen) in excess of the SWSL standard of 1000 µg/l were measured in wells MW-1D, MW2-9, OB-4, and OB-9.
- Zinc – Concentration of zinc in excess of the SWSL standard of 10 µg/l were measured in wells MW-5, MW-7, and OB-9.

Appendix I Compounds
Results were below the corresponding NCAC 2L groundwater quality standards from the sampled monitoring wells with the exceptions noted below:

- Arsenic – A concentration in excess of the NCAC 2L groundwater quality standard for arsenic of 50 µg/L was measured in well OB-4.
- Selenium – Concentrations in excess of the NCAC 2L groundwater quality standard for selenium of 50 µg/L were measured in monitoring wells MW2-7, OB-4, and OB-9.
- Benzene – A concentration in excess of the NCAC 2L groundwater quality standard for benzene of 1 µg/L was measured in well MW-7.
- 1,2 Dichlorethane – A concentration in excess of the NCAC 2L groundwater quality standard for 1,2 Dichlorethane of 0.38 µg/L was measured in well MW-6.

Results were below the corresponding Solid Waste Section Limits (SWSL) for all of the sampled wells with the exceptions noted below:

- Antimony – A concentration in excess of the SWSL standard of 6 µg/l was measured in well OB-4.
- Arsenic – A concentration in excess of the SWSL standard of 10 µg/l was measured in well OB-9.
- Beryllium – Concentrations in excess of the SWSL standard of 1 µg/l were measured in wells MW-7, MW2-7, and OB-9.
- Cadmium – A concentration in excess of the SWSL standard of 1 µg/l was measured in well OB-9.
- Chromium – A concentration in excess of the SWSL standard of 10 µg/l was measured in well MW-4.
- Cobalt – Concentrations in excess of the SWSL standard of 10 µg/l was measured in wells MW-7 and MW2-9.
- Copper – A concentration in excess of the SWSL standard of 10 µg/l was measured in well MW-5.

- Lead – A concentration in excess of the SWSL standard of 10 µg/l was measured in well MW-7.
- Thallium– A concentration in excess of the SWSL standard of 5.5 µg/l was measured in well OB-4.
- Vadadium– Concentrations in excess of the SWSL standard of 25 µg/l was measured in well MW-5, MW-7, and OB-4.
- Zinc– Concentrations in excess of the SWSL standard of 10 µg/l was measured in wells MW-5, MW-7 and OB-9.
- Bromomethane– A concentration in excess of the SWSL standard of 1 µg/l was measured in well MW-7.
- Toluene– A concentration in excess of the SWSL standard of 1 µg/l was measured in well MW-7.
- Xylene (total) – A concentration in excess of the SWSL standard of 530 µg/l was measured in well MW-7.

The preliminary analysis of the cause and significance of these values is provided in Section 4.2. A summary of the laboratory analytical results is provided in Table 1 for the compounds sampled on a semi-annual basis. Table 2 contains the summary of the laboratory results for the Appendix I compounds.

2.0 BACKGROUND

The ash landfill is located at the Duke Energy Belews Creek Steam Station, in Stokes County, NC. The ash landfill is permitted to accept (only) fly ash from Belews Creek Steam Station operations. Belews Creek Steam Station is owned and operated by Duke Energy Carolinas (Duke).

The landfill was originally permitted in 1983. The original landfill was unlined and was permitted with a soil cap one foot thick on the side slopes and two feet thick on flatter areas. A subsequent expansion (Phase I Expansion) was permitted in 2003. This phase was also unlined, but was permitted with a synthetic cap system to be applied at closure.

After groundwater exceedences were observed in wells installed near the landfill, the placement of additional ash in the Phase I Expansion was halted. The closure design was changed to utilize an engineered, synthetic cover system for the entire landfill, both the original landfill and the Phase 1 Expansion. The construction of the synthetic cover system was completed in December 2008.

The ash landfill and nearby surrounding area is portrayed on Figure 1. The ash landfill is located to the north of the surface water divide that runs along Pine Hall Road and to the east of a surface water divide that runs along Middleton Loop Road. These surface water divides appear to serve as the groundwater divides for the area near the landfill. A surface water drainage feature is located to the west of the landfill. This drainage feature

begins to the north of Pine Hall Road and roughly parallels the western side of the landfill, draining to the north, into the Ash Basin. Groundwater flow beneath the landfill is from Pine Hall Road, generally northward, towards the Ash Basin. The Ash Basin is operated as a water treatment facility and is permitted by the NPDES program (NPDES Permit #NC0024406).

The only surface water discharge features in the landfill area is an ephemeral spring located near well MW-2-7 at surface water sampling location SW-1 and a small stream, located in the drainage feature west of the landfill footprint near SW-2. Both of these surface water features drain to the Ash Basin.

3.0 SCOPE OF WORK

To complete the scope of work, S&ME completed the following tasks:

- Received information provided by Duke on field sampling and measurement of groundwater elevations (performed by Duke) for monitoring wells MW-1, MW-1D, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW2-7, MW2-9, OB-4, OB-5, OB-9. This sampling was conducted on April 21, 22, 2009.
- Review of laboratory analytical results for samples. These analyses were performed by a North Carolina certified laboratory, using State approved methods. These results were provided in both in paper format and in an EXCEL file. The EXCEL file was manipulated to conform to the format requirements of the NCDENR Electronic Data Deliverable template.
- Develop a groundwater flow contour map using map data and groundwater elevation data supplied by Duke.
- Provide a preliminary evaluation of the cause and significance of values exceeding NC 2L groundwater standards.
- Prepared and submitted this Groundwater Monitoring Report to Duke and to NCDENR.

4.0 RESULTS

4.1 Site Groundwater Flow

Groundwater flow contours for the site are shown on **Figure 1**. These contours were developed using the measured groundwater elevations in the wells from the April 21, 22, 2009 sampling and from using the approximate surface water elevations for the Belews Creek Ash Basin.

Middleton Loop Road and Pine Hall Road are located along topographic highs and also appear to be groundwater divides. Groundwater flow at the site is from areas of higher topography along Middleton Loop Rd and Pine Hall Road towards the Ash Basin. As shown by the groundwater elevations observed at MW-2 and MW-6, there also appears to be groundwater flow from Pine Hall road towards the south-east and/or south.

4.2 Groundwater Analytical Results

As discussed in Section 1.0, groundwater samples were analyzed for the typical semi-annual compounds. In addition these samples were analyzed for Appendix I compounds as a requirement of the Closure Plan Approval.

The results of the laboratory analyses for the groundwater monitoring well samples for the typical semi-annual samples are summarized in **Table 1.** The laboratory analytical results for the Appendix I compounds are listed in **Table 2.** A summary of the field data is found in **Table 3.**

Semi-Annual Compounds

Results from the monitoring wells were below the corresponding NCAC 2L groundwater quality standards with the exceptions noted below:

- pH – pH values below 6.5 were measured wells MW-1, MW-2, MW-3,MW-4, MW-5, MW-6, MW-7, MW2-7, MW2-9, OB-5, and OB-9. The detected pH values below 6.5 ranged from 4.9 in MW-1 to 6.3 in MW2-9.

  Monitoring well MW-3 is considered to be a background well and should not be impacted by the landfill. The pH values measured in MW-3 was 5.4. The pH values measured in the other wells are similar in magnitude and are consistent with historic readings at the site.

- Arsenic – A concentration in excess of the NCAC 2L groundwater quality standard for arsenic of 50 µg/L was measured in well OB-4. Well OB-4 is located inside of the review boundary and located adjacent to an ash dike constructed as part of the landfill subgrade. The arsenic values for the April sampling are consistent with historic values.

- Boron - Concentrations in excess of the NCAC 2L groundwater quality standard for boron of 315 µg/L were measured in wells MW2-7, MW2-9, OB-4, and OB-9. Wells OB-4, OB-9, and MW-2-7 are within the Review Boundary. Well MW2-9 is approximately 65 feet outside of the landfill Review Boundary, and approximately 10 feet outside of the Ash Basin Review Boundary. Groundwater flow in this region is towards the Ash Basin. It not anticipated that significant boron concentrations are flowing in any direction other than towards the Ash Basin.

- Cadmium – A concentration in excess of the NCAC 2L groundwater quality standard for cadmium of 1.75 µg/L was measured in well OB-9. Well OB-9 is approximately 100 feet inside of the Review Boundary.

- Iron – Concentrations in excess of the NCAC 2L groundwater quality standard for iron of 300 µg/L were measured in wells MW-1, MW-2, MW-3, MW-5,MW-6, MW-7, MW2-9, and OB-5.

  Values for MW-1, MW-2, MW-5, and MW-6 are consistent with historic readings and compare reasonable well with the values for Fe measured at background well MW-3. Well OB-5 is well within the Review Boundary.

US EPA recommends that when sampling for contaminants that may be biased by the presence of turbidity, the turbidity reading is desired to stabilize at a value below 10 Nephelometric Turbidity Units (NTUs).[1] Turbidity values measured in wells MW-6, MW2-7, MW2-9, OB-5 were lower than 10 NTU (Table 3). The turbidity measured in well MW-7 was 664.0, making it difficult to determine if the Fe measured is from soil particles or from impacts from the landfill to groundwater. The elevated Fe concentrations for MW2-9 may be caused by groundwater flowing from the landfill. As described above, the groundwater flow through MW2-9 is towards the Ash Basin.

- Manganese – Concentrations in excess of the NCAC 2L groundwater quality standard for manganese of 50 µg/L were measured in monitoring wells MW-1D, MW-7, MW2-7, MW2-9, OB-4, and OB-9.

  Well MW-1D is located within the Review Boundary. This well was initially sampled on December 15, 2008 with a reading of 15.7 ug/L Mn. The recent sampling result was 483 ug/L Mn. No other parameters were observed in this well that clearly indicates influence from the landfill. As described above, the turbidity readings for well MW-7 were elevated and could be the reason for the elevated Mn values. Additional sampling events are needed to determine if the elevated Mn values are from the landfill.

  The elevated Mn concentrations for MW2-9 may be caused by groundwater flowing from the landfill. As described above, the groundwater flow through MW2-9 is towards the Ash Basin.

  Wells OB-4 and OB-5 are located within the Review Boundary.

- Nitrate (as Nitrogen) – A concentrations in excess of the NCAC 2L groundwater quality standard for nitrate (as nitrogen) 10,000 µg/L was measured in monitoring well MW2-7. The nitrate concentrations in this well have been increasing since the 2005-2006 period. This increase may be due to impacts from fertilizer applied as part of the erosion and sediment control for this portion of the landfill.

- Selenium – Concentrations in excess of the NCAC 2L groundwater quality standard for selenium of 50 µg/L were measured in monitoring wells MW2-7, OB-4, and OB-9. All three wells are located inside of the review Boundary.

- Sulfate – Concentrations in excess of the NCAC 2L groundwater quality standard for sulfate of 250,000 µg/L were measured in monitoring wells MW2-7, OB-4, and OB-9. All three wells are located inside of the review Boundary.

- Total Dissolved Solids – Concentrations in excess of the NCAC 2L groundwater quality standard for total dissolved solids of 500,000 µg/L were measured in monitoring wells MW2-7, OB-4, and OB-9. All three wells are located inside of the review Boundary.

[1] Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers, Ground Water Forum Issue Paper, EPA 542-S-02-001, May 2002, Yeskis and Zavala.

Appendix I Compounds

Results from the monitoring wells were below the corresponding NCAC 2L groundwater quality standards for the Appendix I compounds with the exceptions noted below. Only those Appendix I compounds which are not also sampled semi-annually are discussed below.

- Benzene – A concentration in excess of the NCAC 2L groundwater quality standard for benzene of 1 µg/L was measured in well MW-7. Benzene is not typically associated with leachate from fly ash. The observed benzene may be associated with motor fuels used during landfill operations/closure.
- 1,2 Dichlorethane – A concentration in excess of the NCAC 2L groundwater quality standard for 1,2 Dichlorethane of 0.38 µg/L was measured in well MW-6. Also known as 1,2 DCA, this compound was used as a lead scavenger in gasoline until around 1988 and is used in solvents. This compound is not typically associated with leachate from fly ash. The observed 1,2 Dichloroetane may be from activities associated with motor fuels used at the landfill or solvents used for equipment maintenance.

4.3 Surface Water Analytical Results

No surface water samples were collected this sampling period. No flow was present at location SW-1. Location SW-2 is located in a steep ravine. Due to concerns over safe access to this location, no samples were collected.