ALTAMONT ENVIRONMENTAL, INC.
ENGINEERING & HYDROGEOLOGY
231 HAYWOOD STREET, ASHEVILLE, NC 28801
TEL.828.281.3350 FAC.828.281.3351
WWW.ALTAMONTENVIRONMENTAL.COM

February 9, 2012

Ms. Elizabeth Werner
North Carolina Department of Environment and Natural Resources
Division of Waste Management
Solid Waste Section
1646 Mail Service Center
Raleigh, NC 27699-1636

Subject: Duke Energy Carolinas, LLC
Marshall Steam Station
Catawba County, NC
Dry Ash Landfill, Permit No. 1804
Monitoring Well MW-3 Assessment

Dear Ms. Werner:

On behalf of Duke Energy Carolinas, LLC (Duke), Altamont Environmental Inc. submits the proposed *Groundwater Assessment Work Plan, Marshall Steam Station, Dry Ash Landfill, Permit No. 1804, February 9, 2012.* This proposed assessment work plan is submitted in response to your letter of November 9, 2011 to Mr. Ed Sullivan, P.E. (Duke Energy), DOC ID 15489.

Altamont Environmental Inc. appreciates the opportunity to provide this information to the North Carolina Department of Environment and Natural Resources and to assist Duke Energy with these projects. Please call (828) 281-3350 if you have any questions or require additional information.

Sincerely,

ALTAMONT ENVIRONMENTAL, INC.

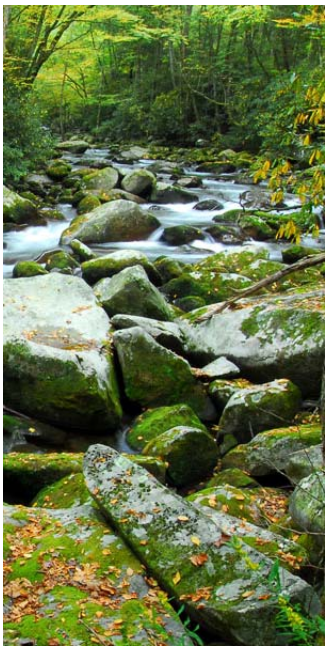
William M. Miller

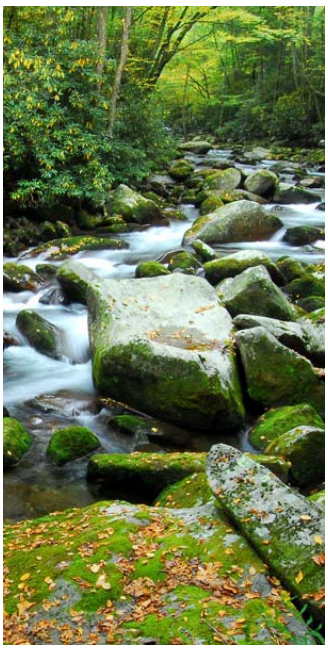
William M. Miller, P.E.
Project Manager

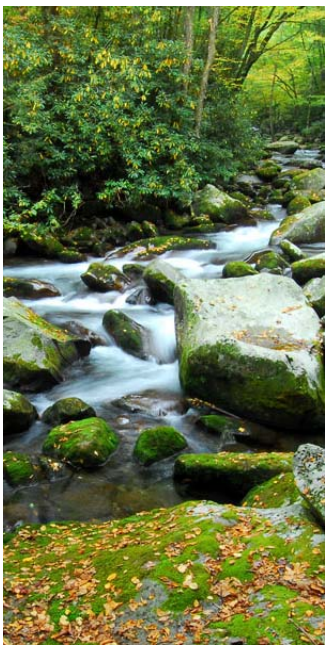
enclosure: *Groundwater Assessment Work Plan, Marshall Steam Station, Dry Ash Landfill, Permit No. 1804, February 9, 2012.*

cc: Mark Poindexter, SWS, mark.poindexter@ncdenr.gov
Jason Watkins, SWS, jason.watkins@ncdenr.gov
Ellen Lorscheider, SWS, ellen.lorscheider@ncdenr.gov
Deb Aja, SWS, deborah.aja@ncdenr.gov
Ed Sullivan, P.E., Duke, Ed.Sullivan@duke-energy.com
Donna Burrell, Duke, Donna.Burrell@duke-energy.com

P:\Duke - Environmental Engineering - 2371\2371.13 Landfill Assessments\Assessment Work Plans\MSS\Dry Ash Landfill\Transmittal Letter Feb 9_Mssdryash.Docx







ALTAMONT ENVIRONMENTAL, INC.

ENGINEERING & HYDROGEOLOGY

Groundwater Assessment Work Plan

Marshall Steam Station

Dry Ash Landfill, Permit No. 1804

February 9, 2012

Prepared for
Duke Energy Carolinas, LLC
8320 East NC Highway 150
Terrell, NC 28682
Project Number 2371.13

Prepared by
Altamont Environmental, Inc.
231 Haywood Street
Asheville, NC 28801
(828) 281-3350

Professional Certification

On behalf of Altamont Environmental, Inc., a firm licensed to practice engineering (certification number C-2185) in the State of North Carolina, I do hereby certify that the information contained in this report is correct and accurate to the best of my knowledge.

William M. Miller 2/9/12

William M. Miller, P.E.

Table of Contents

Professional Certification ii

1.0 Introduction 1

2.0 Background 2

2.1 Site Description 2

2.2 Site Geology and Hydrogeology 2

2.3 Description of Monitoring System 2

2.4 Site Groundwater Flow 3

3.0 Groundwater Quality 4

4.0 Proposed Groundwater Assessment Work Plan 5

4.1 Proposed Groundwater Assessment Work Plan for Well MW-3 5

4.2 Proposed Groundwater Assessment Work Plan for Wells MW-2 and MW-5 5

5.0 Assessment Report and Project Schedule 6

Figures

1. Site Location Map
2. Sample Locations
3. Generalized Groundwater Surface Contours

Tables

1. 2L Standard Groundwater Quality Exceedances for Wells at or Beyond the Compliance Boundary
2. 2L Standard Groundwater Quality Exceedances for Wells at or Beyond the Review Boundary
3. Method of Assessment for Monitoring Wells at or Beyond the Compliance Boundary
4. Method of Assessment for Monitoring Wells at or Beyond the Review Boundary

Appendices

A. Letter from North Carolina Department of Environment and Natural Resources. November 9, 2011. To Ed Sullivan, P.E., Duke Energy. DOC ID 15489.

1.0 Introduction

The Marshall Steam Station Dry Ash Landfill, Permit No. 1804, is located at the Marshall Steam Station in Catawba County and is owned and operated by Duke Energy Carolinas, LLC (Duke).

In a letter, dated November 9, 2011,[1] to Mr. Ed Sullivan, P.E. of Duke Energy Carolinas, LLC (Duke), the North Carolina Department of Environment and Natural Resources (DENR) Division of Waste Management (DWM) stated that exceedances of groundwater standards, established in Title 15A North Carolina Administrative Code (NCAC) Subchapter 2L .0202 Groundwater Quality Standards (2L standards), were reported in groundwater samples collected from groundwater monitoring well MW-3 during the February 8, 2011 monitoring event. The letter is included as Appendix A.

Monitoring well MW-3 is located at the compliance boundary. DENR also stated that industrial landfills are required to comply with the 2L standards at the compliance boundary in accordance with 15A NCAC 13B .0503 (2)(d)(iv).

In addition, the DENR letter stated that concentrations of boron, manganese, and selenium were reported at concentrations above their respective 2L standards in groundwater monitoring wells MW-2 and MW-5. These wells are located at the review boundary.

DENR stated that based on these exceedances, Duke shall submit a groundwater assessment work plan to the DWM Solid Waste Section. This document, prepared by Altamont Environmental Inc. (Altamont) on behalf of Duke, presents the proposed groundwater assessment work plan.

[1]North Carolina Department of Environment and Natural Resources. Division of Waste Management. November 9, 2011, Monitoring Well MW-3 Assessment. Duke Energy – Marshall Steam Dry Ash Landfill. DOC ID 15489.

2.0 Background

2.1 Site Description

Marshall Steam Station (Marshall) is owned and operated by Duke Energy Carolinas, LLC (Duke). Marshall is a four-unit, coal-fired generating facility with a generating capacity of approximately 2070 megawatts. Marshall is the second largest coal facility owned by Duke Energy in the Carolinas and generates enough electricity to power approximately 2 million homes. Since it began commercial operation in 1965, Marshall has been among the most efficient power plants in the nation.

Marshall is located in Catawba County, on Lake Norman (Figure 1). Two ash landfills are permitted at the Marshall Steam Station under the North Carolina Department of Environment and Natural Resources (DENR) Solid Waste Permit No. 1804. These landfills were permitted to receive fly ash generated at Marshall. Both of the landfills are closed and no longer accept fly ash.

The location of the landfill areas is shown on Figure 1. The larger of the two ash landfills has an area of approximately 47 acres. The smaller of the two ash landfills is approximately 14.5 acres in area.

The ash landfill areas are located north and east of the steam station and are located adjacent to the Marshall ash basin. Bottom ash generated by the station is sluiced to the ash basin, along with water discharged from various station systems. Among these flows into the ash basin is the discharge from the Flue Gas Desulfurization system wastewater treatment system. The ash basin is operated under National Pollution Discharge Elimination System (NPDES) Permit Number NC0004987.

The groundwater monitoring wells referenced in the DENR letter are located at the larger landfill. The ground surface in the area of the larger landfill slopes from the elevation along Island Point Road (located north of the landfill, approximate elevation 880 feet to 890 feet), downward toward the Marshall Ash Basin, with a surface water elevation of approximately 790 feet. Lake Norman is located to the east of the Marshall Ash Basin. The full pond elevation of Lake Norman is 760 feet.

2.2 Site Geology and Hydrogeology

The Marshall Steam Station is located in the Piedmont Physiographic Province of North Carolina, within the King's Mountain Belt. The rocks in the area were formed during the Precambrian era and metamorphosed during the Paleozoic era and consist of schist, gneiss, diorite, and granite. The soils that overlie the bedrock in the area have generally formed from the in-place weathering of the parent bedrock. These soils are termed residuum (residual soils) and saprolite. The residuum is typically finer-grained and has a higher clay content than the underlying saprolite. The highly weathered saprolite generally retains the overall structure and appearance of the underlying bedrock. The saprolite grades into partially weathered rock and finally into bedrock.

Groundwater generally occurs within the residuum and saprolite under unconfined conditions. Often, the heterogeneous nature of the soil results in variable porosities and permeabilities both laterally and vertically. However, low permeability units that would result in confining conditions between the overlying soils and bedrock are generally absent. In the underlying bedrock, groundwater occurs predominately in fractures and joints and flow may occur under either unconfined or confined conditions.

2.3 Description of Monitoring System

The groundwater monitoring system at the landfill consists of five groundwater monitoring wells: MW-1, MW-2, MW-3, MW-4, and MW-5. The locations of the wells are shown on Figure 2. Monitoring wells MW-2, MW-3, and MW-5 are located adjacent to the larger, 47 acre ash landfill. Monitoring well MW-1 is located

adjacent to the smaller, 14.5 acre ash landfill. Observation well OB-1, also located at the smaller ash landfill is used only to measure groundwater elevation.

Monitoring well MW-4 is located upgradient from the 47-acre landfill and is described in the *Post-Closure Ground-Water Monitoring Program Sampling and Analysis Plan*[2] as representing upgradient groundwater quality. An observation well, OB-1, is located adjacent to the smaller fill and is used only to measure groundwater levels. All of the groundwater monitoring wells are screened to monitor groundwater in the saprolite layer.

A portion of the ash basin (groundwater) compliance boundary is also shown on Figure 2. Landfill groundwater monitoring wells MW-1, MW-2, MW-3, and MW-5 are located inside of the ash basin compliance boundary. Landfill groundwater monitoring well MW-4 appears to be located near the ash basin compliance boundary.

2.4 Site Groundwater Flow

Generalized groundwater surface contours for the site are shown on Figure 3. These contours were developed using the groundwater elevations measured in the wells during the August 8, 2011 groundwater sampling event and by using the approximate surface water elevations for the Marshall ash basin and the adjacent Lake Norman.

Groundwater flow at the 47 acre landfill site is generally from areas of higher topography to the southwest, toward the ash basin and to the southeast toward an inactive portion of the ash basin. Well MW-4 is located north of the landfill and is at the highest topographic elevation. Groundwater flow is generally from MW-4 toward the 47-acre landfill flowing southwest towards the ash basin. It is expected that flow would be from the topographically higher region north of MW-3 and MW-5 toward the landfill, or in the case of MW-5, toward the inactive portion of ash basin located to the southeast of the landfill.

Well MW-2 is located adjacent to shore of the ash basin. Based on the location of the well and the observed water levels in the well relative to the ash basin pond elevation, the well is likely influenced more by the ash basin than from groundwater flowing from the landfill.

The water elevation at well MW-3 is approximately the same as the pond elevation of the two adjacent ponded areas. These ponded areas are part of the ash basin that was cut off from the remainder of the ash basin by construction of the landfill.

Well MW-5 is located adjacent to the landfill and is adjacent to an inactive portion of the ash basin. This inactive portion of the ash basin no longer contains appreciable free water and is filled with ash that was removed from the ash basin.

The groundwater flow in the region near the smaller fill area (14.5-acre landfill) appears to be from the ash basin (approximate elevation 790 feet) toward the arm of Lake Norman (approximate elevation 760 feet) located east of wells OB-1 and MW-1.

[2] Marshall Steam Station Industrial Landfill-Phase II Permit #18-04 *Post-Closure Ground-Water Monitoring Program Sampling and Analysis Plan*. Dated September 20, 1999, Duke Power.

3.0 Groundwater Quality

In accordance with the *Post-Closure Ground-Water Monitoring Program Sampling and Analysis Plan*[3], the groundwater monitoring is performed semi-annually in February and August. Sampling results are submitted to DENR within 90 days of sampling.

As noted in the DENR letter dated November 9, 2011, exceedances of the 2L standards were reported for groundwater monitoring wells during the February 8, 2011 monitoring event. After review of the DENR November 9, 2011 letter, a telephone conversation was conducted between representatives from DENR, Duke, and Altamont concerning these exceedances. Participating in that conversation were Ms. Elizabeth Werner, Hydrogeologist (DENR), Mr. Ed Sullivan, P.E. (Duke), and Mr. Bill Miller, P.E. (Altamont). During the conversation, Duke proposed that exceedances reported in groundwater sampling events, conducted more recently than the event noted in the DENR letter of November 9, 2011, would be addressed in the proposed assessment work plan. DENR agreed with this proposal.

Table 1 presents the 2L exceedances reported for groundwater monitoring well MW-3, located at the compliance boundary.

Table 2 presents the 2L exceedances reported for groundwater monitoring wells MW-2 and MW-5, located at the review boundary.

[3] Marshall Steam Station Industrial Landfill-Phase II Permit #18-04 *Post-Closure Ground-Water Monitoring Program Sampling and Analysis Plan*. Dated September 20, 1999, Duke Power.

4.0 Proposed Groundwater Assessment Work Plan

4.1 Proposed Groundwater Assessment Work Plan for Well MW-3

The proposed groundwater assessment plan for evaluating the 2L standard exceedances at well MW-3 is provided in Table 3. In general, the proposed groundwater assessment plan for this well is to evaluate if the 2L exceedances at this well can be attributed to the site background water quality and/or if the exceedances can be attributed to sediment or particulate matter, which is preserved in the groundwater samples as a result of well construction or groundwater sampling.

4.2 Proposed Groundwater Assessment Work Plan for Wells MW-2 and MW-5

The proposed groundwater assessment plan for evaluating the 2L exceedances at wells MW-2 and MW-5 is provided in Table 4.

Well MW-2 is located adjacent to the shore of the ash basin. Based on the location of the MW-2 and the observed water levels in the well relative to the ash basin pond elevation, the well has the potential of being influenced more by the ash basin water quality than from water quality of the groundwater flowing from the landfill. In general, the proposed assessment plan for this well will be to review the available water quality parameters for the ash basin and compare this data to the historic water quality parameters measured at MW-2 to determine if the exceedances are related to ash basin water quality.

Well MW-5 is located adjacent to the landfill. A surface water drainage feature, at a lower elevation than the well, is located between the well and the landfill. A review of the screen elevation for MW-5 indicates that the lowest elevation of the well screen may be higher in elevation than the surface water feature. If this is the case, MW-5 may be monitoring groundwater that is not flowing from the landfill. The elevation of the well screen will be accurately determined relative to the adjacent surface water feature. If the elevation survey determines that MW-5 is monitoring groundwater flow from the landfill, then the proposed groundwater assessment plan for MW-5 is to evaluate if the 2L exceedances can be attributed to the site background water quality and/or if the exceedances can be attributed to sediment or particulate matter, which is preserved in the groundwater samples as a result of well construction or groundwater sampling.

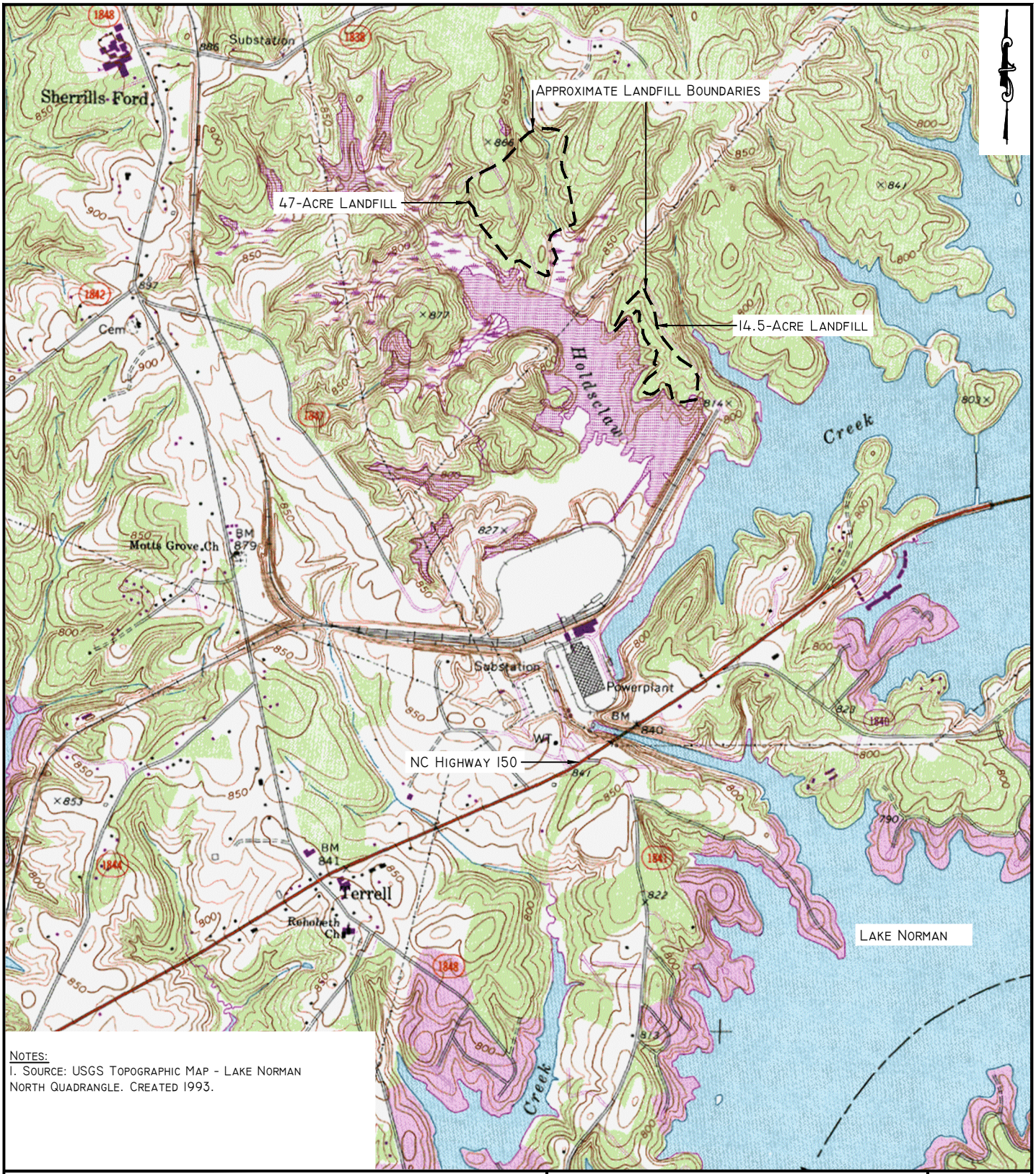
5.0 Assessment Report and Project Schedule

The groundwater assessment report will present results of the work proposed in Section 4.0 and will include interpretations of the results and recommendations for additional work, if deemed necessary. The next groundwater sampling event is scheduled in August 2012. The groundwater assessment report will include analytical results from the August 2012 groundwater sampling event.

The report will be prepared by a North Carolina Professional Engineer.

The project schedule is to submit the groundwater assessment report 120 days after the next scheduled groundwater sampling event unless redevelopment of one or more of the monitoring wells is required. The groundwater assessment report will be submitted 150 days after the next scheduled groundwater sampling event if redevelopment of one or more of the monitoring wells is required. The next groundwater sampling event is scheduled in August 2012. The proposed report submittal date is contingent upon DENR approval of the proposed groundwater assessment work plan by March 30, 2012.

FIGURES



Notes:
1. Source: USGS Topographic Map - Lake Norman North Quadrangle. Created 1993.

Altamont Environmental, Inc.
Engineering & Hydrogeology
231 Haywood Street, Asheville, NC 28801
Tel.828.281.3350 Fax.828.281.3351
www.altamontenvironmental.com

Site Location Map

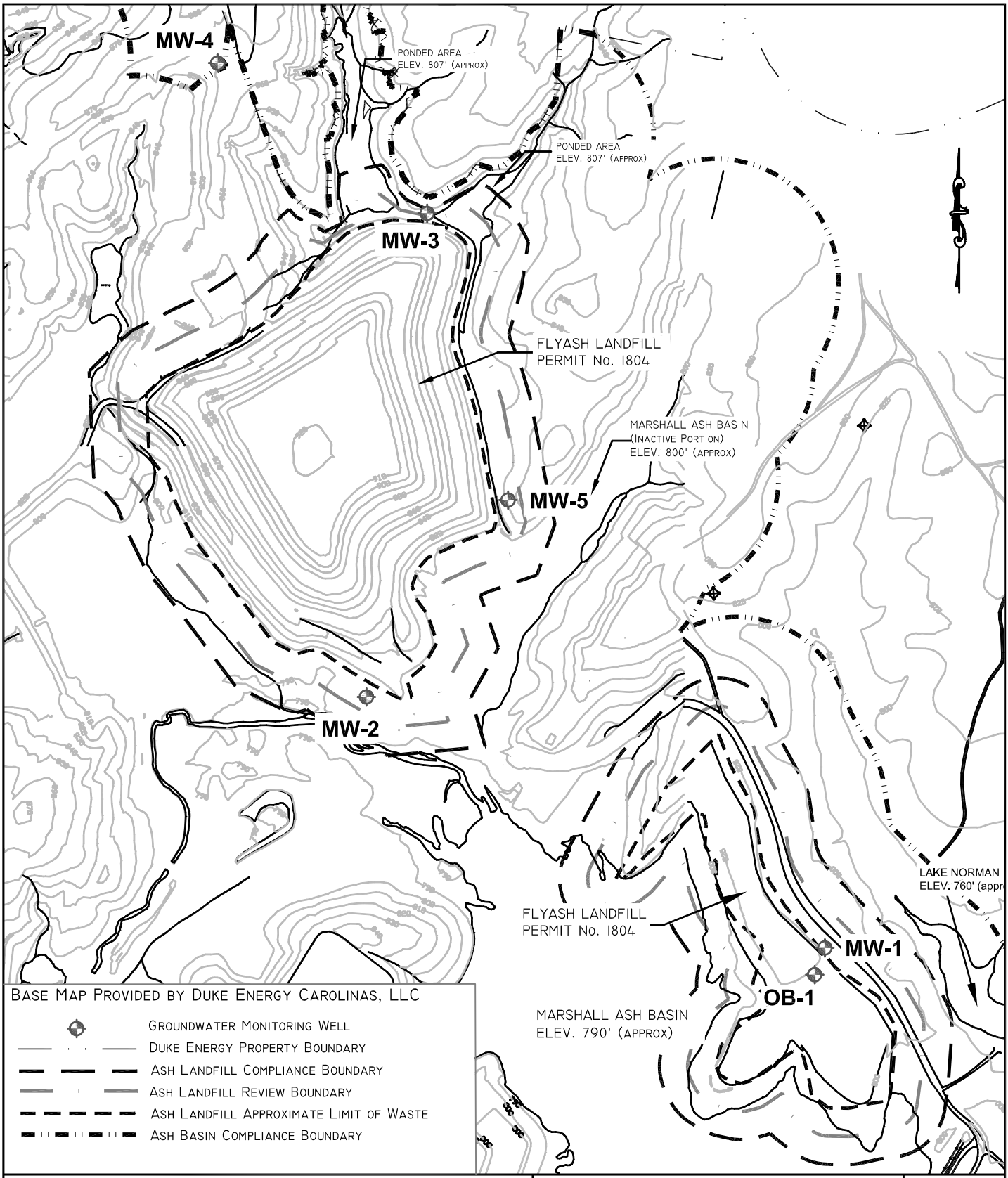
Marshall Steam Station
Dry Ash Landfill Permit No. 1804

Figure 1

Drawn by: Andrew Moore
Project Manager: William M. Miller
Client: Duke Energy Carolinas, LLC
Date: 2/9/12

Scale (feet)
1000 0 1000 2000

File Path: P:\Duke-LF Groundwater Reports-2369\2369.05 MSS Ash LF\Figures\Site Location Map



ALTAMONT ENVIRONMENTAL, INC.
ENGINEERING & HYDROGEOLOGY
231 HAYWOOD STREET, ASHEVILLE, NC 28801
TEL.828.281.3350 FAC.828.281.3351
WWW.ALTAMONTENVIRONMENTAL.COM

SAMPLE LOCATIONS

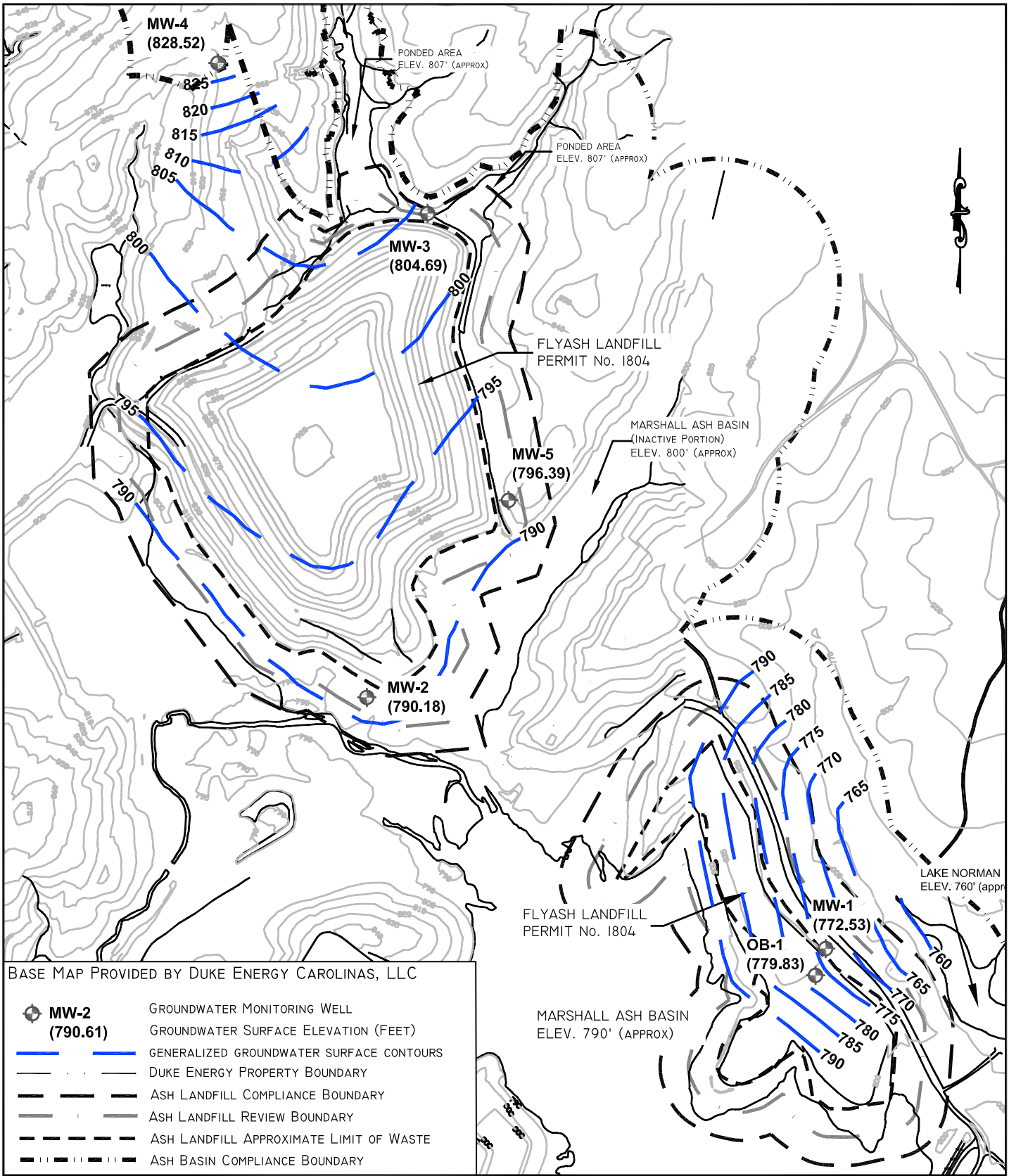
MARSHALL STEAM STATION
DRY ASH LANDFILL PERMIT No. 1804

FIGURE
2

DRAWN BY: ANDREW MOORE
PROJECT MANAGER: WILLIAM M. MILLER
CLIENT: DUKE ENERGY CAROLINAS, LLC
DATE: 2/9/12

SCALE (FEET)
300 0 300 600

FILE PATH: P:\DUKE-LF GROUNDWATER REPORTS-2369\2369.05 MSS ASH LF\2011\AUGUST SAMPLING\FIGURES\MARSHALL ASH LANDFILL



BASE MAP PROVIDED BY DUKE ENERGY CAROLINAS, LLC

MW-2 (790.61)	GROUNDWATER MONITORING WELL GROUNDWATER SURFACE ELEVATION (FEET)
	GENERALIZED GROUNDWATER SURFACE CONTOURS
	DUKE ENERGY PROPERTY BOUNDARY
	ASH LANDFILL COMPLIANCE BOUNDARY
	ASH LANDFILL REVIEW BOUNDARY
	ASH LANDFILL APPROXIMATE LIMIT OF WASTE
	ASH BASIN COMPLIANCE BOUNDARY

ALTAMONT ENVIRONMENTAL, INC.
ENGINEERING & HYDROGEOLOGY
231 HAYWOOD STREET, ASHEVILLE, NC 28801
TEL.828.281.3350 FAC.828.281.3351
WWW.ALTAMONTENVIRONMENTAL.COM

GENERALIZED GROUNDWATER SURFACE CONTOURS

AUGUST 8, 2011
MARSHALL STEAM STATION
DRY ASH LANDFILL PERMIT No. 1804

FIGURE 3

DRAWN BY: ANDREW MOORE
PROJECT MANAGER: WILLIAM M. MILLER
CLIENT: DUKE ENERGY CAROLINAS, LLC
DATE: 2/9/12

SCALE (FEET)
300 0 300 600

FILE PATH: P:\DUKE-LF GROUNDWATER REPORTS-2369\2369.05 MSS ASH LF\2011\AUGUST SAMPLING\FIGURES\MARSHALL ASH LANDFILL

TABLES

Table 1
2L Standard Groundwater Quality Exceedances for Wells at or Beyond the Compliance Boundary
Marshall Dry Ash Landfill, Catawba County, North Carolina

Well ID	Parameter	Sample Date for Exceedance	Date of Report	Analytical Result (µg/L)	15A NCAC 2L Standard (µg/L)
MW-3	Manganese	August 8, 2011	November 2, 2011	58.18	50

Notes:

1. 15A NCAC 2L Standard is from "North Carolina Administrative Code, Title 15A: Department of Environment and Natural Resources, Subchapter 2L - Groundwater Classifications and Standards," DENR (last amended on January 1, 2010).
2. Analytical results provided by Duke Energy Carolinas, LLC.
3. Since the compliance boundary is located beyond the review boundary, these wells are located beyond the review boundary.

Table 2
2L Standard Groundwater Quality Exceedances for Wells at or Beyond the Review Boundary
Marshall Dry Ash Landfill, Catawba County, North Carolina

Well ID	Parameter	Sample Date for Exceedance	Date of Report	Analytical Result (µg/L)	15A NCAC 2L Standard (µg/L)
MW-2	Boron	August 8, 2011	November 2, 2011	2,901	700
	Selenium	August 8, 2011	November 2, 2011	44.05	20
MW-5	Manganese	February 8, 2011	May 11, 2011	51.9	50

Notes:

1. 15A NCAC 2L Standard is from "North Carolina Administrative Code, Title 15A: Department of Environment and Natural Resources, Subchapter 2L - Groundwater Classifications and Standards," DENR (last amended on January 1, 2010).
2. Analytical results provided by Duke Energy Carolinas, LLC.
3. These wells are located inside of the compliance boundary, but outside of the review boundary.

Table 3
Method of Assessment for Monitoring Wells
at or Beyond the Compliance Boundary
Marshall Ash Landfill, Catawba County, North Carolina

Well ID	Parameter	Method of Assessment
MW-3	Manganese	a. Review site groundwater flow to determine if groundwater flow from the landfill is toward MW-3. b. Evaluate if the sources of exceedances are naturally occurring and are from sediment or other particulate matter by performing one or more of the following: 1. Evaluate historic concentrations compared to date of initial waste placement. 2. Evaluate exceedances against background well results. 3. Evaluate exceedances against turbidity values. 4. Evaluate sampling flow rates. 5. Collect and analyze filtered and non-filtered samples. 6. Redevelop well and clean pump if steps above do not resolve issue.

Table 4
Method of Assessment for Wells
At or Beyond the Review Boundary
Marshall Dry Ash Landfill, Catawba County, North Carolina

Well ID	Parameter	Method of Assessment
MW-2	Boron, Selenium	a. Determine accurate groundwater elevation of MW-2 relative to the elevation of the ash basin: 1. Survey top of well casing, elevation of well screen, and ash basin pond elevation. b. Review water quality parameters for ash basin and compare to historic water quality parameters measured at MW-2 to determine if exccedances are related to ash basin water quality.
MW-5	Manganese	a. Review site groundwater flow to determine if groundwater flow toward MW-5 is from landfill: 1. Determine elevation of bottom of well screen relative to adjacent surface water drainage features by survey methods (surface water drainage between landfill and MW-5 and adjacent inactive ash basin area located to the south of the landfill) b. Evaluate if the sources of exceedances are naturally occurring and are from sediment or other particulate matter by performing one or more of the following: 1. Evaluate historic concentrations compared to date of initial waste placement. 2. Evaluate exceedances against background well results. 3. Evaluate exceedances against turbidity values. 4. Evaluate sampling flow rates. 5. Collect and analyze filtered and non-filtered samples. 6. Redevelop well and clean pump if steps above do not resolve issue.

APPENDIX A

LETTER FROM NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES. NOVEMBER 9, 2011. TO ED SULLIVAN, P.E., DUKE ENERGY. DOC ID 15489.

North Carolina Department of Environment and Natural Resources
Division of Waste Management

Beverly Eaves Perdue
Governor

Dexter R. Matthews
Director

Dee Freeman
Secretary

November 9, 2011

Mr. Ed Sullivan, P.E.
Mail Code EC13K
PO Box 1006
Charlotte, NC. 28201

RE: Monitoring Well MW-3 Assessment
Duke Energy – Marshall Steam Dry Ash Landfill
Permit #18-04
Catawba County
DOC ID 15489

Dear Mr. Sullivan:

A review of groundwater analytical data from the FGD Landfill indicates exceedances of groundwater standards established in 15A NCAC 2L .0202 (2L Standards) during the February 8, 2011 monitoring event. Manganese has been reported at concentrations greater than the 2L Standards in groundwater samples collected from MW-3. Monitor well MW-3 appears to be located at the compliance boundary. Industrial landfills are required to comply with the 2L standards at the compliance boundary in accordance with 15A NCAC 13B .503 (2)(d)(iv).

Duke Energy shall acquire the services of a North Carolina licensed professional geologist and submit a groundwater assessment work plan to the Solid Waste Section (Section) outlining how the reported metals contamination in MW-3 will be delineated. The Section will review the submitted work plan, approve, or request additional information or amendments before implementation. Please submit this work plan within 90 days of receiving this letter. The work plan may include, but not limited to an alternate source demonstration for the metals contamination. In addition, monitoring wells MW-2 and MW-5 have boron, manganese and selenium concentrations above their respective 2L Standards and appear to be located at the review boundary, which triggers the need for assessment.

The Section solicits your cooperation and would like to remind you that it is your responsibility to comply with the requirements of the rules and statues since the rules are self-implementing. Please contact me at (919) 707-8253 or via email Elizabeth.werner@ncdenr.gov if you have any questions or concerns regarding this letter. Thank you in advance for your anticipated cooperation in this matter.

Sincerely,

Elizabeth S Werner
Hydrogeologist

cc: William M. Miller, PE, Altamont Environmental Inc.
Mark Poindexter, SWS
Jason Watkins, SWS
Ellen Lorscheider, SWS
Deb Aja, SWS
Central File