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**FALL 2008 SEMIANNUAL WATER QUALITY
MONITORING REPORT**

**MADISON COUNTY
OPERATING SOLID WASTE FACILITY
MADISON COUNTY, NORTH CAROLINA
PERMIT # 58-03**

Prepared for
Madison County, North Carolina

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TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION	1
2.0 METHODS.....	2
2.1 Groundwater and Surface-Water Sampling.....	2
2.2 Leachate	3
3.0 FINDINGS.....	4
3.1 Analytical Results	4
3.1.1 Groundwater – Monitoring Wells.....	5
3.1.2 Surface Water	7
3.1.3 Lined Leachate Basin.....	7
3.2 Hydrogeology.....	8
3.3 Statistical Analyses	9
4.0 SUMMARY	10

FIGURES

1. Site Location Map – Madison County Operating Landfill
2. Sample Locations
3. Generalized Groundwater Flow Direction

TABLES

1. Analytical Data and Field Parameters
2. Solid Waste Section Limit Exceedance Notification
3. 2L Standard, Groundwater Protection Standard, and 2B Standard Exceedance Notification
4. Well Construction Details and Corresponding Elevations

APPENDICES

- A. Boring Log and Well Construction Detail for MW-06R
- B. Sampling Logs and Equipment Calibration Data Sheet
- C. Laboratory Analytical Reports

1.0 INTRODUCTION

The Madison County Solid Waste Department operates a solid waste facility (Operating Landfill) located on Craig Rudisill Road west of U.S. Highway 25/70 and Marshall, North Carolina (Figure 1). The Operating Landfill includes the following permitted components:

- An operating Construction and Demolition Debris (C&D) landfill cell
- An operating transfer station
- A closed C&D landfill cell
- A closed Municipal Solid Waste (MSW) landfill cell (Cell No. 1; Figure 2)

The facility also contains a lined leachate basin. State and federal regulations applicable to landfills are enforced by the North Carolina Department of Environment and Natural Resources (DENR), Division of Waste Management (DWM). The solid waste facility is permitted by the DENR DWM under Permit No. 58-03. The permit requires semiannual monitoring of groundwater, surface-water, and leachate quality.

This report documents the second semiannual groundwater, surface-water, and leachate monitoring event for 2008 and is being submitted in accordance with requirements stipulated in the DENR Solid Waste Management Rules, Title 15A, Subchapter 13B, of the North Carolina Administrative Code (15A NCAC 13B). This semiannual report provides an evaluation of groundwater, surface-water, and leachate quality for the solid waste facility.

Specifically, this report contains the following items:

- Depth to groundwater measurements and corresponding groundwater elevations
- An illustration of groundwater and surface water sampling locations
- Generalized groundwater flow direction map
- Groundwater, leachate, and surface water quality analytical results
- Sampling logs
- Laboratory analytical reports and chain-of-custody forms

2.0 METHODS

2.1 GROUNDWATER AND SURFACE-WATER SAMPLING

On October 14 through 20, 2008, Altamont Environmental, Inc. (Altamont) collected nine groundwater monitoring-well samples, two surface-water samples, and an aqueous sample from the lined leachate basin. One of the monitoring wells sampled, 5803-MW-6R, represents the background groundwater quality. This monitoring well was installed on September 30, 2008 as a replacement to the pre-existing background monitoring well, 5803-MW-6, which has been dry through the spring and late summer 2008. The 5803-MW-6R Boring Log and Well Construction Detail form are included in Appendix A. Sampling locations are shown on Figures 2 and 3.

Prior to collecting groundwater samples from the monitoring wells, the static water level was measured in each well. The monitoring wells were purged using low-flow techniques in accordance with the procedures described in *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*, United States Environmental Protection Agency (EPA), Groundwater Issues (April 1996). During purging, the pH, specific conductivity, dissolved oxygen, oxidation-reduction potential (ORP), turbidity, and temperature were measured and recorded approximately every three minutes. Well purging continued until these parameters stabilized for three consecutive readings. The required stabilization criteria were as follows:

- pH values within +/- 0.1 unit
- specific conductivity values within +/- 3 percent
- temperature, dissolved oxygen, and turbidity values within +/- 10 percent
- ORP values within +/- 10 millivolts

At that time, a groundwater sample was collected using laboratory-supplied sample bottles by a technician wearing a new pair of sterile nitrile gloves. Collected samples were immediately placed on ice in sample coolers for transport to the laboratory. Proper chain-of-custody documentation was followed during collection and transport of each sample. A trip blank was included in the sample cooler and analyzed for Appendix I Volatile Organic Compounds (VOCs).

Surface-water samples 5803-SW-01 and 5803-SW-02 were collected at designated locations from the unnamed stream, which is adjacent to the western border of the Operating Landfill. Sample 5803-SW-01 is representative of surface-water quality upstream of the Operating Landfill; 5803-SW-02 is representative of surface-water quality downstream from the landfill. Samples were collected in laboratory-supplied sample bottles by a technician wearing a new pair of sterile nitrile gloves. Collected samples were immediately placed on ice in sample coolers for transport to the laboratory. Proper chain-of-custody documentation was followed during collection and transport of each sample. As with groundwater sampling, temperature, pH, specific conductivity, dissolved oxygen, and turbidity were measured and recorded at each surface-water sampling location (Table 1).

Field parameters and additional observations pertaining to the Operating Landfill are provided on sampling logs, which are included as Appendix B. Groundwater and surface-water samples were analyzed by Pace Analytical Services, Inc. (Pace), a North Carolina Certified Laboratory, located in Asheville, North Carolina. Altamont submitted the groundwater samples collected from the monitoring wells and the surface-water samples for analyses as follows:

- Appendix I VOCs using EPA Method 8260
- Appendix I Metals using EPA Methods 6010, 6020, and 7470

2.2 LEACHATE

As stated in the previous section, an aqueous sample was collected from the lined leachate basin (5803-LP-01) concurrently with the surface-water and groundwater samples. Specifically the sample was collected from the location where leachate enters the basin via an approximately 36-inch discharge pipe. One round of field parameters was measured and recorded for the sample (see Table 1).

The sampling log for 5803-LP-1 is included in Appendix B. Following collection, sample 5803-LP-01 was immediately placed on ice in a cooler for transport to Pace. The sample was analyzed for the following parameters:

- Appendix I VOCs using EPA Method 8260
- Appendix I Metals using EPA Methods 6010 and 7470

- Biochemical Oxygen Demand (BOD) using Standard Method (SM) 5210B
- Chemical Oxygen Demand (COD) using SM 5220D
- Nitrogen/nitrate using EPA Method 353.2
- Total phosphorus using EPA Method 365.1
- Sulfate using American Society for Testing and Materials (ASTM) Method D516-90

3.0 FINDINGS

3.1 ANALYTICAL RESULTS

The laboratory analytical results for groundwater, surface water, and the lined leachate basin samples collected at the landfill are listed in Table 1. Table 1 is displayed in the Electronic Data Deliverable format specified by the Solid Waste Section (SWS) of the DENR DWM memorandum dated October 27, 2006. The laboratory analytical report issued by Pace is included in Appendix C.

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As stipulated in the October 27, 2006 memorandum referenced above, non-detections were reported as Below Quantitation Limit (BQL), and all concentrations exceeding the laboratory-specific Method Detection Limit (MDL) were reported and appropriately qualified (see Tables 1 through 3). The MDL is the minimum concentration of a substance that can be measured and reported by a laboratory with 99% confidence that the analyte concentration is greater than zero. All detections were compared to analyte-specific Solid Waste Section Limits (SWSLs) established by the NC SWS. The SWSL is the lowest concentration of an analyte in a sample that can be quantitatively determined with suitable precision and accuracy. If the reported concentration is above the laboratory MDL and below the SWSL, the analytical result is qualified as estimated, and is flagged with a “J” qualifier (J-flag).

Detected concentrations of analytes in groundwater samples were compared to the value specified by 15A NCAC 2L.0202 groundwater quality standards (2L Standards). Detected concentrations of analytes in groundwater with no established 2L Standard were compared to the Groundwater Protection Standard (GWPS) pursuant to 15A NCAC 13B.1634. Detections of analytes in surface-water samples were compared to the standard from the 15A NCAC 2B.0200s surface-water quality standards (2B Standard).

3.1.1 Groundwater – Monitoring Wells

Analytical results for groundwater samples collected from the monitoring wells are discussed below. Analytical results are summarized in Tables 1 through 3. The laboratory reports are included in Appendix C.

Appendix I Metals (EPA Methods 6010, 6020, and 7470)

Eleven metals (antimony, barium, beryllium, chromium, cobalt, copper, nickel, selenium, silver, vanadium, and zinc) were detected in groundwater samples at estimated concentrations above the respective MDLs but below the pertinent SWSLs. These results are qualified with a J-flag in Table 1.

The following metals were detected at concentrations above the associated SWSL but below the applicable 2L Standard or GWPS (Table 2):

- Barium in 5803-MW-01 (111 µg/l), 5803-MW-02 (170 µg/l), 5803-MW-03 (198 µg/l), 5803-MW-04 (129 µg/l), 5803-MW-06R (406 µg/l), 5803-MW-07R (163 µg/l), and 5803-MW-09 (155 µg/l)
- Chromium in 5803-MW-06R (10.6 µg/l)
- Cobalt in 5803-MW-02 (18.1 µg/l) and 5803-MW-06R (31.3 µg/l) and
- Zinc in 5803-MW-06R (80.9 µg/l), 5803-MW-07R (13.2 µg/l), and 5803-MW-09 (15.5 µg/l)

The following metals were detected at concentrations above their respective 2L Standards or GWPSs (Table 3):

- Cobalt in 5803-MW-03 (86.7 µg/l)
- Vanadium in 5803-MW-04 (5.0 µg/l), 5803-MW-05 (5.4 µg/l), 5803-MW-06R (61.2 µg/l), 5803-MW-07R (7.5 µg/l), 5803-MW-08 (11.9 µg/l), and 5803-MW-09 (5.0 µg/l)
- Antimony in 5803-MW-06R (3.7 µg/l)

It should be noted that the measured turbidity values for the groundwater samples from all of the monitoring wells, except for 5803-MW-06R, 5803-MW-07R, and 5803-MW-08, ranged from 1.2 to 32.9 nephelometric turbidity units (NTUS), which are acceptable values for groundwater samples (Table 1).

The remaining monitoring wells showed the following turbidity values:

- 5803-MW-06R at greater than 1,000 NTUs
- 5803-MW-07R at 219 NTUs
- 5803-MW-08 at 63.5 NTUs

These are high turbidity values and indicate that the samples contained solid particles. Metals tend to adsorb to the surfaces of solid particles. Therefore the concentrations of metals detected in these three groundwater-monitoring wells may represent both the dissolved metals in the groundwater and the metals that were adsorbed to the solid particles, resulting in a false positive result.

Appendix I VOCs (EPA Method 8260)

One VOC (acetone) was detected at an estimated concentration below its SWSL in one monitoring well (5802-MW-06R).

VOCs were not detected at a concentration above either the associated SWSL, applicable 2L Standard or GWPS (Tables 2 and 3).

3.1.2 Surface Water

Appendix I Metals (EPA Methods 6010, 6020, and 7470)

Seven metals (barium, chromium, cobalt, copper, nickel, vanadium, and zinc) were detected in surface water samples at estimated concentrations above the respective MDLs but below the pertinent SWSLs. These results are qualified with a J flag in Table 1.

Metals were not detected at a concentration above either the associated SWSL or 2B Standard.

Appendix I VOCs (EPA Method 8260)

VOCs were not detected in either of the surface water samples.

3.1.3 Lined Leachate Basin

Appendix I Metals (EPA Methods 6010, 6020, and 7470)

Eight metals (arsenic, barium, chromium, cobalt, copper, nickel, silver and vanadium) were detected at estimated concentrations (J-flags) below the associated SWSLs in the aqueous sample (5803-LP-1) collected from the lined leachate basin (Table 1).

Only zinc was detected at a concentration (18.4 µg/l) above its SWSL. The turbidity of the leachate sample was greater than 1,000 NTUs. Detected metal concentrations may reflect both dissolved constituents and those ions that were adsorbed onto solid particles present in the sample.

Appendix I VOCs (EPA Method 8260)

VOCs were not detected at estimated concentrations (J-flags), below the associated SWSLs.

Three VOCs were detected at concentrations above their SWSLs, as follows:

- Acetone at 399 µg/l
- Methylene chloride at 60 µg/l

- Toluene at 16.6 µg/l

In addition to analyzing for Appendix I metals and Appendix I VOCs, the lined leachate basin sample (5803-LP-01) was also analyzed for BOD, COD, nitrate, phosphorus, and sulfate. The analytical results (shown in Table 1) for these additional parameters are as follows:

- BO at 80 milligrams per liter (mg/l)
- COD at 1,290 mg/l
- Nitrogen/Nitrate at 0.76 mg/l
- Phosphorus at 1.5 mg/l
- Sulfate was not detected

3.2 HYDROGEOLOGY

The predominant groundwater flow direction within the regolith overlying the bedrock at the operating landfill is to the west-northwest, toward an unnamed tributary of Walnut Creek. Figure 3 depicts the generalized groundwater flow direction based groundwater measurements taken by Altamont on October 14 through 20, 2008. Water-level data are summarized on Table 4.

3.3 STATISTICAL ANALYSES

Statistical testing, such as the Kruskal-Wallis non-parametric method, was not conducted on the groundwater quality data from the eight monitoring wells that were sampled during the fall of 2008 at the operating landfill. There is a lack of historical background groundwater-quality data from the current background-monitoring well, MW-6R to warrant such analyses. During the spring 2008 semiannual sampling event, the background-monitoring well MW-6 was dry and therefore not sampled. Throughout the summer of 2008, the well remained dry. Therefore, in September 2008, a replacement background-monitoring well, MW-06R, was installed (Figure 3). The monitoring well was sampled for the first time during the fall 2008 semiannual sampling event. Statistical analysis will resume in spring 2010, once there are sufficient data to perform such analysis (data for at least four sampling events). This situation was discussed and documented on July 25, 2008 with Ms. Jackie Drummond, a Compliance Hydrogeologist for Madison County for the SWS. It was determined during that conversation that statistical analysis would be postponed until a sufficiently large data set had been obtained from the new background well, presumably after the spring sampling event in 2010. The original background-monitoring well, MW-6, which has been dry since spring 2008, will not be abandoned at this time.

A qualitative evaluation of the historical background sampling results from 5803-MW-06 with the current background result from the fall of 2008 (from 5803-MW-06R) is included in Section 4, "Summary".

4.0 SUMMARY

Groundwater

Analyses of data collected during the semiannual groundwater-monitoring event conducted on October 14 through 20, 2008 at the Madison County Landfill indicates that five metals were detected at concentrations above SWSLs in groundwater samples collected from monitoring wells. The concentrations of three metals, cobalt, antimony, and vanadium, exceeded their respective 2L Standard or GWPS in one or more of the groundwater samples. Cobalt was detected in one monitoring well, 5803-MW-03, at a concentration (86.7 µg/l) that exceeded its GWPS of 70 µg/l. Antimony was also detected in only one monitoring well, 5803-MW-06R, at a concentration (3.7 µg/l) that exceeded its GWPS of 1.4 µg/l. Vanadium, however, was detected in six of the monitoring wells (5803-MW-04, 5803-MW-05, 5803-MW-06R, 5803-MW-07R, 5803-MW-08, and 5803-MW-09) at concentrations ranging from 5.0 µg/l to 61.2 µg/l, exceeding the metal's GWPS of 3.5 µg/l.

As described in Section 3.1, the turbidities of three of the monitoring wells, 5803-MW-06R, 5803-MW-07R, and 5803-MW-08 were relatively high (63.5 NTUs to greater than 1,000 NTUs). Therefore, the exceedances of antimony and vanadium in these wells may include both the dissolved metal component and the metal component that was adsorbed onto particulates in the sample. These results may reflect a false positive and may not represent the actual groundwater quality at these wells.

As described in Section 2.1, a new background monitoring well, 5803-MW-06R, was sampled for the first time during the fall 2008 sampling event. A statistical analysis, comparing the groundwater results to this new background well, is not warranted until we have four sampling events ($n = 4$). However, we can evaluate the current data from this new background monitoring well with the pre-existing background monitoring well (5803-MW-06). Samples were collected from the latter background well on an approximately semiannual basis from 1997 to spring 2006. The following table summarizes the historical data from 5803-MW-06 and the current data from 5803-MW-6R.

Metal Exceeding Standard in Fall	Historical Mean Concentration	Detected Concentration in
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2008	in 5803-MW-06 (1999 to 2006)	5803-MW-06R in Fall 2008
Antimony	No historical data	3.7 µg/l
Cobalt	2.84 µg/l	86.7 µg/l
Vanadium	10.1 µg/l	61.2 µg/l

Again, the detected concentrations from the fall 2008 sampling event in 5803-MW-06R may be affected by the turbidity of the sample and may not reflect the dissolved metal concentration in the groundwater.

No VOCs were detected in the groundwater at the operating landfill at concentrations above the associated SWSLs, 2L Standards, or GWPSs.

A comparison of metal detections higher than the 2L Standard in groundwater, to metal detections in the sample collected from the lined leachate basin reveals that metal concentrations in groundwater are uniformly greater than metal detections in landfill leachate. If landfill material or leachate was impacting groundwater at the site, one would expect the leachate to have higher metal concentrations than groundwater, but this is not the case. This observation, combined with those related to groundwater turbidity, further suggest that the metals detected in the monitoring wells may be naturally occurring.

Surface Water

No metals or VOCs were detected above their respective SWSLs or 2B Standards in the surface-water samples. Therefore, on the basis of these data, groundwater discharging from under the landfill into the unnamed stream is not impacting its surface-water quality with regard to Appendix I VOCs or metals.

Lined Leachate Basin

One metal (zinc) and three VOCs (acetone, methylene chloride, and toluene) were detected at concentrations above their respective SWSLs in leachate sample (5803-LP-1).

Altamont will continue to monitor metals and VOCs on a semiannual basis at the operating landfill. The next sampling event is scheduled for April 2009.