Barbee, Zinith

From: Sean Patrick [spatrick@mesco.com]
Sent: Thursday, May 14, 2009 4:25 PM
To: Zinith Barbee
Subject: Wayne Co (Dudley) CAP Revision Draft

Importance: High

Scanned by	Date	Doc ID #
Zinith Barbee	5/21/09	7357

Zinith,

I dropped off the draft revisions for the Wayne Co (Dudley) CAP earlier this afternoon, but forgot to include the Plates. These will be delivered to your office tomorrow. Thought I'd let you know. Thanks.

Sean K. Patrick, L.G.

Municipal Engineering Services Company, PA 1140 Benson Highway, Suite 200 Garner, North Carolina 27529

Office: (919) 772-5393 x122
Fax: (919) 772-1176

CIVIL/SANITARY/ENVIRONMENTAL ENGINEERS
SOLID WASTE MANAGEMENT
Municipal Services Engineering Company, P.A.
SITE PLANNING/SUBDIVISIONS
SUBSURFACE UTILITY ENGINEERING (SUE)

May 14, 2009

Mr. Zinith Barbee, Permitting Branch
Solid Waste Section
Division of Waste Management
North Carolina Department of Environmental and Natural Resources
401 Oberlin Road, Suite 150
Raleigh, NC 27605

Received
MAY 2009
Waste Management

Re: **Response to Document ID 7277, Dated April 17, 2009**
Revised Corrective Action Plan
Wayne County Landfill, Dudley, NC
C&D Permit #96-01

Dear Mr. Barbee:

Please find enclosed the revised Corrective Action Plan for the Wayne County C&D Landfill, permit #96-01. The CAP has been revised as per your comments dated April 17, 2009. Our response to the specific comments follows. The numbers correspond to the numbered sections of the CAP.

Report Text

Comment: **1.1 Include here or elsewhere in the CAP information about water supply wells. An "old WS well" is shown on Plate 2 and, as reported in the ACM, is still utilized. According to its well construction record, the well is 80 feet deep. It penetrates both the uppermost aquifer and confining unit of the Black Creek Aquifer. In the ACM, the Black Creek Aquifer is reportedly 14 feet below ground. In Regulation 15A NCAC 2C .0107(2)(J) is the specification of a distance of 500 feet between landfills and water supply wells. In Regulation 15A NCAC 2C .0113 are specifications for well abandonment. Also, in Section 1.2.4 of the ACM, MESCO reported that no potable wells existed within 2000 feet of the facility, but in the same section reported "9 properties within 2000 feet of the facility" with water supply wells. Therefore, revisions should include a map of potable wells within 2000 feet of the facility and a well abandonment record for the "old WS well" shown on Plate 2.**

Response: *As stated in Section 1.2.4 of the ACM, the requested information regarding potable water supply wells is summarized in Table 16 of the ACM report. Well locations are depicted in Plate 7 of the ACM. Table 1 of the ACM indicates that the screened interval of the existing water supply well ("old WS well") is from 75-80 feet below ground surface (bgs), which is below the Black Creek Confining Unit. This is depicted in the cross-sections presented in both the ACM and CAP reports. It is clear that this water supply well does not connect two separate aquifers as implied by your comment. The issue as to whether or not this well should be abandoned is currently under consideration.*

Comment: 1.4 Explain how the contamination plume has been determined. In the ACM, no field data appears to have been used to delineate it. Unclear is how its dimensions are measured and how its migration will be monitored.

Response: *As reported in the ACM, the contaminant plume was determined from plume models created by MODFLOW (with transport package MT3D^{96}) used to simulate a release. Modeling parameters assumed leakage occurred prior to installation of the cap systems. As with the development of the MODFLOW model, MT3D^{96} transport was calibrated with a trial and adjustment procedure. The retardation coefficient and dispersion factors were calibrated to time periods 2006 and 2007. In an attempt to incorporate historical data, we used 1990 as a baseline, and target step periods of 5 years (1995), 16 years (2006), 17 years (2007), 25 years (2015), 35 years (2025), and 50 years (2040) were simulated in the model. The plume contours were manually transposed onto the plates and discussed in the text.*

Comment : 2.1 Revise the list of constituents of concern (COC's) to include all the constituents specified in the ACM. Explicit in the ACM is what is <u>not</u> a COC. Therefore, it is implied in the ACM that all the constituents detected above "2L" and "statistically significant" are the targeted COC's. Also, the one constituent that had been reportedly "<u>not</u> a constituent of concern"—mercury—is reportedly to be "the result of landfill disposal activities." Therefore, it too should be included on the revised list of COC's.

Response: *Section 2.1.2 of the ACM clearly states that the only organic COCs are chlorobenzene and p-dichlorobenzene. Since mercury had not been detected in groundwater samples since February 2003, and because of its lack of mobility, it was not considered to be of concern, regardless of origin. However, it has been added to the list of COCs at your request. As presented in Section 2.1.1 (Inorganic Constituents) of the ACM, the presence of metals occurring in the background samples, surface water samples, soil samples, and "NURE sediment samples indicate that Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Nickel, Vanadium and Zinc are falsely reported, or naturally occurring and don't represent contamination associated with the landfill." The presence of tin and thallium were attributed to false positives. Based on this data, mercury is the only metal included as a COC in the revised CAP.*

Comment: **2.5.2 Match the reported history of constituents exceeding groundwater standards with the history reported in the ACM. Numerous constituents detected above "2L" are mentioned in sections 2.1.1 and 2.1.2 of the ACM that are not reflected in this section of the CAP.**

Response: *Please refer to the response to the Comment for Section 2.1.*

Comment: **2.5.3 Clarify whether surfacewater samples are still being obtained. Understood is that the sampling points were "dry since the February 1998 sampling event". Between 1998 and 2002 the state experienced drought, which explains "dry" during the four years following the sampling event. However, unclear is whether the existing sampling points are still used or if new surfacewater sampling points should be established.**

Response: *Streamflow conditions have permitted sampling of surfacewater sampling point SW-1 during recent sampling events. Surfacewater sampling points SW-2 and SW-3 have remained dry since February 1998.*

Comment: **3.1.1 Specify which version of the model, BIOSCREEN, has been used to model the site.**

Response: *The BIOSCREEN printouts presented in Appendix A of the CAP report indicate that version 1.4 was used to model the site.*

Comment : **3.1.2 Include more information about performance of the GCCS. Understood is that annual reports are submitted to the Division of Air Quality; however, unreported is how the GCCS has performed as the "safeguard measure" mentioned in Section 6.2.**

Response: *Landfill gas (LFG) is a known contaminant transport mechanism. The GCCS acts as a source control measure by limiting the migration of LFG through the vadose zone. The reference to the GCCS as a "safeguard measure" has, therefore, been deleted from Section 6.2.*

Comment: **8.0 Three revisions are necessary. One, correct the statement to reflect that financial assurance for corrective action had not been submitted. Financial assurance had been shown for closure and post-closure but not for corrective action. Pursuant to Regulation 15A NCAC 13B .1628 (d) financial assurance for corrective action is specified. Two, the cost estimate does not reflect operation of the existing gas collection and control system explained in Section 3.1.2., which is described to have a monthly cost. The final cost of this system should at least reflect the number of years it is paired with MNA. Three, the cost does not reflect surfacewater samples obtained in addition to groundwater samples. More information about financial assurance is at the end of this letter.**

Response: *MESCO revised the referenced section to state, "...Semi-annual costs are/were estimated in the post-closure financial assurance. However, even though estimated costs to* *perform corrective action are relatively minor, to date, financial assurance for corrective action has not been submitted.*

Plates

Comment: **Plate 2 Show all the wetlands at the site. Wetlands are denoted outside the site boundary but not inside the site boundary where map features show them to exist too.**

Response: *Clear is the presence of wetland areas outside of the closed MSW and C&D/MSW areas. Unclear is the map to which you are referring that shows wetland areas existing within the site, and to which phase of the landfill you refer to as the "site".*

Comment: **Plate 3 On this or other plates show location of the relevant point of compliance.**

Plate 5 Clarify depiction of detected volatile organic compounds (VOC's). Unclear is the significance of numerals printed next to some wells and none at other wells, nor what units of measure they presumedly *[sic]* represent. Also unclear is if the intent is to delineate the lateral extent of VOC's or note their highest concentration.

Response: *Plates 3 and 5 have been amended accordingly.*

Ground and Surface Water Sampling and Analysis Plan

Comment: **Because of the number of constituents historically reported to be above groundwater standards and statistically significant, all (of) the wells at the site should be sampled for Appendix II constituents. Pursuant to Regulation 15A NCAC 13B .1634 (a) assessment monitoring is required when violations of groundwater quality standards occur.**

Response: *The "Detection Monitoring" section has been removed from the SAP. All monitoring wells have been placed on an Assessment Monitoring Schedule.*

Financial Assurance

Comment: **The SWS received a letter from the chief financial officer of Wayne County, dated January 28, 2009 regarding the financial assurance mechanism. Costs for closure and post-closure had been submitted but not for corrective action. Also, in Regulation 15A NCAC 13B .1628 (d)(1)(A) is the specification that the cost estimate be adjusted for inflation. Finally, not reflected in financial assurance for corrective action is cost of the gas collection and control system whose operation and maintenance is presumed to continue during the post-closure period. A revised financial assurance mechanism including a cost estimate for the CAP should be sent to Ms. Shawn McKee in the SWS. She can be contacted at 919-508-8512 or at: shawn.mckee@ncdenr.gov.**

Response: *MESCO revised the referenced section to state, "...Semi-annual costs are/were estimated in the post-closure financial assurance. However, even though estimated costs to* *perform corrective action and an initial contingency plan (phytoremediation) are relatively minor, to date, financial assurance for corrective action has not been submitted."*

Attached is the draft of the revised report text for your review. Upon approval a complete hard copy will be sent to your attention. Please contact us by phone at (919) 772-5393, should you have any questions or comments regarding this report.

Sincerely yours,
MUNICIPAL ENGINEERING SERVICES CO., P.A.

Sean K. Patrick, P.G.
Project Geologist

Mark Brown, LG, PG
Senior Geologist

Attachments

Cc: Tom Miller, Lenoir Co., NC

Ground and Surfacewater Sampling and Analysis Plan

Prepared for

Wayne County Landfill
Dudley, North Carolina

DRAFT

Received
MAY 2009
Waste Management

MESCO Project Number: G07058.0

This report is included as Appendix B
Corrective Action Plan completed for Wayne County.

Completed on 2/25/2009
Revised on 5/14/2009

Municipal Services Garner, NC
Engineering Company, P.A. Boone, NC

Municipal Engineering Services Company, P.A.
Garner, Boone and Morehead City, North Carolina

TABLE OF CONTENTS

TABLES

PLATES

ATTACHMENTS

1 INTRODUCTION

1.1 Objective

The objective of the Ground and Surfacewater Sampling and Analysis Plan is to provide clear guidelines and procedures for field and laboratory personnel when obtaining and testing ground and surfacewater samples. This plan is an update, and supersedes the November 1995 SAP for the Wayne County Closed Landfill on top of MSW landfill. The sampling procedures outlined in this analysis plan are guidelines by which sampling will be performed. Deviation from the procedures may be warranted depending on facility conditions or unforeseen sampling variables. Alternative sampling procedures must conform to the N.C. Water Quality Monitoring Guidance Document for Solid Waste Facilities (Guidance Document). Copies of the NCDENR Solid Waste Section technical guidelines for sampling and monitoring are presented in the **Attachments**.

All groundwater and surfacewater monitoring points shall be sampled semi-annually for the constituents listed in Appendix I and Appendix II. In addition to the Appendix I constituents monitoring wells MW-1, MW-2 and MW-8 will be sampled for the following suite of Monitored Natural Attenuation (MNA) parameters.

MNA Performance Parameters

Parameter	Analysis Type	Analytical Method
Dissolved Oxygen (DO)	Field Reading	Multi-parameter Field Instrument w/ flow-through cell
pH	Field Reading	
Oxidation-Reduction Potential (ORP)	Field Reading	
Turbidity	Field Reading	
Conductivity	Field Reading	
Temperature	Field Reading	
Dissolved CO_2	Field Reading	Field Instrument / Hach Kit
Alkalinity (Total as $CaCO_3$)*	Laboratory/Field*	EPA 310.2
Chloride*	Laboratory/Field*	SM 4500-CLB
Iron	Laboratory	SM3111B
Nitrate*	Laboratory/Field*	EPA 353.2 / SM 2320B
Sulfate*	Laboratory/Field*	EPA 375.4 / SM 4500-SO4E
Sulfide*	Laboratory/Field*	EPA 376.1 or SM 4500SE
TOC/BOD/COD	Laboratory	EPA 415.1 / EPA 405.1 / EPA 410.1
Methane	Laboratory	RSK 175
Ethane, Ethene	Laboratory	RSK 175
Hydrogen	Laboratory	AM19GA
Volatile Fatty Acids	Laboratory	AM23G

*For budgetary considerations these analyses may be performed in the field using Hach® brand color wheel test kits.

1.2 Water Quality Monitoring Summary

The nature of the groundwater flow, geology, location of Edwards Branch, and close proximity of several drainage features will require extensive monitoring for early detection of a landfill release. The monitoring plan consists of eight (8) monitoring wells numbered MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, and MW-8 and three (3) surface monitoring points numbered SW-1, SW-2 and SW-3. Monitoring points included in this plan are summarized on **Table E-1**. A topographical map is provided as **Plate A**. Locations of monitoring points are shown on **Plate B**.

Monitoring well MW-1 is the background well located upgradient of the landfill. MW-2 is a downgradient monitoring well for the western portion; designed to intersect groundwater flow from the eastern portion prior to reaching the western tributary of Edwards Branch. MW-3 is a downgradient monitoring well in the northeastern portion of the western landfill. MW-4 is installed on the eastern half of the landfill to detect a potential release from the southeastern area via advection. MW-5 is a downgradient well utilized for the detection of a release from the middle of the landfill. MW-6 is a downgradient monitoring well located on the northeastern side of the landfill, positioned to detect a release from the landfill center. MW-7 is a downgradient monitoring well for the southernmost route of contamination. MW-8 is a downgradient monitoring well for the eastern unit.

Surfacewater sampling point SW-1 is located downstream of the landfill below the confluence of the two forks of Edwards Branch. Surfacewater sampling points SW-2 and SW-3 are located upstream of the landfill on the two separate forks of Edwards Branch. Surfacewater sampling locations are shown in **Plate B**.

Assessment Monitoring

Assessment Monitoring will be performed on MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, and MW-8. Assessment monitoring will consist of collection of groundwater for analysis for the complete list of Appendix I constituents, as well as site-specific Appendix II constituents as determined by the Solid Waste Section. In addition field parameters including dissolved oxygen (DO), oxidation reduction potential (ORP), pH, temperature, turbidity, and conductivity will also be collected.

As indicated in the *Corrective Action Plan*, MNA monitoring will be performed on monitoring wells MW-1, MW-2, and MW-8.

1.3 Sampling Equipment

Groundwater purging and sampling will be performed using a submersible pump and disposable polyethylene bailers. A new bailer will be used to sample each individual well. *Under no circumstance will a disposable bailer used to sample a given well be used to sample any remaining well.* The following procedure will be used to decontaminate the submersible pump:

1. Phosphate-free detergent & de-ionized or distilled water rinse.
2. De-ionized or distilled water rinse.
3. Isopropyl alcohol (isopropanol) rinse.
4. De-ionized or distilled water rinse.

At least one (1) equipment blank will be collected during pump decontamination procedures to ensure that cross-contamination has not occurred as a result of the decontamination process. The standard equipment necessary to conduct sampling for each well consists of sample containers (including trip blanks and equipment blanks), one wide-mouth container, at least one 100-ft spool of nylon twine, at least one box of disposable latex/nitrile gloves, temperature/pH/ORP/conductivity indicator, water level indicator, storage coolers, and ice. All equipment subject to damage and contamination will be transported in sealed, plastic bags or storage containers. The water level indicator will be decontaminated in accordance with Steps 2 and 3 described above prior to placement in a clean plastic bag or storage container.

1.4 Sampling Containers

Ground and surfacewater monitoring will include organic (volatile organic compounds- VOCs) and inorganic (metals) analyses. Samples will be collected for the various analyses in laboratory-supplied containers.

1. Each sample container will be clearly labeled providing the following information: site name, county location, sample identification number, parameters to be analyzed, preservative added, date and time of sampling, and initials of the sampler.
2. Samples to be analyzed for VOC concentrations will be collected first, using three 40-ml glass vials with Teflon septa caps. The sample vials will be completely filled to create zero headspace in the vials.
3. Samples to be analyzed for inorganic contamination will be collected second, using a quart/1-liter polyethylene container.

All sample containers will be obtained from an independent laboratory in a sterilized condition and with the appropriate, method-specific preservative. Care will be taken by the field technician to not allow the preservative to wash out of the sample containers during sampling.

Sampling Containers

Samples to be analyzed for VOC concentrations will be collected into three 40-ml glass vials with Teflon septa caps. The sample vials will be completely filled with zero headspace in the vials. Samples to be analyzed for inorganic compound concentrations will be collected into 1-liter polyethylene containers, with ½ inch space for air permitted. All sample containers will be obtained from an independent laboratory in a sterilized condition. Some of the containers will have a pre-measured amount of preservative in them as necessary. In this event, care will be taken not to rinse the container or to allow the preservative to wash out during sampling.

Groundwater samples to be analyzed for MNA performance parameters will be collected into the container types listed in the table below.

MNA Parameter	Volume	Bottle Type	Preservative
Alkalinity	250 mL	Plastic	none; cool to 4°C
Chloride	125 mL	Plastic	none; cool to 4°C
TOC/COD	250 mL	Glass	Sulfuric acid (H_2SO_4)
BOD	500 mL	Polyethylene	none; cool to 4°C
Iron	125 mL	Plastic	Nitric acid (HNO_3)
Nitrate	125 mL	Plastic	Sulfuric acid (H_2SO_4)
Sulfate	125 mL	Plastic	none; cool to 4°C
Sulfide	250 mL	Glass	Sodium hydroxide (NaOH)
Methane/Ethane/Ethene	125 mL	Plastic	none; cool to 4°C
Hydrogen	-	-	proprietary lab sampler
Volatile Fatty Acids	40 mL	Glass	Hydrochloric Acid (HC1)

2 SAMPLING

Wells will be sampled from upgradient to downgradient locations; or when previous analytical data is available, from least to greatest contamination. This procedure is required to limit potential cross contamination between sampling points.

2.1 Set-Up

A clean sheet of plastic will be placed around the well to provide a clean surface for sampling equipment. The total well depth read from the well tag and the measured depth to water, determined using the water level indicator, will be used to compute the depth of water in the well. The total well depth will be measured and compared to the depth indicated on the well tag as a check for silt buildup or blockage at depth.

All meters used to monitor purge parameters will be calibrated immediately prior to purging and sampling, and those readings recorded in a field logbook. Entries will always include pre- and post- calibration readings as well as the model and serial number of the equipment and the date, time, and person performing the calibration(s). Two standards, which bracket the average or suspected measurements for pH and specific conductance, will be used at the site. Since natural waters (including those impacted by environmental contaminants) tend to have pH values less than 7.0, pH buffers of 4.0 and 7.0 will typically be used for instrument calibration.

Disposable nitrile gloves will be worn by the field technician during sampling to minimize the risk of personal exposure to potentially harmful chemical substances and to minimize the risk of sample cross-contamination. Fresh pairs of nitrile gloves will be worn during each purge and sampling event. The groundwater samples will be transferred from the bailers into method-specific and appropriately preserved containers and placed into a clean cooler containing ice to chill the samples to a temperature of approximately 4°C.

Indicator parameters such as pH, temperature and specific conductance will be measured during purging as an indication that groundwater representative of the formation surrounding a given well is being sampled. Purging is considered complete when at least three well volumes have been purged and indicator parameters have stabilized such that three successive readings vary by no more than 10%. Purging may need to be continued beyond five well volumes if indicator parameters have not stabilized. All information will be recorded on a field data sheet or in a field logbook with copies submitted to the Division of Waste Management with the analytical results.

2.2 Purging

Each well will be purged of approximately three (3) to five (5) volumes of standing water and allowed to settle prior to collection of groundwater samples. If the well should go dry and not recharge before the requisite well volumes are removed, the well will be allowed to recharge and a sample will be collected within 24 hours of the initial purging. The amount of standing water will be calculated by first subtracting the depth-to-water from total well depth. The amount of water in the well (in gallons) will then be determined by using the chart on **Plate C**. For example, a two-inch well that is 29 feet deep and contains 19 feet of standing water will have a well volume of ~3.3 gallons.

After determination of the amount of water to be purged from a given well, the equipment necessary for purging will be assembled at the well. The disposable bailer will be maintained in a stable, upright position while the upper portion of the plastic wrapping will be pulled away to expose only the eyelet used for securing twine to the bailer. After the twine has been secured to the bailer with gloved hands, the bailer will be suspended as the remaining plastic is removed. The bailer will be lowered slowly into the well until the bailer contacts groundwater. The bailer twine will then be cut to an adequate length and secured to prevent loss of the bailer in the well. At no time during purging will the bailer twine be allowed to touch the ground. In order to not allow the twine to touch the ground during purging, the twine will be collected when raising the bailer either by loops gathered in one hand or by alternating hand-to-hand as the bailer is pulled from the well. When purging deep wells (in excess of 40 feet), the ground and the well head may be covered with a clean plastic bag or sheet of plastic with a slit cut to allow the plastic to slide over the well head. This will be a separate sheet of plastic from the one used for the sampling equipment.

2.3 Groundwater Sample Collection

The bailer will be lowered slowly into the well to avoid volatilization of any dissolved-phase compounds that may be present in the groundwater. Once full, the bailer will be retrieved and containers filled by emptying the water through the hole at the bottom of the bailer. Glass 40-mL vials for VOC analyses will be filled in such a manner as to produce zero headspace in the vials. Polyethylene containers for metals analyses will be filled and sealed with the cap, leaving about ½-inch of airspace at the top. In addition to collecting the samples, water will be collected in the wide-mouth container for pH, temperature, and conductivity measurements. Upon completion of sampling, all groundwater samples, including equipment and trip blanks, will be placed in labeled and sealed plastic bags and stored in ice-filled coolers to chill the samples to 4°C pending transport to a NCDENR-certified analytical laboratory. Contaminated nitrile gloves and twine will be discarded.

2.4 Surfacewater Sample Collection

Surfacewater sampling will be taken with given consideration to minimize turbulence and aeration. As during groundwater sampling, surfacewater samples will be collected by a field technician wearing disposable gloves. Containers will be dipped at sampling location points by gently dipping the sample container into surfacewater and allowing surfacewater to flow over the mouth of container so as not to displace any preservative within the sample container. If there is little current movement, the container will be moved slowly through the water laterally. During times of low water, if the water is not deep enough to allow filling of sample containers, an appropriately decontaminated sampling cup will be used to retrieve the sample. All containers will be treated in the same manner as the groundwater samples. The samples will be sealed in labeled, plastic bags, and stored in an ice-filled cooler to chill the samples to 4°C pending transport to a NCDENR-certified analytical laboratory.

2.5 Chain of Custody

Chain-of-custody forms will be used to document the handling of all samples collected and listing all individuals who have taken possession of a given set of samples, including field personnel, laboratory couriers, and laboratory personnel. Trip blanks, equipment blanks, and sample containers will all travel and be stored together. Trip blanks will remain in the condition they are received from the laboratory and will not be opened or tampered with during the sampling. A chain-of-custody record will be completed for each day's samples, indicating the date and time, sample location, sample matrix (soil, water, etc.), and laboratory analyses to be conducted.

3 ANALYSIS

When the water samples reach the laboratory, they will be transferred to a sample custodian who will sign the chain of custody documentation as receipt of the samples. Internal control of the water samples in the laboratory will be in accordance with QA/QC procedures for the laboratory. Copies of QA/QC manuals for approved laboratories are on file at the Division of Solid Waste.

Groundwater and surfacewater will be analyzed for the Appendix I list of constituents. QA/QC procedures utilized during the testing will be in conformance with laboratory QA/QC manual. Monitoring wells MW-1, MW-2 and MW-8 will be sampled for the Appendix I list and the aforementioned MNA parameters.

4 CONCLUSION

This report is included as part of the Corrective Action Plan for the Wayne County Landfill. The ground and surfacewater monitoring plan is designed to be effective in the early detection of any possible release of hazardous constituents to the uppermost aquifer and to provide indicator parameters of the natural degradation process.

MUNICIPAL ENGINEERING SERVICES COMPANY, P.A.

Sean K. Patrick, P.G.
Professional Geologist

Table E-1. Summary of Ground and Surfacewater Monitoring Points

Sampling Point	Type	Gradient	Total Depth (ft)	Designation
MW-1	Monitoring Well	Up	25	Background Well
MW-2	Monitoring Well	Down	15	Performance Well
MW-3	Monitoring Well	Down	18	Monitoring Well
MW-4	Monitoring Well	Down	15	Monitoring Well
MW-5	Monitoring Well	Down	18	Monitoring Well
MW-6	Monitoring Well	Down	18.14	Monitoring Well
MW-7	Monitoring Well	Down	19	Monitoring Well
MW-8	Monitoring Well	Down	29	Performance Well
SW-1	Surfacewater	Downstream	-	Edwards Branch Confluence
SW-2*	Surfacewater	Upstream	-	Western Tributary
SW-3*	Surfacewater	Upstream	-	Eastern Tributary

*Note: *As of May 2009 these surfacewater sampling locations have been dry since February 1998.*

Corrective Action Plan

Prepared for

Wayne County Landfill - Permit #96-01
Dudley, Wayne County, North Carolina

DRAFT

Received
MAY 2009

MESCO Project Number: G07058.0

Completed on 2/25/09
Revised on 5/14/2009

Municipal Services
Garner, NC
Engineering Company, P.A.
Boone, NC

Municipal Engineering Services Company, P.A.
Garner, Boone and Morehead City, North Carolina

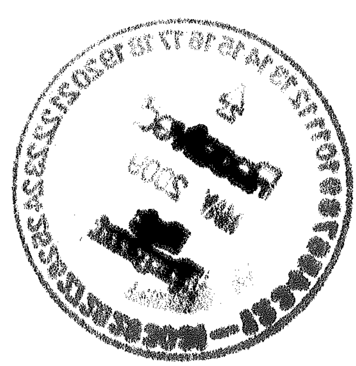

TABLE OF CONTENTS

DRAFT

TABLES

PLATES

APPENDIX

DRAFT

1 INTRODUCTION

1.1 Site Background

The Wayne County landfill is located at 460 S. Landfill Road (SR 1129), Dudley, Wayne County, North Carolina. The Wayne County Construction and Demolition (C&D) landfill operates under permit #96-01. Prior to operating as a C&D landfill, the site operated as a Municipal Solid Waste (MSW) unlined sanitary landfill that consisted of two units. The first unit was closed prior to October 1991, with a 24-inch final soil cover. The second unit was closed by December 31, 1998, with an 18-inch thick cohesive soil cap with a permeability of 1 x 10^{-5} cm/sec, and 18 inches of erosive layer.[5] The C&D landfill was constructed and is operating on top of the second MSW unit. Adjacent to the C&D landfill is the existing Subtitle D MSW landfill, which operates under permit #96-06. The site is monitored under 15A NCAC 13B.1630. A topographic map showing the location of the site is included as **Plate 1**. A site map showing the layout of the permitted facility is included as **Plate 2**.

1.2 Aquifer Characteristics

The site lies within the Atlantic Coastal Plain physiographic province,[1,3] a region that is characterized by flat or gently undulating topography dissected by drainage features with narrow to moderately sloped sides. The site is bounded by an intermittent drainage to the north and east, by SR 1129 to the south, and by another intermittent drainage to the west. The drainage features have recently been reported as being dry during the semi-annual sampling events. The northern drainage feature separates the site from the existing Subtitle D MSW Landfill, and converges with the western drainage feature approximately 375 feet northwest of monitoring well MW-5. Both drainage features eventually converge with Edwards Branch approximately 600 feet west of the existing Subtitle D Leachate Lagoon. Edwards Branch appears to be a perennial stream, based upon field observations made during surfacewater sampling from the existing Subtitle D MSW Landfill.

The lithology below the site consists of unconsolidated surficial sediments composed of white to gray sand that overlie red to orange silty sand interlayered with clay. These surficial sediments are underlain by the Black Creek confining unit, which is an approximately 10-foot thick clay unit at the top of the Cretaceous-age Black Creek Formation that separates the overlying surficial aquifer from the underlying Black Creek aquifer.[10] The Black Creek formation consists of thinly laminated gray to black clay interbedded with gray to tan fine to medium grained sand, with lignitic wood, occasional shell fragments, and glauconite. The estimated depth of the Black Creek confining unit below the site is approximately 13.5 to 37.5 feet below ground surface (bgs), based upon lithologies encountered during previous subsurface investigations[5].

DRAFT

Regionally, Wayne County is located in the Coastal Plain groundwater region of the United States.[3] The unconfined aquifer at the site consists of unconsolidated sediments that are underlain by the Black Creek confining unit. In the area south of Goldsboro, the Black Creek aquifer underlies the surficial aquifer and is confined by the clay/silty clay/sandy clay confining unit. Groundwater typically occurs at depths of less than 20 feet bgs, with the shallowest depths occurring in draws and near drainage features. Groundwater depths in the monitoring wells have been consistent over time, and generally occur in the following depth ranges:

- 0 to 5 ft. bgs: *MW-3, MW-5*
- 5 to 10 ft. bgs: *MW-2, MW-4, MW-6, MW-7*
- 10 to 15 ft. bgs: *MW-1*
- > 15 ft. bgs: *MW-8*

Historical groundwater elevations are provided in **Table 2**. Groundwater flow dynamics are primarily controlled by the surrounding drainage features and ultimately Edwards Branch. Groundwater flow in the surficial aquifer is in a generally west-northwesterly direction. A single-day potentiometric map depicting groundwater flow conditions on August 28, 2008 is provided as **Plate 3**.

Hydraulic conductivity (K) values, hydraulic gradients, and average linear groundwater velocities are summarized in **Table 3**. K values, as determined from slug testing, ranged from 3.10×10^{-5} cm/sec (MW-5) to 6.40×10^{-3} cm/sec (MW-3), with a geometric mean of 3.26×10^{-4} cm/sec. Hydraulic gradient at the site was found to be fairly uniform with an average value of 0.012 ft/ft. Average linear groundwater velocities (v_x), also known as *seepage* velocities, were calculated using the following equation:

$$v_x = \frac{K * i}{n_e}$$

where

v_x is the average linear groundwater velocity [length/time]

K is the hydraulic conductivity [length/time]

n_e is the effective porosity [unitless]

i is the horizontal hydraulic gradient in the direction of groundwater flow, taken as the difference in head elevation between two points divided by the distance between those points [unitless, or length/length]

The calculated average linear groundwater velocities were found to have a median value of 15.3 ft/yr.

1.3 Contaminant Distribution

Groundwater contamination at the site consists of dissolved-phase volatile organic compounds (VOCs) in concentrations exceeding established 15A NCAC 2L groundwater standards (2L Standards). Groundwater contaminants found to exceed 2L Standards are: benzene, *p*-dichlorobenzene (1,4-dichlorobenzene), chlorobenzene, and vinyl chloride (chloroethene). Benzene, chlorobenzene and *p*-dichlorobenzene are aromatic hydrocarbons. Vinyl chloride is a chlorinated aliphatic hydrocarbon. Only chlorobenzene and *p*-dichlorobenzene were identified as contaminants of concern in the *ACM* (see **Section 2.1**). Groundwater impact is limited to the unconfined surficial aquifer. Monitoring wells that have consistently exhibited 2L violations are MW-2 and MW-8. Historical organic detected constituents are shown in **Table 4**. The distribution of dissolved-phase VOC concentrations as determined from the most recent sampling event (August 28, 2008) is depicted in **Plate 5**.

1.4 Site Conceptual Model

Site conceptual and analytical models were developed in the *ACM*. The models consisted of conceptual cross sections and analytical modeling using MODFLOW with $MT3D^{96}$. The lithologic cross-sections from the *ACM* are provided as **Plate 4**.

Physical Process

As dissolved-phase constituents in groundwater, all COCs are subject to the physical processes of advection and dispersion. The primary physical mechanism of plume movement is through advection. Advective flow with applied sorption (retardation) typically slows plume migration. The retardation coefficient (R) used to calculate the expected migration rates for the constituents can be calculated from the following equation [8]:

$$R = 1 + \frac{\rho_d}{n} K_d$$

where

- R is the retardation coefficient
- ρ_d is the dry bulk density of the soil (g/cm^3)
- n is the porosity (unitless)
- K_d is the distribution coefficient (mL/g)

The average dry bulk density (ρ_d) presented in the *ACM* report, as calculated from laboratory dry weights determined during the *Phase 2 Design Hydrogeological Study*, was reported as 1.77 g/cm^3. The distribution coefficient (K_d) can be estimated as the constituent-specific soil–water partitioning coefficient (K_{oc}) times the fraction of organic carbon (f_{oc}) in the soil.[2] A conservative value of 1% (0.01) was chosen for soil organic carbon, based on boring logs and field observations An average total porosity value of 36% (0.36) was used based upon the range of estimated values reported in the *Transition Plan* report. Contaminant velocity in groundwater (v_c) is equal to the seepage velocity divided by the retardation coefficient:[8]

$$v_c = \frac{v_x}{R}$$

where

v_c is the velocity of the contaminant (ft/yr)
v_x is the average linear groundwater velocity, or *seepage velocity* (ft/yr)
R is the retardation coefficient (unitless)

The following table lists retardation coefficients for the relevant COCs. The contaminant velocities are given with respect to the *median* seepage velocity reported in the *ACM* (15.3 ft/yr).

Table of Retardation Coefficients & Contaminant Velocities

Constituent of Concern	Distribution Coefficient (K_d)	Retardation Coefficient (R)	Contaminant Velocity (v_c)
Chlorobenzene	0.83 – 3.89 (K_{oc} = 83 - 389) [8]	5.08 – 20.1	0.76 – 3.0 ft/yr
p-Dichlorobenzene (1,4-Dichlorobenzene)	2.73– 18.3 (K_{oc} = 273 – 1,833) [8]	14.4 – 91.0	0.17 – 1.1 ft/yr
Mercury	6,310 [9]	31,000	4.9 x 10^{-4} ft/yr (0.06 inches/yr)

Note – R values have been re-calculated for this CAP report, and are reported to three significant figures. Contaminant velocities are reported to two significant figures, and are based upon a median seepage velocity of 15.3 feet/year.

The calculated values suggest that chlorobenzene has the potential to travel at up to one-fifth that of the seepage velocities calculated in the *ACM.* *p*-Dichlorobenzene is expected to have a similar, although generally slower, mobility. Mercury is expected to be relatively immobile in groundwater.

Contaminant velocities for chlorobenzene and *p*-dichlorobenzene were calculated at the locations of monitoring wells MW-2 and MW-8, using seepage velocities calculated from individual slug test results. From these contaminant velocities, contaminant travel times to the compliance boundary (point-of-compliance) were calculated. Well-specific contaminant velocities and travel times based on the above retardation factors are summarized in the following table.

Organic COC Contaminant Velocities and Estimated Travel Times to Compliance Boundary					
Monitoring Well	**Seepage Velocity (v_x)**	**Contaminant Velocity (v_c)**		**Time to Relevant Point-of-Compliance (~50 ft. downgradient from MW-2) (~225 ft. crossgradient from MW-8)**	
		Chlorobenzene	***p*-Dichlorobenzene**	**Chlorobenzene**	***p*-Dichlorobenzene**
MW-2	30.9 ft/yr	1.5 – 6.1 ft/yr	0.34 - 2.1 ft/yr	8.2 - 33 yrs	24 – 150 yrs
MW-8	10.9 ft/yr	0.54 – 2.1 ft/yr	0.12 – 0.76 ft/yr	107 – 417 yrs	296 - 1,875 yrs

It must be noted that the relevant point-of-compliance for monitoring well MW-8 is located *cross-gradient* (and somewhat *upgradient*) to that well (see **Plate 3**). Because of this, contaminant transport to that point would occur primarily as a result of *diffusion* as opposed to *advection*, which occurs primarily along *downgradient* flowpaths. Therefore, contaminant travel times from MW-8 to the adjacent point-of-compliance are expected to be much slower than those given in the above table.

Chemical/Biochemical Process

The identified COCs consist of chlorinated aromatic hydrocarbons and metals dissolved in groundwater. Natural biodegradation of chlorinated hydrocarbons occurs primarily through the biochemical process of reductive dechlorination. Reductive dechlorination occurs as the result of microbial activity that progressively removes chlorine atoms from chlorinated hydrocarbons through various oxidation-reduction reactions. Under anaerobic conditions, reductive dechlorination occurs through electron acceptor reactions, with the chlorinated hydrocarbons acting as electron donors rather than as a carbon source for microbial activity. Under aerobic and some anaerobic conditions, reductive dechlorination can occur as a result of electron donor reactions, during which chlorinated hydrocarbons act as both carbon and energy sources for microbial activity. Breakdown of chlorinated aromatic hydrocarbons can also occur through chemical oxidation. [8]

1.5 Regulatory Status

The Wayne County Landfill operates as a C&D landfill over a MSWLF landfill under permit #96-01. Assessment monitoring is currently performed on a semi-annual basis at the site.

2 CONTAMINATION CHARACTERIZATION

2.1 Contaminants of Concern

The following chemical compounds were identified in the ACM as being COCs:

- chlorobenzene, *p*-dichlorobenzene – *chlorinated aromatic hydrocarbons*
- mercury – *toxic, heavy metal*

DRAFT

2.2 Contaminant Source Confirmation

The groundwater contaminant source appears to be the closed MSW landfill cells. The mechanism for the presence of this contamination is precipitation that has percolated through the landfill waste, allowing VOCs to partition from solid/liquid phases into a dissolved phase, and that has subsequently migrated downwards to mix with groundwater. To limit water percolation, the MSW unit was closed with an 18-inch cohesive soil cap with a permeability of 1×10^{-5} cm/sec, and an 18-inch erosive layer. Vegetative cover is also present.

2.3 Source Control Measures

The first unit of the MSW landfill stopped receiving waste by October 1991 and was closed with a 24-inch final soil cover. The second unit was closed with an 18-inch cohesive soil cap with a permeability of 1×10^{-5} cm/sec, and an 18-inch erosive layer. The majority of surrounding property is owned and controlled by Wayne County and is used as a Subtitle D Landfill or current/future borrow site for daily cover in the Subtitle D Landfill. The boundary to the west of the site is a vacant private residence. The property line is the center of the western drainage feature, which is bounded by a wetland area.

A methane extraction system was installed on both units of the MSW landfill, as seen in **Plate 2**. The methane extraction unit was initiated in 2002 and has run continuously since that time. Additional information regarding the methane extraction system is presented in **Section 3.1**.

2.4 Risk Assessment

Risk assessment was performed as part of the *ACM* and assumed direct contact with the identified contamination. Both adult and child hazard index values for contaminants of concern were less than 1 from inhalation, dermal and oral ingestion exposure. Summaries of the corrective action screening results as presented in the *ACM* are included as **Tables 8A-8C**.

2.5 Contaminant Concentrations

2.5.1 Background Concentrations

Background water quality data is collected from upgradient monitoring well MW-1. Water quality samples have been collected since 1994. Historical background results are summarized in **Table 5**. Groundwater results from the February 2008 sampling event are summarized in **Table 6**.

2.5.2 Exceedances of Groundwater Quality Standards

Groundwater contaminants that have exceeded 2L Standards include benzene, chlorobenzene, *p*-dichlorobenzene, and vinyl chloride. Lead concentrations in some samples were also found to exceed 2L Standards. However, this compound was identified in the *ACM* as occurring naturally, and is not of concern in this study.

2.5.3 Exceedances of Surfacewater Quality Standards

Laboratory analysis of surfacewater samples have not detected contaminant concentrations in excess of established NCAC 2B water quality standards. Three (3) surfacewater sampling points have been established at the facility. Surfacewater sampling point SW-1 is located downstream of the landfill below the confluence of the two forks of Edwards Branch. Surfacewater sampling points SW-2 and SW-3 are upstream of the landfill on the two forks of Edwards Branch. Surfacewater sampling point SW-1 has been intermittently dry, and is sampled when streamflow conditions permit. Surfacewater sampling points SW-2 and SW-3 have been historically dry since February 1998. Historical surfacewater results are shown in **Table 7**.

2.6 Media of Concern

Groundwater is the primary media of concern at the site since it acts as the primary mechanism of transport for environmental contaminants emanating from the landfill. Dissolved-phase contaminants can potentially be transported via groundwater and discharged to surfacewater.

Landfill gas (LFG) is a secondary media of concern since it can transport VOCs that have partitioned into the vapor phase, allowing them to re-partition into the dissolved phase into groundwater. An active horizontal gas venting system for methane extraction/collection was installed as part of the *Transition Plan*.

3 SELECTED AND APPROVED REMEDY / TECHNICAL APPROACH

A number of factors influenced selection of remediation alternatives.

- Contamination is within the relevant point of compliance.
- Contamination has been decreasing since installation of the soil caps and landfill gas extraction system.
- Anaerobic conditions exist in the natural wetlands.
- Contaminant velocity is relatively slow.
- Contamination is below risk exposure levels.

- Contamination is limited to the surficial aquifer.
- Modeling illustrates that contamination is maintained within the relevant point of compliance, 50 feet of the property line, or 250 feet from the waste limit.

The most cost effective and efficient system for remediation is continued use of the Gas Extraction System supplemented with Monitored Natural Attenuation (MNA).

3.1 Technical Approach

3.1.1 Monitored Natural Attenuation

Groundwater contamination exists within the unconfined, shallow aquifer. Natural attenuation mechanisms are actively controlling groundwater contaminant movement in this area. Bioscreen was initially run for MW-2 to assess the potential effectiveness of MNA. Bioscreen focused on benzene due to the high half-life of 2 years. Results of Bioscreen are provided in **Appendix A**. Bioscreen results for MW-2 showed an 85% decrease in contamination in 5 years through 1st order decay and a 100% decrease in contamination through instantaneous reaction model. Biochlor modeling was unable to be utilized due to program restrictions that did not match with the site-specific data. The USEPA Natural Attenuation Screening Protocol was also used, which indicated that "adequate evidence for anaerobic biodegradation of chlorinated organics" exists at the site (**Appendix A**). Groundwater sampling will continue to be performed semi-annually on all monitoring wells currently included in the sampling schedule. Additionally, baseline sampling for the full suite of MNA performance parameters listed in **Section 4** and **Appendix B** shall be performed for two years following initiation of the remedial strategy.

3.1.2 Existing Gas Collection and Control System

Municipal Engineering Services Company, P.A. (MESCO) designed, observed the construction, and continues to be involved with the operation of the active Gas Collection and Control System (GCCS) at the Wayne County closed MSWLF. The GCCS consists of two (2) separate cells comprising 77 acres, with 44 vertical wellheads connected to a single blower/flare system. The GCCS is continuously controlled to achieve steady-state operation by stabilizing the rate and quality of the extracted LFG to meet New Source Performance Standard (NSPS) regulatory requirements, control subsurface gas migration, control surface gas emissions, and protect groundwater quality. The GCCS went into operation on February 4, 2003.

The well field is monitored on a monthly basis to evaluate conditions within the landfill and to adjust the collection system wells to achieve optimum performance. To determine that the GCCS flow rate is sufficient

DRAFT

to be compliant with §60.752(b)(2)(ii)(A)(3), gauge pressure and methane content in the gas collection header of each individual well is measured with a GEM 2000 landfill gas extraction monitor. The data is recorded and adjustments immediately made based upon the gas content, perimeter probes, and landfill surface. For the purpose of identifying whether excess air infiltration into the landfill is occurring, each well is monitored monthly for temperature, nitrogen and oxygen as provided in §60.753(c).

Federal Regulation 40 CFR 60.753 requires that the site's landfill gas collection system be operated so that methane concentrations are less than 500 ppm above background at the surface of the landfill. Compliance is demonstrated in accordance with Appendix A, Section 4.3.1, Method 21 through a quarterly "surface scan" along a predetermined 30 meter grid system and around the entire perimeter. Methane concentrations are measured using a field calibrated flame ionization detector (FID). A handheld GPS unit is used to accurately determine measurement locations.

Monitoring reports w/ annual summary are submitted to the NCDENR Division of Air Quality by MESCO. Groundwater contaminant concentrations have generally been decreasing since installation of the soil landfill cap and gas extraction system (2002), indicating that methane extraction appears to be reducing groundwater contaminant levels.

4 GROUNDWATER AND SURFACEWATER MONITORING PLAN

4.1 Groundwater Sampling and Monitoring

Data with which to monitor and evaluate the performance of remediation shall be obtained through a groundwater sampling and monitoring program. All groundwater samples collected from the monitoring wells will be analyzed for Appendix I and II VOC concentrations by EPA method 8260, and for Appendix I and II metals concentrations by EPA method 6010. Additionally, groundwater samples collected from monitoring wells MW-1, MW-2 and MW-8 will be analyzed for the following MNA performance parameters:

MNA Performance Parameters		
Parameter	**Analysis Type**	**Analytical Method**
Dissolved Oxygen (DO)	Field Reading	Multi-parameter Field Instrument w/ flow-through cell
pH	Field Reading	
Oxidation-Reduction Potential (ORP)	Field Reading	
Turbidity	Field Reading	
Conductivity	Field Reading	

DRAFT

MNA Performance Parameters		
Parameter	**Analysis Type**	**Analytical Method**
Temperature	Field Reading	
Dissolved CO_2	Field Reading	Field Instrument / Hach Kit
Alkalinity (Total as $CaCO_3$)*	Laboratory/Field*	EPA 310.2
Chloride*	Laboratory/Field*	SM 4500-CLB
Iron	Laboratory	SM3111B
Nitrate*	Laboratory/Field*	EPA 353.2 / SM 2320B
Sulfate*	Laboratory/Field*	EPA 375.4 / SM 4500-SO4E
Sulfide*	Laboratory/Field*	EPA 376.1 or SM 4500SE
TOC/BOD/COD	Laboratory	EPA 415.1 / EPA 405.1 / EPA 410.1
Methane	Laboratory	RSK 175
Ethane, Ethene	Laboratory	RSK 175
Hydrogen	Laboratory	AM19GA
Volatile Fatty Acids	Laboratory	AM23G
*For budgetary considerations these analyses may be performed in the field using Hach® brand color wheel test kits.		

4.2 Surfacewater Sampling and Monitoring

Surfacewater sampling point SW-1 has been intermittently dry, and is sampled when streamflow conditions permit. Surfacewater sampling points SW-2 and SW-3 have been historically dry since February 1998. Surfacewater sampling will, therefore, only be performed as part of the MNA sampling and monitoring plan when streamflow conditions permit.

5 EVALUATION OF EFFECTIVENESS AND REPORT SUBMITTALS

5.1 Evaluation of Effectiveness

As remediation progresses at the site certain changes in the physical and chemical characteristics of the contaminant plumes should occur. In all areas contaminant concentrations are expected to decrease over the period of remediation, thus resulting in a decrease in the physical extent of the plume. The various methods for evaluating the effectiveness of remediation are discussed in the sections below.

DRAFT

5.1.1 Qualitative and Quantitative Evaluation

Qualitative Evaluation

Qualitative methods include graphical analysis of groundwater analytical data over time in order to visualize changing trends in groundwater chemistry that are expected to occur over time as a result of the various remedial mechanisms/processes that are occurring at the site (e.g. biodegradation, gas extraction). Examples of graphical analyses that will be used include, but are not be limited to, time-series graphs of contaminant concentrations and groundwater levels, distance-concentration graphs of analytical data, and mapping of the contaminant plumes over time.

Quantitative Evaluation

Quantitative evaluation will be conducted through annual revision of Bioscreen models, and through analysis of groundwater analytical data using statistical tests for significance. Statistical significance tests can be grouped into two types, *inter-well* and *intra-well. Inter-well* methods determine statistical significance by examining trends in contaminant concentrations from performance wells with respect to those from background wells, which are used as a control group. As remediation progresses, the performance well data is expected to exhibit decreases in contaminant concentrations, while contaminant concentrations in the background wells are expected to remain relatively stable. Background wells are selected on the basis of location (typically upgradient) and analytical history (non-impacted wells are best). *Intra-well* methods determine statistical significance within individual performance wells by examining historical analytical results (time series) for a given well, thus indicating if changing contaminant concentrations at a given well location result from either remedial activity or natural fluctuation. Comparisons of background well data with sentinel and compliance well data will also be performed to monitor groundwater contaminant movement over time.

Various types of significance tests have been developed to analyze differing types of data populations based upon characteristics such as distribution type (normal vs. non-normal), trend type (changing vs. non-changing), percentage of "non-detect" results for a given population, and the sample population size. This allows for the selection of particular methods that are appropriate for a given situation. For the remedial activity at the subject facility the following statistical tests are proposed for use, although others may be used as the course of remediation progresses:

- Wilcoxon Rank-Sum (Inter-well) - *normal or non-normal data, invariant trends, < 90% non-detects, >3 samples/per well.*
- Parametric Prediction Limit (Inter-well) – *normal data, varying trends,< 15% non-detects.*

- Parametric Prediction Limit (Intra-well) – *normal data, varying trends,≥ 4 samples/well, < 15% non-detects.*
- Non-Parametric Prediction Limit (Inter-Well & Intra-Well) – *normal or non-normal data, can tolerate high percentage of non-detects, compares recent to historical data.*

As indicated by the list above, it is important to note that prior to conducting any test of statistical significance a baseline of analytical data must first be established. For the MNA parameters listed in **Section 4.0** this baseline will consist of the four (4) semi-annual sampling events mentioned previously. *Since some plume areas do not have upgradient wells that are suitable for use as background wells, non-impacted compliance wells may be used if necessary for inter-well statistical analyses.*

5.1.2 Evaluation of Plume Areas

Monitoring well MW-1 will be used as the background well for inter-well statistical analysis of MNA data. Monitoring wells MW-2 and MW-8 will be used as performance wells.

5.2 Refining the Site Conceptual Model

Over the course of corrective action the site conceptual model will be refined to determine the appropriate course of remediation. Additional information on groundwater chemistry, site lithology, plume characteristics, etc. will be used to further improve understanding of contaminant fate and transport at the site, and to determine any changes to the approved remedial measures if necessary. Bioscreen and Biochlor models will be updated semi-annually utilizing well-specific MNA parameter data.

5.3 Report Submittals

Corrective action sampling and monitoring reports will be submitted on a semi-annual basis, within 30 days of receiving all complete laboratory analytical reports. All reports submitted regarding evaluation of effectiveness will establish trends of the indicator parameters and contain tables, maps, and figures relating to field and laboratory data. Laboratory reports, groundwater maps, contamination concentration maps and cross sections will be included.

6 CONTINGENCY PLAN

6.1 Contingency Plan

Should the selected remedial approach not perform as expected and/or the constituent concentrations do not decrease, a contingency plan will be needed. One remedial technology that could potentially supplement MNA of VOC and metals concentrations is phytoremediation. Phytoremediation occurs through several processes including the release of enzymes from the root system that break down hydrocarbons (phytodegradation), increasing evapotranspiration to limit plume migration (phytostabilization), and uptake of hydrocarbons and metals (phytoextraction). To accelerate the natural evapotranspiration process and to allow for hydraulic containment (plume control), the proposed area would be planted with hybrid willows of the genus *Salix*. Hybrid willows have been recognized as being phreatophytic (water-loving) trees with root systems that can extend up to 40 feet bgs. Available literature (e.g. Schnoor, 1997 [7]) indicates an initial planting density of 1,000-2,000 trees/acre (~43 ft^2/tree). As the trees become established over time (1-2 years) competition between plants will reduce this density to ~600-800 trees/acre. Planting of seedlings would likely be performed by mechanical methods to reduce installation costs, and would occur during the spring. Protective fencing to prevent damage to the seedlings by wildlife (e.g. deer) would be constructed around the area of planting. *It must be noted that the proposed contingency plan is subject to change depending on future site and environmental conditions. The proposed phytoremediation area would be determined after the decision to implement the contingency plan is made, and would roughly correspond to the footprint of the dissolved-phase plume as determined through subsequent groundwater sampling and monitoring events.*

6.2 Safeguard Measures and Site Security

Exposure pathways are limited to onsite contact with groundwater. Monitoring wells are cased and secured with locking well caps. Access to the site is limited during operational hours. Heavy vegetation limits access from other areas. Wayne County owns the majority of the property surrounding the facility. Public water is available to the surrounding area.

6.3 Revisions

Requests for modification of the approved corrective action and implementation schedule will be submitted in writing to the Solid Waste Section. No actions regarding modification will be implemented until written approval is received from the Division of Waste Management.

7 SCHEDULE AND MAINTENANCE

7.1 Operations & Maintenance

Wayne County will oversee day-to-day operation and upkeep of the remediation technology. Any equipment required for remediation will be the responsibility of Wayne County. If problems with the remediation system arise, the Solid Waste Section will be notified and a written report will be issued. The Wayne County Department of Solid Waste can be contacted at (252) 566-4194 regarding daily activities.

7.2 Timeline

Implementation of corrective action will begin within 30 days of CAP approval. The MNA performance parameter baseline will be established during the August 2009 semi-annual sampling event. A timeline estimate for sampling events and performance evaluation is presented in **Table 9**.

8 FINANCIAL ASSURANCE REQUIREMENTS

In general accordance with 15A NCAC 13B .0546, demonstration of financial assurance was achieved through the local government financial test. Semi annual sampling costs are/were estimated in the post closure financial assurance. However, even though estimated costs to perform corrective are relatively minor, to date, financial assurance for corrective action has not been submitted. MNA sampling is incorporated with the semi-annual sampling. The additional expense for MNA is seen in laboratory costs.

MNA laboratory cost estimate.

Estimated cost/sample = $750/sample

Total MNA samples = 6 (3 Monitoring wells) samples/year

Estimated laboratory annual costs = $4,500

Continued operation of the GCCS is included in Closure/Post-Closure costs. The financial assurance test is included in the Permit Application for Continued Operation.

9 COMPLETENESS OF CORRECTIVE ACTION

Results indicate implementation of the landfill GCCS and completion of the soil caps have greatly reduced contamination. Residual low-level contamination is further being reduced by natural attenuation. Institutional controls limit access to the site. Public water is available to the surrounding area. Monitored Natural Attenuation will be implemented to correspond with semi-annual sampling.

DRAFT

Respectfully submitted,

MUNICIPAL ENGINEERING SERVICES COMPANY, P.A.

DRAFT

Sean K. Patrick, P.G.
Project Geologist

DRAFT

Mark Brown, LG, PG
Senior Geologist

DRAFT

REFERENCES

[1] Brown, Philip M., et al, 1985, Geologic map of North Carolina: North Carolina Department of Natural Resources and Community Development, scale 1:500,000

[2] Fetter, C.W., 1994, Applied Hydrogeology 3rd ed.: Prentice-Hall Inc., New Jersey, 691 pp.

[3] Heath, R.C., 1984, Groundwater Regions of the United States: U.S. Geological Survey Water Supply Paper 2242, 78 pp.

[4] GAI Consultants, 1994 Ground and Surface Water Monitoring System, Wayne County Landfill, Dudley, North Carolina.

[5] Municipal Engineering Services Company, P.A, April 1994. Wayne County Transition Plan.

[6] Municipal Engineering Services Company, P.A, August 2007. Assessment of Corrective Measures, Wayne County Landfill – Permit #96-01.

[7] Schnoor, J.S., 1997, Phytoremediation: Ground-Water Remediation Technologies Analysis Center Technology Evaluation Report TE-98-01.

[8] United States Environmental Protection Agency (EPA), 1998, Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in the Ground Water, EPA/600/R-98/128.

[9] United States Environmental Protection Agency (EPA), 2005, Partition Coefficients for Metals in Surface Water Soil, and Waste, EPA/600/R-05/074.

[10] Winner, M. D., and Coble, R. W., 1989, Hydrogeologic Framework of the North Carolina Coastal Plain Aquifer System: U.S. Geological Survey Open-File Report 87-690, 155p.

DRAFT