BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS

LIMITED ELEMENTS OF A CORRECTIVE ACTION PLAN

MACON COUNTY LANDFILL

FRANKLIN, NORTH CAROLINA

PERMIT NUMBER 57-03

PREPARED FOR:

MACON COUNTY, NORTH CAROLINA

SOLID WASTE MANAGEMENT DEPARTMENT
C/O MCGILL ASSOCIATES, P.A.
ASHEVILLE, NORTH CAROLINA

PREPARED BY:

BUNNELL-LAMMONS ENGINEERING, INC.
GREENVILLE, SOUTH CAROLINA
ASHEVILLE, NORTH CAROLINA

AUGUST 25, 2010

BLE PROJECT NUMBER J10-1101-05

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS

August 25, 2010

Macon County Solid Waste Management Department
C/O McGill Associates, P.A.
55 Broad Street
Asheville, North Carolina 28801

Attention: Mr. Jeffrey R. Bishop, P.E.

Subject: Limited Elements of a Corrective Action Plan
Macon County Landfill, Permit #57-03
Franklin, North Carolina
BLE Project Number J10-1101-05

Dear Mr. Bishop:

As authorized by your acceptance of BLE Proposal Number P10-0382R2, Bunnell-Lammons Engineering, Inc. (BLE) has completed the subject plan. The purpose of the scope of services was to prepare limited elements of a corrective action plan (CAP) for the subject site.

PROJECT INFORMATION

Macon County owns and operates a recycling center and solid waste disposal facility at 1448 Lakeside Drive in Franklin, North Carolina (Figure 1). The facility includes a network of groundwater monitoring wells which are sampled semi-annually in accordance with the facility permit (Figure 2). Groundwater sampling and reporting is currently performed by REI Consultants, Inc (REIC) under contract with the county.

Based on the continued detection of volatile organic compounds (VOCs) in two monitoring wells (MW-1A and MW-1B) which exceed North Carolina groundwater standards promulgated under NCAC Title 15A 02L .0202 (2L Standards), the NCDENR required the facility to initiate an assessment monitoring program. The county was notified of the requirement in a NCDENR letter dated August 24, 2007.

The letter required the county to submit a groundwater assessment plan to the NCDENR within 30 days of the receipt of the letter. BLE was retained by Macon County to prepare the work plan which was submitted to the NCDENR on September 13, 2007 (*Groundwater Contamination Assessment Plan*, BLE Project No. J07-1101-02). The work plan was approved by NCDENR on September 14, 2007 in a letter to Chris Stahl of Macon County. BLE was retained by Macon County to perform the required assessment defined in the approved work plan.

BLE installed 3 (three) groundwater monitoring wells (MW-23, MW-1D, and MW-5D) from September 12, 2007 through September 20, 2007. REIC collected groundwater samples from each of the newly installed wells and previously existing wells on October 16, 2007.

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Laboratory analysis results indicate that low levels of Appendix I VOCs were detected above the Solid Waste Section Limits (SWSL) in monitoring wells MW-1A, MW-1B, MW-1D, and MW-5D. Appendix I VOCs were not detected above the SWSL in the remaining wells including the downgradient well MW-23.

We concluded that a release of VOCs into the groundwater had occurred at the site which had impacted a localized area west-northwest of the Phase 1/Phase 2 cell overlap. The horizontal and vertical extent of the release appeared to be defined with the data collected from the new assessment wells MW-5D, MW-1D, and MW-23. Areas southwest (MW-2 & MW-3A), northwest (MW-22 & MW-22A), and southeast (MW-17 background) of the Phase 1/Phase 2 cell overlap had not been affected. Since areas downgradient of the release (MW-23) had not been affected we concluded that it was unlikely that the Little Tennessee River (potential receptor) had been impacted.

We recommended that the water quality monitoring plan for the landfill be amended to include substitution of MW-5D for MW-5, which is often dry. We also recommended that MW-1D and MW-23 be added to the semi-annual monitoring plan for assessment purposes only and that Appendix II sampling be discontinued since no evidence of a release of Appendix II compounds from the landfill had been confirmed.

We also recommended that no further assessment be performed since the affected groundwater is limited in extent, appeared to be confined to the landfill property, and no receptors appeared to be affected. Furthermore, we did not recommend implementation of corrective action for this release beyond the changes to the groundwater quality monitoring plan recommended above.

The NCDENR responded to the assessment report in two letters to Macon County dated March 13, 2008 and June 13, 2008. The letters stated that the NCDENR agreed with some of BLE's recommendations with notable exception being the requirement for the performance of an assessment of corrective measures (ACM) report and subsequent implementation of an approved remedial remedy (corrective action). The NCDENR established a September 15, 2008 deadline for submittal of an ACM report. Macon County subsequently retained BLE to prepare the ACM report.

BLE completed the required ACM and issued a report titled *Assessment of Corrective Measures*, BLE Project Number J08-1101-04, dated October 20, 2008. The NCDENR reviewed the ACM and issued a letter dated December 17, 2008, requiring Macon County to conduct a public meeting, to select a remedy and to prepare a *North Carolina Solid Waste Groundwater Corrective Action Permit Modification Application* for submittal to NCDENR.

A public meeting was held on May 9, 2009 and Macon County selected a remedy from the ACM. McGill prepared and submitted a permit application (as specified above) on March 15, 2010 for the selected remedy. The application was approved by the NCDENR in a letter to Macon County dated March 26, 2010.

The NCDENR Solid Waste Management Rules, Title 15A Section 13B, specify that the next step in the corrective action process is the submittal of a schedule for initiating and completing remedial activities. However, the NCDENR has instructed Macon County to prepare and submit a corrective action plan (CAP) within 90 days of receipt of the March 26, 2010 letter.

The CAP requirements are outlined in a guidance document titled *North Carolina Solid Waste Section Guidelines for Corrective Action At Solid Waste Management Facilities – NC Solid Waste Section Corrective Action Plan (CAP) (.1636 and .1637)* dated March 2007. The requirements in this guidance document appear to be loosely based on the requirements in the NCDENR Solid Waste Management Rules, Title 15A Section 13B .1636 and .1637.

Macon County and McGill have discussed the CAP requirements with the NCDENR and we understand that only limited elements of the CAP are to be submitted at this time. To fulfill these requirements, BLE has been retained to prepare and submit limited elements of a CAP (herein) to McGill Associates under McGill's engineering services contract with Macon County.

LIMITED ELEMENTS OF A CORRECTIVE ACTION PLAN

The limited elements of the CAP discuss the contaminant characterization from data in previously submitted reports, the technical approach for the selected remedy, proposed water quality monitoring matrix, remedy monitoring, contingency plan, schedule, financial assurance requirements, and completion of corrective action. The limited elements of the plan herein have been prepared in general accordance with the aforementioned guidance document and pursuant to the requirements described to BLE by McGill.

Chapter 1 -- Introduction

As required by the aforementioned CAP guidelines, the site background and regulatory history have been discussed in the narrative above.

Regional Geology:

The subject site is located within the Blue Ridge Belt. The crystalline rocks of the Blue Ridge occur in generally northeast-southwest trending geologic belts in the Carolinas and Virginia. Precambrian-age (Proterozoic) basement complexes of metamorphosed igneous and sedimentary rocks underlie the region (Hadley and Goldsmith, 1963; Horton and Zullo, 1991). The site is underlain by the Middle to Late Proterozoic-aged metamorphosed undifferentiated parent rocks. The site consists of biotite gneiss interlayered and gradational with biotite garnet gneiss and amphibolites. Devonian and Silurian pegmatites which consist of lenticular to tabulated unfoliated granitic to granodiorite dikes and sills have been noted in the general area (Geologic Map of North Carolina, 1985).

The typical residual soil profile consists of clayey soils near the surface, where soil weathering is more advanced, underlain by sandy silts and silty sands. Residual soil zones develop by the in situ chemical weathering of bedrock, and are commonly referred to as "saprolite." Saprolite usually consists of silt with lesser amounts of sand, clay, and large rock fragments. The thickness of the saprolite in the Blue Ridge ranges from a few feet to more than 100 feet. The boundary between soil and rock is not sharply defined.

A transitional zone of partially weathered rock is normally found overlying the parent bedrock. Partially weathered rock is defined, for engineering purposes, as residual material with standard penetration resistance in excess of 100 blows per foot (bpf). Fractures, joints, and the presence of less resistant rock types facilitate weathering. Consequently, the profile of the partially weathered rock and hard rock is quite irregular and erratic, even over short horizontal distances. Also, it is not unusual to find lenses and boulders of hard rock and zones of partially weathered rock within the soil mantle, well above the general bedrock level.

Regional Hydrogeology:

The uppermost groundwater in the Blue Ridge in the vicinity of the site usually occurs as unconfined, water table aquifers in three primary geologic zones: 1) residual soil; 2) partially weathered rock; and 3) fractured bedrock. These zones are typically interconnected through open fractures and pore spaces. The configuration of the water table generally resembles the local topography.

In the residual soil and partially weathered rock zone, groundwater is stored within the pore spaces and is released to the underlying bedrock through gravity drainage. Groundwater within the bedrock zones occurs primarily in fracture voids. Generally, fractures within the bedrock are very small but may extend to several hundred feet.

Infiltration of precipitation to recharge the water table aquifer is primarily affected by rainfall intensity and duration, pre-existing soil moisture conditions, temperature (evaporation), and plant uptake (transpiration). Seasonal high-water tables are typically observed during the late winter and early spring months of the year when maximum infiltration efficiency occurs due to lower temperatures and less plant uptake (i.e., many plants are dormant). Seasonal low-water tables are typically observed during the summer and fall months when minimum infiltration efficiency occurs due to higher temperatures and greater plant uptake of water.

Local Topography and Hydrogeology:

The landfill is located in Macon County, North Carolina, north of the city of Franklin as shown in Figure 1. Two waste areas are currently located on the site. These areas are designed Phase 1 and Phase 2 (Figure 2). Topographically, the site consists of a hill with radial topography which slopes primarily to the north-northwest. The highest elevation at the site is approximately 2140 feet above mean sea level (MSL) in the southern portion near the landfill entrance, and the lowest elevation is approximately 2000 feet MSL in the northern portion of site along the Little Tennessee River boundary. The relief across the site is approximately 140 feet. Steep topography on the hillsides and side slopes are common along the northern portion of the site.

The surface drainage is radial around the upland portion of site and flows to the north-northeast on the western half of the site and to the north-northeast along the eastern portion of the site. Site drainage ultimately converges with the Little Tennessee River (which has been dammed to form Lake Emory) at the facility's northern property boundary (Figure 2).

The local hydrogeology is similar to the description of the regional hydrogeology above except that fluvial sediments have been observed along the site's northwestern property boundary (Little Tennessee River) in MW-23. These sediments consist of micaceous sandy silty clays with layers of pea gravel at the interface of residual soils. A summary of well construction details are shown on Table 1.

Chapter 2 -- Contaminant Characterization

Groundwater sampling and reporting is currently performed by REIC under contract with the County. REIC provided summary tables of historical analytical results for groundwater and surface water (Appendix A). The summary tables include results from October 2001 through April 2010. In general, low levels of volatile organic compounds and total metals (presumed to be naturally occurring) have been detected at the site.

In previous reports we concluded that a release of VOCs into the groundwater had occurred at the site which had impacted a localized area west-northwest of the Phase 1/Phase 2 cell overlap. The horizontal and vertical extent of the release appeared to be defined with the data collected from the new assessment wells MW-5D, MW-1D, and MW-23. Areas southwest (MW-2 & MW-3A), northwest (MW-22 & MW-22A), and southeast (MW-17 background) of the Phase 1/Phase 2 cell overlap had not been affected. Since areas downgradient of the release (MW-23) had not been affected we concluded that it was unlikely that the Little Tennessee River (potential receptor) had been impacted.

Chapter 3 – Selected and Approved Remedy/Technical Approach

On May 11, 2009 a public hearing was held by the Board of Commissioners of the County of Macon, North Carolina to discuss the results of the ACM report. Mr. Chris Stahl, the Solid Waste Director for Macon County explained the ACM recommendations and conclusions. No one from the public wished to comment and the public hearing was closed. The Board voted unanimously to accept the recommendation for corrective action as noted in the Recommendation and Rationale for Corrective Action section of the ACM. The selected recommendations are as follows:

1) Alterations to the grading of the Phase 1 Cell to prohibit or reduce the impoundment and infiltration of stormwater,
2) Installation of a supplemental landfill gas cut-off trench and passive landfill gas vents within the limits of the Phase 1 Cell to reduce groundwater impact from VOCs which may be present in the landfill gas,
3) Continued semi-annual monitoring of selected sentinel monitoring wells for VOCs to determine fate and transport of contaminants.

Several areas within the Phase 1, Cell 1 area have experienced some settlement since the intermediate cover material was placed. These areas are predominately along the top and upper one-half of the western side slope. This settlement has caused some water to be impounded and the infiltration of this water through the subsurface may facilitate the transfer of contaminants present within the landfill to the groundwater. The proposed regrading of these areas is shown on Sheet C1, Proposed Regrading & Landfill Gas Cut-Off Trench Site Plan, enclosed in Appendix B. The grading plan will basically reestablish positive drainage off the top of the landfill cell and along the upper one-half of the northwestern corner of the cell. The diversion berm located at the approximate mid-point of the western most side slope will be regraded to promote positive drainage off the sides of the landfill cell. Other diversions berms will be regraded as required to promote positive runoff of stormwater from the landfill surface. Erosion control measures will be installed as required prior to any land disturbing activities. Once the regrading is complete, permanent erosion control measures will be installed and the disturbed area will be grassed in accordance with Technical Specification Section 02931, Seeding, Fertilizing and Mulching, included in Appendix C. Details of the slope diversion berm, temporary slope drain and sedimentation/silt fence are shown on Sheet D1, Miscellaneous Details, included in Appendix D.

The proposed supplemental landfill gas cut-off trench and passive landfill gas vents are proposed to be installed along the western and northwestern edge of the Phase 1, Cell 1 area as shown on Sheet C1, Proposed Regrading & Landfill Gas Cut-Off Trench Site Plan, enclosed in Appendix B. The proposed landfill gas cut-off trench will span a distance of approximately 550 linear feet and will contain a minimum of seven (7) passive 6-inch diameter Schedule 40 PVC landfill gas vents at 100 foot spacings. Spacing of the landfill gas vents may vary to accommodate site conditions. The proposed cut-off trench will be located inside the landfill, approximately 50-60 feet from the edge of the liner. The trench will be a minimum of 2 feet wide and extend approximately 10 feet deep as measured from the top of the landfill cover material. Care will be taken not to damage the existing operational cover or cell liner material. The cut-off trench will be filled with North Carolina Department of Transportation (NCDOT) #5 stone or larger. The landfill gas vents will be installed as the trench is backfilled with the stone material. Each passive landfill gas vent will extend to within approximately 2 feet of the bottom of the trench and will terminate 4 feet above the landfill surface with an open turndown to allow any collected landfill gas to vent to the atmosphere. Each vent will have approximately 5 feet of perforated pipe within the stone backfill. The perforations will consist of 4 each ½” diameter holes evenly spaced around the circumference of the pipe with each row spaced 6 inches apart. Each row of holes will be rotated 45 degrees around the circumference from the adjacent row. Once the stone backfill and passive landfill gas vents are in place, a layer of filter fabric will be placed on top of the stone and a 2 foot minimum compacted soil plug will be installed and graded to match the surrounding landfill surface. All disturbed areas will be grassed in accordance with Technical Specification Section 02931, Seeding, Fertilizing and Mulching, included in Appendix C. A detail of the proposed cross-section of the landfill gas cut-off trench is shown on Sheet D1, Miscellaneous Details, included in Appendix D.

Chapter 4 – Groundwater and Surface Water Monitoring

A site map which documents groundwater monitoring well and surface water monitoring locations has been prepared by REIC and is included in Appendix E for reference. We have prepared a groundwater and surface water sampling matrix (Table 2). The table documents the sampling matrix currently in use at the site. We propose no changes to the sampling matrix as part of the CAP. The existing procedures and specifications in the site’s existing water quality management plan (Appendix F) are hereby adopted.

Chapter 5 – Evaluation of Effectiveness and Report Submittals

The approved corrective measure includes grading alterations and the construction of a landfill gas cut-off trench with passive gas vents. The goal of the proposed measures is to reduce and/or eliminate future release of VOCs into the site's groundwater.

We propose evaluation of the effectiveness of the proposed remedies on a periodic basis after the selected remedies are enacted. Specifically, we propose that Macon County evaluate groundwater contaminant trends every five years starting after the proposed remedies are complete.
The evaluation will consist of a groundwater contaminant trend evaluation report which will include site maps, plots of the contaminant trend data, tables of results, a description of the evaluative process, and conclusions and recommendations. We recommend that the evaluation report be prepared by REIC and submitted as a stand-alone report contemporaneous with a semi-annual monitoring report.

We understand that the proposed remedies are expected to be completed by mid 2011. We propose that the first trend evaluation report be submitted to the NCDENR by late 2016.

Chapter 6 – Contingency Plan

In the event the selected corrective actions, consisting of grading alterations and a supplemental landfill gas cut-off trench with passive landfill gas vents, are not effective in reducing the apparent groundwater contamination, then the County will explore implementing an alternative option to further address the apparent groundwater contamination issue. The triggering events and responses required to implement a contingent remedy will be solely based on the results of groundwater and surface water monitoring.

The ACM addressed several alternative corrective actions that could be implemented to supplement or replace the selected corrective action. However, the County may opt to select an alternate remedy that was not specifically listed in the ACM. This alternate remedy would be to initiate closure of the Phase 1, Cell 1 landfill in accordance with the requirements outlined in the North Carolina Department of Environment and Natural Resources (NCDENR) Solid Waste Management Rules, Title 15A, Section 13B .1627, Closure and Post-Closure Requirements for MSWLF Facilities. Prior to implementing the closure of the landfill cell, specific plans and specifications would be developed and submitted to the NCDENR Solid Waste Section for approval.

In general, a cap system would be installed to minimize the infiltration of stormwater into and through the waste mass thereby minimizing the transfer of contaminants present within the landfill to the groundwater. The cap system would be designed to have a permeability less than or equal to the permeability of the base liner system or the in-situ subsoils underlying the landfill, or the permeability specified for the final cover in the effective permit, or a permeability no greater than $1x10^{-5}$ cm/sec, whichever is less. The Permit Drawings for Phase 1, Cell 1 provided a detail of the proposed final cap system consisting of a minimum of 24 inches of soil cover over the waste mass overlain with a 40 mil High Density Polyethylene (HDPE) flexible geomembrane liner covered with 18" of protective soil cover and 6" of topsoil to sustain vegetative growth. In addition to installing the cap system, a landfill gas venting system would be installed below the low-permeability liner system to minimize the pressures exerted on the cap system. The landfill gas venting system would basically consist of the installation of 30-inch minimum diameter passive landfill gas extraction wells strategically located throughout the waste mass. The surface of the landfill cell would be graded to promote positive drainage of stormwater. Diversion berms and associated drainage structures/features would be constructed as needed to minimize erosion. Once the construction of the cap system is complete, a stand of vegetative cover would be established to protect the cap system. A cross-section of the proposed landfill cap system with landfill gas extraction wells, titled "Proposed Landfill Cap System with Landfill Gas Extraction Well", is included in Appendix G. General Technical Specifications for the High Density Polyethylene (HDPE) Flexible Geomembrane Liner [Section 02620] (Appendix H), Landfill Gas Extraction Wells [Section 02440] (Appendix I) and the Seeding, Fertilizing and Mulching (Section 02931) are included in Appendix C. A Site Specific Construction Quality Assurance (SSCQA) Plan for the construction of the cap system would be prepared for the project prior to the beginning of construction activities. Post-Closure care of the cap system would be in accordance with the permitted Closure and Post-Closure Care Plan.

Chapter 7 – Schedule and Maintenance

Schedule:

The proposed schedule for constructing/installing the selected and approved remedy for corrective action is shown in Table 3.

Inspections:

Following the completion of the grading alterations and the construction of the landfill gas cut-off trench, the owner or operator shall conduct periodic inspections of the landfill cover system to ensure the cover system is functioning as intended. Inspections will be performed according to the table below and the condition of the facility will be recorded with notes, maps, and photographs. Since Macon County intends to continue to operate subsequent Phases of the Macon County Landfill Facility, landfill personnel will be on site to perform inspections and conduct routine maintenance on a frequent basis.

The inspections shall take notice of and note the condition of:

- Eroded banks
- Condition of the vegetative cover
- Animal disturbance/burrows
- Subsidence (settlement)
- Cracks in the cover soil
- Any areas of run-on or eroded run-off
- Condition of drainage structures/features
- Condition of the passive landfill gas extraction wells
- Landfill gas monitoring wells
- Groundwater monitoring wells

Schedule of Inspections

Years (following completion of the selected remedy)	**Minimum Yearly Inspections**
0 -2	4
3 – Final Closure	2

Maintenance:

Areas showing subsidence, cracking, signs or erosion, or damage are to be promptly repaired.

The vegetative cover will be trimmed at least two (2) times a year or more frequently as needed. In the early stages of vegetative development, fertilizer and/or compost will be applied annually as needed to enhance vegetative growth.

Vegetative growth around the passive landfill gas extraction wells will be cleaned away and all wells will be clearly marked to prevent accidental damage.

Drainage structures will be cleaned of debris and slope drain pipes will be repaired and/or replaced as necessary.

Safety:

Smoking and/or the use of open flames will not be allowed in the vicinity of the passive landfill gas extraction wells.

Chapter 8 – Financial Assurance Requirements

In general accordance with the requirements of 15A NCAC 13B .1628 (d), Macon County has provided the financial assurance document in Appendix J. We understand that this document includes financial assurance for corrective action as specified in Rule .1637 and that the financial assurance mechanism has been approved by NCDENR.

Chapter 9 – Completion of Corrective Action

We propose that the corrective measures remain in place until one or more of the conditions below are met:

1) Final closure of the landfill or until replaced by an alternative corrective measure.
2) When the site's groundwater is in compliance with promulgated North Carolina groundwater standards.

CLOSING

We appreciate the opportunity to work with the Macon County, McGill, and the NCDENR on this project. We recommend that McGill submit this plan to the NCDENR with a request of written reply to address the plan and schedule herein. Please contact us at (864) 288-1265 if you have any questions or comments regarding this plan.

Sincerely,
BUNNELL-LAMMONS ENGINEERING, INC.

Andrew W. Alexander, P.G., RSM
Senior Hydrogeologist
Registered, NC No. 1475

NORTH CAROLINA LICENSED SEAL 1475 GEOLOGIST ANDREW W. ALEXANDER

Trevor J. Benton, P.G.
Project Hydrogeologist
Registered, NC No. 2025

NORTH CAROLINA LICENSED SEAL 2025 GEOLOGIST TREVOR J. BENTON

cc: Mr. Chris Stahl – Macon County Solid Waste Department

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TABLES

Table 1
Monitoring Well and Groundwater Elevation Data
Macon County Landfill
Franklin, North Carolina
BLE Project Number J10-1101-05

Monitoring Point	Northing[1]	Westing[1]	Northing[2]	Easting[2]	TOC[3]	DTW[4]	Elevation	(below TOC)	Depth	Comments
MW-1A	3068.8	-20.7	NA	NA	**2012.25**	9.58	2002.67	31.10	19.5 - 29.5	Prior survey TOC=2010.20
MW-1B	3050.1	-5.6	NA	NA	**2012.19**	9.54	2002.65	17.45	5 - 15	Prior survey TOC=2010.15
MW-1D	NA	NA	557540.8	691268.4	**2013.65**	50.70	1962.95	63.05	NA - NA	New well
MW-2	2790.0	273.5	NA	NA	2014.78	13.82	2000.96	20.15	8 - 18	
MW-3A	2283.1	177.4	NA	NA	2070.55	60.65	2009.90	67.62	52 - 65	
MW-3B	2311.2	186.2	NA	NA	NA	NA	NA	NA	NA - NA	Not sampled
MW-4	2503.9	-512.1	NA	NA	NA	NA	NA	NA	NA - NA	Not sampled
MW-5	2651.1	-8.7	NA	NA	**2072.92**	NA	<2017.72	55.20	38 - 53	Dry; prior survey TOC=2070.88
MW-5D	NA	NA	557151.2	691279.4	**2075.67**	60.50	2015.17	69.82	NA - NA	New well
MW-10	2859.7	-1083.9	NA	NA	2115.08	58.98	2056.10	67.60	55 - 65	
MW-14	3708.3	-1370.3	NA	NA	2049.54	35.39	2014.15	42.57	29 - 39	
MW-15	3344.5	-1483.6	NA	NA	2029.19	13.91	2015.28	17.97	7 - 17	
MW-17	2496.6	-802.7	NA	NA	2133.30	71.47	2061.83	83.30	66 - 81	
MW-18	2710.2	-1023.1	NA	NA	2115.40	53.44	2061.96	62.08	48 - 63	
MW-19	3750.6	-756.4	NA	NA	2021.00	20.20	2000.80	25.80	7 - 22	
MW-19A	3763.6	-744.0	NA	NA	2020.80	19.62	2001.18	57.09	51.5 - 54	
MW-20	3552.6	-538.7	NA	NA	2015.40	13.64	2001.76	23.03	6 - 21	
MW-21	3341.1	-366.7	NA	NA	2020.90	18.21	2002.69	26.93	8.5 - 23.5	
MW-22	3191.2	-169.2	NA	NA	**2020.92**	18.48	2002.44	25.10	8 - 23	Prior survey TOC=2020.60
MW-22A	3200.8	-151.0	NA	NA	**2017.94**	15.15	2002.79	42.30	36.5 - 39.5	Prior survey TOC=2017.60
MW-23	NA	NA	557666.4	691140.8	**2007.08**	6.20	2000.88	30.95	NA - NA	New well
SW-1	2898.1	455.5	NA	NA	NA	NA	NA	NA	NA - NA	
SW-2	3952.3	-533.7	NA	NA	NA	NA	NA	NA	NA - NA	
SW-3	2578.0	-1899.0	NA	NA	NA	NA	NA	NA	NA - NA	
SW-4	4016.5	-1716.5	NA	NA	NA	NA	NA	NA	NA - NA	

[1] - Coordinates from "Monitoring Well, Surface Water, and Leachate Pond Sample Location Map", Altamont Environmental, Inc., May 14, 2003
[2] - Coordinates from McGill 10/3/07 survey
[3] - Bold, shaded values from McGill 10/3/07 survey, all others from prior survey, date unknown
[4] - Water level measurements taken on 10/16/07 and 10/17/07
TOC - Top Of Casing
All elevation values indicated above mean sea level
bgs - Below Ground Surface
MW - Groundwater Monitoring Well
SW- Surface Water Location
All depth measurments in feet
NA - Data Not Available
DTW - Depth To Groundwater

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Table 2
Sampling Matrix
Macon County Landfill
Franklin, North Carolina
BLE Project Number J10-1101-05

		April	October
	Station ID	Full Appendix I List	Full Appendix I List
Background Wells	MW-10	X	X
	MW-17	X	X
	MW-18	X	X
Compliance Wells	MW-1A	X	X
	MW-1B	X	X
	MW-1D	X	X
	MW-2	X	X
	MW-3A	X	X
	MW-3B		
	MW-4		
	MW-5		
	MW-5D	X	X
	MW-14	X	X
	MW-15	X	X
	MW-19	X	X
	MW-19A	X	X
	MW-20	X	X
	MW-21	X	X
	MW-22	X	X
	MW-22A	X	X
	MW-23	X	X
Surface Water	SW-1	X	X
	SW-2	X	X
	SW-3	X	X
	SW-4	X	X
Leachate	Leachate	X*	X*

Notes:

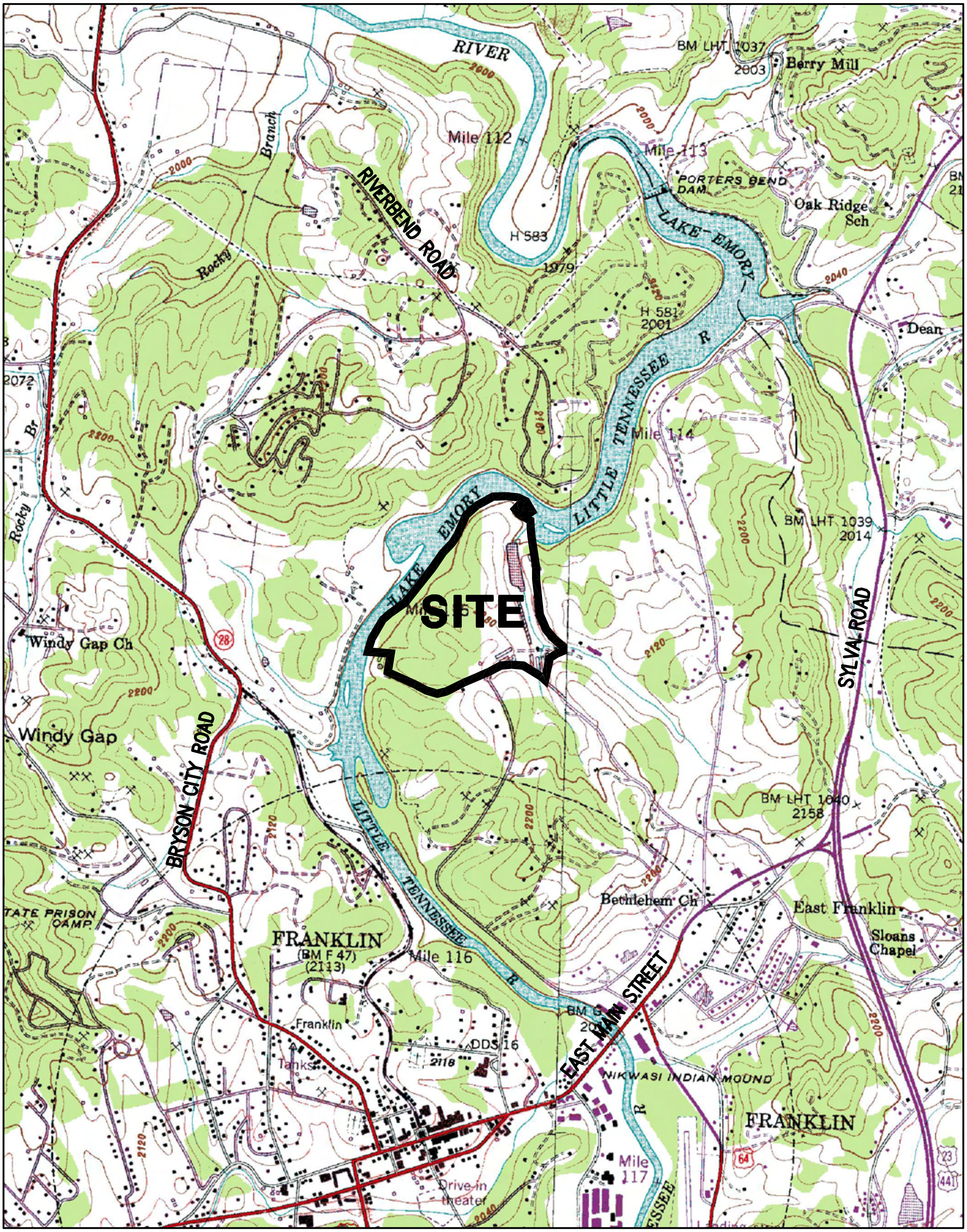
* = Plus NCDENR SWS Leachate Parameters

Water levels collected from all wells except MW-3B and MW-4

Table 3
Proposed Construction Schedule for the Selected and Approved Remedy
Macon County Landfill
Franklin, North Carolina

Item No.	Work Description	Implementation Schedule (Days)	
		Begin	**End**
1	Approval of Contingency Action Plan		0
2	Begin Stakeout activities for Proposed Remedies	0	
	Complete Stakeout activities for Proposed Remedies		60
3	Begin Alterations to the Grading of Phase 1, Cell 1	60	
4	Complete Alterations to the Grading of Phase 1, Cell 1		150
5	Begin Establishment of Vegetative Cover – Grading Alterations	150	
6	Complete Establishment of Vegetative Cover – Grading Alterations		180
7	Begin Installation of Supplemental Landfill Gas Cut-Off Trench and Passive Landfill Gas Vents	180	
8	Complete Installation of Supplemental Landfill Gas Cut-Off Trench and Passive Landfill Gas Vents		240
9	Begin Establishment of Vegetative Cover – Landfill Gas Cut-Off Trench	240	
10	Complete Establishment of Vegetative Cover – Landfill Gas Cut-Off Trench		270
11	Provide Record Documentation of Contingency Action Plan Completion to North Carolina Department of Environment and Natural Resources		290

FIGURES



2000 1000 0 2000 4000

APPROXIMATE SCALE IN FEET

REFERENCE:
USGS TOPOGRAPHIC MAP, 7.5 MINUTE SERIES, CORBIN KNOB AND FRANKLIN, N.C. QUADRANGLES, PHOTOREVISED 1978.

DRAWN: ACE	DATE: 08-18-10	BLE INC. BUNNELL-LAMMONS ENGINEERING, INC. 6004 PONDERS COURT GREENVILLE, SOUTH CAROLINA 29615 PHONE: (864)288-1265 FAX: (864)288-4430	SITE LOCATION MAP MACON COUNTY LANDFILL FRANKLIN, NORTH CAROLINA	FIGURE 1
CHECKED: AWA	CAD: MACONCOLF-05SLM			
APPROVED:	JOB NO: J10-1101-05			

REVISIONS		
No.	DESCRIPTION	BY

DRAWN: ACE
CHECKED: AWA
APPROVED:

DATE: 08-18-10
CAD FILE: MACONCLF-05GWECM
JOB NO: J10-1101-05

BLE INC.
BUNNELL-LAMMONS ENGINEERING, INC.
6004 PONDERS COURT
GREENVILLE, SOUTH CAROLINA 29615
PHONE: (864)288-1265 FAX: (864)288-4430

SITE AND GROUNDWATER ELEVATION CONTOUR MAP
MACON COUNTY LANDFILL
FRANKLIN, NORTH CAROLINA

FIGURE NO. 2

APPENDICES

APPENDIX A

SUMMARY TABLES OF HISTORICAL LABORATORY ANALYTICAL RESULTS

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-1A

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
1,1-Dichloroethane	5	4.7	3.9	*	7.6	8.8	6.9	7.6	6.1	7.1	5.6	6.4	*	*	*	3.8	*	*	*
1,4-Dichlorobenzene	1	*	1	2.2	*	*	*	6.0	*	6.7	5.8	6.5	5.4	5.9	4.2	6.3	3.2	4.6	3.6
Acetone	100	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Benzene	1	1.4	1.6	2.4	*	*	*	4.2	3.5	3.8	2.5	2.1	2.3	2.2	1.8	1.4	1.1	*	*
Carbon Disulfide	100	*	*	8	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Chlorobenzene	3	1.4	1.1	2.2	*	*	5.2	5.3	*	5.6	*	5.3	4.6	5.1	3.5	4.9	*	3.2	*
Chloroethane	10	3.1	2.9	4.1	*	*	*	*	*	5.4	*	*	*	*	*	1.8	*	*	*
cis-1,2-Dichloroethene	5	1.8	1.8	1.9	*	*	*	*	*	*	*	*	*	*	*	1.1	*	*	*
Ethylbenzene	1	5.8	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Methylene Chloride	1	*	*	*	5.8	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Vinyl Chloride	1	1.7	1.8	2.9	*	*	*	3.9	3	4.6	2.8	2.7	2.9	2.2	1.8	1.8	1.3	1.3	1.2
Xylenes, Total	3	13	12	9.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Arsenic	10	*	39	42	5.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Barium	100	34	*	*	750	62	47	*	*	*	*	*	*	*	*	*	*	*	*
Cadmium	1	*	*	*	*	1.2	*	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	10	*	*	*	64	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cobalt	10	*	*	*	35	*	*	*	*	*	*	*	*	12.5	12.4	21.5	17.8	19.7	25.3
Copper	10	*	*	*	59	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Lead	10	15	*	*	81	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Nickel	50	*	*	*	29	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	10	*	*	*	6.4	5.9	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	20	*	*	*	120	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	10	21	*	10	210	*	*	*	*	*	*	*	21.6	29.8	16.4	11.4	*	10.3	*

All constituents reported in parts per billion (ppb)
* - constituent did not exceed the laboratory practical quantitation limit (PQL) or Solid Waste Section Limit (SWSL)
NS - not sampled
Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-1B

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
1,1-Dichloroethane	5	3.3	3.5	4.4	5.3	12	6.5	5.8	5.8	6.7	5.3	6.4	*	*	*	3.2	*	*	*
1,4-Dichlorobenzene	1	*	*	1.2	*	6.4	*	*	*	5.7	5.3	6.0	4.9	5.7	4.4	5.0	3.6	4.1	3
Benzene	1	1	1.3	1.7	*	5.2	*	3.1	3.2	3.6	2.8	3.0	2.2	2.3	1.9	1.5	1.2	*	*
Carbon Disulfide	100	*	*	17	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Chlorobenzene	3	*	*	1.4	*	6.3	*	*	*	5.0	*	5.1	4.0	5.0	3.6	3.9	*	*	*
Chloroethane	10	2	2.5	2.3	*	*	*	*	*	*	*	*	*	*	*	1.3	*	*	*
cis-1,2-Dichloroethene	5	1.3	1.4	1.4	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Ethylbenzene	1	3.7	*	1.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Methylene Chloride	1	*	*		*	6.1	*	*	*	*	*	*	*	*	*	*	*	*	*
Vinyl Chloride	1	1	1.4	1.8	*	5.5	*	2.7	3.0	3.9	2.9	3.0	2.7	2.3	1.8	1.6	1.3	1.3	1.1
Xylenes, Total	3	8.9	6.2	5.3	6	8.4	*	*	*	*	*	*	*	*	*	*	*	*	*
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Antimony	6	*	32	44	5.9	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Barium	100	30	*	*	61	65	52	*	*	*	*	*	*	*	*	*	*	*	*
Cadmium	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	10	*	*	*	3.1	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cobalt	10	*	*	*	*	6.5	5	*	*	*	*	*	*	*	*	14.7	*	*	*
Copper	10	*	*	*	7.6	3.7	2.6	*	*	*	*	*	*	*	*	*	*	*	*
Lead	10	13	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	10	5.3	*	*	*	7.3	*	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	10	12	*	14	10	12	*	*	*	*	*	*	10.1	18.7	*	*	*	*	*

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HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-1D

VOCs	SWSL	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
1,1-Dichloroethane	5	*	5.7	3.2	5.3	5.8	*
1,4-Dichlorobenzene	1	5.9	*	2.2	2.6	4.4	3.9
Benzene	1	2.2	2.6	1.5	2.6	2.7	1.4
Carbon Disulfide	100	*	*	*	*	*	*
Chlorobenzene	3	5.1	*	*	3.0	3.7	3.1
Chloroethane	10	*	*	2.3	*	*	*
cis-1,2-Dichloroethene	5	*	*	*	*	*	*
Ethylbenzene	1	*	*	*	*	*	*
Methylene Chloride	1	*	*	*	*	*	*
Vinyl Chloride	1	2.2	*	*	*	*	*
Xylenes, Total	3	*	*	*	*	*	*
METALS	**SWSL**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Antimony	6	*	*	*	*	*	*
Barium	100	*	668	1720	263	102	179
Beryllium	1	*	2	1.3	*	*	*
Cadmium	1	*	*	0.319	*	*	*
Chromium	10	*	22.8	125	11.3	*	*
Cobalt	10	12.5	34.5	73.4	17.7	19	18.2
Copper	10	*	10.6	64.2	*	*	*
Lead	10	*	28.3	22.7	*	*	*
Nickel	50	*	*	82.1	*	*	*
Selenium	10	*	*	*	*	*	*
Vanadium	20	*	70.5	284	31.7	*	20.5
Zinc	10	29.8	42.9	216	33	*	21.7

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HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-2

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Acetone	**100**	*	*	*	*	11	*	*	*	*	*	*	*	*	*	*	*	*	*
Benzene	**1**	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Carbon Disulfide	**100**	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Antimony	**6**	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Arsenic	**10**	*	*	*	*	*	*	*	*	*	*	*	*	27.9	*	*	*	*	*
Barium	**100**	270	290	330	230	64	140	*	*	*	*	*	*	261	171	347	175	152	*
Cadmium	**1**	4.7	*	*	*	*	7.4	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	**10**	6.2	11	23	5.6	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cobalt	**10**	24	32	40	24	12	24	42.2	49.1	21.6	32.7	23.7	30.1	30.4	29.9	46.1	54.3	31.5	28.7
Copper	**10**	11	14	29	6.4	3	4.1	*	*	*	*	*	*	*	*	*	*	*	*
Lead	**10**	11	17	14	9.7	*	12	*	*	*	*	*	*	*	*	*	*	*	*
Nickel	**50**	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	**10**	32	*	*	11	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	**20**	*	21	34	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	**10**	37	41	59	17	15	*	*	*	*	*	*	14.2	*	*	26.3	10.3	10.2	*

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NS - not sampled
Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-3A

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Acetone	100	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Carbon Disulfide	100	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Barium	100	47	67	44	63	46	42	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	10	*	*	*	2.8	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cobalt	10	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Copper	10	*	*	*	7.7	2.5	2.2	*	*	*	*	*	*	*	*	*	*	*	*
Lead	10	16	26	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	10	5.5	*	*	*	5	*	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	10	13	*	11	16	*	*	*	*	*	*	*	44.3	14.1	23.3	*	12.3	15.3	*

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Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-5

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Carbon Disulfide	100	DRY	DRY	DRY	*	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Xylenes, Total	3	DRY	DRY	DRY	*	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Barium	100	DRY	DRY	DRY	430	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Beryllium	1	DRY	DRY	DRY	1	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Chromium	10	DRY	DRY	DRY	26	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Cobalt	10	DRY	DRY	DRY	12	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Copper	10	DRY	DRY	DRY	24	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Lead	10	DRY	DRY	DRY	7.5	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Nickel	50	DRY	DRY	DRY	18	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Selenium	10	DRY	DRY	DRY	5	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Vanadium	20	DRY	DRY	DRY	36	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Zinc	10	DRY	DRY	DRY	77	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY

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NS - not sampled
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HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-5D

VOCs	SWSL	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Methylene chloride	1	1.2	1.7	1.7	*	1.2	1.3
Xylenes, Total	3	5.8	3.7	6.1	4.7	1.9	2.1
METALS	**SWSL**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Barium	100	1410	823	254	214	352	311
Beryllium	1	*	*	*	*	*	*
Cadmium	1	*	*	2.8	*	*	*
Chromium	10	*	17	11.9	*	*	10.8
Cobalt	10	17.1		*	*	*	*
Copper	10	13.2	14.6	12.7	*	*	*
Lead	10	*	*	*	*	*	*
Nickel	50	*	*	*	*	*	*
Selenium	10	*	*	*	*	*	*
Vanadium	20	*	34.1	*	*	*	*
Zinc	10	37.2	34.2	19.2	89.3	20.3	23.6

All constituents reported in parts per billion (ppb)

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NS - not sampled

Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-10

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Carbon Disulfide	100	*	*	1.4	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
cis-1,2-Dichloroethene	5	*	*	*	*	*	5.9	*	*	*	*	*	*	*	*	*	*	*	*
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Antimony	6	*	*	*	28	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Arsenic	10	6.2	18	*	9	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Barium	100	570	2800	280	1300	450	97	766	*	*	*	*	248	226	235	369	315	254	408
Beryllium	1	*	*	*	1.8	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	10	2.6	100	*	100	*	*	*	*	*	*	*	*	*	*	10.3	*	*	*
Copper	10	*	56	*	89	3.7	*	*	*	*	*	*	*	*	*	*	*	*	*
Cobalt	10	11	73	*	42	6.2	*	*	*	*	*	*	*	*	*	*	*	*	*
Lead	10	22	41	*	29	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Nickel	50	*	21	*	48	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	10	6.3	*	*	11	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	20	*	160	*	170	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	10	18	360	20	260	12	*	*	*	*	*	*	11.0	*	*	31.5	17.3	*	14.5

All constituents reported in parts per billion (ppb)
* - constituent did not exceed the laboratory practical quantitation limit (PQL) or Solid Waste Section Limit (SWSL)
NS - not sampled
Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-14

METALS	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Antimony	**6**	3.9	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Arsenic	**10**	6.5	12	*	7.6	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Barium	**100**	980	860	190	1000	330	330	*	*	*	*	*	341	119	107	*	133	138	172
Beryllium	**1**	*	3.2	*	5.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	**10**	53	37	21	100	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cobalt	**10**	62	48	17	120	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Copper	**10**	43	27	17	100	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Lead	**10**	38	34	6.6	67	7.1	7.1	*	*	*	*	*	*	*	*	*	*	*	*
Nickel	**50**	*	12	*	56	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	**10**	16	*	*	17	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Thallium	**5**	1.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	**20**	93	73	42	220	5.3	5.3	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	**10**	200	*	*	380	75	75	*	*	*	*	*	84.6	*	15.6	12.4	19.7	18.5	21.2

All constituents reported in parts per billion (ppb)
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NS - not sampled
Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-15

METALS	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Antimony	6	3.9	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Arsenic	10	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Barium	100	920	1000	830	150	210	880	697	699	505	*	602	384	359	282	133	477	582	492
Cadmium	1	3.5	*	*	*	*	3.9	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	10	37	26	30	8.2	*	33	*	12.6	*	*	*	*	*	*	*	*	*	*
Cobalt	10	89	74	68	16	8.3	81	35.4	53.3	18.7	20.5	43.3	16.6	*	12.7	*	29.1	15.4	23.1
Copper	10	83	49	81	15	4.2	63	*	*	*	*	*	13.9	*	*	*	37.7	34.5	32.2
Lead	10	40	38	32	6.4	*	38	23.9	26.5	*	*	18.9	*	*	*	*	14.0	10.1	11.4
Nickel	50	*	18	18	9.8	*	26	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	10	12	*	*	*	5.5	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	20	100	84	95	26	*	120	*	51.4	*	*	*	*	*	*	*	*	*	*
Zinc	10	150	150	110	38	35	110	61	72.1	*	*	63.1	40	18	20.8	23.9	86.4	34.5	35

All constituents reported in parts per billion (ppb)

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NS - not sampled

Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-17

METALS	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Antimony	6	*	*	8.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Arsenic	10	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Barium	100	210	130	670	130	330	*	*	*	*	*	*	217	125	152	220	105	112	114
Beryllium	1	*	*	1.4	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cadmium	1	*	*	*	*	3.9	*	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	10	25	21	140	*	65	28.6	23	*	*	10.3	*	*	*	*	13.3	*	*	*
Cobalt	10	25	*	56	11	26	*	12.5	*	*	10.2	*	15.5	*	*	13.1	*	*	*
Copper	10	18	16	130	7.5	62	*	*	*	*	*	*	12.1	*	*	14.7	*	*	*
Lead	10	8	*	44	*	24	41.6	*	*	*	*	*	*	*	*	*	*	*	*
Nickel	50	*	12	43	*	20	*	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	10	*	*	10	6.6	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	20	31	21	180	*	94	*	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	10	60	37	260	31	100	84.8	55.6	*	*	52.9	*	54	23	24.1	65.4	28.5	24.2	29.9

All constituents reported in parts per billion (ppb)
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HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-18

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Carbon Disulfide	**100**	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Arsenic	**10**	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Barium	**100**	110	140	210	190	120	620	*	*	*	*	*	213	146	133	237	175	177	115
Cadmium	**1**	*	*	*	*	*	1.8	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	**10**	3.9	*	12	11	*	48	*	14.7	*	*	13.9	*	*	*	11.1	*	*	*
Copper	**10**		*	*	4	2.4	14	*	*	*	*	*	*	*	*	*	*	*	*
Cobalt	**10**	*	*	*	*	*	14	*	*	*	*	*	*	*	*	*	*	*	*
Nickel	**50**	*	*	*	*	*	20	*	*	*	*	*	*	*	*	*	*	*	*
Lead	**10**	14	*	*	*	*	16	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	**10**	*	*	*	*	5.2	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	**20**	*	*	14	12	*	57	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	**10**	*	26	27	21	*	82	*	*	*	*	68.1	24.6	29.4	*	27.8	13	15.2	11.8

All constituents reported in parts per billion (ppb)
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Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-19

METALS	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Antimony	**6**	6.5	*	*	7.8	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Arsenic	**10**	*	24	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Barium	**100**	530	2600	1300	62	520	660	565	985	1060	941	819	2650	965	452	1170	1000	1020	499
Beryllium	**1**	*	10	*	*	*	*	*	*	*	*	*	2.4			2.2	1.7	1	*
Cadmium	**1**	2.2	*	*	*	*	4.4	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	**10**	40	100	35	2.7	*	61	*	27.7	*	*	*	*	*	*	19.3	12.8	*	*
Cobalt	**10**	30	80	26	*	*	35	*	23	*	*	11.4	*	*	*	25	16.3	*	*
Copper	**10**	33	82	40	7.5	5.3	55	*	*	*	*	*	10.9			24.1	17.6	*	*
Lead	**10**	64	160	61	*	13	80	41.6	56.9	16.1	15	25.2	36.2	13.8	20	64	52.1	18.3	18.1
Nickel	**50**	*	30	*	*	*	25	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	**10**	11	*	*	*	7	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	**20**	68	200	66	*	*	120	*	58.1	*	*	*	*	*	*	31.6	22.9	*	*
Zinc	**10**	130	540	160	11	43	180	80.4	110	*	*	73.8	109	21.8	43.5	139	105	41.2	48.6

All constituents reported in parts per billion (ppb)
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Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-19A

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Carbon Disulfide	100	*	*	9.8	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Barium	100	53	40	40	48	740	48	*	*	*	*	*	*	10.6	*	*	*	*	*
Chromium	10	*	*	*	*	2.9	*	*	*	*	*	*	*	*	*	*	*	*	*
Cobalt	10	*	*	*	*	16	*	*	*	*	*	*	*	*	*	*	*	*	*
Copper	10	14	*	*	*	13	2.4	*	*	*	*	*	*	*	*	*	*	*	*
Lead	10	*	*	*	*	9	*	*	*	*	*	*	*	*	*	*	*	*	*
Nickel	50	*	*	*	*	6.8	*	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	10	*	*	*	*	5.7	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	20	*	*	*	*	7.4	*	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	10	25	10	29	*	45	*	*	*	*	*	*	84.7	*	*	13.2	42.2	13.8	20.6

All constituents reported in parts per billion (ppb)

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NS - not sampled

Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-20

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Carbon Disulfide	**100**	*	*	7	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Arsenic	**10**	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Barium	**100**	160	100	150	200	44	54	*	*	*	*	*	*	*	*	*	*	*	*
Beryllium	**1**	*	*	*	1.6	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	**10**	20	*	19	36	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cobalt	**10**	17	*	13	22	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Copper	**10**	*	*	11	20	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Lead	**10**	15	*	5.9	15	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Nickel	**50**	*	*	*	12	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	**10**	5.8	*	*	5.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	**20**	40	19	42	80	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	**10**	54	22	49	82	*	*	*	*	*	*	*	*	13.7	*	10.6	12.2	*	*

All constituents reported in parts per billion (ppb)
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NS - not sampled
Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-21

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Carbon Disulfide	100	*	*	2.1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Arsenic	10	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Barium	100	78	75	80	40	51	50	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	10	3.9	*	*	3.6	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cobalt	10	*	*	14	*	7.3	7	*	24.4	28.6	21.2	11.3	11.3	*	25.5	*	25.0	*	13.8
Lead	10	17	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	10	6.3	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	10	22	18	30	10	*	*	*	*	*	*	*	14.4	12.3	*	*	*	*	*

All constituents reported in parts per billion (ppb)
* - constituent did not exceed the laboratory practical quantitation limit (PQL) or Solid Waste Section Limit (SWSL)
NS - not sampled
Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-22

METALS	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	10/03 DU	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Arsenic	10	*	27	*	5.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Barium	100	350	2100	180	430	740	660	940	3160	1330	1160	982	1260	1470	371	823	1020	539	712	847
Beryllium	1	*	11	*	2.4	1.9	1.8	*	11.8	4.7	*	*	4.2	2.9	*	2.3	2.8	1.8	1.1	1.9
Cadmium	1	2	*	*	*	*	*	10	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	10	34	140	18	56	18	16	11	366	131	10.2	*	83.7	12.7	*	17.4	61.4	33	*	14.9
Cobalt	10	29	130	15	40	46	42	66	244	100	32.7	31.3	86.2	39.4	*	18.9	59	34.1	18.8	33.9
Copper	10	35	130	19	68	36	32	99	300		*			28.8	*	14.9	54.2	32.5	10.6	22.3
Lead	10	12	48	5.6	20	13	12	33	104	45.4	*	*	41.7	22.4	*	23.2	26.7	21.6	*	11.3
Nickel	50	*	100	*	50	20	18	80	226	92.2	*	*	*	*	*	*	*	*	*	*
Selenium	10	12	*	*	10	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	20	60	270	37	120	20	18	190	616	270	*	*	141	*	*	31.7	109	65.3	*	25.7
Zinc	10	87	340	46	120	71	65	240	672	212	57.1	*	207	74.4	29.5	39.1	153	79.3	31	69.6

All constituents reported in parts per billion (ppb)
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NS - not sampled
Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

MW-22A

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Carbon Disulfide	100	*	*	7.1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Arsenic	10	*	*	*	6.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Barium	100	82	100	85	88	72	100	*	*	*	*	*	*	*	*	*	*	*	102
Beryllium	1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	10	*	*	21	10	4.2	10	*	*	*	*	*	*	*	*	*	*	*	*
Cobalt	10	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Copper	10	*	*	*	6.1	5	6.3	*	*	*	*	*	*	*	*	*	*	*	*
Lead	10	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Nickel	50	*	*	16	8	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	10	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	20	*	*	*	8.6	7	17	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	10	38	13	22	16	15	19	*	*	*	*	*	*	*	*	*	*	18.6	12.4

All constituents reported in parts per billion (ppb)
* - constituent did not exceed the laboratory practical quantitation limit (PQL) or Solid Waste Section Limit (SWSL)
NS - not sampled
Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS
MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL
PERMIT NO: 57-03
FRANKLIN, NORTH CAROLINA

MW-23

VOCs	SWSL	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
1,1-Dichlorethane	5	*	*	1.7	*	*	*
1,4-Dichlorobenzene	1	*	1.3	1.1	1.2	1.3	1.1
METALS	**SWSL**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Arsenic	10	*	*	*	*	*	*
Barium	100	128	109	150	156	145	135
Beryllium	1	*	*	*	*	*	*
Chromium	10	*	*	*	*	*	*
Cobalt	10	*	*	*	*	*	*
Copper	10	*	*	*	*	*	*
Lead	10	*	*	*	*	*	*
Nickel	50	*	*	*	*	*	*
Selenium	10	*	*	*	*	*	*
Vanadium	20	*	*	*	*	*	*
Zinc	10	26.4	*	21.7	21.6	12.4	14.7

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HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

SW-1

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Carbon Disulfide	100	*	*	2.6	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Barium	100	20	14	15	50	13	18	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	10	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Copper	10	*	*	*	*	2.3	3.7	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	10	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	10	22	*	12	*	11	*	*	*	*	*	*	20.1	21.9	*	*	*	11.8	14.1

All constituents reported in parts per billion (ppb)
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NS - not sampled
Only compounds detected above laboratory PQLs or SWSLs are listed

HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

SW-2

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Carbon Disulfide	100	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Arsenic	6	*	*	*	98	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Barium	100	140	120	150	5800	48	57	*	*	*	*	*	*	*	*	*	*	*	*
Beryllium	1	*	*	*	14	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cadmium	1	*	*	*	61	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	10	*	*	*	640	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cobalt	10	*	*	12	890	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Copper	10	*	*	*	1000	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Nickel	50	*	*	*	340	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	10	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Lead	10	*	*	*	500	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Silver	10	*	*	*	9.9	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	20	*	*	*	740	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	10	36	18	23	2600	*	*	*	*	*	*	*	*	*	*	*	*	*	*

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HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

SW-3

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Carbon Disulfide	100	*	*	1.6	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Barium	100	34	49	38	37	79	26	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	10	*	*	*	88	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Copper	10	*	*	*	7.7	3.4	3.7	*	*	*	*	*	*	*	*	*	*	*	*
Lead	10	*	*	*	*	5.2	*	*	*	*	*	*	*	*	*	*	*	*	*
Nickel	50	*	*	*	50	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	20	*	*	*	7.6	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	10	*	*	23	26	24	*	*	*	*	*	*	21.3	17.6	12.3	*	*	*	*

All constituents reported in parts per billion (ppb)
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NS - not sampled
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HISTORICAL ANALYTICAL RESULTS

MACON COUNTY MUNICIPAL SOLID WASTE (MSW) LANDFILL

PERMIT NO: 57-03

FRANKLIN, NORTH CAROLINA

SW-4

VOCs	SWSL	Oct-01	Apr-02	Oct-02	Apr-03	Oct-03	Apr-04	Dec-04	Apr-05	Oct-05	Apr-06	Oct-06	Apr-07	Oct-07	Apr-08	Oct-08	Apr-09	Oct-09	Apr-10
Carbon Disulfide	**100**	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Styrene	**1**	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
METALS	**SWSL**	**Oct-01**	**Apr-02**	**Oct-02**	**Apr-03**	**Oct-03**	**Apr-04**	**Dec-04**	**Apr-05**	**Oct-05**	**Apr-06**	**Oct-06**	**Apr-07**	**Oct-07**	**Apr-08**	**Oct-08**	**Apr-09**	**Oct-09**	**Apr-10**
Barium	**100**	39	40	68	36	96	27	*	*	*	*	*	*	*	*	*	*	*	*
Chromium	**10**	*	*	*	18	2.1	*	*	*	*	*	*	*	*	*	*	*	*	*
Cobalt	**10**	*	*	*	*	7	*	*	*	*	*	*	*	*	*	*	*	*	*
Copper	**10**	*	*	*	3.9	4.6	5.2	*	*	*	*	*	*	*	*	*	*	*	*
Nickel	**50**	*	*	*	12	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Selenium	**10**	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Lead	**10**	*	*	*	*	5.3	*	*	*	*	*	*	*	*	*	*	*	*	*
Vanadium	**20**	*	*	*	*	5.3	*	*	*	*	*	*	*	*	*	*	*	*	*
Zinc	**10**	*	21	20	21	24	12	*	*	*	*	*	*	*	*	*	*	10.8	*

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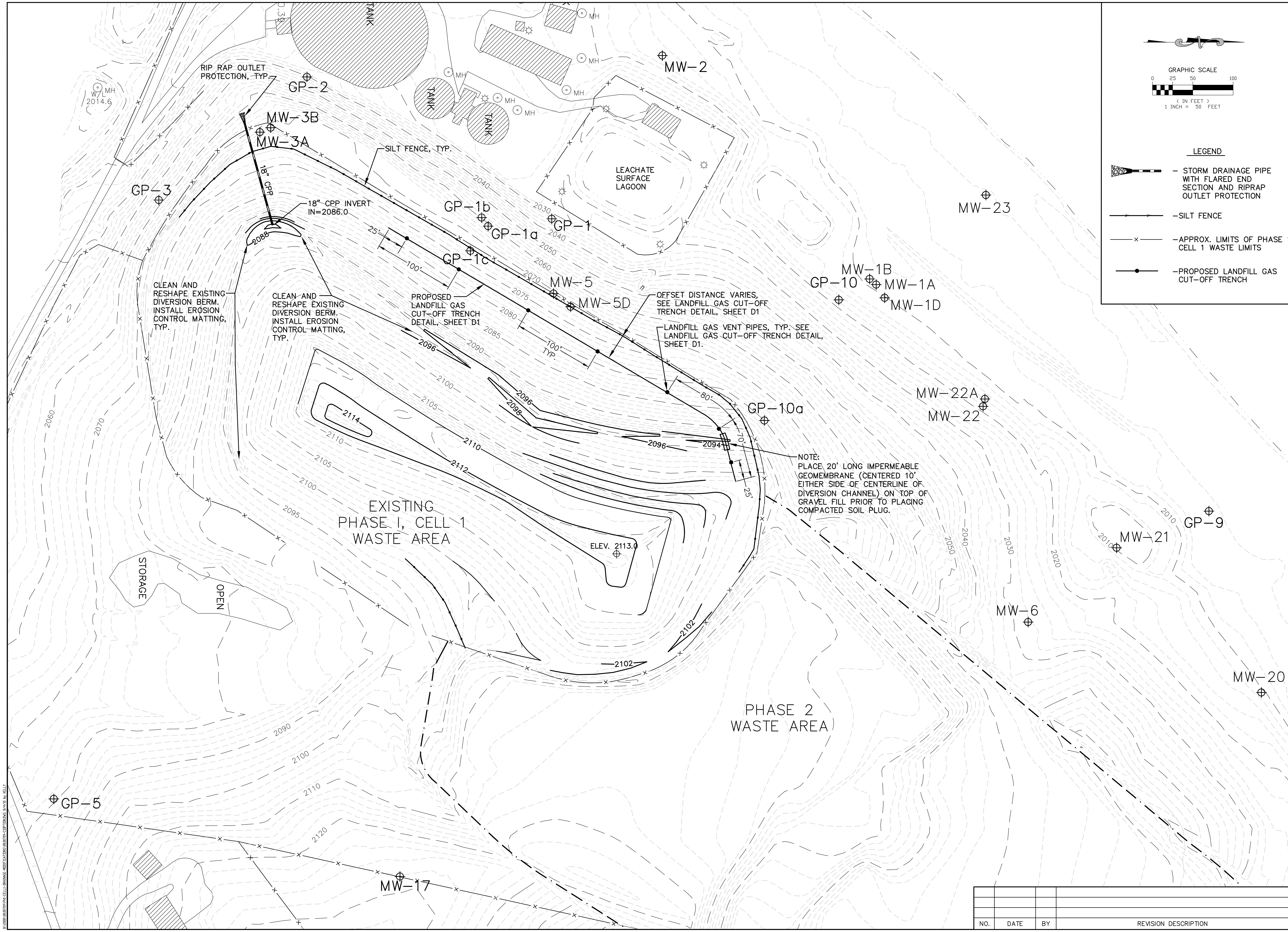
NS - not sampled
Only compounds detected above laboratory PQLs or SWSLs are listed

APPENDIX B

SHEET C1 -- PROPOSED REGRADING & LANDFILL GAS CUT-OFF TRENCH SITE PLAN



MACON COUNTY LANDFILL
PHASE 1, CELL 1
MACON COUNTY
MACON COUNTY, NORTH CAROLINA

McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
55 BROAD STREET ASHEVILLE, NC PH. (828) 252-0575

JOB NO.: 08.00709
DATE: SEPTEMBER 2008
SCALE: 1"=50'
DESIGNED BY: KS
CAD BY: KS
DESIGN REVIEW:
CONST. REVIEW:

PROPOSED REGRADING & LANDFILL GAS CUT-OFF TRENCH SITE PLAN

SHEET
C1

NO.	DATE	BY	REVISION DESCRIPTION

APPENDIX C

TECHNICAL SPECIFICATION SECTION 02931
SEEDING, FERTILIZING AND MULCHING

PART 1: GENERAL

1.01 SCOPE OF WORK

A. This section covers the furnishing of all labor, equipment and materials necessary for the landscaping of all areas of the site disturbed by construction operations and all earth surfaces of embankments including rough and fine grading, topsoil if required, fertilizer, lime, seeding and mulching. The Contractor shall adapt his operations to variations in weather or soil conditions as necessary for the successful establishment and growth of the grasses or legumes.

PART 2: PRODUCTS

2.01 MATERIALS

A. Fertilizer:

1. The quality of fertilizer and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Fertilizer Law and regulations adopted by the North Carolina Board of Agriculture.

2. Fertilizer shall be 10-10-10 grade. Upon written approval of the Engineer a different grade of fertilizer may be used, provided the rate of application is adjusted to provide the same amounts of plant food.

3. During handling and storing, the fertilizer shall be cared for in such a manner that it will be protected against hardening, caking, or loss of plant food values. Any hardened or caked fertilizer shall be pulverized to its original conditions before being used.

B. Lime:

1. The quality of lime and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Lime Law and regulations adopted by the North Carolina Board of Agriculture.

2. During the handling and storing, the lime shall be cared for in such a manner that it will be protected against hardening and caking.

Any hardened or caked lime shall be pulverized to its original condition before being used.

3. Lime shall be agriculture grade ground dolomitic limestone. It shall contain not less than 85% of the calcium and magnesium carbonates and shall be of such fineness that at least 90% will pass a No. 10 sieve and at least 50% will pass a No. 100 sieve.

C. <u>Seed</u>:

1. The quality of seed and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Seed Law and regulations adopted by the North Carolina Board of Agriculture.

2. Seed shall have been approved by the North Carolina Department of Agriculture or any agency approved by the Engineer before being sown, and no seed will be accepted with a date of test more than nine (9) months prior to the date of sowing. Such testing however, will not relieve the Contractor from responsibility for furnishing and sowing seed that meets these specifications at the time of sowing. When a low percentage of germination causes the quality of the seed to fall below the minimum pure live seed specified, the Contractor may elect, subject to the approval of the Engineer, to increase the rate of seeding sufficiently to obtain the minimum pure live seed contents specified, provided that such an increase in seeding does not cause the quantity of noxious weed seed per square yard to exceed the quantity that would be allowable at the regular rate of seed.

3. During handling and storing, the seed shall be cared for in such a manner that it will be protected from damage by heat, moisture, rodents, or other causes.

4. Seed shall be entirely free from bulblets or seed of Johnson Grass, Nutgrass, Sandbur, Wild Onion, Wild Garlic, and Bermuda Grass. The specifications for restricted noxious weed seed refers to the number per pound, singly or collectively, of Blessed Thistle, Wild Radish, Canada Thistle, Corncockle, Field Bindweed, Quackgrass, Dodders, Dock, Horsenettle, Bracted Plantain, Buckhorn or Wild Mustard; but in no case shall the number of Blessed Thistle or Wild Radish exceed 27 seeds of each per pound. No tolerance on weed seed will be allowed.

D. Mulch: Straw mulch shall be threshed straw of oats, rye or wheat free from matured seed of obnoxious weeds or other species which would grow and be detrimental to the specified grass.

E. Tackifier: Emulsified asphalt or organic tackifier such as Reclamare R2400 shall be sprayed uniformly on mulch as it is ejected from blower or immediately thereafter. Tackifier shall be applied evenly over area creating uniform appearance. Rates of application will vary with conditions. Asphalt shall not be used in freezing weather.

PART 3: EXECUTION

3.01 PREPARATION

A. Protection of Existing Trees and Vegetation:

1. Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

2. Provide protection for roots over 1-1/2" diameter cut during construction operations. Coat cut faces with an emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out and cover with earth as soon as possible.

3. The Contractor shall not remove or damage trees and shrubs which are outside the Clearing Limits established by the Owner or those within the Clearing Limits designated to remain.

4. Repair trees scheduled to remain and damaged by construction operations in a manner acceptable to the Engineer. Repair damaged trees promptly to prevent progressive deterioration caused by damage.

5. Replace trees scheduled to remain and damaged beyond repair by construction operations, as determined by the Engineer with trees of similar size and species. Repair and replacement of trees scheduled to remain and damaged by construction operations or lack of adequate protection during construction operations shall be at the Contractor's expense.

B. Grading:

1. Rough grading shall be done as soon as all excavation required in the area has been backfilled. The necessary earthwork shall be accomplished to bring the existing ground to the desired finish elevations as shown on the Contract Drawings or otherwise directed.

2. Fine grading shall consist of shaping the final contours for drainage and removing all large rock, clumps of earth, roots and waste construction materials. It shall also include thorough loosening of the soil to a depth of 6" by plowing, discing, harrowing or other approved methods until the area is acceptable as suitable for subsequent landscaping operations. The work of landscaping shall be performed on a section by section basis immediately upon completion of earthwork.

3. Upon failure or neglect on the part of the Contractor to coordinate his grading with seeding and mulching operations and diligently pursue the control of erosion and siltation, the Engineer may suspend the Contractor's grading operations until such time as the work is coordinated in a manner acceptable to the Engineer.

C. Seedbed Preparation:

1. The Contractor shall cut and satisfactorily dispose of weeds or other unacceptable growth on the areas to be seeded. Uneven and rough areas outside of the graded section, such as crop rows, farm contours, ditches and ditch spoil banks, fence line and hedgerow soil accumulations, and other minor irregularities which cannot be obliterated by normal seedbed preparation operations, shall be shaped and smoothed as directed by the Engineer to provide for more effective seeding and for ease of subsequent mowing operations.

2. The soil shall then be scarified or otherwise loosened to a depth of not less than 6" except as otherwise provided below or otherwise directed by the Engineer. Clods shall be broken and the top 2" to 3" of soil shall be worked into an acceptable seedbed by the use of soil pulverizers, drags, or harrows; or by other methods approved by the Engineer.

3. On 2:1 slopes a seedbed preparation will be required that is the same depth as that required on flatter areas, although the degree

of smoothness may be reduced from that required on the flatter areas if so permitted by the Engineer.

4. On cut slopes that are steeper than 2:1, both the depth of preparation and the degree of smoothness of the seedbed may be reduced as permitted by the Engineer, but in all cases the slope surface shall be scarified, grooved, trenched, or punctured so as to provide pockets, ridges, or trenches in which the seeding materials can lodge.

5. On cut slopes that are either 2:1 or steeper, the Engineer may permit the preparation of a partial or complete seedbed during the grading of the slope. If at the time of seeding and mulching operations such preparation is still in a condition acceptable to the Engineer, additional seedbed preparation may be reduced or eliminated.

6. The preparation of seedbeds shall not be done when the soil is frozen, extremely wet, or when the Engineer determines that it is in an otherwise unfavorable working condition.

D. Application Rates: Seed shall be applied by means of a hydro-seeder or other approved methods. The rates of application of seed, fertilizer and limestone shall be as stated below.

1. Lime and Fertilizer: In the absence of a soil test, the following rates of application of limestone and fertilizer shall be:

   a. 4,000 pounds limestone per acre
   b. 1000 pounds 10-10-10 ($N-P_20_5-K_20$) fertilizer per acre and the remaining quantity applied when vegetation is three inches in height or 45 days after seeding, whichever comes first.

2. Mulch: Mulch shall be applied at the following rates per acre:

   a. 3,000-4,000 pounds straw mulch, or
   b. 1,500-2,000 pounds wood cellulose fiber.
   c. 35-40 cubic yards of shredded or hammermilled hardwood bark
   d. 1,200-1,400 pounds of fiberglass roving

3. Seed: The kinds of seed and the rates of application shall be as contained in this table. All rates are in pounds per acre. *See Notes 1 and 2*.

a. Fall and Winter (Normally August 1 to June 1)
80 pounds of Ky-31 tall fescue and 15 pounds of rye grain

b. Summer (Normally May 1 to September 1)
100 pounds of Ky-31 tall fescue

NOTE:

1. On cut and fill slopes having 2:1 or steeper slopes, add 40 pounds of sericea lespedeza per acre to the planned seeding (hulled in spring and summer unhulled in fall and winter) plus 15 pounds of sudan grass in summer seeding or 25 pounds of rye cereal per acre in fall and winter seeding, if seeded September to February.

2. These seeding rates are prescribed for all sites with less than 50% ground cover and for sites with more than 50% ground cover where complete seeding is necessary to establish effective erosion control vegetative cover. On sites having 50% to 80% ground cover where complete seeding is not necessary to establish vegetative cover, reduce the seeding rate at least one-half the normal rate.

E. Application:

1. Equipment to be used for the application, covering or compaction of limestone, fertilizer, and seed shall have been approved by the Engineer before being used on the project. Approval may be revoked at any time if equipment is not maintained in satisfactory working condition, or if the equipment operation damages the seed.

2. Limestone, fertilizer, and seed shall be applied within 24 hours after completion of seedbed preparation unless otherwise permitted by the Engineer, but no limestone or fertilizer shall be distributed and no seed shall be sown when the Engineer determines that weather and soil conditions are unfavorable for such operations.

3. Limestone may be applied as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, limestone and fertilizer shall be distributed uniformly over the prepared seedbed at the specific rate of application and then harrowed, raked, or otherwise thoroughly worked or mixed into the seedbed.

4. Seed shall be distributed uniformly over the seedbed at the required rate of application, and immediately harrowed, dragged, raked, or otherwise worked so as to cover the seed with a layer of soil. The depth of covering shall be as directed by the Engineer. If

two kinds of seed are to be used which require different depths of covering, they shall be sown separately.

5. When a combination seed and fertilizer drill is used, fertilizer may be drilled in with the seed after limestone has been applied and worked into the soil. If two kinds of seed are being used which require different depths of covering, the seed requiring the lighter covering may be sown broadcast or with a special attachment to the drill, or drilled lightly following the initial drilling operation.

6. When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than 30 minutes prior to application unless otherwise permitted by the Engineer.

7. Immediately after seed has been properly covered the seedbed shall be compacted in the manner and degree approved by the Engineer.

8. When adverse seeding conditions are encountered due to steepness of slope, height of slope, or soil conditions, the Engineer may direct or permit that modifications be made in the above requirements which pertain to incorporating limestone into the seedbed; covering limestone, seed, and fertilizer; and compaction of the seedbed.

9. Such modifications may include but not be limited to the following:

    a. The incorporation of limestone into the seedbed may be omitted on

        i. cut slopes steeper than 2:1;

        ii. on 2:1 cut slopes when a seedbed has been prepared during the excavation of the cut and is still in an acceptable condition; or

        iii. on areas of slopes where the surface of the area is too rocky to permit the incorporation of the limestone.

    b. The rates of application of limestone, fertilizer, and seed on slopes 2:1 or steeper or on rocky surfaces may be reduced or eliminated.

c. Compaction after seeding may be reduced or eliminated on slopes 2:1 or steeper, on rocky surfaces, or on other areas where soil conditions would make compaction undesirable.

F. Mulching:

1. All seeded areas shall be mulched unless otherwise indicated in the special provisions or directed by the Engineer.

2. It shall be spread uniformly at a rate of two tons per acre in a continuous blanket over the areas specified.

3. Before mulch is applied on cut or fill slopes which are 3:1 or flatter, and ditch slopes, the Contractor shall remove and dispose of all exposed stones in excess of 3" in diameter and all roots or other debris which will prevent proper contact of the mulch with the soil.

4. Mulch shall be applied within 24 hours after the completion of the seeding unless otherwise permitted by the Engineer. Care shall be exercised to prevent displacement of soil or seed or other damage to the seeded area during the mulching operations.

5. Mulch shall be uniformly spread by hand or by approved mechanical spreaders or blowers which will provide an acceptable application. An acceptable application will be that which will allow some sunlight to penetrate and air to circulate but also partially shade the ground, reduce erosion, and conserve soil moisture.

6. Mulch shall be held in place by applying a sufficient amount of asphalt or other approved binding material to assure that the mulch is properly held in place. The rate and method of application of binding material shall meet the approval of the Engineer. Where the binding material is not applied directly with the mulch it shall be applied immediately following the mulch operation.

7. The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water, or other causes and shall promptly remove any blockage to drainage facilities which may occur.

G. Maintenance:

1. The Contractor shall keep all seeded areas in good condition, reseeding and mowing if and when necessary as directed by the Engineer, until a good lawn is established over the entire area

seeded and shall maintain these areas in an approved condition until final acceptance of the Contract.

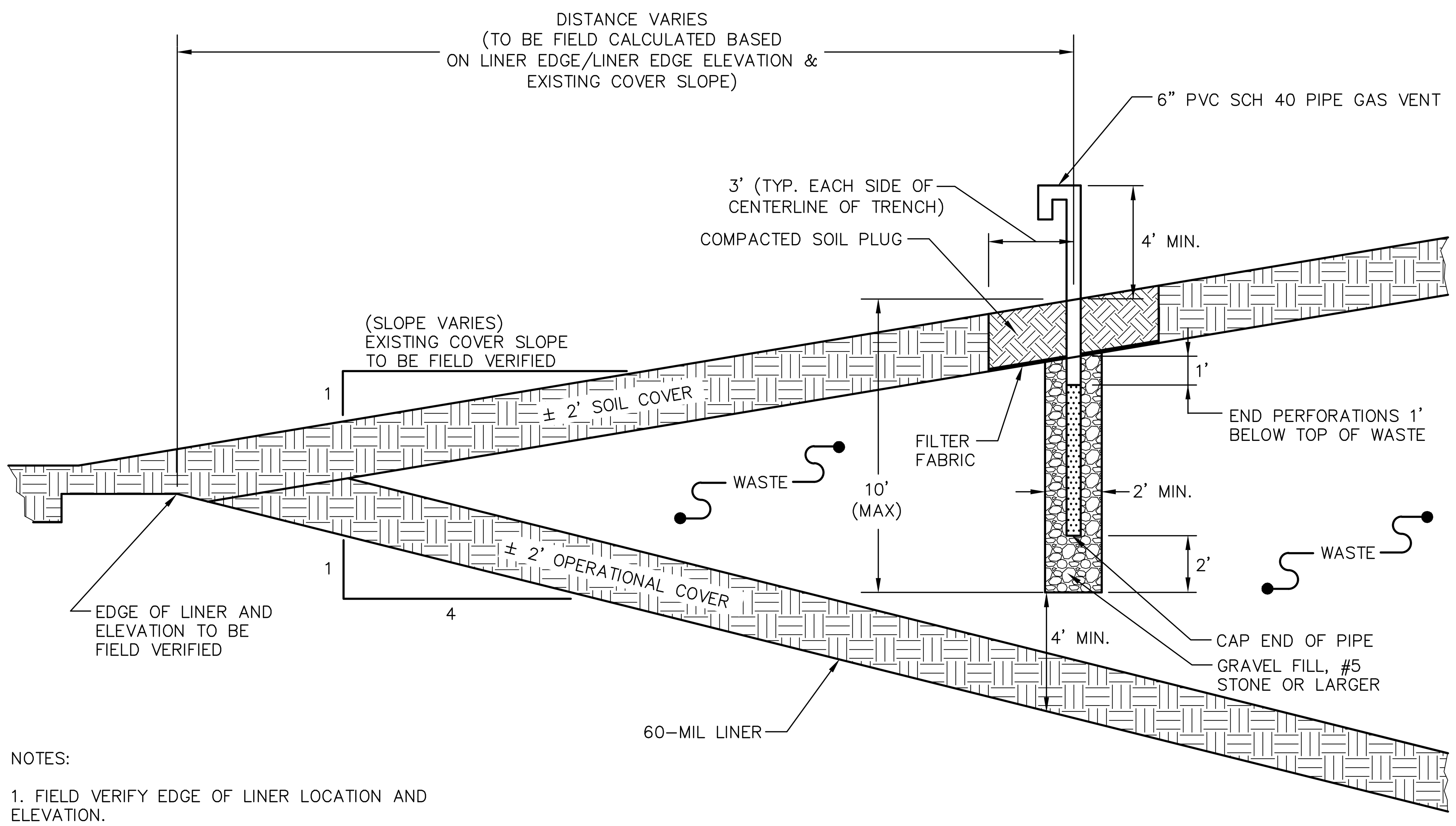
2. Grassed areas will be accepted when a 95% cover by permanent grasses is obtained and weeds are not dominant. On slopes, the Contractor shall provide against washouts by an approved method. Any washouts which occur shall be regraded and reseeded until a good sod is established.

3. Areas of damage or failure due to any cause shall be corrected by being repaired or by being completely redone as may be directed by the Engineer. Areas of damage or failure resulting either from negligence on the part of the Contractor in performing subsequent construction operations or from not taking adequate precautions to control erosion and siltation as required throughout the various sections of the specifications, shall be repaired by the Contractor as directed by the Engineer at no cost to the Owner.

END OF SECTION

APPENDIX D

SHEET D1 -- MISCELLANEOUS DETAILS



NOTES:

1. FIELD VERIFY EDGE OF LINER LOCATION AND ELEVATION.

2. FIELD VERIFY EXISTING COVER SLOPE.

3. FIELD CALCULATE LOCATION OF PROPOSED LANDFILL GAS CUT-OFF TRENCH TO ENSURE MINIMUM OF 4' CLEARANCE ABOVE EXISTING GEOMEMBRANE LINER. (I.E., 4:1 COVER SLOPE – MIN. 28' FROM LINER EDGE, 5:1 COVER SLOPE – MIN. 31' FROM LINER EDGE, ETC.)

4. EXCAVATE CUT-OFF TRENCH A MAXIMUM OF 10' DEEP FROM CENTERLINE ELEVATION OF TRENCH.

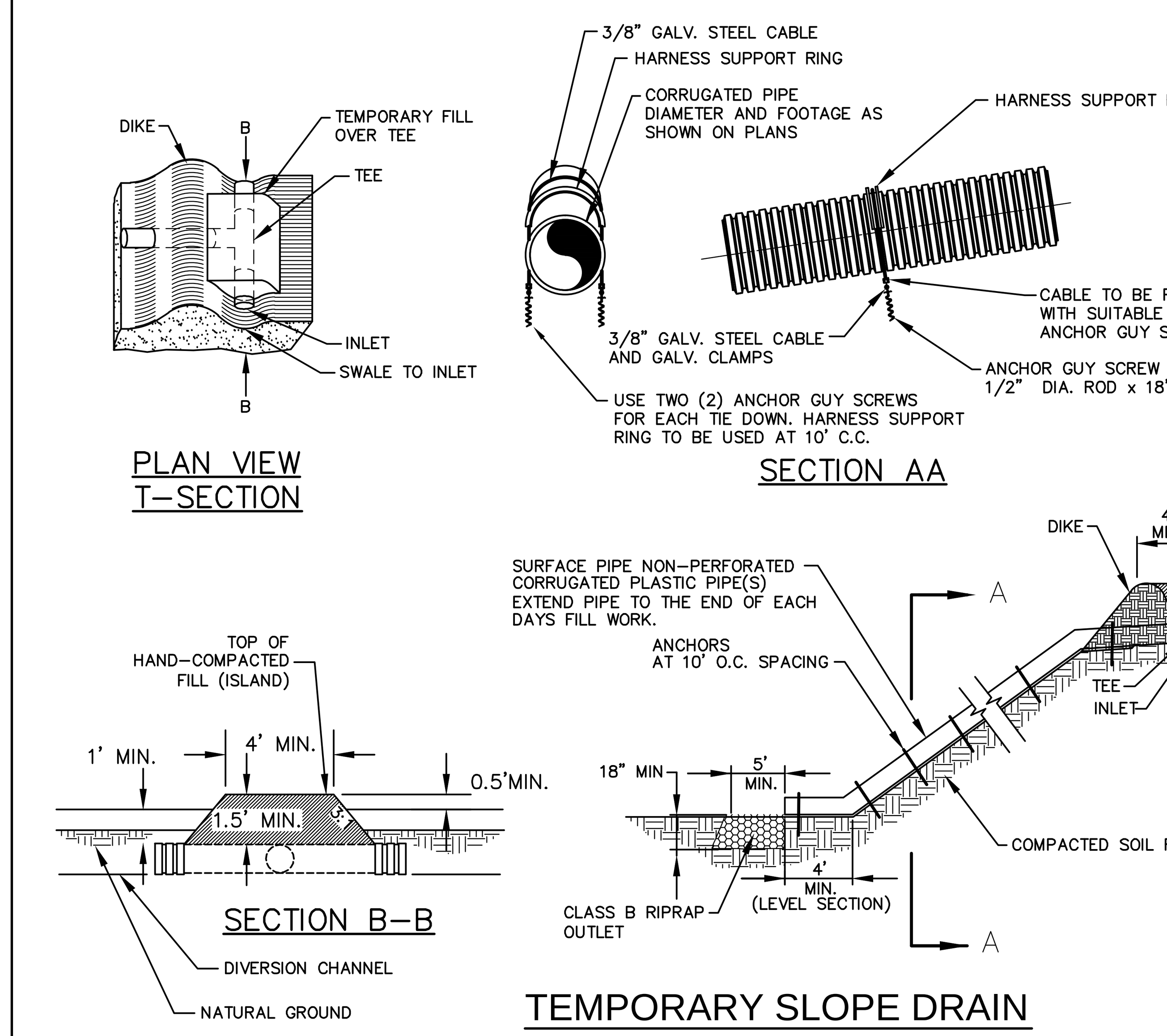
5. PERFORATIONS TO BE 4–1/2" DIAMETER HOLES EVENLY SPACED AROUND PIPE CIRCUMFERENCE. EACH ROW OF HOLES – 6" ON CENTER ALONG PIPE WITH PERFORATIONS ROTATED 45° AROUND CIRCUMFERENCE FROM ADJACENT ROW OF PERFORATIONS.

6. CAP LOWER END OF 6" SCH 40 PVC PIPE PRIOR TO PLACING IN TRENCH AND BACKFILLING WITH GRAVEL.

7. GAS VENTS TO BE SPACED APPROXIMATELY 100' ON CENTER UNLESS OTHERWISE NOTED.

LANDFILL GAS CUT-OFF TRENCH

NOT TO SCALE

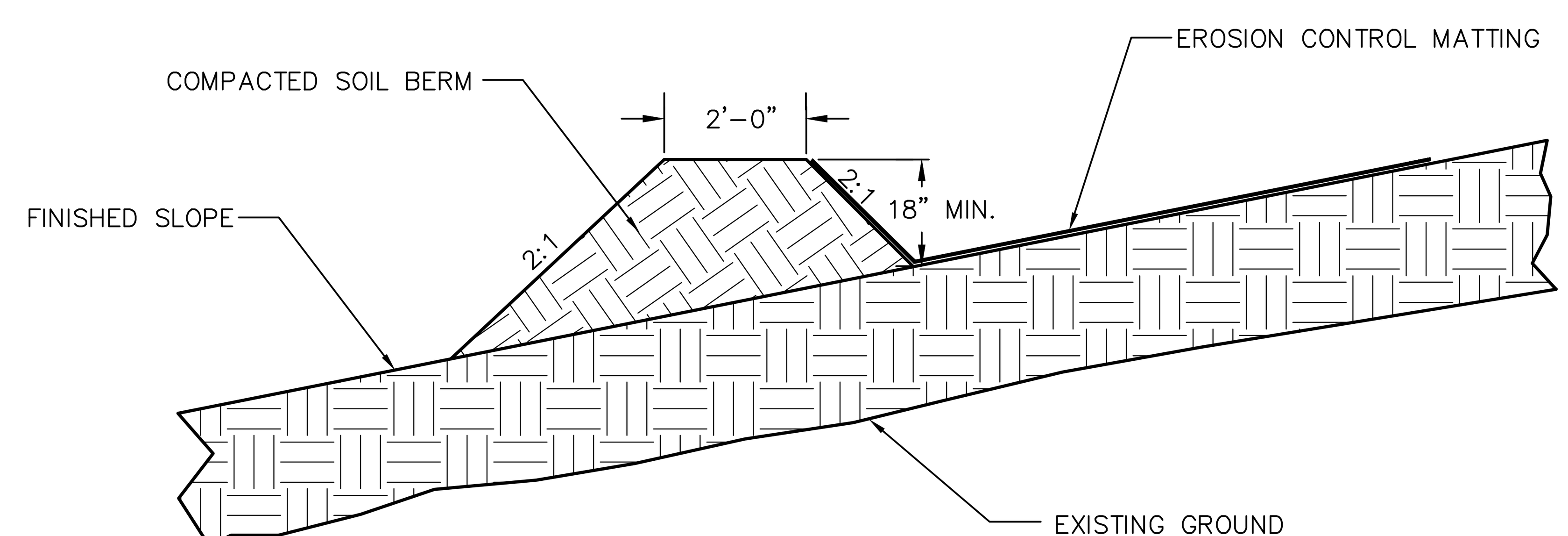


NOTES:

1. PLACE SLOPE DRAINS ON UNDISTURBED SOIL OR WELL COMPACTED FILL AT 200' INTERVALS ALONG NEW FILL SLOPE DURING CONSTRUCTION.
2. SLIGHTY SLOPE SECTION OF PIPE UNDER THE DIVERSION DIKE TOWARD OUTLET.
3. ENSURE THAT ALL SLOPE DRAIN CONNECTIONS ARE WATERTIGHT.
4. INSPECT AFTER EVERY RAINFALL AND MAKE NECESSARY REPAIRS.
5. REFERENCE NCDENR LAND QUALITY SECTION DESIGN MANUAL: 6.32.

TEMPORARY SLOPE DRAIN

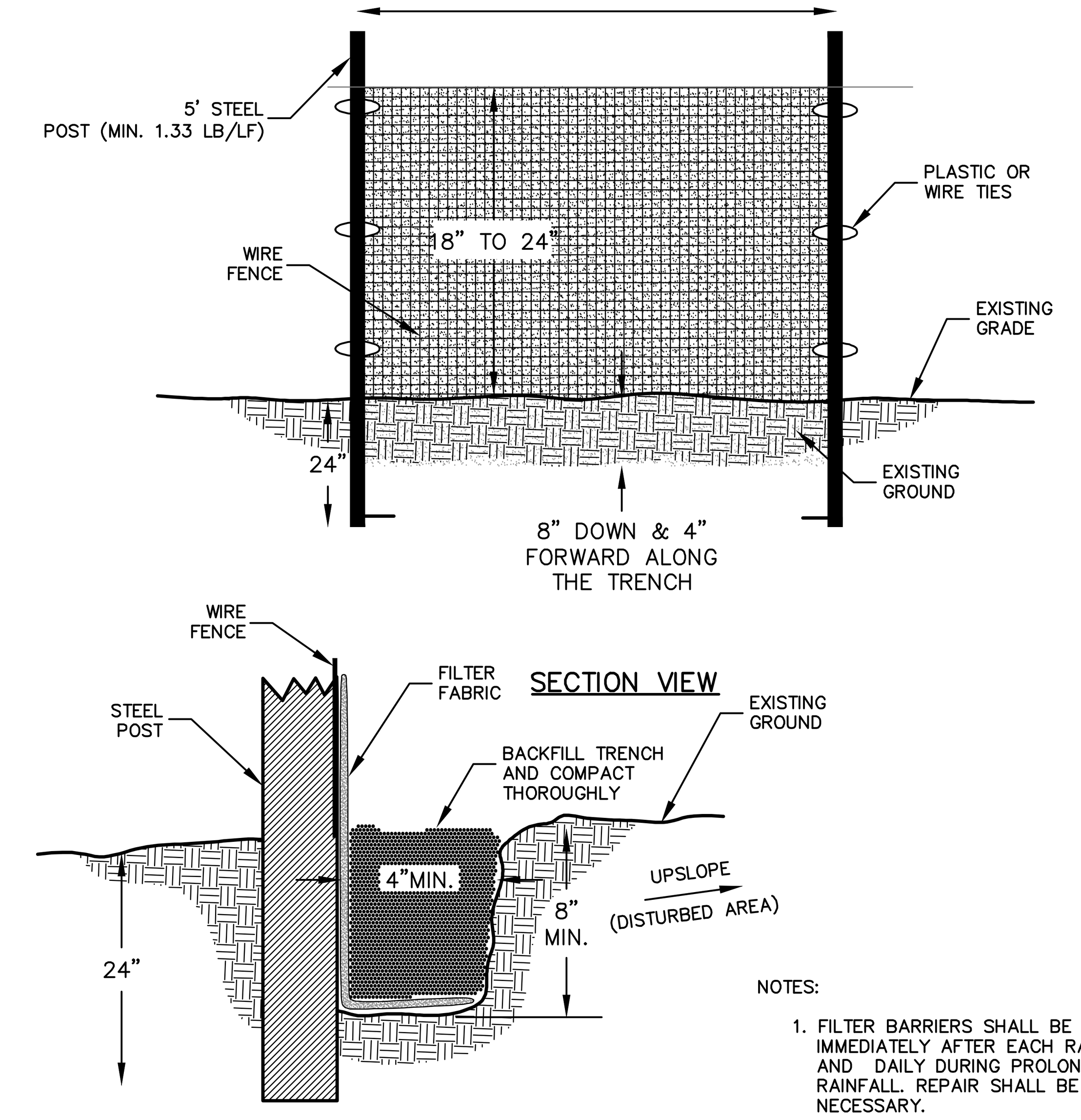
REVISION DATE - JUNE 1, 2007



SLOPE DIVERSION BERM

NOT TO SCALE

8' MAX. STANDARD STRENGTH FABRIC WITH WIRE FENCE (MIN. 14 GUAGE 6"X6" WIRE)
6' MAX EXTRA STRENGTH FABRIC WITHOUT WIRE FENCE



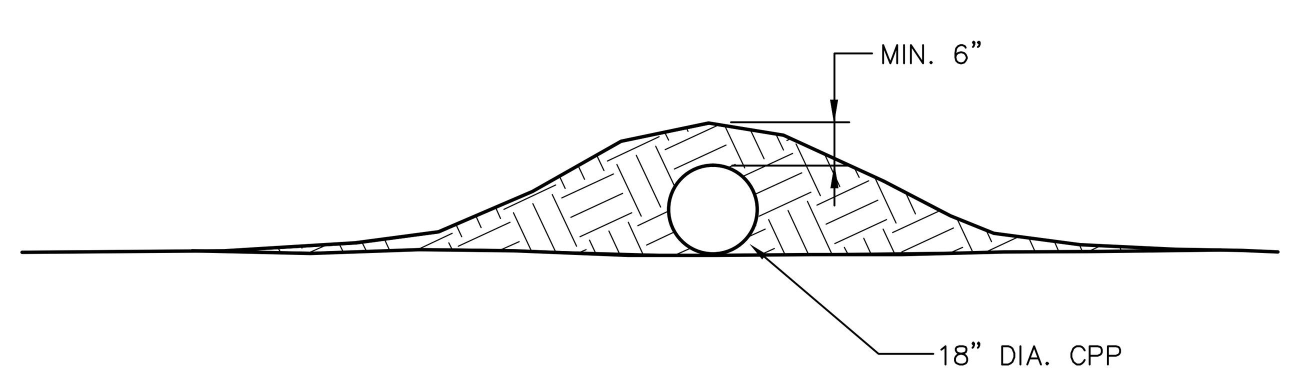
SLOPE	SLOPE LENGTH(FT)	MAXIMUM AREA(SQFT)
<2%	100	10,000
2 TO 5%	75	7,500
5 TO 10%	50	5,000
10 TO 20%	25	2,500
>20%	15	1,500

NOTES:

1. FILTER BARRIERS SHALL BE INSPECTED IMMEDIATELY AFTER EACH RAINFALL AND DAILY DURING PROLONGED RAINFALL. REPAIR SHALL BE MADE AS NECESSARY.
2. FABRIC SHALL BE REPLACED PROMPTLY IF FOUND TO BE IN DISREPAIR.
3. SEDIMENT DEPOSITS SHALL BE REMOVED AFTER EACH STORM EVENT AND WHEN DEPOSITS REACH APPROXIMATELY 1/3 HEIGHT OF BARRIER.
4. REFERENCE NCDENR LAND QUALITY SECTION DESIGN MANUAL: 6.62

SEDIMENTATION/SILT FENCE

REVISION DATE - JUNE 1, 2007



SLOPE DRAIN PIPE COVER

NOT TO SCALE

NO.	DATE	BY	REVISION DESCRIPTION

McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
55 BROAD STREET ASHEVILLE, NC PH. (828) 252-0575

MACON COUNTY LANDFILL
PHASE 1, CELL 1
MACON COUNTY
MACON COUNTY, NORTH CAROLINA

JOB NO.: 08.00709
DATE: MARCH 2010
SCALE: AS NOTED
DESIGNED BY: KS
CAD BY: KS
DESIGN REVIEW:
CONST. REVIEW:
Q:\2008\08.00709\Ph1-Cell1-Drainage-Modifications\08.00709-Details.dwg

MISCELLANEOUS DETAILS

SHEET
D1

APPENDIX E

REIC SITE MAP

MUNICIPAL SOLID WASTE LANDFILL
MACON COUNTY, NORTH CAROLINA
PERMIT NO. 57-03

WATER QUALITY MONITORING LOCATIONS

PREPARED BY:
REI CONSULTANTS, INC.
AUGUST 2010

REI Consultants, Inc.

LEGEND

MONITORING WELL LOCATION
SURFACE WATER SAMPLING LOCATION
TOPOGRAPHIC CONTOURS
LAKE, PONDS, STREAMS

ALL MEASUREMENTS IN FEET

SCALE: 1' = 300'

0 100 200

APPENDIX F

WATER QUALITY MANAGEMENT PLAN

PIN-POINT
ENVIRONMENTAL SERVICES, INC.

1293 Hendersonville Rd.
Suite 8
Asheville, NC 28803
(704) 277-0278

1304 Azalea Court
Suite E
Myrtle Beach, SC 29577
(803) 449-2779
(803) 449-3970

P.O. Box 490
Ellenboro, NC 28040
(704) 453-0884

DESIGN HYDROGEOLOGIC REPORT

and

WATER QUALITY MANAGEMENT PLAN

for

Phase 2, Cell I

Macon County MSWLF
Franklin, North Carolina
Permit # 57-03

June 19, 1997

Fred C. Hankinson
Project Geologist

Leslie A. Crawford
Hydrogeologist

G. Robert Luckadoo
President
Licensed Geologist
N.C. #1062

Design Hydrogeologic Report
for
Macon County MSWLF
Phase 2, Cell 1
Permit #57-03

TABLE OF CONTENTS

TABLES

FIGURES

Design Hydrogeologic Report
for
Macon County MSWLF
Phase 2, Cell 1
Permit #57-03

This report has been prepared to comply with 15A NCAC 13B Rule .1623(b), Design Hydrogeologic Report.

RULE .1623

Area of Investigation: (b) (1)
The proposed Macon County MSWLF including buffer area will occupy approximately 30 acres. Thirty-four test borings have been drilled into the water table and bedrock to determine the hydrologic and geologic conditions in and around the Phase 2 area.

Vertical Separation and Foundation Standards: (b) (1) (A)
Phase 2 of the Macon County MSWLF has been designed so that the base liner system is at least four feet above the projected high water table and bedrock (see Table 1).

Hydrogeologic Investigation: (b) (1) (B)
The hydrogeologic regime is discussed in full in the report.

Design Hydrogeologic Report: (b) (2) (A)

Boring Testing Program: (a) (4)
Thirty-four test borings were drilled within the area of investigation of the proposed Phase 2 (See Sheet 1). At each boring the following information was recorded: standard penetration-resistance, soil classification (based on the Unified Soil Classification System (USCS)), and soil or formation descriptions.

Boring logs with all of the information described above may be found in Appendix 1.

Standard Penetration - Resistance: (a) (4) (A)
The soil borings were advanced by mechanically twisting a continuous flight steel auger into the soil, or by rotary wash drilling. At regular intervals, soil samples were obtained with a standard 1.4-inch I.D., split-tube sampler. The sampler was first seated six inches to penetrate any loose cuttings, and then driven an additional 12 inches with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final 12 inches was recorded and is designated the "penetration resistance".

Samples of in-place soils were obtained during drilling. Several types of soil samples were obtained, including

- split-tube samples
- undisturbed samples, and
- bag (bulk) samples.

Particle Size Analyses: (a) (4) (B)
Particle size analyses were performed on selected, representative soil samples to determine the particle size distribution of the materials (see Appendix 2). After initial drying, the samples were washed over a U.S. standard No. 200 sieve to remove the fines. The samples were then dried and sieved through a standard set of nested sieves. This test was performed in a manner similar to that described by ASTM D 422.

USCS Soil Classification: (a) (4) (C)
Most borings encountered a surficial veneer of grass and topsoil up to 4 or 5 inches thick. The residual soils generally begin with a somewhat clayey zone to depths of 3 to 8 feet. These clayey soils are variably micaceous reddish-brown sandy silts and silty sands. The upper residual soils have Unified Soil Classifications of ML and SM.

The deeper residual soils (or saprolite) at the borings are variably micaceous silty sands with Unified Soil Classifications of SM. Some of these sands are interlayered with sandy silt (ML and MH).

Material dense enough to be termed "partially weathered rock" had a penetration resistance equivalent to or greater than 100 blows per foot.

Formation Descriptions: (a) (4) (D)
Refusal to the soil drilling equipment was encountered at 16 locations in the Phase 2 area at depths ranging between 20 feet (Boring PZ-5) and 94 feet (Boring PZ-7). Refusal material is defined as any material that cannot be penetrated by the soil drilling equipment. Samples of the underlying rock were obtained at 9 locations: PZ-2, PZ-5, PZ-7, PZ-11, PZ-14, B-21, B-26, MW-6A and MW-16A. A bedrock map (Sheet 2) was composed using all of the available auger refusal depths.

Core drilling procedures were required to penetrate refusal materials and determine their character and continuity. Refusal materials were cored according to ASTM D 2113 using a diamond-studded bit fastened to the end of a hollow double-tube core barrel. Core samples were identified and the percent core recovery and rock quality designation (RQD) was determined by a geologist. The percent core recovery (REC) is the ratio of the sample length to the depth cored, expressed as a percent. The RQD is obtained by summing only those pieces of recovered core which are four inches or longer and are at least moderately hard, and dividing by the total length cored. The percent recovery and the RQD are related to soundness and continuity of the refusal material.

The cored rock varies from being very weathered to non-weathered fresh garnetiferous biotite-gneiss. Recoveries and RQD's range from 15 to 96 percent and 0 to 89 percent, respectively. As suggested by the RQD values, the sampled rock at MW-16A had the highest number of joints and was the most fractured. Based upon the number of cores collected, it can be generally stated that weathering and fracturing is very severe in the vicinity of B-21, B-26, PZ-7, MW-16A and MW-6A. However, PZ-5 is located fairly close to B-26 and is relatively fresh, unweathered bedrock. Topographic position may play a role in the weathering zones: B-21, B-26, and PZ-11 are in topographically high locations, i.e. a ridge-top or side-slope. PZ-5, MW-16A and MW-6A are located in draws, in which weathering takes place at a much more rapid pace, thus leaving a very small weathered bedrock zone and a thick layer of soft saprolite. The topographically high borings may have a much broader weathering zone in the upper part of the bedrock because precipitation tends to runoff more readily from slopes and ridge-tops instead of infiltrating into the saprolite and then the fractured bedrock. Thus the bedrock weathering process is quite longer on ridge tops than in draws where runoff tends to accumulate.

Most of the fractures were low to medium-angled fresh joints with some steep, nearly vertical joints. There seemed to be no general trend across the site with regard to fracture density. Some cores that were taken out of topographically high locations were as fractured as those located in draws.

The rock core descriptions can be found with the appropriate boring log in Appendix 1.

Hydrologic Characteristics: (a) (4) (E)

Hydrologic characteristics of site soils were measured both in the laboratory and in the field (in-situ). In-place soils were characterized by conducting laboratory permeability tests on undisturbed samples. For that test, a portion of the undisturbed sample is placed in the permeability apparatus and saturated. Then water is pressed through the sample at a known head, and the rate of flow through the sample is measured. The test was performed in general accordance with ASTM D 5084. The hydraulic conductivity is calculated using Darcy's Law, $Q = kiA$, where "Q" is the measured flow through the sample, "i" is the hydraulic gradient, and "A" is the cross-sectional area of the soil sample. Laboratory permeability tests of undisturbed samples from borings PZ-3, PZ-5, PZ-6, PZ-7, PZ-9, PZ-10, and B-26 yielded results from 1.1×10^{-5} cm/sec to 5.0×10^{-6} cm/sec (see Table 2).

Inflow permeability tests were conducted at 14 observation wells. The results approximate the horizontal hydraulic conductivity of the formation materials exposed to the screened interval at each boring/well location. The field procedure used to measure hydraulic conductivity is as follows:

- measure the stabilized (static) water level in the well
- remove a slug of water from the borehole by bailing or pumping, and
- measure the groundwater level as it recovers to the static water level.

The data were reduced and hydraulic conductivity of the screened intervals calculated using techniques described by Hvorslev (Fetter, 1994). Results of the in-situ permeability tests ranged from 2.6×10^{-3} cm/sec to 8.8×10^{-5} cm/sec. Appendix 3 contains the raw data and results of the inflow permeability tests at all the locations, and Table 3 summarizes the permeability data.

Effective porosities were estimated for borings PZ-3, PZ-5, PZ-6, PZ-7, PZ-9, PZ-10, and B-26. The total porosities for the silty sands and sandy silts were determined in the lab and range between 42 and 58 percent. Effective porosities were estimated from information contained in groundwater textbooks and published handbooks (Fetter, 1988, and Rifai & Hopkins, 1996). Table 2 contains a summary of the porosity data and Appendix 5 shows the reference tables used to estimate the effective porosities.

Subsurface Conditions: (a) (5)
All of the subsurface conditions are discussed in the report.

Groundwater Flow Regime: (a) (6)
The groundwater flow regime within the proposed Phase 2 area is illustrated on the Potentiometric Surface Map (Sheet 3) and the subsurface profile maps (Sheets 5 through 9). (The plan view for the profile maps is shown on Sheet 4). The potentiometric map of Sheet 3 is based on water levels at the site measured on May 6, 1997. The map shows equipotential lines, or contour lines of equal groundwater elevations, and groundwater flow directions.

Local groundwater flow beneath the site is highly controlled by topography, which in turn is controlled by the bedrock. Groundwater flow appears to be radial in the Phase 2 area, and normal to the shoreline of Lake Emory. Groundwater discharges into Lake Emory and the small tributary which flows into the onsite lake. Horizontal flow gradients across the Phase 2 area range from 0.02 to 0.10 ft/ft. An average gradient is about 0.06 ft/ft.

The average groundwater flow velocity across the area was calculated to be approximately 2.3 ft/yr. The velocity was estimated using a formula derived from Darcy's Law:

$$V = \frac{ki}{ne}$$

where:

V = average linear groundwater seepage velocity
k = hydraulic conductivity (1.0×10^{-5} cm/sec)
i = hydraulic gradient (0.06 ft/ft)
ne = effective porosity (.27)

The hydraulic gradient was derived from the groundwater contours shown on Sheet 3, and the value of "ne" was obtained from literature sources.

Water Table Information: (a) (7)

Water Table Elevations: (a) (7) (A)
Water table elevations for all borings at time of boring, 24 hours, and stabilized are presented in Table 4.

Stabilized Water Table Elevations: (a) (7) (B)
Stabilized water table elevations were taken monthly since the installation of the piezometers up until the present. This information is also presented in Table 4.

Projected High Groundwater Levels: (a) (7) (C)
Groundwater fluctuations recorded in wells in the Phase 2 area appear to be mainly affected by seasonal variations in rainfall. Higher water levels are expected to occur in the winter and spring, and lower water levels in the summer and fall. Other causes of groundwater fluctuations are discussed in the following section.

Groundwater level measurements have been taken monthly in all of the piezometers up to the present. Unfortunately, those monthly measurements have amounted to only a half year of stabilized readings, which is not sufficient to determine a maximum annual fluctuation or maximum high water level reading. Therefore, groundwater level measurements from the nearest USGS recording well were taken into consideration. Water level measurements taken after 1995 were not available.

The long-term seasonal high water table was projected based primarily on the historical water level data from a nearby shallow saprolite USGS recording well. USGS well NC-40 is located off of U.S. Highway 276 at Camp Hope, 2 miles south of Cruso, Haywood County, N.C. The indicated location of the well is Latitude 35°23'15" and Longitude 82°48'44", and the elevation is 3,148.3 ft above MSL. The well is an 18.5 feet dug well in the muscovite-biotite gneiss saprolite; it is 12 inches in diameter, cased to 18.5 feet open end, and backfilled with gravel from 4 to 18.5 feet. The USGS has been monitoring water levels in this well since 1955. This well was chosen as a gauge of water level fluctuations because of its similar topographic subsurface setting to that of the Macon Co. MSWLF piezometers.

Based on the 10-year hydrograph (from 1986 to 1996) the greatest magnitude of fluctuation was 4.7 feet. The highest water level recorded for the 10-year period occurred at approximately 2.3 feet in February of 1990 and the low at 6.9 feet in October of 1986. The annual hydrograph for the year of 1995 showed a consistent difference between high and low water level recordings: the high was 2.81 feet in January and the low was 6.12 in August (with a difference of 3.31 feet). These findings are consistent with the above assumption that higher water levels are expected to occur in the winter and spring, and lower water levels in the summer and fall. The 10-year and 1995 hydrographs for NC-40 may be seen in Appendix 4.

Also, historical water levels measured on the monitoring wells surrounding Phase 1 cell were taken into account. MW-1A, MW-1B, MW-2, MW-3A, MW-3B, MW-4 and MW-5 were installed in 1991 and water levels were measured during the semi-annual water quality sampling events (see Table 5). The well that had the highest fluctuation was MW-4, which had a difference of 7.03 ft. between the highest and lowest water levels. The rest of the wells fluctuated between one and three feet from the highest to the lowest water levels. The highest historical water level for MW-4 was recorded on 5/7/97. Other wells that recorded highs on the same date were MW-1A, MW-1B and MW-3A. It is highly unlikely that the water level in MW-4 will rise another seven feet in the future, so it may be safe to assume that the reading on 5/7/97 could be near an all-time high. A safe assumption would be that the water level might rise another three feet (based on data from the other wells).

Applying the above information on the USGS well and the Phase 1 cell monitoring wells to the piezometers in the Phase 2 area, we could assume that the maximum annual fluctuation in the piezometers will be no more than five feet, and probably average around three feet. The projected high groundwater levels were estimated by adding the standard deviation to the high recorded water level for each boring, and then adding another two feet. This would add approximately three feet to each recorded high water level. Table 6 shows the calculation of the projected high water level for each boring.

Groundwater Fluctuations: (a) (7) (D)

Fluctuations in groundwater levels vary with subsurface conditions and topographic position. Groundwater levels also are subject to seasonal and longer term factors such as rainfall intensity and frequency, evapotranspiration due to plant growth and ground cover, and barometric pressure effects. Obviously tidal variations would not influence water level fluctuations because the site is too far inland. The Phase 2 cell is located sufficiently above the 100-year flood plain for Lake Emory. Also, there are no reservoirs, high volume production wells, or injection wells in the area of influence.

Man-made activities that might influence groundwater levels are those associated with site development for landfilling, the wetlands of the former hog waste lagoons, and the adjacent pond. Construction of the proposed Phase 2, once the liner and leachate collection system are in place, will essentially eliminate recharge from precipitation in the lined area. The net result of operation of the existing Phase 1 cell and the proposed Phase 2 is to reduce infiltration to recharge groundwater beneath the site. Thus, on a long-term basis, groundwater levels beneath the site are expected to decline, enhancing (increasing) separation between groundwater and the landfill bottom. The wetlands of the former hog waste lagoons and pond, if drained, would help lower the water level base below the landfill and would also increase the separation between groundwater and the landfill bottom.

Horizontal & Vertical Flow Dimensions: (a) (8)

The generalized groundwater flow regime within the Phase 2 is illustrated on the Potentiometric Surface Map (Sheet 3) and the subsurface profile maps (Sheets 5 through

9). The plan view for the profile maps is shown on Sheet 4. The Potentiometric Surface Map of Sheet 3 is based on water levels at the site measured on May 6, 1997. The map shows equipotential lines, or contour lines of equal groundwater elevations, and groundwater flow directions.

Local groundwater flow beneath the site is highly controlled by topography, which in turn is controlled by the bedrock. Groundwater flow appears to be radial in the Phase 2 area, and normal to the shoreline of Lake Emory. Groundwater discharges into Lake Emory and the small tributary which flows into the onsite lake. Horizontal flow gradients across the Phase 2 area range from 0.02 to 0.10 ft/ft. An average gradient is about 0.06 ft/ft.

The average groundwater flow velocity across the area was calculated to be approximately 2.3 ft/yr. The velocity was estimated using a formula derived from Darcy's Law:

$$V = ki/ne$$

where:

- V = average linear groundwater seepage velocity
- k = hydraulic conductivity ($1.0\text{x}10^{-5}$ cm/sec)
- i = hydraulic gradient (0.06 ft/ft)
- ne = effective porosity (.27)

The hydraulic gradient was derived from the groundwater contours shown on Sheet 3, and the value of "ne" was obtained from literature sources.

The calculated gradients and flow velocities for each cluster can be seen in Table 7.

Vertical gradients may be approximated by comparing water levels in nested well pairs. Five such pairs exist at the site: PZ-3/PZ-3A, PZ-8/PZ-8A, PZ-10/PZ-10A, MW-6/MW-6A and MW-16/MW-16A. The pairs consist of a shallow saprolite well in which the screened zone straddles the water table, and a deeper well installed in the saprolite just above auger refusal. From the water level data set May 6, 1997 the vertical gradients for the existing well pairs are as follows:

Well Cluster	Vertical Difference (ft)	Gradient(ft/ft)	Flow Direction
PZ-3	(-) 0.03	0.001	Upward
*PZ-3A			(Discharging)
PZ-8	(-) 0.56	0.019	Upward
*PZ-8A			(Discharging)
PZ-10	(+) 0.88	0.029	Downward
*PZ-10A			(Recharging)
MW-6	(+) 1.11	0.043	Downward
*MW-6A			(Recharging)
MW-16	(-) 0.43	0.012	Upward
*MW-16A			(Discharging)

* Deeper well

It appears that discharging conditions exist in three of the clusters: PZ-3/PZ-3A, PZ-8/PZ-8A and MW-16/MW-16A. Discharging conditions probably exist because of the proximity of the three clusters to the large discharge area of Lake Emory. PZ-10/PZ-10A and MW-6/MW-6A are recharging. MW-6/MW-6A may be affected by mounding from a nearby sediment pond which makes it appear that recharging conditions exist, when in fact discharging conditions exist because of the proximity to Lake Emory.

Profiles A-A', B-B', D-D', and E-E' (Sheets 5, 6, 8 and 9) are drawn approximately parallel to groundwater contours, or perpendicular to flow. Because of the orientation of these profiles to flow direction, it was deemed inappropriate to show flow arrows.

Profile C-C' (Sheet 7) is drawn approximately perpendicular to groundwater contours, or parallel to groundwater flow. The extrapolated groundwater levels are annotated with arrows to indicate flow direction. Groundwater flows roughly from the southeast to the northwest. There appears to be a groundwater divide between MW-8 and MW-9. The Potentiometric Surface Map (Sheet 3) illustrates the divide in plan view. Thus, the groundwater flow direction is reversed (from the northwest to the southeast) at the divide.

The stratigraphic cross-section C-C' also illustrates the third (vertical) dimension of groundwater flow beneath Phase 2. Vertical gradients may be approximated by comparing water levels in clustered (nested) wells. Five such clusters exist at the site and were discussed above.

As mentioned in Section (a) (4) (E), inflow permeability tests were performed at 14 observation wells. The results approximate the horizontal hydraulic conductivity of the formation materials exposed to the screened interval at each boring/well location. Values of (horizontal) hydraulic conductivity (k) determined from the field tests range from 2.6×10^{-3} to 8.8×10^{-5} cm/sec. For the purpose of estimating groundwater seepage velocity an average value for hydraulic conductivity of 1.0×10^{-5} cm/sec was selected.

Groundwater velocity beneath the area of Phase 2 was estimated using a formula derived from Darcy's Law:

$$V = \frac{ki}{ne}$$

where: V = average linear groundwater seepage velocity
k = hydraulic conductivity (1.0×10^{-5} cm/sec)
i = hydraulic gradient (0.06 ft/ft)
ne = effective porosity (.27)

The hydraulic gradient was derived from the groundwater contours shown on Sheet 3 and the value of "ne" relating specific sediment type to porosity was obtained from literature sources. The calculated, average seepage-flow velocity for groundwater based on the cited parameters is about 2.3 ft/year.

Potentiometric Surface Map: (a) (9)
Please see Sheet 3 for the Potentiometric Surface Map. This map was based on groundwater levels taken on May 6, 1997.

Topographic Map: (a) (10)
Please see Sheet 3 for a topographic map of the site that shows the soil boring locations.

Boring Log: (a) (11)
Please see Appendix 1 for all boring logs.

Other Geologic & Hydrologic Considerations: (a) (12)
The mountainous topographic setting of the Macon Co. MSWLF lends itself to a variety of geologic and hydrologic considerations: There are considerable slopes at the site since the landfill is situated on several ridges; one small drainage system flow from southern part of the landfill to the north and discharges into Lake Emory; and there are no springs. The only resemblance of gullies and trenches would be the steep natural draws; there are no solution/karst related features because the bedrock type is crystalline; rock cores exhibited no known dikes, sills, or faults at the site; no mines are present on the site; Lake Emory is the main discharge feature on the site; and recharge occurs on top of the ridges with groundwater discharging into Lake Emory.

Monitoring System Design Considerations: (b) (2) (B)
The number, spacing, and depths of wells in the monitoring system around the Phase 2 Expansion were determined based on the information gathered and discussed throughout this report and the more specific information that follows.

The uppermost aquifer beneath Phase 2 consists of a complex of soil, saprolite and fractured/weathered bedrock. The flow regime is understood and is discussed in section (a) (8) of this report. Groundwater in the soil and saprolite usually occurs under water table conditions. Water occupies the granular interstices between grains of the saprolite and is hydrostatic balance with the atmosphere at the water surface (water table). The saprolite thickness beneath Phase 2 varies from approximately 20 ft. thick to about 90 ft. thick. This information was based upon the depths to auger refusal. Saprolite is thickest in the northeastern section of the site (90 ft. at PZ-7).

In the crystalline rock beneath the Phase 2 area, groundwater occurs in fractures, joints, and other openings in the rock. These openings intersect the top of the bedrock and are recharged by groundwater in storage in the overlying saprolite. The fractured thickness of the bedrock is generally unknown but considered to exist in the partially weathered rock in the top portion of the bedrock. In other words, as the bedrock deepens, the fractures are less numerable and much smaller. Rock cores taken in and around the Phase 2 area show varying degrees of weathering, with some of the more fractured, less resistant found in the vicinities of B-26, B-21, PZ-7, MW-16A and MW-6A. More fresh, resistant bedrock was found in the areas of PZ-14, PZ-2 and PZ-5.

Groundwater flow appears to be radial in the Phase 2 area, and normal to the shoreline of Lake Emory. Groundwater discharges into Lake Emory and the small tributary which flows into the onsite lake. Horizontal flow gradients across the Phase 2 area range from 0.02 to 0.10 ft/ft. An average gradient is about 0.06 ft/ft. Horizontal gradients of groundwater flow and associated directions, as determined from water level data of May 6, 1997 for three 3-well groups, can be found in Table 7.

Groundwater velocity at the same three monitoring well/piezometer groups were estimated using a formula derived from Darcy's Law:

$$V = \frac{ki}{ne}$$

where:

V = average linear groundwater flow velocity
k = hydraulic conductivity (see Table 3)
i = hydraulic gradient (see Table 7)
ne = effective porosity (estimated to be about 0.27)

The calculated, approximate groundwater flow velocities can also be found in Table 7.

Fluctuations in groundwater levels vary with subsurface conditions and topographic position. Groundwater levels beneath Phase 2 are also subject to seasonal and longer-term factors such as rainfall intensity and frequency, plant growth and related ground cover, and barometric effects. Water level data collected monthly (Table 4) shows that the groundwater levels beneath Phase 2 fluctuate an average of approximately 2.6 ft/year with the largest fluctuation being 6.4 ft/year which occurred in PZ-9.

The subsurface materials in the near surface consist of unsaturated and saturated materials which are hydrologically connected. These materials represent weathering zones rather than distinct units. The uppermost zone consists of somewhat clayey soils which grade unconformably into a variably micaceous silty sand (called the saprolite), and then finally into partially weathered rock. Table 8 contains a listing of these three major weathering zones in the subsurface encountered by the borings, as defined by soil types. Associated values of porosity and hydraulic conductivity, established by in-situ or laboratory testing of site materials, or determined from the literature, also are listed in the table. The subsurface profiles (Sheets 5 through 9) are annotated with soil classification information and with field and laboratory determined hydraulic conductivities. Most of the subsurface penetrated by the borings is characterized by variably micaceous silty sands and some sandy silts. All tend to have hydraulic conductivities in the range of 10^{-5} to 10^{-4} cm/sec. Partially weathered rock at the site exhibits a range of conductivity similar to that of the micaceous silty sands/sandy silts tested, and fractured bedrock has an order of magnitude higher (10^{-3} cm/sec).

Point of Compliance Considerations: (b) (2) (C)
The monitoring system, as depicted on Sheet 1, is the relevant point of compliance. The factors outlined below were also taken into consideration when determining the 'relevant point of compliance'.

The hydrogeologic characteristics of the facility have been covered in depth in Section (a) (4) through (a) (12) of this report.

The leachate storage system is a surface impoundment. It is the same storage system that it is used for the existing Phase I cell, and is located adjacent to the water treatment facility. A monitoring well already exists (MW-2) downgradient of the surface impoundment to detect any leakage.

As mentioned in the discussion on groundwater movement in Section (a) (8), groundwater moves in a northerly and northwesterly direction beneath Phase 2 towards Lake Emory. By making the 'relevant point of compliance' the property boundary, or the eastern edge of the Lake (approximately at elevation 2000 ft.), there is sufficient area to monitor and remediate any contamination from Phase 2.

No groundwater is being taken from the Phase 2 area for public water use. There are two (2) existing water supply wells on the landfill property and two (2) water supply wells adjacent to the landfill property. Locations are shown on Sheet 3.

"**WSW-1**": This well is located on a church property which is adjacent to the landfill property. No information is available on the construction of the well . It is located approximately 575 feet from the Phase 2 waste boundary.

"**WSW-2**": This well is located on the landfill property and is approximately 250 feet deep. It is approximately 400 feet away from the waste boundary.

"**WSW-3**": This well is located on landfill property but there are no construction records. It is approximately 140 feet away from the waste boundary.

"**WSW-4**": This well is located on property adjacent to the landfill property and is a dry well. It is located approximately 600 feet from the waste boundary.

The existing groundwater quality beneath Phase 2 is good, based on water quality samples drawn from existing monitoring wells on the site.

There are no anticipated adverse effects on public health, safety, or welfare as a result of Phase 2.

Rock Corings: (b) (2) (D)
Rock corings were made at the Phase 2 area at the following locations: PZ-2, PZ-5, PZ-7, PZ-11, PZ-14, B-21, B-26, MW-6A and MW-16A (See Sheet 2). The cored rock varies from being very weathered to non-weathered fresh garnetiferous biotite-gneiss. Recoveries and RQD's range from 15 to 96 percent and 0 to 89 percent, respectively. As suggested by the RQD values, the sampled rock at MW-16A had the highest number of joints and was the most fractured. Based upon the number of cores collected, it can be generally stated that weathering and fracturing is very severe in the vicinity of B-21, B-26, PZ-7, MW-16A and MW-6A. However, PZ-5 is located fairly close to B-26 and is relatively fresh, unweathered bedrock. Topographic position may play a role in the weathering zones: B-21, B-26, and PZ-11 are in topographically high locations, i.e. a ridge-top or side-slope. PZ-5, MW-16A and MW-6A are located in draws, in which weathering takes place at a much more rapid pace, thus leaving a very small weathered bedrock zone and a thick layer of soft saprolite. The topographically high borings may have a much broader weathering zone in the upper part of the bedrock because precipitation tends to runoff more readily from slopes and ridge-tops instead of infiltrating into the saprolite and then the fractured bedrock. Thus the bedrock weathering process is quite longer than in draws where runoff tends to accumulate.

Most of the fractures were low to medium-angled fresh joints with some steep, nearly vertical joints. There seemed to be no general trend across the site with regard to fracture density. Some cores that were taken out of topographically high locations were just as fractured as those located in draws.

The rock core descriptions can be found with the appropriate boring log in Appendix 1.

Projected High Groundwater Map: (b) (2) (E)
Please see Sheet 1 for the Projected High Groundwater Map.

Bedrock Contour Map: (b) (2) (F)
Please see Sheet 2 for the Bedrock Contour Map.

Vertical Groundwater Flow: (b) (2) (G)
The stratigraphic cross-section C-C' (Sheet 7) illustrates the third (vertical) dimension of groundwater flow beneath Phase 2.

Groundwater Flow Regime: (b) (2) (H)
Local groundwater flow beneath the site is highly controlled by topography, which in turn is controlled by the bedrock. Groundwater flow appears to be radial in the Phase 2 Expansion area, and normal to the shoreline of Lake Emory. Groundwater discharges into Lake Emory and the small tributary which flows into the onsite lake. Horizontal flow gradients across the Phase 2 area range from 0.02 to 0.10 ft/ft. An average gradient is about 0.06 ft/ft.

Inflow permeability tests were performed at 14 observation wells. The results approximate the horizontal hydraulic conductivity of the formation materials exposed to the screened interval at each boring/well location. Values of (horizontal) hydraulic conductivity (k) determined from the field tests range from 2.6×10^{-3} to 8.8×10^{-5} cm/sec. For the purpose of estimating groundwater seepage velocity an average value for hydraulic conductivity of 1.0×10^{-5} cm/sec was selected.

Groundwater velocity beneath the area of the Phase 2 Expansion was estimated using a formula derived from Darcy's Law:

$$V = \frac{ki}{ne}$$

where:

V = average linear groundwater seepage velocity
k = hydraulic conductivity (1.0×10^{-5} cm/sec)
i = hydraulic gradient (0.06 ft/ft)
ne = effective porosity (.27)

The hydraulic gradient was derived from the groundwater contours shown on Sheet 3 and the value of "ne" relating specific sediment type to porosity was obtained from literature sources. The calculated, average seepage-flow velocity for groundwater based on the cited parameters is about 2.3 ft/year.

Profiles A-A', B-B', D-D', and E-E' (Sheets 5, 6, 8 and 9) are drawn approximately parallel to groundwater contours, or perpendicular to flow. Because of the orientation of these profiles to flow direction, it was deemed inappropriate to show flow arrows.

Profile C-C' (Sheet 7) is drawn approximately perpendicular to groundwater contours, or parallel to groundwater flow. The extrapolated groundwater levels are annotated with arrows to indicate flow direction. Groundwater flows roughly from the southeast to the northwest. There appears to be a groundwater divide between MW-8 and MW-9. The Potentiometric Surface Map (Sheet 3) illustrates the divide in plan view. Thus, the groundwater flow direction is reversed (from the northwest to the southeast) at the divide. The stratigraphic cross-section C-C' also illustrates the third (vertical) dimension of groundwater flow beneath Phase 2.

Vertical gradients may be approximated by comparing water levels in nested well pairs. Five such pairs exist at the site: PZ-3/PZ-3A, PZ-8/PZ-8A, PZ-10/PZ-10A, MW-6/MW-6A and MW-16/MW-16A. The pairs consist of a shallow saprolite well in which the screened zone straddles the water table, and a deeper well installed in the saprolite just above auger refusal. From the water level data set May 6, 1997 the vertical gradients for the existing well pairs are as follows:

Well Cluster	Vertical Difference (ft)	Gradient(ft/ft)	Flow Direction
PZ-3 *PZ-3A	(-) 0.03	0.001	Upward (Discharging)
PZ-8 *PZ-8A	(-) 0.56	0.019	Upward (Discharging)
PZ-10 *PZ-10A	(+) 0.88	0.029	Downward (Recharging)
MW-6 *MW-6A	(+) 1.11	0.043	Downward (Recharging)
MW-16 *MW-16A	(-) 0.43	0.012	Upward (Discharging)

* Deeper well

It appears that discharging conditions exist in three of the clusters: PZ-3/PZ-3A, PZ-8/PZ-8A and MW-16/MW-16A. Discharging conditions probably exist because of the proximity of the three clusters to the large discharge area of Lake Emory. PZ-10/PZ-10A and MW-6/MW-6A are recharging. MW-6/MW-6A may be affected by mounding from a nearby sediment pond which makes it appear that recharging conditions exist, when in fact discharging conditions exist because of the proximity to Lake Emory.

Well Abandonment: (b) (2) (I)

All borings at the site that have not been converted to permanent monitoring wells will be properly abandoned in accordance with the procedures for permanent abandonment of wells, as delineated in 15A NCAC 2C Rule .0113(a)(2).

In addition to the borings four water supply wells that served residences on and adjacent to landfill property will be abandoned prior to development of Phase 2, Cell 1. These four wells were discussed in Section (b) (2) (C).

Water Quality Monitoring Plan: (b) (3)

Groundwater Monitoring Plan: (b) (3) (A)

Monitoring Wells Rationale: (b) (3) (A) (ii)

Eight new monitoring wells and three existing wells have been proposed to monitor subsurface conditions around Phase 2: MW-10, MW-14 and MW-15 (already in place); MW-17; MW-18; MW-19 and MW-19A (moved from MW-16 and MW-16A); MW-20; MW-21; MW-22 and MW-22A. Sheet 1 shows the proposed placement of the monitoring wells around the landfill.

The basic rationale for determining the depth and screened interval of the wells was based upon the intersection of the screened interval with the projected high water table and vertical flow conditions. All of the wells will be shallow wells, screened across the water table in the saprolite, except MW-19A and MW-22A which will have very short screens on top of the bedrock. The screen lengths in the shallow wells will be 15 ft, except for the existing wells which have screen lengths of 10 feet. This length will allow for the seasonal fluctuations in the water table. Water level readings have been taken monthly since the installation of the piezometers. An average water level fluctuation of 2.6 ft. has been observed with a maximum of approximately 6.4 ft. Water level high elevations have been observed to occur mainly in the spring months, i.e., April and May.

The locations for the proposed monitoring wells were chosen basically for the following reasons: location with respect to proposed waste fill boundary, ability to monitor directional extents of potential contaminant migration, and the hydrogeological aspects.

Monitoring well MW-17 will be the background well for Phase 2. It is located upgradient on the groundwater divide that exists over the area. The total depth of MW-17 is proposed to be approximately 60 feet with the screen depth from 45 feet to 60 feet.

Groundwater flow within the cell is mainly in the north to northwest directions. Thus it is considered more crucial to monitor the northern and western sides of the cell. However, two monitoring wells have been proposed to monitor the southeastern side of the cell: MW-18 and the existing MW-10. Monitoring well MW-18 will be approximately 50 feet deep with a screened zone of 35 to 50 feet. The boring log for MW-10 can be seen in Appendix 1. It is 65 feet deep and screened from 55 to 65 feet.

Monitoring wells MW-14 and MW-15 are already in place on the North-northeast side of the cell. These wells will track any migration in that direction, even though the general flow direction is more to the northwest. MW-14 is 39 feet deep and screened from 29 to 39 feet, and MW-15 is 17 feet deep and screened from 7 to 17 feet. The boring logs for these wells can be seen in Appendix 1.

As mentioned above, the predominant groundwater flow direction is in the northwest direction, or normal to the Lake Emory shoreline. It is therefore considered crucial to sufficiently monitor the northwest side of the cell, in between the waste and Lake Emory. Four locations for monitoring wells have been selected to monitor this side: MW-19/MW-19A, MW-20, MW-21 and MW-22/MW-22A. An upward flow gradient exists in this area therefore there will be clusters at two locations (MW-19/MW-19A and MW-22/MW-22A). The shallow well will be screened in the shallow saprolite and the deeper well will be screened in the deep saprolite.

Monitoring wells MW-19/MW-19A will be moved from the MW-16/MW-16A location because of the construction of the berm. This cluster is situated down-gradient of one of the two sumps that will be installed (see Sheet 1). The shallow well, MW-19, will be 20 feet deep with a screened zone from 10 to 20 feet. The deeper well, MW-19A, might be able to detect contamination before the more shallow well because of the upward flow direction. MW-19A will be 55 feet deep with a short screened zone from 52.5 to 55 feet. Monitoring well MW-20 is located downgradient of the second sump. It is proposed to be 20 feet deep with a screened zone of 5 to 20 feet. MW-20, along with MW-21, will detect any contamination that might leak from the sump area. MW-21 will also be 20 feet deep with a screened zone from 5 to 20 feet.

The second cluster, MW-22/MW-22A, is designed to detect contamination in the complex area (around PZ-14 and PZ-15) where the water table transitions from being in the bedrock to the saprolite. The exact location in the bedrock where the groundwater discharges into the saprolite in unknown, thus the design of the MW-22 cluster should detect any contamination flowing along the bedrock-saprolite interface at that transition zone. The shallow well, MW-22, will be 30 feet in depth with a screened zone of 15 to 30 feet. The deeper well, MW-22A, will be installed to auger refusal, around 40 feet in depth with a short screened zone from 37.5 to 40 feet.

Table 9 summarizes the depths and screened intervals for all or the proposed monitoring wells.

In addition to the above monitoring wells, the existing monitoring wells designed for the Phase I cell will continue to be sampled. These wells are MW-1A, MW-1B, MW-2, MW-3A, MW-3B, MW-4 and MW-5. They will be sampled during the same semi-annual sampling event as the new wells.

Monitoring Well Construction

The monitoring wells will be installed in the residuum or saprolite using the hollow stem auger drilling method. Immediately prior to boring activities, the drill rig, all downhole drilling rods, collars, split spoons, hollow stem augers, and other components will be decontaminated using the following procedures:

- thoroughly scrub with non-phosphate based detergent and potable grade water mixture
- rinse with potable grade water and steam clean
- rinse with nano-grade isopropyl alcohol and allow to air dry
- rinse twice with distilled water

Wells will be constructed using 2-inch diameter, flush threaded, schedule 40 PVC casing and screen. No PVC bonding compounds or glues will be used at any time during monitor well construction. In wells completed with the water table intersecting the screen, the screened section will be 15 ft. in length to allow for seasonal fluctuations. No risers will be put in the bottom of the holes.

Following placement of the screen and casing, the sand pack will be placed in the hole. The sand pack will consist of clean, well-sorted #1 sized sand grains. During the placement of the sand pack, care will be taken to avoid bridging and the depth of the sand pack will be monitored to prevent overpacking. The sand pack thickness will extend from the bottom of the well to a point two feet above the top of the well screen. Following the sand pack placement, a two foot thick bentonite seal will be placed immediately above the sand pack. The bentonite seal will be composed of bentonite having no additives such as synthetic or organic polymers. The bentonite seal will be placed by gravity means.

Neat cement grout will be placed above the bentonite seal using the tremie method. The grout mixture will consist of approximately seven gallons of clear potable water with about four pounds of bentonite per 94 pound bag of Portland cement. After placement of the grout, a lockable steel protective enclosure will be installed on the monitoring well. This enclosure will stand approximately two feet above ground surface and have a two foot square concrete pad base. The monitoring well identification number will be marked on the protective casing. Following completion, the enclosure will be locked with a pad lock. All pad locks for monitoring wells will be keyed alike. A metal pole approximately six feet in length with a reflective strip at the top will placed in the ground next to the well to provide easy location of the wells in the field.

An on-site geologist will supervise and record the work as described above. During all drilling and monitoring well activities, the on-site geologist will examine, log, and collect soil and rock samples and will complete all the logs, records, and completion reports.

All monitoring wells will be properly developed using the following procedure:

> Prior to commencing development, the volume of water standing in a well will be calculated using the relationship
>
> $$\mathbf{V = .041d^2h}$$
>
> where V = volume of water (gallons)
> d = diameter of well (inches)
> h = length of water column (feet)
>
> The wells will be developed by bailing or pumping until the water is free of fine-grained sediments or until turbidity values have stabilized. If clear sediment-free water cannot be obtained, at least 10 casing volumes will be removed. During the development of the well, indicating parameters for well stabilization will be taken. These include pH, specific conductance, temperature, and observations of color, clarity, and odor.

Water Level Monitoring

All new monitoring wells will be surveyed in to establish horizontal location and elevation of the measuring points. All elevations will be referenced to a benchmark previously established at the site. All wells will be located horizontally to the nearest 0.1 foot. Vertical elevations of measuring points will be made to the nearest 0.01 foot. Water levels will be collected during groundwater sampling events and measured with an electric water level indicator graduated in 0.01 foot increments. These data will be utilized to construct the potentiometric surface map, determine the horizontal hydraulic gradient, and groundwater flow direction.

Aquifer Testing

The purpose of the aquifer test is to determine the physical characteristics of the aquifer to allow evaluation of groundwater collection alternatives. Slug tests will be conducted on all monitoring wells to determine flow rates and hydraulic conductivities.

Groundwater Sampling and Analysis Plan

The sampling and analysis plan has been designed to comply with 15A NCAC 13B Rule .1632. The basic process for collection of groundwater quality data is to first purge the well prior to sampling, sample the well properly, transport the samples through the chain-of-custody to a Certified Laboratory, analyze the data properly, and interpret the analyses adequately.

Prior to sampling the well, the depth to water will be determined as discussed above. Purging the well will remove any stagnant water or stratified contaminants from the well bore and ensure that water being sampled is representative of the groundwater surrounding the well bore. Wells will be purged with a disposable Teflon bailer, thus eliminating the need for cleaning of bailers. All other equipment will be washed in Alconox and distilled water and then rinsed with distilled water. Groundwater sample collection will begin with the least contaminated wells and conclude with the most contaminated to prevent cross-contamination. The wells will be purged until a minimum of three to five times the volume of standing water in the well has been removed and the specific conductance, temperature, and pH of the groundwater have stabilized as indicated by at least three consecutive readings within 10% of each other. The well may be bailed dry. If the well is bailed dry it is considered a sufficient purge.

The samples will be collected using the disposable Teflon bailer. The bailer will be raised and lowered using new monofilament line. All lines will be discarded after each bailer use. Plastic sheeting will be placed on the ground surrounding the well. The first bailer of sample water will be used for the volatile organic analysis sample. Samples for VOC analyses will be placed into 40 ml vials by pouring the bailer contents down the side of the vial to minimize aeration and volatilization of the sample. The vials will be completed filled to create a meniscus, sealed using the Teflon septum cap, and then inverted and tapped lightly to ensure that no bubbles are present.

Sample labels will be properly marked using a water-proof pen. Samples will be placed on ice in a cooler provided by the laboratory. Field quality control checks will also include collection of blanks. These blanks will be used to evaluate the effects of general sample container collection techniques. Travel or trip blanks will be used to determine is contamination has occurred as a result of improper sample container cleaning. These trip blanks will be prepared prior to the sampling events by the laboratory. One trip blank for each volatile organic method will be provided per cooler used for storing volatile sample vials.

Sample custody procedures as outlined by the State protocol will be followed. Sample bottle chain-of-custody will begin at a certified laboratory, with empty sample containers properly decontaminated and preserved by the laboratory, sealed and ready for sampling. Immediately following the sampling procedures as outlined above, labels will be place on containers by the sampling personnel. The sample location, parameters to be analyzed, and any laboratory preservatives used will be noted on chain-of-custody. Field measurements of pH, temperature, and specific conductivity will also be noted. Samples will be hand delivered to ensure holding times are met.

Several metal analyses require low level detection limits. These analyses are spelled out in the January 18, 1995 memo to Owners and Operators of Currently Operating MSWLFs (see Appendix 6 for specific methods and detection limits). This memo includes lists of metals and the appropriate Method for the required PQL in ppb. This memo will be followed to include the graphite furnace method. For the Appendix I volatile organic analysis the method detection limits must be at or below the PQLs specified on the **APPENDIX I ORGANIC CONSTITUENTS.**

Laboratory quality control and quality assurance procedures will be strictly met. For the Appendix I analyses, EPA Method 8260 organic method will be used with the following protocol procedures: one tune per 12 hours, one blank per 10 samples, one check standard per 10 samples, and one matrix spike duplicate per 10 samples. For the 15 metals of Appendix I analyses, the following quality control and quality assurance procedures will be enforced: one blank per 10 samples, one check standard per 10 samples, one duplicate sample per 10 samples, and one matrix spike duplicate per 20 samples.

The sampling schedule for existing wells is recommended by the Solid Waste Section to be on a semi-annual basis unless otherwise altered. Four baseline sampling episodes will carried out on the newly drilled monitoring wells. The initial sampling event will take place prior to issuing the Permit to Operate. The other three sampling events will be completed within six months of the issue date of the Permit to Operate. The four baseline sampling events will be spaced out over the six month period to provide as much information as possible on seasonal water quality variability.

Surface Water Monitoring Plan: (b) (3) (B)

Surface water will be sampled in four locations on the Macon Co. MSWLF property: SW-1, SW-2, SW-3 and SW-4. The SW-1 location will be taken out of Lake Emory near the discharge point for the water treatment plant. Surface water at SW-2 will be sampled from standing water on the wetlands area. The SW-3 location will be upstream on the small stream and SW-4 will be taken at the discharge point of the stream into the marshy area near Lake Emory.

Water Quality Monitoring Plan

This Water Quality Monitoring Plan for the Macon County Phase 2, Cell 1 will be effective in providing early detection of any release of hazardous constituents (from any point in the MSWLF unit) to the uppermost aquifer, so as to be protective of public health and the environment.

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Licensed Geologist
N.C. #1062

TABLE 1

Projected High Groundwater Levels
Macon County MSWLF Phase 2, Cell 1

Well/Boring #	Projected High Water Level (ft above MSL)	Base Grade elev. (ft above MSL)	Vertical Separation (ft)
MW-7	2017.22	2060.0	42.8
MW-8	2074.54	2088.0	13.46
PZ-1	2022.88	2031.0	8.12
PZ-2	2036.98	2048.0	11.02
PZ-4	2020.97	2082.5	61.53
PZ-5	2037.62	2058.0	20.38
PZ-6	2041.61	2049.0	7.39
PZ-7	dry	2084.0	----
PZ-8	2029.85	2038.5	8.65
PZ-8A	2030.52	2038.5	7.98
PZ-9	2036.54	2078.5	41.96
PZ-11	2067.70	2083.0	15.30
PZ-12	2054.45	2060.5	6.05
PZ-13	2070.21	2098.0	27.79
PZ-16	2031.81	2045.0	13.19

TABLE 2
Summary of Lab Data

Boring/ Well Number	Interval Sampled (ft below ground surface)	Type of Material	Total Porosity* (%)	Effective Porosity** (%)	Lab Hydraulic Conductivity (cm/sec)
PZ-3	45 to 46	Silty Fine to Med. Sand	52	20 - 30	$1.1x10^{-5}$
PZ-5	20 to 21	Silty Fine to Coarse Sand	49	23 - 35	$5.4x10^{-5}$
PZ-6	45 to 46	Silty Fine to Med. Sand	48	20 - 30	$1.8x10^{-5}$
PZ-7	50 to 51	Fine to Med. Sandy Silt	53	13 - 25	$1.4x10^{-5}$
PZ-9	55 to 56	Silty Fine Sand	53	22 - 30	$1.2x10^{-5}$
PZ-10	25 to 26	Fine to Med. Sandy Silt	58	13 - 25	$1.7x10^{-5}$
B-26	15 to 20	Fine to Med. Sandy Silt	42	13 - 25	$5.0x10^{-6}$

* Taken from laboratory test results
** Lower value from Fetter, 1988; higher value from Table 3.1, Natural Attenuation Handbook, (Rifai & Hopkins, 1996)

TABLE 3

Summary of In-Situ Hydraulic Conductivity Tests
Macon CO. MSWLF - Phase 2

Boring/ Well Number	Depth of Screened Interval (ft below ground surface)	Type of Material Exposed to Screened Interval	Hydraulic Conductivity (k) (cm/sec)
MW-6	10 to 20	clayey sand	3.0×10^{-4}
MW-6A	43.5 to 46	partially weathered rock	5.1×10^{-4}
MW-7	15 to 25	silty sand	1.6×10^{-4}
MW-8	35 to 45	silty sand	5.3×10^{-5}
PZ-1	55 to 65	silty sand	2.2×10^{-5}
PZ-2	45 to 55	silty sand	1.4×10^{-5}
PZ-4	45 to 55	silty sand	4.2×10^{-5}
PZ-5	12.5 to 22.5	silty sand and sandy silt	8.8×10^{-5}
PZ-8	20 to 30	silty sand and sandy silt	2.5×10^{-4}
PZ-8A	50 to 60	silty sand	2.5×10^{-5}
PZ-11	45 to 55	partially weathered rock	5.7×10^{-5}
PZ-12	29 to 39	silty sand	1.9×10^{-4}
PZ-14	57 to 125*	fractured bedrock	6.2×10^{-3}
PZ-15	27 to 125*	fractured bedrock	2.6×10^{-3}

* open hole (no screen)

TABLE 4

Groundwater Levels

Macon Co. MSWLF

Depths and elevations to groundwater (ft.) from TOC

Well #	Time of Boring		24 Hours		7 Days		Date: 11/13/96		Date: 12/12/96		Date: 1/23/97	
	Depth	Elev.	Depth	Elev.	Depth	Elev.	Depth	Elev.	Depth	Elev.	Depth	Elev.
MW-6	14.50	2015.32	17.95	2011.87	18.50	2011.32	19.57	2010.25	19.37	2010.45	18.15	2011.67
MW-6A	15.00	2015.65	17.36	2013.29	17.01	2013.64						
MW-7	17.00	2017.40	20.63	2013.77	20.72	2013.68	21.31	2013.09	21.11	2013.29	20.99	2013.41
MW-8	40.00	2067.58	37.92	2069.66	36.56	2071.02	39.55	2068.03	40.02	2067.56	40.50	2067.08
MW-9	22.50	2070.78	25.05	2068.23	25.13	2068.15	26.50	2066.78	26.36	2066.92	***	***
MW-10	62.00	2053.08	53.08	2062.00	53.06	2062.02	54.28	2060.80	54.58	2060.50	***	***
MW-14	23.00	2026.54	34.48	2015.06	34.52	2015.02	34.70	2014.84	34.59	2014.95	34.75	2014.79
MW-15	11.00	2018.19	13.46	2015.73	13.50	2015.69	13.55	2015.64	13.60	2015.59	13.72	2015.47
MW-16	6.00	2014.67	19.06	2001.61	19.34	2001.33	19.09	2001.58	18.85	2001.82	18.89	2001.78
MW-16A	15.00	2004.98	17.24	2002.74								
PZ-1	50.00	2022.21	52.28	2019.93	52.26	2019.95	53.19	2019.02	53.21	2019.00	53.23	2018.98
PZ-2	50.00	2028.78	45.36	2033.42	46.67	2032.11	48.69	2030.09	49.16	2029.62	49.34	2029.44
PZ-3	63.50	2019.50	66.78	2016.22	68.30	2014.70	67.20	2015.80	67.99	2015.01	67.39	2015.61
PZ-3A	65.00	2018.12	67.89	2015.23	67.28	2015.84	***	***	67.33	2015.79	67.49	2015.63
PZ-4	45.00	2025.00	51.57	2018.43	51.53	2018.47	51.94	2018.06	51.87	2018.13	51.95	2018.05
PZ-5	15.50	2033.35	14.17	2034.68	14.27	2034.58	14.66	2034.19	14.40	2034.45	14.20	2034.65
PZ-6	38.00	2037.60	38.81	2036.79	39.10	2036.50	41.21	2034.39	41.74	2033.86	41.84	2033.76
PZ-7	50.00	2025.83	49.60	2026.23	49.75	2026.08	dry		dry		dry	
PZ-8	20.00	2035.54	30.07	2025.47	30.24	2025.30	31.15	2024.39	31.27	2024.27	31.27	2024.27
PZ-8A	23.00	2033.49	29.68	2026.81	31.34	2025.15	***	***	31.77	2024.72	31.68	2024.81
PZ-9	55.00	2032.97	55.20	2032.77	57.76	2030.21	58.54	2029.43	61.61	2026.36	59.04	2028.93
PZ-10	23.50	2034.08	29.13	2028.45	29.27	2028.31	29.82	2027.76	29.11	2028.47	27.19	2030.39
PZ-10A	24.00	2032.02	27.37	2028.65	27.79	2028.23	***	***	27.85	2028.17	26.79	2029.23
PZ-11	51.00	2059.44	46.76	2063.68	46.84	2063.60	47.90	2062.54	48.26	2062.18	***	***
PZ-12	35.00	2050.80	35.58	2050.22	35.56	2050.24						
PZ-13	50.00	2062.56	47.24	2065.32	47.09	2065.47						
PZ-14												
PZ-15												
PZ-16	40.00	2036.33										

*** Unable to measure -- inclement weather; will measure in future

TABLE 4 (cont.)

Well #	Date: 3/11/97		Date: 4/8/97		Date: 5/2/97		Date: 5/6/97	
	Depth	Elev.	Depth	Elev.	Depth	Elev.	Depth	Elev.
MW-6	15.54	2014.28	14.48	2015.34			15.15	2014.67
MW-6A			16.50	2014.15	17.24	2013.41	17.09	2013.56
MW-7	20.19	2014.21	19.99	2014.41			19.74	2014.66
MW-8	39.57	2068.01	38.05	2069.53			36.64	2070.94
MW-9			21.71	2071.57			22.31	2070.97
MW-10	54.48	2060.60	53.77	2061.31			53.14	2061.94
MW-14	34.09	2015.45	35.39	2014.15				
MW-15		2029.19	14.64	2014.55				
MW-16	18.48	2002.19	18.47	2002.20			18.40	2002.27
MW-16A			17.46	2002.52	17.42	2002.56	17.28	2002.70
PZ-1	52.65	2019.56	52.20	2020.01			51.87	2020.34
PZ-2	48.25	2030.53	46.70	2032.08			45.76	2033.02
PZ-3	68.53	2014.47	68.50	2014.50			66.85	2016.15
PZ-3A			67.25	2015.87			66.94	2016.18
PZ-4	51.70	2018.30	51.57	2018.43			51.27	2018.73
PZ-5	13.75	2035.10	13.65	2035.20			13.61	2035.24
PZ-6	40.62	2034.98	38.15	2037.45			37.65	2037.95
PZ-7	dry		dry				dry	
PZ-8	29.85	2025.69	29.20	2026.34			28.67	2026.87
PZ-8A	30.50	2025.99	29.66	2026.83			29.06	2027.43
PZ-9	58.80	2029.17	58.46	2029.51			57.85	2030.12
PZ-10	25.56	2032.02	25.68	2031.90			26.13	2031.45
PZ-10A	25.77	2030.25	25.40	2030.62			25.45	2030.57
PZ-11	47.72	2062.72	46.71	2063.73			45.64	2064.80
PZ-12			34.70	2051.10	34.41	2051.39	34.35	2051.45
PZ-13			46.40	2066.16	45.64	2066.92	45.35	2067.21
PZ-14					79.34	2048.21	79.17	2048.38
PZ-15					85.07	2006.30	84.77	2006.60
PZ-16			48.33	2028.00	47.76	2028.57	47.52	2028.81

TABLE 5

Macon Co. MSWLF
Phase 1 Cell Monitoring Wells

	MW-1A		MW-1B		MW-2		MW-3A		MW-3B		MW-4		MW-5	
	Depth	Elev.	Depth	Elev.	Depth	Elev.	Depth	Elev.	Depth	Elev.	Depth	Elev.	Depth	Elev.
09/28/94	6.67	2005.43			12.84	2003.14	59.90	2012.95	dry		35.84	2062.42	51.90	2020.88
10/13/94	6.57	2005.53			12.90	2003.08	60.05	2012.80	dry		40.54	2057.72	52.19	2020.59
02/01/95	5.95	2006.15			12.74	2003.24	59.94	2012.91	dry		40.50	2057.76	52.15	2020.63
03/15/95	5.95	2006.15			12.29	2003.69	59.12	2013.73	dry		40.30	2057.96	51.65	2021.13
11/28/95	7.58	2004.52			13.15	2002.83	60.23	2012.62	dry		40.61	2057.65	52.66	2020.12
10/15/96	7.86	2004.24	7.77	2004.33	13.40	2002.58	60.03	2012.82	dry		35.06	2063.20	52.26	2020.52
05/07/97	4.86	2007.24	4.83	2007.27	12.50	2003.48	58.62	2014.23	dry		33.58	2064.68	51.36	2021.42

TABLE 6
Projected High Water Levels
Macon Co.- Phase 2, Cell 1

Well #	Mean	Std. Deviation (SD)	High (H)	Projected High (H + SD + 2ft.)	Bedrock Surface Elev.
MW-7	2013.73	0.56	2014.66	2017.22	----
MW-8	2068.98	1.52	2071.02	2074.54	----
PZ-1	2019.60	0.54	2020.34	2022.88	----
PZ-2	2031.29	1.56	2033.42	2036.98	2021.45
PZ-4	2018.33	0.24	2018.73	2020.97	
PZ-5	2034.76	0.38	2035.24	2037.62	2022.11
PZ-6	2035.71	1.66	2037.95	2041.61	----
PZ-7	dry	dry	dry	dry	1978.65
PZ-8	2025.33	0.98	2026.87	2029.85	----
PZ-8A	2025.96	1.09	2027.43	2030.52	----
PZ-9	2029.56	1.77	2032.77	2036.54	----
PZ-11	2063.32	0.90	2064.80	2067.70	2038.28
PZ-12			2051.45	2054.45	2043.76
PZ-13			2067.21	2070.21	----
PZ-14			2048.38	----	2067.40
PZ-15			2006.60	----	2057.26
PZ-16			2028.81	2031.81	2010.69
Boring #					
B-21					2057.3
B-22					2068.9
B-26					2065.8
B-27					2046.0
B-28					2036.9

TABLE 7

Calculated Groundwater Gradients and Flow Velocities
Macon Co. MSWLF

Well Cluster	Gradient (ft/ft)	Groundwater Flow Direction	Groundwater Flow Velocity (ft/yr)
PZ-11 MW-6 MW-16	0.10	Northwest	8.1
MW-9 PZ-13 PZ-12	0.020	North-Northwest	14.8
PZ-8 PZ-4 PZ-3	0.020	Northeast	19.5

TABLE 8

Summary of Hydrologic/Lithologic Data

Weathering Horizon	Unified Soil Classification	Total(1) Porosity (%)	Effective(2) Porosity (%)	Hydraulic(3) Conductivity (cm/sec)
Upper, Somewhat Clayey Soils	SC ML	20 to 50	24 to 25	N/A
Variably Micaceous Sandy Silt and Silty Sand	ML SM	53 to 58 48 to 53	25 to 28	5.4×10^{-5} to 1.1×10^{-5}
Partially Weathered Rock (4)	ML SM	48 to 53	25 to 30	1.2×10^{-5}
Fractured Bedrock (Gneiss)	-----	2 to 5*	1 to 5*	6.2×10^{-5} to 2.6×10^{-5}

(1) Derived from laboratory testing of undisturbed samples

(2) From Figure 4.11 of Fetter (1988) and Natural Attenuation Handbook (Rifai & Hopkins, 1996)

(3) From In-Situ Testing (see Table 3)

(4) Partially Weathered Rock has soil classification characteristics similar to Sandy Silt/Silty Sand Horizon

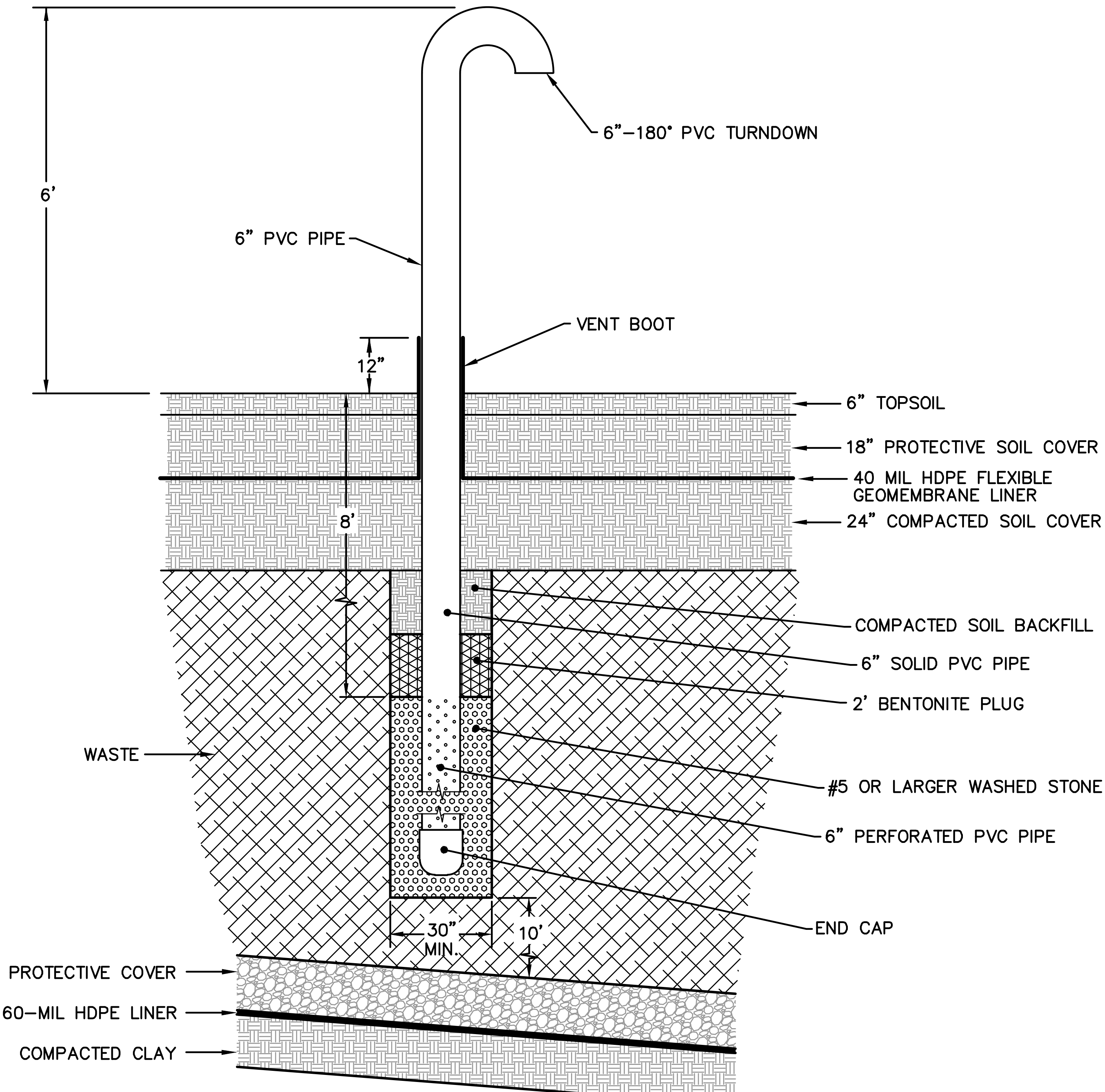
TABLE 9

Proposed Depths of Monitoring Wells
Macon Co. MSWLF
Phase 2, Cell I

Monitoring Well #	Type	Total Well Depth (ft)	Screen Depth (ft)
MW-10 (already in place)	shallow saprolite	65	55 - 65
MW-14 (already in place)	shallow saprolite	39	29 - 39
MW-15 (already in place)	shallow saprolite	17	7 - 17
MW-17	shallow saprolite	60	45 - 60
MW-18	shallow saprolite	50	35 - 50
MW-19	shallow saprolite	20	10 - 20
MW-19A	deep saprolite	55	52.5 - 55
MW-20	shallow saprolite	20	5 - 20
MW-21	shallow saprolite	20	5 - 20
MW-22	shallow saprolite	30	15 - 30
MW-22A	deep saprolite	40	37.5 - 40

APPENDIX G

PROPOSED LANDFILL CAP SYSTEM WITH LANDFILL GAS EXTRACTION WELL



PROPOSED LANDFILL CAP SYSTEM WITH LANDFILL GAS EXTRACTION WELL

NOT TO SCALE

APPENDIX H

TECHNICAL SPECIFICATION SECTION 02620
HIGH DENSITY POLYETHYLENE (HDPE) FLEXIBLE GEOMEMBRANE LINER

02620.1 Scope of Work

The Installer shall furnish all labor, materials, supervision and equipment to complete the HDPE Geomembrane Liner including, but not limited to, anchor trench excavation and backfill, liner layout, seaming, patching, and all necessary and incidental items required to complete the Work, in accordance with the Contract Drawings and these Specifications.

02620.2 Materials

The geomembrane liner shall be made of high-density polyethylene (HDPE) that has an absolute minimum thickness of 40 mils. This means that the geomembrane shall have a thickness of 40 mils at any point measured on the sheet. An average minimum thickness will not be considered. If during conformance testing or on-site testing and inspection, a thickness measurement is found to be less than 40 mils, the material will be rejected for use during construction.

The geomembrane used shall meet, at a minimum, the standards included in Tables 1 and 2 located at the end of this section.

The chemical resistance of the geomembrane liner shall be in keeping with typical properties of high quality polyethylene products currently available through commercial sources.

Geomembrane liner shall be shipped rolled with a protective wrap around each roll, labeled with roll number and manufacturer's batch number. Manufacturer's quality control documentation shall be included with each roll.

The geomembrane shall be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. Any such defect shall be repaired in accordance with the geomembrane manufacturer's recommendations. The Engineer may reject all or portions of units (or rolls) of the geomembrane if in his opinion significant quantities of production or transporting flaws are observed.

The Installer shall submit proposed geomembrane panel layouts to the Engineer at least 14 days prior to mobilization of crews (2 copies). Once the panel layout is approved, the Installer may not change the layout without permission of the Engineer.

02620.3 Construction

The geomembrane liner shall be installed by a specialty contractor, and that specialty contractor must have installed a minimum of 5,000,000 square feet of geomembrane liner since November, 1998.

The geomembrane liner shall be constructed as soon as practical after completion and approval of the compacted clay liner or portion thereof. The top of the compacted clay liner will be surveyed to ensure adequate thickness of clay material and proper grades toward the collection sump area have been achieved. The Contractor shall be responsible for providing survey information for all panel locations, seam locations, destructive testing locations, repairs, and liner flap used to construct the temporary liner edge. The survey must be performed and stamped by a registered Professional Land Surveyor in the State of North Carolina. The survey information shall be provided to the Engineer in a format pre-approved by the Engineer and acceptable to the North Carolina DEHNR, Division of Waste Management, Solid Waste Section. The geomembrane is to cover the bottom of the cell and the side slopes in accordance with the Contract Drawings.

Areas to receive liner installation shall be relatively smooth and even, free of ruts, voids, etc., to the extent required by the Engineer. This shall be accomplished by final dressing of the compacted liner with smooth drum rollers. No vehicles are permitted on final dressed surfaces unless authorized by the Engineer.

An anchor trench (as illustrated on the Contract Drawings) will be required to secure the geomembrane. No loose soil will be allowed to underlie the geomembrane in the anchor trenches. The time schedule for excavation and backfilling of the anchor trenches is to be approved by the Engineer so that desiccation of trench soils does not occur prior to backfilling.

02620.4 Installation of the geomembrane shall be as follows:

All geomembrane installed on side slopes will be 40 mil textured material.

Unroll only those sections that are to be seamed together in one day. Panels should be positioned with the overlap recommended by the manufacturer, but not less than 4 inches.

After panels are initially in place, remove wrinkles as directed by the Engineer. Unroll several panels and allow the liner to "relax" before beginning field seaming. The purpose of this is to make the edges, which are to be bonded, as smooth and free of wrinkles as possible.

Once panels are in place and smooth, commence field seaming operations.

The Installer's Field Superintendent will complete a Daily Report at the end of each day and submit the form daily to the Engineer.

Field seaming shall be in accordance with EPA Technical Guidance document: "The Fabrication of Polyethylene FML Field Seams" EPA/530/SW-89/069 or as follows. Where conflicts exist between the two guidance specifications, the most stringent specification prevails or as directed by the Engineer.

02620.5 All foreign matter (dirt, water, oil, etc.) shall be removed from the edges to be bonded. For extrusion welds, the bonding surfaces must be thoroughly cleaned by mechanical abrasion or alternate methods approved by the Engineer to remove surface cure and prepare the surfaces for bonding. All abrasive buffing shall be performed using No. 80 grit or finer sandpaper. The grinding shall be performed so that any and all grind marks are perpendicular to the edge of sheet. No grinding greater than 1/8 inch outside the welds is permitted or the Engineer can require patching. No solvents shall be used to clean the geomembrane liner.

02620.6 As much as practical, field seaming shall start from the top of the slope down. This will minimize large wrinkles from becoming trapped, which requires cutting and patching. Tack welds (if used) shall use heat only; no double sided tape, glue, or other method will be permitted. The geomembrane should be seamed completely to the ends of all panels to minimize the potential of tear propagation along the seam.

The completed liner shall not exhibit <u>any</u> "trampolining" during any daylight hours (6:00 a.m. to 8:00 p.m.). All areas exhibiting trampolining must be repaired as directed by the Engineer. Additional slack (i.e., 1-3 percent) shall be allowed on the side slopes to reduce the potential for trampolining.

02620.7 At the end of each day or installation segment, all unseamed edges shall be anchored by sand bags or other approved device. Sand bags securing the geomembrane on the side slopes should be connected by a rope fastened at the top of the slope by a temporary anchor. If high winds are expected, boards along the edge of unseamed panels, with weighted sand bags on top, may be used to anchor the geomembrane on the bottom of the cell. Sand bags fastened by rope should be used to secure unseamed edges on the side slopes. Staples, U-shaped rods or other penetrating anchors shall not be used to secure the geomembrane on the side slopes. Any damage to the liner or soil/clay liner including damage due to wind, rain, hail, or other weather shall be the sole responsibility of the Contractor.

02620.8 Field seaming may be extrusion or fusion welding or a combination of these methods. Solvent welding is not acceptable. The Engineer reserves the right to reject any proposed seaming method they believe unacceptable. Double hot wedge fusion welding shall be the predominant seaming method and shall be used when possible. Additional concepts and requirements of proper field seaming include the following.

02620.9 Extrusion welding applies a molten bead of material to preheated sheets of geomembrane. The sheets are then joined by pressure.

02620.10 The fusion welding process heats the area to be joined to the melting point and then applies pressure to join the melted surfaces.

02620.11 The sheets to be joined shall be overlapped at least four (4) inches after the necessary cleaning, aligning and cutting.

02620.12 The seams should be oriented parallel to the line of maximum slope, i.e., oriented up and down, not across, the slope. In corners and odd shaped geometric locations, the number of field seams shall be minimized.

02620.13 No horizontal seams shall be within ten (10) feet from the toe of the slope. No horizontal seams will be allowed on the side slopes unless approved by the Engineer.

02620.14 No seaming shall be attempted above 40°C (104°F) ambient air temperature. Below 5°C (41°F) ambient air temperature, preheating of the geomembrane will be required, unless it is demonstrated that this is not necessary (i.e., acceptable test (start-up) seams which duplicate, as closely as possible, actual field conditions can be achieved). Preheating may be achieved by natural and/or artificial means (shelters and heating devices). Ambient temperature is measured 18 inches above the liner surface. The Installer shall supply instrumentation for measurement of ambient temperature.

02620.15 A moveable protective layer of plastic or approved material may be placed directly below each overlap of geomembrane that is to be seamed. This is to prevent any moisture build-up between the sheets to be welded. The protective layer must be removed after welding.

02620.16 Seaming will extend to the outside edge of panels to be placed in anchor trenches.

02620.17 If required, a firm substrata should be provided by using a flat board, a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

02620.18 Grinding prior to welding shall be done perpendicular to the sheet edge. Over grind greater than 1/8 inch beyond the welded seam or improperly ground areas shall be replaced at the Installer's expense.

02620.19 **Seams at the Panel Corners**

Seams at the panel corners of 3 or 4 sheets shall be completed with a circular patch approximately 12 inches in diameter, extrusion welded to the parent sheets.

02620.20 **Quality Control**

All geomembrane sheet, seams, and patches will be tested and evaluated prior to acceptance. In general, testing of the sheet will be conducted by the manufacturer. Testing of the seams will be conducted by the Installer under observation by the Engineer. The Engineer or a designated, independent geosynthetics laboratory may perform additional testing, as required by these detailed Specifications or as required in the judgment of the Engineer or Authorized Representative to verify that the HDPE sheet and seams meet the specifications. The geosynthetics installer will be required to adhere to the requirements of the Site Specific Construction Quality Assurance Plan. Testing requirements are detailed in the following subsections:

02620.21 **Pre-shipping Sheet Tests**

The Installer or supplier (manufacturer) will be required to submit his Quality Control Program to the Owner prior to initiating field work. At a minimum, the Manufacturer will perform the tests, at the frequencies given in Table 2, on the HDPE sheet prior to shipping HDPE material to the site.

02620.22 **Test Seams (Destructive Tests)**

The Installer shall maintain and use equipment and personnel at the site to perform testing of test seams. These seams will be made on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. At a minimum, test seams shall be made upon each start of work for each seaming crew, upon every four hours of continuous seaming, every time seaming equipment is changed or if significant changes in geomembrane temperature and weather conditions are observed. The technician shall complete the Test Seam Form provided by the CQA Engineer immediately after each test. Requirements for test seams are as follows:

02620.23 The test seam sample will be at least 1.8m (6 feet) long by 0.3m (1 foot) wide with the seam centered lengthwise. Six adjoining specimens 25mm (1 inch) wide each will be cut from the test seam sample. At the Engineer's option, the shear tests may be eliminated for test seams. These specimens will be tested in the field with a tensiometer and/or manual seam tester for both shear (3 specimens) and peel (3 specimens). For dual wedge both inside and outside welds should be tested in the peel. Test seams will be tested by the Installer under approval of the Engineer. The specimens should not fail in the weld. The Installer shall supply all necessary knowledgeable personnel and testing equipment. Quantitative strength measurements from a calibrated field tensiometer, supplied by the Installer, shall be obtained for all three (3) specimens in shear and peel for the test seams. A passing test seam will be achieved when the criteria described in Table 1 (located at the end of this section) are satisfied. If a test seam fails, the entire operation will be repeated. If the additional test seam fails, the seaming apparatus or seamer will not be accepted and will not be used for seaming until the deficiencies are corrected and two consecutive successful full test seams are achieved. Test seam failure is defined as failure of any one of the specimens tested in shear or peel.

02620.24 The Engineer will approve all test seam procedures and results. The six (6) test specimens shall be labeled with initials of the technician, date, and A.M. or P.M. as appropriate; bound together with electrical tape; and retained by the Engineer until the project is over. The Engineer will transfer these specimens to the Owner following the Engineer's acceptance of the geomembrane materials and installation.

02620.25 **<u>Production Seams</u>**

One hundred percent of the production seams will be tested by the Installer continuously using non-destructive techniques and at specified intervals using destructive tests.

All areas failing nondestructive test procedures described below shall be clearly marked both on the liner itself and on the Seam Inspection Quality Control Form.

02620.26 **<u>Non-Destructive Testing</u>**

Single Weld Seams: The Contractor shall maintain and use equipment and personnel at the site to perform continuous vacuum box testing on all single weld production seams except those corner seams where vacuum box testing is impossible. The system shall be capable of applying a vacuum of at least 3 psi. The vacuum shall be held for a minimum of 15 seconds for each section of seam. All vacuum boxes to be used at this job site shall have new gaskets installed prior to reaching the job site. The geosynthetics installer shall also be required to have backup vacuum testing equipment at the job site. If the geosynthetics installer fails to provide the backup equipment, and it results in delays of the project, the geosynthetics installer will be liable for all costs associated with the delay.

Double Weld Seams: The Contractor shall maintain and use equipment and personnel to perform air pressure testing of all double weld seams. The system shall be capable of applying a pressure of at least 30 psi for not less than 5 minutes. All channels between the double weld seam must first be verified that the channel is open throughout the entire test area. The air pressure test results shall be documented. Pressure loss tests shall be conducted in accordance with the procedures outlined in "Pressurized Air Channel Test for Dual Seamed Geomembranes," Geosynthetic Research Institute Test Method GM-6. As outlined by the test method, following a 2 minute pressurized stabilization period, pressure losses over a measurement period of 5 minutes shall not exceed 3 psi.

Double weld seams will also be visually inspected on 100 percent of the seam. If necessary, the outside flap can be pulled back to aid in the visual inspection.

02620.27 **Destructive Testing**

Laboratory destructive testing (LDT) is defined as 12" X 48" samples cut on 500 foot centers for both extrusion and double welded seams. Field destructive testing (FDT) is defined as 3" X 6" samples cut at the end of each seamed area exceeding 200 feet. Both are described below:

Laboratory destructive testing will be performed on an average of every 500 linear feet of production seam. The locations will be selected by the CQA Engineer. Samples will be 12" X 48" in order to provide one sample to the archive, one sample to the Engineer for laboratory testing, and one sample to be retained by the Installer for possible field and/or additional laboratory testing at the option of the Installer.

Before the sample is sent to the laboratory, two specimens, one from each end of the specimen will be tested in peel in a calibrated field tensiometer, supplied by the Installer. Both specimens must meet the qualitative and quantitative criteria listed in Table 1. Testing requirements are as follows: Each sample shall be large enough to test five specimens in peel and five specimens in shear. The average values of each set of five specimens must meet the values shown in Table 1. If the average of the five specimens is adequate, but one of the specimens is below the required value, values for the specimen must be at least 90% of the values required for the sample to pass. All samples must fail in film tear bond (FTB). Samples which do not pass the shear and peel tests will be re-sampled from locations at least 10 feet on each side of the original location. These two re-test samples must pass both shear and peel testing. If these two samples do not pass, then the entire seam represented by the test shall be capped. Tests shall be conducted using a calibrated tensiometer and must meet the criteria outlined in Table 1 located at the end of this section. The Owner will pay for destructive testing of the original destructive samples. The geosynthetics installer will be responsible for all costs associated with resampling and retesting for failing destructive samples beyond a 5% failure rate by quantity. This includes the cost of lab and CQA personnel. The minimum charge for each destructive re-test exceeding the 5% failure rate will be $500.00 per occurrence.

Field Destructive Testing (FDT) shall be small 2" X 6" samples cut out at the beginning and end of each seam exceeding 200 feet in length. Three 1" X 6" specimens will be tested in peel from each sample using the Installer's Field Tensiometer or qualitative peel tester at the option of the Installer. No qualitative peel strength values need to be determined with the Field Destructive test, but each specimen must meet all qualitative criteria listed in Table 1.

The Engineer will approve all seam field and laboratory test procedures and results. All laboratory destructive test specimens will be marked with the seam number and letters then bound together for a particular seam and stored in the Owner's archives. The specimens for the FDT need not be retained.

Each sample area will be clearly marked both on the liner itself (LDT or FDT).

All areas cut out for testing shall be immediately patched by the Installer.

02620.28 <u>**Repair of Damaged and Sampled Areas**</u>

Damaged and sample coupon areas of geomembrane shall be repaired by the Installer by construction of an extrusion welded cap strip. No repairs shall be made to seams by application of an extrusion bead to a seam edge previously welded by fusion or extrusion methods. Repaired areas will be tested for seam integrity as outlined in Section 02620.27 of this specification. Damaged materials are the property of the Contractor and will be removed from the site at the Contractor's expense. The

Contractor will retain all ownership and responsibility for the geomembrane until acceptance by the Engineer. The geomembrane shall be accepted by the Engineer after the installation and repair are complete, and after the Engineer has received documentation for the installation.

02620.29 Potentially Damaging Activities

No support equipment of any type, which may be used by the Contractor, shall be allowed on the geomembrane. Personnel working on the geomembrane shall not smoke, wear damaging shoes, or engage in any activity that could damage the geomembrane. No glass or sharp objects shall be allowed on the geomembrane.

02620.30 Anchor Trench Backfilling

The anchor trench will be backfilled and compacted by the Contractor to a dry density not less than 95 percent of the maximum dry density determined by the Standard Proctor (ASTM D-698). Care should be taken when backfilling the trench to prevent any damage to the geomembrane. Anchor trench soil shall be used as backfill material, wherever acceptable by the Engineer.

02620.31 Protection of Leading Edges

Between construction of partial sections of the membrane liner, excluding temporary phaselines, leading edges of the membrane may be exposed or buried for extended periods of time prior to their joining to adjacent, subsequent membrane sections. The combined action of abrasive soil and equipment impact stresses may “etch” unprotected membrane surfaces sufficiently to affect seam strengths. Therefore, it is necessary to protect leading edges in high activity areas with sacrificial layers of geotextile and HDPE sheet until they are ready for final seaming. As a minimum, each leading edge to be seamed that must be buried or which must be exposed for periods of one month or longer shall be continuously covered by a layer of HDPE sheet. The geotextile shall be nonwoven and have a minimum weight of 8 oz. per square yard. The sacrificial HDPE sheet shall have a minimum thickness equal to that of the membrane liner to be protected. Both protective layers shall have a minimum width of 2 feet. The protective cover sheets shall be either covered with soil or weighted with sand bags to prevent displacement by wind. The edge of the sheet to be protected shall be approximately centered beneath the overlying protective layers prior to burial or weighing with sandbags. Leading edges located in areas expected to receive direct traffic from construction equipment shall be buried under a minimum thickness of one foot of buffer soil.

2620.32 Geomembrane Warranty

The installation shall be warranted against defects in workmanship for a period of 1 year from the date of substantial project completion.

Table 1

Required Physical Properties of Textured Membrane Liner (HDPE) Sheet

Property	Test Method	Required Values (40 Mil. HDPE)
Thickness	ASTM D-5994	**40 mil minimum**
Specific Gravity (Relative Density)	ASTM D-1505	0.940 g/cm^3 min.
% Elongation at Yield	ASTM D6693 Type IV	12
% Elongation at Break	ASTM D6693 Type IV	**100**
Tensile Strength at Yield	ASTM D6693 Type IV	84 lb/in. min.
Tensile Strength at Break	ASTM D6693 Type IV	60 lb/in. min
Carbon Black Content	ASTM D-1603	2% min. - 3% max.
Carbon Black Dispersion	ASTM D-5596	**Cat. 1, & 2 (9 of 10 views) Cat. 3 (1 of 10 views)**
Puncture Resistance	ASTM D4833	60 lb. min.
Tear Resistance	ASTM D 1004	28 lb. min.

Seam Strengths

Shear Strength	ASTM D4437, NSF Modified	80 lb/in
Elongation @ Break	ASTM D4437, NSF Modified	50% (min.)
Peel Strength (Fusion Weld)	ASTM D4437, NSF Modified	60 lb/in
Peel Strength (Extrusion Weld)	ASTM D4437, NSF Modified	52 lb/in

Non-Destructive Testing

Single Weld	Continuous Vacuum Box; Impact	Maintain vacuum of 3 psi, hold vacuum for 15 seconds.
Double Weld	Air Testing	Maintain 30 psi for no less than 5 min.; pressure loss not greater than 3 psi for last 3 minutes.

Table 2

Required Pre-Shipping Sheet Testing of Membrane Liner (HDPE)

Property	Test Method	Frequency
Thickness	ASTM D5994 (Textured)	Each Roll
Specific Gravity (Relative Density)	ASTM D1505	Every 5th roll
Tensile Properties	ASTM D6693 Type IV	Every 5th Roll
Tear Resistance	ASTM D1004	Every 5th Roll
Puncture Resistance	ASTM D-4833	Every 5th Roll
Carbon Black Content	ASTM D1603	Every 5th Roll
Carbon Black Dispersion	ASTM D-5596	Every 5th Roll

END OF SECTION

APPENDIX I

TECHNICAL SPECIFICATION SECTION 02440
LANDFILL GAS EXTRACTION WELLS

02440.1 SCOPE OF WORK

The Contractor shall furnish all labor, materials, supervision, equipment and appurtenances necessary to complete the Landfill Gas (LFG) Extraction Wells in accordance with the Contract Drawings and these Contract Specifications.

The well screens, seals, gravel, and soil backfill packs shall be set at depths shown on the Contract Drawings or as designated in the field by the Engineer. It is expected that combustible gas will be venting from boreholes drilled to install the landfill gas extraction wells. The Contractor's bid price shall include provision for all equipment and procedures necessary to safely install wells under this condition.

All work shall be performed by qualified workmen in accordance with the best standards and practices available.

The Contractor is responsible to provide a level bench area for the auger/drill rig to install the landfill gas extraction wells.

The Contractor, at all times, shall keep the premises free from accumulation of waste materials or debris caused by his operations. He shall remove all his waste materials and debris from the site, as well as all his tools, construction equipment, machinery and surplus materials.

02440.2 MATERIALS

STONE – Stone used for backfilling annular space around the slotted well casing shall be a washed aggregate material meeting the NCDOT Specification for #5 stone or larger. It shall be composed of clean, hard and durable fragments, with a calcium carbonate content of less than one percent (1%) by weight (for which at least one (1) Quality Control test per source shall be performed and submitted to the Engineer for approval). Stone shall be free of dirt, vegetation or other objectionable matter, and free from an excess of soft, thin elongated, laminated, calcareous material or disintegrated pieces.

SOIL – Soil backfill material shall be clean fill free of stones larger than 1-inch (1"), construction debris, refuse, muck, soft clay, loam, sponge material, vegetation/organic matter, or angular rock.

BENTONITE – "Bentonite Plug", as used in the Contract Drawings, shall refer to a well seal comprised of sodium bentonite pellets or chips.
SLOTTED PVC PIPE – Pipe and fittings shall be 6-inch (6") Schedule 80 PVC. The slots or perforations may be as follows: (a) 1/4-inch x 3-inch slots at 1/4 points at 6-inch on center. Stagger adjacent rows by 45 degrees or (b) 1/2-inch holes at 1/4 points at 6-inch on center. Stagger adjacent rows by 45 degrees. Slotted pipes shall be supplied by the manufacturer/supplier/factory. Perforated pipe may be supplied by the manufacturer/supplier/factory or may be field constructed in accordance with the pattern specified above.

SOLID PVC PIPE – Solid pipe and fittings shall be Schedule 80 PVC.

02440.3 HANDLING AND STORING MATERIALS

Unloading and storage of the material shall be the responsibility of the Contractor. The Contractor shall unload materials so as to avoid deformation or other injury thereto. Materials shall not be rolled or dragged over the ground, gravel or rock during handling. The materials shall be stored on sills above storm drainage level and deliver for installation after the well bore has been completed. When any material is damaged during transporting, unloading, handling or storing, the undamaged portions may be used or, if damaged sufficiently, the Engineer will reject the material as being unfit for installation.

The sodium bentonite shall be stored off the ground in an area that is dry and well drained and will be covered with a plastic sheet or waterproof tarpaulin until installation.

If any defective material is discovered after installation, it shall be removed and replaced with sound material or shall be repaired by the Contractor in an approved manner at his own expense.

02440.4 SUBMITTALS

Submit manufacturer's certificates of compliance on materials furnished, product data, manufacturer's brochures containing complete information and instructions pertaining to the storage, handling, installation, inspection, and repair of each material furnished. Submittal information shall include applicable warranties.

The Contractor shall submit copies of their Safety Manual as it pertains to safety procedures and precautions relative to the augering and construction of landfill gas extraction wells.

The Contractor shall submit copies of their Standard Operating Procedures Manual as it pertains to the augering and construction of landfill gas extraction wells as well as the decontamination procedures undertaken prior to relocating to a new well hole or moving the equipment to a staging area or off site.

Contractor shall submit a minimum of five (5) copies of all submittals plus the additional number of copies required by his office, subcontractors, and/or field crews.

02440.5 EXECUTION

DRILLING / AUGERING

The Contractor shall coordinate the start of drilling/augering activities with the Engineer.

The Contractor shall provide at all times an experienced, competent driller during all drilling/augering activities.

The locations of the wells, as shown on the Contract Drawings, shall be surveyed and staked by the Owner prior to beginning drilling/augering activities. Well locations may be adjusted by the Engineer, prior to beginning drilling/augering. The Contractor must use dry drilling/augering equipment.

Wells are to be drilled/augered to the approximate depths and the diameter as shown on the Contract Drawings. The boring depths shown on the Contract Drawings are estimated and may be adjusted in the field by the Engineer. Under no circumstances are the drilling/augering depths, from the well schedule on the Contract Drawings, to be exceeded, unless approved by the Engineer in advance.

All boreholes shall be completed and backfilled prior to the end of each day's work. Under no circumstances shall an open borehole be left unattended. Once the auger is removed for the last time or during periods of maintenance on the drilling equipment when the auger is removed from the borehole, the borehole opening shall be covered with a safety grate.

Wet Borings:

If water is encountered in a boring, the Contractor may be directed to drill beyond the point at which it was encountered. If wet conditions continue, the boring may be terminated, and the length of the perforated pipe adjusted by the Engineer. If wet conditions cease (e.g., due to a perched water layer), then drilling will continue to the design depth.

If water is encountered in a boring at a shallow depth, the Engineer may decrease the well depth and length of perforated pipe, or relocate the well.

Abandoned Borings:

If, in the opinion of the Engineer, the borehole has not reached a sufficient depth to function as an effective extraction well, the Contractor shall abandon the borehole by backfilling it with cuttings removed during drilling. A 2-foot thick bentonite plug will be placed in the borehole at the depth of the low permeability soil barrier layer. The remaining depth of the borehole will then be filled with soil and compacted to several inches above the elevation of the landfill cover.

The Contractor shall keep detailed well logs for all wells drilled, including the total depth of the well, length of perforated pipe, length of solid pipe, the static water level, the depth, thickness, and description of soil or waste strata, the occurrence of the water bearing zones, required plugs and backfill. Well logs shall be submitted to the Engineer.

The Contractor shall remove all loose debris and/or waste material from the auger prior to relocating the equipment to a new drilling location or staging area at the end of each day's operation. All waste shall be disposed in accordance with Section 02440.6.

The bore for the well shall be straight and cleaned of all loose debris before placement of well piping and stone. The well pipe shall be installed in the center of the borehole. The Contractor shall take care to maintain the well pipe vertically plumb during the backfill operation of the bored hole to the satisfaction of the Engineer. If the pipe installed is out of plumb, the Contractor, at his own expense, will correct the alignment.

JOINING OF PIPES

All pipes shall be inspected for cuts, scratches, or other damage prior to installation. Pipe with imperfections shall not be used. All burrs, chips, etc. shall be removed from the pipe interior and exterior. All loose dirt and moisture shall be wiped from the interior and exterior of the pipe end and the interior and exterior of the fitting. All pipe cuts shall be square, perpendicular to the centerline of the pipe. Pipe ends shall be beveled prior to applying primer and solvent cement so that the cement does not get wiped off during insertion into the fitting socket.

A coating of primer, as recommended by the pipe supplier, shall be applied to the entire interior surface of the fitting socket and to an equivalent area on the exterior of the pipe prior to applying solvent cement. The solvent cement shall comply with the requirements of the pipe supplier and shall be applied in strict conformance with the manufacturer's specifications. Pipe shall not be primed or solvent welded when it is raining, when atmospheric temperature is below 40 degrees F, or above 90 degrees F.

After solvent welding, the pipe shall remain undisturbed until cement has thoroughly set.

Pipe and pipe fittings shall be selected so that there will be as small a linear deviation as possible at the joints. Pipe and fittings which do not fit together to form a tight fitting will be rejected.

In addition to priming and solvent welding, lag screws shall be installed at each coupling to secure vertical piping during placement in the well boring. Four lag screws per coupling or two lag screws per bell fitting shall be installed. The length of the lag screws shall equal the sum of the pipe and coupling (or bell fitting) wall thickness. The end of the lag screws shall not protrude through to the interior of the pipe.

BACKFILLING

Backfilling of the well shall commence immediately after the well drilling is completed and the well piping installed. Backfill materials shall be placed carefully within the well to the dimensions shown on the Contract Drawings and as approved by the Engineer. Stone and soil backfill containing foreign material may be rejected on the basis of a visual examination. Both well piping and backfill shall be installed with a safety grate installed over the borehole.

Bentonite pellet plug shall be backfilled in 6-inch lifts. The Contractor shall soak each lift prior to filling the next one.

Soil backfill shall be rodded in the boring to provide even distribution and compaction. If approved by the Engineer, the Contractor may use on-site material at no cost but is responsible for loading and transporting the soil from the borrow area and restoring the borrow area appropriately.

After installation of the riser pipe, the Contractor shall cap the pipe in accordance with the Contract Documents and/or Contract Drawings. The capping system shall be kept in place until just before installing the wellhead assembly.

02440.6 DISPOSAL OF REFUSE TAILINGS

The Contractor shall use whatever means and methods are necessary to prevent contamination of the surrounding landfill surface with the refuse tailings removed from the borehole. Any contamination of the surrounding surface will be immediately removed and the landfill cover restored to its original condition, lines and grades. Refuse tailings from well drilling operations shall be removed at least daily or more often as is necessary to prevent contamination of the surrounding landfill surface. Refuse tailings are to be hauled to the designated disposal area as shown on the Contract Drawings or to the active working face of the landfill at no charge to the Contractor. However, the Contractor shall coordinate this activity with the landfill Owner or operator.

02440.7 MEASUREMENT AND PAYMENT

See Section 01300

END OF SECTION

APPENDIX J

FINANCIAL ASSURANCE DOCUMENT

NCDENR
North Carolina Department of Environment and Natural Resources

Dexter Matthews, Director
Division of Waste Management
Beverly Eaves Perdue, Governor
Dee Freeman, Secretary

April 20, 2010

Evelyn J. Southard
Finance Director
5 West Main Street
Franklin, NC 28734

Re: Local Government Financial Assurance Test for FY 2009
Macon County Landfill, Permit #57-03, Macon County

Dear Ms. Southard:

The Solid Waste Section has approved your financial assurance mechanism dated December 11, 2009 for closure, post-closure, and corrective action costs.

Macon County Landfill	Permit #57-03	Permit #57-01
Closure Costs	$3,430,799.00	$333,213.00
Post Closure Costs	$2,903,808.00	$380,249.00
Corrective Action	$ 72,051.00	
Total	**$7,120,121.00**	

Thank you for your cooperation in providing me your financial assurance mechanism. Please contact me at (919) 508-8502, if you have any questions or concerns.

Sincerely,

Donald Herndon
Compliance Officer
Solid Waste Section

cc: Macon County, Solid Waste Director
Troy Harrison, Environmental Senior Specialist
Allen Gaither, Permitting Engineer