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SOLID WASTE SECTION
ASHEVILLE REGIONAL OFFICE

Fac/Perm/Co ID #	Date	Doc ID#
58 - 03	8/17/09	8418

McGill ASSOCIATES

25th anniversary 1984-2009

August 14, 2009

Mr. Allen Gaither
Regional Engineer
Solid Waste Permitting Section
Division of Waste Management
North Carolina Department of Environment and Natural Resources
2090 U.S. Highway 70
Swannanoa, North Carolina 28778

RE: Response to Technical Review
Application for Continued Operation
Construction & Demolition Landfill Unit 2
Madison County Landfill
Madison County, North Carolina
Permit # 58-03

Dear Mr. Gaither:

Thank you for your review of this submittal for the continued operation of the Unit 2 Construction & Demolition Landfill (C&DLF) at the Madison County Landfill. We have revised the submittal to address the comments listed in your December 16, 2008 letter. The following is our response to your comments:

Closure Plan

Comment 1. Section 1.1, Cap Construction, states that the cross section will consist of an 18" low permeable layer, but does not state the minimum permeability. Please state the minimum permeability in accordance with 15A NCAC 13B .0543(c)(1).

1. Section 1.1 of the Closure and Post-Closure Plan has been revised to include the requirements of the low permeable cap.

Comment 2. Rule 15A NCAC 13B .0543(c)(2)(A) requires the post-settlement surface slopes must be a minimum of five percent and a maximum of 25 percent. Please provide the these numbers or provide documentation demonstrating the proposed maximum slopes meet the criteria outlined in 15A NCAC 13B .0543(c)(3)(C).

2. The minimum and maximum slope requirements for the post-settlement surface slopes of the cap have been added to Section 1.1 of the Closure and Post-Closure Plan and to Figure 1.

Comment 3. Rule 15A NCAC 13B .0543(c)(2)(B) requires a gas venting or collection system must be installed below the low-permeability barrier to minimize pressures exerted on the barrier. Please revise the plan to include this information.

3. Section 1.2 of the Closure and Post-Closure Plan has been revised to show that methane vents are added to the final cap of the C&DLF Unit 2. The location of the vents are shown on Figure 1 and a methane vent detail has been included on Figure 2.

Comment 4. Please submit a complete Construction Quality Assurance Plan in accordance with 15A NCAC 13B .0541.

4. A Site Specific Construction Quality Assurance (SSCQA) Plan for the construction of the final cap of Unit 2 C&DLF has been prepared in accordance with the Sections .0543 and .0541 of the Solid Waste Rules. Additionally, Section 1.3c of Closure and Post-Closure Plan was revised to reference the new SSCQA Plan.

Comment 5. Rule 15A NCAC 13B .0543(c)(4) requires an owner or operator to notify the Division that a notice of the intent to close the unit has been placed in the operating record prior to beginning closure of each C&DLF unit. Please revise the plan to include this information.

5. Section 3.1 of the Closure and Post-Closure Plan has been revised to show that prior to beginning closure of C&DLF Unit 2, Madison County will notify the Division of Waste Management that a notice of the intent to close the unit has been added to the operating record.

Post-Closure Plan

Comment 1. Please re-submit the Design Hydrologic Report and Environmental Monitoring Plan referenced in Section 5.4, Water Quality Monitoring Plan, to satisfy the requirements of 15A NCAC 13B .0543(e)(1)(B).

1. Section 5.4 of the Closure and Post-Closure Plan has been revised to include the requirements for post closure monitoring and maintenance of ground water wells and surface water sites.

Comment 2. Rule 15A NCAC 13B .0543(e)(1)(c) requires a description of the activities to maintain and operate the gas monitoring system. Please revise the plan to include this information.

2. Methane gas monitoring of the C&D Unit 2 Landfill shall be conducted in accordance with 15A NCAC 13B .0544(d). A summary of these requirements is included in Appendix A of the Closure and Post-Closure Plan.

Madison County is in the process of completing their financial assurance submittal. A copy of the letter from Mr. Herndon regarding the approved financial assurance mechanism will be forwarded to your office upon receipt.

Enclosed are the revised Closure and Post-Closure Plan and Site Specific Construction Quality Assurance Plan. We look forward to working with you to finalize this submittal for continued operation of the Madison County C&DLF Unit 2. Please let us know if you have additional questions or if you require additional information.

Sincerely,
McGILL ASSOCIATES, P.A.

JEFFREY R. BISHOP, P.E.
Senior Project Manager

Enclosures

cc: Ed Mussler, NCDENR Solid Waste Section, w/o enc
Jim Huff, Madison County Solid Waste Director, w enc

P:/08.00700/CDLF-Unit2-Closure/ag14aug09-CDLF-Continuation.doc

CLOSURE AND POST-CLOSURE PLAN

MADISON COUNTY LANDFILL
CONSTRUCTION AND DEMOLITION LANDFILL
UNIT 2

MADISON COUNTY, NORTH CAROLINA

JEFFREY R. BISHOP, P.E.

McGill ASSOCIATES

Engineering • Planning • Finance
Asheville, North Carolina

NORTH CAROLINA PROFESSIONAL SEAL 23574 ENGINEER JEFFREY R. BISHOP

June 2008
Revised July 2009

08.00700

CLOSURE AND POST-CLOSURE PLAN
Madison County Landfill
Construction & Demolition Landfill–Unit 2
Madison County, North Carolina

Chapter 1
Overview

The final cap system for Unit 2 of the Construction and Demolition Landfill (CDLF) located at the Madison County Landfill Facility will be constructed in a progressive manner. As substantial areas of the landfill are brought to final grade, the cap system will be constructed in order to minimize infiltration of stormwater, control erosion, and establish and maintain a vegetated cap. The proposed CDLF Unit 2, which covers a total area of approximately 4.3 acres, is estimated to reach capacity in 2022.

1.1 Cap Construction

A detail of the final cap is shown in Figure 2. The post-settlement slopes of the final cap will be at a minimum of five percent and a maximum of 25 percent. The cross-section will consist of an 18-inch low permeable layer and a vegetative supportive layer with a minimum thickness of 18 inches, constructed as follows:

- An 18-inch thick low permeability soil placed directly on top of the waste or intermediate cover. This soil layer shall have a permeability less than or equal to the original soils underlying the landfill or a permeability no greater than 1.0×10^{-5} cm/sec, whichever is less.

- An eighteen (18)-inch thick minimum vegetative\erosion layer capable of sustaining native plant growth.

1.2 Methane Gas Removal System

A methane venting system will be constructed in the final cap of CDLF, Unit 2. The locations of the methane vents and a detail describing the construction of the vents are shown on Figures 1 and 2.

1.3 Final Vegetative Layer

The final vegetative layer will be a total of 18-inches thick. The soil cover will provide support for native vegetation and protect the low permeability barrier.

1.3a - Materials Required

A grass cover is proposed for the Landfill to provide the required cover while minimizing cap maintenance. The surface will be prepared by fertilizing and placing seed in accordance with the North Carolina Erosion and Sediment Control Standards. The final cover will be constructed of

native soils. Although the material will not be required to have a specific classification or permeability, it should be a cohesive soil capable of supporting native vegetation. The upper 6 inches of the final cover should be topsoil.

i. Fertilizer:

The final cover material shall be tested prior to spreading to determine the amount of fertilizer that should be added to achieve optimum growth potential of the required vegetative cover.

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.

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.

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.

ii. Lime

The final cover material shall be tested prior to spreading to determine the amount of lime that should be added to achieve optimum growth potential of the required vegetative cover.

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.

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.

Lime shall be agriculture grade ground dolumitic 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.

iii. Seed:

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.

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.

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.

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 Bindwee, 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.

iv. 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.

1.3b - Construction Requirements

Final cover shall be placed according to the following requirements:

i. The final 6 inches of final cover shall be spread by utilizing small equipment with a relatively low ground pressure. This will reduce the potential of the underlying layers of the final cap being damaged. Prior to placing final soil layer, shape the underlying soil layer to graded lines and cross sections to provide for 6 inches of vegetative supportive soil. Clear the underlying soil layer of materials larger than 2" in diameter.

ii. After alignment of the underlying soil, loosen and till to a depth of 6 inches by disking, harrowing, rototilling, or other approved methods to assure that the final soil layer properly adheres to the underlying soil layer.

iii. After the condition of the underlying soil layer has been approved by the on-site CQA personnel, place and spread final layer to achieve required depth after compaction; rake and remove materials larger than 2 inches. Compact with approved roller equipment, grade to finished tolerances, and prepare the seedbed in accordance with the approved CDLF Unit 2, Technical Specifications.

Seed, fertilizer and lime shall be applied according to the following:

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, unless pre-construction testing is contrary to these rates and can be documented.

All rates are in pounds per acre:

Fertilizer - 1000 lbs. per acre
Lime - 4,000 lbs. per acre
KY-31 Fescue - 100 lbs. per acre
Straw mulch – 60 to 80 bales

For summer seeding the following shall be added:

- German Millet - 10 lbs. per acre
- Sudangrass – 15 lbs. per acre

For winter seeding the following shall be added:

- Rye grain – 15 lbs. per acre

For steep slopes the following shall be added:

- Sericea Lespedeza – 40 lbs. per acre

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. 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.

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.

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.

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.

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

Mulch shall be applied according to the following:

It shall be spread uniformly at the rate given above and in a continuous blanket over the areas specified.

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 2 inches in diameter and all roots or other debris which will prevent proper contact of the mulch with the soil.

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.

Mulch shall be uniformly spread by hand or by approved mechanical spreaders or blowers that 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.

Mulch shall be held in place by applying a sufficient amount of 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.

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 that may occur.

1.3c - Construction Quality Assurance Requirements

Madison County will ensure that the materials described above are utilized for the final cap and that their placement is done in accordance with the above detailed Construction Requirements. The project engineer will ensure that the materials and methods described above are utilized to construct the final cover system, and that all requirements of the Site Specific Construction Quality Assurance Plan are met. A Site Specific Construction Quality Assurance Plan for the construction of the final cap of Unit 2 C&DLF, dated July 2009, has been prepared in accordance with section 15A NCAC 13B .0541 of the Solid Waste Rules.

Chapter 2
On-Site Inventory

2.0 On-Site Waste Inventory

The original disposal airspace for the C&DLF Unit 2 is 152,470 c.y. This is calculated from the record drawing elevations for the base of the landfill to the top of cap contours shown in the permit drawings. The volume of the cap is 3ft. x 187,600 sq. ft., or 20,850 c.y. Therefore, the net available airspace for disposal of construction and demolition waste and daily and intermediate cover for Unit 2 is 131,600 c.y. At the time of closure, assuming a waste compaction density of 0.5 tons per cubic yard, the amount of construction and demolition waste on site is estimated to be 65,800 tons.

Chapter 3
Closure Schedule

3.0 Closure Schedule

3.1 Notification of Division of Solid Waste

Prior to beginning closure of the Unit 2 Construction and Demolition Landfill at the Madison County Landfill, the County will notify the Division of Waste Management that a notice of the intent to close the unit has been placed in the operating record.
Probable Date of Closure: Autumn 2022

3.2 Begin Closure

Madison County will begin closure activities of the CDLF Unit 2 no later than 30 days after the date on which the CDLF unit receives the known final receipt of wastes or, if the CDLF unit has remaining capacity and there is a reasonable likelihood that the CDLF unit will receive additional wastes, no later than one year after the most recent receipt of wastes. Extensions beyond the one-year deadline for beginning closure may be granted by the Division if the owner or operator demonstrates that the CDLF unit has the capacity to receive additional wastes and the owner or operator has taken and will continue to take all steps necessary to prevent threats to human health and the environment from the unclosed CDLF unit.

Probable Date: Fall 2022

3.3 Completion of Closure

Madison County will complete closure activities of the CDLF Unit 2, in accordance with the closure plan within 180 days following the beginning of closure. Extensions of the closure period may be granted by the Division if the owner or operator demonstrates that closure will, of necessity, take longer than 180 days and they have taken and will continue to take all steps to prevent threats to human health and the environment from the unclosed CDLF unit.

Probable Date: Spring 2023

3.4 Recording of Closure

Following closure of the CDLF Unit 2, Madison County will record a notation on the deed to the landfill facility property, or some other instrument that is normally examined during a title search, and notify the Division that the notation has been recorded.

The notation on the deed must in perpetuity notify any potential purchaser of the property that:

1. The land has been previously used as a landfill facility; and

2. Its use is restricted under the Division of Solid Waste approved Closure Plan

Probable Date: Summer 2023

3.5 Engineer's Certification

Following closure, Madison County shall notify the Division of Solid Waste that a certification, signed by the project engineer verifying that closure has been completed in accordance with the closure plan, has been placed in the operating record.

Chapter 4
Financial Assurance

4.0 Financial Assurance

The Financial Assurance provision of Section .0546 of the Solid Waste Management Rules (15A NCAC 13B) requires that owners and operators of Construction and Demolition Landfills (CDLF) must provide for certain minimum measures to insure that the funds to meet the requirements of the regulations governing closure, post-closure and corrective action activities are available in the event that these actions are not taken by the owner or operator.

4.1 North Carolina Solid Waste Rule, Section .0546

In general, Section .0546 provides that the owner and/or operator must:

1. Provide accurate third-party cost estimates for the closure, post-closure care, and potential corrective actions.
2. Select a mechanism for demonstrating financial assurance.
3. Maintain the selected mechanism in compliance with the provisions of Section .0546 throughout the period for which the owner/operator is subject to the provisions of the North Carolina Solid Waste Management Rules (15A NCAC 13B).

The Rule provides for the following alternative mechanisms for demonstrating financial assurance:

1. Trust Fund.
2. Surety bond Guaranteeing Payment or Performance.
3. Letter of Credit.
4. Insurance.
5. Capital Reserve Fund.
6. Local Government Financial Test.
7. Multiple Mechanisms.

Madison County has reviewed the requirements associated with each of these mechanisms and assessed the costs related to their use as the County's financial assurance mechanism. Although the relative cost of these mechanisms does not appear to vary significantly, there are various factors associated with their availability and practicality, which make certain of the mechanisms less attractive than others.

4.2 Local Government Financial Test

Therefore, Madison County has elected to adopt the LOCAL GOVERNMENT FINANCIAL TEST. The Local Government Financial Test is attractive because the County's excellent financial condition makes passing the test quite feasible. Madison County has not had any difficulties passing the LOCAL GOVERNMENT FINANCIAL TEST in recent years and there are not any circumstances that would indicate that this would change.

Chapter 5
Post Closure Plan

5.0 Post Closure Plan

5.1 Inspections

Inspections of the final cover will be performed according to the table below and the condition of the facility will be recorded with notes, maps, and photographs. Madison County personnel will be on-site to perform inspections on a frequent basis.

The inspection will take notice of:

1. Eroded banks
2. Patches of dead vegetation
3. Animal burrows
4. Subsidence (settlement)
5. Cracks along the cover.
6. Catch basins and stormwater control facilities
7. Ground water monitoring wells

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

Schedule of Inspections

Years (Following closure)	Minimum Yearly Inspections
0-2	4
3-30	2

5.2 Maintenance

The vegetative cover will be mowed at least one time a year. In the early stages of development, fertilization will be applied annually as needed.

Seeding of any patches of dead vegetation and proper filling and compaction of any portion of the cap showing subsidence, cracking, or other signs of erosion will be conducted in a timely manner.

Proper repair of any potential erosion problems found to be present during inspection of catch basins, piping, pipe inlets and outlets, and other stormwater control facilities will be conducted in a timely manner.

5.3 Planned Use and Personal Contact

Preliminary proposals for the planned use of the landfill facility, following Closure are inconclusive. No definite plan has been determined as of yet. Most likely, the area will be restricted to landfill maintenance personnel only, thus insuring little or no damage to the final cap system. The person to contact regarding the facility during the Post-Closure period is:

Mr. Jim Huff, Solid Waste Director
Madison County Solid Waste Department
271 Craig Rudisill Road
Marshall, North Carolina 28753
Telephone (828) 649-2311

5.4 Water Quality/Environmental Monitoring Plan

A Design Hydrogeologic Report and Environmental Monitoring Plan for the Construction and Demolition Landfill Unit 2 were prepared by Bunnell-Lammons Engineering, Inc (BLE) as part of the Permit to Construct package. The environmental monitoring plan satisfies the requirements of 15A NCAC 13B .0543 (e)(1)(B) and will continue to be utilized by the Madison County Landfill Staff ground and surface water monitoring.

As part of the Environmental Monitoring Report, a new down gradient monitoring well, MW-9, was installed below the Unit2 waste area. The existing monitoring well, MW-6, will be used as the upgradient well. Groundwater monitoring wells will monitored on a semi-annual basis, in accordance with Section 15A NCAC 13B .0544(b) of the Solid Waste Rules. The post-closure care period shall be 30 years, except as provided under 15A NCAC 13B .0543(e)(2).

As part of the Environmental Monitoring Plan, surface water monitoring point in the vicinity of the Unit 2 Construction and Demolition Landfill are monitored on a semi-annual basis, in accordance with Section 15A NCAC 13B .0544(c) of the Solid Waste Rules. SW-1 and SW-2R are located upstream and downstream of the waste area as shown on Figure 2 of the Environmental Monitoring Plan. Madison County will continue to monitor the surface water locations during the 30-year post-closure care period as required by the Solid Waste Rules, except as provided under 15A NCAC 13B .0543(e)(2).

5.5 Engineer's Certification

Following completion of the post-closure care period, Madison County shall notify the Division of Solid Waste that a certification, signed by the Project Engineer verifying that post-closure care has been completed in accordance with this post-closure plan, has been placed in the operating record.

Chapter 6
Closure and Post Closure Cost Estimates

6.0 Closure and Post Closure Cost Analysis and Summary

6.1 Closure Costs Estimate

Unit 2 (4.3 ACRES) – Closure

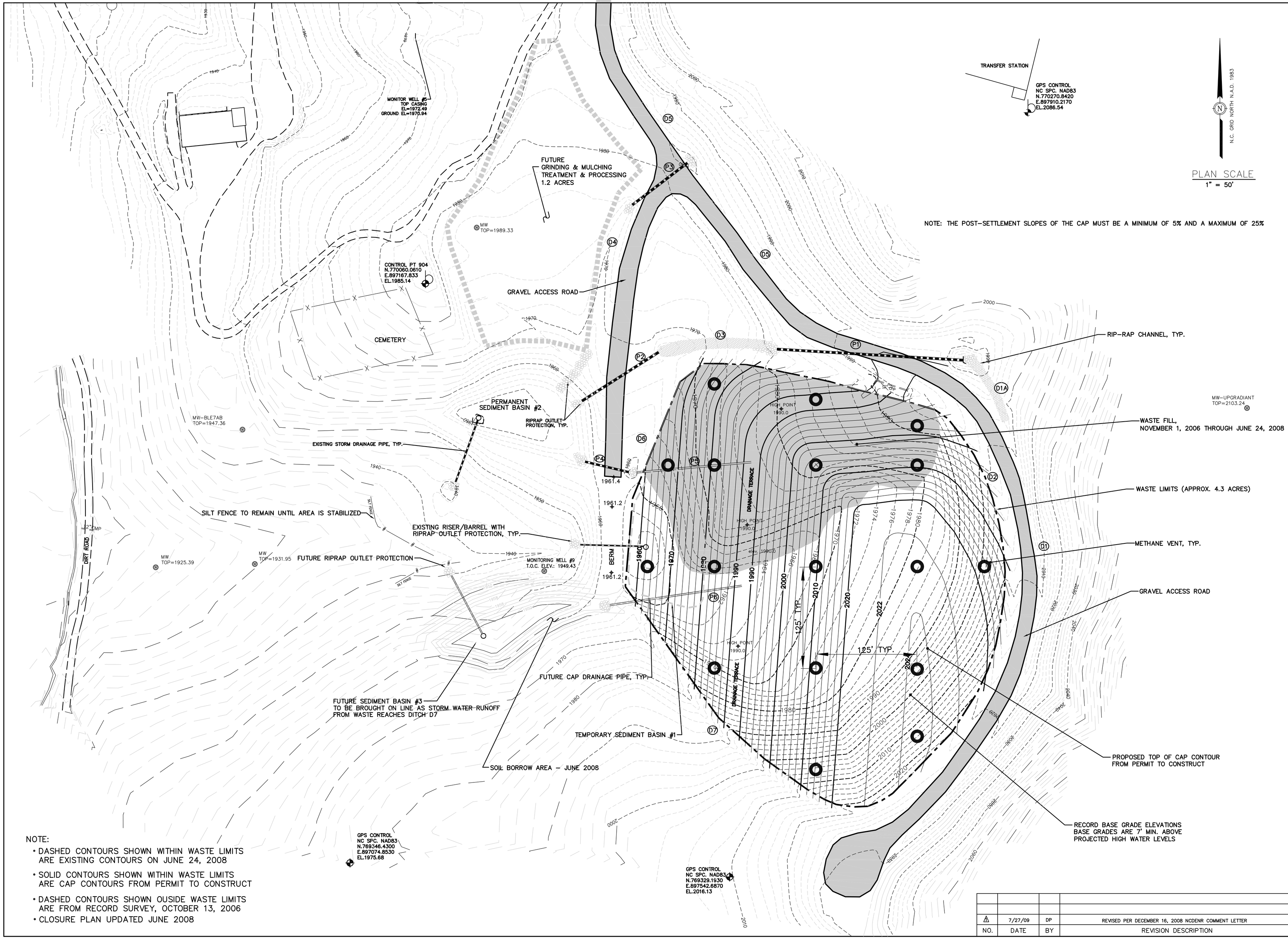
				Unit Cost	Total
Item 1		Earthwork			
	a.	10,340 C.Y.	18" Vegetative Cover	$6.00 /C.Y.	$62,040
	b.	10,340 C.Y.	18" Low Permeability layer	$8.00 /C.Y.	$82,720
Item 2		Sedimentation and Erosion Control			
	a.	4.3 AC.	Grassing	$1,800.00 /A.C.	$7,740
	b.	750 Tons	Rip Rap	$51.00 /Tons	$38,250
	c.	1,000 L.F.	Synthetic Lined Channels	$15.30 /L.F.	$15,300
Item 3		Methane Gas Vents			
	a.	17 Each	Gas Vents	$2,000/ Each	$34,000
Item 4		Engineering			
	a.	Design			$35,000
	b.	Construction Quality Assurance			$30,000
Item 5		Permit Fee			$1,500
Item 6		Contingency (10%)			$31,000
				Total	$337.550

6.2 Post-Closure Costs Estimate

Unit 2 (4.3 ACRES) – Annual Post Closure Care

Item 1		Environmental Monitoring		Unit Cost	Total
	a.	2 Wells Groundwater Monitoring (2 sampling events/year, includes final report)		$500.00/Well	$2,000
	b.	2 Point Surface Water Monitoring (2 sampling events/year, includes final report)		$500.00/Each	$2,000
Item 2		Routine Annual Maintenance			
	a.	4.3 AC.	Grassing Mowing (1 cut/year)	$50.00 /AC.	$215
	b.	1 Each Repair of Cap (0.25 acre repair, 1 foot depth)		$2,500 /Each	$2,500
	c.	4.3 AC.	Re-seeding	$1,000 /AC.	$4,300
Item 3		Annual Permit Fee			$500
Item 4		Contingency (10%)			$1,000
				Total Yearly Cost	$12,515

FIGURE 1
Closure Plan



NOTE:

- DASHED CONTOURS SHOWN WITHIN WASTE LIMITS ARE EXISTING CONTOURS ON JUNE 24, 2008
- SOLID CONTOURS SHOWN WITHIN WASTE LIMITS ARE CAP CONTOURS FROM PERMIT TO CONSTRUCT
- DASHED CONTOURS SHOWN OUSIDE WASTE LIMITS ARE FROM RECORD SURVEY, OCTOBER 13, 2006
- CLOSURE PLAN UPDATED JUNE 2008

NO.	DATE	BY	REVISION DESCRIPTION
1	7/27/09	DP	REVISED PER DECEMBER 16, 2008 NCDENR COMMENT LETTER

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

CONSTRUCTION & DEMOLITION
LANDFILL UNIT 2
MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

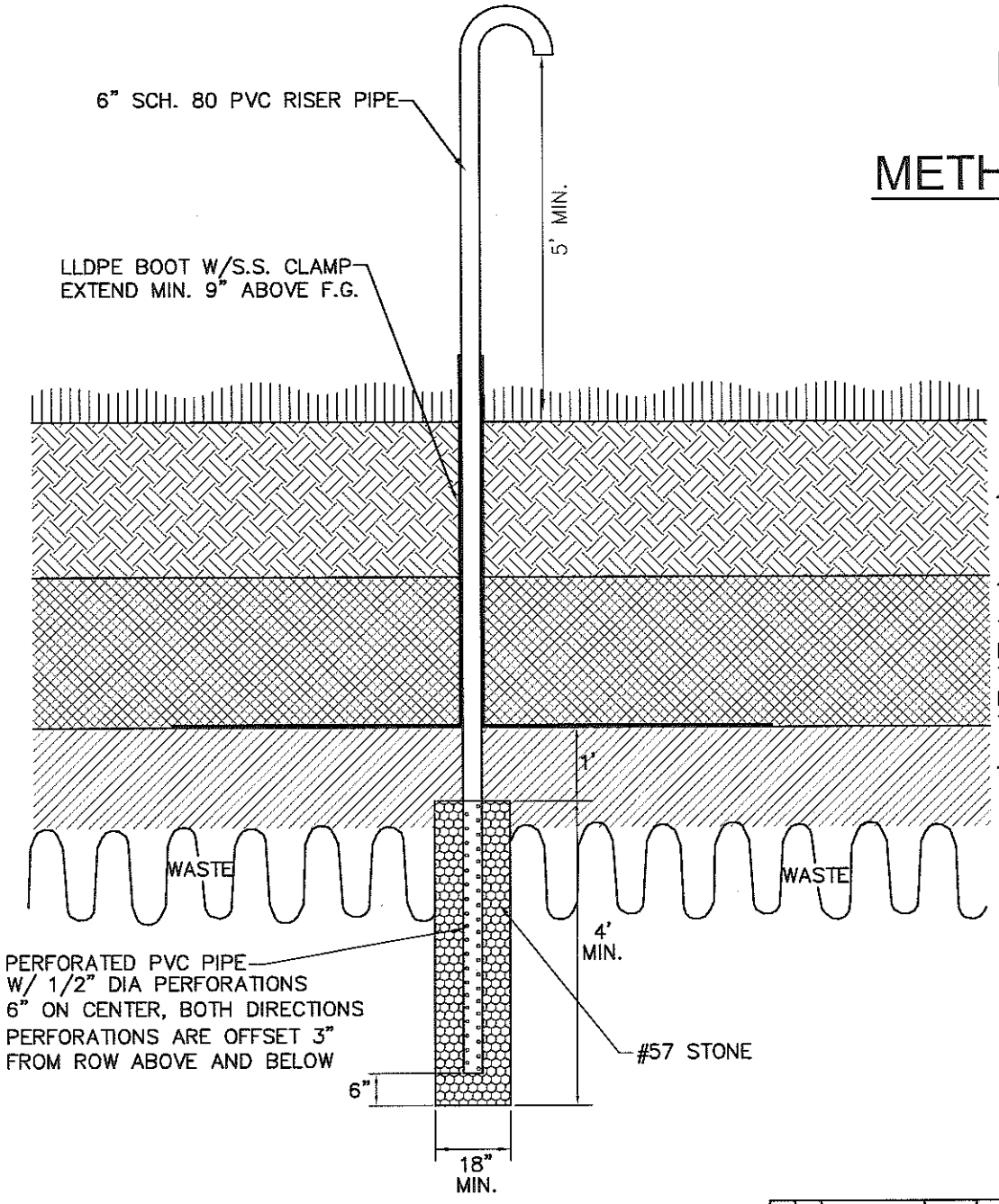
JOB NO.: 00.00700
DATE: JUNE 2008
SCALE: 1" = 50'
DESIGNED BY: DAP
CADD BY: DAP
DESIGN REVIEW: ———
CONST. REVIEW: ———
Q:/00.00700/
C-D-Submittal-6-08.dwg

CLOSURE PLAN

FIGURE
1

FIGURE 2
Methane Gas Vent

FINAL CAP WITH METHANE GAS VENT



NORTH CAROLINA PROFESSIONAL SEAL 23574 ENGINEER JEFFREY R. BISHOP 8/14/09

NO.	DATE	BY	REVISION DESCRIPTION
1	7/27/09	DP	REVISED PER DECEMBER 16, 2008 NCDENR COMMENT LETTER

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

CONSTRUCTION & DEMOLITION LANDFILL - UNIT 2
MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

JOB NO.: 05.00750
DATE: JULY 2009
SCALE: NTS
DESIGNED BY: DAP
CADD BY: DAP
DESIGN REVIEW: ——
CONST. REVIEW: ——
P:\2005\050750\

CLOSURE PLAN

FIGURE 2

SITE SPECIFIC CONSTRUCTION QUALITY ASSURANCE PLAN

MADISON COUNTY LANDFILL CONSTRUCTION AND DEMOLITION LANDFILL, UNIT 2

MADISON COUNTY, NORTH CAROLINA

JEFFREY R. BISHOP, P.E.

McGill ASSOCIATES

Engineering • Planning • Finance
Asheville, North Carolina

NORTH CAROLINA PROFESSIONAL SEAL 23574 ENGINEER JEFFREY R. BISHOP

July 2009

08.00700

SITE SPECIFIC CONSTRUCTION QUALITY ASSURANCE PLAN
Madison County Construction and Demolition Landfill–Unit 2
Madison County, North Carolina

Chapter 1
Introduction

1.1 Project Background

The purpose of this Site Specific Construction Quality Assurance Plan (SSCQAP) is to provide guidance to Madison County Landfill Staff, McGill Associates, and the Construction Quality Assurance (CQA) consultant regarding the required documentation activities during the construction of the engineered Construction and Demolition Landfill (CDLF) Expansion. The successful implementation of the SSCQAP will ensure that the construction and materials meet the design specifications and construction requirements and also that the integrity of the landfill systems be maintained prior to waste placement.

The Madison County Unit 2 CDLF received a Permit to Operate in November 2006, and is expected to serve the County until 2022. The Unit 2 CDLF consists of an approximate 4.3 acres.

1.2 Project Scope

The purpose of this Site Specific Construction Quality Assurance Plan (SSCQAP) is to provide guidance to McGill Associates and the CQA consultant on required documentation activities during the construction of the engineered CDLF cap. This guidance is intended to ensure that construction meets the requirements of Madison County, the Site Specific Construction Quality Assurance Plan (SSCQAP), and project drawings and specifications.

The overall goals of the SSCQAP are to ensure that proper construction techniques and procedures are used to verify that the materials and installation techniques used meet the requirements of the SSCQAP, project drawings and specifications as approved by the NCDENR, Solid Waste Section. Additionally, the program will identify and define problems that may occur during construction and ensure that these problems are corrected before the construction is complete. At completion of work, the program will culminate in a certification report, which documents that, the structural fill has been constructed in substantial compliance with this SSCQAP, project drawings, and specifications. The primary emphasis of the SSCQAP is careful documentation during the preparation and placement of the structural fill.

1.2.1 Scope of Services

The Scope of Services provided by the CQA Consultant for the construction of the cap of the Unit 2 Madison County CDLF, is as follows:

1. Pre-Construction materials evaluation (structural fill).
2. Structural Fill observation, testing, documentation, and verification of construction procedures.
3. Low-permeability soils observation, testing, documentation, and verification of thickness and construction procedures.
4. Vegetative layer observation, testing, documentation, and verification of thickness and construction procedures.
5. Provide CQA Report and CQA Certification that the Unit 2 cap was constructed in accordance with this SSCQAP.

1.2.2 Construction Schedule

Construction of Unit 2 cap shall be completed within 100 consecutive calendar days.

Description
Preconstruction Meeting
Structural Fill (Subgrade) Installation
Low Permeability Soils (Compacted Clay) Installation
Vegetative Soil Layer Installation
Submit CQA Report and CQA Certification

Chapter 2
Parties Involved

2.1 Madison County

Contact: Mr. Jim Huff (828) 249-2311
Title: Solid Waste Director

2.2 McGill Associates, P.A.

Contact: Jeffrey R. Bishop, P.E. (828) 252-0575
Title: Project Engineer

2.3 General Contractor

Contact: TBD (to be determined)
Title:

2.3.1 Surveyor

Contact: TBD
Title:

2.4 Construction Quality Assurance Consultant

Contact: TBD
Title:

2.5 CQA Certifying Engineer

Name: TBD
Title:

2.6 CQA Resident Engineer

Name: TBD
Title:

2.7 Soils Laboratory (permeability testing)

Contact: TBD
Title:

Chapter 3
Preconstruction Meeting

A Preconstruction meeting will be held prior to the beginning of construction. The following people shall be present: Owner representative, Solid Waste Director, Landfill Superintendent, Project Engineer, Design Engineer, Certifying CQA Engineer/CQA Project Manager, Resident CQA Engineer, General Contractor, and all subcontractors. The following items will be discussed at a minimum:

- Any questions about the SSCQAP will be addressed and any modifications that result will be documented. Any modifications to the approved SSCQAP must be approved by the Division of Solid Waste.
- Special permits and state and/or federal regulations.
- Responsibilities, expectations, and roles of each party.
- Lines of authority and proper lines of communication.
- Procedures for documenting and reporting information.
- Distribution and storage of documents and reports, and Review office facilities (copy machine, mailing, etc.)
- Protocol for handling construction deficiencies.
- Protocol for repairs and re-testing.
- Conduct site walk through including the inspection of material handling and storage locations
- Review detailed time schedule for all operations and procedures for material processing.
- Review work area security, check-in procedure, and safety protocol, Review site health and safety requirements.

The Preconstruction Meeting will be documented by McGill Associates and a copy of the meeting minutes will be distributed to all parties who attend.

Chapter 4
Definitions

4.1 Construction Quality Assurance

A planned and systematic application of all means and actions designed to provide adequate confidence that items or services meet design and specifications requirements and will perform satisfactorily in service.

4.2 Construction Quality Control

Those actions which provide a means to measure and regulate the characteristics of an item or services to design, and specifications requirements

4.3 Design Engineer

The individual or firm responsible for the implementation of this SSCQAP, construction drawings, and construction specifications.

4.4 General Contractor

The firm responsible for excavation and placement of the structural fill as specified in this SSCQAP and as shown on the construction drawings and construction specifications.

4.5 Construction Quality Assurance Consultant

The firm responsible for observing, testing and documenting activities related to construction quality assurance during the placement of the structural fill, the low permeability barrier, and the vegetative soils layer. The CQA Certifying Engineer is responsible for issuing a summary certification and documentation report bearing his/her Professional Engineering Seal. The CQA Resident Engineer is responsible for the management of on-site CQA personnel and providing the Project Engineer and Owner with a daily report of the construction activities.

Chapter 5
Documentation Procedures

5.1 Standard Reporting Procedures

The CQA Technicians shall issue a daily report of construction activities. These reports shall include, as a minimum, the following information:

1. An identifying sheet number for cross-referencing and documentation control.
2. Date, project name, location and other identification.
3. Weather conditions.
4. Problems encountered and resolutions.
5. Descriptions and locations of ongoing construction.
6. Equipment and personnel in each work area, including subcontractors.
7. Descriptions and specific locations of areas or units of work being tested and/or observed and documented (identified by coordinates or relative measurements from fixed structures).
8. Locations where soil tests were performed or soil samples were taken.
9. A summary of test results, failures, and re-tests.

5.2 Applicable Forms

As a minimum, the CQA monitors will utilize the following forms for the project:

1. Daily Field Report
2. Weekly Progress Report
3. Nuclear Density Testing
4. Drive Cylinder Test Report
5. Soil Testing Tracking Log
6. Construction Photo Log
7. Certificate of Completion

5.3 Problem/Deficiency Identification and Corrective Action Report

The CQA Monitor is required to inform the General Contractor or their representatives, in a timely manner, of any difference between the interpretation of the SSCQAP, the construction plans and construction specifications by the contractor versus the CQA Monitor's interpretation. In addition, any actual or suspect work deficiencies shall be brought to the Project Engineer's and Owner's attention.

A special meeting shall be held when and if a problem or deficiency is present. At a minimum, the meeting shall be attended by the General Contractor, the Owner, the CQA Resident Engineer, and the CQA Monitor. If the problem involves a possible design modification, the Project Engineer shall be notified. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

1. Define and discuss the problem or deficiency
2. Review alternative solutions
3. Implement an action plan to resolve the problem or deficiency

The CQA Resident Engineer or his representative will document all proceedings.

The CQA Resident Engineer and the Design Engineer shall be authorized to stop work at the construction site.

Any changes and/or modifications to the SSCQAP must be approved by the Owner, Project Engineer, CQA Certifying Engineer, and the Division of Solid Waste.

5.4 Plan Modifications

Design and/or specification changes shall be made only with written approval of the Owner and the Project Engineer. Substantial design changes shall also require approval from the Division of Solid Waste.

5.5 Scope Change

The CQA Resident Engineer shall notify the Project Engineer whenever additional engineering services are requested by Owner that exceeds the original scope of services. An agreement for additional engineering services must be developed prior to any additional engineering services being provided.

5.6 Photographic Documentation

Photographs taken to document observations, problems, and/or deficiencies, or work in progress will include identification of the date, location, direction of view, and time period. Photographs will be filed in chronological order in a permanent protective file by the CQA team. One set of prints shall be turned over to both the Owner and Project Engineer at the conclusion of the project.

The permanent file will also contain a comprehensive index of each photo, which the CQA Monitor is responsible for preparing and maintaining. This index will include the following information:

1. Date of photograph

2. Provide a location and scale where photographed, including information regarding the orientation of the photograph itself for proper viewing
3. Subject description
4. Photo file number

The following is a list of minimum photographs to be taken during cap construction:

1. Existing site conditions at the start of construction.
2. Subgrade proof rolling
3. Test pad construction
4. Low permeability soils placement
5. On-site lab soil testing
6. General Progress photographs
7. Design modifications
8. Construction deficiencies
9. Completed construction

5.7 Final Construction Documentation Report

Once construction of the landfill cap has been completed, the CQA Resident Engineer shall prepare a final CQA report covering the installation and testing of the cap materials. The CQA plan shall be submitted in accordance with Section .0541 of the Solid Waste Rules, and shall include the results of all the construction quality assurance and construction quality control testing, including documentation of any failed test results, description of procedures used to correct the improperly installed material, and results of all retesting performed. The report must contain as-built drawings noting any deviation from the approved engineering plans, a comprehensive narrative including, but not limit to, daily reports from the project engineer, a series of color photographs of major project features, and documentation of major project features. The report must also bear the seal of the project engineer and a certification that construction was completed in accordance with:

a) the CQA plan,
b) the conditions of the permit to construct,
c) soil depth verification surveys (both low permeable and vegetative layers),
c) the requirements of Rule .0541, and
d) acceptable engineering practices.

5.8 Format of CQA Report

As a minimum, the certification report will contain the following items for discussion in the narrative portion of the report. The proposed table of contents is:

5.8.1 Table of Contents

Section

1.0 Summary of Information

1.1 Narrative
1.2 Reference Information

2.0 Soil Preconstruction Data

2.1 Proctors
2.2 Soil Density/Moisture
2.3 Soil Classification

3.0 Subgrade (Structural Fill) Field Data

3.01 Moisture Content
3.02 Field Density Testing

3.1 Clay Liner Field Data

3.11 Moisture Content
3.12 Field Density Testing
3.13 Permeability Testing

4.0 Soil Laboratory Data

4.1 Construction Proctors
4.2 Soil Classification
4.3 Permeability

5.0 Project Meeting Minutes

6.0 Construction Photographs

7.0 Pertinent Information

5.8.2 Draft List of Drawings

As a minimum, the certification will include in an appendix the following proposed list of drawings:

- ap giving elevation information for top of structural fill.
- Map giving elevation information for top of low permeability barrier layer.
- Map giving elevation information for top of vegetative soil layer.
- As-built survey of storm drainage features.

5.9 Site Surveying Requirements

The CQA Resident Engineer shall coordinate all survey activities with the surveyor, provided by the Contractor. Survey services will be required for initial site layout, clay and vegetative layer verification, and as-built survey. One permanent benchmark of known elevation measured from a U.S. Geological Survey benchmark must be established and maintained for each 50 acres of developed landfill, or part thereof. The benchmark shall be the reference point for establishing vertical elevation control. North Carolina State Plane coordinates must be utilized for horizontal control points, one of which is the benchmark. The benchmark and horizontal control must be installed by a Registered Land Surveyor. All grade surveying shall be conducted on a maximum 50-foot grid and a maximum 50-foot frequency along grade breaks. The certification surveys will be as directed by the CQA Resident Engineer and shall include the following items:

- Topographic survey of structural fill grades
- Topographic survey of top of clay liner
- Topographic survey of top of vegetative layer
- Inverts of stormdrain piping
- Inverts of sediment pond structures

Chapter 6
Landfill Cap Construction-Earthwork

6.1 Structural Fill Preparation

6.1.1 Structural Fill

Structural fill shall be the soil placed to achieve the design subgrade contours. Subgrade preparation shall be performed by the General Contractor and in accordance with the construction drawings and construction specifications.

The General Contractor shall be responsible for preparing the subgrade prior to placement of the cap liner system and is responsible for constructing the subgrade in accordance with the technical specifications.

Before beginning placement of the Compacted Clay Cap:

1. The Resident CQA Engineer shall document that a licensed land surveyor has verified that all grades and elevations are consistent with the NCDENR Solid Waste Section approved engineering plans.

2. The Resident CQA Engineer shall document that he/she has visually inspected the structural fill surface to evaluate its suitability and that the surface meets the criteria specified in the project specifications.

3. The prepared subgrade shall be proof-rolled using a smooth-drum roller (minimum 20 tons) making a minimum of two (2) passes in each direction or other procedures and equipment approved by the Project Engineer.

4. The Resident CQA Engineer shall document that the subgrade has been tested for conformance to the construction specifications at the following minimum frequencies:

If a nuclear gauge is used as the primary means of construction testing, the instrument shall be calibrated properly and test data shall be verified using alternate test methods such as drive cylinders. An alternate test method shall be used at least once for every hundred tests performed with the nuclear gauge. The alternate test method should be performed in the same area as an instrument reading in order to allow accurate comparison of the data resulting from the two tests.

Preconstruction Qualification Structural Fill		
Test	**ASTM Method**	**Quantity**
Natural Moisture Content	D2216	1/5,000 YD^3
Laboratory Compaction	D698	1/5,000 YD^3

Construction Testing STRUCTURAL FILL TESTING FREQUENCIES		
TEST	ASTM METHOD	QUANTITY
Field Density	D6938, D1556, D2937	1/5,000 YD^3
Field Moisture	D2216, D6938, D4643	1/5,000 YD^3

6.2 Compacted Clay Liner Material

The Compacted Clay Cap liner shall consist of low-permeability soils placed on the prepared subgrade, in accordance with the Solid Waste Rules and the Permit to Construct documentation.

Table 1 - QA Testing Frequencies and Criteria for Compacted Clay Liner Layer

Preconstruction Qualification		
Test	**ASTM Method**	**Quantity**
Natural Moisture Content	D2216	1/1,000 YD^3 or Change in Material
Grain Size Analysis	D422 or D1140	1/5,000 YD^3 or Change in Material
Classification	D2487	1/5,000 YD^3 or Change in Material
Atterberg Limits	D4318	1/5,000 YD^3 or Change in Material
Laboratory Compaction	D698 - Standard	1/5,000 YD^3 or Change in Material
Permeability **	D5084	1/10,000 YD^3 or Change in Material Three per Moisture-Density Curve

*** Preconstruction test samples shall be taken from the borrow source and or clay stockpiled prior to construction.**

** The Moisture-Density Curve shall show the region in which the required maximum permeability is met. A minimum of three (3) permeability tests (ASTM D5084) shall be performed per curve to establish the zone of acceptable moistures and densities at which the required maximum permeability may be achieved. If the Contractor elects to run multiple curves to enlarge the zone of acceptance, all curves must be submitted.

Construction Testing		
Test	**ASTM Method**	**Quantity**
Field Density	D6938, D1556, D2937	1/10,000 FT^2/Lift
Field Moisture	D2216, D6938, D4643	1/10,000 FT^2/Lift
Classification	D2487	1 per acre per lift
Permeability	Extracted per D1587 Tested Per D5084	1/40,000 FT^2/Lift
Atterberg Limits	D4318	1/5,000 YD^3
Grain Size	D422 or D1140	1/5,000 YD^3
Maximum particle Size		3- inch diameter (lower 18 inches) 1/4-inch diameter (top 6 inches)
Soil Layer Thickness	Observation, Field Measurement	Continuous Observation, Minimum of Five (5) per Lift

If a nuclear gauge is used as the primary method for construction testing of the clay liner, the test data shall be verified by alternate test methods at least once for every 10 tests performed.

Any modifications made to these testing frequencies will require prior approval from the NCDENR Solid Waste Section.

Clay liner material generally consists of cohesive soils with low hydraulic conductivity used as barriers in lining systems. Soils used in clay liners shall consist of clean, select material free of debris, excessive coarse particles or other deleterious matter. Soils with a visibly identifiable organic content, or soils classified according to the Unified Soil Classification System as organic silt or organic clay (OL, OH) shall not be used.

Any tests resulting in the penetration of the compacted clay liner shall be repaired by backfilling the test area with a hand-tamped 50/50 bentonite/clay mixture.

6.4 Clay Liners

Prior to the construction of a clay cap, soil evaluation tests shall be performed to confirm the adequacy of clay liner materials procured from each on-site or off-site source area. All tests shall be performed in a geotechnical laboratory. The General Contractor shall submit the results of source evaluation tests to the Project Engineer. Previous testing and evaluations of the soil sources may also be used to evaluate the soil material. The material shall be accepted or rejected by the Project Engineer according to these results. The acceptance and rejection criteria for the clay liner material will be verified by the construction of a test pad in accordance with the construction specifications

6.4.1 Quality Assurance Testing

Permeability tests shall be performed at a confining pressure of 25 psi +/- 1 psi and with a gradient in accordance with ASTM method D5084. Samples taken from each location shall be compared to the approved moisture-density-permeability relation. Test frequencies for construction testing are given in Table 1 of Section 6.2. The Resident CQA Engineer shall certify that the clay cap was constructed using the same methods and acceptance criteria consistent with test pad construction and tested according to the NCDENR Solid Waste Section approved plans.

6.4.2 Test Pad Construction

The test pad shall be constructed in accordance with the technical specifications. The results of the test pad testing shall be in accordance with Table 1 in Section 6.2 and the previously approved moisture-density-permeability relationship established from preconstruction testing. Field moisture and density tests and laboratory permeability tests will be performed by the Resident CQA Engineer for each lift placed on the test pads to verify the construction method, equipment, and material to achieve the maximum required permeability for the clay liner. If the contractor chooses to construct the test pads within the cell, all lifts of the test pads must

pass to enable them to remain as part of the clay liner. The Contractor shall allow sufficient time for construction and testing of the test pad prior to placement of the Compacted Clay Liner.

6.4.3 Clay Liner Placement

The clay liner shall be placed in lifts, in accordance with Section 02300 of the technical specifications.

6.4.4 Clay liner Acceptance

The Resident CQA Engineer must approve the condition of the clay liner prior to the geosynthetic installer deploying the geomembrane.

The soil components of the lining system will be approved by the Resident CQA Engineer when:

1. The installation of the soil components is finished.

2. Verification of the adequacy of the constructed components, including repairs, if any, is completed in accordance with this SSCQAP and the technical specifications.

All documentation of installation is completed.

The depth and grade of the clay liner has been verified by a licensed surveyor and has been approved by the project engineer.

3. The appropriate frequency of permeability tests have been performed and the results have been approved by the Certifying CQA Engineer.

4. The Soil QA Monitors shall certify that installation of the soil components has proceeded in accordance with this SSCQAP and the Technical Specifications.

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

March 15, 2006 (revised April 10, 2006)

McGill Associates, P.A.
55 Broad Street
Asheville, North Carolina 28801

Attention: Mr. Mark D. Cathey, P.E.

Subject: **Environmental Monitoring Plan**
Proposed Unit 2 C&D Cell Area
Madison County Landfill
Madison County, North Carolina
BLE Project Number J04-2225-04

Dear Mr. Cathey:

As authorized by your acceptance of Bunnell-Lammons Engineering, Inc. (BLE) proposal number P04-0441 dated October 7, 2004, we have completed the Environmental Monitoring Plan for the subject site. This plan addresses the relevant environmental monitoring requirements as outlined in the North Carolina Rules for Solid Waste Management, 15A NCAC .0601.

We appreciate the opportunity to serve as your geological, hydrogeological, and geotechnical consultant on this project and look forward to continue working with you at the Madison County Landfill. If you have any questions, please contact us at (864) 288-1265.

Sincerely,

BUNNELL-LAMMONS ENGINEERING, INC.

NORTH CAROLINA LICENSED 4/10/06 SEAL 1043 GEOLOGIST MARK S. PREDDY

Rick Mayer
Staff Hydrogeologist

Mark S. Preddy, P.G.
Senior Hydrogeologist
Registered, North Carolina No. 1043

CC: Thomas L. Lammons, P.G.
Andrew W. Alexander, P.G.

c:\msp files\madison co. lf nc\222504\2225-04 env mon plan rev1.doc

6004 PONDERS COURT
GREENVILLE, SOUTH CAROLINA 29615

PHONE (864) 288-1265
FAX (864) 288-4430

1.0 PROJECT INFORMATION

The subject construction and demolition (C&D) waste landfill is located in Madison County, North Carolina about two miles west of the town of Marshall (Figure 1). The county plans to construct a new C&D waste cell known as Unit 2, which will cover approximately 5 acres. As part of the permitting process for the expansion area, a Design Hydrogeologic Report (DHR) dated January 31, 2006 was prepared by BLE. The DHR addressed the relevant solid waste regulations under the North Carolina Department of Environment and Natural Resources, Division of Waste Management, Rule T15 NCAC 13B .0504(1)(c), which pertain to the geologic and hydrogeologic conditions of the proposed C&D landfill area.

A geologic study was performed for the entire landfill property in 1990, and was reported in the Site Application Plan (SAP) prepared by Law Environmental, Inc., dated August 7, 1990 (LEI Job No. 56-8550). The DHR prepared by BLE specifically addressed the geologic and hydrogeologic conditions of the proposed 5-acre Unit 2 expansion area of the C&D waste landfill. The 5-acre expansion area falls within the boundaries of the SAP (Figure 1).

As part of the expansion project, we have prepared this Environmental Monitoring Plan (EMP) as required for the Unit 2 C&D expansion site. This EMP supplements the existing Water Quality Monitoring Plan (WQMP) for the existing Municipal and C&D landfills. The current WQMPs were prepared by Law Environmental and were dated April 4, 1994 (MSWLF) and March 2, 1995 (C&D LF). The plans and procedures of the existing WQMPs are adopted herein.

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2.0 EXISTING WATER QUALITY MONITORING SYSTEM

Madison County maintains a system of nine ground-water monitoring wells and two surface-water monitoring points to monitor water quality (Figure 2). The existing ground-water monitoring wells include:

- Background: MW-6;
- Compliance: MW-1, MW-2, MW-3, MW-4, MW-5, MW-7R, and MW-8;
- Water level monitoring only: MW-7.

The existing surface-water sampling locations include:

- Upgradient: SW-1
- Downgradient: SW-2R.

There are no existing compliance wells located downgradient from the proposed Unit 2 C&D waste boundary. The closest compliance well is MW-5 which is located approximately 550 feet sidegradient from the proposed waste boundary. Therefore, the installation of one additional compliance well (MW-9) is required to target areas of convergent ground-water flow. Existing background monitoring well MW-6 is located approximately 550 feet from the proposed C&D waste boundary in a location sufficient for background monitoring of the proposed waste area.

SW-1 is located upstream of the proposed expansion area and SW-2R is located downstream of the proposed expansion area. No changes to the surface-water sampling locations are necessary.

3.0 GROUND-WATER MONITORING PLAN

These revisions to the existing monitoring system are needed to better address requirements in Rule 15A NCAC 13B .0601.

3.1 Subsurface Considerations, Ground-Water Flow Direction and Depth

Site specific factors were considered in redesigning this ground-water detection monitoring system, including the locations and construction details of each proposed monitoring well. In addition, environmental factors were considered, such as seasonal variations of the water table, the horizontal and vertical flow regimes, and lithology characteristics.

Ground-water elevations were measured in the piezometers on site at the time of boring and after 24 hours. Additionally, water level measurements were collected from the piezometers on site during the period from December 2004 to June 2005. The water level data was presented in the DHR. A water-table surface contour map was prepared for the May 19, 2005 data (Figure 2).

Ground water beneath the Unit 2 area flows from east to west. Recharge to the unconfined aquifer occurs at the higher elevations. Shallow ground-water discharge occurs to the on-site creek west

of the proposed cell area. The residual soils and bedrock comprise the unsaturated and saturated zones of the uppermost water table aquifer.

On May 19, 2005, the depth to ground water varied locally from about 2.95 feet above ground surface (BLE-12c) in low elevation areas to about 49.05 feet below ground surface (B-13) in high elevation areas.

3.2 Compliance Boundary

The compliance boundary is less than 250 feet from existing waste boundary and 50 feet or greater from the facility property boundary. Specifically, proposed well MW-9 is located approximately 125 feet from the proposed waste boundary.

3.3 Proposed Monitoring Well Location

Based on the ground-water flow direction in the C&D expansion area (Figure 2), we propose the installation of one additional downgradient ground-water monitoring well. The well will be designated as MW-9. The proposed location for the installation of the additional well is shown on Figure 2. Proposed monitoring well MW-9 is located to intercept convergent ground-water flow west of the proposed cell area.

3.4 Monitoring Well Depths and Screened Intervals

The depth of proposed monitoring well MW-9 will be designed to monitor the uppermost aquifer present at the site. The well will be constructed with a 15-foot long screened interval. The proposed well depth will be determined by either:

- the depth to ground water in the soil and partially weathered rock units, if a sufficient saturated thickness of the aquifer exists above the depth of auger refusal. The screened interval will be set to bracket the water table surface; or
- by the depth of water-bearing fractures in the bedrock unit. The screened interval will be set to intersect the water-bearing fractures.

Based on data from the DHR we anticipate a depth of 2 feet to water and 27 feet to rock at the proposed monitoring well location.

3.5 Proposed Monitoring Well Construction and Laboratory Analysis

The anticipated lithology at the new proposed well locations has been estimated based on the closest available boring/coring data and from cross-sections and plan view geologic maps from the DHR.

It is proposed that the new wells be constructed of 2-inch diameter PVC casing and 15-foot long screened interval, with a sand pack, bentonite seal and grout column in the annular space between the borehole and PVC casing. A lockable standup steel cover should be secured over the well along with a concrete pad at the cover's base.

Drilling techniques, well installation, well development, sampling, and laboratory analyses should follow the procedures in the existing WQMP.

4.0 SURFACE WATER MONITORING PLAN

There are two existing surface-water sampling locations (SW-1 and SW-2R) associated with the existing landfill (Figure 2). The SW-1 location is upstream of the proposed Unit 2 cell and the SW-2R location is downstream of the proposed Unit 2 cell. Both surface-water sampling locations are sufficient for monitoring the expanded landfill site. Sampling and laboratory analyses should continue as performed in the past and should follow the procedures in the existing WQMP.

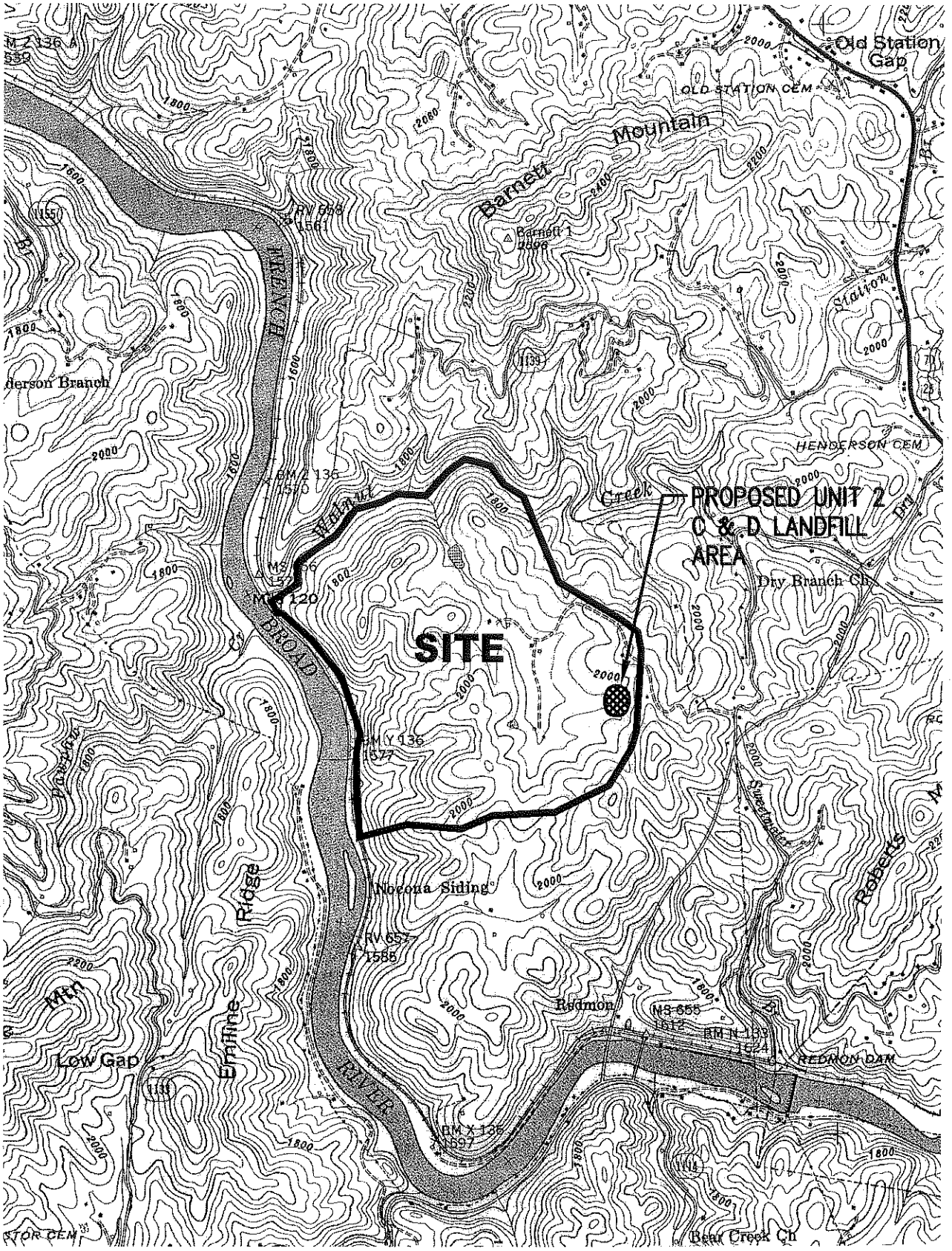
5.0 REVISED WATER QUALITY MONITORING SYSTEM

The revised water quality monitoring system for the existing landfill is shown on Figure 2. Once constructed, the monitoring system will include ten ground-water monitoring wells and two surface-water sampling locations. The water quality monitoring system for the site will include:

- one upgradient monitoring well (MW-6);
- eight downgradient monitoring wells (MW-1 through MW-5, MW-7R, MW-8, and MW-9);
- one monitoring well (MW-7) for water level measurements only;
- one upgradient surface-water location (SW-1); and
- one downgradient surface-water location (SW-2R).

Please note that ground-water compliance monitoring for the Unit 2 C&D area will only require sampling of the upgradient well (MW-6) and of the proposed compliance well (MW-9). Surface-water compliance monitoring for the Unit 2 C&D area will require sampling of the upgradient (SW-1) and downgradient (SW-2R) compliance points.

-oOo-

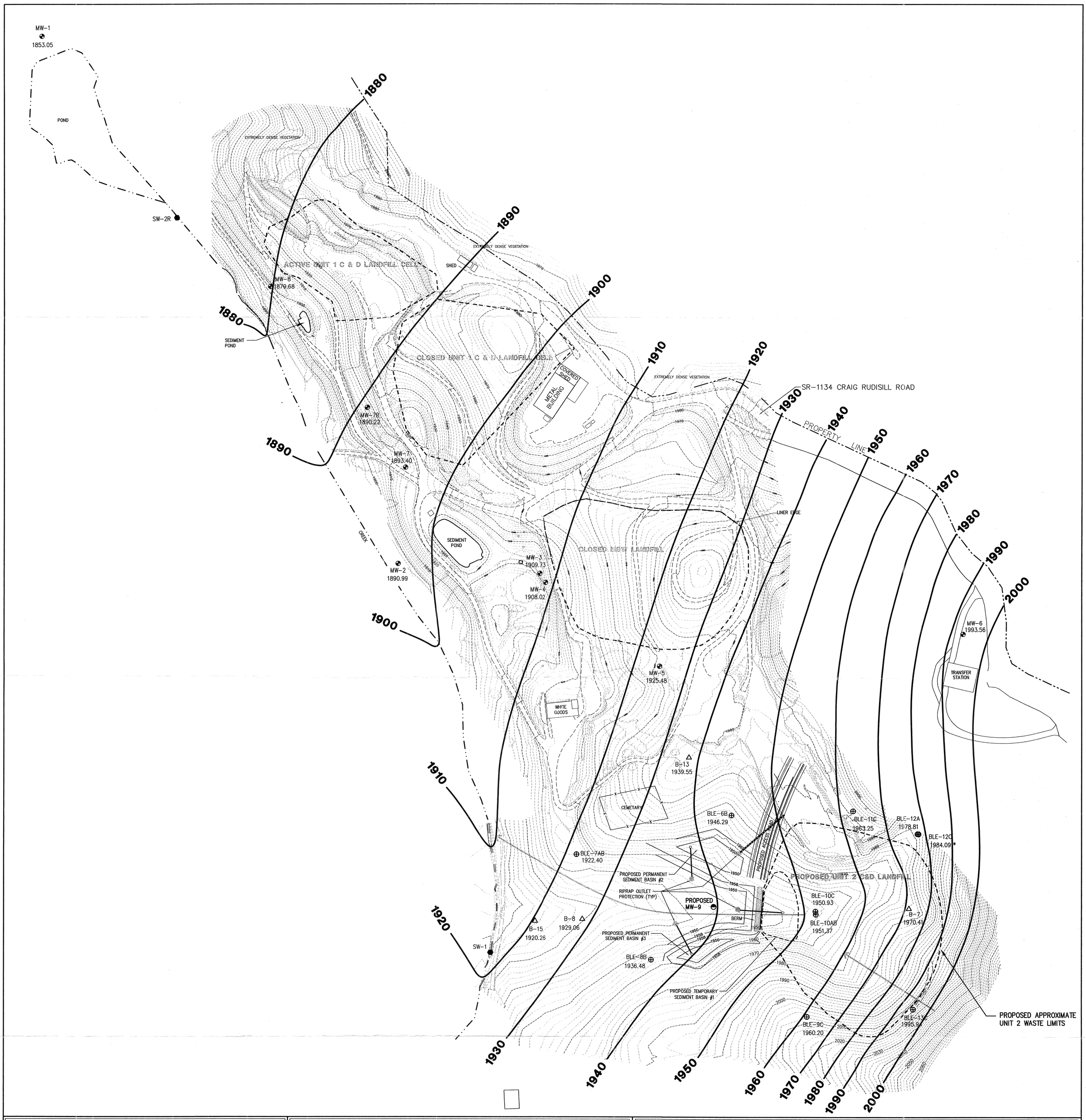


2000 1000 0 2000 4000

APPROXIMATE SCALE IN FEET

REFERENCE:
USGS TOPOGRAPHIC MAP, 7.5 MINUTE SERIES,
MARSHALL, N.C. QUADRANGLE, PHOTOREVISED 1978.

DRAWN: AEH	DATE: 03-03-06	BLE INC. BUNNELL-LAMMONS ENGINEERING, INC. 6004 PONDERS COURT GREENVILLE, SOUTH CAROLINA 29615 PHONE: (864)288-1265 FAX: (864)288-4430	SITE LOCATION MAP PROPOSED UNIT 2 C & D LANDFILL MADISON COUNTY, NORTH CAROLINA	FIGURE
CHECKED: AWA	CAD: MADCLF04-SLM			1
APPROVED:	JOB NO: J04-2225-04			



SAMPLE LOCATION LEGEND

B-15 △	PIEZOMETER INSTALLED BY LAW ENGINEERING CIRCA 1990
BLE-8B ⊕	PIEZOMETER INSTALLED BY BLE CIRCA 2004
MW-2 ◐	GROUND-WATER MONITORING WELL, VARIOUS INSTALLERS AND DATES
SW-1 ●	EXISTING SURFACE WATER SAMPLE LOCATION
MW-9 ◓	PROPOSED GROUND-WATER MONITORING WELL LOCATION

GEOLOGIC LEGEND

2060	TOPOGRAPHIC SURFACE CONTOUR IN FEET MSL CONTOUR INTERVAL = 2 FEET
	WATER
	WASTE BOUNDARY
	UNPAVED ROADS
	PAVED ROADS
	PROPERTY BOUNDARY
—x—x—	FENCE
1951.37	WATER TABLE ELEVATION IN FEET ABOVE MEAN SEA LEVEL ON MAY 19, 2005
1920	WATER TABLE ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL CONTOUR INTERVAL = 10 FEET
	GROUND-WATER FLOW PATHWAYS USED FOR FLOW VELOCITY CALCULATIONS

GENERAL MAP REFERENCE

100 50 0 100 200
APPROXIMATE SCALE IN FEET

NORTH CAROLINA LICENSED SEAL 1043 GEOLOGIST MARK S. PREDDY
4/10/06

NOTES:

1. THE WATER TABLE ELEVATION CONTOURS ARE BASED ON WATER LEVEL DATA COLLECTED ON MAY 19, 2005.
2. *THE WATER LEVEL IN BLE-12C REPRESENTS ARTESIAN CONDITIONS AS THIS WELL IS INSTALLED IN DEEPER FRACTURED BEDROCK STRATA. THE WATER LEVEL WAS NOT USED FOR CONTOURING PURPOSES.

REFERENCES:

1. DRAWING PROVIDED BY McGILL ASSOCIATES TITLED "DRAWING #1, DATED 3/9/95 LATEST".
2. DRAWING TITLED "FACILITY PLAN C & D EXPANSION AREA" BY McGILL ASSOCIATES DATED JUNE 2002.
3. DRAWING PROVIDED BY McGILL ASSOCIATES ON 3-13-06.

REVISIONS		
No.	DESCRIPTION	BY
1	APRIL 2006 – REVISED PROPOSED MONITORING WELL LOCATIONS	MSP

DRAWN	AEH
CHECKED	AWA
APPROVED	
DATE	03-03-06
FILE	MADCLF04-EMP
JOB NO:	J04-2225-04

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

ENVIRONMENTAL MONITORING PLAN
MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

FIGURE NO. 2

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

April 10, 2006

McGill Associates, P.A.
55 Broad Street
Asheville, North Carolina 28801

Attention: Mr. Mark D. Cathey, P.E.

Subject: **Revisions to Design Hydrogeologic Report & Environmental Monitoring Plan C&D Unit 2 Cell Area Madison County Landfill Madison County, North Carolina BLE Project Number J04-2225-04**

Gentlemen:

The North Carolina Solid Waste Section (NCSWS) has completed their review of the *Design Hydrogeologic Report,* dated January 31, 2005, and the *Environmental Monitoring Plan*, dated March 15, 2006 for the Unit 2 C&D area at the Madison County Landfill prepared by Bunnell-Lammons Engineering, Inc. (BLE) with respect to NCSWS Rule T15A NCAC .0504(1)(c). The NCSWS review comments were outlined in a letter dated April 5, 2006 to McGill Associates, P.A. This revisions contained herein address the NCSWS review comments and provides supplemental information where requested.

We appreciate the opportunity to serve as your hydrogeological and geotechnical consultant on this project and look forward to continue working with you at the Madison County Landfill. If you have any questions, please contact us at (864) 288-1265.

Sincerely,

BUNNELL-LAMMONS ENGINEERING, INC.

NORTH CAROLINA LICENSED 4/10/06 SEAL 1043 GEOLOGIST MARK S. PREDDY

Mark S. Preddy, P.G.
Senior Hydrogeologist
Registered, North Carolina #1043

Andrew W. Alexander, P.G.
Senior Hydrogeologist
Registered, North Carolina #1475

cc: Thomas L. Lammons, P.G. - BLE

Attachments: Revised Design Hydrogeologic Report
Revised Environmental Monitoring Plan

c:\msp files\uwharrie lf nc\100241\text\1002-41 review comments.doc

6004 PONDERS COURT
GREENVILLE, SOUTH CAROLINA 29615

PHONE (864) 288-1265
FAX (864) 288-4430

PROJECT INFORMATION

The subject construction and demolition (C&D) waste landfill is located in Madison County, North Carolina about two miles west of the town of Marshall. The landfill plans to construct an additional C&D waste disposal area known as the *Unit 2 C&D area*. BLE performed a geological and geotechnical investigation of the study area as presented in a *design hydrogeologic report* (DHR) dated January 31, 2006. BLE also prepared an *environmental monitoring plan* (EMP) dated March 15, 2006.

The NCSWS reviewed the DHR and EMP during March and April 2006. Upon completion of their review, the NCSWS requested revisions and additional information, as indicated in a letter dated April 5, 2006 from Mr. Bobby Lutfy to McGill Associates, P.A. This report addresses the NCSWS review comments. We have addressed the NCSWS review comments as indicated below, and these comments have been incorporated into the revised DHR and EMP (attached).

INFORMATION REQUESTED BY THE NCSWS

NCSWS Item No. 1:
Section 3.3 – Study Area Physiography and Topography

There is a reference made to the "Broad River", rather than the "French Broad River".

Supplemental Information:
The text correction has been made in Section 3.3 of the revised DHR.

NCSWS Item No. 2:
Table 3 – Summary of Laboratory Results

Some of the Total Porosity and Effective Porosity values on the Table appear to be different from the values based on the laboratory data and/or charts.

Supplemental Information:
The laboratory data sheets for total and effective porosity in Appendix E were revised and the values presented on Table 3 were revised likewise. Also, the text in Section 3.4.3 of the revised DHR was corrected to match the changes to Table 3 and Appendix E.

NCSWS Item No. 3:
Table 5 – Slug Test Results

Based on the Piezometer Logs, the Soil Class for Piezometers BLE-8b and 10ab would appear to include portions of the Residuum and PWR.

Supplemental Information:
The column on Table 5 titled "Unit Screened" has been revised to indicate BLE-8b and BLE-10ab are screened in both the residuum and PWR. Additionally, the text in Section 3.5.5.1 of the DHR has been revised to match these changes.

NCSWS Item No. 4:
Table 6 – Ground-Water Flow Velocity

Representative values of hydraulic conductivity and porosity (total and effective) need to be provided for each hydrogeologic unit.

Supplemental Information:
Table 6 and Section 3.5.5 have been revised to differentiate between the four primary units defined in the DHR: alluvium, residuum, partially weathered rock, and bedrock. Table 6 includes values of hydraulic conductivity and effective porosity for each of these units. Additionally, laboratory values of total porosity, effective porosity, and hydraulic conductivity are included on Table 3 and in Section 3.4.3 of the revised DHR. A summary of field tests of hydraulic conductivity are included on Table 5 and Section 3.5.5.1 of the revised DHR.

NCSWS Item No. 5:
Table 7 – Vertical Hydraulic Gradients

The "horizontal distance between wells" is not indicated. Does the vertical hydraulic gradient change with seasonal fluctuations in the water table?

Supplemental Information:
Table 7 has been corrected to indicate that the horizontal distance between BLE-10ab and BLE-10c is 8 feet.

According to the water level changes observed (Table 4), the vertical hydraulic gradient changes primarily with water level changes in BLE-10ab. Piezometer BLE-10ab had a water level fluctuation of 2.33 feet between December 2004 and June 2005, whereas BLE-10c only had a water level fluctuation of 0.10 feet during the same time period (this comment was added to Section 3.5.6 of the revised DHR).

NCSWS Item No. 6:
Figure 3 – Site Topographic Plan

The topography to the west of Piezometer BLE-11c appears to have been disturbed. What is the reason for the inconsistent topographic elevations in this area?

Supplemental Information:
The relatively flat topography near BLE-11c represents an area that has been excavated in the past as a soil borrow source for the existing landfill (this comment was added to Section 3.3 of the DHR).

NCSWS Item No. 7:
Figure 4 – Geologic Profiles

For Profile B-B', the water table for BLE-10ab is drawn incorrectly. The BLE-12 location is at a relatively high upgradient elevation. Is it possible the shallow soils are more representative of the upper residual soils unit, rather than the alluvium?

Supplemental Information:
The water table at BLE-10ab on Profile B-B' has been corrected on Figure 4 of the revised DHR.

Alluvial soils have been transported from the upland hills to the lower portions of the topographic ravine in which BLE-12a and BLE-12c are located. Physical examination of the soil samples from the boring indicated the soils are not residuum, but rather soil material that has been transported and deposited (i.e, alluvium).

NCSWS Item No. 8:
Figure 6 – May 19, 2005 Water Table Map

At what point does the stream draining the area become a perennial stream?

Supplemental Information:
Our field observations have indicated the westward sloping ravine emanating from the study area serves as a surface water conveyance to the northward flowing perennial stream at the site's western property boundary (this comment was added to Section 3.3 of the revised DHR). The ravine appears not to be perennial in that it has been observed to be dry during most of monthly water level measurements.

NCSWS Item No. 9:
Appendices B and C – Field Logs and Soil Test Boring Records

There appears to be some discrepancies for the top of PWR between the field logs in Appendix B and the final piezometer records in Appendix C.

Supplemental Information:
The field logs in Appendix B and the final piezometer/boring logs in Appendix C have been corrected and included in the revised DHR for borings BLE-6b, BLE-8b, BLE-10ab, BLE-10c, and BLE-13c. The revisions include adjusting the top of the PWR to be the first 6-inch standard penetration test (SPT) interval with a value of 50 or greater. Test revisions regarding unit thicknesses were also made in Sections 3.4.1.2 and 3.4.1.3 of the revised DHR.

NCSWS Item No. 10:
Appendix E – Soil Laboratory test results

Some of the total porosity and effective porosity values in Table 3 appear to be different from the values based on the laboratory data and/or charts.

Supplemental Information:
The laboratory data sheets for total and effective porosity in Appendix E were revised and the values presented on Table 3 were revised likewise. Also, the text in Section 3.4.3 of the revised DHR was corrected to match the changes to Table 3 and Appendix E.

NCSWS Item No. 11:
Appendix F – Piezometer Installation Procedures

There is no mention of grout being used to fill the annular space above the bentonite seal. However, most of the piezometers logs reference grout being used.

Supplemental Information:
Appendix F of the revised DHR has been revised to indicate that grout filled the remaining annulus above the bentonite seal up to the ground surface.

NCSWS Item No. 12:
Appendix I – Precipitation Data

In the table it indicates that the "winter plus spring" ranking "from 1994 to 2005" is 8 of 12 for the time the water level measurements were taken for the CDLF Unit 2 study. This would seem to suggest that there is a good possibility that these records may represent values less that those associated with normal seasonal high conditions. This along with the fact that only two of the piezometer locations are actually within the proposed Unit 2 footprint, and there is significant topographic relief, makes it difficult to demonstrate that a minimum of four feet of vertical separation will be maintained between the waste and the seasonal high water table. Additional evaluation and discussion of the vertical separation of the base grades from seasonal high ground-water elevations is needed using conservative assumptions.

Supplemental Information:
Prior to the 2005 winter-spring season during which the water level measurements were collected, the annual precipitation for 2004 was 8.00 inches *above* the 12-year average, in which the spring, winter, and fall seasons had above average precipitation. Additionally, the precipitation during the winter and spring of 2005 was at slightly below average amounts (only 2.82 inches *below* the winter-spring 12-year average). Although the collective precipitation for the winter-spring of 2005 was slightly below average, the total was still within one standard deviation of the 12-year average (Appendix I). Therefore, with the winter-spring precipitation of 2005 being within one standard deviation of average, coupled with the prior year having well above average precipitation, the seasonal high water levels recorded in the piezometers and wells should still be representative of typical seasonal high levels.

As an additional conservative measure for landfill subgrade design, we understand that the landfill design engineers plan to add an additional 3 foot buffer beyond the required 4-foot vertical separation.

These comments have been added to Section 3.5.3 of the revised DHR. Additionally, updated precipitation data and a chart showing the standard deviation statistic and the average of winter-spring precipitation have been added to Appendix I.

NCSWS Item No. 13:
Water Quality Monitoring Plan

The proposed monitoring well locations are not at the critical point of ground-water flow convergence. Also they are not located the correct distance from the waste boundary, and would

appear to interfere with the permanent sediment basins. A monitoring well needs to be located about 125 feet from the waste boundary, downgradient and in the middle of the drainage feature below C&D Unit 2. It may be necessary to extent the outfall from the temporary sediment basin and/or to protect the monitoring well at this location in some other way.

Supplemental Information:
The EMP has been revised to indicate one proposed monitoring well, MW-9, will be located about 125 feet downgradient from the proposed Unit 2 C&D area, which will be installed during the construction of the subject waste cell.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS

DESIGN HYDROGEOLOGIC REPORT
C&D UNIT 2 CELL AREA

MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

Prepared For:

MCGILL ASSOCIATES, P.A.
55 BROAD STREET
ASHEVILLE, NORTH CAROLINA 28801

Prepared By:

BUNNELL-LAMMONS ENGINEERING, INC.
6004 Ponders Court
Greenville, South Carolina 29615

NORTH CAROLINA LICENSED SEAL 1043 GEOLOGIST MARK S. PREDDY 1/31/06

NORTH CAROLINA LICENSED SEAL 1264 GEOLOGIST THOMAS L. LAMMONS 1/31/06

January 31, 2006

BLE Project Number J04-2225-04

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

January 31, 2006

McGill Associates, P.A.
55 Broad Street
Asheville, North Carolina 28801

Attention: Mr. Mark D. Cathey, P.E.

Subject: **Design Hydrogeologic Report**
C&D Unit 2 Cell Area
Madison County Landfill
Madison County, North Carolina
BLE Project Number J04-2225-04

Gentlemen:

Bunnell-Lammons Engineering, Inc. (BLE) has completed the Design Hydrogeologic Study for the proposed new construction and demolition (C&D) waste disposal area at the Madison County Landfill. This report addresses the relevant geologic and hydrogeologic site application requirements as outlined in the North Carolina Rules for Solid Waste Management .0504(1)(c). The attached report describes the work performed and presents the results obtained.

We appreciate the opportunity to serve as your geological, hydrogeological, and geotechnical consultant on this project and look forward to continue working with you at the subject site. If you have any questions, please contact us at (864) 288-1265.

Sincerely,

BUNNELL-LAMMONS ENGINEERING, INC.

NORTH CAROLINA LICENSED 1-31-06 SEAL 1043 GEOLOGIST MARK S. PREDDY

Mark S. Preddy, P.G.
Senior Hydrogeologist
Registered, North Carolina #1043

NORTH CAROLINA LICENSED SEAL 1264 GEOLOGIST THOMAS L LAMMONS

Thomas L. Lammons, P.G.
Principal Hydrogeologist
Registered, North Carolina #1264

cc: Andrew W. Alexander - BLE

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6004 PONDERS COURT
GREENVILLE, SOUTH CAROLINA 29615

PHONE (864) 288-1265
FAX (864) 288-4430

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1.0 PROJECT INFORMATION

The subject construction and demolition (C&D) waste landfill is located in Madison County, North Carolina about two miles west of the town of Marshall (Figure 1). The county plans to construct a new C&D waste cell known as Unit 2, which will cover approximately 5 acres. As part of the permitting process for the expansion area, this Design Hydrogeologic Report was prepared to address the relevant solid waste regulations under the North Carolina Department of Environment and Natural Resources, Division of Waste Management, Rule T15 NCAC 13B .0504(1)(c), which pertain to the geologic and hydrogeologic conditions of the proposed C&D landfill area.

A geologic study was performed for the entire landfill property in 1990, and was reported in the Site Application Plan (SAP) prepared by Law Environmental, Inc., dated August 7, 1990 (LEI Job No. 56-8550). This study specifically addresses the geologic and hydrogeologic conditions of the proposed 5-acre C&D waste unit. The 5-acre cell falls within the boundaries of the SAP (Figure 1).

-oOo-

2.0 FIELD INVESTIGATION

A discussion of the drilling and soil laboratory testing methodology used in the site evaluation is provided below. The field activities reported below were performed under the direction of a North Carolina licensed geologist. North Carolina-licensed drillers (BLE of Greenville, South Carolina) performed drilling and piezometer installation services. McGill Associates, P.A. of Asheville, North Carolina surveyed the horizontal and vertical coordinates of the final boring and piezometer locations and provided the data to BLE.

2.1 AREA AND FIELD RECONNAISSANCE

The study area was traversed by foot to map rock outcrops and surface drainage features.

2.2 FRACTURE TRACE ANALYSIS

The fracture trace analysis consisted of evaluating exposed rock outcrops and topographic fracture traces and lineaments.

The orientations of bedrock fractures (open joints, open foliation, and open bedding planes) were measured in the field using a Brunton-style compass. The orientation information was collected from exposed rock and saprolite outcrops at the site as well as along nearby roads. The field measurements were plotted on Schmidt lower hemisphere equal-area stereonets and on Rose diagrams.

Topographic fracture traces and lineaments were evaluated using topographic maps. Regionally, pronounced depressions typically develop along zones of weakness in the bedrock where fractures induce preferential weathering. This preferential weathering along bedrock fractures is ultimately expressed topographically as linear valleys. The trend of fracture traces and lineaments greater than 1,000 feet in length within a 1.5-mile radius of the site were measured from USGS topographic maps and plotted on a Rose diagram.

2.3 SOIL TEST BORING AND ROCK CORING

Eight new soil test borings and five new rock corings were performed in the study area to identify the subsurface geology. These new borings supplement the four existing borings performed by Law Environmental, Inc. in 1990. Soil samples were obtained from the borings at 5-foot intervals below the ground surface. Drilling techniques consisted of hollow-stem augering and rock coring. Refer to Appendix A for discussion of the various standard drilling techniques.

Copies of boring logs produced in the field are attached in Appendix B. Soil descriptions on the field logs were based on visual examination and grain-size estimations in accordance with the Unified Soil Classification System (USCS). Upon completion of laboratory grain-size and Atterberg Limit analyses, the preliminary field classifications were adjusted accordingly as reported on the final boring logs. Soil Test Boring/Rock Coring Records showing final descriptions of the soil and rock strata encountered are included in Appendix C.

The soil test boring locations and depths were selected to comply with the applicable North Carolina Solid Waste Section (NCSWS) rules.

2.4 LABORATORY TESTING

Laboratory tests were conducted to confirm the field classifications and quantify pertinent engineering soil properties. Soil samples were collected using split-spoon samplers and from the auger cuttings (bulk samples). The soils were too dense for undisturbed (Shelby tube) sample collection. The laboratory tests were performed in general accordance with applicable ASTM specifications, where available. Brief descriptions of the test procedures are included in Appendix D and the laboratory results are included in Appendix E.

2.5 GROUND-WATER INVESTIGATION

Ten new piezometers were installed to monitor water table elevations and further characterize the study area hydrogeology. These new piezometers supplement the four existing piezometers installed by Law Environmental, Inc. in 1990. At one location in the study area, a piezometer pair was installed to measure vertical hydraulic gradients. Piezometer installation records are included with the boring logs in Appendix C, and field procedures are described in Appendix F. Survey information is presented on Table 1 and piezometer construction details are summarized on Table 2.

Ground-water elevations were measured in the piezometers at the time of boring and after 24 hours. Additionally, measurements were taken in the piezometers on site during the period from December 2004 to June 2005.

Field permeability (slug) tests were performed in four piezometers to measure the *in situ* hydraulic conductivity of different zones in the water table aquifer. Slug test field procedures and data plots are presented in Appendix G.

The piezometers are intended only for investigation purposes and were not constructed as permanent monitoring wells, and will not be part of the permanent ground-water monitoring system. Prior to landfill construction activities, the piezometers will be abandoned in accordance with 15A NCAC 2C, Rule .0113(b) by over-drilling and backfilling the resulting boreholes from the bottom to the ground surface with 5% bentonite cement.

-oOo-

3.0 RESULTS OF INVESTIGATION

3.1 REGIONAL GEOLOGY

The subject site is located within the Blue Ridge Physiographic Province (Figure 2). The crystalline rocks of the Blue Ridge occur in northeast trending belts in western North Carolina. The Blue Ridge includes high-grade metamorphosed sedimentary and igneous rocks that have been exposed to multiple deformations (Horton and Zullo, 1991). Rock types that resulted from the multiple metamorphisms include gneiss, schist and amphibolite with northeast/southwest trending foliation with varying degrees of dip. Quaternary-age sediments consisting of sand and gravel fill the stream valleys. The bedrock in the vicinity of the site consists of late to middle Proterozoic granitic gneiss (Brown and others, 1985; Horton and Zullo, 1991).

Holocene and younger age faults were not indicated on site or within 200 feet of the site from the literature review or from the field reconnaissance.

The typical residual soil profile consists of clayey soils near the surface, where soil weathering is more advanced, underlain by micaceous clayey, 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 micaceous sand with lessor amounts of clay, silt 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.

3.2 REGIONAL HYDROGEOLOGY

Ground water in the Blue Ridge 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 aquifer generally resembles the local topography.

In the residual soil and partially weathered rock zone, ground water is stored within the pore spaces and is released to the underlying bedrock through gravity drainage. Ground water 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.

3.3 STUDY AREA PHYSIOGRAPHY AND TOPOGRAPHY

The site is located in Madison County, North Carolina, as shown in Figure 1. The Proposed C&D Unit 2 area is currently comprised of an undeveloped field with undergrowth and some trees.

The Proposed C&D Unit 2 area topography is characterized by a westward sloping drainage ravine. The highest elevations (approximately 2018 feet above mean sea level [msl]) occur at the southeastern study area boundary with the lower elevations (approximately 1948 feet above msl) occurring along the northwest flowing creek at the study area's western boundary. The relief across the expansion area is approximately 70 feet from east to west.

The surface drainage pattern across the C&D Unit 2 area is from east to west, into the northwest flowing perennial stream at the study area's western boundary. The perennial stream flows into a small pond located on the landfill property. Beyond the pond, the stream flows about 1300 feet into Walnut Creek, which flows southwestward about 2500 feet to the Broad River. There are no perennial streams under the footprint of the proposed landfill expansion area. A topographic map of the site is provided as Figure 3.

No monitoring wells or water supply wells were present in the Proposed C&D Unit 2 area prior to this investigation based on our field reconnaissance. However, ground-water monitoring wells are present at the existing landfill, and there were four pre-existing piezometers in the study area prior to this investigation.

3.4 STUDY AREA SUBSURFACE CONDITIONS

Twelve soil borings (8 new [BLE-6 through BLE-13], 4 pre-existing [B-7, B-8, B-13, and B-15]) were performed on the study area during October and November 2004. One hand-auger boring (BLE-12a) was performed at the site in April 2005. Rock coring was performed at six of the locations (5 new [BLE-9 through BLE-13], 1 pre-existing [B-13]). The geologic conditions encountered while drilling were variable with boulders and seams of partially weathered rock occurring throughout the subsurface soil overburden profile. In general, four zones were encountered: 1) alluvium, 2) the residual soils from weathered gneiss, 3) the partially weathered rock, and 4) the fractured gneiss bedrock. Subsurface geology at the site is shown on two cross sections designated A-A' and B-B' (Figure 4). A description of the subsurface materials encountered is provided below.

3.4.1 Geologic Unit Description

3.4.1.1 Alluvium

Alluvial soils fill the lower elevation areas in the ravine in the central portion of the study area. The alluvial soils were sampled as brown and gray, fine sandy clayey silt (ML) and silty clay (CH). This soil component was encountered in four of the twelve soil borings, generally ranging

from 3.0 to 12.5 feet below ground surface. Standard penetration resistance values (N-values) range from 6 to 22 with an average value of 12, indicating a stiff average consistency.

3.4.1.2 Residual Soil (Saprolite)

The residual soils are the result of the in-place weathering of the gneiss bedrock. The residual soil profile below the topsoil consists of two identifiable components based on the USCS.

The upper soil component consists of reddish-brown and yellowish-brown, slightly micaceous silty clay (CL), sandy clayey silt (ML, MH), and clayey sand (SC). This soil component was encountered in eight of the twelve soil borings, generally ranging from 5.0 to 12.0 feet below ground surface. N-values range from 4 to 20 with an average value of 10, indicating a stiff average consistency.

The upper soil component grades with depth into a coarser grained, less plastic, brown and gray, slightly micaceous sandy silt (ML) and silty sand (SM) which extends to the depth of the partially weathered rock. This soil component was encountered in nine of the twelve soil borings, generally ranging in thickness from 5.0 to 44.0 feet. N-values range from 5 to 64 with an average of 19, indicating a firm average consistency.

3.4.1.3 Partially Weathered Rock

The transition between soil and rock at the site is irregular and consists of partially weathered rock overlying the parent bedrock. The partially weathered rock was sampled as slightly micaceous fine-to-coarse sandy silt and silty fine-to-coarse sand with varying amounts of gravel size rock fragments. This zone was encountered in nine of the twelve borings, ranging in thickness from 3 to 22 feet.

A map of the approximate bedrock surface (auger refusal) is shown as Figure 5. Auger refusal depths may represent competent bedrock or possibly boulders of hard rock within the residual soil and partially weathered rock units. The depth to auger refusal can vary even over short horizontal distances due to boulders, fractures, joints, and the presence of less resistant rock types. Therefore, the actual depth to continuous bedrock will vary somewhat from that presented on Figure 5 and may actually be deeper than indicated.

3.4.1.4 Fractured Bedrock

Bedrock coring was performed at:

- PZ-9c (depth of 35.9 to 54.9 feet),
- PZ-10c (depth of 20.1 to 39.9 feet),
- PZ-11c (depth of 34.0 to 50.0 feet),
- PZ-12c (depth of 12.9 to 30.5 feet),
- PZ-13c (depth of 22.0 to 40.2 feet), and
- B-13 (depth of 70.0 to 80.0 feet).

The bedrock encountered consisted of coarse-grained amphibole gneiss, in which the upper portion of the bedrock cores were generally moderately hard and moderately weathered, and the deeper portions were slightly weathered to fresh and hard to very hard. The steeply-dipping foliation is well-developed. The bedrock fractures are typically very closely to widely spaced and parallel the foliation; typically, the fracture spacing increases with depth. The bedrock core had "good" to "excellent" *recovery* (range of 77 to 100 percent; average of 93 percent) and "very poor" to "excellent" *RQD* (range of 0 to 100 percent; average of 76 percent). In general, the bedrock becomes more competent with depth in which the upper bedrock is typically highly fractured.

3.4.2 Fracture Trace Analysis

A fracture trace analysis was performed for this phase of work. The data plots for the fracture trace analysis are in Appendix H and a summary of the fracture trace analysis is provided below.

The trend of 34 topographic fracture traces and lineaments within 1.5 miles of the site were measured and plotted on a Rose diagram utilizing a 10° interval. The primary fracture trace trend is N21°-40°E, with a secondary trend of N0°-10°E.

The orientations and trends of one open joint surface and nine bedrock foliation planes were measured in the field from rock outcrops, then plotted on Schmidt equal area projections and Rose diagrams. The plots consist of one Schmidt net for plotting poles to the joints and foliation, one Rose diagram utilizing a 10° interval for joint trends, and one Rose diagram utilizing a 10° interval for foliation trends. One primary orientation was observed: N21°-N50°E, dipping 34°-66°SE.

Our analysis of the local topographic fracture trace trends, bedrock joint orientations, and foliation orientations indicate that the prevailing fracture trend in the vicinity of the site is northeast.

3.4.3 Laboratory Testing Results

Laboratory testing of soil samples was performed to measure pertinent engineering and hydrogeologic parameters. A list of the soil laboratory tests performed in the study area is provided in the table below.

SAMPLE ANALYSES	SPLIT SPOON SAMPLES TESTED	UNDISTURBED SAMPLES TESTED	REMOLDED BAG SAMPLES TESTED
Grain-Size Analysis	7	4	2
Natural Moisture Content	7	4	2
Atterberg Limits	7	4	2
Total Porosity	7	4	2
Effective Porosity	7	4	2
Hydraulic Conductivity	-	4	-
Standard Proctor	-	-	2
Remolded permeability	-	-	2

Four undisturbed (Shelby tube) samples, seven split spoon samples, and two bag samples were tested in the laboratory. The test results are summarized on Table 3 and the test procedures and data sheets are included in Appendices D and E, respectively.

Testing results of the sample collected from the alluvial soil component consisted of:

- Natural moisture content values ranging from 38.4 to 44.1 percent;
- LL values ranging from 70 to 92;
- PI values ranging from 43 to 54;
- Average gravel, sand, silt, and clay contents of 0.0, 9.6, 27.3, and 63.2 percent, respectively;
- A hydraulic conductivity value of 3.7×10^{-8} cm/sec;
- Total porosity values ranging from 52.8 to 53.0 percent; and
- Effective porosity values of 0.7 percent.

Testing results of the sample collected from the upper residual soil component consisted of:

- Natural moisture content values ranging from 27.8 to 50.0 percent;
- LL values ranging from 46 to 74;
- PI values ranging from 9 to 29;
- Average gravel, sand, silt, and clay contents of 0.7, 23.7, 44.4, and 31.3 percent, respectively;
- Total porosity values ranging from 51.5 to 54.0 percent;
- Effective porosity values ranging from 0.7 to 17.5 percent;
- Standard Proctors with maximum dry density (MDD) values of 89.2 and 105.2 pounds per cubic foot (pcf) and optimum moisture contents of 28.8 and 20.0 percent, respectively; and
- Remolded permeability values of 1.2×10^{-7} and 2.0×10^{-7} cm/sec (5 percent wet of optimum moisture and 95 percent of the MDD).

Testing results of the samples collected from the deeper residual soil component consisted of:

- Natural moisture content values ranging from 20.2 to 39.8 percent;
- LL values ranging from 38 to 46;
- PI values ranging from 4 to 7;
- Average gravel, sand, silt, and clay contents of 0.8, 51.4, 44.7, and 3.2 percent, respectively;
- Hydraulic conductivity values ranging from 6.9×10^{-4} to 3.7×10^{-5} cm/sec;
- Total porosity values ranging from 50.0 to 58.5 percent; and
- Effective porosity values ranging from 20.0 to 27.0 percent.

Testing results of the sample collected from the partially weathered rock component consisted of:

- Natural moisture content values ranging from 11.6 to 17.0 percent;
- LL values ranging from 28 to 33;
- PI values ranging from 5 to 6;
- Average gravel, sand, silt, and clay contents of 6.2, 57.6, 32.6, and 3.6 percent, respectively;
- Total porosity values ranging from 47.5 to 53.5 percent; and
- Effective porosity values ranging from 22.5 to 30.0 percent.

3.5 STUDY AREA HYDROGEOLOGY

Nine ground-water piezometers (designated BLE-6b, BLE-7ab, BLE-8b, BLE-9c, BLE-10ab, BLE-10c, BLE-11c, BLE-12c, and BLE-13c) were installed at the site during October and November 2004. A tenth piezometer (BLE-12a) was installed via hand-auger in April 2005. The piezometers were installed at the locations indicated on Figure 3. Ground water is present above the bedrock surface in the lower elevation areas in the study area, and below the bedrock surface in higher elevation areas. The water-table aquifer consists of the residual soil, partially weathered rock, and fractured bedrock. These three units are hydraulically connected and thus comprise a single unconfined aquifer. Recharge rates, flow rates and storativity differ between the units based on the unique geologic conditions of each zone. Generally, shallow ground water flows to the west from recharge areas in the upland locations, and discharges to the perennial stream at the expansion area's western border. A description of the hydrogeologic conditions in the study area is provided below.

3.5.1 Piezometer Construction and Nomenclature

Piezometer identification numbers were designated with the letters "a," "b," or "c" depending on the location of the screened interval in the piezometer (Appendix C). Piezometers with a screened interval that brackets the water table and is above the depth of auger refusal were designated with the letter "a". Piezometers with a screened interval at the depth of auger refusal (top of bedrock surface) and below the water table were designated with the letter "b." In cases where the water table was near the depth of auger refusal, the piezometer identification number was designated using "ab". Bedrock piezometers were designated with the letter "c". Piezometers that are dry do not have a letter designation. Piezometers installed by Law Environmental, Inc. do not follow this nomenclature. A typical schematic diagram of piezometer construction and nomenclature is provided in Appendix C. A description of the piezometer construction procedures is provided in Appendix F.

3.5.1.1 Auger Refusal Piezometers

There are seven piezometers ("b" and "ab") in the expansion area with screened intervals at the depth of auger refusal in the residual soil and/or the partially weathered rock zones with the screened interval at or near the water table. These piezometers include: BLE-6b, BLE-7ab, BLE-8b, BLE-10ab, B-7, B-8, and B-15.

3.5.1.2 Bedrock Piezometers

There are six piezometers ("c") in the proposed cell area with screens intersecting ground water in the bedrock unit (BLE-9c, BLE-10c, BLE-11c, BLE-12c, PZ-13c, and B-13).

3.5.1.3 Piezometer Pairs

There are two well clusters in the expansion area: BLE-10ab/BLE-10c and BLE-12a/BLE-12c. The piezometer pairs were used to measure the vertical hydraulic gradient in the upper reaches of the westward trending topographic draw in the central portion of the propose cell area.

3.5.2 Water Table Elevation and Ground-Water Flow Direction

Ground-water level elevations were measured in the piezometers on site at the time of boring and after 24 hours. Additionally, monthly water level measurements were collected between December 2004 and June 2005. Table 4 provides a summary of the water level measurements collected. A water-table surface contour map was prepared for the May 19, 2005 data (Figure 6).

Ground water beneath the site flows from east to west. Recharge to the unconfined aquifer occurs at the higher elevations. Shallow ground-water discharge occurs to the on-site creek west of the proposed cell area.

On May 19, 2005, the depth to ground water varied locally from about 2.95 feet *above* ground surface (PZ-12c) along the centrally located ravine to about 49.05 feet *below* ground surface (B-13) in higher elevation area.

3.5.3 Precipitation and Seasonal Ground-Water Level Trends

Historical NOAA monthly precipitation data were obtained for the North Carolina Division 1 region for the period of January 1994 through June 2005. The data are summarized seasonally in Appendix I such that January-March represents *winter*, April-June represents *spring*, July-September represents *summer*, and October-December represents *fall*.

Historically in the Madison County area, the winter months will experience the most precipitation, with less precipitation in the spring, summer, and fall. In the summer months and fall, the effects of evapotranspiration offset the contribution of this precipitation to recharge of the uppermost aquifer. Because of these natural trends, the amount of ground-water recharge and subsequent increase in water table level is typically greatest during winter and spring seasons.

Water level measurements were obtained at the site between December 2004 and June 2005. These measurements were collected from the ten new piezometers, three existing piezometers, and nine existing wells across the site. Precipitation for the year preceding the water level measurements (2004) was above average, and the precipitation during the period of water level measurements was at near average amounts. Therefore, the seasonal high water levels recorded in the piezometers and wells should be representative of typical seasonal high levels.

Figure 7 is a composite seasonal high water table, which is based on data collected. Each of the piezometers and wells did not necessarily exhibit their highest measured water level to date during the same month. Therefore, as a conservative approach for design purposes, the ground-water contours on this map were established using the highest measured data from each of the piezometers and wells at the site between December 2004 and June 2005.

3.5.4 Man-made Influences to Ground-Water Levels

The existing landfill is being developed in the upland area east of the proposed expansion area. As cell construction proceeds to the expansion area, ground water infiltration and recharge of the water table will be limited, resulting in lower ground-water levels.

3.5.5 Hydraulic Coefficients and Ground-Water Flow Velocity

3.5.5.1 Hydraulic Conductivity

Hydraulic conductivity is defined as the ability of the aquifer material to conduct water under a hydraulic gradient. Four slug tests were performed in the study area during June 2005 to measure the *in situ* hydraulic conductivity of the different zones of the water-table aquifer. The slug test results were evaluated using the Bouwer and Rice Method for partially-penetrating wells in an unconfined aquifer.

Two slug tests were performed in piezometers installed in the residual soil zone (BLE-7ab and BLE-10ab); one slug test was performed in a piezometer installed in the partially weathered rock (BLE-8b); and one slug test was performed in a bedrock piezometer (BLE-11c). The hydraulic conductivity values ranged from 3.3×10^{-4} cm/sec in piezometer BLE-10ab to 1.5×10^{-6} cm/sec in piezometer BLE-11c. The geometric mean hydraulic conductivity is approximately 7.4×10^{-5} cm/sec. The results of the tests are provided in Appendix G and summarized on Table 5.

3.5.5.2 Hydraulic Gradient

The hydraulic gradient is determined by dividing the difference in ground-water elevations at two locations by the horizontal distance between those locations along the direction of ground-water flow. Hydraulic gradients were measured from the May 19, 2005 water table contour map (Figure 6). The steepest hydraulic gradient measured in the study area is about 0.15, which is located in the central portion of the study area between BLE-10ab and BLE-13c. The shallowest gradient in the study area is about 0.047, which is located along the topographic ravine west of the study area. The geometric mean hydraulic gradient is approximately 0.085.

3.5.5.3 Effective Porosity and Specific Yield

Effective porosity is the volume of void spaces through which water or other fluids can travel in a rock or sediment divided by the total volume of the rock or sediment. Effective porosity can be assumed to be approximately equal to specific yield for unconfined (water-table) aquifers. Specific yield is defined as the ratio of the volume of water that drains from a saturated rock owing to the attraction of gravity to the total volume of rock.

Specific yield measurements in the study area within the water bearing zone were measured at an average of 24.6 percent in the slightly micaceous silty sands (Table 3, deeper residual soil and partially weathered rock units). The effective porosity can be expected to range from about 5 to 10 percent for fractured crystalline bedrock (Kruseman and deRidder, 1989). The geometric mean effective porosity is between the soil units (24.6 percent) and the bedrock unit (7.5 percent) is approximately 0.136 percent.

3.5.5.4 Ground-Water Flow Velocity

The velocity of ground-water movement (V) is a function of existing hydraulic gradient (i), the hydraulic conductivity (K) and the effective porosity (n_e), in the equation $V = Ki/n_e$.

Based on these parameters and the data provided above, the estimated geometric mean horizontal ground-water flow velocity is approximately 0.13 feet/day. Table 6 summarizes the ground-water flow velocity calculations.

3.5.6 Vertical Flow Gradients

Vertical flow gradients were evaluated at the site by installing a piezometer pair (BLE-10ab/BLE-10c) located in the upper reaches of the westward trending topographic draw in the central portion of the propose cell area. Based on water level measurements in the piezometers, ground water has a downward (recharging) gradient. Based on the site topography, this vertical gradient is typical for an unconfined aquifer in the Blue Ridge. Ground-water recharge was measured in the upland areas in BLE-10ab/BLE-10c. Ground-water discharge occurs to the perennial stream west of the proposed cell area. Table 7 summarizes the vertical gradient calculations.

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4.0 CONCLUSIONS

The purpose of this evaluation was to characterize the geologic and hydrogeologic conditions of the proposed 5-acre Unit 2 C&D waste landfill expansion area, as required by the North Carolina Department of Environment and Natural Resources, Division of Waste Management, Rule T15 NCAC 13B .0504(1)(c). This report will be incorporated into the "Permit to Construct" submittal package for the new C&D waste disposal area prepared by McGill Associates.

The site is regionally located within the Blue Ridge Physiographic Province, which is characterized by high-grade metamorphosed sedimentary and igneous rocks that have been exposed to multiple Proterozoic and Paleozoic deformations. Rock types in the vicinity of the site that resulted from the multiple metamorphisms include gneiss, schist, and amphibolite with northeast/southwest trending foliation and varying degrees of dip. Quaternary-age sediments fill the stream valleys.

The geologic conditions encountered while drilling were variable with boulders and seams of partially weathered rock occurring throughout the subsurface soil overburden profile. The soil overburden ranges in thickness from 8 to 70 feet. In general, four zones were encountered: 1) alluvium, 2) residual soils from weathered bedrock, 3) partially weathered rock, and 4) fractured bedrock. The alluvium consists of clayey silt (ML) and silty clay (CH). The residual soils are subdivided into two (upper and lower) components. The upper soil component consists of very stiff, slightly micaceous silty clay (CL), sandy clayey silt (ML, MH), and clayey sand (SC). The upper soil component grades with depth into a lower soil component that is coarser grained, less plastic, dense, slightly micaceous sandy silt (ML) and silty sand (SM) and extends to the depth of the partially weathered rock. The partially weathered rock consists of slightly micaceous fine-to-coarse sandy silt and silty fine-to-coarse sand with varying amounts of gravel size rock fragments. The underlying bedrock consists of moderately weathered to fresh, moderately hard to very hard, coarse-grained, amphibole gneiss with steeply-dipping, well-developed foliation, and very closely to widely spaced fractures generally parallel the foliation.

Ground water is present *above* the bedrock surface in the lower elevation areas of the study area where ground water is about 4 feet below the ground surface, and *below* the bedrock surface in higher elevation areas where ground water is about 47 feet below ground surface. The unconfined water-table aquifer consists of the residual soil, partially weathered rock, and fractured bedrock. These three units are hydraulically connected and thus comprise a single unconfined aquifer. Generally, shallow ground water flows to the west from recharge areas in the upland locations, and discharges to the perennial stream at the expansion area's western border.

A detection monitoring system can be designed for the proposed C&D landfill unit based on the characteristics of the site aquifer and the applicable North Carolina Rules. Ground-water monitoring would be effective in areas of convergent ground-water flow between the proposed landfill and the on-site perennial stream.

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TABLE 1

PIEZOMETER/BORING SURVEY INFORMATION

Proposed C&D Waste Area - Unit 2
Madison County, North Carolina
BLE Project Number J04-2225-04

Piezometer	Ground Elevation	TOC Elevation	Easting	Northing
BLE-6b	1967.51	1971.23	897,340.05	769,980.26
BLE-7ab	1944.17	1947.36	896,942.10	769,880.73
BLE-8b	1956.14	1959.66	897,133.67	769,609.95
BLE-9c	2007.43	2010.69	897,534.36	769,466.10
BLE-10ab	1955.21	1959.21	897,556.55	769,728.00
BLE-10c	1955.27	1958.51	897,556.05	769,736.50
BLE-11c	1991.47	1994.78	897,652.28	769,992.11
BLE-12a	1981.13	1983.01	897,817.79	769,932.98
BLE-12c	1981.13	1984.33	897,820.76	769,933.19
BLE-13c	2013.05	2016.32	897,806.81	769,485.01
B-7	1976.34	1978.37	897,796.38	769,743.04
B-8	1929.55	1931.95	896,956.96	769,714.64
B-13	1988.60	1989.47	897,230.94	770,128.93
B-15	1923.66	1925.39	896,835.41	769,710.42
MW-1	1856.50	1859.04	895,595.00	772,075.00
MW-2	1898.49	1898.73	896,482.69	770,624.08
MW-3	1921.53	1923.38	896,846.70	770,599.46
MW-4	1921.84	1923.61	896,862.30	770,576.51
MW-5	1970.94	1972.49	897,155.39	770,362.41
MW-6	2080.39	2082.49	897,918.72	770,424.45
MW-7	1915.36	1917.59	U	U
MW-7R	1916.63	1919.34	896,402.71	771,023.47
MW-8	1897.32	1899.92	896,154.53	771,334.74

NOTES:

1. Measurements are in feet; elevations are relative to mean sea level
2. Surveying was performed by McGill Associates of Asheville, NC
3. "BLE- " = Piezometers installed by BLE; all other borings, piezometers, and wells were performed by others.
4. TOC = Top Of Casing
5. The **bold piezometers** are in the vicinity of the Unit 2 C&D area.

TABLE 2

PIEZOMETER CONSTRUCTION DETAILS

Proposed C&D Waste Area - Unit 2
Madison County, North Carolina
BLE Project Number J04-2225-04

Piezometer	Ground Elev.	TOC Elev.	Top of Rock Depth	Top of Rock Elevation	Well Depth	Screened Interval Depth	Screened Interval Elvation
BLE-6b	1967.51	1971.23	39.20	1928.31	39.20	28.90 - 38.90	1938.61 - 1928.61
BLE-7ab	1944.17	1947.36	31.05	1913.12	31.05	20.75 - 30.75	1923.42 - 1913.42
BLE-8b	1956.14	1959.66	>40.00	<1916.14	38.90	28.60 - 38.60	1927.54 - 1917.54
BLE-9c	2007.43	2010.69	35.00	1972.43	54.90	44.90 - 54.90	1962.53 - 1952.53
BLE-10ab	1955.21	1959.21	21.30	1933.91	21.30	11.00 - 21.00	1944.21 - 1934.21
BLE-10c	1955.27	1958.51	20.10	1935.17	39.45	29.15 - 39.15	1926.12 - 1916.12
BLE-11c	1991.47	1994.78	34.00	1957.47	49.60	39.60 - 49.60	1951.87 - 1941.87
BLE-12a	1981.13	1983.01	>12.50	-	6.25	3.25 - 6.25	1977.88 - 1974.88
BLE-12c	1981.13	1984.33	12.50	1968.63	30.17	20.17 - 30.17	1960.96 - 1950.96
BLE-13c	2013.05	2016.32	22.00	1991.05	40.15	29.85 - 39.85	1983.20 - 1973.20
B-7	1976.34	1978.37	20.00	1956.34	18.00	8.00 - 18.00	1968.34 - 1958.34
B-8	1929.55	1931.95	40.00	1889.55	17.10	7.10 - 17.10	1922.45 - 1912.45
B-13	1988.60	1989.47	70.00	1918.60	79.00	69.00 - 79.00	1919.60 - 1909.60
B-15	1923.66	1925.39	>8.00	<1915.66	8.00	3.00 - 8.00	1920.66 - 1915.66
MW-1	1856.50	1859.04	NS	-	17.00	2.00 - 17.00	1854.50 - 1839.50
MW-2	1898.49	1898.73	NS	-	16.00	1.00 - 16.00	1897.49 - 1882.49
MW-3	1921.53	1923.38	NS	-	25.00	10.00 - 25.00	1911.53 - 1896.53
MW-4	1921.84	1923.61	57.00	1864.84	71.50	61.50 - 71.50	1860.34 - 1850.34
MW-5	1970.94	1972.49	NS	-	61.50	46.50 - 61.50	1924.44 - 1909.44
MW-6	2080.39	2082.49	NS	-	100.00	80.00 - 100.00	2000.39 - 1980.39
MW-7	1915.36	1917.59	NS	-	30.00	15.00 - 30.00	1900.36 - 1885.36
MW-7R	1916.63	1919.34	>41.40	<1875.23	41.40	26.10 - 41.10	1890.53 - 1875.53
MW-8	1897.32	1899.92	>26.60	<1870.72	26.60	16.30 - 26.30	1881.02 - 1871.02

NOTES:

1. Measurements are in feet; elevations are relative to mean sea level
2. "BLE- " = Piezometers installed by BLE; all other borings, piezometers, and wells were performed by others.
3. NS = Not specified on the boring logs or strata noted as rock was most likely PWR.
4. The **bold piezometers** are in the vicinity of the Unit 2 C&D area.

TABLE 3

SUMMARY OF LABORATORY RESULTS

Proposed C&D Waste Area - Unit 2
Madison County, North Carolina
BLE Project Number J04-2225-04

Boring	Split Spoon Depth (ft)	UD Sample Depth (ft)	Bag Sample Depth (ft)	Soil Unit	Nat. Moisture Content (%)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Standard Proctor Opt. Moisture Content (%)	Standard Proctor Max. Dry Density (pcf)	Remolded Permeability Conditions Pressure Gradient (PSI)	Moisture Content %	Moisture Content % Wet of Opt.	Dry Density (pcf)	Dry Density % of MDD	Hydraulic Cond. (cm/sec)	In-Situ Hydraulic Cond. (cm/sec)	Total Porosity (%)	Effective Porosity (%)	Grain Size (% by wt) Gravel	Grain Size (% by wt) Sand	Grain Size (% by wt) Silt	Grain Size (% by wt) Clay	Grain Size (% by wt) % Fines	USCS
BLE-6	3.5 - 5.0	-	-	Upper	28.1%	58	36	22	-	-	-	-	-	-	-	-	-	*52.0%*	1.5%	0.0%	17.6%	33.7%	48.7%	82.4%	MH
BLE-6	-	23.5 - 25.5	-	Deeper	39.8%	42	37	5	-	-	-	-	-	-	-	-	2.3E-04	54.1%	22.0%	0.0%	45.2%	53.9%	0.9%	54.8%	ML
BLE-6	33.5 - 35.0	-	-	PWR	17.0%	32	27	5	-	-	-	-	-	-	-	-	-	*53.5%*	22.5%	0.0%	50.2%	44.5%	5.3%	49.8%	SM
BLE-7	-	8.0 - 10.0	-	Deeper	34.7%	46	39	7	-	-	-	-	-	-	-	-	3.7E-05	58.5%	20.0%	0.0%	42.6%	51.5%	5.9%	57.4%	ML
BLE-8	23.5 - 25.0	-	-	Deeper	21.8%	38	32	6	-	-	-	-	-	-	-	-	-	*50%*	25.0%	3.2%	60.3%	32.6%	3.9%	36.5%	SM
BLE-8	33.5 - 35.0	-	-	PWR	11.6%	33	27	6	-	-	-	-	-	-	-	-	-	*50.0%*	26%	3.0%	61.7%	31.7%	3.6%	35.3%	SM
BLE-9	3.5 - 5.0	-	-	Upper	50.0%	61	48	13	-	-	-	-	-	-	-	-	-	*53.0%*	0.7%	0.0%	13.8%	58.8%	27.4%	86.2%	MH
BLE-9	-	18.0 - 20.0	-	Deeper	20.2%	45	41	4	-	-	-	-	-	-	-	-	6.9E-04	51%	27.0%	0.0%	57.3%	40.8%	1.9%	42.7%	SM
BLE-10	3.5 - 5.0	-	-	Alluvium	44.1%	92	38	54	-	-	-	-	-	-	-	-	-	*53.0%*	0.7%	0.0%	8.8%	28.0%	63.2%	91.2%	CH
BLE-10	18.0 - 20.0	-	-	PWR	13.8%	28	23	5	-	-	-	-	-	-	-	-	-	*47.5%*	30.0%	15.6%	60.8%	21.7%	1.9%	23.6%	SM
BLE-11	-	-	1.0 - 10.0	Upper	27.8%	46	37	9	20.0%	105.2	10	25.1%	5.1%	100.0	95.1%	2.0E-07	-	*54.0%*	17.5%	0.0%	39.3%	50.3%	10.4%	60.7%	ML
BLE-12	-	8.5 - 10.5	-	Alluvium	38.4%	70	27	43	-	-	-	-	-	-	-	-	3.7E-08	52.8%	0.7%	0.0%	10.4%	26.5%	63.1%	89.6%	CH
BLE-13	-	-	1.0 - 10.0	Upper	43.9%	74	45	29	28.8%	89.2	10	33.8%	5.0%	85	95.3%	1.2E-07	-	*51.5%*	2.9%	2.6%	23.9%	34.8%	38.7%	73.5%	MH

NOTES:

1. USCS = Unified Soil Classification System
2. NP = Not Plastic
3. NV = Not Viscous
4. PWR = Partially Weathered Rock
5. Effective Porosity (Specific Yield) is based on grain size analyses and Figure 4.11 (Fetter, 1988)
6. Total Porosity values in *italic case* are based on grain size analyses (Rawls and Brankensiek, 1989). Other values are based on laboratory tests.

Prepared By: MSP
Checked By: RAM

TABLE 4

GROUND-WATER DEPTH & ELEVATION DATA
Proposed C&D Waste Area - Unit 2
Madison County, North Carolina
BLE Project Number J04-2225-04

Piezometer/ Well	Ground Elevation	TOC Elevation	Ground-Water Elevation Data									Maximum Elevation	Minimum Elevation	Head Difference
			TOB	24-hr	12/1/04	1/18/05	2/25/05	3/28/05	4/21/05	5/19/05	6/29/05			
BLE-6b	1967.51	1971.23	1946.07	1945.81	1946.12	1946.30	1946.37	1946.41	**1946.45**	1946.29	1945.59	1946.45	1945.59	0.86
BLE-7ab	1944.17	1947.36	1921.39	1921.62	1921.58	1921.81	1921.79	1922.05	1922.21	**1922.40**	1921.71	1922.40	1921.58	0.82
BLE-8b	1956.14	1959.66	1935.44	1935.64	1935.76	1936.06	1936.11	1936.38	1936.42	**1936.48**	1935.79	1936.48	1935.76	0.72
BLE-9c	2007.43	2010.69	1962.23	NM	1959.08	1959.37	1959.45	1959.99	**1960.25**	1960.20	1959.54	1960.25	1959.08	1.17
BLE-10ab	1955.21	1959.21	1949.58	1950.91	1951.99	1952.08	1952.14	**1952.52**	1952.19	1951.37	1950.19	1952.52	1950.19	2.33
BLE-10c	1955.27	1958.51	1952.02	1951.02	1950.99	**1951.01**	1950.99	1950.93	1951.00	1950.93	1950.91	1951.01	1950.91	0.10
BLE-11c	1991.47	1994.78	1974.47	1962.82	1962.81	1962.80	1962.63	1963.02	**1963.35**	1963.25	1962.40	1963.35	1962.40	0.95
BLE-12a	1981.13	1983.01	Dry	1975.21	NP	NP	NP	NP	1975.21	**1978.81**	1976.13	1978.81	1975.21	3.60
BLE-12c	1981.13	1984.33	NM	1978.18	**1984.10**	NM	**1984.10**	**1984.10**	1984.10	1984.09	1984.09	1984.10	1984.09	0.01
BLE-13c	2013.05	2016.32	2001.40	1993.40	1994.58	1995.77	1996.96	1996.92	**1997.21**	1995.94	1995.24	1997.21	1994.58	2.63
B-7	1976.34	1978.37	NM	1965.24	1971.58	1973.46	**1975.03**	1975.02	1972.56	1970.41	NM	1975.03	1970.41	4.62
B-8	1929.55	1931.95	NM	1924.95	NM	1928.76	1928.83	**1929.13**	1928.97	1929.06	1928.36	1929.13	1928.36	0.77
B-13	1988.60	1989.47	NM	1937.40	1938.93	1939.07	1939.13	1939.39	1939.42	**1939.55**	1939.46	1939.55	1938.93	0.62
B-15	1923.66	1925.39	NM	1917.56	NM	**1923.99**	NM	1920.18	1920.23	1920.26	1919.78	1923.99	1919.78	4.21
MW-1	1856.50	1859.04	NA	NA	NM	NM	1853.76	**1853.95**	1853.57	1853.05	NM	1853.95	1853.05	0.90
MW-2	1898.49	1898.73	NA	NA	1895.31	1894.86	1895.20	**1895.71**	1894.64	1890.99	1893.64	1895.71	1890.99	4.72
MW-3	1921.53	1923.38	NA	NA	NM	1910.88	1911.22	**1911.30**	1910.77	1909.73	1908.47	1911.30	1908.47	2.83
MW-4	1921.84	1923.61	NA	NA	1908.12	1908.18	1908.24	**1908.42**	1908.13	1908.02	1907.40	1908.42	1907.40	1.02
MW-5	1970.94	1972.49	NA	NA	1924.56	1924.75	1924.90	1925.17	1925.21	1925.48	**1925.69**	1925.69	1924.56	1.13
MW-6	2080.39	2082.49	NA	NA	**1994.72**	1992.50	1989.28	NM	1991.42	1993.56	1992.04	1994.72	1989.28	5.44
MW-7	1915.36	1917.59	NA	NA	NM	1892.73	1892.84	1893.13	1893.38	**1893.40**	1892.97	1893.40	1892.73	0.67
MW-7R	1916.63	1919.34	1887.63	1889.65	NM	1889.91	1889.97	1890.23	1890.21	1890.22	**1890.24**	1890.24	1889.91	0.33
MW-8	1897.32	1899.92	1878.32	1880.81	NM	1880.11	**1880.26**	1879.86	1879.63	1879.68	1879.23	1880.26	1879.23	1.03

Piezometer/ Well	Ground Elevation	TOC Elevation	Depth to Water Below Ground Surface								
			TOB	24-hr	12/1/04	1/18/05	2/25/05	3/28/05	4/21/05	5/19/05	6/29/05
BLE-6b	1967.51	1971.23	21.44	21.70	21.39	21.21	21.14	21.10	21.06	21.22	21.92
BLE-7ab	1944.17	1947.36	22.78	22.55	22.59	22.36	22.38	22.12	21.96	21.77	22.46
BLE-8b	1956.14	1959.66	20.70	20.50	20.38	20.08	20.03	19.76	19.72	19.66	20.35
BLE-9c	2007.43	2010.69	45.20	NM	48.35	48.06	47.98	47.44	47.18	47.23	47.89
BLE-10ab	1955.21	1959.21	5.63	4.30	3.22	3.13	3.07	2.69	3.02	3.84	5.02
BLE-10c	1955.27	1958.51	3.25	4.25	4.28	4.26	4.28	4.34	4.27	4.34	4.36
BLE-11c	1991.47	1994.78	17.00	28.65	28.66	28.67	28.84	28.45	28.12	28.22	29.07
BLE-12c	1981.13	1984.33	NM	2.95	-2.97	NM	-2.97	-2.97	-2.97	-2.95	-2.95
BLE-13c	2013.05	2016.32	11.65	19.65	18.47	17.28	16.09	16.13	15.84	17.11	17.81
B-7	1976.34	1978.37	NM	11.10	4.76	2.88	1.31	1.32	3.78	5.93	NM
B-8	1929.55	1931.95	NM	4.60	NM	0.79	0.72	0.42	0.58	0.49	1.19
B-13	1988.60	1989.47	NM	51.20	49.67	49.53	49.47	49.21	49.18	49.05	49.14
B-15	1923.66	1925.39	NM	6.10	NM	-0.33	NM	3.48	3.43	3.40	3.88
MW-1	1856.50	1859.04	NA	NA	NM	NM	2.74	2.55	2.93	3.45	NM
MW-2	1898.49	1898.73	NA	NA	3.18	3.63	3.29	2.78	3.85	7.50	4.85
MW-3	1921.53	1923.38	NA	NA	NM	10.65	10.31	10.23	10.76	11.80	13.06
MW-4	1921.84	1923.61	NA	NA	13.72	13.66	13.60	13.42	13.71	13.82	14.44
MW-5	1970.94	1972.49	NA	NA	46.38	46.19	46.04	45.77	45.73	45.46	45.25
MW-6	2080.39	2082.49	NA	NA	85.67	87.89	91.11	NM	88.97	86.83	88.35
MW-7	1915.36	1917.59	NA	NA	NM	22.63	22.52	22.23	21.98	21.96	22.39
MW-7R	1916.63	1919.34	29.00	26.98	NM	26.72	26.66	26.40	26.42	26.41	26.39
MW-8	1897.32	1899.92	19.00	16.51	NM	17.21	17.06	17.46	17.69	17.64	18.09

NOTES:

1. Elevations are in FEET above mean sea level (MSL); depths are in FEET.
2. TOC = *Top Of Casing*
3. NM = *Not Measured*
4. NP = *Not Present*
5. NA = information *Not Available* to BLE
6. **Bold water levels** represent the highest water level measurement in each piezometer.
7. The **bold piezometers** are in the vicinity of the Unit 2 C&D area.

TABLE 5

SUMMARY OF IN-SITU HYDRAULIC TESTING - SLUG TEST RESULTS

Proposed C&D Waste Area - Unit 2
Madison County, North Carolina
BLE Project Number J04-2225-04

Piezometer	Method	Data Type	Soil Class	Hydraulic Conductivity		
				ft/min	cm/sec	ft/day
BLE-7ab	Bouwer & Rice	Rising	Residuum - mic. silty SAND (SM)	4.94E-04	2.51E-04	7.11E-01
BLE-8b	Bouwer & Rice	Falling	PWR - silty SAND (SM)	4.72E-04	2.40E-04	6.80E-01
BLE-10ab	Bouwer & Rice	Falling	Residuum - mic. Sandy SILT (ML)	6.46E-04	3.28E-04	9.31E-01
BLE-11c	Bouwer & Rice	Falling	Bedrock - Gneiss	2.98E-06	1.51E-06	4.29E-03
Maximum Hydraulic Conductivity				6.46E-04	3.28E-04	9.31E-01
Geometric Mean Hydraulic Conductivity				1.46E-04	7.39E-05	2.10E-01
Minimum Hydraulic Conductivity				2.98E-06	1.51E-06	4.29E-03

NOTES:
The slug test were performed by BLE on June 29-30, 2005

TABLE 6

INTERSTITIAL GROUND-WATER VELOCITY CALCULATIONS

Proposed C&D Waste Area - Unit 2
Madison County, North Carolina
BLE Project Number J04-2225-04

VELOCITY CALCULATION	Hydraulic Conductivity (K) (feet per day)	Hydraulic Gradient (i) (unitless)	Effective Porosity (n_e) (unitless)	Ground-Water Velocity (V) (feet per day)
Geometric mean velocity	0.210	0.085	0.136	0.13

Notes:

1. Hydraulic conductivity values from slug tests (Table 6).
2. Effective porosity estimated from specific yield as described by Fetter (1988).
3. Hydraulic gradients are based on ground-water surface measurements collected on May 19, 2005 and Figure 6.
4. Velocity Equation: $V = Ki/n_e$

TABLE 7

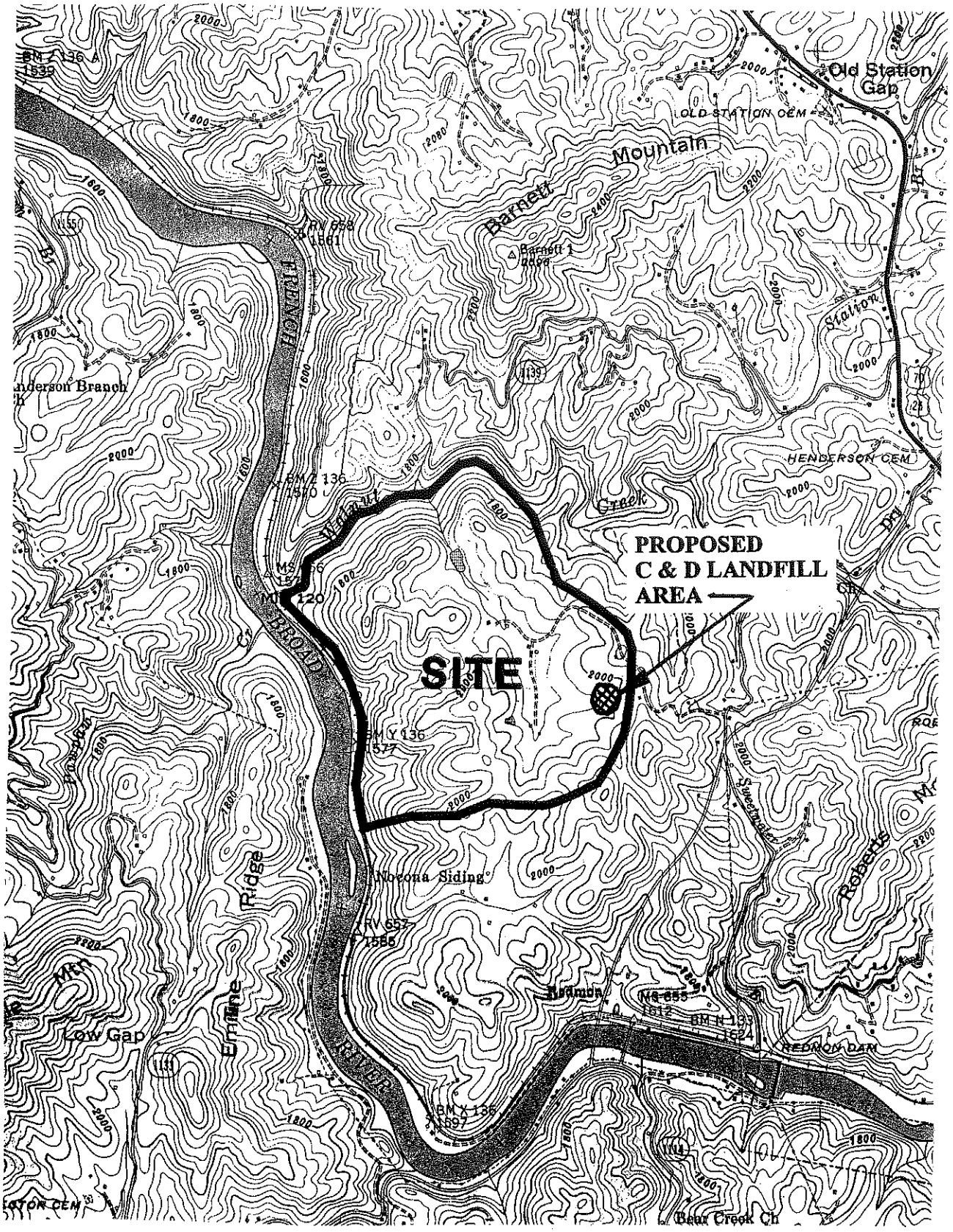
VERTICAL HYDRAULIC GRADIENTS AND FLOW RATES
Proposed C&D Waste Area - Unit 2
Madison County, North Carolina
BLE Project Number J04-2225-04

Well Pairs	Ground Elev. (ft)	TOC Elev. (ft)	Ground Elevation Difference (ft)	Horizontal Distance Between Wells (ft)	Midpoint Screen Elev. (ft)	Vertical Separation Between Well Screens (ft)	5/19/2005		Vertical Hydraulic Gradient (i)	Geometric Mean Hydraulic Conductivity (ft/day)	Geometric Mean Effective Porosity (n_e)	Vertical Flow Velocity (ft/day)	Direction
							Water Elev. (ft)	Head Difference (ft)					
BLE-10ab	1955.21	1959.21	0.06		1939.21	18.09	1951.37	0.44	0.0243228	0.210	0.136	0.038	Recharge
BLE-10c	1955.27	1958.51			1921.12		1950.93						

Notes:

1. Water level elevations measured on May 19, 2005.
2. Hydraulic conductivity values are from Table 5 and effective porosity values are from Table 3.
3. Negitive (-) gradients and velocities indicate an upward (discharge) flow direction.
4. Positive (+) gradients and velocities indicate a downward (recharge) flow direction.
5. Velocity Equation: $V = Ki/n_e$

Prepared By: MSP
Checked By: RAM



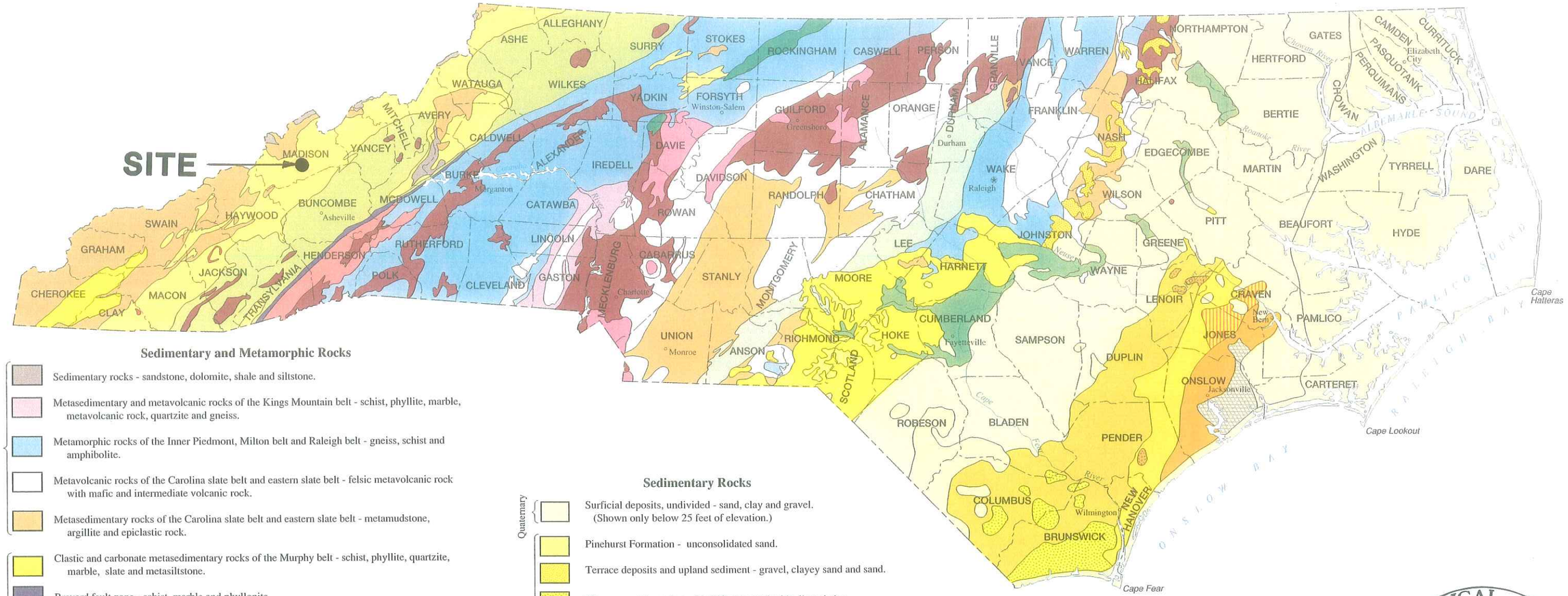
2000 1000 0 2000 4000

APPROXIMATE SCALE IN FEET

REFERENCE:
USGS TOPOGRAPHIC MAP, 7.5 MINUTE SERIES,
MARSHALL, N.C. QUADRANGLE, PHOTOREVISED 1978.

DRAWN: AEH	DATE: 07-22-05	BLE INC. BUNNELL-LAMMONS ENGINEERING, INC. 6004 PONDERS COURT GREENVILLE, SOUTH CAROLINA 29615 PHONE: (864)288-1265 FAX: (864)288-4430	SITE LOCATION MAP MADISON COUNTY C & D LANDFILL MADISON COUNTY, NORTH CAROLINA	FIGURE 1
CHECKED: MSP	CAD: MADISON04-SLM			
APPROVED:	JOB NO: J04-2225-04			

GENERALIZED GEOLOGIC MAP OF NORTH CAROLINA



Sedimentary and Metamorphic Rocks

Late Proterozoic to Early Paleozoic

- Sedimentary rocks - sandstone, dolomite, shale and siltstone.
- Metasedimentary and metavolcanic rocks of the Kings Mountain belt - schist, phyllite, marble, metavolcanic rock, quartzite and gneiss.
- Metamorphic rocks of the Inner Piedmont, Milton belt and Raleigh belt - gneiss, schist and amphibolite.
- Metavolcanic rocks of the Carolina slate belt and eastern slate belt - felsic metavolcanic rock with mafic and intermediate volcanic rock.
- Metasedimentary rocks of the Carolina slate belt and eastern slate belt - metamudstone, argillite and epiclastic rock.

Late Proterozoic

- Clastic and carbonate metasedimentary rocks of the Murphy belt - schist, phyllite, quartzite, marble, slate and metasiltstone.
- Brevard fault zone - schist, marble and phyllonite.
- Clastic metasedimentary and metavolcanic rocks of the Ocoee Supergroup, Grandfather Mountain Formation, Mount Rogers Formation and quartzite of the Sauratown Mountains anticlinorium - slate, metasiltstone, schist, metagraywacke, calc-silicate granofels, quartzite and felsic metavolcanic rock.
- Clastic metasedimentary rock and mafic and felsic metavolcanic rock of the Ashe Metamorphic Suite, Tallulah Falls Formation and Alligator Back Formation - gneiss, schist, metagraywacke, amphibolite and calc-silicate granofels.

Middle Proterozoic

- Felsic gneiss derived from sedimentary and igneous rocks in the northern outcrop area; biotite gneiss in the southern outcrop area; locally migmatitic and mylonitic. Locally and variably interlayered with amphibolite, calc-silicate granofels and rare marble. Intruded by Late Proterozoic mafic and felsic plutons.

Intrusive Rocks

Middle Paleozoic to Late Paleozoic

- Granitic rocks - unfoliated to weakly foliated.
- Syenite - Concord ring dike.

Late Proterozoic to Middle Paleozoic

- Metamorphosed gabbro and diorite - foliated to weakly foliated.
- Metamorphosed granitic rocks - foliated to weakly foliated; locally migmatitic.
- Henderson Gneiss - uneven-grained monzonitic to granodioritic.
- Meta-ultramafic rocks.

Sedimentary Rocks

Quaternary

- Surficial deposits, undivided - sand, clay and gravel. (Shown only below 25 feet of elevation.)

Tertiary

- Pinehurst Formation - unconsolidated sand.
- Terrace deposits and upland sediment - gravel, clayey sand and sand.
- Waccamaw Formation - fossiliferous sand with silt and clay.
- Yorktown Formation and Duplin Formation, undivided -
  - Yorktown Formation- fossiliferous clay and sand.
  - Duplin Formation- shelly sand, sandy marl and limestone.
- Belgrade Formation, undivided -
  - Pollocksville Member- oyster-shell mounds in sand matrix.
  - Haywood Landing Member- fossiliferous clayey sand.
- River Bend Formation - sandy, molluscan-mold limestone.
- Castle Hayne Formation -
  - Spring Garden Member- molluscan-mold limestone.
- Comfort Member and New Hanover Member, undivided -
  - Comfort Member - limestone with bryozoan and echinoid skeletons.
  - New Hanover Member - phosphate-pebble conglomerate.
- Beaufort Formation, undivided -
  - Unnamed upper member - glauconitic, fossiliferous sand and silty clay.
  - Jericho Run Member - siliceous mudstone with sandstone lenses.

Cretaceous

- Peedee Formation - marine sand, clayey sand and clay.
- Black Creek Formation - lignitic sand and clay.
- Middendorf Formation - sand, sandstone and clay.
- Cape Fear Formation - sandstone and sandy mudstone.

Triassic

- Dan River Group, undivided -
  - Stoneville Formation - conglomerate, sandstone and mudstone.
  - Cow Branch Formation - mudstone.
  - Pine Hall Formation - sandstone, mudstone and conglomerate.
- Chatham Group, undivided -
  - Sanford Formation - conglomerate, sandstone and mudstone.
  - Cumnock Formation.- sandstone and mudstone.
  - Pekin Formation - conglomerate, sandstone and mudstone.

50 Miles

GEOLOGICAL SURVEY N.C. 1823

1991

FIGURE 2

Physiography

North Carolina can be divided into three physiographic provinces, the Coastal Plain, the Piedmont and the Blue Ridge. Each province is characterized by particular types of landforms.

The Coastal Plain is characterized by flat land to gently rolling hills and valleys. Elevations range from sea level near the coast to about 600 feet in the Sand Hills of the southern Inner Coastal Plain.

The Piedmont Province lies between the Coastal Plain and the Blue Ridge Mountains. The Piedmont occupies about 45 percent of the area of the state. Along the border between the Piedmont and the Coastal Plain, elevations range from 300 to 600 feet above sea level. To the west, elevations gradually rise to about 1,500 feet above sea level at the foot of the Blue Ridge. The Piedmont is characterized by gently rolling, well rounded hills and long low ridges with a few hundred feet of elevation difference between the hills and valleys. The Piedmont includes some relatively low mountains including the South Mountains and the Uwharrie Mountains.

The Blue Ridge is a deeply dissected mountainous area of numerous steep mountain ridges, intermontane basins and trench valleys that intersect at all angles and give the area its rugged mountain character. The Blue Ridge contains the highest elevations and the most rugged topography in the Appalachian Mountain system of eastern North America. The North Carolina portion of the Blue Ridge is about 200 hundred miles long and ranges from 15 to 55 miles wide. It contains an area of about 6,000 square miles, or about 10 percent of the area of the state.

Within North Carolina, 43 peaks exceed 6,000 feet in elevation and 82 peaks are between 5,000 and 6,000 feet. On the west, the Great Smoky Mountains is the dominant range with several peaks that reach more than 6000 feet. On the eastern side of the North Carolina Blue Ridge, the highest range is the Black Mountains which extend for some 15 miles and contain a dozen peaks that exceed 6,000 feet in elevation. This group includes Mount Mitchell. At an elevation of 6,684 feet, it is the highest peak of eastern North America. Other prominent ranges from northeast to southwest are the Pisgah Mountains, Newfound Mountains, Balsam Mountains, Cowee Mountains, Nantahala Mountains, Snowbird Mountains and the Valley River Mountains.

Geology

Three major classes of rocks common to North Carolina are igneous, metamorphic and sedimentary. North Carolina has a long and complex geologic history. Although much remains to be learned, detailed geologic studies provide a general understanding of regional geological relationships. The state is best described in terms of geological belts; that is, areas with similar rock types and geologic history.

Blue Ridge Belt: This mountainous region is composed of rocks from over one billion to about one-half billion years old. This complex mixture of igneous, sedimentary and metamorphic rock has repeatedly been squeezed, fractured, faulted and twisted into folds. The Blue Ridge belt is well known for its deposits of feldspar, mica and quartz–basic materials used in the ceramic, paint and electronic industries. Olivine is mined for use as refractory material and foundry molding sand.

Inner Piedmont Belt: The Inner Piedmont belt is the most intensely deformed and metamorphosed segment of the Piedmont. The metamorphic rocks range from 500 to 750 million years in age. They include gneiss and schist that have been intruded by younger granitic rocks. The northeast-trending Brevard fault zone forms much of the boundary between the Blue Ridge and Inner Piedmont belts. Although this zone of strongly deformed rocks is one of the major structural features in the southern Appalachians, its origin is poorly understood. Crushed stone for road aggregate and building construction is the principal commodity produced.

Kings Mountain Belt: The belt consists of moderately deformed and metamorphosed volcanic and sedimentary rocks. The rocks are about 400-500 million yearls old. Lithium deposits here provide raw materials for chemical compounds, ceramics, glass, greases, batteries and TV glass.

Milton Belt: This belt consists of gneiss, schist and metamorphosed intrusive rocks. The principal mineral resource is crushed stone for road aggregate and for building construction.

Charlotte Belt: The belt consists mostly of igneous rocks such as granite, diorite and gabbro. These are 300-500 million years old. The igneous rocks are good sources for crushed and dimension stone for road aggregate and buildings.

Carolina Slate Belt: This belt consists of heated and deformed volcanic and sedimentary rocks. It was the site of a series of oceanic volcanic islands about 550-650 million years ago. This belt is known for its numerous abandoned gold mines and prospects. North Carolina led the nation in gold production before the California Gold Rush of 1849. In recent decades, only minor gold mining has taken place, but mining companies continue to show interest in the area. Mineral production is crushed stone for road aggregate and pyrophyllite for refractories, ceramics, filler, paint and insecticide carriers.

Triassic Basins: The basins are filled with sedimentary rocks that formed about 200-190 million years ago. Streams carried mud, silt, sand and gravel from adjacent highlands into rift valleys similar to those of Africa today. The mudstones are mined and processed to make brick, sewer pipe, structural tile and drain tile.

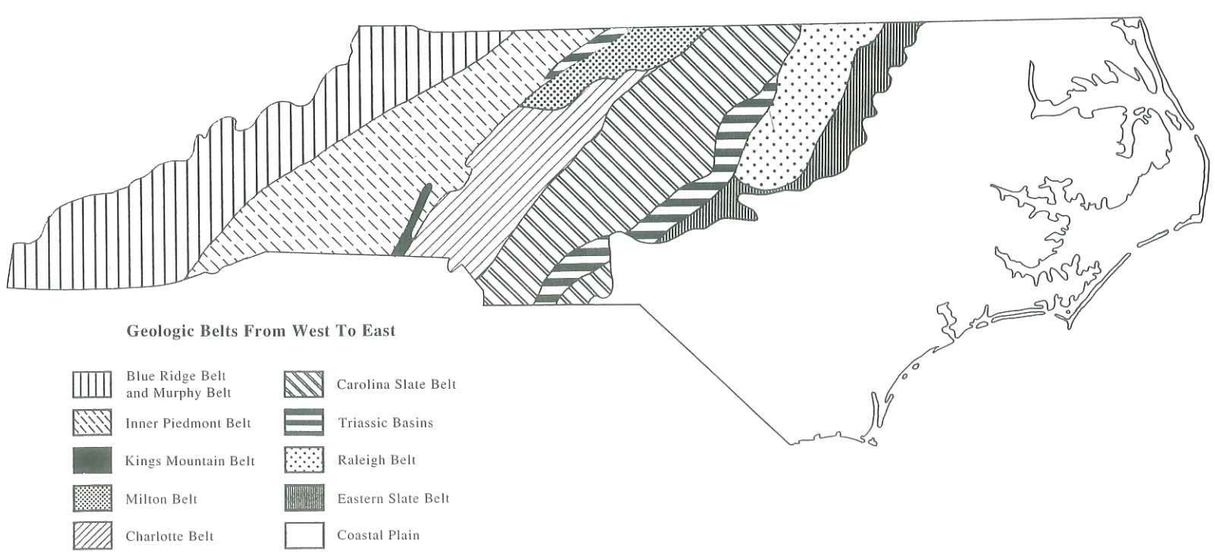
Raleigh Belt: The Raleigh belt contains granite, gneiss and schist. In the 19th century, there were a number of small building stone quarries in this region, but today the main mineral product is crushed stone for construction and road aggregate.

Eastern Slate Belt: This belt contains slightly metamorphosed volcanic and sedimentary rocks similar to those of the Carolina slate belt. The rocks are poorly exposed and partially covered by Coastal Plain sediments. The metamorphic rocks, 500-600 million years old, are intruded by younger, approximately 300 million year old, granitic bodies. Gold was once mined in the belt, and small occurrences of molybdenite, an ore of molybdenum, have been prospected here. Crushed stone, clay, sand and gravel are currently mined in this belt.

Coastal Plain: The Coastal Plain is a wedge of mostly marine sedimentary rocks that gradually thickens to the east. The Coastal Plain is the largest geologic belt in the state, covering about 45 percent of the land area. The most common sediment types are sand and clay, although a significant amount of limestone occurs in the southern part of the Coastal Plain. In the Coastal Plain, geology is best understood from studying data gathered from well drilling. The state's most important mineral resource in terms of dollar value is phosphate, an important fertilizer component, mined near Aurora, Beaufort County. Industrial sand for making container and flat glass and ferrosilicon and used for filtration and sandblasting is mined in the Sand Hills area.

Mineral Industry

North Carolina has important deposits of many minerals and annually leads the nation in the production of feldspar, lithium minerals, scrap mica, olivine and pyrophyllite. The state ranks second in phosphate rock production and ranks in the top five in clay and crushed granite production. North Carolina does not produce significant quantities of metallic minerals.



GEOLOGIC TIME SCALE FOR NORTH CAROLINA

EON	ERA	PERIOD	EPOCH	GEOLOGIC EVENTS IN NORTH CAROLINA	AGE*
PHANEROZOIC	CENOZOIC	Quaternary	Recent	Deposition of sediments in Coastal Plain. Erosion of Piedmont and Appalachian Mountains to their present rugged features.	
			Pleistocene		1.7
		Tertiary	Pliocene		5
			Miocene	Phosphate deposited in eastern North Carolina (Beaufort and Pamlico Counties).	24
			Oligocene	Limestone deposited in Coastal Plain. Weathering and erosion continue in Piedmont and Mountains.	
			Eocene		
			Paleocene		66
	MESOZOIC	Cretaceous	Late	Deposition of estuarine and marine sediments in the Coastal Plain. Continued erosion of the Piedmont and Mountains.	
			Early	Sediments deposited in northern half of the Coastal Plain. Cape Fear Arch begins to develop. Piedmont and Mountains eroded.	138
		Jurassic	Late	Marine sediments deposited on outer continental shelf. Piedmont and mountains eroded.	
			Middle	Weathering and erosion of the Blue Ridge and the Piedmont areas. Emplacement of diabase dikes and sheets.	
			Early		205
		Triassic	Late	Faulting and rifting create Deep River, Dan River, and Davie County basins. Basins fill with continental clastic sediments known as "red beds".	
			Middle	Formation of the Atlantic Ocean as North America and Africa drifted apart. Weathering and erosion of Piedmont and Mountains.	
			Early		240
	PALEOZOIC	Permian		Final collision of North America and Africa. Thrust faulting in west; deformation in eastern Piedmont.	290
		Pennsylvanian		Emplacement of igneous intrusions: Time of uplift and erosion.	330
		Mississippian		Time of uplift and erosion.	360
		Devonian		Emplacement of lithium, mica, and feldspar-rich pegmatites, primarily in the Kings Mountain and Spruce Pine districts. Metamorphism of Carolina slate belt. Period of erosion.	410
		Silurian		Period of uplift and erosion.	435
		Ordovician		Continental collision and beginning of mountain building process--faulting, folding, and metamorphism of pre-existing rocks.	500
		Cambrian		Sandstone, shale, and limestone deposited in the mountain area. Continued deposition of Carolina slate belt rocks. Gold deposits of the slate belt form.	570
PROTEROZOIC		Late		Sedimentary and volcanic rocks deposited in the mountains and Piedmont. Local intrusions of igneous rocks.	900
		Middle		Sedimentary, volcanic, and igneous rocks formed in the Blue Ridge and metamorphosed to gneisses and schists.	1600
		Early		Oldest dated rock in North Carolina is 1,800 million years old.	2500

* Estimated age in millions of years.

Oldest known rock in U.S.- 3,600 million years old.
Oldest known rocks in world- 3,850 million years old.
Formation of the Earth- about 4,500 million years ago.

Commercial Gem- and Mineral-Collecting Sites

Garnet, moonstone, ruby and sapphire - Cowee Valley mines; 8 miles north of Franklin, Macon Co., on NC 28. Panners Creek Gem Lines; southwest of Raleigh off Old Apex Road (gems are from western N.C.)

Emerald, aquamarine and amethyst - mines in the Spr Pine-Little Switzerland area, Mitchell County.

Emerald, hiddenite, rutile and quartz - mines at Hiddenite, Alexander Co., 15 miles northwest of Statesville off NC 90.

Gold - Reed Gold Mine State Historic Site; off NC 200, 6 miles southeast of Concord, Cabarrus County. Cotton Patch Gold Mine; off US 52, 2 miles southeast of New London.

Sapphire - Pressley Mine; off Interstate 40, near Canton, west of Asheville, Haywood Co.

The State Precious Stone - Emerald

The General Assembly of 1973 designated the emerald as the official State precious stone. Emerald is found in North Carolina near Hiddenite in Alexander County and southwest of Spruce Pine in Mitchell County. The largest single emerald crystal found in North America was found at the Rist Mine at Hiddenite in 1969. This crystal weighed 1,438 carats. The *Carolina Emerald*, a 13.14 carat, emerald-cut gem, was also found at the Rist Mine.

The State Rock - Granite

The General Assembly of 1979 designated granite as the official State rock. North Carolina is blessed with an abundance of granite. When granite is crushed, it is used as an aggregate for road and building construction. If granite has the right physical properties, it can be cut into blocks and used for monuments, curb stone and stone for building facings. The largest open-face granite quarry in the world is located at Mount Airy, North Carolina.

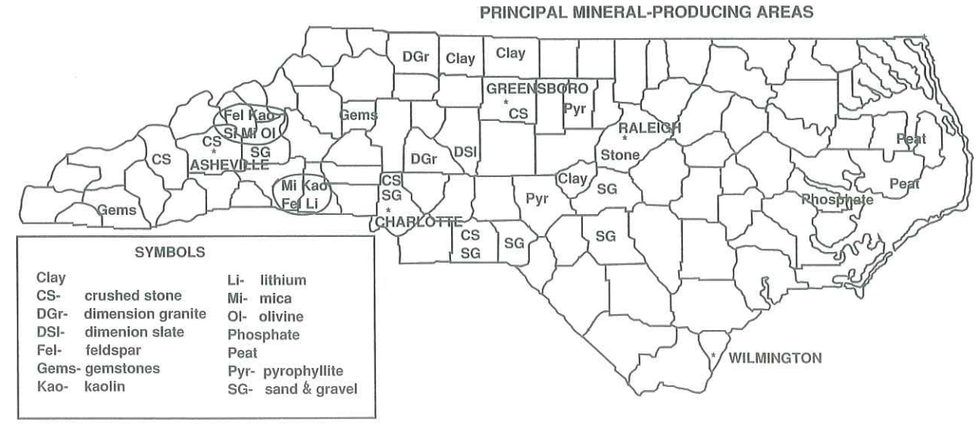
North Carolina Geological Survey
P.O. Box 27687
Raleigh, North Carolina 27611
Phone (919) 733-2423

State of North Carolina
James G. Martin, Governor

Department of Environment, Health, and Natural Resources
William W. Cobey, Jr., Secretary

Division of Land Resources
Charles H. Gardner
Director and State Geologist

PRINCIPAL MINERAL-PRODUCING AREAS



PIEZOMETER LEGEND

B-15 △	PIEZOMETER INSTALLED BY LAW ENGINEERING CIRCA 1990
BLE-8B ⊕	PIEZOMETER INSTALLED BY BLE CIRCA 2004
MW-2	GROUND-WATER MONITORING WELL, VARIOUS INSTALLERS AND DATES

GEOLOGIC LEGEND

2060	TOPOGRAPHIC SURFACE CONTOUR IN FEET MSL CONTOUR INTERVAL = 2 FEET
	WATER
	WASTE BOUNDARY
	UNPAVED ROADS
	PAVED ROADS
	PROPERTY BOUNDARY
—x—x—	FENCE

GENERAL MAP REFERENCE

100 50 0 100 200
APPROXIMATE SCALE IN FEET

NORTH CAROLINA LICENSED SEAL 1043 GEOLOGIST MARK S. PREDDY
1/31/06

REFERENCES:
1. DRAWING PROVIDED BY McGILL ASSOCIATES TITLED "DRAWING #1, DATED 3/9/95 LATEST".
2. DRAWING TITLED "FACILITY PLAN C & D EXPANSION AREA" BY McGILL ASSOCIATES DATED JUNE 2002.

REVISIONS		
No.	DESCRIPTION	BY
1		
2		

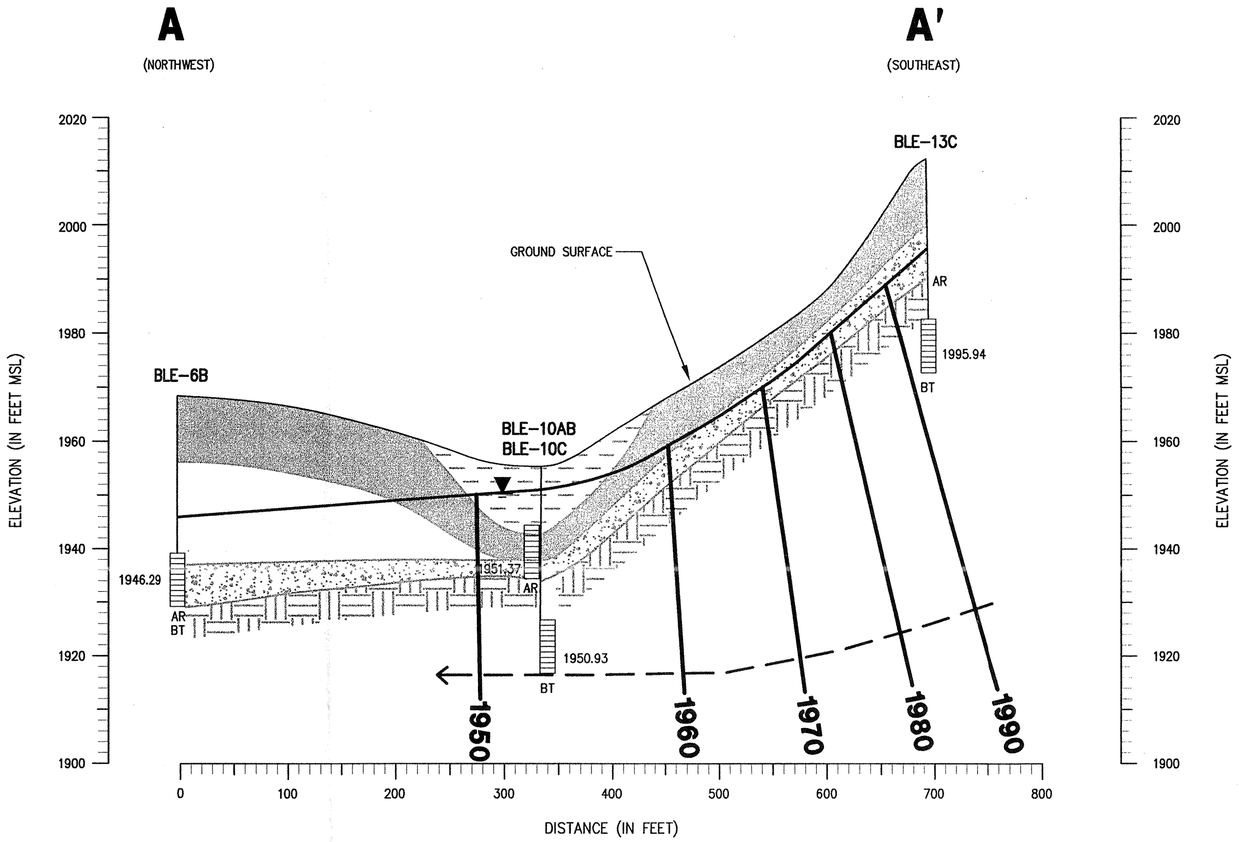
DRAWN	AEH
CHECKED	AWA
APPROVED	

DATE	1-31-06
FILE	MADCLF04-BASE
JOB NO:	J04-2225-04

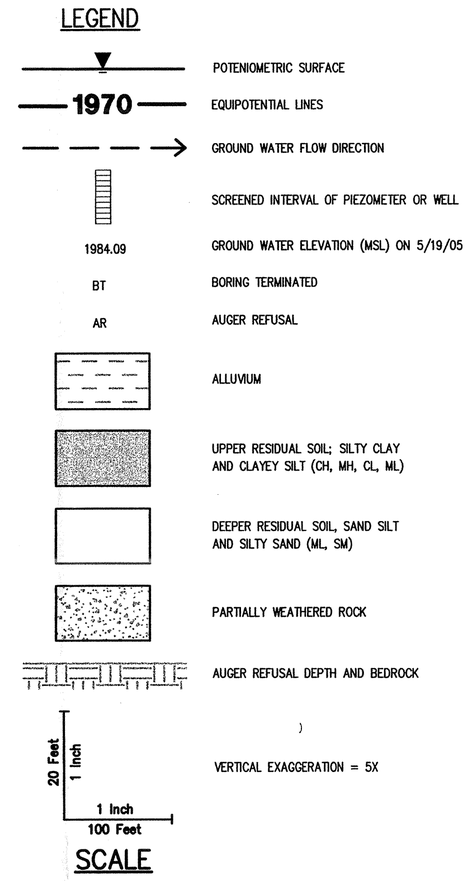
BLE INC.
BUNNELL-LAMMONS ENGINEERING, INC.
6004 PONDERS COURT
GREENVILLE, SOUTH CAROLINA 29615
PHONE: (864)288-1265 FAX: (864)288-4430

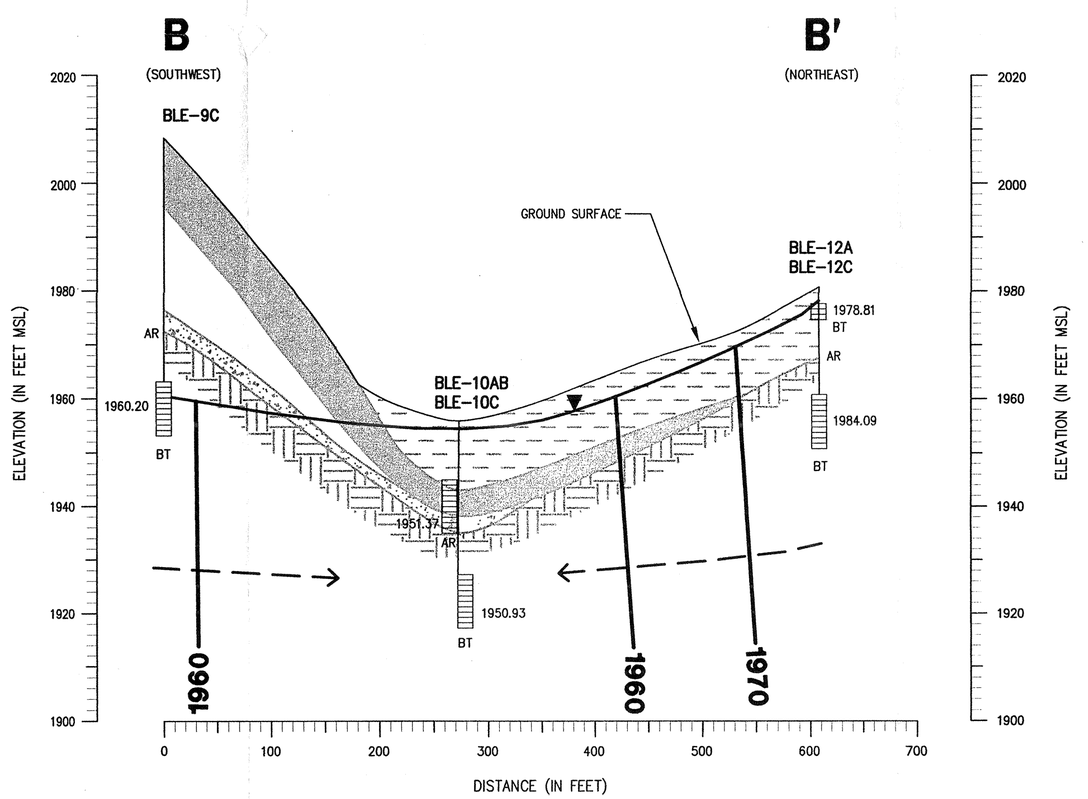
SITE TOPOGRAPHIC PLAN
MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

FIGURE NO. 3

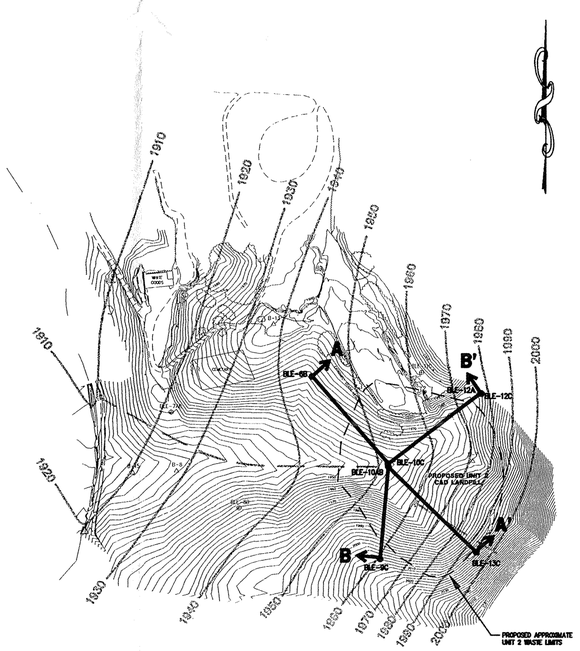


GEOLOGIC PROFILE A-A'





GEOLOGIC PROFILE B-B'



PROFILE LOCATION PLAN

300 150 0 300 600
APPROXIMATE SCALE IN FEET

NORTH CAROLINA LICENSED SEAL 1043 GEOLOGIST MARK S. PREDDY
1/31/06

REVISIONS		
No.	DESCRIPTION	BY

DRAWN:	AEH	DATE:	1-31-06
CHECKED:	RAM	CAD FILE:	MADCLF04-PROF
APPROVED:		JOB NO:	J04-2225-04

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PHONE: (864)288-1265 FAX: (864)288-4430

GEOLOGIC PROFILES
MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

FIGURE NO. 4

PIEZOMETER LEGEND

B-15 △	PIEZOMETER INSTALLED BY LAW ENGINEERING CIRCA 1990
BLE-8B ⊕	PIEZOMETER INSTALLED BY BLE CIRCA 2004
MW-2 ◐	GROUND-WATER MONITORING WELL, VARIOUS INSTALLERS AND DATES

GEOLOGIC LEGEND

2060	TOPOGRAPHIC SURFACE CONTOUR IN FEET MSL CONTOUR INTERVAL = 2 FEET
	WATER
	WASTE BOUNDARY
	UNPAVED ROADS
	PAVED ROADS
	PROPERTY BOUNDARY
—x—x—	FENCE
1900	TOP OF ROCK ELEVATION CONTOUR IN FEET MSL CONTOUR INTERVAL = 10 FEET
1991.05	TOP OF ROCK (AUGER REFUSAL) ELEVATION

GENERAL MAP REFERENCE

100 50 0 100 200
APPROXIMATE SCALE IN FEET

NORTH CAROLINA PROFESSIONAL LICENSED SEAL 1043 GEOLOGIST MARK S. PRUDDY 1/31/06

REFERENCES:
1. DRAWING PROVIDED BY McGILL ASSOCIATES TITLED "DRAWING #1, DATED 3/9/95 LATEST".
2. DRAWING TITLED "FACILITY PLAN C & D EXPANSION AREA" BY McGILL ASSOCIATES DATED JUNE 2002.

REVISIONS		
No.	DESCRIPTION	BY
1		
2		

DRAWN	AEH
CHECKED	MSP
APPROVED	

DATE	1-31-06
FILE	MADCLF04-BEDROCK
JOB NO:	J04-2225-04

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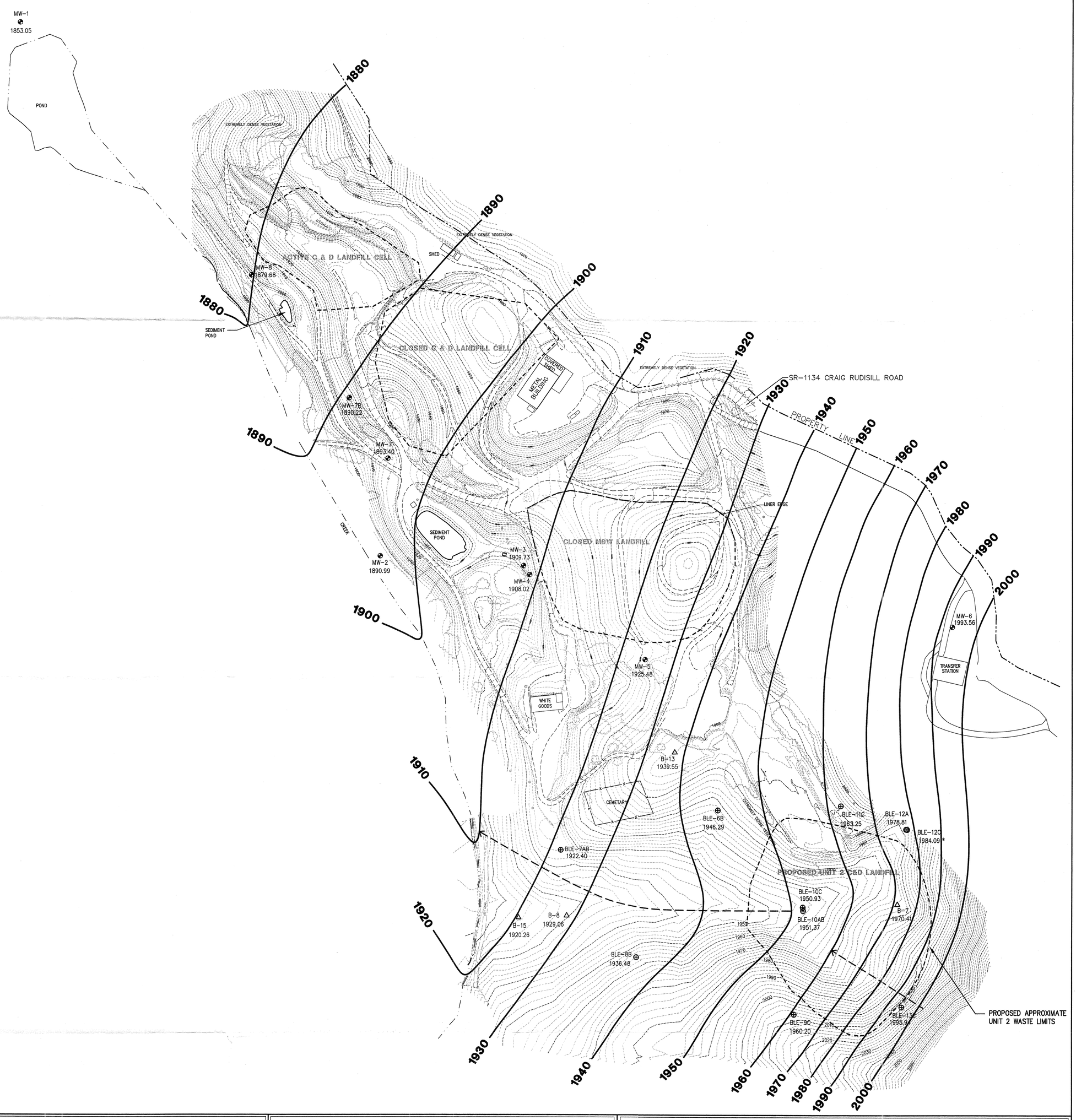
TOP OF BEDROCK (AUGER REFUSAL) ELEVATION CONTOUR MAP

MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

FIGURE NO. 5



PIEZOMETER LEGEND

B-15 △	PIEZOMETER INSTALLED BY LAW ENGINEERING CIRCA 1990
BLE-8B ⊕	PIEZOMETER INSTALLED BY BLE CIRCA 2004
MW-2 ◐	GROUND-WATER MONITORING WELL, VARIOUS INSTALLERS AND DATES

GEOLOGIC LEGEND

2060	TOPOGRAPHIC SURFACE CONTOUR IN FEET MSL CONTOUR INTERVAL = 2 FEET
	WATER
	WASTE BOUNDARY
	UNPAVED ROADS
	PAVED ROADS
	PROPERTY BOUNDARY
—x—x—	FENCE
1951.37	WATER TABLE ELEVATION IN FEET ABOVE MEAN SEA LEVEL ON MAY 19, 2005
1920	WATER TABLE ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL CONTOUR INTERVAL = 10 FEET
←	GROUND-WATER FLOW PATHWAYS USED FOR FLOW VELOCITY CALCULATIONS

GENERAL MAP REFERENCE

NORTH CAROLINA PROFESSIONAL SEAL 1043 GEOLOGIST MARK S. PREDDY 1/31/06

100 50 0 100 200
APPROXIMATE SCALE IN FEET

NOTES:

1. THE WATER TABLE ELEVATION CONTOURS ARE BASED ON WATER LEVEL DATA COLLECTED ON MAY 19, 2005.
2. *THE WATER LEVEL IN BLE-12C REPRESENTS ARTESIAN CONDITIONS AS THIS WELL IS INSTALLED IN DEEPER FRACTURED BEDROCK STRATA. THE WATER LEVEL WAS NOT USED FOR CONTOURING PURPOSES.

REFERENCES:

1. DRAWING PROVIDED BY McGILL ASSOCIATES TITLED "DRAWING #1, DATED 3/9/95 LATEST".
2. DRAWING TITLED "FACILITY PLAN C & D EXPANSION AREA" BY McGILL ASSOCIATES DATED JUNE 2002.

REVISIONS		
No.	DESCRIPTION	BY
1		
2		

DRAWN	AEH
CHECKED	AWA
APPROVED	

DATE	1-31-06
FILE	MADCLF04-WTM-051905
JOB NO:	J04-2225-04

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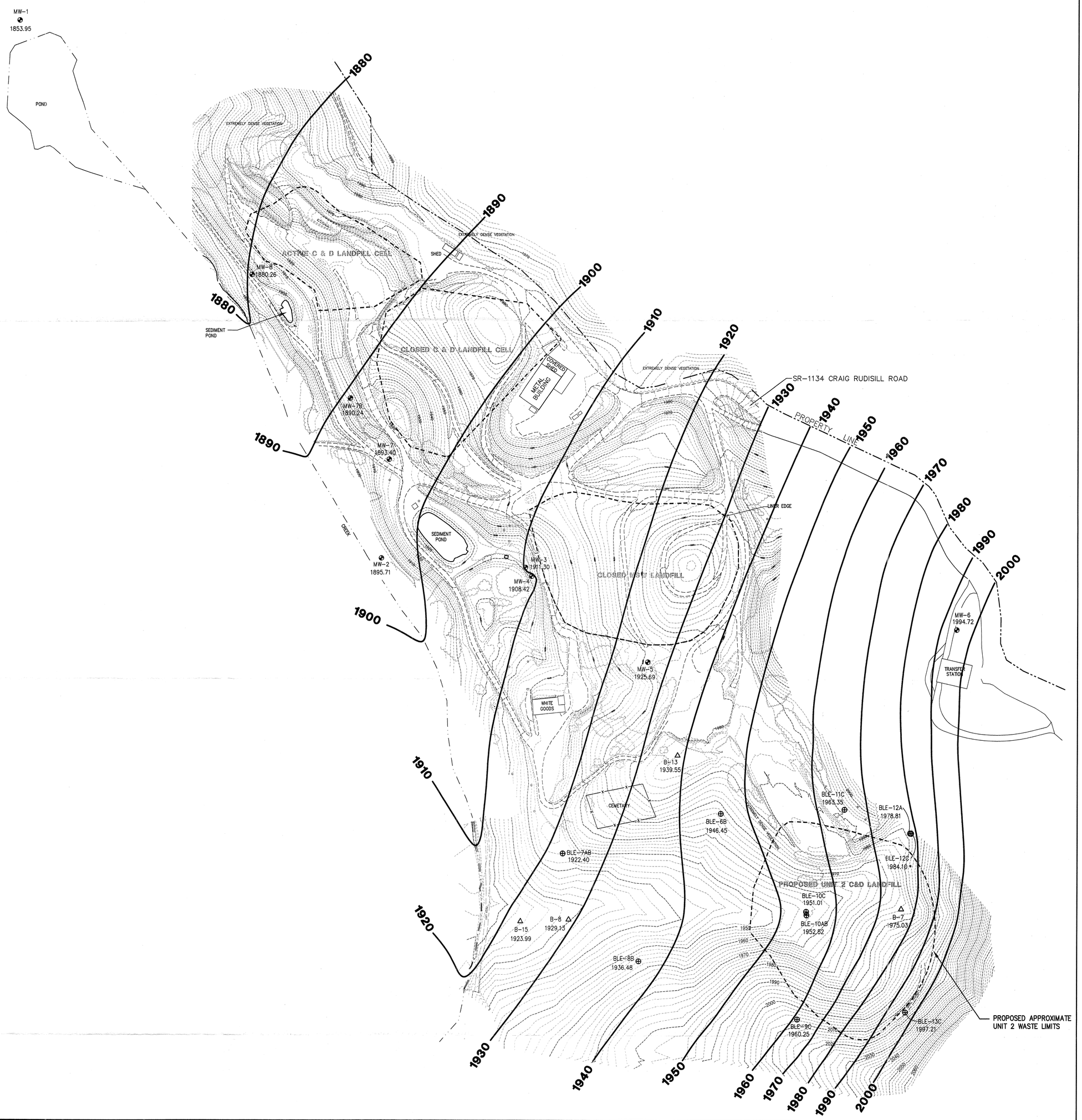
WATER TABLE ELEVATION CONTOUR MAP (MAY 19, 2005)

MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

FIGURE NO. 6



PIEZOMETER LEGEND

B-15 △	PIEZOMETER INSTALLED BY LAW ENGINEERING CIRCA 1990
BLE-8B ⊕	PIEZOMETER INSTALLED BY BLE CIRCA 2004
MW-2 ◕	GROUND-WATER MONITORING WELL, VARIOUS INSTALLERS AND DATES

GEOLOGIC LEGEND

2060	TOPOGRAPHIC SURFACE CONTOUR IN FEET MSL CONTOUR INTERVAL = 2 FEET
	WATER
	WASTE BOUNDARY
	UNPAVED ROADS
	PAVED ROADS
	PROPERTY BOUNDARY
—x—x—	FENCE
1960.25	HIGHEST OBSERVED WATER TABLE ELEVATION IN FEET ABOVE MEAN SEA LEVEL DURING THE OBSERVATION PERIOD
1920	WATER TABLE ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL CONTOUR INTERVAL = 10 FEET

GENERAL MAP REFERENCE

NORTH CAROLINA PROFESSIONAL SEAL 1043 GEOLOGIST MARK S. PREDDY 1/31/06

100 50 0 100 200
APPROXIMATE SCALE IN FEET

NOTES:

1. THE HIGH WATER TABLE ELEVATION CONTOURS ARE BASED ON WATER LEVEL DATA COLLECTED FROM DECEMBER 1, 2004 THROUGH JUNE 29, 2005.
2. * THE WATER LEVEL IN BLE-12C REPRESENTS ARTESIAN CONDITIONS AS THIS WELL IS INSTALLED IN DEEPER FRACTURED BEDROCK STRATA. THE WATER LEVEL WAS NOT USED FOR CONTOURING PURPOSES.

REFERENCES:

1. DRAWING PROVIDED BY McGILL ASSOCIATES TITLED "DRAWING #1, DATED 3/9/95 LATEST".
2. DRAWING TITLED "FACILITY PLAN C & D EXPANSION AREA" BY McGILL ASSOCIATES DATED JUNE 2002.

REVISIONS		
No.	DESCRIPTION	BY
1		
2		

DRAWN	AEH
CHECKED	AWA
APPROVED	

DATE	1-31-06
FILE	MADCLF04-CSHWTM
JOB NO:	J04-2225-04

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6004 PONDERS COURT
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PHONE: (864)288-1265 FAX: (864)288-4430

COMPOSITE SEASONAL HIGH WATER TABLE ELEVATION CONTOUR MAP: (DECEMBER 2004 – JUNE 2005)

MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

FIGURE NO. 7

APPENDIX A

DRILLING AND SAMPLING PROCEDURES

SOIL TEST BORINGS

Soil test borings were advanced by mechanically twisting a continuous flight steel auger into the soil. Soil sampling and penetration testing were performed in general accordance with ASTM D 1586. At regular intervals, soil samples were obtained with a standard 1.4-inch ID, 2-inch OD, split-tube sampler. The sampler was first seated 6 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 designated the "penetration resistance."

CORE DRILLING

Core drilling procedures were required to determine the character and vertical continuity of refusal materials. Refusal to soil drilling equipment may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of solid continuous rock.

Prior to coring, a 3-inch diameter PVC pipe was seated in the refusal material and grouted into place with a cement-bentonite mixture. Refusal materials were then cored according to the ASTM D 2113 using a diamond-studded bit fastened to the end of a hollow, double-tube core barrel. The NQ size designates bits that obtain rock cores 1-7/8 inches in diameter. Upon completion of each drill run, the core inner barrel was brought to the surface, the core recovered was measured, and the core samples were removed and placed in boxes for storage.

The core samples were returned to our laboratory where the refusal material was identified and the percent core recovery and rock quality designation (RQD) was determined by a geologist. The percent core recovery is the ratio of the core length obtained to the length cored, expressed as a percent. The RQD is obtained by summing only those pieces of recovered core which are 4 inches or longer and are at least moderately hard, and dividing by the total length cored. The percent core recovery and the RQD are related to soundness and continuity of the refusal material. Refusal-material descriptions, recoveries and the bit size are shown on a Test Boring Record (see Appendix C).

TEST BORING REPORT

BORING NO. BLE-6B

PROJECT: Madison Co. C&D Landfill - Madison Co., NC
CLIENT: McGill/Madison Co.
CONTRACTOR: BLE
EQUIPMENT USED: CME 750 ATV

BLE JOB NO. J04-2225-04
PAGE NO. 1 of 2
LOCATION:
ELEVATION:
DATE START: 10/26/04
DATE FINISH: 10/26/04
DRILLER: J. Gorman
PREPARED BY: M. Preddy

GROUND WATER		DEPTH TO:		
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE
	0	21.44		
	24	21.7		

	CASING	SAMPLER	CORE BARREL
TYPE	HSA	Split Spoon	XXX
SIZE ID/OD	8.25" OD	2" ID	XXX
HAMMER WT	XXX	140 lb	XXX
HAMMER FALL	XXX	30 "	XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					Topsoil	
5	18	4 7 11	SS-1	CL	V. stiff red-yel sl. moist f. sdy s: CLAY - residuum	GROUT
10	20	4 8 12	SS-2	CL	as above	2" PVC 11.2
15	7	2 2 5	SS-3	SM	loose brown v. moist sl. moist sl. cly s: F-m SAND	BENT
20	6	2 2 4	SS-4	SM	as above	

BLOWS/FT	DENSITY
0-4	VERY LOOSE
5-10	LOOSE
11-20	FIRM
21-30	VERY FIRM
31-50	DENSE
51+	VERY DENSE

BLOWS/FT	CONSISTANCY
0-2	VERY SOFT
3-4	SOFT
5-8	FIRM
9-15	STIFF
16-30	VERY STIFF
31-50	HARD
51+	VERY HARD

SAMPLE ID	
SS	SPLIT SPOON
HP	HYDROPUNCH
UD	UNDISTURBED TUBE
G	GRAB
C	COMPOSITE
B	BAG
NR	NO RECOVERY

WELL DESCRIPTION
STICKUP = 3.5
TOP SAND = 27.0
TOP BENT. = 11.2
SCREEN = 28.9-38.9
SCREEN LENGTH = 10
END CAP = 0.3
WELL TD = 39.2

TEST BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC J04-2225-04

BORING NO. BLE-6B

PAGE 2 OF 2

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
25			UD	SM	as above	BENT; 2" PVC
30	54	11 21 33	SS-6	SM	v. dense gray-brown v. mic sli moist ss F-M SAND	SAND; 27.0; 28.9
35	50/4"	28 50/4"	SS-7	PWR	PWR SA gray-br v. mic moist ss F-M SAND	
40	50/5"	50/5"	SS-8	PWR	as above	38.9; 39.2
45			SS-9		Auger refusal = 39.2'	

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL MATERIALS
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	SAND = 6 bags
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	BENTONITE = 6 bags
21-30	VERY FIRM	9-15	STIFF	G	GRAB	
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	GROUT = YES
51+	VERY DENSE	31-50	HARD	B	BAG	WELL O.D. = 2"
		51+	VERY HARD	NR	NO RECOVERY	WELL TYPE = PVC

TEST BORING REPORT

BORING NO. BLE-7AB

PROJECT: Madison Co. C&D Landfill - Madison Co., NC
CLIENT: McGill/Madison Co.
CONTRACTOR: BLE
EQUIPMENT USED: CME 750 ATV

BLE JOB NO. J04-2225-04
PAGE NO. 1 of 2
LOCATION:
ELEVATION:
DATE START: 10/27/04
DATE FINISH: 10/27/04
DRILLER: J. Gorman
PREPARED BY: M. Preddy

GROUND WATER DATE	HRS AFT COMP	DEPTH TO: WATER	BOT. OF CASING	BOT. OF HOLE
	0	22.78		
	24	22.55		

	CASING	SAMPLER	CORE BARREL
TYPE	HSA	Split Spoon	XXX
SIZE ID/OD	8.25" OD	2" ID	XXX
HAMMER WT	XXX	140 lb	XXX
HAMMER FALL	XXX	30 "	XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					Top Soil	
5	8	2 3 5	SS-1	ML	Firm yel-red sli moist F. sdy cly SILT - residuum	GROUT, 2" PVC
10			UD	ML	Firm red-br sli moist v. mic sli cly F. sdy SILT	
15	5	2 2 3	SS-3	ML	as above	
					Firm red-br sli moist v. mic sli cly F. sdy SILT w/ black slicken-sided fracture surfaces	BENT 16.9, SAND 19.2
20	7	2 3 4	SS-4	ML		

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP = 3.35
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 19.2
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 16.95
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 20.75-30.75
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.3
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 31.05

TEST BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC J04-2225-04

BORING NO. BLE-7AB

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
						20.7'
25	19	4 8 11	SS-5	SM	Firm olive & yel-br sli moist mic si F-C SAND w/ gravel size rock fragments	SAND
30	64	28 35 29	SS-6	SM	V. dense as above	30.7' 31.05
					Auger refusal = 31.05'	
35			SS-7			
40			SS-8			
45			SS-9			

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL MATERIALS
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	SAND = 6 bags
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	BENTONITE = 1 bag
21-30	VERY FIRM	9-15	STIFF	G	GRAB	
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	GROUT = yes
51+	VERY DENSE	31-50	HARD	B	BAG	WELL O.D. = 2"
		51+	VERY HARD	NR	NO RECOVERY	WELL TYPE = PVC

TEST BORING REPORT

BORING NO. BLE-8B

PROJECT: Madison Co. C&D Landfill - Madison Co., NC
CLIENT: McGill/Madison Co.
CONTRACTOR: BLE
EQUIPMENT USED: CME 750 ATV

BLE JOB NO. J04-2225-04
PAGE NO. 1 of 2
LOCATION:
ELEVATION:
DATE START: 10/27/04
DATE FINISH: 10/27/04
DRILLER: J. Gorman
PREPARED BY: M. Preddy

GROUND WATER DATE	HRS AFT COMP	DEPTH TO: WATER	BOT. OF CASING	BOT. OF HOLE
	0	20.7		
	24	20.5		

	CASING	SAMPLER	CORE BARREL
TYPE	HSA	Split Spoon	XXX
SIZE ID/OD	8.25" OD	2" ID	XXX
HAMMER WT	XXX	140 lb	XXX
HAMMER FALL	XXX	30 "	XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					Topsoil	
5	4	2 2 2	SS-1	ML	soft red-br moist sli mic cly SILT - residuum	
10	9	3 4 5	SS-2	ML	stiff yel-br sli moist sli mic cly F. sdy SILT	Grout 2" PVC
15	12	3 5 7	SS-3	ML	as above	
20	18	3 4 6	SS-4	SM	loose gray-brown sli moist v. mic si F-M SAND	

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP = 3.4
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 25.5
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 22.64
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 28.6-38.6
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.3
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 38.9

TEST BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC

J04-2225-04

BORING NO. BLE-8B

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
						GROUT; 2" PVC; 22.6
25	18	7 8 10	SS-5	SM	Firm gray-br moist v. mic si F-C SAND	BENT; 25.5
30	25	8 11 14	SS-6	SM	v. Firm as above	SAND; 28.6
35	87	14 31 56	SS-7	PWR	PWR SA gray-br moist si F-C SAND	
40	50/2"	32 44 50/2"	SS-8	PWR	as above	38.6 38.9
					Boring Terminated = 40'	40.0
45			SS-9			

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL MATERIALS
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	SAND = 6 bags
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	BENTONITE = 1 bag
21-30	VERY FIRM	9-15	STIFF	G	GRAB	
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	GROUT = yes
51+	VERY DENSE	31-50	HARD	B	BAG	WELL O.D. = 2"
		51+	VERY HARD	NR	NO RECOVERY	WELL TYPE = PVC

TEST BORING REPORT

BORING NO. BLE-9C

PROJECT: Madison Co. C&D Landfill - Madison Co., NC
CLIENT: McGill/Madison Co.
CONTRACTOR: BLE
EQUIPMENT USED: CME 750 ATV

BLE JOB NO. J04-2225-04
PAGE NO. 1 of 3
LOCATION:
ELEVATION:
DATE START: 10/28/04
DATE FINISH: 11/11/04
DRILLER: J. Gorman
PREPARED BY: M. Preddy

GROUND WATER		DEPTH TO:		
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE
	0	45.2		

	CASING	SAMPLER	CORE BARREL
TYPE	HSA	Split Spoon	XXX
SIZE ID/OD	8.25" OD	2" ID	XXX
HAMMER WT	XXX	140 lb	XXX
HAMMER FALL	XXX	30 "	XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS
5	5	2 2 3	SS-1	ML	Firm red-br moist sli. mic. cly SILT - residuum (bag sample = 1'-10')
10	5	2 2 3	SS-2	ML	as above
15	9	3 4 5	SS-3	ML	stiff brown sli moist mic sli cly F. sdy SILT
20			UD	SM	Firm brown sli moist v. mic si F-M SAND

WELL: BENT. 2" PVC

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP = 3.4
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 42.4
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = SURFACE
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 44.9-54.9
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.0
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 54.9

TEST BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC J04-2225-04

BORING NO. BLE-9C

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
25	19	8 8 11	SS-5	SM	Firm olive + red-br moist mic cly si F-m SAND	
30	45	9 17 28	SS-6	SM	Dense gray + brown sli moist mic si F-C SAND w/ Gravel	BENT 2" PVC
35	50/2"	50/2"	SS-7	PWR	no recovery	
40			SS-8	Bedrock	Auger refusal = 35.0' (see core log)	
45			SS-9			SAND 42.4 44.4

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL MATERIALS
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	SAND =
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	BENTONITE =
21-30	VERY FIRM	9-15	STIFF	G	GRAB	
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	GROUT =
51+	VERY DENSE	31-50	HARD	B	BAG	WELL O.D. =
		51+	VERY HARD	NR	NO RECOVERY	WELL TYPE =

TEST BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC J04-2225-04

BORING NO. BLE-9C

PAGE 3 OF 3

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
				Bedrock	(see core log)	SAND
50			SS-10			
			SS-11			
55						
					Boring terminated = 54.9'	
			SS-12			
60						
			SS-13			
65						
			SS-14			
70						

54.9

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL MATERIALS
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	SAND = 1.5 bags
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	BENTONITE = 5 bags
21-30	VERY FIRM	9-15	STIFF	G	GRAB	
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	GROUT = NO
51+	VERY DENSE	31-50	HARD	B	BAG	WELL O.D. = 2"
		51+	VERY HARD	NR	NO RECOVERY	WELL TYPE = PVC

CORE BORING REPORT

BORING NO. BLE-9c

PROJECT: Madison Co. C&D Landfill - Madison Co., NC
CLIENT: McGill/Madison Co.
CONTRACTOR: BLE
EQUIPMENT USED: CME 750 ATV

BLE JOB NO. J04-2225-04
PAGE NO. 1 of 2
LOCATION:
ELEVATION:
DATE START: 10/28/04
DATE FINISH: 11/4/04
DRILLER: J. Gorman
PREPARED BY: M. Preddy

GROUND WATER		DEPTH TO:			ORIENTATION		CORE BARREL	
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE	X	VERTICAL	TYPE	NQ
						HORIZONTAL	TYPE	
						INCLINED	Bit (ft)	
						BEARING	Barrel (ft)	
						ANG. FROM VERT.	Total (ft)	

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD	FIELD CLASSIFICATION AND REMARKS	WELL
							(see boring log for BLE-9c)	
35								
		35.9	R-1	(3.8)	95	(1.55) 39	moderately hard, moderately weathered, gray and white, coarse grained amphibole GNEISS; with v. close to closely spaced, horizontal to moderately dipping and widely space steeply dipping, iron-stained fractures; and steeply dipping well-developed foliations	
40		39.9	R-2	(4.4)	88	(1.8) 36		
45		44.9	R-3	(3.9)	78	0	as above	
50		49.9						

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CANT SCRATCH	V. THIN	<2"	HORIZONTAL (0-5)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULTLY	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55)	MOD CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

ORDER FOR CORE DESCRIPTION: FIELD HARDNESS, WEATHERING, COLOR, GRAIN SIZE/TEXTURE, LITHOLOGY, FRACTURE CHARACTERISTICS, BEDDING AND FOLIATION, COMMENTS

Changes
Rod on
GS to TOR
Depth to bit
Run

WELL DESCRIPTION	
SCREEN DEPTH =	STICKUP =
SCREEN LENGTH =	TOP SAND =
END CAP =	TOP BENT. =
WELL TD =	BOT. CASING =

CORE BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC

J04-2225-04

BORING NO. BLE-9c

PAGE 2 OF 2

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD	FIELD CLASSIFICATION AND REMARKS	WELL
			R-4	(5.0)	100	(3.8) 76	V. hard, fresh, gray + white, coarse-grained amphibole GNEISS w/ widely spaced horizontal and steeply dipping iron-stained fractures; and steeply dipping well-developed foliation	
55		54.9						
							3" diameter core hole	

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CANT SCRATCH	V. THIN	<2"	HORIZONTAL (0-5)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULTLY	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55)	MOD CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

ORDER FOR CORE DESCRIPTION: FIELD HARDNESS, WEATHERING, COLOR, GRAIN SIZE/TEXTURE, LITHOLOGY, FRACTURE CHARACTERISTICS, BEDDING AND FOLIATION, COMMENTS

	WELL MATERIALS	
Changes		
Rod on	SAND =	GROUT =
GS to TOR		WELL O.D. =
Depth to bit	BENTONITE =	CASING O.D. =
Run		WELL TYPE =

TEST BORING REPORT

BORING NO. BLE-10 ab

PROJECT:	Madison Co. C&D Landfill - Madison Co., NC
CLIENT:	McGill/Madison Co.
CONTRACTOR:	BLE
EQUIPMENT USED:	CME 750 ATV

BLE JOB NO.	J04-2225-04
PAGE NO.	1 of 2
LOCATION:	
ELEVATION:	
DATE START:	11/3/04
DATE FINISH:	11/3/04
DRILLER:	J. Gorman
PREPARED BY:	M. Preddy

GROUND WATER		DEPTH TO:		
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	5.63		
	24	4.3		

	CASING	SAMPLER	CORE BARREL
TYPE	HSA	Split Spoon	XXX
SIZE ID/OD	8.25" OD	2" ID	XXX
HAMMER WT	XXX	140 lb	XXX
HAMMER FALL	XXX	30"	XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
5	6	2 3 3	SS-1	CH	Firm brown moist si CLAY - alluvium	Bentonite; 2" PVC
10	22	6 10 12	SS-2	CH	Vs stiff gray-green moist mic F.sdy si CLAY w/ quartz gravel	9.1
15	10	4 5 5	SS-3	ML	Stiff yel-red sli moist mic F.sdy cly SILT - residuum	SAND
20	50/4"	27 38 50/4"	SS-4	PWR	PWR SA dk gray v. moist mic cly si F-C SAND w/ gravel	

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP = 3.4
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 9.1
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = surface
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 11.0-21.0
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.3
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 21.3

TEST BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC J04-2225-04

BORING NO. BLE-10a6

PAGE 2 OF 2

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
						21.0
						21.3
					Auger refusal = 21.3'	
25			SS-5			
30			SS-6			
35			SS-7			
40			SS-8			
45			SS-9			

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL MATERIALS
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	SAND = 7 bags
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	BENTONITE = 2.5 bags
21-30	VERY FIRM	9-15	STIFF	G	GRAB	
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	GROUT = NO
51+	VERY DENSE	31-50	HARD	B	BAG	WELL O.D. = 2"
		51+	VERY HARD	NR	NO RECOVERY	WELL TYPE = PVC

TEST BORING REPORT

BORING NO. BLE-10c

PROJECT:	Madison Co. C&D Landfill - Madison Co., NC
CLIENT:	McGill/Madison Co.
CONTRACTOR:	BLE
EQUIPMENT USED:	CME 750 ATV

BLE JOB NO.	J04-2225-04
PAGE NO.	1 of 2
LOCATION:	
ELEVATION:	
DATE START:	11/8/04
DATE FINISH:	11/8/04
DRILLER:	J. Gorman
PREPARED BY:	M. Preddy

GROUND WATER		DEPTH TO:		
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE
	To B	3.25		
	24	4.25		

	CASING	SAMPLER	CORE BARREL
TYPE	HSA	~~Split Spoon~~	XXX
SIZE ID/OD	8.25" OD	~~2" ID~~	XXX
HAMMER WT	XXX	~~140 lb~~	XXX
HAMMER FALL	XXX	~~30"~~	XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					Auger boring next to BLE-10ab	
			SS-1			
5						
			SS-2			2" PVC Bentonite
10						
			SS-3			
15						
			SS-4			
20						

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP = 3.5
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 26.1
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = surface
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 29.15-39.15
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.3
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 39.45

TEST BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC J04-2225-04

BORING NO. BLG-10c

PAGE 2 OF 2

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					Auger refusal = 20.1' (see core log)	Bentonite
25			SS-5			
						26.
30			SS-6			29.1
				Bedrock		Sand
35			SS-7			
40			SS-8			39.1 39.4 39.9
45			SS-9			

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL MATERIALS
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	SAND = 1.5 bags
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	BENTONITE = 2.5 bags
21-30	VERY FIRM	9-15	STIFF	G	GRAB	
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	GROUT = NO
51+	VERY DENSE	31-50	HARD	B	BAG	WELL O.D. = 2"
		51+	VERY HARD	NR	NO RECOVERY	WELL TYPE = PVC

CORE BORING REPORT

BORING NO. BLE-10C

PROJECT: Madison Co. C&D Landfill - Madison Co., NC
CLIENT: McGill/Madison Co.
CONTRACTOR: BLE
EQUIPMENT USED: CME 750 ATV

BLE JOB NO. J04-2225-04
PAGE NO. 1 of 2
LOCATION:
ELEVATION:
DATE START: 11/8/04
DATE FINISH: 11/8/04
DRILLER: J. Gorman
PREPARED BY: M. Preddy

GROUND WATER		DEPTH TO:			ORIENTATION		CORE BARREL	
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE	X	VERTICAL	TYPE	NQ
						HORIZONTAL	TYPE	
						INCLINED	Bit (ft)	
						BEARING	Barrel (ft)	
						ANG. FROM VERT.	Total (ft)	

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD	FIELD CLASSIFICATION AND REMARKS	WELL
							(see boring log for BLE-10c)	
20		20.1	R-1	(4.1)	85	(2.5) 52	moderately hard, severely weathered, gray, white + brown, amphibole GNEISS; severely fractured to gravel size rock fragments	
25		24.9	R-2	(4.9)	98	(4.9) 98	v. hard, fresh, gray + white, coarse grained, Amphibole GNEISS; w/ widely spaced, steep and shallow dipping, iron-stained, fractures, and steeply-dipping well-developed foliation	
30		29.9	R-3	(5.0)	100	(5.0) 100	as above	
35		34.9						

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CANT SCRATCH	V. THIN	<2"	HORIZONTAL (0-5)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULTLY	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55)	MOD CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

ORDER FOR CORE DESCRIPTION: FIELD HARDNESS, WEATHERING, COLOR, GRAIN SIZE/TEXTURE, LITHOLOGY, FRACTURE CHARACTERISTICS, BEDDING AND FOLIATION, COMMENTS

Changes
Rod on
GS to TOR
Depth to bit
Run

WELL DESCRIPTION	
SCREEN DEPTH =	STICKUP =
SCREEN LENGTH =	TOP SAND =
END CAP =	TOP BENT. =
WELL TD =	BOT. CASING =

CORE BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC

J04-2225-04

BORING NO. BL6-10c

PAGE 2 OF 2

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD	FIELD CLASSIFICATION AND REMARKS	WELL
			R-4	(4.9)	98	(4.9) 98	as above	
40		39.9					3" diameter core hole	

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CANT SCRATCH	V. THIN	<2"	HORIZONTAL (0-5)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULTLY	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55)	MOD CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

ORDER FOR CORE DESCRIPTION: FIELD HARDNESS, WEATHERING, COLOR, GRAIN SIZE/TEXTURE, LITHOLOGY, FRACTURE CHARACTERISTICS, BEDDING AND FOLIATION, COMMENTS

Changes

Rod on

GS to TOR

Depth to bit

Run

WELL MATERIALS	
SAND =	GROUT =
	WELL O.D. =
BENTONITE =	CASING O.D. =
	WELL TYPE =

TEST BORING REPORT

BORING NO. BLE-11C

PROJECT: Madison Co. C&D Landfill - Madison Co., NC
CLIENT: McGill/Madison Co.
CONTRACTOR: BLE
EQUIPMENT USED: CME 750 ATV

BLE JOB NO. J04-2225-04
PAGE NO. 1 of 3
LOCATION:
ELEVATION:
DATE START: 10/29/04
DATE FINISH: 11/2/04
DRILLER: J. Gorman
PREPARED BY: M. Preddy

GROUND WATER DATE	HRS AFT COMP	DEPTH TO: WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	16.85		
	24	28.65		

	CASING	SAMPLER	CORE BARREL
TYPE	HSA	Split Spoon	XXX
SIZE ID/OD	8.25" OD	2" ID	XXX
HAMMER WT	XXX	140 lb	XXX
HAMMER FALL	XXX	30 "	XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS
					No topsoil (cut area)
5	5	2 2 3	SS-1	ML	Firm brown sli moist sli mic F. sdy cly SILT - residuum (bag sample = 2'-10')
10	9	2 3 6	SS-2	SM	loose gray-brown sli moist v. mic sli cly si F-M SAND
15	16	3 7 9	SS-3	SM	Firm as above
20	16	4 6 10	SS-4	SM	Firm brown sli moist mic sli cly si F-M SAND

WELL: 2" PVC; Bentonite

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP = 3.3
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 36.1
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = SURFACE
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 39.6-49.6
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.0
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 49.6

TEST BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC

J04-2225-04

BORING NO. BLE-11C

PAGE 2 OF 3

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
25	10	4 5 5	SS-5	Sm	loose as above	
30	50/5"	50/5"	SS-6	PWR	PWR SA gray sli moist mic si F-C SAND w/ gravel	BENT 2" PVC
				PWR	PWR SA gray gneiss rock fragments	
35	50/1"	50/1"	SS-7	Bedrock	Auger refusal = 34.0'	36.1
40			SS-8		(see core log)	SAND 39.6
45			SS-9			

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL MATERIALS
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	SAND =
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	BENTONITE =
21-30	VERY FIRM	9-15	STIFF	G	GRAB	
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	GROUT =
51+	VERY DENSE	31-50	HARD	B	BAG	WELL O.D. =
		51+	VERY HARD	NR	NO RECOVERY	WELL TYPE =

TEST BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC J04-2225-04

BORING NO. BLE-11C

PAGE 3 OF 3

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
				bedrock	(see core log)	SAND
50			SS-10			49.[illegible] 50.[illegible]
					boring terminated = 50.0'	
55			SS-11			
60			SS-12			
65			SS-13			
70			SS-14			

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL MATERIALS
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	SAND = 1 bag
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	BENTONITE = yes
21-30	VERY FIRM	9-15	STIFF	G	GRAB	
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	GROUT = NO
51+	VERY DENSE	31-50	HARD	B	BAG	WELL O.D. = 2"
		51+	VERY HARD	NR	NO RECOVERY	WELL TYPE = PVC

CORE BORING REPORT

BORING NO. BLE-11 c

PROJECT: Madison Co. C&D Landfill - Madison Co., NC
CLIENT: McGill/Madison Co.
CONTRACTOR: BLE
EQUIPMENT USED: CME 750 ATV

BLE JOB NO. J04-2225-04
PAGE NO. 1 of
LOCATION:
ELEVATION:
DATE START: 10/29/04
DATE FINISH: 11/2/04
DRILLER: J. Gorman
PREPARED BY: M. Preddy

GROUND WATER		DEPTH TO:			ORIENTATION		CORE BARREL	
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE	X	VERTICAL	TYPE	NQ
						HORIZONTAL	TYPE	
						INCLINED	Bit (ft)	
						BEARING	Barrel (ft)	
						ANG. FROM VERT.	Total (ft)	

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD	FIELD CLASSIFICATION AND REMARKS	WELL
							(See boring log for BLE-11c)	
35		34.0	R-1	(0.9)	90	90	hard to v. hard, slight to v. slightly weathered, gray and white, coarse-grained, amphibole GNEISS; w/ shallow and steeply dipping, close to moderately closely spaced, iron-stained fractures; and steeply dipping, well-developed foliation.	
		35.0	R-2	(4.7)	94	(3.9) 78		
40		40.0	R-3	(4.4)	88	(2.6) 52		
45		45.0	R-4	(5.0)	100	(5.0) 100		
50		50.0					3" diameter core hole	

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CANT SCRATCH	V. THIN	<2"	HORIZONTAL (0-5)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULTLY	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55)	MOD CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

ORDER FOR CORE DESCRIPTION: FIELD HARDNESS, WEATHERING, COLOR, GRAIN SIZE/TEXTURE, LITHOLOGY, FRACTURE CHARACTERISTICS, BEDDING AND FOLIATION, COMMENTS

Changes
Rod on
GS to TOR
Depth to bit
Run

WELL DESCRIPTION	
SCREEN DEPTH =	STICKUP =
SCREEN LENGTH =	TOP SAND =
END CAP =	TOP BENT. =
WELL TD =	BOT. CASING =

TEST BORING REPORT

BORING NO. BLE-12C

PROJECT: Madison Co. C&D Landfill - Madison Co., NC
CLIENT: McGill/Madison Co.
CONTRACTOR: BLE
EQUIPMENT USED: CME 750 ATV

BLE JOB NO. J04-2225-04
PAGE NO. 1 of 2
LOCATION:
ELEVATION:
DATE START: 10/25/04
DATE FINISH: 11/10/04
DRILLER: J. Gorman
PREPARED BY: M. Preddy

GROUND WATER		DEPTH TO:		
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE
	24	2.95		

	CASING	SAMPLER	CORE BARREL
TYPE	HSA	Split Spoon	XXX
SIZE ID/OD	8.25" OD	2" ID	XXX
HAMMER WT	XXX	140 lb	XXX
HAMMER FALL	XXX	30 "	XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS
					Topsoil
5	13	3 5 8	SS-1	ML	stiff brown + gray sli moist cly sILT - alluvium
10			UD	CH	Firm gray moist si CLAY - alluvium
15			SS-3	Bedrock	Auger refusal = 12.5' (see core log)
20			SS-4		

WELL: BENT; SAND; 17.0; 20.17

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP = 3.0
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 17.0
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = Surface
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 20.17-30.17
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.0
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 30.17

TEST BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC J04-2225-04

BORING NO. BLE-12C

PAGE 2 OF 2

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
				Bedrock	(See core log)	SAND
25			SS-5			
30			SS-6			30.1 30.5
					Boring terminated = 30.5'	
35			SS-7			
40			SS-8			
45			SS-9			

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL MATERIALS
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	SAND = 1 bag
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	BENTONITE = 2 bags
21-30	VERY FIRM	9-15	STIFF	G	GRAB	
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	GROUT = NO
51+	VERY DENSE	31-50	HARD	B	BAG	WELL O.D. = 2"
		51+	VERY HARD	NR	NO RECOVERY	WELL TYPE = PVC

CORE BORING REPORT

BORING NO. BLE-12c

PROJECT: Madison Co. C&D Landfill - Madison Co., NC
CLIENT: McGill/Madison Co.
CONTRACTOR: BLE
EQUIPMENT USED: CME 750 ATV

BLE JOB NO. J04-2225-04
PAGE NO. 1 of 2
LOCATION:
ELEVATION:
DATE START: 10/25/04
DATE FINISH: 11/10/04
DRILLER: J. Gorman
PREPARED BY: M. Preddy

GROUND WATER		DEPTH TO:			ORIENTATION		CORE BARREL	
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE	X	VERTICAL	TYPE	NQ
						HORIZONTAL	TYPE	
						INCLINED	Bit (ft)	
						BEARING	Barrel (ft)	
						ANG. FROM VERT.	Total (ft)	

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD	FIELD CLASSIFICATION AND REMARKS	WELL
10							(See boring log for BLE-12c)	
15		12.9	R-1	(2.0)	77	(1.7) 65	hard to v. hard, v. slightly weathered to fresh, gray and white, coarse-grained, amphibole GNEISS, w/ shallow dipping, close to moderately closely spaced fractures; and steeply dipping well-developed foliation.	
20		15.5	R-2	(4.8)	96	(4.8) 96		
25		20.5	R-3	(4.9)	98	(4.9) 98		

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CANT SCRATCH	V. THIN	<2"	HORIZONTAL (0-5)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULTLY	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55)	MOD CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

ORDER FOR CORE DESCRIPTION: FIELD HARDNESS, WEATHERING, COLOR, GRAIN SIZE/TEXTURE, LITHOLOGY, FRACTURE CHARACTERISTICS, BEDDING AND FOLIATION, COMMENTS

Changes
Rod on
GS to TOR
Depth to bit
Run

WELL DESCRIPTION	
SCREEN DEPTH =	STICKUP =
SCREEN LENGTH =	TOP SAND =
END CAP =	TOP BENT. =
WELL TD =	BOT. CASING =

CORE BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC

J04-2225-04

BORING NO. BLG-12C

PAGE 2 OF 2

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD	FIELD CLASSIFICATION AND REMARKS	WELL
		25.5						
			R-4	(5.0)	100	(5.0) 100	as above	
30								
		30.5					3" diameter core hole	
35								

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CANT SCRATCH	V. THIN	<2"	HORIZONTAL (0-5)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULTLY	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55)	MOD CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

ORDER FOR CORE DESCRIPTION: FIELD HARDNESS, WEATHERING, COLOR, GRAIN SIZE/TEXTURE, LITHOLOGY, FRACTURE CHARACTERISTICS, BEDDING AND FOLIATION, COMMENTS

Changes

Rod on

GS to TOR

Depth to bit

Run

WELL MATERIALS	
SAND =	GROUT =
	WELL O.D. =
BENTONITE =	CASING O.D. =
	WELL TYPE =

TEST BORING REPORT

BORING NO. BLE-13C

PROJECT: Madison Co. C&D Landfill - Madison Co., NC
CLIENT: McGill/Madison Co.
CONTRACTOR: BLE
EQUIPMENT USED: CME 750 ATV

BLE JOB NO. J04-2225-04
PAGE NO. 1 of 2
LOCATION:
ELEVATION:
DATE START: 10/25/04
DATE FINISH: 11/9/04
DRILLER: J. Gorman
PREPARED BY: M. Preddy

GROUND WATER DATE	HRS AFT COMP	DEPTH TO: WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	11.65		
	24	19.65		

	CASING	SAMPLER	CORE BARREL
TYPE	HSA	Split Spoon	XXX
SIZE ID/OD	8.25" OD	2" ID	XXX
HAMMER WT	XXX	140 lb	XXX
HAMMER FALL	XXX	30 "	XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					Topsoil	
5	Ce	2 2 4	SS-1	ML	Firm yel-br sli moist cly SILT - residuum	
10	10	3 4 6	SS-2	ML	stiff brown moist mic F, Sdy cly SILT (bag sample = 1'-10')	2" pvc Bent.
15	50/3"	37 50/3"	SS-3	PWR	PWR SA gray sli moist mic si F-C SAND	
20	50/2"	50/2"	SS-4	PWR	PWR SA gray gneiss rock fragments	

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP = 3.4
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 26.75
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = SURFACE
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 29.85-39.85
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.0
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 40.15

TEST BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC J04-2225-04

BORING NO. BLE-13C

PAGE 2 OF 2

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					Auger refusal = 22.0'	BENT 2" PVC
25			SS-5			
						26.7
30			SS-6		(see core log)	29.8
				Bedrock		SAND
35			SS-7			
40			SS-8			39.85 40.15
					Boring terminated = 40.15'	
45			SS-9			

BLOWS/FT	DENSITY
0-4	VERY LOOSE
5-10	LOOSE
11-20	FIRM
21-30	VERY FIRM
31-50	DENSE
51+	VERY DENSE

BLOWS/FT	CONSISTANCY
0-2	VERY SOFT
3-4	SOFT
5-8	FIRM
9-15	STIFF
16-30	VERY STIFF
31-50	HARD
51+	VERY HARD

SAMPLE ID	
SS	SPLIT SPOON
HP	HYDROPUNCH
UD	UNDISTURBED TUBE
G	GRAB
C	COMPOSITE
B	BAG
NR	NO RECOVERY

WELL MATERIALS

SAND = 1 bag

BENTONITE = 2.5 bags

GROUT = NO

WELL O.D. = 2"

WELL TYPE = PVC

CORE BORING REPORT

BORING NO. BLE-13c

PROJECT: Madison Co. C&D Landfill - Madison Co., NC
CLIENT: McGill/Madison Co.
CONTRACTOR: BLE
EQUIPMENT USED: CME 750 ATV

BLE JOB NO. J04-2225-04
PAGE NO. 1 of 2
LOCATION:
ELEVATION:
DATE START: 10/25/04
DATE FINISH: 11/9/04
DRILLER: J. Gorman
PREPARED BY: M. Preddy

GROUND WATER		DEPTH TO:			ORIENTATION		CORE BARREL	
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE	X	VERTICAL	TYPE	NQ
						HORIZONTAL	TYPE	
						INCLINED	Bit (ft)	
						BEARING	Barrel (ft)	
						ANG. FROM VERT.	Total (ft)	

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD	FIELD CLASSIFICATION AND REMARKS	WELL
							(see boring log for BLE-13c)	
20								
		22.0	R-1	(3.0)	100	(3.0) 100	hard to v. hard, slightly weathered to fresh, gray & white, coarse-grained, Amphibole GNEISS; w/ shallow to moderately dipping, close to widely spaced fractures; and steeply dipping, well-developed foliation	
25		25.0	R-2	(5.0)	100	(5.0) 100		
30		30.0	R-3	(5.0)	100	(3.8) 76		
35		35.0						

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CANT SCRATCH	V. THIN	<2"	HORIZONTAL (0-5)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULTLY	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55)	MOD CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

ORDER FOR CORE DESCRIPTION: FIELD HARDNESS, WEATHERING, COLOR, GRAIN SIZE/TEXTURE, LITHOLOGY, FRACTURE CHARACTERISTICS, BEDDING AND FOLIATION, COMMENTS

Changes
Rod on
GS to TOR
Depth to bit
Run

WELL DESCRIPTION	
SCREEN DEPTH =	STICKUP =
SCREEN LENGTH =	TOP SAND =
END CAP =	TOP BENT. =
WELL TD =	BOT. CASING =

CORE BORING REPORT

Madison Co. C&D Landfill - Madison Co., NC

J04-2225-04

BORING NO. BLF-13c

PAGE 2 OF 2

DEPTH IN FEET	DRILL RATE MIN/FT	CORE NO. DEPTH RANGE	SAMPLE NUMBER	RECOVERY FT	RECOVERY %	RQD	FIELD CLASSIFICATION AND REMARKS	WELL
			R-4	(4.3)	83	(3.2) 62	as above	
40		40.2					3" diameter core hole	
45								

FIELD HARDNESS		BEDDING		ATTITUDE AND ANGLE	JOINTS / SHEAR / FRACTURE		WEATHERING
V. HARD	- KNIFE CANT SCRATCH	V. THIN	<2"	HORIZONTAL (0-5)	V. CLOSE	<2"	FRESH
HARD	- SCRATCHES DIFFICULTLY	THIN	2"-12"	SHALLOW OR LOW ANGLE (5-35)	CLOSE	2"-12"	V. SLIGHT
MOD. HARD	- SCRATCHES EASILY	MEDIUM	12"-36"	MODERATELY DIPPING (35-55)	MOD CLOSE	12"-36"	SLIGHT
SOFT	- GROVES	THICK	36"-120"	STEEP OR HIGH ANGLE (55-85)	WIDE	36"-120"	MODERATE
V. SOFT	- CARVES	V. THICK	>120"	VERTICAL (85-90)	V. WIDE	>120"	MOD. SEVERE
							V. SEVERE
							COMPLETE

ORDER FOR CORE DESCRIPTION: FIELD HARDNESS, WEATHERING, COLOR, GRAIN SIZE/TEXTURE, LITHOLOGY, FRACTURE CHARACTERISTICS, BEDDING AND FOLIATION, COMMENTS

Changes

Rod on

GS to TOR

Depth to bit

Run

WELL MATERIALS	
SAND =	GROUT =
	WELL O.D. =
BENTONITE =	CASING O.D. =
	WELL TYPE =

KEY TO SOIL CLASSIFICATIONS AND CONSISTENCY DESCRIPTIONS

BUNNELL-LAMMONS ENGINEERING, INC.
GREENVILLE, SOUTH CAROLINA

Penetration Resistance* Blows per Foot	Relative Density
SANDS	
0 to 4	Very Loose
5 to 10	Loose
11 to 20	Firm
21 to 30	Very Firm
31 to 50	Dense
over 50	Very Dense

Penetration Resistance* Blows per Foot	Consistency
SILTS and CLAYS	
0 to 2	Very Soft
3 to 4	Soft
5 to 8	Firm
9 to 15	Stiff
16 to 30	Very Stiff
31 to 50	Hard
over 50	Very Hard

*ASTM D 1586

Particle Size Identification

Boulder: Greater than 300 mm
Cobble: 75 to 300 mm
Gravel:
Coarse - 19 to 75 mm
Fine - 4.75 to 19 mm
Sand:
Coarse - 2 to 4.75 mm
Medium - 0.425 to 2 mm
Fine - 0.075 to 0.425 mm
Silt & Clay: Less than 0.075 mm

KEY TO DRILLING SYMBOLS

Screened Interval of Piezometer

Split Spoon Sample

Undisturbed Sample

Groundwater Table at Time of Drilling

Groundwater Table 24 Hours after Completion of Drilling

KEY TO SOIL CLASSIFICATIONS

Topsoil

High Plasticity Clay

Low Plasticity Clay

High Plasticity Silt

Low Plasticity Silt

Clayey Sand

Silty Sand

Partially Weathered Rock

Bedrock

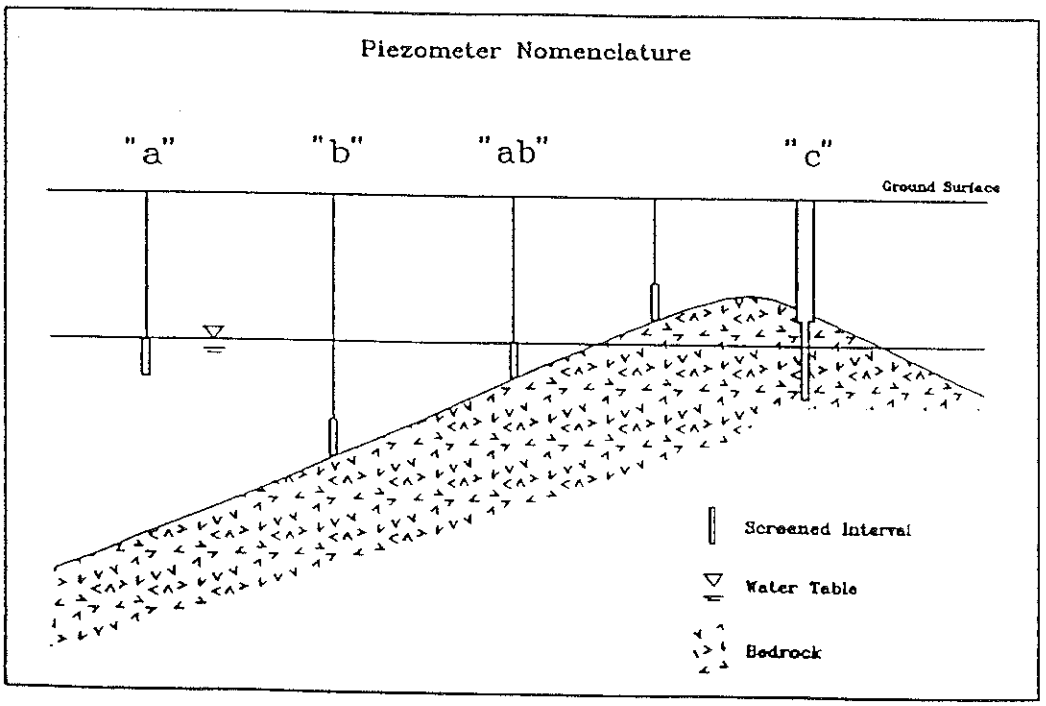
APPENDIX C

SOIL TEST BORING/ROCK CORING RECORDS AND PIEZOMETER DIAGRAMS

Piezometer Construction and Nomenclature

Piezometer identification numbers were designated with the letters "a," "b," or "c" depending on the location of the screened interval in the piezometer. Piezometers with a screened interval which brackets the water table and is above the depth of auger refusal were designated with the letter "a." Piezometers with a screened interval at the depth of auger refusal (top of bedrock surface) and below the water table were designated with the letter "b." In cases where the water table was near the depth of auger refusal, the piezometer identification number was designated using "ab." Bedrock piezometers were designated with the letter "c". Piezometers that are dry do not have a letter designation.

A typical schematic diagram of piezometer construction and nomenclature is shown below.



PIEZOMETER NO. BLE-6B

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PROJECT: Madison County C & D Landfill
PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County
START: 10-26-04 END: 10-26-04
LOCATION: Madison County, North Carolina
ELEVATION: 1967.51
DRILLER: BLE, Inc., J. Gorman
LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 21.44 AFTER 24 HOURS: ▼ 21.7 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
	6-inches of TOPSOIL				SURFACE COMPLETION 3.72-foot stick-up
1965 / 2	Very stiff, reddish-yellow, slightly moist, fine sandy, clayey SILT - (residuum)				
4				18	
6					Grout, 0 to 11.2 feet
1960 / 8					
10				20	
1955 / 12	Firm, brown, very micaceous, slightly moist, slightly clayey, fine to medium sandy SILT				
14				7	
16					
1950 / 18					Bentonite seal, 11.2 to 27 feet
20				6	
22					
1945 / 24				UD	
26					
1940 / 28	Very dense, grayish-brown, very micaceous, slightly moist, silty, fine to medium SAND				
30				54	Filter pack, sand 27 to 39.2 feet
1935 / 32	PARTIALLY WEATHERED ROCK which sampled as grayish-brown, very micaceous, moist, silty, fine to medium SAND				
34				50/4"	2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 28.9 to 38.9 feet
36					
1930 / 38				50/5"	Pipe cap

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-6B

PROJECT: Madison County C & D Landfill
PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County
START: 10-26-04 END: 10-26-04
LOCATION: Madison County, North Carolina
ELEVATION: 1967.51
DRILLER: BLE, Inc., J. Gorman
LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 21.44 AFTER 24 HOURS: ▼ 21.7 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1925 – 42	Auger refusal at 39.2 feet. Ground water encountered at 21.44 feet at time of drilling and at 21.7 feet after 24 hours.				Total well depth, 39.2 feet
44					
46					
1920 – 48					
50					
1915 – 52					
54					
56					
1910 – 58					
60					
1905 – 62					
64					
66					
1900 – 68					
70					
1895 – 72					
74					
76					
1890 – 78					

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

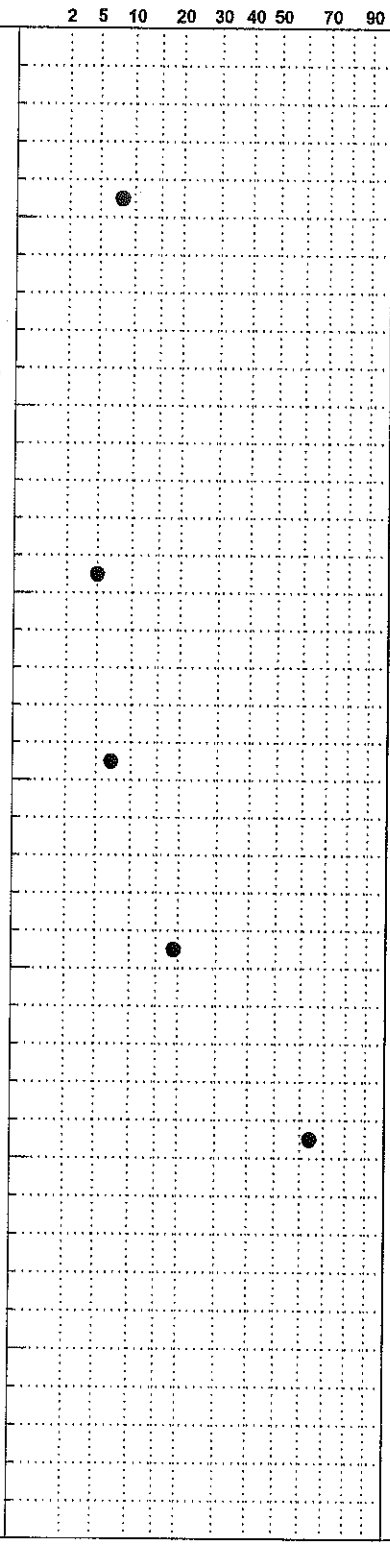
BUNNELL-LAMMONS ENGINEERING, INC.

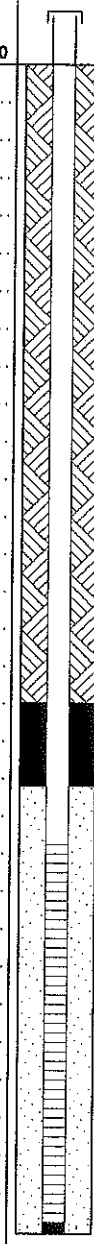
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-7AB

PROJECT: Madison County C & D Landfill
PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County
START: 10-27-04 END: 10-27-04
LOCATION: Madison County, North Carolina
ELEVATION: 1944.17
DRILLER: BLE, Inc., J. Gorman
LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: 22.78 AFTER 24 HOURS: 22.55 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
	6-inches of TOPSOIL			SURFACE COMPLETION 3.19-foot stick-up
	Firm, yellowish-red, slightly moist, fine sandy, clayey SILT - (residuum)			
1940 / 4			8	
	Firm, reddish-brown, slightly moist, very micaceous, slightly clayey, fine sandy SILT			Grout, 0 to 16.95 feet
1935 / 10			UD	
1930 / 14			5	
	Firm, reddish-brown, slightly moist, very micaceous, slightly clayey, fine sandy SILT with black slicken-sided fracture surfaces			Bentonite seal, 16.95 to 19.2 feet
1925 / 20			7	Filter pack, sand 19.2 to 31.05 feet
	Firm to very dense, olive and yellowish-brown, slightly moist, micaceous, silty, fine to coarse SAND with gravel size rock fragments			
1920 / 24			19	2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 20.75 to 30.75 feet
1915 / 30			64	
	Auger refusal at 31.05 feet. Ground water encountered at 22.78 feet at time of drilling and at 22.55 feet after 24 hours.			Pipe cap Total well depth, 31.05 feet
1910 / 34				
1905 / 38				





OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-8B

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04

CLIENT: McGill/Madison County — START: 10-27-04 END: 10-27-04

LOCATION: Madison County, North Carolina — ELEVATION: 1956.14

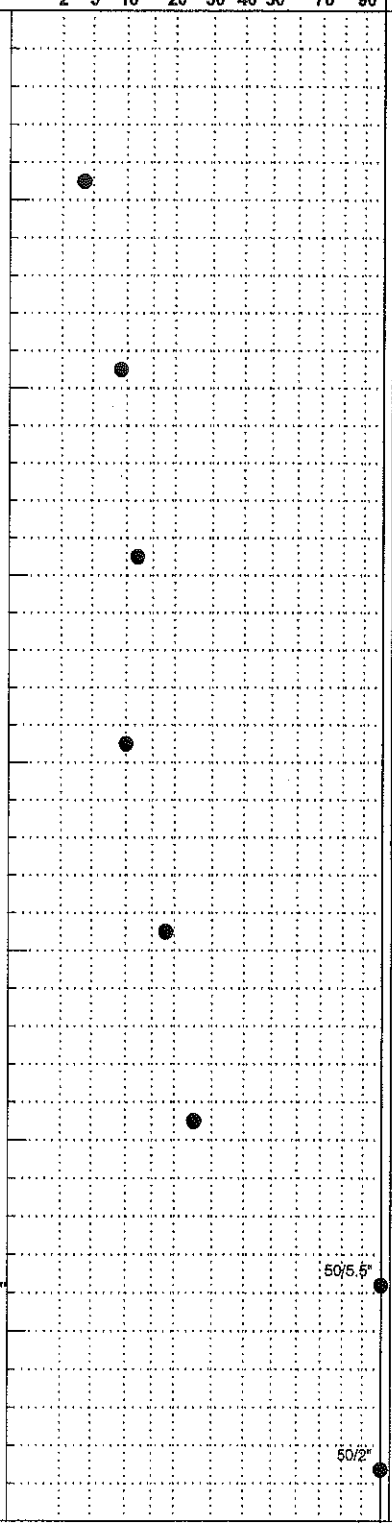
DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy

DRILLING METHOD: CME 750 ATV Hollow stem auger

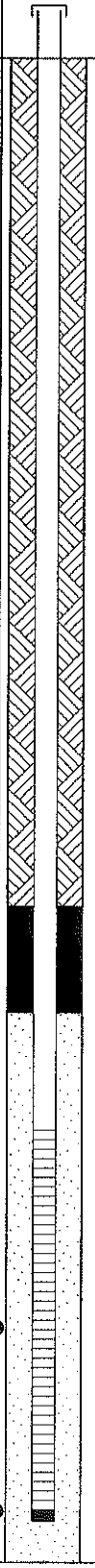
DEPTH TO - WATER> INITIAL: 20.7 AFTER 24 HOURS: 20.5 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES
	6-inches of TOPSOIL		
1955	Soft, reddish-brown, moist, slightly micaceous, clayey SILT - (residuum)		
1950	Stiff, yellowish-brown, slightly moist, slightly micaceous, clayey, fine sandy SILT		
1945			
1940			
1935	Loose, grayish-brown, slightly moist, very micaceous, silty, fine to medium SAND		
1930	Firm to very firm, grayish-brown, moist, very micaceous, silty, fine to coarse SAND		
1925			
1920	PARTIALLY WEATHERED ROCK which sampled as grayish-brown, moist, silty, fine to coarse SAND		

STANDARD PENETRATION RESULTS BLOWS/FOOT



MONITOR WELL INSTALLATION DETAILS



SURFACE COMPLETION
3.52-foot stick-up

Grout, 0 to 22.64 feet

Bentonite seal, 22.64 to 25.5 feet

Filter pack, sand 25.5 to 40 feet

2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 28.6 to 38.6 feet

Pipe cap

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-8B

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04

CLIENT: McGill/Madison County — START: 10-27-04 END: 10-27-04

LOCATION: Madison County, North Carolina — ELEVATION: 1956.14

DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy

DRILLING METHOD: CME 750 ATV Hollow stem auger

DEPTH TO - WATER> INITIAL: 20.7 AFTER 24 HOURS: 20.5 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1915	Boring terminated at 40 feet. Ground water encountered at 20.7 feet at time of drilling and at 20.5 feet after 24 hours.				Total well depth, 38.9 feet
42					
44					
1910 46					
48					
50					
1905					
52					
54					
1900 56					
58					
60					
1895					
62					
64					
1890 66					
68					
70					
1885					
72					
74					
1880 76					
78					

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-9C

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04

CLIENT: McGill/Madison County — START: 10-28-04 END: 11-11-04

LOCATION: Madison County, North Carolina — ELEVATION: 2007.43

DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy

DRILLING METHOD: CME 750 ATV Hollow stem auger

DEPTH TO - WATER> INITIAL: 45.2 AFTER 24 HOURS: CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
2005 / 2	Firm, reddish-brown, moist, slightly micaceous, clayey SILT - (residuum) (Bag sample taken from 1 to 10 feet)		
4		5	
6			
2000 / 8			
10		5	
1995 / 12	Stiff, brown, slightly moist, micaceous, slightly clayey, fine sandy SILT		
14		9	
16			
1990 / 18	Firm, brown, slightly moist, very micaceous, silty, fine to medium SAND		
20		UD	
22			
1985 / 24	Firm, olive and reddish-brown, moist, micaceous, clayey, silty, fine to medium SAND		
26		19	
1980 / 28	Dense, gray and brown, slightly moist, micaceous, silty, fine to coarse SAND with gravel		
30		45	
32			
1975 / 34	no recovery	50/2"	50/2"
36	Moderately hard, moderately weathered, gray and white, coarse grained amphibole GNEISS; with very close to closely spaced, horizontal to moderately dipping and widely spaced steeply dipping, iron-stained fractures; and steeply dipping well-developed foliation		
1970 / 38		R-1	

MONITOR WELL INSTALLATION DETAILS

SURFACE COMPLETION
3.26-foot stick-up

Bentonite seal, 0 to 42.4 feet

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-9C

PROJECT: Madison County C & D Landfill
PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County
START: 10-28-04 END: 11-11-04
LOCATION: Madison County, North Carolina
ELEVATION: 2007.43
DRILLER: BLE, Inc., J. Gorman
LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: 45.2 AFTER 24 HOURS: CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1965 – 42, 44, 46, 1960 – 48, 50	Moderately hard, moderately weathered, gray and white, coarse grained amphibole GNEISS; with very close to closely spaced, horizontal to moderately dipping and widely spaced steeply dipping, iron-stained fractures; and steeply dipping well-developed foliation R-1 recovery = 95%, RQD = 39 R-2 recovery = 88%, RQD = 36 R-3 recovery = 78%, RQD = 0		R-2, R-3		Filter pack, sand 42.4 to 54.9 feet 1-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 44.9 to 54.9 feet
1955 – 52, 54	Very hard, fresh, gray and white, coarse-grained amphibole GNEISS with widely spaced horizontal and steeply dipping iron-stained fractures; and steeply dipping well-developed foliation R-4 recovery = 100%, RQD = 76		R-4		
1950 – 56, 58, 60, 1945 – 62, 64, 66, 1940 – 68, 70, 1935 – 72, 74, 76, 1930 – 78	Auger refusal at 35.0 feet. Ground water encountered at 45.2 feet at time of drilling.				Total well depth, 54.9 feet Core hole diameter, 3-inches

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-10AB

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04

CLIENT: McGill/Madison County — START: 11-3-04 END: 11-3-04

LOCATION: Madison County, North Carolina — ELEVATION: 1955.21

DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy

DRILLING METHOD: CME 750 ATV Hollow stem auger

DEPTH TO - WATER> INITIAL: 5.63 AFTER 24 HOURS: 4.3 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1955	Firm, brown, moist, silty CLAY - (alluvium)				SURFACE COMPLETION 4.0-foot stick-up
2, 4, 6			6		Bentonite seal, 0 to 9.1 feet
8, 10	Very stiff, grayish-green, moist, micaceous, fine sandy, silty CLAY with quartz gravel		22		Filter pack, sand 9.1 to 21.3 feet
12, 14, 16	Stiff, yellowish-red, slightly moist, micaceous, fine sandy, clayey SILT - (residuum)		10		2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 11 to 21 feet
18, 20	PARTIALLY WEATHERED ROCK which sampled as dark gray, very moist, micaceous, clayey, silty, fine to coarse SAND with gravel		50/4"	50/4"	
22, 24	Auger refusal at 21.3 feet. Ground water encountered at 5.63 feet at time of drilling and at 4.3 feet after 24 hours.				Pipe cap Total well depth, 21.3 feet
1950, 1945, 1940, 1935, 1930, 1925, 1920					
26, 28, 30, 32, 34, 36, 38					

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-10C

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04

CLIENT: McGill/Madison County — START: 11-8-04 END: 11-8-04

LOCATION: Madison County, North Carolina — ELEVATION: 1955.27

DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy

DRILLING METHOD: CME 750 ATV Hollow stem auger

DEPTH TO - WATER> INITIAL: 3.25 AFTER 24 HOURS: 4.25 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1955	Firm, brown, moist, silty CLAY - (alluvium)				SURFACE COMPLETION 3.24-foot stick-up
2					
4					
1950			6		
6					
8	Very stiff, grayish-green, moist, micaceous, fine sandy, silty CLAY with quartz gravel				
1945			22		
10					
12	Stiff, yellowish-red, slightly moist, micaceous, fine sandy, clayey SILT - (residuum)				Bentonite seal, 0 to 26.1 feet
14			10		
1940					
16					
18	PARTIALLY WEATHERED ROCK which sampled as dark gray, very moist, micaceous, clayey, silty, fine to coarse SAND with gravel		50/4"	50/4"	
1935					
20	Moderately hard, severely weathered, gray, white and brown, amphibole GNEISS; severely fractured to gravel size rock fragments				
22	R-1 recovery = 85%, RQD = 52		R-1		
24	Very hard, fresh, gray and white, coarse grained, amphibole GNEISS; with widely spaced, steep and shallow dipping, iron-stained fractures; and steeply-dipping well-developed foliation				
1930					
26	R-2 recovery = 98%, RQD = 98				Filter pack, sand 26.1 to 39.9 feet
28	R-3 recovery = 100%, RQD = 100		R-2		
1925	R-4 recovery = 98%, RQD = 98				
30					
32			R-3		
34					1-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 29.15 to 39.15 feet
1920					
36					
38			R-4		
					Pipe cap

OLD GEOT WELL 2225-04.GPJ 8/10/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-10C

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04

CLIENT: McGill/Madison County — START: 11-8-04 END: 11-8-04

LOCATION: Madison County, North Carolina — ELEVATION: 1955.27

DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy

DRILLING METHOD: CME 750 ATV Hollow stem auger

DEPTH TO - WATER> INITIAL: 3.25 AFTER 24 HOURS: 4.25 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1915	Auger refusal at 20.1 feet. Ground water encountered at 3.25 feet at time of drilling and at 4.25 feet after 24 hours.				Total well depth, 39.45 feet Core hole diameter, 3-inches
42					
44					
1910					
46					
48					
1905					
50					
52					
54					
1900					
56					
58					
1895					
60					
62					
64					
1890					
66					
68					
1885					
70					
72					
74					
1880					
76					
78					

OLD GEOT WELL 2225-04.GPJ 8/10/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-11C

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04

CLIENT: McGill/Madison County — START: 10-29-04 END: 11-2-04

LOCATION: Madison County, North Carolina — ELEVATION: 1991.47

DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy

DRILLING METHOD: CME 750 ATV Hollow stem auger

DEPTH TO - WATER> INITIAL: 16.85 AFTER 24 HOURS: 28.65 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1990 / 2	No topsoil (cut area) Firm, brown, slightly moist, slightly micaceous, fine sandy, clayey SILT - (residuum) (Bag sample taken from 2 to 10 feet)				SURFACE COMPLETION 3.31-foot stick-up
4			5		
1985 / 6					
8	Loose to firm, grayish-brown, slightly moist, very micaceous, slightly clayey, silty, fine to medium SAND				
10			9		
1980 / 12					
14			16		
1975 / 16					
18	Firm to loose, brown, slightly moist, micaceous, slightly clayey, silty, fine to medium SAND				Bentonite seal, 0 to 36.1 feet
20			16		
1970 / 22					
24			10		
1965 / 26					
28	PARTIALLY WEATHERED ROCK which sampled as gray, slightly moist, micaceous, silty, fine to coarse SAND with gravel		50/5"	50/5"	
30					
1960 / 32	PARTIALLY WEATHERED ROCK which sampled as gray GNEISS rock fragments		50/1"	50/1"	
34	Hard to very hard, slight to very slightly weathered, gray and white, coarse-grained, amphibole GNEISS; with shallow and steeply dipping, close to moderately closely spaced, iron-stained fractures; and steeply dipping, well-developed foliation. R-1 recovery = 90%, RQD = 90 R-2 recovery = 94%, RQD = 78 R-3 recovery = 88%, RQD = 52 R-4 recovery = 100%, RQD = 100		R-1		
1955 / 36					Filter pack, sand 36.1 to 50 feet
38			R-2		

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-11C

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04

CLIENT: McGill/Madison County — START: 10-29-04 END: 11-2-04

LOCATION: Madison County, North Carolina — ELEVATION: 1991.47

DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy

DRILLING METHOD: CME 750 ATV Hollow stem auger

DEPTH TO - WATER> INITIAL: 16.85 AFTER 24 HOURS: 28.65 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1950, 42, 44, 46, 1945, 48, 50	Hard to very hard, slight to very slightly weathered, gray and white, coarse-grained, amphibole GNEISS; with shallow and steeply dipping, close to moderately closely spaced, iron-stained fractures; and steeply dipping, well-developed foliation. R-1 recovery = 90%, RQD = 90 R-2 recovery = 94%, RQD = 78 R-3 recovery = 88%, RQD = 52 R-4 recovery = 100%, RQD = 100		R-3, R-4		1-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 39.6 to 49.6 feet
1940, 52, 54, 56, 1935, 58, 60, 1930, 62, 64, 66, 1925, 68, 70, 1920, 72, 74, 76, 1915, 78	Auger refusal at 34 feet. Ground water encountered at 16.85 feet at time of drilling and at 28.65 feet after 24 hours.				Total well depth, 49.6 feet Corehole diameter, 3-inches

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-12A

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04

CLIENT: McGill/Madison County — START: 4-19-05 END: 4-19-05

LOCATION: Madison County, North Carolina — ELEVATION: 1981.13

DRILLER: BLE, Inc., C. Brown — LOGGED BY: C. Brown

DRILLING METHOD: Hand auger

DEPTH TO - WATER> INITIAL: NM AFTER 24 HOURS: 2.95 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1980 / 2	4-inches of brown and dark brown, silty, sandy TOPSOIL with grass roots Brown and gray, slightly clayey, fine sandy SILT with some thin banding (horizontal) of brown and light brown, silty, fine SAND - (slightly moist)				SURFACE COMPLETION 1.88-foot stick-up Ground surface elev. = 1981.13' Top of casing elev. = 1983.01' Bentonite seal, 0 to 2.33 feet Filter pack, sand 2.33 to 6.25 feet 1-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 3.25 to 6.25 feet Pipe cap Total well depth, 6.25 feet
4	Brown and gray to brown, moist, fiine sandy, silty CLAY Clay was fairly dense				
1975 / 6	Auger refusal at 6.25 feet, no recovery. No ground water encountered at time of drilling but was encountered at 2.95 feet after 24 hours. Possible water at bottom of boring after 15 minutes.				
8					
10					
1970 / 12					
14					
1965 / 16					
18					
20					
1960 / 22					
24					
1955 / 26					
28					
30					
1950 / 32					
34					
1945 / 36					
38					

OLD GEOT WELL 2225-04.GPJ 8/10/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-12C

PROJECT: Madison County C & D Landfill
PROJECT NO.: J04-2225-04
CLIENT: McGill/Madison County
START: 10-25-04 END: 11-10-04
LOCATION: Madison County, North Carolina
ELEVATION: 1981.13
DRILLER: BLE, Inc., J. Gorman
LOGGED BY: M. Preddy
DRILLING METHOD: CME 750 ATV Hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ AFTER 24 HOURS: ▼ 2.95 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
1980 – 2	6-Inches of TOPSOIL Stiff, brown and gray, slightly moist, clayey SILT - (alluvium)				SURFACE COMPLETION 3.20-foot stick-up
4			13		
1975 – 6					
8	Firm, gray, moist, silty CLAY - (alluvium)				Bentonite seal, 0 to 17 feet
10			UD		
1970 – 12					
14	Hard to very hard, very slightly weathered to fresh, gray and white, coarse-grained, amphibole GNEISS; with shallow dipping, close to moderately closely spaced fractures; and steeply dipping well-developed foliation. R-1 recovery = 77%, RQD = 65 R-2 recovery = 96%, RQD = 96 R-3 recovery = 98%, RQD = 98 R-4 recovery = 100%, RQD = 100		R-1		
1965 – 16					
18			R-2		Filter pack, sand 17 to 30.5 feet
20					
1960 – 22					
24			R-3		
1955 – 26					1-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 20.17 to 30.17 feet
28			R-4		
30					
1950 – 32	Auger refusal at 12.5 feet. Ground water was not encountered at time of drilling but was encountered at 2.95 feet after 24 hours.				Total well depth, 30.17 feet Core hole diameter, 3-inches
34					
1945 – 36					
38					

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-13C

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04

CLIENT: McGill/Madison County — START: 10-25-04 END: 11-9-04

LOCATION: Madison County, North Carolina — ELEVATION: 2013.05

DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy

DRILLING METHOD: CME 750 ATV Hollow stem auger

DEPTH TO - WATER> INITIAL: 11.65 AFTER 24 HOURS: 19.65 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
	6-inches of TOPSOIL Firm, yellowish-brown, slightly moist, clayey SILT - (residuum)				SURFACE COMPLETION 3.27-foot stick-up
2010 / 2 / 4 / 6			6		
2005 / 8 / 10	Stiff, brown, moist, micaceous, fine sandy, clayey SILT (bag sample taken from 1 to 10 feet)		10		
2000 / 12 / 14 / 16	PARTIALLY WEATHERED ROCK which sampled as gray, slightly moist, micaceous, silty, fine to coarse SAND		50/3"	50/3"	Bentonite seal, 0 to 26.75 feet
1995 / 18 / 20	PARTIALLY WEATHERED ROCK which sampled as gray GNEISS rock fragments		50/2"	50/2"	
1990 / 22 / 24 / 26	Hard to very hard, slightly weathered to fresh, gray and white, coarse-grained, amphibole GNEISS; with shallow to moderately dipping, close to widely spaced fractures; and steeply dipping, well-developed foliation R-1 recovery = 100%, RQD = 100 R-2 recovery = 100%, RQD = 100 R-3 recovery = 100%, RQD = 76 R-4 recovery = 83%, RQD = 62		R-1		
1985 / 28 / 30			R-2		Filter pack, sand 26.75 to 40.15 feet
1980 / 32 / 34			R-3		
1975 / 36 / 38			R-4		1-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 29.85 to 39.85 feet

OLD GEOT WELL 2225-04.GPJ 7/20/05

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PIEZOMETER NO. BLE-13C

PROJECT: Madison County C & D Landfill — PROJECT NO.: J04-2225-04

CLIENT: McGill/Madison County — START: 10-25-04 END: 11-9-04

LOCATION: Madison County, North Carolina — ELEVATION: 2013.05

DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy

DRILLING METHOD: CME 750 ATV Hollow stem auger

DEPTH TO - WATER> INITIAL: 11.65 AFTER 24 HOURS: 19.65 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
42	Auger refusal at 22 feet. Ground water encountered at 11.65 feet at time of drilling and at 19.65 feet after 24 hours.				Pipe cap
1970					Total well depth, 40.15 feet
44					Core hole diameter, 3-Inches
46					
1965 48					
50					
52					
1960					
54					
56					
1955 58					
60					
62					
1950					
64					
66					
1945 68					
70					
72					
1940					
74					
76					
1935 78					

OLD GEOT WELL 2225-04.GPJ 7/20/05

Appendix 5

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE (919)733-3221

FOR OFFICE USE ONLY
Quad. No. K 88 d Serial No.
Lat 35 48 40 Long 82 45 25 Pc
Minor Basin
Basin Code
Header Ent. GW-1 Ent.

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR METRO DRILL INC.
DRILLER REGISTRATION NUMBER 1282
STATE WELL CONSTRUCTION PERMIT NUMBER: 57-0016-WM-0016

1. WELL LOCATION: (Show sketch of the location below) MW-1
Nearest Town: MARSHALL County: MADISON
(Road, Community, or Subdivision and Lot No.)
2. OWNER MADISON COUNTY
ADDRESS 25 Long Branch Rd (Street or Route No.)
Marshall (City or Town) NC (State) 28753 (Zip Code)
3. DATE DRILLED 9/28/92 USE OF WELL monitor
4. TOTAL DEPTH 17 ft CUTTINGS COLLECTED ☐ Yes ☒ No
5. DOES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No
6. STATIC WATER LEVEL: 4.72 FT. ☐ above ☒ below TOP OF CASING.
TOP OF CASING IS 2.5 FT. ABOVE LAND SURFACE.
7. YIELD (gpm): - METHOD OF TEST -
8. WATER ZONES (depth): 3 ft below ground
13 ft below ground
9. CHLORINATION: Type - Amount -
10. CASING: None

	Depth From	To	(Diameter) Ft.	Wall Thickness or Weight/Ft.	Material

11. GROUT:

	Depth From	To	Material	Method
	0	0.5	neatcement	pumping

12. SCREEN:

	Depth From	To	Diameter Ft.	Slot Size	Material
	2	17	2 in.	0.010 in.	PVC
			in.	in.	
			in.	in.	

13. ~~GRAVEL~~ Sand PACK:

	Depth From	To	Size	Material
	1.5	17	fine to medium	sand

REMARKS: Environmental Assessment and landfill monitoring

DRILLING LOG

Depth From	To	Formation Description
0	7'	soil
7'	17'	rock

If additional space is needed use back of form.

LOCATION SKETCH
(Show direction and distance from at least two State Roads or other map reference points)
See attached map
Note: 1.0 foot bentonite between grout and sand

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Sharon M. Tindall 12/9/92
SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REVISED 2/90

Submit original to Division of Environmental Management and copy to well owner.

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE (919)733-3221

FOR OFFICE USE ONLY
Quad. No. K88d Serial No.
Lat 35 48 40 Long 82 43 25 Pc
Minor Basin
Basin Code
Header Ent. GW-1 Ent.

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR METRO DRILL INC.
DRILLER REGISTRATION NUMBER 1282

STATE WELL CONSTRUCTION PERMIT NUMBER: 57-0016-WM-0016

WELL LOCATION: (Show sketch of the location below) MW-2

Nearest Town: MARSHALL

County: MADISON

(Road, Community, or Subdivision and Lot No.)

OWNER MADISON COUNTY

ADDRESS 25 Long Branch Rd (Street or Route No.)

Marshall (City or Town) NC (State) 28753 (Zip Code)

DATE DRILLED 9/29/92 USE OF WELL monitor

TOTAL DEPTH 16 feet CUTTINGS COLLECTED ☐ Yes ☒ No

DOES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No

STATIC WATER LEVEL 4.91 FT. ☐ above ☒ below TOP OF CASING.

TOP OF CASING IS 2.5 FT. ABOVE LAND SURFACE.

YIELD (gpm): - METHOD OF TEST -

WATER ZONES (depth):

CHLORINATION: Type - Amount -

CASING: None

Depth From	To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material

GROUT:

Depth From	To	Ft.	Material	Method
+0.50	0.0		neat cement	pumping

SCREEN:

Depth From	To	Ft.	Diameter	Slot Size	Material
1	16		2" in.	0.010 in.	PVC
			in.	in.	
			in.	in.	

~~GRAVEL~~ Sand PACK:

Depth From	To	Ft.	Size	Material
0.5	16		fine to medium	sand

DRILLING LOG

Depth From	To	Formation Description
0	6'	soil
6	16'	rock

If additional space is needed use back of form.

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)

See site map attached

Note: 1) 0.5 foot bentonite between grout base and sand

2) 30" high soil platform constructed around well for wet weather working conditions.

Attention: Dave Pasko

REMARKS: Environmental Assessment and landfill monitoring

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Sharon McTyndall 12/9/92
SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner.

REVISED 2/90

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE (919)733-3221

FOR OFFICE USE ONLY
Quad. No. K88d Serial No.
Lat 35 48 40 Long 82 43 25 Pc
Minor Basin
Basin Code
Header Ent. GW-1 Ent.

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR METRO DRILL INC.
DRILLER REGISTRATION NUMBER 1282

STATE WELL CONSTRUCTION PERMIT NUMBER: 57-0016-WM-0016

1. WELL LOCATION: (Show sketch of the location below) MW-2
Nearest Town: MARSHALL
(Road, Community, or Subdivision and Lot No.)
County: MADISON

2. OWNER MADISON COUNTY
ADDRESS 23 Long Branch Rd (Street or Route No.)
Marshall (City or Town) NC (State) 28753 (Zip Code)

3. DATE DRILLED 9/29/92 USE OF WELL monitor
4. TOTAL DEPTH 16 feet CUTTINGS COLLECTED ☐ Yes ☒ No
5. DOES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No
6. STATIC WATER LEVEL: 4.91 FT. ☐ above ☒ below TOP OF CASING.
TOP OF CASING IS 2.5 FT. ABOVE LAND SURFACE.
7. YIELD (gpm): - METHOD OF TEST -
8. WATER ZONES (depth):
9. CHLORINATION: Type - Amount -
10. CASING: None

	Depth From	To	Diameter	Wall Thickness or Weight/Ft.	Material
From		To	Ft.		
From		To	Ft.		
From		To	Ft.		

11. GROUT:

	Depth From	To	Material	Method
From	+0.50	0.0 Ft.	neat cement	pumping
From		To Ft.		

12. SCREEN:

	Depth From	To	Diameter	Slot Size	Material
From	1	16 Ft.	2" in.	0.010 in.	PVC
From		To Ft.	in.	in.	
From		To Ft.	in.	in.	

13. ~~GRAVEL~~ Sand PACK:

	Depth From	To	Size	Material
From	0.5	16 Ft.	fine to medium	sand
From		To Ft.		

DRILLING LOG

Depth From	To	Formation Description
0	6'	soil
6	16'	rock

If additional space is needed use back of form.

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)
see site map attached
Note: 1) 0.5 foot bentonite between grout base and sand
2) 30" high soil platform constructed around well for wet weather working conditions

REMARKS: Environmental Assessment and Landfill Monitoring

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Sharon M. Tyndall 12/9/92
SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner.

GW-1 REVISED 2/90

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT • GROUNDWATER SECTION
P.O. BOX 27687 • RALEIGH, NC 27611-7687
PHONE (919)733-3221

FOR OFFICE USE ONLY
Quad. No. K88d Serial No.
Lat 35 48 40 Long 82 43 25 Pc
Minor Basin
Basin Code
Header Ent. GW-1 Ent.

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR METRO DRILL INC.
DRILLER REGISTRATION NUMBER 1282

STATE WELL CONSTRUCTION PERMIT NUMBER: 57-0016-WM-0016

1. WELL LOCATION: (Show sketch of the location below) MW-3
Nearest Town: MARSHALL
(Road, Community, or Subdivision and Lot No.)
County: MADISON

2. OWNER MADISON COUNTY
ADDRESS 23 Long Branch Rd (Street or Route No.)
Marshall (City or Town) NC (State) 28753 (Zip Code)

3. DATE DRILLED 9/27/92 USE OF WELL monitor
4. TOTAL DEPTH 25' CUTTINGS COLLECTED ☐ Yes ☒ No
5. DOES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No
6. STATIC WATER LEVEL: 16.01 FT. ☐ above ☒ below TOP OF CASING.
TOP OF CASING IS 2.5 FT. ABOVE LAND SURFACE.
7. YIELD (gpm): - METHOD OF TEST -
8. WATER ZONES (depth):
9. CHLORINATION: Type - Amount -
10. CASING:

Depth From	To	Diameter	Wall Thickness or Weight/Ft.	Material
		Ft.		
		Ft.		
		Ft.		

11. GROUT:

Depth From	To	Material	Method
0	5.9 Ft.	Mat cement	pumping
	Ft.		

12. SCREEN:

Depth From	To	Diameter	Slot Size	Material
10	25 Ft.	2 in.	0.010 in.	PVC
	Ft.	in.	in.	
	Ft.	in.	in.	

13. ~~GRAVEL~~ sand PACK:

Depth From	To	Size	Material
8.3	25 Ft.	fine to medium	sand
	Ft.		

DRILLING LOG

Depth From	To	Formation Description
0	25	soil

If additional space is needed use back of form.

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)
see attached site map

Note: 2.4 ft. bentonite between grout base and sand.

REMARKS: Environmental Assessment and Landfill Monitoring

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Sharon Tyndall 12/9/92
SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REVISED 2/90

Submit original to Division of Environmental Management and copy to well owner.

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE (919)733-3221

FOR OFFICE USE ONLY
Quad. No. K88d Serial No.
Lat 35 48 40 Long 82 45 25 Pc
Minor Basin
Basin Code
Header Ent. GW-1 Ent.

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR METRO DRILL INC.
DRILLER REGISTRATION NUMBER 1282

STATE WELL CONSTRUCTION PERMIT NUMBER: 57-0016-WM-0016

1. WELL LOCATION: (Show sketch of the location below) MW-4
Nearest Town: MARSHALL County: MADISON
(Road, Community, or Subdivision and Lot No.)

2. OWNER MADISON COUNTY
ADDRESS 23 Long Branch Rd (Street or Route No.)
Marshall (City or Town) N.C. (State) 28753 (Zip Code)

3. DATE DRILLED 9/29/92 USE OF WELL monitor

4. TOTAL DEPTH 72 ft CUTTINGS COLLECTED ☐ Yes ☐ No

5. DOES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No

6. STATIC WATER LEVEL: 15.74 FT ☐ above ☒ below TOP OF CASING.
TOP OF CASING IS 2.5 FT. ABOVE LAND SURFACE.

7. YIELD (gpm): - METHOD OF TEST -

8. WATER ZONES (depth):

9. CHLORINATION: Type - Amount -

10. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 57 Ft.	4"		PVC
From		To Ft.			
From		To Ft.			

11. GROUT:

	Depth		Material	Method
From	0	To 52 Ft.	Neat cement	pumping
From		To Ft.		

12. SCREEN:

	Depth		Diameter	Slot Size	Material
From	61.5	To 71.5 Ft.	2 in.	0.010 in.	PVC
From		To Ft.	in.	in.	
From		To Ft.	in.	in.	

13. ~~GRAVEL~~ Sand PACK:

	Depth		Size	Material
From	54.3	To 71.5 Ft.	fine to medium	sand
From		To Ft.		

14. REMARKS: Environmental Assessment and Landfill Monitoring

Depth From	To	DRILLING LOG Formation Description
0	26	soil
26	72	rock

If additional space is needed use back of form.

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)
see attached site plan

Note: 2.3 ft. bentonite between sand and grout base.

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Sharon Tyndall 12/9/92
SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REVISED 2/90

Submit original to Division of Environmental Management and copy to well owner.

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE (919)733-3221

FOR OFFICE USE ONLY
Quad. No. K88d Serial No.
Lat 35 48 40 Long 82 43 25 Pc
Minor Basin
Basin Code
Header Ent. GW-1 Ent.

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR METRO DRILL INC.
DRILLER REGISTRATION NUMBER 1282

STATE WELL CONSTRUCTION PERMIT NUMBER: 57-0016-WM-0016

1. WELL LOCATION: (Show sketch of the location below) MW-5
Nearest Town: MARSHALL
(Road, Community, or Subdivision and Lot No.)
County: MADISON

2. OWNER MADISON COUNTY
ADDRESS 23 Long Branch Rd (Street or Route No.)
Marshall (City or Town) NC (State) 28753 (Zip Code)

3. DATE DRILLED 9/26/92 USE OF WELL monitor
4. TOTAL DEPTH 61.5 ft CUTTINGS COLLECTED ☐ Yes ☒ No
5. DOES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No
6. STATIC WATER LEVEL: 50.11 FT. ☐ above ☒ below TOP OF CASING.
TOP OF CASING IS 2.5 FT. ABOVE LAND SURFACE.
7. YIELD (gpm): - METHOD OF TEST -
8. WATER ZONES (depth): -
9. CHLORINATION: Type - Amount -
10. CASING: none

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From		To	Ft.		
From		To	Ft.		
From		To	Ft.		

11. GROUT:

	Depth		Material	Method
From	0	To 40.5 Ft.	neat cement	pumping
From		To Ft.		

12. SCREEN:

	Depth		Diameter	Slot Size	Material
From	46.5	To 61.5 Ft.	2" in.	0.010 in.	PVC
From		To Ft.	in.	in.	
From		To Ft.	in.	in.	

13. ~~GRAVEL PACK~~: SAND

	Depth		Size	Material
From	43.5	To 61.5 Ft.	fine to medium	sand
From		To Ft.		

14. REMARKS: Environmental Assessment and Landfill Monitoring

Depth From	To	DRILLING LOG Formation Description
0	61.5	soil

If additional space is needed use back of form.

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)
see attached site plan

Note: 3ft. bentonite between grout base and sand

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Sharon M. Tyndall 12/9/92
SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner.

GW-1 REVISED 2/90

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, NC 27611-7687
PHONE (919)733-3221

FOR OFFICE USE ONLY
Quad. No. K88d Serial No.
Lat 36 48 40 Long 82 43 25 Pc
Minor Basin
Basin Code
Header Ent. GW-1 Ent.

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR METRO DRILL INC.
DRILLER REGISTRATION NUMBER 1282

STATE WELL CONSTRUCTION PERMIT NUMBER: 57-0016-WM-0016

1. WELL LOCATION: (Show sketch of the location below) MW-6
Nearest Town: MARSHALL
(Road, Community, or Subdivision and Lot No.)
County: MADISON

2. OWNER MADISON COUNTY
ADDRESS 23 Long Branch Rd. (Street or Route No.)
Marshall (City or Town) NC (State) 28753 (Zip Code)

3. DATE DRILLED 9/29/92 USE OF WELL monitor
4. TOTAL DEPTH 100 ft OUTTINGS COLLECTED ☐ Yes ☒ No
5. DOES WELL REPLACE EXISTING WELL? ☐ Yes ☒ No
6. STATIC WATER LEVEL: 82.17 FT. ☐ above ☒ below TOP OF CASING.
TOP OF CASING IS 2.5 FT. ABOVE LAND SURFACE.
7. YIELD (gpm): - METHOD OF TEST -
8. WATER ZONES (depth): -
CHLORINATION: Type - Amount -
10. CASING: none

	Depth From	To	Diameter	Wall Thickness or Weight/Ft.	Material
From		To	Ft.		
From		To	Ft.		
From		To	Ft.		

11. GROUT:

	Depth From	To	Material	Method
From	0	To 65.8 Ft.	neat cement	pumping
From		To	Ft.	

12. SCREEN:

	Depth From	To	Diameter	Slot Size	Material
From	80	To 100 Ft.	2" in.	0.010 in.	PVC
From		To	Ft. in.	in.	
From		To	Ft. in.	in.	

13. ~~GRAVEL~~ Sand PACK:

	Depth From	To	Size	Material
From	71.8	To 100.0 Ft.	fine to medium	sand
From		To	Ft.	

14. REMARKS: Environmental Assessment and Landfill Monitoring

DRILLING LOG

Depth From	To	Formation Description
0	28	soil
28	100	rock

If additional space is needed use back of form.

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)
See attached site plan

Note: 6.0 feet bentonite between grout base and sand.

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Sharon M. Tyndall 12/9/92
SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner.

GW 1 REVISED 2/90

Department of Environmental, Health & Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY	
QUAD. NO.	SERIAL NO.
Lat.	Long. Pc
Minor Basin	
Basin Code	
Header Ent.	GW-1 Ent.

WELL CONSTRUCTION RECORD

WELL IDENTIFICATION: MW-7

DRILLING CONTRACTOR: Engineering Tectonics

DRILLER REGISTRATION NUMBER: 835

STATE WELL CONSTRUCTION PERMIT NUMBER:

WELL LOCATION: (Show sketch of the location below)

Nearest Town: Marshall County: Madison

101 Briggman Farm Road
(Road, Community, or Subdivision and Lot No.)

OWNER Madison County Solid Waste

ADDRESS 101 Briggman Farm Road
(Street or Route No.)

Marshall NC 28753
State Zip Code

DATE DRILLED 4/12/95 USE OF WELL Monitoring

TOTAL DEPTH 30'

CUTTINGS COLLECTED YES [X] NO [ ]

DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]

STATIC WATER LEVEL Below Top of Casing: 22.85 FT.
(Use "+" if Above Top of Casing)

TOP OF CASING IS 3 FT. Above Land Surface

Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118

YIELD (gpm) N/A METHOD OF TEST N/A

WATER ZONES (depth): Unconfined Aquifer

CHLORINATION: Type N/A Amount N/A

CASING:

Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From 0	To 15 Ft.	2"	Sch 40	PVC
From	To Ft.			
From	To Ft.			

GROUT

Depth		Material	Method
From 0	To 19 Ft.	Portland	Slurry
From	To Ft.		

SCREEN

Depth		Diameter	Slot Size	Material
From 15	To 13 Ft.	2 in.	0.1 in.	PVC
From	To Ft.	in.	in.	
From	To Ft.	in.	in.	

SAND/GRAVEL PACK:

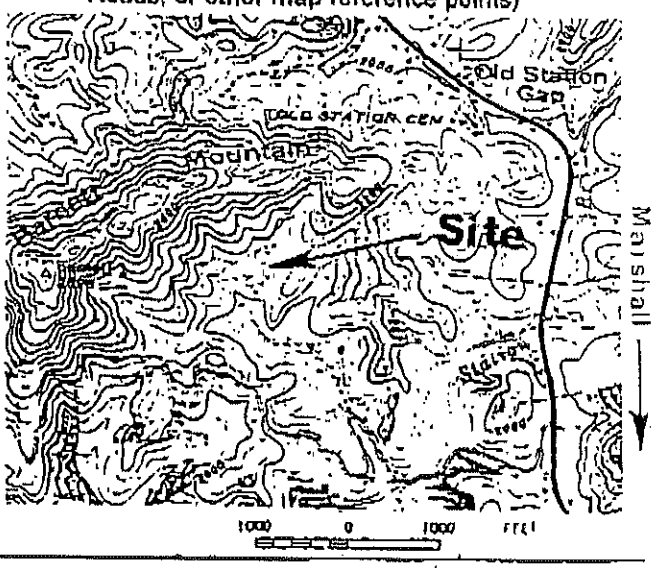
Depth		Size	Material
From 19	To 21 Ft.	Pellets	Bentonite
From 21	To 30 Ft.	Coarse	Sand

REMARKS:

DEPTH (feet) From	To	DRILLING LOG Formation Description
0	6.5	reddish brown clayey micaceous Silt
6.5	12	reddish brown silty micaceous Clay
12	13.5	red micaceous Clay
13.5	17	reddish brown silty micaceous Clay
17	30	light brown silty micaceous Clay with occasional black organic splotches

If additional space is needed, use back of form.

LOCATION SKETCH
(Show direction & distance from at least two State Roads, or other map reference points)



I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

CONTRACTOR OR AGENT 5/5/95 DATE

Division of Environmental Management & copy to well owner

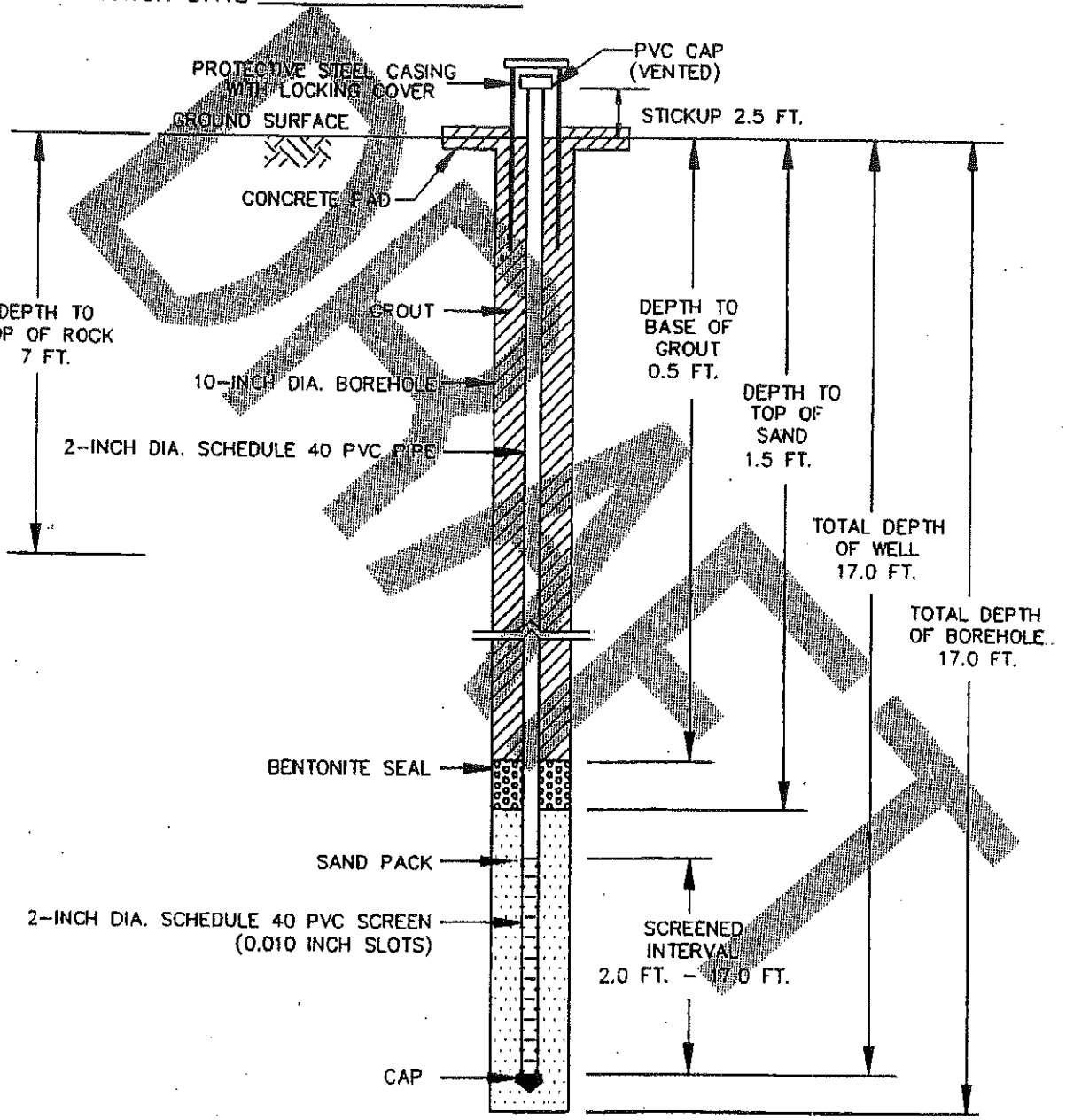
Post-it® Fax Note 7671	Date	# of pages ▶
To ANDY ALEXANDER	From DAVE PASCO	
Co./Dept. BLE	Co. McGILL	
Phone #	Phone #	
Fax # 864/288-4430	Fax #	

JOB NAME MADISON CO. LANDFILL JOB NUMBER 56-8550

WELL NUMBER MW-1 GROUND SURFACE ELEVATION * 1856.5 FT.±

LOCATION SEE SITE PLAN MEASURING POINT ELEVATION * 1859.04 FT.
(TOP OF PVC CASING)

INSTALLATION DATE 09-28-92



* REFERENCED TO SEA LEVEL DATUM.
NOTE: ALL PVC JOINTS ARE FLUSH THREADED.

W4

MADISON CO. LANDFILL
MADISON CO., N.C.

LAW ENVIRONMENTAL, INC.
CHARLOTTE, NORTH CAROLINA

TYPE II
MONITORING WELL
INSTALLATION RECORD

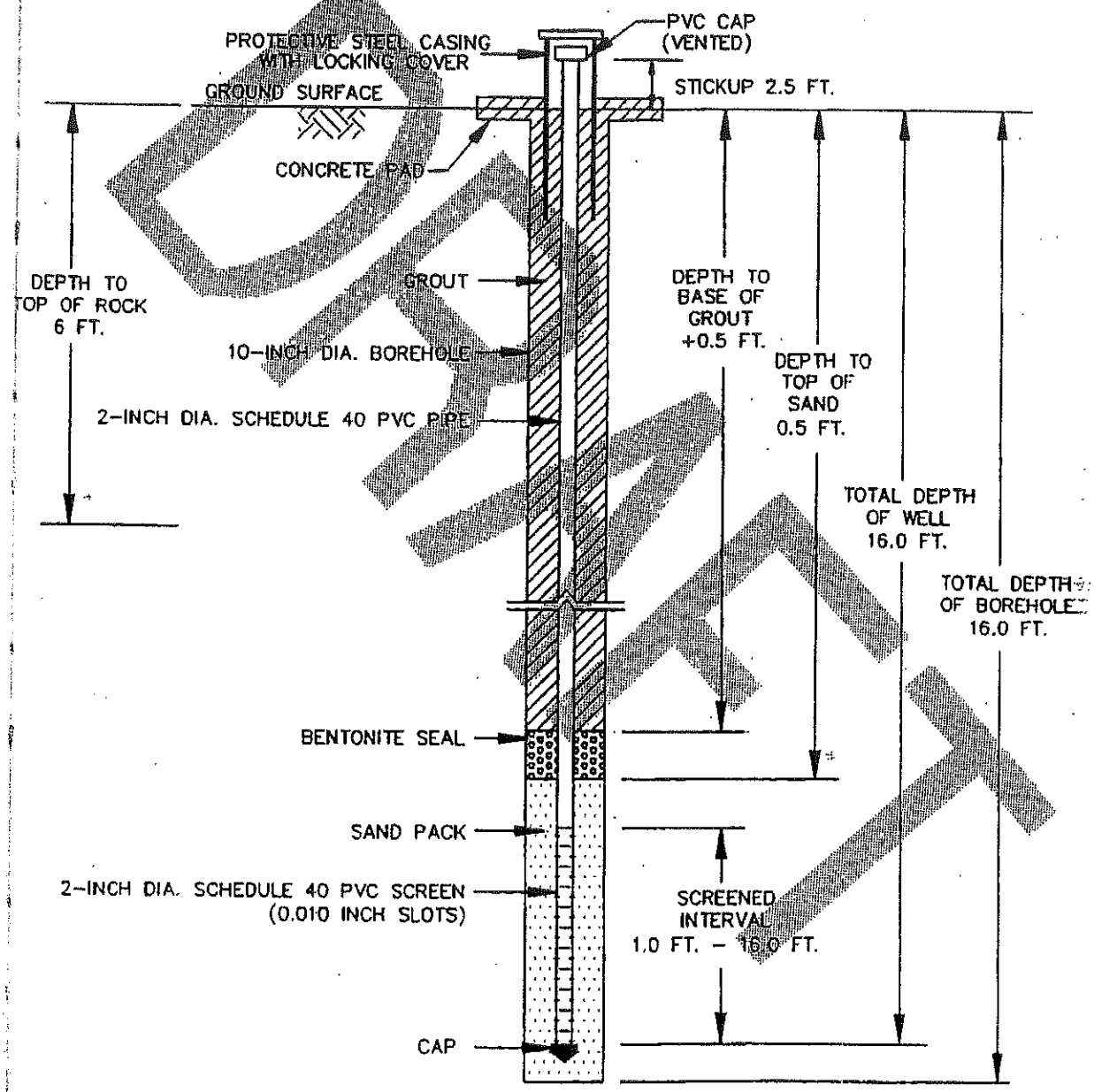
J:\56850\WELL 03/03/94 15:20 DJK

JOB NAME MADISON CO. LANDFILL JOB NUMBER 56-8550

WELL NUMBER MW-2 GROUND SURFACE ELEVATION * 1896.4 FT.±

LOCATION SEE SITE PLAN MEASURING POINT ELEVATION * 1898.94 FT.
(TOP OF PVC CASING)

INSTALLATION DATE 09-29-92



* REFERENCED TO SEA LEVEL DATUM.
NOTE: ALL PVC JOINTS ARE FLUSH THREADED.

W4

MADISON CO. LANDFILL
MADISON CO., N.C.

LAW ENVIRONMENTAL, INC.
CHARLOTTE, NORTH CAROLINA

TYPE II
MONITORING WELL
INSTALLATION RECORD

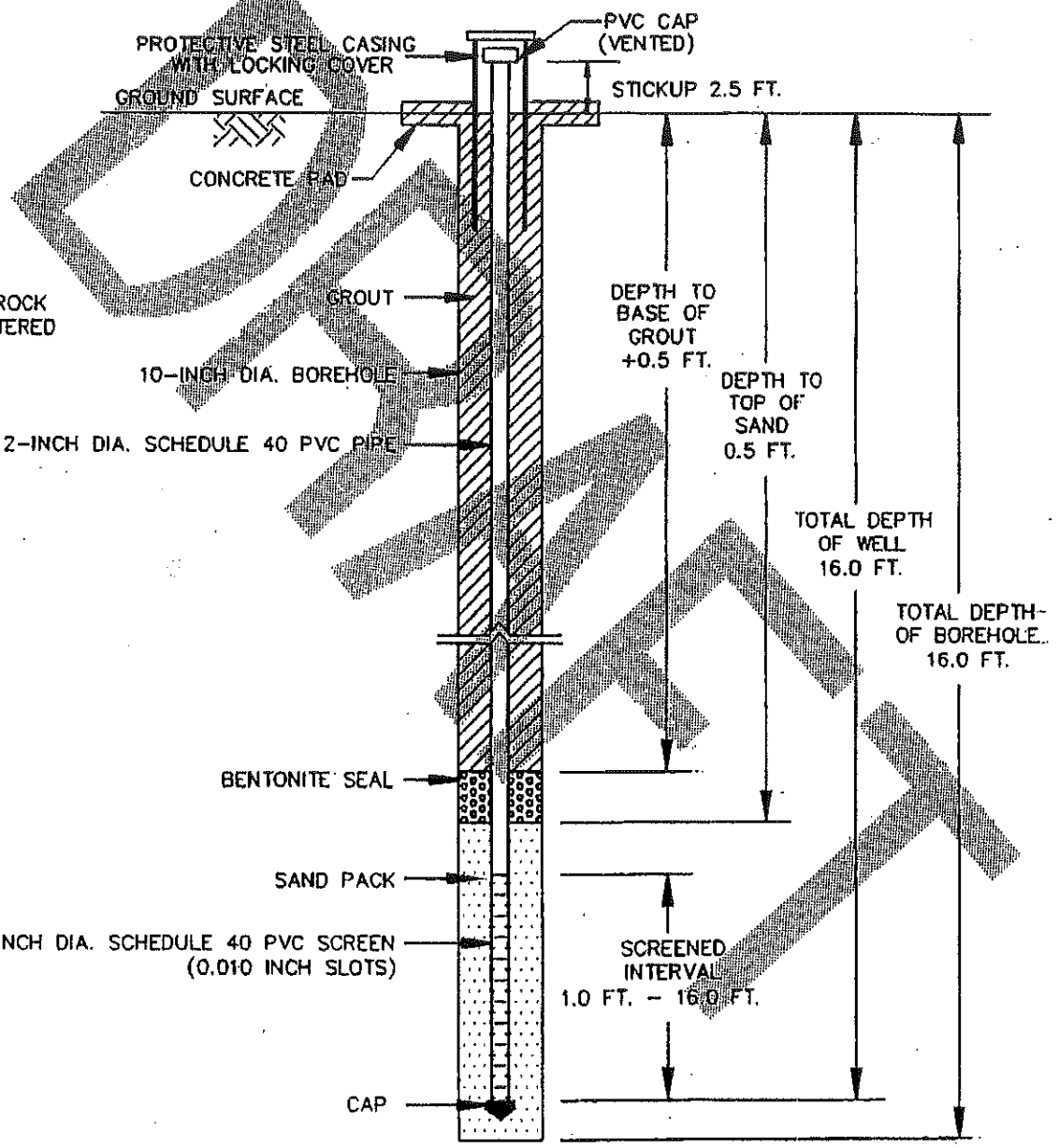
J:\568550\WELL 03/03/94 15:20 DJK

JOB NAME MADISON CO. LANDFILL JOB NUMBER 56-8550

WELL NUMBER MW-3 ** GROUND SURFACE ELEVATION * 1921.2 FT. ±

LOCATION SEE SITE PLAN MEASURING POINT ELEVATION * 1923.72 FT.
(TOP OF PVC CASING)

INSTALLATION DATE 09-24-92



* REFERENCED TO SEA LEVEL DATUM.
NOTE: ALL PVC JOINTS ARE FLUSH THREADED.

W4

MADISON CO. LANDFILL
MADISON CO., N.C.

LAW ENVIRONMENTAL, INC.
CHARLOTTE, NORTH CAROLINA

TYPE II
MONITORING WELL
INSTALLATION RECORD

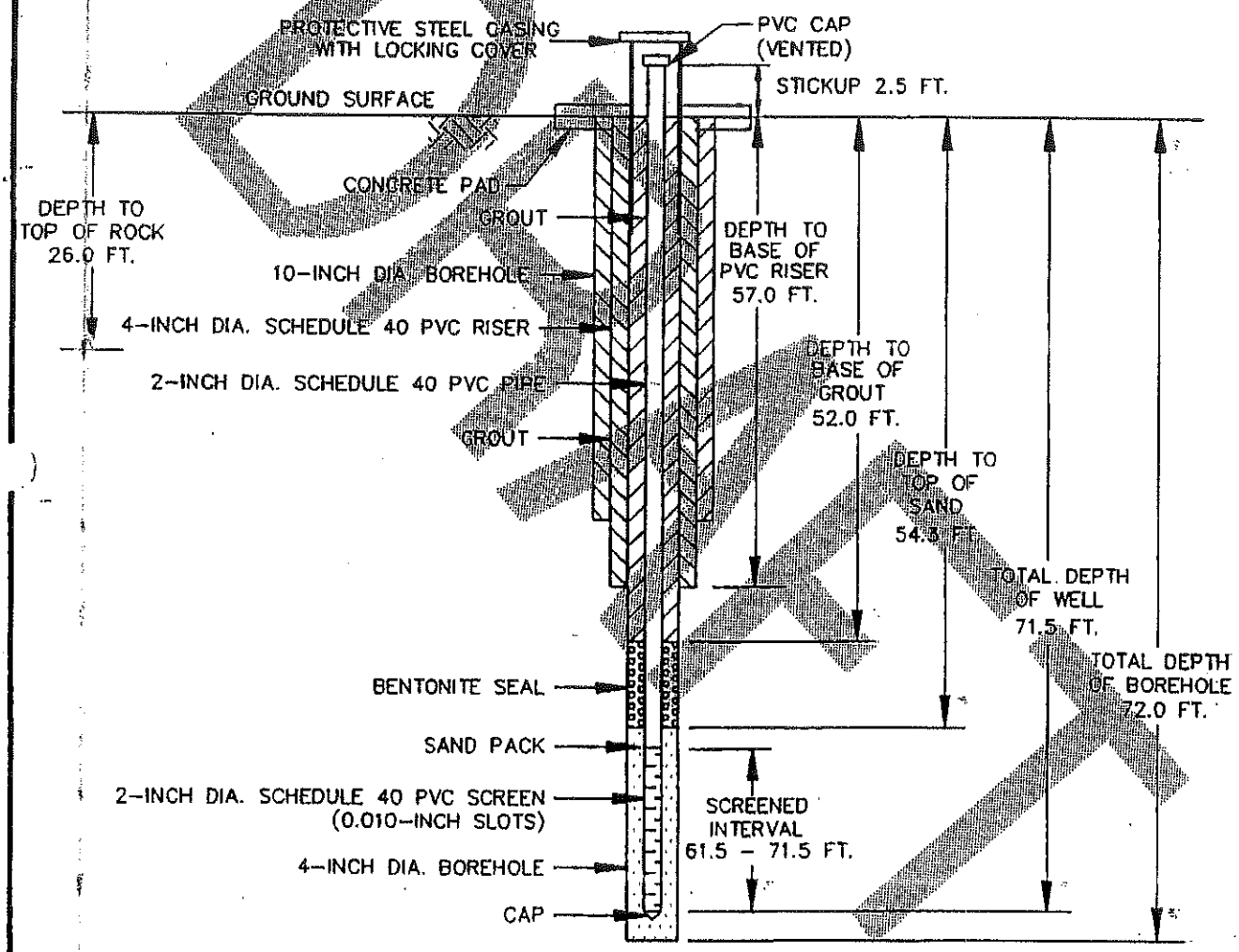
J:\56550\WELLS 03/03/94 15:20 DJK

JOB NAME MADISON CO. LANDFILL JOB NUMBER 56-8550

WELL NUMBER MW-4 GROUND SURFACE ELEVATION * 1921.2 FT. ±

LOCATION SEE SITE PLAN MEASURING POINT ELEVATION * 1923.71 FT.
(TOP OF PVC CASING)

INSTALLATION DATE 09-29-92



* REFERENCED TO MEAN SEA LEVEL
NOTE: ALL PVC JOINTS ARE FLUSH THREADED.

W8

MADISON CO. LANDFILL
MADISON CO., N.C.

LAW ENVIRONMENTAL, INC.
CHARLOTTE, NORTH CAROLINA

TYPE III
MONITORING WELL
INSTALLATION RECORD

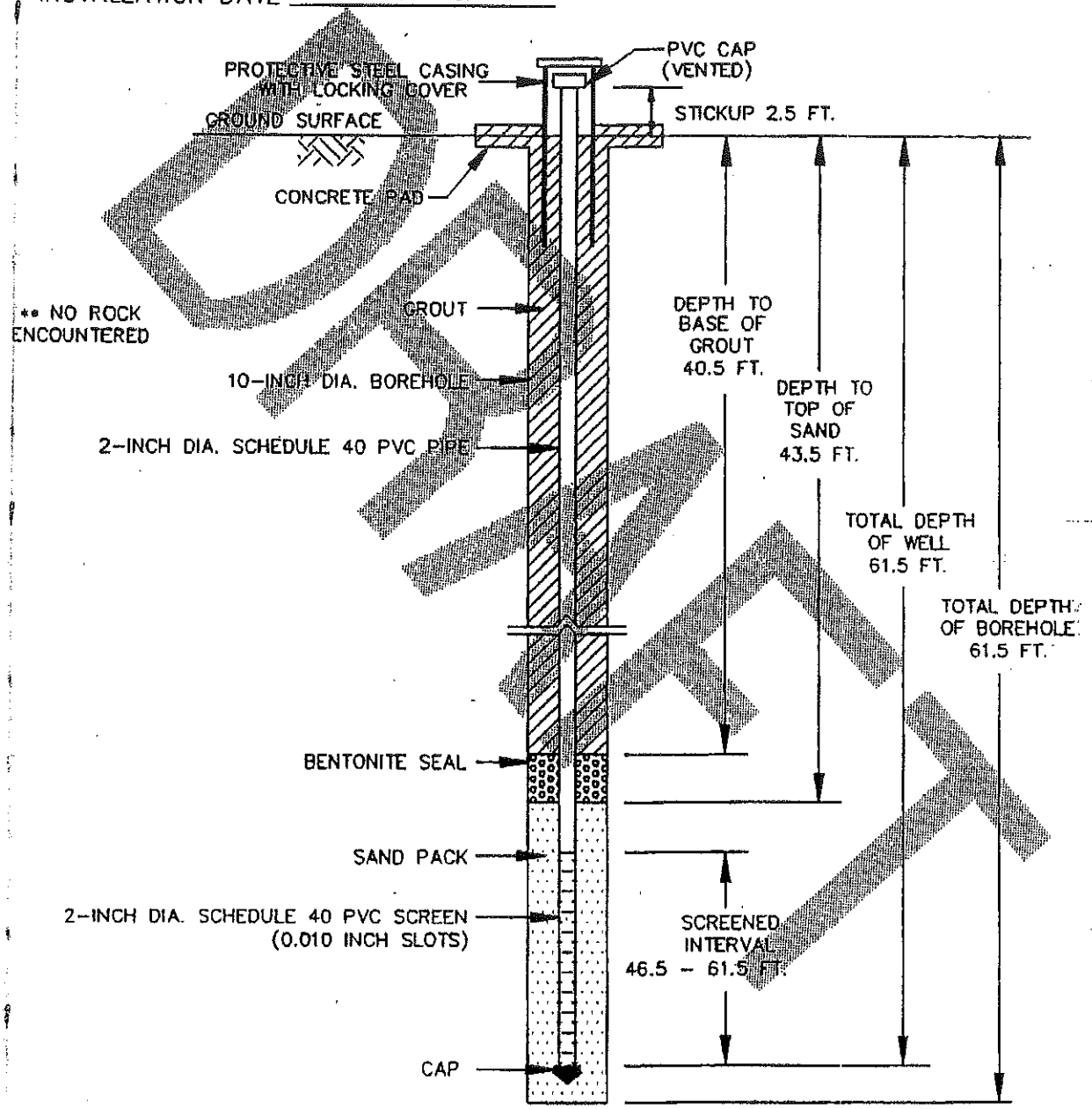
J:\56850\WELLS 03/03/94 15:20 DJK

JOB NAME MADISON CO. LANDFILL JOB NUMBER 56-8550

WELL NUMBER MW-5 ** GROUND SURFACE ELEVATION * 1921.2 FT. ±

LOCATION SEE SITE PLAN MEASURING POINT ELEVATION * 1923.71 FT.
(TOP OF PVC CASING)

INSTALLATION DATE 09-26-92



* REFERENCED TO SEA LEVEL DATUM.
NOTE: ALL PVC JOINTS ARE FLUSH THREADED.

W4

MADISON CO. LANDFILL
MADISON CO., N.C.

LAW ENVIRONMENTAL, INC.
CHARLOTTE, NORTH CAROLINA

TYPE II MONITORING WELL INSTALLATION RECORD

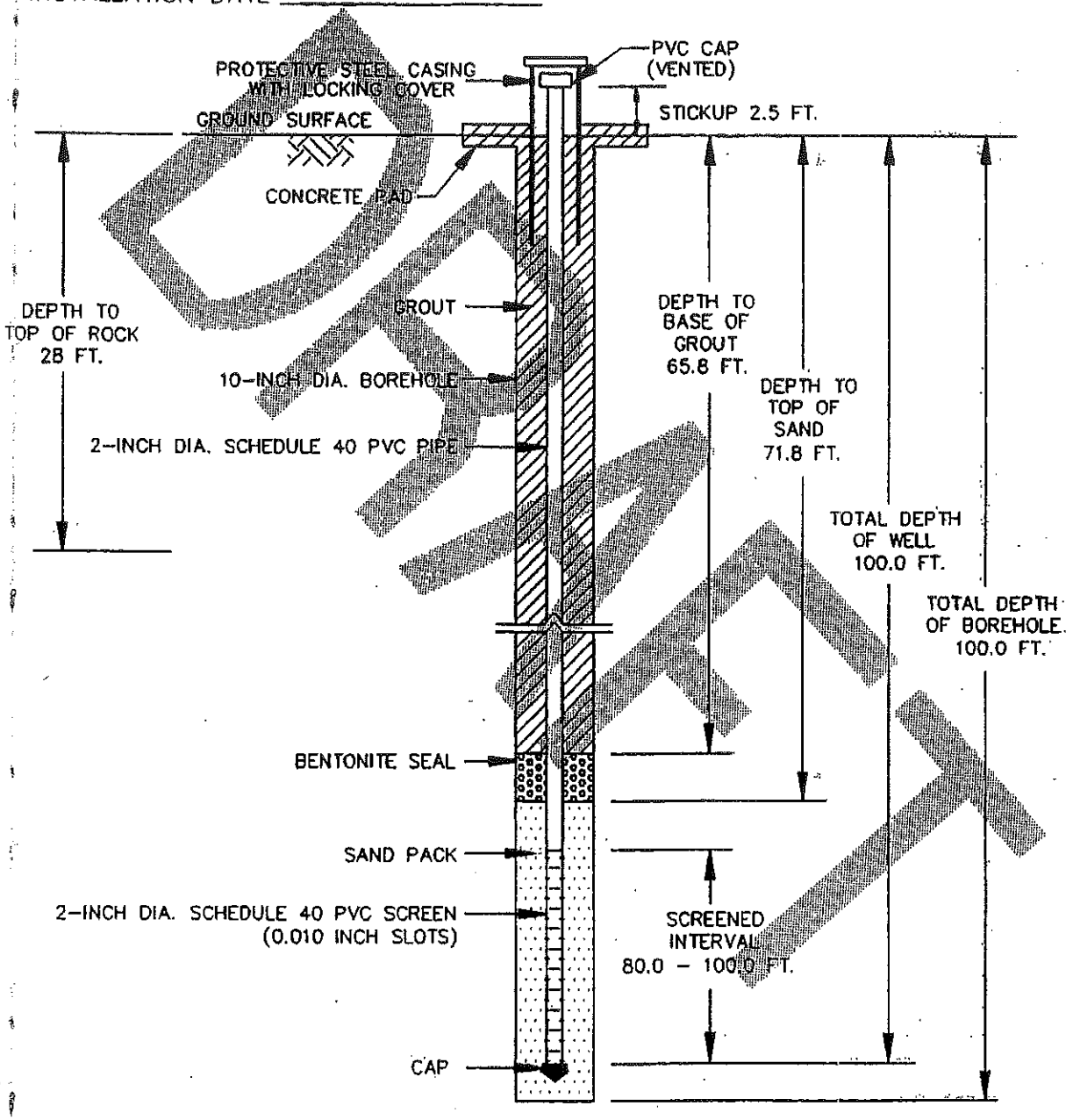
J:\568550\WEL 03/03/94 15:20 DJK

JOB NAME MADISON CO. LANDFILL JOB NUMBER 56-8550

WELL NUMBER MW-6 GROUND SURFACE ELEVATION * 2080.4 FT.±

LOCATION SEE SITE PLAN MEASURING POINT ELEVATION * 2082.87 FT.
(TOP OF PVC CASING)

INSTALLATION DATE 09-29-92



* REFERENCED TO SEA LEVEL DATUM.
NOTE: ALL PVC JOINTS ARE FLUSH THREADED.

W4

MADISON CO. LANDFILL
MADISON CO., N.C.

LAW ENVIRONMENTAL, INC.
CHARLOTTE, NORTH CAROLINA

TYPE II MONITORING WELL INSTALLATION RECORD

J:\568550\WELLS 03/03/94 15:20 DJK

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUND WATER MONITORING WELL NO. MW-7R

PROJECT: Madison County C & D Landfill
PROJECT NO.: J03-2225-03
CLIENT: McGill Associates
START: 7-29-03 END: 7-30-03
LOCATION: Madison County, North Carolina
ELEVATION: 1916.63
DRILLER: Landprobe, K. Thomas
LOGGED BY: TJB
DRILLING METHOD: CME 750 ATV
DEPTH TO - WATER> INITIAL: ▽ 29 AFTER 24 HOURS: ▼ CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	MONITOR WELL INSTALLATION DETAILS
1915 – 2, 4	Yellowish-brown and grayish-brown, moist, slightly micaceous, fine sandy, clayey SILT - (residuum)		SURFACE COMPLETION 2.71-foot stick-up with 4" x 4" stand-up locking steel protective cover with a 3' x 3' concrete pad with survey pin at the base
1910 – 6, 8	Yellowish-brown and grayish-brown, slightly moist, micaceous, fine to medium sandy SILT with clay		1/4-inch weep and vent holes installed in steel cover and well casing, respectively.
1905 – 10, 12, 14	Yellowish-brown and grayish-brown, slightly moist, micaceous, silty, fine to medium SAND with slight clay		5% Bentonite cement, 0 to 29.6 feet
1900 – 16, 18	Yellowish-brown and grayish-brown, slightly moist, micaceous, slightly clayey, fine to medium sandy SILT intermixed with rock fragments (biotite-quartz gneiss)		
1895 – 20, 22, 24	PARTIALLY WEATHERED ROCK which sampled as grayish-brown and yellowish-brown, slightly moist to wet, slightly micaceous, fine to coarse sandy SILT with rock fragments (biotite-quartz gneiss)		Bentonite seal, 20.6 to 23.4 feet
1890 – 26, 28 ▽			#2 DSI filter pack, sand 23.4 to 41.4 feet
1885 – 30, 32			
1880 – 34, 36, 38			.010-inch slotted Schedule 40 PVC well screen, 26.1 to 41.1 feet
1875 – 40, 42			Pipe cap
1870 – 44, 46, 48	Boring terminated at 41.4 feet. Ground water encountered at 29 feet at time of drilling.		Total well depth, 41.4 feet Ground surface elev. = 1916.63' Top of casing elev. = 1919.34' Northing = 771,023.47' Easting = 896,402.71'

GEOT_WELLNB 2225-02.GPJ 9/2/03

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUND WATER MONITORING WELL NO. MW-8

PROJECT: Madison County C & D Landfill
PROJECT NO.: J03-2225-03
CLIENT: McGill Associates
START: 7-28-03 END: 7-29-03
LOCATION: Madison County, North Carolina
ELEVATION: 1897.32
DRILLER: Landprobe, K. Thomas
LOGGED BY: TJB
DRILLING METHOD: CME 750 ATV
DEPTH TO - WATER> INITIAL: ▽ 19 AFTER 24 HOURS: ▼ CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE
1895 – 2	Yellowish-brown and brown, moist, micaceous, clayey, fine to medium sandy SILT - (residuum)	
4	Yellowish-brown and grayish-brown, slightly moist, slightly micaceous, fine to medium sandy SILT with clay	
6, 1890 – 8, 10		
12, 1885 – 14	Grayish-brown, slightly moist, micaceous, silty, fine to medium SAND with rock fragments (biotite quartz gneiss)	
16, 1880 – 18, 20, 1875 – 22, 24, 26	PARTIALLY WEATHERED ROCK which sampled as grayish-brown, moist to wet, silty fine to coarse SAND with rock fragments (biotite quartz gneiss)	
1870 – 28, 30, 1865 – 32, 34, 36, 1860 – 38, 40, 1855 – 42, 44, 46, 1850 – 48	Boring terminated at 26.6 feet. Ground water encountered at 19 feet at time of drilling.	

MONITOR WELL INSTALLATION DETAILS

SURFACE COMPLETION
2.6-foot stick-up with 4" x 4" stand-up locking steel protective cover with a 3' x 3' concrete pad with survey pin at the base

1/4-inch weep and vent holes installed in steel cover and well casing, respectively.

5% Bentonite cement, 0 to 10 feet

Bentonite seal, 10 to 13 feet

#2 DSI filter pack, sand 13 to 26.6 feet

.010-inch slotted Schedule 40 PVC well screen, 16.3 to 26.3 feet

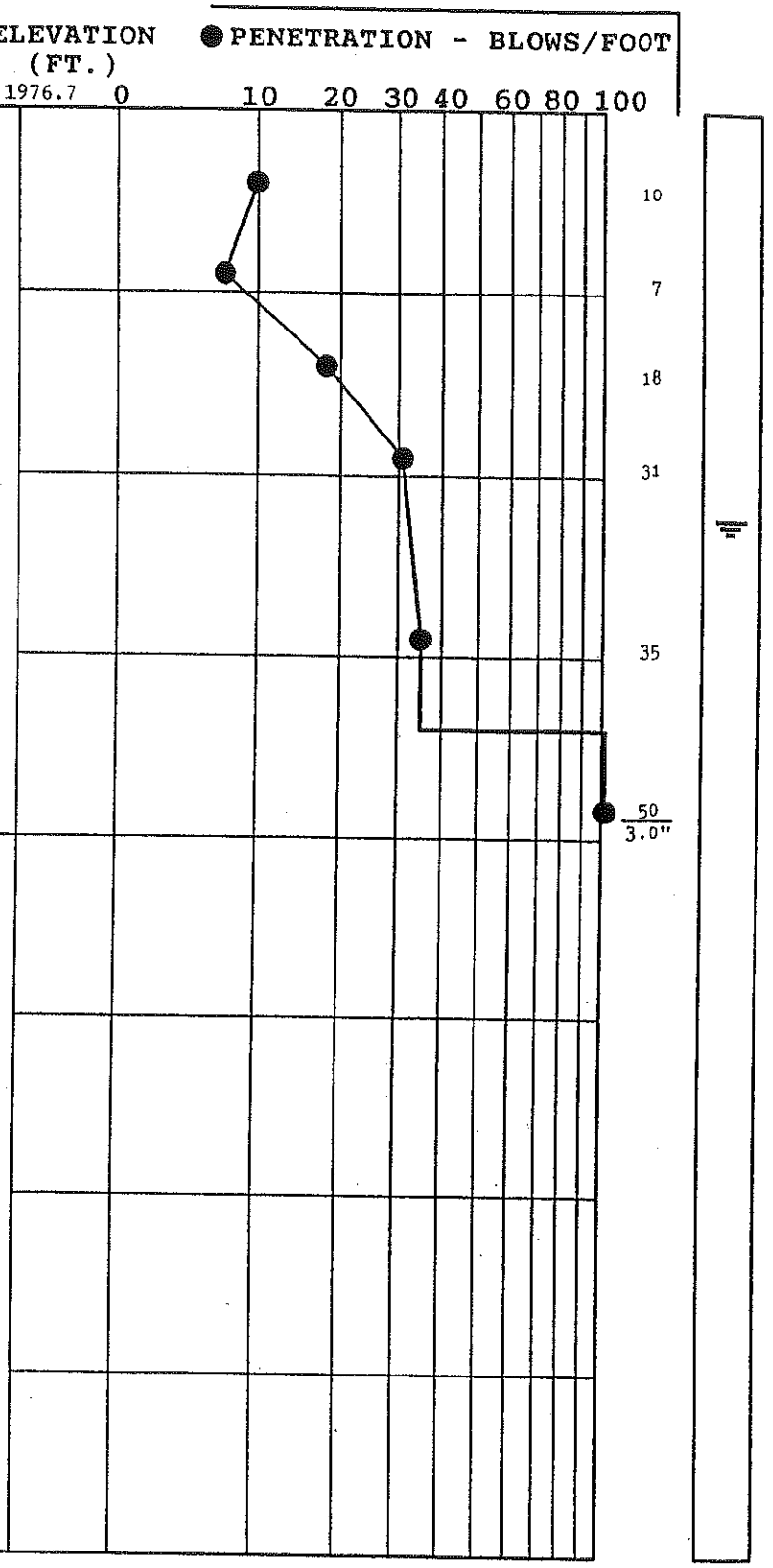
Pipe cap

Total well depth, 26.6 feet

Ground surface elev. = 1897.32'
Top of casing elev. = 1899.92'
Northing = 771,334.74'
Easting = 896,154.53'

GEOT_WELLNB 2225-02.GPJ 9/2/03

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)
0.0		1976.7
0.3	Topsoil	
	Residuum - Firm to Hard Red Brown Micaceous Fine to Coarse Sandy SILT Some Gravel - Wet	
17.0	Partially Weathered Rock That Becomes Black Gray Micaceous Silty Fine to Coarse SAND with Gravel When Sampled - Moist	
20.0	Boring Terminated at 20.0 Feet. Ground Water at 11.1 Feet on 7-18-90.	



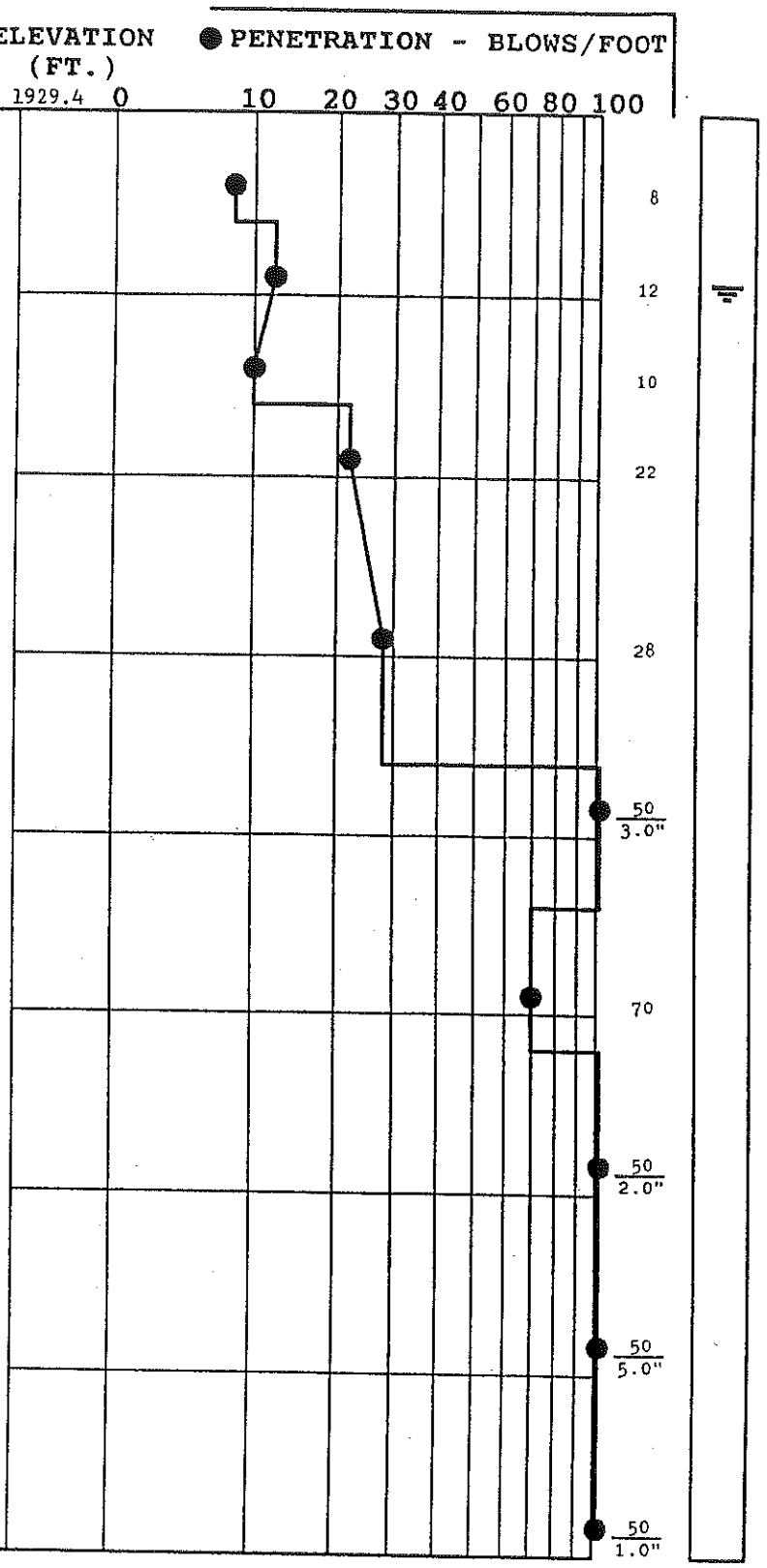
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER B-7
DATE DRILLED 5-6-90
PROJECT NUMBER 56-8550
PROJECT MADISON CO. LANDFILL
PAGE 1 OF 1

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION
0.0	
0.3	Topsoil
3.0	Alluvium - Firm Red Brown Micaceous Slightly Fine Sandy Clayey SILT - Moist
	Residuum - Stiff to Very Stiff Slightly Clayey Silty Fine to Coarse SAND - Moist
8.0	Very Firm Red Gray to Gray Micaceous Silty Fine to Coarse SAND - Wet
18.0	Partially Weathered Rock That Becomes Brown Gray Micaceous Very Silty Fine to Medium SAND When Sampled - Wet
22.0	Residuum - Very Dense Black Gray Micaceous Silty Fine to Medium SAND - Wet
26.0	Partially Weathered Rock That Becomes Black Gray Micaecous Silty Fine to Coarse SAND With Gravel When Sampled - Wet
40.0	



Boring Terminated at 40.0 Feet.
Ground Water at 4.6 Feet on 7-18-90.

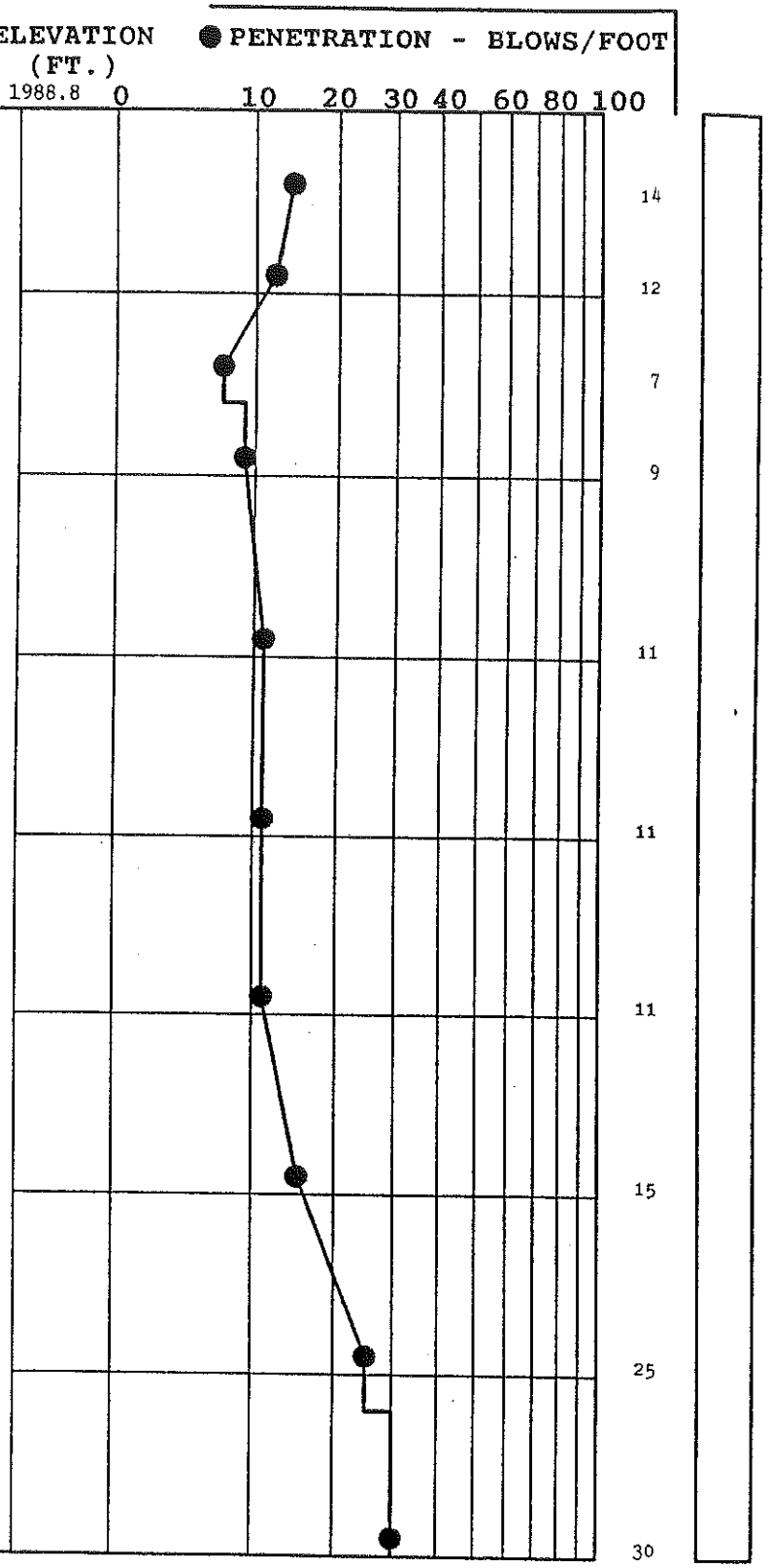
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER B-8
DATE DRILLED 5-6-90
PROJECT NUMBER 56-8550
PROJECT MADISON CO. LANDFILL
PAGE 1 OF 1

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)
0.0		1988.8
0.3	Topsoil	
	Residuum - Stiff to Firm Red Brown Micaceous Slightly Fine to Medium Sandy Clayey SILT	
8.0	Stiff to Very Stiff Red Brown Very Micaceous Fine to Medium Sandy SILT	
36.0	Very Stiff to Hard Gray Brown to Red Gray Very Micaceous Fine to Coarse Sandy SILT With Gravel - Moist	
40.0		



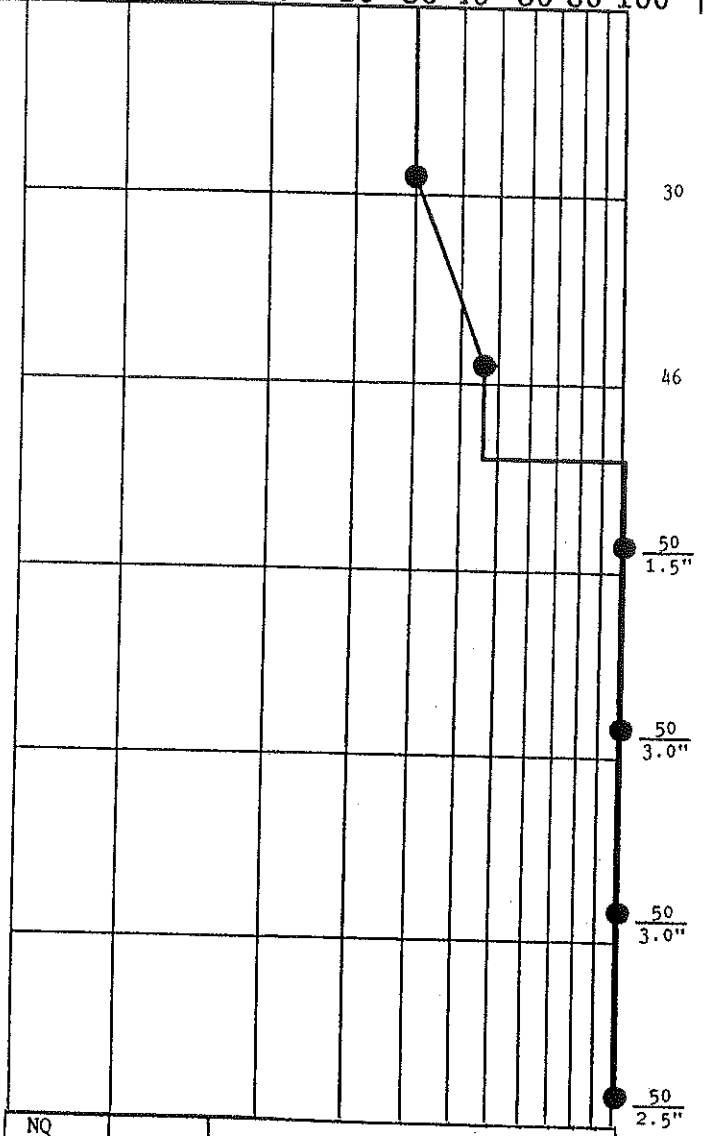
TEST BORING RECORD

BORING NUMBER B-13
DATE DRILLED 5-2/3-90
PROJECT NUMBER 56-8550
PROJECT MADISON CO. LANDFILL
PAGE 1 OF 2

LAW ENGINEERING

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVATIONS USED ABOVE

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT
40.0	Very Stiff to Hard Gray Brown to Red Gray Very Micaceous Fine to Coarse Sandy SILT with Gravel - Moist	1948.8	0 10 20 30 40 60 80 100
52.0	Partially Weathered Rock That Becomes Red Gray to Green Gray Micaceous Silty Fine to Coarse SAND with Gravel When Sampled - Moist		
70.0	Very Soft to Moderately Hard Bluish Gray to Black Hornblende - Biotite Gneiss		
80.0			



NQ REC	RQD	
92%	86%	70.0 TO 71.1 Very Close Joints - Low Dip Complete to Severe Weathering 71.1 - 80 Moderately Close to Wide Joints Moderate to Very Slight Weathering

Drilling Terminated at 80.0 Feet.
Ground Water at 51.2 Feet on 7-18-90.

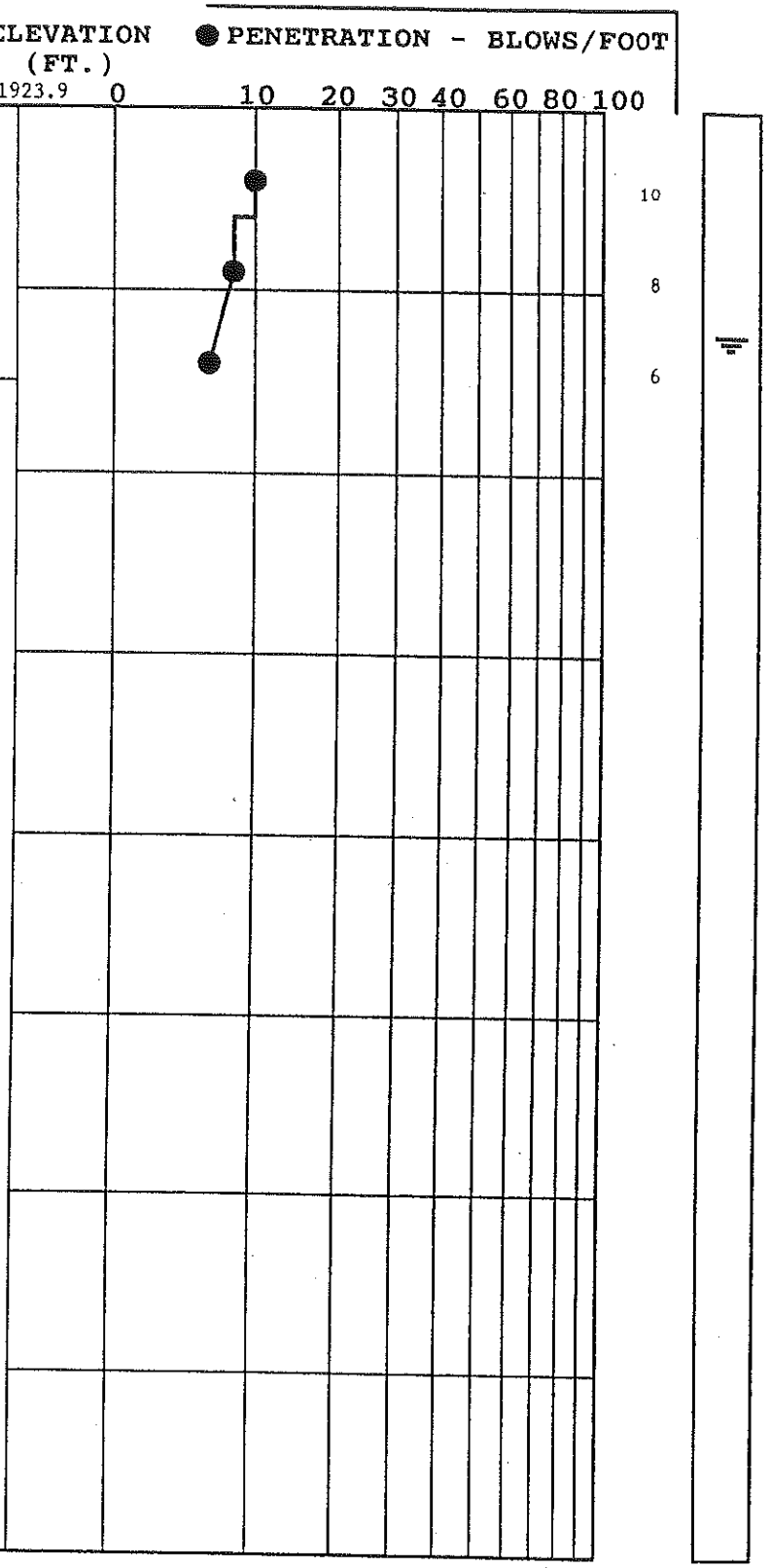
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER B-13
DATE DRILLED 5-2/3-90
PROJECT NUMBER 56-8550
PROJECT MADISON CO. LANDFILL
PAGE 2 OF 2

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)
0.0		1923.9
0.3	Topsoil	
3.0	Alluvium - Stiff Red Brown Slightly Fine Sandy Very Clayey SILT Residuum - Firm Red Brown Micaceous Clayey Fine to Medium Sandy SILT	
8.0	Boring Terminated at 8.0 Feet. Ground Water at 6.1 Feet on 7-18-90.	



TEST BORING RECORD

BORING NUMBER B-15
DATE DRILLED 7-17-90
PROJECT NUMBER 56-8550
PROJECT MADISON CO. LANDFILL
PAGE 1 OF 1

LAW ENGINEERING

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVATIONS USED ABOVE

APPENDIX D

SOIL LABORATORY TEST PROCEDURES

MOISTURE CONTENT AND UNIT WEIGHT

An undisturbed sample is trimmed in the laboratory into a right circular cylinder approximately three to six inches long. The dimensions and weight of the specimen are determined and the total unit weight calculated. Moisture contents are determined from representative portions of the specimen. The soil is dried to a constant weight in an oven at 100 degrees C and the loss of moisture during the drying process is measured. From this data, the moisture content and dry unit weight are computed.

ATTERBERG LIMITS

The Atterberg Limits Tests, Liquid Limit (LL), and Plastic Limit (PL), are performed to aid in the classification of soils and to determine the plasticity and volume change characteristics of the materials. The Liquid Limit is the minimum moisture content at which a soil will flow as a heavy viscous fluid. The Plastic Limit is the minimum moisture content at which the solid behaves as a plastic material. The Plasticity Index (PI) is the numeric difference of Liquid Limit and the Plastic Limit and indicates the range of moisture content over which a soil remains plastic. These tests are performed in accordance with ASTM D 4318.

PARTICLE SIZE DISTRIBUTION

The distribution of soils coarser than the No. 200 (75-um) sieve is determined by passing a representative specimen through a standard set of nested sieves. The weight of material retained on each sieve is determined and the percentage retained (or passing) is calculated. A specimen may be washed through only the No. 200 sieve, if the full range of particle sizes is not required. The percentage of material passing the No. 200 sieve is reported. The distribution of materials finer than No. 200 sieve is determined by use of the hydrometer. The particle sizes and distribution are computed from the time rate of settlement of the different size particles while suspended in water. These tests are performed in accordance with ASTM D 421, D 422, and D 1140.

HYDRAULIC CONDUCTIVITY

The ease with which water flows through a soil is characterized by its hydraulic conductivity. Two general test methods are employed depending on the soil type.

The **Constant Head** method is used for coarse-grained materials (sands and gravels). The sample is confined in permeameter chamber while water is allowed to flow through it from a constant head level. The quantity of water flowing through the specimen in a given time period is used to calculate the hydraulic conductivity. See ASTM D 2434 for a complete description of this test.

Fine-grained materials (silts and clays) require the use of a **Flexible Wall Permeameter**. The sample is prepared in a similar manner as in the triaxial compression test. It is encased in a rubber membrane and placed inside a permeameter chamber. The specimen is back-pressure saturated

and allowed to consolidate under a specified effective stress. Water is then forced through the specimen under a controlled hydraulic gradient. The quantity of water flowing into the sample in a given time period is used to calculate the hydraulic conductivity. This test is performed in general accordance with ASTM D 5084.

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT

CONSTANT VOLUME APPARATUS (ASTM D 5084)

MADISON COUNTY

PROJECT: C & D LANDFILL PHASE II

PROJECT NO.: J04-2225-04

DATE RECEIVED: 2-5-05

TESTED BY: JOHN MATHEW

CHECKED BY: PAUL YARBER

SAMPLE NO. BLE-6

TYPE UNDISTURBED

SAMPLE LOCATION: 23.5-25.5'

SAMPLE DESCRIPTION: GREY & BROWN FI.-MED. SANDY SILT

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	2.968	7.539	2.952	7.498
Sample Diameter	2.881	7.318	2.863	7.272
Length/Diameter Ratio		1.03		
Moisture Content (%)	WW= 171.2 DW= 124.6	37.4	WW= 234.6 DW= 168.6	39.1
Sample Wet Weight (grams)	584.2		588.6	
Wet Density (pcf)	115.0		118.0	
Dry Density (pcf)	83.7		84.8	
Saturation (%) TESTED SG= 2.929	93		99	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT

FALLING HEAD TEST

Confining Pressure (psi) 78.9 | Influent Pressure (psi) 60.2 | Effluent Pressure (psi) 60

Date	Clock Time		Elapsed Time	Pipet Readings				Head		Temp	Gradient	K	Temp	K_{20}
				Initial		Final		Initial	Final					
	Start	End	seconds	in	out	in	out	cm	cm	°C		(cm/sec)	Correction	(cm/sec)
2-7-05	3:37:00	3:37:19	19	1.0	23.0	2.0	22.0	40.092	37.726	22.00	5	2.4E-04	0.953	2.3E-04
	3:37:19	3:37:40	21	2.0	22.0	3.0	21.0	37.726	35.361	22.00	5	2.3E-04	0.953	2.2E-04
	3:37:40	3:38:02	22	3.0	21.0	4.0	20.0	35.361	32.995	22.00	5	2.4E-04	0.953	2.3E-04
	3:38:02	3:38:26	24	4.0	20.0	5.0	19.0	32.995	30.629	22.00	4	2.3E-04	0.953	2.2E-04
		Pipet Length, cm		28.390	28.390									
		Pipet Volume, cc		24	24									
		Cross-sectional Area of Pipet, cm^2		0.8454	0.8454									

HYDRAULIC CONDUCTIVITY (k) 2.3E-04 cm/sec

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT

CONSTANT VOLUME APPARATUS (ASTM D 5084)

MADISON COUNTY

PROJECT: C & D LANDFILL PHASE II

PROJECT NO.: J04-2225-04

DATE RECEIVED: 2-5-05

TESTED BY: JOHN MATHEW

CHECKED BY: PAUL YARBER

SAMPLE NO. BLE-7

TYPE UNDISTURBED

SAMPLE LOCATION: 8.0-10.0'

SAMPLE DESCRIPTION: BROWN FL.-MED. SANDY SILT

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	3.002	7.625	3.004	7.630
Sample Diameter	2.860	7.264	2.850	7.239
Length/Diameter Ratio		1.05		
Moisture Content (%)	WW= 142.5 DW= 105.8	34.7	WW= 262.6 DW= 180.9	45.2
Sample Wet Weight (grams)	516.5		554.3	
Wet Density (pcf)	102.0		110.2	
Dry Density (pcf)	75.7		75.9	
Saturation (%) TESTED SG= 2.929	72		95	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT

FALLING HEAD TEST

Confining Pressure (psi) 77.3 | Influent Pressure (psi) 70.2 | Effluent Pressure (psi) 70

Date	Clock Time		Elapsed Time	Pipet Readings				Head		Temp	Gradient	K	Temp	K_{20}
				Initial		Final		Initial	Final					
	Start	End	seconds	in	out	in	out	cm	cm	°C		(cm/sec)	Correction	(cm/sec)
2-7-05	4:28:00	4:30:00	120	1.0	23.0	2.0	22.0	40.092	37.726	22.00	5	3.9E-05	0.953	3.8E-05
	4:30:00	4:32:10	130	2.0	22.0	3.0	21.0	37.726	35.361	22.00	5	3.9E-05	0.953	3.7E-05
	4:32:10	4:34:28	138	3.0	21.0	4.0	20.0	35.361	32.995	22.00	4	3.9E-05	0.953	3.7E-05
	4:34:28	4:36:58	150	4.0	20.0	5.0	19.0	32.995	30.629	22.00	4	3.9E-05	0.953	3.7E-05
		Pipet Length, cm		28.390	28.390									
		Pipet Volume, cc		24	24									
		Cross-sectional Area of Pipet, cm^2		0.8454	0.8454									

HYDRAULIC CONDUCTIVITY (k) 3.7E-05 cm/sec

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT

CONSTANT VOLUME APPARATUS (ASTM D 5084)

MADISON COUNTY

PROJECT:	C & D LANDFILL PHASE II	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J04-2225-04	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	2-5-05		

SAMPLE NO.	BLE-9	SAMPLE LOCATION:	18.0-20.0'
TYPE	UNDISTURBED	SAMPLE DESCRIPTION:	LIGHT YELLOWISH BROWN SILTY FI.-CO. SAND

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	3.001	7.623	2.953	7.501
Sample Diameter	2.874	7.300	2.849	7.236
Length/Diameter Ratio		1.04		
Moisture Content (%)	WW= 174.1 DW= 144.8	20.2	WW= 254.4 DW= 188.3	35.1
Sample Wet Weight (grams)	557.2		608.4	
Wet Density (pcf)	109.0		123.1	
Dry Density (pcf)	90.7		91.1	
Saturation (%) TESTED SG= 2.947	58		102	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT

FALLING HEAD TEST

Confining Pressure (psi) 95.3 | Influent Pressure (psi) 80.2 | Effluent Pressure (psi) 80

Date	Clock Time		Elapsed Time	Pipet Readings				Head		Temp	Gradient	K	Temp	K_{20}
				Initial		Final		Initial	Final					
	Start	End	seconds	in	out	in	out	cm	cm	°C		(cm/sec)	Correction	(cm/sec)
2-8-05	11:14:00	11:14:15	15	1.0	23.0	3.0	21.0	40.092	35.360	20.00	5	6.4E-04	1.000	6.4E-04
	11:14:15	11:14:32	17	3.0	21.0	5.0	19.0	35.360	30.629	20.00	4	6.5E-04	1.000	6.5E-04
	11:14:32	11:14:51	19	5.0	19.0	7.0	17.0	30.629	25.897	20.00	4	6.8E-04	1.000	6.8E-04
	11:14:51	11:15:11	20	7.0	17.0	9.0	15.0	25.897	21.165	20.00	3	7.8E-04	1.000	7.8E-04
		Pipet Length, cm		28.390	28.390									
		Pipet Volume, cc		24	24									
		Cross-sectional Area of Pipet, cm^2		0.8454	0.8454									

HYDRAULIC CONDUCTIVITY (k) 6.9E-04 cm/sec

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT

CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	MADISON COUNTY C & D LANDFILL PHASE II	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J04-2225-04	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	2-5-05		

SAMPLE NO.	BLE-11	SAMPLE LOCATION:	1.0-10.0'
TYPE	REMOLDED	SAMPLE DESCRIPTION:	GREY & BROWN FI.-MED. SANDY SILT

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	3.000	7.620	2.986	7.584
Sample Diameter	2.850	7.239	2.845	7.226
Length/Diameter Ratio		1.05		
Moisture Content (%)	WW= 126.1 DW= 100.8	25.1	WW= 315.1 DW= 249.1	26.5
Sample Wet Weight (grams)	628.2		637.9	
Wet Density (pcf)	125.0		128.0	
Dry Density (pcf)	100.0		101.2	
Saturation (%) TESTED SG= 2.895	90		98	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT

(PERMOMETER)

Confining Pressure (psi) 70 | Influent Pressure (psi) 60 | Effluent Pressure (psi) 60

Reset (Y/N)	Date	Clock Time	Elapsed Time	HA_{OUT} (cm)	HA_{IN} (cm)	Temp °C	Gradient	K (cm/sec)	Temp Correction	K_{20} (cm/sec)
Y	2-15-05	11:08:17		6.8	1.39	21	10			
		11:11:38	0:03:21	6.3	1.41	21	9	2.1E-07	0.976	2.0E-07
		11:12:23	0:04:06	6.2	1.41	21	9	2.1E-07	0.976	2.0E-07
		11:13:10	0:04:53	6.1	1.42	21	9	2.0E-07	0.976	2.0E-07
		11:14:01	0:05:44	6.0	1.42	21	9	2.0E-07	0.976	2.0E-07

HYDRAULIC CONDUCTIVITY (k) 2.0E-07 cm/sec

% COMPACTION OF STD. PROCTOR MAX. DRY DENSITY (ASTM D 698): 95.1

% WETTER THAN OPTIMUM MOISTURE CONTENT (ASTM D 698): +5.2

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT

CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	MADISON COUNTY C & D LANDFILL PHASE II	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J04-2225-04	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	2-5-05		

SAMPLE NO.	BLE-12	SAMPLE LOCATION:	8.5-10.5'
TYPE	UNDISTURBED	SAMPLE DESCRIPTION:	DARK GREY FL. SANDY SILTY CLAY

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	2.970	7.544	3.008	7.640
Sample Diameter	2.869	7.287	2.860	7.264
Length/Diameter Ratio		1.04		
Moisture Content (%)	WW= 163.2 DW= 117.9	38.4	WW= 248.8 DW= 173.2	43.6
Sample Wet Weight (grams)	568.6		576.7	
Wet Density (pcf)	112.8		113.7	
Dry Density (pcf)	81.5		79.1	
Saturation (%) TESTED SG= 2.767	95		102	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT

(PERMOMETER)

Confining Pressure (psi) 65 | Influent Pressure (psi) 60 | Effluent Pressure (psi) 60

Reset (Y/N)	Date	Clock Time	Elapsed Time	HA_{OUT} (cm)	HA_{IN} (cm)	Temp °C	Gradient	K (cm/sec)	Temp Correction	K_{20} (cm/sec)
Y	2-7-05	3:04:10		9.4	1.28	22	15			
		3:10:48	0:06:38	9.1	1.29	22	14	4.0E-08	0.953	3.8E-08
		3:13:08	0:08:58	9.0	1.30	22	14	3.9E-08	0.953	3.8E-08
		3:15:52	0:11:42	8.9	1.30	22	14	3.8E-08	0.953	3.6E-08
		3:18:46	0:14:36	8.8	1.31	22	14	3.7E-08	0.953	3.5E-08

HYDRAULIC CONDUCTIVITY (k) 3.7E-08 cm/sec

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT

CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	MADISON COUNTY C & D LANDFILL PHASE II	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J04-2225-04	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	2-5-05		

SAMPLE NO.	BLE-13	SAMPLE LOCATION:	1.0-10.0'
TYPE	REMOLDED	SAMPLE DESCRIPTION:	REDDISH & BROWN FL.-MED. SANDY CLAYEY SILT

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	3.000	7.620	3.021	7.673
Sample Diameter	2.850	7.239	2.851	7.242
Length/Diameter Ratio		1.05		
Moisture Content (%)	WW= 175.2 DW= 130.9	33.8	WW= 272.5 DW= 196.4	38.7
Sample Wet Weight (grams)	571.6		592.4	
Wet Density (pcf)	113.8		117.0	
Dry Density (pcf)	85.0		84.3	
Saturation (%) TESTED SG= 2.864	88		99	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT

(PERMOMETER)

Confining Pressure (psi) 70 | Influent Pressure (psi) 60 | Effluent Pressure (psi) 60

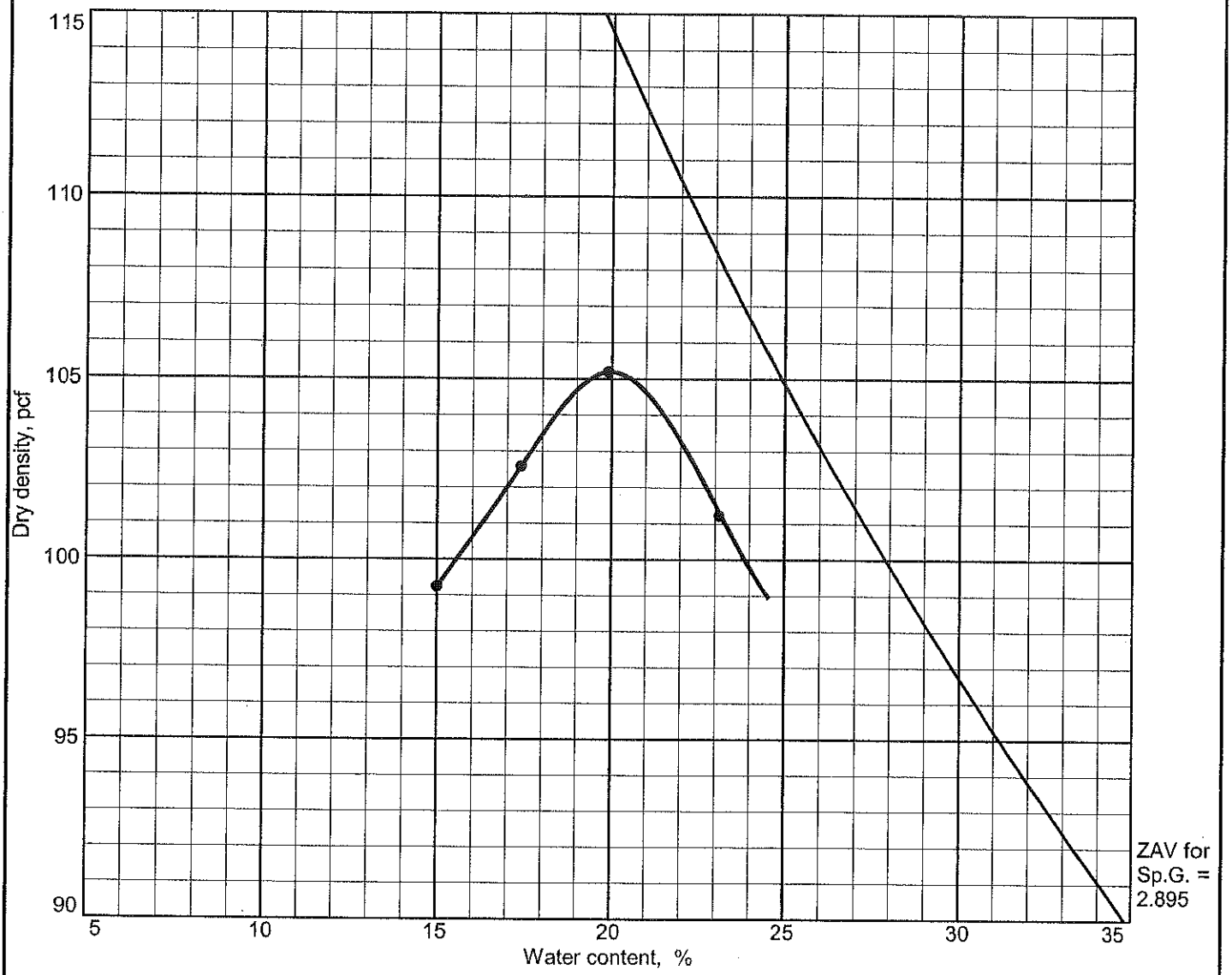
Reset (Y/N)	Date	Clock Time	Elapsed Time	HA_{OUT} (cm)	HA_{IN} (cm)	Temp °C	Gradient	K (cm/sec)	Temp Correction	K_{20} (cm/sec)
Y	2-15-05	10:47:35		6.8	1.39	21	10			
		10:58:06	0:10:31	5.9	1.42	21	8	1.2E-07	0.976	1.2E-07
		10:59:06	0:11:31	5.8	1.43	21	8	1.3E-07	0.976	1.2E-07
		11:00:53	0:13:18	5.7	1.43	21	8	1.2E-07	0.976	1.2E-07
		11:02:26	0:14:51	5.6	1.44	21	8	1.2E-07	0.976	1.2E-07

HYDRAULIC CONDUCTIVITY (k) 1.2E-07 cm/sec

% COMPACTION OF STD. PROCTOR MAX. DRY DENSITY (ASTM D 698): 95.3

% WETTER THAN OPTIMUM MOISTURE CONTENT (ASTM D 698): +5.1

MOISTURE/DENSITY RELATIONSHIP



Test specification: ASTM D 698-00 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
1.0-10.0	ML		27.8	2.895	46	9	0.0	60.7

TEST RESULTS

Maximum dry density = 105.2 pcf

Optimum moisture = 20.0 %

MATERIAL DESCRIPTION

Grey & brown fi.-med. sandy SILT

Project No. J04-2225-04 **Client:** McGill

Project: Madison County C & D Landfill

Phase II

● **Source:** Boring **Sample No.:** BLE-11 **Elev./Depth:** 1.0-10.0

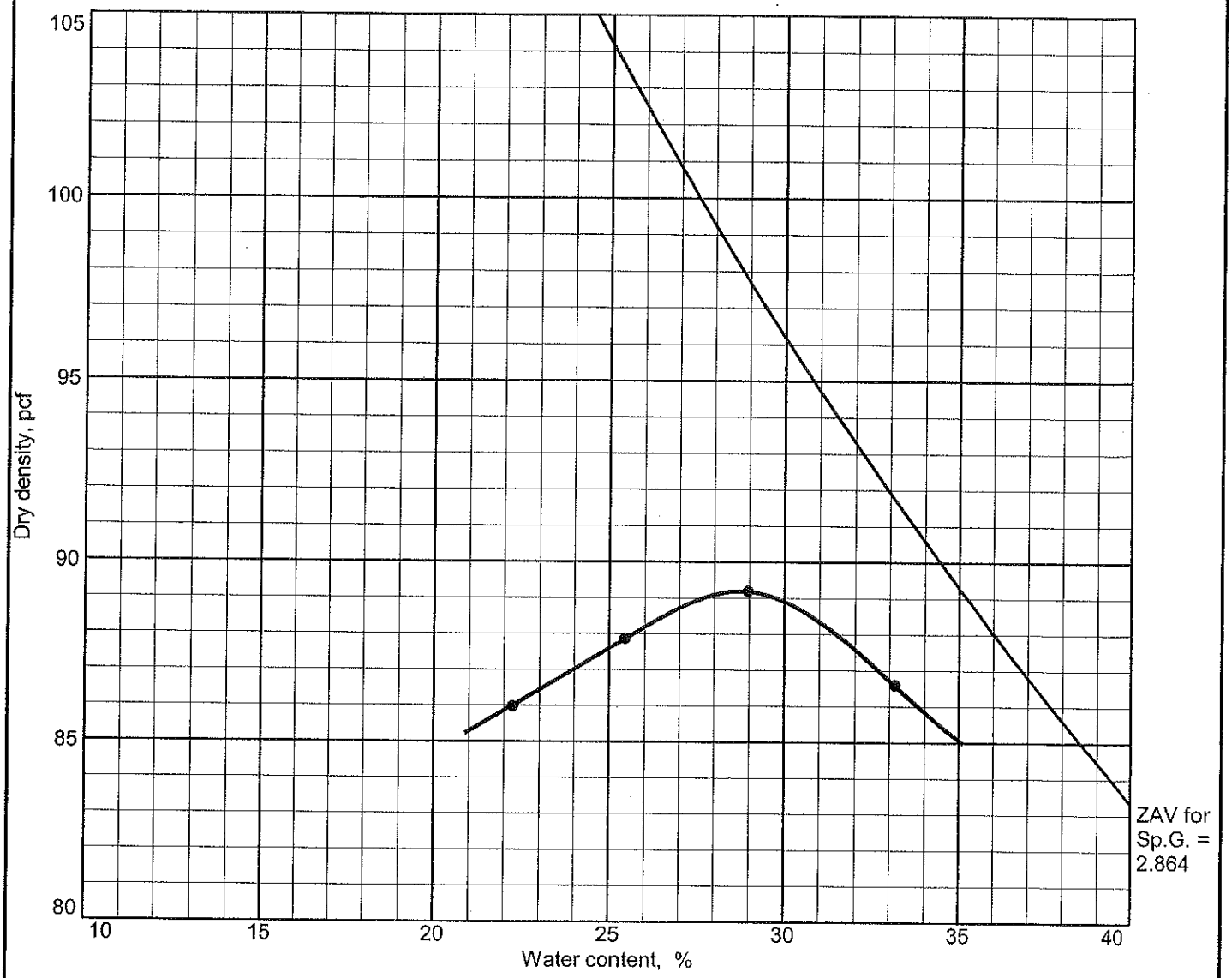
Remarks:

MOISTURE/DENSITY RELATIONSHIP

BUNNELL-LAMMONS ENGINEERING, INC.

Plate

MOISTURE/DENSITY RELATIONSHIP



Test specification: ASTM D 698-00 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
1.0-10.0	MH		43.9	2.864	74	29	2.6	73.5

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 89.2 pcf Optimum moisture = 28.8 %	Reddish brown fi.-med. sandy clayey SILT

Project No. J04-2225-04 **Client:** McGill
Project: Madison County C & D Landfill
Phase II
● **Source:** Boring **Sample No.:** BLE-13 **Elev./Depth:** 1.0-10.0

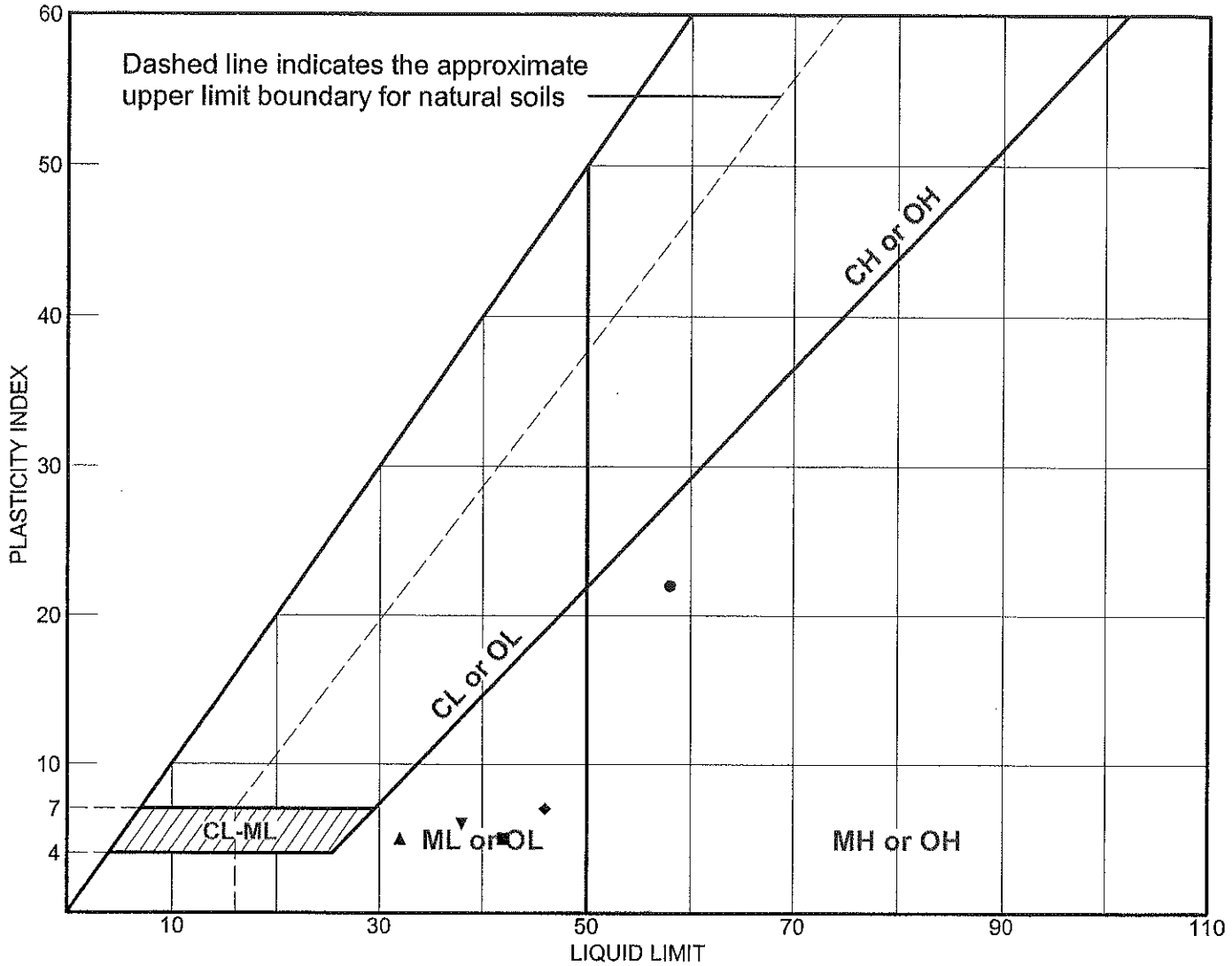
Remarks:

MOISTURE/DENSITY RELATIONSHIP

BUNNELL-LAMMONS ENGINEERING, INC.

Plate

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Boring	BLE-6	3.5-5.0	28.1	36	58	22	MH
■	Boring	BLE-6	23.5-25.5	39.8	37	42	5	ML
▲	Boring	BLE-6	33.5-35.0	17.0	27	32	5	SM
◆	Boring	BLE-7	8.0-10.0	34.7	39	46	7	ML
▼	Boring	BLE-8	23.5-25.0	21.8	32	38	6	SM

LIQUID AND PLASTIC LIMITS TEST REPORT

BUNNELL-LAMMONS ENGINEERING, INC.

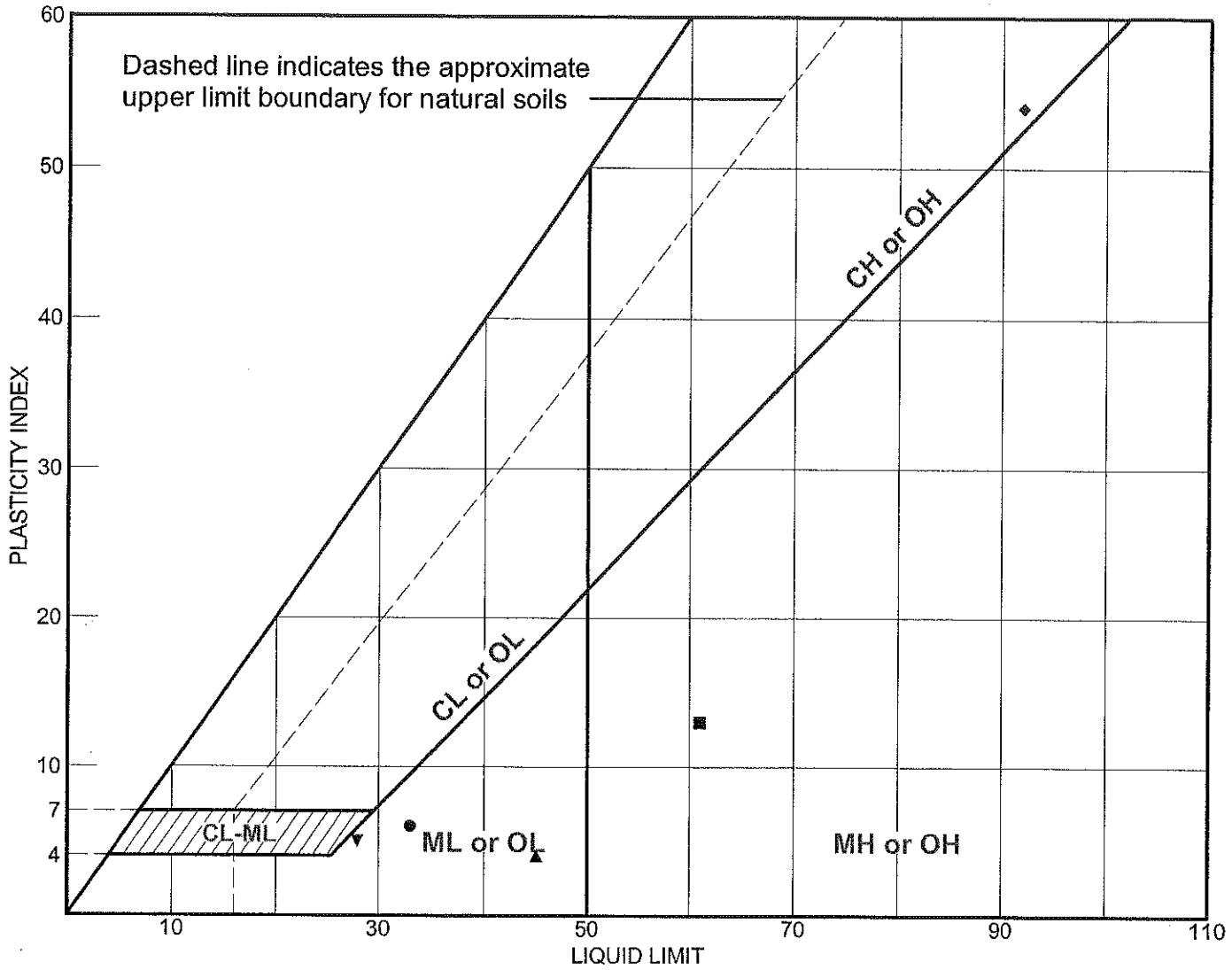
Client: McGill

Project: Madison County C & D Landfill Phase II

Project No.: J04-2225-04

Plate

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Boring	BLE-8	33.5-35.0	11.6	27	33	6	SM
■	Boring	BLE-9	3.5-5.0	50.0	48	61	13	MH
▲	Boring	BLE-9	18.0-20.0	20.2	41	45	4	SM
◆	Boring	BLE-10	3.5-5.0	44.1	38	92	54	CH
▼	Boring	BLE-10	18.5-20.0	13.8	23	28	5	SM

LIQUID AND PLASTIC LIMITS TEST REPORT

BUNNELL-LAMMONS ENGINEERING, INC.

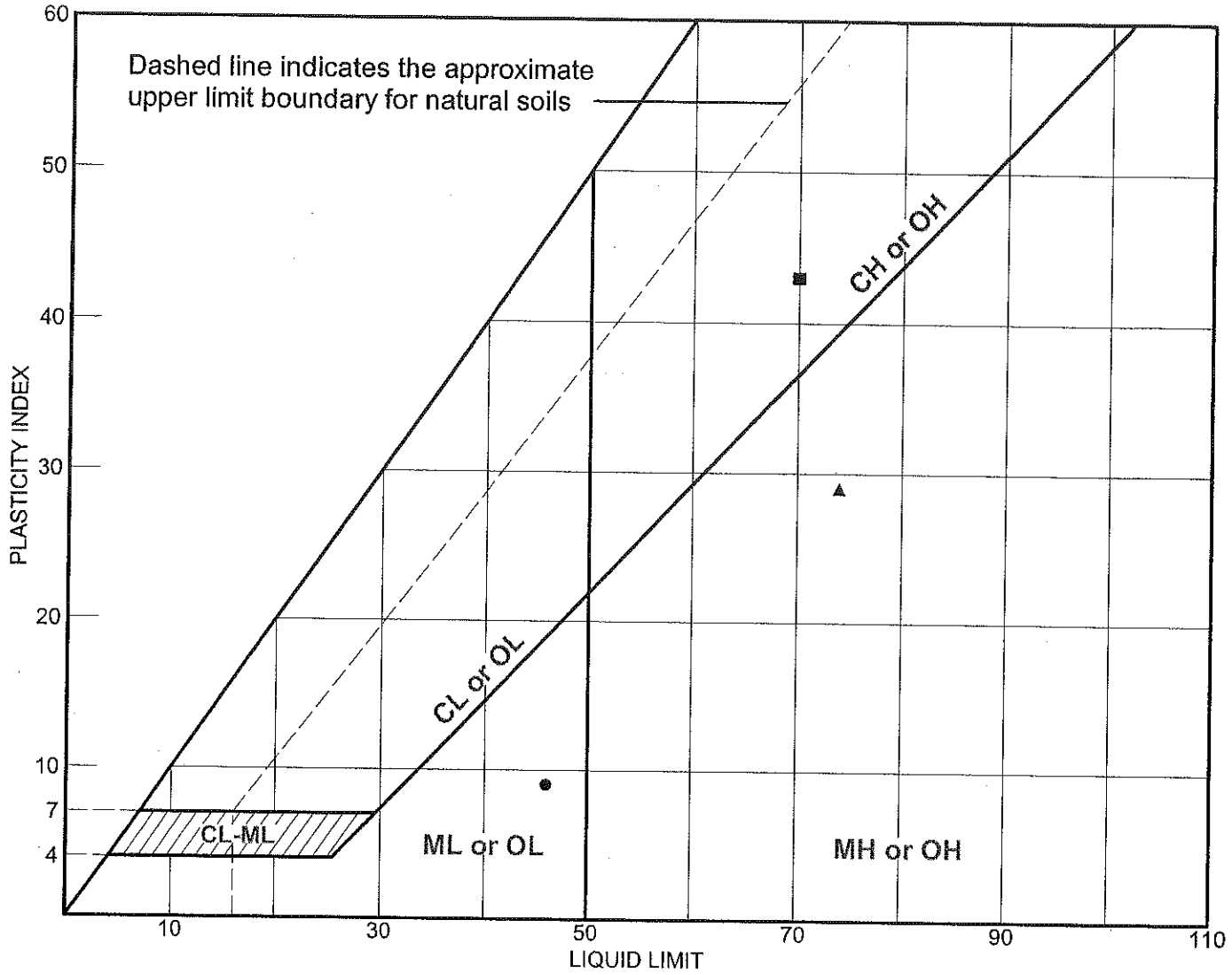
Client: McGill

Project: Madison County C & D Landfill Phase II

Project No.: J04-2225-04

Plate

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Boring	BLE-11	1.0-10.0	27.8	37	46	9	ML
■	Boring	BLE-12	8.5-10.5	38.4	27	70	43	CH
▲	Boring	BLE-13	1.0-10.0	43.9	45	74	29	MH

LIQUID AND PLASTIC LIMITS TEST REPORT

BUNNELL-LAMMONS ENGINEERING, INC.

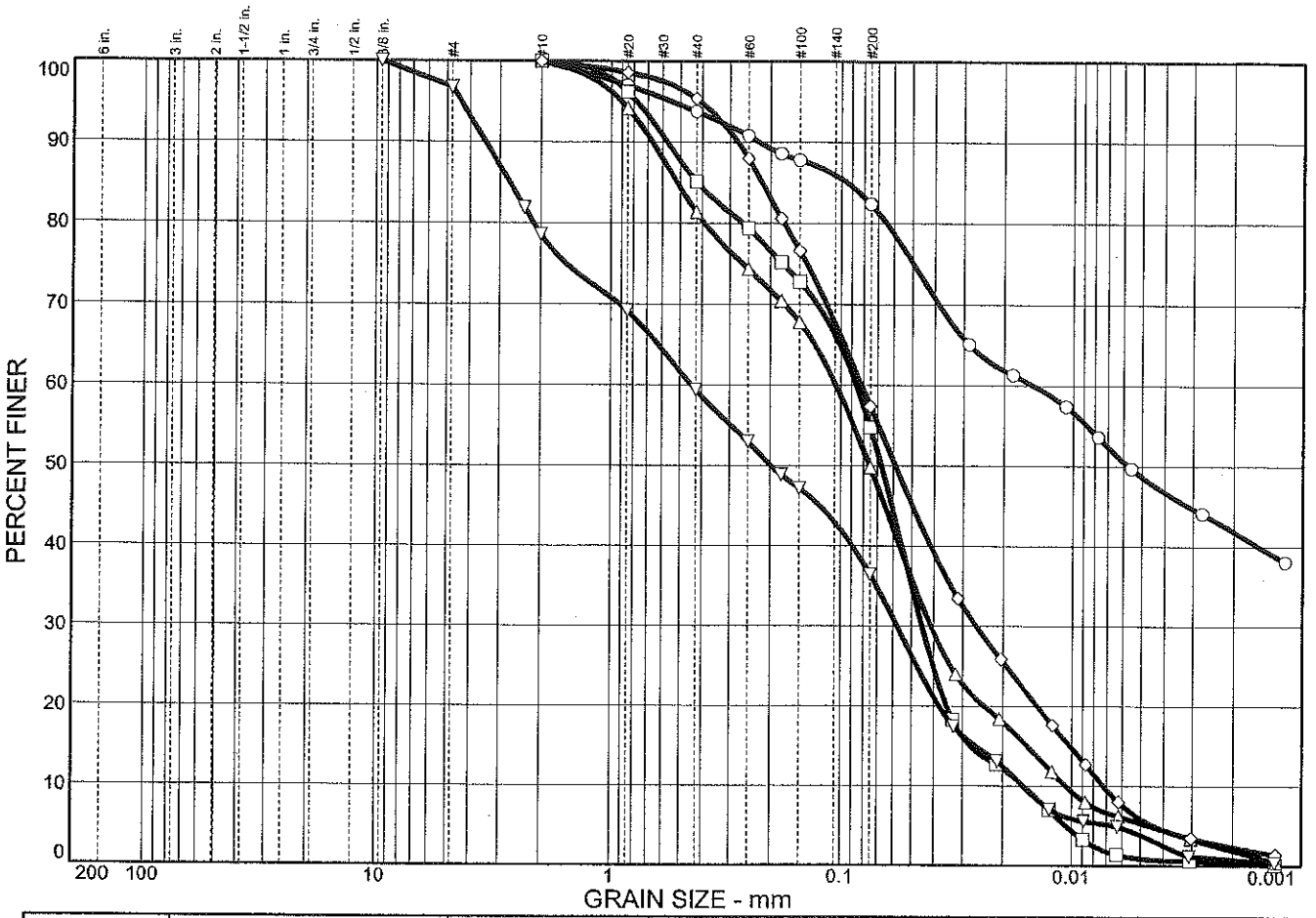
Client: McGill

Project: Madison County C & D Landfill Phase II

Project No.: J04-2225-04

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.0	0.0	6.2	11.4	33.7	48.7
□	0.0	0.0	0.0	0.0	14.8	30.4	53.9	0.9
△	0.0	0.0	0.0	0.0	18.6	31.6	44.5	5.3
◇	0.0	0.0	0.0	0.0	4.6	38.0	51.5	5.9
▽	0.0	0.0	3.2	18.2	19.2	22.9	32.6	3.9

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	DESCRIPTION	USCS
○	Boring	BLE-6	3.5-5.0	Red, brown & black fi. sandy clayey SILT	MH
□	Boring	BLE-6	23.5-25.5	Grey & brown fi.-med. sandy SILT	ML
△	Boring	BLE-6	33.5-35.0	Grey & brown fi.-med. silty SAND	SM
◇	Boring	BLE-7	8.0-10.0	Brown fi.-med. sandy SILT	ML
▽	Boring	BLE-8	23.5-25.0	Grey & brown silty fi.-co. SAND	SM

Particle Size Distribution Report

BUNNELL-LAMMONS ENGINEERING, INC.

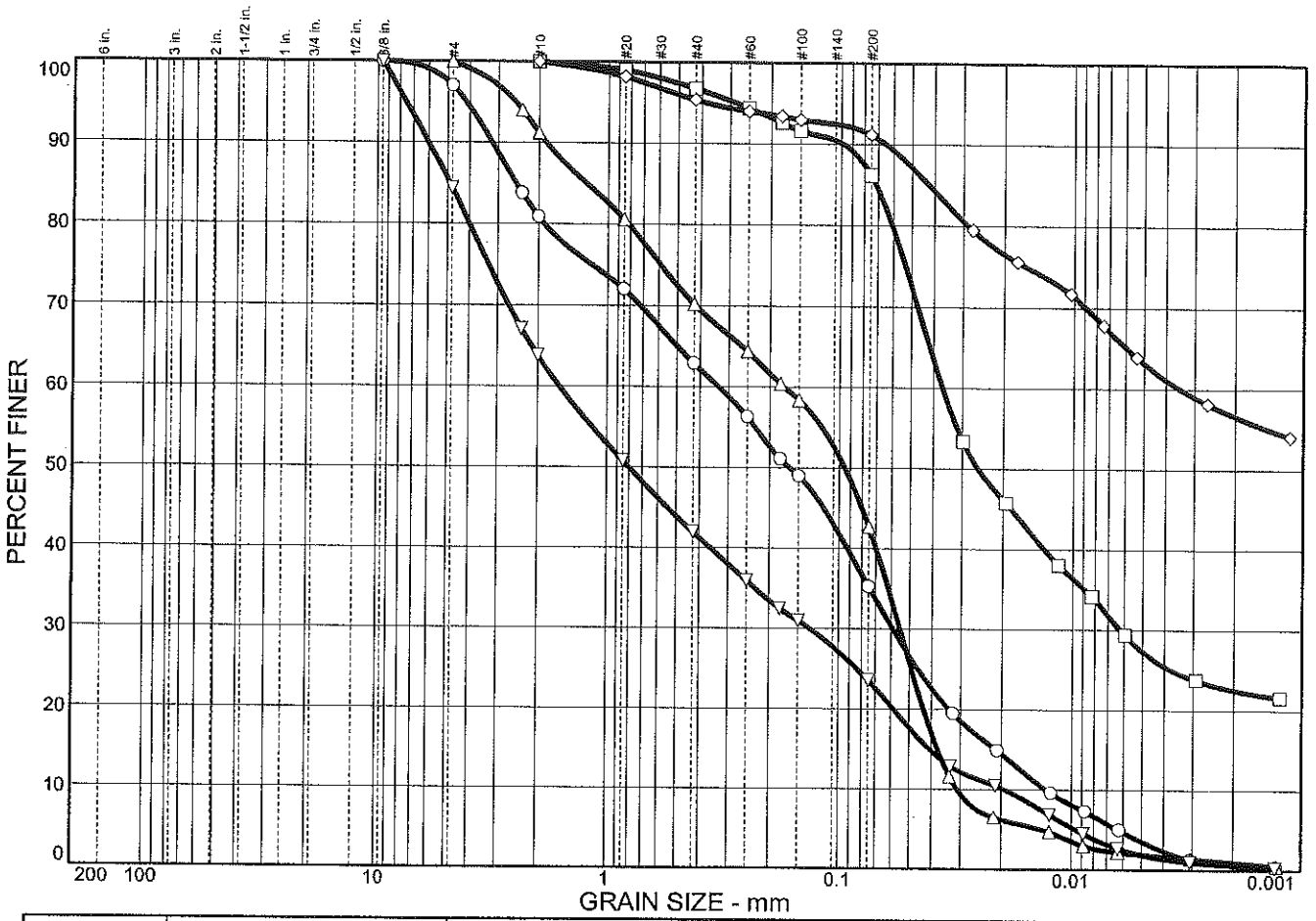
Client: McGill

Project: Madison County C & D Landfill
Phase II

Project No.: J04-2225-04

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	3.0	16.1	18.0	27.6	31.7	3.6
□	0.0	0.0	0.0	0.0	3.2	10.6	58.8	27.4
△	0.0	0.0	0.0	8.8	21.0	27.5	40.8	1.9
◇	0.0	0.0	0.0	0.0	4.6	4.2	28.0	63.2
▽	0.0	0.0	15.6	20.6	21.8	18.4	21.7	1.9

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	DESCRIPTION	USCS
○	Boring	BLE-8	33.5-35.0	Grey & brown silty fi.-co. SAND	SM
□	Boring	BLE-9	3.5-5.0	Reddish brown fi. sandy clayey SILT	MH
△	Boring	BLE-9	18.0-20.0	Light yellowish brown silty fi.-co. SAND	SM
◇	Boring	BLE-10	3.5-5.0	Brown silty CLAY	CH
▽	Boring	BLE-10	18.5-20.0	Brown silty fi.-co. SAND w/gravel	SM

Particle Size Distribution Report

BUNNELL-LAMMONS ENGINEERING, INC.

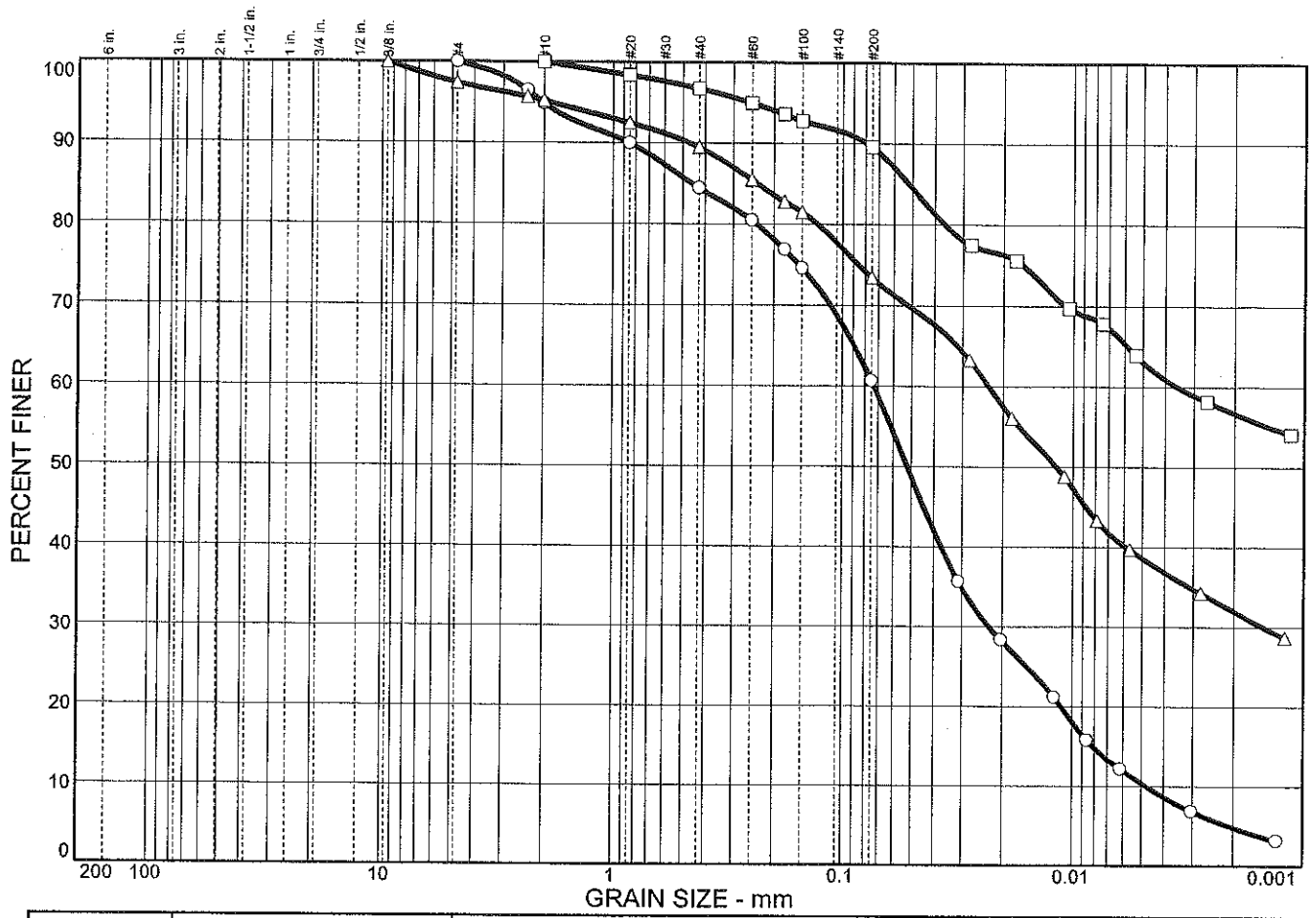
Client: McGill

Project: Madison County C & D Landfill
Phase II

Project No.: J04-2225-04

Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.0	5.1	10.4	23.8	50.3	10.4
□	0.0	0.0	0.0	0.0	3.2	7.2	26.5	63.1
△	0.0	0.0	2.6	2.2	5.7	16.0	34.8	38.7

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	DESCRIPTION	USCS
○	Boring	BLE-11	1.0-10.0	Grey & brown fi.-med. sandy SILT	ML
□	Boring	BLE-12	8.5-10.5	Dark grey fi. sandy silty CLAY	CH
△	Boring	BLE-13	1.0-10.0	Reddish brown fi.-med. sandy clayey SILT	MH

Particle Size Distribution Report

BUNNELL-LAMMONS ENGINEERING, INC.

Client: McGill

Project: Madison County C & D Landfill
Phase II

Project No.: J04-2225-04

Plate

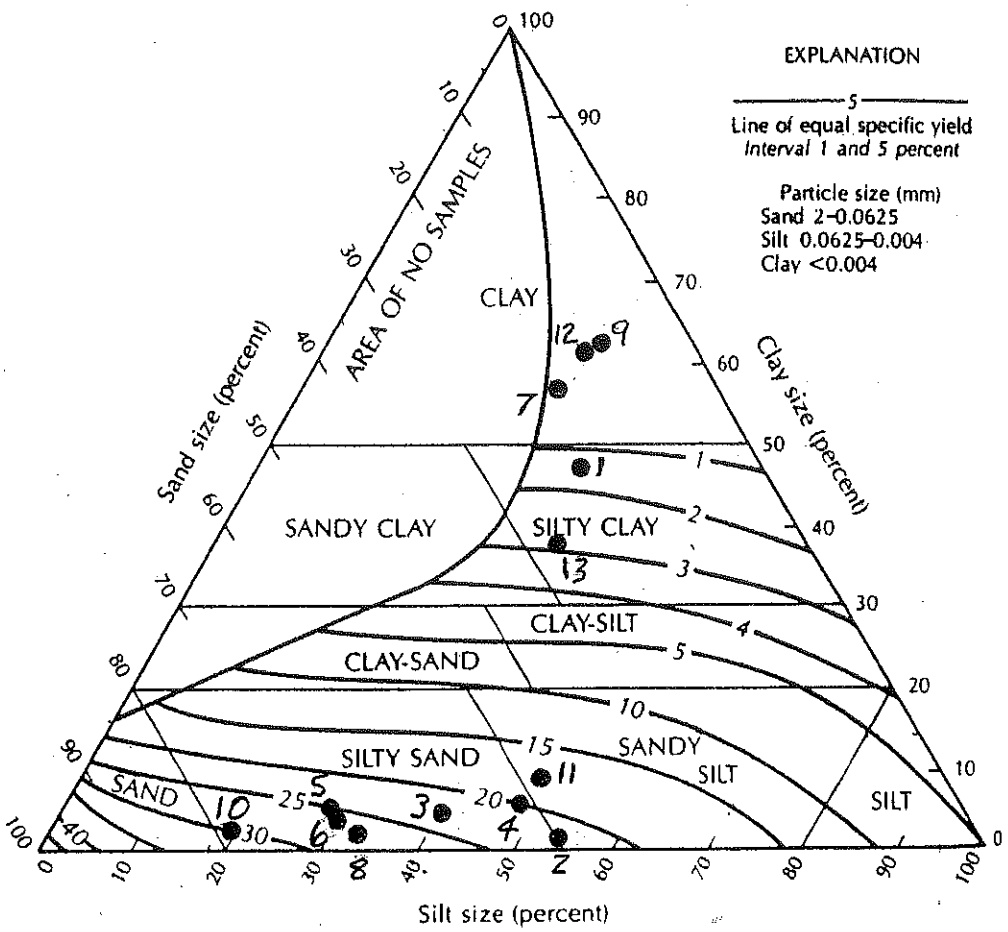
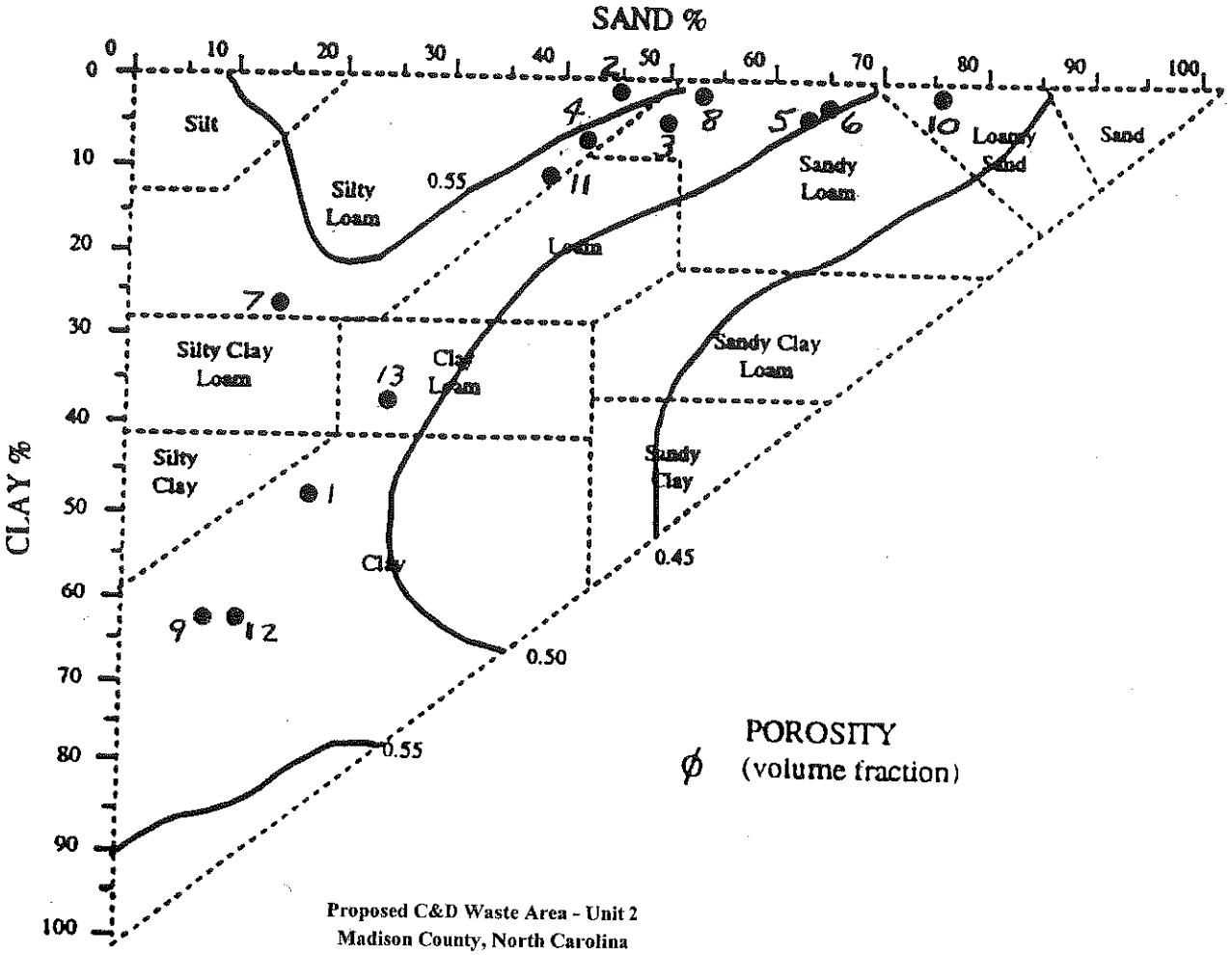


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A.I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

Proposed C&D Waste Area - Unit 2
Madison County, North Carolina
BLE Project Number J04-2225-04

ID#	Boring	Depth (ft)
1	BLE-6	3.5 - 5.0
2	BLE-6	23.5 - 25.5
3	BLE-6	33.5 - 35.0
4	BLE-7	8.0 - 10.0
5	BLE-8	23.5 - 25.0
6	BLE-8	33.5 - 35.0
7	BLE-9	3.5 - 5.0
8	BLE-9	18.0 - 20.0
9	BLE-10	3.5 - 5.0
10	BLE-10	18.0 - 20.0
11	BLE-11	1.0 - 10.0
12	BLE-12	8.5 - 10.5
13	BLE-13	1.0 - 10.0



Proposed C&D Waste Area - Unit 2
Madison County, North Carolina
BLE Project Number J04-2225-04

ID#	Boring	Depth (ft)
1	BLE-6	3.5 - 5.0
2	BLE-6	23.5 - 25.5
3	BLE-6	33.5 - 35.0
4	BLE-7	8.0 - 10.0
5	BLE-8	23.5 - 25.0
6	BLE-8	33.5 - 35.0
7	BLE-9	3.5 - 5.0
8	BLE-9	18.0 - 20.0
9	BLE-10	3.5 - 5.0
10	BLE-10	18.0 - 20.0
11	BLE-11	1.0 - 10.0
12	BLE-12	8.5 - 10.5
13	BLE-13	1.0 - 10.0

(Modified from Rawls and Brankensiek, 1989)

APPENDIX F

PIEZOMETER INSTALLATION PROCEDURES

Ground-water piezometers were installed in the boreholes resulting from the drilling process. Approximate well locations are shown on the attached Piezometer/Boring Location Plan (Figure 3).

The piezometer consists of ¾-inch and 2-inch diameter PVC pipe (Schedule 40 with flush-threaded joints) inserted into an 8.25-inch diameter augured borehole. The bottom 5 to 20-foot section of each piezometer was a manufactured screen with 0.010-inch slots. Washed sand backfill was placed around the outside of the pipe above the top of the well screen. The sand backfill is used to stabilize the formation and to help yield a less turbid ground-water sample.

A bentonite seal (minimum 2-foot thick) was installed on top of the sand backfill up to the ground surface. A PVC cap was placed over the PVC well stickup on each piezometer. Piezometer construction records are attached in Appendix C.

APPENDIX G

SLUG TEST PROCEDURES AND RESULTS

Slug tests were performed in the field to estimate the average hydraulic conductivity of the upper formation material. Hydraulic conductivity is a constant of proportionality relating to the ease with which a fluid passes through a porous medium. These data were used to estimate the ground-water flow velocities of ground water beneath the site. The field procedure was as follows:

- Measure the static ground-water elevation in the well to be tested.
- Affect an instantaneous change to the static water level in the well by removing a known volume of water.
- Measure the rate at which the water level recovers to its original level (see attachments).

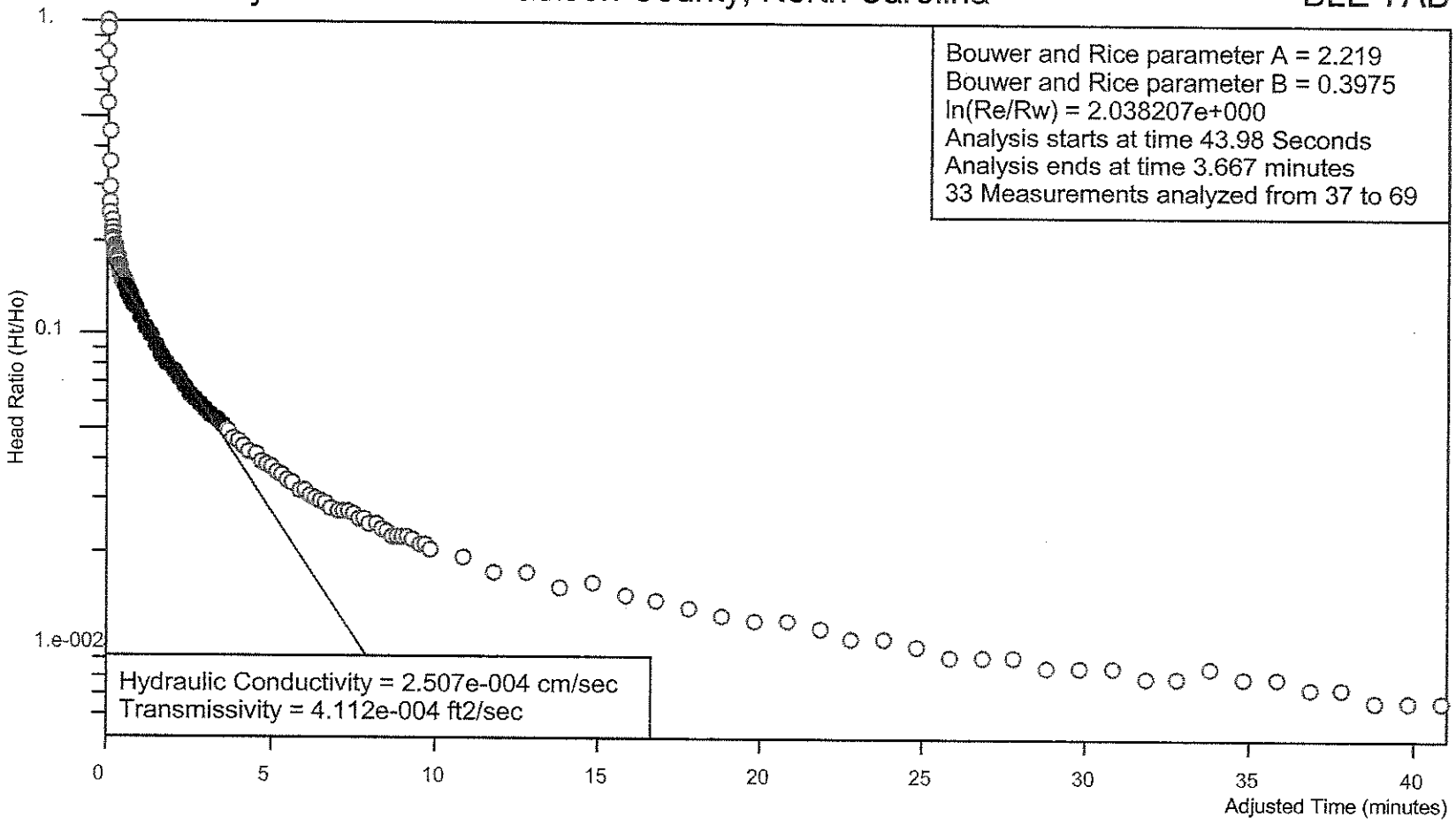
The resulting slug test data (time versus water level) was reduced and hydraulic conductivities were calculated using the Bouwer and Rice Method for partially penetrating wells in unconfined aquifers.

Rising Head Slug Test 6/29/2005

Bouwer and Rice Graph

Madison County C&D Landfill Madison County, North Carolina

BLE-7AB



Ho is 1.505 feet at 7.98 Seconds

Project Number: J05-2225-04 for McGill

Analysis by Rick Mayer

Rising Head Slug Test

Site Name:	Madison County C&D Landfill
Location:	Madison County, North Carolina
Test Date:	6/29/2005
Client:	McGill
Project Number:	J05-2225-04
Import File:	C:\Public PC030\Projects\Madison\Madison Slug Tests\Revised Data\BLE-7/

Well Label:	BLE-7AB
Aquifer Thickness:	50. feet
Screen Length:	10. feet
Casing Radius:	8.333e-002 feet
Effective Radius:	0.3542 feet
Static Water Level:	0. feet
Water Table to Screen Bottom:	8.59 feet
Anisotropy Ratio:	1.
Time Adjustment:	7.98 Seconds

Test starts with trial 0
There are 138 time and drawdown measurements
Maximum head is 1.505 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.133	0.	1.505	1.505	1.
2	0.15	1.7e-002	1.424	1.424	0.9462
3	0.167	3.4e-002	1.218	1.218	0.8093
4	0.183	5.e-002	1.023	1.023	0.6797
5	0.2	6.7e-002	0.836	0.836	0.5555
6	0.217	8.4e-002	0.67	0.67	0.4452
7	0.233	1.e-001	0.536	0.536	0.3561
8	0.25	0.117	0.448	0.448	0.2977
9	0.267	0.134	0.397	0.397	0.2638
10	0.283	0.15	0.366	0.366	0.2432
11	0.3	0.167	0.347	0.347	0.2306
12	0.317	0.184	0.331	0.331	0.2199
13	0.333	0.2	0.317	0.317	0.2106
14	0.35	0.217	0.306	0.306	0.2033
15	0.367	0.234	0.297	0.297	0.1973
16	0.383	0.25	0.289	0.289	0.192
17	0.4	0.267	0.282	0.282	0.1874
18	0.417	0.284	0.276	0.276	0.1834
19	0.433	0.3	0.271	0.271	0.1801
20	0.45	0.317	0.265	0.265	0.1761
21	0.467	0.334	0.261	0.261	0.1734
22	0.483	0.35	0.257	0.257	0.1708
23	0.5	0.367	0.249	0.249	0.1654
24	0.517	0.384	0.248	0.248	0.1648
25	0.533	0.4	0.245	0.245	0.1628
26	0.55	0.417	0.241	0.241	0.1601
27	0.567	0.434	0.238	0.238	0.1581
28	0.583	0.45	0.235	0.235	0.1561
29	0.6	0.467	0.232	0.232	0.1542
30	0.617	0.484	0.23	0.23	0.1528
31	0.633	0.5	0.227	0.227	0.1508
32	0.65	0.517	0.225	0.225	0.1495
33	0.667	0.534	0.222	0.222	0.1475

34	0.683	0.55	0.22	0.22	0.1462
35	0.7	0.567	0.217	0.217	0.1442
36	0.717	0.584	0.214	0.214	0.1422
37	0.733	0.6	0.213	0.213	0.1415
38	0.75	0.617	0.211	0.211	0.1402
39	0.767	0.634	0.209	0.209	0.1389
40	0.783	0.65	0.207	0.207	0.1375
41	0.8	0.667	0.204	0.204	0.1355
42	0.817	0.684	0.203	0.203	0.1349
43	0.833	0.7	0.201	0.201	0.1336
44	0.85	0.717	0.199	0.199	0.1322
45	0.867	0.734	0.198	0.198	0.1316
46	0.883	0.75	0.195	0.195	0.1296
47	0.9	0.767	0.194	0.194	0.1289
48	0.917	0.784	0.191	0.191	0.1269
49	0.933	0.8	0.191	0.191	0.1269
50	0.95	0.817	0.19	0.19	0.1262
51	0.967	0.834	0.188	0.188	0.1249
52	0.983	0.85	0.185	0.185	0.1229
53	1.	0.867	0.182	0.182	0.1209
54	1.167	1.034	0.169	0.169	0.1123
55	1.333	1.2	0.157	0.157	0.1043
56	1.5	1.367	0.147	0.147	9.767e-002
57	1.667	1.534	0.138	0.138	9.169e-002
58	1.833	1.7	0.128	0.128	8.505e-002
59	2.	1.867	0.12	0.12	7.973e-002
60	2.167	2.034	0.113	0.113	7.508e-002
61	2.333	2.2	0.107	0.107	7.11e-002
62	2.5	2.367	0.101	0.101	6.711e-002
63	2.667	2.534	9.6e-002	9.6e-002	6.379e-002
64	2.833	2.7	9.3e-002	9.3e-002	6.179e-002
65	3.	2.867	8.9e-002	8.9e-002	5.914e-002
66	3.167	3.034	8.5e-002	8.5e-002	5.648e-002
67	3.333	3.2	8.2e-002	8.2e-002	5.449e-002
68	3.5	3.367	7.9e-002	7.9e-002	5.249e-002
69	3.667	3.534	7.6e-002	7.6e-002	5.05e-002
70	3.833	3.7	7.3e-002	7.3e-002	4.85e-002
71	4.	3.867	7.e-002	7.e-002	4.651e-002
72	4.167	4.034	6.8e-002	6.8e-002	4.518e-002
73	4.333	4.2	6.6e-002	6.6e-002	4.385e-002
74	4.5	4.367	6.3e-002	6.3e-002	4.186e-002
75	4.667	4.534	6.2e-002	6.2e-002	4.12e-002
76	4.833	4.7	5.9e-002	5.9e-002	3.92e-002
77	5.	4.867	5.7e-002	5.7e-002	3.787e-002
78	5.167	5.034	5.6e-002	5.6e-002	3.721e-002
79	5.333	5.2	5.4e-002	5.4e-002	3.588e-002
80	5.5	5.367	5.3e-002	5.3e-002	3.522e-002
81	5.667	5.534	5.1e-002	5.1e-002	3.389e-002
82	5.833	5.7	5.e-002	5.e-002	3.322e-002
83	6.	5.867	4.8e-002	4.8e-002	3.189e-002
84	6.167	6.034	4.8e-002	4.8e-002	3.189e-002
85	6.333	6.2	4.6e-002	4.6e-002	3.056e-002
86	6.5	6.367	4.5e-002	4.5e-002	2.99e-002
87	6.667	6.534	4.4e-002	4.4e-002	2.924e-002
88	6.833	6.7	4.3e-002	4.3e-002	2.857e-002
89	7.	6.867	4.2e-002	4.2e-002	2.791e-002
90	7.167	7.034	4.1e-002	4.1e-002	2.724e-002

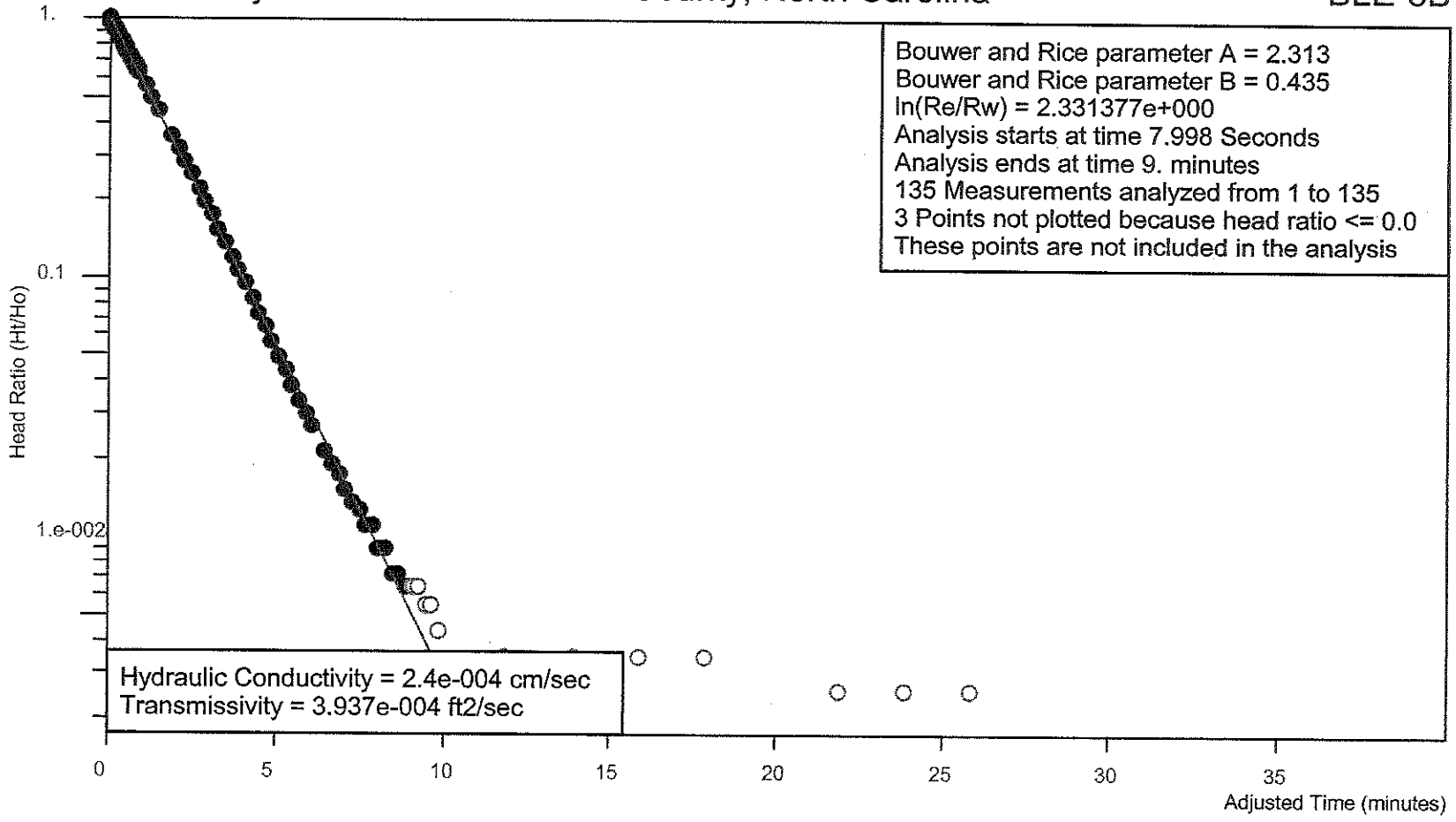
91	7.333	7.2	4.1e-002	4.1e-002	2.724e-002
92	7.5	7.367	4.1e-002	4.1e-002	2.724e-002
93	7.667	7.534	4.e-002	4.e-002	2.658e-002
94	7.833	7.7	3.9e-002	3.9e-002	2.591e-002
95	8.	7.867	3.9e-002	3.9e-002	2.591e-002
96	8.167	8.034	3.7e-002	3.7e-002	2.458e-002
97	8.333	8.2	3.7e-002	3.7e-002	2.458e-002
98	8.5	8.367	3.6e-002	3.6e-002	2.392e-002
99	8.667	8.534	3.5e-002	3.5e-002	2.326e-002
100	8.833	8.7	3.4e-002	3.4e-002	2.259e-002
101	9.	8.867	3.4e-002	3.4e-002	2.259e-002
102	9.167	9.034	3.4e-002	3.4e-002	2.259e-002
103	9.333	9.2	3.4e-002	3.4e-002	2.259e-002
104	9.5	9.367	3.3e-002	3.3e-002	2.193e-002
105	9.667	9.534	3.2e-002	3.2e-002	2.126e-002
106	9.833	9.7	3.2e-002	3.2e-002	2.126e-002
107	10.	9.867	3.1e-002	3.1e-002	2.06e-002
108	11.	10.87	2.9e-002	2.9e-002	1.927e-002
109	12.	11.87	2.6e-002	2.6e-002	1.728e-002
110	13.	12.87	2.6e-002	2.6e-002	1.728e-002
111	14.	13.87	2.3e-002	2.3e-002	1.528e-002
112	15.	14.87	2.4e-002	2.4e-002	1.595e-002
113	16.	15.87	2.2e-002	2.2e-002	1.462e-002
114	17.	16.87	2.1e-002	2.1e-002	1.395e-002
115	18.	17.87	2.e-002	2.e-002	1.329e-002
116	19.	18.87	1.9e-002	1.9e-002	1.262e-002
117	20.	19.87	1.8e-002	1.8e-002	1.196e-002
118	21.	20.87	1.8e-002	1.8e-002	1.196e-002
119	22.	21.87	1.7e-002	1.7e-002	1.13e-002
120	23.	22.87	1.6e-002	1.6e-002	1.063e-002
121	24.	23.87	1.6e-002	1.6e-002	1.063e-002
122	25.	24.87	1.5e-002	1.5e-002	9.967e-003
123	26.	25.87	1.4e-002	1.4e-002	9.302e-003
124	27.	26.87	1.4e-002	1.4e-002	9.302e-003
125	28.	27.87	1.4e-002	1.4e-002	9.302e-003
126	29.	28.87	1.3e-002	1.3e-002	8.638e-003
127	30.	29.87	1.3e-002	1.3e-002	8.638e-003
128	31.	30.87	1.3e-002	1.3e-002	8.638e-003
129	32.	31.87	1.2e-002	1.2e-002	7.973e-003
130	33.	32.87	1.2e-002	1.2e-002	7.973e-003
131	34.	33.87	1.3e-002	1.3e-002	8.638e-003
132	35.	34.87	1.2e-002	1.2e-002	7.973e-003
133	36.	35.87	1.2e-002	1.2e-002	7.973e-003
134	37.	36.87	1.1e-002	1.1e-002	7.309e-003
135	38.	37.87	1.1e-002	1.1e-002	7.309e-003
136	39.	38.87	1.e-002	1.e-002	6.645e-003
137	40.	39.87	1.e-002	1.e-002	6.645e-003
138	41.	40.87	1.e-002	1.e-002	6.645e-003

Falling Head Slug Test 6/29/2005

Bouwer and Rice Graph

Madison County C&D Landfill Madison County, North Carolina

BLE-8B



Project Number: J05-2225-04 for McGill

Analysis by Rick Mayer

Ho is 3.454 feet at 7.998 Seconds

Falling Head Slug Test

Site Name:	Madison County C&D Landfill
Location:	Madison County, North Carolina
Test Date:	6/29/2005
Client:	McGill
Project Number:	J05-2225-04
Import File:	C:\Public PC030\Projects\Madison\Madison Slug Tests\Revised Data\BLE-8B

Well Label:	BLE-8B
Aquifer Thickness:	50. feet
Screen Length:	10. feet
Casing Radius:	8.333e-002 feet
Effective Radius:	0.3542 feet
Static Water Level:	0. feet
Water Table to Screen Bottom:	18.55 feet
Anisotropy Ratio:	1.
Time Adjustment:	7.998 Seconds

Test starts with trial 0
There are 150 time and drawdown measurements
Maximum head is 3.454 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.1333	0.	3.454	3.454	1.
2	0.1366	3.3e-003	3.451	3.451	0.9991
3	0.14	6.7e-003	3.444	3.444	0.9971
4	0.1433	1.e-002	3.438	3.438	0.9954
5	0.1466	1.33e-002	3.432	3.432	0.9936
6	0.15	1.67e-002	3.425	3.425	0.9916
7	0.1533	2.e-002	3.422	3.422	0.9907
8	0.1566	2.33e-002	3.416	3.416	0.989
9	0.16	2.67e-002	3.409	3.409	0.987
10	0.1633	3.e-002	3.403	3.403	0.9852
11	0.1666	3.33e-002	3.4	3.4	0.9844
12	0.17	3.67e-002	3.393	3.393	0.9823
13	0.1766	4.33e-002	3.381	3.381	0.9789
14	0.18	4.67e-002	3.374	3.374	0.9768
15	0.1833	5.e-002	3.368	3.368	0.9751
16	0.1866	5.33e-002	3.365	3.365	0.9742
17	0.19	5.67e-002	3.358	3.358	0.9722
18	0.1933	6.e-002	3.352	3.352	0.9705
19	0.1966	6.33e-002	3.346	3.346	0.9687
20	0.2	6.67e-002	3.343	3.343	0.9679
21	0.2033	7.e-002	3.333	3.333	0.965
22	0.2066	7.33e-002	3.33	3.33	0.9641
23	0.21	7.67e-002	3.323	3.323	0.9621
24	0.2133	8.e-002	3.317	3.317	0.9603
25	0.2166	8.33e-002	3.311	3.311	0.9586
26	0.22	8.67e-002	3.308	3.308	0.9577
27	0.2233	9.e-002	3.301	3.301	0.9557
28	0.2266	9.33e-002	3.295	3.295	0.954
29	0.23	9.67e-002	3.289	3.289	0.9522
30	0.2333	0.1	3.282	3.282	0.9502
31	0.2366	0.1033	3.279	3.279	0.9493
32	0.24	0.1067	3.273	3.273	0.9476
33	0.2433	0.11	3.266	3.266	0.9456

34	0.2466	0.1133	3.26	3.26	0.9438
35	0.2533	0.12	3.251	3.251	0.9412
36	0.2566	0.1233	3.244	3.244	0.9392
37	0.26	0.1267	3.241	3.241	0.9383
38	0.2633	0.13	3.235	3.235	0.9366
39	0.2666	0.1333	3.228	3.228	0.9346
40	0.27	0.1367	3.225	3.225	0.9337
41	0.2733	0.14	3.216	3.216	0.9311
42	0.2766	0.1433	3.212	3.212	0.9299
43	0.28	0.1467	3.206	3.206	0.9282
44	0.2833	0.15	3.2	3.2	0.9265
45	0.2866	0.1533	3.2	3.2	0.9265
46	0.29	0.1567	3.19	3.19	0.9236
47	0.2933	0.16	3.184	3.184	0.9218
48	0.2966	0.1633	3.178	3.178	0.9201
49	0.3	0.1667	3.178	3.178	0.9201
50	0.3033	0.17	3.168	3.168	0.9172
51	0.3066	0.1733	3.165	3.165	0.9163
52	0.31	0.1767	3.158	3.158	0.9143
53	0.3133	0.18	3.152	3.152	0.9126
54	0.3166	0.1833	3.149	3.149	0.9117
55	0.32	0.1867	3.143	3.143	0.91
56	0.3233	0.19	3.136	3.136	0.9079
57	0.33	0.1967	3.127	3.127	0.9053
58	0.3333	0.2	3.12	3.12	0.9033
59	0.35	0.2167	3.089	3.089	0.8943
60	0.3666	0.2333	3.063	3.063	0.8868
61	0.3833	0.25	3.038	3.038	0.8796
62	0.4	0.2667	3.009	3.009	0.8712
63	0.4166	0.2833	2.984	2.984	0.8639
64	0.4333	0.3	2.958	2.958	0.8564
65	0.45	0.3167	2.93	2.93	0.8483
66	0.4666	0.3333	2.901	2.901	0.8399
67	0.4833	0.35	2.879	2.879	0.8335
68	0.5	0.3667	2.854	2.854	0.8263
69	0.5166	0.3833	2.828	2.828	0.8188
70	0.5333	0.4	2.803	2.803	0.8115
71	0.55	0.4167	2.777	2.777	0.804
72	0.5666	0.4333	2.755	2.755	0.7976
73	0.5833	0.45	2.73	2.73	0.7904
74	0.6	0.4667	2.704	2.704	0.7829
75	0.6166	0.4833	2.682	2.682	0.7765
76	0.6333	0.5	2.657	2.657	0.7693
77	0.65	0.5167	2.634	2.634	0.7626
78	0.6666	0.5333	2.612	2.612	0.7562
79	0.7	0.5667	2.568	2.568	0.7435
80	0.7166	0.5833	2.546	2.546	0.7371
81	0.7333	0.6	2.52	2.52	0.7296
82	0.75	0.6167	2.498	2.498	0.7232
83	0.7666	0.6333	2.479	2.479	0.7177
84	0.7833	0.65	2.457	2.457	0.7113
85	0.8	0.6667	2.434	2.434	0.7047
86	0.8166	0.6833	2.412	2.412	0.6983
87	0.8333	0.7	2.393	2.393	0.6928
88	0.85	0.7167	2.371	2.371	0.6865
89	0.8666	0.7333	2.352	2.352	0.6809
90	0.8833	0.75	2.33	2.33	0.6746

91	0.9	0.7667	2.311	2.311	0.6691
92	0.9166	0.7833	2.288	2.288	0.6624
93	0.9333	0.8	2.269	2.269	0.6569
94	0.95	0.8167	2.247	2.247	0.6506
95	0.9666	0.8333	2.228	2.228	0.645
96	0.9833	0.85	2.209	2.209	0.6395
97	1.	0.8667	2.19	2.19	0.634
98	1.2	1.067	1.917	1.917	0.555
99	1.4	1.267	1.71	1.71	0.4951
100	1.6	1.467	1.53	1.53	0.443
101	2.	1.867	1.222	1.222	0.3538
102	2.2	2.067	1.088	1.088	0.315
103	2.4	2.267	0.971	0.971	0.2811
104	2.6	2.467	0.866	0.866	0.2507
105	2.8	2.667	0.771	0.771	0.2232
106	3.	2.867	0.685	0.685	0.1983
107	3.2	3.067	0.606	0.606	0.1754
108	3.4	3.267	0.536	0.536	0.1552
109	3.6	3.467	0.476	0.476	0.1378
110	3.8	3.667	0.418	0.418	0.121
111	4.	3.867	0.368	0.368	0.1065
112	4.2	4.067	0.326	0.326	9.438e-002
113	4.4	4.267	0.285	0.285	8.251e-002
114	4.6	4.467	0.253	0.253	7.325e-002
115	4.8	4.667	0.222	0.222	6.427e-002
116	5.	4.867	0.196	0.196	5.675e-002
117	5.2	5.067	0.171	0.171	4.951e-002
118	5.4	5.267	0.152	0.152	4.401e-002
119	5.6	5.467	0.133	0.133	3.851e-002
120	5.8	5.667	0.117	0.117	3.387e-002
121	6.	5.867	0.104	0.104	3.011e-002
122	6.2	6.067	9.2e-002	9.2e-002	2.664e-002
123	6.6	6.467	7.3e-002	7.3e-002	2.113e-002
124	6.8	6.667	6.6e-002	6.6e-002	1.911e-002
125	7.	6.867	6.e-002	6.e-002	1.737e-002
126	7.2	7.067	5.3e-002	5.3e-002	1.534e-002
127	7.4	7.267	4.7e-002	4.7e-002	1.361e-002
128	7.6	7.467	4.4e-002	4.4e-002	1.274e-002
129	7.8	7.667	3.8e-002	3.8e-002	1.1e-002
130	8.	7.867	3.8e-002	3.8e-002	1.1e-002
131	8.2	8.067	3.1e-002	3.1e-002	8.975e-003
132	8.4	8.267	3.1e-002	3.1e-002	8.975e-003
133	8.6	8.467	2.5e-002	2.5e-002	7.238e-003
134	8.8	8.667	2.5e-002	2.5e-002	7.238e-003
135	9.	8.867	2.2e-002	2.2e-002	6.369e-003
136	9.2	9.067	2.2e-002	2.2e-002	6.369e-003
137	9.4	9.267	2.2e-002	2.2e-002	6.369e-003
138	9.6	9.467	1.9e-002	1.9e-002	5.501e-003
139	9.8	9.667	1.9e-002	1.9e-002	5.501e-003
140	10.	9.867	1.5e-002	1.5e-002	4.343e-003
141	12.	11.87	1.2e-002	1.2e-002	3.474e-003
142	14.	13.87	1.2e-002	1.2e-002	3.474e-003
143	16.	15.87	1.2e-002	1.2e-002	3.474e-003
144	18.	17.87	1.2e-002	1.2e-002	3.474e-003
145	22.	21.87	9.e-003	9.e-003	2.606e-003
146	24.	23.87	9.e-003	9.e-003	2.606e-003
147	26.	25.87	9.e-003	9.e-003	2.606e-003

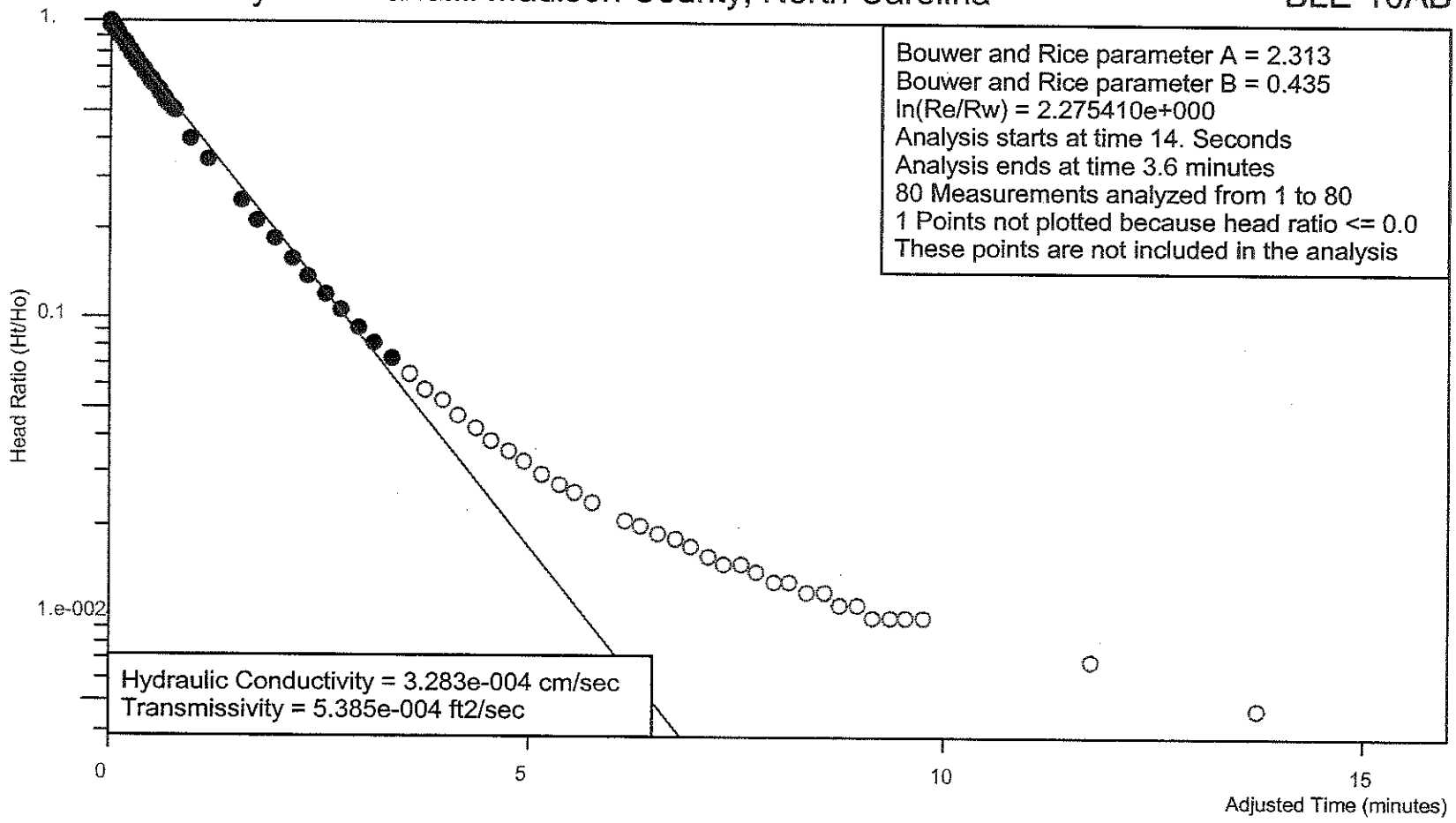
148	28.	27.87	6.e-003	6.e-003	1.737e-003
149	34.	33.87	6.e-003	6.e-003	1.737e-003
150	40.	39.87	6.e-003	6.e-003	1.737e-003

Falling Head Slug Test 6/29/2005

Bouwer and Rice Graph

Madison County C&D Landfill Madison County, North Carolina

BLE-10AB



Ho is 3.181 feet at 14. Seconds

Project Number: J05-2225-04 for McGill

Analysis by Rick Mayer

Falling Head Slug Test

Site Name:	Madison County C&D Landfill
Location:	Madison County, North Carolina
Test Date:	6/29/2005
Client:	McGill
Project Number:	J05-2225-04
Import File:	C:\Public PC030\Projects\Madison\Madison Slug Tests\Revised Data\BLE-10

Well Label:	BLE-10AB
Aquifer Thickness:	50. feet
Screen Length:	10. feet
Casing Radius:	8.333e-002 feet
Effective Radius:	0.3542 feet
Static Water Level:	0. feet
Water Table to Screen Bottom:	16.28 feet
Anisotropy Ratio:	1.
Time Adjustment:	14. Seconds

Test starts with trial 0
There are 114 time and drawdown measurements
Maximum head is 3.181 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.2333	0.	3.181	3.181	1.
2	0.2366	3.3e-003	3.171	3.171	0.9969
3	0.24	6.7e-003	3.162	3.162	0.994
4	0.2433	1.e-002	3.152	3.152	0.9909
5	0.25	1.67e-002	3.133	3.133	0.9849
6	0.2533	2.e-002	3.124	3.124	0.9821
7	0.2566	2.33e-002	3.114	3.114	0.9789
8	0.26	2.67e-002	3.105	3.105	0.9761
9	0.2633	3.e-002	3.098	3.098	0.9739
10	0.2666	3.33e-002	3.089	3.089	0.9711
11	0.27	3.67e-002	3.079	3.079	0.9679
12	0.2733	4.e-002	3.07	3.07	0.9651
13	0.2766	4.33e-002	3.06	3.06	0.962
14	0.28	4.67e-002	3.051	3.051	0.9591
15	0.2833	5.e-002	3.044	3.044	0.9569
16	0.2866	5.33e-002	3.031	3.031	0.9528
17	0.29	5.67e-002	3.025	3.025	0.951
18	0.2933	6.e-002	3.016	3.016	0.9481
19	0.2966	6.33e-002	3.006	3.006	0.945
20	0.3	6.67e-002	2.997	2.997	0.9422
21	0.3033	7.e-002	2.99	2.99	0.94
22	0.3066	7.33e-002	2.981	2.981	0.9371
23	0.31	7.67e-002	2.971	2.971	0.934
24	0.3133	8.e-002	2.962	2.962	0.9312
25	0.3166	8.33e-002	2.952	2.952	0.928
26	0.32	8.67e-002	2.943	2.943	0.9252
27	0.3266	9.33e-002	2.927	2.927	0.9202
28	0.33	9.67e-002	2.92	2.92	0.918
29	0.3333	1.e-001	2.908	2.908	0.9142
30	0.35	0.1167	2.863	2.863	0.9
31	0.3666	0.1333	2.819	2.819	0.8862
32	0.3833	0.15	2.774	2.774	0.8721
33	0.4	0.1667	2.73	2.73	0.8582

34	0.4166	0.1833	2.689	2.689	0.8453
35	0.4333	0.2	2.65	2.65	0.8331
36	0.45	0.2167	2.606	2.606	0.8192
37	0.4666	0.2333	2.568	2.568	0.8073
38	0.4833	0.25	2.523	2.523	0.7931
39	0.5	0.2667	2.485	2.485	0.7812
40	0.5166	0.2833	2.447	2.447	0.7693
41	0.5333	0.3	2.409	2.409	0.7573
42	0.55	0.3167	2.371	2.371	0.7454
43	0.5666	0.3333	2.336	2.336	0.7344
44	0.5833	0.35	2.304	2.304	0.7243
45	0.6	0.3667	2.266	2.266	0.7124
46	0.6166	0.3833	2.234	2.234	0.7023
47	0.6333	0.4	2.2	2.2	0.6916
48	0.65	0.4167	2.168	2.168	0.6815
49	0.6833	0.45	2.104	2.104	0.6614
50	0.7	0.4667	2.073	2.073	0.6517
51	0.7166	0.4833	2.041	2.041	0.6416
52	0.7333	0.5	2.012	2.012	0.6325
53	0.75	0.5167	1.984	1.984	0.6237
54	0.7666	0.5333	1.952	1.952	0.6136
55	0.7833	0.55	1.926	1.926	0.6055
56	0.8	0.5667	1.898	1.898	0.5967
57	0.8166	0.5833	1.869	1.869	0.5876
58	0.8333	0.6	1.844	1.844	0.5797
59	0.85	0.6167	1.815	1.815	0.5706
60	0.8666	0.6333	1.79	1.79	0.5627
61	0.8833	0.65	1.765	1.765	0.5549
62	0.9	0.6667	1.739	1.739	0.5467
63	0.9166	0.6833	1.714	1.714	0.5388
64	0.9333	0.7	1.692	1.692	0.5319
65	0.95	0.7167	1.666	1.666	0.5237
66	0.9666	0.7333	1.644	1.644	0.5168
67	0.9833	0.75	1.622	1.622	0.5099
68	1.	0.7667	1.596	1.596	0.5017
69	1.2	0.9667	1.291	1.291	0.4058
70	1.4	1.167	1.098	1.098	0.3452
71	1.8	1.567	0.799	0.799	0.2512
72	2.	1.767	0.685	0.685	0.2153
73	2.2	1.967	0.59	0.59	0.1855
74	2.4	2.167	0.507	0.507	0.1594
75	2.6	2.367	0.441	0.441	0.1386
76	2.8	2.567	0.384	0.384	0.1207
77	3.	2.767	0.336	0.336	0.1056
78	3.2	2.967	0.295	0.295	9.274e-002
79	3.4	3.167	0.26	0.26	8.174e-002
80	3.6	3.367	0.231	0.231	7.262e-002
81	3.8	3.567	0.206	0.206	6.476e-002
82	4.	3.767	0.184	0.184	5.784e-002
83	4.2	3.967	0.168	0.168	5.281e-002
84	4.4	4.167	0.149	0.149	4.684e-002
85	4.6	4.367	0.136	0.136	4.275e-002
86	4.8	4.567	0.123	0.123	3.867e-002
87	5.	4.767	0.114	0.114	3.584e-002
88	5.2	4.967	0.104	0.104	3.269e-002
89	5.4	5.167	9.5e-002	9.5e-002	2.986e-002
90	5.6	5.367	8.8e-002	8.8e-002	2.766e-002

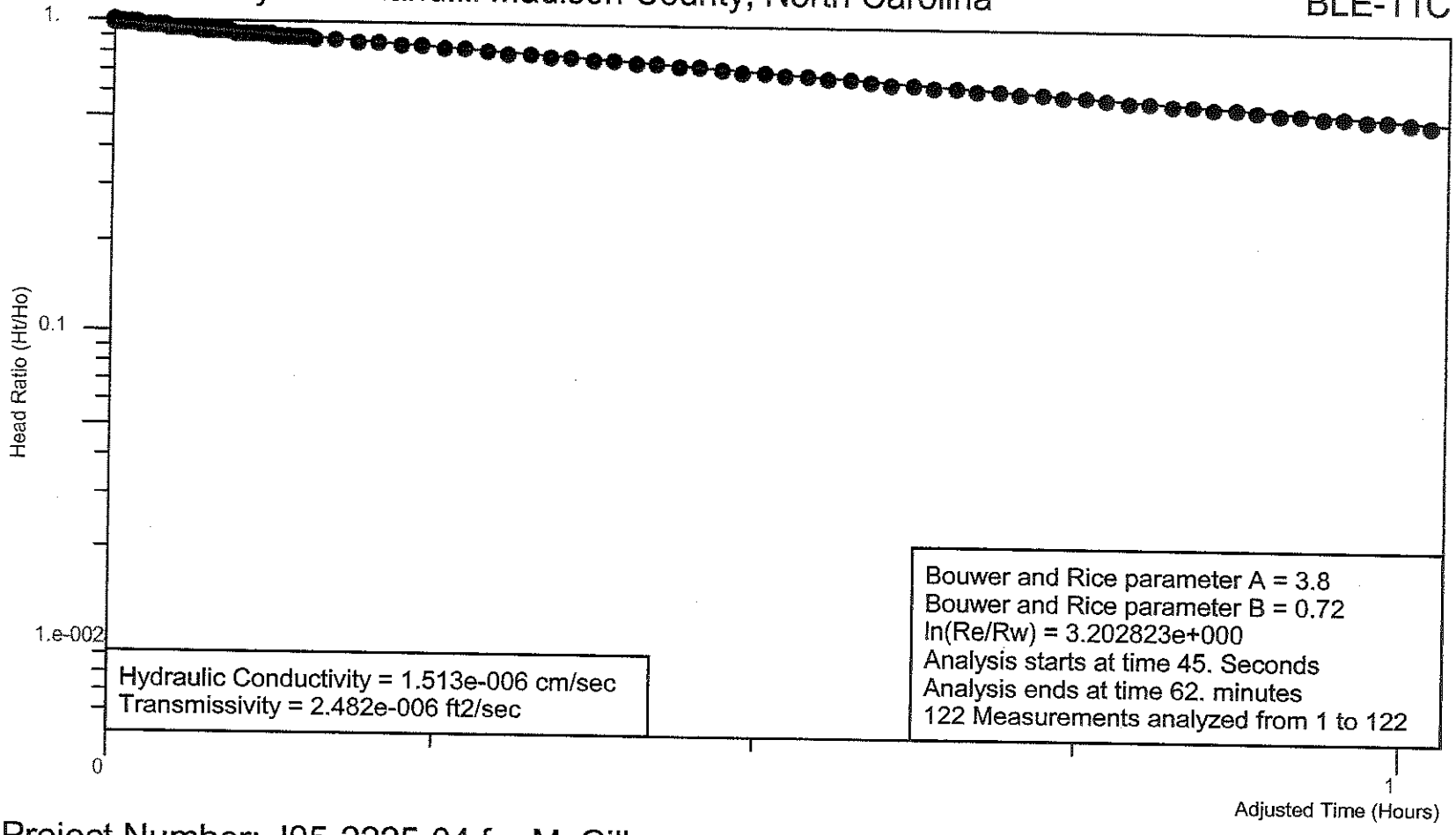
91	5.8	5.567	8.2e-002	8.2e-002	2.578e-002
92	6.	5.767	7.6e-002	7.6e-002	2.389e-002
93	6.4	6.167	6.6e-002	6.6e-002	2.075e-002
94	6.6	6.367	6.3e-002	6.3e-002	1.981e-002
95	6.8	6.567	6.e-002	6.e-002	1.886e-002
96	7.	6.767	5.7e-002	5.7e-002	1.792e-002
97	7.2	6.967	5.4e-002	5.4e-002	1.698e-002
98	7.4	7.167	5.e-002	5.e-002	1.572e-002
99	7.6	7.367	4.7e-002	4.7e-002	1.478e-002
100	7.8	7.567	4.7e-002	4.7e-002	1.478e-002
101	8.	7.767	4.4e-002	4.4e-002	1.383e-002
102	8.2	7.967	4.1e-002	4.1e-002	1.289e-002
103	8.4	8.167	4.1e-002	4.1e-002	1.289e-002
104	8.6	8.367	3.8e-002	3.8e-002	1.195e-002
105	8.8	8.567	3.8e-002	3.8e-002	1.195e-002
106	9.	8.767	3.4e-002	3.4e-002	1.069e-002
107	9.2	8.967	3.4e-002	3.4e-002	1.069e-002
108	9.4	9.167	3.1e-002	3.1e-002	9.745e-003
109	9.6	9.367	3.1e-002	3.1e-002	9.745e-003
110	9.8	9.567	3.1e-002	3.1e-002	9.745e-003
111	10.	9.767	3.1e-002	3.1e-002	9.745e-003
112	12.	11.77	2.2e-002	2.2e-002	6.916e-003
113	14.	13.77	1.5e-002	1.5e-002	4.715e-003
114	16.	15.77	1.2e-002	1.2e-002	3.772e-003

Falling Head Slug Test 6/30/2005

Bouwer and Rice Graph

Madison County C&D Landfill Madison County, North Carolina

BLE-11C



Hydraulic Conductivity = 1.513e-006 cm/sec
Transmissivity = 2.482e-006 ft2/sec

Bouwer and Rice parameter A = 3.8
Bouwer and Rice parameter B = 0.72
ln(Re/Rw) = 3.202823e+000
Analysis starts at time 45. Seconds
Analysis ends at time 62. minutes
122 Measurements analyzed from 1 to 122

Ho is 4.831 feet at 45. Seconds

Project Number: J05-2225-04 for McGill
Analysis by Rick Mayer

Falling Head Slug Test

Site Name:	Madison County C&D Landfill
Location:	Madison County, North Carolina
Test Date:	6/30/2005
Client:	McGill
Project Number:	J05-2225-04
Import File:	C:\Public PC030\Projects\Madison\Madison Slug Tests\Revised Data\BLE-11

Well Label:	BLE-11C
Aquifer Thickness:	50. feet
Screen Length:	10. feet
Casing Radius:	4.166e-002 feet
Effective Radius:	0.125 feet
Static Water Level:	0. feet
Water Table to Screen Bottom:	20.56 feet
Anisotropy Ratio:	1.
Time Adjustment:	45. Seconds

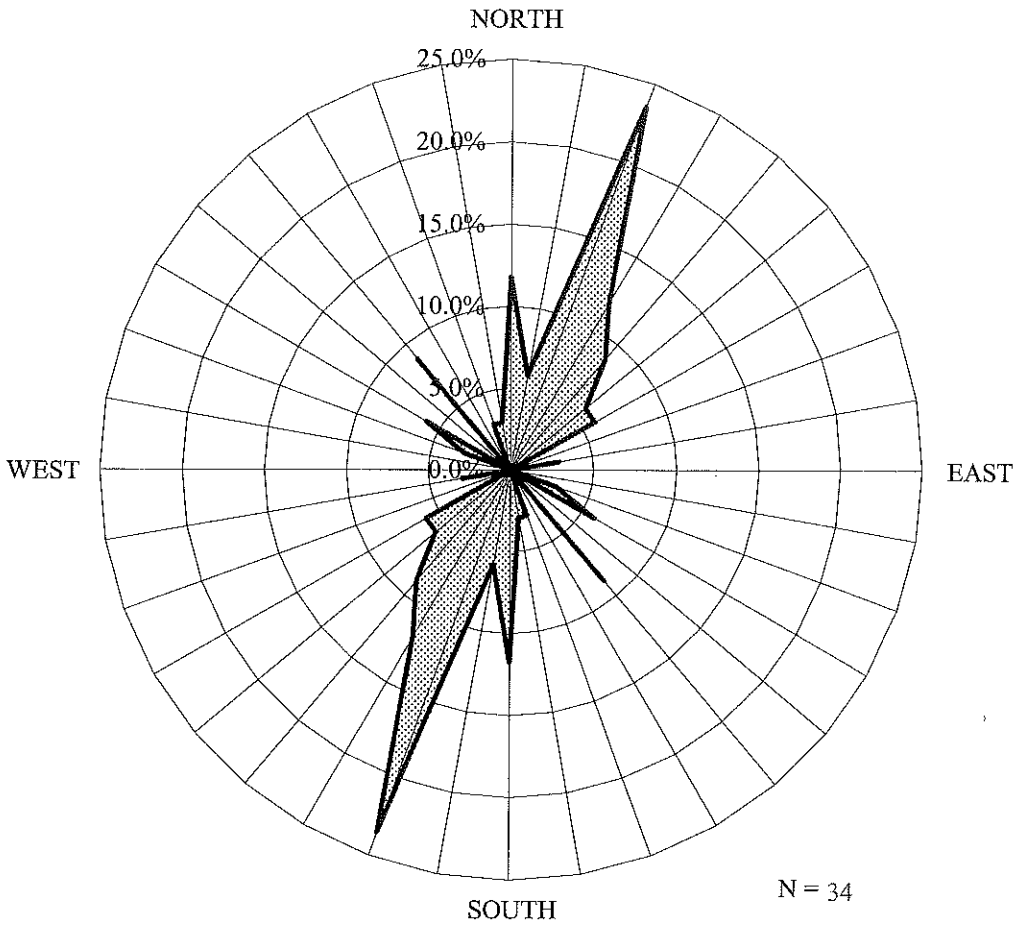
Test starts with trial 0
There are 122 time and drawdown measurements
Maximum head is 4.831 feet
Minimum head is 0. feet

Trial	Time (minutes)	Adjusted Time (minutes)	Drawdown (feet)	Head (feet)	Head Ratio
1	0.75	0.	4.831	4.831	1.
2	0.767	1.7e-002	4.826	4.826	0.999
3	0.783	3.3e-002	4.824	4.824	0.9986
4	0.8	5.e-002	4.821	4.821	0.9979
5	0.817	6.7e-002	4.821	4.821	0.9979
6	0.833	8.3e-002	4.819	4.819	0.9975
7	0.85	0.1	4.817	4.817	0.9971
8	0.867	0.117	4.822	4.822	0.9981
9	0.883	0.133	4.824	4.824	0.9986
10	0.9	0.15	4.819	4.819	0.9975
11	0.917	0.167	4.814	4.814	0.9965
12	0.933	0.183	4.819	4.819	0.9975
13	0.95	0.2	4.814	4.814	0.9965
14	0.967	0.217	4.812	4.812	0.9961
15	0.983	0.233	4.81	4.81	0.9957
16	1.	0.25	4.807	4.807	0.995
17	1.167	0.417	4.798	4.798	0.9932
18	1.333	0.583	4.789	4.789	0.9913
19	1.5	0.75	4.775	4.775	0.9884
20	1.667	0.917	4.763	4.763	0.9859
21	1.833	1.083	4.749	4.749	0.983
22	2.	1.25	4.732	4.732	0.9795
23	2.167	1.417	4.723	4.723	0.9776
24	2.333	1.583	4.711	4.711	0.9752
25	2.5	1.75	4.697	4.697	0.9723
26	2.667	1.917	4.685	4.685	0.9698
27	2.833	2.083	4.676	4.676	0.9679
28	3.	2.25	4.662	4.662	0.965
29	3.167	2.417	4.653	4.653	0.9632
30	3.333	2.583	4.641	4.641	0.9607
31	3.5	2.75	4.629	4.629	0.9582
32	3.667	2.917	4.62	4.62	0.9563
33	3.833	3.083	4.61	4.61	0.9543

34	4.	3.25	4.599	4.599	0.952
35	4.167	3.417	4.589	4.589	0.9499
36	4.333	3.583	4.582	4.582	0.9485
37	4.5	3.75	4.573	4.573	0.9466
38	4.667	3.917	4.564	4.564	0.9447
39	4.833	4.083	4.556	4.556	0.9431
40	5.	4.25	4.547	4.547	0.9412
41	5.167	4.417	4.538	4.538	0.9394
42	5.333	4.583	4.528	4.528	0.9373
43	5.5	4.75	4.521	4.521	0.9358
44	5.667	4.917	4.512	4.512	0.934
45	5.833	5.083	4.505	4.505	0.9325
46	6.	5.25	4.496	4.496	0.9307
47	6.167	5.417	4.488	4.488	0.929
48	6.333	5.583	4.477	4.477	0.9267
49	6.5	5.75	4.47	4.47	0.9253
50	6.667	5.917	4.463	4.463	0.9238
51	6.833	6.083	4.453	4.453	0.9218
52	7.	6.25	4.444	4.444	0.9199
53	7.167	6.417	4.435	4.435	0.918
54	7.333	6.583	4.428	4.428	0.9166
55	7.5	6.75	4.42	4.42	0.9149
56	7.667	6.917	4.413	4.413	0.9135
57	7.833	7.083	4.406	4.406	0.912
58	8.	7.25	4.399	4.399	0.9106
59	8.167	7.417	4.39	4.39	0.9087
60	8.333	7.583	4.383	4.383	0.9073
61	8.5	7.75	4.374	4.374	0.9054
62	8.667	7.917	4.367	4.367	0.904
63	8.833	8.083	4.357	4.357	0.9019
64	9.	8.25	4.35	4.35	0.9004
65	9.167	8.417	4.343	4.343	0.899
66	9.333	8.583	4.334	4.334	0.8971
67	9.5	8.75	4.327	4.327	0.8957
68	9.667	8.917	4.32	4.32	0.8942
69	9.833	9.083	4.313	4.313	0.8928
70	10.	9.25	4.306	4.306	0.8913
71	11.	10.25	4.261	4.261	0.882
72	12.	11.25	4.214	4.214	0.8723
73	13.	12.25	4.17	4.17	0.8632
74	14.	13.25	4.123	4.123	0.8534
75	15.	14.25	4.083	4.083	0.8452
76	16.	15.25	4.043	4.043	0.8369
77	17.	16.25	4.013	4.013	0.8307
78	18.	17.25	3.963	3.963	0.8203
79	19.	18.25	3.923	3.923	0.812
80	20.	19.25	3.874	3.874	0.8019
81	21.	20.25	3.834	3.834	0.7936
82	22.	21.25	3.79	3.79	0.7845
83	23.	22.25	3.752	3.752	0.7767
84	24.	23.25	3.712	3.712	0.7684
85	25.	24.25	3.675	3.675	0.7607
86	26.	25.25	3.64	3.64	0.7535
87	27.	26.25	3.6	3.6	0.7452
88	28.	27.25	3.574	3.574	0.7398
89	29.	28.25	3.525	3.525	0.7297
90	30.	29.25	3.487	3.487	0.7218

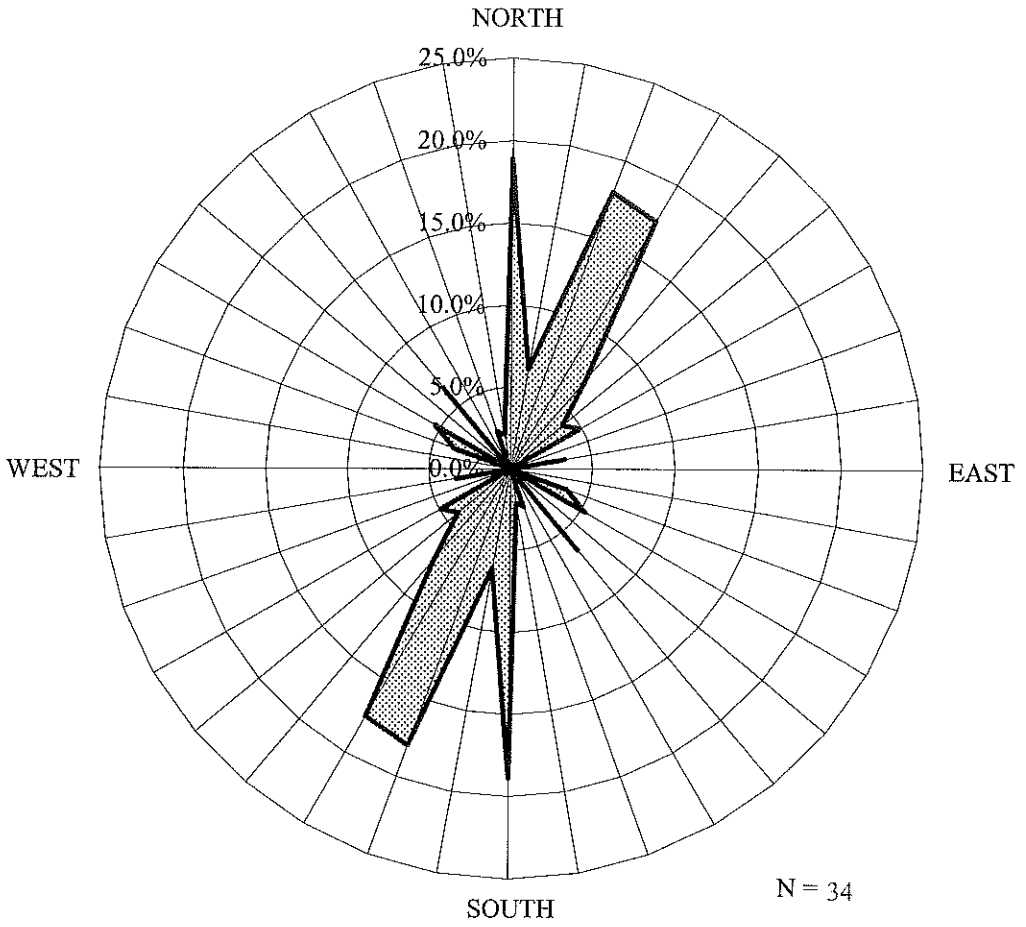
91	31.	30.25	3.455	3.455	0.7152
92	32.	31.25	3.424	3.424	0.7088
93	33.	32.25	3.382	3.382	0.7001
94	34.	33.25	3.344	3.344	0.6922
95	35.	34.25	3.309	3.309	0.685
96	36.	35.25	3.274	3.274	0.6777
97	37.	36.25	3.244	3.244	0.6715
98	38.	37.25	3.208	3.208	0.664
99	39.	38.25	3.176	3.176	0.6574
100	40.	39.25	3.143	3.143	0.6506
101	41.	40.25	3.108	3.108	0.6433
102	42.	41.25	3.077	3.077	0.6369
103	43.	42.25	3.044	3.044	0.6301
104	44.	43.25	3.014	3.014	0.6239
105	45.	44.25	2.988	2.988	0.6185
106	46.	45.25	2.96	2.96	0.6127
107	47.	46.25	2.915	2.915	0.6034
108	48.	47.25	2.887	2.887	0.5976
109	49.	48.25	2.855	2.855	0.591
110	50.	49.25	2.826	2.826	0.585
111	51.	50.25	2.796	2.796	0.5788
112	52.	51.25	2.768	2.768	0.573
113	53.	52.25	2.74	2.74	0.5672
114	54.	53.25	2.707	2.707	0.5603
115	55.	54.25	2.681	2.681	0.555
116	56.	55.25	2.651	2.651	0.5487
117	57.	56.25	2.622	2.622	0.5427
118	58.	57.25	2.594	2.594	0.5369
119	59.	58.25	2.571	2.571	0.5322
120	60.	59.25	2.543	2.543	0.5264
121	61.	60.25	2.519	2.519	0.5214
122	62.	61.25	2.489	2.489	0.5152

ROSE DIAGRAM OF FRACTURE TRACE AND LINEAMENT TRENDS
Percentage Expressed as Number of Fracture Traces/Lineaments
Data Collected within 1.5-Mile Radius of the Madison Co. Landfill, Madison Co., NC
BLE Job Number J04-2225-04

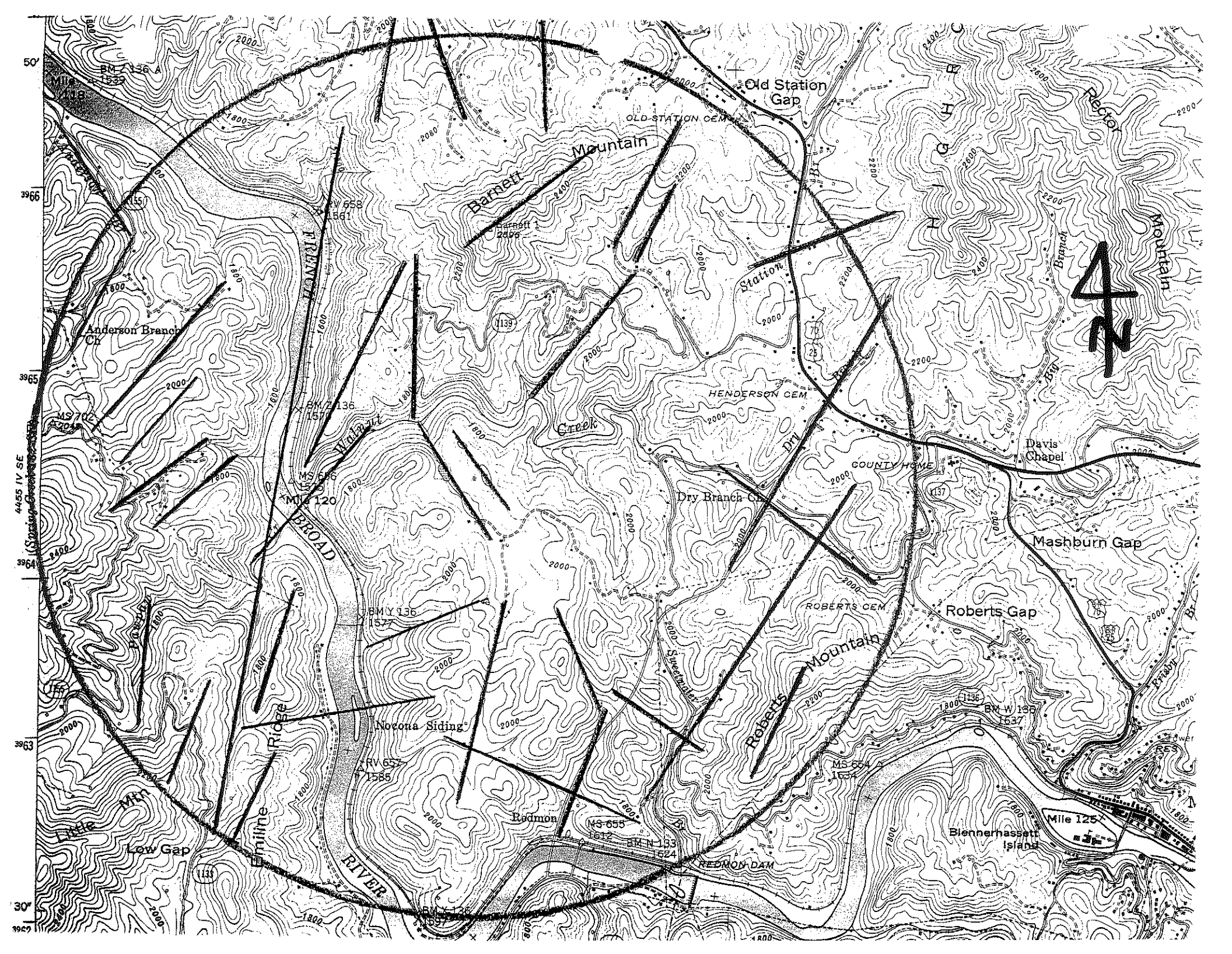


Madison FTA-Area.xls
Rose Diagram (Lineament Trends)

ROSE DIAGRAM OF FRACTURE TRACE AND LINEAMENT TRENDS
Percentage Expressed as Length of Fracture Traces/Lineaments
Data Collected within 1.5-Mile Radius of the Madison Co. LF, Madison Co., NC
BLE Job Number J04-2225-04

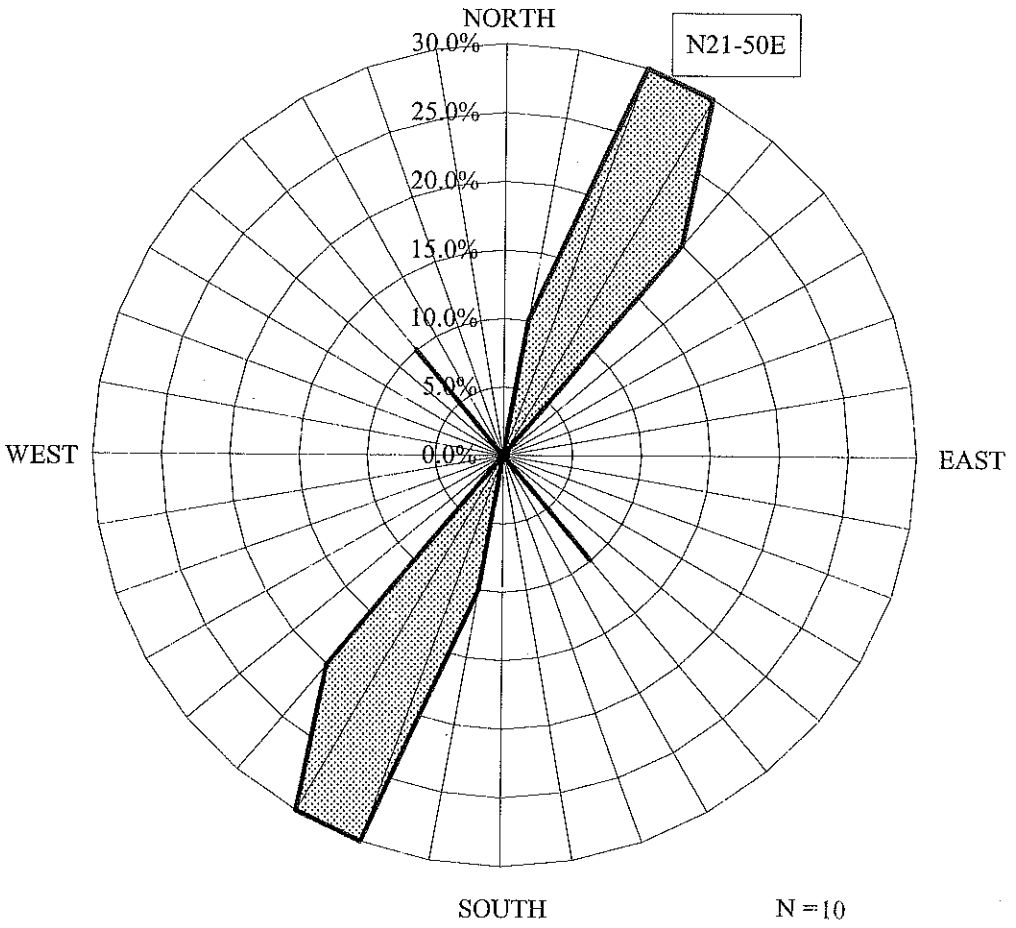


Madison FTA-Area.xls
Rose Diagram (Lineament Length)



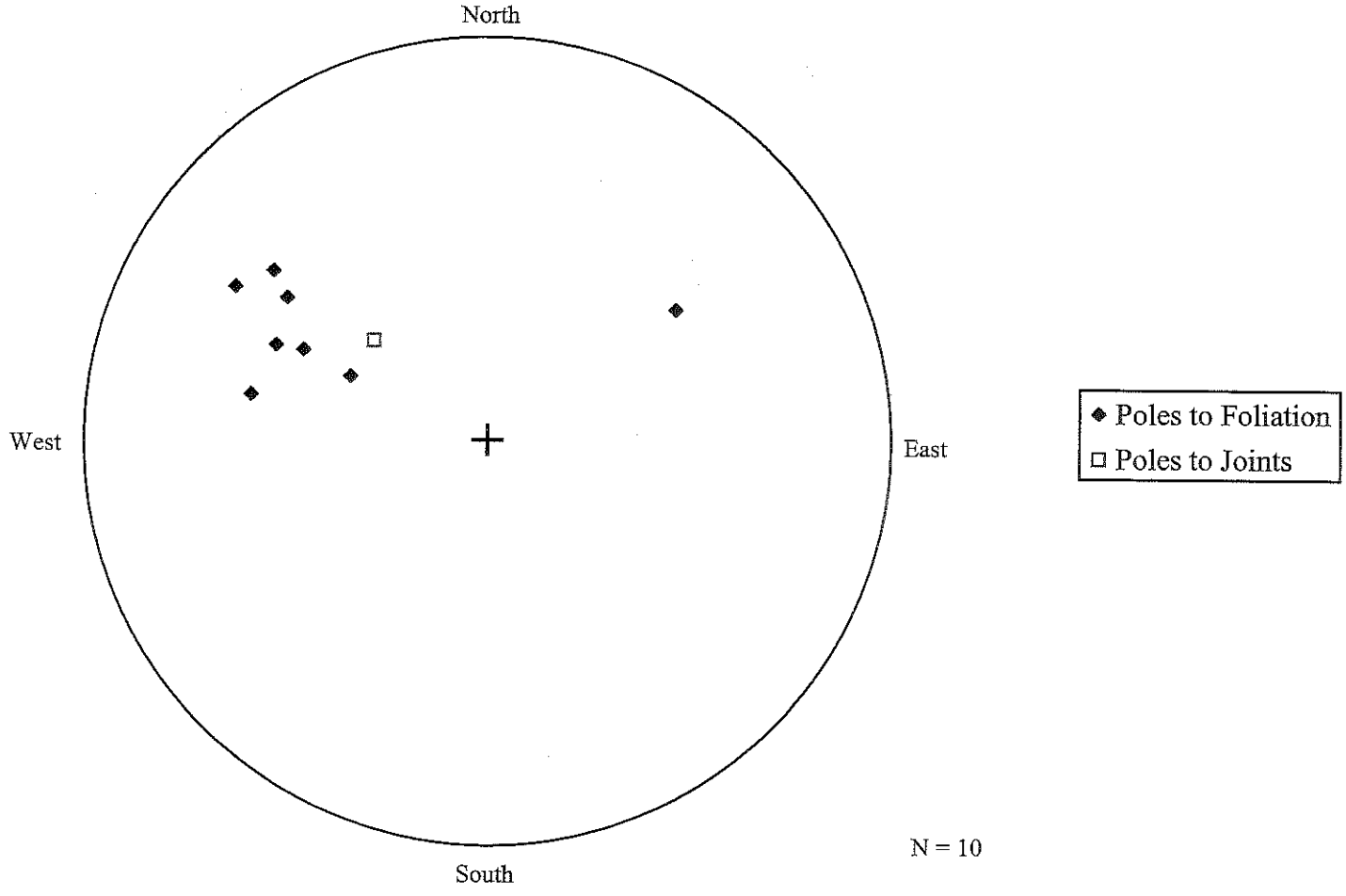
Old Station Gap
OLD STATION CEM
Barnett Mountain
Barnett 1
2896
Rector Mountain
Station
Anderson Branch Ch
FRENCH
BROAD
RIVER
Walnut
Creek
HENDERSON CEM
Dry
Dry Branch Ch
COUNTY HOME
Davis Chapel
Mashburn Gap
ROBERTS CEM
Roberts Gap
Roberts Mountain
Sweetwater
Nocona Siding
Emiline Ridge
Little Mtn
Low Gap
Redmon
REDMON DAM
Blennerhassett Island
Mile 125
Mile 120
Mile 118
BM Z 136 A
1539
RV 658
1561
BM Z 136
1570
MS 702
MS 656
1575
BM Y 136
1577
RV 657
1585
MS 655
1612
BM N 133
1624
MS 654
1634
BM W 136
1637
4455 IV SE
50′
30″
3966
3965
3964
3963

Rose Diagram of Fracture Trends Measured at the Madison Co. LF, NC
BLE Job Number J04-2225-04



Madison STR-DIP.xls
rose diagram

PLOT OF POLES TO FOLIATION & JOINTS
Madison Co. C&D - Madison Co., NC
BLE Job Number J04-2225-04



Stereo 2
Madison STR-DIP.xls

Southern Hemosphere Stereo Projection
Equal Angle

MONTHLY PRECIPITATION DATA - 1994 TO 2005

North Carolina - Division 1
Unit 2 C&D Waste Landfill
Madison County, North Carolina
BLE Project Number J04-2225-04

	Year												
MONTH	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**Monthly Avg.**
January	6.08	7.93	8.98	5.41	10.99	6.61	4.3	3.62	4.97	2.18	2.08	2.67	5.49
February	5.49	5.12	3.88	5.43	7.6	4.68	2.67	3.49	1.65	6.03	4.61	3.73	4.53
March	9.13	3.79	5.19	7.87	4.74	3.79	4.57	5.28	5.86	5.15	2.66	5.11	5.26
April	5	1.68	3.91	5.96	8.09	3.82	6.26	1.73	2.32	6.32	3.52	4.97	4.47
May	2.71	4.57	4.09	3.69	3.25	3.9	3.17	3.46	4.7	9.88	4.78	3.07	4.27
June	7.57	7.26	4.66	6.85	5.55	5.58	3.99	5.07	3.62	5.74	6.7	8.81	5.95
July	6.47	3.64	4.77	4.05	2.69	4.44	4.01	6.13	3.46	8.43	6.89		5.00
August	7.91	7.96	6.56	0.93	2.56	2.2	3.47	3.83	3.45	6.33	4.43		4.51
September	3.9	3.3	6.55	6.51	1.98	2.57	4.19	4.9	7.66	4.64	16		5.65
October	4.59	7.35	1.45	4.4	2.82	3.55	0.06	1.48	4.15	2.25	1.83		3.08
November	3.56	4.82	5.07	2.22	3.19	4.73	4.85	1.76	4.95	5.82	6.13		4.28
December	2.99	2.19	5.58	3.7	4.78	2.44	2.73	3.04	6.47	4.17	4.64		3.88
SEASON													**Seasonal Avg.**
Winter	20.7	16.84	18.05	18.71	**23.33**	15.08	11.54	12.39	12.48	13.36	9.35	11.51	15.28
Spring	15.28	13.51	12.66	16.5	16.89	13.3	13.42	10.26	10.64	**21.94**	15	16.85	14.69
Summer	18.28	14.9	17.88	11.49	7.23	9.21	11.67	14.86	14.57	19.4	**27.32**		15.16
Fall	11.14	14.36	12.1	10.32	10.79	10.72	7.64	6.28	**15.57**	12.24	12.6		11.25
Yearly Totals	65.40	59.61	60.69	57.02	58.24	48.31	44.27	43.79	53.26	66.94	64.27		**Yearly Avg.** 56.38

Year	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Winter (inches)	20.7	16.84	18.05	18.71	**23.33**	15.08	11.54	12.39	12.48	13.36	9.35	11.51
Rank from 1994 to 2005	2	5	4	3	**1**	6	10	9	8	7	12	11
Spring (inches)	15.28	13.51	12.66	16.5	16.89	13.3	13.42	10.26	10.64	**21.94**	15	16.85
Rank from 1994 to 2005	5	7	10	4	2	9	8	12	11	**1**	6	3
Winter plus Spring (inches)	35.98	30.35	30.71	35.21	**40.22**	28.38	24.96	22.65	23.12	35.3	24.35	28.36
Rank from 1994 to 2005	2	6	5	4	**1**	7	9	12	11	3	10	8