McGill ASSOCIATES

Fac/Perm/Co ID #	Date	Doc ID#
58-03	4/18/11	13645

April 18, 2011

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SOLID WASTE SECTION
ASHEVILLE REGIONAL OFFICE

Mr. Allen Gaither, PE
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: Permit Renewal Application for
Madison County Landfill Facility
Permit No. 58-03
Madison County, North Carolina

Dear Mr. Gaither:

On behalf of Madison County, McGill Associates is submitting the following documentation in support of Madison County's permit renewal request for the Madison County Landfill Facility, Permit No. 58-03. Please find enclosed a printed copy of the following Plans in accordance with 15A NCAC 13B .0535, Application Requirements for C&DLF Facilities, (b) Amendment to the permit:

Engineering Plan, Revised April 2011
Site Specific Construction Quality Assurance Plan, July 2009
Operations Plan, Revised February 2011
Closure and Post-Closure Plan, Revised April 2011
Environmental Monitoring Plan, Revised April 2006

We have enclosed a digital copy of the aforementioned documents for your use. In addition to the above noted documents, we have also enclosed, on a separate disk, a digital copy of additional support data and information requested by your office.

The Closure and Post-Closure costs for the Unit 2 C&DLF have been updated per the requirements of the North Carolina Department of Environment and Natural Resources (NCDENR), Division of Waste Management, Solid Waste Section's Financial Assurance website. The updated costs are included in the enclosed Closure and Post-Closure Plan, revised April 2011. The financial assurance mechanism is being prepared based on these costs and will be submitted to the Solid Waste Section for acceptance. Once accepted, a copy will be forwarded to your office for inclusion in this Permit Renewal Application.

Would you please send a copy of the permit renewal invoice to Mr. Jim Huff, Director, Madison County Solid Waste Department so the County can begin the approval process to have the fee paid in a timely manner. Mr. Huff's address is: Madison County Solid Waste Department, 271 Craig Rudisill Road, Marshall, North Carolina 28753. He can also be reached by e-mail at jhuff@madisoncountync.org or by phone at (828) 649-2311.

We look forward to working with you to obtain the permit renewal for the Madison County Solid Waste Facility. Please do not hesitate to call me or Jeff Bishop should you have any questions or need any additional information relative to this submittal.

Sincerely,
McGILL ASSOCIATES, P.A.

WILLIAM H. SPERRY, PE
Project Manager

Enclosures

cc: Mr. Jim Huff, Director, Madison County Solid Waste Department, w/enclosures
Mr. Jeff Bishop, PE, McGill Associates, w/o enclosures

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ENGINEERING PLAN

CONSTRUCTION and DEMOLITION LANDFILL UNIT 2 MADISON COUNTY, NORTH CAROLINA

WILLIAM H. SPERRY, PE

McGill ASSOCIATES

Engineering • Planning • Finance
Asheville, North Carolina

NORTH CAROLINA PROFESSIONAL SEAL 36132 ENGINEER WILLIAM H. SPERRY 4/14/11

February 2006
Revised April 2006
Revised April 2011

11.00702

ENGINEERING PLAN
Madison County
Construction/Demolition Landfill Unit 2

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1.0 Introduction

The Engineering Plan incorporates the plans and specifications relative to the detailed design and performance of the Construction and Demolition Landfill (CDLF) -Unit 2. This plan was developed in accordance with Sections .0503, .0504, and .0505 of the Solid Waste management Rules (15 NCAC 13B). This Engineering Plan discusses the engineering and design of the CDLF Unit 2, which has an estimated life expectancy of sixteen (16) years.

2.0 Engineering Report

2.1 Base Liner System

The CDLF Unit 2 has the following base (from bottom to top):

- A minimum seven (7)-foot vertical buffer between the projected high water table and the landfill base, and
- A minimum seven (7)-foot thick layer of soil placed over any exposed rock.

2.2 Cap System

The CDLF Unit 2 has the following cap system design characteristics (from bottom to top):

- A one (1)-foot thick layer of compacted intermediate cover directly on top of the waste,
- An eighteen (18)-inch thick vegetative\erosion layer

3.0 Design Summary

3.1 Analytical Methods Used for Design Evaluation

3.1.1 Liner Components.

Review of EPA literature and NC regulations.

3.2 Definition of Critical Conditions and Assumptions Made

Critical components:

- A minimum 300-foot buffer between proposed waste limits and property line, and
- A minimum 50-foot buffer between proposed waste limits and streams, and
- A minimum 500-foot buffer between proposed waste limits and all residences and private water supply wells, and
- Base grade separation of seven (7) feet above projected high water table and rock outcrops, and
- Maximize use of existing property, and
- Proposed base liner system and proposed final cap system in accordance with current regulations.

3.3 Technical References Used

- EPA 530-R-93-017 "Solid waste disposal facility criteria, technical manual"
- NC Regulations (15A NCAC 13B)
- Federal Regulations
- NC General Statutes
- Bagchi, Amalendu. (1994). Design, Construction, and Monitoring of Landfills, John Wiley and Sons, Inc., New York, NY.

3.4 Location Restrictions

The CDLF Unit 2 complies with all location restrictions given in Section .0503 of the Solid Waste Management Rules (15A NCAC 13B).

3.4.1 Airports

The CDLF Unit 2 is located in the vicinity of one (1) airport. The Asheville Regional Airport is located approximately 25 miles to the south.

3.4.2 Water Supply

There are approximately 34 private wells located within the 2000-foot study area. These wells are located adjacent to the approximate 34 residences that are located within the study area (some of the residents can be seen on Sheet C2 of the design

drawings). None of these wells lie within 500 feet of the proposed CDLF landfill unit. There are no public supply wells or public water intakes within the 2000-foot or 2-mile study area.

The unnamed stream which transects the landfill property from the south to the north discharges into Walnut Creek at the northern edge of the property, and is approximately 675 feet west of the proposed cell. Walnut Creek discharges to the French Broad River at the property boundary.

3.4.3 Zoning

The Madison County Landfill property, including the proposed CDLF Unit 2, is located in an area approved for landfill activity pursuant to the Madison County Zoning Ordinance. A letter from the Madison County attorney dated June 6, 1990 is included in Appendix 1 of the Site Study Update.

3.4.4 Contamination Sources

There are existing landfill facilities at the Madison County Landfill which are potential sources of contamination. The MSW Unit 1 is approximately 500' to the north of the proposed CD cell. Also, there is a maintenance shed that is 1200' to the north-northwest and could conceivably be a source of contamination. The transfer station is located 400' northeast of the proposed cell, but all leachate from this facility is captured and treated.

3.4.5 Historical Sites

There are no nearby sites that are recognized as having historical importance located near the Madison County Landfill Facility. Refer to the letter from NCDCR dated March 7, 1990 and the archaeological survey dated August 1990, both included in Appendix 3 of the Site Study Update.

3.4.6 Floodplains

Portions of the Madison County Landfill property are located in the 100-year floodplain but only along the French Broad River which flows along the western boundary of the property. The extent of the floodplain will not affect the structural components of the CDLF Unit 2.

3.4.7 Wetlands & Streams

There are no wetlands located in the proposed CDLF Unit 2. Soil & Environmental Consultants, PA (SE&C) conducted a detailed wetland delineation on March 4, 2005. They determined that there was one small marginal wetland located in the proposed Unit 2. However, the United States Army Corps of Engineers (USACE) determined that the area was not a wetland during a follow-up visit on May 3, 2005. Both the USACE Notification of Jurisdictional Determination and a copy of the SE&C report are found in Appendix 1. No streams are located within the proposed Unit 2 footprint. The nearest stream is located 675 feet west of the cell.

3.4.8 Seismic Design

According to the U.S. Geological Survey, there is a 10% chance that the seismic horizontal acceleration of the Madison County Landfill Site will reach 0.08g (8% of the earth's gravitational pull) in the next 50 years. Please refer to Appendix 3 for information regarding acceleration values. Although this does exceed the ten (10) percent (0.1g) limit in 250 years as set forth in Section .1622 of the rules, the .500 rules for siting do not address seismic hazard. The effects of an earthquake exceeding the .1622 limits will have minimal effect on an un-lined construction & demolition landfill cell.

3.4.9 Fault Areas

There are no fault areas located within two hundred (200) feet of the proposed CDLF Unit 2. Please refer to Section 3.1 of the Design Hydrogeologic Report dated January 31, 2006 and prepared by Bunnell-Lammons Engineering.

3.4.10 Unstable Areas

The site does not contain any areas of poor stability within the proposed CDLF Unit 2. The alluvial soils are located in the lower elevation areas, which is limited to the ravine area in the central portion of the site. Soil borings performed in these areas provided average standard penetration resistance values (N-values) of 12, indicating a stiff average soil consistency. Residual soils, which were formed from in-place weathering of bedrock, were encountered on the remainder of the site. There were typically two separate soil layers encountered. The upper layer was found 5 to 12 feet from the ground surface, more plastic than lower-depth soils, and had an average N-value of 10. Soils encountered at lower depths were more coarsely-grained, less plastic, ranged in depth from 5 to 44 feet, and had an average N-value of 19. The soil investigation (borings) performed at the site did

not provide any evidence that the potential for an unstable area exists. All N-values indicate a stiff average consistency and soil types/profiles were consistent throughout the site, which satisfied expectations. Instability and/or differential settlement should not be a concern for the CDLF site.

4.0 Materials and Construction Practices

All materials and methods used for constructing Unit 2 should meet the requirements set forth in Sections .0503, .0504, and .0505 of the Solid Waste Management Rules (15A NCAC 13B).

4.1 Subgrade

The landfill subgrade will be adequately free of organic materials and will consist of on-site soils or select fill material previously approved by the North Carolina Department of Environment and Natural Resources (NC DENR) Solid Waste Section (SWS). The subgrade will be graded according to plans approved by SWS. The landfill operator may be required to notify the SWS's hydrogeologist for inspection of the subgrade once excavation is complete. This notification would be indicated in the Permit To Construct.

Before waste placement, the Project Engineer will visually inspect the subgrade. The Project Engineer will evaluate the integrity of the surface and document proper preparation and elevations according to plans approved by SWS.

4.2 Erosion Control

The erosion control structures are designed and will be maintained to manage the run-off generated by the 24-hour, 25-year storm event and will conform to the requirements of the Sedimentation Pollution Control Law (15A NCAC 4). Refer to Appendix 2 for a copy of the Erosion Control Plan that was submitted to and approved by the North Carolina Land Quality Section.

A copy of the Erosion Control Plan approval letter has also been included in Appendix 2. The Erosion Control Plan contains seeding specifications and seeding schedules to be followed at the site, which can be found in the Closure & Post-Closure Plan as well as Sheets C6 and D2.

4.3 Waste Stream

Madison County basically classifies their waste stream into two main categories: municipal solid waste (MSW) and construction and demolition debris (C&D). The MSW is processed through the transfer station and transported out-of-state for disposal. The C&D waste is disposed of in the C&D Landfill, Unit 2. Municipal solid waste and out-of-County C&D waste are prohibited.

The population of Madison County is estimated to be approximately 21,000 persons. The service area for the Madison County Landfill includes only those businesses, municipalities, and residents located within Madison County. Waste from other counties will not be accepted at the facility.

Currently, waste received at the Unit 2 C&D Landfill for FY09-10 comprises approximately 13 percent of the MSW and C&D waste stream for Madison County. The C&D waste stream for FY09-10 was reported to be approximately 1,524 tons. The reported C&D waste streams for FY05-06 through FY08-09 are 6,327 tons, 4,647 tons, 5,766 tons and 4,034 tons respectively. The C&D waste streams held relatively steady for the period FY05-06 through FY07-08 and begin declining in FY08-09 and declined considerably in FY09-10. The C&D waste stream for FY10-11 appears to follow the general pattern of FY09-10.

The county operates the Unit 2 C&D landfill using basically the same equipment available to them at the time the Facility was constructed. This equipment generally includes a dozer, track loader, wheel loader, single-axle truck, tandem-axle truck, track hoe, farm tractor, skid-steer loaders, compactor, fork lifts, and a chipper. This equipment has been and should continue to be sufficient to operate the landfill with its current waste stream. Madison County budgets for new equipment needed for landfill operations on an annual basis

4.4 Unit 2 C&D Landfill Capacity

The original disposal airspace available for the disposal of construction and demolition (C&D) waste for the Unit 2 C&DLF is 131,600 cubic yards (cy). This was calculated from the record drawing elevations for the base of the landfill to the bottom of the cap contours shown in the permit drawings, as revised after June 30, 2008, when changes pertaining to cap layer thicknesses were implemented by the North Carolina Department of Environment and Natural Resources-Division of Waste Management (Solid Waste Rule 15A NCAC 13B .0543(c)). Based on the June 25, 2010 topographic survey, it has been calculated that approximately 31,200 cy of disposal airspace has been used since the Unit 2 C&DLF waste area was opened in November 2006. This volume consists of both C&D waste material and soil material. Based on Madison County scale records,

approximately 12,591 tons of waste has been disposed in the Unit 2 C&DLF since November 2006. This equates to a waste density of 0.4036 tons/cy, or 807.2 lbs/cy. The waste density is a ratio of how many pounds of waste are disposed in each cubic yard of airspace.

As of the capacity analysis survey performed June 25, 2010, there is approximately 100,400 cy (131,600 cy available airspace – 31,200 cy airspace used to date of survey) of disposal airspace remaining in the Unit 2 C&DLF. The County has seen a large drop in the C&D disposal rate in the past couple of years due to the slow economy. It is difficult to make projections of waste tonnage in the current economic climate; however, a conservative approach when estimating available landfill lifetime is prudent. Construction and demolition disposal can vary greatly from year to year, depending on any large demolition projects being conducted in the County (i.e., such as a school demolition project, etc.). For the purposes of projecting lifetime capacity of the Unit 2 C&DLF, an annual disposal rate of 3,000 tons/yr, along with a 1.5% annual increase, will be utilized. Using the calculated waste density of 0.4036 tons/cy (807.2 lbs/cy), the projected yearly disposal rate of 3,000 tons/yr, and a 1.5% annual increase, the Unit 2 C&DLF lifetime capacity was estimated to be approximately 11.7 years. This means that the Unit 2 waste area is estimated to reach capacity on or around March 2022 which is well beyond the present Five-Year (5-year) Permit Renewal period.

A summary of the above information is as follows:

Table 1: Projected Landfill Capacity

	Madison County C&D Wastes
Original Disposal Airspace	131,600 cy
Disposal Airspace Used (June 23, 2009 – June 25, 2010)	5,500 cy
Disposal Airspace Used (November 1, 2006 – June 25, 2010)	31,200 cy
Waste tonnages disposed (June 23, 2009 – June 25, 2010)	1,496 Tons
Waste tonnages disposed (November 1, 2006 – June 25, 2010)	12,591 Tons
Calculated Waste Density	0.4036 tons/cy or 807.2 lbs/cy
Remaining Disposal Airspace	100,400 cy
Remaining Life	11.7 years or March 2022

The proposed Waste Fill Sequence for the Five-Year (5-year) Permit Renewal period for the Unit 2, C&DLF is included in Appendix 4.

Several variables affect the lifetime capacity of a landfill cell. Waste disposal rates should continue to be monitored by the County to determine their impact on available airspace. Additionally, the projected date of March 2022 that the Unit 2 C&DLF will reach capacity is based on the assumption that the compaction rate will remain constant. It is typical that the early lifts of any landfill show a relatively low compaction rate. As time goes on, the compaction rates tend to increase. An increase in the compaction rate will extend the lifetime of the Unit 2 C&DLF.

4.5 Soil Resources

The following construction quantities for the new C&D Landfill have been estimated:

Cut = 57,900 CY
Fill = 35,900 CY

Approximately 22,000 CY will be stockpiled for future use.

The CDLF Unit 2 will require an average of 1,435 cubic yards of operational cover each year, based on a one (1) to six (6) soil to waste ratio. Approximately 520 cubic yards of soil will be needed each year for intermediate cover. Therefore, a total of 1,955 cubic yards of soil will be needed on an annual basis. The closure soil quantities needed for constructing the final cap will include approximately 10,500 cubic yards of vegetation-supportive soil. Soils needed for the closure will come from on-site borrow areas.

5.0 Design Hydrogeologic Report

The Design Hydrogeologic Report for Unit 2 was prepared by Bunnell-Lammons Engineering, Inc. A copy of this report along with the monitoring plan is included as a part of this Permit Renewal Application.

6.0 Engineering Drawings

6.1 Existing Conditions

Sheet C2 of the design drawings shows existing site roads, existing buildings, location of MSW facilities, and proposed location of the CDLF Unit 2.

6.2 Grading Plans

The grading plans identify the proposed limits of excavation, boring locations, and base grade elevations. Sheet C4 of the design drawings shows base grade elevations and the locations of the borings. Sheet C6 of the design drawings shows the proposed final cap grades for the entire Unit 2.

6.3 Stormwater Management

Stormwater will be collected by constructing benches on the finished cap at an interval of every 35 vertical feet. This will maintain the maximum flow length on the cap surface to approximately 120 linear feet. Ditches will be used to transport water from the bench to the two (2) existing sediment ponds. Each ditch will be sized for the final-developed condition, since the landfill will produce peak runoff at the final-developed condition. All of the stormwater management structures are shown on Sheets C4, C5, and C6. The erosion control details are shown on Sheets D1 and D2.

6.4 Cap System

Sheet C6 of the design drawings shows final grades of the proposed Unit 2. The original cap includes a one (1) foot thick compacted intermediate cover and an eighteen (18)-inch thick vegetative\erosion layer.

6.5 Erosion Control

The Final Erosion Control Plan is shown on Sheet C6 of the design drawings. The erosion control plan consist of all necessary diversion ditches, sediment basins, permanent ditches, stormdrains, and silt fence necessary to control sedimentation on the site. The erosion control structures are designed and will be maintained to manage the run-off generated by the 24-hour, 25-year storm event and will conform to the requirements of the Sedimentation Pollution Control Law (15A NCAC 4). Refer to Appendix 2 for a copy of the Erosion Control Plan that was submitted to the North Carolina Land Quality Section.

6.6 Vertical Separation Requirements

Cross sections of Unit 2 are shown on Sheet numbers CS1 and CS2 of the design drawings. These drawings illustrate the structural fill thickness, the depth of waste, the cap system thickness, and the existing ground elevation. Cross sections of the subsurface conditions, created from boring data at the site, are shown in the Unit 2 Design Hydrogeologic Report. The report also contains a projected high water contour map.

APPENDIX 1

WETLANDS INFORMATION

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action Id. 200531732 County: Madison U.S.G.S. Quad: Marshall

NOTIFICATION OF JURISDICTIONAL DETERMINATION

Property Owner/Agent: S&EC; Kevin Martin
Address: 11010 Raven Ridge Road
Raleigh, NC 27614
Telephone No.: 919-846-5900

Size and location of property (waterbody, road name/number, town, etc.) The project site is located at the existing Madison County Landfill near Marshall in Madison County, North Carolina.

Indicate Which of the Following Apply:

_ Based on preliminary information, there may be wetlands on the above described property. We strongly suggest you have this property inspected to determine the extent of Department of the Army (DA) jurisdiction. To be considered final, a jurisdictional determination must be verified by the Corps.

_ There are wetlands on the above described property subject to the permit requirements of Section 404 of the Clean Water Act (CWA)(33 USC § 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ We strongly suggest you have the wetlands on your property delineated. Due to the size of your property and/or our present workload, the Corps may not be able to accomplish this wetland delineation in a timely manner. For a more timely delineation, you may wish to obtain a consultant. To be considered final, any delineation must be verified by the Corps.

_ The wetland on your property have been delineated and the delineation has been verified by the Corps. We strongly suggest you have this delineation surveyed. Upon completion, this survey should be reviewed and verified by the Corps. Once verified, this survey will provide an accurate depiction of all areas subject to CWA jurisdiction on your property which, provided there is no change in the law or our published regulations, may be relied upon for a period not to exceed five years.

_ The wetlands have been delineated and surveyed and are accurately depicted on the plat signed by the Corps Regulatory Official identified below on _____. Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

X There are no waters of the U.S., to include wetlands, present on the above described project area which are subject to the permit requirements of Section 404 of the Clean Water Act (33 USC 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ The property is located in one of the 20 Coastal Counties subject to regulation under the Coastal Area Management Act (CAMA). You should contact the Division of Coastal Management in Washington, NC, at (252) 946-6481 to determine their requirements.

Remarks: _____

Corps Regulatory Official: Lebeyfah L. Newton

Date 05/03/2005 Expiration Date 05/03/2010

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MAY 05 2005

Action Id. 200531732

Placement of dredged or fill material within waters of the US and/or wetlands without a Department of the Army permit may constitute a violation of Section 301 of the Clean Water Act (33 USC § 1311). If you have any questions regarding this determination and/or the Corps regulatory program, please contact **Rebekah L. Newton** at **828-271-7980**.

Basis For Determination: **N/A.**

Corps Regulatory Official (Initial): RLN

FOR OFFICE USE ONLY:

- A plat or sketch of the property and the wetland data form must be attached to the file copy of this form.
- A copy of the "Notification Of Administrative Appeal Options And Process And Request For Appeal" form must be transmitted with the property owner/agent copy of this form.
- If the property contains isolated wetlands/waters, please indicate in "Remarks" section and attach the "Isolated Determination Information Sheet" to the file copy of this form.

JB

S&EC

Soil & Environmental Consultants, PA

11010 Raven Ridge Road • Raleigh, North Carolina 27614 • Phone: (919) 846-5900 • Fax: (919) 846-9467

www.SandEC.com

March 8, 2005

S&EC Project No.: 05-9413.W1

Madison County Solid Waste Department
Attn: James Huff
271 Craig Rudisell Road
Marshall, NC 28763

Re: Detailed Wetlands Delineation
Madison County Landfill Expansion
Marshall, Madison County, NC (+/- 6 acres evaluated)

Dear Mr. Huff:

On March 4, 2005, S&EC conducted a detailed wetland delineation on the above named project. Figure 1 shows the approximate location of the site on a USGS topographic quadrangle.

EXECUTIVE SUMMARY

We have determined that one small marginal wetland and no jurisdictional waters (i.e., streams, ponds, or lakes) exist on the site. The attached wetland sketch map depicts the approximate location of wetlands identified on the site. Please refer to the sketch map and the results and recommendations section below for more detailed information.

SCOPE OF WORK

The detailed wetland delineation consisted of pedestrian reconnaissance of the property to examine the soils, vegetation, and hydrology for the presence of areas that meet the criteria for jurisdictional wetlands by the procedures described in the Corps of Engineers Wetlands Delineation Manual (January 1987 – Final Report). Areas on the site with positive indicators of hydric soils and evidence of wetland hydrology and hydrophytic vegetation were flagged with sequentially numbered, pink S&EC logo flagging (Flag #'s 1-4). Proof of wetland hydrology would be the existence of hydric soils with oxidized root channels in the upper 12 inches of the "A" horizon, water borne deposits, drift lines, scour marks, drainage patterns, regional indicators of soil saturation, etc. Surface waters such as intermittent and perennial stream channels, ponds, and lakes, which are also subject to regulation by the US Army Corps of Engineers (USACE) as

Charlotte Office:
236 LePhillip Court, Suite C
Concord, NC 28025
Phone: (704) 720-9405
Fax: (704) 720-9406

Greensboro Office:
3817-E Lawndale Drive
Greensboro, NC 27455
Phone: (336) 540-8234
Fax: (336) 540-8235

waters of the US, were also considered. These surface waters may also be referred to as jurisdictional waters to indicate that they are within the jurisdiction of the USACE. It is important to note that wetlands are also classified as waters of the US and regulated by the USACE.

RESULTS & RECOMMENDATIONS

The results of the detailed delineation of jurisdictional wetlands and other waters of the US and the evaluation of surface waters on the site are discussed below.

Wetlands and Jurisdictional Waters:

We have determined that one marginal wetland and no jurisdictional waters (i.e., streams, ponds, or lakes) exist on the site. The wetland sketch map depicts the approximate location of the marginal wetland identified within the evaluated area. No other wetlands or jurisdictional waters were found within the project boundaries.

One (+/- 70ft^2) marginal feature exists on the property that is not believed to be jurisdictional wetlands or waters by S&EC due lack of hydric soils. However due to the marginal nature of these areas, confirmation of our determination should be obtained from the USACE. No other wetlands or jurisdictional waters were found within the project boundaries.

If the Corps decides to claim the marginal wetland area as jurisdictional, all S&EC flags comprising the wetland and jurisdictional waters delineation should be surveyed and a Wetland Delineation Map generated for use in USACE approval and permitting. The Wetland Delineation Map should include all of the information listed on the attached **'Requirements for Wetland Delineation Maps'**. S&EC delineation flag numbers should be shown on the wetland survey. Please have the property owner complete the attached agent authorization form if you would like S&EC to act on their behalf for requesting approval of the wetland delineation. This form will also be used in preparing a permit application for impacts to wetlands or surface waters when we are provided with a plan showing the proposed impacts. **S&EC cannot conduct correspondence with the USACE unless we have agent authorization (see attached Agent Authorization). This authorization form must be filled out in its entirety by the <u>current landowner</u> and sent to S&EC (a faxed copy is acceptable).**

Trout Buffers:

No areas within the limits of evaluation contained streams that would be subject to the Division of Land Quality Trout Buffers.

REGULATIONS

Regulations that apply to jurisdictional wetlands and waters present on the site are discussed below.

Wetland Permitting

Wetland impact permits are issued on a per-project basis as determined by the USACE. The USACE has determined that impacts on parcels sub-divided from larger tracts are sometimes considered to be cumulative to existing impacts for the large tract. If this is the case, then thresholds as discussed below may not apply and impacts to wetlands must be considered in light of existing permits.

Preconstruction notification to the USACE and the NC-DWQ is not required for wetland impacts that meet the general conditions of Nationwide Permit 39 and that impact less than 1/10 acre per project. Depending on which Corps Agent you ask, some believe that landfills do not quality for the 1/10 acre NWP 39 exemption. Preconstruction notification and approval by the USACE is required for wetland impacts that exceed 1/10 of an acre and /or any stream channel impacts. **Preconstruction notification and approval by the NC-DWQ is required for wetland impacts that exceed 1/10 of an acre since the property is west of I-95.** If development impacts exceed the thresholds for notification and proposed impervious area for the project or any part of the project exceeds 30%, then stormwater treatment to meet the pollutant removal design standard of 85% removal of total suspended solids (i.e., wet detention basins, stormwater wetlands, bioretention areas, etc.) will likely be required by the NC-DWQ. The maximum permanent impact allowed per project under the nationwide permits is 1/2 acre of wetland and/or 300 linear feet of USACE important stream channel. Nationwide Permit 39 limits above-grade fills within 100-year floodplains specifically prohibiting above-grade fill within the floodway. Additionally, Nationwide Permit 39 limits stream channelization and relocation to streams with an average annual flow of less than 1cfs.

Per project impacts to vegetated wetlands in excess of 1 acre or impacts to streams that contain "significant aquatic function" in excess of 150 linear feet will most likely require mitigation by the NC-DWQ. The USACE may require mitigation for any wetland/jurisdictional waters impacts. Actual mitigation requirements are typically determined on a case-by-case basis. Wetland mitigation is a complex process that requires planning and monitoring. S&EC will discuss mitigation issues with you if we believe your project may require mitigation. Impacts to channels containing "significant aquatic function" in excess of the notification thresholds may require mitigation. Channel mitigation is typically intended to replace lost significant aquatic functions and values. Relocating channels is considered to be an adverse impact and typically results in mitigation within the new channel. Therefore, this type of

mitigation usually requires that meanders be created within constructed channels. Side-slopes and beds be vegetated; riprap is discouraged.

A complete NC-DWQ 401 Water Quality Certification application for a Nationwide Permit has a maximum 60-day processing period. A complete USACE Nationwide Permit application has a 45-day processing period, while Individual Permit applications submitted to the USACE have no maximum processing periods. **The USACE requires that all impacts to wetlands or Waters of the US, less than 1/10 acre, be reported to the USACE within 30 days of the completion of construction.**

Nationwide Permits can potentially be utilized if the project is designed to impact up to 1/2 acre of jurisdictional wetlands or waters of the US including a maximum of 300 linear feet of important stream channel impact under NWP 39. Cumulative impacts per project over these nationwide thresholds will require an individual permit. Individual Permits require an analysis to determine that the proposed impact is the least environmentally damaging practical alternative, typically require compensatory mitigation, notification to adjacent property owners, a public notice, and may require a public hearing. All impacts greater than 1/10 acre require written justification.

ADDITIONAL SERVICES

If you choose to have us perform additional work, the following is a listing of additional services: (1) Request that the USACE verify our delineation, and (2) Notification to the USACE and NC-DWQ regarding impacts to jurisdictional areas and riparian buffers and permitting issues, if required. This additional work can be completed at our hourly rates or a proposal can be generated. Please advise.

Please call Kevin Martin if you need further explanation of the information provided.

LICENSED SOIL SCIENTIST
KEVIN C. MARTIN
1003
STATE OF NORTH CAROLINA

Sincerely,

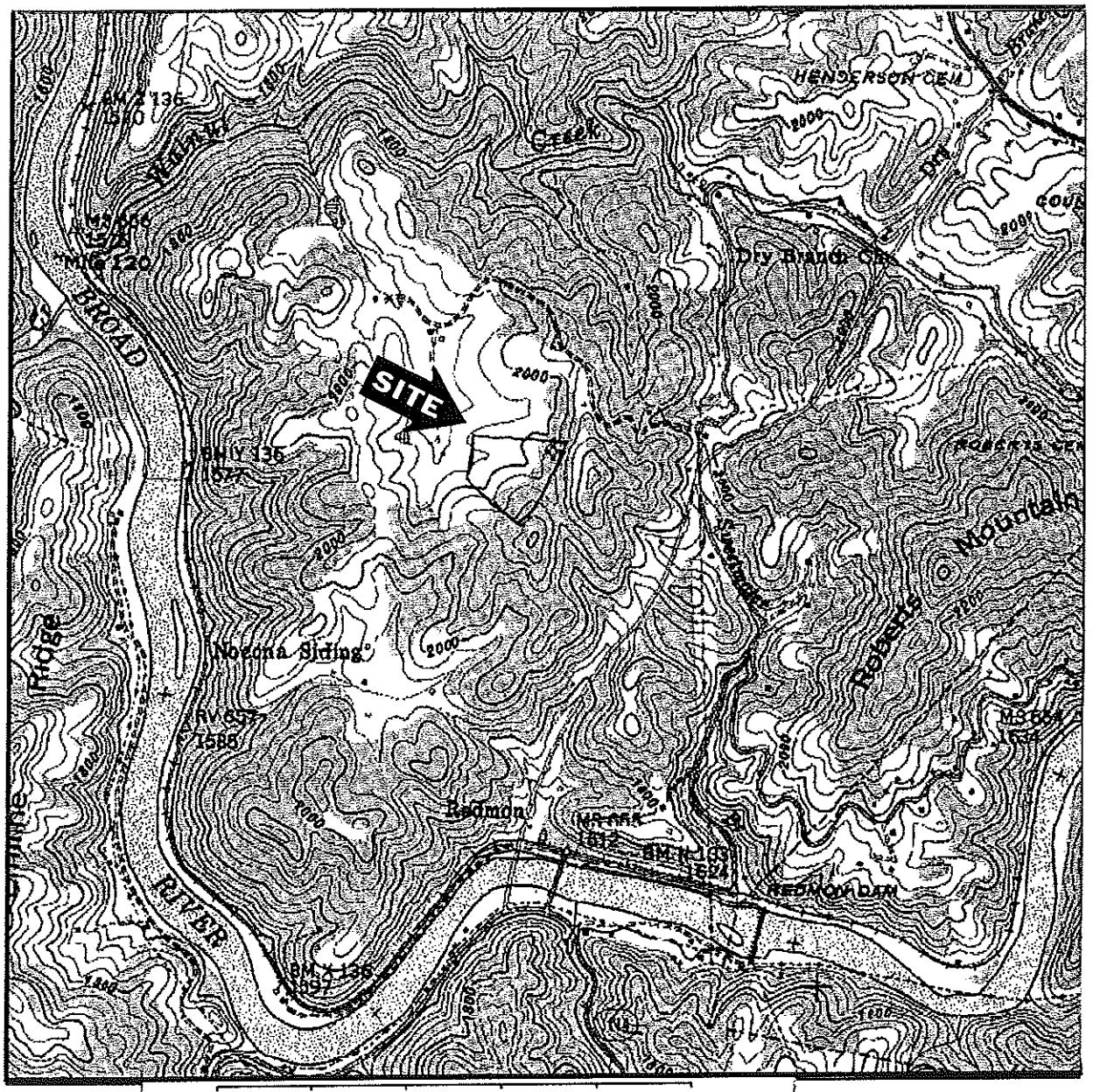
Kevin Martin
NC LSS # 1003
Professional Wetland Scientist # 851

Attachments

3 Corps Wetland Data Forms and Associated Site Photos
USGS Vicinity Maps

Wetland Sketch Map
Agent Authorization
Requirements for Wetland Delineation Maps

c: Jennifer Ballard, McGill Engineers



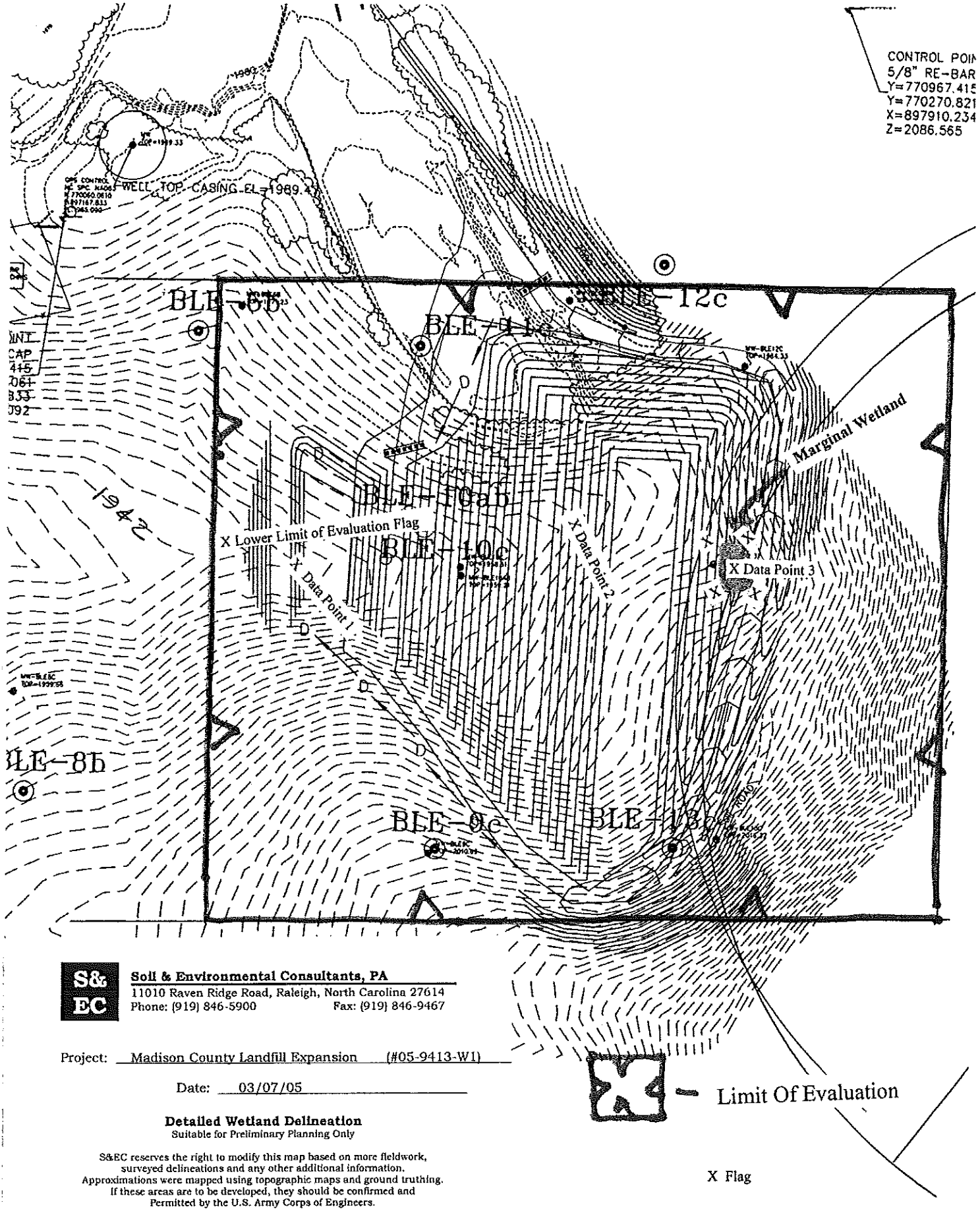
0 0.3 0.6 0.9 1.2 1.5 km

0 0.2 0.4 0.6 0.8 1 mi

N

Map center is UTM 17 344786E 3963915N (WGS84/NAD83)
Marshall quadrangle
Projection is UTM Zone 17 NAD83 Datum

Project #: 05-9413.W1	Scale: 1":2000'	Figure1 – USGS Map	S&EC Soil & Environmental Consultants, PA 11010 Raven Ridge Rd. • Raleigh, NC 27614 (919) 846-5900 • (919) 846-9467 Web Page: www.SandEC.com
Project Mgr.: KM	Date: 03/07/05	Madison County Landfill Expansion Madison County, NC	



S&EC **Soil & Environmental Consultants, PA**
11010 Raven Ridge Road, Raleigh, North Carolina 27614
Phone: (919) 846-5900 Fax: (919) 846-9467

Project: Madison County Landfill Expansion (#05-9413-W1)

Date: 03/07/05

Detailed Wetland Delineation
Suitable for Preliminary Planning Only

S&EC reserves the right to modify this map based on more fieldwork, surveyed delineations and any other additional information. Approximations were mapped using topographic maps and ground truthing. If these areas are to be developed, they should be confirmed and Permitted by the U.S. Army Corps of Engineers.

X – Limit Of Evaluation

X Flag

Wetland Delineation Performed By: Soil & Environmental Consultants, PA
11010 Raven Ridge Road
Raleigh, North Carolina 27614
(919) 846-5900

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Madison County Landfill S&EC # 9413.W1	Date: 3-4-2005
Applicant/Owner: Madison County	County: Madison
Investigator: Kevin Martin	State: NC
Do Normal Circumstances exist on the site? X Yes ___ No	Community ID: ___
Is the site significantly disturbed (Atypical Situation)? ___ Yes X No	Transect ID: ___
Is the area a potential Problem Area? ___ Yes X No	Plot ID: Data Point 1/Image 1
(If needed, explain on reverse.)	

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. *Rubus sp.*	Herb	FAC	9.		
2. *Festuca sp.*	Herb	FAC?	10.		
3. *Solidago sp.*	Herb	FAC?	11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): <100?

Remarks: Site is an old pasture. Could not ID specific species this time of year.

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake or Tide Gauge
- ___ Aerial Photographs
- ___ Other

X No Recorded Data Available

Field Observations:

Depth of Surface Water: N/A (in.)

Depth to Free Water in Pit: N/A (in.)

Depth to Saturated Soil: >18 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12 Inches
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks: No indicators present.

Image01

Wetland Delineation Performed By: Soil & Environmental Consultants, PA
11010 Raven Ridge Road
Raleigh, North Carolina 27614
(919) 846-5900

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Madison County Landfill S&EC # 9413.W1	Date: 3-4-2005
Applicant/Owner: Madison County	County: Madison
Investigator: Kevin Martin	State: NC
Do Normal Circumstances exist on the site? X Yes ___ No	Community ID: ___
Is the site significantly disturbed (Atypical Situation)? ___ Yes X No	Transect ID: ___
Is the area a potential Problem Area? ___ Yes X No	Plot ID: Data Point 2/Image 3
(If needed, explain on reverse.)	

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. *Rubus sp.*	Herb	FAC?	9.		
2. *Festuca sp.*	Herb	FAC?	10.		
3. *Solidago sp.*	Herb	FAC?	11.		
4. *Allium sp.*	Herb	FAC?	12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): <100

Remarks: Could not ID specific species this time of year.

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake or Tide Gauge
___ Aerial Photographs
___ Other
X No Recorded Data Available

Field Observations:

Depth of Surface Water: N/A (in.)

Depth to Free Water in Pit: N/A (in.)

Depth to Saturated Soil: >14 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
___ Saturated in Upper 12 Inches
___ Sediment Deposits
___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
___ Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks: No indicators.

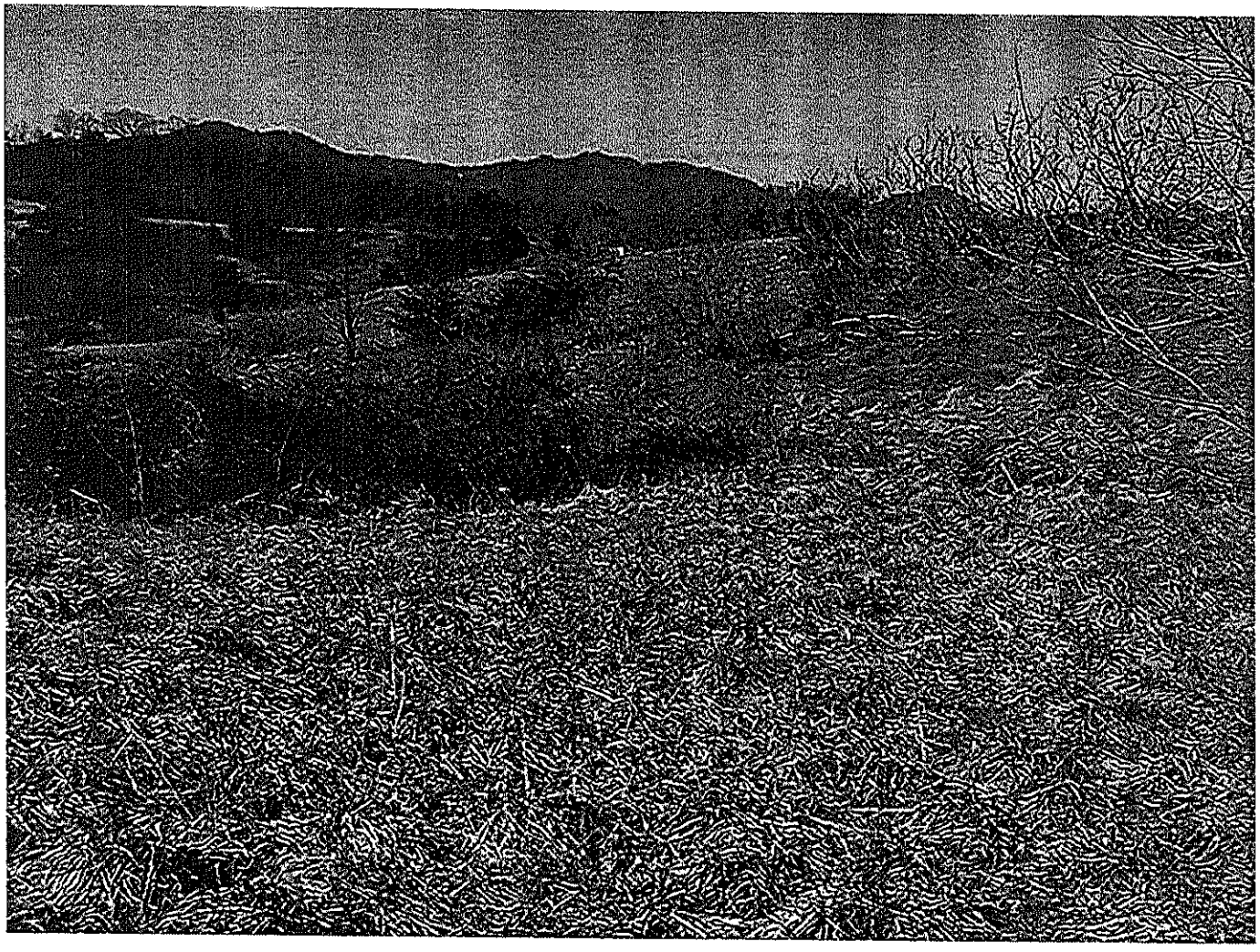


Image03

Wetland Delineation Performed By: Soil & Environmental Consultants, PA
11010 Raven Ridge Road
Raleigh, North Carolina 27614
(919) 846-5900

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Madison County Landfill S&EC # 9413.W1	Date: 3-4-2005
Applicant/Owner: Madison County	County: Madison
Investigator: Kevin Martin	State: NC
Do Normal Circumstances exist on the site? X Yes ___ No	Community ID:
Is the site significantly disturbed (Atypical Situation)? ___ Yes X No	Transect ID:
Is the area a potential Problem Area? ___ Yes X No	Plot ID: Data Point 3/Image ~~5~~ 4
(If needed, explain on reverse.)	

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. *Carex sp.*	Herb	FACW?	9.		
2.			10.		
3.			11.		
4.			12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): 100

Remarks: Could not ID species this time of year.

HYDROLOGY

___ Recorded Data (Describe in Remarks):
___ Stream, Lake or Tide Gauge
___ Aerial Photographs
___ Other
X No Recorded Data Available

Field Observations:

Depth of Surface Water: N/A (in.)

Depth to Free Water in Pit: 0 (in.)

Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
___ Inundated
X Saturated in Upper 12 Inches (Not growing season)
___ Sediment Deposits
___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
X Oxidized Root Channels in Upper 12 Inches
___ Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:

Image04

APPENDIX 2

EROSION CONTROL PLAN

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Land Resources
Land Quality Section

James D. Simons, PG, PE
Director and State Geologist

Michael F. Easley, Governor
William G. Ross Jr., Secretary

September 21, 2005

LETTER OF APPROVAL

James L. Huff
Madison County
271 Craig Rudisill Road
Marshall, NC 28753

RE: Project Name: Construction/Demolition Landfill
Acres Approved: 10.3
Project ID: MADIS-2006-006
County: Madison
City: Marshall
Street: Craig Rudisill Road
River Basin: French Broad
Stream Classification: C
Submitted By: McGill Assoc.
Date Received by LQS: August 31, 2005
Plan Type: New Submittal

Dear Sir or Madam:

This office has reviewed the subject erosion and sedimentation control plan. We find the plan to be acceptable and hereby issue this Letter of Approval. The enclosed Certificate of Approval must be posted at the job site. This plan approval shall expire three (3) years following the date of approval, if no land-disturbing activity has been undertaken, as is required by Title 15A NCAC 4B .0129.

Title 15A NCAC 4B .0118(a) requires that a copy of the approved erosion control plan be on file at the job site. Also, this letter gives the notice required by G.S. 113A-61.1(a) of our right of periodic inspection to insure compliance with the approved plan.

North Carolina's Sedimentation Pollution Control Act is performance-oriented, requiring protection of existing natural resources and adjoining properties. If, following the commencement of this project, the erosion and sedimentation control plan is inadequate to meet the requirements of the Sedimentation Pollution Control Act of 1973 (North Carolina General

Statute 113A-51 through 66), this office may require revisions to the plan and implementation of the revisions to insure compliance with the Act.

Acceptance and approval of this plan is conditioned upon your compliance with Federal and State water quality laws, regulations, and rules. In addition, local city or county ordinances or rules may also apply to this land-disturbing activity. This approval does not supersede any other permit or approval.

Please be aware that your project will be covered by the enclosed NPDES General Stormwater Permit NCGO1000 (Construction Activities). You should first become familiar with all of the requirements for compliance with the enclosed general permit.

Please note that this approval is based in part on the accuracy of the information provided in the Financial Responsibility Form, which you provided. You are requested to file an amended form if there is any change in the information included on the form. In addition, it would be helpful if you notify this office of the proposed starting date for this project. Please notify Dennis G. Owenby or myself if you plan to have a pre-construction conference.

Your cooperation is appreciated.

Sincerely,

Janet Boyer

Janet Boyer
Land Quality Section

Enclosures: Certificate of Approval
NPDES Permit

cc: McGill Assoc.

CERTIFICATE OF PLAN APPROVAL

The posting of this certificate certifies that an erosion and sedimentation control plan has been approved for this project by the North Carolina Department of Environment and Natural Resources in accordance with North Carolina General Statute 113A - 57 (4) and 113A - 54 (d) (4) and North Carolina Administrative Code, Title 15A, Chapter 4B.0107 (c). This certificate must be posted at the primary entrance of the job site before construction begins and until establishment of permanent groundcover as required by North Carolina Administrative Code, Title 15A, Chapter 4B.0127 (b).

CONSTRUCTION / DEMOLITION LANDFILL MADIS-2006-006

Project Name and Location

SEPT. 21, 2005

Date of Plan Approval

NCDENR

Janet S. Boyce

Regional Engineer

CONSTRUCTION/DEMOLITON LANDFILL
MADISON COUNTY LANDFILL

EROSION CONTROL PLAN

MADISON COUNTY, NORTH CAROLINA

McGill ASSOCIATES

MARK D. CATHEY, P.E.

McGILL ASSOCIATES, P.A.
CONSULTING ENGINEERS
55 BROAD STREET
ASHEVILLE, NORTH CAROLINA 28801
828/252-0575

NORTH CAROLINA PROFESSIONAL SEAL 24993 ENGINEER MARK D. CATHEY

8/12/05

AUGUST 2005

04317

CONSTRUCTION/DEMOLITON LANDFILL
MADISON COUNTY LANDFILL

EROSION CONTROL PLAN

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3.....Areas Map

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5.....Pipe Calculations & Inlet/Outlet Protection Calculations

6.....Ditch & Shear Stress Calculations

7.....Appendices

Appendix

1.....Rainfall Intensity Curve – Asheville, NC

2.....Runoff Coefficient Table

3.....Rational Method Formula

4.....Permissible Shear Stresses Table

5.....Max. Velocities for Vegetated Channels

6.....Inlet/Outlet Protection Design Curves

7.....North American Green Product Information – E.C. Matting

Section 1
Narrative

MADISON COUNTY
CONSTRUCTION/DEMOLITION LANDFILL

EROSION CONTROL PLAN

Storm Drainage & Erosion Control Overview

Madison County is in the process of obtaining a permit from the NCDENR Solid Waste Section to construct and operate a new Construction/Demolition (C/D) Landfill at the Madison County Landfill site. This Erosion Control Plan includes measures for preventing and controlling erosion associated with the construction and operation of the C/D Landfill cell. There will be approximately 10.3 acres of disturbance related to this project. Construction will take place in two phases: Phase I of this project is scheduled to begin construction in September 2005 and this portion of the C/D landfill is expected to accept C/D waste for five years. As the Phase 1 area begins to reach its capacity, Phase 2 will be brought on line and is expected to have a lifetime of ten to fifteen years. A 25-year storm is the basis for all flow calculations. Additionally, a 100-year storm was looked at to determine its impact on the landfill. Piping, ditches, and erosion control measures are designed to accept the larger of the Phase 1 or Phase 2 flows. Dirt will be stockpiled in an area just to the north of the C/D site, which is covered under an existing erosion control permit for the adjacent MSW landfill. The project site is located on Craig Rudisill Road (S.R. 1134), just off of S.R. 1136 and 1.4 miles from U.S. Hwy 25/70. The review fee of $550 has been enclosed.

Contact information for Madison County:

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

Phase 1 Erosion Control Measures

Activities associated with bringing the northern half of the C/D cell on line are included in Phase 1 construction. Sedimentation associated with the construction of Phase 1 will primarily be directed to sediment basins 1 & 2. Disturbance from the waste area base grades construction will be diverted to temporary sediment basin 1. Much of the access road construction sedimentation will be directed to sediment basin 2. Drainage from off the project area will be diverted around the C/D waste area to sediment basin 2. Pipes P1 and P2 (see Section 5 for pipe calculations) and ditches D1, D2, and D3 will be the primary conveyance to sediment basin 2, which will receive runoff from approximately 3.0 acres of disturbed area, and 11.2 acres overall. Sediment

basin 1 will receive sheet flow runoff from the C/D waste area, including approximately 4.0 acres of disturbed area and 7.8 acres overall. The sediment basins will be closely monitored by Landfill staff and sediment will be removed before ½ of the basin volume has been filled. Since these basins are sized to serve the entire landfill during periods of peak disturbance, they are much larger than required based on the area that will be disturbed during this project. The excess storage of the basins will be utilized to provide additional stormwater detention time and increase the sediment capturing efficiency of the basins. The sediment basins are designed to accommodate the Q_{25} flow, with a riser/barrel system and 1' x 6' emergency spillway. See Section 4 for sediment basin calculations.

Phase 1 grading and erosion control measures are shown on Sheet C5 of the plans and Phase 2 grading and erosion control measures are shown on C6. A temporary construction entrance has not been included in the erosion control plan because all construction traffic to the site must cross an existing 500' gravel access road adjacent to the MSW landfill cell. The periphery ditches associated with Phase 1 construction are D2, D3, D4, and D8. A summary of these ditches as well as all other ditches associated with the C/D landfill is included in Section 6 of this report. Where possible, ditches were designed so that velocities would not exceed five feet per second in order to avoid permanent ditch linings; however, it was not possible to keep velocities below five feet per second for all ditches. Ditches D3 and D9A&B will require Class 2 riprap lining with filter fabric. The grass-lined ditches will require an erosion control matting in order to establish a good stand of grass. The temporary lining proposed is the North American Green S150 erosion control matting, or approved equal. The S150 is a straw blanket with netting on both sides. Shear stress calculations to support these proposed ditch linings are included in Section 6. Also, see Appendix 4 for permissible shear stresses, Appendix 5 for velocities for vegetated channels, and Appendix 7 for product information for the North American Green erosion control matting.

Phase 2 Erosion Control Measures

As the C/D phase 1 area begins to fill, construction of the remainder of the C/D cell will begin. The access road will be continued to the end at the turn around area and ditches D9A &9B will be constructed at the southern end of the cell. Sediment basin 3 will be constructed. Sediment basin 1 will be removed, with the barrel being grouted and left in place. Sediment from the C/D waste area will be directed to basins 2 & 3. Off-site area drainage will continue to be diverted around the C/D cell in the road side ditches on the upper side of the access road. Much of the disturbed area from the phase 1 construction will be stabilized for years at this point. Sediment basin 3 will serve approximately 3.0 acres of disturbed area and 4.5 acres overall. Sediment basin 2 will actually serve a large drainage area during this phase: 19.7 acres, but the disturbed area for this basin will be less than it was in Phase 1: approximately 2.5 acres. Phase 2 flows to sediment basin 2 were used to calculate the surface area required for the basin. As the final cap is built, ditches at the periphery of the waste area will be the

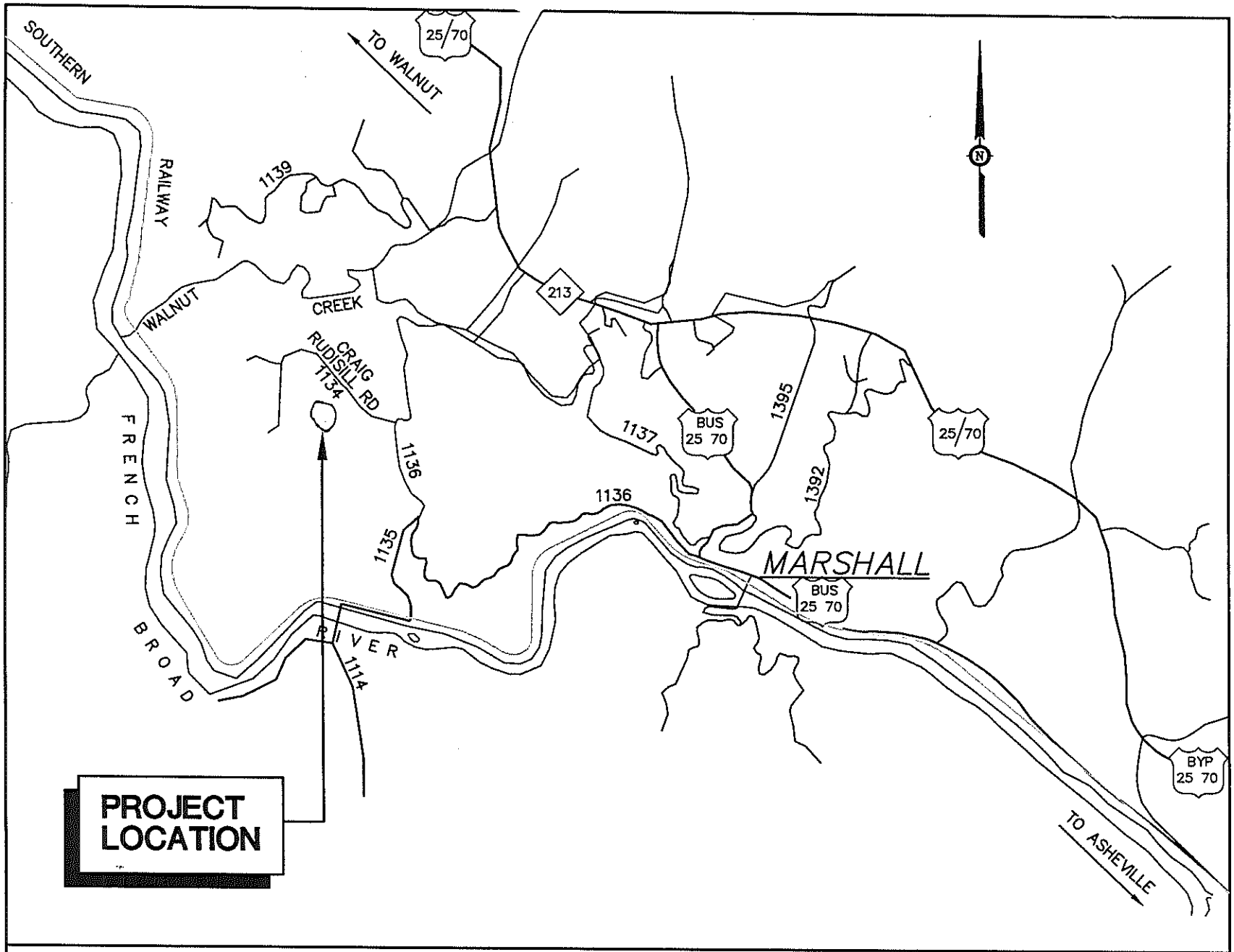
primary conveyance of runoff from the cap, with the terrace ditches (all of which are constructed at 3% slope) being constructed as the cap approaches its final condition. Pipes P5 & P6 will drain the terrace ditches, leading to sediment basins 2 & 3, respectively.

Conclusion

Section 3 of this report includes a map that illustrates the drainage areas that were used for the flow calculations. Sections 4-6 include the erosion control calculations. Section 7 includes the appendices that were used in the erosion control calculations. Erosion control measures will be installed prior to the commencement of construction activities in each Phase. Ditches and ditch linings will be installed. Drainage pipes and inlet/outlet protection will be installed. Ditches will be inspected for damage after each runoff event. Riprap will be placed in ditches where necessary, and at pipe discharges to prevent erosion and washouts. Provisions for a vegetative ground cover sufficient to control erosion must be accomplished within 15 working days or 90 calendar days upon completion of any of the site development. Temporary grassing will also be utilized as necessary to stabilize temporary slopes that are susceptible to erosion. Permanent stabilization of all slopes will commence as soon as possible per the erosion control notes shown on Sheet D2 of the plans. Embankment slopes shall be periodically inspected for erosion. Any damaged areas will be reseeded, fertilized, and mulched immediately. Seeding, fertilizing and mulching shall be in accordance with the North Carolina Erosion and Sedimentation Control Guidelines.

There shall be no discharge of pollutants from the site into waters of the U.S., including wetlands, that violates any requirements of the Clean Water Act, including, but not limited to, the National Pollutant Discharge Elimination Systems (NPDES) requirements, pursuant to Section 402.

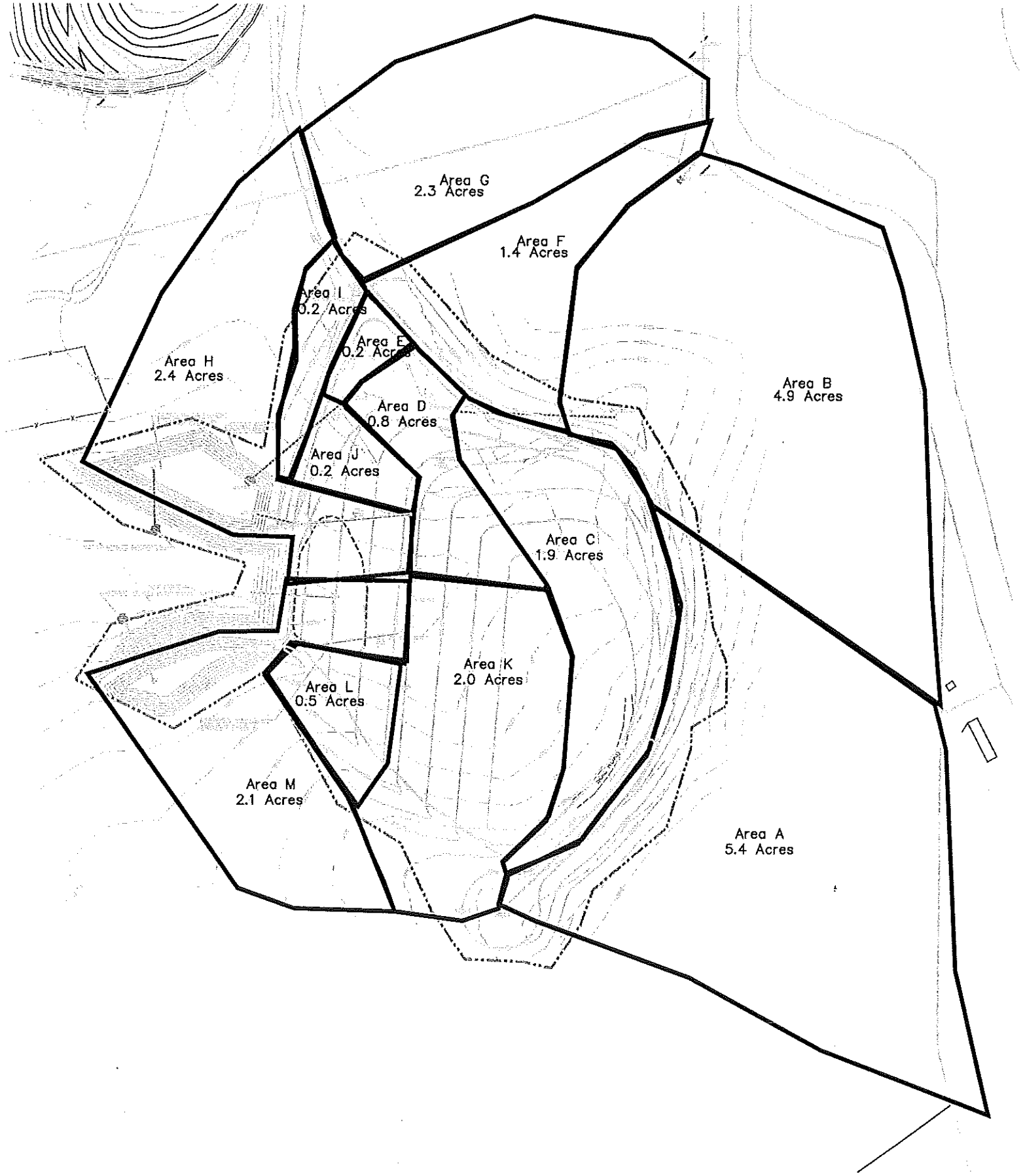
Section 2
Location Map



PROJECT LOCATION MAP

NOT TO SCALE

Section 3
Areas Map


Area G
2.3 Acres
Area F
1.4 Acres
Area I
0.2 Acres
Area E
0.2 Acres
Area H
2.4 Acres
Area B
4.9 Acres
Area D
0.8 Acres
Area J
0.2 Acres
Area C
1.9 Acres
Area K
2.0 Acres
Area L
0.5 Acres
Area M
2.1 Acres
Area A
5.4 Acres

Section 4
Sediment Basin Calculations

Sediment Basin Calculations

See Sheet D2 of the plan set for the sediment basin details and a summary of these sediment basin calculations.

Sediment Basin 1

Volume & Surface Area Determinations

During the construction and operation of Phase 1 of the C/D cell, runoff from approximately 4.0 acres of disturbed area and a total drainage area of approximately 7.8 acres will flow to this basin. Sediment basin 1 will be removed after the Phase 1 C/D waste area is filled and before the Phase 2 area is brought on line. The volume of basin required is 4.0 Ac. x 1800 cf/Ac = 7,200 c.f. The volume of basin 1 provided is 23,400. To determine the surface area of the basin, use:

S.A. = (0.01) q and q = cia to determine flow

S.A. = surface area of basin, in acres
q = flow to basin (25 yr)
t_c = time of concentration = 5 mins.
c = adjusted runoff coefficient = 0.25
i = rainfall intensity (25 yr) = 7.2 inches/hr
a = drainage area to basin = 7.8 acres

q = cia
q = (.25)(7.2)(7.8)
q = 14.0 cfs

S.A. = .01q
S.A. = .01(14.0)
S.A. = 0.140 Ac. = 6,100 s.f. (Required)

The surface area of sediment basin 1 provided is 13,100 s.f.

Spillway Calculations

The principal spillway is a riser-barrel system that will be designed to carry the 25-year storm.

The orifice equation will be used to calculate the barrel diameter. Start by trying an 18" diameter cmp:

$$D = \sqrt{\frac{4Q}{C_d\,(3.14)\sqrt{2gh}}} = \sqrt{\frac{4\,(14.0)}{(0.6)(3.14)\sqrt{2(32.2)(3.25)}}} = \sqrt{2.05} = 1.43'$$

An 18" barrel is sufficient.

The riser is calculated using the weir equation. Start by trying a 24" riser (the cross-sectional area is more than 1.5 times that of the barrel):

$$Q = Cw\ L\ H^{3/2} = (3.33)\ [2(3.14)(1)]\ (1)^{3/2} = 20.9 \text{ c.f.s.}$$

A 24" riser will carry the 25-year storm with room to spare.

The riser/barrel system will be limited by the barrel, which will carry up to 15.4 cfs (using the orifice eq. from above) when the water level in the basin is at the bottom of the emergency spillway. A 100-year storm to this basin will flow 17.9 cfs; therefore, approximately 2.5 cfs will flow through the spillway, at a depth of approximately 0.18 ft. See the attached calculations for emergency spillway flows. The emergency spillway will be a grass-lined channel 1' x 6'.

Floatation Block Calculation
Water displaced by riser = 3.14 x $(1)^2$ x 3.0 = 9.42 cu.ft.
Weight of water = 9.42 cu.ft. x 62.4 lbs/cu.ft. = 590 lbs
Weight of concrete needed = 590 x 1.2 (Safety Factor) = 710 lbs
Concrete volume required = $\frac{710 \text{ lbs}}{150 \text{ lbs/cu.ft.}}$ = 4.73 cu.ft.
Concrete block dimensions: 2' x 2' x 1.5'

Riprap Outlet Protection Calculation
Referring to Appendix 6, fig. 8.06.3, d_{50} riprap size is approximately 5" and apron length is 12'. Use: d_{50} = 6", d_{max} = 9", apron thickness = 14", apron length = 14', and apron width = 16'.

Sediment Basin 2

Volume & Surface Area Determinations
Sediment basin 2 will be constructed during Phase 1 of the C/D construction, and will be left in place throughout the lifetime of the landfill. Initially, approximately 3.0 acres of disturbed area and a total drainage area of 11.2 acres will flow to the basin. The volume of basin required is 3.0 Ac. x 1800 cf/Ac = 5,400 c.f. The volume of basin 1 provided is 115,000. As the Phase 2 area of the cell comes on line, the drainage area to this basin will increase. The flow from this increased drainage area was used to calculate the surface area required for the basin. To determine the surface area of the basin, use: S.A. = (0.01) q. This basin will receive flow from pipe P2, ditch D7, and sheet flow from surrounding area. There will be approximately 16.4 acres of wooded area (c=0.2) and 3.3 acres of grassed area (c=0.3) in this drainage area, with an adjusted c factor of 2.2 Therefore, Q-25 to this basin will be = (0.2)(7.2)(19.7) = 31.2 cfs. The surface area required is: S.A. = 0.01(31.2) = 0.312 Ac. = 13,590 s.f. (Required). The surface area of sediment basin 2 provided is 13,600 s.f.

Spillway Calculations
The principal spillway is a riser-barrel system that will be designed to carry the 25-year storm.
The orifice equation will be used to calculate the barrel diameter. Start by trying a 21" diameter cmp:

$$D = \sqrt{\frac{4Q}{C_d\,(3.14)\sqrt{2gh}}} = \sqrt{\frac{4\,(31.2)}{(0.6)(3.14)\sqrt{2(32.2)(8.125)}}} = \sqrt{2.89} = 1.70'$$

A 21" barrel is sufficient.
The riser is calculated using the weir equation. Start by trying a 30" riser (the cross-sectional area is more than 1.5 times that of the barrel):

$$Q = Cw\,L\,H^{3/2} = (3.33)\,[2(3.14)(1.25)]\,(1.5)^{3/2} = 48.0 \text{ c.f.s.}$$

A 30" riser will carry the 25-year storm with room to spare.
The riser/barrel system will be limited by the barrel, which will carry up to 33.0 cfs (using the orifice eq. from above) when the water level in the basin is at the bottom of the emergency spillway. A 100-year storm to this basin will flow 36.3 cfs; therefore, approximately 3.3 cfs will flow through the spillway, at a depth of

approximately 0.22 ft. See the attached calculations for emergency spillway flows. The emergency spillway will be a grass-lined channel 1' x 6'.

Floatation Block Calculation

Water displaced by riser = 3.14 x $(1.5)^2$ x 7.5 = 53.0 cu.ft.
Weight of water = 53.0 cu.ft. x 62.4 lbs/cu.ft. = 3,307 lbs
Weight of concrete needed = 3,307 x 1.2 (Safety Factor) = 3,970 lbs

$$\text{Concrete volume required} = \frac{3{,}970 \text{ lbs}}{150 \text{ lbs/cu.ft.}} = 26.5 \text{ cu.ft.}$$

Concrete block dimensions: 3.5' x 3.5' x 2.5'

Riprap Outlet Protection Calculation

Referring to Appendix 6, fig. 8.06.3, use: d_{50} = 10", d_{max} = 15", apron thickness = 23", apron length = 22', and apron width = 24'.

Sediment Basin 3

Volume & Surface Area Determinations

Sediment basin 3 will be constructed during the Phase 2 construction of the cell. Sedimentation will be directed to the basin through ditches D9A & D9B and from sheet flow from the C/D Phase 2 waste area. Approximately 3.0 acres of disturbed area and a total drainage of 4.5 acres will flow to the basin. Sediment basin 3 will be left in place throughout the lifetime of the landfill. The volume of basin required is 3.0 Ac. x 1800 cf/Ac = 5,400 c.f. The volume of basin 3 provided is 61,500 c.f. To determine the surface area of the basin, use:

S.A. = (0.01) q and q = cia to determine flow

S.A. = surface area of basin, in acres
q = flow to basin (25 yr)
t_c = time of concentration = 5 mins.
c = runoff coefficient = 0.30
i = rainfall intensity (25 yr) = 7.2 inches/hr
a = drainage area to basin = 4.5 acres

q = cia
q = (.3)(7.2)(4.5)
q = 9.72 cfs
(Required)

S.A. = 0.01q
S.A. = 0.01(9.72)
S.A. = 0.0972 Ac. = 4,250 s.f.

The surface area of sediment basin 3 provided is 7,400 s.f.

Spillway Calculations

The principal spillway is a riser-barrel system that will be designed to carry the 25-year storm.

The orifice equation will be used to calculate the barrel diameter. Start by trying a 18" diameter cmp:

$$D = \sqrt{\frac{4Q}{C_d (3.14)\sqrt{2gh}}} = \sqrt{\frac{4\,(9.72)}{(0.6)(3.14)\sqrt{2(32.2)(8.25)}}} = 0.894 = 0.95'$$

A 18" barrel is sufficient.

The riser is calculated using the weir equation. Start by trying a 24" riser (the cross-sectional area is more than 1.5 times that of the barrel):

$$Q = Cw\ L\ H^{3/2} = (3.33)\ [2(3.14)(1.0)]\ (1.0)^{3/2} = 20.9 \text{ c.f.s.}$$

A 24" riser will carry the 25-year storm with room to spare.
The riser/barrel system will be limited by the riser, which will carry up to 20.9 cfs when the water level in the basin is at the bottom of the emergency spillway. A 100-year storm to this basin will flow 12.4 cfs; therefore, the riser/barrel will carry the 100-year storm. Use an emergency spillway with a grass-lined channel 1' x 6'.

Floatation Block Calculation

Water displaced by riser = $3.14 \times (1)^2 \times 8.0 = 25.1$ cu.ft.
Weight of water = 25.1 cu.ft. x 62.4 lbs/cu.ft. = 1,570 lbs
Weight of concrete needed = 1,570 x 1.2 (Safety Factor) = 1,884 lbs

$$\text{Concrete volume required} = \frac{1{,}884 \text{ lbs}}{150 \text{ lbs/cu.ft.}} = 12.6 \text{ cu.ft.}$$

Concrete block dimensions: 2.5' x 2.5' x 2.0'

Riprap Outlet Protection Calculation

Referring to Appendix 6, fig. 8.06.3, d_{50} riprap size is approximately 5" and apron length is 12'. Use: d_{50} = 6", d_{max} = 9", apron thickness = 14", apron length = 14', and apron width = 16'.

Sed Basin 1 Emer Spillway - Q-100
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Sed Basin 1 Emer Spillway
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.020000	ft/ft
Left Side Slope	1.000000	H : V
Right Side Slope	1.000000	H : V
Bottom Width	6.00	ft
Discharge	2.50	cfs

Results		
Depth	0.18	ft
Flow Area	1.14	ft²
Wetted Perimeter	6.52	ft
Top Width	6.37	ft
Critical Depth	0.17	ft
Critical Slope	0.024441	ft/ft
Velocity	2.19	ft/s
Velocity Head	0.07	ft
Specific Energy	0.26	ft
Froude Number	0.91	
Flow is subcritical.		

$A = 7.8$
$C = 0.25$

$Q_{100} = (.25)(9.2)(7.8)$

$Q_{100} = 17.9$ cfs

NET FLOW TO SPILLWAY: 17.9 cfs (100-yr)
−15.4 cfs (riser/barrel)

2.5 cfs NET

$T = \gamma d s$
$= (62.4)(.18)(.02)$

$T = 0.22$ lbs/ft²

USE GRASS-LINED CHANNEL, NO MATTING

Sed Basin 2 Emer Spillway - Q-100
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Sed Basin 1 Emer Spillway
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.020000	ft/ft
Left Side Slope	1.000000	H : V
Right Side Slope	1.000000	H : V
Bottom Width	6.00	ft
Discharge	3.30	cfs

Results		
Depth	0.22	ft
Flow Area	1.36	ft²
Wetted Perimeter	6.62	ft
Top Width	6.44	ft
Critical Depth	0.21	ft
Critical Slope	0.023166	ft/ft
Velocity	2.43	ft/s
Velocity Head	0.09	ft
Specific Energy	0.31	ft
Froude Number	0.94	
Flow is subcritical.		

A = 19.7
C = 0.2

$Q_{100} = (.2)(9.2)(19.7)$

$Q_{100} = 36.3$ cfs

NET FLOW TO SPILLWAY!
36.3 cfs (100-yr)
−33.0 cfs (riser-barre
3.3 cfs NET

$T = \gamma d s$
$= (62.4)(.22)(.02)$
$T = 0.27$ lbs/ft²

USE GRASS-LINED CHANNEL, NO MATTING

Section 5
Pipe & Outlet Protection Calculations

Notes:

1) All pipes sized for 25 year storm with t_c = 5 minutes
2) n = 0.024 for cmp pipe
3) See Appendix 1 for "I_{25}" chart.
4) See Appendix 2 for "C" table.
5) See Appendix 3 for Rational Formula.
6) See Appendix 4 for Shear Stress Table.
7) See Appendix 6 for Outlet Protection Chart..

Pipe P1 - Q-25
Worksheet for Circular Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Pipe P1
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 4.9
C = 0.2 wooded

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.019000	ft/ft
Diameter	36.00	in
Discharge	14.90	cfs

$Q_{25} = Q_{D1} + CIA$

$= 7.8 + (.2)(7.2)(4.9)$

Results		
Depth	1.13	ft
Flow Area	2.42	ft²
Wetted Perimeter	3.95	ft
Top Width	2.90	ft
Critical Depth	1.23	ft
Percent Full	37.50	
Critical Slope	0.013660	ft/ft
Velocity	6.15	ft/s
Velocity Head	0.59	ft
Specific Energy	1.71	ft
Froude Number	1.19	
Maximum Discharge	53.57	cfs
Full Flow Capacity	49.80	cfs
Full Flow Slope	0.001701	ft/ft
Flow is supercritical.		

$Q_{25} = 14.9$ cfs

PIPE HAS CAPACITY

RIPRAP OUTLET PROTECTION

FROM APPENDIX 6, FIG 8.06.3,

$d_{50} = 8''$, APRON L = 20'

$d_{max} = 12''$ WIDTH = 23'

APRON THICKNESS = 18"

Pipe P1 - Q-100
Worksheet for Circular Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Pipe P1
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 4.9
C = 0.2 wooded

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.019000	ft/ft
Diameter	36.00	in
Discharge	19.20	cfs

Results		
Depth	1.29	ft
Flow Area	2.91	ft²
Wetted Perimeter	4.30	ft
Top Width	2.97	ft
Critical Depth	1.40	ft
Percent Full	43.09	
Critical Slope	0.014154	ft/ft
Velocity	6.59	ft/s
Velocity Head	0.67	ft
Specific Energy	1.97	ft
Froude Number	1.17	
Maximum Discharge	53.57	cfs
Full Flow Capacity	49.80	cfs
Full Flow Slope	0.002825	ft/ft
Flow is supercritical.		

$Q_{100} = Q_{D1} + CIA$

$= 10.2 + (.2)(9.2)(4.9)$

$Q_{100} = 19.2$ cfs

PIPE HAS CAPACITY

Pipe P2 - Q-25
Worksheet for Circular Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Pipe P2
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.054000	ft/ft
Diameter	36.00	in
Discharge	21.10	cfs

Results		
Depth	1.03	ft
Flow Area	2.13	ft²
Wetted Perimeter	3.75	ft
Top Width	2.85	ft
Critical Depth	1.48	ft
Percent Full	34.17	
Critical Slope	0.014415	ft/ft
Velocity	9.89	ft/s
Velocity Head	1.52	ft
Specific Energy	2.54	ft
Froude Number	2.01	
Maximum Discharge	90.31	cfs
Full Flow Capacity	83.95	cfs
Full Flow Slope	0.003411	ft/ft
Flow is supercritical.		

$Q_{25} = Q_{D3} + Q_{D4}$

$= 20.7 + 0.4$

$Q_{25} = 21.1$ cfs

PIPE HAS CAPACITY

RIPRAP OUTLET PROTECTION

FROM APPENDIX 6, FIG. 8.06.3,

$d_{50} = 10''$, APRON $L = 24'$

$d_{MAX} = 15''$ WIDTH $= 27'$

APRON THICKNESS $= 23''$

Pipe P2 - Q-100
Worksheet for Circular Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Pipe P2
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.054000	ft/ft
Diameter	36.00	in
Discharge	27.20	cfs

Results		
Depth	1.17	ft
Flow Area	2.57	ft²
Wetted Perimeter	4.06	ft
Top Width	2.93	ft
Critical Depth	1.69	ft
Percent Full	39.15	
Critical Slope	0.015417	ft/ft
Velocity	10.60	ft/s
Velocity Head	1.75	ft
Specific Energy	2.92	ft
Froude Number	2.00	
Maximum Discharge	90.31	cfs
Full Flow Capacity	83.95	cfs
Full Flow Slope	0.005669	ft/ft
Flow is supercritical.		

$Q_{100} = Q_{D3} + Q_{D4}$

$= 26.6 + 0.6$

$Q_{100} = 27.2$ cfs

PIPE HAS CAPACITY

Pipe P3 - Q-25
Worksheet for Circular Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Pipe P3
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.011000	ft/ft
Diameter	24.00	in
Discharge	5.30	cfs

Results		
Depth	0.89	ft
Flow Area	1.36	ft²
Wetted Perimeter	2.93	ft
Top Width	1.99	ft
Critical Depth	0.81	ft
Percent Full	44.75	
Critical Slope	0.015605	ft/ft
Velocity	3.89	ft/s
Velocity Head	0.24	ft
Specific Energy	1.13	ft
Froude Number	0.83	
Maximum Discharge	13.82	cfs
Full Flow Capacity	12.85	cfs
Full Flow Slope	0.001871	ft/ft
Flow is subcritical.		

$Q_{25} = Q_{D5} + Q_{D6}$
$2.0 + 3.3$

$Q_{25} = 5.3$ cfs

PIPE HAS CAPACITY

RIPRAP OUTLET PROTECTION

FROM APPENDIX 6, FIG. 8.06.3,

$d_{50} = 6''$
$d_{MAX} = 9''$

APRON L = 14'
WIDTH = 16'

APRON THICKNESS = 14"

Pipe P3 - Q-100
Worksheet for Circular Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Pipe P3
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.011000	ft/ft
Diameter	24.00	in
Discharge	6.80	cfs

Results		
Depth	1.03	ft
Flow Area	1.64	ft²
Wetted Perimeter	3.21	ft
Top Width	2.00	ft
Critical Depth	0.92	ft
Percent Full	51.71	
Critical Slope	0.016134	ft/ft
Velocity	4.15	ft/s
Velocity Head	0.27	ft
Specific Energy	1.30	ft
Froude Number	0.81	
Maximum Discharge	13.82	cfs
Full Flow Capacity	12.85	cfs
Full Flow Slope	0.003080	ft/ft
Flow is subcritical.		

$Q_{100} = Q_{D5} + Q_{D6}$

$= 2.6 + 4.2$

$Q_{100} = 6.8$ cfs

PIPE HAS CAPACITY

Pipe P4 - Q-25
Worksheet for Circular Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Pipe P4
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 1.1 Ac
C = 0.4

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.074000	ft/ft
Diameter	24.00	in
Discharge	3.20	cfs

$Q_{25} = (.4)(7.2)(1.1)$

$Q_{25} = 3.2$ cfs

Results		
Depth	0.42	ft
Flow Area	0.48	ft²
Wetted Perimeter	1.90	ft
Top Width	1.63	ft
Critical Depth	0.62	ft
Percent Full	20.93	
Critical Slope	0.015192	ft/ft
Velocity	6.70	ft/s
Velocity Head	0.70	ft
Specific Energy	1.12	ft
Froude Number	2.18	
Maximum Discharge	35.86	cfs
Full Flow Capacity	33.33	cfs
Full Flow Slope	0.000682	ft/ft
Flow is supercritical.		

PIPE HAS CAPACITY.

USE A 30" CMP

RIPRAP OUTLET PROTECTION

FROM APPENDIX 6, FIG. 8.06.3,

$d_{50} = 6''$

$d_{max} = 9''$

APRON L = 14'

WIDTH = 16'

APRON THICKNESS = 14"

Pipe P4 - Q-100
Worksheet for Circular Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Pipe P4
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.074000	ft/ft
Diameter	24.00	in
Discharge	4.10	cfs

Results		
Depth	0.47	ft
Flow Area	0.57	ft²
Wetted Perimeter	2.03	ft
Top Width	1.70	ft
Critical Depth	0.71	ft
Percent Full	23.68	
Critical Slope	0.015308	ft/ft
Velocity	7.21	ft/s
Velocity Head	0.81	ft
Specific Energy	1.28	ft
Froude Number	2.20	
Maximum Discharge	35.86	cfs
Full Flow Capacity	33.33	cfs
Full Flow Slope	0.001120	ft/ft
Flow is supercritical.		

A = 1.1

C = 0.4

$Q_{100} = (.4)(9.2)(1.1)$

$Q_{100} = 4.1$ cfs

PIPE HAS CAPACITY

USE A 30" CMP

Pipe P5 - Q-25
Worksheet for Circular Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Pipe P5
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.222000	ft/ft
Diameter	24.00	in
Discharge	0.91	cfs

A = 0.42 Ac
C = 0.3

Results		
Depth	0.18	ft
Flow Area	0.13	ft²
Wetted Perimeter	1.20	ft
Top Width	1.13	ft
Critical Depth	0.33	ft
Percent Full	8.75	
Critical Slope	0.016116	ft/ft
Velocity	6.77	ft/s
Velocity Head	0.71	ft
Specific Energy	0.89	ft
Froude Number	3.46	
Maximum Discharge	62.10	cfs
Full Flow Capacity	57.73	cfs
Full Flow Slope	0.000055	ft/ft
Flow is supercritical.		

$Q_{25} = (.3)(7.2)(0.42)$

$Q_{25} = 0.91$ cfs

PIPE HAS CAPACITY

RIPRAP OUTLET PROTECTION

FROM APPENDIX 6, FIG. 8.06.3,

$d_{50} = 6''$

$d_{max} = 9''$

APRON L = 14'

WIDTH = 16'

APRON THICKNESS = 14"

Pipe P5 - Q-100
Worksheet for Circular Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Pipe P5
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.222000	ft/ft
Diameter	24.00	in
Discharge	1.20	cfs

Results		
Depth	0.20	ft
Flow Area	0.16	ft²
Wetted Perimeter	1.29	ft
Top Width	1.20	ft
Critical Depth	0.38	ft
Percent Full	9.98	
Critical Slope	0.015755	ft/ft
Velocity	7.36	ft/s
Velocity Head	0.84	ft
Specific Energy	1.04	ft
Froude Number	3.52	
Maximum Discharge	62.10	cfs
Full Flow Capacity	57.73	cfs
Full Flow Slope	0.000096	ft/ft
Flow is supercritical.		

$A = 0.42$ Ac

$C = 0.3$

$Q_{100} = (.3)(9.2)(0.42)$

$Q_{100} = 1.2$ cfs

PIPE HAS CAPACITY

Pipe P6 - Q-25
Worksheet for Circular Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Pipe P6
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.201000	ft/ft
Diameter	24.00	in
Discharge	1.50	cfs

A = 0.68 Ac
C = 0.3

Results		
Depth	0.23	ft
Flow Area	0.20	ft²
Wetted Perimeter	1.38	ft
Top Width	1.27	ft
Critical Depth	0.42	ft
Percent Full	11.37	
Critical Slope	0.015518	ft/ft
Velocity	7.60	ft/s
Velocity Head	0.90	ft
Specific Energy	1.13	ft
Froude Number	3.40	
Maximum Discharge	59.09	cfs
Full Flow Capacity	54.93	cfs
Full Flow Slope	0.000150	ft/ft
Flow is supercritical.		

$Q_{25} = (.3)(7.2)(0.68)$

$Q_{25} = 1.5$ cfs

PIPE HAS CAPACITY

RIPRAP OUTLET PROTECTION

FROM APPENDIX 6, FIG. 8.06.3,

$d_{50} = 6''$

$d_{max} = 9''$

APRON LF 14'

WIDTH = 16'

APRON THICKNESS = 14''

Pipe P6 - Q-100
Worksheet for Circular Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Pipe P6
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.201000	ft/ft
Diameter	24.00	in
Discharge	1.90	cfs

$A = 0.68 Ac$

$C = 0.3$

Results		
Depth	0.25	ft
Flow Area	0.23	ft²
Wetted Perimeter	1.46	ft
Top Width	1.33	ft
Critical Depth	0.48	ft
Percent Full	12.73	
Critical Slope	0.015329	ft/ft
Velocity	8.16	ft/s
Velocity Head	1.04	ft
Specific Energy	1.29	ft
Froude Number	3.44	
Maximum Discharge	59.09	cfs
Full Flow Capacity	54.93	cfs
Full Flow Slope	0.000240	ft/ft
Flow is supercritical.		

$Q_{100} = (.3)(9.2)(0.68)$

$Q_{100} = 1.9 \text{ cfs}$

PIPE HAS CAPACITY

Section 6
Ditch & Shear Stress Calculations

Notes:

1) All ditches sized for 25 year storm with t_c = 5 minutes
2) See Appendix 1 for "I_{25}" chart.
3) See Appendix 2 for "C" table.
4) See Appendix 3 for Rational Formula.
5) See Appendix 4 for Shear Stress Table.
6) See Appendix 5 for Vegetated Channels Velocities
7) See Appendix 7 for North American Green Erosion Control Matting

Ditch D1, Q-25
Worksheet for Trapezoidal Channel

$T_c = 5$ mins
$I_{25} = 7.2$ IN/HR
TYPICAL FOR ALL
25-YEAR FLOW CASES

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.057000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	7.80	cfs

$A = 5.4$ AC (wooded)
$C = 0.2$

$Q_{25} = CIA$
$= (0.2)(7.2)(5.4)$

$Q_{25} = 7.8$ cfs

Results		
Depth	0.38	ft
Flow Area	1.45	ft²
Wetted Perimeter	4.72	ft
Top Width	4.54	ft
Critical Depth	0.53	ft
Critical Slope	0.018698	ft/ft
Velocity	5.38	ft/s
Velocity Head	0.45	ft
Specific Energy	0.83	ft
Froude Number	1.68	
Flow is supercritical.		

DITCH HAS CAPACITY

$T = \gamma d s$
$= (62.4)(0.38)(0.057)$

$T = 1.35$ lbs/ft²

USE GRASS LINED CHANNEL W/ N.A.G. S150
E.C. MATTING

Ditch D1, Q-100
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

$T_c = 5$ mins

$I_{100} = 9.2$ IN/HR

TYPICAL FOR ALL 100-YEAR STORM CALCS

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.057000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	10.20	cfs

$Q_{100} = (.2)(9.2)(5.4)$

Results		
Depth	0.45	ft
Flow Area	1.74	ft²
Wetted Perimeter	5.00	ft
Top Width	4.79	ft
Critical Depth	0.62	ft
Critical Slope	0.017988	ft/ft
Velocity	5.85	ft/s
Velocity Head	0.53	ft
Specific Energy	0.98	ft
Froude Number	1.71	
Flow is supercritical.		

$Q_{100} = 10.2$ cfs

DITCH WILL CARRY 100-YEAR STORM

$T = \gamma d s$
$= (62.4)(0.45)(0.057)$

$T = 1.60$ lbs/ft²

Ditch D1A - Q-25
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D1A
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.150000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	7.80	cfs

Results		
Depth	0.34	ft
Flow Area	1.27	ft^2
Wetted Perimeter	4.54	ft
Top Width	4.38	ft
Critical Depth	0.53	ft
Critical Slope	0.033239	ft/ft
Velocity	6.15	ft/s
Velocity Head	0.59	ft
Specific Energy	0.93	ft
Froude Number	2.01	
Flow is supercritical.		

FROM DITCH D1,
$Q_{25} = 7.8$ cfs

DITCH HAS CAPACITY

$\tau = \gamma d s$
$= (62.4)(.34)(.15)$

$\tau = 3.2$ lbs/ft^2

USE CL 2 RIPRAP DITCH W/ FILTER FABRIC

Ditch D1A - Q-100
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D1A
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.150000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	10.20	cfs

Results		
Depth	0.40	ft
Flow Area	1.52	ft²
Wetted Perimeter	4.79	ft
Top Width	4.60	ft
Critical Depth	0.62	ft
Critical Slope	0.031980	ft/ft
Velocity	6.70	ft/s
Velocity Head	0.70	ft
Specific Energy	1.10	ft
Froude Number	2.05	
Flow is supercritical.		

FROM DITCH D1

$Q_{100} = 10.2$ cfs

DITCH HAS CAPACITY

$\tau = \gamma d S$

$= (62.4)(.4)(.15)$

$\tau = 3.7$ lbs/ft²

Ditch D2 - Q-25
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D2
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 1.9 Ac
C = 0.3 (GRASSED)

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.057000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	4.10	cfs

$Q_{25} = (.3)(7.2)(1.9)$

$Q_{25} = 4.1 \text{ cfs}$

Results		
Depth	0.27	ft
Flow Area	0.94	ft²
Wetted Perimeter	4.19	ft
Top Width	4.06	ft
Critical Depth	0.36	ft
Critical Slope	0.020617	ft/ft
Velocity	4.36	ft/s
Velocity Head	0.30	ft
Specific Energy	0.56	ft
Froude Number	1.60	
Flow is supercritical.		

DITCH HAS CAPACITY

T = yds
$= (62.4)(0.27)(0.057)$

$T = 0.96 \text{ lbs/ft}^2$

USE GRASS-LINED DITCH W/ EC MATTING

Ditch D2 - Q-100
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D2
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 1.9
C = 0.3

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.057000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	5.20	cfs

$Q_{100} = (.3)(9.2)(1.9)$

Results		
Depth	0.31	ft
Flow Area	1.10	ft²
Wetted Perimeter	4.36	ft
Top Width	4.22	ft
Critical Depth	0.41	ft
Critical Slope	0.019867	ft/ft
Velocity	4.72	ft/s
Velocity Head	0.35	ft
Specific Energy	0.65	ft
Froude Number	1.63	
Flow is supercritical.		

$Q_{100} = 5.2$ cfs

DITCH HAS CAPACITY

$T = \gamma d s$

$= (62.4)(0.31)(0.057)$

$T = 1.1$ lbs/ft²

Ditch D3 - Q-25
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D3
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 0.8 Ac
C = 0.3 (GRASSED)

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.108000	ft/ft
Left Side Slope	2.500000	H : V
Right Side Slope	2.500000	H : V
Bottom Width	6.00	ft
Discharge	20.70	cfs

(SEE PIPE CALCS FOR FLOW TO P1)

$Q_{25} = Q_{P1} + Q_{D2} + CIA$

$= 14.9 + 4.1 + (.3)(7.2)(0.8)$

$Q_{25} = 20.7$ cfs

Results		
Depth	0.45	ft
Flow Area	3.22	ft²
Wetted Perimeter	8.43	ft
Top Width	8.26	ft
Critical Depth	0.65	ft
Critical Slope	0.029717	ft/ft
Velocity	6.43	ft/s
Velocity Head	0.64	ft
Specific Energy	1.09	ft
Froude Number	1.81	
Flow is supercritical.		

DITCH HAS CAPACITY

$T = \gamma d s$

$= (62.4)(0.45)(0.108)$

$T = 3.0$ lbs/ft²

USE CL 2 RIPRAP DITCH W/FILTER FABRIC

Ditch D3 - Q-100
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D3
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 0.8
C = 0.3

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.108000	ft/ft
Left Side Slope	2.500000	H : V
Right Side Slope	2.500000	H : V
Bottom Width	6.00	ft
Discharge	26.60	cfs

$Q_{100} = Q_{P1} + Q_{D2} + CIA$

$= 19.2 + 5.2 + (.3)(9.2)(0.8)$

$Q_{100} = 26.6$ cfs

Results		
Depth	0.52	ft
Flow Area	3.81	ft²
Wetted Perimeter	8.81	ft
Top Width	8.61	ft
Critical Depth	0.76	ft
Critical Slope	0.028559	ft/ft
Velocity	6.98	ft/s
Velocity Head	0.76	ft
Specific Energy	1.28	ft
Froude Number	1.85	
Flow is supercritical.		

DITCH HAS CAPACITY

$T = \gamma d s$

$= (62.4)(0.52)(0.108)$

$T = 3.5$ lbs/ft²

Ditch D4 - Q-25
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D4
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 0.2 Ac
C = 0.3 (GRASSED)

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.061000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	1.00	ft
Discharge	0.40	cfs

$Q_{25} = (.3)(7.2)(0.2)$

$Q_{25} = 0.4$ cfs

Results		
Depth	0.12	ft
Flow Area	0.15	ft²
Wetted Perimeter	1.55	ft
Top Width	1.49	ft
Critical Depth	0.15	ft
Critical Slope	0.027879	ft/ft
Velocity	2.61	ft/s
Velocity Head	0.11	ft
Specific Energy	0.23	ft
Froude Number	1.44	
Flow is supercritical.		

DITCH HAS CAPACITY

$T = y d s$
$= (62.4)(0.12)(0.061)$

$T = 0.46$ lbs/ft²

USE GRASS-LINED DITCH W/ EC MATTING

Ditch D4 - Q-100
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D4
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 0.2
C = 0.3

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.061000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	1.00	ft
Discharge	0.60	cfs

$Q_{100} = CIA = (.3)(9.2)(0.2)$

Results		
Depth	0.15	ft
Flow Area	0.20	ft²
Wetted Perimeter	1.69	ft
Top Width	1.62	ft
Critical Depth	0.20	ft
Critical Slope	0.026267	ft/ft
Velocity	2.97	ft/s
Velocity Head	0.14	ft
Specific Energy	0.29	ft
Froude Number	1.48	
Flow is supercritical.		

$Q_{100} = 0.6$ cfs

DITCH HAS CAPACITY

$T = \gamma d s$

$= (62.4)(0.15)(0.061)$

$T = 0.57$ lbs/ft²

Ditch D-5 - Q-25
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D5
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 1.4 Ac
C = 0.2 wooded

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.043000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	2.00	cfs

$Q_{25} = (.2)(7.2)(1.4)$

Results		
Depth	0.19	ft
Flow Area	0.64	ft²
Wetted Perimeter	3.85	ft
Top Width	3.76	ft
Critical Depth	0.23	ft
Critical Slope	0.023209	ft/ft
Velocity	3.11	ft/s
Velocity Head	0.15	ft
Specific Energy	0.34	ft
Froude Number	1.33	
Flow is supercritical.		

$Q_{25} = 2.0$ cfs

DITCH HAS CAPACITY

$T = \gamma d s$

$= (62.4)(0.19)(0.043)$

$T = 0.51$ lbs/ft²

USE GRASS-LINED DITCH W/ EC MATTING

Ditch D-5 - Q-100
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D5
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

$A = 1.4 A_o$

$C = 0.2$

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.043000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	2.60	cfs

$Q_{100} = (.2)(9.2)(1.4)$

Results		
Depth	0.22	ft
Flow Area	0.76	ft²
Wetted Perimeter	3.99	ft
Top Width	3.89	ft
Critical Depth	0.27	ft
Critical Slope	0.022198	ft/ft
Velocity	3.41	ft/s
Velocity Head	0.18	ft
Specific Energy	0.40	ft
Froude Number	1.36	
Flow is supercritical.		

$Q_{100} = 2.6$ cfs

DITCH HAS CAPACITY

$T = \gamma d s$

$= (62.4)(0.22)(0.043)$

$T = 0.59$ lb/ft²

Ditch D6 - Q-25
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D6
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 2.3 Ac
C = 0.2 (wooded)

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.111000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	3.30	cfs

$Q_{25} = (.2)(7.2)(2.3)$

$Q_{25} = 3.3$ cfs

Results		
Depth	0.19	ft
Flow Area	0.65	ft²
Wetted Perimeter	3.86	ft
Top Width	3.77	ft
Critical Depth	0.31	ft
Critical Slope	0.021346	ft/ft
Velocity	5.05	ft/s
Velocity Head	0.40	ft
Specific Energy	0.59	ft
Froude Number	2.14	
Flow is supercritical.		

DITCH HAS CAPACITY

$T = \gamma d s$
$= (62.4)(0.19)(0.111)$

$T = 1.3$ lbs/ft²

USE GRASS-LINED DITCH W/ EC MATTING

Ditch D6 - Q-100
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D6
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.111000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	4.20	cfs

A = 2.3 ac

C = 0.2

Results		
Depth	0.22	ft
Flow Area	0.77	ft²
Wetted Perimeter	3.99	ft
Top Width	3.89	ft
Critical Depth	0.36	ft
Critical Slope	0.020537	ft/ft
Velocity	5.49	ft/s
Velocity Head	0.47	ft
Specific Energy	0.69	ft
Froude Number	2.18	
Flow is supercritical.		

$Q_{100} = (.2)(9.2)(2.3)$

$Q_{100} = 3.3$ cfs

DITCH HAS CAPACITY

$T = \gamma d s$

$= (62.4)(0.22)(0.111)$

$T = 1.5$ lbs/ft²

Ditch D7 - Q-25
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D7
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.050000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	6.20	cfs

Results		
Depth	0.35	ft
Flow Area	1.30	ft²
Wetted Perimeter	4.57	ft
Top Width	4.40	ft
Critical Depth	0.46	ft
Critical Slope	0.019344	ft/ft
Velocity	4.78	ft/s
Velocity Head	0.36	ft
Specific Energy	0.71	ft
Froude Number	1.55	
Flow is supercritical.		

$A = 0.4\ Ac$

$c = 0.3$ (grassed)

$Q_{25} = (.3)(7.2)(0.4) + Q_{P3}$

$Q_{25} = 0.86 + 5.3$

$Q_{25} = 6.2$ cfs

DITCH HAS CAPACITY

$T = \gamma d s$

$= (62.4)(0.35)(0.05)$

$T = 1.1\ lbs/ft^2$

USE GRASS-LINED DITCH W/ EC MATTING

Ditch D7 - Q-100
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D7
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 0.4
C = 0.3

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.050000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	7.90	cfs

$Q_{100} = (.3)(9.2)(0.4) + Q_{P1}$ (6.8 cfs)

$Q_{100} = 7.9$ cfs

Results		
Depth	0.40	ft
Flow Area	1.53	ft²
Wetted Perimeter	4.80	ft
Top Width	4.61	ft
Critical Depth	0.53	ft
Critical Slope	0.018664	ft/ft
Velocity	5.17	ft/s
Velocity Head	0.41	ft
Specific Energy	0.82	ft
Froude Number	1.58	
Flow is supercritical.		

DITCH HAS CAPACITY

$T = \gamma d s$
$= (62.4)(0.40)(0.05)$

$T = 1.2$ lbs/ft²

Ditch D8 - Q-25
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D8
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 0.8 Ac
c = 0.3 grassed

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.061000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	1.70	cfs

$Q_{25} = (.3)(7.2)(0.8)$

$Q_{25} = 1.7$ cfs

Results		
Depth	0.20	ft
Flow Area	0.47	ft²
Wetted Perimeter	2.87	ft
Top Width	2.78	ft
Critical Depth	0.26	ft
Critical Slope	0.023112	ft/ft
Velocity	3.64	ft/s
Velocity Head	0.21	ft
Specific Energy	0.40	ft
Froude Number	1.57	
Flow is supercritical.		

DITCH HAS CAPACITY

$\tau = \gamma d s$

$= (62.4)(0.20)(0.061)$

$\tau = 0.76$ lbs/ft²

USE GRASS-LINED DITCH W/ EC MATTING

Ditch D8 - Q-100
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D8
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 0.8

C = 0.3

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.061000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	2.00	ft
Discharge	2.20	cfs

$Q_{100} = (.3)(9.2)(0.8)$

Results		
Depth	0.23	ft
Flow Area	0.56	ft²
Wetted Perimeter	3.01	ft
Top Width	2.91	ft
Critical Depth	0.30	ft
Critical Slope	0.022219	ft/ft
Velocity	3.96	ft/s
Velocity Head	0.24	ft
Specific Energy	0.47	ft
Froude Number	1.60	
Flow is supercritical.		

$Q_{100} = 2.2$ cfs

DITCH HAS CAPACITY

$T = \gamma d s$

$= (62.4)(.23)(.061)$

$T = 0.88$ lbs/ft²

Ditch D9A - Q-25
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D9A
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.150000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	4.30	cfs

A = 2.0 Ac
C = 0.3 grassed

Results		
Depth	0.24	ft
Flow Area	0.85	ft²
Wetted Perimeter	4.09	ft
Top Width	3.98	ft
Critical Depth	0.37	ft
Critical Slope	0.036376	ft/ft
Velocity	5.05	ft/s
Velocity Head	0.40	ft
Specific Energy	0.64	ft
Froude Number	1.92	
Flow is supercritical.		

$Q_{25} = (.3)(7.2)(2.0)$

$Q_{25} = 4.3$ cfs

DITCH HAS CAPACITY

T = yds
$= (62.4)(0.24)(0.15)$

$T = 2.2$ lbs/ft²

USE CL 2 RIPRAP W/ FILTER FABRIC

Ditch D9A - Q-100
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D9A
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.150000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	5.50	cfs

A = 2.0
C = 0.3

Results		
Depth	0.28	ft
Flow Area	1.00	ft²
Wetted Perimeter	4.26	ft
Top Width	4.13	ft
Critical Depth	0.43	ft
Critical Slope	0.035020	ft/ft
Velocity	5.49	ft/s
Velocity Head	0.47	ft
Specific Energy	0.75	ft
Froude Number	1.96	
Flow is supercritical.		

$Q_{100} = (.3)(9.2)(2.0)$

$Q_{100} = 5.5$ cfs

DITCH HAS CAPACITY

T = γds
= (62.4)(0.28)(0.15)

T = 2.6 lbs/ft²

Ditch D9B - Q-25
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D9A
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

A = 0.5
C = 0.3

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.150000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	5.40	cfs

$Q_{100} = (.3)(9.2)(2.0) + Q_{9A}$ (4.3 cfs)

Results		
Depth	0.28	ft
Flow Area	0.99	ft²
Wetted Perimeter	4.25	ft
Top Width	4.11	ft
Critical Depth	0.42	ft
Critical Slope	0.035118	ft/ft
Velocity	5.45	ft/s
Velocity Head	0.46	ft
Specific Energy	0.74	ft
Froude Number	1.96	
Flow is supercritical.		

$Q_{100} = 6.9$ cfs

DITCH HAS CAPACITY

T = γ ds
= (62.4)(0.28)(0.15)

T = 2.6 lbs/ft²

USE CL 2 RIPRAP W/ FILTER FABRIC

Ditch D9B - Q-100
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\acad-data\haestad\fmw\mad-cd.fm2
Worksheet	Ditch D9A
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	0.150000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	3.00	ft
Discharge	6.90	cfs

Results		
Depth	0.32	ft
Flow Area	1.17	ft²
Wetted Perimeter	4.43	ft
Top Width	4.28	ft
Critical Depth	0.49	ft
Critical Slope	0.033844	ft/ft
Velocity	5.91	ft/s
Velocity Head	0.54	ft
Specific Energy	0.86	ft
Froude Number	2.00	
Flow is supercritical.		

A = 0.5 Ac

C = 0.3 grassed

$Q_{100} = (.3)(9.2)(0.5) + Q_{D9A}$ (5.5 cfs)

$Q_{100} = 6.9$ cfs

DITCH HAS CAPACITY

T = yds

$= (62.4)(0.32)(0.15)$

$T = 3.0$ lbs/ft²

Section 7
Appendices

APPENDIX 1

Q_{100} 9.2

Q_{25} – 7.2

T_c = 5 mins

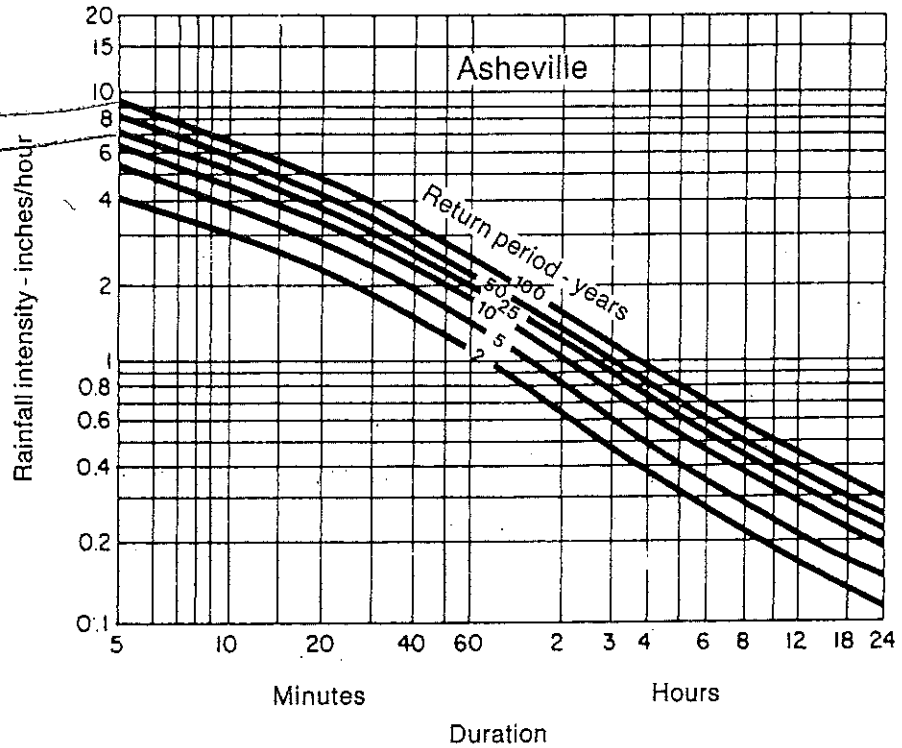


Figure 8.03f Rainfall intensity duration curves—Asheville.

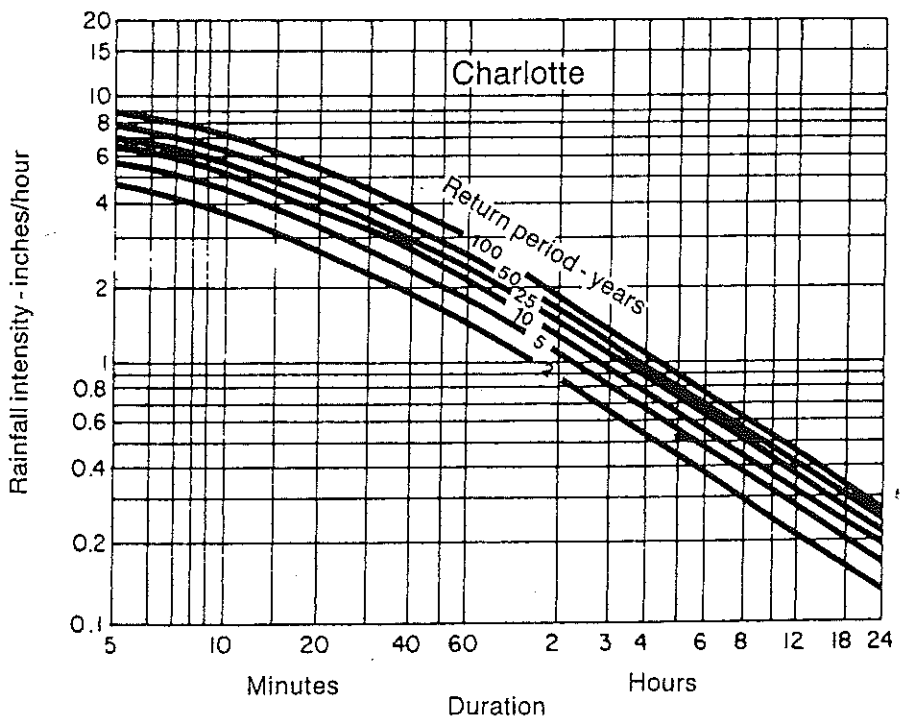


Figure 8.03g Rainfall intensity duration curves—Charlotte.

APPENDIX 2

Table 8.03a
Value of Runoff Coefficient (C) for Rational Formula

Land Use	C
Business:	
Downtown areas	0.70-0.95
Neighborhood areas	0.50-0.70
Residential:	
Single-family areas	0.30-0.50
Multi units, detached	0.40-0.60
Multi units, attached	0.60-0.75
Suburban	0.25-0.40
Industrial:	
Light areas	0.50-0.80
Heavy areas	0.60-0.90
Parks, cemeteries	0.10-0.25
Playgrounds	0.20-0.35
Railroad yard areas	0.20-0.40
Unimproved areas	0.10-0.30
Streets:	
Asphalt	0.70-0.95
Concrete	0.80-0.95
Brick	0.70-0.85
Drives and walks	0.75-0.85
Roofs	0.75-0.85

Land Use	C
Lawns:	
Sandy soil, flat, 2%	0.05-0.10
Sandy soil, ave., 2-7%	0.10-0.15
Sandy soil, steep, 7%	0.15-0.20
Heavy soil, flat, 2%	0.13-0.17
Heavy soil, ave., 2-7%	0.18-0.22
Heavy soil, steep, 7%	0.25-0.35
Agricultural land:	
Bare packed soil	
Smooth	0.30-0.60
Rough	0.20-0.50
Cultivated rows	
Heavy soil no crop	0.30-0.60
Heavy soil with crop	0.20-0.50
Sandy soil no crop	0.20-0.40
Sandy soil with crop	0.10-0.25
Pasture	
Heavy soil	0.15-0.45 USE 0.3
Sandy soil	0.05-0.25
Woodlands	0.05-0.25 USE 0.2

NOTE: The designer must use judgment to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

The overland flow portion of flow time may be determined from Figure 8.03a. The flow time (in minutes) in the channel can be estimated by calculating the average velocity in feet per minute and dividing the length (in feet) by the average velocity.

Step 4. Determine the rainfall intensity, frequency, and duration (Figures 8.03b through 8.03g—source: North Carolina State Highway Commission; Jan. 1973). Select the chart for the locality closest to your location. Enter the "duration" axis of the chart with the calculated time of concentration, T_C. Move vertically until you intersect the curve of the appropriate design storm, then move horizontally to read the rainfall intensity factor, i, in inches per hour.

Step 5. Determine peak discharge, Q (ft^3/sec), by multiplying the previously determined factors using the rational formula (Sample Problem 8.03a).

APPENDIX 3

8.03

ESTIMATING RUNOFF

Estimating peak rate of runoff, volume of runoff, and soil loss are basic to the design of erosion and sedimentation control facilities.

There are many methods of determining runoff. Two acceptable methods, the rational method and the Soil Conservation Service (SCS) peak discharge method, are described in this section.

The rational method is very simple in concept but relies on considerable judgment and experience to evaluate all factors properly. It is used primarily for small drainage areas (less than 50 acres). The SCS method is more sophisticated hydrologically and offers a more accurate approximation of runoff, particularly for areas larger than 20 acres. Choice of method for small areas depends primarily on the experience of the designer.

Rational Method

The rational formula is:

$$Q = CiA$$

where:

- Q = peak rate of runoff in cubic feet per second (cfs).
- C = runoff coefficient, an empirical coefficient representing the relationship between rainfall rate and runoff rate.
- i = average intensity of rainfall in inches/hour, for a storm duration equal to the time of concentration, Tc.
- Tc = time of concentration, in minutes; the estimated time for runoff to flow from the most remote part of the watershed to the point under consideration. It consists of the total time for overland sheet flow and concentrated flow (channel and/or pipe flow).
- A = drainage area in acres.

The general procedure for determining peak discharge using the rational formula is presented below and illustrated in Sample Problem 8.03a.

Step 1. Determine the drainage area in acres.

Step 2. Determine the runoff coefficient, C, for the type of soil/cover in the drainage area (Table 8.03a).

If the land use and soil cover is homogenous over the drainage area, a C value can be determined directly from Table 8.03a. If there are multiple soil cover conditions, a weighted average must be calculated, or the area may be subdivided.

Step 3. Determine the time of concentration, Tc, for the drainage area (i.e., the time of flow from the most remote point in the basin to the design point, in minutes).

Table 8.05g
Permissible Shear Stresses for Riprap and Temporary Liners

Lining Category	Permissible Unit Shear Stress, T_d Lining Type	(lb/ft^2)
Temporary	Woven Paper Net	0.15
	Jute Net	0.45
	Fiberglass Roving:	
	Single	0.60
	Double	0.85
	Straw with Net	1.45
	Curled Wood mat	1.55
	Synthetic Mat	2.00
	d_{50} **Stone Size** (inches)	
Gravel Riprap	1	0.33
	2	0.67
Rock Riprap	6	2.00
	9	3.00
	12	4.00
	15	5.00
	18	6.00
	21	7.80
	24	8.00

Adapted From: FHWA, HEC-15, April 1983, pgs. 17 & 37.

Design Procedure-Temporary Liners

The following is a step-by-step procedure for designing a temporary liner for a channel. Because temporary liners have a short period of service, the design Q may be reduced. For liners that are needed for six months or less, the 2-yr frequency storm is recommended.

Step 1. Select a liner material suitable for site conditions and application. Determine roughness coefficient from manufacturer's specifications or Table 8.05e, pg. 8.05.10.

Step 2. Calculate the normal flow depth using Manning's equation (Figure 8.05d). Check to see that depth is consistent with that assumed for selection of Manning's *n* in Figure 8.05d, pg. 8.05.11. For smaller runoffs Figure 8.05d is not as clearly defined. Recommended solutions can be determined by using the Manning equation.

Step 3. Calculate shear stress at normal depth.

Step 4. Compare computed shear stress with the permissible shear stress for the liner.

Step 5. If computed shear is greater than permissible shear, adjust channel dimensions to reduce shear or select a more resistant lining and repeat steps 1 through 4.

Design of a channel with temporary lining is illustrated in Sample Problem 8.05b, pg. 8.05.14.

APPENDIX 5

Table 8.05a
Maximum Allowable Design Velocities[1]
for Vegetated Channels

Typical Channel Slope Application	Soil Characteristics[2]	Grass Lining	Permissible Velocity[3] for Established Grass Lining (ft/sec)
0-5%	Easily Erodible Non-plastic (Sands & Silts)	Bermudagrass	5.0
		Tall fescue	4.5
		Bahiagrass	4.5
		Kentucky bluegrass	4.5
		Grass-legume mixture	3.5
	Erosion Resistant Plastic (Clay mixes)	Bermudagrass	6.0
		Tall fescue	5.5
		Bahiagrass	5.5
		Kentucky bluegrass	5.5
		Grass-legume mixture	4.5
5-10%	Easily Erodible Non-plastic (Sands & Silts)	Bermudagrass	4.5
		Tall fescue	4.0
		Bahiagrass	4.0
		Kentucky bluegrass	4.0
		Grass-legume mixture	3.0
	Erosion Resistant Plastic (Clay Mixes)	Bermudagrass	5.5
		Tall fescue	5.0
		Bahiagrass	5.0
		Kentucky bluegrass	5.0
		Grass-legume mixture	3.5
>10%	Easily Erodible Non-plastic (Sands & Silts)	Bermudagrass	3.5
		Tall fescue	2.5
		Bahiagrass	2.5
		Kentucky bluegrass	2.5
	Erosion Resistant Plastic (Clay Mixes)	Bermudagrass	4.5
		Tall fescue	3.5
		Bahiagrass	3.5
		Kentucky bluegrass	3.5

Source: USDA-SCS Modified

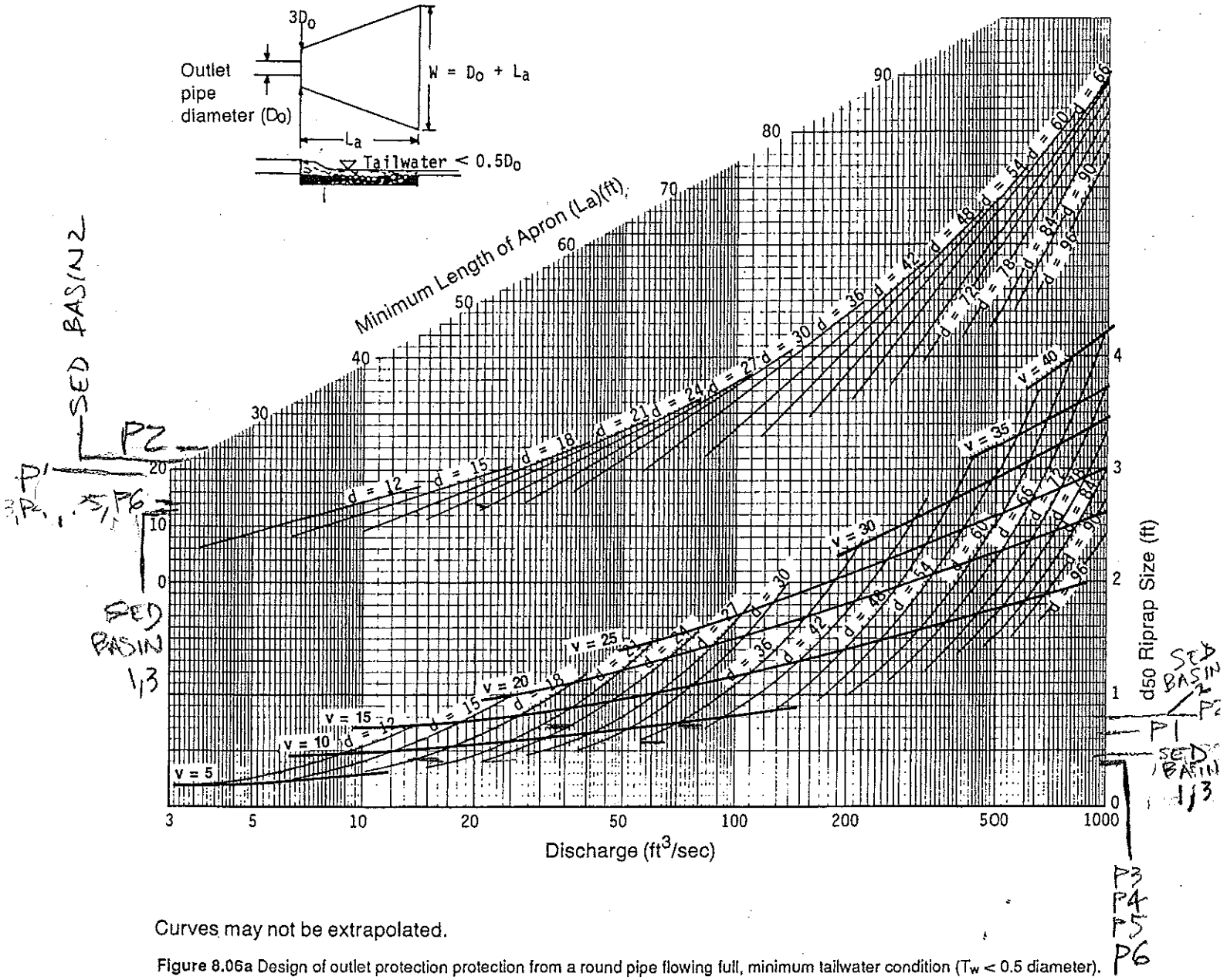
NOTE: [1]Permissible Velocity based on 10-yr storm peak runoff
[2]Soil erodibility based on resistance to soil movement from concentrated flowing water.
[3]Before grass is established, permissible velocity is determined by the type of temporary liner used.

Selecting Channel Cross-Section Geometry

To calculate the required size of an open channel, assume the design flow is uniform and does not vary with time. Since actual flow conditions change throughout the length of a channel, subdivide the channel into design reaches, and design each reach to carry the appropriate capacity.

The three most commonly used channel cross-sections are "V"-shaped, parabolic, and trapezoidal. Figure 8.05b gives mathematical formulas for the area, hydraulic radius and top width of each of these shapes.

APPENDIX 6



Curves may not be extrapolated.

Figure 8.06a Design of outlet protection protection from a round pipe flowing full, minimum tailwater condition (T_w < 0.5 diameter).

APPENDIX 7

Site Search
GO
Home
Products
Design Software
Installation
NPDES
Research & Development
Resources
Guarantee
Distributor Locator
ZIP/Postal Code
GO
Erosion Control Specialists
About the Company
Contact
Site Map
Media
Distributor Login

PRODUCTS

Application Guide

Standard Erosion Control Blankets

Product	Product Description	Longevity	Applications	Permissible Shear Stress lbs./sq. ft. (Pascal)	Max. Flow Velocity feet/sec. (meters/sec.)	Typical Projects
S75	Single Net Straw Blanket	12 months	4:1 - 3:1 Slopes Low Flow Channels	Bare Soil/1.55 (74)	5 (1.52)	Highways; Mines; Pipeline; Woodlands; Golf Courses; Residential Lawns; Wetland Mitigation; Bioengineering
DS75	Rapid Degrading Net	45 - 60 Days				
S150	Double Net Straw Blanket	12 months	3:1 - 2:1 Slopes Moderate Flow Channels	Bare Soil/1.75 (84)	6 (1.83)	
DS150	Rapid Degrading Nets	45 - 60 Days				
SC150	Double Net Blanket 70% Straw/30% Coconut	24 months	2:1 - 1:1 Slopes Medium Flow Channels	Bare Soil/2.00 (96)	8 (2.44)	Steeper Slopes; Landfills
C125	Double Net Blanket 100% Coconut	36 months	1:1 & Greater Slopes High Flow Channels	Bare Soil/2.25 (108)	10 (3.05)	Landfill Caps; Drainage Ditches

Product	Product Description	Applications	Limiting Shear Stress lbs./sq. ft. (Pascal) Bare Soil 0.5 hrs	Bare Soil 50 hrs	Vegetated 0.5 hrs	Vegetated 50 hrs	Permissible Velocity FPS (MPS) Unveg.	Permissible Velocity FPS (MPS) Veg.	Typical Projects
P300	Double Net Blanket Polypropylene Fiber	1:1 Slopes Extended Flow Areas High Flow Channels	3.0 (144)	2.0 (96)	8.0 (384)	8.0 (384)	9 (2.7)	16 (4.9)	Roadside Ditches; Shoreline Protection; Severe Slopes

Biodegradeable Erosion Control Blankets

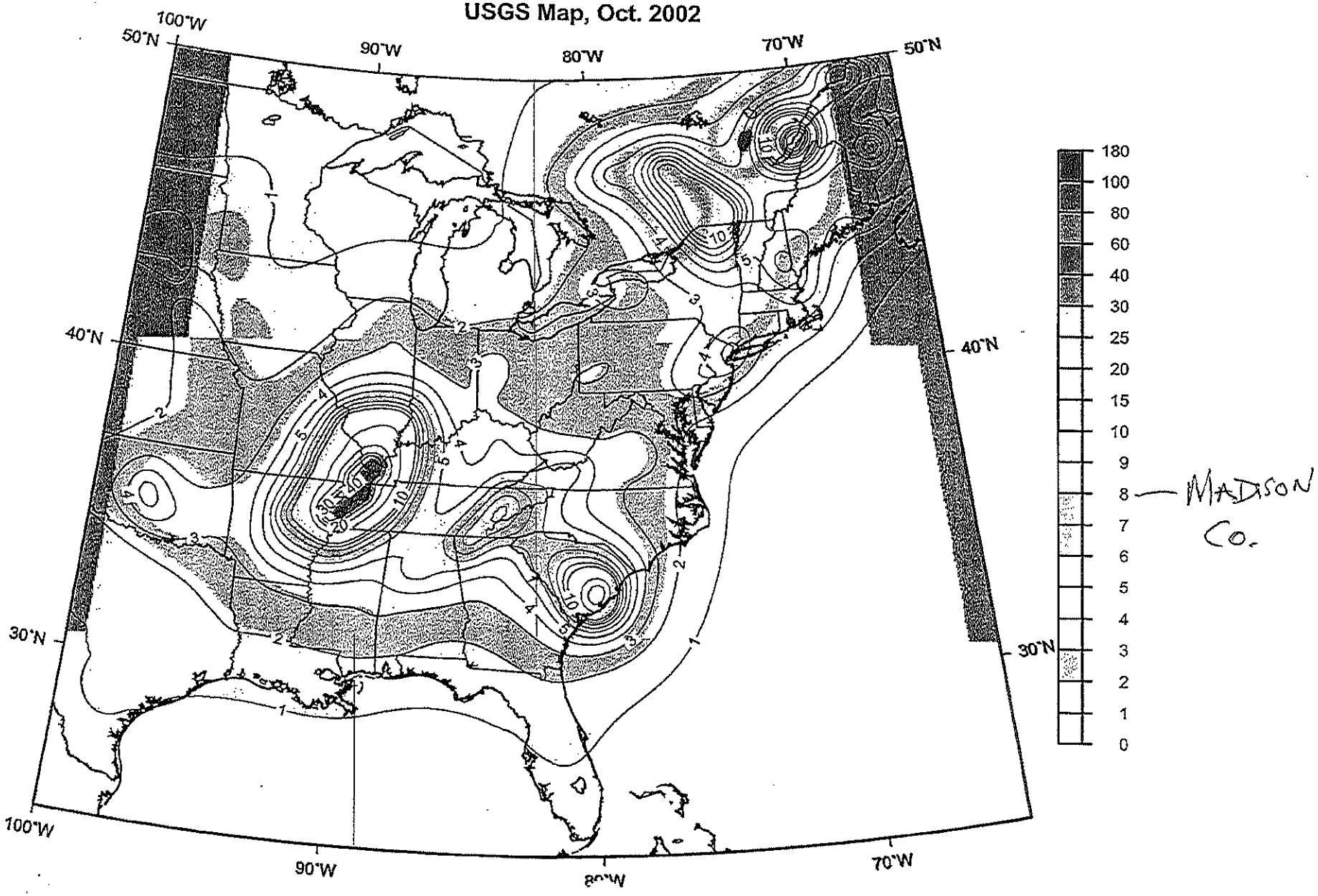
Product	Product Description	Longevity	Applications	Permissible Shear Stress lbs./sq. ft. (Pascal)	Max. Flow Velocity feet/sec. (meters/sec.)	Typical Projects
S75BN	Organic Net	12 months	4:1 - 3:1 Slopes Low Flow Channels	Bare Soil/1.60 (76)	Highways; Mines; Pipeline; Woodlands; Golf Courses; Residential Lawns; Wetland Mitigation;	5 (1.52)
S150BN	Organic Nets	12 months	3:1 - 2:1 Slopes Moderate Flow	Bare Soil/1.85 (88)		6 (1.83)

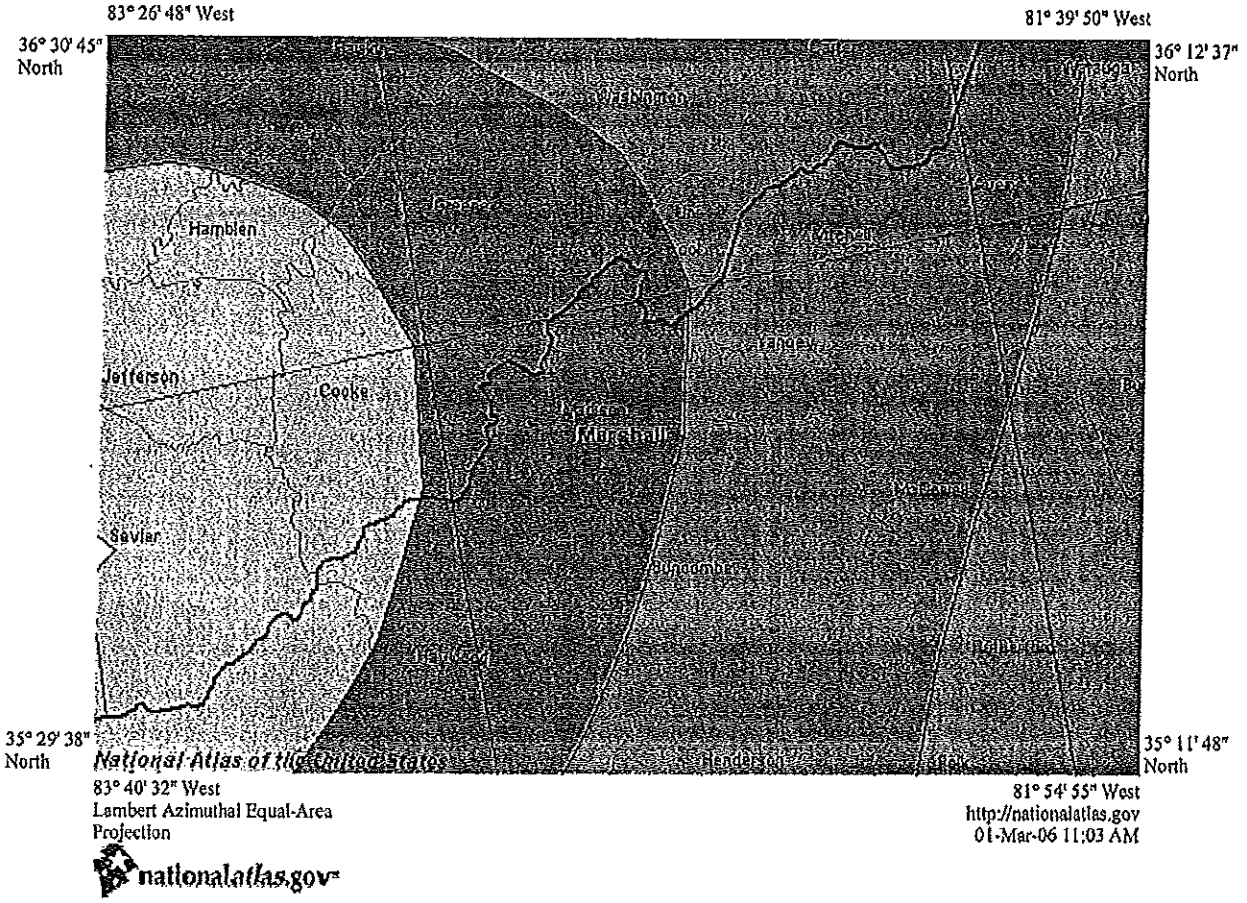
App
Star
S
E
T
P
Bioc
S
E
T
Turf
Reir
Mat
V
Sedi

APPENDIX 3

SEISMIC HAZARD

Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002



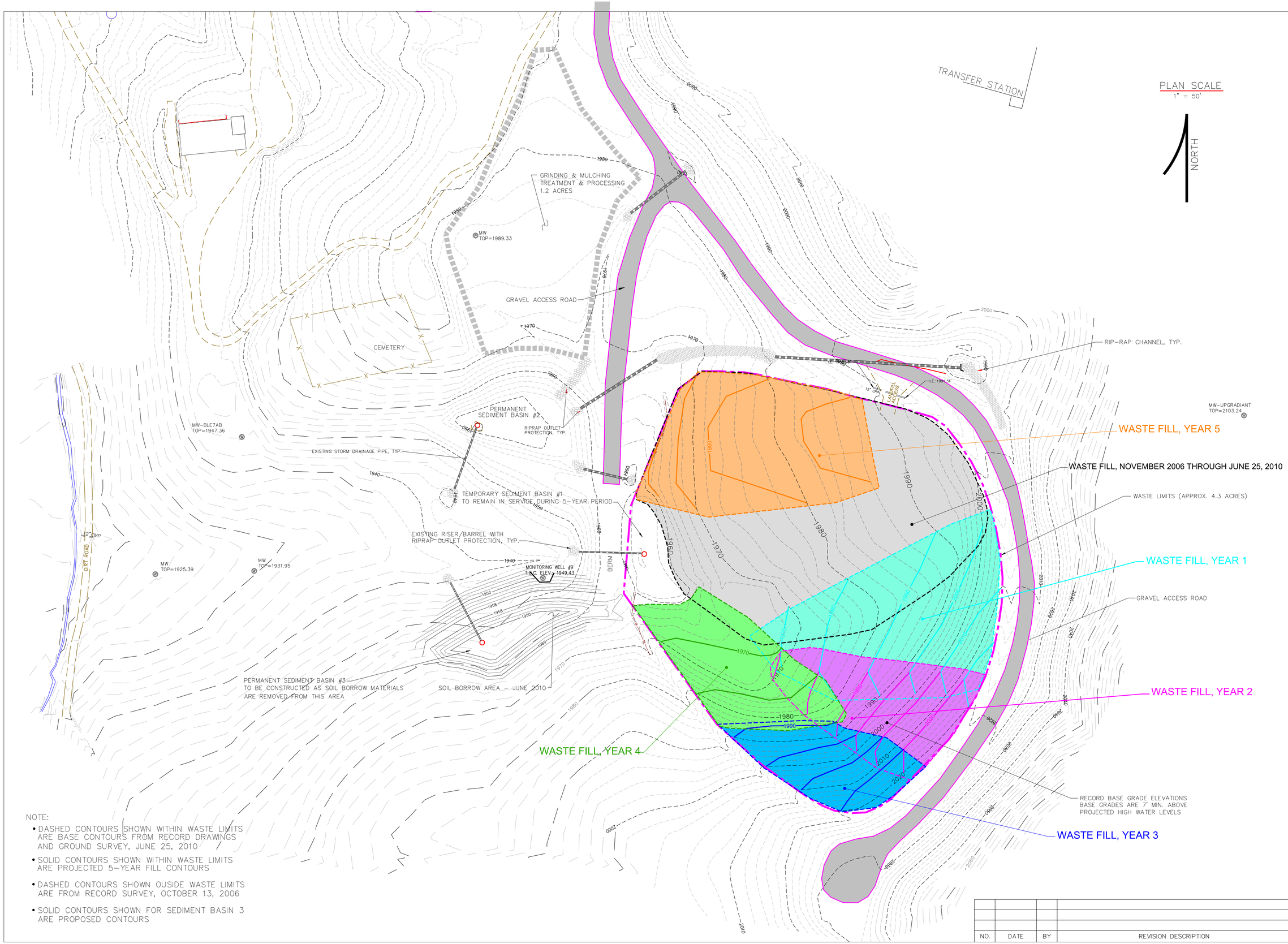


Seismic Hazard
Source: U.S. Geological Survey

Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years

N Peak Horizontal Acceleration (%g)

- 100
- 80
- 60
- 40
- 30
- 25
- 20
- 15
- 10
- 9
- 8 — MADISON COUNTY
- 7
- 6
- 5
- 4
- 3
- 2
- 1
- 0



NOTE:

- DASHED CONTOURS SHOWN WITHIN WASTE LIMITS ARE BASE CONTOURS FROM RECORD DRAWINGS AND GROUND SURVEY, JUNE 25, 2010
- SOLID CONTOURS SHOWN WITHIN WASTE LIMITS ARE PROJECTED 5-YEAR FILL CONTOURS
- DASHED CONTOURS SHOWN OUSIDE WASTE LIMITS ARE FROM RECORD SURVEY, OCTOBER 13, 2006
- SOLID CONTOURS SHOWN FOR SEDIMENT BASIN 3 ARE PROPOSED CONTOURS

NO.	DATE	BY	REVISION DESCRIPTION

McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
55 BROAD STREET ASHEVILLE, NC 28801 PH. (828) 252-0575 FIRM LICENSE # C-0459

C & D LANDFILL UNIT 2
PERMIT RENEWAL
PERMIT # 58-03
MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

JOB NO.: 09.00729
DATE: APRIL 2011
SCALE: 1" = 50'
DESIGNED BY: DAP
CADD BY: DAP
DESIGN REVIEW: ____
CONST. REVIEW: ____
Q:/09.00729/C-D-Fill Sequence.dwg

5-YEAR
WASTE FILL SEQUENCE

FIGURE
1

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.

OPERATIONS PLAN

SOLID WASTE TRANSFER STATION
CONSTRUCTION and DEMOLITION
LANDFILL - UNIT 2
MULCHING AND GRINDING TREATMENT AND PROCESSING

MADISON COUNTY, NORTH CAROLINA

WILLIAM H. SPERRY, PE

McGill ASSOCIATES

Engineering • Planning • Finance
Asheville, North Carolina

NORTH CAROLINA PROFESSIONAL SEAL 36132 ENGINEER WILLIAM H. SPERRY

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OPERATIONS PLAN

SOLID WASTE TRANSFER STATION
CONSTRUCTION AND DEMOLITION LANDFILL – UNIT 2
MULCHING AND GRINDING TREATMENT AND PROCESSING

MADISON COUNTY, NORTH CAROLINA

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Appendix B: Underground Leachate Storage Tank
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Appendix C: Leachate Acceptance Letter, Town of Marshall, North Carolina
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OPERATIONS PLAN

SOLID WASTE TRANSFER STATION
CONSTRUCTION AND DEMOLITION LANDFILL – UNIT 2
MULCHING AND GRINDING TREATMENT AND PROCESSING

MADISON COUNTY, NORTH CAROLINA
September 2010

INTRODUCTION

1.0 Purpose of Plan

This operation plan has been developed for the Solid Waste Transfer Station and the Construction and Demolition Landfill – Unit 2 located in Madison County, North Carolina. This plan has been prepared in accordance with the requirements of the North Carolina Department of Environment and Natural Resources (NCDENR), Division of Solid Waste Management, Solid Waste Rules (15A NCAC 13B).

The purpose of this plan is to provide the owner and operator with a reference manual that includes necessary information and procedures for properly operating the Transfer Station, Construction and Demolition Landfill – Unit 2 and other ancillary services. The plan will assist the County with complying with the applicable rules and regulations concerning the operation of various processing facilities. All personnel involved with the management or supervision of operations at the facility will be required to review the Operation Plan and to maintain the facility in conformance with applicable requirements. A copy of the Operation Plan will be kept in the vicinity of the various operations at all times.

2.0 Facility Location

The Solid Waste Transfer Station, Construction and Demolition Landfill – Unit 2, Mulching and Grinding Treatment and Processing Facility and other ancillary services are located on property owned by Madison County just North of Marshall, North Carolina. This property also contains the closed municipal solid waste (MSW) landfill, a closed construction and demolition (C/D) landfill, a recycling center, scale house facility, the Madison County Sheriff's Department Firing Range and one of the County's convenience centers.

3.0 Service Area

The Transfer Station Facility will provide waste disposal services for waste materials generated in Madison County only.

4.0 Stormwater Management

The Madison County Landfill Facility operates under a stormwater discharge permit issued by the NCDENR-Division of Water Quality, Permit No. NCG120082, requiring regular monitoring of stormwater discharge locations.

5.0 Facility Site Plan / Site Description Map

The Revised Facility Site Plan is included in Appendix A. Appendix A also includes Site Description Maps for the site that defines the metes and bounds survey of the facility. The original facility property boundary is shown in Figure 2, Site Description Map, Landfill Site, Law Environmental, Revised December 18, 1991. Figure 2 is a metes and bounds survey of the original Landfill Site as prepared by McMahan & Associates, P.A., dated November 15, 1990. An additional tract was subsequently added to the original landfill site and is noted as Parcel One, 1.11 acres, on a survey prepared by McMahan & Associates, P.A., Revised June 2, 2005. Parcel Two, 0.75 acres, is included in the original Site Description Map (Law Environmental) and was initially intended as a trade-off in the negotiations by the County to acquire Parcel One. However, this trade-off did not occur and Parcel Two remains in the overall site property boundary.

SOLID WASTE TRANSFER STATION

1.0 Overview

The Transfer Station consists of a pre-engineered metal building with an approximate 3,600 ft^2 tipping floor and lowered access/loading corridor for transfer trucks. Incoming waste collection vehicles deposit municipal solid waste (MSW) directly onto the concrete tipping floor of the facility. Once the MSW has been dumped onto the tipping floor, it will be inspected for illegal wastes and/or hazardous wastes. Illegal and hazardous wastes will be diverted from the waste stream and disposed of properly in a hazardous waste landfill. Construction and demolition (C/D) waste will be diverted from the waste stream and taken to the Construction and Demolition Landfill – Unit 2. Once the MSW has been inspected for unacceptable materials, a loader will push the remaining MSW to the rear of the tipping floor where it will be dropped into a transfer truck on the lower level. The waste will then be transferred by truck to Lakeway Recycling and Sanitation Landfill in Lowland, Tennessee on Hwy. 160, Tennessee DEC Number SNL32-0280.

Normal operating hours for the Transfer Station are 8:00 a.m. to 3:45 p.m., Monday through Friday. The Transfer Station is closed on Saturday, Sunday and the following holidays: New Year's Day, Independence Day, Thanksgiving Day, Christmas Day and other holidays as designated by the County. The normal operating hours for the Citizen's Convenience Center, located at the Madison County Landfill Facility, are 8:00 a.m. to 4:30 p.m. Monday through Friday and 8:00 a.m. to 12:00 noon on Saturday. The Citizen's Convenience Center is closed on Sunday and the following holidays: New Year's Day, Independence Day, Thanksgiving Day, Christmas Day and other holidays as designated by the County.

2.0 Personnel

The facility is owned and operated by Madison County. A minimum of two (2) staff employees is required for the daily operation of the Transfer Station. These employees are properly trained in safety procedures and the inspection of incoming wastes (refer to section 4, "Inspection of Wastes"). Training material published by the Solid Waste Association of North America (SWANA), is utilized for initial training of on-site personnel and for continuing education. The Transfer Station employees also direct and coordinate the movement of collection vehicles into and out of the Transfer Station.

3.0 Characterization of Waste Stream

The waste received at the Solid Waste Transfer Station will have the same characterization as the waste accepted at a MSW landfill.

4.0 Inspection of Wastes

Access to the Transfer Station is controlled by properly trained employees, located at the entrance of the facility. As the contents of the collection vehicles are emptied onto the tipping floor, an employee will conduct periodic visual inspections of the waste materials. If unacceptable waste is found, the driver of the vehicle will be instructed to terminate dumping and the unacceptable waste will be reloaded onto the vehicle for removal from the site. Examples of unacceptable wastes include large containers of liquid waste, sludges, drums that have not been emptied and crushed prior to delivery, and containers either smoking or emitting noxious vapors.

If hazardous waste is identified during vehicle dumping, facility personnel will immediately notify the driver and if necessary, contact NCDENR and the Hazardous Materials Emergency Response Team. The appropriate information concerning the waste will be provided to those officials and the recommended steps will be taken until properly trained handlers of hazardous waste arrive on-site.

Infectious or medical waste haulers are advised that the Transfer Station does not accept such wastes and that the hauler will have to transport the infectious wastes to an approved facility for disposal.

Should a "hot load" occur in a vehicle using the facility; the attendant will not permit the load to be discharged onto the tipping floor. The vehicle operator will be advised to move the vehicle to a paved area located outside the Transfer Station where the load will be discharged. The local fire department will be notified prior to discharge to identify the cause of the problem and extinguish the load fire. Once the load has been extinguished and the cause determined, the load will be taken into the facility for disposal. No asbestos or animal wastes will be accepted at the Transfer Station.

The above limitations on the types of wastes that will be accepted do not circumvent the incidental wastes that may be found in the residential waste stream that is expected at the facility.

5.0 Traffic Control

Site personnel control access to the Transfer Station. A gate controls the entrance to the landfill and the transfer station. As vehicles arrive at the Transfer Station, site personnel will direct the driver to position the vehicle at the correct unloading location once there is sufficient room to maneuver on the concrete floor. When the contents of the vehicle are emptied, the driver is instructed to move the vehicle away from the tipping floor and exit the Transfer Station.

During times when several vehicles are at the Transfer Station at the same time, haulers are instructed to wait within the staging area located outside the entrance to the building. The tipping area will allow for two (2) trucks to dump simultaneously.

6.0 Housekeeping, Litter and Vector Control

Incoming wastes will be transported to the Transfer Station in covered or enclosed vehicles. Outgoing transfer trailers will also be covered or enclosed. Throughout the day and at the end of each working day, facility personnel will police the building and surrounding site for litter. Collected litter is placed in containers for proper disposal. A yard hydrant will be available to wash down the concrete tipping floor and adjacent equipment areas when needed. The equipment used for pushing trash on the tipping floor will also have a bucket equipped with a squeegee. The wash water flows into a trench drain located just inside of the building entrance. The drain will be covered by a metal grate to block large debris that might clog the drain. The metal grate is raked periodically and the collected trash is placed into containers for proper disposal. The drain is connected to a six (6)-inch sewer line that also services the office and restrooms for the facility. The sewer line drains to a wastewater storage tank outside the Transfer Station. A wastewater hauling truck will be scheduled to pump out wastewater as necessary.

Odors are controlled by prompt unloading and transfer of all delivered wastes at the Transfer Station. The Transfer Station has the upper 60' end of the building completely open, which will allow adequate access to all areas of the building to ease operations, maintenance, and cleaning. The open end of the building and roof mounted ventilation fans will provide adequate fresh air exchange to control odor problems.

The daily removal of solid waste in conjunction with daily housekeeping procedures effectively controls the development of vector related problems. The tipping floor is constructed of concrete, which is a relatively impervious, readily cleanable material. Floor and equipment wash-downs at the Transfer Station will also reduce both odor and vector problems. As described previously, wash water will be diverted to the wastewater storage tanks located outside the building. Licensed exterminators will also be available to visit the Transfer Station as needed.

7.0 Dust and Fire Control

Since collection and transfer vehicles travel at low speeds on paved roads, dust generation is not a problem. Since the Transfer Station is located on the current landfill property, dust-controlling efforts of the landfill will keep dust generation at the Transfer Station to a minimum. Furthermore, periodic wash down of the

tipping floor and equipment will also prevent excessive build-up of dirt and dust at the facility.

Fire control is provided by portable hand-held fire extinguishers as well as a yard hydrant located just outside the building. Fire protection will be provided by the local fire department, which is aware of the fire control needs for the facility. In the event that a fire occurs, the local authorities will be notified immediately. The telephone numbers of local fire, police, ambulance and hospital facilities are posted in and around the facility at all times. In the event of a fire at the facility the NCDENR will be notified within 24 hours and written notification will be submitted within 15 days.

8.0 Wastewater Collection

The metal roof building that covers the Transfer Station minimizes wastewater generation. The driveway is sloped away from the transfer station floor to restrict outside flow from entering building. Wastewater flow at the Transfer Station will consist of wash down water and flow from the restroom. A trench drain collects the wash down water, while the restroom is plumbed to the wastewater collection line. The wastewater collection lines drain into an on-site storage tank with a capacity of approximately 5,000 gallons.

The level of liquid in the tank is generally monitored on a weekly basis or more often as operations/conditions dictate. A wastewater hauling truck will be scheduled as necessary to pump out wastewater to insure the tank has adequate reserve capacity to sustain normal operations. The wastewater will be hauled to the Town of Marshall Wastewater Treatment Facility. A copy of the letter from the Town of Marshall, agreeing to accept the leachate from the Madison County Solid Waste Facility is included in Appendix C.

9.0 Storm Water Management and Erosion Control

Areas adjacent to the Transfer Station are graded away from the building. Gutters and downspouts will also be positioned on the building to divert discharge of storm water to diversion ditches and storm drains.

10.0 Zoning

Since the Transfer Station is located on the Madison County Landfill property, zoning approved for the current solid waste management facilities would allow construction of the Transfer Station.

11.0 Facility Inspections

Regular maintenance inspections of the facility will be conducted. The inspections will be conducted by site personnel who are familiar with the buildings and equipment at the site, as well as operations of the facility. Monthly inspections, at a minimum, will include inspections of the following:

1. Building, foundation, and push walls
2. Ventilation system
3. Fire equipment
4. Electrical systems
5. Floor drains and yard hydrant
6. Wastewater storage tank

If unsatisfactory conditions are noted during the inspection or by Transfer Station personnel at any other time, the concerns will be reported to the Madison County Solid Waste Director. If a threat to safety or to the environment is identified, immediate action will be taken to correct the situation. If necessary, operations at the Transfer Station will be suspended temporarily until the proper corrective actions have been taken. In the unlikely event of a severe accident, the proper authorities will be notified and off-site support requested.

CONSTRUCTION AND DEMOLITION LANDFILL – UNIT 2

1.0 Waste Acceptance and Disposal Requirements

The CDLF Unit 2 will accept construction/demolition debris, wastes acceptable for disposal in a land clearing-inert debris landfill, and other wastes specifically approved by the Division. The CDLF will only accept waste generated in Madison County.

Construction/demolition debris is defined in the General Statutes as waste or debris resulting solely from construction, remodeling, repair, or demolition operations on pavement, buildings, or other structures.

Land clearing debris is defined in the Rules as waste that is generated solely through land clearing activities such as stumps, trees, limbs, brush, grass, and other naturally occurring vegetative matter.

Disposal of yard trash will not be allowed in the CDLF Facility. Yard trash is defined in the North Carolina General Statutes 130A-290 as "solid waste consisting solely of vegetative matter resulting from landscaping maintenance".

The CDLF will only accept permitted inert waste generated in Madison County. Madison County will notify the division within 24 hours of any attempts to dispose of non-permitted waste.

The Solid Waste Section may approve specific wastes for approval on a case-by-case basis for disposal at the CDLF. These wastes must be demonstrated to be inert through the Toxicity Characteristic Leaching Procedure (TCLP).

The new CDLF will accept asbestos waste if packaged properly in accordance with 40 CFR 61 and G.S. 150B-14(c). The waste shall be disposed of in virgin soil and at the bottom of the working face or in an area not contiguous with other disposal areas. The area shall be covered with soil immediately in a manner to avoid any airborne conditions and the disposal area shall be marked and/or the location documented in the permanent operating record of the landfill so that the waste is not disturbed by future landfilling activities.

1.1 Prohibited Wastes

The following wastes are prohibited from disposal at the CDLF:

- All municipal solid waste (MSW).
- All industrial waste.

- Hazardous waste as defined within 15A NCAC 13A, including hazardous waste from conditionally exempt small quantity generators.

- Polychlorinated biphenyls (PCB) waste as defined in 40 CFR 761.

- All liquid wastes are banned from the CDLF facility.

  NOTES: Liquid Waste means any waste material that is determined to contain "free liquids" as defined by Method 9095 (Paint Filter Liquids Test), as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical methods" (EPA Pub. No. SW-846).

  Paint Filter Liquids Test
  Procedure: The test is performed by placing a 100-milliliter sample of the waste in question in a conical, 400-micron paint filter. The waste is considered to be a liquid waste if any liquid from the waste passes through the filter within five minutes.

- Wastes prohibited by Statute GS 130A-309.10 of the North Carolina Solid Waste Management Rules. These wastes include:

  - used oil
  - yard trash
  - white goods
  - antifreeze (ethylene glycol)
  - whole scrap tires
  - lead-acid batteries

- Wastewater treatment sludges or any other waste containing organics.

1.2 Asbestos

All waste containing asbestos shall be managed in accordance with 40 CFR 61. When possible, the waste shall be placed at the bottom of the working face and in direct contact with the base liner system. Large quantities of asbestos shall be designated and located by the landfill operator. The horizontal location should be measured between two (2) permanent points and the elevation estimated and both recorded. The waste shall be covered with soil immediately upon disposal in a manner not to cause airborne materials.

1.3 Waste Inspections

Madison County shall continue a program at the landfill for detecting and preventing the disposal of hazardous or liquid waste or any other waste that the CDLF facility is not permitted to receive. The frequency of random inspections shall be based on the type and quantity of wastes received daily, and the accuracy and confidence desired in conclusions drawn from inspection observations. All incoming wastes of an unidentifiable nature or origin will be inspected. This shall include but not be limited to haulers with unknown service areas, to loads brought to the facility in vehicles not typically used for disposal of construction and demolition waste, and to loads transported by previous would-be offenders. The inspector should question the transporter about the source/composition of the materials for wastes of unidentifiable nature which are received from sources other than household (e.g., industrial or commercial establishments). The program will include the following:

Landfill personnel will conduct random inspections of typical incoming loads. Inspections will occur at a designated site, adjacent to the working face of the landfill unit. The load will be carefully spread by a front-end loader with personnel trained to identify hazardous and liquid waste or any other unacceptable waste. The frequency of the random inspections will be based on the type and quantity of wastes received, but not less than one inspection per week.

A record will be kept of each inspection that is performed. These records will be included and maintained in the operating record of the landfill.

Madison County will provide annual training to all landfill personnel in regard to recognizing hazardous and liquid waste.

Madison County has developed a contingency plan to properly manage identified hazardous or liquid waste. The plan involves the identification of the waste by inspection. If the inspector determines a load of waste to be of a hazardous nature, the landfill will not accept the waste and require that hauler remove the waste from the facility. If the inspector determines a load of waste to include wastes that should not be disposed of in the CDLF but can be disposed of in a MSW Landfill, then the hauler will be required to load the waste back into his vehicle and transport the load to the MSW transfer station.

2.0 Cover Material Requirements

2.1 Requirements

Madison County shall cover the disposed waste with six (6) inches of earthen material at least once a week or when the working area reaches one-half acre in size, or more often as necessitated by the nature of the waste to control disease vectors, fires, odors, blowing litter, water infiltration and scavenging.

2.2 Intermediate Cover

Madison County shall cover all waste areas that will be inactive for more than twelve (12) months and that have not reached final elevations with a minimum of one (1) foot of intermediate cover.

3.0 Disease and Vector Control

Madison County will control the spread of disease vectors by maintaining the cover requirements and picking up wind-blown trash as necessary to maintain a clean site.

4.0 Air Quality

4.1 Title V Air Permit Requirements

Madison County shall operate the Madison County CDLF in compliance with all applicable requirements developed under the State Implementation Plan (SIP) approved or promulgated by the U.S. EPA Administrator pursuant to Section 110 of the Clean Air Act, as amended. The Madison County Landfill will <u>not</u> be required to obtain a Title V operating permit since the on-site volume of waste is considerably less than the 2.5 million Megagrams of waste threshold. The existing MSW cell has a total capacity of 128,000 cubic yards of waste which equates to approximately .06 million Megagrams.

4.2 Prohibition on Open Burning

No open burning of solid waste shall be allowed at the landfill, except for the infrequent burning of land clearing debris that is generated by on-site clearing or debris from emergency clean-up operations. Any such infrequent burning will be approved by the local fire marshal and all local and State guidelines will be followed. The County will obtain all applicable permits prior to burning.

4.3 Hot Load Procedures

If a hot load of waste is delivered to the landfill, the driver shall not be allowed to dump the load. The driver shall be directed to a gravel or paved area in front of the MSW Transfer Station and instructed to dump the load there. The fire should be extinguished if possible and the local fire department called immediately.

If a load of waste is unknowingly a "hot" load and is discharged onto the working face, it will immediately be watered and extinguished by landfill personnel if possible and the local fire department will be called immediately. Equipment and a stockpile of soil shall also be maintained in close proximity to the working face for controlling accidental fires.

The local fire department, which is located approximately 3.0 miles from the Madison County Landfill, will also be contacted and informed of the potential fire hazards at the landfill. Arrangements will be made with the fire department to provide access to the landfill site. They will also be provided with operational information of the facility in case of emergency.

4.4 Hot Load Notification

Madison County shall provide verbal notification to the Solid Waste Division within 24 hours of a fire at the landfill and written notice within 15 days.

5.0 Access and Safety Requirements

5.1 Landfill Access

Access to the site is currently controlled by means of gates. A security check station and weigh scales is located at the landfill entrance to evaluate waste stream and proper disposal. A properly trained and certified attendant will be on duty at all times while it is open for public use to insure compliance with operational requirements. Restroom and maintenance facilities currently in place at the existing building will remain operational. Access roads to the site will be of all weather construction and maintained in good condition.

5.2 Dust Control

Dust generated due to landfill activities will be controlled. Dust will be controlled through the application of water by truck, or other approved dust control products, if necessary. Removal of mud and dirt from the roads will also be a part of the dust control measures. Additionally, the final cover will be vegetated as soon as practical in order to minimize the blowing of dust on-site.

5.3 Signage

Signs providing information on disposal procedures, the hours which the site is open for public use, the permit number, stating that no hazardous or un-permitted waste can be received without written permission, stating that no liquid waste can be received for disposal, and other pertinent information will be posted at the site entrance. Most of these signs are located at the landfill entrance, which currently provides access to the MSW Transfer Station, and also provides access to the CDLF Unit 2. Therefore, additional signage will be located along the access road beyond the access point to the MSW facilities that prohibits MSW waste from being received at the CDLF Facility. Traffic signs and markers shall be provided as necessary to promote an orderly traffic pattern and direct incoming vehicles to the proper dumping area (MSW or C&D). Adequate signage will be located along the access roads to direct vehicles to and from the discharge area and maintain efficient operating conditions. A sign shall be placed in clear view of each incoming waste transporter, which shall read as follows:

> NOTICE: RANDOM WASTE SCREENING IS PRACTICED HERE. WE RESERVE THE RIGHT TO INSPECT ANY LOAD OR PORTION OF A LOAD ARRIVING AT OUR FACILITY. WE WILL REJECT ALL: HAZARDOUS WASTES, PCBs, LIQUIDS AND ANY UNACCEPTABLE WASTE AS DETERMINED BY OUR MANAGEMENT. YOUR PARTICIPATION IN THIS PROGRAM IS NOT OPTIONAL!

5.4 Prohibition on Scavenging

Scavenging of solid waste is prohibited unless approved by the Owner or Operator and the removal is not performed on the working face.

6.0 Erosion and Sedimentation Control Requirements

Proposed erosion/sedimentation control structures include sediment basins, storm drains, and diversion ditches. Sedimentation basins will be checked after periods of significant runoff. Sediment will be removed from the basins to their original dimensions when sediment accumulates to one half of the design depths. The sedimentation basins, embankments, ditches, inlets and outlets will also be inspected for erosion damage. All necessary repairs will be made immediately. Any trash or debris within the riser pipes will be removed.

The first five (5)-year permitting period will require the use of a temporary sediment basin and one (1) permanent basin. The remainder of the CDLF will require construction and operation of a second permanent basin.

Stormwater will be controlled by constructing intermediate benches as necessary on the finished cap. The benches will be constructed so as to maintain a maximum flow length on the cap surface of approximately 120 linear feet. Ditches will be used to transport water from the bench to sediment basins. Ditches will be of adequate size to handle estimated peak runoff at the final-developed condition.

The erosion control structures have been designed and will be maintained to manage the run-off generated by the 24-hour, 25-year storm event and will conform to the requirements of the Sedimentation Pollution Control Law (15A NCAC 4).

Storm drain outlets and diversion ditches will be inspected for damage after each runoff event. Riprap and/or composite liners will be placed in ditches and at pipe outlets to prevent erosion and washouts. Provisions for a vegetative ground cover sufficient to control erosion must be accomplished within fifteen (15) working days or 90 calendar days upon completion of any phase of CDLF development. Temporary grassing will also be utilized as necessary to stabilize temporary slopes that are susceptible to erosion.

Embankment slopes shall be periodically inspected for erosion. The embankment slopes shall be mowed at a frequency sufficient to maintain a good stand of vegetation. The slopes shall be mowed once in any one (1) year period. The embankment slopes shall be refertilized in the second year unless vegetation growth is fully adequate. Any damaged areas will be reseeded, fertilized, and mulched immediately. Seeding, fertilizing and mulching shall be in accordance with the North Carolina Erosion and Sedimentation Control Guidelines.

7.0 Drainage Control and Water Protection Requirements

7.1 Surface Water

Surface water from outside the operational area will be diverted from the waste area by the use of perimeter ditches. The perimeter ditches direct surface water to the sedimentation basins.

7.2 Discharge of Water and Leachate

There shall be no discharge of pollutants from the landfill into waters of the U.S., including wetlands, that violates any requirements of the Clean Water Act, including, but not limited to, the National Pollutant Discharge Elimination Systems (NPDES) requirements, pursuant to Section 402.

There shall be no discharge of a non-point source of pollution into waters of the U.S., including wetlands, that violates any requirement of area-wide or State-wide water quality management plan that has been approved under Section 208 or 219 of the Clean Water Act, as amended.

7.3 Solid Waste Requirements

Solid waste shall never be disposed of in ponded water.

8.0 Record Keeping Requirements

8.1 Record Keeping Requirements

Landfill personnel shall record and retain the following information in an operating record at the landfill, or at an alternate location that has been approved by the Division.

-Inspection of existing facilities,
-Inspection records and waste determination records,
-Location of large quantities of asbestos,
-Training received by landfill personnel,
-Waste amounts received by weight, which includes source or generation,
-Semi-annual monitoring of ground water wells, and
-Any demonstration, certification, finding, monitoring, testing, or other analytical data required by the North Carolina Solid Waste Management Rules (15A NCAC 13B).

8.2 Operating Record

This information shall be collected and documentation of such collection shall be kept in the permanent operating record of the CDLF. The Operating Record, this Operations Plan, and a copy of the approved design drawings and construction drawings will remain at the Madison County Landfill Facility at all times. This information will be readily available for inspection by the Solid Waste Section.

9.0 Spreading and Compacting Requirements

Waste will be placed in the CDLF in lifts of approximately five (5) to ten (10) feet thick, according to the Filling Sequence drawings, as shown in Section 5 of the Permit To Operate submittal package. Following placement of the initial lift, the solid waste will be compacted as densely as possible using compactors and dozers. Waste placement will be in lifts not to exceed 10 feet. In order to increase compaction, waste should be placed from the down gradient to upgradient direction when possible. The working face shall be maintained in as small an area as possible to increase compaction and to reduce the amount of daily cover required. The stormwater cover shall remain on the largest area possible in order to divert the stormwater from the active area of the landfill.

MULCHING AND GRINDING TREATMENT AND PROCESSING

1.0 Purpose of Plan

This operations plan has been developed for the Mulching and Grinding Treatment and Processing Facility (MGT&P) located at the Madison County MSW Landfill in Madison County, North Carolina. This plan has been prepared in accordance with the requirements of the North Carolina Department of Environment and Natural Resources (DENR), Division of Solid Waste Management, Solid Waste Rules (15A NCAC 13B).

The purpose of this plan is to provide the owner and operator with a reference manual that includes necessary information, procedures, and applicable rules for properly operating the Treatment & Processing Facility. All personnel involved with the management or supervision of operations at the facility will be required to review the Operations Plan and to maintain the facility in conformance with applicable requirements. A copy of the Operations Plan will be kept in the vicinity of the Mulching and Grinding Treatment and Processing Facility at all times.

2.0 Facility Location

The Mulching Facility is located at the Madison County Landfill, MSW facility located off of Craig Rudisill Road, S.R. 1134, and is operated by Madison County. The Mulching Facility is located between the new Construction and Demolition (C&D) landfill-Unit 2 and the recently closed MSW landfill.

3.0 Service Area

This Treatment and Processing Facility will provide service for all of Madison County.

4.0 Siting Requirements

The proposed MGT&P facility siting requirements are shown on the attached Figure #1 and are described as follows:

1) The proposed Mulching Facility is not located in the 100-year flood plain.
2) A 50-foot buffer between all property lines and the treatment and processing areas is maintained.
3) Madison County has no zoning requirements for the MGT&P facility property.
4) The site grades are designed to ensure that there will be no standing water in the treatment and processing area and there will be no off-site drainage problems.

5) An all-weather gravel access road to the site will be kept passable at all times.
6) An erosion control permit for the primary site was approved on September 12, 2005.
7) Access to the Mulching Facility is controlled by properly trained employees.
8) The area will be graded to divert runoff to a sediment basin. Both the ditches and the sediment basin can be utilized to control runoff from a potential fire.

5.0 Operations Procedures

5.1 Overview

The Mulching and Grinding Treatment and Processing Facility will consist of an area of approximately 1.2 acres located between the closed MSW landfill cell and the new CDLF-Unit2 cell. The normal operating hours will be in accordance with CDLF Unit 2 operating hours.

5.2 Personnel

The facility is owned and operated by Madison County. CDLF personnel will operate the MGT&P facility based on it's proximity to the CDLF Unit 2. These employees are properly trained in safety procedures and the inspection of incoming wastes. Training material published by the Solid Waste Association of North America (SWANA) is utilized for initial training of on-site personnel and for continuing education. The employees also direct and coordinate the movement of collection vehicles into and out of the Mulching Facility.

5.3 Technical Operational Requirements

The following operational criteria shall be met at the Mulching and Grinding Treatment and Processing Facility:

1) Only clean unpainted untreated wood and brush will be used in the mulching process.
2) Mulched materials will be removed from the site several times a year.
3) Sludges may not be included in mulched materials.
4) Neither hazardous waste nor asbestos containing waste shall be accepted at the mulching facility.
5) Household hazardous waste shall not be accepted at the mulching facility.
6) The Mulching Facility shall not allow uncontrolled public access.

5.4 Traffic Control

Access to the Mulching Facility is controlled by properly trained employees who are located at the entrance of the facility. As vehicles arrive at the Mulching Facility, site personnel will direct the driver to position the vehicle at the correct unloading location. When the contents of the vehicle are emptied, the driver is instructed to move the vehicle away from the Mulching Facility area.

5.5 Housekeeping, Litter, and Vector Control

Incoming wastes will be transported to the Mulching Facility in covered or enclosed vehicles. Outgoing transfer trailers will also be covered or enclosed. Facility personnel will police the area for litter as necessary. Vectors shall be controlled so as to protect the public health and welfare.

5.6 Fire Control

In the event that a fire occurs, the local authorities will be notified immediately. The telephone numbers of local fire, police, ambulance and hospital facilities are posted in and around the facility at all times. In the event of a fire at the facility the DENR will be notified within 24 hours and written notification will be submitted within 15 days.

5.7 Storm Water Management and Erosion Control

An erosion control permit developed for the area where the MGT&P facility C&D Unit 2 will be located was approved by the NCDENR, Land Quality Section on September 12, 2005. Standard erosion control practices, such as a sediment basin, silt fencing, vegetating slopes, and diversion ditches will be utilized at the site.

5.8 Zoning

Madison County has no zoning requirements for the landfill property and thus, no zoning for the MGT&P facility is required.

5.9 Temporary Disaster Debris Staging/Storage Area

The Mulching and Grinding Treatment and Processing Facility (MGT&P) has been designated as the Temporary Disaster Debris Staging/Storage Area for vegetative waste from within Madison County resulting from a significant natural disaster. The waste would be processed in accordance with this Plan or depending on the volume, may be removed for processing and/or disposal at an off-site permitted facility.

HOUSEHOLD HAZARDOUS WASTE COLLECTION FACILITY

1.0 Wastes Received

The household hazardous waste collection facility only receives household hazardous waste (HHW) generated by homeowners and conditionally exempt small quantity generators from within Madison County.

The household hazardous waste collection facility will not accept any radioactive waste, explosives or infectious waste.

2.0 Reporting Requirements

The County shall maintain records on the amount of household hazardous waste received for disposal at the facility and the amounts shipped off site for recycling, reuse, treatment and/or disposal. Records will be compiled on a monthly basis and maintained at the facility for inspection.

On or before August 1st of each calendar year, the County shall report to the Solid Waste Section the amount of household hazardous waste received at the facility and the amounts shipped off site for recycling, reuse, treatment and/or disposal. The reporting period shall be for the previous year, beginning July 1st and ending June 30th.

OTHER SERVICES, COLLECTION FACILITIES AND/OR OPERATIONS

1.0 White Goods/Metals

The Madison County Landfill Facility does accept white goods and other recyclable metal products which are taken to a designated collection facility located south of the closed MSW Landfill. All appliances containing chlorofluorocarbon (CFC) refrigerants are segregated from the other scrap metals. Any refrigerator/freezer equipped with locking doors will have the door(s) removed immediately. County staff periodically removes and recycles the refrigerant from the applicable appliances. Records of this activity are maintained on site. All scrap metal is periodically removed from the site by a recycling contractor.

2.0 Scrap Tires

The Madison County Landfill Facility accepts scrap tires for recycling which are taken to a designated collection facility located adjacent to the maintenance/recycling building. Once the tire trailers are loaded, an authorized tire recycler will remove the trailers for processing.

3.0 Waste Oil, Antifreeze and Used Oil Filters

The Madison County Landfill Facility accepts waste oil, used oil filters and waste antifreeze which are taken to a designated collection facility located between the closed MSW landfill and the active C&D – Unit 2 landfill. Waste oil, used oil filters and antifreeze are periodically collected by an authorized recycler for processing.

4.0 Cooking Oil

The Madison County Landfill Facility accepts used cooking oil at a designated collection facility located in the area of the maintenance/recycling facility building. The used cooking oil is periodically collected by an authorized recycler for further processing.

5.0 Batteries

Waste batteries are collected by the Madison County Landfill Facility at a designated collection facility located at the citizen's disposal facility located near the scale house. The battery collection area is covered to protect the batteries from the weather and prevent runoff from the collection facility.

6.0 Electronics

Madison County intends to begin the collection of scrap electronics in the near future. The intent is to locate the collection facility in the general vicinity of the existing white goods/scrap metal collection area. The County intends to palletize the scrap electronics and store them in covered containers until such time as a full trailer load is accumulated at which time an authorized recycler will collect the items for further processing.

7.0 Underground Leachate Storage Tank

The underground leachate storage tank will be equipped with continuous leak detection and high liquid level monitoring devices. Each alarm condition will be visually indicated by a dedicated indicator which is to remain lit until such time as the alarm condition is corrected. Each alarm condition will also be audibly annunciated via a pulsing horn which can be silenced manually via a horn silence button.

The system console shall be equipped with a "system detecting" indicator light to visually indicate to the operator that the detection systems are operating as intended. The system console will be inspected by the operator at least weekly to confirm system operation. Results of the inspection will be recorded in the underground leachate storage tank inspection monitoring reports

A monitoring access point will be provided to allow the operator to manually check the depth of liquid within the tank from which the volume of stored liquid can be determined based on a tank calibration chart. The volume of liquid within the tank will be checked at least weekly. However, during the initial 6-months following installation of the tank, the volume of stored leachate will be checked more often as necessary in order to establish a general schedule for leachate removal activities. Results of the leachate volume monitoring results will be recorded in the underground leachate storage tank inspection monitoring reports.

Leachate will periodically be removed from the underground storage tank by the County or a licensed wastewater hauler and hauled to and disposed of at the Town of Marshall's wastewater treatment plant. A copy of the letter from the Town of Marshall, agreeing to accept the leachate from the Madison County Solid Waste Facility is included in Appendix C. Results of the leachate removal/hauling operation will be recorded in the underground leachate storage tank inspection monitoring reports.

EXPLOSIVE GAS CONTROL

1.0 Methane Gas Concentration Limits

Madison County must ensure that:

i. The concentration of methane gas generated by the landfill does not exceed 25 percent of the Lower Explosive Limit* (25% LEL) for methane in landfill structures (excluding gas control or recovery system components); and

ii. The concentration of methane gas does not exceed 100 percent of the Lower Explosive Limit (100% LEL) for methane at the landfill property boundary.

2.0 Explosive Gas Monitoring Program

Madison County will routinely monitor for explosive gas to ensure that the standards of 1.0 Methane Gas Concentration Limits are met. See Appendix D for the Explosive Gas Monitoring Procedure plan for the Madison County Landfill, Permit No. 58-03, located at 271 Craig Rudisil Road, Marshall, North Carolina 28753. The minimum frequency of monitoring will be quarterly.

3.0 Methane Gas Response Plan

If methane gas levels exceeding the limits specified in 1.0 Methane Gas Concentration Limits are detected, the owner or operator will:

i. Immediately take all necessary steps to ensure protection of human health, i.e. no smoking, temporarily abandon any affected structure and notify the Division of Solid Waste Management.

ii. Within seven days of detection, place in the operating record the methane gas levels detected and a description of the steps taken to protect human health; and

iii. Within 60 days of detection, prepare and implement a remediation plan for the methane gas releases, place a copy of the plan in the operating record, and notify the NCDENR, Solid Waste Section that the plan has been implemented. The plan will describe the nature and extent of the problem and the proposed remedy.

* - "Lower Explosive Limit" (LEL) means the lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 25° C and atmospheric pressure.

APPENDIX A

Revised Facility Site Plan

Site Description Maps

APPENDIX B

Underground Leachate Storage Tank

Appendix B
Underground Leachate Storage Tank

Narrative

Introduction

Madison County has evaluated the option of continuing to operate the existing leachate lagoon versus constructing/installing an alternative method to manage the onsite collection of leachate from the Closed MSW Landfill. Since the MSW Landfill has been closed, the leachate flows from the facility have continued to diminish to the point that continued operation of the leachate lagoon is no longer feasible. Daily leachate flows from the Closed MSW Landfill have been determined to be approximately fifty to seventy-five (50-75) gallons per day or a maximum of approximately 2,250 gallons per month. Additional liquid accumulating in the existing leachate lagoon, that must be removed and treated by the County, is due to precipitation falling in the exposed lagoon area. To minimize the amount of leachate that must be removed and treated, the County proposes to install an underground leachate storage tank and remove the existing leachate lagoon from service. The proposed tank would be a double-wall fiberglass reinforced tank with an interstitial space between the primary and secondary walls to allow for the monitoring of potentially leaked product from the primary tank structure. The tank will be equipped with a continuous leak detection device as well as a high level alarm with both monitoring devices having visual and audible alarm systems. The tank would be equipped with an access monitoring port for manually measuring the depth/volume of accumulated leachate. Leachate will be periodically removed from the underground tank by the County or a licensed wastewater hauler and hauled to and disposed of at the Town of Marshall's wastewater treatment plant. A copy of the letter from the Town of Marshall, agreeing to accept the leachate from the Madison County Solid Waste Facility is included in Appendix C.

Construction Procedures

The proposed tank will be located between the existing leachate lagoon and the stormwater management basin west of the Closed MSW Landfill as shown on Sheet C-101, titled "Site Plan" included in Enclosure "A". The initial step will be to field verify the grades of the existing leachate collection line at the proposed connection point approximately 40-feet down gradient from the existing intermediate manhole/valve vault. Based on the elevation at this point, the proposed elevation of the tank will be confirmed such that: 1) the bottom elevation of the tank will be a minimum of two feet above the seasonal high groundwater table and a minimum of two feet vertical separation shall be maintained between bedrock and the lowest point of the tank and 2) an adequate slope of no less than 2% can be maintained on the proposed leachate collection line running to the tank from the connection point with the existing leachate collection line. Based on available data and field surveys, the bottom elevation of the tank is proposed to be approximately 1908. The groundwater elevation at the location of the tank has been estimated to be approximately 1903.6 based on the interpolation of groundwater elevation data collected during the fall 2010 scheduled groundwater monitoring event. Based on the aforementioned information, the bottom elevation of the tank should be in excess of four vertical feet above the

groundwater elevation. Section A-A of the Tank Detail as shown on Sheet C-501, Miscellaneous Details, Madison County Landfill, Leachate Collection System Modifications, revised 12-13-10, included in Enclosure "A" of Appendix B, Underground Leachate Storage Tank, provides a graphical depiction of the proposed tank elevation relative to the interpolated groundwater elevation at that location. The existing vertical separation between the proposed bottom elevation of the tank and the groundwater elevation at the site should allow for necessary field adjustments of the tank elevation to ensure a minimum of 2% slope on the leachate collection lines while still maintaining the required two-foot separation between the bottom of the tank and the groundwater. Bedrock is not anticipated to be an issue at this proposed underground storage tank location.

The tank will be installed in accordance with the particular manufacturer's installation instructions. A Technical Specification for the proposed double-wall fiberglass tank and integral monitoring devices is included in Enclosure "B" for reference. Once the underground leachate collection tank and all appurtenances have been installed and checked for proper operation, the leachate collection line will be installed to a point near the tie-in with the existing leachate collection line. A detail of the underground storage tank installation as well as all appurtenances is shown on Sheet C-501 titled "Miscellaneous Details" included in Enclosure A. At that point, the existing valve in the manhole/valve vault will be shut and any leachate within the line will be allowed to drain to the existing leachate lagoon. Once the line is free of visible flow the existing leachate line will be cut and the connection to the proposed leachate collection line to the tank will be constructed. A detail of the proposed connection to the existing leachate collection line is shown on Sheet C-501 titled "Miscellaneous Details" included in Enclosure "A". Care will be taken to ensure that no residual liquid will be discharged to the surrounding soil material. Once the connection is complete, the existing valve will be opened and the liquid allowed to flow to the underground leachate collection tank.

Once the underground leachate storage tank is in operation, the remaining leachate collection line and the existing leachate lagoon will be removed from service. The leachate collection line will be removed from the tie-in point with the new leachate collection line to the discharge point in the existing lagoon. The removed pipe will be disposed of in accordance with applicable Federal and State requirements. All liquid waste and waste residues will be removed from the existing leachate lagoon impoundment by the County or a licensed hauler and hauled to and disposed of at the Town of Marshall's wastewater treatment plant. A copy of the letter from the Town of Marshall, agreeing to accept the leachate from the Madison County Solid Waste Facility is included in Appendix C. The daily volume of leachate removed from the existing leachate lagoon during the draw down prior to removal of the system components will be coordinated with the Town of Marshall. Once all liquid and waste residues have been removed, the system components (liners, etc.) will be removed from the impoundment and disposed of in accordance with applicable Federal and State requirements. Soils immediately below the impoundment's system components will be tested to ensure the soils have not become contaminated. Once testing is complete and the results confirmed, the impoundment will be backfilled with soil and graded to match the surrounding topography as shown on Sheet C-101 titled "Site Plan" included in Enclosure "A". If the soils below the system components have become contaminated, the Solid Waste Section will be notified and corrective actions undertaken to remediate any contaminated areas prior to backfilling with soil material.

Operations

The underground leachate storage tank will be equipped with continuous leak detection and high liquid level monitoring devices. Each alarm condition will be visually indicated by a dedicated indicator which is to remain lit until such time as the alarm condition is corrected. Each alarm condition will also be audibly annunciated via a pulsing horn which can be silenced manually via a horn silence button.

The system console shall be equipped with a "system detecting" indicator light to visually indicate to the operator that the detection systems are operating as intended. The system console will be inspected by the operator at least weekly to confirm system operation. Results of the inspection will be recorded in the underground leachate storage tank inspection monitoring reports

A monitoring access point will be provided to allow the operator to manually check the depth of liquid within the tank from which the volume of stored liquid can be determined based on a tank calibration chart. The volume of liquid within the tank will be checked at least weekly. However, during the initial 6-months following installation of the tank, the volume of stored leachate will be checked more often as necessary in order to establish a general schedule for leachate removal activities. Results of the leachate volume monitoring results will be recorded in the underground leachate storage tank inspection monitoring reports.

Leachate will periodically be removed from the underground storage tank by the County or a licensed wastewater hauler and hauled to and disposed of at the Town of Marshall's wastewater treatment plant. A copy of the letter from the Town of Marshall, agreeing to accept the leachate from the Madison County Solid Waste Facility is included in Appendix C. Results of the leachate removal/hauling operation will be recorded in the underground leachate storage tank inspection monitoring reports.

ENCLOSURE "A"

Sheet C-101, Site Plan

Sheet C-501, Miscellaneous Details, Revised 12-13-10

ENCLOSURE "B"

Technical Specification

PART I: GENERAL

1.01 Scope of Work

A. This section covers the furnishing of all labor, supervision, equipment and materials necessary to furnish and install, complete and ready to use, the Double-Wall Fiberglass Reinforced Tank(s) including all appurtenances, excavation, foundation preparation, tank setting, backfilling, compaction and all necessary and incidental items required to complete the Work, all in accordance with the Contract Drawings and these Contract Specifications.

1.02 Quality Assurance

A. Tank manufacturer shall have verifiable experience in the manufacture of Double-Wall Fiberglass Reinforced Tanks.

B. Governing Standards, as applicable:

Tank manufacturer shall be in the business of manufacturing tanks to Underwriters Laboratories (UL) Standard 1316.

PART II: PRODUCTS

2.01 Double-Wall Fiberglass Reinforced (FR) Underground Storage Tanks

A. Loading Conditions – Tank shall meet the following design criteria:

1. Internal Load – Tank shall withstand a 5-psig air-pressure test with 5:1 safety factor. Contractor shall individually test tanks for leakage prior to installation. Maximum test pressure is 5 psig.
2. Vacuum Test – To verify structural integrity, every standard 10'-diameter tank and smaller shall be vacuum tested by the manufacturer at the factory to 11.5" of mercury.
3. Surface Loads – Tank shall withstand surface H-20 axle loads when properly installed according to manufacturer's current Installation Manual and Operating Guidelines.
4. External Hydrostatic Pressure and Burial Depth – Tank shall be capable of being buried in ground with 7' of overburden over the top of the tank, the hole fully flooded and a safety factor of 5:1 against general buckling.

5. Tank shall support accessory equipment – such as drop tubes, submersible pumps and ladders – when installed according to the tank manufacturer's current Installation Manual and Operating Guidelines.

B. Product Storage

1. Tank shall be capable of storing leachate or chemicals with specific gravity up to 1.1.
2. Tank shall be vented to atmospheric pressure.
3. Tank shall be capable of storing products identified in the manufacturer's current standard limited warranty.

C. Materials

1. Tank shall be manufactured with 100% resin and glass-fiber reinforcement. No sand fillers.
2. Premium resin shall be used in fabricating the inner surface of all landfill leachate and chemical tanks.

D. Tank Dimensions

1. Tank shall have nominal capacity of 4,000 gallons.
2. Tank shall have nominal outside diameter of six (6) to eight (8) feet.

E. Service Conditions and Requirements

1. When applicable, an Underground Tank (UT) Application form, which shall include the composition of landfill leachate to be collected in the tank, shall be completed and submitted to the manufacturer for approval prior to tank manufacture.
2. Approval for each application of the tank, any limitations on use and any design considerations shall be provided by the manufacturer.
3. When approved, the completed form shall be returned to the customer and becomes a part of the Limited Warranty for the tank.

F. Interstitial Space

1. Tank shall have a space between the primary and secondary walls to allow for the free flow and containment of leaked product from the primary tank. The monitoring space shall provide equal communication in all directions. The space shall also allow the insertion of a monitoring device through a monitoring fitting.

2.02 Accessories

A. Leak Monitoring and Overfill Detection System

Provide a continuous leak and overfill detection system utilizing electro-optic technology or other approved monitoring systems.

1. Alarm Controller

   Alarm console to be NEMA 4X with remote sensor test capability at console utilizing test button. When pressed the test button will test entire system electronic from control panel to sensors. Console to be UL listed to provide intrinsically safe output circuits to electro-optic sensors in Class I, Group D hazardous locations. Console to be OMNTEC Mfg., Inc., Model ELP21LU-series or equal. Console must monitor both interstitial space and high level in tank for presence of liquid. Each alarm condition to be visually indicated by a dedicated red L.E.D. indicator which is to remain lit until alarm condition is corrected. Each alarm condition to also be audibly annunciated via a 95-decibel piezoelectric pulsing horn which can be silenced via the horn silence button. Console shall also provide a green "system detecting" indicator. Each alarm to have N.O. dry contacts for control purposed, as well as low voltage outputs for optional NEMA 4X RA-series remote audio/visual alarm panel.

2. Interstitial Sensor

   Interstitial sensor to be OMNTEC Model LWF (for dry fiberglass interstitial) or equal. Sensor(s) to be self diagnostic with dry condition creating a normally closed light beam and an alarm condition opening (refracting) the normally closed light beam. Sensor(s) and console to be UL listed and third party tested as a system.

3. High Level Sensor

   High level sensor to be OMNTEC L-1 series, or equal, and be of proper length to alarm at 90% of tank capacity. Sensor(s) to be self diagnostic with dry condition creating a normally closed light beam and an alarm condition opening (refracting) the normally closed light beam. Sensor(s) and console to be UL listed and third party tested as a system.

B. Anchor Straps

1. Straps shall be compatible anchor straps as supplied by tank manufacturer.
2. Number and location of straps shall be as specified by the tank manufacturer.
3. Each strap shall be capable of withstanding a maximum load of 25,000 pounds.

C. Prefabricated Concrete Deadman Anchors

1. Deadman shall be as supplied by the tank manufacturer.
2. Number, length and weight shall be as specified by the tank manufacturer.
3. Deadman shall provide adjustable anchor points for the anchor straps.

D. Manways

1. All tanks for leachate use shall require at least one manway.
2. All manways shall be flanged and of the diameter as shown on the plans, complete with UL-listed cover, gasket and hardware.
3. Location is shown on tank drawings.
4. Manway extensions, as shown on the plans, shall be of the same material as the tank as supplied by the tank manufacturer.

E. Gauge Plates

1. Gauge plates shall be installed under each service fitting and manway opening.

F. Ladders (optional as shown on the Plans)

1. Ladders shall be the standard ladder as supplied by tank manufacturer.
2. Ladder material (fiberglass or aluminum) shall be shown on tank drawings.

G. Internal Pump Platform (Optional as shown on the Plans)

1. Contact tank manufacturer with pump details.

H. Fittings

1. All fittings shall be located along the top centerline of the tank. Bottom drain and tangential nozzles are not allowed.
2. All standard NPT threaded fittings shall be constructed of carbon steel.

3. All standard NPT threaded fittings shall be half-couplings, and 2"-, 4"- or 6"-diameter. Reducers are to be used for smaller sizes where shown and provided by contractor.
4. All NPT fittings shall withstand a minimum of 150 foot-pounds of torque and 1,000 foot-pounds of bending, both with a 2:1 safety factor.
5. All optional FRP nozzles shall be flat-faced, flanged and gusseted, and are available in 2"-, 4"-, 6"- or 8"-diameter.
6. All optional FRP nozzles shall conform to ANSI B16.5 150# bolting pattern.
7. Each interstitial-space monitor fitting shall consist of a 2" NPT fitting on the secondary tank.

PART III: SUBMITTALS

A. Submit manufacturer's product data; certificates of compliance on materials utilized during construction and on materials furnished; and brochures/manuals containing complete information and instructions pertaining to storage, handling, installation, wiring, inspection, repair and testing for each product/material furnished. Submittal information shall include applicable warranties.

B. Contractor/Tank Installer shall submit copies of qualifications/certifications relative to the installation of Fiberglass Reinforced Underground Storage Tanks and ancillary equipment.

PART IV: INSTALLATION AND TESTING

4.01 Installation

A. The Fiberglass Reinforced Underground Storage Tank and all accessories shall be installed in accordance with the manufacturer's installation Manual and Operating Guidelines for Double-Wall Fiberglass Underground Storage Tanks in effect at time of installation.

B. Contractor/Tank Installer shall be qualified in the installation of Double-Wall Fiberglass Reinforced Underground Storage Tanks.

C. Leak Monitoring and Overfill Detection Systems and all accessories shall be installed in accordance with the manufacturer's Installation Manual and Operating Guidelines for Leak Monitoring and Overfill Detection Systems in effect at time of installation.

4.02 Testing

A. Tank shall be tested in accordance with the manufacturer's Installation Manual and Operating Guidelines for Double-Wall Fiberglass Reinforced Underground Storage Tanks in effect at time of installation.

B. Leak Monitoring and Overfill Detection System shall be tested in accordance with the manufacturer's Installation Manual and Operating Guidelines for Leak Monitoring and Overfill Detection Systems in effect at time of installation.

C. Testing results shall be submitted to the Owner.

PART V: WARRANTY

5.01 Warranty

A. Warranty shall be manufacturer's limited warranty for Double-Wall Fiberglass Reinforced Underground Storage Tanks in effect at time of purchase.

B. Warranty shall be manufacturer's limited warranty for the Leak Monitoring and Overfill Detection System in effect at time of purchase.

END OF SECTION

APPENDIX C

Leachate Acceptance Letter
Town of Marshall, North Carolina

TOWN OF MARSHALL

P.O. BOX 548
180 SOUTH MAIN STREET
MARSHALL, NC 28753

828-649-3031
828-649-3413 Fax

Lawrence Ponder, Mayor
Aileen Payne, Mayor Pro-Tem

12 September, 2010

Mr. Jim Huff
Solid Waste Director
Madison County, North Carolina

RE: Acceptance of Leachate at the Town of Marshall Wastewater Treatment Facility from the Madison County Solid Waste Landfill

Dear Mr. Huff,

Per the Town of Marshall Pretreatment program Regulations, the Town of Marshall will accept leachate from the Madison County Solid Waste Landfill under the following conditions:

1. All leachate to be delivered to the wastewater treatment facility shall be tested by a NC certified wastewater laboratory before delivery and must be approved by the Town of Marshall Pretreatment Program Coordinator.
2. The Maximum Daily Load Limit for Biochemical Oxygen Demand (BOD_5) of the leachate delivered to the wastewater plant shall not exceed 30 pounds per day.
3. The Maximum Daily Load Limit for Total Suspended Solids (TSS) of the leachate delivered to the plant shall not exceed 30 pounds per day.
4. The pH of the leachate shall be between 6 and 9 Standard pH Units (SU).
5. The maximum daily flow of leachate to be accepted shall be calculated using the concentrations measured for BOD_5 and TSS in the formula:

$$\text{Maximum Allowable Flow (MGD)} = \frac{\text{Allowable Pounds per Day}}{\text{Concentration mg/l (8.34)}}$$

6. In no case shall flows above 9,000 gallons per day (0.009 MGD) be accepted at the Wastewater Treatment Facility.
7. The Town of Marshall shall designate the dump location for the leachate pump and haul operation.

Respectfully Submitted,

Lawrence Ponder
Mayor
Town of Marshall

Alderman: David Allen Billie Jean Haynie Dennis Ledford Luther Nix

APPENDIX D

Explosive Gas Monitoring Procedure

Appendix D

EXPLOSIVE GAS MONITORING PROCEDURE
MADISON COUNTY LANDFILL
PERMIT #58-03

Quarterly the Madison County landfill will monitor for explosive landfill gases at the landfill gas monitoring probes/wells, as shown on Sheet C-101, Facility Plan, Madison County Landfill, in Appendix A. The County is also required to perform quarterly monitoring at/in all existing and future enclosed on-site structures. Currently, the occupied on-site structures include the Maintenance and Recycling Building and the Scale House. Other small structures include miscellaneous storage structures, valve control houses, pump stations, etc.

The location and spacing of the landfill gas monitoring probes/wells are in accordance with Permit No. 58-03, for the Madison County Landfill Facility.

The migration of methane and other explosive landfill gases (landfill gas) is induced by pressure gradients. Landfill gases will move from areas of high pressure to those of low pressure following the path of least resistance. Landfill gas will generally migrate vertically until it reaches the landfill surface where it may begin to flow horizontally until it finds a pathway out through the permeable in situ soils or a landfill gas venting/extraction system. Experience has shown that whenever gas is migrating no matter what the spacing or depth of the monitoring probes, the gas will fill the void created by the monitoring well and an explosive gas detection meter will monitor the level of concentration.

The level of methane gas (CH_4), a constituent within the landfill gas, can be detected by use of an instrument designed to detect explosive gas concentrations. In this case, the instrument that will be used will be a landfill gas detection metering device specifically designed for use in monitoring landfill gas concentrations. The meter will be equipped with an internal vacuum pump capable of drawing gas from within the voids in the monitoring probe/well. Meter readings will depict methane gas (CH_4) concentrations in percent of the Lower Explosive Limit (% LEL) and/or total percent methane gas concentration (% CH_4). Depending on the particular meter utilized, other readings such as the percent concentration of carbon dioxide (% CO_2) and percent concentration of oxygen (% O_2) will be recorded. The field calibration and use of the monitoring instrument should be in accordance with the manufacturer's instructions. Observations and readings for the landfill gas monitoring probes/wells will be recorded on the "Landfill Gas Measurements - Field Worksheet, Madison County Landfill, Permit #58-03" included as Attachment 1 to Appendix D. Observations for the various on-site structures will also be recorded on the attached form.

Exterior Monitoring and Response Plan

Quarterly, a County employee or contractor for the County will visit each landfill gas monitoring probe/well. Using the detection instrument, he/she will determine if landfill gas is present in the monitoring probe/well. Observations will be recorded on the aforementioned "Landfill Gas Measurements - Field Worksheet, Madison County Landfill, Permit #58-03" form.

If landfill gas is present and the level is detected at or above the lower explosive limit (100% LEL) then the Madison County Solid Waste Director will be notified immediately. If it is determined that explosive landfill gas has or may have migrated beyond the particular monitoring well then additional steps may be implemented to delineate the extent of any suspected landfill gas migration. If it is determined that explosive landfill gas has or may have migrated across the landfill boundary then the facility will immediately take all necessary steps to ensure protection of human health. The Solid Waste Director will then notify the North Carolina Department of Environment and Natural Resources (NCDENR), Solid Waste Section in the Asheville Office. The Director will follow-up the telephone call with an electronic mail message detailing the event and the steps taken to protect human health. Within seven (7) days of detection, the methane gas levels detected and a description of the steps taken to protect human health will be placed in the operating record. Within 60 days of the detection of suspected landfill gas migration beyond the landfill boundary, the County will prepare and implement a remediation plan for the suspected landfill gas releases. A copy of the remediation plan will be placed in the operating record and the NCDENR will be notified that the plan has been implemented. The plan will describe the nature and extent of the problem and the proposed remedy. Resampling of the affected landfill gas monitoring wells will be performed as necessary to evaluate the effectiveness of the approved remediation plan.

Interior/Structure Monitoring and Response Plan

Other quarterly monitoring locations will be the on-site structures located within the landfill's Facility Boundary. Each structure will be monitored for explosive landfill gas using the following general protocol:

1. Crawl spaces, if applicable, will be monitored;
2. Corners in the structure, if accessible, will be monitored;
3. Any observed holes, cracks and/or pipe penetrations through the foundation will be monitored.

Observations will be recorded on the aforementioned "Landfill Gas Measurements - Field Worksheet, Madison County Landfill, Permit #58-03" form.

If methane gas is detected at or above 25% of its lower explosive limit (25% LEL) in any structure, excluding gas control or gas recovery system components, the detection instrument will be recalibrated in accordance with the manufacturer's recommendations/procedures and the structure resampled. If the reading is still at or above 25% LEL, immediately evacuate the building and take all steps necessary to protect human health. The Madison County Solid Waste Director will be immediately notified. The Solid Waste Director will then notify the NCDENR,

Solid Waste Section in the Asheville Office. The Director will follow-up the telephone call with an electronic mail message detailing the event and the steps taken to protect human health. Within seven (7) days of initial detection, the methane gas levels detected and a description of the steps taken to protect human health will be placed in the operating record. Upon taking the necessary safety precautions, attempt to determine the source of the explosive gas. If the source is found, initiate repairs to prevent re-infiltration of the landfill gas or remove the source. If the source of the landfill gas infiltration can not be easily determined and/or promptly corrected then the structure must be closed and marked to prevent further occupancy. The County will then prepare and implement a remediation plan for the suspected landfill gas releases within sixty (60) days of initial detection. The plan will describe the nature and extent of the problem and the proposed remedy. A copy of the remediation plan will be placed in the operating record and the NCDENR will be notified that the plan has been implemented. The structure will remain closed for occupancy until such time as the repairs and/or remediation plan have been implemented, completed and the structure retested for the presence of landfill gas. The structure will be reopened for occupancy once the landfill gas concentrations are below the 25% LEL concentration.

Landfill/Explosive Gas Monitoring Procedures

The following general procedures should be followed relative to conducting monitoring in onsite structures and/or the landfill gas monitoring probes/wells on the site:

Preliminary Procedures:

a. Prepare the Landfill Gas Measurements – Field Worksheet (Attachment 1) noting the name of the person taking readings, date, weather conditions, ambient temperature, atmospheric pressure, gas monitoring equipment, factory calibration date and field calibration date.
b. Check the monitoring instrument to ensure the water trap has a clean dry filter and the inlet particulate filter is clean and dry, if so equipped.
c. Check the monitoring instrument for proper operation and battery strength.
d. Field calibrate the monitoring instrument in accordance with the manufacturer's recommendation/procedure.
e. Proceed to the first monitoring point.

Interior/Structure Monitoring Procedures:

a. Prior to entering/monitoring the structure 1) note the time on the Landfill Gas Measurements – Field Worksheet form for the particular structure being monitored 2) turn the meter on and purge with ambient air to obtain a methane reading of 0%.

b. For interior monitoring, proceed to the test area and enter as gently as possible. Avoid creating air movement, which can disperse methane. If sampling air in a closed space such as a leachate pump station, keep the cover closed as much as possible to prevent dispersal of the gas. If

monitoring in a confined space, install a gas probe rod on the end of the tube and insert it into the space. **Sampling personnel should never enter a confined space without proper training and the appropriate permit and supervisory approval.**

c. Let the meter stabilize and read the gas levels indicated, (i.e. % LEL or % volume for methane, and carbon dioxide and oxygen if so equipped).

d. Note results on the Landfill Gas Measurements – Field Worksheet (Attachment 1). The location of the test should be noted.

e. Replace covers or caps removed to access sampling areas.

f. Repeat the process for the next monitoring location or structure.

If methane gas levels are detected and confirmed to be at or above 25% of the LEL, the facility will immediately initiate the response plan outlined in the Interior/Structure Monitoring and Response Plan noted above.

Exterior Monitoring Procedures:

a. Purge the meter with on-site ambient air to obtain a methane reading of 0%.

b. Record time of sample collection at the landfill gas probe/well.

c. Check monitoring point for condition and suitability for monitoring. Record any problems with the location of the Landfill Gas Measurements Field Worksheet.

d. Remove the sample tube cap. Connect the sample tube to the sample port.

e. First, monitor the relative pressure inside the probe if the monitoring instrument is so equipped. Draw a sample through the meter. Monitor methane readings until a steady state methane reading is obtained. Record the steady state reading.

f. Disconnect sample tube from the probe/well. Replace the tube cap whenever the meter is not connected to the tube.

g. Proceed to the next monitoring point and repeat the above procedures.

If methane gas levels are detected and confirmed to be at or above 100% of the LEL, the facility will immediately initiate the response plan outlined in the Exterior Monitoring and Response Plan noted above.

ATTACHMENT 1

LANDFILL GAS MEASUREMENTS – FIELD WORKSHEET
Madison County Landfill
Permit #58-03

LANDFILL GAS MEASUREMENTS – FIELD WORKSHEET
Madison County Landfill
Permit #58-03

Name of Person Taking Readings: _____ Date: _____

Weather Conditions: _____ Ambient Temperature: _____

Atmospheric Pressure: _____

Gas Monitoring Equipment: _____

Factory Calibration Date: _____ Field Calibration Date: _____

Well/Probe ID or Structure	Time	Readings (stable or variable)	% LEL	% CH_4	% CO_2	% O_2	Notes:
LFG-01							
LFG-02							
LFG-03							
LFG-04							
LFG-05							
LFG-06							
Maint. & Recycle Bldg.							
Scale House							
*							

* - Other miscellaneous structures will be monitored and the observations noted on the form.

Field Observation Notes:

_____

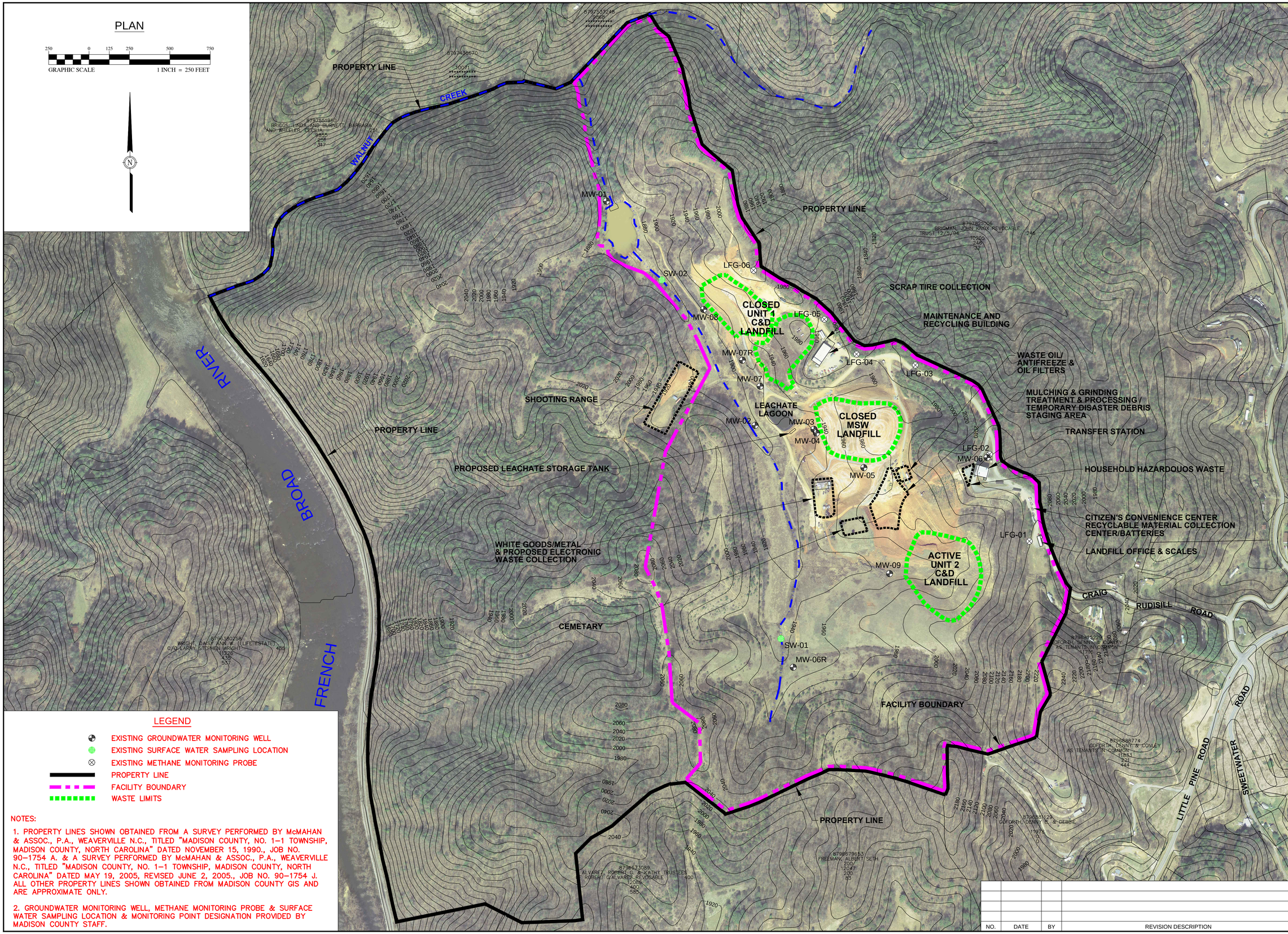
_____

_____

_____

_____

_____



LEGEND

- EXISTING GROUNDWATER MONITORING WELL
- EXISTING SURFACE WATER SAMPLING LOCATION
- EXISTING METHANE MONITORING PROBE
- PROPERTY LINE
- FACILITY BOUNDARY
- WASTE LIMITS

NOTES:

1. PROPERTY LINES SHOWN OBTAINED FROM A SURVEY PERFORMED BY McMAHAN & ASSOC., P.A., WEAVERVILLE N.C., TITLED "MADISON COUNTY, NO. 1–1 TOWNSHIP, MADISON COUNTY, NORTH CAROLINA" DATED NOVEMBER 15, 1990., JOB NO. 90–1754 A. & A SURVEY PERFORMED BY McMAHAN & ASSOC., P.A., WEAVERVILLE N.C., TITLED "MADISON COUNTY, NO. 1–1 TOWNSHIP, MADISON COUNTY, NORTH CAROLINA" DATED MAY 19, 2005, REVISED JUNE 2, 2005., JOB NO. 90–1754 J. ALL OTHER PROPERTY LINES SHOWN OBTAINED FROM MADISON COUNTY GIS AND ARE APPROXIMATE ONLY.

2. GROUNDWATER MONITORING WELL, METHANE MONITORING PROBE & SURFACE WATER SAMPLING LOCATION & MONITORING POINT DESIGNATION PROVIDED BY MADISON COUNTY STAFF.

NO.	DATE	BY	REVISION DESCRIPTION

McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
55 BROAD STREET ASHEVILLE, NC 28801 PH. (828) 252-0575

MADISON COUNTY LANDFILL
FACILITY PLAN

MADISON COUNTY

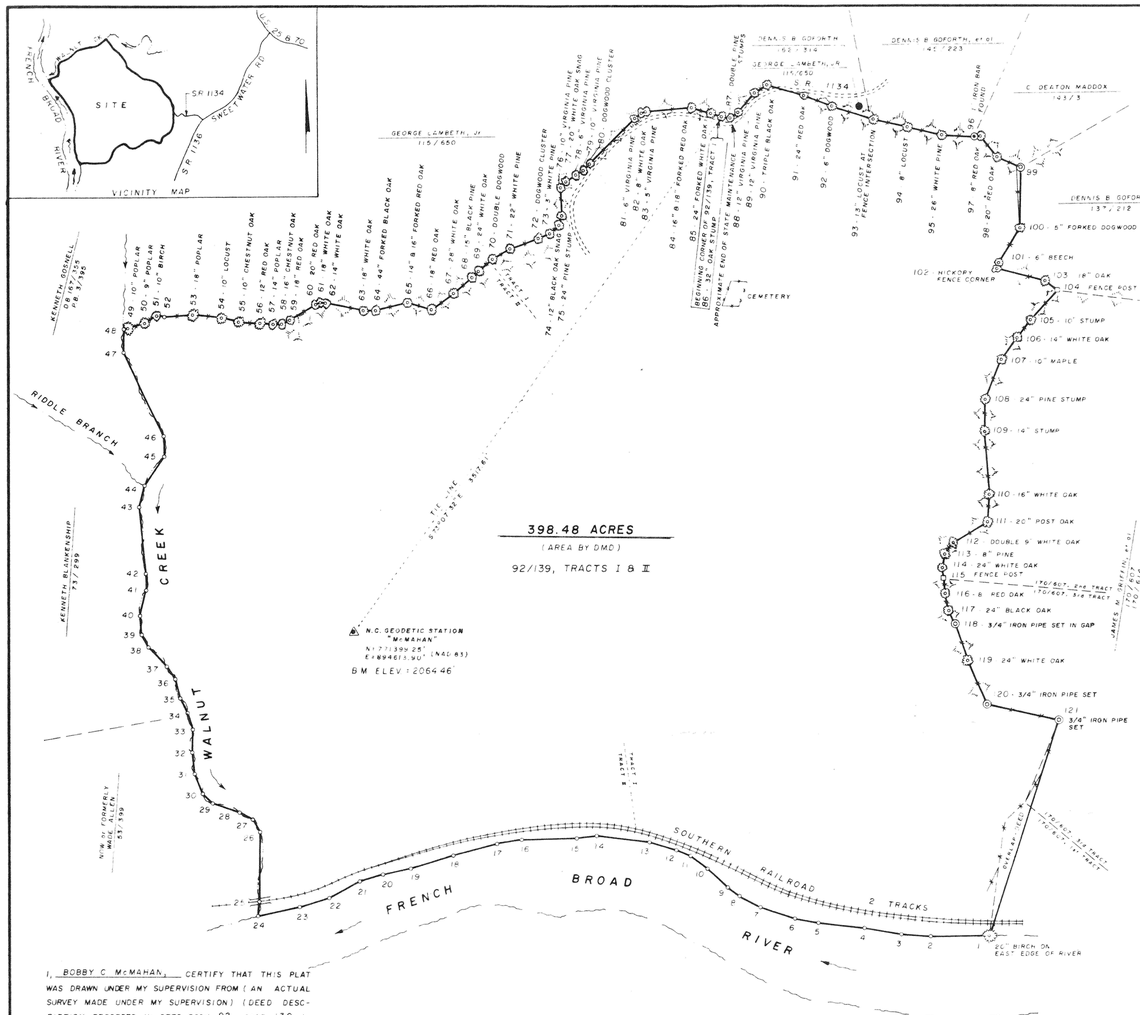
MADISON COUNTY, NORTH CAROLINA

JOB NO.: 09.00729
DATE: FEBRUARY 2010
DESIGNED BY: WHS
CADD BY: KS
DESIGN REVIEW: XXX
CONST. REVIEW: XXX
FILE NAME: 60/0729-C-101-Facility Plan.dwg

FACILITY PLAN

SHEET
C-101

Q:\2009\09.00729\Design\Solid Waste\Drawings\58-03_Facility-Plan_Active-Landfill_Craig-Rudisill-Road\09.00729-C-101-Facility Plan.dwg 8/6/2010 1:38 PM KELLY



Pt to Pt	BEARING	DISTANCE	Pt to Pt	BEARING	DISTANCE
1- 2	N 19°10'54"W	323.14'	62- 63	S 07°33'35"E	206.24'
2- 3	N 16°11'21"W	161.40'	63- 64	S 21°14'46"E	88.43'
3- 4	N 08°19'32"W	207.18'	64- 65	S 33°09'46"E	187.44'
4- 5	N 12°10'17"W	260.86'	65- 66	S 03°57'18"E	136.44'
5- 6	N 08°25'37"W	136.47'	66- 67	S 15°15'14"E	111.82'
6- 7	N 00°00'00"E	200.00'	67- 68	S 58°58'11"E	136.16'
7- 8	N 08°44'46"E	131.53'	68- 69	S 17°52'34"E	136.16'
8- 9	N 18°26'06"E	79.06'	69- 70	S 69°06'00"E	174.00'
9- 10	N 24°34'17"E	154.35'	70- 71	S 48°55'10"E	172.40'
10- 11	N 17°50'00"E	115.43'	71- 72	S 59°56'10"E	132.40'
11- 12	N 06°42'15"E	85.59'	72- 73	S 27°55'28"E	62.05'
12- 13	N 03°28'06"W	165.30'	73- 74	S 50°38'24"E	78.44'
13- 14	N 09°54'15"W	119.77'	74- 75	N 82°39'15"E	142.45'
14- 15	N 30°04'07"W	109.77'	75- 76	N 74°43'03"E	139.44'
15- 16	N 21°02'15"W	278.57'	76- 77	N 70°44'55"E	43.23'
16- 17	N 29°51'56"W	143.27'	77- 78	S 55°52'27"E	44.04'
17- 18	N 33°21'59"W	245.46'	78- 79	S 45°09'23"E	49.46'
18- 19	N 36°52'12"W	250.00'	79- 80	S 61°31'15"E	49.63'
19- 20	N 30°39'02"W	156.92'	80- 81	S 64°56'15"E	146.63'
20- 21	N 36°01'39"W	136.01'	81- 82	S 52°47'39"E	84.13'
21- 22	N 46°02'50"W	164.49'	82- 83	S 37°26'15"E	49.66'
22- 23	N 36°37'44"W	168.00'	83- 84	S 23°44'15"E	241.66'
23- 24	N 29°24'42"W	241.87'	84- 85	S 41°55'15"E	133.33'
24- 25	N 79°45'21"E	84.34'	85- 86	S 12°55'15"E	63.78'
25- 26	N 71°35'36"E	381.37'	86- 87	S 16°[illegible]'15"E	42.[illegible]
26- 27	N 42°30'38"E	81.39'	87- 88	S 14°[illegible]'15"E	18.[illegible]
27- 28	N 10°00'20"E	86.31'	88- 89	S 11°[illegible]'15"E	8.[illegible]
28- 29	N 00°00'00"E	155.00'	89- 90	S 14°[illegible]'15"E	[illegible]
29- 30	N 26°33'54"E	78.26'	90- 91	[illegible]	[illegible]
30- 31	N 50°31'40"E	117.35'	91- 92	[illegible]	[illegible]
31- 32	N 65°33'22"E	120.83'	92- 93	[illegible]	[illegible]
32- 33	N 71°33'54"E	126.49'	93- 94	[illegible]	[illegible]
33- 34	N 53°44'46"E	93.01'	94- 95	S 67°[illegible]'15"E	42.[illegible]
34- 35	N 47°07'15"E	95.52'	95- 96	S 13°32'10"E	154.[illegible]
35- 36	N 52°55'41"E	107.00'	96- 97	S 12°47'[illegible]"E	68.42'
36- 37	N 36°52'15"E	73.00'	97- 98	S 31°44'15"W	167.95'
37- 38	N 28°52'13"E	149.65'	98- 99	S 06°46'52"W	135.33'
38- 39	N 42°30'38"E	81.39'	99-100	S 09°26'36"W	323.79'
39- 40	N 67°06'56"E	103.08'	100-101	N 77°35'29"W	243.14'
40- 41	N 84°05'38"E	145.77'	101-102	S 88°39'10"W	79.37'
41- 42	N 70°35'36"E	90.14'	102-103	S 09°35'55"E	279.94'
42- 43	N 66°11'39"E	371.62'	103-104	S 17°57'56"W	77.95'
43- 44	N 82°[illegible]'15"E	122.76'	104-105	N 67°09'33"W	284.[illegible]
44- 45	S 79°34'04"E	194.05'	105-106	N 69°36'24"W	[illegible]
45- 46	N 70°41'09"E	111.56'	106-107	N 75°35'[illegible]"W	14.[illegible]
46- 47	N 45°50'18"E	514.39'	107-108	N 84°25'21"W	24.[illegible]
47- 48	N 71°28'05"E	128.03'	108-109	S 77°14'22"W	[illegible]
48- 49	S 35°53'05"E	24.94'	109-110	S 66°30'42"W	[illegible]
49- 50	S 35°53'05"E	96.61'	110-111	S 77°06'32"W	[illegible]
50- 51	S 47°22'39"E	74.62'	111-112	N 49°58'47"W	221.85'
51- 52	S 12°41'44"E	41.02'	112-113	N 72°08'37"W	74.40'
52- 53	S 23°18'51"E	118.61'	113-114	[illegible]	[illegible]
53- 54	S 13°40'01"E	158.97'	114-115	[illegible]	41.[illegible]
54- 55	S 03°32'40"E	94.58'	115-116	[illegible]	86.[illegible]
55- 56	S 14°45'55"E	123.50'	116-117	[illegible]	99.[illegible]
56- 57	S 13°06'42"E	71.06'	117-118	[illegible]	79.[illegible]
57- 58	S 21°06'32"E	73.55'	118-119	S 64°39'05"W	274.[illegible]
58- 59	S 47°46'[illegible]"E	35.30'	119-120	S 46°46'02"W	254.[illegible]
59- 60	[illegible]	160.42'	120-121	S 06°52'15"E	432.[illegible]
60- 61	[illegible]	26.65'	121- 1	S 80°42'15"E	1255.[illegible]
61- 62	[illegible]	49.57'			

NOTE: ALL CORNERS AT EDGE OF FRENCH BROAD RIVER AND CENTERLINE OF WALNUT CREEK ARE UNMARKED CORNERS (EXCEPT BIRCH ON EAST EDGE OF RIVER).

I, BOBBY C. McMAHAN, CERTIFY THAT THIS PLAT WAS DRAWN UNDER MY SUPERVISION FROM (AN ACTUAL SURVEY MADE UNDER MY SUPERVISION) (DEED DESCRIPTION RECORDED IN DEED BOOK 92, PAGE 139); THAT THE BOUNDARIES NOT SURVEYED ARE SHOWN AS BROKEN LINES PLOTTED FROM INFORMATION FOUND IN DEED BOOK ____, PAGE ____; THAT THE RATIO OF PRECISION AS CALCULATED BY LATITUDES AND DEPARTURES DOES EXCEED ONE PART IN 5,000; THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED.
WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 15th DAY OF NOVEMBER, 1990.

SURVEYOR: Bobby C. McMahan
REGISTRATION NO.: 2475

NORTH CAROLINA PROFESSIONAL SEAL 2475 LAND SURVEYOR BOBBY C. McMAHAN

I, EDITH H. McMAHAN, A NOTARY PUBLIC IN AND FOR THE COUNTY OF BUNCOMBE, STATE OF NORTH CAROLINA, DO HEREBY CERTIFY THAT BOBBY C. McMAHAN, A REGISTERED LAND SURVEYOR, PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED THE DUE EXECUTION OF THE FOREGOING INSTRUMENT.

THIS THE 15th DAY OF NOVEMBER, 1990.

NOTARY PUBLIC

MY COMMISSION EXPIRES: APRIL 1, 1995

STATE OF NORTH CAROLINA, COUNTY OF MADISON
THE FOREGOING CERTIFICATE OF EDITH H. McMAHAN, A NOTARY PUBLIC OF THE STATE AND COUNTY DESIGNATED IS CERTIFIED TO BE CORRECT. THIS ____ DAY OF ____ 19 90.

REGISTER OF DEEDS MADISON COUNTY

BY ____ DEPUTY

FILED FOR REGISTRATION ON THE ____ DAY OF ____, 1990
AT ____ O'CLOCK ____ M, AND RECORDED IN ____

REGISTER OF DEEDS MADISON COUNTY

BY ____ DEPUTY

LEGEND
- 3/4" IRON PIPE SET
- 1" IRON BAR FOUND
- TREE
- UNMARKED CORNER
- FENCE
- TOP OF RIDGE

SURVEY FOR

MADISON COUNTY

NO. 1-1 TOWNSHIP
MADISON COUNTY
NORTH CAROLINA

400 0 400 800 1600
SCALE: 1" = 400'
DATE: NOV. 15, 1990
REVISED: ____

McMAHAN & ASSOC., P.A.
P.O. BOX 1296
WEAVERVILLE, N.C. 28787
704-645-5554

JOB NO. 90-7[illegible]

DUNCAN-PARNELL, INC. CHARLOTTE 1986 800-432-9022

REV. DEC. 18, 1991.

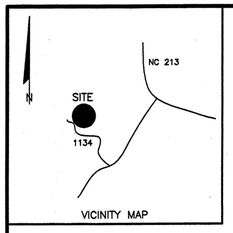
LAW ENVIRONMENTAL
CHARLOTTE, NORTH CAROLINA

PROPOSED SANITARY LANDFILL
MADISON COUNTY, NORTH CAROLINA

SITE DESCRIPTION MAP
LANDFILL SITE

JOB NO.	56-8550	FIGURE	2

PLAT BOOK ____, PAGE _____



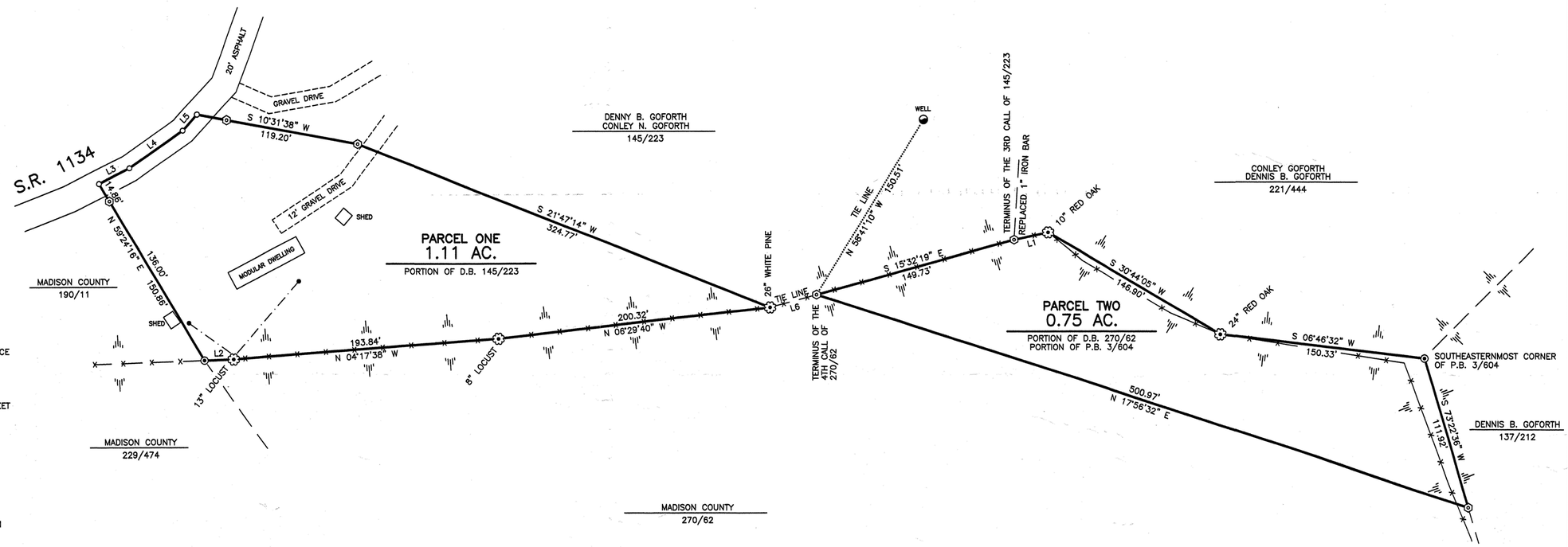
VICINITY MAP

LINE	BEARING	DISTANCE
L1	S 12°45'07" E	25.42'
L2	N 02°05'44" W	21.32'
L3	S 26°51'19" E	24.97'
L4	S 35°24'47" E	47.77'
L5	S 47°37'02" E	15.51'
L6	S 15°32'19" E	35.24'

LEGEND

- 3/4" IRON PIPE (FOUND)
- TREE (SPECIES AND DIAMETER AS NOTED)
- 5/8" REBAR WITH I.D. CAP (SET)
- UNMARKED POINT
- UTILITY POLE WITH OVERHEAD LINES
- FENCE
- RIDGE

TRUE NORTH BY SOLAR OBSERVATION



I HEREBY CERTIFY TO ONE OF THE FOLLOWING:

a. ☒ THAT THE SURVEY CREATES A SUBDIVISION OF LAND WITHIN THE AREA OF A COUNTY OR MUNICIPALITY THAT HAS AN ORDINANCE THAT REGULATES PARCELS OF LAND;

b. ☐ THAT THE SURVEY IS LOCATED IN A PORTION OF A COUNTY OR MUNICIPALITY THAT IS UNREGULATED AS TO AN ORDINANCE THAT REGULATES PARCELS OF LAND;

c. ☐ ANY OF THE FOLLOWING:
1. THAT THE SURVEY IS OF AN EXISTING PARCEL OR PARCELS OF LAND AND DOES NOT CREATE A NEW STREET OR CHANGE AN EXISTING STREET;
2. THAT THE SURVEY IS OF AN EXISTING BUILDING OR OTHER STRUCTURE, OR NATURAL FEATURE, SUCH AS A WATERCOURSE; OR
3. THAT THE SURVEY IS A CONTROL SURVEY.

d. ☐ THAT THE SURVEY IS OF ANOTHER CATEGORY, SUCH AS THE RECOMBINATION OF EXISTING PARCELS, A COURT-ORDERED SURVEY, OR OTHER EXCEPTION TO THE DEFINITION OF SUBDIVISION;

e. ☐ THAT THE INFORMATION AVAILABLE TO THE SURVEYOR IS SUCH THAT THE SURVEYOR IS UNABLE TO MAKE A DETERMINATION TO THE BEST OF THE SURVEYOR'S PROFESSIONAL ABILITY AS TO THE PROVISIONS CONTAINED IN (a) THROUGH (d) ABOVE.

NORTH CAROLINA PROFESSIONAL SEAL L-2475 LAND SURVEYOR BOBBY C. McMAHAN

I, BOBBY C. McMAHAN CERTIFY THAT THIS PLAT WAS DRAWN UNDER MY DIRECT SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION, DEED DESCRIPTION RECORDED IN DEED BOOK SEE PAGE PLAT, PLAT BOOK --, PAGE --; THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED AS DRAWN FROM INFORMATION IN DEED BOOK --, PAGE --; THAT THE RATIO OF PRECISION AS CALCULATED IS 1: 10,000; THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED.
WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER AND SEAL THIS 2ND DAY OF JUNE, A.D., 20 05.

SURVEYOR: Bobby C. McMahan
REGISTRATION NUMBER: 2475

FILED FOR REGISTRATION ON THE ____ DAY OF _____, 200__
AT ___ O'CLOCK ___.M., AND RECORDED IN _____

REGISTER OF DEEDS MADISON COUNTY

BY _____ DEPUTY

_____
MADISON COUNTY ZONING OFFICER

I, _____, REVIEW OFFICER OF MADISON COUNTY, CERTIFY THAT THE MAP OR PLAT TO WHICH THIS CERTIFICATION IS AFFIXED MEETS ALL STATUTORY REQUIREMENTS FOR RECORDING.

DATE: _____

_____
REVIEW OFFICER

SURVEY FOR

MADISON COUNTY

NO. 1-1 TOWNSHIP
MADISON COUNTY
NORTH CAROLINA

0' 50' 100' 150' 200'

SCALE : 1" = 50'

DATE : MAY 19, 2005
REVISED : JUNE 2, 2005

McMAHAN & ASSOCIATES, P.A.
P.O. BOX 1296
WEAVERVILLE, N.C. 28787
828-645-5554
FAX: 828-645-3041

JOB NO. 90-1754 J
E:\R14DWGS\1754J.DWG

APPENDIX B

Underground Leachate Storage Tank

Appendix B
Underground Leachate Storage Tank

Narrative

Introduction

Madison County has evaluated the option of continuing to operate the existing leachate lagoon versus constructing/installing an alternative method to manage the onsite collection of leachate from the Closed MSW Landfill. Since the MSW Landfill has been closed, the leachate flows from the facility have continued to diminish to the point that continued operation of the leachate lagoon is no longer feasible. Daily leachate flows from the Closed MSW Landfill have been determined to be approximately fifty to seventy-five (50-75) gallons per day or a maximum of approximately 2,250 gallons per month. Additional liquid accumulating in the existing leachate lagoon, that must be removed and treated by the County, is due to precipitation falling in the exposed lagoon area. To minimize the amount of leachate that must be removed and treated, the County proposes to install an underground leachate storage tank and remove the existing leachate lagoon from service. The proposed tank would be a double-wall fiberglass reinforced tank with an interstitial space between the primary and secondary walls to allow for the monitoring of potentially leaked product from the primary tank structure. The tank will be equipped with a continuous leak detection device as well as a high level alarm with both monitoring devices having visual and audible alarm systems. The tank would be equipped with an access monitoring port for manually measuring the depth/volume of accumulated leachate. Leachate will be periodically removed from the underground tank by the County or a licensed wastewater hauler and hauled to and disposed of at the Town of Marshall's wastewater treatment plant. A copy of the letter from the Town of Marshall, agreeing to accept the leachate from the Madison County Solid Waste Facility is included in Appendix C.

Construction Procedures

The proposed tank will be located between the existing leachate lagoon and the stormwater management basin west of the Closed MSW Landfill as shown on Sheet C-101, titled "Site Plan" included in Enclosure "A". The initial step will be to field verify the grades of the existing leachate collection line at the proposed connection point approximately 40-feet down gradient from the existing intermediate manhole/valve vault. Based on the elevation at this point, the proposed elevation of the tank will be confirmed such that: 1) the bottom elevation of the tank will be a minimum of two feet above the seasonal high groundwater table and a minimum of two feet vertical separation shall be maintained between bedrock and the lowest point of the tank and 2) an adequate slope of no less than 2% can be maintained on the proposed leachate collection line running to the tank from the connection point with the existing leachate collection line. Based on available data and field surveys, the bottom elevation of the tank is proposed to be approximately 1908. The groundwater elevation at the location of the tank has been estimated to be approximately 1903.6 based on the interpolation of groundwater elevation data collected during the fall 2010 scheduled groundwater monitoring event. Based on the aforementioned information, the bottom elevation of the tank should be in excess of four vertical feet above the

groundwater elevation. Section A-A of the Tank Detail as shown on Sheet C-501, Miscellaneous Details, Madison County Landfill, Leachate Collection System Modifications, revised 12-13-10, included in Enclosure "A" of Appendix B, Underground Leachate Storage Tank, provides a graphical depiction of the proposed tank elevation relative to the interpolated groundwater elevation at that location. The existing vertical separation between the proposed bottom elevation of the tank and the groundwater elevation at the site should allow for necessary field adjustments of the tank elevation to ensure a minimum of 2% slope on the leachate collection lines while still maintaining the required two-foot separation between the bottom of the tank and the groundwater. Bedrock is not anticipated to be an issue at this proposed underground storage tank location.

The tank will be installed in accordance with the particular manufacturer's installation instructions. A Technical Specification for the proposed double-wall fiberglass tank and integral monitoring devices is included in Enclosure "B" for reference. Once the underground leachate collection tank and all appurtenances have been installed and checked for proper operation, the leachate collection line will be installed to a point near the tie-in with the existing leachate collection line. A detail of the underground storage tank installation as well as all appurtenances is shown on Sheet C-501 titled "Miscellaneous Details" included in Enclosure A. At that point, the existing valve in the manhole/valve vault will be shut and any leachate within the line will be allowed to drain to the existing leachate lagoon. Once the line is free of visible flow the existing leachate line will be cut and the connection to the proposed leachate collection line to the tank will be constructed. A detail of the proposed connection to the existing leachate collection line is shown on Sheet C-501 titled "Miscellaneous Details" included in Enclosure "A". Care will be taken to ensure that no residual liquid will be discharged to the surrounding soil material. Once the connection is complete, the existing valve will be opened and the liquid allowed to flow to the underground leachate collection tank.

Once the underground leachate storage tank is in operation, the remaining leachate collection line and the existing leachate lagoon will be removed from service. The leachate collection line will be removed from the tie-in point with the new leachate collection line to the discharge point in the existing lagoon. The removed pipe will be disposed of in accordance with applicable Federal and State requirements. All liquid waste and waste residues will be removed from the existing leachate lagoon impoundment by the County or a licensed hauler and hauled to and disposed of at the Town of Marshall's wastewater treatment plant. A copy of the letter from the Town of Marshall, agreeing to accept the leachate from the Madison County Solid Waste Facility is included in Appendix C. The daily volume of leachate removed from the existing leachate lagoon during the draw down prior to removal of the system components will be coordinated with the Town of Marshall. Once all liquid and waste residues have been removed, the system components (liners, etc.) will be removed from the impoundment and disposed of in accordance with applicable Federal and State requirements. Soils immediately below the impoundment's system components will be tested to ensure the soils have not become contaminated. Once testing is complete and the results confirmed, the impoundment will be backfilled with soil and graded to match the surrounding topography as shown on Sheet C-101 titled "Site Plan" included in Enclosure "A". If the soils below the system components have become contaminated, the Solid Waste Section will be notified and corrective actions undertaken to remediate any contaminated areas prior to backfilling with soil material.

Operations

The underground leachate storage tank will be equipped with continuous leak detection and high liquid level monitoring devices. Each alarm condition will be visually indicated by a dedicated indicator which is to remain lit until such time as the alarm condition is corrected. Each alarm condition will also be audibly annunciated via a pulsing horn which can be silenced manually via a horn silence button.

The system console shall be equipped with a "system detecting" indicator light to visually indicate to the operator that the detection systems are operating as intended. The system console will be inspected by the operator at least weekly to confirm system operation. Results of the inspection will be recorded in the underground leachate storage tank inspection monitoring reports

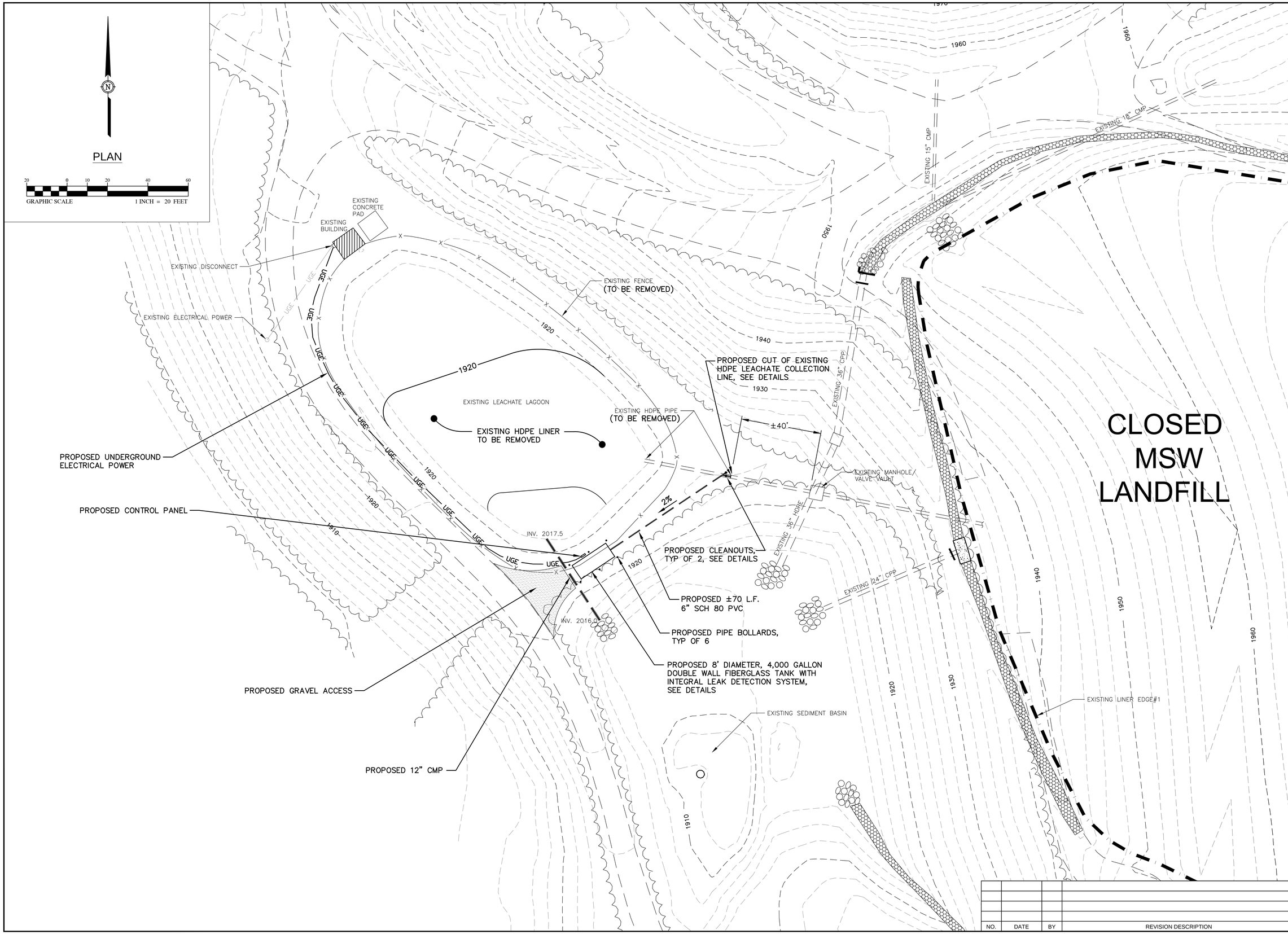
A monitoring access point will be provided to allow the operator to manually check the depth of liquid within the tank from which the volume of stored liquid can be determined based on a tank calibration chart. The volume of liquid within the tank will be checked at least weekly. However, during the initial 6-months following installation of the tank, the volume of stored leachate will be checked more often as necessary in order to establish a general schedule for leachate removal activities. Results of the leachate volume monitoring results will be recorded in the underground leachate storage tank inspection monitoring reports.

Leachate will periodically be removed from the underground storage tank by the County or a licensed wastewater hauler and hauled to and disposed of at the Town of Marshall's wastewater treatment plant. A copy of the letter from the Town of Marshall, agreeing to accept the leachate from the Madison County Solid Waste Facility is included in Appendix C. Results of the leachate removal/hauling operation will be recorded in the underground leachate storage tank inspection monitoring reports.

ENCLOSURE "A"

Sheet C-101, Site Plan

Sheet C-501, Miscellaneous Details, Revised 12-13-10



NO.	DATE	BY	REVISION DESCRIPTION

McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
55 BROAD STREET ASHEVILLE, NC 28801 PH: (828) 252-0575 FIRM LICENSE # C-0459

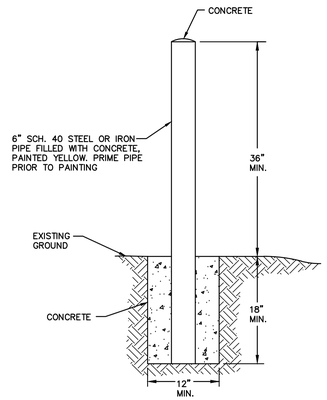
MADISON COUNTY LANDFILL
LEACHATE COLLECTION SYSTEM MODIFICATION
MADISON COUNTY
MADISON COUNTY, NORTH CAROLINA

JOB NO.: 09.00729
DATE: JULY, 2010
DESIGNED BY: WHS
CADD BY: KS
DESIGN REVIEW: ____
CONST. REVIEW: ____
FILE NAME: 09.00729-C-101-Site Plan.dwg

SITE PLAN

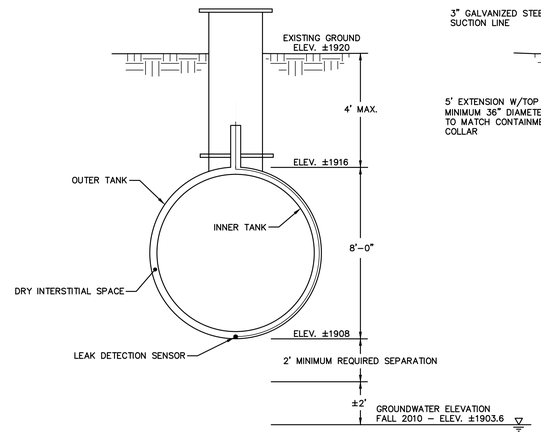
SHEET
C-101

Q:\2009\09.00729\Design\Solid Waste\Drawings\Leachate Collection System Modification\09.00729-C-101-Site Plan.dwg 8/6/2010 1:45 PM KELLY

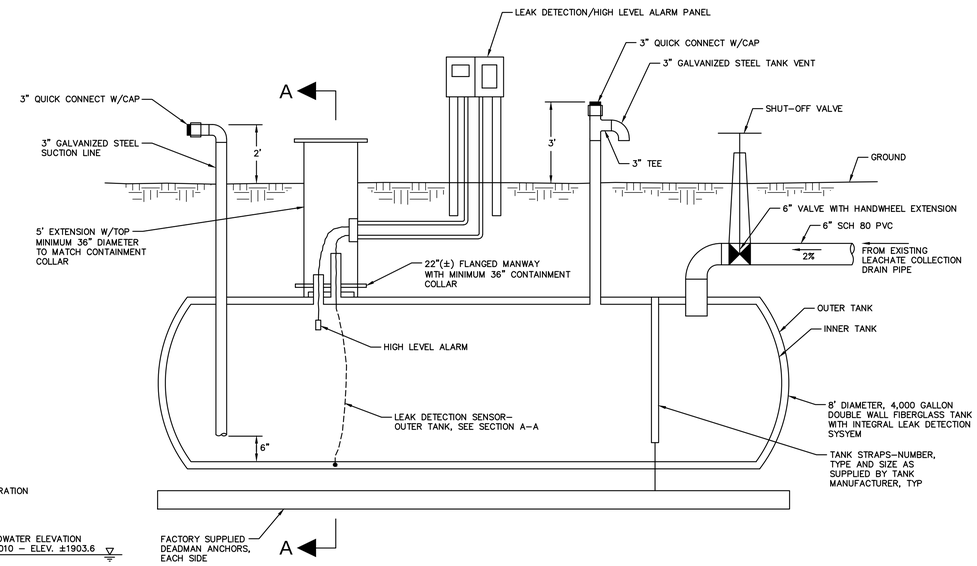


BOLLARD DETAIL

REVISION DATE - NOVEMBER 3, 2008



SECTION A–A

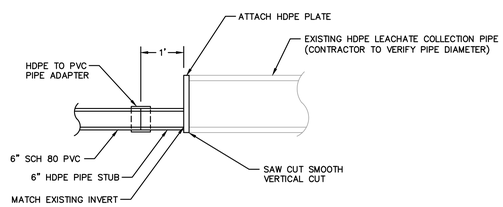


ELEVATION VIEW

NOTE:
ESTIMATED GROUNDWATER ELEVATION AT THE PROPOSED TANK LOCATION (±1903.6) BASED ON INTERPOLATED GROUNDWATER CONTOURS BETWEEN MW–3(1908.76), MW–4(1907.03) AND MW–2 (1894.24) FOR FALL 2010 GROUNDWATER MONITORING EVENT. GROUNDWATER ELEVATIONS WERE PROVIDED BY ALTAMONT ENVIRONMENTAL, INC.

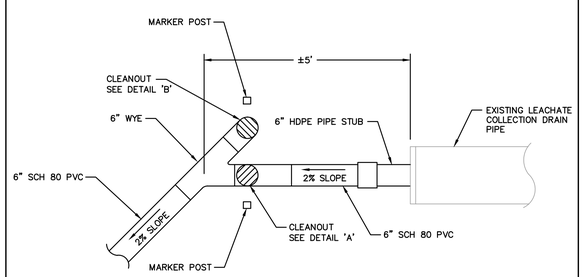
TANK DETAIL

NTS



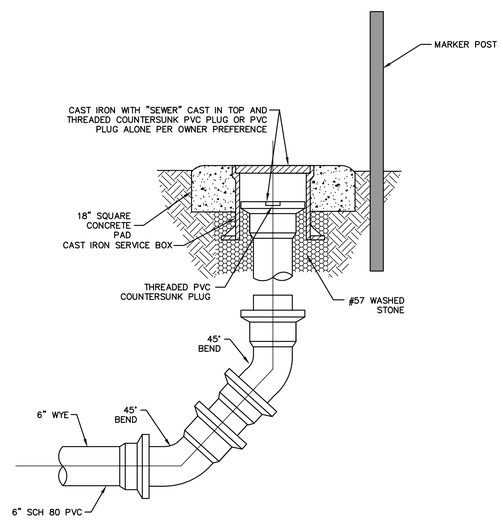
EXISTING LEACHATE COLLECTION DRAIN CAP

NTS



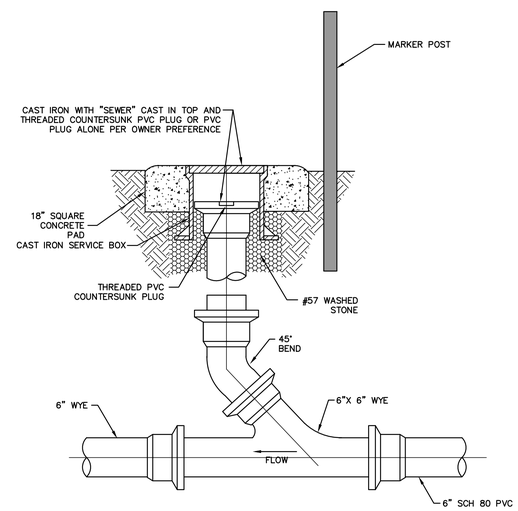
CLEANOUT PLAN

NTS



CLEANOUT DETAIL 'B'

NTS



CLEANOUT DETAIL 'A'

NTS

NO.	DATE	BY	REVISION DESCRIPTION
1	12-13-10	KS	REVISED PER NCDENR COMMENTS

McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
55 BROAD STREET ASHEVILLE, NC 28801 PH. (828) 252-0575 FIRM LICENSE # C-0459

NORTH CAROLINA PROFESSIONAL SEAL 13642 WILLIAM H. STOWE

MADISON COUNTY LANDFILL
LEACHATE COLLECTION SYSTEM MODIFICATION
MADISON COUNTY
MADISON COUNTY, NORTH CAROLINA

JOB NO.: 09.00729
DATE: JULY, 2010
DESIGNED BY: WHS
CADD BY: KS
DESIGN REVIEW: ____
CONST. REVIEW: ____
FILE NAME: 09.00729-C-501-Miscellaneous Details.dwg

MISCELLANEOUS DETAILS

SHEET
C-501

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ENCLOSURE "B"

Technical Specification

PART I: GENERAL

1.01 Scope of Work

A. This section covers the furnishing of all labor, supervision, equipment and materials necessary to furnish and install, complete and ready to use, the Double-Wall Fiberglass Reinforced Tank(s) including all appurtenances, excavation, foundation preparation, tank setting, backfilling, compaction and all necessary and incidental items required to complete the Work, all in accordance with the Contract Drawings and these Contract Specifications.

1.02 Quality Assurance

A. Tank manufacturer shall have verifiable experience in the manufacture of Double-Wall Fiberglass Reinforced Tanks.

B. Governing Standards, as applicable:

Tank manufacturer shall be in the business of manufacturing tanks to Underwriters Laboratories (UL) Standard 1316.

PART II: PRODUCTS

2.01 Double-Wall Fiberglass Reinforced (FR) Underground Storage Tanks

A. Loading Conditions – Tank shall meet the following design criteria:

1. Internal Load – Tank shall withstand a 5-psig air-pressure test with 5:1 safety factor. Contractor shall individually test tanks for leakage prior to installation. Maximum test pressure is 5 psig.
2. Vacuum Test – To verify structural integrity, every standard 10'-diameter tank and smaller shall be vacuum tested by the manufacturer at the factory to 11.5" of mercury.
3. Surface Loads – Tank shall withstand surface H-20 axle loads when properly installed according to manufacturer's current Installation Manual and Operating Guidelines.
4. External Hydrostatic Pressure and Burial Depth – Tank shall be capable of being buried in ground with 7' of overburden over the top of the tank, the hole fully flooded and a safety factor of 5:1 against general buckling.

5. Tank shall support accessory equipment – such as drop tubes, submersible pumps and ladders – when installed according to the tank manufacturer's current Installation Manual and Operating Guidelines.

B. Product Storage

1. Tank shall be capable of storing leachate or chemicals with specific gravity up to 1.1.
2. Tank shall be vented to atmospheric pressure.
3. Tank shall be capable of storing products identified in the manufacturer's current standard limited warranty.

C. Materials

1. Tank shall be manufactured with 100% resin and glass-fiber reinforcement. No sand fillers.
2. Premium resin shall be used in fabricating the inner surface of all landfill leachate and chemical tanks.

D. Tank Dimensions

1. Tank shall have nominal capacity of 4,000 gallons.
2. Tank shall have nominal outside diameter of six (6) to eight (8) feet.

E. Service Conditions and Requirements

1. When applicable, an Underground Tank (UT) Application form, which shall include the composition of landfill leachate to be collected in the tank, shall be completed and submitted to the manufacturer for approval prior to tank manufacture.
2. Approval for each application of the tank, any limitations on use and any design considerations shall be provided by the manufacturer.
3. When approved, the completed form shall be returned to the customer and becomes a part of the Limited Warranty for the tank.

F. Interstitial Space

1. Tank shall have a space between the primary and secondary walls to allow for the free flow and containment of leaked product from the primary tank. The monitoring space shall provide equal communication in all directions. The space shall also allow the insertion of a monitoring device through a monitoring fitting.

2.02 Accessories

A. Leak Monitoring and Overfill Detection System

Provide a continuous leak and overfill detection system utilizing electro-optic technology or other approved monitoring systems.

1. Alarm Controller

   Alarm console to be NEMA 4X with remote sensor test capability at console utilizing test button. When pressed the test button will test entire system electronic from control panel to sensors. Console to be UL listed to provide intrinsically safe output circuits to electro-optic sensors in Class I, Group D hazardous locations. Console to be OMNTEC Mfg., Inc., Model ELP21LU-series or equal. Console must monitor both interstitial space and high level in tank for presence of liquid. Each alarm condition to be visually indicated by a dedicated red L.E.D. indicator which is to remain lit until alarm condition is corrected. Each alarm condition to also be audibly annunciated via a 95-decibel piezoelectric pulsing horn which can be silenced via the horn silence button. Console shall also provide a green "system detecting" indicator. Each alarm to have N.O. dry contacts for control purposed, as well as low voltage outputs for optional NEMA 4X RA-series remote audio/visual alarm panel.

2. Interstitial Sensor

   Interstitial sensor to be OMNTEC Model LWF (for dry fiberglass interstitial) or equal. Sensor(s) to be self diagnostic with dry condition creating a normally closed light beam and an alarm condition opening (refracting) the normally closed light beam. Sensor(s) and console to be UL listed and third party tested as a system.

3. High Level Sensor

   High level sensor to be OMNTEC L-1 series, or equal, and be of proper length to alarm at 90% of tank capacity. Sensor(s) to be self diagnostic with dry condition creating a normally closed light beam and an alarm condition opening (refracting) the normally closed light beam. Sensor(s) and console to be UL listed and third party tested as a system.

B. Anchor Straps

1. Straps shall be compatible anchor straps as supplied by tank manufacturer.
2. Number and location of straps shall be as specified by the tank manufacturer.
3. Each strap shall be capable of withstanding a maximum load of 25,000 pounds.

C. Prefabricated Concrete Deadman Anchors

1. Deadman shall be as supplied by the tank manufacturer.
2. Number, length and weight shall be as specified by the tank manufacturer.
3. Deadman shall provide adjustable anchor points for the anchor straps.

D. Manways

1. All tanks for leachate use shall require at least one manway.
2. All manways shall be flanged and of the diameter as shown on the plans, complete with UL-listed cover, gasket and hardware.
3. Location is shown on tank drawings.
4. Manway extensions, as shown on the plans, shall be of the same material as the tank as supplied by the tank manufacturer.

E. Gauge Plates

1. Gauge plates shall be installed under each service fitting and manway opening.

F. Ladders (optional as shown on the Plans)

1. Ladders shall be the standard ladder as supplied by tank manufacturer.
2. Ladder material (fiberglass or aluminum) shall be shown on tank drawings.

G. Internal Pump Platform (Optional as shown on the Plans)

1. Contact tank manufacturer with pump details.

H. Fittings

1. All fittings shall be located along the top centerline of the tank. Bottom drain and tangential nozzles are not allowed.
2. All standard NPT threaded fittings shall be constructed of carbon steel.

3. All standard NPT threaded fittings shall be half-couplings, and 2"-, 4"- or 6"-diameter. Reducers are to be used for smaller sizes where shown and provided by contractor.
4. All NPT fittings shall withstand a minimum of 150 foot-pounds of torque and 1,000 foot-pounds of bending, both with a 2:1 safety factor.
5. All optional FRP nozzles shall be flat-faced, flanged and gusseted, and are available in 2"-, 4"-, 6"- or 8"-diameter.
6. All optional FRP nozzles shall conform to ANSI B16.5 150# bolting pattern.
7. Each interstitial-space monitor fitting shall consist of a 2" NPT fitting on the secondary tank.

PART III: SUBMITTALS

A. Submit manufacturer's product data; certificates of compliance on materials utilized during construction and on materials furnished; and brochures/manuals containing complete information and instructions pertaining to storage, handling, installation, wiring, inspection, repair and testing for each product/material furnished. Submittal information shall include applicable warranties.

B. Contractor/Tank Installer shall submit copies of qualifications/certifications relative to the installation of Fiberglass Reinforced Underground Storage Tanks and ancillary equipment.

PART IV: INSTALLATION AND TESTING

4.01 Installation

A. The Fiberglass Reinforced Underground Storage Tank and all accessories shall be installed in accordance with the manufacturer's installation Manual and Operating Guidelines for Double-Wall Fiberglass Underground Storage Tanks in effect at time of installation.

B. Contractor/Tank Installer shall be qualified in the installation of Double-Wall Fiberglass Reinforced Underground Storage Tanks.

C. Leak Monitoring and Overfill Detection Systems and all accessories shall be installed in accordance with the manufacturer's Installation Manual and Operating Guidelines for Leak Monitoring and Overfill Detection Systems in effect at time of installation.

4.02 Testing

A. Tank shall be tested in accordance with the manufacturer's Installation Manual and Operating Guidelines for Double-Wall Fiberglass Reinforced Underground Storage Tanks in effect at time of installation.

B. Leak Monitoring and Overfill Detection System shall be tested in accordance with the manufacturer's Installation Manual and Operating Guidelines for Leak Monitoring and Overfill Detection Systems in effect at time of installation.

C. Testing results shall be submitted to the Owner.

PART V: WARRANTY

5.01 Warranty

A. Warranty shall be manufacturer's limited warranty for Double-Wall Fiberglass Reinforced Underground Storage Tanks in effect at time of purchase.

B. Warranty shall be manufacturer's limited warranty for the Leak Monitoring and Overfill Detection System in effect at time of purchase.

END OF SECTION

APPENDIX C

Leachate Acceptance Letter
Town of Marshall, North Carolina

TOWN OF MARSHALL

P.O. BOX 548
180 SOUTH MAIN STREET
MARSHALL, NC 28753

828-649-3031
828-649-3413 Fax

Lawrence Ponder, Mayor
Aileen Payne, Mayor Pro-Tem

12 September, 2010

Mr. Jim Huff
Solid Waste Director
Madison County, North Carolina

RE: Acceptance of Leachate at the Town of Marshall Wastewater Treatment Facility from the Madison County Solid Waste Landfill

Dear Mr. Huff,

Per the Town of Marshall Pretreatment program Regulations, the Town of Marshall will accept leachate from the Madison County Solid Waste Landfill under the following conditions:

1. All leachate to be delivered to the wastewater treatment facility shall be tested by a NC certified wastewater laboratory before delivery and must be approved by the Town of Marshall Pretreatment Program Coordinator.
2. The Maximum Daily Load Limit for Biochemical Oxygen Demand (BOD_5) of the leachate delivered to the wastewater plant shall not exceed 30 pounds per day.
3. The Maximum Daily Load Limit for Total Suspended Solids (TSS) of the leachate delivered to the plant shall not exceed 30 pounds per day.
4. The pH of the leachate shall be between 6 and 9 Standard pH Units (SU).
5. The maximum daily flow of leachate to be accepted shall be calculated using the concentrations measured for BOD_5 and TSS in the formula:

$$\text{Maximum Allowable Flow (MGD)} = \frac{\text{Allowable Pounds per Day}}{\text{Concentration mg/l (8.34)}}$$

6. In no case shall flows above 9,000 gallons per day (0.009 MGD) be accepted at the Wastewater Treatment Facility.
7. The Town of Marshall shall designate the dump location for the leachate pump and haul operation.

Respectfully Submitted,

Lawrence Ponder
Mayor
Town of Marshall

Alderman: David Allen Billie Jean Haynie Dennis Ledford Luther Nix

APPENDIX D

Explosive Gas Monitoring Procedure

Appendix D

EXPLOSIVE GAS MONITORING PROCEDURE
MADISON COUNTY LANDFILL
PERMIT #58-03

Quarterly the Madison County landfill will monitor for explosive landfill gases at the landfill gas monitoring probes/wells, as shown on Sheet C-101, Facility Plan, Madison County Landfill, in Appendix A. The County is also required to perform quarterly monitoring at/in all existing and future enclosed on-site structures. Currently, the occupied on-site structures include the Maintenance and Recycling Building and the Scale House. Other small structures include miscellaneous storage structures, valve control houses, pump stations, etc.

The location and spacing of the landfill gas monitoring probes/wells are in accordance with Permit No. 58-03, for the Madison County Landfill Facility.

The migration of methane and other explosive landfill gases (landfill gas) is induced by pressure gradients. Landfill gases will move from areas of high pressure to those of low pressure following the path of least resistance. Landfill gas will generally migrate vertically until it reaches the landfill surface where it may begin to flow horizontally until it finds a pathway out through the permeable in situ soils or a landfill gas venting/extraction system. Experience has shown that whenever gas is migrating no matter what the spacing or depth of the monitoring probes, the gas will fill the void created by the monitoring well and an explosive gas detection meter will monitor the level of concentration.

The level of methane gas (CH_4), a constituent within the landfill gas, can be detected by use of an instrument designed to detect explosive gas concentrations. In this case, the instrument that will be used will be a landfill gas detection metering device specifically designed for use in monitoring landfill gas concentrations. The meter will be equipped with an internal vacuum pump capable of drawing gas from within the voids in the monitoring probe/well. Meter readings will depict methane gas (CH_4) concentrations in percent of the Lower Explosive Limit (% LEL) and/or total percent methane gas concentration (% CH_4). Depending on the particular meter utilized, other readings such as the percent concentration of carbon dioxide (% CO_2) and percent concentration of oxygen (% O_2) will be recorded. The field calibration and use of the monitoring instrument should be in accordance with the manufacturer's instructions. Observations and readings for the landfill gas monitoring probes/wells will be recorded on the "Landfill Gas Measurements - Field Worksheet, Madison County Landfill, Permit #58-03" included as Attachment 1 to Appendix D. Observations for the various on-site structures will also be recorded on the attached form.

Exterior Monitoring and Response Plan

Quarterly, a County employee or contractor for the County will visit each landfill gas monitoring probe/well. Using the detection instrument, he/she will determine if landfill gas is present in the monitoring probe/well. Observations will be recorded on the aforementioned "Landfill Gas Measurements - Field Worksheet, Madison County Landfill, Permit #58-03" form.

If landfill gas is present and the level is detected at or above the lower explosive limit (100% LEL) then the Madison County Solid Waste Director will be notified immediately. If it is determined that explosive landfill gas has or may have migrated beyond the particular monitoring well then additional steps may be implemented to delineate the extent of any suspected landfill gas migration. If it is determined that explosive landfill gas has or may have migrated across the landfill boundary then the facility will immediately take all necessary steps to ensure protection of human health. The Solid Waste Director will then notify the North Carolina Department of Environment and Natural Resources (NCDENR), Solid Waste Section in the Asheville Office. The Director will follow-up the telephone call with an electronic mail message detailing the event and the steps taken to protect human health. Within seven (7) days of detection, the methane gas levels detected and a description of the steps taken to protect human health will be placed in the operating record. Within 60 days of the detection of suspected landfill gas migration beyond the landfill boundary, the County will prepare and implement a remediation plan for the suspected landfill gas releases. A copy of the remediation plan will be placed in the operating record and the NCDENR will be notified that the plan has been implemented. The plan will describe the nature and extent of the problem and the proposed remedy. Resampling of the affected landfill gas monitoring wells will be performed as necessary to evaluate the effectiveness of the approved remediation plan.

Interior/Structure Monitoring and Response Plan

Other quarterly monitoring locations will be the on-site structures located within the landfill's Facility Boundary. Each structure will be monitored for explosive landfill gas using the following general protocol:

1. Crawl spaces, if applicable, will be monitored;
2. Corners in the structure, if accessible, will be monitored;
3. Any observed holes, cracks and/or pipe penetrations through the foundation will be monitored.

Observations will be recorded on the aforementioned "Landfill Gas Measurements - Field Worksheet, Madison County Landfill, Permit #58-03" form.

If methane gas is detected at or above 25% of its lower explosive limit (25% LEL) in any structure, excluding gas control or gas recovery system components, the detection instrument will be recalibrated in accordance with the manufacturer's recommendations/procedures and the structure resampled. If the reading is still at or above 25% LEL, immediately evacuate the building and take all steps necessary to protect human health. The Madison County Solid Waste Director will be immediately notified. The Solid Waste Director will then notify the NCDENR,

Solid Waste Section in the Asheville Office. The Director will follow-up the telephone call with an electronic mail message detailing the event and the steps taken to protect human health. Within seven (7) days of initial detection, the methane gas levels detected and a description of the steps taken to protect human health will be placed in the operating record. Upon taking the necessary safety precautions, attempt to determine the source of the explosive gas. If the source is found, initiate repairs to prevent re-infiltration of the landfill gas or remove the source. If the source of the landfill gas infiltration can not be easily determined and/or promptly corrected then the structure must be closed and marked to prevent further occupancy. The County will then prepare and implement a remediation plan for the suspected landfill gas releases within sixty (60) days of initial detection. The plan will describe the nature and extent of the problem and the proposed remedy. A copy of the remediation plan will be placed in the operating record and the NCDENR will be notified that the plan has been implemented. The structure will remain closed for occupancy until such time as the repairs and/or remediation plan have been implemented, completed and the structure retested for the presence of landfill gas. The structure will be reopened for occupancy once the landfill gas concentrations are below the 25% LEL concentration.

Landfill/Explosive Gas Monitoring Procedures

The following general procedures should be followed relative to conducting monitoring in onsite structures and/or the landfill gas monitoring probes/wells on the site:

Preliminary Procedures:

a. Prepare the Landfill Gas Measurements – Field Worksheet (Attachment 1) noting the name of the person taking readings, date, weather conditions, ambient temperature, atmospheric pressure, gas monitoring equipment, factory calibration date and field calibration date.
b. Check the monitoring instrument to ensure the water trap has a clean dry filter and the inlet particulate filter is clean and dry, if so equipped.
c. Check the monitoring instrument for proper operation and battery strength.
d. Field calibrate the monitoring instrument in accordance with the manufacturer's recommendation/procedure.
e. Proceed to the first monitoring point.

Interior/Structure Monitoring Procedures:

a. Prior to entering/monitoring the structure 1) note the time on the Landfill Gas Measurements – Field Worksheet form for the particular structure being monitored 2) turn the meter on and purge with ambient air to obtain a methane reading of 0%.

b. For interior monitoring, proceed to the test area and enter as gently as possible. Avoid creating air movement, which can disperse methane. If sampling air in a closed space such as a leachate pump station, keep the cover closed as much as possible to prevent dispersal of the gas. If

monitoring in a confined space, install a gas probe rod on the end of the tube and insert it into the space. **Sampling personnel should never enter a confined space without proper training and the appropriate permit and supervisory approval.**

c. Let the meter stabilize and read the gas levels indicated, (i.e. % LEL or % volume for methane, and carbon dioxide and oxygen if so equipped).

d. Note results on the Landfill Gas Measurements – Field Worksheet (Attachment 1). The location of the test should be noted.

e. Replace covers or caps removed to access sampling areas.

f. Repeat the process for the next monitoring location or structure.

If methane gas levels are detected and confirmed to be at or above 25% of the LEL, the facility will immediately initiate the response plan outlined in the Interior/Structure Monitoring and Response Plan noted above.

Exterior Monitoring Procedures:

a. Purge the meter with on-site ambient air to obtain a methane reading of 0%.

b. Record time of sample collection at the landfill gas probe/well.

c. Check monitoring point for condition and suitability for monitoring. Record any problems with the location of the Landfill Gas Measurements Field Worksheet.

d. Remove the sample tube cap. Connect the sample tube to the sample port.

e. First, monitor the relative pressure inside the probe if the monitoring instrument is so equipped. Draw a sample through the meter. Monitor methane readings until a steady state methane reading is obtained. Record the steady state reading.

f. Disconnect sample tube from the probe/well. Replace the tube cap whenever the meter is not connected to the tube.

g. Proceed to the next monitoring point and repeat the above procedures.

If methane gas levels are detected and confirmed to be at or above 100% of the LEL, the facility will immediately initiate the response plan outlined in the Exterior Monitoring and Response Plan noted above.

ATTACHMENT 1

LANDFILL GAS MEASUREMENTS – FIELD WORKSHEET
Madison County Landfill
Permit #58-03

LANDFILL GAS MEASUREMENTS – FIELD WORKSHEET
Madison County Landfill
Permit #58-03

Name of Person Taking Readings: _____ Date: _____

Weather Conditions: _____ Ambient Temperature: _____

Atmospheric Pressure: _____

Gas Monitoring Equipment: _____

Factory Calibration Date: _____ Field Calibration Date: _____

Well/Probe ID or Structure	Time	Readings (stable or variable)	% LEL	% CH_4	% CO_2	% O_2	Notes:
LFG-01							
LFG-02							
LFG-03							
LFG-04							
LFG-05							
LFG-06							
Maint. & Recycle Bldg.							
Scale House							
*							

* - Other miscellaneous structures will be monitored and the observations noted on the form.

Field Observation Notes:

_____

_____

_____

_____

_____

_____

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

June 2008
Revised July 2009
Revised April 2011

11.00702

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

NCDENR – DWM – SWS – Financial Assurance – Multiplier for local government – fiscal year July 1, 2010 - June 30, 2011	1.01
	=======
ADJUSTED TOTAL – Closure Costs – Unit 2, C&D Landfill	**$340,926**

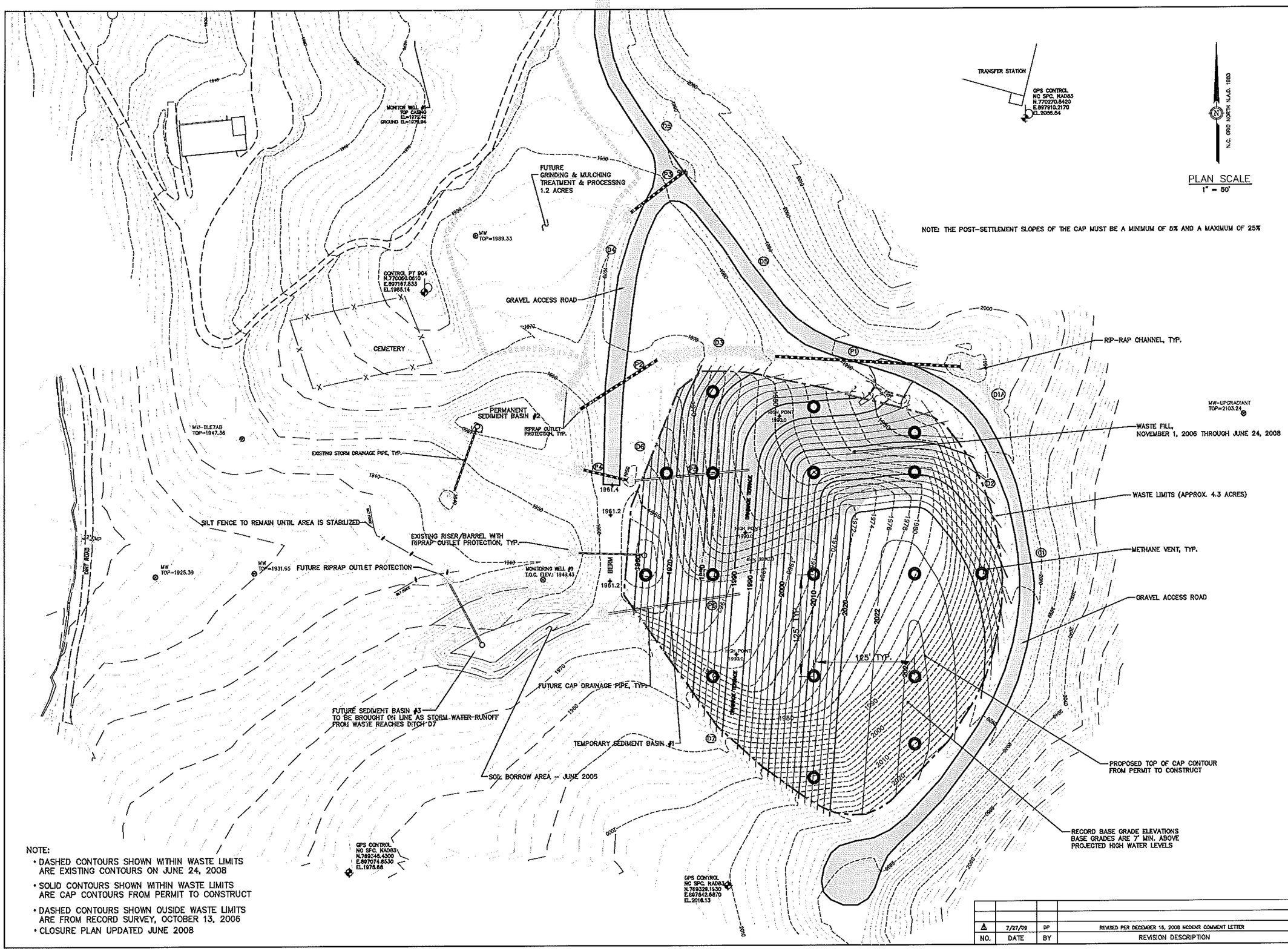
6.2 Post-Closure Costs Estimate

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

NCDENR – DWM – SWS – Financial Assurance – Multiplier for local government – fiscal year July 1, 2010 - June 30, 2011	1.01
	========
ADJUSTED TOTAL – Yearly Post-Closure Costs – Unit 2, C&D Landfill	**$12,640**

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 18, 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

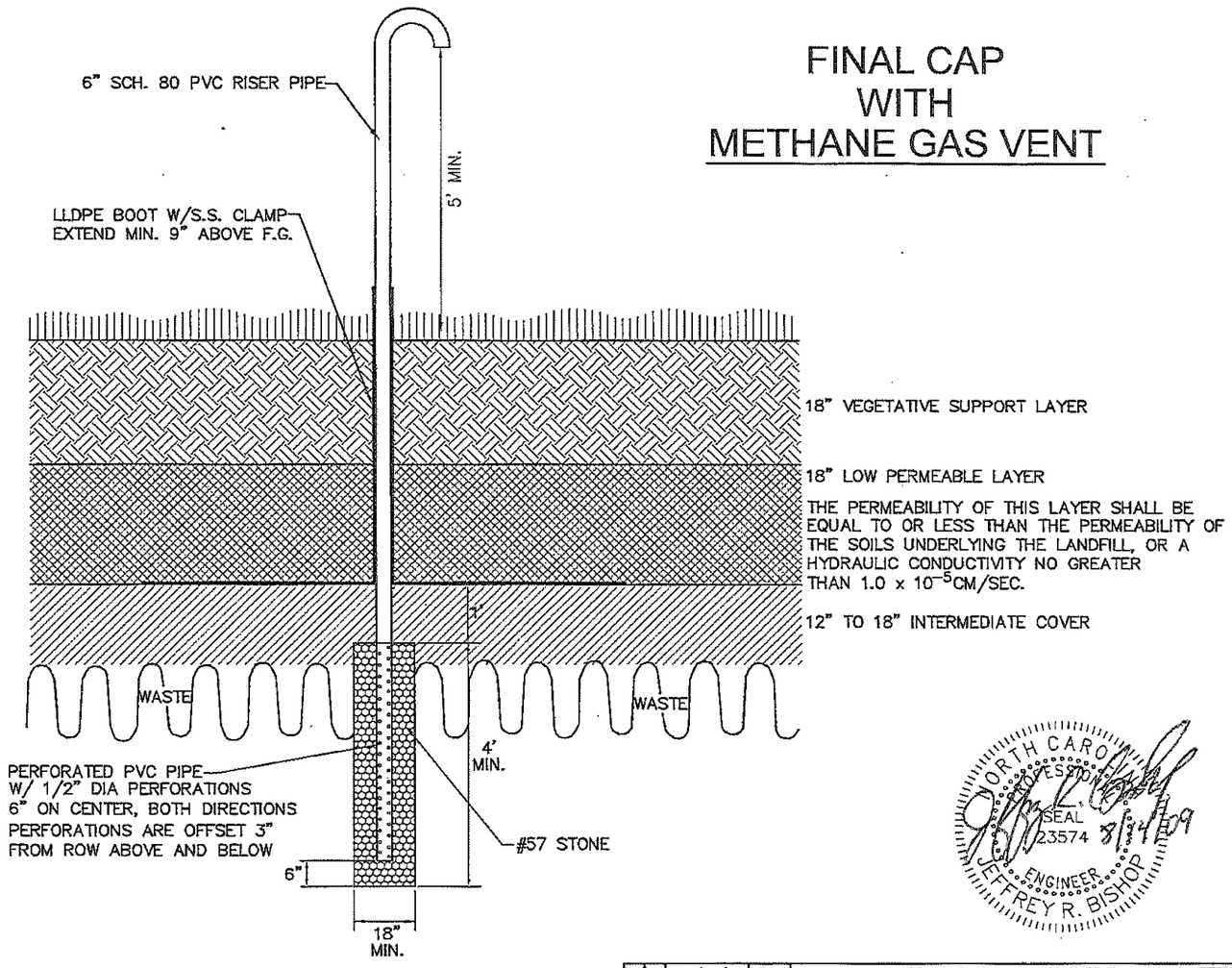
JOB NO.: C0.00700
DATE: JUNE 2008
SCALE: 1" = 50'
DESIGNED BY: DAP
CADD BY: DAP
DESIGN REVIEW: ____
CONST. REVIEW: ____
Q:/00.00700/C-D-Submittal-9-08.dwg

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
ASHEVILLE, NC

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

CLOSURE PLAN

FIGURE 2

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.

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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.

-oOo-

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.

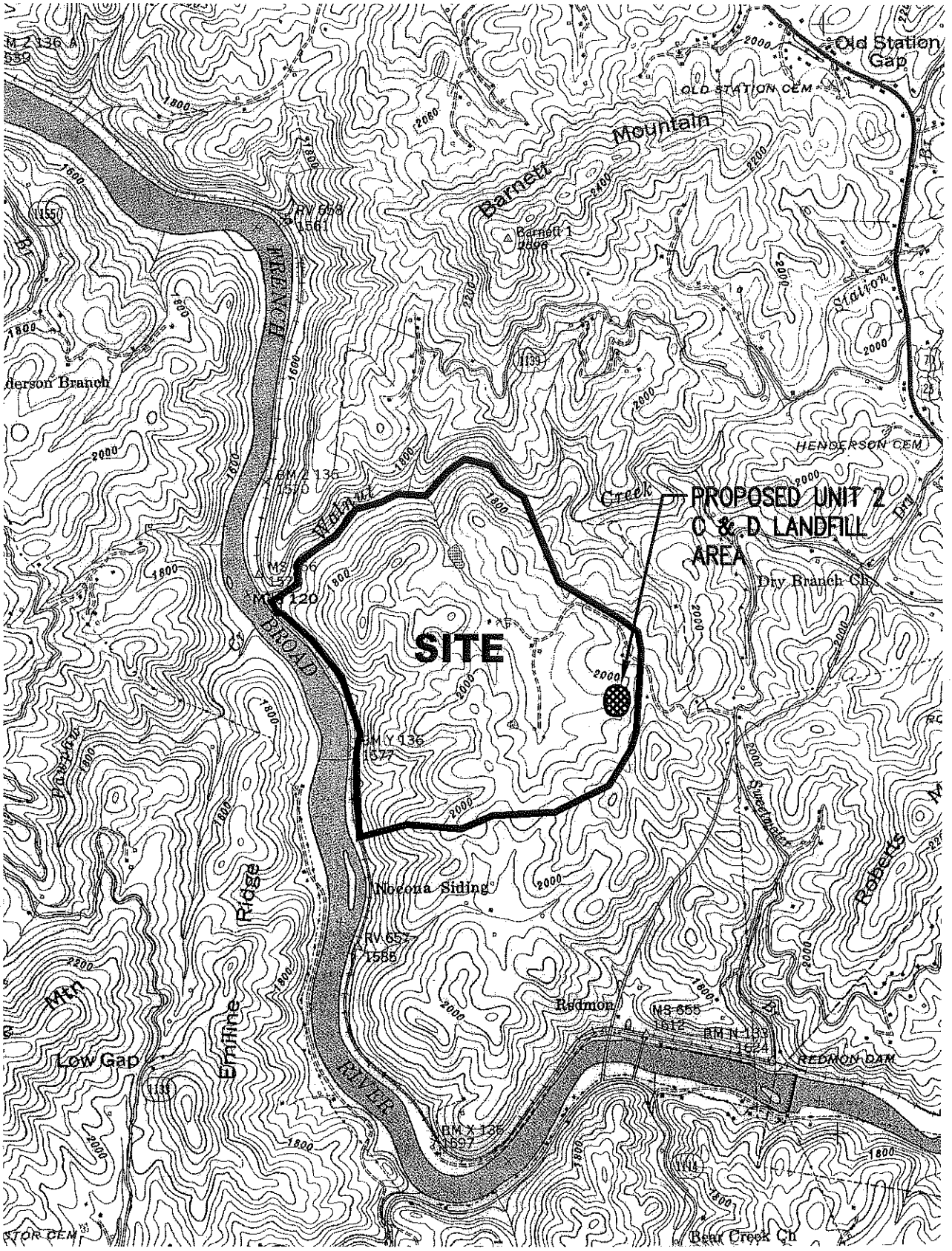
5.0 REVISED WATER QUALITY MONITORING SYSTEM

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-

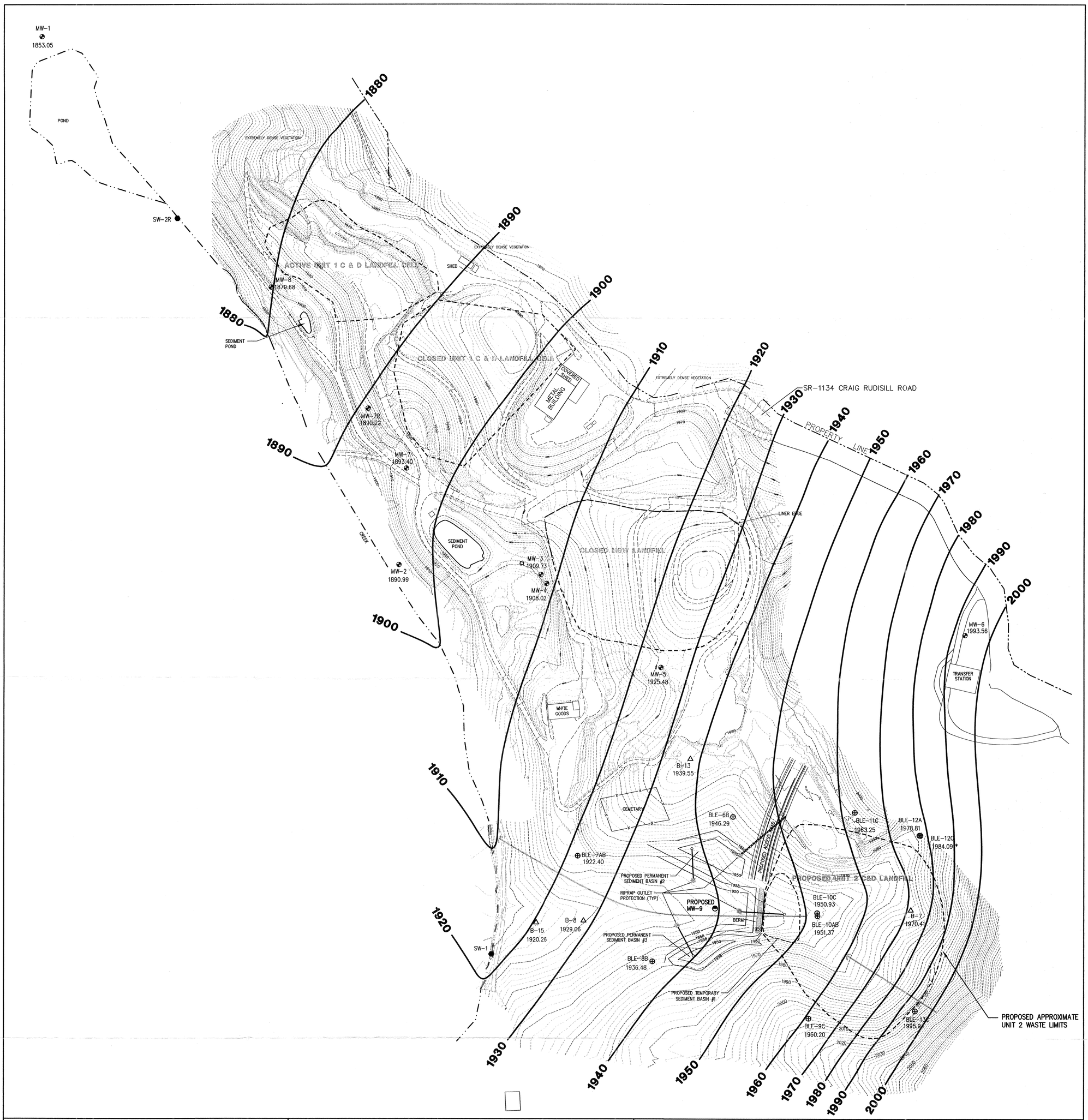


2000 1000 0 2000 4000

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

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

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.
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

FACILITY PLAN

CONSTRUCTION and DEMOLITION LANDFILL UNIT 2

MADISON COUNTY, NORTH CAROLINA

MARK D. CATHEY, P.E.

McGill ASSOCIATES

Engineering • Planning • Finance
Asheville, North Carolina

NORTH CAROLINA PROFESSIONAL SEAL 24993 ENGINEER MARK D. CATHEY

4/13/06

February 2006
Revised April 2006

04317

FACILITY PLAN
Madison County MSW Landfill Facility
Construction/Demolition Landfill Unit 2

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Appendices:
App. 1 - Approval to Continue Operations
App. 2 - Volume Calculations

1.0 Site Development

Madison County currently owns and operates a Landfill Facility in the south central part of the County, approximately 2 miles west of the Town of Marshall in Madison County, North Carolina. The County owns approximately 390 acres of property that has historically been referred to as the Brigman property. The property is bound by the French Broad River to the west and Walnut Creek to the north. The facility is accessed from Craig Rudisil Road off Sweetwater Road. Little Pine Road connects Sweetwater Road with Highway 25/70.

The County submitted a Site Plan Application for development of the Brigman property (prepared by Law Environmental, dated August 7, 1990) to the North Carolina Department of Environment and Natural Resources (NCDENR), Division of Waste Management (DWM), Solid Waste Section (SWS). The DWM, SWS issued an approval letter, dated November 9, 1990 for the Site Plan Application.

The County submitted a Construction Plan Application for a Proposed Demolition Landfill to the SWS in April 1991. The Application was prepared by Law Environmental and dated April 26, 1991. The Construction Plan Application for the demolition landfill was approved on June 10, 1991. The landfill, although originally referred to as a demolition landfill, was operated as a Land Clearing and Inert Debris (LCID) Landfill until March 1995. A Permit Application for a Construction/Demolition Landfill (CDLF) was submitted to the SWS in May 1994 for the purpose of expanding the demolition landfill to receive construction/demolition debris in conjunction with the LCID waste already accepted. The Permit Application for the CDLF was prepared by Law Environmental, dated May 6, 1994. After several supplemental submittals to the original Permit Application, including submittals dated July 29, 1994, March 2, 1995, and March 10, 1995, the plan was approved and the permit modification issued on March 22, 1995 to allow the County to operate the Construction/Demolition Landfill. A permit amendment request was submitted to SWS on March 7, 2001. A Permit Modification Request for expanding the existing Construction/Demolition Landfill by approximately 4.7 acres was submitted in July 2001. Approval to construct the expansion was received on June 2, 2003. Estimates indicate that the expanded landfill will reach capacity by April 2006.

Madison County intends to develop a new C&D landfill to the southeast of the existing MSW Landfill Cell 1 in the area designated as Area 2 in the original Site Plan submitted by Law Engineering dated August 7, 1990. This new CDLF

will be referred to as CDLF Unit 2. The CDLF will serve the residents of Madison County. The population of Madison County was last estimated at 19,951 by the U.S. Census Bureau in 2004.

The County submitted a Construction Plan Application for a Proposed Sanitary Municipal Landfill to the SWS in March 1992. The Application was prepared by Law Environmental and dated March 20, 1992. A Permit to Construct (Permit No. 58-03, Part 1) the facility was issued on April 10, 1992. A Permit to Operate (Permit No. 58-03, Part 2) was issued on September 13, 1993. Cell 1 began accepting waste on September 27, 1993. The County requested permit renewal for Cell 1 in 1998, and received verbal approval to continue operations at the MSW Landfill in May 2000. Please refer to Appendix 1 for a copy of the official approval letter dated June 4, 2003. The Cell reached capacity in January 2004. The final cap of the MSW cell is currently being constructed. Madison County has chosen not to pursue development of another MSWLF cell at this time. Therefore, the County has constructed a MSW Transfer Station at the Madison County MSW Landfill Facility.

The Madison County MSW Transfer Station was constructed in the summer of 2001 and began operating in February 2002. The County's waste is currently being dumped at the Transfer Station Facility and compacted into large transfer trucks that are hauled to the Carter Valley Landfill in Kingsport, Tennessee for disposal. The Madison County Transfer Station Facility is shown on Sheet C2 of the design drawings.

Sheet C2 also shows the location of the scale house/landfill office and the household drop-off that is located near the entrance of the MSW Landfill Facility. The Recycling/Maintenance Facility, leachate storage pond, leachate spray irrigation demonstration site, white-goods management area, and the closed MSW Landfill Cell 1 and the proposed CDLF Unit 2 are also shown on Sheet C2.

The Recycling Facility receives all of the recyclable materials that are collected from the convenience centers, which are located at various locations around the County. The recyclables are processed and bulked at the facility and hauled to or packaged for pickup by the purchasers of each respective recyclable material.

The leachate storage pond is located southwest of the existing MSWLF Cell 1 and collects the leachate discharged from the MSWLF cell. The leachate holding pond has a maximum volume of 677,000 gallons with 2.5 feet of freeboard provided. However, leachate volumes have been drastically reduced

over the past couple of years due to the fact that the landfill has reached the permitted design grades and has been covered with one (1) foot of intermediate cover. In addition, the closure of the cell will be complete once final vegetation is established in the spring. Also, Madison County received approval for performing a leachate management demonstration project on a portion of the existing landfill property in 1998, in conjunction with North Carolina State University and the Madison County/North Carolina Agricultural Extension Service. The demonstration project consists of implementing spray irrigation as a means of leachate management. The leachate is periodically used to irrigate the native vegetation on an adjacent portion of the County's property. The County periodically tests the irrigated vegetation, the underlying soil, and groundwater to determine the effects that the leachate has on the irrigated area. The County is currently irrigating the demonstration site on a quarterly basis and testing has not discovered any detrimental impacts to date.

1.1 Landfill Units

The existing MSW Landfill Cell 1 has a footprint of approximately 4.0 acres and was designed for a total capacity of approximately 128,300 cubic yards. As previously discussed, Cell 1 reached final design grades in January 2004. Closure of Cell 1 is being performed in accordance with the approved Closure and Post-Closure Plan and the conditions of Permit No. 58-03. Post-Closure monitoring of the MSW cell will also be performed in accordance with the approved plan and Permit No. 58-03.

The existing CDLF (Unit 1) has a footprint of approximately 6.5 acres and as designed for a total capacity of approximately 43,700 cubic yards. As previously discussed, the existing CDLF received an expansion permit and was modified for a total capacity of approximately 78,100 cubic yards. The CDLF Expansion is expected to reach capacity in April 2006.

The proposed CDLF (Unit 2) has a footprint of approximately 4.3 acres and total estimated operating capacity of 148,500 cubic yards. This includes air space that is available for placing waste and operational and daily cover, and results in an estimated life expectancy of approximately 14.8 years. Unit 2 is estimated to reach capacity in 2021. Placement volumes for Unit 2 were calculated assuming a fill density of 1,000 pounds per cubic yard. Please refer to Volume Calculations in Appendix 2.

1.2 Buffer Zones

Sheet C3 of the design drawings shows the proposed layout of the CDLF Unit 2. The buffer requirements for the proposed facility are indicated on this drawing. A minimum 300-ft buffer is shown between the eastern property line and the proposed limits of Construction/Demolition waste. A minimum 500-ft buffer is shown between the closest residence and its associated drinking water well, which is located to the east of the proposed CDLF Unit 2, and the proposed waste limits.

A minimum undisturbed buffer of 50 feet will be maintained between the adjacent stream and the limits of construction. The adjacent stream is located to the west of the proposed CDLF. Required buffers are also shown on the aerial photo on Sheet C2.

1.3 Landfill Facilities

Madison County currently has and will maintain the solid waste management facilities necessary for maintaining a MSWLF landfill, MSW Transfer Station, and a CDLF at the Madison County facility. These facilities generally consist of a landfill office, scale house, household drop-off, recycling/maintenance facility, white goods management facility, chipping area, leachate holding pond, and leachate management facilities.

2.0 Landfill Construction

The only additional landfill construction planned at the Madison County MSW Landfill Facility is the construction of a proposed CDLF Unit 2. The Permit To Construct documents for the CDLF Unit 2 have been attached within this application. The permit drawings illustrate the proposed grading associated with construction and operation of the CDLF Unit 2. These documents include the following:

- Limits of grading,
- Existing landfill facilities,
- Limits of the development phases,
- Proposed base grades,
- Location of access roads,
- Location of sediment basins and drainage structures, and
- Proposed cap system

2.1 Grading

Subgrade will be provided by excavated soil within the CDLF Unit 2 limits and other on-site borrow areas located at the Madison County Landfill, adjacent to the proposed CDLF Unit 2, as shown on Sheet C2 of the plans.

2.2 Base Grades of Cell

The base grades of the landfill are shown on Sheet C4 of the permit drawings. The grades shown represent the base of the landfill and were used to calculate airspace volumes provided by each phase of the proposed landfill. The projected high water level (PHWL) must be located a minimum of four (4) feet below the base grades of the landfill, but a safety factor of three (3) additional feet was added to the design, resulting in a seven (7) foot separation between the PHWL and the proposed base grade elevations. These grades are shown on Sheets C4 and C4A.

2.3 Access Roads

Access roads for the proposed CDLF Unit 2 will be composed of a compacted subgrade overlain by eight (8) inches of CABC. The location of the access roads is shown on Sheet C3 of the permit drawings.

2.4 Sediment Basins

The site contains three (3) proposed sediment basins that will be utilized for the development of the CDLF Unit 2. These sediment basins are discussed in the Erosion Control Plan that was submitted to the Land Quality Section. A copy of the Erosion Control Plan is included in the CDLF Engineering Plan, Appendix 2.

2.5 Cell Closure

The surface slopes of the final cap for the proposed CDLF Unit 2 will be constructed with 4:1 slopes (twenty-five percent). Components of the proposed closure cap, from bottom to top, will include a 12-inch thick intermediate soil cover followed by an eighteen (18)-inch thick vegetative/erosion layer.

3.0 Landfill Operation

3.1 Waste Acceptance and Disposal Requirements

The proposed construction/demolition debris landfill (CDLF) Unit 2 will accept construction/demolition debris, wastes acceptable for disposal in a land clearing-inert debris landfill, and other wastes specifically approved by the division.

Construction/demolition debris is defined in the General Statutes as waste or debris resulting solely from construction, remodeling, repair, or demolition operations on pavement, buildings, or other structures.

Land clearing debris is defined in the rules as waste that is generated solely through land clearing activities such as stumps, trees, limbs, brush, grass, and other naturally occurring vegetative matter.

Disposal of yard trash will not be allowed in the CDLF Facility. Yard trash is defined in the North Carolina General Statutes 130A-290 as "solid waste consisting solely of vegetative matter resulting from landscaping maintenance".

The CDLF will only accept permitted waste generated in Madison County. Madison County will notify the division within 24 hours of any attempts to dispose of non-permitted waste.

The Solid Waste Section may approve specific wastes for approval on a case-by-case basis for disposal at the CDLF. These wastes must be demonstrated to be inert through the Toxicity Characteristic Leaching Procedure (TCLP).

The new CDLF will accept asbestos waste if packaged properly in accordance with 40 CFR 61 and G.S. 150B-14(c). The waste shall be disposed of in virgin soil and at the bottom of the working face or in an area not contiguous with other disposal areas. The area shall be covered with soil immediately in a manner to avoid any airborne conditions and the disposal area shall be marked and/or the location documented in the permanent operating record of the landfill so that the waste is not disturbed by future landfilling activities.

Brush and Christmas Trees received at the new CDLF will be chipped and used to produce mulch that is provided to the citizens of Madison County free of charge.

The following wastes are prohibited from disposal at the landfill:

- Hazardous waste as defined within 15A NCAC 13A, including hazardous waste from conditionally exempt small quantity generators.

- Polychlorinated biphenyls (PCB) waste as defined in 40 CFR 761.

- All Liquid wastes.

- Wastes prohibited by Statute GS 130A-309.10 of the North Carolina Solid Waste Management Rules. These wastes include:

    - used oil
    - yard trash
    - white goods
    - antifreeze (ethylene glycol)
    - whole scrap tires
    - lead-acid batteries

- All municipal solid waste. This waste shall be transported to the MSW Transfer Station so that it can be transported to a facility that is permitted to properly dispose of the waste.

4.0 Facility Report

4.1 Waste Stream

Madison County currently classifies their MSW and C&D waste as residential, commercial, or industrial. All MSW and C&D waste not originating in Madison County (out-of-county) is prohibited from disposal at the Madison County MSW Landfill Facility.

The population of Madison County, according to the United States Census Bureau in 2004, was estimated at 19,951. Madison County received 12,464 tons of waste for fiscal year ending June 30, 2001. The service area for the Madison County Landfill includes businesses, municipalities, and residents located within Madison County. Waste from other counties will not be accepted at the facility.

Based on the Madison County Annual Solid Waste Report for the Fiscal Year beginning July 1, 2000, the estimated breakdown of the entire waste stream generated by Madison County is classified as follows: Residential makes up 55%, Commercial is 10%, Industrial makes up 7% and Construction/Demolition represents the remaining 28%.

The majority of C&D waste received at the existing C&D Landfill is classified as commercial and makes up approximately 55% of the entire C&D waste stream. Industrial waste accounts for another 15% of the C&D waste stream. Residential waste accounts for approximately 30% and the remainder of the C&D waste stream.

Municipal waste accounts for 72 percent of the total county waste stream. These percentages were calculated using previous scale records. The current MSW waste stream is approximately 9,000 tons per year. After removing the C&D waste volumes from the overall waste volumes, the remaining waste stream is comprised of approximately 76% residential, 14% commercial, and 10% industrial.

The average waste stream expected for the CDLF Unit 2 is estimated to be 5,022 tons per year over the life of the landfill. This design volume was calculated by determining the C&D waste volumes received at the facility for the 2002 calendar year and assuming an annual population growth of 1.5% to determine the average disposal volume for the life of the proposed CDLF Unit 2.

4.2 Landfill Capacity

The new C&D landfill has a total estimated operating capacity of 148,500 cubic yards. This includes air space that is available for placing waste and operational and daily cover. The first five (5)-year permitting period will require covering the entire 4.3-acre waste area and will provide the County an estimated volume capacity of 46,171 CY. This will include placement of 10-15 feet of waste within the cell, and is estimated to reach capacity in 2011. The remaining life span of CDLF Unit 2 will include placement of an additional 20-25 feet of waste within the cell, and will provide the County an additional estimated volume capacity of 102,300 CY. The total estimated life expectancy of the C&D Unit 2 Landfill is approximately 14.8 years. CDLF Unit 2 is estimated to reach capacity in 2021. Please refer to Appendix 2 for volume calculations.

4.3 Soil Resources

The following construction quantities for the proposed CDLF Unit 2 have been estimated:

Cut = 57,900 CY
Fill = 35,900 CY

Approximately 22,000 CY will be stockpiled for future use.

The CDLF Unit 2 will require an average of 1,435 cubic yards of operational cover each year, based on a one (1) to six (6) soil to waste ratio. Approximately 520 cubic yards of soil will be needed each year for intermediate cover. Therefore, a total of 1,955 cubic yards of soil will be needed on an annual basis. The closure soil quantities needed for constructing the final cap will include approximately 10,500 cubic yards of vegetation-supportive soil. Soils needed for the closure will come from on-site borrow areas.

4.4 Equipment Resources

The county will operate the CDLF Unit 2 using basically the same equipment available to them at this time. This equipment includes one dozer, 1 track loader, 1 wheel loader, 1 single-axle truck, 1 tandem-axle truck, 1 track hoe, 1 farm tractor, 2 skid-steer loaders, 1 compactor, 2 fork lifts, and 1 chipper. This equipment should be sufficient for operating the landfill with its current waste stream. Madison County budgets for new equipment needed for landfill operations on an annual basis.

APPENDIX 1

Approval to Continue Operations, Madison County MSWLF, Permit No. 58-03
Dated June 4, 2003

North Carolina
Department of Environment and Natural Resources

Division of Waste Management

Michael F. Easley, Governor
William G. Ross Jr., Secretary
Dexter R. Matthews, Director

NCDENR

June 4, 2003

McGILL ASSOC. • FILE COPY
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JUN 0 9 2003
Project # 01305
File # 2.2.1

Jim Brown
Madison County Landfill
271 Craig Rudisil Road
Marshall, NC 28573

Ref: Permit Number 58-03

Mr. Brown:

Enclosed is your Permit to Operate number 58-03. This permit authorizes the continued operation of the MSW Facility including the MSW disposal unit, Transfer Station, and the construction and operation of the C&D and LCID units.

There are water monitoring requirements that need completion. The following steps must be taken in addition to the operational conditions of the permit.

- Within 30 days of the date of the permit, the Section must approve a completed monitoring plan.
- Within 60 days of the date of the permit, any new monitoring wells must be installed.
- Within 90 days of the date of the permit, initial water samples must be submitted to the Section.

Please refer all correspondence and questions regarding water-monitoring requirements to Mr. Bobby Lutfy, 919-733-0692 extension 258.

The Section has also looked at potential expansion of C&D / LCID disposal to the north west of the approved C&D / LCID units. The Section offers the following observations to alert you to potential issues should Madison County wish to explore expanding the C&D disposal area.

- The aquifer in this area is likely to be within bedrock.
- Aquifer in bedrock is typically difficult to assess and monitor.
- Any expansion in this direction could require rigorous investigation and suitability cannot be assured.

Questions regarding expansion to the northwest should also be directed to Mr. Lufty.

Thank you,

Wm D Sessoms

William D. Sessoms

Copy: Central Files
Al Hetzel – DWM
Bobby Lutfy - DWM
Chris Brown – McGill Engineering

North Carolina
Department of Environment and Natural Resources

Division of Waste Management

Michael F. Easley, Governor
William G. Ross Jr., Secretary
Dexter R. Matthews, Director

NCDENR

FACILITY PERMIT NO: 58-03
Part 2-Permit to Operate
Date of Original Issue, Cell 1A: September 13, 1993
Construction & Demolition Unit: March 22, 1995
Transfer Station: February 5, 2002
Household Hazardous Waste Collection: February 28, 2002
Construction & Demolition Unit & LCID Unit: June 2, 2003

MUNICIPAL SOLID WASTE LANDFILL

FACILITY PERMIT

MADISON COUNTY

is hereby issued a PERMIT to OPERATE

LAND-OF-SKY MUNICIPAL SOLID WASTE LANDFILL FACILITY

Construction & Demolition Unit

Transfer Station

Household Hazardous Waste Collection

located off Sweetwater Road, Marshall Township, Madison County, North Carolina in accordance with Article 9, Chapter 130A, of the General Statutes of North Carolina and all rules promulgated thereunder and subject to the conditions set forth in this permit. The facility is located and described by the legal description of the site or the property map contained within the approved application.

James C. Coffey, Section Chief
Solid Waste Section

1646 Mail Service Center, Raleigh, North Carolina 27699-1646
Phone: 919-733-0692 \ FAX: 919-733-4810 \ Internet: www.enr.state.nc.us
AN EQUAL OPPORTUNITY \ AFFIRMATIVE ACTION EMPLOYER -- 50% RECYCLED / 10% POST CONSUMER PAPER

ATTACHMENT 3

Approved Documents

PART I: GENERAL FACILITY

1. Inter-Agency Task Force Comments, Division of Solid Waste Management, March 27, 1990.

2. *Site Plan Application, Proposed Sanitary Municipal Landfill, Brigman Property, Madison County, North Carolina*, prepared by Law Environmental, dated August 7, 1990.

3. Completeness Review Letter, August 17, 1990.

4. Madison County zoning letter, August 22, 1990.

5. Site approval resolution, August 27, 2990.

6. Biological Assessment of the Proposed Landfill Site, Division of Parks and Recreation, August 24, 1990.

7. *Responses to Completeness Review, Potential Landfill Site, Madison County, North Carolina*, prepared by Law Environmental, Inc., dated August 30, 1990.

8. Historic Preservation Office comments, August 31, 1990.

9. Madison County Site Suitability Letter, Division of Solid Waste Management, November 9, 1990.

10. Conditional Approval of Boring Plan, October 25, 1990.

PART II: MUNICIPAL SOLID WASTE LANDFILL

11. *Revised Construction Plan Application, Proposed Sanitary Municipal Landfill, Madison County, North Carolina*, prepared by Law Environmental, Inc., dated March 20, 1992.

12. *Construction Quality Assurance Report and Landfill Operations and Maintenance Plan, New Madison County Sanitary Landfill*, prepared by Law Environmental, Inc., dated July 21, 1993.

13. *Response to DSWM Letter, New Madison County Sanitary Landfill, Marshall, North Carolina*, prepared by Law Environmental, Inc., dated August 24, 1993.

PART III: CONSTRUCTION AND DEMOLITION LANDFILL

14. *Permit Application for Madison County C/D Landfill*, dated May 6, 1994, prepared by Law Environmental, Inc.

15. Response to June 24, 1994 review letter, *Proposed Madison County C/D Landfill*, dated July 29, 1994, prepared by Law Environmental, Inc.

16. Response to January 26, 1995 review letter, *Proposed Madison County C/D Landfill*, dated March 2, 1995, prepared by Law Environmental, Inc.

17. *Addendum to Proposed C/D Landfill Permit Application*, dated March 10, 1995, prepared by Law Environmental, Inc.

18. *Permit Modification Application for Proposed Construction and Demolition Landfill Expansion, Madison County MSW Landfill Facility, Madison County, North Carolina, Permit Number 58-03*, dated July 19, 2002, prepared by McGill Associates, P.A.

19. *Site Hydrogeologic Report 5-Acre Expansion Area, Madison County C&D Waste Landfill, Madison County, North Carolina*, dated July 9, 2002, prepared by Bunnell-Lammons Engineering, Inc.

PART IV: LAND CLEARING AND INERT DEBRIS LANDFILL

20. *Permit Modification Application for Proposed Construction and Demolition Landfill Expansion, Madison County MSW Landfill Facility, Madison County, North Carolina, Permit Number 58-03*, dated July 19, 2002, prepared by McGill Associates, P.A.

PART V: YARD WASTE

PART VI: MISCELLANEOUS FACILITIES

TRANSFER STATION

21. Approved transfer facility permit application and operations plan submitted by McGill Associates dated 14 September 2000 and revised 7 December 2000 including letters addressing zoning, sediment and erosion control approval, and disposal of leachate.

22. Letter dated 26 November 2001 from McGill Associates on behalf of Madison County requesting a Permit to Operate and including "as-built" record drawings of the facility.

ATTACHMENT 4

Conditions of Permit to Operate

PART I: GENERAL FACILITY CONDITIONS

1. This permit shall be reviewed, pursuant to 15A NCAC 13B .0201(e), no later than December 31, 2004.

2. In the event of conflicts between this Permit to Operate and previously issued conditions, the conditions of this Permit to Operate shall supersede previously issued conditions.

3. The solid waste management units within this facility shall conform to all operating procedures described in the approved plans, 15A NCAC 13B, and the conditions specified herein.

4. Additional conditions and revision of the approved documents or changes during the operation of the landfill require approval by the North Carolina Solid Waste Section.

5. On or before August 1 of each year, the permittee shall report the amount of waste received (in tons) at this facility and disposed of in the landfill units to the Solid Waste Section, on forms prescribed by the Section. The reporting period shall be for the previous year, beginning July 1 and ending on June This report shall include the following information:

   a. The amount of waste received and land filled in tons, compiled on a monthly basis and by specific waste type if diverted to a specific unit within the permitted facility.

   b. A physical survey of volume utilized in the MSW cells shall be performed during the second quarter of the calendar year. The date and volume, in cubic yards, shall be included in the report.

   c. The amount of waste, in tons, from scale records, disposed in the MSW cells since June 24, 1997 through the date of the annual volume survey.

   d. The completed report shall be forwarded to the Regional Waste Management Specialist for the facility. A copy of the completed report shall be forwarded to the County Manager of each county from which waste was received.

6. Ground water quality at this facility is subject to the "Classifications and Water Quality Standards Applicable To The Groundwater of North Carolina", 15A NCAC 2L. This includes, but is not limited to, provisions for detection monitoring, assessment, and corrective action.

7. The facility has an approved gross volume of approximately 152,000 cubic yards consistent with the approved final contours. Actual waste disposal capacity may vary depending upon waste compaction and amount and type of operational cover.

PART II: MUNICIPAL LANDFILL UNIT SPECIFIC CONDITIONS

GENERAL CONDITIONS

8. This permit approves the operation of the municipal solid waste landfill as well as the on-site environmental management and protection facilities as described in the approved plans.

MONITORING AND REPORTING

9. Ground water monitoring at this unit shall be as prescribed by the appropriate requirements of 15A NCAC 13B .1630-.1637 and the approved monitoring plan.

10. A readily accessible unobstructed path shall be cleared and maintained so that four-wheel drive vehicles may access monitoring well locations at all times.

11. A field log book which details all development, sampling, repair, and all other pertinent activities associated with each monitoring well and all sampling activities associated with each surface water and leachate sampling location shall be kept as part of the permanent facility record.

12. Records of all ground-water, surface water and leachate analytical data shall be kept as part of the permanent facility record.

13. Ground water monitoring wells and surface water sampling locations must be sampled for Appendix I constituents at least semi-annually according to the specifications outlined in the approved water quality monitoring plan and the current policies and guidelines of the Section in effect at the time of sampling.

14. Reports of the analytical data for each water quality sampling event shall be submitted to the Section within 60 days of the respective sampling event. Analytical data shall be submitted in a manner prescribed by the Section.

15. The four independent samples which comprise the initial baseline sampling event shall be collected from each ground water monitoring well and the report shall be submitted to the Section within six months after issuance of the Permit to Operate.

16. Untreated leachate shall be sampled and analyzed at least semi-annually concurrently with the ground and surface water sampling. The leachate shall be analyzed for all Appendix I constituents, pH, specific conductance, BOD and COD, phosphate, nitrate, and sulfate.

Test results shall be submitted to the Section along with ground and surface water test results. In the event leachate is recirculated, additional leachate sampling may be required.

OPERATIONAL CONDITIONS

17. The landfill unit shall conform to all operating requirements described in the approved plans, 15A NCAC 13B .1626, and the conditions specified herein.

18. The use of alternative daily cover requires approval, prior to implementation, by the Solid Waste Section. Requests for alternative daily cover approval must include a comprehensive use and demonstration for the effectiveness plan developed according to Section guidelines and consistent with the approved plan. Plans which are approved by the Section will be incorporated into, and made a part of, the approved documents found in Attachment 3.

19. The use of leachate recirculation as a leachate management tool requires approval, by the Solid Waste Section, prior to implementation. Requests for leachate recirculation approval must include a comprehensive management plan developed according to Section guidelines and which is consistent with the approved operation plan. Plans which are approved by the Section will be incorporated into, and made a part of, the approved documents found in Attachment 3.

20. The MSWLF unit is permitted to co-dispose of wastewater treatment sludge generated within the facility's approved service area, subject to the terms and procedures of the approved plan.

21. Closure or partial closure of any MSWLF unit shall be in accordance with the Closure Plans described in the approved plans and 15A NCAC 13B .1629. Final Closure Plans shall be submitted to the Division at least 90 days prior to implementation. Closure and Post-closure plans, including financial instruments shall be updated annually pursuant to 15A NCAC 13B .1628.

PART III: CONSTRUCTION AND DEMOLITION DEBRIS UNIT SPECIFIC CONDITIONS

22. The C&D unit is approved for a disposal capacity consistent with the approved contours as shown on the approved plans.

23. Operation of the C&D unit shall be in accordance with NCAC 13B .0505, the approved plans, and the following specific conditions:

    a. The C&D unit is permitted to receive the following waste types:

        i. Land Clearing Debris as defined in G.S. §130A-290, specifically, solid waste which is generated solely from land clearing activities, such as stumps,

trees, etcetera;

ii. Inert Debris defined as solid waste which consists solely of material that is virtually inert, such as brick, concrete, rock, and clean soil;

iii. Asphalt in accordance with G.S. §130A-294(m); and

iv. Construction and Demolition Debris defined as solid waste resulting solely from construction, remodeling, repair, or demolition operations on pavement, buildings, and other structures.

b. Waste shall be covered with six-inches of suitable cover at least once per week, or when the active working area reaches one-half acre in size, or more often as necessitated by the nature of the waste, so as to prevent the site from becoming a visual nuisance and to prevent fire, windblown materials, vectors, or water infiltration. Areas which have not received additional waste for twelve months or more, but where final elevations have not been reached, shall be covered with one-foot of soil cover.

c. Ground water and surface water sampling and analysis shall conform to the specifications found in the approved plans.

24. Closure Requirements - The C&D unit shall be closed in accordance with the approved plans and the requirements of the Division of Waste Management at the time of closure. A final closure plan shall be submitted for review at least 90 days prior to closure of any phase of the C&D landfill unit.

PART IV: LAND CLEARING AND INERT DEBRIS UNIT SPECIFIC CONDITIONS

PART V: YARD WASTE UNIT SPECIFIC CONDITIONS

PART VI: MISCELLANEOUS FACILITY CONDITIONS

TRANSFER STATION

25. The Transfer Facility may receive solid waste that is generated within the approved service area and shall dispose of said solid waste at the Carter Valley Landfill (Waste Management, Inc. of Tennessee) located in Church Hill Tennessee.

26. This permit is for the operation of the Transfer Facility in accordance with the approved plans. Any future modification to these plans shall be approved by the NC Solid Waste Section.

27. All sedimentation and erosion control activities shall be conducted in accordance with the Sedimentation and Pollution Control Act, 15A NCAC 4.

28. Operation of the facility shall occur in accordance with 15A NCAC 13B .0402 *Operational Requirements for Transfer Facilities*, the approved operations plan and these additional requirements:

    a. The owner or operator of a municipal solid waste management facility shall not knowingly dispose of any type or form of municipal solid waste that is generated within the boundaries of a unit of local government that by ordinance:

        i. Prohibits generators or collectors of municipal solid waste from disposing of that type or form of municipal waste.

        ii. Requires generators or collectors of municipal solid waste to recycle that type or form of municipal solid waste.

    b. Waste shall not be stored on the "tipping floor" after operating hours. Waste can be stored in transfer trailers, at the facility with covers in place, after operating hours, but no longer than 48 hours.

    c. The tipping floor and transfer trailer loading area shall be maintained in a clean, sanitary condition after operating hours in accordance with the approved Operational Plan.

    d. On or before August 1 (or at an earlier date as requested by the Division) of each year, the owner or operator shall report to the NC Solid Waste Section, for the previous year beginning 1 July and ending 30 June, the amount by weight of the solid waste that was received at the facility and disposed of in a landfill, incinerated, or converted to fuel. To the maximum extent practicable, such reports shall indicate by weight the COUNTY of origin of all solid waste. The owner or operator shall transmit a copy of the report to the county in which the facility is located and to each county in which waste originated.

HOUSEHOLD HAZARDOUS WASTE COLLECTION

OPERATIONAL CONDITIONS

29. This permit is for operation of a Permanent Household Hazardous Waste Collection Facility.

30. This permanent household hazardous waste collection facility is permitted to receive household hazardous waste (HHW) generated by homeowners and conditionally exempt small quantity generators of Madison County. Unacceptable HHW that shall not be collected

at this facility includes radioactive waste, explosives, and infectious waste.

31. Any revisions to the approved plan shall be approved by the North Carolina Division of Waste Management, Solid Waste Section prior to implementation.

32. This facility shall conform to all operating procedures in the approved plan, 15A NCAC 13B .0400, and the current Section policies and guidelines for HHW Collection Facilities.

33. Household Hazardous Waste Identification Number NCPH05802001 shall be used to ship wastes off site for recycling, treatment, or disposal.

REPORTING REQUIREMENTS

34. The permittee shall maintain records for the amount of HHW received at the facility and the amounts shipped off site for recycling, treatment, and disposal. Records must be compiled on a monthly basis and maintained at the facility for inspection upon request by Solid Waste Section personnel.

35. On or before August 1 of each year, the permittee shall report to the Solid Waste Section the amount of HHW (in pounds) received at this facility and the amounts shipped off site for recycling, reuse, and / or disposal. The reporting period shall be for the previous year, beginning July 1 and ending June 30.

36. A copy of this permit and the approved plan shall be maintained at the facility. Copies of this permit shall be forwarded to the local fire department, local hospitals, and other appropriate emergency agencies.

APPENDIX 2

Volume Calculations

Madison Co. C&D Volume Predictions

February 2006

Year	Tons	Cumulative Tons	CY	Cumulative CY
2000-2001	3,421	--	6,842	--
2001-2002	5,501	--	11,002	--
2002-2003	3,933	--	7,866	--
2003-2004	4,285	--	8,570	--
2004-2005	4,349	--	8,699	--
2005-2006	4,415	--	8,829	--
2006-2007	4,481	4,481	8,961	8,961
2007-2008	4,548	9,029	9,096	18,057
2008-2009	4,616	13,645	9,232	27,289
2009-2010	4,685	18,330	9,371	36,660
2010-2011	4,756	23,086	9,511	46,171
2011-2012	4,827	27,913	9,654	55,825
2012-2013	4,899	32,812	9,799	65,624
2013-2014	4,973	37,785	9,946	75,570
2014-2015	5,048	42,833	10,095	85,665
2015-2016	5,123	47,956	10,246	95,911
2016-2017	5,200	53,156	10,400	106,311
2017-2018	5,278	58,434	10,556	116,867
2018-2019	5,357	63,791	10,714	127,581
2019-2020	5,438	69,229	10,875	138,456
2020-2021	5,519	74,748	11,038	149,494
2021-2022	5,602	80,350	11,204	160,698
2022-2023	5,686	86,036	11,372	172,070
2023-2024	5,771	91,807	11,543	183,613
2024-2025	5,858	97,665	11,716	195,329

From aerial and survey data:		
Total Acreage =	4.3	acres
Gross Airspace =	166,000	CY
Final Cover =	17,500	CY
Net Airspace =	148,500	CY

Year 2003-2004 is an average of the three previous years.
Year 2004-2005 was abnormal due to increased hurricane damage.
A 1.5% tonnage increase was applied to each subsequent year starting with 2003-2004.

Assume: 0.5 Tons/CY (compaction density)

After 5 years (2006-2011), airspace used = 46,171 CY
After 5 years (2011-2016), airspace used = 95,911 CY
After 5 years (2016-2021), airspace used = 149,494 CY

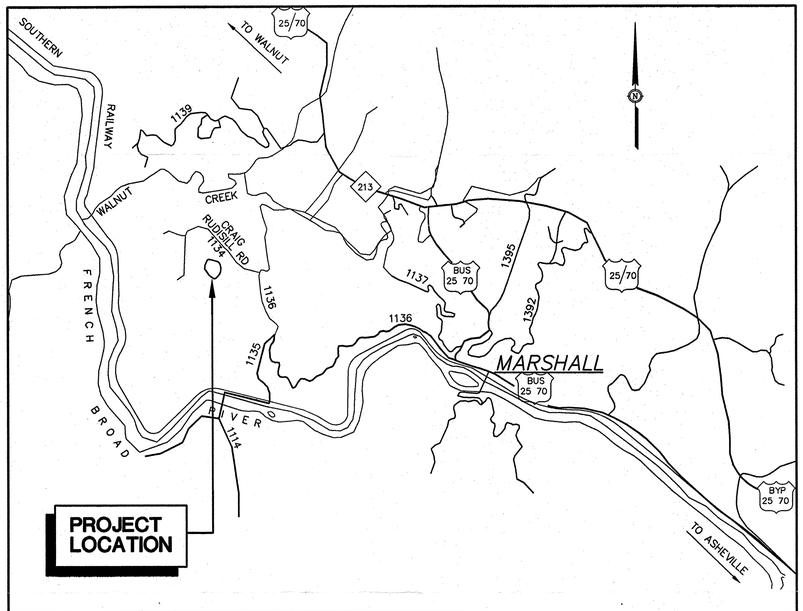
total net airspace = 148,500 CY ---> total waste = 74,250 Tons
first 15 years = 149,494 CY
remaining = -994 CY

Using estimate for 2021-2022, it will require -0.18 of that year to fill remaining airspace.

ESTIMATED LIFE SPAN OF CDLF UNIT 2: 14.8 YEARS

CONSTRUCTION/DEMOLITION LANDFILL
MADISON COUNTY LANDFILL

MADISON COUNTY, NORTH CAROLINA



PROJECT LOCATION MAP NOT TO SCALE

SCHEDULE OF DRAWINGS

G1. . . COVER SHEET - PROJECT LOCATION MAP
C1. . . TWO-MILE PERIMETER MAP
C2. . . AERIAL PHOTO & 2,000-FOOT PERIMETER MAP
C3. . . SITE PLAN
C4. . . BASE GRADES
C4A. . SEPARATION BETWEEN HIGH WATER LEVELS & BASE GRADES
C5. . . 5-YEAR PERMITTING PERIOD INTERMEDIATE GRADES & EROSION CONTROL PLAN
C6. . . CAP GRADES & FINAL EROSION CONTROL PLAN
CS1. . CROSS-SECTION A-A
CS2. . CROSS-SECTION B-B
D1. . . MISCELLANEOUS DETAILS
D2. . . MISCELLANEOUS DETAILS

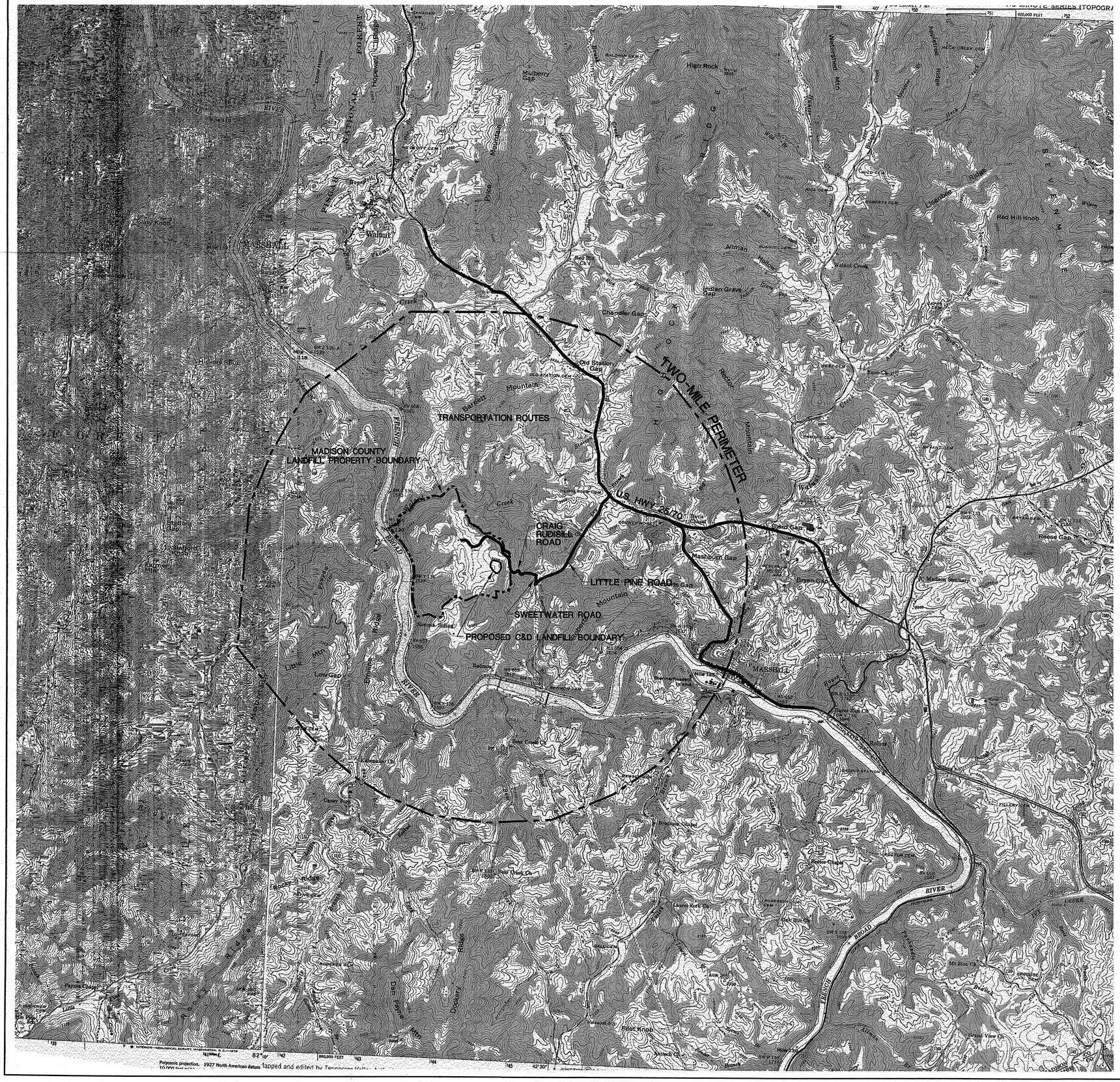
McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
55 BROAD STREET ASHEVILLE, NC 28801 PH. (828) 252-0575

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 24993 MARK D. CATHEY
4/13/06

APRIL 2006

FOR REGULATORY REVIEW

L: dwgs/04317/Permit/04317-G1.dwg



N.C. GRID NORTH N.A.D. 1983

FOR REGULATORY REVIEW

LEGEND

- LANDFILL PROPERTY
- WASTE TRANSPORTATION ROUTES

SCALE 1" = 2000'

0 1000 2000 3000 4000 5000

NO.	DATE	BY	REVISION DESCRIPTION

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

CONSTRUCTION / DEMOLITION LANDFILL
MADISON COUNTY LANDFILL

MADISON COUNTY, NORTH CAROLINA

JOB NO.: 04317
DATE: JANUARY 2006
SCALE: 1" = 2000'
DESIGNED BY: KFS
CADD BY: KFS
DESIGN REVIEW: _____
CONST. REVIEW: _____
04317/Permit/04317-Two-Mile-2000.dwg

TWO-MILE PERIMETER MAP

SHEET C1

LANDFILL PROPERTY LINE

2,000 - FOOT PERIMETER

EXISTING C/D LANDFILL TO BE CLOSED

LEACHATE SPRAY IRRIGATION DEMONSTRATION SITE

MAINTENANCE/RECYCLING BUILDING

CLOSED MSW LANDFILL

ACCESS ROAD

CRAIG RUDISILL ROAD

TRANSFER STATION

LEACHATE POND

WHITE GOODS

SR-1134

HOUSEHOLD DROP-OFF

PROPOSED BORROW/STOCKPILE AREA

PROPOSED 20' GRAVEL ACCESS ROADS

OFFICE & SCALES

LANDFILL ENTRANCE

MADISON COUNTY D.B. 190/PG. 11

PROPOSED C&D LANDFILL

PROPOSED C&D WASTE LIMITS

MADISON COUNTY D.B. 375/PG. 423

RESIDENCE HAS BEEN ADDED SINCE AERIAL PHOTO WAS TAKEN

MADISON COUNTY
PIN NO. 8796-79-3852
D.B. 229/PG. 474

STREAM

DRY BRANCH ROAD

RELOCATED WELL

LANDFILL PROPERTY LINE

N.C. GRID NORTH N.A.D. 1983

FOR REGULATORY REVIEW

NOTE:
PROPERTY LINES SHOWN ARE FROM MADISON CO. GIS DEPT.

SCALE 1" = 200'
0 100 200 300 400 500

NO.	DATE	BY	REVISION DESCRIPTION
1	4/10/06	DP	REVISED PER NCDENR COMMENT LETTER, DATED APRIL 5, 2006

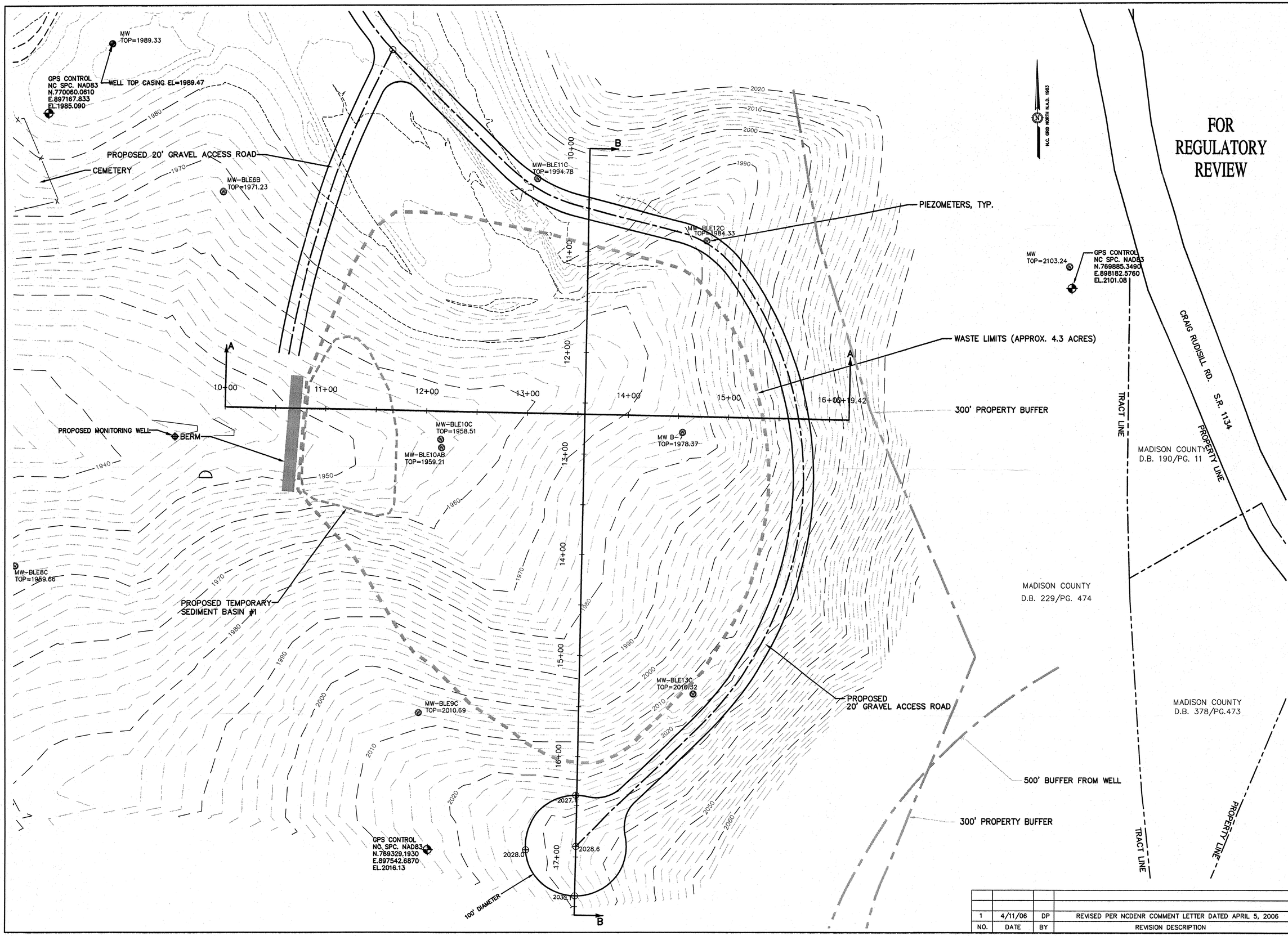
McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
55 BROAD STREET ASHEVILLE, NC PH. (828) 252-0575

CONSTRUCTION / DEMOLITION LANDFILL
MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

JOB NO.: 04317
DATE: JANUARY 2006
SCALE: 1" = 200'
DESIGNED BY: KFS
CADD BY: KFS
DESIGN REVIEW: _____
CONST. REVIEW: _____
04317/Permit/04317-C2.dwg

AERIAL PHOTO & 2000-FOOT PERIMETER MAP

SHEET C2



NO.	DATE	BY	REVISION DESCRIPTION
1	4/11/06	DP	REVISED PER NCDENR COMMENT LETTER DATED APRIL 5, 2006

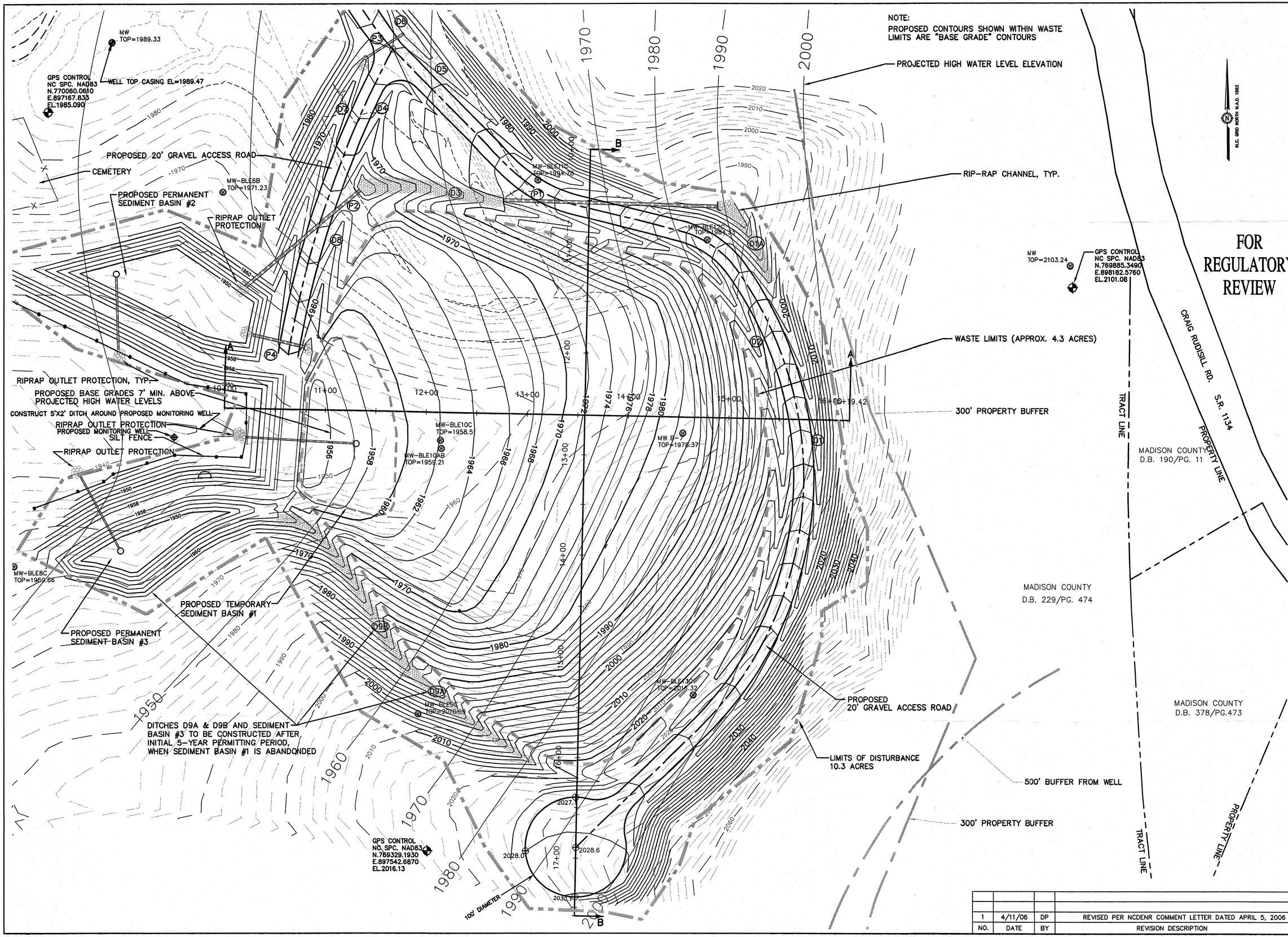
McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
55 BROAD STREET ASHEVILLE, NC PH. (828) 252-0575

CONSTRUCTION / DEMOLITION LANDFILL
MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

JOB NO.: 04317
DATE: JANUARY 2006
SCALE: 1" = 40'
DESIGNED BY: KFS
CADD BY: KFS
DESIGN REVIEW: ____
CONST. REVIEW: ____
04317/Permit/04317-C3.dwg

SITE PLAN

SHEET
C3



FOR REGULATORY REVIEW

NO.	DATE	BY	REVISION DESCRIPTION
1	4/11/06	DP	REVISED PER NCDENR COMMENT LETTER DATED APRIL 5, 2006

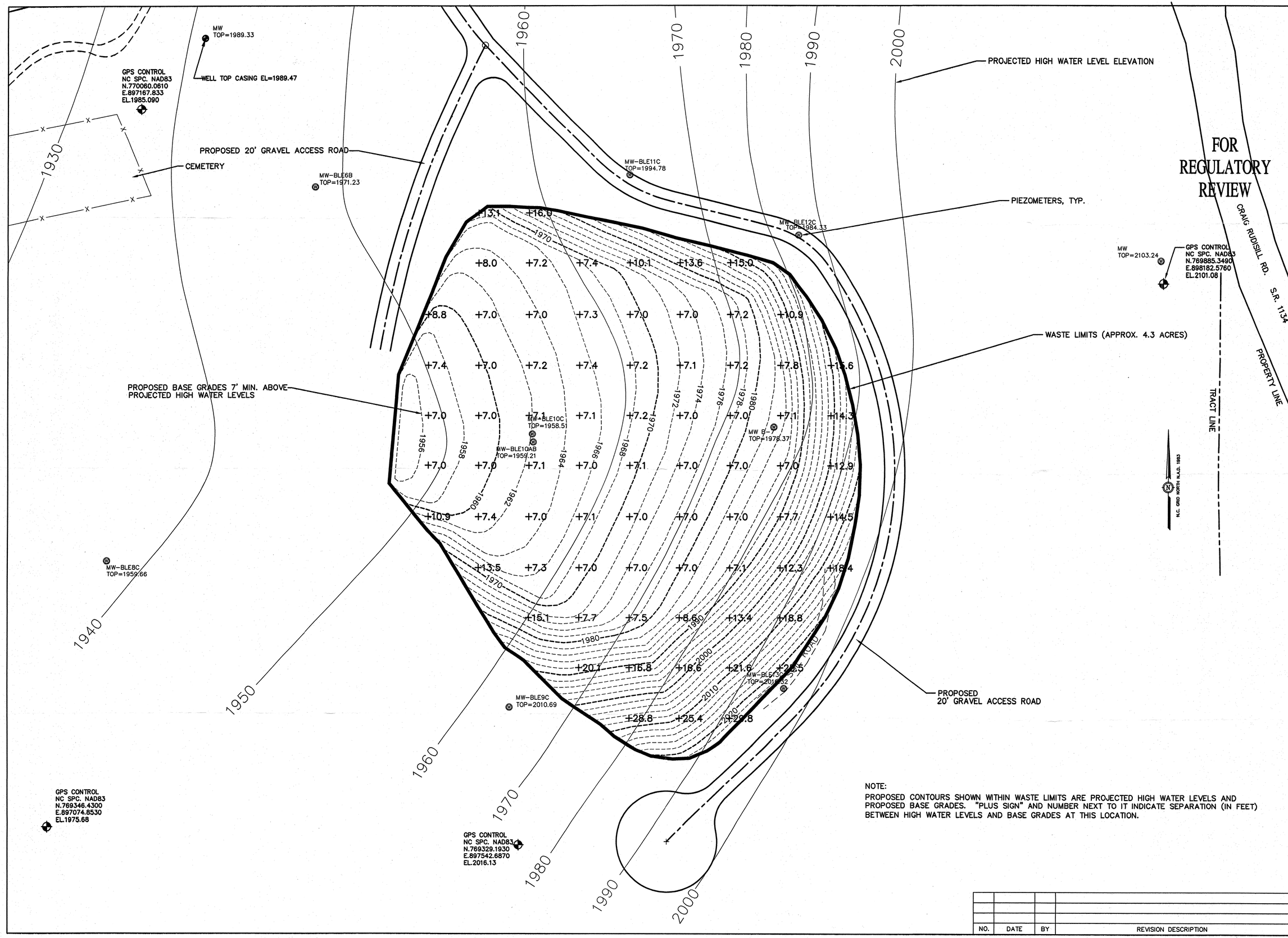
McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
55 BROAD STREET ASHEVILLE, NC PH. (828) 252-0575

CONSTRUCTION / DEMOLITION LANDFILL
MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

JOB NO.: 04317
DATE: JANUARY 2006
SCALE: 1" = 40'
DESIGNED BY: KFS
CADD BY: KFS
DESIGN REVIEW:
CONST. REVIEW:
04317/Permit/04317-C4.dwg

BASE GRADES

SHEET C4



NOTE:
PROPOSED CONTOURS SHOWN WITHIN WASTE LIMITS ARE PROJECTED HIGH WATER LEVELS AND PROPOSED BASE GRADES. "PLUS SIGN" AND NUMBER NEXT TO IT INDICATE SEPARATION (IN FEET) BETWEEN HIGH WATER LEVELS AND BASE GRADES AT THIS LOCATION.

NO.	DATE	BY	REVISION DESCRIPTION

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

CONSTRUCTION / DEMOLITION LANDFILL
MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

JOB NO.: 04317
DATE: APRIL 2006
SCALE: 1" = 40'
DESIGNED BY: DP
CADD BY: DP
DESIGN REVIEW:
CONST. REVIEW:
04317/Permit/04317-C4A.dwg

SEPARATION BETWEEN HIGH WATER LEVELS & BASE GRADES

SHEET
C4A

GPS CONTROL
NC SPC. NAD83
N.770060.0610
E.897167.833
EL.1985.090

WELL TOP CASING EL=1989.47

PROPOSED 20' GRAVEL ACCESS ROAD

CEMETERY

PROPOSED PERMANENT SEDIMENT BASIN #2

RIPRAP OUTLET PROTECTION

RIPRAP OUTLET PROTECTION, TYP.

SILT FENCE

RIPRAP OUTLET PROTECTION

PROPOSED TEMPORARY SEDIMENT BASIN #1

PROPOSED PERMANENT SEDIMENT BASIN #3

DITCHES D9A & D9B AND SEDIMENT BASIN #3 TO BE CONSTRUCTED AFTER INITIAL 5-YEAR PERMITTING PERIOD, WHEN SEDIMENT BASIN #1 IS ABANDONDED

GPS CONTROL
NC SPC. NAD83
N.769329.1930
E.897542.6870
EL.2016.13

100' DIAMETER

RIP-RAP CHANNEL, TYP.

GPS CONTROL
NC SPC. NAD83
N.769885.3490
E.898182.5760
EL.2101.08

PROPOSED BASE GRADES

WASTE LIMITS (APPROX. 4.3 ACRES)

PROPOSED 5-YEAR PERMITTING PERIOD INTERMEDIATE GRADES

300' PROPERTY BUFFER

PROPOSED 20' GRAVEL ACCESS ROAD

LIMITS OF DISTURBANCE 10.3 ACRES

500' BUFFER FROM WELL

300' PROPERTY BUFFER

MADISON COUNTY
D.B. 190/PG. 11

MADISON COUNTY
D.B. 229/PG. 474

MADISON COUNTY
D.B. 378/PG.473

TRACT LINE

PROPERTY LINE

CRAIG RUDISILL RD.

S.R. 1134

N.C. GRID NORTH N.A.D. 1983

FOR REGULATORY REVIEW

NO.	DATE	BY	REVISION DESCRIPTION
1	4/11/05	DP	REVISED PER NCDENR COMMENT LETTER DATED APRIL 5, 2006

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

CONSTRUCTION / DEMOLITION LANDFILL
MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

JOB NO.: 04317
DATE: JANUARY 2006
SCALE: 1" = 40'
DESIGNED BY: KFS
CADD BY: KFS
DESIGN REVIEW:
CONST. REVIEW:
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5-YEAR PERMITTING PERIOD
INTERMEDIATE GRADES
& EROSION CONTROL PLAN

SHEET
C5

GPS CONTROL
NC SPC. NAD83
N.770060.0610
E.897167.833
EL.1985.090

WELL TOP CASING EL=1989.47

PROPOSED 20' GRAVEL ACCESS ROAD

CEMETERY

PROPOSED PERMANENT SEDIMENT BASIN #2

RIPRAP OUTLET PROTECTION

RIPRAP OUTLET PROTECTION, TYP.

REMOVE RISER, GROUT & ABANDON BARREL

RIPRAP OUTLET PROTECTION

PROPOSED PERMANENT SEDIMENT BASIN #3

DITCHES D9A & D9B AND SEDIMENT BASIN #3 TO BE CONSTRUCTED AFTER INITIAL 5-YEAR PERMITTING PERIOD, WHEN SEDIMENT BASIN #1 IS ABANDONDED

GPS CONTROL
NC SPC. NAD83
N.769329.1930
E.897542.6870
EL.2016.13

100' DIAMETER

HIGH POINT 1990.0

DRAINAGE TERRACE

elev. 1990.0

NOTE:
PROPOSED CONTOURS SHOWN WITHIN WASTE LIMITS ARE "FINAL CAP" CONTOURS

RIP-RAP CHANNEL, TYP.

WASTE LIMITS (APPROX. 4.3 ACRES)

300' PROPERTY BUFFER

GPS CONTROL
NC SPC. NAD83
N.769885.3490
E.898182.5760
EL.2101.08

MADISON COUNTY
D.B. 190/PG. 11

MADISON COUNTY
D.B. 229/PG. 474

MADISON COUNTY
D.B. 378/PG.473

PROPOSED 20' GRAVEL ACCESS ROAD

LIMITS OF DISTURBANCE 10.3 ACRES

500' BUFFER FROM WELL

300' PROPERTY BUFFER

CRAIG RUDISILL RD. S.R. 1134

TRACT LINE

PROPERTY LINE

N.C. GRID NORTH N.A.D. 1983

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CONSTRUCTION / DEMOLITION LANDFILL
MADISON COUNTY LANDFILL

MADISON COUNTY, NORTH CAROLINA

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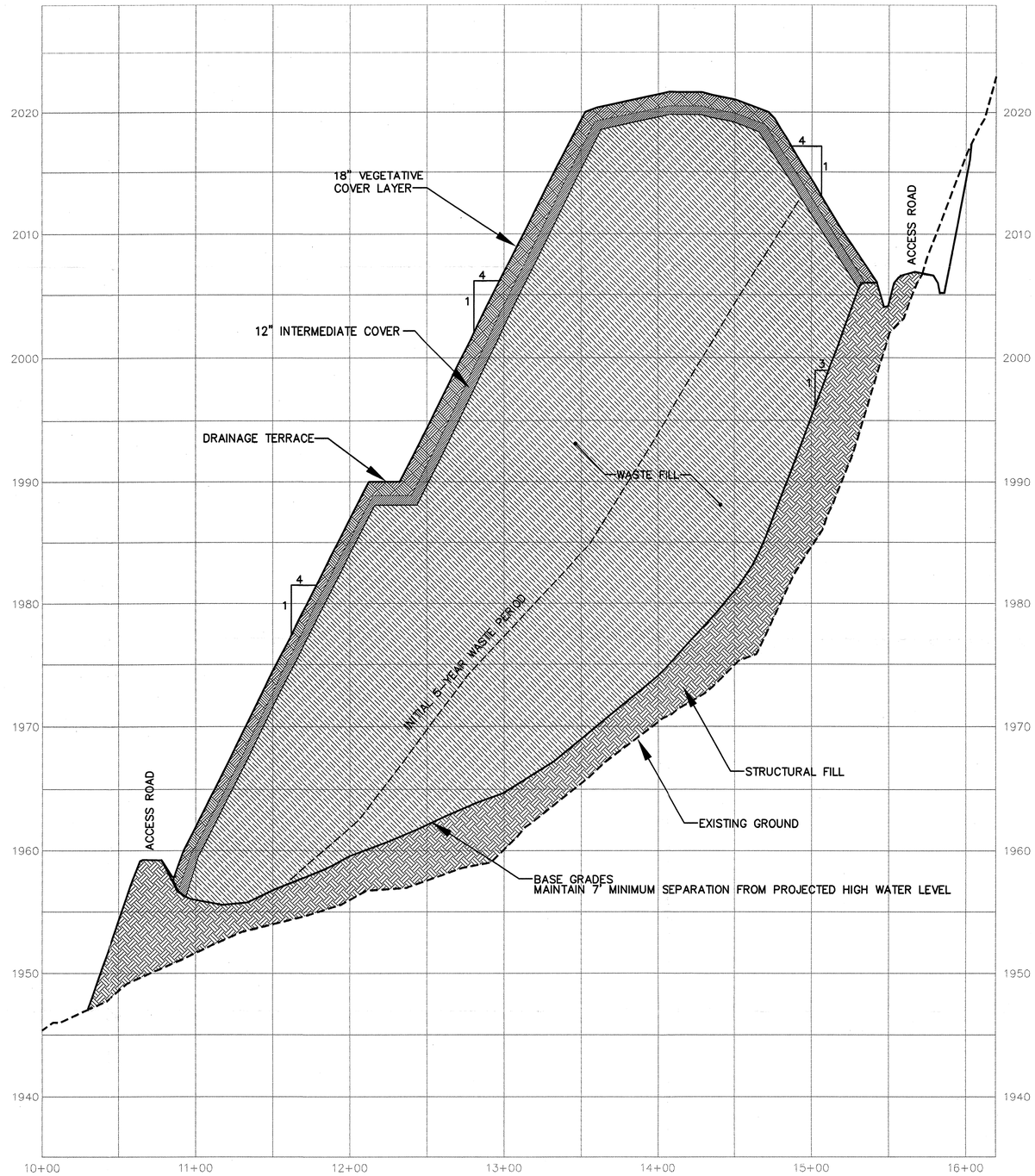
CAP GRADES & FINAL EROSION CONTROL PLAN

SHEET
C6



CROSS-SECTION A-A

SCALE: HORIZ. 1" = 40'
VERT. 1" = 5'

NOTE: CAP LAYERS SHOWN ARE LARGER THAN ACTUAL WIDTH FOR CLARITY

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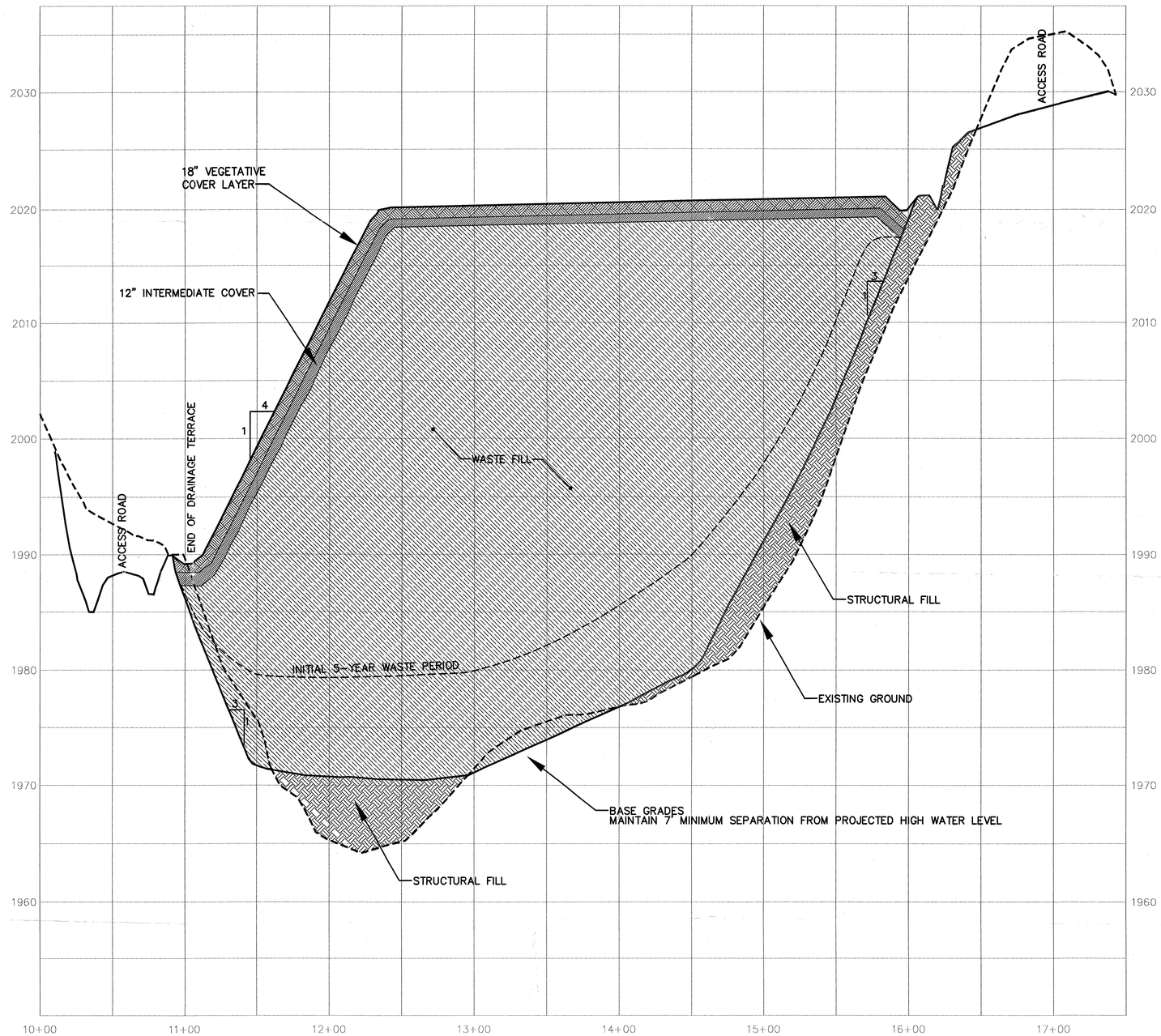
CROSS-SECTION A-A

SHEET
CS1



CROSS-SECTION B-B

SCALE: HORIZ. 1" = 40'
VERT. 1" = 5'

NOTE: CAP LAYERS SHOWN ARE LARGER THAN ACTUAL WIDTH FOR CLARITY

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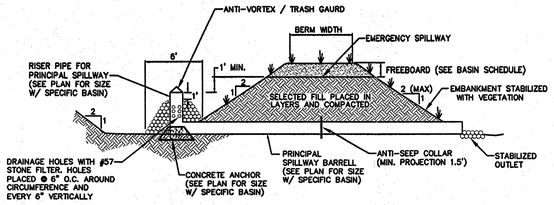
CROSS-SECTION B-B

SHEET
CS2

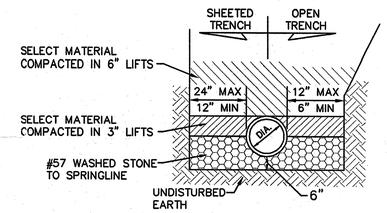
SEDIMENT BASIN INFORMATION																
BASIN NO.	Q_{25} (cfs)	S.A. REQ'D. (sq. ft.)	S.A.. PROVIDED (sq. ft.)	VOL. REQ'D. (cu. ft.)	VOL. PROVIDED (cu. ft.)	TOP DAM ELEV. (FT.)	SPILLWAY ELEV. (FT.)	TOP RISER ELEV. (FT)	BARREL INV. IN ELEV. (FT)	BARREL INV. OUT ELEV. (FT)	RISER SIZE (IN)	BARREL SIZE (IN)	BARREL L/SLOPE	EMERGENCY SPILLWAY	BERM WIDTH	FLOTATION BLOCK DIMENSIONS (FT)
1	14.0	6,100	13,100	7,200	23,400	1959.0	1958.0	1957.0	1954.0	1944.0	24	18	107'/9.3%	1' x 6'	16'	2 x 2 x 1.5
2	31.2	13,590	13,600	5,400	115,000	1958.0	1957.0	1955.5	1948.0	1945.0	30	21	70'/4.3%	1' x 6'	10'	3.5 x 3.5 x 2.5
3	9.7	4,250	7,400	5,400	61,500	1958.0	1957.0	1956.0	1948.0	1940.0	24	18	80'/10.0%	1' x 6'	10'	2.5 x 2.5 x 2.0



SEDIMENT BASIN WITH RISER DETAIL

NOTES:

1. RIRAP SHALL BE CHECKED AFTER EACH RAINFALL TO ENSURE AGAINST EROSION AND SHALL BE REPAIRED AS REQUIRED.
2. SEDIMENT SHALL BE REMOVED WHEN DEPTH OF SEDIMENT REACHES 1/2 HEIGHT OF DAM.
3. RIPRAP SHALL BE REMOVED AFTER AREA IS STABILIZED, TO ALLOW UNOBSTRUCTED FLOW OF STORM WATER THROUGH PIPE.



STORM DRAINAGE PIPING

TYPICAL TRENCHING DETAILS

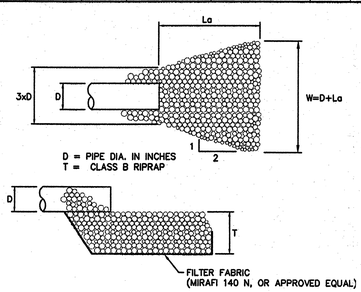
NTS

GENERAL CONSTRUCTION NOTES

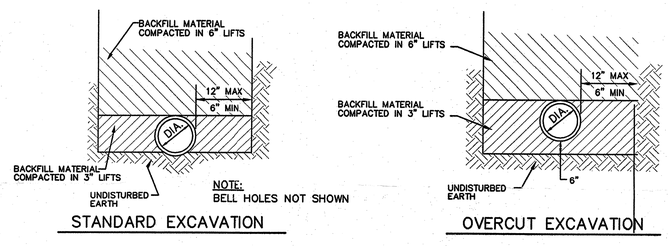
1. UNLESS OTHERWISE STATED, ALL FILL AREAS SHALL BE CONSTRUCTED IN LAYERS OF 8" MAXIMUM THICKNESS, WITH WATER ADDED OR SOIL CONDITIONED TO THE OPTIMUM MOISTURE CONTENT AS DETERMINED BY THE ENGINEER AND COMPACTED WITH A SHEEP'S FOOT ROLLER TO A COMPACTION EQUAL TO OR GREATER THAN 95% (100% IN THE TOP 2" OF THE SUBGRADE BELOW ROADWAYS AND PARKING LOTS) OF THE DENSITY OBTAINED BY COMPACTING A SAMPLE OF THE MATERIAL IN ACCORDANCE WITH THE STANDARD PROCTOR METHOD OF MOISTURE-DENSITY RELATIONSHIP TEST, ASTM D157 OR AASHO T-180 UNLESS SPECIFIED IN OTHER SPECIFICATIONS.
2. ENTIRE AREA TO BE GRADED SHALL BE CLEARED AND GRUBBED. NO FILL SHALL BE PLACED ON ANY AREA NOT CLEARED AND GRUBBED.
3. ALL SOIL EROSION CONTROL MEASURES REQUIRED BY THE GRADING PLAN SHALL BE PERFORMED PRIOR TO GRADING, CLEARING OR GRUBBING. ALL EROSION CONTROL DEVICES SUCH AS SILT FENCES, ETC., SHALL BE MAINTAINED IN WORKABLE CONDITION FOR THE LIFE OF THE PROJECT AND SHALL BE REMOVED AT THE COMPLETION OF THE PROJECT ONLY ON THE ENGINEER'S APPROVAL. PAYMENT SHALL BE CONSIDERED INCIDENTAL TO CLEARING AND GRUBBING. IF DURING THE LIFE OF THE PROJECT, A STORM CAUSES SOIL EROSION WHICH CHANGES FINISH GRADES OR CREATES "GULLIES" AND "WASHED AREAS", THESE SHALL BE REPAIRED AT NO EXTRA COST, AND ALL SILT WASHED OFF OF THE PROJECT SITE ONTO ADJACENT PROPERTY SHALL BE REMOVED AS DIRECTED BY THE ENGINEER AT NO EXTRA COST. THE CONTRACTOR SHALL ADHERE TO ANY APPROVED EROSION CONTROL PLANS WHETHER INDICATED IN THE CONSTRUCTION PLANS OR UNDER SEPARATE COVER.
4. ABANDONED UTILITIES SUCH AS CULVERTS, WATER PIPE, HYDRANTS, CASTINGS, PIPE APPURTENANCES, UTILITY POLES, ETC., SHALL BE THE PROPERTY OF THE SPECIFIC UTILITY AGENCY, OR COMPANY HAVING JURISDICTION. BEFORE THE CONTRACTOR CAN REMOVE, DESTROY, SALVAGE, REUSE, SELL OR STORE FOR HIS OWN USE ANY ABANDONED UTILITY, HE MUST PRESENT TO THE OWNER WRITTEN PERMISSION FROM THE UTILITY INVOLVED.
5. THE CONTRACTOR IS RESPONSIBLE FOR THE COORDINATION OF ADJUSTMENT OF ALL UTILITY SURFACE ACCESSES WHETHER HE PERFOMS THE WORK OR A UTILITY COMPANY PERFORMS THE WORK.
6. THE CONTRACTOR SHALL CONTROL ALL "DUST" BY PERIODIC WATERING AND SHALL PROVIDE ACCESS AT ALL TIMES FOR PROPERTY OWNERS AND GUESTS WITHIN THE PROJECT AREA AND FOR EMERGENCY VEHICLES. ALL OPEN DITCHES AND HAZARDOUS AREAS SHALL BE CLEARLY MARKED IN ACCORDANCE WITH THE SPECIFICATIONS.
7. ALL AREAS WHERE THERE IS EXPOSED DIRT SHALL BE SEEDED, FERILIZED AND MULCHED ACCORDING TO THE SPECIFICATIONS. THE FINISHED SURFACE SHALL BE TO GRADE AND SMOOTH, FREE OF ALL ROCKS LARGER THAN 3", EQUIPMENT TRACKS, DIRT CLODS, BUMPS, RIDGES AND GOUGES PRIOR TO SEEDING; THE SURFACE SHALL BE LOOSENED TO A DEPTH OF 1' (+/-) TO ACCEPT SEED. THE CONTRACTOR SHALL NOT PROCEED WITH SEEDING OPERATIONS WITHOUT FIRST OBTAINING THE ENGINEER'S APPROVAL OF THE GRADED SURFACE. ALL SEEDING SHALL BE PERFOMED BY A MECHANICAL "HYDRO-SEEDER". HAND SEEDING SHALL BE AUTHORIZED ON AN AREA BY AREA APPROVAL BY THE ENGINEER.
8. CONTRACTOR SHALL VERIFY ALL ELEVATIONS BEFORE INSTALLATION OF FACILITIES.
9. CONCRETE AND MASONRY SHALL MEET THE REQUIREMENT OF APPROPRIATE SECTION OF NCDOT STANDARD SPECIFICATIONS FOR ROAD AND STRUCTURES (LATEST EDITION). CONCRETE SHALL BE CLASS A, 4000 PSI MINIMUM, MEETING THE REQUIREMENTS OF SECTIONS 900, 1000, 1000-4.H, AND 4200, CONSTRUCTED IN ACCORDANCE WITH SECTION 825. MASONRY SHALL MEET THE REQUIREMENTS OF SECTON 940, CONSTRUCTED IN ACCORDANCE WITH SECTION 830 AND/OR 834.
10. WHERE SPECIFIED, STORM DRAIN PIPE SHALL BE CORRUGATED METAL PIPE (CMP) CONFORMING TO AASHTO M-36, WITH REROLLED ENDS TO ACCOMMODATE CORRUGATED COUPLING BANDS. 18" PIPE SHALL BE 16 GAUGE, 24" AND 30" PIPE SHALL BE 14 GAUGE AND 36" & 48" PIPE SHALL BE 12 GAUGE. COUPLING BANDS SHALL CONFORM TO NCDOT 932-3(A). DIMPLE BANDS SHALL NOT BE USED.

FOR REGULATORY REVIEW

RIPRAP APRON SIZING							
OUTLET NO.	PIPE DIA. (Do)	3 x Do	APRON LENGTH (La)	APRON WIDTH (W) W = Do + La	RIPRAP SIZE d_{50}	d_{max}	Thickness
P1	36"	9'	20'	23'	8"	12"	18"
P2	36"	9'	24'	27'	10"	15"	23"
P3	24"	6'	14'	16'	6"	9"	14"
P4	24"	6'	14'	16'	6"	9"	14"
P5	24"	6'	14'	16'	6"	9"	14"
P6	24"	6'	14'	16'	6"	9"	14"
Sed Basin 1	18"	4.5'	14'	16'	6"	9"	14"
Sed Basin 2	21"	5.25'	22'	24'	10"	15"	23"
Sed Basin 3	18"	4.5'	14'	16'	6"	9"	14"



INLET/OUTLET PROTECTION



STANDARD EXCAVATION — OVERCUT EXCAVATION

NOTE: 1. CONSTRUCTION OF TRENCHES SHALL COMPLY WITH ALL FEDERAL, STATE AND LOCAL SAFETY AND HEALTH REGULATIONS WHICH HAVE JURISDICTION AT THE PROJECT SITE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO BE FAMILIAR WITH THE APPLICABLE REGULATIONS AND FOLLOW THEM ACCORDINGLY.

2. PAYMENT FOR SELECT BACKFILL IN TRENCH SHALL BE FOR ACTUAL QUANTITIES AND SHALL NOT EXCEED THE WIDTH OF TRENCH SHOWN ON THIS DETAIL.

TYPICAL TRENCHING DETAILS

NTS

NORTH CAROLINA LAND QUALITY SECTION

EROSION CONTROL NOTES

GENERAL: ALL EROSION CONTROL MEASURES ARE TO BE PERFORMED IN STRICT ACCORDANCE WITH REQUIREMENTS OF THE NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES, DIVISION OF LAND RESOURCES, LAND QUALITY SECTION. THE FOLLOWING CONSTRUCTION SEQUENCE SHALL BE COMPLIED WITH FOR ALL WORK.

1. – OBTAIN GRADING PERMIT
2. – INSTALL ALL EROSION CONTROL MEASURES AS REQUIRED BY THE NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES, DIVISION OF LAND RESOURCES, LAND QUALITY SECTION.
3. – OBTAIN CERTIFICATE OF COMPLIANCE THROUGH ON-SITE INSPECTION BY A REPRESENTATIVE OF THE NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES, DIVISION OF LAND RESOURCES, LAND QUALITY SECTION.
4. – PROCEED WITH GRADING, CLEARING AND GRUBBING.
5. – SEED AND MULCH DENUDED AREA WITHIN 15 DAYS AFTER FINISHED GRADE ARE ESTABLISHED. SEED AND SOIL AMENDMENTS SHALL BE PLACED ON A PREPARED SEEDBED AT THE FOLLOWING RATES PER ACRE.

LIME	4,000 LBS
FERTILIZER (10-10-10)	1,000 LBS
KY-31 FESCUE	100 LBS
STRAW MULCH	60-80 BALES

FOR SUMMER SEEDING ADD TO THE ABOVE:

GERMAN MILLET	10 LBS
SUDAN GRASS	15 LBS

FOR WINTER SEEDING ADD TO THE ABOVE

RYE GRAIN	15 LBS

FOR ALL SLOPES 2:1 OR STEEPER ADD TO THE ABOVE:

SERICEA LESPEDEZA	40 LBS

IF HYDROSEEDING IS USED, WOOD CELLULOSE MAY BE SUBSTITUTED FOR STRAW MULCH AT THE RATE OF 1,000 LBS PER ACRE.

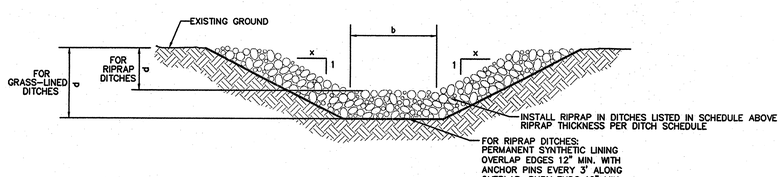
ALL SEEDING SHALL BE MAINTAINED, WATERED ETC., UNTIL A PERMANENT VEGETATIVE GROUND COVER IS ESTABLISHED OVER ALL DISTURBED AREAS.

6. – MAINTAIN SOIL EROSION CONTROL MEASURES UNTIL PERMANENT GROUND COVER IS ESTABLISHED.
7. – REMOVE SOIL EROSION CONTROL MEASURES AND STABILIZE THESE AREAS.
8. – REQUEST FINAL APPROVAL BY THE NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES, DIVISION OF LAND RESOURCES, LAND QUALITY SECTION.

DITCH SCHEDULE

DITCH	SLOPE(%)	b	d	X	D_{50}	RIPRAP THICKNESS	PROPOSED DITCH LINING
D1	5.7	3	2	2		N/A	GRASS-LINED W/NORTH AMERICAN GREEN S150 EROSION CONTROL MATTING*
D1A	15.0	3	2	2	9"	21"	CL. 2 RIP-RAP LINED W/MIRAFI 140N FILTER FABRIC*
D2	5.7	3	3	2		N/A	GRASS-LINED W/NORTH AMERICAN GREEN S150 EROSION CONTROL MATTING*
D3	10.8	6	3	2.5	9"	21"	CL. 2 RIP-RAP LINED W/MIRAFI 140N FILTER FABRIC*
D4	6.1	1	2	2		N/A	GRASS-LINED W/NORTH AMERICAN GREEN S150 EROSION CONTROL MATTING*
D5	4.3	3	2.5	2		N/A	GRASS-LINED W/NORTH AMERICAN GREEN S150 EROSION CONTROL MATTING*
D6	11.1	3	2	2		N/A	GRASS-LINED W/NORTH AMERICAN GREEN S150 EROSION CONTROL MATTING*
D7	5.0	3	3	2		N/A	GRASS-LINED W/NORTH AMERICAN GREEN S150 EROSION CONTROL MATTING*
D8	6.1	2	3	2		N/A	GRASS-LINED W/NORTH AMERICAN GREEN S150 EROSION CONTROL MATTING*
D9A	15.0	3	3	2	6"	18"	CL. 2 RIP-RAP LINED W/MIRAFI 140N FILTER FABRIC*
D9B	15.0	3	3	2	9"	21"	CL. 2 RIP-RAP LINED W/MIRAFI 140N FILTER FABRIC*

* OR APPROVED EQUAL. INSTALL PER MANUFACTURERS RECOMMENDATION



TYPICAL DITCH DETAIL

NTS

STORM DRAINAGE PIPE SCHEDULE						
PIPE	MATERIAL	LENGTH	SIZE	SLOPE	INV. IN ELEV.	INV. OUT ELEV.
P1	CMP	213 L.F.	36"	1.9%	1983.5	1979.5
P2	CMP	149 L.F.	36"	5.4%	1962.0	1954.0
P3	CMP	46 L.F.	24"	1.1%	1972.5	1972.0
P4	CMP	54 L.F.	30"	7.4%	1956.0	1952.0
P5	CMP	143 L.F.	24"	22.2%	1988.5	1956.0
P6	CMP	164 L.F.	24"	20.1%	1988.5	1955.5

STORM DRAINAGE PIPING NOTES:
1) PIPE P1 HAS CONCRETE 'L' ENDWALL AT INVERT IN, PER NCDOT STD. DETAIL 838.05.
2) PIPE P4 HAS FLARED-END SECTION AT INVERT IN.

PIPE SCHEDULE

NO.	DATE	BY	REVISION DESCRIPTION

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

CONSTRUCTION / DEMOLITION LANDFILL
MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

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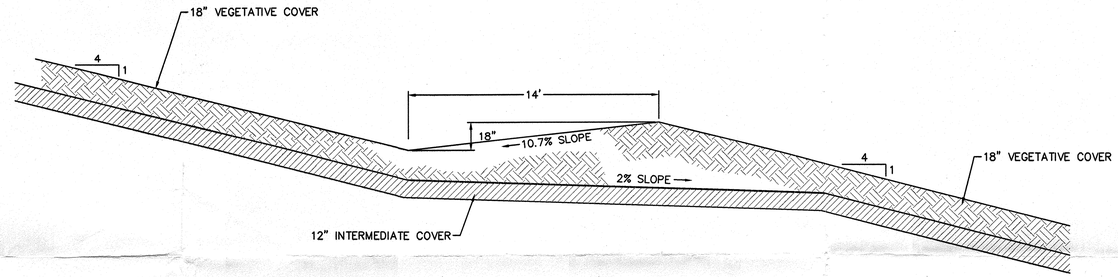
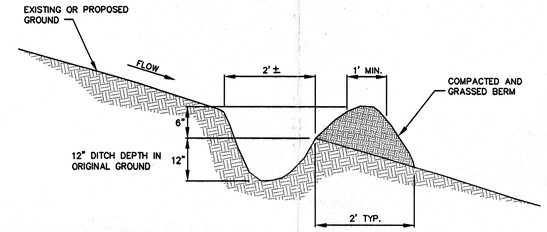
MISCELLANEOUS DETAILS

SHEET D1

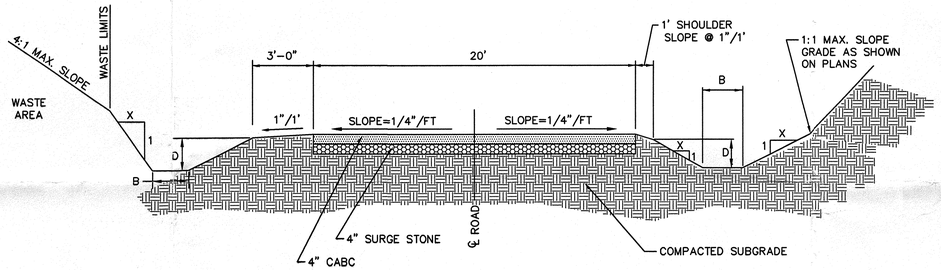


TERRACE DETAIL

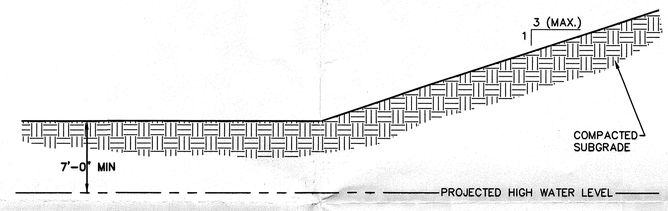


TEMPORARY DIVERSION DITCH

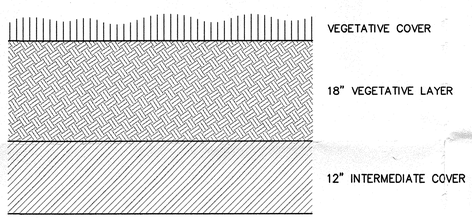
FOR REGULATORY REVIEW



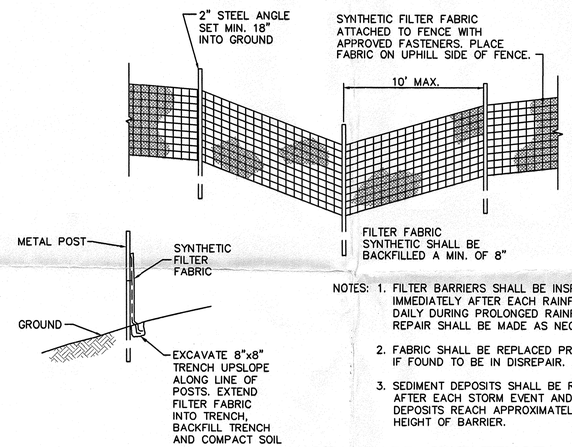
TYPICAL ROAD SECTION



LANDFILL BASE



CAP DETAIL



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

STANDARD SILT FENCE

NTS

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MISCELLANEOUS DETAILS

SHEET D2

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

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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).

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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.

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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

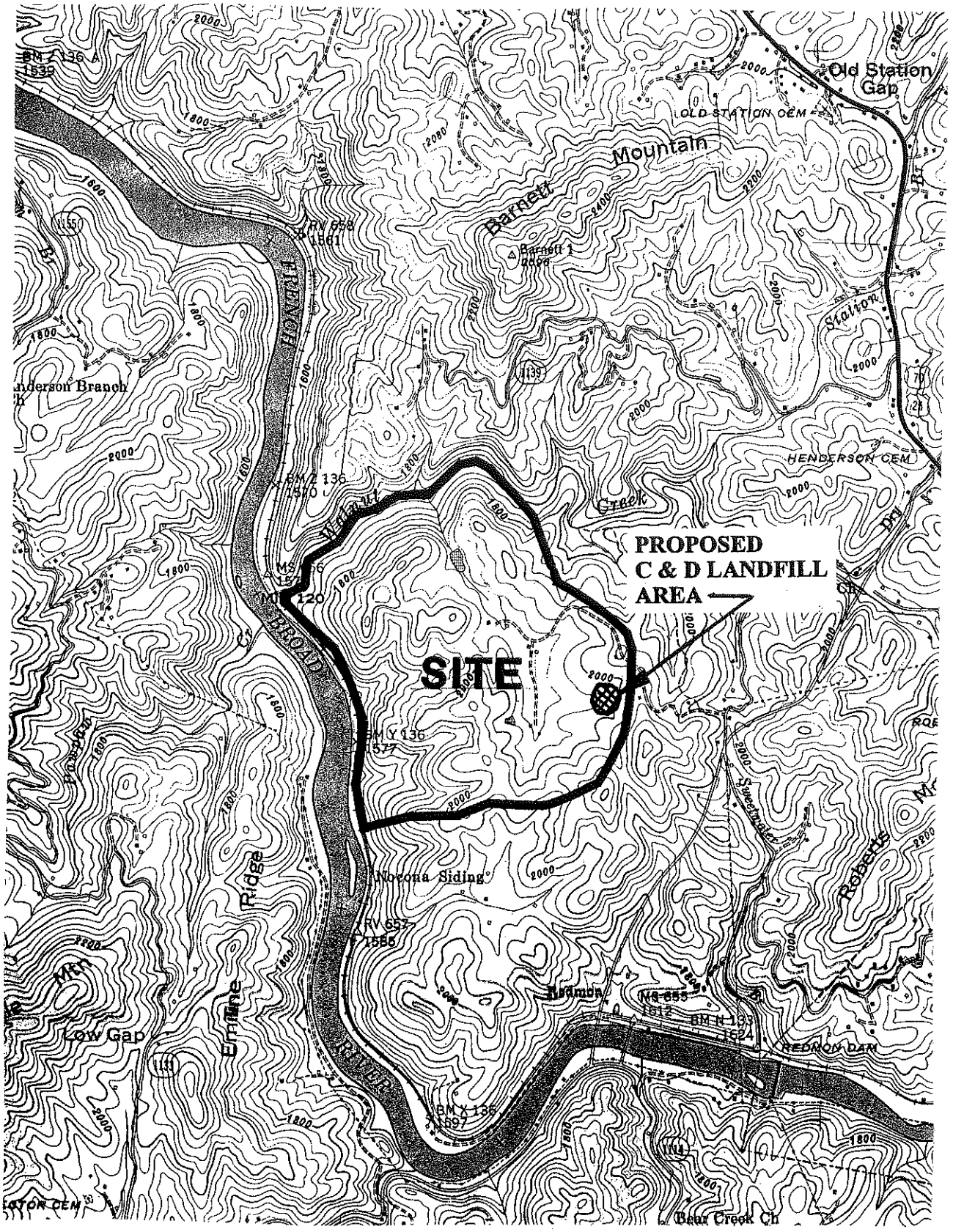
VERTICAL HYDRAULIC GRADIENTS AND FLOW RATES
Proposed C&D Waste Area - Unit 2
Madison County, North Carolina
BLE Project Number J04-2225-04

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



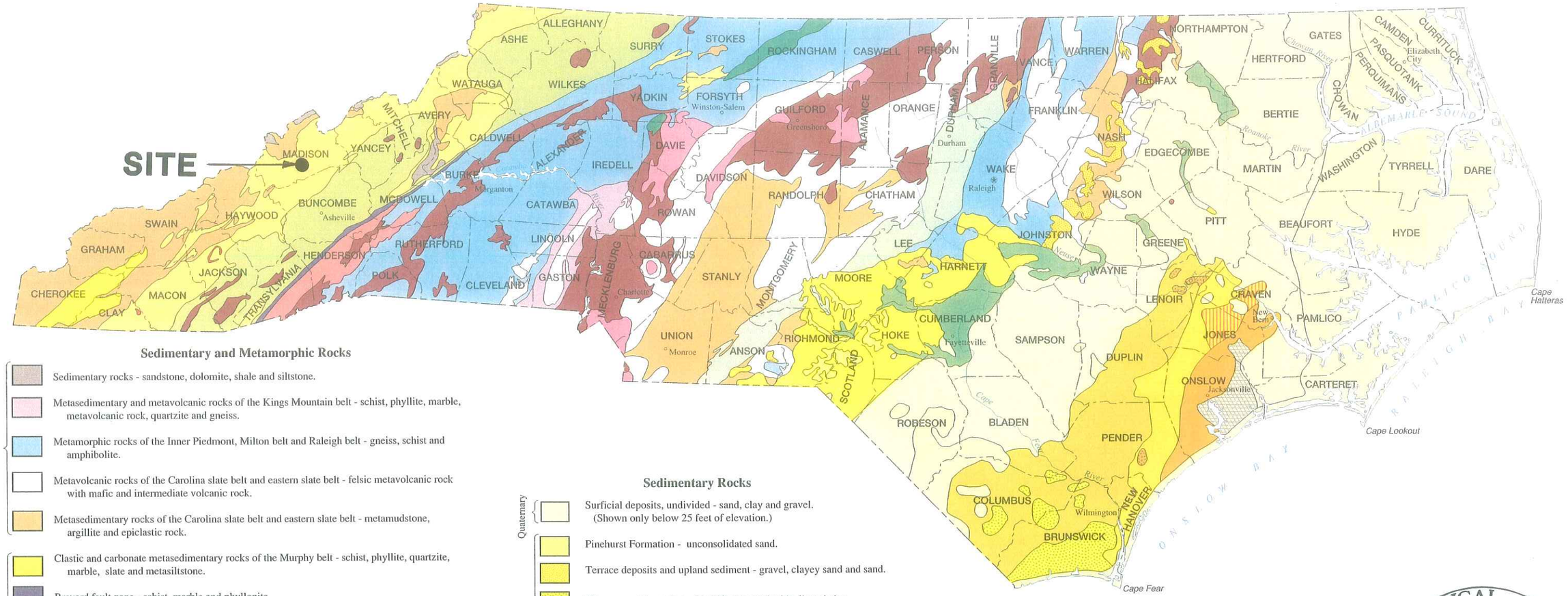
2000 1000 0 2000 4000

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.

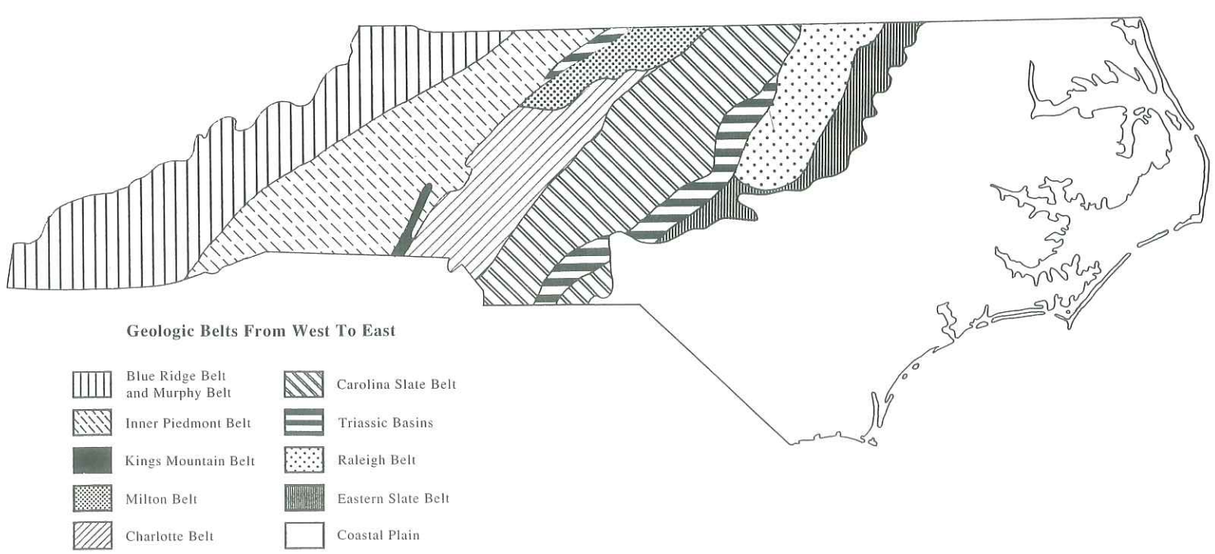
Raleigh Belt: The Raleigh belt contains granite, gneiss and schist. In the 19th century, there were a number of small building stone quarries in this region, but today the main mineral product is crushed stone for construction and road aggregate.

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.

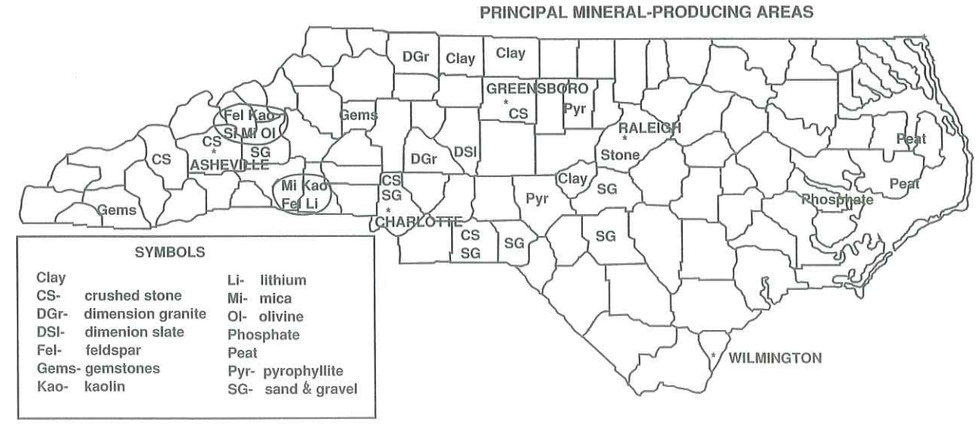
North Carolina Geological Survey
P.O. Box 27687
Raleigh, North Carolina 27611
Phone (919) 733-2423

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

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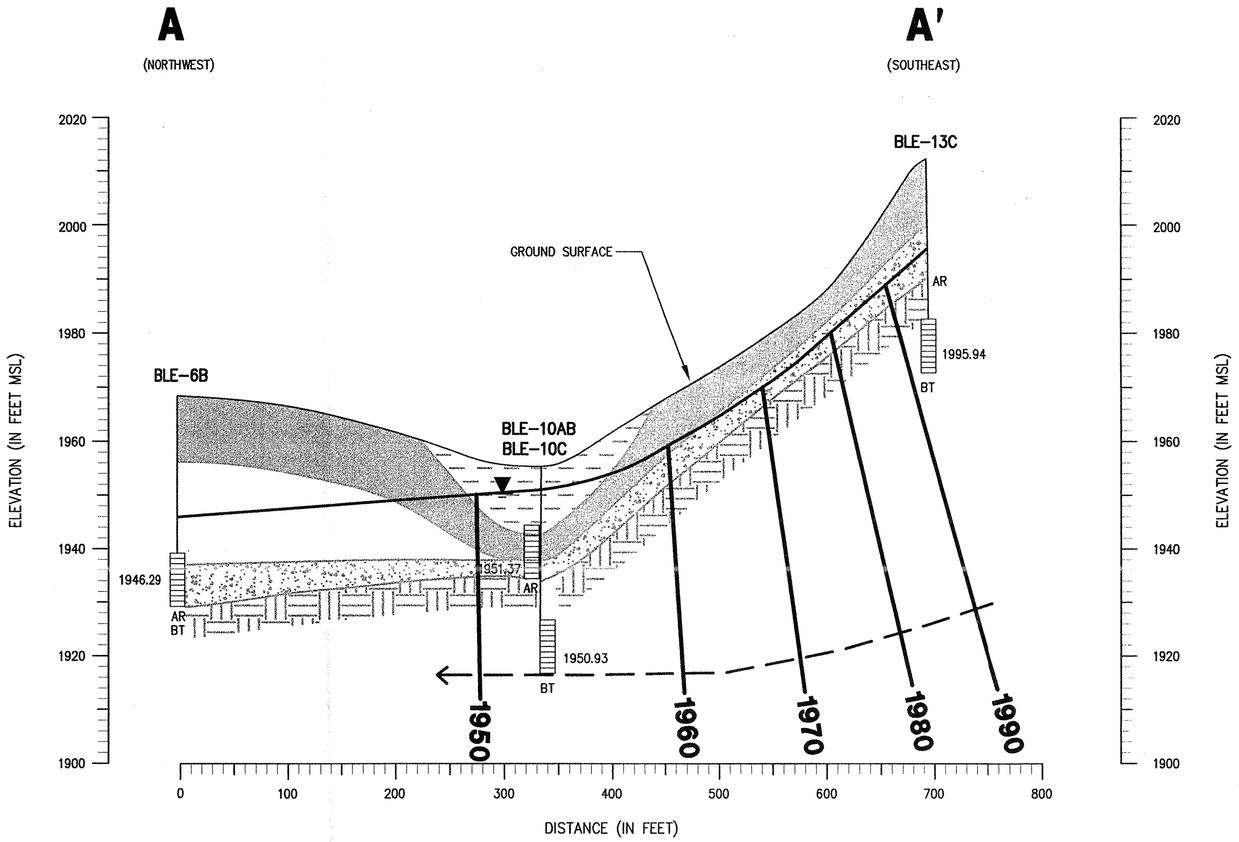
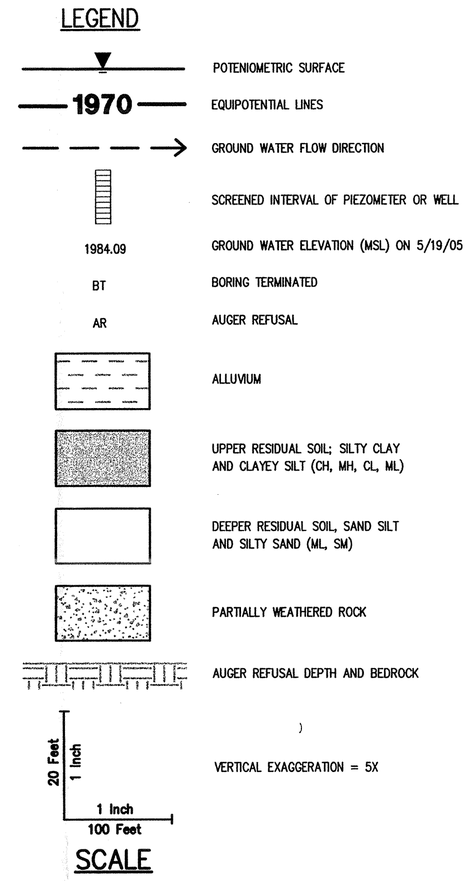
BUNNELL-LAMMONS ENGINEERING, INC.
6004 PONDERS COURT
GREENVILLE, SOUTH CAROLINA 29615
PHONE: (864)288-1265 FAX: (864)288-4430

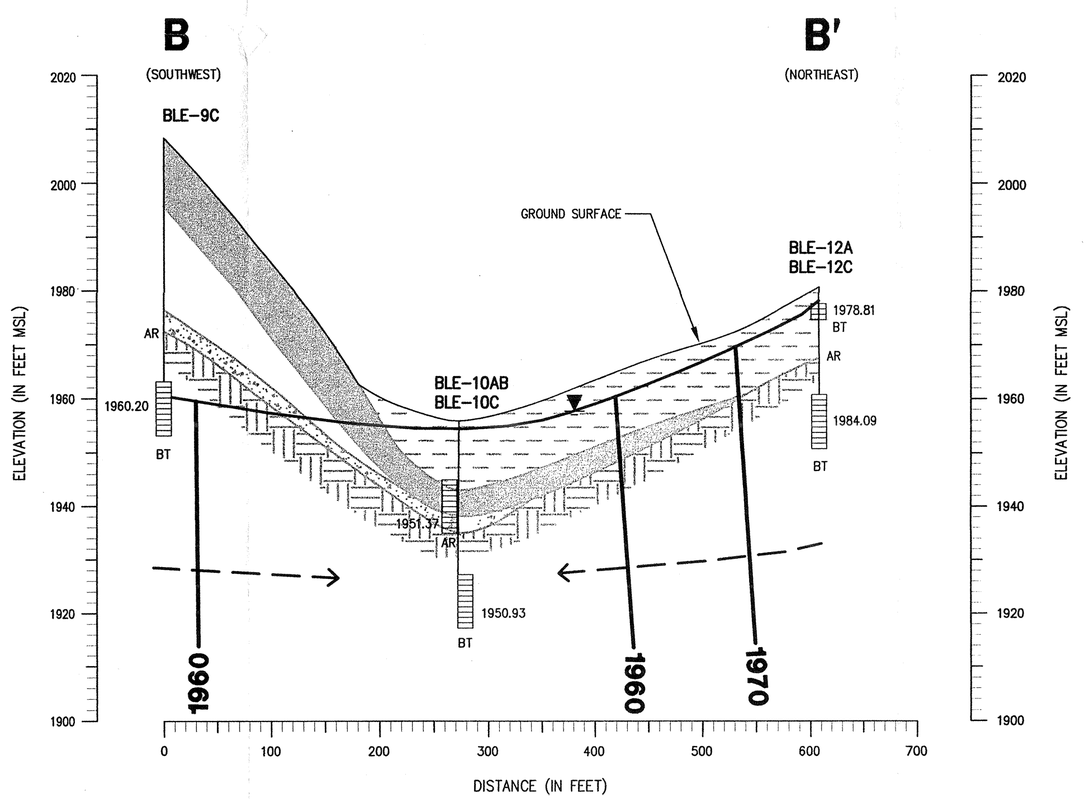
SITE TOPOGRAPHIC PLAN
MADISON COUNTY LANDFILL
MADISON COUNTY, NORTH CAROLINA

FIGURE NO. 3

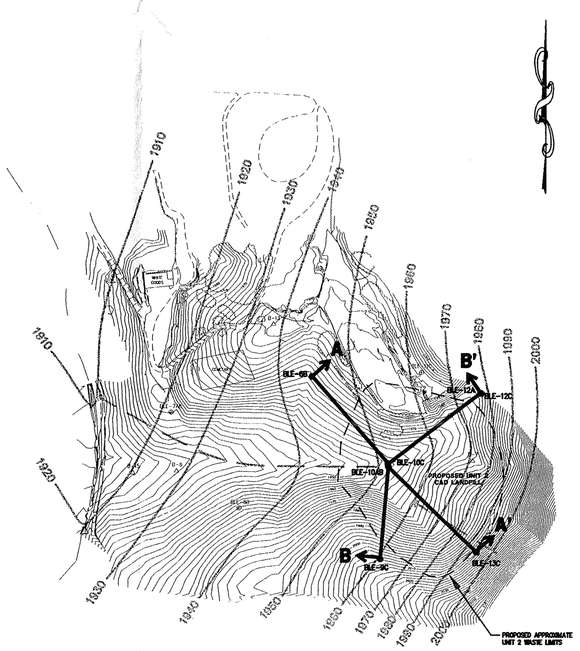


GEOLOGIC PROFILE A-A'





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

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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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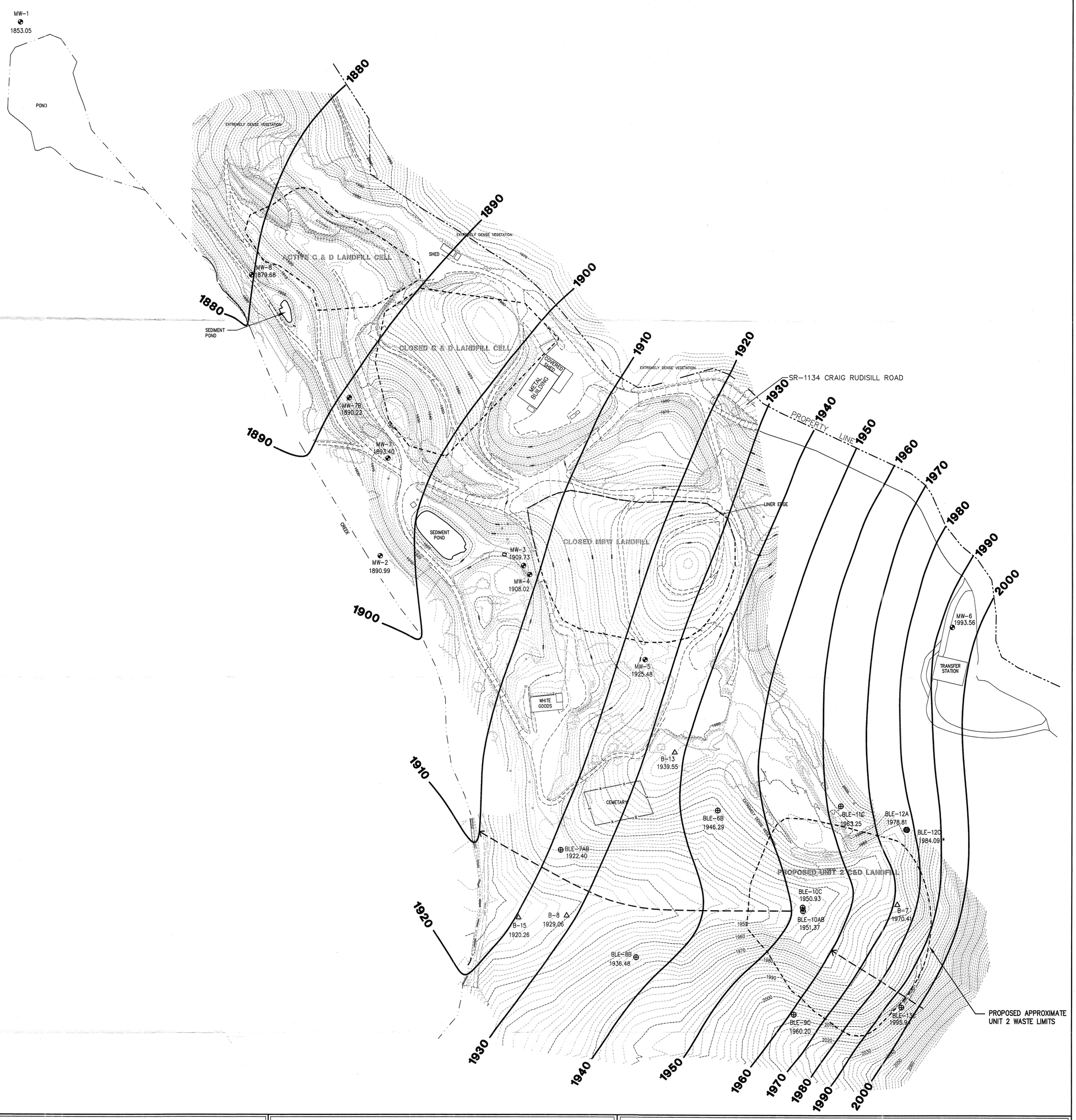
TOP OF BEDROCK (AUGER REFUSAL) ELEVATION CONTOUR MAP

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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GREENVILLE, SOUTH CAROLINA 29615
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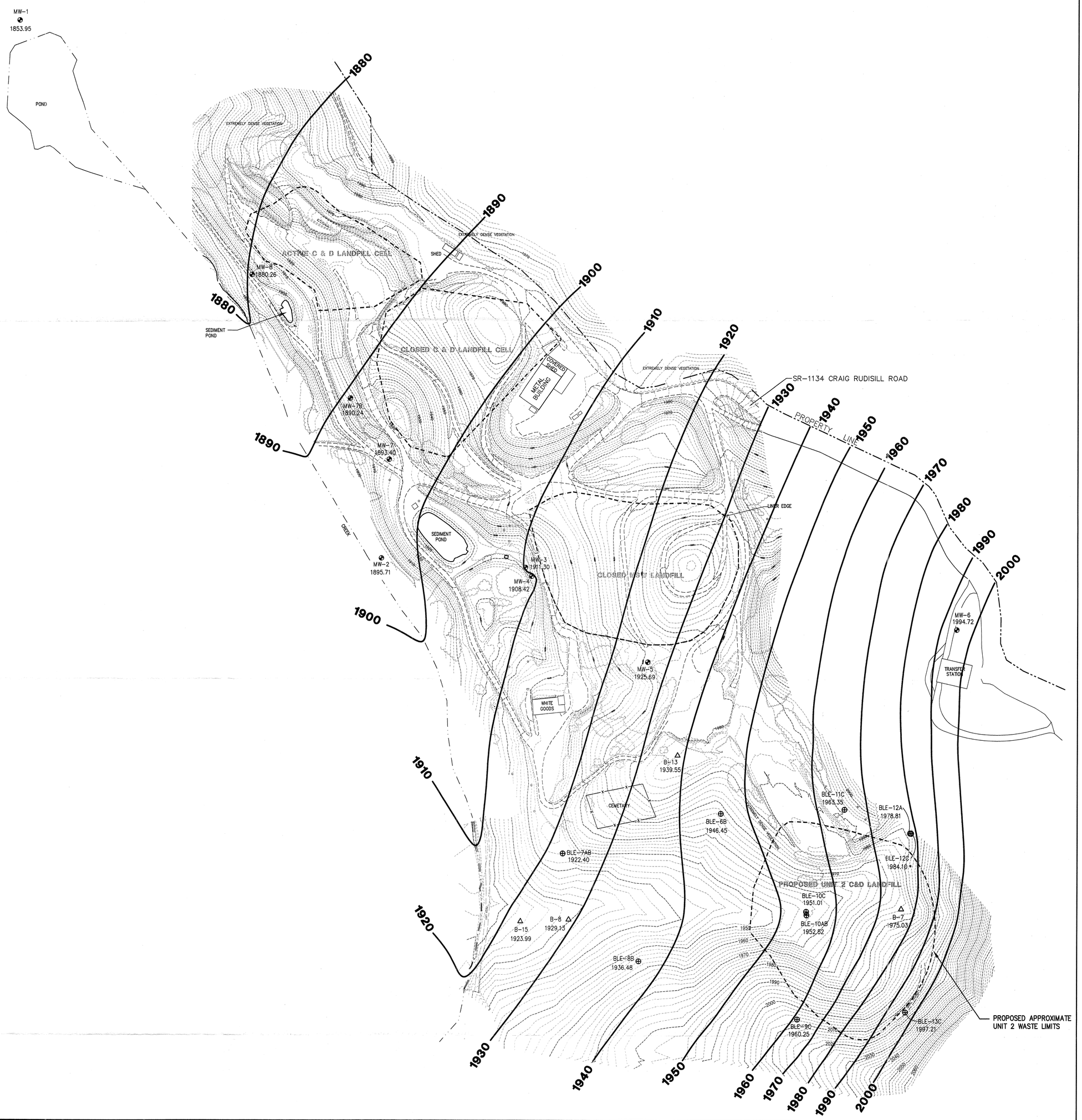
WATER TABLE ELEVATION CONTOUR MAP (MAY 19, 2005)

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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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

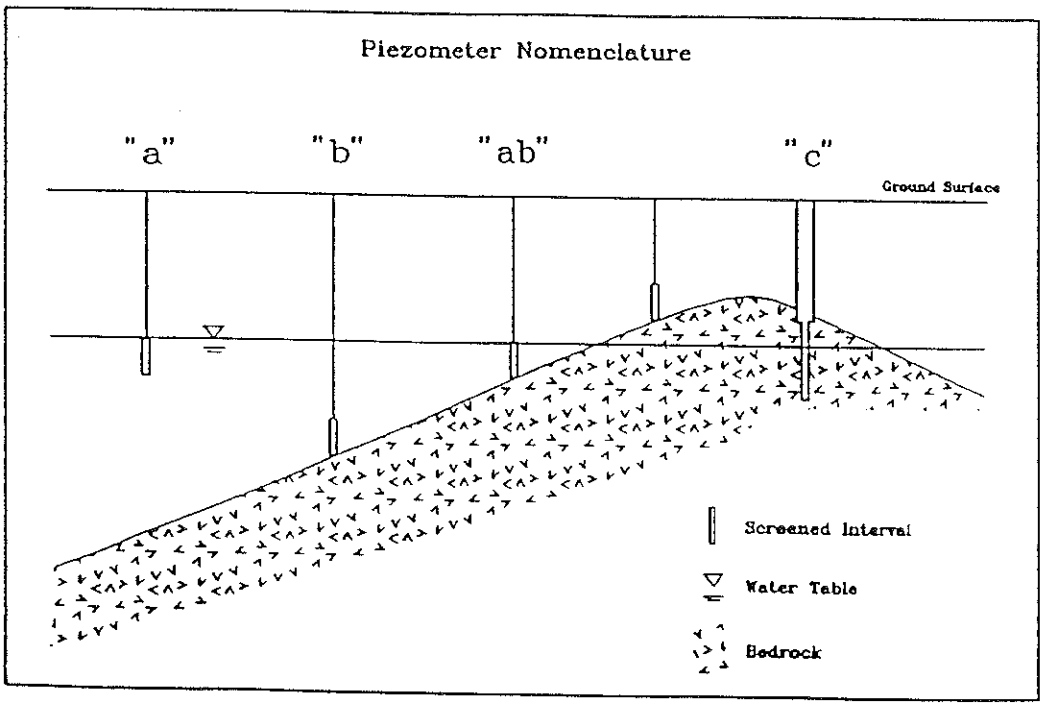
APPENDIX C

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				

Standard penetration results scale: 2 5 10 20 30 40 50 70 90

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

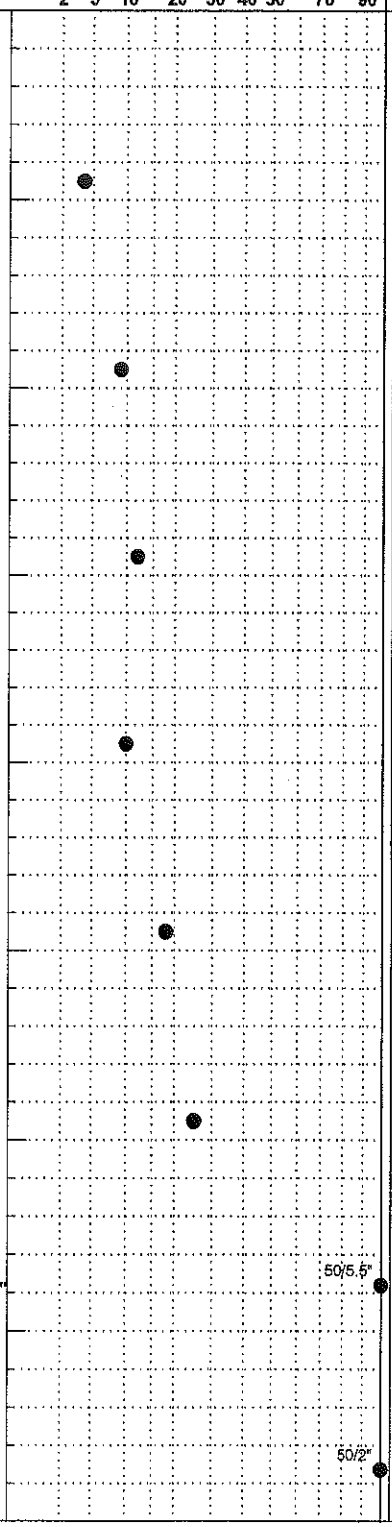
DRILLER: BLE, Inc., J. Gorman — LOGGED BY: M. Preddy

DRILLING METHOD: CME 750 ATV Hollow stem auger

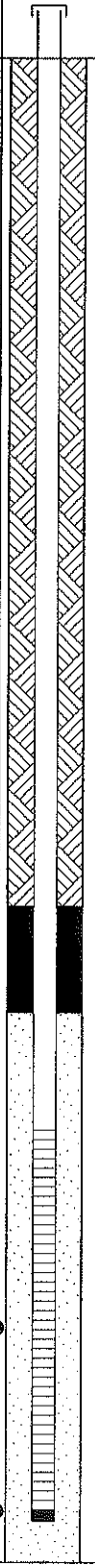
DEPTH TO - WATER> INITIAL: 20.7 AFTER 24 HOURS: 20.5 CAVING>

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:

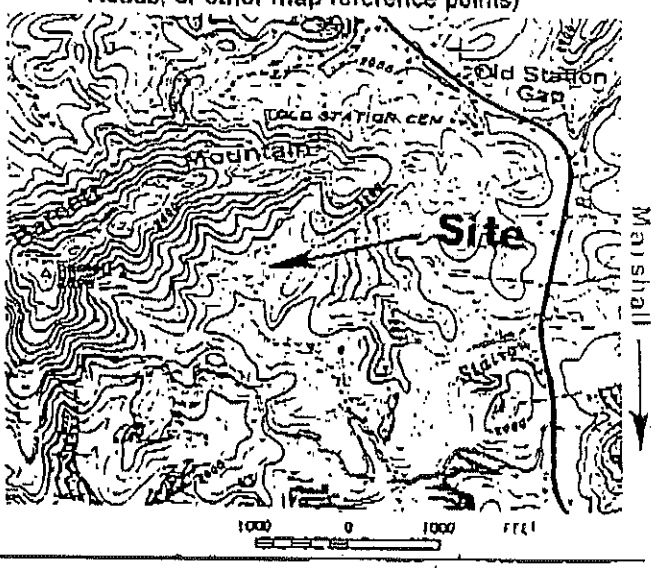
Depth		Size	Material
From 19	To 21 Ft.	Pellets	Bentonite
From 21	To 30 Ft.	Coarse	Sand

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

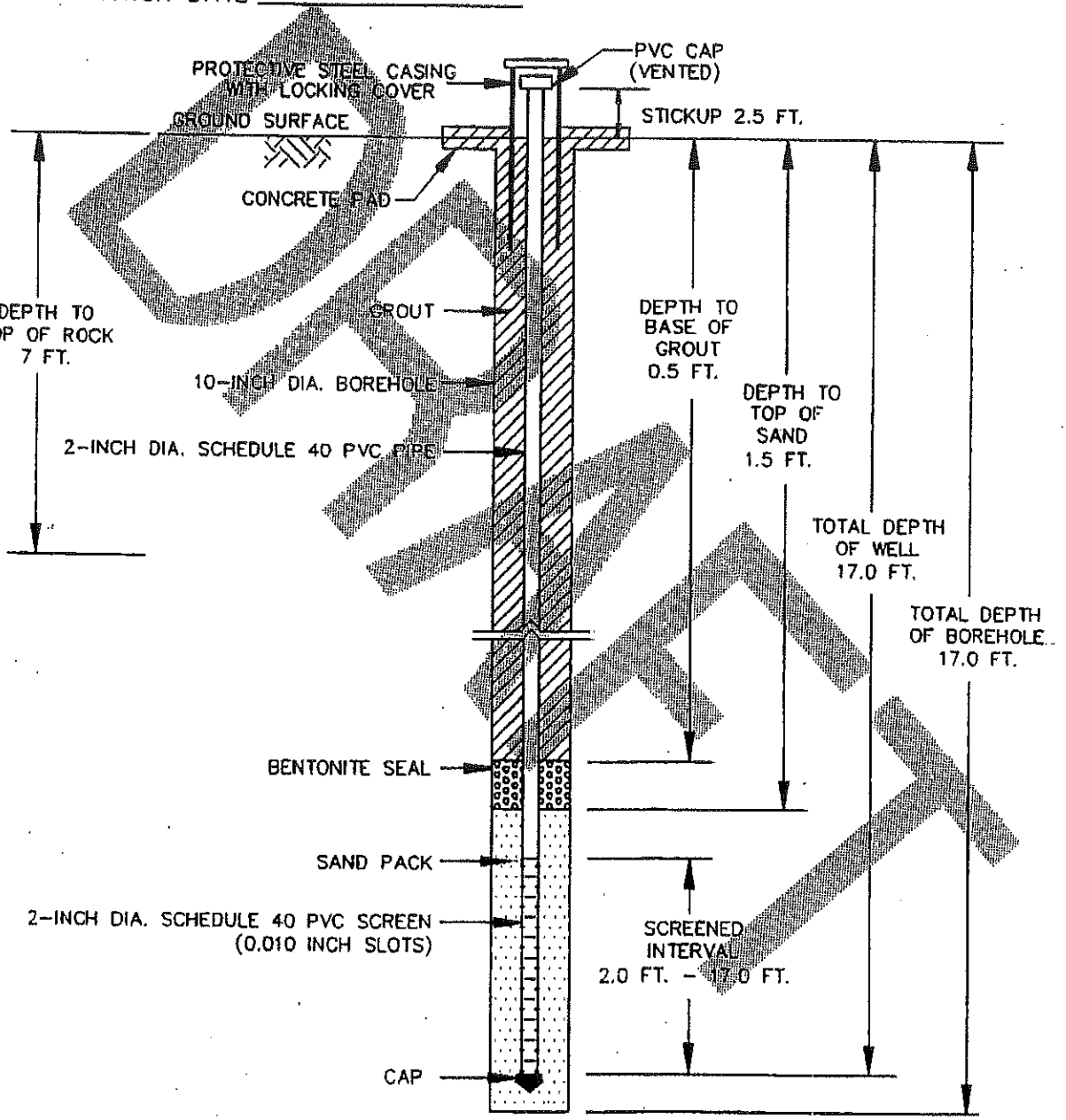
Post-it® Fax Note 7671	Date	# of pages ▶
To ANDY ALEXANDER	From DAVE PASCO	
Co./Dept. BLE	Co. McGILL	
Phone #	Phone #	
Fax # 864/288-4430	Fax #	

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

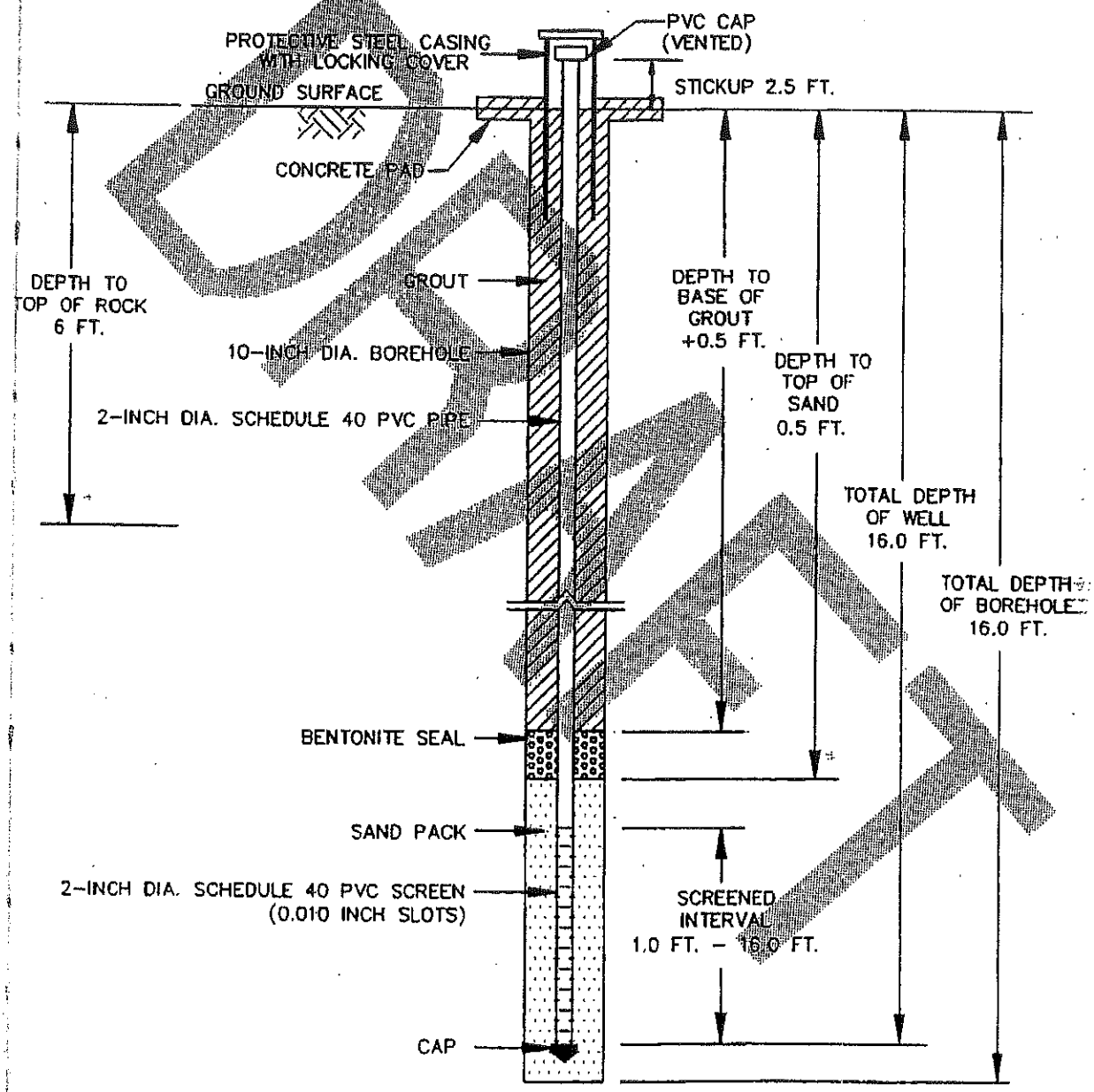
J:\56850\WELL 03/03/94 15:20 DJK

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

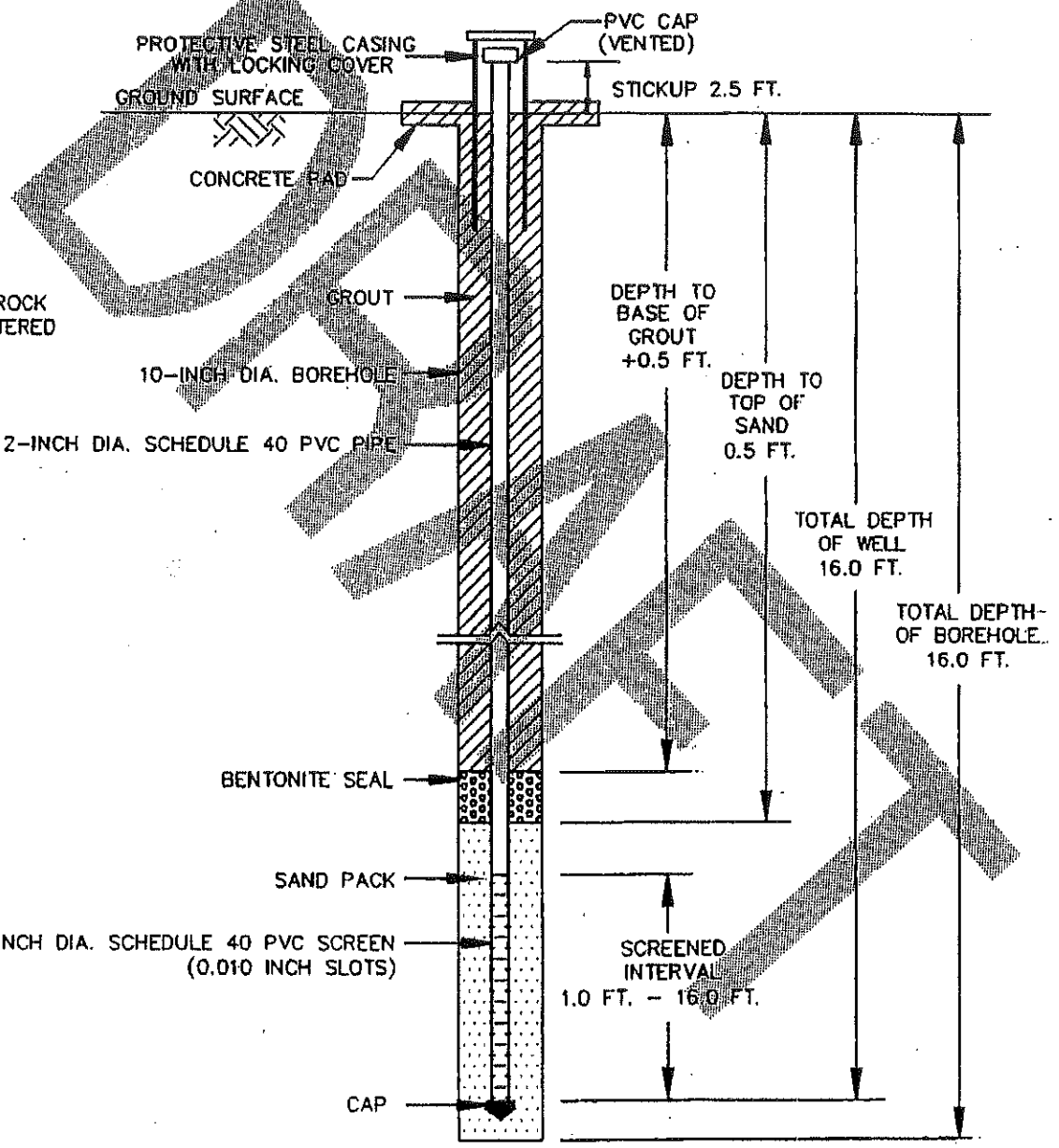
J:\568550\WELL 03/03/94 15:20 DJK

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

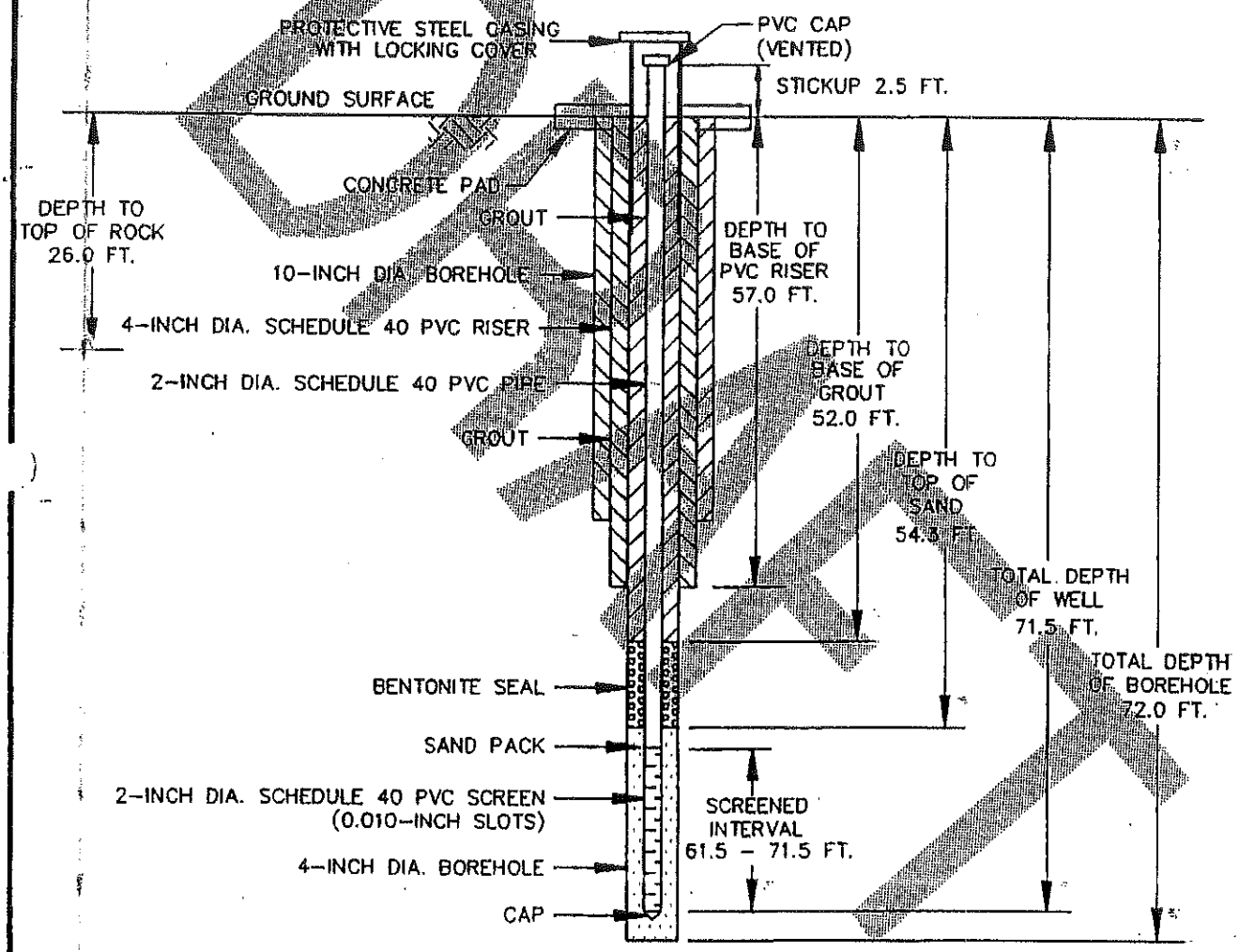
J:\56550\WELLS 03/03/94 15:20 DJK

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

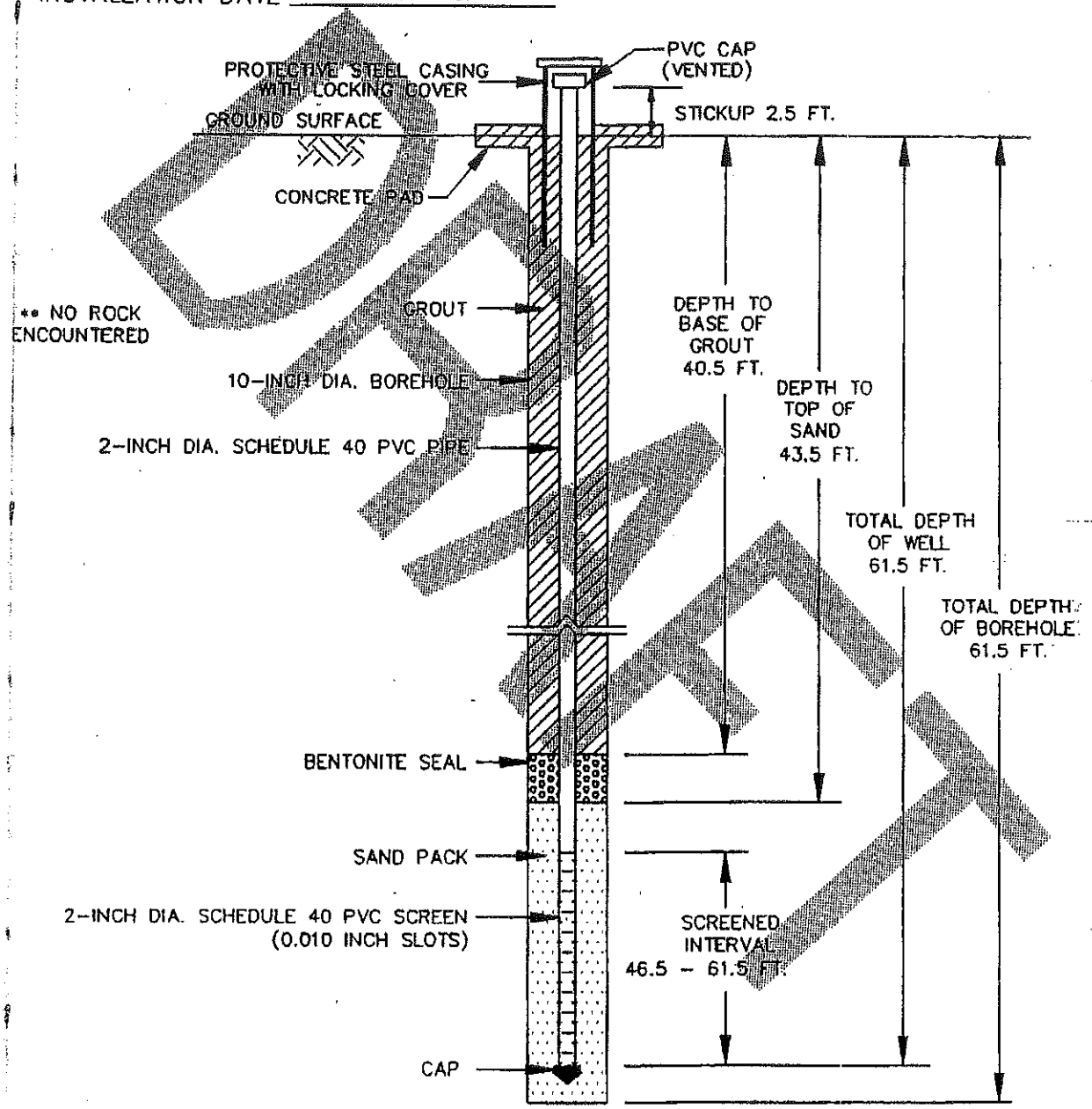
J:\56850\WELLS 03/03/94 15:20 DJK

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

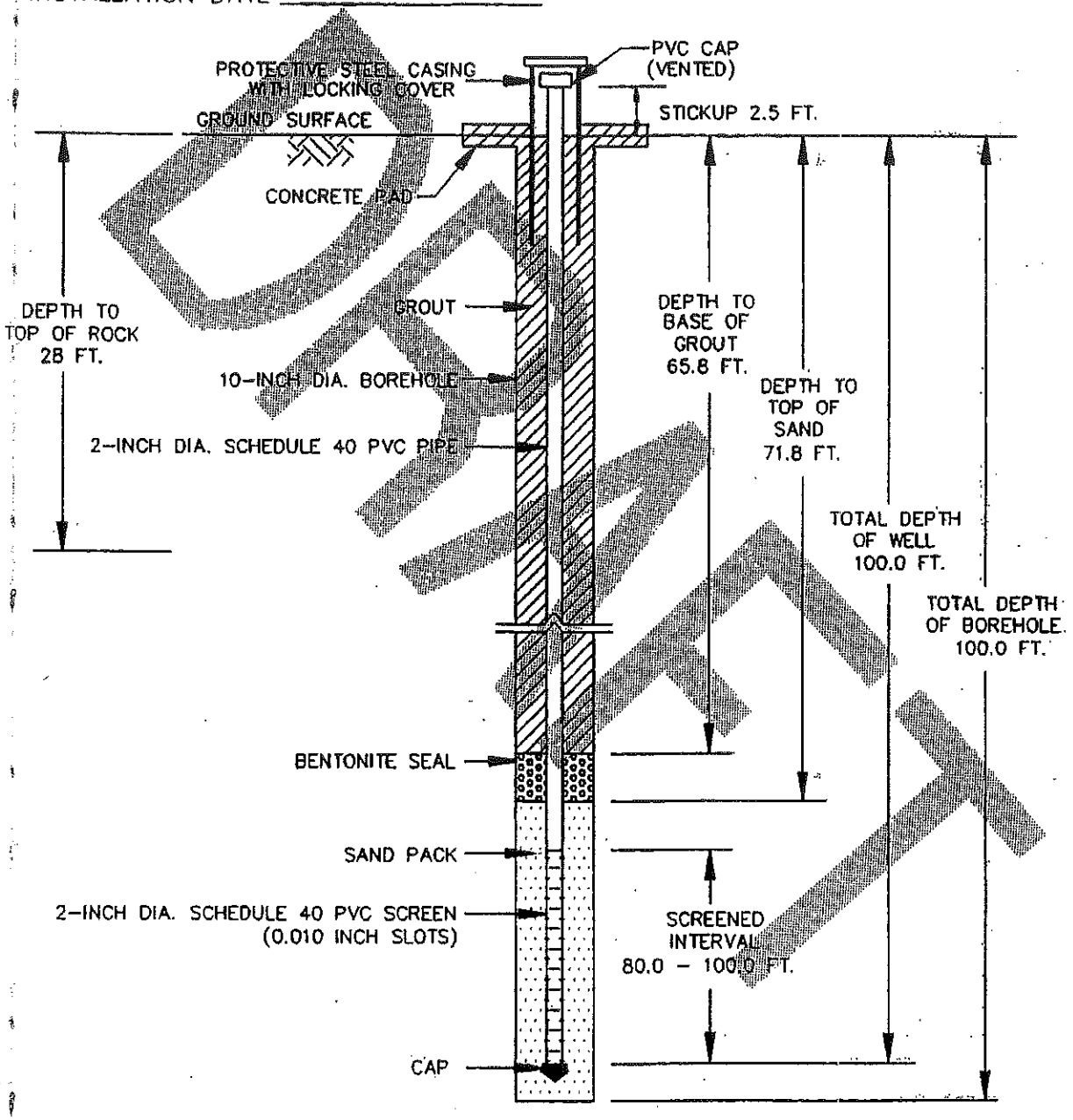
J:\568550\WEL 03/03/94 15:20 DJK

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

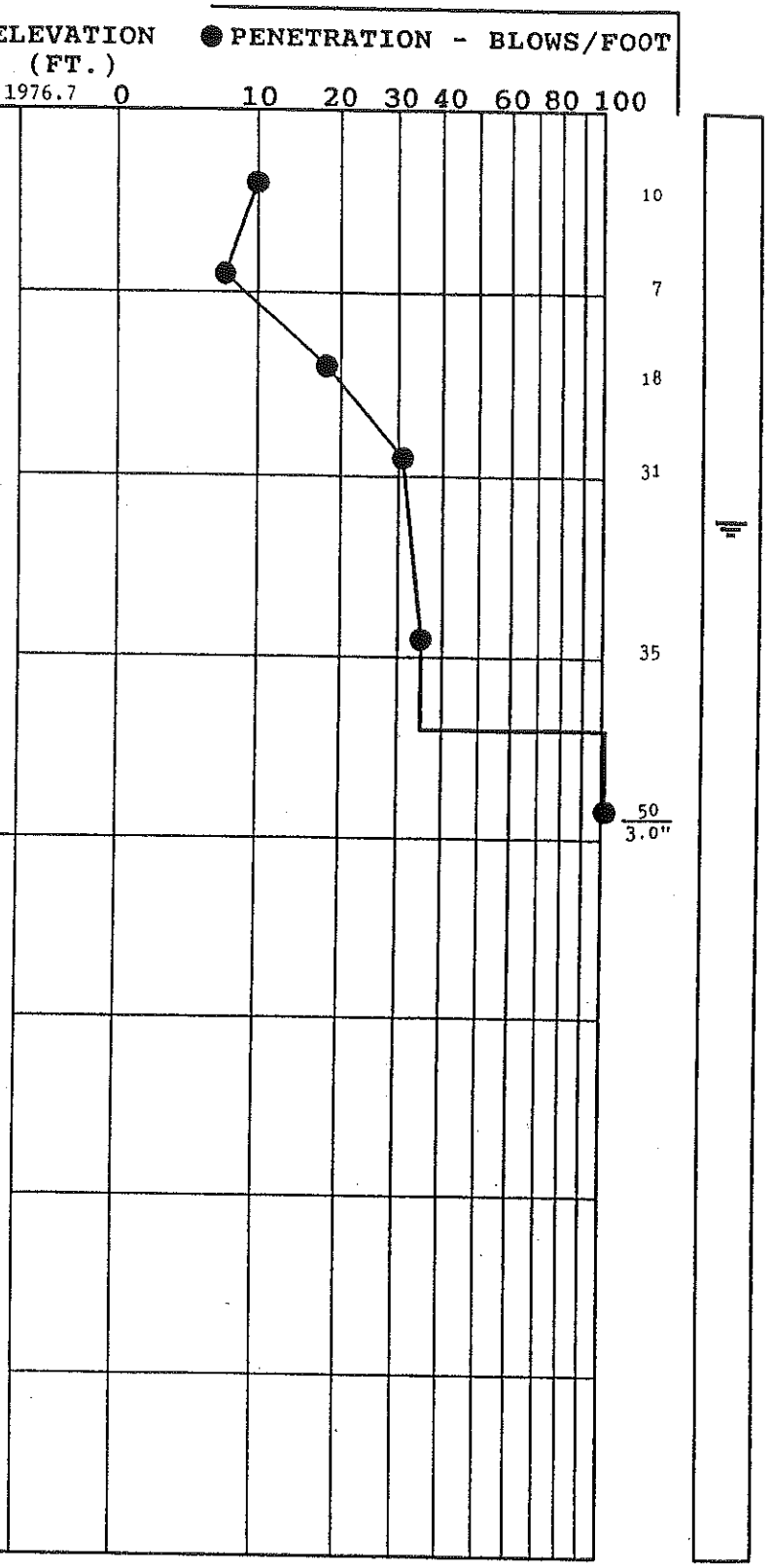
Pipe cap

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.	



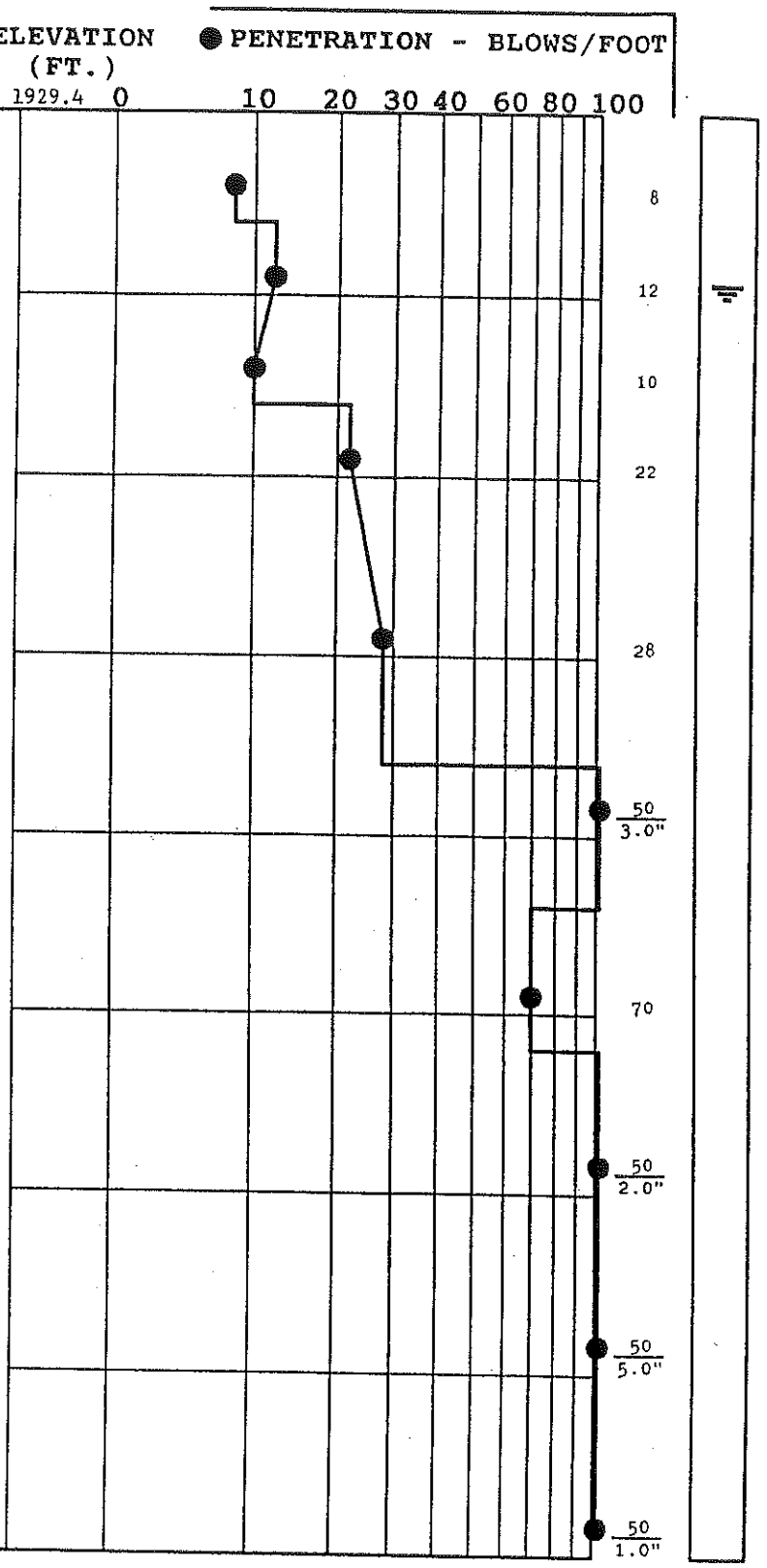
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVATIONS USED ABOVE

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.

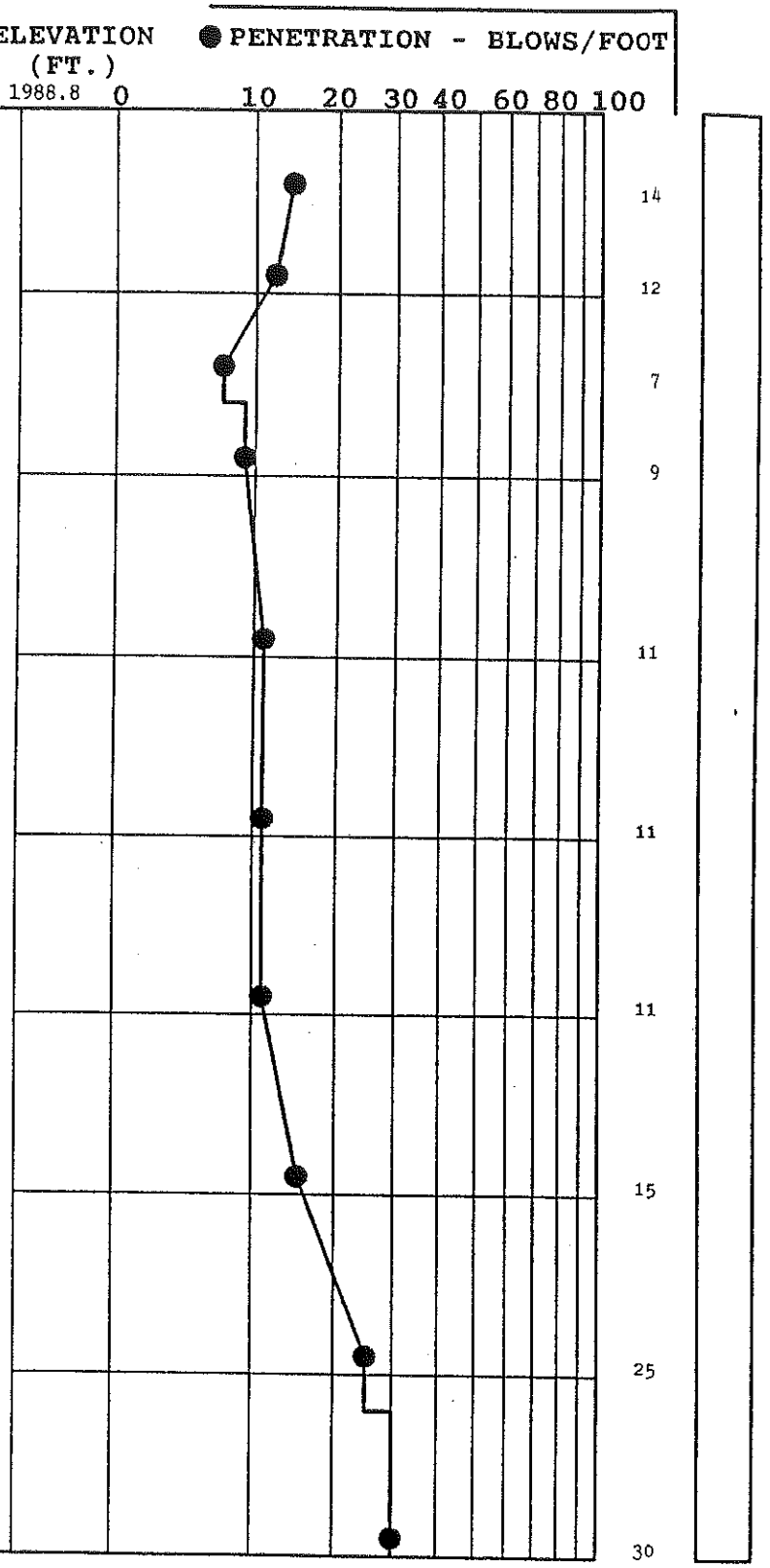
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVATIONS USED ABOVE

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		



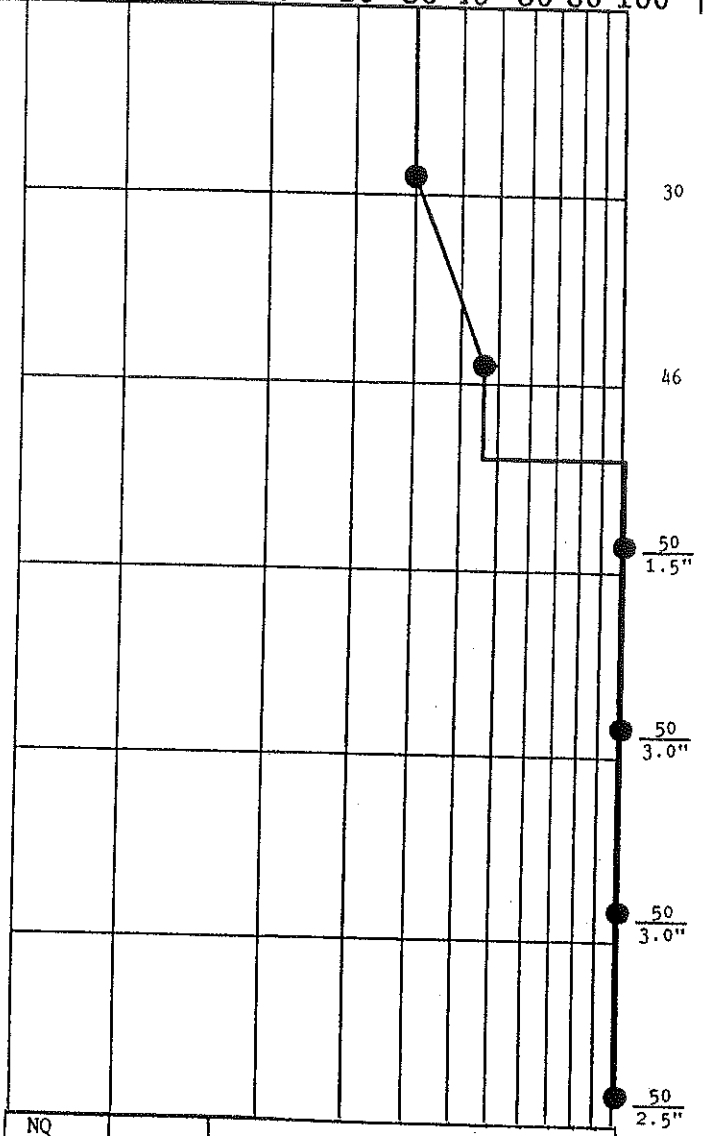
TEST BORING RECORD

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.

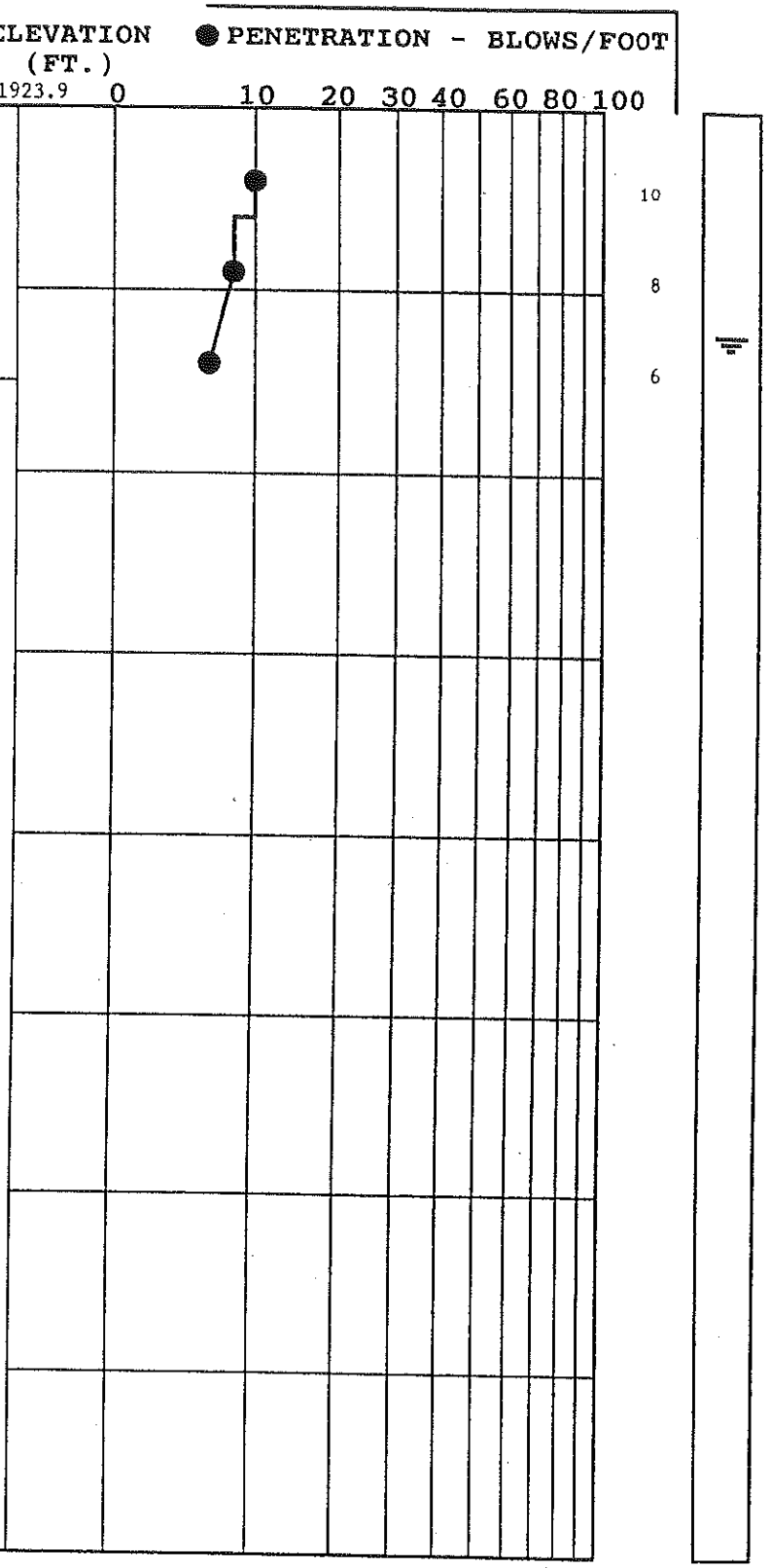
SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVATIONS USED ABOVE

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

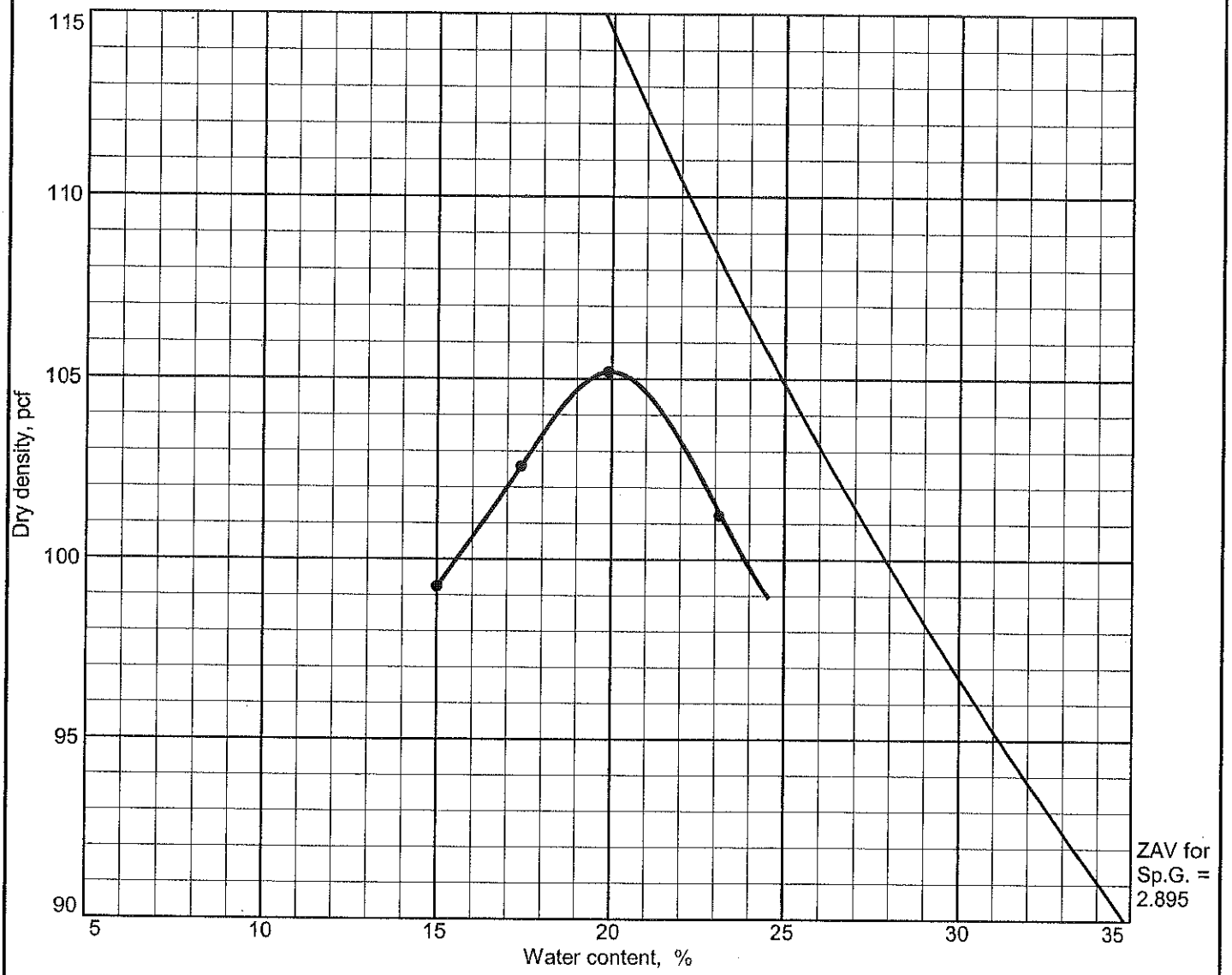
Reset (Y/N)	Date	Clock Time	Elapsed Time	HA_{OUT} (cm)	HA_{IN} (cm)	Temp °C	Gradient	K (cm/sec)	Temp Correction	K_{20} (cm/sec)
Y	2-15-05	10:47:35		6.8	1.39	21	10			
		10:58:06	0:10:31	5.9	1.42	21	8	1.2E-07	0.976	1.2E-07
		10:59:06	0:11:31	5.8	1.43	21	8	1.3E-07	0.976	1.2E-07
		11:00:53	0:13:18	5.7	1.43	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

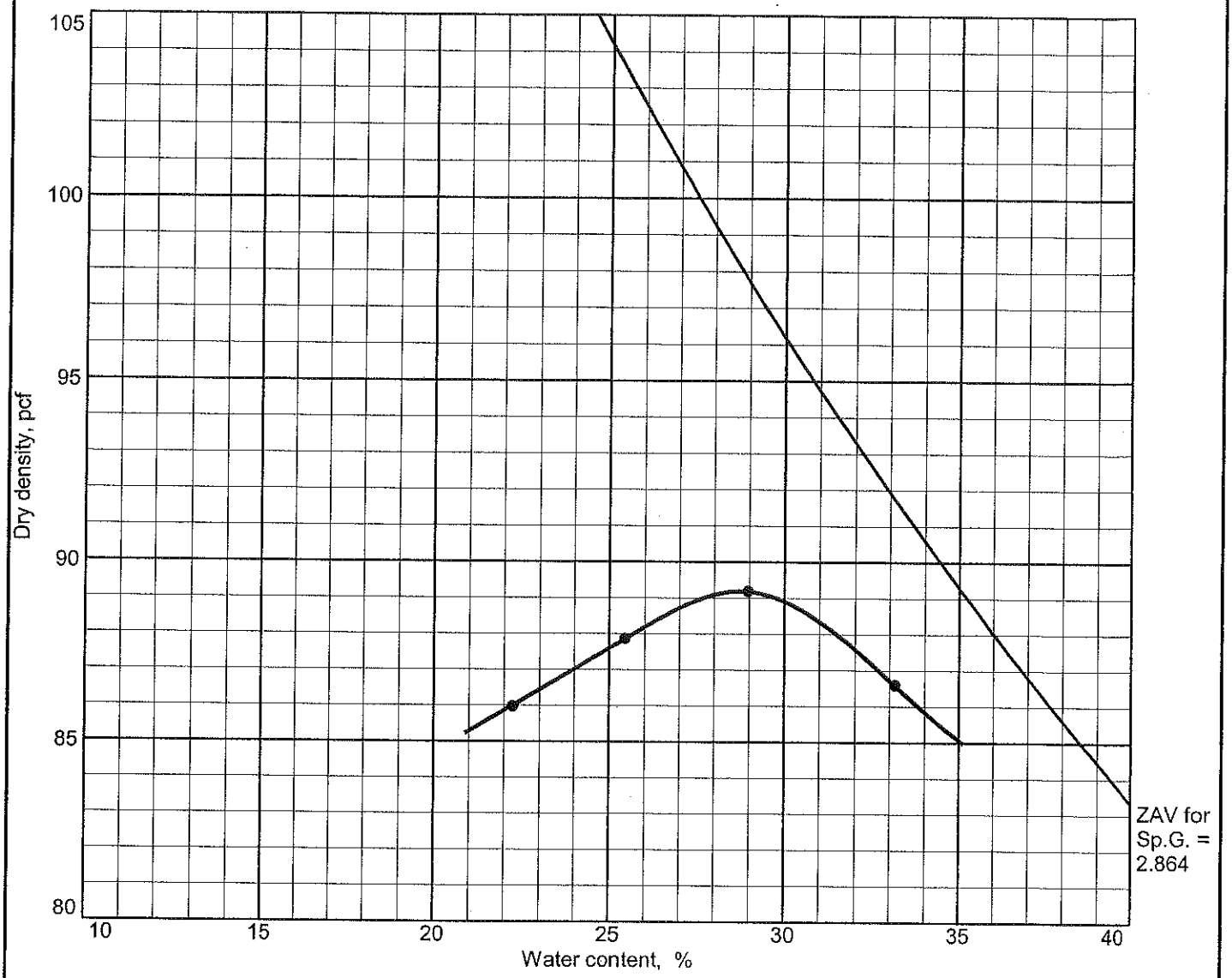
Remarks:

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

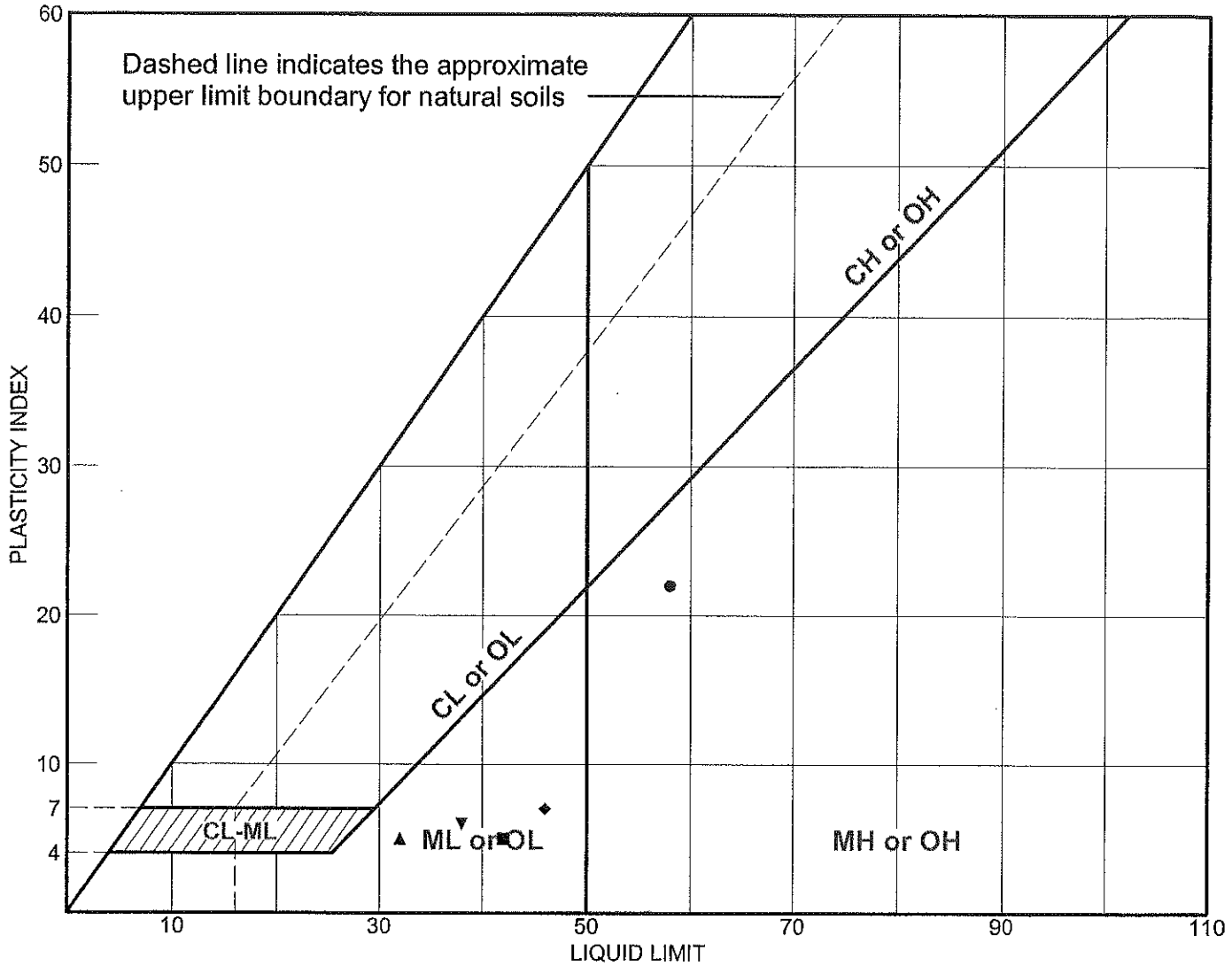
Remarks:

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.

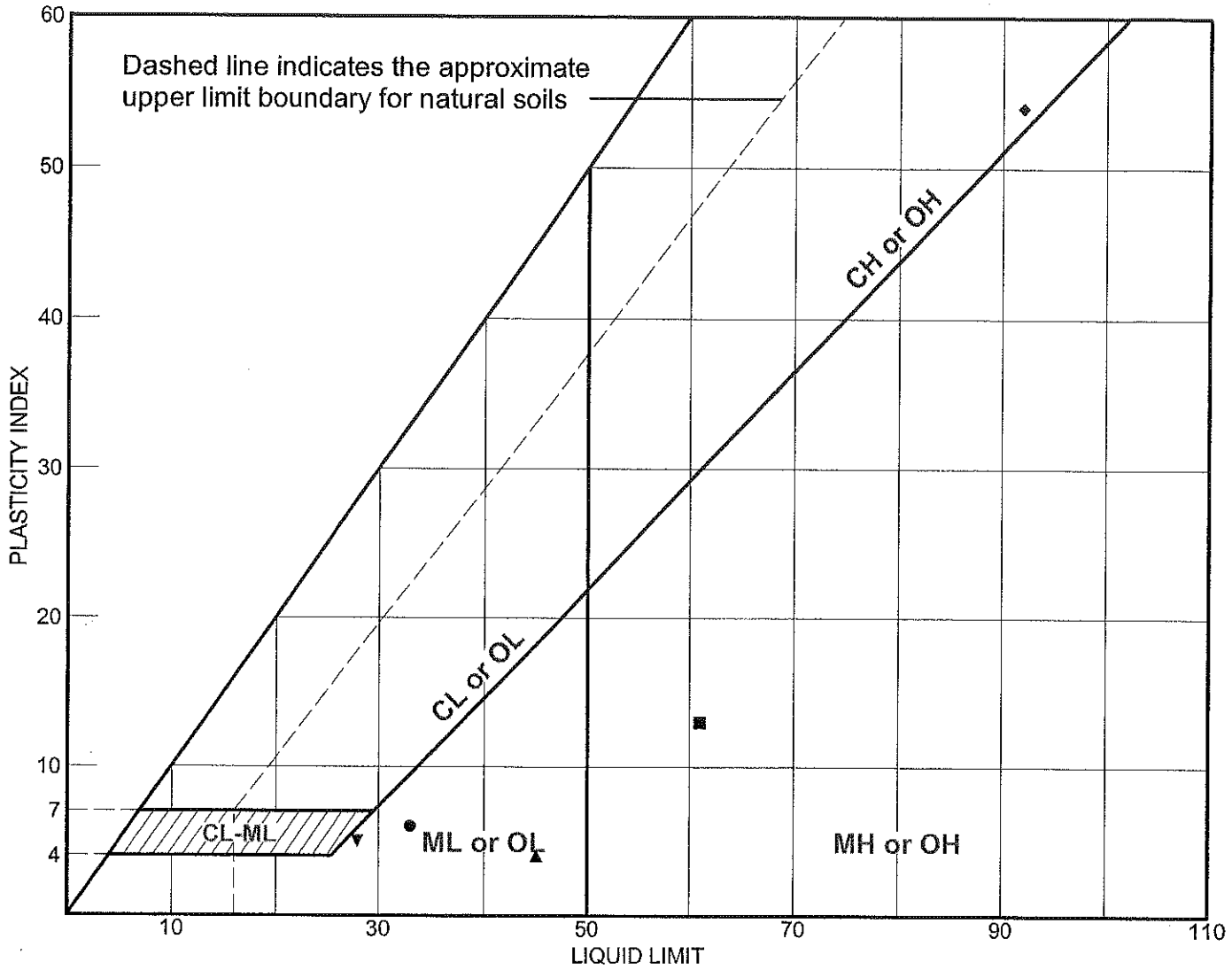
Client: McGill

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.

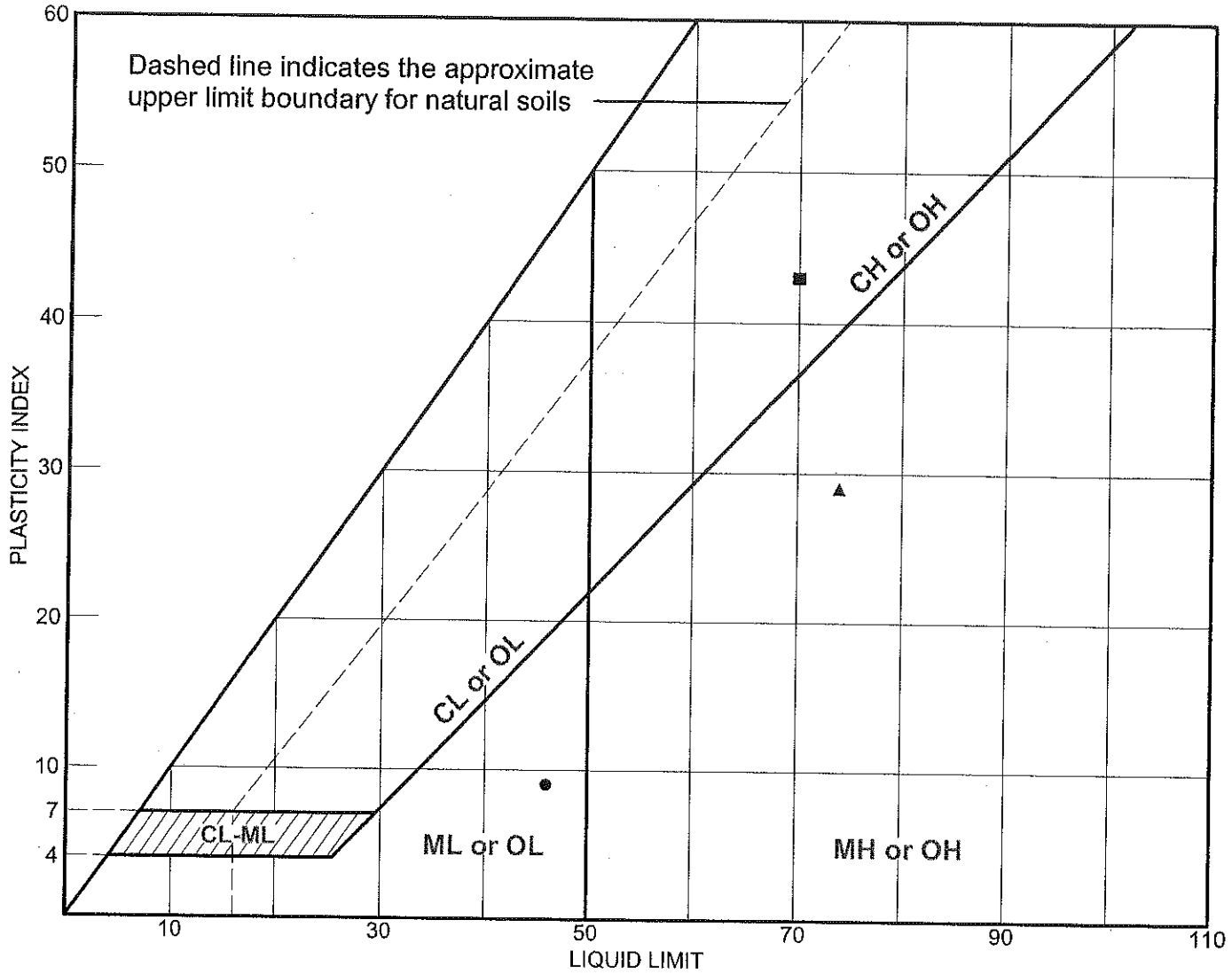
Client: McGill

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.

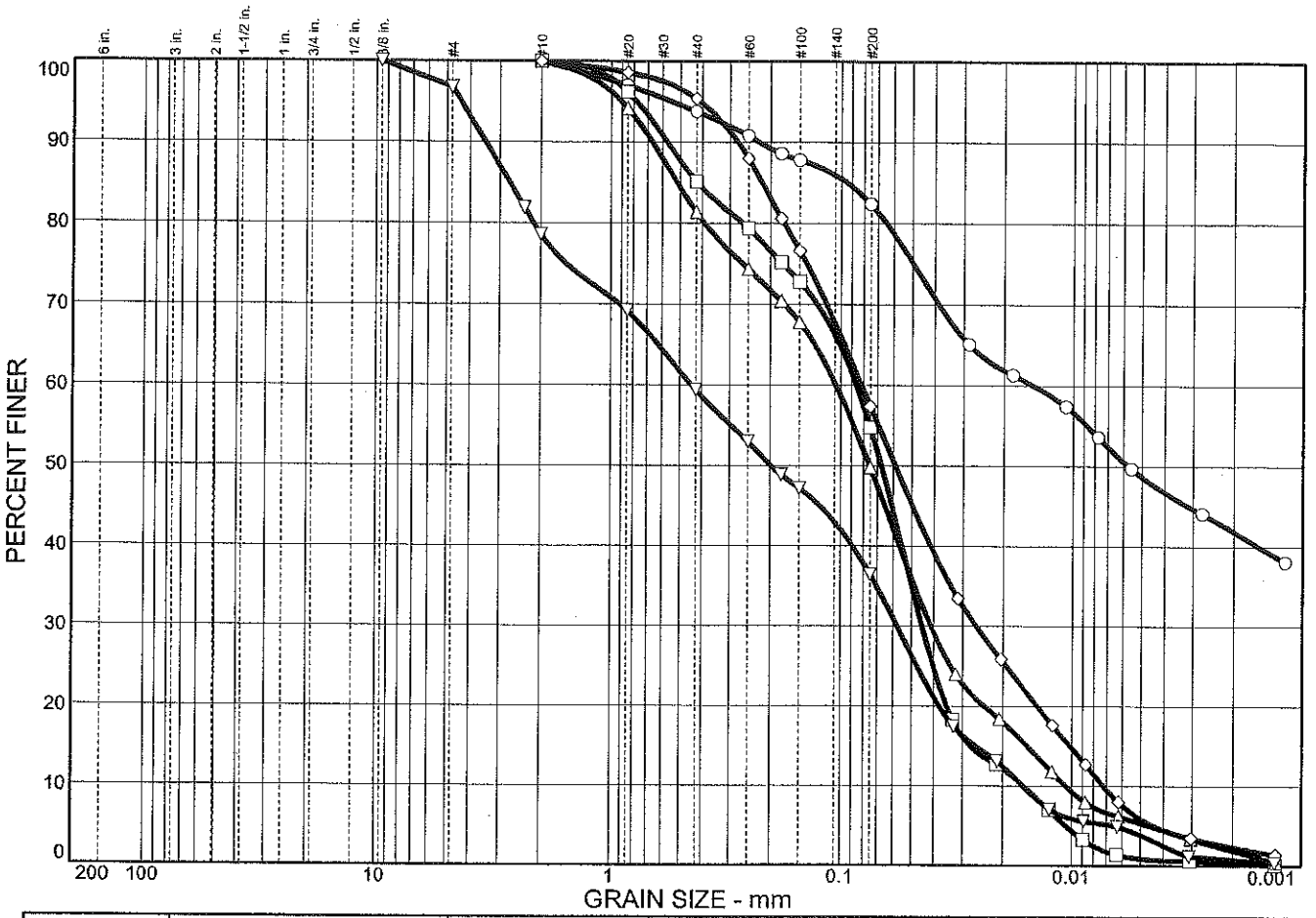
Client: McGill

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.

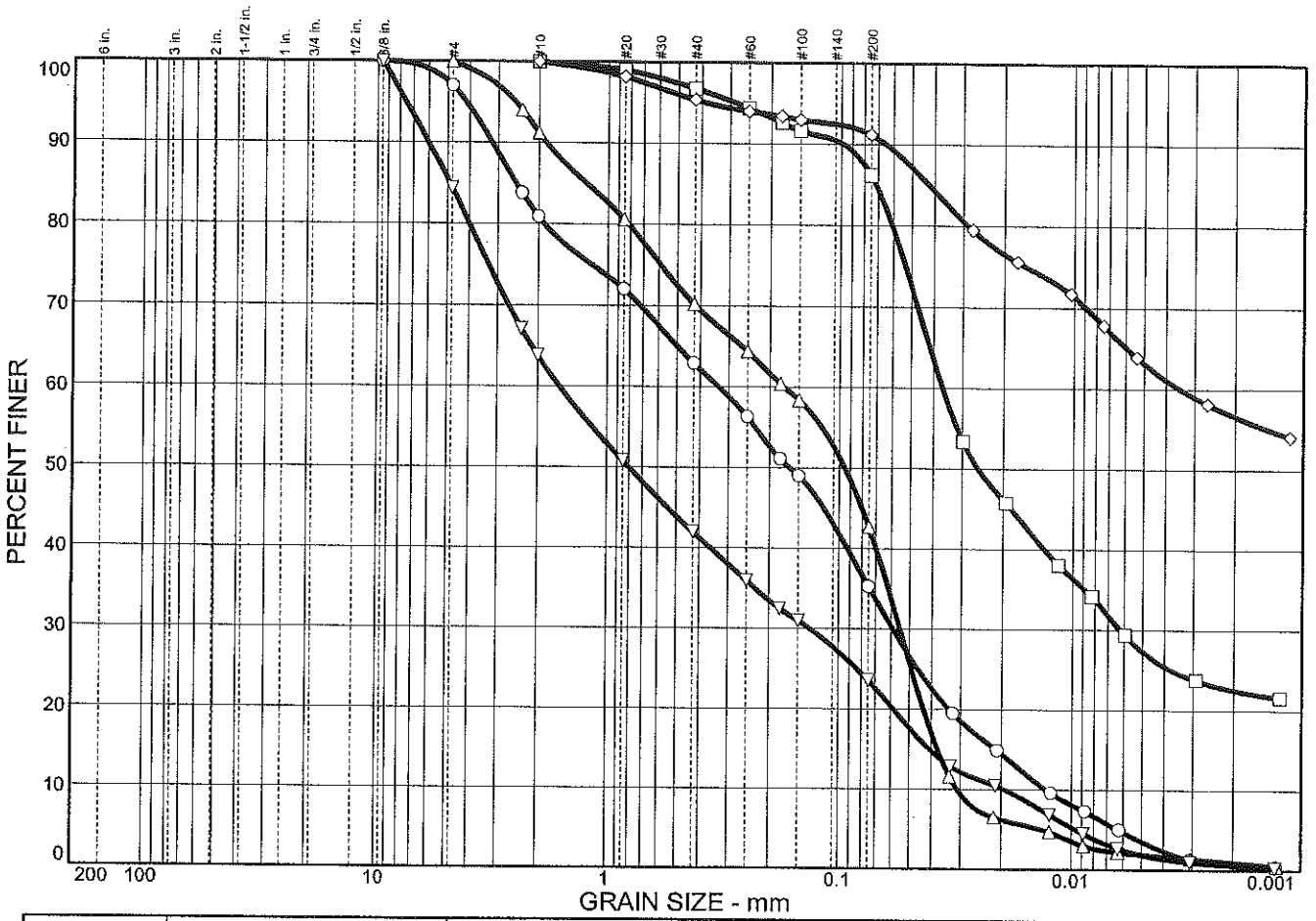
Client: McGill

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.

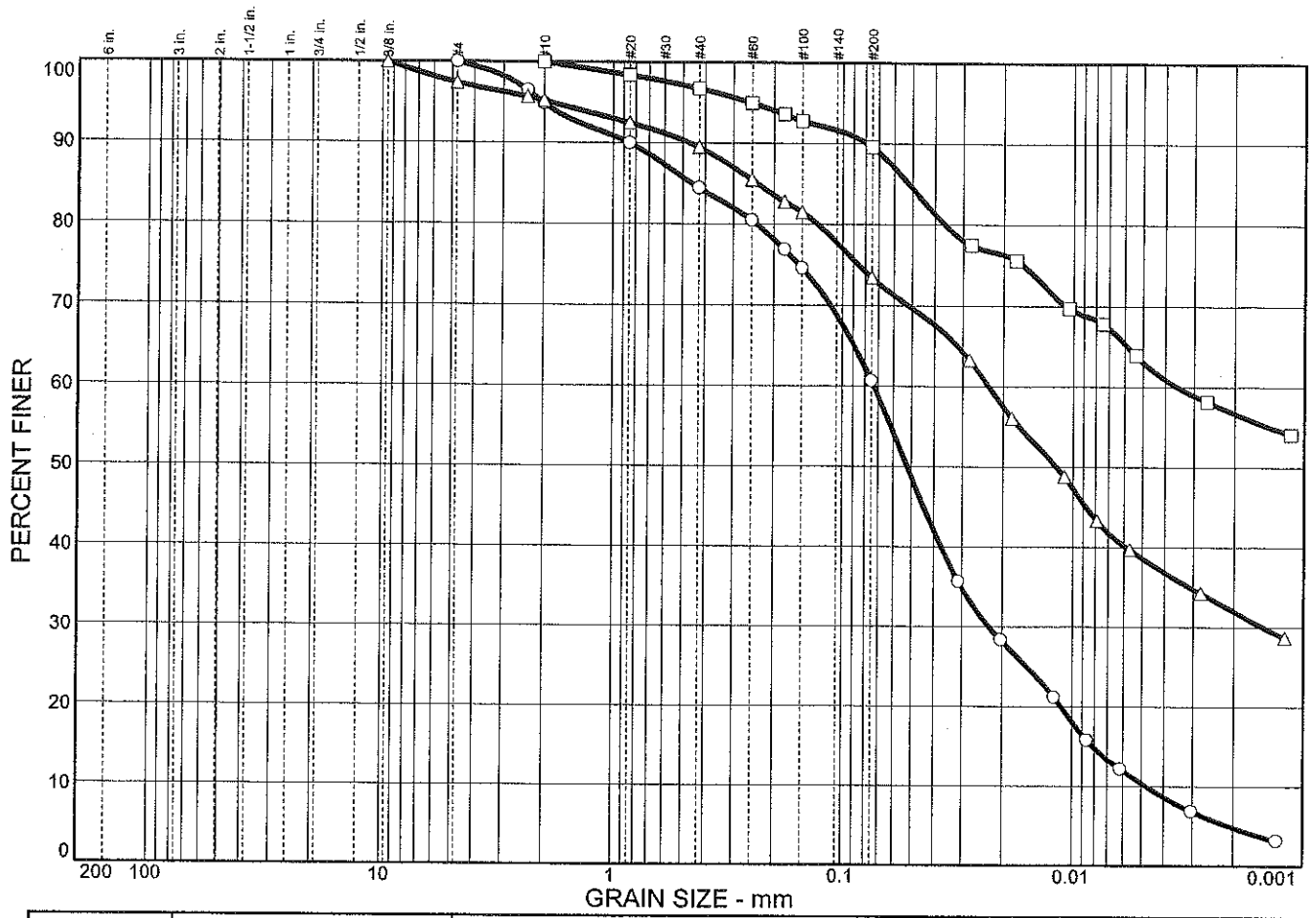
Client: McGill

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

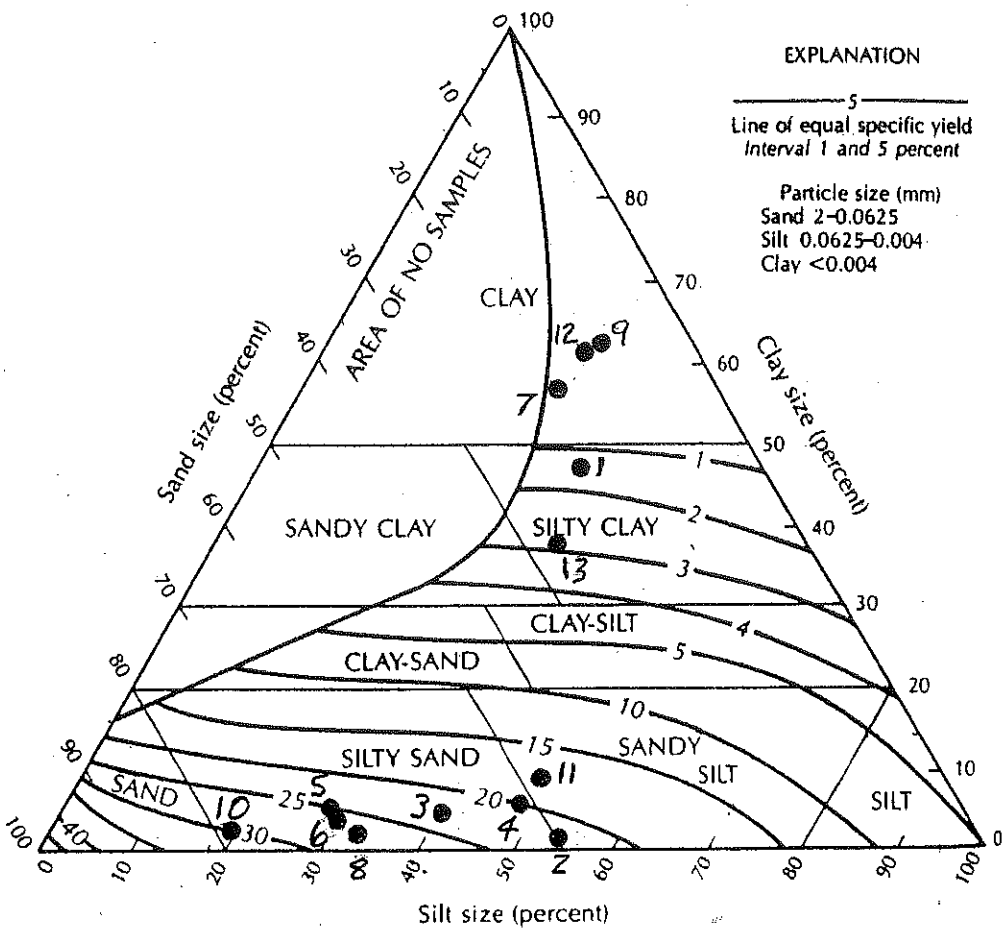
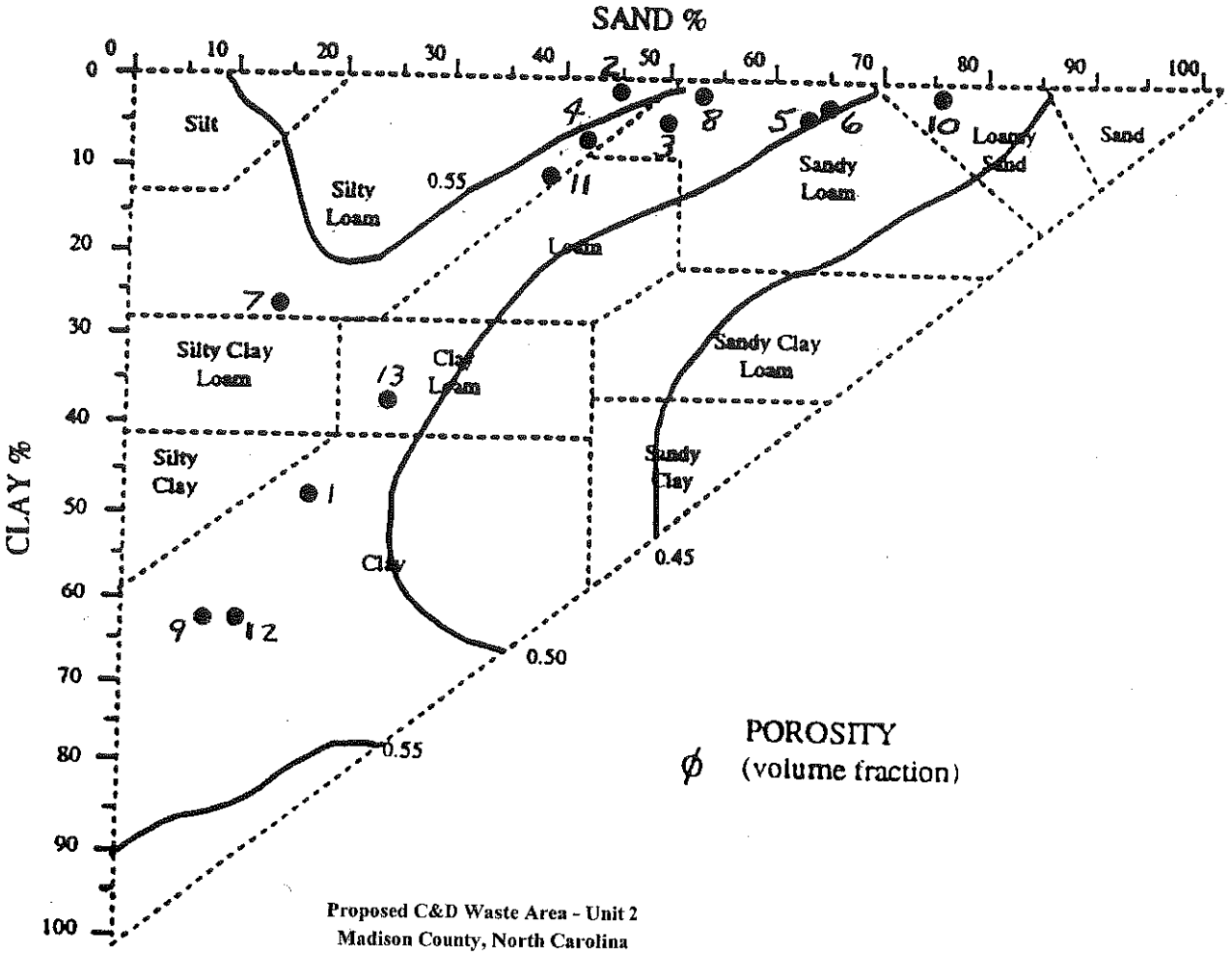


FIGURE 4.11 Textural classification triangle for unconsolidated materials showing the relation between particle size and specific yield. Source: A.I. Johnson, U.S. Geological Survey Water-Supply Paper 1662-D, 1967.

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).

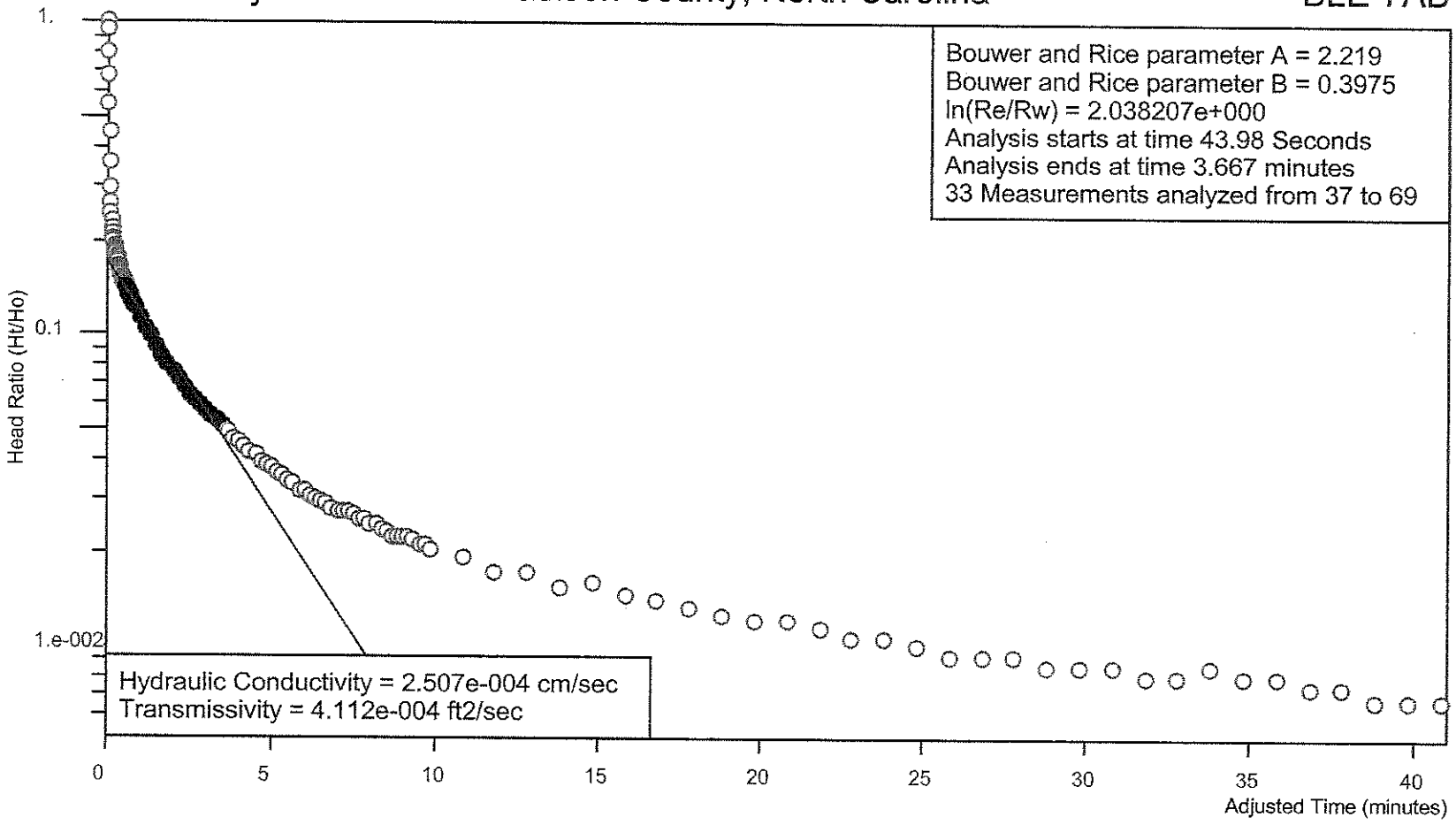
The resulting slug test data (time versus water level) was reduced and hydraulic conductivities were calculated using the Bouwer and Rice Method for partially penetrating wells in unconfined aquifers.

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

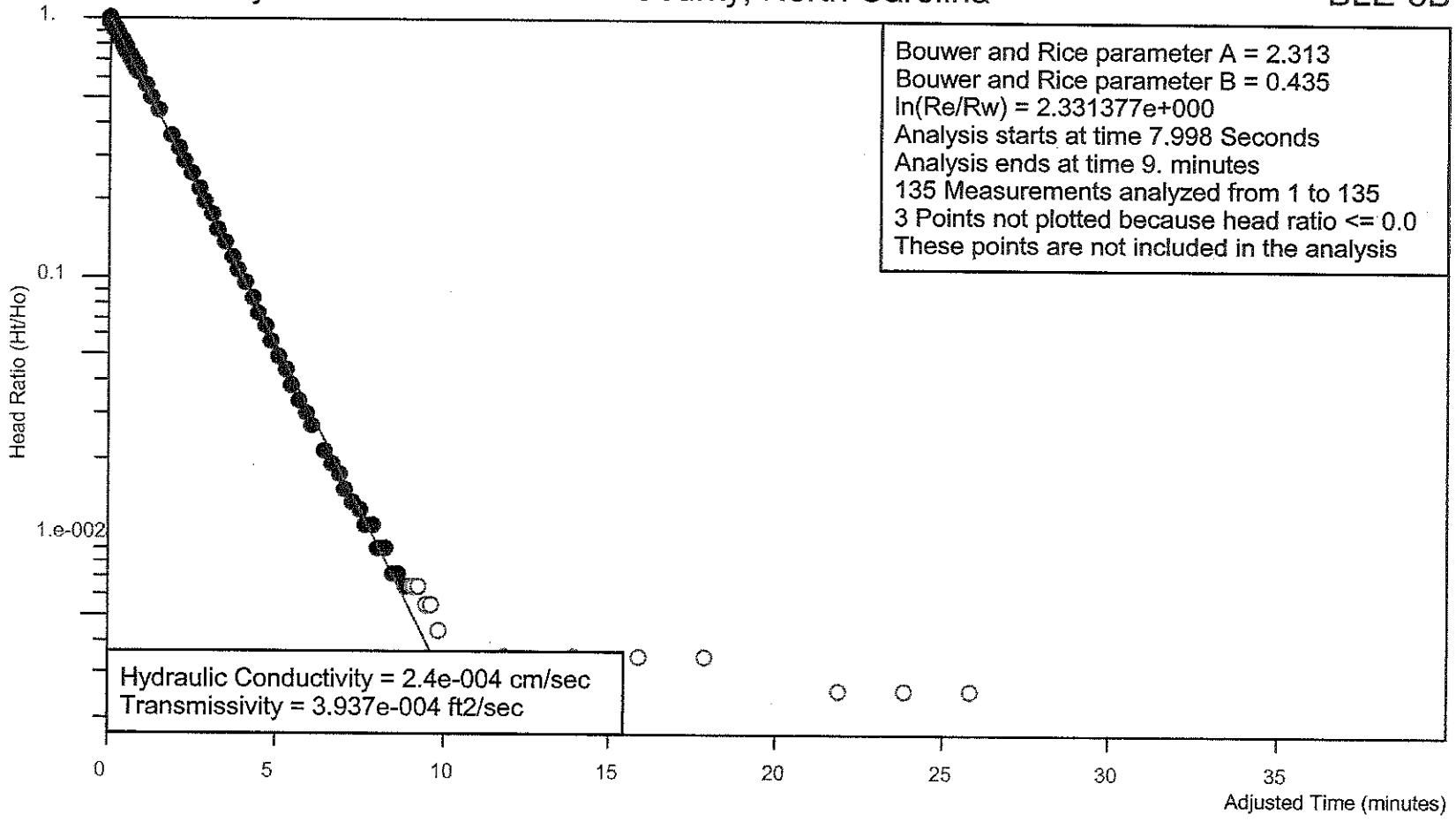
91	7.333	7.2	4.1e-002	4.1e-002	2.724e-002
92	7.5	7.367	4.1e-002	4.1e-002	2.724e-002
93	7.667	7.534	4.e-002	4.e-002	2.658e-002
94	7.833	7.7	3.9e-002	3.9e-002	2.591e-002
95	8.	7.867	3.9e-002	3.9e-002	2.591e-002
96	8.167	8.034	3.7e-002	3.7e-002	2.458e-002
97	8.333	8.2	3.7e-002	3.7e-002	2.458e-002
98	8.5	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

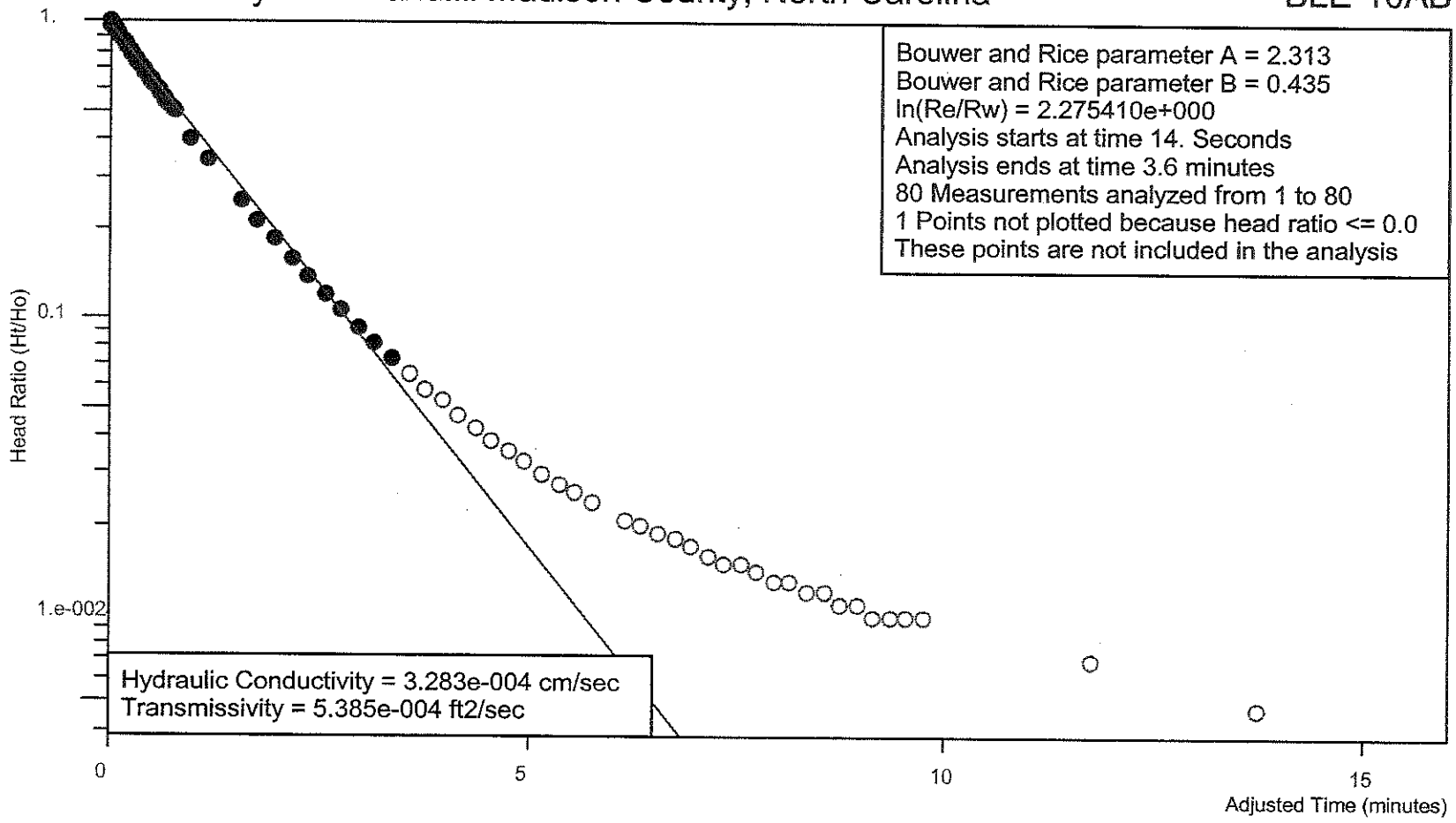
148	28.	27.87	6.e-003	6.e-003	1.737e-003
149	34.	33.87	6.e-003	6.e-003	1.737e-003
150	40.	39.87	6.e-003	6.e-003	1.737e-003

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

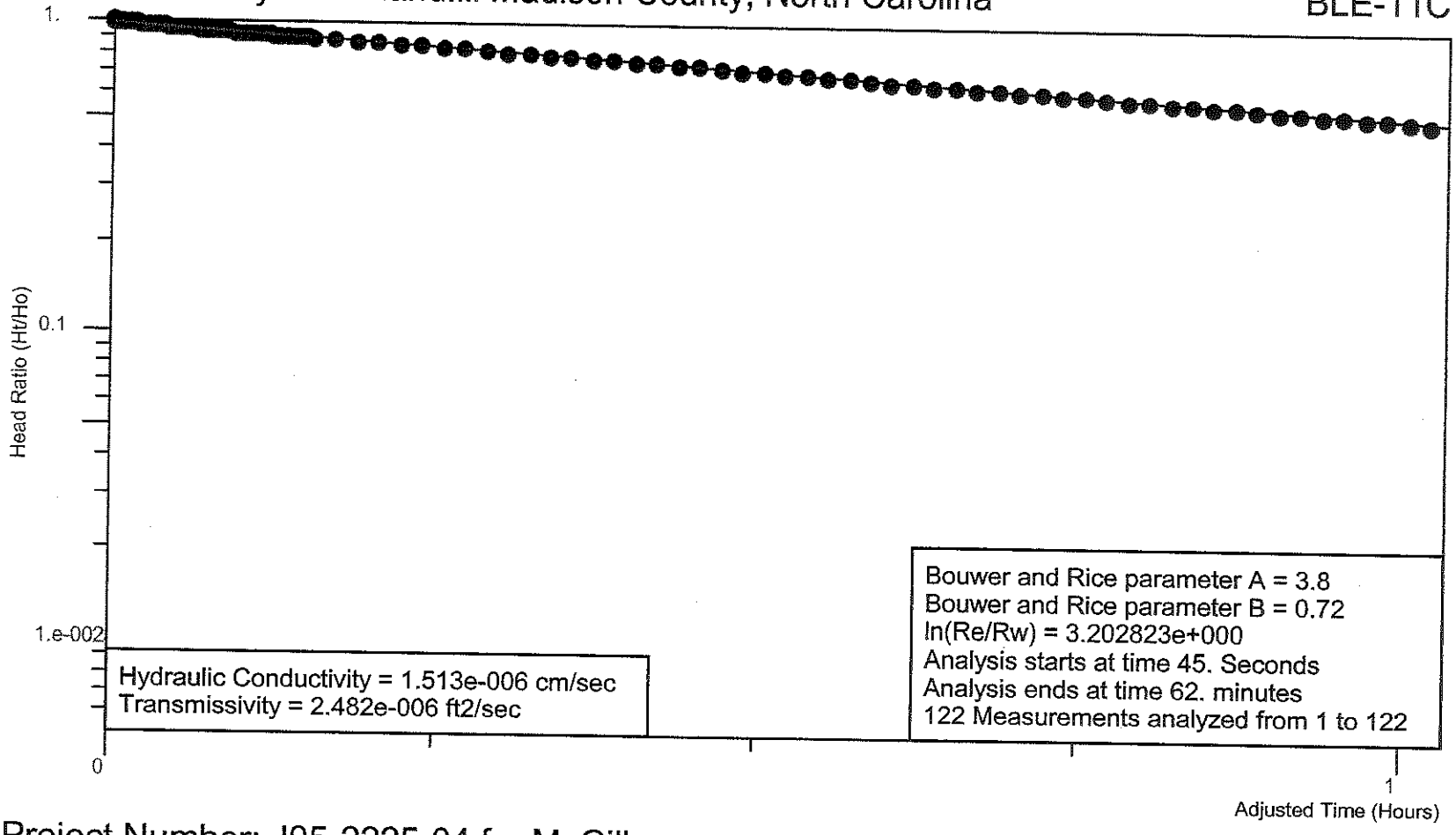
91	5.8	5.567	8.2e-002	8.2e-002	2.578e-002
92	6.	5.767	7.6e-002	7.6e-002	2.389e-002
93	6.4	6.167	6.6e-002	6.6e-002	2.075e-002
94	6.6	6.367	6.3e-002	6.3e-002	1.981e-002
95	6.8	6.567	6.e-002	6.e-002	1.886e-002
96	7.	6.767	5.7e-002	5.7e-002	1.792e-002
97	7.2	6.967	5.4e-002	5.4e-002	1.698e-002
98	7.4	7.167	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

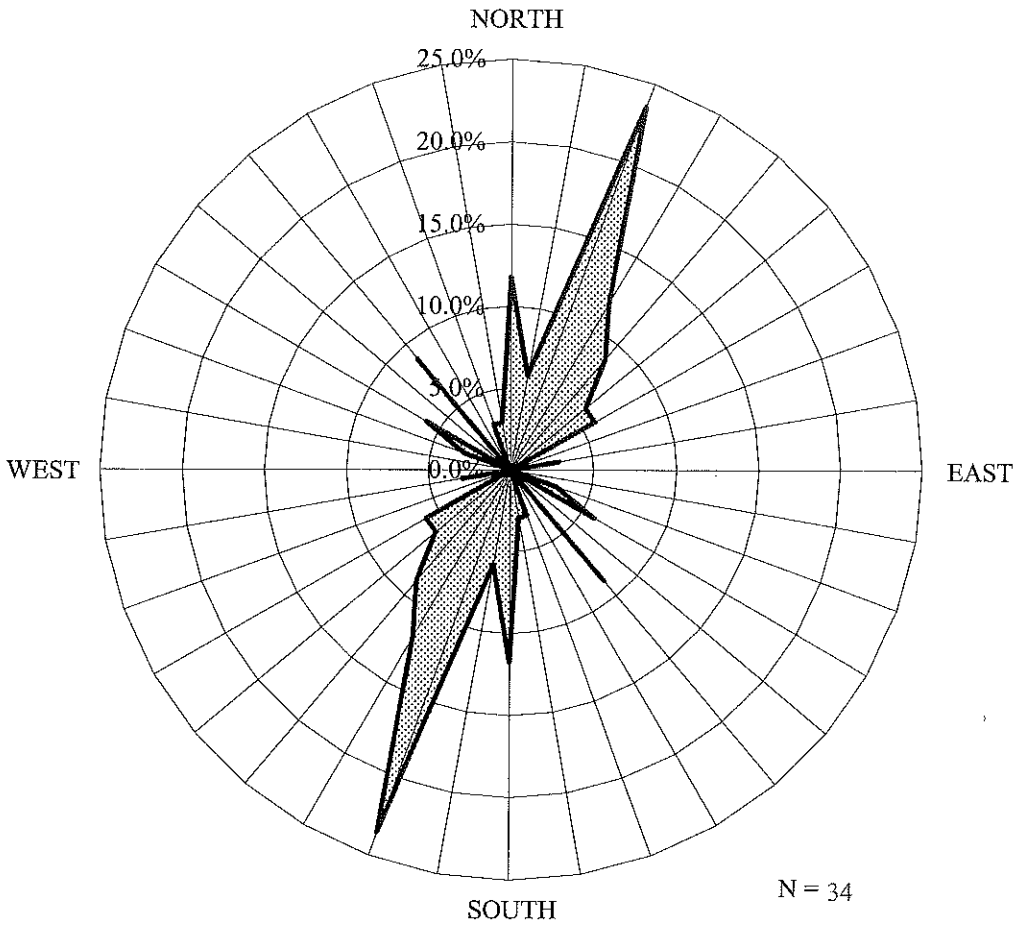
Test starts with trial 0
There are 122 time and drawdown measurements
Maximum head is 4.831 feet
Minimum head is 0. feet

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

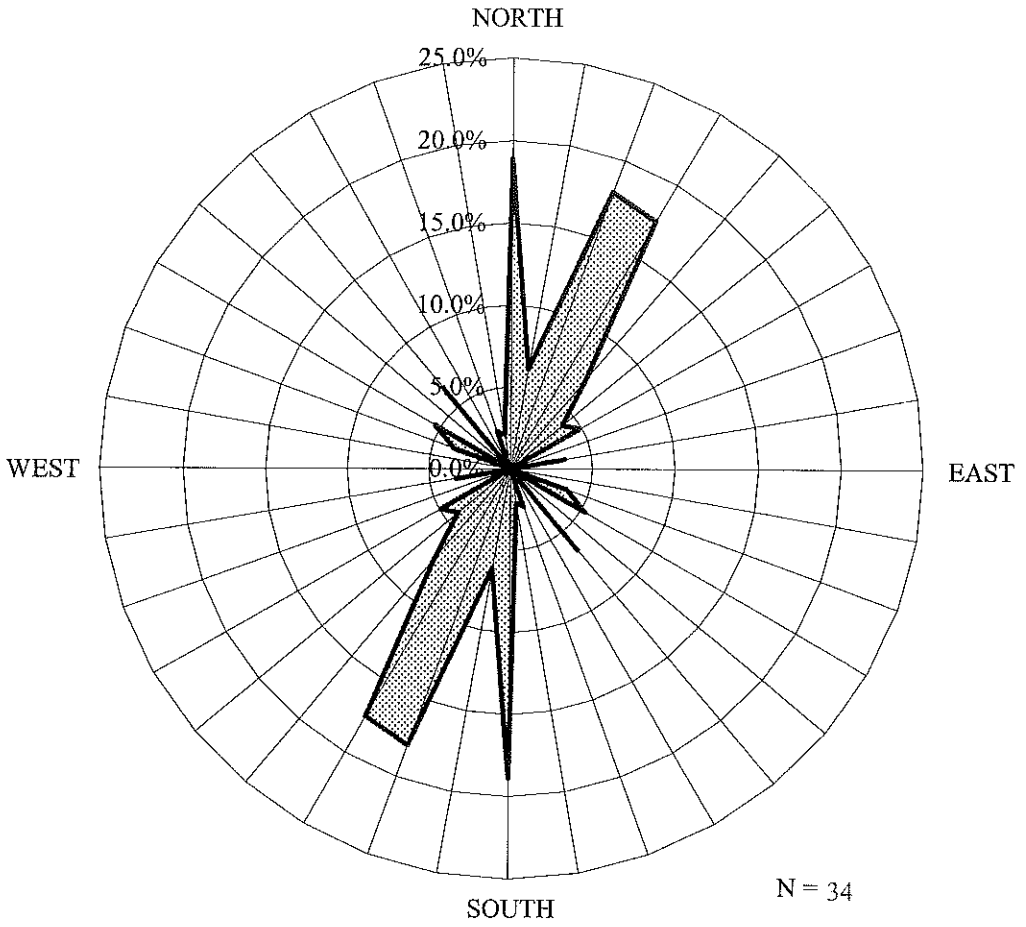
91	31.	30.25	3.455	3.455	0.7152
92	32.	31.25	3.424	3.424	0.7088
93	33.	32.25	3.382	3.382	0.7001
94	34.	33.25	3.344	3.344	0.6922
95	35.	34.25	3.309	3.309	0.685
96	36.	35.25	3.274	3.274	0.6777
97	37.	36.25	3.244	3.244	0.6715
98	38.	37.25	3.208	3.208	0.664
99	39.	38.25	3.176	3.176	0.6574
100	40.	39.25	3.143	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

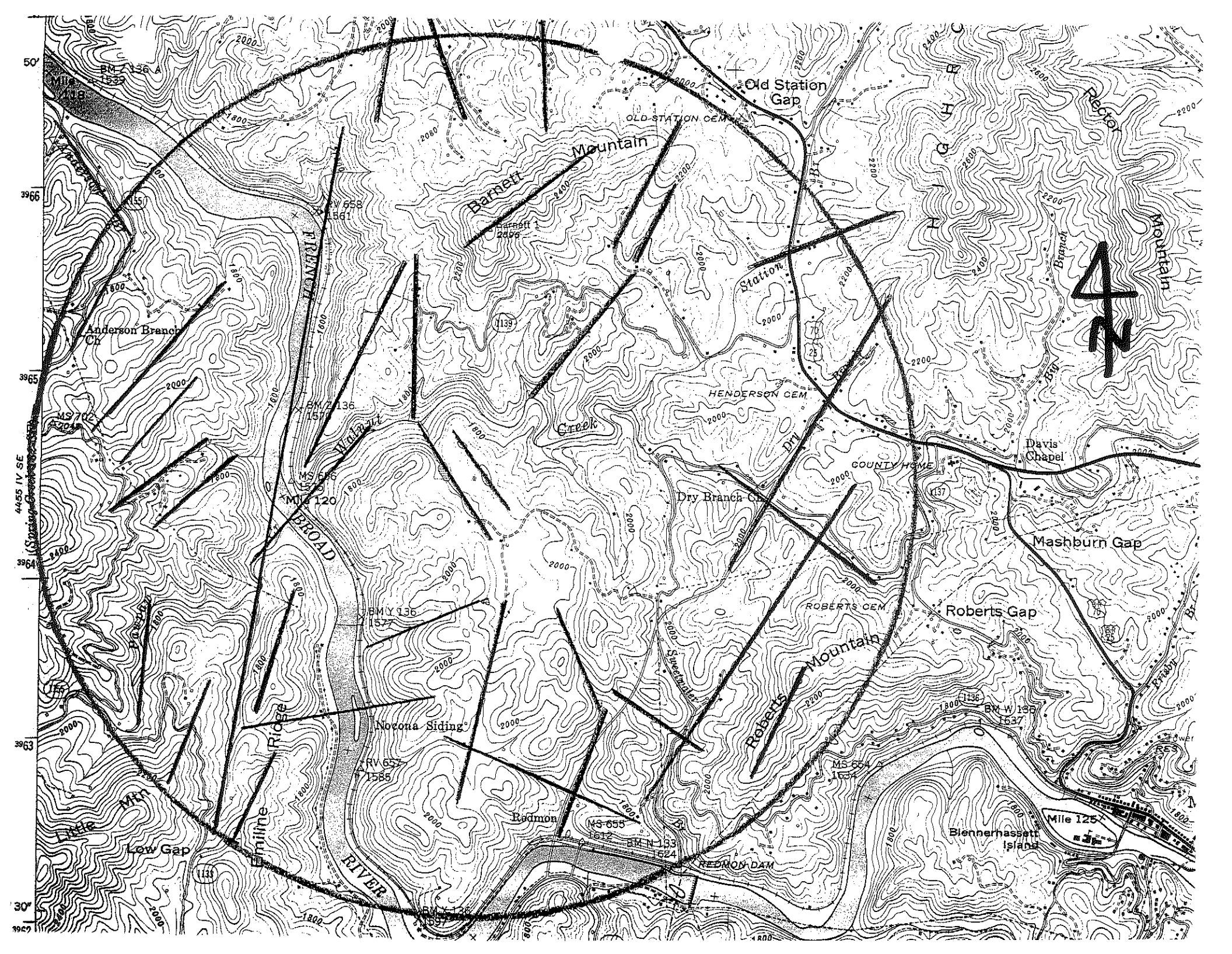


Madison FTA-Area.xls
Rose Diagram (Lineament Trends)

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

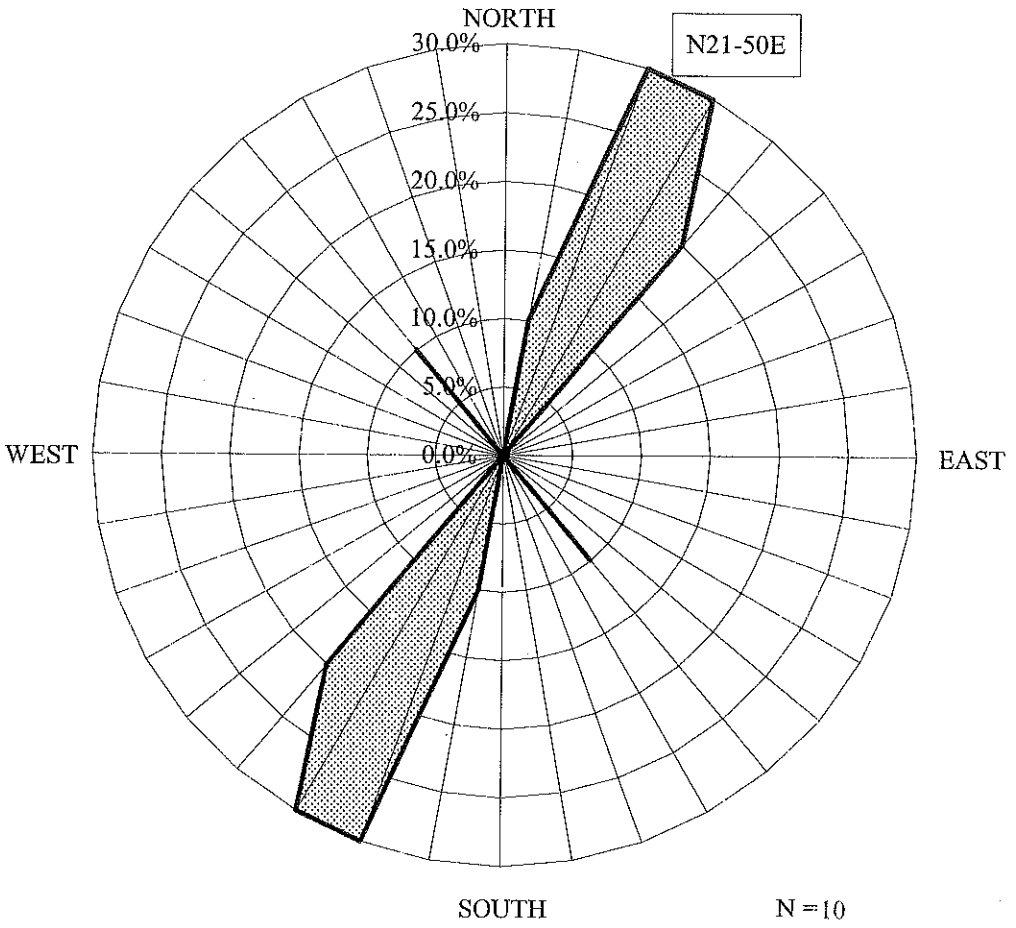


Madison FTA-Area.xls
Rose Diagram (Lineament Length)



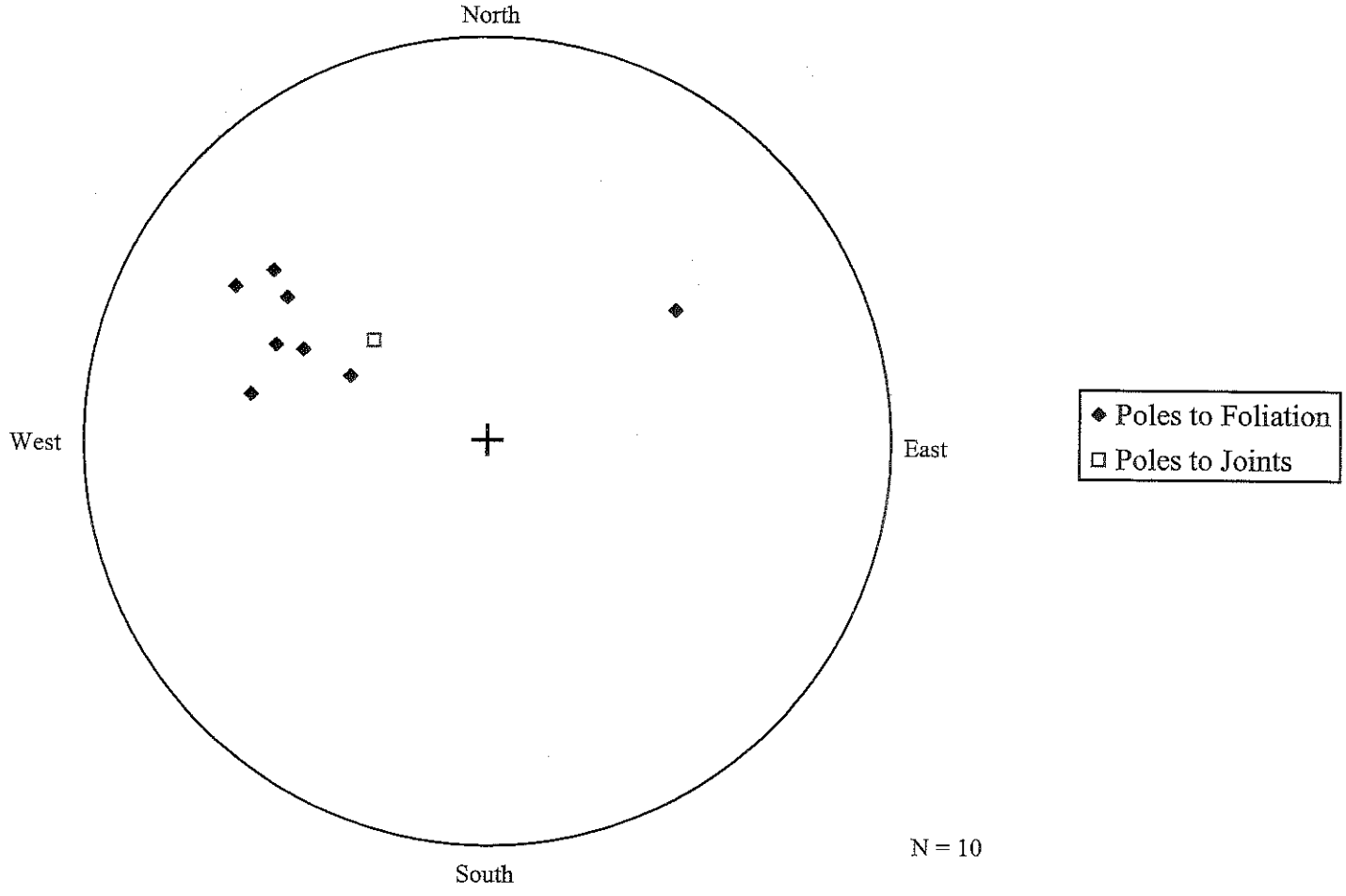
Old Station Gap
OLD STATION CEM
Barnett Mountain
Barnett 1
2896
Rector Mountain
Station
Anderson Branch Ch
FRENCH
BROAD
RIVER
Walnut
Creek
HENDERSON CEM
Dry
Dry Branch Ch
COUNTY HOME
Davis Chapel
Mashburn Gap
ROBERTS CEM
Roberts Gap
Roberts Mountain
Sweetwater
Nocona Siding
Emiline Ridge
Little Mtn
Low 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