Carmen Johnson
44-07 ~~4/10/12~~
4/11/12 CJ

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS

DESIGN HYDROGEOLOGIC REPORT PHASES 3 AND 4

WHITE OAK MSW LANDFILL HAYWOOD 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 2/27/09

NORTH CAROLINA LICENSED SEAL 1475 GEOLOGIST ANDREW W. ALEXANDER 2/27/09

NORTH CAROLINA PROFESSIONAL SEAL No. 13814 ENGINEER DANIEL B. BUNNELL 2/27/09

July 11, 2008
(Revised February 27, 2009)

BLE Project Number J07-1957-02

McGill ASSOCIATES

25th anniversary 1984-2009

February 27, 2009

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

RE: Response to Technical Review
Permit to Construct
MSW Phases 3 & 4
White Oak MSW Landfill Permit # 44-07
Haywood County, North Carolina

Dear Mr. Gaither:

Thank you for your review of the Permit to Construct submittal for MSW Phases 3 & 4 at the White Oak Landfill in Haywood County. We understand that the North Carolina Department of Environment and Natural Resources (NCDENR) will only grant a Permit to Construct MSW Phase 3 at this time. A submittal for a Permit to Construct MSW Phase 4 will be presented to NCDENR in approximately five years, as MSW Phase 3 reaches its capacity. We would; however, like the NCDENR to continue with the review of the Design Hydro Report and Environmental Monitoring Plan for both MSW Phases 3 and 4. We have revised the submittal to address the comments listed in your January 27, 2009 letter. Additionally, BLE, Inc. has prepared their response pertaining to the Design Hydro Report and Environmental Monitoring Plan Technical Review Letter, prepared by Zinith Barbee, dated February 9, 2009. This submittal reflects the revisions made by BLE, Inc., presented in their response, dated February 27, 2009. The following revisions were made to the Permit to Construct submittal to address the revisions of the Design Hydro Report:

- Clay grades in the bottom of the MSW Phase 3 area (and the corresponding subgrade and drainage layer elevations) were revised due to BLE, Inc. adding a correction factor of 1.35 feet to the estimated seasonal high water elevations, as shown on Figure 7 of the Design Hydro Report. These revisions are depicted on Sheets C3A, C3B, C4, C22, C23, and C24 of the Permit to Construct drawings. Also, Figure 1 is included herein to illustrate the separations between the seasonal high water elevations and the top of clay liner elevations. The 8-foot minimum separation noted in Section 2.1 of the Engineering Plan has been maintained.

- In order to clarify the construction of the proposed ground water monitoring wells, the locations of these proposed wells have been added to Sheets C1, C5, C22, and C23 of the Permit to Construct drawings.
- The geotechnical investigation of landfill subsidence has not been revised. There is a 1.35 feet reduction in the depth of waste fill, which adds a safety factor to the calculations.

The following is our response to your January 27, 2009 comment letter:

Facility Plan

1. Rule .1619(e)(1)(D) requires a discussion of procedures for segregated management at different on-site facilities.

1. Section 1.3 of the Facility Plan has been revised to include information pertaining to segregation management of on-site facilities.

2. Rule .1619(e)(4)(C)(i) requires leachate pipeline operating capacity.

2. Leachate pipeline operating capacity information has been added to Section 2.6 of the Facility Plan. The leachate pumps design pump rate has been revised from 26.5 gpm to 35 gpm to allow for an additional margin of safety. Section 4.5 of the Facility Plan and Section 2.5 of the Engineering Plan have been revised to show the increased pump flow rate. An additional method for the removal of leachate in extreme cases has been added to Section 4.6 of the Facility Plan, Section 2.6 of the Engineering Plan, and Section 12e of the Operations Plan. The discharge of the stormwater removal pump will be diverted to proposed manhole 2 of the leachate gravity system, if needed in extreme cases during the early phases of filling MSW Phase 3. The location of the stormwater removal pump is shown on Sheet C5 and the location of manhole 2 is shown on Sheet C18 of the Permit to Construct drawings.

3. Rule .1619(e)(4)(C)(iii) requires final disposal plans and applicable discharge limits, including documented prior approval of the waste water treatment plant which may be designated in the plan. Section 4.5 of the Facility Plan states the correspondence with the Town of Waynesville concerning leachate disposal in found in Appendix C. There is no Appendix C in the Facility Plan.

3. The permit from the Town of Waynesville Public Works Director to Haywood County regarding acceptance of leachate at the Waynesville Waste Water Treatment Facility (WWTF) is included in Appendix C. The Waynesville WWTF utilizes conventional primary treatment processes with secondary biological processes and discharges an average of 3.5 million gallons per day of treated waste water into the Pigeon River. The County is required to submit analyses results to the Town on a yearly basis, however, analyses are performed semi-annually and the County submits these semi-annual

results to the Town. The White Oak Landfill has a monthly average limitation of 25,000 gallons per day, with a maximum of 30,000 gallons per day.

Engineering Plan

4. *Rule .1620(b) requires the plan to meet the requirements of this Rule and the design engineer shall incorporate a statement certifying this fact and bearing his or her seal of registration.*

4. A certification page has been added to the front of the Engineering Plan.

5. *Rule .1620(e)(2) requires grading plans: proposed limits of excavation, subgrade elevations, boring locations, intermediate grading for partial construction. Sheet C3 shows proposed grading contours, but there is a Note within Cell 3 stating contours within Phase 3 consist of existing, proposed top of clay, ground water and rock elevations. Please provide a drawing with subgrade elevations as required.*

5. Sheet 3A, depicting the subgrade elevations within the MSW Phase 3 waste area, has been added to the Permit to Construct package. The original Sheet 3, ***Phase 3 Clay Liner Grades***, has been renamed to 3B, and illustrates the top of clay elevations. Additionally, the *2496* and *2498* clay contours, in the vicinity of the sump area, have been revised to more accurately depict the contours in this area, and are shown on the enclosed Sheets 3A, 3B, and 4. Only the MSW Phase 3 drawings have been revised since a Permit to Construct will not be granted for MSW Phase 4 at this time. Additionally, Sheets 3A, 3B, and 4 have been modified to reflect the revisions of the Design Hydro Report, as noted above. The 8-foot minimum separation noted in Section 2.1 of the Engineering Plan has been maintained.

Construction Quality Assurance Plan

6. *Section 6.3 states soils used in clay liners shall consist of clean, select material free of debris, excessive coarse particles or other deleterious matter. Please provide maximum grain size limits for the compacted clay liner material.*

6. Grain size limits for the compacted clay liner are listed in the table in Section 2300.2 of the Technical Specifications, Section 8 of the Permit to Construct package. Additionally, maximum particle size requirements for the clay liner have been added to Table 1, Section 6.3 of the CQA Plan. Table 1 has also been modified to clarify the requirements of pre-construction and construction testing.

7. *Section 6.3 states 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 25 tests performed. The Section would prefer a frequency of one out of every 10 tests performed, or 10 percent, for all such verification tests.

7. Section 6.3 of the CQA Plan has been revised to include nuclear gauge verification testing at a frequency of one out of every 10 tests performed.

8. Section 6.4.2 states permeability tests shall be performed at a confining pressure of 25 psi +/- 1 psi. Please provide documentation that the proposed confining pressures are realistic relative to this proposed landfill phase.

8. Using a confining pressure of 25 p.s.i. during permeability testing is a conservative method of evaluating the hydraulic conductivity of soils. The confining pressure of 25 psi for permeability testing was selected to model both the overburden waste pressure (maximum of 60 psi) and the residual or locked-in stress from hauling and compaction equipment (range from about 30 to 100 psi). In the MSW Phase 3 area, 57% of the clay liner area will have waste fill and soil pressures in excess of 25 p.s.i. Only those areas at the outer periphery of the landfill will experience pressures less than 25 p.s.i.; however, in these areas the landfill construction equipment (i.e. drum and sheep's foot rollers) will exert pressure on the clay liner in the range of 30 to 100 p.s.i.

9. Rule .1624(b)(8)(c)(3) requires any tests resulting in the penetration of the compacted clay liner shall be repaired using bentonite or as approved by the Division. Please specify the proposed repair method for compacted clay liner test locations.

9. Any penetration within any portion or lift of the clay liner shall be promptly backfilled by the Contractor with a 50/50 mix of hand tamped soil and bentonite fill. This information is included in Section 2300.15 of the Technical Specifications and Section 6.3 of the CQA Plan.

10. Rule .1624(b)(2)(D) requires the leachate collection system shall be operated to remove leachate from the landfill in such a way as to ensure that the leachate head on the composite liner does not exceed one foot under normal operating conditions. Please indicate how you will determine functionality of the leachate collection system prior to opening the landfill.

10. Section 2400.7(a)6 of the Technical Specifications has been added to include the requirement for the Contractor to video inspect all main trunk lines of the leachate collection system (approximately 1,800 l.f.) and the leachate gravity sewer beneath proposed MSW Phase 3, prior to acceptance by Haywood County. Additionally, the Contractor will conduct a pump test on each pump to verify that the leachate sump pumps are operating at their design rates.

Operations Plan

11. *Page 6 states daily cover will be the combination of soil, synthetic cover, and mulched material. Just to be clear, the Section will only approve the use of a soil/mulch mixture with at least a 3:1 soil to mulch ratio for use as daily cover.*

11. Section 2(b)ii of the Operations Plan has been revised to include two procedures for the use of mulch/soil mixture as an ADC. An extension until July 9, 2009 for the Mulching Demonstration Period has been granted. In regards to the synthetic cover ADC's, the County received approval for the use of a synthetic cover in the Permit To Construct MSW Phase 2, in the March 2000 Operations Plan, although the type of cover material was never specified in the plan. Since that time, the County has been using rolls of plastic available from any hardware store. Appendix 2A includes the March 2000 synthetic cover operational procedures, with the addition at this time of the type of material used. This material is used exclusively on the vertical working face when baled wastes are disposed. The County requested and completed a demonstration period for the use of another synthetic cover, to be used on the working face when loose-fill wastes are disposed. Appendix 2B includes the operational procedures for this second type of cover, which can also be used on the vertical face, if needed. The Permitting Branch of the Solid Waste Section is waiting for the County to complete the Demonstration Report prior to final approval of this second synthetic cover. The County wishes to keep both synthetic cover ADC's in the Operations Plan because both baled and loose-fill wastes are disposed at the landfill. Section 2(b) of the Operations Plan has been revised to show both synthetic cover ADC's.

12. *Item 1.d states asbestos wastes will be put in a hole dug out of the existing waste and buried immediately. This operation may contradict Rule .1626(1)(d) with requires asbestos wastes to be disposed of (i) at the bottom of the working face, or (ii) in an area not contiguous with other disposal areas. Also,*

12. The County does not excavate a hole to dispose of asbestos wastes, but there is a specified area where asbestos is disposed. The asbestos wastes are brought to the designated area and the landfill operator immediately covers the wastes with a minimum of six inches of soil. Asbestos is only accepted on Thursdays and haulers are expected to call 24 hours beforehand. Section 1d of the Operations Plan was modified to show the asbestos wastes cover procedures.

13. *Item 2.b states a daily cover of soil/mulch mixture consisting of 1.5 inches of mulched material combined with 4.5 inches of soil. Just to be clear, the soil/mulch mixture must be mixed such that the mulch is completely incorporated into the soil. Also, please provide a description of the procedure to measure, mix and place the soil/mulch mixture.*

13. Two procedures for creating the mulch/soil ADC mixture have been added to Section 2(b)ii of the Operations Plan.

14. *Item 3a states Haywood County will prevent or control on-site populations of disease vectors using techniques appropriate for the protection of human health and the environment. Please list any techniques and describe any techniques that may be used other than covering with soil.*

14. In conjunction with the development of the White Oak Landfill, the County was required to construct a chain-link "bear" fence. The fence will be relocated as part of the MSW Phase 3 & 4 expansion. Section 3a of the Operations Plan has been revised to include the requirement of the bear fence.

15. *Item 8.e provides a note on the 404/401 permits required for impacting wetlands and jurisdictional waters. This note is not required or relevant to the Operations Plan.*

15. Sections .1626(8)e (i) and (ii) of the Solid Waste Rules refer to the impact of an MSWLF on wetlands and waters of the United States. Wetlands and waters of the United States will be impacted by the construction of MSW Phase 3 at the White Oak Landfill. Haywood County has obtained the proper permits for these impacts and wishes to ensure that this information is included in the record. Additionally, Section 8.f of the Operations Plan refers to Section 8.e.

16. *Item 9.a(ii) states liquid waste will not be placed in the landfill unless the waste is leachate or gas condensate derived from the landfill. Rule .1626(9)(a)(ii) places additional restrictions on the placing leachate or gas condensate in the landfill.*

16. The White Oak Landfill meets all of the requirements of .1626(9)(a)(ii). The leachate collection system for MSW Phase 3 was designed in accordance with Section .1624 of the Solid Waste Rules. Additionally, the County must go through the proper permitting channels prior to the implementation of any leachate recirculation operation, as noted in Appendix 4 of the Operations Plan.

17. *Item 12.a states the leachate collection system test wells will be checked on a quarterly basis for blockages and leachate lines will be cleaned as necessary. Please qualify the procedure used to check for blockages and quantify the criteria that will be used to determine proper operation of the LCS. The Section recommends annual camera inspections to insure proper functionality of the LCS.*

17. The requirements for proper operation of the leachate collection system are listed in Section .1624(2) of the Solid Waste Rules and will be the basis for determining the functionality of the leachate collection system pumps. Leachate levels will be monitored using the level indicators on the pumps. High water alarms are an important feature of the pumping system and will alert County Landfill Staff when high leachate levels are encountered. The leachate head test wells will be available as a leachate depth verification monitoring location and as an access point for jet-cleaning and video inspection of leachate

collection lines. To verify leachate depths via the test wells, the County will utilize their environmental monitoring and testing company to record leachate levels. Due to budgetary constraints, Haywood County will annually review the feasibility of performing jet-cleaning and/or video inspection of leachate lines. Section 12.a of the Operations Plan has been modified to reflect the procedures described in this response. The County wishes to remove the quarterly testing for blockages as the water levels indicated in the pumping systems will be the primary method of verification of leachate depths on the liner.

Additionally, Section 12a of the Operations Plan was modified to show the installation of a side slope riser pumping station within existing MSW Phase 1, Cells 1-3, in the vicinity of the existing sump. This side slope riser pumping station will be operated in the same manner as the two proposed pumping stations within MSW Phase 3. The MSW Phase 1 pumping station is a backup to the existing gravity sump system. This pumping station will not include a test well, but the side slope riser itself can act as a port to monitor leachate levels, if necessary.

18. *There is no discussion of the procedures used to dispose of the baled wastes currently being placed in the landfill. At a minimum, a discussion of the transport, disposal and cover of the bales should be presented.*

18. Haywood County has been disposing of baled wastes since 2000 and waste bales were illustrated in the Fill Sequence drawings of the MSW Phase 2 Permit to Construct documentation. Baled wastes are handled, placed, and covered in similar fashion as loose wastes. Wastes are transported to the landfill primarily by County-operated transfer trucks, where they are placed on the floor of the cell as close to the working face as possible. Landfill operators stack bales and construct a working face in 8' to 10' lifts. A reference to baled and loose wastes has been added to Sections 1a and 1g of the Operations Plan. Wastes are covered with approved daily cover materials. The County has the option of using either of the two approved synthetic covers on the vertical face when bales comprise the working face. The two synthetic cover ADC operations are described in detail in Appendices 2A and 2B. Appendix 2A was approved in the MSW Phase 2 Permit to Construct in 2000 and refers to the cover used exclusively on the vertical faces when bales are being disposed. Appendix 2B refers to the synthetic cover that is currently under review for approval, and may be used with either loose-fill or baled wastes.

19. *The Operations Plan should be revised to include all recent revisions (ie. treatment and processing, composting, etc.).*

19. Recent modifications to the Operations Plan are included, including the Mulching and Grinding Treatment and Processing Operations Plan (Appendix 5), the Small Type 2 Composting Facility Operations Plan (Appendix 6), the new synthetic cover ADC (Section 2b and Appendix 2B), and the use of compost as an Alternative Cover Material (Section 2c). The Mulching and Grinding Treatment and Processing Operation and the Composting Operation are currently under a demonstration period, until July 9, 2009.

Closure and Post-Closure Plan

20. *Rule .1629(b)(1)(B) requires an estimate of the largest area of the MSWLF unit ever requiring the specified cap system at any time during the active life.*

20. An area encompassing Phases 1 through 3 and a portion of Phase 4, covering approximately 34 acres, is an estimate of the largest area of the MSWLF unit ever requiring the specified cap system at any time during the active life.

21. *Rule .1629(c)(1) requires a description of the monitoring and maintenance activities required in Paragraph (d) of Rule .1627 for each MSWLF unit, and the frequency at which these activities shall be performed. Please refer to Paragraph (d) of Rule .1627 to ensure all required components are covered.*

21. A reference to the 30-year post-closure care period has been added to Section 4.1 of the Closure and Post-Closure Care Plan.

22. *The review of the Design Hydrologic Report and Water Quality monitoring Plan will be sent under separate cover by Mr. Zinith Barbee.*

22. As shown in the introduction to this letter, BLE, Inc. has addressed the concerns expressed in Mr. Barbee's Technical Review letter, dated February 9, 2009. The engineering drawings included in this submittal have been revised to reflect BLE's modifications to the Design Hydro Report and to illustrate the locations of the proposed ground water monitoring wells. A copy of BLE's response letter will be forwarded to your office upon receipt.

Haywood County is required to ensure that the construction and operation of MSW Phase 3 does not cause or contribute to violations of any State water quality standards. An erosion control plan for the construction and operation of MSW Phases 3 and 4 has been approved by the NCDENR-Land Quality Section. A copy of the approved erosion control permit has been forwarded to your office under separate cover. The Contractor will be required to strictly adhere to the conditions set forth in the erosion control plan during the construction of MSW Phase 3. After a Permit to Operate MSW Phase 3 is granted, the County must continue best management practices to ensure that the requirements of .1622(3) are met. Additionally, the monitoring of ground and surface water locations as part of the Environmental Monitoring Plan will be implemented to gauge the impact of the MSWLF operation on nearby water resources. The MSW Phases 3 and 4 areas were evaluated for the location restrictions specified in Section .1622 of the Solid Waste Rules, as part of the 'MSWLF Facility Site Study, White Oak Landfill', dated November 4, 1998.

Enclosed are two hard copies and a digital copy of each the following:

1) Revised Facility Plan.
2) Revised Engineering Plan
3) Revised Construction Quality Assurance Plan
4) Revised Operations Plan
5) Revised Closure and Post-Closure Plan
6) Revised Technical Specification 2300
7) Revised Technical Specification 2400
8) Revised Permit to Construct Drawings. The following drawings have been revised: Cover Sheet, C3A, C3B, C4, C5, C22, C23, and C24.

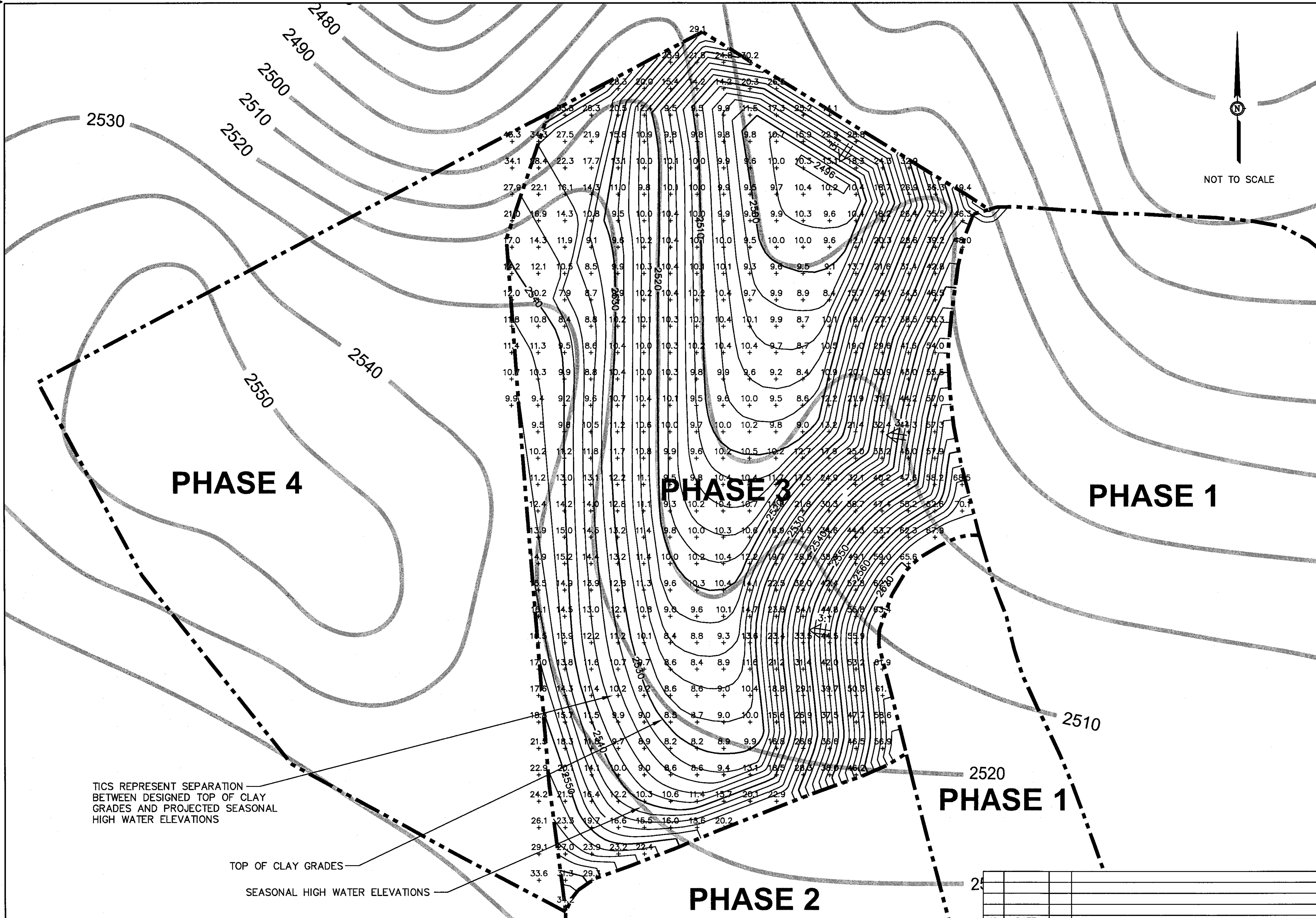
We look forward to continuing to work with you to finalize the Permit to Construct MSW Phase 3 submittal for Haywood County. Please let us know if you have additional questions or if you require additional information.

Sincerely,
McGILL ASSOCIATES, P.A.

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

Enclosures

cc: Ed Mussler, NCDENR Solid Waste Section, w/o enc
Zinith Barbee, NCDENR Hydrogeologist, w/o enc
David Cotton, Haywood County Manager, w/o enc
Stephen King, Haywood County Solid Waste Director, w/o enc



NO.	DATE	BY	REVISION DESCRIPTION

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

WHITE OAK LANDFILL
PERMIT TO CONSTRUCT
MSW PHASES 3&4

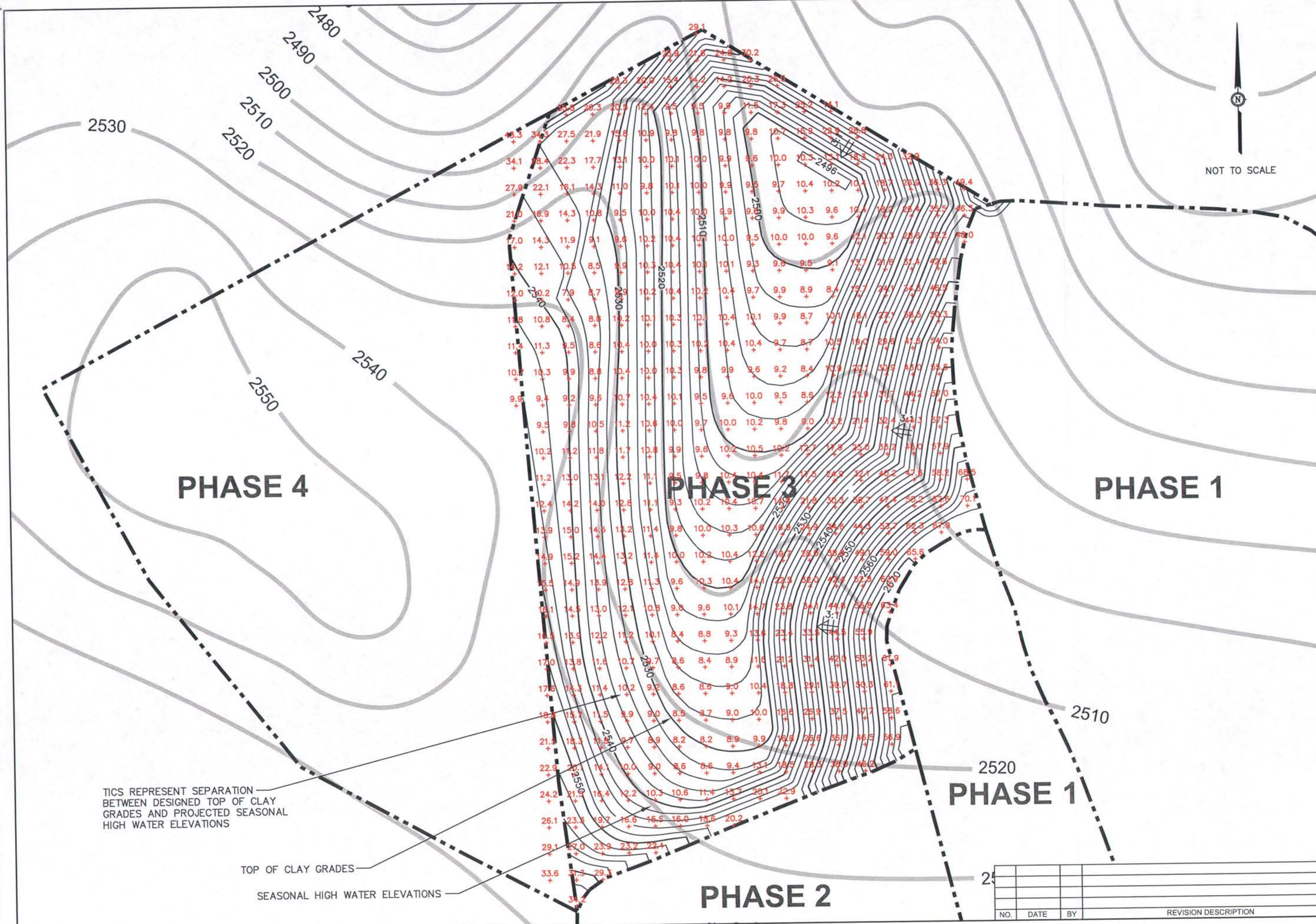
HAYWOOD COUNTY

HAYWOOD COUNTY, NORTH CAROLINA

JOB NO.: 07518
DATE: MARCH 2009
DESIGNED BY: KS
CADD BY: KS
DESIGN REVIEW:
CONST. REVIEW:
FILE NAME: Clay-Water-Separations-11X17.dwg

TOP OF CLAY/ SEASONAL HIGH WATER ELEVATIONS SEPARATION

FIGURE 1



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WHITE OAK LANDFILL
PERMIT TO CONSTRUCT
MSW PHASES 3&4

HAYWOOD COUNTY

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TOP OF CLAY/ SEASONAL HIGH WATER ELEVATIONS SEPARATION

FIGURE 1

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

February 27, 2009

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

Attention: Mr. Jeffrey Bishop, P.E.

Subject: **Revisions to the *Design Hydrogeologic Report* and *Environmental Monitoring Plan,* Phases 3 & 4 to address NCSWS Technical Review Comments dated February 9, 2009 – Doc ID 6606**
White Oak Landfill (MSWLF – Phase 3 & 4)
Haywood County, North Carolina
Permit 44-07
BLE Project Number J07-1957-02

Dear Mr. Bishop:

The North Carolina Solid Waste Section (NCSWS) has completed their technical review of the *Design Hydrogeologic Report* (DHR) dated July 11, 2008, and *Environmental Monitoring Plan* (EMP), dated July 11, 2008 for the proposed Phase 3 & 4 areas at the White Oak MSW Landfill prepared by Bunnell-Lammons Engineering, Inc. (BLE). The NCSWS technical review comments were outlined in a letter from the NCSWS dated February 9, 2009. This letter addresses the NCSWS review comments and provides supplemental and revised information where requested. Additionally, a revised copy of the DHR is attached which incorporates the changes mentioned in this letter.

BACKGROUND INFORMATION

The White Oak Landfill is located in Haywood County, North Carolina approximately 12 miles north of Waynesville at the Fines Creek Exit (Exit 15) off of Interstate 40. The facility consists of four active or proposed waste units including:

1) MSWLF (Phases 1 & 2),
2) Proposed MSWLF Expansions (Phases 3 & 4),
3) C&D Landfill (Phase 1), and
4) an LCID Landfill.

The landfill is owned and operated by Haywood County. Currently, the Phase 1 and 2 areas have been developed. Haywood County now plans to develop the Phase 3 and 4 areas.

A DHR and EMP for the Phase 3 & 4 areas both dated July 11, 2008 were prepared by BLE (Job Number J07-1957-02) and submitted to the NCSWS. The DHR addressed the geological, hydrogeological, and geotechnical investigation required for the site permitting and design process

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under applicable North Carolina Rules for Solid Waste Management 15A NCAC 13B .1623 (b). The EMP addressed the water monitoring requirements required for the site permitting and design process under applicable North Carolina Rules for Solid Waste Management 15A NCAC 13B .1631.

Mr. Zinith Barbee of the NCSWS reviewed the DHR and EMP and conveyed questions and comments in a letter dated February 9, 2009. The information provided below addresses Mr. Barbee's comments and has been incorporated into the attached revised DHR.

RESPONSE TO REVIEW COMMENTS BY THE NCSWS

NCSWS Item No. 1:
1.0 Clarify what is to be constructed. Consistent use of the proper terminology as defined in Regulation .1619(c) is required throughout the application.

Supplemental Information:
We concur with the NCSWS comment and the text of the DHR has been revised to eliminate the use of the term "cell" where the term "phase" would be appropriate.

NCSWS Item No. 2:
2.1 Correct what is stated in the regulation cited in the study. Regulation .1623 (b) specifies borings per acre of "area of investigation", not a cell within a phase, nor does it specify "150 feet downgradient of cells."

Supplemental Information:
We concur with the NCSWS comment and the text of the DHR has been revised to use the phrase "area of investigation" where appropriate.

NCSWS Item No. 3:
2.2 Base seasonal high groundwater elevation on data collected for a year.

Supplemental Information:
Regulation .1623 (a)(7)(B) requires the "Tabulations of stabilized water table elevations over time in order to develop an understanding of seasonal fluctuation in the tater table." These data are presented in the DHR. No changes have been made to the DHR except those presented in the supplemental information for NCSWS Item No. 26 shown below.

NCSWS Item No. 4:
2.4 Include the fracture trace analysis and Rose diagrams to which this section refers.

Supplemental Information:
We concur with the NCSWS comment and the pertinent text from the referenced report has been copied and is included as Appendix J (new) of the revised DHR. We understand that Plate 3 (Stream Traces) and Plate 3B (Rose Diagram) have not been located by Haywood County and were not provided to BLE.

NCSWS Item No. 5:
3.3 In the explanation of ponds and ravines, include what appears to be an unidentified pond or basin east of PZ-9.

Supplemental Information:
We concur with the NCSWS comment and the DHR text has been revised to include discussion of the subject feature. The feature has been identified as an existing sedimentation pond which receives stormwater runoff from the Phase 2 perimeter access road.

NCSWS Item No. 6:
3.4.1.3 Identify which borings shown in Figure 3 are used to establish bedrock.

Supplemental Information:
We concur with the NCSWS comment and the DHR text has been revised to include a reference to the subject borings. Those borings are identified as BLE-7D, BLE-9, P-4, and MW-2D in the text.

NCSWS Item No. 7:
3.4.2 See comment for Section 2.4.

Supplemental Information:
We concur with the NCSWS comment and the DHR text includes a reference to the newly included Appendix J.

NCSWS Item No. 8:
3.4.3 Include information about the "upper 10 feet of bedrock" pursuant to Regulation .1623 (b)(2)(D). Also, include the value for hydraulic conductivity for partially-weathered rock and bedrock.

Supplemental Information:
Information on the "upper 10 feet of bedrock" is provided in Section 3.4.1.3 of the DHR and on the boring logs in Appendix C. Please note that we have added the boring log for MW-2D to Appendix C for reference. Information on the "hydraulic conductivity of partially-weathered rock and bedrock" is provided in Section 3.5.5.1 and on Table 8 of the DHR. No changes have been made to the DHR.

NCSWS Item No. 9:
3.5.2.1 See comment for Section 2.2.

Supplemental Information:
The data required by Regulation .1623 (a)(7)(B) and Regulation .1623 (a)(7)(C) has been provided in the DHR. No changes have been made to the DHR except those presented in the supplemental information for NCSWS Item No. 26 shown below.

NCSWS Item No. 10:
3.5.2.2 See comment for Section 2.2.

Supplemental Information:
The data required by Regulation .1623 (a)(7)(B) and Regulation .1623 (a)(7)(C) has been provided in the DHR. No changes have been made to the DHR except those presented in the supplemental information for NCSWS Item No. 26 shown below.

NCSWS Item No. 11:
3.5.4 Two revisions are necessary. One, see comment for Section 3.3 to account for all the locations where the reported groundwater mounding will occur. Two, correct the final sentence to convey that groundwater receptors—two buffered streams—exist downgradient of proposed Phase 3. The current sentence appears to refer to "cell construction" of existing Phase 1, which consists of four cells in another drainage basin.

Supplemental Information:
We concur with the NCSWS comment and the DHR text has been revised to include references to the subject features.

NCSWS Item No. 12:
3.5.6 In the table included in the text, replace "Phase 4" with "Phase 3" and replace "PZ-" with "BLE-" to reflect what is shown in Table 9.

Supplemental Information:
We concur with the NCSWS comment and the DHR text has been revised to correct the typographical errors and well location descriptions.

NCSWS Item No. 13:
3.6.1 Correct the reference to Horton and Zullo to reflect what they reported about faults near the site. Explain what is a "Holocene fault" and cite where in the reference the authors defined and discussed it. Regulation .1622(4)(a) specifies "a fault that has had displacement in Holocene time", which the USGS reported occurred in an earthquake near the site in December 2008. In Regulation .1622(4)(a)(b)(iii) Holocene is defined as "extending from the "Pleistocene Epoch to the present."

Supplemental Information:
We concur with the NCSWS comment and the DHR text has been revised to correct the reference to the cited publication. Additionally, we understand from the NCSWS letter that an earthquake was reported near the site (approximately 2 miles northeast) in December 2008; approximately 6 months after the DHR was submitted. On February 16, 2009, we mobilized a North Carolina Licensed Geologist from our staff to the site to conduct an on-site reconnaissance for evidence of faulting on the site. The geologist conducted the reconnaissance on foot and investigated the site within the Phase 3 and 4 areas and within 200 feet of the Phase boundaries. No evidence of seismically induced features (faults, sloughs, escarpments, etc.) were observed at that time. The results of that investigation are included in the revised DHR text.

NCSWS Item No. 14:

3.6.5 Two revisions are necessary. One, see comment for Section 3.4.1.3, which address locations of corings. Two, explain and show how groundwater flow will be altered by the deep excavation in Phase 4.

Supplemental Information:

We concur with the NCSWS comment and the DHR text has been revised to include references to the corings and to describe possible changes to groundwater flow related to the excavation of soils in Phase 4. We conclude that the groundwater elevations in the Phase 4 area will generally be lowered over time; however, groundwater flow directions should not significantly change.

NCSWS Item No. 15:

3.6.6 This section is topically about engineered fill, but excavation in Phase 3 is actually described. Mentioned is "an apparent existing storm water control feature" about which more information is required pursuant to .1623(b)(2)(A), which refers to specifications in .1623(a)(12). In addition, explain the "existing fill soil near BLE-3", which is located in the groundwater discharge feature shown in drawings.

Supplemental Information:

We concur with the NCSWS comment and the DHR text has been revised to include a discussion of the physical features and fill soils in Phase 3. This section now describes the previously constructed north-south trending stormwater control feature through the center of the Phase 3 area. The feature includes two retention basins separated by a small dam (roughly located between the BLE-3 and BLE-4 borings). The feature was dry during the design hydrogeologic investigation. The feature is partially filled with sediment which has appeared to accumulate from stormwater runoff. These sediments are shown on the boring logs and in the cross sections in the DHR. Sections 3.6.5 and 3.6.6 of the DHR describe the presence of these soils and the procedures to remove and replace the soils with engineered fill.

NCSWS Item No. 16:

Table 3 Show seasonal high for the year instead of the highest groundwater elevation measured during the seasonal low.

Supplemental Information:

Table 3 shows seasonal high groundwater elevations as required by Regulation .1623 (a)(7)(B) and Regulation .1623 (a)(7)(C). No changes have been made to the DHR except those presented in the supplemental information for NCSWS Item No. 26 shown below.

NCSWS Item No. 17:

Figure 2 Include the state hydrogeologic map, which more relevant to the report.

Supplemental Information:

We have included Figure 5 and Table 1 from the *Preliminary Hydrogeologic Assessment and Study Plan for a Regional Ground-Water Resource Investigation of the Blue Ridge Piedmont Provinces of North Carolina* (USGS Water-Resources Investigation Report 02-4105) in the DHR. The documents have been included in Appendix K (new). The state geologic map is still included in the DHR as Figure 2.

NCSWS Item No. 18:
Figure 3 Identify what appears to be an unlabeled basin or pond located east of PZ-9.

Supplemental Information:
We concur with the NCSWS comment and Figure 3 has been revised to include a label for the feature in question.

NCSWS Item No. 19a (these comments refer to Figure 4 in the DHR):
Figure 4 Revise cross section AA' to show the following corrections. One, correct the groundwater elevation at BLE-16.

Supplemental Information:
We have reviewed the groundwater elevation at BLE-16 and it is displayed correctly on Figure 4. No changes have been made.

NCSWS Item No. 19b (these comments refer to Figure 4 in the DHR):
Figure 4 Revise cross section AA' to show the following corrections. Two, show that bedrock depths are inferred. Boring logs used to depict the cross section do not show depths to bedrock.

Supplemental Information:
We concur with the NCSWS comment and Figure 4 has been revised to show a dashed (bedrock) line between borings BLE-11 and BLE-16.

NCSWS Item No. 19c (these comments refer to Figure 4 in the DHR):
Figure 4 Revise cross section AA' to show the following corrections. Three, either end the cross section at BLE-3, or show only what is logged for BLE-4. The boring for BLE-4 terminated at 2.5 feet.

Supplemental Information:
There is a footnote on the BLE-4 boring log (Appendix C) that explains that the BLE-4 boring refused on boulders in fill soil and not on bedrock. These boulders and fill soils were discovered in test pits performed by McGill Associates on June 4, 2008 (as documented on the BLE-4 boring log). Therefore, the cross section A-A' accurately depicts the subsurface geology at the A' termination point and has not been changed.

NCSWS Item No. 19d (these comments refer to Figure 4 in the DHR):
Figure 4 Revise cross section BB' to show the following corrections. One, correct groundwater elevations between BLE-1 and BLE-2.

Supplemental Information:
We have reviewed the groundwater elevations between BLE-1 and BLE-2 and they are correct as shown. No changes have been made.

NCSWS Item No. 19e (these comments refer to Figure 4 in the DHR):
Figure 4 Revise cross section BB' to show the following corrections. Two, show where bedrock depths are inferred.

Supplemental Information:
We concur with the NCSWS comment and Figure 4 has been revised to show a dashed (bedrock) line between borings BLE-1 and BLE-5.

NCSWS Item No. 19e (these comments refer to Figure 4 in the DHR):
Figure 4 Revise cross section BB' to show the following corrections. Three, either end the cross section at BLE-7D, or show only what is logged for BLE-8. The boring for BLE-4{sic BLE-8} terminated at 3 feet.

Supplemental Information:
We concur with the NCSWS comment and the boring logs for BLE-8 (Appendix B and C) have been revised to show the geology encountered. The B-B' transect is terminated at BLE-8 in accordance with the geology observed in the boring. No changes have been made to Figure 4.

The next 6 items refer to the NCSWS review comments for the EMP

NCSWS Item No. 20 (EMP comment):
The SWS evaluated groundwater monitoring plans for Phase 3 and 4. For Phase 3 include an upgradient monitoring well at the relevant point of compliance. Pursuant to Regulation .1631 (a)(2)(A) the relevant point of compliance is "established no more than 250 feet from a waste boundary."

Supplemental Information:
The cited regulation specifies the requirements for the location of compliance points and not for the location of background/upgradient wells which is specified in .1631 (a)(1)(A-C). Please note that the upgradient wells MW-11S and MW-11D have been established as background points for the facility in compliance with the regulation. No changes have been made to the EMP.

NCSWS Item No. 21 (EMP comment):
Locate the groundwater monitoring system for Phase 4 away from areas of excavation, fill, stockpile, and road construction, and locate the system at the point of relevant compliance.

Supplemental Information:
The proposed monitoring well locations for Phase 4 are located within the limits specified in the regulations. Please note that the proposed wells are to be installed along the outer perimeter of the proposed access road in areas graded for drill rig access. Due to steep topography in the areas around Phase 4, drill rig access is very limited. We understand that the cost of grading to install monitoring wells at greater distances from the perimeter road would be very high. We request that the monitoring well locations be approved as proposed.

NCSWS Item No. 22 (EMP comment):

In the areas of excavation, fill, road construction, and sediment basins proposed for Phases 3, show where existing downgradient groundwater monitoring wells for Phase 1 will be relocated.

Supplemental Information:

We understand that none of the monitoring wells in this area (MW-3, MW-3D, MW-4A, & MW-8) are to be abandoned as part of the construction of Phase 3. In areas where fill soils will be placed, we understand that these wells will be extended to the ground surface during grading and that new well heads (pads and protective covers) will be installed upon completion of grading. We request that the existing monitoring wells be approved as they are currently installed. In areas where waste cells will be constructed within Phase 3, the existing monitoring wells MW-5A, MW-5D, MW-12, MW-13S, and MW-13D will be abandoned and not replaced as specified in the EMP.

NCSWS Item No. 23 (EMP comment):

3.1 See comment in Section 2.2 for the Design Hydrogeologic Report, which is relevant to determining depths and screen depths for groundwater monitoring wells for both Phase 3 and Phase 4.

Supplemental Information:

As specified in the EMP, all groundwater monitoring wells are to be installed with a 15-foot long screened section. The wells will be installed so that the screen brackets the water table at the time of well installation. This type of well construction allows water table fluctuations in either direction (rise or fall). Our projected well depths are based on actual water table elevations observed on February 14, 2008 as shown on Figure 3, on proposed design grade elevations at the well locations, and in accordance with the proposed well construction described above. Please note that field-specific conditions encountered during drilling/well installation are the primary factors for determining well installation depth. We request that the proposed well depths be approved as described.

NCSWS Item No. 24 (EMP comment):

3.2 Specify where the relevant point of compliance for both Phase 3 and 4 are located pursuant to .1631 (a)(2).

Supplemental Information:

The regulations specify that the relevant point of compliance will be approved by the Division based on consideration of several factors specified therein. Those data are provided in the DHR and EMP and were used by BLE to select the proposed groundwater monitoring well locations shown in the EMP. Therefore, ipso facto, the proposed relevant point(s) of compliance for Phase 3 and 4 are the proposed well locations and existing surface water sampling locations themselves. No changes have been made to the EMP.

NCSWS Item No. 25 (EMP comment):
3.4 Without a sufficiently characterized seasonal high groundwater table pursuant to Regulation .1624 (b)(7), proposed well depths cannot be evaluated.

Supplemental Information:
Please refer to the supplemental information provided for NCSWS Item No. 23 above. Please also note that Regulation .1624 (b)(7) refers to geotechnical analysis of landfill subgrades and is not applicable to proposed well depths.

The next 2 items refer to the NCSWS review comments for the DHR

NCSWS Item No. 26 (DHR comment):
3.5.2.1. Use the historical data accumulated at the site to determine when seasonal high groundwater occurs. Data from the National Oceanic and Atmosphere Administration (NOAA) does not reflect local variation within Haywood County.

Supplemental Information:
We have evaluated the historical groundwater elevation data shown on Table 3 for wells monitored prior to and during the September 20, 2007 through February 14, 2008 DHR monitoring period to establish when seasonal high groundwater elevations may occur at the site. The majority of the data consists of April and October measurements with no other measurements collected during the year. With only two points per year there is not sufficient data to determine the time frame during which the average seasonal high occurs. However, the April groundwater elevations were higher than the October groundwater elevations.

To determine when seasonal high groundwater elevations occur in Haywood County, we downloaded groundwater level monitoring data from the North Carolina Division of Water Resources – Water Data Retrieval site (http://www.ncwater.org/wrisars/). There are four groundwater wells (M 90T1, M 90T2, M 90U1, M 90U2) in Haywood County which DWR personnel measured water levels from approximately June 1985 through December 1990. These wells are located approximately 12 miles east-southeast of the subject site. We have prepared time series plots for each well and have included them in Appendix E of the DHR. The plots show that the average seasonal high groundwater elevations occur in (or near) April each year.

Since the monitoring period at the subject site ended in February 2008, we have prepared an additional table (Table 3B) for inclusion in the DHR to project a new seasonal high for April 2008. Table 3B calculates a difference between the highest April groundwater elevation (from either 2005, 2006, or 2007) and the measured seasonal high for monitoring wells MW-5A, MW-5D, MW-12, MW-13S and MW-13D from the 2007-2008 DHR monitoring period. These wells are within the Phase 3 area and have sufficient water level data history. An average head difference of 1.35 feet (range of 0.83 to 1.69 feet) was calculated for these wells. The 1.35 foot correction factor was added to the previously measured seasonal high to estimate a new projected seasonal high (April 2008) for each piezometer and well (Table 3B). Figure 7 (in the DHR) has been revised to show the projected seasonal high for April 2008. McGill Associates has incorporated the new April 2008 projected seasonal high groundwater levels in their subgrade design.

Post-settlement separation between bottom of clay liner and seasonal high groundwater (September 2007 through February 2008) were calculated by BLE and presented in Appendix I (Geotechnical Calculations) of the DHR. The post settlement liner-groundwater separations range from 6.95 feet at the P-6 location to 43.27 feet at the BLE-17 location. Since the revised seasonal high groundwater elevation has been increased 1.35 feet the resulting revised post-settlement separation from the water table to the bottom of the clay liner would range from 5.6 feet to 41.92 feet. The revised separations continue to exceed the 4 foot minimum specification in the regulations.

Haywood County is included in NOAA NC Division 1 and that data is routinely used as a representative measure for estimation of local precipitation and other atmospheric phenomenon.

NCSWS Item No. 27 (DHR comment):
3.5.3. Delete the sentence where groundwater is described as flowing "to the north." In the sentence before it, groundwater reportedly "flows in a radial patern {sic}", which occurs in the upper aquifer before reaching fractures oriented north and south in the deeper aquifer.

Supplemental Information:
The text in this section accurately describes the groundwater flow at the subject site. No changes have been made to the DHR text.

CLOSING

We appreciate the opportunity to serve as your hydrogeological and geotechnical consultant at this site. If you have any questions, please do not hesitate contacting us at (864) 288-1265.

Sincerely,
BUNNELL-LAMMONS ENGINEERING, INC.

Andrew W. Alexander, P.G.
Senior Hydrogeologist

Mark S. Preddy, P.G.
Senior Hydrogeologist

Attachments: Revised DHR

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

RECEIVED
MAR - 6 2009
SOLID WASTE SECTION

July 11, 2008
(Revised February 27, 2009)

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

Attention: Mr. Jeffrey Bishop, P.E.

Subject: **Design Hydrogeologic Report**
Phases 3 & 4
White Oak MSW Landfill
Haywood County, North Carolina
BLE Project Number J07-1957-02

Gentlemen:

Bunnell-Lammons Engineering, Inc. (BLE) has completed the Design Hydrogeologic Study for Phases 3 & 4 at the White Oak MSW Landfill. This report addresses the relevant site application requirements as outlined in the North Carolina Rules for Solid Waste Management, 15A NCAC 13B .1623 (b). The attached report describes the work performed and presents the results obtained.

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

Sincerely,

BUNNELL-LAMMONS ENGINEERING, INC.

NORTH CAROLINA LICENSED SEAL 1043 GEOLOGIST MARK S. PREDDY
2/27/09

Mark S. Preddy, P.G.
Senior Hydrogeologist
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NORTH CAROLINA LICENSED SEAL 1475 GEOLOGIST ANDREW W. ALEXANDER
2/27/09

Daniel B. Bunnell /jas

Daniel B. Bunnell, P.E.
Principal Geotechnical Engineer
Registered, North Carolina #13814

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REPORT CROSS-REFERENCE INDEX OF APPLICABLE NORTH CAROLINA STATE REGULATIONS

15A NCAC 13B .1623 (b) Design Hydrogeologic Report Requirements

STATE REGULATIONS	LOCATION IN REPORT
(b) (1) (A)	Sections 3.5.2.1, 3.6.3; Table 3, 3B; Figures 5, 7; Appendices E, I
(b) (1) (B)	Section 3.5; Tables 3, 3B, 4, 5,7, 8, 9; Figures 4, 6, 7, 8; Appendices C, F, H
(b) (2) (A)	From 15A NCAC 13B .1623(a)
(a) (4) (A)	Sections 2.1, 3.4.1; Appendices A, B, C
(a) (4) (B)	Sections 2.3, 3.4.3; Tables 5, 6; Appendices G, H
(a) (4) (C)	Sections 3.4.1, 3.4.3; Tables 5, 6; Appendices B, C, H
(a) (4) (D)	Sections 3.4; Tables 5, 6; Appendices B, C
(a) (4) (E)	Sections 3.4.3, 3.5.5; Tables 4, 5, 8; Appendices F, H
(a) (5)	Sections 2.4, 3.4.2
(a) (6)	Figure 4
(a) (7) (A)	Table 3
(a) (7) (B)	Table 3; Appendix E
(a) (7) (C)	Section 3.5.2.2; Table 3, 3B; Figure 8; Appendix E
(a) (7) (D)	Sections 3.2, 3.5.2, 3.5.3, 3.5.4
(a) (8)	Sections 3.5.5, 3.5.6; Tables 7, 9; Figures 4, 6; Appendix F
(a) (9)	Figures 6, 7, 8
(a) (10)	Figure 3
(a) (11)	Appendices B, C
(a) (12)	Sections 3.3, 3.4.2; Appendix I
(b) (2) (B)	Sections 3.4, 3.5; Tables 3, 3B, 4, 7, 8, 9; Figures 4, 5, 6, 7, 8
(b) (2) (C)	Sections 3.0; Tables 3, 3B, 4, 7, 8, 9; Figures 4, 5, 6, 7, 8
(b) (2) (D)	Sections 2.1, 2.4, 3.4.1.3, 3.4.2; Figure 5; Appendices B, C
(b) (2) (E)	Figure 7
(b) (2) (F)	Figure 5
(b) (2) (G)	Figure 4
(b) (2) (H)	Section 3.5; Tables 3, 3B, 4, 7, 8, 9; Figures 4, 6, 7, 8
(b) (2) (I)	Section 2.2
(b) (3) (A)	Included in a separate document prepared by BLE
(b) (3) (B)	Included in a separate document prepared by BLE
(b) (3) (C)	Included in a separate document prepared by BLE

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1.0 PROJECT INFORMATION

The existing 286-acre White Oak Municipal Solid Waste (MSW) Landfill facility is located in Haywood County, North Carolina, approximately 12 miles north of Waynesville at the Fines Creek Exit (Exit 15) off of Interstate 40 (Figure 1). The landfill is owned and operated by Haywood County. Currently, Phase 1 and 2 areas have been developed. Haywood County now plans to develop the Phase 3 and 4 areas. The existing and proposed waste cell layout is provided on Figure 3.

The landfill development is being implemented in phases as new solid waste units are needed. This *Design Hydrogeologic Report* (DHR) addresses the geological and geotechnical investigation required for the construction permitting process. The investigation was performed in accordance with the applicable North Carolina Rules for Solid Waste Management (15A NCAC 13B .1623 (b)). Data from previously performed investigations are compiled into this report, as is relevant to the Phase 3 and 4 areas. The previous investigations include the following:

- *Project Design Manual, White Oak Sanitary Landfill*, Tribble & Richardson, Inc, dated March 1992.
- *Permit Renewal, Landfill Expansion, Design Hydrogeologic Report, White Oak Sanitary Landfill*, Steffen, Robertson, and Kirsten, Inc. Project Number 83507, dated September, 1997.
- *Permit Renewal, Landfill Expansion, Design Hydrogeologic Report (REV 1), White Oak Sanitary Landfill*, Steffen, Robertson, and Kirsten, Inc. Project Number 83507, dated July, 1998.
- *Site Hydrogeologic Report, White Oak Subtitle D Landfill*, Municipal Engineering Project Number G98010.5, dated February 8, 2000.

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2.0 FIELD INVESTIGATION

The field investigation of the Phase 3 and 4 areas was conducted during July 2007 through February 2008, and February 2009. Taken together, the investigation of the Phase 3 and 4 areas has included:

- performing soil test borings and rock coring;
- installing permanent groundwater monitoring wells and temporary piezometers;
- measuring water levels;
- performing hydraulic testing on piezometers;
- performing soil laboratory testing;
- performing settlement and slope stability evaluations; and
- evaluating location restrictions as outlined in the applicable solid waste regulations.

A discussion of the investigative methodologies used in the site evaluation is provided below. The field activities reported below were performed under the direction of a North Carolina-licensed geologist or engineer. A North Carolina-licensed driller performed the borings, piezometer installation, and monitoring well installation. The boring locations/piezometers were surveyed for horizontal and vertical control, by McGill Associates, Inc. of Asheville, North Carolina, after completion of the drilling activities.

2.1 TEST BORING AND SOIL SAMPLING

The North Carolina Department of Environment and Natural Resources (DENR) requires that Design Hydrogeologic Studies include the performance of one boring per acre in the area of investigation. The area of Phases 3 and 4 is approximately 19.9 acres. Including previous phases of work and this project, 26 borings have been performed in the Phase 3 and 4 areas, which include 24 piezometers/wells. Eight of the borings were pre-existing and 18 new borings were performed during this phase of work.

The new soil test boring locations and depths were selected to comply with the applicable NCDENR rules and were performed in general accordance with ASTM D 1586. Soil samples were obtained from the soil test borings at 2.5-foot intervals within the upper ten feet below the ground surface, and at five-foot intervals deeper than ten feet below the ground surface. Drilling techniques consisted of hollow-stem augering and rock coring. Refer to Appendix A for discussion of the various drilling techniques used.

Soil test boring logs were produced in the field by a geologist (Appendix B). The 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 on the final boring logs. The final boring log records are included in Appendix C.

2.2 GROUNDWATER INVESTIGATION

Nineteen piezometers were installed to monitor water table elevations and further characterize the study area hydrogeology. The piezometers supplement the five monitoring wells installed by others during previous phases of work in the Phase 3 and 4 areas. Piezometer installation records are included with the boring logs in Appendix C, and field installation procedures are described in Appendix D. Survey information for the piezometers and monitoring wells is presented on Table 1, and well/piezometer construction details are summarized on Table 2.

Groundwater elevations were measured in the new piezometers at the time of boring and after 24 hours. Measurements were taken in the piezometers and monitoring wells during the period from September 2007 to February 2008 to determine the seasonal groundwater trends. The historical water level data is included on Table 3 and 3B, which includes available water level information from the monitoring wells from June 1998 to April 2007. Historical precipitation data and groundwater levels for the Haywood County region are included in Appendix E.

Field permeability (slug) tests were performed in six piezometers in the study area to measure the *in situ* hydraulic conductivity of different units of the water table aquifer. Slug test field procedures and data plots are presented in Appendix F and a summary of the results are presented on Table 4.

The piezometers are intended only for investigation use, were not constructed as permanent monitoring wells, and will not be part of the permanent groundwater monitoring system. Prior to construction activities, the piezometers will be abandoned in accordance with 15A NCAC 2C, Rule .0113(a)(2) by drilling them out and filling the resulting boreholes with a grout mixture.

2.3 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, Shelby tubes (undisturbed), and from the auger cuttings (bulk samples). The laboratory tests were performed in general accordance with applicable ASTM specifications, where available. Brief descriptions of the test procedures are included in Appendix G. Soil laboratory testing results are included in Appendix H and are summarized on Tables 5 and 6, which include laboratory results from tests performed during this phase of work.

2.4 FRACTURE TRACE ANALYSIS

The fracture trace analysis consisted of evaluating exposed rock outcrops and topographic fracture traces and lineaments as discussed below. The data was included in the *Site Hydrogeologic Report,* {SHR} *White Oak Subtitle D Landfill*, Municipal Engineering Project Number G98010.5, dated February 8, 2000. The text of the SHR which describes the results of the analysis is included in Appendix J. We understand that Plate 3 (Stream Traces) and Plate 3B (Rose Diagram) referenced in the SHR have not been located by Haywood County and were not provided to BLE. A general description of the work performed for the SHR is provided below and in Section 3.4.2.

Exposed Rock Outcrops: Using a Brunton compass, the orientations of exposed bedrock fractures (open joints, open foliation, open bedding planes) were measured. The field measurements were plotted on a Schmidt lower hemisphere equal-area stereonet and Rose diagrams.

Topographic Fracture Traces and Lineaments: Regionally, pronounced depressions typically develop along zones of weakness in the bedrock where fractures induce preferential weathering.

This preferential weathering along the 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-mile radius of the site were measured from topographic maps and plotted as data on Rose diagrams.

2.5 FIELD RECONNAISSANCE

As described in the DHR text, the study area was traversed to map rock outcrops and surface drainage features. This investigation was conducted by Municipal Engineering in 2000 and/or others in prior years.

We understand from a NCSWS letter dated February 9, 2009, that an earthquake was reported near the site (approximately 2 miles northeast) in December 2008; approximately 6 months after the original DHR was submitted. On February 16, 2009, we mobilized a North Carolina Licensed Geologist from our staff to the site to conduct an on-site reconnaissance for evidence of faulting on the site. The geologist conducted the reconnaissance on foot and investigated the site within the Phase 3 and 4 areas and within 200 feet of the Phase boundaries. No evidence of seismically induced features (faults, sloughs, escarpments, etc,) were observed at that time.

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3.0 RESULTS OF INVESTIGATION

3.1 REGIONAL GEOLOGY

The subject site is located within the Blue Ridge Belt (Figure 2). The crystalline rocks of the Blue Ridge occur in generally northeast-southwest trending geologic belts in the Carolinas and Virginia. Precambrian-age (Proterozoic) basement complexes of metamorphosed igneous and sedimentary rocks underlie the region (Hadley and Goldsmith, 1963; Horton and Zullo, 1991). The site is underlain by the Middle to Late Proterozoic-aged Spring Creek Granitoid Gneiss, which are metamorphosed-igneous rocks. The multiple metamorphic deformations of the igneous rocks have resulted in biotite granitic gneiss interlayered with biotite granodiorite gneiss, tonalitic gneiss, quartz monzodiorite gneiss, amphibolite, biotite gneiss, and biotite schist (Carter and Weiner, 1999). Late Proterozoic-aged Great Smoky Group has been mapped southeast of the facility boundary, which are metamorphosed-sedimentary rocks. The multiple metamorphic deformations of the sedimentary rocks have resulted in metagraywache, with lesser amounts of locally interbedded kyanite-garnet-mica schist, garnet-mica schist, and calc-silicate granofels (Carter and Weiner, 1999). In the vicinity of the site, bedding and foliation generally strike northeast-southwest and dips moderately to the southeast. Structurally, the contact between the Spring Creek Granitoid Gneiss and the Great Smoky Graywacke is mapped as a thrust fault in which the Great Smokey formation overlies the Spring Creek formation (Carter and Weiner, 1999).

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 sandy silts and silty sands. Residual soil zones develop by the *in situ* chemical weathering of bedrock, and are commonly referred to as "saprolite." Saprolite usually consists of silt with lessor amounts of sand, clay, and large rock fragments. The thickness of the saprolite in the Piedmont 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. Often during construction, this material can be excavated using conventional earth moving equipment.

3.2 REGIONAL HYDROGEOLOGY

The uppermost groundwater in the Blue Ridge in the vicinity of the site usually occurs as unconfined, water table aquifers in three primary geologic zones: 1) residual soil; 2) partially weathered rock; and 3) fractured bedrock. These zones are typically interconnected through open fractures and pore spaces. The configuration of the water table generally resembles the local topography. The USGS Water-Resources Investigations Report 02-4105 *Preliminary Hydrogeologic Assessment and Study Plan for a Regional Ground-Water Resource Investigation of* *the Blue Ridge and Piedmont Provinces of North Carolina* (Daniel and Dahlen, 2002) maps the area of investigation in the *Gneiss, felsic* hydrogeologic unit which consists mainly of grantitic gneiss (Appendix K). This classification is in general consensus with our field observations.

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

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

3.3 STUDY AREA PHYSIOGRAPHY AND TOPOGRAPHY

The landfill is located in Haywood County, North Carolina, as shown in Figure 1. The Phase 3 and 4 areas are located to the north and west of existing Phases 1 and 2.

Topographically, the Phase 3 and 4 areas consist of a hill with radial topography in Phase 4, and a north-northeast trending drainage ravine in Phase 3. The upland portion of the hill in Phase 4 has been used as borrow soils for landfill activities is relatively flat. A portion of the drainage ravine in Phase 3 has been used as a temporary surface water sediment pond. The highest elevation in the proposed cell area is approximately 2620 feet above mean sea level (MSL) in the western portion of Phase 4, and the lowest elevation is approximately 2488 feet MSL in the northern portion of Phase 3 along the drainage ravine. The relief across Phases 3 and 4 is approximately 132 feet. Steep topography on the hillsides and side slopes of the ravines are common in Phases 3 and 4.

The surface drainage is radial around the upland portion of Phase 4 and converges towards the north-northeast trending ravine in Phase 3 and the northwest trending ravine south of Phase 4. An existing sedimentation pond which receives stormwater runoff from the Phase 2 perimeter access road is present east of the PZ-9 boring (southeast of the Phase 4 area). These drainage ravines ultimately converge with the Pigeon River at the facility's northern property boundary. A topographic map/site plan is provided as Figure 3.

3.4 STUDY AREA SUBSURFACE CONDITIONS

Twenty-six borings (twenty-three soil test borings and three auger borings) have been performed in the Phase 3 and 4 areas, and rock coring was performed at four of these locations. The geologic conditions encountered while drilling were often variable with boulders and seams of partially weathered rock occurring throughout the subsurface soil overburden profile. In general, three zones were encountered: 1) the residual soils from weathered gneiss, 2) the partially weathered rock, 3) the fractured gneiss bedrock. Subsurface geology at the site is shown on two cross sections designated A-A', and B-B' (Figure 4). The subsurface conditions encountered in the Phase 3 and 4 areas are generally consistent with previous evaluations at the site (Section 1.0). A description of the subsurface materials encountered is provided below.

3.4.1 Geologic Unit Description

3.4.1.1 Residual Soil

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

The upper soil component consists of brown and gray, sandy clayey silt and sandy silty clay and was encountered in four soil test borings in the Phase 3 and 4 areas. Where encountered, the thickness of this component varies, and generally ranging from 2.5 to 13.5 feet below ground surface, with an average thickness of 5.5 feet. USCS classifications of these soils are ML-CL, ML, and MH. Standard penetration resistance values (N-values) range from 4 to 19 with an average value of 10, indicating a stiff average consistency.

The upper soil component grades with depth into a coarser grained, less plastic, gray and brown micaceous, sandy silt and silty sand which extends to the depth of the partially weathered rock and/or auger refusal. Where encountered, the thickness of this component ranges from 3 to greater than 98 feet, with an average thickness of 49.3 feet. USCS classifications of these soils are ML and SM. N-values range from 3 to 91 with an average of 27, indicating a very firm average consistency.

Float rock (small boulders) was present in some locations at the ground surface and within the residual soil zone above the partially weathered rock level.

3.4.1.2 Partially Weathered Rock

The transition between soil and rock at the site is irregular and consists of partially weathered rock overlying the parent bedrock. Where encountered, this zone ranges in thickness from 0.5 to 12.5 feet in the Phase 3 and 4 areas.

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.

3.4.1.3 Fractured Bedrock

Bedrock coring has been performed at four different locations for a total of 76.4 feet in the area of investigation. These bedrock coring locations include BLE-7D, BLE-9, P-4, and MW-2D (Appendix C). The upper bedrock profile consists of well-foliated, moderately weathered to fresh, quartz-biotite-feldspar gneiss, which is part of the Spring Creek Granitoid Gneiss Formation. The bedrock core had generally "good" recovery (range of 42 to 100 percent; average of 88 percent) and "good" RQD (range of 25 to 100 percent; average of 76 percent). In general, the bedrock becomes more competent with depth.

3.4.2 Fracture Trace Analysis

A fracture trace analysis was performed and reported along with the data plots as part of *Site Hydrogeologic Report, White Oak Subtitle D Landfill*, Municipal Engineering Project Number G98010.5, dated February 8, 2000 (Appendix J). A summary of the fracture trace analysis is provided below.

The trend of topographic fracture traces and lineaments within one mile of the site were measured from the Cove Creek Gap and Fines Creek USGS topographic maps. Two primary trends were observed: N5°-25°W and N35°-45°W. Two secondary trends were observed: N5°-30°E and N75°-85°E.

The primary foliation trends are N5°-20°W and N9°-20°E. The primary joint trends are N20°-40°W and N10°-20°E.

Results of the fracture trace analysis indicate that from local lineament trends, and bedrock joint and foliation orientations that the prevailing fracture trends are northwest. The primary north-northeast lineament trend was observed in the bedrock foliation pattern. The primary northwest lineament trend was observed in the bedrock joint pattern.

3.4.3 Laboratory Testing Results

A list of the soil laboratory tests performed in the Phase 3 and 4 areas is provided in the table below. The laboratory test results are summarized in Tables 5 and 6. Laboratory data sheets are in Appendix H.

SAMPLE ANALYSES	SPLIT SPOON SAMPLES TESTED	SHELBY TUBE SAMPLES TESTED	REMOLDED BAG SAMPLES TESTED
Grain-Size Analysis	10	8	3
Natural Moisture Content	10	8	-
Atterberg Limits	10	8	3
Total Porosity	10	8	-
Effective Porosity	10	8	-
In Situ Saturated permeability*	-	8	-
Triaxial Shear	-	1	-
Consolidation	-	1	-
Standard Proctor	-	-	3
Remolded permeability	-	-	3

* Hydraulic Conductivity

Ten split-spoon samples, eight undisturbed Shelby Tube samples, and three bulk samples were collected and tested in the laboratory to measure natural soil conditions in the Phase 3 and 4 areas.

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

- Natural moisture content values ranging from 20.2 to 35.4 percent;
- with Liquid Limits (LL) values ranging from 52 to 59;
- Plasticity Index (PI) values ranging from 13 to 18;
- Average gravel, sand, silt, and clay contents of 0.1, 38.7, 44.6, and 16.6 percent, respectively;
- In-situ hydraulic conductivity values ranging from 1.1 x 10^{-5} to 2.6 x 10^{-4} cm/sec;
- Total porosity values ranging from 47.9 to 52.5 percent;
- Effective porosity values ranging from 3.5 to 21.0 percent;
- Standard Proctor results with optimum moisture contents of 23.8 and 25.7 percent and maximum dry densities (MDD) of 94.7 and 94.3 pcf; and
- Remolded hydraulic conductivity values of 4.8 x 10^{-7} and 8.8 x 10^{-8} cm/sec (at 7.2 and 5.4 percent wet of optimum and 95.1 and 95.0 percent of the MDD).

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

- Natural moisture content values ranging from 14.4 to 31.6 percent;
- LL values ranging from 34 to 55;
- PI values ranging from 4 to 13;
- Average gravel, sand, silt, and clay contents of 4.7, 54.8, 33.0, and 7.5 percent, respectively;
- In-situ hydraulic conductivity values ranging from 2.4 x 10^{-5} to 2.2 x 10^{-4} cm/sec;
- Total porosity values ranging from 39.4 to 52.5 percent;
- Effective porosity values ranging from 10.5 to 32.0 percent;
- Triaxial testing of an in-situ sample indicated total and effective cohesive strength (C) of 0.063 and 0.064 kips per square foot (ksf), respectively, and a total and effective Phi (ϕ) angle of 18.80 and 36.73 degrees, respectively;
- Consolidation testing of an in-situ sample indicated a preconsolidation pressure (P_p) of 8.06 ksf, a virgin slope (c_c) of 0.12, and a void ratio (e_o) of 0.760;
- A Standard Proctor result with an optimum moisture content of 22.4 percent and a MDD of 97.9 pcf; and
- A remolded hydraulic conductivity value of 2.9 x 10^{-7} (at 5.6 percent wet of optimum and 95.0 percent of the MDD).

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

- Natural moisture content values of 12.6 and 13.7 percent;
- LL values of 29 and 30;
- PI values of 3 to 8;
- Average gravel, sand, silt, and clay contents of 1.1, 64.8, 29.3, and 4.8 percent, respectively;
- Total porosity values of 49.0 and 49.5 percent; and
- Effective porosity values of 23.5 and 30.5 percent.

3.5 STUDY AREA HYDROGEOLOGY

Nineteen piezometers and five monitoring wells have been installed in, or close to, the Phase 3 and 4 areas. Groundwater is present above the bedrock surface in the lower elevation areas, but at or 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, although recharge rates, flow rates and storativity differ between the units based on the unique geologic conditions of each zone. The generalized configuration of the water table surface is a subdued replica of the ground surface. Generally, shallow groundwater flows to the north towards the Pigeon River. There is also a southwestward component of flow on the southern side of Phase 3. The hydrogeologic conditions encountered in the Phase 3 and 4 areas are generally consistent with the conditions encountered during previous phases of work at the landfill. A description of the hydrogeologic conditions in the study area is provided below.

3.5.1 Piezometer and Monitoring Wells

The piezometers and monitoring wells are set to intersect the groundwater in the deep residuum, partially weathered rock, or bedrock as indicated on Table 2. Piezometer and monitoring well installation diagrams are included in Appendix C and installation procedures are included in Appendix D.

3.5.2 Groundwater Elevations

3.5.2.1 Seasonal High Groundwater Elevations

Historical NOAA monthly precipitation data were obtained from Division 1, North Carolina. Haywood County is included in NOAA NC Division 1 and that data is routinely used as a representative measure for estimation of local precipitation and other atmospheric phenomenon. The data are summarized seasonally such that January-March represents *winter*, April-June represents *spring*, July-September represents *summer*, and October-December represents *fall* (Appendix E).

Historically in the Haywood County region, summer months will experience the most precipitation. However, the effects of evapotranspiration offset the contribution of this precipitation to recharge of the uppermost aquifer. Significant precipitation also occurs in the spring and winter months when evapotranspiration is limited. Because of these natural trends, the amount of groundwater recharge, and subsequent increase in water table level is typically greatest during winter and spring seasons.

Monthly water levels were collected from the piezometers and monitoring wells on site from September 2007 to February 2008 (DHR monitoring period). Those data are shown on Table 3. We have evaluated the historical groundwater elevation data shown on Table 3 for wells monitored prior to and during the DHR monitoring period to establish when seasonal high groundwater elevations may occur at the site. The majority of the data consists of April and October measurements with no other measurements collected during the year. With only two points per year there is not sufficient data to determine the time frame during which the average seasonal high occurs. However, the April groundwater elevations were higher than the October groundwater elevations.

To determine when seasonal high groundwater elevations occur in Haywood County, we downloaded groundwater level monitoring data from the North Carolina Division of Water Resources – Water Data Retrieval site (http://www.ncwater.org/wrisars/). There are four groundwater wells (M 90T1, M 90T2, M 90U1, M 90U2) in Haywood County which DWR personnel measured water levels from approximately June 1985 through December 1990. These wells are located approximately 12 miles east-southeast of the subject site. We have prepared time series plots for each well and have included them in Appendix E. The plots show that the average seasonal high groundwater elevations occur in (or near) April each year.

Since the DHR monitoring period at the subject site ended in February 2008, we have prepared Table 3B to project a seasonal high for April 2008. Table 3B calculates a difference between the highest April groundwater elevation (from either 2005, 2006, or 2007) and the measured 2007-2008 seasonal high for monitoring wells MW-5A, MW-5D, MW-12, MW-13S and MW-13D. These wells are within the Phase 3 area and have sufficient water level data history. An average head difference of 1.35 feet (range of 0.83 to 1.69 feet) was calculated for these wells. The 1.35 foot correction factor was added to the measured seasonal high (Table 3) to estimate a new projected seasonal high (April 2008) for each piezometer and well (Table 3B).

Post-settlement separation between bottom of clay liner and measured seasonal high groundwater (September 2007 through February 2008) were calculated by BLE and presented in Appendix I (Geotechnical Calculations). The post settlement liner-groundwater separations range from 6.95 feet at the P-6 location to 43.27 feet at the BLE-17 location. Since the projected seasonal high groundwater elevation has been increased 1.35 feet the resulting revised post-settlement separation from the water table to the bottom of the clay liner would range from 5.6 feet to 41.92 feet. The revised separations continue to exceed the 4 foot minimum specification in the regulations.

Figure 7 represents the projected seasonal high water table for April 2008 in each piezometer/well as shown on Table 3B.

3.5.2.2 Estimated Long-Term Seasonal High Groundwater Elevations

Groundwater levels were periodically recorded in piezometers and monitoring wells at the site between June 1998 and February 2008 (Table 3). On the average, the groundwater levels in the pre-existing monitoring wells and piezometer have typically varied on the average of 3.61 feet between the historical highest water level elevations and the 2007-2008 seasonal high levels (Table 3). Based on these water level trends, an estimated long-term seasonal high water table elevation contour map was prepared (Figure 8). This map is a composite water table contour map using: 1) the historical highest water level elevation in the pre-existing monitoring wells and piezometers; and 2) adding 3.61 feet to the maximum observed water level in each of the newly installed piezometer in the Phase 3 and 4 areas.

3.5.3 Groundwater Flow Direction

Groundwater at the site flows in a radial pattern around the upland areas, and has a configuration similar to topography. Flow beneath the Phase 3 and 4 areas is predominantly to the north towards the Pigeon River. There is also a southwestward component of flow on the southern side of Phase 3. Groundwater flow is through the soil matrix, the weathered fracture openings, and the bedrock fractures. Recharge to the unconfined aquifer occurs at the higher elevations. Groundwater discharge is to the northeastward trending drainage features on the northern side of Phases 3 and 4, and to the northwestward trending drainage feature located south of Phase 3.

3.5.4 Man-made Influences to Groundwater Levels

Man-made features that could influence groundwater levels at the site include existing and proposed lined waste cells, and existing and proposed sediment ponds.

Currently, Phases 1 and 2 have been constructed in the upland (recharge) area in the central portion of the site. As construction proceeds, groundwater infiltration and recharge of the water table aquifer will be limited, resulting in lower groundwater levels in the vicinity of the waste unit.

A previously constructed north-south trending stormwater control feature is present through the center of the Phase 3 area. The feature includes two retention basins separated by a small dam (roughly located between the BLE-3 and BLE-4 borings). The feature was dry during the design hydrogeologic investigation and did not appear to influence groundwater levels. The feature is partially filled with sediment which has appeared to accumulate from stormwater runoff. This feature will be removed upon construction of Phase 3 and will not influence groundwater levels. The small sediment basin southwest of Phase 4 was also dry at the time of the investigation and did not appear to influence groundwater levels.

One sediment basin and one leachate lagoon have been constructed north of Phase 1 and one small sediment basin has been constructed southwest of Phase 4. The small sediment basin southwest of Phase 4 will be abandoned and replaced with larger basin as shown on Figure 3. Four additional sediment basins are proposed to be constructed during the development of Phases 3 and 4 (two north and one northeast of Phases 3 and 4, and one southwest of Phase 4; Figure 3). It is our understanding that the leachate lagoon has a liner system, and the sediment ponds do not have liner systems. As a result, the groundwater table may be slightly mounded in the vicinity of the existing and proposed sediment ponds.

There are two buffered streams located between the proposed location of Phase 3 construction and the Pigeon River, which is the downgradient groundwater discharge area at the site.

3.5.5 Hydraulic Coefficients and Groundwater Flow Velocity

The velocity of groundwater flow is derived from the equation:

$$V = \frac{Ki}{n_e}$$

Where

V is the flow velocity
K is the hydraulic conductivity
i is the hydraulic gradient; and
n_e is the effective porosity.

Estimated values for these parameters are provided below and summarized on Tables 4, 5, and 8.

3.5.5.1 Hydraulic Conductivity

Hydraulic conductivity is defined as the ability of the aquifer material to conduct water under a hydraulic gradient. Six slug tests have been performed in the Phase 3 and 4 areas 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. The slug tests performed at the site include:

- Three tests performed in piezometers set in the deep residual soil;
- One test in a piezometer set in the partially weathered rock; and
- Two tests performed in piezometers set in the bedrock.

The water table was encountered below the upper residual soil; therefore, hydraulic conductivity in the unsaturated zone was determined by laboratory testing four undisturbed soil samples (Section 3.4.3 and Table 5). Based on the slug tests conducted in the Phase 3 and 4 areas, the range of hydraulic conductivity values is as follows:

- 1.1×10^{-5} cm/sec (BLE-11) to 4.7×10^{-4} cm/sec (BLE-3) in deep residuum;
- 2.6×10^{-5} cm/sec (BLE-14) in partially weathered rock; and
- 1.9×10^{-6} cm/sec (BLE-9) to 2.0×10^{-4} cm/sec (BLE-7D) in the bedrock.

3.5.5.2 Hydraulic Gradient

The hydraulic gradient is determined by dividing the difference in groundwater elevations at two locations by the horizontal distance between those locations along the direction of groundwater flow. Hydraulic gradients in the Phase 3 and 4 areas range from about 0.222 in the northern portion of proposed Phase 4, to about 0.0435 in the central portion of proposed Phase 3. The average hydraulic gradient across the study areas is 0.133 (Table 7).

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 soil divided by the total volume of the soil. Effective porosity can be assumed to be approximately equal to specific yield. Specific yield is defined as the ratio of the volume of water that drains from saturated sediment owing to the attraction of gravity to the total volume of sediment. The laboratory grain size analyses were used to derive values for specific yield and effective porosity (Fetter, 1994).

Based on grain size analyses (Tables 5 and 8), effective porosity measurements in the study area range from about:

- 3.5 to 21.0% (average = 15.3%) in the upper residuum;
- 10.5 to 32.0% (average = 23.4%) in the deep residuum;
- 23.5% to 30.5% (average = 27.0%) in the partially weathered rock;
- the effective porosity can be expected to range from about 5% to 10% for fractured crystalline bedrock (average = 7.5%) according to Kruseman and deRidder (1989).

3.5.5.4 Groundwater Flow Velocity

The velocity of groundwater movement (V) is a function of existing hydraulic gradient (i), the hydraulic conductivity (K), and the effective porosity (n_e), in the equation $V = Ki/n_e$ in the deep residuum, partially weathered rock, and bedrock. Based on these parameters and the data provided above, the horizontal movement of groundwater across Phase 3 and 4, summarized on Table 7, is approximately:

- 0.068 to 0.74 feet/day in the deep residual soil zone,
- 0.011 to 0.070 feet/day in the partially weathered rock zone, and
- 0.024 to 0.99 feet/day in the bedrock zone.

3.5.6 Vertical Flow Gradients

Vertical flow gradients were evaluated at four locations in the Phase 3 and 4 areas. Based on groundwater level measurements on February 14, 2008 from the piezometers and wells, the following vertical gradients were observed:

PIEZOMETER PAIR	LOCATION DESCRIPTION	RECHARGE GRADIENT	DISCHARGE GRADIENT
MW-5A/MW-5D	Located on the western flanks of the Phase 1 boundary and upgradient of the BLE-7S/BLE-7D well pair in Proposed Phase 3.	X	
BLE-7S/BLE-7D	Topographically low area along the northern boundary of Proposed Phase 3 (downgradient of MW-5A/MW-5D).		X

The vertical gradients observed at the site are typical for unconfined aquifers in this portion of the Blue Ridge. Groundwater recharge occurs in the upland areas in Phases 3 and 4. Discharge occurs to drainage feature in the central portion of Phase 3 and the drainage feature south of Phase 4, which both flow towards the Pigeon River north of the site. Vertical flow gradients are summarized on Table 9.

3.6 GEOTECHNICAL CONSIDERATIONS

An evaluation of the potential impact from faults, seismic zones and unstable areas, as required by 15A NCAC13B.1622 subsections (4), (5), and (6), was previously prepared by others for the current landfill site and documented as part of prior SHR and DHR projects (Section 1.0). These items were briefly reviewed to provide a background for our geotechnical evaluation. The results of our update to these items are provided below.

3.6.1 Fault Areas

No Holocene faults are documented in the *Geology of the Carolinas* (Horton and Zullo, 1991) which are located in or near the area of investigation. Faults of this age are only documented in the coastal regions of South Carolina. The USGS Map MF-916 *Young Faults in the United States as a Guide to Possible Fault Activity*, (Howard and Others, 1978) does not document the presence of faults with Holocene age displacement in the area of investigation.

Additionally, as documented in Section 2.5 of this report, no evidence of seismically induced features (faults, sloughs, escarpments, etc,) were observed on February 16, 2009 by our geologist either within the Phase 3 and 4 areas or within 200 feet of the Phase boundaries.

3.6.2 Seismic Impact Zones

According to the definition of seismic impact zones in 15A NCAC 13B.1622 (5), this site is in a seismic impact zone. The maximum horizontal acceleration expressed as a percentage of the earth's gravity (g) in rock is 0.176g with a 2% probability of being exceeded in 50 years (equal to 10% probability in 250 years; USGS, 2006). The design of the landfill considered the seismic condition. BLE has performed a seismic stability analysis for the design of Phases 3 and 4. The results of the analysis are provided in Appendix I and indicate the landfill is stable under both static and seismic conditions.

3.6.3 Unstable Areas

An unstable area according to 15A NCAC 13B.1622 (6) is defined as a location that is susceptible to natural or human induced events or forces capable of impairing the integrity of some or all of the landfill structural components responsible for preventing releases from a landfill. Unstable areas could include poor foundation conditions, areas susceptible to mass movements, and karst terrains. Site and subsurface data obtained was evaluated to determine if unstable site areas exist. The site is not in a karst area. No unstable conditions were present. BLE evaluated specific subgrade settlement and slope stability conditions for Phases 3 and 4. The analyses results are provided in Appendix I. The resulting settlements will be well within tolerable limits. Slope stability analysis indicates the planned subgrade, structural fill slopes, waste mound, and cap are stable.

3.6.4 Permeability of Potential On-Site Soils for Liner and Cover Construction

The permeability of selected potential on-site borrow soils were determined as indicated in Section 3.4.3 titled Laboratory Testing Results. Three bag samples of soil were collected (two of the upper residuum and one of the deeper residuum). The samples were compacted at varying percents of the Standard Proctor maximum dry density, and at varying moisture contents of the Standard Proctor optimum moisture content. Hydraulic conductivity values of the upper residuum were 4.8×10^{-7} and 8.8×10^{-8} cm/sec.

The near surface soils at the site consist of three general soil types based on topographic position. The near surface soils in the higher elevation areas, including the upper portions of the hill side-slopes, consist of reddish-brown silty clay and clayey silt. These soils generally transition to light brown clayey silt along the lower elevations of the hill side-slopes.

The red-brown silty clay and clayey silts along the higher portions of the site present the most favorable materials for use as compacted clay liner, soil liner, or closure cap soils. The plasticity of these soils fall generally well below the "A" line. The clayey soils are found immediately below the topsoil to depths of 2 to 4 feet in limited quantity. Soils that could be used as compacted soil liner can be found over a limited portion of the site. During site clearing and stripping activities, these soils should be carefully delineated and stockpiled for later use.

The *in situ* moistures of the silty clay will vary based on recent rainfall; however, they should be found at moisture contents within a few points of the standard Proctor optimum moisture content. Some modification of moisture will be required during soil liner or cap construction.

3.6.5 Excavation

Excavation of the residual soils can be accomplished using conventional earth moving equipment. Historical excavation of the site has typically employed track excavators, dozers, and trucks. Some excavation has been performed using tractor scrapers. An estimated bedrock elevation (auger refusal) contour map was developed as Figure 5 which is based on auger refusal depths in the soil borings drilled at this site. Materials sufficiently hard to cause refusal to the mechanical drill augers may result from continuous bedrock, boulders, lenses, ledges, or layers of relatively hard rock or residual soil. Coring was performed at four locations in the area of investigation where refusal to augering occurred (BLE-7D, BLE-9, P-4, and MW-2D). Continuous rock was found with varying recovery and Rock Quality Designation (RQD) as discussed above in Section 3.4.1.3. Due to its typically varying surface, the actual occurrence of hard rock during site grading may vary somewhat from that presented in Figure 5.

There is usually no sharp distinction between soil and rock in residual soil areas as at this site. Typically, the degree of weathering simply decreases with greater depth until solid rock is eventually reached. The partially weathered rock, as well as the soil above, may also contain boulders, lenses or ledges of hard rock. The mechanical auger used in this exploration could penetrate some of the partially weathered rock of the transitional zone. The ease of excavation will depend on the geologic structure of the material itself, such as the direction of bedding, planes or weakness and spacing between discontinuities. Weathered rock or rock that cannot be penetrated by the mechanical drill auger will likely require heavy excavating equipment with ripping tools or other methods for removal, if desired.

Significant volumes of soils are planned for excavation from the Phase 4 area for construction of the proposed waste units. We conclude that as the result of the soil removal, the groundwater elevations in the Phase 4 area will generally be lowered over time; however, groundwater flow directions should not significantly change.

3.6.6 Engineered Fill

The residual soils that will be excavated from the cell areas to achieve the design subgrade elevations are suitable for use as structural fill. Some moisture modification (wetting or drying) may be required depending on the particular area of excavation. The existing fill soils near BLE-3, which form an apparent existing storm water control feature and potential surface sediment deposits in the central lower areas in Phase No. 3, should be evaluated for reuse as fill at the time of excavation by the geotechnical engineer. Conventional compaction equipment and methods should be appropriate.

Fill used for raising site grades should be uniformly compacted to at least 95 percent of the standard Proctor maximum dry density (ASTM D 698). Prior to fill placement, the areas to receive structural fill should be stripped of topsoil and vegetation and proofrolled using a loaded dump truck or similar equipment. The proofrolling should be observed by the geotechnical/CQA engineer or his representative. Any areas which undergo rutting or excessive degradation should be excavated to firm soils.

Partially weathered rock may be mixed with the soil borrow materials provided it can be broken down by the excavation and compaction equipment into particles with a maximum dimension of 6 inches. Larger boulders or rock pieces may be used in the lower portions of the deeper fills if the boulders are placed individually and soil compacted around and over each boulder. Sufficient quantities of soil should be mixed with the partially weathered rock so that voids do not result between the pieces of partially weathered rock and the fill meets the compaction requirements.

Before filling operations begin, representative samples of each proposed fill materials should be collected and tested to determine the compaction and classification characteristics. The maximum dry density and optimum moisture content should be determined. Once compaction begins, a sufficient number of density tests should be performed to measure the degree of compaction being obtained.

Earthwork cut or fill slopes can be constructed as steep as 2H:1V (horizontal:vertical). Structural fill slopes at the 2H:1V inclination should initially be constructed at two to three feet beyond the design slope due to difficulty of compacting the edge of slopes, then trimmed to final grade leaving the exposed face well compacted. Slopes of 3H:1V or flatter, can be compacted in place without overfilling. Cut and fill slope surfaces outside the cell area should be protected from erosion by grassing or other means. Where the cell embankment is to be constructed on natural slopes steeper than 4H:1V, we recommend that the fill soils be keyed into the slopes using horizontal benches (stair-step fashion) to facilitate placement and compaction of structural fill and to prevent formation of a potential slip surface.

The surface of compacted subgrade soils can deteriorate and lose its support capabilities when exposed to environmental changes and construction activity. Deterioration can occur in the form of freezing, formation of erosion gullies, extreme drying, exposure for a long period of time, or rutting by construction traffic. We recommend that if the fill soils within the cell become deteriorated or softened, they be proofrolled, scarified and recompacted (and additional fill placed, if necessary) prior to construction of the compacted soil liner. Additionally, any excavations through the cell embankments (such as leachate collection line trenches) should be properly backfilled in compacted lifts. Recompaction of subgrade surfaces and compaction of backfill should be checked with a sufficient number of density tests to determine if adequate compaction is being achieved.

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4.0 CONCLUSIONS

The proposed Phase 3 cell location is along a northeast trending drainage feature west of existing Phase 1. The proposed Phase 4 cell location is on a hill west of proposed Phase 3. The Phase 3 and 4 areas' subsurface geology and hydrogeology are typical of Blue Ridge terrain in this vicinity of North Carolina with deeply weathered biotite gneiss. No unusual or unexpected geologic features were observed in the Phase 3 and 4 areas.

Groundwater flow beneath the Phase 3 and 4 areas is predominantly to the north towards the Pigeon River. There is also a southwestward component of flow on the southern side of Phase 4. Groundwater flow is through the soil matrix, the weathered fracture openings, and the bedrock fractures. Recharge to the unconfined aquifer occurs at the higher elevations. Groundwater discharge is to the northeastward trending drainage features on the northern side of Phases 3 and 4, and to the northwestward trending drainage feature located south of Phase 3. Other than these natural features, there are no groundwater receptors to this landfill phase.

The site is favorable for landfill development considering geotechnical aspects. The site is in a seismic impact zone, but the landfill structural components have been designed, using conventional construction, to resist the seismic magnitude. The existing residuum and the planned structural fill will form a stable foundation for the landfill. Anticipated subgrade total and differential settlements of the completed waste cells are expected to be well within acceptable limits of the structural components and leachate collection system of a MSW landfill. The on-site residual soils are suitable for use as structural fill. The residual soils and the planned new engineered fill will form stable slopes and provide acceptable interface friction with the base and cap liner systems. The planned structural fill and waste mound slopes will be stable under static and seismic conditions. Low permeability surficial soils that could be used to construct a base clay liner ($K \leq 1.0 \times 10^{-7}$ cm/sec) or final cover cap ($K \leq 1.0 \times 10^{-5}$ cm/sec) are present on site in limited quantities. Careful selection and use of these clayey soils will be required during waste cell development.

This Design Hydrogeologic Report was prepared to satisfy the requirements specified in the North Carolina Title 15A NCAC 13B .1623 (b). Based on the results of field and laboratory testing, it is our opinion that the study area is geologically, hydrogeologically, and geotechnically suitable for municipal solid waste landfill cell development. This Design Hydrogeologic Report, while specifically addressing Phases 3 and 4, also considers the potential expanded landfill footprint and grades shown in the Facility Plan.

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5.0 ANNOTATED BIBLIOGRAPHY

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TABLES

TABLE 1

MONITORING WELL, PIEZOMETER, AND BORING SURVEY INFORMATION

White Oak MSW Landfill - Phase 3 & 4 DHR
Haywood County, North Carolina
BLE Project Number J07-1957-02

Well/ Piezometer	Ground Elevation	TOC Elevation	Northing	Easting	Status of Well/Piezometer
BLE-1	**2574.23**	**2577.77**	**720937.6102**	**811220.4171**	**Present**
BLE-2	**2525.68**	**2529.57**	**721195.5520**	**811425.0105**	**Present**
BLE-3	**2519.77**	**2523.43**	**721364.1500**	**811475.5286**	**Present**
BLE-4 (boring)	**2560.09**	**NA**	**721347.2616**	**811709.1865**	**Abandoned**
BLE-5	**2497.10**	**2500.99**	**721592.0538**	**811514.7738**	**Present**
BLE-6	**2532.96**	**2536.67**	**721667.9455**	**811741.4725**	**Present**
BLE-7S	**2492.12**	**2495.30**	**721759.8035**	**811585.9715**	**Present**
BLE-7D	**2491.92**	**2495.70**	**721766.2970**	**811589.4921**	**Present**
BLE-8 (boring)	**2473.09**	**NA**	**721934.7910**	**811656.4570**	**Abandoned**
BLE-9	**2552.54**	**2556.63**	**721775.5467**	**811375.3773**	**Present**
BLE-10	**2612.97**	**2615.73**	**721574.7601**	**810881.4408**	**Present**
BLE-11	**2630.61**	**2634.27**	**721450.3759**	**810649.4778**	**Present**
BLE-12	**2620.95**	**2624.50**	**721285.4999**	**810817.1273**	**Present**
BLE-13	**2609.39**	**2612.66**	**721419.1687**	**811109.9420**	**Present**
BLE-14	**2610.41**	**2613.65**	**721222.6091**	**811099.9933**	**Present**
BLE-15	**2584.11**	**2587.90**	**720930.9031**	**811053.8980**	**Present**
BLE-16	**2614.70**	**2618.50**	**721398.3928**	**810908.9271**	**Present**
BLE-17	**2611.46**	**2615.91**	**721159.4128**	**810931.6189**	**Present**
MW-1A	2517.97	2520.02	721096.3047	812481.4745	Present
MW-2	2494.43	2496.71	721460.7647	812309.4391	Present
MW-2D	2494.69	2496.89	721456.0050	812311.8744	Present
MW-3	2435.06	2437.28	721947.2608	812058.3839	Present
MW-3D	2434.17	2436.94	721956.0474	812071.8689	Present
MW-4A	2496.19	2498.54	721692.8083	811976.7333	Present
MW-5A	**2502.29**	**2503.58**	**721496.6325**	**811628.8222**	**Present**
MW-5D	**2502.18**	**2502.90**	**721503.8890**	**811631.0644**	**Present**
MW-8	2474.84	2477.33	721704.5021	812155.0344	Present
MW-9	UK	2430.15	UK	UK	Present
MW-11S	UK	2674.58	719905.8752	811642.8913	Present
MW-11D	2672.01	2674.89	719909.3380	811651.5544	Present
MW-12	**2526.93**	**2529.63**	**721082.9594**	**811524.1854**	**Present**
MW-13S	**2529.67**	**2532.20**	**721079.1672**	**811454.9494**	**Present**
MW-13D	**2528.11**	**2530.86**	**721088.3729**	**811454.4229**	**Present**
MW-14	UK	2711.69	UK	UK	Present
MW-15	UK	2547.41	UK	UK	Present
P-4	**2571.25**	**2573.14**	**721895.9954**	**811433.5246**	**Present**
P-5	**2485.02**	**2487.78**	**721882.4117**	**811171.8164**	**Present**
P-6	**2594.13**	**2597.74**	**721486.7978**	**811249.7675**	**Present**

Notes:

1. **Bold** borings represent those in the Phase 3 and 4 Cell area.
2. Measurements are in feet; elevations are relative to mean sea level.
3. TOC = *Top Of Casing*
4. NA = *Not Applicable*
5. UK = *Unknown*
6. Surveying was performed by McGill Associates.
7. Source of elevation data for MW-9, MW-14 and MW-15 cannot be confirmed.

Prepared By: IAI
Checked By: AWA

TABLE 2

MONITORING WELL AND PIEZOMETER CONSTRUCTION DETAILS

White Oak MSW Landfill - Phase 3 & 4 DHR
Haywood County, North Carolina
BLE Project Number J07-1957-02

Well/ Piezometer	Ground Elev.	TOC Elev.	Auger Refusal Depth	Auger Refusal Elev.	Bedrock Drilling Depth	Screened Interval Depth	Screened Interval Elevation	Zone Screened	Status of Well/Piezometer
BLE-1	2574.23	2577.77	66.0	2508.2	NA	55.0 - 65.0	2519.2 - 2509.2	Deep Residuum/PWR	Present
BLE-2	2525.68	2529.57	>40.0	<2485.7	NA	29.0 - 39.0	2496.7 - 2486.7	Deep Residuum	Present
BLE-3	2519.77	2523.43	>50.0	<2469.8	NA	38.0 - 48.0	2481.8 - 2471.8	Deep Residuum	Present
BLE-4 (boring)	2560.09	NA	2.5	2557.6	NA	NA	NA	-	Abandoned
BLE-5	2497.10	2500.99	26.0	2471.1	NA	15.0 - 25.0	2482.1 - 2472.1	Deep Residuum/PWR	Present
BLE-6	2532.96	2536.67	46.0	2487.0	NA	36.0 - 46.0	2497.0 - 2487.0	Deep Residuum	Present
BLE-7S	2492.12	2495.30	26.0	2466.1	NA	15.1 - 25.1	2477.1 - 2467.1	Deep Residuum	Present
BLE-7D	2491.92	2495.70	32.0	2459.9	32.0 - 60.0	49.6 - 59.6	2442.3 - 2432.3	Bedrock	Present
BLE-8 (boring)	2473.09	NA	3.0	2470.1	NA	NA	NA	-	Abandoned
BLE-9	2552.54	2556.63	25.0	2527.5	25.0 - 49.0	37.7 - 47.7	2514.8 - 2504.8	Bedrock	Present
BLE-10	2612.97	2615.73	>78.9	<2534.1	NA	68.7 - 78.7	2544.3 - 2534.3	Deep Residuum	Present
BLE-11	2630.61	2634.27	>103.0	<2527.6	NA	92.6 - 102.6	2538.0 - 2528.0	Deep Residuum	Present
BLE-12	2620.95	2624.50	>90.2	<2530.8	NA	80.0 - 90.0	2541.0 - 2531.0	Deep Residuum	Present
BLE-13	2609.39	2612.66	86.0	2523.4	NA	71.4 - 81.4	2538.0 - 2528.0	PWR	Present
BLE-14	2610.41	2613.65	73.5	2536.9	NA	63.0 - 73.0	2547.4 - 2537.4	Deep Residuum/PWR	Present
BLE-15	2584.11	2587.90	>75.0	<2509.1	NA	64.1 - 74.1	2520.0 - 2510.0	Deep Residuum/PWR	Present
BLE-16	2614.70	2618.50	>80.0	<2534.7	NA	68.2 - 78.2	2546.5 - 2536.5	Deep Residuum	Present
BLE-17	2611.46	2615.91	101.0	2510.5	NA	89.7 - 99.7	2521.8 - 2511.8	Deep/PWR	Present
MW-1A	2517.97	2520.02	26.0	2492.0	NA	10.4 - 25.4	2507.6 - 2492.6	Deep Residuum	Present
MW-2	2494.43	2496.71	35.5	2458.9	NA	19.9 - 34.9	2474.5 - 2459.5	Deep Residuum/PWR	Present
MW-2D	2494.69	2496.89	36.9	2457.8	36.9 - 55.1	44.6 - 54.6	2450.1 - 2440.1	Bedrock	Present
MW-3	2435.06	2437.28	21.2	2413.9	NA	5.6 - 20.6	2429.5 - 2414.5	Deep Residuum	Present
MW-3D	2434.17	2436.94	21.4	2412.8	21.4 - 37.0	26.5 - 36.5	2407.7 - 2397.7	Bedrock	Present
MW-4A	2496.19	2498.54	27.9	2468.3	27.9 - 100.3	85.2 - 100.2	2411.0 - 2396.0	Bedrock	Present
MW-5A	2502.29	2503.58	20.1	2482.2	NA	4.5 - 19.5	2497.8 - 2482.8	Deep Residuum	Present
MW-5D	2502.18	2502.90	20.0	2482.2	20.0 - 36.2	25.7 - 35.7	2476.5 - 2466.5	Bedrock	Present
MW-8	2474.84	2477.33	>42.8	<2432.0	NA	31.0 - 41.0	2443.8 - 2433.8	Deep Residuum	Present
MW-9	UK	2430.15	11	UK	UK	4.5 - 9.5	UK	Fill	Present
MW-11S	UK	2674.58	UK	UK	UK	UK	UK	UK	Present
MW-11D	2672.01	2674.89	97.0	2575.0	97.0 - 128.0	118.0 - 127.6	2554.0 - 2544.4	Bedrock	Present
MW-12	2526.93	2529.63	UK	UK	UK	UK	UK	UK	Present
MW-13S	2529.67	2532.20	UK	UK	UK	UK	UK	UK	Present
MW-13D	2528.11	2530.86	UK	UK	UK	UK	UK	UK	Present
MW-14	UK	2711.69	UK	UK	UK	UK	UK	UK	Present
MW-15	UK	2547.41	UK	UK	UK	UK	UK	UK	Present
P-4	2571.25	2573.14	59.0	2512.3	59.0 - 81.0	71.0 - 81.0	2500.3 - 2490.3	Bedrock	Present
P-5	2485.02	2487.78	20.0	2465.0	20.0 - 52.3	42.3 - 52.3	2442.7 - 2432.7	Bedrock	Present
P-6	2594.13	2597.74	58.0	2536.1	58.0 - 67.5	57.5 - 67.5	2536.6 - 2526.6	Bedrock	Present

Notes:

1. **Bold** borings represent those in the Phase 3 and 4 Cell area.
2. Measurements are in feet; elevations are relative to mean sea level.
3. TOC = *Top Of Casing*
4. NA = *Not Available*
5. UK = *Unknown*
6. PWR = *Partially Weathered Rock*
7. Surveying was performed by McGill Associates.
8. Source of elevation data for MW-9, MW-14 and MW-15 cannot be confirmed.

GROUNDWATER DEPTH ELEVATION MEASUREMENTS

White Oak MSW Landfill - Phase 3 & 4 DHR
Haywood County, North Carolina
BLE Project Number J07-1957-02

WELL	GROUND ELEV.	TOC ELEV.	TOB	24-Hr	1998 6/9/98	1998 7/7/98	1998 8/17/98	1998 9/25/98	1998 10/27/98	2004 10/21/04	2005 4/18/05	2005 10/13/05	2006 4/25/06	2006 10/20/06	2007 4/26/07	2007 9/20/07	2007 10/25/07	2007 11/30/07	2007 12/14/07	2008 1/16/08	2008 2/14/08	Sept '07 to Feb '08 Seasonal High Elev.	Data from 1998 to 2008 Maximum Elev.	Data from 1998 to 2008 Minimum Elev.	Data from 1998 to 2008 Difference Feet	Estimated Long-Term Seasonal High AVG Difference Feet	Estimated Long-Term Seasonal High LTSHWT Feet	Estimated Long-Term Seasonal High Data Source
			GROUNDWATER ELEVATION MEASUREMENTS																									
BLE-1	2574.23	2577.77	2526.23	2531.73	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	**2531.12**	2530.75	2530.36	2530.22	2529.85	2529.64	2531.12	2531.12	2529.64	1.48	-	2534.73	Calculation
BLE-2	2525.68	2529.57	2508.58	2513.23	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2512.97	2513.07	2513.04	2513.10	2513.42	**2513.76**	2513.76	2513.76	2512.97	0.79	-	2517.37	Calculation
BLE-3	2519.77	2523.43	2500.27	2501.33	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2500.95	2501.17	2501.25	2501.34	2501.58	**2501.87**	2501.87	2501.87	2500.95	0.92	-	2505.48	Calculation
BLE-5	2497.10	2500.99	2485.80	2492.50	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2491.98	2492.64	2492.48	2492.81	2493.11	**2493.33**	2493.33	2493.33	2491.98	1.35	-	2496.94	Calculation
BLE-6	2532.96	2536.67	2488.31	2488.25	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2488.24	2488.16	2488.47	2488.54	2488.77	**2488.93**	2488.93	2488.93	2488.16	0.77	-	2492.54	Calculation
BLE-7S	2492.12	2495.30	2481.82	2484.32	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2483.72	2483.31	2483.76	2483.99	2484.69	**2484.83**	2484.83	2484.83	2483.31	1.52	-	2488.44	Calculation
BLE-7D	2491.92	2495.70	2483.62	2483.52	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2484.41	2484.73	2484.47	2484.65	2485.05	**2485.24**	2485.24	2485.24	2484.41	0.83	-	2488.85	Calculation
BLE-9	2552.54	2556.63	2509.84	2509.54	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	**2509.28**	2506.28	2505.73	2505.60	2505.39	2505.11	2509.28	2509.28	2505.11	4.17	-	2512.89	Calculation
BLE-10	2612.97	2615.73	2551.47	NM	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	**2551.22**	2551.03	2550.45	2544.28	2543.80	2543.41	2551.22	2551.22	2543.41	7.81	-	2554.83	Calculation
BLE-11	2630.61	2634.27	2540.91	2546.01	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	**2540.95**	2540.75	2540.17	2540.12	2539.57	2539.21	2540.95	2540.95	2539.21	1.74	-	2544.56	Calculation
BLE-12	2620.95	2624.50	2545.05	2545.05	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	**2545.19**	2544.94	2544.35	2544.27	2543.73	2543.30	2545.19	2545.19	2543.30	1.89	-	2548.80	Calculation
BLE-13	2609.39	2612.66	2540.39	2541.89	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	**2542.44**	2542.40	2542.07	2541.98	2541.60	2541.19	2542.44	2542.44	2541.19	1.25	-	2546.05	Calculation
BLE-14	2610.41	2613.65	2551.31	2551.21	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	**2551.21**	2551.10	2550.60	2550.49	2549.97	2549.46	2551.21	2551.21	2549.46	1.75	-	2554.82	Calculation
BLE-15	2584.11	2587.90	2526.36	2527.01	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	**2527.18**	2526.87	2526.49	2526.43	2526.24	2526.53	2527.18	2527.18	2526.24	0.94	-	2530.79	Calculation
BLE-16	2614.70	2618.50	2546.20	2552.49	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	**2555.63**	2555.25	2554.55	2554.42	2553.80	2553.34	2555.63	2555.63	2553.34	2.29	-	2559.24	Calculation
BLE-17	2611.46	2615.91	2523.86	2538.05	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2521.72	**2537.59**	2537.00	2536.94	2536.32	2535.88	2537.59	2537.59	2521.72	15.87	-	2541.20	Calculation
MW-1A	2517.97	2520.02	UK	UK	**2503.77**	2503.33	2502.69	2502.39	2502.14	2502.30	2502.97	2501.58	2502.47	2500.81	2500.65	2496.12	2495.46	2495.06	2494.94	2495.33	2496.07	2496.12	2503.77	2494.94	8.83	7.65	2503.77	Max 6/98-2/08
MW-2	2494.43	2496.71	UK	UK	2467.35	2466.91	2466.14	2465.61	2465.53	2466.65	**2467.78**	2466.00	2467.47	2465.84	2466.68	2465.36	2465.26	2465.15	2465.20	2465.44	2466.10	2466.10	2467.78	2465.15	2.63	1.68	2467.78	Max 6/98-2/08
MW-2D	2494.69	2496.89	UK	UK	NM	NM	NM	NM	NM	2466.89	**2468.06**	2466.26	2467.71	2466.03	2466.89	2465.55	2465.39	2465.35	2465.34	2465.64	2466.25	2466.25	2468.06	2465.34	2.72	1.81	2468.06	Max 6/98-2/08
MW-3	2435.06	2437.28	UK	UK	2429.72	2429.20	2428.03	2426.93	2426.51	2428.99	2430.58	2428.38	**2430.60**	2428.07	2428.93	2427.02	2426.70	2426.39	2426.51	2427.17	2428.01	2428.01	2430.60	2426.39	4.21	2.59	2430.60	Max 6/98-2/08
MW-3D	2434.17	2436.94	UK	UK	NM	NM	NM	NM	NM	2420.62	**2421.37**	2420.13	2421.17	2420.23	2420.24	2419.58	2419.45	2419.30	2419.31	2419.57	2419.89	2419.89	2421.37	2419.30	2.07	1.48	2421.37	Max 6/98-2/08
MW-4A	2496.19	2498.54	UK	UK	2459.44	**2463.46**	2462.80	2456.35	2460.26	2451.96	2451.41	2450.77	2448.97	2447.77	2447.46	2448.14	2448.14	2448.27	2448.19	2448.07	2448.08	2448.27	2463.46	2447.46	16.00	15.19	2463.46	Max 6/98-2/08
MW-5A	2502.29	2503.58	UK	UK	2497.22	2496.56	2496.28	2495.95	2495.88	2497.43	2498.48	2497.49	**2499.28**	NM	2498.08	2496.80	2497.12	2497.06	2497.14	2497.34	2497.59	2497.59	2499.28	2495.88	3.40	1.69	2499.28	Max 6/98-2/08
MW-5D	2502.18	2502.90	UK	UK	2496.24	2495.85	2495.69	2495.52	2495.50	2496.25	2496.92	2496.30	**2497.58**	NM	2496.72	2495.82	2496.14	2496.31	2496.38	2496.55	2496.75	2496.75	2497.58	2495.50	2.08	0.83	2497.58	Max 6/98-2/08
MW-8	2474.84	2477.33	UK	UK	NM	NM	NM	NM	NM	2446.80	**2447.63**	2446.30	2447.37	2445.96	2446.59	2445.30	2445.00	2444.77	2444.79	2445.05	2445.63	2445.63	2447.63	2444.77	2.86	2.00	2447.63	Max 6/98-2/08
MW-9	UK	2430.15	UK	UK	NM	NM	NM	NM	NM	2420.90	2421.02	2420.83	2420.99	**2421.09**	2420.87	NM	NM	NM	NM	NM	NM	-	2421.09	2420.83	0.26	-	2421.09	Max 6/98-2/08
MW-11S	UK	2674.58	UK	UK	NM	NM	NM	NM	NM	2590.86	2592.08	2593.90	2594.94	**2595.11**	2593.96	NM	NM	NM	NM	NM	NM	-	2595.11	2590.86	4.25	-	2595.11	Max 6/98-2/08
MW-11D	2672.01	2674.89	UK	UK	NM	NM	NM	NM	NM	2590.52	2591.74	2593.52	2594.30	**2594.57**	2593.35	NM	NM	NM	NM	NM	NM	-	2594.57	2590.52	4.05	-	2594.57	Max 6/98-2/08
MW-12	2526.93	2529.63	UK	UK	NM	NM	NM	NM	NM	2517.33	2518.09	2517.43	**2518.63**	2517.51	2517.73	2517.03	2516.86	2516.89	2516.93	2517.20	2517.40	2517.40	2518.63	2516.86	1.77	1.23	2518.63	Max 6/98-2/08
MW-13S	2529.67	2532.20	UK	UK	NM	NM	NM	NM	NM	2519.53	2520.35	2519.88	**2520.50**	2519.41	2519.82	2518.68	2518.44	2518.36	2518.34	2518.57	2518.84	2518.84	2520.50	2518.34	2.16	1.66	2520.50	Max 6/98-2/08
MW-13D	2528.11	2530.86	UK	UK	NM	NM	NM	NM	NM	2518.22	2519.03	2518.55	**2519.10**	2518.23	2518.50	2517.64	2517.46	2517.34	2517.29	2517.53	2517.76	2517.76	2519.10	2517.29	1.81	1.34	2519.10	Max 6/98-2/08
MW-14	UK	2711.69	UK	UK	NM	NM	NM	NM	NM	2612.36	2613.19	**2613.51**	2612.41	2611.74	2610.50	NM	NM	NM	NM	NM	NM	-	2613.51	2610.50	3.01	-	2613.51	Max 6/98-2/08
MW-15	UK	2547.41	UK	UK	NM	NM	NM	NM	NM	2538.49	2538.70	2538.39	**2538.71**	2538.33	2538.33	NM	NM	NM	NM	NM	NM	-	2538.71	2538.33	0.38	-	2538.71	Max 6/98-2/08
P-4	2571.25	2573.14	UK	UK	2503.85	2504.56	2504.34	**2504.73**	2503.73	NM	NM	NM	NM	NM	NM	2496.95	2496.69	2496.44	2496.33	2496.06	2495.85	2496.95	2504.73	2495.85	8.88	7.78	2504.73	Max 6/98-2/08
P-5	2485.02	2487.78	UK	UK	**2462.73**	2461.36	2460.35	2459.62	2459.15	NM	NM	NM	NM	NM	NM	2456.34	2455.93	2455.73	2455.67	2456.55	2458.26	2458.26	2462.73	2455.67	7.06	4.47	2462.73	Max 6/98-2/08
P-6	2594.13	2597.74	UK	UK	2538.68	**2538.83**	2538.71	2538.57	2538.23	NM	NM	NM	NM	NM	NM	2536.05	2535.87	2535.59	2535.50	2535.27	2535.05	2536.05	2538.83	2535.05	3.78	2.78	2538.83	Max 6/98-2/08
																									AVG (Avg Diff)	3.61		

WELL	GROUND ELEV.	TOC ELEV.	TOB	24-Hr	1998 6/9/98	1998 7/7/98	1998 8/17/98	1998 9/25/98	1998 10/27/98	2004 10/21/04	2005 4/18/05	2005 10/13/05	2006 4/25/06	2006 10/20/06	2007 4/26/07	2007 9/20/07	2007 10/25/07	2007 11/30/07	2007 12/14/07	2008 1/16/08	2008 2/14/08
			DEPTH TO WATER BELOW GROUND SURFACE																		
BLE-1	2574.23	2577.77	48.00	42.50	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	43.11	43.48	43.87	44.01	44.38	44.59
BLE-2	2525.68	2529.57	17.10	12.45	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	12.71	12.61	12.64	12.58	12.26	11.92
BLE-3	2519.77	2523.43	19.50	18.44	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	18.82	18.60	18.52	18.43	18.19	17.90
BLE-5	2497.10	2500.99	11.30	4.60	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	5.12	4.46	4.62	4.29	3.99	3.77
BLE-6	2532.96	2536.67	44.65	44.71	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	44.72	44.80	44.49	44.42	44.19	44.03
BLE-7S	2492.12	2495.30	10.30	7.80	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	8.40	8.81	8.36	8.13	7.43	7.29
BLE-7D	2491.92	2495.70	8.30	8.40	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	7.51	7.19	7.45	7.27	6.87	6.68
BLE-9	2552.54	2556.63	42.70	43.00	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	43.26	46.26	46.81	46.94	47.15	47.43
BLE-10	2612.97	2615.73	61.50	NM	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	61.75	61.94	62.52	68.69	69.17	69.56
BLE-11	2630.61	2634.27	89.70	84.60	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	89.66	89.86	90.44	90.49	91.04	91.40
BLE-12	2620.95	2624.50	75.90	75.90	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	75.76	76.01	76.60	76.68	77.22	77.65
BLE-13	2609.39	2612.66	69.00	67.50	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	66.95	66.99	67.32	67.41	67.79	68.20
BLE-14	2610.41	2613.65	59.10	59.20	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	59.20	59.31	59.81	59.92	60.44	60.95
BLE-15	2584.11	2587.90	57.75	57.10	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	56.93	57.24	57.62	57.68	57.87	57.58
BLE-16	2614.70	2618.50	68.50	62.21	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	59.07	59.45	60.15	60.28	60.90	61.36
BLE-17	2611.46	2615.91	87.60	73.41	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	89.74	73.87	74.46	74.52	75.14	75.58
MW-1A	2517.97	2520.02	UK	UK	14.20	14.64	15.28	15.58	15.83	15.67	15.00	16.39	15.50	17.16	17.32	21.85	22.51	22.91	23.03	22.64	21.90
MW-2	2494.43	2496.71	UK	UK	27.08	27.52	28.29	28.82	28.90	27.78	26.65	28.43	26.96	28.59	27.75	29.07	29.17	29.28	29.23	28.99	28.33
MW-2D	2494.69	2496.89	UK	UK	NM	NM	NM	NM	NM	27.80	26.63	28.43	26.98	28.66	27.80	29.14	29.30	29.34	29.35	29.05	28.44
MW-3	2435.06	2437.28	UK	UK	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW-3D	2434.17	2436.94	UK	UK	NM	NM	NM	NM	NM	13.55	12.80	14.04	13.00	13.94	13.93	14.59	14.72	14.87	14.86	14.60	14.28
MW-4A	2496.19	2498.54	UK	UK	36.75	32.73	33.39	39.84	35.93	44.23	44.78	45.42	47.22	48.42	48.73	48.05	48.05	47.92	48.00	48.12	48.11
MW-5A	2502.29	2503.58	UK	UK	5.07	5.73	6.01	6.34	6.41	4.86	3.81	4.80	3.01	NM	4.21	5.49	5.17	5.23	5.15	4.95	4.70
MW-5D	2502.18	2502.90	UK	UK	5.94	6.33	6.49	6.66	6.68	5.93	5.26	5.88	4.60	NM	5.46	6.36	6.04	5.87	5.80	5.63	5.43
MW-8	2474.84	2477.33	UK	UK	NM	NM	NM	NM	NM	28.04	27.21	28.54	27.47	28.88	28.25	29.54	29.84	30.07	30.05	29.79	29.21
MW-9	UK	2430.15	UK	UK	NM	NM	NM	NM	NM	UK	UK	UK	UK	UK	UK	NM	NM	NM	NM	NM	NM
MW-11S	UK	2674.58	UK	UK	NM	NM	NM	NM	NM	UK	UK	UK	UK	UK	UK	NM	NM	NM	NM	NM	NM
MW-11D	2672.01	2674.89	UK	UK	NM	NM	NM	NM	NM	81.49	80.27	78.49	77.71	77.44	78.66	NM	NM	NM	NM	NM	NM
MW-12	2526.93	2529.63	UK	UK	NM	NM	NM	NM	NM	9.60	8.84	9.50	8.30	9.42	9.20	9.90	10.07	10.04	10.00	9.73	9.53
MW-13S	2529.67	2532.20	UK	UK	NM	NM	NM	NM	NM	10.14	9.32	9.79	9.17	10.26	9.85	10.99	11.23	11.31	11.33	11.10	10.83
MW-13D	2528.11	2530.86	UK	UK	NM	NM	NM	NM	NM	9.89	9.08	9.56	9.01	9.88	9.61	10.47	10.65	10.77	10.82	10.58	10.35
MW-14	UK	2711.69	UK	UK	NM	NM	NM	NM	NM	UK	UK	UK	UK	UK	UK	NM	NM	NM	NM	NM	NM
MW-15	UK	2547.41	UK	UK	NM	NM	NM	NM	NM	UK	UK	UK	UK	UK	UK	NM	NM	NM	NM	NM	NM
P-4	2571.25	2573.14	UK	UK	67.40	66.69	66.91	66.52	67.52	NM	NM	NM	NM	NM	NM	74.30	74.56	74.81	74.92	75.19	75.40
P-5	2485.02	2487.78	UK	UK	22.29	23.66	24.67	25.40	25.87	NM	NM	NM	NM	NM	NM	28.68	29.09	29.29	29.35	28.47	26.76
P-6	2594.13	2597.74	UK	UK	55.45	55.30	55.42	55.56	55.90	NM	NM	NM	NM	NM	NM	58.08	58.26	58.54	58.63	58.86	59.08

Notes:

1. TOB = *Time Of Boring*
2. TOC = *Top Of Casing*
3. NP = *Not Present* at time of measurement
4. NM = *Not Measured*
5. UK= *unknown*
6. Measurements are in feet; elevations are relative to mean sea level.
7. Bold elevations represent highest observed elevations between 6/9/98 to 2/14/08.

Prepared By: IAI
Checked By: AWA

White Oak MSW Landfill - Phase 3 & 4 DHR
Haywood County, North Carolina
BLE Project Number J07-1957-02

WELL	GROUND ELEV.	TOC ELEV.	GROUNDWATER ELEVATION MEASUREMENTS TOB	24-Hr	1998 6/9/98	7/7/98	8/17/98	9/25/98	10/27/98	2004 10/21/04	2005 4/18/05	10/13/05	2006 4/25/06	10/20/06	2007 4/26/07	9/20/07	10/25/07	11/30/07	12/14/07	2008 1/16/08	2/14/08	Sept '07 to Feb '08 Seasonal High Elev.	Apr '05 to Apr '07 Maximum Historical Elev.	Elevation Difference (Feet)	Projected April '08 Seasonal High Elev.
BLE-1	2574.23	2577.77	2526.23	2531.73	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2531.12	2530.75	2530.36	2530.22	2529.85	2529.64	2531.12	-	-	2532.47
BLE-2	2525.68	2529.57	2508.58	2513.23	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2512.97	2513.07	2513.04	2513.10	2513.42	2513.76	2513.76	-	-	2515.11
BLE-3	2519.77	2523.43	2500.27	2501.33	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2500.95	2501.17	2501.25	2501.34	2501.58	2501.87	2501.87	-	-	2503.22
BLE-5	2497.10	2500.99	2485.80	2492.50	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2491.98	2492.64	2492.48	2492.81	2493.11	2493.33	2493.33	-	-	2494.68
BLE-6	2532.96	2536.67	2488.31	2488.25	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2488.24	2488.16	2488.47	2488.54	2488.77	2488.93	2488.93	-	-	2490.28
BLE-7S	2492.12	2495.30	2481.82	2484.32	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2483.72	2483.31	2483.76	2483.99	2484.69	2484.83	2484.83	-	-	2486.18
BLE-7D	2491.92	2495.70	2483.62	2483.52	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2484.41	2484.73	2484.47	2484.65	2485.05	2485.24	2485.24	-	-	2486.59
BLE-9	2552.54	2556.63	2509.84	2509.54	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2509.28	2506.28	2505.73	2505.60	2505.39	2505.11	2509.28	-	-	2510.63
BLE-10	2612.97	2615.73	2551.47	NM	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2551.22	2551.03	2550.45	2544.28	2543.80	2543.41	2551.22	-	-	2552.57
BLE-11	2630.61	2634.27	2540.91	2546.01	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2540.95	2540.75	2540.17	2540.12	2539.57	2539.21	2540.95	-	-	2542.30
BLE-12	2620.95	2624.50	2545.05	2545.05	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2545.19	2544.94	2544.35	2544.27	2543.73	2543.30	2545.19	-	-	2546.54
BLE-13	2609.39	2612.66	2540.39	2541.89	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2542.44	2542.40	2542.07	2541.98	2541.60	2541.19	2542.44	-	-	2543.79
BLE-14	2610.41	2613.65	2551.31	2551.21	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2551.21	2551.10	2550.60	2550.49	2549.97	2549.46	2551.21	-	-	2552.56
BLE-15	2584.11	2587.90	2526.36	2527.01	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2527.18	2526.87	2526.49	2526.43	2526.24	2526.53	2527.18	-	-	2528.53
BLE-16	2614.70	2618.50	2546.20	2552.49	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2555.63	2555.25	2554.55	2554.42	2553.80	2553.34	2555.63	-	-	2556.98
BLE-17	2611.46	2615.91	2523.86	2538.05	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	2521.72	2537.59	2537.00	2536.94	2536.32	2535.88	2537.59	-	-	2538.94
MW-1A	2517.97	2520.02	UK	UK	2503.77	2503.33	2502.69	2502.39	2502.14	2502.30	2502.97	2501.58	2502.47	2500.81	2500.65	2496.12	2495.46	2495.06	2494.94	2495.33	2496.07	2496.12	-	-	2497.47
MW-2	2494.43	2496.71	UK	UK	2467.35	2466.91	2466.14	2465.61	2465.53	2466.65	2467.78	2466.00	2467.47	2465.84	2466.68	2465.36	2465.26	2465.15	2465.20	2465.44	2466.10	2466.10	-	-	2467.45
MW-2D	2494.69	2496.89	UK	UK	NM	NM	NM	NM	NM	2466.89	2468.06	2466.26	2467.71	2466.03	2466.89	2465.55	2465.39	2465.35	2465.34	2465.64	2466.25	2466.25	-	-	2467.60
MW-3	2435.06	2437.28	UK	UK	2429.72	2429.20	2428.03	2426.93	2426.51	2428.99	2430.58	2428.38	2430.60	2428.07	2428.93	2427.02	2426.70	2426.39	2426.51	2427.17	2428.01	2428.01	-	-	2429.36
MW-3D	2434.17	2436.94	UK	UK	NM	NM	NM	NM	NM	2420.62	2421.37	2420.13	2421.17	2420.23	2420.24	2419.58	2419.45	2419.30	2419.31	2419.57	2419.89	2419.89	-	-	2421.24
MW-4A	2496.19	2498.54	UK	UK	2459.44	2463.46	2462.80	2456.35	2460.26	2451.96	2451.41	2450.77	2448.97	2447.77	2447.46	2448.14	2448.14	2448.27	2448.19	2448.07	2448.08	2448.27	-	-	2449.62
MW-5A	2502.29	2503.58	UK	UK	2497.22	2496.56	2496.28	2495.95	2495.88	2497.43	2498.48	2497.49	**2499.28**	NM	2498.08	2496.80	2497.12	2497.06	2497.14	2497.34	2497.59	2497.59	2499.28	1.69	2498.94
MW-5D	2502.18	2502.90	UK	UK	2496.24	2495.85	2495.69	2495.52	2495.50	2496.25	2496.92	2496.30	**2497.58**	NM	2496.72	2495.82	2496.14	2496.31	2496.38	2496.55	2496.75	2496.75	2497.58	0.83	2498.10
MW-8	2474.84	2477.33	UK	UK	NM	NM	NM	NM	NM	2446.80	2447.63	2446.30	2447.37	2445.96	2446.59	2445.30	2445.00	2444.77	2444.79	2445.05	2445.63	2445.63	-	-	2446.98
MW-9	UK	2430.15	UK	UK	NM	NM	NM	NM	NM	2420.90	2421.02	2420.83	2420.99	2421.09	2420.87	NM	NM	NM	NM	NM	NM	-	-	-	-
MW-11S	UK	2674.58	UK	UK	NM	NM	NM	NM	NM	2590.86	2592.08	2593.90	2594.94	2595.11	2593.96	NM	NM	NM	NM	NM	NM	-	-	-	-
MW-11D	2672.01	2674.89	UK	UK	NM	NM	NM	NM	NM	2590.52	2591.74	2593.52	2594.30	2594.57	2593.35	NM	NM	NM	NM	NM	NM	-	-	-	-
MW-12	2526.93	2529.63	UK	UK	NM	NM	NM	NM	NM	2517.33	2518.09	2517.43	**2518.63**	2517.51	2517.73	2517.03	2516.86	2516.89	2516.93	2517.20	2517.40	2517.40	2518.63	1.23	2518.75
MW-13S	2529.67	2532.20	UK	UK	NM	NM	NM	NM	NM	2519.53	2520.35	2519.88	**2520.50**	2519.41	2519.82	2518.68	2518.44	2518.36	2518.34	2518.57	2518.84	2518.84	2520.50	1.66	2520.19
MW-13D	2528.11	2530.86	UK	UK	NM	NM	NM	NM	NM	2518.22	2519.03	2518.55	**2519.10**	2518.23	2518.50	2517.64	2517.46	2517.34	2517.29	2517.53	2517.76	2517.76	2519.10	1.34	2519.11
MW-14	UK	2711.69	UK	UK	NM	NM	NM	NM	NM	2612.36	2613.19	2613.51	2612.41	2611.74	2610.50	NM	NM	NM	NM	NM	NM	-	-	-	-
MW-15	UK	2547.41	UK	UK	NM	NM	NM	NM	NM	2538.49	2538.70	2538.39	2538.71	2538.33	2538.33	NM	NM	NM	NM	NM	NM	-	-	-	-
P-4	2571.25	2573.14	UK	UK	2503.85	2504.56	2504.34	2504.73	2503.73	NM	NM	NM	NM	NM	NM	2496.95	2496.69	2496.44	2496.33	2496.06	2495.85	2496.95	-	-	2498.30
P-5	2485.02	2487.78	UK	UK	2462.73	2461.36	2460.35	2459.62	2459.15	NM	NM	NM	NM	NM	NM	2456.34	2455.93	2455.73	2455.67	2456.55	2458.26	2458.26	-	-	2459.61
P-6	2594.13	2597.74	UK	UK	2538.68	2538.83	2538.71	2538.57	2538.23	NM	NM	NM	NM	NM	NM	2536.05	2535.87	2535.59	2535.50	2535.27	2535.05	2536.05	-	-	2537.40
																							AVG (Avg Diff)	1.35	

WELL	GROUND ELEV.	TOC ELEV.	DEPTH TO WATER BELOW GROUND SURFACE TOB	24-Hr	1998 6/9/98	7/7/98	8/17/98	9/25/98	10/27/98	2004 10/21/04	2005 4/18/05	10/13/05	2006 4/25/06	10/20/06	2007 4/26/07	9/20/07	10/25/07	11/30/07	12/14/07	2008 1/16/08	2/14/08
BLE-1	2574.23	2577.77	48.00	42.50	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	43.11	43.48	43.87	44.01	44.38	44.59
BLE-2	2525.68	2529.57	17.10	12.45	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	12.71	12.61	12.64	12.58	12.26	11.92
BLE-3	2519.77	2523.43	19.50	18.44	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	18.82	18.60	18.52	18.43	18.19	17.90
BLE-5	2497.10	2500.99	11.30	4.60	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	5.12	4.46	4.62	4.29	3.99	3.77
BLE-6	2532.96	2536.67	44.65	44.71	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	44.72	44.80	44.49	44.42	44.19	44.03
BLE-7S	2492.12	2495.30	10.30	7.80	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	8.40	8.81	8.36	8.13	7.43	7.29
BLE-7D	2491.92	2495.70	8.30	8.40	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	7.51	7.19	7.45	7.27	6.87	6.68
BLE-9	2552.54	2556.63	42.70	43.00	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	43.26	46.26	46.81	46.94	47.15	47.43
BLE-10	2612.97	2615.73	61.50	NM	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	61.75	61.94	62.52	68.69	69.17	69.56
BLE-11	2630.61	2634.27	89.70	84.60	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	89.66	89.86	90.44	90.49	91.04	91.40
BLE-12	2620.95	2624.50	75.90	75.90	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	75.76	76.01	76.60	76.68	77.22	77.65
BLE-13	2609.39	2612.66	69.00	67.50	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	66.95	66.99	67.32	67.41	67.79	68.20
BLE-14	2610.41	2613.65	59.10	59.20	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	59.20	59.31	59.81	59.92	60.44	60.95
BLE-15	2584.11	2587.90	57.75	57.10	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	56.93	57.24	57.62	57.68	57.87	57.58
BLE-16	2614.70	2618.50	68.50	62.21	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	59.07	59.45	60.15	60.28	60.90	61.36
BLE-17	2611.46	2615.91	87.60	73.41	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	89.74	73.87	74.46	74.52	75.14	75.58
MW-1A	2517.97	2520.02	UK	UK	14.20	14.64	15.28	15.58	15.83	15.67	15.00	16.39	15.50	17.16	17.32	21.85	22.51	22.91	23.03	22.64	21.90
MW-2	2494.43	2496.71	UK	UK	27.08	27.52	28.29	28.82	28.90	27.78	26.65	28.43	26.96	28.59	27.75	29.07	29.17	29.28	29.23	28.99	28.33
MW-2D	2494.69	2496.89	UK	UK	NM	NM	NM	NM	NM	27.80	26.63	28.43	26.98	28.66	27.80	29.14	29.30	29.34	29.35	29.05	28.44
MW-3	2435.06	2437.28	UK	UK	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
MW-3D	2434.17	2436.94	UK	UK	NM	NM	NM	NM	NM	13.55	12.80	14.04	13.00	13.94	13.93	14.59	14.72	14.87	14.86	14.60	14.28
MW-4A	2496.19	2498.54	UK	UK	36.75	32.73	33.39	39.84	35.93	44.23	44.78	45.42	47.22	48.42	48.73	48.05	48.05	47.92	48.00	48.12	48.11
MW-5A	2502.29	2503.58	UK	UK	5.07	5.73	6.01	6.34	6.41	4.86	3.81	4.80	3.01	NM	4.21	5.49	5.17	5.23	5.15	4.95	4.70
MW-5D	2502.18	2502.90	UK	UK	5.94	6.33	6.49	6.66	6.68	5.93	5.26	5.88	4.60	NM	5.46	6.36	6.04	5.87	5.80	5.63	5.43
MW-8	2474.84	2477.33	UK	UK	NM	NM	NM	NM	NM	28.04	27.21	28.54	27.47	28.88	28.25	29.54	29.84	30.07	30.05	29.79	29.21
MW-9	UK	2430.15	UK	UK	NM	NM	NM	NM	NM	UK	UK	UK	UK	UK	UK	NM	NM	NM	NM	NM	NM
MW-11S	UK	2674.58	UK	UK	NM	NM	NM	NM	NM	UK	UK	UK	UK	UK	UK	NM	NM	NM	NM	NM	NM
MW-11D	2672.01	2674.89	UK	UK	NM	NM	NM	NM	NM	81.49	80.27	78.49	77.71	77.44	78.66	NM	NM	NM	NM	NM	NM
MW-12	2526.93	2529.63	UK	UK	NM	NM	NM	NM	NM	9.60	8.84	9.50	8.30	9.42	9.20	9.90	10.07	10.04	10.00	9.73	9.53
MW-13S	2529.67	2532.20	UK	UK	NM	NM	NM	NM	NM	10.14	9.32	9.79	9.17	10.26	9.85	10.99	11.23	11.31	11.33	11.10	10.83
MW-13D	2528.11	2530.86	UK	UK	NM	NM	NM	NM	NM	9.89	9.08	9.56	9.01	9.88	9.61	10.47	10.65	10.77	10.82	10.58	10.35
MW-14	UK	2711.69	UK	UK	NM	NM	NM	NM	NM	UK	UK	UK	UK	UK	UK	NM	NM	NM	NM	NM	NM
MW-15	UK	2547.41	UK	UK	NM	NM	NM	NM	NM	UK	UK	UK	UK	UK	UK	NM	NM	NM	NM	NM	NM
P-4	2571.25	2573.14	UK	UK	67.40	66.69	66.91	66.52	67.52	NM	NM	NM	NM	NM	NM	74.30	74.56	74.81	74.92	75.19	75.40
P-5	2485.02	2487.78	UK	UK	22.29	23.66	24.67	25.40	25.87	NM	NM	NM	NM	NM	NM	28.68	29.09	29.29	29.35	28.47	26.76
P-6	2594.13	2597.74	UK	UK	55.45	55.30	55.42	55.56	55.90	NM	NM	NM	NM	NM	NM	58.08	58.26	58.54	58.63	58.86	59.08

Notes:

1. TOB = *Time Of Boring*
2. TOC = *Top Of Casing*
3. NP = *Not Present* at time of measurement
4. NM = *Not Measured*
5. UK= *unknown*
6. Measurements are in feet; elevations are relative to mean sea level.
7. Bold elevations represent highest observed elevations between 6/9/98 to 2/14/08.

Prepared By: IAI/TZS
Checked By: AWA

TABLE 4

SUMMARY OF IN-SITU HYDRAULIC CONDUCTIVITY TESTING -SLUG TEST RESULTS
White Oak MSW Landfill - Phase 3 & 4 DHR
Haywood County, North Carolina
BLE Project Number J07-1957-02

Well	Method	Data Type	Aquifer Unit	Hydraulic Conductivity (K) ft/min	Hydraulic Conductivity (K) cm/sec	Hydraulic Conductivity (K) ft/day
BLE-3	Bouwer-Rice	Falling Head	Deep Residuum	9.2E-04	4.7E-04	1.3
BLE-7S	Bouwer-Rice	Falling Head	Deep Residuum	1.7E-04	8.6E-05	0.24
BLE-7D	Bouwer-Rice	Falling Head	Bedrock	3.9E-04	2.0E-04	0.56
BLE-9	Bouwer-Rice	Rising Head	Bedrock	3.7E-06	1.9E-06	0.0053
BLE-11	Bouwer-Rice	Falling Head	Deep Residuum	2.2E-05	1.1E-05	0.032
BLE-14	Bouwer-Rice	Falling Head	Partially Weathered Rock	5.2E-05	2.6E-05	0.074
Deep Residuum	Maximum Hydraulic Conductivity			9.2E-04	4.7E-04	1.3
	Geometric Mean Hydraulic Conductivity			1.5E-04	7.6E-05	0.22
	Minimum Hydraulic Conductivity			2.2E-05	1.1E-05	0.032
Partially Weathered Rock	Hydraulic Conductivity			5.2E-05	2.6E-05	0.074
Bedrock	Maximum Hydraulic Conductivity			3.9E-04	2.0E-04	0.56
	Geometric Mean Hydraulic Conductivity			3.8E-05	1.9E-05	0.054
	Minimum Hydraulic Conductivity			3.7E-06	1.9E-06	0.0053
All Units	Maximum Hydraulic Conductivity			9.2E-04	4.7E-04	1.3
	Geometric Mean Hydraulic Conductivity			7.9E-05	4.0E-05	0.11
	Minimum Hydraulic Conductivity			3.7E-06	1.9E-06	0.0053

Notes:
1. K = Hydraulic Conductivity
2. The data was reduced and the hydraulic conductivities calculated using SuperSlug (version 3.0)

TABLE 5

SUMMARY OF LABORATORY RESULTS - SPLIT SPOON & SHELBY TUBE SAMPLES

White Oak MSW Landfill - Phase 3 & 4 DHR
Haywood County, North Carolina
BLE Project Number J07-1957-02

						Triaxial Shear				Consolidation												
	Split-Spoon	Shelby Tube		Hydraulic Cond.	Nat. Moisture	Cohesion (ksf)		Φ (degree)		Precon. Press.	Virgin Slope	Void Ratio	Effective	Total	Atterberg Limits			Grain Size (% by wt)				
Boring	Depth (ft)	Depth (ft)	Soil Unit	(cm/sec)	Content (%)	Total	Effective	Total	Effective	Pc (ksf)	at 16ksf Cc	(eo)	Porosity (%)	Porosity (%)	LL	PL	PI	Gravel	Sand	Silt	Clay	USCS
BLE-1	-	3.5 - 5.5	upper residuum	2.6E-04	32.1%	-	-	-	-	-	-	-	20.2%	47.9%	59	46	13	0.0%	36.6%	57.2%	6.2%	MH
BLE-1	63.5 - 65.0	-	PWR	-	12.6%	-	-	-	-	-	-	-	30.5%	*49.0%*	29	26	3	0.8%	70.8%	26.8%	1.6%	SM
BLE-2	23.5 - 25.0	-	deep residuum	-	24.8%	-	-	-	-	-	-	-	32.0%	*47.0%*	42	38	4	24.2%	54.7%	19.0%	2.1%	SM
BLE-3	-	6.0 - 8.0	deep residuum	1.8E-04	20.4%	-	-	-	-	-	-	-	10.5%	39.4%	42	29	13	4.6%	46.1%	27.7%	21.6%	SM
BLE-3	8.5 -10.0	-	deep residuum	-	15.4%	-	-	-	-	-	-	-	18.5%	*47.5%*	46	34	12	2.9%	60.8%	23.4%	12.9%	SM
BLE-3	-	23.5 - 25.0	deep residuum	3.5E-05	31.6%	-	-	-	-	-	-	-	24.0%	46.4%	44	35	9	0.0%	55.2%	38.2%	6.6%	SM
BLE-6	6.0 - 7.5	-	deep residuum	-	14.4%	-	-	-	-	-	-	-	26.0%	*47.0%*	34	29	5	15.5%	56.9%	20.7%	6.9%	SM
BLE-7	-	1.0 - 3.0	upper residuum	1.1E-05	35.4%	-	-	-	-	-	-	-	16.5%	50.8%	56	43	13	0.0%	43.8%	42.0%	14.2%	MH
BLE-7	13.5 - 15.0	-	deep residuum	-	27.4%	-	-	-	-	-	-	-	28.5%	*49.5%*	42	36	6	0.1%	67.8%	28.8%	3.3%	SM
BLE-9	-	13.5 - 15.5	deep residuum	2.2E-04	23.8%	-	-	-	-	-	-	-	25.2%	50.2%	37	33	4	0.0%	60.4%	33.0%	6.6%	SM
BLE-10	-	1.0 - 3.0	deep residuum	5.4E-05	20.3%	-	-	-	-	8.06	0.12	0.760	27.5%	45.7%	55	49	6	0.0%	65.6%	30.3%	4.1%	SM
BLE-10	-	9.5 - 11.5	deep residuum	2.4E-05	24.2%	-	-	-	-	-	-	-	21.0%	46.4%	45	38	7	0.0%	42.3%	51.3%	6.4%	ML
BLE-11	6.0 - 7.5	-	upper residuum	-	20.2%	-	-	-	-	-	-	-	21.0%	*52.5%*	52	38	14	0.0%	47.8%	43.6%	8.6%	MH
BLE-13	-	23.5 - 25.0	deep residuum	6.9E-05	21.2%	-	-	-	-	-	-	-	22.0%	44.9%	42	35	7	0.0%	41.2%	55.8%	3.0%	ML
BLE-13	43.5 - 45.0	-	deep residuum	-	15.5%	-	-	-	-	-	-	-	23.0%	*48.0%*	45	34	11	9.2%	54.9%	26.4%	9.5%	SM
BLE-15	8.5 - 10.0	-	upper residuum	-	27.9%	-	-	-	-	-	-	-	3.5%	*51.0%*	52	34	18	0.4%	26.6%	35.8%	37.2%	MH
BLE-16	73.5 - 75.0	-	deep residuum	-	22.2%	-	-	-	-	-	-	-	22.5%	*52.5%*	37	32	5	0.4%	51.3%	41.6%	6.7%	SM
BLE-17	98.5 - 100.0	-	PWR	-	13.7%	-	-	-	-	-	-	-	23.5%	*49.5%*	30	26	4	1.3%	58.8%	31.8%	8.1%	SM
BLE-9/-10	-	13.5-15.0/9.5-11.5	deep residuum	-	-	0.063	0.064	18.80	36.73	-	-	-	-	-	-	-	-	-	-	-	-	SM

Notes:
1. Effective Porosity (Specific Yield) is based on grain size analyses and Figure 4.11 (Fetter, 1994)
2. Total Porosity values in *italic case* are based on grain size analyses.
3. USCS = Unified Soil Classification System. Refer to Appendix C for a description of the abbreviations.

Prepared By: IAI
Checked By: JH/MSP

TABLE 6

SUMMARY OF LABORATORY RESULTS - REMOLDED BAG SAMPLES

White Oak MSW Landfill - Phase 3 & 4 DHR
Haywood County, North Carolina
BLE Project Number J07-1957-02

				Standard Proctor		Remolded Permeability Conditions						Atterberg Limits			Grain Size (% by wt)				
Boring	Bag Sample Depth (ft)	Soil Unit	Natual Moisure	Opt. Moisture Content (%)	Max. Dry Density (pcf)	Effective Stress(PSI)	Moisture Content (%)	% Wet of Opt.	Dry Density (pcf)	% of MDD	Hydraulic Cond. (cm/sec)	LL	PL	PI	Gravel	Sand	Silt	Clay	USCS
BLE-11	15.5 - 18.0	deep residuum	-	22.4%	97.9	15	28.0%	5.6%	93.0	95.0%	2.9E-07	59	37	22	0.4%	32.9%	37.5%	29.2%	MH
BLE-14	16.0 - 18.0	upper residuum	-	23.8%	94.7	15	31.0%	7.2%	90.1	95.1%	4.8E-07	63	40	23	0.0%	24.0%	46.7%	29.3%	MH
BLE-15	1.0 - 8.0	upper residuum	-	25.7%	94.3	15	31.1%	5.4%	89.6	95.0%	8.8E-08	63	35	28	0.5%	15.5%	25.6%	58.4%	MH

Notes:
1. USCS = Unified Soil Classification System. Refer to Appendix C for a description of the abbreviations.

TABLE 7

INTERSTITIAL GROUNDWATER FLOW VELOCITY CALCULATIONS
White Oak MSW Landfill - Phase 3 & 4 DHR
Haywood County, North Carolina
BLE Project Number J07-1957-02

Geologic Unit	Velocity Calculation	Hydraulic Conductivity (K) (feet per day)	Hydraulic Gradient (i) (unitless)	Effective Porosity (n_e) (unitless)	Groundwater Flow Velocity (V) (feet per day)
Deep Residuum	Max K, Max n_e, & Min i	1.3	0.0435	0.320	**0.18**
	Geometric Mean K, and Average n_e & i	0.22	0.133	0.234	**0.12**
	Max K, and Average n_e & i	1.3	0.133	0.234	**0.74**
	Min K, Min n_e, & Max i	0.032	0.222	0.105	**0.068**
Partially Weathered Rock	K, Average n_e & i	0.074	0.133	0.270	**0.036**
	K, Max n_e, & Min i	0.074	0.0435	0.305	**0.011**
	K, Min n_e, & Max i	0.074	0.222	0.235	**0.070**
Bedrock	Max K, Max n_e, & Min i	0.56	0.0435	0.100	**0.24**
	Geometric Mean K, and Average n_e & i	0.054	0.133	0.075	**0.096**
	Max K, and Average n_e & i	0.56	0.133	0.075	**0.99**
	Min K, Min n_e, & Max i	0.0053	0.222	0.050	**0.024**

Notes:

1. Groundwater velocity derived from $V = Ki/n_e$ where:
   K = hydraulic conductivity, i = hydraulic gradient, and n_e = effective porosity.
2. The hydraulic conductivity values in the Deep Residuum, Partially Weathered Rock, and Bedrock are from slug tests (Table 4).
3. Effective porosity values in the Deep Residuum and Partially Weathered Rock are from soil laboratory tests (Table 5).
4. Effective porosity values in the Bedrock are from published values (5 to 10 percent) (Kruseman & deRidder, 1989).
5. Hydraulic gradient information is from the February 14, 2008 Water Table Contour Map (Figure 6).
6. The high velocity hydraulic gradient (0.222 ft/ft) is in the northern portion of Phase 4.
   (maximum calculated hydraulic gradient of 0.222 [180 feet between the 2490 and 2530 contours]).
7. The low velocity hydraulic gradient (0.0435 ft/ft) is in the central portion of Phase 3.
   (minimum calculated hydraulic gradient of 0.0435 [230 feet between the 2490 and 2500 contours]).
8. Upper Residuum is typically above the water table, and is therefore not used in the calculations on this Table.

Prepared By: MSP
Checked By: IAI

TABLE 8

SUMMARY OF HYDROGEOLOGIC CHARACTERISTICS OF GEOLOGIC UNITS

White Oak MSW Landfill - Phase 3 & 4 DHR
Haywood County, North Carolina
BLE Project Number J07-1957-02

Geologic Unit	USCS	Grain Size				Total Porosity				Effective Porosity				Hydraulic Conductivity (cm/sec)		
		gravel	sand	silt	clay	max	min	average	geomean	max	min	average	geomean	max	min	geomean
Upper Residual Soil	CL, ML, MH	0.1%	38.7%	44.7%	16.6%	52.5%	47.9%	50.5%	50.5%	21.0%	3.5%	15.3%	12.5%	2.6E-04	1.1E-05	5.3E-05
Deep Residual Soil	SM, ML	4.7%	54.8%	33.0%	7.5%	52.5%	39.4%	47.0%	46.9%	32.0%	10.5%	23.4%	22.7%	4.7E-04	1.1E-05	7.6E-05
Partially Weathered Rock	SM	1.1%	64.8%	29.3%	4.9%	49.5%	49.0%	49.3%	49.2%	30.5%	23.5%	27.0%	26.8%	2.6E-05	-	-
Bedrock	Biotite-Quartz-Feldspar Gneiss	-	-	-	-	10.0%	5.0%	7.5%	7.1%	10.0%	5.0%	7.5%	7.1%	2.0E-04	1.9E-06	1.9E-05

<u>Notes:</u>

1. Values are summarized from Table 4 (Summary of Slug Test Results) and Table 5 (Summary of Laboratory Results).
   The hydraulic conductivity values for the Deep Residuum, Partially Weathered Rock, and Bedrock are from slug testing, and from soil laboratory testing in the Upper Residuum.
2. Grain size values are averages.
3. "geomean" is the geometric mean.
4. Values of porosity in Bedrock are from published values (Kruseman & deRidder, 1989).

Prepared By: IAI
Checked By: MSP

TABLE 9

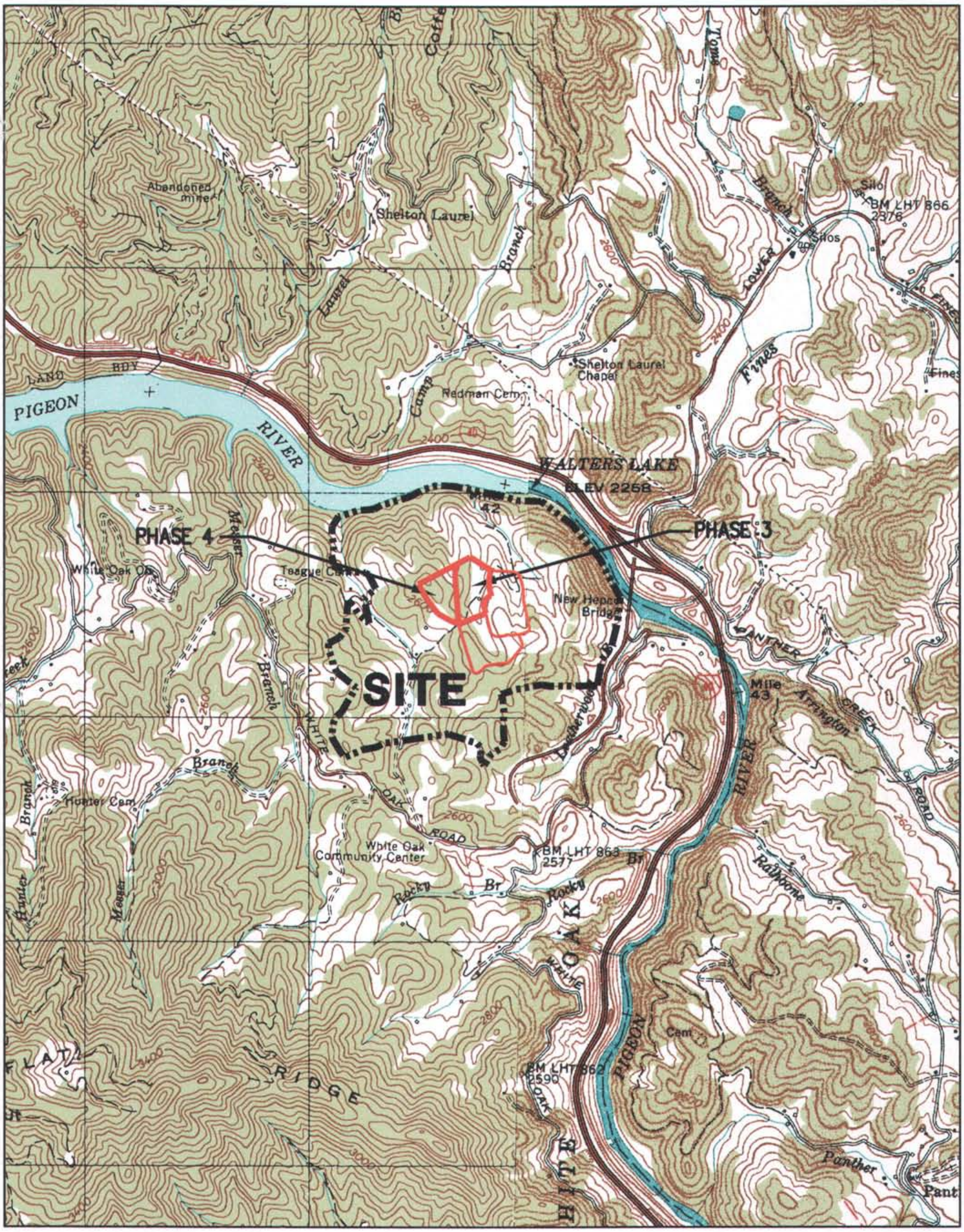
VERTICAL HYDRAULIC GRADIENTS AND FLOW RATES
White Oak MSW Landfill - Phase 3 & 4 DHR
Haywood County, North Carolina
BLE Project Number J07-1957-02

Well Pairs	Ground Elev. (ft)	TOC Elev. (ft)	Ground Elevation Difference (ft)	Horizontal Distance Between Wells (ft)	Midpoint Screen Elev. (ft)	Vertical Separation Between Screens Midpoints (ft)	2/14/2008 Water Elev. (ft)	2/14/2008 Head Difference (ft)	Vertical Hydraulic Gradient (i)	Geometric Mean Hydraulic K(ft/day)	Geometric Mean Effective Porosity (n)	Vertical Flow Velocity (ft/day)	Direction
MW-5A	2502.29	2503.58	0.11	7.6	2490.30	18.80	2497.59	0.84	0.045	0.1144	0.1159	0.044	Recharge
MW-5D	2502.18	2502.90			2471.50		2496.75						
BLE-7S	2492.12	2495.30	0.20	7.4	2475.23	37.93	2484.86	-0.40	-0.011	0.1144	0.1159	-0.010	Discharge
BLE-7D	2491.92	2495.70			2437.30		2485.26						

Notes:
1. Water level elevations measured on 2/14/2008.
2. Hydraulic conductivity values are from Table 4 and effective porosity values are estimated from averages or similar soil types on Table 8.
3. Negitive (-) gradients and velocities indicate an upward flow direction.
4. Positive (+) gradients and velocities indicate a downward flow direction.

Prepared By: IAI
Checked By: AWA

FIGURES



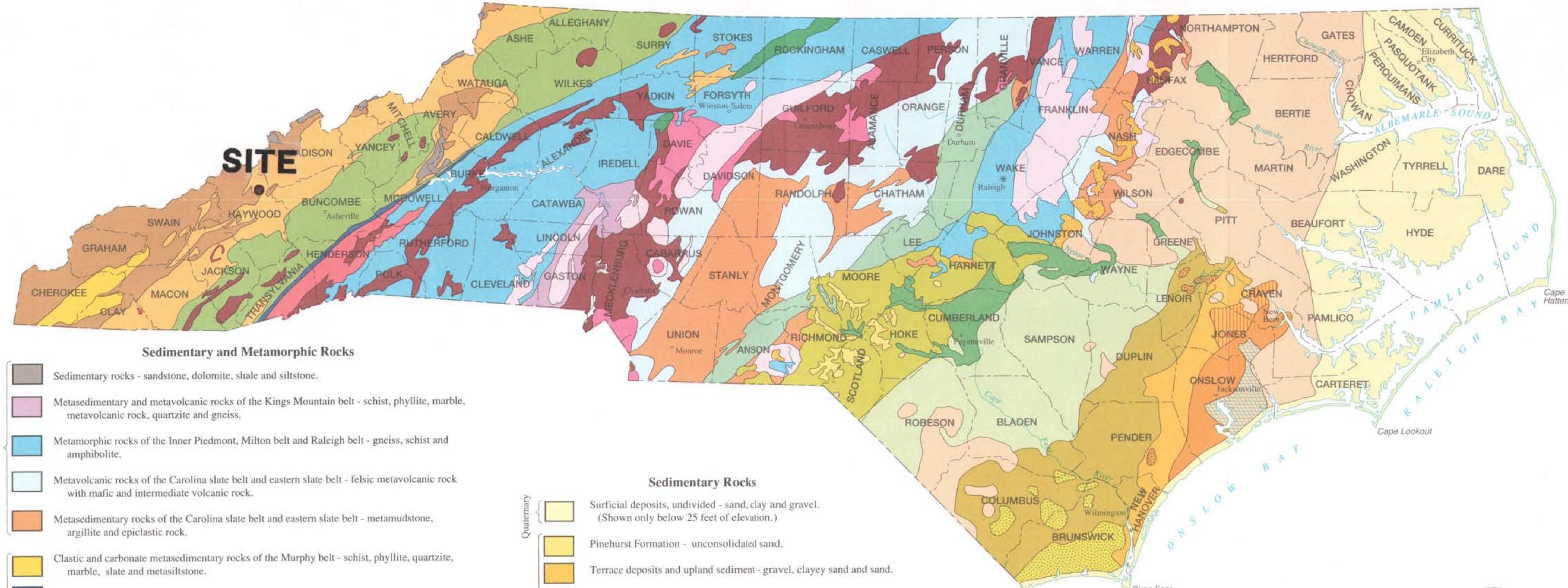
2000 1000 0 2000 4000

APPROXIMATE SCALE IN FEET

REFERENCE:
USGS TOPOGRAPHIC MAP, 7.5 MINUTE SERIES,
COVE CREEK GAP AND FINES CREEK, N.C. QUADRANGLES, 1967.

DRAWN: AEH	DATE: 07-11-08	BLE INC. BUNNELL-LAMMONS ENGINEERING, INC. 6004 PONDERS COURT GREENVILLE, SOUTH CAROLINA 29615 PHONE: (864)288-1265 FAX: (864)288-4430	SITE LOCATION MAP WHITE OAK LANDFILL HAYWOOD COUNTY, NORTH CAROLINA	FIGURE 1
CHECKED: MSP	CAD: HCWOLF-02 SLM			
APPROVED:	JOB NO: J07-1957-02			

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

Reprinted, 1996

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.

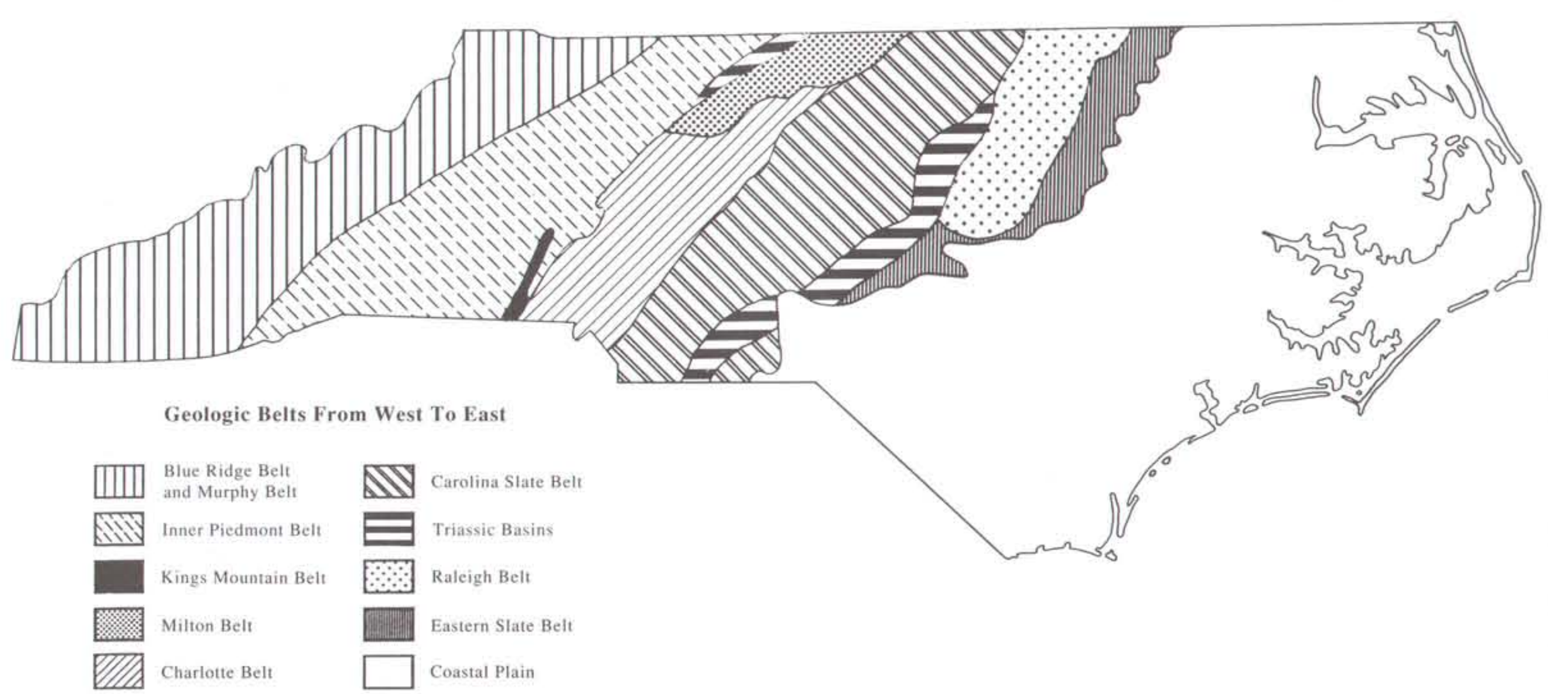
Raleigh Belt: The Raleigh belt contains granite, gneiss and schist. In the 19th century, there were a number of small building stone quarries in this region, but today the main mineral product is crushed stone for construction and road aggregate.

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 aad 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 milions 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 Spruce 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.

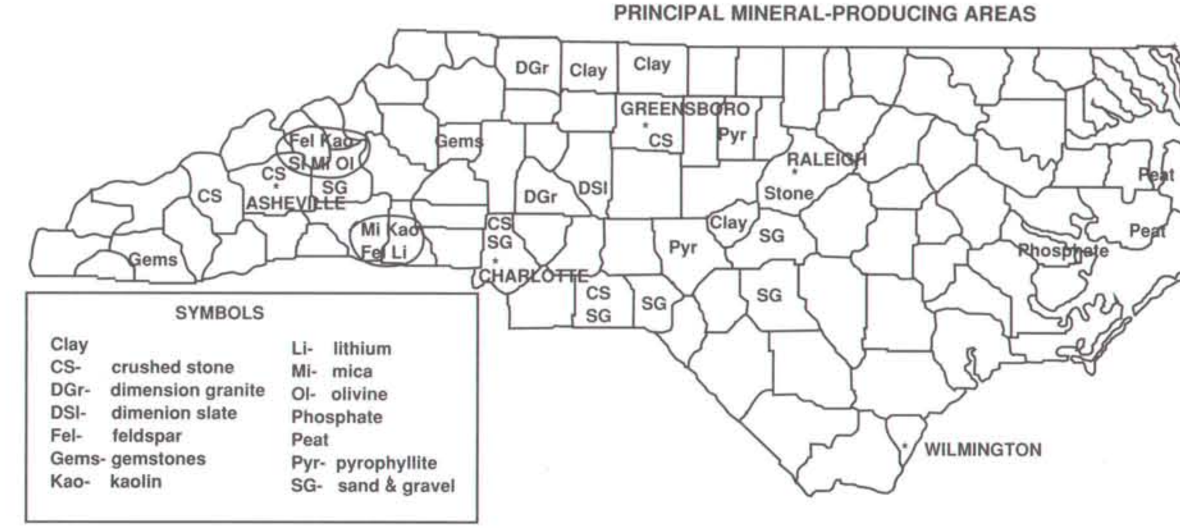
STATE OF NORTH CAROLINA
James B. Hunt, Jr., Governor

Department of Environment, Health and Natural Resources
Jonathan B. Howes, Secretary

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

North Carolina Geological Survey
P.O. Box 27687, Raleigh, N.C. 27611-7687
Telephone (919)733-2423; FAX (919)733-0900
e-mail: jeff_reid@mail.ehnr.state.nc.us
http://www.ehnr.state.nc.us/EHNR/DLR/JEFF/rock1.htm

PRINCIPAL MINERAL-PRODUCING AREAS



"Drawings Under Seperate Cover"

APPENDICES

APPENDIX A

DRILLING AND SAMPLING PROCEDURES

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 4-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 and HQ sizes designate bits that obtain rock cores 1-7/8 and 2-1/2 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).

APPENDIX B

FIELD LOGS OF BORINGS

TEST BORING REPORT

BORING NO. BLE-1

PROJECT:	White Oak Landfill
CLIENT:	McGill Associates
CONTRACTOR:	Landprobe
EQUIPMENT USED:	CME 750 with 4-1/4 inch hollow stem auger

BLE JOB NO.	J07-1957-02
PAGE NO.	1 of
LOCATION:	
ELEVATION:	
DATE START:	7/18/07
DATE FINISH:	7/18/07
DRILLER:	T. Gradwell
PREPARED BY:	T. Livingston

GROUND WATER		DEPTH TO:		
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	48		
	24	42.5		

	CASING	SAMPLER	CORE BARREL
TYPE			
SIZE ID/OD			
HAMMER WT	XXX		XXX
HAMMER FALL	XXX		XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					6" TOPSOIL	
		2, 5, 6	SS-1		STIFF, LT BR, YELLOW, F. SA, SILT	2" PVC
5			UD		BR, MIC, F. SA, SI, CLAY	
		4, 10, 10	SS-2		V. STIFF, GRAY, F. SA, SI, CLAY	
10		4, 7, 9	SS-3		V. STIFF, GRAY, BR, F. SA, SILT	
15		4, 12, 13	SS-4		V. STIFF, BR, MIC, F. SA, SILT	GROUT
20		4, 11, 11	SS-5		V. STIFF, BR, GRAY, WHITE, MIC, F-M SA, SILT W/ROCK FRAGMENTS	

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP =
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 52.8
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 50.6
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 55-65
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 65.0
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 65.2

TEST BORING REPORT

White Oak Landfill

J07-1957-02

BORING NO. BLE-1 0

PAGE 2 OF

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
25		9 13 13	SS-6		V. STIFF, GRAY, BR, MIC, F-M SA, SILT	2" PVC
30		9 13 14	SS-7			GROUT
35		9 14 15	SS-8		V. STIFF, LT BR, WHITE, MIC, F-M SA, SILT	
40		12 16 22	SS-9		HARD TO V. STIFF, BR, BLK, MIC, F-M SA, SILT	
45		5 10 19	SS-10			

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

White Oak Landfill — J07-1957-02

BORING NO. BLE-1 0 — PAGE 3 OF 3

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
50		5 9 12				GROUT, 2" PVC; 50.0
						BENT; 52.8
55		6 8 15				55.0
60		7 10 12			PWR - BR + WHITE ROCK FRAGMENTS	SAND
65		50/3" — —			PWR - GRAY + WHITE, MIC, SI, F-M SAND	65.0 65.2 66.0
					AUGER REFUSAL @ 66' BGS. GW @ 48.0' @ TOB AND 42.5' AFTER 24 HRS	
70						

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

BORING NO. BLE-2

PROJECT:	White Oak Landfill
CLIENT:	McGill Associates
CONTRACTOR:	Landprobe
EQUIPMENT USED:	CME 750 with 4-1/4 inch hollow stem auger

BLE JOB NO.	J07-1957-02
PAGE NO.	1 of 2
LOCATION:	
ELEVATION:	
DATE START:	7/13/07
DATE FINISH:	7/13/07
DRILLER:	T. Gradwell
PREPARED BY:	T. Livingston

GROUND WATER		DEPTH TO:		
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	17.1		
	24 HR	12.45		

	CASING	SAMPLER	CORE BARREL
TYPE			
SIZE ID/OD			
HAMMER WT	XXX		XXX
HAMMER FALL	XXX		XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					6" TOPSOIL	
		2, 2, 2	SS-1		SOFT, BR, F-M SA, SI, CLAY	
5		2, 2, 2	SS-2		SOFT, YELLOW, BR, MIC, F-M SA, SILT	GROUT; 2" PVC
		4, 5, 6	SS-3		FIRM, BLK, BR, MOI, MIC, SI, F-M SAND	
10		3, 6, 11	SS-4			
15		2, 1, 2	SS-5		SOFT, TAN, GRAY, WHITE, MOI, MIC, F-M SA, SILT	
20		2, 1, 2	SS-6		SOFT, GRAY, BR, MIC, WET, F. SA, SILT	

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP =
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 26.8
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 24.4
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 29.0 - 39.0
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.2
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 39.2

TEST BORING REPORT

White Oak Landfill — J07-1957-02

BORING NO. BLE-2 — 0

PAGE 2 OF 2

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
						GROUT; 2" PVC
25		7, 7, 19	SS-7		V. FIRM, BR, BLK, GRAY, MIC, SI, F-M SAND	24.4
						BENT
						26.8
30		2, 2, 4	SS-8		LOOSE, GRAY, BR, MIC, SI, F-M SAND	29.0
35		5, 11, 15	SS-9		V. FIRM, MIC, GRAY, BROWN, SI, F-M SAND	SAND
40		7, 12, 18	SS-10		V. FIRM, GRAY, BR, SI, F-M SAND	39.0; 39.2; 40.0
					BORING TERM. @ 40.0' BGS. GW @ 17.1' @ TOB AND 12.45 24HR	
45						

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

BORING NO. BLE-3

PROJECT:	White Oak Landfill
CLIENT:	McGill Associates
CONTRACTOR:	Landprobe
EQUIPMENT USED:	CME 750 with 4-1/4 inch hollow stem auger

BLE JOB NO.	J07-1957-02
PAGE NO.	1 of 2
LOCATION:	
ELEVATION:	
DATE START:	7/12/07
DATE FINISH:	7/12/07
DRILLER:	T. Gradwell
PREPARED BY:	T. Livingston

GROUND WATER		DEPTH TO:		
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	19.5		
	24	18.44		

	CASING	SAMPLER	CORE BARREL
TYPE			
SIZE ID/OD			
HAMMER WT	XXX		XXX
HAMMER FALL	XXX		XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					6" TOPSOIL	2" PVC; GROUT
		2, 2, 4	SS-1		FIRM, BR, SI, F-M SAND (FILL)	
5		2, 2, 2	SS-2		SOFT, LT BR, MIC, F. SA, SILT (FILL)	
			UD		BR, F. SA, SI, CLAY	
10		2, 4, 5	SS-3		STIFF, BR, F-M SA, SI, CLAY	
15		7, 10, 15	SS-4		V. FIRM, BR, BLK, MIC, SI, F-C SAND	
20		3, 4, 5	SS-5		STIFF, RED, BR, WET, SI, F-C SAND	

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP =
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 36.0
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 33.0
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 38.0 - 48.0
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.2
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 48.2

TEST BORING REPORT

White Oak Landfill | **J07-1957-02** | **BORING NO.** BLE-3 0 | PAGE 2 OF 3

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
25			UD		Lt Br, Gray, Mic, F-M Sa, Silt	Grout; 2" PVC
30		6 8 10			V. Stiff, Gray, Br, Wet, Mic, F-M Sa, Silt	Grout; 2" PVC
35		12 19 19			Dense, Gray, White, Blk, Mic, Si, F-M Sand	33.0; Bent; 36.0
40		9 12 12			V. Firm, Dk Br, Mic, F-M Sand w/ Rock Fragments	38.0; Sand
45		13 19 28			Dense, Gray, Mic, Si, F-M Sand w/Rock Fragments	Sand

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

White Oak Landfill — J07-1957-02 — BORING NO. BLE-3 — PAGE 3 OF 3

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
						SAND; 48.0; 48.2
		12			PWR- V. DENSE, WHITE, BR, BLK, MIC, F-M SAND	
		26				
50		31				50.0
					BORING TERM @ 50' BGS. GW @ 19.5' @ TOB AND 18.44' AFTER 24 HRS.	
55						

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

BORING NO. BLE-4

PROJECT: White Oak LF - Haywood Co
CLIENT: McGill Asso.
CONTRACTOR:
EQUIPMENT USED:

BLE JOB NO. J07-1957-02
PAGE NO. 1 of 1
LOCATION:
ELEVATION:
DATE START: 9/6/07
DATE FINISH:
DRILLER: TG - BE
PREPARED BY: T. Livingston

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

	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	
			SS-1		No Samples	
					Boring Term. @ 2.5	
5			SS-2			
			SS-3			
10			SS-4			
15			SS-5			
20			SS-6			

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

TEST BORING REPORT

BORING NO. BLE-5

PROJECT:	White Oak Landfill	BLE JOB NO.	J07-1957-02
CLIENT:	McGill Associates	PAGE NO.	1 of 2
CONTRACTOR:	Landprobe	LOCATION:	
EQUIPMENT USED:	CME 750 with 4-1/4 inch hollow stem auger	ELEVATION:	
		DATE START:	7/16/07
		DATE FINISH:	7/16/07
		DRILLER:	T. Gradwell
		PREPARED BY:	T. Livingston

GROUND WATER		DEPTH TO:		
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	11.3		
	24	4.6		

	CASING	SAMPLER	CORE BARREL
TYPE			
SIZE ID/OD			
HAMMER WT	XXX		XXX
HAMMER FALL	XXX		XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					6" TOPSOIL	
		1, 2, 3	SS-1		FIRM, BR, SILTY, CLAY	
5		3, 2, 3	SS-2		FIRM, BR, BLK, GRAY, MOI, MIC, F. SA, CL, SILT	GROUT; 2" PVC
		1, 2, 3	SS-3		FIRM, BR, MOI, MIC, F-M SA, SILT	
10		5, 10, 12	SS-4		V. FIRM, LT BR, BLK, MOI, SI, F-C SAND	10.6
						BENT; 12.9
15		5, 7, 8	SS-5		FIRM, GRAY, BR, WET, MIC, SI, F. SAND	SAND
20		50/4", –, –	SS-6		PWR – GRAY, BR, SI, F-M SAND W/ ROCK FRAGMENTS	

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP =
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 12.9
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 10.6
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 15-25
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.2
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 25.2

TEST BORING REPORT

White Oak Landfill | J07-1957-02 | BORING NO. BLE-5 | 0 | PAGE 2 OF 2

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
		9			PWR - BLK & BR, MIC, SI, F-M SAND W/ROCK FRAGMENTS	SAND 25.0
		29				25.2
-25		18				26.0
-30						
-35						
-40						
-45						

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

BORING NO. BLE-6

PROJECT: WHITE OAK LF
CLIENT:
CONTRACTOR:
EQUIPMENT USED: 4 ½" HSA

BLE JOB NO. 1957-02
PAGE NO. 1 of 3
LOCATION:
ELEVATION:
DATE START:
DATE FINISH:
DRILLER: TG-BE
PREPARED BY: TL

GROUND WATER DATE	HRS AFT COMP	DEPTH TO: WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	44.65	BGS	
	24	44.70	BGS	

	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	
		3, 3, 4	SS-1	MH	FIRM TO STIFF, BR, RED, SOME CLAYEY, F. SANDY SILT	
5		4, 5, 6	SS-2	SM	FIRM TO V. FIRM, BR, RED, BLK, SILTY, F-M SAND	
		5, 6, 6	SS-3	SM		GROUT; 2" PVC
10		6, 8, 10	SS-4	SM		
15		4, 8, 10	SS-5	SM		
20		5, 7, 8	SS-6	SM	FIRM TO V. FIRM, BR, BLK, GRAY, SILTY, 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 = 3.9
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 33.4
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 27.0
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 46.0 - 36.0
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.2
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 46.2

TEST BORING REPORT

BORING NO. BLE-6
PAGE 2 OF 3

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
25		5 9 13	SS-7	SM		GROUT
30		5 9 10	SS-8	SM	FIRM, GRY, BR, MIC, SILTY, FINE SAND	BENTONITE; 2" PVC
35		5 6 9	SS-9	ML	STIFF, GRY, BLK, MIC, F. SDY SILT	SAND; 36.1
40		5 7 10	SS-10	ML	V. STIFF, BR, MIC, F. SANDY SILT	
45		6 8 11	SS-11	ML	V. STIFF, GRY, BR, MIC, SL. MOIST, F. SANDY SILT	

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

BORING NO. 3LE-6
PAGE 3 OF 3

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
			GS-1	PWR	GNEISS ROCK FRAGMENTS	46.0 46.2
					BORING TERM @ 46.0 AUGER REFUSAL	
50			SS-12			
55			SS-13			
60			SS-14			
65			SS-15			
70			SS-16			

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

BORING NO. BLE-7

PROJECT:	White Oak Landfill
CLIENT:	McGill Associates
CONTRACTOR:	Landprobe
EQUIPMENT USED:	CME 750 with 4-1/4 inch hollow stem auger

BLE JOB NO.	J07-1957-02
PAGE NO.	1 of 2
LOCATION:	
ELEVATION:	
DATE START:	7/17/07
DATE FINISH:	7/17/07
DRILLER:	T. Gradwell
PREPARED BY:	T. Livingston

GROUND WATER		DEPTH TO:		
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	10.3		
	24 Hr	7.8		

	CASING	SAMPLER	CORE BARREL
TYPE			
SIZE ID/OD			
HAMMER WT	XXX		XXX
HAMMER FALL	XXX		XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					6" TOPSOIL	2" PVC
		3, 3, 5	SS-1		FIRM, BR, SI, CLAY	
5		2, 3, 3	SS-2		FIRM, LT. BR, CL, SILT	GROUT
		2, 4, 5	SS-3		LOOSE, LT. BR, BLK, GREY, SI, F-M SAND	
10		2, 5, 7	SS-4		FIRM, LT BR, WHITE, WET, SI, F-C SAND	10.8
						BENT. 13.0
15		2, 2, 3	SS-5		FIRM, GRAY, BR, WET, MIC, SI, F-M SAND	15.0
20		4, 5, 6	SS-6		STIFF, DK BR, GRAY, WET, MIC, SI F-M SAND	SAND

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

TEST BORING REPORT

BORING NO. BLE-7 0
PAGE 2 **OF** 2

White Oak Landfill **J07-1957-02**

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
25		3 5 6	SS-7		STIFF, GRAY, BR MIC, SILTY, F-M SAND	SAND 25.0 25.2
					AUGER REFUSAL @ 26' BGS. GW @ 10.3' @ TOB AND 7.8' AFTER 24 HRS.	
30						
35						
40						
45						

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

BORING NO. BLE-7D

PROJECT: White Oak LF - Haywood Co
CLIENT:
CONTRACTOR:
EQUIPMENT USED:

BLE JOB NO. J07-1957-02
PAGE NO. 1 of 3
LOCATION:
ELEVATION:
DATE START: 9/11/07
DATE FINISH: 9/12/07
DRILLER: TG - BE
PREPARED BY: T. Livingston

GROUND WATER		DEPTH TO:		
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	8.3		
	24	8.3		

	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
				6"	Topsoil	
			SS-1		SEE BORING LOG FOR BLE-7	
5			SS-2			
			SS-3			Grout / 2" PVC
10			SS-4			
15			SS-5			
20			SS-6			

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 = 46.9
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 30.2
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 59.6 - 49.6
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.2
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 59.8

TEST BORING REPORT

BORING NO. BLE-7D

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
						2" PVC
25			SS-7			GROUT
30			SS-8			
					AUGER REFUSAL @ 32.0	
					CHANGE OVER TO AIR HAMMER	
35			SS-9		SEE CORING REPORT	BENTONITE
40			SS-10			
45			SS-11			

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

BORING NO. BLE-7D

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
						46.9
50			SS-12			SAND 49.6
55			SS-13			
						59.6
						59.8
60			SS-14			60.0
					BORING TERMINATED @ 60.0	
65			SS-15			
70			SS-16			

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 =

CORE BORING REPORT

BORING NO. BLE-7D

PROJECT:	WHITE OAK LF
CLIENT:	McGILL ASSO.
CONTRACTOR:	
EQUIPMENT USED:	

BLE JOB NO.	J07-1957-02
PAGE NO.	1 of 2
LOCATION:	
ELEVATION:	
DATE START:	
DATE FINISH:	
DRILLER:	
PREPARED BY:	TL

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
30								
		32.0					AUGER REFUSAL 32.0'	32
			R-1	15"	42	(9") 25	HARD, SLI WEATHERED, BR, DRK GRY, WHITE, COARSE GRAINED QUARTZ FELDSPAR BIOTITE GNEISS; W/ THICK FOLIATION, V. CLOSE STAINED FRACTURES	33
35		35.0						
			R-2	60"	100	(59") 98	V. HARD, FRESH, BR, DRK GRY, WHITE, FINE TO COARSE GRAINED QTZ-FELDSPAR BIOTITE GNEISS; MOD. FOLIATION, THIN, FOLIATION, AND CLOSE TO V. CLOSE SPACED STAINED FRACTURES	
40		40.0						
			R-3	60"	100	(54") 90		
45		45.0						

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

BORING NO. BLE-7D
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	54"	90	(50") 83		
50		50.0						
			R-5	58"	97	(30") 50		
55		55.0						
			R-6	60"	100	(43") 72		
60		60.0						60.0
							WELL SET	

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	WELL MATERIALS	
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-8

PROJECT:	Haywood County White Oak DHR
CLIENT:	McGill Associates
CONTRACTOR:	Landprobe
EQUIPMENT USED:	CME 750 with 4-1/4 inch hollow stem auger

BLE JOB NO.	1957-02
PAGE NO.	1 of 1
LOCATION:	
ELEVATION:	
DATE START:	7-18-07
DATE FINISH:	7-18-07
DRILLER:	T. Gradwell
PREPARED BY:	T. Livingston

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

	CASING	SAMPLER	CORE BARREL
TYPE			
SIZE ID/OD			
HAMMER WT	XXX		XXX
HAMMER FALL	XXX		XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					6-inches Topsoil	
					Gray and brown, mic, silty fine sand	
					Auger refusal at 3 ft.	
5					No groundwater at time of drilling.	
10						
15						
20						

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

TEST BORING REPORT

BORING NO. BLE-9

PROJECT:	WHITE OAK LF - HAYWOOD CO
CLIENT:	
CONTRACTOR:	
EQUIPMENT USED:	
BLE JOB NO.	507-1957-02
PAGE NO.	1 of 3
LOCATION:	
ELEVATION:	
DATE START:	9/6/07
DATE FINISH:	9/7/07
DRILLER:	TG
PREPARED BY:	TL

GROUND WATER DATE	HRS AFT COMP	DEPTH TO: WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	42.7		
	24	43.0		

	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	
		3 / 4 / 4	SS-1	ML	FIRM TO STIFF, BR + GRAY, F. SANDY, CLAYEY, MIC., SILT	
5		4 / 5 / 5	SS-2	ML		
		5 / 5 / 6	SS-3	ML	STIFF TO V. STIFF, BR, GRAY, BL, MIC., F. SANDY, SILT	2" PVC; GROUT
10		5 / 6 / 7	SS-4	ML		
15			~~SS5~~ UD	ML		
20		5 / 7 / 8	SS-6	ML		

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP = 3.8
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 35.4
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 23.6
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 47.7-37.7
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.2
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 47.9

TEST BORING REPORT

BORING NO. BLE-9

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
						23.1
25		50/3"	SS-7	SM	PWR, GRAY, WHITE, SILTY SAND W/ ROCK FRAGMENTS	
					AUGER REFUSAL @ 25.0	
					CHANGE OVER TO AIR HAMMER	2" PVC
30			SS-8			BENTONITE
35			SS-9		SEE CORING REPORT	35.0
						37.7
40			SS-10			SAND
45			SS-11			

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

BORING NO. BLB-9

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
						SAND 47.5 47.9
50			SS-12		BORING TERM. @ 49.0	
55			SS-13			
60			SS-14			
65			SS-15			
70			SS-16			

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 =

CORE BORING REPORT

BORING NO. BLE-9

PROJECT: WHITE OAK LF
CLIENT:
CONTRACTOR:
EQUIPMENT USED:

BLE JOB NO. J07-1957-02
PAGE NO. 1 of 2
LOCATION:
ELEVATION:
DATE START: 9/6/07
DATE FINISH: 9/7/07
DRILLER: TG
PREPARED BY: TL

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
25		25.0					AUGER REFUSAL	25
30		30.0	R-1	48"	80	(30") 50	MOD. HARD, SL WEATHERED, BRN, DK GRAY, WHITE, F. TO COARSE GRAINED, QTZ-FELDSPAR-BIOTITE GNEISS; W/ MOD. DEVELOPED, V. THIN, SHALLOW DIPPING FOLIATION, AND CLOSE TO V. CLOSE SPACED, SHALLOW AND STEEPLY DIPPING, IRON STAINED FRACTURES	
35		35.0	R-2	45"	75	(37") 62		
40		40.0	R-3	55"	92	(41") 68		

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

BORING NO. BLE-9
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	58"	97	(52") 87		44.0
45		45.0					SOFT, MOD. WEATHERED, BRN, GRN, F. GRAINED BIOTITE SCHIST; W/ WELL DEVELOPED, V. THIN, SHALLOW DIPPING FOLIATION, SHALLOW DIPPING IRON STAINED FRACTURES.	45.0
			R-5					
49		49.0					HARD, V. SL. WEATHERED, BRN, DK GRAY, WHITE, F. TO COARSE GRAINED, QTZ-FELDSPAR-BIOTITE GNEISS; MOD. DEVELOPED FOLIATION, V. CLOSE SPACED FRACTURES	49.0
							WELL SET	

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-10

PROJECT: WHITE OAK LF
CLIENT:
CONTRACTOR:
EQUIPMENT USED: 4 1/2" HSA

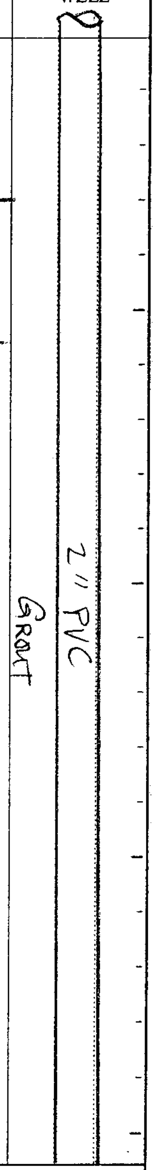
BLE JOB NO. 1957-02
PAGE NO. 1 of 4
LOCATION:
ELEVATION:
DATE START: 7/24/07
DATE FINISH: 7/26/07
DRILLER:
PREPARED BY: TL

GROUND WATER DATE	HRS AFT COMP	DEPTH TO: WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	61.5		

	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
		4, 6, 6	SS-1	ML	STIFF, DK RED, LT. BR, F. SANDY SILT
5		6, 10, 15	SS-2	SM	V. FIRM, LT. BR, SI, F-M SAND
		6, 11, 14	SS-3	MH	V. STIFF, DK. RED, LT BR, FINE SANDY, CLAYEY SILT
10		6, 12, 13	SS-4	MH	
15		10, 12, 15	SS-5	MH	
20		8, 13, 16	SS-6	MH	

WELL



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 = 66.7
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 62.7
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 68.7-78.7
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.2
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 78.9

TEST BORING REPORT

BORING NO. BLE-10

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
25		11 16 15	SS-7	MH		2" PVC
30		11 15 13	SS-8	SM	V. FIRM, RED, BR, GRAY, SI F-M SAND	
35		9 16 20	SS-9	ML	HARD, RED, BR, GRAY, F. SANDY SILT	
40		11 20 37	SS-10	MLS	V. HARD TO HARD LT BR, GRAY, BLK, F-M SANDY SILT	
45		10 26 26	SS-11	MLS		

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

BORING NO. BLE-10

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
50		11 / 20 / 21	SS-12	MLS		GROUT; 2" PVC
55		10 / 12 / 20	SS-13	MLS		
60		6 / 14 / 27	SS-14	ML	V. STIFF, BR, WH, GRAY, F. SANDY SILT	
65		14 / 28 / 30	SS-15	ML	V. HARD, GRAY, BRN, WH., F. SANDY SILT	62.7; BENTONITE
70		13 / 21 / 25	SS-16	ML	HARD TO V. HARD, GRAY, BR, MICACEOUS, MOIST, F. SANDY SILT	66.7; SAND; 68.7

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

BORING NO. BLE-10

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
75		11 20 50	SS-17	ML		
						78.7 78.9
80			SS-18		BORING TERM @ 78.9	
85			SS-19			
90			SS-20			
95			SS-21			

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

PROJECT:	WHITE OAK LF
CLIENT:	
CONTRACTOR:	
EQUIPMENT USED:	4 1/2" HSA

BORING NO.	BLE-11
BLE JOB NO.	1957-02
PAGE NO.	1 of 5
LOCATION:	
ELEVATION:	
DATE START:	8/3/07
DATE FINISH:	
DRILLER:	K. THOMAS
PREPARED BY:	TL

GROUND WATER		DEPTH TO:		
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	89.7		
	24	84.6		

	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
		3 / 4 / 7	SS-1	ML	STIFF TO V. STIFF, DK. RED, LT. BR, F. SANDY SILT	GROUT; 2" PVC
5		3 / 6 / 9	SS-2	ML		
		4 / 6 / 8	SS-3	ML		
10		4 / 9 / 10	SS-4	ML		
15		3 / 5 / 7	SS-5	ML	STIFF, DK RED, LT. BR, F. SANDY SILT	
20		4 / 5 / 9	SS-6	ML		

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP = 2.6
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 90.1
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 71.0
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 92.6-102.6
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.2
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 102.8

TEST BORING REPORT

BORING NO. BLE-11

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
25		3 5 8	SS-7	ML		
30		5 7 10	SS-8	ML	STIFF TO V. STIFF, RED, LT. BR, BLK F. SANDY SILT	GROUT; 2" PVC
35		4 5 9	SS-9	ML		
40		7 9 12	SS-10	ML		
45		8 11 14	SS-11	ML	V. STIFF, RED, BR, GRAY, MIC., FINE SANDY SILT	

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 BOARING REPORT

BORING NO. BLE-11

PAGE 3 OF 5

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
50		3 9 12	SS-12	ML		
55		5 10 10	SS-13	ML	V. STIFF, WHITE, LT. BR, FINE SANDY SILT	
60		16 22 24	SS-14	MH	HARD TO V. STIFF, RED, BR, CLAYEY, F. SANDY SILT	2" PVC
65		6 10 14	SS-15	MH		GROUT
70		2 5 11	SS-16	ML	V. STIFF, GRAY, BR, FI SANDY, SILT	

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

BORING NO. BLE-11
PAGE 4 OF 5

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
						71.0
75		8 10 12	SS-17	ML		
80		10 14 16	SS-18	ML	V. STIFF, GRAY, LT. BR, MIC, FINE SANDY SILT	2" PVC BENTONITE
85		10 18 20	SS-19	MH	V. HARD, RED, GRY, LT BR, CLAYEY, F. SDY SILT	
90		14 16 18	SS-20	ML	V. STIFF TO HARD, GRY, BR, BLK, MIC. 14 F. SANDY SILT — MOIST	90.1
95		8 10 12	SS-21	ML		SAND

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

BORING NO. BLE-11
PAGE 5 OF 5

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
100			SS-22	ML		SAND
						102.4
						102.8
105			SS-23		BORING TERM. @ 103.0	
110			SS-24			
115			SS-25			
120			SS-26			

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

BORING NO. BLE-12

PROJECT: WHITE OAK LF - HAYWOOD CO.
CLIENT:
CONTRACTOR:
EQUIPMENT USED:

BLE JOB NO. J07-1957-02
PAGE NO. 1 of 4
LOCATION:
ELEVATION:
DATE START:
DATE FINISH:
DRILLER: TG-BE
PREPARED BY: TL

GROUND WATER DATE	HRS AFT COMP	DEPTH TO: WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	75.9		
	24	75.9		

	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
		3, 4, 5	SS-1	MH	STIFF, RED ~~BRN~~, CLAYEY, SILT	
5		4, 4, 6	SS-2	MH		
		4, 5, 6	SS-3	ML	STIFF TO V. STIFF, RED, BRN, F. SANDY, SILT	GROUT; 2" PVC
10		5, 7, 9	SS-4	ML		
15		5, 7, 8	SS-5	ML		
20		5, 8, 8	SS-6	ML	V. STIFF, RED & LT. BR, F. SANDY, SILT w/SOME CLAY	

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 = 2.2
TOP SAND = 77.8
TOP BENT. = 68.3
SCREEN = 90.0 - 80.0
SCREEN LENGTH = 10
END CAP = 0.2
WELL TD = 90.2

TEST BORING REPORT

BORING NO. BLB-12

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
25		4 / 8 / 11	SS-7	ML		
30		4 / 8 / 11	SS-8	ML	V. STIF LT. BR + RED, F. SANDY, SILT	GROUT; 2" PVC
35		5 / 8 / 11	SS-9	ML	V. STIFF, BR, RED, BLK, MIC., FINE SANDY, SILT	
40		10 / 10 / 16	SS-10	ML		
45		5 / 8 / 14	SS-11	ML	V. STIFF, BRN, GRAY, MIC., F. SANDY, SILT	

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

BORING NO. BLE-12
PAGE 3 OF 4

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
50		4 / 8 / 12	SS-12	ML		
55		4 / 5 / 9	SS-13	ML	FIRM TO DENSE, BRN, RED, BLK, SILTY, FINE SAND	GROUT; 2" PVC
60		6 / 10 / 23	SS-14	ML		
65		9 / 14 / 18	SS-15	ML	HARD, GRAY, BRN, BLK, MIC, F. SANDY, SILT	
70		10 / 22 / 29	SS-16	ML		68.3

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

BORING NO. BLE-12
PAGE 4 OF 4

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
75		10, 16, 20	SS-17	ML		BENTONITE; 2" PVC
						77.9
80		10, 20, 22	SS-18	ML		80.0
					HARD, GRAY, BR, MIC, F. SANDY SILT	SAND
85		8, 12, 20	SS-19	ML		
90		10, 14, 22	SS-20	ML		90.0; 90.2
					BORING TERM. @ 90.2	
95			SS-21			

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

BORING NO. BLE-13

PROJECT:	White Oak Landfill	BLE JOB NO.	J07-1957-02
CLIENT:	McGill Associates	PAGE NO.	1 of
CONTRACTOR:	Landprobe	LOCATION:	
EQUIPMENT USED:	CME 750 with 4-1/4 inch hollow stem auger	ELEVATION:	

GROUND WATER		DEPTH TO:				CASING	SAMPLER	CORE BARREL
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE	TYPE			
	TOB	69.0			SIZE ID/OD			
	24 Hr	67.5			HAMMER WT	XXX		XXX
					HAMMER FALL	XXX		XXX

DATE START:	7/22/07
DATE FINISH:	7/22/07
DRILLER:	T. Gradwell
PREPARED BY:	T. Livingston

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
		7 7 7	SS-1		Stiff, Dk Red & Br, Si, CLAY	
5		13 13 13	SS-2		PWR, Wh, Pink, Quartz Rock	
		5 7 9	SS-3		V. Stiff, Dk Red, Br, Mic, F-M Sa, SILT	
10		9 14 15	SS-4			Grout; 2" PVC
15		7 10 15	SS-5		V. Stiff, Dk Red, Mic, Cl, F-M Sa, SILT	
20		7 10 15	SS-6			

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP =
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 69.4
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 66.8
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 71.4-81.4
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.2
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 81.6

TEST BORING REPORT

BORING NO. BLE-13 0

White Oak Landfill J07-1957-02 PAGE 2 OF

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
25			UD			
30		8 16 20	SS-7		HARD, DK RED, BR, MIC, F-M SA, SILT	GROUT 2" PVC
35		17 20 24	SS-8			
40		12 18 23	SS-9		HARD, BLK, BR, RED, MIC, SI, F-M SAND	
45		8 15 20	SS-10		HARD, DK BR, MIC, F. SA, SILT	

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

BORING NO. BLE-13 0

White Oak Landfill **J07-1957-02** PAGE 3 OF 4

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
50		8 / 16 / 26	SS-11		HARD, BR + LT BR, MIC, F. SA, SILT	
55		13 / 22 / 22	SS-12		HARD TO V. HARD, BLK, BR, GRAY, MOI, F. SA, SILT	
60		15 / 20 / 23	SS-13			GROUT; 2" PVC
65		28 / 30 / 33	SS-14			66.8
70		23 / 32 / 40	SS-15			BENT; 69.4

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

BORING NO. BLE-130

White Oak Landfill J07-1957-02 PAGE 4 OF 4

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
						71.4
		26 48 50/3"	SS-16		PWR - GRAY + WHITE, Si, F-M SAND	SAND
75						
80						81.4 81.6
		50/3"	SS-17			
85						86
					AUGER REFUSAL @ 86.0' BGS. GW AT 69.0' @ TOB AND 67.5' AFTER 24HRS.	
90						
95						

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

BORING NO. BLE-14

PROJECT: WHITE OAK LF - HAYWOOD CO

CLIENT:

CONTRACTOR:

EQUIPMENT USED:

BLE JOB NO. J07-1957-02

PAGE NO. 1 of 4

LOCATION:

ELEVATION:

DATE START: 9/4/07

DATE FINISH:

DRILLER: TG-BE

PREPARED BY: T. LIVINGSTON

GROUND WATER DATE	HRS AFT COMP	DEPTH TO: WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	59.1		
	24	59.2		

	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	WELL
		3, 4, 6	SS-1	ML	STIFF TO V. STIFF RED, LT BRN, F. SANDY SILT W/ SOME CLAY	
5		4, 5, 7	SS-2	ML		2" PVC
		4, 4, 7	SS-3	ML		GROUT
10		4, 6, 8	SS-4	ML		
15		4, 7, 9	SS-5	ML		
20		6, 9, 11	SS-6	MH	V. STIFF, RED, BRN, BLK, MIC., FINE SANDY, CLAYEY, SILT	

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP = 4.0
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 60.3
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 45.7
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 73.3-63.3
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.2
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 73.5

TEST BORING REPORT

BORING NO. BLE-14

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
25		5 9 12	SS-7	MH		
30		6 8 12	SS-8	MH		GROUT 2" PVC
					V. HARD TO STIFF, GRAY, BRN, MIC., F. SANDY, SILT	
35		11 21 30	SS-9	ML		
40		14 28 33	SS-10	ML		
45		11 16 21	SS-11	ML		

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

BORING NO. BLE-14

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
						45.7
50		9 / 12 / 14	SS-12	ML		
					V. STIFF TO HARD, BR, GRAY, MIC., MOIST, F. SANDY, SILT	BENTONITE; 2" PVC
55		12 / 13 / 16	SS-13	ML		
60		14 / 15 / 18	SS-14	ML		60.3
						63.3
65		13 / 14 / 17	SS-15	ML		SAND
					V. HARD, GRY, BLK, WHITE, SILTY, F-M SAND	
70		50/1"	SS-16	ML		

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

BORING NO. BLE-14

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
						SAND
						73.3
					BORING TERM @ 73.5	73.5
			SS-17		AUGER REFUSAL	
75						
			SS-18			
80						
			SS-19			
85						
			SS-20			
90						
			SS-21			
95						

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

BORING NO. BLE-15

PROJECT:	White Oak Landfill	BLE JOB NO.	J07-1957-02
CLIENT:	McGill Associates	PAGE NO.	1 of 4
CONTRACTOR:	Landprobe	LOCATION:	
EQUIPMENT USED:	CME 750 with 4-1/4 inch hollow stem auger	ELEVATION:	
		DATE START:	7/19/07
		DATE FINISH:	7/20/07
		DRILLER:	T. Gradwell
		PREPARED BY:	T. Livingston

GROUND WATER		DEPTH TO:		
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	57.75		
	24 Hr	57.1		

	CASING	SAMPLER	CORE BARREL
TYPE			
SIZE ID/OD			
HAMMER WT	XXX		XXX
HAMMER FALL	XXX		XXX

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					6" TOPSOIL	
		5, 6, 8	SS-1		STIFF TO V. STIFF, DK RED, SI, CLAY	
5		3, 5, 8	SS-2			
		5, 9, 10	SS-3			2" PVC / GROUT
10		3, 4, 6	SS-4			
15		5, 12, 15	SS-5		V. STIFF TO HARD, BR & PURPLE, MIC, F. SA, CL, SILT	
20		9, 15, 18	SS-6			

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP =
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 62.1
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 59.7
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 64.13-74.13
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.2
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 74.33

TEST BORING REPORT

White Oak Landfill — J07-1957-02

BORING NO. BLE-15 — 0

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
25		9 / 15 / 19	SS-7		HARD, BR, F. SA, CL, SILT	
30		5 / 6 / 11	SS-8		V. STIFF, RED + BR, SI, CLAY	
35		4 / 6 / 6	SS-9		STIFF, LT. BR, F. SA, SILT	GROUT 2" PVC
40		7 / 8 / 9	SS-10		V. STIFF, GRAY + BR, MIC, F. SA, SILT	
45		7 / 9 / 19	SS-11			

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

White Oak Landfill — J07-1957-02

BORING NO. BLE-15 — PAGE 3 OF 4

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
		7				
		9	SS-12			
50		11				GROUT
		7				
		8	SS-13		V. STIFF, BR + GRAY, MIC, F. SA, SILT W/ROCK FRAGMENTS	2" PVC
55		13				
		5				
		9	SS-14			
60		15				59.7
						62.1
		9				
		12	SS-15		V. FIRM, WHITE + LT. BR, MOIST, SI, F-M SAND	64.15
65		14				SAND
		15				
		22	SS-16		V. DENSE, GRAY + BR, SI, F-M SAND	
70		50/6"				

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

BORING NO. BLE-15 0

White Oak Landfill J07-1957-02 PAGE 4 OF 4

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
						SAND
75		14 26 50/4"	SS-17		V. DENSE, OR, BR, S, F-M SAND W/ROCK FRAGMENTS	74.1 74.3 75.
					BORING TERM. @ 75' BGS. GW ENCOUNTERED @ 57.75' @ TOB AND @ 57.1' AFTER 24 HOURS.	
80						
85						
90						
95						

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

BORING NO. BLE-10

PROJECT: White Oak MSW LF
CLIENT: McGill Asso.
CONTRACTOR:
EQUIPMENT USED: 4 ½" HSA

BLE JOB NO. J07-1957-02
PAGE NO. 1 of 4
LOCATION:
ELEVATION:
DATE START: 7/29/07
DATE FINISH:
DRILLER:
PREPARED BY: TL

GROUND WATER		DEPTH TO:		
DATE	HRS AFT COMP	WATER	BOT. OF CASING	BOT. OF HOLE
	TOB	68.5		

	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
		14, 12, 15	SS-1	SM	V. Firm White, Lt Br Silty F-M Sand	
5		6, 10, 11	SS-2	SM		
		7, 7, 9	SS-3	ML	V. Stiff Lt. Br, Red, Wh Fine Sandy Silt	
10		9, 10, 11	SS-4	ML		Grout; 2" PVC
15		8, 12, 15	SS-5	ML		
20		7, 14, 15	SS-6	ML	Red, Dk Red, Blk Fine Sandy Silt V. Stiff To Hard	

BLOWS/FT	DENSITY	BLOWS/FT	CONSISTANCY	SAMPLE ID		WELL DESCRIPTION
0-4	VERY LOOSE	0-2	VERY SOFT	SS	SPLIT SPOON	STICKUP = 4.0
5-10	LOOSE	3-4	SOFT	HP	HYDROPUNCH	TOP SAND = 67.6
11-20	FIRM	5-8	FIRM	UD	UNDISTURBED TUBE	TOP BENT. = 64.7
21-30	VERY FIRM	9-15	STIFF	G	GRAB	SCREEN = 68.2 – 78.2
31-50	DENSE	16-30	VERY STIFF	C	COMPOSITE	SCREEN LENGTH = 10
51+	VERY DENSE	31-50	HARD	B	BAG	END CAP = 0.2
		51+	VERY HARD	NR	NO RECOVERY	WELL TD = 78.4

TEST BORING REPORT

BORING NO. BLE-16

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
					SAME AS ABOVE	GROUT; 2" PVC
25		8, 10, 14	SS-7	ML		
30		9, 11, 18	SS-8	ML		
35		10, 17, 19	SS-9	ML		
40		10, 12, 27	SS-10	ML		
45		12, 20, 27	SS-11	SM	LT RED, LT BR, BLK SILTY FINE SAND	

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

BORING NO. BLE-12
PAGE 3 OF 4

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
50		12 / 25 / 30	SS-12	SM	V. DENSE LT. BR, GRAY SI F-M SAND	GROUT / 2" PVC
55		12 / 15 / 25	SS-13	SM	V. DENSE BR, GRY, RED SI F-M SAND	
60		9 / 16 / 24	SS-14	ML	HARD, BR, GRAY FINE SANDY SILT	
65		10 / 12 / 20	SS-15	ML		64.7 BENTONITE
70		10 / 14 / 20	SS-16	ML		67.4 / 68.2 SAND

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

BORING NO. BLB-16

DEPTH IN FEET	CASING BLOWS PER FT	SAMPLER BLOWS PER 6"	SAMPLE NUMBER	USCS	FIELD CLASSIFICATION AND REMARKS	WELL
75		12 24 25	SS-17	SM	DENSE, GRAY, LT. BROWN, F-M SILTY SAND	SAND
						78.2 78.4
80		8 18 32	SS-18	ML	HARD, GRAY, BRN, F. SANDY SILT	80.0
					BORING TERM. @ 80.0	
85			SS-19			
90			SS-20			
95			SS-21			

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 =

APPENDIX C

SOIL AND ROCK BORING RECORDS AND WELL DIAGRAMS

APPENDIX C

SOIL AND ROCK BORINGS RECORDS AND WELL DIAGRAMS

Piezometers and monitoring wells have been installed at the site since 1990. The piezometers were installed as part of Site Hydrogeologic and Design Hydrogeologic investigations performed at the site in the past. The monitoring wells were installed as part of the water quality monitoring system for the constructed landfill cells.

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

Symbol	Description
	Grab Sample
	Split Spoon Sample
	Undistrurbed Sample

NR = No reaction to HCL

NA = Not applicable

NS = No sample

Symbol	Description
▽	Groundwater Table at Time of Drilling
▼	Groundwater Table 24 Hours after Completion of Drilling

KEY TO SOIL CLASSIFICATIONS

Well-graded Gravel GW	Low Plasticity Clay CL	Clayey Silt MH	Silty Sand SM
Poorly-graded Gravel GP	Sandy Clay CLS	Sandy Silt MLS	Topsoil TOPSOIL
Partially Weathered Rock BLDRCBBL	Silty Clay CL-ML	Sand SW	Trash MUCKPEAT
High Plasticity Clay CH	Silt ML	Clayey Sand SC	Fill FILL

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-1

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02

CLIENT: McGill Associates — START: 7-18-07 END: 7-18-07

LOCATION: Haywood County, North Carolina — ELEVATION: 2574.23

DRILLER: Landprobe, T. Gradwell — LOGGED BY: T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ∇ 48 — AFTER 24 HOURS: ▼ 42.5 — CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES (blows)	STANDARD PENETRATION RESULTS BLOWS/FOOT (N)
0	6-inches of TOPSOIL		
0.5–3.5	Stiff, light brownish-yellow, fine sandy SILT - (residuum)	2, 5, 6	11
3.5–6 (2570 at 4)	Brown, micaceous, slightly clayey, sandy SILT	UD	
6–13.5 (2565 at 9)	Very stiff, grayish-brown, fine sandy SILT	4, 10, 10	20
		4, 7, 9	16
13.5–18.5 (2560 at 14)	Very stiff, brown, micaceous, fine sandy SILT	4, 12, 13	25
18.5–23.5 (2555 at 19)	Very stiff, brown and gray and white, micaceous, fine to medium sandy SILT with rock fragments	4, 11, 11	22
23.5–33.5 (2550 at 24; 2545 at 29)	Very stiff, grayish-brown, micaceous, fine to medium sandy SILT	9, 13, 13	26
		9, 13, 14	27
33.5–38.5 (2540 at 34)	Very stiff, light brownish-white, micaceous, fine to medium sandy SILT	9, 14, 15	29
38.5– (2535 at 39)	Hard to very stiff, brown and black, micaceous, fine to medium sandy SILT	12, 16, 22	38

MONITOR WELL INSTALLATION DETAILS

SURFACE COMPLETION
3.57-foot stick-up

Neat cement grout, 0 to 50.6 feet

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-1

PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START: 7-18-07	END: 7-18-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2574.23
DRILLER:	Landprobe, T. Gradwell	LOGGED BY:	T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ▽ 48 AFTER 24 HOURS: ▼ 42.5 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
42 ▼	Hard to very stiff, brown and black, micaceous, fine to medium sandy SILT				
2530 – 44			X	5 10 19	
46					
48 ▽					
2525 – 50			X	5 9 12	
52					Bentonite seal, 50.6 to 52.8 feet
2520 – 54			X	6 8 15	Filter pack, sand 52.8 to 66 feet
56					
58					
2515 – 60			X	7 10 12	
62					2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 55 to 65 feet
2510 – 64	PARTIALLY WEATHERED ROCK which sampled as gray and white, micaceous, silty, fine to medium SAND		X	50/3"	
66	Auger refusal at 66 feet. Groundwater encountered at 48.0 feet at time of drilling and at 42.5 feet after 24 hours.				Pipe cap Total well depth, 65.2 feet
68					
2505 – 70					
72					
2500 – 74					
76					
78					
2495					

SPT scale: 2 5 10 20 30 40 50 70 90

GEOT_WELL 1957-02. /11/08

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BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

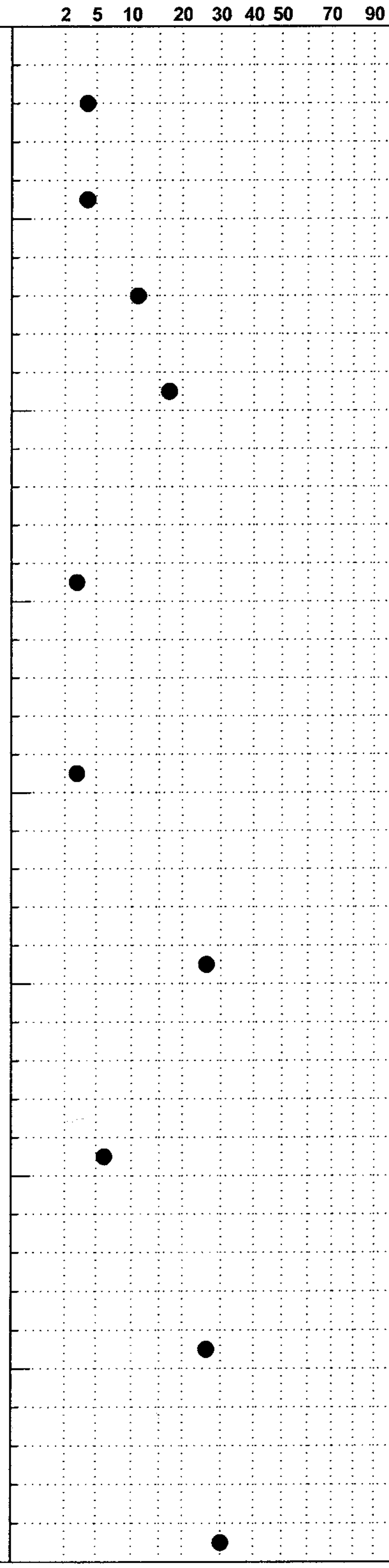
GROUNDWATER MONITORING WELL NO. BLE-2

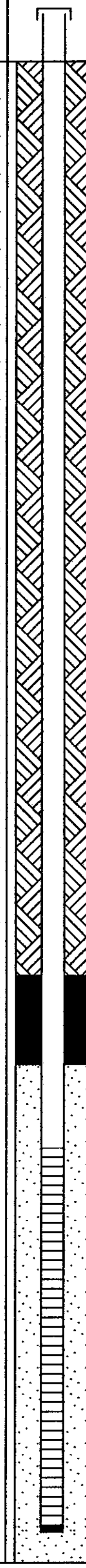
PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START: 7-13-07	END: 7-13-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2525.68
DRILLER:	Landprobe, T. Gradwell	LOGGED BY:	T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ▽ 17.1 AFTER 24 HOURS: ▼ 12.45 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
2525	6-inches of TOPSOIL		**SURFACE COMPLETION** 3.91-foot stick-up
2	Soft, brown, fine to medium sandy, silty CLAY - (residuum)	2 2 2	
4	Soft, yellowish-brown, micaceous, fine to medium sandy SILT	2 2 2	
2520 / 6	Firm, blackish-brown, moist, micaceous, silty, fine SAND	4 5 6	
8 / 10 / 2515 / 12		3 6 11	Neat cement, 0 to 24.4 feet
14 / 2510 / 16	Soft, tan, gray and white, moist, micaceous, fine to medium sandy SILT	2 1 2	
18 / 20 / 2505 / 22	Soft, grayish-brown, micaceous, wet, fine sandy SILT	2 1 2	
24 / 2500 / 26	Very firm, brown, black and gray, micaceous, silty, fine to medium SAND - saprolite	7 7 19	Bentonite seal, 24.4 to 26.8 feet
28			Filter pack, sand 26.8 to 40 feet
30 / 2495 / 32	Loose, gray and brown, micaceous, silt, fine to medium SAND	2 2 4	
34 / 2490 / 36 / 38	Very firm, micaceous, gray and brown, silty, fine to medium SAND - saprolite	5 11 15	2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 29 to 39 feet
	Very firm, gray and brown, silty, fine to medium SAND	7 12 18	Pipe cap





GROUNDWATER MONITORING WELL NO. BLE-2

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02
CLIENT: McGill Associates — START: 7-13-07 END: 7-13-07
LOCATION: Haywood County, North Carolina — ELEVATION: 2525.68
DRILLER: Landprobe, T. Gradwell — LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ∇ 17.1 AFTER 24 HOURS: ▼ 12.45 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
2485	Boring terminated at 40 feet. Groundwater encountered at 17.1 feet at time of drilling and at 12.45 feet after 24 hours.				Total well depth, 39.2 feet
42					
44					
2480 / 46					
48					
50					
2475 / 52					
54					
2470 / 56					
58					
60					
2465 / 62					
64					
2460 / 66					
68					
70					
2455 / 72					
74					
2450 / 76					
78					

GROUNDWATER MONITORING WELL NO. BLE-3

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PROJECT: White Oak MSW Landfill
PROJECT NO.: J07-1957-02
CLIENT: McGill Associates
START: 7-12-07 END: 7-12-07
LOCATION: Haywood County, North Carolina
ELEVATION: 2519.77
DRILLER: Landprobe, T. Gradwell
LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 19.5 AFTER 24 HOURS: ▼ 18.44 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
0 – 0.5	6-inches of TOPSOIL			SURFACE COMPLETION: 3.68-foot stick-up
0.5 – 3	Firm, brown, silty, fine to medium SAND - (fill)	SPT	2, 2, 4	
3 – 6	Soft, light brown, micaceous, fine sandy SILT - (fill)	SPT	2, 2, 2	
6 – 14	Loose, brown, silty, fine to coarse SAND - (residuum)	UD; SPT	UD; 2, 4, 5	
14 – 19	Very firm, brown and black, micaceous, silty, fine to coarse SAND	SPT	7, 10, 15	Neat cement, 0 to 33 feet
19 – 24	Loose, light gray and white, silty, fine to medium SAND	SPT	3, 4, 5	
24 – 29	Light gray and white, silty, fine to medium SAND	UD	UD	
29 – 34	Very stiff, gray and brown, wet, micaceous, fine to medium sandy SILT	SPT	6, 8, 10	
34 – 39	Dense, gray, white and black, micaceous, silty, fine to medium SAND	SPT	12, 19, 19	Bentonite seal, 33 to 36 feet; Filter pack, sand 36 to 50 feet
39 –	Very firm, dark brown, micaceous, silty, fine to medium SAND with rock fragments	SPT	9, 12, 12	2-inch diameter, 0.010-inch slotted Schedule 40 PVC well

Elevation scale: 2515, 2510, 2505, 2500, 2495, 2490, 2485, 2480
Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38
Blows/foot scale: 2, 5, 10, 20, 30, 40, 50, 70, 90

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-3

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02
CLIENT: McGill Associates — START: 7-12-07 END: 7-12-07
LOCATION: Haywood County, North Carolina — ELEVATION: 2519.77
DRILLER: Landprobe, T. Gradwell — LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 19.5 AFTER 24 HOURS: ▼ 18.44 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
42	Very firm, dark brown, micaceous, silty, fine to medium SAND with rock fragments				screen, 38 to 48 feet
44 / 2475	Dense, gray, micaceous, silty, fine to medium SAND with rock fragments		X	13, 19, 28	2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 38 to 48 feet
48					Pipe cap
50 / 2470	Very dense, white and brown, micaceous, silty, fine to medium SAND		X	12, 26, 31	Total well depth, 48.2 feet
50	Boring terminated at 50 feet. Groundwater encountered at 19.5 feet at time of drilling and at 18.44 feet after 24 hours.				

Depth scale: 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78
Elevation scale: 2475, 2470, 2465, 2460, 2455, 2450, 2445, 2440
SPT scale: 2 5 10 20 30 40 50 70 90

GEOT_WELL 1957-02.G... /11/08

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SOIL TEST BORING NO. BLE-4

PROJECT: White Oak MSW Landfill | PROJECT NO.: J07-1957-02

CLIENT: McGill Associates | START: 9-6-07 END: 9-6-07

LOCATION: Haywood County, North Carolina | ELEVATION: 2560.09

DRILLER: Landprobe, T. Gradwell | LOGGED BY: T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ▽ ______ AFTER 24 HOURS: ▼ ______ CAVING> ______

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE
	6-inches of TOPSOIL	
	No sample	
	Auger refusal at 2.5 feet on fill boulders. Four test pits advanced to depths of 10 to 11 feet below ground surface were performed by McGill Associates on 6-4-08. The test pits encountered fill soil with numerous boulders which were found to be responsible for the auger refusal in BLE-4. Bedrock was not encountered in any test pit. No ground water encountered at time of drilling.	

Elevation scale: 2555, 2550, 2545, 2540, 2535, 2530, 2525
Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38

GEOT_NOWELLNB 19[illegible]GPJ 7/11/08

GROUNDWATER MONITORING WELL NO. BLE-5

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START: 7-16-07	END: 7-16-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2497.10
DRILLER:	Landprobe, T. Gradwell	LOGGED BY:	T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ∇ 11.3 AFTER 24 HOURS: ▼ 4.6 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES (blows)	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
0 – 0.5	6-inches of TOPSOIL			**SURFACE COMPLETION** 3.91-foot stick-up
2495 / 2	Firm, brown, silty CLAY - (residuum)	1 2 3	5	
4 (▼ 4.6)	Firm, brown, black and gray, moist, micaceous, fine sandy, clayey SILT	3 2 3	5	Neat cement, 0 to 10.6 feet
2490 / 6	Firm, brown, moist, micaceous, fine to medium sandy SILT	1 2 3	5	
8 – 10 (∇ 11.3)	Very firm, light brown/black, moist, silty, fine to coarse SAND	5 10 12	22	Bentonite seal, 10.6 to 12.9 feet
2485 / 14	Firm, gray and brown, wet, micaceous, silty, fine SAND	5 7 8	15	Filter pack, sand 12.9 to 25.2 feet
2480 / 18 – 2475 / 22	PARTIALLY WEATHERED ROCK which sampled as gray and brown, silty SAND with rock fragments	50/4"	50/4"	2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 15 to 25 feet
24	Dense, black and brown, micaceous, silty SAND with rock fragments	9 29 10	39	Pipe cap
2470 / 26	Auger refusal at 26 feet. Groundwater encountered at 11.3 feet at time of drilling and at 4.6 feet after 24 hours.			Total well depth, 25.2 feet

GEOT_WELL 1957-02. 11/08

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-6

PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START: 9-6-07	END: 9-6-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2532.96
DRILLER:	Landprobe, T. Gradwell	LOGGED BY:	T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ▽ 44.65 AFTER 24 HOURS: ▼ 44.70 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES / STANDARD PENETRATION RESULTS BLOWS/FOOT
0	6-inches of TOPSOIL	
0.5	Firm to stiff, brown and red, slightly clayey, fine sandy SILT - (residuum)	3-3-4
2530 / 3	Firm to very firm, brown, red and black, silty, fine to medium SAND	4-5-6; 5-6-6; 6-8-10; 4-8-10
2515 / 17	Firm to very firm, brown, black and gray, silty, fine to medium SAND	5-7-8; 5-9-13
2505 / 27	Firm, gray and brown, micaceous, silty, fine SAND	5-9-10
2500 / 32	Stiff, gray and black, micaceous, fine sandy SILT	5-6-9
2495 / 37	Very stiff, brown, micaceous, fine sandy SILT	5-7-10

MONITOR WELL INSTALLATION DETAILS

SURFACE COMPLETION
3.74-foot stick-up

Neat cement, 0 to 27 feet

Bentonite seal, 27 to 33.4 feet

Filter pack, sand 33.4 to 46.2 feet

2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 36 to 46 feet

GROUNDWATER MONITORING WELL NO. BLE-6

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PROJECT: White Oak MSW Landfill | PROJECT NO.: J07-1957-02
CLIENT: McGill Associates | START: 9-6-07 END: 9-6-07
LOCATION: Haywood County, North Carolina | ELEVATION: 2532.96
DRILLER: Landprobe, T. Gradwell | LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: 44.65 AFTER 24 HOURS: 44.70 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
42	Very stiff, brown, micaceous, fine sandy SILT				2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 36 to 46 feet
2490 – 44	Very stiff, gray and brown, micaceous, slightly moist, fine sandy SILT		X	6-8-11	
46	GNEISS rock fragments				Pipe cap
2485 – 48	Auger refusal at 46 feet. Groundwater encountered at 44.65 feet at time of drilling and at 44.70 feet after 24 hours.				Total well depth, 46.2 feet
50					
52					
2480 – 54					
56					
2475 – 58					
60					
62					
2470 – 64					
66					
2465 – 68					
70					
72					
2460 – 74					
76					
2455 – 78					

Blows/foot scale: 2 5 10 20 30 40 50 70 90

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-7S

PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START: 7-17-07	END: 7-17-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2492.12
DRILLER:	Landprobe, T. Gradwell	LOGGED BY:	T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ▽ 10.3 AFTER 24 HOURS: ▼ 7.8 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	STANDARD PENETRATION RESULTS BLOWS/FOOT (samples)
0–0.5	6-inches of TOPSOIL	
0.5–6	Firm, light brown, very sandy, clayey SILT - (residuum)	3-3-5; 2-3-3
6–8.5	Loose, light brown, black and gray, silty SAND	2-4-5
8.5–13.5	Firm, light brown and white, wet, silty, fine to coarse SAND	2-5-7
13.5–18.5	Loose, gray and brown, wet, micaceous, silty, fine to medium SAND	2-2-3
18.5–23.5	Firm, dark brown and gray, wet, micaceous, silty, fine to medium SAND	4-5-6
23.5–26	Firm, gray and brown, micaceous, silty, fine to medium SAND	3-5-6
26	Auger refusal at 26 feet. Groundwater encountered at 10.3 feet at time of drilling and at 7.8 feet after 24 hours.	

Elevation scale: 2490 (2 ft), 2485, 2480, 2475, 2470, 2465, 2460, 2455; depth scale 2 to 38 ft.

Blows/foot scale: 2 5 10 20 30 40 50 70 90

MONITOR WELL INSTALLATION DETAILS

SURFACE COMPLETION
Flush

Neat cement, 0 to 10.8 feet

Bentonite seal, 10.8 to 13 feet

Filter pack, sand 13 to 26 feet

2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 15.07 to 25.07 feet

Pipe cap

Total well depth, 25.27 feet

GEOT_WELL 1957-02. /11/08

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-7D

PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START: 9-11-07	END: 9-12-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2491.92
DRILLER:	Landprobe, T. Gradwell/BF	LOGGED BY:	T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger and NQ rock coring

DEPTH TO - WATER> INITIAL: 8.3 AFTER 24 HOURS: 8.3 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES (BLOWS)	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)	MONITOR WELL INSTALLATION DETAILS
0	6-inches of TOPSOIL			SURFACE COMPLETION 3.8-foot stick-up
0.5 (2490 at 2)	Firm, light brown, very sandy, clayey SILT - (residuum)	3-3-5		
4		2-3-3		
6 (2485 at 7)	Loose, light brown, black and gray, silty SAND	2-4-5		
8	Firm, light brown and white, wet, silty, fine to coarse SAND	2-5-7		
13 (2480 at 12)	Loose, gray and brown, wet, micaceous, silty, fine to medium SAND	2-2-3		Neat cement, 0 to 30.2 feet
18 (2475 at 17)	Firm, dark brown and gray, wet, micaceous, silty, fine to medium SAND	4-5-6		
23 (2470 at 22)	Firm, gray and brown, micaceous, silty, fine to medium SAND	3-5-6		
32 (2460)	Auger refusal at 32 feet. Changed over to rock coring.	R-1		
33	Hard, slightly weathered, brown, dark gray and white, coarse grained QUARTZ FELDSPAR BIOTITE GNEISS; with thick foliation, very close stained fractures R-1 recovery = 42%, RQD = 25%			Bentonite seal, 30.2 to 46.9 feet
35.5 (2455 at 37)	Very hard, fresh, brown, dark gray and white, fine to coarse grained QUARTZ FELDSPAR BIOTITE GNEISS; moderate foliation, thin foliation and close to very closely spaced stained fragments R-2 recovery = 100%, RQD = 98% R-3 recovery = 100%, RQD = 90%	R-2		

Groundwater encountered at 8 ft.

GEOT_WELL 1957-02.GPJ 11/08

GROUNDWATER MONITORING WELL NO. BLE-7D

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02
CLIENT: McGill Associates — START: 9-11-07 END: 9-12-07
LOCATION: Haywood County, North Carolina — ELEVATION: 2491.92
DRILLER: Landprobe, T. Gradwell/BF — LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger and NQ rock coring
DEPTH TO - WATER> INITIAL: ∇ 8.3 AFTER 24 HOURS: ▼ 8.3 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
40–60 (2450 at 42, 2445, 2440, 2435)	R-4 recovery = 90%, RQD = 83% R-5 recovery = 97%, RQD = 50% R-6 recovery = 100%, RQD = 72%		R-3, R-4, R-5, R-6		Bentonite seal, 30.2 to 46.9 feet Filter pack, sand 46.9 to 60 feet 2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 49.6 to 59.6 feet Pipe cap
60–80 (2430, 2425, 2420, 2415)	Boring terminated at 60 feet. Groundwater encountered at 8.3 feet at time of drilling and at 8.3 feet after 24 hours.				Total well depth, 59.8 feet

Depth scale: 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78
Elevation scale: 2450, 2445, 2440, 2435, 2430, 2425, 2420, 2415

GEOT_WELL 1957-02 [illegible]/11/08

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SOIL TEST BORING NO. BLE-8

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02

CLIENT: McGill Associates — START: 7-18-07 END: 7-18-07

LOCATION: Haywood County, North Carolina — ELEVATION: 2473.09

DRILLER: Landprobe, T. Gradwell — LOGGED BY: T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ∇ ______ AFTER 24 HOURS: ▼ ______ CAVING> ______

ELEVATION/ DEPTH (FT)	SOIL DESCRIPTION	SOIL TYPE
0–0.5	6-inches of TOPSOIL	
0.5–3 (2470 at ~3)	Gray and brown, micaceous, silty, fine to medium SAND	
3	Auger refusal at 3 feet. No groundwater encountered at time of drilling.	

Elevation scale: 2470, 2465, 2460, 2455, 2450, 2445, 2440, 2435

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38

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BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-9

PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START: 9-6-07	END: 9-7-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2552.54
DRILLER:	Landprobe, T. Gradwell	LOGGED BY:	T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger and NQ rock coring

DEPTH TO - WATER> INITIAL: ∇ 42.7 AFTER 24 HOURS: ▼ 43.0 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT
0 – 0.5	6-inches of TOPSOIL		
0.5 – 5	Firm to stiff, brown and gray, micaceous, fine sandy, clayey SILT - (residuum)	3-4-4	8
		4-5-5	10
5 – 20	Firm, brown, silty, fine to medium SAND	5-5-6	11
		5-6-7	13
		UD	
		5-7-8	15
20 – 25	PARTIALLY WEATHERED ROCK which sampled as gray and white, silty SAND with rock fragments	50/5"	50/5"
25	Auger refusal at 25 feet.		
25 –	Moderately hard, slightly weathered, brown, dark gray and white, fine to coarse grained, QUARTZ FELDSPAR BIOTITE GNEISS; with moderately developed, very thin, shallow dipping foliation, and close to very closely spaced, shallow and steeply dipping, iron stained fractures R-1 recovery = 80%, RQD = 50% R-2 recovery = 75%, RQD = 62% R-3 recovery = 92%, RQD = 68% R-4 recovery = 97%, RQD = 87%	R-1, R-2, R-3	

Elevation scale: 2550, 2545, 2540, 2535, 2530, 2525, 2520, 2515. Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38.

Blows/foot scale: 2 5 10 20 30 40 50 70 90

MONITOR WELL INSTALLATION DETAILS

SURFACE COMPLETION
4.12-foot stick-up

Neat cement, 0 to 23.6 feet

Bentonite seal, 23.6 to 35.4 feet

Filter pack, sand 35.4 to 49 feet

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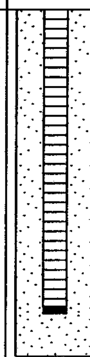
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-9

PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START: 9-6-07	END: 9-7-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2552.54
DRILLER:	Landprobe, T. Gradwell	LOGGED BY:	T. Livingston
DRILLING METHOD:	8-1/4 inch O.D. hollow stem auger and NQ rock coring		
DEPTH TO - WATER>	INITIAL: 42.7	AFTER 24 HOURS: 43.0	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
2510 / 42–48	Moderately hard, slightly weathered, brown, dark gray and white, fine to coarse grained, QUARTZ FELDSPAR BIOTITE GNEISS; with moderately developed, very thin, shallow dipping foliation, and close to very closely spaced, shallow and steeply dipping, iron stained fractures R-1 recovery = 80%, RQD = 50% R-2 recovery = 75%, RQD = 62% R-3 recovery = 92%, RQD = 68% R-4 recovery = 97%, RQD = 87%		R-4		2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 37.7 to 47.7 feet
2505 / 46–49	Soft, moderately weathered, brown and gray, fine grained BIOTITE SCHIST; with well developed, very thin, shallow dipping foliation, shallow dipping, iron stained fracture		R-5		Pipe cap
49–53	Hard, very slightly weathered, brown, dark gray and white, fine to coarse grained, QUARTZ-FELDSPAR-BIOTITE GNEISS; moderately developed foliation, very closely spaced fractures R-5				Total well depth, 47.9 feet
2500	Boring terminated at 49 feet. Groundwater encountered at 42.7 feet at time of drilling and at 43.0 feet after 24 hours.				



Depth scale: 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78
Elevation scale: 2510, 2505, 2500, 2495, 2490, 2485, 2480, 2475

GEOT_WELL 1957-02. /11/08

GROUNDWATER MONITORING WELL NO. BLE-10

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START:	7-24-07 END: 7-26-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2612.97
DRILLER:	Landprobe, T. Gradwell	LOGGED BY:	T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ▽ 61.5 AFTER 24 HOURS: ▼ ______ CAVING> ______

ELEVATION/ DEPTH (FT): 2610 (≈3 ft), 2605 (≈8 ft), 2600 (≈13 ft), 2595 (≈18 ft), 2590 (≈23 ft), 2585 (≈28 ft), 2580 (≈33 ft), 2575 (≈38 ft); depth scale 2 – 38

DESCRIPTION
Firm, dark red and light brown, silty, fine to medium SAND - (residuum)
Very firm, light brown, silty, fine to medium SAND
Very stiff, dark red and light brown, slightly clayey, fine to medium sandy SILT
Very firm, red, brown and gray, silty, fine to medium SAND
Hard, red, brown and gray, fine sandy SILT
Very hard to hard, light brown, gray and black, fine to medium sandy SILT

STANDARD PENETRATION RESULTS BLOWS/FOOT (scale: 2 5 10 20 30 40 50 70 90)

Depth (ft, approx.)	Blows
1–2.5	4, 6, 6
3.5–5	6, 10, 15
6–7.5	6, 11, 14
8.5–10	6, 12, 13
13.5–15	10, 12, 15
18.5–20	8, 13, 16
23.5–25	11, 16, 15
28.5–30	11, 15, 13
33.5–35	9, 16, 20
38.5–40	11, 20, 37

MONITOR WELL INSTALLATION DETAILS

SURFACE COMPLETION
2.78-foot stick-up

Neat cement, 0 to 62.7 feet

GEOT_WELL 1957-02 /11/08

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-10

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02
CLIENT: McGill Associates — START: 7-24-07 END: 7-26-07
LOCATION: Haywood County, North Carolina — ELEVATION: 2612.97
DRILLER: Landprobe, T. Gradwell — LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ∇ 61.5 AFTER 24 HOURS: ▼ ______ CAVING> ______

ELEVATION/ DEPTH (FT)	DESCRIPTION
41 to 57	Very hard to hard, light brown, gray and black, fine to medium sandy SILT
57 to 62	Very stiff, brown, white and gray, fine sandy SILT
62 to 67	Hard, gray, brown and white, fine sandy SILT
67 to 78.9	Hard to very hard, gray and brown, micaceous, moist, fine sandy SILT
78.9	Boring terminated at 78.9 feet.

Elevation scale: 2570 (approx. 43 ft), 2565 (48 ft), 2560 (53 ft), 2555 (58 ft), 2550 (63 ft), 2545 (68 ft), 2540 (73 ft), 2535 (78 ft). Depth scale: 42 to 78 ft. Water level (∇) at 61.5 ft.

STANDARD PENETRATION RESULTS BLOWS/FOOT (scale: 2 5 10 20 30 40 50 70 90)

Sample depth (ft)	Blows
43.5–45	10 / 26 / 26
48.5–50	11 / 20 / 21
53.5–55	10 / 12 / 20
58.5–60	6 / 14 / 27
63.5–65	14 / 28 / 30
68.5–70	13 / 21 / 25
73.5–75	11 / 20 / 50

MONITOR WELL INSTALLATION DETAILS

- Neat cement, 0 to 62.7 feet
- Bentonite seal, 62.7 to 66.7 feet
- Filter pack, sand 66.7 to 78.9 feet
- 2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 68.7 to 78.7 feet
- Pipe cap

GEOT_WELL 1957-02 .../11/08

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-10

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02
CLIENT: McGill Associates — START: 7-24-07 END: 7-26-07
LOCATION: Haywood County, North Carolina — ELEVATION: 2612.97
DRILLER: Landprobe, T. Gradwell — LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 61.5 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
	Groundwater encountered at 61.5 feet at time of drilling.				Total well depth, 78.9 feet
82					
2530					
84					
86					
2525 — 88					
90					
92					
2520					
94					
96					
2515 — 98					
100					
102					
2510					
104					
106					
2505 — 108					
110					
112					
2500					
114					
116					
2495 — 118					

GEOT_WELL 1957-02.[illegible]/11/08

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-11

PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START: 8-3-07	END: 8-3-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2630.61
DRILLER:	Landprobe, K. Thomas	LOGGED BY:	T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ▽ 89.7 AFTER 24 HOURS: ▼ 84.6 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
2630 / 0	Stiff to very stiff, dark red and light brown, fine sandy SILT - (residuum)		SURFACE COMPLETION 3.68-foot stick-up
2		3-4-7	
4		3-6-9	
2625 / 6		4-6-8	
8 / 10		4-9-10	
2620 / 12	Stiff, dark red and light brown, fine sandy SILT		
14		3-5-7	
2615 / 16 / 18 / 20		4-5-9	Neat cement, 0 to 71.0 feet
2610 / 22 / 24		3-5-8	
2605 / 26	Stiff to very stiff, red, light brown and black, fine sandy SILT		
28 / 30		5-7-10	
2600 / 32 / 34		4-5-9	
2595 / 36 / 38		7-9-12	

STANDARD PENETRATION RESULTS scale: 2 5 10 20 30 40 50 70 90

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-11

PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START: 8-3-07	END: 8-3-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2630.61
DRILLER:	Landprobe, K. Thomas	LOGGED BY:	T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ∇ 89.7 AFTER 24 HOURS: ▼ 84.6 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
2590 / 41–42	Stiff to very stiff, red, light brown and black, fine sandy SILT				
42–52	Very stiff, red, brown and gray, micaceous, fine sandy SILT		✕ (43.5–45)	8-11-14	
			✕ (48.5–50)	3-9-12	Neat cement, 0 to 71.0 feet
52–57	Very stiff, white and light brown, fine sandy SILT		✕ (53.5–55)	5-10-10	
57–67	Hard to very stiff, red and brown, clayey, fine sandy SILT		✕ (58.5–60)	16-22-24	
			✕ (63.5–65)	6-10-14	
67–77	Very stiff, gray and brown, fine sandy SILT		✕ (68.5–70)	2-5-11	
			✕ (73.5–75)	8-10-12	Bentonite seal, 71.0 to 90.1 feet
77–	Very stiff, gray and light brown, micaceous, fine sandy SILT		✕ (78.5–80)	10-14-16	

Elevation scale: 2590, 2585, 2580, 2575, 2570, 2565, 2560, 2555. Depth scale: 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78. Blows/foot scale: 2, 5, 10, 20, 30, 40, 50, 70, 90.

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BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-11

PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START: 8-3-07	END: 8-3-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2630.61
DRILLER:	Landprobe, K. Thomas	LOGGED BY:	T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ▽ 89.7 AFTER 24 HOURS: ▼ 84.6 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES / STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
2550 / 81–82	Very stiff, gray and light brown, micaceous, fine sandy SILT		Bentonite seal, 71.0 to 90.1 feet
82–87	Hard, red, gray and light brown, clayey, fine sandy SILT	10-18-20 (84–85.5)	
87–103	Very stiff to hard, gray, brown and black, micaceous, moist, fine sandy SILT	14-16-18 (89–90.5); 8-10-12 (94–95.5)	Filter pack, sand 90.1 to 102.8 feet; 2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 92.6 to 102.6 feet; Pipe cap; Total well depth, 102.8 feet
103	Boring terminated at 103.0 feet. Groundwater encountered at 89.7 feet at time of drilling and at 84.6 feet after 24 hours.		

Elevation scale: 2550, 2545, 2540, 2535, 2530, 2525, 2520, 2515. Depth scale: 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118. Blows/foot scale: 2, 5, 10, 20, 30, 40, 50, 70, 90.

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-12

PROJECT: White Oak MSW Landfill
PROJECT NO.: J07-1957-02
CLIENT: McGill Associates
START: 8-30-07 END: 8-31-07
LOCATION: Haywood County, North Carolina
ELEVATION: 2620.95
DRILLER: Landprobe, T. Gradwell
LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ∇ 75.9 AFTER 24 HOURS: ▼ 75.9 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES (blows)	MONITOR WELL INSTALLATION DETAILS
2620 / 0–5	Stiff, red, clayey SILT - (residuum)	3-4-5; 4-4-6	SURFACE COMPLETION 3.57-foot stick-up
2615 / 5–15	Stiff to very stiff, red and brown, fine sandy SILT	4-5-6; 5-7-9; 5-7-8	
2605 / 15–27	Very stiff, red and light brown, fine sandy SILT with some clay	5-8-8; 4-8-11	Neat cement, 0 to 68.3 feet
2595 / 27–32	Very stiff, light brown and red, fine sandy SILT	4-8-11	
2590 / 32–40	Very stiff, brown, red and black, micaceous, fine sandy SILT	5-8-11; 10-10-16	

STANDARD PENETRATION RESULTS BLOWS/FOOT (scale: 2 5 10 20 30 40 50 70 90)

GROUNDWATER MONITORING WELL NO. BLE-12

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BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START: 8-30-07	END: 8-31-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2620.95
DRILLER:	Landprobe, T. Gradwell	LOGGED BY:	T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ∇ 75.9 AFTER 24 HOURS: ▼ 75.9 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION
2580 / 41–42	Very stiff, brown, red and black, micaceous, fine sandy SILT
42–52	Very stiff, brown and gray, micaceous, fine sandy SILT
52–62	Firm to dense, brown, red and black, silty, fine SAND
62–80	Hard to very hard, gray, brown and black, micaceous, fine sandy SILT

STANDARD PENETRATION RESULTS BLOWS/FOOT (2, 5, 10, 20, 30, 40, 50, 70, 90)

Sample depth (ft)	Blows
44	5 8 14
49	4 8 12
54	4 5 9
59	6 10 23
64	9 14 18
69	10 22 29
74	10 16 20
79	10 20 22

MONITOR WELL INSTALLATION DETAILS

- Neat cement, 0 to 68.3 feet
- Bentonite seal, 68.3 to 77.8 feet
- Filter pack, sand 77.8 to 90.2 feet

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GROUNDWATER MONITORING WELL NO. BLE-12

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BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PROJECT: White Oak MSW Landfill | PROJECT NO.: J07-1957-02
CLIENT: McGill Associates | START: 8-30-07 END: 8-31-07
LOCATION: Haywood County, North Carolina | ELEVATION: 2620.95
DRILLER: Landprobe, T. Gradwell | LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ∇ 75.9 AFTER 24 HOURS: ▼ 75.9 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
2540	Hard to very hard, gray, brown and black, micaceous, fine sandy SILT				
82	Hard, gray and brown, micaceous, fine sandy SILT				Filter pack, sand 77.8 to 90.2 feet
84			X	8 / 12 / 20	
2535 / 86					
88			X	10 / 14 / 22	2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 80.0 to 90.0 feet
90					Pipe cap
2530	Boring terminated at 90.2 feet. Groundwater encountered at 75.9 feet at time of drilling and at 75.9 feet after 24 hours.				Total well depth, 90.2 feet
92					
94					
2525 / 96					
98					
100					
2520 / 102					
104					
2515 / 106					
108					
110					
2510 / 112					
114					
2505 / 116					
118					

SPT scale: 2 5 10 20 30 40 50 70 90

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GROUNDWATER MONITORING WELL NO. BLE-13

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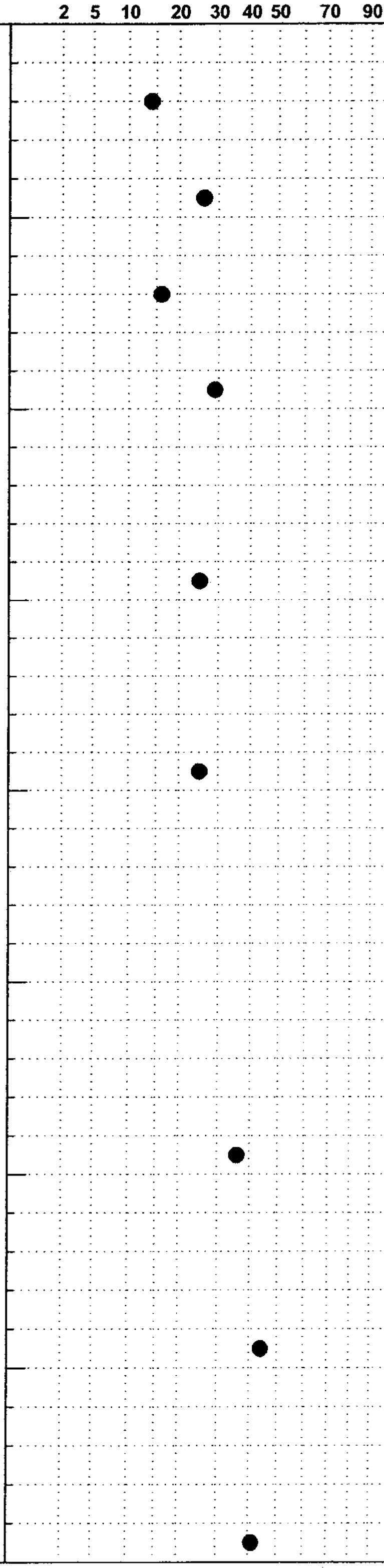
BUNNELL-LAMMONS ENGINEERING, INC.
Geotechnical And Environmental Consultants

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02
CLIENT: McGill Associates — START: 7-22-07 END: 7-22-07
LOCATION: Haywood County, North Carolina — ELEVATION: 2609.39
DRILLER: Landprobe, T. Gradwell — LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ∇ 69.0 AFTER 24 HOURS: ▼ 67.5 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT
0–3.5	Stiff, dark red and brown, silty CLAY - (residuum)		X	7 7 7
3.5–6 (2605 at 4.4)	White and pinkish, quartz GRAVEL		X	13 13 13
6–13.5 (2600 at 9.4)	Very stiff, dark red and brown, micaceous, fine to medium sandy SILT		X	5 7 9
			X	9 14 15
13.5–28.5 (2595, 2590, 2585)	Very stiff, dark red and brown, micaceous, clayey, fine to medium sandy SILT		X	7 10 15
			X	7 10 15
28.5– (2580, 2575, 2570)	Hard, dark red, red and brown, micaceous, fine to medium sandy SILT		X	8 16 20
			X	17 20 24
			X	12 18 23

STANDARD PENETRATION RESULTS BLOWS/FOOT: 2 5 10 20 30 40 50 70 90



MONITOR WELL INSTALLATION DETAILS

SURFACE COMPLETION
3.29-foot stick-up

Neat cement, 0 to 66.8 feet

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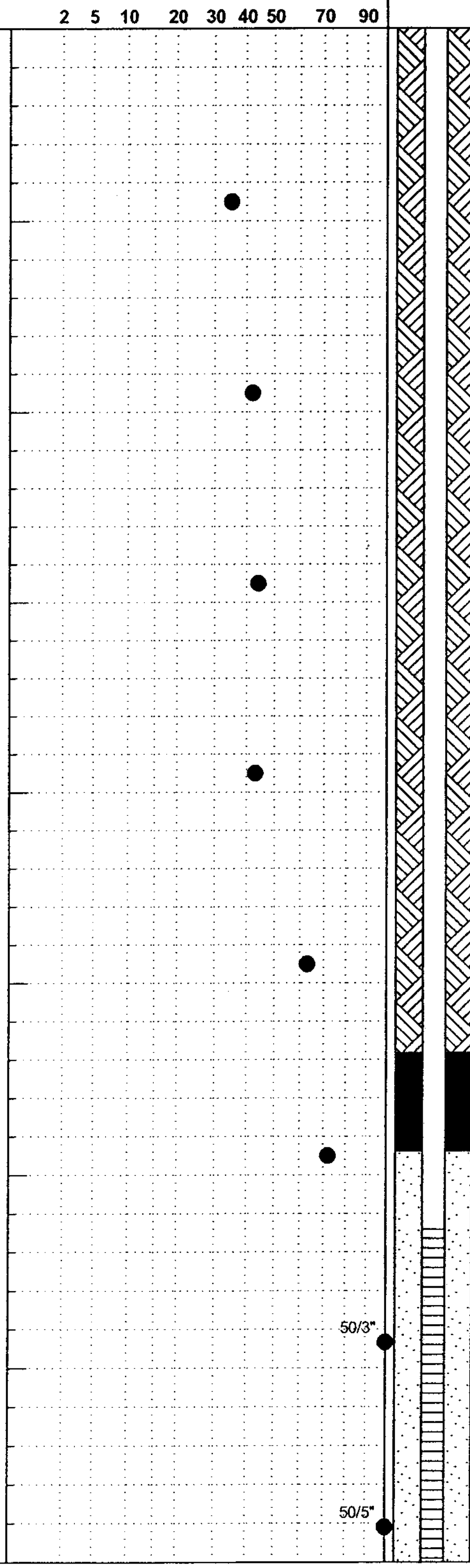
BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-13

PROJECT: White Oak MSW Landfill | PROJECT NO.: J07-1957-02
CLIENT: McGill Associates | START: 7-22-07 END: 7-22-07
LOCATION: Haywood County, North Carolina | ELEVATION: 2609.39
DRILLER: Landprobe, T. Gradwell | LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ∇ 69.0 AFTER 24 HOURS: ▼ 67.5 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	STANDARD PENETRATION RESULTS BLOWS/FOOT
40–43.5	Hard, black, brown and red, micaceous, silty, fine to medium SAND	
2565 / 43.5–48.5	Dense, dark brown, micaceous, silty, fine to medium SAND	8 15 20
2560 / 48.5–53.5	Hard, brown and light brown, micaceous, fine sandy SILT	8 16 26
2555 / 53.5–73.5	Hard to very hard, brown, black and gray, moist, fine sandy SILT	13 22 22
2550		15 20 23
2545		28 30 33
2540		23 32 40
2535 / 73.5–	PARTIALLY WEATHERED ROCK which sampled as gray and white, silty, fine to medium SAND	26 48 50/3"
2530		43 50/5"



MONITOR WELL INSTALLATION DETAILS

- Neat cement, 0 to 66.8 feet
- Bentonite seal, 66.8 to 69.4 feet
- Filter pack, sand 69.4 to 81.6 feet
- 2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 71.4 to 81.4 feet

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-13

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02
CLIENT: McGill Associates — START: 7-22-07 END: 7-22-07
LOCATION: Haywood County, North Carolina — ELEVATION: 2609.39
DRILLER: Landprobe, T. Gradwell — LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 69.0 AFTER 24 HOURS: ▼ 67.5 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
82 – 86 (2525 at ~84.4)	PARTIALLY WEATHERED ROCK which sampled as gray and white, silty, fine to medium SAND		50/3" (at ~84)	50/3"	Pipe cap; Total well depth, 81.6 feet
86	Auger refusal at 86 feet. Groundwater encountered at 69.0 feet at time of drilling and at 67.5 feet after 24 hours.				

Depth scale: 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118
Elevation scale: 2525, 2520, 2515, 2510, 2505, 2500, 2495, 2490

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-14

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02

CLIENT: McGill Associates — START: 9-4-07 END: 9-4-07

LOCATION: Haywood County, North Carolina — ELEVATION: 2610.41

DRILLER: Landprobe, T. Gradwell — LOGGED BY: T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ∇ 59.1 AFTER 24 HOURS: ▼ 59.2 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES (blows)	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
2610 / 0	Stiff to very stiff, red and light brown, fine sandy SILT with some clay - (residuum)			SURFACE COMPLETION 3.26-foot stick-up
2		3 4 6	●	
4		4 5 7	●	
2605 / 6		4 4 7	●	
8		4 6 8	●	
2600 / 10				
12				
14		4 7 9	●	
2595 / 16				
18	Very stiff, red, brown and black, micaceous, fine sandy, clayey SILT	6 9 11	●	
2590 / 20				Neat cement, 0 to 45.7 feet
22				
24		5 9 12	●	
2585 / 26				
28		10 8 12	●	
2580 / 30				
32	Hard to stiff, gray, brown, micaceous, fine sandy SILT			
34		11 21 30	●	
2575 / 36				
38		17 28 33	●	

Blows/foot scale: 2 5 10 20 30 40 50 70 90

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-14

PROJECT: White Oak MSW Landfill | PROJECT NO.: J07-1957-02
CLIENT: McGill Associates | START: 9-4-07 END: 9-4-07
LOCATION: Haywood County, North Carolina | ELEVATION: 2610.41
DRILLER: Landprobe, T. Gradwell | LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ∇ 59.1 AFTER 24 HOURS: ▼ 59.2 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES (STANDARD PENETRATION RESULTS BLOWS/FOOT)	MONITOR WELL INSTALLATION DETAILS
2570 / 40–52	Hard to stiff, gray, brown, micaceous, fine sandy SILT	11, 16, 21; 9, 12, 14	Neat cement, 0 to 45.7 feet
52–67	Very stiff to hard, brown and gray, micaceous, moist, fine sandy SILT	12, 13, 16; 14, 15, 18; 13, 14, 17	Bentonite seal, 45.7 to 60.3 feet; Filter pack, sand 60.3 to 73.5 feet
67–73.5	PARTIALLY WEATHERED ROCK which sampled as gray, black and white, silty, fine to medium SAND	50/1"	2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 63.3 to 73.3 feet; Pipe cap
73.5	Auger refusal at 73.5 feet. Groundwater encountered at 59.1 feet at time of drilling and at 59.2 feet after 24 hours.		Total well depth, 73.5 feet

Elevation scale: 2570, 2565, 2560, 2555, 2550, 2545, 2540, 2535. Depth scale: 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78. SPT scale: 2 5 10 20 30 40 50 70 90.

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-15

PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START: 7-19-07	END: 7-20-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2584.11
DRILLER:	Landprobe, T. Gradwell	LOGGED BY:	T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ▽ 57.75 AFTER 24 HOURS: ▼ 57.1 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
0	6-inches of TOPSOIL		**SURFACE COMPLETION** 3.81-foot stick-up
0.5	Stiff to very stiff, dark red, clayey SILT - (residuum)	5-6-8; 3-5-8; 5-9-10; 3-4-6	
2570 / 13.5	Very stiff to hard, brown and purple, micaceous, fine sandy SILT	5-12-15; 9-15-18	
2560 / 23.5	Hard, brown, fine sandy SILT	9-15-19	
2555 / 28.5	Very stiff, red and brown SILT	5-6-11	Neat cement, 0 to 59.7 feet
2550 / 33.5	Stiff, light brown, fine sandy SILT	4-6-6	
2545 / 38.5	Very stiff, gray and brown, micaceous, fine sandy SILT	7-8-9	

Elevation scale: 2580, 2575, 2570, 2565, 2560, 2555, 2550, 2545. Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38. Blows/foot scale: 2 5 10 20 30 40 50 70 90.

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-15

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02
CLIENT: McGill Associates — START: 7-19-07 END: 7-20-07
LOCATION: Haywood County, North Carolina — ELEVATION: 2584.11
DRILLER: Landprobe, T. Gradwell — LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 57.75 AFTER 24 HOURS: ▼ 57.1 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES (STANDARD PENETRATION RESULTS BLOWS/FOOT)
41 to 53.5	Very stiff, gray and brown, micaceous, fine sandy SILT	7-9-19 (at 44 ft); 7-9-11 (at 49 ft)
53.5 to 63.5	Very stiff, brown and gray, micaceous, fine sandy SILT with rock fragments	7-8-13 (at 54 ft); 5-9-15 (at 59 ft)
63.5 to 68.5	Very firm, white and light brown, moist, silty, fine to medium SAND	9-12-14 (at 64 ft)
68.5 to 73.5	PARTIALLY WEATHERED ROCK which sampled as gray and brown, silty, fine to medium SAND	15-22-50/6" (at 69 ft)
73.5 to 75	PARTIALLY WEATHERED ROCK which sampled as orange and brown, silty, fine to medium SAND with rock fragments	14-26-50/4" (at 74 ft)

Boring terminated at 75 feet. Groundwater encountered at 57.75 feet at time of drilling and at 57.1 feet after 24 hours.

Elevation scale: 2540 (44 ft), 2535, 2530, 2525, 2520, 2515, 2510, 2505. Depth scale: 42–78 ft.

Standard penetration scale: 2 5 10 20 30 40 50 70 90

MONITOR WELL INSTALLATION DETAILS

- Neat cement, 0 to 59.7 feet
- Bentonite seal, 59.7 to 62.1 feet
- Filter pack, sand 62.1 to 75 feet
- 2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 64.13 to 74.13 feet
- Pipe cap
- Total well depth, 74.33 feet

GEOT WELL 1957-02.GPJ 7/11/08

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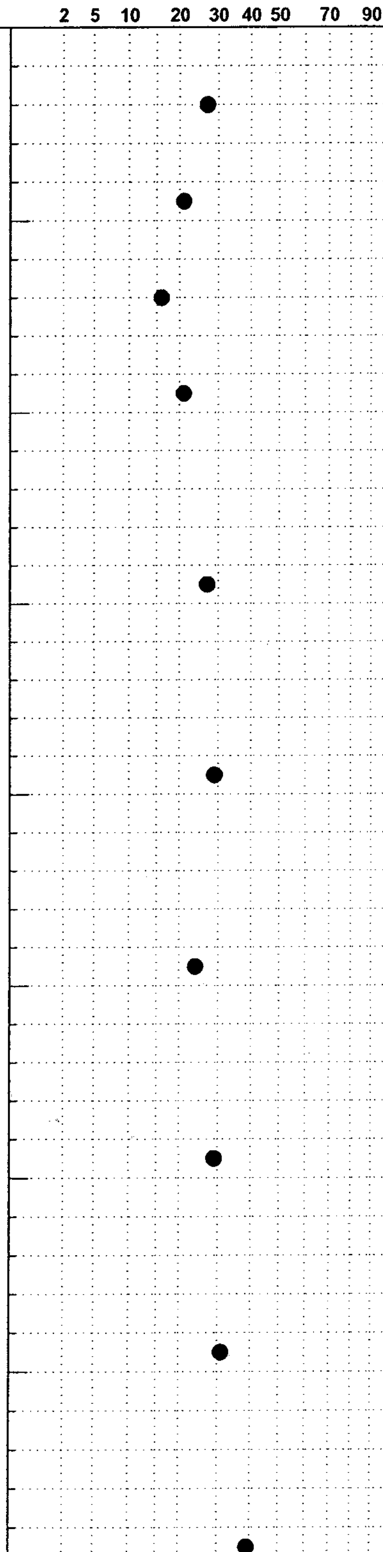
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-16

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02
CLIENT: McGill Associates — START: 7-29-07 END: 7-29-07
LOCATION: Haywood County, North Carolina — ELEVATION: 2614.70
DRILLER: Landprobe, T. Gradwell — LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ∇ 68.5 AFTER 24 HOURS: ▼ ______ CAVING> ______

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
0–5 (2614.7–2610)	Very firm, white and light brown, silty, fine SAND - (residuum)		1–2.5: 14, 12, 15; 3.5–5: 6, 10, 11		**SURFACE COMPLETION** 3.82-foot stick-up
5–17 (2610–2598)	Very stiff, light brown, red and white, fine sandy SILT		6–7.5: 7, 7, 9; 8.5–10: 9, 10, 11; 13.5–15: 8, 12, 15		
17–40 (2598–2575)	Very stiff to hard, red, dark red and black, fine sandy SILT		18.5–20: 7, 14, 15; 23.5–25: 8, 10, 14; 28.5–30: 9, 11, 18; 33.5–35: 10, 12, 19; 38.5–40: 10, 12, 27		Neat cement, 0 to 64.7 feet



Elevation scale: 2610, 2605, 2600, 2595, 2590, 2585, 2580, 2575
Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-16

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02
CLIENT: McGill Associates — START: 7-29-07 END: 7-29-07
LOCATION: Haywood County, North Carolina — ELEVATION: 2614.70
DRILLER: Landprobe, T. Gradwell — LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ▽ 68.5 AFTER 24 HOURS: ▼ ____ CAVING> ____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES (blows)	STANDARD PENETRATION RESULTS BLOWS/FOOT (2 5 10 20 30 40 50 70 90)
40–42	Very stiff to hard, red, dark red and black, fine sandy SILT		
42–48 (2570 at ~45)	Dense, light red, light brown and black, silty, fine SAND	12 20 27	
47–52 (2565 at ~50)	Very dense, light brown and gray, silty, fine to medium SAND	12 25 30	
52–57 (2560 at ~55)	Very dense, brown, gray and red, silty, fine to medium SAND	12 15 25	
57–72 (2555, 2550, 2545)	Hard, brown and gray, fine sandy SILT	9 16 24; 10 12 20; 10 14 20	
72–77 (2540 at ~75)	Dense, gray and light brown, fine to medium silty SAND	12 24 25	
77–80 (2535 at 80)	Hard, gray and brown, fine sandy SILT	8 18 32	

Water level ▽ at 68.5 ft.

MONITOR WELL INSTALLATION DETAILS

- Neat cement, 0 to 64.7 feet
- Bentonite seal, 64.7 to 67.4 feet
- Filter pack, sand 67.4 to 80 feet
- 2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 68.2 to 78.2 feet
- Pipe cap
- Total well depth, 78.4 feet

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GROUNDWATER MONITORING WELL NO. BLE-16

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02
CLIENT: McGill Associates — START: 7-29-07 END: 7-29-07
LOCATION: Haywood County, North Carolina — ELEVATION: 2614.70
DRILLER: Landprobe, T. Gradwell — LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ∇ 68.5 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
82	Boring terminated at 80 feet. Groundwater encountered at 68.5 feet at time of drilling.				
84					
2530					
86					
88					
2525 / 90					
92					
94					
2520					
96					
98					
2515 / 100					
102					
104					
2510					
106					
108					
2505 / 110					
112					
114					
2500					
116					
118					
2495					

GROUNDWATER MONITORING WELL NO. BLE-17

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PROJECT: White Oak MSW Landfill	PROJECT NO.: J07-1957-02
CLIENT: McGill Associates	START: 7-20-07 END: 7-21-07
LOCATION: Haywood County, North Carolina	ELEVATION: 2611.46
DRILLER: Landprobe, T. Gradwell	LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger	

DEPTH TO - WATER> INITIAL: ∇ 87.6 AFTER 24 HOURS: ▼ 73.4 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
0	6-inches of TOPSOIL		SURFACE COMPLETION 4.45-foot stick-up
0.5	Stiff to very stiff, red, light brown and gray, fine sandy SILT - (residuum)	4-5-6	
		5-5-7	
		5-10-12	
8.5	Very stiff to stiff, red, micaceous, clayey, fine sandy SILT	12-15-15	
		4-5-9	
18.5	Very stiff, red and light brown, fine sandy SILT	4-8-10	Neat cement, 0 to 85 feet
		9-10-15	
28.5	Very stiff, purple and brown, fine sandy SILT	6-8-14	
33.5	Very firm, red and light brown, silty, fine SAND	9-12-15	
		10-16-18	

Elevation scale: 2610, 2605, 2600, 2595, 2590, 2585, 2580, 2575. Depth scale: 2 to 38 ft. SPT scale: 2, 5, 10, 20, 30, 40, 50, 70, 90.

GEOT WELL 1957-... GPJ 7/11/08

GROUNDWATER MONITORING WELL NO. BLE-17

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PROJECT: White Oak MSW Landfill — PROJECT NO.: J07-1957-02
CLIENT: McGill Associates — START: 7-20-07 END: 7-21-07
LOCATION: Haywood County, North Carolina — ELEVATION: 2611.46
DRILLER: Landprobe, T. Gradwell — LOGGED BY: T. Livingston
DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger
DEPTH TO - WATER> INITIAL: ∇ 87.6 AFTER 24 HOURS: ▼ 73.4 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SAMPLES (blows)	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
2570 / 42	Very firm, red and light brown, silty, fine SAND			
44	Dense, purple and red, fine sandy SILT	10 15 19	●	
2565 / 46–48				
50	Very firm, purple, light brown and black, micaceous, silty, fine to medium SAND	5 7 12	●	
2560 / 52–54		9 12 15	●	
2555 / 56–58				
60	Dense to very firm, brown, silty, fine SAND	12 15 17	●	Neat cement, 0 to 85 feet
2550 / 62–64		17 20 22	●	
2545 / 66–68				
70		7 12 15	●	
2540 / 72				
74	Hard, gray, moist, micaceous, fine sandy SILT	10 15 17	●	
2535 / 76–78				
80	Very stiff to hard, red, brown and gray, moist, clayey, fine sandy SILT	5 12 17	●	

STANDARD PENETRATION scale: 2 5 10 20 30 40 50 70 90

GEOT_WELL 1957-02.GPJ 7/11/08

GROUNDWATER MONITORING WELL NO. BLE-17

BLE INC.

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

PROJECT:	White Oak MSW Landfill	PROJECT NO.:	J07-1957-02
CLIENT:	McGill Associates	START: 7-20-07	END: 7-21-07
LOCATION:	Haywood County, North Carolina	ELEVATION:	2611.46
DRILLER:	Landprobe, T. Gradwell	LOGGED BY:	T. Livingston

DRILLING METHOD: 8-1/4 inch O.D. hollow stem auger

DEPTH TO - WATER> INITIAL: ▽ 87.6 AFTER 24 HOURS: ▼ 73.4 CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	STANDARD PENETRATION RESULTS BLOWS/FOOT	MONITOR WELL INSTALLATION DETAILS
2530 / 82 – 88	Very stiff to hard, red, brown and gray, moist, clayey, fine sandy SILT		X	15 17 20	Neat cement, 0 to 85 feet; Bentonite seal, 85 to 87.1 feet; Filter pack, sand 87.1 to 101 feet
88 – 98	Firm to very dense, brown, gray and black, silty, fine to medium SAND		X	8 14 15	2-inch diameter, 0.010-inch slotted Schedule 40 PVC well screen, 89.7 to 99.7 feet
			X	10 12 14	
98 – 101	PARTIALLY WEATHERED ROCK which sampled as brown, gray and black, silty, fine to medium SAND		X	34 50/5"	Pipe cap
2510 / 101	Auger refusal at 101.0 feet. Groundwater encountered at 87.6 feet at time of drilling and at 73.4 feet after 24 hours.				Total well depth, 99.9 feet

Elevation scale: 2530, 2525, 2520, 2515, 2510, 2505, 2500, 2495
Depth scale: 82, 84, 86, 88, 90, 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118
Blows/foot scale: 2 5 10 20 30 40 50 70 90

GEOT WELL 1957-02.GPJ 7/11/08

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT
0.0	FILL, consists of stiff to very stiff moist brown fine sandy micaceous silt (ML).		23 14
12.0	Firm moist red-brown silty micaceous fine to coarse SAND (SM).		18
15.0	Stiff moist brown and orange-brown fine sandy micaceous SILT (ML).		13 11
26.0	PARTIALLY WEATHERED ROCK (PWR), sampled as dry yellow, gray, and orange-brown silty micaceous fine to coarse sand, with trace rock fragments.		50/4" 50/2" 50/0"
37.2	Auger refusal encountered at 37.2 feet. Boring terminated.		

Penetration scale: 0, 10, 20, 30, 40, 60, 80, 100

REMARKS:

Borehole dry at completion of drilling. Drillers: W.Whichard and G.Copland. Drill Rig: CME-550 ATV. Boring Type: 8" HSA.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GWM-5
DATE DRILLED	September 15, 1993
PROJECT NUMBER	472-07913-03
PROJECT	White Oak Sanitary Landfill
PAGE 1 OF 1	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	●. PENETRATION - BLOWS/FOOT
0.0	Firm moist brown fine to coarse sandy micaceous SILT (ML)		8
8.0	Loose wet brown, gray, and white silty micaceous fine to coarse SAND (SM), with rock fragments and boulders		6 9
18.5	PARTIALLY WEATHERED ROCK (PWR), sampled as wet brown, gray, and white silty micaceous sand, with rock fragments		50/6"
20.1	Auger refusal encountered at 20.1 feet. Boring terminated.		

Penetration scale: 0, 10, 20, 30, 40, 60, 80, 100

REMARKS:

Groundwater encountered at 9.0 feet. Type II Monitoring Well Installed. Drillers: W.Whichard and G.Copland. Drill Rig: CME-550 ATV. Boring Type: 8" HSA.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GWM-5A
DATE DRILLED	September 25, 1993
PROJECT NUMBER	472-07913-03
PROJECT	White Oak Sanitary Landfill
PAGE 1 OF 1	

LAW ENGINEERING

TYPE II MONITORING WELL INSTALLATION RECORD

JOB NAME: White Oak Landfill
JOB NUMBER: 472-07913-03

WELL NUMBER: GWM-5A
INSTALLATION DATE: 09/25/93

LOCATION: West Drainage Feature (See Record Drawings)

GROUND SURFACE ELEVATION:
REFERENCE POINT ELEVATION:

GRANULAR BACKFILL MATERIAL: NC #2 sand
SLOT SIZE: 0.010"

SCREEN MATERIAL: PVC
SCREEN DIAMETER: 2"

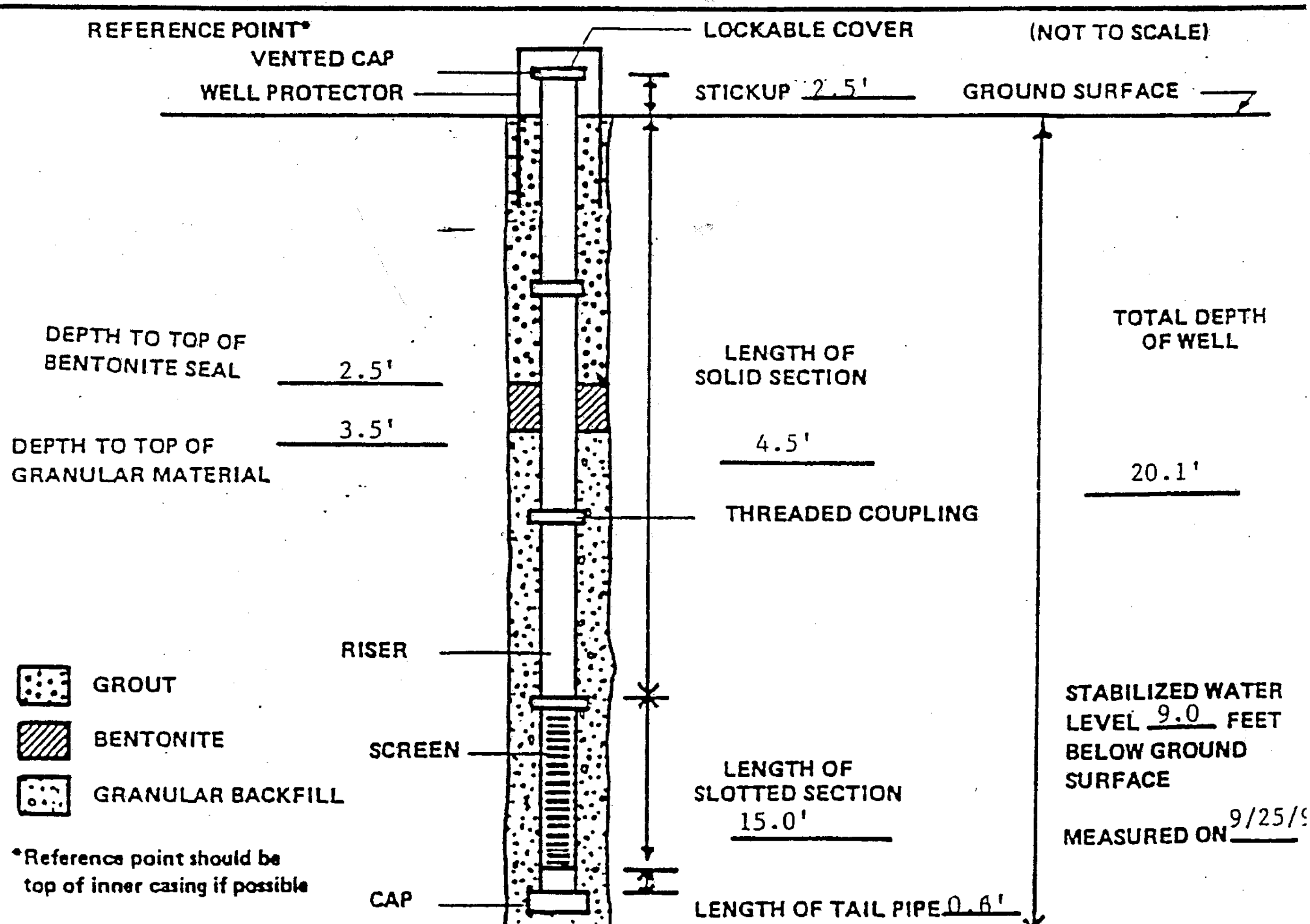
RISER MATERIAL: PVC
RISER DIAMETER: 2"

DRILLING TECHNIQUE: HSA
DRILLING CONTRACTOR: Law Engineering

BOREHOLE DIAMETER: 8"
LAW ENGINEERING FIELD REPRESENTATIVE: Hoda Kablawi

LOCK BRAND: Master
SIZE/MODEL: #3

KEY CODE/COMBINATION: 0536



LAW ENGINEERING TESTING COMPANY

TYPE II MONITORING WELL INSTALLATION RECORD

FIGURE 2

NORTH CAROLINA DEPARTMENT OF NATURAL ...

DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION

P.O. BOX 27687 - RALEIGH, N.C. 27611, PHONE (919) 733-6083

FOR OFFICE USE ONLY

Quad. No. ______ Serial No. ______
Lat. ______ Long. ______ Pc ______
Minor Basin ______
Basin Code ______
Header Ent. ______ GW-1 Ent. ______

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR Law Engineering

DRILLER REGISTRATION NUMBER 332

GWM-5A

LANDFILL CONSTRUCTION PERMIT NUMBER: 44-07

1. WELL LOCATION: (Show sketch of the location below)

Nearest Town: White Oak, North Carolina

County: Haywood

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

2. OWNER Haywood County, North Carolina

ADDRESS 420 N. Main Street (Street or Route No.)

Waynesville (City or Town) NC (State) 28786 (Zip Code)

3. DATE DRILLED 9/25/93 USE OF WELL Monitoring

4. TOTAL DEPTH 20.1' CUTTINGS COLLECTED ☒ Yes ☐ No

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

6. STATIC WATER LEVEL: 11.5' FT. ☐ above ☒ below TOP OF CASING.
TOP OF CASING IS 2.5' FT. ABOVE LAND SURFACE.

7. YIELD (gpm): N/A METHOD OF TEST N/A

WATER ZONES (depth): ______

9. CHLORINATION: Type N/A Amount N/A

10. CASING:

	Depth		Diameter	Wall Thickness or Weight/Ft.	Material
From	0	To 4.5 Ft.	2"		PVC
From		To Ft.			
From		To Ft.			

11. GROUT:

	Depth		Material	Method
From	0	To 2.5 Ft.	Cem-Bent	Tremie
From		To Ft.		

12. SCREEN:

	Depth		Diameter	Slot Size	Material
From	4.5	To 19.5 Ft.	2" in.	0.010 in.	PVC
From		To Ft.	in.	in.	
From		To Ft.	in.	in.	

13. GRAVEL PACK:

	Depth		Size	Material
From	3.5'	To 20.1 Ft.		NC#2 sand
From		To Ft.		

REMARKS: Bentonite 2.5' to 3.5'

DRILLING LOG

Depth From	Depth To	Formation Description
0'	8'	Sandy SILT
8'	18.5'	Silty sand
18.5'	20.1'	Partially weathered rock

If additional space is needed use back of form.

LOCATION SKETCH

(Show direction and distance from at least two State Road or other map reference points)

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.

Thomas M. Schipporeit — SIGNATURE OF CONTRACTOR OR AGENT

10/1/93 — DATE

GW-1 Revised 11/84

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

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0, 10, 20, 30, 40, 60, 80, 100)
0.0	Overburden Soils (Brown silty sand) See Boring GWM-5A for detailed soil descriptions		
20.0	Hard Rock (Brown)		
36.2	Boring terminated at 36.2 feet		

REMARKS:

Groundwater measured at 6.1 feet after stabilization. Type II Monitoring Well Installed. Driller: Caldwell Well Drilling. Drill Rig: Truck-Mount Driltech D25. Boring Type: 6-1/4" Air-Rotary.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GWM-5D
DATE DRILLED	September 29, 1993
PROJECT NUMBER	472-07913-03
PROJECT	White Oak Sanitary Landfill
PAGE 1 OF 1	

LAW ENGINEERING

TYPE II MONITORING WELL INSTALLATION RECORD

JOB NAME: White Oak Landfill
JOB NUMBER: 472-07913-03

WELL NUMBER: GWM-5D
INSTALLATION DATE: 9/29/93 & 9/30/93

LOCATION: West Drainage Feature (See Record Drawings)

GROUND SURFACE ELEVATION:
REFERENCE POINT ELEVATION:

GRANULAR BACKFILL MATERIAL: NC #2 Sand
SLOT SIZE: 0.010"

SCREEN MATERIAL: PVC
SCREEN DIAMETER: 2"

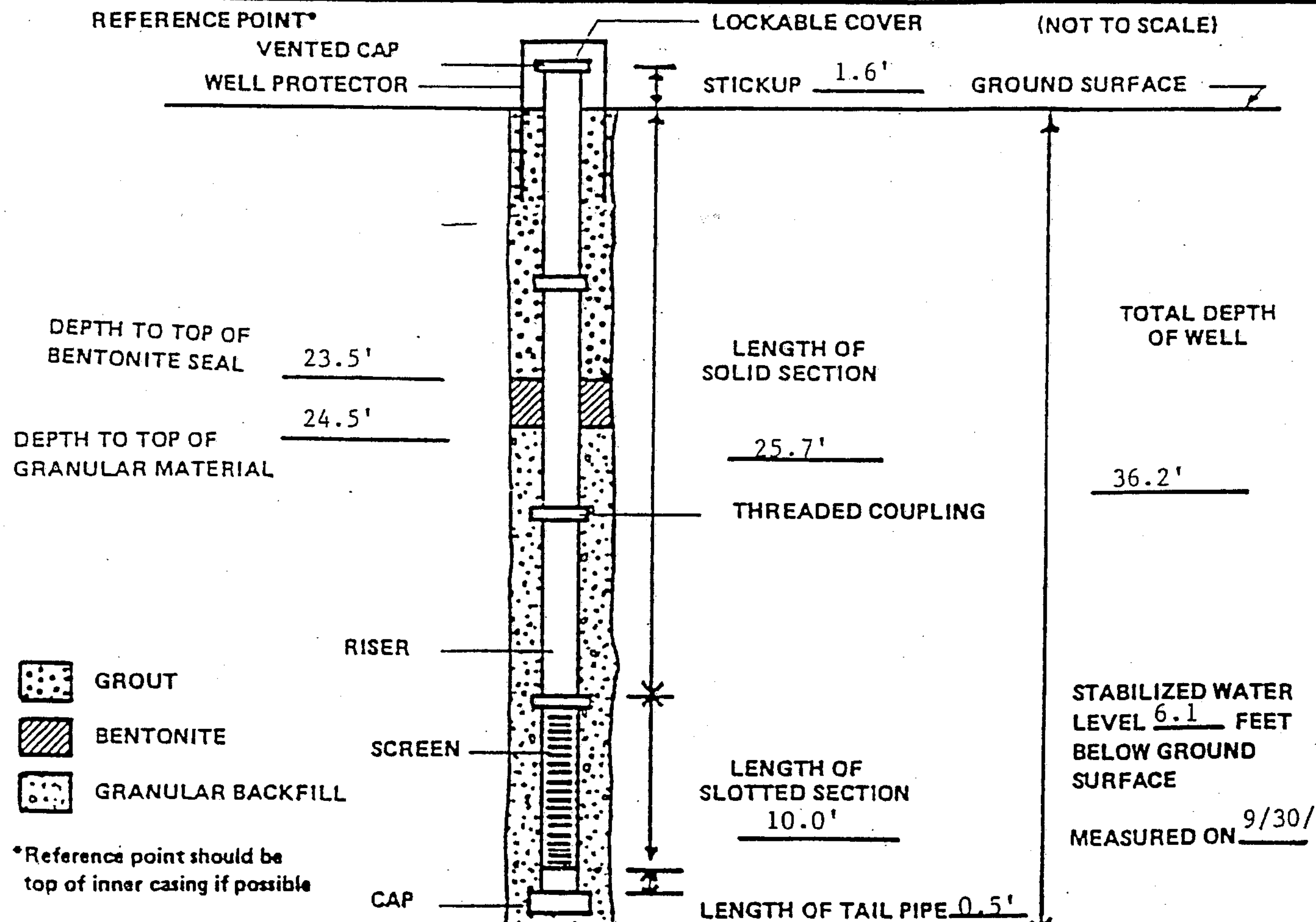
RISER MATERIAL: PVC
RISER DIAMETER: 2"

DRILLING TECHNIQUE: Air-Rotary
DRILLING CONTRACTOR: Caldwell

BOREHOLE DIAMETER: 6 1/4"
LAW ENGINEERING FIELD REPRESENTATIVE: T. Schipporeit

LOCK BRAND: Master
SIZE/MODEL: #3

KEY CODE/COMBINATION: 0536



LAW ENGINEERING TESTING COMPANY

TYPE II MONITORING WELL INSTALLATION RECORD

FIGURE 2

North Carolina - Department of Environment, Health, and 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

GWM-5D

DRILLING CONTRACTOR: Caldwell

LANDFILL . CONSTRUCTION

DRILLER REGISTRATION NUMBER: 99 PERMIT NUMBER: 44-07

1. WELL LOCATION: (Show sketch of the location below)
Nearest Town: White Oak County: Haywood
(Road, Community, or Subdivision and Lot No.)
2. OWNER Haywood County, North Carolina
ADDRESS 420 N. Main Street
(Street or Route No.)
Waynesville (City or Town) NC (State) 28786 (Zip Code)
3. DATE DRILLED 9/29/93 USE OF WELL Monitoring
4. TOTAL DEPTH 36.2'
5. CUTTINGS COLLECTED YES [ ] NO [X]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 7.7 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 1.6 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
9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth):
11. CHLORINATION: Type N/A Amount N/A
12. CASING:

Depth From	To	Ft. Diameter	Wall Thickness or Weight/Ft.	Material
0	25.7	2"		PVC

13. GROUT:

Depth From	To	Material	Method
0	23.5 Ft.	Cement-Bent.	Tremie

14. SCREEN:

Depth From	To	Diameter	Slot Size	Material
25.7	35.7 Ft	2 in.	0.010 in.	PVC

15. SAND/GRAVEL PACK:

Depth From	To	Size	Material
24.5	36.2 Ft.		NC #2 Sand

16. REMARKS: Bentonite 23.5' to 24.5'

DRILLING LOG

DEPTH From	To	Formation Description
0'	20'	Silty sand
20'	36.2'	Hard 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)

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.

Thomas M. Schuppert — SIGNATURE OF CONTRACTOR OR AGENT
10-4-93 — DATE

GW-1 REV. 5/91

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

LOG OF BORING: P-4

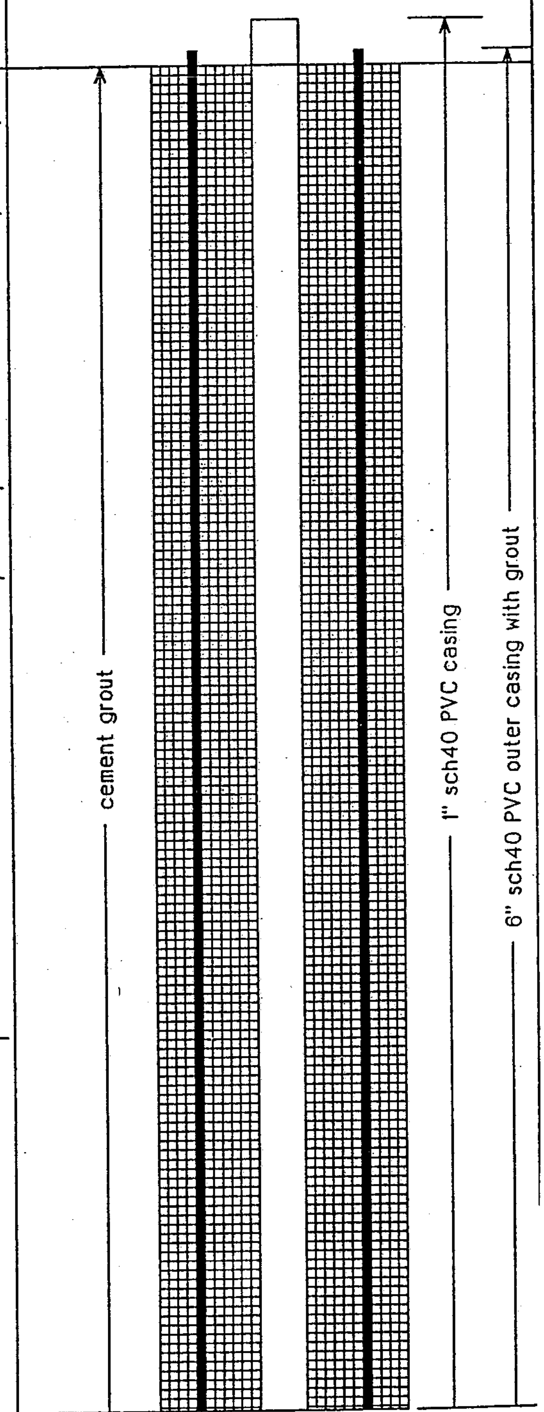
ect: Haywood County
Project No. G98010.5
HSA SS NQ

Drilling Contractor: Graham & Currie
Registration Number: 537

Surface Elevation: 2571.66ft
Top of Casing: 2573.73ft

DEPTH (ft)	BLOWS PER FOOT	DESCRIPTION OF MATERIAL
	8	Topoil top 2"
		CLAYEY SILT (ML); red to brown, firm, with sand and small white and black rock fragments
5	20	SANDY SILT (ML); medium dense, saprolite, medium to coarse grained, trace clay
10	29	-grades with thin veins and rock fragments
15	30	SILTY SAND (SM); red-brown and white, medium dense, fine sand, saprolite, some fragments
		PARTIALLY WEATHERED ROCK, fine and coarse layers
20	41	
25	58	-grades with rock fragments, highly fractured quartz vein
30	91	-rock fragments
	50/4	SANDY SILT (ML); tan orange, dense, saprolite, iron staining on relict minerals, some mica, trace clay
35		
40	43	
		-grades to phyllitic texture
45	50/4	

PIEZOMETER DIAGRAM



Completion Depth: 81ft
DATE: 5/9/98

Depth to Water: 62 ft WD

MUNICIPAL ENGINEERING SERVICES COMPANY, P.A.

LOG OF BORING: P-4

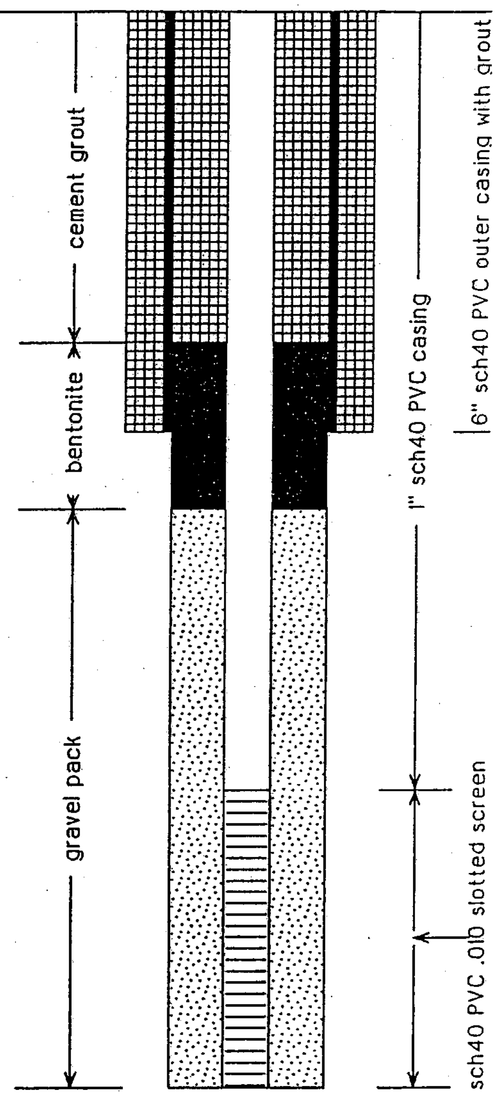
Project: Haywood County
Project No. G98010.5
Type: HSA SS NQ

Drilling Contractor: Graham & Currie
Registration Number: 537

Surface Elevation: 2571.66ft
Top of Casing: 2573.73ft

DEPTH (ft)	BLOWS PER FOOT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL
50	30		X	-grades medium dense, some mica, trace quartz grains and clay
55	42		X	-grades with medium to coarse grains
				Auger Refusal at 59 feet
60				PARTIALLY WEATHERED ROCK
65				
70				GNEISS; grey, moderately weathered, muscovite, biotite, quartz, feldspar, iron staining in fractures fractures parallel to banding at 45 to 60 degrees; REC=77%, RQD=59%
75				REC=100%, RQD=78%
80				
				End of Boring at 81 feet
85				
90				

PIEZOMETER DIAGRAM



Completion Depth: 81ft
DATE: 5/9/98

Depth to Water: 62 ft WD

MUNICIPAL ENGINEERING SERVICES COMPANY, P.A.

LOG OF BORING: P-5

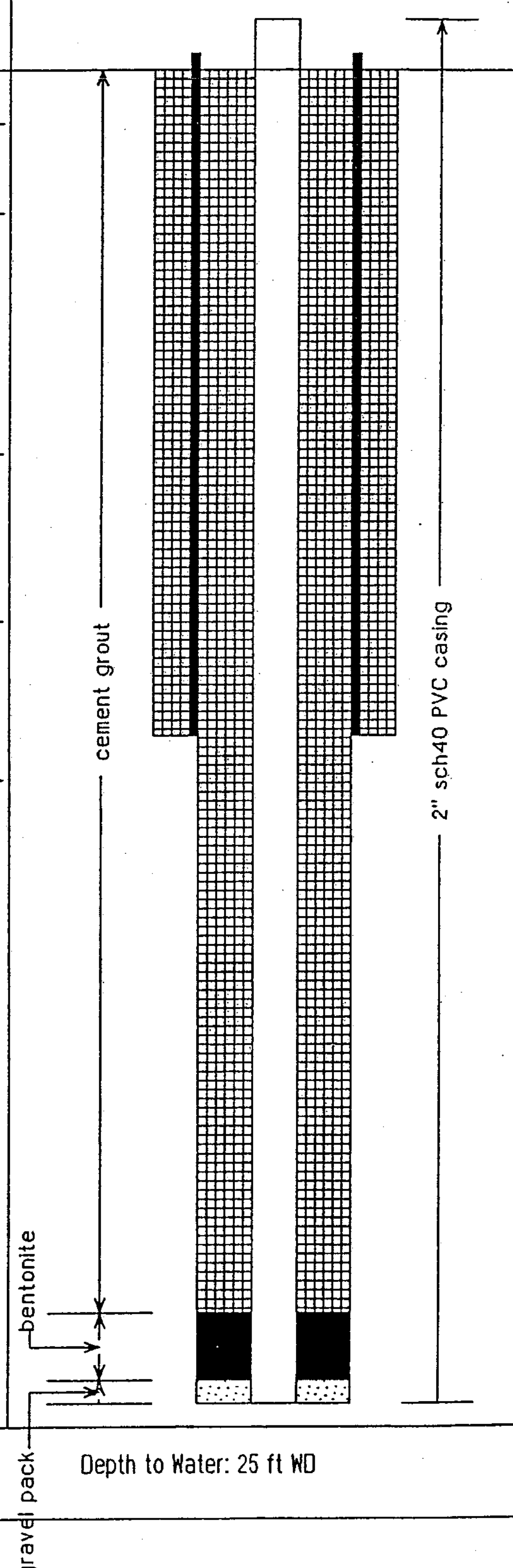
Project: Haywood County
Project No. G98010.5
HSA SS AH

Drilling Contractor: Graham & Currie
Registration Number: 537

Surface Elevation: 2485.54ft
Top of Casing: 2488.38ft

DEPTH (ft)	BLOWS PER FOOT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL
	6			Topsoil top 2"
	12			CLAYEY SILT (ML); dark brown, moist, firm, root debris and organics, trace mica
5				SANDY SILT (ML); dark brown, medium dense, with coarse sand, pebbles and rock fragments, trace mica
10	18			-grades with trace pebbles, trace rock fragments
15	7			SILT (ML); medium brown, moist, firm, with yellow mottles, micaceous, trace clay
	50/5			SILTY SAND (SM); tan, moist, very dense, few pebbles and rock fragments
20				Auger Refusal at 20.0 feet
25				GNEISS
30				
35				
40				

PIEZOMETER DIAGRAM



Completion Depth: 52.3ft
DATE: 5/25/98

Depth to Water: 25 ft WD

MUNICIPAL ENGINEERING SERVICES COMPANY, P.A.

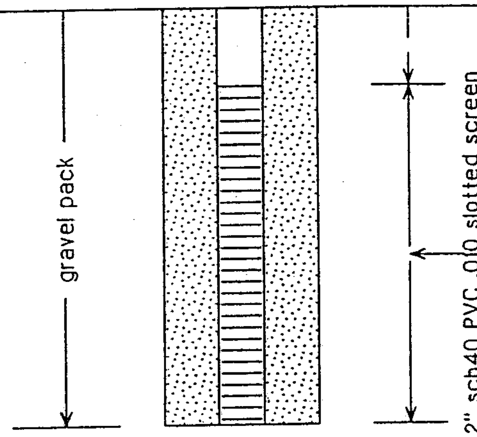
LOG OF BORING: P-5

ect: Haywood County
Project No. G98010.5
HSA SS AH

Drilling Contractor: Graham & Currie
Registration Number: 537

Surface Elevation: 2485.54ft
Top of Casing: 2488.38ft

DEPTH (ft)	BLOWS PER FOOT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	PIEZOMETER DIAGRAM
45					
50					
52.3				End of Boring at 52.3 feet	
55					
60					
65					
70					
75					
80					



Completion Depth: 52.3ft
DATE: 5/25/98

Depth to Water: 25 ft WD

MUNICIPAL ENGINEERING SERVICES COMPANY, P.A.

LOG OF BORING: P-6

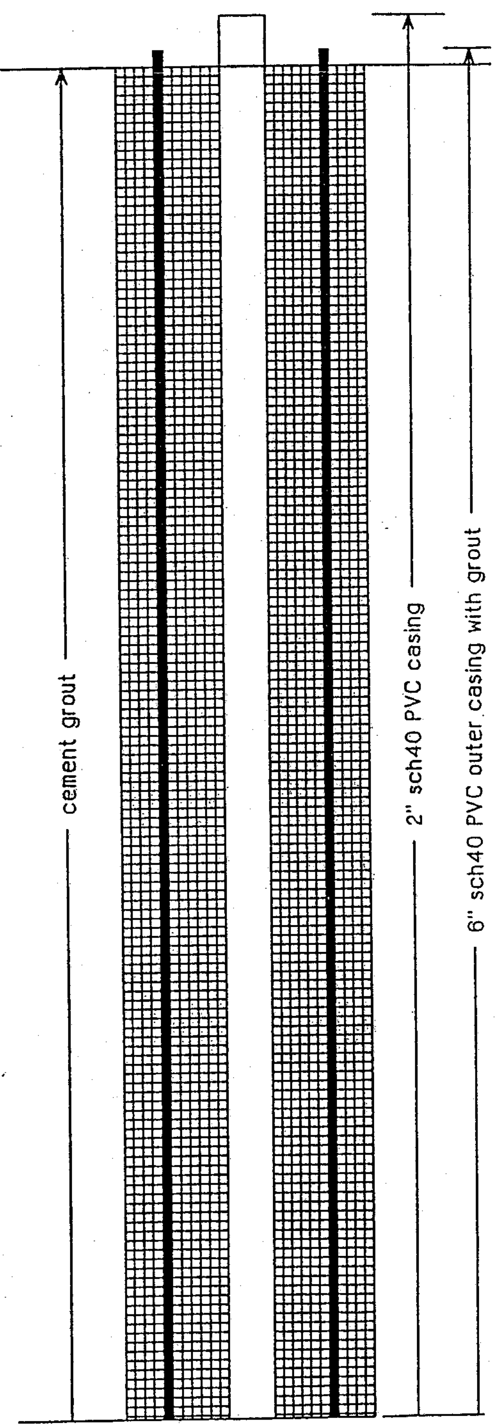
ject: Haywood County
Project No. G98010.5
· HSA SS AH

Drilling Contractor: Graham & Currie
Registration Number: 537

Surface Elevation: 2594.19ft
Top of Casing: 2597.24ft

DEPTH (ft)	BLOWS PER FOOT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL
	6			CLAYEY SILT (ML); red to brown, damp, with black mottles, some mica and coarse sand, trace root debris
5	9			SANDY SILT (ML); light orange to tan, loose, micaceous, some coarse grains
10	14			-grades light orange to tan, medium dense, faint relict structure
				SILT (ML); brown, damp, medium dense, with medium to coarse sand and mica
15	14			
20	22			-grades light brown, with fine to coarse sand, trace rock fragments
25	18			-grades less micaceous, less medium sand, brown and black mottles
				SANDY SILT (ML); medium to dark brown, medium dense, zones of coarse sand and fragments, some mica
30	19			
35	23			-zone of biotite gneiss
	20			PARTIALLY WEATHERED ROCK; iron staining on relict fracture surfaces
40				

PIEZOMETER DIAGRAM



Completion Depth: 67.5ft
DATE: 5/25/98

Depth to Water: 59 ft WD

MUNICIPAL ENGINEERING SERVICES COMPANY, P.A.

LOG OF BORING: P-6

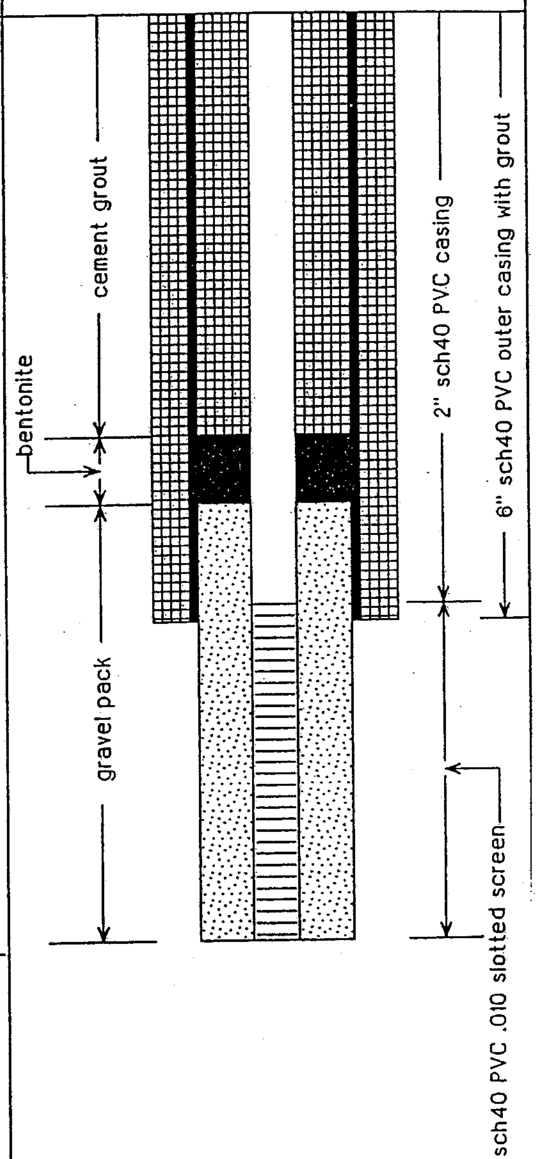
ect: Haywood County
Project No. G98010.5
: HSA SS AH

Drilling Contractor: Graham & Currie
Registration Number: 537

Surface Elevation: 2594.19ft
Top of Casing: 2597.24ft

DEPTH (ft)	BLOWS PER FOOT	DESCRIPTION OF MATERIAL
45	45	-grades with angular quartz fragments
		SANDY SILT (ML): zones of white fine sand and silt, dark brown micaceous layers
50	52	
		SILTY SAND (SM): brown, very dense, medium to coarse grained, with rock fragments, some mica
55	50/5	
		Auger Refusal at 58 feet
		GNEISS
60		fracture at 60 feet
65		
		fracture at 67 feet
		End of Boring at 67.5 feet
70		
75		
80		

PIEZOMETER DIAGRAM



Completion Depth: 67.5ft
DATE: 5/25/98

Depth to Water: 59 ft WD

MUNICIPAL ENGINEERING SERVICES COMPANY, P.A.

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT (0 10 20 30 40 60 80 100)
0.0	Overburden Soils (Brown silty sand and sandy silt.) See Boring GWM-2 for detailed soil descriptions		
36.9	White and gray, fresh, hard to very hard GRANITIC GNEISS, with no joints, very thin to thin foliation		

REMARKS:

Type III Monitoring Well Installed. Drillers: J.Voekel and M.Wagner. Drill Rig: Truck Mount. Boring Type: 8-1/4" ID HSA and PQ Rock Coring.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GWM-2D
DATE DRILLED	September 23, 1993
PROJECT NUMBER	472-07913-03
PROJECT	White Oak Sanitary Landfill
PAGE 1 OF 2	

LAW ENGINEERING

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	● PENETRATION - BLOWS/FOOT 0 10 20 30 40 60 80 100
	White and gray, fresh, hard to very hard GRANITIC GNEISS, with no joints, very thin to thin foliation		
48.8	Dark gray, white, and brown, slight to moderately weathered, moderately hard to hard GRANITIC GNEISS, with close jointing and very thin to thin foliation		
55.1	Core Run #1: 36.9 to 39.8 feet RQD = 100% Core Run #2: 39.8 to 42.9 feet RQD = 100% Core Run #3: 42.9 to 47.9 feet RQD = 100% Core Run #4: 47.9 to 53.0 feet RQD = 95% Core Run #5: 53.0 to 55.1 feet RQD = 95% Boring terminated at 55.1 feet on 9/26/93.		

REMARKS:

Type III Monitoring Well Installed. Drillers: J.Voekel and M.Wagner. Drill Rig: Truck Mount. Boring Type: 8-1/4" ID HSA and PQ Rock Coring.

SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ABOVE

TEST BORING RECORD

BORING NUMBER	GWM-2D
DATE DRILLED	September 23, 1993
PROJECT NUMBER	472-07913-03
PROJECT	White Oak Sanitary Landfill

LAW ENGINEERING

TYPE III MONITORING WELL INSTALLATION RECORD - Part A

JOB NAME White Oak Sanitary Landfill JOB NUMBER 472-07913-03

WELL NUMBER GWM-2D INSTALLATION DATE 9/23 - 9/26/93

LOCATION Haywood County, North Carolina

GROUND SURFACE ELEVATION

CASING MATERIAL PVC CASING DIAMETER 6"

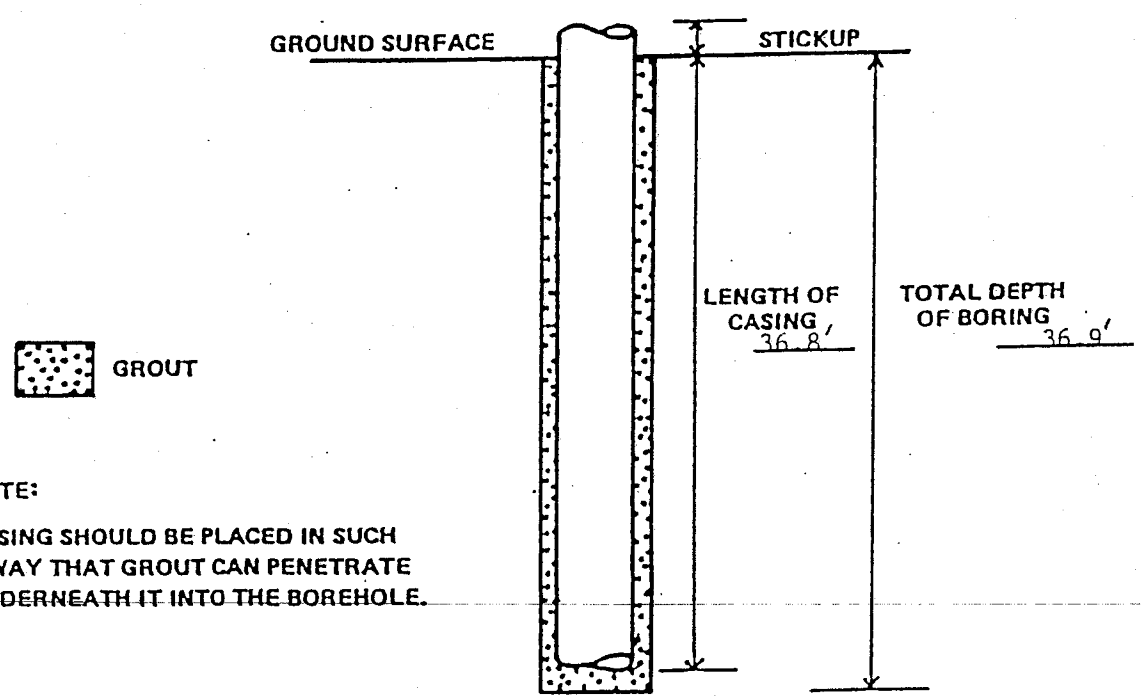
BOREHOLE DIAMETER 12 5/8"

DRILLING TECHNIQUE HSA

DRILLING CONTRACTOR Law Engineering

LAW ENGINEERING FIELD REPRESENTIVE Hoda S. Kablawi

(NOT TO SCALE)



NOTE:

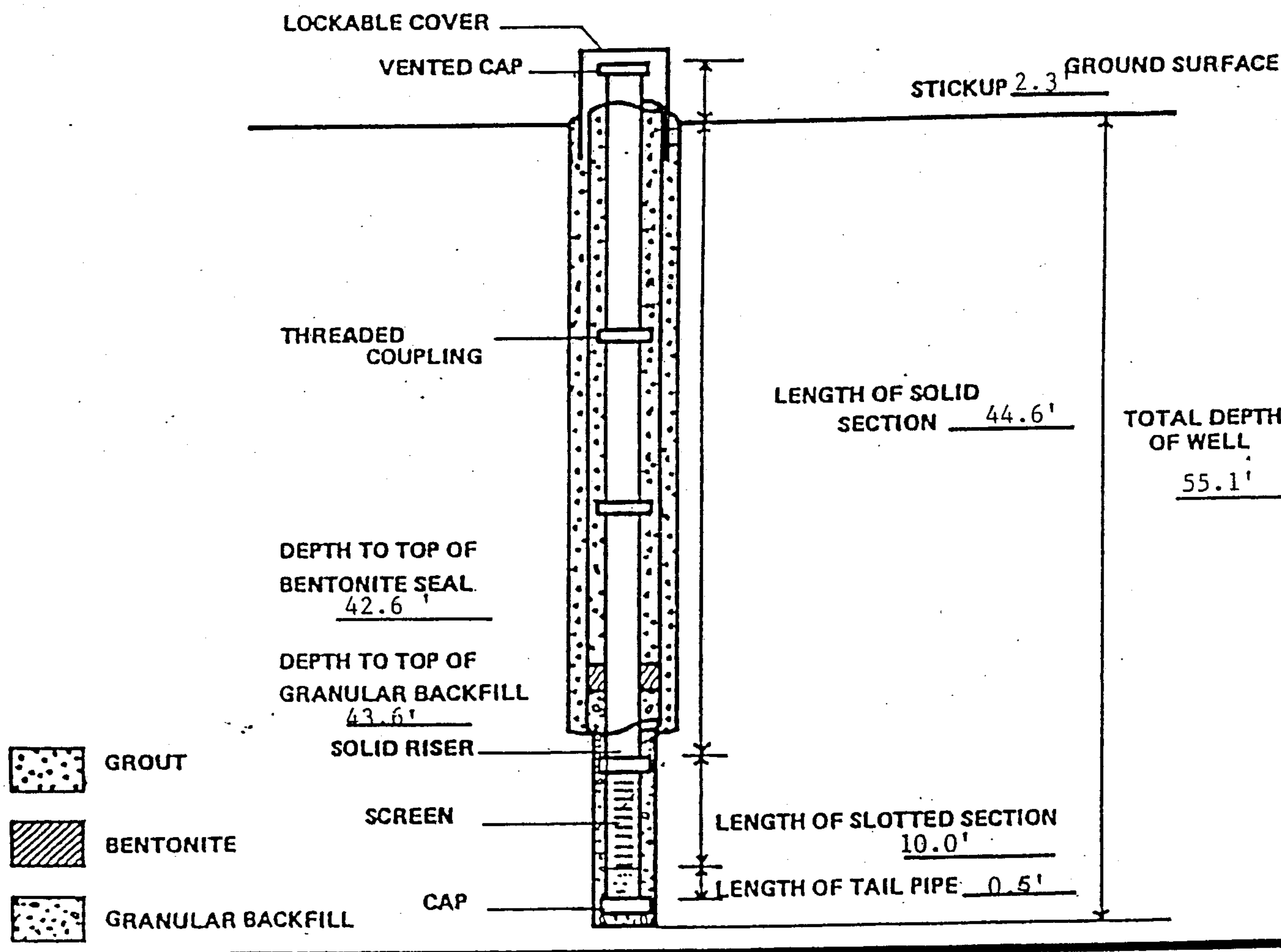
CASING SHOULD BE PLACED IN SUCH A WAY THAT GROUT CAN PENETRATE UNDERNEATH IT INTO THE BOREHOLE.

	LAW ENGINEERING TESTING COMPANY	FIGURE 3A

TYPE III MONITORING WELL INSTALLATION RECORD - Part B

JOB NAME White Oak Landfill
JOB NUMBER 472-07913-03
WELL NUMBER GWM-2D
INSTALLATION DATE 9/23 - 9/26/93
LOCATION East Access Road, Cell 1 (See Record Drawings)
GROUND SURFACE ELEVATION ______
REFERENCE POINT ELEVATION ______
GRANULAR BACKFILL NC #2 Sand
SLOT SIZE 0.010"
SCREEN MATERIAL PVC
SCREEN DIAMETER 2"
RISER MATERIAL PVC
RISER DIAMETER 2"
BOREHOLE DIAMETER 4.8"
LAW ENGINEERING FIELD REP. Hoda Kablawi
DRILLING TECHNIQUE HSA & PQ-Coring
DRILLING CONTRACTOR Law Engineering
LOCK: BRAND Master SIZE/MODEL #3 KEYCODE/COMBINATION 0536
STABILIZED WATER LEVEL 28.0 FEET BELOW GROUND SURFACE, MEASURED ON 9/30/93

(NOT TO SCALE)



LAW ENGINEERING TESTING COMPANY

FIGURE 3 B

North Carolina - Department of Environment, Health, and 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

GWM-2D

DRILLING CONTRACTOR: Law Engineering

DRILLER REGISTRATION NUMBER: 332

LANDFILL CONSTRUCTION PERMIT NUMBER: 44-07

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: White Oak, North Carolina County: Haywood
   ______ (Road, Community, or Subdivision and Lot No.)
2. OWNER Haywood
   ADDRESS 420 N. Main Street (Street or Route No.)
   Waynesville NC 28786
   City or Town State Zip Code
3. DATE DRILLED 9/23-9/26/93 USE OF WELL Monitoring
4. TOTAL DEPTH 55.1'
5. CUTTINGS COLLECTED YES [x] NO [ ]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 30.3 FT. (Use "+" if Above Top of Casing)
8. TOP OF CASING IS 2.3 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

9. YIELD (gpm): N/A METHOD OF TEST N/A
10. WATER ZONES (depth):
11. CHLORINATION: Type N/A Amount N/A
12. CASING:

Depth From	Depth To	Diameter	Wall Thickness or Weight/Ft.	Material
0	36.8 Ft.	6"		PVC
0	44.6 Ft.	2"		PVC
	Ft.			

13. GROUT:

Depth From	Depth To	Material	Method
0	36.9 Ft.	Cem-Bent.	Tremie
0	42.6 Ft.	Cem-Bent.	Tremie

14. SCREEN:

Depth From	Depth To	Diameter	Slot Size	Material
44.6	54.6 Ft	2" in.	0.010 in.	PVC
	Ft.	in.	in.	
	Ft.	in.	in.	

15. SAND/GRAVEL PACK:

Depth From	Depth To	Size	Material
43.6	55.1 Ft.		NC#2 Sand
	Ft.		

16. REMARKS: Bentonite 42.6' to 43.6'

DEPTH From – To	DRILLING LOG Formation Description
0' - 36.9'	Sandy Silt/Silty San
36.9' - 55.1'	Hard 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)

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.

Thomas M. Shufford 10-4-93

SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 REV. 5/91

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

APPENDIX D

PIEZOMETER INSTALLATION PROCEDURES

APPENDIX D

PIEZOMETER INSTALLATION PROCEDURES

Groundwater 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 2-inch diameter PVC pipe (Schedule 40 with flush-threaded joints) inserted into a 8.25-inch diameter augured borehole. The bottom 5 to 10-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 to at least 1 to 2 feet above the top of the well screen. A bentonite seal (minimum 2-foot thick) was installed on top of the sand backfill. A cement-bentonite grout mixture was tremied from the top the bentonite seal 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 E

PRECIPITATION AND GROUNDWATER LEVEL DATA AND CHARTS

MONTHLY PRECIPITATION DATA - 1992 TO 2008

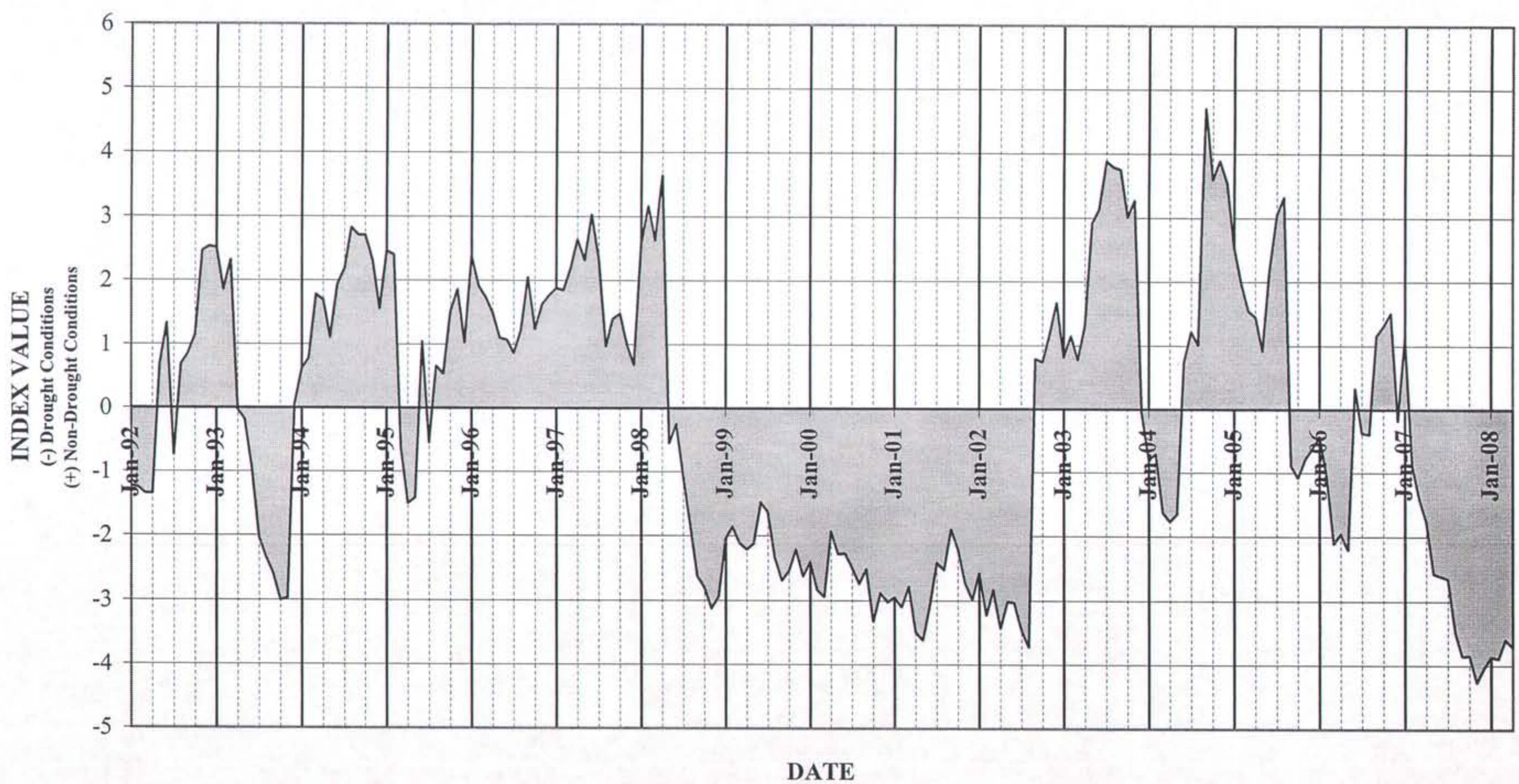
North Carolina Division 1
White Oak MSW Landfill
Haywood Co., North Carolina
BLE Job Number J07-1957-02

	Year																	
MONTH	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**Monthly Avg.**
January	3.62	5.55	6.08	7.93	8.98	5.41	10.99	6.61	4.3	3.62	4.97	2.18	2.08	2.67	5.27	4.8	3.68	5.22
February	4.43	3.23	5.49	5.12	3.88	5.43	7.6	4.68	2.67	3.49	1.65	6.03	4.61	3.8	2.35	1.81	3.47	4.10
March	4.65	7.26	9.13	3.79	5.19	7.87	4.74	3.79	4.57	5.28	5.86	5.15	2.66	4.65	1.78	4.12	5.18	5.04
April	3.83	3.9	5	1.68	3.91	5.96	8.09	3.82	6.26	1.73	2.32	6.32	3.52	4.47	4.7	2.61	3.04	4.19
May	5.96	3.96	2.71	4.57	4.09	3.69	3.25	3.9	3.17	3.46	4.7	9.88	4.78	2.87	2.71	1.48		4.07
June	6.17	2.19	7.57	7.26	4.66	6.85	5.55	5.58	3.99	5.07	3.62	5.74	6.7	8.59	5.37	4.03		5.56
July	2.9	2.79	6.47	3.64	4.77	4.05	2.69	4.44	4.01	6.13	3.46	8.43	6.88	8.7	4.04	4.56		4.87
August	7.45	4.17	7.91	7.96	6.56	0.93	2.56	2.2	3.47	3.83	3.45	6.33	4.43	7.28	5.27	2.17		4.75
September	4.4	3.57	3.9	3.3	6.55	6.51	1.98	2.57	4.19	4.9	7.66	4.64	16	0.9	7.39	2.85		5.08
October	4.75	1.64	4.59	7.35	1.45	4.4	2.82	3.55	0.06	1.48	4.15	2.25	1.83	3.1	4.35	3.21		3.19
November	7.89	4.14	3.56	4.82	5.07	2.22	3.19	4.73	4.85	1.76	4.95	5.82	6.13	4.77	4.65	2.23		4.42
December	5.53	4.73	2.99	2.19	5.58	3.7	4.78	2.44	2.73	3.04	6.47	4.17	4.64	4.57	4.18	4.67		4.15
SEASON																		**Seasonal Avg.**
Winter	12.7	16.04	20.7	16.84	18.05	18.71	**23.33**	15.08	11.54	12.39	12.48	13.36	9.35	11.12	9.4	10.73	12.33	14.36
Spring	15.96	10.05	15.28	13.51	12.66	16.5	16.89	13.3	13.42	10.26	10.64	**21.94**	15	15.93	12.78	8.12		13.89
Summer	14.75	10.53	18.28	14.9	17.88	11.49	7.23	9.21	11.67	14.86	14.57	19.4	**27.31**	16.88	16.7	9.58		14.70
Fall	**18.17**	10.51	11.14	14.36	12.1	10.32	10.79	10.72	7.64	6.28	15.57	12.24	12.6	12.44	13.18	10.11		11.76
Yearly Totals	61.58	47.13	65.40	59.61	60.69	57.02	58.24	48.31	44.27	43.79	53.26	66.94	64.26	56.37	52.06	38.54		**Yearly Avg.** 54.64

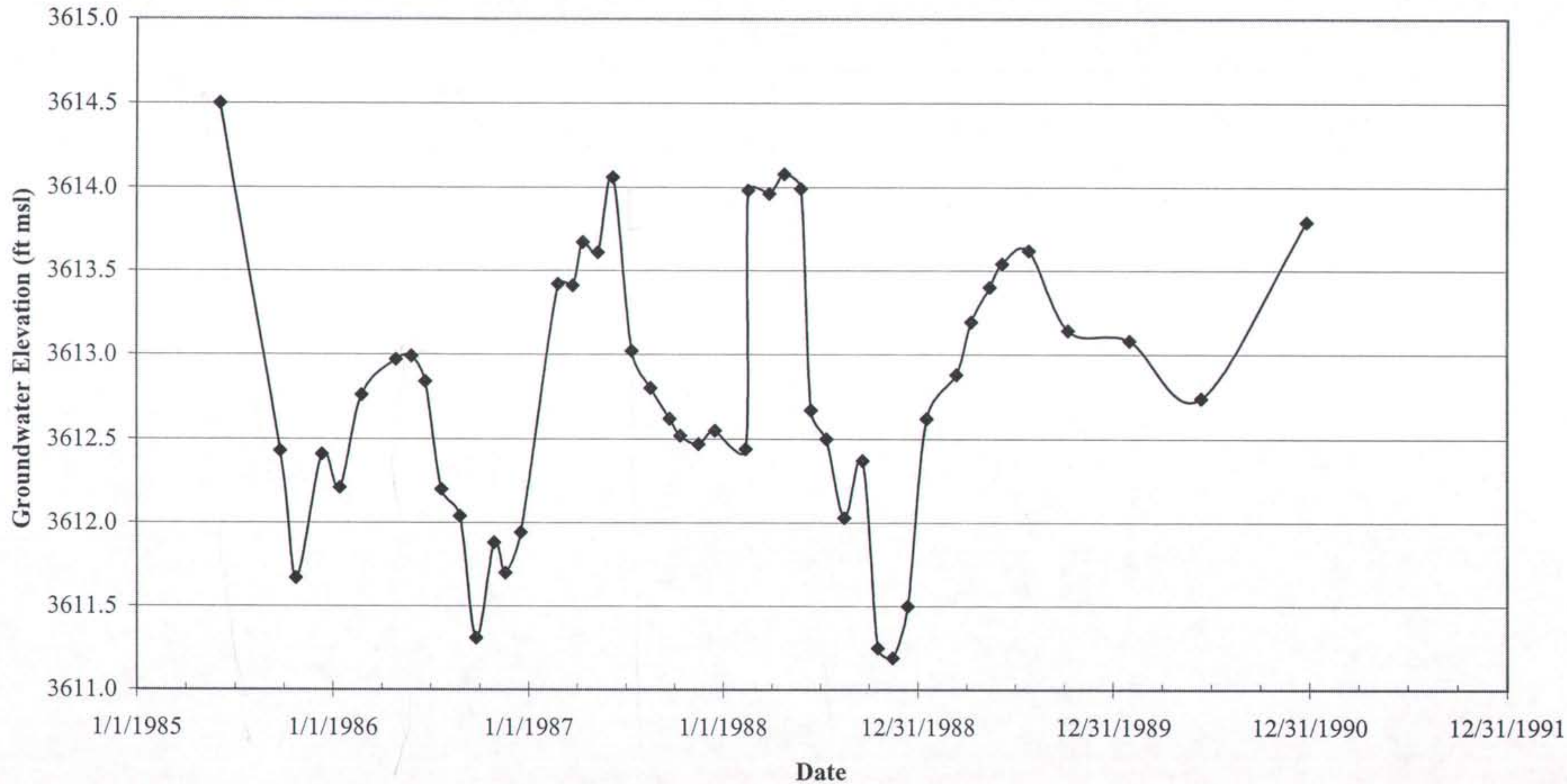
Data Source: NOAA, public information - Updated through March 2008.

PALMER DROUGHT SEVERITY INDEX

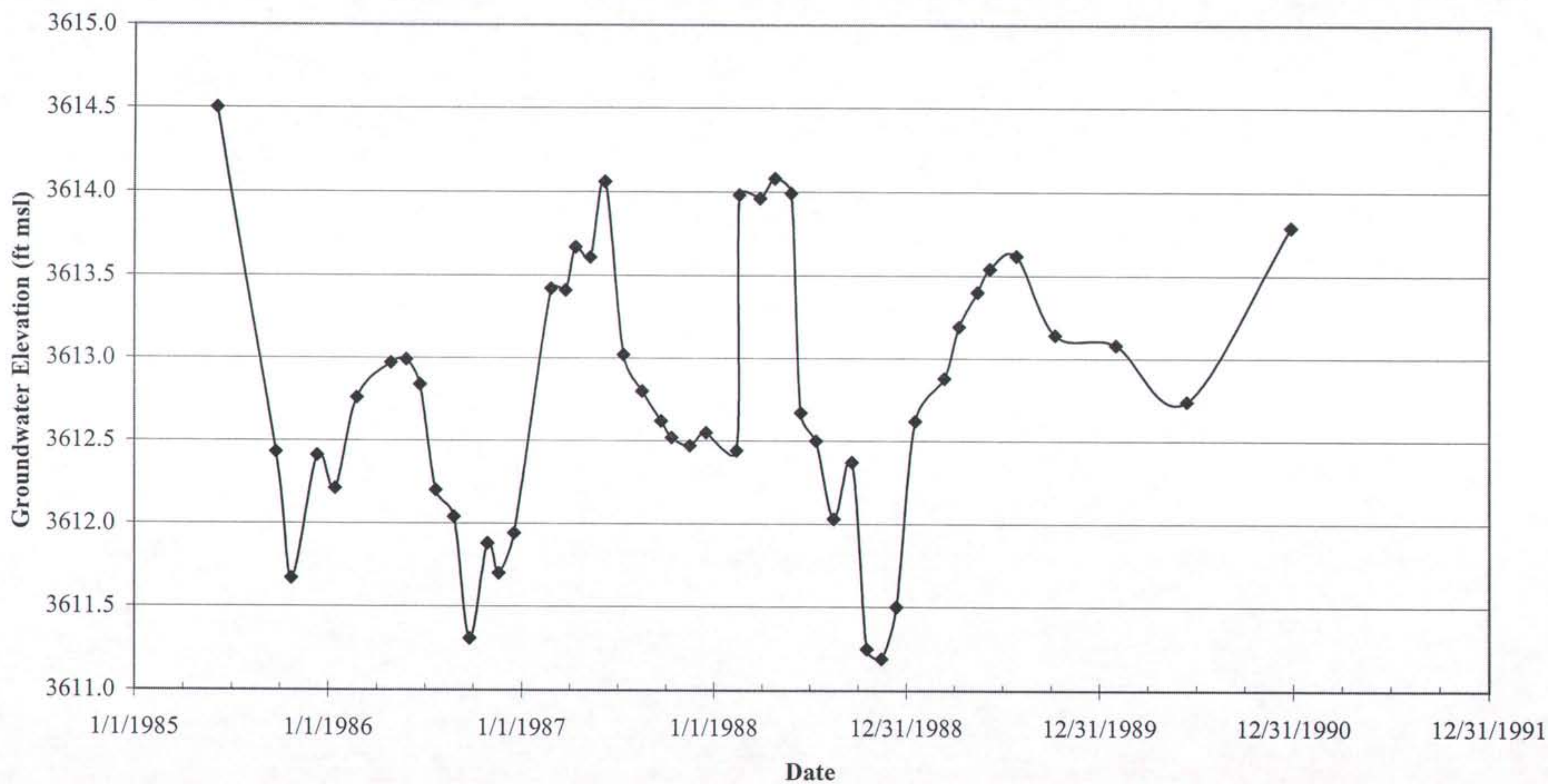
North Carolina Division 1
White Oak MSW Landfill
Haywood County, NC
BLE Project Number J07-1957-02



Time Series Plot of Well M 90U1 Groundwater Elevations
Latitude: 35.59389° N
Longitude: 82.84694° W
Haywood County, NC



Time Series Plot of Well M 90U1 Groundwater Elevations
Latitude: 35.59389° N
Longitude: 82.84694° W
Haywood County, NC



Time Series Plot of Well M 90U2 Groundwater Elevations
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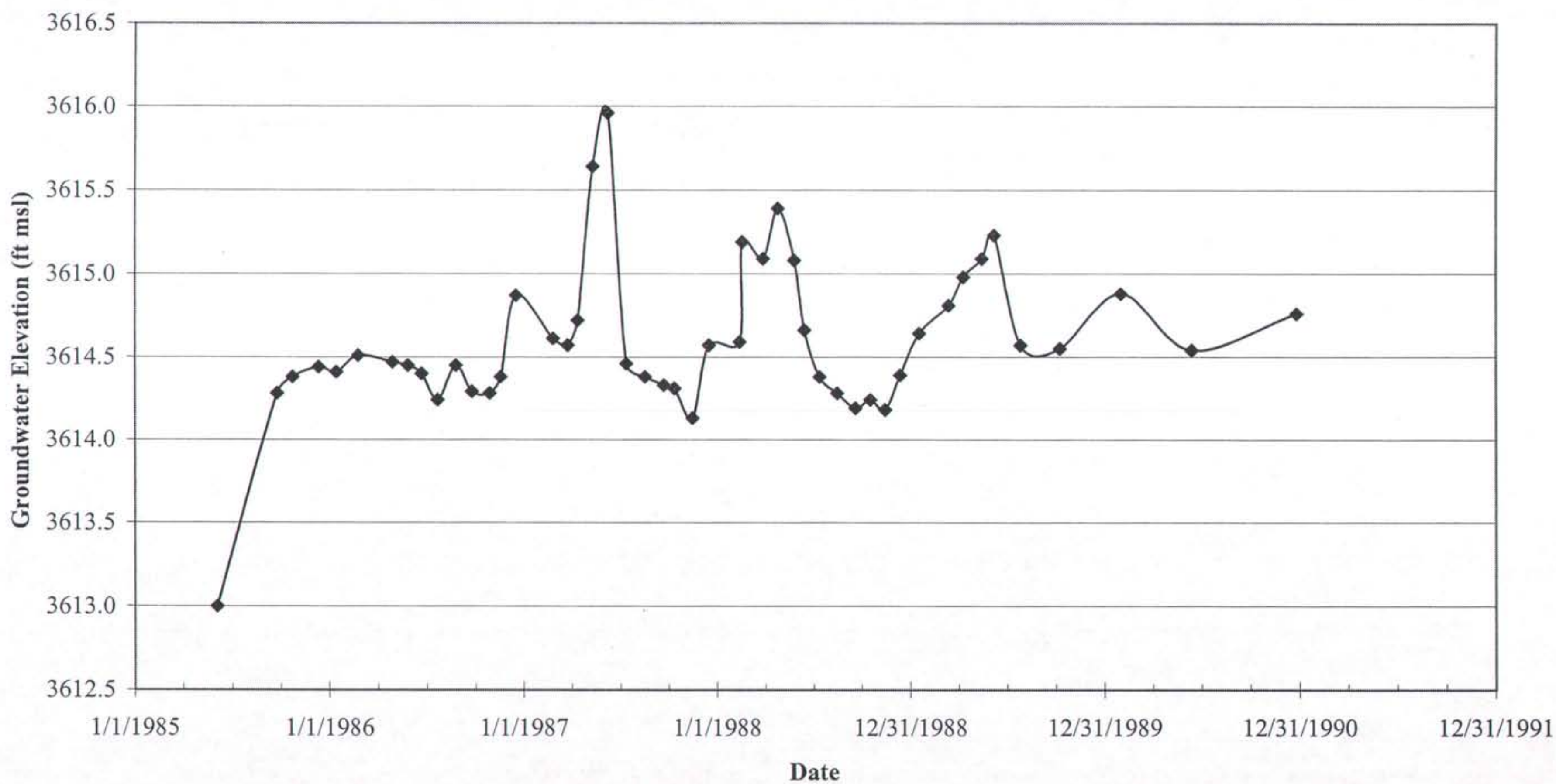
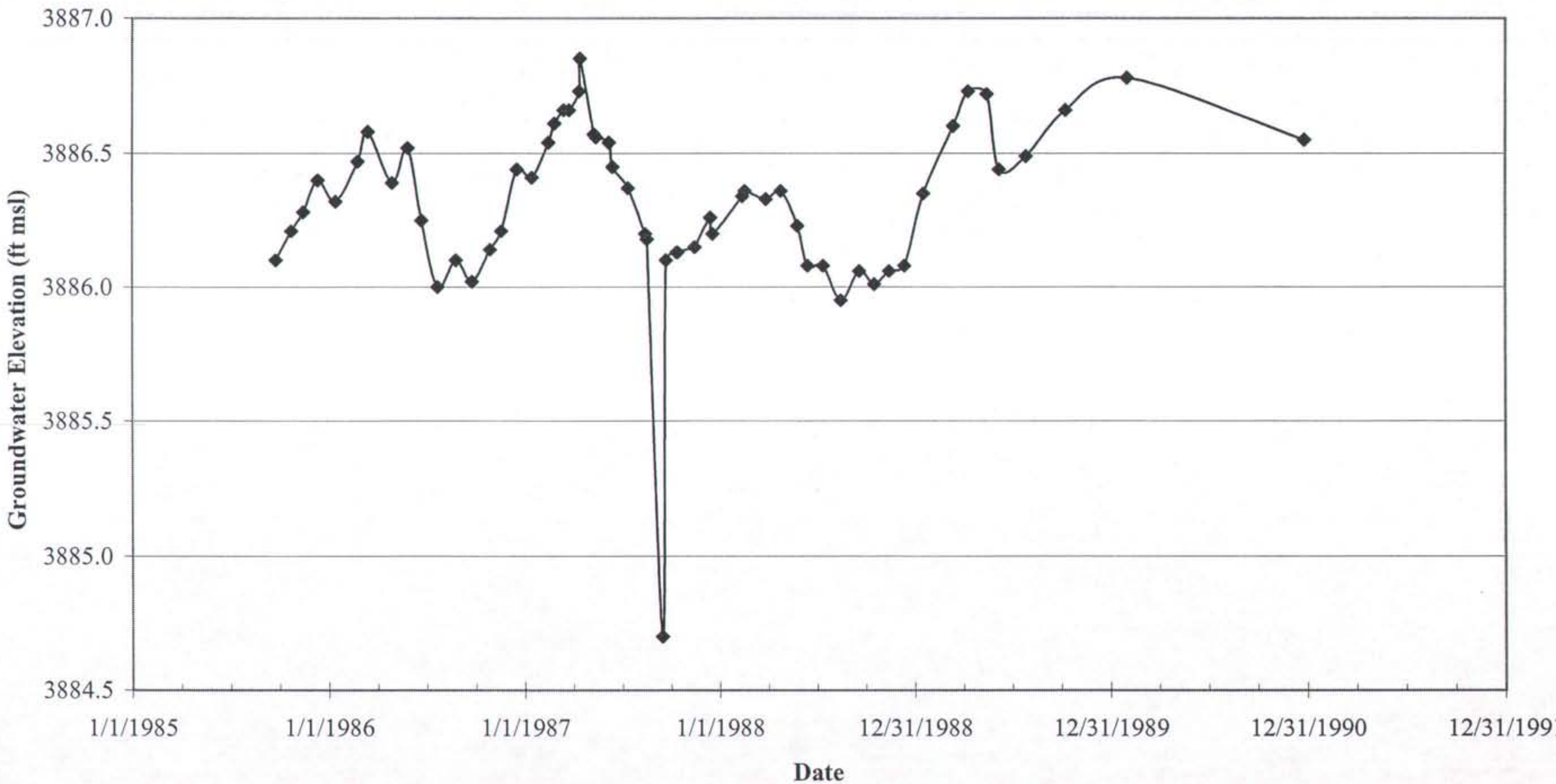
Longitude: 82.84667° W
Haywood County, NC



Time Series Plot of Well M 90T2 Groundwater Elevations
Latitude: 35.60333° N
Longitude: 82.84306° W
Haywood County, NC



APPENDIX F

SLUG TEST PROCEDURES AND RESULTS

APPENDIX F

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 groundwater flow velocities of groundwater beneath the site. The field procedure was as follows:

- Measure the static groundwater 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 shown on the attached sheets the water level recovers to its original level.

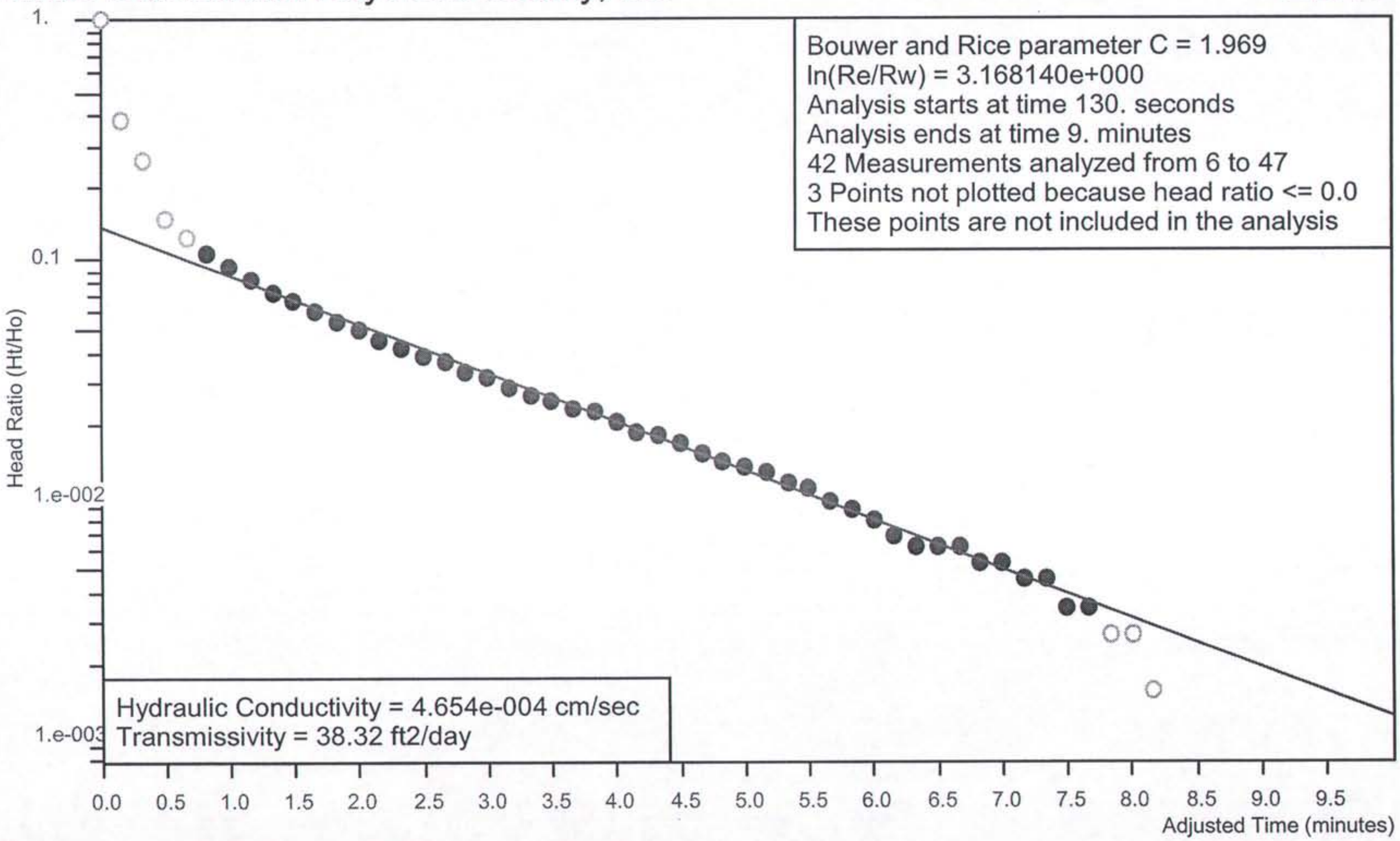
The resulting slug test data (time versus water level) was reduced and hydraulic conductivity values were calculated using the Bouwer and Rice Method for partially-penetrating wells in an unconfined aquifer.

Rising Head Slug Test 9/26/07

White Oak Landfill Haywood County, NC

Bouwer and Rice Graph

BLE-3



Ho is 2.598 feet at 79.98 seconds

Project Number J07-1957-02 for McGill Associates

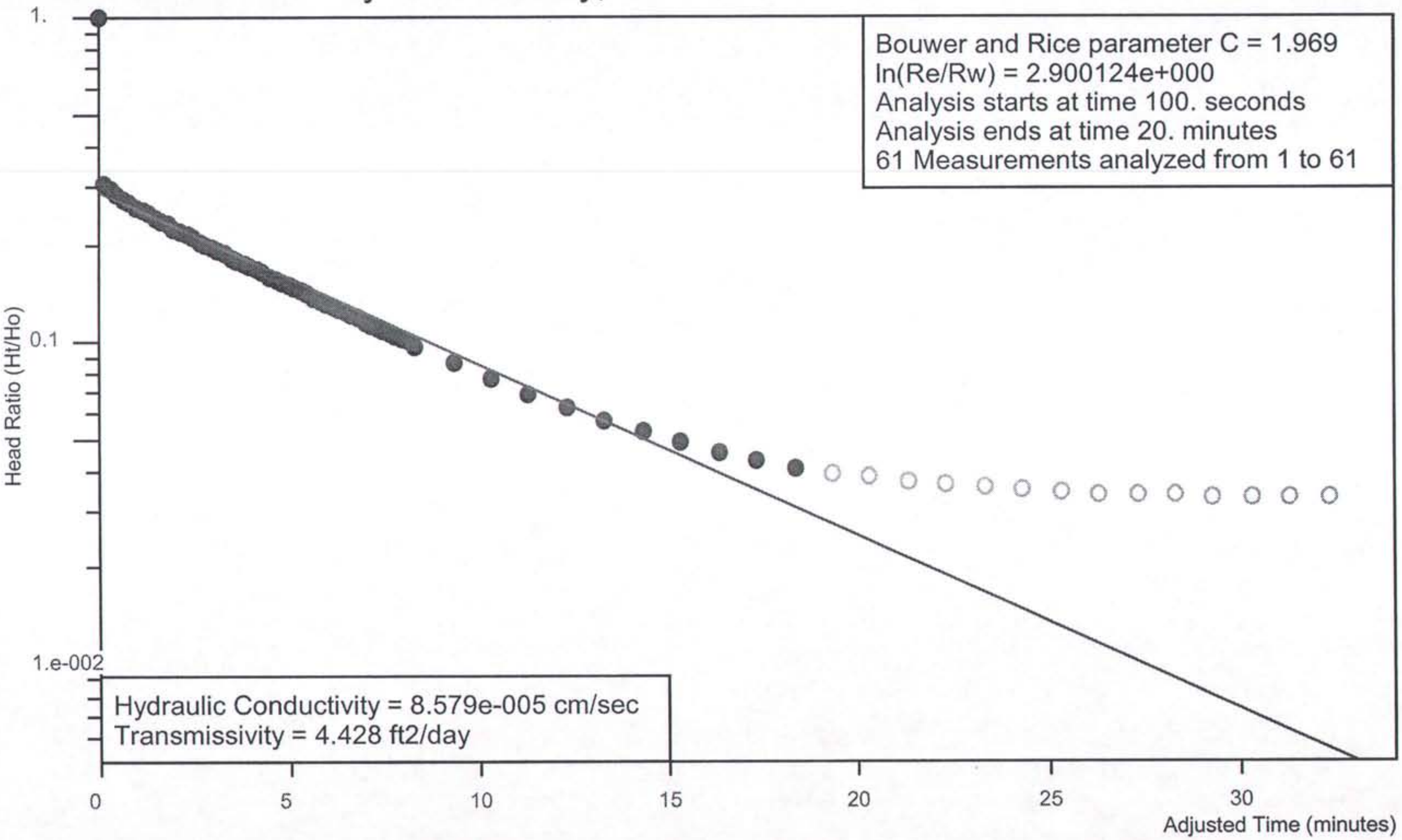
Analysis by Bunnell-Lammons Engineering, Inc.

Rising Head Slug Test 9/26/07

White Oak Landfill Haywood County, NC

Bouwer and Rice Graph

BLE-7



Bouwer and Rice parameter C = 1.969
ln(Re/Rw) = 2.900124e+000
Analysis starts at time 100. seconds
Analysis ends at time 20. minutes
61 Measurements analyzed from 1 to 61

Hydraulic Conductivity = 8.579e-005 cm/sec
Transmissivity = 4.428 ft2/day

Ho is 12.01 feet at 100. seconds

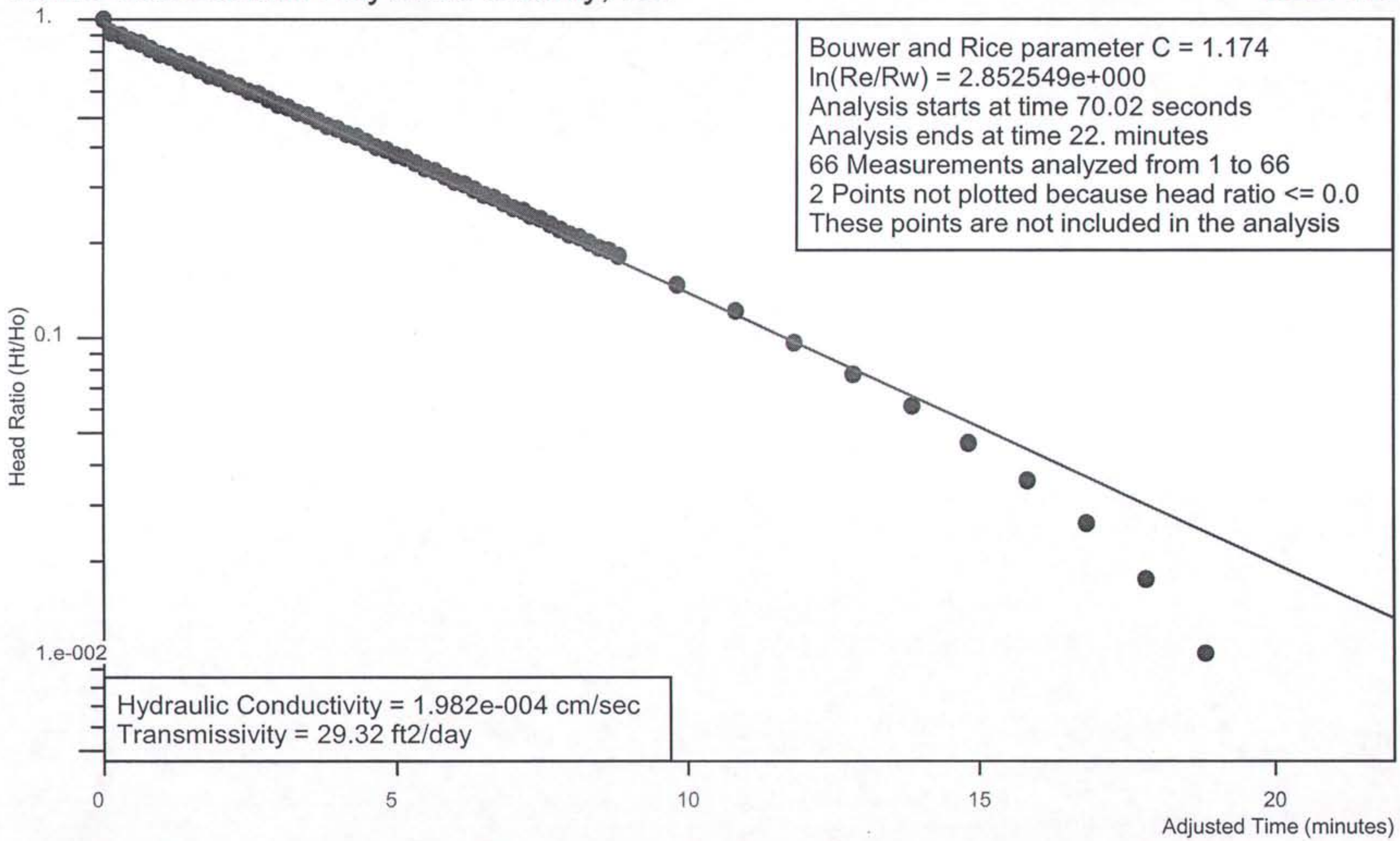
Project Number J07-1957-02 for McGill Associates
Analysis by Bunnell-Lammons Engineering, Inc.

Falling Head Slug Test 9/26/07

White Oak Landfill Haywood County, NC

Bouwer and Rice Graph

BLE-7D



Ho is 4.141 feet at 70.02 seconds

Project Number J07-1957-02 for McGill Associates

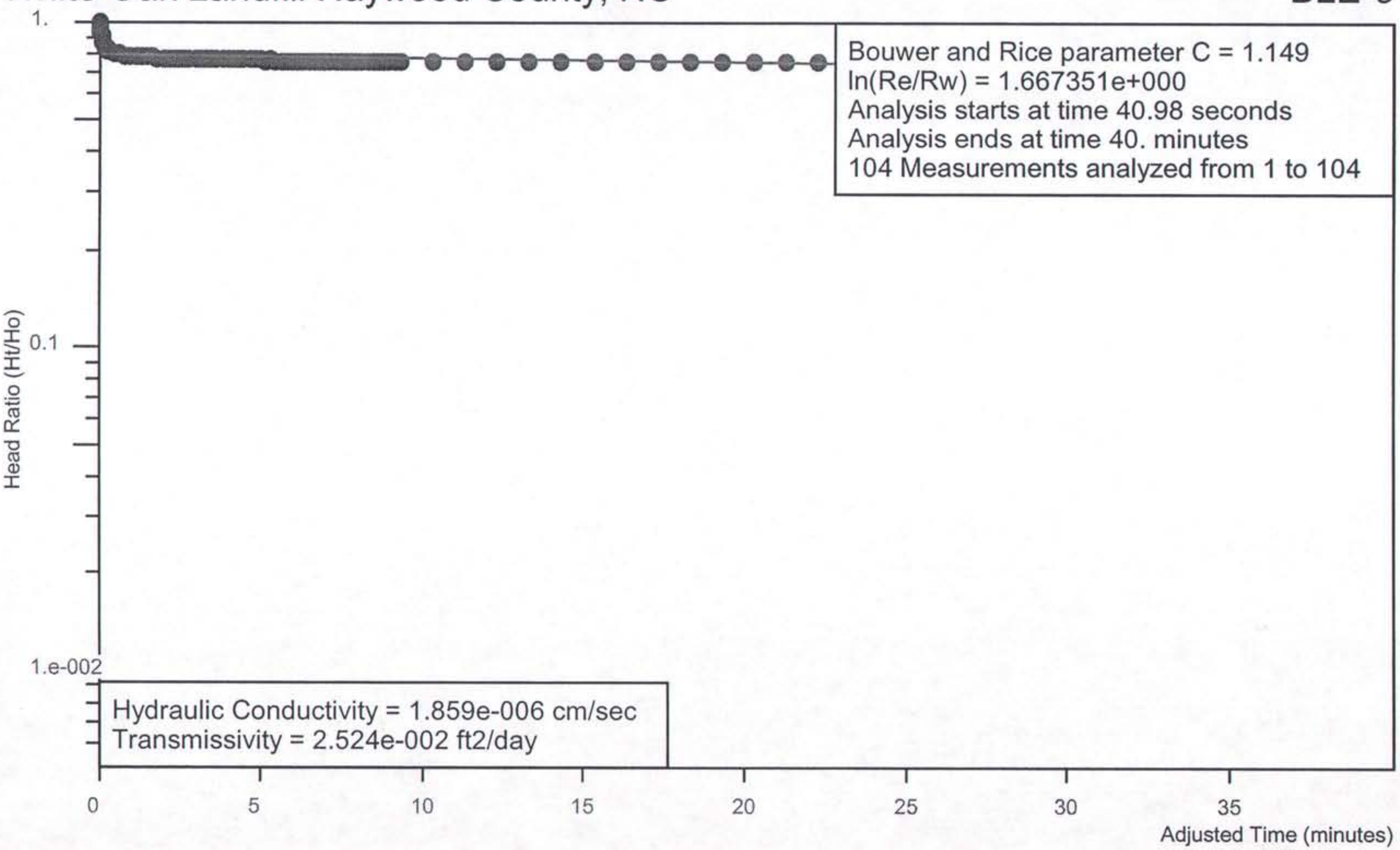
Analysis by Bunnell-Lammons Engineering, Inc.

Rising Head Slug Test 9/26/07

White Oak Landfill Haywood County, NC

Bouwer and Rice Graph

BLE-9

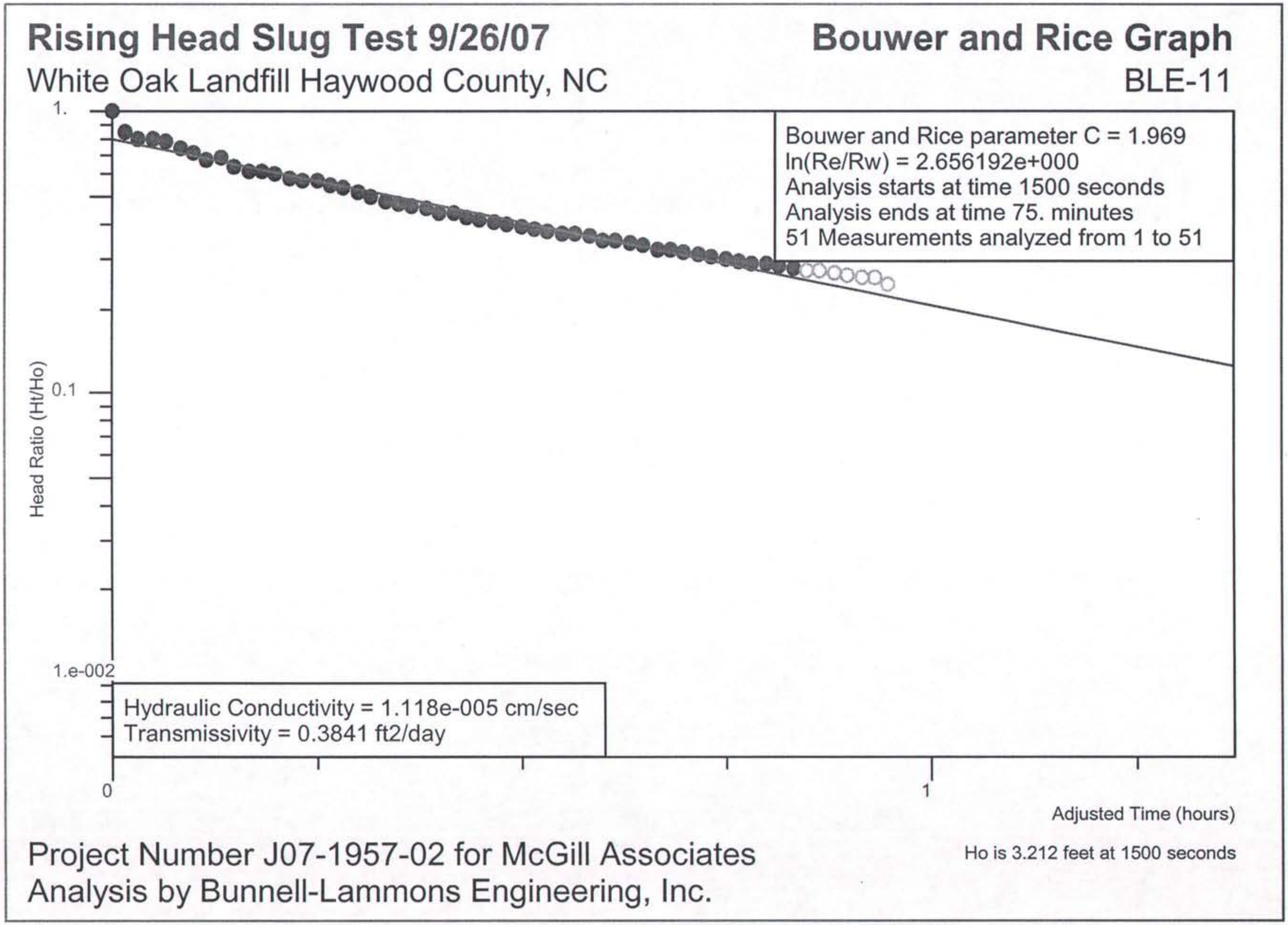


Bouwer and Rice parameter C = 1.149
ln(Re/Rw) = 1.667351e+000
Analysis starts at time 40.98 seconds
Analysis ends at time 40. minutes
104 Measurements analyzed from 1 to 104

Hydraulic Conductivity = 1.859e-006 cm/sec
Transmissivity = 2.524e-002 ft2/day

Ho is 1.871 feet at 40.98 seconds

Project Number J07-1957-02 for McGill Associates
Analysis by Bunnell-Lammons Engineering, Inc.



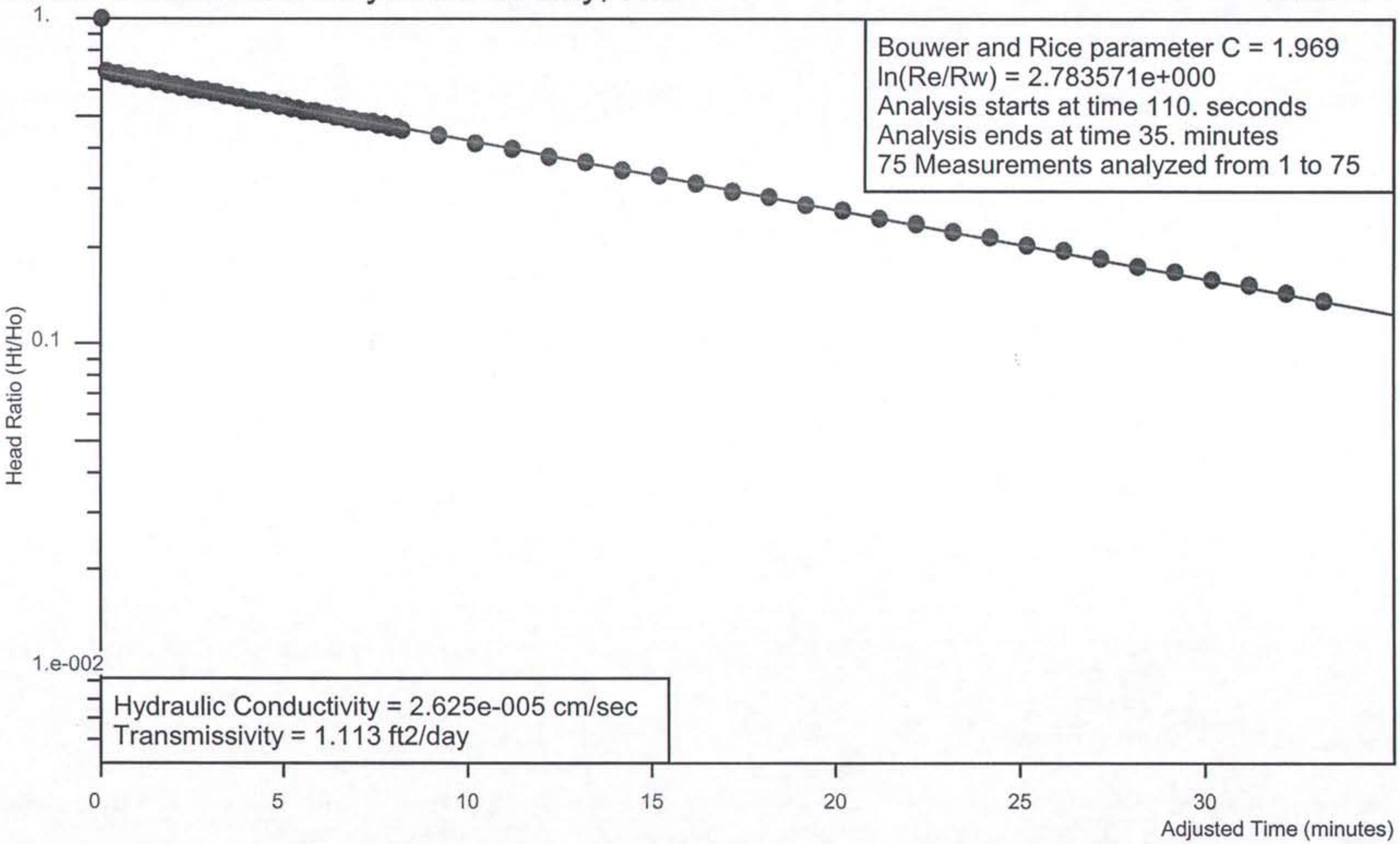
Rising Head Slug Test 9/26/07
Bouwer and Rice Graph
White Oak Landfill Haywood County, NC
BLE-11
1.
0.1
1.e-002
Head Ratio (Ht/Ho)
Bouwer and Rice parameter C = 1.969
ln(Re/Rw) = 2.656192e+000
Analysis starts at time 1500 seconds
Analysis ends at time 75. minutes
51 Measurements analyzed from 1 to 51
Hydraulic Conductivity = 1.118e-005 cm/sec
Transmissivity = 0.3841 ft2/day
0
1
Adjusted Time (hours)
Ho is 3.212 feet at 1500 seconds
Project Number J07-1957-02 for McGill Associates
Analysis by Bunnell-Lammons Engineering, Inc.

Falling Head Slug Test 9/26/07

White Oak Landfill Haywood County, NC

Bouwer and Rice Graph

BLE-14



Ho is 5.481 feet at 110. seconds

Project Number J07-1957-02 for McGill Associates

Analysis by Bunnell-Lammons Engineering, Inc.

APPENDIX G

SOIL LABORATORY TEST PROCEDURES

APPENDIX G

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 indicated 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 place 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 wit ASTM D 5084.

COMPACTION

Bulk samples of potential borrow soils from the project site were collected and transported to the laboratory for compaction testing. A standard Proctor compaction test (ASTM D 698) was performed on each sample to determine compaction characteristics, including the maximum dry density and optimum moisture content. Test results are presented on the attached Compaction Test sheet.

CONSOLIDATION

A single section of the undisturbed sample was extruded from its sampling tube for consolidation testing. The sample was then trimmed into a disc 2.4 inches in diameter and 1 inch thick. The disc was confined in a stainless steel ring and sandwiched between porous plates. It was then subjected to incrementally increasing vertical loads and the resulting deformations measured with a micrometer dial gauge. The test results are presented in the form of a pressure versus percent strain curve on the accompanying Consolidation Test sheet.

TRIAXIAL SHEAR

Multi-stage consolidated undrained triaxial compression tests were conducted on relatively undisturbed soil samples. Each sample was trimmed and the initial moisture content and unit weight was determined. The trimmed sample was placed into a waterproof membrane and loaded into the test cell. The sample was subjected to an assigned confining pressure and allowed to consolidate. The sample was then subjected to an axial compressive load, which was gradually increased until incipient failure, at which point the confining pressure was increased and the process repeated. Pore pressures were measured during the test to permit determination of the total stress and effective stress parameters. The test results are used to estimate the strength parameters of the soil (angle of internal friction and cohesion). The test results are presented in the form of Stress-Strain Curves and Mohr Diagrams on the accompanying Triaxial Shear Test sheets.

APPENDIX H

SOIL LABORATORY TEST RESULTS

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT

CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT: WHITE OAK LANDFILL HAYWOOD COUNTY, NC
TESTED BY: JOHN MATHEW

PROJECT NO.: J07-1957-02
CHECKED BY: PAUL YARBER

DATE RECEIVED: 11-2-07

SAMPLE NO. BLE-1
SAMPLE LOCATION: 3.5-5.5'

TYPE UNDISTURBED
SAMPLE DESCRIPTION: TAN FI. SANDY CLAYEY SILT

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	2.902	7.371	2.989	7.592
Sample Diameter	2.853	7.247	2.872	7.295
Length/Diameter Ratio		1.02		
Moisture Content (%)	WW= 158.2 DW= 119.8	32.1	WW= 231.5 DW= 174.1	33.0
Sample Wet Weight (grams)	569.9		593.0	
Wet Density (pcf)	117.0		116.7	
Dry Density (pcf)	88.6		87.7	
Saturation (%) ASSUMED SG= 2.722	95		96	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT

FALLING HEAD TEST

Confining Pressure (psi) 64.2 | 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)
11-9-07	5:00:0	5:00:34	34	1.0	23.0	3.0	21.0	40.092	35.361	21	5	2.8E-04	0.976	2.7E-04
11-9-07	5:00:34	5:01:15	41	3.0	21.0	5.0	19.0	35.361	30.629	21	4	2.6E-04	0.976	2.6E-04
11-9-07	5:01:15	5:02:03	48	5.0	19.0	7.0	17.0	30.629	25.897	21	4	2.6E-04	0.976	2.6E-04
11-9-07	5:02:03	5:03:00	57	7.0	17.0	9.0	15.0	25.897	21.166	21	3	2.7E-04	0.976	2.6E-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) 2.6E-04 cm/sec

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT
CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	WHITE OAK LANDFILL HAYWOOD COUNTY, NC	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J07-1957-02	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	11-2-07		

SAMPLE NO.	BLE-3	SAMPLE LOCATION:	6.0-8.0'
TYPE	UNDISTURBED	SAMPLE DESCRIPTION:	BROWN SILTY FI.-CO. SAND

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	2.898	7.361	2.902	7.371
Sample Diameter	2.850	7.239	2.874	7.300
Length/Diameter Ratio		1.02		
Moisture Content (%)	WW= 184.7 DW= 153.4	20.4	WW= 264.0 DW= 212.4	24.3
Sample Wet Weight (grams)	598.3		621.7	
Wet Density (pcf)	123.3		125.8	
Dry Density (pcf)	102.4		101.2	
Saturation (%) ASSUMED SG= 2.71	85		98	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT
FALLING HEAD TEST

Confining Pressure (psi) 66.2 — Influent Pressure (psi) 60.2 — Effluent Pressure (psi) 60

Date	Clock Time		Elapsed Time seconds	Pipet Readings				Head		Temp	Gradient	K	Temp	K_{20}
				Initial		Final		Initial	Final					
	Start	End		in	out	in	out	cm	cm	°C		(cm/sec)	Correction	(cm/sec)
11-9-07	3:37:00	3:37:24	24	1.0	23.0	2.0	22.0	40.092	37.726	21	5	1.9E-04	0.976	1.9E-04
11-9-07	3:37:24	3:37:49	25	2.0	22.0	3.0	21.0	37.726	35.361	21	5	2.0E-04	0.976	1.9E-04
11-9-07	3:37:47	3:38:16	29	3.0	21.0	4.0	20.0	35.361	32.995	21	5	1.8E-04	0.976	1.8E-04
11-9-07	3:38:16	3:38:46	30	4.0	20.0	5.0	19.0	32.995	30.629	21	4	1.9E-04	0.976	1.8E-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) 1.8E-04 cm/sec

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT
CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	WHITE OAK LANDFILL HAYWOOD COUNTY, NC	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J07-1957-02	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	11-2-07		

SAMPLE NO.	BLE-3	SAMPLE LOCATION:	23.5-25.0'
TYPE	UNDISTURBED	SAMPLE DESCRIPTION:	LIGHT GREY & WHITE SILTY FI.-MED. SAND

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	2.957	7.511	2.920	7.417
Sample Diameter	2.856	7.254	2.860	7.264
Length/Diameter Ratio		1.04		
Moisture Content (%)	WW= 175.5 DW= 133.4	31.6	WW= 204.9 DW= 161.7	26.7
Sample Wet Weight (grams)	588.7		592.3	
Wet Density (pcf)	118.4		120.3	
Dry Density (pcf)	90.0		94.9	
Saturation (%) ASSUMED SG= 2.689	98		94	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT
FALLING HEAD TEST

Confining Pressure (psi) 78.2 | 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)
11-9-07	4:13:00	4:15:06	126	1.0	23.0	2.0	22.0	40.092	37.726	21	5	3.7E-05	0.976	3.6E-05
11-9-07	4:15:06	4:17:22	136	2.0	22.0	3.0	21.0	37.726	35.361	21	5	3.7E-05	0.976	3.6E-05
11-9-07	4:17:22	4:19:50	148	3.0	21.0	4.0	20.0	35.361	32.995	21	5	3.6E-05	0.976	3.5E-05
11-9-07	4:19:50	4:22:31	161	4.0	20.0	5.0	19.0	32.995	30.629	21	4	3.5E-05	0.976	3.5E-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) 3.5E-05 cm/sec

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT
CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT: WHITE OAK LANDFILL HAYWOOD COUNTY, NC
TESTED BY: JOHN MATHEW
PROJECT NO.: J07-1957-02
CHECKED BY: PAUL YARBER
DATE RECEIVED: 11-2-07

SAMPLE NO. BLE-7
SAMPLE LOCATION: 1.0-3.0'
TYPE UNDISTURBED
SAMPLE DESCRIPTION: LIGHT BROWN FI.-MED. SANDY CLAYEY SILT

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	2.978	7.564	2.952	7.498
Sample Diameter	2.854	7.249	2.858	7.259
Length/Diameter Ratio		1.04		
Moisture Content (%)	WW= 146.9 DW= 108.5	35.4	WW= 264.9 DW= 186.2	42.3
Sample Wet Weight (grams)	563.1		580.1	
Wet Density (pcf)	112.6		116.7	
Dry Density (pcf)	83.2		82.0	
Saturation (%) ASSUMED SG= 2.708	93		108	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT
(PERMOMETER)

Confining Pressure (psi) 72 | Influent Pressure (psi) 70 | Effluent Pressure (psi) 70

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	11-8-07	4:18:06		4.8	2.20	21	5			
	11-8-07	4:18:32	0:00:26	3.5	2.25	21	3	1.2E-05	0.976	1.1E-05
	11-8-07	4:18:40	0:00:34	3.3	2.26	21	2	1.1E-05	0.976	1.1E-05
	11-8-07	4:18:55	0:00:49	3.0	2.27	21	2	1.1E-05	0.976	1.0E-05
	11-8-07	4:19:10	0:01:04	2.8	2.28	21	1	1.0E-05	0.976	1.0E-05

HYDRAULIC CONDUCTIVITY (k) 1.1E-05 cm/sec

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT
CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	WHITE OAK LANDFILL HAYWOOD COUNTY, NC	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J07-1957-02	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	11-2-07		

SAMPLE NO.	BLE-9	SAMPLE LOCATION:	13.5-15.5'
TYPE	UNDISTURBED	SAMPLE DESCRIPTION:	GREY & BROWN SILTY FI.-MED. SAND

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	2.952	7.498	2.956	7.508
Sample Diameter	2.850	7.239	2.846	7.229
Length/Diameter Ratio		1.04		
Moisture Content (%)	WW= 179.7 DW= 145.1	23.8	WW= 248.1 DW= 186.0	33.4
Sample Wet Weight (grams)	521.5		569.5	
Wet Density (pcf)	105.5		115.4	
Dry Density (pcf)	85.2		86.5	
Saturation (%) ASSUMED SG= 2.752	65		93	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT
FALLING HEAD TEST

Confining Pressure (psi) 82.2 | Influent Pressure (psi) 70.2 | Effluent Pressure (psi) 70

Date	Clock Time		Elapsed Time seconds	Pipet Readings				Head		Temp	Gradient	K	Temp	K_{20}
				Initial		Final		Initial cm	Final cm	°C		(cm/sec)	Correction	(cm/sec)
	Start	End		in	out	in	out							
11-9-07	3:50:10	3:50:31	21	1.0	23.0	2.0	22.0	40.092	37.726	21	5	2.2E-04	0.976	2.2E-04
11-9-07	3:50:31	3:50:53	22	2.0	22.0	3.0	21.0	37.726	35.361	21	5	2.3E-04	0.976	2.2E-04
11-9-07	3:50:53	3:51:17	24	3.0	21.0	4.0	20.0	35.361	32.995	21	5	2.2E-04	0.976	2.2E-04
11-9-07	3:51:17	3:51:44	27	4.0	20.0	5.0	19.0	32.995	30.629	21	4	2.1E-04	0.976	2.1E-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) 2.2E-04 cm/sec

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT
CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	**WHITE OAK LANDFILL HAYWOOD COUNTY, NC**	TESTED BY:	**JOHN MATHEW**
PROJECT NO.:	**J07-1957-02**	CHECKED BY:	**PAUL YARBER**
DATE RECEIVED:	**11-2-07**		

SAMPLE NO.	**BLE-10**	SAMPLE LOCATION:	**1.0-3.0'**
TYPE	**UNDISTURBED**	SAMPLE DESCRIPTION:	**RED & BROWN SILTY FI.-MED. SAND**

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	2.321	5.895	2.330	5.918
Sample Diameter	2.864	7.275	2.882	7.320
Length/Diameter Ratio		0.81		
Moisture Content (%)	WW= 175.6 DW= 146.0	20.3	WW= 210.8 DW= 158.3	33.2
Sample Wet Weight (grams)	430.4		466.8	
Wet Density (pcf)	109.7		117.0	
Dry Density (pcf)	91.2		87.9	
Saturation (%) ASSUMED SG= 2.693	65		98	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT
FALLING HEAD TEST

Confining Pressure (psi) 72.2 | 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)
11-8-07	5:14:00	5:16:17	137	1.0	23.0	3.0	21.0	40.092	35.361	21	6	5.5E-05	0.976	5.4E-05
11-8-07	5:16:17	5:18:53	156	3.0	21.0	5.0	19.0	35.361	30.629	21	6	5.5E-05	0.976	5.4E-05
11-8-07	5:18:53	5:21:55	182	5.0	19.0	7.0	17.0	30.629	25.897	21	5	5.5E-05	0.976	5.4E-05
11-8-07	5:21:55	5:25:36	221	7.0	17.0	9.0	15.0	25.897	21.166	21	4	5.5E-05	0.976	5.3E-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)	**5.4E-05**	**cm/sec**

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT
CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	WHITE OAK LANDFILL HAYWOOD COUNTY, NC	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J07-1957-02	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	11-2-07		

SAMPLE NO.	BLE-10	SAMPLE LOCATION:	9.5-11.5'
TYPE	UNDISTURBED	SAMPLE DESCRIPTION:	RED & BROWN FI.-MED. SANDY SILT

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	2.937	7.460	2.999	7.617
Sample Diameter	2.846	7.229	2.894	7.351
Length/Diameter Ratio		1.03		
Moisture Content (%)	WW= 174.6 DW= 140.6	24.2	WW= 271.8 DW= 207.2	31.2
Sample Wet Weight (grams)	552.3		608.9	
Wet Density (pcf)	112.6		117.6	
Dry Density (pcf)	90.7		89.6	
Saturation (%) ASSUMED SG= 2.715	76		95	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT
FALLING HEAD TEST

Confining Pressure (psi) 69.2 | 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)
11-9-07	3:17:00	3:20:06	186	1.0	23.0	2.0	22.0	40.092	37.726	21	5	2.5E-05	0.976	2.5E-05
11-9-07	3:20:06	3:23:29	203	2.0	22.0	3.0	21.0	37.726	35.361	21	5	2.5E-05	0.976	2.4E-05
11-9-07	3:23:29	3:27:09	220	3.0	21.0	4.0	20.0	35.361	32.995	21	5	2.4E-05	0.976	2.4E-05
11-9-07	3:27:09	3:31:11	242	4.0	20.0	5.0	19.0	32.995	30.629	21	4	2.4E-05	0.976	2.3E-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) 2.4E-05 cm/sec

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT
CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	WHITE OAK LANDFILL HAYWOOD COUNTY, NC	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J07-1957-02	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	11-2-07		

SAMPLE NO.	BLE-13	SAMPLE LOCATION:	23.5-25.0'
TYPE	UNDISTURBED	SAMPLE DESCRIPTION:	RED & BROWN FI.-MED. SANDY SILT

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	3.019	7.668	2.930	7.442
Sample Diameter	2.859	7.262	2.860	7.264
Length/Diameter Ratio		1.06		
Moisture Content (%)	WW= 187.7 DW= 154.9	21.2	WW= 245.3 DW= 186.0	31.9
Sample Wet Weight (grams)	578.2		581.9	
Wet Density (pcf)	113.6		117.8	
Dry Density (pcf)	93.8		89.3	
Saturation (%) ASSUMED SG= 2.73	71		96	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT
FALLING HEAD TEST

Confining Pressure (psi) 80.2 | 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)
11-9-07	2:58:00	3:00:19	139	1.0	23.0	3.0	21.0	40.092	35.361	21	5	7.1E-05	0.976	6.9E-05
11-9-07	3:00:19	3:02:58	159	3.0	21.0	5.0	19.0	35.361	30.629	21	4	7.1E-05	0.976	6.9E-05
11-9-07	3:02:58	3:06:03	185	5.0	19.0	7.0	17.0	30.629	25.897	21	4	7.1E-05	0.976	6.9E-05
11-9-07	3:06:03	3:09:46	223	7.0	17.0	9.0	15.0	25.897	21.166	21	3	7.1E-05	0.976	6.9E-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) 6.9E-05 cm/sec

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT
CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	WHITE OAK LANDFILL HAYWOOD COUNTY, NC	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J07-1957-02	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	10-24-07		

SAMPLE NO.	BLE-11	SAMPLE LOCATION:	DEPTH 15 TO 18 FEET
TYPE	REMOLDED	SAMPLE DESCRIPTION:	BROWN FI. SANDY CLAYEY SILT

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	3.000	7.620	2.961	7.521
Sample Diameter	2.850	7.239	2.845	7.226
Length/Diameter Ratio		1.05		
Moisture Content (%)	WW= 156.6 DW= 122.3	28.0	WW= 289.9 DW= 225.2	28.7
Sample Wet Weight (grams)	598.3		599.4	
Wet Density (pcf)	119.1		121.3	
Dry Density (pcf)	93.0		94.2	
Saturation (%) ASSUMED SG= 2.693	94		99	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT
(PERMOMETER)

Cell Pressure (psi) 85 | Influent Pressure (psi) 70 | Effluent Pressure (psi) 70

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	10-26-07	4:19:45		7.5	2.09	21	10			
	10-26-07	4:35:47	0:16:02	4.9	2.19	21	5	3.0E-07	0.976	2.9E-07
	10-26-07	4:36:30	0:16:45	4.8	2.20	21	5	3.0E-07	0.976	2.9E-07
	10-26-07	4:37:28	0:17:43	4.7	2.20	21	5	3.0E-07	0.976	2.9E-07
	10-26-07	4:38:33	0:18:48	4.6	2.21	21	5	3.0E-07	0.976	2.9E-07

HYDRAULIC CONDUCTIVITY (k) 2.9E-07 cm/sec

% COMPACTION OF STD. PROCTOR MAX. DRY DENSITY (ASTM D 698): 95.0
% WETTER THAN OPTIMUM MOISTURE CONTENT (ASTM D 698): +5.6

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT

CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	WHITE OAK LANDFILL HAYWOOD COUNTY, NC	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J07-1957-02	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	10-24-07		

SAMPLE NO.	BLE-14	SAMPLE LOCATION:	DEPTH 16 TO 18 FEET
TYPE	REMOLDED	SAMPLE DESCRIPTION:	DARK BROWN FI. SANDY CLAYEY SILT

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	3.000	7.620	3.004	7.630
Sample Diameter	2.850	7.239	2.859	7.262
Length/Diameter Ratio		1.05		
Moisture Content (%)	WW= 125.6 DW= 95.9	31.0	WW= 279.1 DW= 208.9	33.6
Sample Wet Weight (grams)	592.5		603.1	
Wet Density (pcf)	117.9		119.1	
Dry Density (pcf)	90.1		89.2	
Saturation (%) ASSUMED SG= 2.688	97		103	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT

(PERMOMETER)

Cell Pressure (psi) 85 | Influent Pressure (psi) 70 | Effluent Pressure (psi) 70

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	10-26-07	4:11:23		7.5	2.09	21	10			
	10-26-07	4:16:06	0:04:43	6.0	2.15	21	7	5.0E-07	0.976	4.8E-07
	10-26-07	4:16:30	0:05:07	5.9	2.15	21	7	4.9E-07	0.976	4.8E-07
	10-26-07	4:16:55	0:05:32	5.8	2.16	21	7	4.9E-07	0.976	4.8E-07
	10-26-07	4:17:21	0:05:58	5.7	2.16	21	7	4.9E-07	0.976	4.8E-07

HYDRAULIC CONDUCTIVITY (k) 4.8E-07 cm/sec

% COMPACTION OF STD. PROCTOR MAX. DRY DENSITY (ASTM D 698): 95.1

% WETTER THAN OPTIMUM MOISTURE CONTENT (ASTM D 698): +7.2

BLE INC.

HYDRAULIC CONDUCTIVITY TEST REPORT
CONSTANT VOLUME APPARATUS (ASTM D 5084)

PROJECT:	WHITE OAK LANDFILL HAYWOOD COUNTY, NC	TESTED BY:	JOHN MATHEW
PROJECT NO.:	J07-1957-02	CHECKED BY:	PAUL YARBER
DATE RECEIVED:	10-24-07		

SAMPLE NO.	BLE-15	SAMPLE LOCATION:	DEPTH 1 TO 8 FEET
TYPE	REMOLDED	SAMPLE DESCRIPTION:	BROWN FI. SANDY CLAYEY SILT

SAMPLE DIMENSIONS AND PROPERTIES

ITEM	INITIAL		FINAL	
	inches	centimeters	inches	centimeters
Sample Length	3.000	7.620	2.959	7.516
Sample Diameter	2.850	7.239	2.848	7.234
Length/Diameter Ratio		1.05		
Moisture Content (%)	WW= 101.6 DW= 77.5	31.1	WW= 254.5 DW= 193.4	31.6
Sample Wet Weight (grams)	589.8		592.9	
Wet Density (pcf)	117.4		119.8	
Dry Density (pcf)	89.6		91.1	
Saturation (%) ASSUMED SG= 2.722	94		99	

HYDRAULIC CONDUCTIVITY TESTING MEASUREMENT
(PERMOMETER)

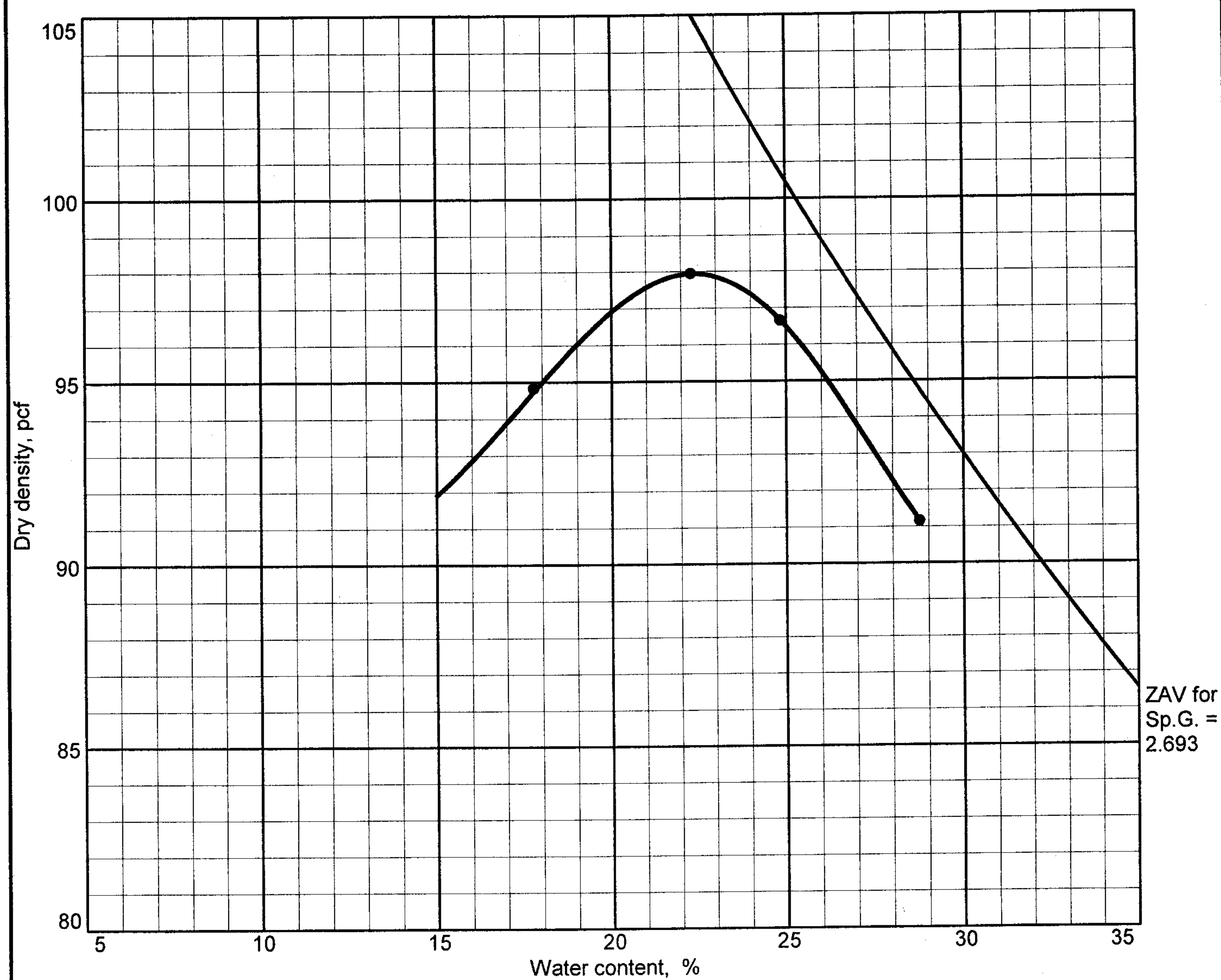
Cell Pressure (psi) 85 | Influent Pressure (psi) 70 | Effluent Pressure (psi) 70

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	10-26-07	4:10:40		7.1	1.69	21	10			
	10-26-07	4:19:56	0:09:16	6.5	1.71	21	9	9.1E-08	0.976	8.9E-08
	10-26-07	4:21:33	0:10:53	6.4	1.72	21	9	9.1E-08	0.976	8.9E-08
	10-26-07	4:23:20	0:12:40	6.3	1.72	21	9	9.1E-08	0.976	8.8E-08
	10-26-07	4:25:10	0:14:30	6.2	1.72	21	8	9.0E-08	0.976	8.8E-08

HYDRAULIC CONDUCTIVITY (k) 8.8E-08 cm/sec

% COMPACTION OF STD. PROCTOR MAX. DRY DENSITY (ASTM D 698): 95.0
% WETTER THAN OPTIMUM MOISTURE CONTENT (ASTM D 698): +5.4

MOISTURE/DENSITY RELATIONSHIP



Test specification: ASTM D 698-00a Method B Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
15.5-18.0	MH			2.693	59	22	0.0	66.7

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 97.9 pcf Optimum moisture = 22.4 %	Brown fi. sandy clayey SILT

Project No. J07-1957-02 **Client:** McGill

Project: White Oak Landfill

● **Source:** Boring **Sample No.:** BLE-11 **Elev./Depth:** 15.5-18.0

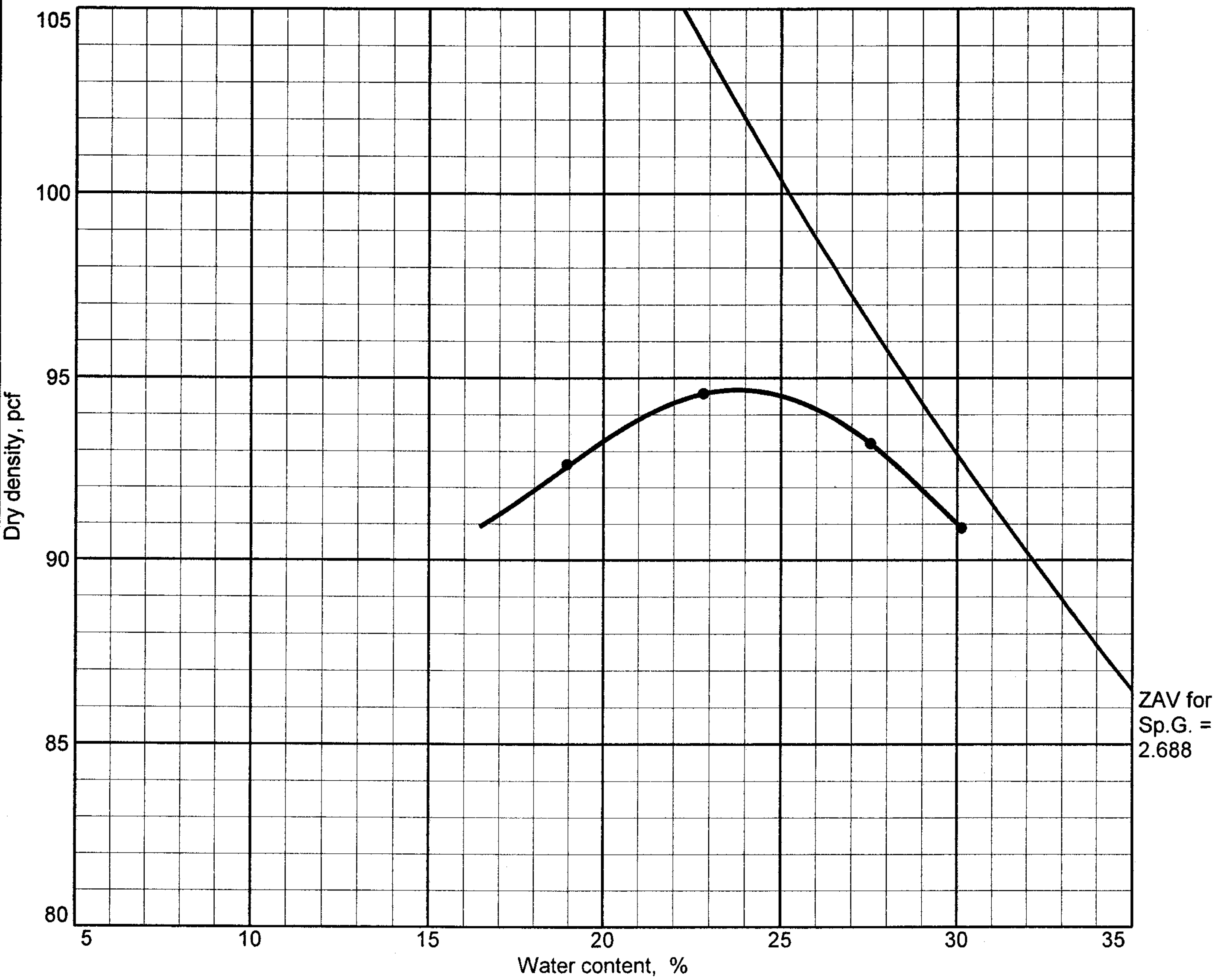
Bunnell Lammons Engineering, Inc.

Greenville, SC

Remarks:

Plate

MOISTURE/DENSITY RELATIONSHIP



Test specification: ASTM D 698-00a Method B Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
16.0-18.0	MH			2.688	63	23	0.0	76.0

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 94.7 pcf Optimum moisture = 23.8 %	Dark brown fi. sandy clayey SILT

Project No. J07-1957-02 **Client:** McGill
Project: White Oak Landfill

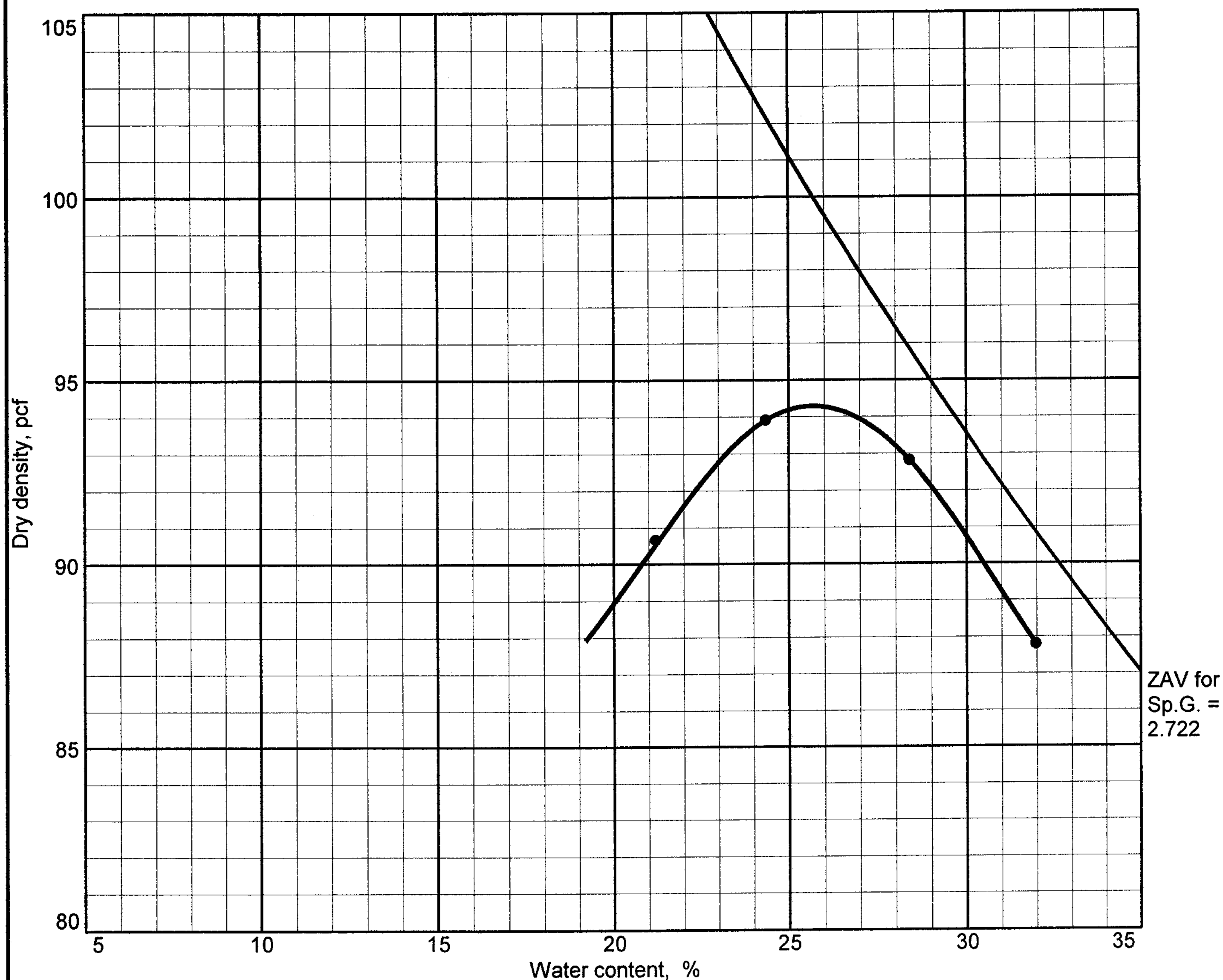
● **Source:** Boring **Sample No.:** BLE-14 **Elev./Depth:** 16.0-18.0

Remarks:

Bunnell Lammons Engineering, Inc.
Greenville, SC

Plate

MOISTURE/DENSITY RELATIONSHIP



Test specification: ASTM D 698-00a Method B Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
1.0-8.0	MH			2.722	63	28	0.0	84.0

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 94.3 pcf Optimum moisture = 25.7 %	Brown fi. sandy clayey SILT

Project No. J07-1957-02 **Client:** McGill

Project: White Oak Landfill

● **Source:** Boring **Sample No.:** BLE-15 **Elev./Depth:** 1.0-8.0

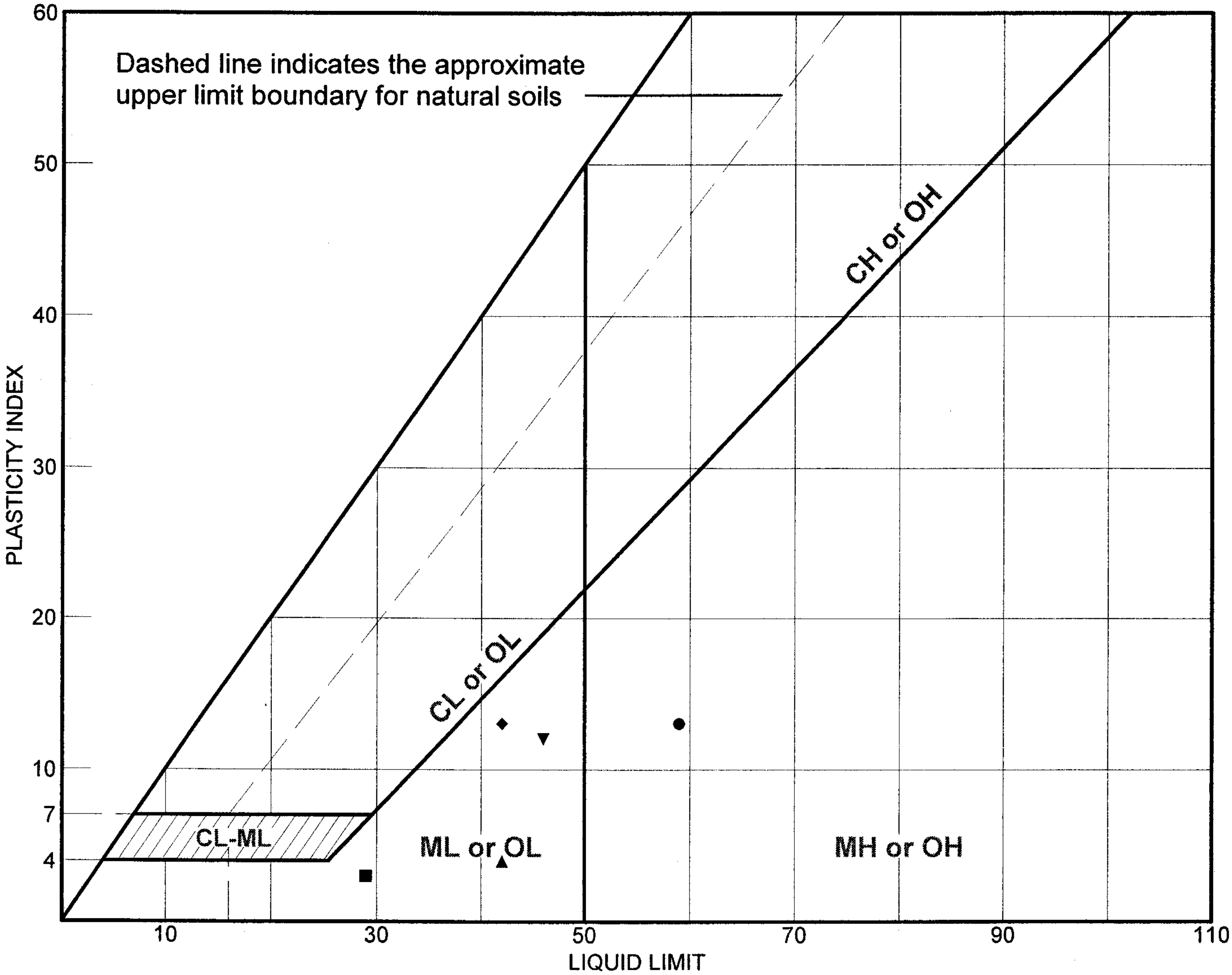
Remarks:

Bunnell Lammons Engineering, Inc.

Greenville, SC

Plate

LIQUID AND PLASTIC LIMITS TEST REPORT

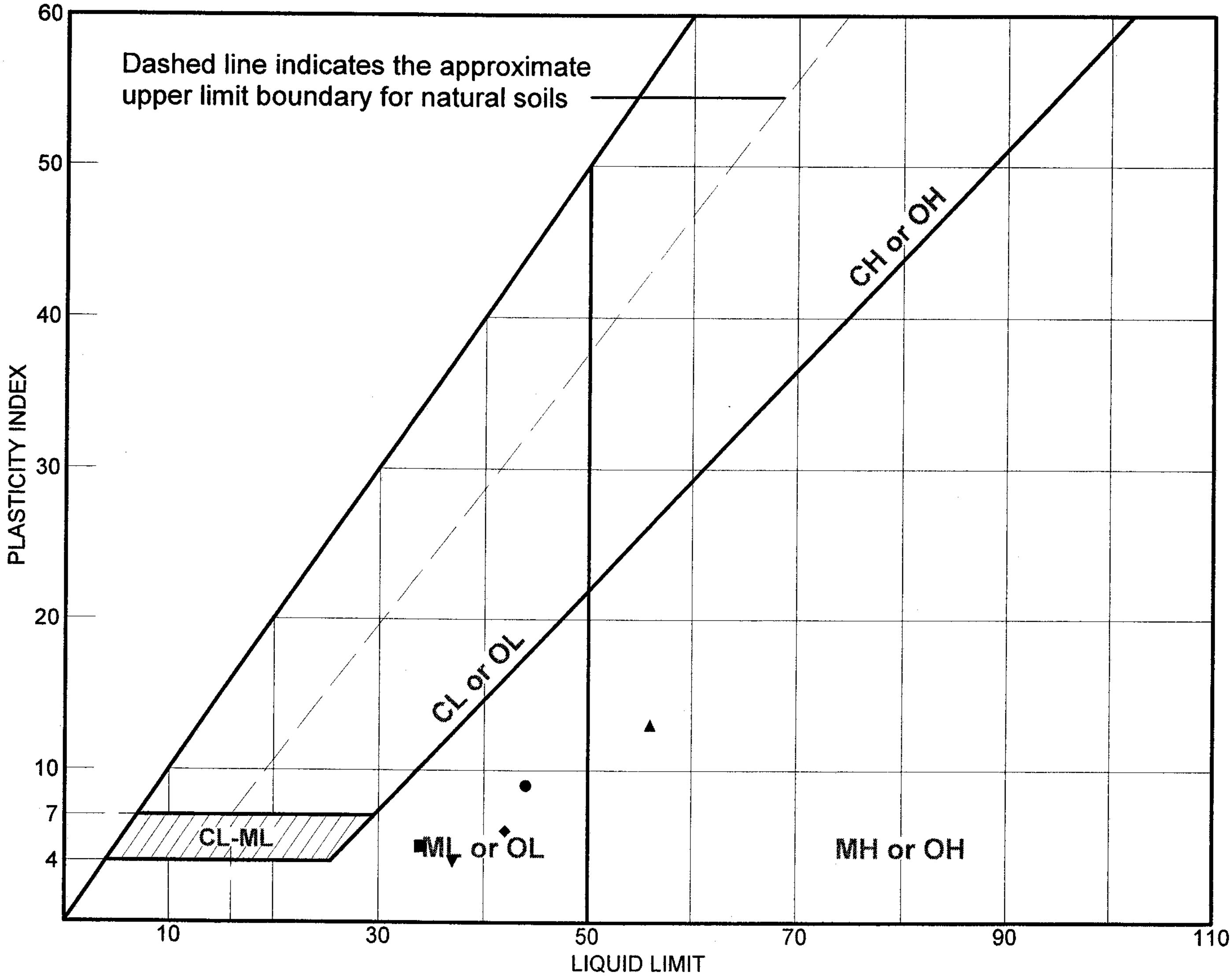


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Boring	BLE-1	3.5-5.5	32.1	46	59	13	MH
■	Boring	BLE-1	63.5-65.0	12.6	26	29	3	SM
▲	Boring	BLE-2	23.5-25.0	24.8	38	42	4	SM
◆	Boring	BLE-3	6.0-8.0	20.4	29	42	13	SM
▼	Boring	BLE-3	8.5-10.0	15.4	34	46	12	SM

LIQUID AND PLASTIC LIMITS TEST REPORT **Bunnell Lammons Engineering, Inc.** **Greenville, SC**	**Client:** McGill **Project:** White Oak Landfill **Project No.:** J07-1957-02 **Plate**

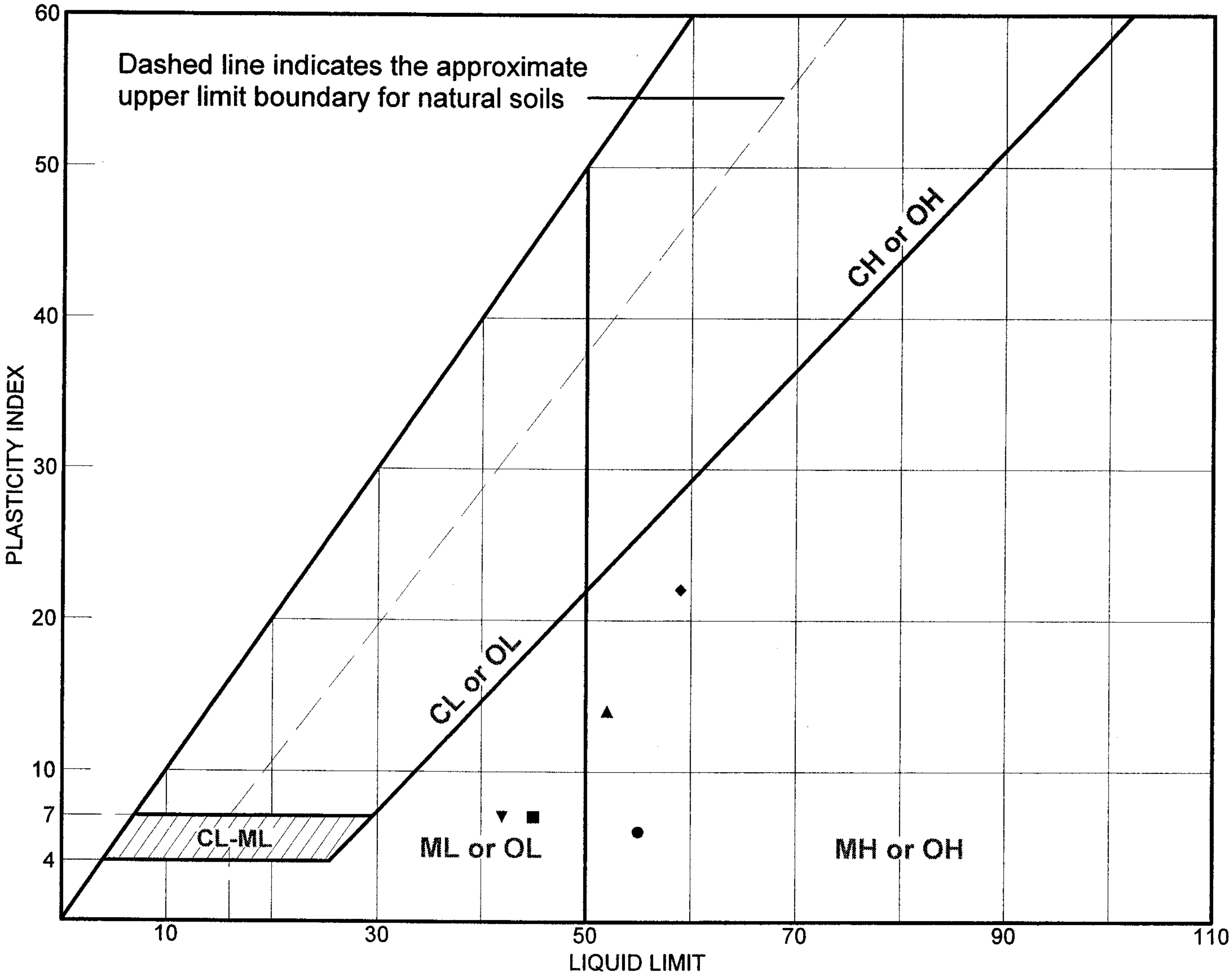
LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Boring	BLE-3	23.5-25.0	31.6	35	44	9	SM
■	Boring	BLE-6	6.0-7.5	14.4	29	34	5	SM
▲	Boring	BLE-7	1.0-3.0	35.4	43	56	13	MH
◆	Boring	BLE-7	13.5-15.0	27.4	36	42	6	SM
▼	Boring	BLE-9	13.5-15.5	23.8	33	37	4	SM

LIQUID AND PLASTIC LIMITS TEST REPORT **Bunnell Lammons Engineering, Inc.** **Greenville, SC**	**Client:** McGill **Project:** White Oak Landfill **Project No.:** J07-1957-02 **Plate**

LIQUID AND PLASTIC LIMITS TEST REPORT

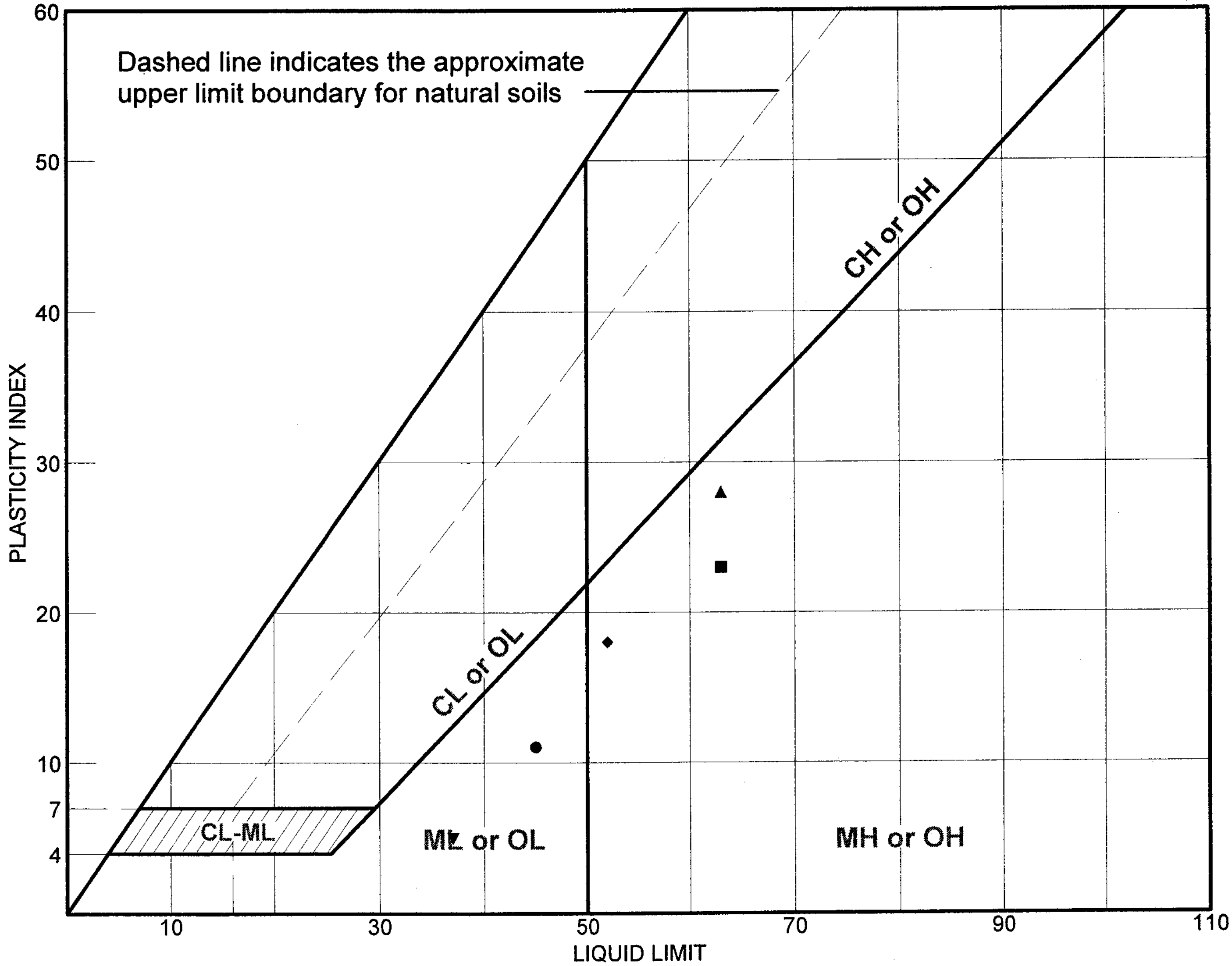


SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Boring	BLE-10	1.0-3.0	20.3	49	55	6	SM
■	Boring	BLE-10	9.5-11.5	24.2	38	45	7	ML
▲	Boring	BLE-11	6.0-7.5	20.2	38	52	14	MH
◆	Boring	BLE-11	15.5-18.0		37	59	22	MH
▼	Boring	BLE-13	23.5-25.0	21.2	35	42	7	ML

LIQUID AND PLASTIC LIMITS TEST REPORT **Bunnell Lammons Engineering, Inc.** **Greenville, SC**	**Client:** McGill **Project:** White Oak Landfill **Project No.:** J07-1957-02 **Plate**

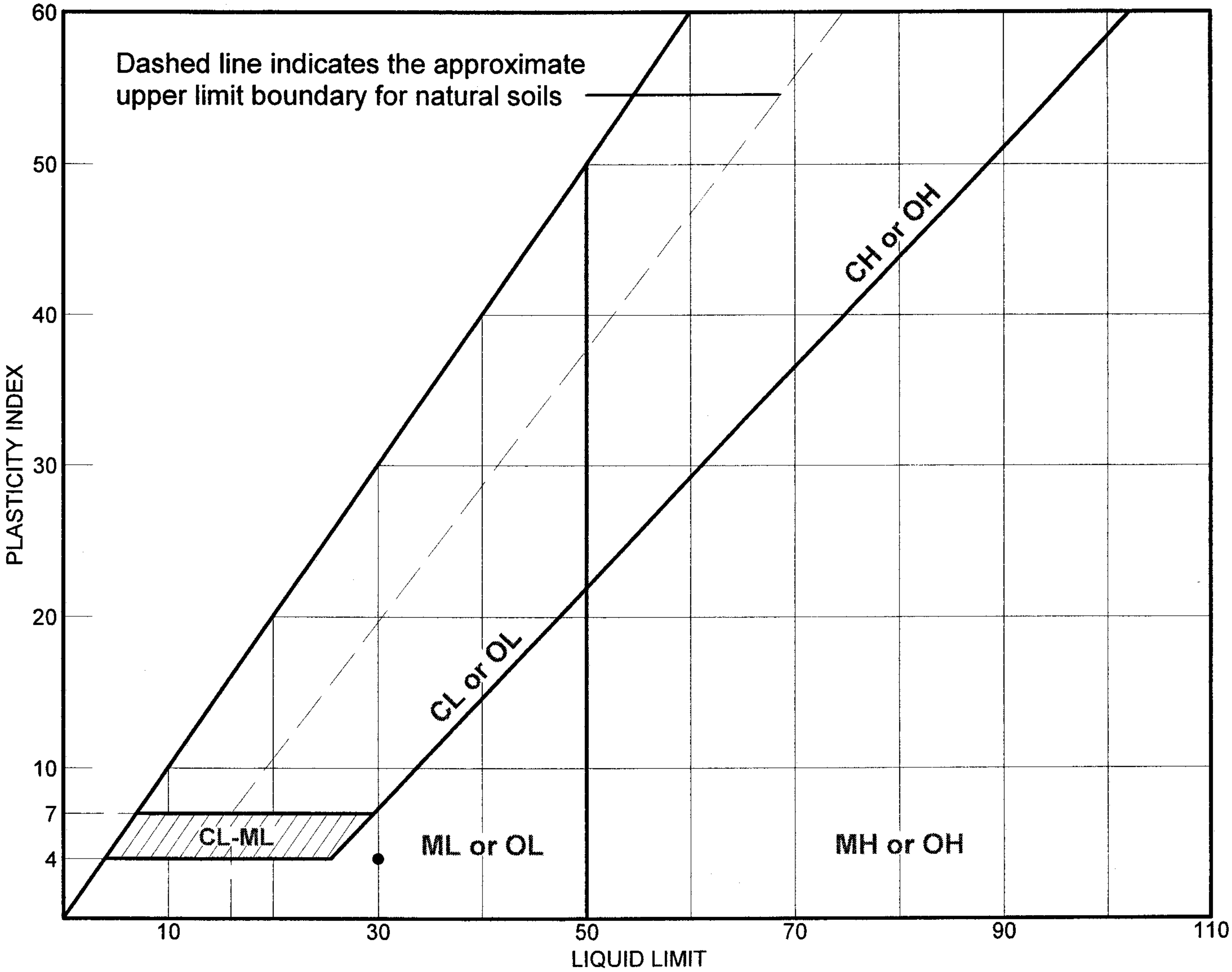
LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Boring	BLE-13	43.5-45.0	15.5	34	45	11	SM
■	Boring	BLE-14	16.0-18.0		40	63	23	MH
▲	Boring	BLE-15	1.0-8.0		35	63	28	MH
◆	Boring	BLE-15	8.5-10.0	27.9	34	52	18	MH
▼	Boring	BLE-16	73.5-75.0	22.2	32	37	5	SM

LIQUID AND PLASTIC LIMITS TEST REPORT	**Client:** McGill
Bunnell Lammons Engineering, Inc.	**Project:** White Oak Landfill
Greenville, SC	**Project No.:** J07-1957-02 **Plate**

LIQUID AND PLASTIC LIMITS TEST REPORT

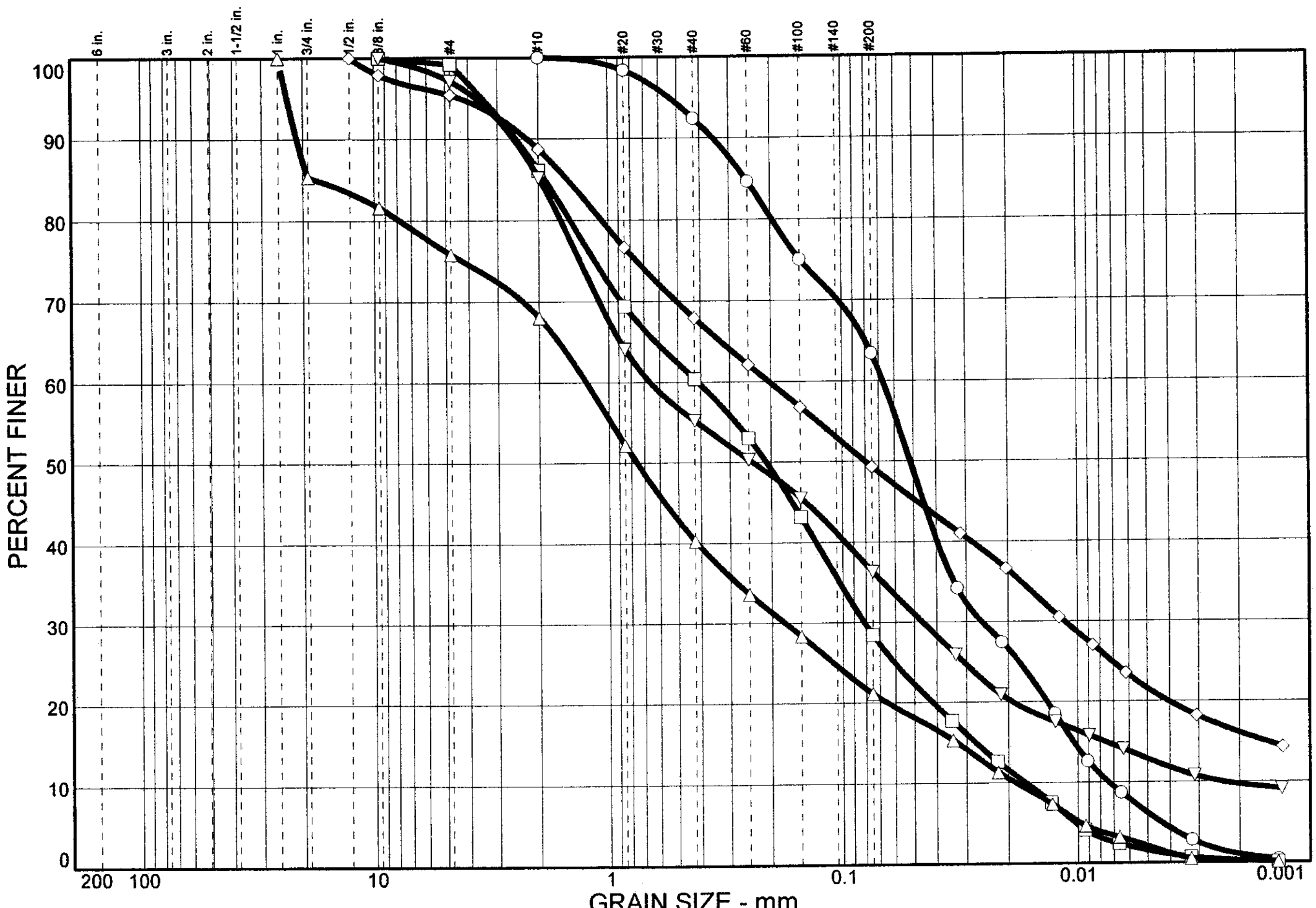


SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Boring	BLE-17	98.5-100.0	13.7	26	30	4	SM

LIQUID AND PLASTIC LIMITS TEST REPORT
Bunnell Lammons Engineering, Inc.
Greenville, SC

Client: McGill
Project: White Oak Landfill
Project No.: J07-1957-02
Plate

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.0	0.0	7.6	29.0	57.2	6.2
□	0.0	0.0	0.8	13.1	25.7	32.0	26.8	1.6
△	0.0	14.7	9.5	7.8	27.7	19.2	19.0	2.1
◇	0.0	0.0	4.6	6.7	20.8	18.6	27.7	21.6
▽	0.0	0.0	2.9	11.9	30.0	18.9	23.4	12.9

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	DESCRIPTION	USCS
○	Boring	BLE-1	3.5-5.5	Tan fi. sandy clayey SILT	MH
□	Boring	BLE-1	63.5-65.0	Grey & brown silty fi.-co. SAND	SM
△	Boring	BLE-2	23.5-25.0	Dark grey silty fi.-co. SAND w/gravel	SM
◇	Boring	BLE-3	6.0-8.0	Brown silty fi.-co. SAND	SM
▽	Boring	BLE-3	8.5-10.0	Light brown silty fi.-co. SAND	SM

Particle Size Distribution Report

Bunnell Lammons Engineering, Inc.

Greenville, SC

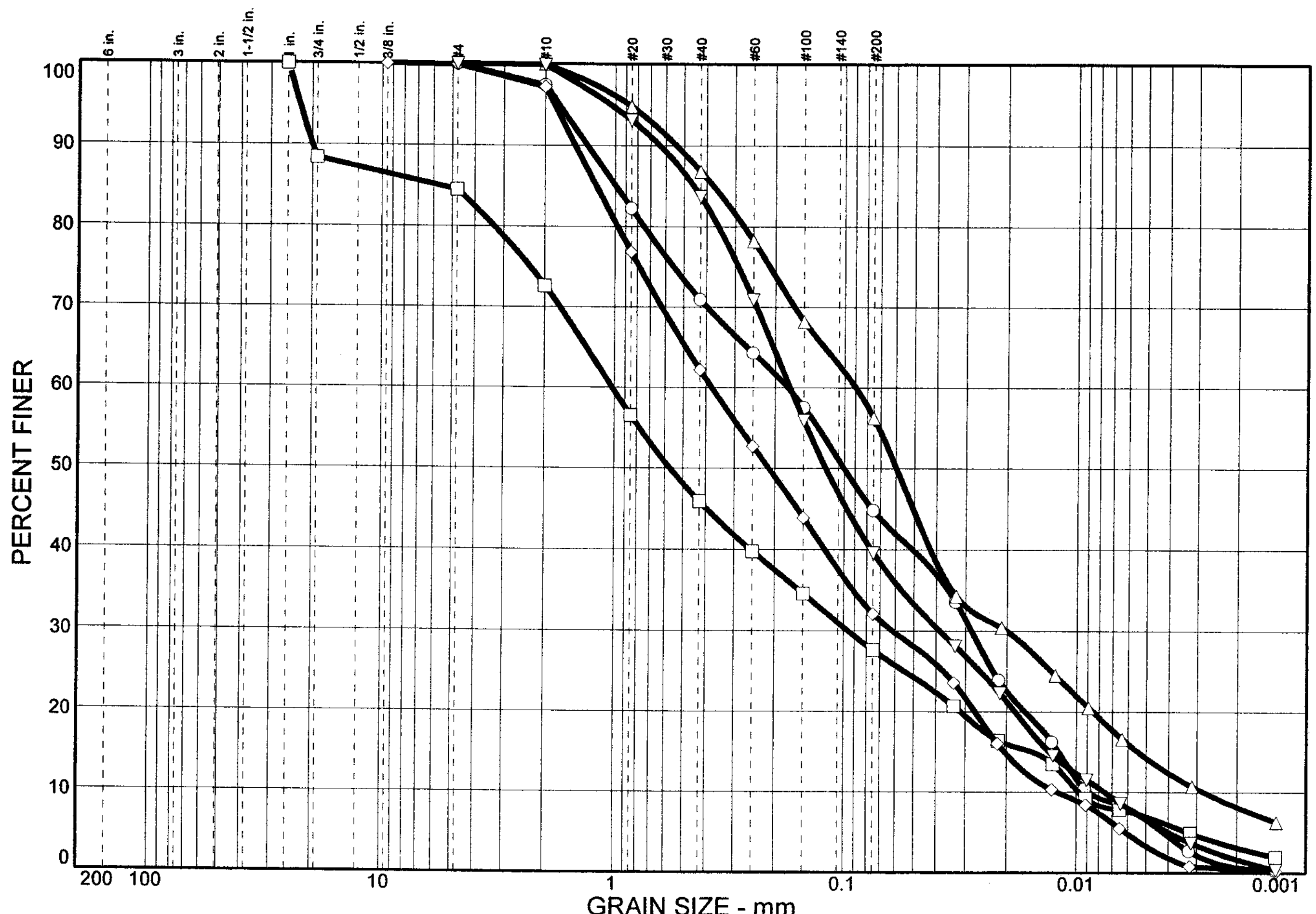
Client: McGill

Project: White Oak Landfill

Project No.: J07-1957-02

Plate

Particle Size Distribution Report



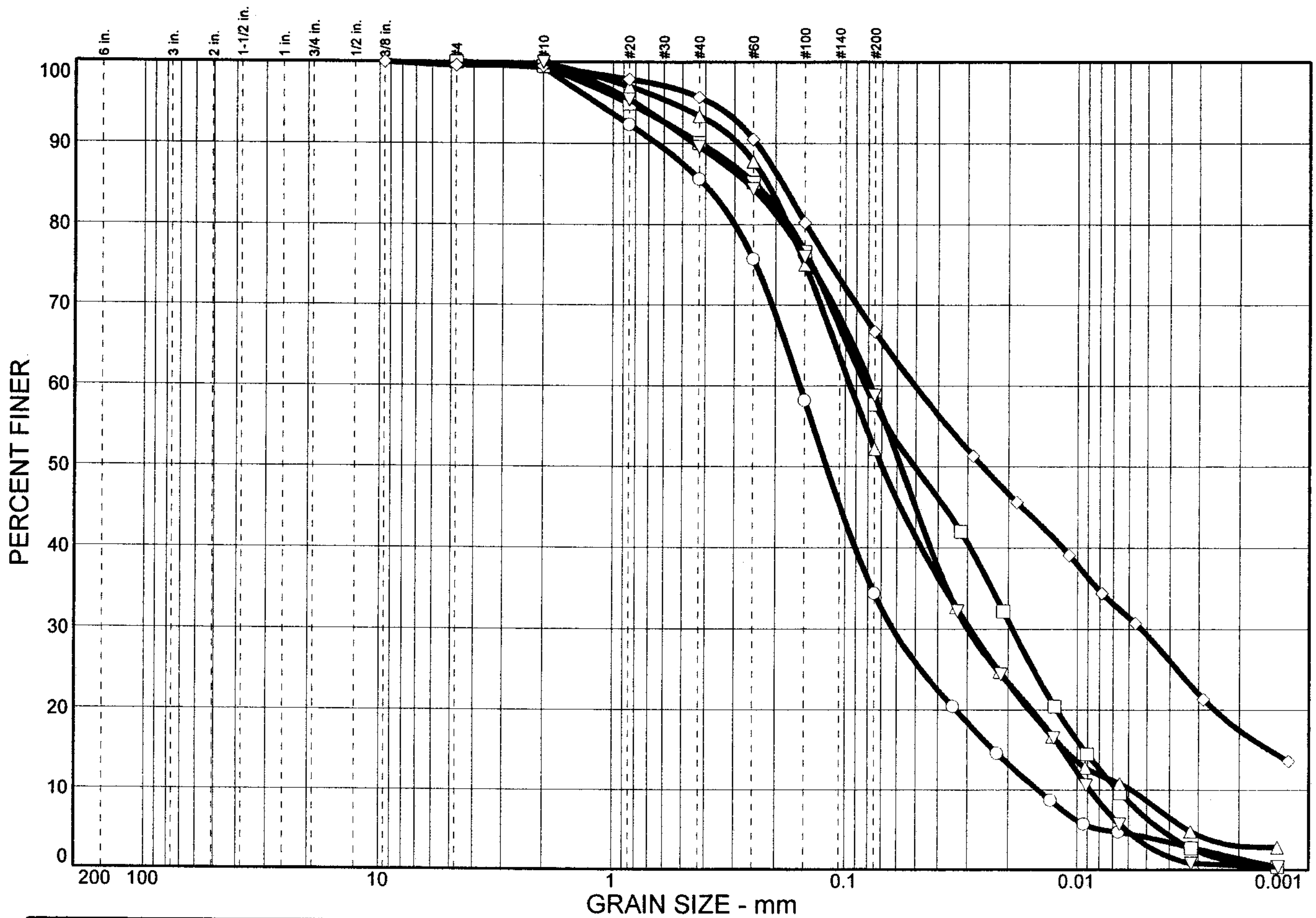
	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.0	2.6	26.5	26.1	38.2	6.6
□	0.0	11.6	3.9	11.9	26.7	18.3	20.7	6.9
△	0.0	0.0	0.0	0.0	13.2	30.6	42.0	14.2
◇	0.0	0.0	0.1	2.7	35.0	30.1	28.8	3.3
▽	0.0	0.0	0.0	0.1	16.2	44.1	33.0	6.6

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	DESCRIPTION	USCS
○	Boring	BLE-3	23.5-25.0	Light grey & white silty fi.-med. SAND	SM
□	Boring	BLE-6	6.0-7.5	Brown silty fi.-co. SAND w/gravel	SM
△	Boring	BLE-7	1.0-3.0	Light brown fi.-med. sandy clayey SILT	MH
◇	Boring	BLE-7	13.5-15.0	Grey & brown silty fi.-med. SAND	SM
▽	Boring	BLE-9	13.5-15.5	Grey & brown silty fi.-med. SAND	SM

Particle Size Distribution Report **Bunnell Lammons Engineering, Inc.** **Greenville, SC**	**Client:** McGill **Project:** White Oak Landfill **Project No.:** J07-1957-02 **Plate**

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	0.0	0.7	13.7	51.2	30.3	4.1
□	0.0	0.0	0.0	0.5	9.4	32.4	51.3	6.4
△	0.0	0.0	0.0	0.0	6.6	41.2	43.6	8.6
◇	0.0	0.0	0.4	0.1	3.8	29.0	37.5	29.2
▽	0.0	0.0	0.0	0.0	10.4	30.8	55.8	3.0

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	DESCRIPTION	USCS
○	Boring	BLE-10	1.0-3.0	Red & brown silty fi.-med. SAND	SM
□	Boring	BLE-10	9.5-11.5	Red & brown fi.-med. sandy SILT	ML
△	Boring	BLE-11	6.0-7.5	Light red & brown fi. sandy clayey SILT	MH
◇	Boring	BLE-11	15.5-18.0	Brown fi. sandy clayey SILT	MH
▽	Boring	BLE-13	23.5-25.0	Red & brown fi.-med. sandy SILT	ML

Particle Size Distribution Report

Bunnell Lammons Engineering, Inc.

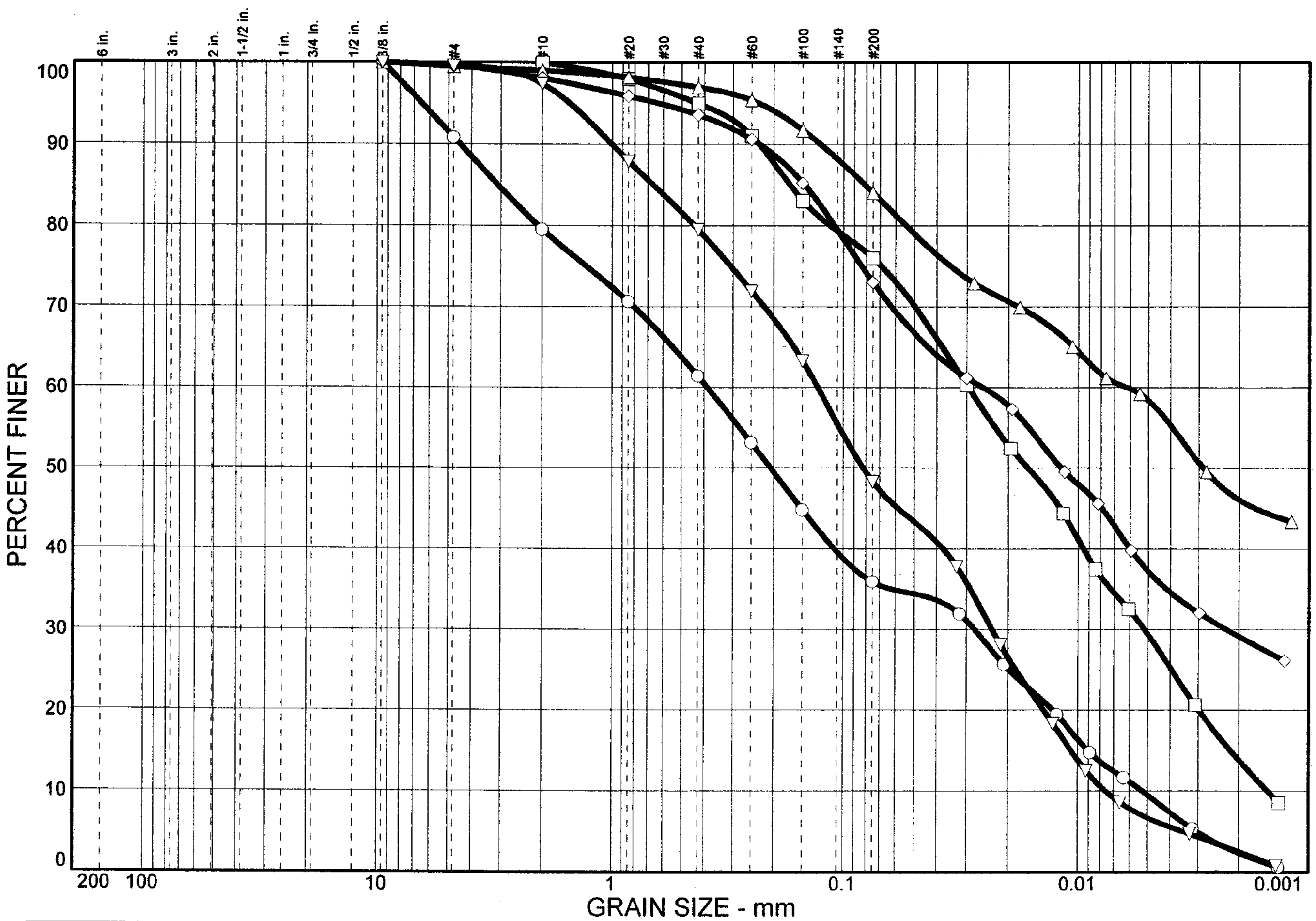
Greenville, SC

Client: McGill

Project: White Oak Landfill

Project No.: J07-1957-02 **Plate**

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	9.2	11.3	18.1	25.5	26.4	9.5
□	0.0	0.0	0.0	0.0	5.0	19.0	46.7	29.3
△	0.0	0.0	0.5	0.5	2.0	13.0	25.6	58.4
◇	0.0	0.0	0.4	1.5	4.5	20.6	35.8	37.2
▽	0.0	0.0	0.4	2.2	17.9	31.2	41.6	6.7

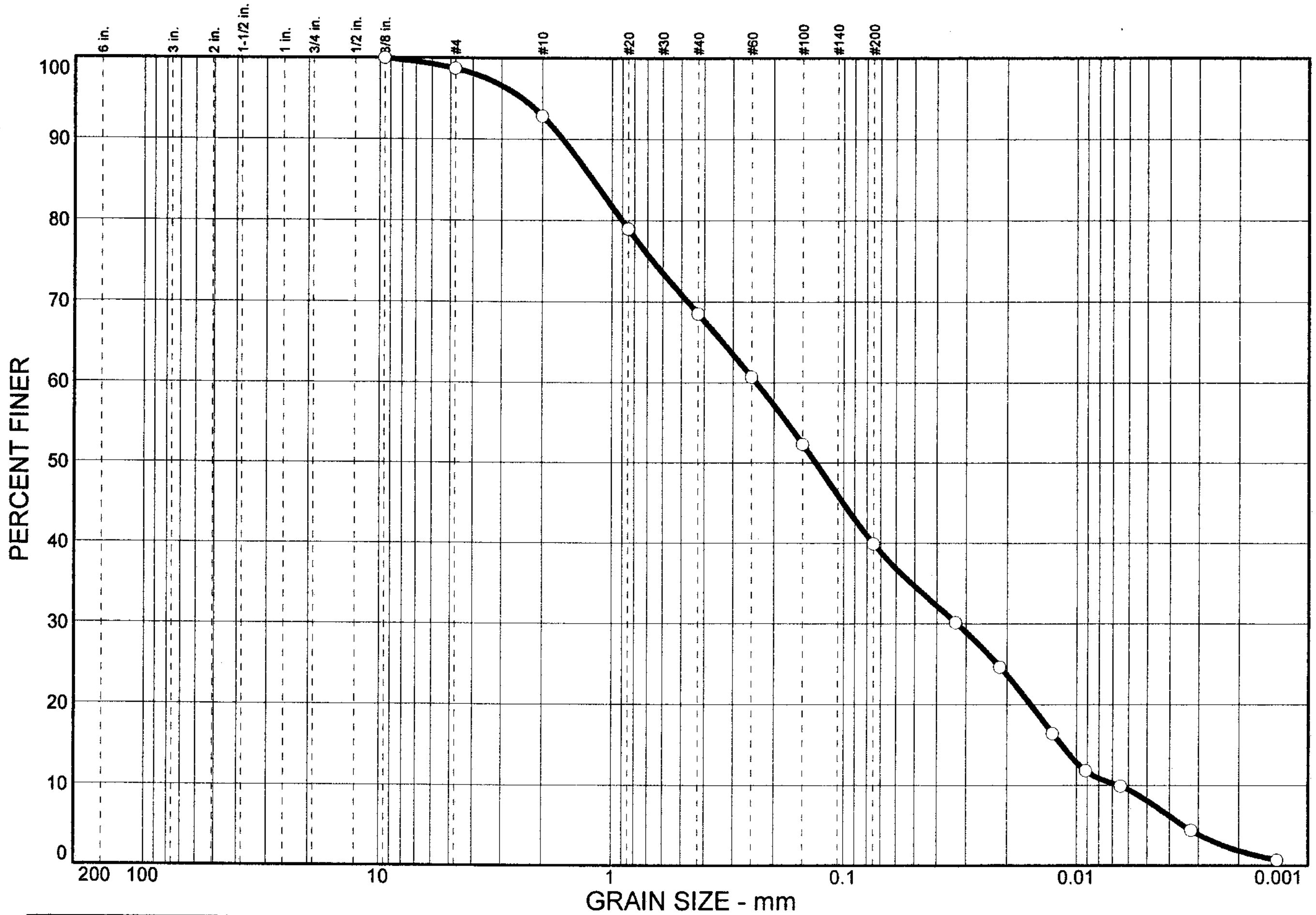
SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	DESCRIPTION	USCS
○	Boring	BLE-13	43.5-45.0	Grey & brown silty fi.-co. SAND	SM
□	Boring	BLE-14	16.0-18.0	Dark brown fi. sandy clayey SILT	MH
△	Boring	BLE-15	1.0-8.0	Brown fi. sandy clayey SILT	MH
◇	Boring	BLE-15	8.5-10.0	Red & brown fi. sandy clayey SILT	MH
▽	Boring	BLE-16	73.5-75.0	Grey & brown silty fi.-med. SAND	SM

Particle Size Distribution Report
Bunnell Lammons Engineering, Inc.
Greenville, SC

Client: McGill
Project: White Oak Landfill
Project No.: J07-1957-02 **Plate**

Particle Size Distribution Report



	% COBBLES	% GRAVEL		% SAND			% FINES	
		CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
○	0.0	0.0	1.3	5.9	24.3	28.6	31.8	8.1

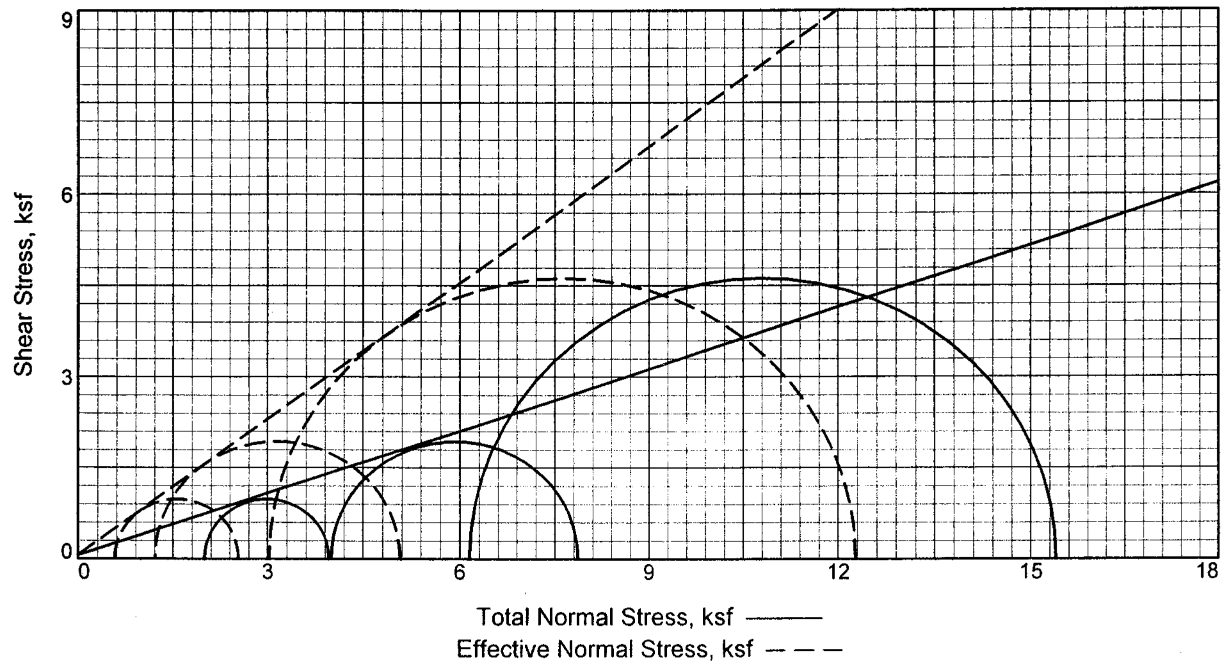
SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	DESCRIPTION	USCS
○	Boring	BLE-17	98.5-100.0	Grey & brown silty fi.-med. SAND	SM

Particle Size Distribution Report
Bunnell Lammons Engineering, Inc.
Greenville, SC

Client: McGill
Project: White Oak Landfill
Project No.: J07-1957-02 **Plate**

TRIAXIAL SHEAR TEST REPORT



Type of Test: CU with Pore Pressures

Sample Type: Undisturbed

No.	Fluid Press. psi		Fail. Stress, ksf		Ult. Stress, ksf		Principal Stresses at Failure ksf	
	Cell	Back	Deviator	Total Pore Pressure	Deviator	Total Pore Pressure	$\bar{\sigma}_1$	$\bar{\sigma}_3$
1	73.900	60.000	1.963	10.066	2.238	9.994	2.539	0.576
2	87.800	60.000	3.866	11.434	4.087	11.232	5.075	1.210
3	102.700	60.000	9.252	11.765	9.840	10.728	12.276	3.024

No.	Consolidated Sample Parameters						
	% Water Content	Dry Dens. pcf	Satur-ation	Void Ratio	Diameter in.	Height in.	Strain Rate in/min.
1	33.1	85.6	92.2%	0.9692	2.828	5.953	0.019
2	29.1	93.8	98.7%	0.7969	2.812	5.892	0.019
3	30.3	93.2	101.2%	0.8092	2.817	5.871	0.019

Mohr-Coulomb Strength Parameters

	Total	Effective
Strength intercept, c=	0.063 ksf	0.064 ksf
Friction angle, ϕ =	18.80 deg	36.73 deg
Tangent, ϕ =	0.34	0.75

Material Description

Red & brown fi.-med. sandy SILT (BLE-9[1&2], 13.5-15.0; BLE-10[3], 9.5-11.5)

Client: McGill

Project: White Oak Landfill

Source of Sample: Boring

Sample Number: BLE-9/10

Date Sampled:

File: WHITEO1

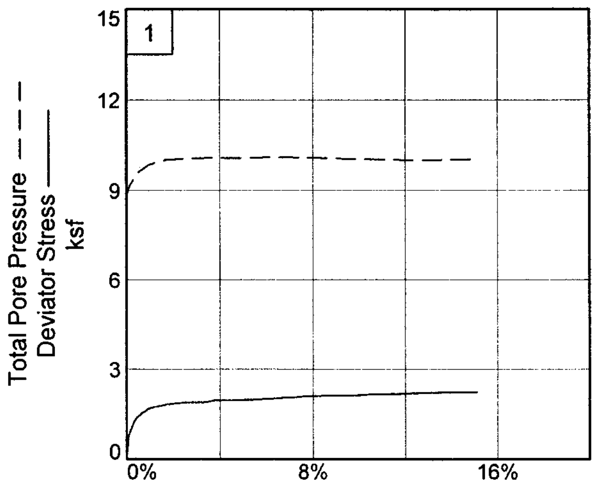
Remarks:

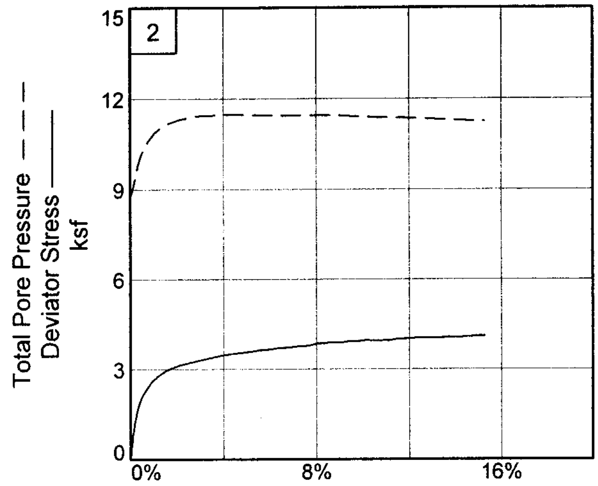
TRIAXIAL SHEAR TEST REPORT

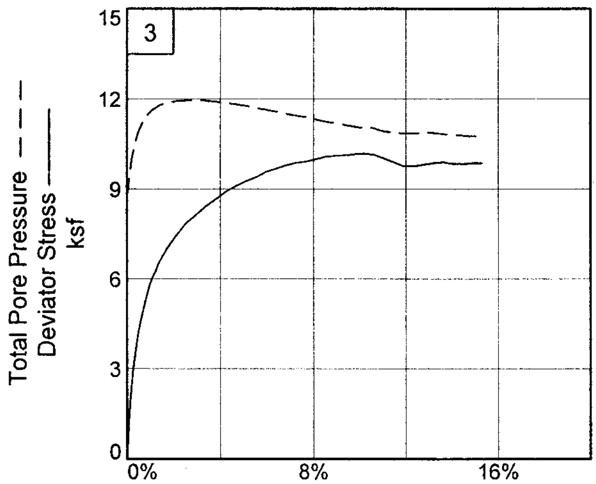
Bunnell Lammons Engineering, Inc.

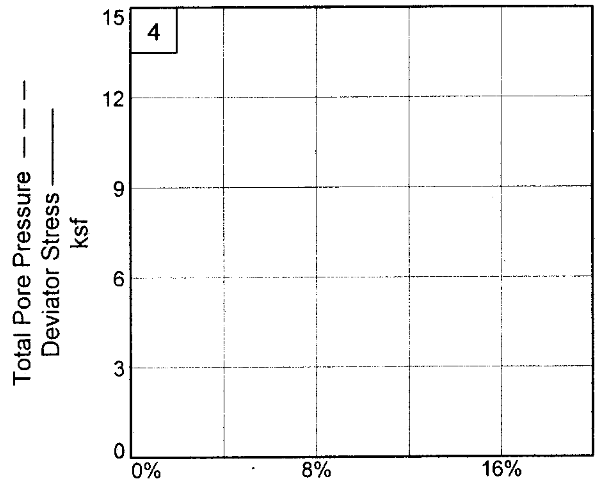
Proj. No.: J07-1957-02

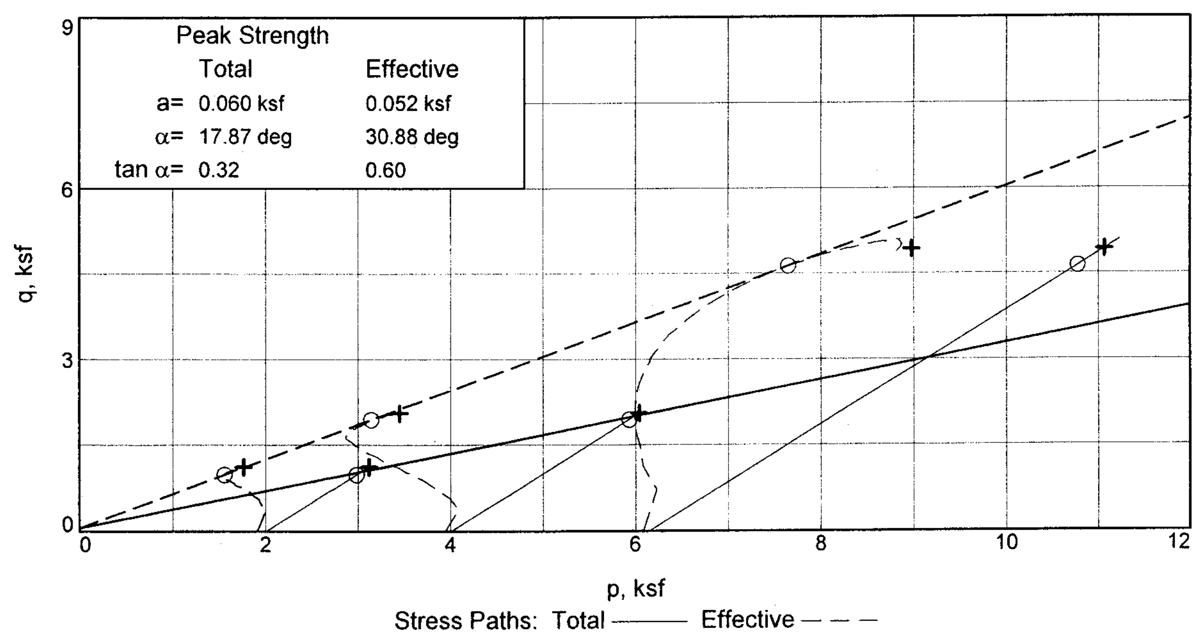
Plate 1







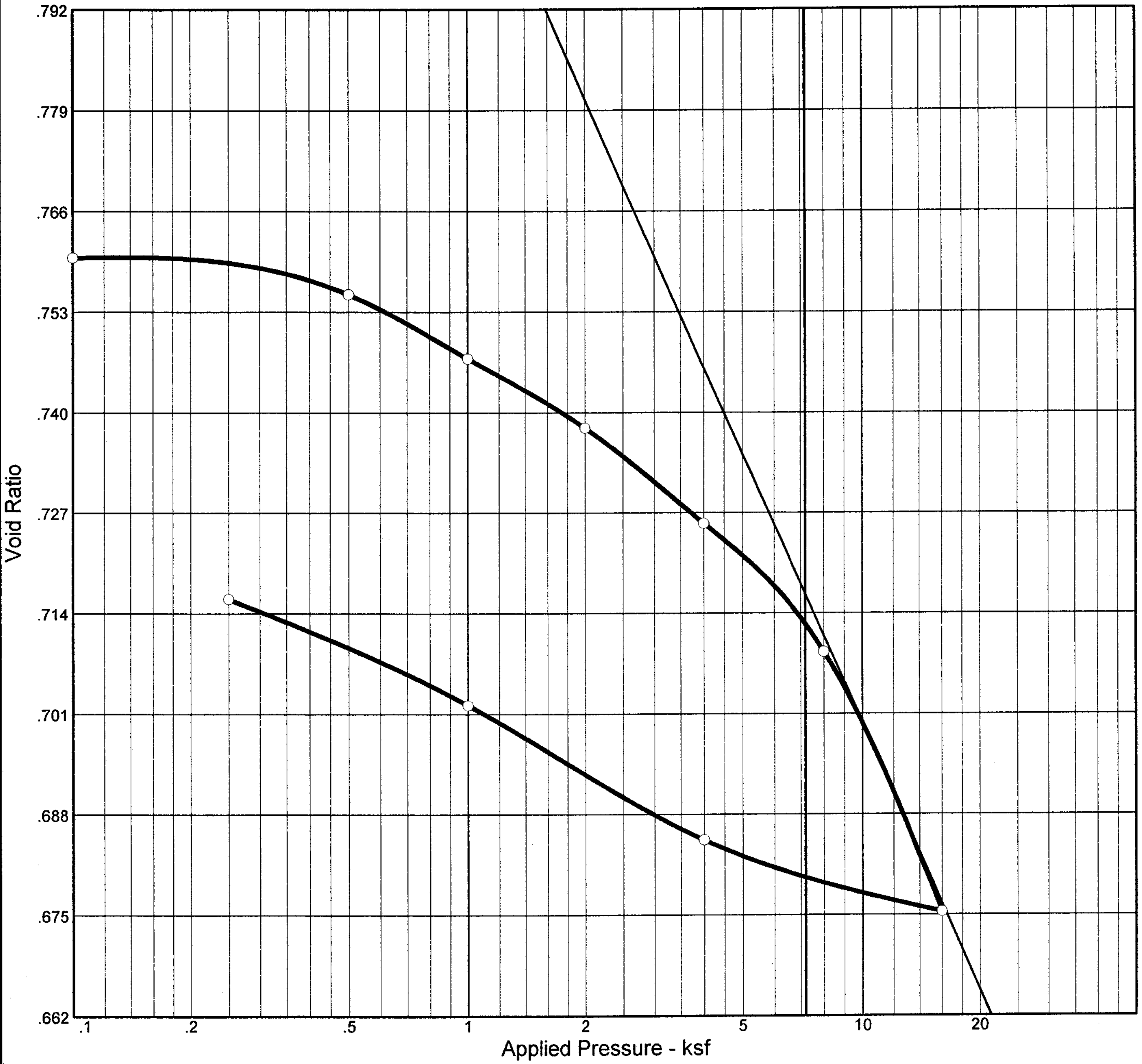




Client: McGill
Project: White Oak Landfill
Source of Sample: Boring **Sample Number:** BLE-9/10
Project No.: J07-1957-02 **Plate** 2

Bunnell Lammons Engineering, Inc.

CONSOLIDATION TEST REPORT



Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (ksf)	C_c	Initial Void Ratio
63.5 %	18.2 %	94.0	55	6	2.65	8.06	0.12	0.760

MATERIAL DESCRIPTION	USCS	AASHTO
Red & brown silty fi.-med. SAND	SM	

Project No. J07-1957-02 **Client:** McGill

Project: White Oak Landfill

Source: Boring **Sample No.:** BLE-10 **Elev./Depth:** 1.0-3.0

Bunnell Lammons Engineering, Inc.

Greenville, SC

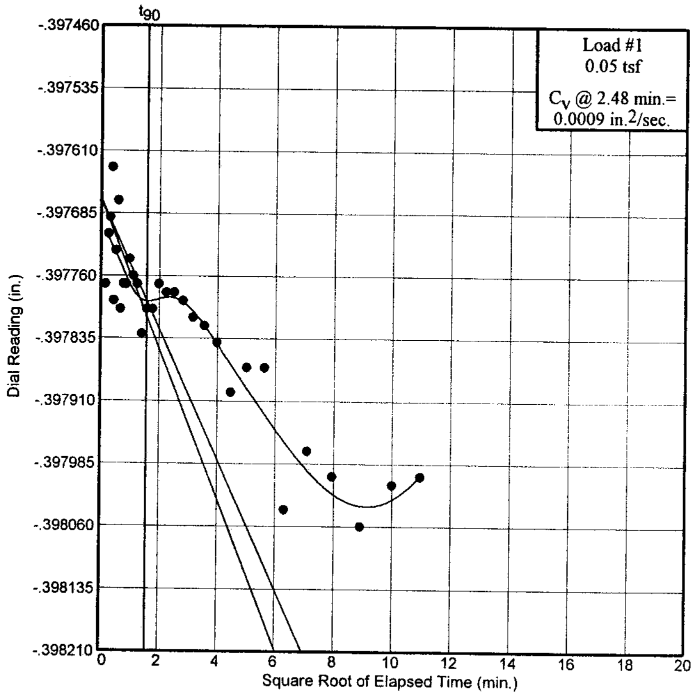
Remarks:

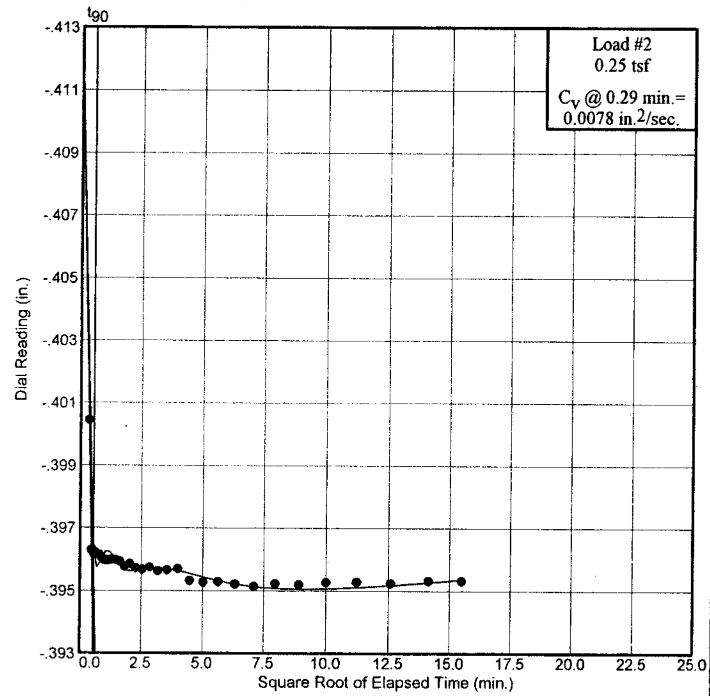
Plate

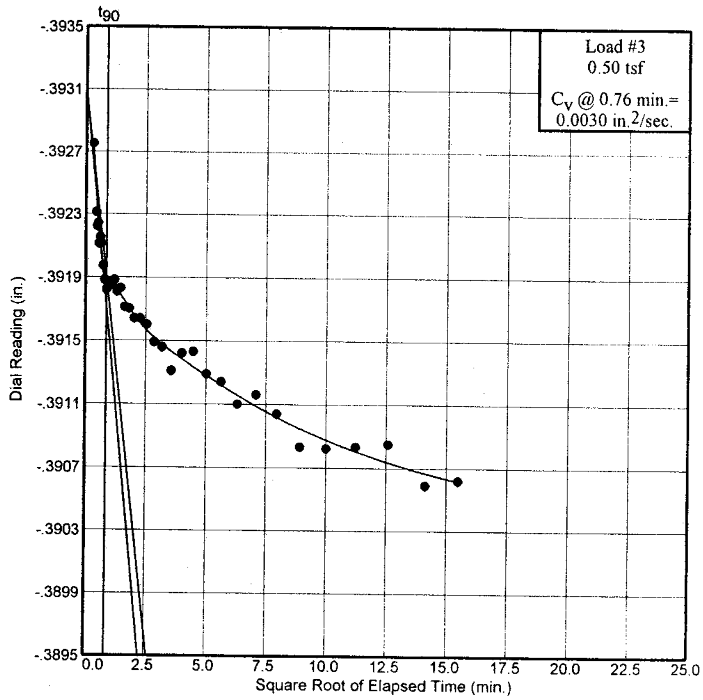
Dial Reading vs. Time

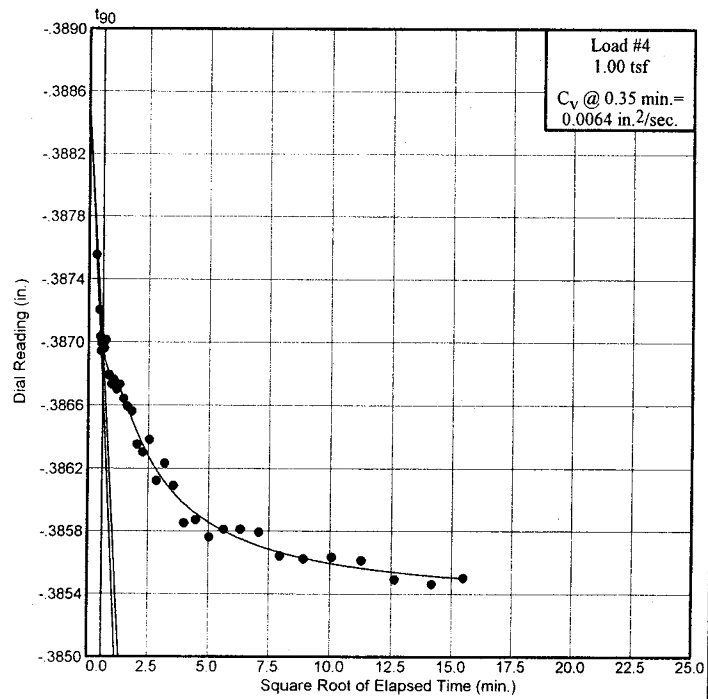
Project No.: J07-1957-02
Project: White Oak Landfill

Source: Boring | Sample No.: BLE-10 | Elev./Depth: 1.0-3.0









Bunnell Lammons Engineering, Inc.

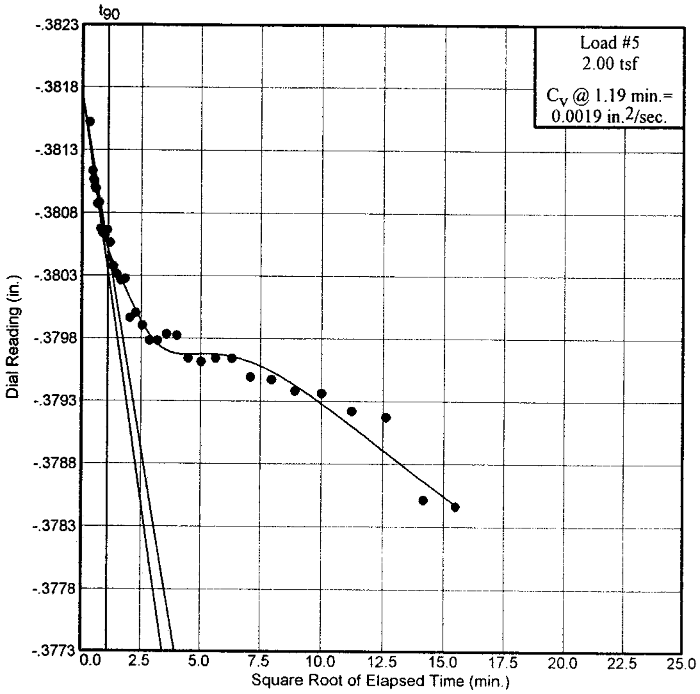
Greenville, SC

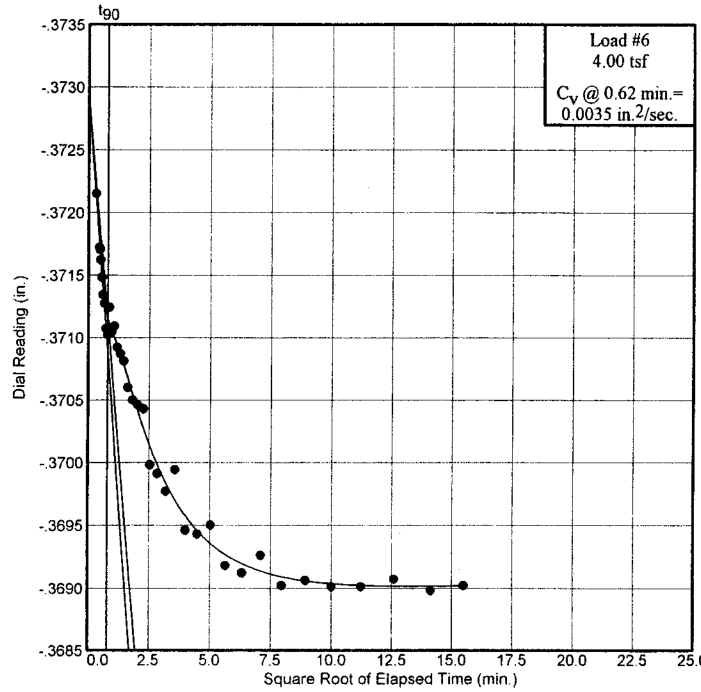
Plate

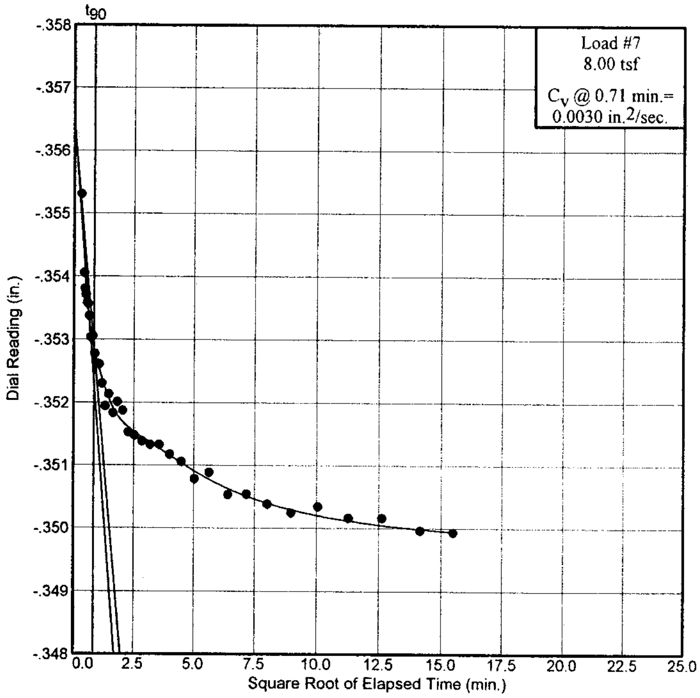
Dial Reading vs. Time

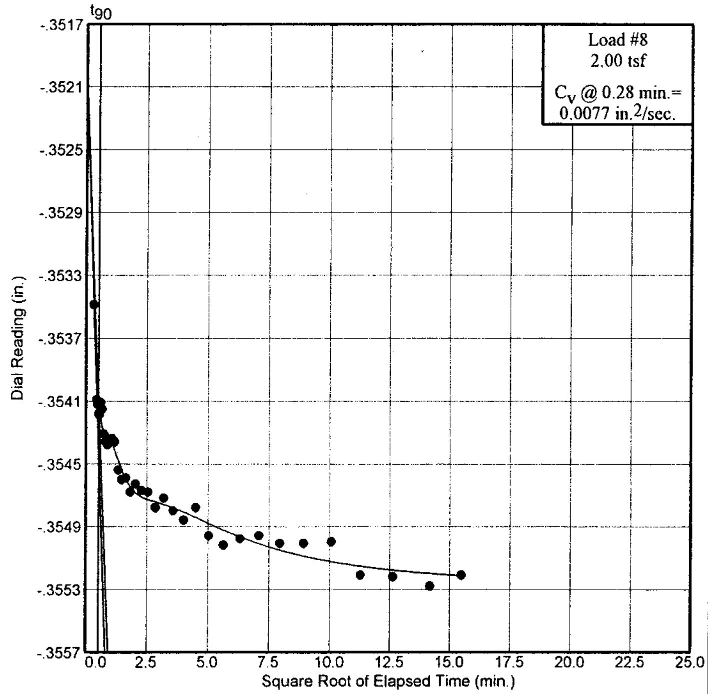
Project No.: J07-1957-02
Project: White Oak Landfill

Source: Boring | Sample No.: BLE-10 | Elev./Depth: 1.0-3.0









Bunnell Lammons Engineering, Inc.

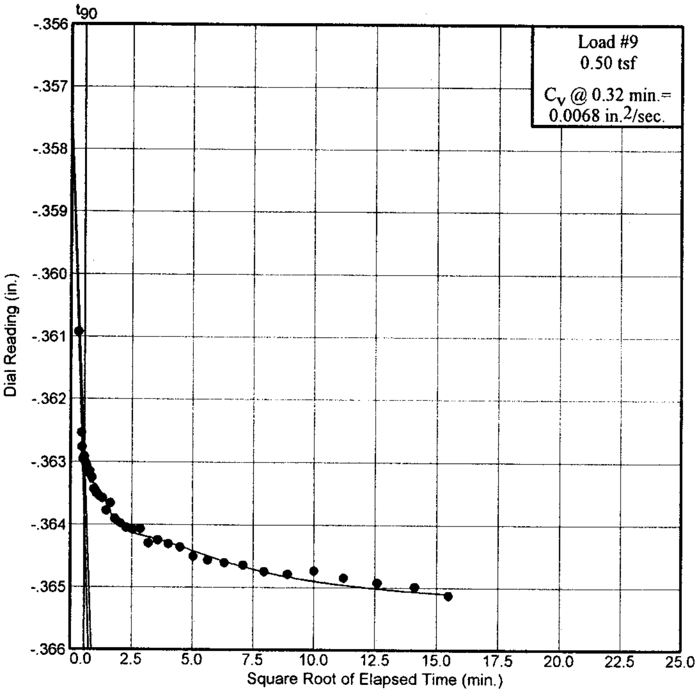
Greenville, SC

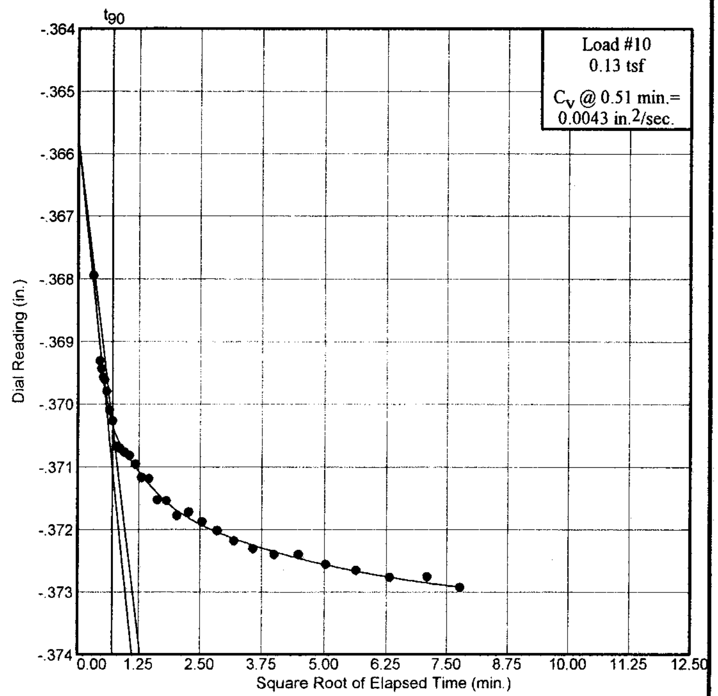
Plate

Dial Reading vs. Time

Project No.: J07-1957-02
Project: White Oak Landfill

Source: Boring   Sample No.: BLE-10   Elev./Depth: 1.0-3.0





Bunnell Lammons Engineering, Inc.

Greenville, SC

Plate

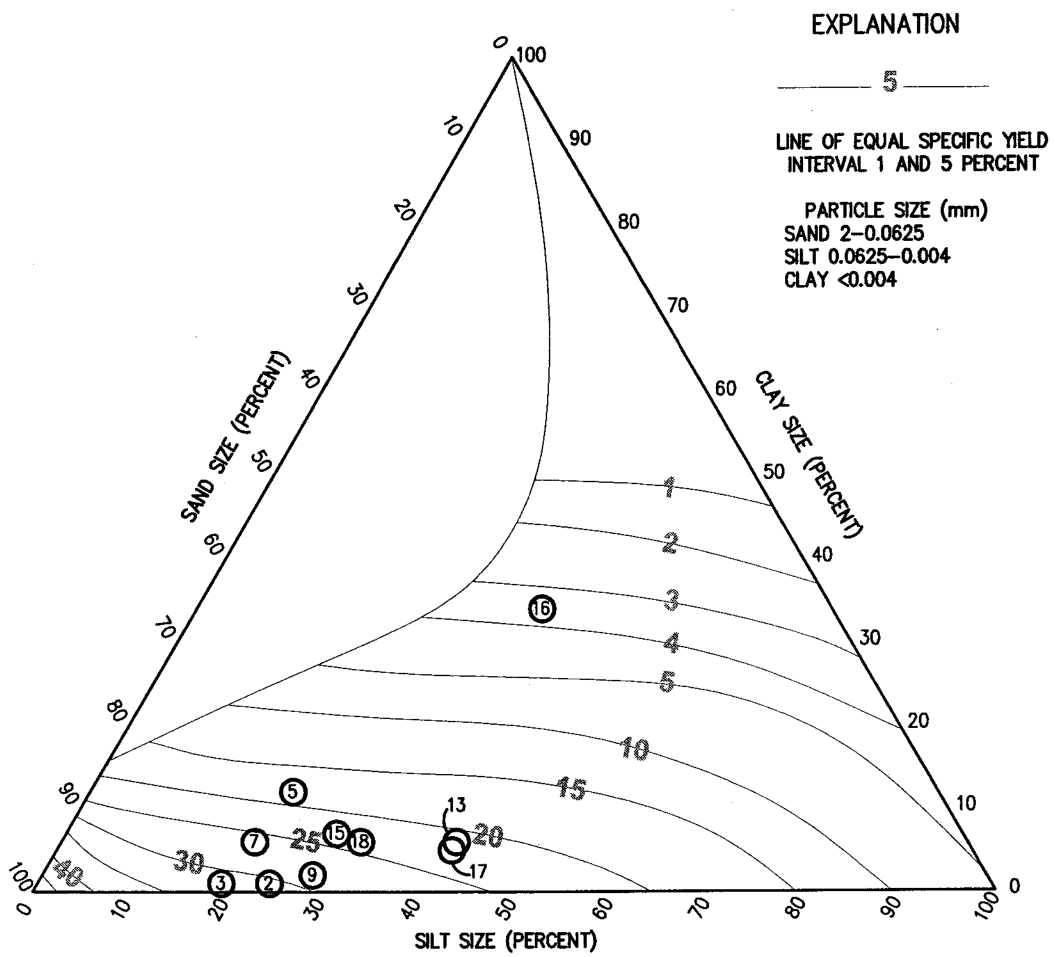


FIGURE 4.11 FROM FETTER, C.W., 1994, APPLIED HYDROGEOLOGY
TEXTURAL CLASSIFICATION TRIANGLE FOR UNCONSOLIDATED MATERIALS SHOWING THE RELATION BETWEEN PARTICAL SIZE AND SPECIFIC YIELD. SOURCE: A.I. JOHNSON, U.S. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1662-D, 1967.

ID#	BORING	DEPTH (FT)
2	BLE-1	63.5 – 65.0
3	BLE-2	23.5 – 25.0
5	BLE-3	8.5 – 10.0
7	BLE-6	6.0 – 7.5
9	BLE-7	13.5 – 15.0
13	BLE-11	6.0 – 7.5
15	BLE-13	43.5 – 45.0
16	BLE-15	8.5 – 10.0
17	BLE-16	73.5 – 75.0
18	BLE-17	98.5 – 100.0

DRAWN: MSP	DATE: 06-02-08	BLE INC. BUNNELL-LAMMONS ENGINEERING, INC. 6004 PONDERS COURT GREENVILLE, SOUTH CAROLINA 29615 PHONE: (864)288-1265 FAX: (864)288-4430	**EFFECTIVE POROSITY ESTIMATION** WHITE OAK MSW LANDFILL HAYWOOD COUNTY, NORTH CAROLINA	FIGURE **H-1**
CHECKED:	CAD: HCWOLF02-EFF POROS pg1			
APPROVED:	JOB NO: J07-1957-02			

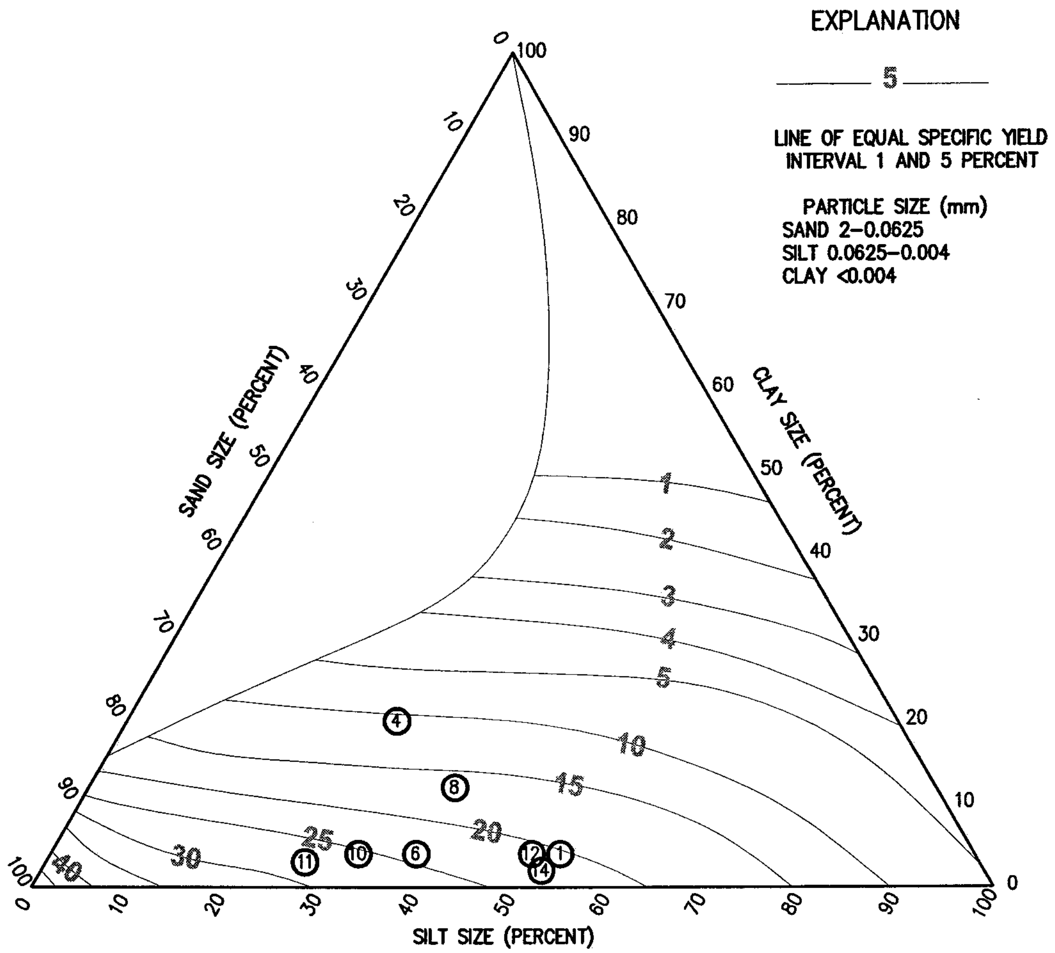
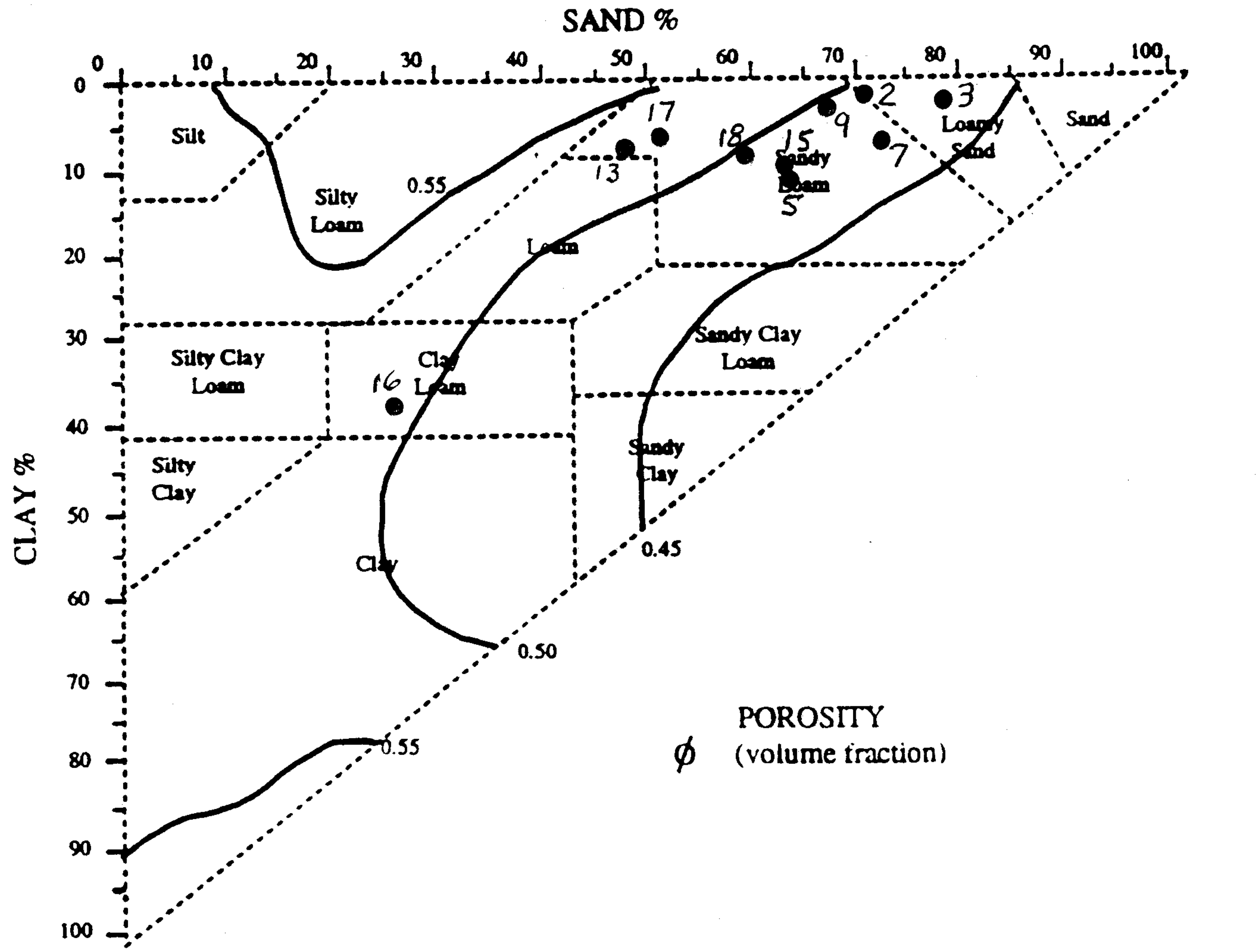


FIGURE 4.11 FROM FETTER, C.W., 1994, APPLIED HYDROGEOLOGY
TEXTURAL CLASSIFICATION TRIANGLE FOR UNCONSOLIDATED MATERIALS SHOWING THE RELATION BETWEEN PARTICAL SIZE AND SPECIFIC YIELD. SOURCE: A.I. JOHNSON, U.S. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1662-D, 1967.

ID#	BORING	DEPTH (FT)
1	BLE-1	3.5 – 5.5
4	BLE-3	6.0 – 8.0
6	BLE-3	23.5 – 25.0
8	BLE-7	1.0 – 3.0
10	BLE-9	13.5 – 15.5
11	BLE-10	1.0 – 3.0
12	BLE-10	9.5 – 11.5
14	BLE-13	23.5 – 25.0

DRAWN: MSP	DATE: 06-02-08	BLE INC. BUNNELL-LAMMONS ENGINEERING, INC.	EFFECTIVE POROSITY ESTIMATION	FIGURE
CHECKED:	CAD: HCWOLF02-EFF POROS pg2	6004 PONDERS COURT GREENVILLE, SOUTH CAROLINA 29615	WHITE OAK MSW LANDFILL	H-2
APPROVED:	JOB NO: J07-1957-02	PHONE: (864)288-1265 FAX: (864)288-4430	HAYWOOD COUNTY, NORTH CAROLINA	



White Oak MSW Landfill - Phase 3 & 4 DHR
Haywood County, North Carolina
BLE Project Number J07-1957-02

ID#	Boring	Depth (ft)
1	BLE-1	3.5 - 5.5
2	BLE-1	63.5 - 65.0
3	BLE-2	23.5 - 25.0
4	BLE-3	6.0 - 8.0
5	BLE-3	8.5 -10.0
6	BLE-3	23.5 - 25.0
7	BLE-6	6.0 - 7.5
8	BLE-7	1.0 - 3.0
9	BLE-7	13.5 - 15.0
10	BLE-9	13.5 - 15.5
11	BLE-10	1.0 - 3.0
12	BLE-10	9.5 - 11.5
13	BLE-11	6.0 - 7.5
14	BLE-13	23.5 - 25.0
15	BLE-13	43.5 - 45.0
16	BLE-15	8.5 - 10.0
17	BLE-16	73.5 - 75.0
18	BLE-17	98.5 - 100.0

APPENDIX I

GEOTECHNICAL CALCULATIONS

APPENDIX I

GEOTECHNICAL CALCULATIONS METHODOLOGY
WHITE OAK MSW LANDFILL
HAYWOOD COUNTY, NORTH CAROLINA
BLE Project No. J07-1957-02

SETTLEMENT CONSIDERATIONS:

Site and subsurface data obtained was evaluated to determine subgrade settlement. Settlements were evaluated utilizing data obtained from soil test borings, test pits, laboratory testing of soil samples, field observations by a geotechnical engineer and our experience with settlement monitoring of sites in the Piedmont Region.

Site grading plans for construction of Phases 3 and 4, prepared by McGill Associates, indicate a combination of earthwork cut and fill will be made to establish the cell areas. The analysis considered potential future landfill expansion which would result in a landfill final cap maximum elevation of 2687 feet msl. Foundation support conditions for the landfill liner system will consist of either residual soils over weathered rock or engineered fill overlying residual soils. The rock and partially weathered rock underlying the site are relatively incompressible and will not realize appreciable settlements under the anticipated landfill loading. The residual soils are typically firm to very firm sandy clayey silts grading coarser with depth into dense silty sands with some gravel. Modest settlements will be realized from compression of the upper zones of residual soils and the anticipated fills.

Soil elastic modulus values for settlement analyses were selected based on previously developed correlations with standard penetration resistance values in similar soils. The analyses conservatively assumed the stress increase within the soil layers was equal to the full surcharge pressure of the waste mound. The surcharge pressures were estimated based on an assumed unit weight of 70 pounds per cubic foot (pcf) of waste. Settlements were estimated for the borings within the proposed cells. Some variations in structural fill height and individual soil layer thickness occur from location to location; however, due to the general uniformity of the subsurface conditions and the broad load application, the subgrade settlement will vary primarily with the height of the waste. The magnitude of settlement is well within tolerances of a conventional base liner system.

SLOPE STABILITY CONSIDERATIONS:

The planned landfill structural fill, base liner, and closure cap slopes were analyzed for static, seismic, and interface stability. The initial and final grading plans prepared by McGill Associates, P.A., indicate base liner slopes of 3 horizontal to 1 vertical or flatter and closure cap slopes of 4 horizontal to 1 vertical. A perimeter fill slope will be constructed at 2 horizontal to 1 vertical.

According to the definition of seismic impact zones in 15A NCAC 13B.1622 (5), this site is in a seismic impact zone. The maximum horizontal acceleration expressed as a percentage of the earth's gravity (g) in rock is 0.176g with a 2% probability of being exceeded in 50 years (equal to 10% probability in 250 years; NC Building Code, 2006 IBC). The slope configurations were analyzed using the maximum horizontal acceleration of 0.176g. The analysis of the structural fill and waste mound slopes was performed using the computer program Slope/W by Geoslope International. The analysis results are attached and indicate the designed slopes are stable when subjected to both static and seismic conditions.

ROCK AND GROUNDWATER SEPARATION FROM CLAY LINER SUBGRADE

GEOTECHNICAL ANALYSIS - PHASES 3 & 4
WHITE OAK MSW LANDFILL
HAYWOOD COUNTY, NORTH CAROLINA
BLE Project No. J07-1957-02
June 2008

Boring Number	Calculated Settlement Feet	Cap Elev. minus FML Elev. Feet	Clay Subgrade Elevation (FML-2 Feet) Feet	Groundwater Elevation Seasonal High Feet	Groundwater Elevation Separation[1] Feet	Rock or Auger Refusal Elevation Feet	Rock Elevation Separation[2] Feet
BLE-1	0.58	104	2566	2531.12	34.30	2508.23	57.19
BLE-2	1.25	118	2523	2513.76	7.99	< 2485.7	> 35.1
BLE-3	0.59	97	2511	2501.87	8.54	< 2469.8	> 40.6
BLE-5	0.36	58	2503	2493.33	9.31	2471.10	31.54
BLE-6	0.00	1	2523	2488.93	34.07	2486.96	36.04
BLE-7D	0.41	12	2506	2485.24	20.35	2459.92	45.67
BLE-9	0.00	4	2532	2509.28	22.72	2527.54	4.46
BLE-13	0.00	56	2552	2542.44	9.56	2523.39	28.61
BLE-14	0.04	88	2559	2551.21	7.75	2536.91	22.05
BLE-16	0.00	48	2563	2555.63	7.37	< 2534.7	> 28.3
BLE-17	0.14	60	2581	2537.59	43.27	2510.46	70.40

References: McGill Associates, PA drawing dated June 2008.
BLE Seasonal High Water Table Map (9/20/07 to 2/14/08); Figure 7.

Notes: 1 Separation between post-settlement bottom of clay liner and seasonal high groundwater.
2 Separation between post-settlement bottom of clay liner and top of rock (refusal).

SETTLEMENT CALCULATIONS

WHITE OAK MSW LANDFILL
HAYWOOD COUNTY, NORTH CAROLINA
Bunnell-Lammons Engineering, Inc. Project No. J07-1957-02

June 2008

Subsurface Layer (feet - feet)	Soil Type	Standard Penetration Resistance N-Value (bpf)	Layer Thickness (feet)	Total Soil Unit Weight (pcf)	Effective Soil Unit Weight (pcf)	Surcharge Pressure[1] (psf)	Soil Modulus (ksf)	Layer Settlement (inches)
Boring BLE-1								
2568-2536	Very Stiff sandy SILT	24	32	120	120	6,750	670	3.9
2536-2510	Very Stiff sandy SILT	26	26	120	58	6,750	700	3.0
2510-2508	PWR	200	2	140	78	6,750	2710	0.1
Total Thickness of Compressible Material			60	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**7.0**

SETTLEMENT CALCULATIONS

WHITE OAK MSW LANDFILL
HAYWOOD COUNTY, NORTH CAROLINA
Bunnell-Lammons Engineering, Inc. Project No. J07-1957-02

June 2008

Subsurface Layer (feet - feet)	Soil Type	Standard Penetration Resistance N-Value (bpf)	Layer Thickness (feet)	Total Soil Unit Weight (pcf)	Effective Soil Unit Weight (pcf)	Surcharge Pressure[1] (psf)	Soil Modulus (ksf)	Layer Settlement (inches)
Boring BLE-2								
2525-2520	Soft sandy SILT	4	5	120	120	8,305	200	2.5
2520-2512	Firm silty SAND	14	8	120	120	8,305	470	1.7
2512-2502	Soft sandy SILT	3	10	120	58	8,305	170	5.9
2502-2471	Very Firm silty SAND	22	31	120	58	8,305	630	4.9
Total Thickness of Compressible Material			54	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**15.0**
Boring BLE-3								
2513-2506	Loose silty SAND	9	8	110	110	6,950	350	1.9
2506-2501	Very Firm silty SAND	25	5	120	120	6,950	690	0.6
2501-2491	Loose silty SAND	9	10	110	48	6,950	350	2.4
2491-2471	Dense silty SAND	31	20	130	68	6,950	790	2.1
2471-2470	Very Dense silty SAND	57	1	130	68	6,950	1180	0.1
Total Thickness of Compressible Material			44	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**7.1**

1. Surcharge pressure assumes weight of solid waste of 70 pcf

SETTLEMENT CALCULATIONS

WHITE OAK MSW LANDFILL
HAYWOOD COUNTY, NORTH CAROLINA
Bunnell-Lammons Engineering, Inc. Project No. J07-1957-02

June 2008

Subsurface Layer (feet - feet)	Soil Type	Standard Penetration Resistance N-Value (bpf)	Layer Thickness (feet)	Total Soil Unit Weight (pcf)	Effective Soil Unit Weight (pcf)	Surcharge Pressure[1] (psf)	Soil Modulus (ksf)	Layer Settlement (inches)
Boring BLE-5								
2505-2497	Fill	NA	8	120	120	4,220	300	1.4
2497-2489	Firm clayey SILT	5	8	120	58	4,220	240	1.7
2489-2479	Firm silty SAND	18	10	120	58	4,220	550	0.9
2479-2474	PWR	150	5	140	78	4,220	2240	0.1
2474-2471	Dense silty SAND	39	3	130	68	4,220	920	0.2
Total Thickness of Compressible Material			34	Feet				
						TOTAL ESTIMATED SETTLEMENT (inches)		**4.3**
Boring BLE-7D								
2508-2492	Fill	NA	15	120	120	2,840	300	1.7
2492-2486	Firm clayey SILT	7	6	120	120	2,840	300	0.7
2486-2479	Loose silty SAND	10	7	120	58	2,840	370	0.6
2479-2474	Loose silty SAND	5	5	120	58	2,840	240	0.7
2474-2460	Firm silty SAND	11	14	120	58	2,840	400	1.2
Total Thickness of Compressible Material			47	Feet				
						TOTAL ESTIMATED SETTLEMENT (inches)		**4.9**

[1] Surcharge pressure assumes weight of solid waste of 70 pcf

SETTLEMENT CALCULATIONS

WHITE OAK MSW LANDFILL
HAYWOOD COUNTY, NORTH CAROLINA
Bunnell-Lammons Engineering, Inc. Project No. J07-1957-02

June 2008

Subsurface Layer (feet - feet)	Soil Type	Standard Penetration Resistance N-Value (bpf)	Layer Thickness (feet)	Total Soil Unit Weight (pcf)	Effective Soil Unit Weight (pcf)	Surcharge Pressure[1] (psf)	Soil Modulus (ksf)	Layer Settlement (inches)
Boring BLE-14								
2561-2544	Very Stiff to Hard sandy SILT	30	17	120	58	685	300	0.5
2544-2537	PWR	200	7	140	78	685	2710	0.0
Total Thickness of Compressible Material			24	Feet				
						TOTAL ESTIMATED SETTLEMENT (inches)		**0.5**
Boring BLE-17								
2583-2568	Very Stiff sandy SILT	28	15	120	120	1,140	300	0.7
2568-2563	Hard sandy SILT	34	5	120	120	1,140	840	0.1
2563-2538	Very Firm silty SAND	29	25	120	120	1,140	760	0.5
2538-2514	Very Stiff to Hard sandy SILT	31	24	120	58	1,140	790	0.4
2514-2511	PWR	100	3	140	78	1,140	1710	0.0
Total Thickness of Compressible Material			72	Feet				
						TOTAL ESTIMATED SETTLEMENT (inches)		**1.7**

[1] Surcharge pressure assumes weight of solid waste of 70 pcf

SUMMARY OF GLOBAL STABILITY ANALYSIS

WHITE OAK LANDFILL
PHASES 3 & 4
HAYWOOD COUNTY, NORTH CAROLINA
June 2008

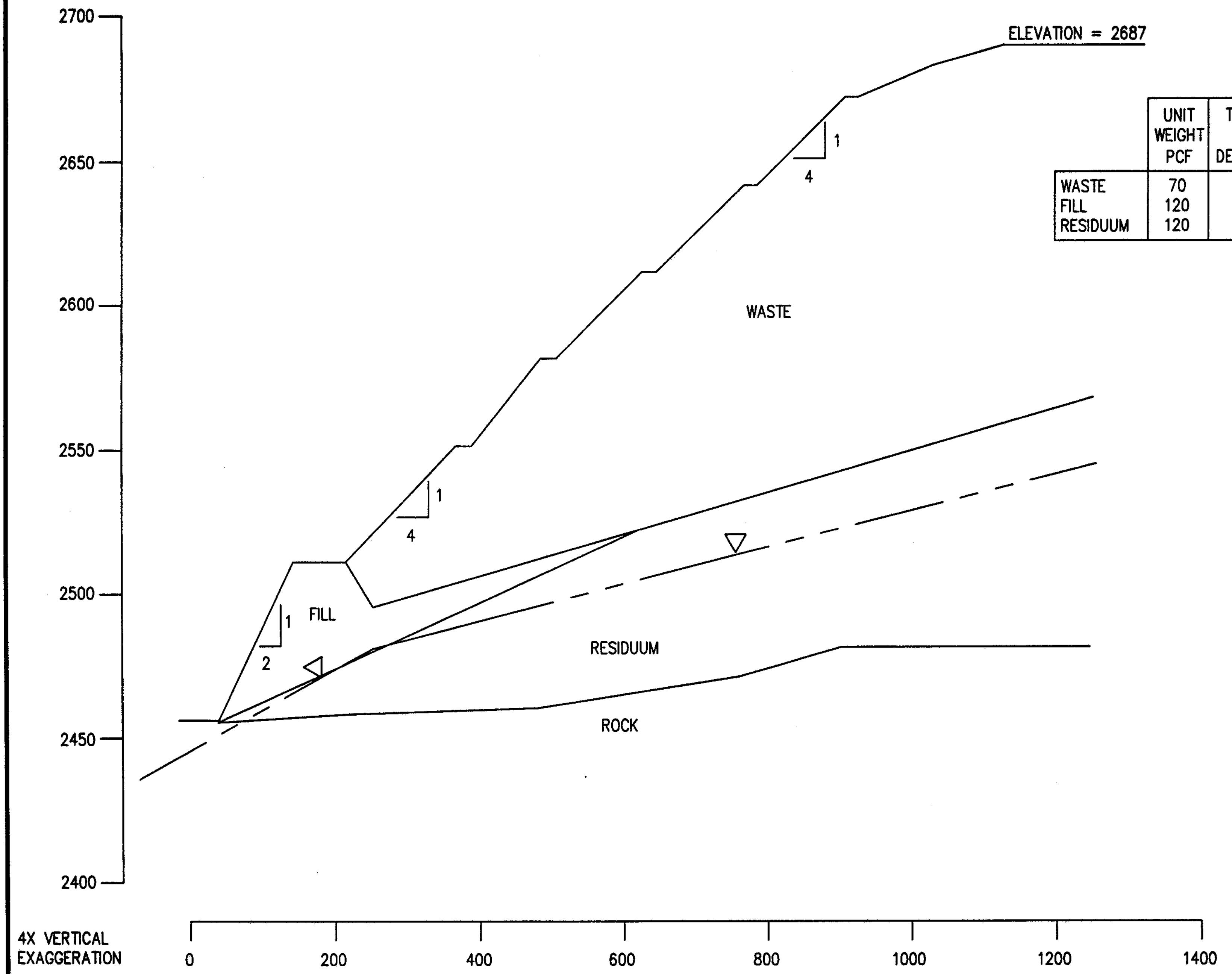
BLE Project No. J07-1957-02

Stability Analysis	Static Conditions		Seismic Conditions[1]	
	Result	Recommended Minimum[2]	Result	Recommended Minimum[2]
Waste Slope (4H : 1V) & Foundation	3.1	1.5	1.6	1.0
Fill Slope (2H : 1V)	1.6	1.5	1.1	1.0

Notes:

(1) Seismic horizontal acceleration at bedrock level = 0.176g

(2) Recommended minimum factors of safety: Static Conditions: 1.5
Seismic Conditions: 1.0



	UNIT WEIGHT PCF	TOTAL Ø DEGREES	STRESS C PSF	EFFECTIVE Ø DEGREES	STRESS C' PSF
WASTE	70	30	200	30	200
FILL	120	26	100	32	100
RESIDUUM	120	18	0	36	0

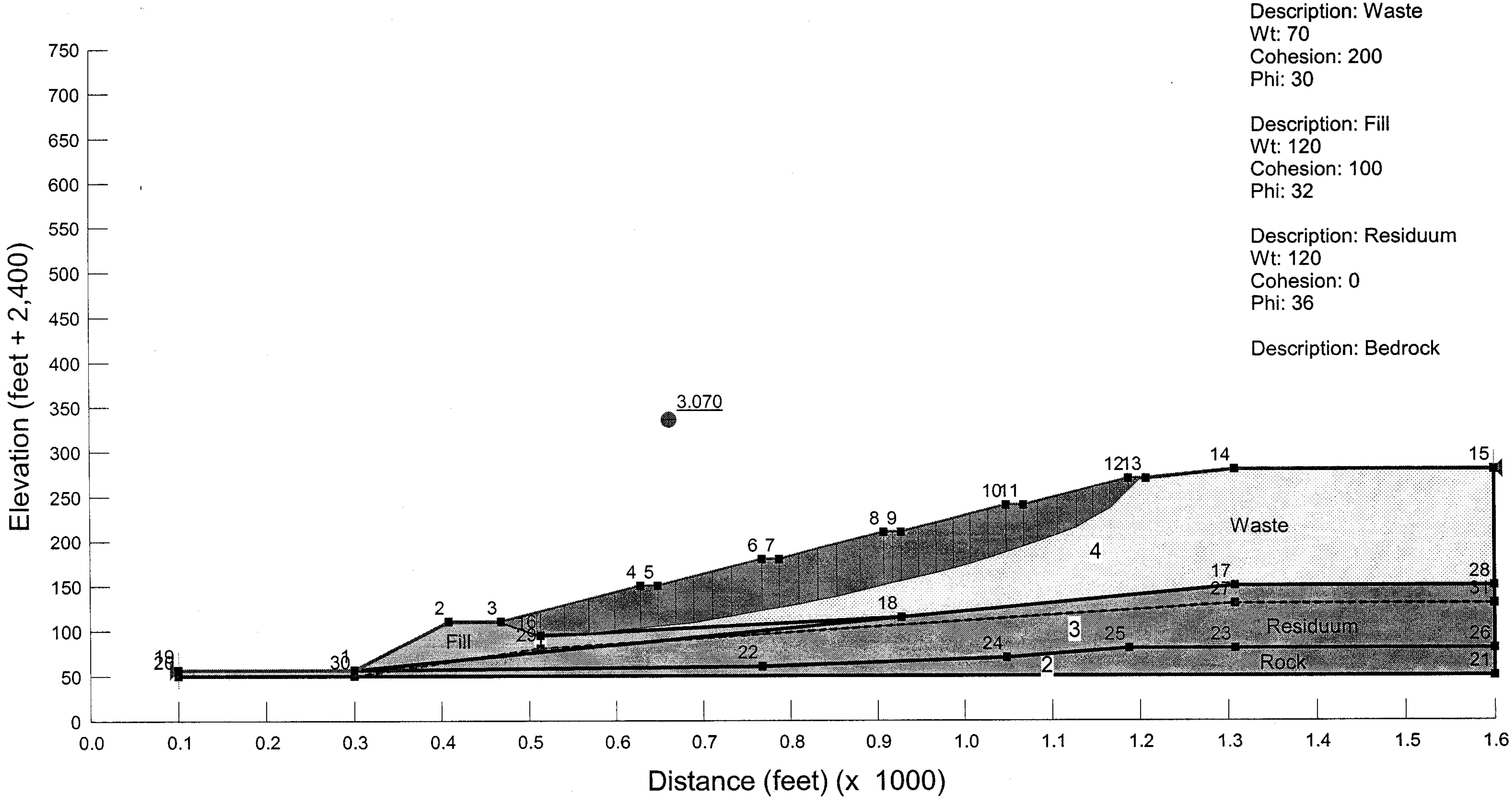
DRAWN: AEH	DATE: 06-16-08		
CHECKED: GLW	CAD: HCWOFL-02SECT		
APPROVED:	JOB NO: J08-1957-02		

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

SECTION
WHITE OAK MSW LANDFILL
HAYWOOD COUNTY, NORTH CAROLINA

FIGURE
X

Title: White Oak Landfill - Haywood County, NC
Comments: BLE Project No. J07-1957-02
Directory: C:\Public PC033\Slope Stability\White Oak Landfill\Effective Stress - Static - Autolocate.gsz
Date: 6/5/2008
Time: 2:49:46 PM
Horz Seismic Load: 0



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Comments: BLE Project No. J07-1957-02
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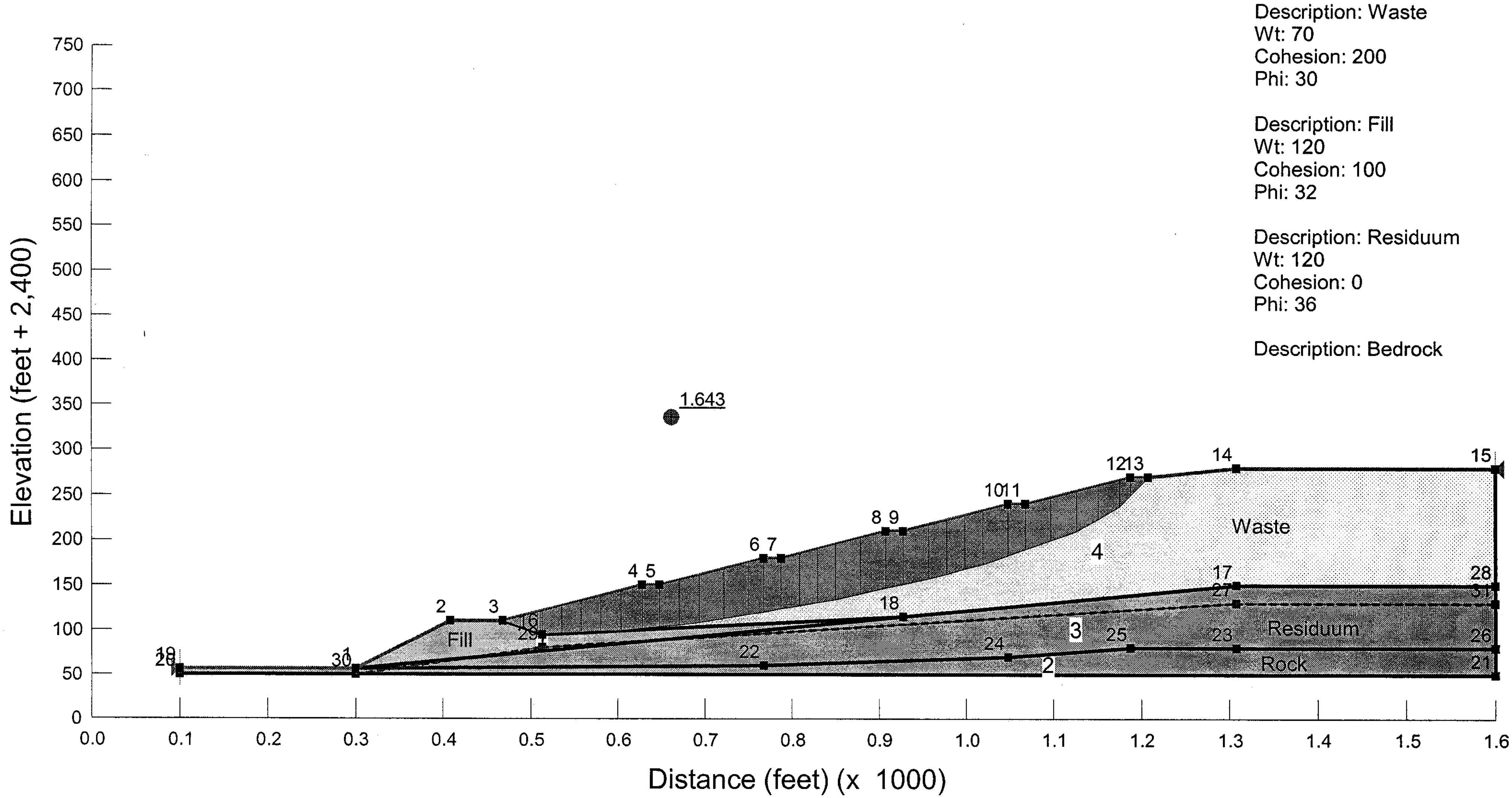

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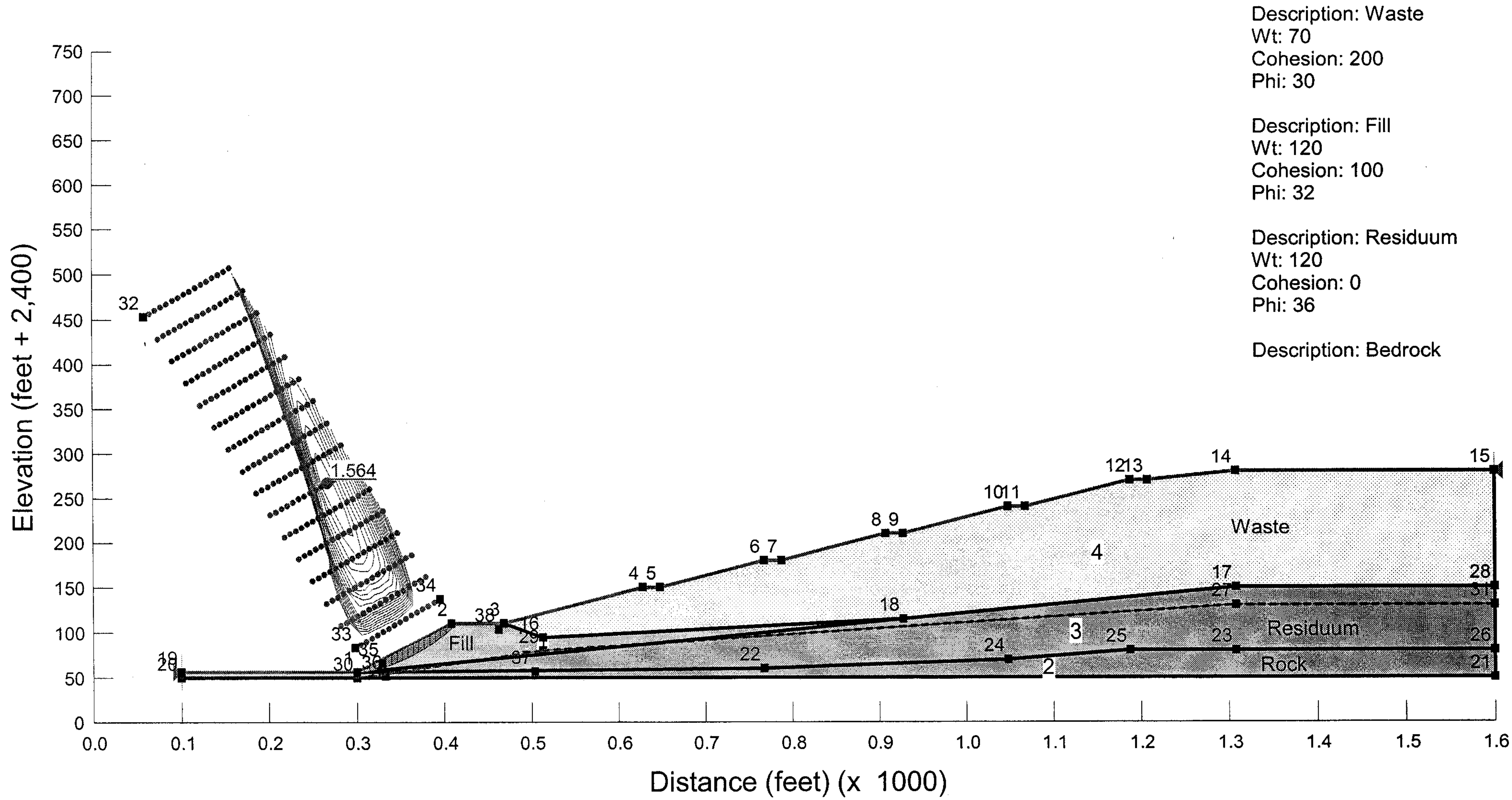

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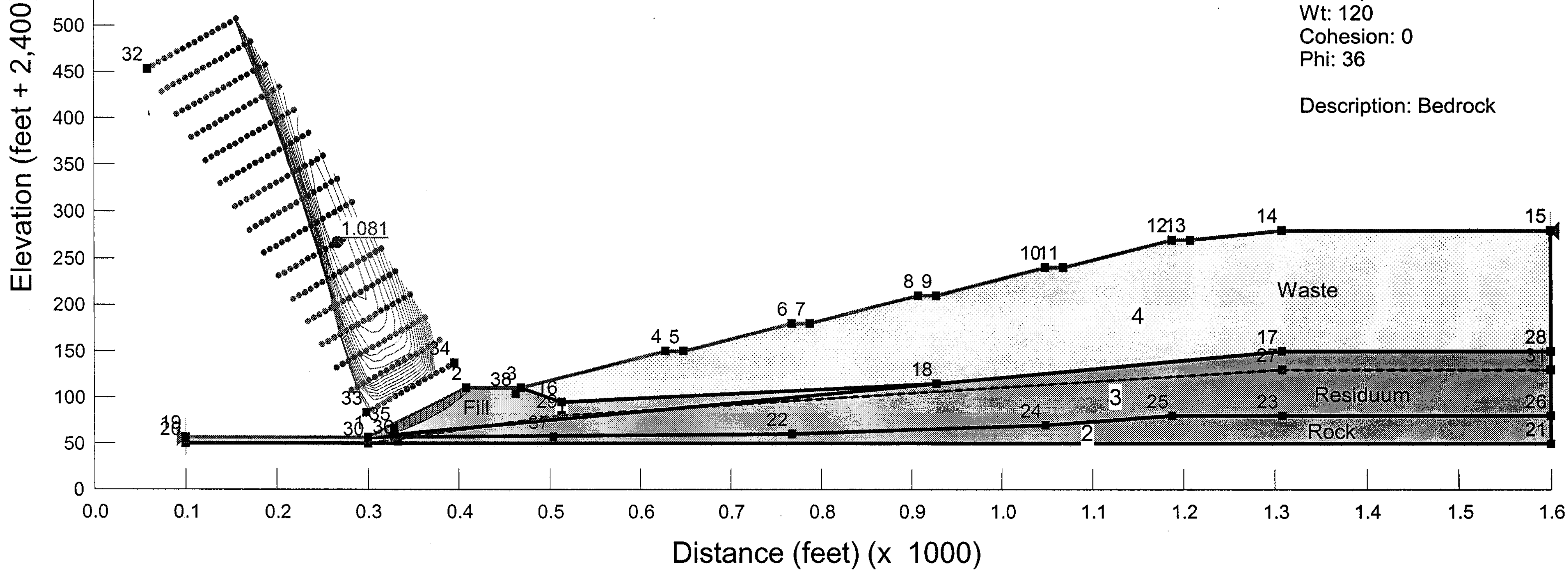
Date: 6/30/2008
Time: 3:57:07 PM
Horz Seismic Load: 0.176

Description: Waste
Wt: 70
Cohesion: 200
Phi: 30

Description: Fill
Wt: 120
Cohesion: 100
Phi: 32

Description: Residuum
Wt: 120
Cohesion: 0
Phi: 36

Description: Bedrock



Stability of Final Cover Against Sliding

Reference: Matasovic, N (1991) Selection of Method for Seismic Slope Stability Analysis," Proceedings of Second International Conference on Recent Advances in Geotechnical Earthquake Engineering & Soil Dynamics, St. Louis, Volume 2, pages 1057-1062.

$$FS = \frac{c/(\gamma z \cos^2\beta) + \tan\phi[1-\gamma_w(z-d_w)/(\gamma z)] - k_s \tan\beta \tan\phi}{k_s + \tan\beta}$$

FS = Factor of Safety (minimum: 1.5 static; 1.0 Dynamic)

c = Cohesion of Cover Layer

γ = Unit Weight of Cover Layer

z = Depth to Failure Surface

β = Slope Angle (4H:1V or $\beta = 14°$)

ϕ = Interface Friction Angle of assumed failure surface

γ_w = Unit Weight of Water

d_w = Depth to Seepage Surface

k_s = seismic coefficient

BLE INC.
BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS
GREENVILLE, SOUTH CAROLINA • ASHEVILLE, NORTH CAROLINA

JOB NO. J07-1957	SHEET 2 OF 2
PHASE 02	TASK
JOB NAME White Oak MSW Landfill	
BY G. Weekley	DATE 6-16-08
CHECKED BY [illegible]	DATE 6-19-08

Stability of Final Cover

$\gamma = 110$ pcf $K_S = 0.176$

$\gamma_w = 62.4$ pcf

$c = 25$ psf

$\phi = 20°$

$z = 2$ Feet

$d_w = 1.0$ Foot

Static

$$FS = \frac{50/(110 \times 2 \times \cos^2 14°) + \tan 20° [1 - 62.4(2-1)/(110 \times 2)]}{\tan 14°}$$

$$FS = \frac{0.241 + 0.261}{0.249} = 2.02 \geq 1.5$$ ok against sliding

Dynamic

$$FS = \frac{50/(110 \times 2 \times \cos^2 14) + \tan 20° [1 - 62.4(2-1)/(110 \times 2)] - 0.176 \tan 14° \tan 20°}{0.176 + \tan 14°}$$

$$FS = \frac{0.241 + 0.261 - 0.011}{0.176 + 0.249} = \frac{0.486}{0.425} = 1.14 \geq 1.0$$

Ok against sliding during seismic event

APPENDIX J

REGIONAL AND SITE SPECIFIC GEOLOGY TEXT FROM THE FEBRUARY 2000 SHR

APPENDIX I

GEOTECHNICAL CALCULATIONS METHODOLOGY
WHITE OAK MSW LANDFILL
HAYWOOD COUNTY, NORTH CAROLINA
BLE Project No. J07-1957-02

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SLOPE STABILITY CONSIDERATIONS:

The planned landfill structural fill, base liner, and closure cap slopes were analyzed for static, seismic, and interface stability. The initial and final grading plans prepared by McGill Associates, P.A., indicate base liner slopes of 3 horizontal to 1 vertical or flatter and closure cap slopes of 4 horizontal to 1 vertical. A perimeter fill slope will be constructed at 2 horizontal to 1 vertical.

According to the definition of seismic impact zones in 15A NCAC 13B.1622 (5), this site is in a seismic impact zone. The maximum horizontal acceleration expressed as a percentage of the earth's gravity (g) in rock is 0.176g with a 2% probability of being exceeded in 50 years (equal to 10% probability in 250 years; NC Building Code, 2006 IBC). The slope configurations were analyzed using the maximum horizontal acceleration of 0.176g. The analysis of the structural fill and waste mound slopes was performed using the computer program Slope/W by Geoslope International. The analysis results are attached and indicate the designed slopes are stable when subjected to both static and seismic conditions.

ROCK AND GROUNDWATER SEPARATION FROM CLAY LINER SUBGRADE

GEOTECHNICAL ANALYSIS - PHASES 3 & 4
WHITE OAK MSW LANDFILL
HAYWOOD COUNTY, NORTH CAROLINA
BLE Project No. J07-1957-02
June 2008

Boring Number	Calculated Settlement Feet	Cap Elev. minus FML Elev. Feet	Clay Subgrade Elevation (FML-2 Feet) Feet	Groundwater Elevation Seasonal High Feet	Groundwater Elevation Separation[1] Feet	Rock or Auger Refusal Elevation Feet	Rock Elevation Separation[2] Feet
BLE-1	0.58	104	2566	2531.12	34.30	2508.23	57.19
BLE-2	1.25	118	2523	2513.76	7.99	< 2485.7	> 35.1
BLE-3	0.59	97	2511	2501.87	8.54	< 2469.8	> 40.6
BLE-5	0.36	58	2503	2493.33	9.31	2471.10	31.54
BLE-6	0.00	1	2523	2488.93	34.07	2486.96	36.04
BLE-7D	0.41	12	2506	2485.24	20.35	2459.92	45.67
BLE-9	0.00	4	2532	2509.28	22.72	2527.54	4.46
BLE-13	0.00	56	2552	2542.44	9.56	2523.39	28.61
BLE-14	0.04	88	2559	2551.21	7.75	2536.91	22.05
BLE-16	0.00	48	2563	2555.63	7.37	< 2534.7	> 28.3
BLE-17	0.14	60	2581	2537.59	43.27	2510.46	70.40

References: McGill Associates, PA drawing dated June 2008.
BLE Seasonal High Water Table Map (9/20/07 to 2/14/08); Figure 7.

Notes: 1 Separation between post-settlement bottom of clay liner and seasonal high groundwater.
2 Separation between post-settlement bottom of clay liner and top of rock (refusal).

SETTLEMENT CALCULATIONS

WHITE OAK MSW LANDFILL
HAYWOOD COUNTY, NORTH CAROLINA
Bunnell-Lammons Engineering, Inc. Project No. J07-1957-02

June 2008

Subsurface Layer (feet - feet)	Soil Type	Standard Penetration Resistance N-Value (bpf)	Layer Thickness (feet)	Total Soil Unit Weight (pcf)	Effective Soil Unit Weight (pcf)	Surcharge Pressure[1] (psf)	Soil Modulus (ksf)	Layer Settlement (inches)
Boring BLE-1								
2568-2536	Very Stiff sandy SILT	24	32	120	120	6,750	670	3.9
2536-2510	Very Stiff sandy SILT	26	26	120	58	6,750	700	3.0
2510-2508	PWR	200	2	140	78	6,750	2710	0.1
Total Thickness of Compressible Material			60	Feet				
				TOTAL ESTIMATED SETTLEMENT (inches)				**7.0**

SETTLEMENT CALCULATIONS

WHITE OAK MSW LANDFILL
HAYWOOD COUNTY, NORTH CAROLINA
Bunnell-Lammons Engineering, Inc. Project No. J07-1957-02

June 2008

Subsurface Layer (feet - feet)	Soil Type	Standard Penetration Resistance N-Value (bpf)	Layer Thickness (feet)	Total Soil Unit Weight (pcf)	Effective Soil Unit Weight (pcf)	Surcharge Pressure[1] (psf)	Soil Modulus (ksf)	Layer Settlement (inches)
Boring BLE-2								
2525-2520	Soft sandy SILT	4	5	120	120	8,305	200	2.5
2520-2512	Firm silty SAND	14	8	120	120	8,305	470	1.7
2512-2502	Soft sandy SILT	3	10	120	58	8,305	170	5.9
2502-2471	Very Firm silty SAND	22	31	120	58	8,305	630	4.9
Total Thickness of Compressible Material			54	Feet				
					TOTAL ESTIMATED SETTLEMENT (inches)			**15.0**
Boring BLE-3								
2513-2506	Loose silty SAND	9	8	110	110	6,950	350	1.9
2506-2501	Very Firm silty SAND	25	5	120	120	6,950	690	0.6
2501-2491	Loose silty SAND	9	10	110	48	6,950	350	2.4
2491-2471	Dense silty SAND	31	20	130	68	6,950	790	2.1
2471-2470	Very Dense silty SAND	57	1	130	68	6,950	1180	0.1
Total Thickness of Compressible Material			44	Feet				
					TOTAL ESTIMATED SETTLEMENT (inches)			**7.1**

1. Surcharge pressure assumes weight of solid waste of 70 pcf

SETTLEMENT CALCULATIONS

WHITE OAK MSW LANDFILL
HAYWOOD COUNTY, NORTH CAROLINA
Bunnell-Lammons Engineering, Inc. Project No. J07-1957-02

June 2008

Subsurface Layer (feet - feet)	Soil Type	Standard Penetration Resistance N-Value (bpf)	Layer Thickness (feet)	Total Soil Unit Weight (pcf)	Effective Soil Unit Weight (pcf)	Surcharge Pressure[1] (psf)	Soil Modulus (ksf)	Layer Settlement (inches)
Boring BLE-5								
2505-2497	Fill	NA	8	120	120	4,220	300	1.4
2497-2489	Firm clayey SILT	5	8	120	58	4,220	240	1.7
2489-2479	Firm silty SAND	18	10	120	58	4,220	550	0.9
2479-2474	PWR	150	5	140	78	4,220	2240	0.1
2474-2471	Dense silty SAND	39	3	130	68	4,220	920	0.2
Total Thickness of Compressible Material			34	Feet				
				TOTAL ESTIMATED SETTLEMENT (inches)				**4.3**
Boring BLE-7D								
2508-2492	Fill	NA	15	120	120	2,840	300	1.7
2492-2486	Firm clayey SILT	7	6	120	120	2,840	300	0.7
2486-2479	Loose silty SAND	10	7	120	58	2,840	370	0.6
2479-2474	Loose silty SAND	5	5	120	58	2,840	240	0.7
2474-2460	Firm silty SAND	11	14	120	58	2,840	400	1.2
Total Thickness of Compressible Material			47	Feet				
				TOTAL ESTIMATED SETTLEMENT (inches)				**4.9**

[1] Surcharge pressure assumes weight of solid waste of 70 pcf

SETTLEMENT CALCULATIONS

WHITE OAK MSW LANDFILL
HAYWOOD COUNTY, NORTH CAROLINA
Bunnell-Lammons Engineering, Inc. Project No. J07-1957-02

June 2008

Subsurface Layer (feet - feet)	Soil Type	Standard Penetration Resistance N-Value (bpf)	Layer Thickness (feet)	Total Soil Unit Weight (pcf)	Effective Soil Unit Weight (pcf)	Surcharge Pressure[1] (psf)	Soil Modulus (ksf)	Layer Settlement (inches)
Boring BLE-14								
2561-2544	Very Stiff to Hard sandy SILT	30	17	120	58	685	300	0.5
2544-2537	PWR	200	7	140	78	685	2710	0.0
Total Thickness of Compressible Material			24	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**0.5**
Boring BLE-17								
2583-2568	Very Stiff sandy SILT	28	15	120	120	1,140	300	0.7
2568-2563	Hard sandy SILT	34	5	120	120	1,140	840	0.1
2563-2538	Very Firm silty SAND	29	25	120	120	1,140	760	0.5
2538-2514	Very Stiff to Hard sandy SILT	31	24	120	58	1,140	790	0.4
2514-2511	PWR	100	3	140	78	1,140	1710	0.0
Total Thickness of Compressible Material			72	Feet				
							TOTAL ESTIMATED SETTLEMENT (inches)	**1.7**

[1] Surcharge pressure assumes weight of solid waste of 70 pcf

SUMMARY OF GLOBAL STABILITY ANALYSIS

WHITE OAK LANDFILL
PHASES 3 & 4
HAYWOOD COUNTY, NORTH CAROLINA
June 2008

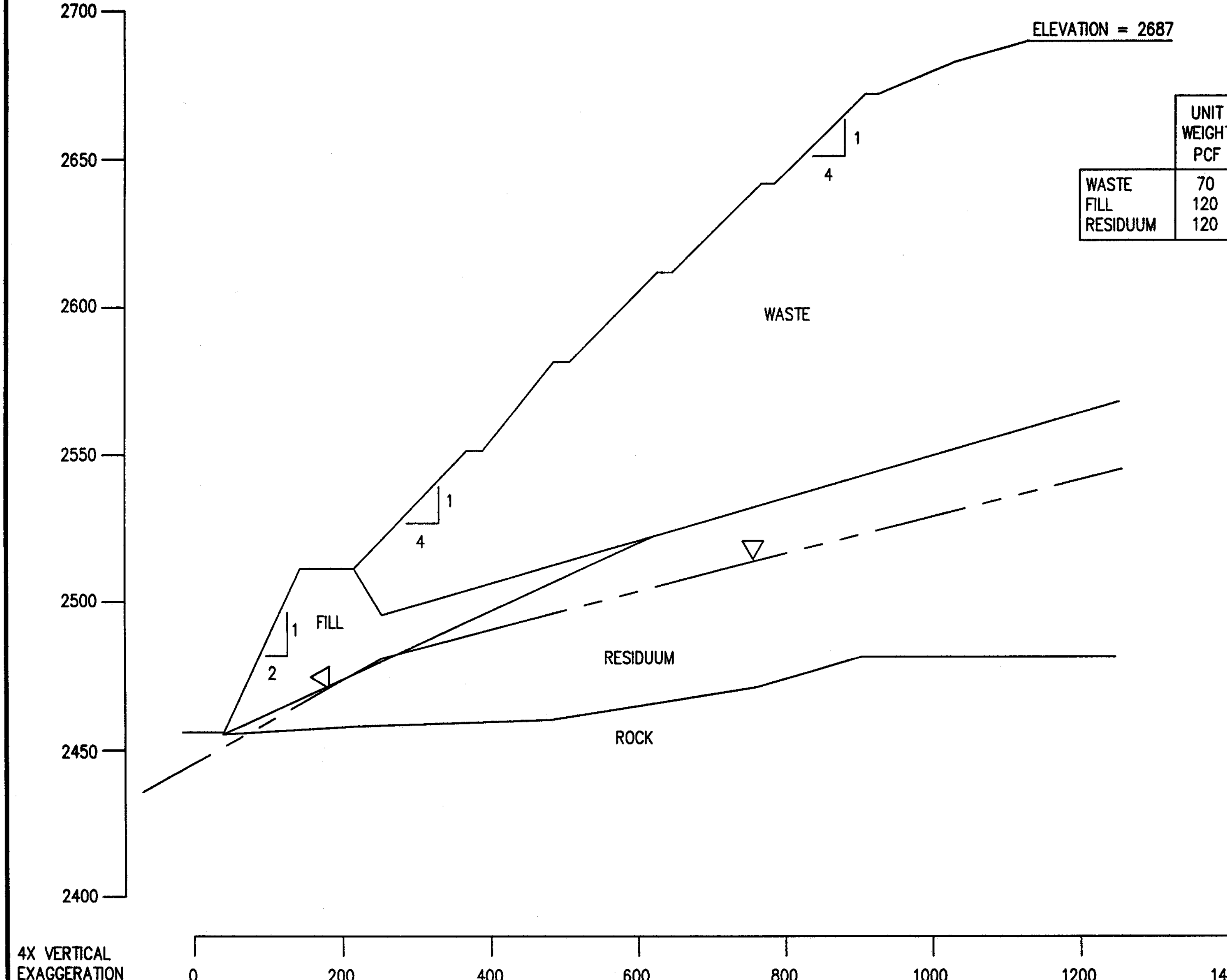
BLE Project No. J07-1957-02

Stability Analysis	Static Conditions		Seismic Conditions[1]	
	Result	Recommended Minimum[2]	Result	Recommended Minimum[2]
Waste Slope (4H : 1V) & Foundation	3.1	1.5	1.6	1.0
Fill Slope (2H : 1V)	1.6	1.5	1.1	1.0

Notes:

[1] Seismic horizontal acceleration at bedrock level = 0.176g

[2] Recommended minimum factors of safety: Static Conditions: 1.5
Seismic Conditions: 1.0



	UNIT WEIGHT PCF	TOTAL Ø DEGREES	STRESS C PSF	EFFECTIVE Ø DEGREES	STRESS C' PSF
WASTE	70	30	200	30	200
FILL	120	26	100	32	100
RESIDUUM	120	18	0	36	0

DRAWN: AEH	DATE: 06-16-08		
CHECKED: GLW	CAD: HCWOFL-02SECT		
APPROVED:	JOB NO: J08-1957-02		

BLE INC.

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

SECTION
WHITE OAK MSW LANDFILL
HAYWOOD COUNTY, NORTH CAROLINA

FIGURE X

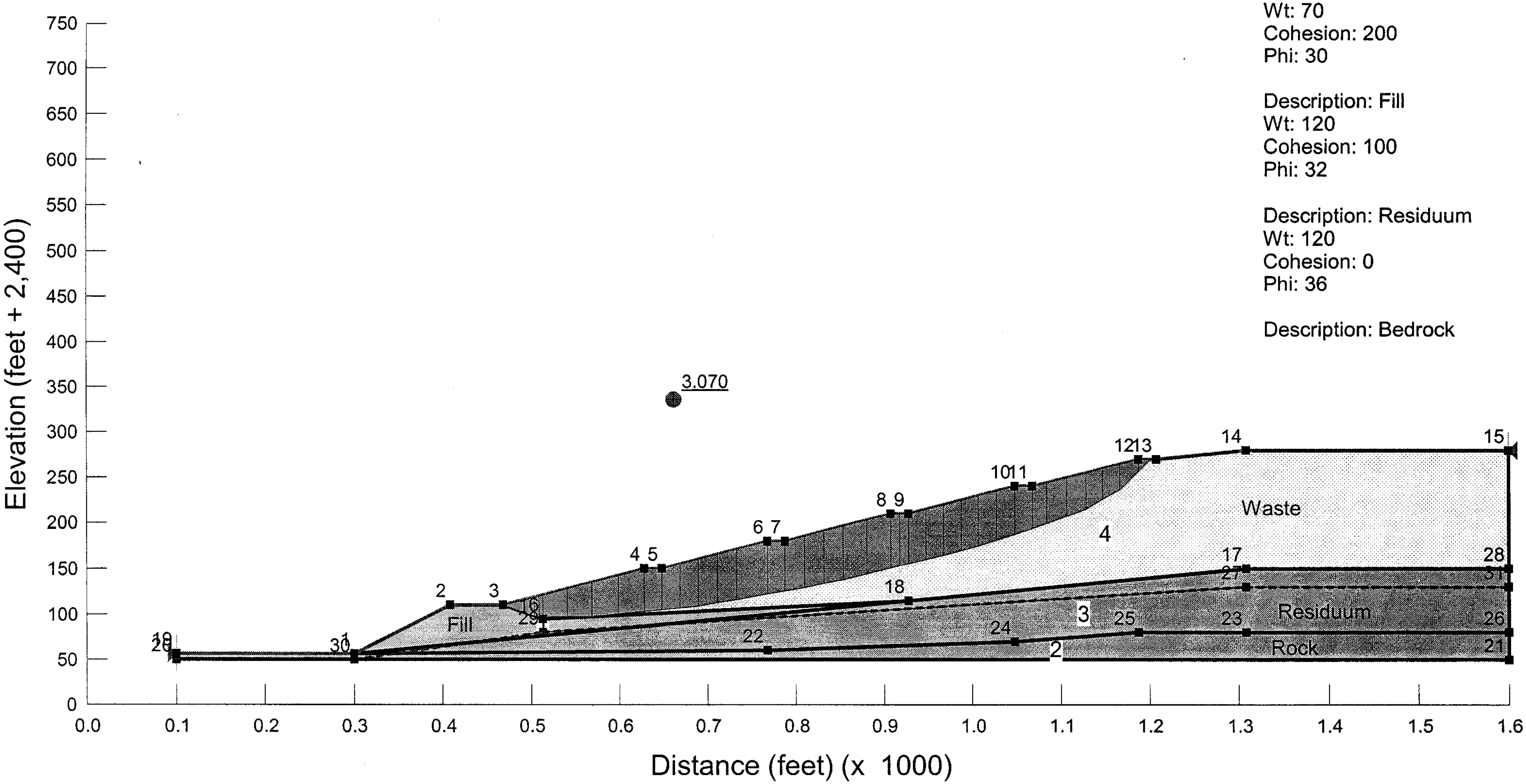
Title: White Oak Landfill - Haywood County, NC
Comments: BLE Project No. J07-1957-02
Directory: C:\Public PC033\Slope Stability\White Oak Landfill\Effective Stress - Static - Autolocate.gsz
Date: 6/5/2008
Time: 2:49:46 PM
Horz Seismic Load: 0

Description: Waste
Wt: 70
Cohesion: 200
Phi: 30

Description: Fill
Wt: 120
Cohesion: 100
Phi: 32

Description: Residuum
Wt: 120
Cohesion: 0
Phi: 36

Description: Bedrock



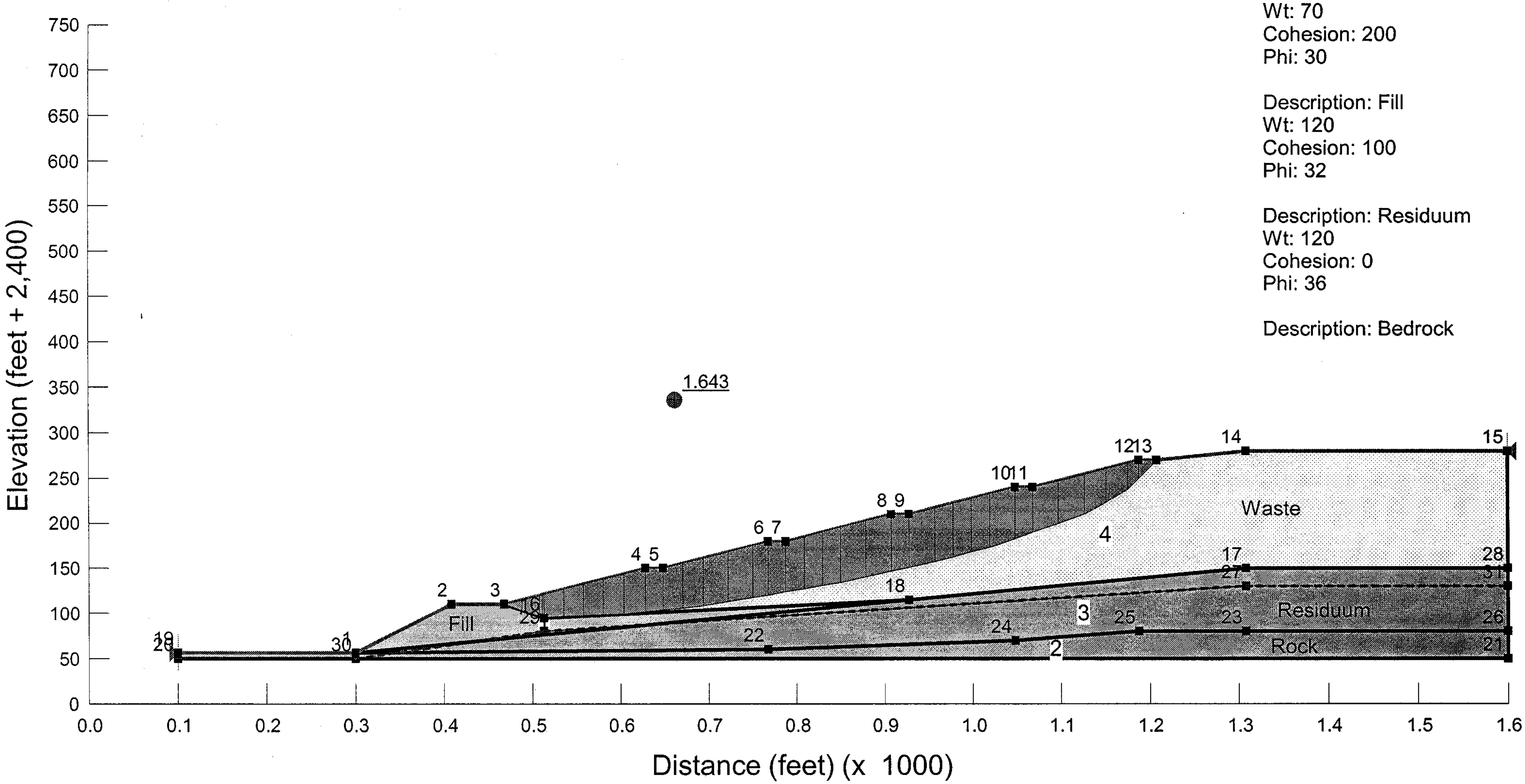
Title: White Oak Landfill - Haywood County, NC
Comments: BLE Project No. J07-1957-02
Directory: C:\Public PC033\Slope Stability\White Oak Landfill\Effective Stress - Seismic - Autolocate.gsz
Date: 7/2/2008
Time: 10:28:14 AM
Horz Seismic Load: 0.176

Description: Waste
Wt: 70
Cohesion: 200
Phi: 30

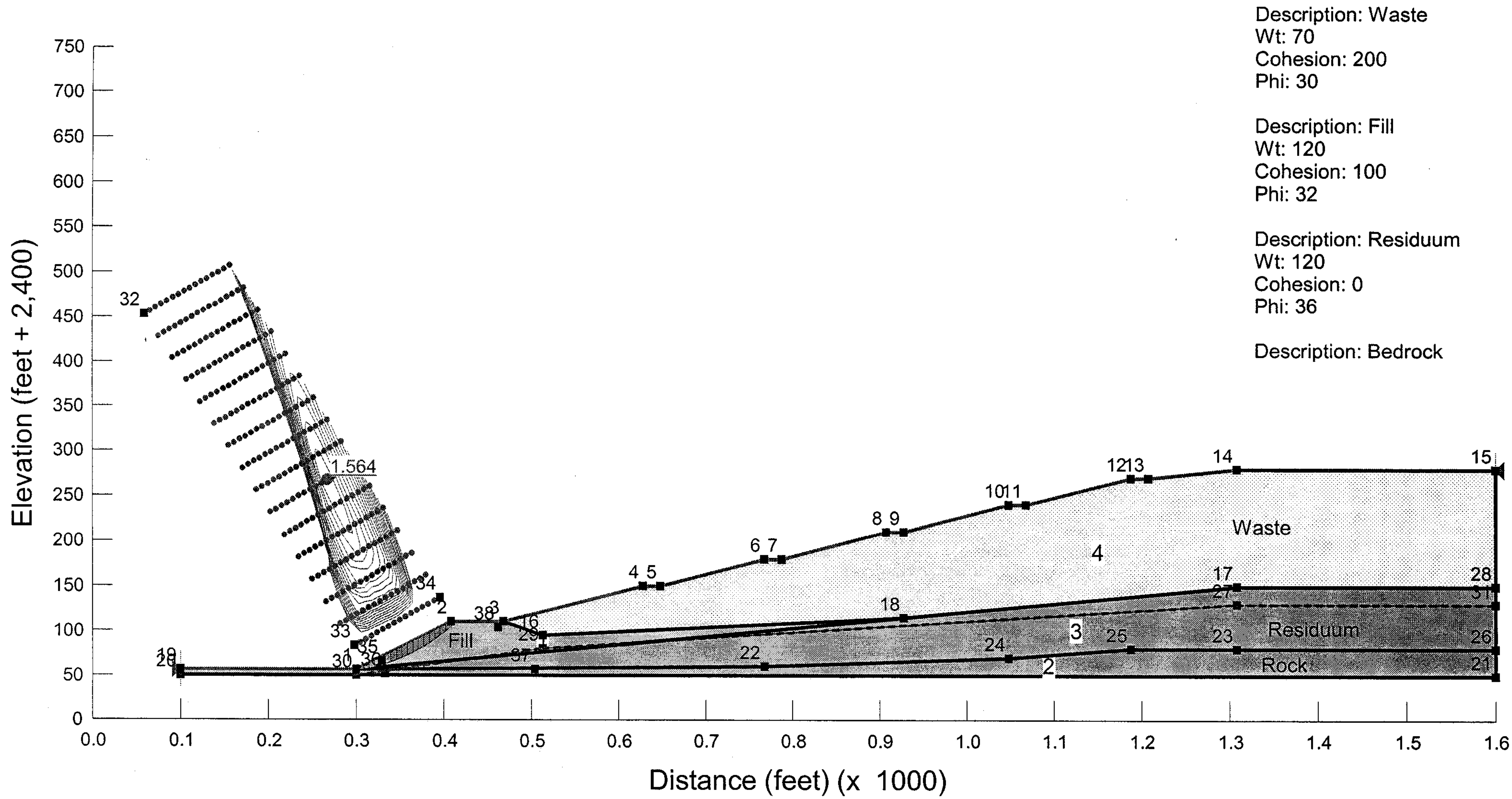
Description: Fill
Wt: 120
Cohesion: 100
Phi: 32

Description: Residuum
Wt: 120
Cohesion: 0
Phi: 36

Description: Bedrock



Title: White Oak Landfill - Haywood County, NC
Comments: BLE Project No. J07-1957-02
Directory: C:\Public PC033\Slope Stability\White Oak Landfill\Effective Stress - Static - Circular - Fill Slope.gsz
Date: 6/5/2008
Time: 3:01:37 PM
Horz Seismic Load: 0



Title: White Oak Landfill - Haywood County, NC
Comments: BLE Project No. J07-1957-02
Directory: C:\Public PC033\Slope Stability\White Oak Landfill\Effective Stress - Seismic - Circular - Fill Slope DBB Change.gsz
Date: 6/30/2008
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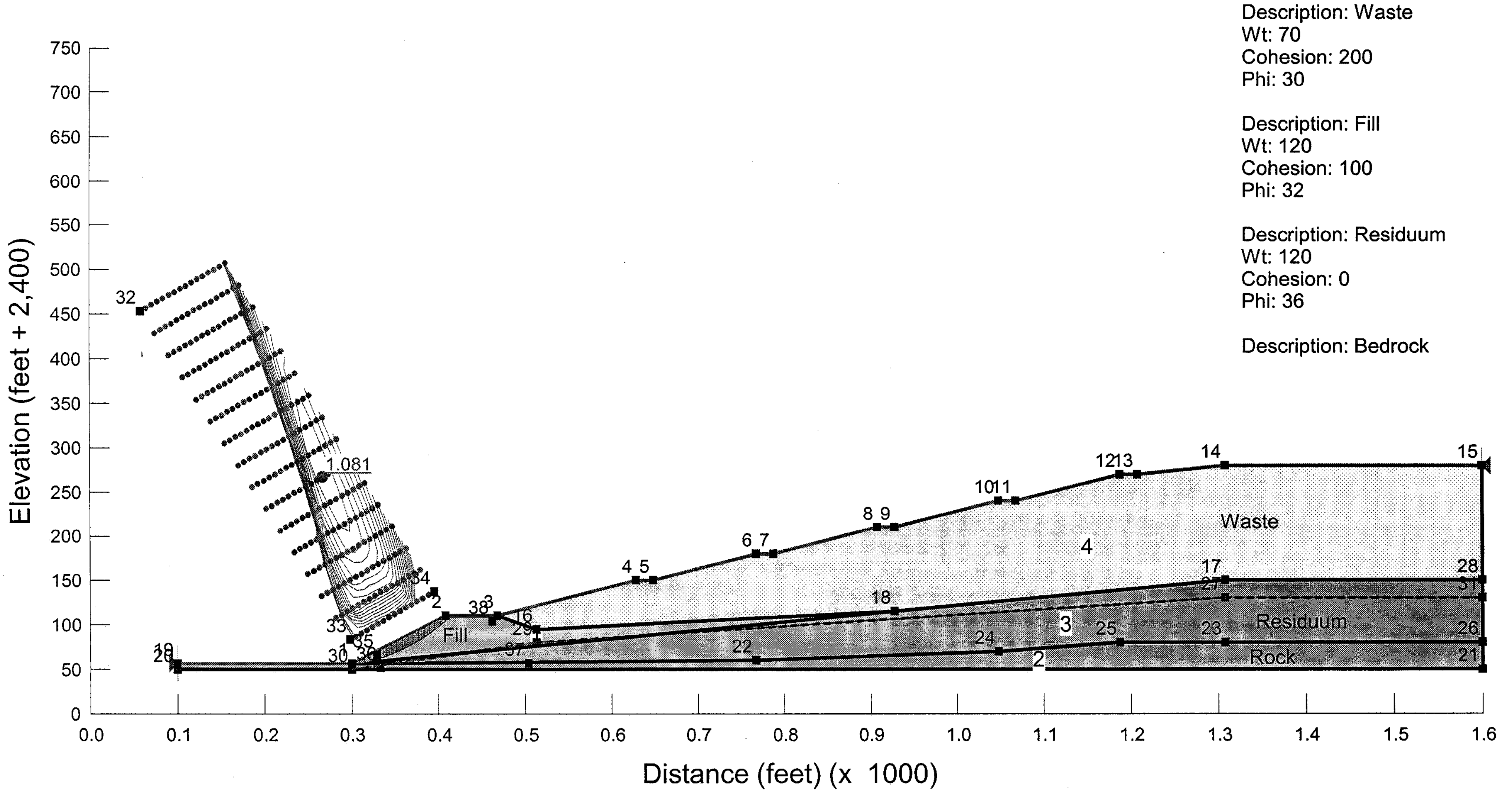
Horz Seismic Load: 0.176



BLE INC.
BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS
GREENVILLE, SOUTH CAROLINA • ASHEVILLE, NORTH CAROLINA

JOB NO. J07-1957 SHEET 1 OF 2
PHASE 02 TASK
JOB NAME White Oak MSW Landfill
BY G. Weekley DATE 6-16-08
CHECKED BY HELVEY DATE 6-19-08

Stability of Final Cover Against Sliding

Reference: Matasovic, N (1991) Selection of Method for Seismic Slope Stability Analysis," Proceedings of Second International Conference on Recent Advances in Geotechnical Earthquake Engineering & Soil Dynamics, St. Louis, Volume 2, pages 1057-1062.

$$FS = \frac{C/(\gamma z \cos^2\beta) + \tan\phi[1-\gamma_w(z-d_w)/(\gamma z)] - K_s \tan\beta \tan\phi}{K_s + \tan\beta}$$

FS = Factor of Safety (minimum: 1.5 static; 1.0 Dynamic)

C = Cohesion of Cover Layer

γ = Unit Weight of Cover Layer

z = Depth to Failure Surface

β = Slope Angle (4H:1V or $\beta = 14°$)

ϕ = Interface Friction Angle of assumed failure surface

γ_w = Unit Weight of Water

d_w = Depth to Seepage Surface

K_s = Seismic Coefficient

BLE INC. BUNNELL-LAMMONS ENGINEERING, INC. GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS GREENVILLE, SOUTH CAROLINA • ASHEVILLE, NORTH CAROLINA	JOB NO. J07-1957 SHEET 2 OF 2 PHASE 02 TASK JOB NAME White Oak MSW Landfill BY G. Weekley DATE 6-16-08 CHECKED BY KELVC? DATE 6-19-08

Stability of Final Cover

$\gamma = 110$ pcf $\qquad K_S = 0.176$

$\gamma_w = 62.4$ pcf

$c = 25$ psf

$\phi = 20°$

$z = 2$ Feet

$d_w = 1.0$ Foot

Static

$$FS = \frac{50/(110 \times 2 \times \cos^2 14°) + \tan 20°[1 - 62.4(2-1)/(110 \times 2)]}{\tan 14°}$$

$$FS = \frac{0.241 + 0.261}{0.249} = 2.02 \geq 1.5$$ ok against sliding

Dynamic

$$FS = \frac{50/(110 \times 2 \times \cos^2 14) + \tan 20°[1 - 62.4(2-1)/(110 \times 2)] - 0.176 \tan 14° \tan 20°}{0.176 + \tan 14°}$$

$$FS = \frac{0.241 + 0.261 - 0.011}{0.176 + 0.249} = \frac{0.486}{0.425} = 1.14 \geq 1.0$$

ok against sliding during seismic event

APPENDIX J

REGIONAL AND SITE SPECIFIC GEOLOGY TEXT FROM THE FEBRUARY 2000 SHR

Municipal Services
Garner, N.C.

Engineering Company, P.A.
Boone, N.C.

Site Hydrogeologic Study
White Oak Subtitle D Landfill
Haywood County, North Carolina

Project No. G98010.5

GEOLOGIC CONSIDERATIONS

The stratigraphy and structure of the southern Appalachian region have been the topic of many investigations and professional papers. In addition to previous observations by Law Engineering and Hatcher, MESCO personnel documented rock types and structure within the vicinity of the proposed landfill site. These observations were used in conjunction with extensive field reconnaissance performed by Hadley and Goldsmith to construct a geologic map outlining structures and lithologies within and surrounding the proposed site.[9] The derived geologic map and accompanying field notes are presented in Plate 2.

Regional Geology

Regionally the site lies near Ocoee series rocks that include both the older Snowbird Group and younger Great Smoky Group. The site itself overlies the Precambrian age basement complex that consists of metamorphosed plutonic rocks and the Carolina Gneiss.[9] Both units have experienced various degrees of polymetamorphism in both the Precambrian and Paleozoic where the original structure of the rocks was massively deformed, if not completely destroyed. The plutonic rocks, as described by Hadley and Goldsmith, stratigraphically overlie the Carolina Gneiss and are described as massive, often coarse textured rocks with varying textures and compositions. The composition of these meta-crystalline plutonic rocks (orthogneisses) suggests the parent materials were felsic igneous intrusions, namely granite and granodiorite. Though the underlying Carolina Gneiss is similar in texture and appearance, its composition suggests it was derived from very old meta-sedimentary units.[9] A non-conformity exists between the plutonic rocks of the basement complex and the overlying Thunderhead Sandstone that outcrops to the west and south of the site.

Structurally, the site is located very near the Cataloochee Divide Syncline between the kyanite and staurolite isograds. The degree of metamorphism increases to the south-southeast.[9] The Cataloochee Anticlinorium, located to the northwest of the site, is bounded by the Greenbrier Fault and bisected by the Cold Springs Fault. Located north-northwest of the site are small, high angle reverse faults that roughly parallel the Cold Springs Fault. However, the lateral continuity of these faults is not established across the Pigeon River. Ridgeline orientation typically parallels structural features which trend northeast/southwest.

A stream trace analysis was performed within a 1 mile radius of the site. Structurally controlled features were traced from USGS 7.5 min Cove Creek Gap and Fines Creek Quadrangles. Dominant stream trends in the region are N5W to N25W and N35W to N45W, and minor trends are N5E to N30E and N75E to N85E. Field reconnaissance reveals major foliations trend N5W to N20W paralleling one of the dominant stream traces. Major joints trend N20W to N40W paralleling major stream traces. Other major foliation orientations (N9E to N20E) and joint orientations (N10E to N20E) parallel the minor stream traces. Stream traces do not appear to vary greatly between rock types, however, east of the Pigeon River stream traces trend N75W to east/west to N75E. This indicates a difference in fracturing on the opposite side of the Pigeon River which is likely following a major fracture system. Stream traces are presented on Plate 3. The Rose diagram on Plate 3B summarized the orientations of approximate straight line stream and drainage segments.

The site lies within a seismic impact zone defined as an area having greater than 10 percent probability that the maximum expected horizontal acceleration expressed as a percentage of the earth's gravitational pull (g) will exceed 0.10 g in 250 years.[1] There are no Holocene faults present within 200 feet of the landfill site.[12]

Site Specific Geology

Rock outcrop and core samples support the boundaries outlined by Hadley and Goldsmith.[9] Most of the core samples are layered, coarse-grained gneiss with varied degrees of fracturing and weathering. Some samples display granitic texture and good relict crystalline structure with only slight secondary orientation. Other samples show a typically gneissic texture that is massively foliated with interlayers of biotite mica and coarse-grained plagioclase and quartz. Although changes in texture and composition are observed, the rocks underlying and outcropping within and directly adjacent to the site are classified as Precambrian plutonic basement rocks.

The most abundant on-site locations of rock outcrops are on the steep slopes that rise from the Pigeon River along the eastern and northern boundary of the site. Outcrop locations observed by Hatcher and Law Engineering were confirmed in the field by MESCO personnel. On-site outcrops consist of Precambrian basement granitoid gneiss with varying degrees of foliation. No faults are evident on site.

Small boulders of fine grained, white sandstone are found on the head of the slope where abandoned borehole P-8 is located. These are likely relicts of the overlying Thunderhead Sandstone. Soils weathered from the sandstone unit are not present in any borehole within the proposed site nor are there any sandstone outcrops within the site boundaries. The reported contact between the Thunderhead Sandstone and the basement complex lies west and south of the site as mapped by Hadley and Goldsmith.[9] The location of this contact was confirmed in the field by MESCO personnel.

FIELD INVESTIGATION

MESCO installed twenty-one borings for the site hydrogeologic study from March through May 1998, and nine borings from December 1999 through January 2000. Piezometers were installed in all borings that reached the water table and their locations were surveyed by MESCO in accordance with 15A NCAC 13B.1632. Boring B-8 reached neither the surface of intact rock nor the water table and was terminated and abandoned at a depth of 120 feet. Borings were drilled to provide both extended groundwater readings and subsurface data necessary for site characterization. Elevations from both the piezometers and monitoring wells will be used to define the potentiometric surface and groundwater flow characteristics. The locations of all borings and monitoring wells are provided on Plate 1. Water elevations and pertinent bore-hole and monitoring well depths are presented on Table 1.

APPENDIX K

USGS WATER-RESOURCES INVESTIGATIONS REPORT 02-4105 (PARTIAL)

Preliminary Hydrogeologic Assessment and Study Plan for a Regional Ground-Water Resource Investigation of the Blue Ridge and Piedmont Provinces of North Carolina

By Charles C. Daniel, III, and Paul R. Dahlen

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 02–4105

Prepared in cooperation with

The Groundwater Section of the North Carolina Department of Environment and Natural Resources, Division of Water Quality

Raleigh, North Carolina
2002

Table 1. Classification and lithologic description of hydrogeologic units in the Blue Ridge and Piedmont Provinces of North Carolina

[From Daniel, 1989]

Symbol	Hydrogeologic unit	Lithologic description
		IGNEOUS INTRUSIVE ROCKS
IFI	Igneous, felsic intrusive	Light-colored, mostly granitic rocks, fine- to coarse-grained, some porphyritic, usually massive, locally foliated; includes granite, granodiorite, quartz diorite, quartz monzonite, alaskites.
III	Igneous, intermediate intrusive	Gray to greenish-gray, medium- to coarse-grained, massive rocks of dioritic composition; includes assemblages of closely associated diorite and gabbro where they are too closely associated to be mapped separately.
IMI	Igneous, mafic intrusive	Dark greenish-gray to black, medium- to coarse-grained intrusive bodies; primarily gabbroic in composition, includes closely associated gabbro and diorite where they are too closely associated to be mapped separately, ultramafic rocks, diabase, dunite.
		METAMORPHIC ROCKS
		Metaigneous Rocks (Intrusive)
MIF	Metaigneous, felsic	Light-colored, massive to foliated metamorphosed bodies of varying assemblages of felsic intrusive rock types; local shearing and jointing are common.
MII	Metaigneous, intermediate	Gray to greenish-gray, medium- to coarse-grained, massive to foliated, well-jointed, metamorphosed bodies of dioritic composition.
MIM	Metaigneous, mafic	Massive to schistose greenstone, amphibolite, metagabbro and metadiabase, may be strongly sheared and recrystallized; metamorphosed ultramafic bodies are often strongly foliated, altered to serpentine, talc, chlorite-tremolite schist and gneiss.
		Metavolcanic Rocks (Extrusive-Eruptive)
MVF	Metavolcanic, felsic	Chiefly dense, fine-grained, light-colored to greenish-gray felsic tuffs and felsic crystal tuffs, includes interbedded felsic flows. Felsic lithic tuffs, tuff breccias, and some epiclastic rocks; recrystallized fine-grained groundmass contains feldspar, sericite, chlorite, and quartz. Often with well-developed cleavage, may be locally sheared; phyllitic zones are common throughout the Carolina slate belt.
MVI	Metavolcanic, intermediate	Gray to dark grayish-green tuffs and crystal tuffs generally of andesitic composition; most with well-developed cleavage; also includes interbedded lithic tuffs and flows of probable andesitic and basaltic composition and minor felsic volcanic rocks.
MVM	Metavolcanic, mafic	Grayish-green to dark-green, fine- to medium-grained andesitic to basaltic tuffs, crystal tuffs, crystal-lithic tuffs, tuff breccias and flows; pyroclastic varieties may contain lithic fragments; commonly exhibits prominent cleavage; alteration minerals include chlorite, epidote, calcite, and tremolite-actinolite.
MVE	Metavolcanic, epiclastic	Primarily coarse sediments including interbedded graywackes and arkoses and minor conglomerates, interbedded argillites and felsic volcanic rocks; much of the sequence is probably subaqueous in origin and most of the rocks were derived from volcanic terranes.
MVU	Metavolcanic, undifferentiated	Volcanic rocks of all origins (extrusive and eruptive) and compositions (felsic to mafic) interbedded in such a complex assemblage that mapping of individual units is not practical.
		Metasedimentary Rocks
ARG	Argillite	Fine-grained, thinly laminated rock having prominent bedding plane and axial plane cleavage; locally includes beds of mudstone, shale, thinly laminated silt-stone, conglomerate, and felsic volcanic rock.
GNF	Gneiss, felsic	Mainly granitic gneiss; light-colored to gray, fine- to coarse-grained rocks, usually with distinct layering and foliation, often interlayered with mafic gneisses and schists.
GNM	Gneiss, mafic	Mainly biotite hornblende gneiss; fine- to coarse-grained, dark gray to green to black rock, commonly with distinct layering and foliation, often interlayered with biotite and hornblende gneisses and schists, and amphibolite layers at some places.
MBL	Marble	Fine- to medium-grained, recrystallized limestone and dolostone; found primarily in the Murphy belt.
PHL	Phyllite	Light-gray to greenish-gray to white, fine-grained rock having well-developed cleavage; composed primarily of sericite but may contain chlorite; phyllitic zones are common throughout the Carolina slate belt and probably represent zones of shearing, although displacement of units is usually not recognizable.

Table 1. Classification and lithologic description of hydrogeologic units in the Blue Ridge and Piedmont Provinces of North Carolina (Continued)

[From Daniel, 1989]

Symbol	Hydrogeologic unit	Lithologic description
QTZ	Quartzite	Metasandstone, often feldspathic to highly feldspathic, thin- to thick-bedded with graded bedding at some places, includes meta-arkose and metaconglomerate; often interbedded with mica schist, phyllite, and slate.
SCH	Schist	Schistose rocks containing primarily the micas muscovite or biotite or both, occasional sericite and chlorite schists; locally interlayered with hornblende gneiss and schist, commonly with distinct layering and foliation.
SLT	Slate	Fine-grained metamorphic rock formed from such rocks as shale and volcanic ash, possesses the property to part along planes independent of the original bedding (slaty cleavage).
	MISCELLANEOUS	
TRI	Triassic sedimentary rocks	Mainly red beds, composed of shale, sandstone, arkose, and conglomerate (fanglomerate near basin margins).
CPL	Coastal Plain basement	Undifferentiated crystalline basement rocks of igneous and metamorphic origin overlain unconformably by sedimentary sands, gravels, clays, and marine deposits.

felsic, intermediate, or mafic except for the addition in the metavolcanic group of epiclastic rocks and compositionally undifferentiated rocks. These two groups were added to the metavolcanic group because they represent significant areas of metavolcanic rocks with distinct characteristics. The epiclastic rocks are the result of volcaniclastic deposits being reworked by sedimentary processes that included sufficient admixture of terrigenous sediment during deposition to make the rocks texturally distinct. The areas mapped as compositionally undifferentiated rocks contain complex and small-scale stratigraphic changes that make differentiation of separate units impractical. Composition also is shown in the metasedimentary units of gneiss, marble, and quartzite. The other metasediments are designated primarily on the basis of texture (grain size, degree of metamorphism, and development of foliation).

Two miscellaneous classifications account for the sedimentary rocks within the Triassic basins and the undifferentiated crystalline basement rocks east of the Fall Line that are overlain unconformably by sediments of Cretaceous age and younger.

By using the classification scheme in table 1 and the most recent geologic maps available, Daniel and Payne (1990) compiled a hydrogeologic unit map for the Blue Ridge and Piedmont Provinces in North Carolina (fig. 5). The percentage of the study area underlain by each hydrogeologic unit is given in table 2. Well-location maps were superimposed on the hydrogeologic unit map, and the units corresponding to the well locations were coded and entered into a computerized data file for analysis to determine the well yields in each unit (Daniel, 1989). The relation between well yield and hydrogeologic unit identified by Daniel (1989) is shown in figure 6.

Table 2. Relative percentages of hydrogeologic units in the Blue Ridge and Piedmont Provinces of North Carolina

Hydrogeologic unit[a]	Percent
GNF	22
GNM	18
MIF	9.9
QTZ	7.3
ARG	6.4
MVF	6.3
IFI	5.4
SCH	5.2
TRI	5.1
MII	3.1
MVU	3.0
MIM	1.9
MVE	1.9
PHL	1.7
SLT	0.8
IMI	0.7
MVM	0.6
MVI	0.5
III	0.1
MBL	0.1

[a] Hydrogeologic units are named and described in table 1.

Additional analyses were made by Daniel (1989) to determine the relation between well yield, and other well characteristics, and topographic setting. These data also have been used to determine the average saturated thickness of regolith associated with each hydrogeologic

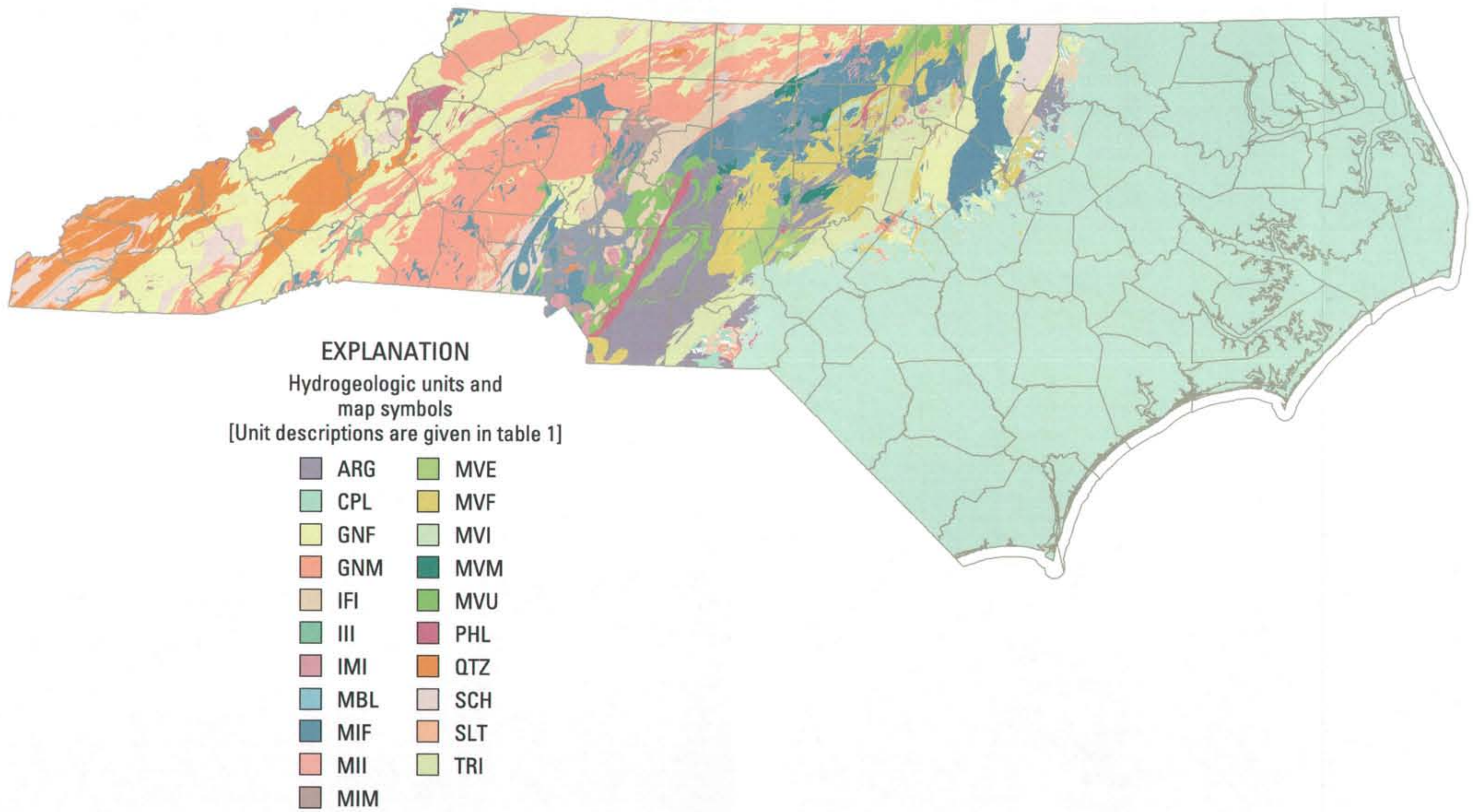


Figure 5. Hydrogeologic units within the Blue Ridge and Piedmont Provinces of North Carolina (from Daniel and Payne, 1990).